

# 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

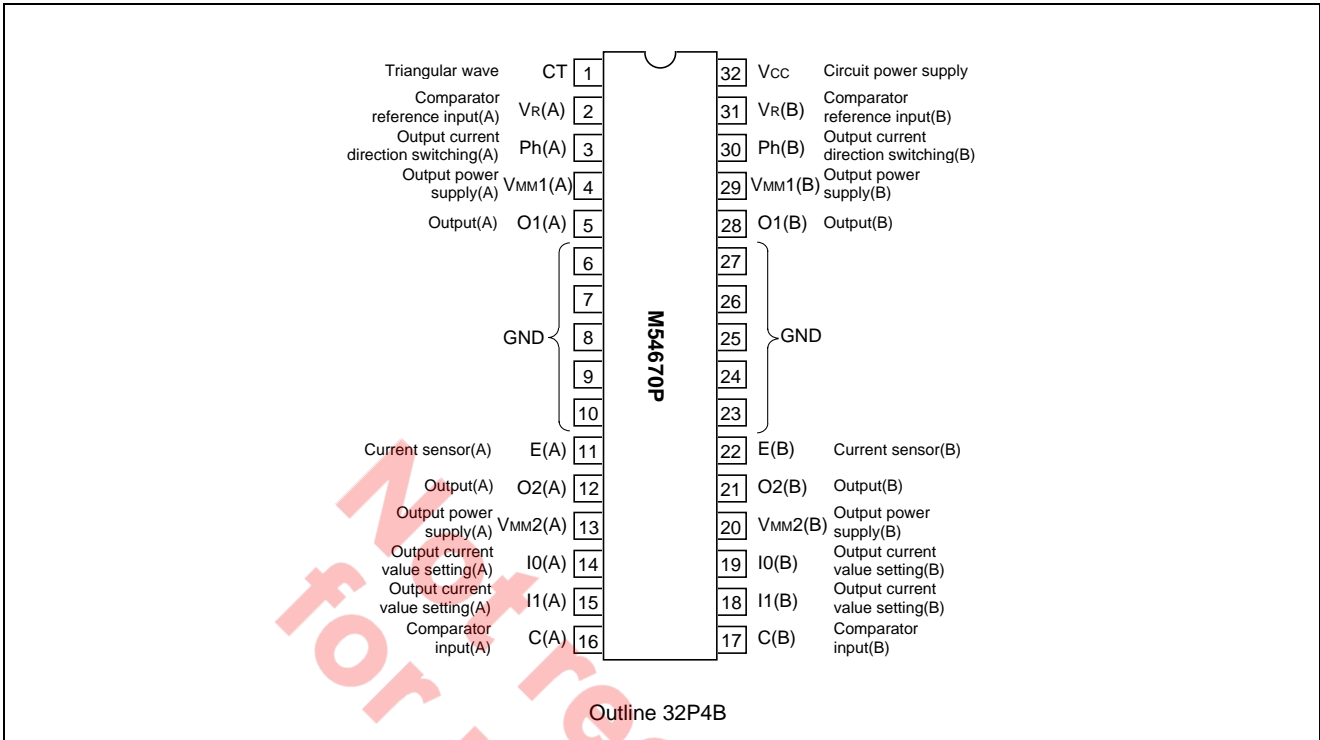
### Function

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).

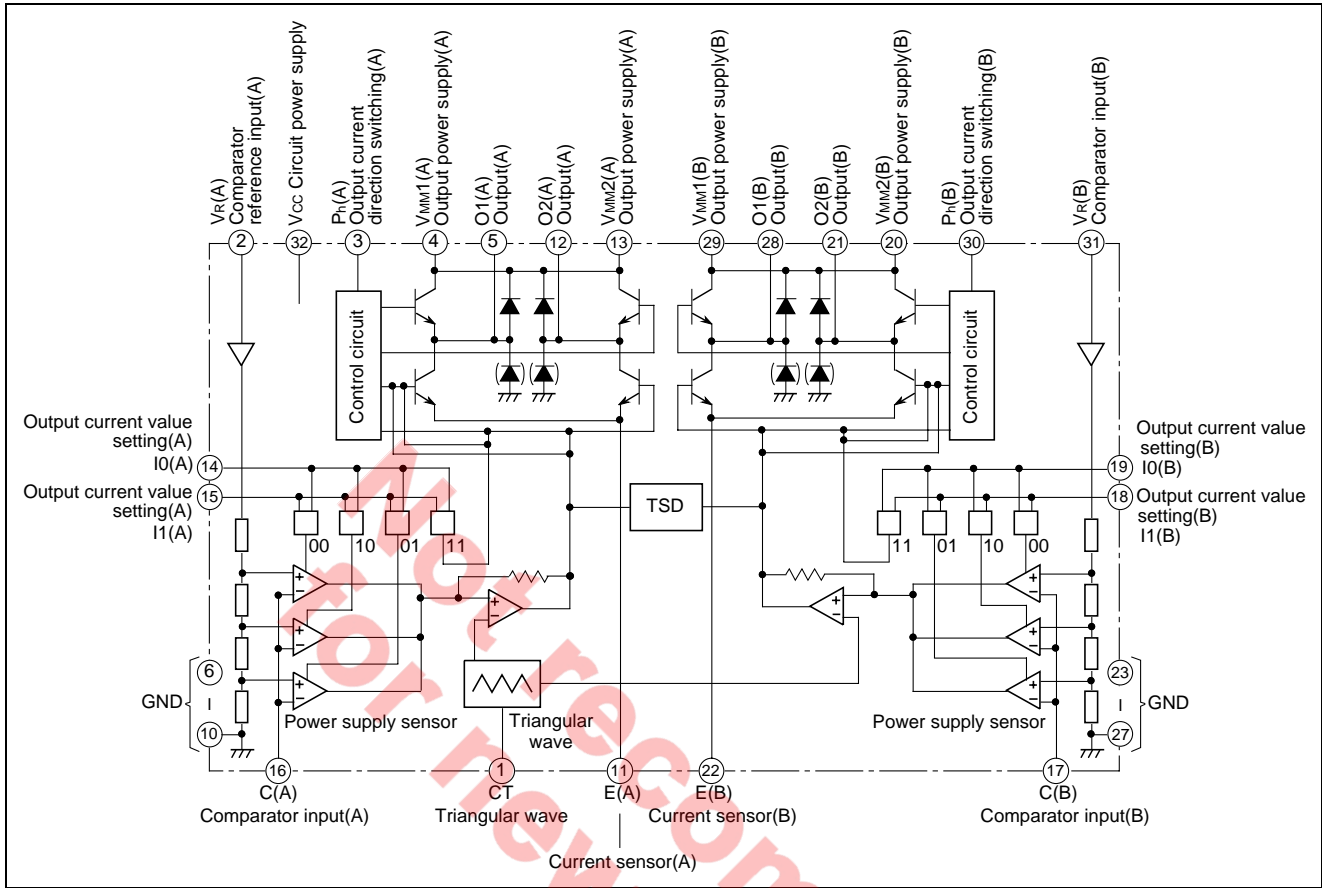
The coil current value can be selected among four levels (0 to max.) by selecting the combination of three internal comparators by logic input (pins 14, 15, 18 and 19). It also can be continuously controlled with VR pins (pins 2 and 31). By selecting an I input pin among pins 14, 15, 18 or 19, the operation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



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	VR=5V, IO=I1=0
		VCM	265	285	305	VR=5V, IO=1, I1=0
		VCL	90	110	130	VR=5V, IO=0, I1=1
Comparator input current	ICO	-20	-2	20	μA	IO=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  $C_f$  is externally connected to CT pin in order to fix the PWM oscillator frequency. The frequency  $f_c$  is calculated as follows.

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

## (6) Analog control

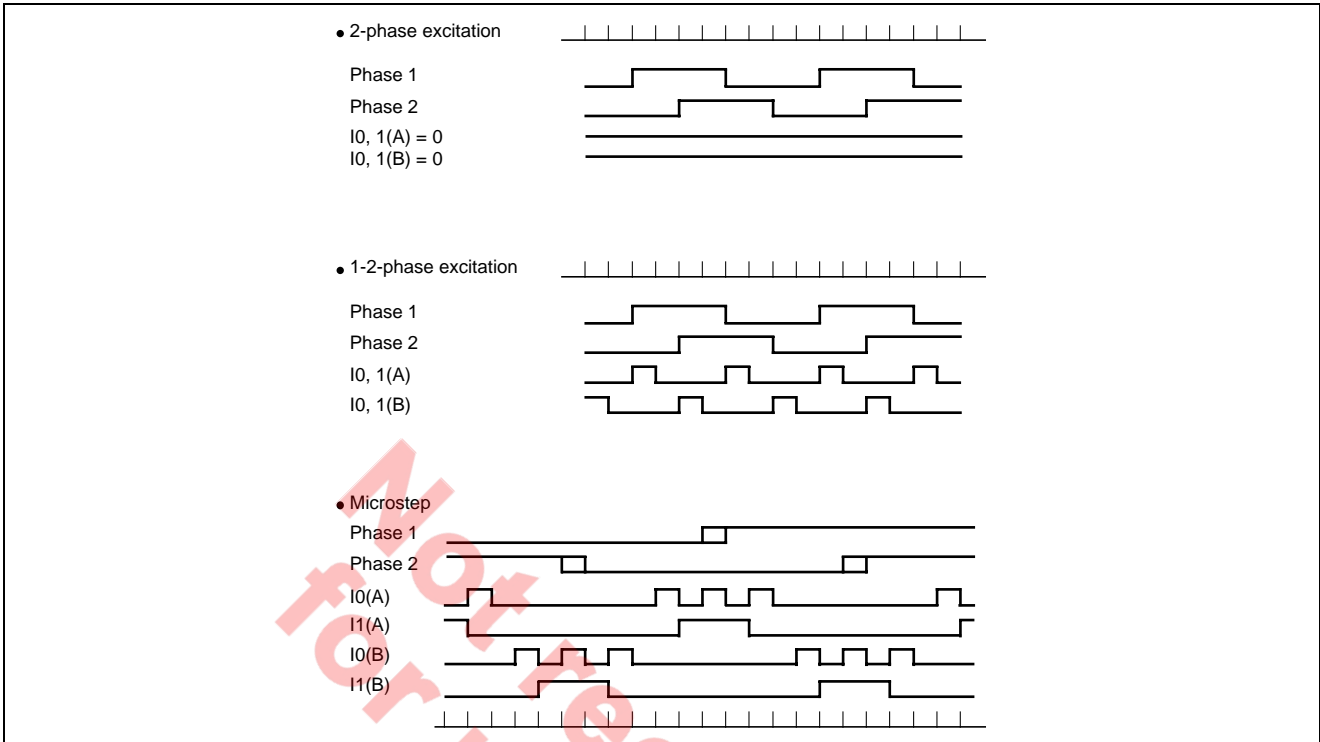
The output current level can be continuously changed by changing the voltage at VR or the feedback voltage to the comparator.

## (7) Thermal shutdown function

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

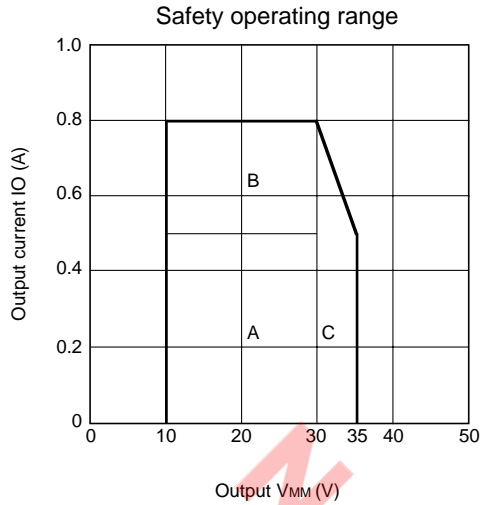
Regarding this function, refer to "PRECAUTIONS FOR USE."

Timing Chart

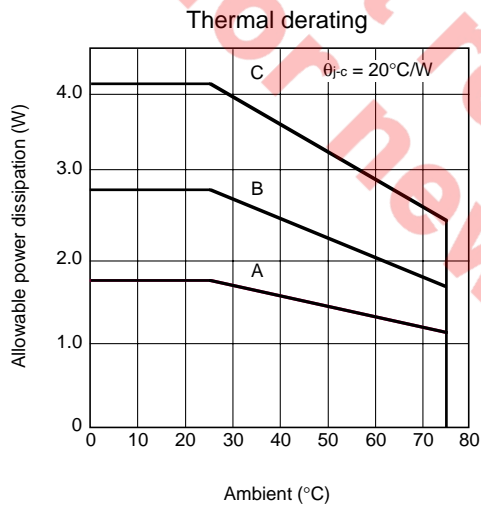


Not recommended for new design

Typical Characteristics (Absolute maximum ratings)

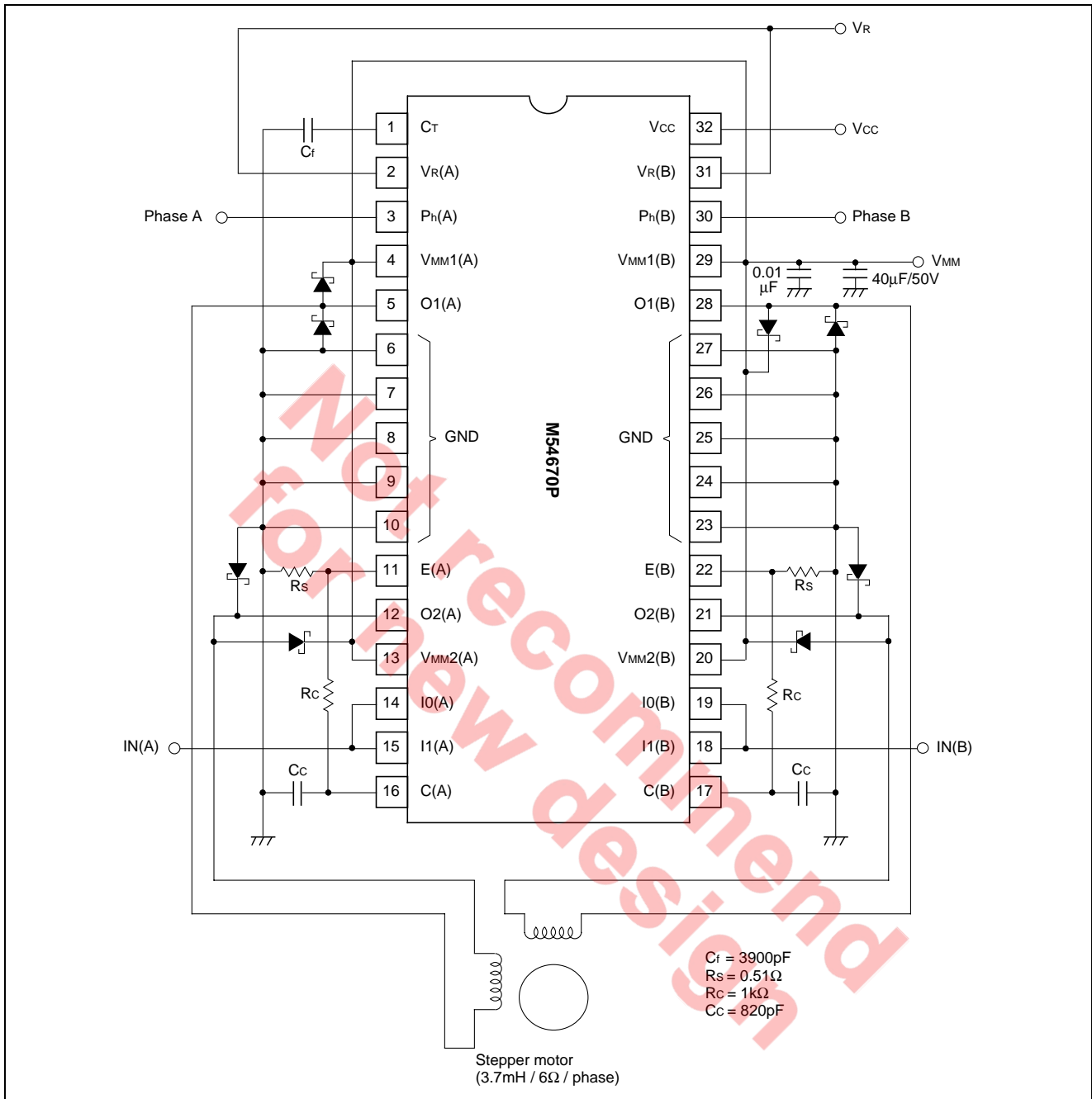


- A : Recommended
- B : Schottky diodes should be externally connected between output pin and power supply pin.
- C : Schottky diodes should be externally connected between output pin and power supply pin and between output pin and GND pin.



- A : Free air ( $\theta_{c-a} = 50^\circ\text{C/W}$ )
- B : With 10cm<sup>2</sup> aluminum heat ( $\theta_{c-a} = 25^\circ\text{C/W}$ )
- C : With 100cm<sup>2</sup> aluminum heat ( $\theta_{c-a} = 10^\circ\text{C/W}$ )
- $T_{j(max)} = 150^\circ\text{C}$

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.

Not recommend  
for new design

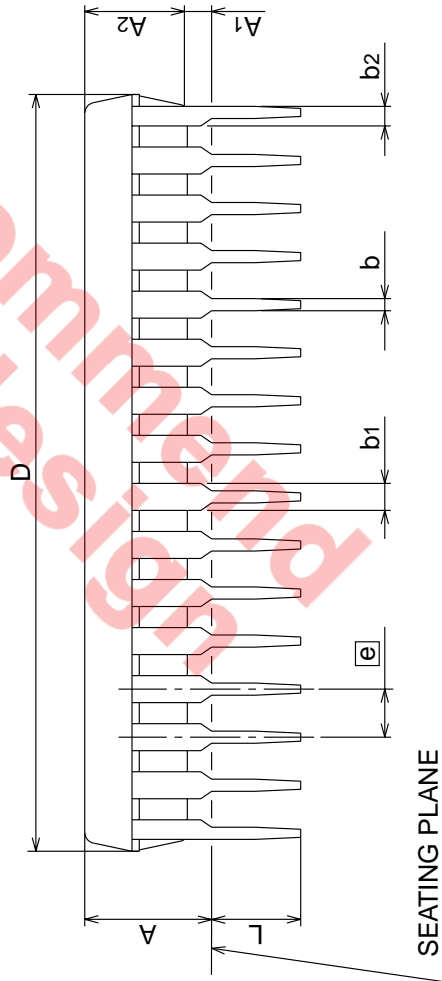
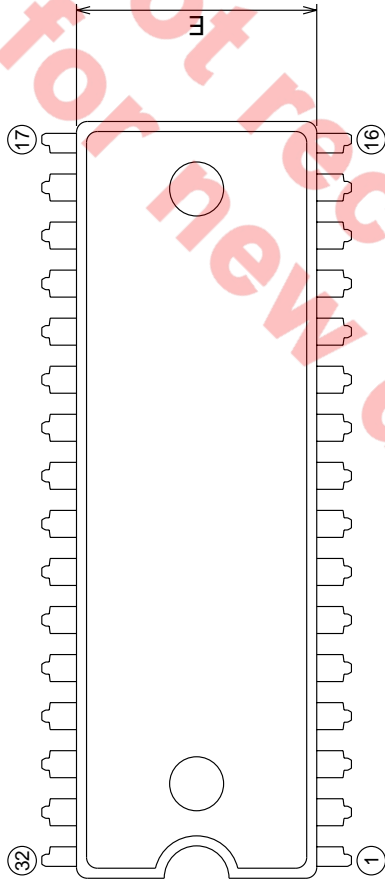
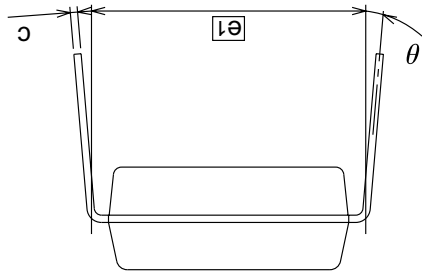
Package Dimensions

Plastic 32pin 400mil SDIP

(MMP)

32P4B

EIAJ Package Code SDIP32-P-400-1.78	JEDEC Code —	Weight(g) 2.2	Lead Material Alloy 42/Cu Alloy
--	-----------------	------------------	------------------------------------



Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	—	—	5.08
A1	0.51	—	—
A2	—	3.8	—
b	0.35	0.45	0.55
b1	0.9	1.0	1.3
b2	0.63	0.73	1.03
c	0.22	0.27	0.34
D	27.8	28.0	28.2
E	8.75	8.9	9.05
e	—	1.778	—
ei	—	10.16	—
L	3.0	—	—
$\theta$	0°	—	15°

## Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

---

Keep safety first in your circuit designs!

1. Renesas Technology Corp. puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.  
Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corp. product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corp. or a third party.
  2. Renesas Technology Corp. assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
  3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corp. without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor for the latest product information before purchasing a product listed herein.  
The information described here may contain technical inaccuracies or typographical errors.  
Renesas Technology Corp. assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.  
Please also pay attention to information published by Renesas Technology Corp. by various means, including the Renesas Technology Corp. Semiconductor home page (<http://www.renesas.com>).
  4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corp. assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
  5. Renesas Technology Corp. semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corp. or an authorized Renesas Technology Corp. product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
  6. The prior written approval of Renesas Technology Corp. is necessary to reprint or reproduce in whole or in part these materials.
  7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.  
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
  8. Please contact Renesas Technology Corp. for further details on these materials or the products contained therein.
- 



### RENESAS SALES OFFICES

<http://www.renesas.com>

**Renesas Technology America, Inc.**  
450 Holger Way, San Jose, CA 95134-1368, U.S.A  
Tel: <1> (408) 382-7500 Fax: <1> (408) 382-7501

**Renesas Technology Europe Limited.**  
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, United Kingdom  
Tel: <44> (1628) 585 100, Fax: <44> (1628) 585 900

**Renesas Technology Europe GmbH**  
Dornacher Str. 3, D-85622 Feldkirchen, Germany  
Tel: <49> (89) 380 70 0, Fax: <49> (89) 929 30 11

**Renesas Technology Hong Kong Ltd.**  
7/F., North Tower, World Finance Centre, Harbour City, Canton Road, Hong Kong  
Tel: <852> 2265-6688, Fax: <852> 2375-6836

**Renesas Technology Taiwan Co., Ltd.**  
FL 10, #99, Fu-Hsing N. Rd., Taipei, Taiwan  
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

**Renesas Technology (Shanghai) Co., Ltd.**  
26/F., Ruijin Building, No.205 Maoming Road (S), Shanghai 200020, China  
Tel: <86> (21) 6472-1001, Fax: <86> (21) 6415-2952

**Renesas Technology Singapore Pte. Ltd.**  
1, Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632  
Tel: <65> 6213-0200, Fax: <65> 6278-8001