

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.

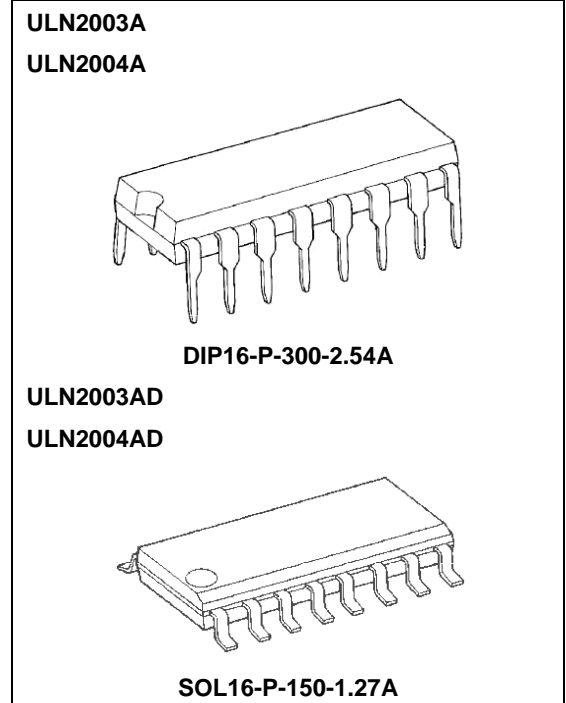
All units feature integral clamp diodes for switching inductive loads.

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 |

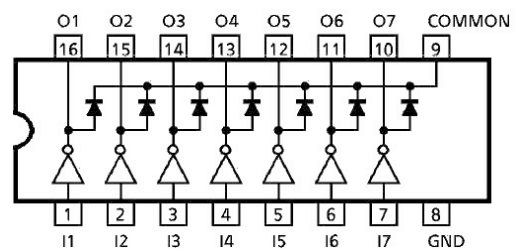


Weight

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

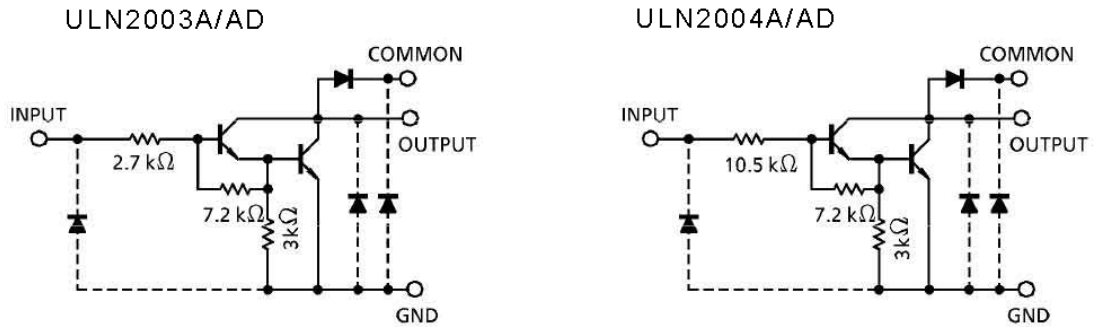
SOP16-P-150-1.27A : 0.15g (Typ.)

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 _{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 _{CE (SUS)} | | 0 | - | 50 | | |
| Output current | A | I _{OUT} | T _{pw} = 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 _{IN} | | 0 | - | 24 | V | |
| Input Voltage (Output On) | ULN2003A | V _{IN(ON)} | I _{OUT} =400mA h _{FE} =800 | 2.8 | - | 24 | V | |
| | ULN2004A | | | 6.2 | - | 24 | | |
| Input Voltage (Output Off) | ULN2003A | V _{IN(OFF)} | | 0 | - | 0.7 | V | |
| | ULN2004A | | | 0 | - | 1.0 | | |
| Clamp Diode Reverse Voltage | | V _R | | - | - | 50 | V | |
| Clamp Diode Forward Current | | I _F | | - | - | 350 | mA | |
| Power Dissipation | A | P _D | Ta =85 | - | - | 0.76 | W | |
| | AD | | (Note) Ta =85 | - | - | 0.325 | | |

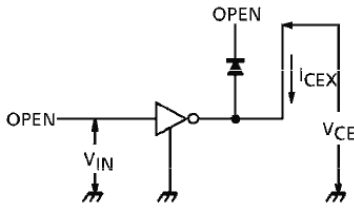
(Note) : On glass epoxy PCB (30 X 30 X1.6mm Cu 50%)

ELECTRICAL CHARACTERISTICS (Ta =25 unless otherwise noted)

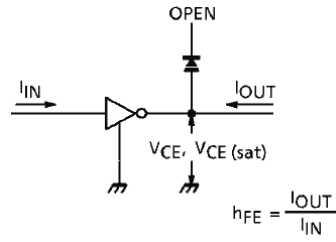
| CHARACTERISTIC | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT | | | |
|--------------------------------------|----------------------|---------------------|---|--|------|--------------------------|------|----|--|---|
| Output Leakage Current | I _{CEX} | 1 | V _{CE} = 50V, Ta = 25 | - | - | 50 | μA | | | |
| | | | V _{CE} = 50V, Ta = 85 | - | - | 100 | | | | |
| Collector-Emitter Saturation Voltage | V _{CE(sat)} | 2 | I _{OUT} = 350mA, I _{IN} = 500 μA | - | 1.3 | 1.6 | V | | | |
| | | | I _{OUT} = 200mA, I _{IN} = 350 μA | - | 1.1 | 1.3 | | | | |
| | | | I _{OUT} = 100mA, I _{IN} = 250 μA | - | 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 μA, Ta =85 | 50 | 65 | - | μA | | | |
| 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, Ta = 25 | - | - | 50 | μA | | | |
| | | | V _R = 50V, Ta = 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 | - | μS | | | |
| Turn-Off Delay | t _{OFF} | 8 | V _{OUT} = 50V, R _L = 125 C _L = 15pF | - | 0.2 | - | | | | |

TEST CIRCUIT

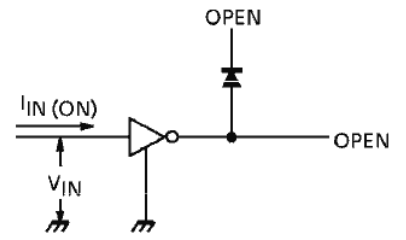
1. I_{CEX}



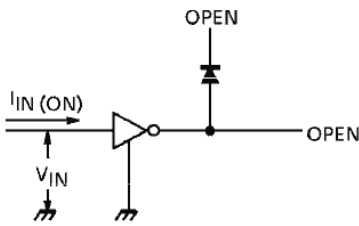
2. $V_{CE(sat)}$, h_{FE}



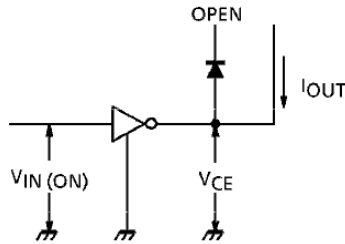
3. $I_{IN(ON)}$



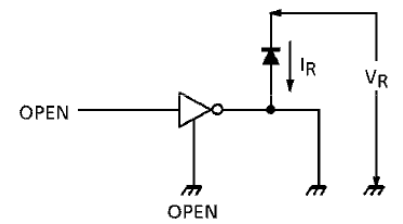
4. $I_{IN(OFF)}$



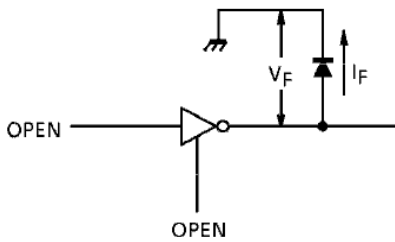
5. $V_{IN(ON)}$



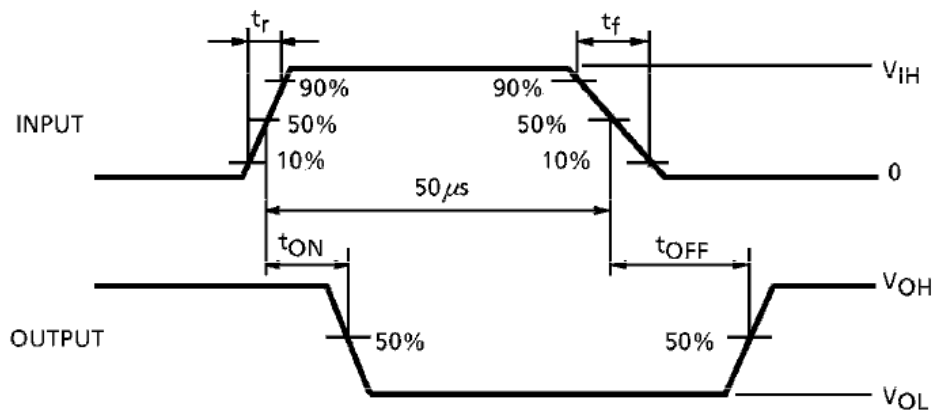
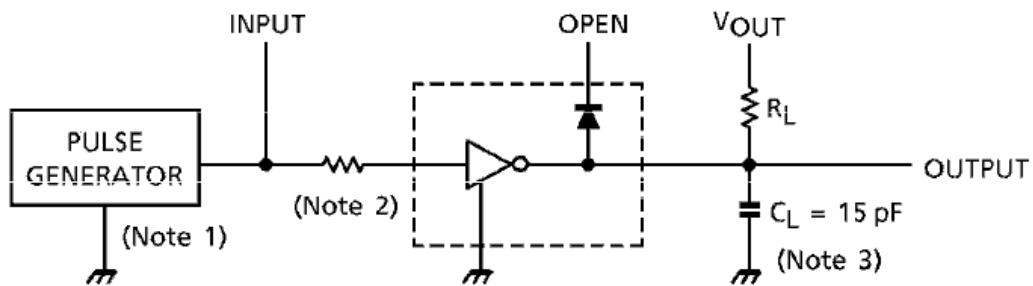
6. I_R



7. V_F



8. t_{ON} , t_{OFF}



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

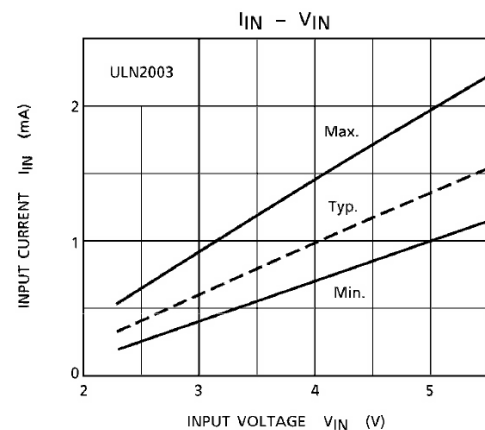
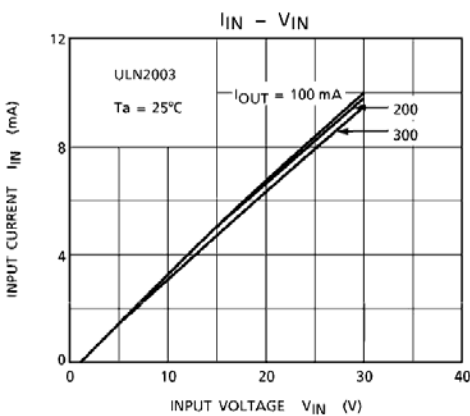
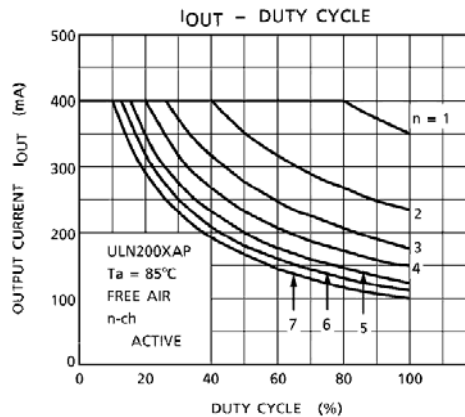
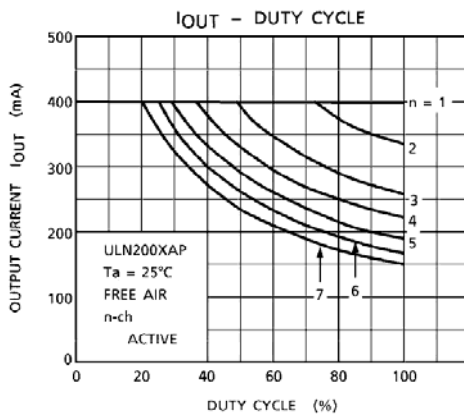
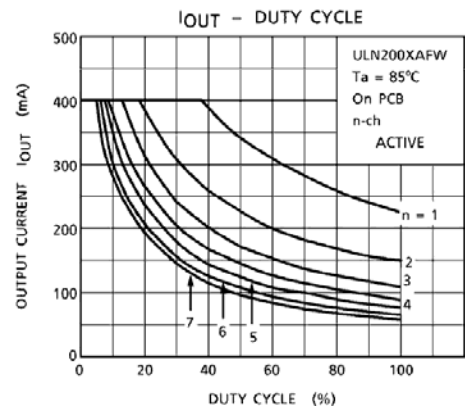
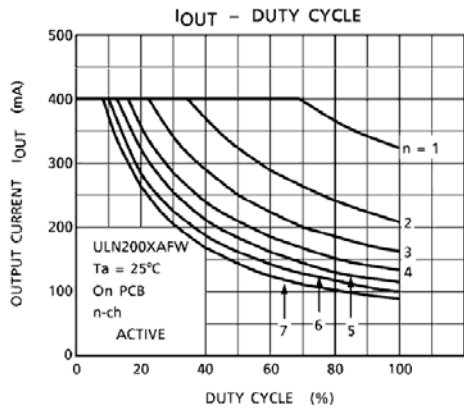
INPUT CONDITION

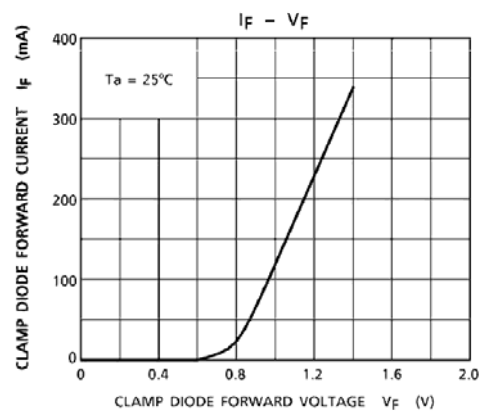
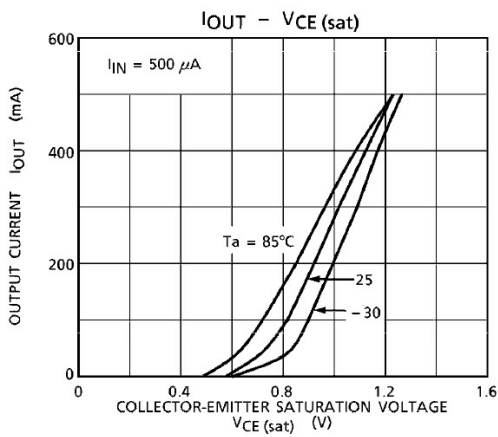
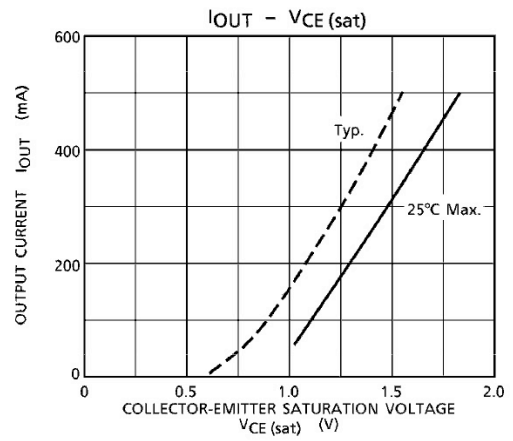
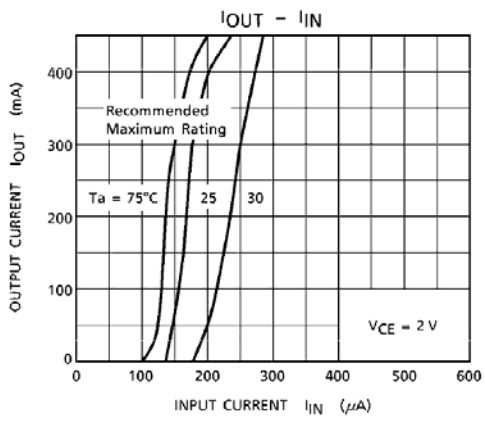
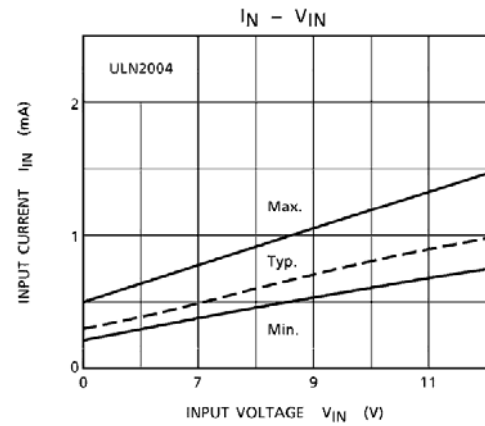
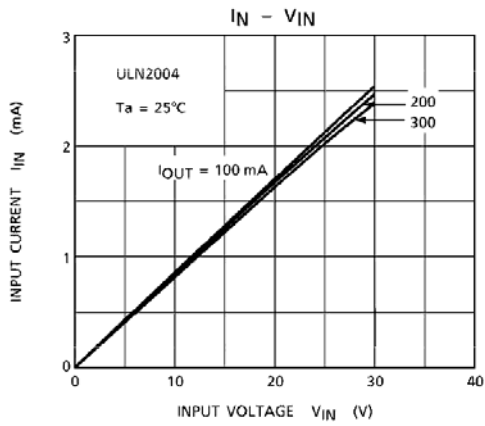
| TYPE NUMBER | R1 | V_{IH} |
|-------------|----|----------|
| ULN2003A/AD | 0 | 3V |
| ULN2004A/AD | 0 | 8V |

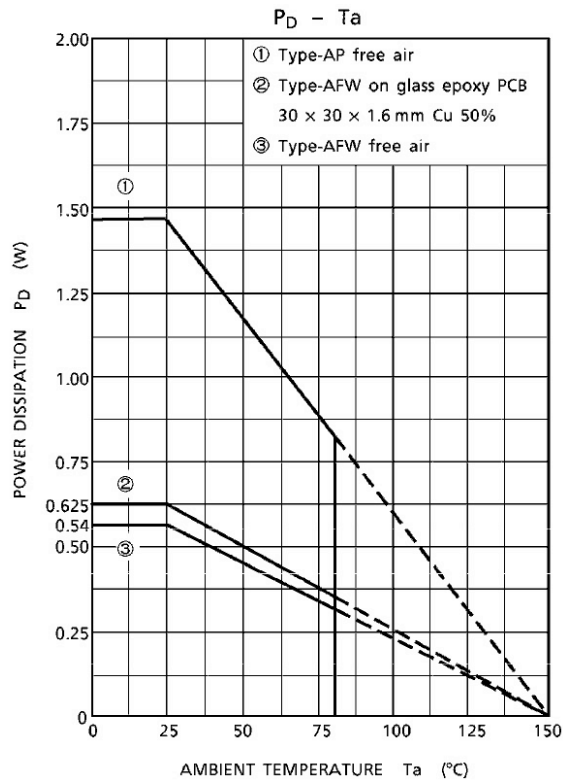
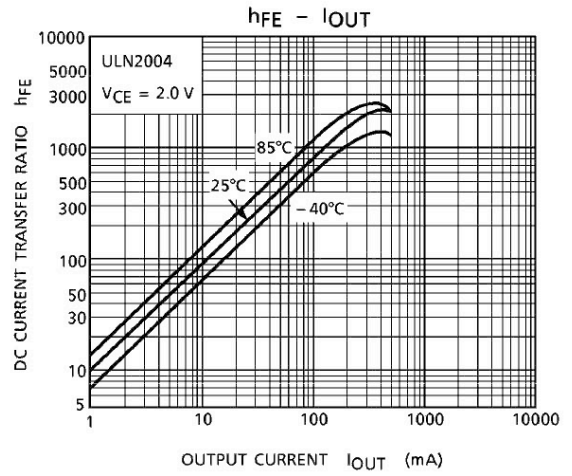
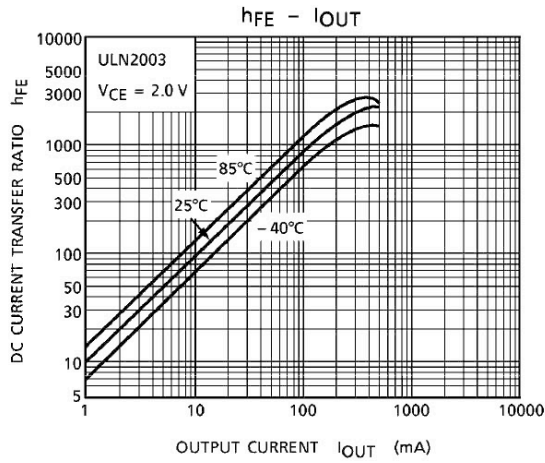
- (Note 3) : C_L includes probe and jig capacitance.

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.

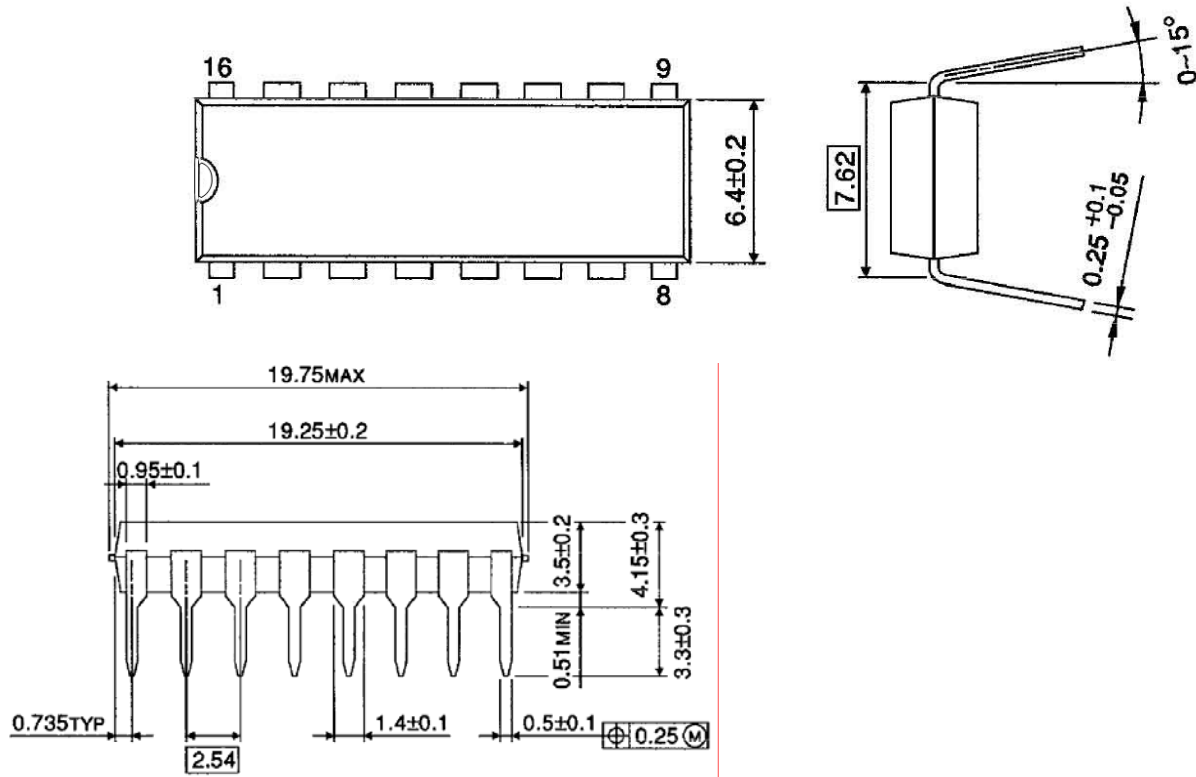






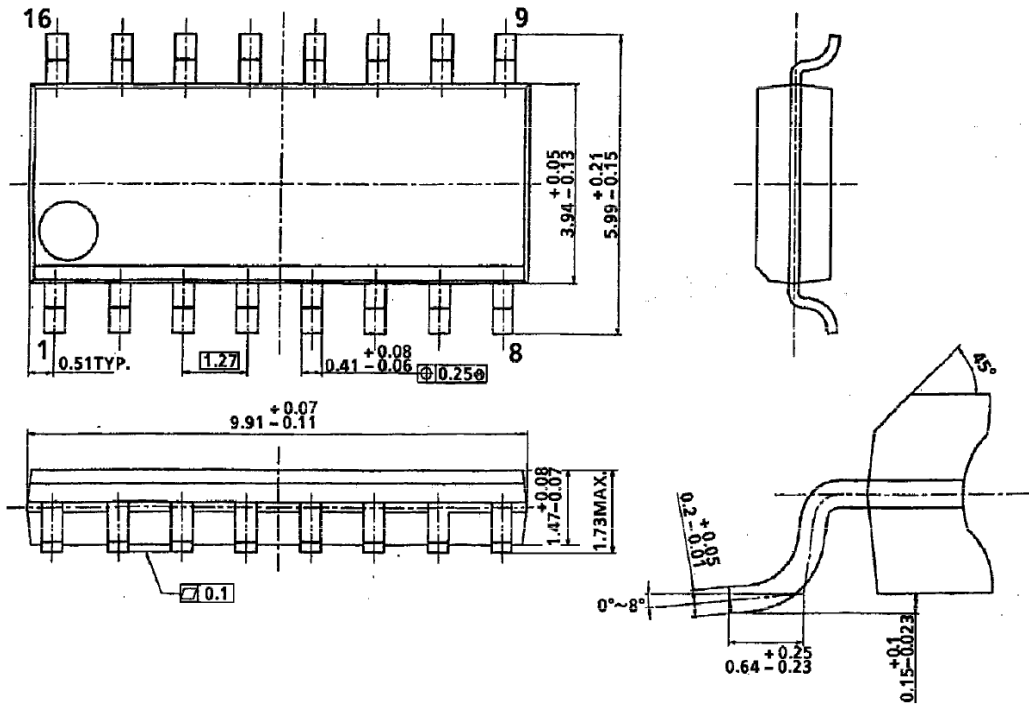
OUTLINE DRAWING

DIP16-P-300-2.54A



Weight : 1.11g (Typ.)

OUTLINE DRAWING
SOL16-P-150-1.27A



Weight : 0.15g (Typ.)