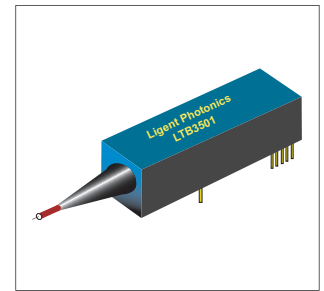




The LTB3501 bi-directional optical transceiver is ideally suited for 155 Mb/sec FSAN (Full Service Access Network) point-to-point Fiber to the Home equipment, or SONET/SDH OC-3, ATM, Fast Ethernet and ONU PON applications where a single SMF fiber is required to simultaneously carry both Tx and Rx signals up to 20 km. A built-in high isolation WDM enables full duplex operation. It is mounted in the MSA compliant 2X5 small form factor (SFF) package with fiber pigtail. FC or MU optical connectors are standard options. The transmitter and receiver subassemblies incorporate a high performance 1310 nm MQW F-P laser assembly and high sensitivity 1550 nm PIN/TIA photo receiver with limiting amplifier. The differential AC coupled Tx and Rx data interfaces are LVPECL compatible; the single ended control and monitor functions include Rx\_SD, which is LVPECL compatible and Tx\_DISABLE, which is LVTTTL compatible. The device operates from a single 3.3-volt power supply and is designed for operation over the extended temperature range of  $-10^{\circ}$  to  $+70^{\circ}$  Centigrade. 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 SC connector
- Single +3.3V power supply
- 100 mA nominal Tx section DC current
- 120 mA nominal Rx section DC current
- Industry standard SFF 2x5 outline
- 1310 nm MQW F-P laser diode transmitter
- High sensitivity 1550 nm PIN/TIA receiver with limiter
- Cross talk > -30 dB
- Differential LVPECL input and output interface
- Single ended LVTTTL Tx DISABLE function
- Single ended LVPECL Rx SD Alarm function
- Wave solderable and aqueous washable package
- Operating temperature range  $-10$  to  $+70^{\circ}$  C

#### 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 (accession number 0210091-00) 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.

#### Absolute Maximum Ratings

| Parameter                    | Symbol | Min | Max | Units        |
|------------------------------|--------|-----|-----|--------------|
| Storage Temperature          | Tstg   | -40 | +85 | $^{\circ}$ C |
| Operating Temperature        | Tamb   | -10 | +70 | $^{\circ}$ C |
| DC Supply                    | VCC    | 0   | 4.5 | Volts        |
| Signal / Data Input Voltage  | Vin    | GND | Vcc | Volts        |
| Signal / Data Output Current | Iout   | -   | 30  | mA           |

#### Typical Operating Characteristics (T = $-10$ to $70^{\circ}$ C, VCC = 3.3 Volts, ICC = 100 mA TYP)

| Parameter    | Symbol | MIN   | TYP | MAX   | Units  |
|--------------|--------|-------|-----|-------|--------|
| Power Supply | VCC    | 3.135 | 3.3 | 3.465 | V      |
| Bit Rate     |        | -     | 155 | 170   | Mb/sec |

#### Transmitter Section (F-P Laser Transmitter)

|   |                 |   |      |       |         |
|---|-----------------|---|------|-------|---------|
| Optical Output (into 9/125 $\mu$ SMF)   | Pout            | -14                                     | -    | -8    | dBm     |
| Tx Wavelength                           | $\lambda_{out}$ | 1260                                    | 1310 | 1360  | nm      |
| RMS Spectral Line Width                 | $\Delta\lambda$ | -                                       | -    | 6     | nm      |
| Extinction Ratio                        | ER              | 10                                      | -    | -     | dB      |
| Output Eye (Telcordia/Bellcore)         |                 | TR-NWT-000253 and ITU-T G.957 compliant |      |       |         |
| Tx optical rise / fall time (10 - 90 %) | tr              | -                                       | -    | 2     | ns      |
| Input Noise floor                       | Rin             | -                                       | -    | -116  | dB/√Hz  |
| Total Jitter                            | Tj              | -                                       | -    | 1     | nsec    |
| Signal / Data Input Current (LOW)       | IIL             | -350                                    | -    | -     | $\mu$ A |
| Signal / Data Input Current (HIGH)      | IiH             | -                                       | -    | 350   | $\mu$ A |
| Differential Signal Input Voltage       | VIH-VIL         | 300                                     | -    | -     | mV p-p  |
| Signal / Data Input Voltage (LOW)       | VIL-VCC         | -2                                      | -    | -1.58 | V       |
| Signal / Data Input Voltage (HIGH)      | VIH-VCC         | -1.1                                    | -    | -0.74 | V       |

#### Receiver Section (PIN/TIA Receiver)

|  |                |      |      |       |       |
|--|----------------|------|------|-------|-------|
| Rx Optical Sensitivity                 | Pin            | -    | -    | -31   | dBm   |
| Rx Operating Wavelength                | $\lambda_{in}$ | 1480 | 1550 | 1600  | nm    |
| Rx Optical Pin Max                     | Pin MAX        | -8   | -    | -     | dBm   |
| Signal Detect (ASSERT / Low to High)   | Pa             | -    | -    | -33   | dBm   |
| Signal Detect (DEASSERT / High to Low) | Pd             | -43  | -    | -     | dBm   |
| Signal Detect Hysteresis               | None           | 1    | -    | 4     | dB    |
| Optical Return Loss                    | RL             | 14   | -    | -     | dB    |
| Signal Data Output Voltage - LOW       | VIL-VCC        | -2   | -    | -1.58 | Volts |
| Signal Data Output Voltage - HIGH      | VIH-VCC        | -1.1 | -    | -0.74 | Volts |

#### Logic States: Tx ENABLE/DISABLE (LVTTTL); Rx SD (ECL 10K, 10KH, 100K, LVPECL)

|                            |         |         |   |       |       |
|----------------------------|---------|---------|---|-------|-------|
| Tx ENABLE (Tx DIS = LOW)   | Tx DISL | 0       | - | 0.8   | Volts |
| Tx DISABLE (Tx DIS = HIGH) | Tx DISH | VCC-1.3 | - | VCC   | Volts |
| Tx DISABLE shut off time   | Tx DIS  | -       | - | 1     | msec  |
| Rx SIGNAL DETECT (LOW)     | VIL-VCC | -2      | - | -1.58 | Volts |
| Rx SIGNAL DETECT (HIGH)    | VIH-VCC | -1.1    | - | -0.74 | Volts |

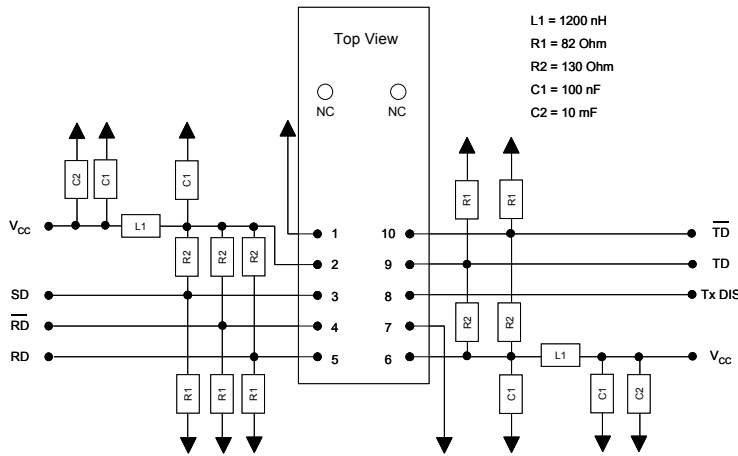


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**LTB3501 1310 nm Tx / 1550 nm Rx**

**20 km 155 MBPS SFF Pigtail Bi-Directional Transceiver**



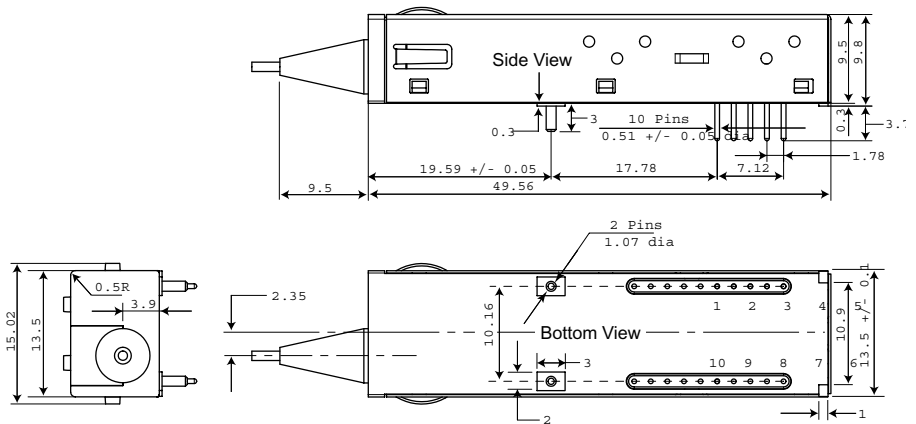
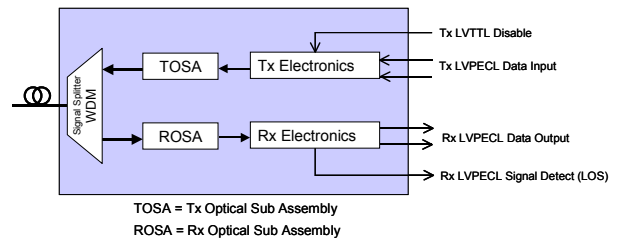
**SFF 2X5 Bi-Directional Transceiver Pin Description**

| Pin | Name   | Level  | Notes                           |
|-----|--------|--------|---------------------------------|
| 1   | Vee    |        | Rx -DC, Ground                  |
| 2   | Vcc    |        | Rx +DC Supply                   |
| 3   | Rx_SD  | LVPECL | HIGH = Normal; LOW = No Light   |
| 4   | RDn    | LVPECL | Rx Differential Data Out (-)    |
| 5   | RDp    | LVPECL | Rx Differential Data Out (+)    |
| 6   | Vcc    |        | Tx +DC Supply                   |
| 7   | Vee    |        | Tx -DC, Ground                  |
| 8   | Tx_DIS | LVTTTL | LOW = Normal, HIGH = Tx Disable |
| 9   | TDp    | LVPECL | x Differential Data In (+)      |
| 10  | TDn    | LVPECL | Tx Differential Data In (-)     |

**Circuit Design Notes**

- The circuit layout must minimize stray lead inductance that could generate unwanted (spurious) signals or unwanted RF oscillation.
- The input impedance for each phase of the differential input and output signals is 50 Ohms to ground (82 Ohms in parallel with 130 Ohms). The use of micro strip is recommended for each signal path.
- The parasitic inductance of leaded components may desensitize the receiver or reduce the transmitter drive signal ( $R+j\omega L$ ). The use of high quality chip resistors and chip capacitors are recommended.
- High-Q chokes are recommended for DC power supply decoupling to prevent a feedback path that can lead to unwanted RF oscillation. A 10 mF tantalum electrolytic capacitor is recommended for pulse charge storage.
- A ground plane on the bottom of the PCB may reduce the possibility of unwanted spurious signals and improve the sensitivity of the receiver. Plated through holes are recommended to minimize parasitic lead inductance.

**Bi-Directional Transceiver Block Diagram**



Dimensions are in mm  
Tolerances are ±0.01 mm

**How to Order**

| Part Number | Data Rate  | Transmitter   | Receiver | Reach | Temperature Range | Package Option                           |
|-------------|------------|---------------|----------|-------|-------------------|--|
| LTB3501 NC  | 155 Mb/sec | 1310 nm / F-P | 1550 nm  | 20 km | -10 to 70 °C      | SMF Pigtail without Optical Connector    |
| LTB3501 FC  | 155 Mb/sec | 1310 nm / F-P | 1550 nm  | 20 km | -10 to 70 °C      | SMF Pigtail with FC/PC Optical Connector |
| LTB3501 MU  | 155 Mb/sec | 1310 nm / F-P | 1550 nm  | 20 km | -10 to 70 °C      | SMF Pigtail with MU/PC Optical Connector |

April 2, 2004