

## FEATURES

- Operates from  $\pm 5\text{V}$  to  $\pm 15\text{V}$  Supplies
- Fully Protected Against Overload
- Outputs Can Be Driven  $\pm 30\text{V}$  Without Damage
- Three-State Outputs; Outputs Open When Off
- Bipolar Circuit—No Latchup
- $\pm 30\text{V}$  Input Range
- Triple Driver/Receiver
- No Supply Current in Shutdown
- $30\text{k}\Omega$  Input Impedance
- Meets All RS232 Specifications
- 16-Pin Version—Pin Compatible with MC145406
- Available in SO Package
- $15\text{kV}$  ESD: LT1039A

## APPLICATIONS

- RS232 Interface
- Terminals
- Modems

## DESCRIPTION

The LT<sup>®</sup>1039 is a triple RS232 driver/receiver that includes shutdown. Each receiver will accept up to  $\pm 30\text{V}$  input and can drive either TTL or CMOS logic. The RS232 drivers accept TTL logic inputs and output RS232 voltage levels. The outputs are fully protected against overload and can be shorted to ground or up to  $\pm 30\text{V}$  without damage to the drivers. Additionally, when the system is shut down or power is off, the outputs are in a high impedance state allowing data line sharing. Bipolar circuitry makes this driver/receiver exceptionally rugged against overloads or **ESD** damage.

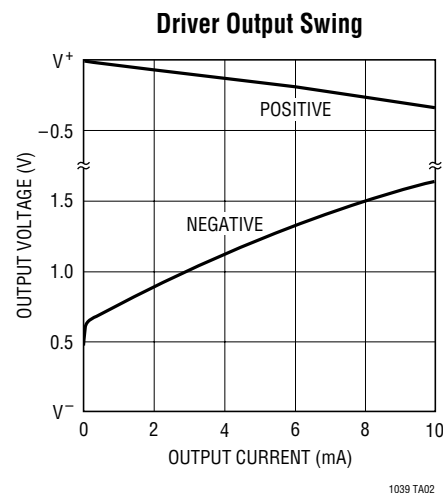
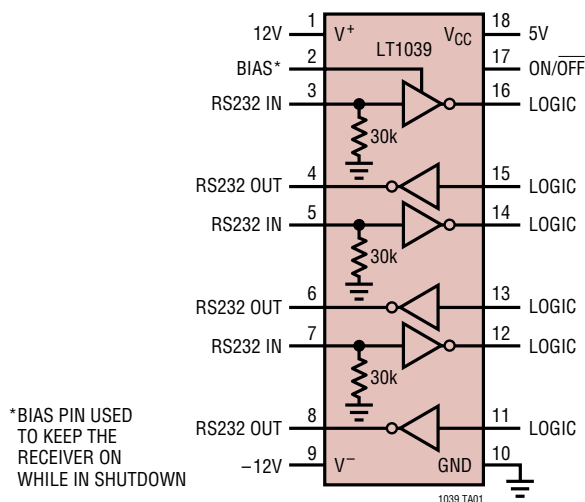
A BIAS pin allows one receiver to be kept on while the rest of the part is shut down.

The LT1039 is also available in the 16-pin version, without shutdown or BIAS pin functions.

For applications requiring operation from a single 5V supply, see the LT1080A/LT1081A, LT1180A/LT1181A and LT1130A data sheets. For applications requiring  $15\text{kV}$  ESD, see the LT1039A.

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## TYPICAL APPLICATION



## ABSOLUTE MAXIMUM RATINGS (Note 1)

|                          |                                    |                                      |                |
|--------------------------|------------------------------------|--------------------------------------|----------------|
| Supply Voltage           |                                    | Short-Circuit Duration               | Indefinite     |
| Driver ( $V^+$ , $V^-$ ) | $\pm 16V$                          | Operating Temperature Range          |                |
| Receiver ( $V_{CC}$ )    | 7V                                 | LT1039C                              | 0°C to 70°C    |
| Logic Inputs             | $V^-$ to 25V                       | LT1039I                              | -40°C to 85°C  |
| Receiver Inputs          | $\pm 30V$                          | LT1039M                              | -55°C to 125°C |
| ON/OFF Input             | GND to 12V                         | Storage Temperature Range            | -65°C to 150°C |
| Driver Outputs           | ( $V^- + 30V$ ) to ( $V^+ - 30V$ ) | Lead Temperature (Soldering, 10 sec) | 300°C          |

## PACKAGE/ORDER INFORMATION

| TOP VIEW                                                                                                                                                                                                                                                                                                                                                                                    | ORDER PART NUMBER                       | TOP VIEW                                                                                                                                                                                                                                                                                                                                                                                    | ORDER PART NUMBER                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| <p>J PACKAGE<br/>16-LEAD CERDIP</p> <p>N PACKAGE<br/>16-LEAD PDIP</p> <p>SW PACKAGE<br/>16-LEAD PLASTIC SO WIDE</p> <p><math>T_{JMAX} = 150^\circ C</math>, <math>\theta_{JA} = 100^\circ C/W</math> (J)<br/> <math>T_{JMAX} = 150^\circ C</math>, <math>\theta_{JA} = 140^\circ C/W</math> (N)<br/> <math>T_{JMAX} = 150^\circ C</math>, <math>\theta_{JA} = 150^\circ C/W</math> (SW)</p> | LT1039CN16<br>LT1039CSW16<br>LT1039MJ16 | <p>J PACKAGE<br/>18-LEAD CERDIP</p> <p>N PACKAGE<br/>18-LEAD PDIP</p> <p>SW PACKAGE<br/>18-LEAD PLASTIC SO WIDE</p> <p><math>T_{JMAX} = 150^\circ C</math>, <math>\theta_{JA} = 100^\circ C/W</math> (J)<br/> <math>T_{JMAX} = 150^\circ C</math>, <math>\theta_{JA} = 120^\circ C/W</math> (N)<br/> <math>T_{JMAX} = 150^\circ C</math>, <math>\theta_{JA} = 120^\circ C/W</math> (SW)</p> | LT1039CJ<br>LT1039CN<br>LT1039CSW<br>LT1039IN<br>LT1039ISW<br>LT1039MJ |

## ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ C$ .

| PARAMETER                                                                                              | CONDITIONS                                                                                 | MIN     | TYP                        | MAX                        | UNITS              |
|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|---------|----------------------------|----------------------------|--------------------|
| <b>Driver <math>V^+ = 12V</math>, <math>V^- = -12V</math>, <math>V_{ON/OFF} = 2.5V</math> (Note 2)</b> |                                                                                            |         |                            |                            |                    |
| Output Voltage Swing                                                                                   | Load = 3k to Ground<br>Positive<br>Negative                                                | ●<br>●  | $V^+ - 0.4$<br>$V^- + 1.5$ | $V^+ - 0.1$<br>$V^- + 1.0$ | V<br>V             |
| Logic Input Voltage Levels                                                                             | Input Low Level ( $V_{OUT} = \text{High}$ )<br>Input High Level ( $V_{OUT} = \text{Low}$ ) | ●<br>●  | 2.0                        | 1.4<br>1.4                 | 0.8<br>V           |
| Logic Input Current                                                                                    | $V_{IN} \geq 2.0V$<br>$V_{IN} \leq 0.8V$                                                   |         | 1<br>5                     | 20<br>20                   | $\mu A$<br>$\mu A$ |
| Output Short-Circuit Current                                                                           | Sourcing Current, $V_{OUT} = 0V$<br>Sinking Current, $V_{OUT} = 0V$                        | 5<br>-5 | 15<br>-15                  |                            | mA<br>mA           |
| Output Leakage Current                                                                                 | Shutdown (Notes 3, 4), $V_{OUT} = \pm 18V$ , $V_{IN} = 0V$                                 | ●       | 10 (25°C)                  | 200                        | $\mu A$            |
| Supply Leakage Current                                                                                 | Shutdown (Note 3)                                                                          | ●       | 1 (25°C)                   | 100                        | $\mu A$            |
| Slew Rate                                                                                              | $R_L = 3k$ , $C_L = 51pF$                                                                  | 4       | 15                         | 30                         | V/ $\mu s$         |
| Supply Current                                                                                         | $V_{OUT} = \text{Low}$                                                                     |         | 4                          | 8                          | mA                 |

# ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ .

| PARAMETER                                                                                       | CONDITIONS                                                                     | MIN   | TYP                      | MAX | UNITS         |
|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------|--------------------------|-----|---------------|
| <b>Receiver <math>V_{CC} = 5\text{V}</math>, <math>V_{ON/OFF} = 2.5\text{V}</math> (Note 2)</b> |                                                                                |       |                          |     |               |
| Input Voltage Thresholds                                                                        | Input Low Level ( $V_{OUT} = \text{High}$ )                                    | ● 0.5 | 1.3                      |     | V             |
|                                                                                                 | Input High Level ( $V_{OUT} = \text{Low}$ )                                    | ●     | 1.7                      | 2.8 | V             |
| Hysteresis                                                                                      |                                                                                | ● 0.1 | 0.4                      | 1.0 | V             |
| Input Resistance                                                                                |                                                                                | ●     | 30                       |     | k $\Omega$    |
| Output Voltage                                                                                  | Output Low, $I_{OUT} = -1.6\text{mA}$                                          | ●     | 0.4                      | 0.5 | V             |
|                                                                                                 | Output High, $I_{OUT} = 160\mu\text{A}$                                        | ● 3.5 | 4.8                      |     | V             |
| Output Short-Circuit Current                                                                    | Sourcing Current, $V_{OUT} = 0\text{V}$ (Note 5)                               | ● 0.5 | 1                        |     | mA            |
|                                                                                                 | Sinking Current, $V_{OUT} = V_{CC}$                                            | ● -10 |                          |     | mA            |
| Output Leakage Current                                                                          | Shutdown (Note 2), $0\text{V} \leq V_{OUT} \leq V_{CC}$ , $V_{IN} = 0\text{V}$ | ●     | 1                        | 10  | $\mu\text{A}$ |
| Supply Current                                                                                  |                                                                                | ●     | 4                        | 7   | mA            |
| Supply Leakage Current                                                                          | Shutdown (Note 3)                                                              | ●     | 1 ( $25^\circ\text{C}$ ) | 100 | $\mu\text{A}$ |
| ON/OFF Pin Current                                                                              | $0\text{V} \leq V_{ON/OFF} \leq 5\text{V}$                                     | ● -15 |                          | 80  | $\mu\text{A}$ |

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

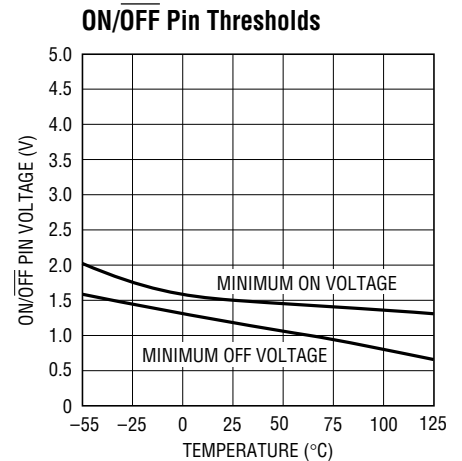
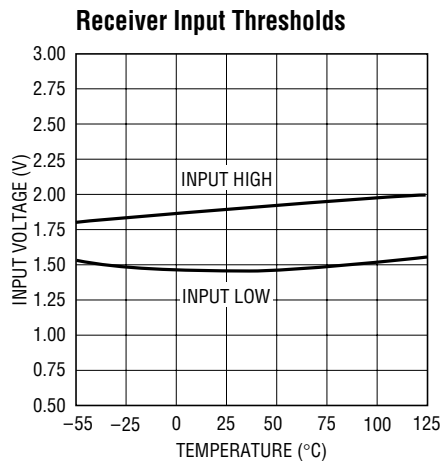
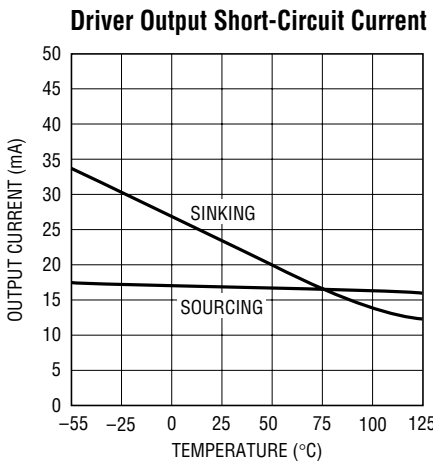
**Note 2:**  $V_{ON/OFF} = 5\text{V}$  for LT1039M grade devices.

**Note 3:**  $V_{ON/OFF} = 0.4\text{V}$  for  $-55^\circ\text{C} \leq T_A \leq 100^\circ\text{C}$  and  $V_{ON/OFF} = 0.2\text{V}$  for  $100^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ . Does not apply to LT1039-16 part.

**Note 4:** For  $T_A \geq 100^\circ\text{C}$ , leakage current is  $350\mu\text{A}$  max.

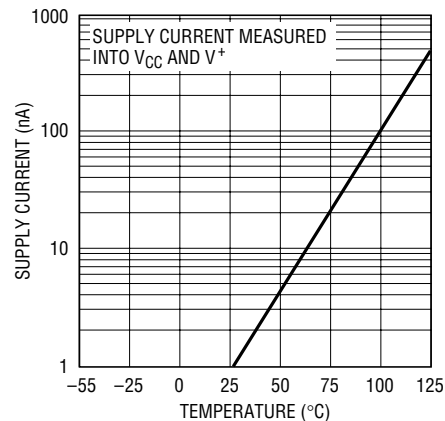
**Note 5:** For  $T_A \leq -25^\circ\text{C}$ , output source current is  $0.4\text{mA}$ .

# TYPICAL PERFORMANCE CHARACTERISTICS



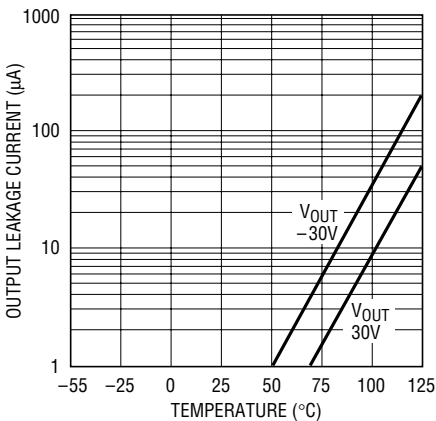
TYPICAL PERFORMANCE CHARACTERISTICS

Supply Current in Shutdown



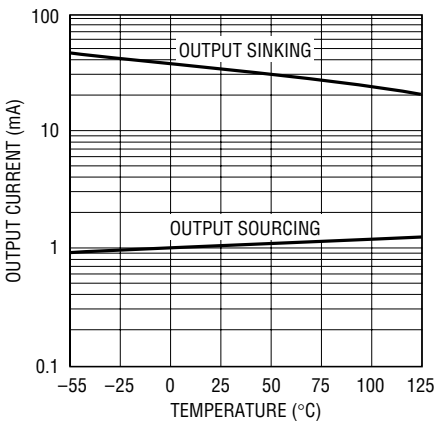
1039 G04

Driver Output Leakage in Shutdown



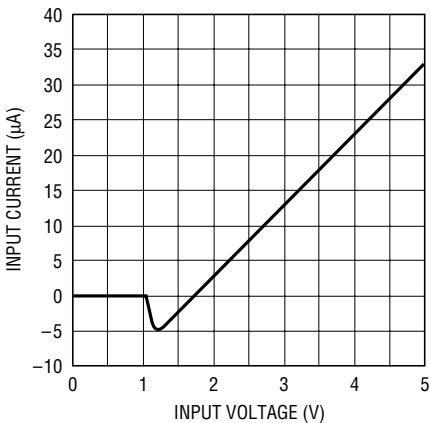
1039 G05

Receiver Output Short-Circuit Current



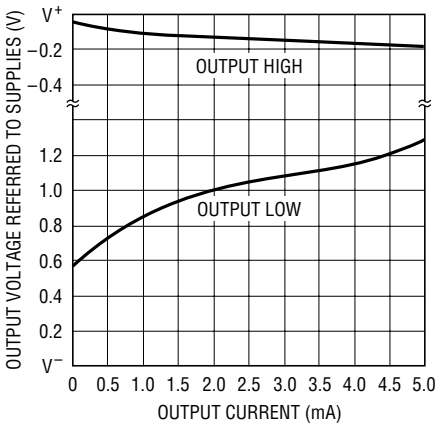
1039 G06

ON/OFF Pin Current vs Voltage



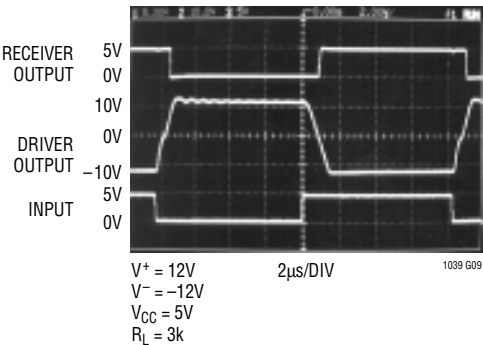
1039 G07

Driver Output Swing vs Current



1039 G08

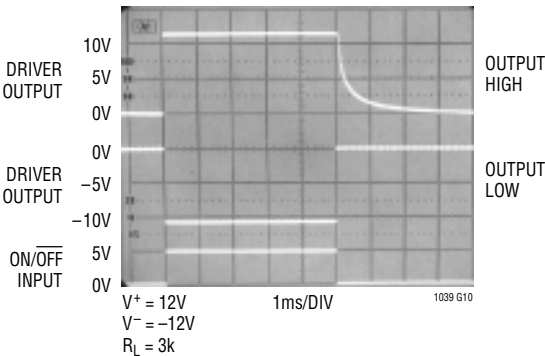
Output Waveforms



1039 G09

DRIVER OUTPUT CONNECTED TO RECEIVER INPUT

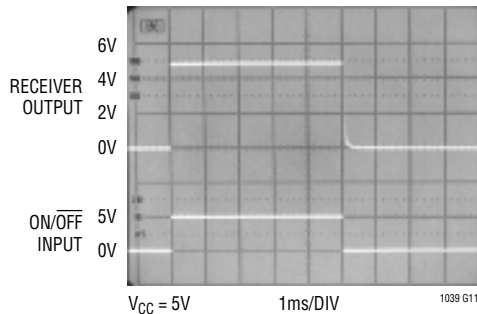
Shutdown to Driver Output



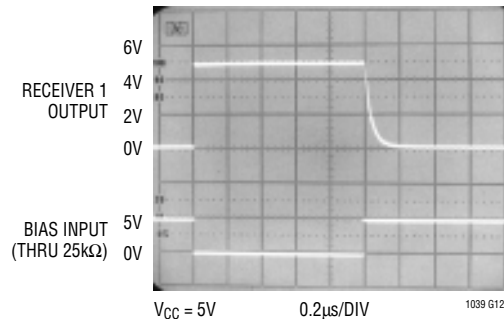
1039 G10

## TYPICAL PERFORMANCE CHARACTERISTICS

Shutdown to Receiver Output



BIAS Pin Response Time



## PIN FUNCTIONS (Pin numbers listed are for 18-pin device)

**V<sup>+</sup>, V<sup>-</sup> (Pins 1, 9):** Driver Supply Pins. Supply current drops to zero in shutdown mode. Driver outputs are in a high impedance state when V<sup>+</sup> and V<sup>-</sup> = 0V.

**BIAS (Pin 2):** Keeps receiver 1 on while the LT1039 is in the shutdown mode. Leave BIAS pin open when not in use. See Applications Information for proper use.

**REC IN (Pins 3, 5, 7):** Receiver Input Pins. Accepts RS232 voltage levels ( $\pm 30V$ ) and has 0.4V of hysteresis to provide noise immunity. Input impedance is nominally 30k $\Omega$ .

**TR OUT (Pins 4, 6, 8):** Driver Outputs with RS232 Voltage Levels. Outputs are in a high impedance state when in the shutdown mode or when power is off (V<sup>+</sup> and V<sup>-</sup> = 0V) to allow data line sharing. Outputs are fully short-circuit protected from V<sup>-</sup> + 30V to V<sup>+</sup> - 30V with power on, off or in the shutdown mode. Typical output breakdowns are greater than  $\pm 45V$  and higher applied voltages will not damage the device if moderately current limited.

**GND (Pin 10):** Ground Pin.

**TR IN (Pins 11, 13, 15):** RS232 Driver Input Pins. Inputs are TTL/CMOS compatible. Inputs should not be allowed to float. Tie unused inputs to V<sub>CC</sub>.

**REC OUT (Pins 12, 14, 16):** Receiver Outputs with TTL/CMOS Voltage Levels. Outputs are in a high impedance state when in the shutdown mode to allow data line sharing. Outputs are fully short-circuit protected to ground or V<sub>CC</sub> with power on, off or in the shutdown mode.

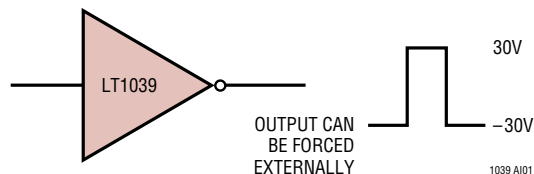
**ON/OFF (Pin 17):** Controls the operation mode of the LT1039 and is TTL/CMOS compatible. A logic low puts the device in the shutdown mode which reduces input supply current to zero and places both driver and receiver outputs in a high impedance state.

**V<sub>CC</sub> (Pin 18):** 5V Power for Receivers.

## APPLICATIONS INFORMATION

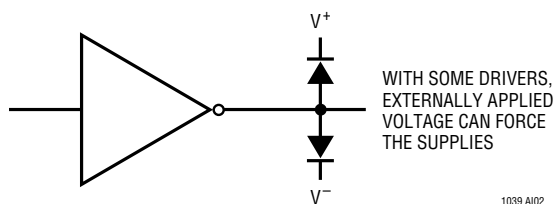
The driver output stage of the LT1039 offers significantly improved protection over older bipolar and CMOS designs. In addition to current limiting, the driver output can be externally forced to  $\pm 30V$  with no damage or excessive current flow, and will not disrupt the supplies.

**LT1039 Driver**



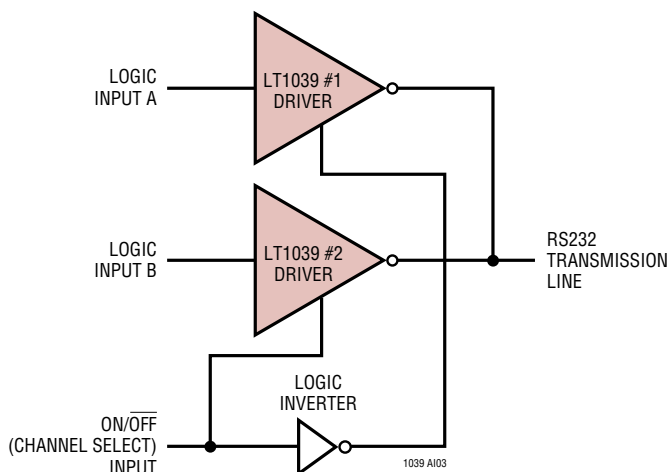
Some drivers have diodes connected between the outputs and the supplies, so externally applied voltages can cause excessive supply voltage to develop

**Older RS232 Drivers and Other CMOS Drivers**

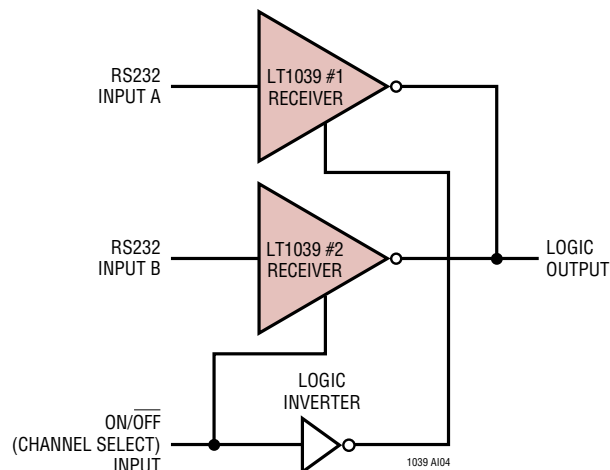


Placing the LT1039 in the shutdown mode (Pin 17 low) puts both the driver and receiver outputs in a high impedance state. This allows data line sharing and transceiver applications.

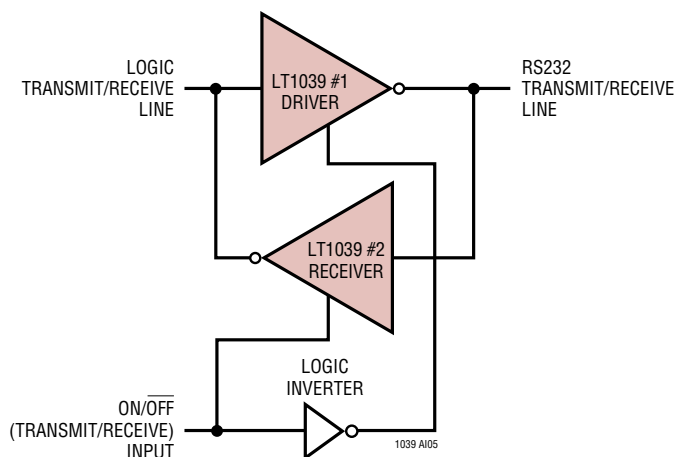
**Sharing a Transmitter Line**



**Sharing a Receiver Line**



**Transceiver**

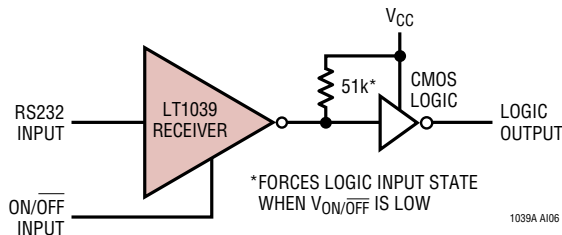


The shutdown mode also drops all supply currents ( $V_{CC}$ ,  $V^+$ ,  $V^-$ ) to zero for power conscious systems.

## APPLICATIONS INFORMATION

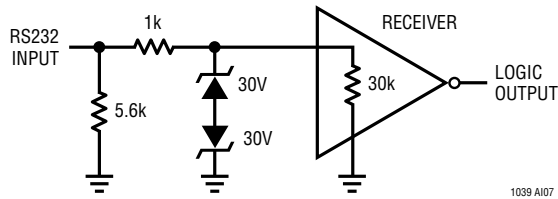
When driving CMOS logic from a receiver that will be used in the shutdown mode and there is no other active receiver on the line, a 51k resistor can be placed from the logic input to  $V_{CC}$  to force a definite logic level when the receiver output is in a high impedance state.

### Driving CMOS Logic from a Receiver



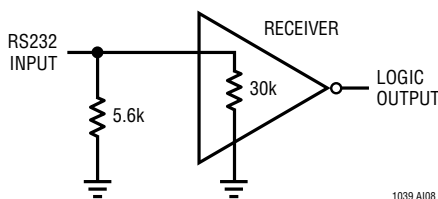
To protect against receiver input overloads in excess of  $\pm 30V$ , a voltage clamp can be placed on the data line and still maintain RS232 compatibility.

### Input Overvoltage Protection



The receiver input impedance of the LT1039 is nominally 30k $\Omega$ . For applications requiring a 5k $\Omega$  input impedance, a 5.6k resistor can be connected from the receiver input to ground.

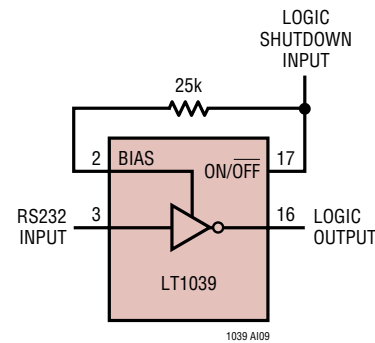
### 5k $\Omega$ Impedance Matching



Driver inputs should not be allowed to float. Any unused inputs should be tied to  $V_{CC}$ .

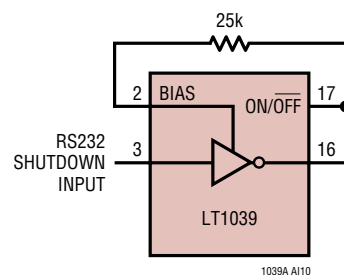
The BIAS pin is used to "keep alive" one receiver while in the shutdown mode (all other circuitry being inactive). This allows a system to be in shutdown and still have one active receiver for transferring data.

### Keeping Alive One Receiver While in Shutdown



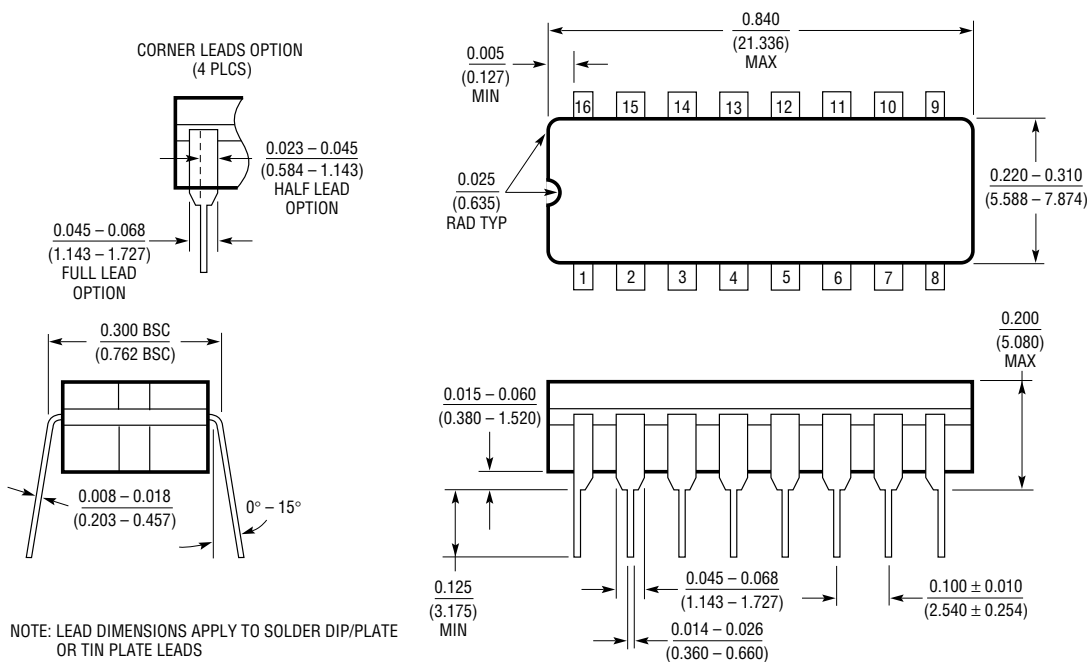
It can also be used to make an RS232 compatible shutdown control line. Driving the BIAS pin low through a resistance of 24k to 30k keeps the receiver active. Do not drive the BIAS pin directly from a logic output without the series resistor. An unused BIAS pin should be left open.

### RS232 Compatible Shutdown Control Line

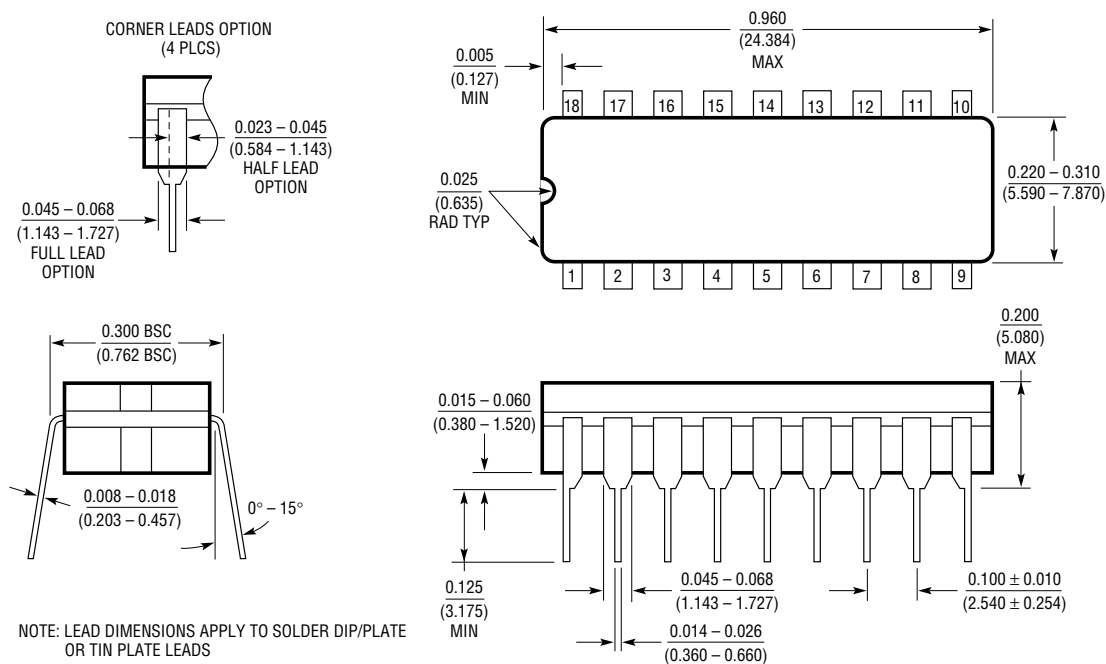


# PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

## J Package 16-Lead Cerdip (Narrow 0.300, Hermetic) (LTC DWG # 05-08-1110)



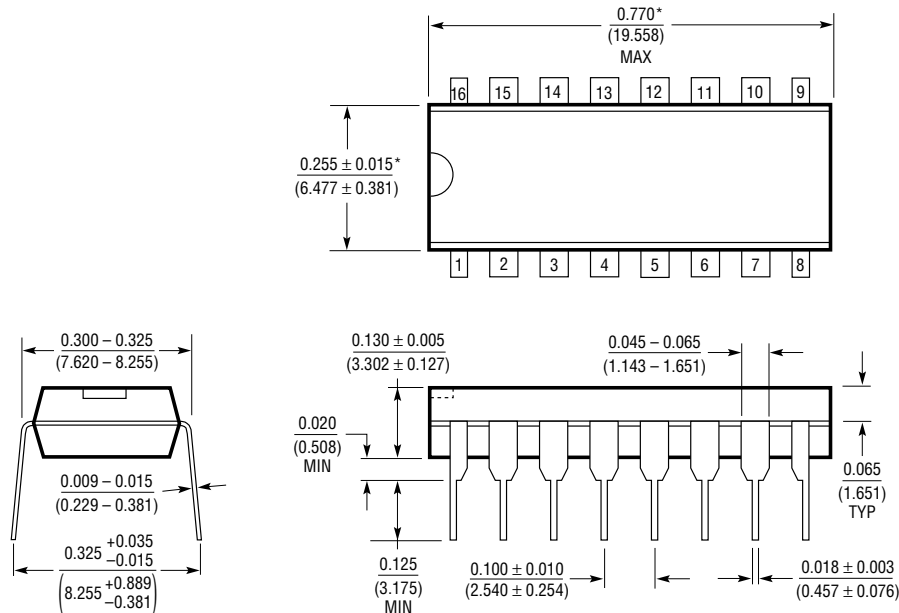
## J Package 18-Lead Cerdip (Narrow 0.300, Hermetic) (LTC DWG # 05-08-1110)





# PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

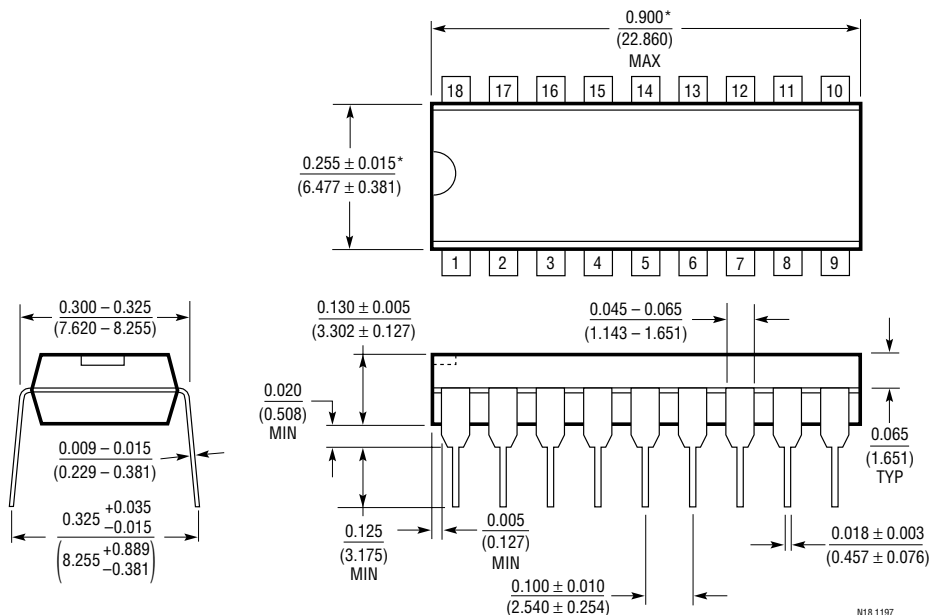
## N Package 16-Lead PDIP (Narrow 0.300) (LTC DWG # 05-08-1510)



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

N16 1197

## N Package 18-Lead PDIP (Narrow 0.300) (LTC DWG # 05-08-1510)



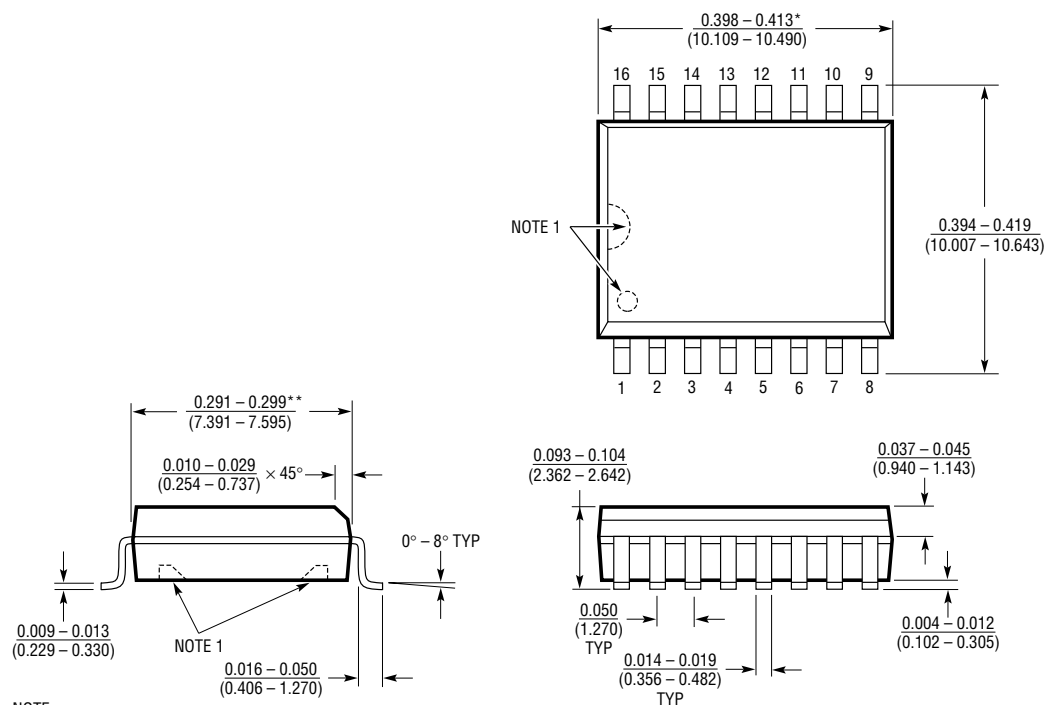
\*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 INCH (0.254mm)

N18 1197

# **PACKAGE DESCRIPTION**

Dimensions in inches (millimeters) unless otherwise noted.

## **SW Package** **16-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

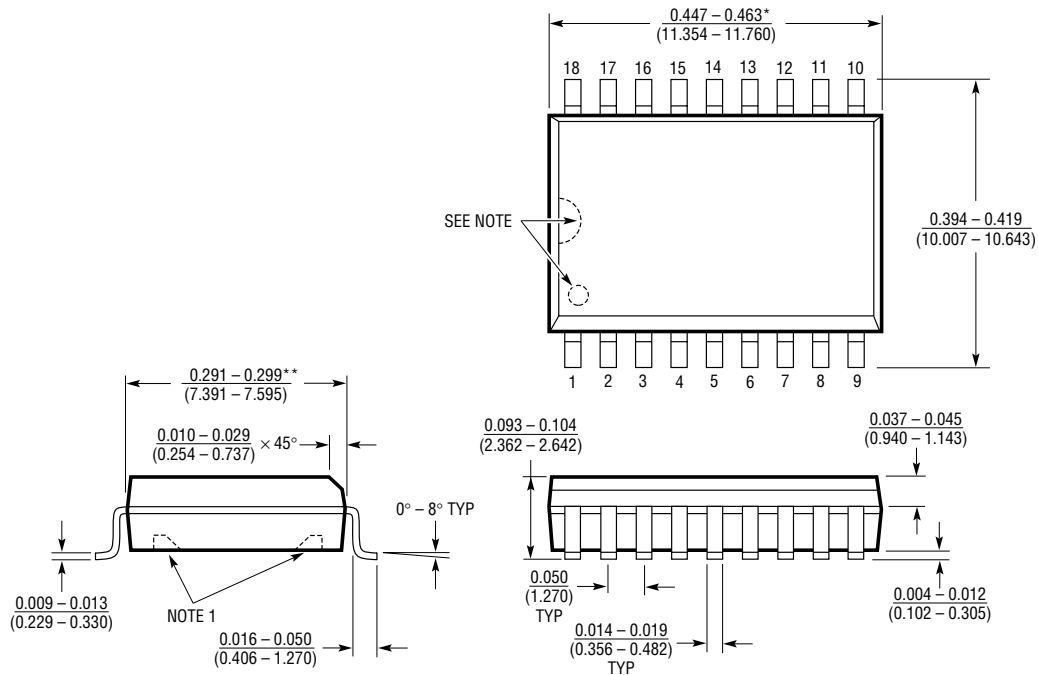
\*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

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

S16 (WIDE) 0396

# PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

## SW Package 18-Lead Plastic Small Outline (Wide 0.300) (LTC DWG # 05-08-1620)



S18 (WIDE) 0396

The schematic diagram illustrates the RS232 interface circuit. It features two integrated circuits: the LT1080A (ON/OFF) and the LT1039. The LT1080A is connected to a 5V supply (pin 17) and has its VCC (pin 18) connected to the 5V supply. Its TTL IN (pin 1) and TTL OUT (pin 2) are connected to RS232 IN and RS232 OUT respectively. The LT1039 is connected to a 5V supply (pin 17) and has its VCC (pin 18) connected to the 5V supply. Its TTL IN (pin 1) and TTL OUT (pin 2) are connected to RS232 IN and RS232 OUT respectively. The circuit includes several capacitors (C1+, C1-, C2+, C2-) and resistors (5k, 30k) for signal conditioning. A shutdown pin is also shown.

| PART NUMBER        | DESCRIPTION                                | COMMENTS                                                          |
|--------------------|--------------------------------------------|-------------------------------------------------------------------|
| LTC®485            | Low Power RS485 Transceiver                | Industry Standard                                                 |
| LT1039A/LT1039A-16 | Triple RS232 Driver/Receiver with Shutdown | ±15kV ESD Protection                                              |
| LT1137A            | 5V 3-Driver/5-Receiver RS232 Transceiver   | ±15kV ESD Protection                                              |
| LT1180A/LT1181A    | 5V 2-Driver/2-Receiver RS232 Transceiver   | Industry Standard, 0.1µF Capacitors                               |
| LTC1345            | V.35 Transceiver                           | Single 5V Supply Using 0.1µF Capacitors                           |
| LTC1348            | 3.3V 3-Driver/5-Receiver RS232 Transceiver | Operates from 3.3V to 5V Supplies, 5 Receivers Active in Shutdown |