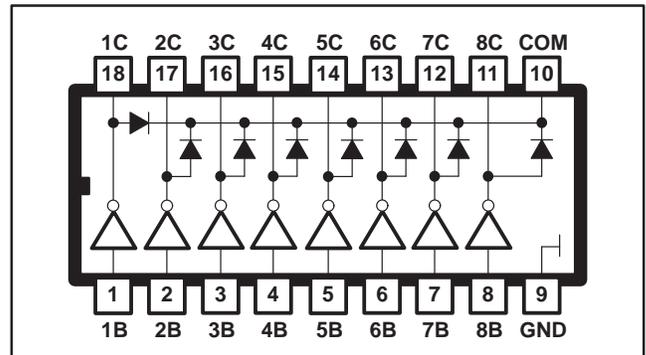


## HIGH-VOLTAGE, HIGH-CURRENT DARLINGTON TRANSISTOR ARRAY

- 500-mA-Rated Collector Current (Single Output)
- High-Voltage Outputs . . . 50 V
- Output Clamp Diodes
- Inputs Compatible With Various Types of Logic
- Relay Driver Applications
- Compatible With ULN2800A-Series

N DUAL-IN-LINE PACKAGE  
(TOP VIEW)



### description

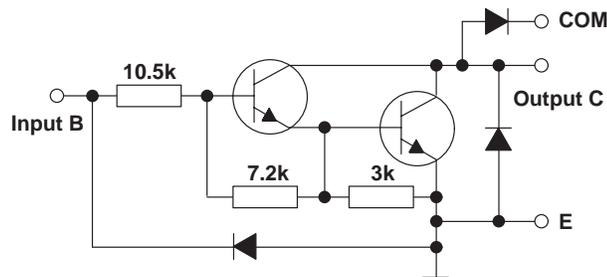
The ULN2804A is a monolithic high-voltage, high-current Darlington transistor array, comprising eight npn Darlington pairs. All units feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of each Darlington pair is 500 mA. Outputs and inputs can each be paralleled for higher current capability.

Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED and gas discharge), line drivers, and logic buffers.

The ULN2804A has an approximate 10.5-k $\Omega$  series input resistor to allow its operation directly from CMOS or PMOS, utilizing supply voltages of 6 to 15 volts.

The ULN2804A is characterized for operation from  $-20^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

### schematic (each Darlington pair)



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

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# ULN2804A

## DARLINGTON TRANSISTOR ARRAY

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### absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)

|   |                |
|---|----------------|
| Collector-emitter voltage   | 50 V           |
| Input voltage (see Note 1)  | 30 V           |
| Continuous collector current  | 500 mA         |
| Output clamp diode current  | 500 mA         |
| Total substrate-terminal current  | -2.5 A         |
| Continuous dissipation (total package) at (or below) 25°C free air temperature (see Note 2) | 1150 mW        |
| Operating free-air temperature range  | -20°C to 85°C  |
| Storage temperature range   | -65°C to 150°C |
| Lead temperature 1/16 inch from case for 10 seconds   | 260°C          |

- NOTES: 1. All voltages values, unless otherwise noted, are with respect to the emitter/substrate terminal E.  
 2. For operation above 25°C free-air temperature, refer to the Dissipation Derating Curves in the Thermal Information section.

### electrical characteristics at 25°C free-air temperature (unless otherwise noted)

| PARAMETER   | TEST FIGURE | TEST CONDITIONS  | ULN2804A |      |      | UNIT |
|---|-------------|--|----------|------|------|------|
|   |             |  | MIN      | TYP  | MAX  |      |
| I <sub>CEX</sub> Collector cutoff current                 | 1           | V <sub>CE</sub> = 50 V, I <sub>I</sub> = 0                             |          |      | 50   | μA   |
|   | 2           | T <sub>A</sub> = 70°C, V <sub>I</sub> = 1 V, V <sub>CE</sub> = 50 V    |          |      | 500  |      |
| I <sub>I(off)</sub> Off-state input current               | 3           | V <sub>CE</sub> = 50 V, I <sub>C</sub> = 500 μA, T <sub>A</sub> = 70°C | 50       | 65   |      | μA   |
| I <sub>I(ON)</sub> Input current                          | 4           | V <sub>I</sub> = 3.85 V  |          |      |      | mA   |
|   |             | V <sub>I</sub> = 5 V   |          | 0.35 | 0.5  |      |
|   |             | V <sub>I</sub> = 12 V  |          | 1.0  | 1.45 |      |
| V <sub>I(on)</sub> On-state input voltage                 | 6           | V <sub>CE</sub> = 2 V, I <sub>C</sub> = 125 mA                         |          |      | 5    | V    |
|   |             | V <sub>CE</sub> = 2 V, I <sub>C</sub> = 200 mA                         |          |      | 6    |      |
|   |             | V <sub>CE</sub> = 2 V, I <sub>C</sub> = 250 mA                         |          |      |      |      |
|   |             | V <sub>CE</sub> = 2 V, I <sub>C</sub> = 275 mA                         |          |      | 7    |      |
|   |             | V <sub>CE</sub> = 2 V, I <sub>C</sub> = 300 mA                         |          |      |      |      |
|   |             | V <sub>CE</sub> = 2 V, I <sub>C</sub> = 350 mA                         |          |      | 8    |      |
| V <sub>CE(sat)</sub> Collector-emitter saturation voltage | 5           | I <sub>I</sub> = 250 μA, I <sub>C</sub> = 100 mA                       |          | 0.9  | 1.1  | V    |
|   |             | I <sub>I</sub> = 350 μA, I <sub>C</sub> = 200 mA                       |          | 1.0  | 1.3  |      |
|   |             | I <sub>I</sub> = 500 μA, I <sub>C</sub> = 350 mA                       |          | 1.3  | 1.6  |      |
| I <sub>R</sub> Clamp-diode reverse current                | 7           | V <sub>R</sub> = 50 V  |          |      | 50   | μA   |
| V <sub>F</sub> Clamp-diode forward voltage                | 8           | I <sub>F</sub> = 350 mA  |          | 1.7  | 2    | V    |
| C <sub>i</sub> Input capacitance                          |             | V <sub>I</sub> = 0 V, f = 1 MHz  |          | 15   | 25   | pF   |

### switching characteristics at 25°C free-air temperature

| PARAMETER  | TEST CONDITIONS   | MIN                 | TYP  | MAX | UNIT |
|--|---|---------------------|------|-----|------|
| t <sub>PLH</sub> Propagation delay time, low- to high-level output | See Figure 9  |                     | 0.25 | 1   | μs   |
| t <sub>PHL</sub> Propagation delay time, high- to low-level output |   |                     | 0.25 | 1   | μs   |
| V <sub>OH</sub> High-level output voltage after switching          | V <sub>S</sub> = 50 V, I <sub>O</sub> = 300 mA, See Figure 10 | V <sub>S</sub> - 20 |      |     | mV   |



PARAMETER MEASUREMENT INFORMATION

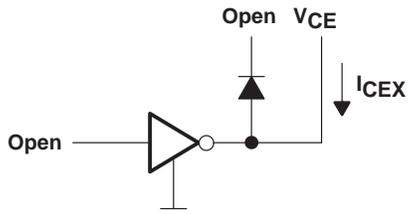


Figure 1.  $I_{CEX}$

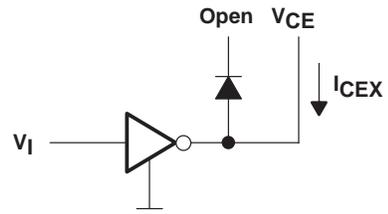


Figure 2.  $I_{CEX}$

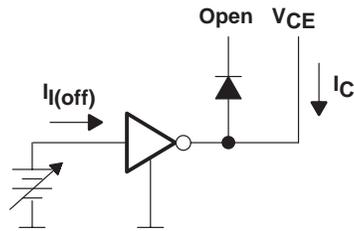


Figure 3.  $I_{I(off)}$

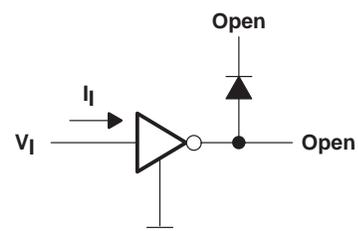


Figure 4.  $I_{I(on)}$

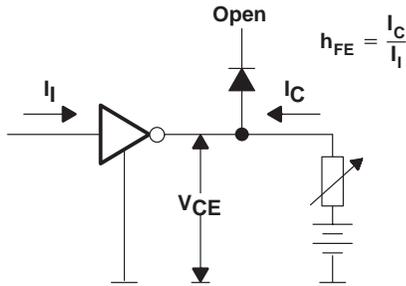


Figure 5.  $h_{FE}$ ,  $V_{CE(sat)}$

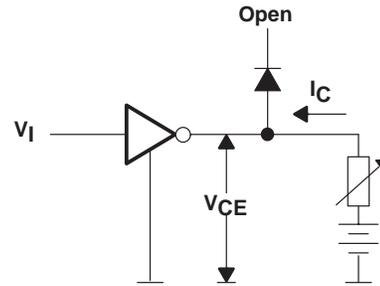


Figure 6.  $V_{I(on)}$

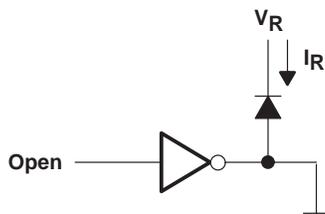


Figure 7.  $I_R$

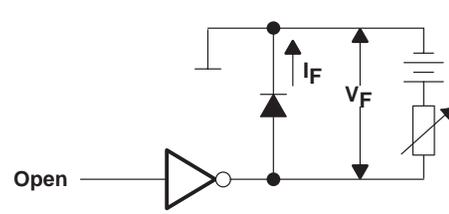
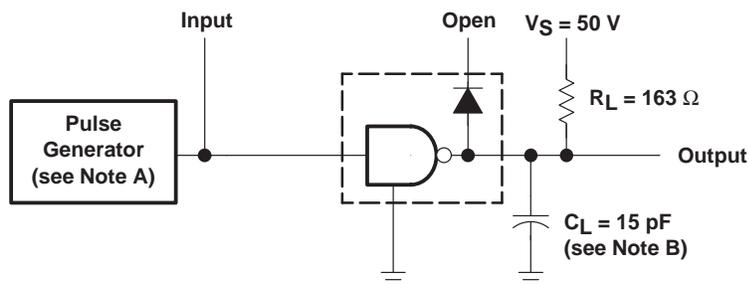


Figure 8.  $V_F$

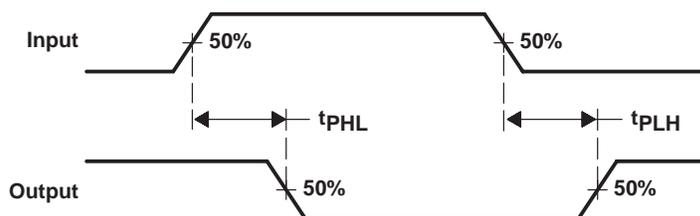
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## PARAMETER MEASUREMENT INFORMATION



### TEST CIRCUITS

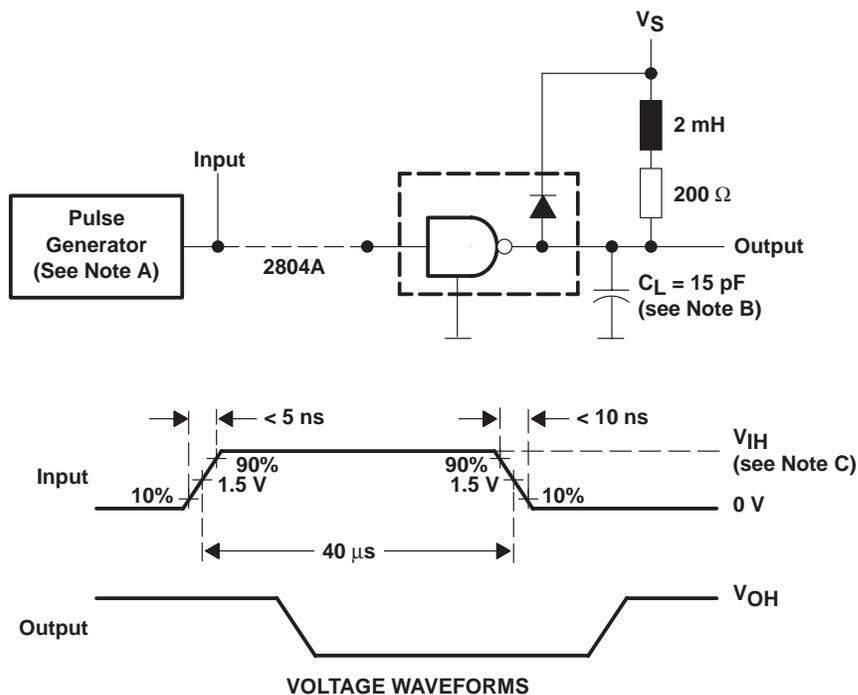


### VOLTAGE WAVEFORMS

- NOTES: A. The pulse generator has the following characteristics: PRR = 12.5 KHz,  $Z_O = 50 \Omega$ .  
B.  $C_L$  includes probe and jig capacitance.

Figure 9. Propagation Delay Times

PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The pulse generator has the following characteristics: PRR = 12.5 kHz,  $Z_{Out} = 50 \Omega$ .  
 B.  $C_L$  includes probe and jig capacitance.  
 C.  $V_{IH} = 8 \text{ V}$

Figure 10. Latch-Up Test

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