DARLINGTON ARRAYS

- SEVEN DARLINGTONS PER PACKAGE
- OUTPUT CURRENT 500mA PER DRIVER (600mA PEAK)
- OUTPUT VOLTAGE 50V
- 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

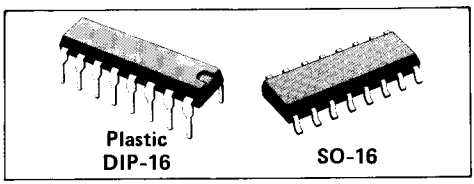
The ULN2001A, ULN2002A, ULN2003A and ULN2004A are high voltage, high current darlington arrays each containing seven open collector darlington pairs with common emitters. Each channel is rated at 500mA and can withstand peak currents of 600mA. Suppression diodes are included for inductive load driving 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	14-25V PMOS
ULN2003A	5V TTL, CMOS
ULN2004A	6-15V CMOS, PMOS

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

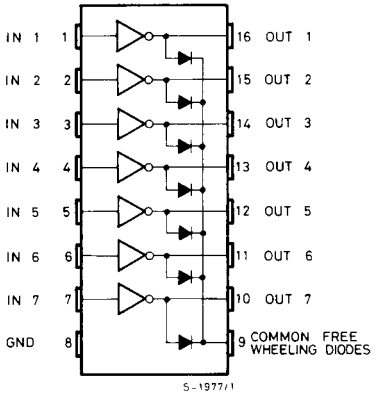
The ULN2001A/2002A/2003A and 2004A are supplied in 16 pin plastic DIP packages with a copper leadframe to reduce thermal resistance. They are available also in small outline package (SO-16) as ULN2001D/2002D/2003D/2004D.



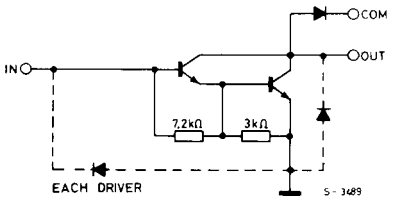
ABSOLUTE MAXIMUM RATINGS

V_o	Output voltage	50	V
V_{in}	Input voltage (for ULN2002A/D - 2003A/D - 2004/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

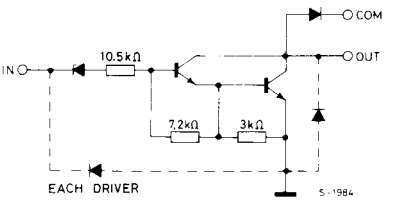
CONNECTION DIAGRAM



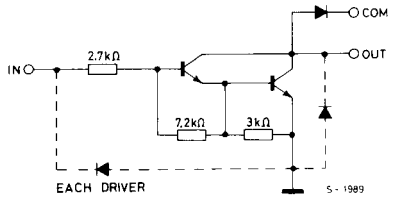
SCHEMATIC DIAGRAM



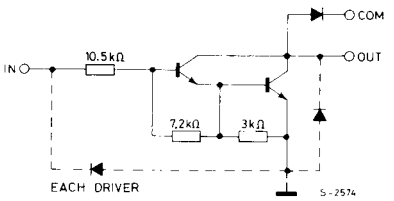
Series ULN-2001A
(each driver)



Series ULN-2002A
(each driver)



Series ULN-2003A
(each driver)



Series ULN-2004A
(each driver)

THERMAL DATA			DIP-16	SO-16
$R_{th\,j\text{-}amb}$	Thermal resistance junction-ambient	max	70°C/W	165°C/W

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C unless otherwise specified)

Parameter		Test conditions	Min.	Typ.	Max.	Unit	Fig.
I_{CEX}	Output leakage current	V_{CE} = 50V			50	μA	1a
		T_{amb} = 70°C V_{CE} = 50V			100	μA	1a
		T_{amb} = 70°C for **ULN2002A**					
		V_{CE} = 50V V_i = 6V			500	μA	1b
		for **ULN2004A**					
		V_{CE} = 50V V_i = 1V			500	μA	1b
$V_{CE(sat)}$	Collector-emitter saturation voltage	I_C = 100mA I_B = 250 μA		0.9	1.1	V	2
		I_C = 200mA I_B = 350 μA		1.1	1.3	V	2
		I_C = 350mA I_B = 500 μA		1.3	1.6	V	2
$I_{i(on)}$	Input current	for **ULN2002A** V_i = 17V		0.82	1.25	mA	3
		for **ULN2003A** V_i = 3.85V		0.93	1.35	mA	3
		for **ULN2004A** V_i = 5V		0.35	0.5	mA	3
		V_i = 12V		1	1.45	mA	3
$I_{i(off)}$	Input current	T_{amb} = 70°C I_C = 500 μA	50	65		μA	4
$V_{i(on)}$	Input voltage	for **ULN2002A**					
		V_{CE} = 2V I_C = 300 mA			13	V	5
		for **ULN2003A**					
		V_{CE} = 2V I_C = 200 mA			2.4	V	5
		V_{CE} = 2V I_C = 250 mA			2.7	V	5
		V_{CE} = 2V I_C = 300 mA			3	V	5
		for **ULN2004A**					
		V_{CE} = 2V I_C = 125 mA			5	V	5
		V_{CE} = 2V I_C = 200 mA			6	V	5
		V_{CE} = 2V I_C = 275 mA			7	V	5
		V_{CE} = 2V I_C = 350 mA			8	V	5
h_{FE}	DC forward current gain	for **ULN2001A**					
		V_{CE} = 2V I_C = 350 mA	1000			–	2
C_i	Input capacitance			15	25	pF	–
t_{PLH}	Turn-on delay time	0.5 V_i to 0.5 V_o		0.25	1	μs	–
t_{PHL}	Turn-off delay time	0.5 V_i to 0.5 V_o		0.25	1	μs	–
I_R	Clamp diode leakage current	V_R = 50V			50	μA	6
		T_{amb} = 70°C V_R = 50V			100	μA	6
V_F	Clamp diode forward voltage	I_F = 350 mA		1.7	2	V	7

TEST CIRCUITS

Fig. 1a

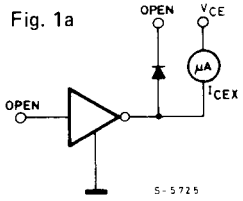


Fig. 1b

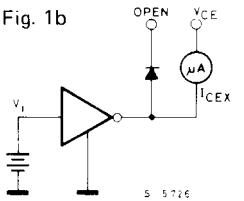


Fig. 2

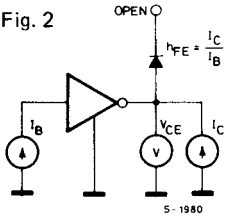


Fig. 3

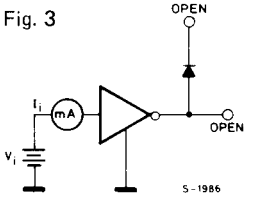


Fig. 4

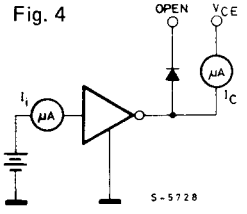


Fig. 5

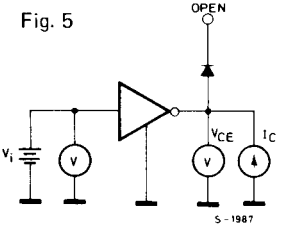


Fig. 6

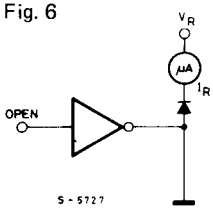
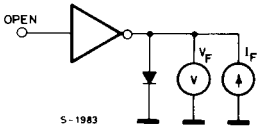
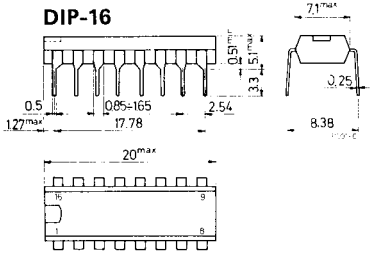


Fig. 7



MECHANICAL DATA (Dimensions in mm)

DIP-16



SO-16