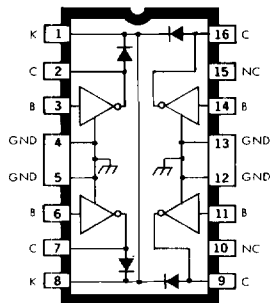


# 2061 THRU 2069

## 1.5 A DARLINGTON SWITCHES

**ULN2064/65B**



Dwg. No. A-9765A

### ABSOLUTE MAXIMUM RATINGS at +25°C Free-Air Temperature for Any One Driver (unless otherwise noted)

|                                                       |                 |
|-------------------------------------------------------|-----------------|
| Output Voltage, $V_{CEX}$ .....                       | See Guide       |
| Output Sustaining Voltage,<br>$V_{CE(SUS)}$ .....     | See Guide       |
| Output Current, $I_{OUT}$ (Note 1) .....              | 1.75 A          |
| Input Voltage, $V_{IN}$ (Note 2) .....                | See Guide       |
| Input Current, $I_B$ (Note 3) .....                   | 25 mA           |
| Supply Voltage,<br>$V_S$ (ULN2068B/LB & 2069B) .....  | 10 V            |
| Total Package Power Dissipation,<br>$P_D$ .....       | See Graph       |
| Operating Temperature Range, (Note 4),<br>$T_A$ ..... | -20°C to +85°C  |
| Storage Temperature Range,<br>$T_S$ .....             | -55°C to -150°C |

1. Allowable combinations of output current, number of outputs conducting, and duty cycle are shown on following pages.
2. Input voltage is referenced to the substrate (no connection to other pins) for the ULN2061/62M, reference is ground for all other types.
3. Input current may be limited by maximum allowable input voltage.
4. The ULN2065B and ULN2068B are also available for operation between -40°C and +85°C. Change third character from 'N' to 'Q'.

High-voltage, high-current Darlington arrays ULN2061M through ULN2069B are designed for interface between low-level logic and a variety of peripheral loads such as relays, solenoids, dc and stepper motors, magnetic print hammers, multiplexed LED and incandescent displays, heaters, and similar loads. Output OFF voltage ratings of 50 V and 80 V are available. In the DIP, the quad drivers can drive resistive loads to 480 watts (1.5 A x 80 V, 26% duty cycle). For inductive loads, sustaining voltages of 35 V and 50 V at 100 mA are specified.

Dual-driver arrays ULN2061M and the higher-voltage ULN2062M are used for common-emitter (externally connected) or emitter-follower applications. They are supplied in 8-pin plastic mini-DIPs.

Quad drivers ULN2064B/LB, ULN2065B, ULN2068B/LB, and ULN2069B are intended for use with TTL, low-speed TTL, and 5 V MOS logic. The ULN2065B and ULN2069B are selected for the 80 V minimum output breakdown specification. The ULN2068B/LB and ULN2069B have pre-driver stages and are recommended for applications requiring high gain (low input-current loading). Quad-driver arrays are supplied with heat-sink contact tabs in 16-pin plastic DIPs (suffix B) and 20-lead surface-mountable wide-body SOICs (suffix LB).

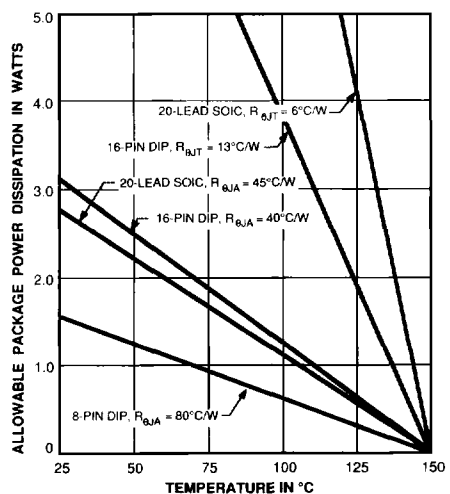
### FEATURES

- TTL, DTL, MOS, CMOS Compatible Inputs
- Transient-Protected Outputs
- Loads to 480 Watts
- Heat-Sink Contact Tabs on Quad Arrays

Always order by complete part number, e.g., **ULN2061M**. See matrix on next page. Note that all devices are not available in all package types.

# 2061 THRU 2069

## 1.5 A DARLINGTON SWITCHES



Dwg. GP-027

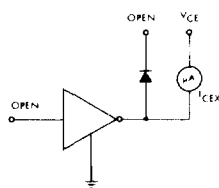
### SELECTION GUIDE

| Part Number* | Max. $V_{CEX}$ | Min. $V_{CE(SUS)}$ | Max. $V_{IN}$ | Application                          |
|--------------|----------------|--------------------|---------------|--------------------------------------|
| ULN2061M     | 50 V           | 35 V               | 30 V          | TTL, DTL, Schottky TTL, and 5 V CMOS |
| ULN2062M     | 80 V           | 50 V               | 60 V          |                                      |
| ULN2064B     | 50 V           | 35 V               | 15 V          | TTL, DTL, Schottky TTL, and 5 V CMOS |
| ULN2064LB    | 50 V           | 35 V               | 15 V          |                                      |
| ULN2065B†    | 80 V           | 50 V               | 15 V          | TTL, DTL, Schottky TTL, and 5 V CMOS |
| ULN2068B†    | 50 V           | 35 V               | 15 V          |                                      |
| ULN2068LB    | 50 V           | 35 V               | 15 V          |                                      |
| ULN2069B     | 80 V           | 50 V               | 15 V          |                                      |

\* Suffixes 'LB' are SOICs, 'B' and 'M' are DIPs.

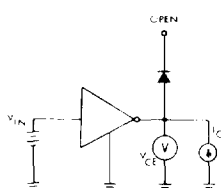
† These devices are also available for operation between  $-40^{\circ}\text{C}$  and  $+85^{\circ}\text{C}$ . To order, change third character from 'N' to 'Q'.

### TEST FIGURES



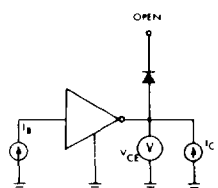
Dwg. No. A-9729A

FIGURE 1



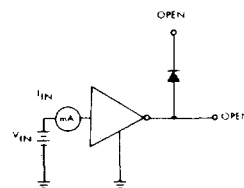
Dwg. No. A-10,350

FIGURE 2



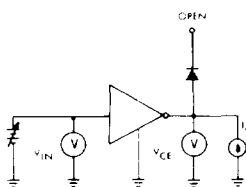
Dwg. No. A-10,349

FIGURE 3



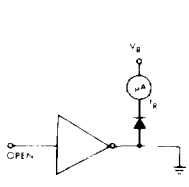
Dwg. No. A-9732

FIGURE 4



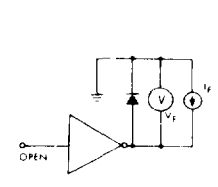
Dwg. No. A-9734A

FIGURE 5



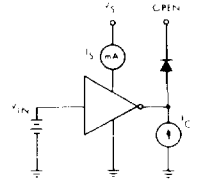
Dwg. No. A-9735A

FIGURE 6



Dwg. No. A-9736

FIGURE 7



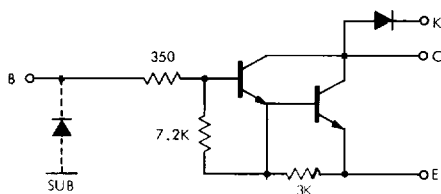
Dwg. No. A-10,351

FIGURE 8

# 2061 THRU 2069

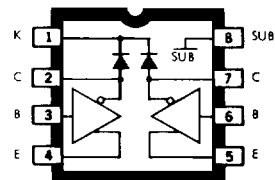
## 1.5 A DARLINGTON SWITCHES

### PARTIAL SCHEMATIC



Dwg. No. A-10,352B

### ULN2061/62M



Dwg. No. A-10,230A

### ELECTRICAL CHARACTERISTICS at +25°C (unless otherwise noted).

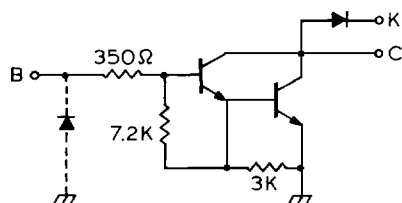
| Characteristic                       | Symbol        | Test Fig. | Applicable Devices | Test Conditions                                     | Limits |      |               |
|--------------------------------------|---------------|-----------|--------------------|-----------------------------------------------------|--------|------|---------------|
|                                      |               |           |                    |                                                     | Min.   | Max. | Units         |
| Output Leakage Current               | $I_{CEX}$     | 1         | ULN2061M           | $V_{CE} = 50 \text{ V}$                             | —      | 100  | $\mu\text{A}$ |
|                                      |               |           |                    | $V_{CE} = 50 \text{ V}, T_A = 70^\circ\text{C}$     | —      | 500  | $\mu\text{A}$ |
|                                      |               |           | ULN2062M           | $V_{CE} = 80 \text{ V}$                             | —      | 100  | $\mu\text{A}$ |
|                                      |               |           |                    | $V_{CE} = 80 \text{ V}, T_A = 70^\circ\text{C}$     | —      | 500  | $\mu\text{A}$ |
| Output Sustaining Voltage            | $V_{CE(SUS)}$ | 2         | ULN2061M           | $I_C = 100 \text{ mA}, V_{IN} = 0.4 \text{ V}$      | 35     | —    | V             |
|                                      |               |           | ULN2062M           | $I_C = 100 \text{ mA}, V_{IN} = 0.4 \text{ V}$      | 50     | —    | V             |
| Collector-Emitter Saturation Voltage | $V_{CE(SAT)}$ | 3         | Both               | $I_C = 500 \text{ mA}, I_B = 625 \mu\text{A}$       | —      | 1.1  | V             |
|                                      |               |           |                    | $I_C = 750 \text{ mA}, I_B = 935 \mu\text{A}$       | —      | 1.2  | V             |
|                                      |               |           |                    | $I_C = 1.0 \text{ A}, I_B = 1.25 \text{ mA}$        | —      | 1.3  | V             |
|                                      |               |           |                    | $I_C = 1.25 \text{ A}^{**}, I_B = 2.0 \text{ mA}$   | —      | 1.4  | V             |
|                                      |               | —         | ULN2062M           | $I_C = 1.5 \text{ A}^{**}, I_B = 2.25 \text{ mA}$   | —      | 1.5  | V             |
| Input Current                        | $I_{IN(ON)}$  | 4         | Both               | $V_{IN} = 2.4 \text{ V}$                            | 1.4    | 4.3  | mA            |
|                                      |               |           |                    | $V_{IN} = 3.75 \text{ V}$                           | 3.3    | 9.6  | mA            |
| Input Voltage                        | $V_{IN(ON)}$  | 5         | Both               | $V_{CE} = 2.0 \text{ V}, I_C = 1.0 \text{ A}$       | —      | 2.0  | V             |
|                                      |               |           | ULN2061M           | $V_{CE} = 2.0 \text{ V}, I_C = 1.25 \text{ A}^{**}$ | —      | 2.5  | V             |
|                                      |               |           | ULN2062M           | $V_{CE} = 2.0 \text{ V}, I_C = 1.5 \text{ A}^{**}$  | —      | 2.5  | V             |
| Turn-On Delay                        | $t_{PLH}$     | —         | Both               | $0.5 E_{in} \text{ to } 0.5 E_{out}$                | —      | 1.0  | $\mu\text{s}$ |
| Turn-Off Delay                       | $t_{PHL}$     | —         | Both               | $0.5 E_{in} \text{ to } 0.5 E_{out}$                | —      | 1.5  | $\mu\text{s}$ |
| Clamp Diode Leakage Current          | $I_R$         | 6         | ULN2061M           | $V_R = 50 \text{ V}$                                | —      | 50   | $\mu\text{A}$ |
|                                      |               |           | ULN2061M           | $V_R = 50 \text{ V}, T_A = 70^\circ\text{C}$        | —      | 100  | $\mu\text{A}$ |
|                                      |               | 6         | ULN2062M           | $V_R = 80 \text{ V}$                                | —      | 50   | $\mu\text{A}$ |
|                                      |               |           | ULN2062M           | $V_R = 80 \text{ V}, T_A = 70^\circ\text{C}$        | —      | 100  | $\mu\text{A}$ |
| Clamp Diode Forward Voltage          | $V_F$         | 7         | Both               | $I_F = 1.0 \text{ A}$                               | —      | 1.75 | V             |
|                                      |               |           |                    | $I_F = 1.5 \text{ A}$                               | —      | 2.0  | V             |

\*\*Pulse-Test

# 2061 THRU 2069

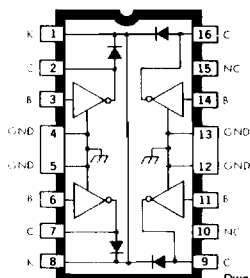
## 1.5 A DARLINGTON SWITCHES

### PARTIAL SCHEMATIC



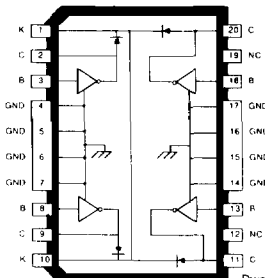
Dwg. No. A-10,353C

### ULN2064/65B



Dwg. No. A-9765A

### ULN2064LB



Dwg. No. A-14,326

### ELECTRICAL CHARACTERISTICS at +25°C (unless otherwise noted).

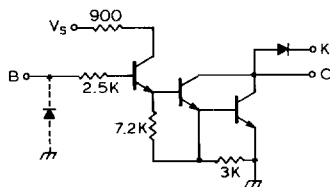
| Characteristic                       | Symbol        | Test Fig. | Applicable Devices | Test Conditions                                 | Limits |      |               |
|--------------------------------------|---------------|-----------|--------------------|-------------------------------------------------|--------|------|---------------|
|                                      |               |           |                    |                                                 | Min.   | Max. | Units         |
| Output Leakage Current               | $I_{CEX}$     | 1         | ULN2064*           | $V_{CE} = 50 \text{ V}$                         | —      | 100  | $\mu\text{A}$ |
|                                      |               |           |                    | $V_{CE} = 50 \text{ V}, T_A = 70^\circ\text{C}$ | —      | 500  | $\mu\text{A}$ |
|                                      |               |           | ULN2065B           | $V_{CE} = 80 \text{ V}$                         | —      | 100  | $\mu\text{A}$ |
|                                      |               |           |                    | $V_{CE} = 80 \text{ V}, T_A = 70^\circ\text{C}$ | —      | 500  | $\mu\text{A}$ |
| Output Sustaining Voltage            | $V_{CE(SUS)}$ | 2         | ULN2064*           | $I_C = 100 \text{ mA}, V_{IN} = 0.4 \text{ V}$  | 35     | —    | V             |
|                                      |               |           | ULN2065B           | $I_C = 100 \text{ mA}, V_{IN} = 0.4 \text{ V}$  | 50     | —    | V             |
| Collector-Emitter Saturation Voltage | $V_{CE(SAT)}$ | 3         | Both               | $I_C = 500 \text{ mA}, I_B = 625 \mu\text{A}$   | —      | 1.1  | V             |
|                                      |               |           |                    | $I_C = 750 \text{ mA}, I_B = 935 \mu\text{A}$   | —      | 1.2  | V             |
|                                      |               |           |                    | $I_C = 1.0 \text{ A}, I_B = 1.25 \text{ mA}$    | —      | 1.3  | V             |
|                                      |               |           |                    | $I_C = 1.25 \text{ A}, I_B = 2.0 \text{ mA}$    | —      | 1.4  | V             |
|                                      |               |           | ULN2065B           | $I_C = 1.5 \text{ A}, I_B = 2.25 \text{ mA}$    | —      | 1.5  | V             |
| Input Current                        | $I_{IN(ON)}$  | 4         | Both               | $V_{IN} = 2.4 \text{ V}$                        | 1.4    | 4.3  | mA            |
|                                      |               |           |                    | $V_{IN} = 3.75 \text{ V}$                       | 3.3    | 9.6  | mA            |
| Input Voltage                        | $V_{IN(ON)}$  | 5         | Both               | $V_{CE} = 2.0 \text{ V}, I_C = 1.0 \text{ A}$   | —      | 2.0  | V             |
|                                      |               |           | ULN2064*           | $V_{CE} = 2.0 \text{ V}, I_C = 1.25 \text{ A}$  | —      | 2.5  | V             |
|                                      |               |           | ULN2065B           | $V_{CE} = 2.0 \text{ V}, I_C = 1.5 \text{ A}$   | —      | 2.5  | V             |
| Turn-On Delay                        | $t_{PLH}$     | —         | Both               | $0.5 E_{in} \text{ to } 0.5 E_{out}$            | —      | 1.0  | $\mu\text{s}$ |
| Turn-Off Delay                       | $t_{PHL}$     | —         | Both               | $0.5 E_{in} \text{ to } 0.5 E_{out}$            | —      | 1.5  | $\mu\text{s}$ |
| Clamp Diode Leakage Current          | $I_R$         | 6         | ULN2064*           | $V_R = 50 \text{ V}$                            | —      | 50   | $\mu\text{A}$ |
|                                      |               |           |                    | $V_R = 50 \text{ V}, T_A = 70^\circ\text{C}$    | —      | 100  | $\mu\text{A}$ |
|                                      |               |           | ULN2065B           | $V_R = 80 \text{ V}$                            | —      | 50   | $\mu\text{A}$ |
|                                      |               |           |                    | $V_R = 80 \text{ V}, T_A = 70^\circ\text{C}$    | —      | 100  | $\mu\text{A}$ |
| Clamp Diode Forward Voltage          | $V_F$         | 7         | Both               | $I_F = 1.0 \text{ A}$                           | —      | 1.75 | V             |
|                                      |               |           |                    | $I_F = 1.5 \text{ A}$                           | —      | 2.0  | V             |

\* Complete part number includes suffix to identify package style: B = DIP with heat sink tabs, LB = SOIC with heat sink tabs.

# 2061 THRU 2069

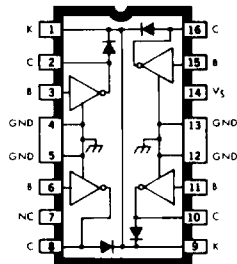
## 1.5 A DARLINGTON SWITCHES

### PARTIAL SCHEMATIC



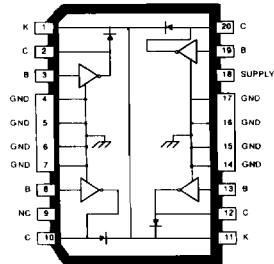
Dwg. No. A-10,354C

### ULN2068/69B



Dwg. No. A-10,310

### ULN2068LB



Dwg. No. A-14,327

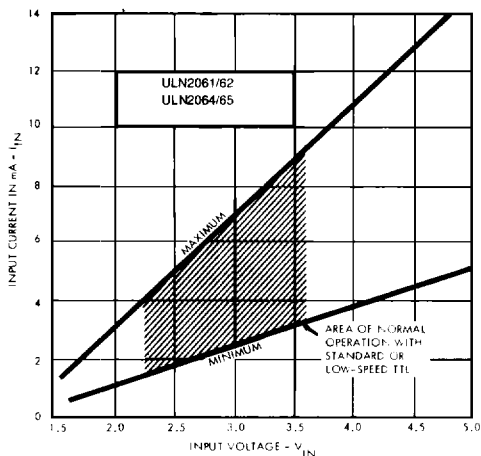
### ELECTRICAL CHARACTERISTICS at +25°C, $V_S = 5.0$ V (unless otherwise noted).

| Characteristic                       | Symbol        | Test Fig. | Applicable Devices | Test Conditions                                | Limits |      |         |
|--------------------------------------|---------------|-----------|--------------------|------------------------------------------------|--------|------|---------|
|                                      |               |           |                    |                                                | Min.   | Max. | Units   |
| Output Leakage Current               | $I_{CEX}$     | 1         | ULN2068*           | $V_{CE} = 50$ V                                | —      | 100  | $\mu$ A |
|                                      |               |           |                    | $V_{CE} = 50$ V, $T_A = 70^\circ\text{C}$      | —      | 500  | $\mu$ A |
|                                      |               |           | ULN2069B           | $V_{CE} = 80$ V                                | —      | 100  | $\mu$ A |
|                                      |               |           |                    | $V_{CE} = 80$ V, $T_A = 70^\circ\text{C}$      | —      | 500  | $\mu$ A |
| Output Sustaining Voltage            | $V_{CE(SUS)}$ | 2         | ULN2068*           | $I_C = 100$ mA, $V_{IN} = 0.4$ V               | 35     | —    | V       |
|                                      |               |           | ULN2069B           | $I_C = 100$ mA, $V_{IN} = 0.4$ V               | 50     | —    | V       |
| Collector-Emitter Saturation Voltage | $V_{CE(SAT)}$ | 3         | Both               | $I_C = 500$ mA, $V_{IN} = 2.75$ V              | —      | 1.1  | V       |
|                                      |               |           |                    | $I_C = 750$ mA, $V_{IN} = 2.75$ V              | —      | 1.2  | V       |
|                                      |               |           |                    | $I_C = 1.0$ A, $V_{IN} = 2.75$ V               | —      | 1.3  | V       |
|                                      |               |           |                    | $I_C = 1.25$ A, $V_{IN} = 2.75$ V              | —      | 1.4  | V       |
|                                      |               |           | ULN2069B           | $I_C = 1.5$ A, $V_{IN} = 2.75$ V               | —      | 1.5  | V       |
| Input Current                        | $I_{IN(ON)}$  | 4         | Both               | $V_{IN} = 2.75$ V                              | —      | 550  | $\mu$ A |
|                                      |               |           |                    | $V_{IN} = 3.75$ V                              | —      | 1000 | $\mu$ A |
| Input Voltage                        | $V_{IN(ON)}$  | 5         | ULN2068*           | $V_{CE} = 2.0$ V, $I_C = 1.25$ A               | —      | 2.75 | V       |
|                                      |               |           | ULN2069B           | $V_{CE} = 2.0$ V, $I_C = 1.5$ A                | —      | 2.75 | V       |
| Supply Current                       | $I_S$         | 8         | Both               | $I_C = 500$ mA, $V_{IN} = 2.75$ V              | —      | 6.0  | mA      |
| Turn-On Delay                        | $t_{PLH}$     | —         | Both               | $0.5 E_{in}$ to $0.5 E_{out}$                  | —      | 1.0  | $\mu$ s |
| Turn-Off Delay                       | $t_{PHL}$     | —         | Both               | $0.5 E_{in}$ to $0.5 E_{out}$ , $I_C = 1.25$ A | —      | 1.5  | $\mu$ s |
| Clamp Diode Leakage Current          | $I_R$         | 6         | ULN2068*           | $V_R = 50$ V                                   | —      | 50   | $\mu$ A |
|                                      |               |           |                    | $V_R = 50$ V, $T_A = 70^\circ\text{C}$         | —      | 100  | $\mu$ A |
|                                      |               |           | ULN2069B           | $V_R = 80$ V                                   | —      | 50   | $\mu$ A |
|                                      |               |           |                    | $V_R = 80$ V, $T_A = 70^\circ\text{C}$         | —      | 100  | $\mu$ A |
| Clamp Diode Forward Voltage          | $V_F$         | 7         | Both               | $I_F = 1.0$ A                                  | —      | 1.75 | V       |
|                                      |               |           |                    | $I_F = 1.5$ A                                  | —      | 2.0  | V       |

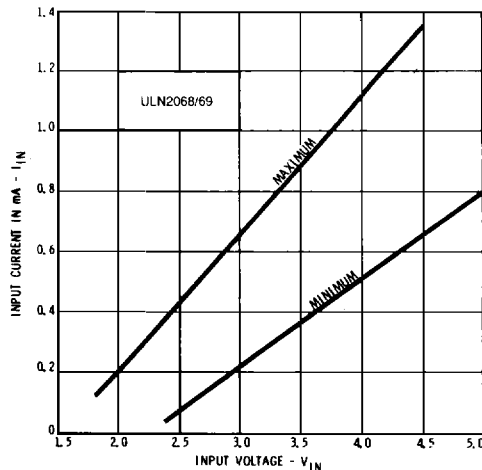
\*Complete part number includes suffix to identify package style: B = DIP with heat sink tabs, LB = SOIC with heat sink tabs.

# 2061 THRU 2069 1.5 A DARLINGTON SWITCHES

## INPUT CURRENT AS A FUNCTION OF INPUT VOLTAGE AT +25°C

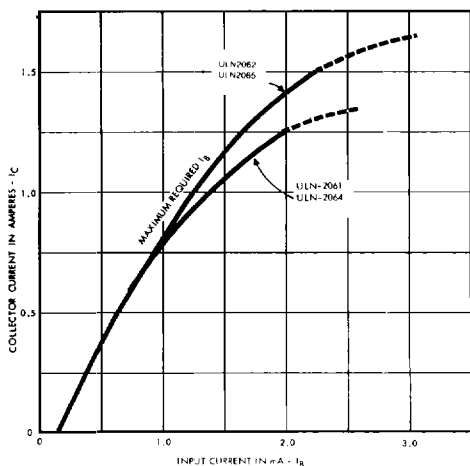


Dwg. No. A-10.363C

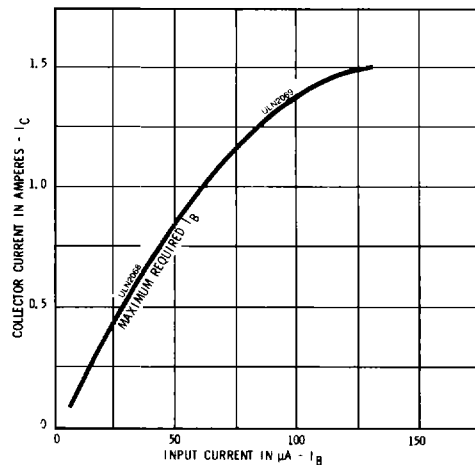


Dwg. No. A-12.306A

## COLLECTOR CURRENT AS A FUNCTION OF INPUT CURRENT AT +25°C



Dwg. No. A-10.358C

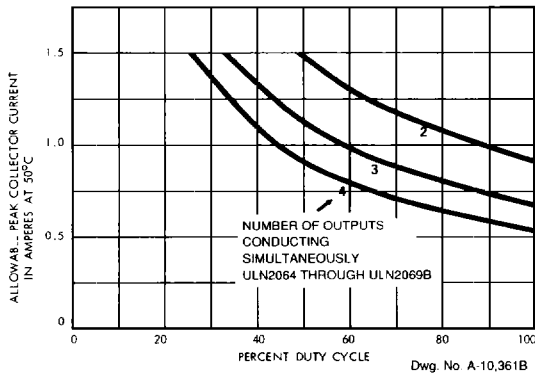
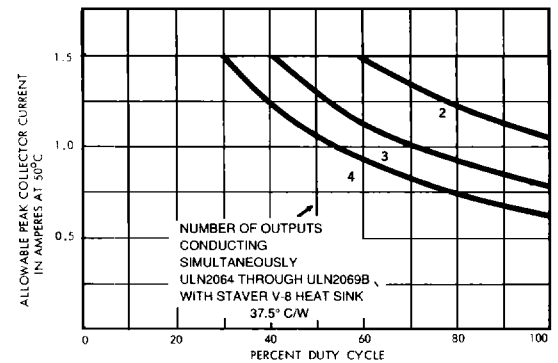
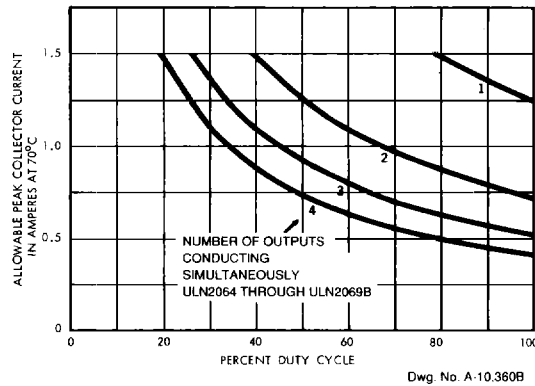
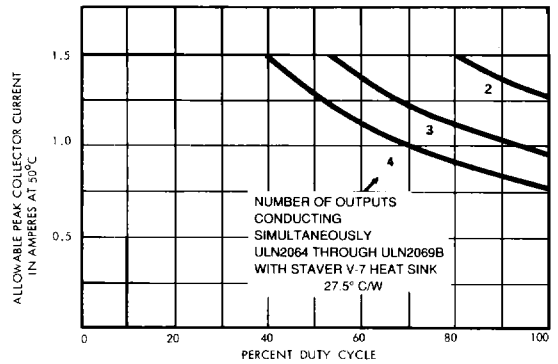
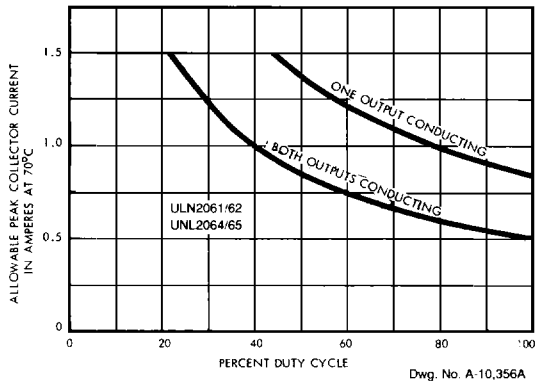


Dwg. No. A-12.306A

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## 1.5 A DARLINGTON SWITCHES

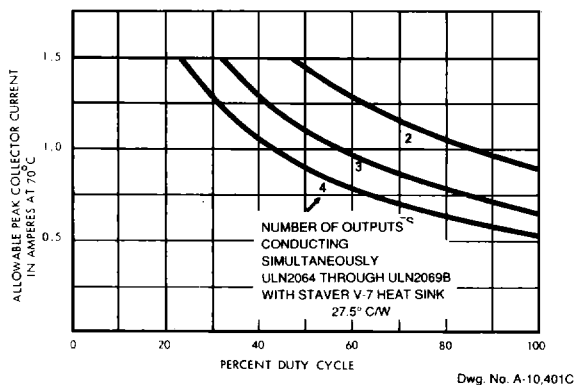
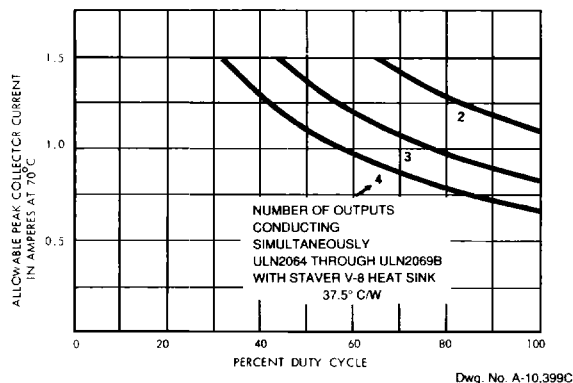
### PEAK COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE (DUAL IN-LINE PACKAGED DEVICES)



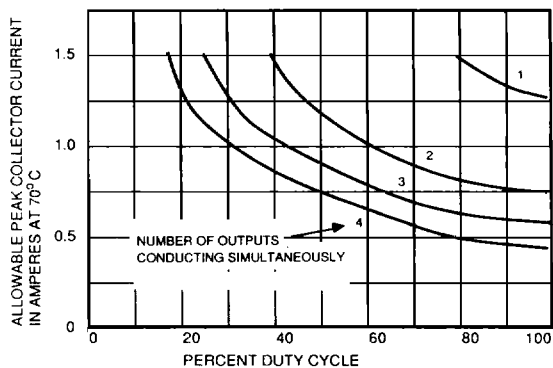
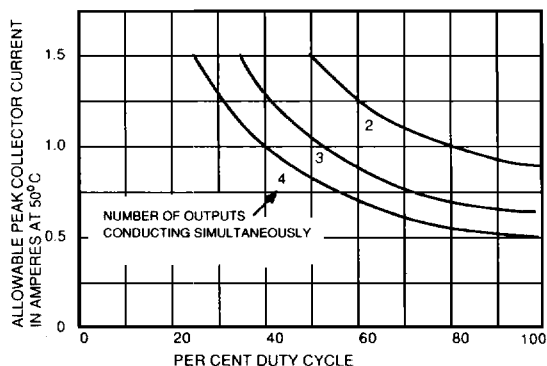
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## 1.5 A DARLINGTON SWITCHES

### PEAK COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE (DUAL IN-LINE PACKAGED DEVICES, cont'd)



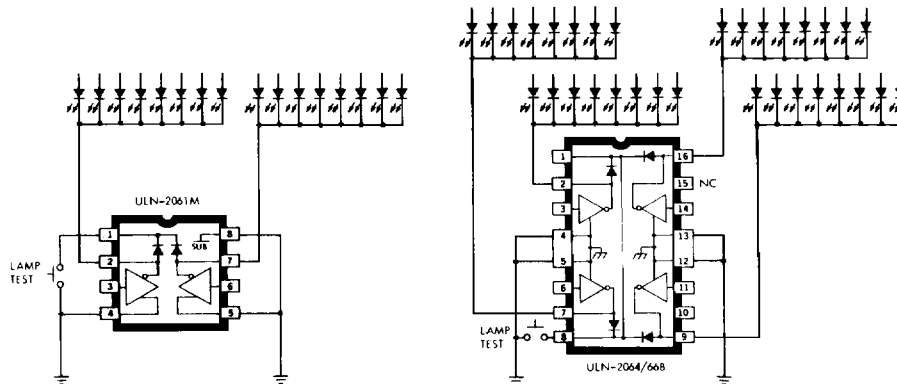
(ULN2064LB and ULN2068LB only)



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## 1.5 A DARLINGTON SWITCHES

### TYPICAL APPLICATION



Dwg. No. B-1365

### COMMON-CATHODE LED DRIVERS

(Type ULN2068B/LB is also applicable)