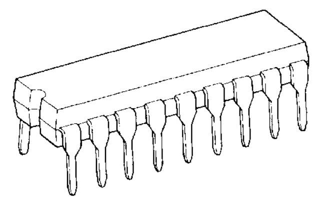
TOSHIBA Bipolar Digital Integrated Circuit Silicon Monolithic

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

8ch Darlington Sink Driver

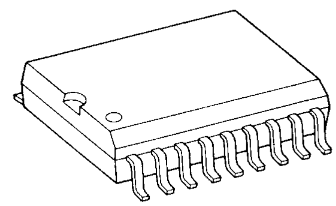
The ULN2803APG / AFWG Series are high−voltage, high−current darlington drivers comprised of eight NPN darlington pairs.
All units feature integral clamp diodes for switching inductive loads.
Applications include relay, hammer, lamp and display (LED) drivers.
The suffix (G) appended to the part number represents a Lead (Pb)-Free product.

ULN2803APG
ULN2804APG



DIP18-P-300-2.54F

ULN2803AFWG
ULN2804AFWG



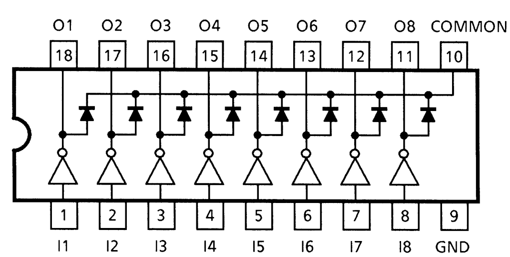
SOL18-P-300-1.27

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

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−18pin
- Package Type−AFWG : SOL−18pin

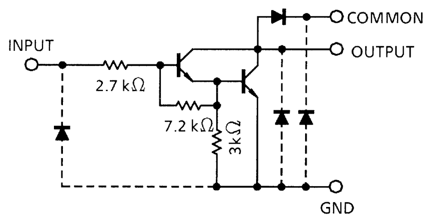
Pin Connection (top view)



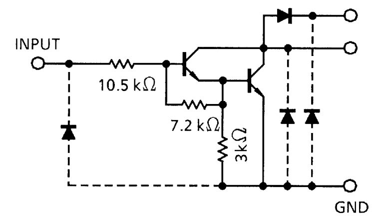
Type	Input Base Resistor	Designation
ULN2803APG / AFWG	2.7 kΩ	TTL, 5 V CMOS
ULN2804APG / AFWG	10.5 kΩ	6~15 V PMOS, CMOS

Schematics (each driver)

ULN2803APG / AFWG



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		$V_{CE\,(SUS)}$	−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	APG	P_D	1.47	W
	AFWG		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		$V_{CE\ (SUS)}$		0	—	50	V
Output current	APG	I_{OUT}	T_{pw} = 25 ms, Duty = 10%, 8 Circuits	0	—	347	mA / ch
			T_{pw} = 25 ms, Duty = 50%, 8 Circuits	0	—	123	
	AFWG		T_{pw} = 25 ms, Duty = 10%, 8 Circuits	0	—	268	
			T_{pw} = 25 ms, Duty = 50%, 8 Circuits	0	—	90	
Input voltage		V_{IN}		0	—	30	V
Input voltage (Output on)	ULN2803A	$V_{IN\ (ON)}$		3.5	—	30	V
	ULN2804A			8	—	30	
Clamp diode reverse voltage		V_R		—	—	50	V
Clamp diode forward current		I_F		—	—	400	mA
Power dissipation	APG	P_D	Ta = 85°C	—	—	0.76	W
	AFWG		Ta = 85°C (Note)	—	—	0.48	

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

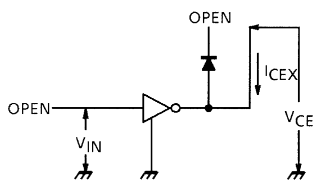
Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Cir−Cuit	Test Condition		Min	Typ.	Max	Unit
Output leakage current		I_{CEX}	1	V_{CE} = 50 V	Ta = 25°C	—	—	50	μA
				V_{CE} = 50 V	Ta = 85°C	—	—	100	
	ULN2804A			V_{CE} = 50 V	V_{IN} = 1 V	—	—	500	
Collector−emitter saturation voltage		VCE (sat)	2	I_{OUT} = 350 mA, I_{IN} = 500 μA		—	1.3	1.6	V
				I_{OUT} = 200 mA, I_{IN} = 350 μA		—	1.1	1.3	
				I_{OUT} = 100 mA, I_{IN} = 250 μA		—	0.9	1.1	
Input current	ULN2803A	$I_{IN\ (ON)}$	2	V_{IN} = 3.85 V		—	0.93	1.35	mA
	ULN2804A			V_{IN} = 5 V		—	0.35	0.5	
				V_{IN} = 12 V		—	1.0	1.45	
		$I_{IN\ (OFF)}$	4	I_{OUT} = 500 μA, Ta = 85°C		50	65	—	μA
Input voltage (Output on)	ULN2803A	$V_{IN\ (ON)}$	5	V_{CE} = 2 V, I_{OUT} = 200 mA		—	—	2.4	V
				V_{CE} = 2 V, I_{OUT} = 250 mA		—	—	2.7	
				V_{CE} = 2 V, I_{OUT} = 300 mA		—	—	3.0	
	ULN2804A			V_{CE} = 2 V, I_{OUT} = 125 mA		—	—	5.0	
				V_{CE} = 2 V, I_{OUT} = 200 mA		—	—	6.0	
				V_{CE} = 2 V, I_{OUT} = 275 mA		—	—	7.0	
				V_{CE} = 2 V, I_{OUT} = 350 mA		—	—	8.0	
DC current transfer ratio		h_{FE}	2	V_{CE} = 2 V, I_{OUT} = 350 mA		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 = 350 mA		—	—	2.0	V
Input capacitance		C_{IN}	—			—	15	—	pF
Turn−on delay		t_{ON}	8	R_L = 125 Ω, V_{OUT} = 50 V		—	0.1	—	μs
Turn−off delay		t_{OFF}		R_L = 125 Ω, V_{OUT} = 50 V		—	0.2	—	

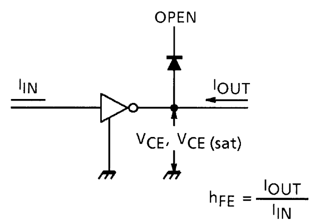
Note: $V_R = V_R$ MAX.

Test Circuit

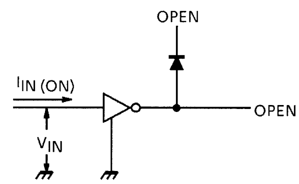
1. I_{CEX}



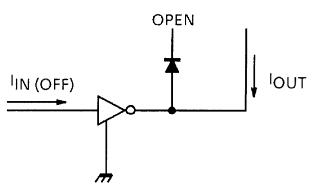
2. $V_{CE\ (sat)}$, h_{FE}



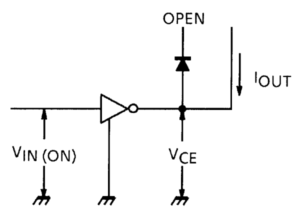
3. $I_{IN\ (ON)}$



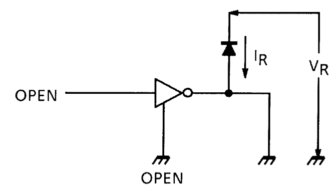
4. $I_{IN\ (OFF)}$



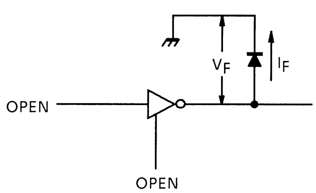
5. $V_{IN\ (ON)}$



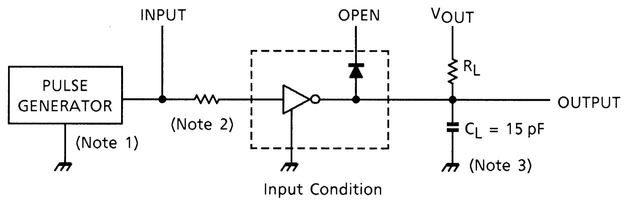
6. I_R

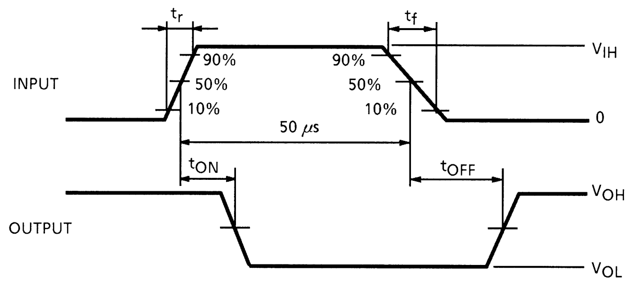


7. V_F



8. t_{ON}, t_{OFF}





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

Note 2: See below.

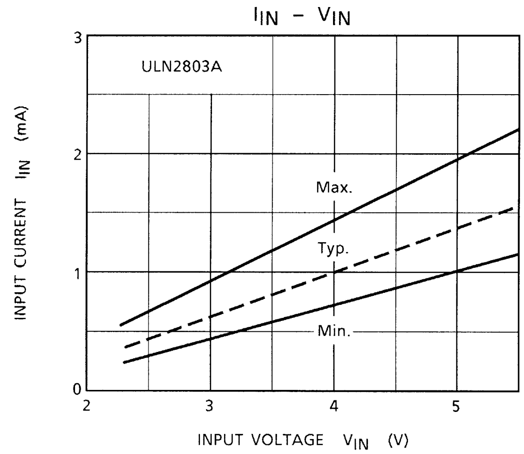
Input Condition

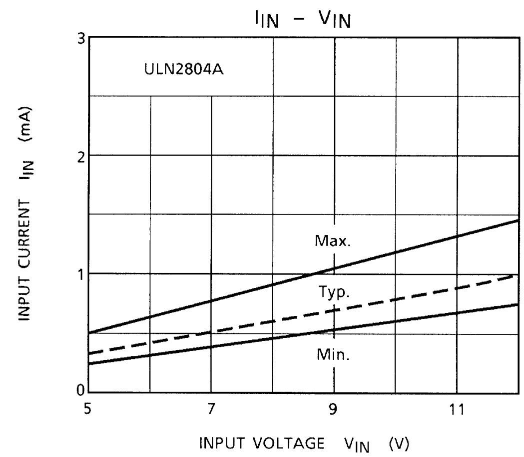
Type Number	R1	V_{IH}
ULN2803A	0Ω	3 V
ULN2804A	0Ω	8 V

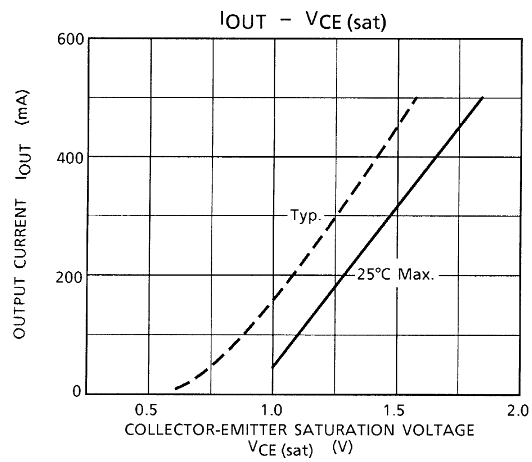
Note 3: C_L includes probe and jig capacitance

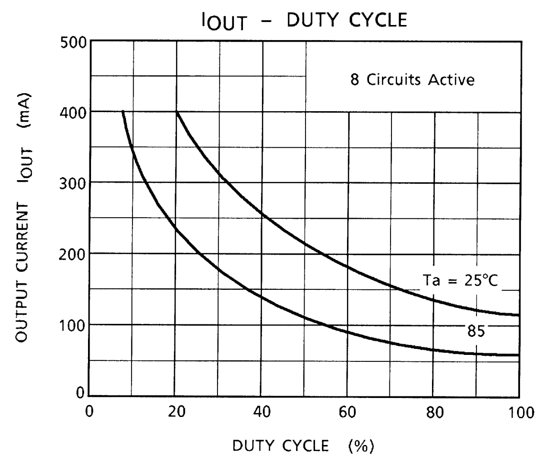
Precautions for Using

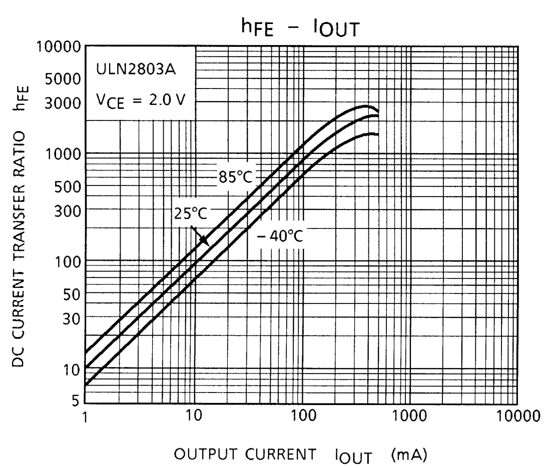
This IC does not integrate protection circuits such as overcurrent and overvoltage protectors.
Thus, if excess current or voltage is applied to the IC, the IC may be damaged. Please design the IC so that excess current or voltage will not be applied to the IC.
Utmost care is necessary in the design of 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.

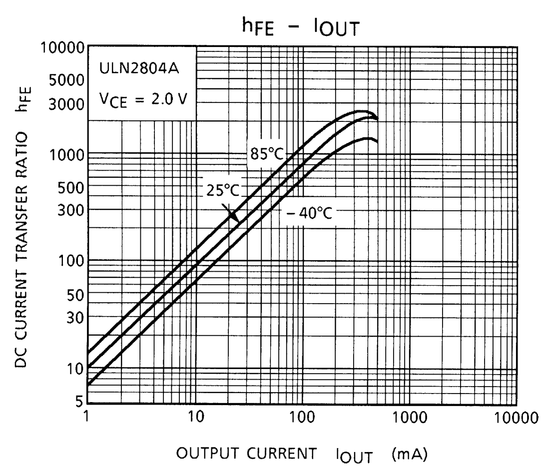

IIN – VIN
ULN2803A
Max.
Typ.
Min.
INPUT CURRENT IIN (mA)
INPUT VOLTAGE VIN (V)
0
1
2
3
2
3
4
5

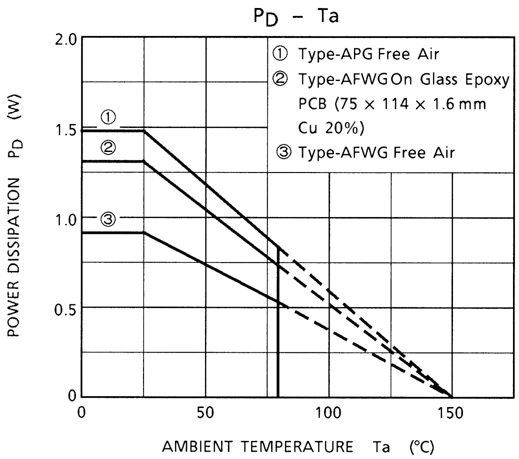

IIN – VIN
ULN2804A
Max.
Typ.
Min.
INPUT CURRENT IIN (mA)
INPUT VOLTAGE VIN (V)
0
1
2
3
5
7
9
11


IOUT – VCE (sat)
Typ.
25°C Max.
OUTPUT CURRENT IOUT (mA)
COLLECTOR-EMITTER SATURATION VOLTAGE
VCE (sat) (V)
0
200
400
600
0.5
1.0
1.5
2.0


IOUT – DUTY CYCLE
8 Circuits Active
Ta = 25°C
85
OUTPUT CURRENT IOUT (mA)
DUTY CYCLE (%)
0
100
200
300
400
500
0
20
40
60
80
100

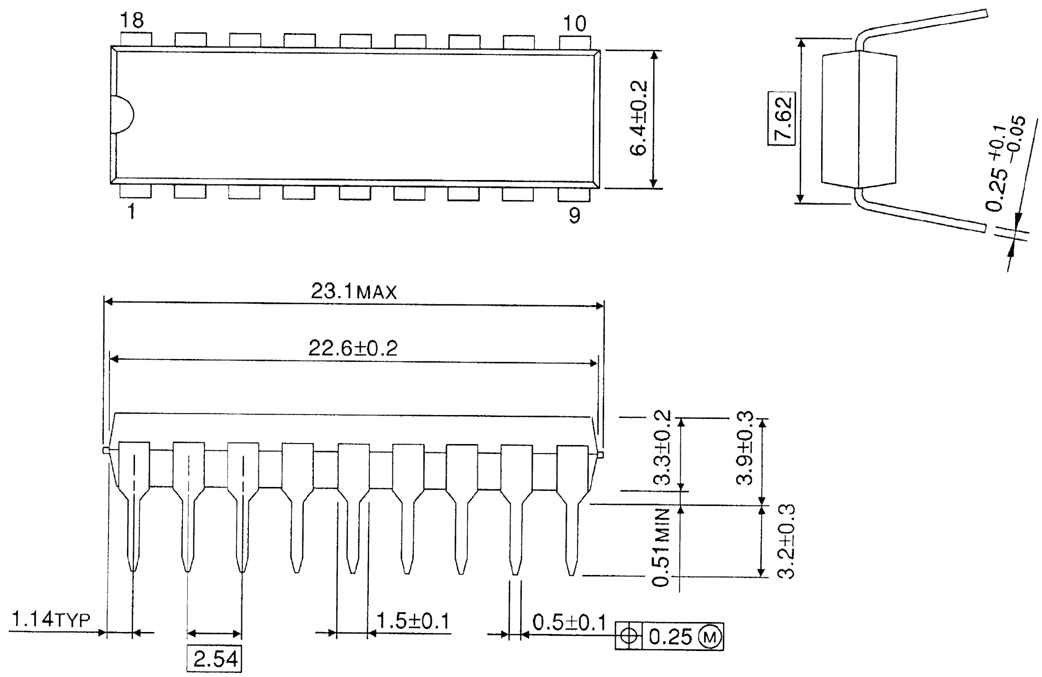

hFE – IOUT
ULN2803A
VCE = 2.0 V
85°C
25°C
– 40°C
DC CURRENT TRANSFER RATIO hFE
OUTPUT CURRENT IOUT (mA)
10000
5000
3000
1000
500
300
100
50
30
10
5
1
10
100
1000
10000


hFE – IOUT
ULN2804A
VCE = 2.0 V
85°C
25°C
– 40°C
DC CURRENT TRANSFER RATIO hFE
OUTPUT CURRENT IOUT (mA)
10000
5000
3000
1000
500
300
100
50
30
10
5
1
10
100
1000
10000


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

Package Dimensions

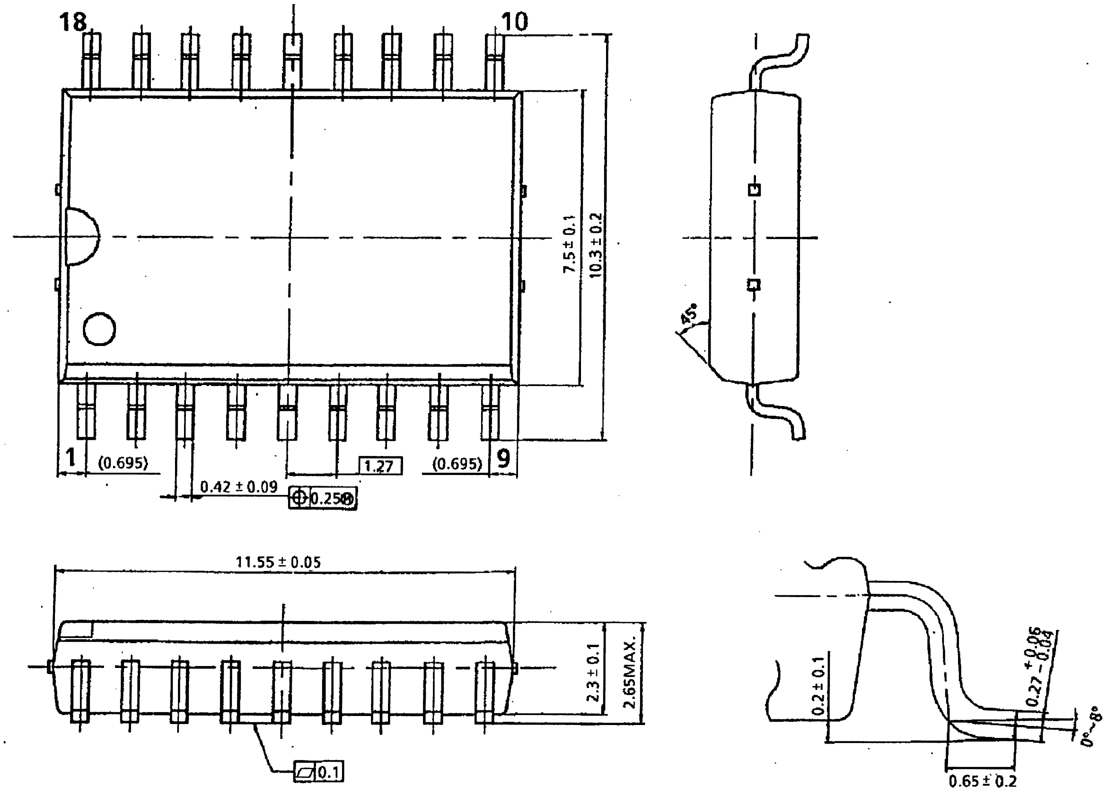
DIP18−P−300−2.54F Unit: mm



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