TOSHIBA BiCD Integrated Circuit Silicon Monolithic

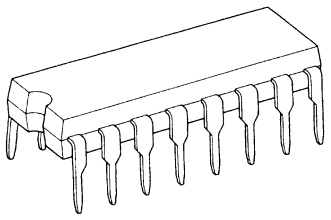
TB6674PG, TB6674FG, TB6674FAG

Stepping Motor Driver IC

TB6674PG, TB6674FG, and TB6674FAG are stepping motor driver ICs with MOS output transistors.

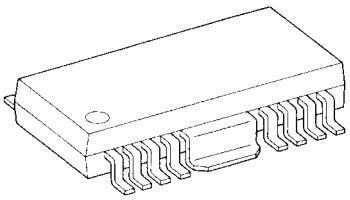
The ICs can control two-phase stepping motor forward and reverse by bipolar driving. They have a power-saving circuit and a standby circuit.

TB6674PG



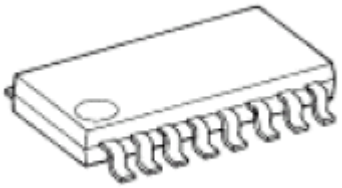
DIP16-P-300-2.54A

TB6674FG



HSOP16-P-300-1.00

TB6674FAG



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.)

Features

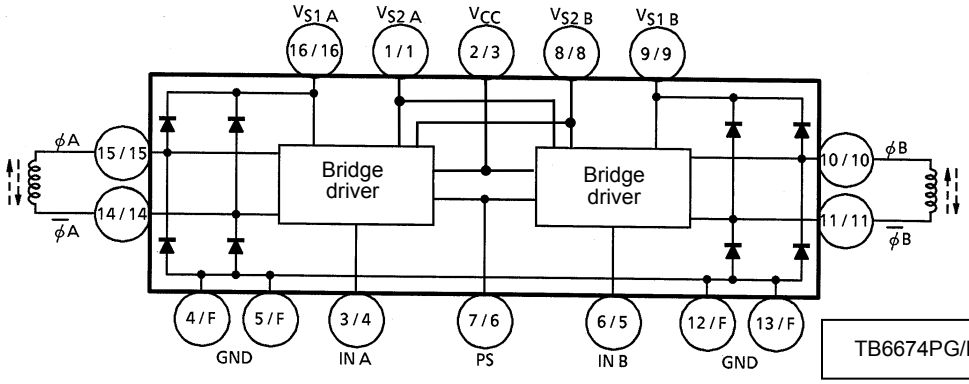
- They are similar substituting products of TA7774PG, TA7774FG, and TA7774FAG. Both products have same packages and same pin assignments.
- One-chip two-phase bipolar stepping motor driver (including two bridge drivers)
- Power saving operation is available.
- Standby operation is available.
  Current consumption ≤ 20 μA (typ.)
- Built-in punch-through current restriction circuit for system reliability and noise suppression.
- TTL-compatible inputs INA, INB, PS, and Vs2B terminals
- ON resistance PS = L : 2.9 Ω (Typ.)
  PS = H: 7.9 Ω (Typ.)
- High driving ability.
  <TB6674PG/FG>
  : $I_{O\ (START)}$ 350 mA (MAX.) : V_{S1} ENABLE
  : $I_{O\ (HOLD)}$ 100 mA (MAX.) : V_{S2} ENABLE
  <TB6674FAG>
  : $I_{O\ (START)}$ 100 mA (MAX.) : V_{S1} ENABLE
  : $I_{O\ (HOLD)}$ 50 mA (MAX.) : V_{S2} ENABLE
- Typical PKG DIP16 pin, HSOP16 pin, SSOP16 pin
- GND terminal = HEAT SINK
- Process :BiCD0.6 (30 V)
- Over current shutdown circuit (ISD).
- Thermal shutdown circuit (TSD).
- Undervoltage lockout circuit (UVLO).
- Pull-down resistance for input terminal (250 kΩ).

The following conditions apply to solderability:
About solderability, following conditions were confirmed

(1)Use of Sn-37Pb solder Bath
·solder bath temperature: 230℃
·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℃
·dipping time: 5 seconds
·the number of times: once
·use of R-type flux

Block Diagram



Note: TB6674FG: Terminals 2, 7, 12, and 13 are NC.

TB6674FG: 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)	φB	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)	φA	Output A
16 / (16)	$V_{S1\ A}$	High-voltage power supply terminal.

Pin No. of ( ) :TB6674FG

Truth Table 1.

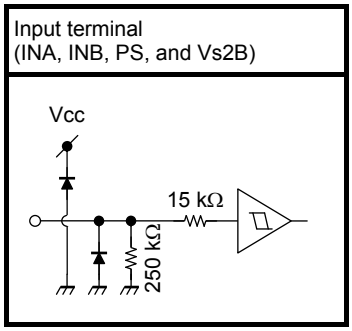
Input		Output		
PS	IN	φ	$\overline{\Phi}$	
L	L	L	H	ENABLE V_{S1}
L	H	H	L	ENABLE V_{S1}
H	L	L	H	ENABLE V_{S2} (Power saving)
H	H	H	L	ENABLE V_{S2} (Power saving)

Truth Table 2.

V_{S2B}	
L	POWER OFF (Standby mode)
H	OPERATION

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

<Terminal circuit>



The diagram is partly-provided and omitted or simplified for explanatory purposes.

Absolute Maximum Ratings (Ta = 25°C)

Characteristic		Symbol	Rating	Unit
Supply voltage		V_{CC}	6.0	V
		V_{S1}	24.0	
		V_{S2}	Up to V_{CC}	
Output current	TB6674PG TB6674FG	$I_{O\ (PEAK)}$	±400	mA
		$I_{O\ (START)}$	±350	
		$I_{O\ (HOLD)}$	±100	
	TB6674FAG	$I_{O\ (PEAK)}$	±200	
		$I_{O\ (START)}$	±100	
		$I_{O\ (HOLD)}$	±50	
Input voltage		V_{IN}	Up to V_{CC}	V
Power dissipation	TB6674PG	P_D	1.4 (Note 1)	W
			2.7 (Note 2)	
	TB6674FG		0.9 (Note 3)	
			1.4 (Note 4)	
	TB6674FAG		0.78 (Note 5)	
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: IC only

Note 4: 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 5: 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.

Operating Conditions (Ta = 25°C)

Characteristic		Symbol	Min.	Typ.	Max.	Unit
Supply voltage		V_{CC}	4.5	−	5.5	V
		V_{S1}	8.0	−	22.0	
		V_{S2A}	2.7	−	5.5	
Output current	TB6674PG TB6674FG	I_O	−	−	±350	mA
	TB6674FAG	I_O	−	−	±100	
Input voltage		V_{IN}	0	−	V_{CC}	V
Maximum frequency of input pulse		f_{IN}	−	−	25	kHz
Minimum resolution of input pulse		t_W	20	−	−	μs

Value of ON resistance tends to increase when the difference between Vs1 and Vs2A becomes 5 V or less.

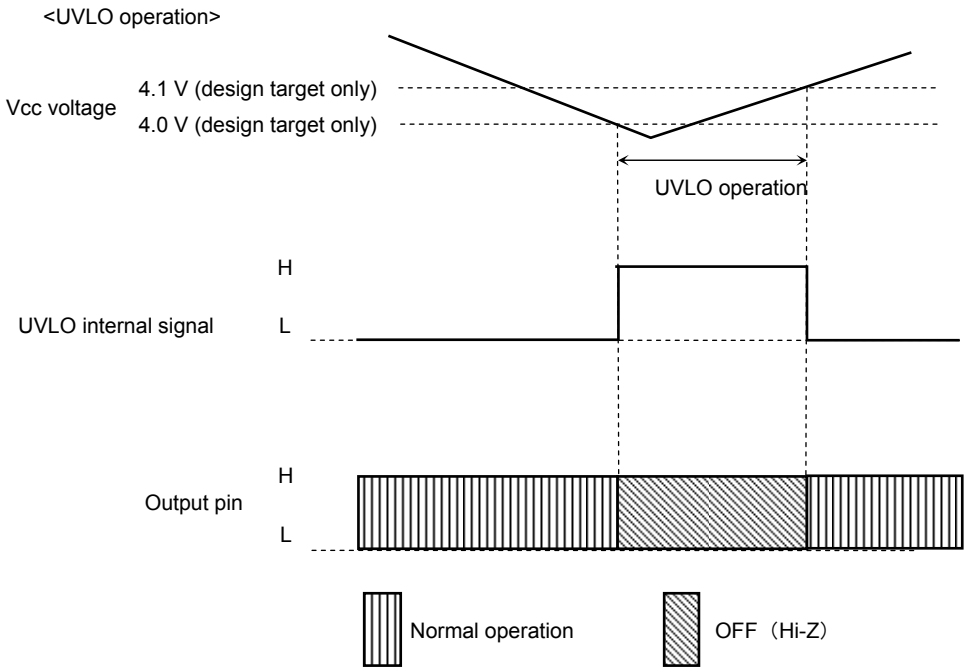
Electrical Characteristics (Unless otherwise specified, Ta = 25°C, V_{CC} = 5 V, V_{S1} = 12 V, and V_{S2A} = 5 V)

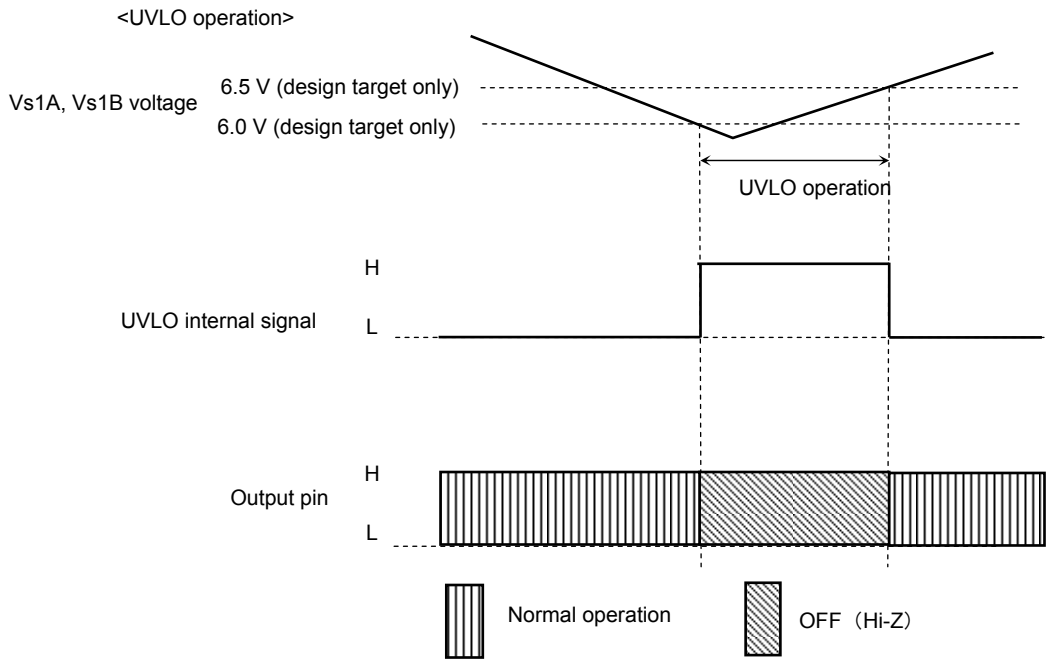
Characteristic		Symbol	Test Cir−cuit	Test Condition		Min	Typ.	Max	Unit
Supply current		I_{CC1}	1	PS: H, V_{S2B}: H		—	3	5	mA
		I_{CC2}		PS: L, V_{S2B}: H		—	3	5	
		I_{CC3}		V_{S2B}: L		—	1	20	μA
Input voltage	High	$V_{IN\,H}$	—	INA, INB, PS, Vs2B		2.0	—	Vcc	V
	Low	$V_{IN\,L}$				−0.2	—	0.8	
Input hysteresis voltage*		V_{INhys}	1			—	90	—	mV
Input current		$I_{IN\,(H)}$	1	INA, INB, PS, Vs2B V_{IN} = 5.0 V Built in pull-down resistance.		5	20	38	μA
		$I_{IN\,(L)}$		V_{IN} = 0 V		—	—	1	μA
Output ON resistance (Note)	TB6674PG TB6674FG	$R_{on\,1H}$	2	PS: L, V_{S2B}: H	I_{OUT} = 400 mA	—	2	5	Ω
		$R_{on\,2H}$	3	PS: H, V_{S2B}: H	I_{OUT} = 100 mA	—	7	16	
		$R_{on\,L}$	2	V_{S2B}: H	I_{OUT} = 400 mA	—	0.9	3.5	
	TB6674FAG	$R_{on\,1H}$	2	PS: L, V_{S2B}: H	I_{OUT} = 200 mA	—	2	5	
		$R_{on\,2H}$	3	PS: H, V_{S2B}: H	I_{OUT} = 50 mA	—	7	16	
		$R_{on\,L}$	2	V_{S2B}: H	I_{OUT} = 200 mA	—	0.9	3.5	
Diode forward voltage		$V_{F\,U}$	4	I_F = 350 mA, PS = L		—	1.2	2.5	V
		$V_{F\,L}$				—	1.0	2.2	
Delay time		t_{pLH}	—	IN − φ		—	0.5	—	μs
		t_{pHL}				—	0.5	—	
Thermal shutdown circuit*		TSD	—	(Design target only)		—	160	—	°C
TSD hysteresis *		TSDhys	—	(Design target only)		—	20	—	°C

* : Toshiba does not implement testing before shipping.

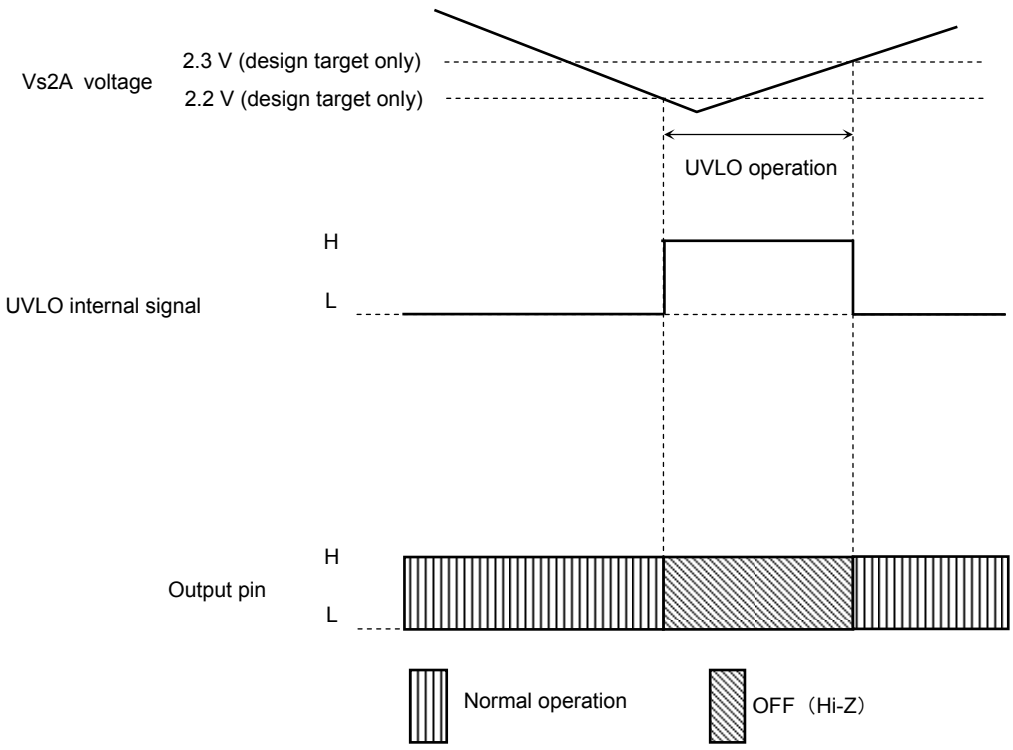
Undervoltage Lockout Circuit（UVLO）

The TB6674 incorporates an under voltage lockout circuit.
Outputs are turned off (Hi-Z) under the conditions as follows;
$V_{CC} \leq 4.0$ V (Design target) or
$V_{S1A} \leq 6.0$ V (Design target) and $V_{S1B} \leq 6.0$ V (Design target) or
$V_{S2A} \leq 2.2$ V (Design target)
The UVLO circuit has a hysteresis and the function recovers under the conditions as follows;
$V_{CC} = 4.1$ V (Design target), V_{S1A}/ $V_{S1B} = 6.5$ V (Design target), $V_{S2A} = 2.3$ V (Design target)





<UVLO operation>



Over Current Protection (ISD) Circuit

The IC incorporates the over current protection circuit that monitors the current flowing through each output power transistor. If a current, which is out of the detecting current, is sensed at any one of these transistors, all output transistors are turned off (Hi-Z). (However, ISD is not incorporated in upper PchDMOS when PS is high level (Vs2A is 5 V usage) because ON resistance is large.

Masking time is 20 µs. The operation does not recover automatically (latch method). There are two recovery methods written below.

(1) Power monitor turns on when any of the power supply decreases and reaches the specified voltage.

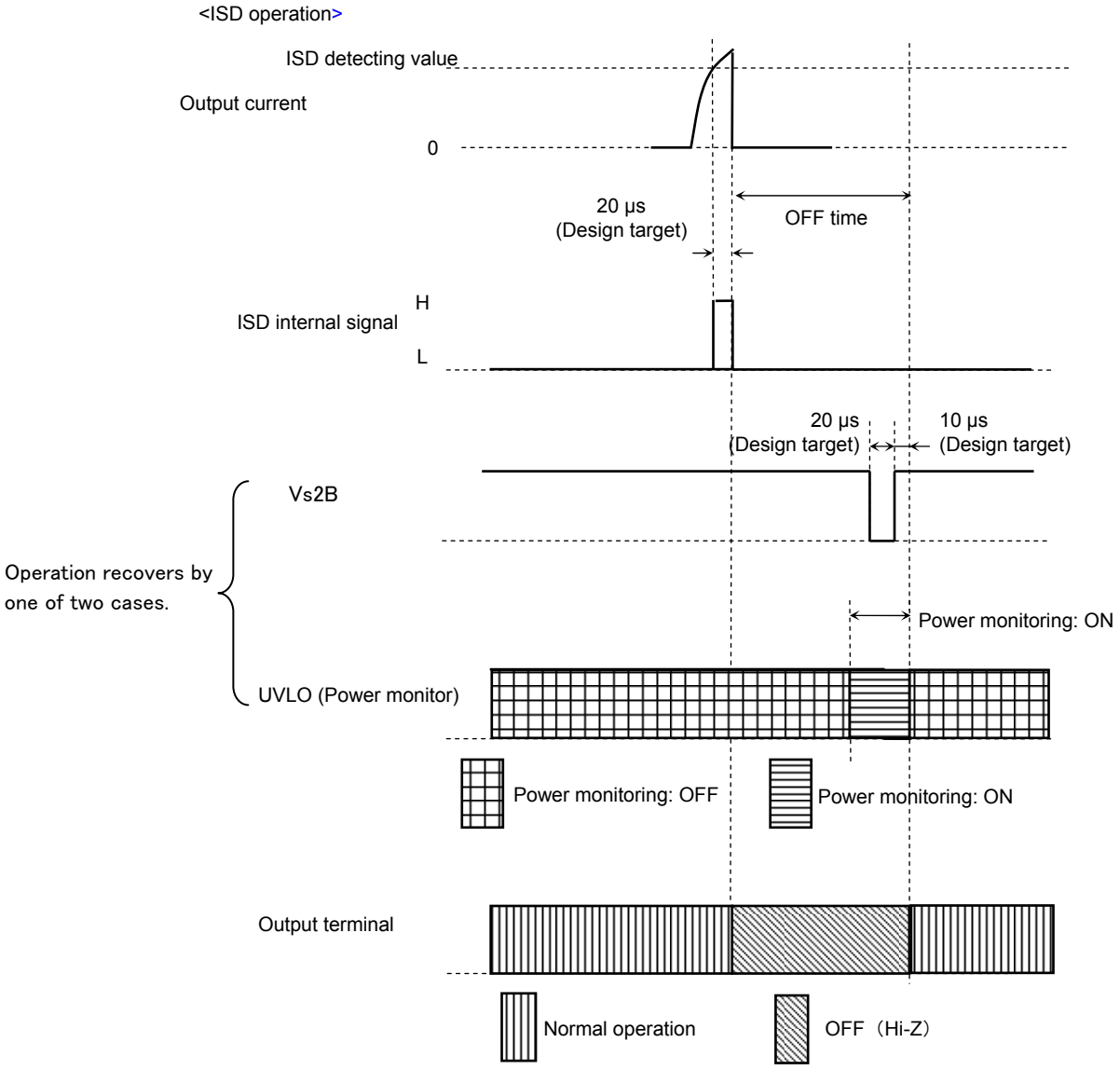
(2) Vs2B is set low level for 20 µs or more and then set high. The operation recovers in 10 µs.

Reference design target of detecting current is as follows;

PS = L, VS1A (12 V) :PchDMOS = 1.1 A

PS = H/PS = L in common :Lower NchDMOS = 1.4 A

Please reduce the external noise to prevent malfunction for ISD.

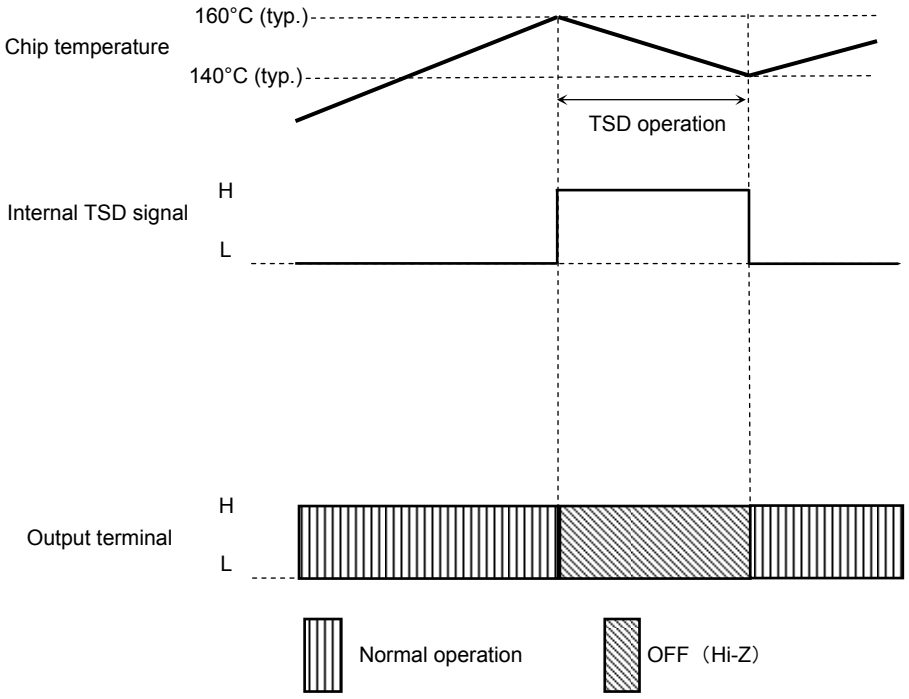


Thermal Shutdown Circuit (TSD)

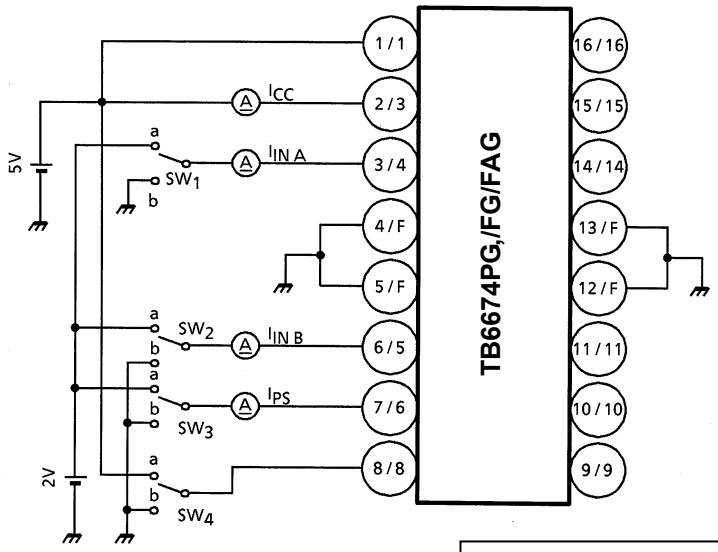
The TB6674 incorporates a thermal shutdown circuit. If the junction temperature (T_j) exceeds 160°C (design target only), all the outputs are tuned off（Hi-Z）.
It recovers automatically at 140℃. It has a hysteresis width of 20℃.

TSD = 160°C (design target only)

< TSD operation >



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

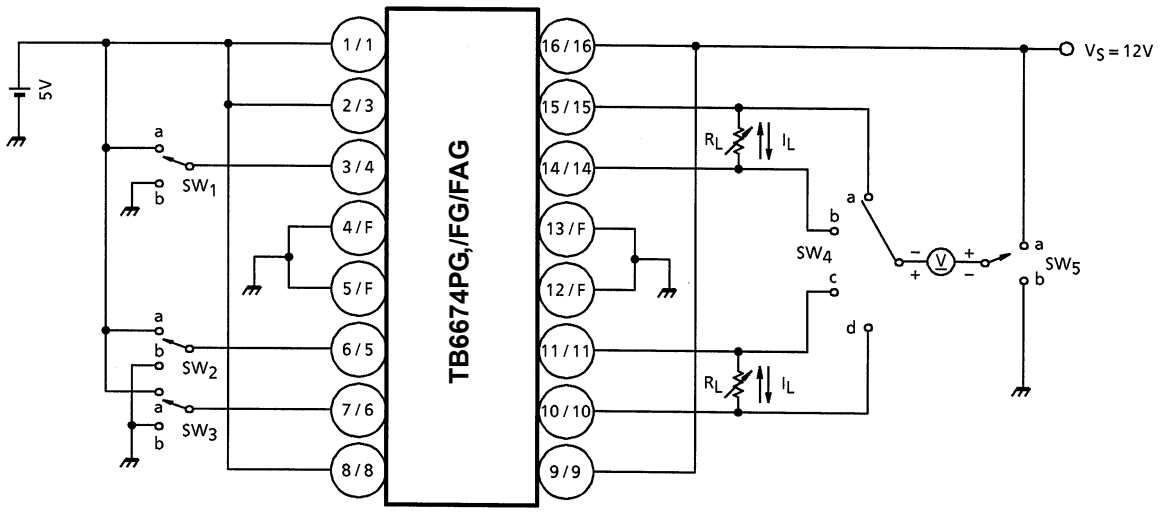


TB6674PG/FAG / TB6674FG

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

All terminals of INA, INB, and PS should output low or be connected to the ground terminal in measuring I_{CC3}.

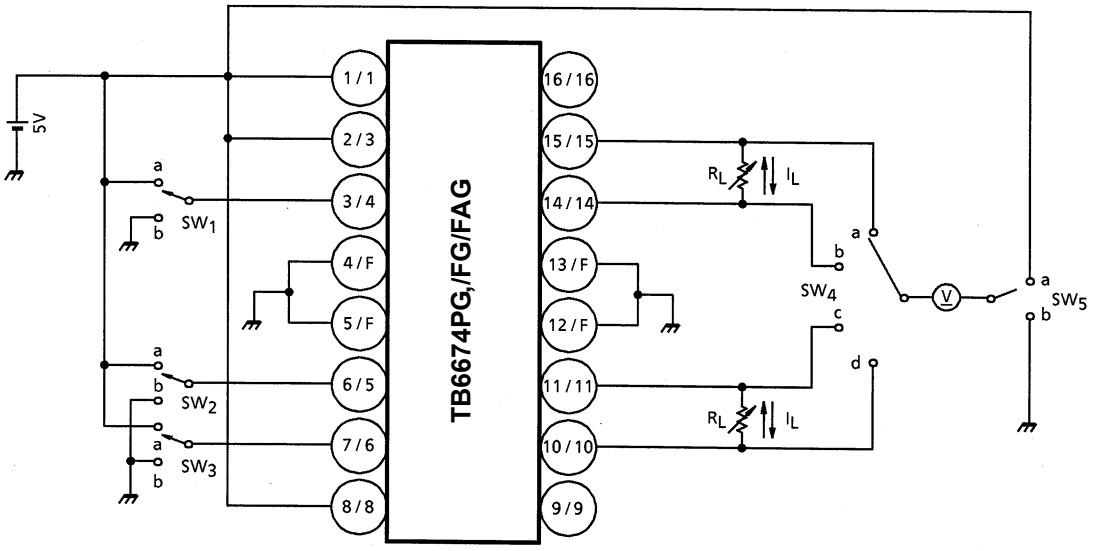
Test Circuit 2. Ron $_{1H1}$, Ron $_{1H2}$, Ron $_{L2}$, and Ron $_{L3}$



*: 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		

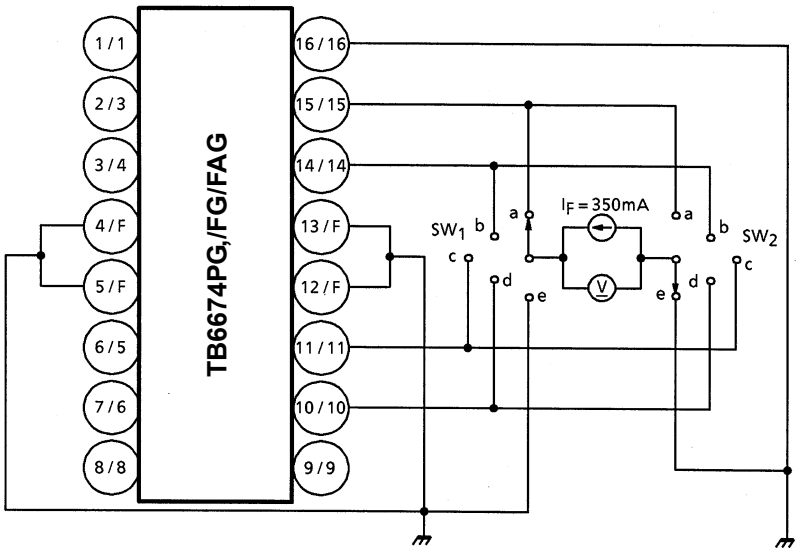
Test Circuit 3. Ron $_{2H1}$, Ron $_{2H2}$, and Ron $_{L1}$



*: 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		

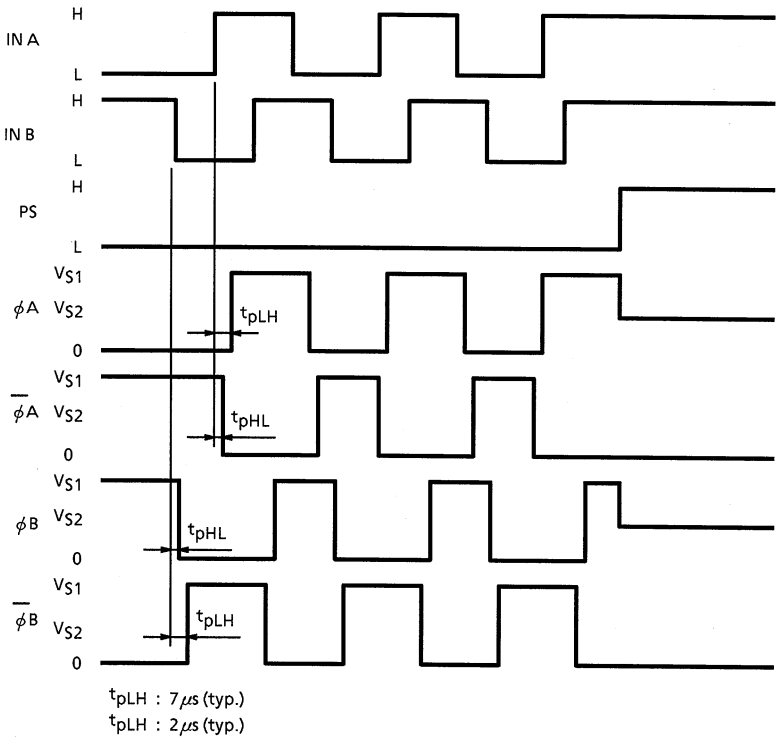
Test Circuit 4. $V_{F\,U}$, and $V_{F\,L}$



Measuring Method

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

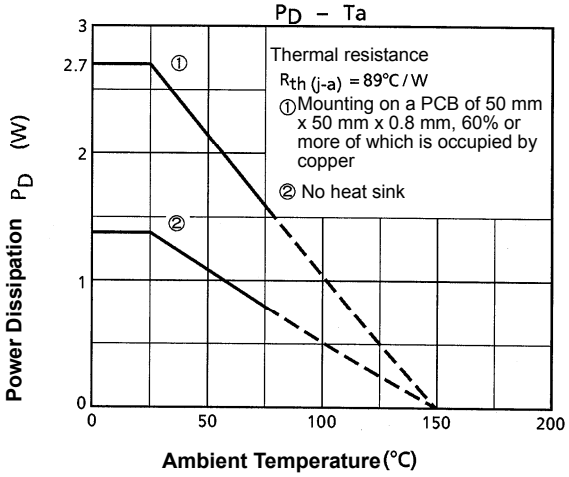
Timing Chart (two-phase excitation)



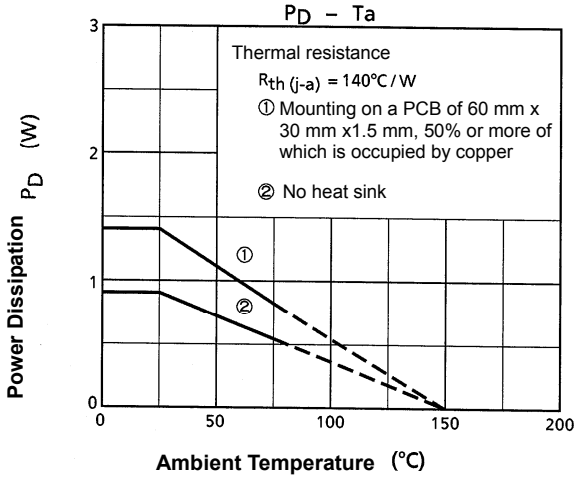
t_{pLH} : 7 μs (typ.)
t_{pLH} : 2 μs (typ.)

Thermal Performance Characteristics

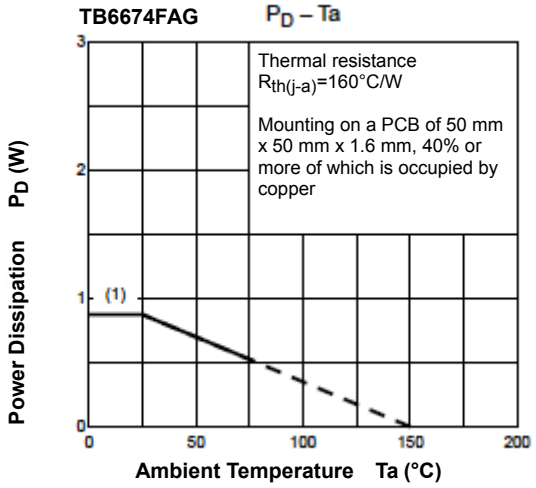
TB6674PG



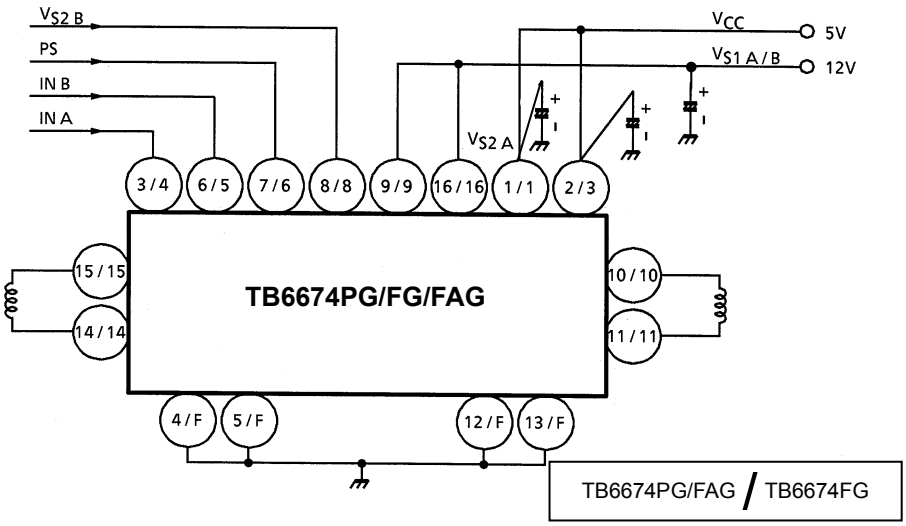
TB6674FG



TB6674FAG



Application Circuit



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

Note 2: Supply smoothing capacitor* should be connected between each supply terminal (Vcc, V_{S2A}, and $V_{S1A/B}$) and GND terminal. *: (Ex.): Capacitors of tens of μF and 0.1 μF which are connected in parallel.

Note 3: 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 terminals.

Note 4: By our short-circuited examination of neighboring terminals, when 9 and 10 terminals or 15 and 16 terminals are short-circuited, the TB6674PG, TB6674FG, and TB6674FAG in any case might to be destroyed and cause the trouble of smoking etc. Please use an appropriate fuse to the power supply line.

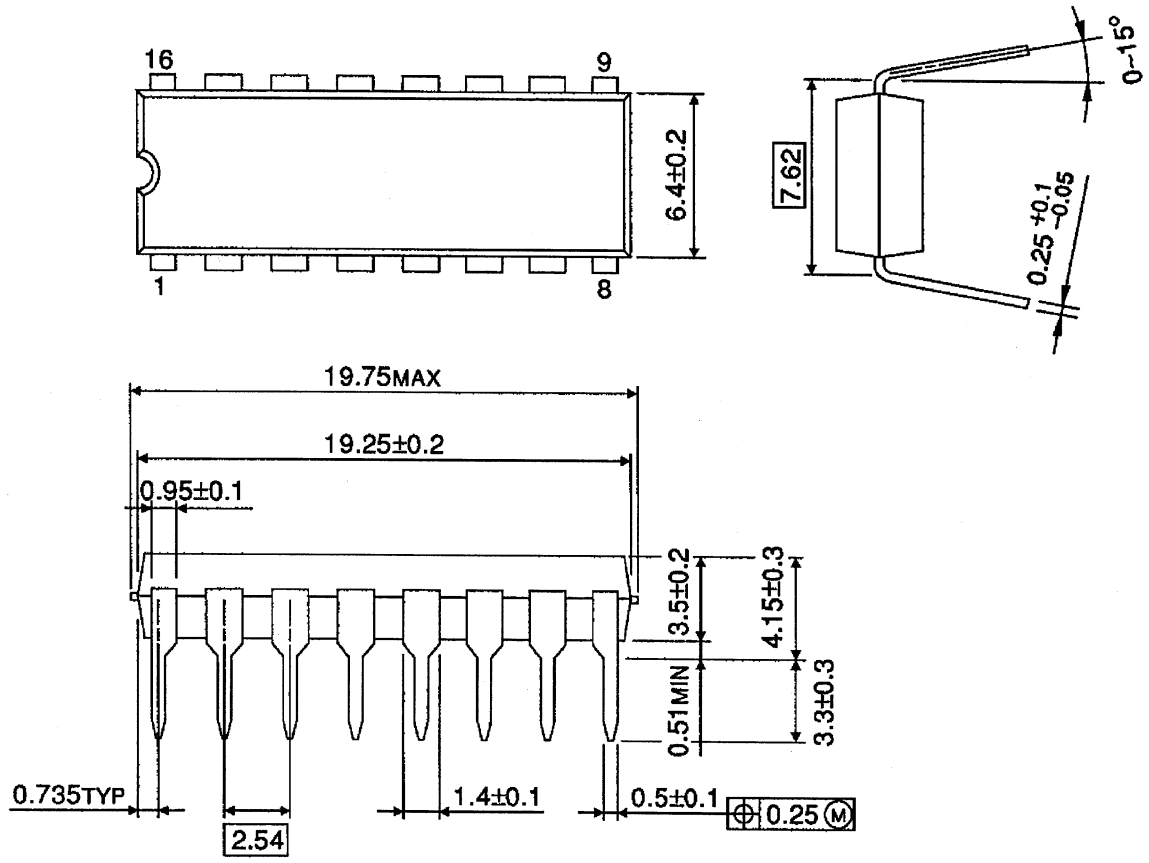
Note 5: Connect V_{S1A} terminal and V_{S1B} terminal externally.

Note 6: Connect each GND terminal externally.

Package Dimensions

DIP16-P-300-2.54A

Unit: mm

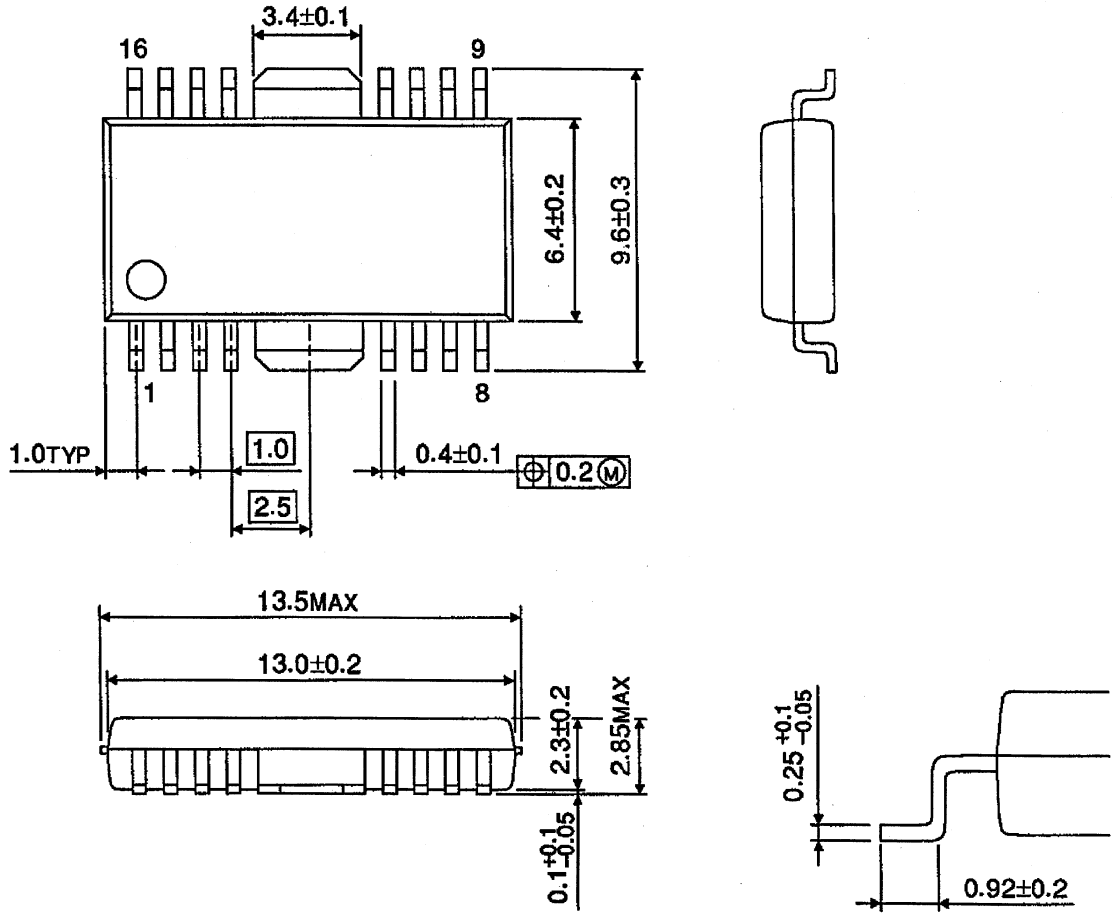


Weight: 1.11 g (Typ.)

Package Dimensions

HSOP16-P-300-1.00

Unit: mm

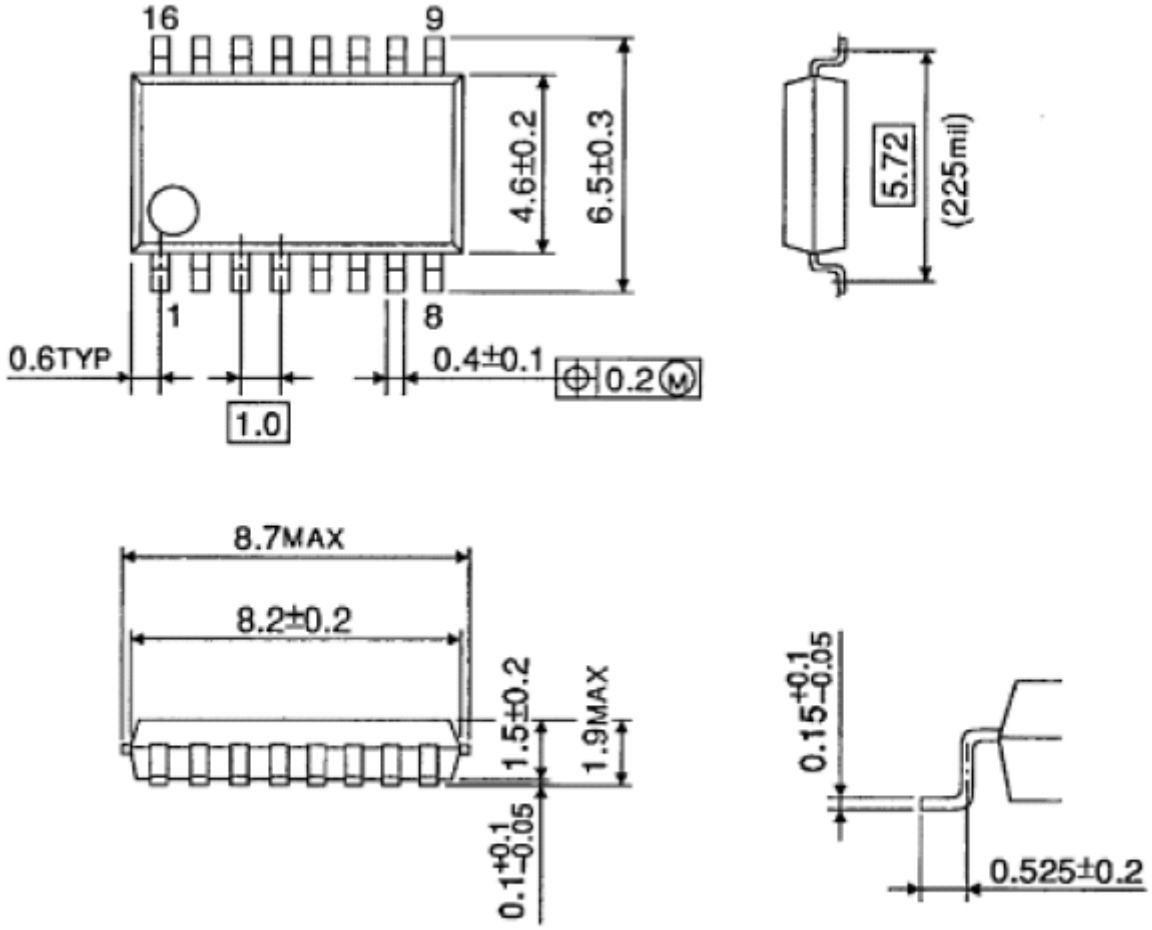


Weight: 0.50 g (Typ.)

Package Dimensions

SSOP16-P-225-1.00A

Unit: mm



Weight: 0.14 g (Typ.)