

# 7-Digit Darlington Current Driver

# ULN2003A/ ULN2004A

## FEATURES

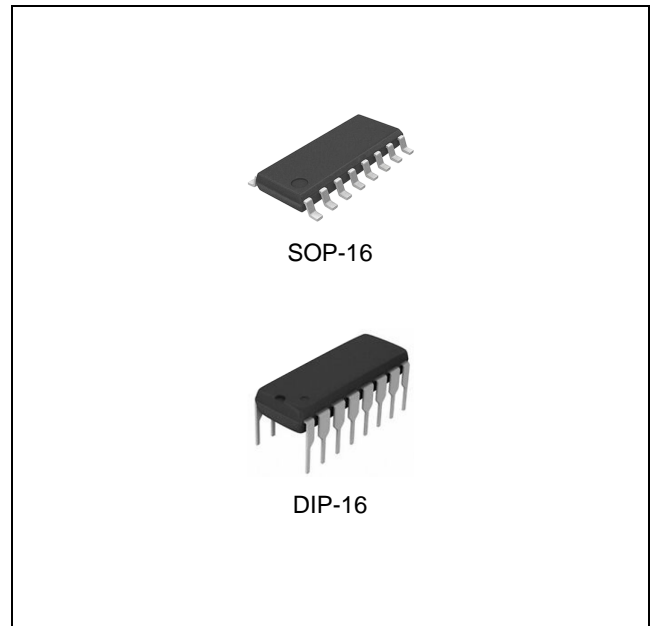
- 7 Darlington Arrays per Package
- 500 mA Rated Collector Current (Single Output)
- Output voltage 50V
- Output Clamp Diodes
- Input Compatible with Various Types of Logic
- Relay-Driver Applications
- Input pins placed opposite to output pins to simplify layout

## APPLICATION

- Relay Drivers
- Stepper and DC Brushed Motor Drivers
- Lamp Drivers
- Display Drivers
- Line Drivers
- Logic Buffers

## DESCRIPTION

The ULN2003A and ULN2004A are monolithic high-voltage, high-current Darlington transistor arrays. Each consists of seven NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of a single Darlington pair is 500 mA. The Darlington pairs may be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED and gas discharge), line drivers, and logic buffers.



## ORDERING INFORMATION

Device	Package
ULN2003AD	SOP-16
ULN2004AD	
ULN2003AN	DIP-16
ULN2004AN	

## ABSOLUTE MAXIMUM RATINGS (Note 1)

CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Output Voltage	$V_O$	-	50	V
Input Voltage <small>(Note 2)</small>	$V_I$	-	30	V
Peak Collector Current	$I_C$	-	500	mA
Output Clamp Current	$I_{OK}$	-	500	mA
Total Emitter-Terminal Current	$I_E$	-	2.5	A
Maximum Junction Temperature	$T_J$	-	150	°C
Storage Temperature	$T_{STG}$	-60	150	°C
Lead Temperature (Soldering, 5sec)	$T_{SOL}$	-	260	°C

## RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Output Voltage	$V_O$	-	50	V
Junction Temperature	$T_J$	-40	125	°C
Operating Free-Air Temperature Range	$T_A$	-40	85	°C
Package Thermal Resistance *	$\Theta_{JA-SOP-16}$	-	120	°C/W
	$\Theta_{JA-DIP-16}$	-	80	°C/W

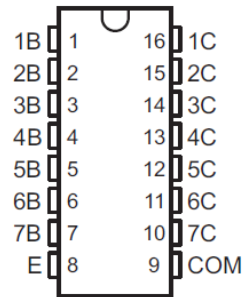
## ORDERING INFORMATION

Package	Order No.	Description	Package Marking	Status
SOP-16	ULN2003AD	7-Digit Darlington Current Driver	ULN2003A	Active
SOP-16	ULN2004AD	7-Digit Darlington Current Driver	ULN2004A	Active
DIP-16	ULN2003AN	7-Digit Darlington Current Driver	ULN2003A	Active
DIP-16	ULN2004AN	7-Digit Darlington Current Driver	ULN2004A	Active

# 7-Digit Darlington Current Driver

# ULN2003A/ ULN2004A

## PIN CONFIGURATION



SOP-16 / DIP-16

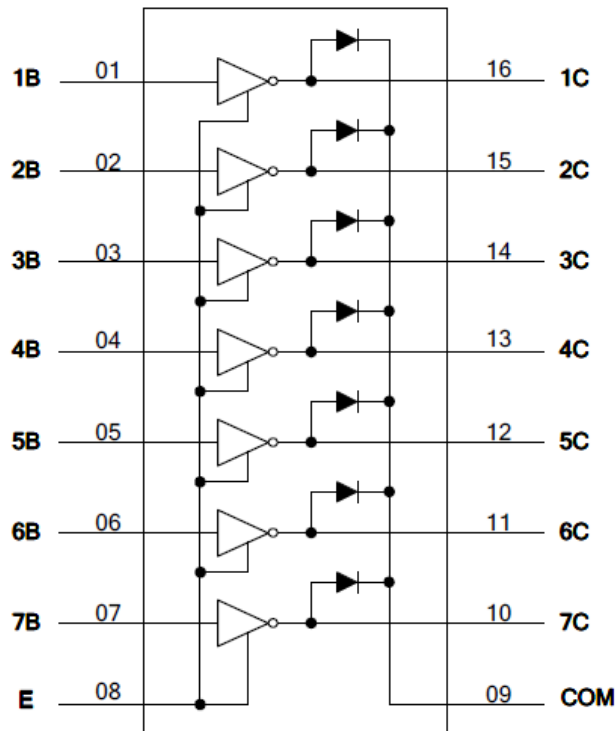
## PIN DESCRIPTION

Pin No.		Pin Name	Pin Function
SOP-16	DIP-16		
1	1	1B	Channel 1 through 7 Darlington Base Input
2	2	2B	
3	3	3B	
4	4	4B	
5	5	5B	
6	6	6B	
7	7	7B	
8	8	E	Common Emitter shared by All Channels
9	9	COM	Common Cathode Node for Flyback Diodes
10	10	7C	Channel 1 through 7 Darlington Collector Output
11	11	6C	
12	12	5C	
13	13	4C	
14	14	3C	
15	15	2C	
16	16	1C	

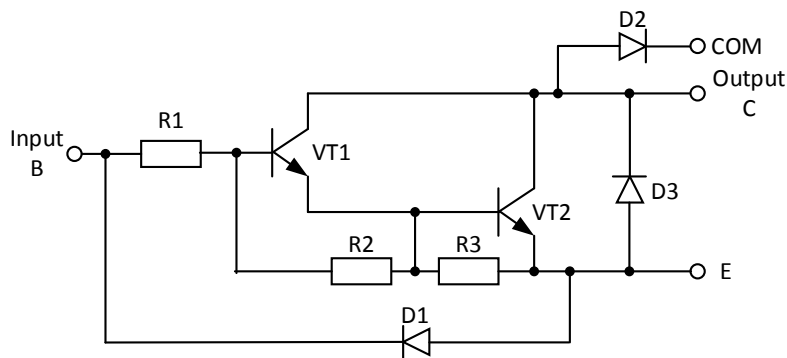
# 7-Digit Darlington Current Driver

# ULN2003A/ ULN2004A

## PIN CONNECTION DIAGRAM



## BLOCK DIAGRAM



- R1 : Resistor  
2.7k $\Omega$  for ULN2003A  
10.5k $\Omega$  for ULN2004A
- R2 : Resistor  
7.2 k $\Omega$
- R3 : Resistor  
3.0 k $\Omega$

## ELECTRICAL CHARACTERISTICS (Note 3)

Limits in standard typeface are for  $T_J=25^\circ\text{C}$ , unless otherwise specified.

PARAMETER	SYMBOL	TEST FIGURE	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
ON-State Input Voltage	$V_{I(ON)}$	Fig. 1.	$V_{CE}=2\text{V}$ , for ULN2003A	$I_C=200\text{mA}$	-	-	2.4	V
				$I_C=250\text{mA}$	-	-	2.7	
				$I_C=300\text{mA}$	-	-	3.0	
			$V_{CE}=2\text{V}$ , for ULN2004A	$I_C=125\text{mA}$	-	-	5.0	
				$I_C=200\text{mA}$	-	-	6.0	
				$I_C=275\text{mA}$	-	-	7.0	
				$I_C=350\text{mA}$	-	-	8.0	
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	Fig. 2.	$I_I=250\mu\text{A}$ , $I_C=100\text{mA}$		-	0.9	1.1	V
			$I_I=350\mu\text{A}$ , $I_C=200\text{mA}$		-	1.0	1.3	
			$I_I=500\mu\text{A}$ , $I_C=350\text{mA}$		-	1.2	1.6	
Output Leakage Current	$I_{CEX}$	Fig. 3. Fig. 4.	$V_{CE}=50\text{V}$ ,	$I_I=0\text{mA}$	-	-	50	$\mu\text{A}$
			$V_{CE}=50\text{V}$ , $T_A=85^\circ\text{C}$	$I_I=0\text{mA}$	-	-	100	
				$V_I=1\text{V}$	-	-	500	
Clamp Forward Voltage	$V_F$	Fig. 5.	$I_F=350\text{mA}$		-	1.7	2	V
Off-State Input Current	$I_{I(OFF)}$	Fig. 6.	$V_{CE}=50\text{V}$ , $I_C=500\mu\text{A}$ , $T_A=85^\circ\text{C}$		50	65	-	$\mu\text{A}$
Input Current	$I_{I(ON)}$	Fig. 7.	for ULN2003A	$V_I=3.85\text{V}$	-	-	1.35	mA
			for ULN2004A	$V_I=5\text{V}$	-	-	0.5	
				$V_I=12\text{V}$	-	-	1.45	
Clamp Diode Leakage Current	$I_R$	Fig. 8.	$V_R=50\text{V}$		-	-	50	$\mu\text{A}$
			$V_R=50\text{V}$ , $T_A=85^\circ\text{C}$		-	-	100	
Turn-On Propagation Delay Time	$t_{PLH}$	-	$0.5V_I$ to $0.5V_O$		-	0.25	1	$\mu\text{s}$
Turn-Off Propagation Delay Time	$t_{PHL}$	-	$0.5V_I$ to $0.5V_O$		-	0.25	1	

Note 1. Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Note 2. All voltage values are with respect to the emitter/substrate terminal E, unless otherwise noted.

Note 3. The device is not guaranteed to function outside its operating ratings.

## PARAMETER MEASUREMENT INFORMATION

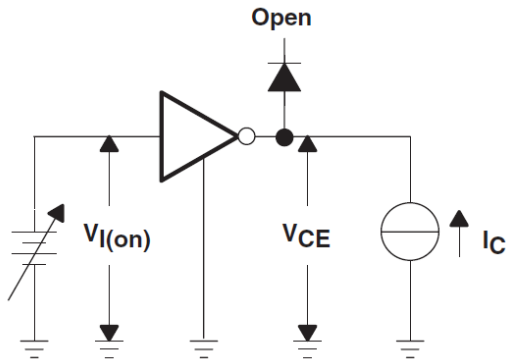


Fig. 1. ON-State Input Voltage Test Circuit

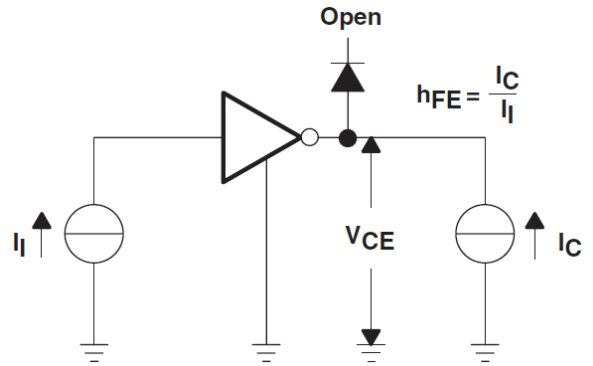


Fig. 2. Collector-Emitter Saturation Voltage Test Circuit

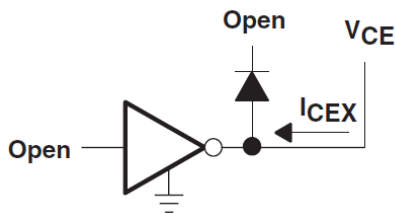


Fig. 3. Output Leakage Current Test Circuit

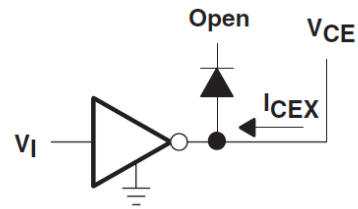


Fig. 4. Output Leakage Current Test Circuit

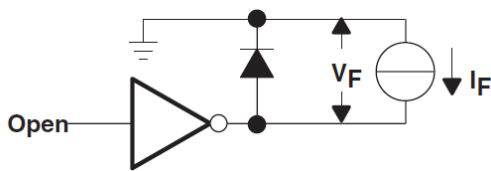


Fig. 5. Clamp Forward Voltage Test Circuit

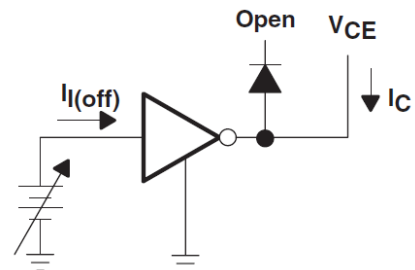


Fig. 6. Off-State Input Current Test Circuit

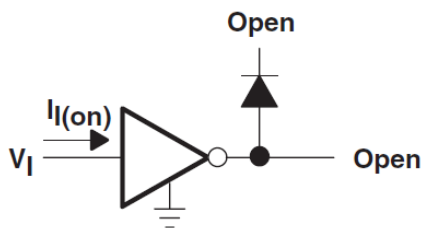


Fig. 7. Input Current Test Circuit

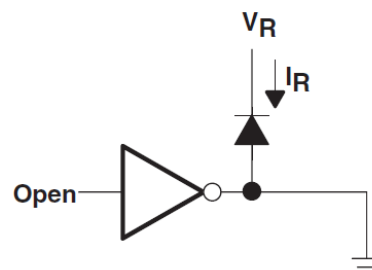


Fig. 8. Clamp Diode Leakage Current Test Circuit

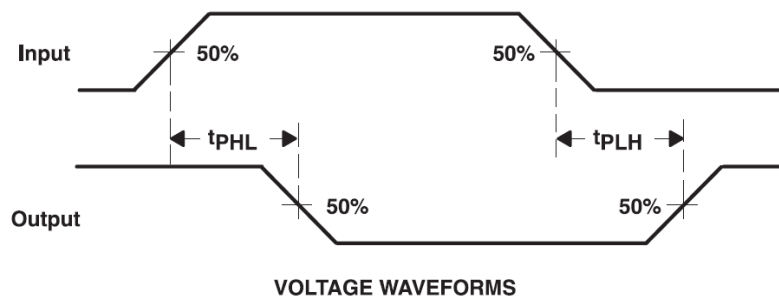


Fig. 9. Propagation Delay Time Waveform

**APPLICATION INFORMATION**

T.B.D.

**TYPICAL OPERATING CHARACTERISTICS**

T.B.D.

## REVISION NOTICE

The description in this datasheet is subject to change without any notice to describe its electrical characteristics properly.