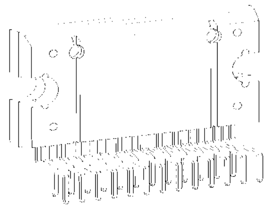
TOSHIBA BiCD Integrated Circuit Silicon Monolithic

TB6600HG

PWM Chopper-Type bipolar Stepping Motor Driver IC

The TB6600HG is a PWM chopper-type single-chip bipolar sinusoidal micro-step stepping motor driver.
Forward and reverse rotation control is available with 2-phase, 1-2-phase, W1-2-phase, 2W1-2-phase, and 4W1-2-phase excitation modes.
2-phase bipolar-type stepping motor can be driven by only clock signal with low vibration and high efficiency.

TB6600HG



HZIP25-P-1.00F

Weight
HZIP25-P-1.00F: 7.7g(typ.)

Features

- PWM constant current drive single-chip bipolar sinusoidal micro-step stepping motor driver
- BiCD 0.13 (50 V) process
- Ron (upper + lower) = 0.4 Ω (typ.)
- Selectable excitation mode (1/1, 1/2, 1/4, 1/8, and 1/16 step)
- Output withstand voltage: V_{CC} = 8 to 42 V (operation range)
  V_{CC} = 50 V (absolute maximum ratings, maximum value)
- Output current: I_{OUT} = 5.0 A (absolute maximum ratings, peak, within 100ms)
  I_{OUT} = 4.5 A (operating range, maximal value)
- Built-in thermal shutdown (TSD) circuit, over-current detection (ISD) circuit, and under voltage lock out (UVLO) circuit.
- Single power supply

Absolute Maximum Ratings (Ta = 25°C)

Characteristic	Symbol	Rating	Unit
Power supply voltage	V_{CC}	50	V
Output current (per one phase)	$I_{O\ (PEAK)}$	5.0/phase (Note 1)	A
Drain current (ALERT, DOWN)	$I_{(ALERT)}$	1	mA
	$I_{(MO)}$		
Input voltage	V_{IN}	6	V
Power dissipation	P_D	3.2 (Note 2)	W
		40 (Note 3)	
Operating temperature	T_{opr}	−30 to 85	°C
Storage temperature	T_{stg}	−55 to 150	°C

Note 1:T = 100ms

Note 2:Ta = 25°C, No heat sink

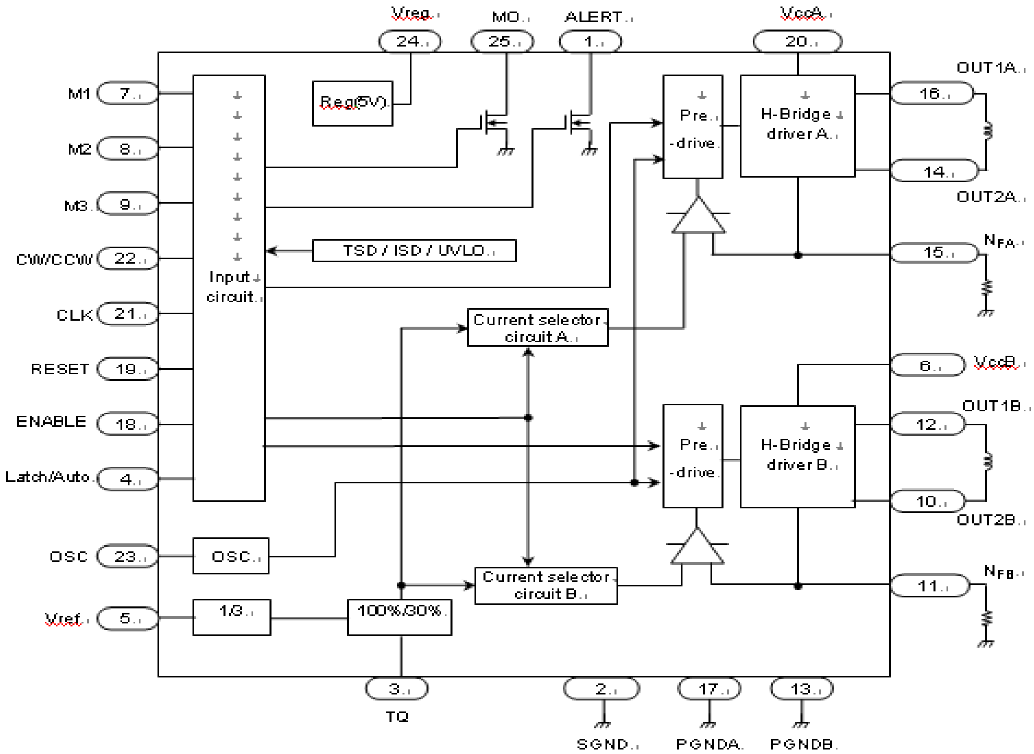
Note 3:Ta = 25°C, with infinite heat sink.

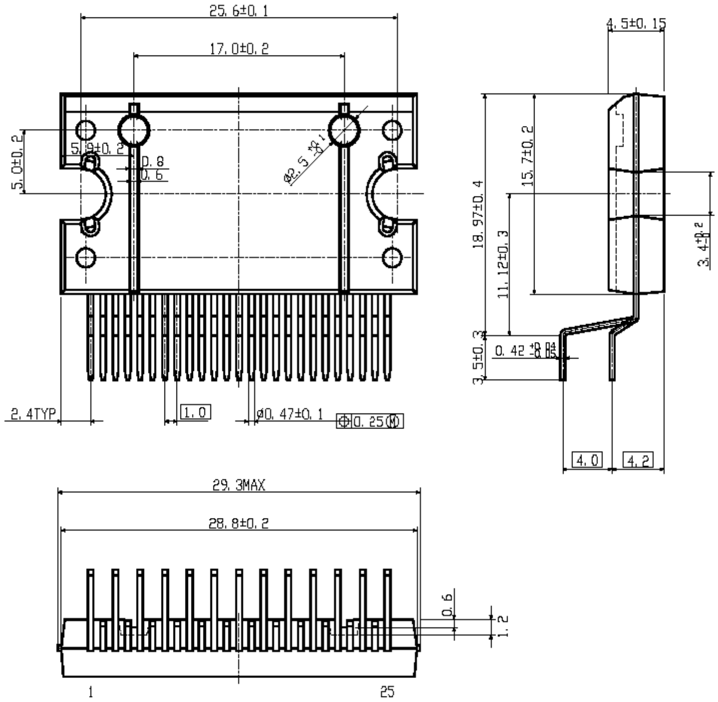
Operating Range (Ta = 25°C)

Characteristic	Symbol	Min	Typ.	Max	Unit
Power supply voltage	V_{CC}	8.0	—	42	V
Output current	I_{OUT}	—	—	4.5	A
Input voltage	V_{IN}	0	—	5.5	V
	V_{ref}	0.3	—	3.5	V
Clock frequency	f_{CLK}	—	—	200	kHz
Chopping frequency	f_{chop}	20	40	60	kHz
OSC frequency	f_{OSC}	2.0	4.0	6.0	MHz

Please use the contents published in this material as a reference. Please inquire about a formal technical data sheet.

Block Diagram





Pin No.	I/O	Symbol	Function
1	Output	ALERT	TSD / ISD monitor pin
2	—	SGND	Signal ground
3	Input	TQ	Torque (output current) setting input pin
4	Input	Latch/Auto	Select a return type for TSD.
5	Input	Vref	Voltage input for 100% current level
6	Input	VccB	B channel Power supply
7	Input	M1	Excitation mode setting input pin
8	Input	M2	Excitation mode setting input pin
9	Input	M3	Excitation mode setting input pin
10	Output	OUT2B	B channel output 2
11	—	N_{FB}	B channel output current detection pin
12	Output	OUT1B	B channel output 1
13	—	PGNDB	Power ground
14	Output	OUT2A	A channel output 2
15	—	N_{FA}	A channel output current detection pin
16	Output	OUT1A	A channel output 1
17	—	PGNDA	Power ground
18	Input	ENABLE	Enable signal input pin
19	Input	RESET	Reset signal input pin
20	Input	V_{CCA}	A channel Power supply
21	Input	CLK	CLK pulse input pin
22	Input	CW/CCW	Forward/reverse control pin
23	—	OSC	Resistor connection pin for internal oscillation setting
24	Output	V_{reg}	Control side connection pin for power capacitor
25	Output	MO	Electrical angle monitor pin

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

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Input voltage	High	$V_{IN\ (H)}$	M1, M2, M3, CW/CCW, CLK, RESET, ENABLE, Latch/Auto, and TQ	2.0	—	5.5	V
	Low	$V_{IN\ (L)}$		−0.2	—	0.8	
V_{CC} supply current		Icc_1	Output open, RESET: H, ENABLE: H, M1:L, M2:L, M3:H (1/1-step mode) CLK:L	—	3.1	7	mA
		Icc_3	Standby mode (M1:L, M2:L, M3:L)	—	1.8	4	
Minimum CLK pulse width		tw_{CLKH}		2.2	—	—	μs
		tw_{CLKL}					
Output residual voltage		V_{OL} MO	I_{OL} = 1 mA	—	—	0.5	V
		V_{OL} ALERT					
Internal constant voltage		Vreg	External capacitor = 0.1 μF (in standby mode)	4.5	5.0	5.5	V
TSD operation temperature (Note)		TSD	Design target value	—	160	—	°C
TSD hysteresis(Note)		TSDhys	Design target value	—	90	—	°C
Over current detection current (Note)		ISD	All outputs, Design target value	—	6.5	—	A
Oscillation frequency		f_{OSC}	External resistance R_{OSC} = 51 kΩ	2.8	4	5.2	MHz
Output ON resistor		$Ron_U + Ron_L$	I_{OUT} = 4 A	—	0.4	0.6	Ω

Note: Pre-shipment testing is not performed.

Description of Functions

(1) Excitation Settings

Input			Mode (Excitation)
M1	M2	M3	
L	L	L	Standby mode (Operation of the internal circuit is almost turned off.)
L	L	H	1/1 (2-phase excitation, full-step)
L	H	L	1/2A type (1-2 phase excitation A type) (0% - 71% - 100%)
L	H	H	1/2B type (1-2 phase excitation B type) (0% - 100%)
H	L	L	1/4 (W1-2 phase excitation)
H	L	H	1/8 (2W1-2 phase excitation)
H	H	L	1/16 (4W1-2 phase excitation)
H	H	H	Standby mode (Operation of the internal circuit is almost turned off.)

(2)Function (I/O truth table)

Input				Output mode
CLK	CW/CCW	RESET	ENABLE	
↑	L	H	H	CW
↑	H	H	H	CCW
X	X	L	H	Initial mode
X	X	X	L	Z

X: Don't Care

Notes on Contents

Block Diagrams

Some of the functional blocks, circuits, or constants in the block diagram may be omitted or simplified for explanatory purposes.

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) Over current Protection Circuit
Over current protection circuits (referred to as current limiter circuits) do not necessarily protect ICs under all circumstances. If the over current protection circuits operate against the over current, clear the over current status immediately.
Depending on the method of use and usage conditions, such as exceeding absolute maximum ratings can cause the over current protection circuit to not operate properly or IC breakdown before operation. In addition, depending on the method of use and usage conditions, if over current continues to flow for a long time after operation, the IC may generate heat resulting in breakdown.

(2) 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.

(3) 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.

(4) 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 absolute maximum ratings. To avoid this problem, take the effect of back-EMF into consideration in system design.

(5) Others
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.

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