JIANGSU CHANGJING ELECTRONICS TECHNOLOGY CO., LTD

Plastic-Encapsulate Darlington Transistors

ULN2003 DARLINGTON TRANSISTOR (NPN)

Description

ULN2003 is high voltage, high current darlington arrays each containing seven open collector darlington pairs with common emitters. Each channel 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.

Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED and gas discharge), line drivers, and logic buffers. The ULN2003 device has a 2.7-kΩ series base resistor for each Darlington pair for operation directly with TTL or 5-V CMOS devices.

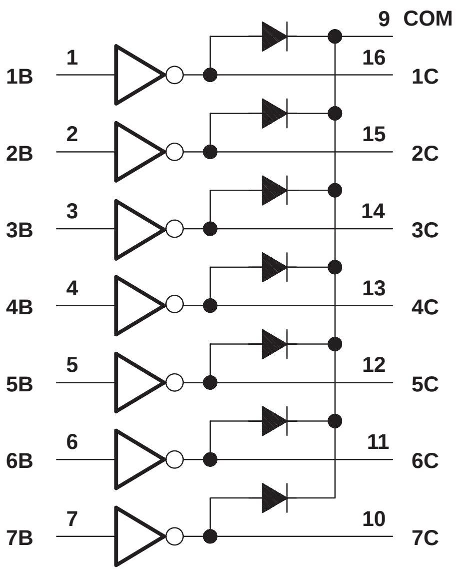
Features

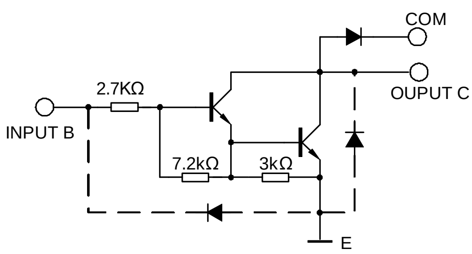
- 500-mA-Rated Collector Current (Single Output)
- High-Voltage Outputs: 40 V
- Output Clamp Diodes
- Inputs Compatible With Various Types of Logic
- Relay-Driver Applications

Applications

- Relay Drivers
- Hammer Drivers
- Lamp Drivers
- Line Drivers
- Logic Buffers
- Stepper Motors
- IP Camera
- HVAC Valve and LED Dot Matrix

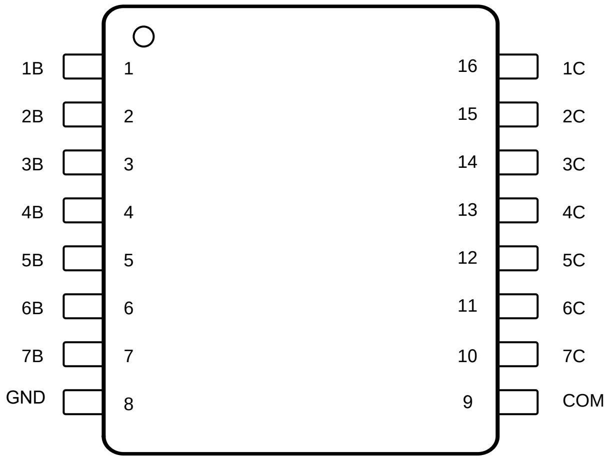
Logic Diagram





Pin Configuration and Functions

Top View



Not to scale

Pin Functions

PIN		TYPE	DESCRIPTION
NAME	NO.		
1B	1	I	Channel 1 through 7 Darlington base input
2B	2		
3B	3		
4B	4		
5B	5		
6B	6		
7B	7		
1C	16	O	Channel 1 through 7 Darlington collector output
2C	15		
3C	14		
4C	13		
5C	12		
6C	11		
7C	10		
GND	8	—	Common emitter shared by all channels (typically tied to ground)
COM	9	I/O	Common cathode node for flyback diodes (required for inductive loads)

Typical Characteristics

ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	ULN2003 MIN	ULN2003 TYP	ULN2003 MAX	UNIT
Output voltage	V_O			40	V
Input voltage	V_I			30	V
Collector current(continuous current)	I_C			500	mA
Base current(continuous current)	I_B			25	mA
Operating Ambient Temperature	T_A	-20		85	℃
Operating Junction Temperature	T_J			150	℃
Storage Temperature	T_{stg}	-55		150	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃ unless otherwise specified)

PARAMETER		TEST CONDITIONS		ULN2003 MIN	ULN2003 TYP	ULN2003 MAX	UNIT
I_{CEX}	Collector cutoff current	V_{CE} = 40 V, Tamb=+85℃				100.0	μA
		V_{CE} = 40 V, Tamb=+25℃				50.0	μA
V_{CES}	Collector-emitter saturation voltage	I_C = 350 mA, I_B=500uA			1.1	1.6	V
		I_C = 200 mA, I_B=350uA			0.95	1.3	
		I_C = 100 mA, I_B=250uA			0.85	1.1	
$II_{(ON)}$	Input current(ON)	V_I = 3.85 V			0.93	1.35	mA
$VI_{(ON)}$	Input voltage(ON)	V_{CE} = 2.0 V, I_C=200mA				2.4	V
		V_{CE} = 2.0 V, I_C=250mA				2.7	
		V_{CE} = 2.0 V, I_C=300mA				3.0	
$II_{(OFF)}$	Input current(OFF)	V_{CE} = 2.0 V, I_C=350mA		50	100		μA
C_I	Input capacitance				15	30	pF
t_{ON}	On delay time	50%EI to 50% EO			0.25	1.0	μs
t_{OFF}	Off delay time	50%EI to 50% EO			0.25	1.0	μs
I_R	Clamp reverse current	V_R = 50 V	TA=+25℃			50.0	μA
			TA=+85℃			100.0	
V_F	Clamp forward voltage	IF=350mA			1.5	2.0	V

Typical Characteristics Measurement

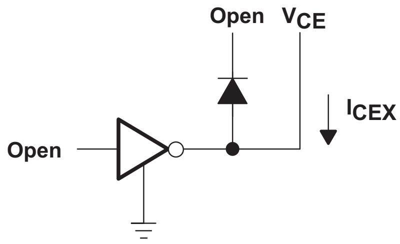


Figure 1. I_{CEX} Test Circuit

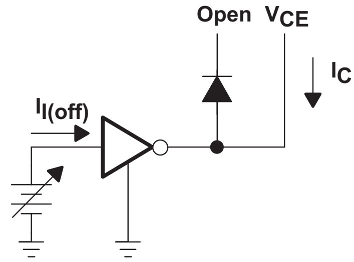


Figure 2. $I_{I(off)}$ Test Circuit

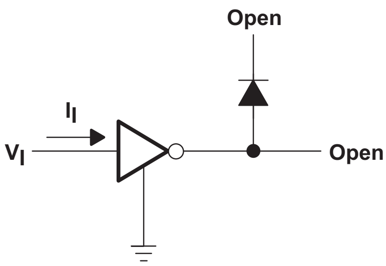


Figure 3. $I_{I(on)}$ Test Circuit

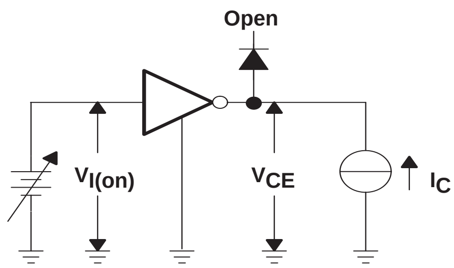
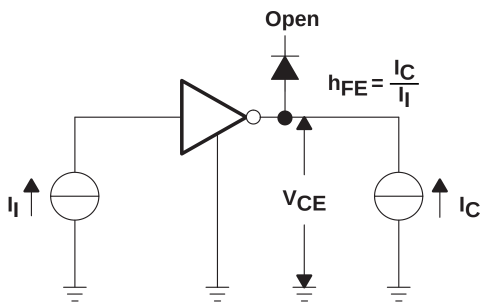


Figure 4. $V_{I(on)}$ Test Circuit



NOTE: I_I is fixed for measuring $V_{CE(sat)}$, variable for measuring hFE.

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

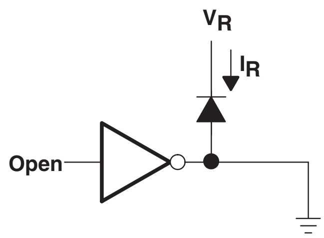


Figure 6. I_R Test Circuit

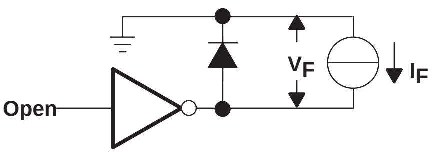


Figure 7. V_F Test Circuit

Typical Application

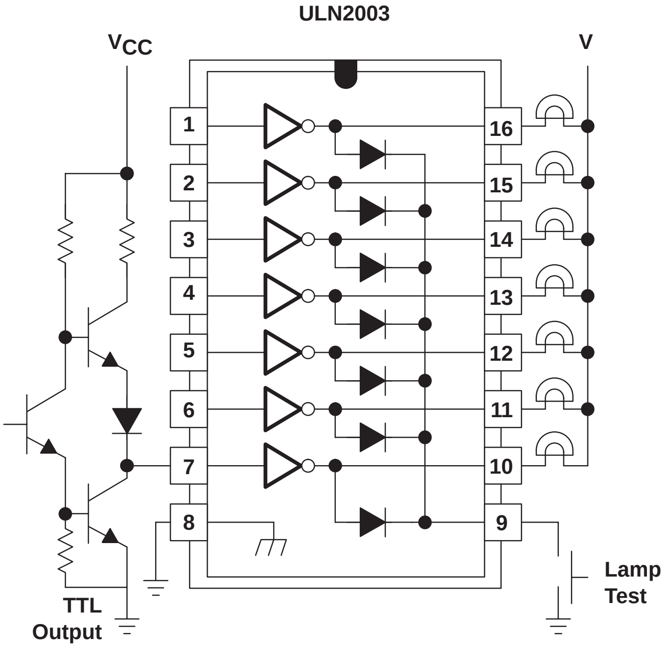


Figure 8. TTL to Load

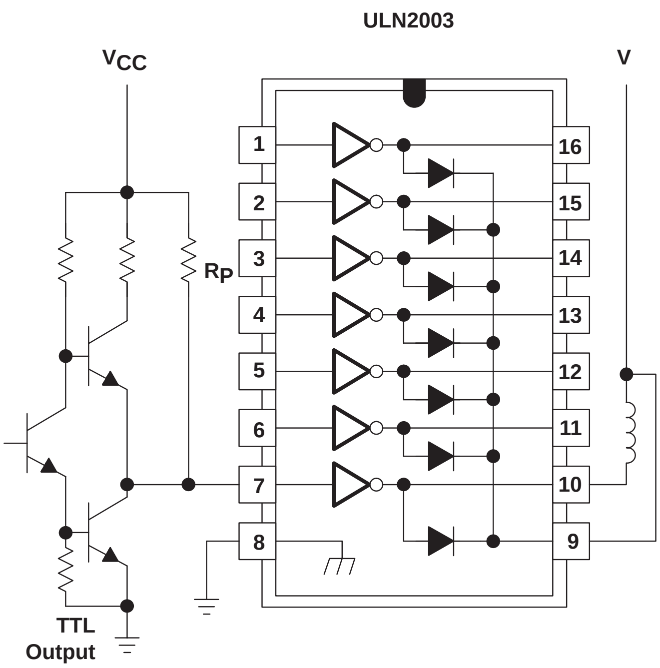
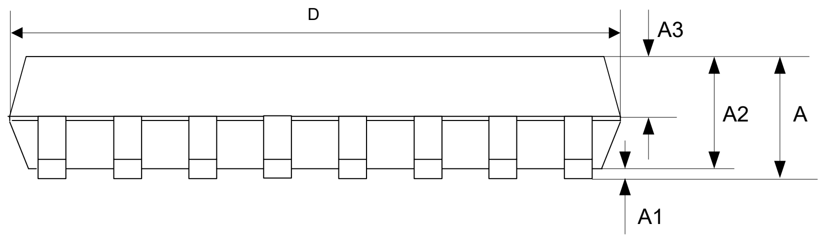
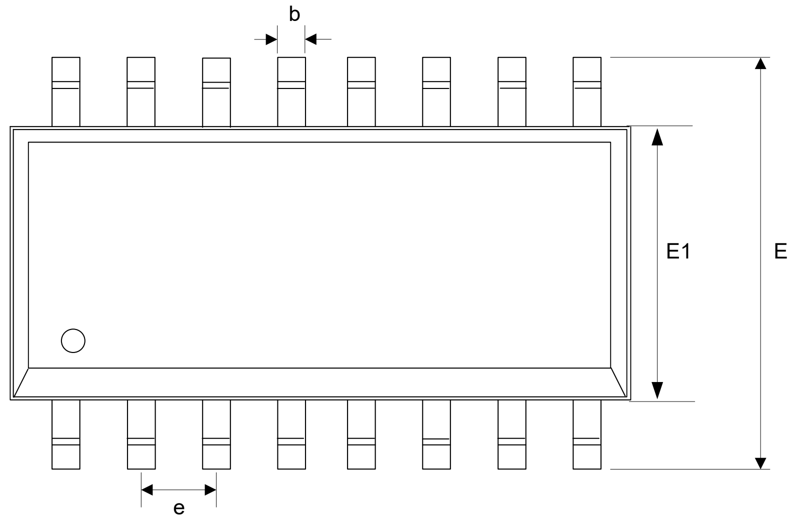
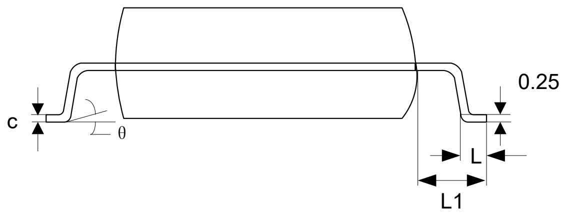


Figure 9. Use of Pullup Resistors to Increase Drive Current

SOP-16 Package Outline Dimensions

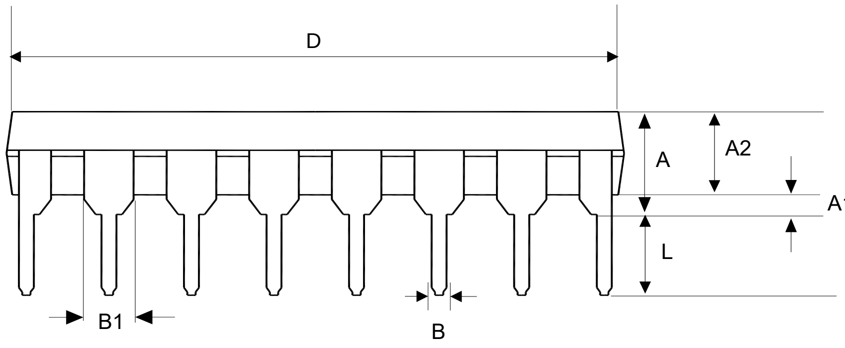


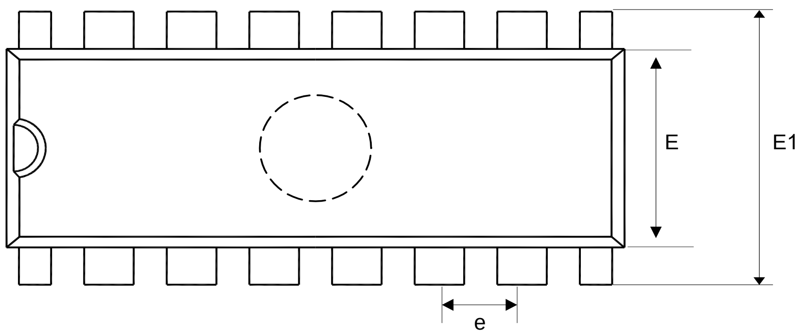


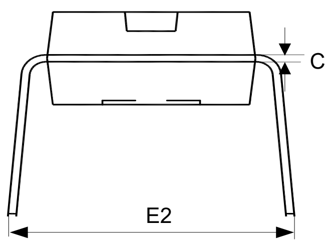


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	-	-	1.75
A1	0.10	-	0.25
A2			1.60
A3	0.97	1.02	1.07
b	0.35	-	0.46
c	0.19	-	0.25
D	9.80		10.0
E	5.80	6.00	6.20
E1	3.80		4.00
e	1.27BSC		
L	0.70	0.5	1.00
L1	1.40BSC		
θ	0	-	8°

DIP-16 Package Outline Dimensions







SYMBOL	MILLIMETER	
	Min	Max
A	3.710	4.310
A1	0.510	
A2	3.200	3.600
B	0.380	0.570
B1	1.524(BSC)	
C	0.204	0.360
D	18.800	19.200
E	6.200	6.600
E1	7.320	7.920
e	2.540(BSC)	
L	3.000	3.600
E2	8.400	9.0070

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