

## 80 V - 1.5 A QUAD DARLINGTON SWITCHES

- OUTPUT CURRENT TO 1.5 A EACH DARLINGTON
- MINIMUM BREAKDOWN 80 V
- SUSTAINING VOLTAGE AT LEAST 50 V
- INTEGRAL SUPPRESSION DIODES (ULN2065B, ULN2067B, ULN2069B and ULN2071B)
- ISOLATED DARLINGTON PINOUT (ULN2075B and ULN2077B)
- VERSIONS COMPATIBLE WITH ALL POPULAR LOGIC FAMILIES

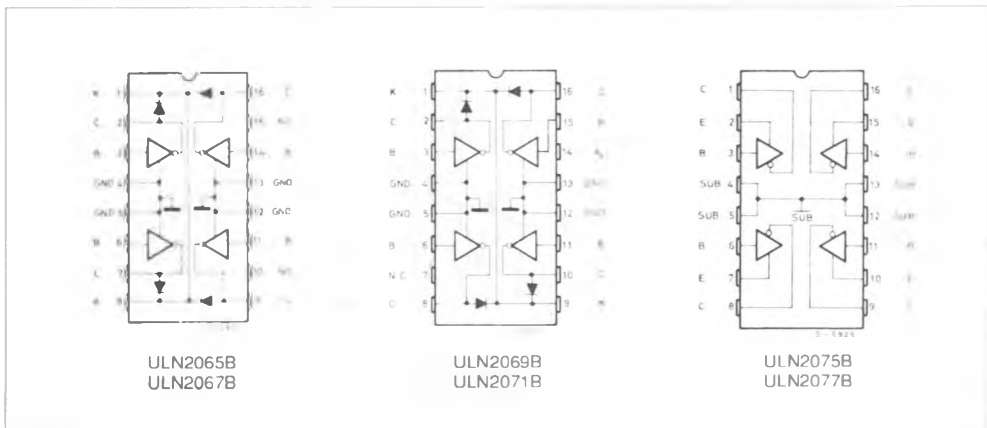
tible with 6-15 VCMOS and PMOS. The ULN2069B and ULN2071B include a predriver stage to provide extragain, reducing the load on control logic.

### DESCRIPTION

Designed to interface logic to a wide variety of high current, high voltage loads, these devices each contain four NPN darlington switches delivering up to 1.5 A with a specified minimum breakdown of 80 V and a sustaining voltage of 50 V. The ULN2065B, ULN2067B, ULN2069B and ULN2071B contain integral suppression diodes for inductive loads and have common emitters; the ULN2075B and ULN2077B feature isolated darlington pinouts and are intended for applications such as emitter follower configurations. Inputs of the ULN2065B, ULN2069B and ULN2075B are compatible with popular 5 V logic families and the ULN2067B, ULN2071B and ULN2077B are compa-



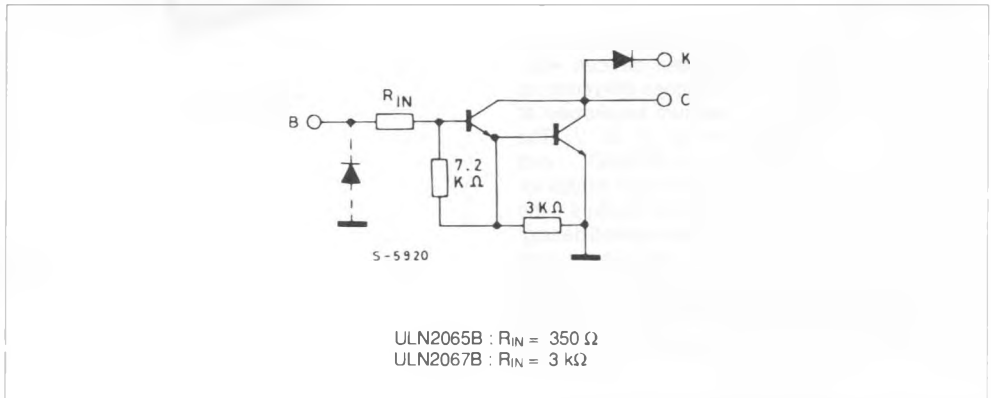
### PIN CONNECTIONS AND ORDER CODES



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_{CEX}$	Output Voltage	80	V
$V_{CE(sus)}$	Output Sustaining Voltage	50	V
$I_O$	Output Current	1.75	A
$V_i$	Input Voltage for ULN2075B – 2077B	60	V
	for ULN2067B – 2071B	30	V
	for ULN2065B – 2069B	15	V
$I_i$	Input Current	25	mA
$V_s$	Supply Voltage for ULN2069B	10	V
	for ULN2071B	20	V
$P_{Tot}$	Power Dissipation : at $T_{pins} = 90\text{ }^\circ\text{C}$	4.3	W
	at $T_{amb} = 70\text{ }^\circ\text{C}$	1	W
$T_{amb}$	Operating Ambient Temperature Range	- 20 to 85	$^\circ\text{C}$
$T_{stg}$	Storage Temperature	- 55 to 150	$^\circ\text{C}$

**SCHEMATIC DIAGRAM**

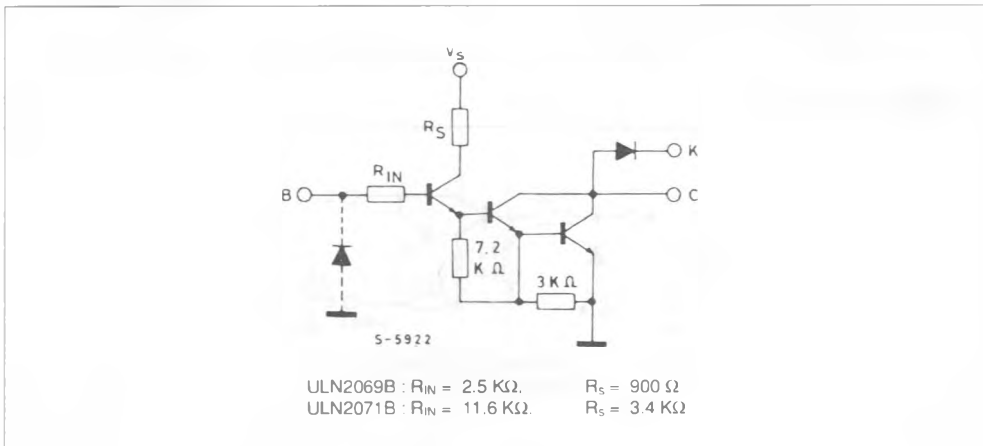


**ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified )

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	Fig.
$I_{CEX}$	Output Leakage Current	for <b>ULN2065B – ULN2067B</b> $V_{CE} = 80\text{ V}$ $V_{CE} = 80\text{ V}$ $T_{amb} = 70\text{ }^{\circ}\text{C}$			100 500	$\mu\text{A}$ $\mu\text{A}$	1
$V_{CE(sus)}$	Collector-emitter Sustaining Voltage	for <b>ULN2065B – ULN2067B</b> $I_C = 100\text{ mA}$ $V_i = 0.4\text{ V}$	50			V	2
$V_{CE(sat)}$	Collector-emitter Saturation Voltage	$I_C = 500\text{ mA}$ $I_B = 625\text{ }\mu\text{A}$ $I_C = 750\text{ mA}$ $I_B = 935\text{ }\mu\text{A}$ $I_C = 1\text{ A}$ $I_B = 1.25\text{ mA}$ $I_C = 1.25\text{ A}$ $I_B = 2\text{ mA}$ for <b>ULN2065B – ULN2067B</b> $I_C = 1.5\text{ A}$ $I_B = 2.25\text{ mA}$			1.1 1.2 1.3 1.4 1.5	V V V V V	3
$I_{i(on)}$	Input Current	for <b>ULN2065B</b> $V_i = 2.4\text{ V}$ for <b>ULN2065B</b> $V_i = 3.75\text{ V}$ for <b>ULN2067B</b> $V_i = 5\text{ V}$ for <b>ULN2067B</b> $V_i = 12\text{ V}$	1.4 3.3 0.6 1.7		4.3 9.6 1.8 5.2	mA mA mA mA	4
$V_{i(on)}$	Input Voltage	for <b>ULN2065B</b> $V_{CE} = 2\text{ V}$ $I_C = 1\text{ A}$ $V_{CE} = 2\text{ V}$ $I_C = 1.5\text{ A}$ for <b>ULN2067B</b> $V_{CE} = 2\text{ V}$ $I_C = 1\text{ A}$ $V_{CE} = 2\text{ V}$ $I_C = 1.5\text{ A}$			2 2.5 6.5 10	V V V V	5
$t_{PLH}$	Turn-on Delay Time	$0.5 V_i$ to $0.5 V_o$			1	$\mu\text{s}$	
$t_{PHL}$	Turn-off Delay Time	$0.5 V_i$ to $0.5 V_o$			1.5	$\mu\text{s}$	
$I_R$	Clamp Diode Leakage Current	for <b>ULN2065B – ULN2067B</b> $V_R = 80\text{ V}$ $V_R = 80\text{ V}$ $T_{amb} = 70\text{ }^{\circ}\text{C}$			50 100	$\mu\text{A}$ $\mu\text{A}$	6
$V_F$	Clamp Diode Forward Voltage	$I_F = 1\text{ A}$ $I_F = 1.5\text{ A}$			1.75 2	V V	7

- Notes :** 1. Input voltage is with reference to the substrate (no connection to any other pins) for the ULN2075B and ULN2077B reference is ground for all other types.  
2. Input current may be limited by maximum allowable input voltage.

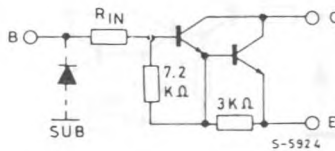
**SCHEMATIC DIAGRAM**



**ELECTRICAL CHARACTERISTICS** ( $V_s = 5\text{ V}$  for ULN2069B.  $V_s = 12\text{ V}$  for ULN2071B.  $T_{amb} = 25\text{ }^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	Fig.
$I_{CEX}$	Output Leakage Current	for <b>ULN2069B - ULN2071B</b> $V_{CE} = 80\text{ V}$ $V_{CE} = 80\text{ V}$ $T_{amb} = 70\text{ }^\circ\text{C}$			100 500	$\mu\text{A}$ $\mu\text{A}$	1
$V_{CE(sus)}$	Collector-emitter Sustaining Voltage	for <b>ULN2069B - ULN2071B</b> $I_C = 100\text{ mA}$ $V_i = 0.4\text{ V}$	50			V	2
$V_{CE(sat)}$	Collector-emitter Saturation Voltage	for <b>ULN2069B</b> $I_C = 500\text{ mA}$ $V_i = 2.75\text{ V}$ $I_C = 750\text{ mA}$ $V_i = 2.75\text{ V}$ $I_C = 1\text{ A}$ $V_i = 2.75\text{ V}$ $I_C = 1.25\text{ A}$ $V_i = 2.75\text{ V}$ $I_C = 1.5\text{ A}$ $V_i = 2.75\text{ V}$ for <b>ULN2071B</b> $I_C = 500\text{ mA}$ $V_i = 5\text{ V}$ $I_C = 750\text{ mA}$ $V_i = 5\text{ V}$ $I_C = 1\text{ A}$ $V_i = 5\text{ V}$ $I_C = 1.25\text{ A}$ $V_i = 5\text{ V}$ $I_C = 1.5\text{ A}$ $V_i = 5\text{ V}$			1.1 1.2 1.3 1.4 1.5	V V V V V	2
$I_{i(on)}$	Input Current	for <b>ULN2069B</b> $V_i = 2.75\text{ V}$ for <b>ULN2069B</b> $V_i = 3.75\text{ V}$ for <b>ULN2071B</b> $V_i = 5\text{ V}$ for <b>ULN2071B</b> $V_i = 12\text{ V}$			550 1000 400 1250	$\mu\text{A}$ $\mu\text{A}$ $\mu\text{A}$ $\mu\text{A}$	4
$V_{i(on)}$	Input Voltage	$V_{CE} = 2\text{ V}$ $I_C = 1.5\text{ A}$ for <b>ULN2069B</b> for <b>ULN2071B</b>			2.75 5	V	5
$I_s$	Supply Current	for <b>ULN2069B</b> $I_C = 500\text{ mA}$ $V_i = 2.75\text{ V}$ for <b>ULN2071B</b> $I_C = 500\text{ mA}$ $V_i = 5\text{ V}$			6 4.5	mA mA	8
$t_{PLH}$	Turn-on Delay Time	$0.5\text{ V}_i$ to $0.5\text{ V}_o$			1	$\mu\text{s}$	
$t_{PHL}$	Turn-off Delay Time	$0.5\text{ V}_i$ to $0.5\text{ V}_o$ $I_C = 1.25\text{ A}$			1.5	$\mu\text{s}$	
$I_R$	Clamp Diode Leakage Current	for <b>ULN2069B - ULN2071B</b> $V_R = 80\text{ V}$ $V_R = 80\text{ V}$ $T_{amb} = 70\text{ }^\circ\text{C}$			50 100	$\mu\text{A}$ $\mu\text{A}$	6
$V_F$	Clamp Diode Forward Voltage	$I_F = 1\text{ A}$ $I_F = 1.5\text{ A}$			1.75 2	V V	7

**SCHEMATIC DIAGRAM**



ULN2075B :  $R_{IN} = 350\ \Omega$   
 ULN2077B :  $R_{IN} = 3\ \text{k}\Omega$

**ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	Fig.
$I_{CEX}$	Output Leakage Current	for <b>ULN2075B – ULN2077B</b> $V_{CE} = 80\text{ V}$ $V_{CE} = 80\text{ V}$ $T_{amb} = 70\text{ }^{\circ}\text{C}$			100 500	$\mu\text{A}$ $\mu\text{A}$	1
$V_{CE(sus)}$	Collector-emitter Sustaining Voltage	for <b>ULN2075B – ULN2077B</b> $I_C = 100\text{ mA}$ $V_i = 0.4\text{ V}$	50			V	2
$V_{CE(sat)}$	Collector-emitter Saturation Voltage	$I_C = 500\text{ mA}$ $I_B = 625\text{ }\mu\text{A}$ $I_C = 750\text{ mA}$ $I_B = 935\text{ }\mu\text{A}$ $I_C = 1\text{ A}$ $I_B = 1.25\text{ mA}$ $I_C = 1.25\text{ A}$ $I_B = 2\text{ mA}$ for <b>ULN2075B – ULN2077B</b> $I_C = 1.5\text{ A}$ $I_B = 2.25\text{ mA}$			1.1 1.2 1.3 1.4 1.5	V V V V V	3
$I_{i(on)}$	Input Current	for <b>ULN2075B</b> $V_i = 2.4\text{ V}$ for <b>ULN2075B</b> $V_i = 3.75\text{ V}$ for <b>ULN2077B</b> $V_i = 5\text{ V}$ for <b>ULN2077B</b> $V_i = 12\text{ V}$	1.4 3.3 0.6 1.7		4.3 9.6 1.8 5.2	mA mA mA mA	4
$V_{i(on)}$	Input Voltage	for <b>ULN2075B</b> $V_{CE} = 2\text{ V}$ $I_C = 1\text{ A}$ $V_{CE} = 2\text{ V}$ $I_C = 1.5\text{ A}$ for <b>ULN2077B</b> $V_{CE} = 2\text{ V}$ $I_C = 1\text{ A}$ $V_{CE} = 2\text{ V}$ $I_C = 1.5\text{ A}$			2 2.5 6.5 10	V V V V	5
$t_{PLH}$	Turn-on Delay Time	$0.5 V_i$ to $0.5 V_o$			1	$\mu\text{s}$	
$t_{PHL}$	Turn-off Delay Time	$0.5 V_i$ to $0.5 V_o$			1.5	$\mu\text{s}$	

**TEST CIRCUITS**

Figure 1.

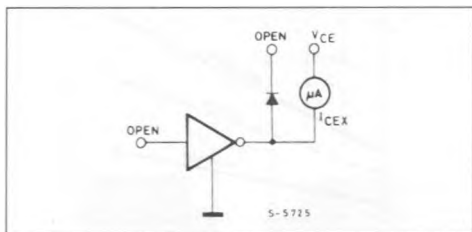


Figure 2.

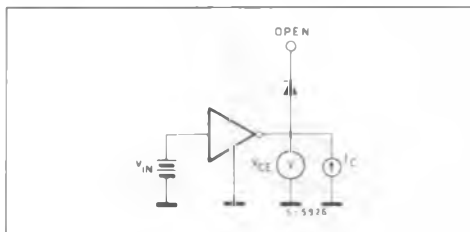


Figure 3.

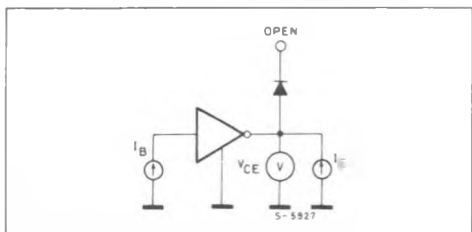


Figure 4.

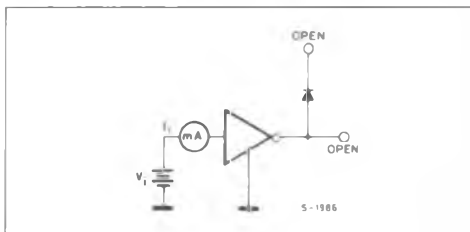


Figure 5.

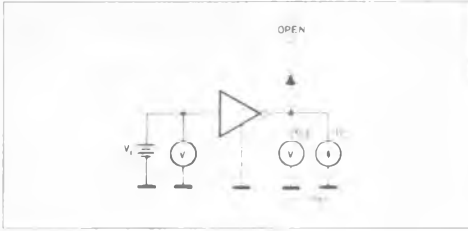


Figure 7.

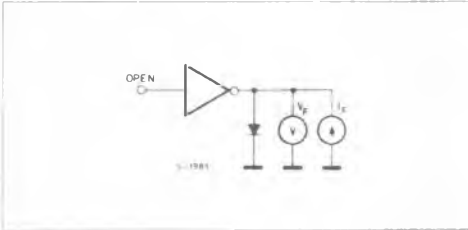


Figure 9 : Input Current as a Function of Input Voltage.

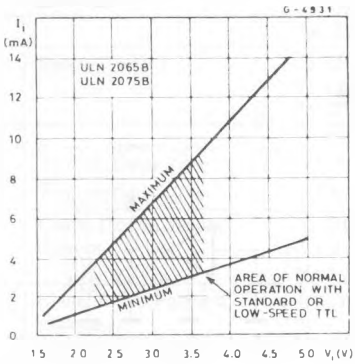


Figure 6.

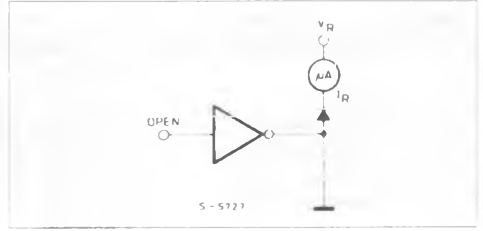


Figure 8.

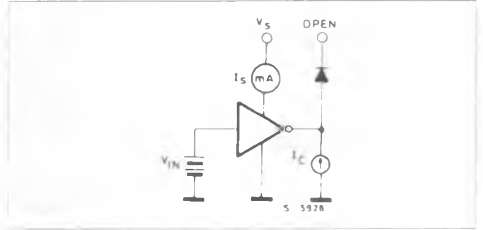
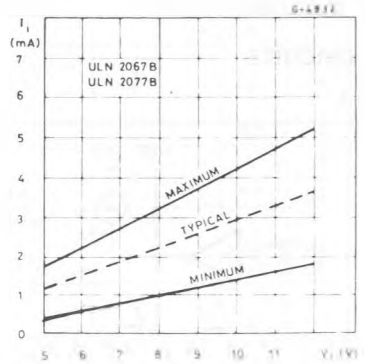
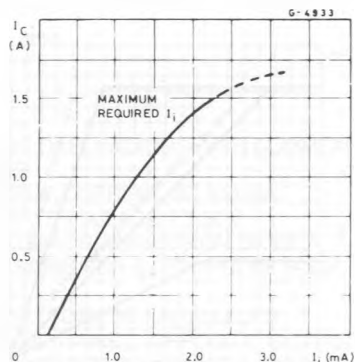


Figure 10 : Input Current as a Function of Input Voltage.



**Figure 11** : Collector Current as a Function of Input Current.

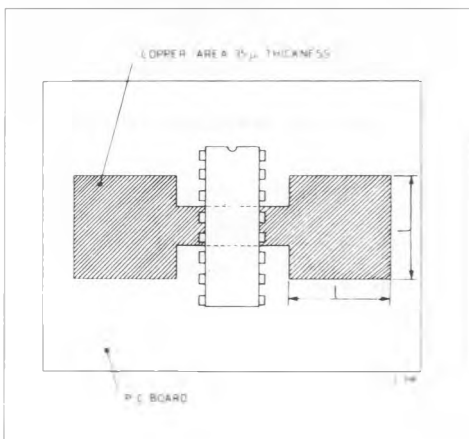


**MOUNTING INSTRUCTIONS**

The  $R_{th\ j-amb}$  can be reduced by soldering the GND pins to a suitable copper area of the printed circuit board (Fig. 12) or to an external heatsink (Fig. 13).

The diagram of figure 14 shows the maximum dissipable power  $P_{tot}$  and the  $R_{th\ j-amb}$  as a function of the side " $W_{\infty}$ " of two equal square copper areas having a thickness of  $35\ \mu$  (1.4 mils).

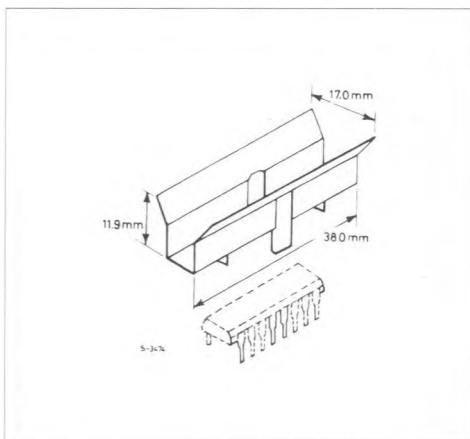
**Figure 12** : Example of P.C. Board Area which is Used as Heatsink.



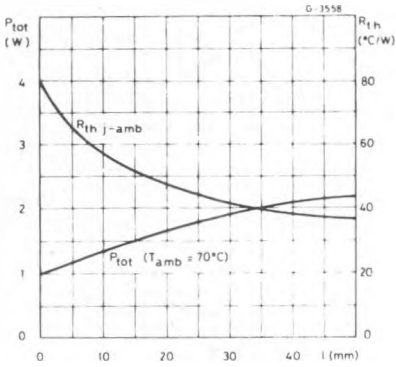
During soldering the pins temperature must not exceed  $260\ ^\circ\text{C}$  and the soldering time must not be longer than 12 seconds.

The external heatsink or printed circuit copper area must be connected to electrical ground.

**Figure 13** : External Heatsink Mounting Example.



**Figure 14** : Maximum Dissipable Power and Junction to Ambient Thermal Resistance vs. Side "l".



**Figure 15** : Maximum Allowable Power Dissipation vs. Ambient Temperature.

