

## ULN2003A, ULN2003AD, ULN2004A, ULN2004AD

### 7CH DARLINGTON SINK DRIVER

The ULN2003A/AD Series are high-voltage, high-current darlington drivers comprised of seven NPN darlington pairs.

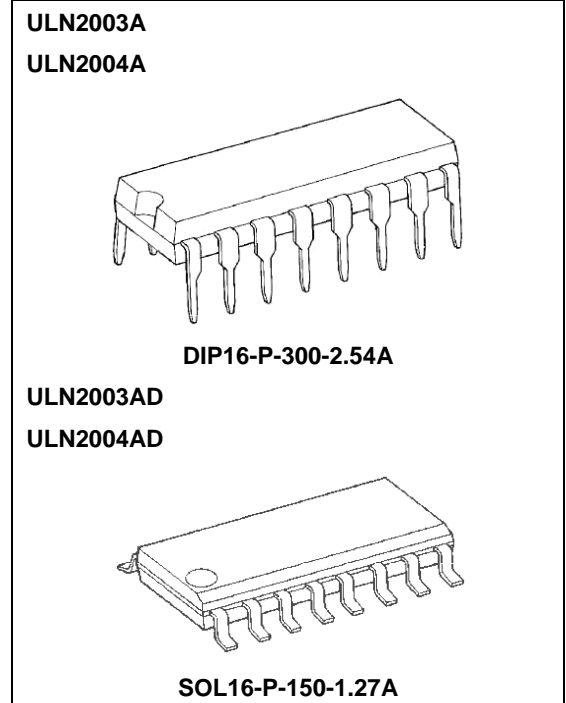
All units feature integral clamp diodes for switching inductive loads.

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

#### FEATURES

- Output current (single output) 500mA MAX.
- High sustaining voltage output  
50V MIN. (ULN2003A/AD Series)
- Output clamp diodes
- Inputs compatible with various types of logic
- Package Type-A : DIP-16pin
- Package Type-AD : SOP-16pin

TYPE	INPUT BASE RESISTOR	DESIGNATION
ULN2003A/AD	2.7k	TTL, 5V CMOS
ULN2004A/AD	10.5 k	6~15V PMOS, CMOS

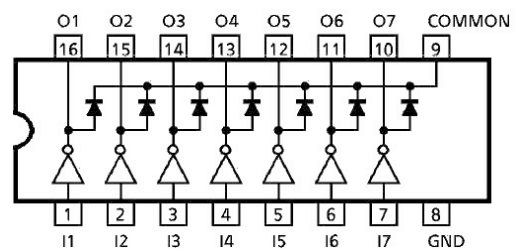


#### Weight

DIP16-P-300-2.54A : 1.11g (Typ.)

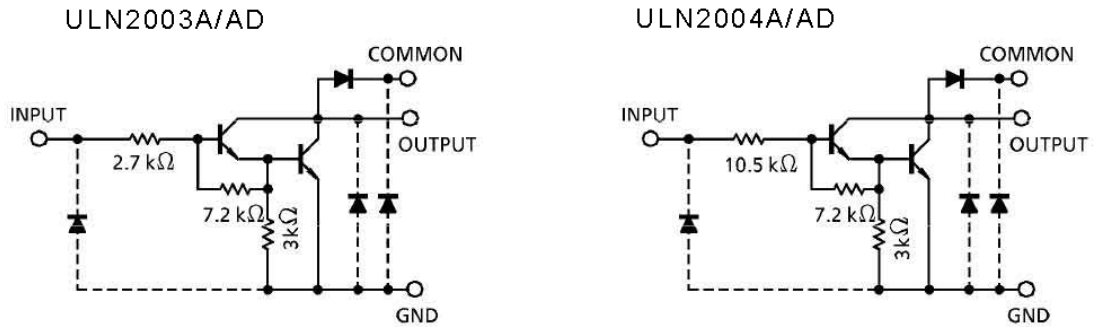
SOP16-P-150-1.27A : 0.15g (Typ.)

#### PIN CONNECTION (TOP VIEW)



980910EBA1

## SCHEMATICS (EACH DRIVER)



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

### MAXIMUM RATINGS (Ta = 25 °C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Output Sustaining Voltage		V <sub>CE (SUS)</sub>	-0.5~50	V
Output Current		I <sub>OUT</sub>	500	mA/ch
Input Voltage		V <sub>IN</sub>	-0.5~30	V
Clamp Diode Reverse Voltage		V <sub>R</sub>	50	V
Clamp Diode Forward Current		I <sub>F</sub>	500	mA
Power Dissipation	A	P <sub>D</sub>	1.47	W
	AD		0.54/0.625 (Note)	
Operating Temperature		T <sub>opr</sub>	-40~85	
Storage Temperature		T <sub>stg</sub>	-55~150	

**(Note)** : On glass epoxy PCB (30 x 30 x 1.6mm Cu 50%)

**RECOMMENDED OPERATING CONDITIONS (Ta= -40-85 )**

CHARACTERISTIC		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	
Output Sustaining Voltage		V <sub>CE (SUS)</sub>		0	-	50		
Output current	A	I <sub>OUT</sub>	T <sub>pw</sub> = 25ms 7 Circuits	Duty=10%	0	-	370	mA/ch
				Duty=50%	0	-	130	
	AD		Ta =85	Duty=10%	0	-	233	
			Tj=120	Duty=50%	0	-	70	
Input Voltage		V <sub>IN</sub>		0	-	24	V	
Input Voltage (Output On)	ULN2003A	V <sub>IN(ON)</sub>	I <sub>OUT</sub> =400mA h <sub>FE</sub> =800	2.8	-	24	V	
	ULN2004A			6.2	-	24		
Input Voltage (Output Off)	ULN2003A	V <sub>IN(OFF)</sub>		0	-	0.7	V	
	ULN2004A			0	-	1.0		
Clamp Diode Reverse Voltage		V <sub>R</sub>		-	-	50	V	
Clamp Diode Forward Current		I <sub>F</sub>		-	-	350	mA	
Power Dissipation	A	P <sub>D</sub>	Ta =85	-	-	0.76	W	
	AD		(Note) Ta =85	-	-	0.325		

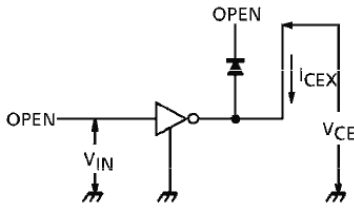
**(Note)** : On glass epoxy PCB (30 X 30 X1.6mm Cu 50%)

**ELECTRICAL CHARACTERISTICS** ( $T_a = 25$  unless otherwise noted)

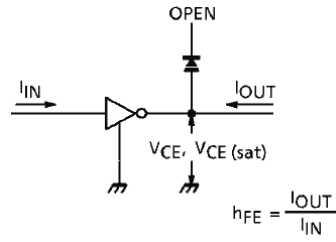
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT			
Output Leakage Current	$I_{CEX}$	1	$V_{CE} = 50V, T_a = 25$	-	-	50	$\mu A$			
			$V_{CE} = 50V, T_a = 85$	-	-	100				
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	2	$I_{OUT} = 350mA, I_{IN} = 500 \mu A$	-	1.3	1.6	V			
			$I_{OUT} = 200mA, I_{IN} = 350 \mu A$	-	1.1	1.3				
			$I_{OUT} = 100mA, I_{IN} = 250 \mu A$	-	0.9	1.1				
DC Current Transfer Ratio	$h_{FE}$	2	$V_{CE} = 2V, I_{OUT} = 350mA$	1000	-	-				
Input Current (Output On)	ULN2003A	$I_{IN(ON)}$	3	$V_{IN} = 2.4V, I_{OUT} = 350mA$	-	0.4	0.7	mA		
	ULN2004A								$V_{IN} = 9.5V, I_{OUT} = 350mA$	-
Input Current (Output Off)	$I_{IN(OFF)}$	4	$I_{OUT} = 500 \mu A, T_a = 85$	50	65	-	$\mu A$			
Input Voltage (Output On)	ULN2003A	$V_{IN(ON)}$	5	$V_{CE} = 2V$ $H_{FE} = 800$		$I_{OUT} = 350mA$	-	-	3.2	V
						$I_{OUT} = 200mA$	-	-	2.5	
	ULN2004A					$I_{OUT} = 350mA$	-	-	4.7	
						$I_{OUT} = 200mA$	-	-	4.4	
Clamp Diode Reverse Current	$I_R$	6	$V_R = 50V, T_a = 25$	-	-	50	$\mu A$			
			$V_R = 50V, T_a = 85$	-	-	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	$V_{OUT} = 50V, R_L = 125$ $C_L = 15pF$	-	0.1	-	$\mu S$			
Turn-Off Delay	$t_{OFF}$	8	$V_{OUT} = 50V, R_L = 125$ $C_L = 15pF$	-	0.2	-				

### TEST CIRCUIT

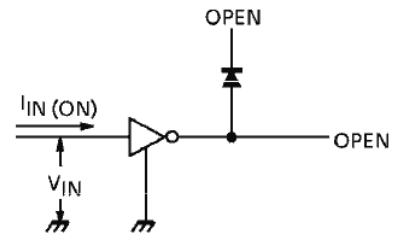
1.  $I_{CEX}$



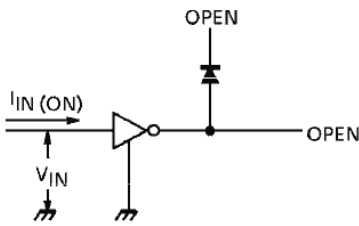
2.  $V_{CE(sat)}$ ,  $h_{FE}$



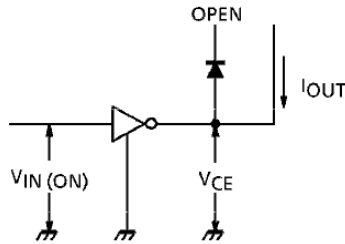
3.  $I_{IN(ON)}$



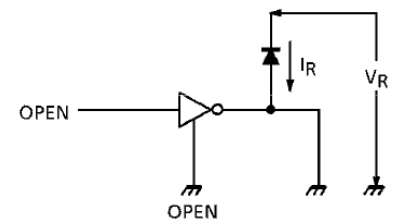
4.  $I_{IN(OFF)}$



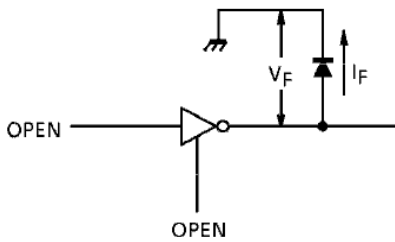
5.  $V_{IN(ON)}$



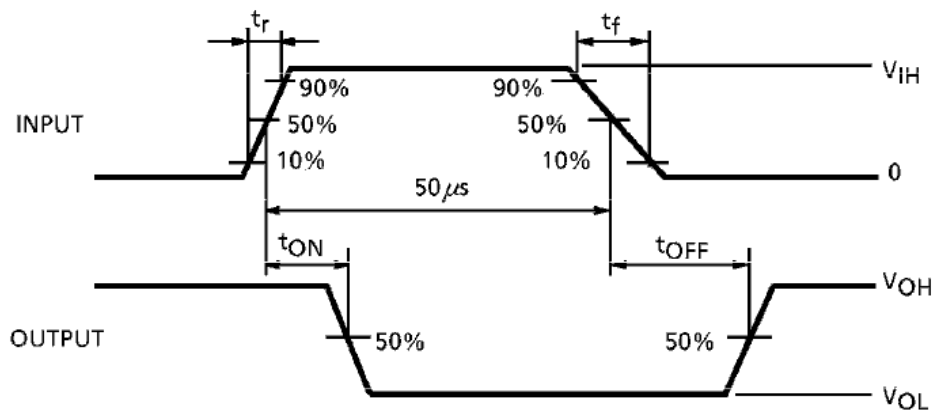
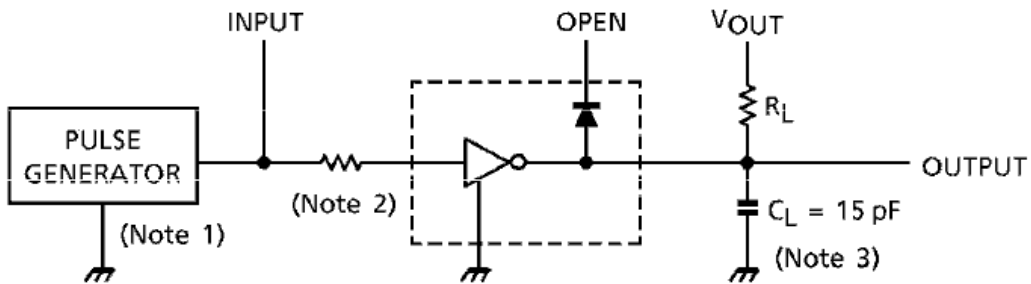
6.  $I_R$



7.  $V_F$



### 8. t<sub>ON</sub>, t<sub>OFF</sub>



- (Note 1) : Pulse width 50  $\mu$ s, duty cycle 10%  
 Output impedance 50  $\Omega$ ,  $t_r$  5ns,  $t_f$  10ns
- (Note 2) : See below

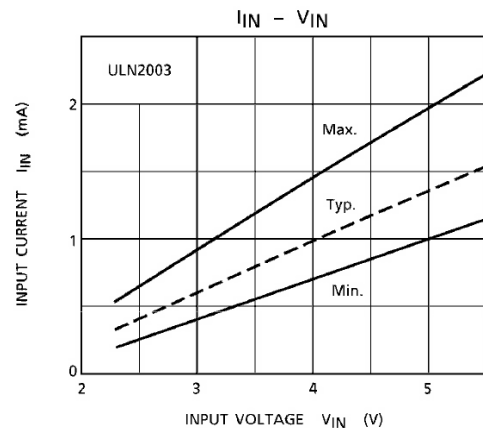
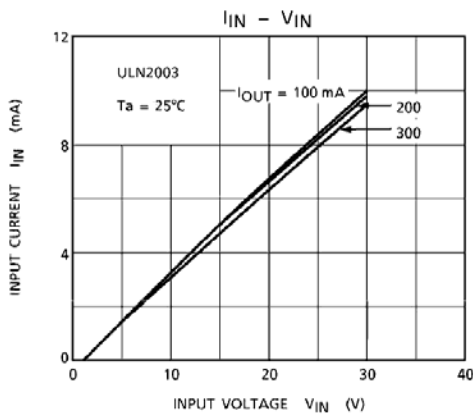
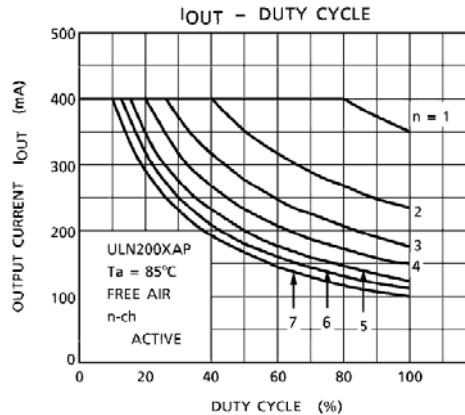
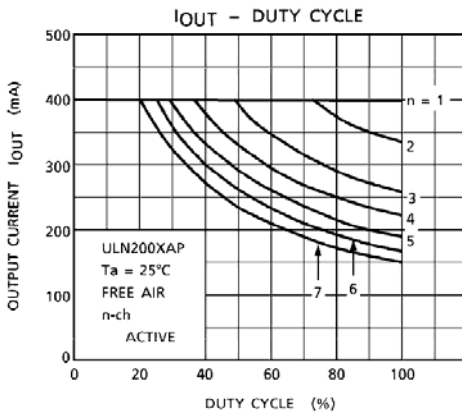
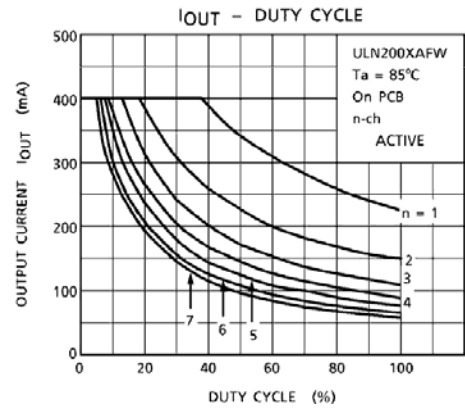
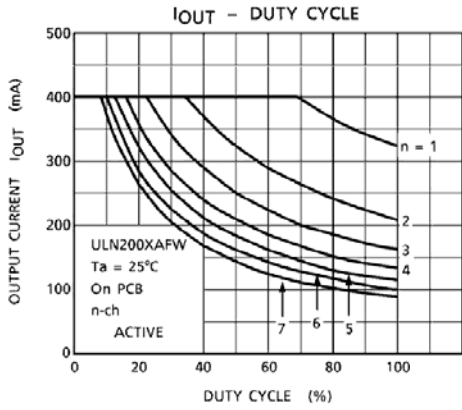
#### INPUT CONDITION

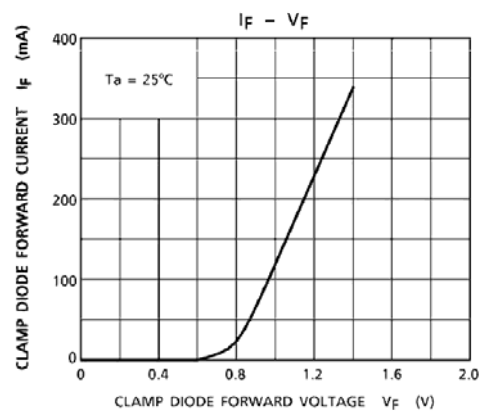
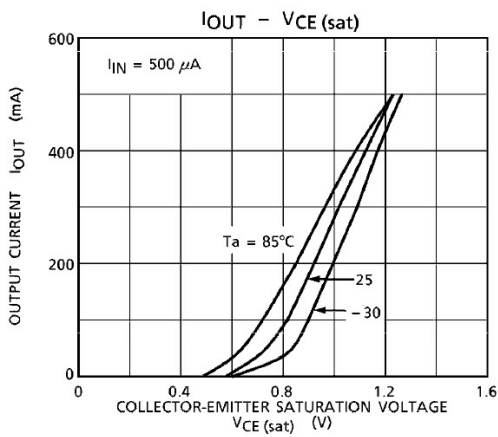
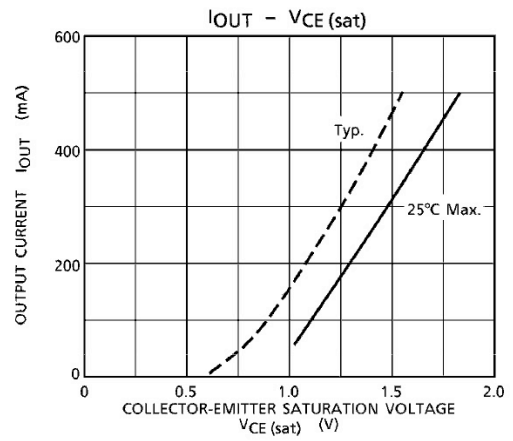
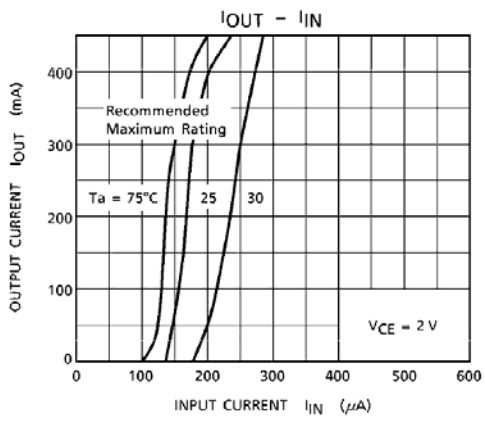
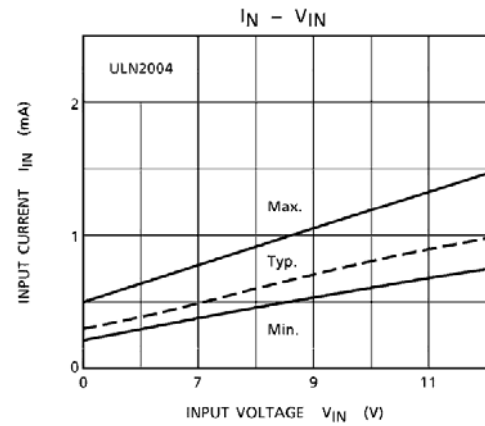
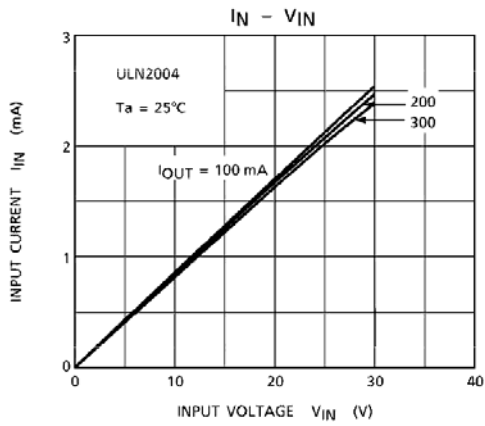
TYPE NUMBER	R1	V <sub>IH</sub>
ULN2003A/AD	0	3V
ULN2004A/AD	0	8V

- (Note 3) : C<sub>L</sub> includes probe and jig capacitance.

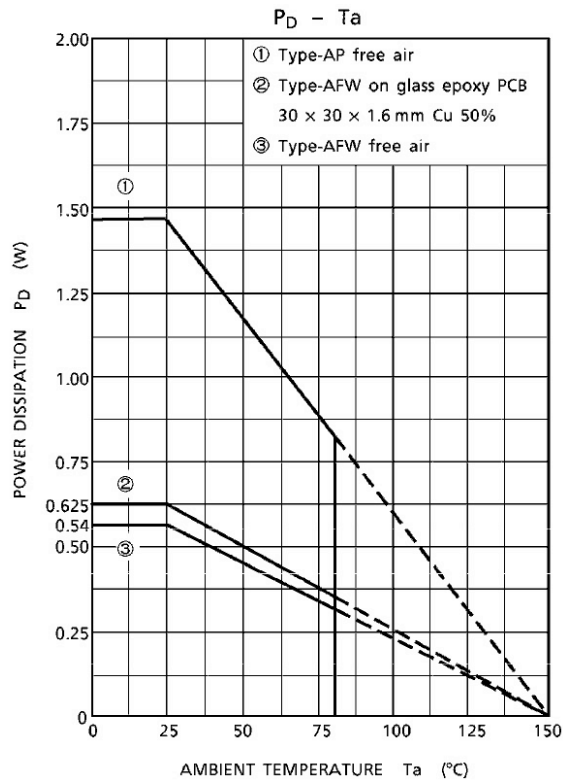
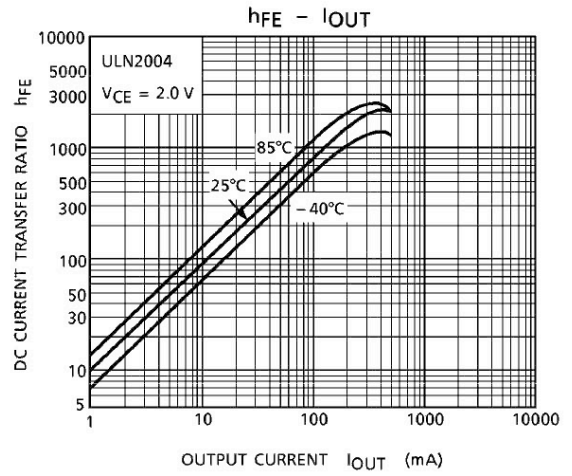
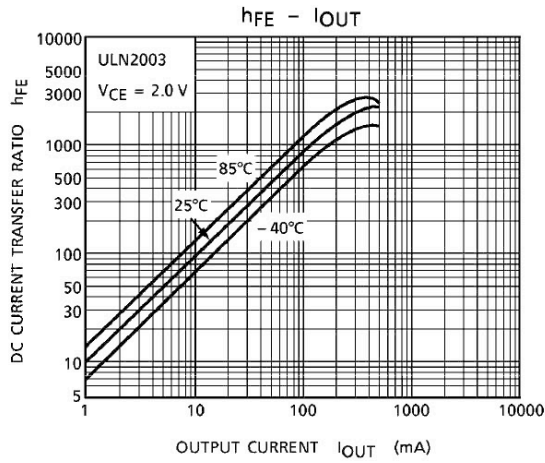
#### PRECAUTIONS for USING

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.



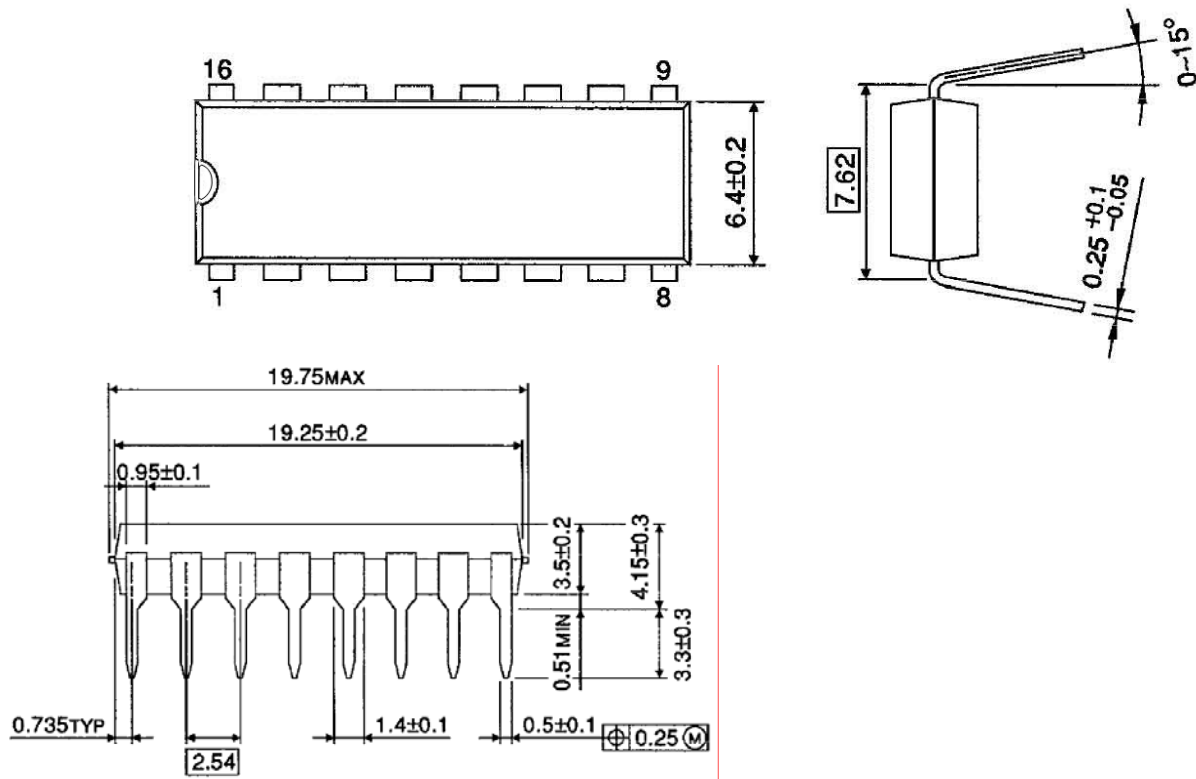






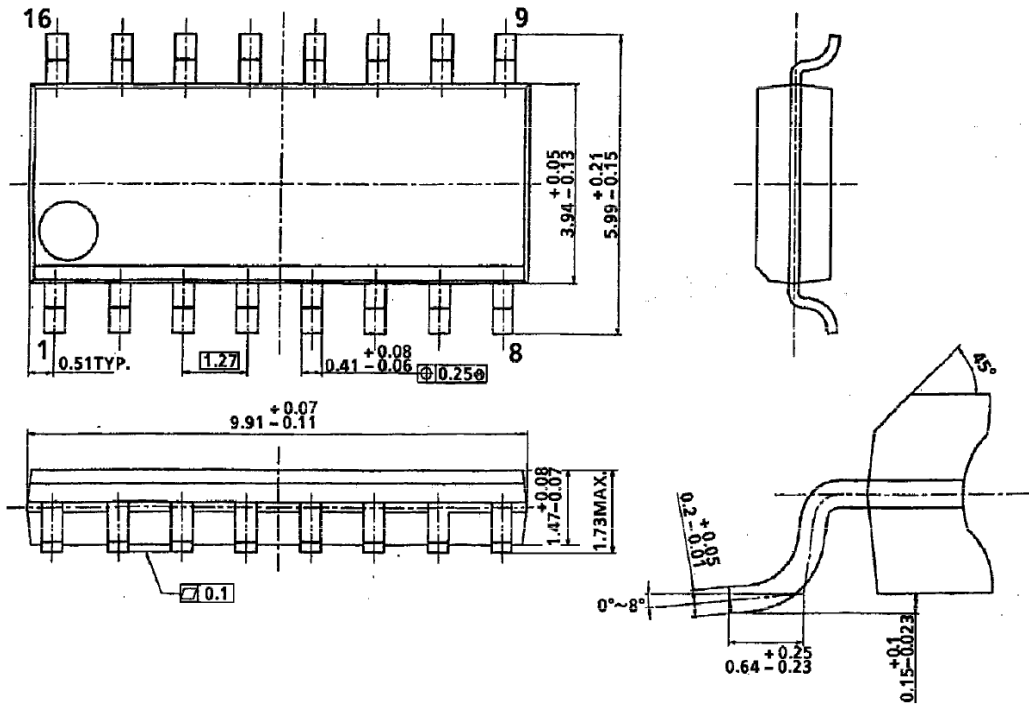
OUTLINE DRAWING

DIP16-P-300-2.54A



Weight : 1.11g (Typ.)

OUTLINE DRAWING  
SOL16-P-150-1.27A



Weight : 0.15g (Typ.)