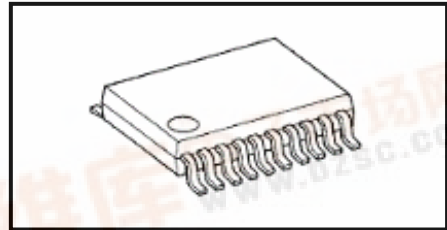# TOSHIBA

<div align="right">

TB6593FNG

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Toshiba Bi-CD Integrated Circuit　Silicon Monolithic

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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.

Features

- Power supply voltage　　　: VM=15V　Max.
- Output current　　　　　: Iout=1.2A(ave) / 3.2A (peak)
- Output low ON resistor　　: 0.35　　((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

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

The TB6593FNG is a 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
   *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
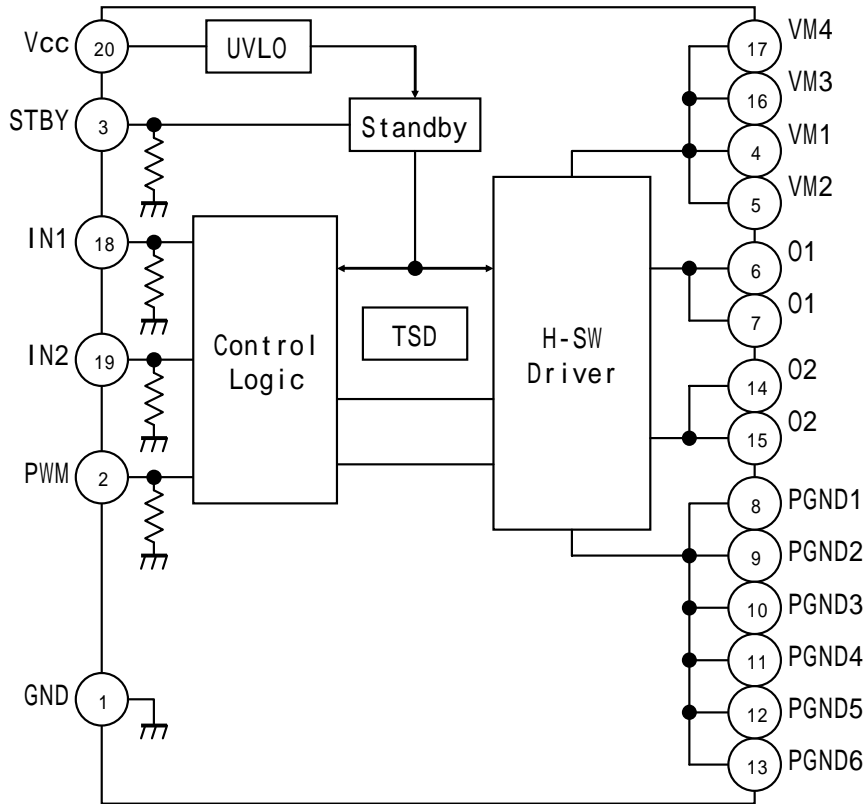
Pin Functions

Pin NO.	Symbol	Characteristics	Remarks
1	GND	Small signal GND	
2	PWM	PWM signal input	"H"=Active / 200k pull-down at internal
3	STBY	Standby signal input	"L"=standby / 200k 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	200k pull-down at internal
19	IN2	Control signal input2	
20	Vcc	Small signal supply	Vcc=2.7V 5.5V

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	0.96	W	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.

<ON>
t1

<OFF>
t2

<Short break>
t3

<OFF>
t4

<ON>
t5

VM

OUT1
Voltage   wave

t1

t3

t5

GND

t2   t4
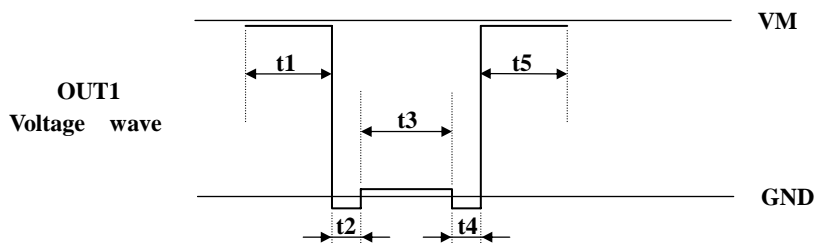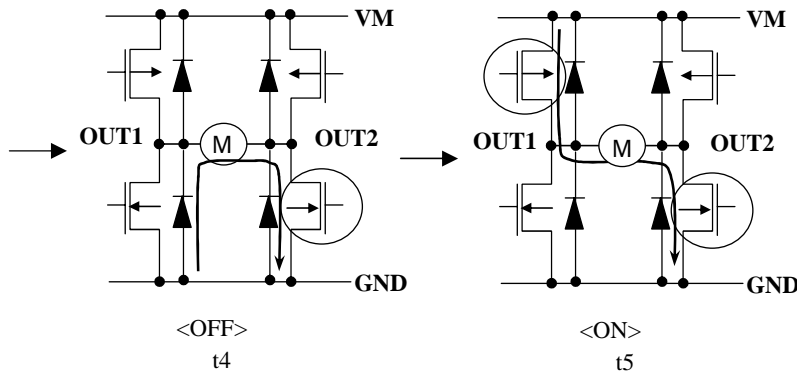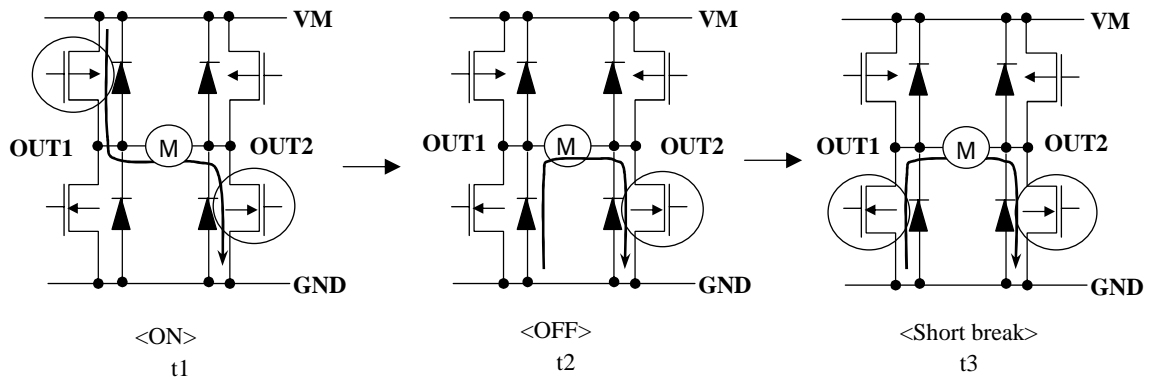
Electrical Characteristics (unless otherwise specified, V_{CC} = 3 V, VM = 4.5V, Ta = 25°C)

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
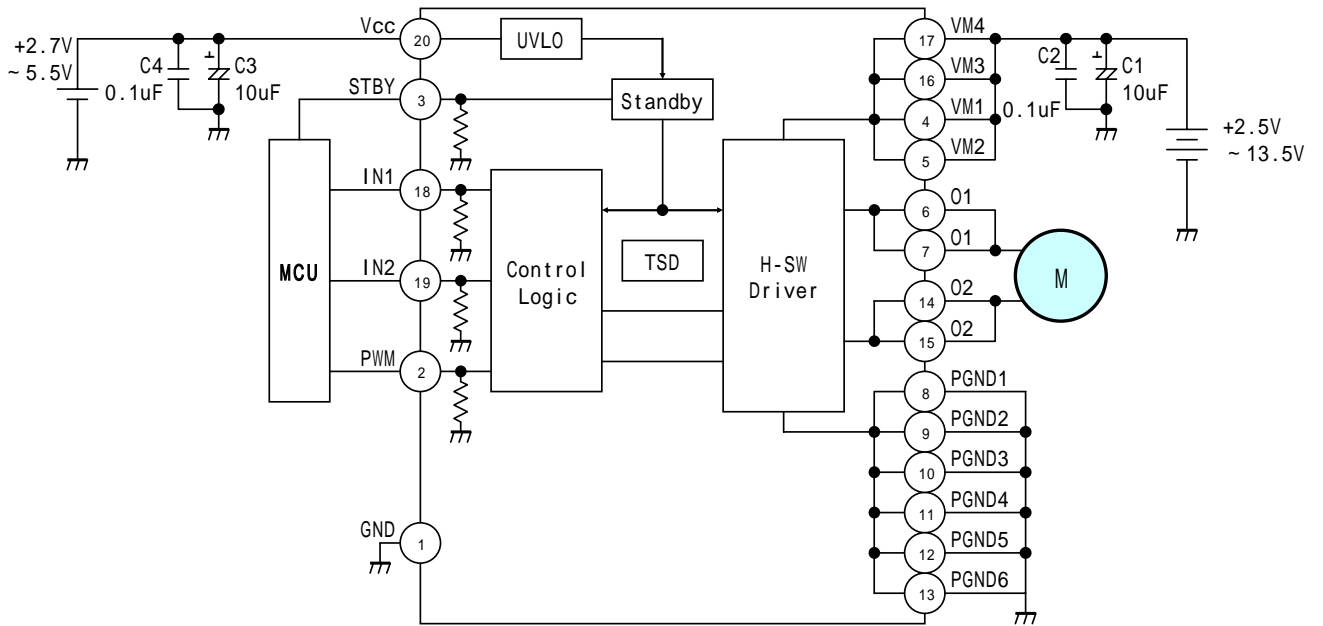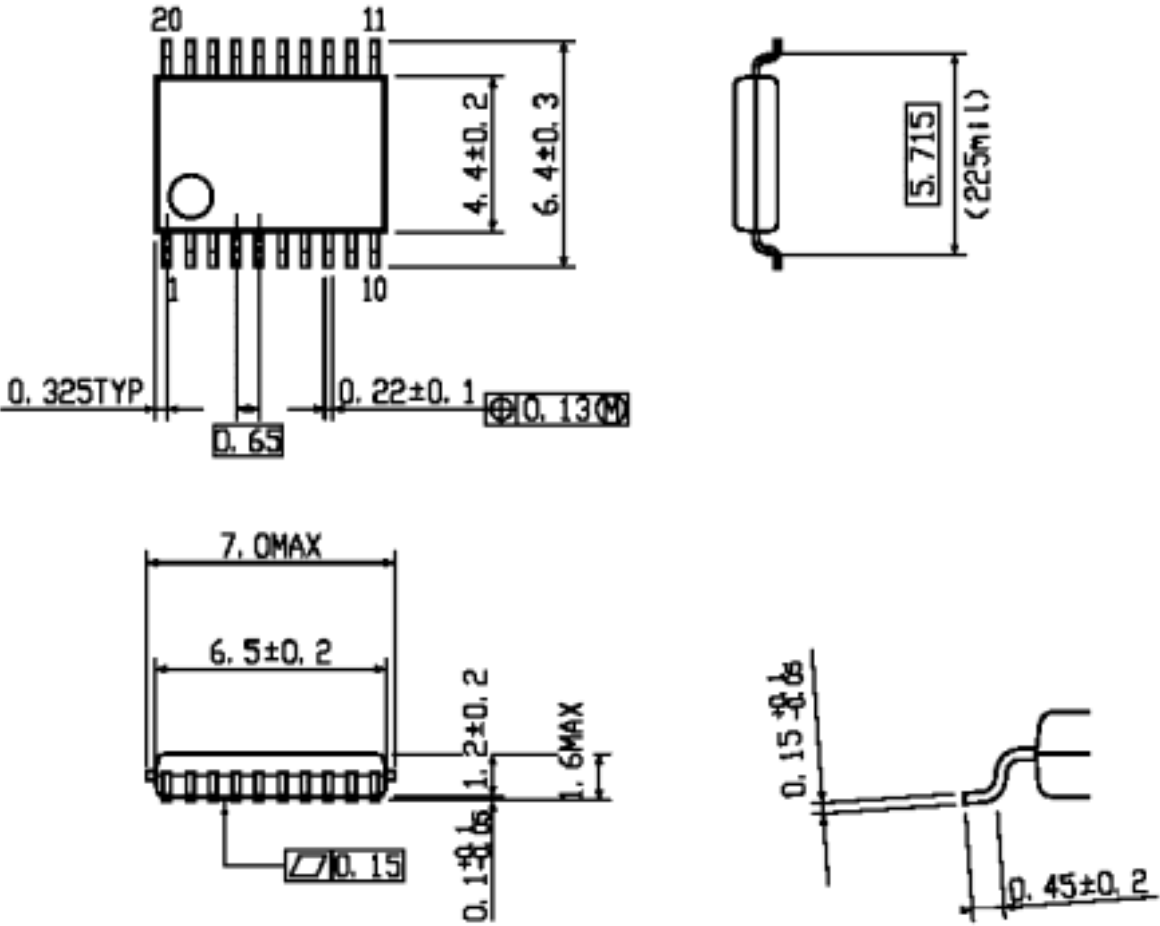

Note : The power supply capacitor should be connected as close as possible to the IC.

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. Maximum Ratings
The absolute maximum ratings of a semiconductor device are a set of specified parameter values which must not be exceeded during operation, even for an instant.
If any of these ratings are exceeded during operation, the device electrical characteristics may be irreparably altered and the reliability and lifetime of the device can no longer be guaranteed.
Moreover, these operations with exceeded ratings may cause breakdown, damage and/or degradation to other equipment. Applications using the device should be designed so that each maximum rating will never be exceeded in 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 at the mass production design stage.
Toshiba does not grant any license to any industrial property rights by providing these examples of application circuits.

6. 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.

About the handling of ICs
Install the product correctly to avoid breakdown, damage and/or degradation to the product or equipment.

About overcurrent protection and heat protection circuits

These protection functions are intended to guard against certain output short circuits or other abnormal conditions with only temporary effect, and are not guaranteed to prevent the IC from being damaged.
- These protection features may not be effective if the product is operated outside the guaranteed operating ranges, and some output short circuits may result in the IC being damaged.
The overcurrent protection feature is only intended to protect the IC from a temporary short circuit.
Short circuits of longer duration may damage the IC through undue stress. The systems must be configured so that any overcurrent condition will be eliminated as soon as possible.

Counter-electromotive force

When the motor reverses or stops, counter-electromotive force in the motor may influence the current to flow to the power source. If the power source lacks sink capability, the IC power and output pins may exceed the rating. The counter-electromotive force of the motor varies depending on the conditions of use and the features of the motor.
Therefore ensure that there is no damage to the IC or problem in operation, and no error in or damage to peripheral circuits resulting from counter-electromotive force.

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