TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA7774PG,TA7774FG,TA7774FAG

Stepping Motor Driver IC

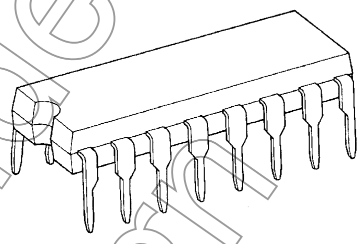
The TA7774PG and TA7774FG/FAG are two-phase bipolar stepping motor driver ICs designed especially for 3.5- or 5.25-inch FDD head actuator drives.

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

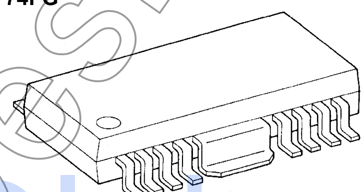
- One-chip two-phase bipolar stepping motor driver
- Power saving operation is available.
- Standby operation is available.
  Current consumption ≤ 115 μA
- Built-in punch-through current restriction circuit for system reliability and noise suppression
- TTL-compatible inputs INA, INB, and PS pins
-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

TA7774PG



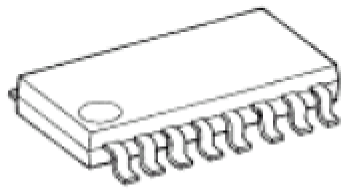
DIP16-P-300-2.54A

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.)

The following conditions apply to solderability:

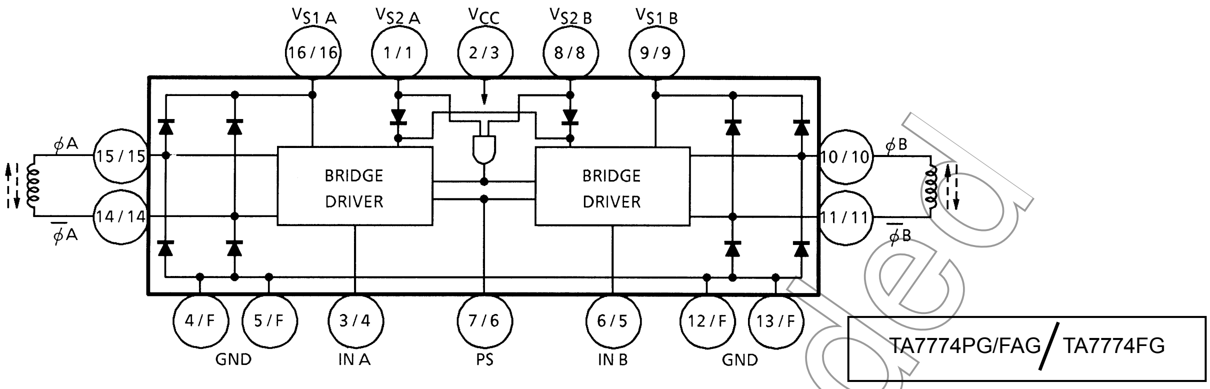
About solderability, following conditions were confirmed

- 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

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)	$V_{S2\,A}$	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)	$V_{S2\,B}$	Standby signal input terminal, Truth Table 2
9 / (9)	$V_{S1\,B}$	High-voltage power supply terminal
10 / (10)	ϕ B	Output B
11 / (11)	$\overline{\phi}$ B	Output $\overline{B}$
12 / (F)	GND	GND terminal
13 / (F)	GND	GND terminal
14 / (14)	$\overline{\phi}$ A	Output $\overline{A}$
15 / (15)	ϕ A	Output A
16 / (16)	$V_{S1\,A}$	High-voltage power supply terminal.

( ): TA7774FG

Truth Table 1

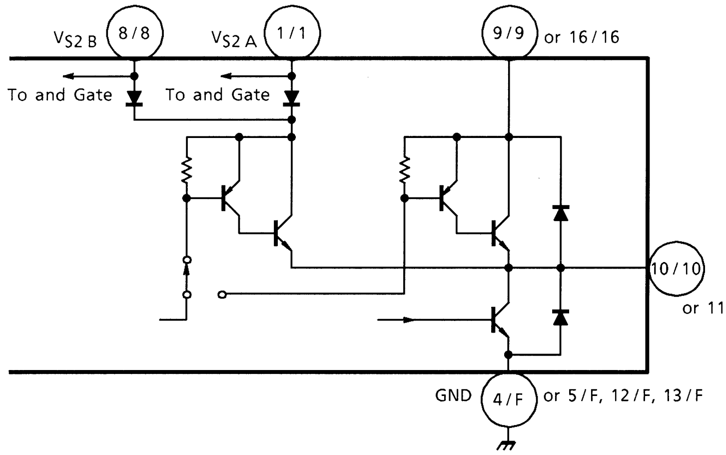
Input		Output		
PS	IN	ϕ	$\overline{\phi}$	
L	L	L	H	Enable V_{S1}
L	H	H	L	Enable V_{S1}
H	L	L	H	Enable V_{S2} (power saving)
H	H	H	L	Enable V_{S2} (power saving)

Truth Table 2

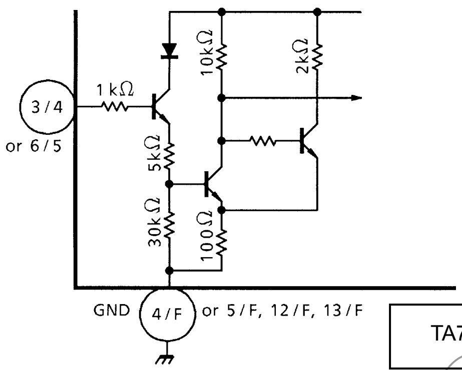
$V_{S2\,B}$	
L	Power off (standby)
H	Operation

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

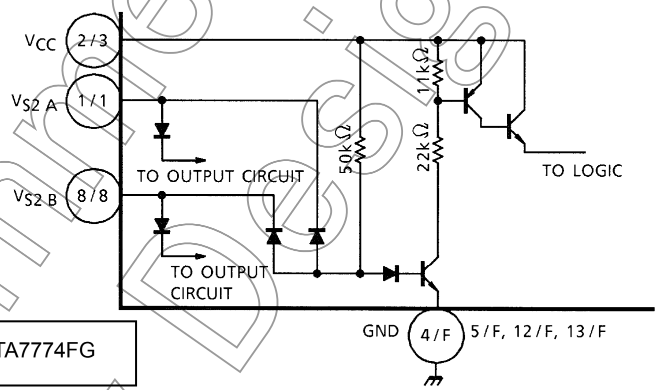
Output Circuit



Input Circuit IN A, IN B



Input Circuit $V_{S2\,A}$ or $V_{S2\,B}$



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.

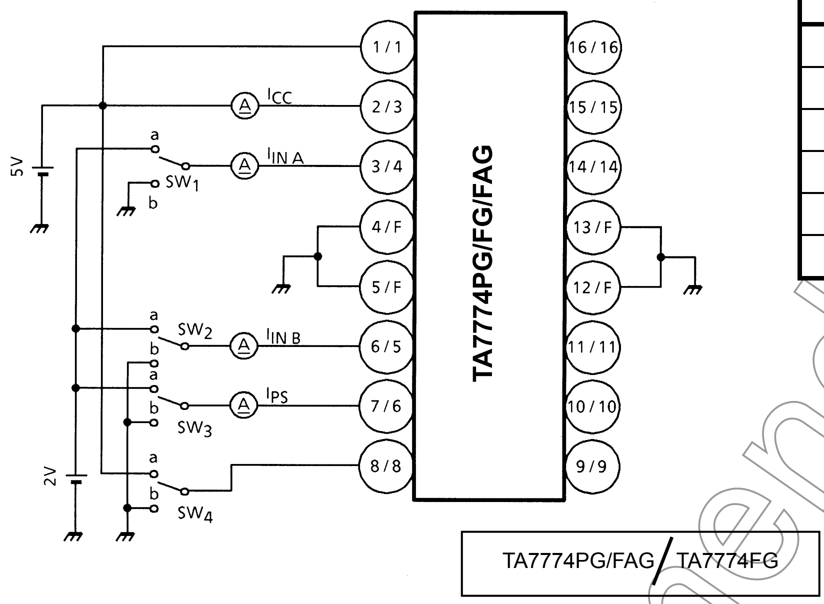
Electrical Characteristics
(Unless otherwise specified, Ta = 25°C, V_{CC} = 5 V, V_{S1} = 12 V, V_{S2A} = 5 V)

Characteristic		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Supply current		I_{CC1}	1	PS: H, $V_{S2\,B}$: H		—	9	14	mA
		I_{CC2}		PS: L, $V_{S2\,B}$: H		—	8.5	13	
		I_{CC3}		$V_{S2\,B}$: L		70	90	115	μA
Input voltage		$V_{IN\,H}$	—	T_j = 25°C $V_{S2\,B}$: H	Pin 3, 6	2.0	—	V_{CC}	V
		$V_{IN\,L}$				GND	—	0.8	
		$V_{PS\,H}$			Pin 7	2.0	—	V_{CC}	
		$V_{PS\,L}$				GND	—	0.8	
		$V_{S2\,BH}$		T_j = 25°C	Pin 8	3.5	—	V_{CC}	
		$V_{S2\,BL}$				GND	—	0.4	
Input current		I_{IN}	1	T_j = 25°C, $V_{S2\,B}$: H V_{IN} / PS (2 V): sink current	Pin 3, 6	—	2.6	30	μA
		I_{PS}			Pin 7	—	2.6	30	
Output saturation voltage	TA7774PG TA7774FG	$V_{SAT\,1H1}$	2	PS: L, $V_{S2\,B}$: H	I_{OUT} = 100 mA	—	0.9	—	V
		$V_{SAT\,1H2}$			I_{OUT} = 400 mA	—	1.2	1.5	
		$V_{SAT\,2H1}$	3	PS: H, $V_{S2\,B}$: H	I_{OUT} = 20 mA	—	1.6	—	
		$V_{SAT\,2H2}$			I_{OUT} = 100 mA	—	1.8	2.1	
		$V_{SAT\,L1}$	2	$V_{S2\,B}$: H	I_{OUT} = 20 mA	—	0.03	—	
		$V_{SAT\,L2}$			I_{OUT} = 100 mA	—	0.15	—	
		$V_{SAT\,L3}$			I_{OUT} = 400 mA	—	0.35	0.6	
	TA7774FAG	$V_{SAT\,1H1}$	2	PS: L, $V_{S2\,B}$: H	I_{OUT} = 100 mA	—	0.9	—	
		$V_{SAT\,1H2}$			I_{OUT} = 200 mA	—	1.0	1.3	
		$V_{SAT\,2H1}$	3	PS: H, $V_{S2\,B}$: H	I_{OUT} = 20 mA	—	1.6	—	
		$V_{SAT\,2H2}$			I_{OUT} = 50 mA	—	1.7	2.0	
		$V_{SAT\,L1}$	2	$V_{S2\,B}$: H	I_{OUT} = 20 mA	—	0.03	—	
		$V_{SAT\,L2}$			I_{OUT} = 100 mA	—	0.15	—	
		$V_{SAT\,L3}$			I_{OUT} = 200 mA	—	0.2	0.4	
Diode forward voltage		$V_{F\,U}$	4	I_F = 350 mA		—	1.5	—	V
		$V_{F\,L}$				—	1.0	—	
Delay time		t_{pLH}	—	IN − ϕ		—	7	—	μs
		t_{pHL}				—	2	—	
Operating voltage		$V_{CC\,(opr.)}$	—	V_{CC} = ST		4.5	5.0	5.5	V

Recommended operating voltage $V_{S1\,(opr.)}$ 12 V ± 10%
$V_{S2A\,(opr.)}$ 5 V ± 10%

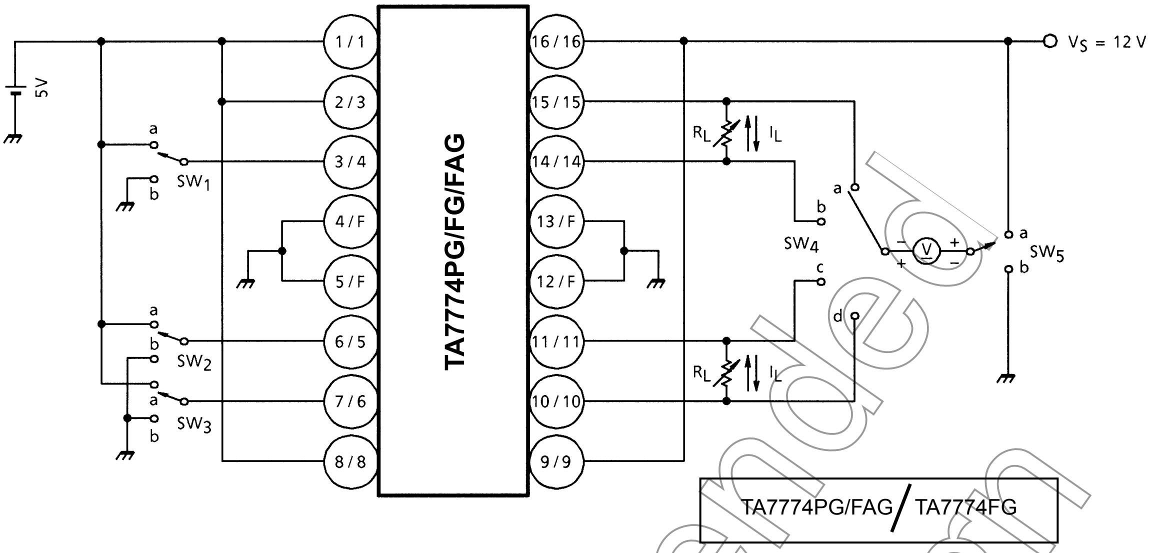
Operating voltage restriction $V_{S1} \geq V_{S2A}$

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

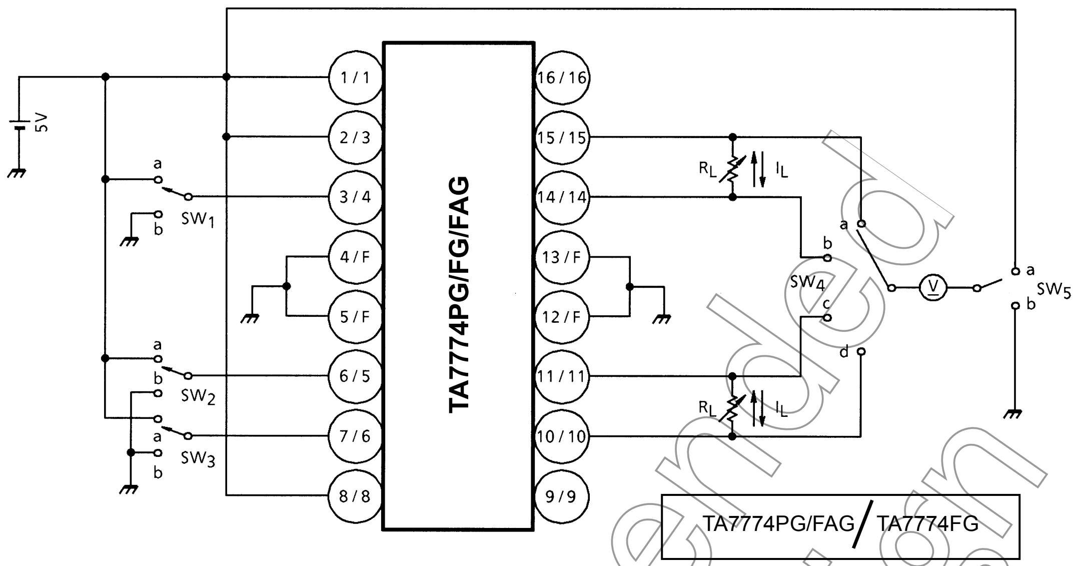
Test Circuit 2 $V_{SAT\ 1H1}$, $V_{SAT\ 1H2}$, $V_{SAT\ L2}$, $V_{SAT\ L3}$



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		

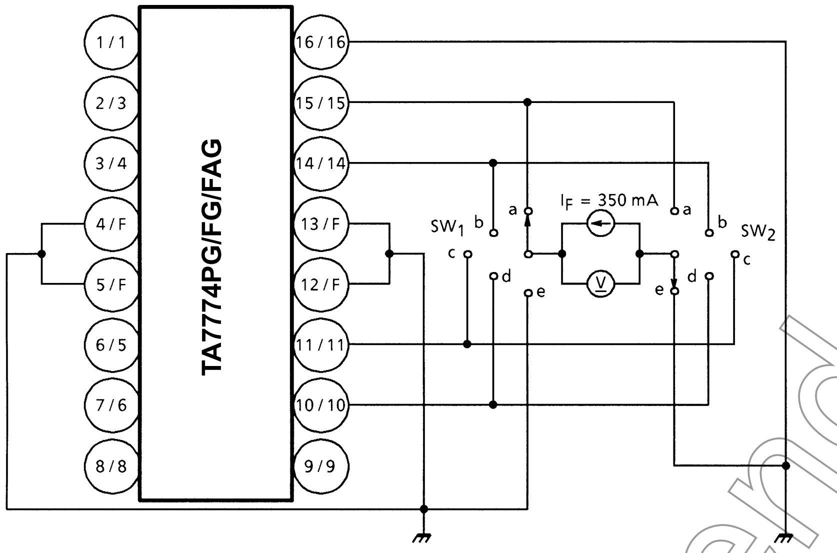
Test Circuit 3 $V_{SAT\ 2H1}$, $V_{SAT\ 2H2}$, $V_{SAT\ L1}$



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 $V_{F\,U}$, $V_{F\,L}$

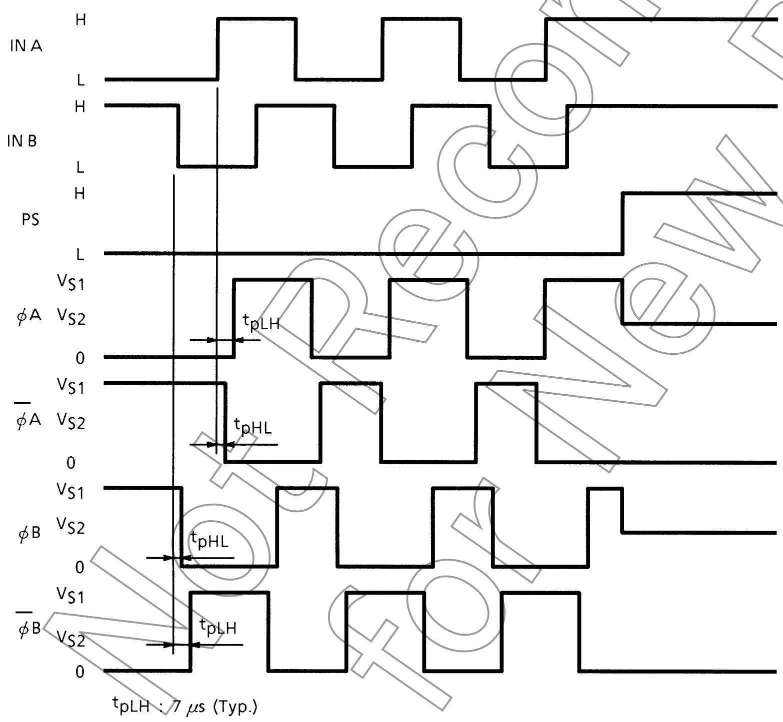


TA7774PG/FAG / TA7774FG

Measuring Method

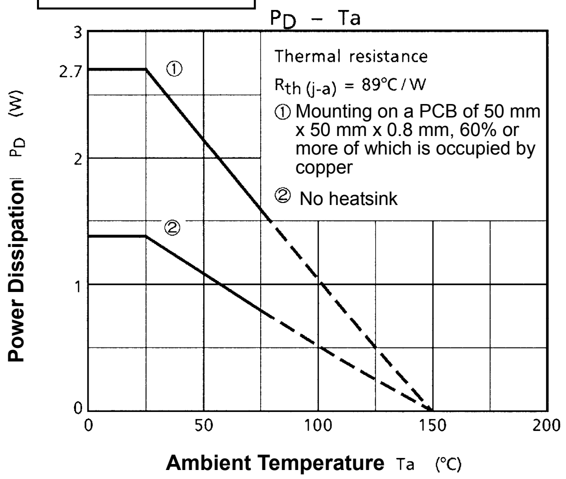
ITEM	SW_1	SW_2
$V_{F\,U}$	a	e
	b	
	c	
	d	
$V_{F\,L}$	e	a
		b
		c
		d

Timing Chart (two-phase excitation)

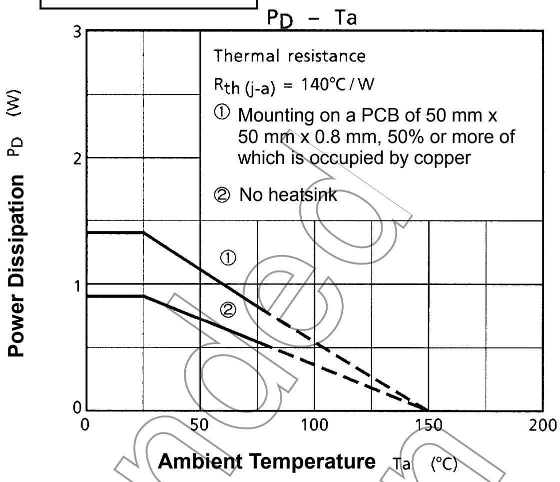


t_{pLH} : 7 μs (Typ.)
t_{pLH} : 2 μs (Typ.)

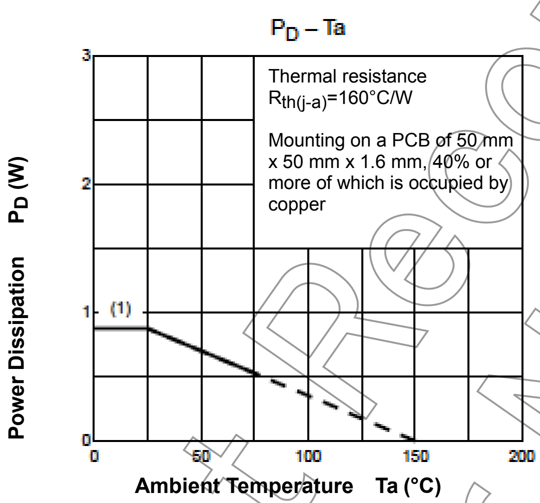
TA7774PG



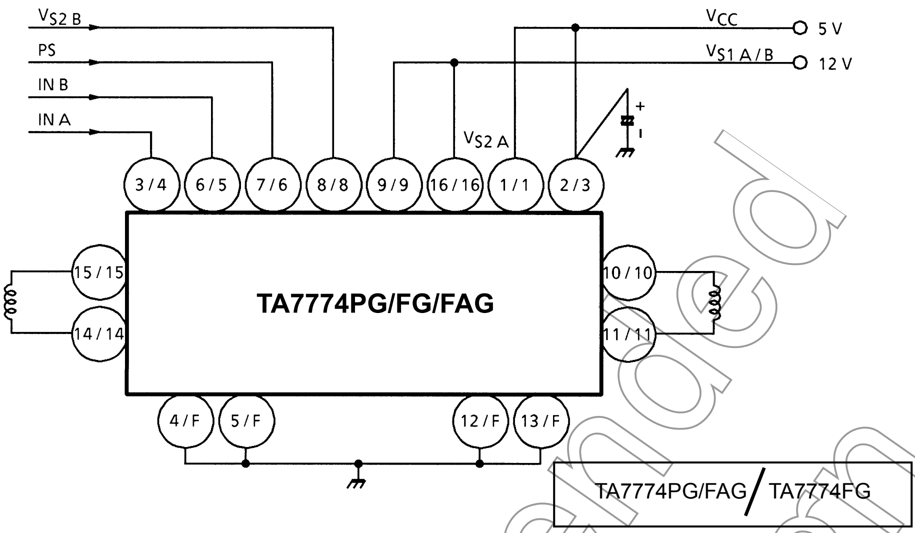
TA7774FG



TA7774FAG



Application Circuit

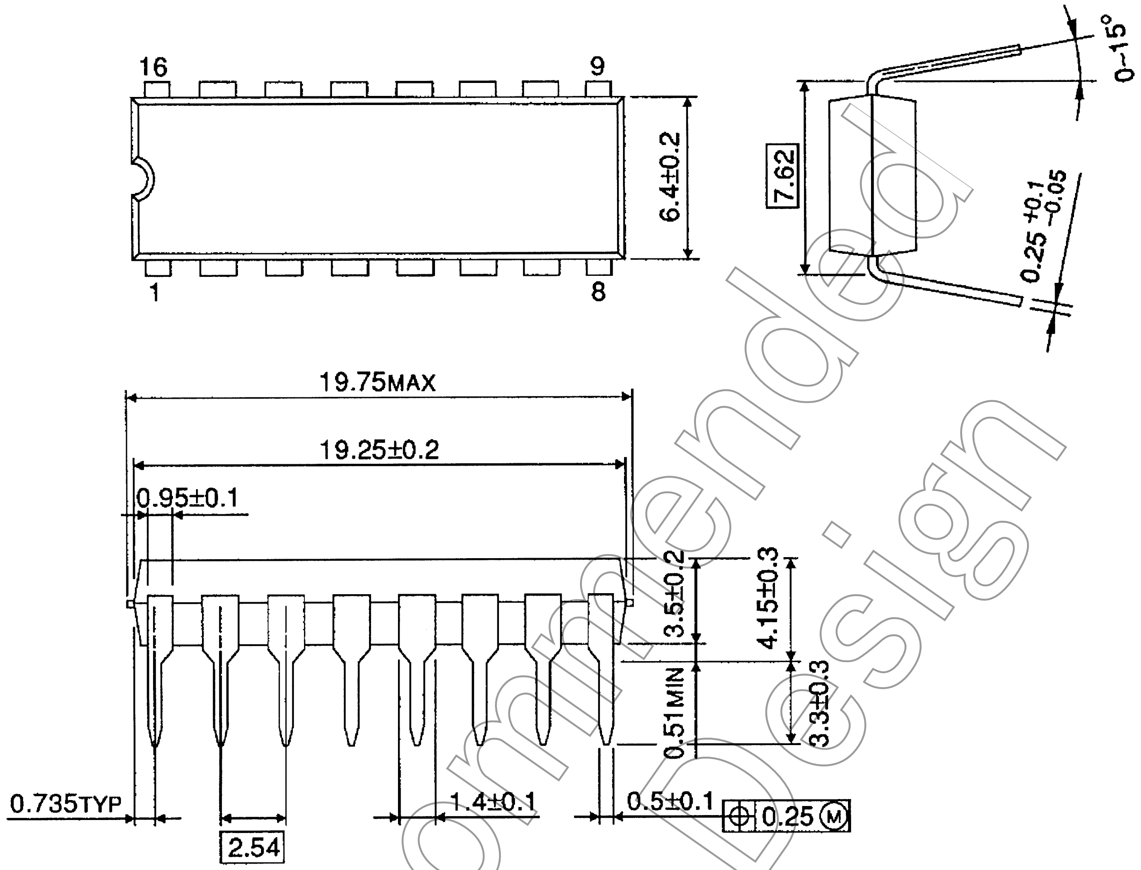


Note 1: Connect the V_{S2A} pin to the lower supply voltage (5 V).

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

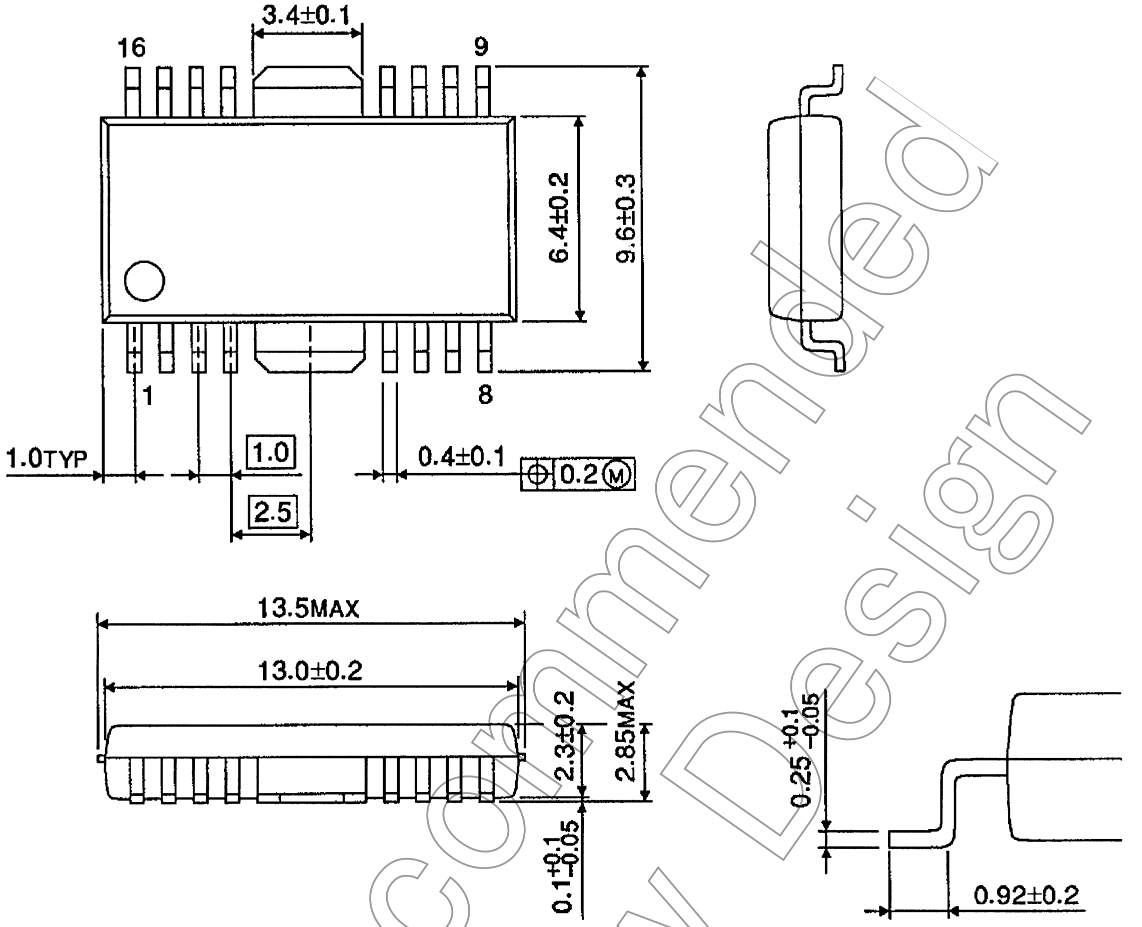
DIP16−P−300−2.54A Unit: mm



Weight: 1.11 g (typ.)

Package Dimensions

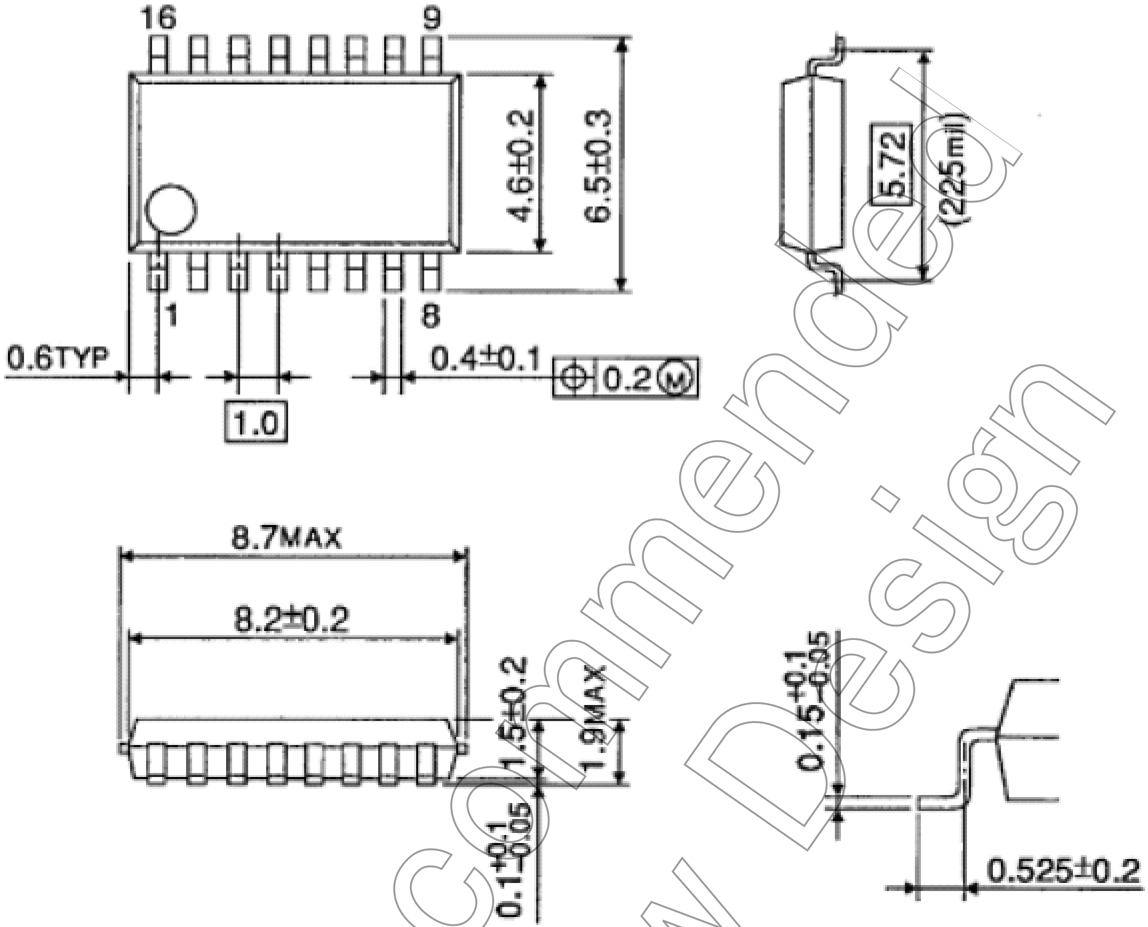
HSOP16−P−300−1.00 Unit: mm



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.
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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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