

# 5V Low Power RS232 3-Driver/5-Receiver Transceiver with 2 Receivers Active in Shutdown

## FEATURES

- **Low Supply Current: 300 $\mu$ A**
- **Two Receivers Kept Alive in Shutdown**
- **ESD Protection Over  $\pm 10$ kV**
- **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 LT1137A and LT1237
- Flowthrough Architecture

## APPLICATIONS

- Notebook Computers
- Palmtop Computers

## DESCRIPTION

The LTC<sup>®</sup>1349 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.

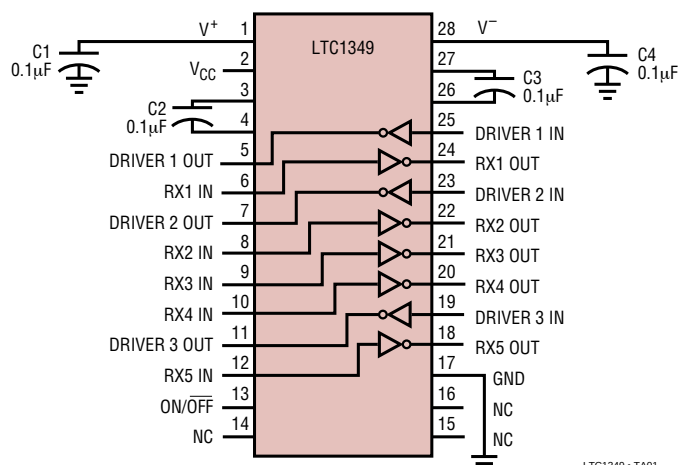
In Shutdown mode, two receivers are kept alive and the supply current is 35 $\mu$ A. All RS232 outputs assume a high impedance state in Shutdown and with the power off.

The LTC1349 is fully compliant with all data rate and overvoltage RS232 specifications. The transceiver can operate up to 120k baud with a 2500pF, 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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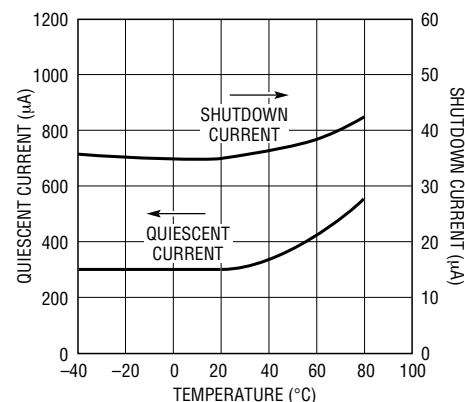
## TYPICAL APPLICATION

**3-Drivers/5-Receivers with Shutdown**



LTC1349 • TA01

**Quiescent and Shutdown Supply Current vs Temperature**



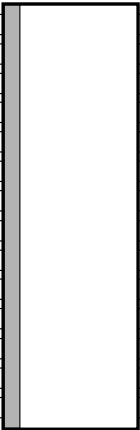
TEST CONDITION:  
V<sub>CC</sub> = 5V, ALL DRIVER INPUTS TIED TO V<sub>CC</sub>.

LTC1349 • TA02

## ABSOLUTE MAXIMUM RATINGS

|                                      |                                  |
|--------------------------------------|----------------------------------|
| 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 (LTC1349C)                | $0^{\circ}C$ to $70^{\circ}C$    |
| Industrial (LTC1349I)                | $-40^{\circ}C$ to $85^{\circ}C$  |
| 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 <sup>+</sup>                                                                                                                                                                  | 1  | 28 V <sup>-</sup>          |
| V <sub>CC</sub>                                                                                                                                                                 | 2  | 27 C2 <sup>+</sup>         |
| C1 <sup>+</sup>                                                                                                                                                                 | 3  | 26 C2 <sup>-</sup>         |
| C1 <sup>-</sup>                                                                                                                                                                 | 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<br>28-LEAD SSOP                                                                                                                                                       |    | NW PACKAGE<br>28-LEAD PDIP |
| SW PACKAGE<br>28-LEAD PLASTIC SO                                                                                                                                                |    |                            |
| T <sub>JMAX</sub> = 125°C, θ <sub>JA</sub> = 96°C/W (G)<br>T <sub>JMAX</sub> = 125°C, θ <sub>JA</sub> = 56°C/W (NW)<br>T <sub>JMAX</sub> = 125°C, θ <sub>JA</sub> = 85°C/W (SW) |    |                            |

|                                                                                |
|--------------------------------------------------------------------------------|
| LTC1349CG<br>LTC1349CNW<br>LTC1349CSW<br>LTC1349IG<br>LTC1349INW<br>LTC1349ISW |
|--------------------------------------------------------------------------------|

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 noted.

| PARAMETER                     | CONDITIONS                                                                                              | MIN             | TYP               | MAX        | UNITS              |
|-------------------------------|---------------------------------------------------------------------------------------------------------|-----------------|-------------------|------------|--------------------|
| <b>Any Driver</b>             |                                                                                                         |                 |                   |            |                    |
| Output Voltage Swing          | 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>●      | 1.4<br>1.4        | 0.8        | V<br>V             |
| Logic Input Current           | $V_{IN} = 5V$<br>$V_{IN} = 0V$                                                                          | ●<br>●          |                   | 5<br>-5    | $\mu A$<br>$\mu A$ |
| Output Short-Circuit Current  | $V_{OUT} = 0V$                                                                                          | ±9              | ±12               |            | 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>1.3<br>1.7 | 2.4        | V<br>V             |
| Hysteresis                    |                                                                                                         | ●               | 0.1               | 0.4        | 1.0                |
| 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>●          | 3.5               | 0.2<br>4.8 | 0.4                |
| Output Short-Circuit Current  | Sinking Current, $V_{OUT} = V_{CC}$                                                                     |                 | -15               | -40        | mA                 |
| Output Leakage Current        | Shutdown, $0 \leq V_{OUT} \leq V_{CC}$ (Note 3)                                                         | ●               |                   | 1          | 10                 |
| <b>Power Supply Generator</b> |                                                                                                         |                 |                   |            |                    |
| $V^+$ Output Voltage          | $I_{OUT} = 0mA$<br>$I_{OUT} = 12mA$                                                                     |                 | 8.0<br>7.5        |            | V<br>V             |
| $V^-$ Output Voltage          | $I_{OUT} = 0mA$<br>$I_{OUT} = -12mA$                                                                    |                 | -8.0<br>-7.0      |            | V<br>V             |
| Supply Rise Time              | Shutdown to Turn-On                                                                                     |                 | 0.2               |            | ms                 |

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**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 noted.

| PARAMETER                           | CONDITIONS                                                                                | MIN | TYP | MAX | UNITS   |
|-------------------------------------|-------------------------------------------------------------------------------------------|-----|-----|-----|---------|
| <b>Power Supply</b>                 |                                                                                           |     |     |     |         |
| $V_{CC}$ Supply Current             | No Load (All Drivers $V_{IN} = V_{CC}$ )(Note 2), $0^{\circ}C \leq T_A \leq 70^{\circ}C$  | ●   | 0.3 | 0.8 | mA      |
|                                     | No Load (All Drivers $V_{IN} = 0V$ )(Note 2), $0^{\circ}C \leq T_A \leq 70^{\circ}C$      | ●   | 0.5 | 1.0 | mA      |
|                                     | No Load (All Drivers $V_{IN} = V_{CC}$ )(Note 2), $0^{\circ}C \leq T_A \leq 85^{\circ}C$  | ●   | 0.3 | 1.0 | mA      |
|                                     | No Load (All Drivers $V_{IN} = V_{CC}$ )(Note 2), $-40^{\circ}C \leq T_A \leq 0^{\circ}C$ | ●   | 0.3 | 1.5 | mA      |
|                                     | No Load (All Drivers $V_{IN} = 0V$ )(Note 2), $-40^{\circ}C \leq T_A \leq 85^{\circ}C$    | ●   | 0.5 | 1.5 | mA      |
| Supply Leakage Current ( $V_{CC}$ ) | Shutdown (Note 3)                                                                         | ●   | 35  | 50  | $\mu A$ |
| On/Off Threshold Low                |                                                                                           | ●   | 1.4 | 0.8 | V       |
| On/Off Threshold High               |                                                                                           | ●   | 2.0 | 1.4 | V       |

**AC CHARACTERISTICS**

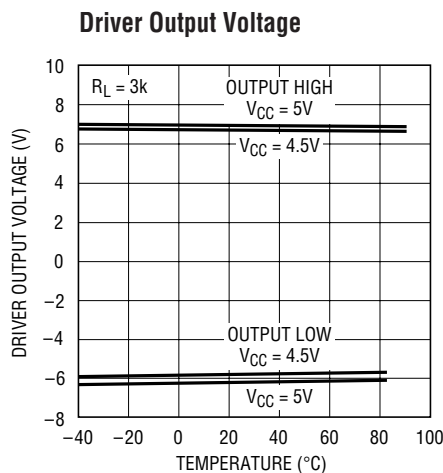
The ● denotes specifications which apply over the full operating temperature range.  $V_{CC} = 5V$ ,  $C1 = C2 = C3 = C4 = 0.1\mu F$ , unless noted.

| PARAMETER                                    | CONDITIONS                  | MIN | TYP | MAX | UNITS      |
|----------------------------------------------|-----------------------------|-----|-----|-----|------------|
| Slew Rate                                    | $R_L = 3k$ , $C_L = 51pF$   |     | 8   | 30  | V/ $\mu s$ |
|                                              | $R_L = 3k$ , $C_L = 2500pF$ | 3   | 5   |     | V/ $\mu s$ |
| Driver Propagation Delay<br>(TTL to RS232)   | $t_{HLD}$ (Figure 1)        | ●   | 2   | 3.5 | $\mu s$    |
|                                              | $t_{LHD}$ (Figure 1)        | ●   | 2   | 3.5 | $\mu s$    |
| Receiver Propagation Delay<br>(RS232 to TTL) | $t_{HLR}$ (Figure 2)        | ●   | 0.3 | 0.8 | $\mu s$    |
|                                              | $t_{LHR}$ (Figure 2)        | ●   | 0.2 | 0.8 | $\mu s$    |

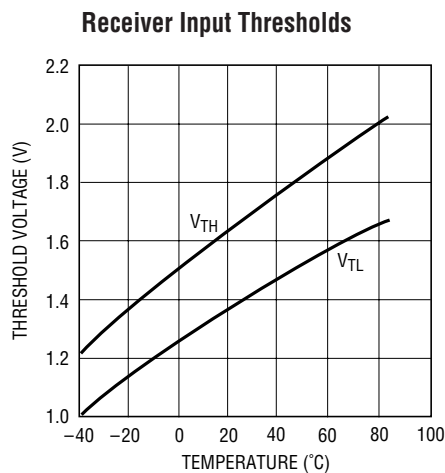
**Note 1:** Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

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

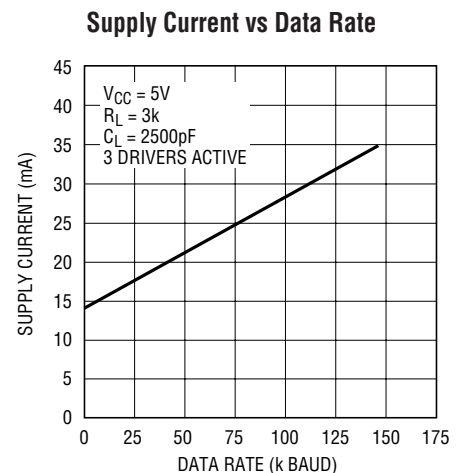
**Note 3:** Supply current and leakage current measurements in Shutdown are performed with  $V_{ON/OFF} = 0V$ .

**TYPICAL PERFORMANCE CHARACTERISTICS**

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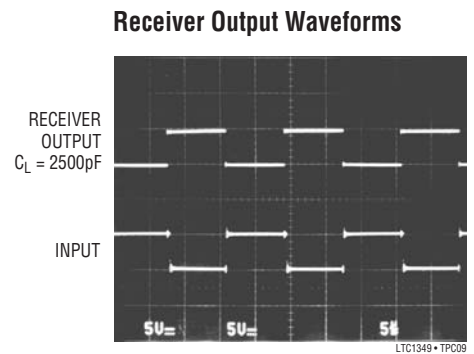
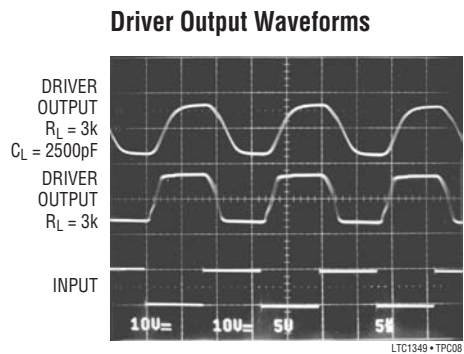
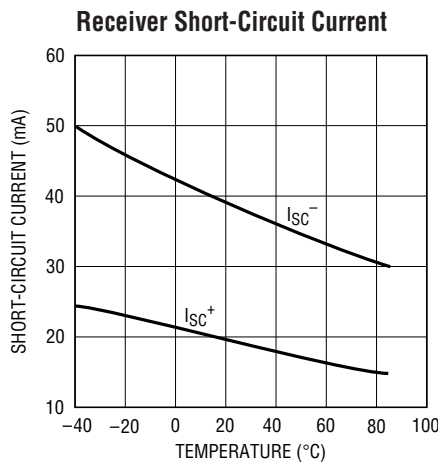
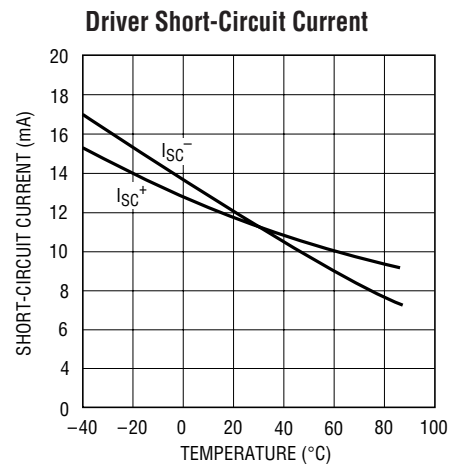
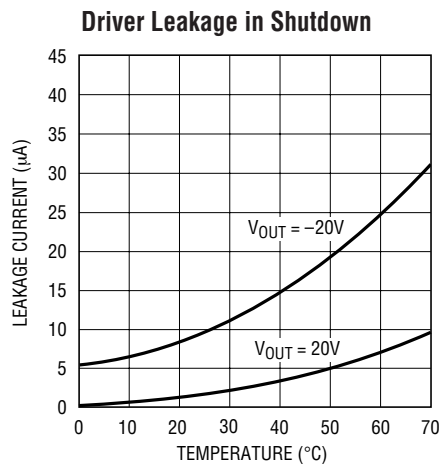
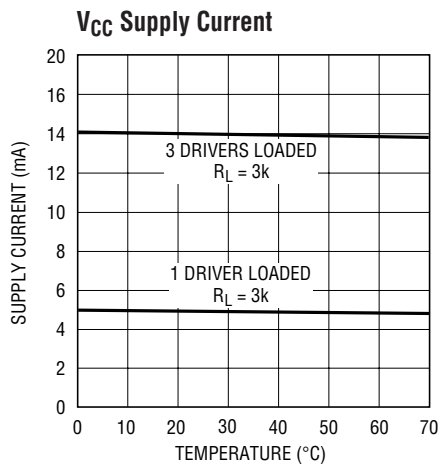


LTC1349 • TPC02



LTC1349 • TPC03

## TYPICAL PERFORMANCE CHARACTERISTICS



## PIN FUNCTIONS

**V<sub>CC</sub>**: 5V Input Supply Pin. Supply current is typically 35µA 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 Shutdown mode, with receivers 4 and 5 kept alive and the supply current equal to 35µA. All driver outputs and other receiver outputs are in high impedance state. This pin can not 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  $V^+$  and  $V^-$  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 20Ω.

## 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. Receiver 1, 2 and 3 outputs are in a high impedance state when in Shutdown mode to allow data line sharing. Receivers 4 and 5 are kept alive in Shutdown.

## SWITCHING TIME WAVEFORMS

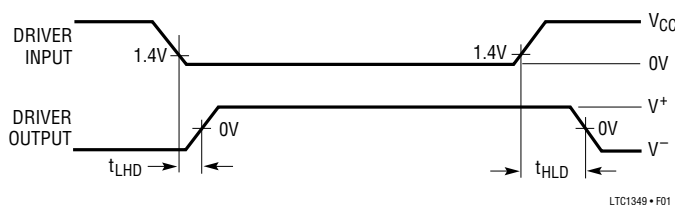


Figure 1. Driver Propagation Delay Timing

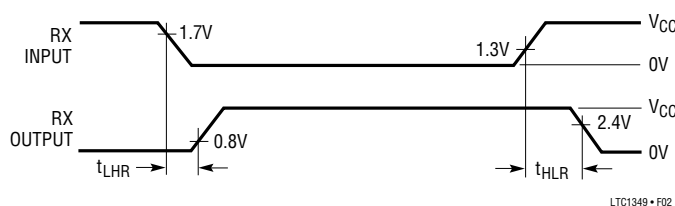
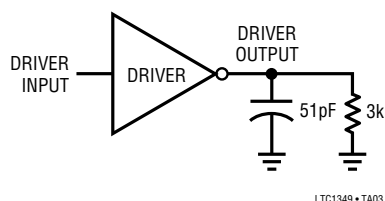


Figure 2. Receiver Propagation Delay Timing

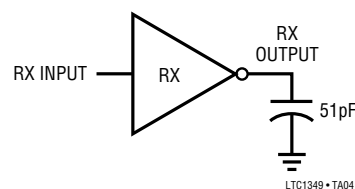
## TEST CIRCUITS

Driver Timing Test Load



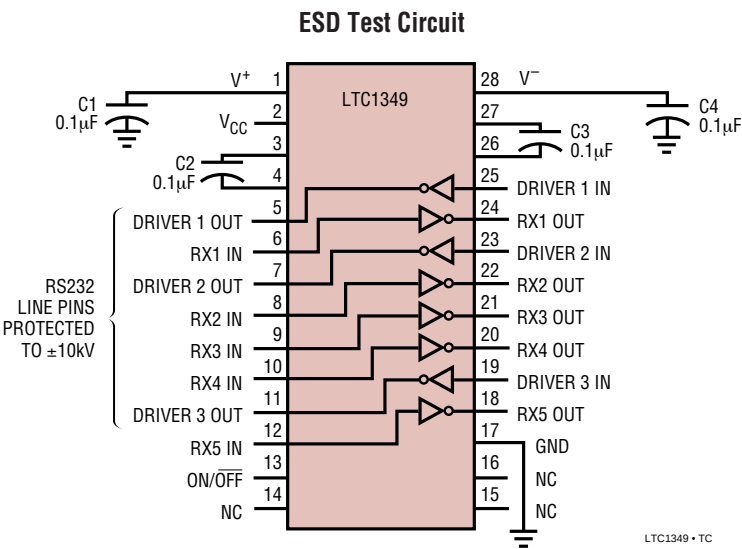
LTC1349 • TA03

Receiver Timing Test Load



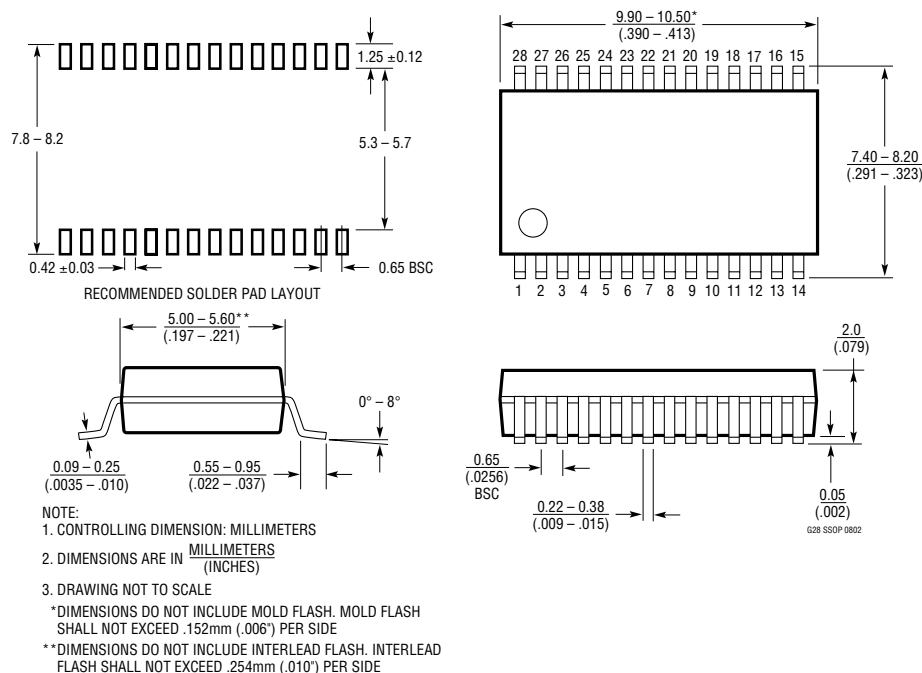
LTC1349 • TA04

TEST CIRCUITS

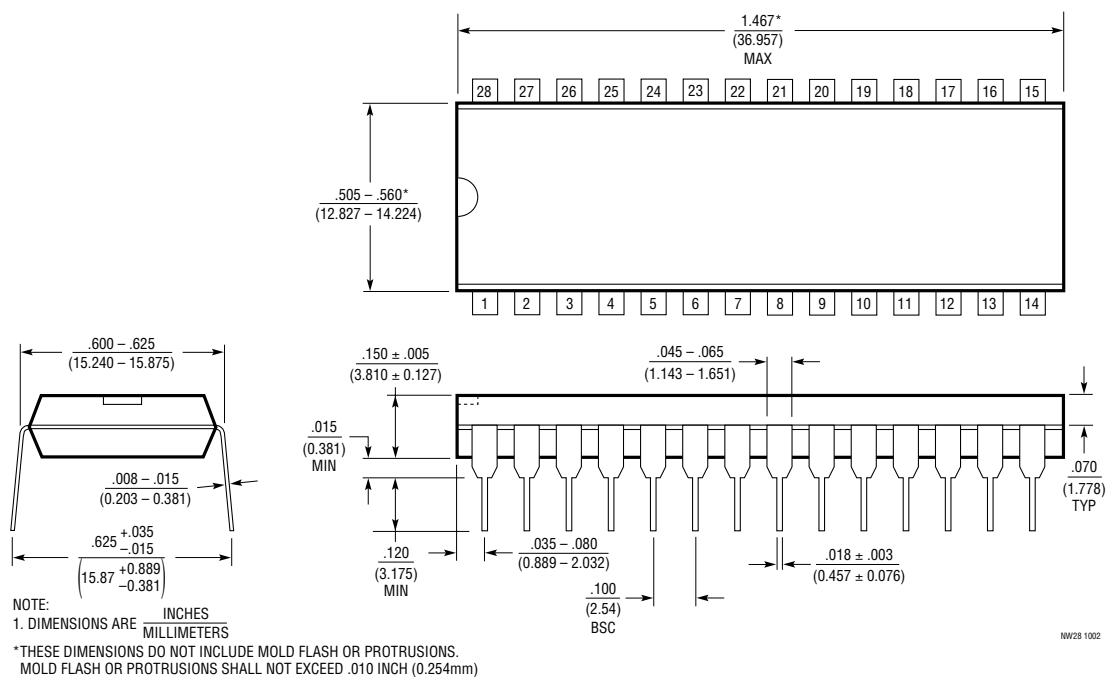


## PACKAGE DESCRIPTION

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



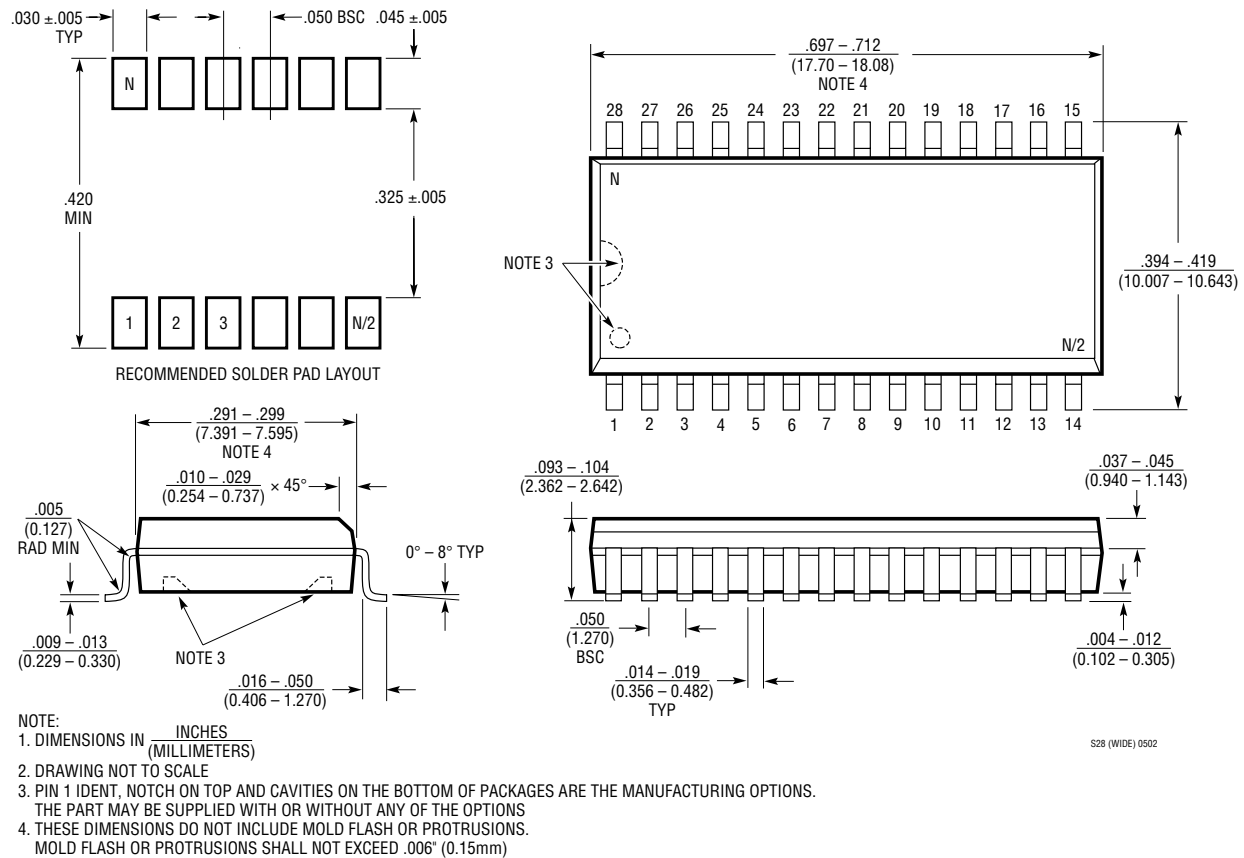
### NW Package 28-Lead PDIP (Wide .600 Inch) (Reference LTC DWG # 05-08-1520)



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## PACKAGE DESCRIPTION

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



## RELATED PARTS

| PART NUMBER           | DESCRIPTION                                        | COMMENTS                                           |
|-----------------------|----------------------------------------------------|----------------------------------------------------|
| LT <sup>®</sup> 1137A | 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            |
| LTC1337               | 5V, 3 Driver, 5 Receiver RS232 Transceiver         | 300μA Supply Current, 1μA in Shutdown              |
| LTC1348               | 3.3V to 5V, 3 Driver, 5 Receiver RS232 Transceiver | True RS232 on 3.3V, 5 Receivers Active in Shutdown |