

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

## FEATURES

- **Low Supply Current: 500 $\mu$ A**
- **0.2 $\mu$ A Supply Current in SHUTDOWN**
- 50 $\mu$ A Supply Current in RECEIVER ALIVE Mode
- **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
- Flowthrough Architecture

## APPLICATIONS

- Battery-Powered Modems
- Battery-Powered DCE
- Notebook Computers
- Palmtop Computers

## DESCRIPTION

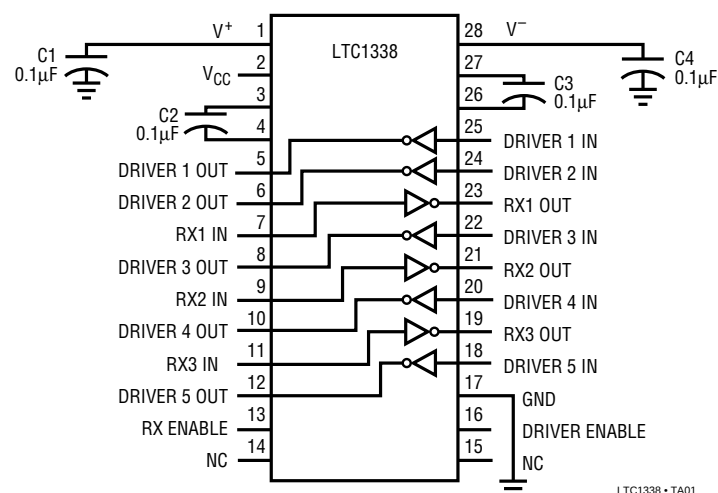
The LTC1338 is a 5-driver/3-receiver RS232 transceiver with very low supply current. In the no load condition, the supply current is only 500 $\mu$ A. The charge pump only requires four 0.1 $\mu$ F capacitors.

In SHUTDOWN mode, the supply current is further reduced to 0.2 $\mu$ A. In RECEIVER ALIVE mode, all three receivers are kept alive and the supply current is 50 $\mu$ A. All RS232 outputs assume a high impedance state in SHUTDOWN and with the power off.

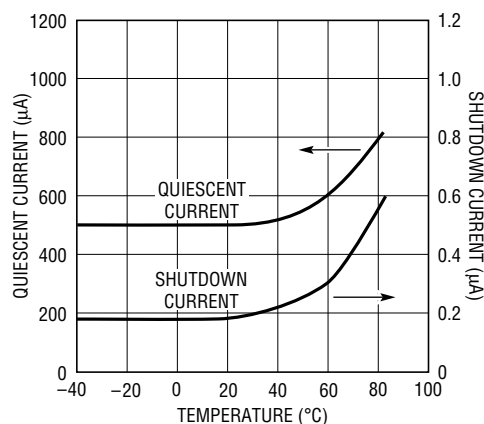
The LTC1338 is fully compliant with all data rate and overvoltage RS232 specifications. The transceiver can operate up to 120k baud with a 2500pF, 3k $\Omega$  load. Both driver outputs and receiver inputs can be forced to  $\pm 25$ V without damage, and can survive multiple  $\pm 10$ kV ESD strikes.

## TYPICAL APPLICATION

5-Drivers/3-Receivers with SHUTDOWN



Supply Current



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

LTC1338 • TA02

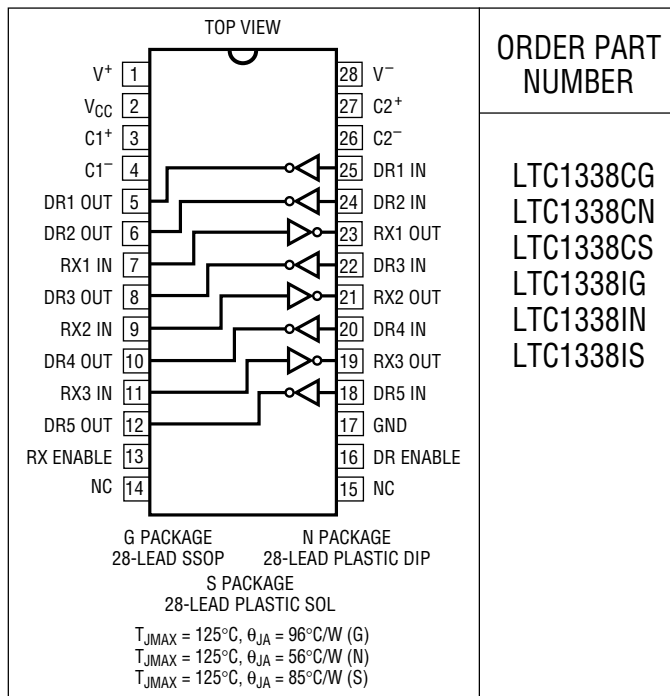
# LTC1338

## ABSOLUTE MAXIMUM RATINGS

(Note 1)

|                                      |                                  |
|--------------------------------------|----------------------------------|
| Supply Voltage ( $V_{CC}$ )          | 6V                               |
| Input Voltage                        |                                  |
| Driver                               | $-0.3V$ to $V_{CC} + 0.3V$       |
| Receiver                             | $-25V$ to $25V$                  |
| Driver/Receiver Enable 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 (LTC1338C)                | $0^{\circ}C$ to $70^{\circ}C$    |
| Industrial (LTC1338I)                | $-40^{\circ}C$ 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



ORDER PART  
NUMBER

LTC1338CG  
LTC1338CN  
LTC1338CS  
LTC1338IG  
LTC1338IN  
LTC1338IS

## DC ELECTRICAL CHARACTERISTICS

$V_{CC} = 5V, C1 = C2 = C3 = C4 = 0.1\mu F$ , unless otherwise noted.

| PARAMETER                     | CONDITIONS                                          | MIN  | TYP      | MAX       | UNITS      |
|-------------------------------|-----------------------------------------------------|------|----------|-----------|------------|
| <b>Any Driver</b>             |                                                     |      |          |           |            |
| Output Voltage Swing          | 3k to GND                                           | 5.0  | 7.0      |           | V          |
|                               | Positive                                            |      |          |           | V          |
|                               | Negative                                            | -5.0 | -6.5     |           | V          |
| Logic Input Voltage Level     | Input Low Level ( $V_{OUT} = \text{High}$ )         |      | 1.4      | 0.8       | V          |
|                               | Input High Level ( $V_{OUT} = \text{Low}$ )         | 2.0  | 1.4      |           | V          |
| Logic Input Current           | $0 \leq V_{IN} \leq V_{CC}$                         |      |          | $\pm 5$   | $\mu A$    |
| Output Short-Circuit Current  | $V_{OUT} = 0V$                                      |      | $\pm 12$ |           | mA         |
| Output Leakage Current        | SHUTDOWN, $V_{OUT} = \pm 20V$ (Note 3)              |      | $\pm 10$ | $\pm 500$ | $\mu A$    |
| <b>Any Receiver</b>           |                                                     |      |          |           |            |
| Input Voltage Thresholds      | Input Low Threshold                                 | 0.8  | 1.3      |           | V          |
|                               | Input High Threshold                                |      | 1.7      | 2.4       | V          |
| Hysteresis                    |                                                     | 0.1  | 0.4      | 1         | V          |
| Input Resistance              | $-10V \leq V_{IN} \leq 10V$                         | 3    | 5        | 7         | k $\Omega$ |
| Output Voltage                | Output Low, $I_{OUT} = -1.6mA$ ( $V_{CC} = 5V$ )    |      | 0.2      | 0.4       | V          |
|                               | Output High, $I_{OUT} = 160\mu A$ ( $V_{CC} = 5V$ ) | 3.5  | 4.8      |           | V          |
| 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        | $\mu A$    |
| <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          |
|                               | $I_{OUT} = -12mA$                                   |      | -7.0     |           | V          |
| Supply Rise Time              | SHUTDOWN to Turn-On                                 |      | 0.2      |           | ms         |

## DC ELECTRICAL CHARACTERISTICS $V_{CC} = 5V$ , $C1 = C2 = C3 = C4 = 0.1\mu F$ , unless otherwise noted.

| PARAMETER                             | CONDITIONS                                                                               | MIN | TYP | MAX | UNITS   |
|---------------------------------------|------------------------------------------------------------------------------------------|-----|-----|-----|---------|
| <b>Power Supply</b>                   |                                                                                          |     |     |     |         |
| $V_{CC}$ Supply Current               | No Load (All Driver $V_{IN} = V_{CC}$ )(Note 2) $0^{\circ}C \leq T_A \leq 70^{\circ}C$   |     | 0.5 | 1.0 | mA      |
|                                       | No Load (All Driver $V_{IN} = 0V$ )(Note 2) $0^{\circ}C \leq T_A \leq 70^{\circ}C$       |     | 1.0 | 1.5 | mA      |
|                                       | No Load (All Driver $V_{IN} = V_{CC}$ )(Note 2) $-40^{\circ}C \leq T_A \leq 85^{\circ}C$ |     | 0.5 | 1.5 | mA      |
|                                       | No Load (All Driver $V_{IN} = 0V$ )(Note 2) $-40^{\circ}C \leq T_A \leq 85^{\circ}C$     |     | 1.0 | 2.0 | mA      |
|                                       | RECEIVER ALIVE Mode (Note 4)                                                             | ●   | 50  | 80  | $\mu A$ |
| Supply Leakage Current ( $V_{CC}$ )   | SHUTDOWN (Note 3)                                                                        | ●   | 0.2 | 10  | $\mu A$ |
| Driver/Receiver Enable Threshold Low  |                                                                                          | ●   | 1.4 | 0.8 | V       |
| Driver/Receiver Enable Threshold High |                                                                                          | ●   | 2.0 | 1.4 | V       |

## AC CHARACTERISTICS $V_{CC} = 5V$ , $C1 = C2 = C3 = C4 = 0.1\mu F$ , unless otherwise noted.

| PARAMETER                                    | CONDITIONS                  | MIN | TYP | MAX | UNITS      |
|----------------------------------------------|-----------------------------|-----|-----|-----|------------|
| Slew Rate                                    | $R_L = 3k$ , $C_L = 51pF$   |     | 8   | 30  | V/ $\mu s$ |
|                                              | $R_L = 3k$ , $C_L = 2500pF$ | 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 | $\mu s$    |

The ● denotes specifications which apply over the operating temperature range of  $0^{\circ}C$  to  $70^{\circ}C$  or  $-40^{\circ}C$  to  $85^{\circ}C$ .

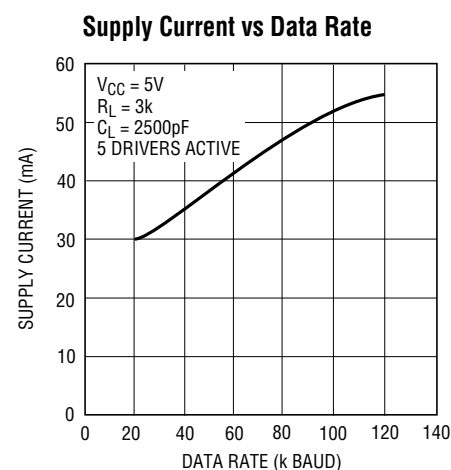
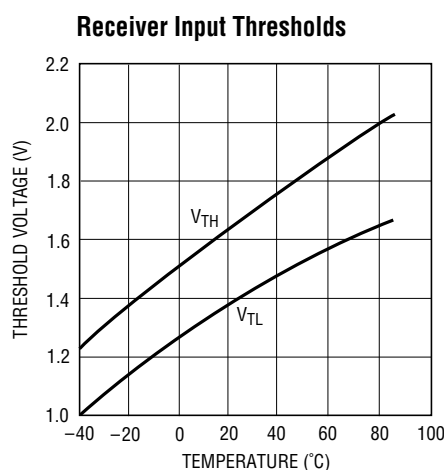
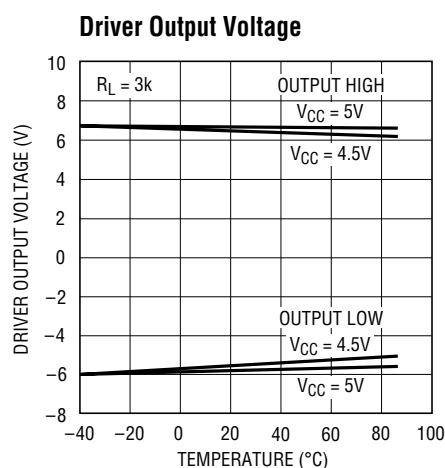
**Note 1:** Absolute maximum ratings are those values beyond which the life of the device may be impaired.

**Note 2:** Supply current is measured with driver and receiver outputs unloaded. The  $V_{DRIVER\ ENABLE}$  and  $V_{RECEIVER\ ENABLE} = V_{CC}$ .

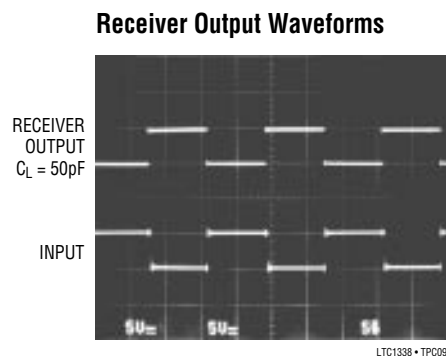
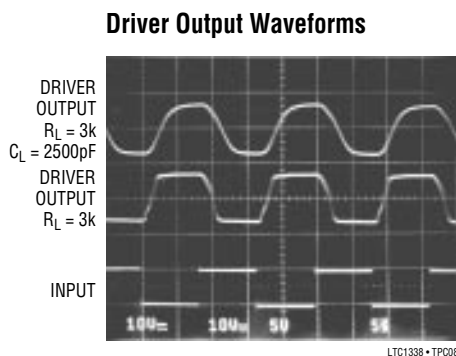
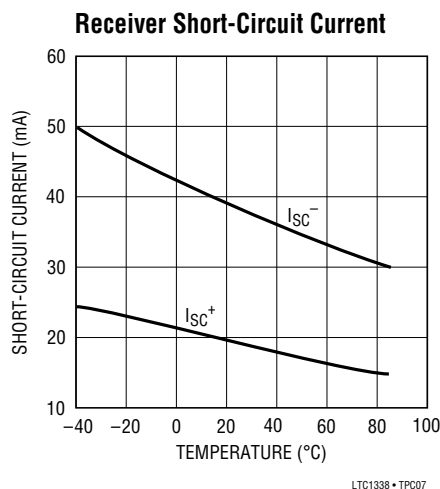
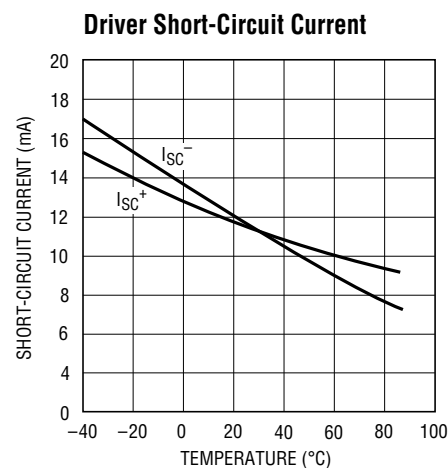
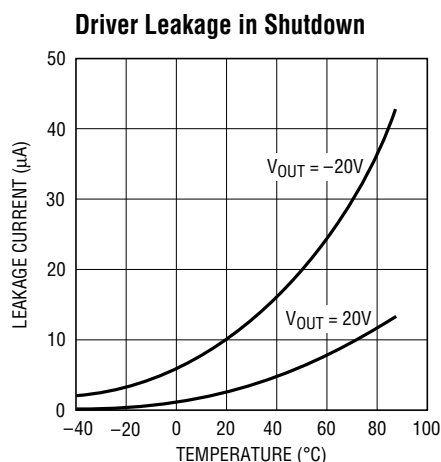
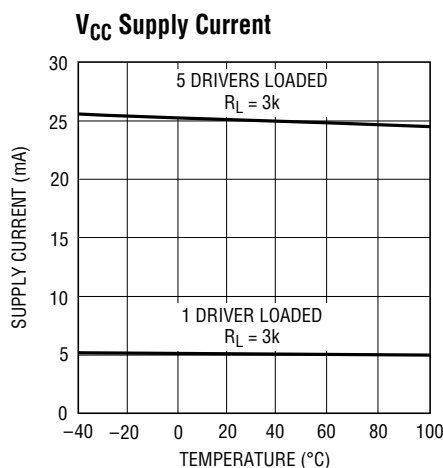
**Note 3:** Supply current and leakage current measurements in SHUTDOWN are performed with  $V_{DRIVER\ ENABLE}$  and  $V_{RECEIVER\ ENABLE} = 0V$ .

**Note 4:** Supply current measurement in RECEIVER ALIVE mode is performed with  $V_{DRIVER\ ENABLE} = 0V$  and  $V_{RECEIVER\ ENABLE} = V_{CC}$ .

## TYPICAL PERFORMANCE CHARACTERISTICS



## TYPICAL PERFORMANCE CHARACTERISTICS



## PIN FUNCTIONS

**V<sub>CC</sub>:** 5V Input Supply Pin. Supply current less than 0.2μA in the SHUTDOWN mode. This pin should be decoupled with a 0.1μF ceramic capacitor.

**GND:** Ground Pin.

**RECEIVER ENABLE:** TTL/CMOS Compatible Enable Pin. Refer to Table 1 for its functional description. This pin can not float.

**DRIVER ENABLE:** TTL/CMOS Compatible Enable Pin. Refer to Table 1 for its functional description. This pin can not float.

**V<sup>+</sup>:** Positive Supply Output (RS232 Drivers).  $V^+ \cong 2V_{CC} - 1V$ . 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).  $V^- \cong 2V_{CC} - 1.5V$ . 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, RECEIVER ALIVE mode or  $V_{CC} = 0V$ . The driver outputs are protected against ESD to  $\pm 10kV$  for human body model discharges.

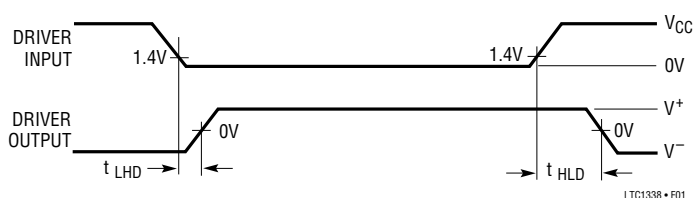
**RX IN:** Receiver Inputs. These pins can be forced to  $\pm 25V$  without damage. The receiver inputs are protected against ESD to  $\pm 10kV$  for human body model discharges. Each receiver provides 0.4V of hysteresis for noise immunity.

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

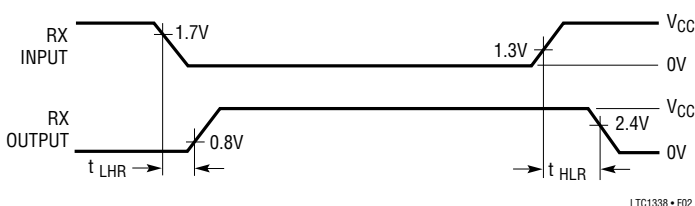
**Table 1. Functional Description**

| MODE             | RX ENABLE | DR ENABLE | DRIVERS                                | RECEIVERS                                | $I_{CC}$ ( $\mu A$ )(TYP) |
|------------------|-----------|-----------|----------------------------------------|------------------------------------------|---------------------------|
| SHUTDOWN         | 0         | 0         | All driver outputs are high impedance. | All receiver outputs are high impedance. | 0.2                       |
| Receiver Disable | 0         | 1         | All drivers alive.                     | All receiver outputs are high impedance. | 500                       |
| RECEIVER ALIVE   | 1         | 0         | All driver outputs are high impedance. | All receivers alive.                     | 50                        |
| Normal           | 1         | 1         | All drivers alive.                     | All receivers alive.                     | 500                       |

## SWITCHING TIME WAVEFORMS



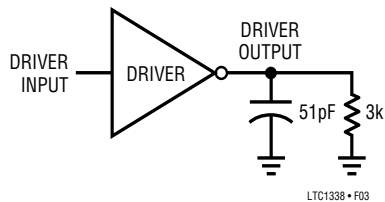
**Figure 1. Driver Propagation Delay Timing**



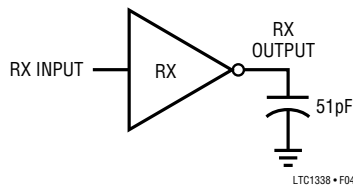
**Figure 2. Receiver Propagation Delay Timing**

## TEST CIRCUITS

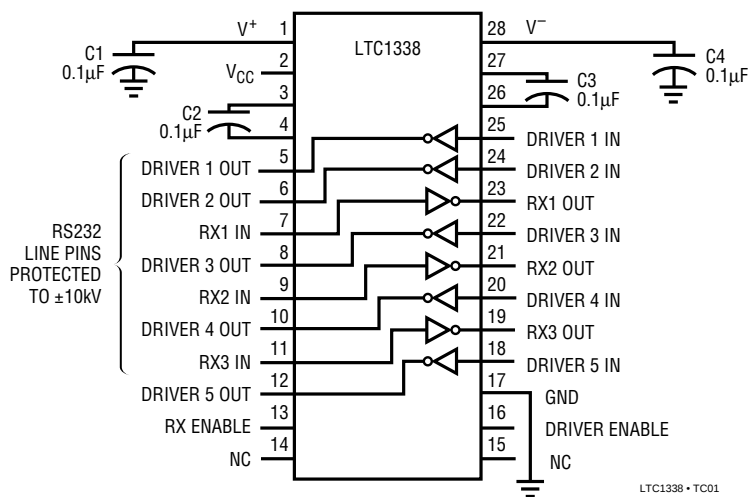
## Driver Timing Test Load



## Receiver Timing Test Load



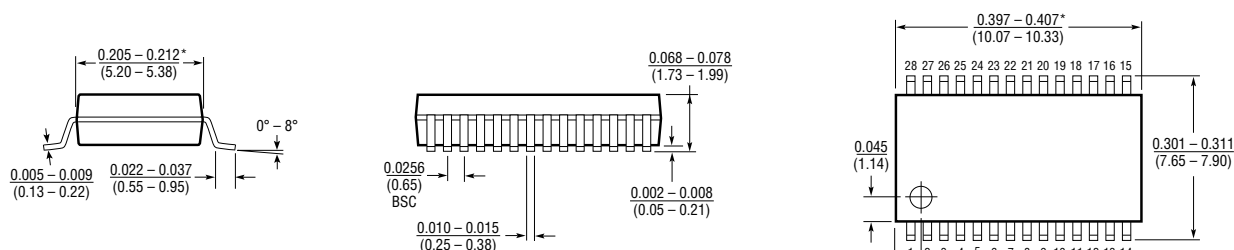
## ESD Test Circuit



# PACKAGE DESCRIPTION

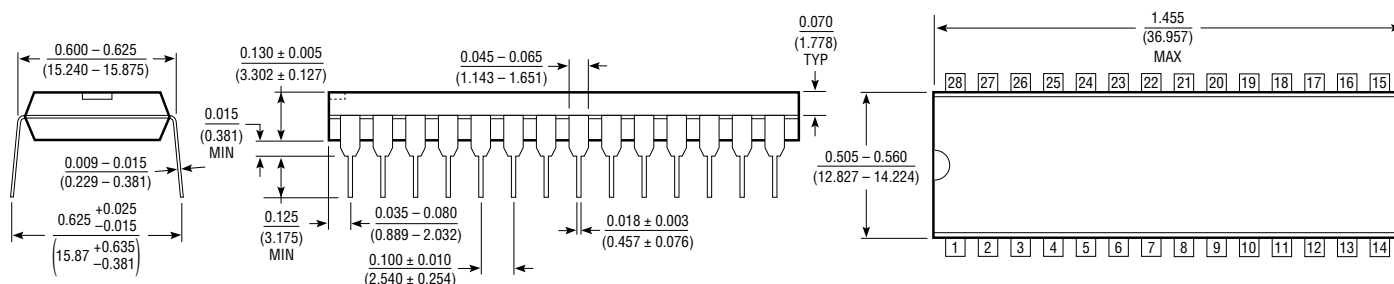
Dimensions in inches (millimeters) unless otherwise noted.

## G Package 28-Lead SSOP

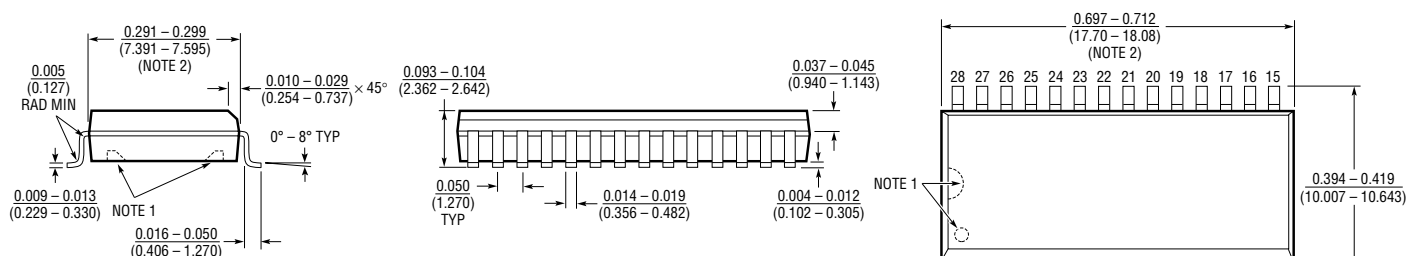


\*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 INCH (0.15mm).

## N Package 28-Lead Plastic DIP



## S Package 28-Lead SOL



- NOTE:
- PIN 1 IDENT, NOTCH ON TOP AND CAVITIES ON THE BOTTOM OF PACKAGES ARE THE MANUFACTURING OPTIONS. THE PART MAY BE SUPPLIED WITH OR WITHOUT ANY OF THE OPTIONS.
  - THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 INCH (0.15mm).

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