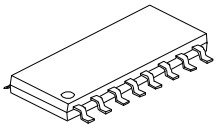
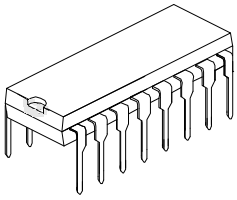
ULN2004

LINEAR INTEGRATED CIRCUIT

7CH DARLINGTON SINK DRIVER



SOP-16



DIP-16

■ DESCRIPTION

The UTC **ULN2004** are high-voltage, high-current darlington drivers comprised of seven NPN darlingto pairs.

All units feature integral clamp diodes for switching inductive loads.

Applications include relay, hammer, lamp and display (LED) drivers.

■ FEATURES

*Output current (single output): 500mA (MAX.)
*High sustaining voltage output: 50V (MIN.)
*Output clamp diodes
*Inputs compatible with various types of logic

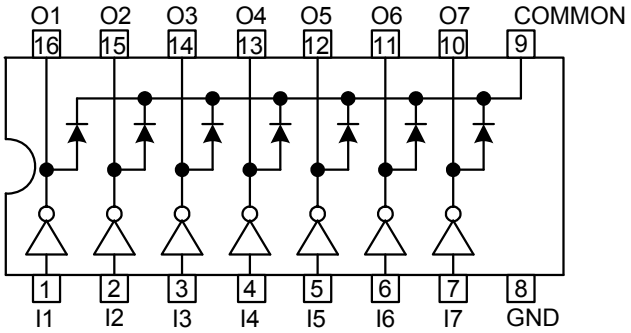
■ ORDERING INFORMATION

Ordering Number		Package	Packing
Lead Free	Halogen Free		
ULN2004L-D16-T	ULN2004G-D16-T	DIP-16	Tube
ULN2004L-S16-R	ULN2004G-S16-R	SOP-16	Tape Reel
ULN2004L-S16-T	ULN2004G-S16-T	SOP-16	Tube

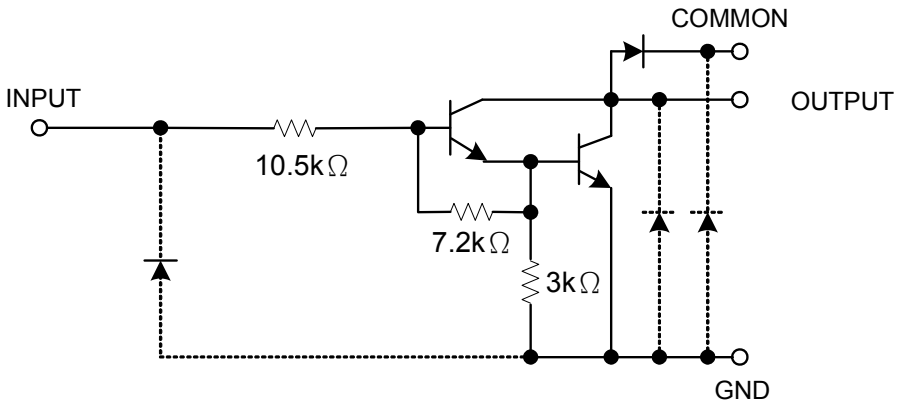
ULN2004L-D16-T
(1)Packing Type
(2)Package Type
(3)Lead Free

(1) R: Tape Reel, T: Tube
(2) D16: DIP-16, S16: SOP-16
(3) G: Halogen Free, L: Lead Free

PIN CONNECTION



■ BLOCK DIAGRAM



Note: The input and output parasitic diodes cannot be used as clamp diodes.

■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER		SYMBOL	RATING	UNIT
Output Sustaining Voltage		V_{OUT}	-0.5~50	V
Output Current		I_{OUT}	500	mA / ch
Input Voltage		V_{IN}	-0.5~30	V
Clamp Diode Reverse Voltage		V_R	50	V
Clamp Diode Forward Current		I_F	500	mA
Power Dissipation	DIP-16	P_D	1.47	W
	SOP-16		0.625	W
Junction Temperature		T_J	+125	℃
Operating Temperature		T_{OPR}	-40~+85	℃
Storage Temperature		T_{STG}	-40~+150	℃

Note 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ RECOMMENDED OPERATING CONDITIONS (Ta=-40～+85℃)

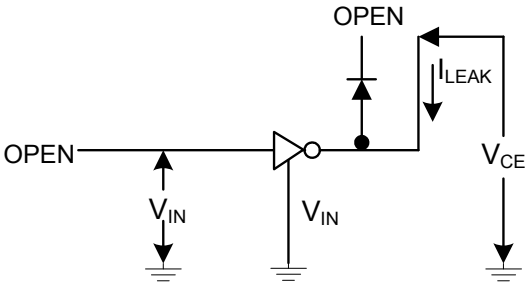
CHARACTERISTIC		SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Output Sustaining Voltage		V_{OUT}			0		50	V
Output Current	DIP-16	I_{OUT}	T_{pw} = 25ms, 7 Circuits, Ta = 85℃, TJ = 120℃	Duty = 10%	0		370	mA/ch
				Duty = 50%	0		130	
	SOP-16			Duty = 10%	0		233	
				Duty = 50%	0		70	
Input Voltage		V_{IN}			0		24	V
Input Voltage (Output On)		$V_{IN\ (ON)}$	I_{OUT} = 400mA, h_{FE} = 800		6.2		24	V
Input Voltage (Output Off)		$V_{IN\ (OFF)}$			0		1.0	V
Clamp Diode Reverse Voltage		V_R					50	V
Clamp Diode Forward Current		I_F					350	mA
Power Dissipation	DIP-16	P_D	Ta = 85℃				0.76	W
	SOP-16		Ta = 85℃				0.325	

■ ELECTRICAL CHARACTERISTICS (Ta=25℃ unless otherwise specified)

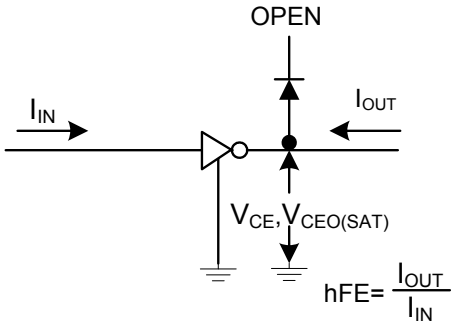
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Output Leakage Current	I_{LEAK}	1	V_{CE} = 50 V, Ta = 25℃				50	μA
			V_{CE} = 50 V, Ta = 85℃				100	
Collector-Emitter Saturation Voltage	$V_{CEO(SAT)}$	2	I_{OUT} = 350 mA, I_{IN} = 500 μA			1.3	1.6	V
			I_{OUT} = 200 mA, I_{IN} = 350 μA			1.1	1.3	
			I_{OUT} = 100 mA, I_{IN} = 250 μA			0.9	1.1	
DC Current Transfer Ratio	h_{FE}	2	V_{CE} = 2 V, I_{OUT} = 350 mA		1000			
Input Current (Output On)	$I_{IN\ (ON)}$	3	V_{IN} = 9.5 V, I_{OUT} = 350 mA			0.8	1.2	mA
Input Current (Output Off)	$I_{IN\ (OFF)}$	4	I_{OUT} = 500 μA, Ta = 85°C		50	65		μA
Input Voltage (Output On)	$V_{IN(ON)}$	5	V_{CE} = 2 V, h_{FE} = 800	I_{OUT} = 350 mA			4.7	V
				I_{OUT} = 200 mA			4.4	
Clamp Diode Reverse Current	I_R	6	V_R = 50 V, Ta = 25°C				50	μA
			V_R = 50 V, Ta = 85°C				100	
Clamp Diode Forward Voltage	V_F	7	I_F = 350 mA				2.0	V
Input Capacitance	C_{IN}					15		pF
Turn-On Delay	t_{ON}	8	V_{OUT} = 50 V, R_L = 125 Ω, C_L = 15 pF			0.1		μs
Turn-Off Delay	t_{OFF}	8	V_{OUT} = 50 V, R_L = 125 Ω, C_L = 15 pF			0.2		

■ TEST CIRCUIT

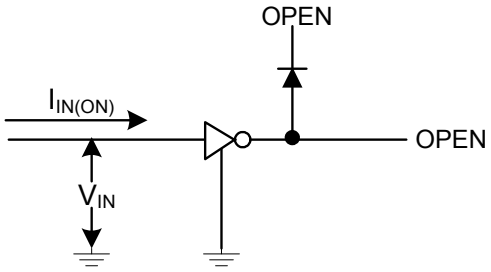
1. I_{LEAK}



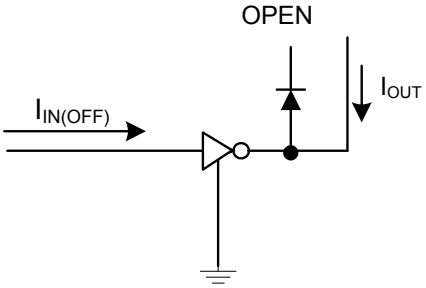
2. $V_{CEO(SAT)}$,hFE



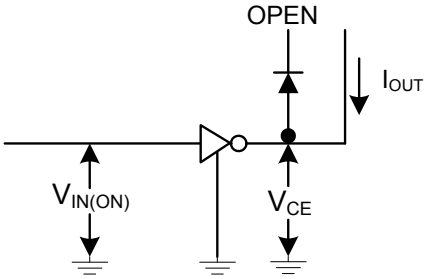
3. $I_{IN(ON)}$



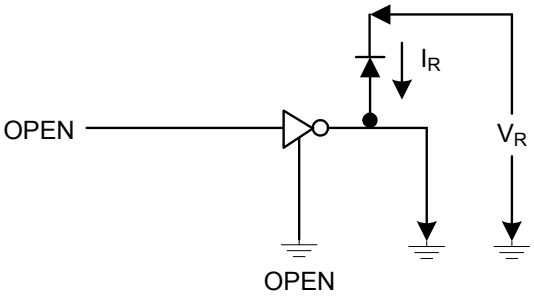
4. $I_{IN(OFF)}$



5. $V_{IN(ON)}$

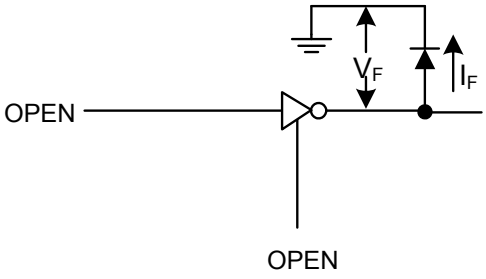


6. I_R

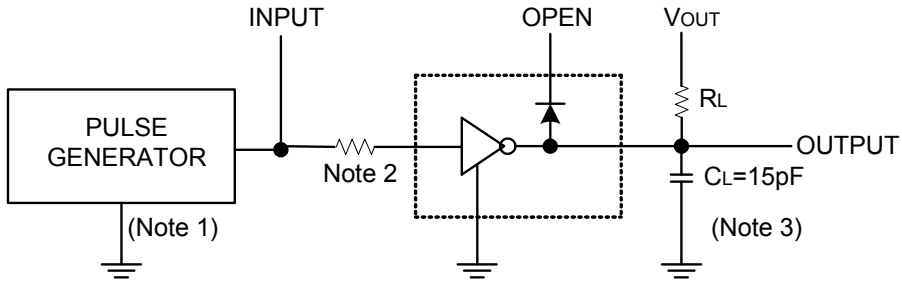


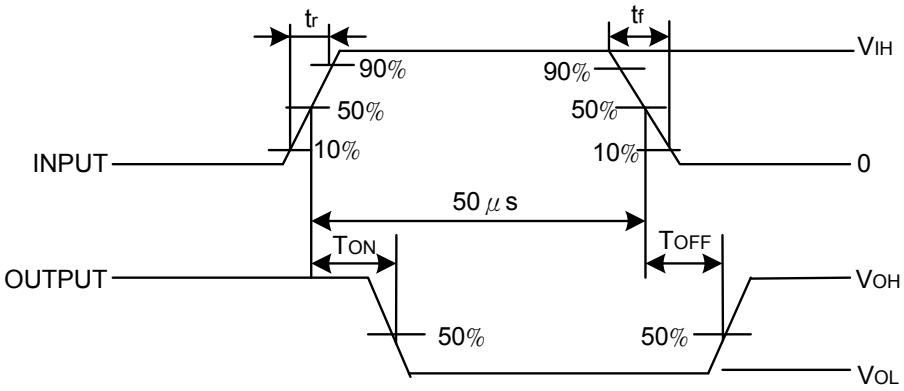
■ TEST CIRCUIT(cont.)

7. V_F



8. t_{ON}, t_{OFF}





Note1: Pulse width 50 μs ,duty cycle 10%
Output impedance 50Ω, tr≦5ns, tf≦10ns

Note2: See below

INPUT CONDITION

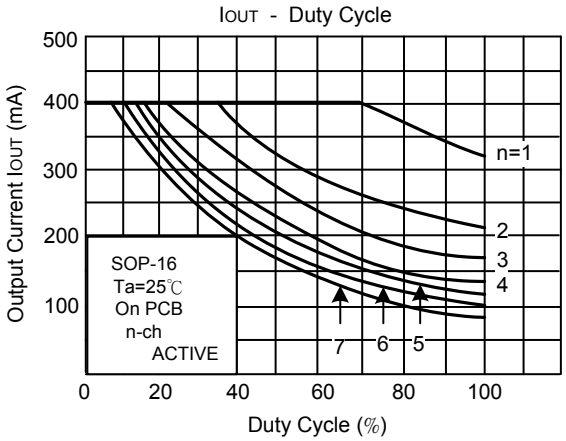
TYPE NUMBER	R1	V_{IH}
ULN2004	0	8V

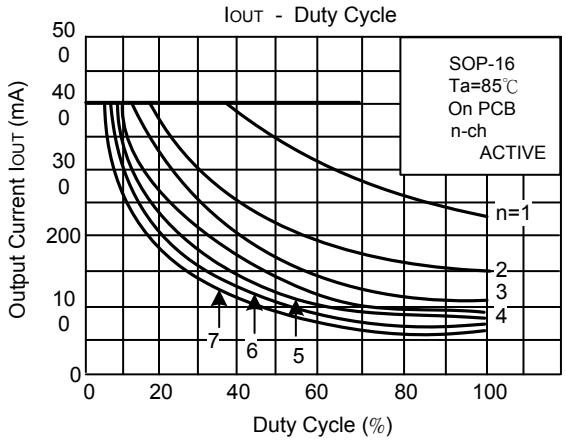
Note3: C_L includes probe and jig capacitance

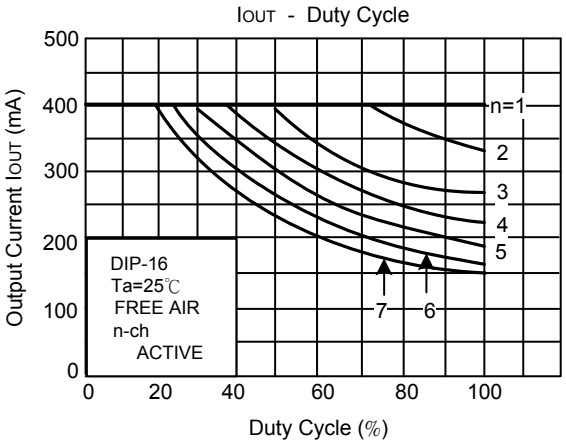
■ PRECAUTIONS FOR USING

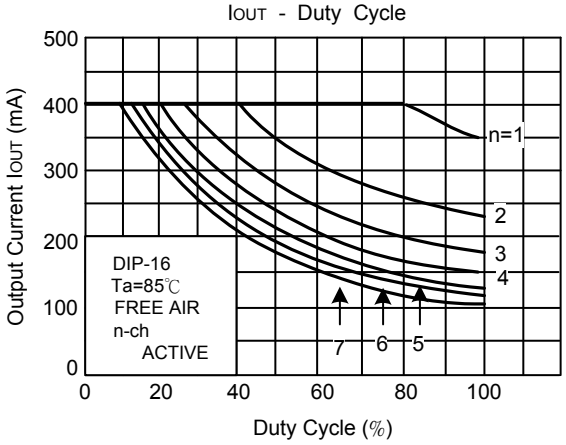
This IC does not include built-in protection circuits for excess current or overvoltage. If this IC is subjected to excess current or overvoltage, it may be destroyed. Hence, the utmost care must be taken when systems which incorporate this IC are designed. Utmost care is necessary in the design of the output line, COMMON and GND line since IC may be destroyed due to short-circuit between outputs, air contamination fault, or fault by improper grounding.

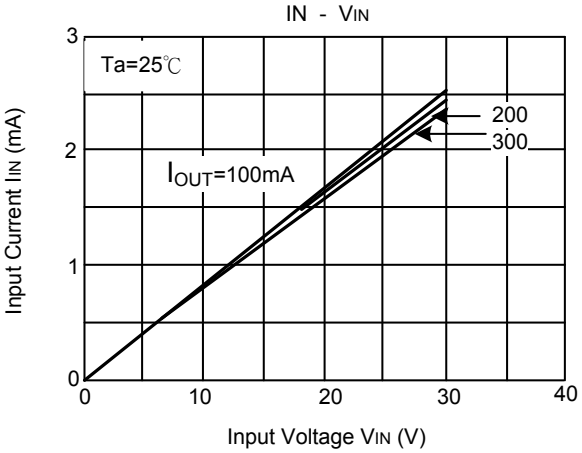
■ TYPICAL CHARACTERISTICS

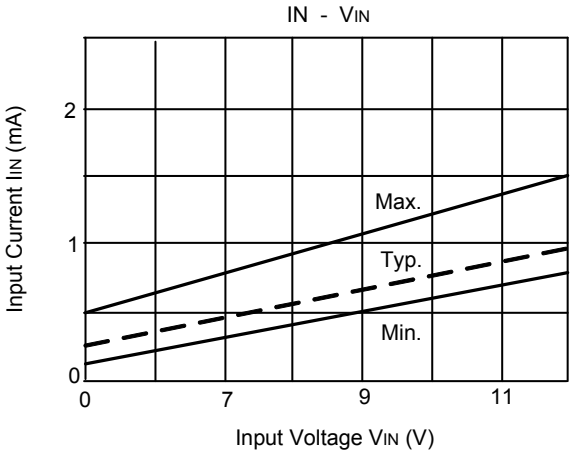




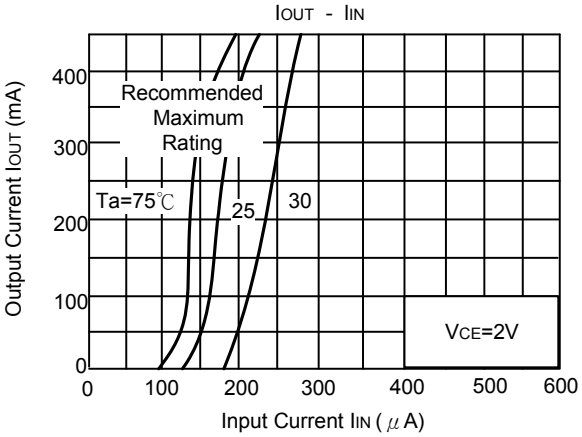


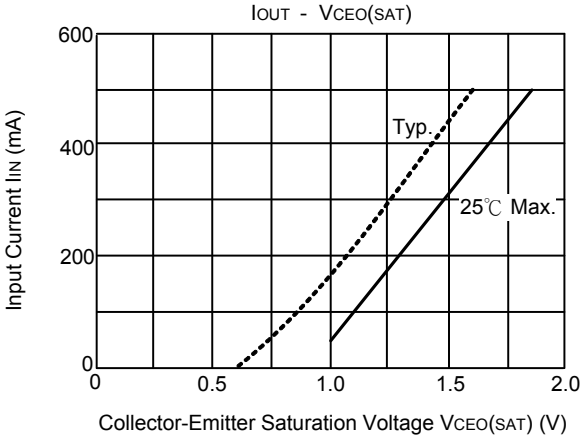


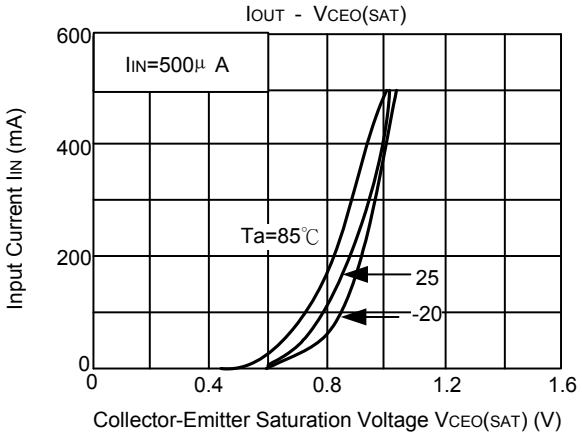


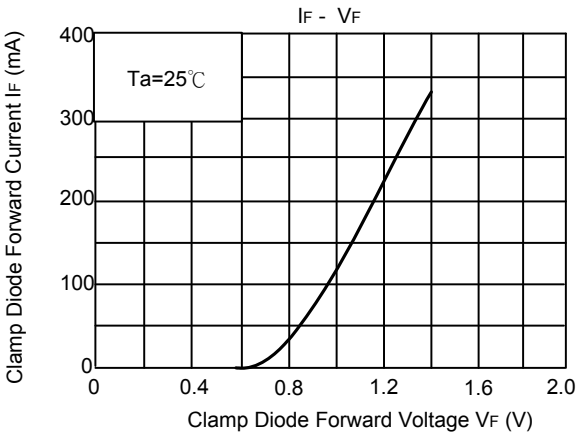


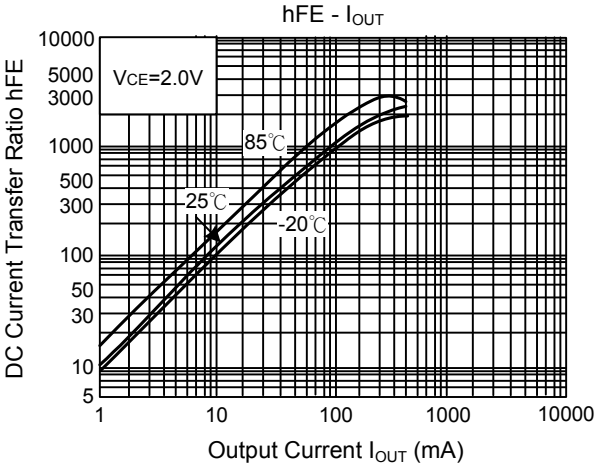
■ TYPICAL CHARACTERISTICS(cont.)











■ TYPICAL CHARACTERISTICS(cont.)