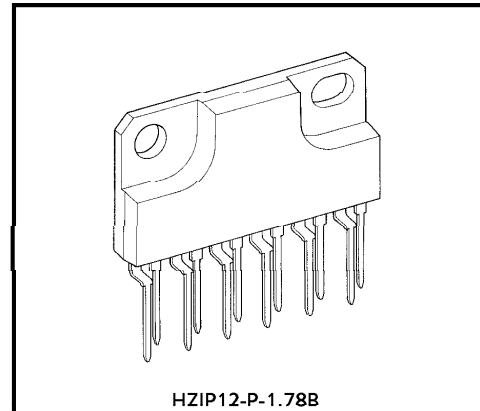


TA8053H

3A DC MOTOR DRIVER WITH DIAGNOSIS

The TA8053H is a bidirectional DC motor driver with a current capacity of 3A. Inputs DI1 and DI2 are combined to select one of forward, reverse, stop, and brake modes. The inputs are TTL-compatible, and separate power supplies are provided for the logic and output sections. The IC also incorporates various protective functions as well as a self-diagnostic function for diagnostic output.

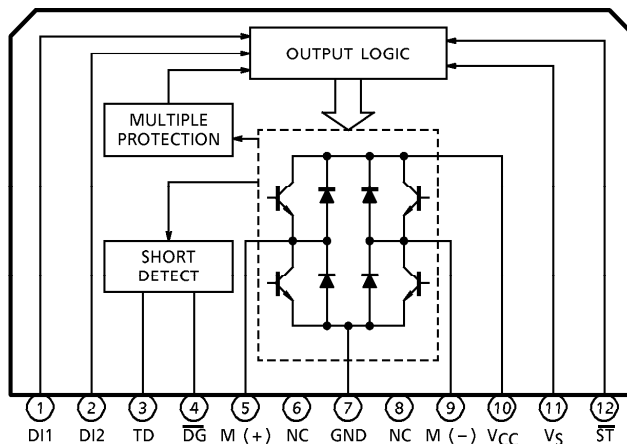


Weight : 4.0g (Typ.)

FEATURES

- Output current capacity : 3A (Max.)
- Small standby current consumption : 100 μ A (Max.)
- Four operation modes : Forward, reverse, stop, and brake
- Multiple protective functions : Short-circuit protection, thermal shutdown, and over-voltage shutdown
- Self-diagnostic output : On short-circuit detection
- Built-in counter electromotive force absorption diodes.
- Plastic package HZIP-12pin

BLOCK DIAGRAM AND PIN LAYOUT



961001EBA2

- TOSHIBA is continually working to improve the quality and the 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 observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product 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 products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.
- The products described in this document are subject to foreign exchange and foreign trade control laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.

PIN DESCRIPTION

PIN No.	SYMBOL	DESCRIPTION
1	DI1	Output status control pin.
2	DI2	Connects to a PNP-type voltage comparator.
3	TD	Delays the \overline{DG} output. A capacitor is placed between this pin and GND. When the pin is open, \overline{DG} is in switching state.
4	\overline{DG}	Self-diagnostic output pin. When the output current increases above 6A (typically), a switching waveform is output from this pin as from M (+) and M (-). If a capacitor is connected to the TD pin, the signal from this pin will go low after a certain delay. The output is an open-collector output. The delay time is approximately calculated by the following formula : T_D (ms) = $50 \times C_T$ (μ F) Permissible C_T range : 0.01 μ F to 2 μ F
5	M (+)	Connects to the DC motor. Both the sink and the source have a current capacity of 3A. Diodes for absorbing counter electromotive force are contained on the V_{CC} and GND sides.
6	NC	Not connected
7	GND	Grounded
8	NC	Not connected
9	M (-)	Connects to the DC motor together with pin 5 and has the same function as pin 5. This pin is controlled by the inputs from pins 1 and 2.
10	V_{CC}	Power supply pin for the output section
11	V_S	Power supply pin for the control section. This pin is completely separated from the V_{CC} pin.
12	\overline{ST}	When this pin is opened or grounded, the output turns off to reduce the current consumption below 100 μ A. If standby mode is not needed, the pin is connected to V_{CC} .

TRUTH TABLE

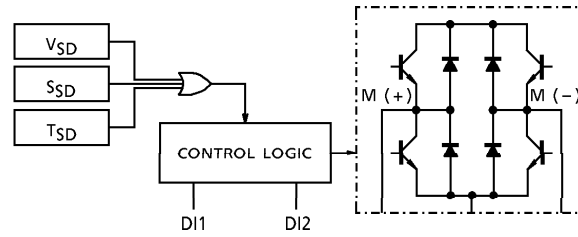
INPUT		OUTPUT			OUTPUT MODE
DI1	DI2	\overline{ST}	M (+)	M (-)	
H	H	H	L	L	BRAKE
L	H	H	L	H	REVERSE
H	L	H	H	L	FORWARD
L	L	H	OFF (high impedance)		STOP
H/L	H/L	L	OFF (high impedance)		STANDBY

DESCRIPTION OF MULTI-PROTECTIVE OPERATION

The TA8053H has functions for protection from over-voltage (V_{SD}), over-current (I_{SD}), and overheat (T_{SD}). These functions protect the IC (and the motor load in some cases) from deterioration or destruction due to power-related overstress.

The three functions work independently.

Each function is explained below.



1. Over-voltage protection (V_{SD})

- Basic operation

When the voltage supplied to the V_{CC} pin is up to the V_{SD} detection voltage, the output is controlled by the input signals. However, when the V_{CC} voltage exceeds the detection voltage, the output enters high-impedance state regardless of the input signals.

- Detailed explanation

The V_{SD} voltage is detected by comparing the reference voltage which is constructed by zener diode. When the center voltage of the resistor is higher than the Zener voltage, a transistor-off instruction is issued to the control logic. When it is lower than the Zener voltage, the logic is controlled by the input signals from pins 1 and 2.

2. Overheat protection (T_{SD})

- Basic operation

When the junction (chip) temperature is up to the T_{SD} detection temperature, the output is controlled by the input signals. When it exceeds the T_{SD} detection temperature, the output enters high-impedance state regardless of the input signals.

- Detailed explanation

The temperature is detected by monitoring V_{BE} of a transistor on the chip. When the transistor V_{BE} is lower than the internal reference voltage, an output transistor-off instruction is issued to the control logic. When it is higher than the internal reference voltage, the logic is controlled by the input signals from pins 1 and 2.

3. Over-current protection (I_{SD})

- Basic operation

When the output current (pin 5 or 9, I sink or I source) is up to the I_{SD} detection current, the output is controlled by the input signals. When it exceeds the detection current, the output assumes a switching waveform as shown in Fig.1.

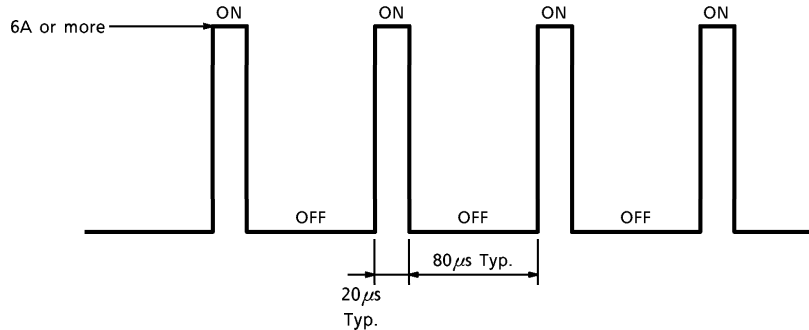


Fig.1 Basic Operation

- Detailed explanation

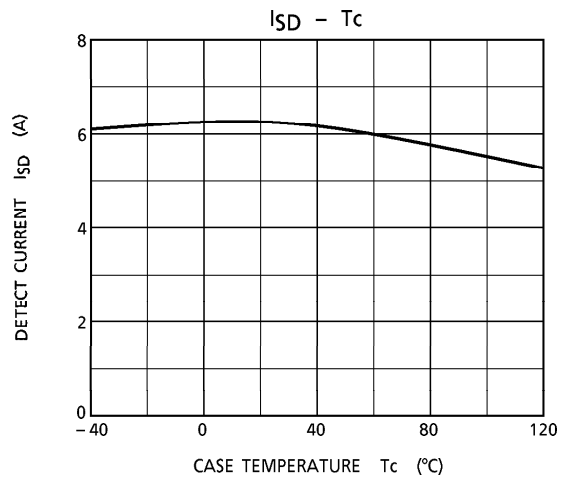
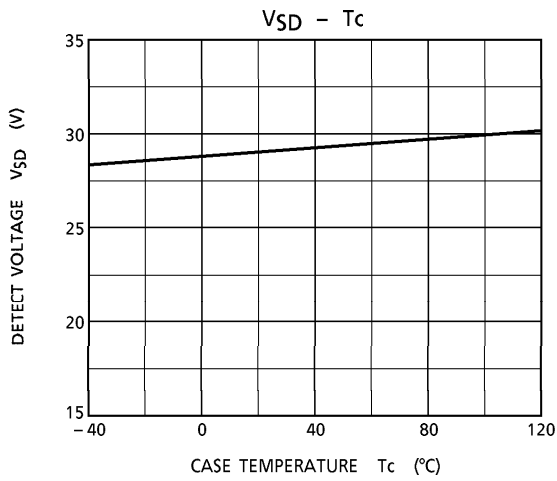
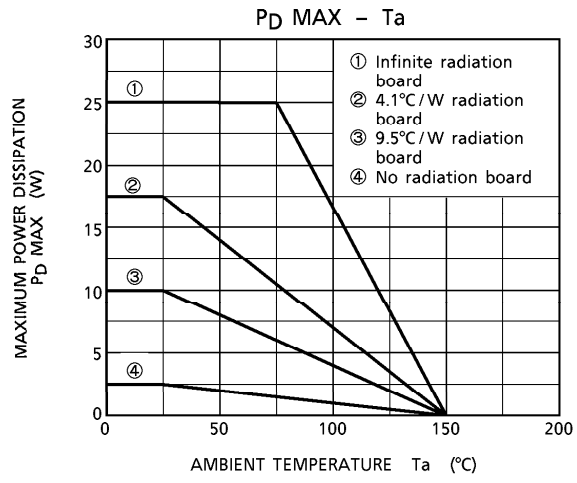
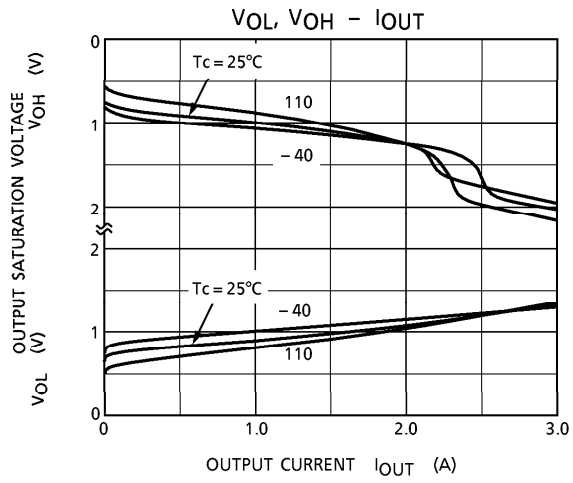
The output current is detected by monitoring the V_{BE} from each output transistor. One detection circuit connects to one of the output transistors and leads to the short-circuit protection circuit. When a current exceeding the I_{SD} detection current flows through one of the four output transistors, the short-circuit protection circuit is activated. This circuit contains a timer. When over-current condition continues for $20\mu s$ (typically), the protection circuit places the output in high-impedance mode and, $80\mu s$ (typically) later, returns the IC to ON mode. The switching-waveform output is repeated until over-current condition is no longer present.

MAXIMUM RATINGS ($T_a = 25^\circ C$)

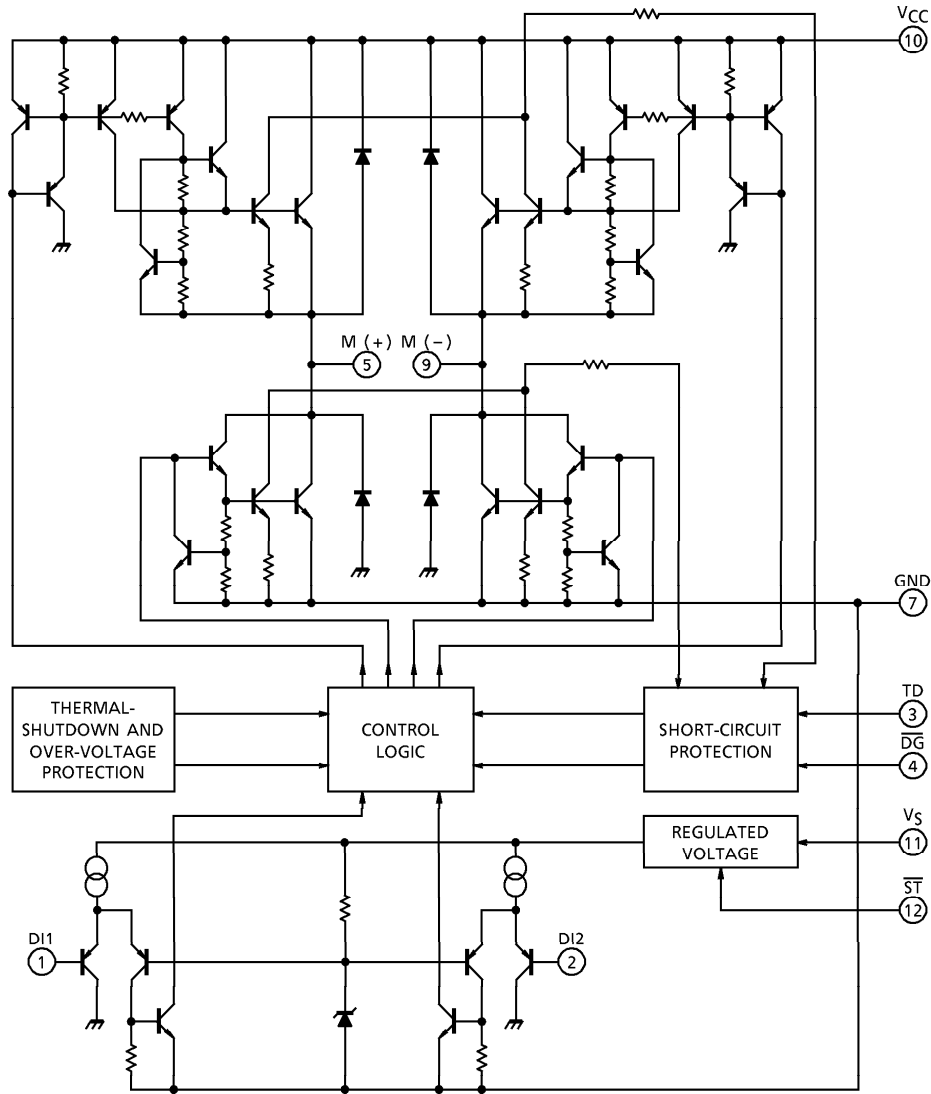
CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{CC}	30	V
	V_{CC}	60 (1s)	
Input Voltage	V_{IN}	$-0.3 \sim V_{CC}$	V
Output Current	$I_{O AVE}$	3.0	A
Operating Temperature	T_{opr}	$-40 \sim 110$	$^\circ C$
Storage Temperature	T_{stg}	$-55 \sim 150$	$^\circ C$
Power Dissipation	P_D	25	W
Lead Temperature-time	T_{sol}	260 (10s)	$^\circ C$

ELECTRICAL CHARACTERISTICS ($V_{CC} = 6 \sim 16V$, $T_c = -40 \sim 110^\circ C$)

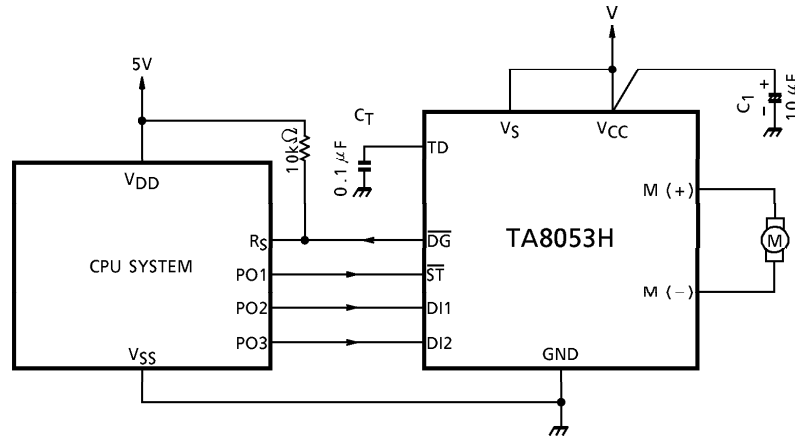
CHARACTERISTIC	SYMBOL	PIN	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Consumption (I)	I_{S1}	V_S	—	Stop	—	8	14	mA
	I_{S2}		—	Forward / Reverse	—	22	42	
	I_{S3}		—	Brake	—	22	42	
Current Consumption (II)	I_{CC1}	V_{CC}	—	Stop	—	5	8	mA
	I_{CC2}		—	Forward / Reverse	—	18	42	
	I_{CC3}		—	Brake	—	5	8	
Input Voltage	V_{IL}	DI1 / DI2	—	—	—	0.8	—	V
	V_{IH}		—	—	2.0	—	—	
Input Current	I_{IL}	DI1 / DI2	—	$V_{IN} = 0.4$	—	—	-50	μA
	I_{IH}		—	$V_{IN} = V_{CC}$	—	—	10	
Input Voltage	V_{IL}	\overline{ST}	—	—	—	—	0.8	V
	V_{IH}		—	—	2.0	—	—	
Input Current	I_{IL}	\overline{ST}	—	$V_{IN} = 0.4$	—	—	50	μA
	I_{IH}		—	$V_{IN} = V_{CC}$	—	—	4	
Output Saturation Voltage	V_{sat} (total)	M (+) /	—	$I_O = 1.5A$	1.0	2.1	2.8	V
		M (-)	—	$I_O = 3.0A$	2.0	3.3	4.1	
Output Leakage Current	I_{LEAK-U}	M (+) /	—	$V_O = 0V$	—	—	-100	μA
	I_{LEAK-L}	M (-)	—	$V_O = V_{CC}$	—	—	100	
Output Voltage	V_{OL}	\overline{DG}	—	$I_{OL} = 3mA$	—	—	0.5	V
Output Leakage Current	I_{LEAK}		—	$V_{OUT} = V_{CC}$	—	—	10	μA
Diode Forward Voltage	V_{F-U}	M (+) /	—	$I_F = 3.0A$	—	5.0	—	V
	V_{F-L}	M (-)	—	$I_F = 3.0A$	—	1.5	—	
Over-current Detection	I_{SD}	—	—	—	4.2	6	8	A
Shutdown Temperature	T_{SD}	—	—	—	—	150	—	$^\circ C$
Over-voltage Detection	V_{SD}	—	—	—	26	29	32	V
Standby Current	I_S	$V_{CC} + V_S$	—	$\overline{ST} = GND$	—	—	100	μA
Thermal Resistance	$R\theta_{j-c}$	—	—	—	—	3	—	$^\circ C / W$
Transfer Delay Time	t_{pLH}	—	—	—	—	1	10	μA
	t_{pHL}		—	—	—	—	1	



I/O EQUIVALENT CIRCUIT



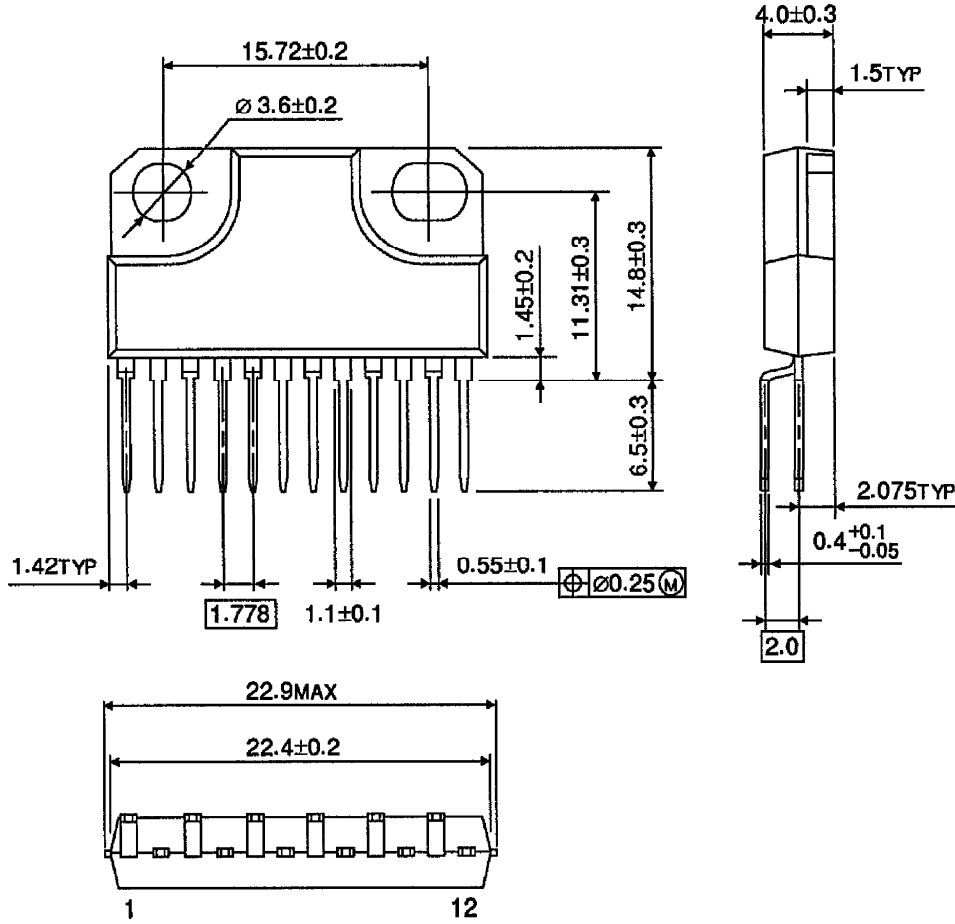
EXAMPLE OF APPLICATION CIRCUIT



- (*) Cautions for wiring
 - C₁ is for absorbing disturbance noise, etc.
 - So, connect it as close as possible.

OUTLINE DRAWING
HZIP12-P-1.78B

Unit : mm



Weight : 4.0g (Typ.)