LTC1350

3.3V Low Power EIA/TIA-562 3-Driver/ 5-Receiver Transceiver

FEATURES

- **Low Supply Current: 300μA**
- **Receivers 4 and 5 Kept Alive in Shutdown: 35μA**
- **ESD Protection: ±10kV**
- **Operates from a Single 3.3V Supply**
- Uses Small Capacitors: 0.1μF
- Operates to 120kBaud
- Three-State Outputs are High Impedance When Off
- Output Overvoltage Does Not Force Current Back into Supplies
- EIA/TIA-562 I/O Lines Can Be Forced to ±25V Without Damage
- Flowthrough Architecture

APPLICATIONS

- Notebook Computers
- Palmtop Computers

DESCRIPTION

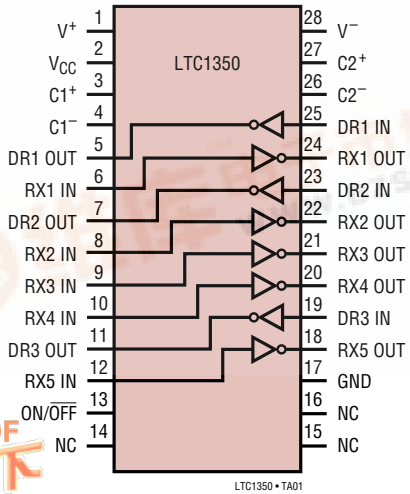
The LTC®1350 is a 3-driver/5-receiver EIA/TIA-562 transceiver with very low supply current. In the no load condition, the supply current is only 300μA. The charge pump only requires four 0.1μF capacitors.

In Shutdown mode, two receivers are kept alive and the supply current is only 35μA. All RS232 outputs assume a high impedance state in Shutdown or with the power off.

The LTC1350 is fully compliant with all data rate and overvoltage EIA/TIA-562 specifications. The transceiver can operate up to 120kbaud with a 1000pF and 3kΩ load. Both driver outputs and receiver inputs can be forced to ±25V without damage and can survive multiple ±10kV ESD strikes.

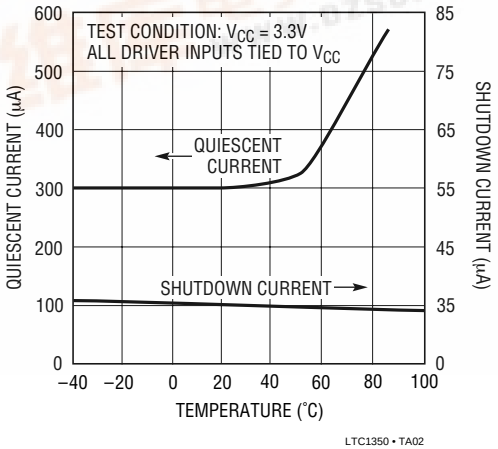
TYPICAL APPLICATION

3-Drivers/5-Receivers with Shutdown



LTC1350 • TA01

Quiescent and Shutdown Supply Current vs Temperature

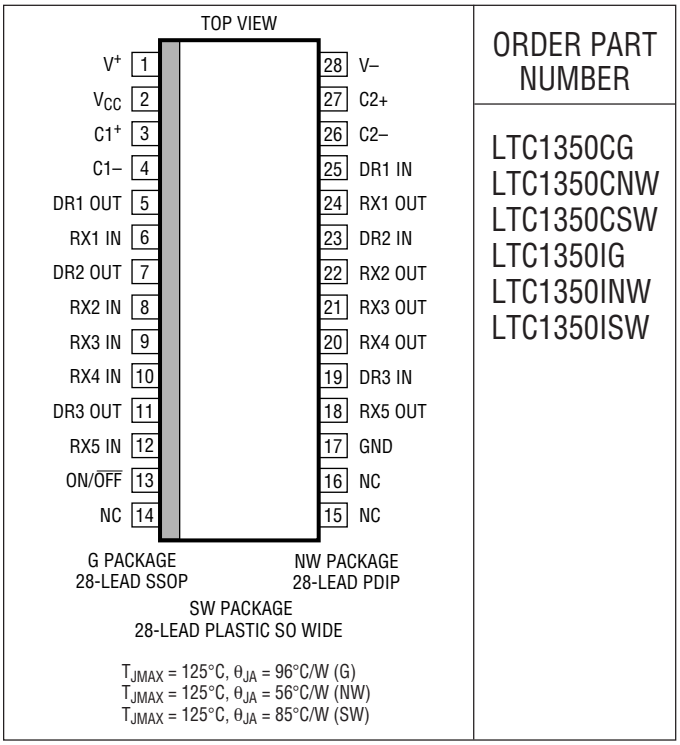


LTC1350 • TA02

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_{CC}) 5V
Input Voltage
  Driver ..... $-0.3V$ to $V_{CC} + 0.3V$
  Receiver ..... $-25V$ to $25V$
  ON/$\overline{OFF}$ Pin ..... $-0.3V$ 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
  Commercial (LTC1350C) ..... 0°C to 70°C
  Industrial (LTC1350I) ..... -40°C to 85°C
Storage Temperature Range ..... -65°C to 150°C
Lead Temperature (Soldering, 10 sec) ..... 300°C

PACKAGE/ORDER INFORMATION



ORDER PART NUMBER

LTC1350CG
LTC1350CNW
LTC1350CSW
LTC1350IG
LTC1350INW
LTC1350ISW

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 = 0.1μF, unless noted.

PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
Any Driver							
Output Voltage Swing	3k to GND	Positive	●	3.7	4.5		V
		Negative	●	–3.7	–4.5		V
Logic Input Voltage Level	Input Low Level (V_{OUT} = High)		●		1.4	0.8	V
	Input High Level (V_{OUT} = Low)		●	2.0	1.4		V
Logic Input Current	$V_{IN} = V_{CC}$		●			5	μA
	V_{IN} = 0V		●			–5	μA
Output Short-Circuit Current	V_{OUT} = 0V			±9	±10		mA
Output Leakage Current	Shutdown (Note 3), V_{OUT} = ±20V				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	1	V
Input Resistance	V_{IN} = ±10V			3	5	7	kΩ
Output Voltage	Output Low, $I_{OUT} = -1.6$mA (V_{CC} = 3.3V)		●		0.2	0.4	V
	Output High, I_{OUT} = 160μA (V_{CC} = 3.3V)		●	3.0	3.2		V
Output Short-Circuit Current	Sinking Current, $V_{OUT} = V_{CC}$			–3	–20		mA
Output Leakage Current	Shutdown (Note 3), 0V ≤ V_{OUT} ≤ V_{CC}		●		1	10	μA

DC ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range. V_{CC} = 3.3V, C1 = C2 = C3 = C4 = 0.1μF, unless noted.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Power Supply Generator						
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 to Turn-On			0.2		ms
Power Supply						
V_{CC} Supply Current	No Load (All Drivers $V_{IN} = V_{CC}$)(Note 2) 0°C ≤ T_A ≤ 70°C	●		0.3	0.6	mA
	No Load (All Drivers V_{IN} = 0)(Note 2) 0°C ≤ T_A ≤ 70°C	●		0.5	1.0	mA
	No Load (All Drivers $V_{IN} = V_{CC}$)(Note 2) 0°C ≤ T_A ≤ 85°C	●		0.3	1.0	mA
	No Load (All Drivers $V_{IN} = V_{CC}$)(Note 2) –40°C ≤ T_A ≤ 0°C	●		0.3	1.5	mA
	No Load (All Drivers V_{IN} = 0)(Note 2) –40°C ≤ T_A ≤ 85°C	●		0.5	1.5	mA
	Shutdown (Note 3)	●		35	50	μA
ON/$\overline{OFF}$ Threshold Low		●		1.4	0.8	V
ON/$\overline{OFF}$ 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 = 0.1μF, unless noted.

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

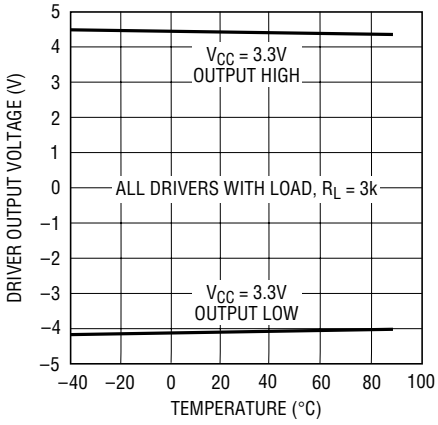
Note 1: Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

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

Note 3: Supply current measurement in Shutdown mode is performed with $V_{ON/\overline{OFF}}$ = 0V.

TYPICAL PERFORMANCE CHARACTERISTICS

Driver Output Voltage vs Temperature



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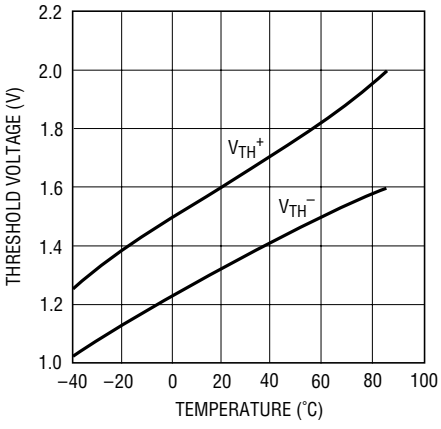
Receiver Input Thresholds vs Temperature



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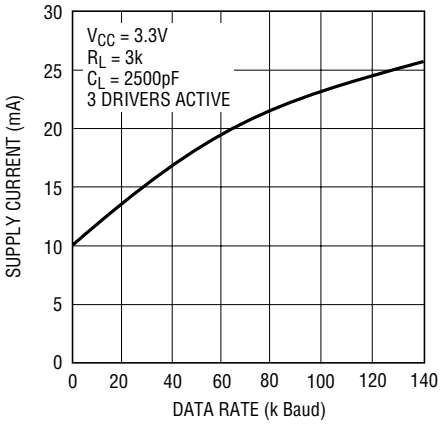
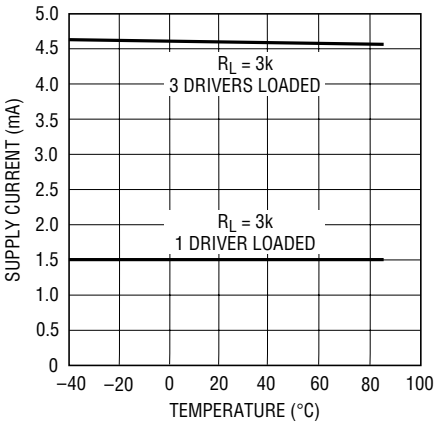
Supply Current vs Data Rate



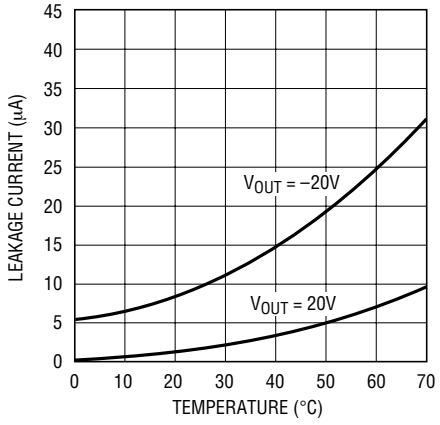
LTC1350 • TPC03

V_{CC} Supply Current vs Temperature



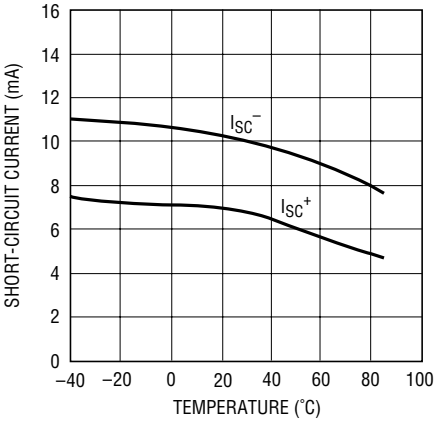
LTC1350 • TPC04

Driver Leakage in Shutdown vs Temperature



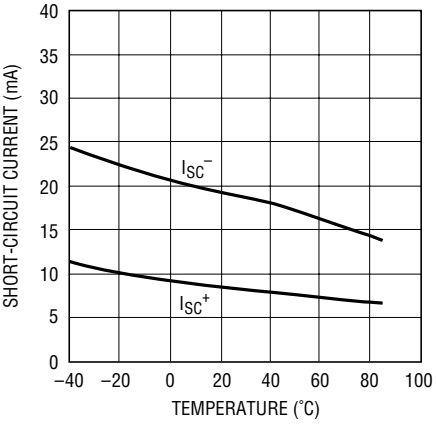
LTC1350 • TPC05

Driver Short-Circuit Current vs Temperature



LTC1350 • TPC06

Receiver Short-Circuit Current vs Temperature



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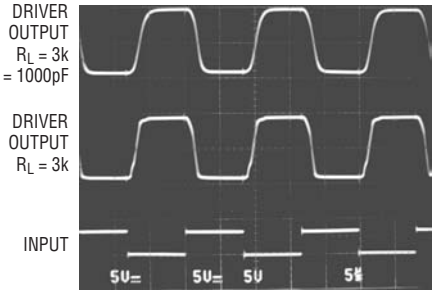
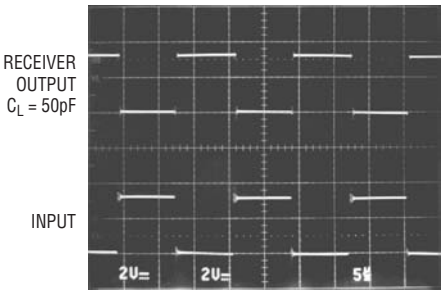
Driver Output Waveforms



LTC1350 • TPC08

Receiver Output Waveform



LTC1350 • TPC09

PIN FUNCTIONS

V_{CC}: 3.3V Input Supply Pin. Supply current is typically 35μA in the Shutdown mode. This pin should be decoupled with a 0.1μF ceramic capacitor.

GND: Ground Pin.

ON/$\overline{OFF}$: TTL/CMOS Compatible Shutdown Pin. A logic low puts the device in the Shutdown mode with receivers 4 and 5 kept alive and the supply current equal to 35μA. All driver and other receiver outputs are in high impedance state. This pin cannot float.

V^+: Positive Supply Output. $V^+ \cong 2V_{CC} - 1V$. This pin requires an external capacitor (C = 0.1μF) for charge storage. The capacitor may be tied to ground or V_{CC}. With multiple devices, the V^+ and V^- pins may be paralleled into common capacitors. For a large number of devices, increasing the size of the shared common storage capacitors is recommended to reduce ripple.

V^-: Negative Supply Output. $V^- \cong -(2V_{CC} - 1.3V)$. This pin requires an external capacitor (C = 0.1μF) for charge storage.

$C1^+$, $C1^-$, $C2^+$, $C2^-$: Commutating Capacitor Inputs. These pins require two external capacitors (C = 0.1μF): 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 20Ω.

DR IN: EIA/TIA-562 Driver Input Pins. Inputs are TTL/CMOS compatible. Inputs should not be allowed to float. Tie unused inputs to V_{CC}.

DR OUT: Driver Outputs at EIA/TIA-562 Voltage Levels. Outputs are in a high impedance state when in the Shutdown 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. Receiver 1, 2 and 3 outputs are in a high impedance state when in Shutdown mode to allow data line sharing. Receivers 4 and 5 are kept alive in Shutdown.

SWITCHING TIME WAVEFORMS

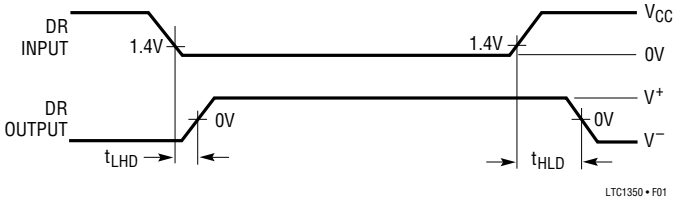


Figure 1. Driver Propagation Delay Timing

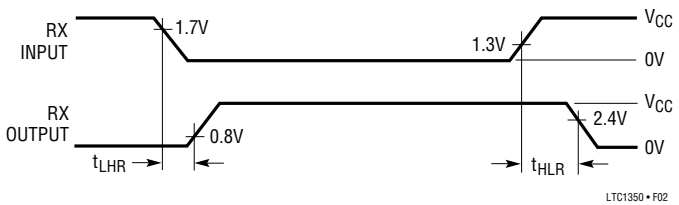
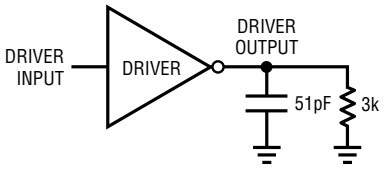


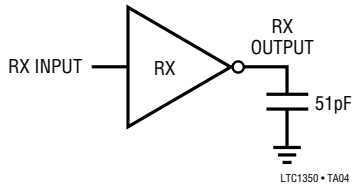
Figure 2. Receiver Propagation Delay Timing

TEST CIRCUITS

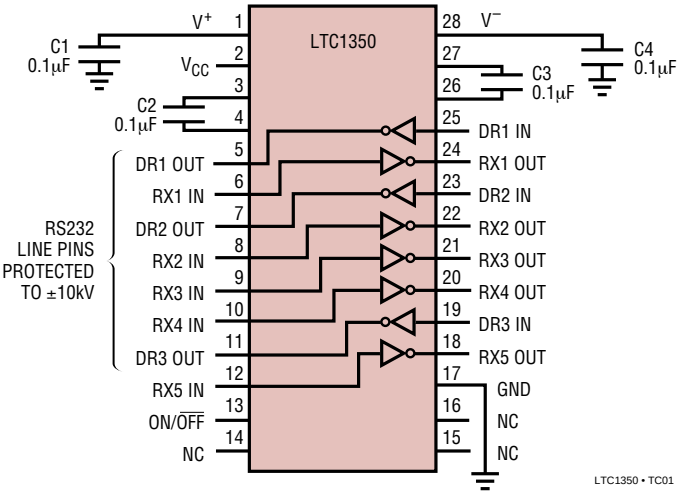
Driver Timing Test Load



Receiver Timing Test Load

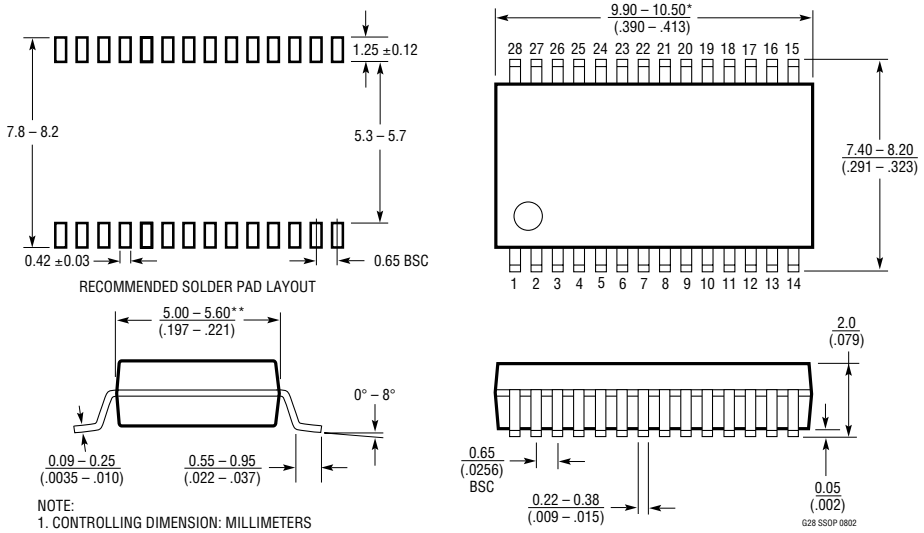


ESD Test Circuit



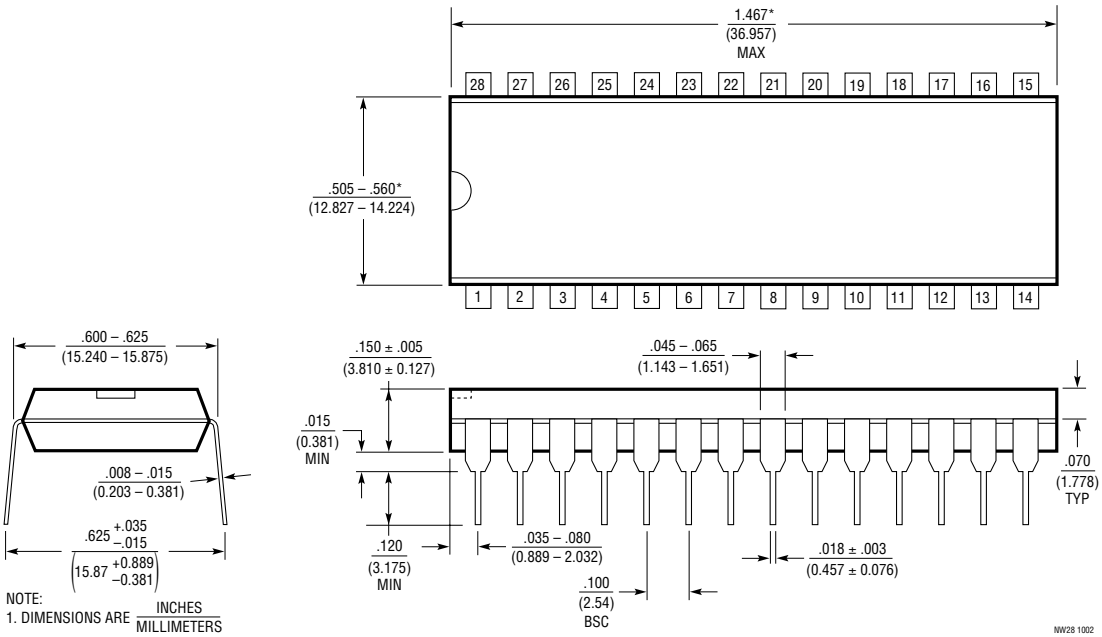
PACKAGE DESCRIPTION

G Package
28-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

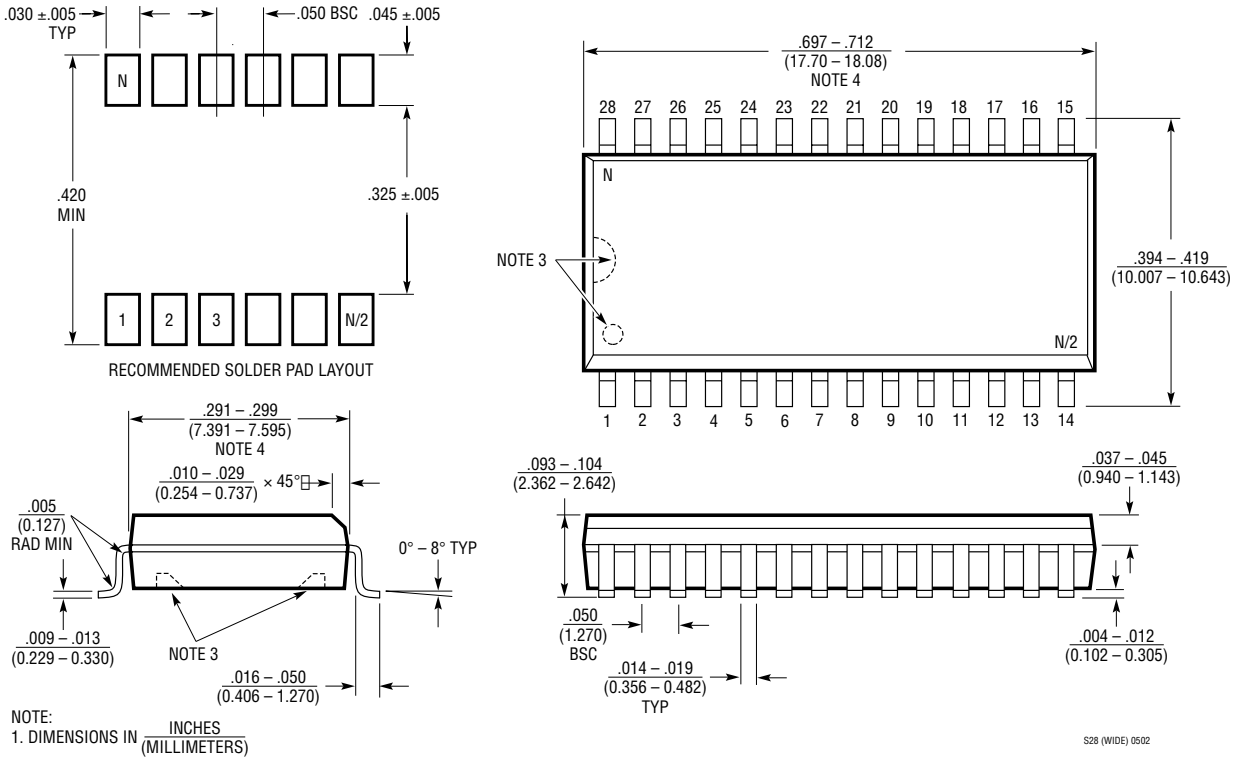
NW Package
28-Lead PDIP (Wide .600 Inch)
(Reference LTC DWG # 05-08-1520)



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)

PACKAGE DESCRIPTION

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



NOTE:
1. DIMENSIONS IN INCHES (MILLIMETERS)
2. DRAWING NOT TO SCALE
3. PIN 1 IDENT, NOTCH ON TOP AND CAVITIES ON THE BOTTOM OF PACKAGES ARE THE MANUFACTURING OPTIONS. THE PART MAY BE SUPPLIED WITH OR WITHOUT ANY OF THE OPTIONS
4. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT®1137A	5V, 3 Driver, 5 Receiver RS232 Transceiver	±15kV ESD per IEC 1000-4
LTC1327	3.3V, 3 Driver, 5 Receiver RS562 Transceiver	300μA Supply Current, 0.2μA in Shutdown
LTC1337	5V, 3 Driver, 5 Receiver RS232 Transceiver	300μA Supply Current, 1μA in Shutdown
LTC1348	3.3V to 5V, 3 Driver, 5 Receiver RS232 Transceiver	True RS232 on 3.3V, 5 Receivers Active in Shutdown
LTC1385	3.3V, 2 Driver, 2 Receiver RS562 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
LTC2844	3.3V, Software-Selectable Multiprotocol Transceiver	4 Drivers, 4 Receivers for Control Signals Including LL
LTC2845	3.3V, Software-Selectable Multiprotocol Transceiver	5 Drivers, 5 Receivers for Control Signals Including LL, RL and TM
LTC2846	3.3V, Software-Selectable Multiprotocol Transceiver	4 Drivers, 4 Receivers with Termination for Data/Clock

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