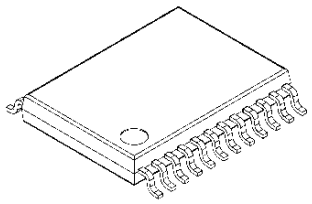
TOSHIBA Bi-CMOS Linear Integrated Circuit Silicon Monolithic

TB9101FNG

2ch H-Bridge driver for DC Brushed Motor

TB9101FNG is a 2ch H-bridge driver which is designed specifically for Automotive. This IC has built-in for directly driving small DC Brushed motor.
Forward/Reverse/Stop/Brake can be set by Input signal (DI1A,DI1B,DI2A,DI2B). These Inputs are TTL, thus, TB9101FNG can be controlled by external MCU, directory. Standby mode, Miscellaneous Abnormal Detection are built-in.
TB9101FNG is for wide application such as for Automotive Air-condition system (Dumper control), Door Mirror control.

SSOP24-P-300-0.65A



Weight: 0.14 g (typ.)

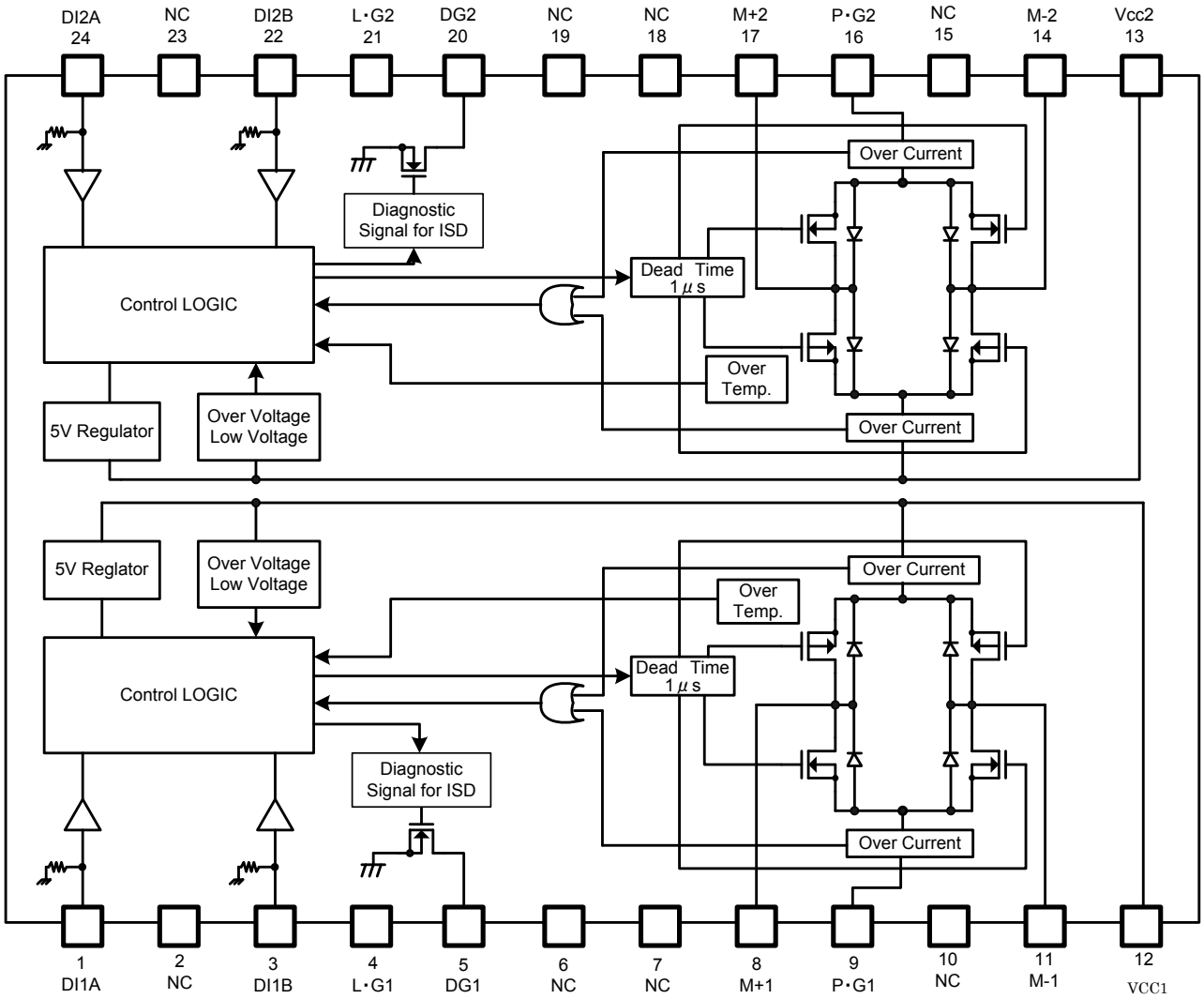
Feature

··Motor Driver : 2ch H-Bridge with Driver (Directry drive external Motor)
RON: RHON(Pch)=0.6Ω(typ.), RLON(Nch)=0.6Ω(typ.)
··Standby mode : 0mA(typ.)
··Operating Voltage range : 7 to 18V (Absolute Maximum Rating 40V)
··Operating Temperature range
: -40°C to 125°C
··Miscellaneous Abnormal Detection
: Motor Over Current (with Output monitor signal)
VCC Over Voltage
VCC Low Voltage
IC internal Over Temperature
··Package : SSOP24-P-300-0.65A

··AEC-Q100 Qualified

··The product(s) is/are compatible with RoHS regulations (2011 / 65 / EU) as indicated, if any, on the packaging label ("[[G]]/RoHS COMPATIBLE", "[[G]]/RoHS [[Chemical symbol(s) of controlled substance(s)]]", "RoHS COMPATIBLE" or "RoHS COMPATIBLE, [[Chemical symbol(s) of controlled substance(s)]]>MCV").

INTERNAL BLOCK DIAGRAM AND PIN LAYOUT



*1: Some of the functional blocks, circuit, or constants in the block diagram may be omitted or Simplified for explanatory purpose.

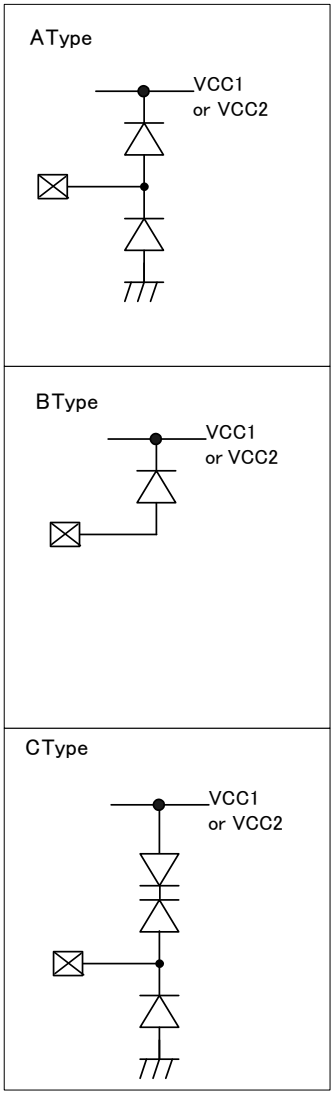
*2: Install the product correctly. Otherwise, it may result in break down, damage and/or deterioration to the product or equipment.

·PIN CONNECTION

PIN No.		PIN NAME		NOTES
CH1	CH2	CH1	CH2	
1	24	DI1A	DI2A	Input for Motor control.(refer to “Motor Operation1” in next page)
3	22	DI1B	DI2B	
4	21	L·G1	L·G2	GND for 5V Circuit.
5	20	DG1	DG2	Over Current Detection Monitor signal. The Output is Open Drain type. When Over Current is detected on each Motor, DG1/DG2 output “L”. External Pull Up to 5V is required.
8	17	M +1	M +2	Output for Motor 1,2 drivring. Build-in Over Current detection.
9	16	P·G1	P·G2	GND for Motor driving.
11	14	M -1	M -2	Output for Motor 1,2 drivring., Build-in Over Current detection
12	13	VCC1	VCC2	12V Power Supply(typ.). Build-in Over/Low Voltage Detecion
2,6,7,10, 15,18,19, 23		NC		no connecton. keep open on PCB

Internal protection circuit

Terminal No.	Name	Internal Protection circuit
1	DI1A	A Type(VCC1/ L·G1)
2	NC	—
3	DI1B	A Type(VCC1/ L·G1)
4	L·G1	B Type(VCC1)
5	DG1	A Type(VCC1/ L·G1)
6	NC	—
7	NC	—
8	M+1	—
9	P·G1	B Type(VCC1)
10	NC	—
11	M-1	—
12	VCC1	C Type(VCC2/ L·G1)
13	VCC2	C Type(VCC1/ L·G2)
14	M-2	—
15	NC	—
16	P·G2	B Type(VCC2)
17	M+2	—
18	NC	—
19	NC	—
20	DG2	A Type(VCC2/ L·G2)
21	L·G2	B Type(VCC2)
22	DI2B	A Type(VCC2/ L·G2)
23	NC	—
24	DI2A	A Type(VCC2/ L·G2)



FUNCTIONAL DESCRIPTION

(1) Motor control

TB9101FNG build-in 2 H-Bridge. These 2 H-Bridge is controlled by Input DI1A/DI1B DI2A/DI2B, independently. The operation modes are as follows.

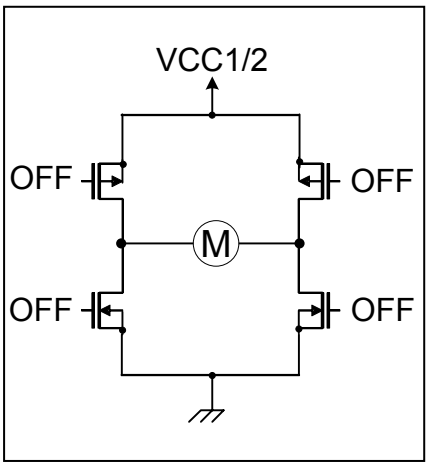
·Motor Operation 1

Input		Output		Operation Mode
DI1A / DI2A	DI1B / DI2B	M +1 / M+2	M -1 / M-2	
H	H	L	L	BRAKE
H	L	H	L	FORWARD Rotation(CW)
L	H	L	H	REVERSE Rotation(CCW)
L	L	OFF (Hi-Z)		STANDBY

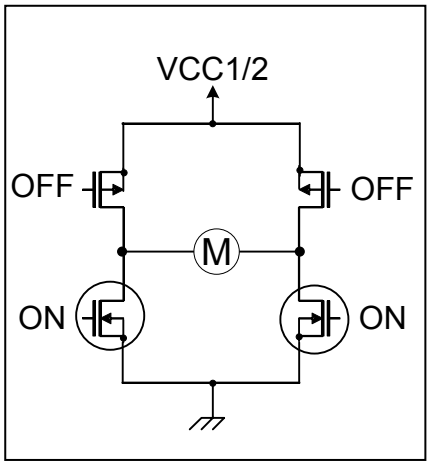
CAUTION: When Motor operation is stopped, it is prefer to go to BRAKE mode, first. Then after reducing Motor rotation speed, goes to STANDBY mode. It can be reducing Motor Back Electromotive Force.

·H-Bridge Circuit in Standby mode and BRAKE mode

Standby mode



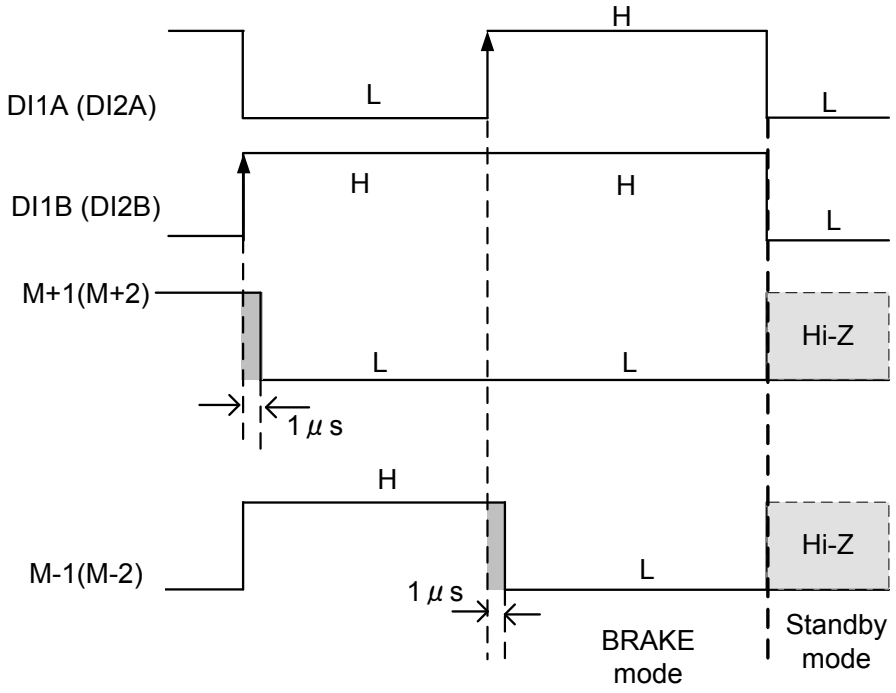
Brake mode

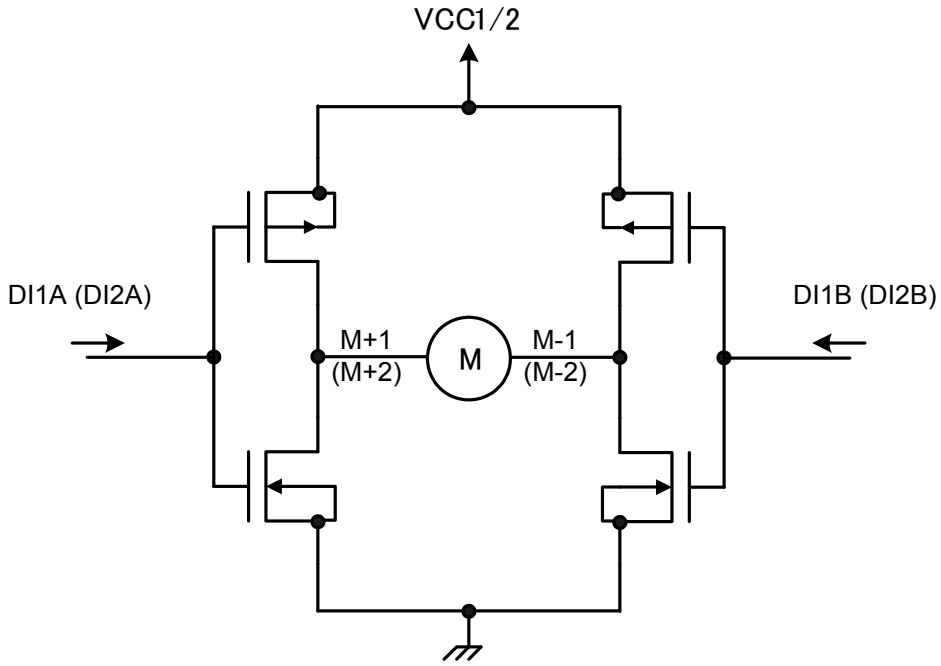


●Standby mode: DI1A/DI1B = ”L”, DI2A/DI2B = ”L”
- ·5V Regulator OFF
- ·Motor Drive Output (M+1/M-1, M+2/M-2) OFF(Hi-Z)
- ·Abnormal Detection Circuit OFF (VCC Over Voltage, Over Current, Over Temp. VCC Low Voltage)

·DEAD TIME Generation

TB9101FNG generate “DEAD TIME” on Motor drive output signal (M+1,M+2,M-1,M-2) which is Hi-Z status during 1μs(typ.). at rising Edge of each Input (DI1A,DI1B,DI2A,DI2B) . This is to protect power short by simultaneous ON of Hi-side and Lo-side MOSFET which consist of the same Half Bridge.



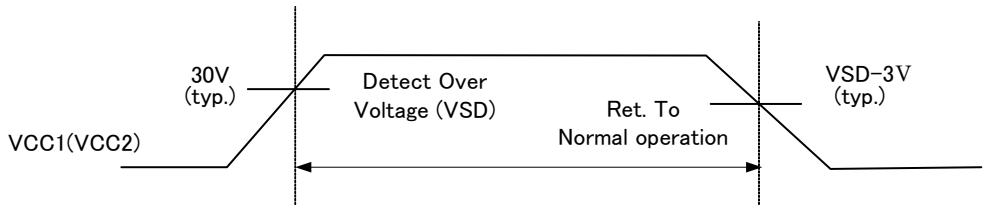


·Miscellaneous Abnormal Detection

TB9101FNG has Miscellaneous Abnormal Detection, such as Over Voltage (VSD) for VCC1,VCC2 Motor Over Current (ISD), CHIP inner Over Temperature(TSD), Low Voltage for VCC1,VCC2. These Detection are set for each H-Bridge independently.

(1). Over Voltage Detection for VCC1,VCC2 (VSD: detection 30V(typ.))

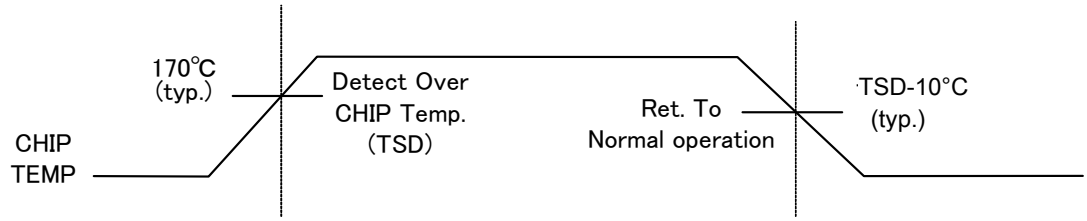
TB9101FNG has Over Voltage Detection for VCC1 and VCC2, independently. When each voltage is over 30V(typ.), the driver of that H-Bridge Output is turned OFF(Hi-Z). When the voltage drop to lower than 27V(typ.), the driver return to normal operation which is controlled by each Input (DI1A,DI1B,DI2A,DI2B). The internal signal of Over Voltage Detection has chattering protection circuit. If the voltage continues to exceed the Over Voltage Detection value, though the state of the Over Voltage Detection is released by the above mentioned, the Over Voltage Detection is enabled again, and each output of the motor driver is turned OFF(Hi-Z) again.



CAUTION1: This Over Voltage Detection is not to clamp Battery Voltage for TB9101FNG Thus, the system should keep lower operation voltage than the Maximum rating Spec.

(2). Over Temperature Detection (TSD: detection typ.170°C)

TB9101FNG has Over Temperature Detection for each internal H-Bridge, independently. When the Temp of H-Bridge is over 170°C.(typ.), that H-Bridge Output is turned OFF(Hi-Z). After detecting TSD, when that H-Bridge Temp. drop to lower than TSD-10°C (typ.), the driver return to normal operation which is controlled by each Input (DI1A,DI1B,DI2A,DI2B) The internal signal of Over Temperature Detection has chattering protection circuit. If the temperature continues to exceed the Over Temperature Detection value, though the state of the Over Temperature Detection is released by the above-mentioned, the Over Temperature Detection is enabled again, and each output of the motor driver is turned OFF(Hi-Z) again.

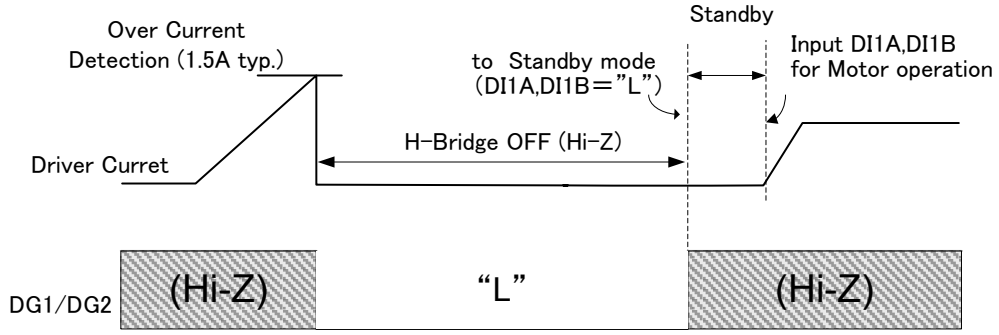


CAUTION2: The Absolute maximum Temperature of TB9101FNG is 150°C(Max). This Over Temperature Detection function does not intend to limit the CHIP temperature. Thus, the above Absolute Maximum Temperature never is over to use TB9101FNG. If any of these rating would be exceeded during operation, the device 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 break down, damage and/or degradation to any other equipment. Applications using the device should be designed such 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 documents.
In addition, this IC has a built-in over-temperature detection function, but this function does not reduce to 170 °C below the temperature of the IC.
Also for the function of the operation guarantee range, please use as an auxiliary.
This Over Temp. Detection is worded over the Max. Rating Temperature and shipping test does not perform at the Max. Rating Temp.

(3). Over Current Detection (ISD: detection typ. 1.5A)

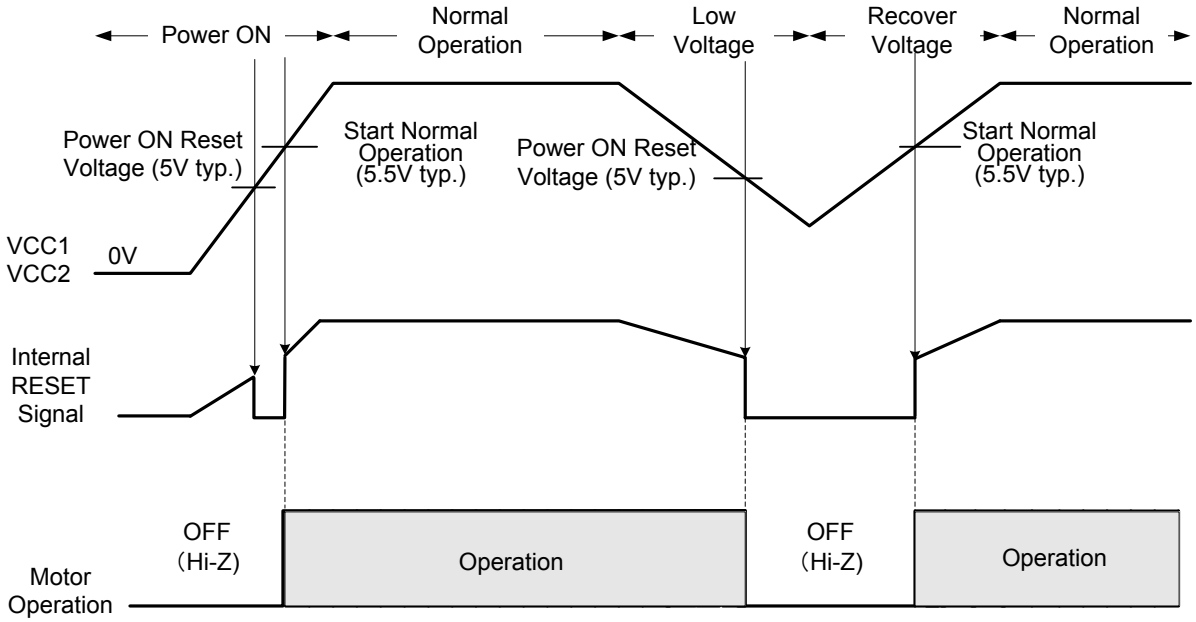
TB9101FNG has Over Current of Motor Detection for each H-Bridge independently. When Motor Current is over ±1.5A(typ.), that H-Bridge Output is turned OFF(Hi-Z), and each Diagnostic signal (DG1,DG2) is changed to “L”. This Diagnostic signal DG1 and DG2 are the Output of Open-Drain typ. Thus, the status in normal operation is “Hi-Z” and external Pull up to 5V power line is required. After detecting Over Current of each H-Bridge, that Output for Motor drive are kept OFF(Hi-Z) and Diagnostic signal of each H-Bridge(DG1, DG2) is kept “L”, even the Current return to normal level. This Over Current Detection condition can be reset by going to Standby mode (DI1A=DI1B=L or DI2A=DI2B=L). The internal signal of Over Current Detection and Release has a chattering protection circuit to prevent mulfunction. If the Motor Current is still over after reset by Standby mode operation, TB9101FNG detect it after going to Motor operation from Standby mode (change anyone of that H-bridge Input (DI1A/DI1B or DI2A/DI2B) to “H”), and change Motor drive Output to Hi-Z and output ”L” from each DG1/DG2, again.
When VCC Low Voltage is detected (5v typ.) after Over Current detection, Over Current detection status is reset by Power On Reset. Thus, in this case, even the Voltage return to normal and mode return to normal operation, previous Over Current Detection status does not be held. The internal signal of Over Current Detection has chattering protection circuit.



CAUTION: Over Current Detection circuits is only intended to provide temporary protection against irregular conditions such as an output short-circuit; they do not necessarily guarantee the complete IC safety.
Therefore, output short-circuit(short to VCC or GND) the ground fault Since the IC may be destroyed, the design of routing output line, VCC, and GND lines sufficient attention Please.

(4) Low Voltage Detection for VCC1,VCC2 (detection typ. 5V)

TB9101FNG has Low Voltage Detection for VCC1 and VCC2, independently. When each voltage drop to lower than 5V(typ.), Power On Reset is done and the Output of that H-Bridge is turned OFF(Hi-Z). Also Over Current Detection and Over Temperature Detection are OFF. When the voltage rise up to 5.5V (typ.), the driver return to normal operation which is controlled by each Input (DI1A,DI1B,DI2A,DI2B).
Release signal and Low Voltage Detection is designed to prevent a malfunction and a built-in chattering prevention circuit.



·ELECTRICAL CHARACTERISTICS

(1) ABSOLUTE MAXIMUM RATING (Ta=25°C)

ITEM	SYMBOL	PIN	CONDITION	RATING	UNIT
Supply Voltage	VCC	VCC1,VCC2	DC Voltage	-0.3 to +40	V
Output Current	IOUT	M+1, M-1, M+2, M-2	at Current Detection	±1.5	A
			—	±1.0	
	IOL	DG1,DG2	—	+2.5	mA
Input Voltage	VIN	DI1A, DI1B DI2A, DI2B	—	-0.3 to +40	V
Output Voltage	VOUT	M+1, M-1, M+2, M-2	—	-0.3 to +40	V
		DG1,DG2	—		
Operating Temp.	Topr	—	—	-40 to +125	°C
Storage Temp.	Tstg	—	—	-55 to +150	
Soldering Temp./Time	Tsol	—	Manual Soldering	260 (10s)	
Power Dissipation	PD	—	PCB 76.2×114.3×t1.6mm Mono Layer, Cu:30%	1.32	W

CAUTION 1:The above current spec. value of "+" is Input from outside,"-" is Output from TB9101FNG.

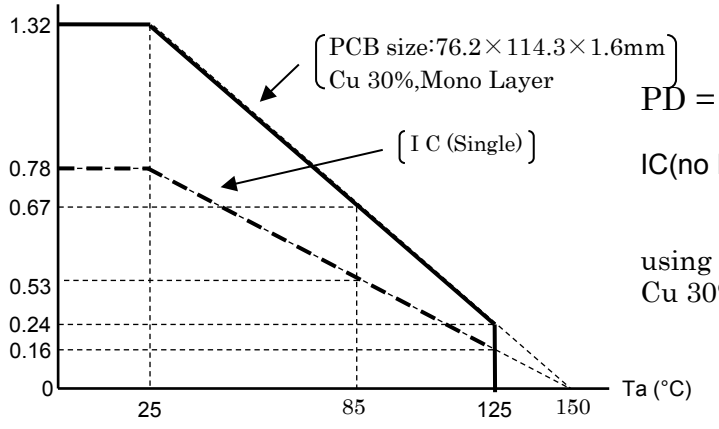
CAUTION 2: Please do not exceed the absolute maximum rating, including the reverse voltage.

CAUTION 3: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 rating would be 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 break down, damage and/or degradation to any other equipment. Applications using the device should be designed such 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 these documents.

Package (SSOP24-P-300-0.65A) Thermal Resistance

ITEM	SYMBOL	RATING	CONDITION	UNIT
Thermal Resistance	Rθj-a	160	IC	°C/W
		95	PCB Mono Layer, size:76.2×114.3×t1.6mm, Cu:30%, Cu thickness:35μm	°C/W
		60	PCB 4Layer, size:76.2×114.3×t1.6mm Cu:30%, Cu thickness:35μm	°C/W

(1) PD max －Ta(Reference Data)



$PD = (150 - Ta)/R_{\theta j\text{-}a}$

IC(no PCB) at 25°C.
(150-25)/160 = 0.781 (W)

using PCB(Mono Layer) size:76.2×114.3×1.6mm Cu 30% at 25°C.
(150-25)/95 = 1.32(W)

·ELECTRICAL CHARACTERISTICS (cont.)

(2) IC CHARACTERISTICS

The following are under condition VCC1,VCC2 = 7 to 18V, Ta=-40 to 125°C. unless otherwise follows

ITEM	SYMBOL	PIN	Condition	MIN	TYP.	MAX	UNIT
Current Consumption (No Load)	ICC	VCC1+VCC2	CH1 or 2 CW or CCW CH1+2 CW or CCW CH1+2 BRAKE	—	—	7	mA
Standby Current	Istby	VCC1, VCC2	DI1A,DI2A,DI1B, DI2B=L	—	0	10	μA
Input Voltage	VIL	DI1A, DI1B, DI2A, DI2B	—	—	—	0.8	V
	VIH		—	2.0	—	—	
Input Current	IIL	DI1A, DI1B, DI2A, DI2B	VIN=0.4V	—	5	10	μA
	IIH		VIN=5V	10	50	100	
Output Voltage “L”	VOL	DG1, DG2	IOL=2.5mA	—	—	0.4	V
Input Current “H”	IIH	DG1, DG2	V(DG1,DG2)=18V	—	—	10	μA

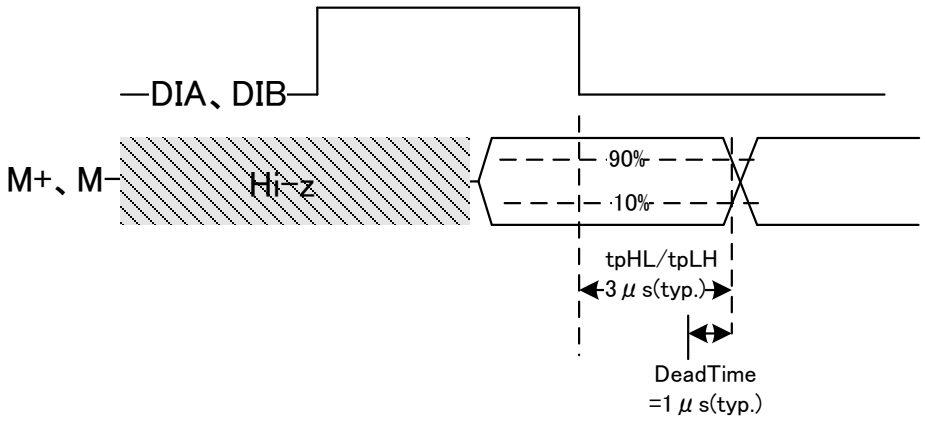
·ELECTRICAL CHARACTERISTICS (cont.)

(3) MOTOR DRIVER

The following are under condition VCC1,VCC2 = 7 to 18V, Ta=-40 to 125°C. unless otherwise follows

ITEM	SYMBOL	PIN	Condition	MIN	TYP.	MAX	UNIT
H-side Output ON Resistance	RHON	M+1, M-1 M+2, M-2	IOUT=-0.5A,Ta=+25°C	-	0.60	1.2	Ω
			IOUT=-0.5A,Ta=125°C	-	1.0	-	
			IOUT=-0.5A,Ta=-40°C	0.22	0.44	-	
L-side Output ON Resistance	RLON		IOUT=+0.5A,Ta=+25°C	-	0.60	1.2	
			IOUT=+0.5A,Ta=125°C	-	1.0	-	
			IOUT=+0.5A,Ta=-40°C	0.23	0.46	-	
Output OFF Leak Current	ILO		Output OFF VOUT=0V	-10	-	-	μA
			Output OFF VOUT=VCC1, 2	-	-	10	
Output Delay Time	tpHL		Rload=100Ω	-	3	10	μs
	tpLH		Rload=100Ω	-	3	10	

CAUTION: When Motor is rotated, it makes Electromotive Force. The Electrical Specification must be kept, even with this Electromotive Force.



·ELECTRICAL CHARACTERISTICS (cont.)

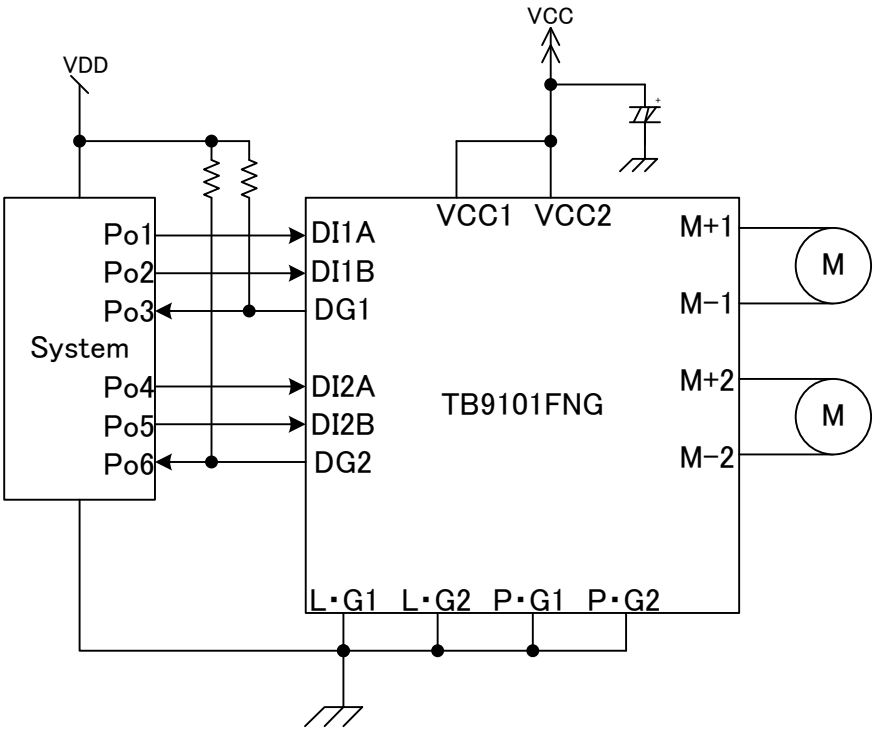
(4) ABNORMAL DETECTION

The following are under condition VCC1,VCC2 = 7 to 18V, Ta=-40 to 125°C. Unless otherwise follows

ITEM	SYMBOL	PIN	Condition	MIN	TYP.	MAX	UNIT
Over Voltage Detection ON	VSD	VCC1 VCC2	-	27	30	33	V
Over Voltage Detection OFF	VSD(hys)			-	VSD-3	-	
Over Temperature Detection ON	TSD	-	*1	150	170	190	°C
Over Temperature Detection OFF	TSD(hys)			TSD-5	TSD-10	TSD-20	
Over Current Detection	ISD	M+1, M-1 M+2, M-2	-	±1	±1.5	±2.5	A
Low Voltage Detection ON	VRSTH	VCC1, VCC2		-	5.0	-	V
Low Voltage Detection OFF	VRSTL	VCC1, VCC2		4.5	5.5	6.0	

Note *1: Impossible to test in mass production

REFERENCE APPLICATION CIRCUIT DIAGRAM



CAUTION1: The capacitor connected to VCC, and connect to absorb, such as voltage fluctuations due to motor load variation and noise from the outside.
Therefore, please be connected as close to the IC as much as possible.

CAUTION2: Install the product correctly. Otherwise, it may result in break down, damage and/or deterioration to the product or equipment.

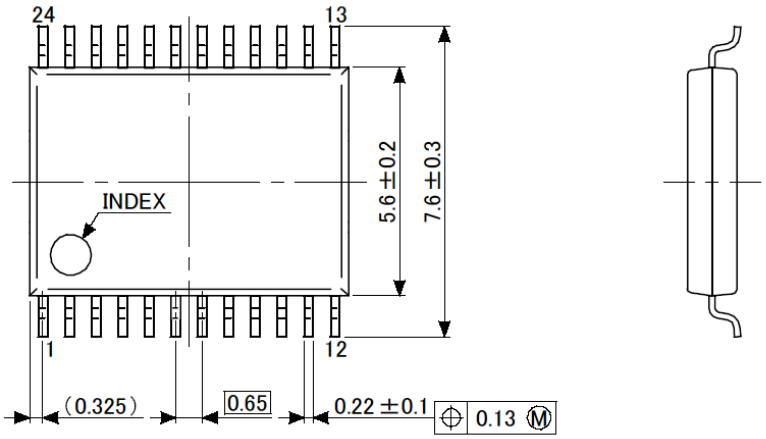
CAUTION3: The application circuits shown in this document are provided for reference purposes only. Especially, a thorough evaluation is required on the phase of mass production design.
Toshiba dose not grant the use of any industrial property rights with these examples of application circuits.

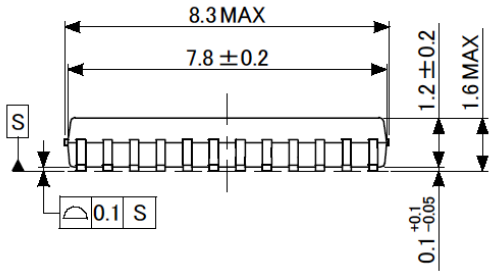
CAUTION4: Short Circuit between each Output signal, Output Signal and Power line (Battery, Regurator Output, GND) may make the cause of IC distruction or Damage.

CAUTION5: Overvoltage detection function does not clamp the power potential.
VCC supply must be protected externally so as not to absolute maximum ratings over.

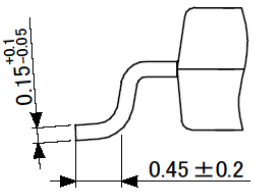
PACKAGE

SSOP24-P-300-0.65A Unit: mm





Detailed diagram of tip of terminal



Weight: 0.14 g (typ.)

【CAUTION 】

·Some of the functional blocks, circuits, or constants in the block diagram may be omitted or Simplified for explanatory purpose.

·The equivalent circuit diagrams may be simplified or some parts of them may be omitted for explanatory purpose.

·Timing charts may be simplified for explanatory purpose.

·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 rating would be 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 break down, damage and/or degradation to any other equipment. Applications using the device should be designed such 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 documents.

·Ensure that the IC is mounted correctly. Failing to do so may result in the IC or target equipment being damage

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Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

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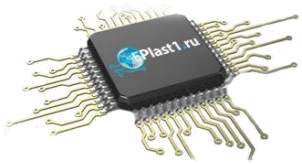
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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