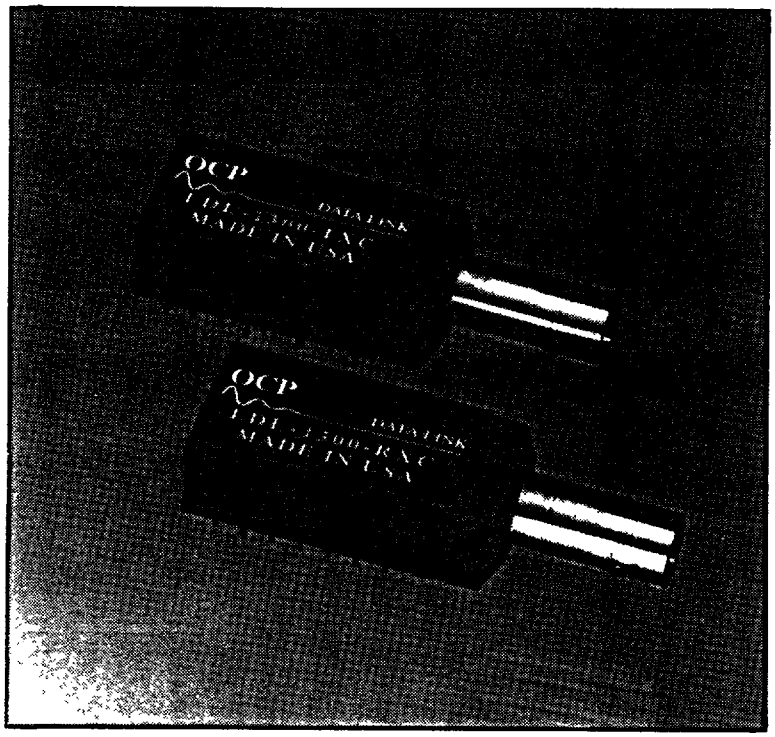
T-41-91

# LDL-1300 Conductive Plastic Data Link Modules



## Features

- ☐ *Three High Speed Versions*
  - *100 Mb/s*
  - *160 Mb/s*
  - *220 Mb/s*
- ☐ *1320 nm Wavelength Operation*
- ☐ *15 to 19 dB Link Budget with 62.5/125 micron Fiber*
- ☐ *Standard Logic Interface — 10 K and 100 K ECL Compatible*
- ☐ *Transmitter DISABLE Control Input*
- ☐ *Low Electrical Power Consumption*
- ☐ *Single Supply Voltage (+5 V or -5.2 V)*
- ☐ *Small 16-Pin Conductive Plastic Packages*
- ☐ *-40°C to +70°C Operating Temperature Range*

## Description

The LDL-1300 Data Links are low cost, high performance transmitter/receiver modules designed for use with multimode optical fiber. Data rates from 1 to 220 Mb/s and distances of 2 kilometers or more are supported. The extended operating temperature range and receiver sensitivity of these data links make them useful in rugged environments as well as in typical computer and data communications applications.

All electronic and optical functions are contained within the standard low profile PC-board mountable 16-pin dual-in-line (DIP) package transmitter and receiver modules. The modules incorporate custom bipolar integrated circuits and ST™ compatible receptacles for ease of handling and connection. The transmitter modules provides a Transmit Disable control input and $V_{BB}$ voltage reference for ease of use.

LDL-1300 Series modules are also available which have been customized at 45 and 270 Mbaud as well as for 50$\mu$m fiber.

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## Transmitter Performance Characteristics ($T_a$ = +25°C)

| | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| Electrical Interface | | | | | |
| Supply Voltage[1] | $V_{EE}$ | -5.7 | -5.2 | -4.7 | V |
| Supply Current | $I_{EE}$ | - | 105 | 125 | mA |
| Power Dissipation | P | - | 550 | 700 | mW |
| Optical Interface | | | | | |
| ON:OFF Ratio | - | 20:1 | - | - | - |
| Output Power Temperature Coefficient [5] | - | - | -0.7 | -1.0 | %/°C |
| Center Wavelength [6] | $\lambda_c$ | 1280 | 1320 | 1355 | nm |
| Temperature Coefficient of $\lambda_c$ | - | - | +0.3 | - | nm/°C |
| Spectral Width (FWHM) [6] | $\Delta\lambda$ | - | 150 | 170 | nm |
| Temperature Coefficient of $\Delta\lambda$ | - | - | +0.4 | - | nm/°C |
| Type A (100 Mb/s) | | | | | |
| Optical Output Power [2,3] | $\overline{P}_o$ | -17.0 | -15.0 | - | dBm |
| Rise/Fall Time [4] | $t_r/t_f$ | - | 4.0 | 5.0 | ns |
| Data Rate | B | DC | - | 100 | Mb/s |
| Type B (160 Mb/s) | | | | | |
| Optical Output Power [2,3] | $\overline{P}_o$ | -18.0 | -16.0 | - | dBm |
| Rise/Fall Time [4] | $t_r/t_f$ | - | 2.5 | 3.0 | ns |
| Data Rate | B | DC | - | 160 | Mb/s |
| Type C (220 Mb/s) | | | | | |
| Optical Output Power [2,3] | $\overline{P}_o$ | -19.0 | -17.0 | - | dBm |
| Rise/Fall Time [4] | $t_r/t_f$ | - | 2.2 | 2.5 | ns |
| Data Rate | B | DC | - | 220 | Mb/s |

Notes:
1. Can also operate on a DC +5 V power supply. Tolerance is ±5%.
2. Average coupled power into 62.5/125 micron graded index fiber with 50% duty cycle drive signal.
3. Approximately 4.5 dB less power coupled into 50/125 micron graded index fiber.
4. Measured from 10-90% points.
5. At -40°C, the average optical output power is approximately 2 dB above that at 25°C. At 70°C the average optical output power is approximately 2 dB below that at 25°C.
6. Measured with 50% duty cycle drive signal.

## Transmitter Signal Interface

| Parameter | Symbol | Minimum | Maximum | Units |
|---|---|---|---|---|
| Input HIGH Voltage | $V_{IHS}$ | $V_{CC}$ -1.165 | $V_{CC}$ -0.88 | V |
| Input LOW Voltage | $V_{ILS}$ | $V_{CC}$ -1.81 | $V_{CC}$ -1.475 | V |
| Differential Input Voltage | $V_{DIF}$ | 0.3 | 1.1 | V |
| Input Common Mode Range [1] | $V_{ICM}$ | - | 1.0 | V |

[1] Permissible ±$V_{ICM}$ with respect to $V_{BB}$ ($V_{CC}$ -1.32 volts)

## Transmitter Operation

The transmitter behaves logically as a differential input gate which controls a 1300 nanometer light emitting diode. When the DATA input voltage is greater than the $\overline{DATA}$ input voltage, the LED is ON. When the $\overline{DATA}$ signal is greater than the DATA input voltage, the LED is OFF. When used in a single-ended application, the unused input pin should be connected to $V_{BB}$ . The DISABLE control input turns the LED off when forced to ECL logic "high" independent of the input data. For normal operation, the DISABLE input should be left open or forced to ECL logic "low".

## Receiver Performance Characteristics ($T_a$ = +25°C)

| Parameter | | Symbol | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|---|
| Electrical Interface | | | | | | |
| Supply Voltage [1] | | $V_{EE}$ | -5.7 | -5.2 | -4.7 | V |
| Supply Current [2] | | $I_{EE}$ | - | 55 | 65 | mA |
| Power Dissipation | | P | - | 285 | 350 | mW |
| Optical Interface | | | | | | |
| Data Rate | Type A | B | 1 | - | 100 | Mb/s |
| | Type B | B | 1 | - | 160 | Mb/s |
| | Type C | B | 1 | - | 220 | Mb/s |
| Sensitivity ($10^{-12}$ BER) [3, 6] | | $\overline{P}_{IN}$ | -34 | -36 | - | dBm |
| Dynamic Range | | | 18 | 20 | - | dB |
| Temperature Derating (-40°C to +70°C) [4] | | | -1 | 0 | +1 | dB |
| Wavelength of Operation | | $\lambda$ | 1100 | 1320 | 1600 | nm |
| Carrier Detection Level [5] | | $\overline{P}_{CD}$ | -42 | -37 | -35 | dBm |
| Hysteresis | | | 1.5 | 2.0 | 4.0 | dB |

Notes:
1. Can also operate on a DC +5 V power supply. Tolerance is ±5%.
2. Measured with open circuited outputs.
3. Average incident power for all fiber sizes up to 62.5/125 micron measured at the input connector with balanced code optical input with 2.5 ns rise/fall time ($2^7$ - 1 PRBS test pattern).
4. Measured under conditions of maximum data rate 50% duty cycle input signal over temperature range of -40°C to +70°C. Minimum average sensitivity over temperature range is -33 dBm.
5. Carrier detection output threshold is an ECL level signal which switches from high to low level when the average input optical signal is below this nominal power level.
6. For Type C, the minimum sensitivity is -33 dBm, measured and specified at 200 Mb/s.

## Receiver Signal Interface

| Parameter | Symbol | Minimum | Maximum | Units |
|---|---|---|---|---|
| Output HIGH Voltage (Data, $\overline{Data}$) | $V_{OH}$ | $V_{CC}$ -1.025 | $V_{CC}$ -0.88 | V |
| Output LOW Voltage (Data, $\overline{Data}$) | $V_{OL}$ | $V_{CC}$ -1.81 | $V_{CC}$ -1.62 | V |

## Receiver Operation

The receiver converts optical energy to a photocurrent using a high performance PIN diode. The photocurrent is converted to a proportional analog voltage by a transimpedance amplifier. This low level analog signal is amplified by additional gain stages and processed through a shaping filter and a comparator to generate the differential emitter coupled logic (ECL) output signals. Both outputs (DATA and $\overline{DATA}$) are open emitters requiring termination to $V_{CC}$ -2 volts with 50 ohms or to $V_{EE}$ with 510 ohms. For optimum performance, both outputs should be terminated in the same manner, even if only one is used.

The threshold detection circuit monitors the level of the incoming optical signal and outputs a logic LOW signal when insufficient photocurrent is produced. The threshold signal can be used to control an external squelch circuit to gate off spurious outputs generated by the receiver when no optical input is available. The outputs are open emitter ECL requiring termination (510 ohms to $V_{EE}$ is recommended).

Except for the final ECL output stage, the LDL-1300 Series receivers are high gain, wide bandwidth analog components. To achieve the best performance in terms of receiver sensitivity and threshold circuit operation, good grounding and isolation from power supply noise are essential.



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## Absolute Maximum Ratings

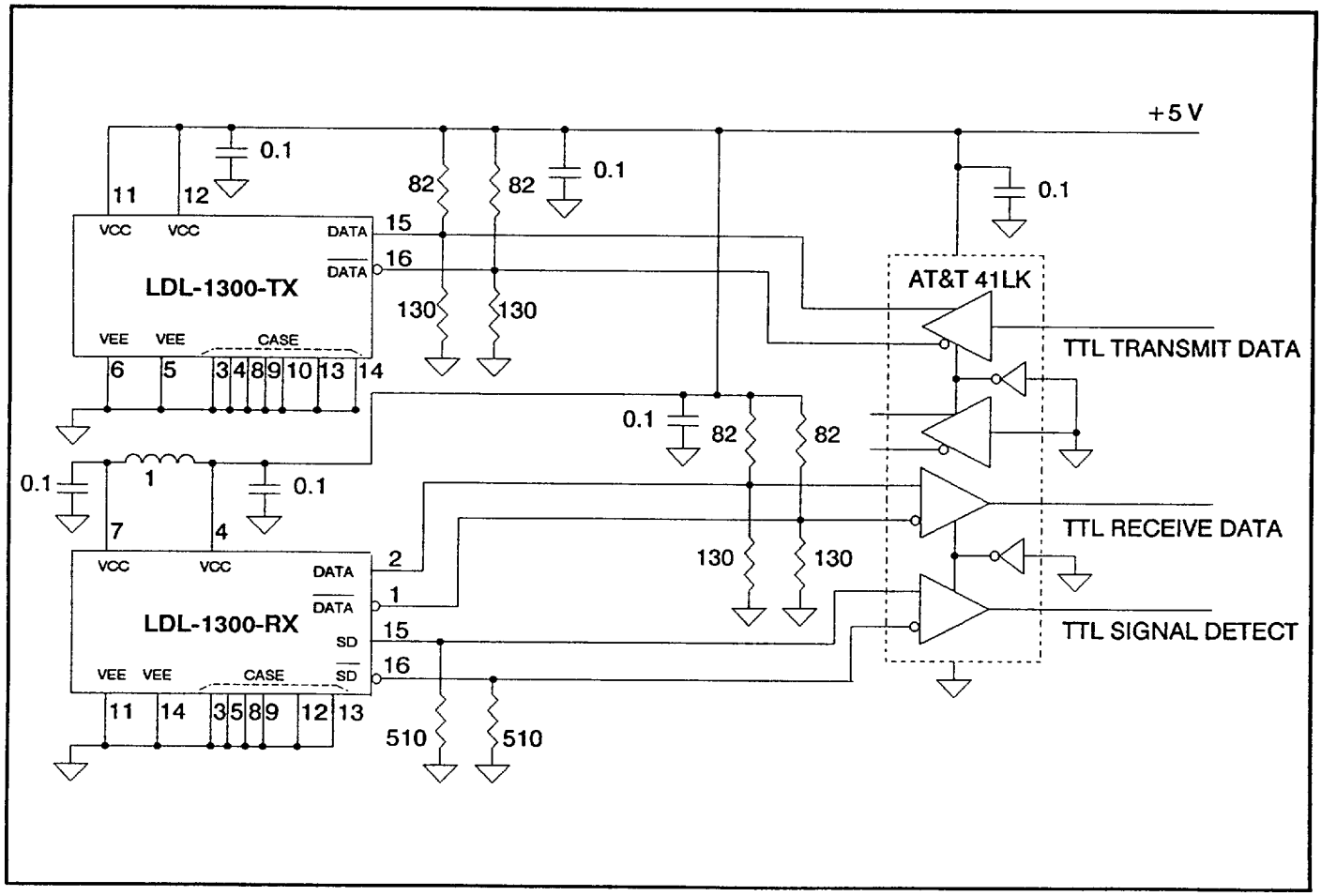
| Characteristic | | Minimum | Maximum | Units |
|---|---|---|---|---|
| Storage Temperature | | -55 | +100 | °C |
| Operating Temperature | | -40 | +85 | °C |
| Supply Voltage[1] | | - | +6.0 | V |
| Input Voltage [2] | | - | +6.0 | V |
| Lead Soldering | Temperature | - | 240 | °C |
| | Time | - | 10 | sec |

Notes:
1. Measured from $V_{CC}$ to $V_{EE}$.
2. Measured with respect to $V_{EE}$.

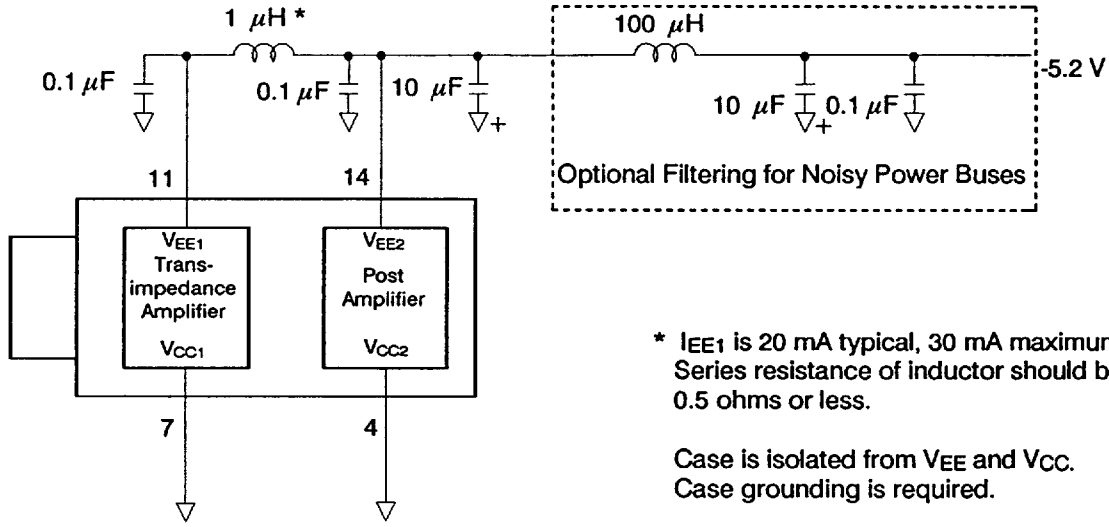
## Data Encoding

The receiver circuit utilizes capacitive interstage coupling which limits the permissible duty cycle variations in the serial data. A DC balanced optical signal generated by a scrambling or encoding circuit is optimal for this type of data link. Unrestricted NRZ or bursty transmissions will require special precautions.

## Interfacing with TTL Circuits



## LDL-1300-RX Recommended De-Coupling Circuit for -5.2 V Operation



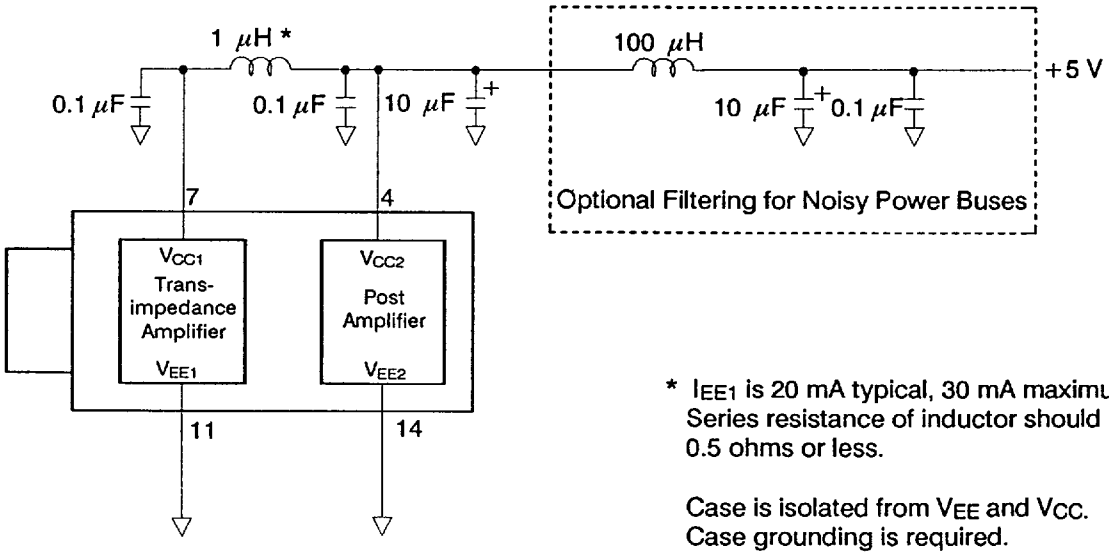

* $I_{EE1}$ is 20 mA typical, 30 mA maximum. Series resistance of inductor should be 0.5 ohms or less.

Case is isolated from $V_{EE}$ and $V_{CC}$. Case grounding is required.

## EMI Susceptibility

The cases of both the transmitter and receiver should be grounded to shield the internal circuitry. The power supply leads should be bypassed with RF quality capacitors (0.1microfarad) close to the package. To isolate the receiver from power supply noise, the receiver should be further isolated by a PI filter. A solid ground plane under and around the receiver is highly recommended.

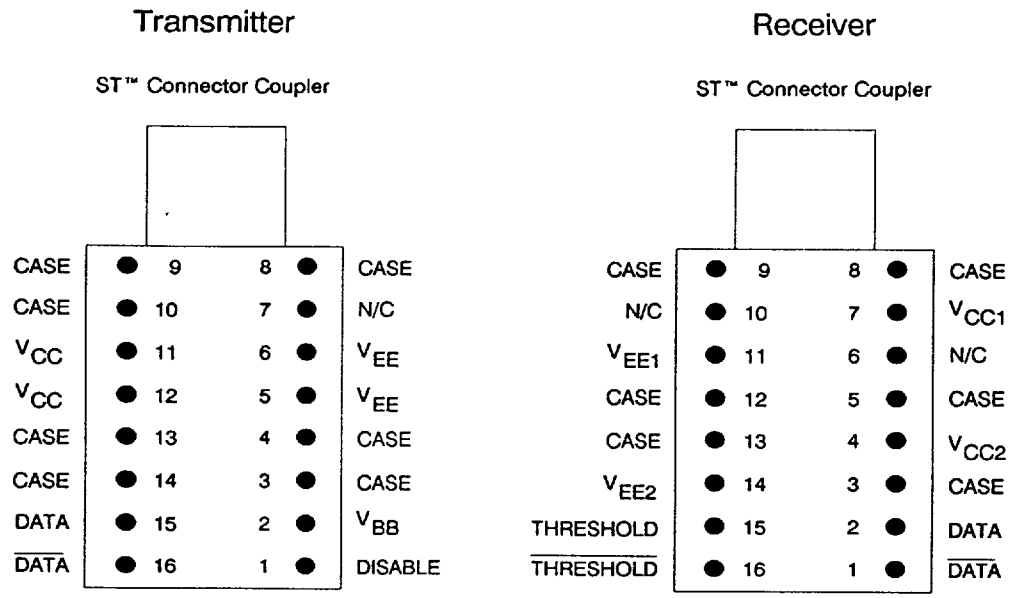
## LDL-1300-RX Recommended De-Coupling Circuit for +5.0 V Operation




* $I_{EE1}$ is 20 mA typical, 30 mA maximum. Series resistance of inductor should be 0.5 ohms or less.

Case is isolated from $V_{EE}$ and $V_{CC}$. Case grounding is required.

## Pin Assignments (Top View)

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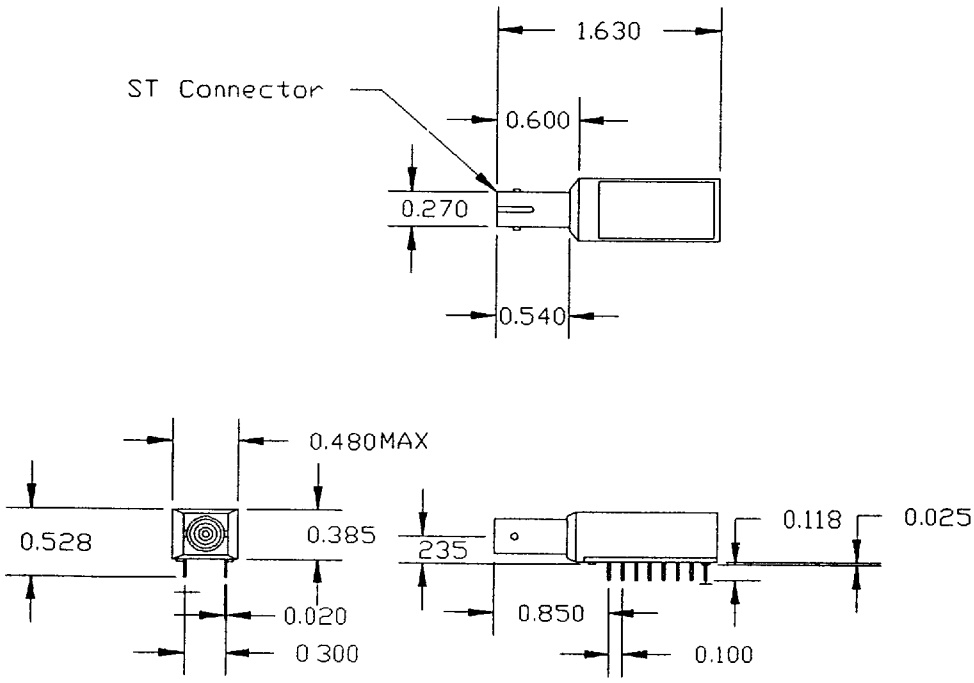
N/C — No internal connection

## Outline Drawing




Dimension in inches
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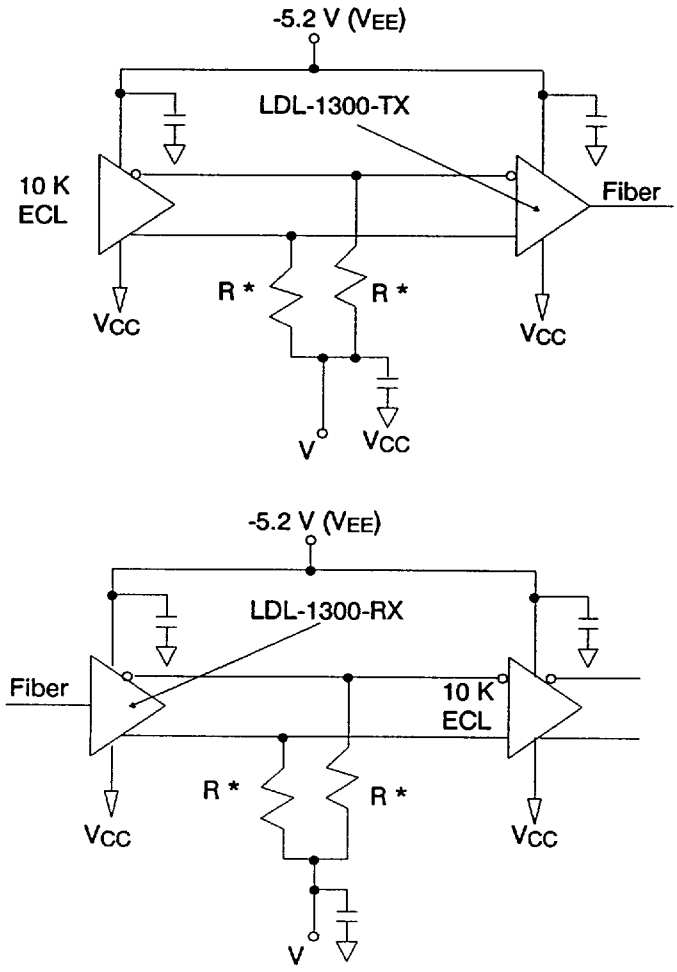
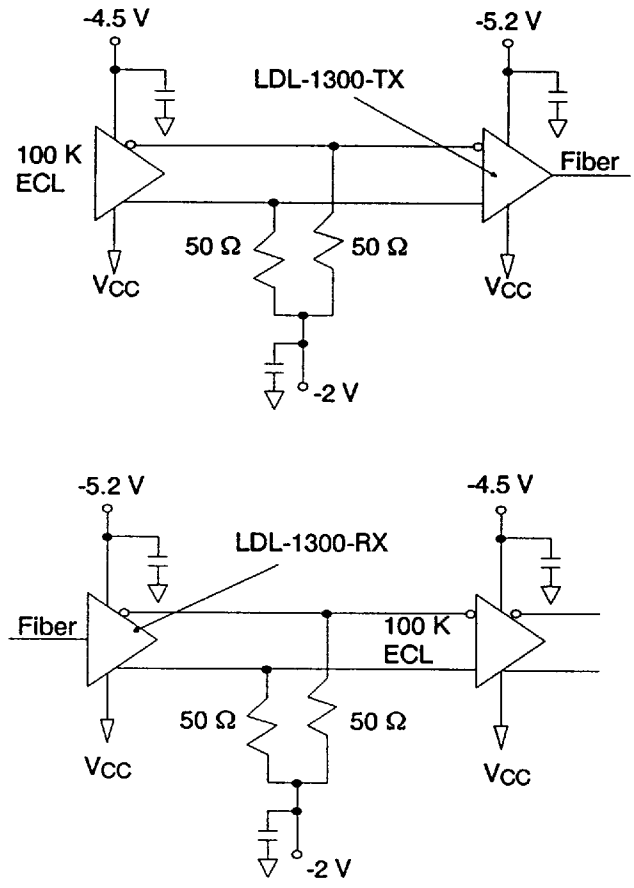
## Application Examples

10 K ECL Typical Interface Configuration



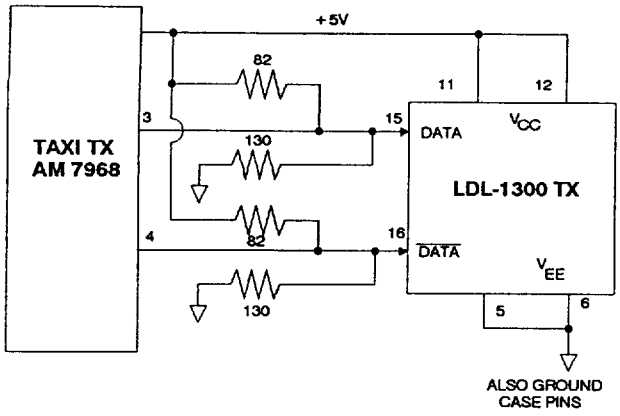

100 K ECL Typical Interface Configuration

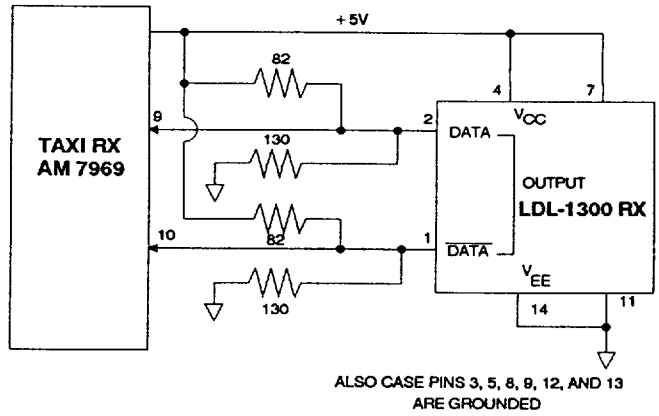



* If V = -5.2 V, then R = 510 Ω
If V = -2 V, then R = 50 Ω

Note: If positive supply voltage is used for both a LDL-1300-RX/TX and an ECL 10 K gate ($V_{CC}$ = 5.0 V, $V_{EE}$ = 0 V), they are still logically fully compatible and can have the common power supply voltage.

## Application Examples




## Ordering Information

| Complete Optical Data Link | Transmitter Module | Receiver Module |
|---|---|---|
| LDL-1300A | LDL-1300-TXA | LDL-1300-RXA |
| LDL-1300B | LDL-1300-TXB | LDL-1300-RXB |
| LDL-1300C | LDL-1300-TXC | LDL-1300-RXC |

**HANDLING PRECAUTIONS:**
Normal handling precautions for electrostatic-sensitive devices should be taken.

**Optical Communication Products, Inc.**
9736 Eton Avenue
Chatsworth, CA 91311
Phone: 818 -701-0164
Fax: 818-701-1468



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