

## ULN2803AP, ULN2803AFW, ULN2804AP, ULN2804AFW

### 8CH DARLINGTON SINK DRIVER

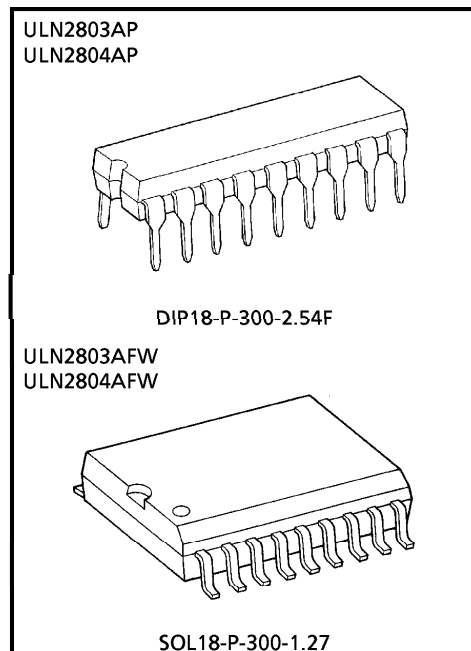
The ULN2803AP / AFW Series are high-voltage, high-current darlington drivers comprised of eight NPN darlington pairs.

All units feature integral clamp diodes for switching inductive loads.

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

#### FEATURES

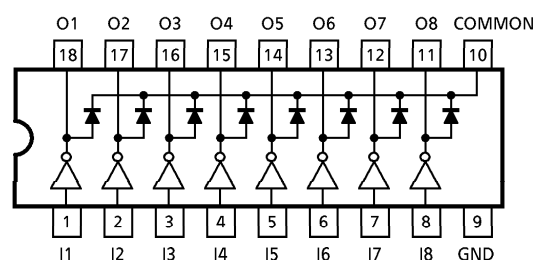
- Output current (single output)  
500mA (Max.) (ULN2803AP / AFW series)
- High sustaining voltage output  
50V (Min.) (ULN2803AP / AFW series)
- Output clamp diodes
- Inputs compatible with various types of logic.
- Package type-AP : DIP-18pin
- Package type-AFW : SOL-18pin



Weight  
DIP18-P-300-2.54F : 1.478g (Typ.)  
SOL18-P-300-1.27 : 0.48g (Typ.)

| TYPE            | INPUT BASE RESISTOR | DESIGNATION      |
|-----------------|---------------------|------------------|
| ULN2803AP / AFW | 2.7k $\Omega$       | TTL, 5V CMOS     |
| ULN2804AP / AFW | 10.5k $\Omega$      | 6~15V PMOS, CMOS |

#### PIN CONNECTION (TOP VIEW)

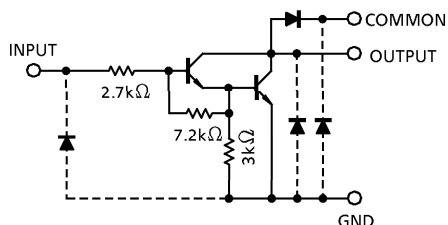


961001EBA1

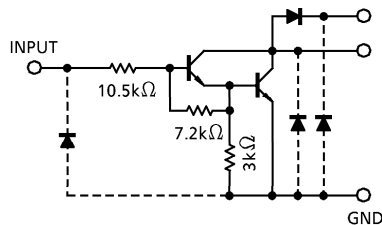
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**SCHEMATICS (EACH DRIVER)**

ULN2803AP / AFW



ULN2804AP / AFW



(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           | AP  | $P_D$         | 1.47               | W       |
|                             | AFW |               | 0.92 / 1.31 (Note) |         |
| Operating Temperature       |     | $T_{opr}$     | - 40~85            | °C      |
| Storage Temperature         |     | $T_{stg}$     | - 55~150           | °C      |

(Note) On Glass Epoxy PCB (75 × 114 × 1.6mm Cu 20%)

## RECOMMENDED OPERATING CONDITIONS (Ta = -40~85°C)

| CHARACTERISTIC                 |                    | SYMBOL                | TEST CONDITION                                    | MIN. | TYP. | MAX. | UNIT    |
|--------------------------------|--------------------|-----------------------|---------------------------------------------------|------|------|------|---------|
| Output Sustaining Voltage      |                    | V <sub>CE (SUS)</sub> |                                                   | 0    | —    | 50   | V       |
| Output Current                 | AP                 | I <sub>OUT</sub>      | T <sub>pw</sub> = 25ms, Duty = 10%,<br>8 Circuits | 0    | —    | 347  | mA / ch |
|                                |                    |                       | T <sub>pw</sub> = 25ms, Duty = 50%,<br>8 Circuits | 0    | —    | 123  |         |
|                                | AFW                |                       | T <sub>pw</sub> = 25ms, Duty = 10%,<br>8 Circuits | 0    | —    | 268  |         |
|                                |                    |                       | T <sub>pw</sub> = 25ms, Duty = 50%,<br>8 Circuits | 0    | —    | 90   |         |
| Input Voltage                  |                    | V <sub>IN</sub>       |                                                   | 0    | —    | 30   | V       |
| Input Voltage<br>(Output On)   | ULN2803AP<br>/ AFW | V <sub>IN (ON)</sub>  |                                                   | 3.5  | —    | 30   | V       |
|                                | ULN2804AP<br>/ AFW |                       |                                                   | 8    | —    | 30   |         |
| Clamp Diode Reverse Voltage    |                    | V <sub>R</sub>        |                                                   | —    | —    | 50   | V       |
| Clamp Diode Forward<br>Current |                    | I <sub>F</sub>        |                                                   | —    | —    | 400  | mA      |
| Power Dissipation              | AP                 | P <sub>D</sub>        | T <sub>a</sub> = 85°C                             | —    | —    | 0.76 | W       |
|                                | AFW                |                       | T <sub>a</sub> = 85°C (Note)                      | —    | —    | 0.48 |         |

(Note) On Glass Epoxy PCB (75×114×1.6mm Cu 20%)

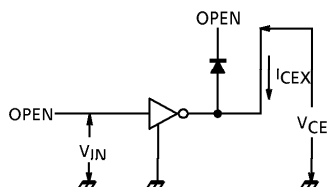
## ELECTRICAL CHARACTERISTICS (Ta = 25°C)

| CHARACTERISTIC                                       |                                                | SYMBOL                | TEST CIR-<br>CUIT     | TEST CONDITION                                    |                                                 | MIN. | TYP. | MAX. | UNIT |
|------------------------------------------------------|------------------------------------------------|-----------------------|-----------------------|---------------------------------------------------|-------------------------------------------------|------|------|------|------|
| Output Leakage Current<br><div>ULN2804AP / AFW</div> |                                                | I <sub>CEX</sub>      | 1                     | V <sub>CE</sub> = 50V                             | T <sub>a</sub> = 25°C                           | —    | —    | 50   | μA   |
|                                                      |                                                |                       |                       | V <sub>CE</sub> = 50V                             | T <sub>a</sub> = 85°C                           | —    | —    | 100  |      |
|                                                      |                                                |                       |                       | V <sub>CE</sub> = 50V                             | V <sub>IN</sub> = 1V                            | —    | —    | 500  |      |
| Collector-Emitter Saturation Voltage                 |                                                | V <sub>CE (sat)</sub> | 2                     | I <sub>OUT</sub> = 350mA, I <sub>IN</sub> = 500μA |                                                 | —    | 1.3  | 1.6  | V    |
|                                                      |                                                |                       |                       | I <sub>OUT</sub> = 200mA, I <sub>IN</sub> = 350μA |                                                 | —    | 1.1  | 1.3  |      |
|                                                      |                                                |                       |                       | I <sub>OUT</sub> = 100mA, I <sub>IN</sub> = 250μA |                                                 | —    | 0.9  | 1.1  |      |
| Input Current                                        | ULN2803AP / AFW                                | I <sub>IN (ON)</sub>  | 2                     | V <sub>IN</sub> = 3.85V                           |                                                 | —    | 0.93 | 1.35 | mA   |
|                                                      | V <sub>IN</sub> = 5V                           |                       |                       | —                                                 | 0.35                                            | 0.5  |      |      |      |
|                                                      | V <sub>IN</sub> = 12V                          |                       |                       | —                                                 | 1.0                                             | 1.45 |      |      |      |
|                                                      |                                                |                       | I <sub>IN (OFF)</sub> | 4                                                 | I <sub>OUT</sub> = 500μA, T <sub>a</sub> = 85°C |      | 50   | 65   | —    |
| Input Voltage (Output On)                            | ULN2803AP / AFW                                | V <sub>IN (ON)</sub>  | 5                     | V <sub>CE</sub> = 2V, I <sub>OUT</sub> = 200mA    |                                                 | —    | —    | 2.4  | V    |
|                                                      | V <sub>CE</sub> = 2V, I <sub>OUT</sub> = 250mA |                       |                       | —                                                 | —                                               | 2.7  |      |      |      |
|                                                      | V <sub>CE</sub> = 2V, I <sub>OUT</sub> = 300mA |                       |                       | —                                                 | —                                               | 3.0  |      |      |      |
|                                                      | V <sub>CE</sub> = 2V, I <sub>OUT</sub> = 125mA |                       |                       | —                                                 | —                                               | 5.0  |      |      |      |
|                                                      | V <sub>CE</sub> = 2V, I <sub>OUT</sub> = 200mA |                       |                       | —                                                 | —                                               | 6.0  |      |      |      |
|                                                      | V <sub>CE</sub> = 2V, I <sub>OUT</sub> = 275mA |                       |                       | —                                                 | —                                               | 7.0  |      |      |      |
|                                                      | V <sub>CE</sub> = 2V, I <sub>OUT</sub> = 350mA |                       |                       | —                                                 | —                                               | 8.0  |      |      |      |
| DC Current Transfer Ratio                            |                                                | h <sub>FE</sub>       | 2                     | V <sub>CE</sub> = 2V, I <sub>OUT</sub> = 350mA    |                                                 | 1000 | —    | —    |      |
| Clamp Diode Reverse Current                          |                                                | I <sub>R</sub>        | 6                     | T <sub>a</sub> = 25°C (Note)                      |                                                 | —    | —    | 50   | μA   |
|                                                      |                                                |                       |                       | T <sub>a</sub> = 85°C (Note)                      |                                                 | —    | —    | 100  |      |
| Clamp Diode Forward Voltage                          |                                                | V <sub>F</sub>        | 7                     | I <sub>F</sub> = 350mA                            |                                                 | —    | —    | 2.0  | V    |
| Input Capacitance                                    |                                                | C <sub>IN</sub>       | —                     |                                                   |                                                 | —    | 15   | —    | pF   |
| Turn-On Delay                                        |                                                | t <sub>ON</sub>       | 8                     | R <sub>L</sub> = 125Ω, V <sub>OUT</sub> = 50V     |                                                 | —    | 0.1  | —    | μs   |
| Turn-Off Delay                                       |                                                | t <sub>OFF</sub>      |                       | R <sub>L</sub> = 125Ω, V <sub>OUT</sub> = 50V     |                                                 | —    | 0.2  | —    |      |

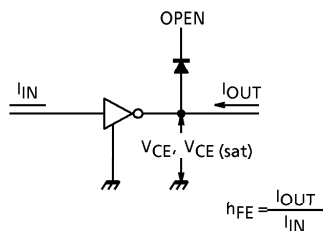
(Note) V<sub>R</sub> = V<sub>R</sub> MAX.

**TEST CIRCUIT**

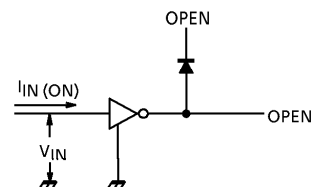
1.  $I_{CEX}$



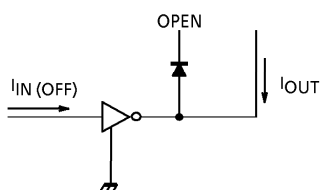
2.  $V_{CE(sat)}$ ,  $h_{FE}$



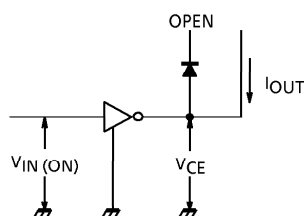
3.  $I_{IN(ON)}$



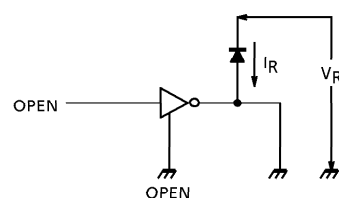
4.  $I_{IN(OFF)}$



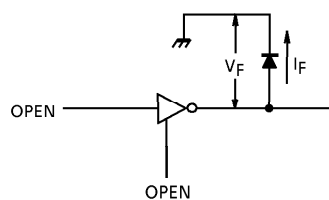
5.  $V_{IN(ON)}$



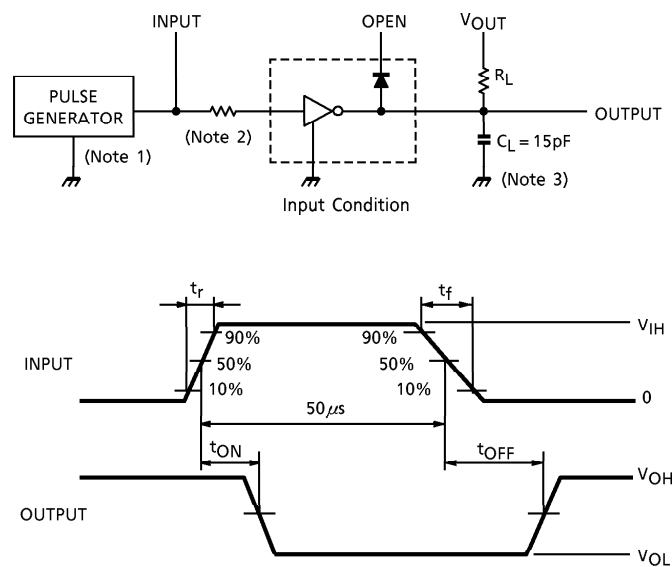
6.  $I_R$



7.  $V_F$



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



- (Note 1) Pulse Width  $50\mu s$ , Duty Cycle 10%  
Output Impedance  $50\Omega$ ,  $t_r \leq 5ns$ ,  $t_f \leq 10ns$   
(Note 2) See below.

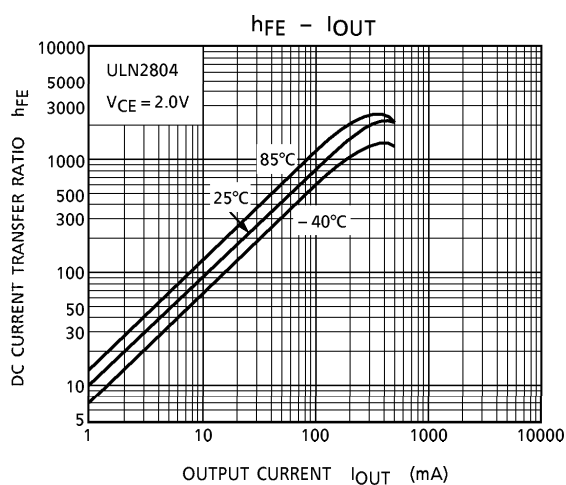
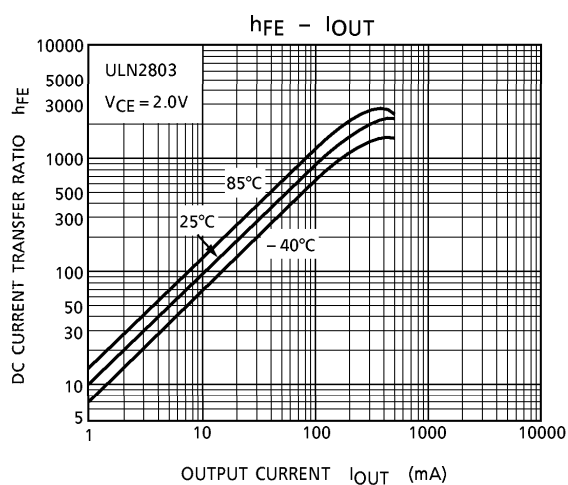
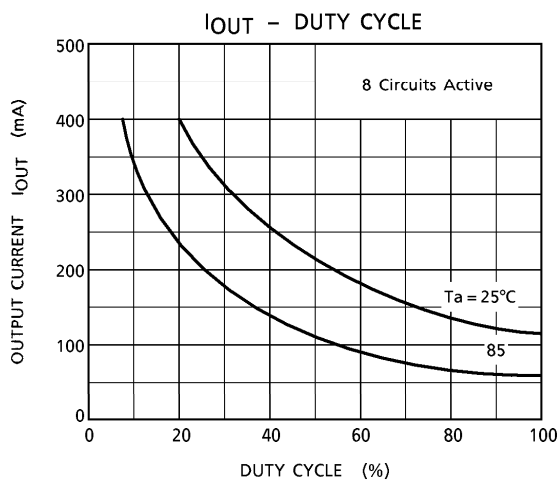
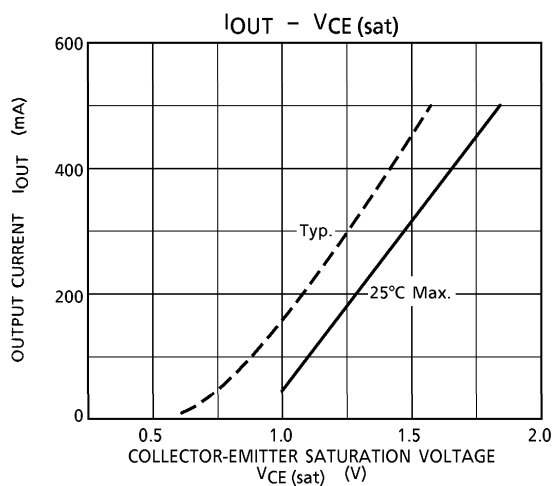
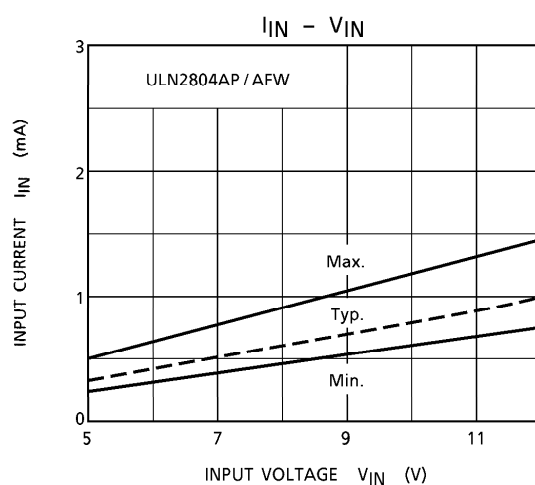
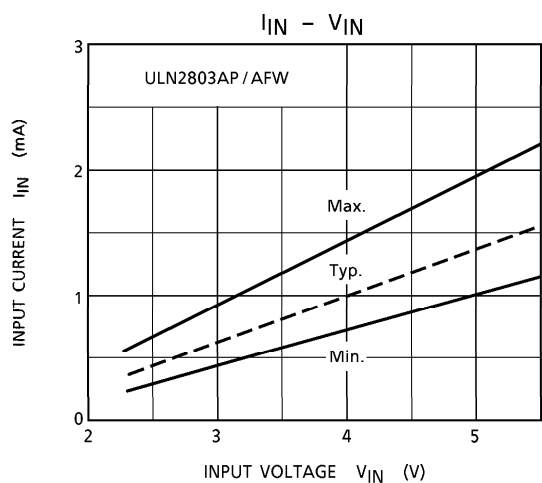
INPUT CONDITION

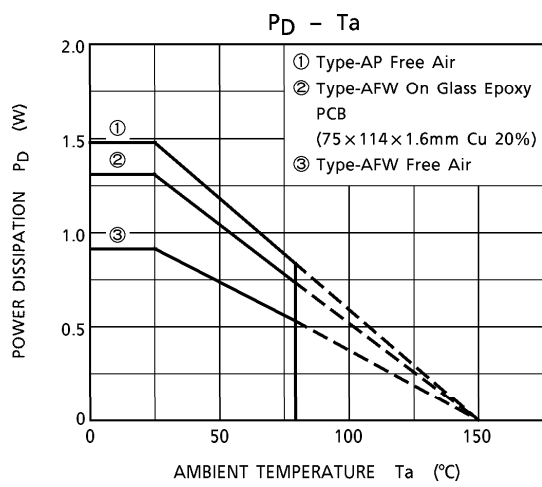
| TYPE NUMBER     | R1        | $V_{IH}$ |
|-----------------|-----------|----------|
| ULN2803AP / AFW | $0\Omega$ | 3V       |
| ULN2804AP / AFW | $0\Omega$ | 8V       |

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

PRECAUTIONS for USING

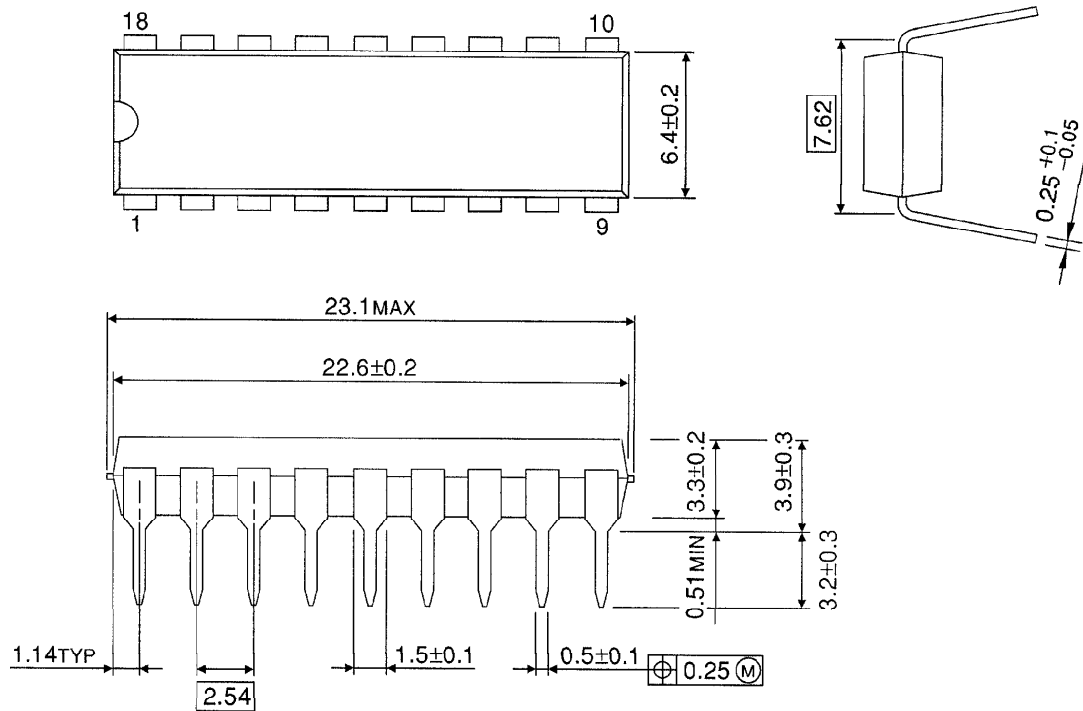
Utmost care is necessary in the design of the output line, COMMON and GND line since IC may be destroyed due to short-circuit between outputs, air contamination fault, or fault by improper grounding.





**OUTLINE DRAWING**  
DIP18-P-300-2.54F

Unit : mm

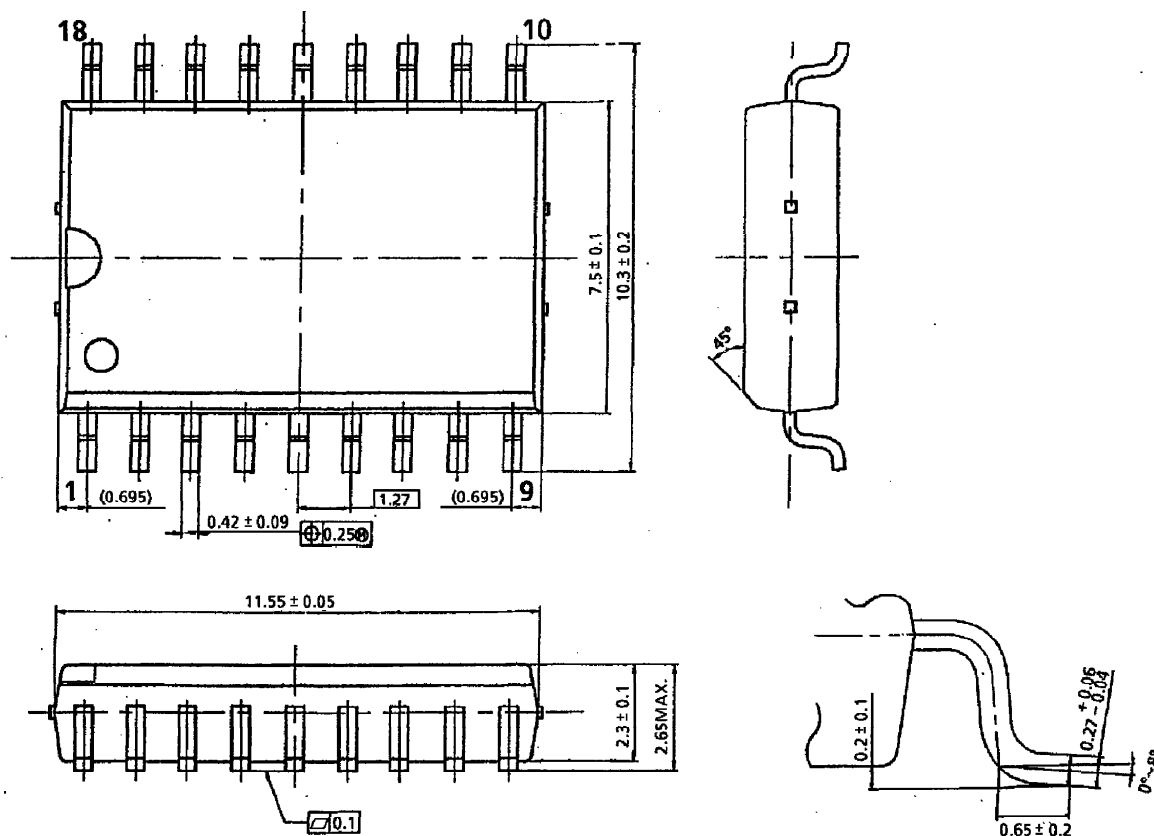


Weight : 1.478g (Typ.)

**OUTLINE DRAWING**

SOL18-P-300-1.27

Unit : mm



Weight : 0.48g (Typ.)