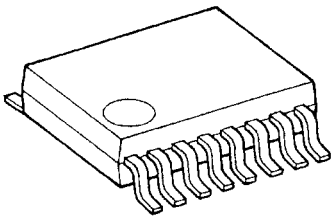
Toshiba Bi-CD Integrated Circuit Silicon Monolithic

T B 6 6 1 4 F N G (Target Spec)

DC Motor Driver

TB6614FNG is a driver IC for DC motor with output transistor in LD MOS structure with low ON-resistor. Two input signals, IN1 and IN2, can choose one of four modes such as CW, CCW, short brake, and stop mode.



SSOP16-P-225-0.65B

Weight: 0.07 g (Typ)

Features

- Supply Voltage ; VM=15V（Max.）
- Output Current ; Iout=1.2A(ave)／3.2A (peak)
- Output low-ON resistor ; 0.4Ω (Upper＋Lower Typ. Target @Vcc=VM=5V)
- Standby（Power save）system
- CW/CCW/short brake/stop function modes
- Direct-PWM control terminal included
- Built-in thermal shutdown circuit and low voltage detecting circuit
- Small package SSOP16（0.65mm pitch）
- Response to Pb free packaging

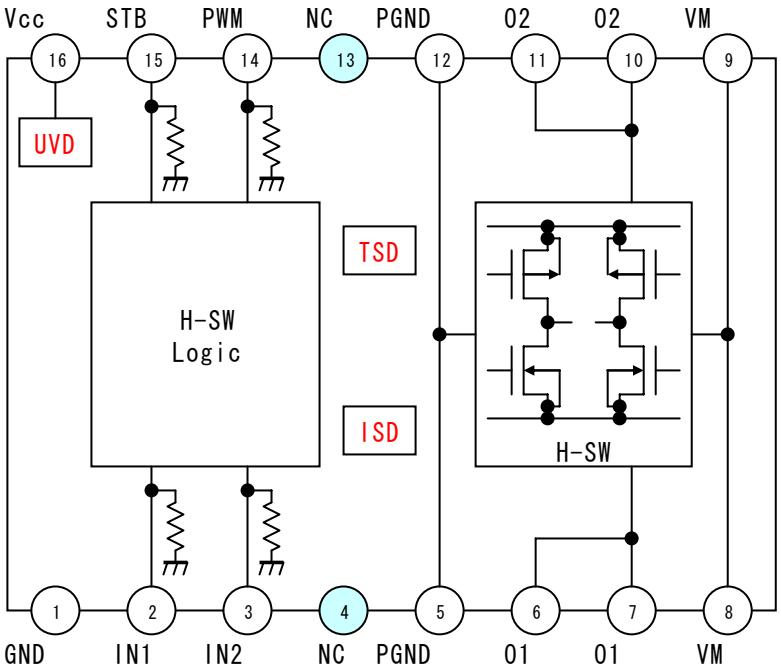
This product has a MOS structure and is sensitive to electrostatic discharge. When handling this product, ensure that the environment is protected against electrostatic discharge by using an earth strap, a conductive mat and an ionizer. Ensure also that the ambient temperature and relative humidity are maintained at reasonable levels.

About solderability, following conditions were confirmed

(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



Pin functions

PinNO.	Symbol	I/O	Description	Remarks
1	GND	—	Small signal GND	Small signal GND
2	IN1	I	Control signal input1	200kΩ pull down R included
3	IN2		Control signal input2	
4	NC	—	Non connection pin	
5	PGND	—	Power GND	Motor GND
6	O1	O	Output1	
7	O1			
8	VM	—	Motor supply voltage	VM=2.5V to 13.5V
9	VM		Motor supply voltage	
10	O2	O	output2	
11	O2			
12	PGND	—	Power GND	Motor GND
13	NC	—	Non connection pin	
14	PWM	I	PWM signal input	200kΩ pull down R included
15	STB		STB signal input	
16	Vcc	—	Small signal supply voltage	Vcc=2.7V to 5.5V

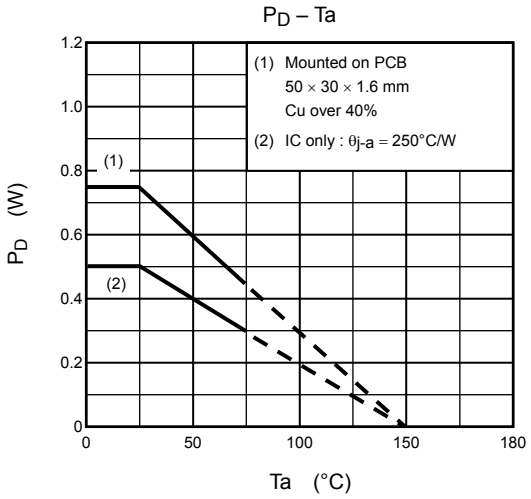
Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit	Remarks
Supply voltage	VM	15	V	
	Vcc	6		
Input voltage	VIN	-0.2～6	V	IN1,IN2,PWM,STBY
Output voltage	Vout	-0.2～15	V	O1,O2
Output current	Iout	1.2	A	
	Iout (pulse)	3.2		tw=20ms pulse, Duty=20%
	Iout (peak)	4.5		tw=50ms、single pulse
Power dissipation	PD	0.78	W	Mounted on 50×50×1.6mm Cu40% PCB
		0.5		IC only（θj-a=250°C /W）
Operation temperature	Topr	-20～85	°C	
Storage temperature	Tstg	-55～150	°C	

Operating Range (Ta=-20°C to 85°C)

Characteristics	Symbol	Min.	Typ.	Max.	unit	remarks
Supply voltage	Vcc	2.7	3	5.5	V	
	VM	2.5	5	13.5	V	
Output current	Iout	---	---	1	A	VM≧4.5V
		---	---	0.5		2.5V≦VM＜4.5V
Switching Frequency	fPWM	---	---	200	kHz	

PD-Ta (for reference)

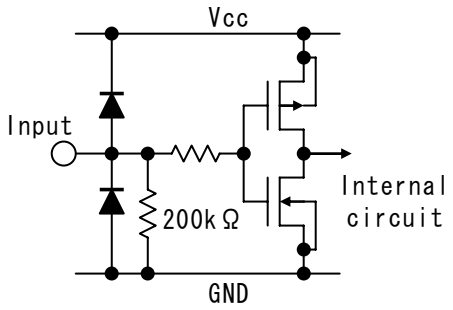


Control function truth table

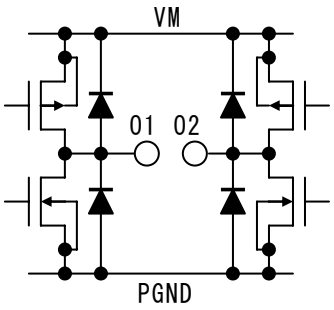
input				Output		
IN1	IN2	STBY	PWM	O1	O2	Mode
H	H	H	—	L	L	Brake
L	H	H	H	L	H	CW(CCW)
			L	L	L	Brake
H	L	H	H	H	L	CCW(CW)
			L	L	L	Brake
L	L	H	—	OFF(Hi-Z	OFF(Hi-Z)	Stop
—	—	L	—	OFF(Hi-Z)	OFF(Hi-Z)	standby

（— : Don't care）

Input terminal; IN1,IN2,PWM,STBY

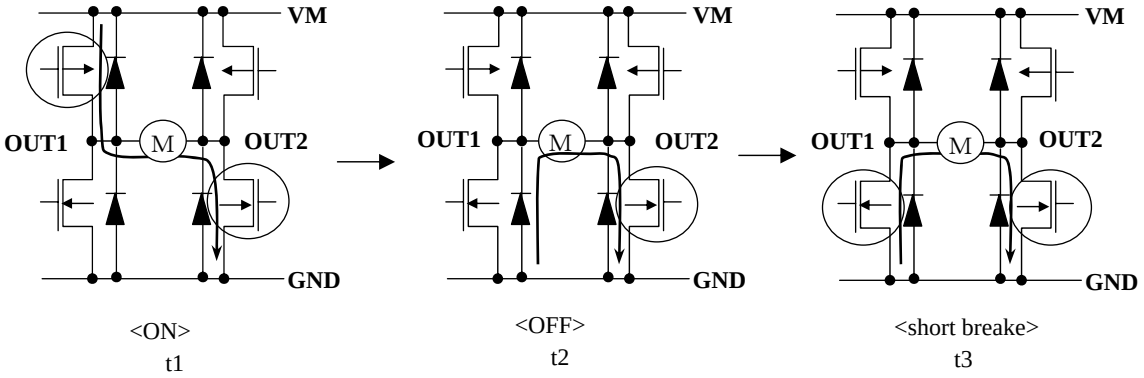


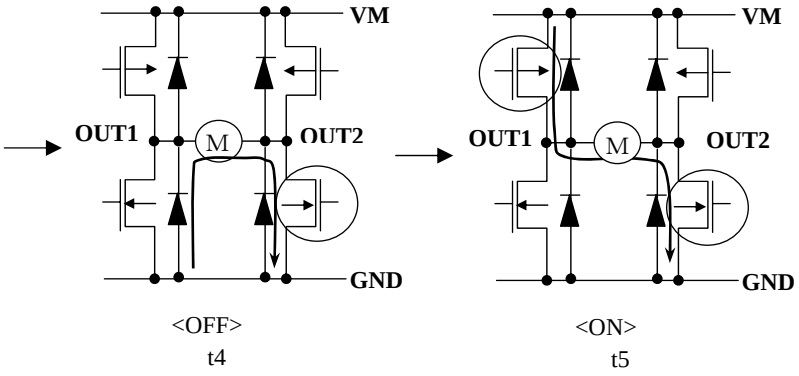
Output terminal; O1,O2

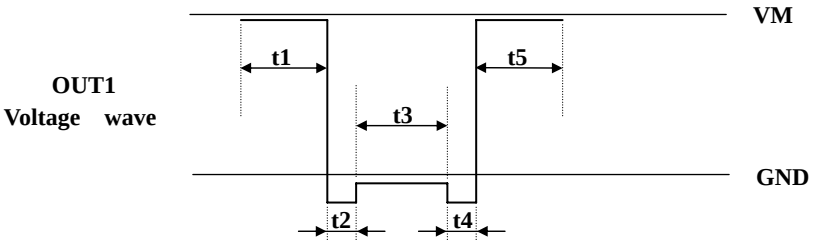


Function description

- To prevent penetrating current, dead time t2 and t4(design target=100ns) is provided in switching to each mode in the IC.



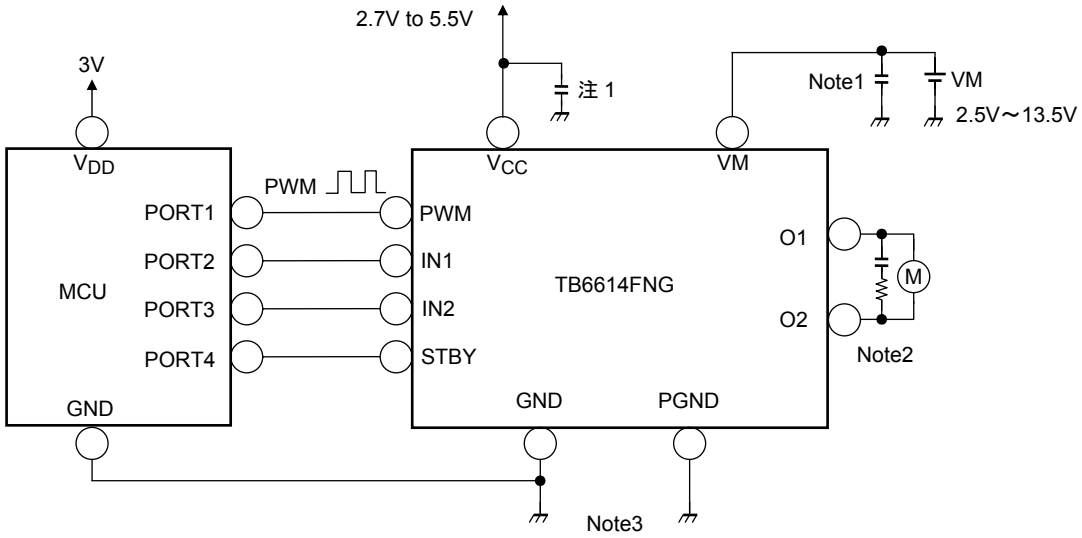




Electrical Characteristics (unless otherwise specified, Ta= 25°C, V_{cc}=3V, VM=5V)

Characteristics	symbol	Test condition	Min.	Typ.	Max.	Unit
Supply current	Icc	STBY=Vcc	---	(1)	(1.5)	mA
	Icc(STB)	STBY=0V	---	---	1	μA
	IM(STB)		---	---	1	
Control input voltage	VIH		2	---	Vcc+0.2	V
	VIL		-0.2	---	0.8	
Control input current	IIH	VIN=3V	5	15	25	μA
	IIL	VIN=0V	---	---	1	
Stand by input voltage	VIH(STB)		2	---	Vcc+0.2	V
	VIL(STB)		-0.2	---	0.8	
Stand by input current	IIH(STB)	VIN=3V	5	15	25	μA
	IIL(STB)	VIN=0V	---	---	1	
Output on resistance	Ron	Io=1A,Vcc=VM=5V	---	(0.4)	(0.6)	Ω
Output leak current	IL(U)	VM=Vout=15V	---	---	1	μA
	IL(L)	VM=15V,Vout=0V	-1	---	---	
Regenerative diode VF	VF(U)	IF=1A	---	1	1.1	V
	VF(L)		---	1	1.1	
Low voltage detecting voltage	UVLD	Vcc (design target)	---	2.0	---	V
Recovering voltage	UVLC		---	2.2	---	
Thermal shutdown circuit operating temperature	TSD	(Design target)	---	170	---	°C
Thermal shutdown hysteresis	ΔTSD		---	20	---	

Application circuit example



Note1: Connect the bypass capacitor for Vcc or VM noise as close as possible to the IC.

Note2: Connect resistor for limitation of charge current in case using capacitor between motor terminals to reduce noise.

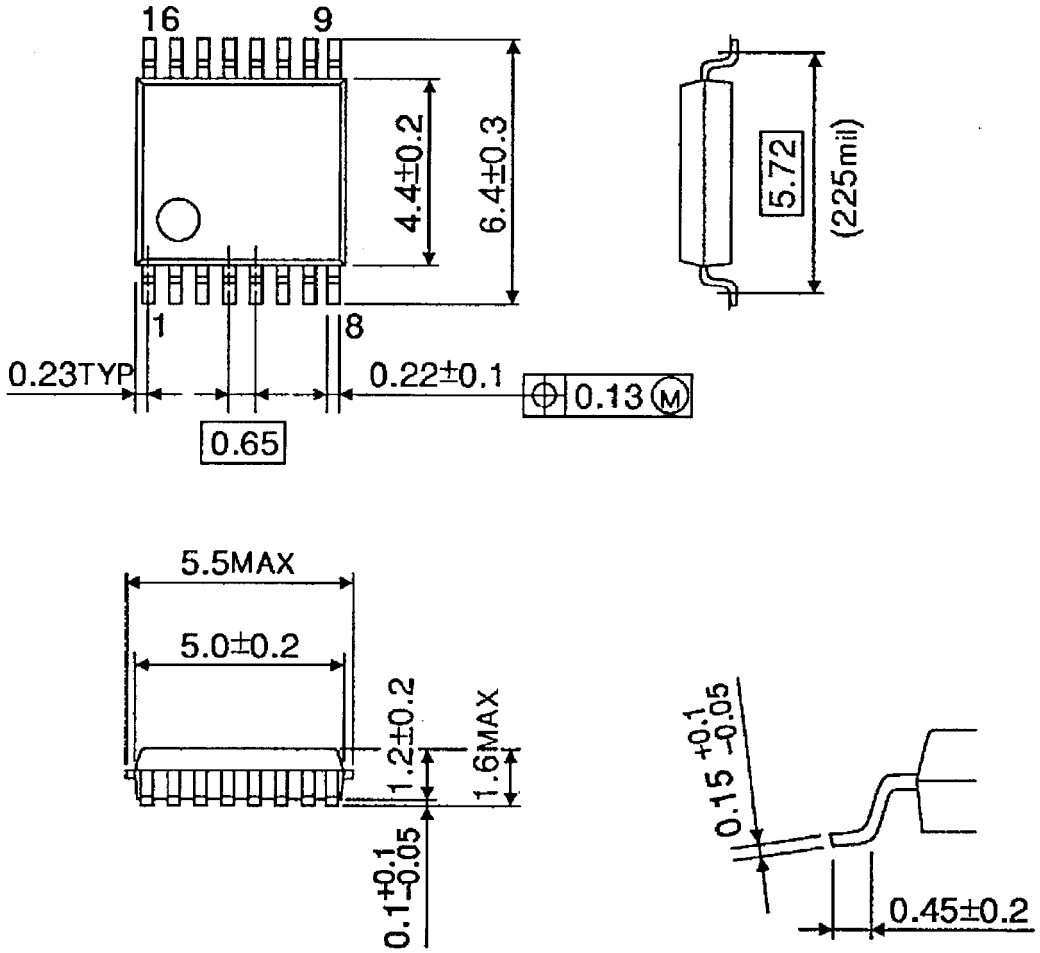
Note3: Avoid the common impedance of GND amd PGND if possible.

Note4: Design Vcc, VM, GND, PGND line with well-attention as there is possibility of IC destruction from short of output terminals or supply voltage or ground level or neighboring terminals.

Other: Add over-current protect system with a fuse or a current limit device for total system safety, considering that large current beyond absolute maximum rating runs through the IC from some factor.

Package dimensions

SSOP16-P-225-0.65B Unit : mm



Weight: 0.07 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) 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 considerate 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 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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20070701-EN GENERAL

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