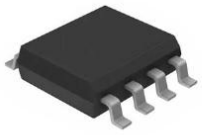
High-voltage High-current Darlington Transistor Arrays

ULN2001D

General Description



SOP-8

DIP-8

The ULN2001D is high-voltage high-current Darlington transistor arrays each containing three open collector common emitter pairs. Each pair is rated at 500mA. Suppression diodes are included for inductive load driving, the inputs and outputs are pinned in opposition to simplify board layout.

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

The ULN2001D is available in both a small outline 8-pin package (DIP8, SOP8).

Features

- 500mA-Rated Collector Current(single output)
- High-Voltage Outputs: 50V
- Output Clamp Diodes
- Inputs Compatible With Various Types of Logic
- Relay-Driver Applications

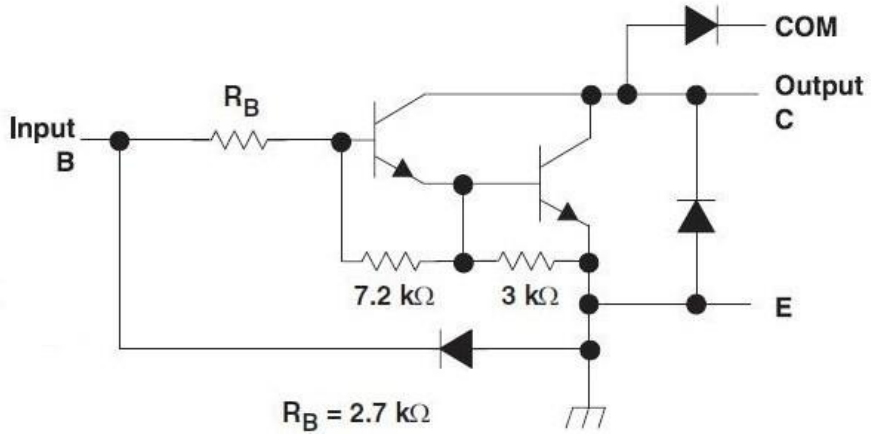
Applications

- Relay drive
- Indicator light drive
- Display screen driver

Order information

Product model	Package	Manner of packing	Minimum packing quantity
ULN2001D	SOP-8	REEL	3500
ULN2001DN	DIP-8	TUBE	50

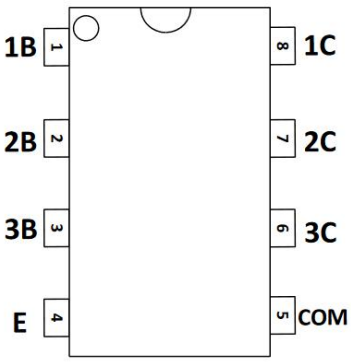
Functional Block Diagram

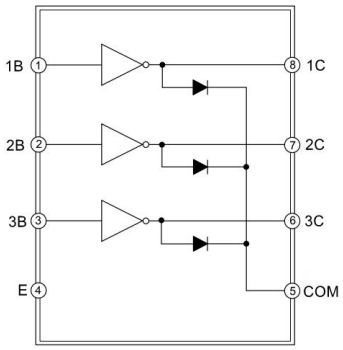


Note: All resistor values shown are nominal.

The collentor-emitter diode is a parasitic structure and should not be used to conduct current.If the collector(s) go below ground an external Schoottky diode should be added to clamp negative undershoots.

Pin Configuration And Connection Diagram





Pin Descriptions

Pin Number	Pin Name	Function
1	1B	Input pair1
2	2B	Input pair2
3	3B	Input pair3
4	E	Common Emitter (ground)
5	COM	Common Clamp Diodes
6	3C	Output pair3
7	2C	Output pair2
8	1C	Output pair1

Absolute Maximum Ratings (1)

At 25°C free-air temperature (unless otherwise noted)

Symbol	Parameter		Min	Max	Unit
V_{CC}	Collector to emitter voltage			50	V
V_R	Clamp diode reverse voltage(2)			50	V
V_I	Input voltage(2)			30	V
I_{CP}	Peak collector current	See typical		500	mA/ch
I_{OK}	Output clamp current			500	mA
I_{TE}	Total emitter-terminal current			–1.5	A
P_D	Power Dissipation	SOP-8		0.625	W
		DIP-8		0.75	
T_A	Operating free-air temperature	ULN2001D	–40	+105	°C
θ_{JA}	Thermal Resistance Junction-to-Ambient(3)			63	°C/W
θ_{JC}	Thermal Resistance Junction-to-Case(4)			12	
T_J	Operating virtual junction temperature			+150	°C
T_{STG}	Storage temperature range		–65	+150	°C
ESD	Human Body Mode		--	3000	V

(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.

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

(3) Maximum power dissipation is a function of TJ(max), θ_{JA}, and TA. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.

(4) Maximum power dissipation is a function of TJ(max), θ_{JC}, and TA. The maximum allowable power dissipation at any allowable ambient temperature is $PD = (T_{J(max)} - T_A)/\theta_{JC}$. Operating at the absolute maximum T_J of 150°C can affect reliability.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
VCC	Collector to Emitter voltage	-	50	V
TA	Operating Ambient Temperature	-40	+85	℃
VI	Input voltage	0	12	V
Iout	Output current		350	mA/ch

Note: Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability.

Electrical Characteristics

Parameter		Test Figure	Test Conditions		ULN2001D			Unit
					MIN	TYP	MAX	
$V_{I(on)}$	On-state input voltage	Figure 6	V_{CE} = 2 V	I_C = 200 mA	--	--	2.4	V
				I_C = 250 mA	--	--	2.7	
				I_C = 300 mA	--	--	3	
$V_{CE(sat)}$	Collector-emitter saturation voltage	Figure 5	I_I = 250 μA,	I_C = 100 mA	--	0.9	1.1	V
			I_I = 350 μA,	I_C = 200 mA	--	1	1.3	
			I_I = 500 μA,	I_C = 350 mA	--	1.2	1.6	
I_{CEX}	Collector cutoff current	Figure 1	V_{CE} = 50 V	I_I = 0	--	--	50	μA
		Figure 2	V_{CE} = 50 V, T_A = +105°C	I_I = 0	--	--	100	
V_F	Clamp forward voltage	Figure 8	I_F = 350 mA		--	1.7	2	V
$I_{I(off)}$	Off-state input current	Figure 3	V_{CE} = 50 V, I_C = 500 μA		50	65	--	μA
I_I	Input current	Figure 4	V_I = 3.85 V		--	0.93	1.35	mA
I_R	Clamp reverse current	Figure 7	V_R = 50 V	T_A = 25°C	--	--	50	μA
				T_A = 70°C	--	--	100	
C_i	Input capacitance		V_I = 0, f = 1 MHz		--	15	25	pF

Switching Characteristics

(TA = +25°C, unless otherwise specified)

Parameter		Test Conditions	ULN2001D			Unit
			MIN	TYP	MAX	
t_{PLH}	Propagation delay time, low- to high-level output	Figure 9	--	0.25	1	μs
t_{PHL}	Propagation delay time, high- to low-level output	Figure 9	--	0.25	1	μs
V_{OH}	High-level output voltage after switching	V_S = 50 V, I_O = 300 mA, Figure 9	V_S–20	--	--	mV

Parameter Measurement Information

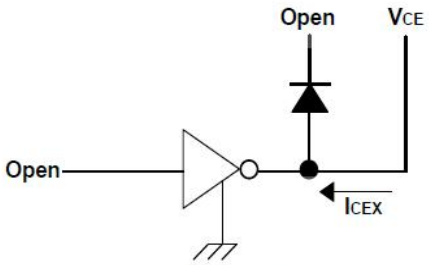


Fig.1 I_{CEX} Test Circuit

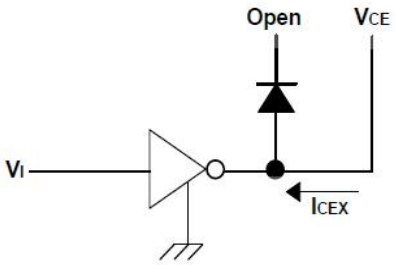


Fig.2 I_{CEX} Test Circuit

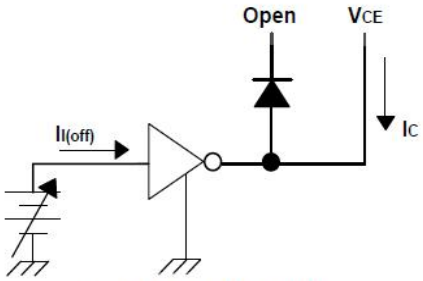


Fig.3 $I_{I(off)}$ Test Circuit

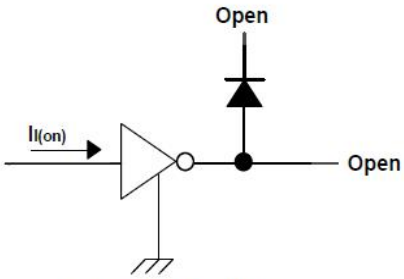


Fig.4 I_I Test Circuit

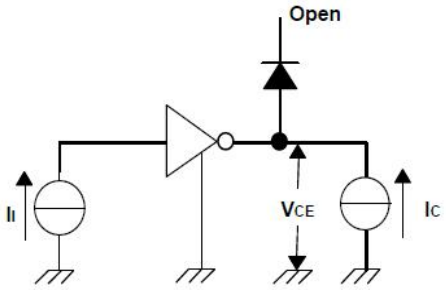


Fig. 5 h_{FE} , $V_{CE(sat)}$ Test Circuit

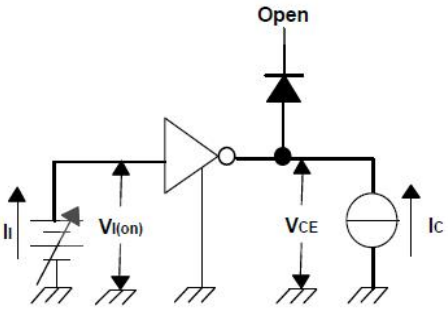


Fig. 6 $V_{I(on)}$ Test Circuit

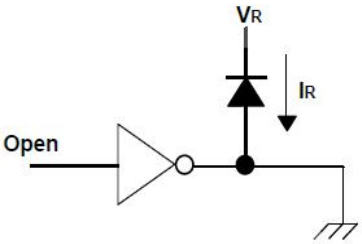


Fig. 7 I_R Test Circuit

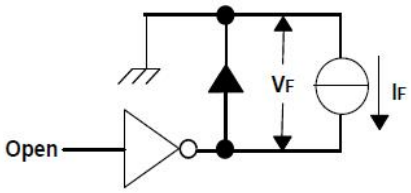


Fig. 8 V_F Test Circuit

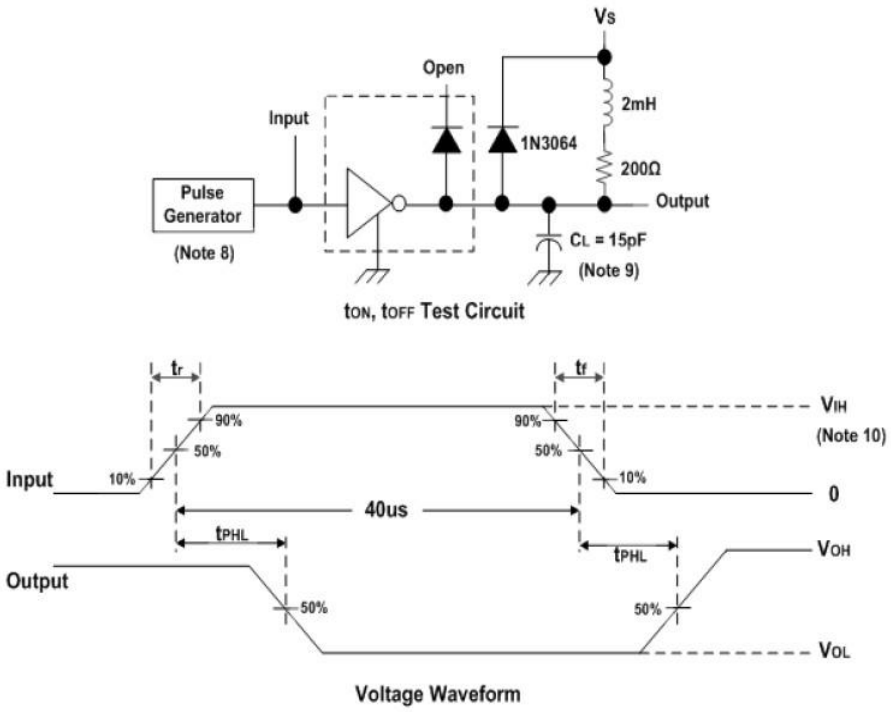


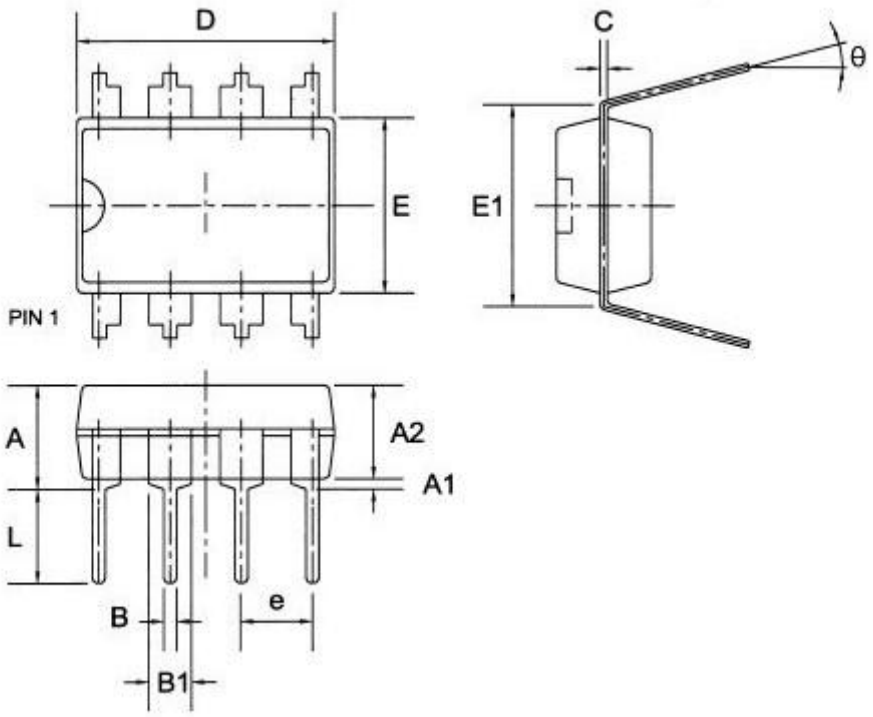
Fig. 9 Latch-Up Test Circuit and Voltage Waveform

Notes:

8. The pulse generator has the following characteristics:Pulse Width=12.5Hz, output impedance 50Ω, tr≤5ns, tr≤10ns.
9. C_L includes prove and jig capacitance.
10. V_{IH}=3V

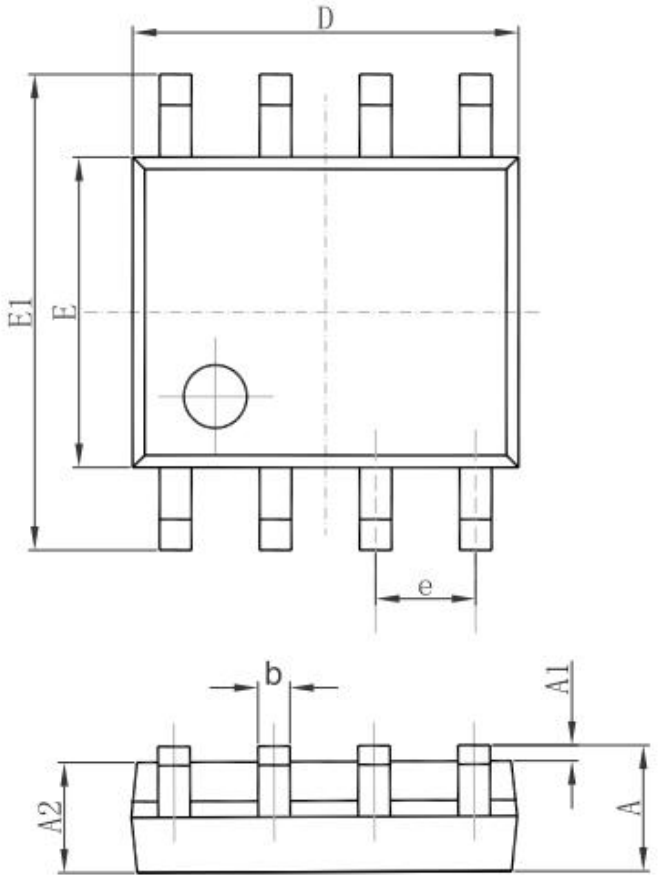
Package Information

DIP-8 Outline Dimensions



Symbol	Dimension (mm)			Symbol	Dimension (mm)		
	MIN	NOM	MAX		MIN	NOM	MAX
A	-	-	4.31	D	8.95	9.20	9.45
A1	0.38	-	-	E	6.15	6.4	6.65
A2	3.15	3.4	3.65	E1	-	7.62	-
B	0.38	0.46	0.51	e	-	2.54	-
B1	1.27	1.52	1.77	L	3.00	3.30	3.60
C	0.2	0.25	0.3		0°	-	15°

SOP-8 Outline Dimensions



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.00	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Special Version

The company reserves the right of final interpretation of this specification.

Version Change Description

Versions：V1.0 Writer：XinCHun Li Time：2025.12.15

Modify the record：

1. Editio princeps

Statement

The information in the usage specification is correct at the time of publication, Shanghai Siproin Microelectronics Co.,Ltd has the right to change and interpret the specification, and reserves the right to modify the product without prior notice. Users can obtain the latest version information from our official website or other effective channels before confirmation, and verify whether the relevant information is complete and up to date.

With any semiconductor product, there is a certain possibility of failure or failure under certain conditions. The buyer is responsible for complying with safety standards and taking safety measures when using the product for system design and complete machine manufacturing. The product is not authorized to be used as a critical component in life-saving or life-sustaining products or systems, in order to avoid potential failure risks that may cause personal injury or property loss.