

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA7774P/PG, TA7774F/FG, TA7774FAG

Stepping Motor Driver IC

The TA7774P/PG and TA7774F/FG/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

TA7774P/PG/F/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

TA7774PG/FG-FAG:

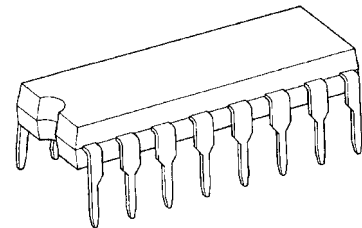
The TA7774PG/FG/FAG is a lead-free (Pb-free) product.

The following conditions apply to solderability:

*Solderability

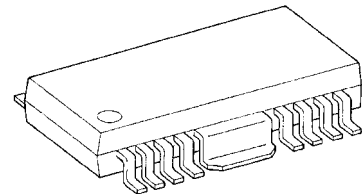
1. Use of Sn-37Pb solder bath
*solder bath temperature = 230°C
*dipping time = 5 seconds
*number of times = once
*use of R-type flux
2. Use of Sn-3.0Ag-0.5Cu solder bath
*solder bath temperature = 245°C
*dipping time = 5 seconds
*number of times = once
*use of R-type flux

TA7774P/PG



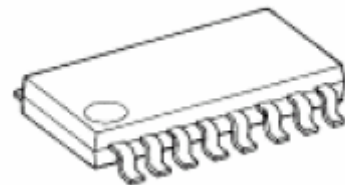
DIP16-P-300-2.54A

TA7774F/FG



HSOP16-P-300-1.00

TA7774FAG



SSOP16-P-225-1.00A

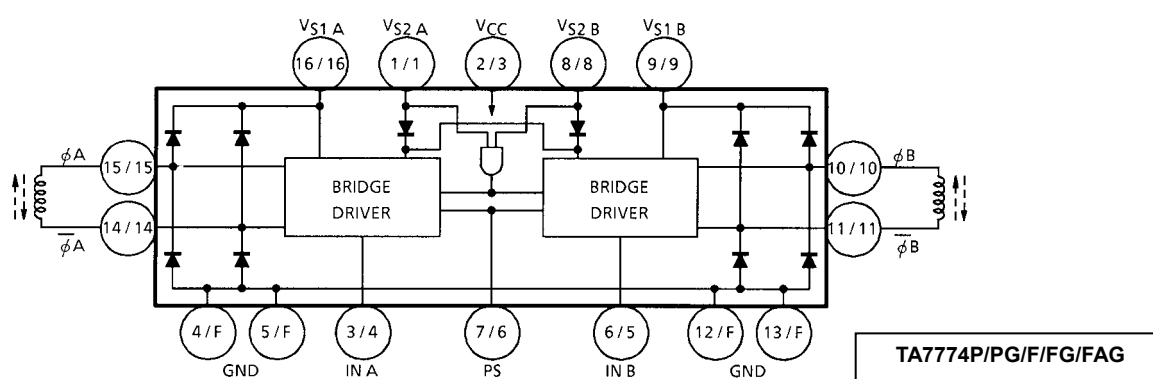
Weight

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 TA7774F/FG are all NC; the heat fin is connected to GND.

Pin Description

Pin No.	Symbol	Functional Description
1 / (1)	V_{S2A}	Low-voltage power supply terminal
2 / (3)	V_{CC}	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)	V_{S2B}	Standby signal input terminal, Truth Table 2
9 / (9)	V_{S1B}	High-voltage power supply terminal
10 / (10)	ϕB	Output B
11 / (11)	$\phi \bar{B}$	Output $\bar{B}$
12 / (F)	GND	GND terminal
13 / (F)	GND	GND terminal
14 / (14)	$\phi \bar{A}$	Output $\bar{A}$
15 / (15)	ϕA	Output A
16 / (16)	V_{S1A}	High-voltage power supply terminal.

(): TA7774F/FG

Truth Table 1

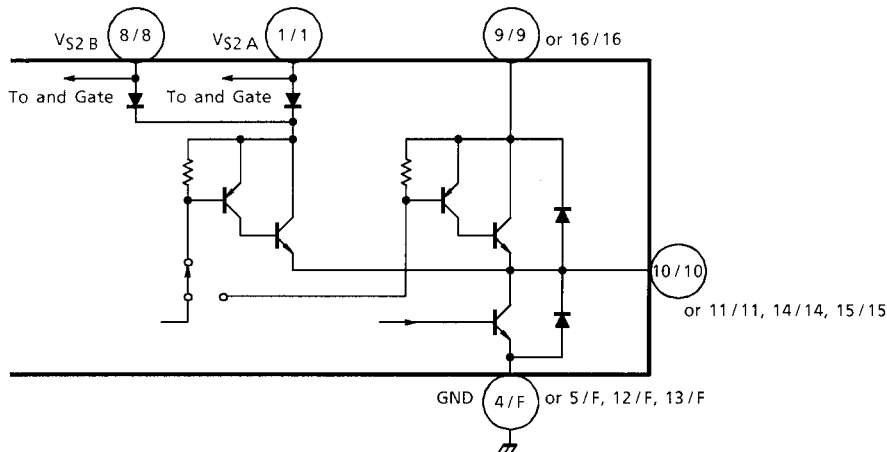
Input		Output		
PS	IN	ϕ	$\overline{\phi}$	
L	L	L	H	Enable V_{S1}
L	H	H	L	Enable V_{S1}
H	L	L	H	Enable V_{S2} (power saving)
H	H	H	L	Enable V_{S2} (power saving)

Truth Table 2

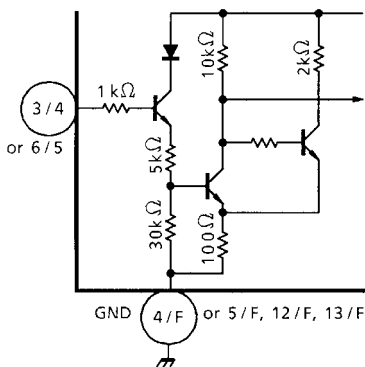
V_{S2B}	
L	Power off (standby)
H	Operation

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

Output Circuit

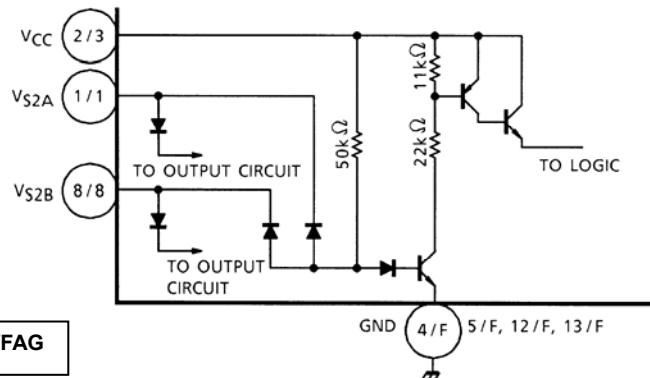


Input Circuit IN A, IN B



TA7774P/PG/F/FG/FAG

Input Circuit VS2 A or VS2 B



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	TA7774P/PG TA7774F/FG	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	TA7774P/PG	P _D	1.4 (Note 1)	W
			2.7 (Note 2)	
	TA7774F/FG		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 × 50 × 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 × 30 × 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 × 50 × 1.6 mm PCB, 40% or more of which is occupied by copper.

Electrical Characteristics

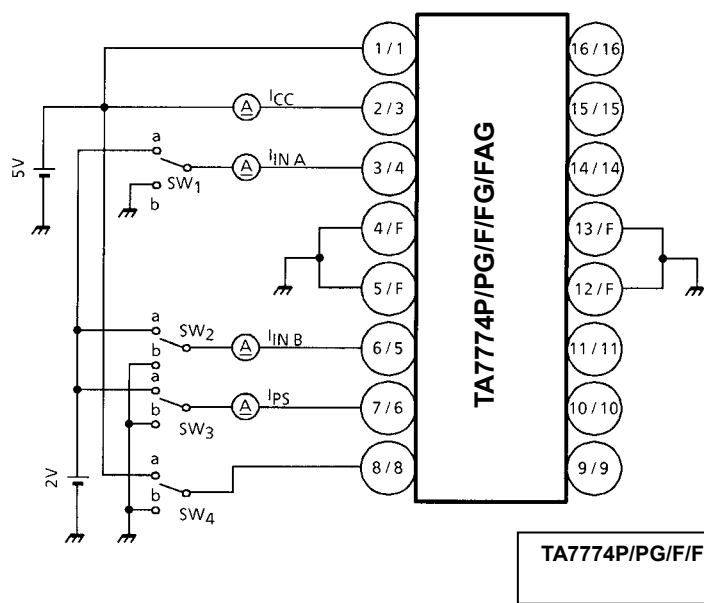
(Unless otherwise specified, Ta = 25°C, VCC = 5 V, VS1 = 12 V, VS2A = 5 V)

Characteristic		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Supply current		ICC1	1	PS: H, VS2B: H		—	9	14	mA
		ICC2		PS: L, VS2B: H		—	8.5	13	
		ICC3		VS2B: L		70	90	115	μA
Input voltage		VINH	—	Tj = 25°C VS2B: H	Pin 3, 6	2.0	—	VCC	V
		VINL				GND	—	0.8	
		VPSH			Pin 7	2.0	—	VCC	
		VPSL				GND	—	0.8	
		VS2BH		Tj = 25°C	Pin 8	3.5	—	VCC	
		VS2BL				GND	—	0.4	
Input current		IIN	1	Tj = 25°C, VS2B: H VIN / PS (2 V): sink current	Pin 3, 6	—	2.6	30	μA
		IPS			Pin 7	—	2.6	30	
Output saturation voltage	TA7774P/PG TA7774F/FG	VSAT1H1	2	PS: L, VS2B: H	IOU = 100 mA	—	0.9	—	V
		VSAT1H2			IOU = 400 mA	—	1.2	1.5	
		VSAT2H1	3	PS: H, VS2B: H	IOU = 20 mA	—	1.6	—	
		VSAT2H2			IOU = 100 mA	—	1.8	2.1	
		VSATL1	2	VS2B: H	IOU = 20 mA	—	0.03	—	
		VSATL2			IOU = 100 mA	—	0.15	—	
		VSATL3			IOU = 400 mA	—	0.35	0.6	
	TA7774FAG	VSAT1H1	2	PS: L, VS2B: H	IOU = 100 mA	—	0.9	—	
		VSAT1H2			IOU = 200 mA	—	1.0	1.3	
		VSAT2H1	3	PS: H, VS2B: H	IOU = 20 mA	—	1.6	—	
		VSAT2H2			IOU = 50 mA	—	1.7	2.0	
		VSATL1	2	VS2B: H	IOU = 20 mA	—	0.03	—	
		VSATL2			IOU = 100 mA	—	0.15	—	
		VSATL3			IOU = 200 mA	—	0.2	0.4	
Diode forward voltage		VFU	4	If = 350 mA		—	1.5	—	V
		VFL				—	1.0	—	
Delay time		tpLH	—	IN - φ		—	7	—	μs
		tpHL				—	2	—	
Operating voltage		VCC (opr.)	—	VCC = ST		4.5	5.0	5.5	V

Recommended operating voltage VS1 (opr.) 12 V ± 10%
 VS2A (opr.) 5 V ± 10%

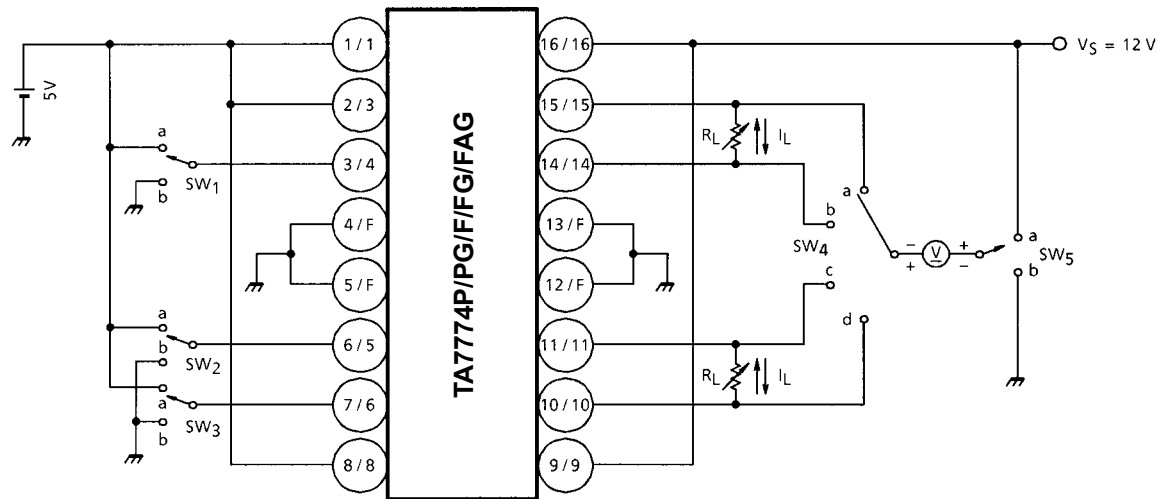
Operating voltage restriction VS1 ≥ VS2A

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

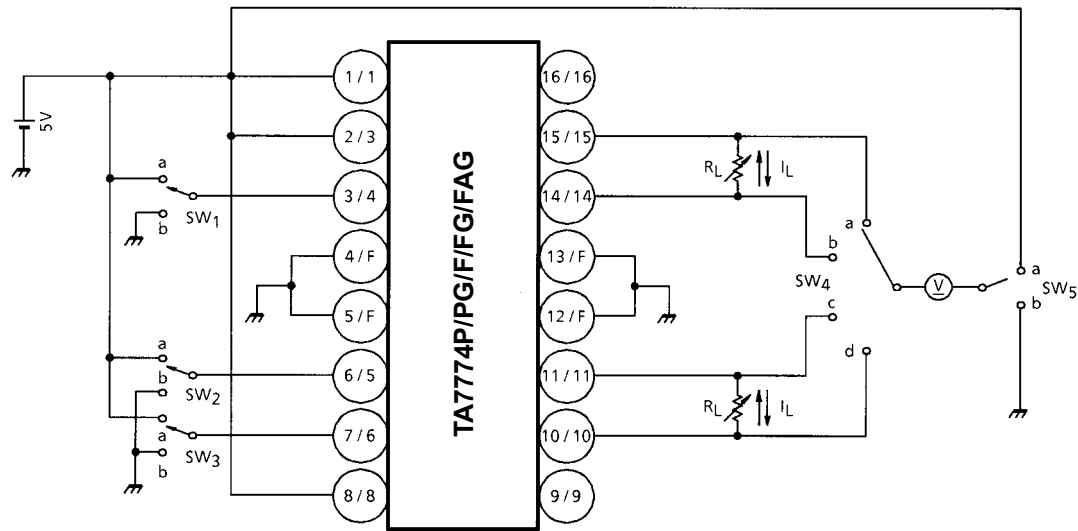
Test Circuit 2 $V_{SAT\ 1H1}$, $V_{SAT\ 1H2}$, $V_{SAT\ L2}$, $V_{SAT\ L3}$



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		

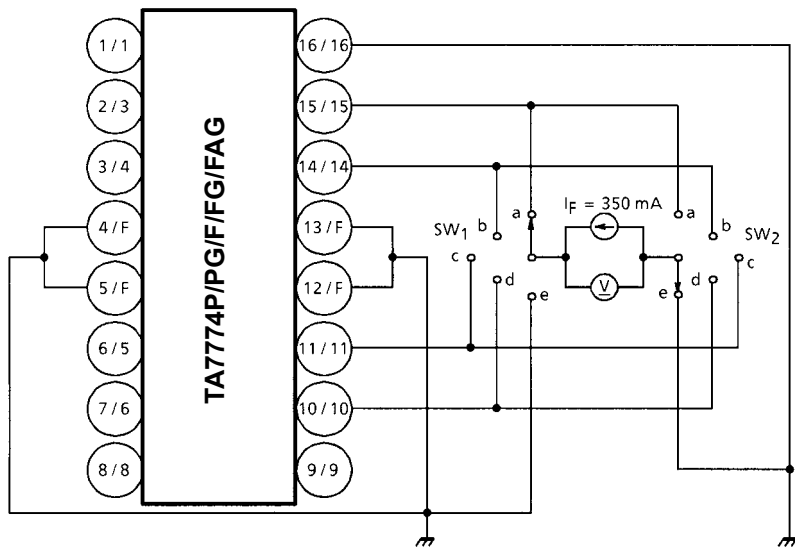
Test Circuit 3 V_{SAT} 2H1, V_{SAT} 2H2, V_{SAT} L1



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		

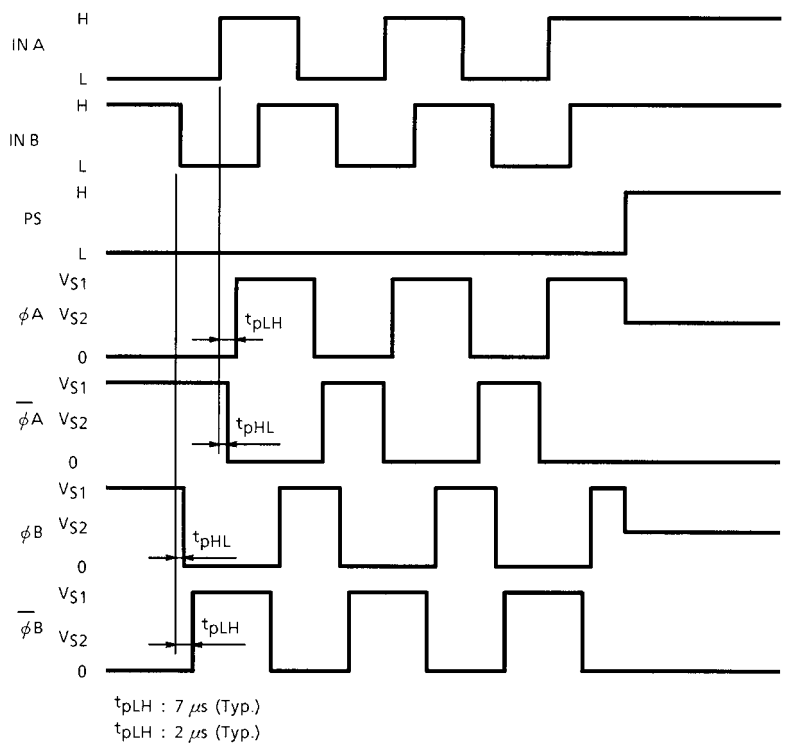
Test Circuit 4 V_{FU} , V_{FL}



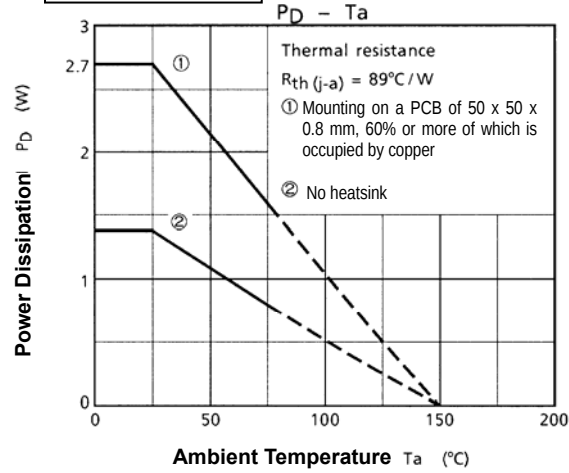
Measuring Method

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

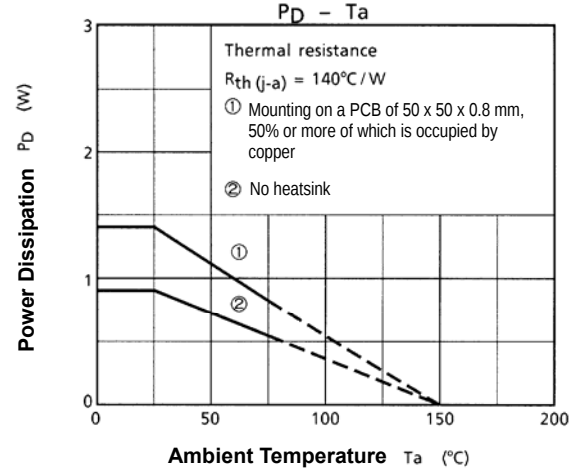
Timing Chart (two-phase excitation)



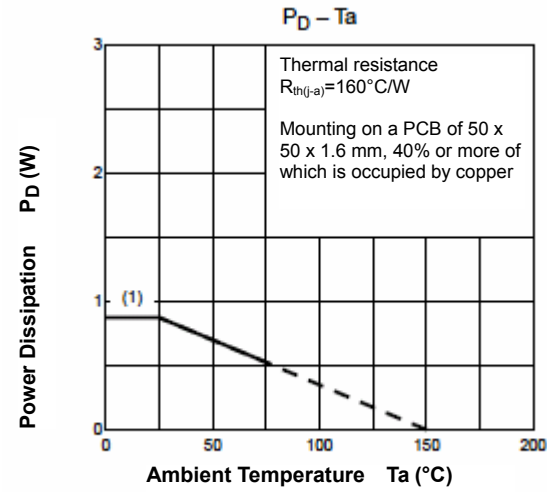
TA7774P/PG



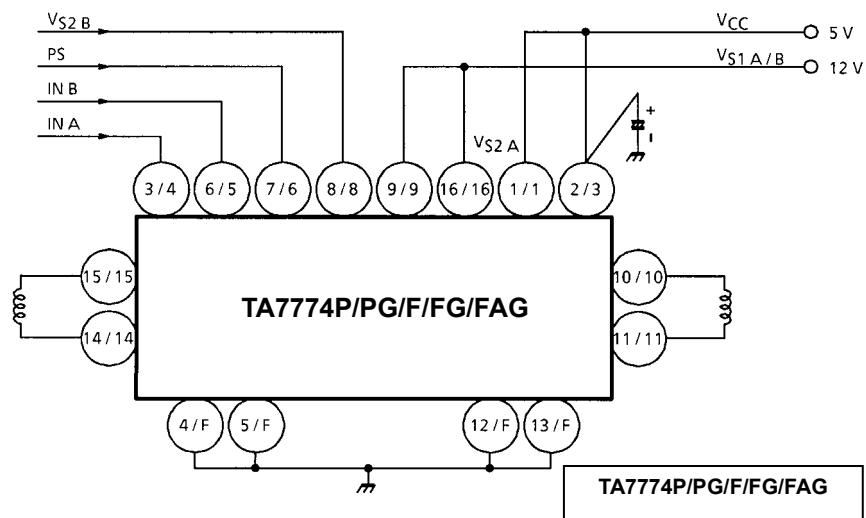
TA7774F/FG



TA7774FAG



Application Circuit



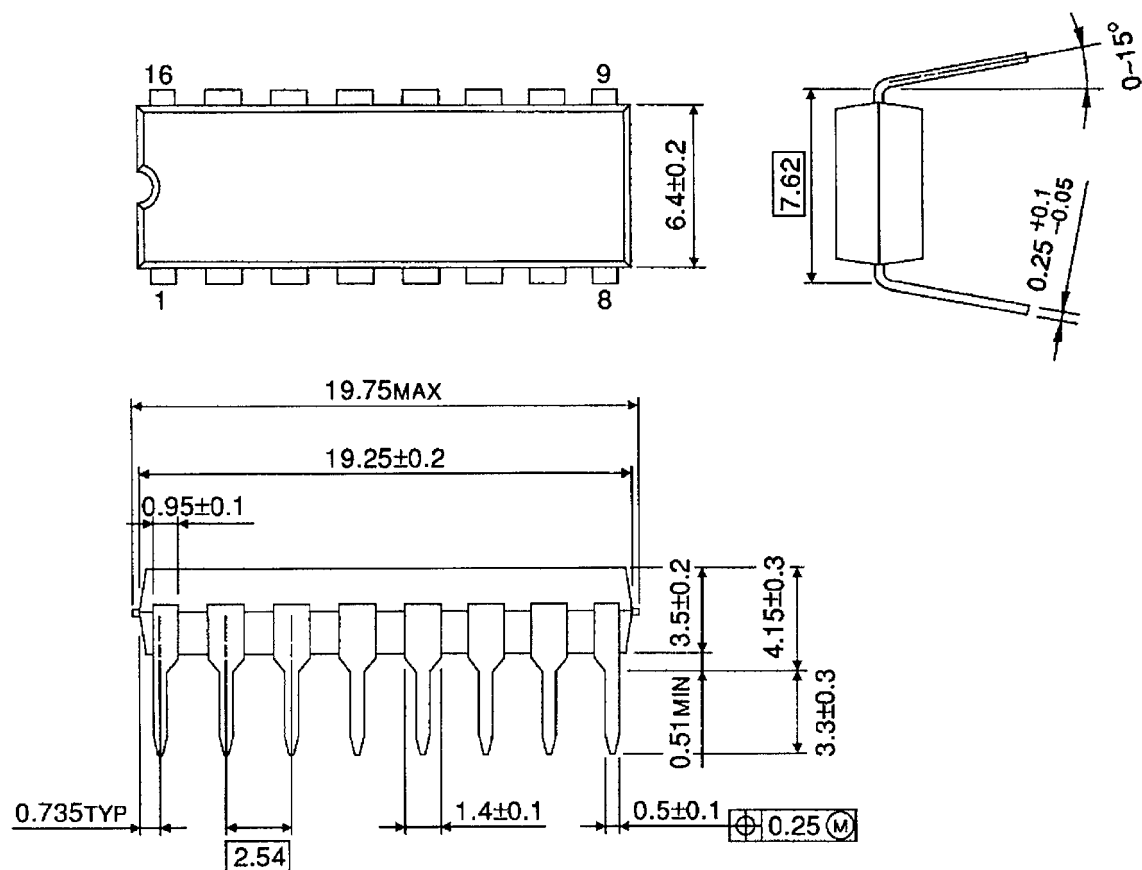
Note 1: Connect the VS2A pin to the lower supply voltage (5 V).

Note 2: Utmost care is necessary in the design of the output, VCC, VM, 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

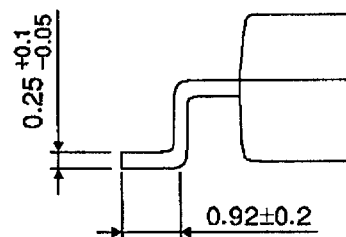
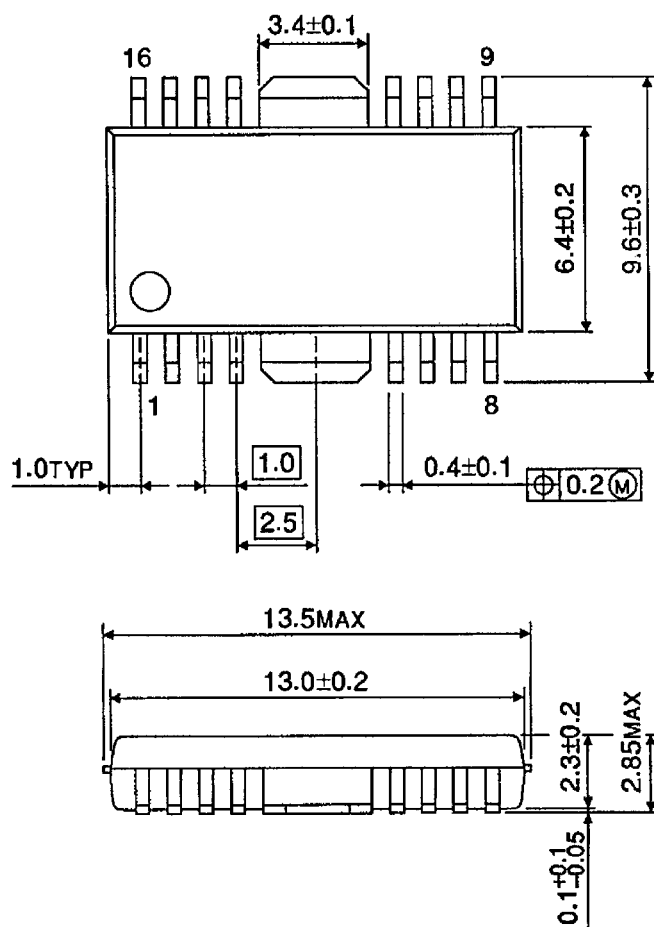


Weight: 1.11 g (typ.)

Package Dimensions

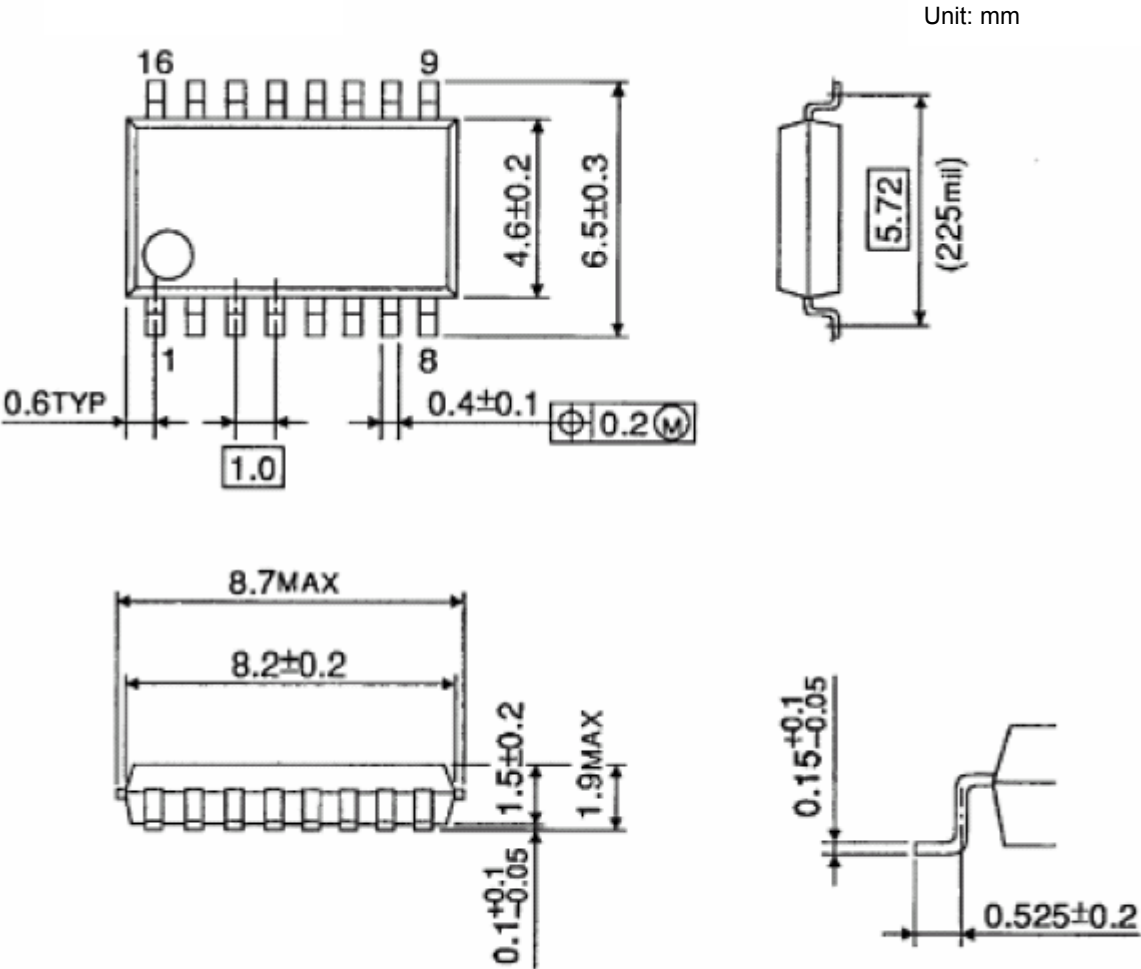
HSOP16-P-300-1.00

Unit: mm



Weight: 0.50 g (typ.)

SSOP16-P-225-1.00A



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.

RESTRICTIONS ON PRODUCT USE

070122EBA_R6

- The information contained herein is subject to change without notice. 021023_D
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc. 021023_A
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk. 021023_B
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations. 060106_Q
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patents or other rights of TOSHIBA or the third parties. 070122_C
- Please use this product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances.
Toshiba assumes no liability for damage or losses occurring as a result of noncompliance with applicable laws and regulations. 060819_AF
- The products described in this document are subject to foreign exchange and foreign trade control laws. 060925_E