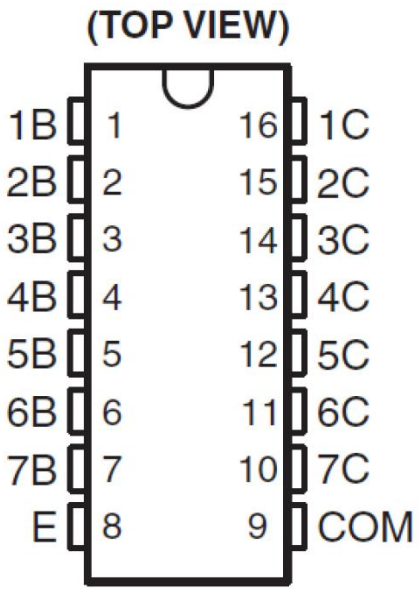
General Description

The ULN2003A is high-voltage high-current Darlington transistor arrays each containing seven 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 ULN2003A is available in both a small outline 16-pin package (SOP16 and TSSOP16).

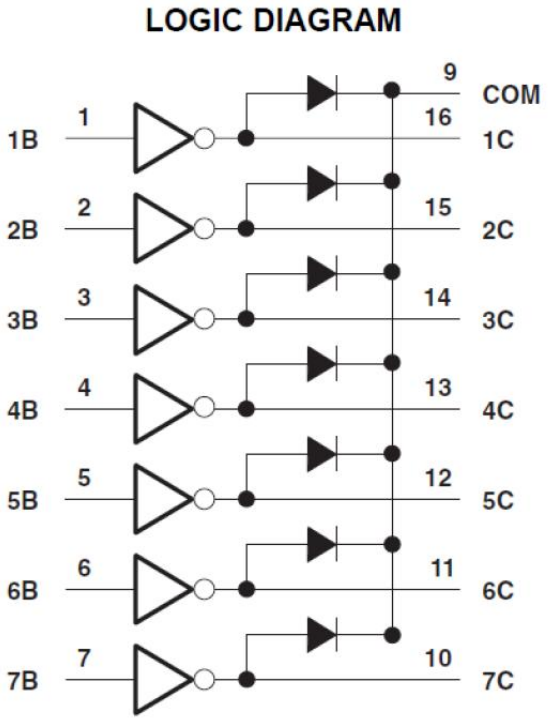
Features

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

Pin Assignments



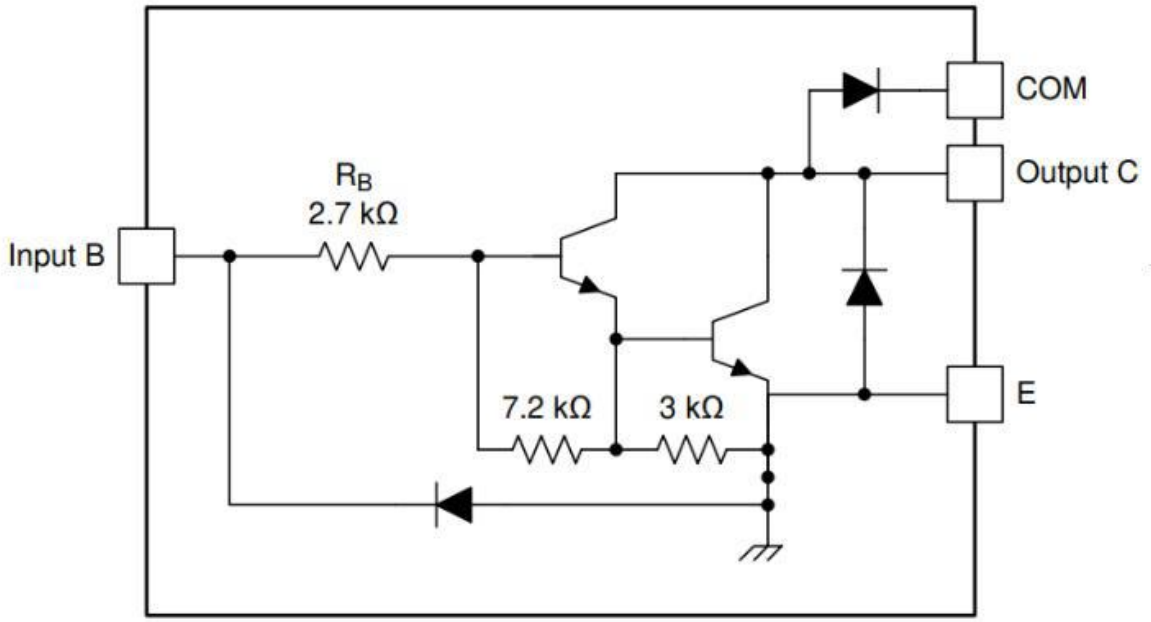
General Description



Pin Descriptions

Pin Number	Pin Name	Function
1	1B	Input pair1
2	2B	Input pair1
3	3B	Input pair1
4	4B	Input pair1
5	5B	Input pair1
6	6B	Input pair1
7	7B	Input pair1
8	E	Common Emitter (ground)
9	COM	Common Clamp Diodes
10	7C	Output pair7
11	6C	Output pair6
12	5C	Output pair5
13	4C	Output pair4
14	3C	Output pair3
15	2C	Output pair2
16	1C	Output pair1

Functional Block Diagram



Note: All resistor values shown are nominal.

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

Ordering Information

Type Number	Package Name	Package Quantity	Mark Code
ULN2003AXS16/R5	SOP-16L	2500 Tape&Reel	A2003
ULN2003AXT16/R6	TSSOP-16L	3000 Tape&Reel	A2003

Absolute Maximum Ratings

Ta=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 characteristics		500	mA
I_{ok}	Output clamp current			500	mA
I_{TE}	Total emitter-terminal current			-2.5	A
T_A	Operating free-air temperature range	ULN2003A	-40	+105	℃
θ_{JA}	Thermal Resistance Junction-to-Ambient(3)			63	℃/W
θ_{Jc}	Thermal Resistance Junction-to-Case(4)			12	
T_J	Operating virtual junction temperature			+150	℃
T_{STG}	Storage temperature range		-65	+150	℃
ESD	Human Body Mode		--	2000	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), θJA, and TA. The maximum allowable power dissipation at any allowable ambient temperature is PD = (TJ(max) – TA)/θJA. Operating at the absolute maximum TJ of 150°C can affect reliability.

(4)Maximum power dissipation is a function of TJ(max), θJC, and TA. The maximum allowable power dissipation at any allowable ambient temperature is PD = (TJ(max) – TA)/θJC. Operating at the absolute maximum TJ of 150°C can affect reliability.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{cc}	Collector to Emitter voltage	-	50	V
T_A	Operating Ambient Temperature	-40	+105	℃

Electrical Characteristics

(Ta= 25℃, unless otherwise specified)

Parameter		Test Figure	Test Conditions		ULN2003A			Unit
					MIN	TYP	MAX	
$V_{I(on)}$	On-state input voltage	Figure 6	VCE=2V	IC=200mA	--	--	2.4	V
				IC=250mA	--	--	2.7	
				IC=300mA	--	--	3	
$V_{CE(sat)}$	Collector-emitter saturation voltage	Figure 5	II=250 μA,	IC=100mA	--	0.9	1.1	V
			II=350 μA,	IC=200mA	--	1	1.3	
			II=500 μA,	IC=350mA	--	1.2	1.6	
I_{CEX}	Collector cutoff current	Figure 1	V_{CE}=50 V,	II=0	--	--	50	μA
		Figure 2	V_{CE}=50V, T_A=+105℃	II=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	VI=3.85V		--	0.93	1.35	mA
I_R	Clamp reverse current	Figure 7	VR=50V		--	--	50	μA
				TA=70℃	--	--	100	
C_I	Input capacitance		VI=0, f=1MHz		--	15	25	pF

Part measurement information

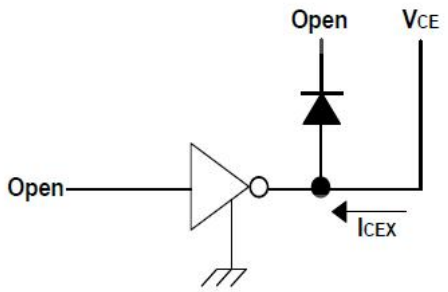


Fig.1 I_{CEX} Test Circuit

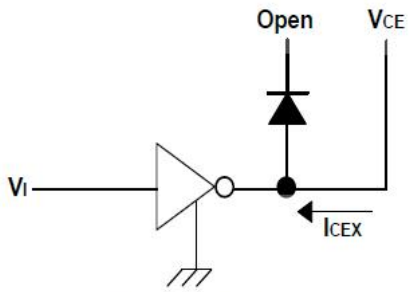


Fig.2 I_{CEX} Test Circuit

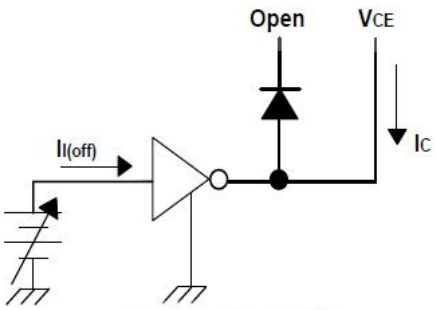


Fig.3 $I_{I(off)}$ Test Circuit

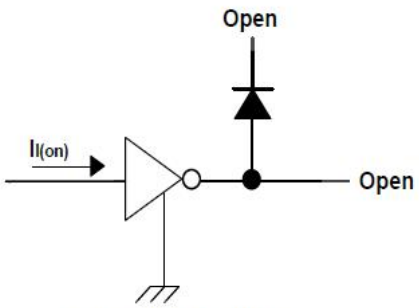


Fig.4 I_I Test Circuit

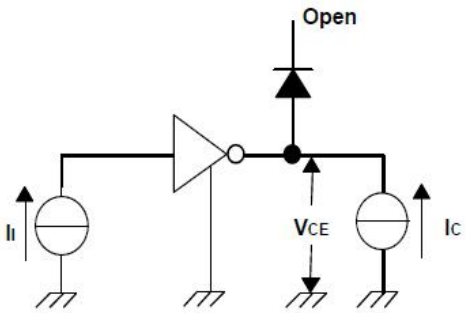


Fig. 5 h_{FE} , $V_{CE(sat)}$ Test Circuit

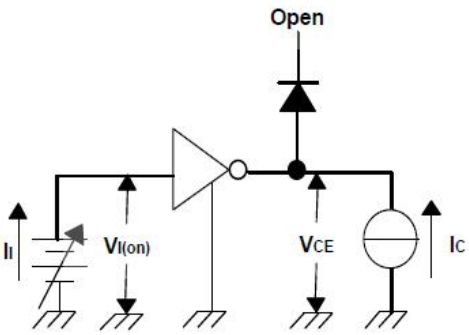


Fig. 6 $V_{I(on)}$ Test Circuit

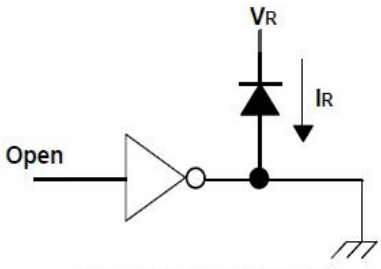


Fig. 7 I_R Test Circuit

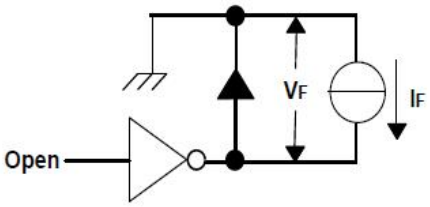
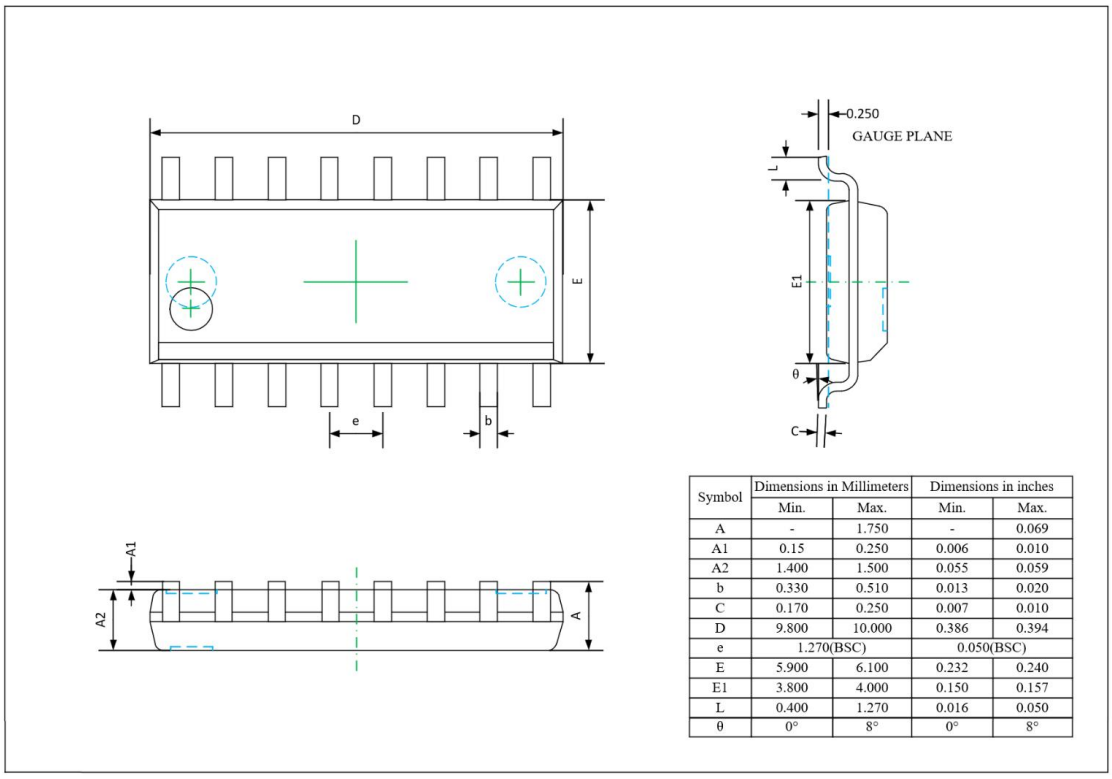


Fig. 8 V_F Test Circuit

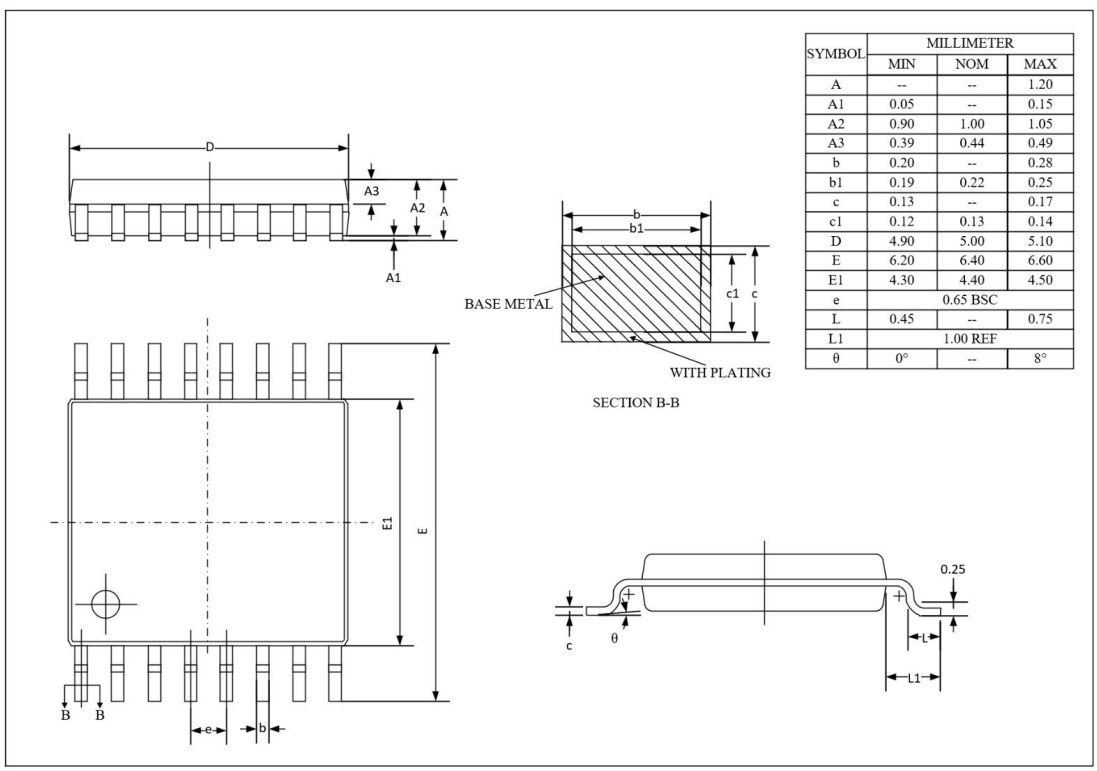
Outline Dimensions

SOP-16L



Symbol	Dimensions in Millimeters		Dimensions in inches	
	Min.	Max.	Min.	Max.
A	-	1.750	-	0.069
A1	0.15	0.250	0.006	0.010
A2	1.400	1.500	0.055	0.059
b	0.330	0.510	0.013	0.020
C	0.170	0.250	0.007	0.010
D	9.800	10.000	0.386	0.394
e	1.270(BSC)		0.050(BSC)	
E	5.900	6.100	0.232	0.240
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

TSSOP-16L



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	--	--	1.20
A1	0.05	--	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	--	0.28
b1	0.19	0.22	0.25
c	0.13	--	0.17
c1	0.12	0.13	0.14
D	4.90	5.00	5.10
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65 BSC		
L	0.45	--	0.75
L1	1.00 REF		
θ	0°	--	8°

Important Notice

Linearin is a global fabless semiconductor company specializing in advanced high-performance high-quality analog/mixed-signal IC products and sensor solutions. The company is devoted to the innovation of high performance, analog-intensive sensor front-end products and modular sensor solutions, applied in multi-market of medical & wearable devices, smart home, sensing of IoT, intelligent industrial & smart factory (industry 4.0), and automotives. Linearin's product families include widely-used standard catalog products, solution-based application specific standard products (ASSPs) and sensor modules that help customers achieve faster time-to-market products. Go to http://www.linearin.com for a complete list of Linearin product families.

For additional product information, or full datasheet, please contact with the Linearin's Sales Department or Representatives.