TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT   SILICON MONOLITHIC

TA8050P

1.5A MOTOR DRIVER WITH BRAKE FUNCTION

The TA8050P is a 1.5A motor driver which directly drives a bidirectional DC motor. Inputs DI1 and DI2 are combined to select one of forward, reverse, stop, and brake modes. Since the inputs are TTL-compatible, this IC can be controlled directly from a CPU or other control system. The IC also has various protective functions.

HSIP7-P-2.54

Weight: 1.9 g (typ.)

FEATURES

- Bidirectional DC motor driver
- Current capacity   : 1.5A
- Four modes   : Forward, Reverse, Stop, and Brake
- Recommended operating supply voltage range: V_{CC} = 6V to 16V
- Protective functions   : Thermal Shutdown, Short Circuit Protection, and Overvoltage Shutdown
- Built-in diode for counteracting counter electromotive force
- Plastic HSIP-7 pin
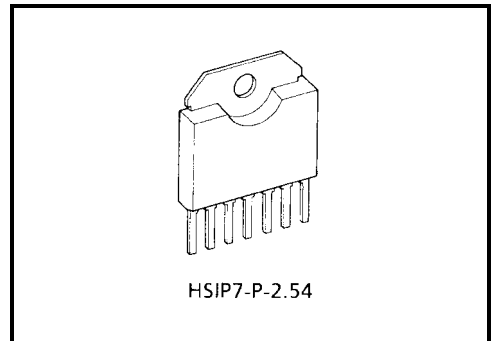
BLOCK DIAGRAM AND PIN LAYOUT
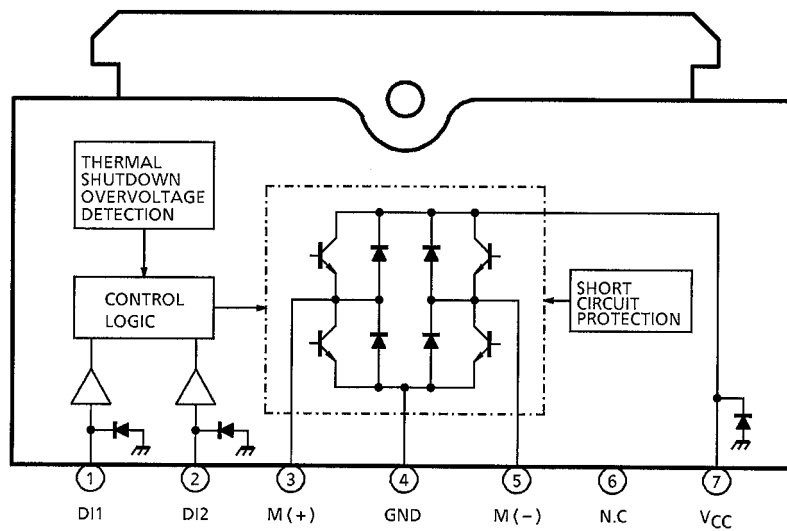
PIN DESCRIPTION

PIN No.	SYMBOL	DESCRIPTION
1 2	DI1 DI2	Output status control pin. Connects to a PNP-type voltage comparator.
3	M (+)	Connects to the DC motor. Both the sink and the source have a current capacity of 1.5A. Diodes for absorbing counter electromotive force are contained on the V_{CC} and GND sides.
4	GND	Grounded
5	M (−)	Connects to the DC motor together with pin 3 and has the same function as pin 3. This pin is controlled by the inputs from pins 1 and 2.
6	NC	Not connected. (Electrically, this pin is completely open.)
7	V_{CC}	Power supply pin. This pin has a function to turn off the output when the applied voltage exceeds 27.5V, thus protecting the IC and the load.

TRUTH TABLE

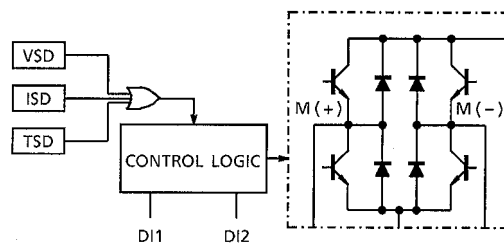| Input		Output		
DI1	DI2	M (+)	M (−)	
H	H	L	L	(Note)
L	H	L	H	
H	L	H	L	
L	L	OFF (high impedance)		(Note)

Note: Brake mode comes into effect when both M (+) and M (−) go low ; Stop mode comes into effect when both M (+) and M (−) turn OFF.

DESCRIPTION OF MULTI-PROTECTIVE OPERATION

The TA8050P has functions for protection from overvoltage (VSD), overcurent (ISD), and overheat (TSD). 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 3 or 5, 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.
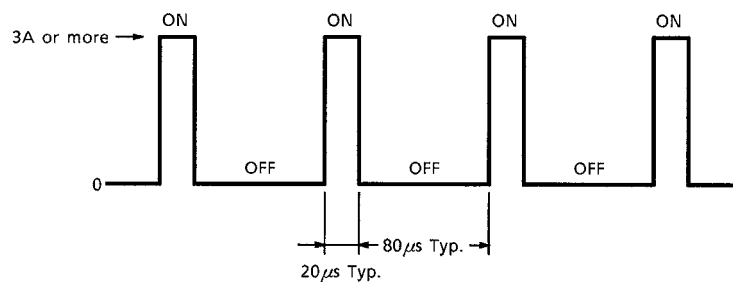

Fig.1 Basic Operation

- Detailed explanation

  The output current is detected by monitoring the VBE 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 ISD 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.
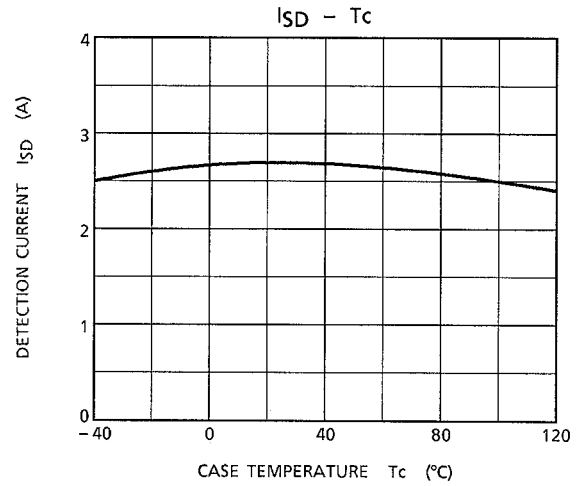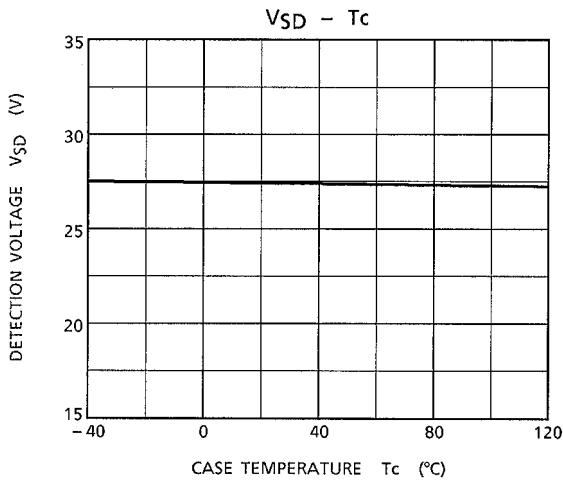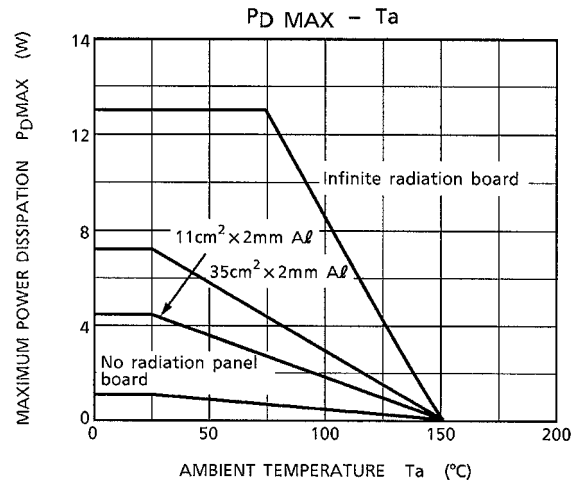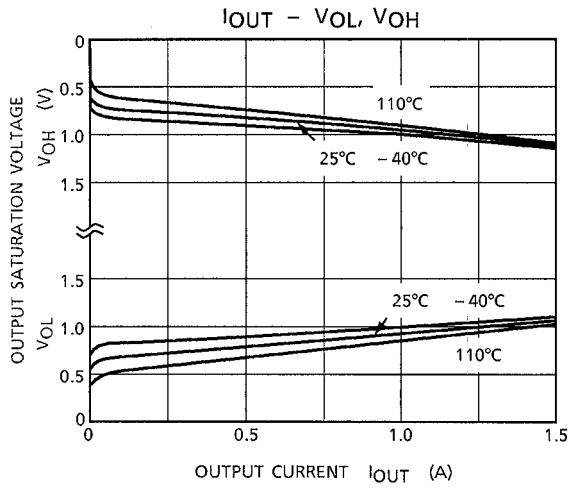
MAXIMUM RATINGS (Ta = 25°C)

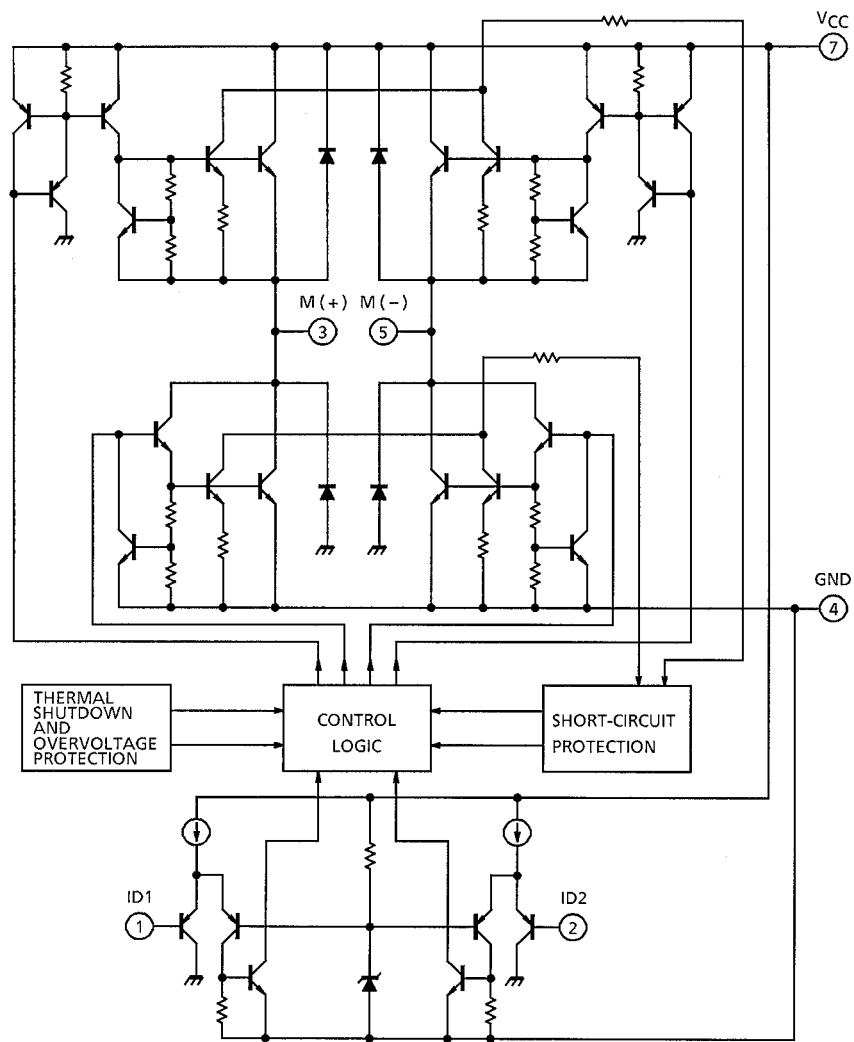| CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	30	V
	V_{CC}	60 (1s)	
Input Voltage	V_{IN}	−0.3 to V_{CC}	V
Output Current	$I_{O\text{-}AVE}$	1.5	A
Operation Temperature	T_{opr}	−40 to 110	°C
Storage Temperature	T_{stg}	−55 to 150	°C
Power Dissipation	P_D	12.5	W
Lead Temperature Time	T_{sol}	260 (10s)	°C

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

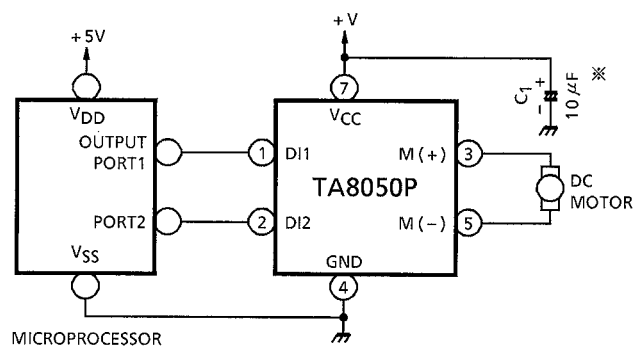| CHARACTERISTIC	SYMBOL	PIN	TEST CIRCUIT	TEST CONDITION	MIN	TYP.	MAX	UNIT
Current Consumption	I_{CC1}	V_{CC}	—	Stop	—	8	15	mA
	I_{CC2}		—	Forward / Reverse	—	27	50	
	I_{CC3}		—	Brake	—	16	30	
Input Voltage	V_{IL}	DI1 / DI2	—		—	—	0.8	V
	V_{IH}		—		2.0	—	—	
Input Current	I_{IL}	DI1 / DI2	—	V_{IN} = 0.4V	—	—	−100	µA
	I_{IH}		—	V_{IN} = V_{CC}	—	—	100	
Output Saturation Voltage	V_{sat} (total)	M (+) / M (−)	—	I_O = 1.5A, Tc = 25°C	—	2.2	2.9	V
			—	I_O = 1.5A, Tc = 110°C	—	2.2	2.8	
Output Leakage Current	$I_{LEAK\text{-}U}$	M (+) / M (−)	—	V_O = 0V	—	—	−100	µA
	$I_{LEAK\text{-}L}$		—	V_O = V_{CC}	—	—	100	
Diodes Forward Voltage	$V_{F\text{-}U}$	M (+) / M (−)	—	IF = 1.5A	—	2.6	—	V
	$V_{F\text{-}L}$		—		—	1.5	—	
Over-Current Detection	I_{SD}		—		1.8	3	4	A
Shutdown Temperature	T_{SD}		—		—	150	—	°C
Over-Voltage Detection	V_{SD}		—		25	27.5	30	V
Thermal Resistance	$R\theta_{j\text{-}c}$		—		—	4	—	°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 6V to 16V. If the guaranteed range is exceeded in practical use, make sure that the IC operates normally in application.

$I_{OUT} - V_{OL}, V_{OH}$

Output saturation voltage vs output current graph. Y-axis: OUTPUT SATURATION VOLTAGE V_{OH} (V) and V_{OL} (V). X-axis: OUTPUT CURRENT I_{OUT} (A). Curves labeled 110°C, 25°C, −40°C.

$P_D MAX - Ta$

Maximum power dissipation vs ambient temperature. Y-axis: MAXIMUM POWER DISSIPATION P_DMAX (W). X-axis: AMBIENT TEMPERATURE Ta (°C). Curves labeled Infinite radiation board, $11cm^2 \times 2mm$ Aℓ, $35cm^2 \times 2mm$ Aℓ, No radiation panel board.

$V_{SD} - Tc$

Detection voltage vs case temperature. Y-axis: DETECTION VOLTAGE V_{SD} (V). X-axis: CASE TEMPERATURE Tc (°C).

$I_{SD} - Tc$

Detection current vs case temperature. Y-axis: DETECTION CURRENT I_{SD} (A). X-axis: CASE TEMPERATURE Tc (°C).

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I / O EQUIVALENT CIRCUIT

EXAMPLE OF APPLICATION CIRCUIT

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

PACKAGE DIMENSIONS

HSIP7-P-2.54

Unit : mm
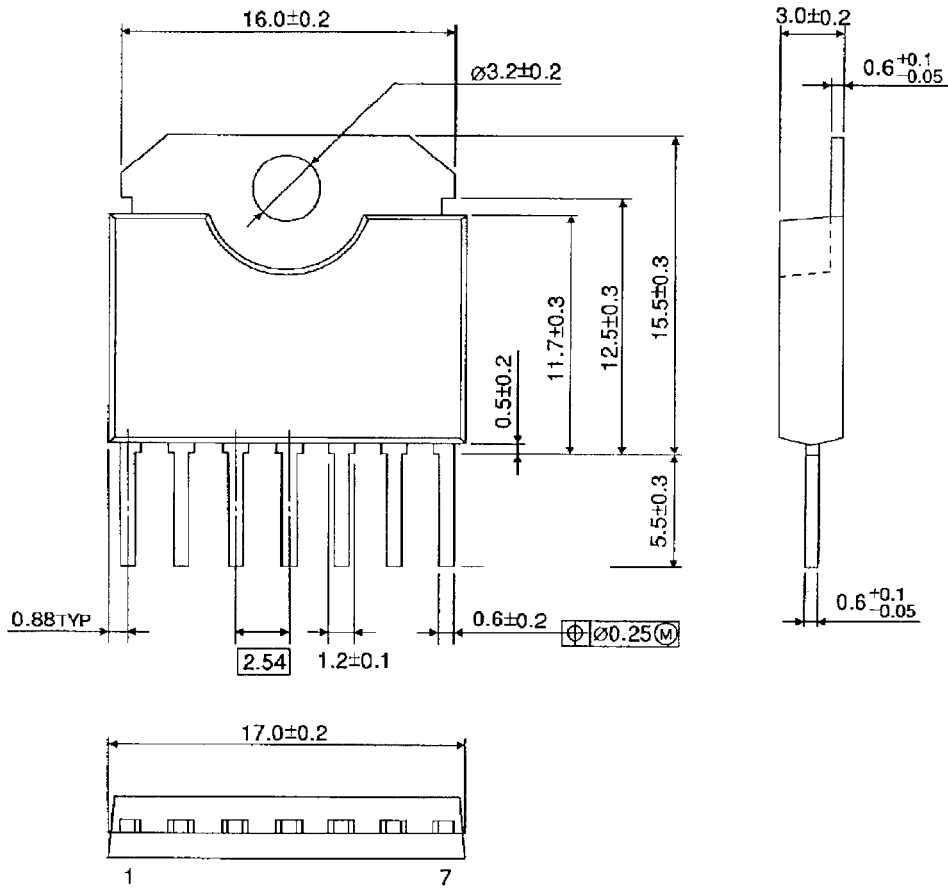
Weight: 1.9g (Typ.)

RESTRICTIONS ON PRODUCT USE