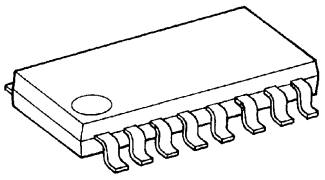
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA8401F/FG

Functional Bridge Driver

Features

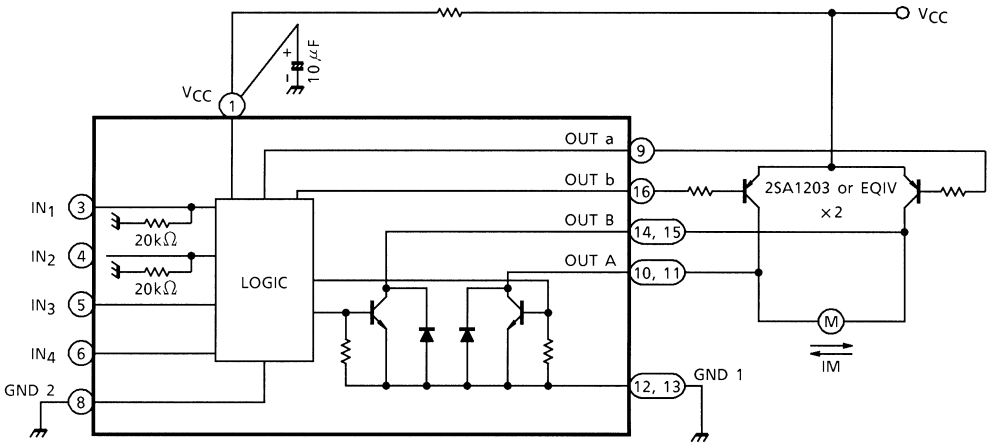
- Wide operating supply voltage range:
  V_{CC} (opr.) = 3.0~15 V
- Capsuled in a flat package (16-pin)
- Forward and reverse rotation, stop and brake modes are available by means of rotation control signals.
- High efficiency is obtained.
- Can be used as an interface driver.



SSOP16-P-225-1.00A

Weight: 0.14 g (typ.)

Block Diagram



The TA8401FG 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-3.0Ag-0.5Cu solder bath
   *solder bath temperature = 245°C
   *dipping time = 5 seconds
   *number of times = once
   *use of R-type flux

Pin Description

Pin No.	Symbol	Functional Description	
1	V_{CC}	Power supply voltage	
2	NC	No connection	
3	IN_1	Signal input terminal	Truth Table 1
4	IN_2	Signal input terminal	
5	IN_3	Signal input terminal	
6	IN_4	Signal input terminal	
7	NC	No connection	
8	GND 2	Logic GND terminal	
9	OUT a	Output a	
10	OUT A	Output A	
11	OUT A		
12	GND 1	Power GND terminal	
13	GND 1		
14	OUT B	Output B	
15	OUT B		
16	OUT b	Output b	

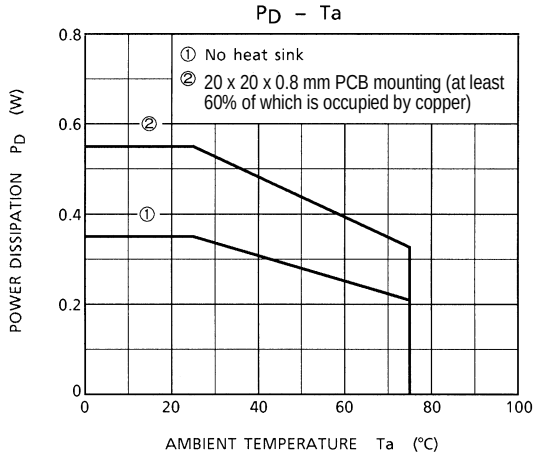
Functions

(1) Bridge Driver (Truth Table 1)

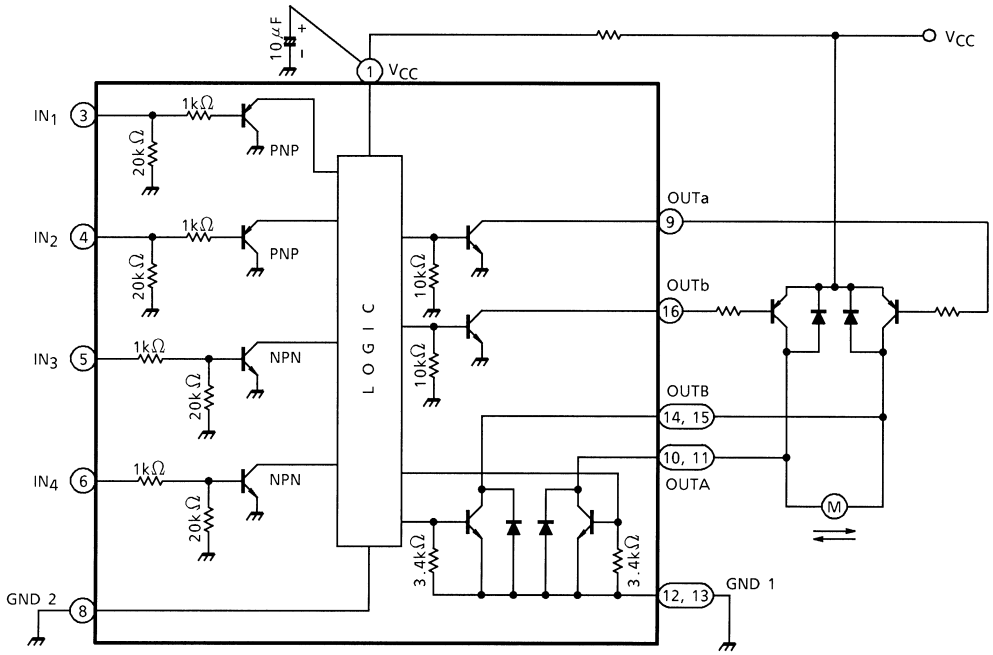
CONTROL	INPUT MODE				OUTPUT				OPERATING MODE	NOTE
	IN_1	IN_2	IN_3	IN_4	OUT A	OUT B	OUT a	OUT b		
2-input control	H	L	H	H	ON (−500 mA)	—	ON (−25 mA)	—	Forward Rotation	—
	L	H	H	H	—	ON (−500 mA)	—	ON (−25 mA)	Reverse Rotation	
	H	H	H	H	ON (−500 mA)	ON (−500 mA)	—	—	Brake	
	L	L	H	H	—	—	—	—	STOP	
1-input control	H	L	L	H	ON (−500 mA)	—	ON (−25 mA)	—	A ON	
	L	L	L	H	—	ON (−500 mA)	—	ON (−25 mA)	B ON	
	H / L	H	L	H	ON (−500 mA)	ON (−500 mA)	—	—	AB ON	HIGH 2.0 V (MIN)
	—	—	—	L	—	—	—	—	INHIBIT	LOW 0.3 V (MAX)

(2) Interface driver application

If IN_3 and IN_4 are connected to "HIGH", OUT A and OUT B can be used as interface driver outputs for each input.
(Connect OUT a and OUT b to GND)



Input-Output Circuit



Maximum Ratings (Ta = 25°C)

Characteristic	Symbol	Rating	Unit
Peak supply voltage	V_{CC}	18	V
Output current	$I_{O\ (AVE.)}$	0.5	A
Power dissipation	P_D	350 (Note 1)	mW
		550 (Note 2)	
Operating temperature	T_{opr}	−30~75	°C
Storage temperature	T_{stg}	−55~150	°C

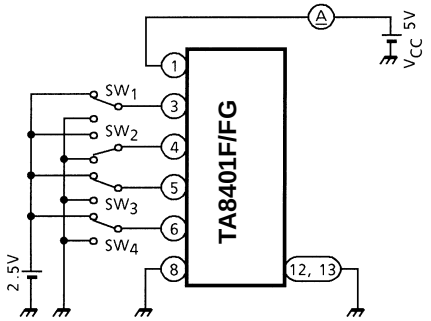
Note 1: No heat sink
Note 2: Mounted on a PCB (PCB area, 20 × 20 × 0.8 mm; cu area, over 60%)

Electric Characteristics
(unless otherwise specified, Ta = 25°C, V_{CC} = 5 V)

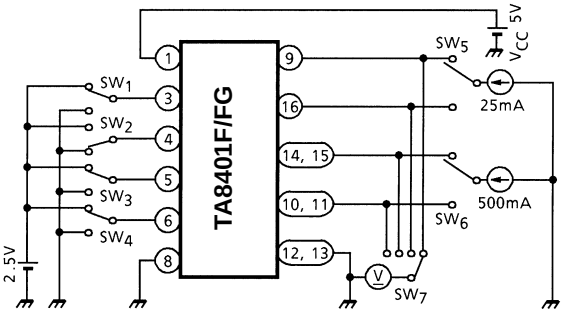
Characteristic		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Supply current		I_{CC1}	1	Output open CW / CCW mode	—	13	20	mA
		I_{CC2}	1	Output open stop mode	—	11	15	
		I_{CC3}	1	Output open brake mode	—	17	26	
		I_{CC4}	1	Inhibit (INPUT4 = "L")	—	2.4	7	
Output saturation voltage		V_{sat1}	2	I_{O1} = 500 mA, lower side (Output A, B)	—	0.3	0.5	V
		V_{sat2}	2	I_{O2} = 25 mA, upper side (Output a, b)	—	0.3	0.55	
Output TR leakage current		I_L	3	V_C = 15 V	—	—	50	μA
Input voltage	"H" Level	$V_{IN\ 1,\ 2\ (H)}$	—	—	2.0	—	V_{CC}	V
	"L" Level	$V_{IN\ 1,\ 2\ (L)}$	—	—	—	—	0.8	
Input current	"L" Level	$I_{IN1,\ 2}$	4	Input "L", V_{IN} = 0 V (source current)	—	—	20	μA
Input voltage	"H" Level	$V_{IN\ 3,\ 4\ (H)}$	—	—	1.0	—	V_{CC}	V
	"L" Level	$V_{IN\ 3,\ 4\ (L)}$	—	—	—	—	0.3	
Input current	"H" Level	$I_{IN3,\ 4}$	4	Input "H" (sink current) V_{IN} = 1 V	—	—	30	μA
Diode forward voltage		V_F	5	I_F = 0.5 A, V_{CC} = 0 V	—	1.3	—	V

Test Circuits

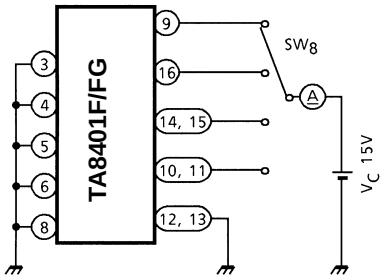
1. $I_{CC1, 2, 3, 4}$



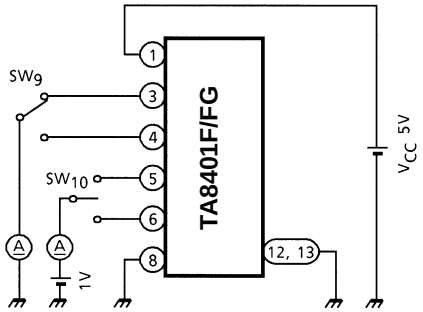
2. $V_{sat1, 2}$



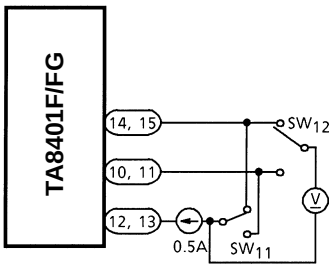
3. I_L



4. I_{IN}



5. V_F



Notes on Using the TA8401F/FG

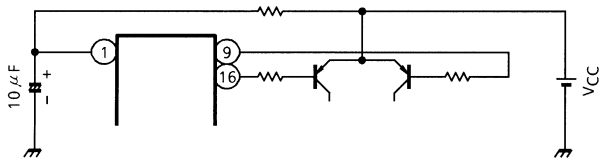
The TA8401F/FG functionable bridge driver is an IC specifically developed to control rotation switching in brush motors. This IC has been carefully designed and strengthened to withstand counter-electromotive force or startup rush current, which are problems often associated with driving brush motors.

However, as with other power ICs, application circuits must be designed not to apply surge voltage or excess current that exceeds the standard values. In addition, when designing PCBs, make sure the wiring pattern does not cause oscillation, which can result in equipment malfunction or destruction of the IC.

The following are notes on use of the TA8401F/FG. These should be reflected at the design stage.

(1) Power supply voltage

To avoid the motor current affecting the TA8401F/FG control-side power supply, we recommend you use two power supplies: an external transistor power supply, and a TA8401F/FG control-side power supply. However, when using a single power supply, connect as in the diagram below.



(2) Maximum voltage and current

The maximum supply voltage (pin 1) for the TA8401F/FG is 18 V. The operating supply voltage is in the range of 1.8~15 V. No voltage exceeding this range should be applied to pin 1.

The maximum current is 0.5 A (ave.) or 1.5 A (peak). The circuit should be designed so that rush current at startup does not exceed peak current, and average current during steady operation does not exceed 0.5 A.

(3) External diodes

As the block diagram shows, the TA8401F/FG has internal diodes.

The lower two diodes, which are the IC's internal parasitic diodes, have a relatively large capacitance. However, when a motor with a large reactance such as a core motor is driven, the upper two diodes may be damaged by the motor's counter-electromotive force. In such a case, connect external diodes in parallel. The lower diodes should not be subjected to high current. For brake operation, therefore, external diodes should be connected.

(4) PCB design

The following points concern the TA8401F/FG pattern design around the power supply line (pin 1) and the pattern design of the GND (pin 8, pin 12 / 13).

a) Ensure that the bypass capacitor between pin 1 and GND does not share impedance with other lines.
b) The GND line should not be shared by other circuits.
c) The capacitance of the bypass capacitor should be as large as possible.

(5) Oscillation remedies

To prevent noise from sparks when using brush motors, a capacitor may be connected between both pins.

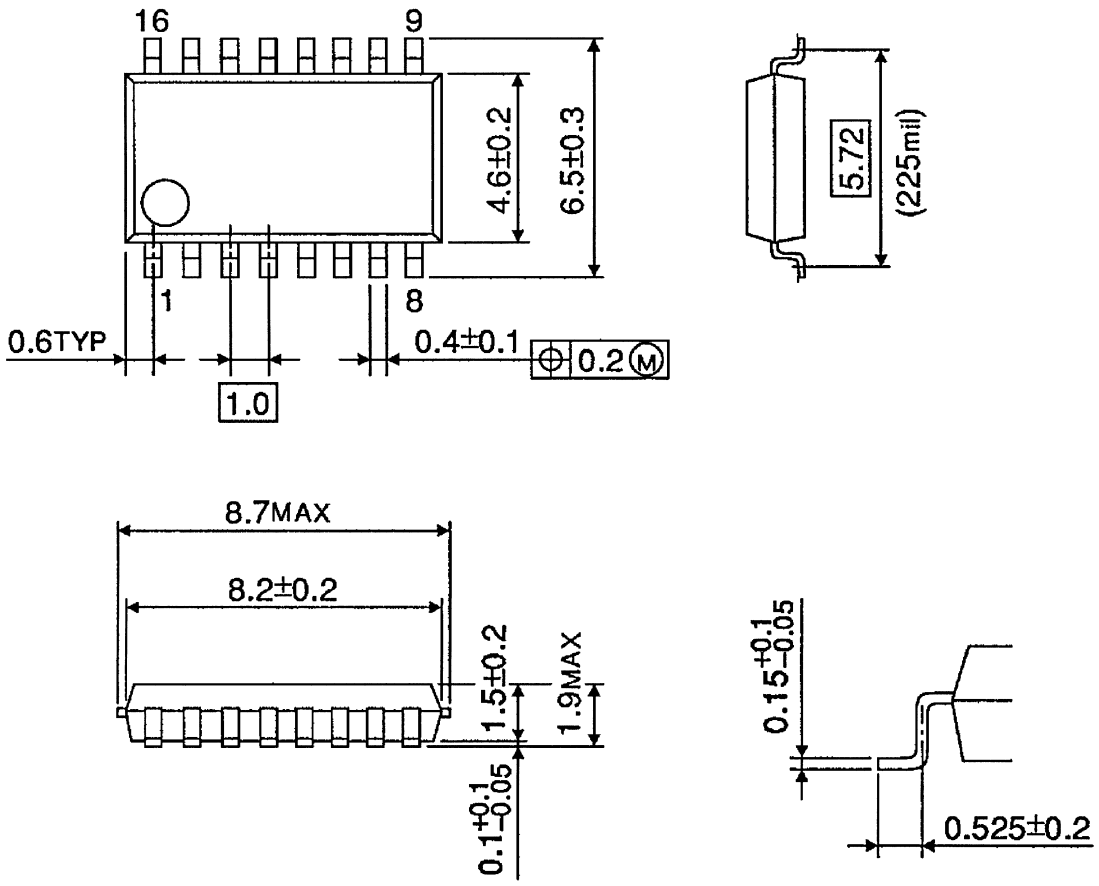
When using the TA8401F/FG, the capacitor is connected between outputs (pins 10 / 11 and pins 14 / 15. This may cause oscillation. Therefore avoid connecting the capacitor where possible. If connection is necessary to overcome noise, connect resistors in series as shown in the technical data.

The values for the capacitor and resistors must be determined according to the motor.

Note: Particular care is necessary in the design of the output, V_{CC} and GND lines since the IC may be destroyed due to short circuits between outputs, air contamination faults, or faults caused by improper grounding.

Package Dimensions

SSOP16−P−225−1.00A Unit: mm



Weight: 0.14 g (typ.)

Notes on Contents

1. Block Diagrams

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

2. Equivalent Circuits

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

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 used only 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.

Handling of ICs

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

Overcurrent 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. Ensure, therefore, that there is no error in or damage to the IC or peripheral circuits resulting from counter-electromotive force.

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