

TOSHIBA Bipolar Linear Integrated Circuit

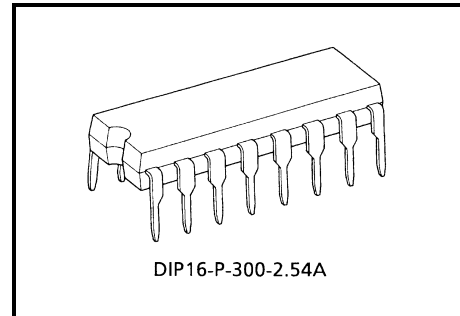
# TA8492P/PG

## Three-Phase Full-Wave Brushless DC Motor Driver IC

The TA8492P/PG is a three-phase full-wave supply voltage control motor driver IC.

### Features

- Output current:  $I_O$  (max) = 1.5 A
- Supply voltage control motor driver
- CW/CCW/STOP function
- Operating voltage range:  $V_{CC}$  (opr.) = 7~18 V  
 $V_S$  (opr.) = 0~18 V

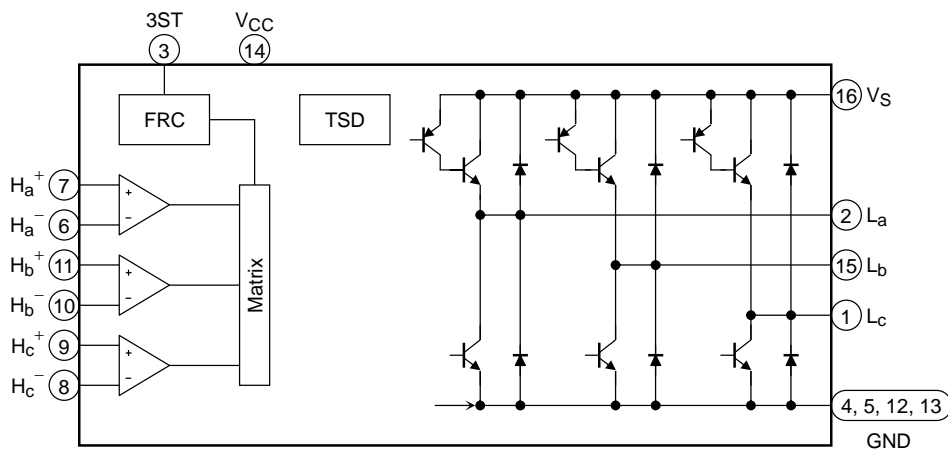


Weight: 1.11 g (typ.)

TA8492PG:  
 The TA8492PG is Pb-free product.  
 The following conditions apply to solderability:  
 \*Solderability

1. Use of Sn-63Pb 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

### Block Diagram



## Pin Function

Pin No.	Symbol	Function
1	$L_c$	c-phase drive output pin
2	$L_a$	a-phase drive output pin
3	3ST	Switching CW/CCW/Stop
4	GND	—
5	GND	—
6	$H_a^-$	a-phase negative hall signal input pin
7	$H_a^+$	a-phase positive hall signal input pin
8	$H_c^-$	c-phase negative hall signal input pin
9	$H_c^+$	c-phase positive hall signal input pin
10	$H_b^-$	b-phase negative hall signal input pin
11	$H_b^+$	b-phase positive hall signal input pin
12	GND	—
13	GND	—
14	$V_{CC}$	Supply voltage pin for control circuits
15	$L_b$	b-phase drive output pin
16	$V_S$	Supply voltage pin for output circuit

## Function

FRS	Hall Input			Output		
	$H_a$	$H_b$	$H_c$	$L_a$	$L_b$	$L_c$
Forward	1	0	1	L	H	M
	1	0	0	L	M	H
	1	1	0	M	L	H
	0	1	0	H	L	M
	0	1	1	H	M	L
	0	0	1	M	H	L
Reverse	1	0	1	H	L	M
	1	0	0	H	M	L
	1	1	0	M	H	L
	0	1	0	L	H	M
	0	1	1	L	M	H
	0	0	1	M	L	H
Stop	1	0	1	High Impedance		
	1	0	0			
	1	1	0			
	0	1	0			
	0	1	1			
	0	0	1			

## Maximum Ratings (Ta = 25°C)

Characteristic	Symbol	Rating	Unit
Supply voltage	V <sub>S</sub>	20	V
	V <sub>CC</sub>	20	V
Output current	I <sub>O</sub>	1.5	A
Power dissipation	P <sub>D</sub>	1.4 (Note 1)	W
		2.7 (Note 2)	
Operating temperature	T <sub>opr</sub>	-30~85	°C
Storage temperature	T <sub>stg</sub>	-55~150	°C

Note 1: Not mounted on the PCB

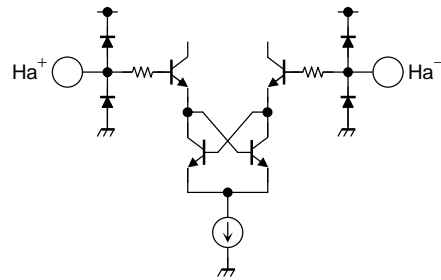
Note 2: Mounted on the PCB (PCB area: 50 × 50 × 0.8 mm cu area: 60% or greater)

## Electrical Characteristics (Ta = 25°C, V<sub>CC</sub> = V<sub>S</sub> = 12 V)

Characteristic		Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Supply current		I <sub>CC-1</sub>	1	V <sub>CC</sub> = 12 V, 3ST: GND, V <sub>S</sub> : Open	—	5.0	7.0	mA
		I <sub>CC-2</sub>		V <sub>CC</sub> = 18 V, 3ST: GND, V <sub>S</sub> : Open	—	6.0	9.0	
		I <sub>CC-3</sub>		Stop (3ST = V <sub>CC</sub> )	—	2.5	4	
Output saturation voltage	Upper	V <sub>SAT (U)</sub>	2	I <sub>O</sub> = 1 A (source current)	—	1.35	1.7	V
	Lower	V <sub>SAT (L)</sub>	3	I <sub>O</sub> = 1 A (sink current)	—	0.4	0.6	
Output leak current	Upper	I <sub>L (U)</sub>	4	V <sub>S</sub> = 20 V	—	—	50	μA
	Lower	I <sub>L (L)</sub>	5	V <sub>S</sub> = 20 V	—	—	50	
Hall amp.	Input sensitivity	V <sub>H</sub>	6	—	20	—	400	mV <sub>p-p</sub>
	Common mode input voltage range	V <sub>CMRH</sub>	7	—	2	—	V <sub>CC</sub> - 3.5	V
CW/CCW control operation voltage	Stop	V <sub>STP</sub>	6	—	V <sub>CC</sub> - 0.4	—	V <sub>CC</sub>	V
	CW	V <sub>FW</sub>		—	2.5	—	6.5	
	CCW	V <sub>RV</sub>		—	0	—	0.4	
Thermal shutdown operating temperature		T <sub>SD</sub>	—	—	—	160	—	°C

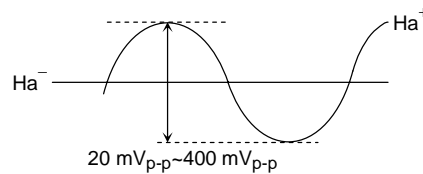
**Functional Description**

- Hall amp. circuit

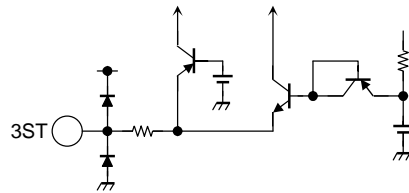


The Hall amp is a high-gain amp. The input sensitivity is 20 mV<sub>p-p</sub> (min). Make sure that the input amplitude does not exceed 400 mV<sub>p-p</sub>.

The common-mode voltage  $V_{CMRH} = 2.0$  to  $V_{CC} - 3.5$  V.



- CW/CCW/Stop control circuit

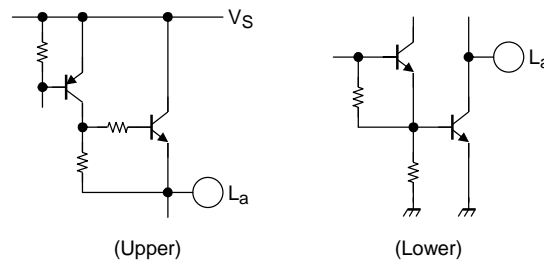


In Reverse mode, the control input (3ST) voltage range is  $V_{RV} = 0$  to 0.4 V. However, keep the voltage as close to the IC GND as possible (see the application circuit diagram).

Similarly, in Stop mode, keep the voltage as close to the IC VCC as possible.

In Forward mode, Toshiba recommend an input voltage of  $V_{CC}/2$ .

- Output circuits



The output circuit uses voltage control where the upper and lower output transistors are saturated and the output current is controlled by the  $V_S$  voltage. To reduce switching noise, connect a snubber capacitor to the output circuit.

- Thermal shutdown circuit

The circuit turns off output when  $T_j = 160^\circ\text{C}$  (typ.) (according to design specification)

## Handling Precautions

### CW/CCW/Stop Control Circuit

- a) At 3ST input, because the input voltage ranges for VRV (Reverse mode) and VSTP (Stop mode) are narrow, make sure no impedance is caused between the IC VCC and GND pins. Do not connect an input resistor to the 3ST pin since doing so will cause voltage offset.
- b) When controlling the rotation direction using 3ST input, switch the direction from Reverse to Stop mode or vice versa with  $V_S = 0\text{ V}$  to eliminate the risk of punch-through current being generated at output.

### Hall Amp. Circuit

A Hall IC input amplitude of over 400 mV<sub>p-p</sub> will cause an output function error. Make sure the amplitude is within the specified range.

### Output Circuits

Particular care is necessary in the design of the output, V<sub>S</sub>, VCC and GND lines since the IC may be destroyed by short circuits between outputs, air contamination faults, or faults resulting from improper grounding.

### External Parts

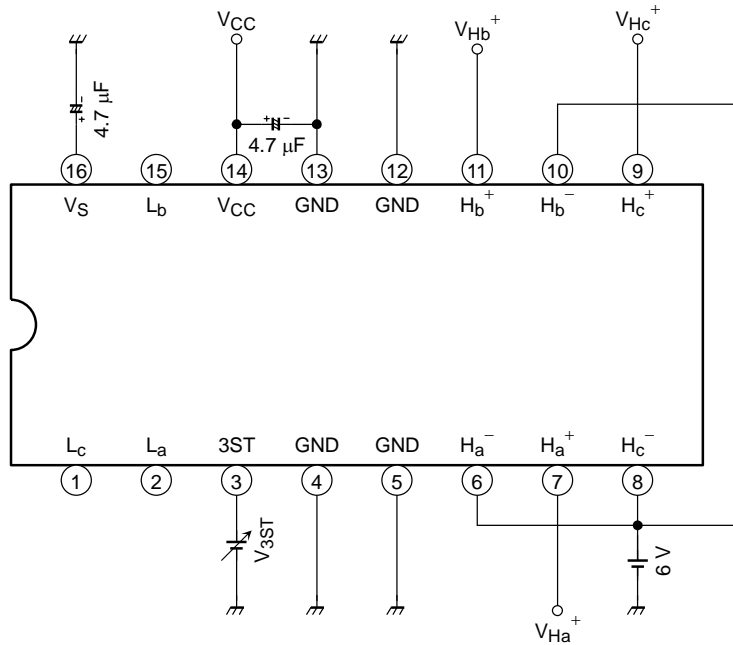
Symbol	Function	Recommended Value	Remarks
C <sub>1</sub>	Power supply line oscillation prevention	4.7 μF	—
C <sub>2</sub>	Power supply line oscillation prevention	4.7 μF	—
C <sub>3</sub>	Output noise reduction	4.7 μF	(Note 3)
R <sub>1</sub>	Hall bias	—	(Note 4)

Note 3: Set an appropriate value depending on the motor and use conditions.  
Set an appropriate value so that the Hall IC output common-mode input voltage and amplitude fall within the specified ranges in the Electrical Characteristics table.

Note 4: Be sure to set this bias so that the Hall element output amplitude and common-mode input voltage fall within the ranges specified in the table of electrical characteristics.

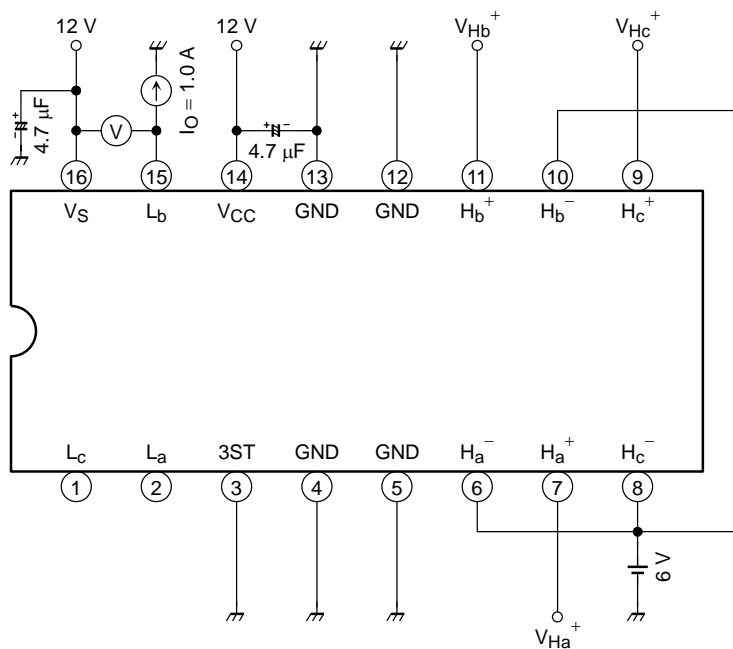
**Test Circuits**

**1. I<sub>CC1</sub>, I<sub>CC2</sub>, I<sub>CC3</sub>**



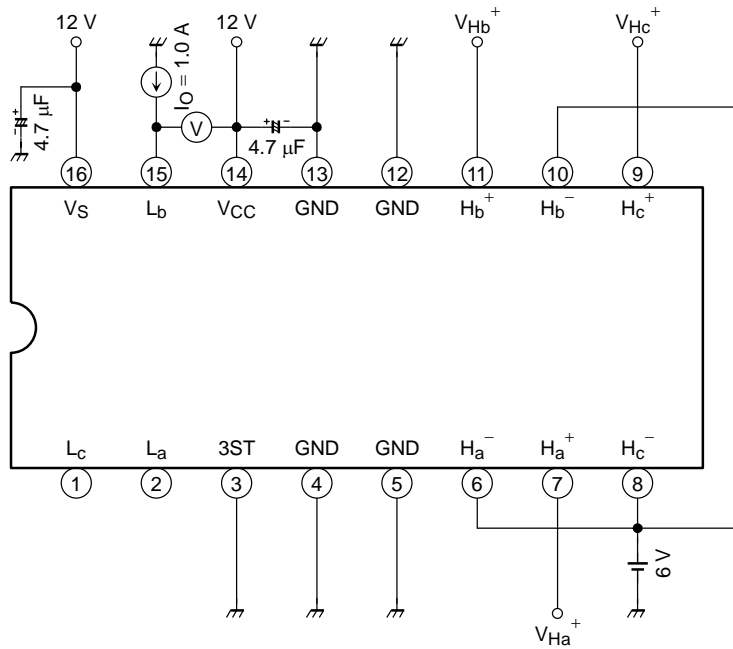
- I<sub>CC1</sub>: Input  $V_{Ha}^+$ ,  $V_{Hb}^+$ ,  $V_{Hc}^+$  (6.01 V/5.99 V).  $V_{CC} = 12\text{ V}/V_{3ST} = \text{GND}$
- I<sub>CC2</sub>: Input  $V_{Ha}^+$ ,  $V_{Hb}^+$ ,  $V_{Hc}^+$  (6.01 V/5.99 V).  $V_{CC} = 18\text{ V}/V_{3ST} = \text{GND}$
- I<sub>CC3</sub>: Input  $V_{Ha}^+$ ,  $V_{Hb}^+$ ,  $V_{Hc}^+$  (6.01 V/5.99 V).  $V_{CC} = 12\text{ V}/V_{3ST} = V_{CC}$

**2. V<sub>SAT</sub> (U)**



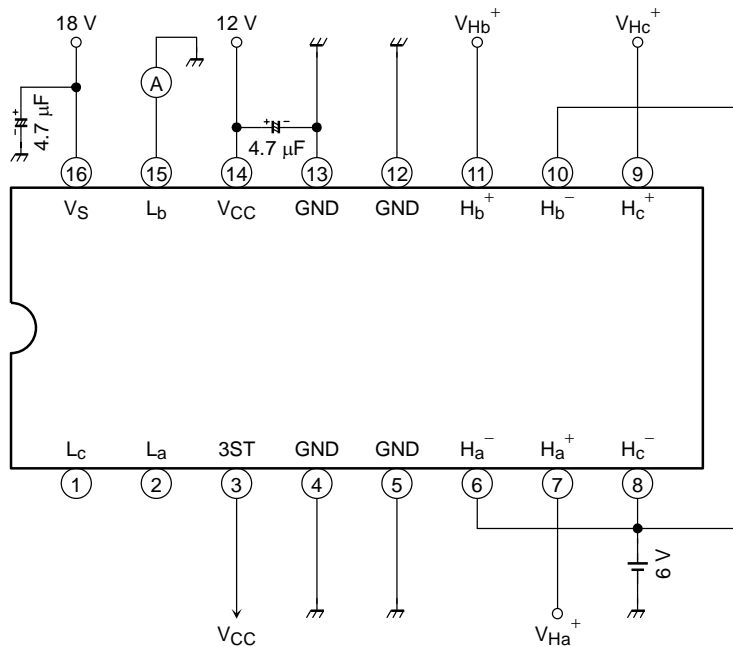
- V<sub>SAT</sub> (U): Input  $V_{Ha}^+$ ,  $V_{Hb}^+$ ,  $V_{Hc}^+$  (6.01 V/5.99 V), check that the output function is at High level, then measure phases a, b, and c.

**3.  $V_{SAT}(L)$**



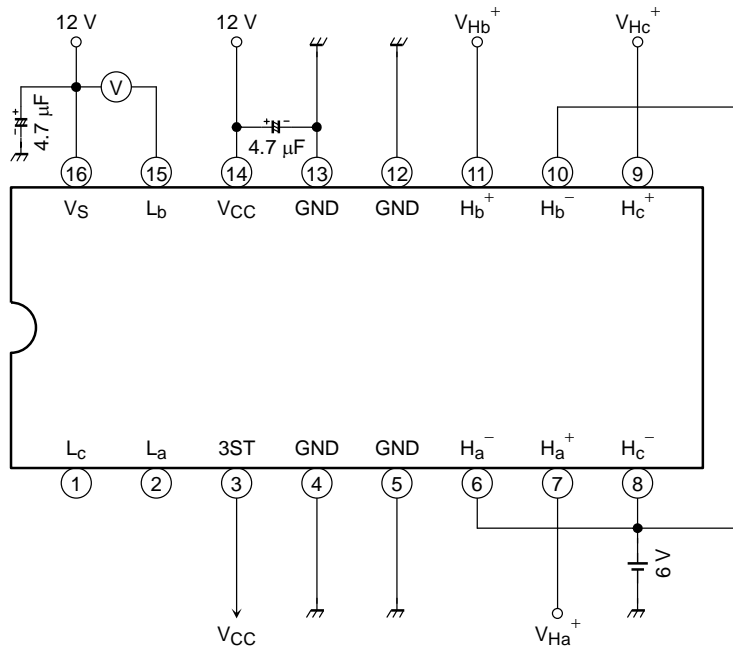
- $V_{SAT}(L)$ : Input  $V_{Ha}^+$ ,  $V_{Hb}^+$ ,  $V_{Hc}^+$  (6.01 V/5.99 V) and check that the output function is "L". (a-phase, b-phase, c-phase)

**4.  $I_L(U)$**



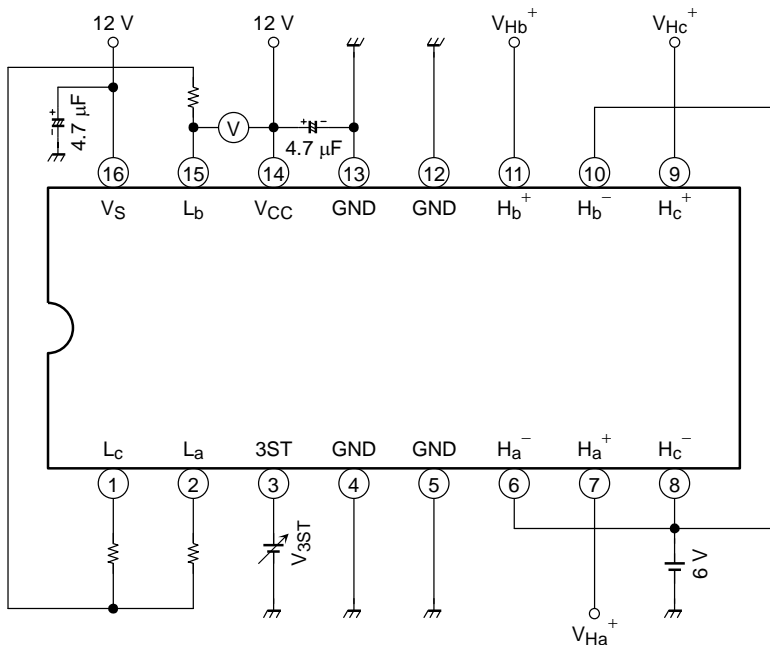
- $I_L(U)$ : Check that the output function is high impedance at  $3ST = V_{CC}$ . (a-phase, b-phase, c-phase)

**5.  $I_L(L)$**



- $I_L(L)$ : Check that the output function is high impedance at  $3ST = VCC$ . (a-phase, b-phase, c-phase)

**6.  $V_H, V_{STP}, V_{FW}, V_{RV}$**

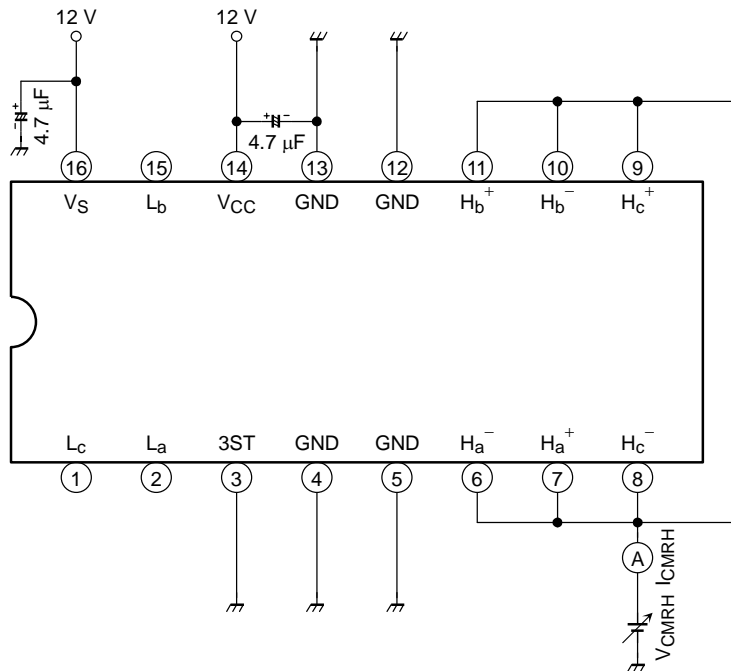


- $V_H$ : Input  $V_{Ha}^+, V_{Hb}^+, V_{Hc}^+$  (6.01 V/5.99 V) and check the output function. (a-phase, b-phase, c-phase) AT  $V_{3ST} = GND$ .
- $V_{STP}$ : When  $V_{3ST}$  is 8.5 V, input  $V_{Ha}^+, V_{Hb}^+, V_{Hc}^+$  (6.01 V/5.99 V), fix the output function, then check that the output function is at high impedance.
- $V_{FW}$ : Input  $V_{Ha}^+, V_{Hb}^+, V_{Hc}^+$  (6.01 V/5.99 V) and check that the output function is forward mode. AT  $V_{3ST} = 2.5 V/6.5 V$ .



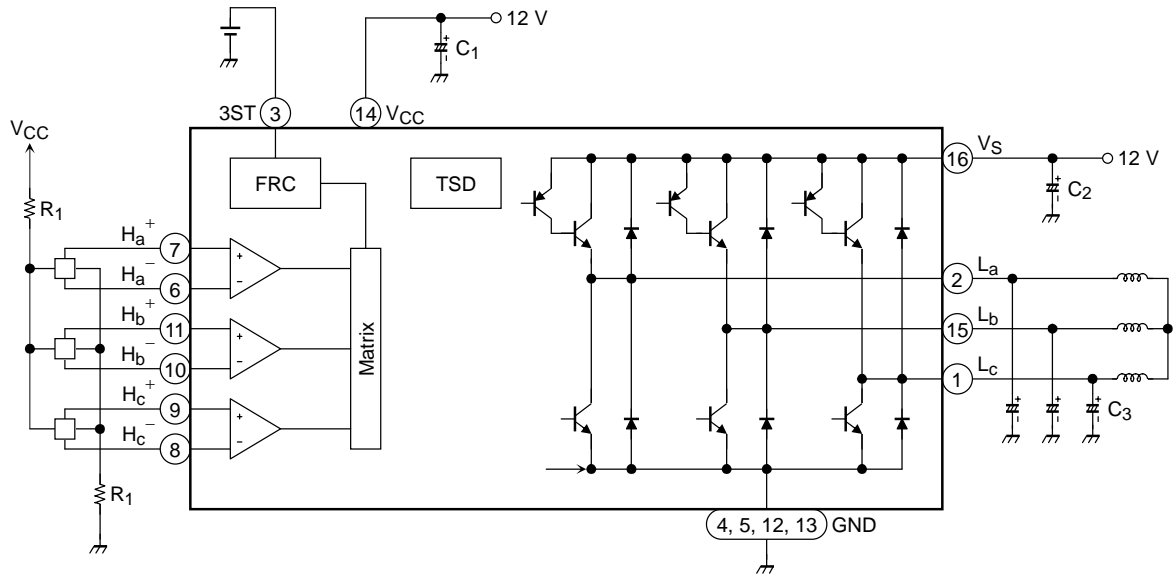
- VRV: Input  $V_{Ha}^+$ ,  $V_{Hb}^+$ ,  $V_{Hc}^+$  (6.01 V/5.99 V) and check that the output function is reverse mode.  
AT  $V_{3ST} = 0.4$  V.

## 7. VCMRH



- VCMRH: Measure the  $I_{CMRH}$  gap between  $V_{CMRH} = 2$  V and 8.5 V.

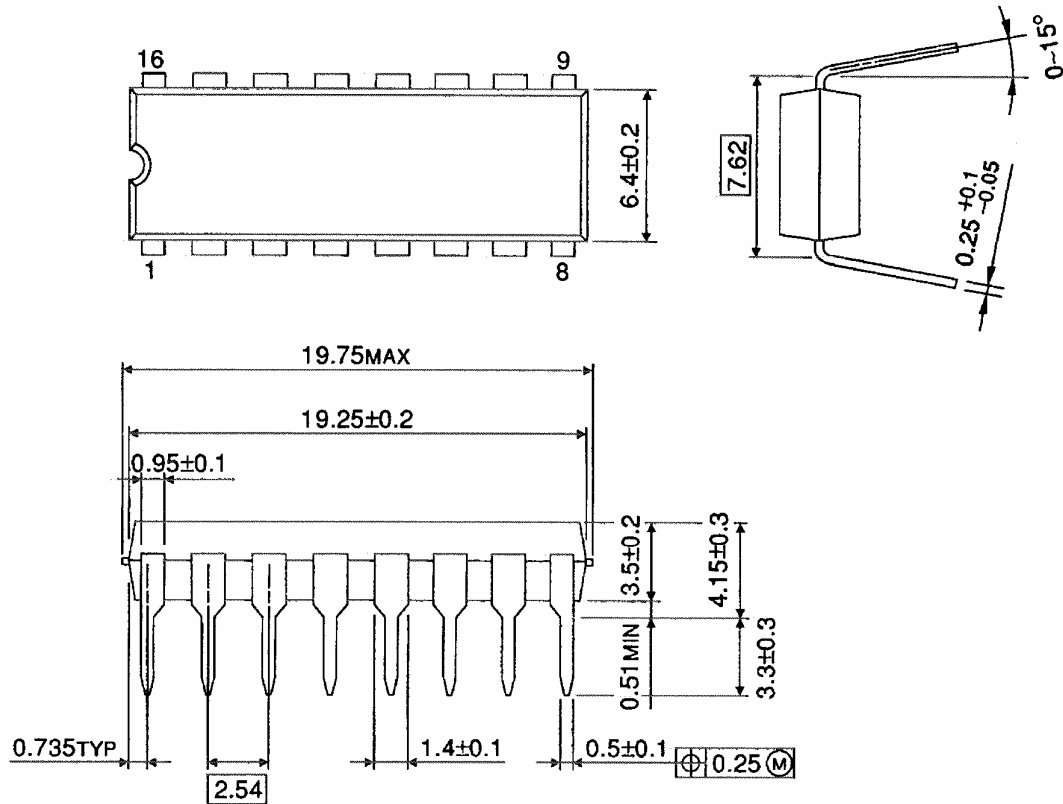
Application Circuit



## Package Dimensions

DIP16-P-300-2.54A

Unit : mm



Weight: 1.11 g (typ.)

## Notes of Contents

### 1. Block Diagrams

Some functional blocks, circuits, or constants may be omitted or simplified in the block diagram 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. Maximum Ratings

The absolute maximum ratings of a semiconductor device are a set of specified parameter values that must not be exceeded during operation, even for an instant.

If any of these ratings are exceeded during operation, the electrical characteristics of the device may be irreparably altered and the reliability and lifetime of the device can no longer be guaranteed.

Moreover, any exceeding of the ratings during operation may cause breakdown, damage and/or degradation in other equipment. Applications using the device should be designed so that no maximum rating will ever be exceeded under any operating conditions.

Before using, creating and/or producing designs, refer to and comply with the precautions and conditions set forth in this document.

### 5. Application Circuits

The application circuits shown in this document are provided for reference purposes only. Thorough evaluation is required, especially in the mass production design phase.

In furnishing these examples of application circuits, Toshiba does not grant the use of any industrial property rights.

### 6. Test Circuits

Components in the test circuits are only used to obtain and confirm the device characteristics. These components and circuits are not guaranteed to prevent malfunction or failure in application equipment.

## Handling of the IC

Ensure that the product is installed correctly to prevent breakdown, damage and/or degradation in the product or equipment.

## Overcurrent Protection and Heat Protection Circuits

These protection functions are intended only as a temporary means of preventing output short circuits or other abnormal conditions and are not guaranteed to prevent damage to the IC.

If the guaranteed operating ranges of this product are exceeded, these protection features may not operate and some output short circuits may result in the IC being damaged.

The overcurrent protection feature is intended to protect the IC from temporary short circuits only.

Short circuits persisting over long periods may cause excessive stress and damage the IC. Systems should be configured so that any overcurrent condition will be eliminated as soon as possible.

## Counter-electromotive Force

When the motor reverses or stops, the effect of counter-electromotive force may cause the current to flow to the power source.

If the power supply is not equipped with sink capability, the power and output pins may exceed the maximum rating.

The counter-electromotive force of the motor will vary depending on the conditions of use and the features of the motor. Therefore make sure there will be no damage to or operational problem in the IC, and no damage to or operational errors in peripheral circuits caused by counter-electromotive force.

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