

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[®]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.

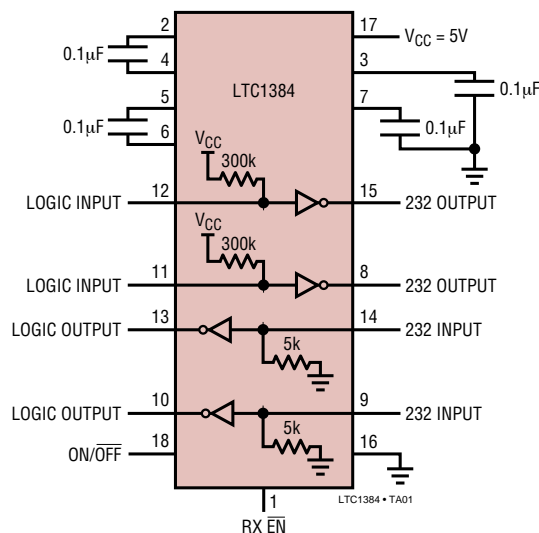
The transceiver operates in one of two modes, Normal and Shutdown. In the Normal mode, I_{CC} is only $220\mu A$ with the driver outputs unloaded. In the Shutdown mode, the charge pump is turned off, the driver outputs are forced into three-state, both receivers are kept active and I_{CC} drops to $35\mu A$. 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.

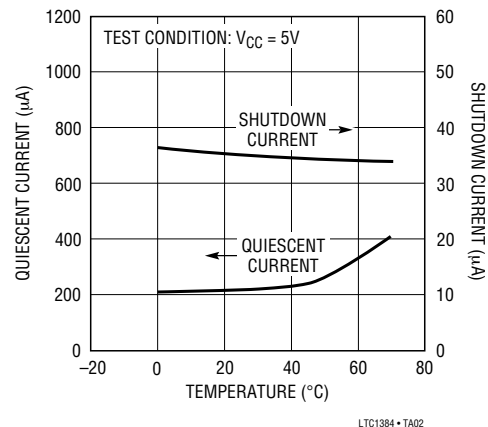
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TYPICAL APPLICATION

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, ON/OFF 20, VCC 19, GND 18, TR1 OUT 17, RX1 IN 16, RX1 OUT 15, TR1 IN 14, TR2 IN 13, RX2 OUT 12, NC 11</p> <p>G PACKAGE 20-LEAD SSOP</p> <p>$T_{JMAX} = 125^{\circ}C, \theta_{JA} = 135^{\circ}C/W$</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, ON/OFF 18, VCC 17, GND 16, TR1 OUT 15, RX1 IN 14, RX1 OUT 13, TR1 IN 12, TR2 IN 11, RX2 OUT 10</p> <p>N PACKAGE 18-LEAD PDIP</p> <p>SW PACKAGE 18-LEAD PLASTIC SO</p> <p>$T_{JMAX} = 125^{\circ}C, \theta_{JA} = 65^{\circ}C/W$ $T_{JMAX} = 125^{\circ}C, \theta_{JA} = 85^{\circ}C/W$</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	
Any Driver						
Output Voltage Swing	3k to GND	Positive ● Negative ●	5.0 7.0	-5.0 -6.5	V V	
Logic Input Voltage Level	Input Low Level ($V_{OUT} = High$) Input High Level ($V_{OUT} = Low$)	●	1.4	0.8	V	
Logic Input Current	$V_{IN} = V_{CC}$ $V_{IN} = 0V$	●	-20	5	μA μA	
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	μA	
Any Receiver						
Input Voltage Thresholds	Input Low Threshold Input High Threshold	●	0.8	1.3	V	
		●	1.7	2.4	V	
Hysteresis		●	0.1	0.4	1	V
Input Resistance	$-10V \leq V_{IN} \leq 10V$		3	5	7	k Ω
Output Voltage	Output Low, $I_{OUT} = -1.6mA$ ($V_{CC} = 5V$) Output High, $I_{OUT} = 160\mu A$ ($V_{CC} = 5V$)	●	0.2	0.4	V	
		●	3.0	3.2	V	

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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	μA
Power Supply Generator					
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
Power Supply					
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	μA
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.

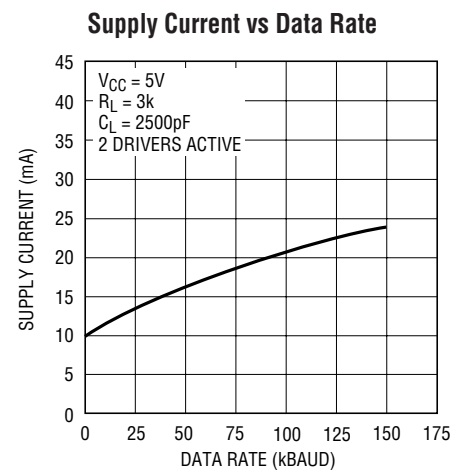
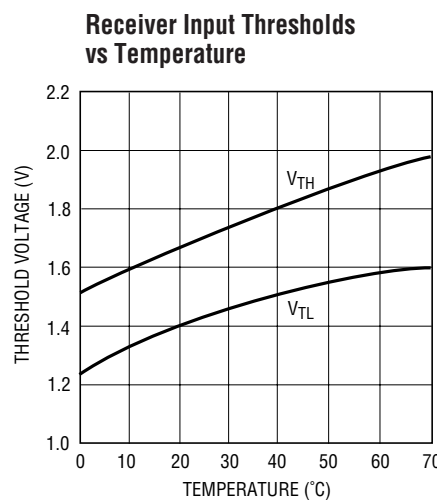
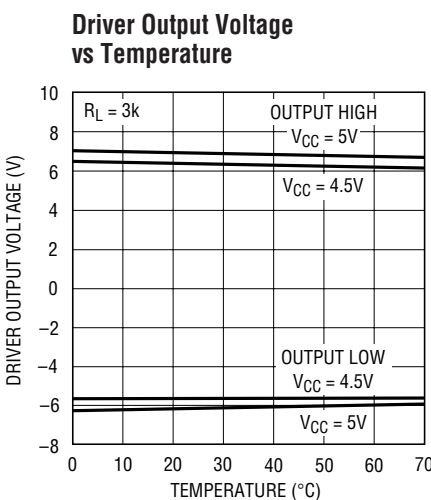
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Slew Rate	$R_L = 3k$, $C_L = 51pF$		8	30	V/ μS
	$R_L = 3k$, $C_L = 2500pF$	3	5		V/ μS
Driver Propagation Delay (TTL to RS232)	t_{HLD} (Figure 1)	●	2	3.5	μS
	t_{LHD} (Figure 1)	●	2	3.5	μS
Receiver Propagation Delay (RS232 to TTL)	t_{HLR} (Figure 2)	●	0.3	0.8	μS
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

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.

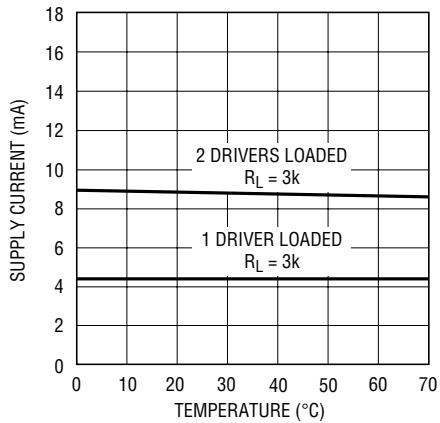
TYPICAL PERFORMANCE CHARACTERISTICS



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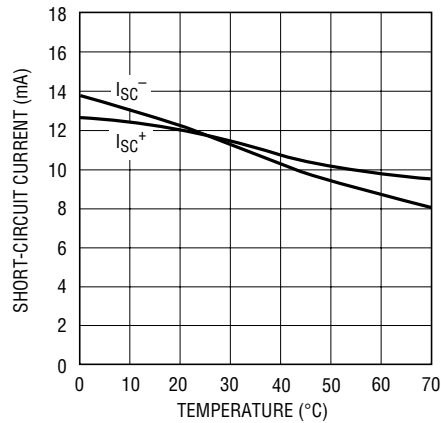
TYPICAL PERFORMANCE CHARACTERISTICS

V_{CC} Supply Current vs Temperature



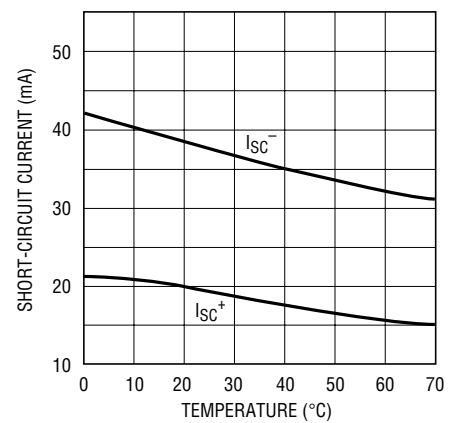
LTC1384 • TPC04

Driver Short-Circuit Current vs Temperature



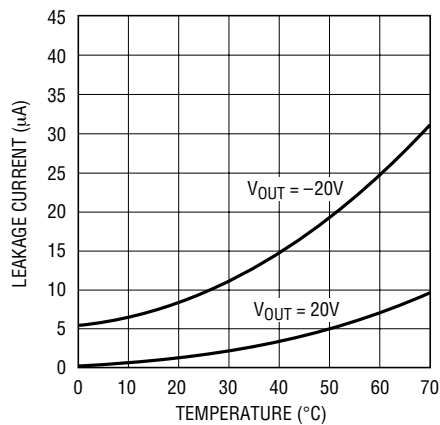
LTC1384 • TPC05

Receiver Short-Circuit Current vs Temperature



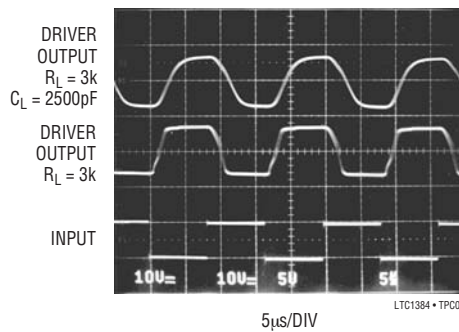
LTC1384 • TPC06

Driver Leakage in Shutdown vs Temperature



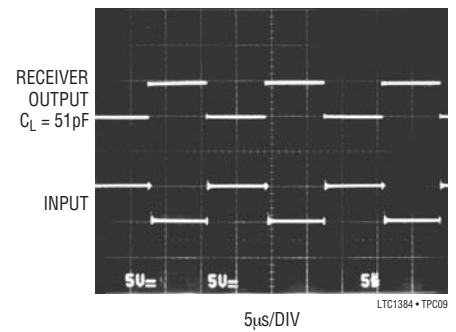
LTC1384 • TPC07

Driver Output Waveforms



LTC1384 • TPC08

Receiver Output Waveforms



LTC1384 • TPC09

PIN FUNCTIONS

V_{CC}: 5V Input Supply Pin. This pin should be decoupled with a 0.1 μ 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 μ 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⁺: 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⁻: 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⁺, C1⁻, C2⁺, C2⁻: Commutating Capacitor Inputs. These pins require two external capacitors $C = 0.1\mu\text{F}$: 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 2 Ω .

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

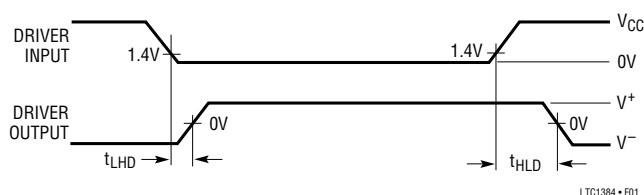


Figure 1. Driver Propagation Delay Timing

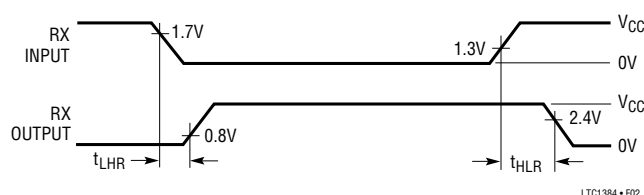
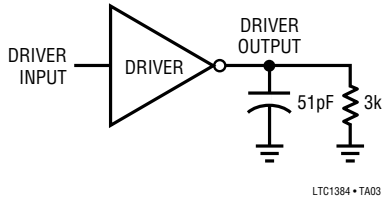


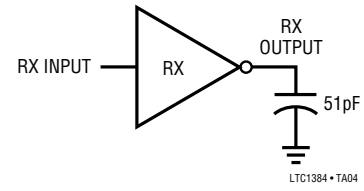
Figure 2. Receiver Propagation Delay Timing

TEST CIRCUITS

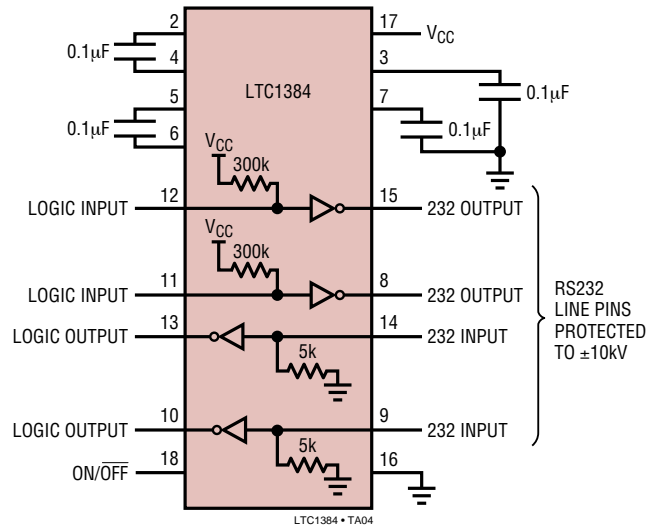
Driver Timing Test Load



Receiver Timing Test Load

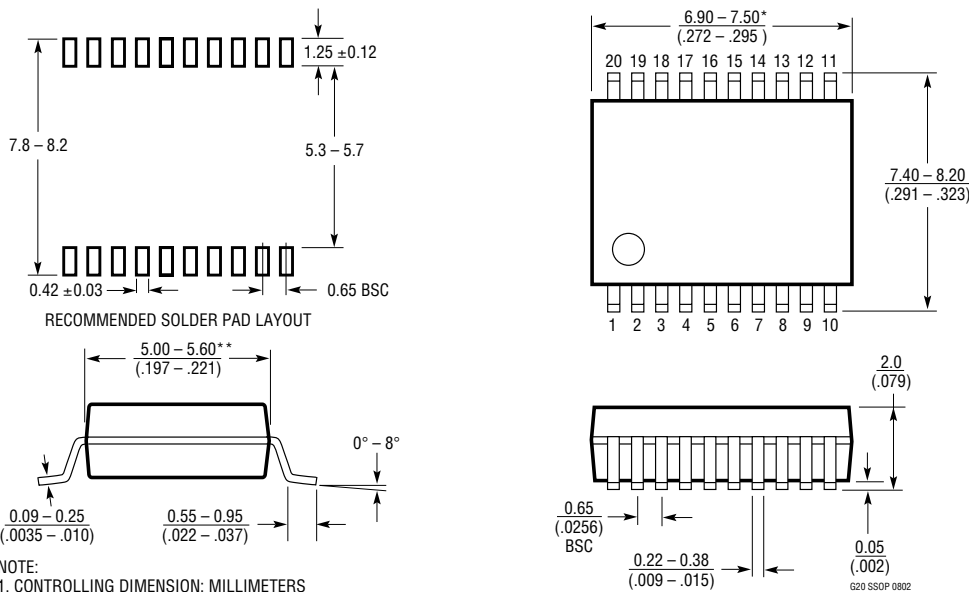


ESD Test Circuit



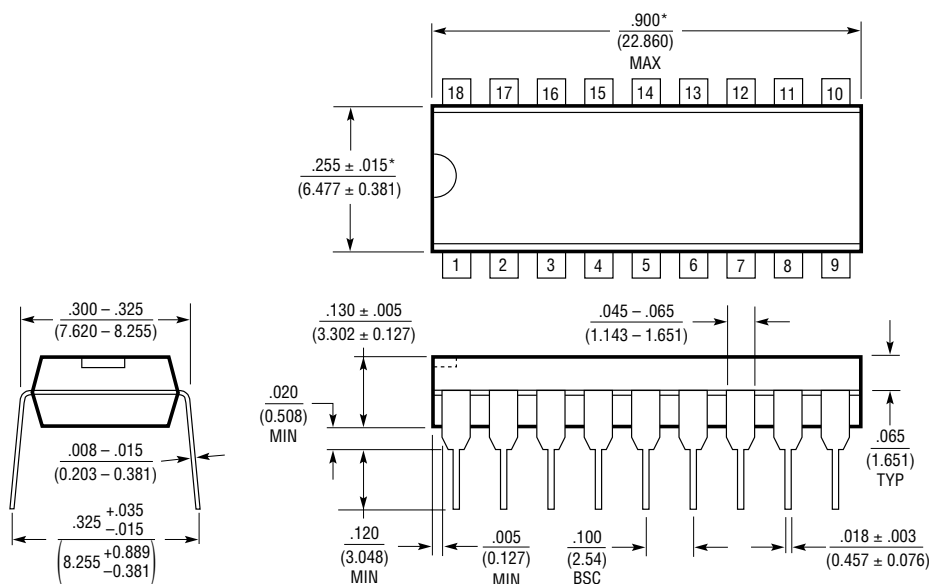
PACKAGE DESCRIPTION

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