

# 5V Low Power RS232 Transceiver with 2 Receivers Active in Shutdown

## FEATURES

- Operates from a Single 5V Supply
- Low Supply Current:  $I_{CC} = 220\mu A$
- $I_{CC} = 35\mu A$  in Shutdown Mode with Both Receivers Kept Alive
- ESD Protection Over  $\pm 10kV$
- Uses Small Capacitors:  $0.1\mu F$
- Operates to 120kbaud
- Output Overvoltage Does Not Force Current Back into Supplies
- RS232 I/O Lines Can Be Forced to  $\pm 25V$  Without Damage
- Pin Compatible with LT1180A

## APPLICATIONS

- Notebook Computers
- Palmtop Computers

## DESCRIPTION

The LTC<sup>®</sup>1384 is an ultra-low power 2-driver/2-receiver RS232 transceiver that operates from a single 5V supply. The charge pump requires only four space-saving  $0.1\mu F$  capacitors.

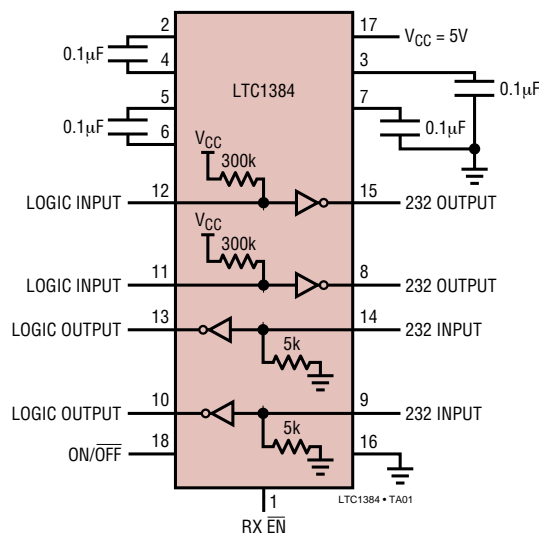
The transceiver operates in one of two modes, Normal and Shutdown. In the Normal mode,  $I_{CC}$  is only  $220\mu A$  with the driver outputs unloaded. In the Shutdown mode, the charge pump is turned off, the driver outputs are forced into three-state, both receivers are kept active and  $I_{CC}$  drops to  $35\mu A$ . The receiver outputs may be forced into three-state at any time using the receiver enable (RX  $\overline{EN}$ ) pin.

The LTC1384 is fully compliant with all data rate and overvoltage RS232 specifications. The transceiver can operate up to 120kbaud with a  $2500pF$ ,  $3k\Omega$  load. Both driver outputs and receiver inputs can be forced to  $\pm 25V$  without damage and can survive multiple  $\pm 10kV$  ESD strikes.

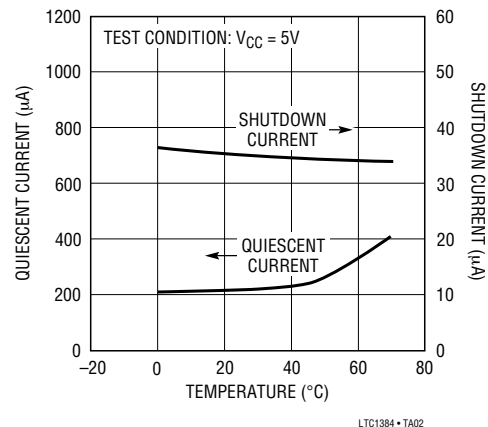
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## TYPICAL APPLICATION

2-Drivers/2-Receivers with Shutdown and Receiver Enable



Quiescent and Shutdown Supply Current vs Temperature



LTC1384 • TA02

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage ( $V_{CC}$ )	6V	Short-Circuit Duration	
Input Voltage		$V^+$	30 sec
Driver	-0.3V to $V_{CC} + 0.3V$	$V^-$	30 sec
Receiver	-25V to 25V	Driver Output	Indefinite
Digital Input	-0.3V to $V_{CC} + 0.3V$	Receiver Output	Indefinite
Output Voltage		Operating Temperature Range	
Driver	-25V to 25V	LTC1384C	0°C to 70°C
Receiver	-0.3V to $V_{CC} + 0.3V$	LTC1384I	-40°C to 85°C
		Storage Temperature Range	-65°C to 150°C
		Lead Temperature (Soldering, 10 sec)	300°C

## PACKAGE/ORDER INFORMATION

<p>TOP VIEW</p> <p>RX EN 1, C1+ 2, V+ 3, C1- 4, C2+ 5, C2- 6, V- 7, TR2 OUT 8, RX2 IN 9, NC 10, 20 ON/OFF, 19 VCC, 18 GND, 17 TR1 OUT, 16 RX1 IN, 15 RX1 OUT, 14 TR1 IN, 13 TR2 IN, 12 RX2 OUT, 11 NC</p> <p>G PACKAGE 20-LEAD SSOP</p> <p><math>T_{JMAX} = 125^{\circ}C, \theta_{JA} = 135^{\circ}C/W</math></p>	<p>ORDER PART NUMBER</p> <p>LTC1384CG LTC1384IG</p>	<p>TOP VIEW</p> <p>RX EN 1, C1+ 2, V+ 3, C1- 4, C2+ 5, C2- 6, V- 7, TR2 OUT 8, RX2 IN 9, 18 ON/OFF, 17 VCC, 16 GND, 15 TR1 OUT, 14 RX1 IN, 13 RX1 OUT, 12 TR1 IN, 11 TR2 IN, 10 RX2 OUT</p> <p>N PACKAGE 18-LEAD PDIP</p> <p>SW PACKAGE 18-LEAD PLASTIC SO</p> <p><math>T_{JMAX} = 125^{\circ}C, \theta_{JA} = 65^{\circ}C/W</math>      <math>T_{JMAX} = 125^{\circ}C, \theta_{JA} = 85^{\circ}C/W</math></p>	<p>ORDER PART NUMBER</p> <p>LTC1384CN LTC1384CSW LTC1384IN LTC1384ISW</p>
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Consult LTC Marketing for parts specified with wider operating temperature ranges.

## DC ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range.  $V_{CC} = 5V$ ,  $C1 = C2 = C3 = C4 = 0.1\mu F$ ,  $V_{ON/OFF} = V_{CC}$ ,  $RX\ EN = 0V$ , unless otherwise noted.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS	
<b>Any Driver</b>						
Output Voltage Swing	3k to GND	Positive Negative	● ●	5.0 -5.0	7.0 -6.5	V V
Logic Input Voltage Level	Input Low Level ( $V_{OUT} = High$ ) Input High Level ( $V_{OUT} = Low$ )	● ●	● ●	1.4 2.0	0.8 1.4	V V
Logic Input Current	$V_{IN} = V_{CC}$ $V_{IN} = 0V$	● ●	●	-20	5 -40	$\mu A$ $\mu A$
Output Short-Circuit Current	$V_{OUT} = 0V$	●	●	±9	±12	mA
Output Leakage Current	Shutdown or $V_{CC} = 0V$ (Note 3), $V_{OUT} = \pm 10V$	●	●	±10	±500	$\mu A$
<b>Any Receiver</b>						
Input Voltage Thresholds	Input Low Threshold Input High Threshold	● ●	●	0.8 1.7	1.3 2.4	V V
Hysteresis		●	●	0.1	0.4 1	V
Input Resistance	$-10V \leq V_{IN} \leq 10V$	●	●	3	5 7	k $\Omega$
Output Voltage	Output Low, $I_{OUT} = -1.6mA$ ( $V_{CC} = 5V$ ) Output High, $I_{OUT} = 160\mu A$ ( $V_{CC} = 5V$ )	● ●	●	3.0	0.2 3.2	V V

**DC ELECTRICAL CHARACTERISTICS** The ● denotes specifications which apply over the full operating temperature range.  $V_{CC} = 5V$ ,  $C1 = C2 = C3 = C4 = 0.1\mu F$ ,  $V_{ON/OFF} = V_{CC}$ ,  $R_X \overline{EN} = 0V$ , unless otherwise noted.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Short-Circuit Current	Sinking Current, $V_{OUT} = V_{CC}$	-15	-40		mA
	Sourcing Current, $V_{OUT} = 0V$	10	20		mA
Output Leakage Current	$\overline{EN} = V_{CC}$ , $0V \leq V_{OUT} \leq V_{CC}$	●	1	10	$\mu A$
<b>Power Supply Generator</b>					
$V^+$ Output Voltage	$I_{OUT} = 0mA$		8.0		V
	$I_{OUT} = 8mA$		7.5		V
$V^-$ Output Voltage	$I_{OUT} = 0mA$		-8.0		V
	$I_{OUT} = -8mA$		-7.0		V
Supply Rise Time	Shutdown to Turn-On		0.2		ms
<b>Power Supply</b>					
$V_{CC}$ Supply Current	No Load (Note 2), $0^\circ C$ to $70^\circ C$	●	0.22	0.5	mA
	No Load (Note 2), $-40^\circ C$ to $85^\circ C$	●	0.35	1.0	mA
Supply Leakage Current ( $V_{CC}$ )	Shutdown (Note 3)	●	35	50	$\mu A$
Digital Input Threshold Low		●	1.4	0.8	V
Digital Input Threshold High		●	2.0	1.4	V

**AC CHARACTERISTICS** The ● denotes specifications which apply over the full operating temperature range.  $V_{CC} = 5V$ ,  $C1 = C2 = C3 = C4 = 0.1\mu F$ , unless otherwise noted.

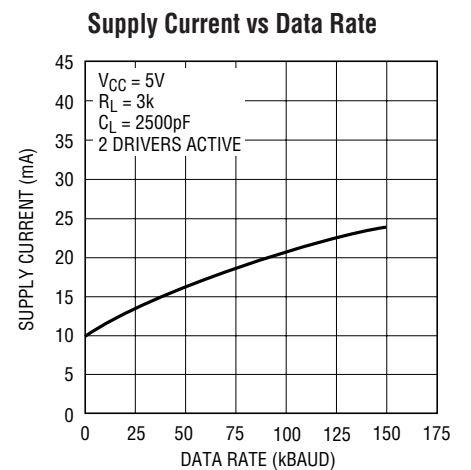
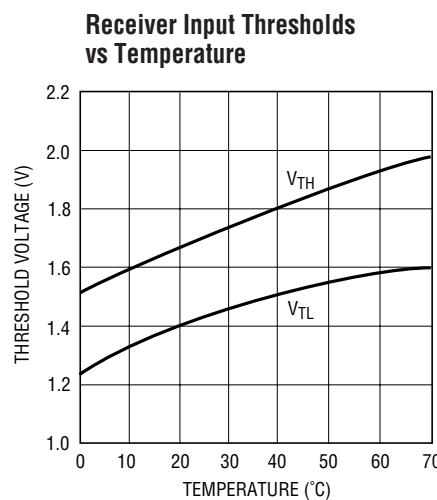
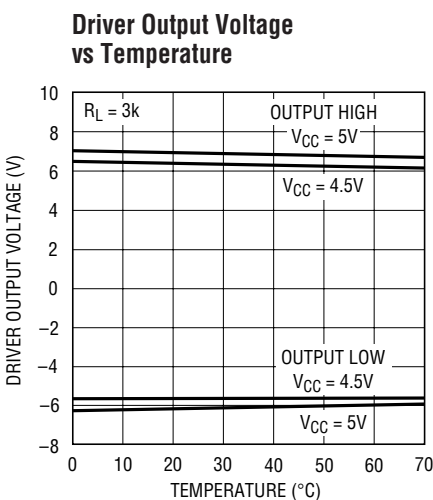
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Slew Rate	$R_L = 3k$ , $C_L = 51pF$		8	30	V/ $\mu S$
	$R_L = 3k$ , $C_L = 2500pF$	3	5		V/ $\mu S$
Driver Propagation Delay (TTL to RS232)	$t_{HLD}$ (Figure 1)	●	2	3.5	$\mu S$
	$t_{LHD}$ (Figure 1)	●	2	3.5	$\mu S$
Receiver Propagation Delay (RS232 to TTL)	$t_{HLR}$ (Figure 2)	●	0.3	0.8	$\mu S$
	$t_{LHR}$ (Figure 2)	●	0.3	0.8	$\mu S$

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

**Note 3:** Measurements made in the Shutdown mode are performed with  $V_{ON/OFF} = 0V$ .

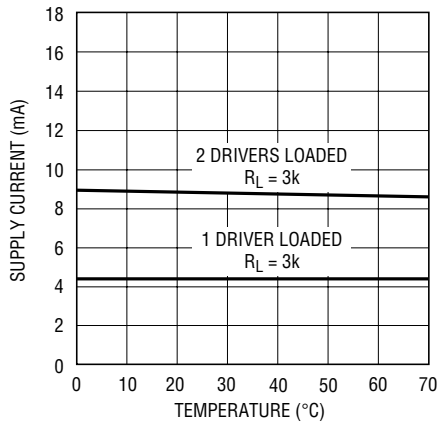
**Note 2:** Supply current is measured with driver and receiver outputs unloaded.

**TYPICAL PERFORMANCE CHARACTERISTICS**



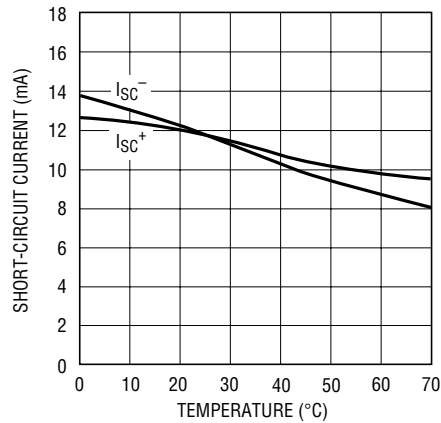
## TYPICAL PERFORMANCE CHARACTERISTICS

**V<sub>CC</sub> Supply Current vs Temperature**



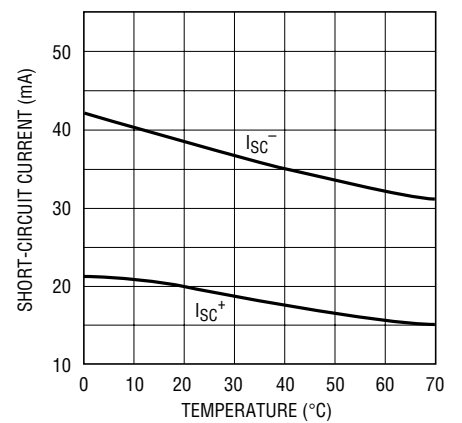
LTC1384 • TPC04

**Driver Short-Circuit Current vs Temperature**



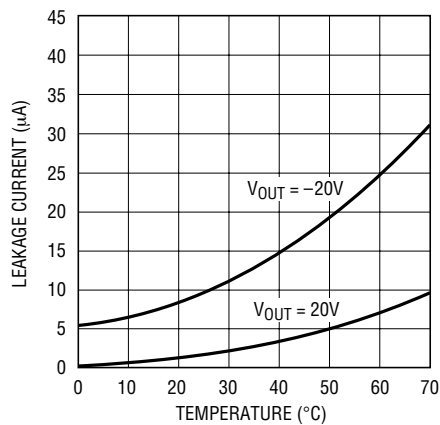
LTC1384 • TPC05

**Receiver Short-Circuit Current vs Temperature**



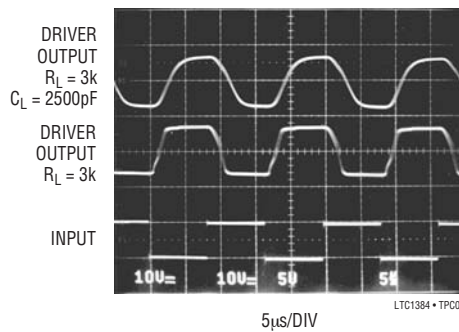
LTC1384 • TPC06

**Driver Leakage in Shutdown vs Temperature**



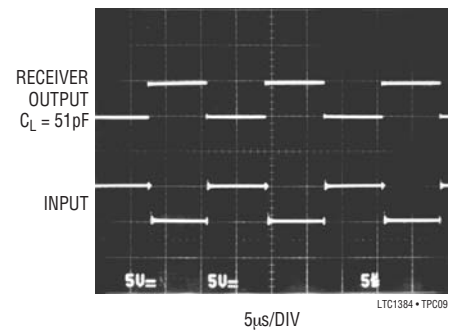
LTC1384 • TPC07

**Driver Output Waveforms**



LTC1384 • TPC08

**Receiver Output Waveforms**



LTC1384 • TPC09

## PIN FUNCTIONS

**V<sub>CC</sub>**: 5V Input Supply Pin. This pin should be decoupled with a 0.1 $\mu$ F ceramic capacitor.

**GND**: Ground Pin.

**ON/OFF**: TTL/CMOS Compatible Shutdown Pin. A logic low puts the device in the Shutdown mode independent of the RX  $\overline{\text{EN}}$  pin. The supply current of the device drops to 35 $\mu$ A (two receivers alive) and both driver outputs are forced into three-state.

**RX  $\overline{\text{EN}}$** : TTL/CMOS Compatible Receiver Enable Pin. A logic high forces the receiver outputs into three-state. A logic low enables the receiver outputs.

**V<sup>+</sup>**: Positive Supply Output (RS232 Drivers).  $V^+ \cong 2V_{CC} - 2V$ . This pin requires an external capacitor  $C = 0.1\mu\text{F}$  for charge storage. The capacitor may be tied to ground or  $V_{CC}$ . With multiple devices, the  $V^+$  and  $V^-$  pins may share a common capacitor. For large numbers of devices, increasing the size of the shared common storage capacitors is recommended to reduce ripple.

**V<sup>-</sup>**: Negative Supply Output (RS232 Drivers).  $V^- \cong -(2V_{CC} - 2V)$ . This pin requires an external capacitor  $C = 0.1\mu\text{F}$  for charge storage.

**C1<sup>+</sup>, C1<sup>-</sup>, C2<sup>+</sup>, C2<sup>-</sup>**: Commutating Capacitor Inputs. These pins require two external capacitors  $C = 0.1\mu\text{F}$ : one from C1<sup>+</sup> to C1<sup>-</sup> and another from C2<sup>+</sup> to C2<sup>-</sup>. To maintain charge pump efficiency, the capacitor's effective series resistance should be less than 2 $\Omega$ .

**TR IN**: RS232 Driver Input Pins. Inputs are TTL/CMOS compatible. The inputs of unused drivers can be left unconnected since 300k input pull-up resistors to  $V_{CC}$  are included on chip. To minimize power consumption, the internal driver pull-up resistors are disconnected from  $V_{CC}$  in the Shutdown mode.

**TR OUT**: Driver Outputs at RS232 Voltage Levels. Outputs are in a high impedance state when in the Shutdown or  $V_{CC} = 0V$ . The driver outputs are protected against ESD to  $\pm 10\text{kV}$  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  $\pm 10\text{kV}$  for human body model discharges. Each receiver provides 0.4V of hysteresis for noise immunity.

**RX OUT**: Receiver Outputs with TTL/CMOS Voltage Levels. A logic high at RX  $\overline{\text{EN}}$  puts the outputs into three-state.

## SWITCHING TIME WAVEFORMS

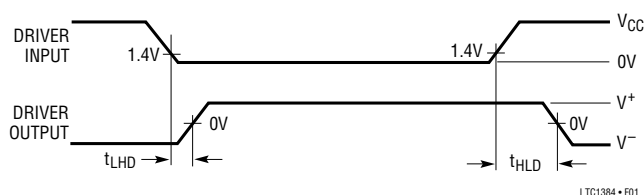


Figure 1. Driver Propagation Delay Timing

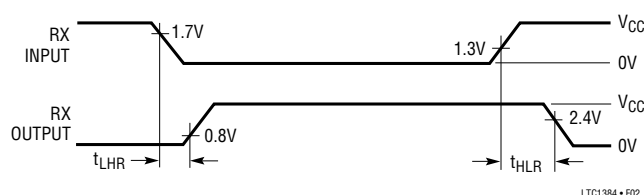
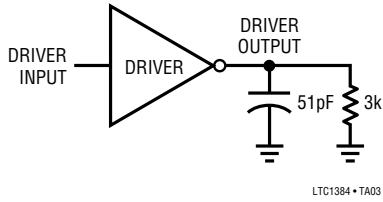


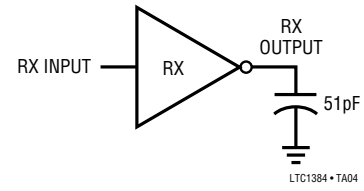
Figure 2. Receiver Propagation Delay Timing

## TEST CIRCUITS

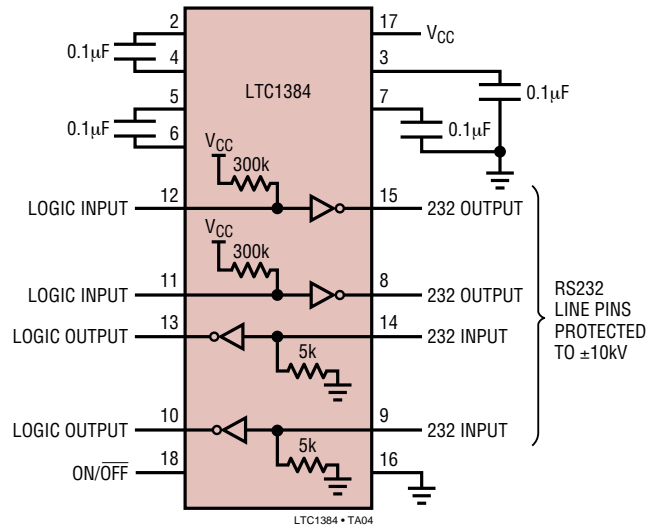
**Driver Timing Test Load**



**Receiver Timing Test Load**

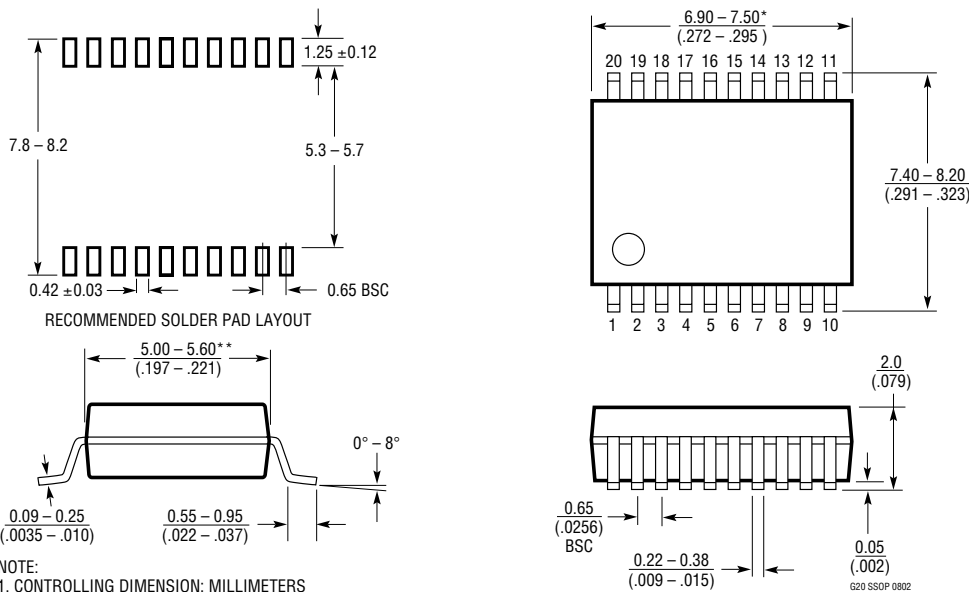


**ESD Test Circuit**



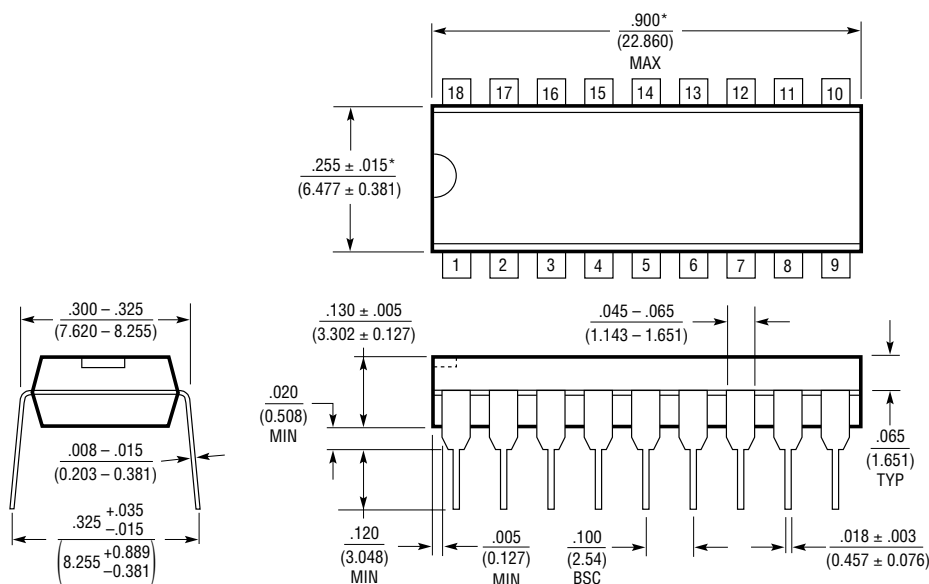
# PACKAGE DESCRIPTION

## G Package 20-Lead Plastic SSOP (5.3mm) (Reference LTC DWG # 05-08-1640)



- NOTE:
1. CONTROLLING DIMENSION: MILLIMETERS
  2. DIMENSIONS ARE IN  $\frac{\text{MILLIMETERS}}{\text{INCHES}}$
  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

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



- 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)

N18 1002