TOSHIBA Bipolar Digital Integrated Circuit Silicon Monolithic

# ULN2803APG,ULN2803AFWG,ULN2804APG,ULN2804AFWG (Manufactured by Toshiba Malaysia)

#### 8ch Darlington Sink Driver

The ULN2803APG / AFWG Series are high-voltage, high-current darlington drivers comprised of eight NPN darlington pairs.

All units feature integral clamp diodes for switching inductive loads.

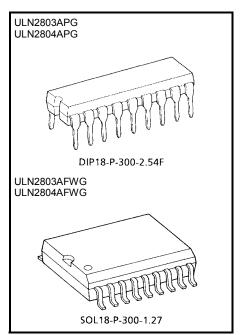
Applications include relay, hammer, lamp and display (LED) drivers.

The suffix (G) appended to the part number represents a Lead (Pb)-Free product.

#### **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-APG : DIP-18pinPackage Type-AFWG : SOL-18pin

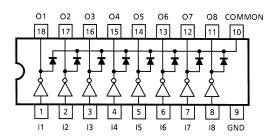


Weight

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

#### Pin Connection (top view)

Туре	Input Base Resistor	Designation
ULN2803APG / AFWG	2.7 kΩ	TTL, 5 V CMOS
ULN2804APG / AFWG	10.5 kΩ	6~15 V PMOS, CMOS

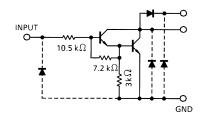


# Schematics (each driver)

ULN2803APG / AFWG

# OCOMMON 2.7 kΩ 7.2 kΩ GND

### ULN2804APG / AFWG



Note: The input and output parasitic diodes cannot be used as clamp diodes.

# Absolute Maximum Ratings (Ta = 25°C)

Characteristic		Symbol	Rating	Unit	
Output sustaining voltage		V <sub>CE</sub> (SUS)	-0.5~50	V	
Output current		lout	500	mA / ch	
Input voltage		V <sub>IN</sub>	-0.5~30	V	
Clamp diode reverse voltage		V <sub>R</sub>	50	V	
Clamp diode forward current		I <sub>F</sub>	500	mA	
Power dissipation	APG	D_	1.47	W	
	AFWG	P <sub>D</sub>	0.92 / 1.31 (Note)	VV	
Operating temperature		T <sub>opr</sub>	-40~85	°C	
Storage temperature		T <sub>stg</sub>	-55~150	°C	

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

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# Recommended Operating Conditions (Ta = -40-85°C)

Characteristic		Symbol	Test Condition	Min	Тур.	Max	Unit	
Output sustaining vo	ltage	V <sub>CE</sub> (SUS)		0 — 5		50	V	
Output current	400		T <sub>pw</sub> = 25 ms, Duty = 10%, 8 Circuits	0	_	347	mA / ch	
	APG		T <sub>pw</sub> = 25 ms, Duty = 50%, 8 Circuits	0	_	123		
	AFWG	Гоит	T <sub>pw</sub> = 25 ms, Duty = 10%, 8 Circuits	0	_	268		
			T <sub>pw</sub> = 25 ms, Duty = 50%, 8 Circuits	0	_	90		
Input voltage		V <sub>IN</sub>		0	_	30	V	
Input voltage	ULN2803A	V		3.5	_	30	V	
(Output on)	ULN2804A	V <sub>IN (ON)</sub>		8	_	30	V	
Clamp diode reverse voltage		V <sub>R</sub>		_	_	50	V	
Clamp diode forward current		lF		_	_	400	mA	
Dower dissination	APG	D-	Ta = 85°C	_	_	0.76	w	
Power dissipation	AFWG	- P <sub>D</sub>	Ta = 85°C (Note)	_	_	0.48	] *v	

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



# Electrical Characteristics (Ta = 25°C)

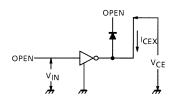
Cł	naracteristic	Symbol	Test Cir- Cuit	Test Condition		Min	Тур.	Max	Unit
Output leakage current		I <sub>CEX</sub>	1	V <sub>CE</sub> = 50 V	Ta = 25°C	_	_	50	μA
				V <sub>CE</sub> = 50 V	Ta = 85°C	_	_	100	
	ULN2804A			V <sub>CE</sub> = 50 V	V <sub>IN</sub> = 1 V	_	_	500	
		VCE (sat)	2	I <sub>OUT</sub> = 350 mA,	I <sub>IN</sub> = 500 μA	_	1.3	1.6	
Collector-emit	tter saturation voltage			I <sub>OUT</sub> = 200 mA, I <sub>IN</sub> = 350 μA I <sub>OUT</sub> = 100 mA, I <sub>IN</sub> = 250 μA		_	1.1	1.3	V
						_	0.9	1.1	
	ULN2803A			V <sub>IN</sub> = 3.85 V		_	0.93	1.35	
Input current	ULN2804A	I <sub>IN (ON)</sub>	2	V <sub>IN</sub> = 5 V		_	0.35	0.5	mA
input current	ULN2804A			V <sub>IN</sub> = 12 V		_	1.0	1.45	
		I <sub>IN (OFF)</sub>	4	I <sub>OUT</sub> = 500 μA, Ta = 85°C		50	65	_	μΑ
	ULN2803A	Vin (on)		V <sub>CE</sub> = 2 V, I <sub>OUT</sub> = 200 mA		_	_	2.4	V
			5	V <sub>CE</sub> = 2 V, I <sub>OUT</sub> = 250 mA		_	_	2.7	
				$V_{CE}$ = 2 V, $I_{OUT}$ = 300 mA $V_{CE}$ = 2 V, $I_{OUT}$ = 125 mA $V_{CE}$ = 2 V, $I_{OUT}$ = 200 mA $V_{CE}$ = 2 V, $I_{OUT}$ = 275 mA $V_{CE}$ = 2 V, $I_{OUT}$ = 350 mA		_	_	3.0	
Input voltage (Output on)	ULN2804A					_	_	5.0	
						_	_	6.0	
						_	_	7.0	
						_	_	8.0	
DC current tra	DC current transfer ratio		2	V <sub>CE</sub> = 2 V, I <sub>OU</sub>	<sub>T</sub> = 350 mA	1000	_	_	
Clamp diods r	overse current		6	Ta = 25°C	(Note)	_	_	50	
Clamp diode reverse current		I <sub>R</sub>	0	Ta = 85°C	(Note)	_	_	100	μA
Clamp diode for	np diode forward voltage $V_F$ 7 $I_F$ = 350 mA			_	_	2.0	V		
Input capacita	nce	e 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 R <sub>L</sub> = 125 Ω, V <sub>OUT</sub> = 50 V		_	0.1	_	- µs
Turn-off delay	1	toff	0			_	0.2	_	

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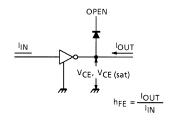
Note:  $V_R = V_R MAX$ .

# **Test Circuit**

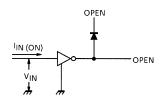
# 1. I<sub>CEX</sub>



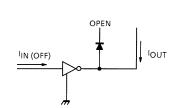
# 2. V<sub>CE (sat),</sub> h<sub>FE</sub>



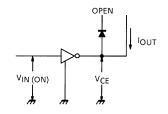
# 3. I<sub>IN (ON)</sub>



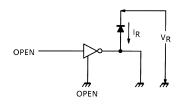
# 4. I<sub>IN (OFF)</sub>



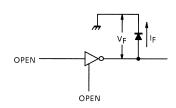
# 5. V<sub>IN (ON)</sub>



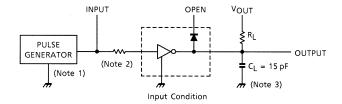
# 6. I<sub>R</sub>

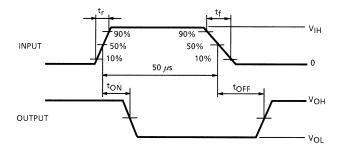


# 7. V<sub>F</sub>



### 8. ton, toff





Note 1: Pulse Width 50 µs, Duty Cycle 10%

Output Impedance 50  $\Omega$ ,  $t_r \le 5$  ns,  $t_f \le 10$  ns

Note 2: See below.

Input Condition

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Type Number	R1	$V_{IH}$						
ULN2803A	0Ω	3 V						
ULN2804A	0Ω	8 V						

Note 3: C<sub>L</sub> includes probe and jig capacitance

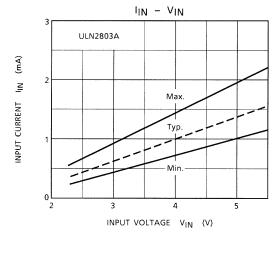
## **Precautions for Using**

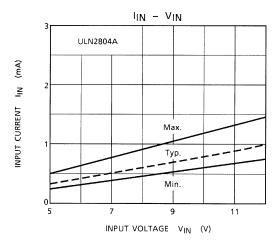
This IC does not integrate protection circuits such as overcurrent and overvoltage protectors.

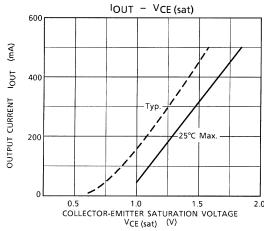
Thus, if excess current or voltage is applied to the IC, the IC may be damaged. Please design the IC so that excess current or voltage will not be applied to the IC.

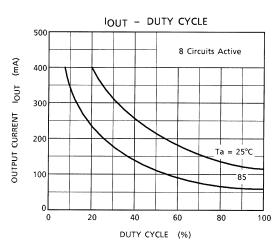
Utmost care is necessary in the design of the output line, COMMON and GND line since IC may be destroyed due to short–circuit between outputs, air contamination fault, or fault by improper grounding.

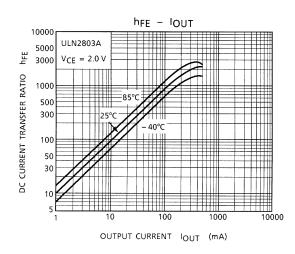
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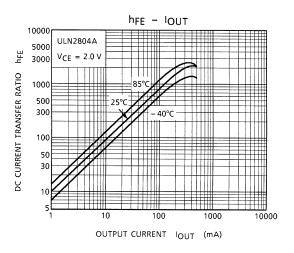


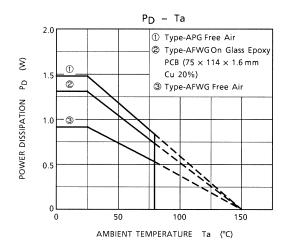






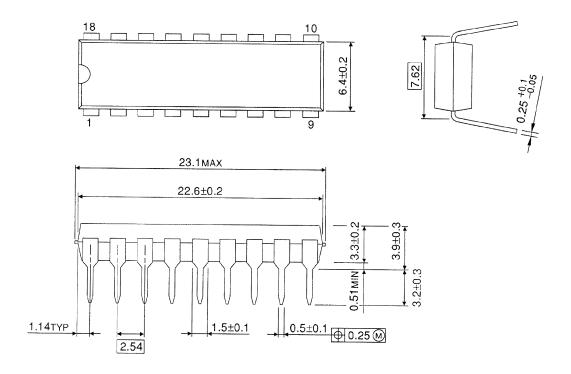






# **Package Dimensions**

DIP18-P-300-2.54F Unit: mm

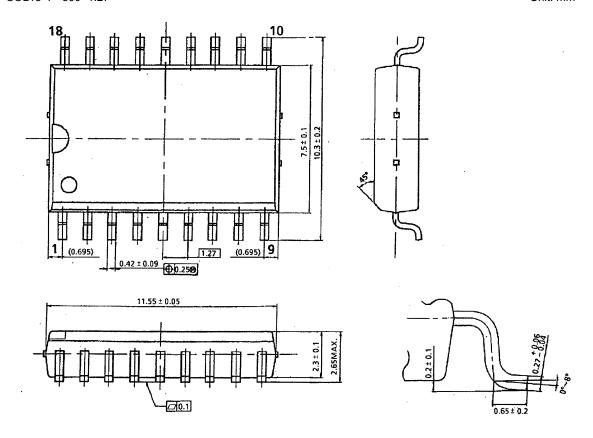


Weight: 1.478 g (Typ.)

# **Package Dimensions**

SOL18-P-300-1.27

Unit: mm



Weight: 0.48 g (Typ.)

#### **Notes on Contents**

#### 1. Schematics

The schematics may be simplified or some parts of them may be omitted for explanatory purposes.

#### 2. Absolute Maximum Ratings

The absolute maximum ratings of a semiconductor device are a set of specified parameter values that must not be exceeded during operation, even for an instant.

If any of these ratings are exceeded during operation, the electrical characteristics of the device may be irreparably altered and the reliability and lifetime of the device can no longer be guaranteed.

Moreover, any exceeding of the ratings during operation may cause breakdown, damage and/or degradation in other equipment. Applications using the device should be designed so that no absolute maximum rating will ever be exceeded under any operating conditions.

Before using, creating and/or producing designs, refer to and comply with the precautions and conditions set forth in this document.

#### 3. Recommended Operating Conditions

The values of the conditions are applied within the range of the operating temperature and not guaranteed.

#### 4. AC Characteristics

AC characteristics that mean turn-on and turn-off time are targeted design values and not guaranteed.

#### 5. Application Circuits

The application circuits shown in this document are provided for reference purposes only. Thorough evaluation is required, especially in the phase of mass production design.

In furnishing these examples of application circuits, Toshiba does not grant the use of any industrial property rights.

#### 6. Graphics Characteristics

Graphics characteristics are reference ones and not guaranteed.

#### Handling of the IC

Ensure that the product is installed correctly to prevent breakdown, damage and/or degradation in the product or equipment.

About solderability, following conditions were confirmed

- Solderability
  - (1) Use of Sn-37Pb solder Bath
    - solder bath temperature = 230°C
    - · dipping time = 5 seconds
    - · the number of times = once
    - · use of R-type flux
  - (2) Use of Sn-3.0Ag-0.5Cu solder Bath
    - · solder bath temperature = 245°C
    - · dipping time = 5 seconds
    - · the number of times = once
    - · use of R-type flux

#### RESTRICTIONS ON PRODUCT USE

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