

ULN2003

LINEAR INTEGRATED CIRCUIT

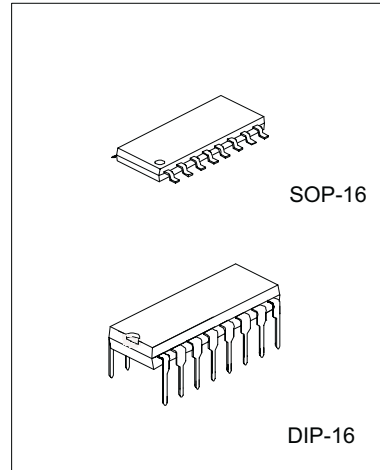
THESE HIGH-VOLTAGE, HIGH-CURRENT

DESCRIPTION

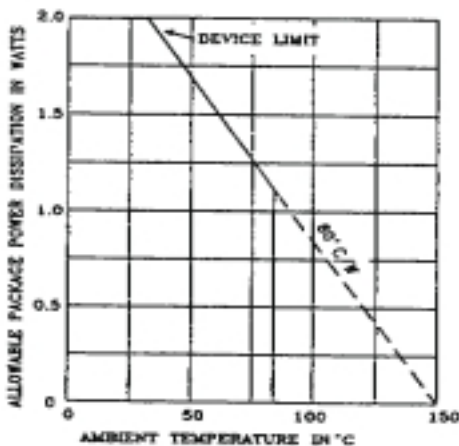
Darlington arrays are comprised of seven silicon NPN darlington pairs on a common monolithic substrate. All units have open-collector outputs and integral diodes for inductive load transient suppression.

FEATURES

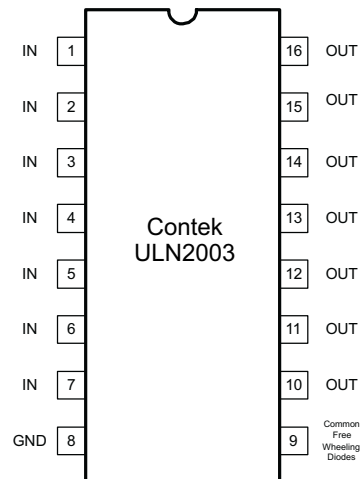
- * ULN2003 has a 2.7kΩ series base resistor for each darlington pair, allowing operation directly with TTL or CMOS operating at a supply voltage of 5V. These devices will handle numerous interface needs particularly those beyond the capabilities of standard logic buffers.
- * ULN2003 is the original high-voltage, high-current darlington array. The output transistors are capable of sinking 500mA and will sustain at least 50V in the off state. Output may be paralleled for higher load-current capability.
- * ULN2003 darlington arrays are furnished in a 16-pin dual in-line plastic package. These can also be supplied in a hermetic dual in-line package for use in military and aerospace applications.



ALLOWABLE AVERAGE POWER DISSIPATION AS A FUNCTION OF AMBIENT TEMPERATURE



PIN CONFIGURATIONS



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ABSOLUTE MAXIMUM RATINGS

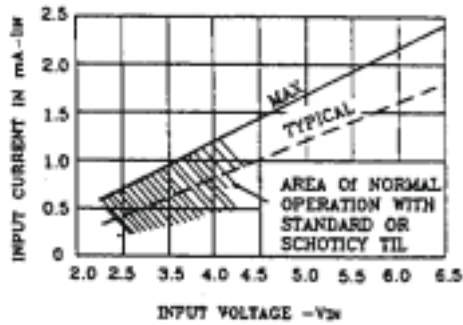
PARAMETER	SYMBOL	VALUE	UNIT
Input Voltage	V_{IN}	30	V
Continuous Input Current	I_{IN}	25	mA
Power Dissipation (one darlington pair)	P_D	1	W
Operating Ambient Temperature Range	T_A	-20 to +85	C
Storage Temperature Range	T_S	-55 to +150	C

*Debate at the rate of 16.67mW/ C above +25 C

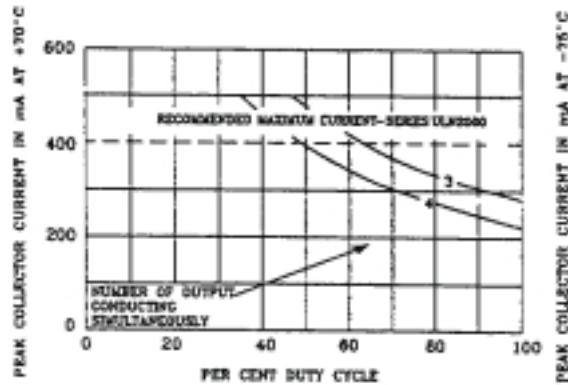
Under normal operating conditions, these devices will sustain 350mA per output with $V_{CE(STA)}=1.6V$ at +70 C
With a pulse width of 20ms and a duty cycle of 34%.

PARTIAL SCHEMATICS

Series ULN2003
(each driver)



PEAK COLLECTOR CURRENT AS A FUNCTION OF DUTY CYCLE



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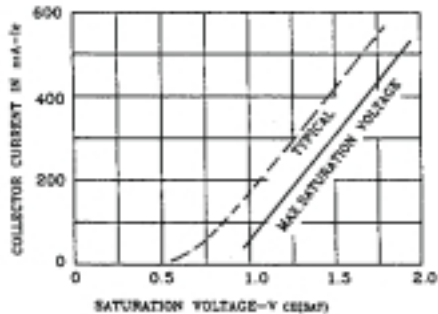
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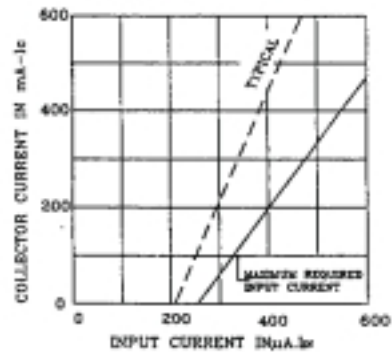
ELECTRICAL CHARACTERISTICS (Ta = 25 °C, Unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	FIG
Output Leakage Current	I_{CEX}	$V_{CE}=50V, T_A=25\text{ }^{\circ}\text{C}$ $V_{CE}=50V, T_A=70\text{ }^{\circ}\text{C}$			50 100	μA	1
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	$I_C=100\text{mA}, I_S=250\mu\text{A}$ $I_C=200\text{mA}, I_S=350\mu\text{A}$ $I_C=350\text{mA}, I_S=500\mu\text{A}$		0.9 1.1 1.3	1.1 1.3 1.6	V	2
Input Current	$I_{IN(ON)}$	$V_{IN}=3.85\text{V}$		0.93	1.35	mA	3
Input Voltage	$I_{IN(OFF)}$	$I_C=500\mu\text{A}, T_A=70\text{ }^{\circ}\text{C}$	50	65		μA	4
	$V_{IN(ON)}$	$V_{CE}=2.0\text{V}, I_C=200\text{mA}$ $V_{CE}=2.0\text{V}, I_C=250\text{mA}$ $V_{CE}=2.0\text{V}, I_C=300\text{mA}$			2.4 2.7 3.0	V	5
Input Capacitance	C_{IN}			15	25	pF	
Turn-On Delay	t_{PLH}	0.5 Ein to 0.5 Eout		0.25	1.0	μS	
Turn-Off Delay	t_{PHL}	0.5 Ein to 0.5 Eout		0.25	1.0	μS	
Clamp Diode Leakage Current	I_R	$V_R=50\text{V}, T_A=25\text{ }^{\circ}\text{C}$ $V_R=50\text{V}, T_A=70\text{ }^{\circ}\text{C}$			50 100	μA	6 6
Clamp Diode Forward Voltage	V_F	$I_F=350\text{mA}$		1.7	2.0	V	7

COLLECTOR CURRENT AS A FUNCTION OF SATURATION VOLTAGE



COLLECTOR CURRENT AS A FUNCTION OF INPUT CURRENT



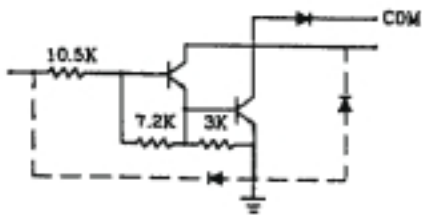
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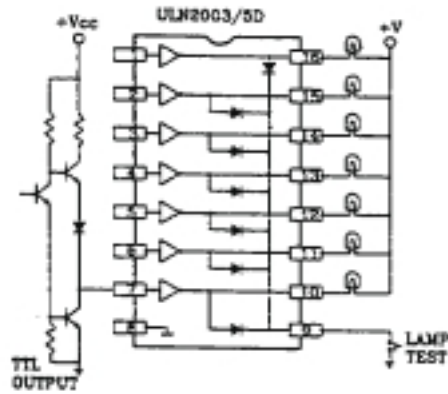
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INPUT CURRENT AS A FUNCTION OF INPUT VOLTAGE

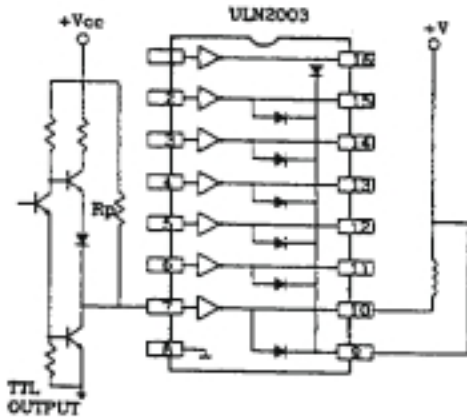
SERIES ULN2003



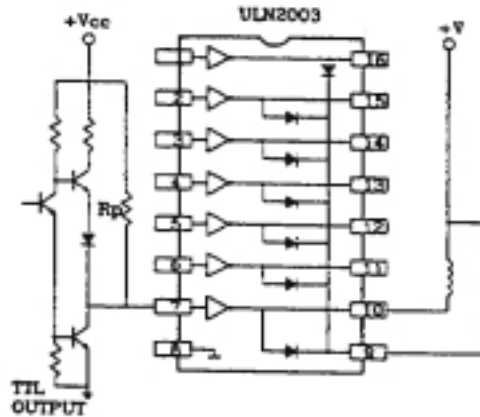
TTL TO LOAD



USE OF PULL-UP RESISTORS TO INCREASE DRIVE CURRENT



USE OF PULL-UP RESISTORS TO INCREASE DRIVE CURRENT



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TEST CIRCUIT

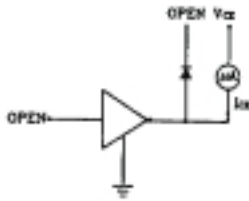


FIGURE 1

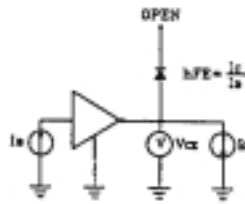


FIGURE 2

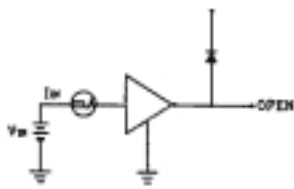


FIGURE 3

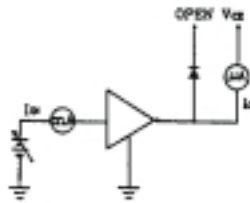


FIGURE 4

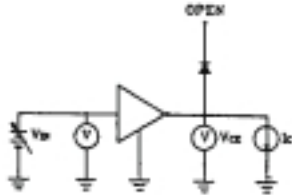


FIGURE 5

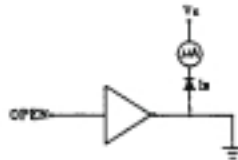


FIGURE 6

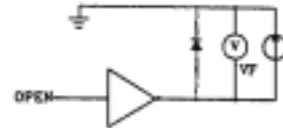


FIGURE 7