LINEAR TECHNOLOGY

5V Low Power RS232 3-Driver/5-Receiver Transceiver

FEATURES

- **Low Supply Current: 300μA**
- **ESD Protection: Over ±10kV**
- 1μA Supply Current in Shutdown
- Operates from a Single 5V Supply
- Uses Small Capacitors: 0.1μF
- Operates to 120k Baud
- Three-State Outputs Are High Impedance When Off
- Output Overvoltage Does Not Force Current Back into Supplies
- RS232 I/O Lines Can Be Forced to ±25V without Damage
- Pin Compatible with LT®1137A and LT1237
- Flowthrough Architecture

APPLICATIONS

- Notebook Computers
- Palmtop Computers

DESCRIPTION

The LTC®1337 is a 3-driver/5-receiver RS232 transceiver with very low supply current. In the no load condition, the supply current is only 300μA. The charge pump only requires four 0.1μF capacitors and can supply up to 12mA of extra current to power external circuitry.

In Shutdown mode, the supply current is further reduced to 1μA. All RS232 outputs assume a high impedance state in Shutdown and with the power off.

The LTC1337 is fully compliant with all data rate and overvoltage RS232 specifications. The transceiver can operate up to 120k baud with a 1000pF//3kΩ load. Both driver outputs and receiver inputs can be forced to ±25V without damage, and can survive multiple ±10kV ESD strikes.

LT, LTC and LT are registered trademarks of Linear Technology Corporation.

TYPICAL APPLICATION

3-Drivers/5-Receivers with Shutdown

1337 TA01

Supply Current
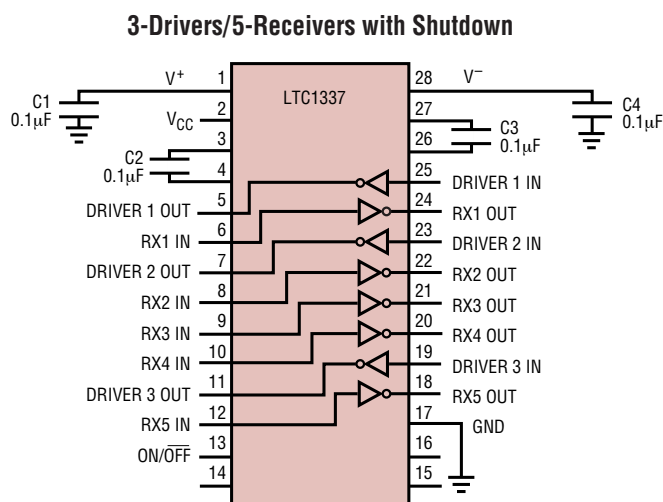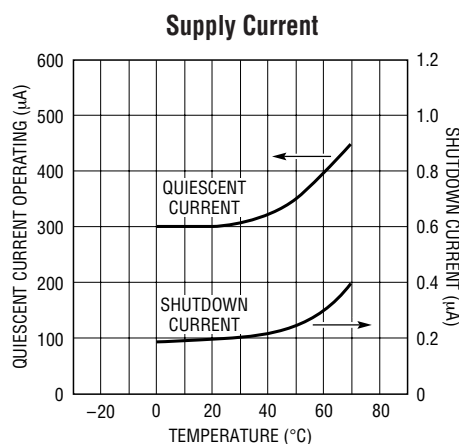
TEST CONDITION:
V_{CC} = 5V, ALL DRIVER INPUTS TIED TO V_{CC}

1337 TA02

LTC1337

ABSOLUTE MAXIMUM RATINGS

(Note 1)

Supply Voltage (V_{CC}) 6V
Input Voltage
   Driver .... −0.3V to V_{CC} + 0.3V
   Receiver .... −25V to 25V
   On/$\overline{Off}$ Pin .... −0.3V to V_{CC} + 0.3V
Output Voltage
   Driver .... −25V to 25V
   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
   Commercial (LTC1337C) .... 0°C to 70°C
Storage Temperature Range .... −65°C to 150°C
Lead Temperature (Soldering, 10 sec)................ 300°C

PACKAGE/ORDER INFORMATION

TOP VIEW

V^+ 1	28 V^-
V_{CC} 2	27 C2+
C1$^+$ 3	26 C2−
C1− 4	25 DR1 IN
DR1 OUT 5	24 RX1 OUT
RX1 IN 6	23 DR2 IN
DR2 OUT 7	22 RX2 OUT
RX2 IN 8	21 RX3 OUT
RX3 IN 9	20 RX4 OUT
RX4 IN 10	19 DR3 IN
DR3 OUT 11	18 RX5 OUT
RX5 IN 12	17 GND
ON/$\overline{OFF}$ 13	16 NC
NC 14	15 NC

G PACKAGE
28-LEAD PLASTIC SSOP

NW PACKAGE
28-LEAD PDIP

SW PACKAGE
28-LEAD PLASTIC SO

T_{JMAX} = 125°C, θ_{JA} = 96°C/W (G)
T_{JMAX} = 125°C, θ_{JA} = 56°C/W (NW)
T_{JMAX} = 125°C, θ_{JA} = 85°C/W (SW)
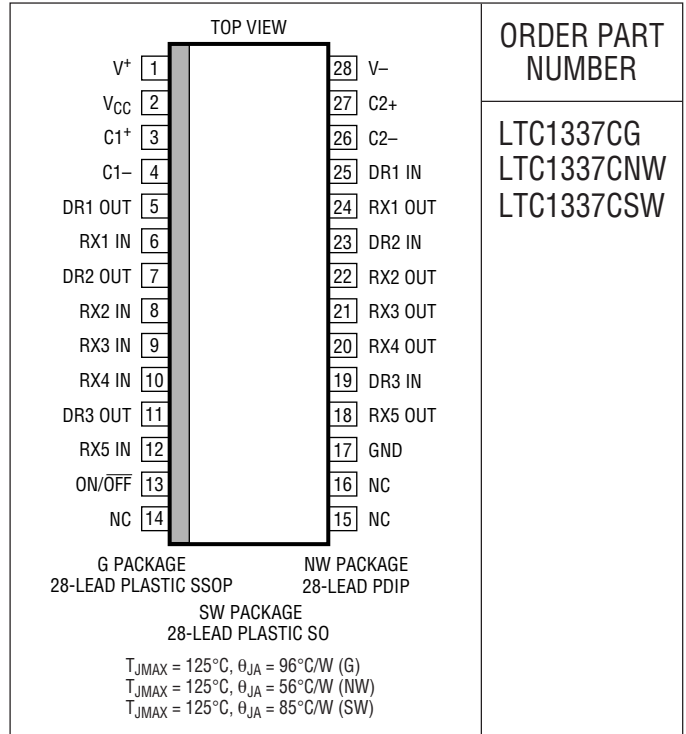
ORDER PART
NUMBER

LTC1337CG
LTC1337CNW
LTC1337CSW

DC ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range. V_{CC} = 5V, C1 = C2 = C3 = C4 = 0.1µF, unless otherwise noted.

PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
Any Driver							
Output Voltage Swing	R_L = 3k to GND	Positive	●	5.0	7.0		V
	R_L = 3k to GND	Negative	●	−5.0	−6.5		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	V_{IN} = 5V		●			5	µA
	V_{IN} = 0		●			−5	µA
Output Short-Circuit Current	V_{OUT} = 0V				±10		mA
Output Leakage Current	Shutdown, V_{OUT} = ±20V (Note 3)		●		10	500	µA
Any Receiver							
Input Voltage Thresholds	Input Low Threshold		●	0.8	1.3		V
	Input High Threshold		●		1.7	2.4	V
Hysteresis			●	0.1	0.4	1	V
Input Resistance	−10V ≤ V_{IN} ≤ 10V			3	5	7	kΩ
Output Voltage	Output Low, I_{OUT} = −1.6mA (V_{CC} = 5V)		●		0.2	0.4	V
	Output High, I_{OUT} = 160µA (V_{CC} = 5V)		●	3.5	4.8		V
Output Short-Circuit Current	Sourcing Current, V_{OUT} = 0			15	20		mA
	Sinking Current, V_{OUT} = V_{CC}			−15	−40		mA
Output Leakage Current	Shutdown, 0 ≤ V_{OUT} ≤ V_{CC} (Note 3)		●		1	10	µA

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LINEAR
TECHNOLOGY

DC ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range. V_{CC} = 5V, C1 = C2 = C3 = C4 = 0.1µF, unless otherwise noted.
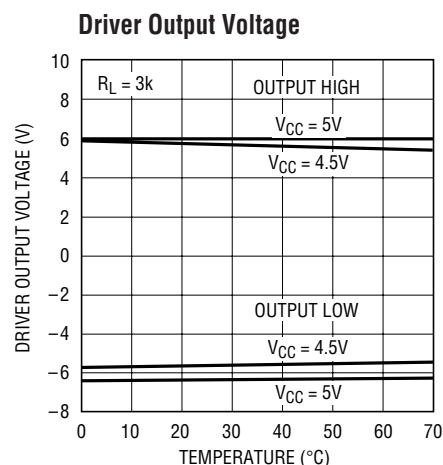
PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Power Supply Generator						
V^+ Output Voltage	I_{OUT} = 0mA			8.0		V
	I_{OUT} = 12mA			7.5		V
V^- Output Voltage	I_{OUT} = 0mA			−8.0		V
	I_{OUT} = 12mA			−6.5		V
Supply Rise Time	Shutdown to Turn-On			0.2		ms
Power Supply						
V_{CC} Supply Current	No Load (Note 2)	●		0.3	0.5	mA
Supply Leakage Current (V_{CC})	Shutdown (Note 3)	●		1	10	µA
On/$\overline{Off}$ Threshold Low		●		1.4	0.8	V
On/$\overline{Off}$ Threshold High		●	2.0	1.4		V

AC CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range. V_{CC} = 5V, C1 = C2 = C3 = C4 = 0.1µF, unless otherwise noted.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Slew Rate	R_L = 3k, C_L = 51pF			8	30	V/µs
	R_L = 3k, C_L = 2500pF		2	4		V/µs
Driver Propagation Delay	t_{HLD} (Figure 1)	●		2	3	µs
(TTL to RS232)	t_{LHD} (Figure 1)	●		2	3	µs
Receiver Propagation Delay	t_{HLR} (Figure 2)	●		0.3	0.6	µs
(RS232 to TTL)	t_{LHR} (Figure 2)	●		0.2	0.6	µs

Note 1: Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.
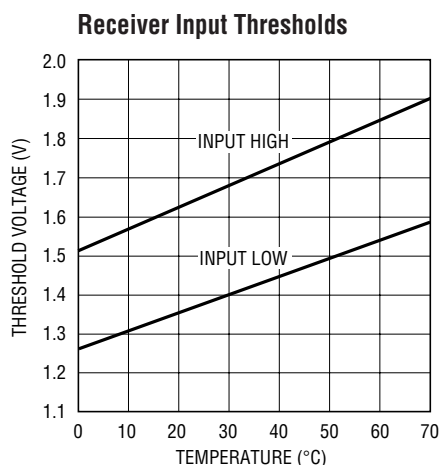
Note 2: Supply current is measured with driver and receiver outputs unloaded and driver inputs tied high.

Note 3: Supply current and leakage measurements in Shutdown are performed with V_{ON} = 0V.
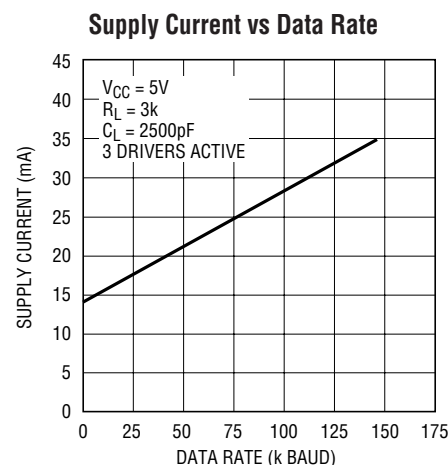
TYPICAL PERFORMANCE CHARACTERISTICS

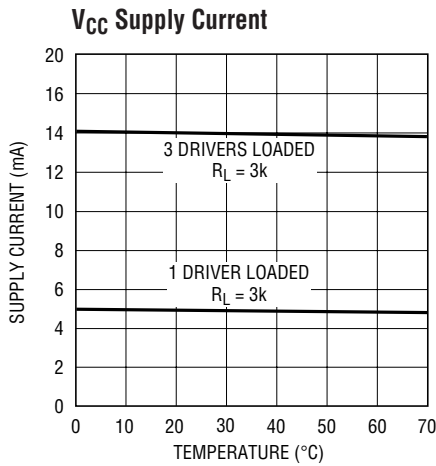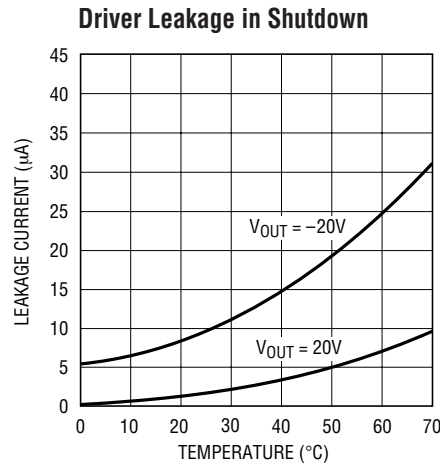**Driver Output Voltage**

1337 G01

Receiver Input Thresholds

1337 G02

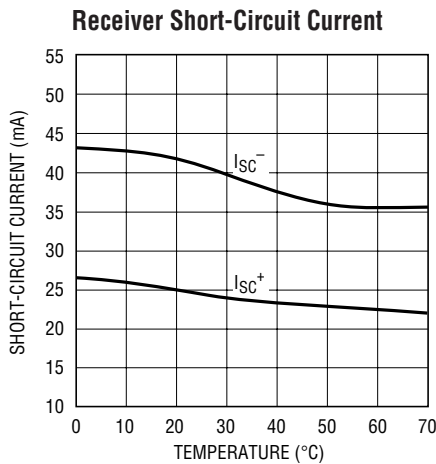**Supply Current vs Data Rate**

1337 G03

TYPICAL PERFORMANCE CHARACTERISTICS

V_CC Supply Current

SUPPLY CURRENT (mA) vs TEMPERATURE (°C)

3 DRIVERS LOADED
R_L = 3k

1 DRIVER LOADED
R_L = 3k

1337 G04

Driver Leakage in Shutdown

LEAKAGE CURRENT (μA) vs TEMPERATURE (°C)

$V_{OUT} = -20V$

$V_{OUT} = 20V$

1337 G05

Driver Short-Circuit Current

SHORT-CIRCUIT CURRENT (mA) vs TEMPERATURE (°C)

I_{SC}^-

I_{SC}^+

1337 G06

Receiver Short-Circuit Current

SHORT-CIRCUIT CURRENT (mA) vs TEMPERATURE (°C)

I_{SC}^-

I_{SC}^+

1337 G07

Driver Output Waveforms

DRIVER OUTPUT
R_L = 3k
C_L = 2500pF

DRIVER OUTPUT
R_L = 3k

INPUT

10V=   10V=   5U   5⌐
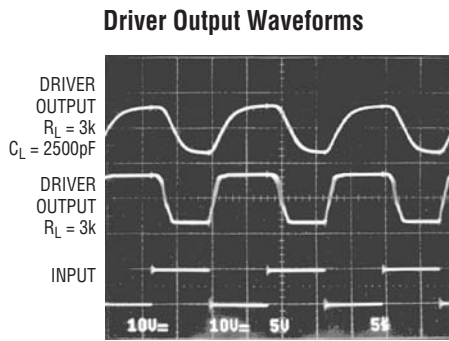
Receiver Output Waveforms

RX OUTPUT
C_L = 50pF

INPUT

5V=   5V=   5⌐

PIN FUNCTIONS

V_CC: 5V Input Supply Pin. Supply current less than 1μA in the Shutdown mode. This pin should be decoupled with a 0.1μF ceramic capacitor.

GND: Ground Pin.

ON/OFF: TTL/CMOS Compatible Shutdown Pin. A logic low puts the device in the Shutdown mode which reduces input supply current to less than 1μA and places all drivers and receivers in high impedance state. This pin cannot float.

V⁺: Positive Supply Output (RS232 Drivers). $V^+ \cong 2V_{CC} - 1V$. This pin requires an external capacitor C = 0.1μF for charge storage. The capacitor may be tied to ground or 5V.

With multiple devices, the V⁺ and V⁻ pins may be paralleled into common capacitors. For large numbers of devices, increasing the size of the shared common storage capacitors is recommended to reduce ripple.

V⁻: Negative Supply Output (RS232 Drivers). $V^- \cong (2V_{CC} - 1.5V)$. This pin requires an external capacitor C = 0.1μF for charge storage.

C1⁺, C1⁻, C2⁺, C2⁻: Commutating Capacitor Inputs. These pins require two external capacitors C = 0.1μF. 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 50Ω.

PIN FUNCTIONS

DRIVER IN: RS232 Driver Input Pins. 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. Outputs are in a high impedance state when in Shutdown mode or $V_{CC} = 0V$. The driver outputs are protected against ESD to ±10kV for human body model discharges.

RX IN: Receiver Inputs. These pins can be forced to ±25V without damage. 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.
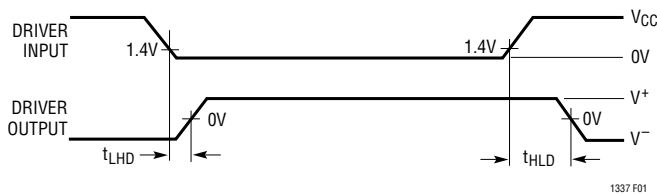
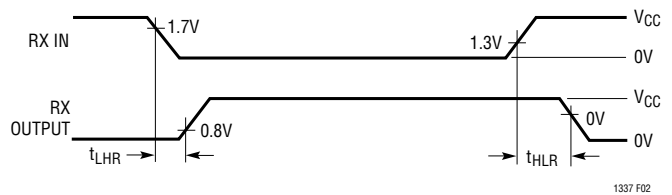# SWITCHING TIME WAVEFORMS

Figure 1. Driver Propagation Delay Timing

Figure 2. Receiver Propagation Delay Timing
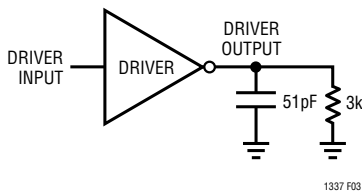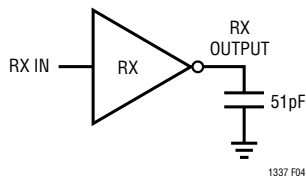
TEST CIRCUITS
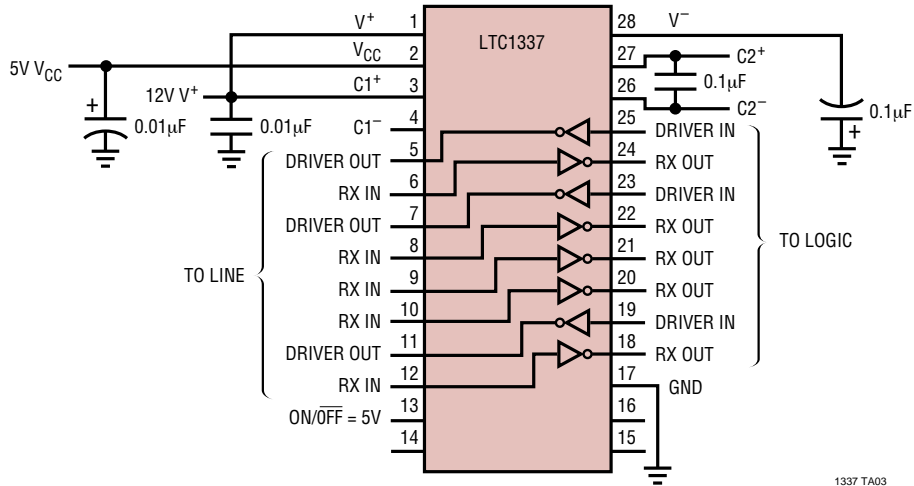

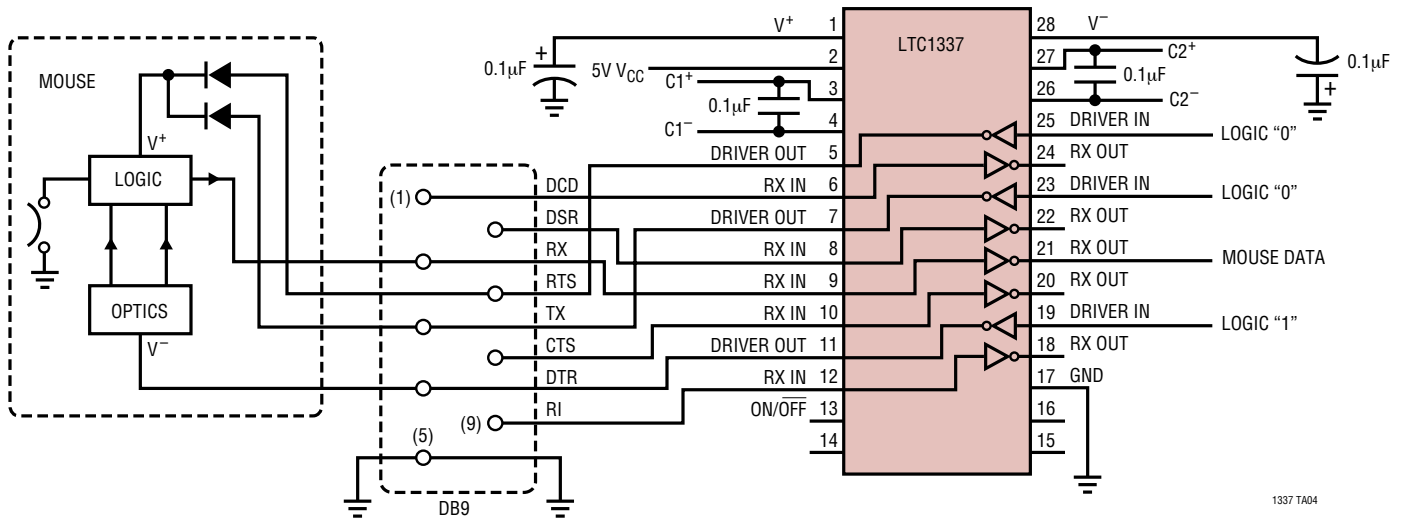Figure 3. Driver Timing Test Load

Figure 4. Receiver Timing Test Load

ESD Test Circuit
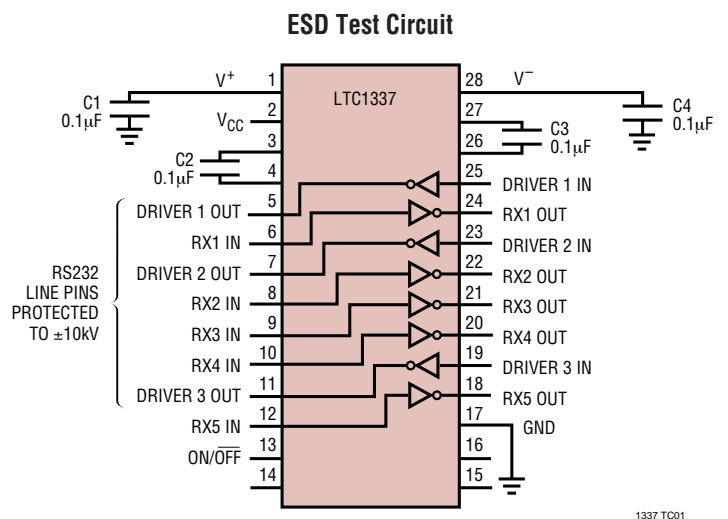
TYPICAL APPLICATIONS

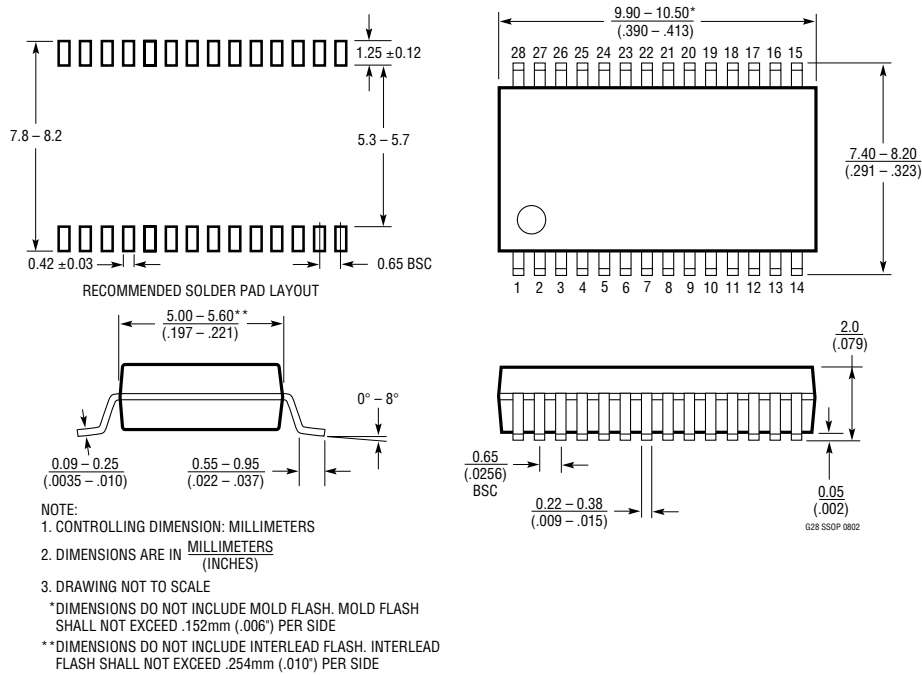**Operation Using 5V and 12V Power Supplies**

1337 TA03

Typical Mouse Driving Application

1337 TA04

1337fa

PACKAGE DESCRIPTION

G Package
**28-Lead Plastic SSOP (5.3mm)**
(Reference LTC DWG # 05-08-1640)

1.25 ±0.12

7.8 – 8.2

5.3 – 5.7

0.42 ±0.03

0.65 BSC

RECOMMENDED SOLDER PAD LAYOUT

9.90 – 10.50*
(.390 – .413)

28 27 26 25 24 23 22 21 20 19 18 17 16 15

7.40 – 8.20
(.291 – .323)

1 2 3 4 5 6 7 8 9 10 11 12 13 14

5.00 – 5.60**
(.197 – .221)

0° – 8°

0.09 – 0.25
(.0035 – .010)

0.55 – 0.95
(.022 – .037)

2.0
(.079)

0.65
(.0256)
BSC

0.22 – 0.38
(.009 – .015)

0.05
(.002)

G28 SSOP 0802

NOTE:
1. CONTROLLING DIMENSION: MILLIMETERS
2. DIMENSIONS ARE IN $\frac{MILLIMETERS}{(INCHES)}$
3. DRAWING NOT TO SCALE
 *DIMENSIONS DO NOT INCLUDE MOLD FLASH. MOLD FLASH
 SHALL NOT EXCEED .152mm (.006") PER SIDE
 **DIMENSIONS DO NOT INCLUDE INTERLEAD FLASH. INTERLEAD
 FLASH SHALL NOT EXCEED .254mm (.010") PER SIDE

NW Package
28-Lead PDIP (Wide .600 Inch)
(Reference LTC DWG # 05-08-1520)

1.467*
(36.957)
MAX

28 27 26 25 24 23 22 21 20 19 18 17 16 15

.505 – .560*
(12.827 – 14.224)

1 2 3 4 5 6 7 8 9 10 11 12 13 14

.600 – .625
(15.240 – 15.875)

.008 – .015
(0.203 – 0.381)

.625 $^{+.035}_{-.015}$
(15.87 $^{+0.889}_{-0.381}$)

.150 ± .005
(3.810 ± 0.127)

.015
(0.381)
MIN

.120
(3.175)
MIN

.035 – .080
(0.889 – 2.032)

.100
(2.54)
BSC

.045 – .065
(1.143 – 1.651)

.018 ± .003
(0.457 ± 0.076)

.070
(1.778)
TYP

NOTE:
1. DIMENSIONS ARE $\frac{INCHES}{MILLIMETERS}$
 *THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
 MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH (0.254mm)

NW28 1002

1337fa

LTC1337

PACKAGE DESCRIPTION

**SW Package
28-Lead Plastic Small Outline (Wide .300 Inch)**
(Reference LTC DWG # 05-08-1620)
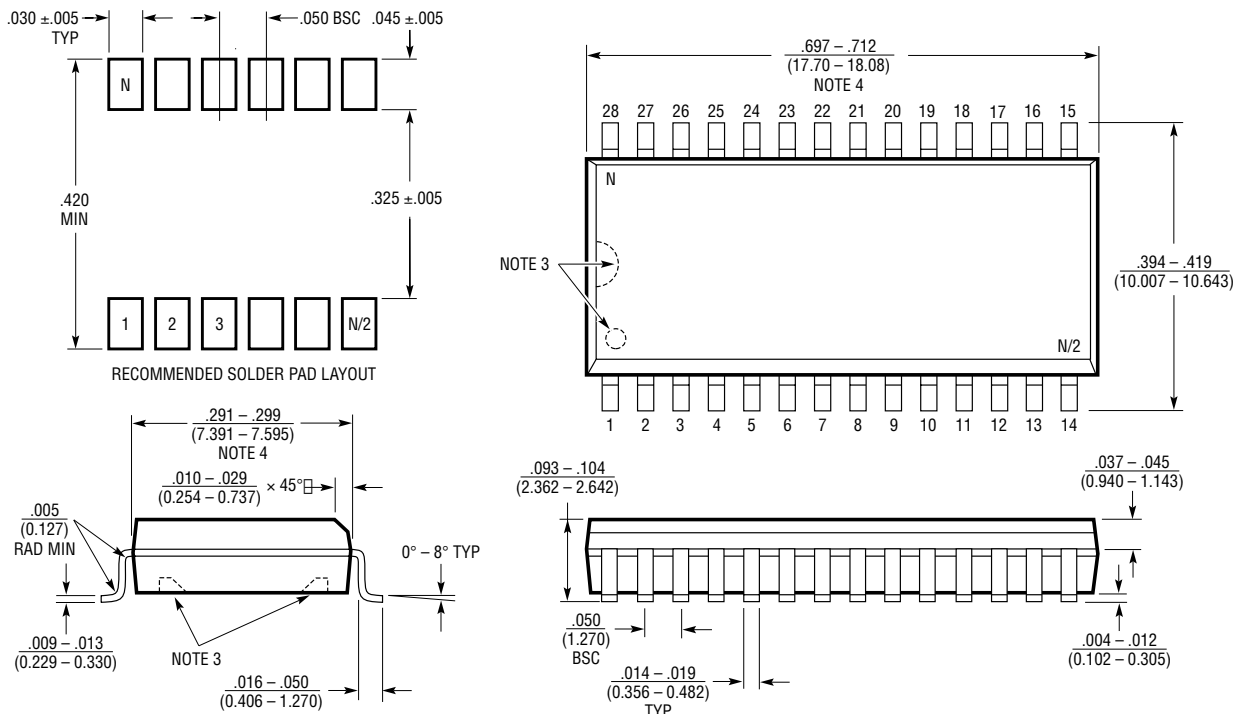
NOTE:
1. DIMENSIONS IN $\frac{INCHES}{(MILLIMETERS)}$
2. DRAWING NOT TO SCALE
3. PIN 1 IDENT, NOTCH ON TOP AND CAVITIES ON THE BOTTOM OF PACKAGES ARE THE MANUFACTURING OPTIONS.
   THE PART MAY BE SUPPLIED WITH OR WITHOUT ANY OF THE OPTIONS
4. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
   MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

S28 (WIDE) 0502

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1137A	5V, 3 Driver, 5 Receiver RS232 Transceiver	±15kV ESD per IEC 1000-4
LTC1327	3.3V, 3 Driver, 5 Receiver RS562 Transceiver	300μA Supply Current, 0.2μA in Shutdown
LTC1348	3.3V to 5V, 3 Driver, 5 Receiver RS232 Transceiver	True RS232 on 3.3V, 5 Receivers Active in Shutdown

1337fa

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