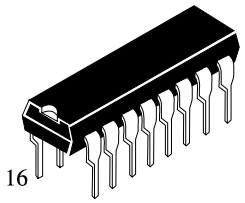
ILN2004

HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAYS

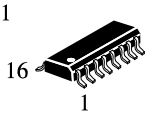
The ILN2004 are monolithic high-voltage, high-current Darlington transistor arrays. Each consists of seven n-p-n Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of a single Darlington pair is 500 mA. The Darlington 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.

The ILN2004 has a 10.5kΩ series base resistor for each Darlington pair for operation directly with 6-15V CMOS devices.

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



N SUFFIX
PLASTIC

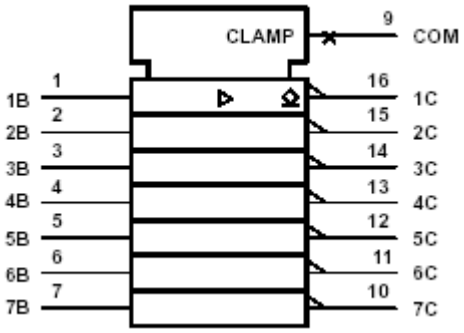


D SUFFIX
SOIC

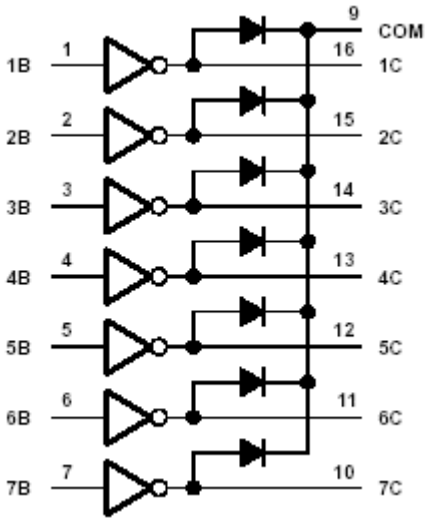
ORDERING INFORMATION

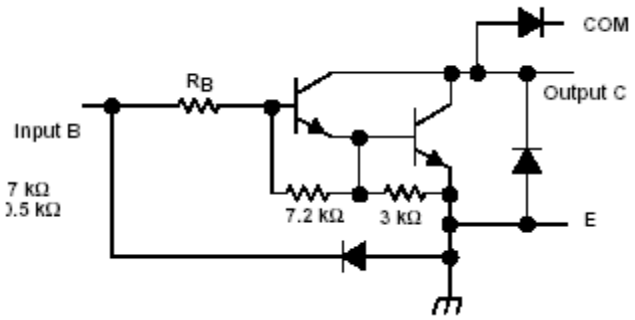
ILN2004N Plastic
ILN2004D SOIC
T_A = -20°C to 85° C for all packages

LOGIC SYMBOL



LOGIC DIAGRAM





SCHEMATICS (each Darlington Pair)
ILN2004: R_B = 10.5 kΩ
All resistor values shown are nominal.

Absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)

Symbol	Parameter	Value	Unit
	Collector-emitter voltage	50	V
V_I	Input voltage(see Note 1)	30	V
	Peak collector current (see Figures 14 and 15)	500	mA
I_{OK}	Output clamp current	500	mA
	Total emitter-terminal current	–2.5	A
	Continuous total power dissipation	See Dissipation Rating Table	
T_A	Operating free-air temperature range	–20 to 85	°C
Tstg	Storage temperature range	–65 to 150	°C
	Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260	°C

NOTE 1: All voltage values are with respect to the emitter/substrate terminal E, unless otherwise noted.

Dissipation Rating Table

PACKAGE	T_A=25°C POWER RATING	DERATING FACTOR above T_A=25°C	T_A=85°C POWER RATING
D	950mW	7.6mW/°C	494mW
N	1150mW	9.2mW/°C	598 mW

Electrical Characteristics, T_A = 25°C (unless otherwise noted)

Symbol	Parameter	Test Figure	Test Conditions	Min.	Typ.	Max.	Unit
Vi(on)	Input Voltage	6	V_{CE}= 2V I_C = 125mA I_C = 200mA I_C = 275mA I_C = 350mA			 5 6 7 8	V
$V_{CE(sat)}$	Collector-emitter Saturation Voltage	5	I_C = 100mA, I_B = 250mA I_C = 200 mA, I_B = 350mA I_C = 350mA, I_B = 500mA		0.9 1.1 1.3	1.1 1.3 1.6	V
I_{CEX}	Output Leakage Current	2	V_{CE} = 50V, Vi = 1V			500	uA
V_F	Clamp Diode Forward Voltage	8	I_F = 350mA		1.7	2	V
Ii(off)	Off-state Input Current	3	V_{CE}= 50V, T_{amb} = 70°C, I_C = 500mA	50	65		uA
Ii	Input Current	4	Vi = 5V Vi = 12V		0.35 1	0.5 1.45	mA
I_R	Clamp Reverse Current	7	V_R = 50V Tamb = 70°C, V_R = 50V			50 100	uA
C_i	Input Capacitance				15	25	pF
Switching Characteristics, T_A= 25°C							
t_{PLH}	Turn-on Delay Time		See Fig.9		0.25	1	us
t_{PHL}	Turn-off Delay Time		See Fig.9		0.25	1	us
V_{OH}	High level output voltage after switching		V_S= 50V, I_O= 300mA See Fig.10	V_S-20			mV

PARAMETER MEASUREMENT INFORMATION

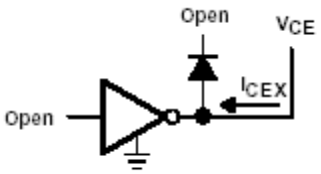


Figure 1. I_{CEX} Test Circuit

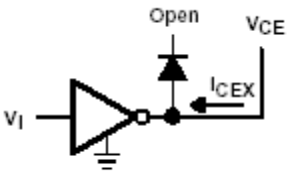


Figure 2. I_{CEX} Test Circuit

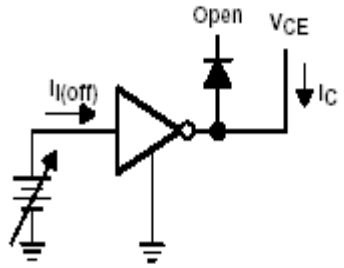


Figure 3. $I_{I(off)}$ Test Circuit

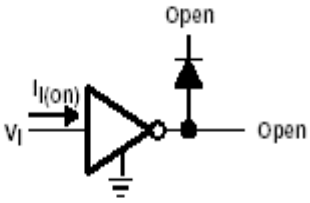
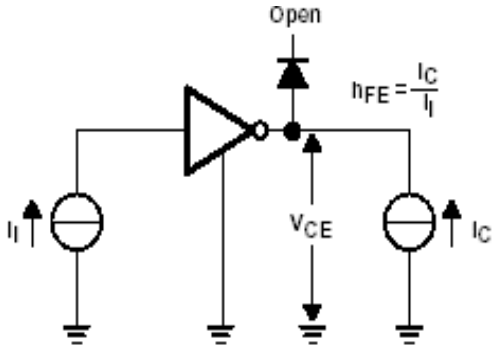


Figure 4. I_I Test Circuit



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

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

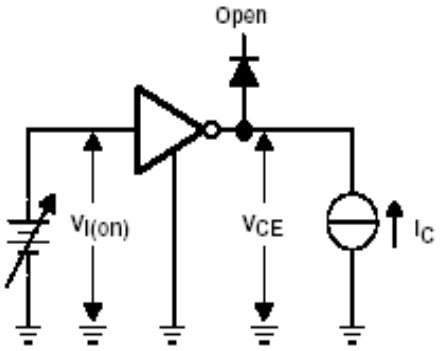


Figure 6. $V_{I(on)}$ Test Circuit

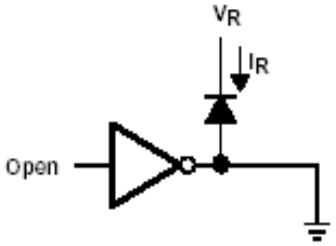


Figure 7. I_R Test Circuit

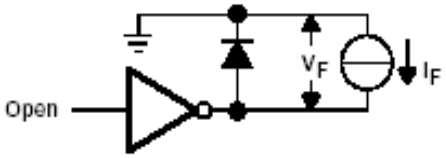


Figure 8. V_F Test Circuit

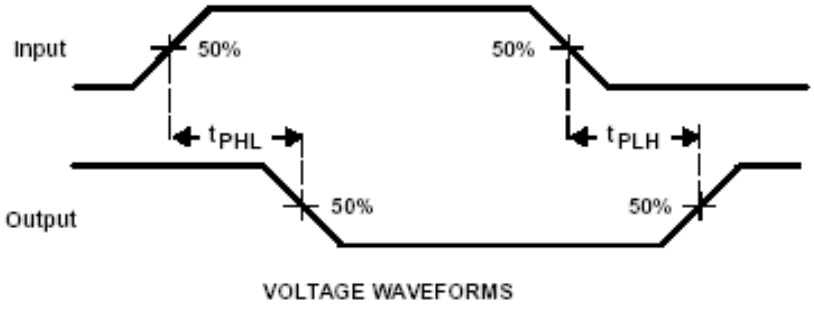
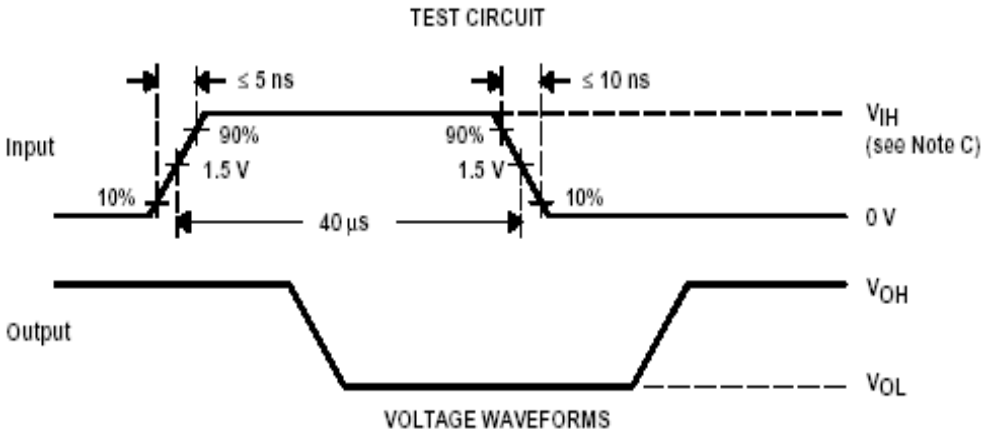


Figure 9. Propagation Delay-Time Waveforms



NOTES: A. The pulse generator has the following characteristics: PRR = 12.5 kHz, Z_O = 50 □ .
B. C_L includes probe and jig capacitance.
C. V_{IH} = 12 V;

Figure 10. Latch-Up Test Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

COLLECTOR-EMITTER SATURATION VOLTAGE vs COLLECTOR CURRENT (ONE DARLINGTON)

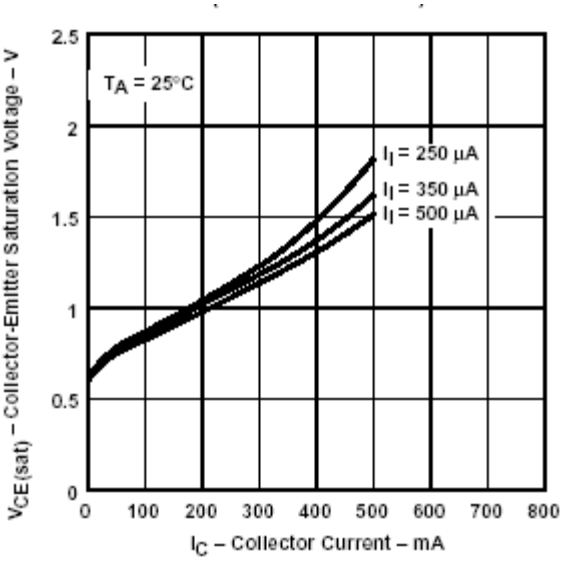


Figure 11

COLLECTOR-EMITTER SATURATION VOLTAGE vs TOTAL COLLECTOR CURRENT TWO DARLINGTONS PARALLELED)

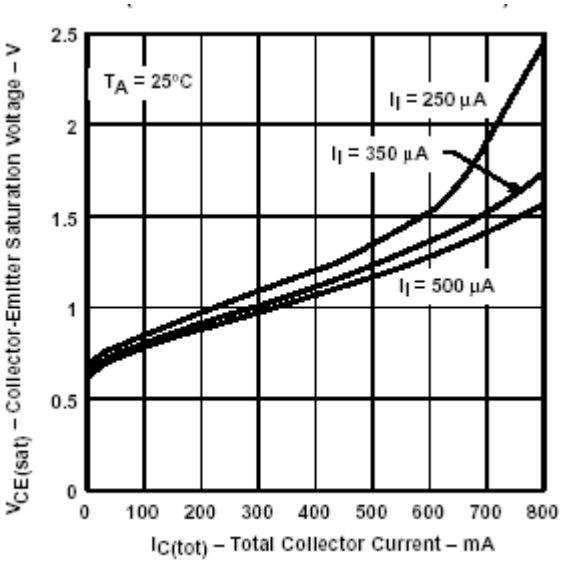


Figure 12

COLLECTOR CURRENT
vs
INPUT CURRENT

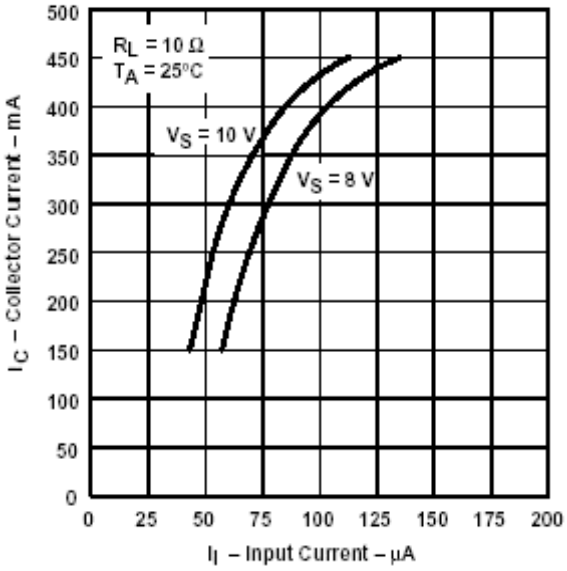


Figure 13

THERMAL INFORMATION

D PACKAGE MAXIMUM COLLECTOR CURRENT vs DUTY CYCLE

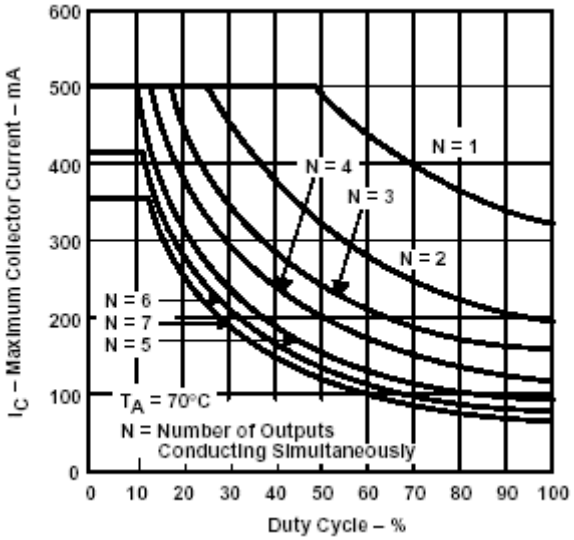


Figure 14

N PACKAGE MAXIMUM COLLECTOR CURRENT vs DUTY CYCLE

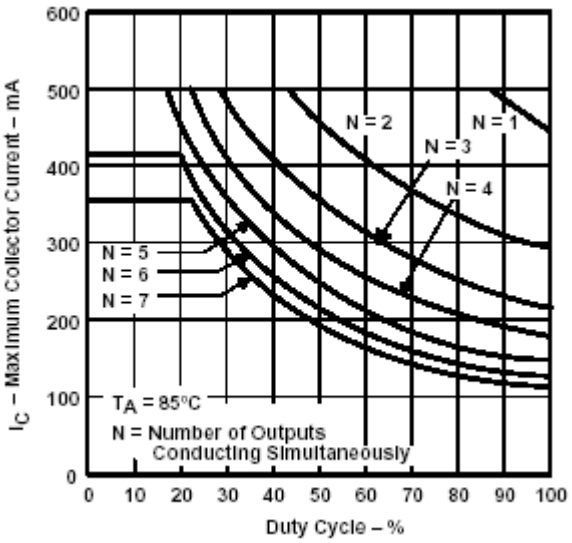


Figure 15

APPLICATION INFORMATION

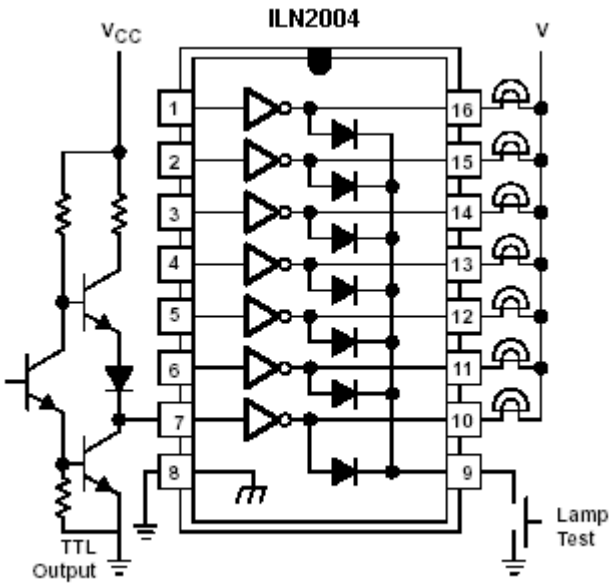


Figure 16. TTL to Load

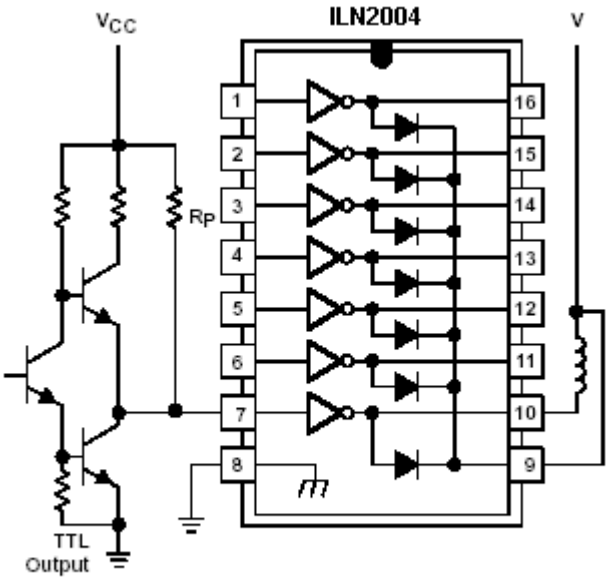
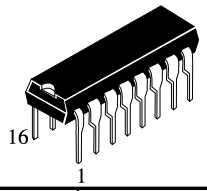
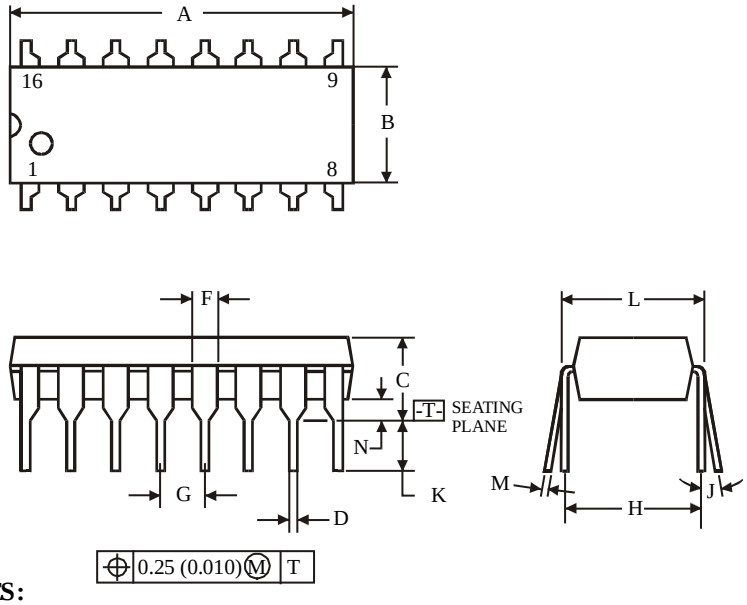


Figure 17. Use of Pullup Resistors to Increase Drive Current

N SUFFIX PLASTIC DIP
(MS - 001BB)



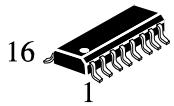


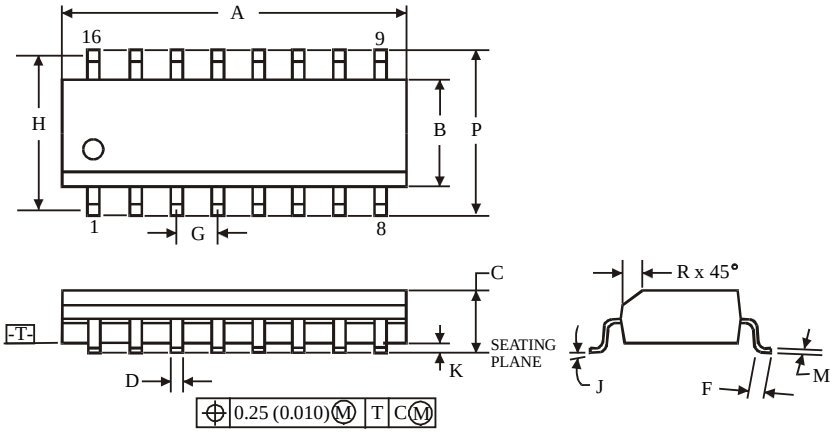
	Dimension, mm	
Symbol	**MIN**	**MAX**
A	18.67	19.69
B	6.10	7.11
C		5.33
D	0.36	0.56
F	1.14	1.78
G	2.54	
H	7.62	
J	0°	10°
K	2.92	3.81
L	7.62	8.26
M	0.20	0.36
N	0.38	

NOTES:

1. Dimensions “A”, “B” do not include mold flash or protrusions.
   Maximum mold flash or protrusions 0.25 mm (0.010) per side.

D SUFFIX SOIC
(MS - 012AC)





	Dimension, mm	
Symbol	**MIN**	**MAX**
A	9.80	10.00
B	3.80	4.00
C	1.35	1.75
D	0.33	0.51
F	0.40	1.27
G	1.27	
H	5.72	
J	0°	8°
K	0.10	0.25
M	0.19	0.25
P	5.80	6.20
R	0.25	0.50

NOTES:

1. Dimensions A and B do not include mold flash or protrusion.
2. Maximum mold flash or protrusion 0.15 mm (0.006) per side
   for A; for B – 0.25 mm (0.010) per side.