

# ULN2803A

## High-current Darlington Transistor Arrays

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### Features

- Wide operating voltage range
- Eight-way high-gain Darlington array
- High output voltage (up to 50V)
- High output current (up to 500mA)
- It can be directly connected with TTL, CMOS and PMOS
- Built-in clamp diode for sensitive load

### Applications

- Relay drive
- Dc lighting drive
- Stepper motor drive
- Solenoid valve
- Dc brushless motor drive

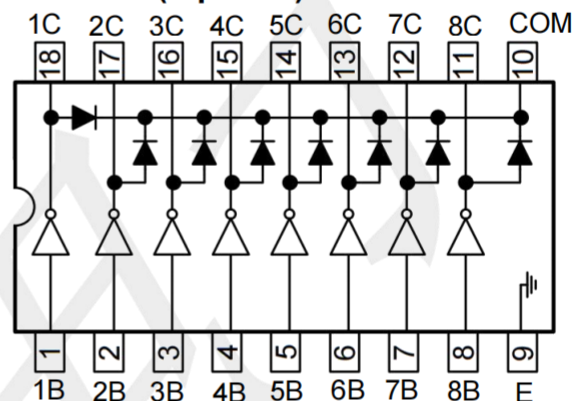
**MARKING:**



### General Description

The are high-voltage, high-current darlington drivers comprised of eight NPN Darlington pairs. All units feature integral clamp diodes for switching inductive loads. Applications include relay, hammer, lamp and display (LED)drivers.

### Pinout (top view)



### Pin Configurations

| Pin Number | Pin Name | Pin Function            |
|------------|----------|-------------------------|
| 1          | 1B       | Input pair1             |
| 2          | 2B       | Input pair2             |
| 3          | 3B       | Input pair3             |
| 4          | 4B       | Input pair4             |
| 5          | 5B       | Input pair5             |
| 6          | 6B       | Input pair6             |
| 7          | 7B       | Input pair7             |
| 8          | 8B       | Input pair8             |
| 9          | E        | Common Emitter (ground) |
| 10         | COM      | Common Clamp Diodes     |
| 11         | 8C       | Output pair8            |
| 12         | 7C       | Output pair7            |
| 13         | 6C       | Output pair6            |
| 14         | 5C       | Output pair5            |
| 15         | 4C       | Output pair4            |
| 16         | 3C       | Output pair3            |
| 17         | 2C       | Output pair2            |
| 18         | 1C       | Output pair1            |

### Absolute Maximum Ratings

At 25°C free-air temperature (unless otherwise noted)

| Symbol           | Parameter                                 | MIN                         | MAX  | UNIT |
|------------------|-------------------------------------------|-----------------------------|------|------|
| V <sub>CC</sub>  | Collector to emitter voltage              | --                          | 50   | V    |
| V <sub>R</sub>   | Clamp diode reverse voltage(2)            | --                          | 50   | V    |
| V <sub>I</sub>   | Input voltage(2)                          | --                          | 30   | V    |
| I <sub>CP</sub>  | Peak collector current                    | See typical characteristics |      | mA   |
| I <sub>OK</sub>  | Output clamp current                      | --                          | 500  | mA   |
| I <sub>TE</sub>  | Total emitter-terminal current            | --                          | -2.5 | A    |
| T <sub>A</sub>   | Operating free-air temperature range      | -20                         | +70  | °C   |
| θ <sub>JA</sub>  | Thermal Resistance Junction-to-Ambient(3) | --                          | 63   | °C/W |
| θ <sub>JC</sub>  | Thermal Resistance Junction-to-Case(4)    | --                          | 12   | °C/W |
| T <sub>J</sub>   | Operating virtual junction temperature    | --                          | +150 | °C   |
| T <sub>STG</sub> | Storage temperature range                 | -65                         | +150 | °C   |
| ESD              | Human Body Model                          | --                          | 3000 | V    |

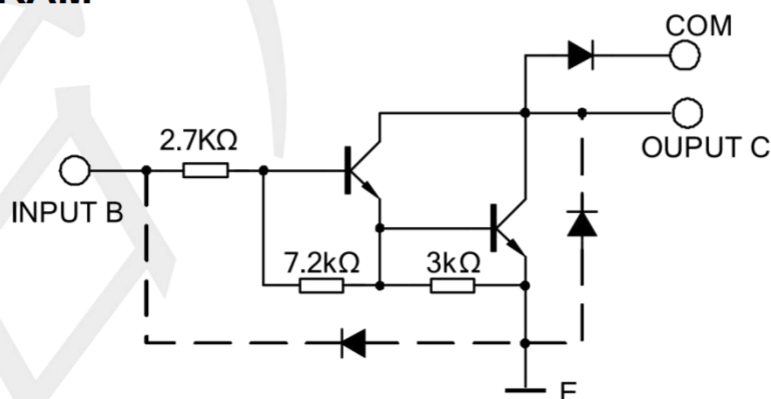
(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) All voltage values are with respect to the emitter/substrate terminal E, unless otherwise noted.

(3) Maximum power dissipation is a function of T<sub>J</sub>(max), θ<sub>JA</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any allowable ambient temperature is  $PD = (T_J(max) - T_A)/\theta_{JA}$ . Operating at the absolute maximum T<sub>J</sub> of 150°C can affect reliability.

(4) Maximum power dissipation is a function of T<sub>J</sub>(max), θ<sub>JC</sub>, and T<sub>A</sub>. The maximum allowable power dissipation at any allowable ambient temperature is  $PD = (T_J(max) - T_A)/\theta_{JC}$ . Operating at the absolute maximum T<sub>J</sub> of 150°C can affect reliability.

### BLOCK DIAGRAM



Note: The input and output parasitic diodes cannot be used as clamp diodes.

### Electrical Characteristics

(TA=+25°C, unless otherwise specified )

| SYM BOL               | PARAMETER                            | Test Figure | Test Conditions                             | MIN | TYP  | MAX  | UNIT |
|-----------------------|--------------------------------------|-------------|---------------------------------------------|-----|------|------|------|
| VCC                   | Collector to Emitter voltage         |             |                                             | --  | --   | 50   | V    |
| TA                    | Operating Ambient Temperature        |             |                                             | -40 | --   | +105 | °C   |
| V <sub>I</sub> (on)   | On-state input voltage               | Figure 6    | VCE = 2 V, IC = 200 mA                      | --  | --   | 2.4  | V    |
|                       |                                      |             | VCE = 2 V, IC = 250 mA                      | --  | --   | 2.7  | V    |
|                       |                                      |             | VCE = 2 V, IC = 300 mA                      | --  | --   | 3.0  | V    |
| V <sub>CE</sub> (sat) | Collector-emitter saturation voltage | Figure 5    | I <sub>I</sub> = 250 μA, IC = 100 mA        | --  | 0.9  | 1.1  | V    |
|                       |                                      |             | I <sub>I</sub> = 350 μA, IC = 200 mA        | --  | 1.0  | 1.3  | V    |
|                       |                                      |             | I <sub>I</sub> = 500 μA, IC = 350 mA        | --  | 1.2  | 1.6  | V    |
| I <sub>CEX</sub>      | Collector cutoff current             | Figure 1    | VCE = 50 V, I <sub>I</sub> = 0              | --  | --   | 50   | uA   |
|                       |                                      | Figure 2    | VCE = 50 V, I <sub>I</sub> = 0<br>TA=+150°C | --  | --   | 100  | uA   |
| V <sub>F</sub>        | Clamp forward voltage                | Figure 8    | IF = 350 mA                                 | --  | 1.7  | 2.0  | V    |
| I <sub>I</sub> (off)  | Off-state input current              | Figure 3    | VCE = 50 V, IC = 500 μA                     | 50  | 65   | --   | uA   |
| I <sub>I</sub>        | Input current                        | Figure 4    | V <sub>I</sub> = 3.85V                      | --  | 0.93 | 1.35 | mA   |
|                       |                                      |             | V <sub>I</sub> = 5.0V                       | --  | --   | --   | mA   |
|                       |                                      |             | V <sub>I</sub> = 12V                        | --  | --   | --   | mA   |
| I <sub>R</sub>        | Clamp reverse current                | Figure 7    | VR = 50 V                                   | --  | --   | 50   | uA   |
|                       |                                      |             | VR = 50 V, TA=+70°C                         | --  | --   | 100  | uA   |
| Ci                    | Input capacitance                    |             | VI = 0, f = 1 MHz                           | --  | 15   | 25   | PF   |

### Switching Characteristics

(TA = +25°C, unless otherwise specified)

| SYMBOL           | PARAMETER                                         | Test Conditions                      | MIN   | TYP  | MAX | UNIT |
|------------------|---------------------------------------------------|--------------------------------------|-------|------|-----|------|
| t <sub>PLH</sub> | Propagation delay time, low- to high-level output | See Figure 9                         | --    | 0.25 | 1.0 | μs   |
| t <sub>PHL</sub> | Propagation delay time, high- to low-level output | See Figure 9                         | --    | 0.25 | 1.0 | μs   |
| V <sub>OH</sub>  | High-level output voltage after switching         | VS = 50 V, IO = 300 mA, See Figure 9 | VS-20 | --   | --  | mV   |

### Parameter Measurement Information

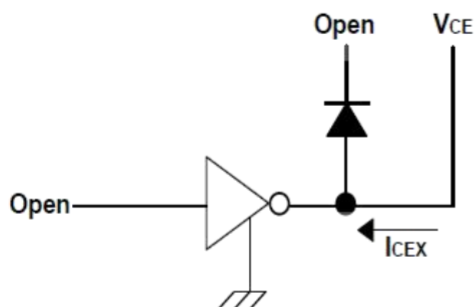


Fig.1 ICEX Test Circuit

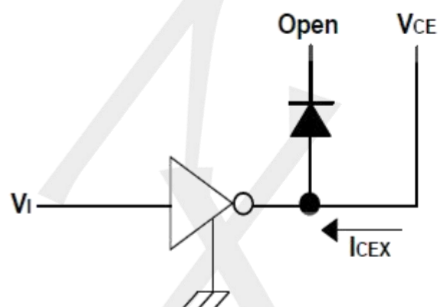


Fig.2 ICEX Test Circuit

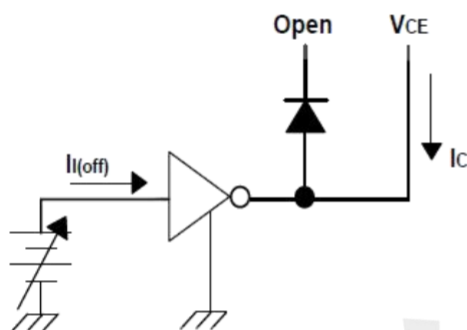


Fig.3 II(off) Test Circuit

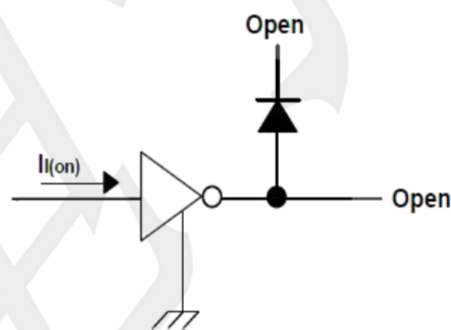


Fig.4 II Test Circuit

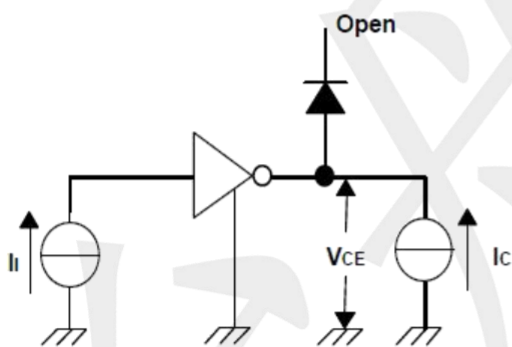


Fig. 5  $h_{FE}$ ,  $V_{CE(sat)}$  Test Circuit

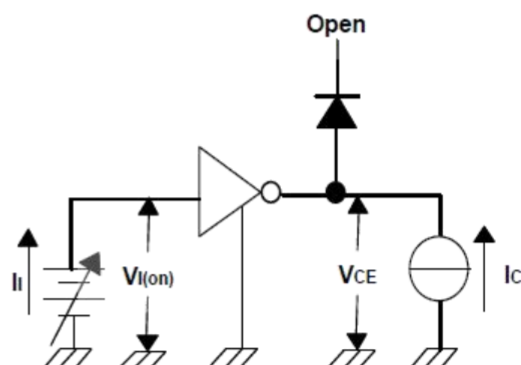


Fig. 6  $V_{I(on)}$  Test Circuit

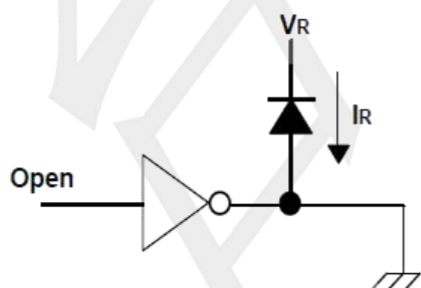


Fig. 7  $I_R$  Test Circuit

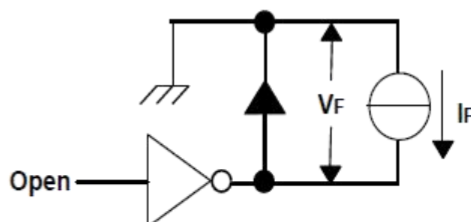


Fig. 8  $V_F$  Test Circuit

### Parameter Measurement Information

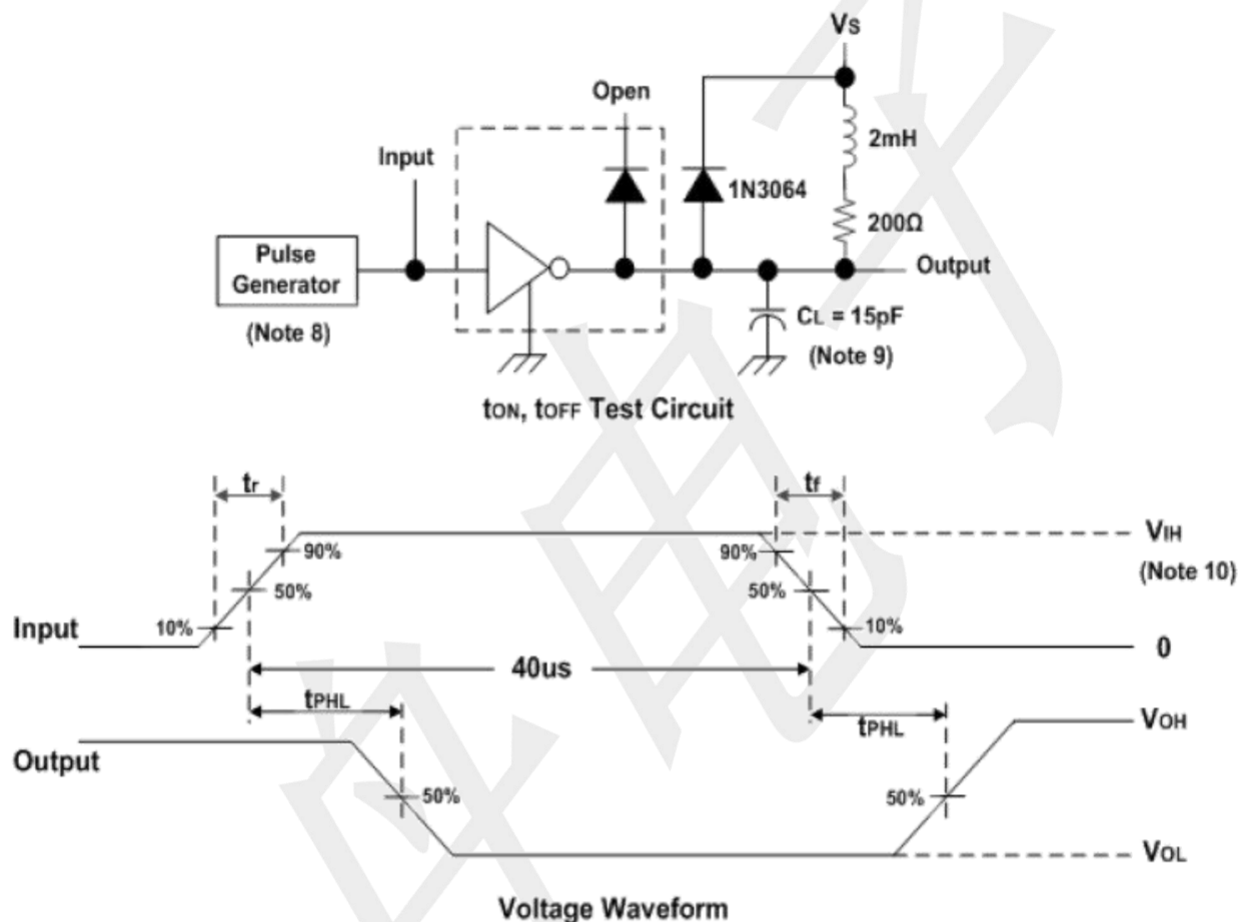


Fig. 9 Latch-Up Test Circuit and Voltage Waveform

Notes: 8. The pulse generator has the following characteristics:

Pulse Width=12.5Hz, output impedance 50Ω,  $t_r \leq 5ns$ ,  $t_f \leq 10ns$ .

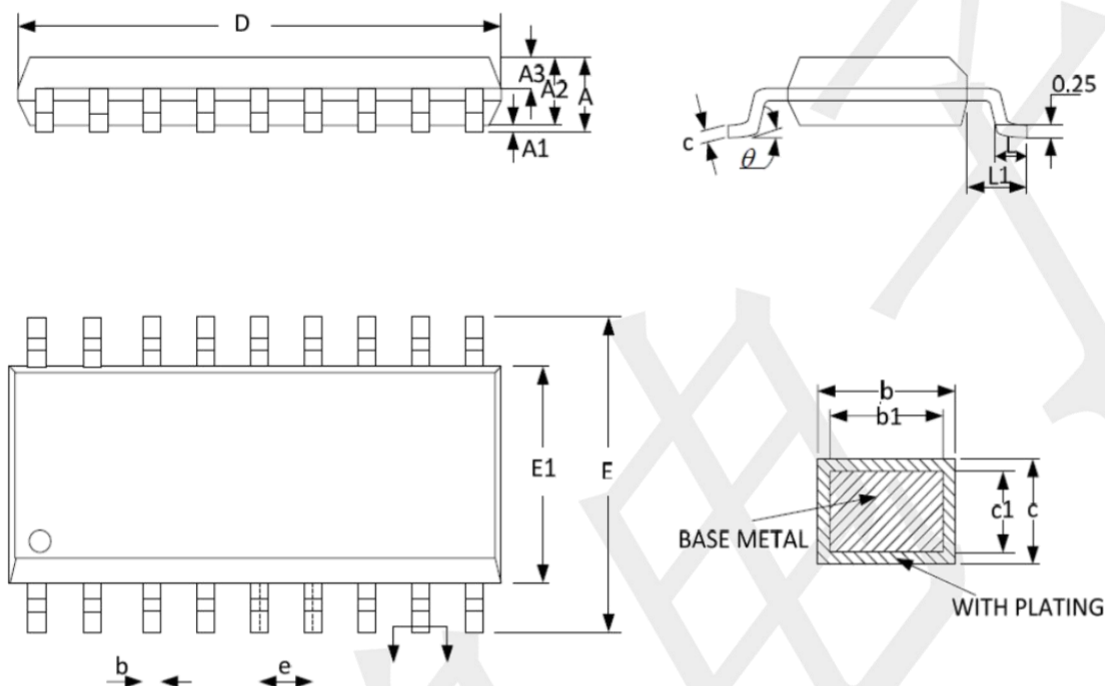
9. CL includes probe and jig capacitance.

10.  $V_{IH} = 3V$



### Package information

#### SOP18



| SYMBOL   | MILLMETER |       |       |
|----------|-----------|-------|-------|
|          | MIN       | NOM   | MAX   |
| A        | -         | -     | 2.70  |
| A1       | 0.08      | 0.18  | 0.28  |
| A2       | 2.10      | 2.30  | 2.50  |
| A3       | 0.92      | 1.02  | 1.12  |
| b        | 0.35      | -     | 0.44  |
| b1       | 0.34      | 0.37  | 0.39  |
| c        | 0.26      | -     | 0.31  |
| c1       | 0.24      | 0.25  | 0.26  |
| D        | 11.25     | 11.45 | 11.65 |
| E        | 10.10     | 10.30 | 10.50 |
| E1       | 7.30      | 7.50  | 7.70  |
| e        | 1.27BSC   |       |       |
| L        | 0.70      | 0.85  | 1.00  |
| L1       | 1.40BSC   |       |       |
| $\theta$ | 0°        | -     | 8°    |