



The LTB5312 bidirectional optical transceiver is ideally suited for 155 Mb/sec FSAN (Full Service Access Network) point-to-point Fiber to the Home equipment, or SONET/SDH OC-3, ATM, Fast Ethernet and PON applications where a single SMF fiber is required to simultaneously carry both Tx and Rx signals up to 20 km. The built-in high isolation WDM enables full duplex operation. It is mounted in the MSA compliant 2x10 small form pluggable (SFP) package with the LC optical receptacle. The transmitter and receiver subassemblies incorporate a high performance 1550 nm MQW F-P laser assembly and high sensitivity 1310 nm PIN/TIA photo receiver with limiting amplifier. The differential internally AC coupled Tx and Rx data interfaces are LVPECL compatible. The Rx_LOS, Tx_DIS and Tx_FAULT monitor and control functions are LVTTTL compatible. The two-wire I²C interface is compatible with the 8472 Rev 9.3 digital diagnostic standard. It operates from a single 3.3-volt power supply and is rated for operation over the temperature range of -40°C to +85°C. The Class I laser transmitter complies with international safety standards.



Applications

- Full Service Access Network (FSAN)
- Fiber to the Home (FTTH) ONU PON
- ATM, SONET, OC-3

Features and Benefits

- Transmitter and receiver in a single compact package
- Tx/Rx distance up to 20 km
- Integral simplex LC connector
- Single +3.3V power supply
- 60 mA nominal Tx section DC current
- 100 mA nominal Rx section DC current
- Industry standard SFP 2x10 outline
- 1550 nm F-P laser diode transmitter
- High sensitivity 1310 nm PIN/TIA receiver with limiter
- Cross talk > -40 dB
- Differential AC-coupled LVPECL input and output interface
- Operating temperature range -40°C to +85°C

Monitor and Control Functions

- Rx_LOS LVTTTL
- Tx_DIS LVTTTL
- Tx_FAULT LVTTTL
- SDA LVTTTL / LVCMOS
- SCL LVTTTL / LVCMOS
- US FDA Accession Number 0210091-00

Laser Safety

This device incorporates a Class 1 laser source and complies with IEC 825, U.S. FDA 21, CFR 1040.10 and 1040.11 regulations. It must be operated within the specified temperature and voltage limits. The module optical ports module must be terminated with an optical connector or dust plug. Any internal modification to the transceiver renders the device non-compliant, voids any warranties and could result in a health hazard.

RECOMMENDED OPERATING CONDITIONS					
Parameter	Symbol	Min	Typ	Max	Units
Ambient Operating Temperature	T _{amb}	-40	25	85	°C
DC Supply Voltage	V _{CC}	3.135	3.3	3.465	Volts
Module Supply Current	I _{IN}	-	160	210	mA
Module Power Dissipation	P _D	-	525	700	mW
Signaling Speed +/- 100 ppm	S	-	155	-	Mb/s
Useful Reach	D	-	20	-	km
ORDERING INFORMATION					
Part Number	Description				
LTB5312	SFP Bidirectional Transceiver, 1310 nm Rx, 1550 Tx				



ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Units	
Storage Temperature	Tstg	-40	+85	°C	Exceeding the Absolute Maximum Ratings may cause irreversible damage to the device.
Operating Temperature Range	Tamb	-40	+85	°C	
DC Supply	VCC	0	3.6	Volts	The device is not intended to be operated under the condition of simultaneous Absolute Maximum Ratings, a condition which may cause irreversible damage to the device.
Relative Humidity - Storage	RH _s	0	95	%	
Relative Humidity - Operating	RH _o	0	85	%	

CONTROL AND MONITOR FUNCTION LOGIC LEVELS

Parameter	State	Min	Max	Units	Condition	Notes
Rx_LOS	HIGH	2.0	V _{cc} + 0.3	V	Receiver OFF	Requires 4.7 K to 10 K Pull-Up
	LOW	0	0.8	V	Receiver ON	
Tx_DIS	HIGH	2.0	V _{cc} + 0.3	V	Laser OFF	Incorporates internal 4.7 K to 10 K Pull-Up
	LOW	0	0.8	V	Laser ON	
Tx_FAULT	HIGH	2.0	V _{cc} + 0.3	V	Laser FAULT	Requires 4.7 K to 10 K Pull-Up
	LOW	0	0.8	V	Laser NORMAL	
SDA	HIGH	2.0	V _{cc} + 0.3	V	I2C Serial Data	Requires 4.7 K to 10 K Pull-Up
	LOW	0	0.8	V		
SCL	HIGH	2.0	V _{cc} + 0.3	V	I2C Serial CLOCK	Requires 4.7 K to 10 K Pull-Up
	LOW	0	0.8	V		

TRANSMITTER ELECTRICAL AND OPTICAL CHARACTERISTICS (T_{case} = -40°C to +85°C, V_{cc} = 3.3 V)

Parameter	Symbol	Min	Typ	Max	Units	Conditions / Notes
Transmitter Type		1550 nm F-P				
Transmitter Monitor and Control		Tx_FAULT, Tx_DISABLE				
Average Output Power (9/125 μ SMF)	P _{out}	-15	-	-8	dBm	
Extinction Ratio	ER	10.0	-	-	dB	
Optical Rise and Fall Time	t _r / t _f	-	-	2	ns	20% to 80%
Tx Wavelength	λ	1510	1550	1590	nm	
Spectral Line Width @ -20 dB	Δλ	-	1.5	4.0	nm	
Optical Isolation		30	-	-	dB	
DC Supply Current	I _{CC}	-	60	90	mA	
Differential Input Voltage		350	-	1600	mV	Peak to Peak
Tx_DATA Input Load Impedance	R _{IN}	2500	-	-	Ohms	



RECEIVER OPTICAL AND ELECTRICAL CHARACTERISTICS (T_{case} = -40°C to +85°C, V_{cc} = 3.3 V)

Parameter	Symbol	Min	Typ	Max	Units	Conditions / Notes
Receiver Type		1310 nm PIN/TIA				
Optical Signal Indicator		Signal Detect				
Wavelength	λ	1100	1310	1670	nm	
Received Optical Power	P _{in}	-32	-	-	dBm	BER<10 ⁻¹⁰ , 155 Mb/s, PRBS 2 ²³ -1
Maximum Input Optical Power	P _{in(max)}				dBm	
Receiver Reflectance	RFL				dB	
Receiver Settling Time	t _{rx}	-	-	2	ns	20% to 80%
Rx_LOS Range	P _a	-45	-	-31	dBm	
Rx_LOS Hysteresis	P _{hy}	-	3	5	dB	
Rx_LOS Output Load	R _{SDL}	-	50	-	Ohms	To V _{cc} -2
Cross Talk	CT	-	-	-40	dB	
DC Supply Current	I _{CCR}	-	100	120	mA	Not including RX_DATA load current
Data Output Voltage	V _{out}	-	800	-	mV	Single ended output
Rx_DATA Load Impedance	R _{DL}	-	50	-	Ohms	To V _{cc} -2

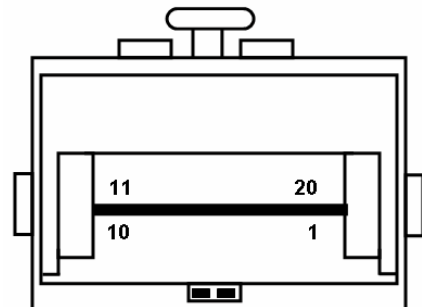


PIN ASSIGNMENT

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 Electrical Pad Layout
Top View Bottom View



Transceiver Pin Locations

SFP PIN ASSIGNMENT

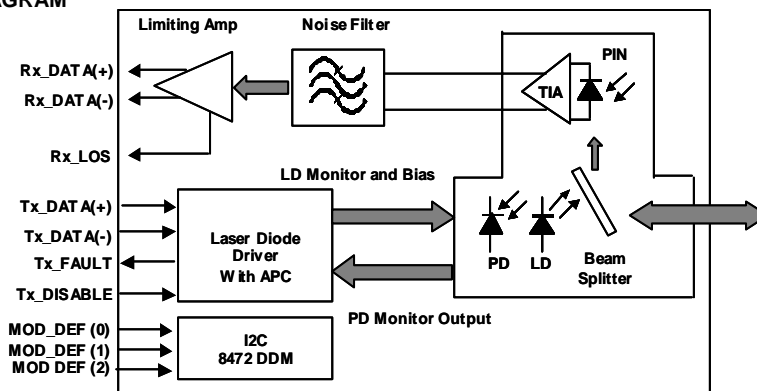
Pin	Symbol	Logic Type	Description	Notes
1	V _{EET}	N/A	Transmitter Ground	
2	TX_FAULT	LVTTTL	Transmitter Fault, LOW = Normal Operation, HIGH = Fault Indication	Note 1
3	TX_DIS	LVTTTL	Transmit Disable, LOW = Normal Operation, HIGH = Disables Module	Note 1
4	MOD_DEF 2	LVTTTL	Module Definition 2 - Two-Wire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

- 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
- 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.



TRANSCEIVER BLOCK DIAGRAM



APPLICATIONS INFORMATION

Transmitter Section

The transmitter section consists of a high reliability 1550 nm F-P laser diode (LD) with back facet monitor photo detector (PD). A driver IC converts the LVPECL differential input data signal into an analog current source that drives the LD. The APC circuit provides for temperature compensation of the laser diode thereby stabilizing the output power and the extinction ratio. The transmitter is provided with the TX_DISABLE and TX_FAULT control and monitoring functions. The SFP MSA digital diagnostics are enabled via the 2-wire I²C data bus.

TX_FAULT

The TX_FAULT monitor function is implemented as an open collector/drain output. It requires a 4,700 to 10,000 Ohm Pull Up resistor on the host PCB. Logic HIGH (2.0 to 3.465V) indicates a laser fault, which can be caused by excessive optical output power or excessive laser drive current. Logic LOW (0 to 0.8V) indicates normal operation. The Tx_FAULT can be reset by toggling the Tx_DISABLE line. When the logic voltage is >0.8V and <2.0V, the logic state is undefined.

TX_DISABLE

The Tx_DISABLE is a control function that can be used to shut down the transmitter optical output. It incorporates an internal 4,700 to 10,000 Ohm Pull Up resistor. Logic HIGH (2.0 to 3.465V) shuts down the transmitter. Logic LOW (0 to 0.8V) enables the transmitter. When the logic voltage is >0.8V and <2.0V, the logic state is undefined. If the Tx_DISABLE port is open the transmitter is disabled.

TX_DATA

Tx_DATA (Inverted) and Tx_DATA (Non Inverted) are the differential transmitter input signal lines. They are internally AC-coupled and differentially terminated with 100 Ohms. The inputs will accept differ-

ential swings of 500 – 2400 mV (250 – 1200 mV single-ended), though it is recommended that values between 500 and 1200 mV differential (250 – 600 mV single-ended) be used for best EMI performance.

Receiver Section

The receiver optical subassembly (ROSA) incorporates a planar In-GaAs PIN photo detector, which can detect optical signals in the range of 1100 nm to 1700 nm. The high-reliability photo detector is characterized by its low dark current. The receiver electronics includes an integrated low noise preamplifier and AGC amplifier (TIA), which are mounted in a TO-Metal Can assembly with the photo detector. The TIA drives the band pass filter (BPF) and limiting amplifier. The differential output of the limiting amplifier is LVPECL compatible. The receiver is provided with the Rx_SIGNAL DECECT monitor function.

Rx_LOS

The Rx_LOS monitor function is an open collector/drain output. It requires a 4,700 to 10,000 Ohm Pull Up resistor on the host PCB. Logic HIGH (2.0 to 3.465V) indicates loss of signal, which can be caused by “no signal” arriving at the optical input, a weak signal arriving at the optical input, a broken fiber or a disconnected optical connector. Logic LOW (0 to 0.8V) indicates normal operation. When the logic voltage is >0.8V and <2.0V, the logic state is undefined.

Rx_DATA

The Rx_DATA (Inverted) and Rx_DATA (Non Inverted) are differential receiver output signal lines. They are internally AC-coupled and require a 100 OHM differential termination at the user interface. The voltage swing on these lines will be between 370 and 2000 mV differential (185 – 1000 mV single ended) when properly terminated.



SFP MSA and SFF 8472 REVISION 9.3 DIGITAL DIAGNOSTICS

This device incorporates the SFF-8472 Revision 9.3 digital diagnostic monitoring and control functions, which provide backward compatibility with the SFP-MSA digital diagnostic interface.

This device incorporates two 128-bytes data tables:

1. Table A0 (HEX) contains 128-bytes of information relating to the type of device as shown in the table below. The data is programmed into memory at the time the device is manufactured and is normally WRITE ENABLED.
2. Table A2 (HEX) contains 128-bytes of real-time dynamic data from the internal calibration of the device, which includes the module temperature, the transmit output power, the receiver input power, the module DC operating current and the DC oper-

ating voltage. At the time the device is manufactured upper and lower WARNING and ALARM limits are stored in the EEPROM and WRITE PROTECTED. During operation, the stored values are compared with the real time data generated by the transceiver and a FLAG is SET if the WARNING or ALARM values are exceeded.

The SFF-8472 Revision 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.

CODE TABLE FOR 8472 DIGITAL DIAGNOSTICS - Page A0 HEX (WRITE ENABLED)

Address	Bytes	HEX	DECIMAL	Name of Field	Field Description
00	1	03	3	ID Field	SFP transceiver
01	1	04	4	Extended ID Field	SFP function is defined by serial ID only
02	1	07	7	Connector ID Field	LC optical connector
04	1	8	8	Transceiver ID Field	1550 m Tx Intermediate Reach
05	1	02	2	Transceiver ID Field	SONET OC-3
11	1	03	3	Transceiver Encoding	NRZ
12	1	02	2	Nominal Bit Rate	155 Mb/s
14	1	14	20	Link Length	20 km
15	1	FF	255	Link Length > 25.4 km	GBIC compatibility requirement
20 to 35	16	XX	XX	Vendor Name	Ligent Photonics
37 to 39	3	XX	XX	Vendor IEEE ID	TBD - assigned at time of production
40 to 55	16	XX	XX	Ligent Part Number	LTD5312 - assigned at time of production
56 to 59	4	XX	XX	Ligent Rev Number	1.2 - assigned at time of production
60 to 61	2	06, 0E	13, 10	Wavelength	1550
65	1	1A	26	SFP Codes	Rx LOS, Tx DIS, Tx FAULT
66, 67	1	XX	XX	Bit Rate Max Tolerance	20 percent - assigned at time of production
68 to 83	16	XX	XX	Ligent Serial Number	Assigned at time of production
84 to 91	8	XX	XX	Ligent Date Code	Assigned at time of production
92	1	68	104	Type of Diagnostics	Average Power, Internal Calibration, 8472 DDM
93	1	B0	176	Enhanced Options	Alarm / Warning Flags, Soft Fault, LOS
94	1	01	1	8472 Compatibility	Compatible with 8472 Rev 9.3



PAGE A2 (HEX) SFF 8472 REVISION 9.3 DIGITAL DIAGNOSTICS

Page A2 (HEX) contains the ALARM, WARNING and ACTUAL data for 5 different transceiver parameters. The information is stored in the "two's-complement" format with the MSB occupying the lower byte and the LSB occupying the higher byte as shown in the table below. For each of the 5 parameters there are 10 memory locations:

1. High ALARM Value
2. Low ALARM Value
3. High WARNING Value
4. Low WARNING Values
5. Real Time Data

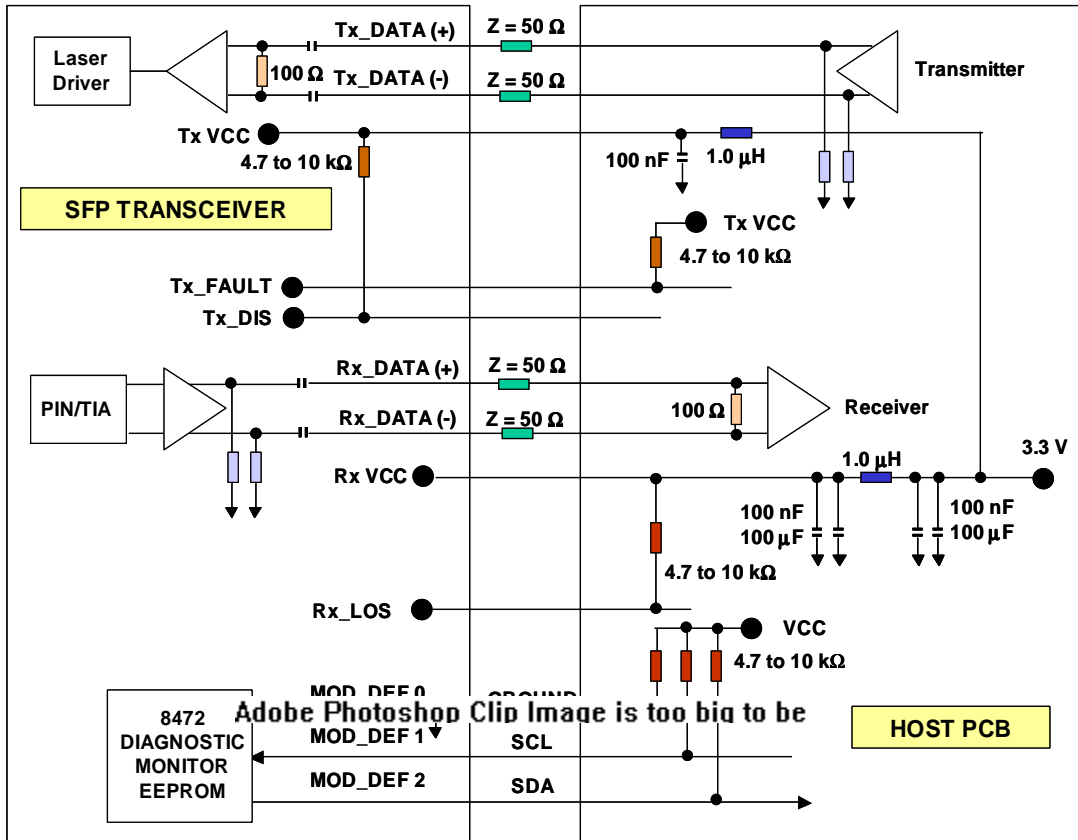
When an ALARM or WARNING value is reached, a FLAG is set that can be read by the I²C serial interface. The FLAG is a single bit in a specific 8-bit memory location. It is possible to have several ALARM and WARNING FLAGS set within a single 8-bit byte. In the table below, bytes 112, 113, 116 and 117 are the FLAG memory locations and the number in the parenthesis is the bit location with the 8-bit byte.

SFF-8472 Rev 9.3 A2 (HEX) ADDRESS TABLE FOR ALARM AND WARNING DATA (WRITE PROTECTED)

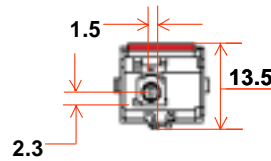
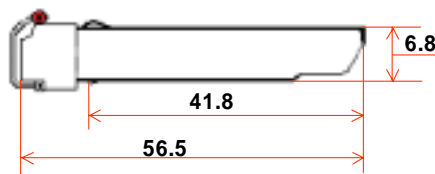
8472 Parameter	Alarm Threshold Data				Warning Threshold Data				Measured Values		Alarm Bit (Set) Address + Position		Warning Bit (Set) Address + Position	
	High Value		Low Value		High Value		Low Value				High	Low	High	Low
	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	High	Low	High	Low
Temperature	00	01	02	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)



RECOMMENDED INTERFACE CIRCUIT



SFP OUTLINE DRAW-



Dimensions are in mm





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 610004-3. 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 require-

ments including UL1950, CSA 22.2, and IEC 60950-1, and has been designed to meet the flammability requirements of UL94.

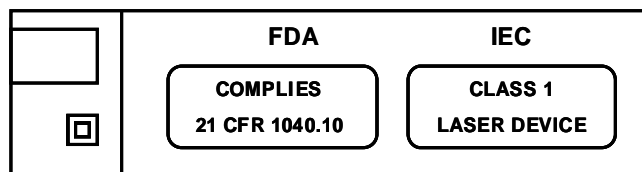
Notice

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

