

## 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.

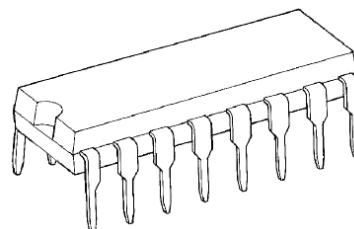
### FEATURES

- 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

ULN2003A

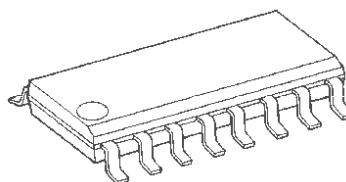
ULN2004A



DIP16-P-300-2.54A

ULN2003AD

ULN2004AD



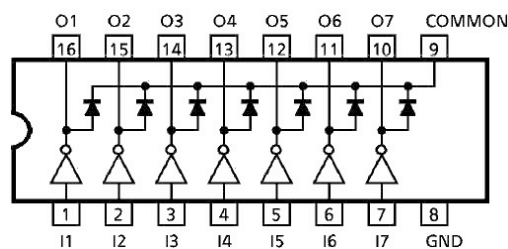
SOL16-P-150-1.27A

Weight

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

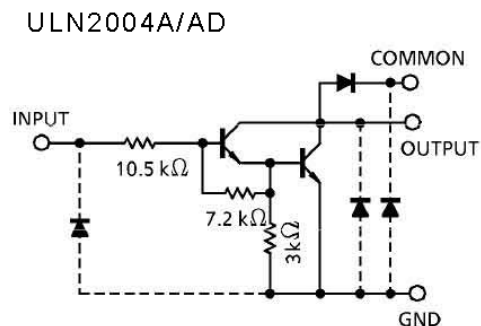
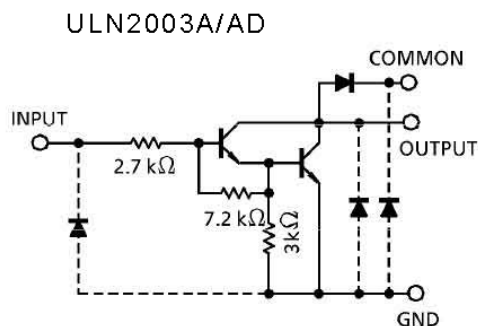
SOP16-P-150-1.27A : 0.15g (Typ.)

### 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		$V_{CE(SUS)}$	-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	A	$P_D$	1.47	W
	AD		0.54/0.625 (Note)	
Operating Temperature		$T_{opr}$	-40~85	
Storage Temperature		$T_{stg}$	-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</sub> (SUS)			0	-	50	
Output current	A	I <sub>OUT</sub>	T <sub>pw</sub> = 25ms 7 Circuits Ta =85 Tj=120	Duty=10%	0	-	370	mA/ch
				Duty=50%	0	-	130	
	AD			Duty=10%	0	-	233	
				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	

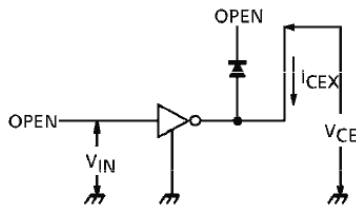
**(Note)** : On glass epoxy PCB (30 X 30 X1.6mm Cu 50%)

**ELECTRICAL CHARACTERISTICS** (Ta =25 unless otherwise noted)

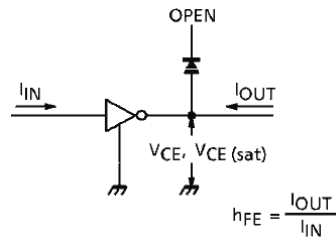
CHARACTERISTIC		SYMBOL	TEST CIR- CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Leakage Current		I <sub>CEX</sub>	1	V <sub>CE</sub> = 50V, Ta = 25		-	-	50	μ A
				V <sub>CE</sub> = 50V, Ta = 85		-	-	100	
Collector-Emitter Saturation Voltage		V <sub>CE(sat)</sub>	2	I <sub>OUT</sub> = 350mA, I <sub>IN</sub> = 500 μ A		-	1.3	1.6	V
				I <sub>OUT</sub> = 200mA, I <sub>IN</sub> = 350 μ A		-	1.1	1.3	
				I <sub>OUT</sub> = 100mA, I <sub>IN</sub> = 250 μ A		-	0.9	1.1	
DC Current Transfer Ratio		h <sub>FE</sub>	2	V <sub>CE</sub> = 2V, I <sub>OUT</sub> = 350mA		1000	-	-	
Input Current (Output On)	ULN2003A	I <sub>IN(ON)</sub>	3	V <sub>IN</sub> = 2.4V, I <sub>OUT</sub> = 350mA		-	0.4	0.7	mA
	ULN2004A			V <sub>IN</sub> = 9.5V, I <sub>OUT</sub> = 350mA		-	0.8	1.2	
Input Current (Output Off)		I <sub>IN(OFF)</sub>	4	I <sub>OUT</sub> = 500 μ A, Ta =85		50	65	-	μ A
Input Voltage (Output On)	ULN2003A	V <sub>IN(ON)</sub>	5	V <sub>CE</sub> = 2V H <sub>FE</sub> = 800	I <sub>OUT</sub> = 350mA	-	-	3.2	V
	I <sub>OUT</sub> = 200mA				-	-	2.5		
	I <sub>OUT</sub> = 350mA				-	-	4.7		
	I <sub>OUT</sub> = 200mA				-	-	4.4		
Clamp Diode Reverse Current		I <sub>R</sub>	6	V <sub>R</sub> = 50V, Ta = 25		-	-	50	μ A
				V <sub>R</sub> = 50V, Ta = 85		-	-	100	
Clamp Diode Forward Voltage		V <sub>F</sub>	7	I <sub>F</sub> = 350 mA		-	-	2.0	V
Input Capacitance		C <sub>IN</sub>	-			-	15	-	pF
Turn-On Delay		t <sub>ON</sub>	8	V <sub>OUT</sub> = 50V, R <sub>L</sub> = 125 C <sub>L</sub> = 15pF		-	0.1	-	μ S
Turn-Off Delay		t <sub>OFF</sub>	8	V <sub>OUT</sub> = 50V, R <sub>L</sub> = 125 C <sub>L</sub> = 15pF		-	0.2	-	

### TEST CIRCUIT

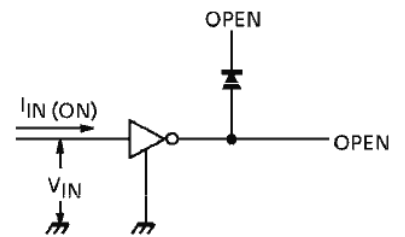
1.  $I_{CEX}$



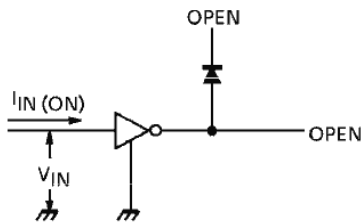
2.  $V_{CE(sat)}$ ,  $h_{FE}$



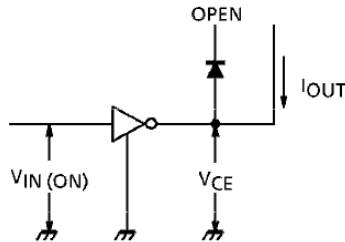
3.  $I_{IN(ON)}$



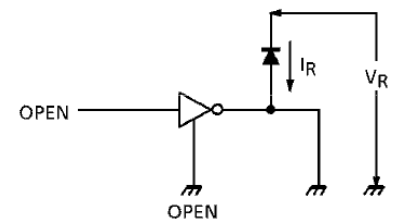
4.  $I_{IN(OFF)}$



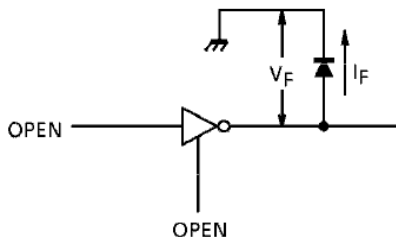
5.  $V_{IN(ON)}$



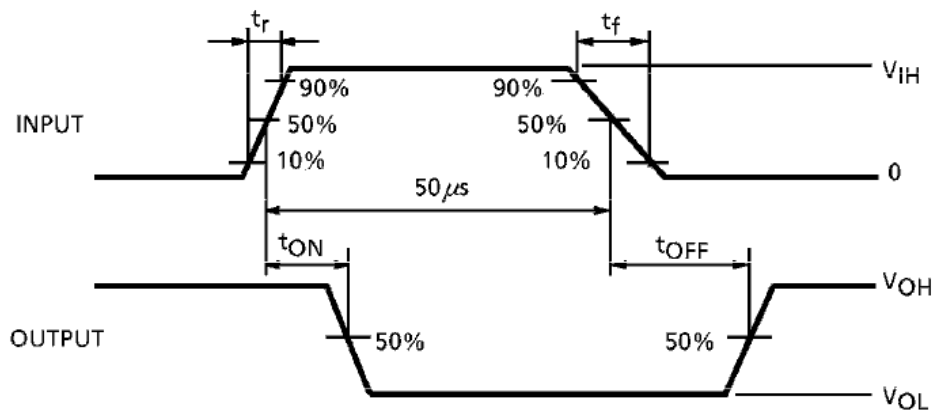
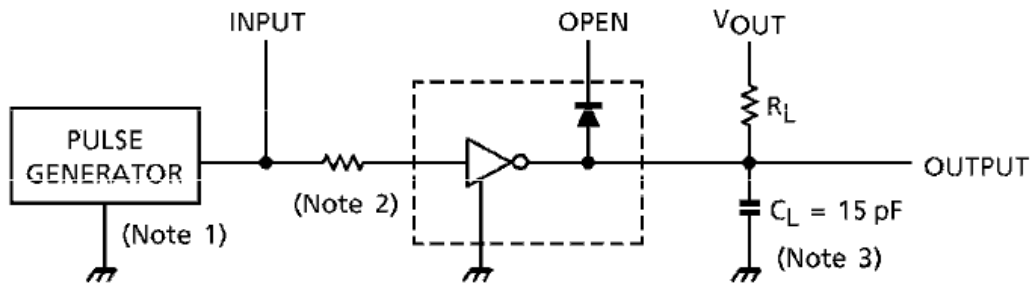
6.  $I_R$



7.  $V_F$



### 8. $t_{ON}$ , $t_{OFF}$



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

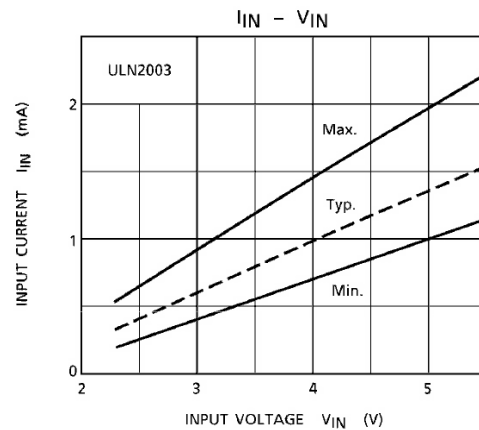
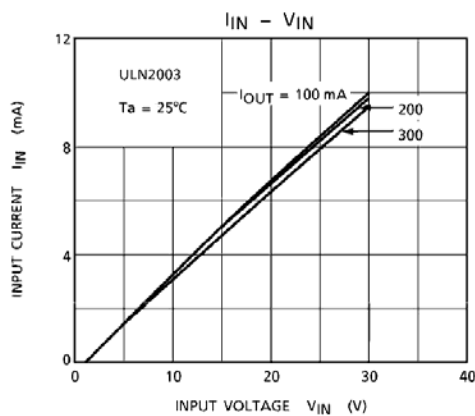
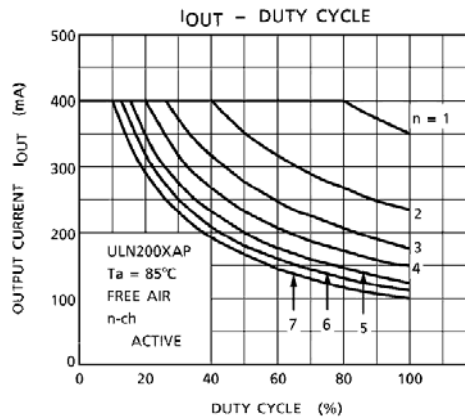
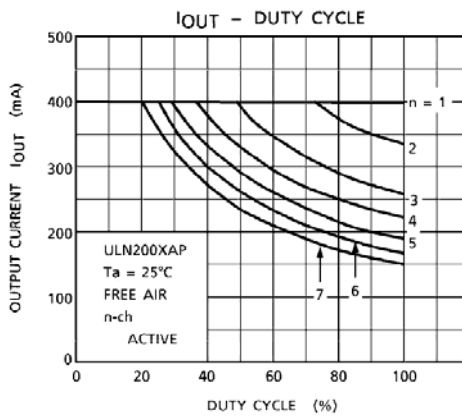
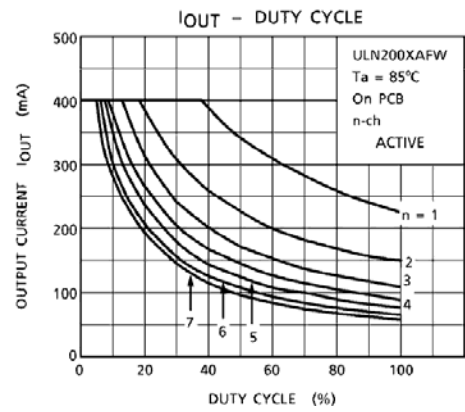
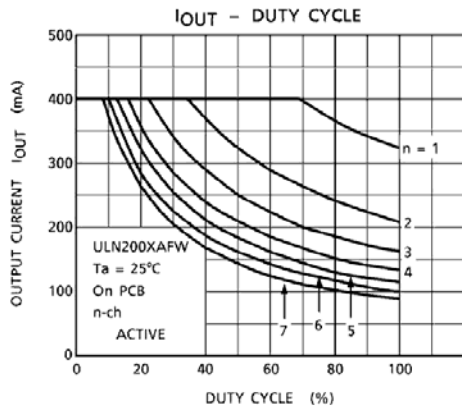
#### INPUT CONDITION

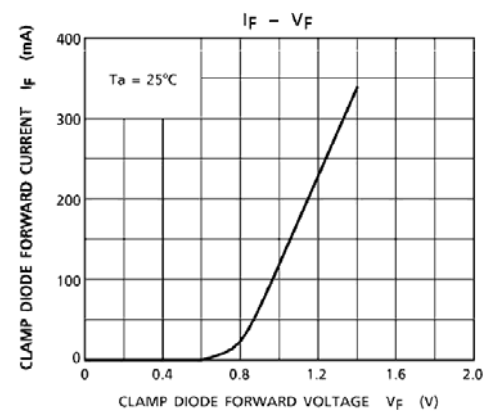
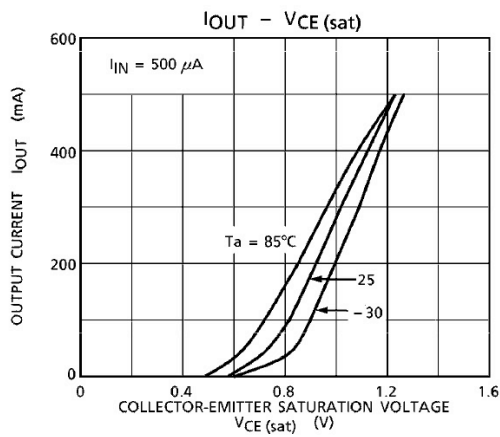
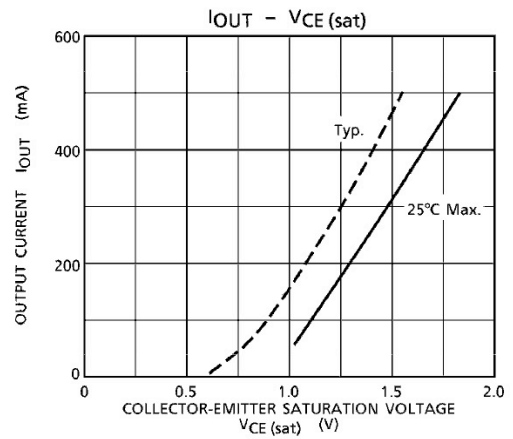
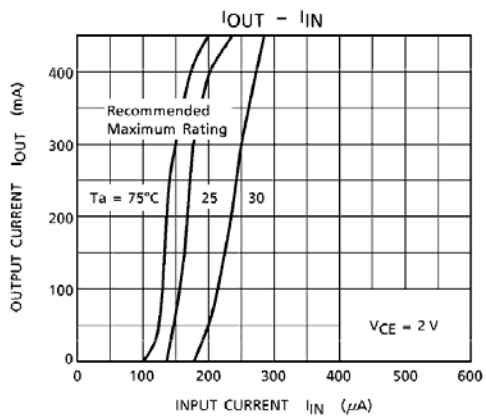
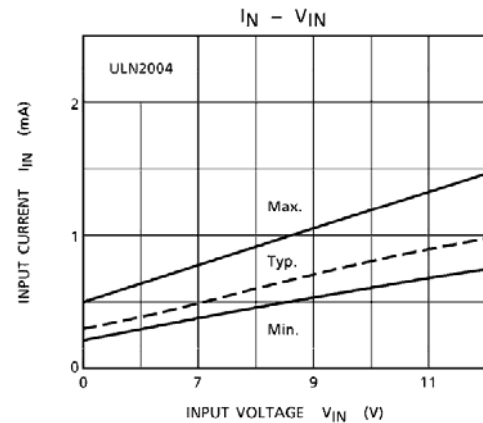
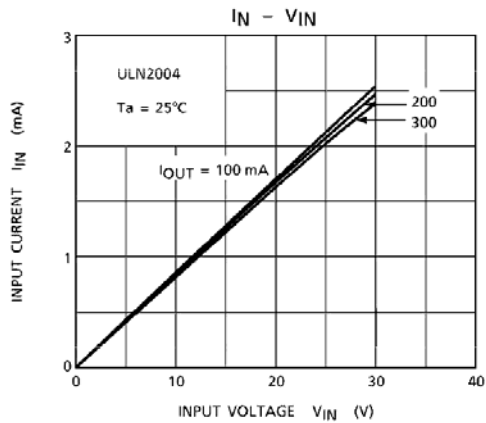
TYPE NUMBER	R1	$V_{IH}$
ULN2003A/AD	0	3V
ULN2004A/AD	0	8V

- (Note 3) :  $C_L$  includes probe and jig capacitance.

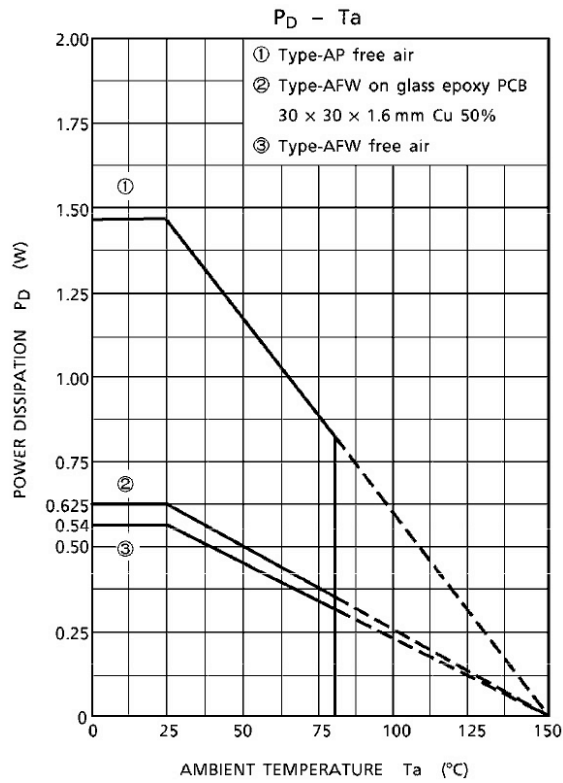
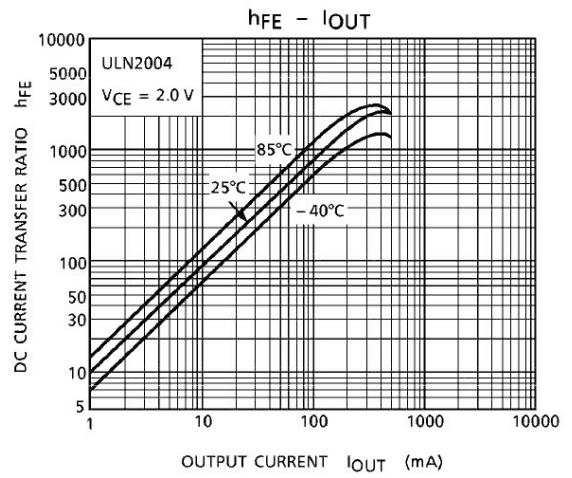
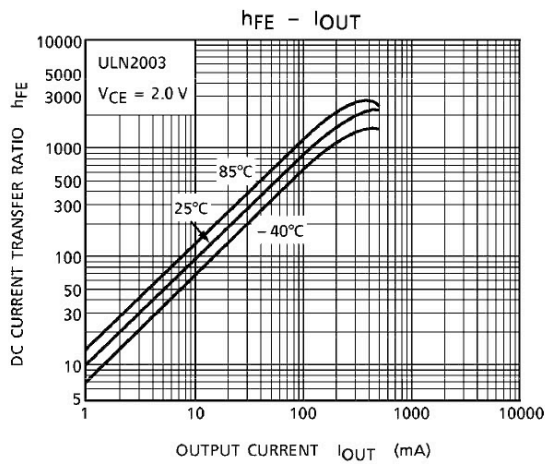
#### PRECAUTIONS for USING

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.



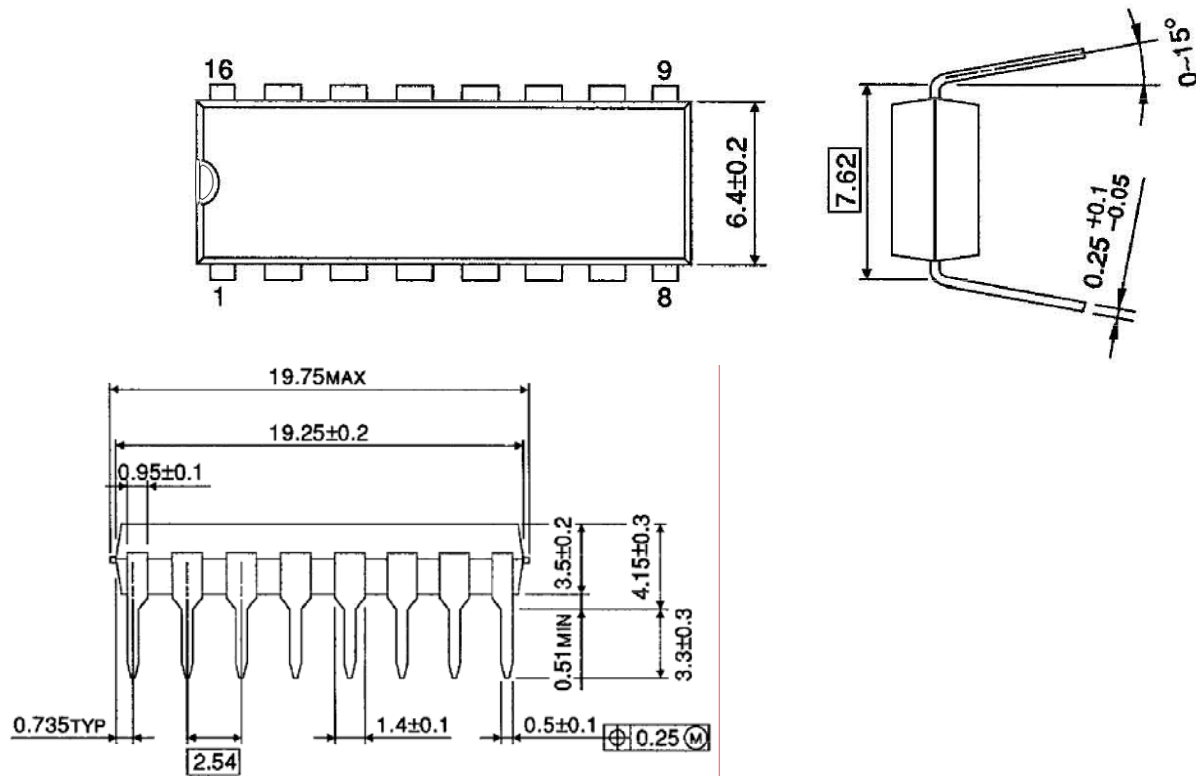






## OUTLINE DRAWING

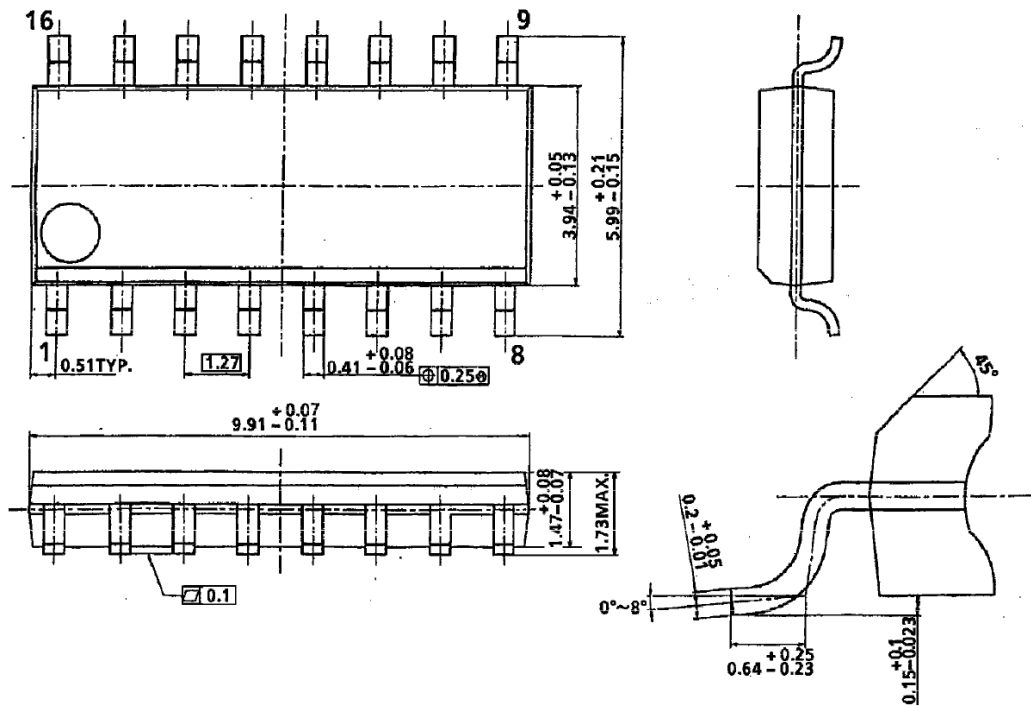
DIP16-P-300-2.54A



Weight : 1.11g (Typ.)

**OUTLINE DRAWING**

**SOL16-P-150-1.27A**



**Weight : 0.15g (Typ.)**