

# Low Power 5V RS232 Dual Driver/Receiver with 0.1 $\mu$ F Capacitors

## FEATURES

- ESD Protection over  $\pm 10\text{kV}$
- Uses Small Capacitors: 0.1 $\mu\text{F}$
- 120kbaud Operation for  $R_L = 3\text{k}$ ,  $C_L = 2500\text{pF}$
- 250kbaud Operation for  $R_L = 3\text{k}$ ,  $C_L = 1000\text{pF}$
- Outputs Withstand  $\pm 30\text{V}$  Without Damage
- CMOS Comparable Low Power: 40mW
- Operates from a Single 5V Supply
- Rugged Bipolar Design
- Outputs Assume a High Impedance State When Off or Powered Down
- Meets All RS232 Specifications
- Available With or Without Shutdown
- Absolutely No Latch-up
- Available in SO Package

## APPLICATIONS

- Portable Computers
- Battery-Powered Systems
- Power Supply Generator
- Terminals
- Modems

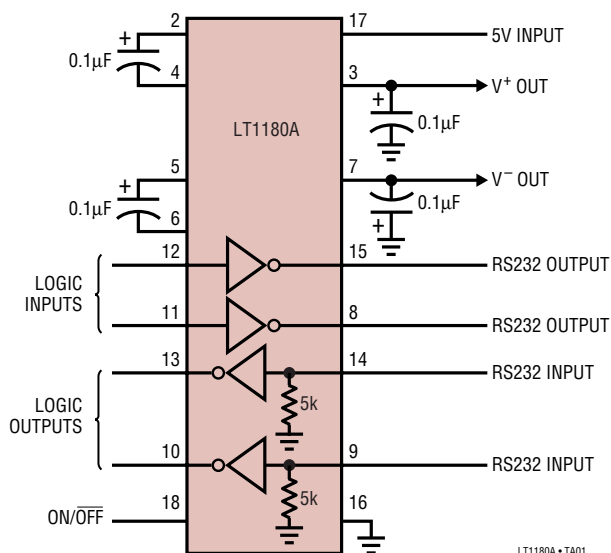
## DESCRIPTION

The LT<sup>®</sup>1180A/LT1181A are dual RS232 driver/receiver pairs with integral charge pump to generate RS232 voltage levels from a single 5V supply. These circuits feature rugged bipolar design to provide operating fault tolerance and ESD protection unmatched by competing CMOS designs. Using only 0.1 $\mu\text{F}$  external capacitors, these circuits consume only 40mW of power, and can operate to 120k baud even while driving heavy capacitive loads. New ESD structures on the chip allow the LT1180A/LT1181A to survive multiple  $\pm 10\text{kV}$  strikes, eliminating the need for costly TransZorbs<sup>®</sup> on the RS232 line pins. The LT1180A/LT1181A are fully compliant with EIA RS232 standards. Driver outputs are protected from overload, and can be shorted to ground or up to  $\pm 30\text{V}$  without damage. During shutdown or power-off conditions, driver and receiver outputs are in a high impedance state, allowing line sharing.

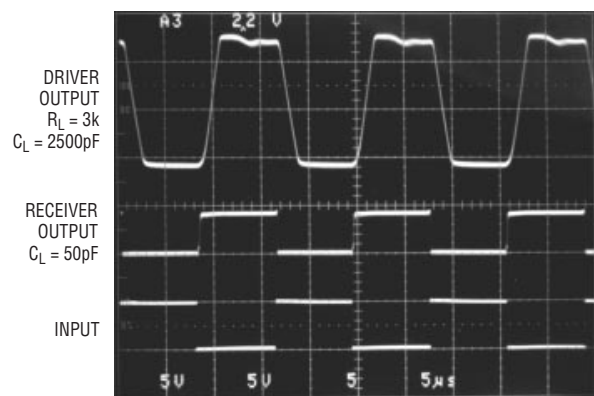
The LT1181A is available in 16-pin DIP and SO packages. The LT1180A is supplied in 18-pin DIP and SO packages for applications which require shutdown.

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TransZorb is a registered trademark of General Instruments, GSI

## TYPICAL APPLICATION



Output Waveforms



LT1180A • TA02

LT1180A • TA01

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# LT1180A/LT1181A

## ABSOLUTE MAXIMUM RATINGS (Note 1)

|                             |                            |                                      |                |
|-----------------------------|----------------------------|--------------------------------------|----------------|
| Supply Voltage ( $V_{CC}$ ) | 6V                         | Short-Circuit Duration               |                |
| $V^+$                       | 13.2V                      | $V^+$                                | 30 sec         |
| $V^-$                       | -13.2V                     | $V^-$                                | 30 sec         |
| Input Voltage               |                            | Driver Output                        | Indefinite     |
| Driver                      | $V^-$ to $V^+$             | Receiver Output                      | Indefinite     |
| Receiver                    | -30V to 30V                | Operating Temperature Range          |                |
| ON/OFF                      | -0.3V to 12V               | LT1180AI/LT1181AI                    | -40°C to 85°C  |
| Output Voltage              |                            | LT1180AC/LT1181AC                    | 0°C to 70°C    |
| Driver                      | $V^+ - 30V$ to $V^- + 30V$ | Storage Temperature Range            | -65°C to 150°C |
| Receiver                    | -0.3V to $V_{CC} + 0.3V$   | Lead Temperature (Soldering, 10 sec) | 300°C          |

## PACKAGE/ORDER INFORMATION

|                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <p>TOP VIEW</p> <p>N PACKAGE<br/>18-LEAD PDIP<br/><math>T_{JMAX} = 125^\circ\text{C}</math>, <math>\theta_{JA} = 80^\circ\text{C/W}</math>, <math>\theta_{JC} = 36^\circ\text{C/W}</math> (N)<br/><math>T_{JMAX} = 125^\circ\text{C}</math>, <math>\theta_{JA} = 90^\circ\text{C/W}</math>, <math>\theta_{JC} = 26^\circ\text{C/W}</math> (SW)</p> | <p>ORDER PART NUMBER</p> <p>LT1180ACN<br/>LT1180ACSW<br/>LT1180AIN<br/>LT1180AISW</p> | <p>TOP VIEW</p> <p>N PACKAGE<br/>16-LEAD PDIP<br/><math>T_{JMAX} = 125^\circ\text{C}</math>, <math>\theta_{JA} = 90^\circ\text{C/W}</math>, <math>\theta_{JC} = 46^\circ\text{C/W}</math> (N)<br/><math>T_{JMAX} = 125^\circ\text{C}</math>, <math>\theta_{JA} = 95^\circ\text{C/W}</math>, <math>\theta_{JC} = 27^\circ\text{C/W}</math> (SW)</p> | <p>ORDER PART NUMBER</p> <p>LT1181ACN<br/>LT1181ACSW<br/>LT1181AIN<br/>LT1181AISW</p> |
| <p>J PACKAGE<br/>18-LEAD CERDIP<br/><math>T_{JMAX} = 150^\circ\text{C}</math>, <math>\theta_{JA} = 100^\circ\text{C/W}</math>, <math>\theta_{JC} = 40^\circ\text{C/W}</math> (J)</p> <p><b>OBsolete PACKAGE</b><br/>Consider N Package for Alternate Source</p>                                                                                    | <p>LT1180AMJ</p>                                                                      | <p>J PACKAGE<br/>16-LEAD CERDIP<br/><math>T_{JMAX} = 150^\circ\text{C}</math>, <math>\theta_{JA} = 100^\circ\text{C/W}</math>, <math>\theta_{JC} = 40^\circ\text{C/W}</math> (J)</p> <p><b>OBsolete PACKAGE</b><br/>Consider N Package for Alternate Source</p>                                                                                    | <p>LT1181AMJ</p>                                                                      |

Consult LTC Marketing for parts specified with wider operating temperature ranges.

## ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the operating temperature range ( $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$  for commercial grade, and  $-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$  for industrial grade. (Note 2)

| PARAMETER                            | CONDITIONS                           | MIN | TYP  | MAX | UNITS         |
|--------------------------------------|--------------------------------------|-----|------|-----|---------------|
| <b>Power Supply Generator</b>        |                                      |     |      |     |               |
| $V^+$ Output                         |                                      |     | 7.9  |     | V             |
| $V^-$ Output                         |                                      |     | -7.0 |     | V             |
| Supply Current ( $V_{CC}$ )          | (Note 3), $T_A = 25^\circ\text{C}$   | ●   | 9    | 13  | mA            |
|                                      |                                      | ●   |      | 16  | mA            |
| Supply Current When OFF ( $V_{CC}$ ) | Shutdown (Note 4) LT1180A Only       | ●   | 1    | 10  | $\mu\text{A}$ |
| Supply Rise Time                     | $C1 = C2 = C3 = C4 = 0.1\mu\text{F}$ |     | 0.2  |     | ms            |
| Shutdown to Turn-On                  | LT1180A Only                         |     | 0.2  |     | ms            |
| ON/OFF Pin Thresholds                | Input Low Level (Device Shutdown)    | ●   | 0.8  | 1.2 | V             |
|                                      | Input High Level (Device Enabled)    | ●   | 1.6  | 2.4 | V             |

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# ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the operating temperature range ( $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$  for commercial grade, and  $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$  for industrial grade. (Note 2)

| PARAMETER                                   | CONDITIONS                                                                                |                      |   | MIN        | TYP         | MAX        | UNITS                          |
|---------------------------------------------|-------------------------------------------------------------------------------------------|----------------------|---|------------|-------------|------------|--------------------------------|
| ON/OFF Pin Current                          | $0V \leq V_{ON/OFF} \leq 5V$                                                              | ●                    |   | -15        |             | 80         | $\mu\text{A}$                  |
| Oscillator Frequency                        |                                                                                           |                      |   |            | 130         |            | kHz                            |
| <b>Driver</b>                               |                                                                                           |                      |   |            |             |            |                                |
| Output Voltage Swing                        | Load = 3k to GND                                                                          | Positive<br>Negative | ● | 5.0        | 7.5<br>-6.3 | -5.0       | V<br>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                         | $0.8V \leq V_{IN} \leq 2.0V$                                                              | ●                    |   |            | 5           | 20         | $\mu\text{A}$                  |
| Output Short-Circuit Current                | $V_{OUT} = 0V$                                                                            |                      |   | $\pm 9$    | 17          |            | mA                             |
| Output Leakage Current                      | Shutdown $V_{OUT} = \pm 30V$ (Note 4)                                                     | ●                    |   |            | 10          | 100        | $\mu\text{A}$                  |
| Date Rate (Note 7)                          | $R_L = 3k, C_L = 2500pF$<br>$R_L = 3k, C_L = 1000pF$                                      |                      |   | 120<br>250 |             |            | kBaud<br>kBaud                 |
| Slew Rate                                   | $R_L = 3k, C_L = 51pF$                                                                    |                      |   |            | 15          | 30         | V/ $\mu\text{s}$               |
| $R_L = 3k, C_L = 2500pF$                    |                                                                                           |                      |   | 4          | 7           |            | V/ $\mu\text{s}$               |
| Propagation Delay                           | Output Transition $t_{HL}$ High-to-Low (Note 5)<br>Output Transition $t_{LH}$ Low-to-High |                      |   |            | 0.6<br>0.5  | 1.3<br>1.3 | $\mu\text{s}$<br>$\mu\text{s}$ |
| <b>Receiver</b>                             |                                                                                           |                      |   |            |             |            |                                |
| Input Voltage Thresholds                    | Input Low Threshold ( $V_{OUT} = \text{High}$ )                                           | C Grade              | ● | 0.8        | 1.3         |            | V                              |
|                                             | Input High Threshold ( $V_{OUT} = \text{Low}$ )                                           | C Grade              | ● |            | 1.7         | 2.4        | V                              |
|                                             | Input LowI,                                                                               | M Grade              | ● | 0.2        | 1.3         |            | V                              |
|                                             | Input HighI,                                                                              | M Grade              | ● |            | 1.7         | 3.0        | V                              |
| Hysteresis                                  |                                                                                           |                      | ● | 0.1        | 0.4         | 1.0        | V                              |
| Input Resistance                            | $V_{IN} = \pm 10V$                                                                        |                      |   | 3          | 5           | 7          | k $\Omega$                     |
| Output Leakage Current                      | Shutdown (Note 4) $0 \leq V_{OUT} \leq V_{CC}$                                            | ●                    |   |            | 1           | 10         | $\mu\text{A}$                  |
| Output Voltage                              | Output Low, $I_{OUT} = -1.6mA$                                                            | ●                    |   |            | 0.2         | 0.4        | V                              |
|                                             | Output High, $I_{OUT} = 160\mu\text{A}$ ( $V_{CC} = 5V$ )                                 | ●                    |   | 3.5        | 4.2         |            | V                              |
| Output Short-Circuit Current                | Sinking Current, $V_{OUT} = V_{CC}$<br>Sourcing Current, $V_{OUT} = 0V$                   |                      |   | 10         | -20<br>20   | -10<br>mA  | mA                             |
| Propagation Delay                           | Output Transition $t_{HL}$ High-to-Low (Note 6)                                           |                      |   |            | 250         | 600        | ns                             |
|                                             | Output Transition $t_{LH}$ Low-to-High                                                    |                      |   |            | 350         | 600        | ns                             |

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

**Note 2:** Testing done at  $V_{CC} = 5V$  and  $V_{ON/OFF} = 3V$ , unless otherwise specified.

**Note 3:** Supply current is measured as the average over several charge pump cycles.  $C^+ = C^- = C1 = C2 = 0.1\mu\text{F}$ . All outputs are open, with all driver inputs tied high.

**Note 4:** Supply current measurements in SHUTDOWN are performed with  $V_{ON/OFF} \leq 0.1V$ .

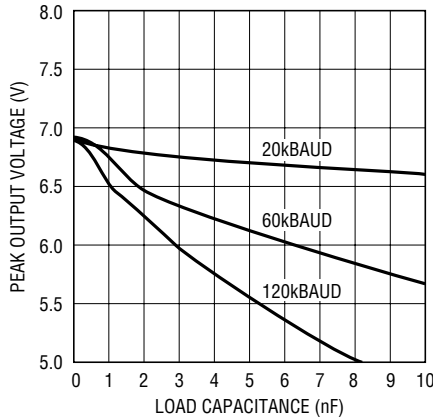
**Note 5:** For driver delay measurements,  $R_L = 3k$  and  $C_L = 51pF$ . Trigger points are set between the driver's input logic threshold and the output transition to the zero crossing ( $t_{HL} = 1.4V$  to  $0V$  and  $t_{LH} = 1.4V$  to  $0V$ ).

**Note 6:** For receiver delay measurements,  $C_L = 51pF$ . Trigger points are set between the receiver's input logic threshold and the output transition to standard TTL/CMOS logic threshold ( $t_{HL} = 1.3V$  to  $2.4V$  and  $t_{LH} = 1.7V$  to  $0.8V$ ).

**Note 7:** Data rate operation guaranteed by slew rate, short-circuit current and propagation delay tests.

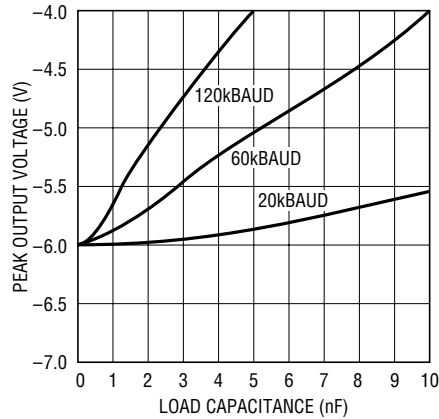
## TYPICAL PERFORMANCE CHARACTERISTICS

**Driver Maximum Output Voltage vs Load Capacitance**



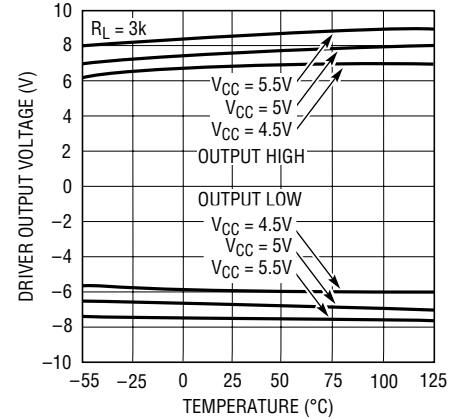
LT1180A • TPC01

**Driver Minimum Output Voltage vs Load Capacitance**



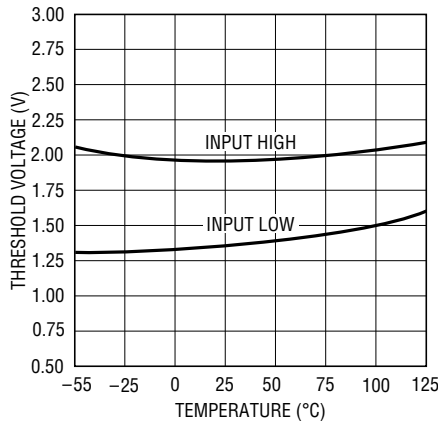
LT1180A • TPC02

**Driver Output Voltage**



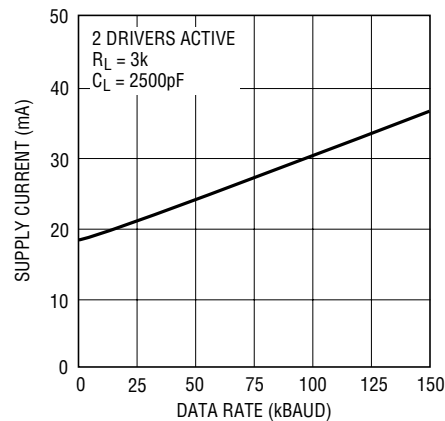
LT1180A • TPC03

**Receiver Input Thresholds**



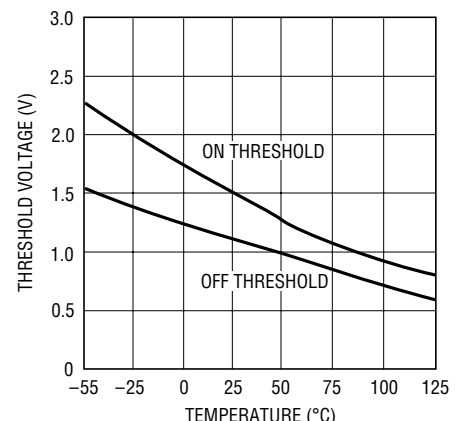
LT1180A • TPC04

**Supply Current vs Data Rate**



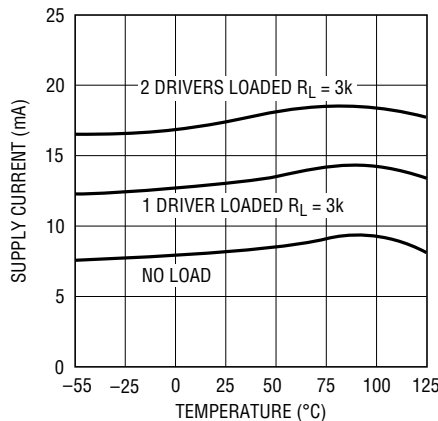
LT1180A • TPC05

**ON/OFF Thresholds**



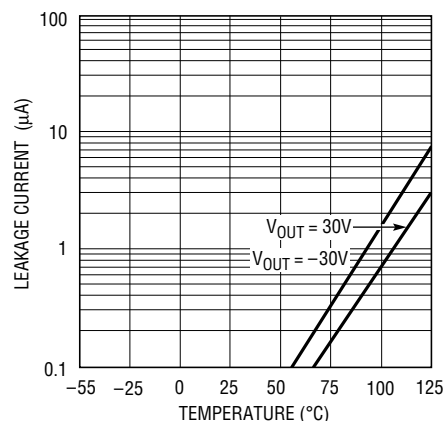
LT1180A • TPC06

**Supply Current**



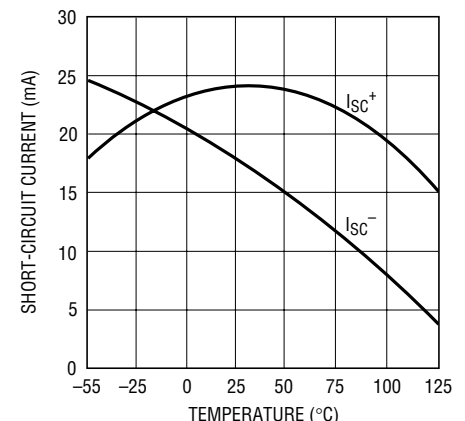
LT1180A • TPC07

**Driver Leakage in Shutdown**



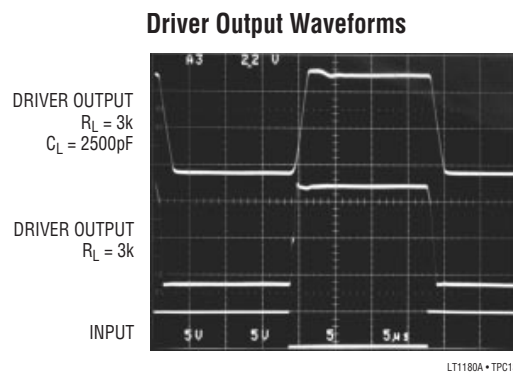
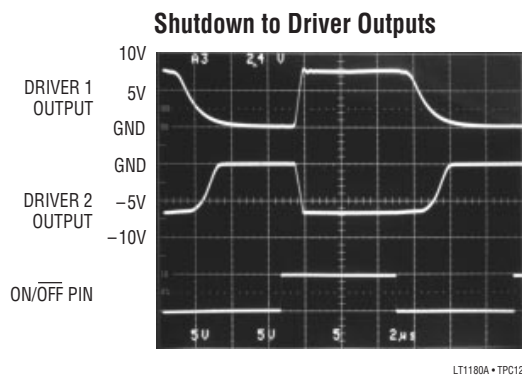
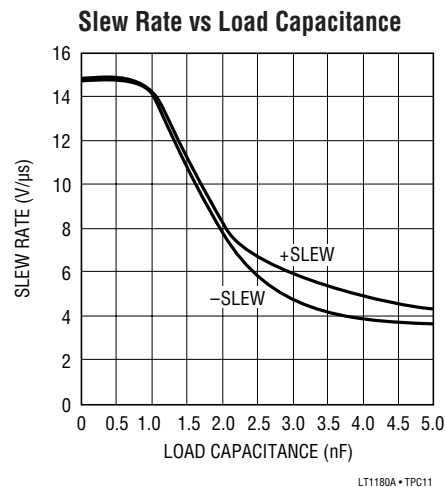
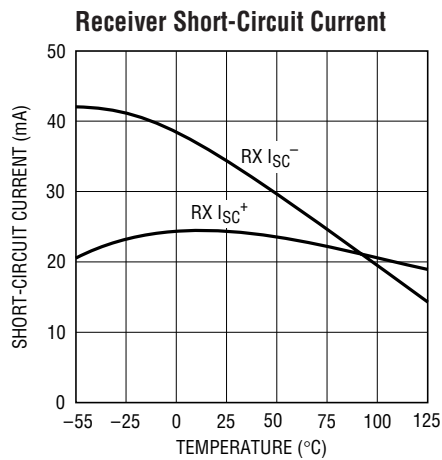
LT1180A • TPC08

**Driver Short-Circuit Current**



LT1180A • TPC09

## TYPICAL PERFORMANCE CHARACTERISTICS



## PIN FUNCTIONS

**V<sub>CC</sub>:** 5V Input Supply Pin. This pin should be decoupled with a 0.1μF ceramic capacitor close to the package pin. Insufficient supply bypassing can result in low output drive levels and erratic charge pump operation.

**GND:** Ground Pin.

**ON/OFF:** A TTL/CMOS Compatible Operating Mode Control. A logic low puts the LT1180A in shutdown mode. Supply current drops to zero and both driver and receiver outputs assume a high impedance state. A logic high fully enables the device.

**V<sup>+</sup>:** Positive Supply Output (RS232 Drivers).  $V^+ \approx 2V_{CC} - 1.5V$ . This pin requires an external charge storage capacitor  $C \geq 0.1\mu F$ , tied to ground or  $V_{CC}$ . Larger value capacitors may be used to reduce supply ripple. With multiple transceivers, the  $V^+$  and  $V^-$  pins may be paralleled into common capacitors.

**V<sup>-</sup>:** Negative Supply Output (RS232 Drivers).  $V^- \approx -(2V_{CC} - 2.5V)$ . This pin requires an external charge storage capacitor  $C \geq 0.1\mu F$ . Larger value capacitors may be used to reduce supply ripple. With multiple transceivers, the  $V^+$  and  $V^-$  pins may be paralleled into common capacitors.

## PIN FUNCTIONS

**TR1 IN, TR2 IN:** RS232 Driver Input Pins. These inputs are TTL/CMOS compatible. Inputs should not be allowed to float. Tie unused inputs to  $V_{CC}$ .

**TR1 OUT, TR2 OUT:** Driver Outputs at RS232 Voltage Levels. Driver output swing meets RS232 levels for loads up to 3k. Slew rates are controlled for lightly loaded lines. Output current capability is sufficient for load conditions up to 2500pF. Outputs are in a high impedance state when in shutdown mode,  $V_{CC} = 0V$ , or when the driver disable pin is active. Outputs are fully short-circuit protected from  $V^- + 30V$  to  $V^+ - 30V$ . Applying higher voltages will not damage the device if the overdrive is moderately current limited. Short circuits on one output can load the power supply generator and may disrupt the signal levels of the other outputs. The driver outputs are protected against ESD to  $\pm 10kV$  for human body model discharges.

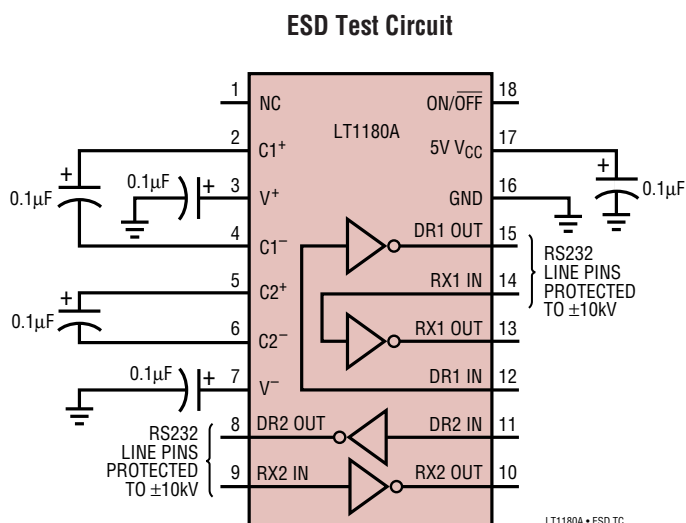
**REC1 IN, REC2 IN:** Receiver Inputs. These pins accept RS232 level signals ( $\pm 30V$ ) into a protected 5k terminating resistor. The receiver inputs are protected against ESD to  $\pm 10kV$  for human body model discharges. Each receiver provides 0.4V of hysteresis for noise immunity. Open receiver inputs assume a logic low state.

**REC1 OUT, REC2 OUT:** Receiver outputs with TTL/CMOS Voltage Levels. Outputs are in a high impedance state when in shutdown mode to allow data line sharing. Outputs are fully short-circuit protected to ground or  $V_{CC}$  with the power on, off or in the shutdown mode.

**C1+, C1-, C2+, C2-:** Commutating Capacitor Inputs. These pins require two external capacitors  $C \geq 0.1\mu F$ : one from  $C1^+$  to  $C1^-$  and another from  $C2^+$  to  $C2^-$ .  $C1$  should be deleted if a separate 12V supply is available and connected to pin  $C1^+$ . Similarly,  $C2$  should be deleted if a separate  $-12V$  supply is connected to pin  $V^-$ .

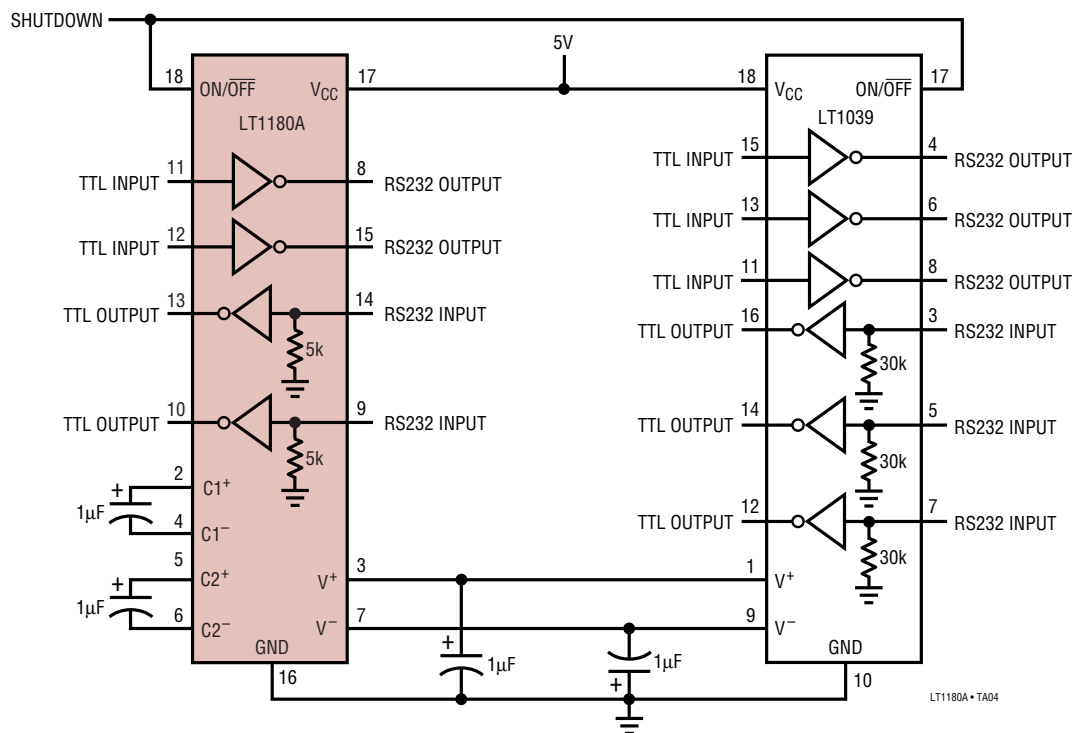
## ESD PROTECTION

The RS232 line inputs of the LT1180A/LT1181A have on-chip protection from ESD transients up to  $\pm 10kV$ . The protection structures act to divert the static discharge safely to system ground. In order for the ESD protection to function effectively, the power supply and ground pins of the circuit must be connected to ground through low impedances. The power supply decoupling capacitors and charge pump storage capacitors provide this low impedance in normal application of the circuit. The only constraint is that low ESR capacitors must be used for bypassing and charge storage. ESD testing must be done with pins  $V_{CC}$ ,  $V_L$ ,  $V^+$ ,  $V^-$ , and GND shorted to ground or connected with low ESR capacitors.



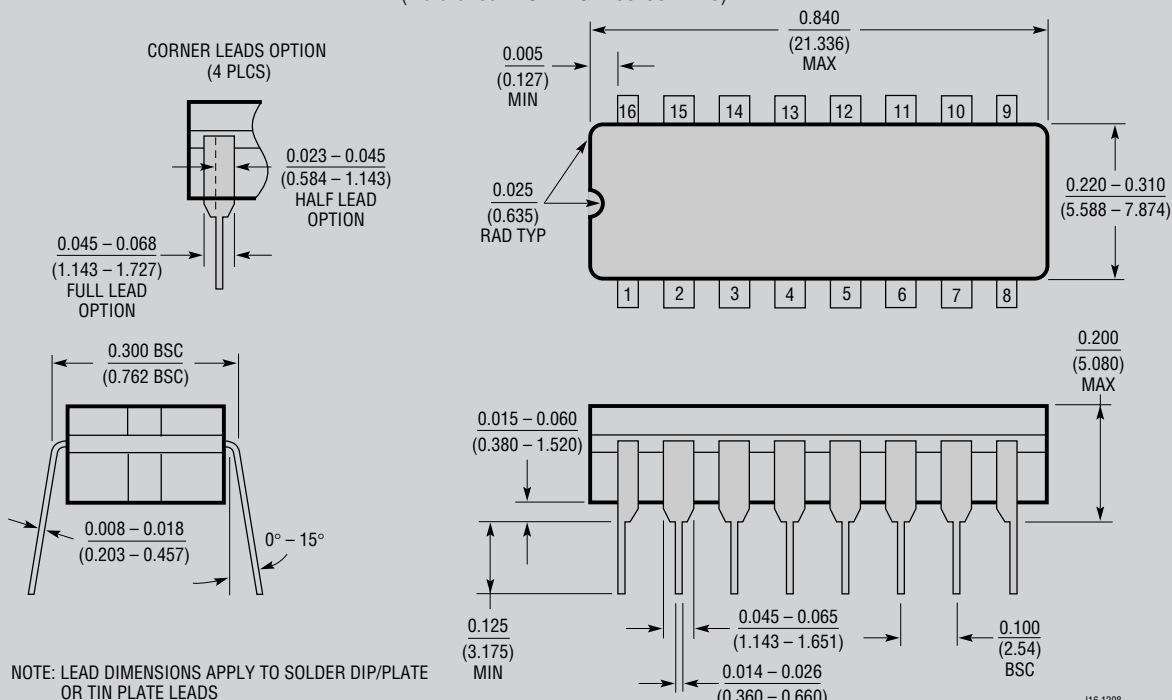
## TYPICAL APPLICATION

### Supporting an LT1039 (Triple Driver/Receiver)

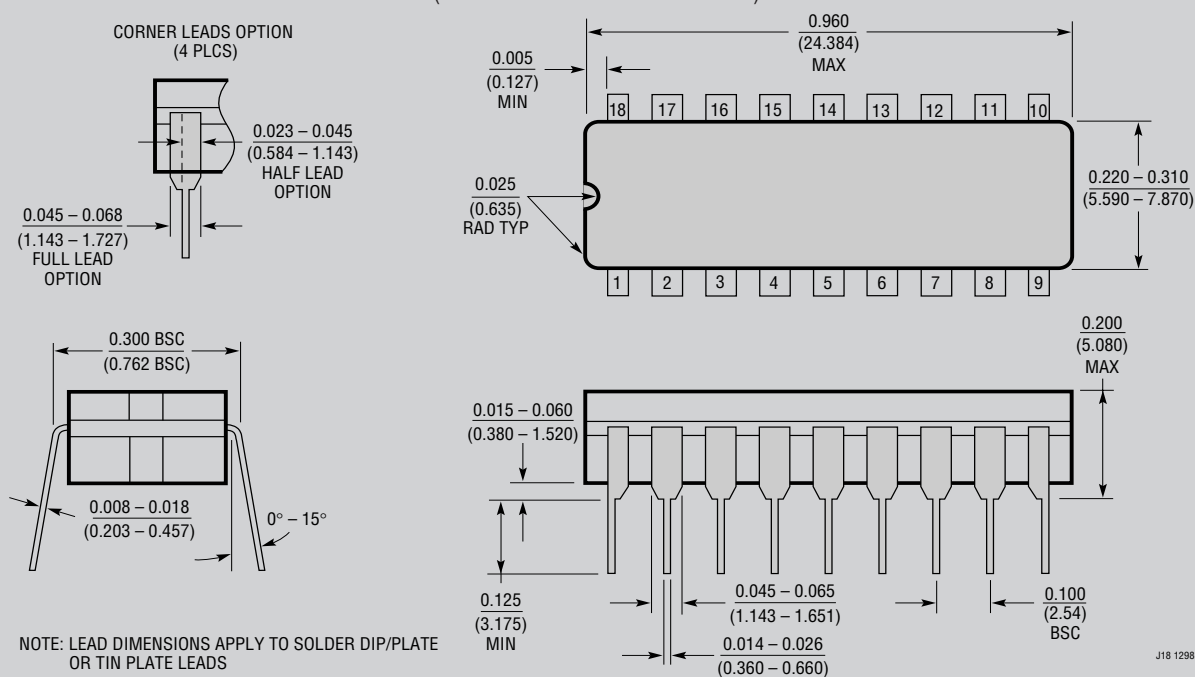


# PACKAGE DESCRIPTION

## J Package 16-Lead Cerdip (Narrow .300 Inch, Hermetic) (Reference LTC DWG # 05-08-1110)



## J Package 18-Lead Cerdip (Narrow .300 Inch, Hermetic) (Reference LTC DWG # 05-08-1110)

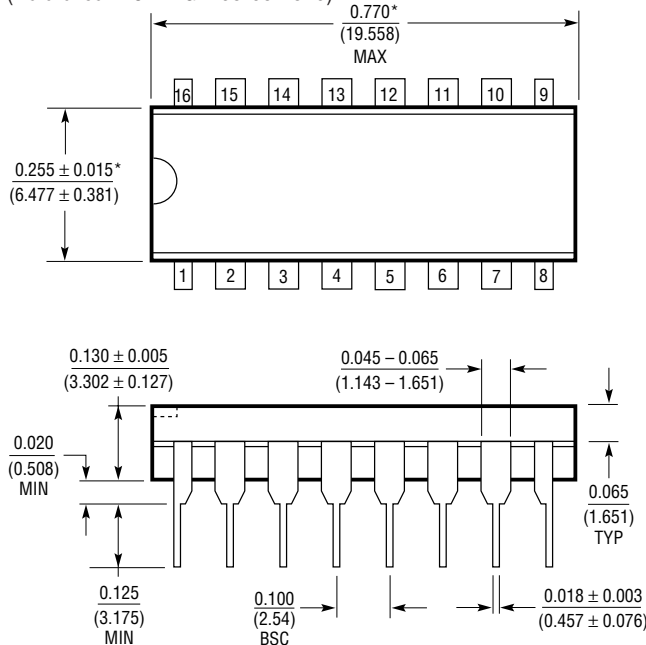


**OBSOLETE PACKAGES**



# PACKAGE DESCRIPTION

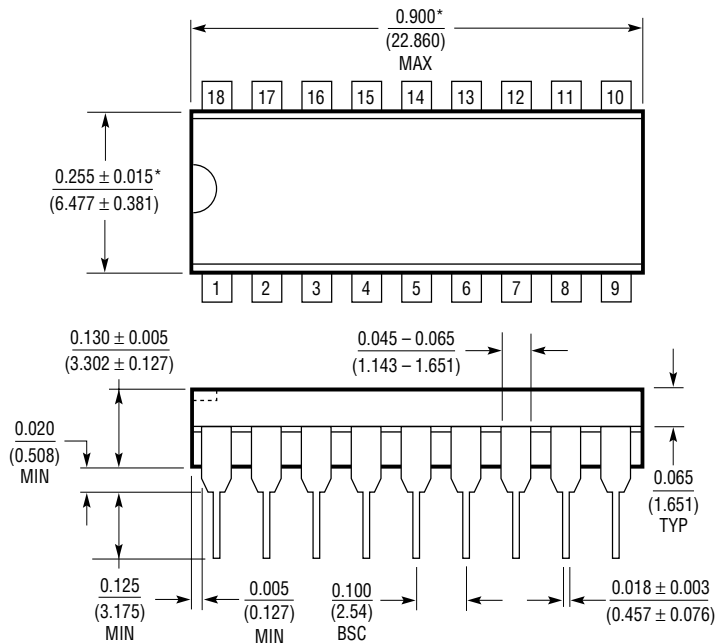
## N Package 16-Lead PDIP (Narrow .300 Inch) (Reference LTC DWG # 05-08-1510)



\*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 INCH (0.254mm)

N16 1098

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



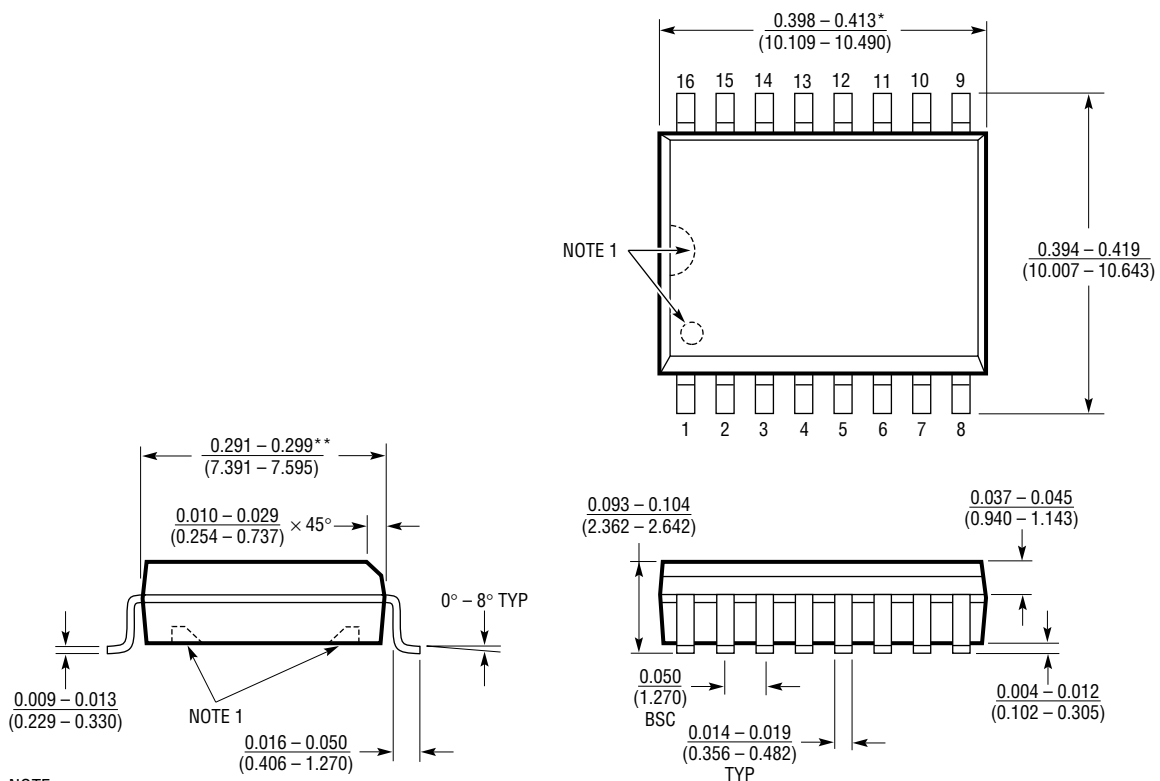
\*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 INCH (0.254mm)

N18 1098

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## PACKAGE DESCRIPTION

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



**NOTE:**

- 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

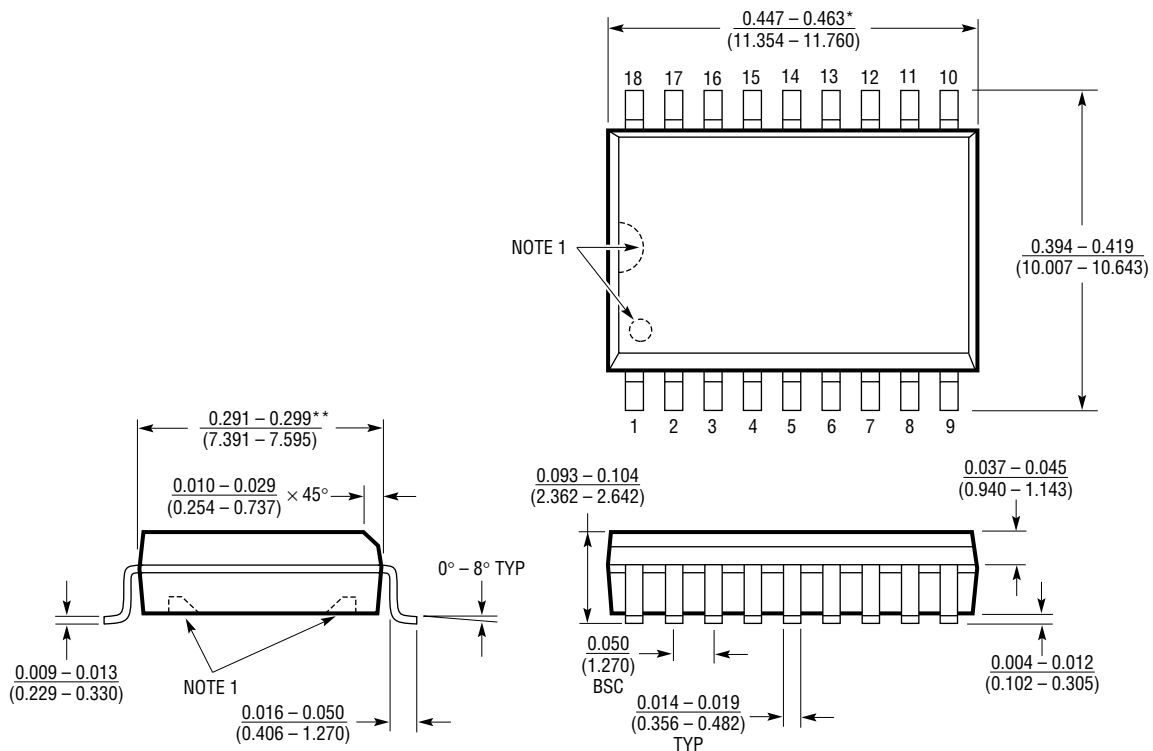
\*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

\*\*DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

S16 (WIDE) 1098

# PACKAGE DESCRIPTION

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



**NOTE:**

1. 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

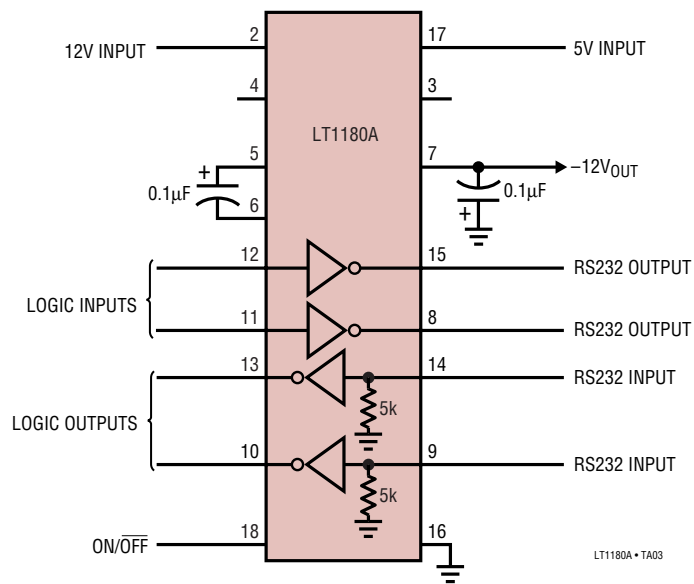
\*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

\*\*DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

S18 (WIDE) 1098

TYPICAL APPLICATION

Operation Using 5V and 12V Power Supplies



RELATED PARTS

| PART NUMBER     | DESCRIPTION                               | COMMENTS                                                        |
|-----------------|-------------------------------------------|-----------------------------------------------------------------|
| LT1280A/LT1281A | 5V 2-Driver/2-Receiver RS232 Transceivers | Pin Compatible with LT1180A/LT1181A, I <sub>CC</sub> = 10mA Max |
| LT1381          | 5V 2-Driver/2-Receiver RS232 Transceiver  | Narrow 16-Pin SO Package                                        |
| LT1780/LT1781   | 5V 2-Driver/2-Receiver RS232 Transceivers | IEC 1000-4-2 Level 4 Compliance                                 |

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,  
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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