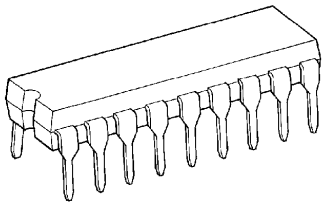
TOSHIBA BIPOLAR DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# ULN2803AP, ULN2803AFW, ULN2804AP, ULN2804AFW

## 8CH DARLINGTON SINK DRIVER

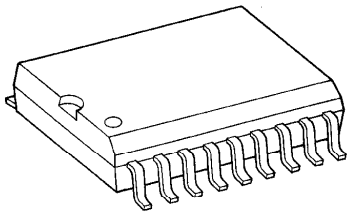
The ULN2803AP / AFW Series are high-voltage, high-current darlington drivers comprised of eight NPN darlington pairs.
All units feature integral clamp diodes for switching inductive loads.
Applications include relay, hammer, lamp and display (LED) drivers.

ULN2803AP
ULN2804AP



DIP18-P-300-2.54F

ULN2803AFW
ULN2804AFW



SOL18-P-300-1.27

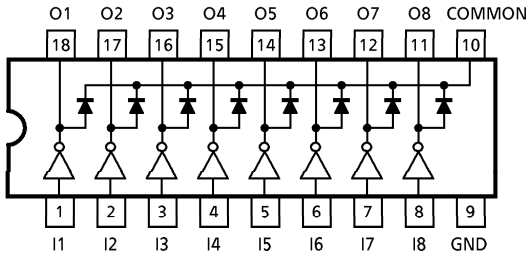
Weight
DIP18-P-300-2.54F : 1.478g (Typ.)
SOL18-P-300-1.27 : 0.48g (Typ.)

**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

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

**PIN CONNECTION** (TOP VIEW)

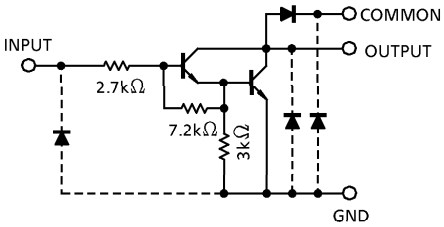



961001EBA1

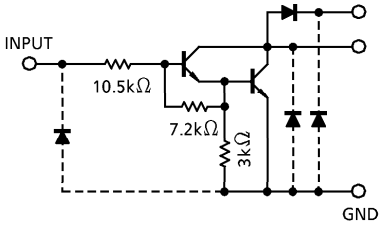

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- The information contained herein is subject to change without notice.

**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 | | $V_{CE\ (SUS)}$ | | 0 | — | 50 | V |
| Output Current | AP | $I_{OUT}$ | $T_{pw}$ = 25ms, Duty = 10%, 8 Circuits | 0 | — | 347 | mA / ch |
| | | | $T_{pw}$ = 25ms, Duty = 50%, 8 Circuits | 0 | — | 123 | |
| | AFW | | $T_{pw}$ = 25ms, Duty = 10%, 8 Circuits | 0 | — | 268 | |
| | | | $T_{pw}$ = 25ms, Duty = 50%, 8 Circuits | 0 | — | 90 | |
| Input Voltage | | $V_{IN}$ | | 0 | — | 30 | V |
| Input Voltage (Output On) | ULN2803AP / AFW | $V_{IN\ (ON)}$ | | 3.5 | — | 30 | V |
| | ULN2804AP / AFW | | | 8 | — | 30 | |
| Clamp Diode Reverse Voltage | | $V_R$ | | — | — | 50 | V |
| Clamp Diode Forward Current | | $I_F$ | | — | — | 400 | mA |
| Power Dissipation | AP | $P_D$ | Ta = 85°C | — | — | 0.76 | W |
| | AFW | | Ta = 85°C (Note) | — | — | 0.48 | |

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

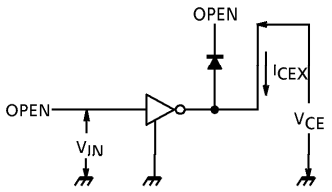
**ELECTRICAL CHARACTERISTICS** (Ta = 25°C)

| CHARACTERISTIC | | SYMBOL | TEST CIR-CUIT | TEST CONDITION | | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| Output Leakage Current | | $I_{CEX}$ | 1 | $V_{CE}$ = 50V | Ta = 25°C | — | — | 50 | μA |
| | | | | $V_{CE}$ = 50V | Ta = 85°C | — | — | 100 | |
| | ULN2804AP / AFW | | | $V_{CE}$ = 50V | $V_{IN}$ = 1V | — | — | 500 | |
| 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 | |
| | | | | $I_{OUT}$ = 100mA, $I_{IN}$ = 250μA | | — | 0.9 | 1.1 | |
| Input Current | ULN2803AP / AFW | $I_{IN\ (ON)}$ | 2 | $V_{IN}$ = 3.85V | | — | 0.93 | 1.35 | mA |
| | ULN2804AP / AFW | | | $V_{IN}$ = 5V | | — | 0.35 | 0.5 | |
| | | | | $V_{IN}$ = 12V | | — | 1.0 | 1.45 | |
| | | $I_{IN\ (OFF)}$ | 4 | $I_{OUT}$ = 500μA, Ta = 85°C | | 50 | 65 | — | μA |
| Input Voltage (Output On) | ULN2803AP / AFW | $V_{IN\ (ON)}$ | 5 | $V_{CE}$ = 2V, $I_{OUT}$ = 200mA | | — | — | 2.4 | V |
| | | | | $V_{CE}$ = 2V, $I_{OUT}$ = 250mA | | — | — | 2.7 | |
| | | | | $V_{CE}$ = 2V, $I_{OUT}$ = 300mA | | — | — | 3.0 | |
| | ULN2804AP / AFW | | | $V_{CE}$ = 2V, $I_{OUT}$ = 125mA | | — | — | 5.0 | |
| | | | | $V_{CE}$ = 2V, $I_{OUT}$ = 200mA | | — | — | 6.0 | |
| | | | | $V_{CE}$ = 2V, $I_{OUT}$ = 275mA | | — | — | 7.0 | |
| | | | | $V_{CE}$ = 2V, $I_{OUT}$ = 350mA | | — | — | 8.0 | |
| DC Current Transfer Ratio | | $h_{FE}$ | 2 | $V_{CE}$ = 2V, $I_{OUT}$ = 350mA | | 1000 | — | — | |
| Clamp Diode Reverse Current | | $I_R$ | 6 | Ta = 25°C (Note) | | — | — | 50 | μA |
| | | | | Ta = 85°C (Note) | | — | — | 100 | |
| 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 | $R_L$ = 125Ω, $V_{OUT}$ = 50V | | — | 0.1 | — | μs |
| Turn-Off Delay | | $t_{OFF}$ | | $R_L$ = 125Ω, $V_{OUT}$ = 50V | | — | 0.2 | — | |

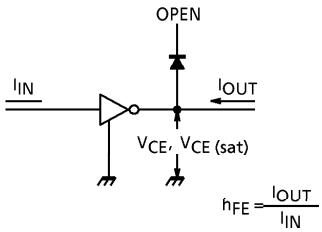
(Note) $V_R = V_R$ MAX.

**TEST CIRCUIT**

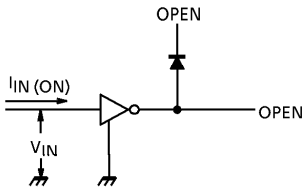
1. $I_{CEX}$



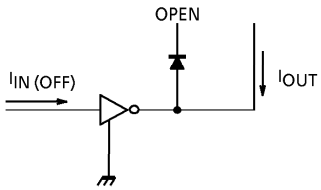

2. $V_{CE\ (sat)}$, $h_{FE}$



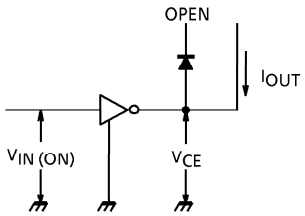

3. $I_{IN\ (ON)}$



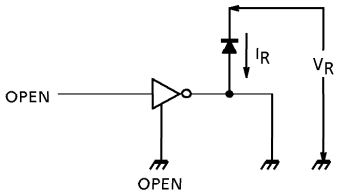

4. $I_{IN\ (OFF)}$



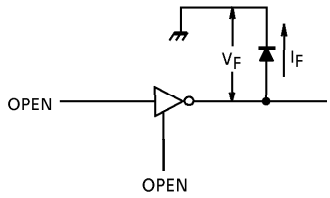

5. $V_{IN\ (ON)}$



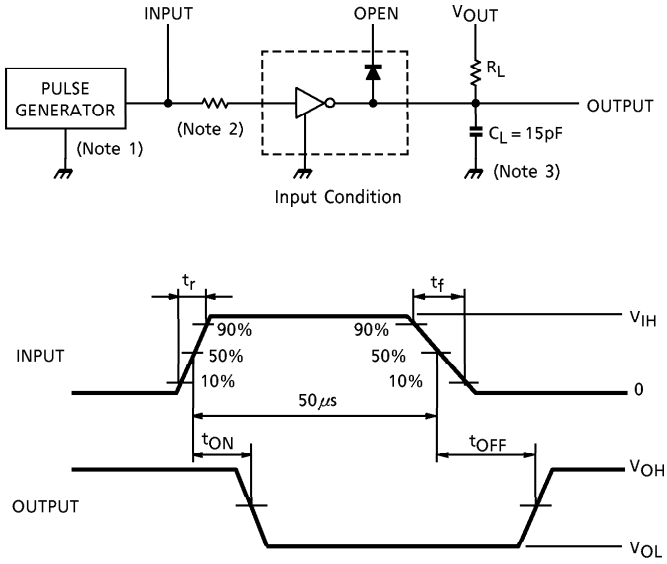

6. $I_R$




7. $V_F$



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




(Note 1) Pulse Width 50$\mu$s, Duty Cycle 10%
Output Impedance 50$\Omega$, $t_r \leqq$ 5ns, $t_f \leqq$ 10ns

(Note 2) See below.

INPUT CONDITION

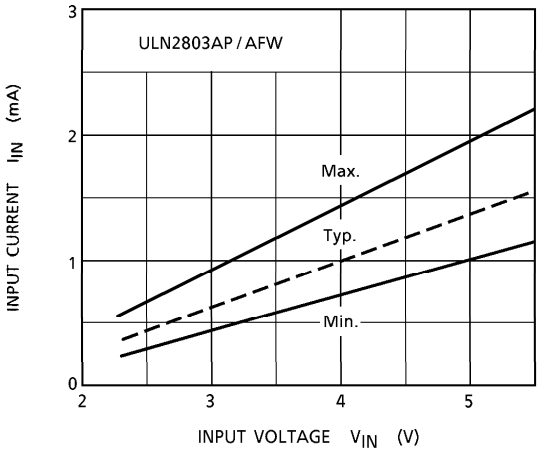
| TYPE NUMBER | R1 | $V_{IH}$ |
|---|---|---|
| ULN2803AP / AFW | 0$\Omega$ | 3V |
| ULN2804AP / AFW | 0$\Omega$ | 8V |

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

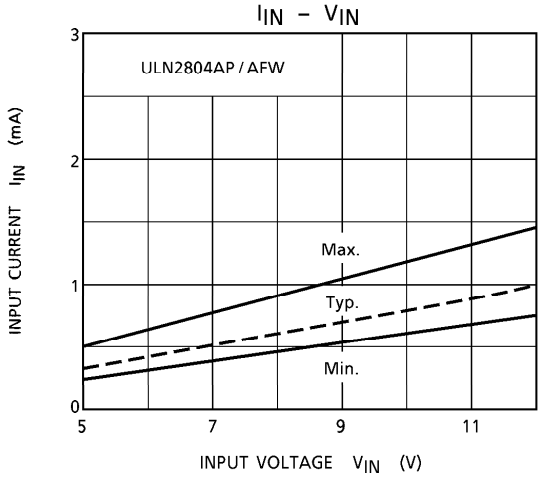
PRECAUTIONS for USING

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.

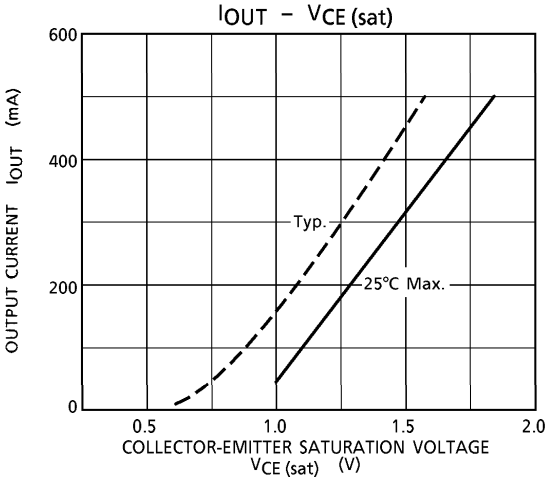
$I_{IN}$ – $V_{IN}$



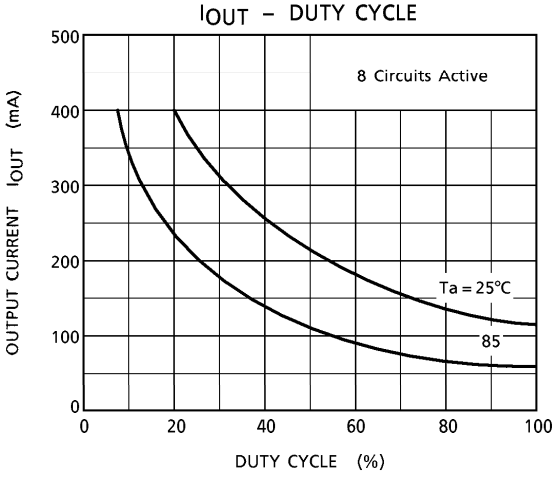

$I_{IN}$ – $V_{IN}$



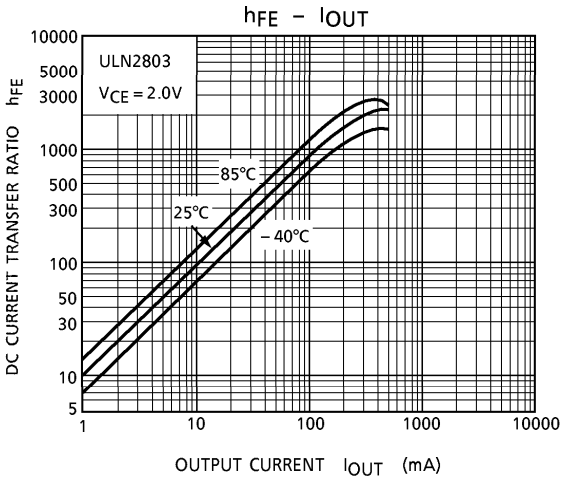

$I_{OUT}$ – $V_{CE\ (sat)}$



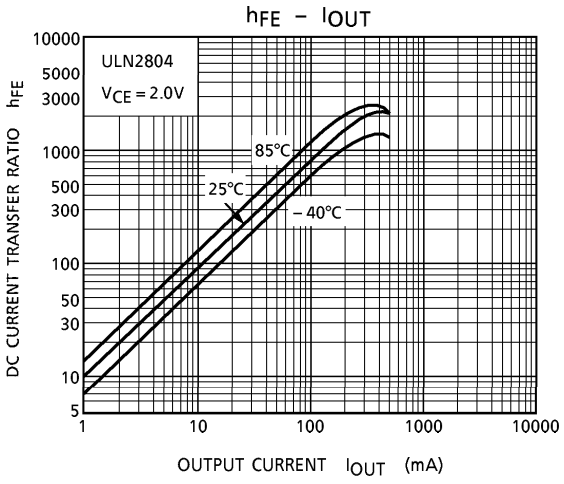

$I_{OUT}$ – DUTY CYCLE

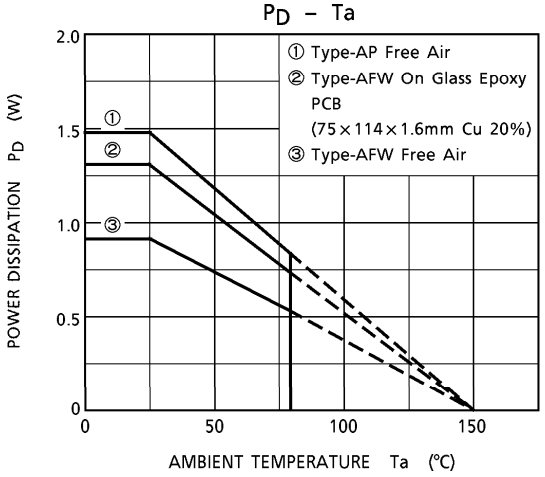



$h_{FE}$ – $I_{OUT}$




$h_{FE}$ – $I_{OUT}$

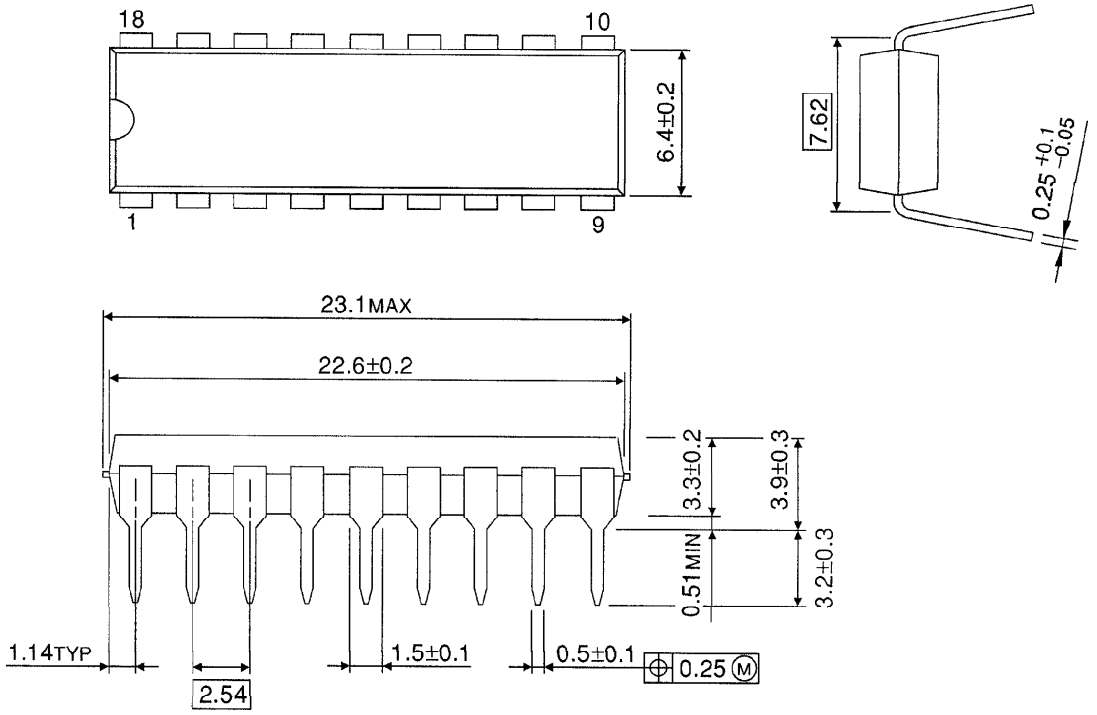



$P_D$ – Ta
① Type-AP Free Air
② Type-AFW On Glass Epoxy PCB
(75×114×1.6mm Cu 20%)
③ Type-AFW Free Air
POWER DISSIPATION $P_D$ (W)
2.0
1.5
1.0
0.5
0
①
②
③
0
50
100
150
AMBIENT TEMPERATURE Ta (°C)

**OUTLINE DRAWING**

DIP18-P-300-2.54F

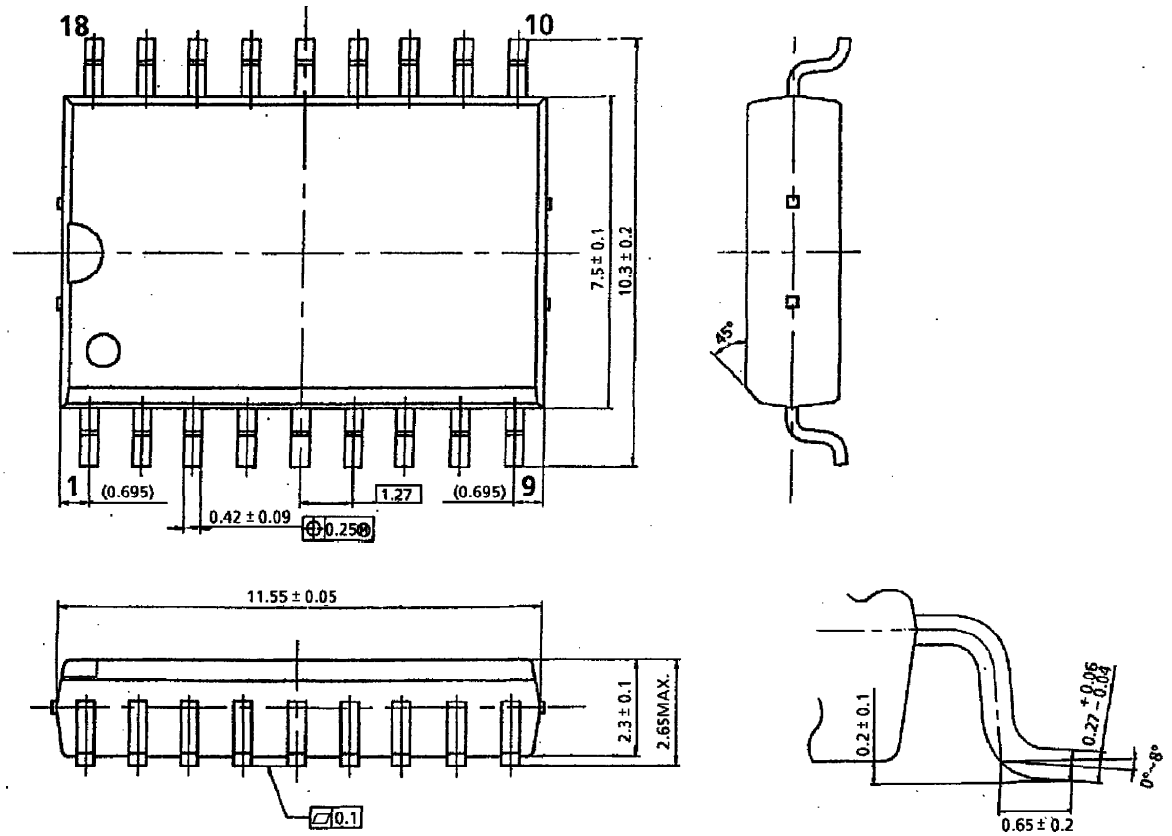
Unit : mm




Weight : 1.478g (Typ.)

**OUTLINE DRAWING**

SOL18-P-300-1.27 Unit : mm




Weight : 0.48g (Typ.)