

# 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

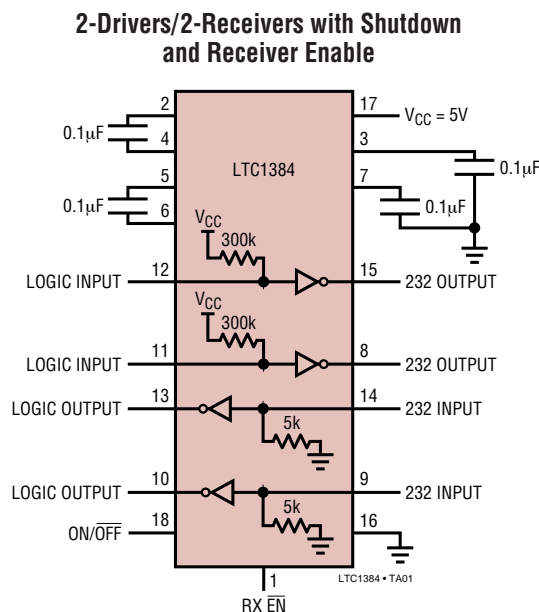
The LTC<sup>®</sup>1384 is an ultra-low power 2-driver/2-receiver RS232 transceiver that operates from a single 5V supply. The charge pump requires only four space-saving  $0.1\mu F$  capacitors.

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.

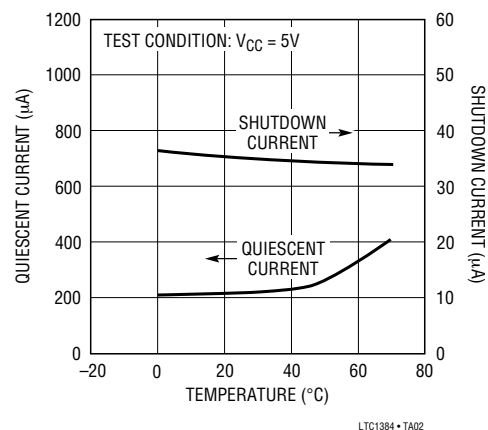
The LTC1384 is fully compliant with all data rate and overvoltage RS232 specifications. The transceiver can operate up to 120kbaud with a  $2500pF$ ,  $3k\Omega$  load. Both driver outputs and receiver inputs can be forced to  $\pm 25V$  without damage and can survive multiple  $\pm 10kV$  ESD strikes.

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## TYPICAL APPLICATION



**Quiescent and Shutdown Supply Current vs Temperature**



## ABSOLUTE MAXIMUM RATINGS

Supply Voltage ( $V_{CC}$ )	6V
Input Voltage	
Driver	$-0.3V$ to $V_{CC} + 0.3V$
Receiver	$-25V$ to $25V$
Digital Input	$-0.3V$ 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

LTC1384C	$0^{\circ}C$ to $70^{\circ}C$
LTC1384I	$-40^{\circ}C$ to $85^{\circ}C$

Storage Temperature Range  $-65^{\circ}C$  to  $150^{\circ}C$

Lead Temperature (Soldering, 10 sec)  $300^{\circ}C$

## PACKAGE/ORDER INFORMATION

<p>TOP VIEW</p> <p>G PACKAGE 20-LEAD SSOP</p> <p><math>T_{JMAX} = 125^{\circ}C</math>, <math>\theta_{JA} = 135^{\circ}C/W</math></p>	<p>ORDER PART NUMBER</p> <p>LTC1384CG LTC1384IG</p>	<p>TOP VIEW</p> <p>N PACKAGE 18-LEAD PDIP</p> <p>SW PACKAGE 18-LEAD PLASTIC SO</p> <p><math>T_{JMAX} = 125^{\circ}C</math>, <math>\theta_{JA} = 65^{\circ}C/W</math>      <math>T_{JMAX} = 125^{\circ}C</math>, <math>\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	● 5.0	7.0		V
	Positive	● -5.0	-6.5		V
Logic Input Voltage Level	Input Low Level ( $V_{OUT} = \text{High}$ )	●	1.4	0.8	V
	Input High Level ( $V_{OUT} = \text{Low}$ )	● 2.0	1.4		V
Logic Input Current	$V_{IN} = V_{CC}$	●		5	$\mu A$
	$V_{IN} = 0V$	●	-20	-40	$\mu A$
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	● 0.8	1.3		V
	Input High Threshold	●	1.7	2.4	V
Hysteresis		● 0.1	0.4	1	V
Input Resistance	$-10V \leq V_{IN} \leq 10V$		3	5	k $\Omega$
Output Voltage	Output Low, $I_{OUT} = -1.6mA$ ( $V_{CC} = 5V$ )	●	0.2	0.4	V
	Output High, $I_{OUT} = 160\mu A$ ( $V_{CC} = 5V$ )	● 3.0	3.2		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, $V_{OUT} = V_{CC}$ Sourcing Current, $V_{OUT} = 0V$	-15 10	-40 20		mA 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	$I_{OUT} = 0mA$ $I_{OUT} = 8mA$		8.0 7.5		V V
$V^-$ Output Voltage	$I_{OUT} = 0mA$ $I_{OUT} = -8mA$		-8.0 -7.0		V 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 $70^\circ C$ No Load (Note 2), $-40^\circ C$ to $85^\circ C$	● ●	0.22 0.35	0.5 1.0	mA 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	$R_L = 3k$ , $C_L = 51pF$ $R_L = 3k$ , $C_L = 2500pF$		8 5	30	V/ $\mu s$ V/ $\mu s$
Driver Propagation Delay (TTL to RS232)	$t_{HLD}$ (Figure 1) $t_{LHD}$ (Figure 1)	● ●	2 2	3.5 3.5	$\mu s$ $\mu s$
Receiver Propagation Delay (RS232 to TTL)	$t_{HLR}$ (Figure 2) $t_{LHR}$ (Figure 2)	● ●	0.3 0.3	0.8 0.8	$\mu s$ $\mu s$

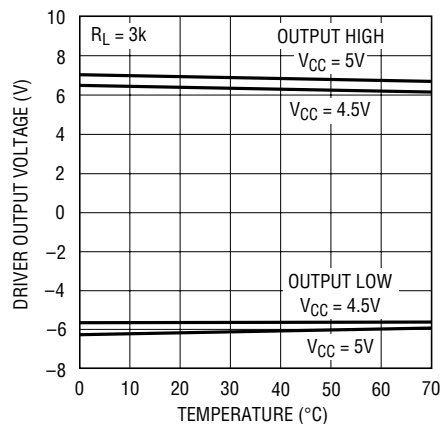
**Note 1:** Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

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

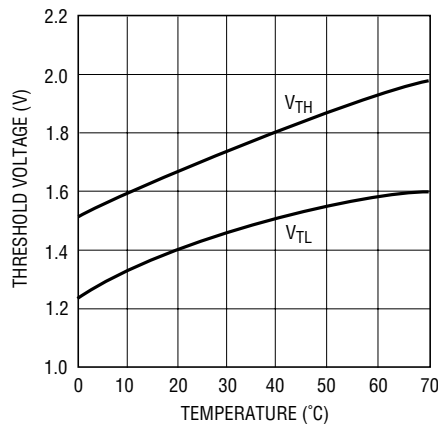
**Note 2:** Supply current is measured with driver and receiver outputs unloaded.

**TYPICAL PERFORMANCE CHARACTERISTICS**

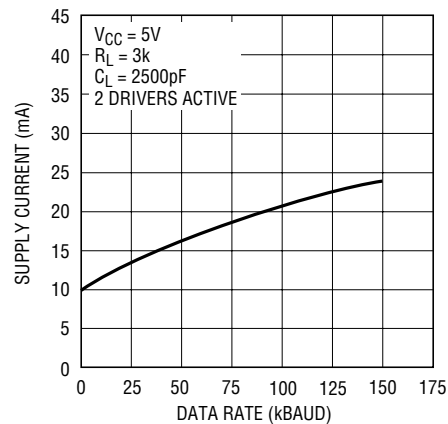
**Driver Output Voltage  
vs Temperature**



**Receiver Input Thresholds  
vs Temperature**



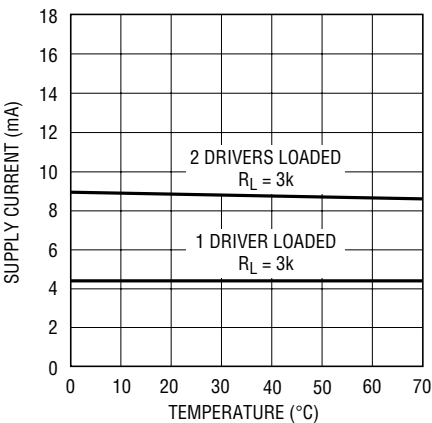
**Supply Current vs Data Rate**



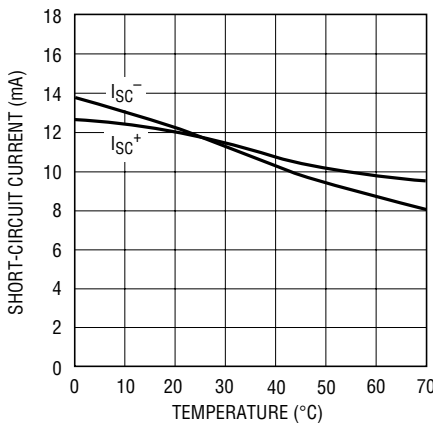
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TYPICAL PERFORMANCE CHARACTERISTICS

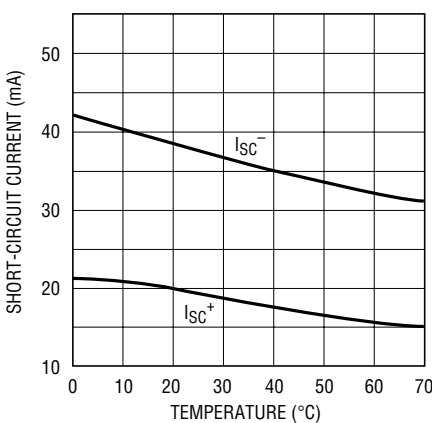
V<sub>CC</sub> Supply Current vs Temperature



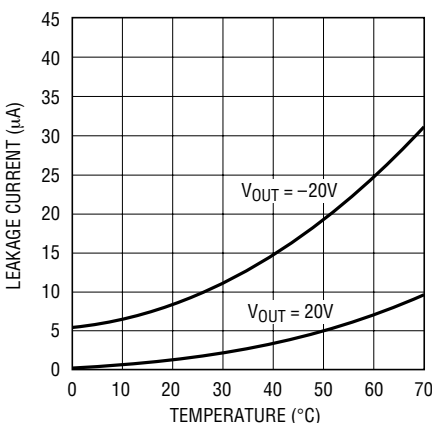
Driver Short-Circuit Current vs Temperature



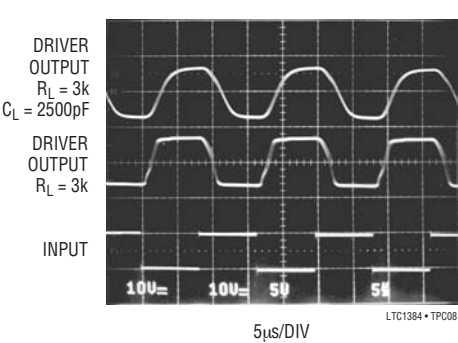
Receiver Short-Circuit Current vs Temperature



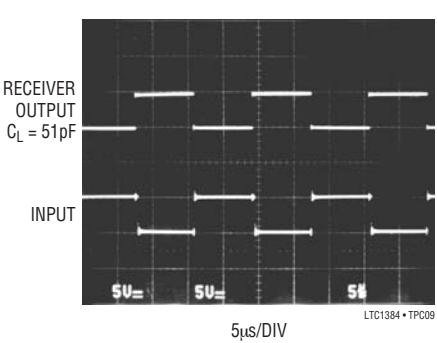
Driver Leakage in Shutdown vs Temperature



Driver Output Waveforms



Receiver Output Waveforms



## PIN FUNCTIONS

**V<sub>CC</sub>**: 5V Input Supply Pin. 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 independent of the RX  $\overline{\text{EN}}$  pin. The supply current of the device drops to 35μA (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 2Ω.

**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  $\pm 10kV$  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. A logic high at RX  $\overline{\text{EN}}$  puts the outputs into three-state.

## SWITCHING TIME WAVEFORMS

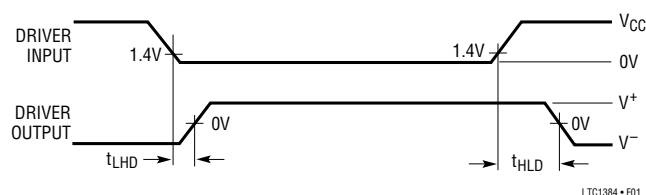


Figure 1. Driver Propagation Delay Timing

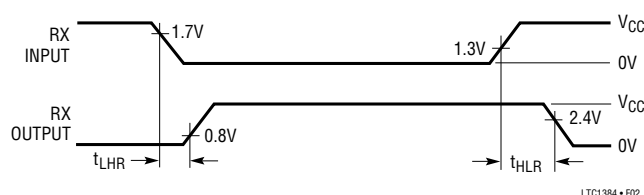
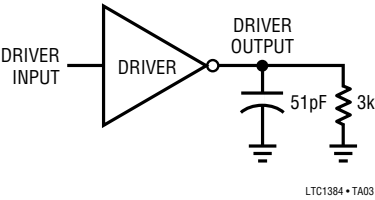


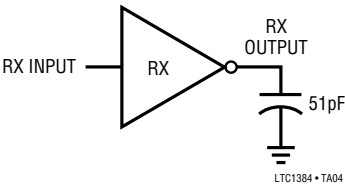
Figure 2. Receiver Propagation Delay Timing

TEST CIRCUITS

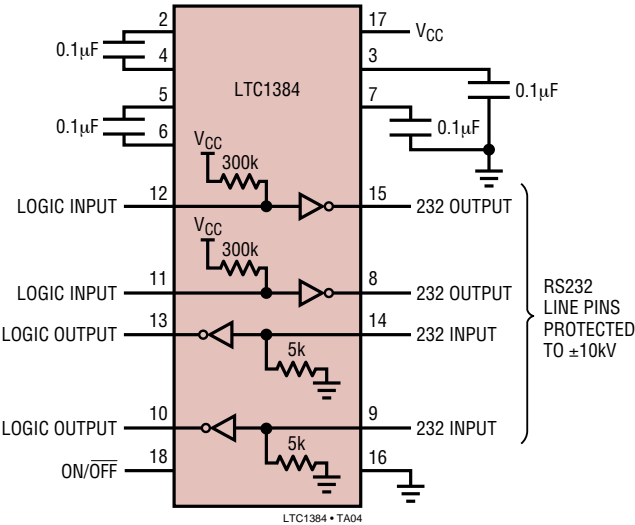
Driver Timing Test Load



Receiver Timing Test Load

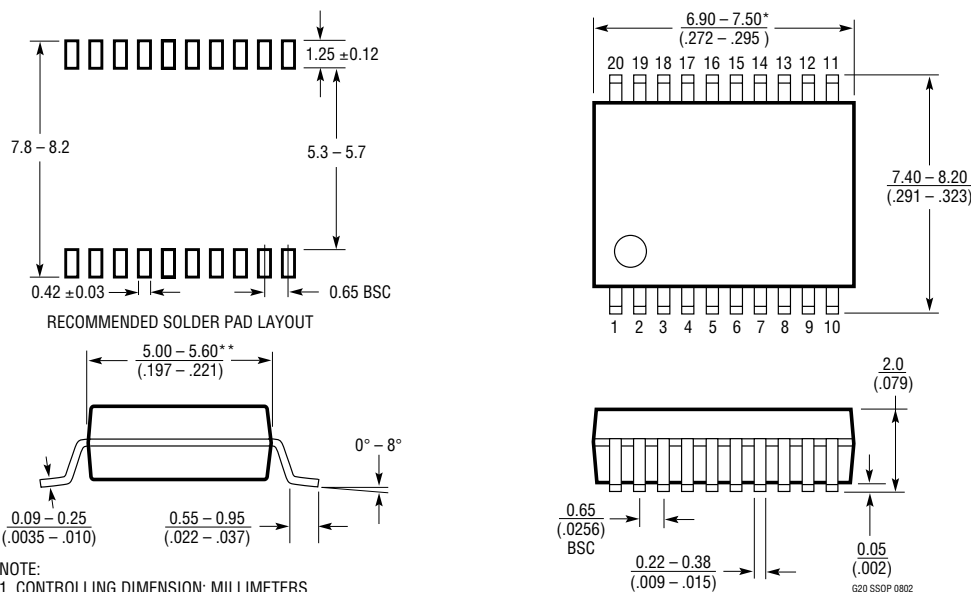


ESD Test Circuit

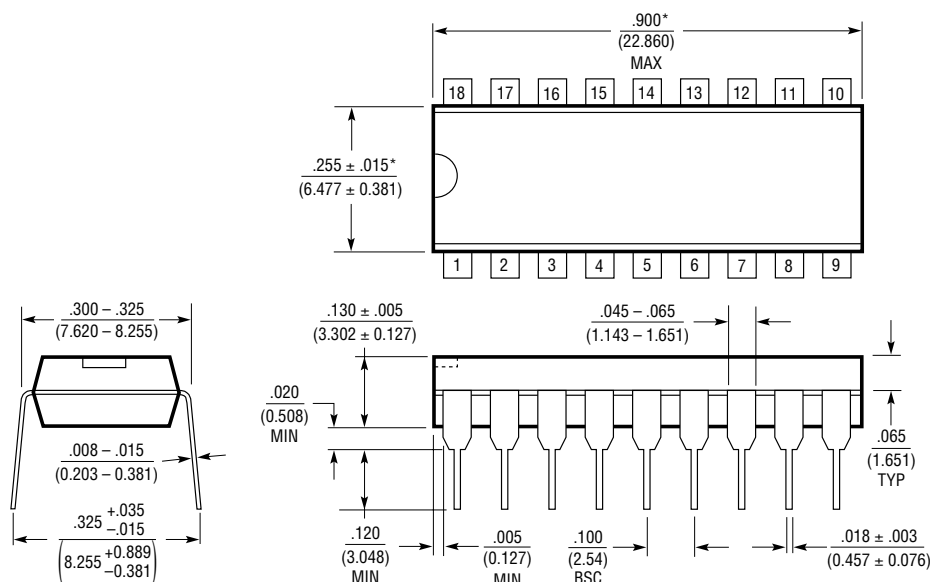


## PACKAGE DESCRIPTION

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



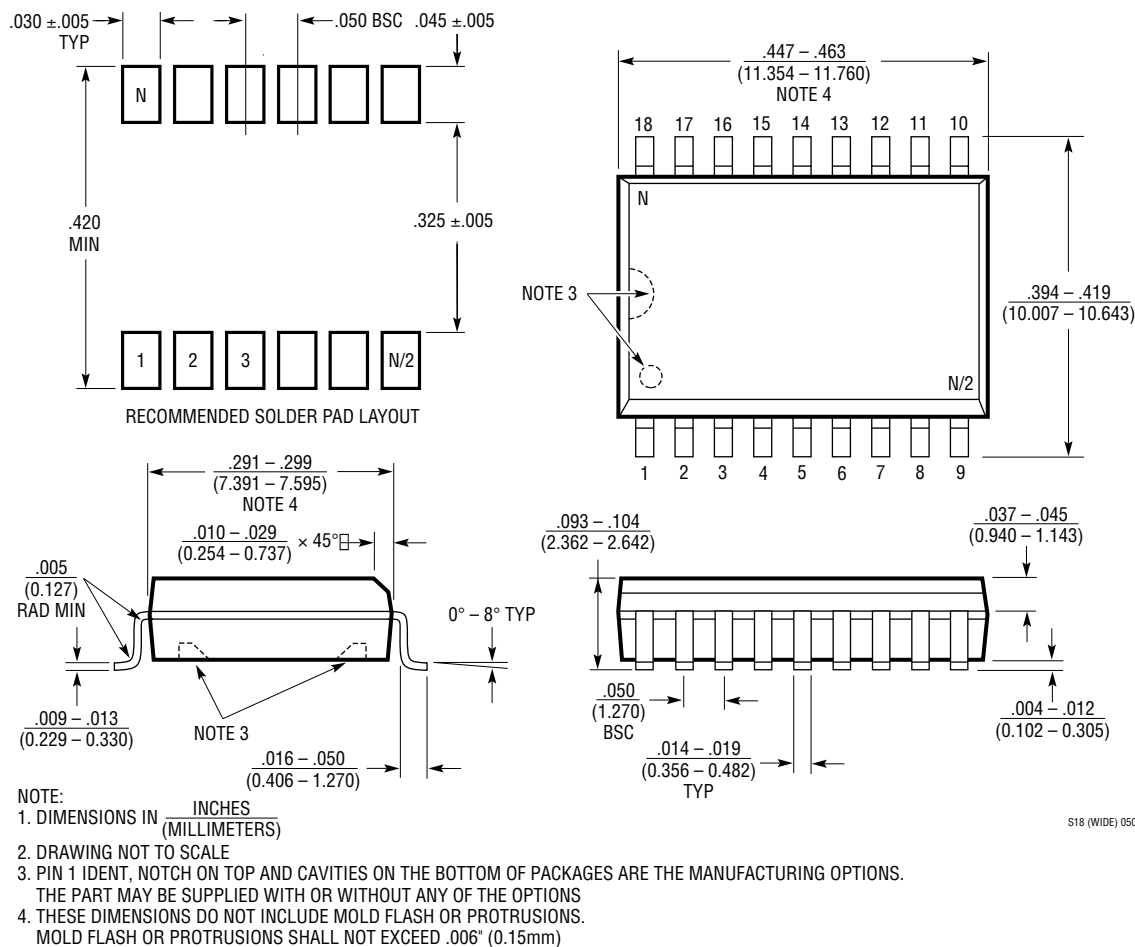
### N Package 18-Lead PDIP (Narrow .300 Inch) (Reference LTC DWG # 05-08-1510)



N18 1002

## PACKAGE DESCRIPTION

**SW Package**  
**18-Lead Plastic Small Outline (Wide .300 Inch)**  
 (Reference LTC DWG # 05-08-1620)



## RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1780/LT1781	5V, 2 Driver, 2 Receiver RS232 Transceivers	±15kV ESD per IEC 1000-4
LTC1382	5V, 2 Driver, 2 Receiver RS232 Transceiver	220µA Supply Current, 0.2µA in Shutdown
LTC1383	5V, 2 Driver, 2 Receiver RS232 Transceiver	220µA Supply Current, Narrow 16-pin SO
LTC1385	3.3V, 2 Driver, 2 Receiver RS562 Transceiver	220µA Supply Current, 2 Receivers Active in Shutdown
LTC1386	3.3V, 2 Driver, 2 Receiver RS562 Transceiver	220µA Supply Current, Narrow 16-pin SO