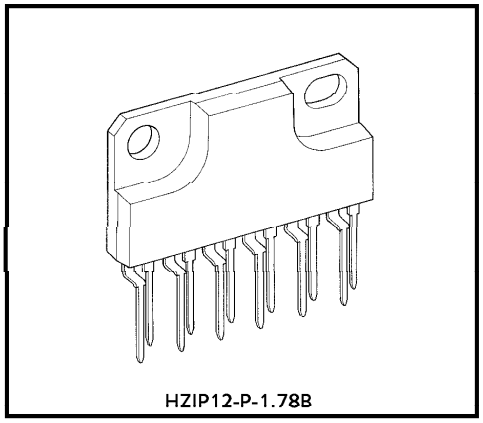
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

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.



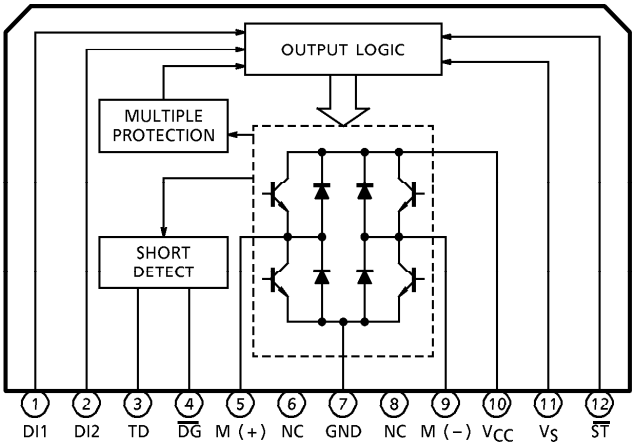
HZIP12-P-1.78B

Weight : 4.0g (Typ.)

FEATURES

- Output current capacity : 3A (Max.)
- Small standby current consumption : 100μA (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



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PIN DESCRIPTION

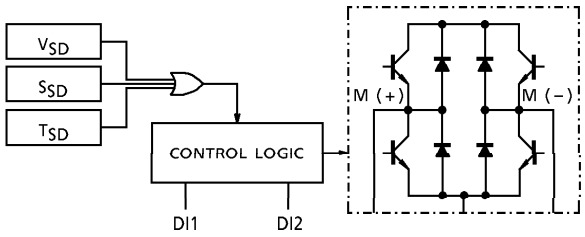
PIN No.	SYMBOL	DESCRIPTION
1 2	DI1 DI2	Output status control pin. Connects to a PNP-type voltage comparator.
3	TD	Delays the $\overline{DG}$ output. A capacitor is placed between this pin and GND. When the pin is open, $\overline{DG}$ is in switching state.
4	$\overline{DG}$	Self-diagnostic output pin. 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 × C_T (μF) Permissible C_T range : 0.01μF to 2μF
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 100μA. 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 constracted by zenner 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.

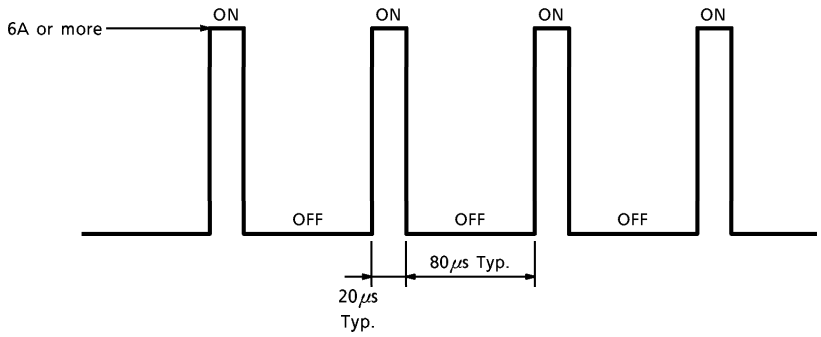


Fig.1 Basic Operation

- 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 20μs (typically), the protection circuit places the output in high-impedance mode and, 80μs (typically) later, returns the IC to ON mode. The switching-waveform output is repeated until over-current condition is no longer present.

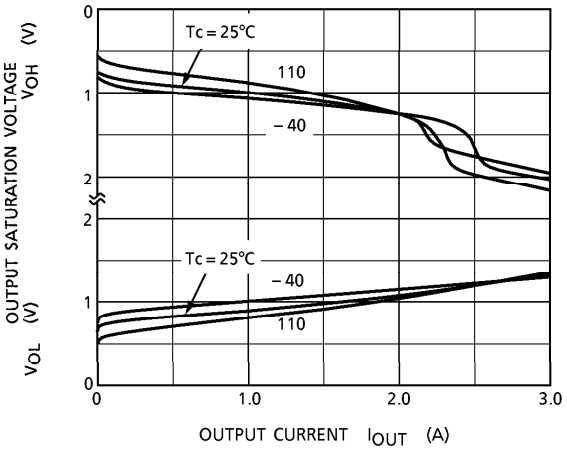
MAXIMUM RATINGS (Ta = 25°C)

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

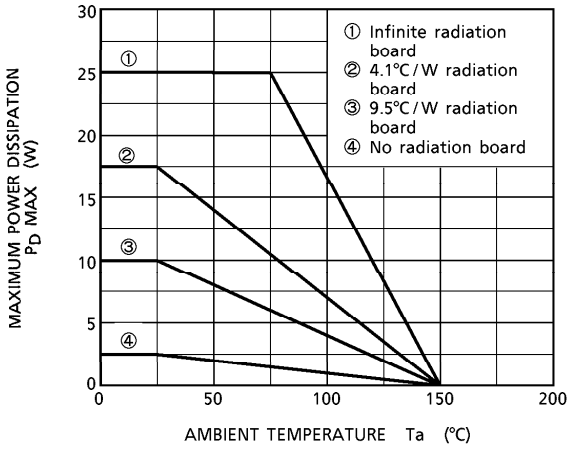
ELECTRICAL CHARACTERISTICS (V_{CC} = 6~16V, Tc = −40~110°C)

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	mA
Output Saturation Voltage	V_{sat} (total)	M (+) / M (−)	—	I_O = 1.5A	1.0	2.1	2.8	V
			—	I_O = 3.0A	2.0	3.3	4.1	
Output Leakage Current	I_{LEAK-U}	M (+) / M (−)	—	V_O = 0V	—	—	−100	μA
	I_{LEAK-L}		—	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 (+) / M (−)	—	I_F = 3.0A	—	5.0	—	V
	V_{F-L}		—	I_F = 3.0A	—	1.5	—	
Over-current Detection	I_{SD}	—	—	—	4.2	6	8	A
Shutdown Temperature	T_{SD}	—	—	—	—	150	—	°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	—	°C / W
Transfer Delay Time	t_{pLH}	—	—	—	—	1	10	μA
	t_{pHL}		—	—	—	1	10	

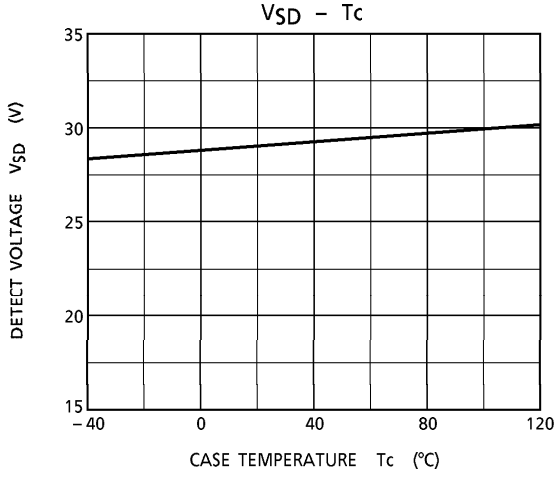
V_{OL}, V_{OH} – I_{OUT}



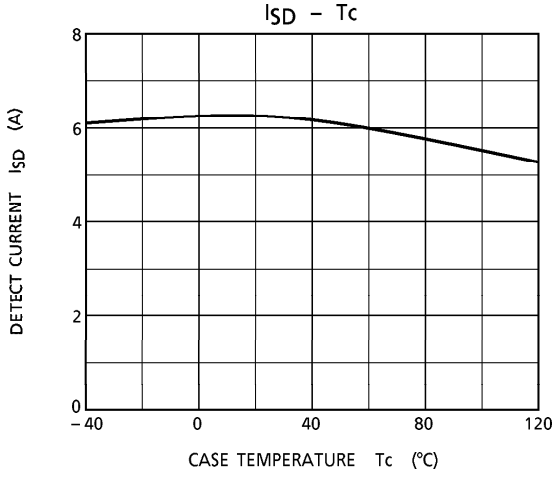
P_D MAX – Ta



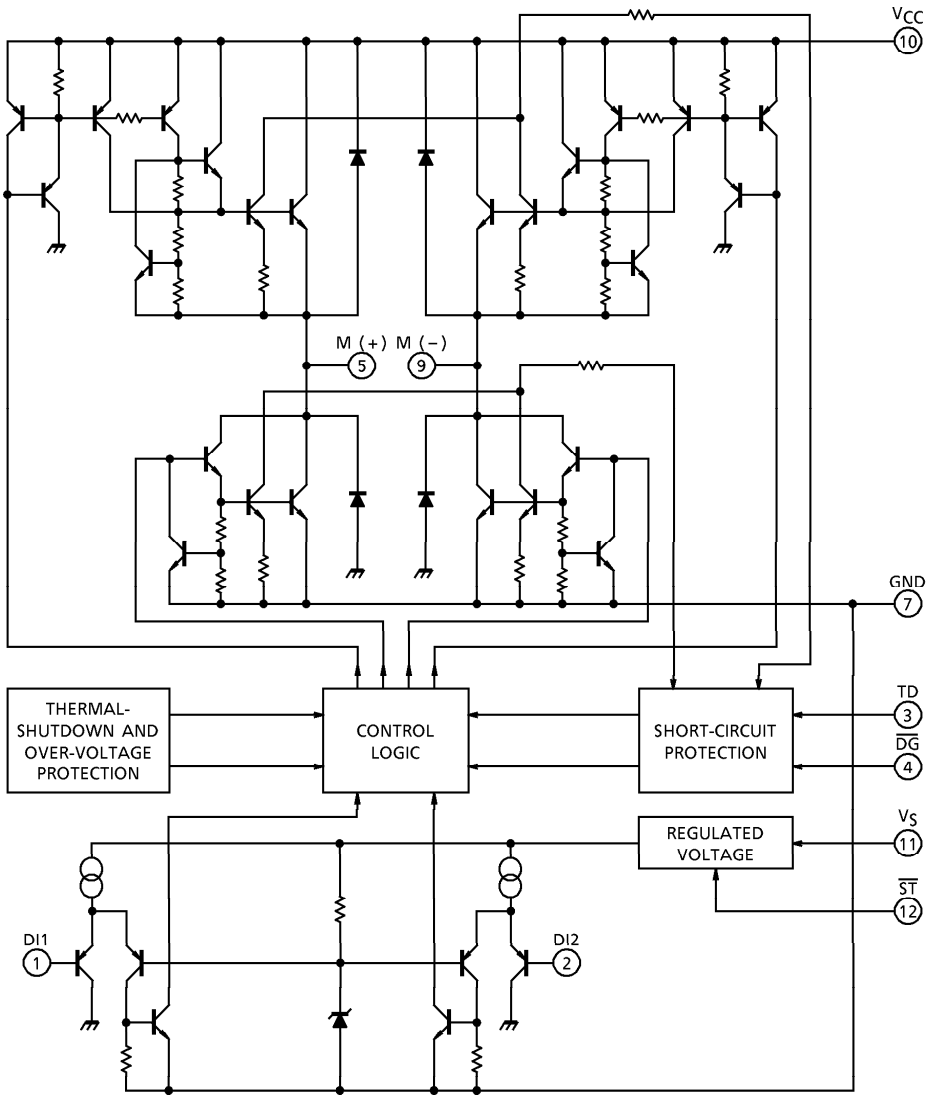
V_{SD} – Tc



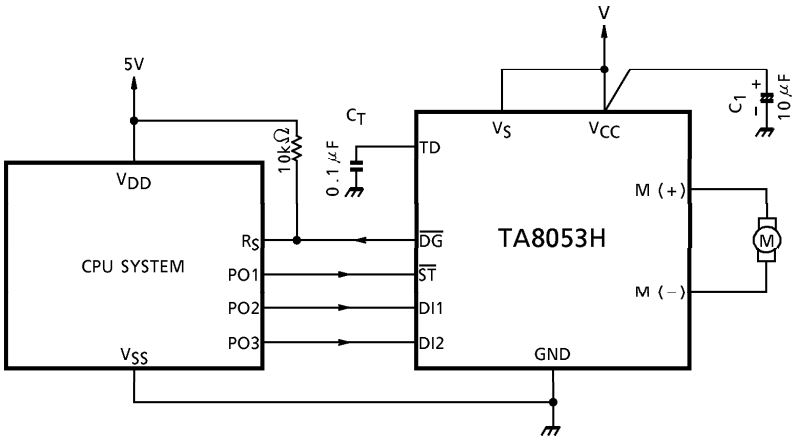
I_{SD} – Tc



I / O EQUIVALENT CIRCUIT



EXAMPLE OF APPLICATION CIRCUIT



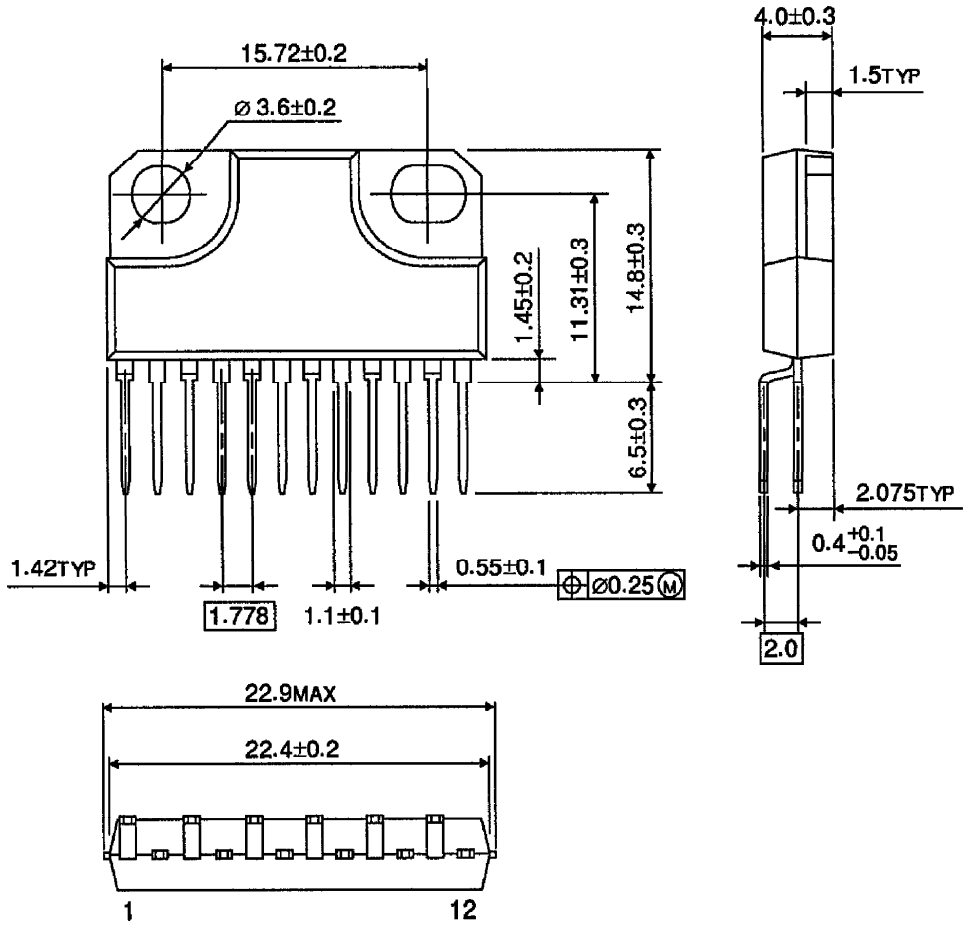
(*) Cautions for wiring

C_1 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.)