

# 5V Low Power RS232 3-Driver/5-Receiver Transceiver

## FEATURES

- **Low Supply Current: 300 $\mu$ A**
- **ESD Protection: Over  $\pm 10$ kV**
- 1 $\mu$ A Supply Current in Shutdown
- Operates from a Single 5V Supply
- Uses Small Capacitors: 0.1 $\mu$ F
- Operates to 120k Baud
- Three-State Outputs Are High Impedance When Off
- Output Overvoltage Does Not Force Current Back into Supplies
- RS232 I/O Lines Can Be Forced to  $\pm 25$ V without Damage
- Pin Compatible with LT<sup>®</sup>1137A and LT1237
- Flowthrough Architecture

## APPLICATIONS

- Notebook Computers
- Palmtop Computers

## DESCRIPTION

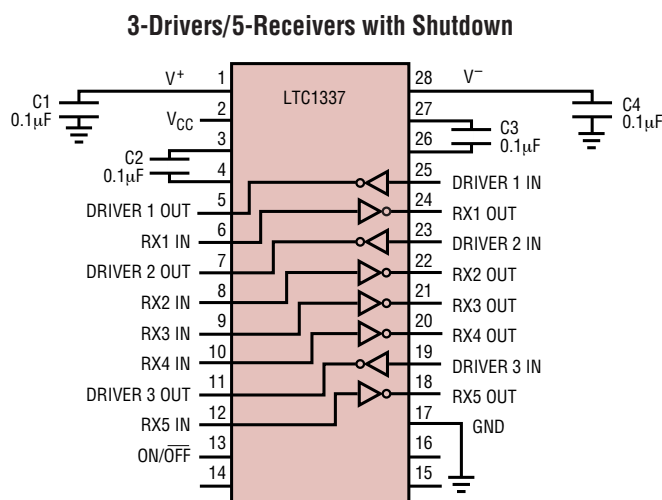
The LTC<sup>®</sup>1337 is a 3-driver/5-receiver RS232 transceiver with very low supply current. In the no load condition, the supply current is only 300 $\mu$ A. The charge pump only requires four 0.1 $\mu$ F capacitors and can supply up to 12mA of extra current to power external circuitry.

In Shutdown mode, the supply current is further reduced to 1 $\mu$ A. All RS232 outputs assume a high impedance state in Shutdown and with the power off.

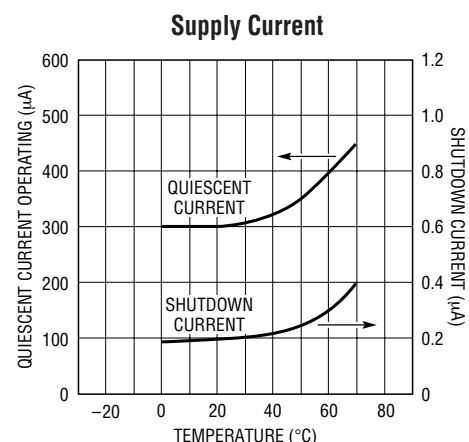
The LTC1337 is fully compliant with all data rate and overvoltage RS232 specifications. The transceiver can operate up to 120k baud with a 1000pF//3k $\Omega$  load. Both driver outputs and receiver inputs can be forced to  $\pm 25$ V without damage, and can survive multiple  $\pm 10$ kV ESD strikes.

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## TYPICAL APPLICATION



1337 TA01



TEST CONDITION:  
 V<sub>CC</sub> = 5V, ALL DRIVER INPUTS TIED TO V<sub>CC</sub>

1337 TA02

## ABSOLUTE MAXIMUM RATINGS

(Note 1)

|                                      |                                  |
|--------------------------------------|----------------------------------|
| Supply Voltage ( $V_{CC}$ )          | 6V                               |
| Input Voltage                        |                                  |
| Driver                               | $-0.3V$ to $V_{CC} + 0.3V$       |
| Receiver                             | $-25V$ to $25V$                  |
| On/Off Pin                           | $-0.3V$ to $V_{CC} + 0.3V$       |
| Output Voltage                       |                                  |
| Driver                               | $-25V$ to $25V$                  |
| Receiver                             | $-0.3V$ to $V_{CC} + 0.3V$       |
| Short Circuit Duration               |                                  |
| $V^+$                                | 30 sec                           |
| $V^-$                                | 30 sec                           |
| Driver Output                        | Indefinite                       |
| Receiver Output                      | Indefinite                       |
| Operating Temperature Range          |                                  |
| Commercial (LTC1337C)                | $0^{\circ}C$ to $70^{\circ}C$    |
| Storage Temperature Range            | $-65^{\circ}C$ to $150^{\circ}C$ |
| Lead Temperature (Soldering, 10 sec) | $300^{\circ}C$                   |

## PACKAGE/ORDER INFORMATION

| TOP VIEW                                                       |            | ORDER PART NUMBER                     |
|----------------------------------------------------------------|------------|---------------------------------------|
| $V^+$ 1                                                        | 28 $V^-$   | LTC1337CG<br>LTC1337CNW<br>LTC1337CSW |
| $V_{CC}$ 2                                                     | 27 C2+     |                                       |
| C1+ 3                                                          | 26 C2-     |                                       |
| C1- 4                                                          | 25 DR1 IN  |                                       |
| DR1 OUT 5                                                      | 24 RX1 OUT |                                       |
| RX1 IN 6                                                       | 23 DR2 IN  |                                       |
| DR2 OUT 7                                                      | 22 RX2 OUT |                                       |
| RX2 IN 8                                                       | 21 RX3 OUT |                                       |
| RX3 IN 9                                                       | 20 RX4 OUT |                                       |
| RX4 IN 10                                                      | 19 DR3 IN  |                                       |
| DR3 OUT 11                                                     | 18 RX5 OUT |                                       |
| RX5 IN 12                                                      | 17 GND     |                                       |
| ON/OFF 13                                                      | 16 NC      |                                       |
| NC 14                                                          | 15 NC      |                                       |
| G PACKAGE 28-LEAD PLASTIC SSOP                                 |            | NW PACKAGE 28-LEAD PDIP               |
| SW PACKAGE 28-LEAD PLASTIC SO                                  |            |                                       |
| $T_{JMAX} = 125^{\circ}C$ , $\theta_{JA} = 96^{\circ}C/W$ (G)  |            |                                       |
| $T_{JMAX} = 125^{\circ}C$ , $\theta_{JA} = 56^{\circ}C/W$ (NW) |            |                                       |
| $T_{JMAX} = 125^{\circ}C$ , $\theta_{JA} = 85^{\circ}C/W$ (SW) |            |                                       |

Consult LTC Marketing for parts specified with wider operating temperature ranges.

## DC ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range.  $V_{CC} = 5V$ ,  $C1 = C2 = C3 = C4 = 0.1\mu F$ , unless otherwise noted.

| PARAMETER                    | CONDITIONS                                                                                              | MIN             | TYP         | MAX        | UNITS              |
|------------------------------|---------------------------------------------------------------------------------------------------------|-----------------|-------------|------------|--------------------|
| <b>Any Driver</b>            |                                                                                                         |                 |             |            |                    |
| Output Voltage Swing         | $R_L = 3k$ to GND<br>$R_L = 3k$ to GND                                                                  | ● 5.0<br>● -5.0 | 7.0<br>-6.5 |            | V<br>V             |
| Logic Input Voltage Level    | Input Low Level ( $V_{OUT} = \text{High}$ )<br>Input High Level ( $V_{OUT} = \text{Low}$ )              | ● 2.0<br>● 2.0  | 1.4<br>1.4  | 0.8        | V<br>V             |
| Logic Input Current          | $V_{IN} = 5V$<br>$V_{IN} = 0$                                                                           | ●<br>●          |             | 5<br>-5    | $\mu A$<br>$\mu A$ |
| Output Short-Circuit Current | $V_{OUT} = 0V$                                                                                          |                 | $\pm 10$    |            | mA                 |
| Output Leakage Current       | Shutdown, $V_{OUT} = \pm 20V$ (Note 3)                                                                  | ●               | 10          | 500        | $\mu A$            |
| <b>Any Receiver</b>          |                                                                                                         |                 |             |            |                    |
| Input Voltage Thresholds     | Input Low Threshold<br>Input High Threshold                                                             | ●<br>●          | 0.8<br>1.7  | 1.3<br>2.4 | V<br>V             |
| Hysteresis                   |                                                                                                         | ●               | 0.1         | 0.4        | 1                  |
| Input Resistance             | $-10V \leq V_{IN} \leq 10V$                                                                             |                 | 3           | 5          | 7                  |
| Output Voltage               | Output Low, $I_{OUT} = -1.6mA$ ( $V_{CC} = 5V$ )<br>Output High, $I_{OUT} = 160\mu A$ ( $V_{CC} = 5V$ ) | ●<br>●          | 0.2<br>4.8  | 0.4        | V<br>V             |
| Output Short-Circuit Current | Sourcing Current, $V_{OUT} = 0$<br>Sinking Current, $V_{OUT} = V_{CC}$                                  |                 | 15<br>-15   | 20<br>-40  | mA<br>mA           |
| Output Leakage Current       | Shutdown, $0 \leq V_{OUT} \leq V_{CC}$ (Note 3)                                                         | ●               | 1           | 10         | $\mu A$            |

**DC ELECTRICAL CHARACTERISTICS**

The ● denotes specifications which apply over the full operating temperature range.  $V_{CC} = 5V$ ,  $C1 = C2 = C3 = C4 = 0.1\mu F$ , unless otherwise noted.

| PARAMETER                           | CONDITIONS          | MIN | TYP  | MAX | UNITS   |
|-------------------------------------|---------------------|-----|------|-----|---------|
| <b>Power Supply Generator</b>       |                     |     |      |     |         |
| $V^+$ Output Voltage                | $I_{OUT} = 0mA$     |     | 8.0  |     | V       |
|                                     | $I_{OUT} = 12mA$    |     | 7.5  |     | V       |
| $V^-$ Output Voltage                | $I_{OUT} = 0mA$     |     | -8.0 |     | V       |
|                                     | $I_{OUT} = 12mA$    |     | -6.5 |     | V       |
| Supply Rise Time                    | Shutdown to Turn-On |     | 0.2  |     | ms      |
| <b>Power Supply</b>                 |                     |     |      |     |         |
| $V_{CC}$ Supply Current             | No Load (Note 2)    | ●   | 0.3  | 0.5 | mA      |
| Supply Leakage Current ( $V_{CC}$ ) | Shutdown (Note 3)   | ●   | 1    | 10  | $\mu A$ |
| On/Off Threshold Low                |                     | ●   | 1.4  | 0.8 | V       |
| On/Off Threshold High               |                     | ●   | 2.0  | 1.4 | V       |

**AC CHARACTERISTICS**

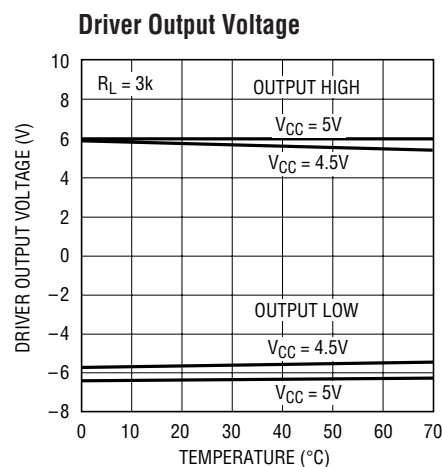
The ● denotes specifications which apply over the full operating temperature range.  $V_{CC} = 5V$ ,  $C1 = C2 = C3 = C4 = 0.1\mu F$ , unless otherwise noted.

| PARAMETER                  | CONDITIONS                  | MIN | TYP | MAX | UNITS      |
|----------------------------|-----------------------------|-----|-----|-----|------------|
| Slew Rate                  | $R_L = 3k$ , $C_L = 51pF$   |     | 8   | 30  | V/ $\mu s$ |
|                            | $R_L = 3k$ , $C_L = 2500pF$ | 2   | 4   |     | V/ $\mu s$ |
| Driver Propagation Delay   | $t_{HLD}$ (Figure 1)        | ●   | 2   | 3   | $\mu s$    |
| (TTL to RS232)             | $t_{LHD}$ (Figure 1)        | ●   | 2   | 3   | $\mu s$    |
| Receiver Propagation Delay | $t_{HLR}$ (Figure 2)        | ●   | 0.3 | 0.6 | $\mu s$    |
| (RS232 to TTL)             | $t_{LHR}$ (Figure 2)        | ●   | 0.2 | 0.6 | $\mu s$    |

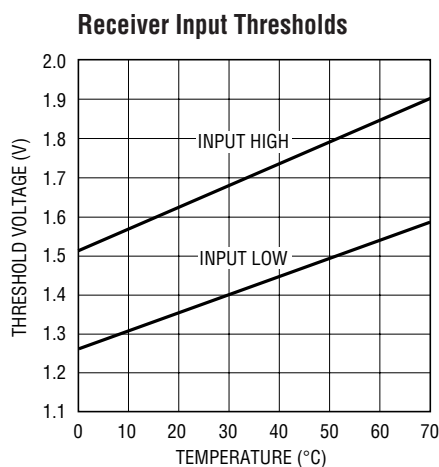
**Note 1:** Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

**Note 2:** Supply current is measured with driver and receiver outputs unloaded and driver inputs tied high.

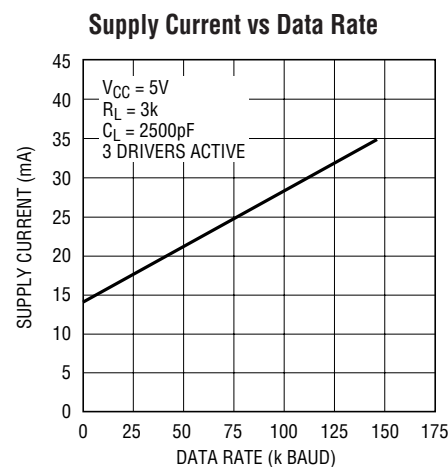
**Note 3:** Supply current and leakage measurements in Shutdown are performed with  $V_{ON} = 0V$ .

**TYPICAL PERFORMANCE CHARACTERISTICS**

1337 G01

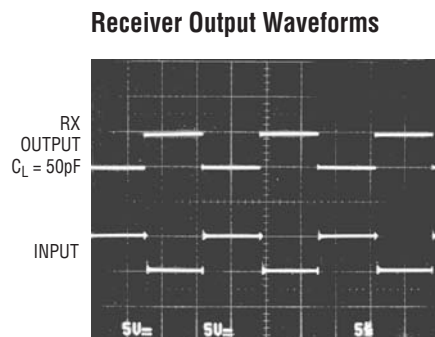
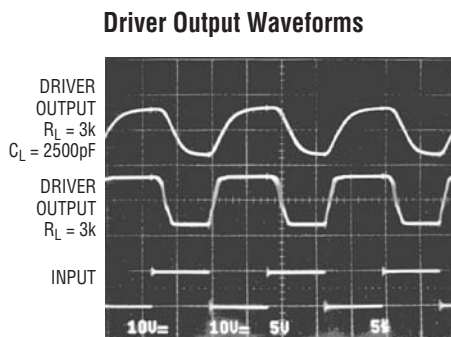
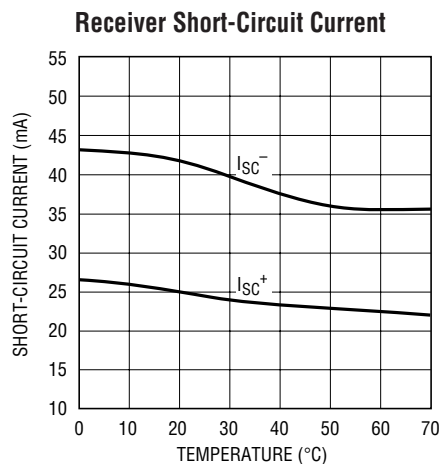
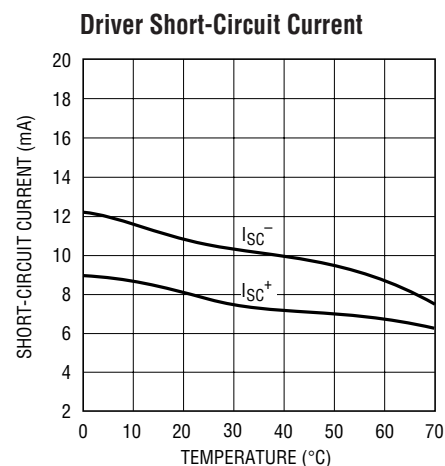
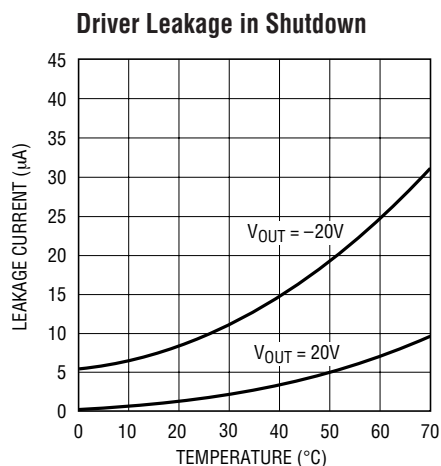
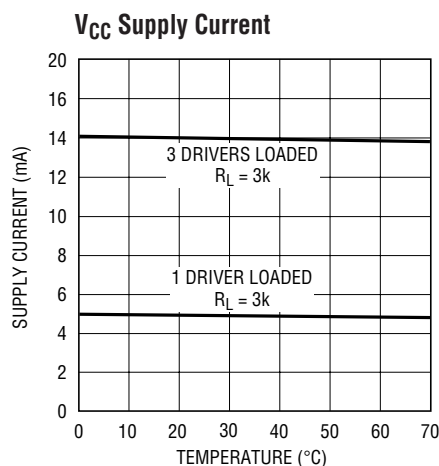


1337 G02



1337 G03

## TYPICAL PERFORMANCE CHARACTERISTICS



## PIN FUNCTIONS

**V<sub>CC</sub>**: 5V Input Supply Pin. Supply current less than 1µA in the Shutdown mode. This pin should be decoupled with a 0.1µF ceramic capacitor.

**GND**: Ground Pin.

**ON/OFF**: TTL/CMOS Compatible Shutdown Pin. A logic low puts the device in the Shutdown mode which reduces input supply current to less than 1µA and places all drivers and receivers in high impedance state. This pin cannot float.

**V<sup>+</sup>**: Positive Supply Output (RS232 Drivers).  $V^+ \approx 2V_{CC} - 1V$ . This pin requires an external capacitor  $C = 0.1\mu F$  for charge storage. The capacitor may be tied to ground or 5V.

With multiple devices, the V<sup>+</sup> and V<sup>-</sup> pins may be paralleled into common capacitors. For large numbers of devices, increasing the size of the shared common storage capacitors is recommended to reduce ripple.

**V<sup>-</sup>**: Negative Supply Output (RS232 Drivers).  $V^- \approx (2V_{CC} - 1.5V)$ . This pin requires an external capacitor  $C = 0.1\mu F$  for charge storage.

**C1<sup>+</sup>, C1<sup>-</sup>, C2<sup>+</sup>, C2<sup>-</sup>**: Commutating Capacitor Inputs. These pins require two external capacitors  $C = 0.1\mu F$ . One from C1<sup>+</sup> to C1<sup>-</sup>, and another from C2<sup>+</sup> to C2<sup>-</sup>. To maintain charge pump efficiency, the capacitor's effective series resistance should be less than 50Ω.

## PIN FUNCTIONS

**DRIVER IN:** RS232 Driver Input Pins. Inputs are TTL/CMOS compatible. Inputs should not be allowed to float. Tie unused inputs to  $V_{CC}$ .

**DRIVER OUT:** Driver Outputs at RS232 Voltage Levels. Outputs are in a high impedance state when in Shutdown mode or  $V_{CC} = 0V$ . The driver outputs are protected against ESD to  $\pm 10kV$  for human body model discharges.

**RX IN:** Receiver Inputs. These pins can be forced to  $\pm 25V$  without damage. The receiver inputs are protected against ESD to  $\pm 10kV$  for human body model discharges. Each receiver provides 0.4V of hysteresis for noise immunity.

**RX OUT:** Receiver Outputs with TTL/CMOS Voltage Levels. Outputs are in a high impedance state when in Shutdown mode to allow data line sharing.

## SWITCHING TIME WAVEFORMS

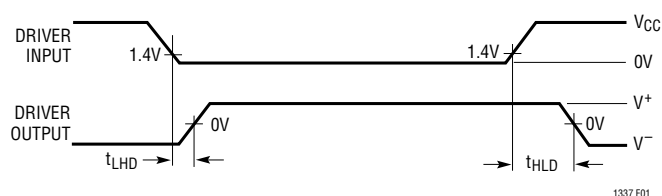


Figure 1. Driver Propagation Delay Timing

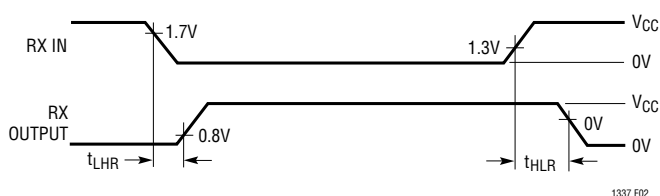


Figure 2. Receiver Propagation Delay Timing

## TEST CIRCUITS

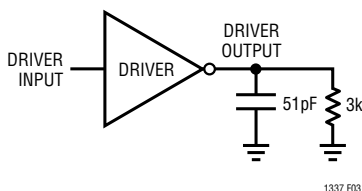


Figure 3. Driver Timing Test Load

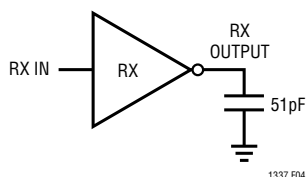
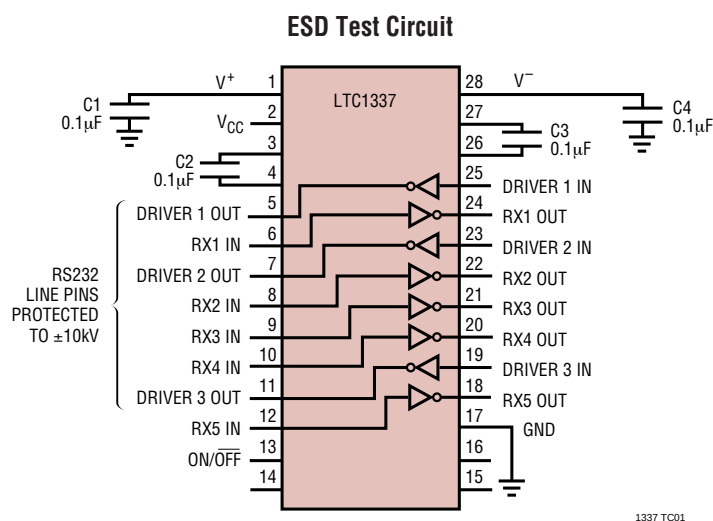


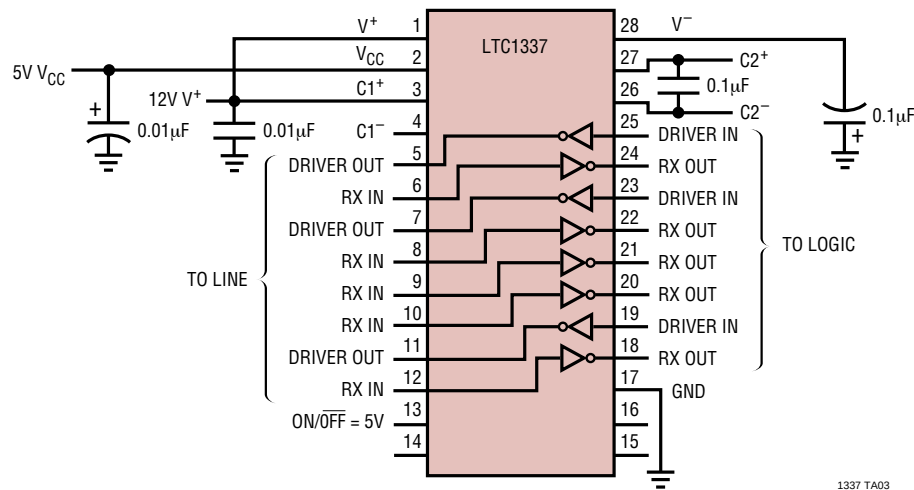
Figure 4. Receiver Timing Test Load



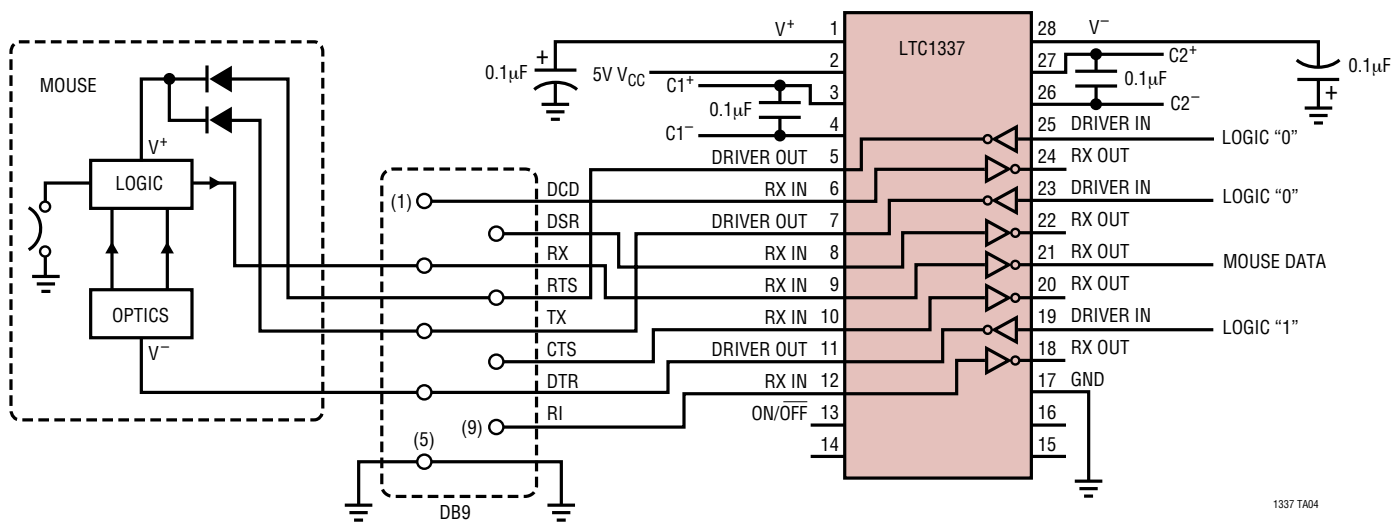
1337 TC01

TYPICAL APPLICATIONS

Operation Using 5V and 12V Power Supplies

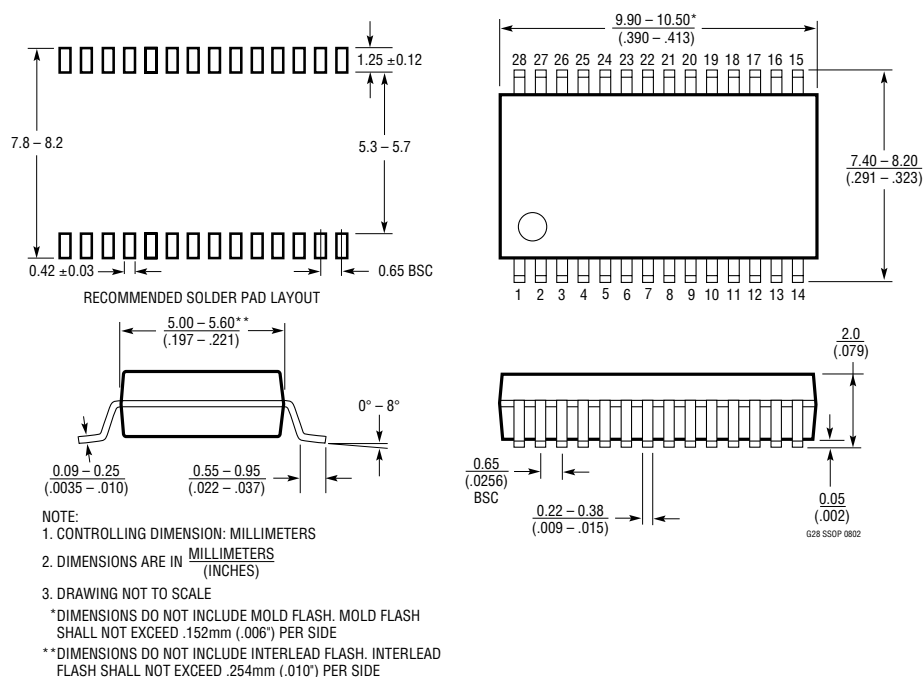


Typical Mouse Driving Application

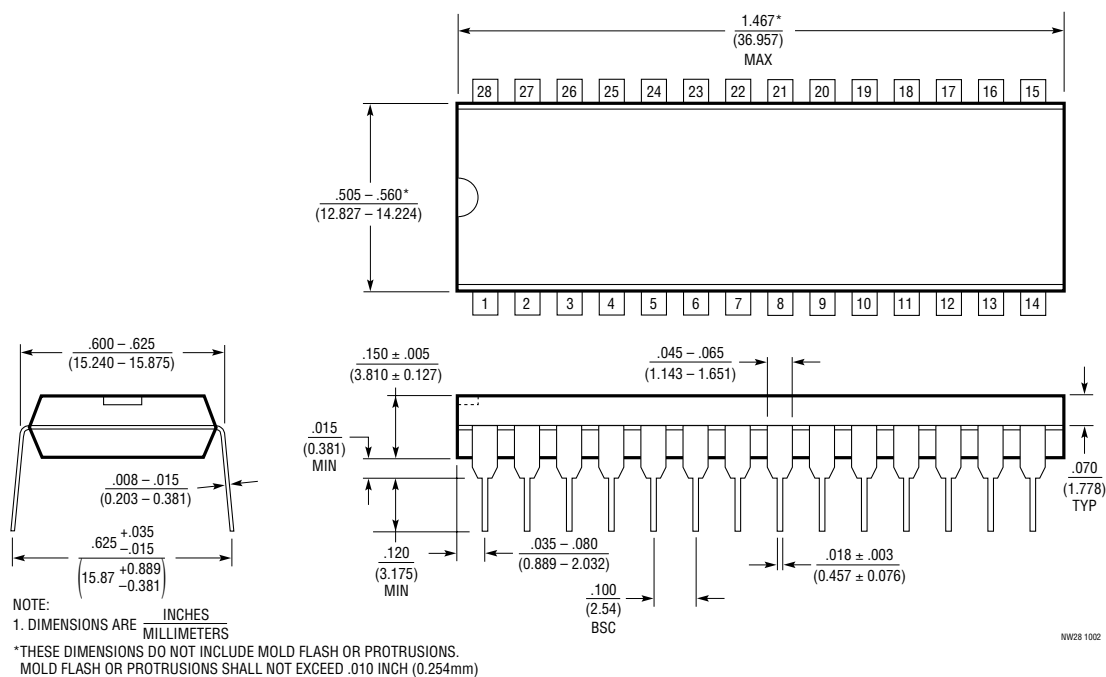


# PACKAGE DESCRIPTION

## G Package 28-Lead Plastic SSOP (5.3mm) (Reference LTC DWG # 05-08-1640)



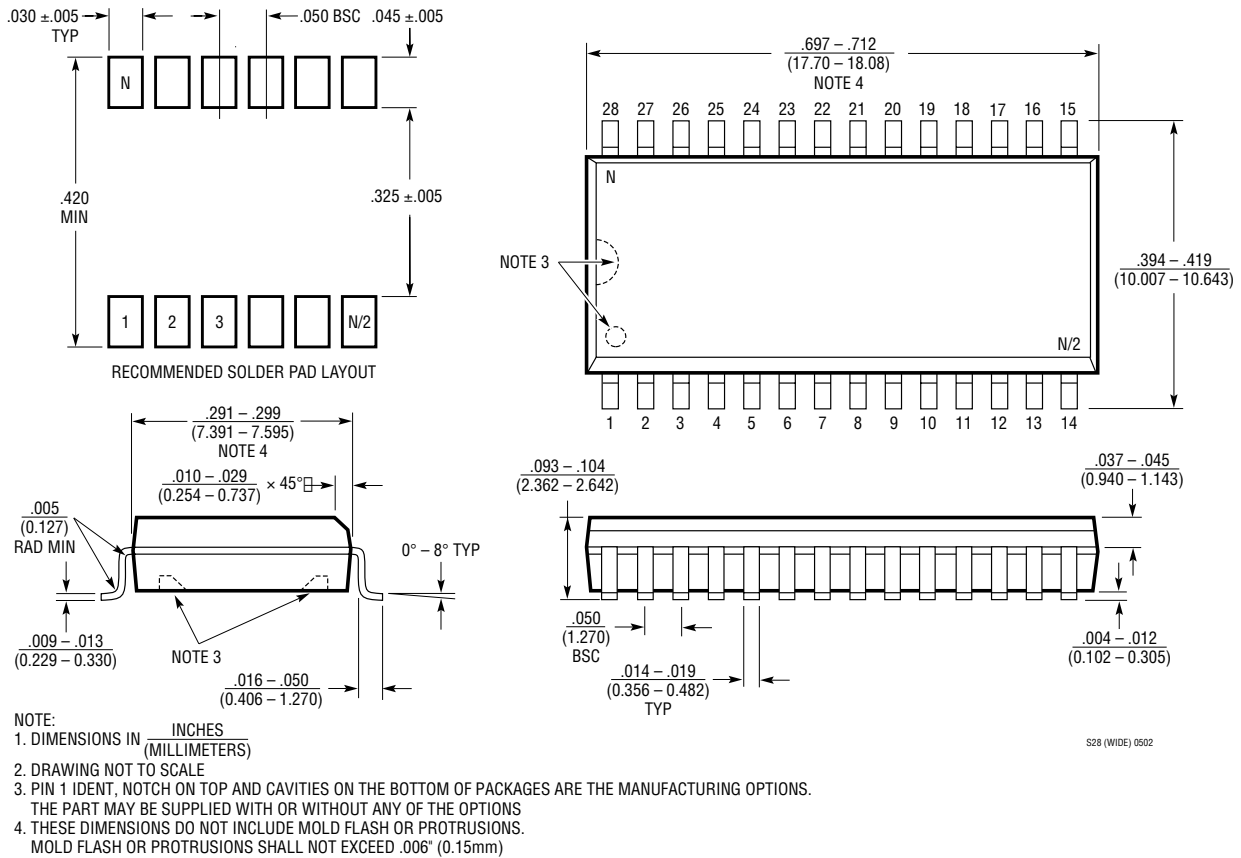
## NW Package 28-Lead PDIP (Wide .600 Inch) (Reference LTC DWG # 05-08-1520)



1337fa

## PACKAGE DESCRIPTION

### SW Package 28-Lead Plastic Small Outline (Wide .300 Inch) (Reference LTC DWG # 05-08-1620)



## RELATED PARTS

| PART NUMBER | DESCRIPTION                                        | COMMENTS                                           |
|-------------|----------------------------------------------------|----------------------------------------------------|
| LT1137A     | 5V, 3 Driver, 5 Receiver RS232 Transceiver         | ±15kV ESD per IEC 1000-4                           |
| LTC1327     | 3.3V, 3 Driver, 5 Receiver RS562 Transceiver       | 300µA Supply Current, 0.2µA in Shutdown            |
| LTC1348     | 3.3V to 5V, 3 Driver, 5 Receiver RS232 Transceiver | True RS232 on 3.3V, 5 Receivers Active in Shutdown |