

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

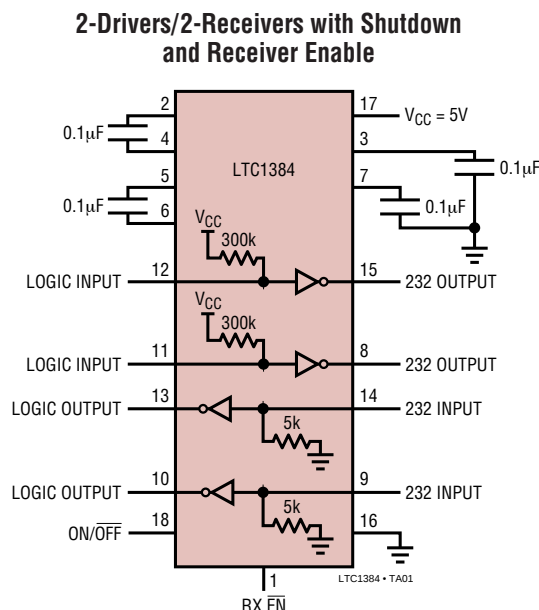
The LTC[®]1384 is an ultra-low power 2-driver/2-receiver RS232 transceiver that operates from a single 5V supply. The charge pump requires only four space-saving $0.1\mu F$ capacitors.

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.

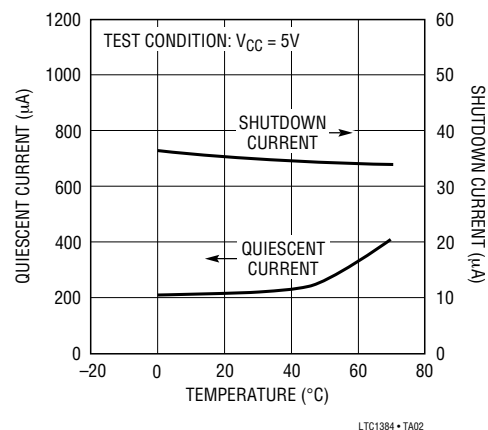
The LTC1384 is fully compliant with all data rate and overvoltage RS232 specifications. The transceiver can operate up to 120kbaud with a $2500pF$, $3k\Omega$ load. Both driver outputs and receiver inputs can be forced to $\pm 25V$ without damage and can survive multiple $\pm 10kV$ ESD strikes.

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TYPICAL APPLICATION



Quiescent and Shutdown Supply Current vs Temperature



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	$0^{\circ}C$ to $70^{\circ}C$
Receiver	$-0.3V$ to $V_{CC} + 0.3V$	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

TOP VIEW RX EN 1, 20 ON/OFF C1+ 2, 19 VCC V+ 3, 18 GND C1- 4, 17 TR1 OUT C2+ 5, 16 RX1 IN C2- 6, 15 RX1 OUT V- 7, 14 TR1 IN TR2 OUT 8, 13 TR2 IN RX2 IN 9, 12 RX2 OUT NC 10, 11 NC G PACKAGE 20-LEAD SSOP $T_{JMAX} = 125^{\circ}C$, $\theta_{JA} = 135^{\circ}C/W$	ORDER PART NUMBER LTC1384CG LTC1384IG	TOP VIEW RX EN 1, 18 ON/OFF C1+ 2, 17 VCC V+ 3, 16 GND C1- 4, 15 TR1 OUT C2+ 5, 14 RX1 IN C2- 6, 13 RX1 OUT V- 7, 12 TR1 IN TR2 OUT 8, 11 TR2 IN RX2 IN 9, 10 RX2 OUT N PACKAGE 18-LEAD PDIP SW PACKAGE 18-LEAD PLASTIC SO $T_{JMAX} = 125^{\circ}C$, $\theta_{JA} = 65^{\circ}C/W$ $T_{JMAX} = 125^{\circ}C$, $\theta_{JA} = 85^{\circ}C/W$	ORDER PART NUMBER LTC1384CN LTC1384CSW LTC1384IN LTC1384ISW
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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	●	5.0	7.0	V
			-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	μA
	$V_{IN} = 0V$	●	-20	-40	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	●	0.8	1.3	V
	Input High Threshold	●	1.7	2.4	V
Hysteresis		●	0.1	0.4	V
Input Resistance	$-10V \leq V_{IN} \leq 10V$		3	5	k Ω
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	μA
Power Supply Generator					
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
Power Supply					
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	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	$R_L = 3k$, $C_L = 51pF$ $R_L = 3k$, $C_L = 2500pF$		8 5	30	V/ μs V/ μs
Driver Propagation Delay (TTL to RS232)	t_{HLD} (Figure 1) t_{LHD} (Figure 1)	● ●	2 2	3.5 3.5	μs μs
Receiver Propagation Delay (RS232 to TTL)	t_{HLR} (Figure 2) t_{LHR} (Figure 2)	● ●	0.3 0.3	0.8 0.8	μs μs

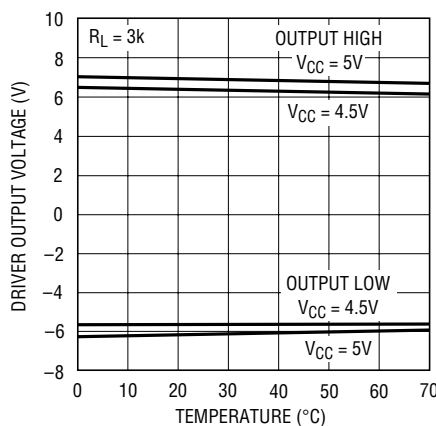
Note 1: Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

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

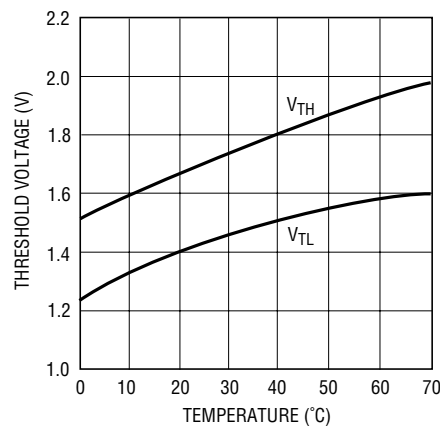
Note 2: Supply current is measured with driver and receiver outputs unloaded.

TYPICAL PERFORMANCE CHARACTERISTICS

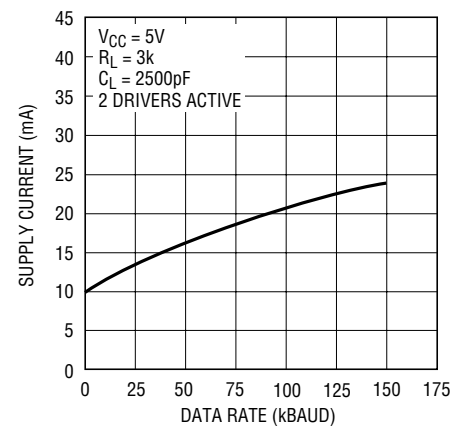
**Driver Output Voltage
vs Temperature**



**Receiver Input Thresholds
vs Temperature**

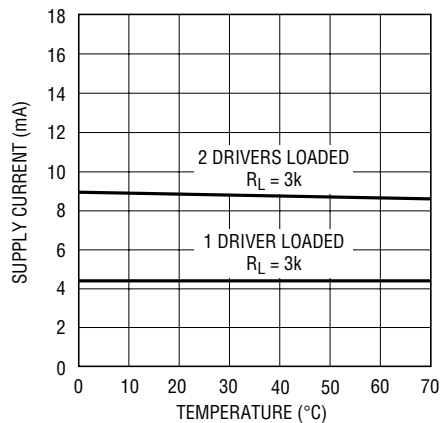


Supply Current vs Data Rate

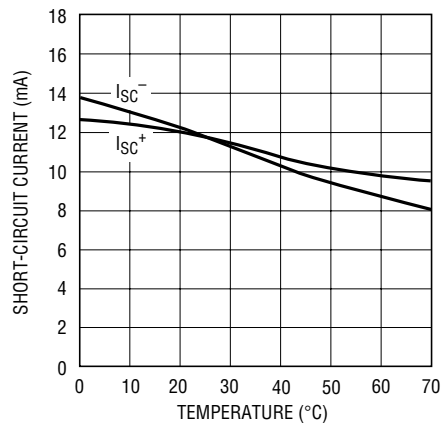


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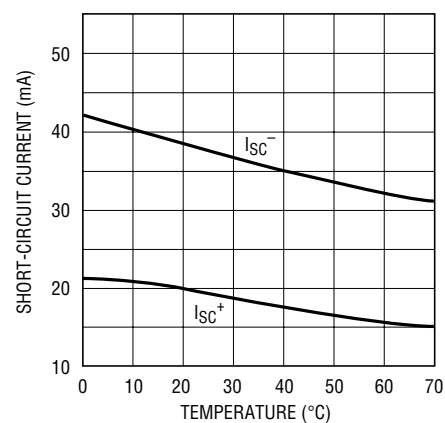
TYPICAL PERFORMANCE CHARACTERISTICS

V_{CC} Supply Current vs Temperature

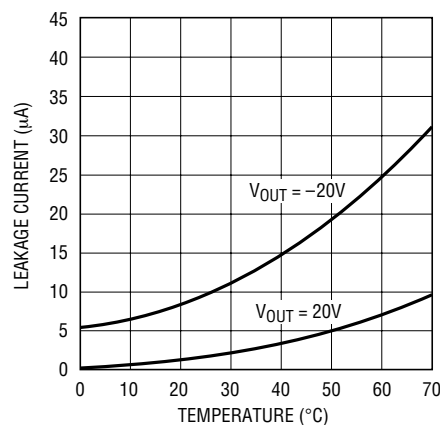
LTC1384 • TPC04

Driver Short-Circuit Current vs Temperature

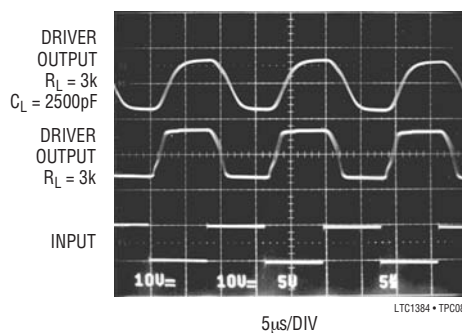
LTC1384 • TPC05

Receiver Short-Circuit Current vs Temperature

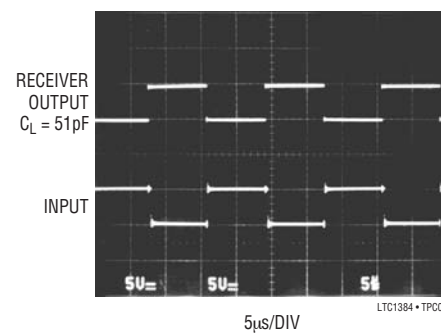
LTC1384 • TPC06

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 0.1μF 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⁺: 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 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 ±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. A logic high at RX $\overline{\text{EN}}$ puts the outputs into three-state.

SWITCHING TIME WAVEFORMS

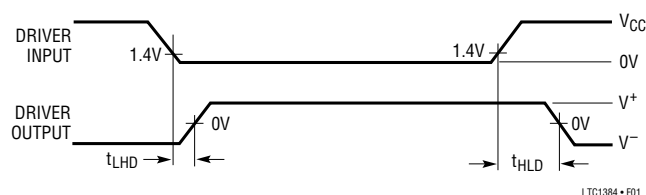


Figure 1. Driver Propagation Delay Timing

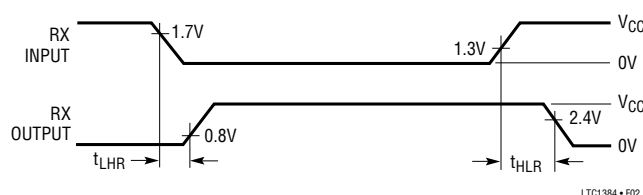
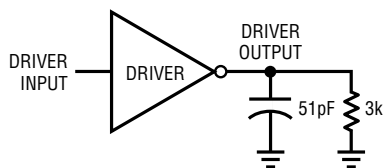


Figure 2. Receiver Propagation Delay Timing

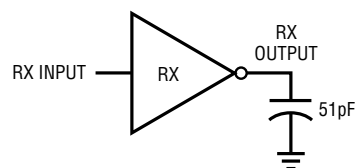
TEST CIRCUITS

Driver Timing Test Load



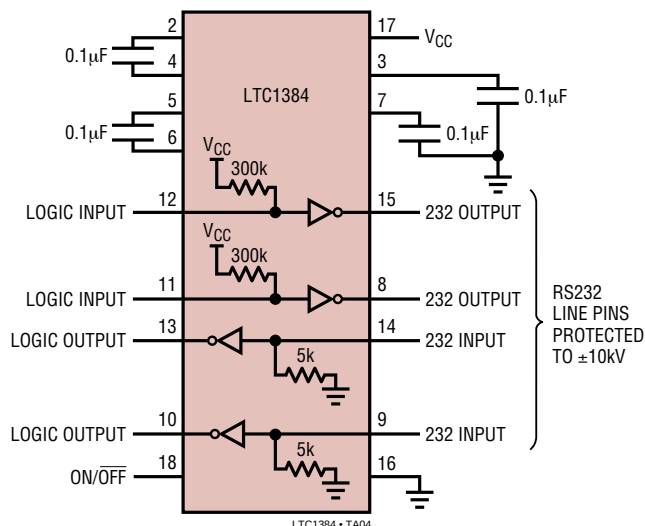
LTC1384 • TA03

Receiver Timing Test Load



LTC1384 • TA04

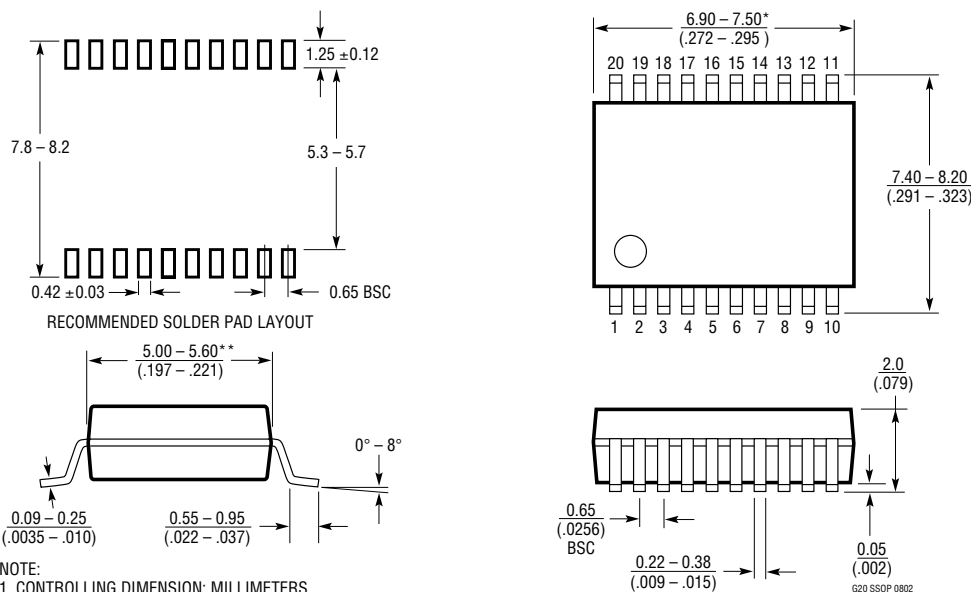
ESD Test Circuit



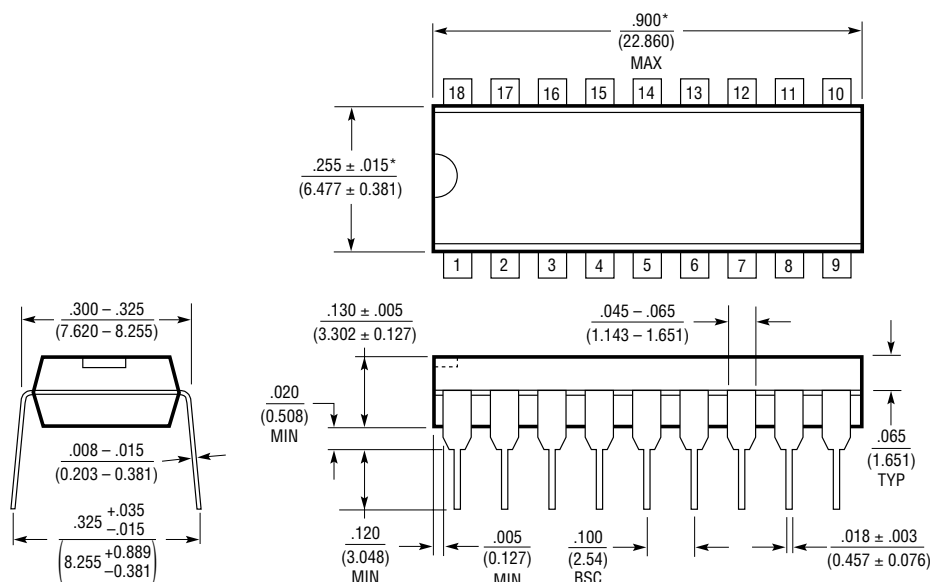
LTC1384 • TA04

PACKAGE DESCRIPTION

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



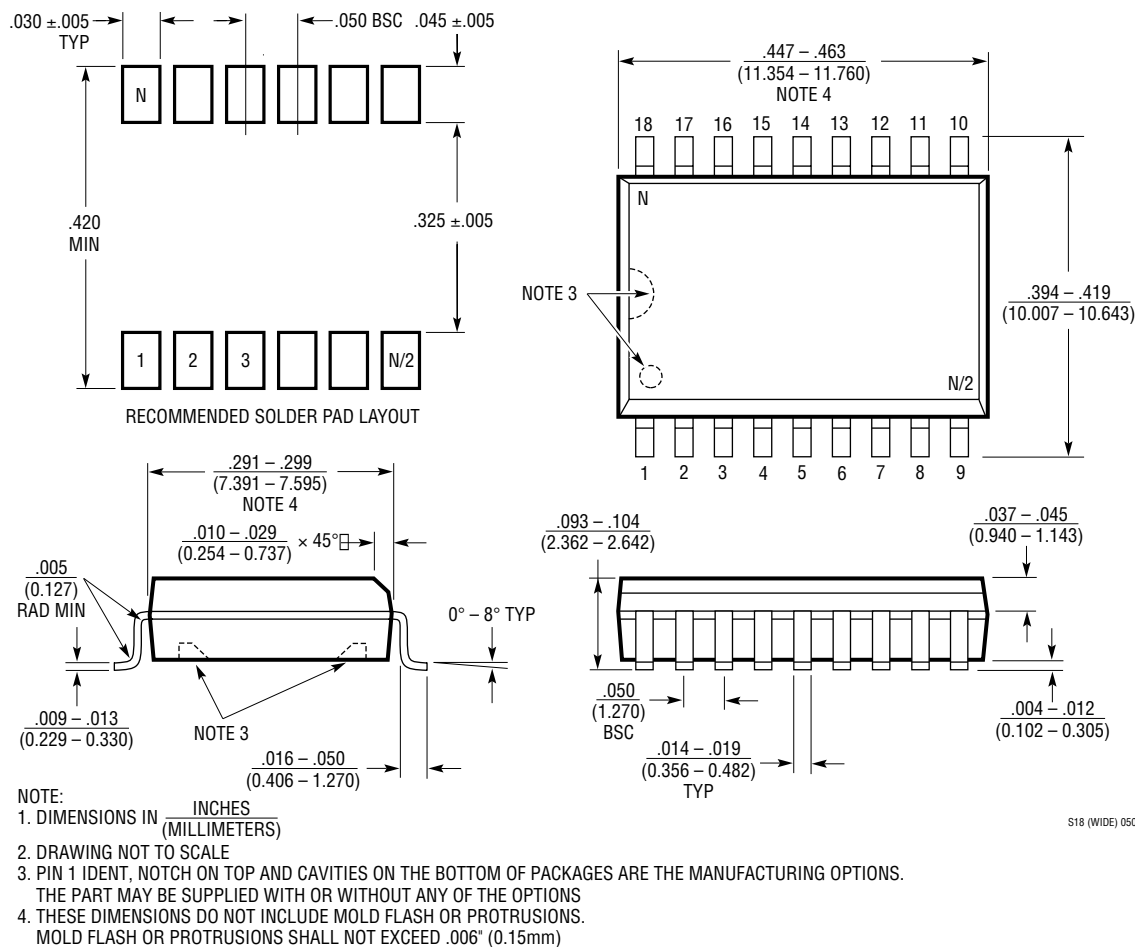
N Package 18-Lead PDIP (Narrow .300 Inch) (Reference LTC DWG # 05-08-1510)



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