M54645AL

BI-DIRECTIONAL MOTOR DRIVER

DESCRIPTION

The M54645AL is a semiconductor integrated circuit, capable of directly driving small bidirectional motors.

FEATURES

- Wide operating voltage range (V_{CC}= 4 ~18V)
- Can be driven by the outputs of NMOS and CMOS ICs
- Large drive current ($Io_{(max)}$=±3.0A)
- Internal switching regulator
- Built-in clamp diode
- Brake function provided
- Internal thermal shutdown circuit

APPLICATION

Audio equipment such as tape decks and radio cassette recorders; VCRs and other consumer products.

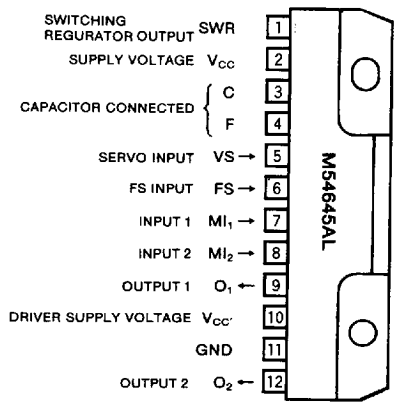
FUNCTION

The M54645AL can directly drive small bidirectional motors. Forward, backward, braking and OFF states are selected by two inputs. The output voltage (either Vs and FS) is selected by the FS input.

The output circuit consists of NPN Darlington transistors for both current source and sink, and can supply output currents of ± 3 A max.

An internal thermal shutdown circuit protects the IC from thermal destruction in the event of motor blockage or other abnormalities by setting both outputs in the open (off) mode.

PIN CONFIGURATION (TOP VIEW)



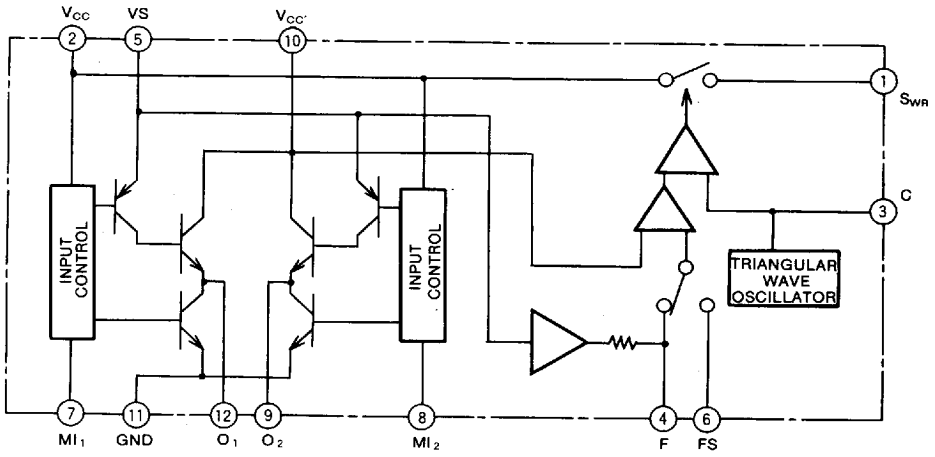
Outline 12P9B

TRUTH TABLE

Inputs		Outputs		Motor state
IN_1	IN_2	$\overline{O}_1$	$\overline{O}_2$	
L	L	OFF	OFF	Open
H	L	H	L	Forward
L	H	L	H	Reverse
H	H	L	L	Brake

FS input	$V_{CC'}$ voltage
L	VS
H	FS

BLOCK DIAGRAM



BI-DIRECTIONAL MOTOR DRIVER

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Note	Ratings	Unit
V_{CC}	Supply voltage		−0.5～+28	V
V_I	Input voltage	$V_I \leq V_{CC}$	−0.5～+28	V
I_{OP}	Peak output current	$t_{OP} \leq$ 30msec, repetitive cycle time $\geq$ 6.0Hz	±3.0	A
I_O	Continuous output current		±600	mA
I_{OSWR}	Switching regulator output current	$t_{OP} \leq$ 30msec, repetitive cycle time $\geq$ 6.0Hz	0～3.0	A
P_d	Power dissipation	T_a=75℃	1.2	W
Topr	Operating temperature		−10～+75	℃
Tstg	Storage temperature		−55～+125	℃

ELECTRICAL CHARACTERISTICS (T_a=25℃, V_{CC}=18V, unless otherwise noted)

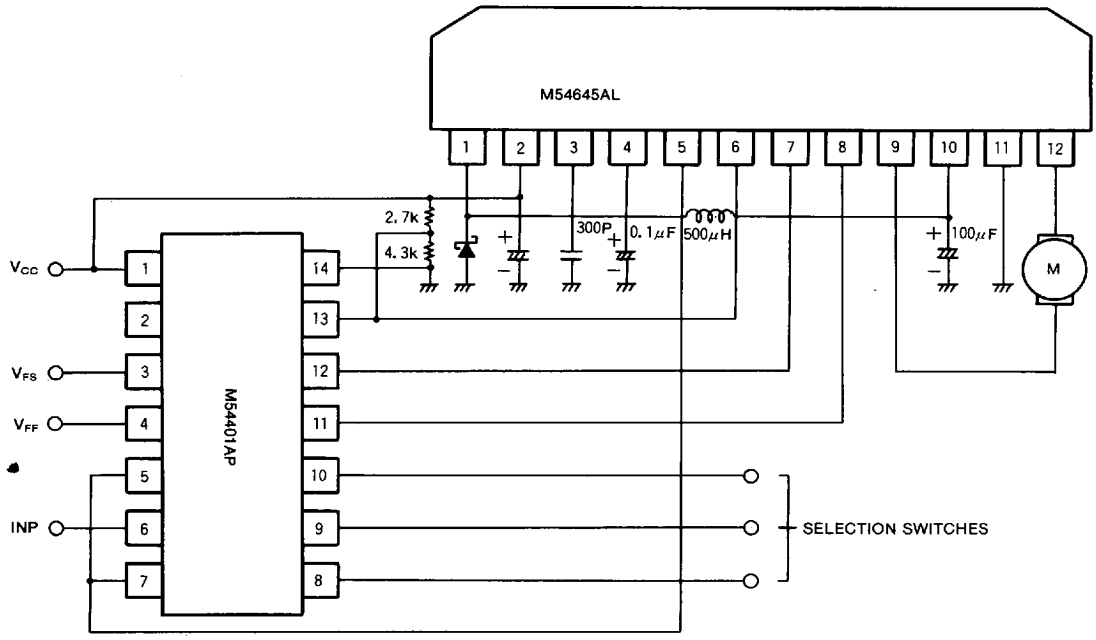
Symbol	Parameter	Test conditions	Test pin	Limits			Unit
				Min	Typ	Max	
I_{CC}	Supply current	Output OFF mode	2	3.5	5.5	9.0	mA
$I_{SWR(leak)}$	Switching regulator output leakage current	V_I=0V, output OFF mode V_{CC}=22V	1		0	−100	μA
$V_{SWR(sat)}$	Switching regulator output saturation voltage	I_{SWR}=−0.1A	1		1.4	2.0	V
		I_{SWR}=−1.0A			1.9	2.8	
		I_{SWR}=−2.5A (Note 1)			2.5	3.7	
V_{TR} H	Triangular wave threshold voltage	Pin C : 300pF	3	4.3	5.1	5.3	V
V_{TR} L				1.5	1.8	2.1	
f_{TR}	Triangular wave oscillation frequency	Pin C : 300pF		31	52	75	kHz
V_{4LIM}	Pin 4 limit	V_5=0V V_6=0V	4	1.1	1.6	2.1	V
V_4	Pin 4 voltage	30kΩ between pin 4 and GND V_5=V_6=0V		0.6	1.1	1.3	V
ΔV_{5-4}	Offset voltage between pins 4 and 5	V_5=10V V_6=0V	4, 5	−0.15	−0.04	+0.15	V
ΔV_{6-4}	Offset voltage between pins 4 and 6	V_6=8V	4, 6	−0.2	0.05	+0.2	V
V_{TH6}	FS input threshold	V_5=3V Voltage when V4 change	6	0.7	1.3	1.8	V
V_{TH7}	MI1 threshold voltage		7	0.6	1.2	1.8	V
V_{TH8}	MI2 threshold voltage		8	0.6	1.2	1.8	V
I_{Oleak}	Output leakage current		9, 12		0	±100	μA
$V_{OH(sat)}$	High-level output saturation voltage	I_{OH}=−0.1A			1.4	2.0	V
		I_{OH}=−1.0A			1.9	2.8	
		I_{OH}=−2.5A (Note 1)			2.5	3.7	
$V_{OL(sat)}$	Low-level output saturation voltage	I_{OL}=0.1A			0.78	1.05	V
		I_{OL}=1.0A			1.1	1.7	
		I_{OL}=2.5A (Note 1)			1.4	1.9	
BV_{CER}	Output transistor withstand voltage	I_O=20mA	9, 12	28	45		V
ΔV_{4-10}	Offset voltage between pins 4 and 10		10	0	0.1	0.2	V
ΔV_{6-10}	Offset voltage between pins 6 and 10		10	0	0.1	0.2	V
V_{10} ON	Activating voltage at pin 10	V_5=V_6=0V Voltage when V1 changes	10	0.50	0.78	1.10	V
V_{10} OFF	Shutdown voltage at pin 10	V_5=V_6=0V Voltage when V1 changes	10	0.50	0.78	1.10	V
T_S	Thermal shutdown temperature	Temperature at the center of the heat sink		140	165	190	℃

Note 1 : The measurement must be conducted within 30msec.

MITSUBISHI ELECTRIC

BI-DIRECTIONAL MOTOR DRIVER

APPLICATION EXAMPLE



Note. • A fast-recovery or Schottky diode must be used in the filter circuit.
• The lead lengths of the capacitor between the M54645AL V_{CC} pin and GND must be as short as possible.
• GND line must be as thick as possible.

PRECAUTIONS FOR USE

1. Allowable power dissipation

The allowable power dissipation of the IC (P_d) is calculated by the following formula.

$P_d \fallingdotseq V_{CC} \times I_{CC} + I_O (V_{CC} - V_{OH}) + V_{OL} + V_{SWR(sat)}$

This value must not exceed the maximum allowable power dissipation shown in the thermal derating characteristics. Please note that if repetive peak currents are applied, the allowable power dissipation is less.

2. Thermal shutdown

A thermal shutdown circuit is built in to protect the device against thermal destruction when excessive currents are applied. This function shuts down the output stage of the switching regulator when the temperature at the back of the IC reaches 165℃ (140℃ min).

3. Triangular wave oscillator

The relationship between the externally connected capacitance C and the frequency is given by the following formula.

$$1/f \fallingdotseq \frac{3.2 \times C}{100 \times 10^{-6}} \times 2 \text{ (Hz)}$$

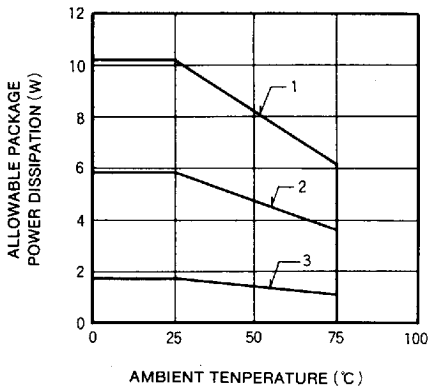
Capacitor should be located close to the IC with lead lengths as short as possible, as it can be easily affected by the switching regulator.

4. Switching regulator

A fast-recovery or Schottky diode should be used in the filter circuit of the switching regulator. If a conventional diode is used, excessively large switching currents may flow.

TYPICAL CHARACTERISTICS

THERMAL DERATING CHARACTERISTICS



1) INFINITE HEAT SINK
2) 25cm^2×1.5mm (t) ALUMINUM HEAT SINK
3) FREE AIR