M54640P

Stepper Motor Driver

REJ03F0042-0100Z
Rev.1.0
Sep.19.2003

Description

The M54640P is a semiconductor IC to drive a stepper motor by the bipolar method.

Features

- Bipolar and constant-current drive
- Wide current control rage (20 – 800mA)
- Wide supply voltage drive range (10 – 40V)
- Built in flywheel diodes
- Current level can be changed by steps or continuously.
- Built in a thermal shutdown circuit

Application

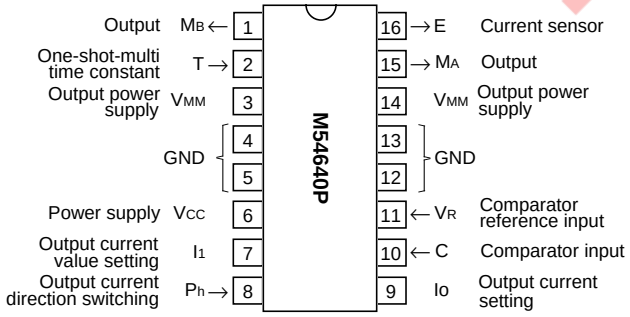
Printer, FDD, HDD, Fax

Function

The M54640P drives a stepper motor by the bipolar drive method to change the current direction of a single coil and controls the current direction with PHASE input pin. In order to obtain higher efficiency, the constant current drive system to control the coil current is introduced. The current value can be selected among four levels (0 to max.) by selecting the combination of three internal comparators by logic input. It also can be continuously changed by controlling the reference voltage. Conversion to voltage is conducted by the current value sensing resistor (Rs) and the voltage is sensed with each comparator, and then each comparator output triggers monomulti and the current is cut for a certain time (t_{OFF}) by utilizing the inductance of the coil.

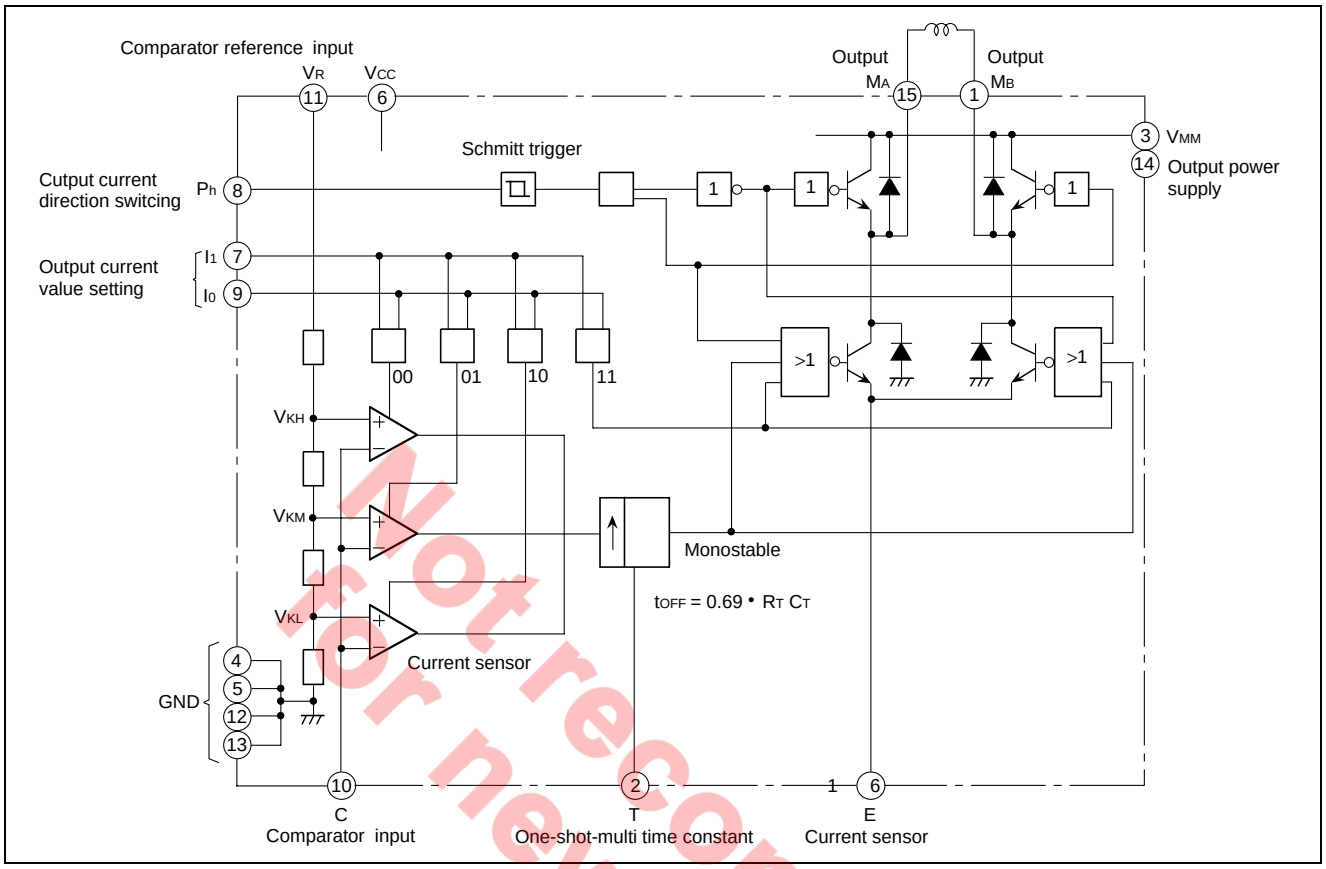
Also, diodes needed for choppering and a thermal shutdown circuit as a countermeasure against overvoltage are built in this circuit.

Pin Configuration



Outline 16P4

Block Diagram



Absolute Maximum Ratings

(Ta = 25°C, unless otherwise noted.)

Parameter	Symbol	Ratings	Unit	Conditions
Supply voltage	V_{CC}	–0.3 to 7	V	
Output supply voltage	V_{MM}	–0.3 to 45	V	
Logic input voltage	V_L	–0.3 to 6	V	
Analog input voltage	V_C	–0.3 to Vcc	V	
Comparative input voltage	V_R	–0.3 to 15	V	
Logic input current	I_L	–10	mA	
Analog input current	I_C	–10	mA	
Output supply current	I_{MM}	±1000	mA	
Power dissipation	Pd	1.92	W	Mounted on a board
Operating temperature	Topr	–20 to 75	°C	
Storage temperature	Tstg	–55 to 125	°C	

Note : Every voltage value is measured when the voltage at GND pin is 0V. The maximum and the minimum of each voltage value are shown in absolute values.

Regarding current directions, inflow current is shown in a positive value and outflow current is shown in a negative value. The maximum and the minimum of each current value are shown in absolute values.

Recommended Operating Condition

(Ta = 25°C, unless otherwise noted.)

Parameter	Symbol	Limits			Unit
		Min.	Typ.	Max.	
Supply voltage	V_{CC}	4.75	5	5.25	V
Output supply voltage	V_{MM}	10		40	V
Output current	I_O	20		800	mA
Logic input rise time	t_{PLH}			2	µS
Logic input fall time	t_{PHL}			2	µS
Thermal shutdown temperature	T_{ON}		175		°C

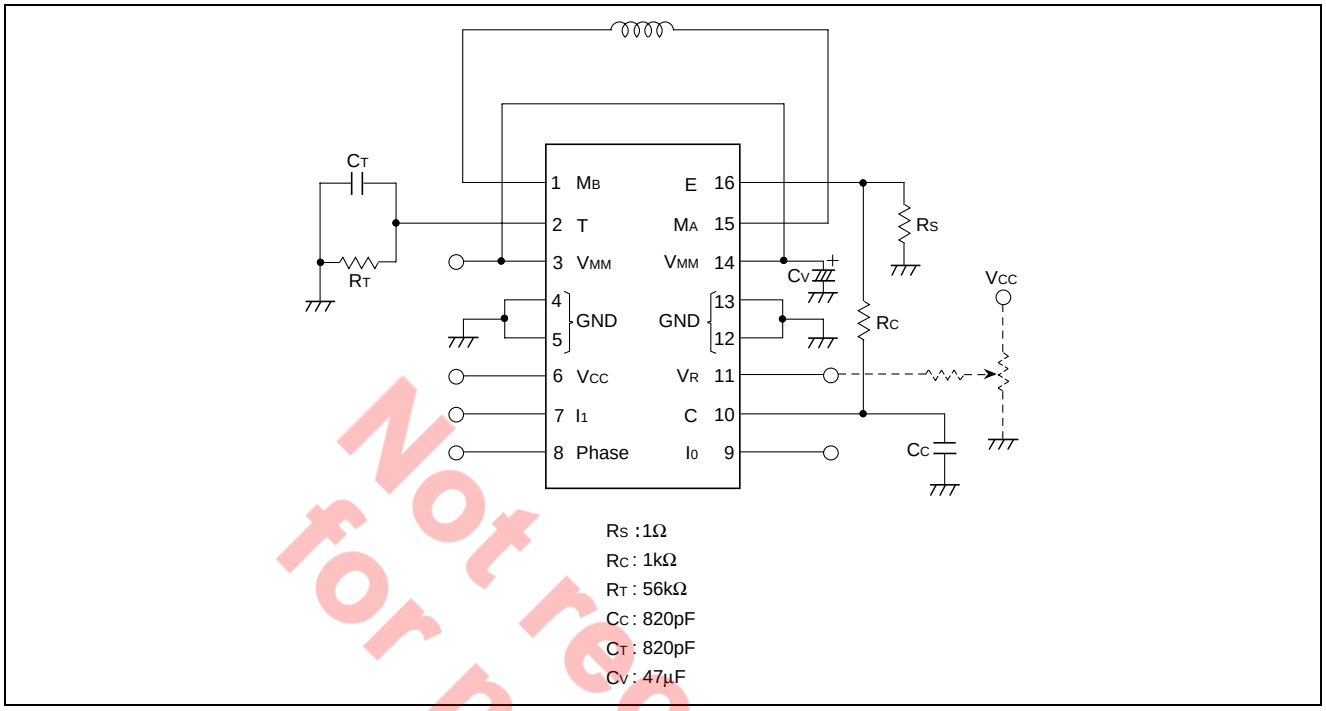
Electrical characteristics

(Ta = 25°C, V_{CC} = 5.0V, unless otherwise noted.)

Parameter		Symbol	Limits			Unit	Test conditions
			Min.	Typ.	Max.		
Logic input voltage	"H"	V_{IH}	2.0		V_{CC}	V	V_{CC}=5V
	"L"	V_{IL}	0		0.8		
Comparator threshold		V_{CH}	400	430	450	mV	V_R=5V, I0=I1=0
		V_{CM}	240	260	280		V_R=5V, I0=1,I1=0
		V_{CL}	75	90	100		V_R=5V, I0=0, I1=1
Comparator input current		I_{CO}	–20		20	µA	
Output cutoff current		I_{OFF}			100	µA	I0=I1=1(Ta=25°C)
Saturation voltage		Vsat			4.0	V	The voltage at the sensing resistor is not included. I_O=500mA
Cutoff time		t_{OFF}	25	30	35	µS	V_{MM}=10V, t_{ON} ≥ 5µs
Turnoff delay		td		1.6	2.0	µS	Ta=25°C, dVK/dt ≥ 50mV/µs
Supply current		I_{CC}			25	mA	V_{CC}=5V
Logic input current	"H"	I_{IH}			20	µA	V_I=2.4V
	"L"	I_{IL}			–0.4	mA	V_I=0.4V

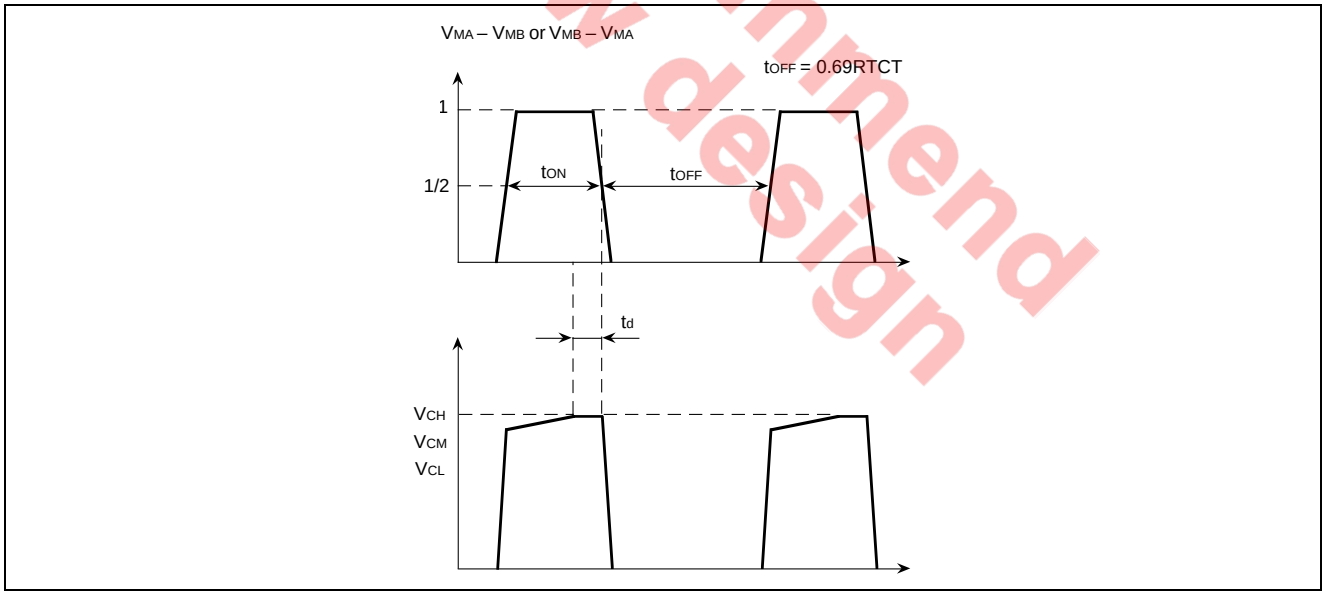
Switching Characteristics

Test Circuit



RS : 1Ω
RC : 1kΩ
RT : 56kΩ
CC : 820pF
CT : 820pF
CV : 47µF

Switching Waveforms



Application Description

- PHASE INPUT
  Phase input decides the output mode.

Phase	MA	MB
H	H	L
L	L	H

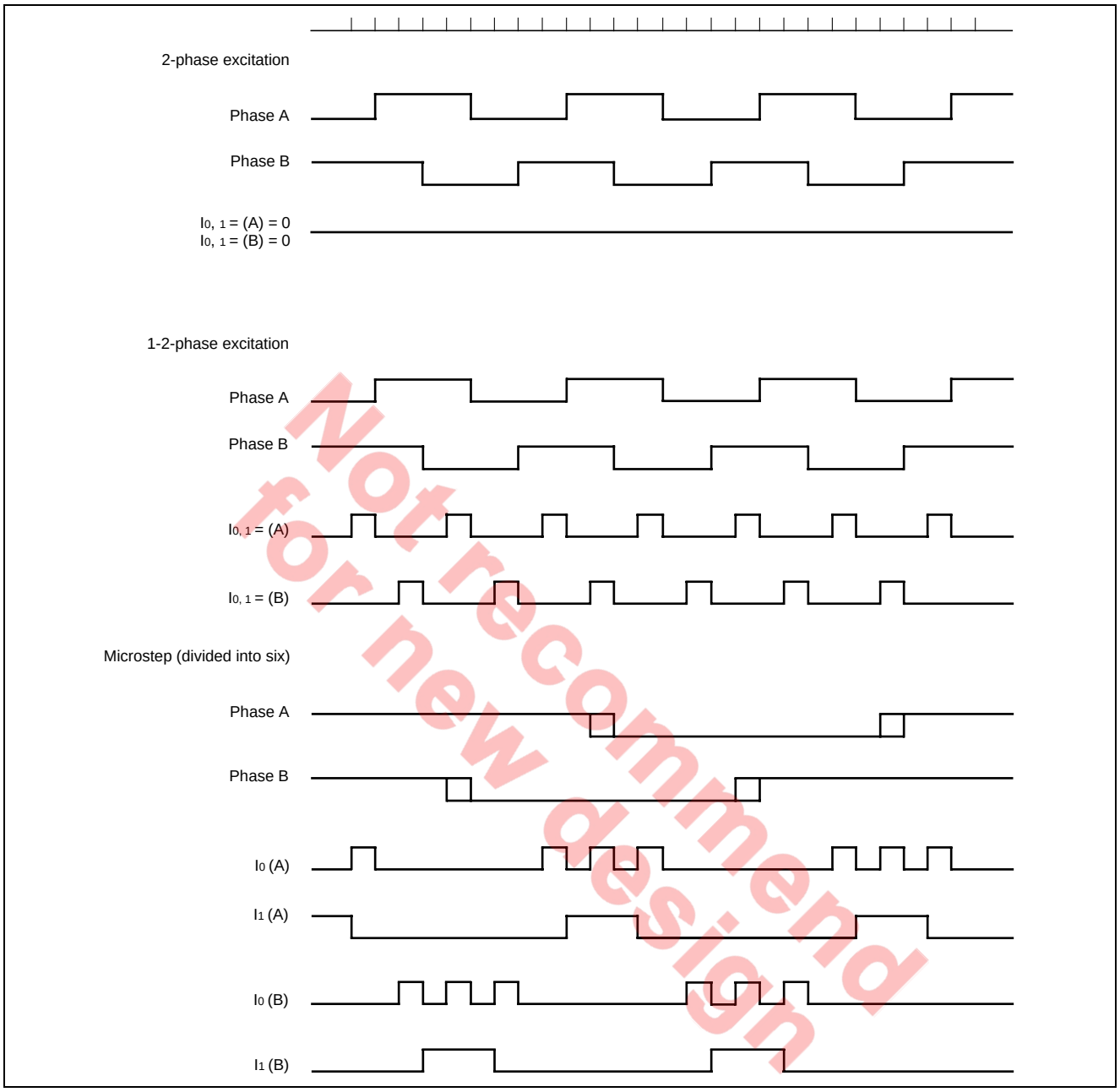
- I0, I1
  I0 and I1 fixed based on the comparison voltage V_R decide the output current level.
  The current level can be continuously changed by changing the voltage at V_R continuously.

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

- Current sensor
  When the voltage fall at the current sensing resistor and the selected current level becomes 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 comparison level.
  After the cutoff time (t_{OFF}), the output stage is in ON state again.
  This operation is repeated.
- Single pulse generator
  At the comparator output rise edge, the monostable is triggered.
  The pulse width of the monostable at the external timing Rt and Ct is as follows.
  t_{OFF} = 0.69 x RtCt
  Retrigger during t_{OFF} is neglected.
  - Analog control

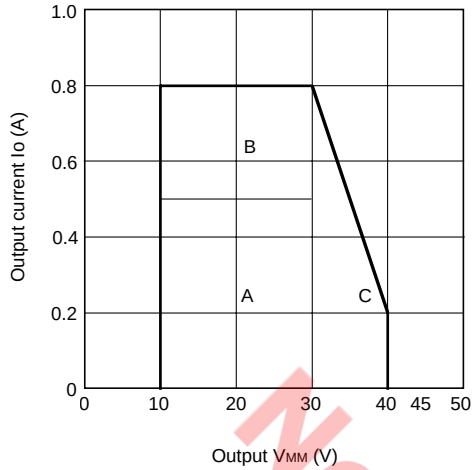
  The output current level can be continuously changed by changing the voltage at V_R or the feedback voltage to the comparator.

Timing Chart



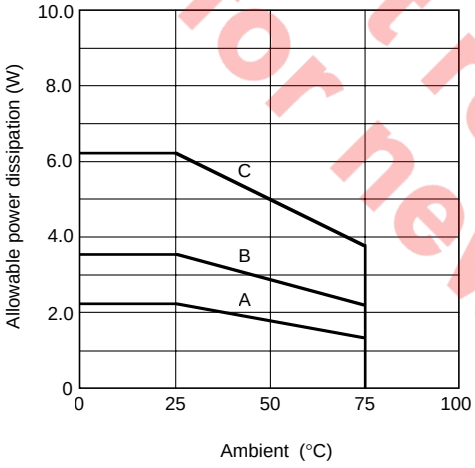
Typical Characteristics (Absolute maximum ratings)

Safety operating temperature



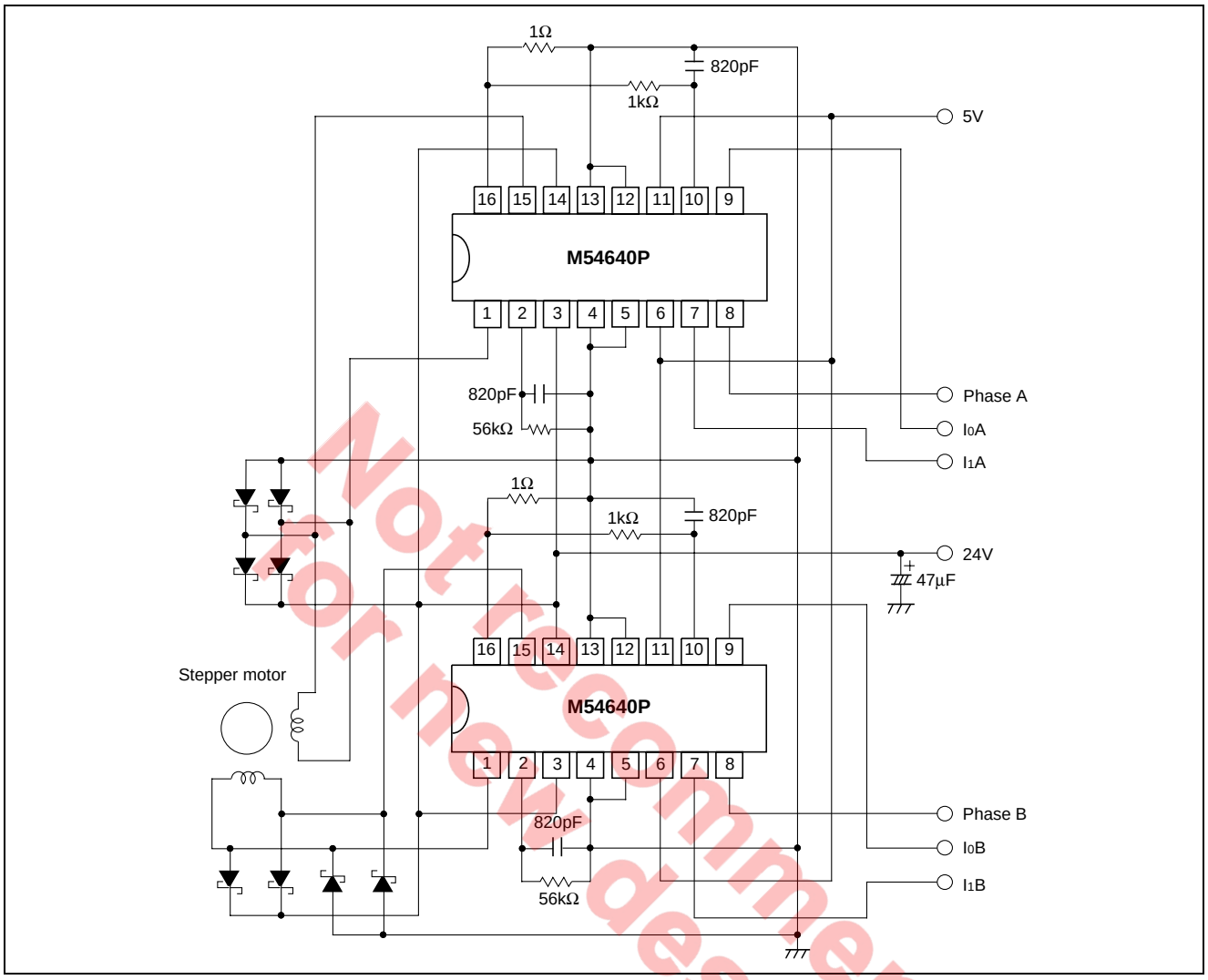
A : Recommended
B : Schottky diodes should be externally connected between output pins and power supply pins.
C : Schottky diodes should be externally instaalled between output pins and power supply pins and between output pins and GND pin.

Thermal derating



$\theta_{j\text{-}c}$ = 10°C/W
A : Mounted on a 25cm^2 glass epoxy board which is coated with copper on one side.
$\theta_{c\text{-}a}$ = 45°C/W
B : 10cm^2 aluminum heat sink (1t) is used.
$\theta_{c\text{-}a}$ = 25°C/W
C : 100cm^2 aluminum heat sink (1t) is used.
$\theta_{c\text{-}a}$ = 10°C/W
$T_{j(max)}$ = 150°C

Application Example



Precautions for use

(1) When the whole output current changes by a large margin (for example, when overheat protection 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 at the point near to IC pin between Vcc pin and GND pin. (See above application example.)

(3) Thermal shutdown function

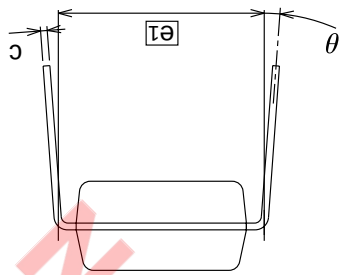
- The state of thermal shutdown operation may differ according to the way of wiring within a board. Therefore, sufficient board evaluation should be conducted before use. When the board is changed, operation on the replacing board should be evaluated.
- The circuit board on which this IC is mounted is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

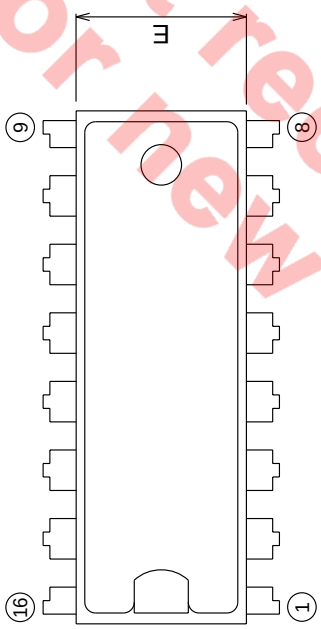
Package Dimensions

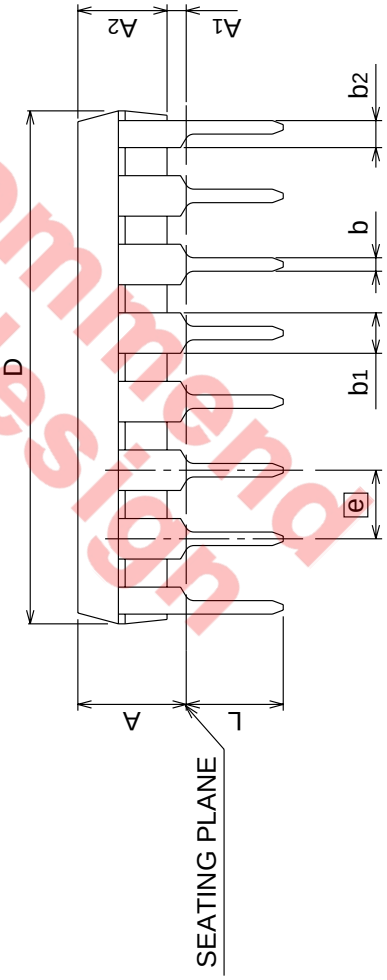
16P4 (MMP) **Plastic 16pin 300mil DIP**

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
DIP16-P-300-2.54	—	1.0	Alloy 42/Cu Alloy

Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	—	—	4.5
A_1	0.51	—	—
A_2	—	3.3	—
b	0.4	0.5	0.59
b_1	1.4	1.5	1.8
b_2	0.9	1.0	1.3
c	0.22	0.27	0.34
D	18.8	19.0	19.2
E	6.15	6.3	6.45
e	—	2.54	—
e1	—	7.62	—
L	3.0	—	—
θ	0°	—	15°







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

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

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