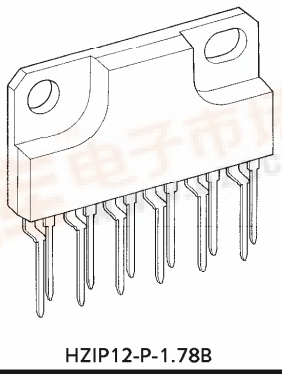
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

TA8051P

3A MOTOR DRIVER WITH BRAKE FUNCTION

The TA8051P 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 standby and various protective functions.



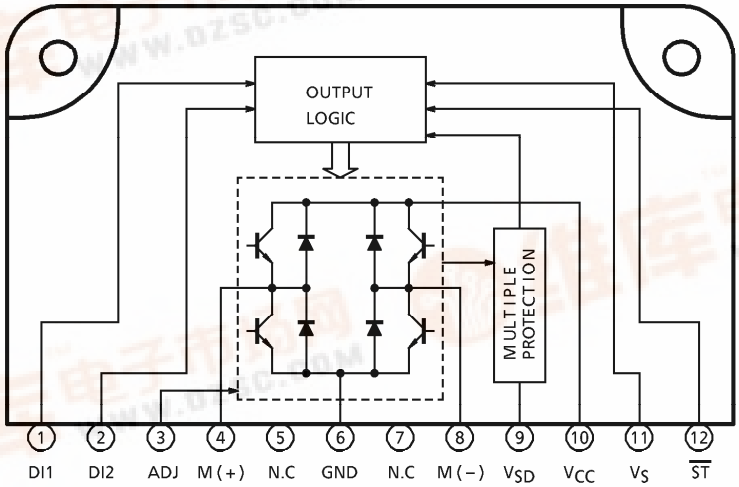
HZIP12-P-1.78B

Weight : 4.0g (Typ.)

FEATURES

- Output current capacity : 3A (max.)
- Small standby current consumption : 100μA (max.)
- Separate V_{CC} supplies for output and logic control sections
- Four modes : Forward, reverse, stop, and brake
- Multiple protective functions : Short-circuit protection, thermal shutdown, and overvoltage shutdown
- Built-in diode for counteracting counter electromotive force
- Plastic package HZIP-12 pin

BLOCK DIAGRAM AND PIN LAYOUT



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PIN DESCRIPTION

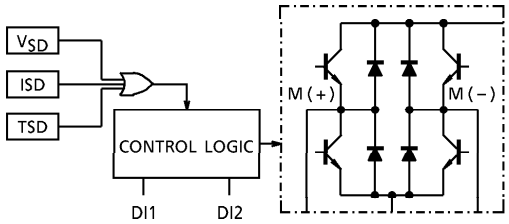
PIN No.	SYMBOL	DESCRIPTION
1 2	DI1 DI2	Output status control pin. Connects to a PNP-type voltage comparator.
3	Adj	Overcurrent detection current setup pin. When this pin is grounded, the ISD value is increased by 1A (typically).
4	M (+)	Connects to the DC motor. Both the sink and the source have a current capacity of 3A. Diodes for absorbing counter electromotive force are contained on the V_{CC} and GND sides.
5	N·C	Not connected
6	GND	Grounded
7	N·C	Not connected
8	M (−)	Connects to the DC motor together with pin 4 and has the same function as pin 4. This pin is controlled by the inputs from pins 1 and 2.
9	V_{SD}	Overvoltage detection pin. When a voltage higher than 27.5V (typically) is applied to this pin, the output turns off (enters stop mode). Generally, the pin is directly connected to the V_{CC} pin (pin 10). If overvoltage protection is not needed, the pin is opened or grounded.
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 connected to V_{CC}.

DESCRIPTION OF MULTI-PROTECTIVE OPERATION

The TA8051P has functions for protection from overvoltage (V_{SD}), overcurrent (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. Overvoltage protection (VSD)

   - 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 Zener voltage with the voltage obtained by dividing V_{CC} with a resistor. 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_F of a diode on the chip. When the diode V_F 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. Overcurrent protections (I_{SD})

   - Basic operation

     When the output current (pin 4 or 8, 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.

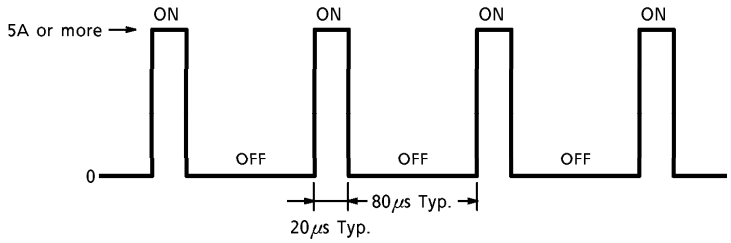


Fig.1 Basic Operation

- 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 overcurrent 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 overcurrent condition is no longer present.

MAXIMUM RATINGS (Ta = 25°C)

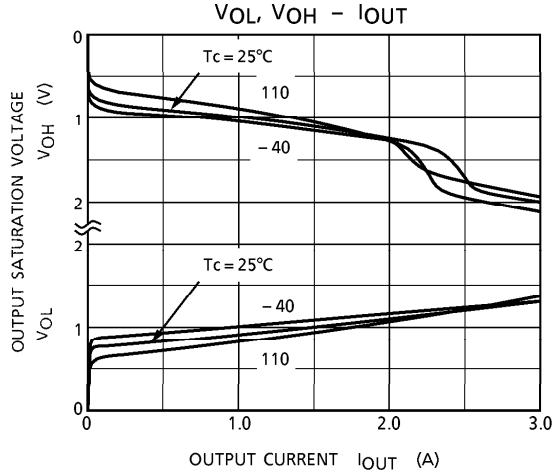
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	30	V
	V_{CC}	60 (1s)	
Input Voltage	V_{IN}	− 0.3 to V_{CC}	V
Output Current	$I_{O\ AVE}$	3.0	A
Operation Temperature	T_{opr}	− 40 to 110	°C
Storage Temperature	T_{stg}	− 55 to 150	°C
Power Dissipation	P_D	25	W
Lead Temperature-time	T_{sol}	260 (10s)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

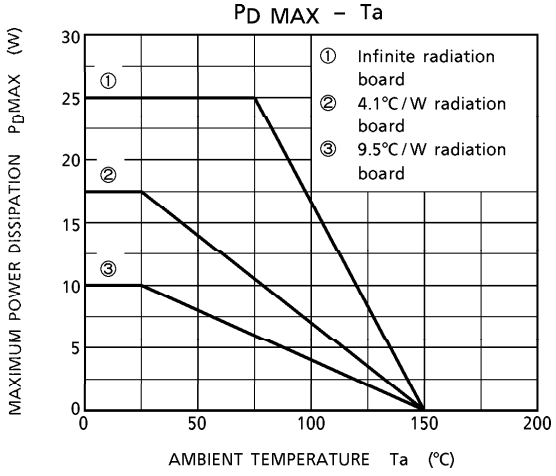
ELECTRICAL CHARACTERISTICS (V_{CC} = 6 to 16V, Tc = − 40 to 110°C)

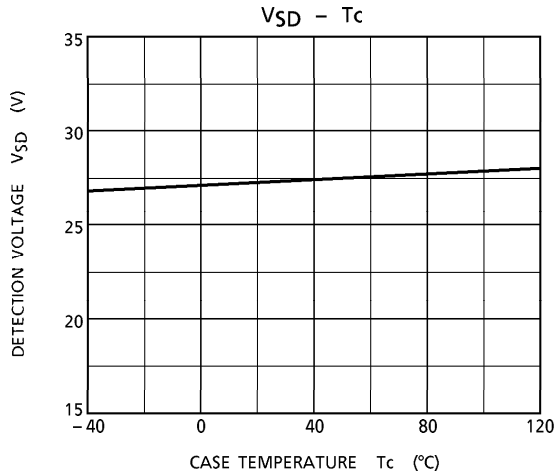
CHARACTERISTIC	SYMBOL	PIN	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Current Consumption (Ⅰ)	I_{S1}	V_S	—	Stop	—	6	12	mA
	I_{S2}		—	Forward / Reverse	—	20	40	
	I_{S3}		—	Brake	—	20	40	
Current Consumption (Ⅱ)	I_{CC1}	V_{CC}	—	Stop	—	3	6	mA
	I_{CC2}		—	Forward / Reverse	—	16	40	
	I_{CC3}		—	Brake	—	3	6	
Input Voltage	V_{IL}	DI1 / DI2	—	—	—	—	0.8	V
	V_{IH}		—	—	2.0	—	—	
Input Current	I_{IL}	DI1 / DI2	—	V_{IN} = 0.4	—	—	− 20	μA
	I_{IH}		—	V_{IN} = V_{CC}	—	—	10	
Input Voltage	V_{IL}	$\overline{ST}$	—	—	—	—	0.5	V
	V_{IH}		—	—	2.0	—	—	
Input Current	I_{IL}	$\overline{ST}$	—	V_{IN} = 0.4	—	—	10	μA
	I_{IH}		—	V_{IN} = V_{CC}	—	—	1	mA
Output Saturation Voltage	V_{sat} (total)	M (+) / M (−)	—	I_O = 1.5A	—	2.1	2.8	V
			—	I_O = 3.0A	—	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	
Diode Forward Voltage	V_{F-U}	M (+) / M (−)	—	I_F = 3.0A	—	5.0	—	V
	V_{F-L}		—	I_F = 3.0A	—	1.5	—	
Overcurrent Detection	I_{SD}	—	—	—	3.5	5	6.5	A
		—	—	Adj = GND	—	6	—	
Shutdown Temperature	T_{SD}	—	—	—	—	150	—	°C
Overvoltage Detection	V_{SD}	—	—	—	25	27.5	30	V
Standby Current	I_S	V_{CC} + V_S	—	—	—	—	100	μA
Thermal Resistance	$R_{\theta j\text{-}c}$	—	—	—	—	3	—	°C / W
Transfer Delay Time	t_{pLH}	—	—	—	—	1	10	μs
	t_{pHL}	—	—	—	—	1	10	

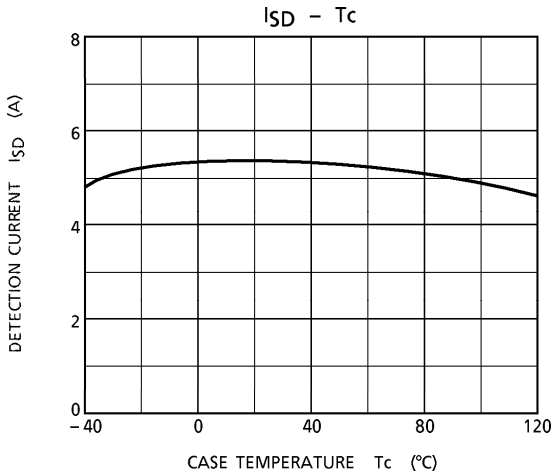
TRUTH TABLE

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)		STAND·BY

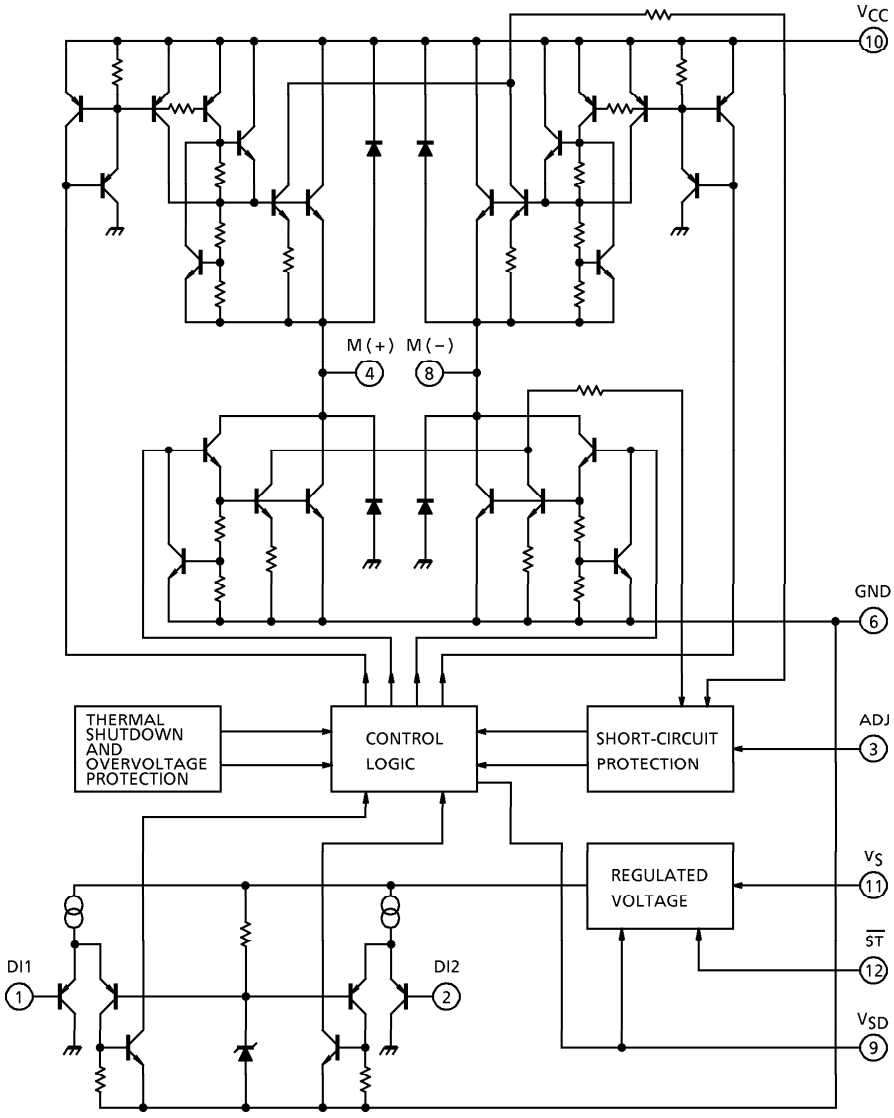






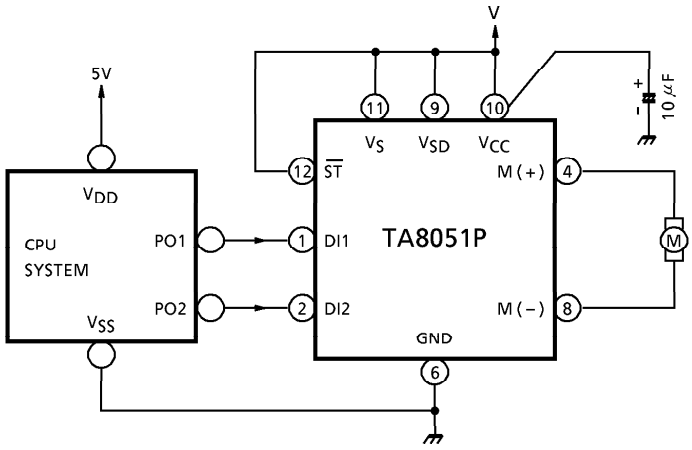


I/O EQUIVALENT CIRCUIT

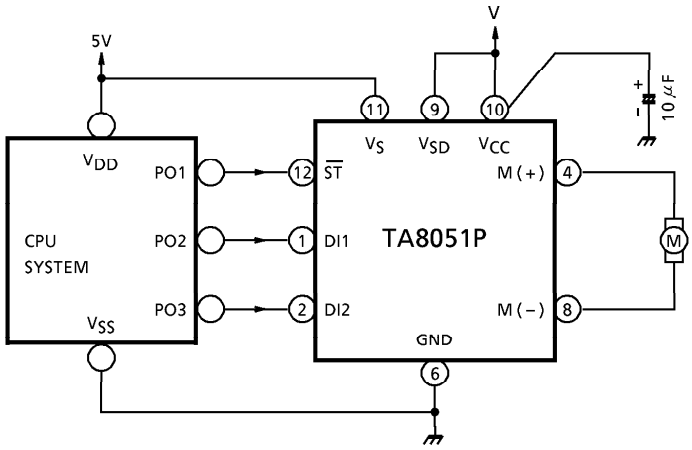


EXAMPLE OF APPLICATION CIRCUIT

1. Standard Circuit



2. Power Supply Separation and Standby Functions



OUTLINE DRAWING

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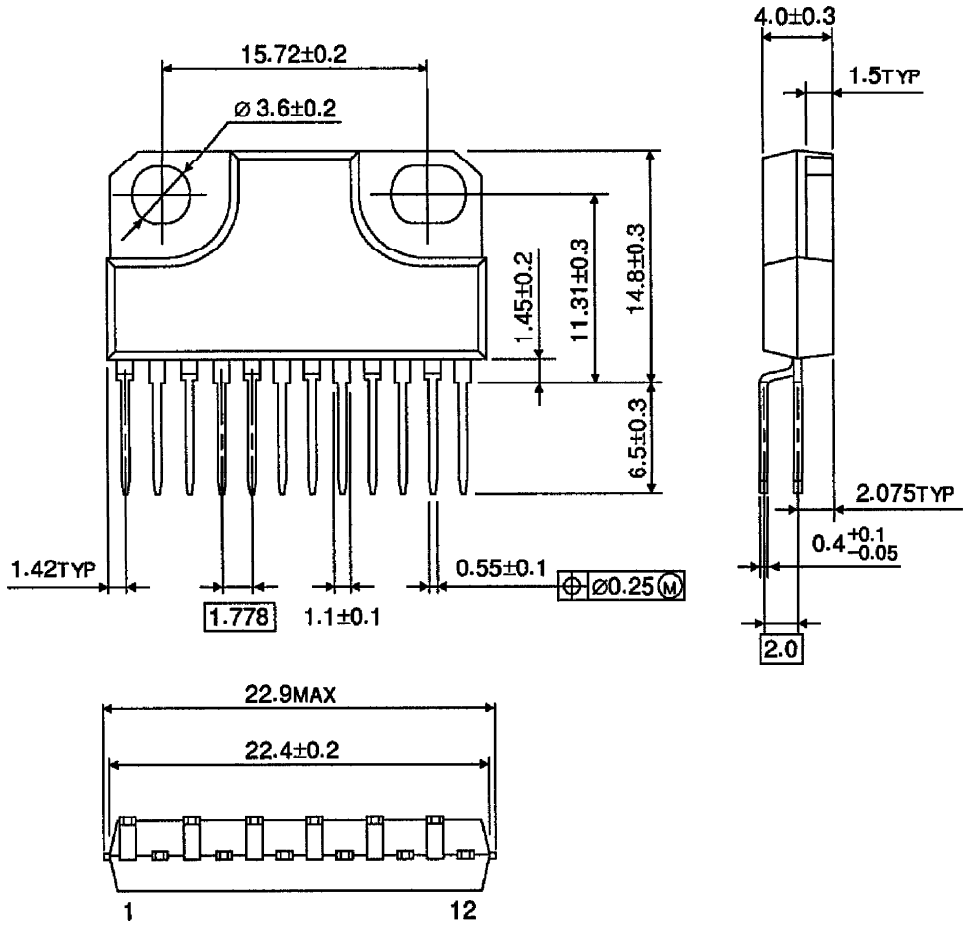
Unit : mm



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