

## Advanced Low Power 5V RS232 Dual Driver/Receiver with Small Capacitors

### FEATURES

- 0.1 $\mu$ F Capacitors
- Absolutely No Latchup
- CMOS Comparable Low Power — 70mW
- **Superior to CMOS**
  - Improved Speed — Operates Over 64K Baud
  - Improved Protection — Outputs Can be Forced to  $\pm 30$ V Without Damage
  - Three-State Outputs are High Impedance When Off
  - Smaller Board Area Required
- 1 $\mu$ A Supply Current in Shutdown
- Available in SO Package
- Available With or Without Shutdown

### APPLICATIONS

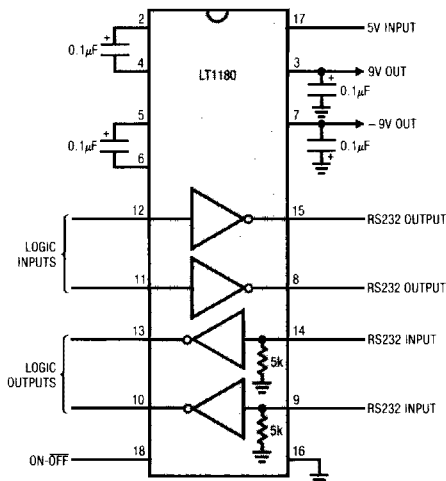
- Portable Computers
- Battery Powered RS232 Systems
- Power Supply Generator
- Terminals
- Modems

### DESCRIPTION

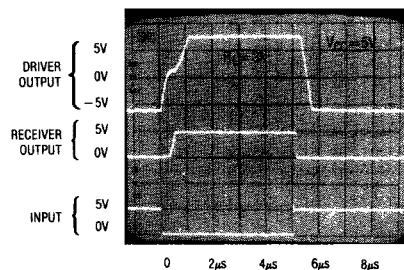
The LT1180 and LT1181 are the only dual RS232 driver/receiver with charge pump to guarantee absolutely no latchup. Requiring only 0.1 $\mu$ F charge pump capacitors, these interface optimized devices provide a realistic balance between CMOS levels of power dissipation and real world requirements for ruggedness. Small capacitors reduce cost as well as board size. The driver outputs are fully protected against overload and can be shorted to  $\pm 30$ V. Unlike CMOS, the advanced architecture of the LT1180/LT1181 does not load the signal line when "shut down" or when power is off. Both the receiver and RS232 outputs are put into a high impedance state. An advanced output stage allows driving higher capacitive loads at higher speeds with exceptional ruggedness against ESD.

For applications requiring up to 5 drivers and 5 receivers with charge pump in one package see the LT1130 Series data sheet. A version of the LT1180/81, the LT1080 and LT1081 is available for applications requiring extra current from the charge pump to power other circuitry. All of Linear Technology's RS232 IC's are available in standard surface mount packages.

### TYPICAL APPLICATION



Output Waveforms



## ABSOLUTE MAXIMUM RATINGS

Supply Voltage ( $V_{CC}$ )	6V
$V^+$	13.2V
$V^-$	-13.2V
Input Voltage	
Driver	$V^-$ to $V^+$
Receiver	-30V to 30V
On-Off Pin	GND to 12V
Output Voltage	
Driver	$V^- + 30V$ to $V^+ - 30V$
Receiver	-0.3V to $V_{CC} + 0.3V$

Short Circuit Duration	
$V^+$	30 Seconds
$V^-$	30 Seconds
Driver Output	Indefinite
Receiver Output	Indefinite
Operating Temperature Range	
LT1180M/LT1181M	-55°C to 125°C
LT1180I/LT1181I	-40°C to 85°C
LT1180C/LT1181C	0°C to 70°C
Lead Temperature (Soldering, 10 sec.)	300°C

## PACKAGE/ORDER INFORMATION

<p>TOP VIEW</p> <p>J PACKAGE 18-LEAD CERAMIC DIP</p> <p>N PACKAGE 18-LEAD PLASTIC DIP</p>	<p>ORDER PART NUMBER</p> <p>LT1180MJ LT1180IJ LT1180IN LT1180CJ LT1180CN</p>
<p>TOP VIEW</p> <p>J PACKAGE 16-LEAD CERAMIC DIP</p> <p>N PACKAGE 16-LEAD PLASTIC DIP</p>	<p>ORDER PART NUMBER</p> <p>LT1181MJ LT1181IJ LT1181IN LT1181CJ LT1181CN</p>

<p>TOP VIEW</p> <p>S PACKAGE 18-LEAD PLASTIC SOL</p>	<p>ORDER PART NUMBER</p> <p>LT1180IS LT1180CS</p>
<p>TOP VIEW</p> <p>S PACKAGE 16-LEAD PLASTIC SOL</p>	<p>ORDER PART NUMBER</p> <p>LT1181IS LT1181CS</p>

**ELECTRICAL CHARACTERISTICS** (Note 1),

PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
<b>Driver</b>							
Output Voltage Swing	Load = 3k to GND Both Outputs.	Positive Negative	● ●	5.0 -5.0	7.3 -6.5		V V
Logic Input Voltage Level	Input Low Level ( $V_{OUT} = \text{High}$ ) Input High Level ( $V_{OUT} = \text{Low}$ )		● ●	2.0	1.4 1.4	0.8	V V
Logic Input Current	$V_{IN} \geq 2.0V$ $V_{IN} \leq 0.8V$		● ●		5 5	20 20	$\mu A$ $\mu A$
Output Short Circuit Current	Sourcing Current, $V_{OUT} = 0V$ Sinking Current, $V_{OUT} = 0V$			7 -7	12 -12		mA mA
Output Leakage Current	SHUTDOWN (Note 2), $V_{OUT} = \pm 30V$		●		10	100	$\mu A$
Slew Rate	$R_L = 3k\Omega$ , $C_L = 51pF$			4	15	30	V/ $\mu s$
<b>Receiver</b>							
Input Voltage Thresholds	Input Low Threshold, LT1180C, LT1181C LT1180I, M/LT1181I, M	●	0.8	1.3			V
		●	0.2	1.3			V
	Input High Threshold, LT1180C/LT1181C LT1180I, M/LT1181I, M	●		1.7	2.4		V
		●		1.7	3.0		V
Hysteresis		●	0.1	0.4	1.0		V
Input Resistance			3	5	7		k $\Omega$
Output Voltage	Output Low, $I_{OUT} = -1.6mA$ Output High, $I_{OUT} = 160\mu A$ ( $V_{CC} = 5V$ )	●		0.2	0.4		V
		●	3.5	4.8			V
Output Short Circuit Current	Sinking Current, $V_{OUT} = V_{CC}$ Sourcing Current, $V_{OUT} = 0V$		-10	-20			mA
			0.6	1			mA
Output Leakage Current	SHUTDOWN (Note 2), $0V \leq V_{OUT} \leq V_{CC}$	●		1	10		$\mu A$
Supply Current	(Note 3) $T_A = 125^\circ C$	●		14	23		mA
		●			30		mA
Supply Leakage Current ( $V_{CC}$ )	SHUTDOWN (Note 2) (LT1180 Only)	●		1	100		$\mu A$
On-Off Pin Current	$0V \leq V_{ON-OFF} \leq 5V$ (LT1180 Only)	●	-15		80		$\mu A$

The ● denotes specifications which apply over the operating temperature range ( $0^\circ C \leq T_A \leq 70^\circ C$  for commercial grade,  $-40^\circ C \leq T_A \leq 85^\circ C$  for industrial grade or  $-55^\circ C \leq T_A \leq 125^\circ C$  for military grade devices).

**Note 1:** These parameters apply for  $V_{ON-OFF} = 3V$ ,  $V_{CC} = 5V$  and  $C = 0.1\mu F$  unless otherwise specified.

**Note 2:**  $V_{ON-OFF} = 0.4V$  for  $-55^\circ C \leq T_A \leq 100^\circ C$ , and  $V_{ON-OFF} = 0.2V$  for  $100^\circ C \leq T_A \leq 125^\circ C$  (LT1180 only).

**Note 3:** Unless otherwise specified,  $V_{CC} = 5V$ , external loading of  $V^+$  and  $V^-$  equals zero and the driver outputs are low (inputs high).

## PIN FUNCTIONS (Pin numbers refer to LT1180)

**V<sub>CC</sub> (Pin 17):** Input supply pin. Supply current drops to zero in the SHUTDOWN mode.

**GND (Pin 16):** Ground pin.

**On-Off (Pin 18):** Controls the operation mode of the LT1180 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. A logic high fully enables the device.

**V+ (Pin 3):** Positive supply for RS232 drivers.  $V+ \approx 2V_{CC} - 1.5V$ . Requires an external capacitor ( $\geq 0.1\mu F$ ) for charge storage. Capacitor may be tied to ground or +5V input supply. With multiple transceivers, the V+ and V- pins may be paralleled into common capacitors.

**V- (Pin 7):** Negative supply for RS232 drivers.  $V- \approx -(2V_{CC} - 2.5V)$ . Requires an external capacitor ( $\geq 0.1\mu F$ ) for charge storage. With multiple transceivers, the V+ and V- pins may be paralleled into common capacitors.

**TR1 IN; TR2 IN (Pins 12, 11):** RS232 driver input pins. Inputs are TTL/CMOS compatible. Inputs should not be allowed to float. Tie unused inputs to V<sub>CC</sub>.

**TR1 OUT; TR2 OUT (Pins 15, 8):** Driver outputs with RS232 voltage levels. Outputs are in a high impedance state when in the SHUTDOWN mode or when power is off ( $V_{CC} = 0V$ ) 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. Shorting one output will affect output from the other.

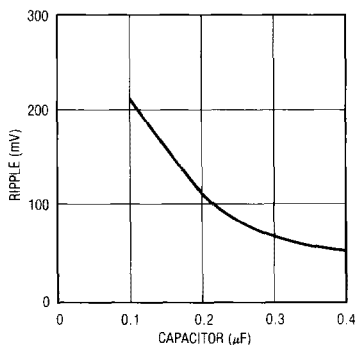
**REC1 IN; REC2 IN (Pins 14, 9):** Receiver inputs. Accepts RS232 voltage levels ( $\pm 30V$ ) and has 0.4V of hysteresis to provide noise immunity. Input impedance is nominally 5k $\Omega$ .

**REC1 OUT; REC2 OUT (Pins 13, 10):** 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.

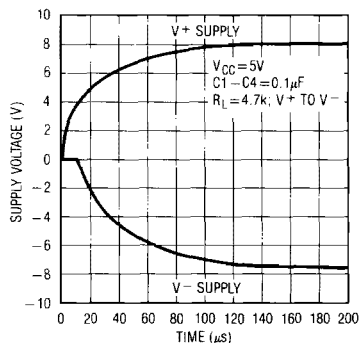
**C1+; C1-; C2+; C2- (Pins 2, 4, 5, 6):** Requires an external capacitor ( $\geq 0.1\mu F$ ) from C1+ to C1- and another from C2+ to C2-. Pin 2 can be used for connecting a second positive supply. When a separate positive supply is used, C1 can be deleted.

## TYPICAL PERFORMANCE CHARACTERISTICS

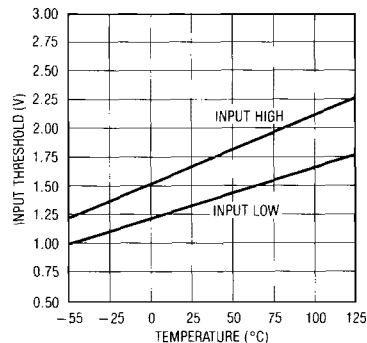
Supply Ripple vs Capacitor



Supply Generation from V<sub>CC</sub> or Shutdown

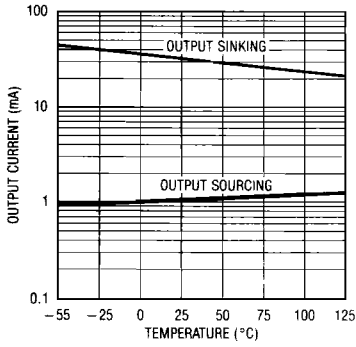


Receiver Input Thresholds

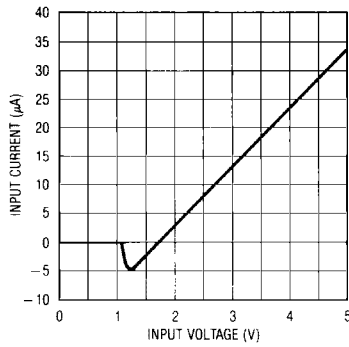


# TYPICAL PERFORMANCE CHARACTERISTICS

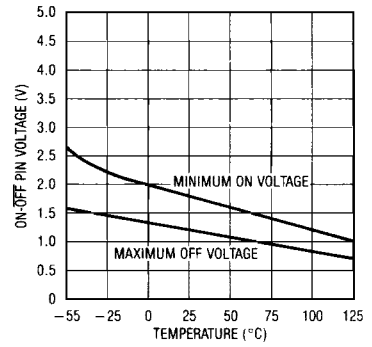
**Receiver Output Short Circuit Current**



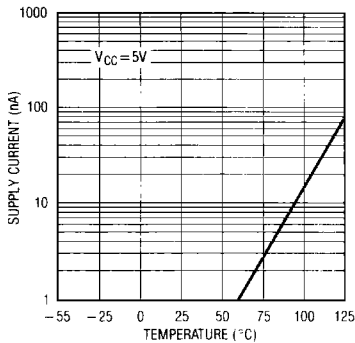
**On-Off Pin Current vs Voltage**



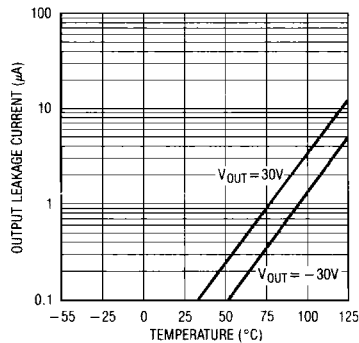
**On-Off Pin Thresholds**



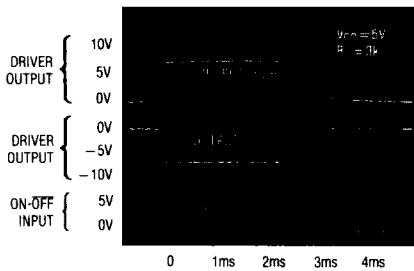
**Supply Current in Shutdown**



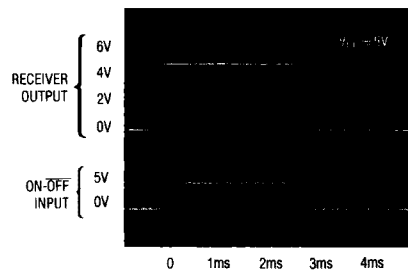
**Driver Output Leakage in Shutdown**



**Shutdown to Driver Output**



**Shutdown to Receiver Output**



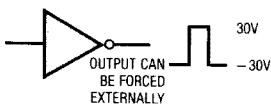
## APPLICATION HINTS

The driver output stage of the LT1180 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. Some drivers have diodes connected between the outputs and the supplies, so externally applied voltages can cause excessive supply voltage to develop.

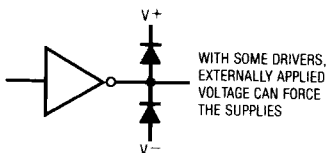
Placing the LT1180 in the SHUTDOWN mode (Pin 18 low) puts both the driver and receiver outputs in a high impedance state. This allows data line sharing and transceiver applications.

The SHUTDOWN mode also drops input supply current ( $V_{CC}$ ; Pin 17) to zero for power-conscious systems.

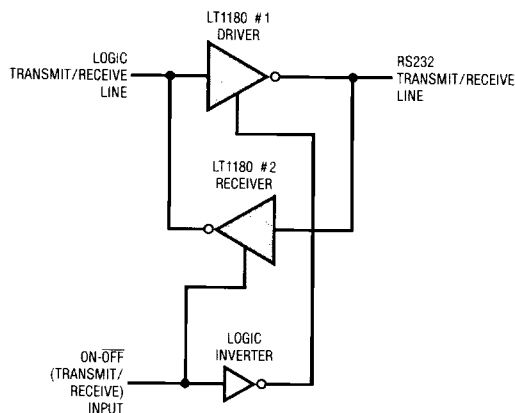
LT1180/LT1181 Driver



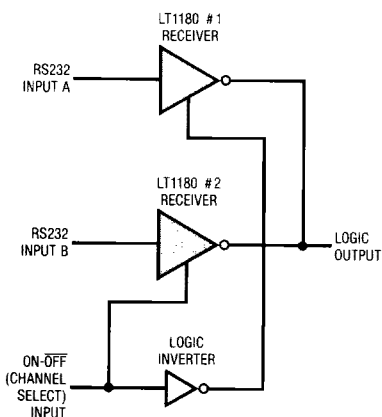
Older RS232 Drivers and CMOS Drivers



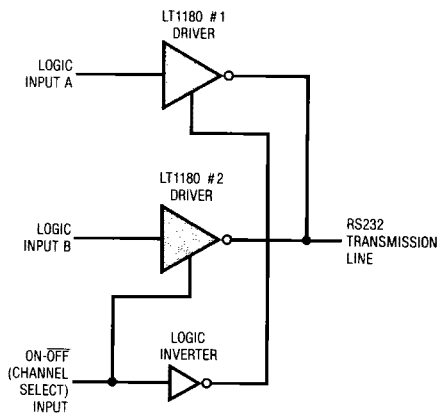
Transceiver



Sharing a Receiver Line



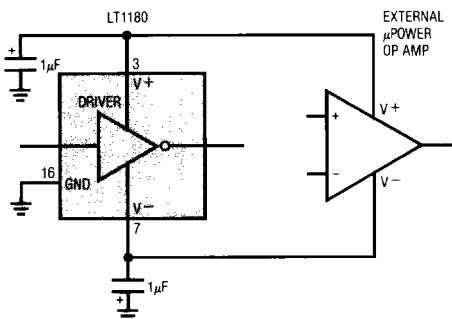
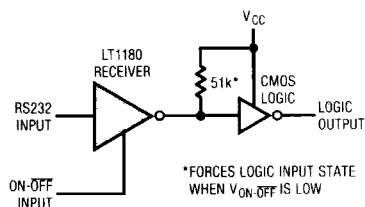
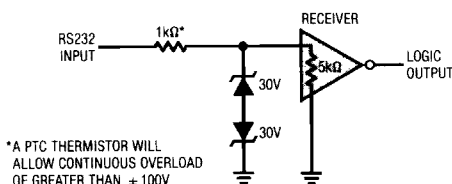
Sharing a Transmitter Line



## APPLICATION HINTS

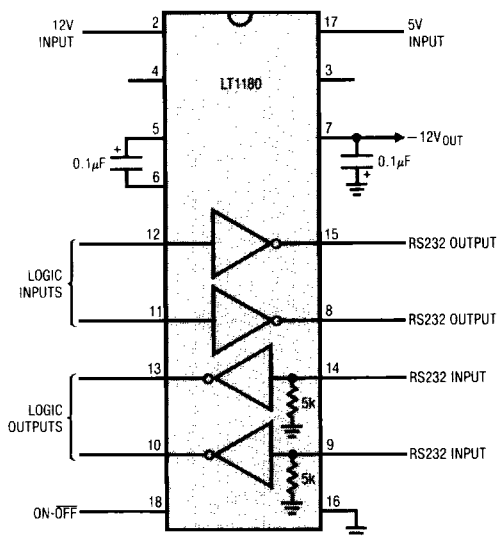
When driving CMOS logic from a receiver that will be used in the SHUTDOWN mode and there is no other active receiver on the line, a 51k resistor can be placed from the logic input to  $V_{CC}$  to force a definite logic level when the receiver output is in a high impedance state.

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.



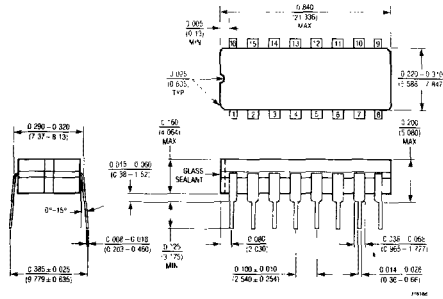
## TYPICAL APPLICATION

Operating with 12V and 5V Supplies



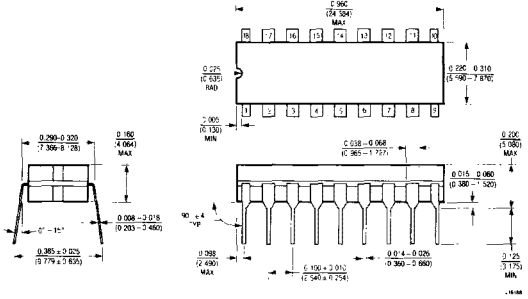
**PACKAGE DESCRIPTION** Dimensions in inches (millimeters) unless otherwise noted.

**J Package  
16-Lead Ceramic DIP**



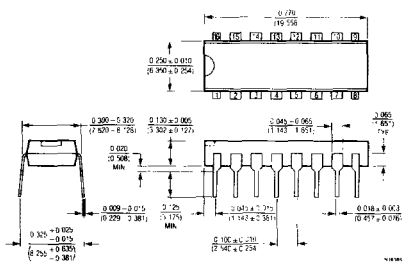
	T <sub>max</sub>	θ <sub>ja</sub>	θ <sub>jc</sub>
LT1181MJ/J	150°C	100°C/W	40°C/W
LT1181CJ	150°C	100°C/W	40°C/W

**J Package  
18-Lead Ceramic DIP**



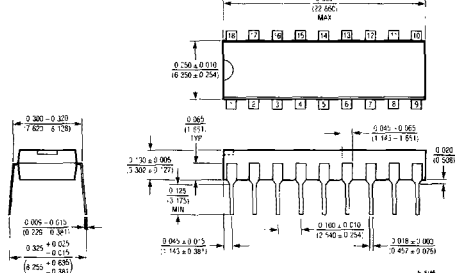
	T <sub>max</sub>	θ <sub>ja</sub>	θ <sub>jc</sub>
LT1180MJ/J	150°C	100°C/W	40°C/W
LT1180CJ	150°C	100°C/W	40°C/W

**N Package  
16-Lead Plastic DIP**



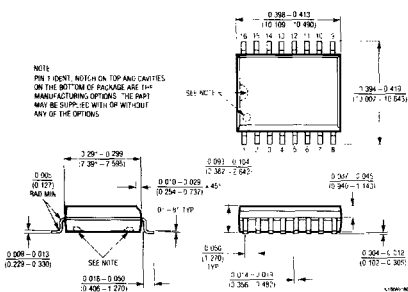
	T <sub>max</sub>	θ <sub>ja</sub>	θ <sub>jc</sub>
LT1181CN/N	125°C	120°C/W	50°C/W

**N Package  
18-Lead Plastic DIP**



	T <sub>max</sub>	θ <sub>ja</sub>	θ <sub>jc</sub>
LT1180CN/N	125°C	120°C/W	50°C/W

**S Package  
16-Lead Plastic SOL**



**S Package  
18-Lead Plastic SOL**

