Advanced Low Power 5V RS232 Transceiver with Small Capacitors

FEATURES

- ESD Protection over ±**10kV**
- Uses Small Capacitors: 0.1µF, 0.2µF
- 1µA Supply Current in SHUTDOWN
- Pin Compatible with LT1137
- Operates to 120k Baud
- 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
- Improved Protection: RS232 I/O Lines Can Be Forced to ±30V without Damage
- Output Overvoltage Does Not Force Current Back into Supplies
- Absolutely No Latch-up
- Available in SO Package

APPLICATIONS

- Notebook Computers
- Palmtop Computers

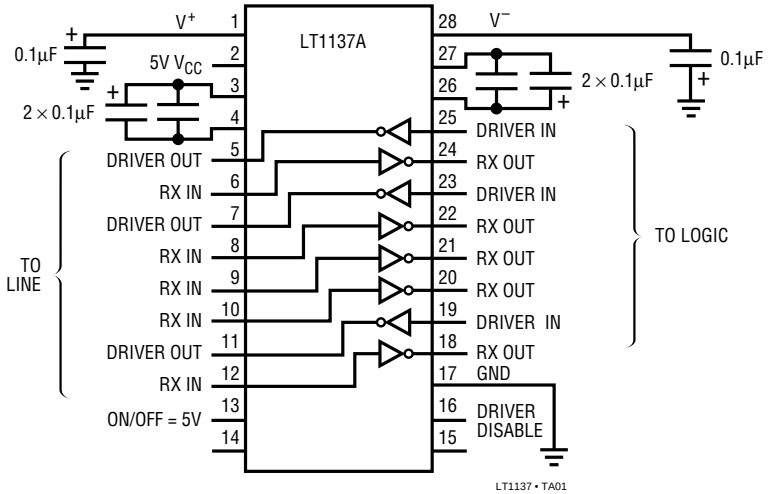
DESCRIPTION

The LT1137A is a three-driver, five-receiver RS232 transceiver, pin compatible with the LT1137, offering performance improvements and two SHUTDOWN modes. The LT1137A's charge pump is designed for extended compliance, and can deliver over 40mA of load current. Supply current is typically 12mA, competitive with similar CMOS devices. An advanced driver output stage operates up to 120k baud while driving heavy capacitive loads.

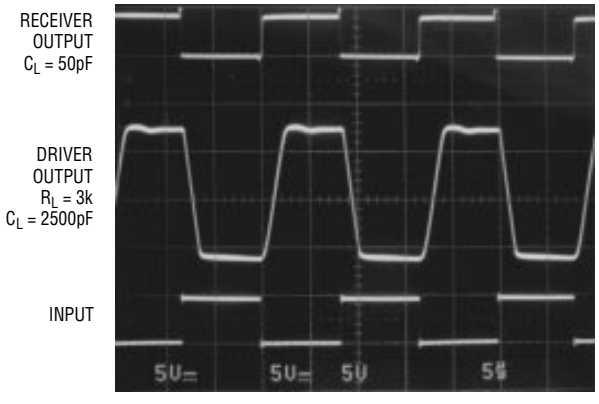
The LT1137A is fully compliant with all EIA-RS232 specifications. Special bipolar construction techniques protect the drivers and receivers beyond the fault conditions stipulated for RS232. Driver outputs and receiver inputs can be shorted to ±30V without damaging the device or the power supply generator. In addition, the RS232 I/O pins are resilient to multiple ±10kV ESD strikes.

The transceiver has two SHUTDOWN modes. One mode disables the drivers and the charge pump, the other shuts down all circuitry. While shut down, the drivers and receivers assume high impedance output states.

TYPICAL APPLICATION



Output Waveforms



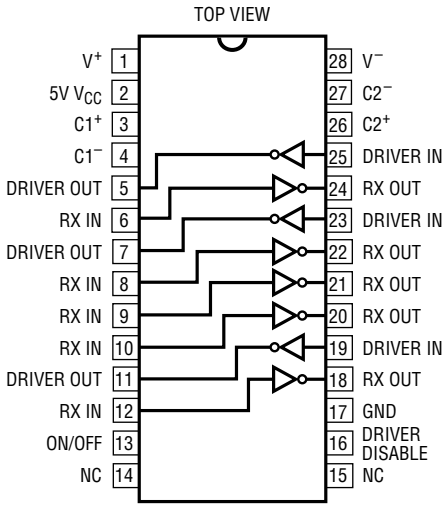
LT1137A • TA02

ABSOLUTE MAXIMUM RATINGS

(Note 1)

Supply Voltage (V_{CC}) 6V
V^+ 13.2V
V^- (Note 7) ..... –6.5V
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
  LT1137AC ..... 0°C to 70°C
  LT1137AI ..... –40°C to 85°C
Storage Temperature Range ..... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) ..... 300°C

PACKAGE/ORDER INFORMATION



N PACKAGE
28-LEAD PLASTIC DIP

S PACKAGE
28-LEAD SOL

G PACKAGE
28-LEAD SSOP

T_{JMAX} = 150°C, θ_{JA} = 56°C/W (N)
T_{JMAX} = 150°C, θ_{JA} = 85°C/W (S)
T_{JMAX} = 150°C, θ_{JA} = 96°C/W (G)

ORDER PART NUMBER
LT1137ACN
LT1137ACS
LT1137ACG
LT1137AIN
LT1137AIS

Consult factory for Military grade parts.

ELECTRICAL CHARACTERISTICS (Note 2)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Power Supply Generator						
V^+ Output				8.6		V
V^- Output				–7.2		V
Supply Current (V_{CC})	(Note 3)	●		12	17	mA
Supply Current When OFF (V_{CC})	SHUTDOWN (Note 4) DRIVER DISABLE	●		1 4	10	µA mA
Supply Rise Time SHUTDOWN to Turn-On	C1, C2, C^+, C^- = 1µF, C^+, C^- = 0.1µF, C1, C2 = 0.2µF			2.0 0.2		ms ms
ON/OFF Pin Thresholds	Input Low Level (Device SHUTDOWN) Input High Level (Device Enabled)	● ●	 2.4	1.4 1.4	0.8	V V
ON/OFF Pin Current	$0V \le V_{ON/OFF} \le 5V$	●	–15		80	µA
Driver Disable Pin Thresholds	Input Low Level (Drivers Enabled) Input High Level (Drivers Disabled)	● ●	 2.4	1.4 1.4	0.8	V 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	●	5.0	7.5		V
		Negative	●		–6.3	–5.0	V
Logic Input Voltage Level	Input Low Level (V_{OUT} = High)		●		1.4	0.8	V
	Input High Level (V_{OUT} = Low)		●	2.0	1.4		V
Logic Input Current	$0.8V \le V_{IN} \le 2V$		●		5	20	µA
Output Short-Circuit Current	V_{OUT} = 0V				±17		mA
Output Leakage Current	SHUTDOWN V_{OUT} = ±25V (Note 4)		●		10	100	µA
Slew Rate	R_L = 3k, C_L = 51pF				15	30	V/µs
	R_L = 3k, C_L = 2500pF			4	15		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	V_{IN} = ±10V			3	5	7	kΩ
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 Leakage Current	SHUTDOWN (Note 4) $0 \le V_{OUT} \le V_{CC}$		●		1	10	µA
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

The ● denotes specifications which apply over the operating temperature range ($0°C \le T_A \le 70°C$ for commercial grade, and $-40°C \le T_A \le 85°C$ for industrial 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 $V_{ON/OFF}$ = 3V.

Note 3: Supply current is measured with driver and receiver outputs unloaded and the driver inputs tied high.

Note 4: Supply current and leakage current measurements in SHUTDOWN are performed with $V_{ON/OFF}$ = 0.1V. Supply current measurements using DRIVER DISABLE are performed with $V_{DRIVER\ DISABLE}$ = 3V.

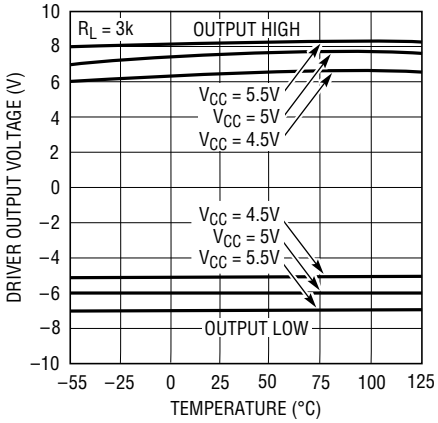
Note 5: For driver delay measurements, R_L = 3k and C_L = 51pF. Trigger points are set between the driver's input logic threshold and the output transition to the zero crossing (t_{HL} = 1.4V to 0V and t_{LH} = 1.4V to 0V).

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: Absolute maximum externally applied voltage. Internal charge pump may force a larger value on this pin.

TYPICAL PERFORMANCE CHARACTERISTICS

Driver Output Voltage



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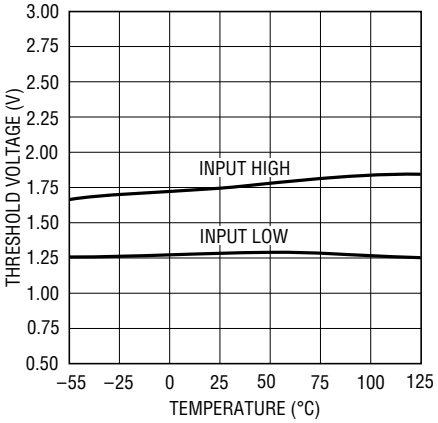
Receiver Input Thresholds



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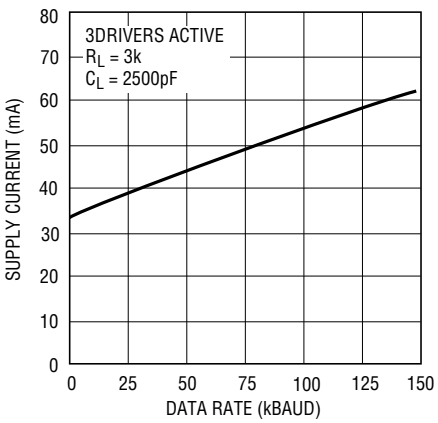
Supply Current vs Data Rate



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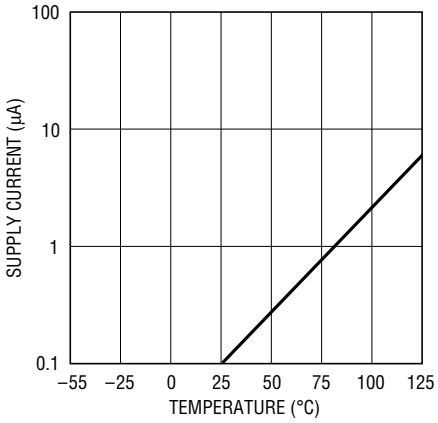
Supply Current in SHUTDOWN



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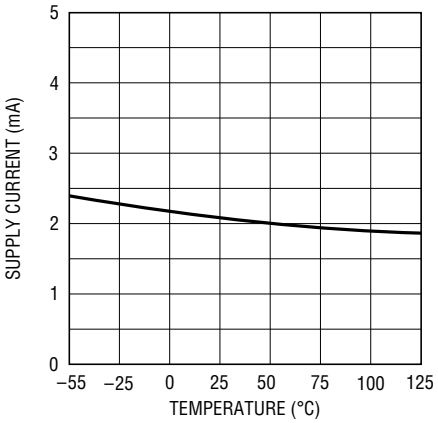
Supply Current in DRIVER DISABLE



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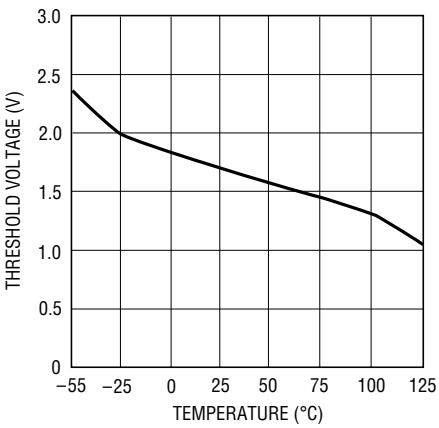
Driver Disable Threshold



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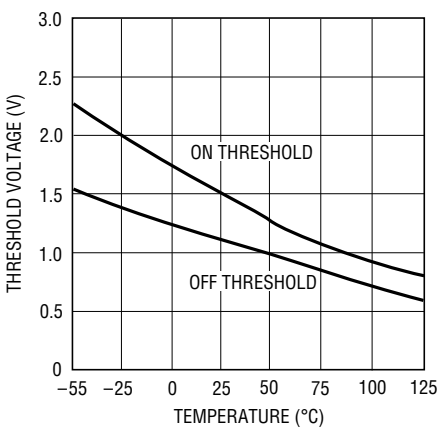
On/Off Thresholds



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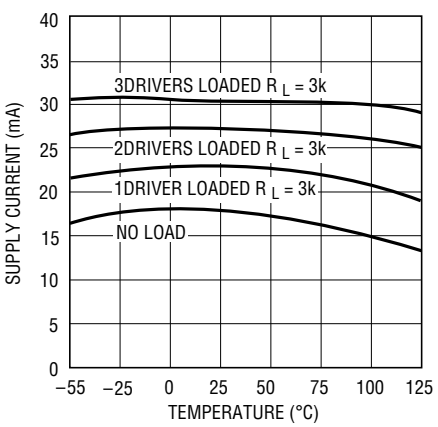
Supply Current



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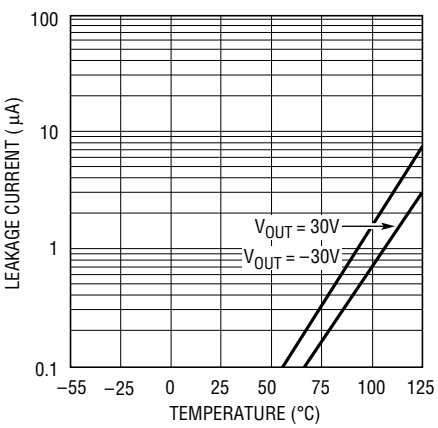
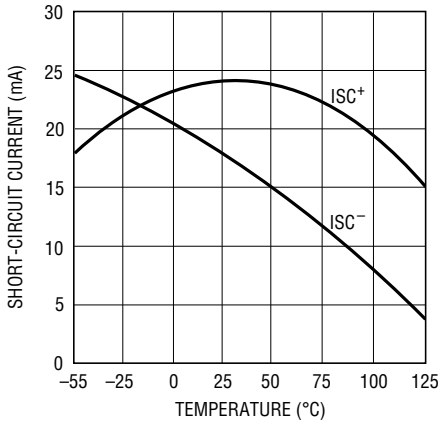
Driver Leakage in SHUTDOWN



LT1137A • TPC09

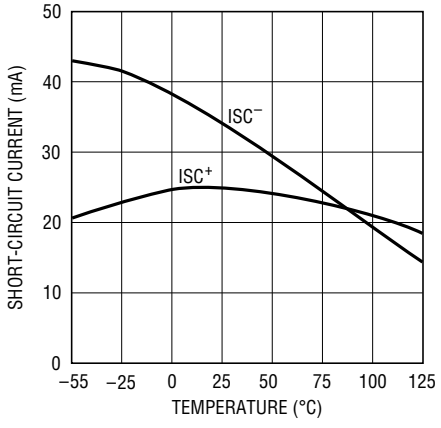
TYPICAL PERFORMANCE CHARACTERISTICS

Driver Short-Circuit Current



LT1137A • TPC10

Receiver Short-Circuit Current



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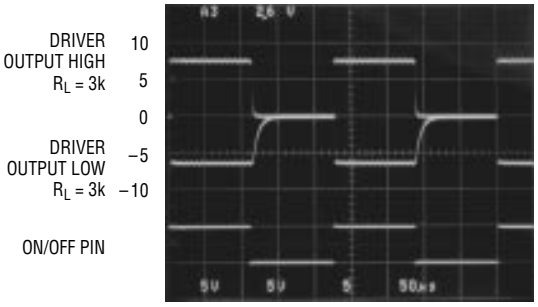
SHUTDOWN to Driver Output



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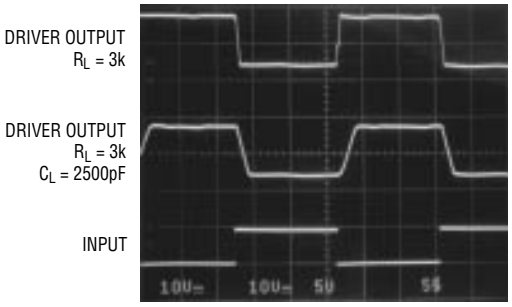
Driver Output Waveforms



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PIN FUNCTIONS

V_{CC}: 5V Input Supply Pin. Supply current drops to zero in the SHUTDOWN mode. This pin should be decoupled with a 0.1µF ceramic capacitor close to the package pin. Insufficient supply bypassing can result in low output drive levels and erratic charge pump operation.

GND: Ground Pin.

ON/OFF: TTL/CMOS Compatible Operating Mode Control. A logic low puts the device in the SHUTDOWN mode which reduces input supply current to zero and places all of the drivers and receivers in high impedance state. 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. Receivers remain active under these conditions. Floating the driver disable pin or driving it to a logic low level fully enables the transceiver. A logic low on the On/Off pin supersedes the state of the Driver Disable pin. Supply current drops to 4mA when in DRIVER DISABLE mode.

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 shared common 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 $C \geq 0.1\mu F$. V^- is short-circuit proof for 30 seconds.

$C1^+$, $C1^-$, $C2^+$, $C2^-$: 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 $C2^-$. To maintain charge pump efficiency, the capacitor's effective series resistance should be less than 2Ω. 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. In applications where larger positive voltages are available, such as 12V, C1 may be omitted and the positive voltage may be connected directly to the $C1^+$ pin. In this mode of operation, the V^+ pin should be decoupled with a $0.1\mu F$ ceramic capacitor.

DRIVER IN: RS232 Driver Input Pins. These 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. Driver output swing meets RS232 levels for loads up to 3k. Slew rates are controlled for lightly loaded lines. Output current capability is sufficient for load conditions up to 2500pF. 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^- + 30V to 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.

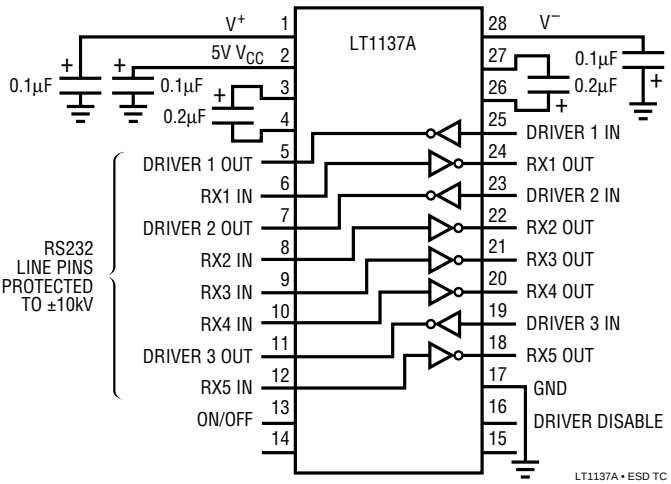
RX IN: Receiver Inputs. These pins accept RS232 level signals (±30V) into a protected 5k terminating resistor. The receiver inputs are protected against ESD to ±10kV for human body model discharges. Each receiver provides 0.4V of hysteresis for noise immunity. Open receiver inputs assume a logic low state.

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 are fully short-circuit protected to ground or V_{CC} with the power on, off, or in SHUTDOWN mode.

ESD PROTECTION

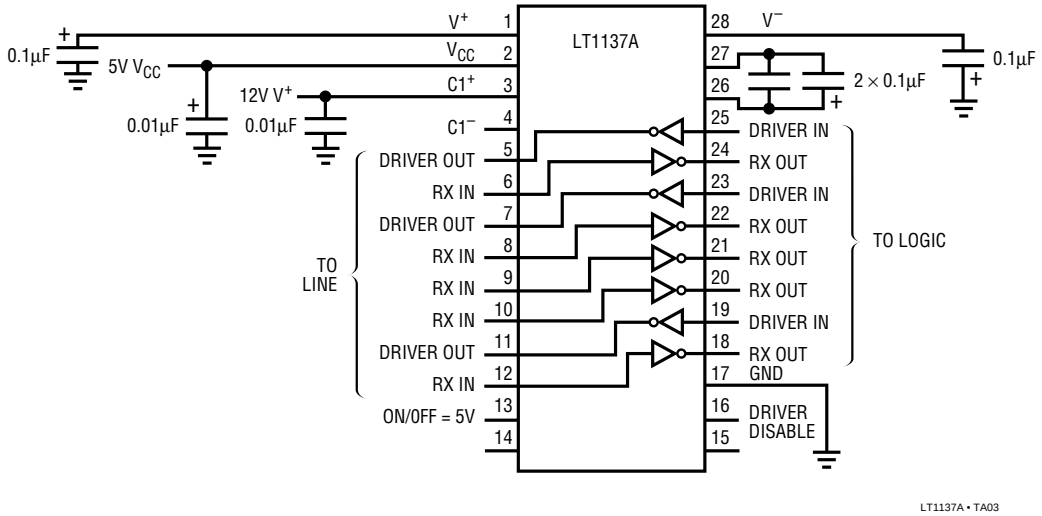
The RS232 line inputs of the LT1137A have on-chip protection from ESD transients up to ±10kV. The protection structures act to divert the static discharge safely to system ground. In order for the ESD protection to function effectively, the power supply and ground pins of the LT1137A must be connected 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



TYPICAL APPLICATIONS

Operation Using 5V and 12V Power Supplies



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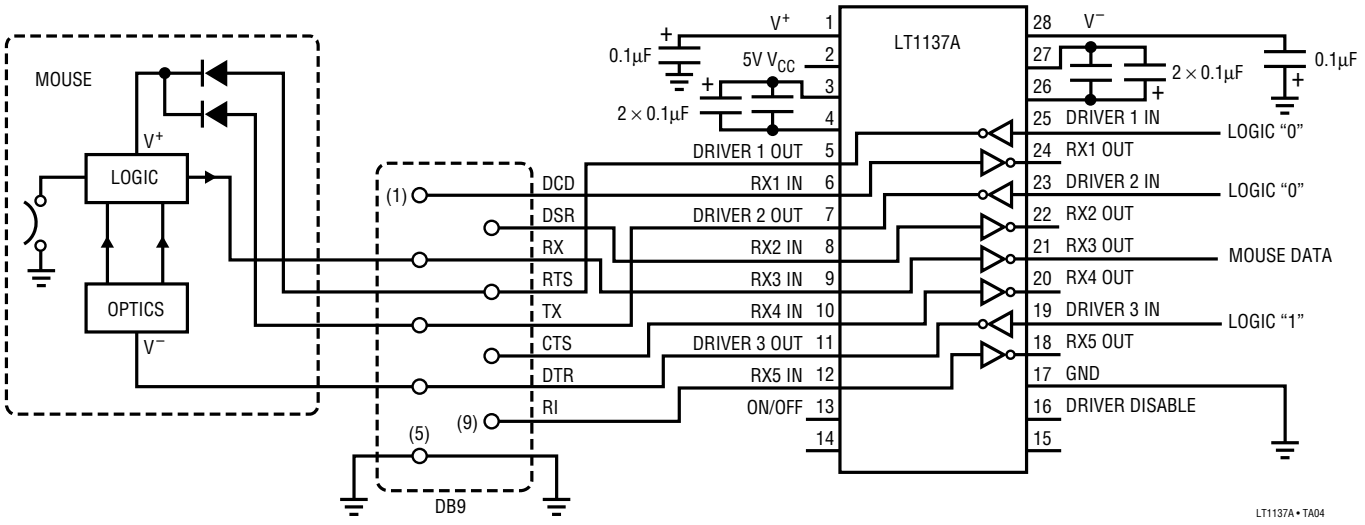
Typical Mouse Driving Application

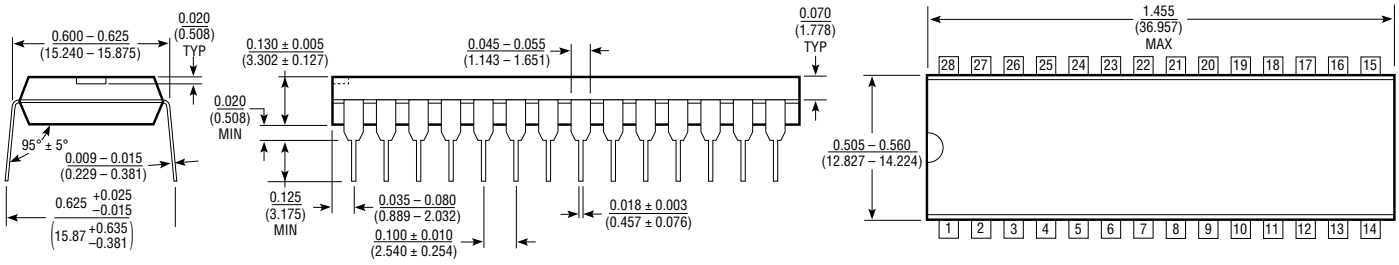


LT1137A • TA04

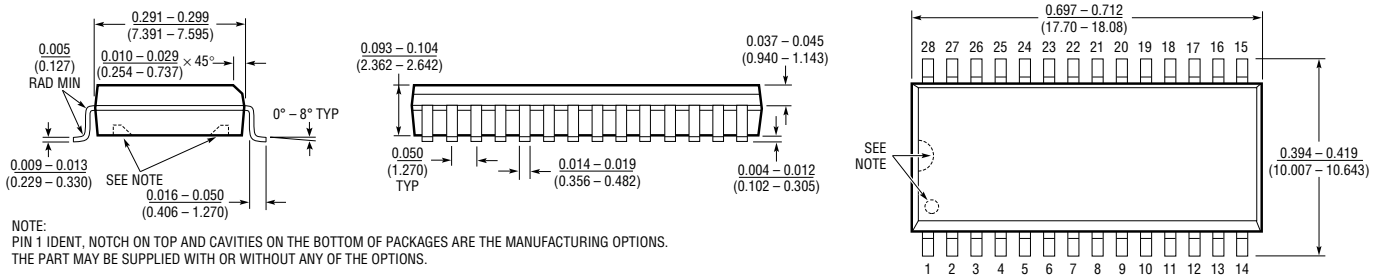
PACKAGE DESCRIPTION

Dimensions in inches (millimeters) unless otherwise noted.

N Package
28-Lead Plastic DIP

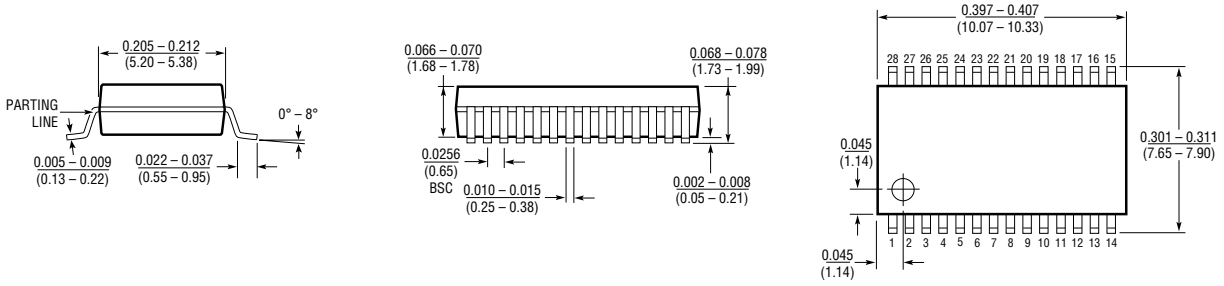


S Package
28-Lead SOL



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.

G Package
28-Lead SSOP



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