



Seven high voltage withstand, high current Darlington transistor array

Description :

ULN2003A is a single-chip integrated high voltage, high current Darlington transistor array, which contains seven independent Darlington transistor driving circuits internally. The Flyback diode is designed inside the circuit, which can be used to drive inductive loads such as relays and stepping motors. A single Darlington tube collector can output a current of 500mA. Parallel connection of Darlington tubes can achieve higher output current capacity. This circuit can be widely used for relay drive, lighting drive, display screen drive (LED), stepper motor drive, and logic buffer. Each Darlington transistor is connected in series with a 2.7K base resistor, which can be directly connected to TTL /CMOS circuits at a working voltage of 5V, and can directly process data that originally required standard logic buffers for processing.

Features :

-500mA collector output current (single circuit)

-Input compatible TTL/CMOS logic signal

-Static electricity capacity: 8000V (HBM)

-High voltage resistance (50V)

-Adopting DIP/SOP16

Application :

-Relay drive	-Indicator light drive
-DC lighting drive	-Stepper motor drive
-DC brushless motor drive	-Display screen drive



Internal schematic diagram:



ULN2003A Schematic diagram of single drive circuit

Logic diagram:







Pin Assignment :



DIP/SOP16

Pin No.	Pin Definition	OUT/INPUT	Function Description		
1	1B	I	1 channel input pin		
2	2B	I	2 channel input pin		
3	3B	I	3 channel input pin		
4	4B	I	4 channel input pin		
5	5B	I	5 channel input pin		
6	6B	Ι	6 channel input pin		
7	7B	I	7 channel input pin		
8	E	-	grounding		
9	СОМ	-	Clamping diode common terminal		
10	7C	0	7-channel output pin		
11	6C	0	6-channel output pin		
12	5C	0	5-channel output pin		
13	4C	0	4-channel output pin		
14	3C	0	3-channel output pin		
15	2C	0	2-channel output pin		
16	1C	0	1-channel output pin		



Absolute Maximum Ratings

paramete	r	symbol	value	unit
Collector emitter voltage (10-16	5 pins)	V _{CE}	-0.5~50	V
COM terminal voltage (9 pins)	•	V _{COM}	50	V
Input voltage (1-7 pins)		VI	-0.5~30	V
Peak current of collector		I _{CP}	500	mA/ch
Output clamp diode forward pe	ak current	І _{ок}	500	mA
Maximum peak current of total emitter		I _{ET}	-2.5	А
Maximum working junction temperature ⁽²⁾		Tj	150	°C
welding temperature			260	°C,10s
Storage temperature range		T _{stg}	-60 ~ +150	°C
$consumption^{(1)(2)}$	DIP16	P.	1.47	۱۸/
Consumption	SOP16	r D	0.54/0.625(3)	

Note: 1. The maximum power consumption can be calculated according to the following relationship

 $P_D = \left(T^j - T_A\right) / \theta_{JA}$

2. Tj (max) is 150 , where TA represents the ambient temperature at which the circuit operates;

3. On a glass epoxy resin PCB board ($30 \times 30 \times 1.6$ mm copper 50%).

Recommended operating conditions

para	meter		symbol	condition		MIN	MAX	unit				
collector en	nitter vo	ltage	V_{CE}							0	50	V
	פוס	16			Duty=10%	0	370					
		10			Duty=50%	0	130	m \ /ch				
output curren		16	OUT	$T_{A}=85$ C	Duty=10%	0	233	mA/cn				
	501	10		1j=120 C	Duty=50%	0	70					
Control signal	input vo	oltage	V _{IN}			0	24	V				
Input voltage (output on)		V _{IN(ON)}	I _{out} =400mA h _{FE} =800		2.8	24	V					
Input voltage (output off) V _{IN(OFF)}				0	0.7	V						
Clamping diode	e reverse	voltage	V _R				50	V				
Clamping diode fo	rward pea	k current	I _F				350	mA				
Operating	Diperating DIP16 T _A SOP16		erating DIP16		-40	+85	ŝ					
range			-40	+85	C							
	DIP16		D	т _ с	οr°C		0.76					
consumption	SOP16 PD TA= 85 C			0.325	vv							

Note : On a glass epoxy resin PCB board ($30 \times 30 \times 1.6$ mm copper 50%).





Electrical characteristics : (TA=25 ,unless otherwise specified)

	parameter	test chart	Test conditions		MIN	TYP	MAX	unit	
Conduction state					I _c =200mA		1.9	2.4	
V _{I(ON)}		P4	V _{CE} =2V		I _c =250mA		2.0	2.7	V
	input voltage				I _c =300mA		2.1	3	
			V _I =2.4V	I _c =30)mA		0.78		
			V _I =2.4V	I _c =60)mA		0.82		
V _{CE(SAT)}	Collector emitter	P5	V _I =2.4V	I _c =12	20mA		0.9		V
	saturation voltage drop		V _I =2.4V	I _c =24	l0mA		1.1		
			V _I =2.4V	I _c =35	i0mA		1.25		
V _F	Clamping diode forward voltage drop	P8	I _F =350mA			1.4	1.6	V	
	Collector off	P1	V _{CE} =50V I _I =0			-	50		
CEX	leakage current	P2	$V_{CE}=50V$ $T_{A}=85^{\circ}C$ $V_{I}=0V$			-	100	μΑ	
			V _{IN} =12	V			4		
.	In much Comment	D4	V _{IN} =6	V	L -60mA		1.7		m۸
11	Input Current	P4	V _{IN} =4.5	SV I _C =60mA		1.1		ma	
			V _{IN} =2.4V			0.35			
l _R	Clamping diode reverse current	P7	V _R =50V			-	100	μA	
CIN	Input capacitance					15		pF	
t _{PLH}	Low High Transmission Delay	P 9	VL=12V RL=45Ω			0.15	1	μs	
t _{PHL}	Transmission delay high low	P 9	VL=12V RL=45Ω			0.15	1	μs	

Schematic diagram of parameter testing



P5 HFE, VCE(sat) Test Circuit



P2 ICEXTest Circuit



P4 I₁Test Circuit



P7 I_RTest Circuit



ULN2003A



P9 Transmission Delay Waveform

Note: The capacitance load in Figure 9 is the parasitic capacitance of the oscilloscope probe





Typical Applications



Considering that some applications currently use a single chip microcomputer with Pull-up resistor, the output state of the single chip microcomputer is uncertain when it is powered on. At this time, the ULN2003A input stage will open the load due to the influence of the Pull-up resistor of the single chip microcomputer. To avoid the misoperation of the load, it is recommended that customers with such application problems connect a 4K pull-down resistance to the ground at the input stage, as shown in the figure above





PACKAGE MECHANICAL DATA

DIP16







Dimensions In Millimeters							
Symbol :	Min :	Max: Symbol: Min: Max					
Α	6.100	6.680	L	0.500	0.800		
В	18.940	19.560	а	1.524 TYP			
D	8.200	9.200	b	0.889 TYP			
D1	7.42	7.820	с	0.457 TYP			
E	3.100	3.550	d	2.540 TYP			
L	0.500	0.800		-			

SOP16





Dimensions In Millimeters								
Symbol :	Symbol: Min: Max: Symbol: Min: Max:							
Α	1.225	1.570	D	0.400	0.950			
A1	0.100	0.250	Q	0°	<mark>8</mark> °			
В	9.800	10.00	а	0.420 TYP				
С	5.800	6.250	b	1.270 TYP				
C1	3.800	4.000						