LINEAR TECHNOLOGY

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

FEATURES

- **Low Supply Current: 300μA**
- 1μA Supply Current in SHUTDOWN
- **ESD Protection: Over ±10kV**
- 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 LT1137A and LT1237
- Flowthrough Architecture

APPLICATIONS
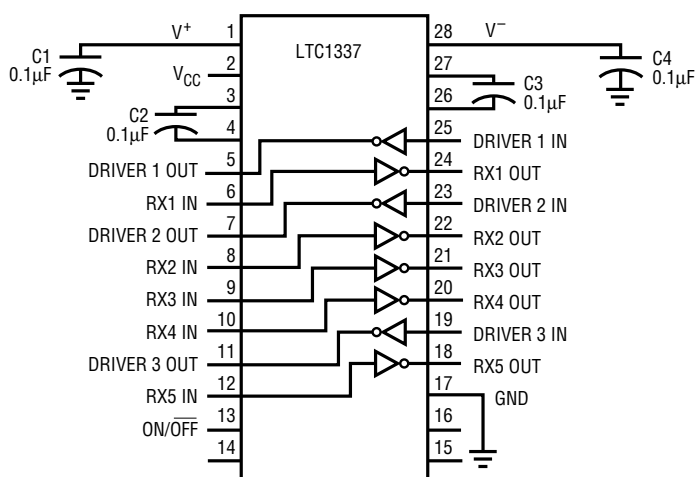
- Notebook Computers
- Palmtop Computers

DESCRIPTION

The LTC1337 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.

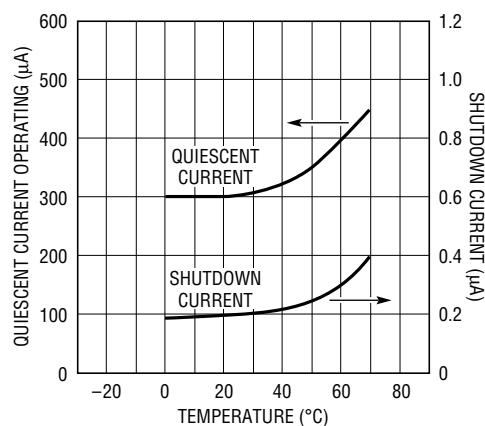## TYPICAL APPLICATION

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/$\overline{\text{Off}}$ 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

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

G PACKAGE
28-LEAD SSOP
N PACKAGE
28-LEAD PLASTIC DIP
S PACKAGE
28-LEAD PLASTIC SOL

T_{JMAX} = 125°C, θ_{JA} = 96°C/W (G)
T_{JMAX} = 125°C, θ_{JA} = 56°C/W (N)
T_{JMAX} = 125°C, θ_{JA} = 85°C/W (S)

DC ELECTRICAL CHARACTERISTICS 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	200	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				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

DC ELECTRICAL CHARACTERISTICS $V_{CC} = 5V$, 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

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

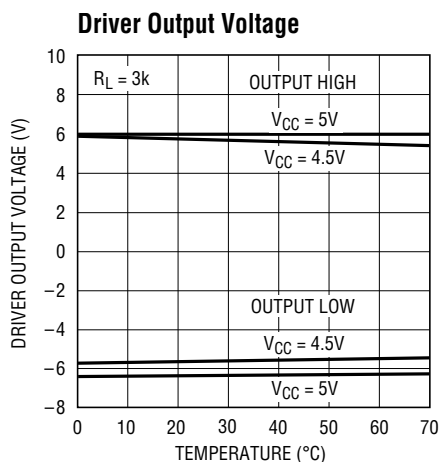The ● denotes specifications which apply over the operating temperature range (0°C ≤ T_A ≤ 70°C).

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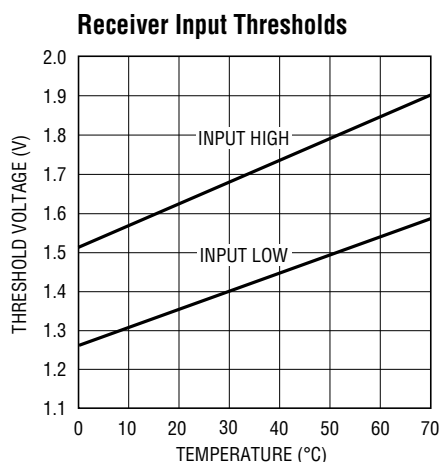
Note 2: Supply current is measured with driver and receiver outputs unloaded and driver inputs tied high.

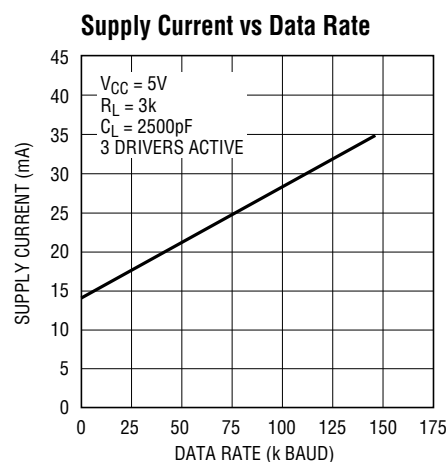**Note 3:** Supply current and leakage measurements in SHUTDOWN are performed with $V_{ON} = 0V$.
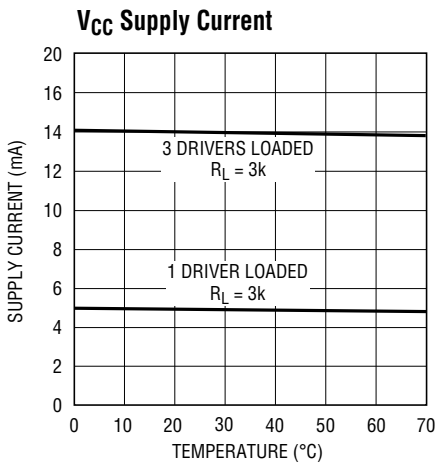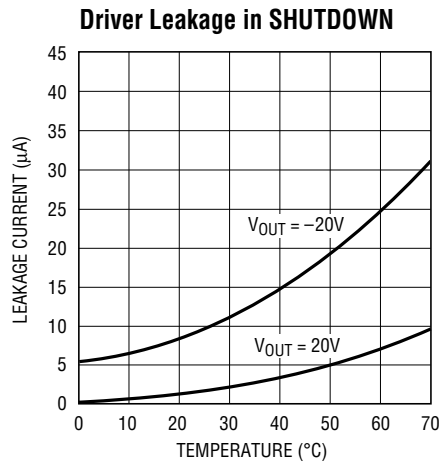
TYPICAL PERFORMANCE CHARACTERISTICS

Driver Output Voltage

1337 G01

Receiver Input Thresholds

1337 G02

Supply Current vs Data Rate

1337 G03

TYPICAL PERFORMANCE CHARACTERISTICS

V_{CC} Supply Current

3 DRIVERS LOADED
$R_L = 3k$

1 DRIVER LOADED
$R_L = 3k$

1337 G04

Driver Leakage in SHUTDOWN

$V_{OUT} = -20V$

$V_{OUT} = 20V$

1337 G05

Driver Short-Circuit Current

I_{SC}^-

I_{SC}^+

1337 G06

Receiver Short-Circuit Current

I_{SC}^-

I_{SC}^+

1337 G07

Driver Output Waveforms

DRIVER OUTPUT
$R_L = 3k$
$C_L = 2500pF$

DRIVER OUTPUT
$R_L = 3k$

INPUT

Receiver Output Waveforms

RX OUTPUT
$C_L = 50pF$

INPUT
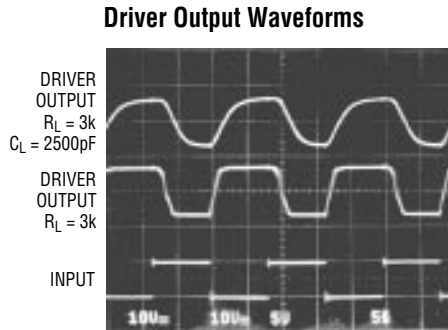
PIN FUNCTIONS

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.

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 paral-

leled 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 $\pm 10kV$ for human body model discharges.

RX IN: Receiver Inputs. These pins can be forced to $\pm 25V$ without damage. The receiver inputs are protected against ESD to $\pm 10kV$ 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.
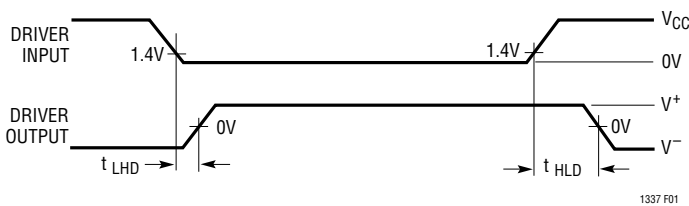
SWITCHING TIME WAVEFORMS

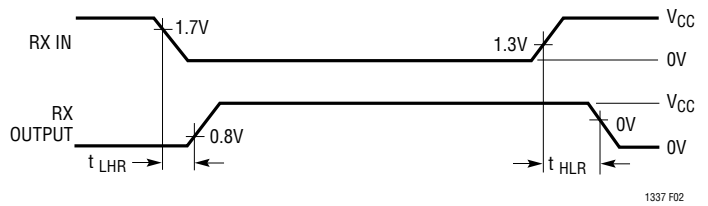

Figure 1. Driver Propagation Delay Timing

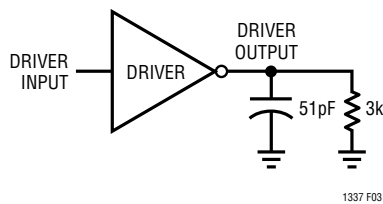Figure 2. Receiver Propagation Delay Timing

TEST CIRCUITS

Figure 3. Driver Timing Test Load

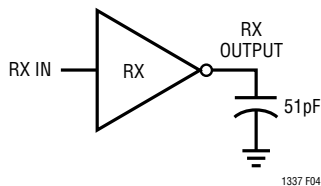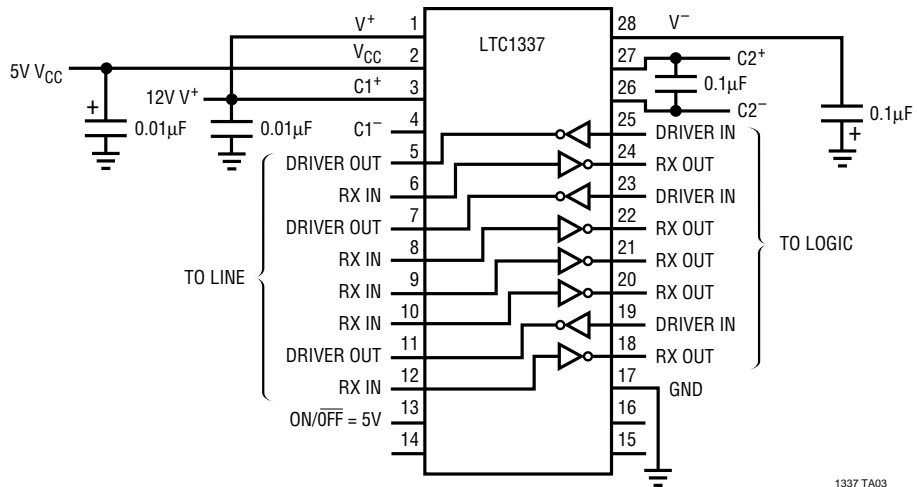Figure 4. Receiver Timing Test Load

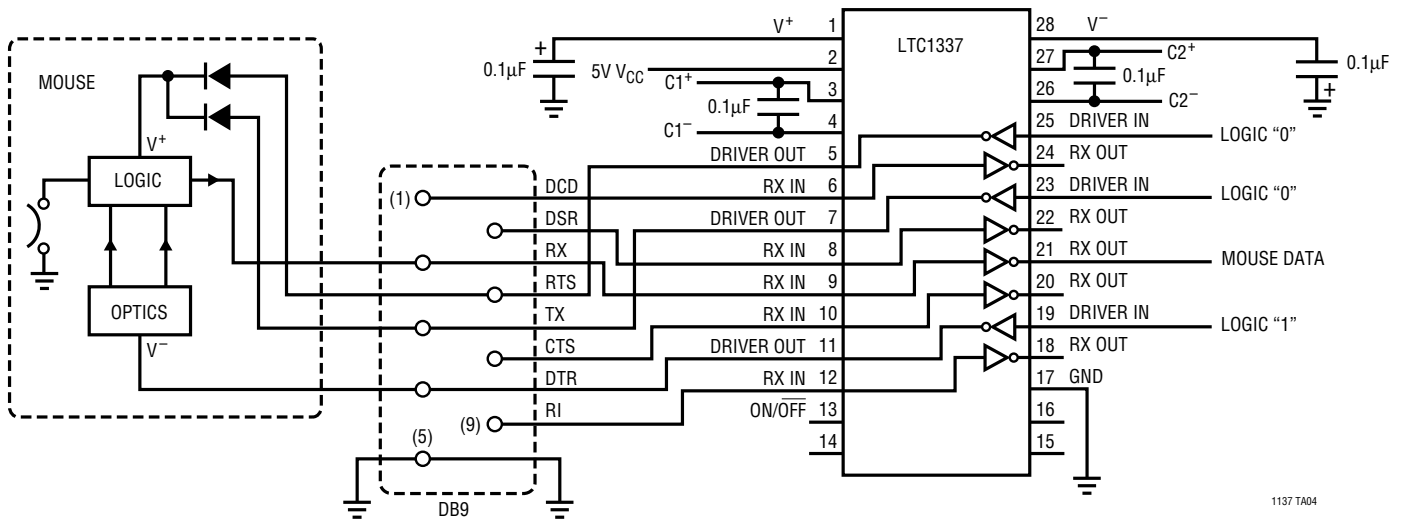**ESD Test Circuit**

TYPICAL APPLICATIONS

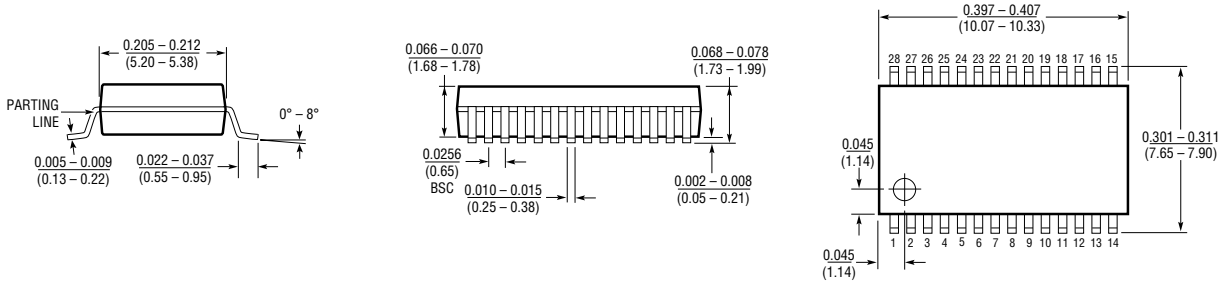**Operation Using 5V and 12V Power Supplies**

1337 TA03

Typical Mouse Driving Application

1137 TA04

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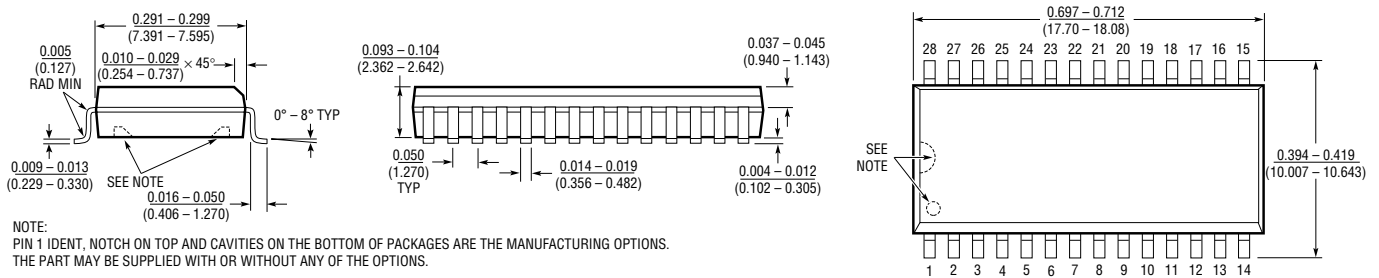**Dimensions in inches (millimeters) unless otherwise notes.**

G Package
28-Lead SSOP

0.205 – 0.212
(5.20 – 5.38)

PARTING
LINE

0° – 8°

0.005 – 0.009
(0.13 – 0.22)

0.022 – 0.037
(0.55 – 0.95)

0.066 – 0.070
(1.68 – 1.78)

0.068 – 0.078
(1.73 – 1.99)

0.0256
(0.65)
BSC

0.010 – 0.015
(0.25 – 0.38)

0.002 – 0.008
(0.05 – 0.21)

0.397 – 0.407
(10.07 – 10.33)

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

0.045
(1.14)

0.301 – 0.311
(7.65 – 7.90)

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

0.045
(1.14)

N Package
28-Lead Plastic DIP

0.600 – 0.625
(15.240 – 15.875)

0.020
(0.508)
TYP

95° ± 5°

0.009 – 0.015
(0.229 – 0.381)

0.625 $^{+0.025}_{-0.015}$

$\left(15.87 ^{+0.635}_{-0.381}\right)$

0.130 ± 0.005
(3.302 ± 0.127)

0.020
(0.508)
MIN

0.125
(3.175)
MIN

0.045 – 0.055
(1.143 – 1.651)

0.035 – 0.080
(0.889 – 2.032)

0.100 ± 0.010
(2.540 ± 0.254)

0.018 ± 0.003
(0.457 ± 0.076)

0.070
(1.778)
TYP

1.455
(36.957)
MAX

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

0.505 – 0.560
(12.827 – 14.224)

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

S Package
28-Lead SOL

0.005
(0.127)
RAD MIN

0.291 – 0.299
(7.391 – 7.595)

0.010 – 0.029
(0.254 – 0.737) × 45°

0° – 8° TYP

0.009 – 0.013
(0.229 – 0.330)

SEE NOTE

0.016 – 0.050
(0.406 – 1.270)

0.093 – 0.104
(2.362 – 2.642)

0.037 – 0.045
(0.940 – 1.143)

0.050
(1.270)
TYP

0.014 – 0.019
(0.356 – 0.482)

0.004 – 0.012
(0.102 – 0.305)

0.697 – 0.712
(17.70 – 18.08)

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

SEE
NOTE

0.394 – 0.419
(10.007 – 10.643)

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

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.

LINEAR TECHNOLOGY

U.S. Area Sales Offices

NORTHEAST REGION
Linear Technology Corporation
One Oxford Valley
2300 E. Lincoln Hwy.,Suite 306
Langhorne, PA 19047
Phone: (215) 757-8578
FAX: (215) 757-5631

Linear Technology Corporation
266 Lowell St., Suite B-8
Wilmington, MA 01887
Phone: (508) 658-3881
FAX: (508) 658-2701

SOUTHEAST REGION
Linear Technology Corporation
17060 Dallas Parkway
Suite 208
Dallas, TX 75248
Phone: (214) 733-3071
FAX: (214) 380-5138

CENTRAL REGION
Linear Technology Corporation
Chesapeake Square
229 Mitchell Court, Suite A-25
Addison, IL 60101
Phone: (708) 620-6910
FAX: (708) 620-6977

SOUTHWEST REGION
Linear Technology Corporation
22141 Ventura Blvd.
Suite 206
Woodland Hills, CA 91364
Phone: (818) 703-0835
FAX: (818) 703-0517

NORTHWEST REGION
Linear Technology Corporation
782 Sycamore Dr.
Milpitas, CA 95035
Phone: (408) 428-2050
FAX: (408) 432-6331

International Sales Offices

FRANCE
Linear Technology S.A.R.L.
Immeuble "Le Quartz"
58 Chemin de la Justice
92290 Chatenay Malabry
France
Phone: 33-1-41079555
FAX: 33-1-46314613

GERMANY
Linear Techonolgy GMBH Untere
Hauptstr. 9
D-85386 Eching
Germany
Phone: 49-89-3197410
FAX: 49-89-3194821

JAPAN
Linear Technology KK
5F YZ Bldg.
Iidabashi, Chiyoda-Ku
Tokyo, 102 Japan
Phone: 81-3-3237-7891
FAX: 81-3-3237-8010

KOREA
Linear Technology Korea Branch
Namsong Building, #505
Itaewon-Dong 260-199
Yongsan-Ku, Seoul
Korea
Phone: 82-2-792-1617
FAX: 82-2-792-1619

SINGAPORE
Linear Technology Pte. Ltd.
101 Boon Keng Road
#02-15 Kallang Ind. Estates
Singapore 1233
Phone: 65-293-5322
FAX: 65-292-0398

TAIWAN
Linear Technology Corporation
Rm. 801, No. 46, Sec. 2
Chung Shan N. Rd.
Taipei, Taiwan, R.O.C.
Phone: 886-2-521-7575
FAX: 886-2-562-2285

UNITED KINGDOM
Linear Technology (UK) Ltd.
The Coliseum, Riverside Way
Camberley, Surrey GU15 3YL
United Kingdom
Phone: 44-276-677676
FAX: 44-276-64851

World Headquarters

Linear Technology Corporation
1630 McCarthy Blvd.
Milpitas, CA 95035-7487
Phone: (408) 432-1900
FAX: (408) 434-0507