M54649L

DUAL Bi-DIRECTIONAL MOTOR DRIVER

DESCRIPTION

The M54649L is a semiconductor integrated circuit that is capable of directly driving two smallsize bi-directional motors rotating in both forward and reverse directions.

FEATURES

● Capable of driving two motors in both forward and reverse directions
● Equipped with "H" output voltage control pin
● Built-in thermal protection circuit
● Large output current drive ($I_{O(max)}$ = 1.6A)
● Wide range of operating supply voltage (V_{CC} = 4 – 18V)
● Capable of directly driving with CMOS IC output

APPLICATION

Sound equipment such as tape deck and radio cassette, VTR, and other general consumer appliances

FUNCTION

The M54649L consists of input circuit, control circuit, constant current circuit and output circuit.
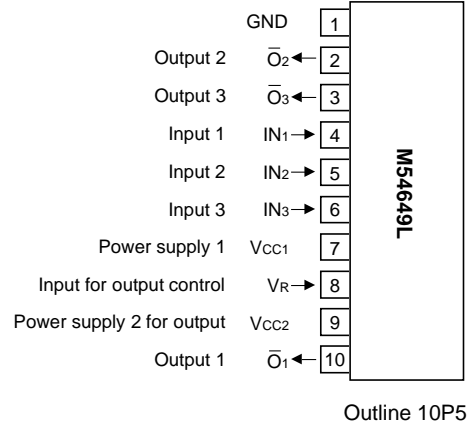
Two motors are connected to the IC; both of them are connected to output pin $\overline{O}_1$, and one is connected to output $\overline{O}_2$, and the other is connected to output $\overline{O}_3$. The motors are controlled by three input levels of input pins IN_1 to IN_3. As shown in the logic truth table, the control statuses of 'forward rotation', 'reverse rotation', 'brake' and 'OFF' are selectable.

The input circuit provides hysteresis functions that prevent malfunction due to rounding at rising edge and falling edge of input signals.
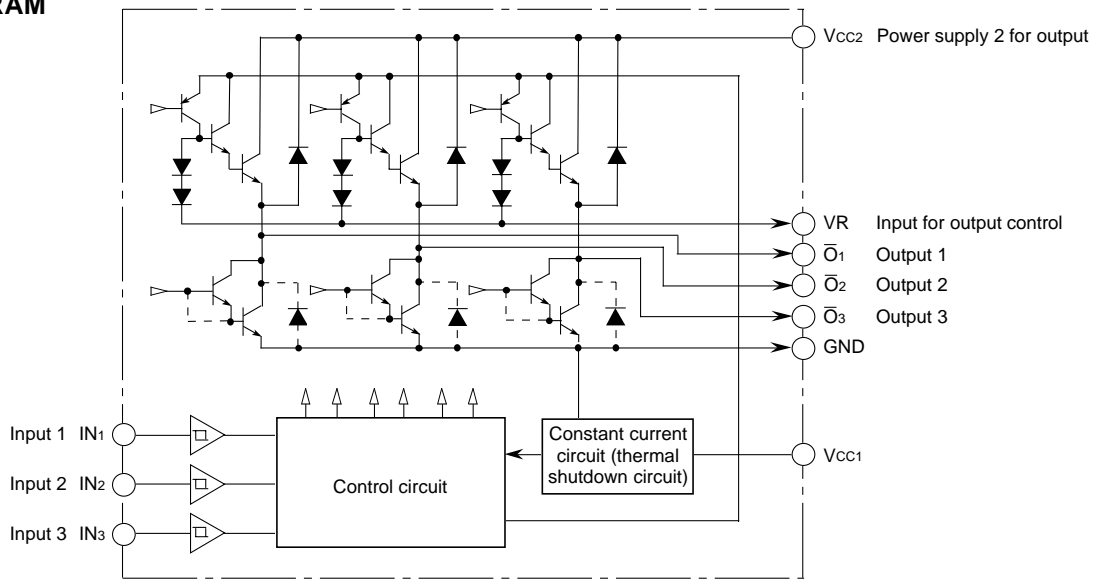
Both the current source side and sink side of the output circuit adopt Darlington circuit configuration of the NPN transistor, allowing up to ±1.6A output current to flow.

In addition, the IC contains a thermal protection circuit to put all outputs in the "OPEN" mode for preventing the IC from thermal braking when failures such as motor lock occurs.

PIN CONFIGURATION (TOP VIEW)

		Pin
	GND	1
Output 2	$\overline{O}_2$ ←	2
Output 3	$\overline{O}_3$ ←	3
Input 1	IN_1 →	4
Input 2	IN_2 →	5
Input 3	IN_3 →	6
Power supply 1	V_{CC1}	7
Input for output control	V_R →	8
Power supply 2 for output	V_{CC2}	9
Output 1	$\overline{O}_1$ ←	10

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Outline 10P5

BLOCK DIAGRAM

LOGIC TRUTH TABLE

Input			Output			Remarks
IN$_1$	IN$_2$	IN$_3$	$\overline{O}_1$	$\overline{O}_2$	$\overline{O}_3$	
L	L	L / H	L	L	L	Brake
H	L	L	H	L	OPEN	↻
H	L	H	L	H	OPEN	↺
L	H	L	H	OPEN	L	↻
L	H	H	L	OPEN	H	↺
H	H	L / H	L	L	L	Brake

ABSOLUTE MAXIMUM RATINGS (Ta = 25°C, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V$_{CC(1)}$	Supply voltage(1)		-0.5 – +20.0	V
V$_{CC(2)}$	Supply voltage(2)		-0.5 – +22.0	V
V$_I$	Input voltage	V$_{CC(1)}$ or less	-0.5 – +7.0	V
V$_O$	Output voltage		-2.0 – V$_{CC}$+2.5	V
I$_{OP}$	Motor rush current	t$_{op}$≤50ms ; duty of 1/50	±1.60	A
I$_O$	Continuous output current	(Note 1)	±600	mA
P$_d$	Power dissipation	Power apply time of 10sec or less	2.78	W
T$_{opr}$	Operating temperature		-20 – 75	°C
T$_{stg}$	Storage temperature		-55 – 125	°C

Note 1: Pay attention to P$_d$ when the IC operations in the stationary status.
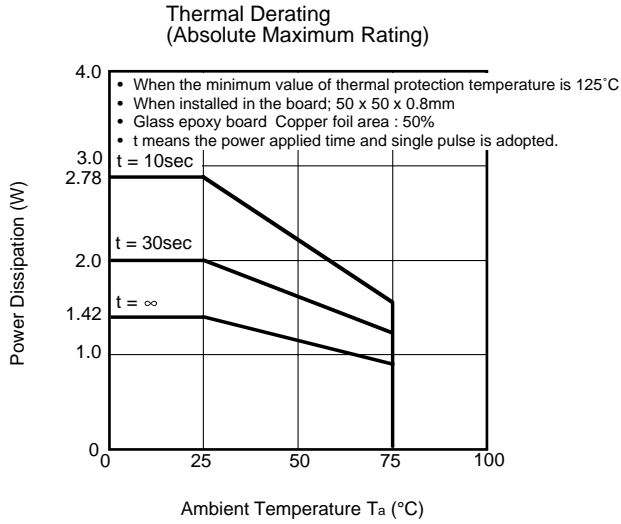
RECOMMENDED OPERATING CONDITION (Ta=25°C, unless otherwise noted)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V$_{CC(1)}$	Supply voltage(1)		4.0	12.0	18.0	V
V$_{CC(2)}$	Supply voltage(2)		0.0		22.0	V
I$_O$	Output current				±600	mA
V$_{IH}$	"H"input voltage		3.5		V$_{CC}$	V
V$_{IL}$	"L" input voltage		0.0		1.0	V
V$_R$	Control voltage		0.0		18.0	V
T$_{ON}$	Thermal shutdown temperature		125	150		°C
ΔT$_{ON-OFF}$	Hysteresis temperature width			50		°C

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

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
I$_{O(leak)}$	Output leak current	Output OPEN status V$_O$ = 0 or 20V	V$_{CC1,2}$ = 20V			±100	μA
V$_{OL}$	"L" output saturation voltage	I$_{OL}$ = 500mA	V$_{CC1,2}$ = 12V			1.5	V
V$_{OH}$	"H" output saturation voltage	I$_{OH}$ = -500mA	V$_{CC1,2}$ = 12V	10.0			V
ΔV$_O$	Output offset voltage	I$_O$ = ±500mA V$_R$ = 6.0V	V$_{CC1,2}$ = 12V	-0.5		0.5	V
I$_R$	8-pin output current	I$_O$ = ±500mA V$_R$ = 6.0V	V$_{CC1,2}$ = 12V	0.2		1.5	mA
I$_{CC1}$	Supply current	V$_{IN1,2,3}$ = 1.0V I$_O$ = 0mA Output OPEN	V$_{CC1,2}$ = 12V		8.0	24.0	mA

TYPICAL CHARACTERISTICS

Thermal Derating
(Absolute Maximum Rating)

- When the minimum value of thermal protection temperature is 125°C
- When installed in the board; 50 x 50 x 0.8mm
- Glass epoxy board Copper foil area : 50%
- t means the power applied time and single pulse is adopted.

Power Dissipation (W) vs Ambient Temperature T_a (°C)

APPLICATION EXAMPLE
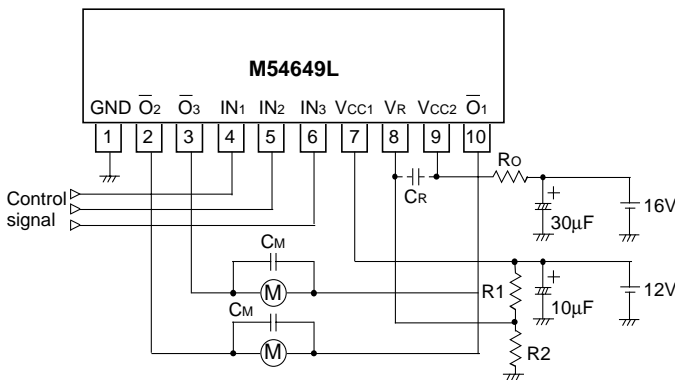
C_M : Capacitor for noise absorption when the motor rotates.
Use the IC with C_M set to 0.1μF or less.

R_O : Resistance for current limitation with the output short-circuited.
Use the IC with R_O set to 2 to 3 Ω (1 Watt class or higher).

$\binom{R_1}{R_2}$: Resistance for setting "H" output voltage.
"H" output voltage $V_{O(H)}$ is given by the following formula:

$$V_{O(H)} \fallingdotseq V_{CC1} \times \frac{R_2}{R_1+R_2}$$

As the resistance values of R_1 and R_2 are larger, $V_{O(H)}$ for the output current of V_R is higher than the set value.

C_R : When another power supply is used for V_R voltage, output voltage may be oscillated. When this is the case, connect capacitor C_R (approx. 0.01μF) to a portion between V_R and V_{CC2}.

CAUTIONS

1. Input Circuit Format

For ON voltage (V_{IH}), apply a voltage of 3.5V to V_{CC1}. For OFF voltage (V_{IL}), apply a voltage of 0 to 1V.

When the input voltage is approx. 7.8V or more, the impedance changes to approx. 5 kΩ. Therefore, set the voltage to 7V or less.
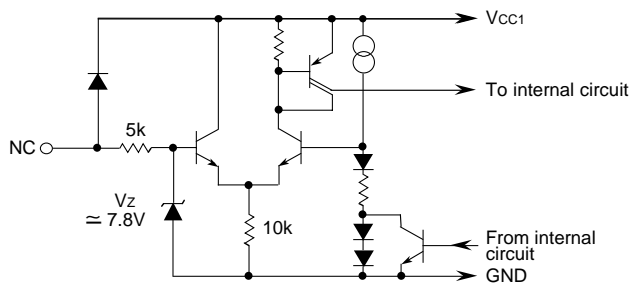
2. Output Voltage Control

The output control circuit by V_R pin is as shown in the diagram below. A voltage almost equal to the voltage at V_R pin is output (to the high-level side).

The maximum output voltage is achieved with $V_{CC2} \geq V_{CC1}$ when V_R pin is opened, and the voltage is given by the following formula:

$$V_O = V_{CC1} - V_{sat}(Tr1) - V_{BE}(Tr2) - V_{BE}(Tr3)$$

In this status, the output voltage can be controlled by varying V_{CC1}.
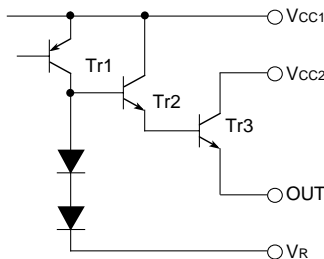
3. Caution for Braking

As soon as the status of a rotating motor is switched to the brake status, other motor may be adversely affected. Be careful when the IC is actually used.

4. Allowable Power Dissipation

The allowable power dissipation of IC (P_d) is calculated by the following formula, with $V_{CC2} \geq V_{CC1}$:

$$P_d = V_{CC1} \times I_{CC1} + I_O \{(V_{CC2} - V_{OH}) + V_{OL}\}$$

Make a design in such a way that the power dissipation cannot exceed the maximum allowable power dissipation.

5. Thermal Shutdown

To prevent thermal breaking with excessive power applied, this IC is equipped with a thermal shutdown circuit.

When the temperature of the IC chip reaches 150°C (125°C min.), this function works. When the IC is placed in the all output OPEN mode, and the temperature goes down to 100°C (125°C max.), this function is released.

Since the thermal protection function of this IC may not work in abnormal status (oscillation, low supply voltage, output short-circuit, etc.), check the operation in the IC installation status when using this function.

6. ASO Curve
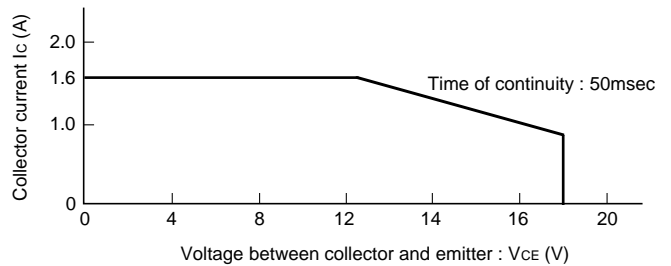
7. Others

The capacitance between the power supply and the ground should be placed at a position close to the IC, if possible. If it is placed far away from the IC, oscillation may take place.

When the motor back electromotive force is large with the brakes applied, for example, malfunction may occur in internal parasitic Di. If flyback current of 1A or more flows, add Schottky Di to the portion between the output and the GND.

When the IC is used at a high speed for PWM, etc., note that switching of output results in delay of approx. 10μs.