

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA7774PG, TA7774FG, TA7774FAG

Stepping Motor Driver IC

The TA7774PG and TA7774FG/FAG are two-phase bipolar stepping motor driver ICs designed especially for 3.5- or 5.25-inch FDD head actuator drives.

The ICs have a dual-bridge driver supporting the bipolar driving of induced loads, a power-saving circuit, and a standby circuit. They are ideal for achieving reduced set size and lower power consumption.

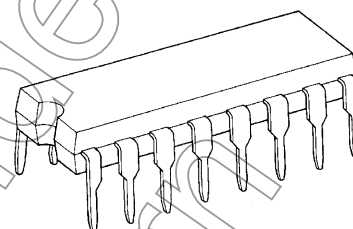
Features

- One-chip two-phase bipolar stepping motor driver
- Power saving operation is available.
- Standby operation is available.
Current consumption $\leq 115 \mu\text{A}$
- Built-in punch-through current restriction circuit for system reliability and noise suppression
- TTL-compatible inputs INA, INB, and PS pins
- High driving ability
TA7774PG/FG
: $I_{O(\text{START})}$ 350 mA (MAX): V_{S1} ENABLE
: $I_{O(\text{HOLD})}$ 100 mA (MAX): V_{S2} ENABLE
TA7774FAG
: $I_{O(\text{START})}$ 100 mA (MAX): V_{S1} ENABLE
: $I_{O(\text{HOLD})}$ 50 mA (MAX): V_{S2} ENABLE
- Typical PKG DIP16 pin, HSOP16 pin, and SSOP16 pin
- GND pin = heatsink

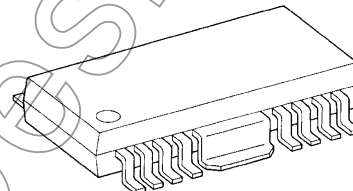
The following conditions apply to solderability:

About solderability, following conditions were confirmed

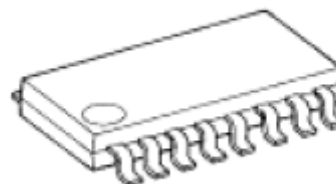
- Solderability
 - (1) Use of Sn-37Pb solder Bath
 - solder bath temperature: 230°C
 - dipping time: 5 seconds
 - the number of times: once
 - use of R-type flux
 - (2) Use of Sn-3.0Ag-0.5Cu solder Bath
 - solder bath temperature: 245°C
 - dipping time: 5 seconds
 - the number of times: once
 - use of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

TA7774PG


DIP16-P-300-2.54A

TA7774FG


HSOP16-P-300-1.00

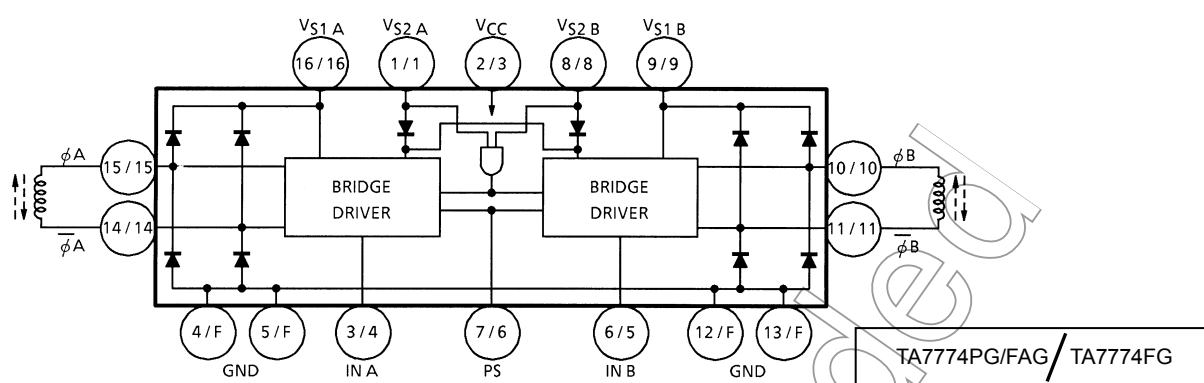
TA7774FAG


SSOP16-P-225-1.00A

Weight

DIP16-P-300-2.54A: 1.11 g (typ.)
 HSOP16-P-300-1.00: 0.50 g (typ.)
 SSOP16-P-225-1.00A: 0.14 g (typ.)

Block Diagram



Note: Pins 2, 7, 12, and 13 of the TA7774FG are all NC; the heat fin is connected to GND.

Pin Description

Pin No.	Symbol	Functional Description
1 / (1)	VS2 A	Low-voltage power supply terminal
2 / (3)	VCC	Power voltage supply terminal for control
3 / (4)	IN A	A-ch forward rotation / reverse rotation signal input terminal, Truth Table 1
4 / (F)	GND	GND terminal
5 / (F)	GND	GND terminal
6 / (5)	IN B	B-ch forward rotation / reverse rotation signal input terminal, Truth Table 1
7 / (6)	PS	Power saving signal input terminal
8 / (8)	VS2 B	Standby signal input terminal, Truth Table 2
9 / (9)	VS1 B	High-voltage power supply terminal
10 / (10)	φ B	Output B
11 / (11)	φ B	Output, \bar{B}
12 / (F)	GND	GND terminal
13 / (F)	GND	GND terminal
14 / (14)	φ A	Output \bar{A}
15 / (15)	φ A	Output A
16 / (16)	VS1 A	High-voltage power supply terminal.

(): TA7774FG

Truth Table 1

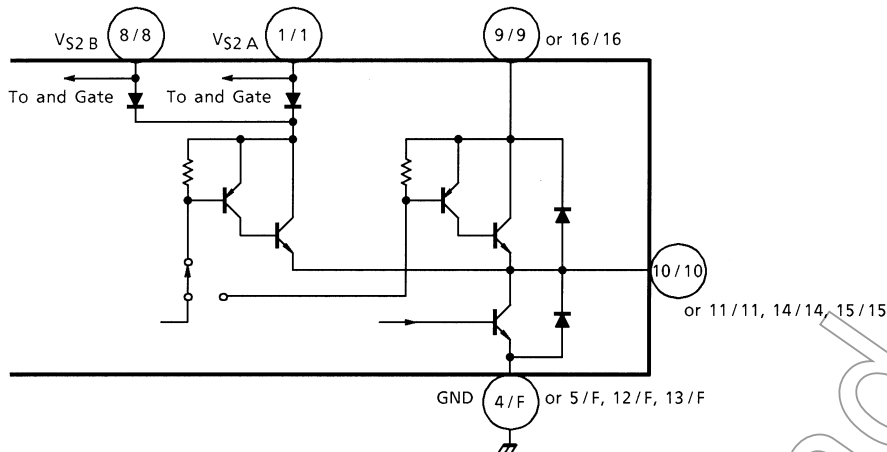
Input		Output		
PS	IN	ϕ	$\bar{\phi}$	
L	L	L	H	Enable V _{S1}
L	H	H	L	Enable V _{S1}
H	L	L	H	Enable V _{S2} (power saving)
H	H	H	L	Enable V _{S2} (power saving)

Truth Table 2

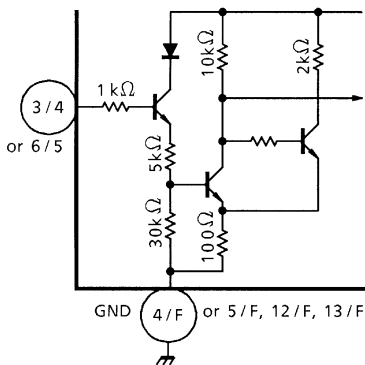
V _{S2B}	
L	Power off (standby)
H	Operation

Note: Apply 5 V to V_{S2A} as a supply terminal.

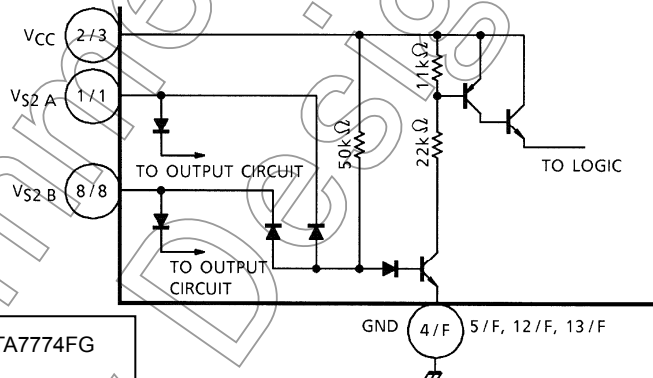
Output Circuit



Input Circuit IN A, IN B



Input Circuit Vs2 A or Vs2 B



TA7774PG/FAG / TA7774FG

Absolute Maximum Ratings (Ta = 25°C)

Characteristic		Symbol	Rating	Unit
Supply voltage		V _{CC}	7.0	V
		V _{S1}	17.0	
		V _{S2}	≤V _{CC}	
Output current	TA7774PG TA7774FG	I _O (PEAK)	±400	mA
		I _O (START)	±350	
		I _O (HOLD)	±100	
	TA7774FAG	I _O (PEAK)	±200	
		I _O (START)	±100	
		I _O (HOLD)	±50	
Input voltage		V _{IN}	≤V _{CC}	V
Power dissipation	TA7774PG	P _D	1.4 (Note 1)	W
			2.7 (Note 2)	
	TA7774FG		1.4 (Note 3)	
	TA7774FAG		0.78 (Note 4)	
Operating temperature		T _{opr}	−30 to 75	°C
Storage temperature		T _{stg}	−55 to 150	°C

Note 1: IC only

Note 2: This value is obtained if mounting is on a 50 mm × 50 mm × 0.8 mm PCB, 60% or more of which is occupied by copper.

Note 3: This value is obtained if mounting is on a 60 mm × 30 mm × 1.6 mm PCB, 50% or more of which is occupied by copper.

Note 4: This value is obtained if mounting is on a 50 mm × 50 mm × 1.6 mm PCB, 40% or more of which is occupied by copper.

Electrical Characteristics

(Unless otherwise specified, $T_a = 25^\circ\text{C}$, $V_{CC} = 5\text{ V}$, $V_{S1} = 12\text{ V}$, $V_{S2A} = 5\text{ V}$)

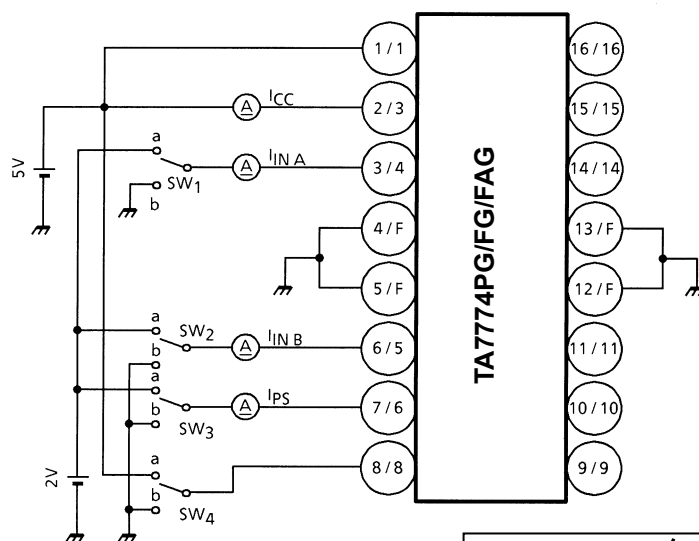
Characteristic	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Supply current	I_{CC1}	1	PS: H, $V_{S2\text{ B}}$: H	—	9	14	mA
	I_{CC2}		PS: L, $V_{S2\text{ B}}$: H	—	8.5	13	
	I_{CC3}		$V_{S2\text{ B}}$: L	70	90	115	μA
Input voltage	V_{INH}	—	$T_j = 25^\circ\text{C}$ $V_{S2\text{ B}}$: H	Pin 3, 6	2.0	—	V
	V_{INL}			GND	—	0.8	
	V_{PSH}			Pin 7	2.0	—	
	V_{PSL}			GND	—	0.8	
	V_{S2BH}		$T_j = 25^\circ\text{C}$	Pin 8	3.5	—	
	V_{S2BL}			GND	—	0.4	
Input current	I_{IN}	1	$T_j = 25^\circ\text{C}$, $V_{S2\text{ B}}$: H V_{IN} / PS (2 V): sink current	Pin 3, 6	—	2.6	μA
	I_{PS}			Pin 7	—	2.6	
Output saturation voltage	TA7774PG TA7774FG	2	PS: L, $V_{S2\text{ B}}$: H	$I_{OUT} = 100\text{ mA}$	—	0.9	V
				$I_{OUT} = 400\text{ mA}$	—	1.2	
		3	PS: H, $V_{S2\text{ B}}$: H	$I_{OUT} = 20\text{ mA}$	—	1.6	
				$I_{OUT} = 100\text{ mA}$	—	1.8	
		2	$V_{S2\text{ B}}$: H	$I_{OUT} = 20\text{ mA}$	—	0.03	
				$I_{OUT} = 100\text{ mA}$	—	0.15	
	TA7774FAG	2	PS: L, $V_{S2\text{ B}}$: H	$I_{OUT} = 100\text{ mA}$	—	0.9	
				$I_{OUT} = 200\text{ mA}$	—	1.0	
		3	PS: H, $V_{S2\text{ B}}$: H	$I_{OUT} = 20\text{ mA}$	—	1.6	
				$I_{OUT} = 50\text{ mA}$	—	1.7	
		2	$V_{S2\text{ B}}$: H	$I_{OUT} = 20\text{ mA}$	—	0.03	
				$I_{OUT} = 100\text{ mA}$	—	0.15	
				$I_{OUT} = 200\text{ mA}$	—	0.2	
				$I_{OUT} = 200\text{ mA}$	—	0.4	
Diode forward voltage	V_{FU}	4	$I_F = 350\text{ mA}$	—	1.5	—	V
	V_{FL}			—	1.0	—	
Delay time	t_{pLH}	—	$I_N - \phi$	—	7	—	μs
	t_{pHL}			—	2	—	
Operating voltage	$V_{CC\text{ (opr.)}}$	—	$V_{CC} = \text{ST}$	4.5	5.0	5.5	V

Recommended operating voltage $V_{S1\text{ (opr.)}} 12\text{ V} \pm 10\%$

$V_{S2A\text{ (opr.)}} 5\text{ V} \pm 10\%$

Operating voltage restriction $V_{S1} \geq V_{S2A}$

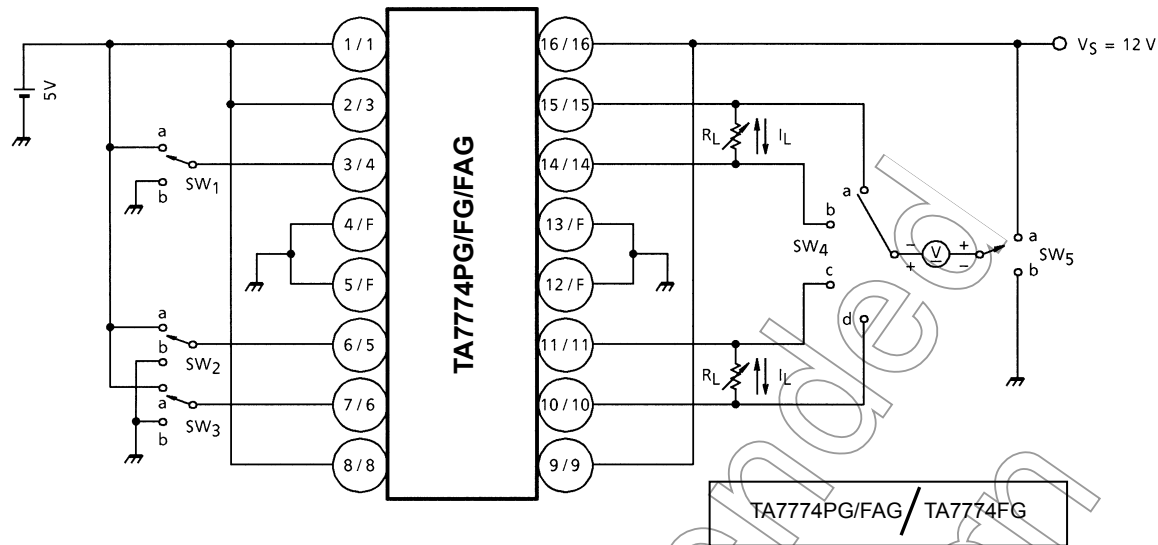
Test Circuit 1 I_{CC1} , I_{CC2} , I_{CC3} , $I_{IN A}$, $I_{IN B}$, I_{PS}



Item	SW ₁	SW ₂	SW ₃	SW ₄
I_{CC1}	b	b	a	a
I_{CC2}	b	b	b	a
I_{CC3}	b	b	—	b
$I_{IN A}$	a	—	—	a
$I_{IN B}$	—	a	—	a
I_{PS}	—	—	a	a

TA7774PG/FAG / TA7774FG

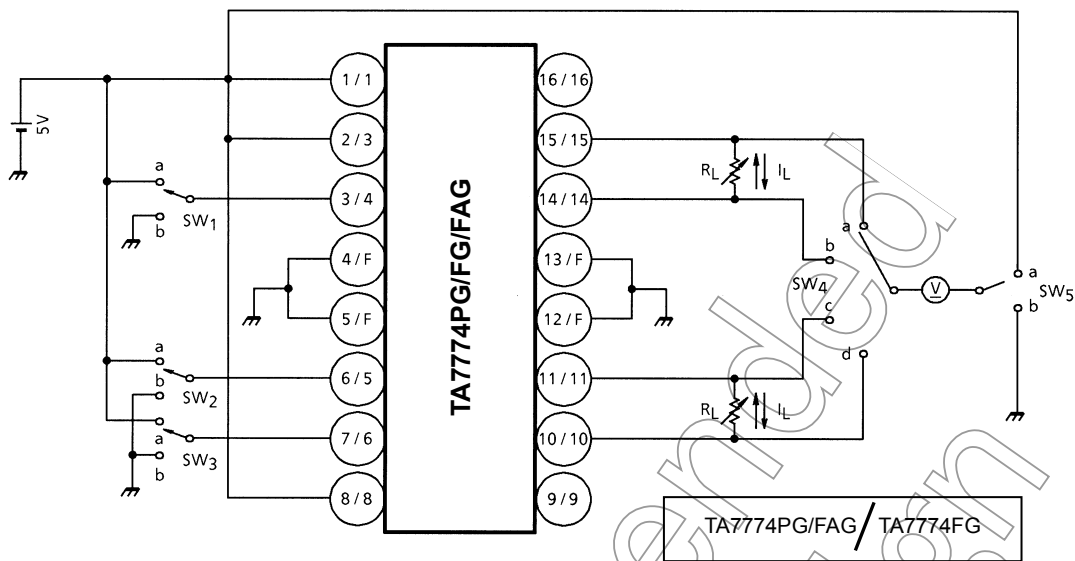
Test Circuit 2 $V_{SAT\ 1H1}$, $V_{SAT\ 1H2}$, $V_{SAT\ L2}$, $V_{SAT\ L3}$



Note: Adjust R_L to correspond to I_L .

Item	SW ₁	SW ₂	SW ₃	SW ₄	SW ₅	I_L (mA)
$V_{SAT\ 1H1}$	a	—	b	a	a	100
	b	—		b		
	—	a		d		
	—	b		c		
$V_{SAT\ 1H2}$	a	—	b	a	a	400
	b	—		b		
	—	a		d		
	—	b		c		
$V_{SAT\ L2}$	a	—	—	b	b	100
	b	—		a		
	—	a		c		
	—	b		d		
$V_{SAT\ L3}$	a	—	b	b	b	400
	b	—		a		
	—	a		c		
	—	b		d		

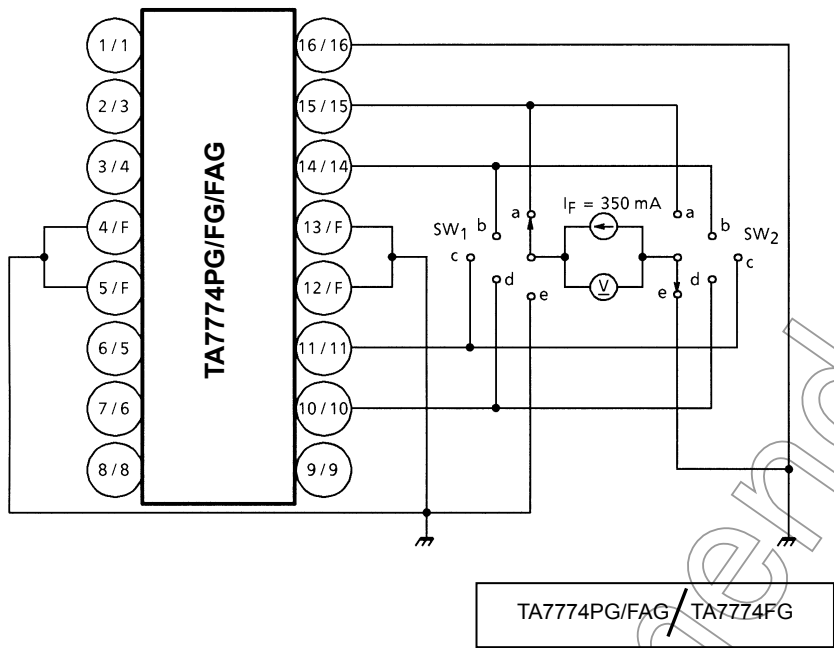
Test Circuit 3 $V_{SAT\ 2H1}$, $V_{SAT\ 2H2}$, $V_{SAT\ L1}$



Note: Adjust R_L to correspond to I_L .

Item	SW ₁	SW ₂	SW ₃	SW ₄	SW ₅	I_L (mA)
$V_{SAT\ 2H1}$	a	—	a	a	a	20
	b	—		b		
	—	a		c		
	—	b		d		
$V_{SAT\ 2H2}$	a	—	a	a	a	100
	b	—		b		
	—	a		c		
	—	b		d		
$V_{SAT\ L1}$	a	—	a	b	b	20
	b	—		a		
	—	a		c		
	—	b		d		

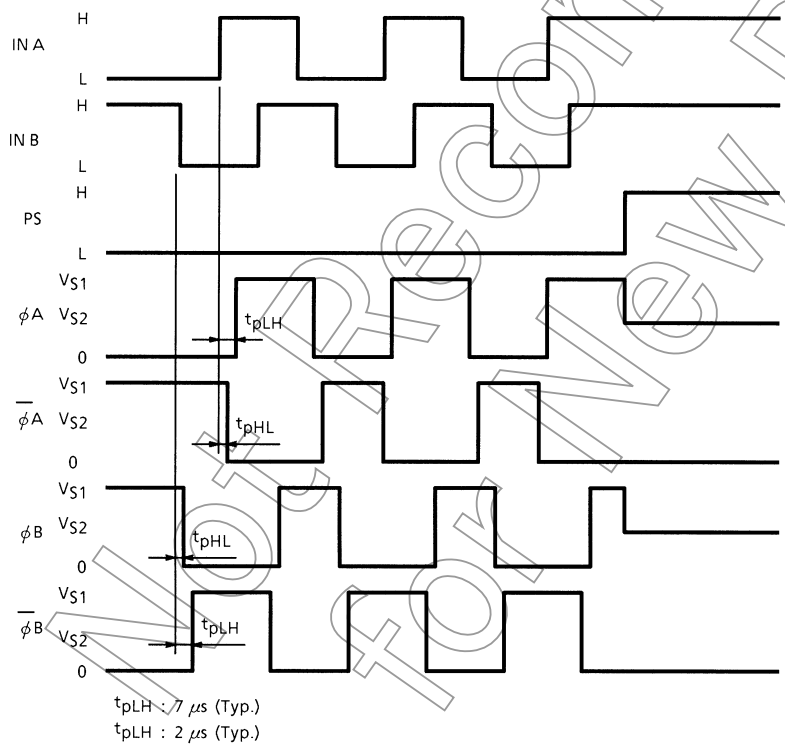
Test Circuit 4 V_{FU} , V_{FL}

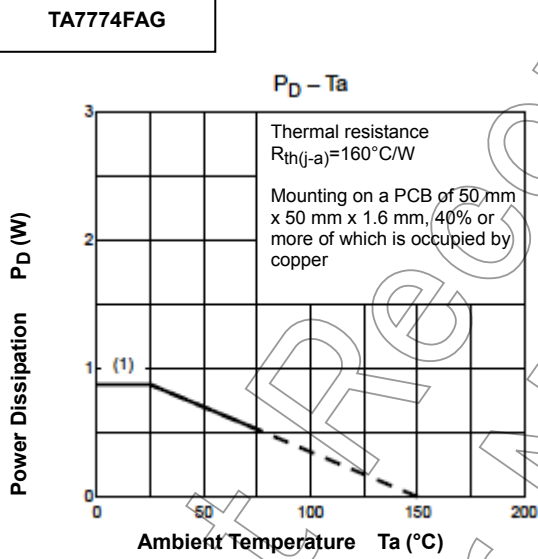
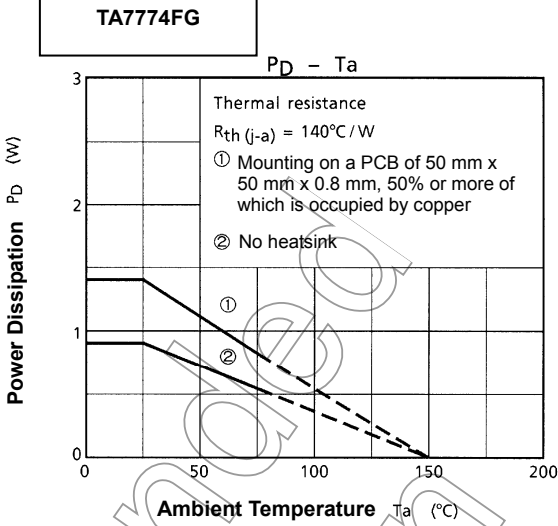
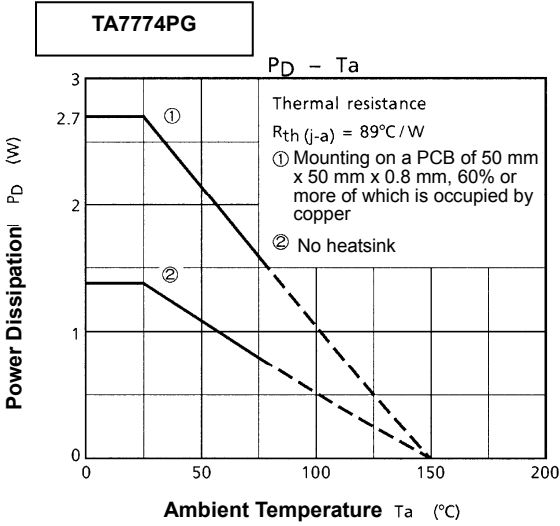


Measuring Method

ITEM	SW ₁	SW ₂
V_{FU}	a	e
	b	
	c	
	d	
V_{FL}	e	a
		b
		c
		d

Timing Chart (two-phase excitation)



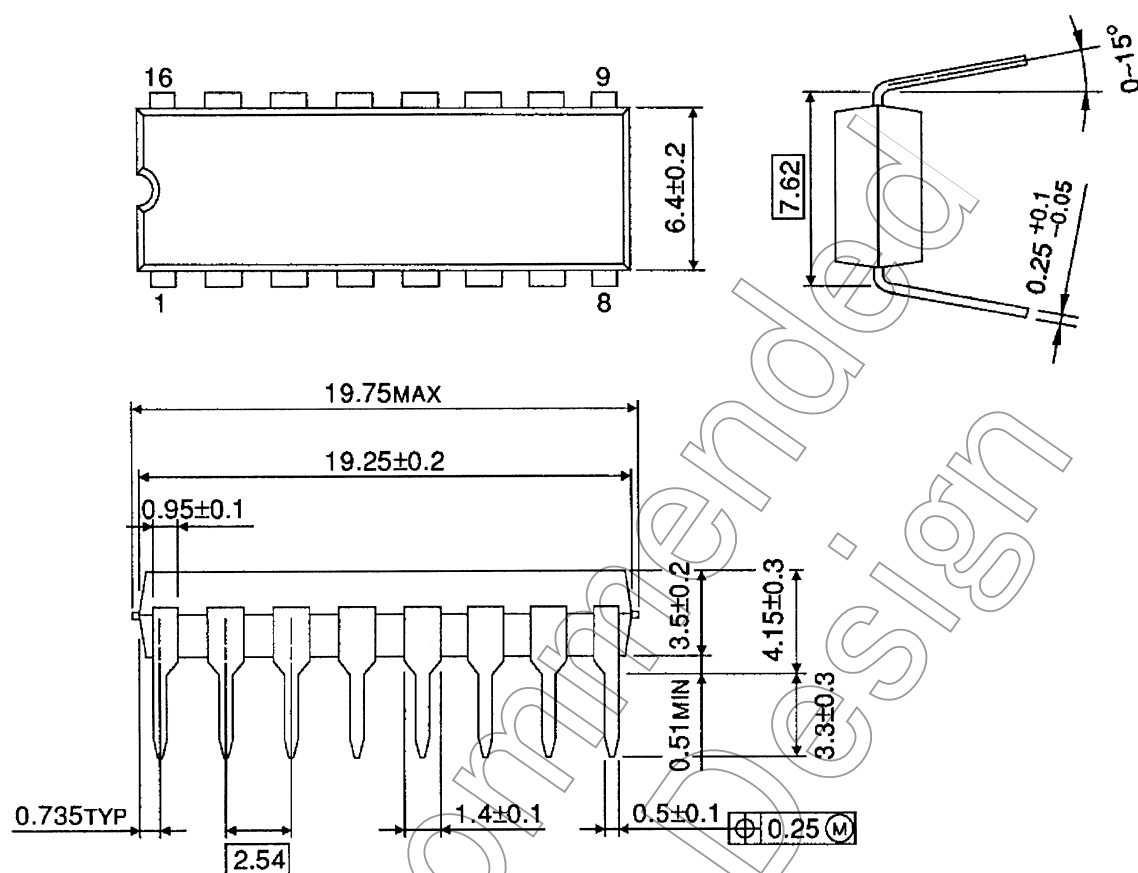


Note 2: Utmost care is necessary in the design of the output, V_{CC} , V_M , and GND lines since the IC may be destroyed by short-circuiting between outputs, air contamination faults, or faults due to improper grounding, or by short-circuiting between contiguous pins.

Package Dimensions

DIP16-P-300-2.54A

Unit: mm

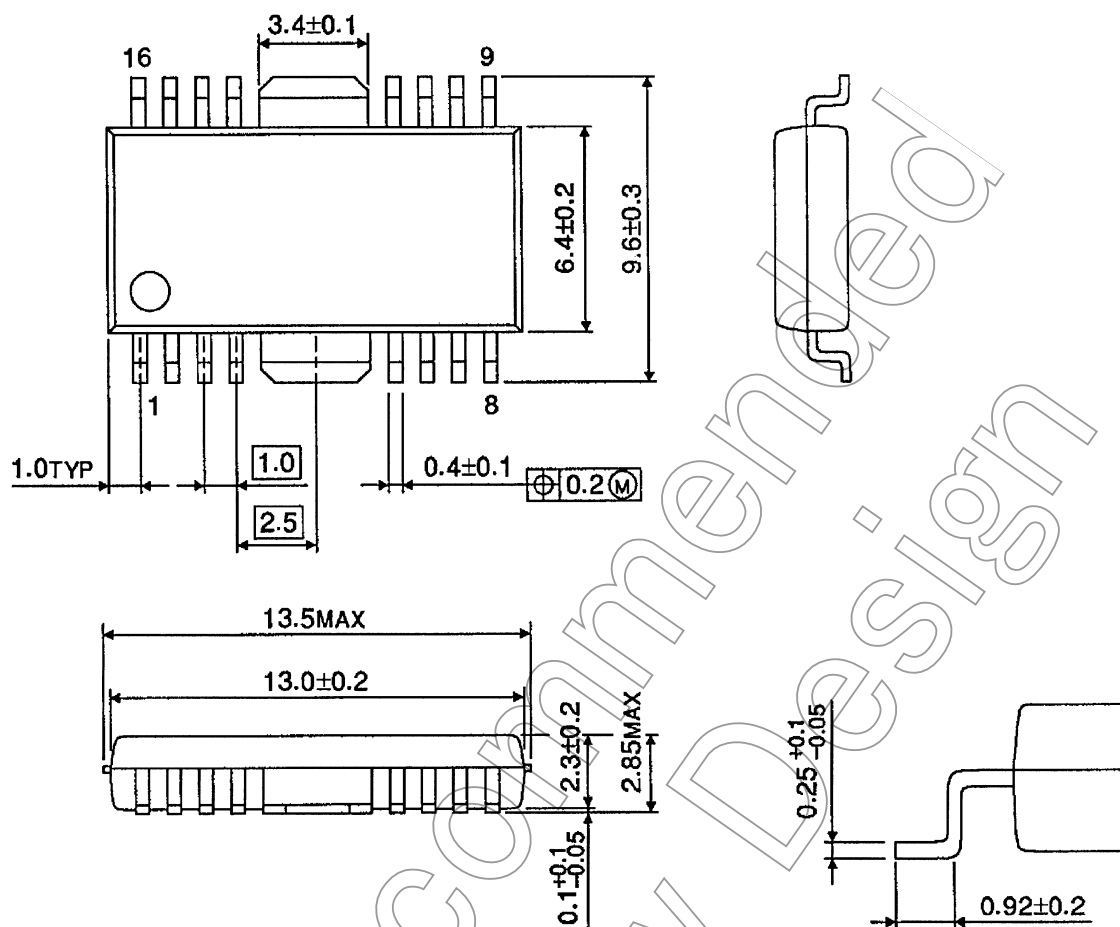


Weight: 1.11 g (typ.)

Package Dimensions

HSOP16-P-300-1.00

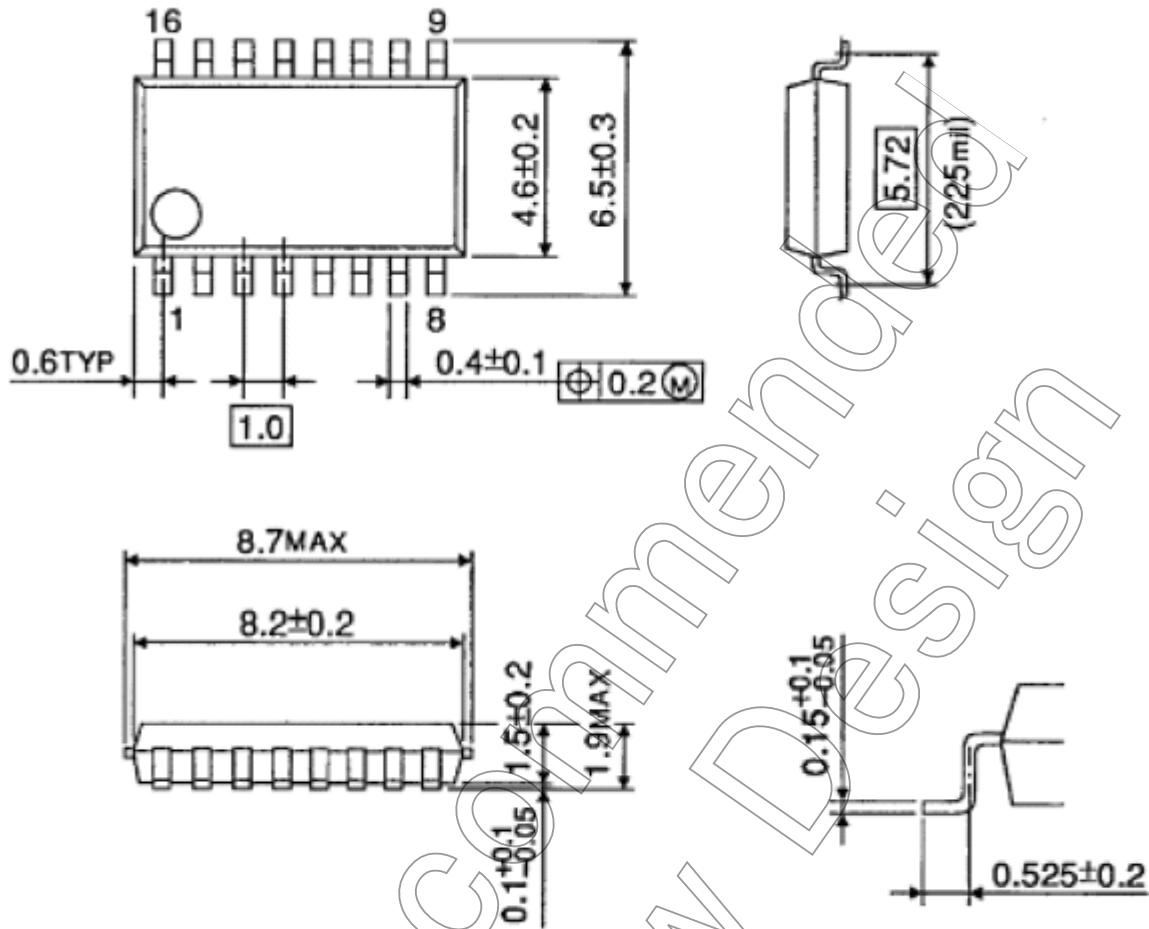
Unit: mm



Weight: 0.50 g (typ.)

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 consideration 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 flows 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.

Not Recommended
for New Design

RESTRICTIONS ON PRODUCT USE

- Toshiba Corporation, and its subsidiaries and affiliates (collectively "TOSHIBA"), reserve the right to make changes to the information in this document, and related hardware, software and systems (collectively "Product") without notice.
- This document and any information herein may not be reproduced without prior written permission from TOSHIBA. Even with TOSHIBA's written permission, reproduction is permissible only if reproduction is without alteration/omission.
- Though TOSHIBA works continually to improve Product's quality and reliability, Product can malfunction or fail. Customers are responsible for complying with safety standards and for providing adequate designs and safeguards for their hardware, software and systems which minimize risk and avoid situations in which a malfunction or failure of Product could cause loss of human life, bodily injury or damage to property, including data loss or corruption. Before creating and producing designs and using, customers must also refer to and comply with (a) the latest versions of all relevant TOSHIBA information, including without limitation, this document, the specifications, the data sheets and application notes for Product and the precautions and conditions set forth in the "TOSHIBA Semiconductor Reliability Handbook" and (b) the instructions for the application that Product will be used with or for. Customers are solely responsible for all aspects of their own product design or applications, including but not limited to (a) determining the appropriateness of the use of this Product in such design or applications; (b) evaluating and determining the applicability of any information contained in this document, or in charts, diagrams, programs, algorithms, sample application circuits, or any other referenced documents; and (c) validating all operating parameters for such designs and applications. **TOSHIBA ASSUMES NO LIABILITY FOR CUSTOMERS' PRODUCT DESIGN OR APPLICATIONS.**
- Product is intended for use in general electronics applications (e.g., computers, personal equipment, office equipment, measuring equipment, industrial robots and home electronics appliances) or for specific applications as expressly stated in this document. Product is neither intended nor warranted for use in equipment or systems that require extraordinarily high levels of quality and/or reliability and/or a malfunction or failure of which may cause loss of human life, bodily injury, serious property damage or serious public impact ("Unintended Use"). Unintended Use includes, without limitation, equipment used in nuclear facilities, equipment used in the aerospace industry, medical equipment, equipment used for automobiles, trains, ships and other transportation, traffic signaling equipment, equipment used to control combustions or explosions, safety devices, elevators and escalators, devices related to electric power, and equipment used in finance-related fields. Do not use Product for Unintended Use unless specifically permitted in this document.
- Do not disassemble, analyze, reverse-engineer, alter, modify, translate or copy Product, whether in whole or in part.
- Product shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable laws or regulations.
- The information contained herein is presented only as guidance for Product use. No responsibility is assumed by TOSHIBA for any infringement of patents or any other intellectual property rights of third parties that may result from the use of Product. No license to any intellectual property right is granted by this document, whether express or implied, by estoppel or otherwise.
- **ABSENT A WRITTEN SIGNED AGREEMENT, EXCEPT AS PROVIDED IN THE RELEVANT TERMS AND CONDITIONS OF SALE FOR PRODUCT, AND TO THE MAXIMUM EXTENT ALLOWABLE BY LAW, TOSHIBA (1) ASSUMES NO LIABILITY WHATSOEVER, INCLUDING WITHOUT LIMITATION, INDIRECT, CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OR LOSS, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF OPPORTUNITIES, BUSINESS INTERRUPTION AND LOSS OF DATA, AND (2) DISCLAIMS ANY AND ALL EXPRESS OR IMPLIED WARRANTIES AND CONDITIONS RELATED TO SALE, USE OF PRODUCT, OR INFORMATION, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, ACCURACY OF INFORMATION, OR NONINFRINGEMENT.**
- Do not use or otherwise make available Product or related software or technology for any military purposes, including without limitation, for the design, development, use, stockpiling or manufacturing of nuclear, chemical, or biological weapons or missile technology products (mass destruction weapons). Product and related software and technology may be controlled under the Japanese Foreign Exchange and Foreign Trade Law and the U.S. Export Administration Regulations. Export and re-export of Product or related software or technology are strictly prohibited except in compliance with all applicable export laws and regulations.
- Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. Please use Product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. TOSHIBA assumes no liability for damages or losses occurring as a result of noncompliance with applicable laws and regulations.