



## SEVEN DARLINGTON ARRAYS

- SEVEN DARLINGTONS PER PACKAGE
- OUTPUT CURRENT 500 mA PER DRIVER (600 mA PEAK)
- OUTPUT VOLTAGE 50 V
- INTEGRAL SUPPRESSION DIODES FOR INDUCTIVE LOADS
- OUTPUTS CAN BE PARALLELED FOR HIGHER CURRENT
- TTL/CMOS/PMOS/DTL COMPATIBLE INPUTS
- INPUTS PINNED OPPOSITE OUTPUTS TO SIMPLIFY LAYOUT

### DESCRIPTION

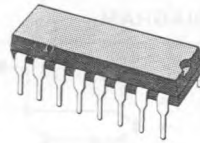
The ULN2001A, ULN2002A, ULN2003 and ULN2004A are high voltage, high current darlington arrays each containing seven open collector darlington pairs with common emitters. Each channel is rated at 500 mA and can withstand peak currents of 600 mA. Suppression diodes are included for inductive load driving and the inputs are pinned opposite the outputs to simplify board layout.

The four versions interface to all common logic families :

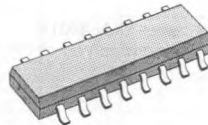
ULN2001A	General Purpose. DTL. TTL. PMOS. CMOS
ULN2002A	14-25 V PMOS
ULN2003A	5 V TTL. CMOS
ULN2004A	6-15 V CMOS. PMOS

These versatile devices are useful for driving a wide range of loads including solenoids, relays DC motors, LED displays filament lamps, thermal print-heads and high power buffers.

The ULN2001A/2002A/2003A and 2004A are supplied in 16 pin plastic DIP packages with a copper leadframe to reduce thermal resistance. They are available also in small outline package (SO-16) as ULN2001D/2002D/2003D/2004D.



**DIP-16 Plastic**  
(0.25)



**SO-16J**

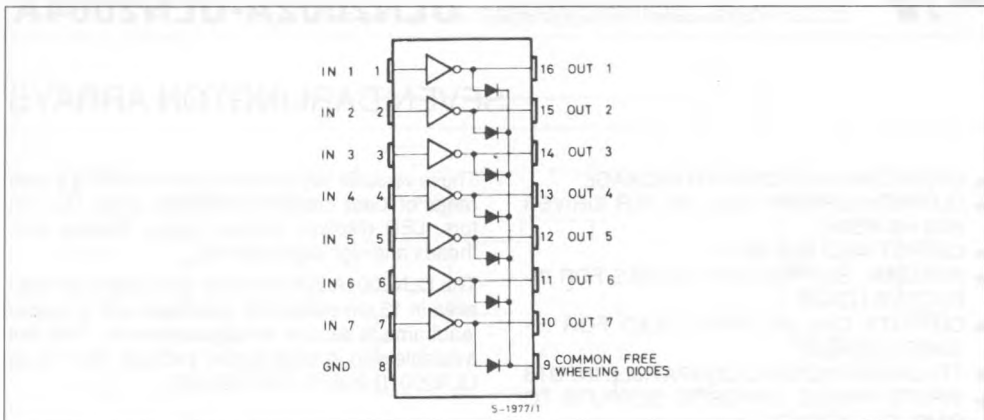
**ORDER CODES :**  
ULN2001A/2A/3A/4A (DIP-16)  
ULN2001D/2D/3D/4D (SO-16)

### ABSOLUTE MAXIMUM RATINGS

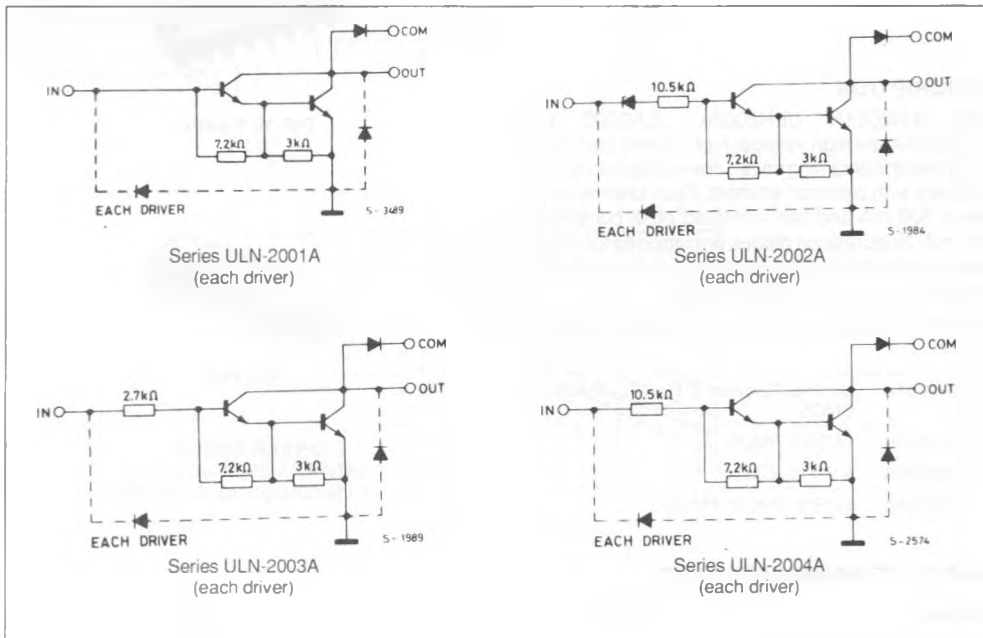
Symbol	Parameter	Value	Unit
$V_o$	Output Voltage	50	V
$V_{in}$	Input Voltage (for ULN2002A/D - 2003A/D - 2004A/D)	30	V
$I_c$	Continuous Collector Current	500	mA
$I_b$	Continuous Base Current	25	mA
$T_{amb}$	Operating Ambient Temperature Range	- 20 to 85	°C
$T_{stg}$	Storage Temperature Range	- 55 to 150	°C
$T_j$	Junction Temperature	150	°C

# ULN2001A-ULN2002A-ULN2003A-ULN2004A

## PIN CONNECTION



## SCHEMATIC DIAGRAM



## THERMAL DATA

			DIP-16	SO-16
$R_{th(j-c)}$	Thermal Resistance Junction-ambient	Max.	70 °C/W	165 °C/W

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	$V_{CE} = 50\text{ V}$			50	$\mu\text{A}$	1a	
		$T_{amb} = 70\text{ }^{\circ}\text{C}$	$V_{CE} = 50\text{ V}$		100	$\mu\text{A}$	1a	
		$T_{amb} = 70\text{ }^{\circ}\text{C}$ for <b>ULN2002A</b>	$V_{CE} = 50\text{ V}$	$V_i = 6\text{ V}$		500	$\mu\text{A}$	1b
		for <b>ULN2004A</b>	$V_{CE} = 50\text{ V}$	$V_i = 1\text{ V}$		500	$\mu\text{A}$	1b
$V_{CE(sat)}$	Collector-emitter Saturation Voltage	$I_C = 100\text{ mA}$	$I_B = 250\text{ }\mu\text{A}$	0.9	1.1	V	2	
		$I_C = 200\text{ mA}$	$I_B = 350\text{ }\mu\text{A}$	1.1	1.3	V	2	
		$I_C = 350\text{ mA}$	$I_B = 500\text{ }\mu\text{A}$	1.3	1.6	V	2	
$I_{(ON)}$	Input Current	for <b>ULN2002A</b>	$V_i = 17\text{ V}$	0.82	1.25	mA	3	
		for <b>ULN2003A</b>	$V_i = 3.85\text{ V}$	0.93	1.35	mA	3	
		for <b>ULN2004A</b>	$V_i = 5\text{ V}$	0.35	0.5	mA	3	
		$V_i = 12\text{ V}$	1	1.45	mA	3		
$I_{C(ON)}$	Input Current	$T_{amb} = 70\text{ }^{\circ}\text{C}$	$I_C = 500\text{ }\mu\text{A}$	50	65	$\mu\text{A}$	4	
$V_{I(ON)}$	Input Voltage	for <b>ULN2002A</b>	$V_{CE} = 2\text{ V}$	$I_C = 300\text{ mA}$		13	V	5
		for <b>ULN2003A</b>	$V_{CE} = 2\text{ V}$	$I_C = 200\text{ mA}$		2.4	V	5
		$V_{CE} = 2\text{ V}$	$I_C = 250\text{ mA}$		2.7	V	5	
		$V_{CE} = 2\text{ V}$	$I_C = 300\text{ mA}$		3	V	5	
		for <b>ULN2004A</b>	$V_{CE} = 2\text{ V}$	$I_C = 125\text{ mA}$		5	V	5
		$V_{CE} = 2\text{ V}$	$I_C = 200\text{ mA}$		6	V	5	
		$V_{CE} = 2\text{ V}$	$I_C = 275\text{ mA}$		7	V	5	
$V_{CE} = 2\text{ V}$	$I_C = 350\text{ mA}$		8	V	5			
$h_{FE}$	DC Forward Current Gain	for <b>ULN2001A</b>	$V_{CE} = 2\text{ V}$	$I_C = 350\text{ mA}$	1000		—	2
C	Input Capacitance			15	25	pF	—	
$t_{PLH}$	Turn-on Delay Time	$0.5\text{ V}$ to $0.5\text{ V}_O$		0.25	1	$\mu\text{s}$	—	
$t_{PHL}$	Turn-off Delay Time	$0.5\text{ V}$ to $0.5\text{ V}_O$		0.25	1	$\mu\text{s}$	—	
$I_R$	Clamp Diode Leakage Current	$V_R = 50\text{ V}$			50	$\mu\text{A}$	6	
		$T_{amb} = 70\text{ }^{\circ}\text{C}$	$V_R = 50\text{ V}$		100	$\mu\text{A}$	6	
$V_F$	Clamp Diode Forward Voltage	$I_F = 350\text{ mA}$		1.7	2	V	7	

TEST CIRCUITS

Figure 1a.

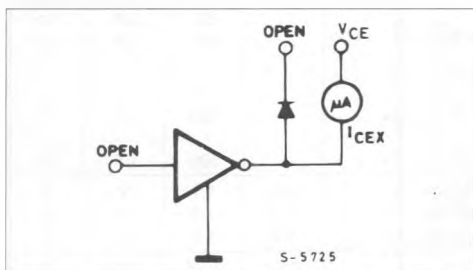


Figure 1b.

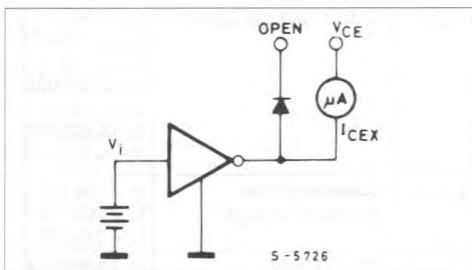


Figure 2.

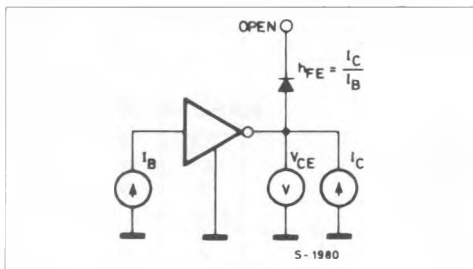


Figure 3.

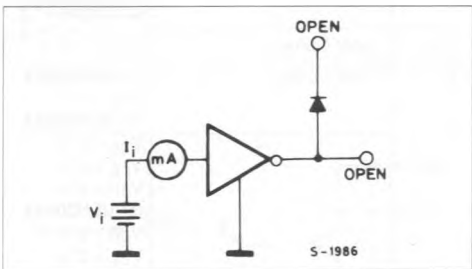


Figure 4.

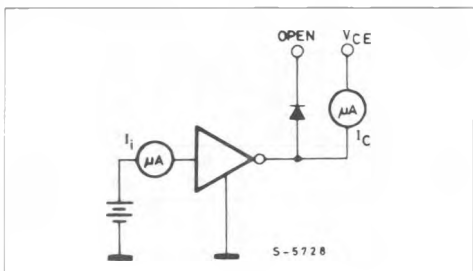


Figure 5.

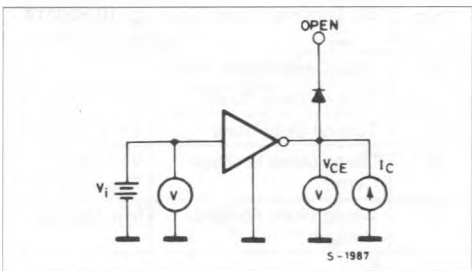


Figure 6.

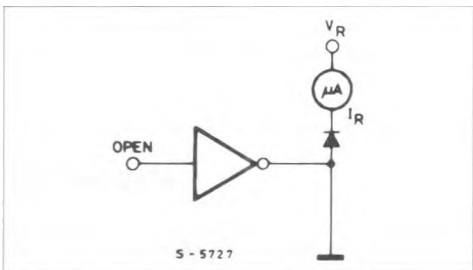


Figure 7.

