

TOSHIBA BIPOLAR DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

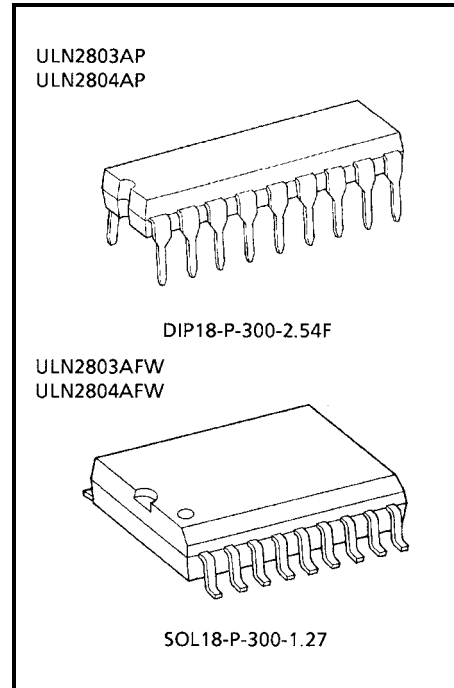
## ULN2803AP,ULN2803AFW,ULN2804AP,ULN2804AFW (Manufactured by Toshiba Malaysia)

### 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

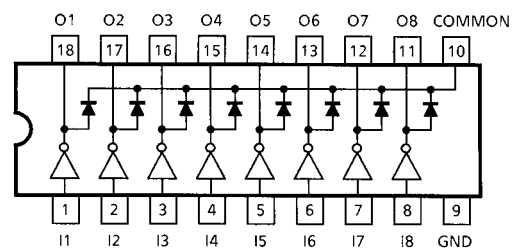
- Output current (single output)  
500 mA (Max.)
- High sustaining voltage output  
50 V (Min.)
- Output clamp diodes
- Inputs compatible with various types of logic.
- Package Type-AP : DIP-18pin
- Package Type-AFW : SOL-18pin



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

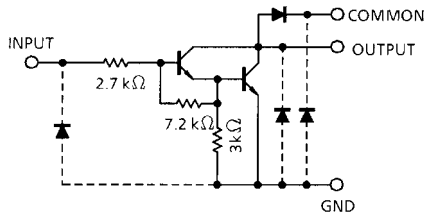
| TYPE            | INPUT BASE RESISTOR | DESIGNATION       |
|-----------------|---------------------|-------------------|
| ULN2803AP / AFW | 2.7 k $\Omega$      | TTL, 5 V CMOS     |
| ULN2804AP / AFW | 10.5 k $\Omega$     | 6~15 V PMOS, CMOS |

### PIN CONNECTION (TOP VIEW)

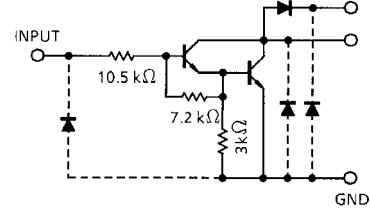


## SCHEMATICS (EACH DRIVER)

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 × 1.6 mm 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> = 25 ms, Duty = 10%,<br>8 Circuits | 0   | —    | 347  | mA /<br>ch |
|                              |                    |                       | T <sub>pw</sub> = 25 ms, Duty = 50%,<br>8 Circuits | 0   | —    | 123  |            |
|                              | AFW                |                       | T <sub>pw</sub> = 25 ms, Duty = 10%,<br>8 Circuits | 0   | —    | 268  |            |
|                              |                    |                       | T <sub>pw</sub> = 25 ms, 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 Current  |                    | I <sub>F</sub>        |                                                    | —   | —    | 400  | mA         |
| Power Dissipation            | AP                 | P <sub>D</sub>        | Ta = 85°C                                          | —   | —    | 0.76 | W          |
|                              | AFW                |                       | Ta = 85°C (Note)                                   | —   | —    | 0.48 |            |

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

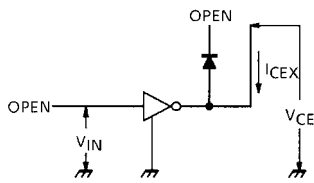
## ELECTRICAL CHARACTERISTICS (Ta = 25°C)

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

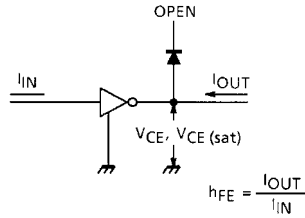
Note: V<sub>R</sub> = V<sub>R</sub> MAX.

## TEST CIRCUIT

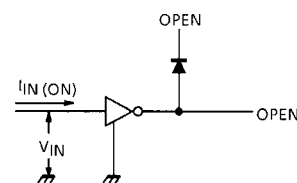
### 1. $I_{CEX}$



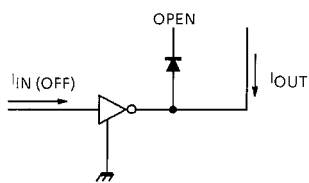
### 2. $V_{CE(sat)}$ , $h_{FE}$



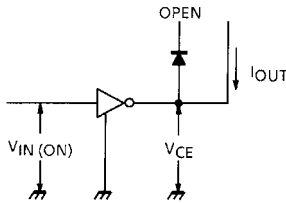
### 3. $I_{IN(ON)}$



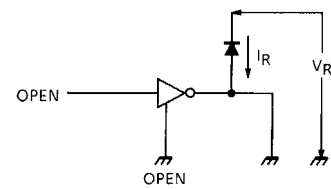
### 4. $I_{IN(OFF)}$



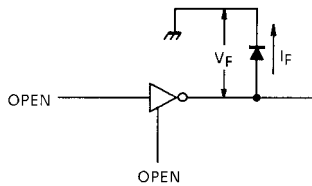
### 5. $V_{IN(ON)}$



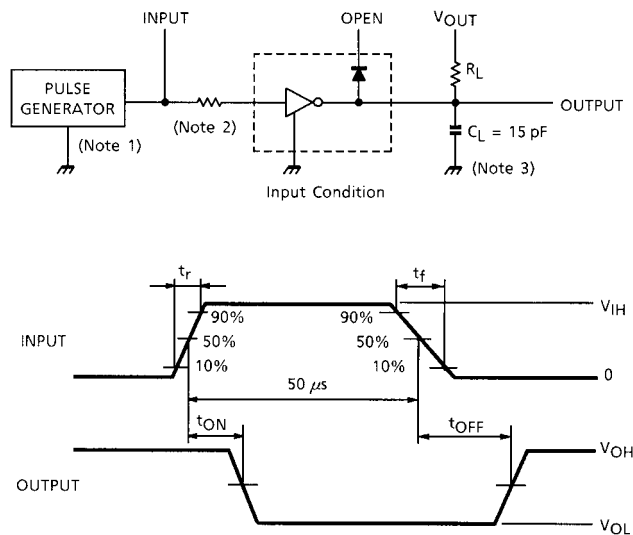
### 6. $I_R$



### 7. $V_F$



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



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

Note 2: See below.

### INPUT CONDITION

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

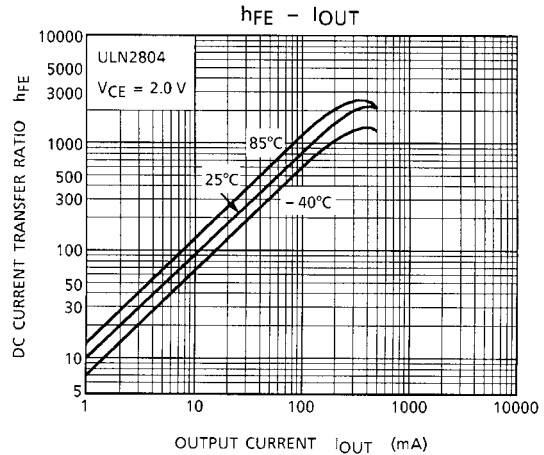
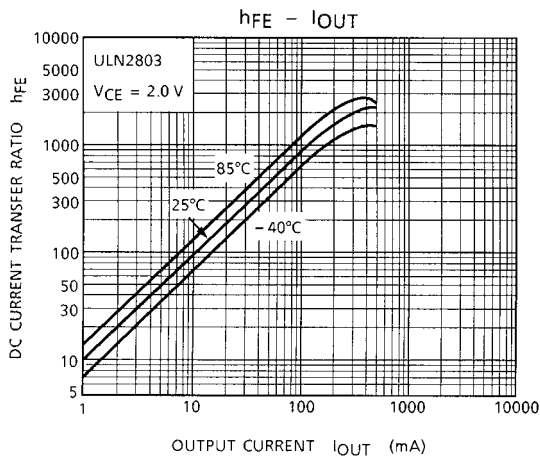
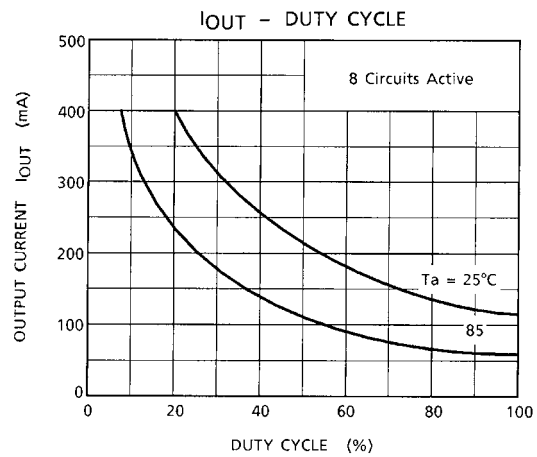
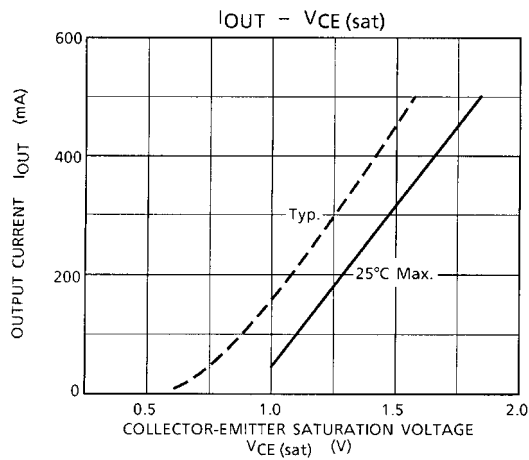
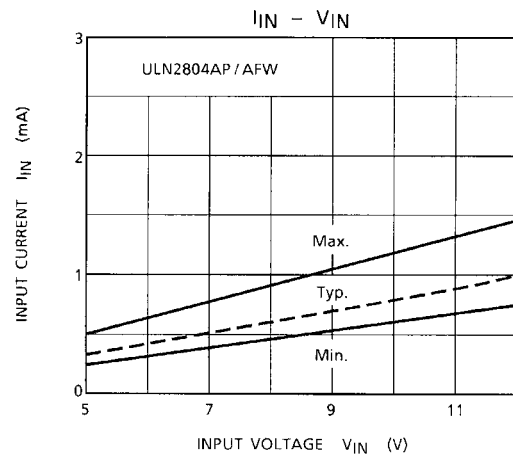
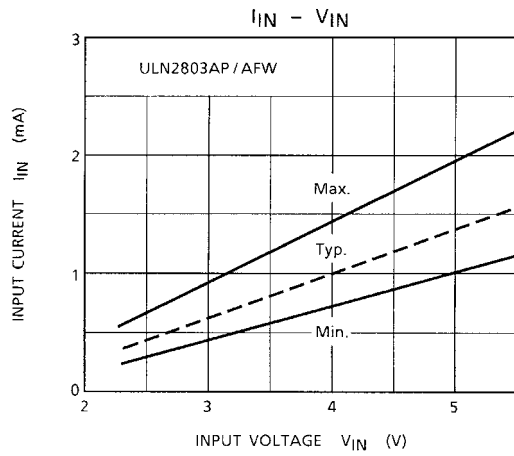
Note 3:  $C_L$  includes probe and jig capacitance

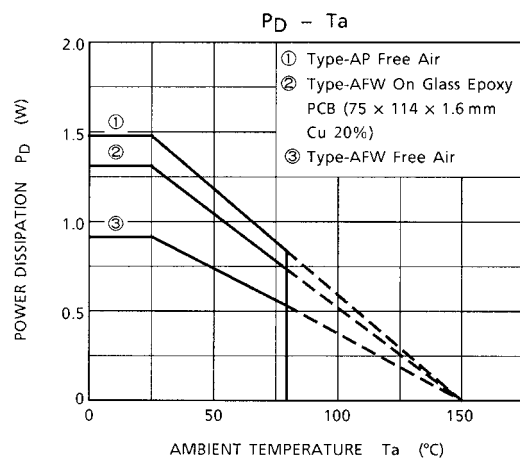
## PRECAUTIONS for USING

This IC does not integrate protection circuits such as overcurrent and overvoltage protectors.

Thus, if excess current or voltage is applied to the IC, the IC may be damaged. Please design the IC so that excess current or voltage will not be applied to the IC.

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.

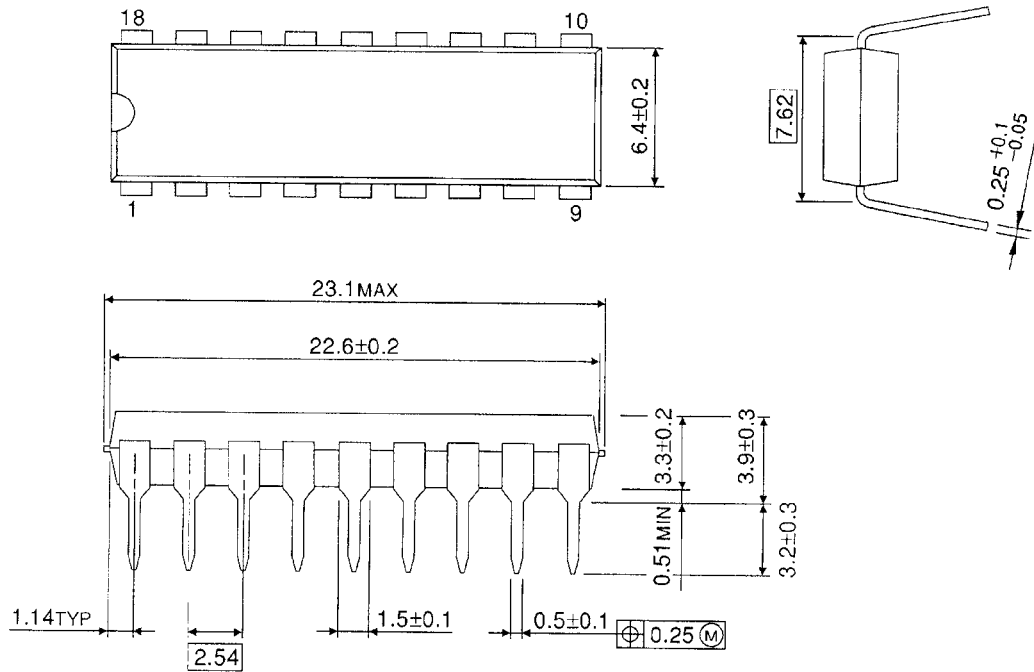




## PACKAGE DIMENSIONS

DIP18-P-300-2.54F

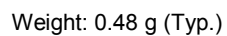
Unit: mm



Weight: 1.478 g (Typ.)

SOL18-P-300-1.27

Unit: mm



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030619EBA

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