



ULN2004M1

LINEAR INTEGRATED CIRCUIT

7CH DARLINGTON SINK DRIVER

DESCRIPTION

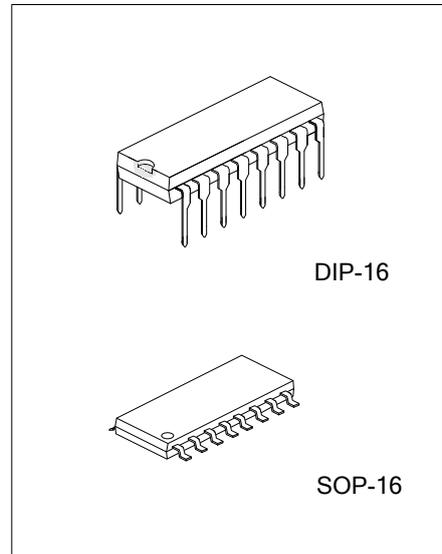
The UTC **ULN2004M1** are high-voltage, high-current darlington drivers comprised of seven NPN darlington pairs.

All units feature integral clamp diodes for switching inductive loads.

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

FEATURES

- * MSL1 Robust Package Design
- * Output current (single output): 500mA (MAX.)
- * High sustaining voltage output: 50V (MIN.)
- * Output clamp diodes
- * Inputs compatible with various types of logic
- * Green & Pb free



ORDERING INFORMATION

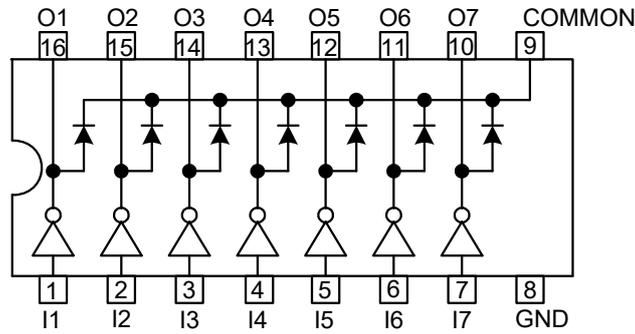
Ordering Number	Package	Packing
ULN2004M1-D16-T	DIP-16	Tube
ULN2004M1-S16-R	SOP-16	Tape Reel

<p>ULN2004M1-D16-T</p> <p>(1) Packing Type</p> <p>(2) Package Type</p>	<p>(1) T: Tube, R: Tape Reel</p> <p>(2) D16: DIP-16, S16: SOP-16</p>
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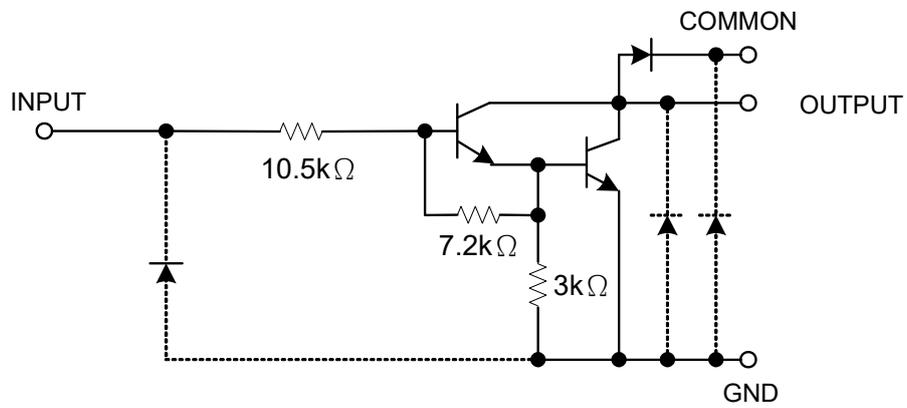
MARKING

DIP-16	SOP-16

■ PIN CONNECTION



■ BLOCK DIAGRAM



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

■ ABSOLUTE MAXIMUM RATINGS (T_A=25°C, unless otherwise specified)

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
	SOP-16		0.625
Junction Temperature	T _J	+150	°C
Operating Temperature	T _{OPR}	-40 ~ +85	°C
Storage Temperature	T _{STG}	-40 ~ +150	°C

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 (T_A=-40 ~ +85°C, unless otherwise specified)

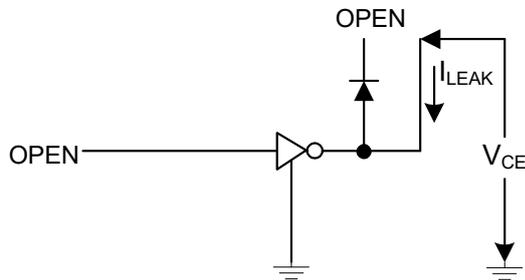
CHARACTERISTIC	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Sustaining Voltage	V _{OUT}		0		50	V
Output Current	I _{OUT}	T _{PW} = 25ms 7 Circuits T _A = 85°C T _J = 120°C	Duty = 10%	0	385	mA/ch
			Duty = 50%	0	175	mA/ch
			Duty = 10%	0	205	mA/ch
			Duty = 50%	0	85	mA/ch
Input Voltage	V _{IN}		0		24	V
Input Voltage (Output On)	V _{IN(ON)}	I _{OUT} = 400mA	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	T _A = 85°C		0.76	W
	SOP-16		T _A = 85°C		0.325	W

■ ELECTRICAL CHARACTERISTICS (T_A =25°C unless otherwise specified)

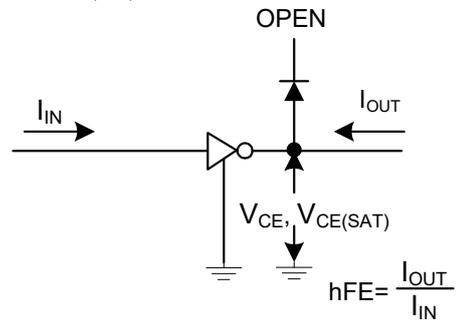
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Leakage Current	I _{LEAK}	1	V _{CE} =50V, T _A =25°C			50	μA
			V _{CE} =50V, T _A =85°C			100	μA
Collector-Emitter Saturation Voltage	V _{CE(SAT)}	2	I _{OUT} =350mA, I _{IN} =500μA		1.3	1.6	V
			I _{OUT} =200mA, I _{IN} =350μA		1.1	1.3	V
			I _{OUT} =100mA, I _{IN} =250μA		0.9	1.1	V
DC Current Transfer Ratio	h _{FE}	2	V _{CE} =2V, I _{OUT} =350mA	1000			
Input Current (Output On)	I _{IN(ON)}	3	V _{IN} =9.5V, I _{OUT} =350mA		0.8	1.2	mA
Input Current (Output Off)	I _{IN(OFF)}	4	I _{OUT} =500μA, T _A =85°C	50	65		μA
Input Voltage (Output On)	V _{IN(ON)}	5	V _{CE} =2V	I _{OUT} =350mA		4.7	V
				I _{OUT} =200mA		4.4	V
Clamp Diode Reverse Current	I _R	6	V _R =50V, T _A =25°C			50	μA
			V _R =50V, T _A =85°C			100	μA
Clamp Diode Forward Voltage	V _F	7	I _F =350mA			2.0	V
Input Capacitance	C _{IN}				15		pF
Turn-On Delay	t _{ON}	8	V _{OUT} =50V, R _L =125Ω, C _L =15pF		0.1		μs
Turn-Off Delay	t _{OFF}	8	V _{OUT} =50V, R _L =125Ω, C _L =15pF		0.2		μs

■ TEST CIRCUIT

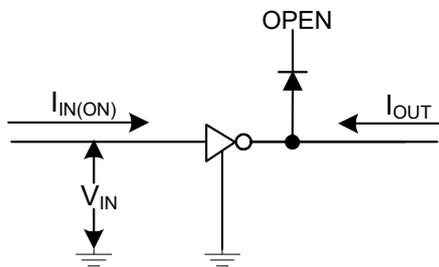
1. I_{LEAK}



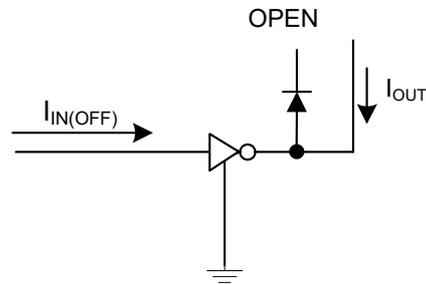
2. $V_{CE(SAT)}, h_{FE}$



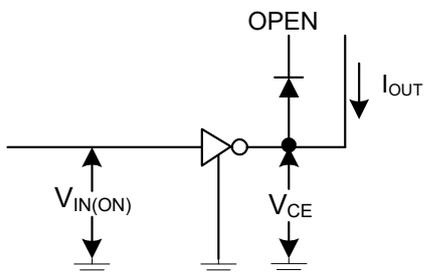
3. $I_{IN(ON)}$



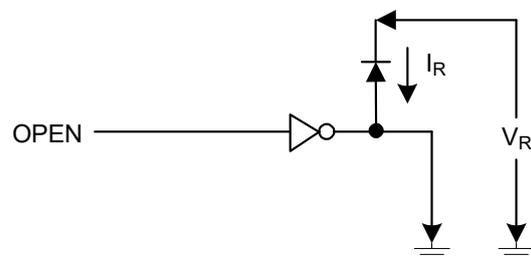
4. $I_{IN(OFF)}$



5. $V_{IN(ON)}$

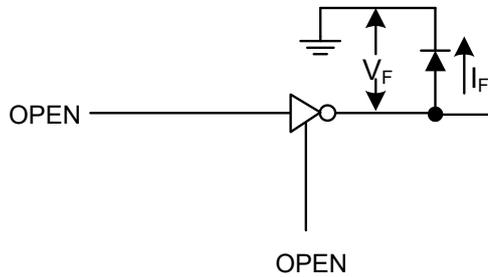


6. I_R

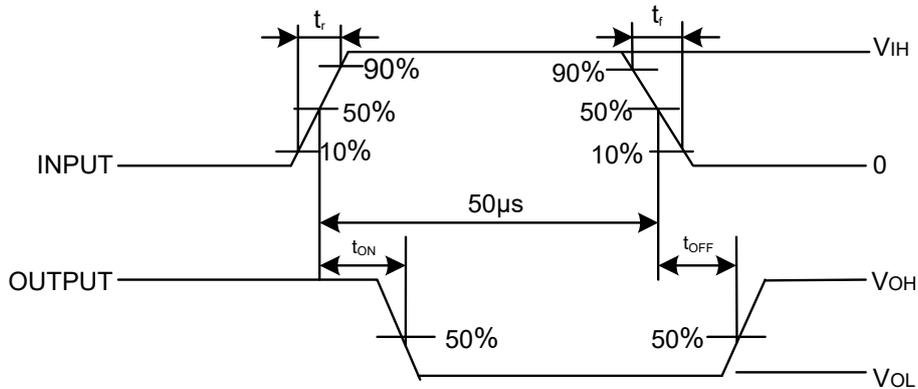
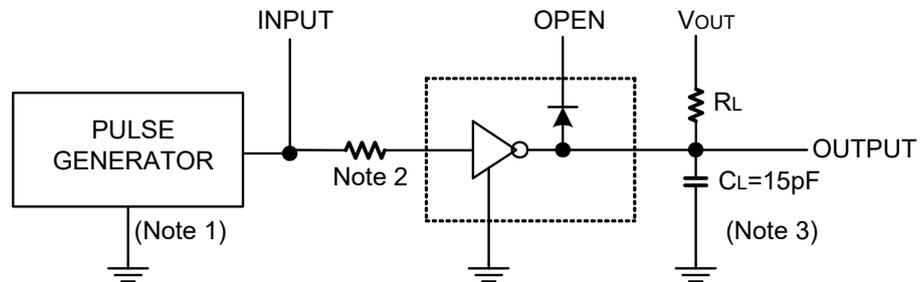


■ TEST CIRCUIT (Cont.)

7. V_F



8. t_{ON}, t_{OFF}



Note1: Pulse width 50µs ,duty cycle 10%
Output impedance 50Ω, $t_r \leq 5ns$, $t_f \leq 10ns$

2: See below

INPUT CONDITION

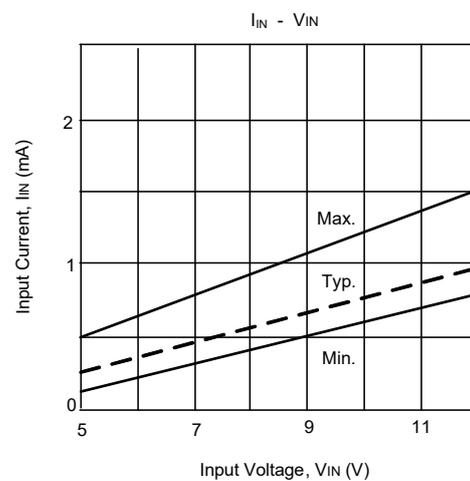
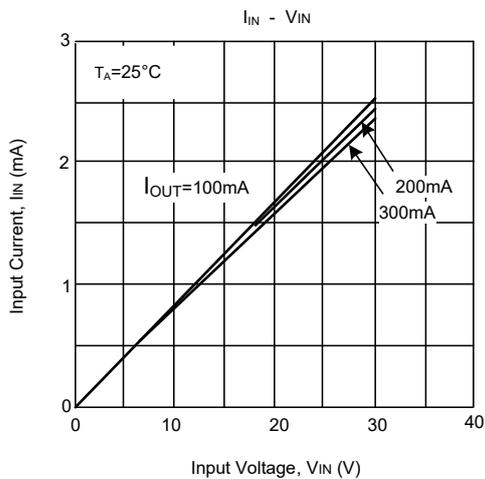
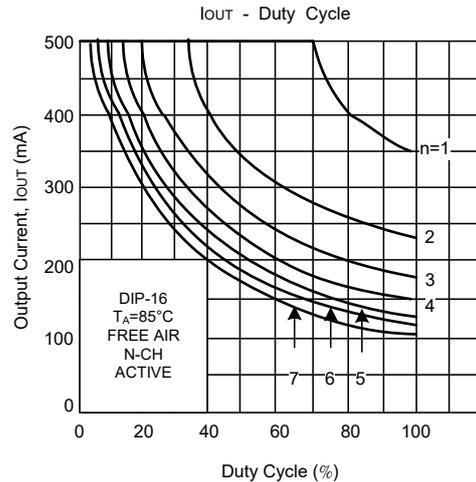
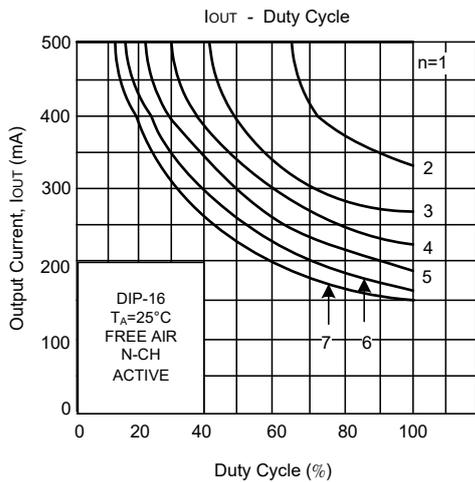
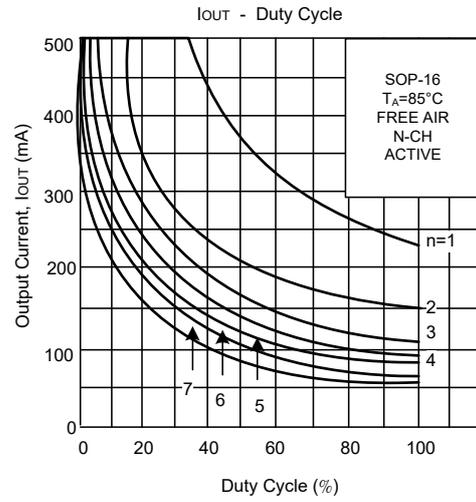
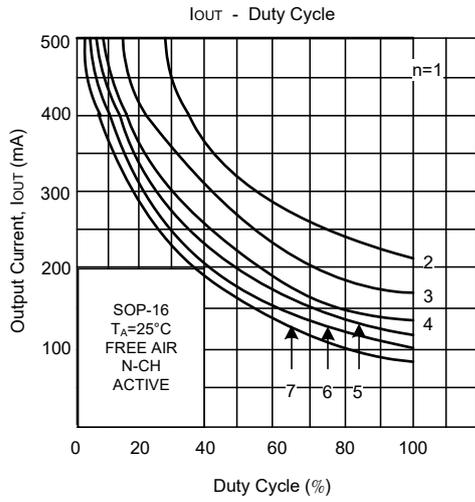
TYPE NUMBER	R1	V_{IH}
ULN2004	0	8V

3: CL includes probe and jig capacitance

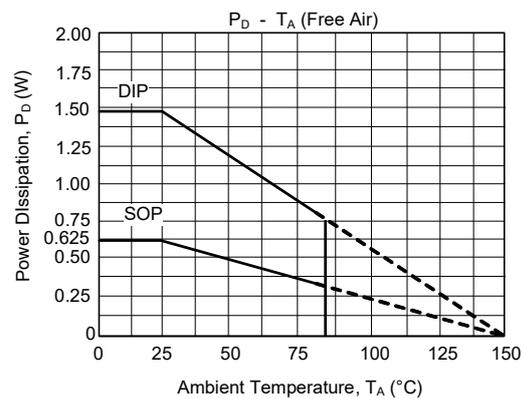
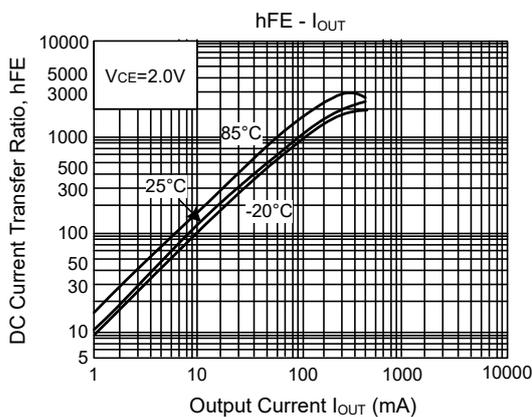
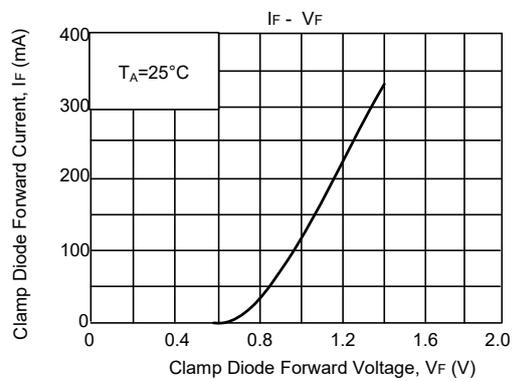
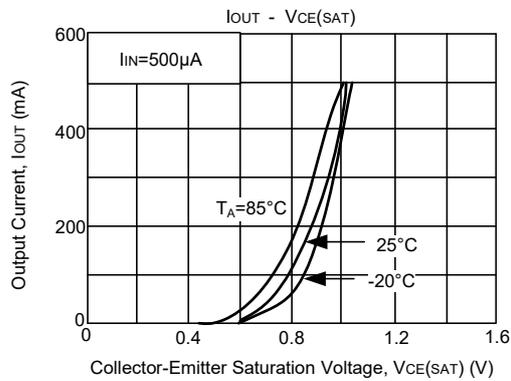
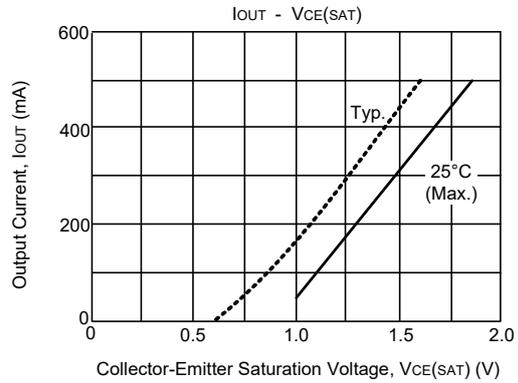
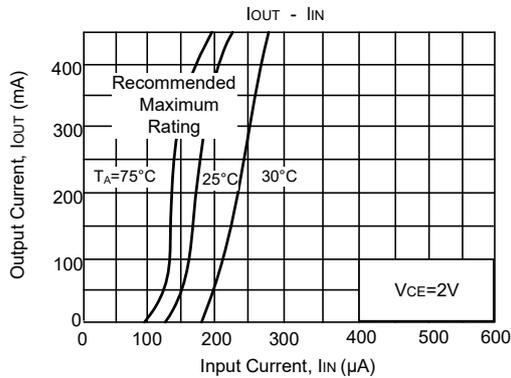
■ PRECAUTIONS FOR USING

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.)



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