

## FEATURES

- **On-Chip ESD Protection:**
  - ±15kV Human Body Model
  - ±15kV IEC-1000-4-2 Air Gap Test\*\*
  - ±8kV IEC-1000-4-2 Contact Test
- 125kBd Operation with 3kΩ/2500pF Load
- 250kBd Operation with 3kΩ/1000pF Load
- Outputs Can Be Driven ±30V Without Damage
- No Supply Current in Shutdown
- Operates from ±5V to ±15V Supplies
- Fully Protected Against Overload
- Three-State Outputs; Outputs Open When Off
- Bipolar Circuit—No Latchup
- ±30V Input Range
- Triple Driver/Receiver
- 30kΩ Input Impedance
- Meets All RS232 Specifications
- 16-Pin Version—Pin Compatible with MC145406
- Available in SO Package

## APPLICATIONS

- RS232 Interface
- Terminals
- Modems

## DESCRIPTION

The **LTC®1039A** is a triple RS232 driver/receiver that includes shutdown. Each receiver will accept up to ±30V 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 ±30V 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. On-chip ESD protection eliminates the need for external protection devices.

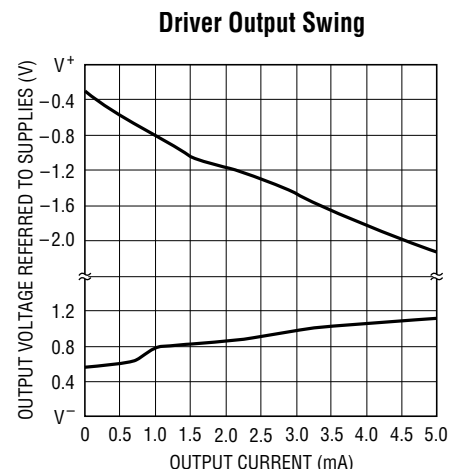
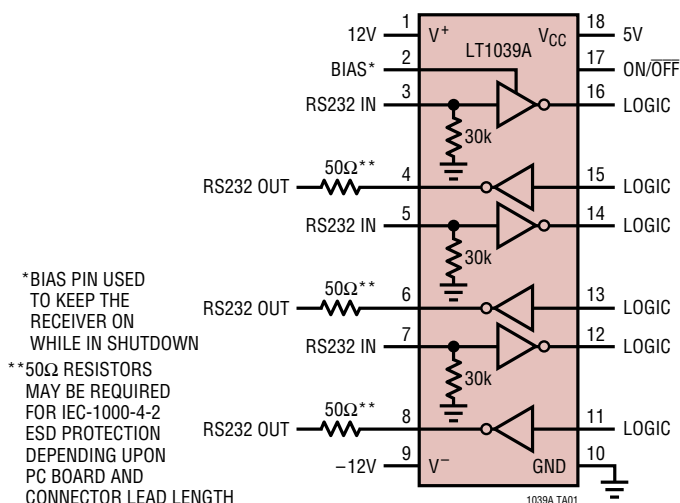
A bias pin allows one receiver to be kept on while the rest of the part is shut down.

The LT1039A 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 LT1180A/LT1181A and LT1130A data sheets.

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## TYPICAL APPLICATION

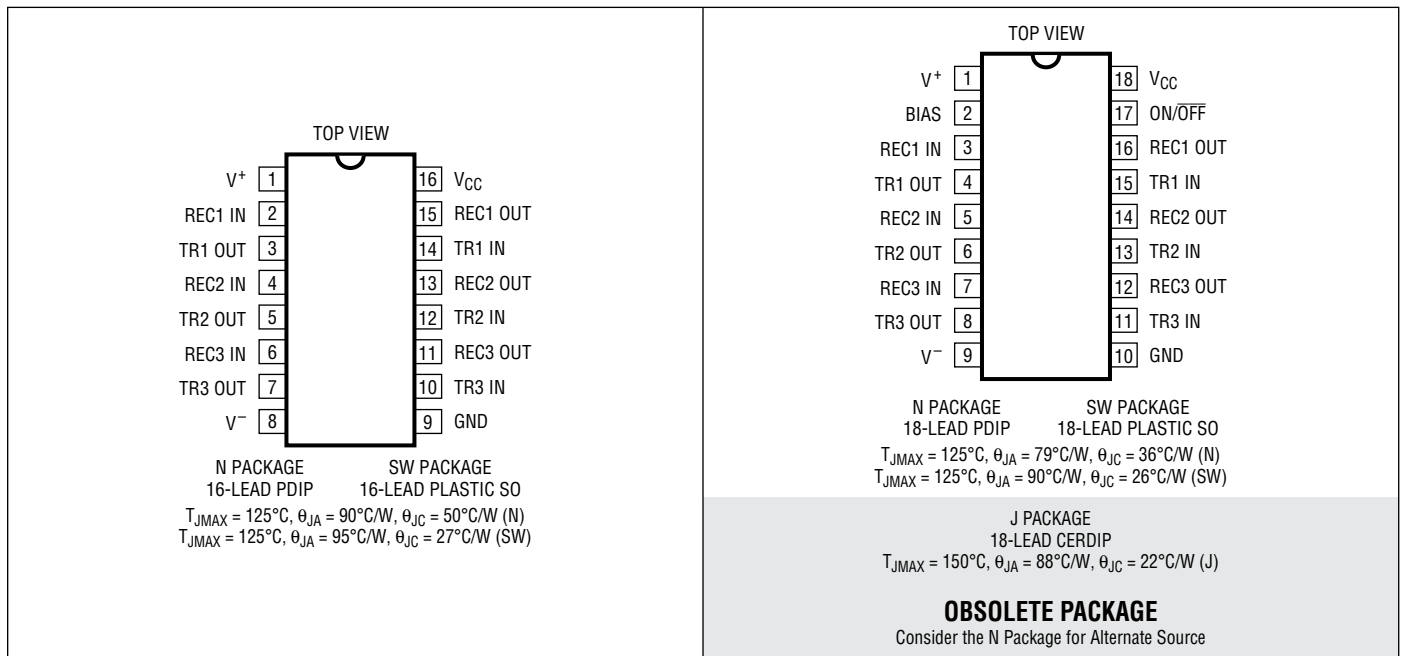


# LT1039A/LT1039A-16

## ABSOLUTE MAXIMUM RATINGS (Note 1)

Supply Voltage	Short-Circuit Duration..... Indefinite
Driver ( $V^+$ , $V^-$ )..... $\pm 16V$	Operating Temperature Range
Receiver ( $V_{CC}$ )..... $7V$	LT1039AC..... $0^\circ C$ to $70^\circ C$
Logic Inputs..... $V^-$ to $25V$	LT1039AM ( <b>OBSOLETE</b> )..... $-55^\circ C$ to $125^\circ C$
Receiver Inputs..... $\pm 30V$	Storage Temperature Range..... $-65^\circ C$ to $150^\circ C$
ON/OFF Input..... GND to $12V$	Lead Temperature (Soldering, 10 sec)..... $300^\circ C$
Driver Outputs..... $V^- + 30V$ to $V^+ - 30V$	

## PIN CONFIGURATION



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

## ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PART MARKING*	PACKAGE DESCRIPTION	TEMPERATURE RANGE
			<b>OBSOLETE PACKAGE</b>	
LT1039ACSW16#PBF	LT1039ACSW16#TRPBF	LT1039ACSW16	16-Lead Plastic SO (Wide)	$0^\circ C$ to $70^\circ C$
LT1039ACSW#PBF	LT1039ACSW #TRPBF	LT1039ACSW	18-Lead Plastic SO (Wide)	$0^\circ C$ to $70^\circ C$
LT1039ACN16#PBF	N/A	LT1039ACN16	16-Lead Plastic PDIP	$0^\circ C$ to $70^\circ C$
LT1039ACN#PBF	N/A	LT1039ACN	18-Lead Plastic PDIP	$0^\circ C$ to $70^\circ C$
LT1039AMJ#PBF	LT1039AMJ#TRPBF		18-Lead CERDIP	$-55^\circ C$ to $125^\circ C$

Consult LTC Marketing for parts specified with wider operating temperature ranges. \*The temperature grade is identified by a label on the shipping container.

For more information on lead free part marking, go to: <http://www.linear.com/leadfree/>

For more information on tape and reel specifications, go to: <http://www.linear.com/tapeandreeel/>

## ELECTRICAL CHARACTERISTICS

The ● denotes the 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>Driver <math>V^+ = 12\text{V}</math>, <math>V^- = -12\text{V}</math>, <math>V_{\text{ON/OFF}} = 2.5\text{V}</math> (Note 2)</b>					
Output Voltage Swing	Load = 3k to Ground Positive Negative	● ●	$V^+ - 2.0$ $V^+ - 1.3$	$V^- + 1.5$ $V^- + 1.0$	V V
Logic Input Voltage Levels	Input Low Level ( $V_{\text{OUT}} = \text{High}$ ) Input High Level ( $V_{\text{OUT}} = \text{Low}$ )	● ●	2.0	1.4 1.4	0.8 V V
Logic Input Current	$V_{\text{IN}} \geq 2.0\text{V}$ $V_{\text{IN}} \geq 0.8\text{V}$			1 5	20 $\mu\text{A}$ 20 $\mu\text{A}$
Output Short-Circuit Current	Sourcing Current, $V_{\text{OUT}} = 0\text{V}$ Sinking Current, $V_{\text{OUT}} = 0\text{V}$		20 -15	30 -30	mA mA
Output Leakage Current	Shutdown (Notes 3, 4), $V_{\text{OUT}} = \pm 18\text{V}$ , $V_{\text{IN}} = 0\text{V}$	●		10	200 $\mu\text{A}$
Supply Leakage Current	Shutdown (Note 3)	●		1	100 $\mu\text{A}$
Slew Rate	$R_L = 3\text{k}$ , $C_L = 51\text{pF}$ to $2500\text{pF}$		4	15	30 V/ $\mu\text{s}$
Supply Current	$V_{\text{OUT}} = \text{Low}$			1	5 mA
Prop Delay ( $t_{\text{PLH}}$ ) ( $t_{\text{PHL}}$ )				0.6 0.8	1.2 1.2 $\mu\text{s}$ $\mu\text{s}$
<b>Receiver <math>V_{\text{CC}} = 5\text{V}</math>, <math>V_{\text{ON/OFF}} = 2.5\text{V}</math> (Note 2)</b>					
Input Voltage Thresholds	Input Low Level ( $V_{\text{OUT}} = \text{High}$ ) Input High Level ( $V_{\text{OUT}} = \text{Low}$ )	● ●	0.5	1.3 1.7	2.8 V V
Hysteresis		●	0.1	0.4	1.0 V
Input Resistance		●		30	k $\Omega$
Output Voltage	Output Low, $I_{\text{OUT}} = -1.6\text{mA}$ Output High, $I_{\text{OUT}} = 160\mu\text{A}$	● ●	3.5	0.4 4.8	0.5 V V
Output Short-Circuit Current	Sourcing Current, $V_{\text{OUT}} = V_{\text{CC}}$ Sinking Current, $V_{\text{OUT}} = 0\text{V}$	● ●	-10 15	-30 25	mA mA
Output Leakage Current	Shutdown (Note 2), $0\text{V} \leq V_{\text{OUT}} \leq V_{\text{CC}}$ , $V_{\text{IN}} = 0\text{V}$	●		1	10 $\mu\text{A}$
Supply Current	(Note 5)	●		2	5 mA
Supply Leakage Current	Shutdown (Note 3)	●		1	100 $\mu\text{A}$
ON/OFF Pin Current	$0\text{V} \leq V_{\text{ON/OFF}} \leq 5\text{V}$	●	-15		80 $\mu\text{A}$
Prop Delay ( $t_{\text{PLH}}$ ) ( $t_{\text{PHL}}$ )				200 300	600 600 ns ns

**Note 1:** Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

**Note 2:**  $V_{\text{ON/OFF}} = 5\text{V}$  for LT1039AM grade devices.

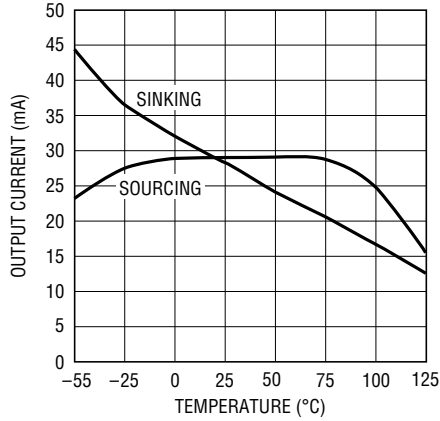
**Note 3:**  $V_{\text{ON/OFF}} = 0.4\text{V}$  for  $-55^\circ\text{C} \leq T_A \leq 100^\circ\text{C}$  and  $V_{\text{ON/OFF}} = 0.2\text{V}$  for  $100^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ . Does not apply to LT1039A-16 part.

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

**Note 5:** Bias pin open on 18-pin version.

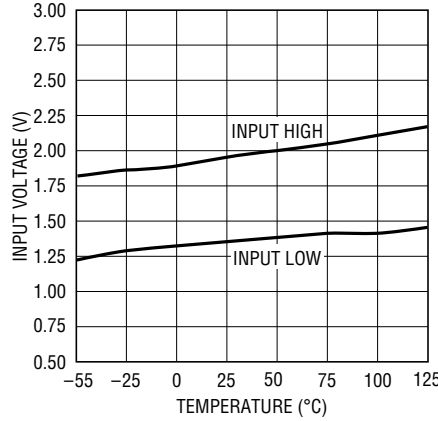
## TYPICAL PERFORMANCE CHARACTERISTICS

### Driver Output Short-Circuit Current



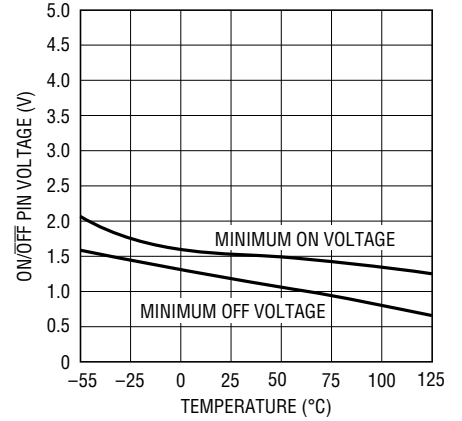
1039A G01

### Receiver Input Thresholds



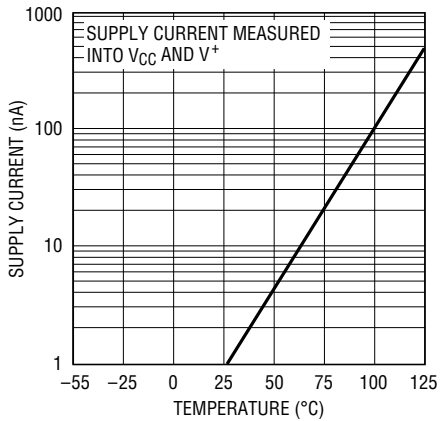
1039A G02

### ON/OFF Pin Thresholds



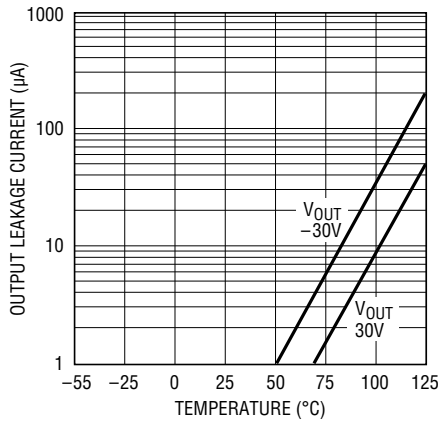
1039A G03

### Supply Current in Shutdown



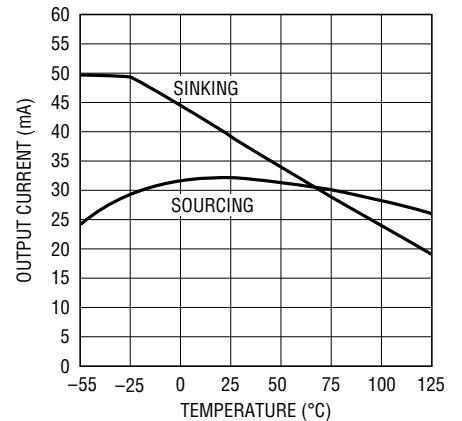
1039A G04

### Driver Output Leakage in Shutdown



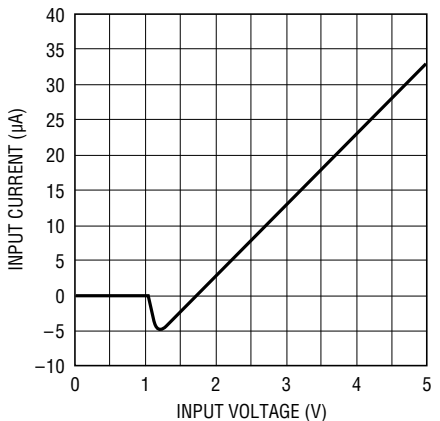
1039A G05

### Receiver Output Short-Circuit Current



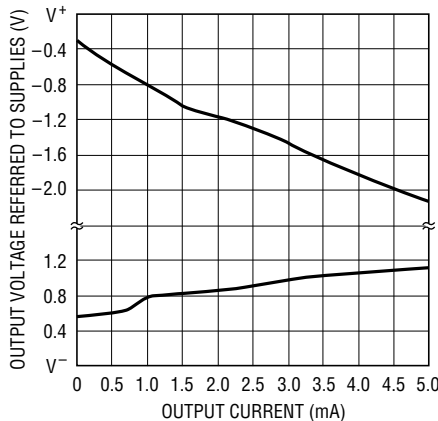
1039A G06

### ON/OFF Pin Current vs Voltage



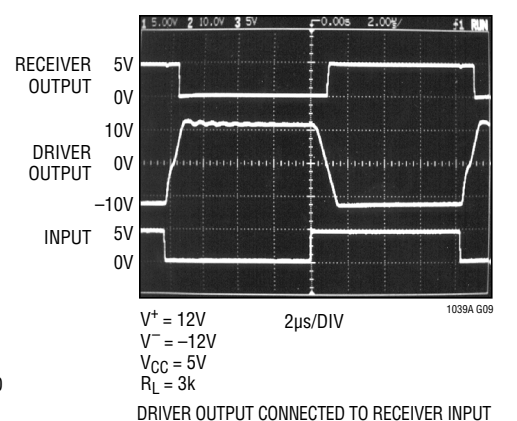
1039A G07

### Driver Output Swing vs Current



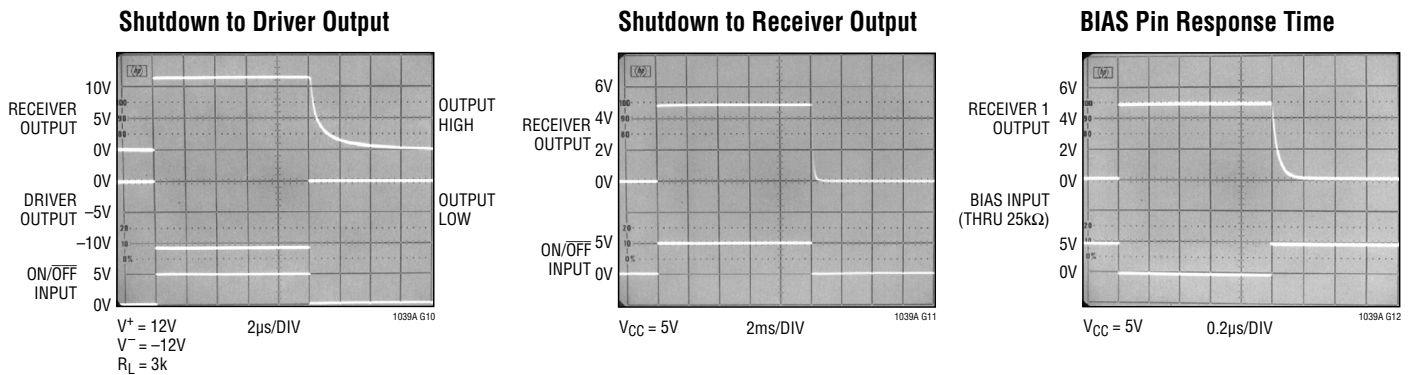
1039A G08

### Output Waveforms



1039afb

## TYPICAL PERFORMANCE CHARACTERISTICS



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

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

**BIAS (Pin 2):** Keeps receiver 1 on while the LT1039A 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 $\Omega$ . Receiver input pins are internally protected from ESD transients. In order to insure proper functioning of the ESD protection devices, the  $V_{CC}$  and  $V^-$  supply pins must be bypassed with low ESR capacitors located close to the pins. A 0.1 $\mu$ F ceramic capacitor works well.

**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 ( $V^+$  and  $V^- = 0V$ ) to allow data line sharing. Outputs are fully short-circuit protected from  $V^- + 30V$  to  $V^+ - 30V$  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. Driver-

output pins are internally protected from ESD transients. In order to insure proper functioning of the ESD protection devices, the  $V^+$  and  $V^-$  supply pins must be bypassed with low ESR capacitors located close to the pins. 0.1 $\mu$ F ceramic capacitors work well.

**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  $V_{CC}$ .

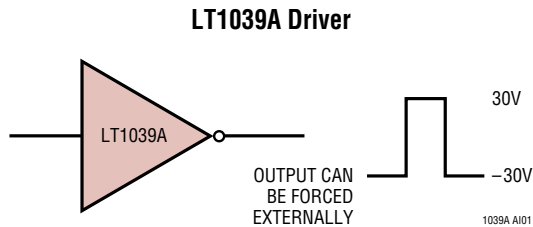
**REC OUT (Pins 12, 14, 16):** Receiver Outputs with TTL/CMOS Voltage Levels. Outputs are in a high impedance state when in the shutdown mode to allow data line sharing. Outputs are fully short-circuit protected to ground or  $V_{CC}$  with power on, off or in the shutdown mode.

**ON/OFF (Pin 17):** Controls the operation mode of the LT1039A 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.

**$V_{CC}$  (Pin 18):** 5V Power for Receivers.

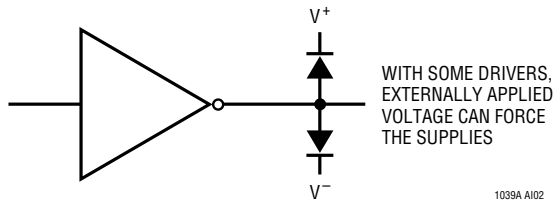
## APPLICATIONS INFORMATION

The driver output stage of the LT1039A 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.



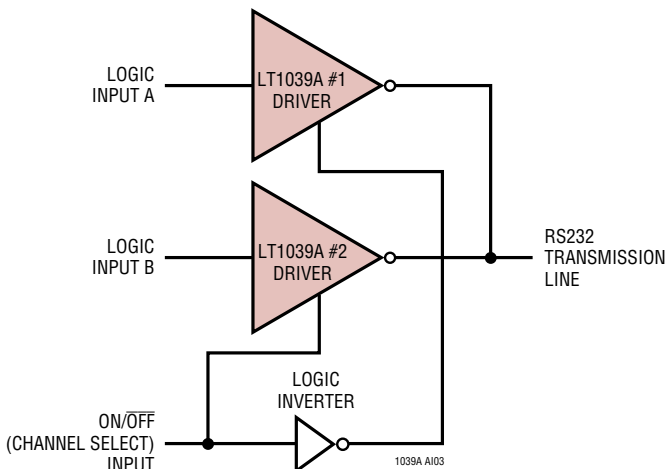
The driver outputs utilize high impedance overvoltage protection, eliminating the flow of fault currents into supplies, as will happen with conventional diode clamp-configurations.

### Older RS232 Drivers and Other CMOS Drivers

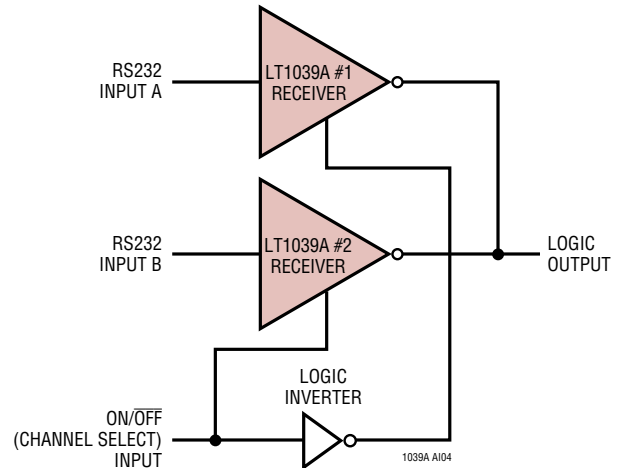


Placing the LT1039A in the shutdown mode (Pin 17 low) puts both the driver and receiver outputs in a high impedance state. This allows data line sharing and transceiver-applications.

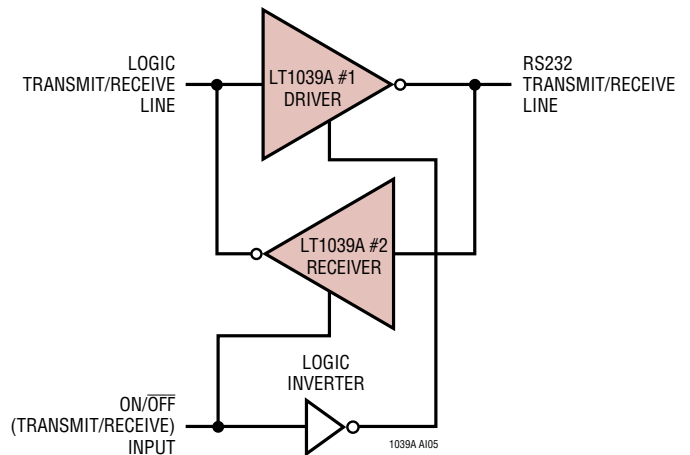
### Sharing a Transmitter Line



### Sharing a Receiver Line



### Transceiver

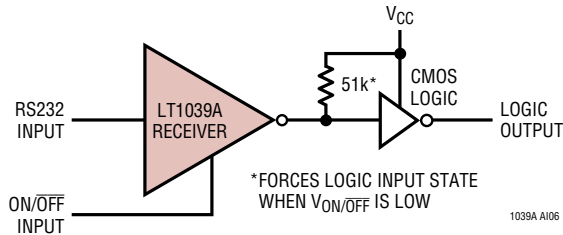


The shutdown mode also drops all supply currents ( $V_{CC}$ ,  $V^+$ ,  $V^-$ ) to zero for power conscious systems.

## APPLICATIONS INFORMATION

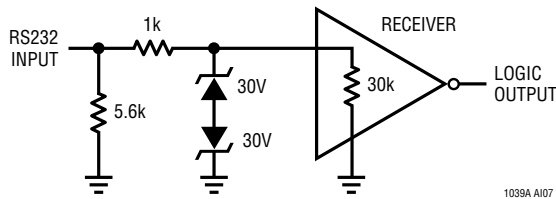
When driving CMOS logic from a receiver that will be used in the shutdown mode and there is no other active receiver on the line, a 51k resistor can be placed from the logic input to  $V_{CC}$  to force a definite logic level when the receiver output is in a high impedance state.

### Driving CMOS Logic from a Receiver



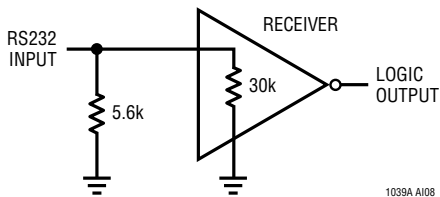
To protect against receiver input overloads in excess of  $\pm 30V$ , a voltage clamp can be placed on the data line and still maintain RS232 compatibility.

### Input Overvoltage Protection



The receiver input impedance of the LT1039A 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.

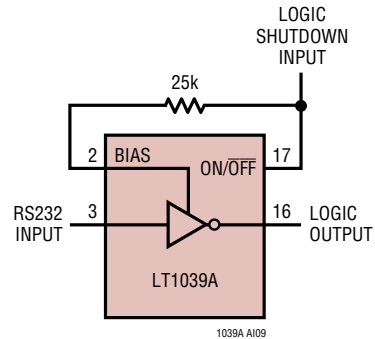
### 5kΩ Impedance Matching



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

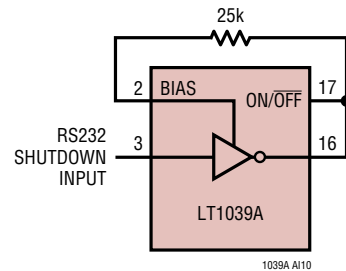
The BIAS pin is used to “keep alive” one receiver while in the shutdown mode (all other circuitry being inactive). This allows a system to be in shutdown and still have one active receiver for transferring data.

### 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.

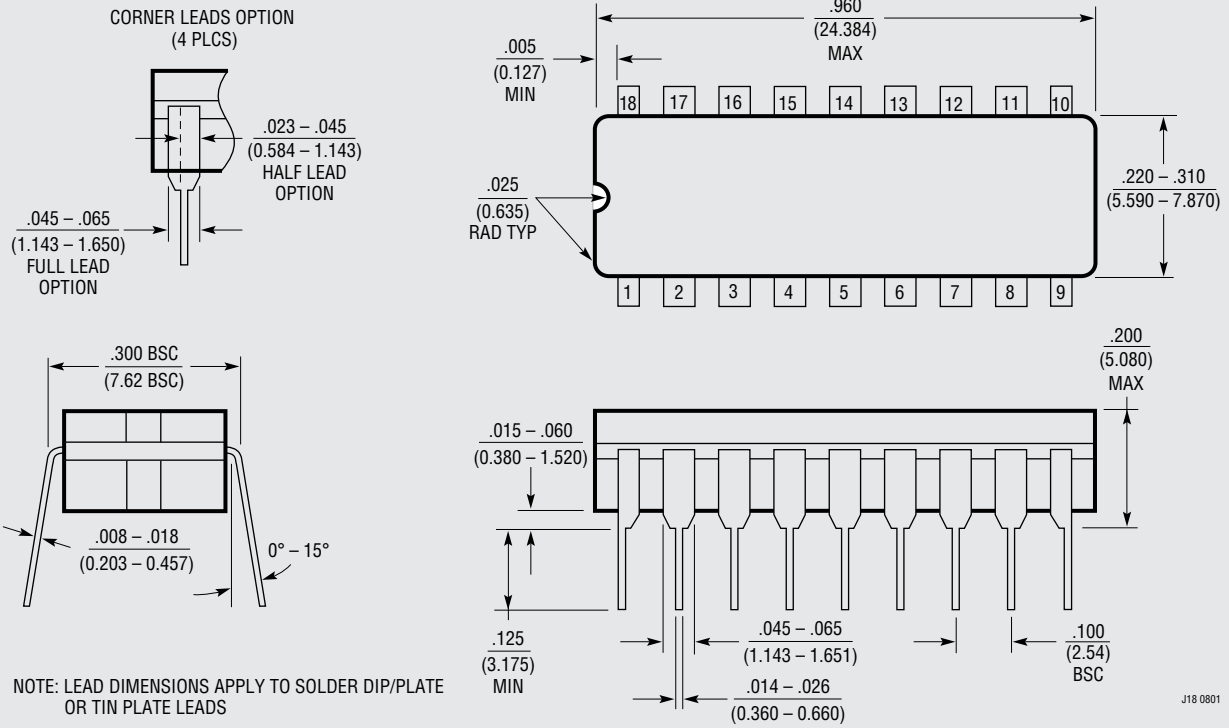
### RS232 Compatible Shutdown Control Line



# PACKAGE DESCRIPTION

Please refer to <http://www.linear.com/designtools/packaging/> for the most recent package drawings.

## J Package 18-Lead CERDIP (Narrow .300 Inch, Hermetic) (Reference LTC DWG # 05-08-1110)



**OBsolete PACKAGE**

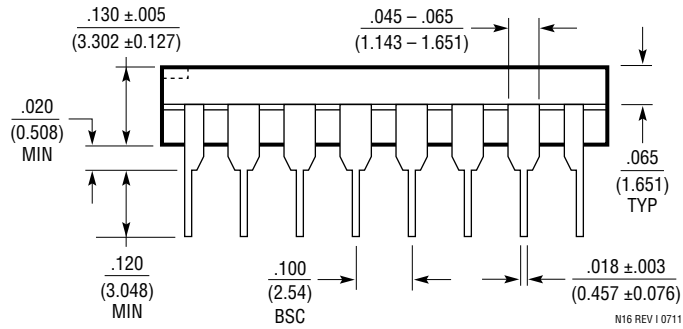
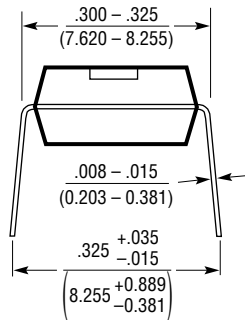
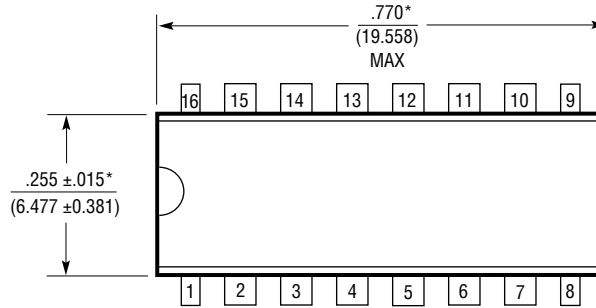
J18 0801



# PACKAGE DESCRIPTION

Please refer to <http://www.linear.com/designtools/packaging/> for the most recent package drawings.

**N Package**  
**16-Lead PDIP (Narrow .300 Inch)**  
 (Reference LTC DWG # 05-08-1510 Rev I)



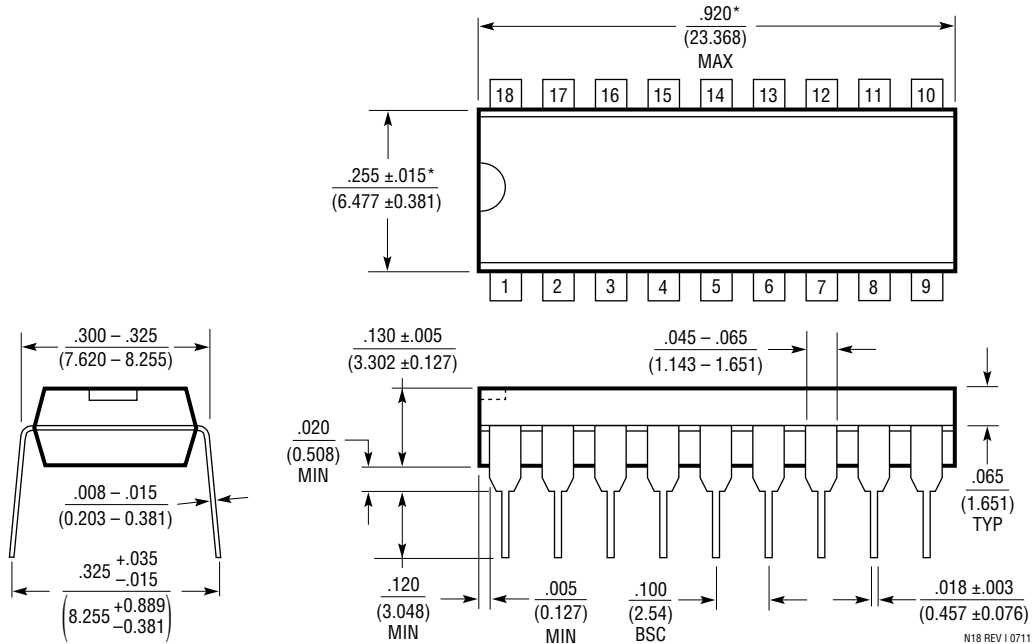
NOTE:  
 1. DIMENSIONS ARE  $\frac{\text{INCHES}}{\text{MILLIMETERS}}$

\*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
 MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH (0.254mm)

## PACKAGE DESCRIPTION

Please refer to <http://www.linear.com/designtools/packaging/> for the most recent package drawings.

**N Package**  
**18-Lead PDIP (Narrow .300 Inch)**  
 (Reference LTC DWG # 05-08-1510 Rev I)

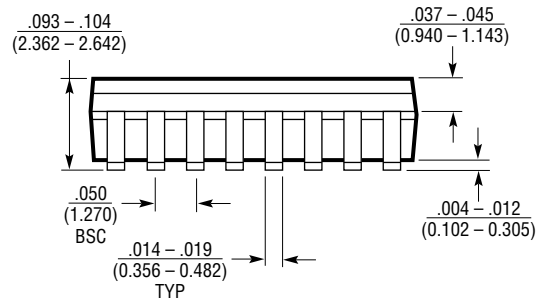
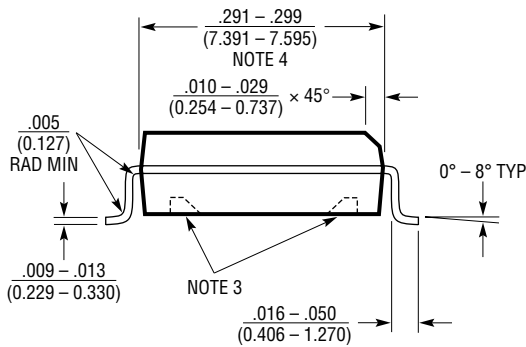
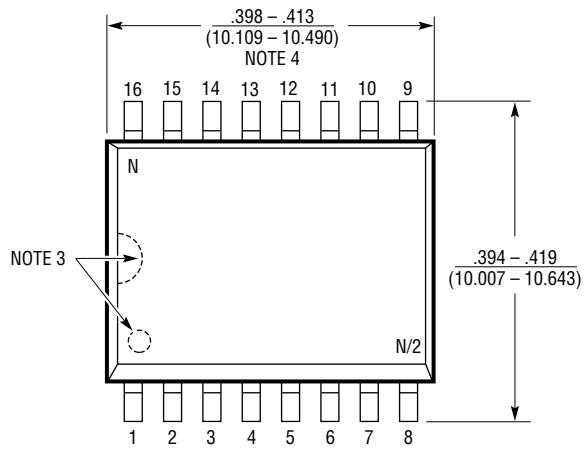
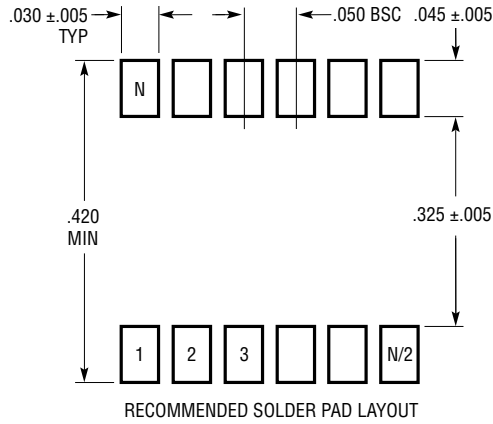


N18 REV I 0711

# PACKAGE DESCRIPTION

Please refer to <http://www.linear.com/designtools/packaging/> for the most recent package drawings.

## SW Package 16-Lead Plastic Small Outline (Wide .300 Inch) (Reference LTC DWG # 05-08-1620)



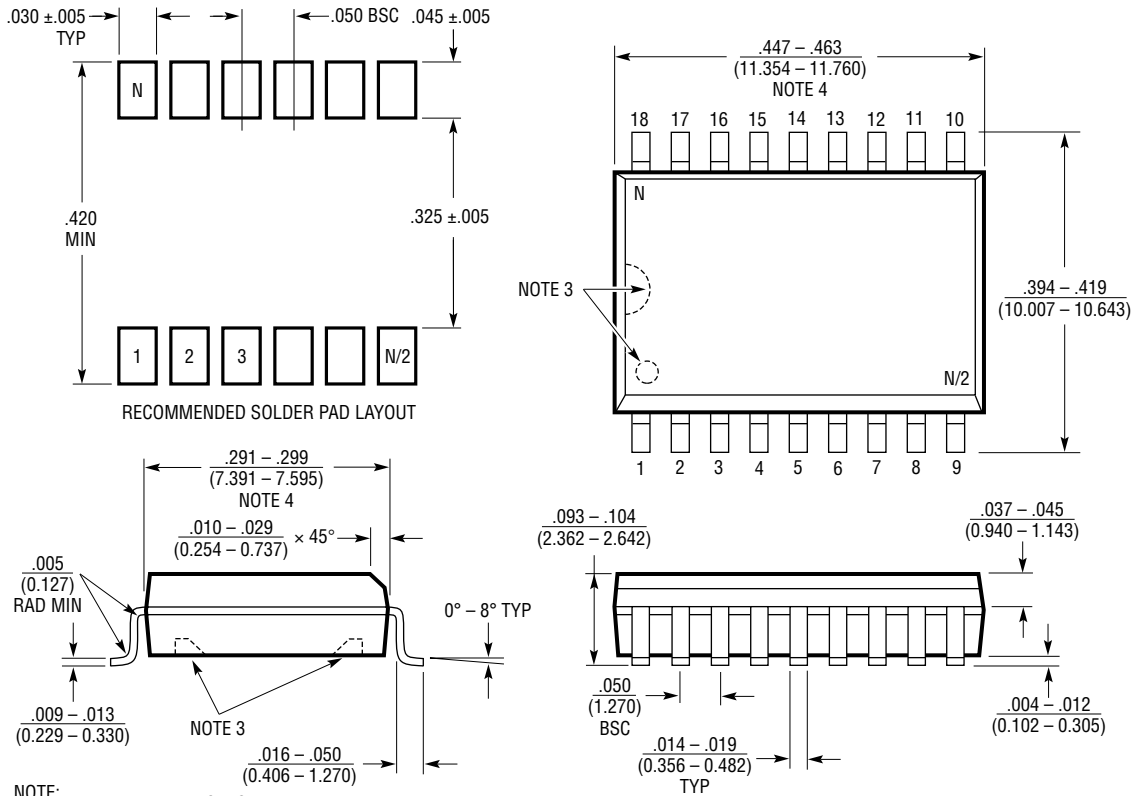
- NOTE:
1. DIMENSIONS IN  $\frac{\text{INCHES}}{\text{(MILLIMETERS)}}$
  2. DRAWING NOT TO SCALE
  3. PIN 1 IDENT, NOTCH ON TOP AND CAVITIES ON THE BOTTOM OF PACKAGES ARE THE MANUFACTURING OPTIONS. THE PART MAY BE SUPPLIED WITH OR WITHOUT ANY OF THE OPTIONS
  4. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

S16 (WIDE) 0502

## PACKAGE DESCRIPTION

Please refer to <http://www.linear.com/designtools/packaging/> for the most recent package drawings.

### SW Package 18-Lead Plastic Small Outline (Wide .300 Inch) (Reference LTC DWG # 05-08-1620)



- NOTE:
1. DIMENSIONS IN  $\frac{\text{INCHES}}{\text{MILLIMETERS}}$
  2. DRAWING NOT TO SCALE
  3. 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
  4. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED  $.006''$  (0.15mm)

S18 (WIDE) 0502

**REVISION HISTORY** (Revision history begins at Rev B)

REV	DATE	DESCRIPTION	PAGE NUMBER
B	12/12	Removed LT1039AI from Abs Max Ratings and Package/Order Information Updated N and SW Package Descriptions	2 9-12