

# 3.3V Low Power EIA/TIA-562 Transceiver

## FEATURES

- Operates from a Single 3.3V Supply
- Low Supply Current:  $I_{CC} = 200\mu A$
- $I_{CC} = 35\mu A$  in Driver Disable Mode
- $I_{CC} = 0.2\mu A$  in Shutdown Mode
- ESD Protection Over  $\pm 10kV$
- Uses Small Capacitors:  $0.1\mu F$
- Operates to 120kbaud
- Output Overvoltage Does Not Force Current Back into Supplies
- EIA/TIA-562 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>1385 is an ultra-low power, 2-driver/2-receiver EIA/TIA-562 transceiver which operates from a single 3.3V supply. The charge pump requires only four space-saving  $0.1\mu F$  capacitors.

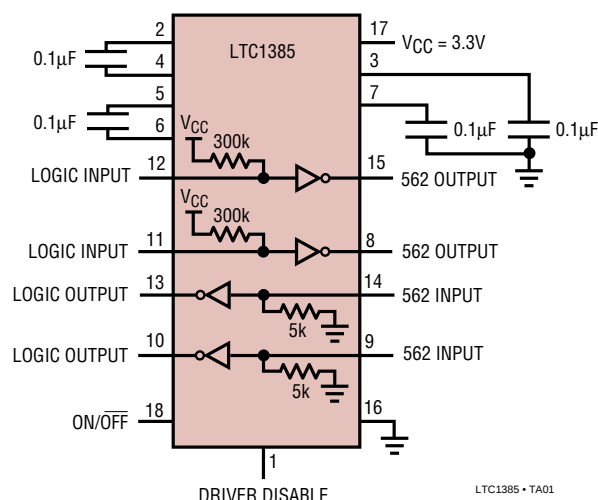
The transceiver operates in one of three modes: Normal, Driver Disable or Shutdown. In the Normal mode,  $I_{CC}$  is only  $200\mu A$  in the unloaded condition. In the Driver Disable mode, the charge pump is turned off, the driver outputs are forced into three-state, both receivers are kept active, and  $I_{CC}$  drops to  $35\mu A$ . In the Shutdown mode, everything is turned off and  $I_{CC}$  drops to  $0.2\mu A$ .

The LTC1385 is fully compliant with all data rate and overvoltage EIA/TIA-562 specifications. The transceiver can operate up to 120kbaud with a  $1000pF$ ,  $3k\Omega$  load. Both driver outputs and receiver inputs can be forced to  $\pm 25V$  without damage, and can survive multiple  $\pm 10kV$  ESD strikes.

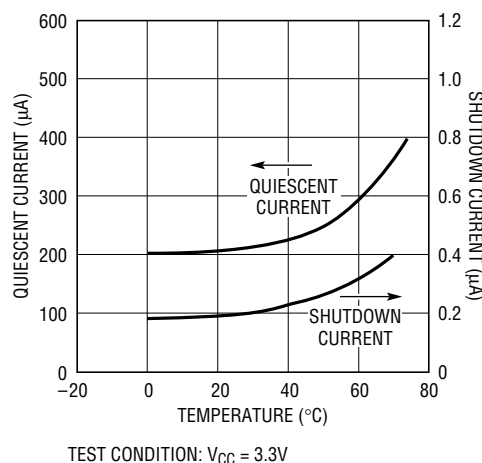
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## TYPICAL APPLICATION

2-Drivers/2-Receivers with Shutdown  
and Driver Disable



Quiescent and Shutdown Supply Current  
vs Temperature



LTC1385 • TA02

## ABSOLUTE MAXIMUM RATINGS

|                             |                            |
|-----------------------------|----------------------------|
| Supply Voltage ( $V_{CC}$ ) | 5V                         |
| 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

|          |                                 |
|----------|---------------------------------|
| LTC1385C | $0^{\circ}C$ to $70^{\circ}C$   |
| LTC1385I | $-40^{\circ}C$ 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><b>TOP VIEW</b></p> <p>G PACKAGE<br/>20-LEAD SSOP</p> <p><math>T_{JMAX} = 125^{\circ}C</math>, <math>\theta_{JA} = 135^{\circ}C/W</math></p> | <p><b>ORDER PART NUMBER</b></p> <p>LTC1385CG<br/>LTC1385IG</p> | <p><b>TOP VIEW</b></p> <p>N PACKAGE<br/>18-LEAD PDIP</p> <p>SW PACKAGE<br/>18-LEAD PLASTIC SO</p> <p><math>T_{JMAX} = 125^{\circ}C</math>, <math>\theta_{JA} = 85^{\circ}C/W</math></p> | <p><b>ORDER PART NUMBER</b></p> <p>LTC1385CN<br/>LTC1385CSW<br/>LTC1385IN<br/>LTC1385ISW</p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|

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.  $V_{CC} = 3.3V$ ,  $C1 = C2 = C3 = C4 = 0.1\mu F$ ,  $V_{ON/OFF} = V_{CC}$ , Driver Disable =  $V_{CC}$ , unless noted.

| PARAMETER                    | CONDITIONS                                                                     | MIN    | TYP      | MAX       | UNITS   |
|------------------------------|--------------------------------------------------------------------------------|--------|----------|-----------|---------|
| <b>Any Driver</b>            |                                                                                |        |          |           |         |
| Output Voltage Swing         | 3k to GND                                                                      | ●<br>● | 3.7      | 4.5       | V       |
|                              |                                                                                |        | -3.7     | -4.5      | 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 | $V_{OUT} = 0V$                                                                 |        | $\pm 10$ |           | mA      |
| Output Leakage Current       | Shutdown or Driver Disable or $V_{CC} = 0V$ (Note 3,4),<br>$V_{OUT} = \pm 20V$ | ●      | $\pm 10$ | $\pm 500$ | $\mu A$ |

**DC ELECTRICAL CHARACTERISTICS**

The ● denotes specifications which apply over the full operating temperature range.  $V_{CC} = 3.3V$ ,  $C1 = C2 = C3 = C4 = 0.1\mu F$ ,  $V_{ON/OFF} = V_{CC}$ , Driver Disable =  $V_{CC}$ , unless noted.

| PARAMETER                           | CONDITIONS                                            |   | MIN | TYP  | MAX | UNITS      |
|-------------------------------------|-------------------------------------------------------|---|-----|------|-----|------------|
| <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  | 1.0 | V          |
| Input Resistance                    | $-10V \leq V_{IN} \leq 10V$                           |   | 3   | 5    | 7   | k $\Omega$ |
| Output Voltage                      | Output Low, $I_{OUT} = -1.6mA$ ( $V_{CC} = 3.3V$ )    | ● |     | 0.2  | 0.4 | V          |
|                                     | Output High, $I_{OUT} = 160\mu A$ ( $V_{CC} = 3.3V$ ) | ● | 3.0 | 3.2  |     | V          |
| Output Short-Circuit Current        | Sinking Current, $V_{OUT} = V_{CC}$                   |   | -5  | -20  |     | mA         |
|                                     | Sourcing Current, $V_{OUT} = 0V$                      |   | 2   | 7    |     | mA         |
| Output Leakage Current              | Shutdown (Note 4), $0V \leq V_{OUT} \leq V_{CC}$      | ● |     | 1    | 10  | $\mu A$    |
| <b>Power Supply Generator</b>       |                                                       |   |     |      |     |            |
| $V^+$ Output Voltage                | $I_{OUT} = 0mA$                                       |   |     | 5.7  |     | V          |
|                                     | $I_{OUT} = 5mA$                                       |   |     | 5.5  |     | V          |
| $V^-$ Output Voltage                | $I_{OUT} = 0mA$                                       |   |     | -5.3 |     | V          |
|                                     | $I_{OUT} = -5mA$                                      |   |     | -5.0 |     | V          |
| Supply Rise Time                    | Shutdown or Driver Disable to Turn-On                 |   |     | 0.2  |     | ms         |
| <b>Power Supply</b>                 |                                                       |   |     |      |     |            |
| $V_{CC}$ Supply Current             | No Load (Note 2), $0^\circ C$ to $70^\circ C$         | ● |     | 0.2  | 0.5 | mA         |
|                                     | No Load (Note 2), $-40^\circ C$ to $85^\circ C$       | ● |     | 3.5  | 1.0 | mA         |
| Supply Leakage Current ( $V_{CC}$ ) | Shutdown (Note 4)                                     | ● |     | 0.2  | 10  | $\mu A$    |
|                                     | Driver Disable (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.  $V_{CC} = 3.3V$ ,  $C1 = C2 = C3 = C4 = 0.1\mu F$ , unless noted.

| PARAMETER                                          | CONDITIONS               |   | MIN | TYP | MAX | UNITS      |
|----------------------------------------------------|--------------------------|---|-----|-----|-----|------------|
| Slew Rate                                          | $R_L = 3k, C_L = 51pF$   |   |     | 8   | 30  | V/ $\mu s$ |
|                                                    | $R_L = 3k, C_L = 1000pF$ |   | 3   | 5   |     | V/ $\mu s$ |
| Driver Propagation Delay<br>(TTL to EIA/TIA-562)   | $t_{HLD}$ (Figure 1)     | ● |     | 2   | 3.5 | $\mu s$    |
|                                                    | $t_{LHD}$ (Figure 1)     | ● |     | 2   | 3.5 | $\mu s$    |
| Receiver Propagation Delay<br>(EIA/TIA-562 to TTL) | $t_{HLR}$ (Figure 2)     | ● |     | 0.3 | 0.8 | $\mu s$    |
|                                                    | $t_{LHR}$ (Figure 2)     | ● |     | 0.2 | 0.8 | $\mu s$    |

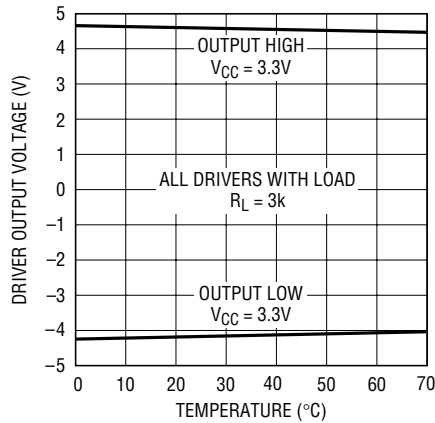
**Note 1:** Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

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

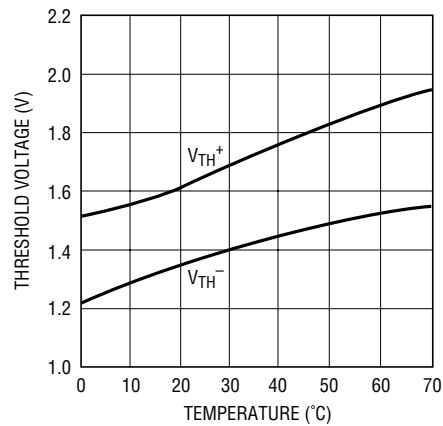
**Note 3:** Measurements made in the Driver Disable mode are performed with  $V_{DRIVER\ DISABLE} = GND$  and  $V_{ON/OFF} = V_{CC}$ .

**Note 4:** Measurements made in the Shutdown mode are performed with  $V_{ON/OFF} = 0V$ .

## TYPICAL PERFORMANCE CHARACTERISTICS

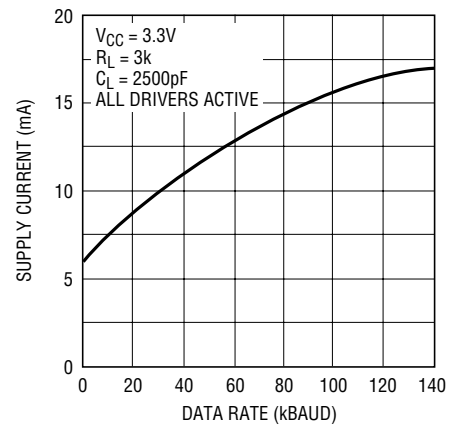
Driver Output Voltage  
vs Temperature

LTC1385 • TPC01

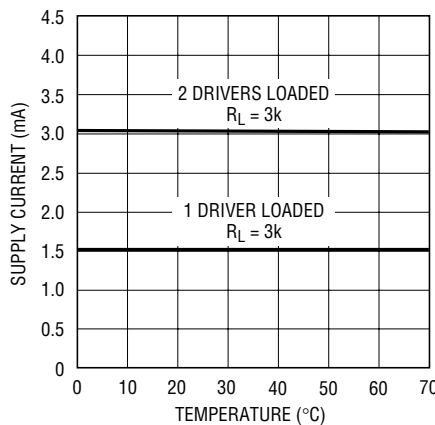
Receiver Input Thresholds  
vs Temperature

LTC1385 • TPC02

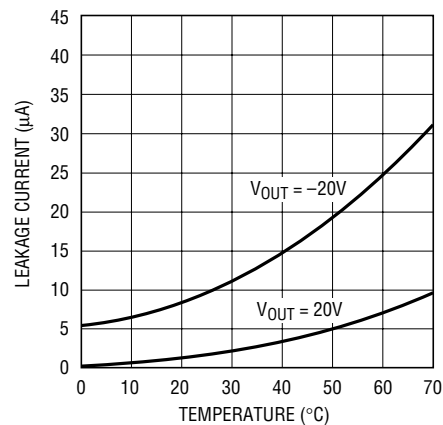
Supply Current vs Data Rate



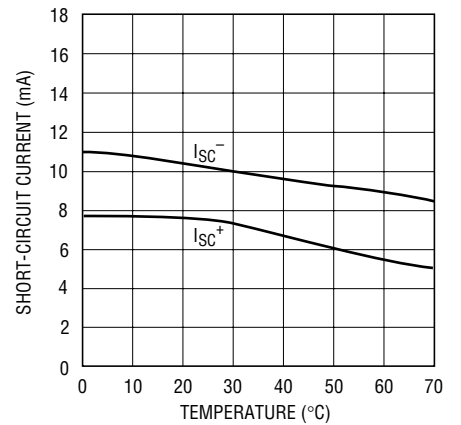
LTC1385 • TPC03

 $V_{CC}$  Supply Current  
vs Temperature

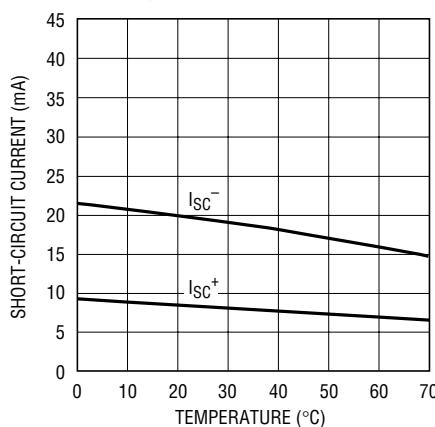
LTC1385 • TPC04

Driver Leakage in Shutdown  
vs Temperature

LTC1385 • TPC05

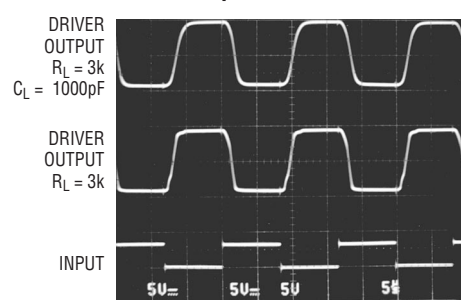
Driver Short-Circuit Current  
vs Temperature

LTC1385 • TPC06

Receiver Short-Circuit Current  
vs Temperature

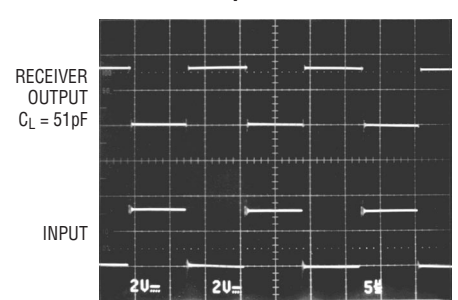
LTC1385 • TPC06

Driver Output Waveforms



LTC1385 • TPC08

Receiver Output Waveform



LTC1385 • TPC09

## PIN FUNCTIONS

**V<sub>CC</sub>**: 3.3V 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 Driver Disable pin. The supply current drops to 0.2μA and all driver and receiver outputs are forced into three-state.

**DRIVER DISABLE**: TTL/CMOS Compatible Input Pin. With the ON/OFF pin held high, a logic low forces the part into the Driver Disable mode with the charge pump turned off and the driver outputs forced into three-state. Both receivers remain active and the supply current drops to 35μA. A logic high forces the part into the Normal mode.

**V<sup>+</sup>**: Positive Supply Output (EIA/TIA-562 Drivers).  $V^+ \cong 2V_{CC} - 1V$ . This pin requires an external capacitor  $C = 0.1\mu F$  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 a large number of devices, increasing the size of the shared common storage capacitors is recommended to reduce ripple.

**V<sup>-</sup>**: Negative Supply Output (EIA/TIA-562 Drivers).  $V^- \cong -(2V_{CC} - 1.3V)$ . This pin requires an external capacitor  $C = 0.1\mu F$  for charge storage.

**C1<sup>+</sup>, C1<sup>-</sup>, C2<sup>+</sup>, C2<sup>-</sup>**: Commutating Capacitor Inputs. These pins require two external capacitors  $C = 0.1\mu F$ : 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**: EIA/TIA-562 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 EIA/TIA-562 Voltage Levels. Outputs are in a high impedance state when in the Shutdown or Driver Disable 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 the Shutdown mode.

## SWITCHING TIME WAVEFORMS

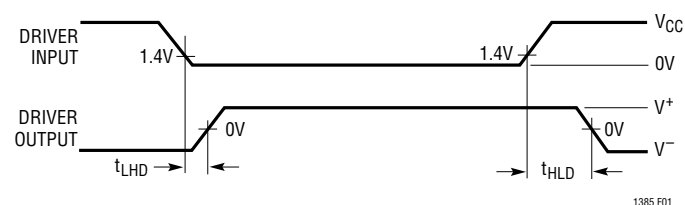


Figure 1. Driver Propagation Delay Timing

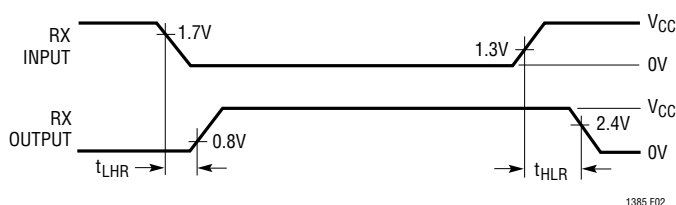
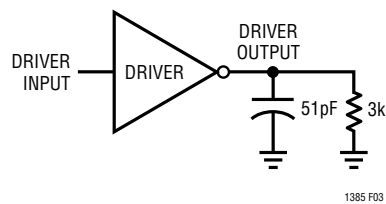


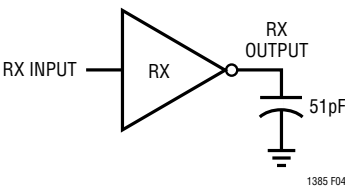
Figure 2. Receiver Propagation Delay Timing

TEST CIRCUITS

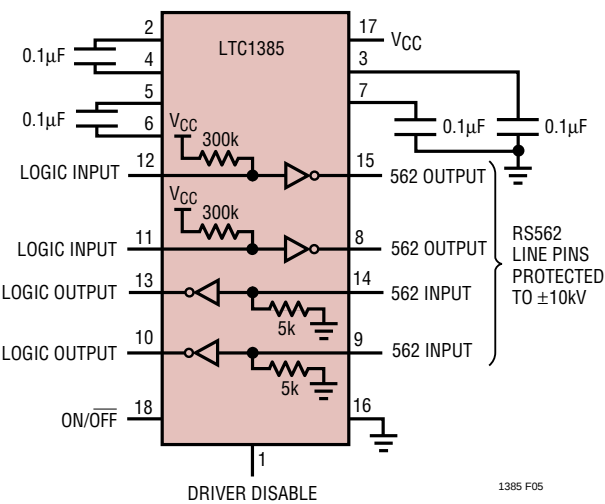
Driver Timing Test Load



Receiver Timing Test Load

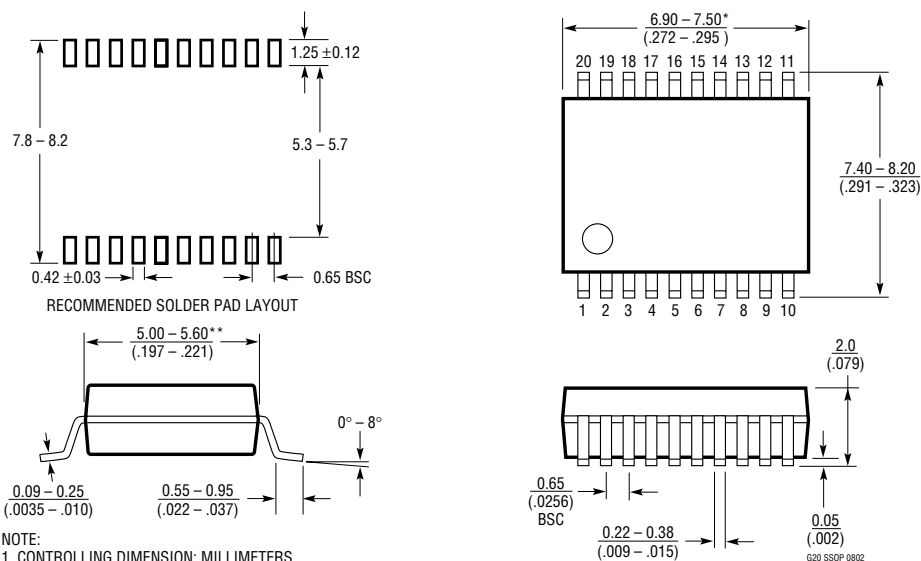


ESD Test Circuit

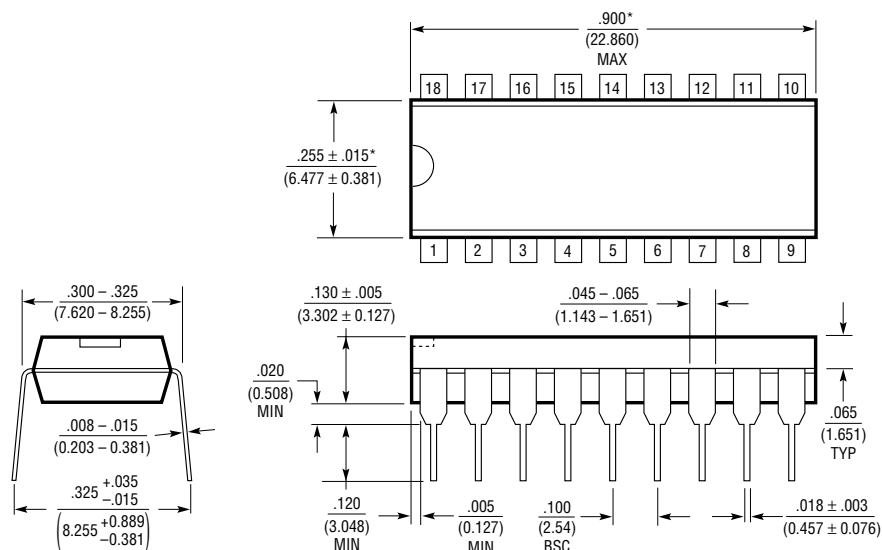


## PACKAGE DESCRIPTION

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

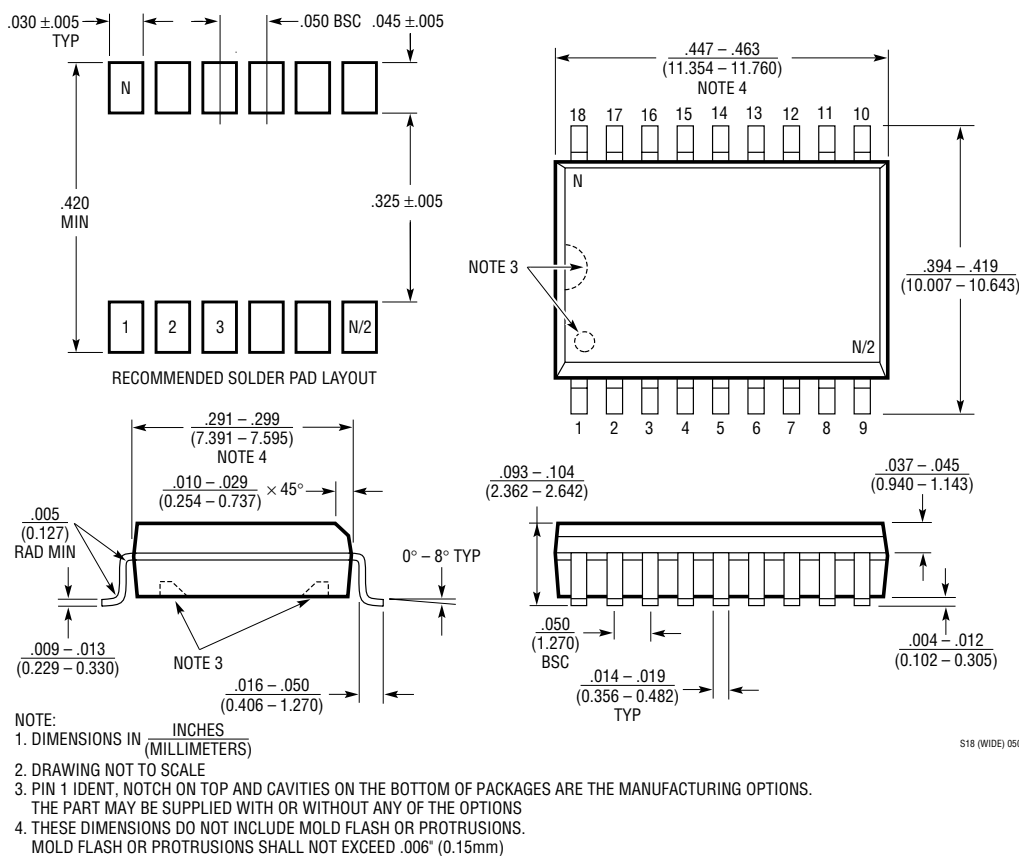


### N Package 18-Lead PDIP (Narrow .300 Inch) (Reference LTC DWG # 05-08-1510)



## 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                             |
| 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   |
| LTC1382       | 5V, 2 Driver, 2 Receiver RS232 Transceiver         | 200µA Supply Current, 0.2µA in Shutdown              |
| LTC1383       | 5V, 2 Driver, 2 Receiver RS232 Transceiver         | 200µA Supply Current, Narrow 16-Pin SO               |
| LTC1384       | 5V, 2 Driver, 2 Receiver RS232 Transceiver         | 200µA Supply Current, 2 Receivers Active in Shutdown |
| LTC1386       | 3.3V, 2 Driver, 2 Receiver RS562 Transceiver       | 200µA Supply Current, Narrow 16-Pin SO               |