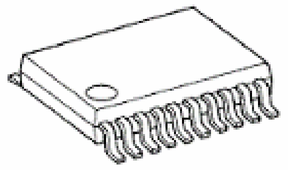
Toshiba Bi-CD Integrated Circuit Silicon Monolithic

TB6593FNG

Driver IC for DC motor

TB6593FNG 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.



Weight
SSOP20-P-225-0.65: 0.09g (Typ.)

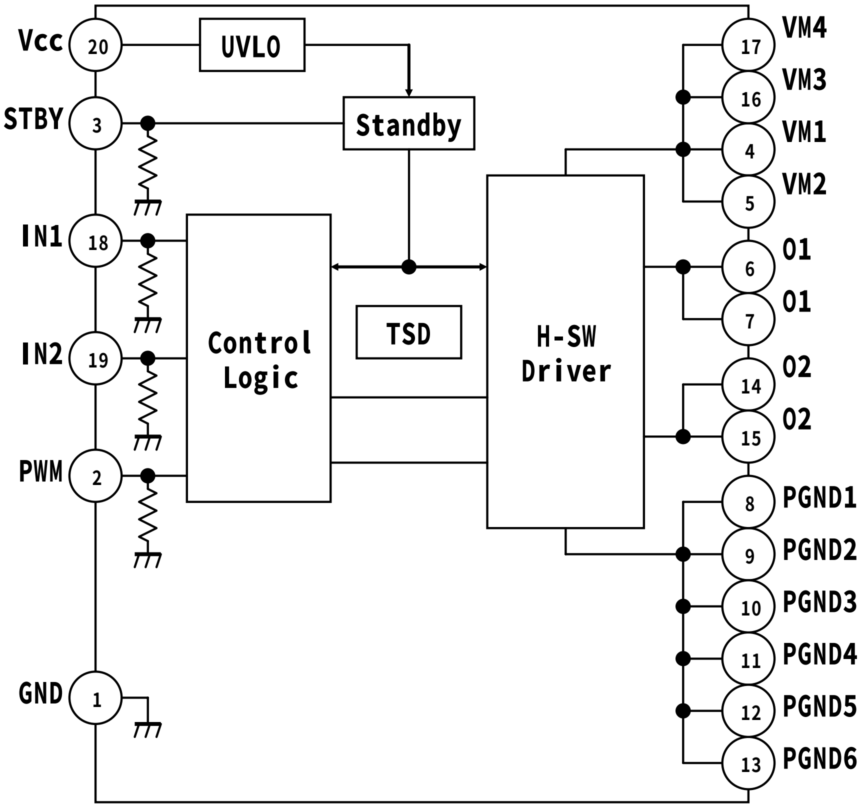
Features

- Power supply voltage : VM=15V (Max.)
- Output current : Iout=1.2A(ave) / 3.2A (peak)
- Output low ON resistor : 0.35Ω ((typ. @VM≧5V)
- Standby (Power save)system
- CW/CCW/short brake/stop function modes
- Built-in thermal shutdown circuit and low voltage detecting circuit
- Small faced package (SSOP20:0.65mm pitch)
- Response to Pb free packaging

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

* 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.

Block Diagram



Pin Functions

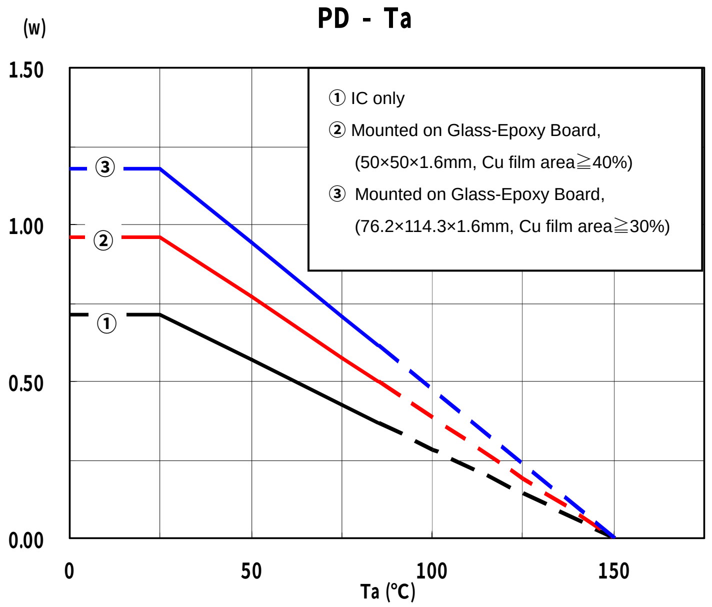
Pin NO.	Symbol	Characteristics	Remarks
1	GND	Small signal GND	
2	PWM	PWM signal input	“H”=Active / 200kΩ pull-down at internal
3	STBY	Standby signal input	“L”=standby / 200kΩ pull-down at internal
4	VM1	VM supply	VM=2.5V~13.5V
5	VM2		
6	O1	Output1	
7	O1		
8	PGND1	Power GND	
9	PGND2		
10	PGND3		
11	PGND4		
12	PGND5		
13	PGND6		
14	O2	Output2	
15	O2		
16	VM3	VM supply	VM=2.5V~13.5V
17	VM4		
18	IN1	Control signal nput1	200kΩ pull-down at internal
19	IN2	Control signal input2	
20	Vcc	Small signal supply	Vcc=2.7V～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,STBY,PWM pins
Output voltage	Vout	15	V	O1,O2 pins
Output current	Iout	1.2	A	
	Iout (peak)	3.2		tw=10ms, Superimposed pulse, Duty is 30% or less.
Power dissipation	PD	1.18	W	76.2×114.3×1.6mm When it is packaged to the board made of glass-epoxy (Cu30%).
		0.96		50×50×1.6mm When it is packaged to the board made of glass-epoxy (Cu40%).
		0.71		IC only
Operating temperature	Topr	-20～85	℃	
Storage temperature	Tstg	-55～150	℃	

Operating Range (Ta = –20 to 85°C)

Characteristics	Symbol	Min	Typ.	Max	Unit
Supply voltage	Vcc	2.7	3	5.5	V
	VM	2.5	5	13.5	V
Output current (H-SW)	Iout	---	---	1.0	A
Switching frequency	fPWM	---	---	100	kHz

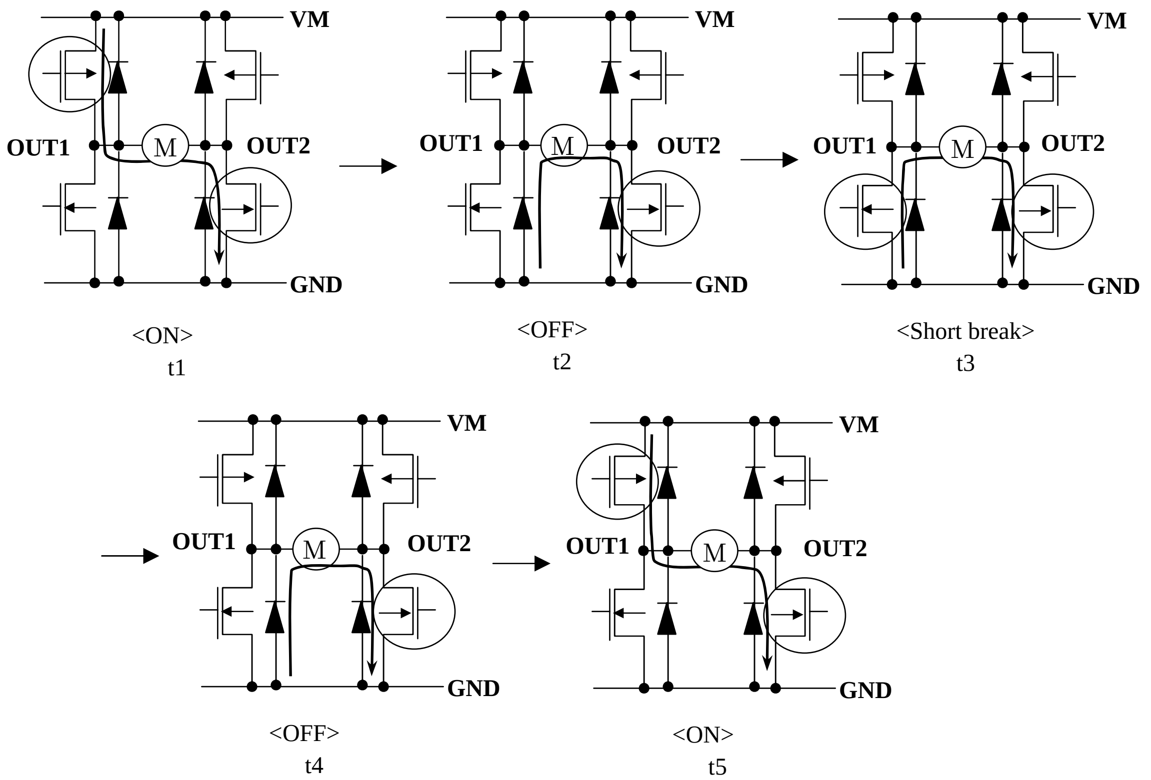


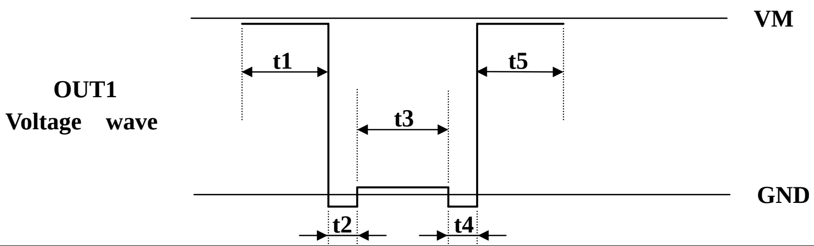
H-SW Control Function

Input				Output		
IN1	IN2	PWM	STBY	OUT1	OUT2	Mode
H	H	H	H	L	L	Short brake
L	H	H	H	L	H	CCW
		L	H	L	L	Short brake
H	L	H	H	H	L	CW
		L	H	L	L	Short brake
L	L	H	H	OFF (High impedance)		Stop
H／L	H／L	H	L	OFF (High impedance)		Standby

H-SW Operating Description

・To prevent penetrating current, dead time t2 and t4 (300ns：Designed value) is provided in switching to each mode in the IC.

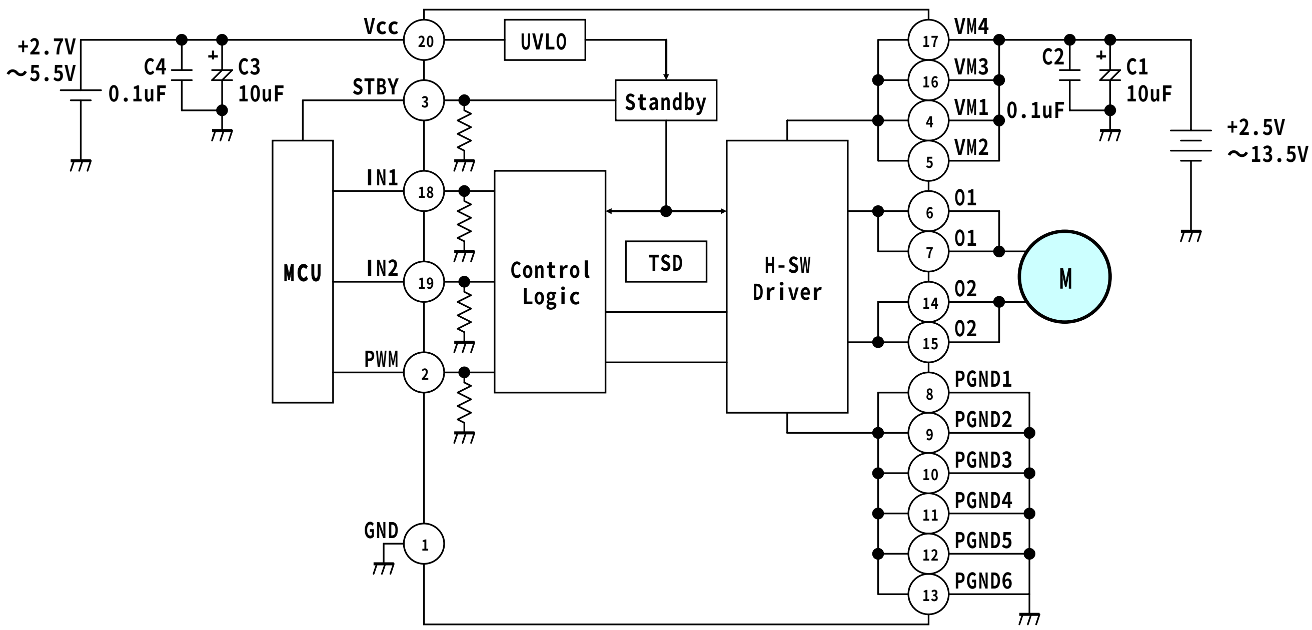




Electrical Characteristics (unless otherwise specified, V_{CC} = 3 V, VM = 4.5V, Ta = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Supply current	Icc	STBY=Vcc	---	0.9	1.2	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	
Standby input voltage	VIH(STB)		2	---	Vcc+0.2	V
	VIL(STB)		-0.2	---	0.8	
Standby input current	IIH(STB)	VIN=3V	5	15	25	μA
	IIL(STB)	VIN=0V	---	---	1	
Output saturating voltage	Vsat(U+L)	Io=1A	---	0.35	0.5	V
Output leakage 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	(Designed value)	---	2.0	---	V
Recovering voltage	UVLC		---	2.2	---	
Thermal shutdown circuit operating temperature	TSD	(Designed value)	---	170	---	℃
Thermal shutdown hysteresis	ΔTSD		---	20	---	

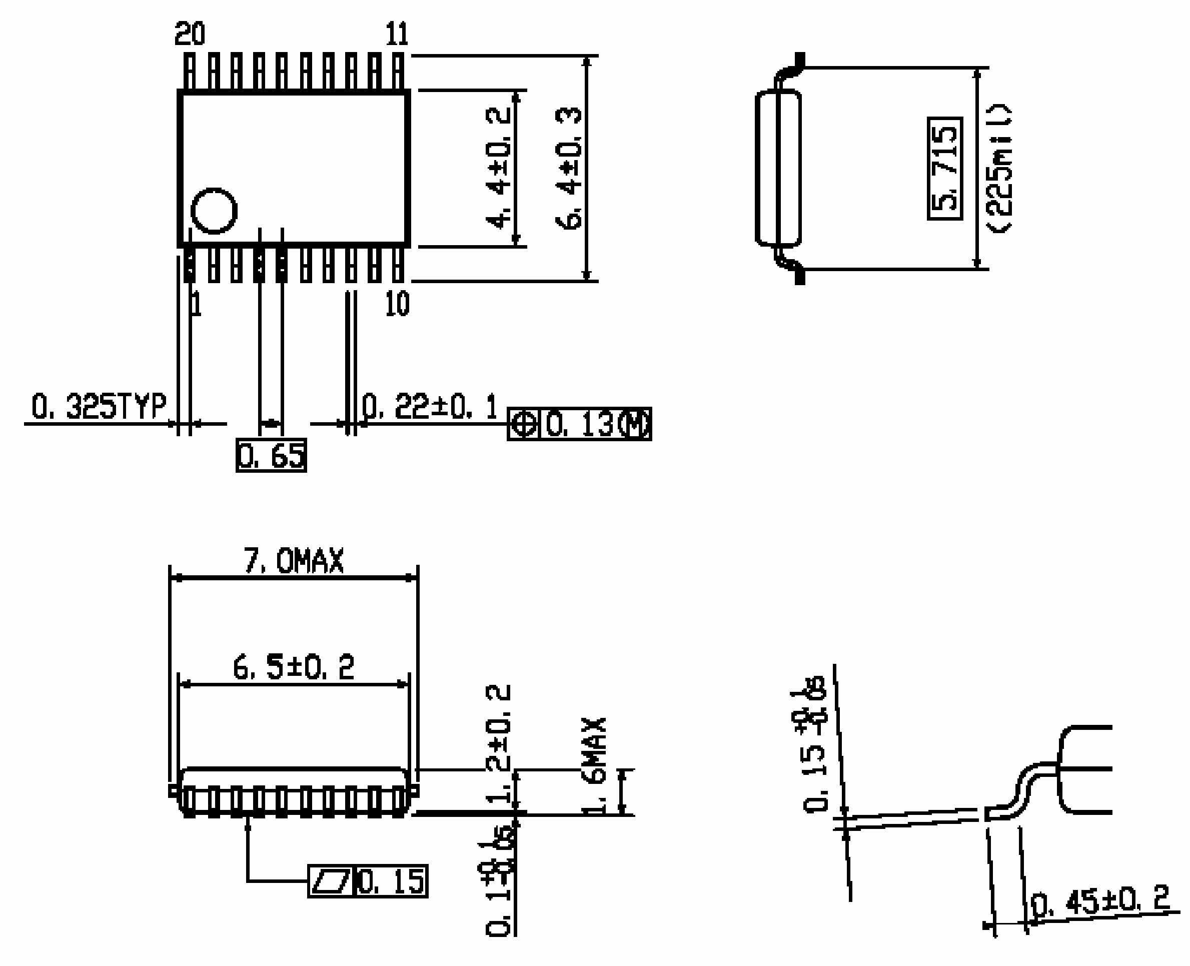
Typical Application Diagram



Note : The power supply capacitor should be connected as close as possible to the IC.

Package Dimennsions

SSOP20-P-225-0.65 Unit: mm



Weight: 0.09 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 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.

RESTRICTIONS ON PRODUCT USE

070122EBA_R6

- The information contained herein is subject to change without notice. 021023_D
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc. 021023_A
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer’s own risk. 021023_B
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations. 060106_Q
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patents or other rights of TOSHIBA or the third parties. 070122_C
- Please use this product in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances.
  Toshiba assumes no liability for damage or losses occurring as a result of noncompliance with applicable laws and regulations. 060819_AF
- The products described in this document are subject to foreign exchange and foreign trade control laws. 060925_E