# 5V RS232 Transceiver with One Receiver Active in Shutdown

## FEATURES

- One Receiver Remains Active While in Shutdown
- ESD Protection Over ±**10kV**
- Uses Small Capacitors: 0.1µF, 0.2µF
- 60µA Supply Current in Shutdown
- Pin Compatible with LT1137A
- 120kBaud Operation for $R_L$ = 3k, $C_L$ = 2500pF
- 250kBaud Operation for $R_L$ = 3k, $C_L$ = 1000pF
- CMOS Comparable Low Power: 60mW
- Operates from a Single 5V Supply
- Easy PC Layout: Flowthrough Architecture
- Rugged Bipolar Design
- Outputs Assume a High Impedance State When Off or Powered Down
- Absolutely No Latchup
- Available in SSOP Package

## APPLICATIONS

- Notebook Computers
- Palmtop Computers

## DESCRIPTION

The LT®1341 is an advanced low power three-driver, five-receiver RS232 transceiver. Included on the chip is a shutdown pin for reducing supply current to near zero. During shutdown one receiver remains active to detect incoming RS232 signals, for example, to wake up a system. All other receivers and the drivers assume high impedance states during shutdown.

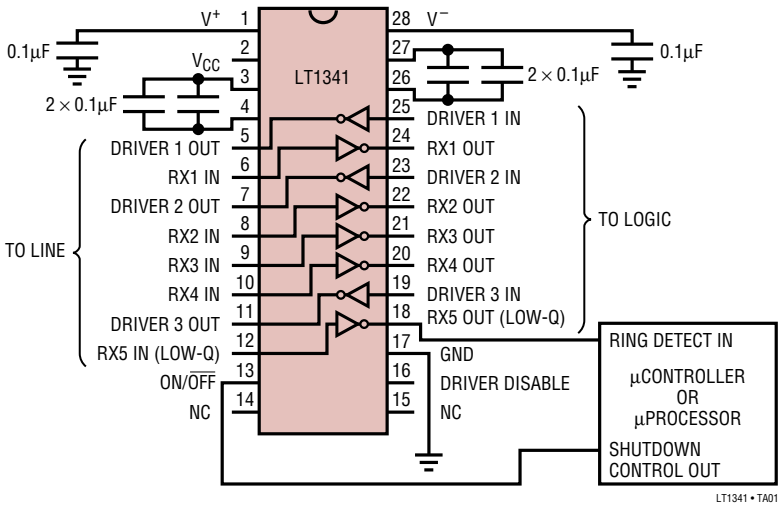
The driver disable function provides additional control of operating mode. When driver disable is high the charge pump and drivers turn off. Receivers continue to operate during driver disable.

New ESD structures on the chip allow the LT1341 to survive multiple ±10kV strikes, eliminating the need for costly TransZorbs® on the RS232 line pins.

The LT1341 is fully compliant with all EIA RS232 specifications and operates in excess of 120kbaud even driving heavy capacitive loads.

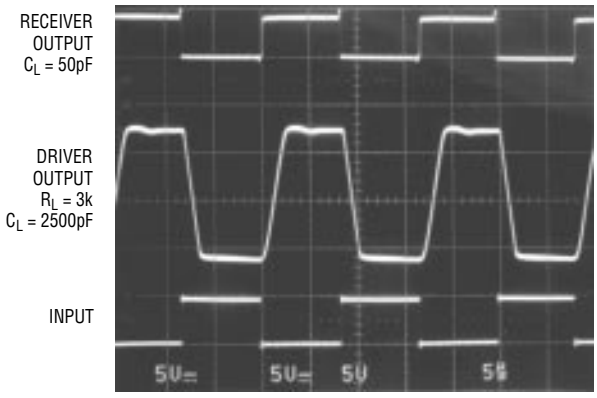


## TYPICAL APPLICATION




LT1341 • TA01

**Output Waveforms**



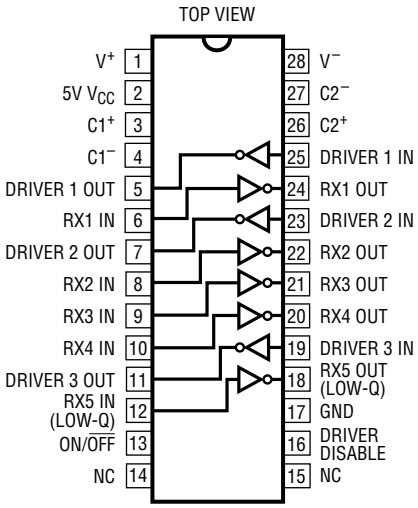

LT1341 • TA02

## ABSOLUTE MAXIMUM RATINGS

**(Note 1)**

Supply Voltage ($V_{CC}$) ..... 6V
$V^+$ ..... 13.2V
$V^-$ ..... –13.2V
Input Voltage
  Driver ..... $V^+$ to $V^-$
  Receiver ..... 30V to –30V
Output Voltage
  Driver ..... –30V to 30V
  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
  LT1341C ..... 0°C to 70°C
Storage Temperature Range ..... –65°C to 150°C
Lead Temperature (Soldering, 10 sec)..... 300°C

## PACKAGE/ORDER INFORMATION




G PACKAGE
28-LEAD PLASTIC SSOP

NW PACKAGE
28-LEAD (WIDE) PDIP

SW PACKAGE
28-LEAD (WIDE) PLASTIC SO

$T_{JMAX}$ = 125°C, $\theta_{JA}$ = 96°C/W (G)
$T_{JMAX}$ = 125°C, $\theta_{JA}$ = 56°C/W (NW)
$T_{JMAX}$ = 125°C, $\theta_{JA}$ = 85°C/W (SW)

| ORDER PART NUMBER |
|---|
| LT1341CG |
| LT1341CNW |
| LT1341CSW |

Consult factory for Industrial and Military grade parts.

## ELECTRICAL CHARACTERISTICS (Note 2)

| PARAMETER | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| **Power Supply Generator** | | | | | | |
| $V^+$ Output | | | | 8.6 | | V |
| $V^-$ Output | | | | –7 | | V |
| Supply Current ($V_{CC}$) | (Note 3) | | | 14 | 17 | mA |
| Supply Current When OFF ($V_{CC}$) | Shutdown (Note 4)<br>Driver Disable | ●<br> | | 0.06<br>3 | 0.150<br> | mA<br>mA |
| Supply Rise Time<br>Shutdown to Turn-On | C1 = C2 = 0.2µF,<br>$C^+ = C^- = 0.1\mu F$ | | | 0.2 | | ms |
| ON/$\overline{OFF}$ Pin Thresholds | Input Low Level (Device Shut Down)<br>Input High Level (Device Enabled) | ●<br>● | <br>2.4 | 1.4<br>1.4 | 0.8<br> | V<br>V |
| ON/$\overline{OFF}$ Pin Current | $0V \le V_{ON/\overline{OFF}} \le 5V$ | ● | –15 | | 80 | µA |
| DRIVER DISABLE Pin Thresholds | Input Low Level (Drivers Enabled)<br>Input High Level (Drivers Disabled) | ●<br>● | <br>2.4 | 1.4<br>1.4 | 0.8<br> | V<br>V |
| DRIVER DISABLE Pin Current | $0V \le V_{DRIVER\ DISABLE} \le 5V$ | ● | –10 | | 500 | µA |
| Oscillator Frequency | | | | 130 | | kHz |

## ELECTRICAL CHARACTERISTICS (Note 2)

| PARAMETER | CONDITIONS | | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **Any Driver** | | | | | | | |
| Output Voltage Swing | Load = 3k to GND | Positive | ● | 5 | 7.3 | | V |
| | | Negative | ● | | –6.5 | –5 | V |
| Logic Input Voltage Level | Input Low Level ($V_{OUT}$ = High) | | ● | | 1.4 | 0.8 | V |
| | Input High Level ($V_{OUT}$ = Low) | | ● | 2 | 1.4 | | V |
| Logic Input Current | $0.8V \le V_{IN} \le 2V$ | | ● | | 5 | 20 | µA |
| Output Short-Circuit Current | $V_{OUT}$ = 0V | | | ±9 | ±17 | | mA |
| Output Leakage Current | Shutdown $V_{OUT}$ = ±30V (Note 4) | | ● | | 10 | 100 | µA |
| Data Rate (Note 7) | $R_L$ = 3k, $C_L$ = 2500pF | | | 120 | | | kBaud |
| | $R_L$ = 3k, $C_L$ = 1000pF | | | 250 | | | kBaud |
| Slew Rate | $R_L$ = 3k, $C_L$ = 51pF | | | | 15 | 30 | V/µs |
| | $R_L$ = 3k, $C_L$ = 2500pF | | | 4 | 6 | | V/µs |
| Propagation Delay | Output Transition $t_{HL}$ High to Low (Note 5) | | | | 0.6 | 1.3 | µs |
| | Output Transition $t_{LH}$ Low to High | | | | 0.5 | 1.3 | µs |
| **Any Receiver** | | | | | | | |
| Input Voltage Thresholds | Input Low Threshold ($V_{OUT}$ = High) | | | 0.8 | 1.3 | | V |
| | Input High Threshold ($V_{OUT}$ = Low) | | | | 1.7 | 2.4 | V |
| Hysteresis | | | ● | 0.1 | 0.4 | 1.0 | V |
| Input Resistance | | | | 3 | 5 | 7 | kΩ |
| Output Leakage Current | Shutdown (Note 4) $0 \le V_{OUT} \le V_{CC}$ | | ● | | 1 | 10 | µA |
| **Receivers 1 Through 4** | | | | | | | |
| Output Voltage | Output Low, $I_{OUT}$ = –1.6mA | | ● | | 0.2 | 0.4 | V |
| | Output High, $I_{OUT}$ = 160µA ($V_{CC}$ = 5V) | | ● | 3.5 | 4.2 | | V |
| Output Short-Circuit Current | Sinking Current, $V_{OUT} = V_{CC}$ | | | | –20 | –10 | mA |
| | Sourcing Current, $V_{OUT}$ = 0V | | | 10 | 20 | | mA |
| Propagation Delay | Output Transition $t_{HL}$ High to Low (Note 6) | | | | 250 | 600 | ns |
| | Output Transition $t_{LH}$ Low to High | | | | 350 | 600 | ns |
| **Receiver 5 (Low-$I_Q$ RX)** | | | | | | | |
| Output Voltage | Output Low, $I_{OUT}$ = –500µA | | ● | | 0.2 | 0.4 | V |
| | Output High, $I_{OUT}$ = 160µA ($V_{CC}$ = 5V) | | ● | 3.5 | 4.2 | | V |
| Output Short-Circuit Current | Sinking Current, $V_{OUT} = V_{CC}$ | | | | –4 | –2 | mA |
| | Sourcing Current, $V_{OUT}$ = 0V | | | 2 | 4 | | mA |
| Propagation Delay | Output Transition $t_{HL}$ High to Low (Note 6) | | | | 1 | 3 | µs |
| | Output Transition $t_{LH}$ Low to High | | | | 1 | 3 | µs |

The ● denotes specifications which apply over the full operating temperature range ($0°C \le T_A \le 70°C$ for commercial grade).

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

**Note 2:** Testing done at $V_{CC}$ = 5V and $V_{ON/\overline{OFF}}$ = 3V.

**Note 3:** Supply current is measured as the average over several charge pump cycles. $C^+ = C^- = 0.1\mu F$, C1 = C2 = 0.2µF. All outputs are open with all driver inputs tied high.

**Note 4:** Supply current and leakage measurements in shutdown are performed with $V_{ON/\overline{OFF}} \le 0.1V$. Supply current measurements using driver disable are performed with $V_{DRIVER\ DISABLE} \ge 3V$.

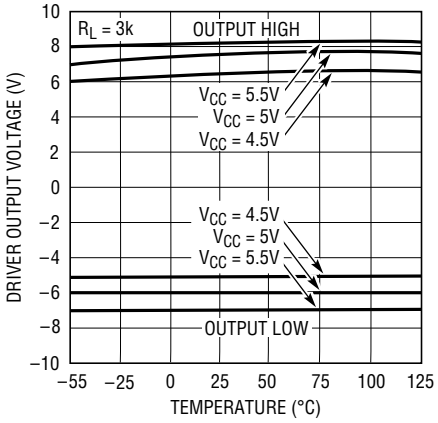
**Note 5:** For driver delay measurements, $R_L$ = 3k and $C_L$ = 51pF. Trigger points are set between the driver's input logic threshold and the output transition to the zero crossing ($t_{HL}$ = 1.4V to 0V and $t_{LH}$ = 1.4V to 0V).

**Note 6:** For receiver delay measurements, $C_L$ = 51pF. Trigger points are set between the receiver's input logic threshold and the output transition to standard TTL/CMOS logic threshold ($t_{HL}$ = 1.3V to 2.4V and $t_{LH}$ = 1.7V to 0.8V).

**Note 7:** Data rate operation guaranteed by slew rate, short-circuit current and propagation delay tests.

# TYPICAL PERFORMANCE CHARACTERISTICS

### Driver Output Voltage

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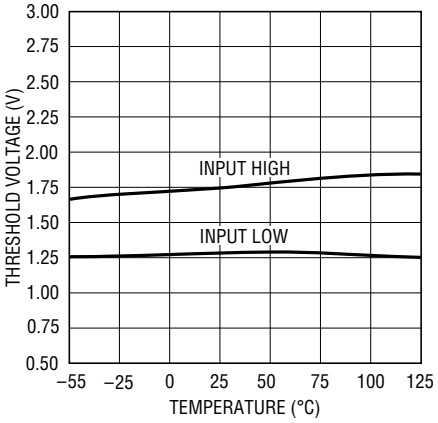
### Receiver Input Thresholds

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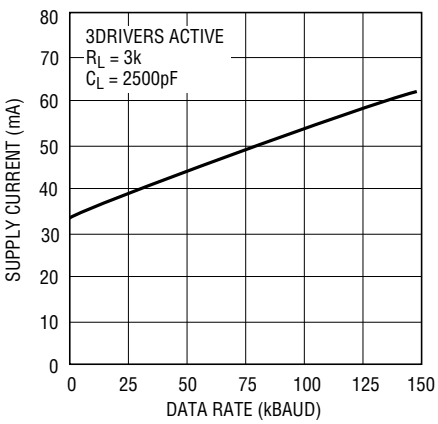
### Supply Current vs Data Rate

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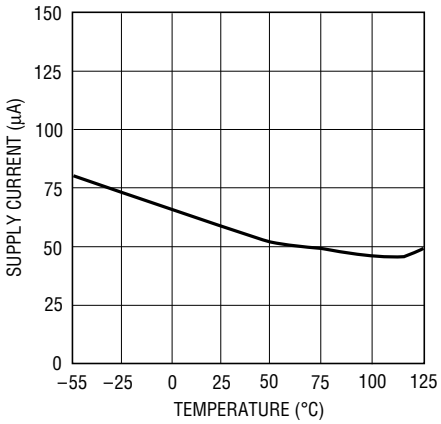
### Supply Current in Shutdown

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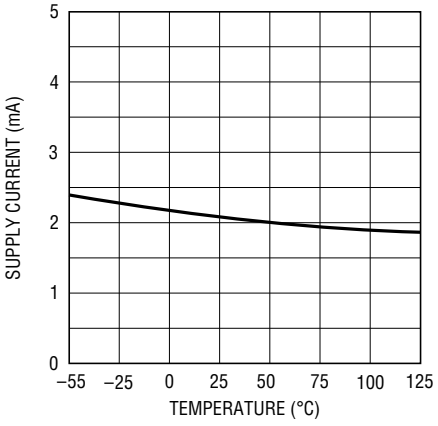
### Supply Current in Driver Disable

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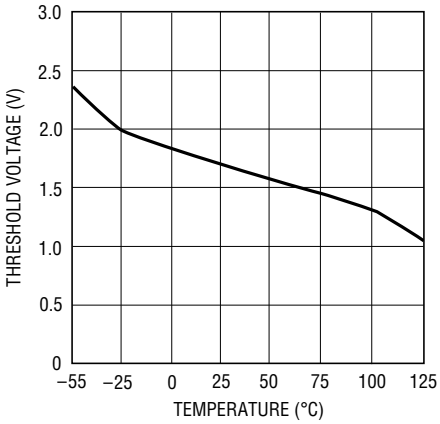
### DRIVER DISABLE Threshold

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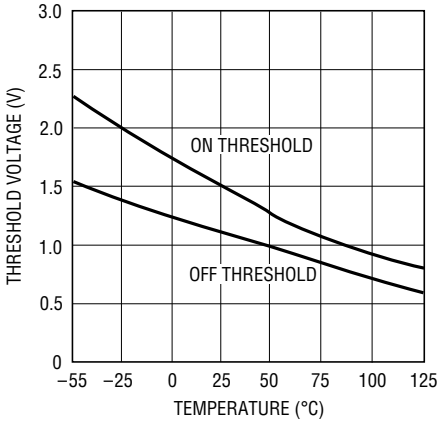
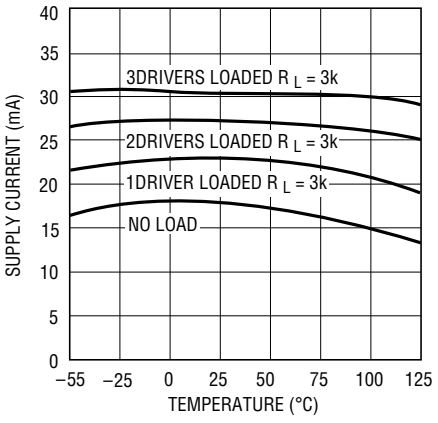
### ON/$\overline{\text{OFF}}$ Thresholds



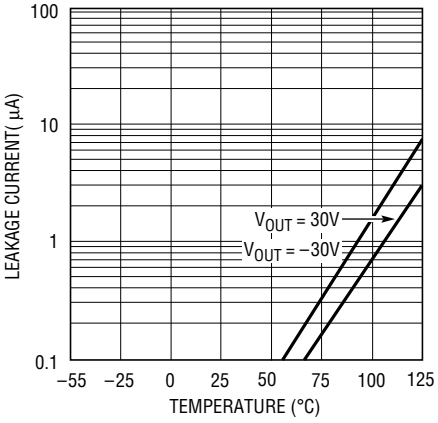

LT1341 • TPC07

### Supply Current




LT1341 • TPC08

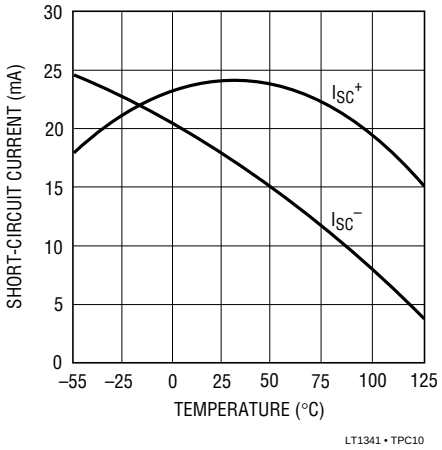
### Driver Leakage in Shutdown




LT1341 • TPC09

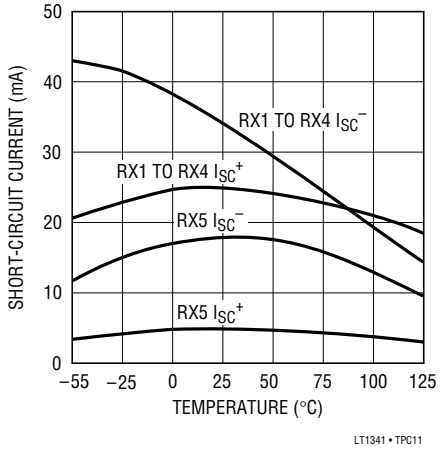
## TYPICAL PERFORMANCE CHARACTERISTICS

**Driver Short-Circuit Current**



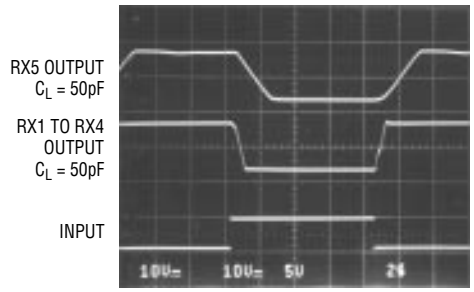

LT1341 • TPC10

**Receiver Short-Circuit Current**



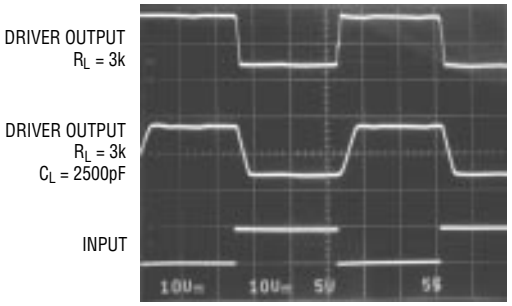

LT1341 • TPC11

**Receiver Output Waveforms**




LT1341 • TPC12

**Driver Output Waveforms**

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## PIN FUNCTIONS

**$V_{CC}$:** 5V Input Supply Pin. This pin should be decoupled with a 0.1µF ceramic capacitor close to the package pin. Insufficient supply bypassing can lead to low output drive levels and erratic charge pump operation.

**GND:** Ground Pin.

**ON/$\overline{OFF}$:** A TTL/CMOS logic low puts the device in the low power shutdown mode. All of the drivers and four receivers go to a high impedance state. Receiver RX5 remains active while the transceiver is in shutdown. The transceiver consumes only 60µA of supply current while in shutdown. A logic high fully enables the transceiver.

**DRIVER DISABLE:** This pin provides an alternate control for the charge pump and RS232 drivers. A logic high on this pin shuts down the charge pump and places all drivers in a high impedance state. All receivers remain active under these conditions. Floating the driver disable pin or driving it to a logic low level fully enables the transceiver. Supply current drops to 3mA when in driver disable mode. A logic low on the ON/$\overline{OFF}$ pin supersedes the state of the DRIVER DISABLE pin.

**$V^+$:** Positive Supply Output (RS232 Drivers). $V^+ \approx 2V_{CC} - 1.5V$. This pin requires an external charge storage capacitor $C \geq 0.1\mu F$, tied to ground or $V_{CC}$. Larger value capacitors may be used to reduce supply ripple. With multiple transceivers, the $V^+$ and $V^-$ pins may be paralleled into common capacitors. For large numbers of transceivers, increasing the size of the storage capacitors is recommended to reduce ripple.

## PIN FUNCTIONS

**$V^-$:** Negative Supply Output (RS232 Drivers). $V^- \approx -(2V_{CC} - 2.5V)$. This pin requires an external charge storage capacitor $C \geq 0.1\mu F$. To reduce supply ripple, increase the size of the storage capacitor. With multiple transceivers, the $V^+$ and $V^-$ pins may be paralleled into common filter capacitors.

**$C1^+$, $C1^-$, $C2^+$, $C2^-$:** Commutating Capacitor Inputs. These pins require two external capacitors $C \geq 0.2\mu F$: one from $C1^+$ to $C1^-$, and another from $C2^+$ to $C2^-$. The capacitor's effective series resistance should be less than $2\Omega$. For $C \geq 1\mu F$, low ESR tantalum capacitors work well in this application, although small value ceramic capacitors may be used with a minimal reduction in charge pump compliance. When a 12V supply is available, C1 may be omitted. Connect the 12V supply to $C1^+$ and $V^+$. The 12V supply should be decoupled with a $0.1\mu F$ ceramic capacitor.

**DRIVER IN:** RS232 Driver Input Pins. These inputs are TTL/CMOS compatible. 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, $V_{CC}$ = 0V, or when the DRIVER DISABLE pin is active. Outputs are fully short-circuit protected from $V_{OUT} = V^- + 30V$ to $V_{OUT} = V^+ - 30V$. Applying higher voltages will not damage the device if the overdrive is moderately current limited. Short circuits on one output can load the power supply generator and may disrupt the signal levels of the other outputs. The driver outputs are protected against ESD to ±10kV for human body model discharges.

**RX IN:** Receiver Inputs. These pins accept RS232 level signals (±30V) into a protected 5k terminating resistor. The receiver inputs are protected against ESD to ±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. Outputs, including LOW-Q RX OUT, are fully short-circuit protected to ground or $V_{CC}$ with the power on, off, or in shutdown mode.

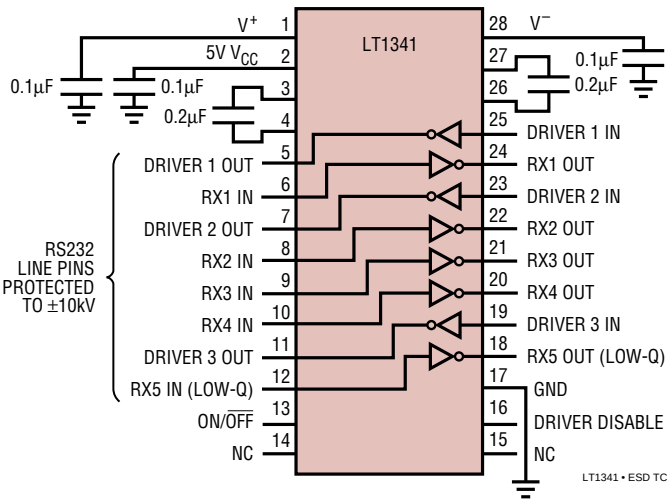
**LOW Q-CURRENT RX IN:** Low Power Receiver Input. This special receiver remains active when the part is in shutdown mode, consuming typically 60µA. This receiver has the same input and protection characteristics as the other receivers.

**LOW Q-CURRENT RX OUT:** Low Power Receiver Output. This pin produces the same TTL/CMOS output voltage levels with slightly decreased speed and short-circuit current.

## ESD PROTECTION

The RS232 line inputs of the LT1341 have on-chip protection from ESD transients up to ±10kV. The protection structures act to divert the static discharge safely to system ground. In order for the ESD protection to function effectively, the power supply and ground pins of the LT1341 must be connected to ground through low impedances. The power supply decoupling capacitors and charge pump storage capacitors provide this low impedance in normal application of the circuit. The only constraint is that low ESR capacitors must be used for bypassing and charge storage. ESD testing must be done with pins $V_{CC}$, $V^+$, $V^-$ and GND shorted to ground or connected with low ESR capacitors.

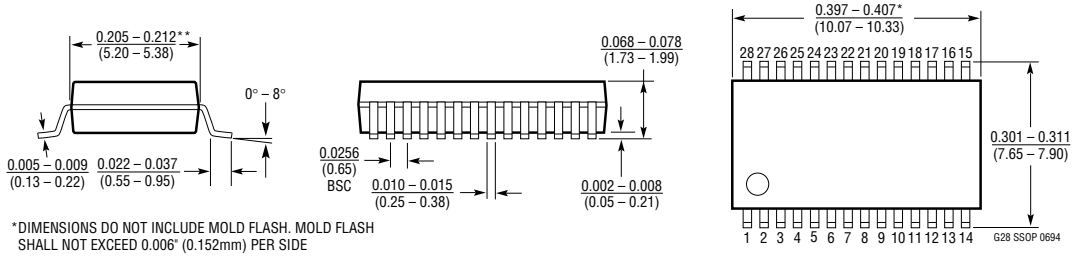
**ESD Test Circuit**



# PACKAGE DESCRIPTION

**Dimensions in inches (millimeters) unless otherwise noted.**

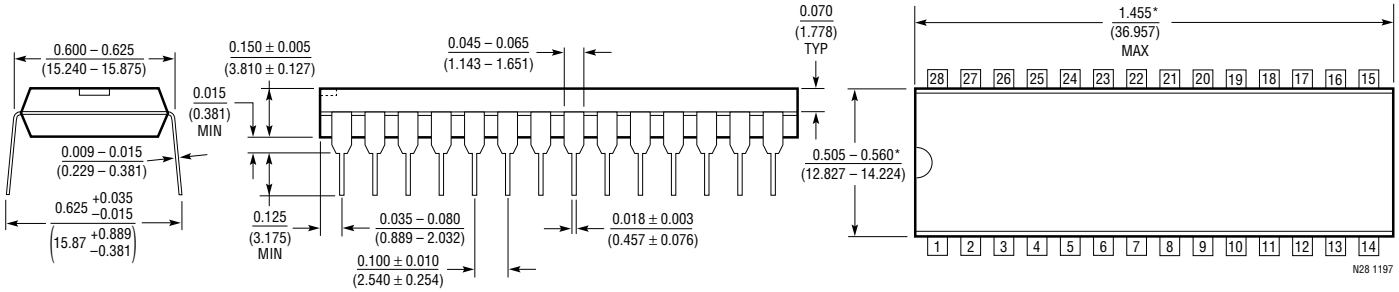
## G Package
## 28-Lead Plastic SSOP (0.209)
(LTC DWG # 05-08-1640)




*DIMENSIONS DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

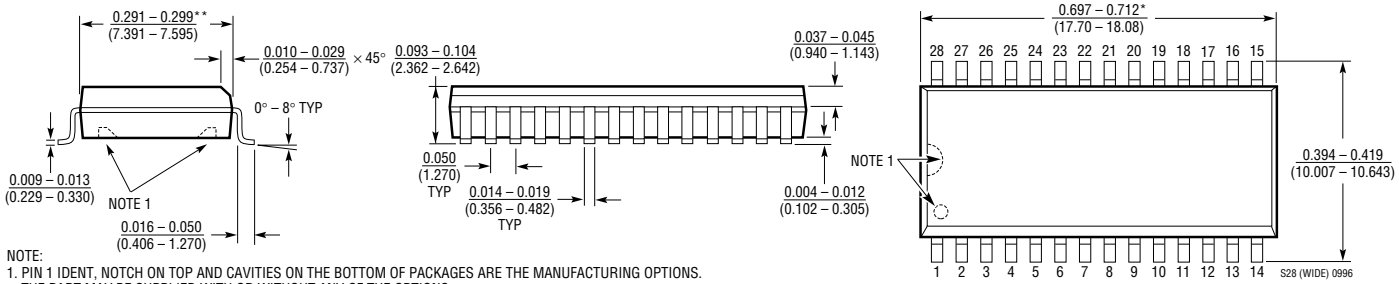
**DIMENSIONS DO NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

## NW Package
## 28-Lead PDIP (Wide 0.600)
(LTC DWG # 05-08-1520)




*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 INCH (0.254mm)

## SW Package
## 28-Lead Plastic Small Outline (Wide 0.300)
(LTC DWG # 05-08-1620)




NOTE:
1. 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

*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

**DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE