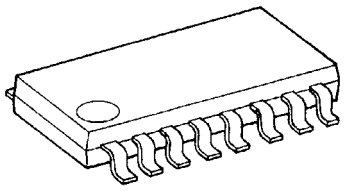
TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA8401F/FG

Functional Bridge Driver

Features

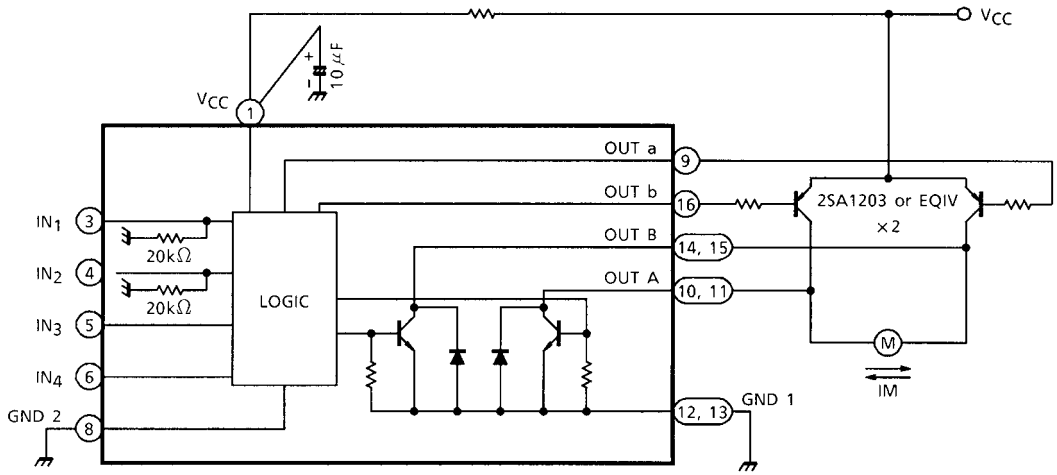
- Wide operating supply voltage range:
  V_{CC} (opr.) = 3.0~15 V
- Capsuled in a flat package (16-pin)
- Forward and reverse rotation, stop and brake modes are available by means of rotation control signals.
- High efficiency is obtained.
- Can be used as an interface driver.



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-37Pb 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	

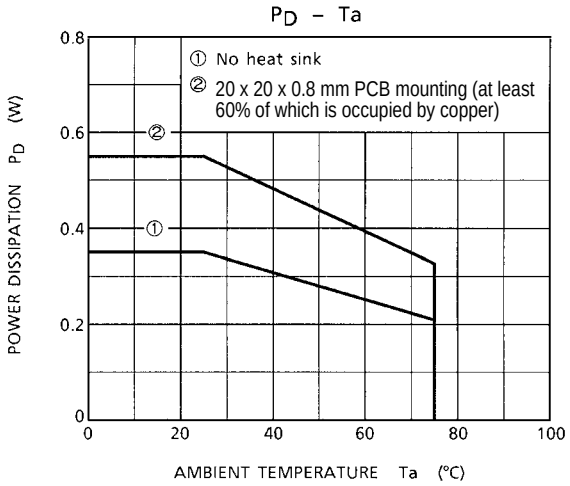
Functions

(1) Bridge Driver (Truth Table 1)

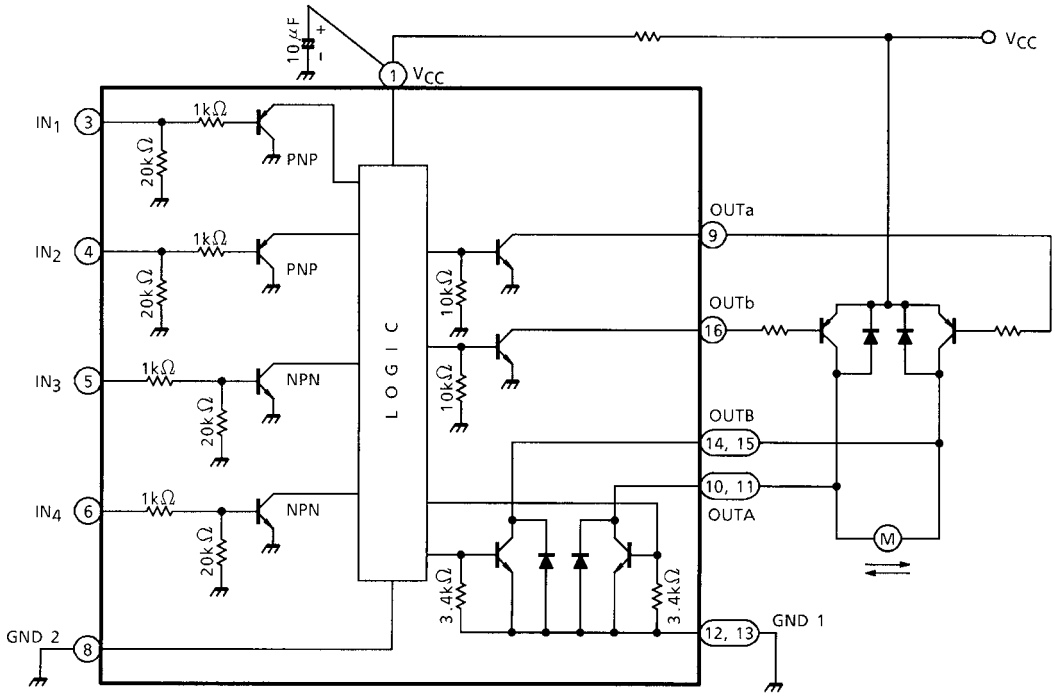
CONTROL	INPUT MODE				OUTPUT				OPERATING MODE	NOTE
	IN_1	IN_2	IN_3	IN_4	OUT A	OUT B	OUT a	OUT b		
2-input control	H	L	H	H	ON (−500 mA)	—	ON (−25 mA)	—	Forward Rotation	—
	L	H	H	H	—	ON (−500 mA)	—	ON (−25 mA)	Reverse Rotation	
	H	H	H	H	ON (−500 mA)	ON (−500 mA)	—	—	Brake	
	L	L	H	H	—	—	—	—	STOP	
1-input 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



Absolute 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

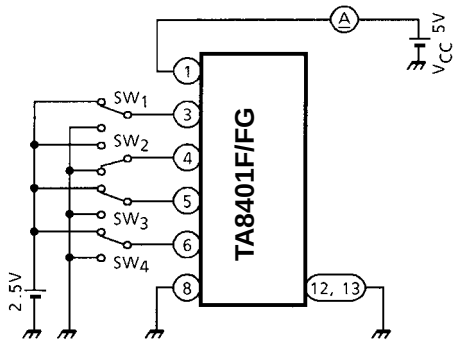
Note 2: Mounted on a PCB (PCB area, 20 × 20 × 0.8 mm; cu area, over 60%)

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

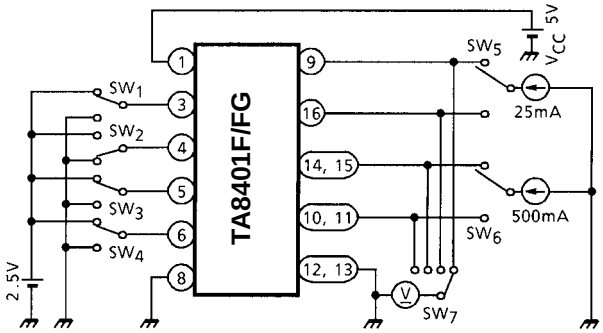
Characteristic		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Supply current		I_{CC1}	1	Output open CW / CCW mode	—	13	20	mA
		I_{CC2}	1	Output open stop mode	—	11	15	
		I_{CC3}	1	Output open brake mode	—	17	26	
		I_{CC4}	1	Inhibit (INPUT4 = "L")	—	2.4	7	
Output saturation voltage		V_{sat1}	2	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

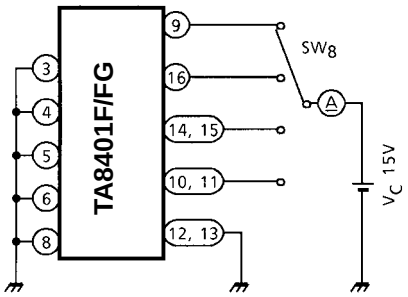
1. $I_{CC1, 2, 3, 4}$



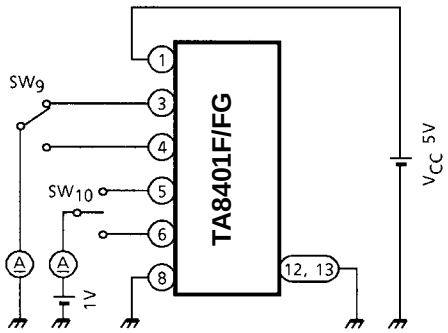
2. $V_{sat1, 2}$



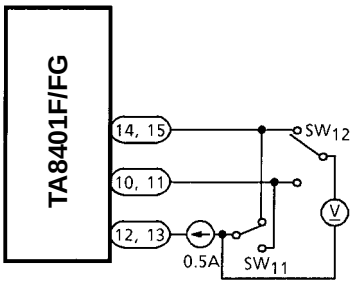
3. I_L



4. I_{IN}



5. V_F



・Utmost care is necessary in the design of the output, V_{CC}, V_M, and GND lines since the IC may be destroyed by short-circuiting between outputs, air contamination faults, or faults due to improper grounding, or by short-circuiting between contiguous pins.

Notes on Using the TA8401F/FG

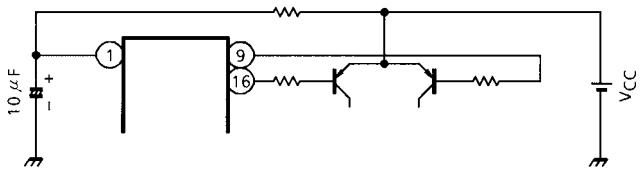
The TA8401F/FG functionable bridge driver is an IC specifically developed to control rotation switching in brush motors. This IC has been carefully designed and strengthened to withstand counter-electromotive force or startup rush current, which are problems often associated with driving brush motors.

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.

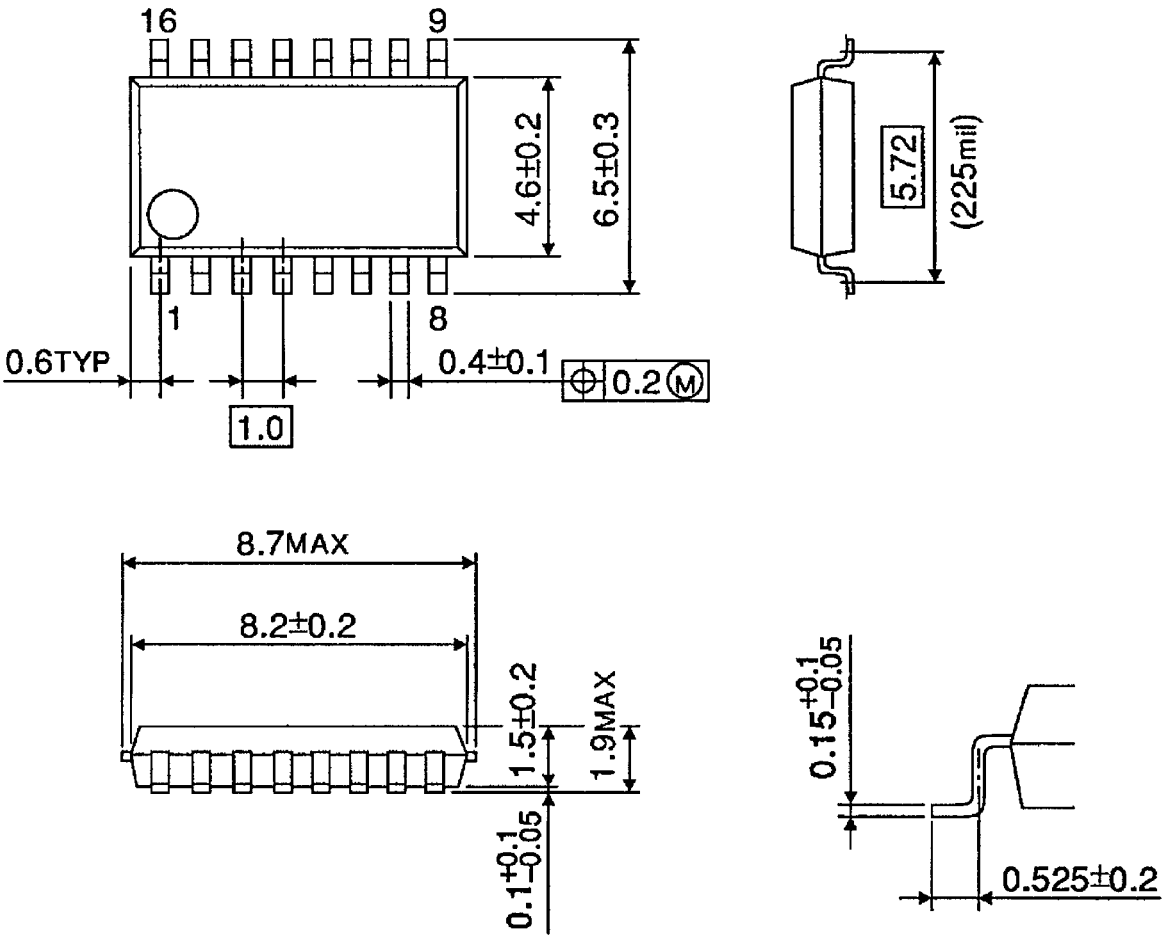
When using the TA8401F/FG, the capacitor is connected between outputs (pins 10 / 11 and pins 14 / 15. This may cause oscillation. Therefore avoid connecting the capacitor where possible. If connection is necessary to overcome noise, connect resistors in series as shown in the technical data.

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 of the functional blocks, circuits, or constants in the block diagram 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 explanatory purposes.

3. Timing Charts

Timing charts may be simplified for explanatory purposes.

4. 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.

5. 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.

IC Usage Considerations

Notes on handling of ICs

[1] The absolute maximum ratings of a semiconductor device are a set of ratings that must not be exceeded, even for a moment. Do not exceed any of these ratings.
Exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.

[2] Use an appropriate power supply fuse to ensure that a large current does not continuously flow in case of over current and/or IC failure. The IC will fully break down when used under conditions that exceed its absolute maximum ratings, when the wiring is routed improperly or when an abnormal pulse noise occurs from the wiring or load, causing a large current to continuously flow and the breakdown can lead smoke or ignition. To minimize the effects of the flow of a large current in case of breakdown, appropriate settings, such as fuse capacity, fusing time and insertion circuit location, are required.

[3] If your design includes an inductive load such as a motor coil, incorporate a protection circuit into the design to prevent device malfunction or breakdown caused by the current resulting from the inrush current at power ON or the negative current resulting from the back electromotive force at power OFF. IC breakdown may cause injury, smoke or ignition.
Use a stable power supply with ICs with built-in protection functions. If the power supply is unstable, the protection function may not operate, causing IC breakdown. IC breakdown may cause injury, smoke or ignition.

[4] Do not insert devices in the wrong orientation or incorrectly.
Make sure that the positive and negative terminals of power supplies are connected properly.
Otherwise, the current or power consumption may exceed the absolute maximum rating, and exceeding the rating(s) may cause the device breakdown, damage or deterioration, and may result injury by explosion or combustion.
In addition, do not use any device that is applied the current with inserting in the wrong orientation or incorrectly even just one time.

Points to remember on handling of ICs

(1) Heat Radiation Design

In using an IC with large current flow such as power amp, regulator or driver, please design the device so that heat is appropriately radiated, not to exceed the specified junction temperature (T_J) at any time and condition. These ICs generate heat even during normal use. An inadequate IC heat radiation design can lead to decrease in IC life, deterioration of IC characteristics or IC breakdown. In addition, please design the device taking into considerate the effect of IC heat radiation with peripheral components.

(2) Back-EMF

When a motor rotates in the reverse direction, stops or slows down abruptly, a current flow back to the motor's power supply due to the effect of back-EMF. If the current sink capability of the power supply is small, the device's motor power supply and output pins might be exposed to conditions beyond maximum ratings. To avoid this problem, take the effect of back-EMF into consideration in system design.

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