M54670P

2-Phase Stepper Motor Driver

REJ03F0045-0100Z
Rev.1.0
Sep.19.2003

Description

The M54670P is a semiconductor IC to drive a bipolar stepper motor directly by controlling the coil current with the constant current method.

Features

- Wide operating voltage range (10 – 35V)
- Wide output current control range (20 – 800mA)
- Bipolar and constant current drive
- Built in flywheel
- Current level can be changed by steps or continuously.
- Built in a thermal shutdown circuit

Application

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

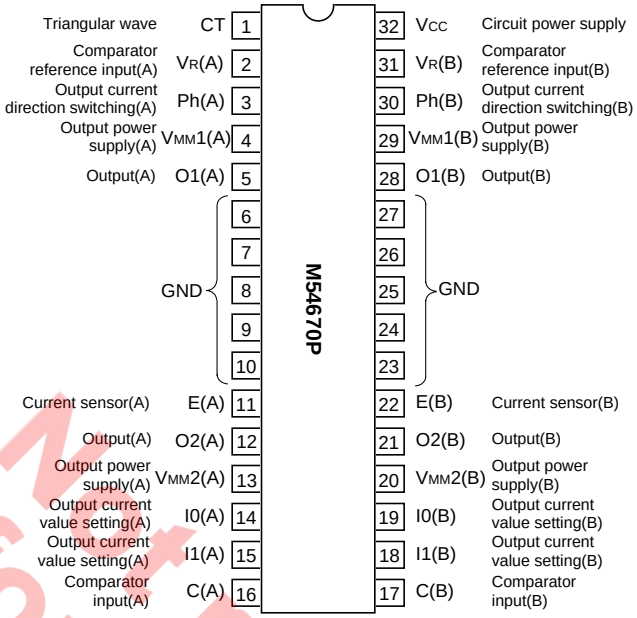
Function

The M54670P 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 3 and 30).

The coil current value can be selected among four levels (0 to max.) by selecting the combination of three internal comparators by logic input (pins 14, 15, 18 and 19). It also can be continuously controlled with VR pins (pins 2 and 31). By selecting an I input pin among pins 14, 15, 18 or 19, the operation timing, 2-phase excitation, 1-2-phase excitation or microstep, can be selected.

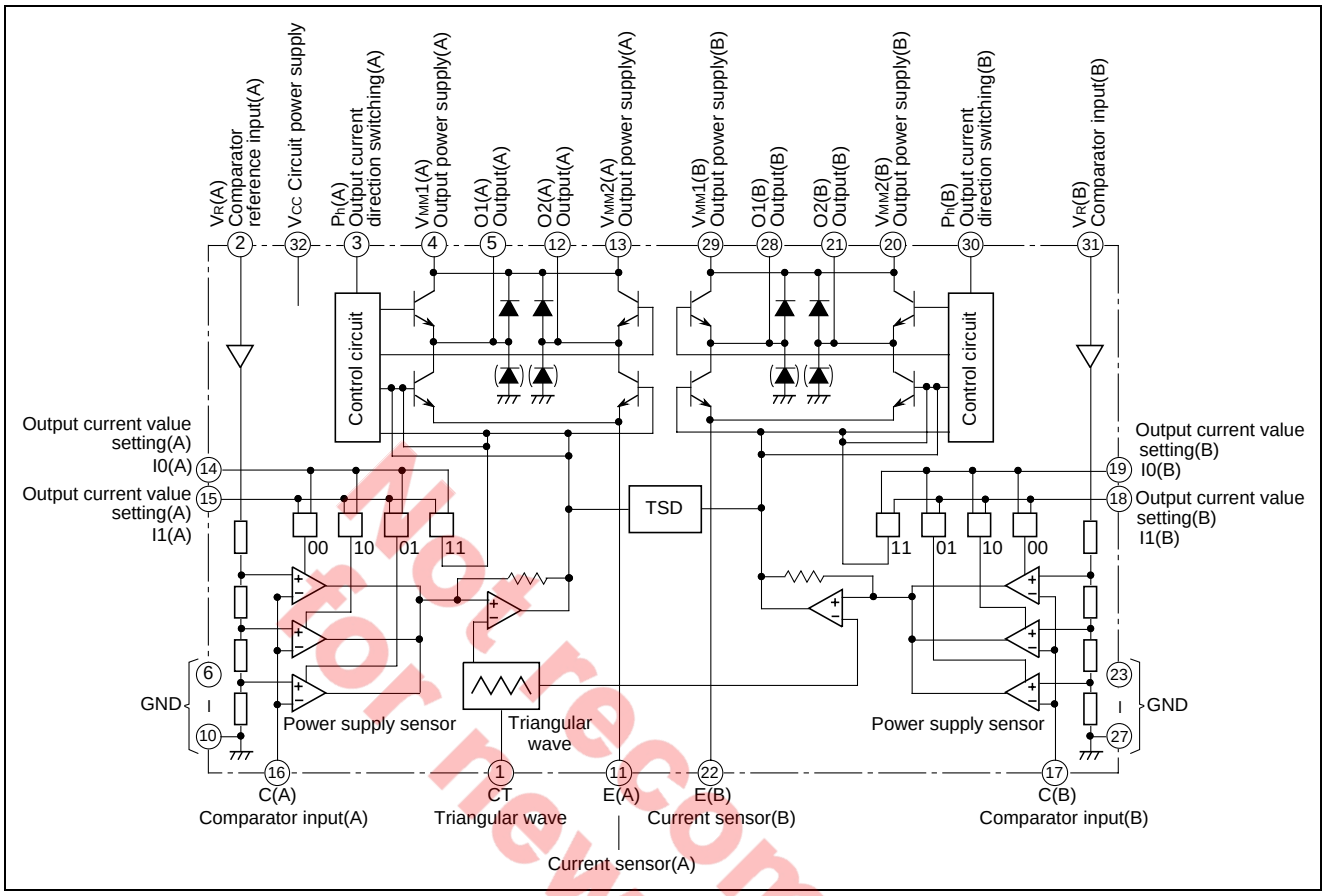
Because two control circuits are built in this IC, a stepper motor can be driven with a single IC by the 2-phase bipolar method.

Pin Configuration



Outline 32P4B

Block Diagram



Absolute Maximum Ratings

(Ta = 25°C, unless otherwise noted.)

Parameter	Symbol	Ratings	Unit	Conditions
Supply voltage	VCC	–0.3 to 7	V	
Output supply voltage	VMM	–0.3 to 40	V	
Logic input voltage	VL	–0.3 to 6	V	
Comparator input voltage	VC	Vcc	V	
Reference input voltage	VR	7	V	
Output current	IO	±1.0	A	
Allowable power dissipation	Pd	1.92	W	Mounted on a board
Operating temperature	Topr	–20 to 75	°C	
Storage temperature	Tstg	–55 to 125	°C	

Recommended Operating Condition

(Ta = 25°C, VCC = 5.0V, unless otherwise noted.)

Parameter	Symbol	Limits			Unit
		Min.	Typ.	Max.	
Supply voltage	VCC	4.75	5.00	5.25	V
Output supply voltage	VMM	10		35	V
Reference input voltage	IR	0	—	800	V
Output current	IO	20		800	mA
Logic input rise time	tPLH			2.0	µS
Logic input fall time	tPHL			2.0	µS
Thermal shutdown temperature*	TON		175		°C

Note * : Refer to "PRECAUTIONS FOR USE."

Electrical characteristics

(Ta = 25°C, VCC = 5.0V, VMM = 10V, unless otherwise noted.)

Parameter		Symbol	Limits			Unit	Test conditions
			Min.	Typ.	Max.		
Logic input voltage	"H"	VIH	2.0		Vcc	V	VCC=5V
	"L"	VIL	0		0.8		
Comparator threshold		VCH	430	460	480	mV	VR=5V, I0=I1=0
		VCM	265	285	305		VR=5V, I0=1,I1=0
		VCL	90	110	130		VR=5V, I0=0, I1=1
Comparator input current		ICO	–20	–2	20	µA	I0=I1=1(Ta=25°C)
Output cutoff current		IOFF		0	100	µA	
Saturation voltage		Vsat		3.0	4.5	V	Voltage at sensing resistor is not included. IO=500mA
PWM oscillator frequency		fc	16.5	33	66	KHz	VMM=10V, Cf = 3900pF
Turnoff delay		td		1.0	2.0	µS	Ta=25°C, dVK/dt ≥ 50mV/µs
Supply current		ICC		8.0	25	mA	VCC=5V
Logic input current	"H"	IIH		180	400	µA	VI=2.4V
	"L"	IIL		20	50	µA	VI=0.4V

Application Description

(1) PHASE INPUT

Phase input decides the output mode.

Phase	O1	O2
H	L	H
L	H	L

(2) I0, I1

I0 and I1 fixed based on the comparative voltage VR decide the output current level.

I0	I1	Current level
H	H	0
L	H	Low
H	L	Typ
L	L	High

(3) VR (Comparative voltage)

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

(4) Current sensor

When the voltage fall at the current sensing resistor and the selected current level become of the same level, the output state is cut off for a certain time by inverting the comparator.

During this cutoff time, the current volume decreases slightly due to the L component of the motor and falls short of the comparative level. During the time fixed based on the PWM frequency, the output stage goes in ON state and then in OFF state and this ON/OFF operation is repeated.

(5) PWM oscillator

A capacitor C_t is externally connected to CT pin in order to fix the PWM oscillator frequency. The frequency fc is calculated as follows.

$$f_c = \frac{1}{7.77 \times 10^3 \times C_t}$$

(6) Analog control

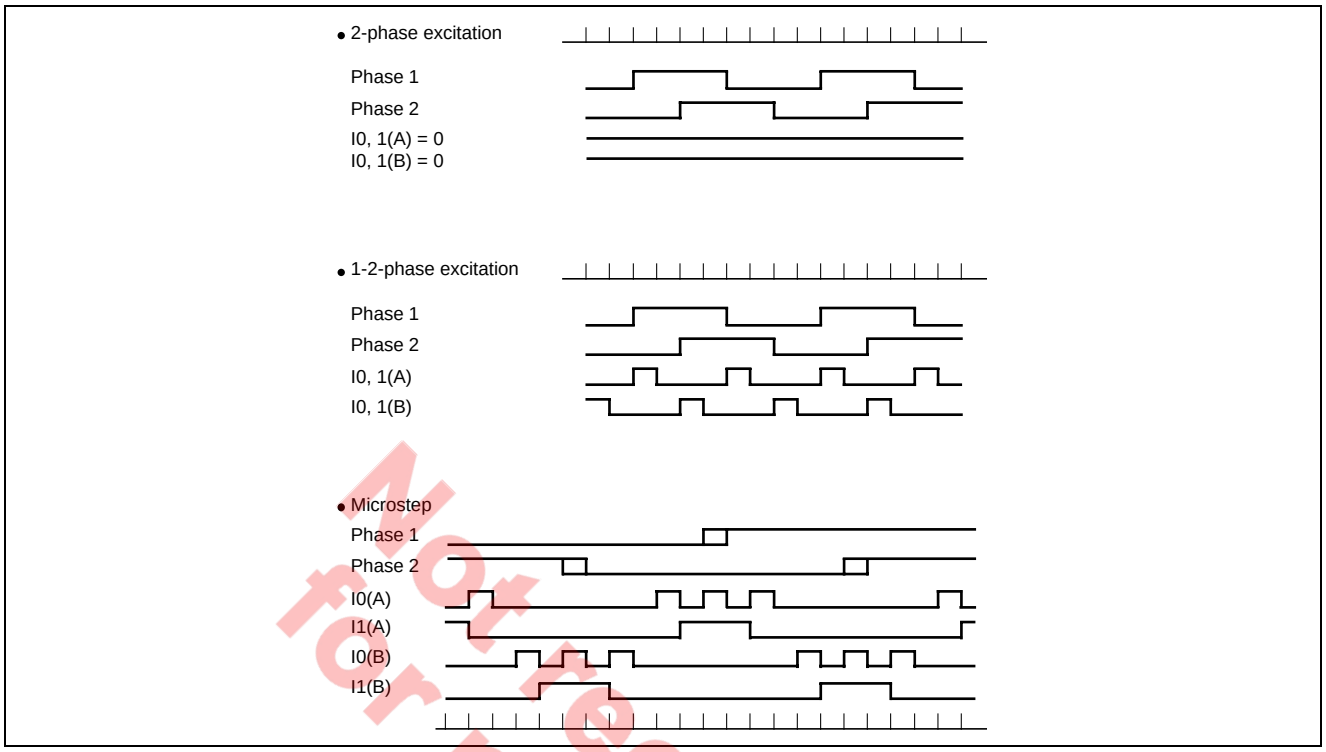
The output current level can be continuously changed by changing the voltage at VR or the feedback voltage to the comparator.

(7) Thermal shutdown function

This IC has a function to protect itself against thermal damage which is caused when the chip temperature rises abnormally.

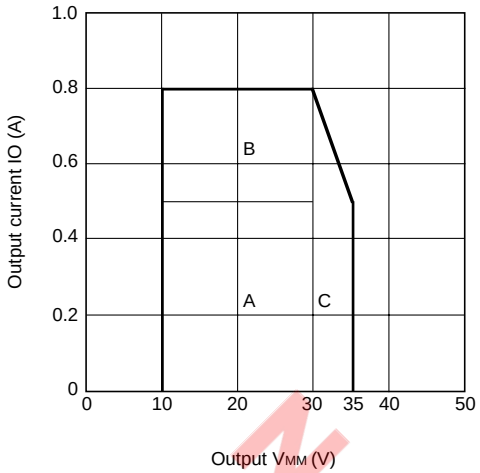
Regarding this function, refer to “PRECAUTIONS FOR USE.”

Timing Chart



Typical Characteristics (Absolute maximum ratings)

Safety operating range

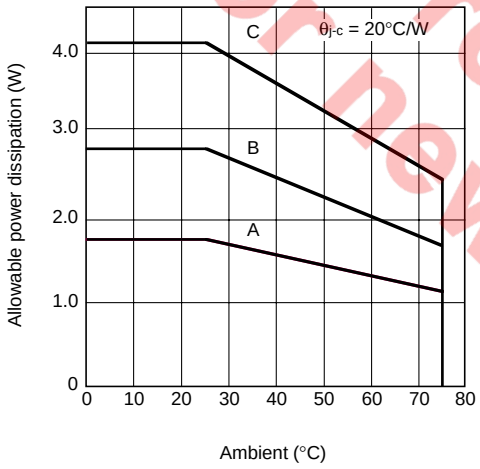


A : Recommended

B : Schottky diodes should be externally connected between output pin and power supply pin.

C : Schottky diodes should be externally connected between output pin and power supply pin and between output pin and GND pin.

Thermal derating



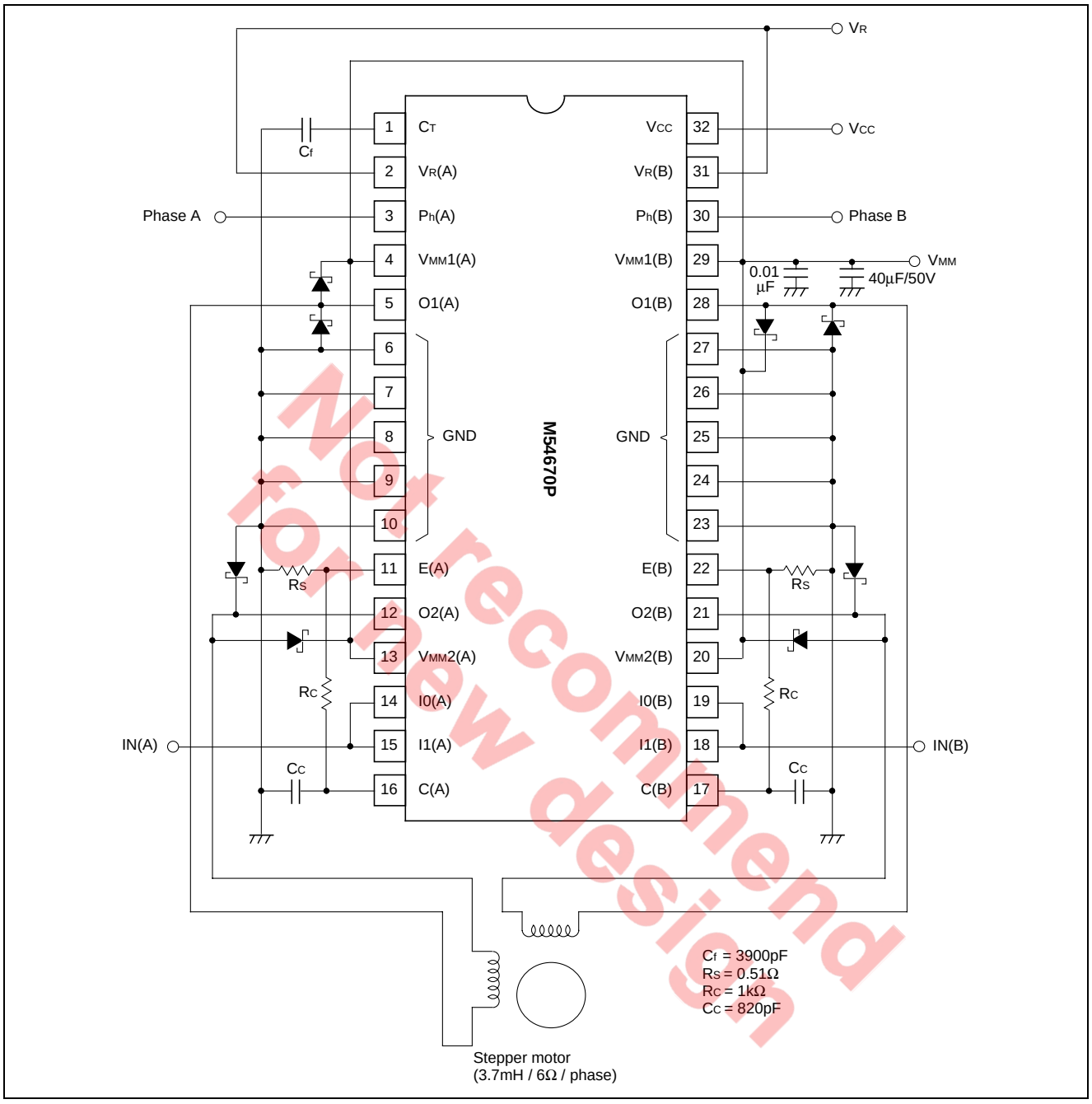
A : Free air ($\theta_{c\text{-}a}$ = 50°C/W)

B : With 10cm^2 aluminum heat ($\theta_{c\text{-}a}$ = 25°C/W)

C : With 100cm^2 aluminum heat ($\theta_{c\text{-}a}$ = 10°C/W)

$T_{j(max)}$ = 150°C

Application Example (Stepping motor driver)



Precautions for use

(1) 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.

(2) 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.

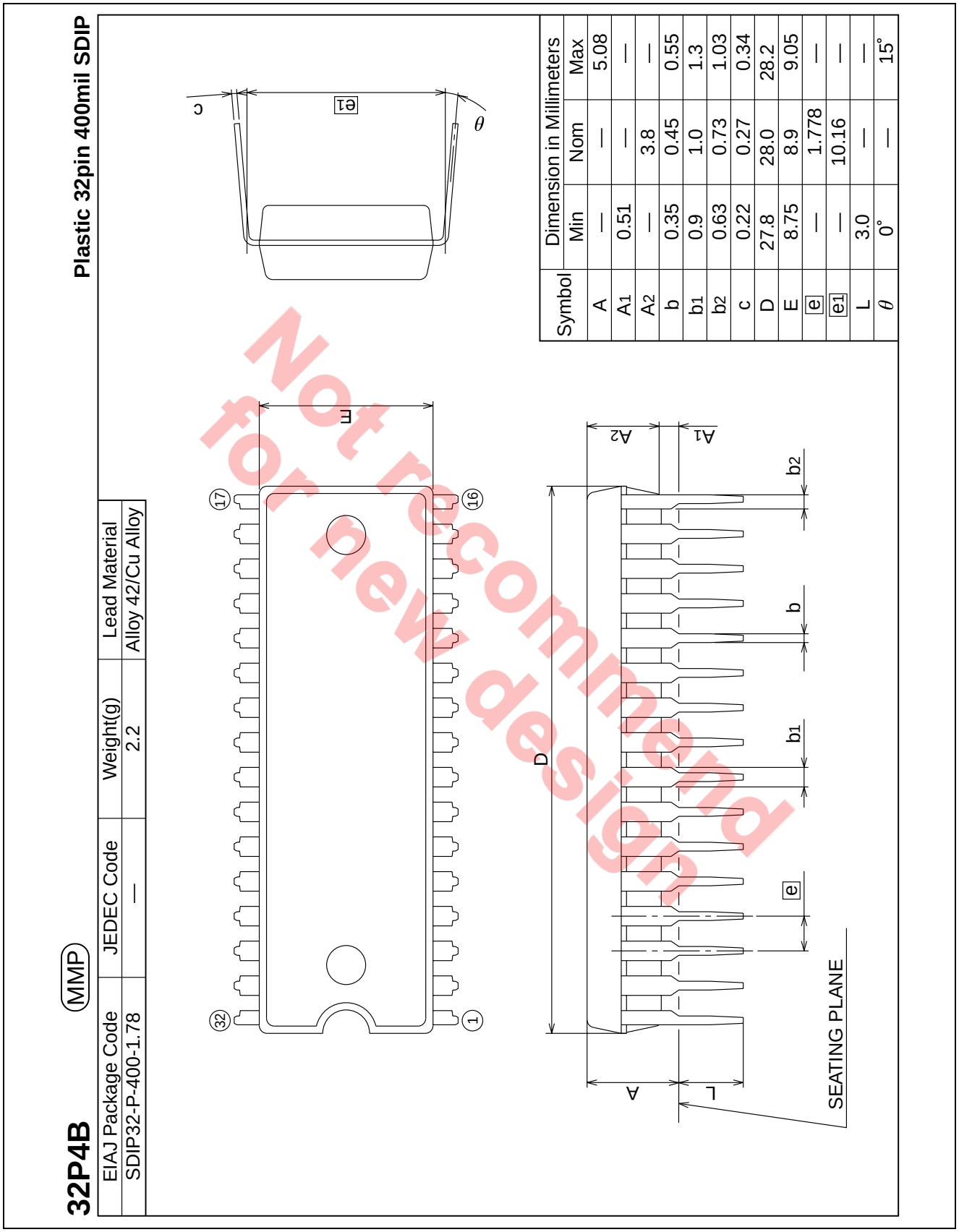
(3) Thermal shutdown function

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.

Package Dimensions



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