

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

TA8440H/HQ

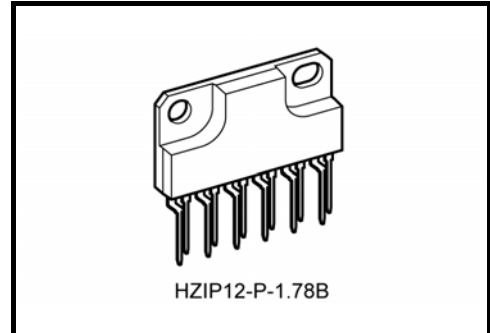
Full-bridge Driver (H-Switch) for DC Motor
(Driver for Switching between Forward and Reverse Rotation)

The TA8440H/HQ is a full-bridge driver for selecting the forward and reverse running of a motor with brushes and can control four modes: forward, reverse, stop and braking.

The motor driving unit and the control unit have a separate power supply line, and the TA8440H/HQ can also be used as a stepping motor driver.

Features

- Output current is up to 1.5 A (AVE.) and 3.0 A (PEAK).
- 4 modes of forward, reverse, stop, and braking are available and a back-electromotive force absorbing diode has been built-in.
- Thermal shutdown circuit incorporated
- Input is compatible with CMOS.
- Built-in input pull-up resistor. BRAKE = 200 k Ω (typ.)
- Built-in input pull-down resistor. IN, ENABLE = 100 k Ω (typ.)



Weight: 4.04 g (typ.)

The TA8440HQ:

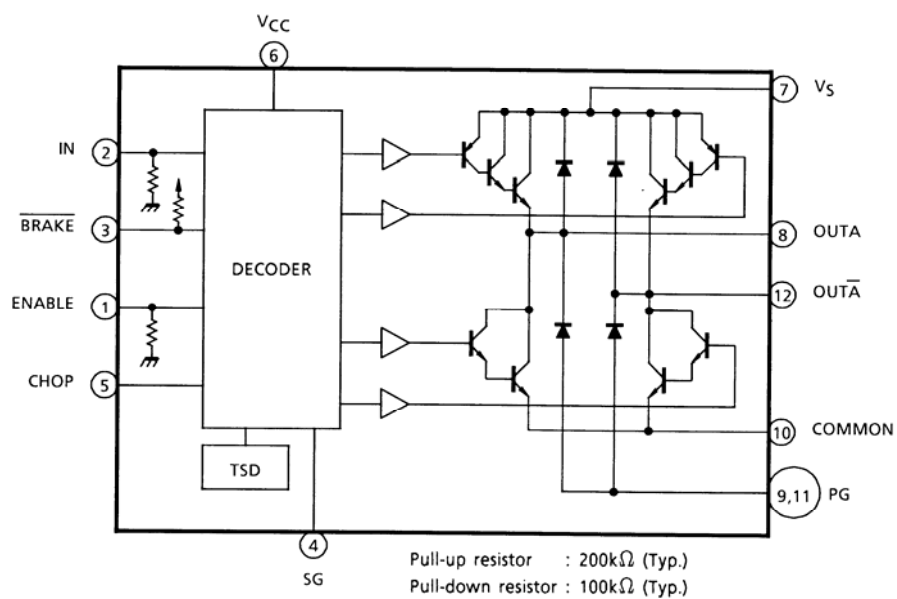
The TA8440HQ is Sn-Ag plated product including Pb.

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
 - *the number of times = once
 - *use of R-type flux

Block Diagram



Pin Function

Pin No.	Symbol	Functional Description
1	ENABLE	ENABLE terminal output is OFF when L
2	IN	Forward rotation/reverse rotation switch terminal
3	$\overline{\text{BRAKE}}$	BRAKE terminal output is OFF when L
4	SG	Signal GND
5	CHOP	PWM signal input terminal
6	V _{CC}	Power voltage supply terminal for control
7	V _S	Power voltage supply terminal for motor driver
8	OUTA	Output terminal
9	PG	Power GND
10	COMMON	COMMON terminal
11	PG	Power GND
12	OUT $\overline{\text{A}}$	Output terminal

TA8440F: 3, 6, 8, 10, 11, 12, 19, 20 pin is No connection.

Function

Input				Output		Mode
IN	BRAKE	ENABLE	CHOP	OUTA	OUT $\overline{\text{A}}$	Motor
H	H	H	L	H	L	CW/CCW
L	H	H	L	L	H	CCW/CW
*	*	L	*	∞	∞	Stop
*	L	H	*	L	L	Brake
H	H	H	H	∞	L	Chop
L	H	H	H	L	∞	Chop

*: Don't care

∞ : High impedance

Absolute Maximum Rating (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Supply voltage		V _{CC}	7	V
		V _S	50	
Input voltage		V _{IN}	-0.3 to V _{CC}	V
Output current	AVE.	I _O (AVE.)	1.5	A
	PEAK	I _O (PEAK)	3.0	A
Power dissipation		P _D	2.25 (Note 1)	W
			25.0 (Note 2)	
Operating temperature		T _{opr}	-30 to 75	°C
Storage temperature		T _{stg}	-55 to 150	°C

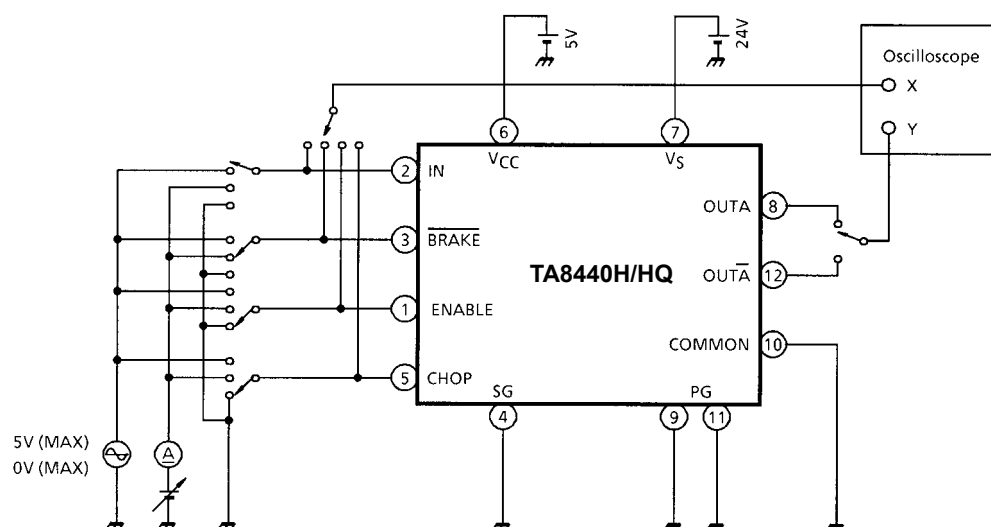
Note 1: No heat sink

Note 2: T_c = 75°C

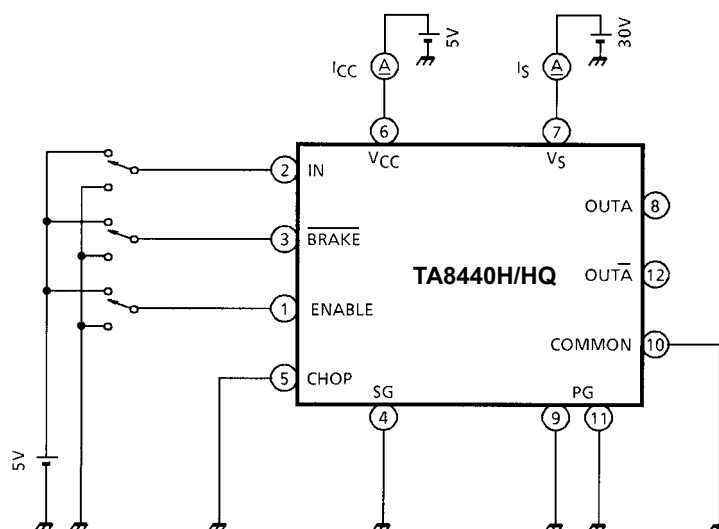
Electrical Characteristics (V_{CC} = 5 V, V_S = 24 V, Ta = 25°C)

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit	
Input voltage	High	V _{IN} (H)	1	IN, CHOP, ENABLE, $\overline{\text{BRAKE}}$		3.5	—	V _{CC}	V	
	Low	V _{IN} (L)				GND	—	1.5		
Input current	High	I _{IN-1} (H)	1	CHOP	V _{IN} = 5 V	—	5	52	μA	
		I _{IN-2} (H)		IN, ENABLE		—	40	60		
		I _{IN-3} (H)		$\overline{\text{BRAKE}}$		—	0	5.5		
Input current	Low	I _{IN-1} (L)		CHOP	V _{IN} = 0 V Source type	—	0	5.5		
		I _{IN-2} (L)		IN, ENABLE		—	0	5.5		
		I _{IN-3} (L)		$\overline{\text{BRAKE}}$		—	25	52		
Current consumption (I)		I _{CC1}	2	Stop		—	6	10.5	mA	
		I _{CC2}		Forward/reverse		—	10	14.5		
		I _{CC3}		Brake		—	14	18.5		
Current consumption (II)		I _{S1}	2	Stop		—	2	4.2	mA	
		I _{S2}		Forward/reverse		—	3.5	5.0		
		I _{S3}		Brake		—	2.5	3.7		
Output saturation voltage	Upper side	V _{sat-U1}	3	I _{OUT} = 1.5A		1.5	2.0	2.7	V	
	Under side	V _{sat-L1}				0.7	1.25	1.9		
	Upper side	V _{sat-U2}		I _{OUT} = 3.0A		2.7	3.0	3.9		
	Under side	V _{sat-L2}				1.7	2.0	2.9		
Diode forward orientation voltage	Upper side	V _{F-U1}	—	I _{OUT} = 1.5A		—	3.5	—	V	
	Under side	V _{F-L1}				—	1.3	—		
Output leakage Current	Upper side	I _{OH}	4	V _S = 30V		—	—	200	μA	
	Under side	I _{OL}				—	—	100		
Shut down temperature		T _{SD}	—	—		—	170	—	°C	
Transfer time		t _{pLH}	—	IN-OUT		—	2.7	—	μs	
		t _{pHL}				—	1.2	—		
		t _{pLH}		CHOP-OUT		—	0.7	—		
		t _{pHL}				—	2.5	—		
		t _{pLH}		ENABLE-OUT		—	2.9	—		
		t _{pHL}				—	1.1	—		
		t _{pLH}		$\overline{\text{BRAKE}}$ -OUT		—	45	—		
		t _{pHL}				—	45	—		

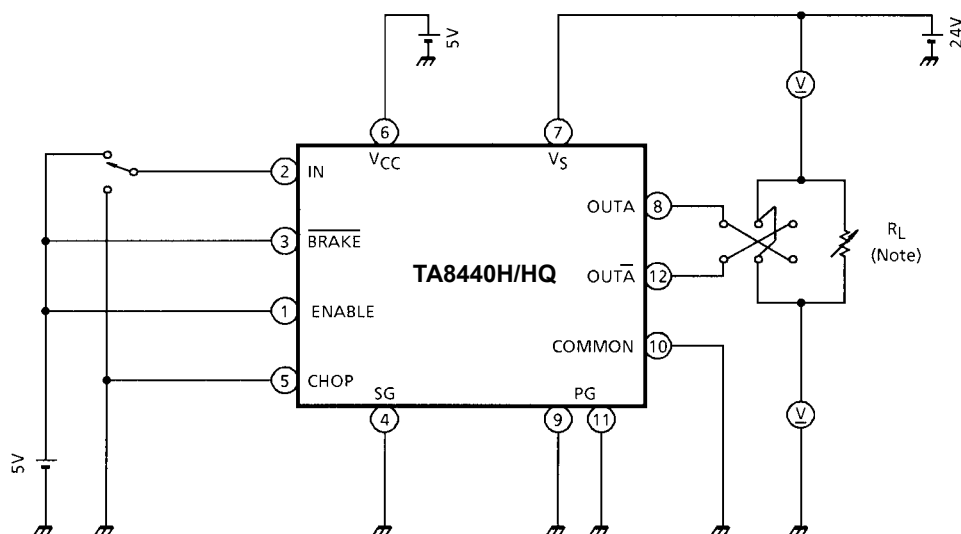
Test Circuit 1 V_{IN} (H), V_{IN} (L), I_{IN} (H), I_{IN} (L)



Test Circuit 2 I_{CC1} , I_{CC2} , I_{CC3} , I_{S1} , I_{S2} , I_{S3}

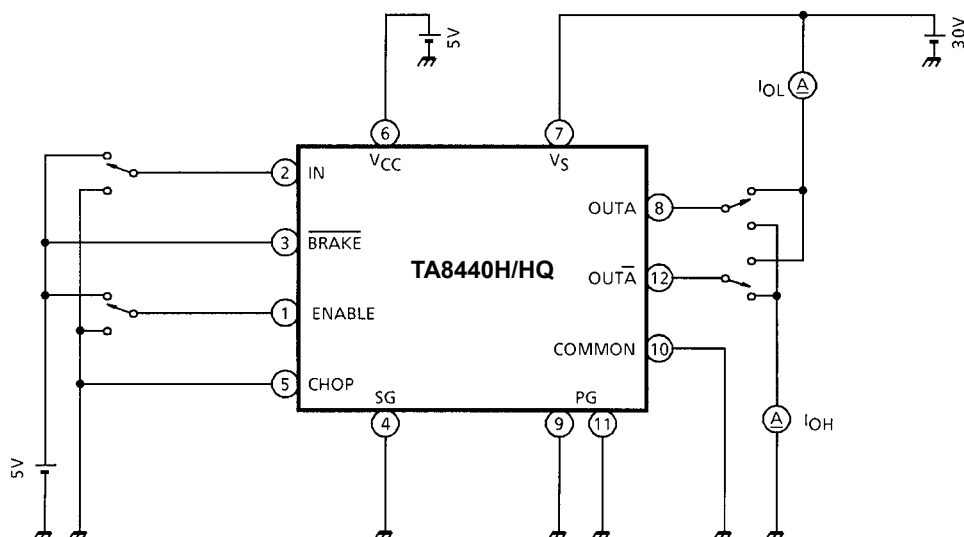


Test Circuit 3 V_{sat-L} , V_{sat-U}

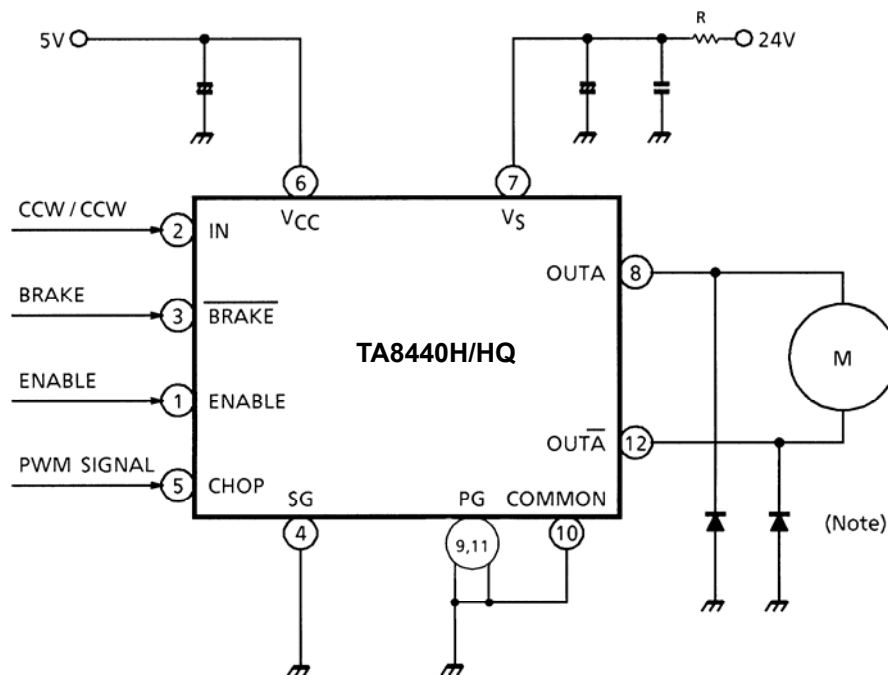


Note: Calibrate I_{OUT} to 1.5 / 3.0 A by R_L .

Test Circuit 4 I_{OH} , I_{OL}



Application Circuit



Note 1: Connect a Schottky diode (Toshiba 2GWJ42 or equivalent) for pass-through current prevention between each of the two outputs and a ground.

Note 2: When turning on the power for the IC, raise V_S after V_{CC} has been raised to its rated level (or V_{CC} and V_S simultaneously). When shutting off the power, drop V_{CC} after V_S (or V_S and V_{CC} simultaneously).

Note 3: Keep the control pins (IN, BRAKE, ENABLE, and CHOP) low before the supply voltage V_{CC} has been raised to its rated level. (Alternatively, raise all these voltages simultaneously.)

Note 4: Insert a current limiting resistor (R) or fuse for over-current protection.

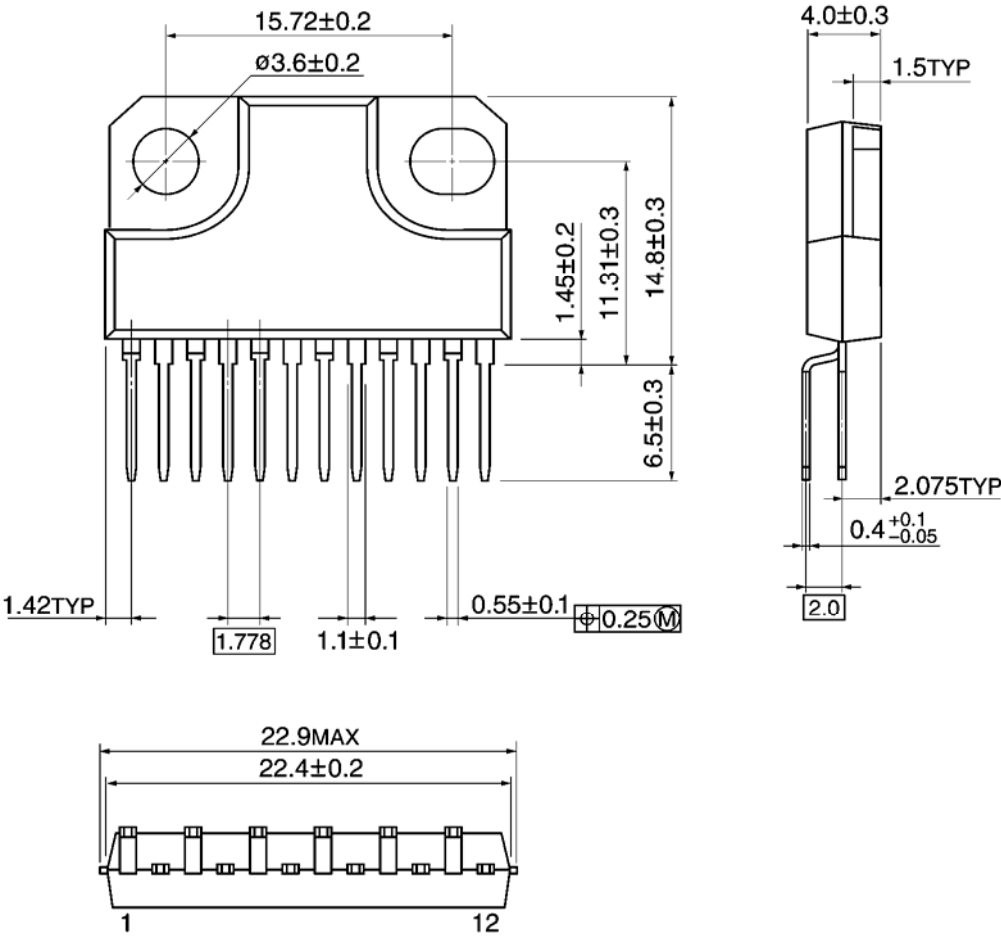
Note 5: The IC contains a thermal circuit breaker. However, if the IC operates over its absolute maximum rating, breakdown may occur before the protection circuit starts operating.

Note 6: 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

HZIP12-P-1.78B

Unit: mm



Weight: 4.04 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) Thermal Shutdown Circuit**

Thermal shutdown circuits do not necessarily protect ICs under all circumstances. If the thermal shutdown circuits operate against the over temperature, clear the heat generation status immediately.

Depending on the method of use and usage conditions, such as exceeding absolute maximum ratings can cause the thermal shutdown circuit to not operate properly or IC breakdown before operation.

(2) 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.

(3) 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.

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