# M54672SP

2-PHASE STEPPER MOTOR DRIVER

## DESCRIPTION

The M54672SP is a semiconductor IC to drive a stepper motor directly by controlling the coil current with the constant current method.

## FEATURES

- Wide output current control range (20 – 1200mA)
- Bipolar and constant current drive
- Built in a thermal shutdown circuit
- Built in flywheel diodes

## APPLICATION

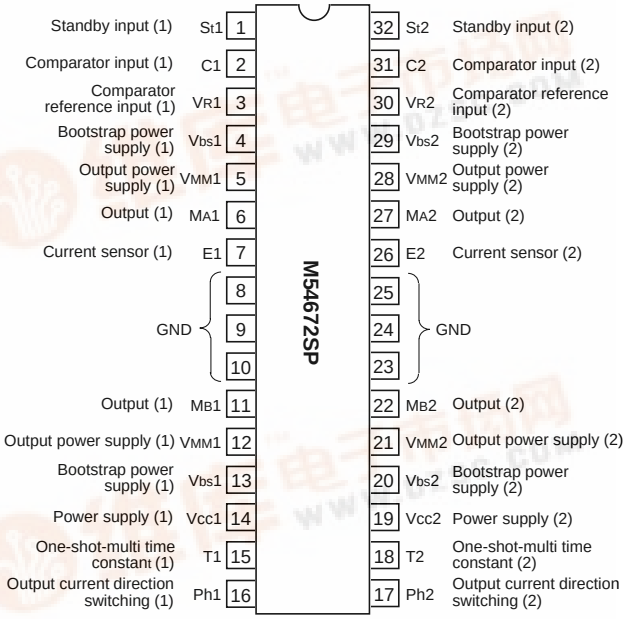
Office automation equipment such as printer, FDD, HDD and FAX

## FUNCTION

The M54672SP can drive a stepper motor by the 2-phase bipolar method and also control the coil current. Furthermore, it controls the direction of the coil current with Ph input pins (pins 16 and 17) and the coil current value with $V_R$ pins (pins 3 and 30).

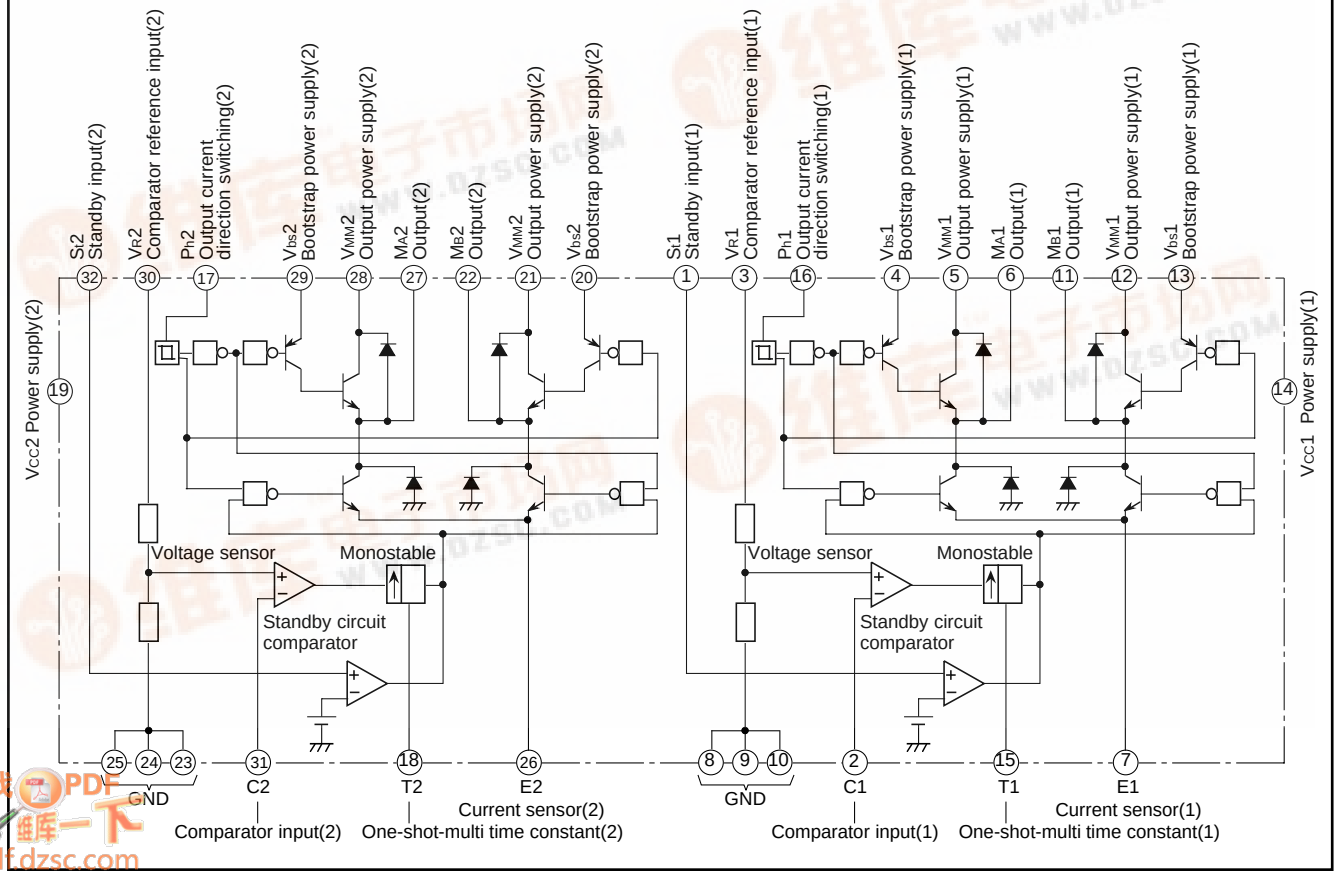
Because two control circuits are built in this IC, a stepper motor can be driven with a single IC by the 2-phase bipolar method.

## PIN CONFIGURATION (TOP VIEW)




Outline 32P4B

## BLOCK DIAGRAM



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

| Symbol | Parameter | Conditions | Ratings | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | | -0.3 – 7 | V |
| $V_{MM}$ | Output supply voltage | | -0.3 – 24 | V |
| $V_{bs}$ | Bootstrap supply voltage | | -0.3 – 27 | V |
| $V_L$ | Logic input voltage | | -0.3 – 6 | V |
| $V_C$ | Analog input voltage | | -0.3 – $V_{CC}$ | V |
| $V_R$ | Comparative input voltage | | -0.3 – 15 | V |
| $I_L$ | Logic input current | | -10 | mA |
| $I_C$ | Analog input current | | -10 | mA |
| $I_{MM}$ | Output supply current | | ±1500 | mA |
| $P_d$ | Allowable loss | | 1.70 | W |
| $T_{opr}$ | Operating temperature | | -20 – 75 | °C |
| $T_{stg}$ | Storage temperature | | -55 – 125 | °C |

## RECOMMENDED OPERATING CONDITIONS (Ta=25˚C, unless otherwise noted)

| Symbol | Parameter | Limits | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| $V_{CC}$ | Supply voltage | 4.5 | 5 | 5.5 | V |
| $V_{MM}$ | Output supply voltage | 10 | 12 | 20 | V |
| $V_{bs}$ | Bootstrap supply voltage | $V_{bs} \geq V_{MM}+1V$ | | 24 | V |
| $I_O$ | Output current | 20 | 800 | 1200 | mA |
| $t_{PLH}$ | Logic input rise time | | | 2 | µs |
| $t_{PHL}$ | Logic input fall time | | | 2 | µs |
| $T_{ON}$ | Thermal shutdown temperature | | 160 | | °C |

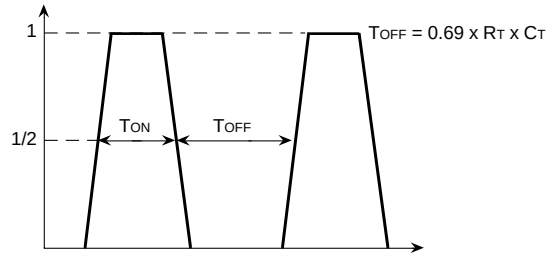
## ELECTRICAL CHARACTERISTICS (Ta=25˚C, unless otherwise noted)

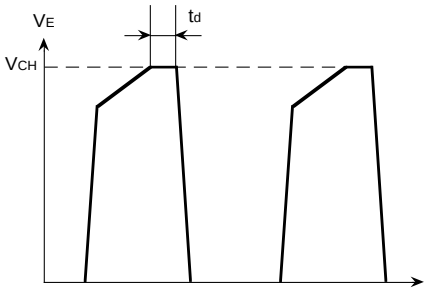
| Symbol | Parameter | | Test conditions | Limits | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| $V_{IH}$ | Logic input voltage | "H" | $V_{CC}$=5V | 2.0 | | $V_{CC}$ | V |
| $V_{IL}$ | | "L" | | 0 | | 0.8 | V |
| $V_{CH}$ | Comparator threshold | | $V_R$=5V | 420 | 450 | 480 | mV |
| $I_{CO}$ | Comparator input current | | | -20 | | 20 | µA |
| $I_{OFF}$ | Output cutoff current | | | | | 100 | µA |
| $V_{sat}$ | Saturation voltage | | Voltage at sensing resistor is not included. $V_{bs}$=12.7V, $V_{MM}$=12V, $I_O$=800mA | | 1.0 | 1.5 | V |
| $t_{OFF}$ | Cutoff time | | $V_{MM}$=12V, $t_{ON} \geq$ 5µs | 5 | 10 | 15 | µs |
| $t_d$ | Turn-off delay | | dVK/dt ≥ 50mV/µs | | 1.6 | 2.0 | µs |
| $I_{CC}$ | Supply current | | $V_{CC}$=5V, 1phase | | | 25 | mA |
| $I_{IH}$ | Logic input current | "H" | $V_I$=2.4V | | | 100 | µA |
| $I_{IL}$ | | "L" | $V_I$=0.4V | -0.4 | | | mA |

## SWITCHING CHARACTERISTICS

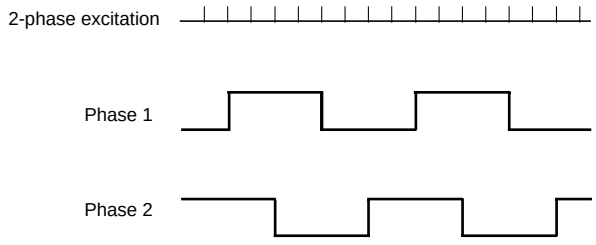
### Switching waveforms

$V_{MA}$-$V_{MB}$ or $V_{MB}$-$V_{MA}$




## TIMING CHART




## APPLICATION DESCRIPTION

(1) PHASE INPUT

Phase input decides the output mode.

| PHASE | $M_A$ | $M_B$ |
|---|---|---|
| H | H | L |
| L | L | H |

(2) $V_R$ (Comparative voltage)

The current level can be continuously changed by changing the voltage at $V_R$ continuously.

(3) Current sensor

When the voltage fall at the current sensing resistor and the selected current level become of the same level, the comparator triggers the monostable. Then the output stage is cut off for a certain time ($T_{OFF}$). During this cutoff time, the current volume decreases slightly and falls short of the comparative level.

After the cutoff time ($T_{OFF}$), the output stage is in ON state again. This operation is repeated.

(4) Single pulse generator

At the comparator output rise edge, the monostable is triggered. The pulse width of the monostable at the external timing $C_T$ and $R_T$ is as follows.

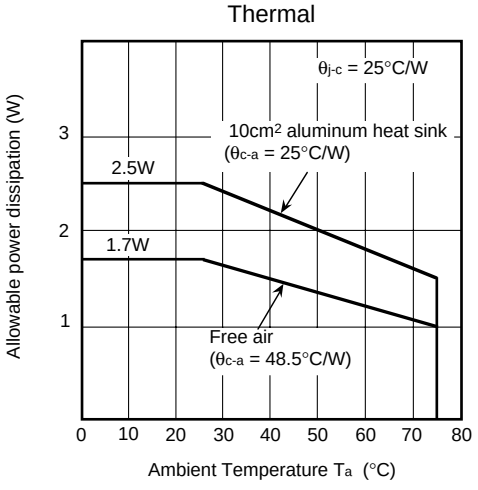
$T_{OFF} = 0.69 \times C_T \times R_T$

Retrigger during $T_{OFF}$ is neglected.

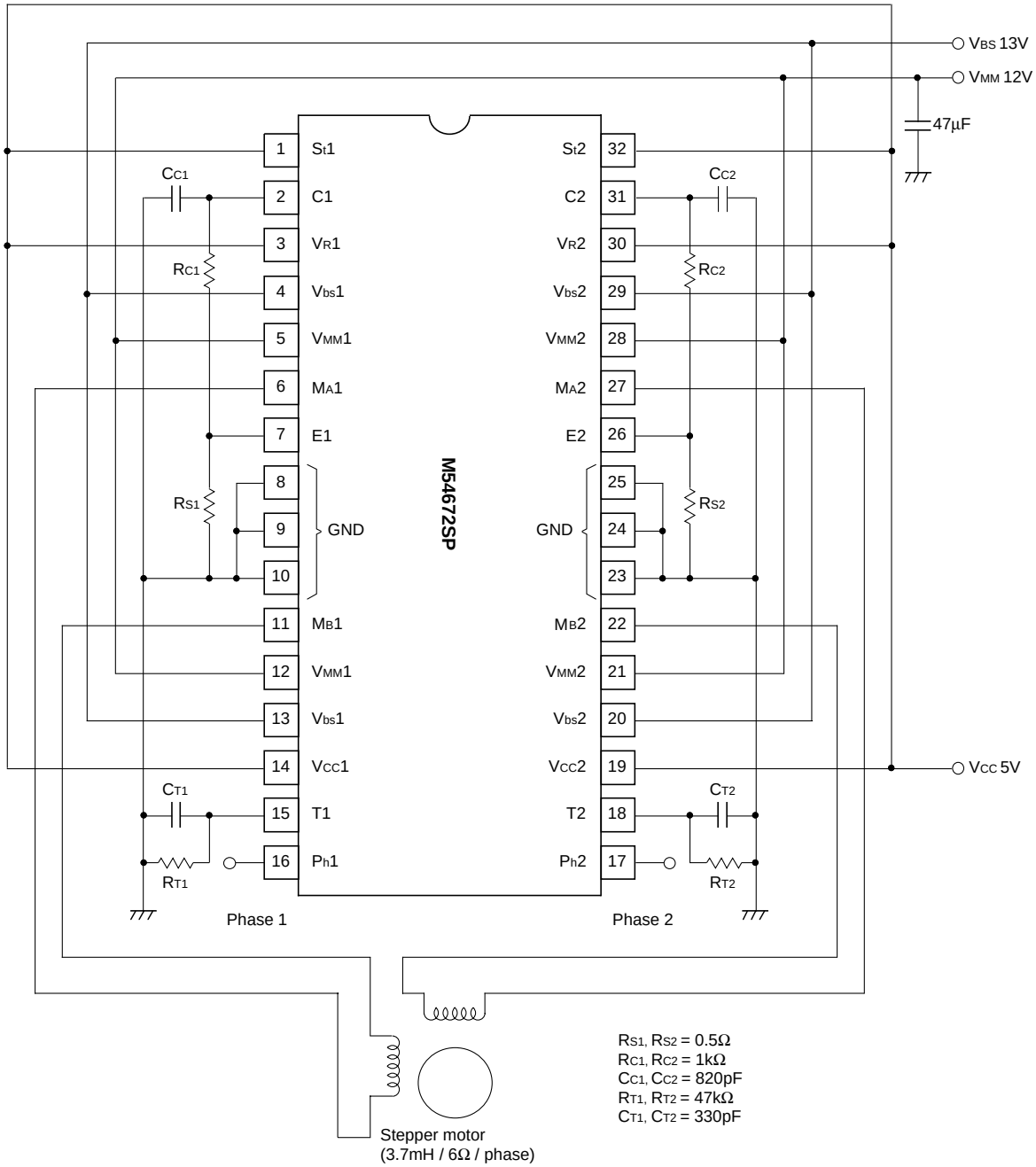
(5) Analog control

The output current level can be continuously changed by changing the voltage at $V_R$ or the feedback voltage to the comparator.

## TYPICAL CHARACTERISTICS



## APPLICATION EXAMPLE (Stepping motor driver)



## PRECAUTIONS FOR USE

(1) Before use, never forget to short-circuit Vcc1 and Vcc2.

(2) When the whole output current changes by a large margin (for example, when thermal shutdown operation causes intermittent flow of output current), the supply voltage may undergo a change. Therefore, selection and wiring of power supply should be conducted cautiously to avoid such a situation that the supply voltage exceeds the absolute maximum ratings.

(3) When the supply voltage changes by a large margin, the operation of this IC may become unstable. In this case, the change of supply voltage can be controlled by connecting a capacitor between Vcc pin and GND pin.

(4) Thermal shutdown function

The state of thermal shutdown operation may differ according to the way of wiring within a board. Therefore, sufficient board evaluation should be conducted before use. When the board is changed, operation on the replacing board should be evaluated.

The circuit board on which this IC is mounted is designed to realize low impedance between power supply and output pin. Therefore, it is desirable to take a safe measure such as fixing a fuse to avoid such a situation that the board is damaged by a fire when output pin is internally short-circuited by excessively applied surge voltage by accident.