

M54543AL

Bi-DIRECTIONAL MOTOR DRIVER  
WITH BRAKE FUNCTION AND THERMAL SHUT DOWN FUNCTION

DESCRIPTION

The M54543AL is a semiconductor IC capable of directly driving a smallsize bi-directional motor for forward/reverse rotation.

FEATURES

- Wide operating voltage range ( $V_{cc} = 4V$  to  $16V$ )
- Direct drive capability by TTL, PMOS and CMOS IC outputs
- Low output saturation voltage (large voltage across motor)
- Built-in clamp diode
- Large output current drive ( $I_o$  (max) =  $\pm 1.5A$ )
- With brake function
- Built-in thermal shut-down protector circuit

APPLICATION

Commercial-use equipment, audio such as tape recorder or radio cassette recorder, and VCR.

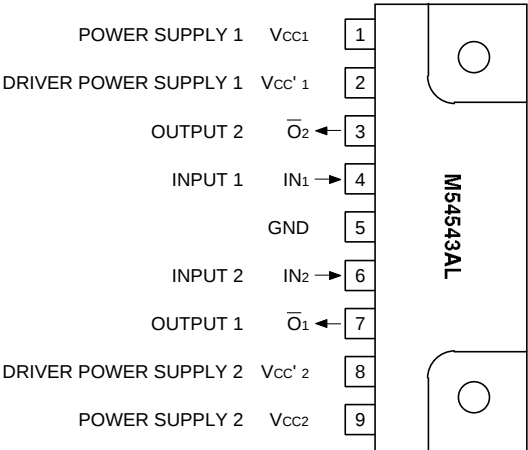
FUNCTIONAL DESCRIPTION

The M54543AL is an IC for driving a smallsize bi-directional motor for forward/reverse rotation. When both of inputs 1 and 2 are "L", outputs 1 and 2 are "OFF". When input 1 is "H" and input 2 is "L", output 1 is "H" and output 2 is "L" (forward rotation). When input 1 is "L" and input 2 is "H", output 1 is "L" and output 2 is "H" (reverse rotation). When both of inputs 1 and 2 are "H", both of outputs 1 and 2 are "L" (braking).

The IC is provided with a control circuit power supply ( $V_{cc}$ ) and an output power supply ( $V_{cc}'$ ) independently. The motor rotation speed can be changed by operating  $V_{cc}$  and  $V_{cc}'$  from a separate supply and varying the voltage of  $V_{cc}$  or  $V_{cc}'$ .

The IC is also provided with a built-in thermal protector circuit to protect it from thermal destruction in case of abnormal condition such as motor blocking.

PIN CONFIGURATION (TOP VIEW)

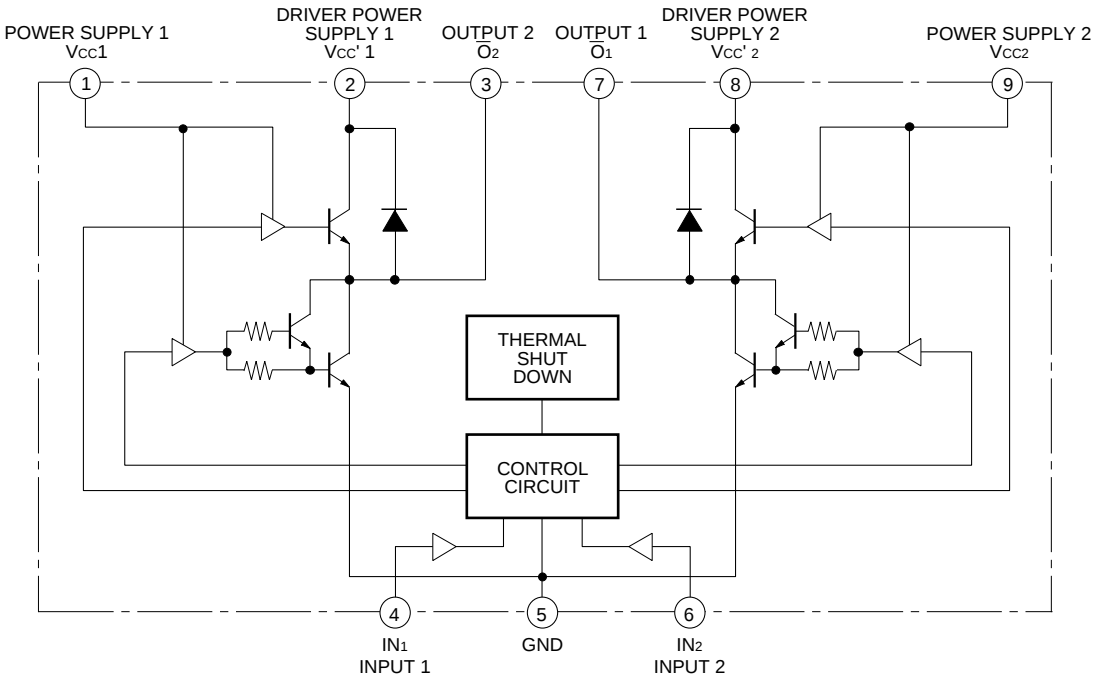


Outline 9P9

LOGIC TRUTH TABLE

| INPUT |     | OUTPUT      |             | NOTE         |
|-------|-----|-------------|-------------|--------------|
| IN1   | IN2 | O1          | O2          |              |
| L     | L   | "OFF" state | "OFF" state | Open         |
| H     | L   | H           | L           | ex.Forward → |
| L     | H   | L           | H           | ex.Reverse ← |
| H     | H   | L           | L           | Braking      |

BLOCK DIAGRAM



**M54543AL****Bi-DIRECTIONAL MOTOR DRIVER  
WITH BRAKE FUNCTION AND THERMAL SHUT DOWN FUNCTION****ABSOLUTE MAXIMUM RATINGS** (Ta=25°C, unless otherwise noted)

| Symbol               | Parameter                     | Conditions                                              | Ratings                       | Unit |
|----------------------|-------------------------------|---------------------------------------------------------|-------------------------------|------|
| V <sub>CC</sub> (1)  | Supply voltage (1)            |                                                         | -0.5 to +16                   | V    |
| V <sub>CC</sub> (2)  | Supply voltage (2)            | With an external heat sink (3000mm <sup>2</sup> ¥1.5mm) | -0.5 to +20                   | V    |
| V <sub>CC'</sub>     | Driver supply voltage         |                                                         | -0.5 to +16                   | V    |
| V <sub>I</sub>       | Input voltage                 |                                                         | 0 to V <sub>CC</sub>          | V    |
| V <sub>O</sub>       | Output voltage                |                                                         | -0.5 to V <sub>CC'</sub> +2.5 | V    |
| I <sub>O</sub> (max) | Peak output current           | top=10ms : Repetitive cycle 0.2Hz max                   | ±1.5                          | A    |
| I <sub>O</sub> (1)   | Continuous output current (1) |                                                         | ±330                          | mA   |
| I <sub>O</sub> (2)   | Continuous output current (2) | With an external heat sink (3000mm <sup>2</sup> ¥1.5mm) | ±600                          | mA   |
| P <sub>d</sub>       | Power dissipation             | Ta=75°C                                                 | 1.15                          | W    |
| T <sub>opr</sub>     | Operating temperature         |                                                         | -10 to +75                    | °C   |
| T <sub>stg</sub>     | Storage temperature           |                                                         | -55 to +125                   | °C   |

**RECOMMENDED OPERATING CONDITIONS** (Ta=25°C, unless otherwise noted)

| Symbol                | Parameter                    | Test conditions     | Limits |      |                 | Unit |
|-----------------------|------------------------------|---------------------|--------|------|-----------------|------|
|                       |                              |                     | Min.   | Typ. | Max.            |      |
| V <sub>CC</sub>       | Supply voltage               |                     | 4      | 12   | 15              | V    |
| I <sub>O</sub>        | Continuous output current    |                     |        |      | ±300            | mA   |
| V <sub>IH</sub>       | "H" Input voltage            |                     | 2      |      | V <sub>CC</sub> | V    |
| V <sub>IL</sub>       | "L" Input voltage            |                     | 0      |      | 0.4             | V    |
| t <sub>B</sub>        | Motor braking interval       |                     | 10     | 100  |                 | ms   |
| T <sub>j</sub> (shut) | Thermal shutdown temperature | V <sub>CC</sub> ≥7V |        | 150  |                 | °C   |

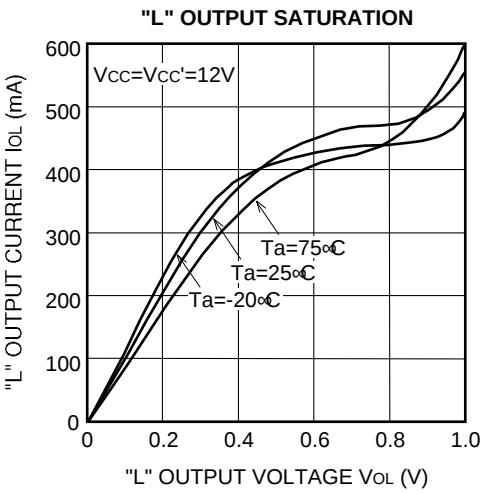
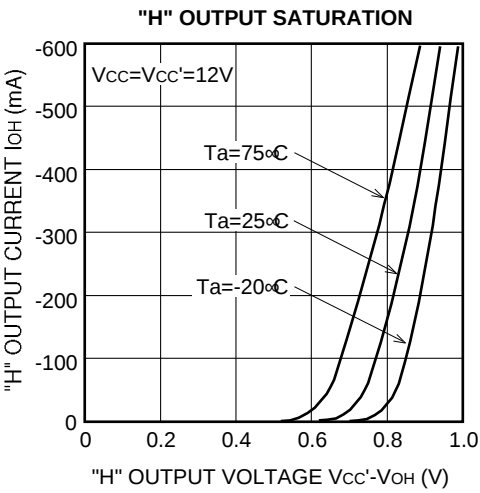
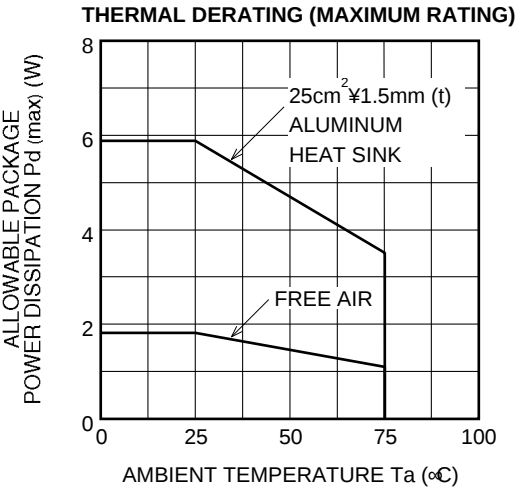
**ELECTRICAL CHARACTERISTICS** (Ta=25°C, unless otherwise noted)

| Symbol                | Parameter                         | Test conditions                                                                  |                                            |                            | Limits |      |      | Unit |
|-----------------------|-----------------------------------|----------------------------------------------------------------------------------|--------------------------------------------|----------------------------|--------|------|------|------|
|                       |                                   |                                                                                  |                                            |                            | Min.   | Typ. | Max. |      |
| I <sub>O</sub> (leak) | Output leak current               | V <sub>CC</sub> =V <sub>CC'</sub> =20V                                           | V <sub>O</sub> =20V                        |                            |        |      | 100  | mA   |
|                       |                                   | V <sub>I1</sub> =V <sub>I2</sub> =0V                                             | V <sub>O</sub> =0V                         |                            |        |      | -100 |      |
| V <sub>OH</sub> (1)   | "H" Output saturation voltage (1) | V <sub>CC</sub> =V <sub>CC'</sub> =12V                                           | V <sub>I1</sub> =2V<br>V <sub>I2</sub> =0V | I <sub>OH</sub> (1)=-200mA | 10.8   | 11.2 |      | V    |
|                       |                                   |                                                                                  |                                            | I <sub>OH</sub> (1)=-500mA | 10.7   | 11.1 |      |      |
| V <sub>OH</sub> (2)   | "H" Output saturation voltage (2) | V <sub>CC</sub> =V <sub>CC'</sub> =12V                                           | V <sub>I1</sub> =0V<br>V <sub>I2</sub> =2V | I <sub>OH</sub> (2)=-200mA | 10.8   | 11.2 |      | V    |
|                       |                                   |                                                                                  |                                            | I <sub>OH</sub> (2)=-500mA | 10.7   | 11.1 |      |      |
| V <sub>OL</sub> (1)   | "L" Output saturation voltage (1) | V <sub>CC</sub> =V <sub>CC'</sub> =12V                                           | V <sub>I1</sub> =0V<br>V <sub>I2</sub> =2V | I <sub>OL</sub> (1)=200mA  |        | 0.2  | 0.5  | V    |
|                       |                                   |                                                                                  |                                            | I <sub>OL</sub> (1)=500mA  |        | 0.95 | 1.35 |      |
|                       |                                   |                                                                                  | V <sub>I1</sub> =V <sub>I2</sub> =2V       |                            |        | 0.95 | 1.35 |      |
| V <sub>OL</sub> (2)   | "L" Output saturation voltage (2) | V <sub>CC</sub> =V <sub>CC'</sub> =12V                                           | V <sub>I1</sub> =2V<br>V <sub>I2</sub> =0V | I <sub>OL</sub> (2)=200mA  |        | 0.2  | 0.5  | V    |
|                       |                                   |                                                                                  |                                            | I <sub>OL</sub> (2)=500mA  |        | 0.95 | 1.35 |      |
|                       |                                   |                                                                                  | V <sub>I1</sub> =V <sub>I2</sub> =2V       |                            |        | 0.95 | 1.35 |      |
| I <sub>IH</sub> (1)   | "H" Input current (1)             | V <sub>CC</sub> =V <sub>CC'</sub> =12V, V <sub>I1</sub> =2V, V <sub>I2</sub> =0V |                                            |                            | 50     |      | 120  | mA   |
| I <sub>IH</sub> (2)   | "H" Input current (2)             | V <sub>CC</sub> =V <sub>CC'</sub> =12V, V <sub>I1</sub> =0V, V <sub>I2</sub> =2V |                                            |                            | 50     |      | 120  | mA   |
| I <sub>CC</sub>       | Supply current                    | V <sub>CC</sub> =V <sub>CC'</sub> =16V<br>Output open                            | V <sub>I1</sub> =2V, V <sub>I2</sub> =0V   |                            |        |      | 20   | mA   |
|                       |                                   |                                                                                  | V <sub>I1</sub> =0V, V <sub>I2</sub> =2V   |                            |        |      |      |      |
|                       |                                   |                                                                                  | V <sub>I1</sub> =V <sub>I2</sub> =2V       |                            |        |      | 20   |      |
|                       |                                   |                                                                                  | V <sub>I1</sub> =V <sub>I2</sub> =0V       |                            |        |      | 4    |      |

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TYPICAL CHARACTERISTICS



# M54543AL

## Bi-DIRECTIONAL MOTOR DRIVER WITH BRAKE FUNCTION AND THERMAL SHUT DOWN FUNCTION

### PRECAUTIONS FOR APPLICATION

- (1) If the motor resistance is high (small output current: several tens of mA at a light load) and  $V_{CC}$  is greater than  $V_{CC'}$  in application examples 2) and 3), current may counter-flow from the  $V_{CC}$  pin to the  $V_{CC'}$  pin.

The motor can work at a light load even when the  $V_{CC'}$  pin is opened. For light-load applications, use the M54544AL.

The thermal protection of the IC may not work depending on an abnormal condition (such as oscillation, low supply voltage or output short). When using the function, check its operation in the actual using state.

If the motor has a large counter electromotive force at a braking time, etc., the internal parasitic Di may malfunction.

If fly-back current of 1A or more flows, put a shottkey Di between the output and the GND.

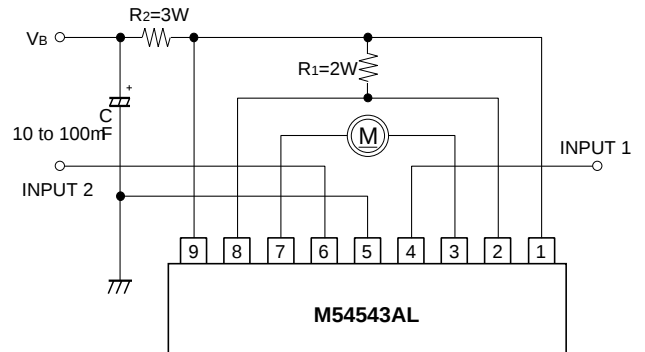
Remember that the IC has an about 10ms delay in output switching for high-speed applications such as PWM.

- (2) As far as motor control and driver IC's are concerned, some possibilities are considered for these IC's to cause such unexpected cases as fire or smoke if they are used beyond its ratings in datasheet or used, even transiently, under the overload conditions. So your action will be highly appreciated to fully look into the rating limits and the using conditions before you use these IC's.

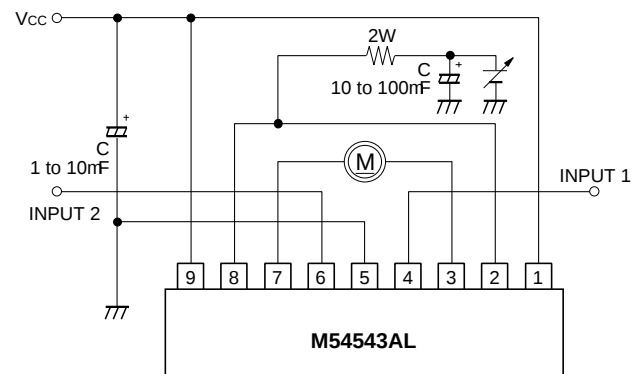
And if these IC's are to be used under the conditions out of our specifications, please never fail to give us a contact as to under what conditions they are used.

### APPLICATION EXAMPLES

#### 1) Motor speed control by $V_{CC}$ and $V_{CC'}$



#### 2) Motor speed control by the $V_{CC'}$



#### 3) Motor speed control by the $V_{CC}$

