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M54646AP

2-Phase Stepper Motor Driver

Description

The M54646AP is a semiconductor IC to drive bipolar stepper motors by controlling winding current with reference to a designated current level.

Features

- Wide driver voltage range (10 – 40V)
- Wide output current control range (20 – 800mA)
- Bipolar and constant current control
- Built-in flywheel diode
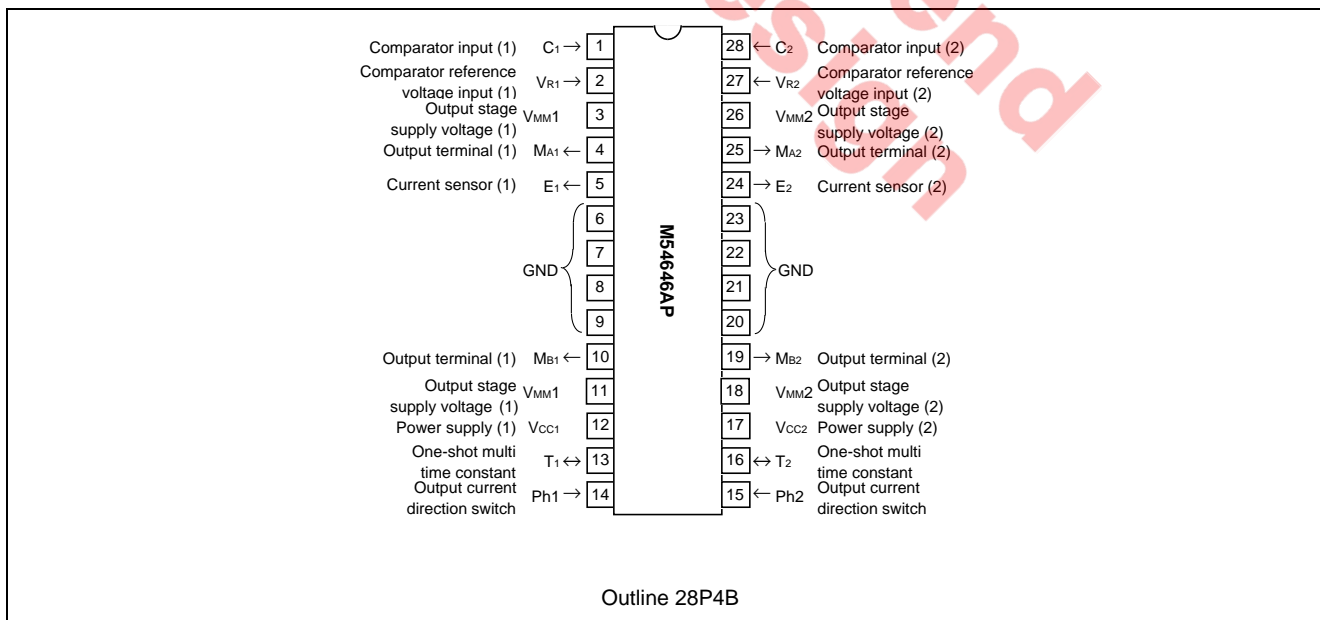- Built-in thermal protection circuit

Application

Office automation equipment such as printers, FDDs, HDDs and facsimiles
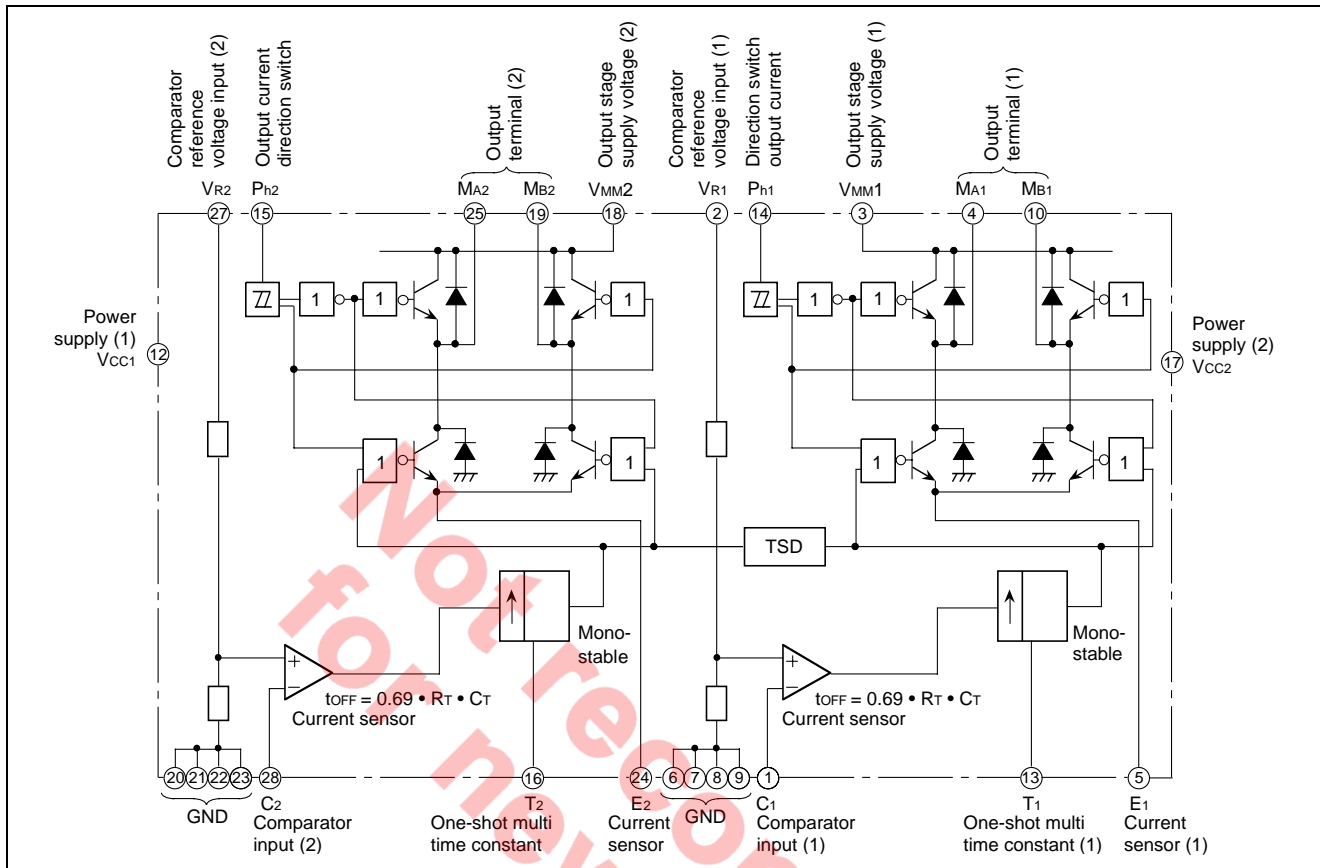
Function

M54646AP Integrated Circuit drives two-phase bipolar stepper motors while controlling winding current: It controls winding current direction by inputting phases (pins 14 and 15) and, at the same time, controls winding current amperage with terminals V_R (pins (2) and (27)).

Provided with control circuits that output two phases, this IC is sufficient to drive a two-phase bipolar stepper motor.

Pin Configuration

Comparator input (1)	$C_1 \rightarrow$	1	28 $\leftarrow C_2$	Comparator input (2)
Comparator reference voltage input (1)	$V_{R1} \rightarrow$	2	27 $\leftarrow V_{R2}$	Comparator reference voltage input (2)
Output stage supply voltage (1)	$V_{MM}1$	3	26 $V_{MM}2$	Output stage supply voltage (2)
Output terminal (1)	$M_{A1} \leftarrow$	4	25 $\rightarrow M_{A2}$	Output terminal (2)
Current sensor (1)	$E_1 \leftarrow$	5	24 $\rightarrow E_2$	Current sensor (2)
GND		6 7 8 9	23 22 21 20	GND
Output terminal (1)	$M_{B1} \leftarrow$	10	19 $\rightarrow M_{B2}$	Output terminal (2)
Output stage supply voltage (1)	$V_{MM}1$	11	18 $V_{MM}2$	Output stage supply voltage (2)
Power supply (1)	V_{CC1}	12	17 V_{CC2}	Power supply (2)
One-shot multi time constant	$T_1 \leftrightarrow$	13	16 $\leftrightarrow T_2$	One-shot multi time constant
Output current direction switch	$Ph1 \rightarrow$	14	15 $\leftarrow Ph2$	Output current direction switch

M54646AP

Outline 28P4B

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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 stage 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	
Reference input voltage	V_R	−0.3 to 15	V	
Logic input current	I_L	−10	mA	
Analog input current	I_c	−10	mA	
Output current	I_O	±1000	mA	
Power dissipation	Pd	1.92	W	
Operating temperature	Topr	−20 to 85	°C	
Storage temperature	Tstg	−55 to 125	°C	

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Recommended Operating Condition

(Ta = 25°C, unless otherwise noted.)

Parameter	Symbol	Limits Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	4.5	5	5.5	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}		165		°C

Electrical characteristics

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

Parameter		Symbol	Limits Min.	Typ.	Max.	Unit	Test conditions
Logic input voltage	"H"	V_{IH}	2.0		Vcc	V	V_{CC}=5V
	"L"	V_{IL}	0		0.8		
Comparator threshold voltage		V_{CH}	400	430	450	mV	V_R=5V
Comparator input current		I_{CO}	−20		20	μA	
Output cutoff current		I_{OFF}			100	μA	
Total saturation voltage		Vsat			3.5	V	Sensing resistance is not included. (I_O=500mA)
Cutoff time		t_{OFF}	25	30	35	μS	V_{MM}=10V, $t_{ON} \geq 5$μs
Turnoff delay		td		1.6	2.0	μS	dVK/dt $\geq$ 50mV/μs
Power current		I_{CC}			25	mA	V_{CC}=5V, 1phase
Logic input current	"H"	I_{IH}			20	μA	VI=2.4V
	"L"	I_{IL}	−0.4			mA	VI=0.4V

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Switching Characteristics

Switching Waveform
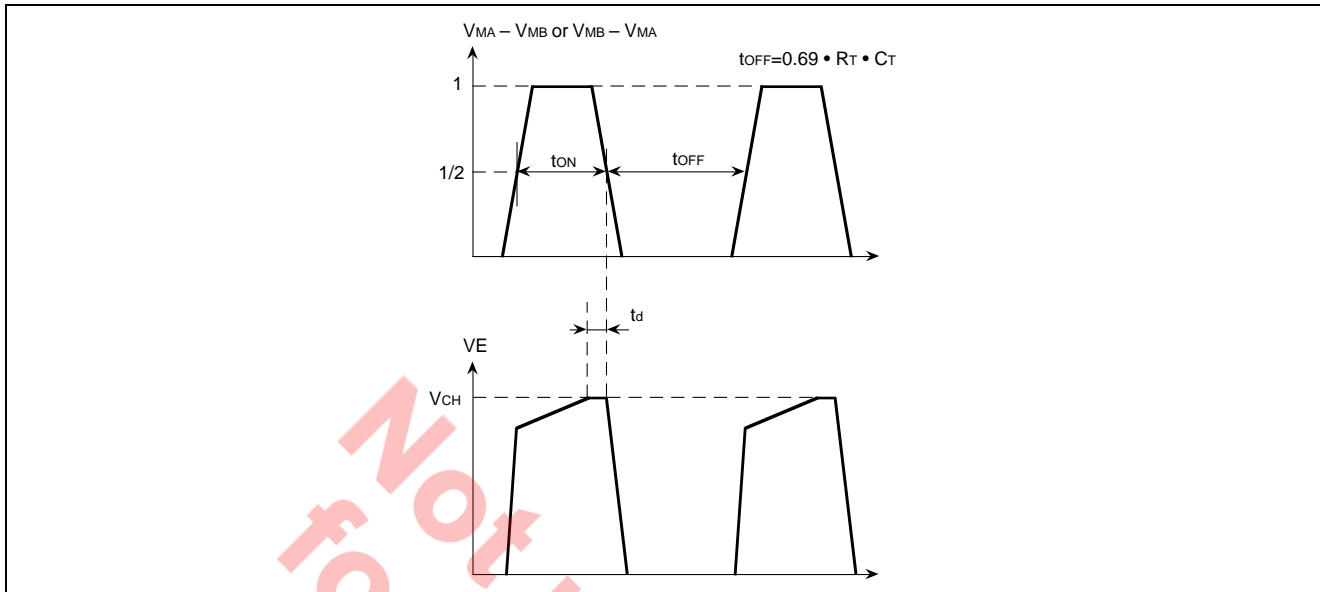
Timing Chart
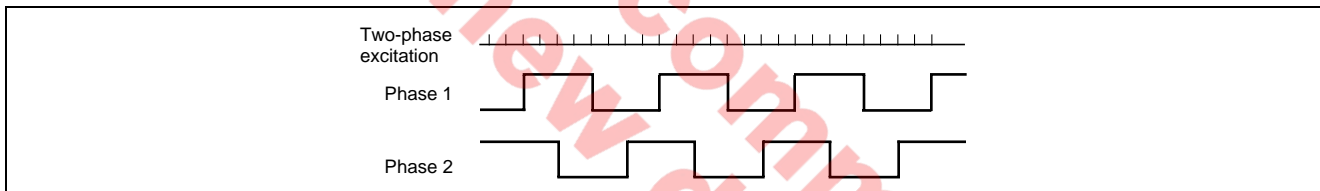
Application Directions

(1) Phase Input

Phase input determines output mode:

Phase	MA	MB
H	H	L
L	L	H

(2) V_R (reference voltage)

Stepless current level variation is available by continuously changing V_R.

(3) Current sensor

Compares voltage converted from amperage by current sensing resistor to designated reference voltage level. When they are the same, comparator triggers Mono-stable, and shuts off output transistor during time frame t_{OFF}. During this period, current level decreases to slightly below reference level. When period has passed, output transistor is reactivated. This series of operations is repeated.

(4) Single-pulse generator

Mono-stable is triggered at comparator output phase rise edge. Mono-stable output pulse width is determined by input to timing terminals R_T and C_T, as follows:
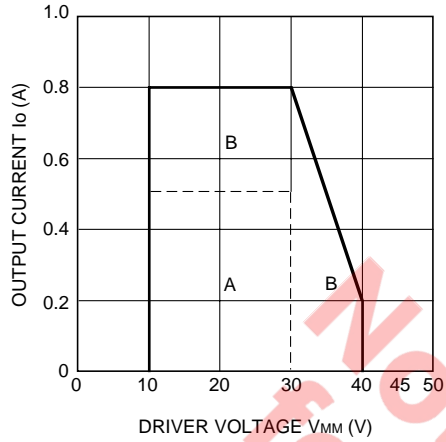
$$t_{OFF} = 0.69 \times R_T \times C_T$$

If new trigger occurs during tOFF, it is ignored.

(5) Analog control

Stepless output current level variation is available by continuously changing voltage V_R or feedback voltage to comparator.
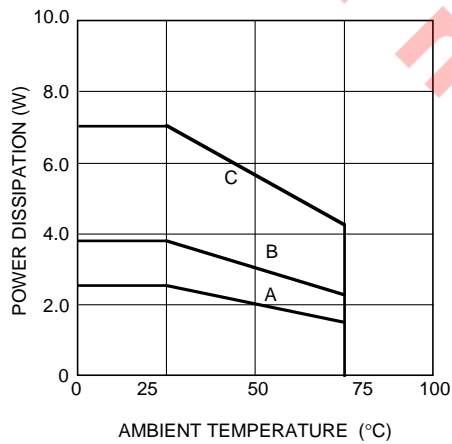
AREA OF SAFE OPERATION

A: Recommended operational range
B: External Schottky diode to be connected between output terminal and power terminal as well as between output terminal and GND.
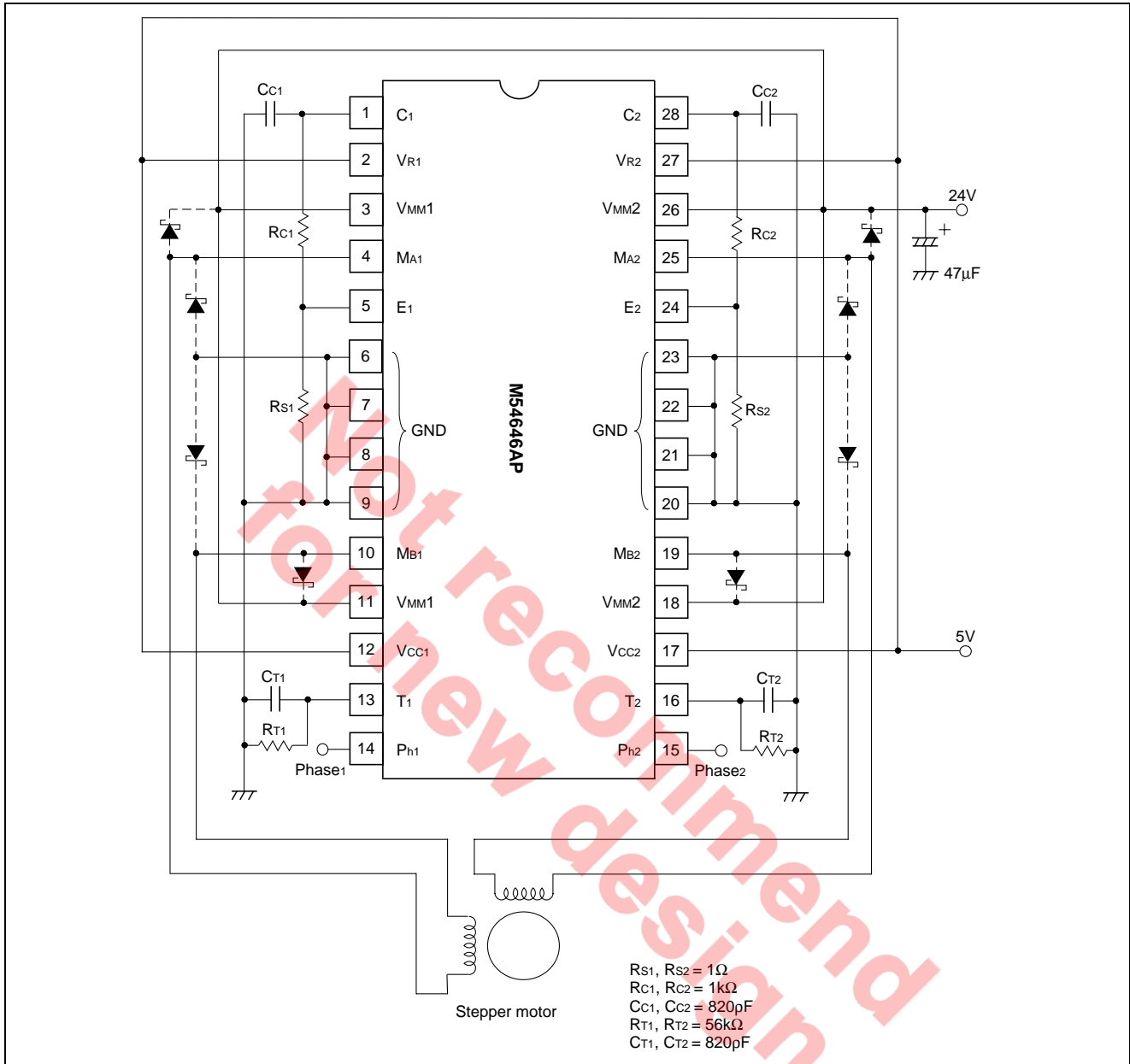
∗ This regulation is for temporary electric power use. For continuous use, be sure power dissipation does not go beyond package's operational range.

THERMAL DERATING

θj-c = 8°C/W
A: Mounted on 25cm^2 glassfiber epoxy resin circuit board with one side copper-foiled
θc-a = 42°C/W
B: With aluminum heat sink (1t) 10cm^2
θc-a = 25°C/W
C: With aluminum heat sink (1t) 100cm^2
θc-a = 10°C/W
Tj(max) = 150°C

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Application Example

R$_{S1}$, R$_{S2}$ = 1Ω
R$_{C1}$, R$_{C2}$ = 1kΩ
C$_{C1}$, C$_{C2}$ = 820pF
R$_{T1}$, R$_{T2}$ = 56kΩ
C$_{T1}$, C$_{T2}$ = 820pF

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CAUTIONS

(1) Be sure to short-circuit VCC1 and VCC2 before use.

(2) When IC total output current changes greatly, e.g. when output current flows intermittently due to thermal protection operation, supply voltage may fluctuate. Provide power supply and wiring such that even in such a case amperage will not exceed absolute maximum rating.

(3) Excessive power voltage fluctuations may cause unstable IC operation. To regulate such fluctuations, connect capacitor between terminals VCC and GND as close to IC terminal as possible. (Refer to application example.)

(4) Thermal protection function

• Thermal protection characteristics may differ depending on wiring layout. Be sure to test IC on circuit board before use.
  After circuit board is replaced, test IC again.

• Circuit boards on which this IC mounted are designed such that impedance between power supply and output terminal will be kept low; therefore, IC output terminal may be short- circuited internally if excessive surge voltage is applied accidentally from outside. To prevent circuit board from burning in such a case, take safety measures such as installation of a fuse.

(5) Flywheel diode
  This IC has built in flywheel diode to provide a return current route to motor. To prevent overheating and malfunction in operational areas where great current and voltage are applied, install a Schottky diode externally. For details, refer to "Area of Safe Operation" and "Application Example."
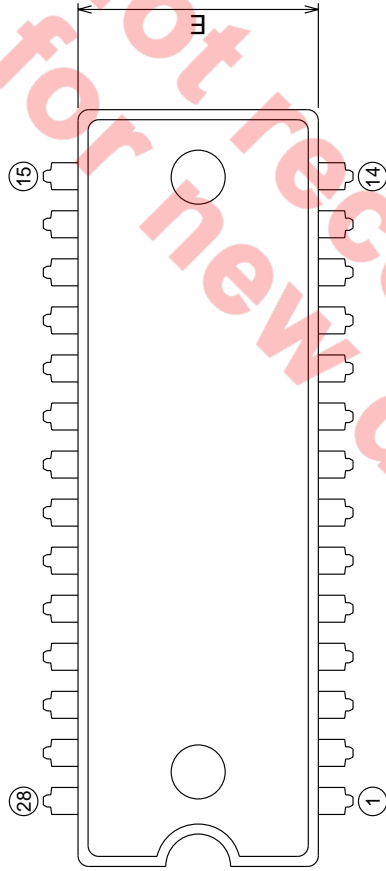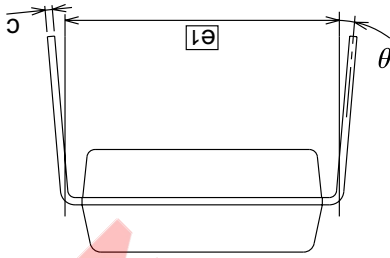
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Package Dimensions

28P4B

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
SDIP28-P-400-1.78	—	2.2	Cu Alloy

Plastic 28pin 400mil SDIP

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
c	0.22	0.27	0.34
D	27.8	28.0	28.2
E	8.75	8.9	9.05
e	—	1.778	—
e1	—	10.16	—
L	3.0	—	—
θ	0°	—	15°

SEATING PLANE

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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