

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

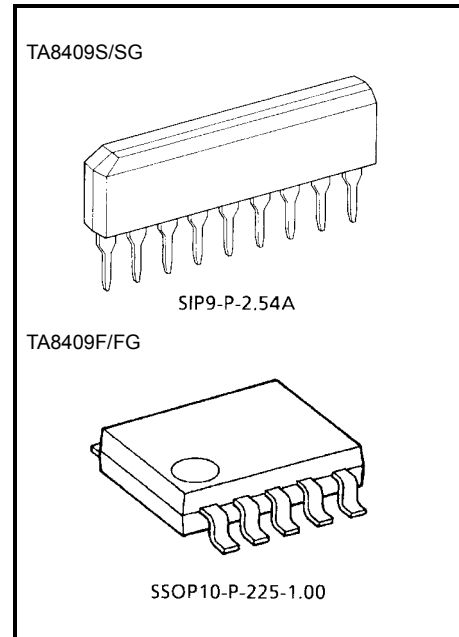
# TA8409S/SG, TA8409F/FG

## Bridge Driver

The TA8409S/SG and TA8409F/FG are bridge drivers with output voltage control.

### Features

- Modes available (CW/CCW/STOP/BRAKE)
- Output current up to 0.4 A (AVE) and 1.0 A (PEAK)
- Wide range of operating voltages  
 $V_{CC} \text{ (opr.)} = 4.5 \text{ to } 20 \text{ V}$   
 $V_S \text{ (opr.)} = 0 \text{ to } 20 \text{ V}$   
 $V_{ref} \text{ (opr.)} = 0 \text{ to } 20 \text{ V} \quad (V_{ref} \leq V_S)$
- Built-in thermal shutdown
- Standby mode available (STOP MODE)
- Hysteresis for all inputs.



Weight

SIP9-P-2.54A: 0.92 g (typ.)

SSOP10-P-225-1.00: 0.09 g (typ.)

TA8409FG/SG:

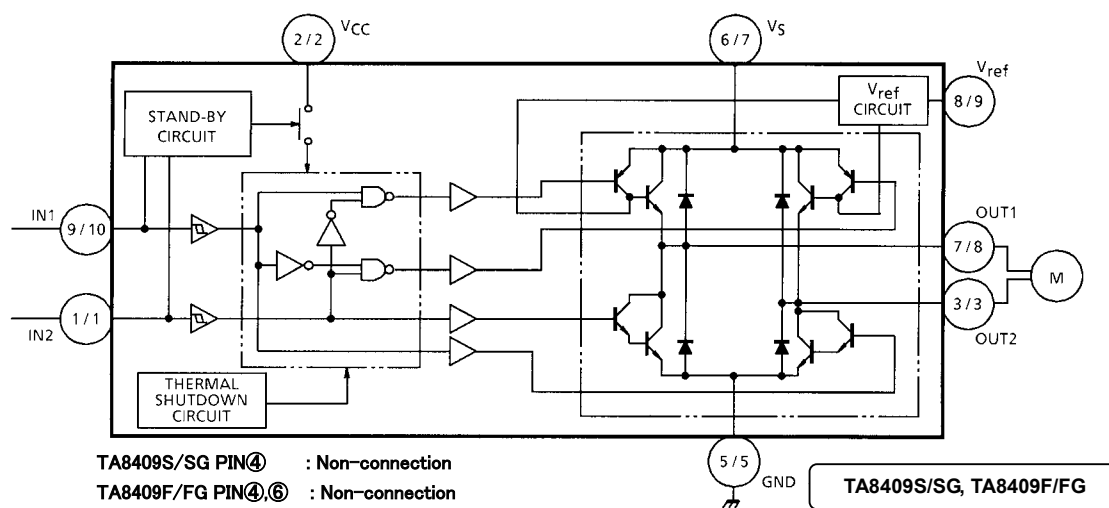
The TA8409FG/SG is a Pb-free product.

The following conditions apply to solderability:

\*Solderability

1. Use of Sn-63Pb solder bath
  - \*solder bath temperature = 230°C
  - \*dipping time = 5 seconds
  - \*number of times = once
  - \*use of R-type flux
2. Use of Sn-3.0 Ag-0.5 Cu solder bath
  - \*solder bath temperature = 245°C
  - \*dipping time = 5 seconds
  - \*the number of times = once
  - \*use of R-type flux

## Block Diagram



## Pin Function

### TA8409S/SG

| Pin No. | Symbol           | Functional Description                         |
|---------|------------------|--|
| 1       | IN2              | Input terminal                                 |
| 2       | V <sub>CC</sub>  | Supply voltage terminal for logic              |
| 3       | OUT2             | Output terminal                                |
| 4       | NC               | Non-connection                                 |
| 5       | GND              | GND terminal                                   |
| 6       | V <sub>S</sub>   | Supply voltage terminal for motor driver       |
| 7       | OUT1             | Output terminal                                |
| 8       | V <sub>ref</sub> | Reference voltage terminal for control circuit |
| 9       | IN1              | Input terminal                                 |

### TA8409F/FG

| Pin No. | Symbol           | Functional Description                          |
|---------|------------------|---|
| 1       | IN2              | Input terminal                                  |
| 2       | V <sub>CC</sub>  | Supply voltage terminal for logic               |
| 3       | OUT2             | Output terminal                                 |
| 4       | NC               | Non-connection                                  |
| 5       | GND              | GND terminal                                    |
| 6       | NC               | Non-connection                                  |
| 7       | V <sub>S</sub>   | Supply voltage terminal for motor driver        |
| 8       | OUT1             | Output terminal                                 |
| 9       | V <sub>ref</sub> | Reference voltage terminal for control circuit. |
| 10      | IN1              | Input terminal                                  |

## Function

| Input |      | Output |      | Mode   |
|-------|------|--------|------|--------|
| IN 1  | IN 2 | OUT1   | OUT2 | MB     |
| 0     | 0    | ∞      | ∞    | STOP   |
| 1     | 0    | H      | L    | CW/CCW |
| 0     | 1    | L      | H    | CCW/CW |
| 1     | 1    | L      | L    | BRAKE  |

∞: High impedance

Note: Inputs are all high active type.

**Maximum Ratings (Ta = 25°C)**

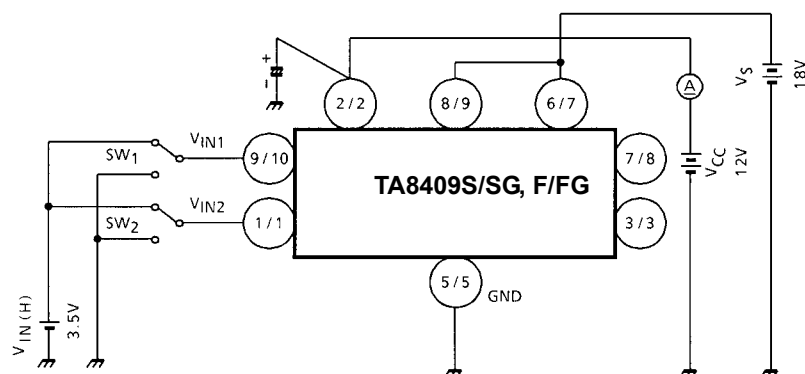
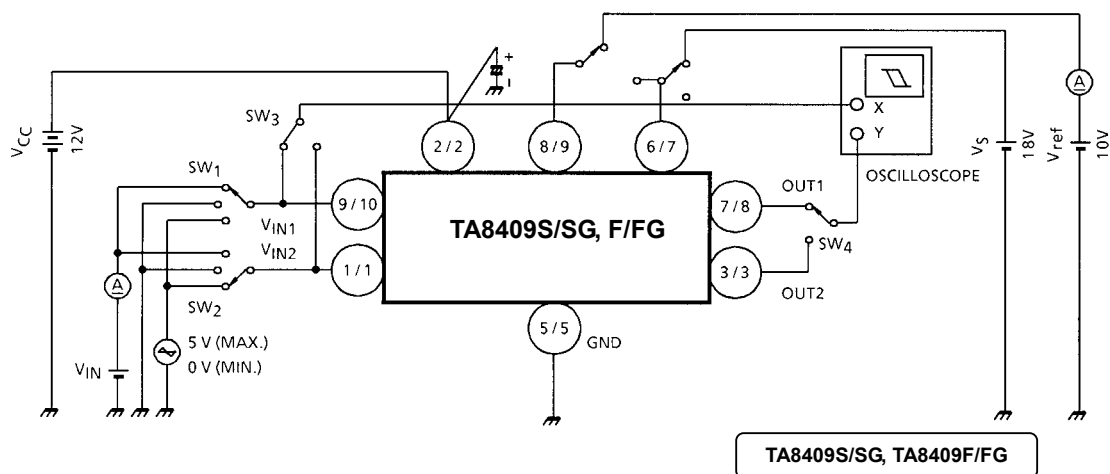
| Characteristics       |            | Symbol                | Rating       | Unit |
|-----------------------|------------|-----------------------|--------------|------|
| Supply voltage        |            | V <sub>CC</sub>       | 25           | V    |
| Motor drive voltage   |            | V <sub>S</sub>        | 25           | V    |
| Reference voltage     |            | V <sub>ref</sub>      | 25           | V    |
| Output current        | PEAK       | I <sub>O</sub> (PEAK) | 1.0          | A    |
|                       | AVE.       | I <sub>O</sub> (AVE.) | 0.4          |      |
| Power dissipation     | TA8409F/FG | P <sub>D</sub>        | 0.735 (Note) | W    |
|                       | TA8409S/SG |                       | 0.95         |      |
| Operating temperature |            | T <sub>opr</sub>      | -30 to 75    | °C   |
| Storage temperature   |            | T <sub>stg</sub>      | -55 to 150   | °C   |

Note: This rating is obtained when the device is mounted on a 50 × 50 × 1.6 mm PCB with a Cu area of 30% or more.

**Electrical Characteristics (Ta = 25°C, V<sub>CC</sub> = 12 V, V<sub>S</sub> = 18 V)**

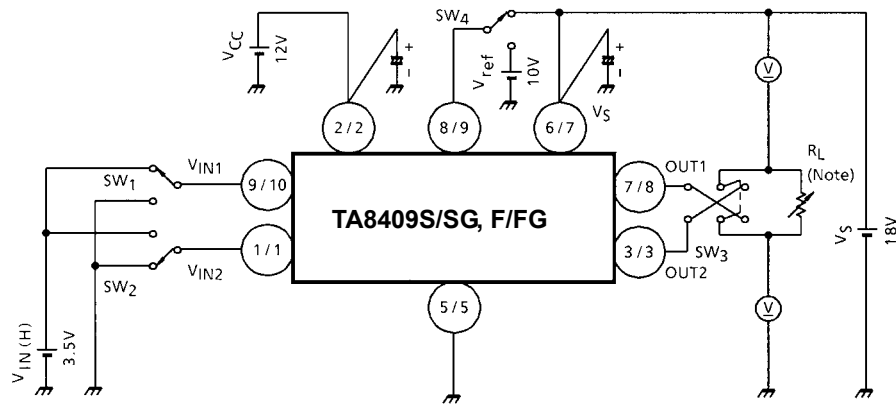
| Characteristics                   |            | Symbol                | Test Circuit | Test Condition  | Min  | Typ. | Max  | Unit |
|-----------------------------------|------------|-----------------------|--------------|---|------|------|------|------|
| Supply current                    |            | I <sub>CC1</sub>      | 1            | Output OFF, CW/CCW mode   | —    | 10.0 | 15.0 | mA   |
|                                   |            | I <sub>CC2</sub>      | 1            | Output OFF, STOP mode   | —    | 0    | 50   | μA   |
|                                   |            | I <sub>CC3</sub>      | 1            | Output OFF, BREAK mode  | —    | 6.5  | 10.0 | mA   |
| Input operating voltage           | 1 (High)   | V <sub>IN1</sub>      | 2            | T <sub>j</sub> = 25°C IN1, 2  | 3.5  | —    | 5.5  | V    |
|                                   | 2 (Low)    | V <sub>IN2</sub>      | 2            | T <sub>j</sub> = 25°C IN1, 2  | GND  | —    | 0.8  |      |
| Input current                     |            | I <sub>IN</sub>       | 2            | Sink mode, V <sub>IN</sub> = 3.5 V  | —    | 3    | 10   | μA   |
| Input hysteresis voltage          |            | ΔV <sub>T</sub>       | 2            | —   | —    | 0.7  | —    | V    |
| Saturation voltage                | Upper side | V <sub>SAT U-1</sub>  | 3            | V <sub>ref</sub> = V <sub>S</sub> , V <sub>OUT</sub> -V <sub>S</sub> measure<br>I <sub>O</sub> = 0.2 A, CW/CCW mode | —    | 0.9  | 1.2  | V    |
|                                   | Lower side | V <sub>SAT L-1</sub>  | 3            | V <sub>ref</sub> = V <sub>S</sub> , V <sub>OUT</sub> -GND measure<br>I <sub>O</sub> = 0.2 A, CW/CCW mode            | —    | 0.8  | 1.2  |      |
|                                   | Upper side | V <sub>SAT U-2</sub>  | 3            | V <sub>ref</sub> = V <sub>S</sub> , V <sub>OUT</sub> -V <sub>S</sub> measure<br>I <sub>O</sub> = 0.4 A, CW/CCW mode | —    | 1.0  | 1.35 |      |
|                                   | Lower side | V <sub>SAT L-2</sub>  | 3            | V <sub>ref</sub> = V <sub>S</sub> , V <sub>OUT</sub> -GND measure<br>I <sub>O</sub> = 0.4 A, CW/CCW mode            | —    | 0.9  | 1.35 |      |
| Output voltage                    |            | V <sub>SAT U-1'</sub> | 3            | V <sub>ref</sub> = 10 V, V <sub>OUT</sub> -GND measure<br>I <sub>O</sub> = 0.2 A                                    | 10.4 | 11.2 | 12.2 | V    |
|                                   |            | V <sub>SAT U-2'</sub> | 3            | V <sub>ref</sub> = 10 V, V <sub>OUT</sub> -GND measure<br>I <sub>O</sub> = 0.4 A                                    | —    | 10.9 | —    |      |
| Output transistor leakage current | Upper side | I <sub>LU</sub>       | 4            | V <sub>L</sub> = 25 V   | —    | —    | 50   | μA   |
|                                   | Lower side | I <sub>LL</sub>       | 4            | V <sub>L</sub> = 25 V   | —    | —    | 50   |      |
| Diode forward voltage             | Upper side | V <sub>F U-1</sub>    | 5            | I <sub>F</sub> = 0.4 A  | —    | 1.5  | —    | V    |
|                                   | Lower side | V <sub>F L-1</sub>    | 5            | I <sub>F</sub> = 0.4 A  | —    | 0.9  | —    |      |
| Reference current                 |            | I <sub>ref</sub>      | 2            | V <sub>ref</sub> = 10 V, source mode  | —    | 20   | 40   | μA   |

**lcc1, lcc2, lcc3**

 $V_{IN1}, V_{IN2}, I_{IN}, \Delta V_T, I_{ref}$ 

## Test Circuit 3

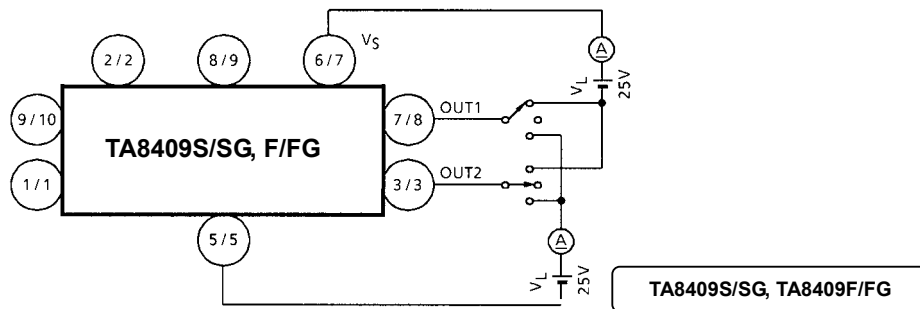
$V_{SAT\ U-1, 2}$ ,  $V_{SAT\ L-1, 2}$ ,  $V_{SAT\ U-1', 2'}$



Note: Calibrate  $I_{OUT}$  to 0.2/0.4 A by  $R_L$ .

## Test Circuit 4

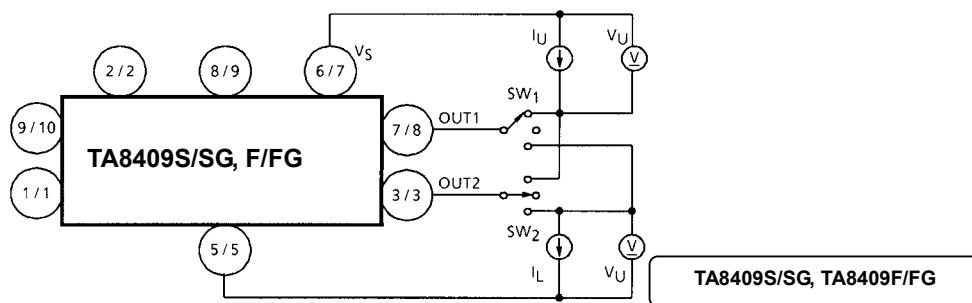
$I_{L\ U, L}$



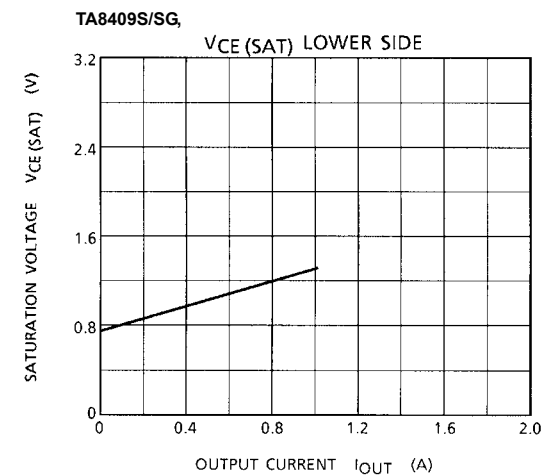
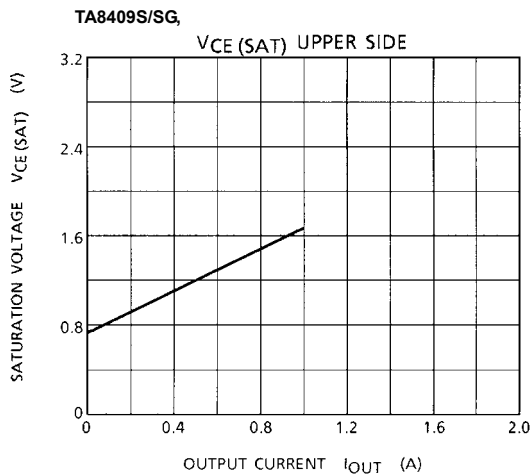
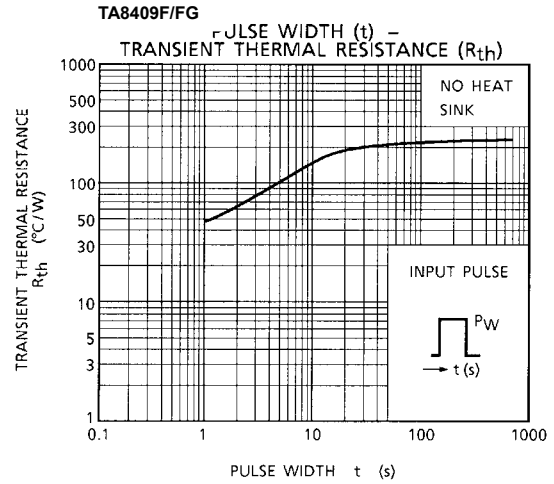
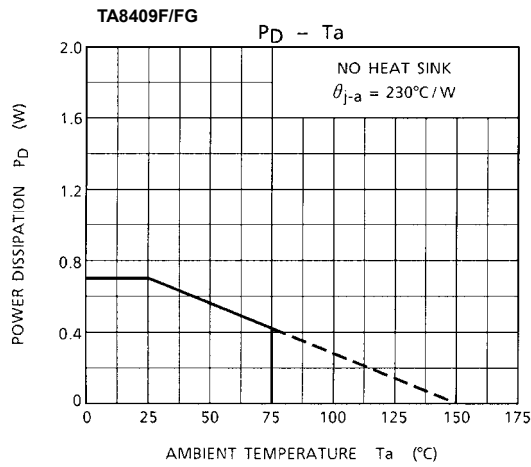
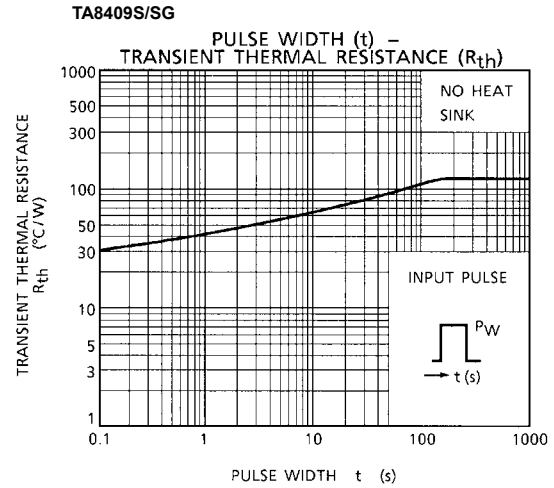
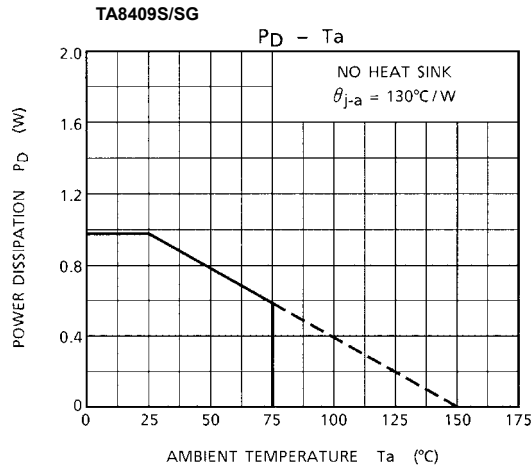
TA8409S/SG, TA8409F/FG

## Test Circuit 5

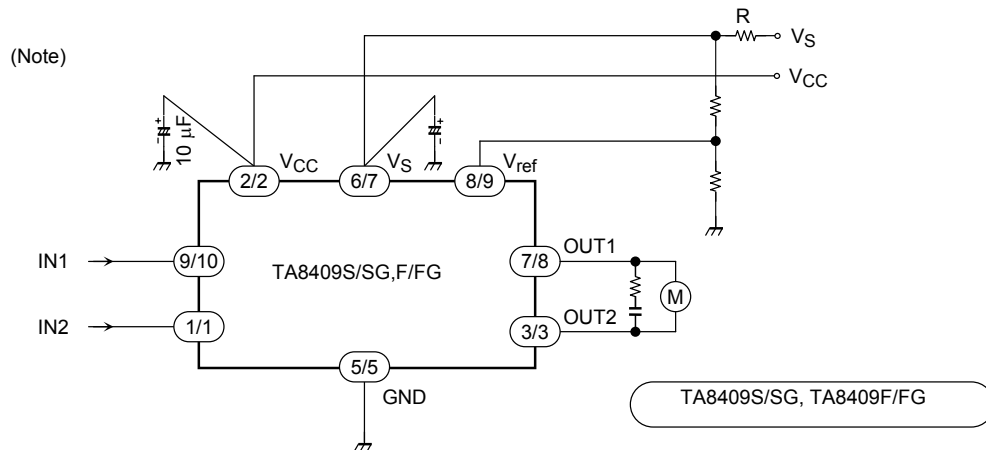
$V_F\ U-1, 2$ ,  $V_F\ L-1, 2$



TA8409S/SG, TA8409F/FG



## Application Circuit



Note 1: Attach a bypass capacitor to the  $V_S$  pin as required.

Note 2: Utmost care is necessary in the design of the output line,  $V_S$ ,  $V_{CC}$  and GND line since the IC may be destroyed by short-circuits between outputs, by supply faults, or by ground faults. Bear in mind also that mounting the IC in the reverse orientation may also cause a breakdown.

Note 3: Switching the inputs may allow a pass-through current to flow. Keep the IC device in STOP mode (for at least 100  $\mu$ s) during the switching. Alternatively, insert a current-limiting resistor R.

Note 4: Use a current-limiting resistor R or fuse for overcurrent protection.

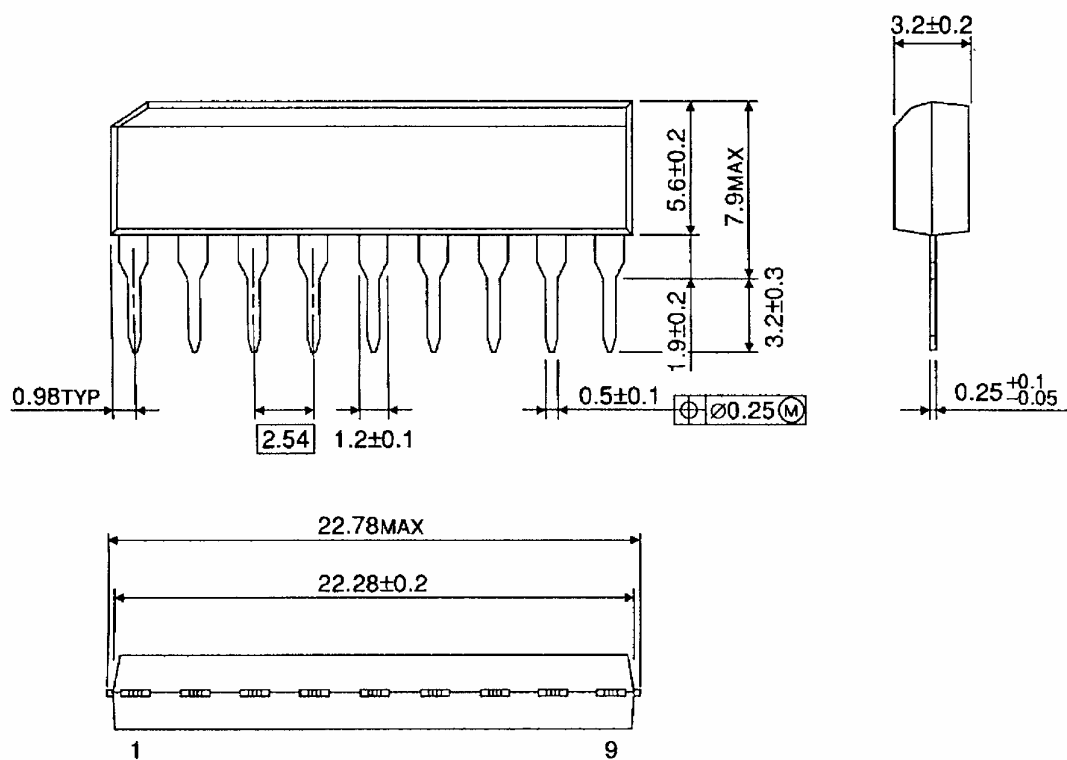
Note 5: When turning on the power for the IC device, apply  $V_S$  after  $V_{CC}$  (or  $V_{CC}$  and  $V_S$  simultaneously).  
When shutting off the power, drop  $V_S$  before  $V_{CC}$  (or  $V_S$  and  $V_{CC}$  simultaneously).  
When turning on the power ( $V_{CC}$ ), keep both inputs (IN1 and IN2) on a low level.



## Package Dimensions

SIP9-P-2.54A

Unit : mm

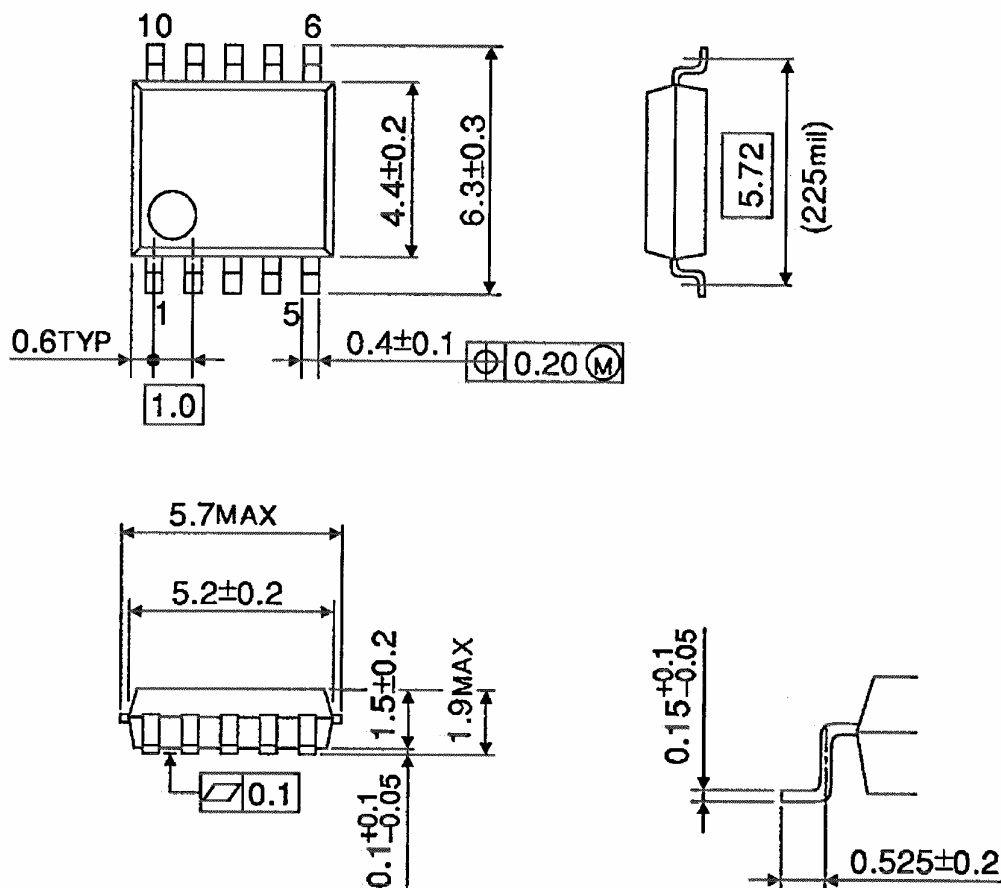


Weight: 0.92 g (typ.)

## Package Dimensions

SSOP10-P-225-1.00

Unit : mm



Weight: 0.09 g (typ.)

## Notes on Contents

### 1. Block Diagrams

Some of the functional blocks, circuits, or constants in the block diagrams may be omitted or simplified for explanatory purposes.

### 2. Equivalent Circuits

The equivalent circuit diagrams may be simplified or some parts of them may be omitted for purposes.

### 3. Timing Charts

Timing charts may be simplified for explanatory purposes.

### 4. Maximum Ratings

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

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

Moreover, these operations with exceeded ratings may cause breakdown, damage and/or degradation to other equipment. Applications using the device should be designed so that each maximum rating will never be exceeded in any operating conditions.

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

### 5. Application Circuits

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

Toshiba does not grant any license to any industrial property rights by providing these examples of application circuits.

### 6. Test Circuits

Components in the test circuits are only used to obtain and confirm the device characteristics. These components and circuits are not guaranteed to prevent malfunction or failure from occurring in the application equipment.

## About the handling of ICs

Install the product correctly to avoid breakdown, damage and/or degradation to the product or equipment.

## About over-current protection and heat protection circuits

These protection functions are intended to guard against certain output short circuits or other abnormal conditions with only temporary effect, and are not guaranteed to prevent the IC from being damaged.

These protection features may not be effective if the product is operated outside the guaranteed operating ranges, and some output short circuits may result in the IC being damaged.

The overcurrent protection feature is only intended to protect the IC from a temporary short circuit.

Short circuits of longer duration may damage the IC through undue stress. The systems must be configured so that any overcurrent condition will be eliminated as soon as possible.

### Counter-electromotive force

When the motor reverses or stops, counter-electromotive force in the motor may influence the current to flow to the power source. If the power source lacks sink capability, the IC power and output pins may exceed the rating. The counter-electromotive force of the motor varies depending on the conditions of use and the features of the motor.

Therefore ensure that there is no damage to the IC or problem in operation, and no error in or damage to peripheral circuits resulting from counter-electromotive force.

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