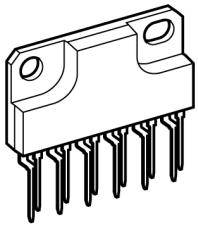
TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

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.



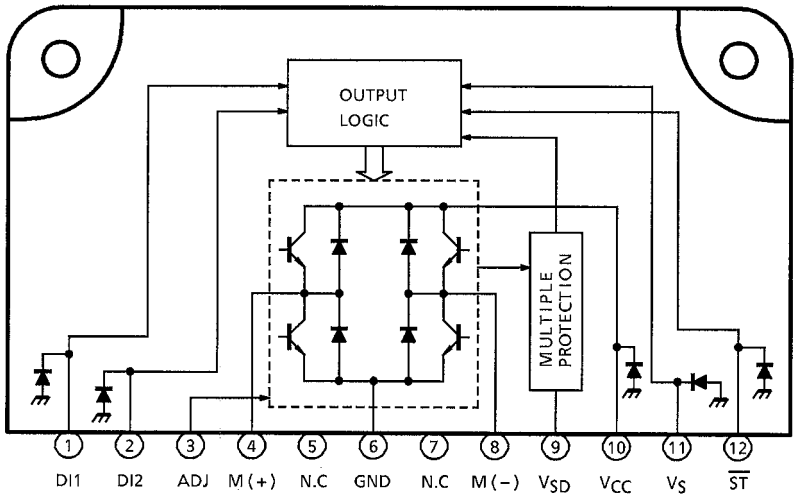
HZIP12-P-1.78B

Weight: 4.0 g (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
- Recommended operating supply voltage range: V_{CC} = 6V to 16V、Vs = 6V to 16V
- Operating temerature range : −40 to 110°C
- Plastic package HZIP-12 pin

BLOCK DIAGRAM AND PIN LAYOUT



PIN DESCRIPTION

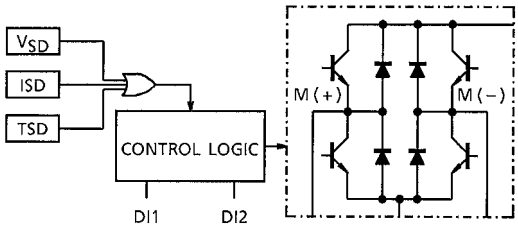
PIN No.	SYMBOL	DESCRIPTION
1 2	DI1 DI2	Output status control pin. Connects to a PNP-type voltage comparator.
3	A_{dj}	Overcurrent detection current setup pin. When this pin is grounded, the ISD value is increased by 1A (typically) .
4	M (+)	Connects to the DC motor. Both the sink and the source have a current capacity of 3A. Diodes for absorbing counter electromotive force are contained on the V_{CC} and GND sides.
6	GND	Grounded
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}.
5, 7	NC	Not connected. (Electrically, this pin is completely open.)

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

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 (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 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.

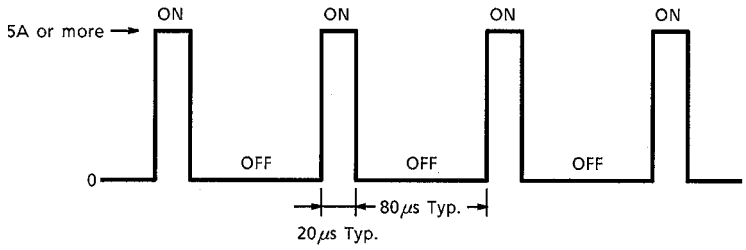


Fig.1 Basic Operation

- 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 20 μs (typically) , the protection circuit places the output in high-impedance mode and, 80 μs (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)

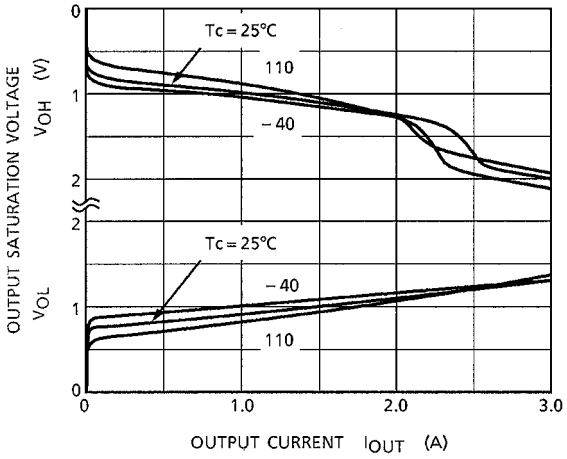
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	30	V
	V_{CC}	60 (1s)	
Input Voltage	V_{IN}	−0.3 to V_{CC}	V
Output Current	$I_{O\ AVE}$	3.0	A
Operation Temperature	T_{opr}	−40 to 110	°C
Storage Temperature	T_{stg}	−55 to 150	°C
Power Dissipation	P_D	25	W
Lead Temperature Time	T_{sol}	260 (10s)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

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

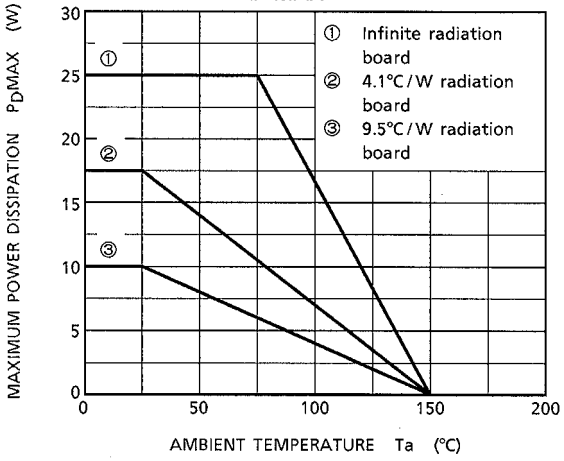
CHARACTERISTIC	SYMBOL	PIN	TEST CIR-CUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Current Consumption (I)	I_{S1}	V_S	—	Stop	—	6	12	mA
	I_{S2}		—	Forward / Reverse	—	20	40	
	I_{S3}		—	Brake	—	20	40	
Current Consumption (II)	I_{CC1}	V_{CC}	—	Stop	—	3	6	mA
	I_{CC2}		—	Forward / Reverse	—	16	40	
	I_{CC3}		—	Brake	—	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	Vsat(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 = VCC	—	—	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	$R\theta_{j-c}$		—		—	3	—	°C / W
Transfer Delay Time	t_{pLH}		—		—	1	10	μs
	t_{pHL}		—		—	1	10	

Note: The parameter values above are guaranteed in the operating voltage range of 8V to 16V. If the guaranteed range is exceeded in practical use, make sure that the IC operates normally in application.

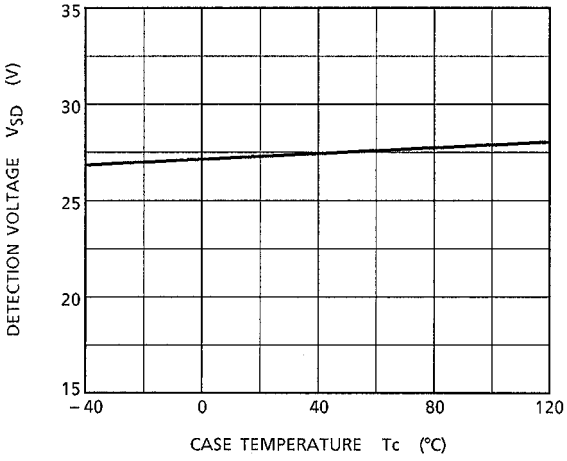
V_{OL}, V_{OH} – I_{OUT}



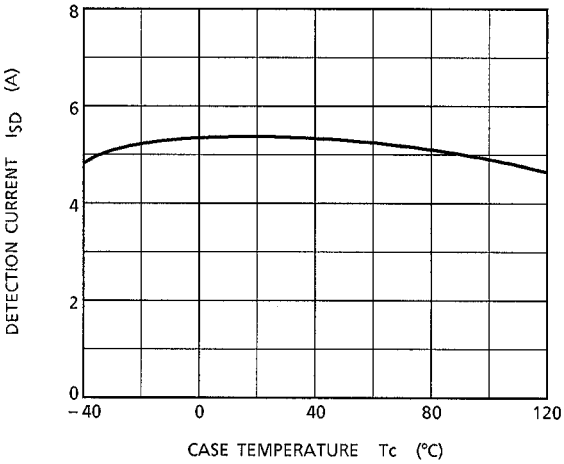
$P_{D\ MAX}$ – Ta



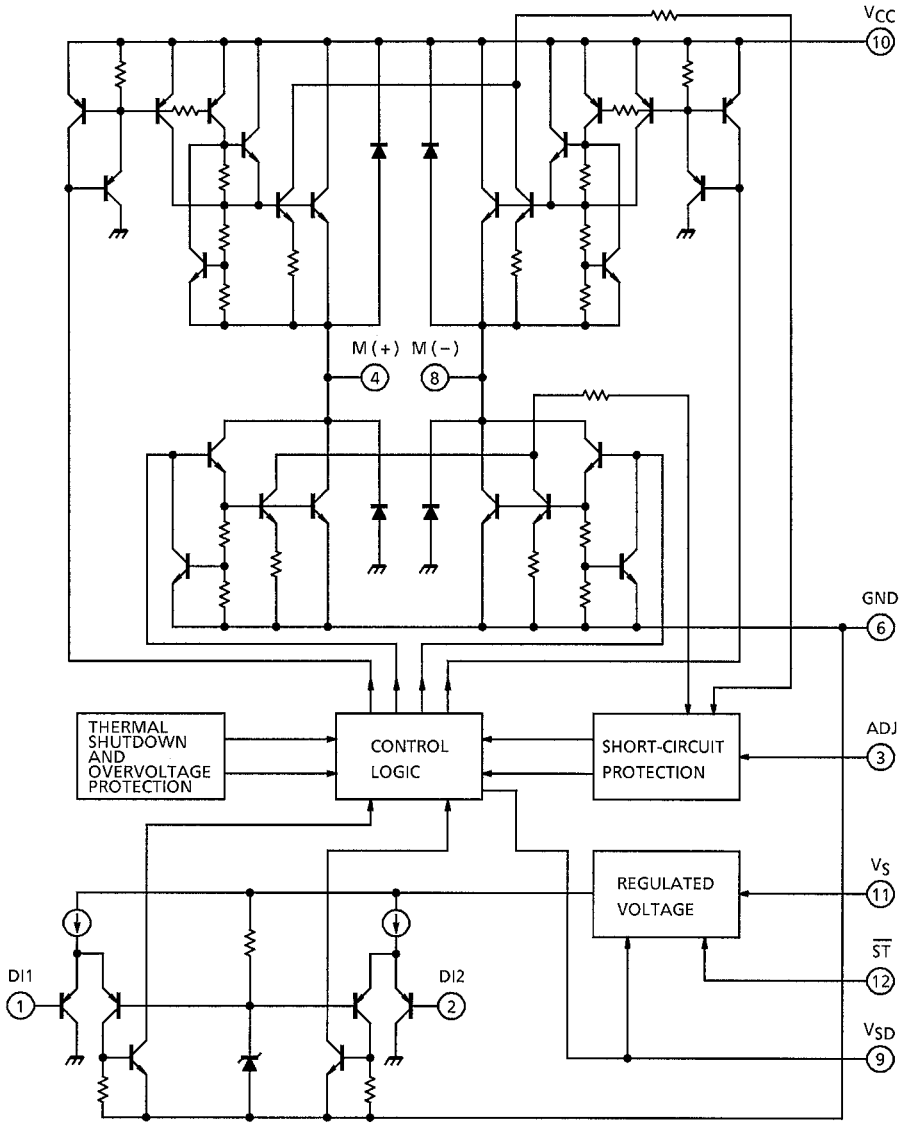
V_{SD} – Tc



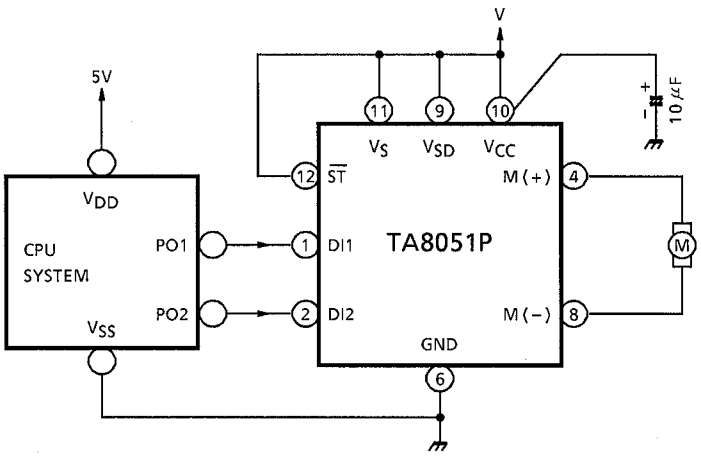
I_{SD} – Tc



I / O EQUIVALENT CIRCUIT



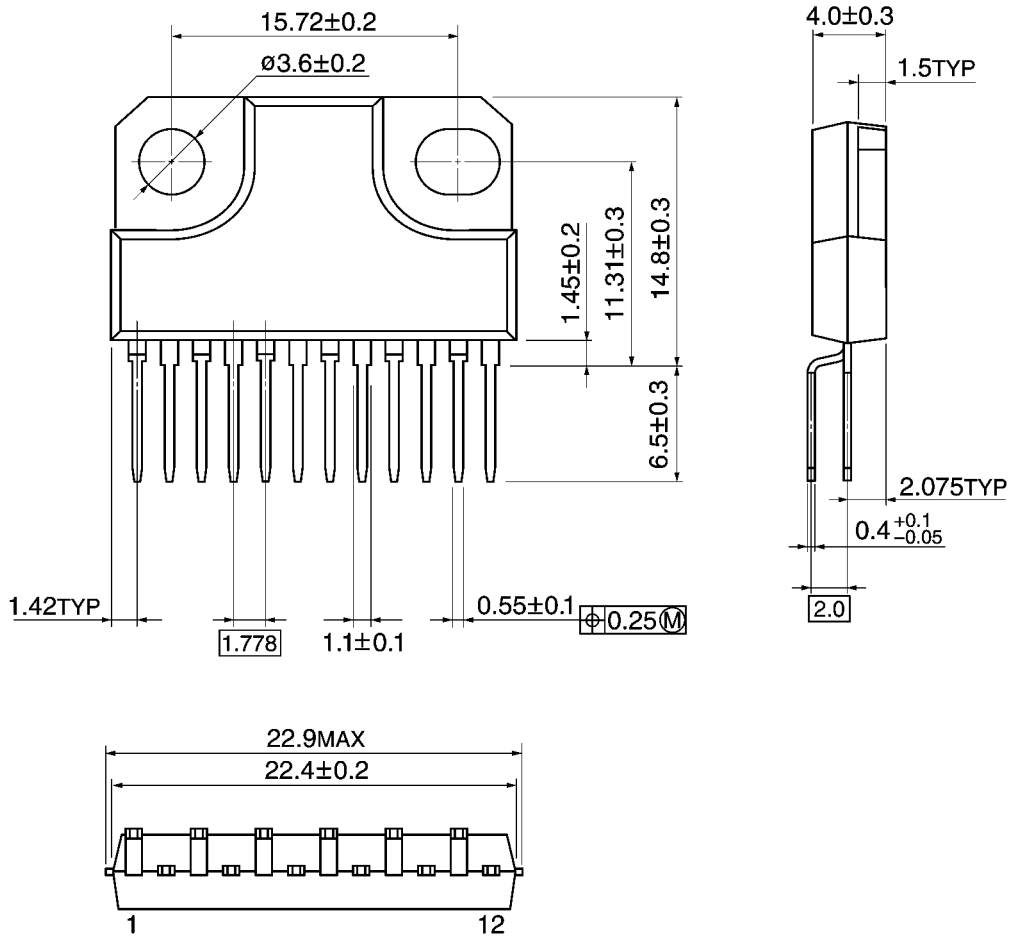
EXAMPLE OF APPLICATION CIRCUIT



Note : Connect this capacitor as close to the IC as possible.

Package Dimensions

HZIP12-P-1.78B Unit: mm



Weight: 4.0 g (typ.)

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