

To our customers,

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## Old Company Name in Catalogs and Other Documents

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April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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# M54646AP

## 2-Phase Stepper Motor Driver

REJ03F0044-0100Z

Rev.1.0

Sep.19.2003

### 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

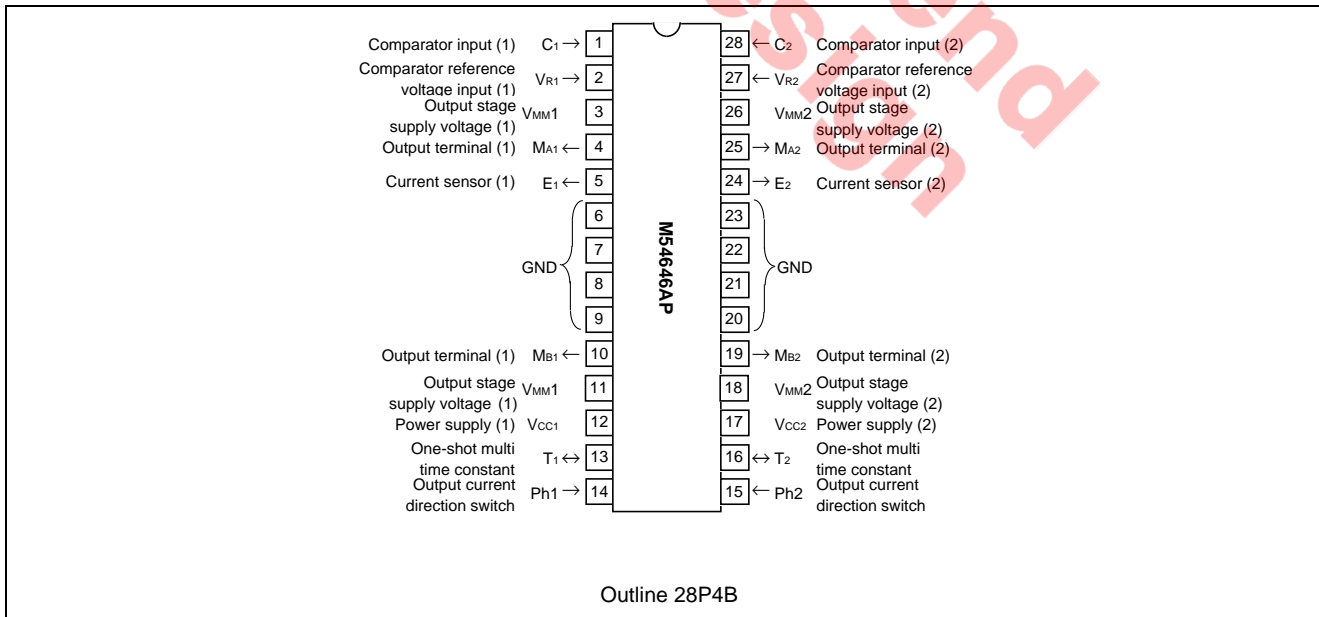
Office automation equipment such as printers, FDDs, HDDs and facsimiles

### Function

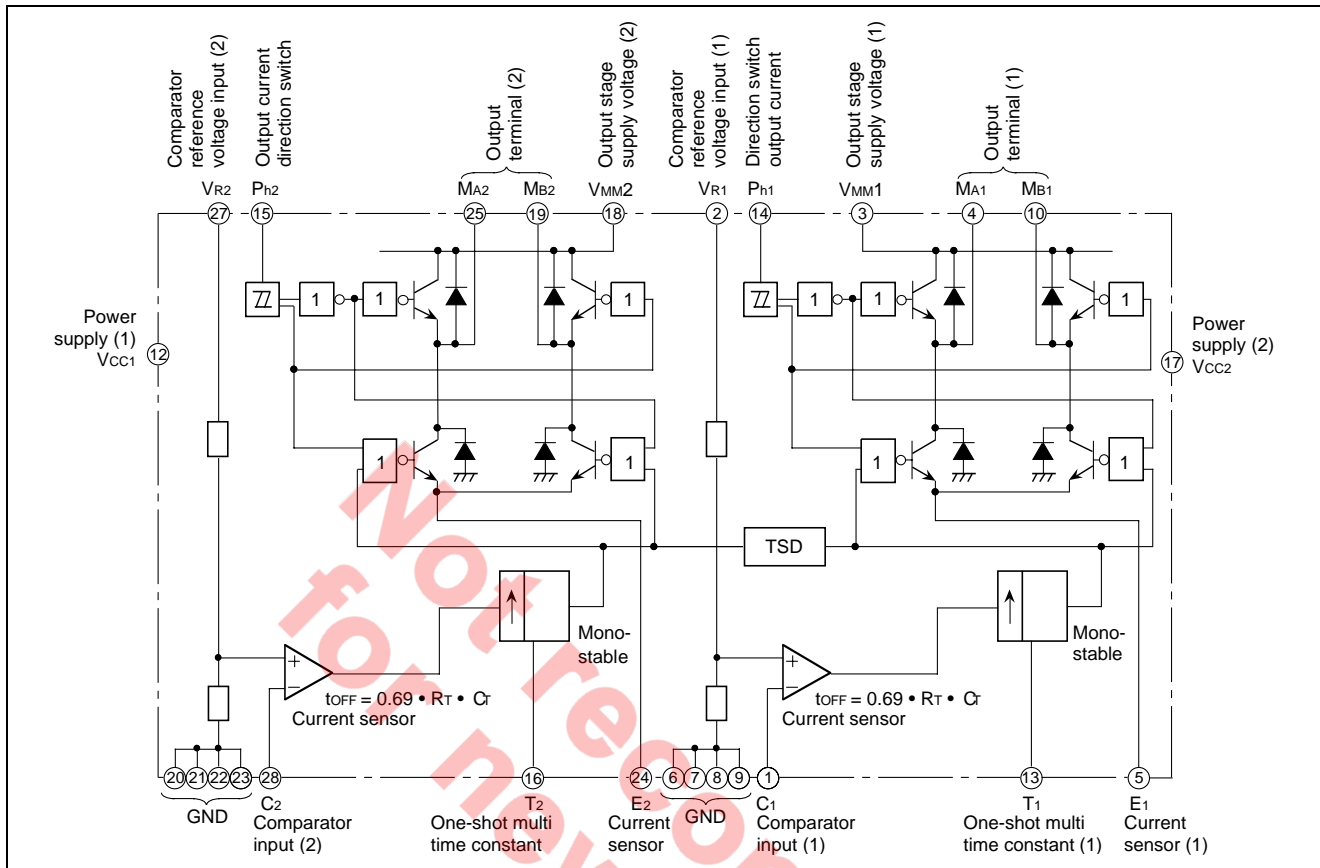
M54646AP Integrated Circuit drives two-phase bipolar stepper motors while controlling winding current: It controls winding current direction by inputting phases (pins 14 and 15) and, at the same time, controls winding current amperage with terminals  $V_R$  (pins (2) and (27)).

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

### Pin Configuration



## Block Diagram



## Absolute Maximum Ratings

(Ta = 25°C, unless otherwise noted.)

Parameter	Symbol	Ratings	Unit	Conditions
Supply voltage	V <sub>CC</sub>	-0.3 to 7	V	
Output stage supply voltage	V <sub>MM</sub>	-0.3 to 45	V	
Logic input voltage	V <sub>L</sub>	-0.3 to 6	V	
Analog input voltage	V <sub>C</sub>	-0.3 to V <sub>CC</sub>	V	
Reference input voltage	V <sub>R</sub>	-0.3 to 15	V	
Logic input current	I <sub>L</sub>	-10	mA	
Analog input current	I <sub>C</sub>	-10	mA	
Output current	I <sub>O</sub>	±1000	mA	
Power dissipation	P <sub>d</sub>	1.92	W	
Operating temperature	T <sub>opr</sub>	-20 to 85	°C	
Storage temperature	T <sub>stg</sub>	-55 to 125	°C	

## Recommended Operating Condition

(Ta = 25°C, unless otherwise noted.)

Parameter	Symbol	Limits			Unit
		Min.	Typ.	Max.	
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	$\mu$ S
Logic input fall time	$t_{PHL}$			2	$\mu$ S
Thermal shutdown temperature	$T_{ON}$		165		°C

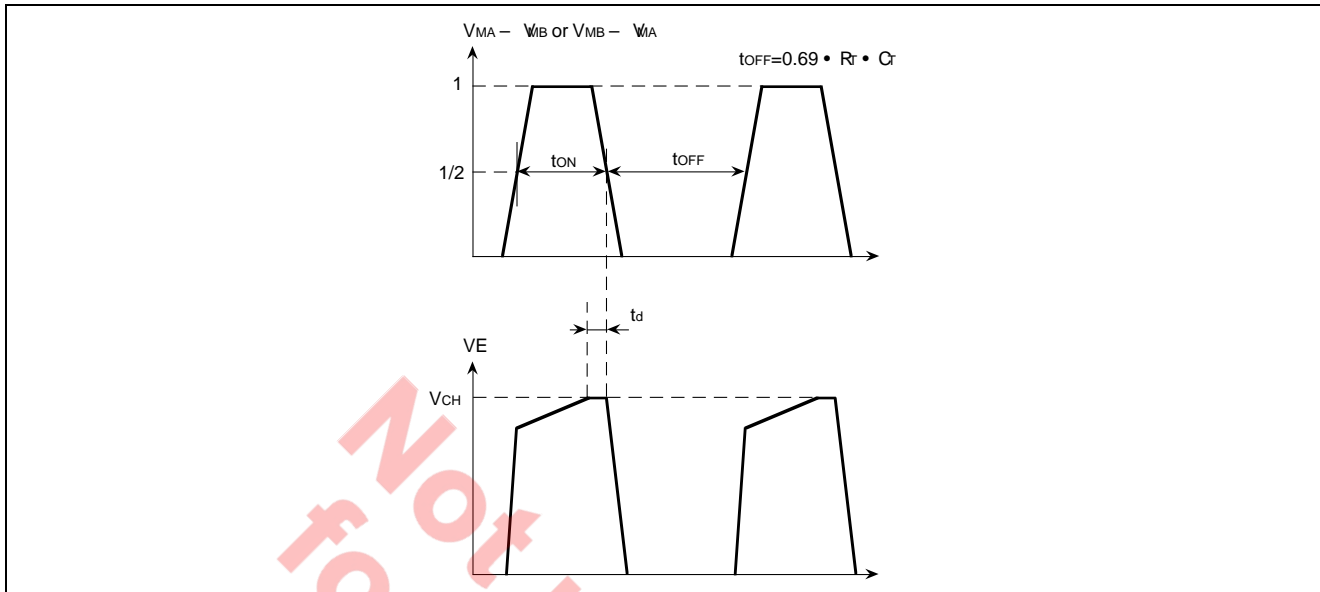
## Electrical characteristics

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

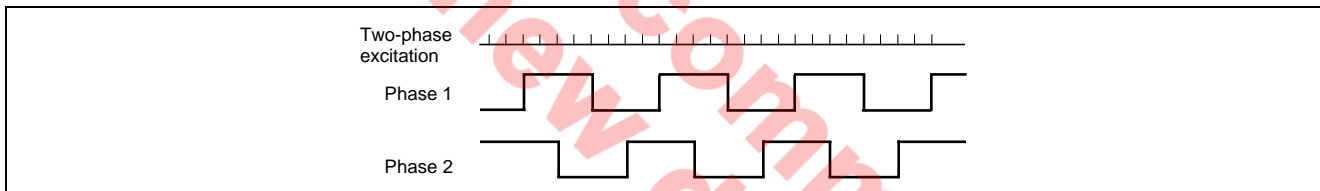
Parameter	Symbol	Limits			Unit	Test conditions
		Min.	Typ.	Max.		
Logic input voltage	"H" $V_{IH}$	2.0		$V_{CC}$	V	$V_{CC}=5V$
	"L" $V_{IL}$	0		0.8		
Comparator threshold voltage	$V_{CH}$	400	430	450	mV	$V_R=5V$
Comparator input current	$I_{CO}$	-20		20	$\mu$ A	
Output cutoff current	$I_{OFF}$			100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

## 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:

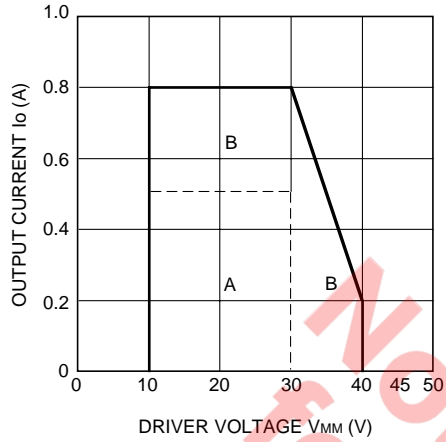
$$t_{OFF} = 0.69 \times R_T \times C_T$$

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.

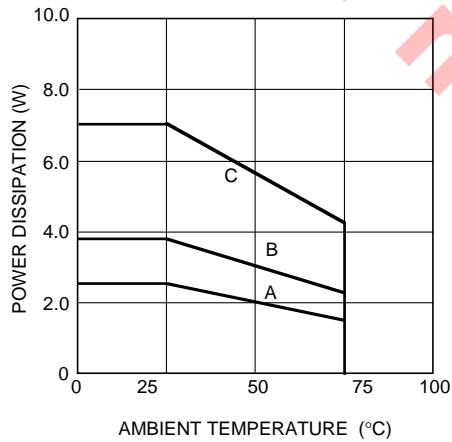
**AREA OF SAFE OPERATION**



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.

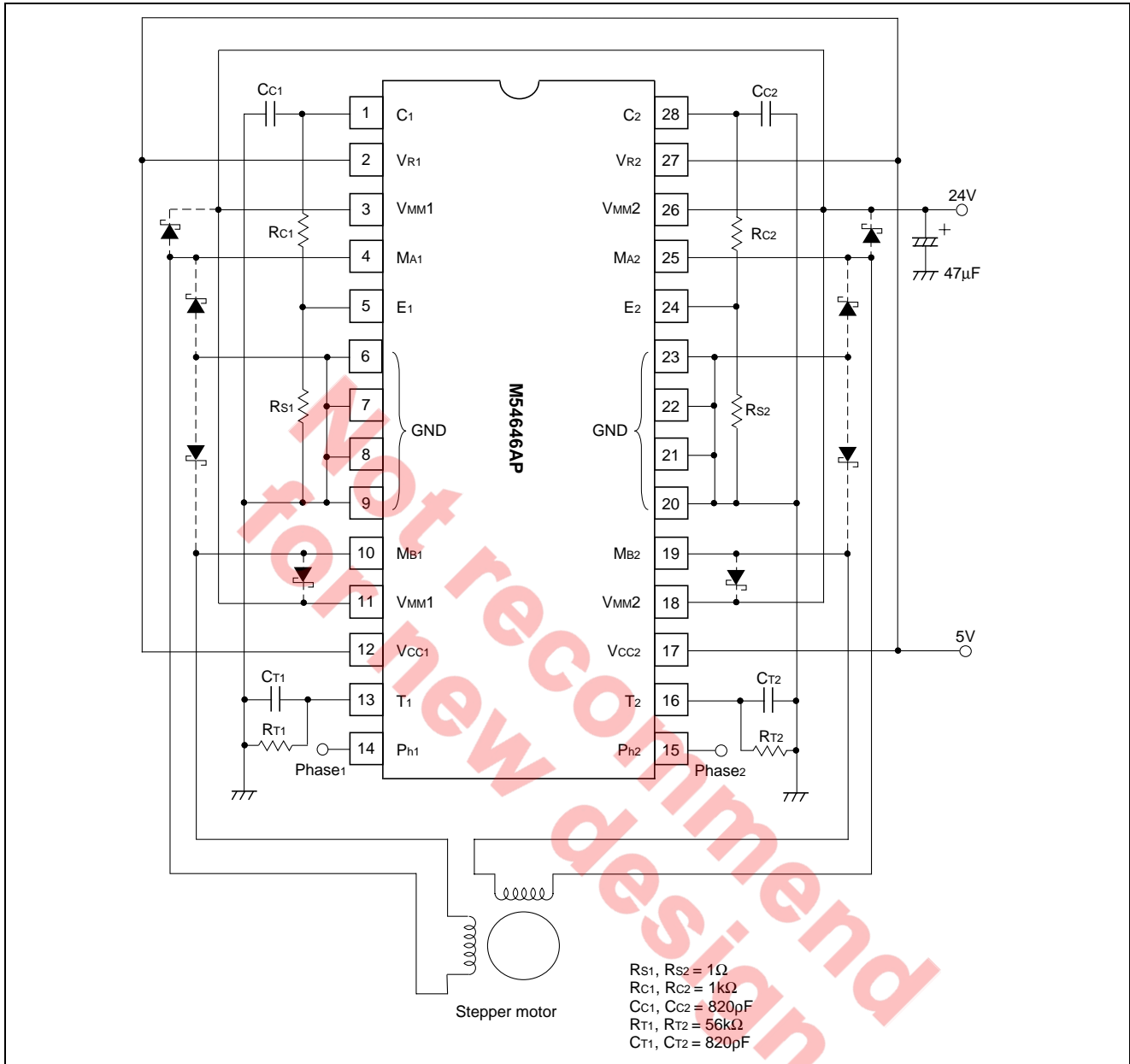
\* This regulation is for temporary electric power use. For continuous use, be sure power dissipation does not go beyond package's operational range.

**THERMAL DERATING**



$\theta_{j-c} = 8^{\circ}\text{C/W}$   
 A: Mounted on 25cm<sup>2</sup> glassfiber epoxy resin circuit board with one side copper-foiled  
 $\theta_{c-a} = 42^{\circ}\text{C/W}$   
 B: With aluminum heat sink (1t) 10cm<sup>2</sup>  
 $\theta_{c-a} = 25^{\circ}\text{C/W}$   
 C: With aluminum heat sink (1t) 100cm<sup>2</sup>  
 $\theta_{c-a} = 10^{\circ}\text{C/W}$   
 $T_{j(max)} = 150^{\circ}\text{C}$

Application Example





## 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.”

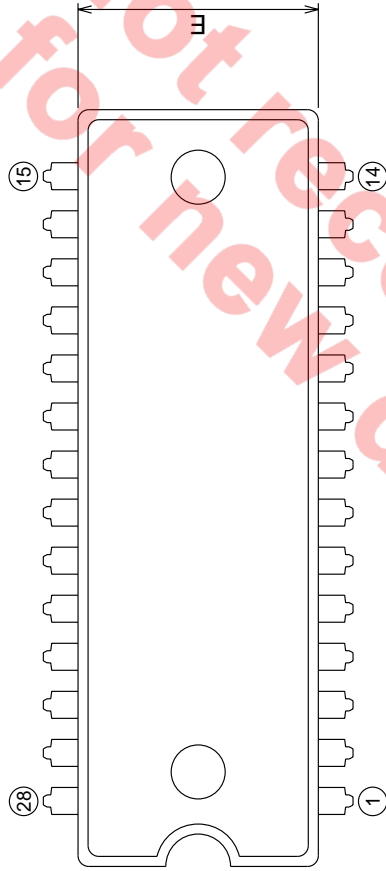
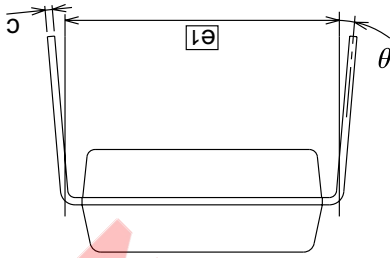
Not recommend  
for new design

Package Dimensions

Plastic 28pin 400mil SDIP

28P4B

EIAJ Package Code SDIP28-P-400-1.78	JEDEC Code —	Weight(g) 2.2	Lead Material Cu Alloy
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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	—	—
theta	0°	—	15°

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Tel: <44> (1628) 585 100, Fax: <44> (1628) 585 900

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Tel: <49> (89) 380 70 0, Fax: <49> (89) 929 30 11

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