

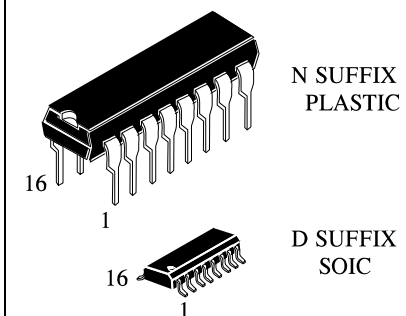
HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAYS

ILN2004

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

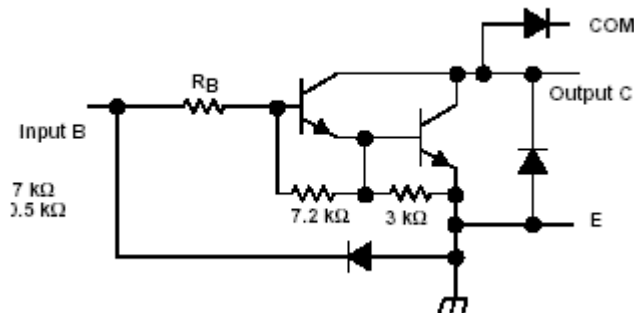
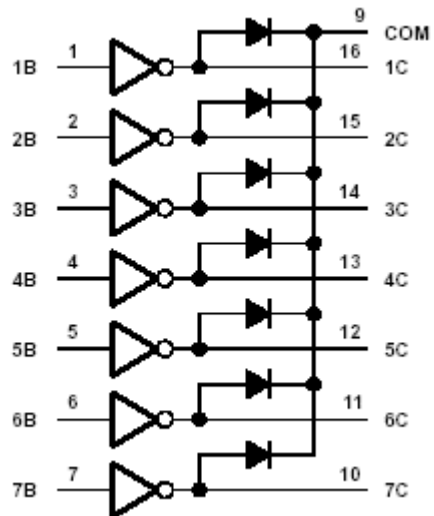
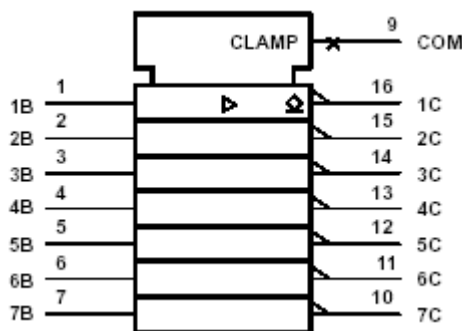


N SUFFIX
PLASTIC

D SUFFIX
SOIC

ORDERING INFORMATION
 ILN2004N Plastic
 ILN2004D SOIC
 T_A = -40°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	-40 to 85	°C
Tstg	Storage temperature range	-55 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	$T_A=25^{\circ}\text{C}$ POWER RATING	DERATING FACTOR above $T_A=25^{\circ}\text{C}$	$T_A=85^{\circ}\text{C}$ POWER RATING
D	950mW	7.6mW/°C	494mW
N	1150mW	9.2mW/°C	598 mW

Electrical Characteristics, $T_A = 25^{\circ}\text{C}$ (unless otherwise noted)

Symbol	Parameter	Test Figure	Test Conditions	Min.	Typ.	Max.	Unit
$V_{i(on)}$	Input Voltage	6	$V_{CE}=2\text{V}$ $I_C = 125\text{mA}$ $I_C = 200\text{mA}$ $I_C = 275\text{mA}$ $I_C = 350\text{mA}$			5 6 7 8	V
$V_{CE(sat)}$	Collector-emitter Saturation Voltage	5	$I_C = 100\text{mA}, I_B = 250\text{mA}$ $I_C = 200\text{ mA}, I_B = 350\text{mA}$ $I_C = 350\text{mA}, I_B = 500\text{mA}$		0.9 1.1 1.3	1.1 1.3 1.6	V
I_{CEX}	Output Leakage Current	2	$V_{CE} = 50\text{V}, V_i = 1\text{V}$			500	uA
V_F	Clamp Diode Forward Voltage	8	$I_F = 350\text{mA}$		1.7	2	V
$I_{i(off)}$	Off-state Input Current	3	$V_{CE}=50\text{V}, T_{amb} = 70^{\circ}\text{C},$ $I_C = 500\text{mA}$	50	65		uA
I_i	Input Current	4	$V_i = 5\text{V}$ $V_i = 12\text{V}$		0.35 1	0.5 1.45	mA
I_R	Clamp Reverse Current	7	$V_R = 50\text{V}$ $T_{amb} = 70^{\circ}\text{C}, V_R = 50\text{V}$			50 100	uA
C_i	Input Capacitance				15	25	pF
Switching Characteristics, $T_A=25^{\circ}\text{C}$							
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		$V_S=50\text{V}, I_O=300\text{mA}$ See Fig.10	V_S-20			mV

PARAMETER MEASUREMENT INFORMATION

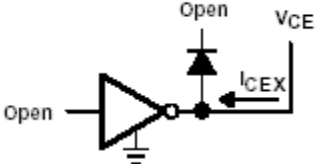


Figure 1. I_CEX Test Circuit

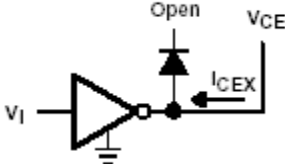


Figure 2. I_CEX Test Circuit

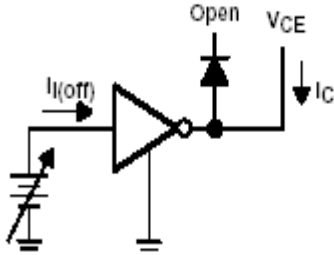


Figure 3. I_{I(off)} Test Circuit

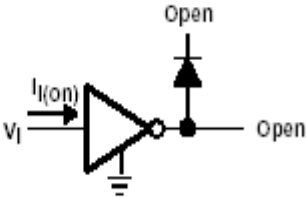
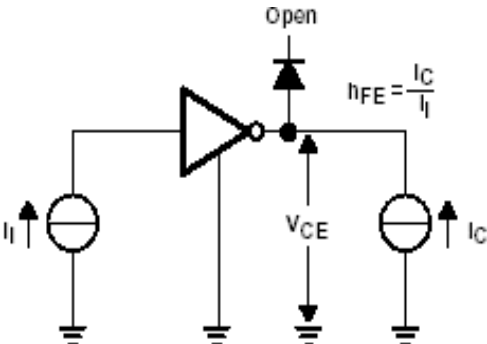


Figure 4. I_I Test Circuit



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

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

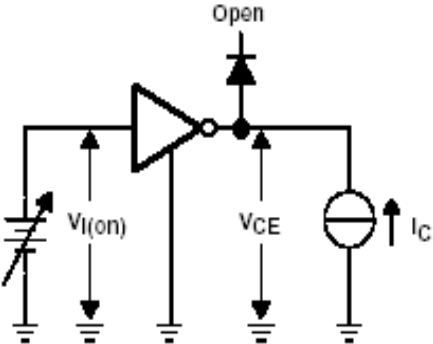


Figure 6. V_{I(on)} Test Circuit

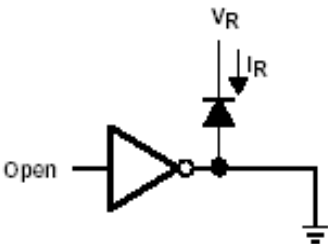


Figure 7. I_R Test Circuit

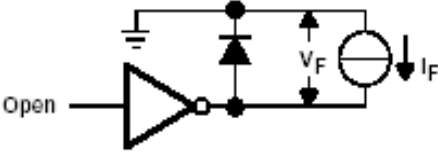


Figure 8. V_F Test Circuit

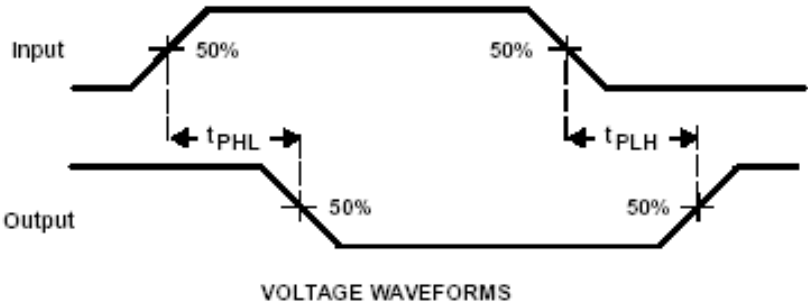
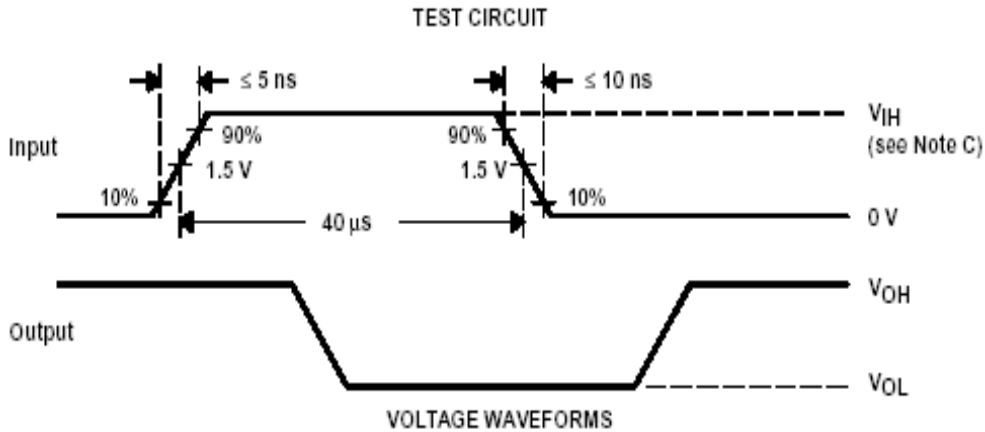


Figure 9. Propagation Delay-Time Waveforms



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

Figure 10. Latch-Up Test Circuit and Voltage Waveforms

TYPICAL CHARACTERISTICS

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

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

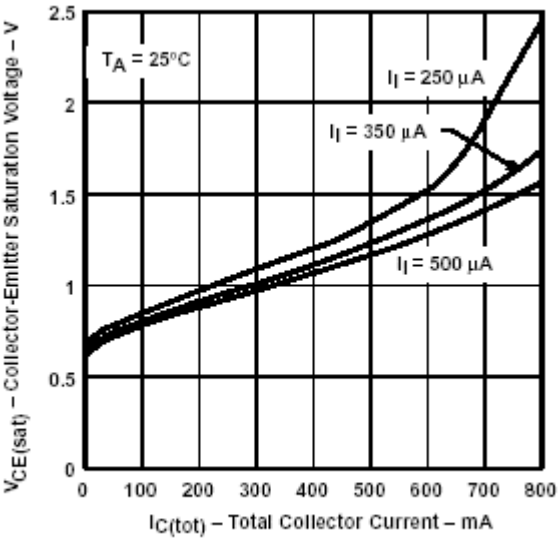


Figure 12

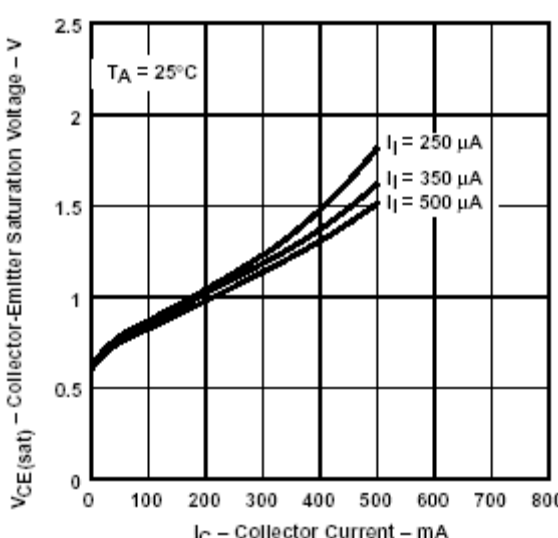


Figure 11

COLLECTOR CURRENT
vs
INPUT CURRENT

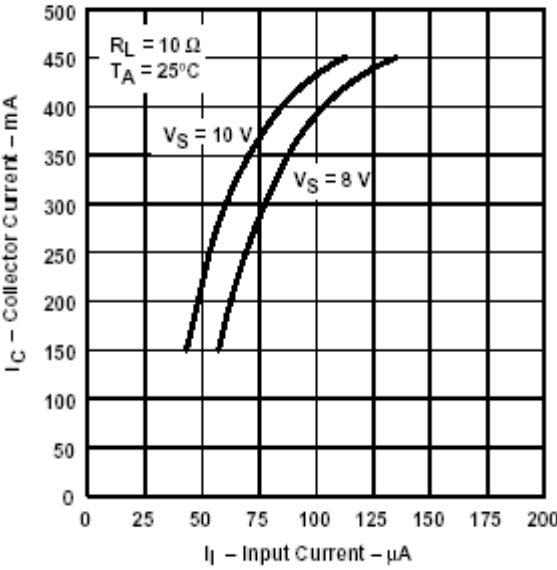


Figure 13

THERMAL INFORMATION

D PACKAGE MAXIMUM COLLECTOR CURRENT
vs DUTY CYCLE

N PACKAGE MAXIMUM COLLECTOR CURRENT
vs DUTY CYCLE

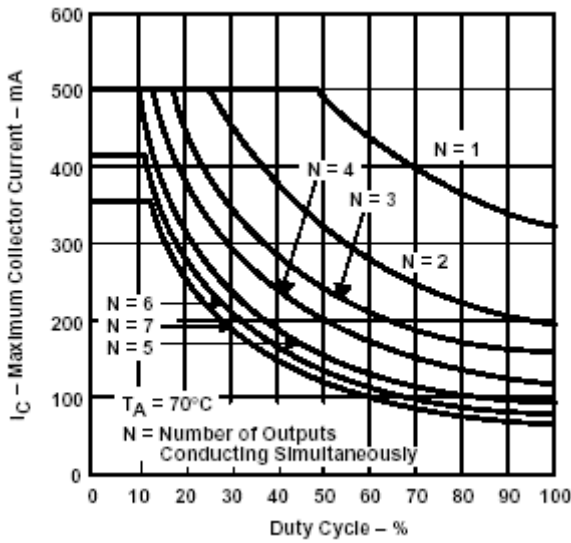


Figure 14

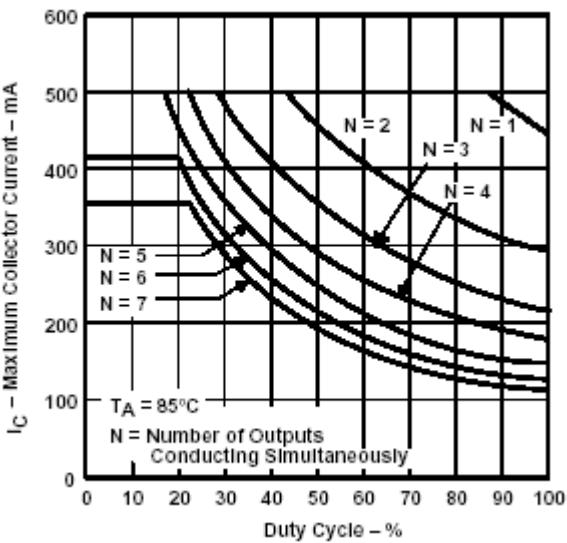


Figure 15

APPLICATION INFORMATION

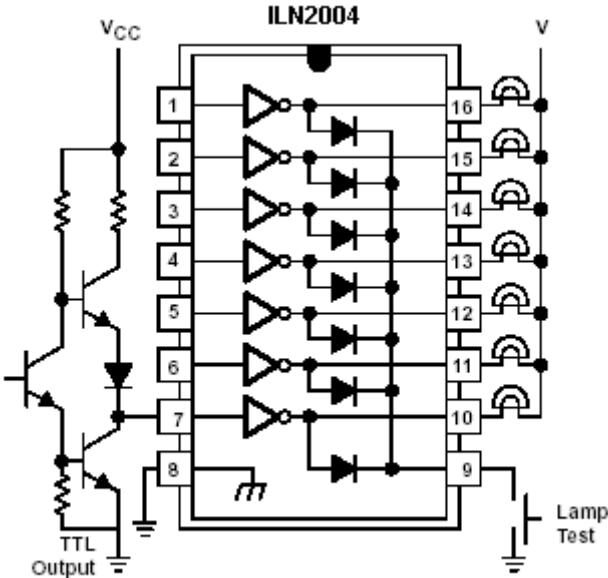


Figure 16. TTL to Load

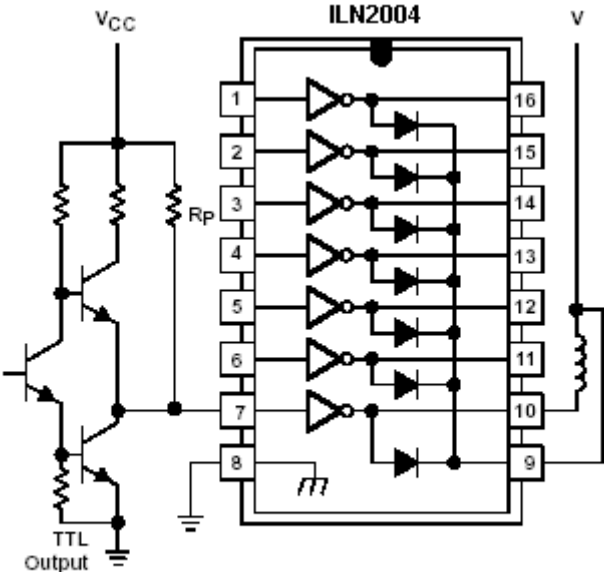
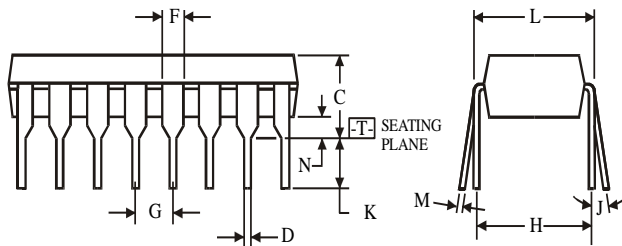
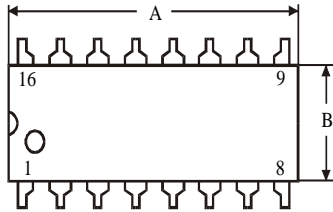
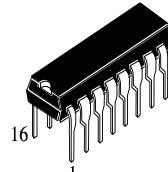


Figure 17. Use of Pullup Resistors to Increase Drive Current

**N SUFFIX PLASTIC DIP
(MS - 001BB)**



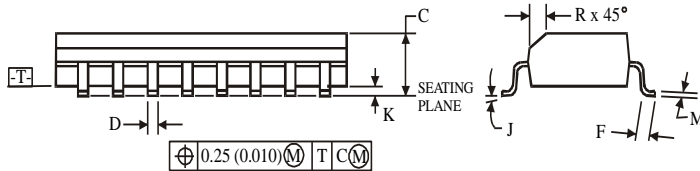
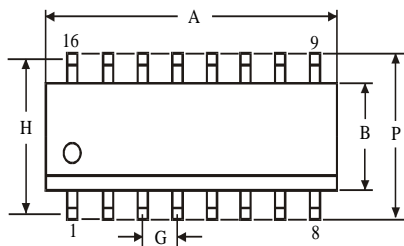
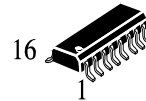
$\oplus 0.25 (0.010) \text{ (M) T}$

NOTES:

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

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	

**D SUFFIX SOIC
(MS - 012AC)**



$\oplus 0.25 (0.010) \text{ (M) T (C) (M)}$

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.

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

Type Document Revision History

Rev	Date	Initiator	Description of Change
00	Jan. 2011	SM Jung	Establishment
01	Oct. 2018	HG Ryu	Changed the Temperature Range Operation Temperature: -20°C to 85° C -> -40°C to 85° C Storage temperature range: -60°C to 150° C -> -55°C to 150° C