

TOSHIBA Bipolar Digital Integrated Circuit Silicon Monolithic

# TD6304AP,TD6308AP

## Auto Reverse & Auto Eject Plunger Driver

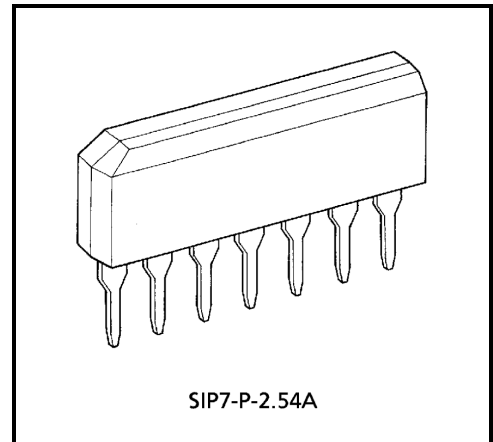
TD6304AP, TD6308AP are IC developed for auto reverse / auto eject on a car stereo.

There are two methods for driving the plunger; one is to drive it after motor rotation detecting signal is stopped and the other is to drive it optionally by program switch.

Further, this IC can be used as a solenoid driver in the control circuit of a stereo, remote control system and other electric accessories.

### Features

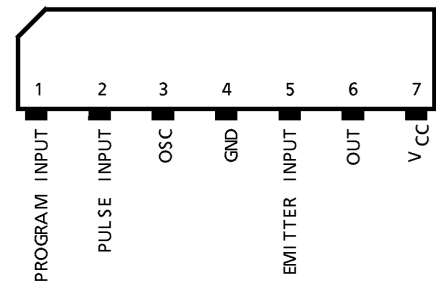
- Plunger driving output transistor is built in.  
No.6 pin output  $I_{OUT} = 200\text{mA}$  ( $V_{CE(sat)} = 0.7\text{V}$  (max.))
- Manual operation by program switch is possible.
- Time for output pulse generation after rotation detecting signal is stopped and output pulse width are variable by external mounted capacitor and resistor. (Duty cycle of output pulse is set inside IC)
- A load dump circuit is built in for protection from overvoltage.
- Operating supply voltage  $V_{CC(opr)} = 8\sim 16\text{V}$   
(7 pin voltage)
- TD6304AP is 1 / 4 duty cycle.
- TD6308AP is 1 / 8 duty cycle.



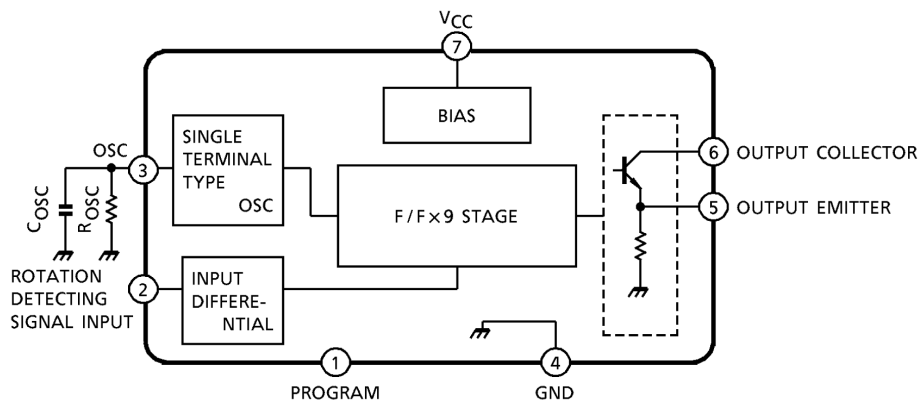
SIP7-P-2.54A

Weight: 0.7g (typ.)

### Pin Connection (side view)



**Block Diagram**



**Pin Description**

Pin No.	Symbol	Designation	Function
1	Prog	Program switch terminal	Terminal used for forcing plunger output on regardless of state of rotation detecting output / input. However, one output only is transmitted per operation.
2	Input	Rotation detecting signal input terminal	Rotation detecting pulse input terminal. Plunger output is transmitted at certain time after input is stopped.
3	OSC	Oscillator terminal	Terminal used for connecting oscillation capacitor and resistor for setting response time and driving time of plunger output, when $C_{OSC} = 0.22\mu F$ , $R_{OSC} = 30k\Omega$ , $f_{OSC} \approx 500Hz$ is attained.
5	E-out	Emitter output terminal	Emitter output of output transistor is transmitted. Further, this terminal is used for darlington connection with an externally mounted transistor. This terminal is normally earthed to GND through a resistor.
6	Out	Plunger output terminal	Plunger driving output terminal. $V_{sat} = 0.7V$ and $I_{OUT} = 200mA$ are transmitted when 5 pin is earthed. (open collector)
7	$V_{CC}$	Power terminal	Supply voltage $V_{CC} = 8.0\sim 16.0V$ is applied.
4	GND	Earth terminal	For grounding

## Outline Of Function

- (1) How to decide oscillator frequency

Oscillator wave form



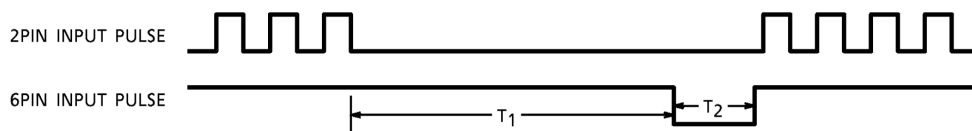
$$T_{OSC} = C_{OSC} (0.247R_{OSC} + 1435) \text{ ( ms )}$$

COSC and ROSC are an externally mounted resistor and capacitor deciding oscillator frequency, respectively.

TOSC can be calculated from above calculating formula, but when TOSC – ROSC graph is used, COSC and ROSC deciding desired oscillator frequency can be selected easily.

- (2) Plunger output when pulse input is stopped.

Output wave form and timing are as follows.



- (a) In case of TD6304AP

T<sub>1</sub>: Plunger response time typical 0.75s (when f<sub>OSC</sub> ≐ 500Hz)

T<sub>2</sub>: Plunger drive time typical 0.25s (when f<sub>OSC</sub> ≐ 500Hz)

Above T<sub>1</sub> and T<sub>2</sub> can be calculated from the following formula:

$$T_1 = \frac{3}{4} \times 512 \times T_{OSC} \text{ [s]}$$

$$T_2 = \frac{1}{4} \times 512 \times T_{OSC} \text{ [s]}$$

- (b) In case of TD6308AP

T<sub>1</sub>: Plunger response time typical 0.88s (when f<sub>OSC</sub> ≐ 500Hz)

T<sub>2</sub>: Plunger drive time typical 0.12s (when f<sub>OSC</sub> ≐ 500Hz)

T<sub>1</sub> and T<sub>2</sub> can be calculated from the following formula:

$$T_1 = \frac{7}{8} \times 512 \times T_{OSC} \text{ [s]}$$

$$T_2 = \frac{1}{8} \times 512 \times T_{OSC} \text{ [s]}$$

(c) Method for selecting  $T_1$  and  $T_2$  from graphs.

Externally mounted capacitor and resistor for plunger response time  $T_1$  and plunger drive time  $T_2$  can be easily selected when  $T_1$ ,  $T_2$  – COSC, ROSC graphs are used. For instance, in case of TD6304AP, if it is desired to set plunger response time  $T_1$  at 1s, when  $COSC = 0.47\mu F$  is used at plunger response time shown by dotted line, ROSC is approx.  $20k\Omega$  and the plunger drive time  $T_2$  shown by solid line will be 0.34s.

Other COSC can also be selected in the same manner.

When  $COSC = 0.33\mu F$ ,  $ROSC \approx 30k\Omega$ ,  $T_2 \approx 0.34s$

When  $COSC = 0.22\mu F$ ,  $ROSC \approx 47k\Omega$ ,  $T_2 \approx 0.34s$

and values of  $T_1$  and  $T_2$  do not change even when C and R constants are changed.

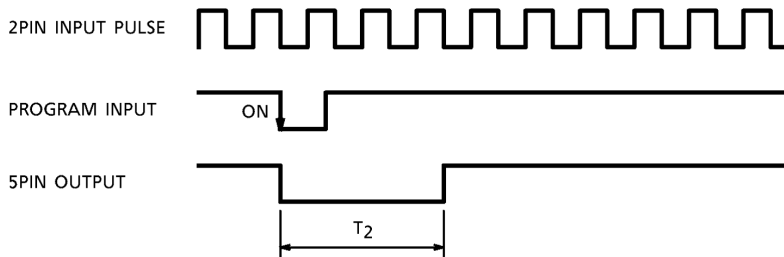
$T_1$  and  $T_2$  of TD6308AP can be selected in the same manner as in TD6304AP.

Duty cycle is, TD6304AP  $T_1 : T_2 = 3 : 1$

TD6308AP  $T_1 : T_2 = 7 : 1$

(3) Plunger output when program switch is operated.

Output wave form and timing are as follows.



$T_2$ : Plunger drive time

In case of TD6304AP,  $T_2$  is 0.25s (when  $f_{OSC} \approx 500Hz$ )

In case of TD6308AP,  $T_2$  is 0.12s (when  $f_{OSC} \approx 500Hz$ )

Actually, output is transmitted only one time within 50ms after program switch is operated.

## Maximum Ratings (Ta = 25°C)

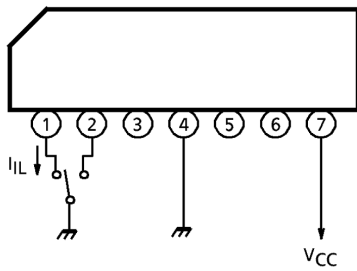
Characteristic	Symbol	Rating	Unit
Supply voltage	V <sub>CC</sub>	30	V
Output voltage	V <sub>OUT</sub>	30	V
Output current	I <sub>OUT</sub>	400	mA
Power dissipation	P <sub>D</sub>	400	mW
Operating temperature	T <sub>opr</sub>	-30~75	°C
Storage temperature	T <sub>stg</sub>	-55~150	°C

## Electrical Characteristics (unless otherwise specified, V<sub>CC</sub> = 13.2V, Ta = 25°C)

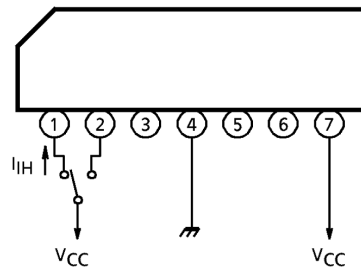
Characteristic		Symbol	Test Cir-cuit	Test Condition	Min.	Typ.	Max.	Unit
Operating supply voltage		V <sub>CC</sub>	—	Ta = -30~75°C	8.0	—	16.0	V
Supply current		I <sub>CC1</sub>	3	Plunger on	7.5	13.0	20.0	mA
		I <sub>CC2</sub>	4	Plunger off	3.6	5.0	8.0	mA
Plunger output current		I <sub>OUT</sub>	5	V <sub>CE (sat)</sub> = 0.7V	200	—	—	mA
Saturation voltage between collector and emitter		V <sub>CE (sat)</sub>	—	Test for pins no.6 & no.5 I <sub>OUT</sub> = 400mA	—	—	1.5	V
Input current	"L" level	I <sub>IL</sub>	1	Test for pins no.1 & no.2 V <sub>IL</sub> = 0 V <sub>IH</sub> = 13.2V	60	—	130	μA
	"H" level	I <sub>IH</sub>	2		—	—	5.0	μA
Rotary detecting input voltage	"H" level	V <sub>IH</sub>	6	Input signals of no. 2 pins	2.5	—	V <sub>CC</sub>	V
	"L" level	V <sub>IL</sub>	6		—	—	0.8	V
Oscillator frequency		f <sub>OSC</sub>	—	C = 0.22μF, R = 30kΩ	—	500	—	Hz
Plunger response time	TD6304AP	T <sub>1</sub>	—	f <sub>OSC</sub> = 500Hz	—	0.75	—	s
	TD6308AP				—	0.88	—	
Plunger driving time	TD6304AP	T <sub>2</sub>	—	f <sub>OSC</sub> = 500Hz	—	0.25	—	s
	TD6308AP				—	0.12	—	

## Test Circuit

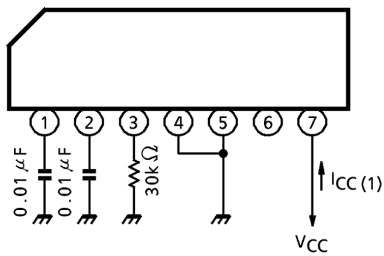
1.  $I_{IL}$



2.  $I_{IH}$

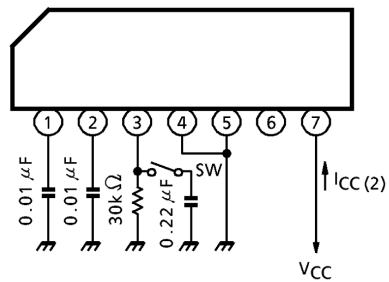


3.  $I_{CC(1)}$



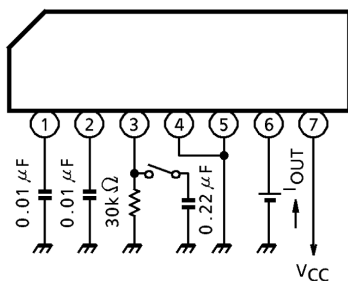
(Note) Output should be off

4.  $I_{CC(2)}$



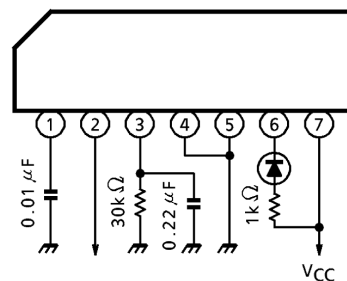
(Note) When output is on, take a measurement with switch "S" opened.

5.  $I_{OUT}$



(Note) When output is on, open switch "S" and measure current  $I_{OUT}$  that flows when  $V = 0.7V$  is applied to no.6 pin.

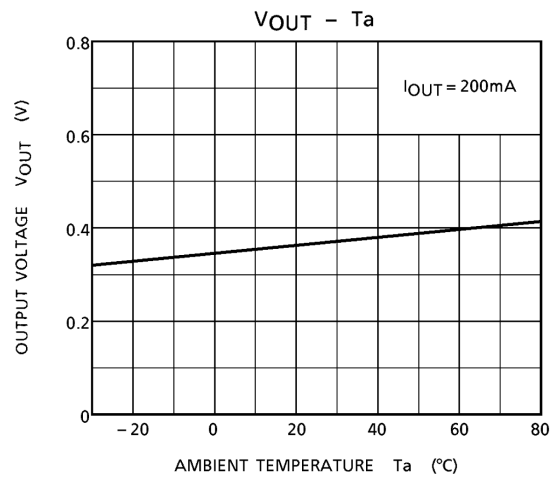
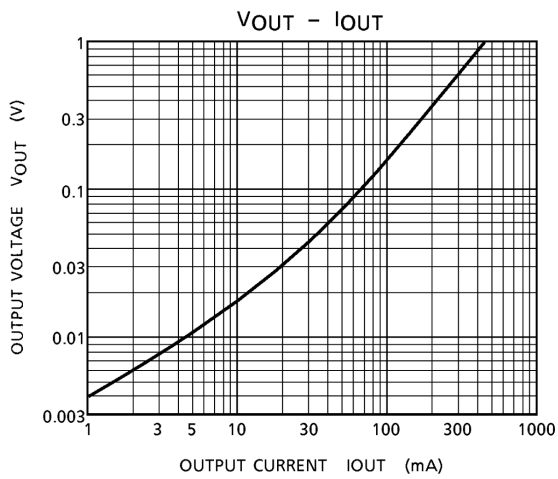
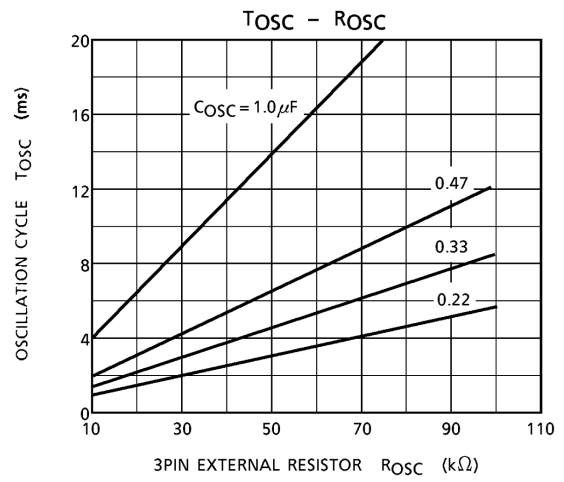
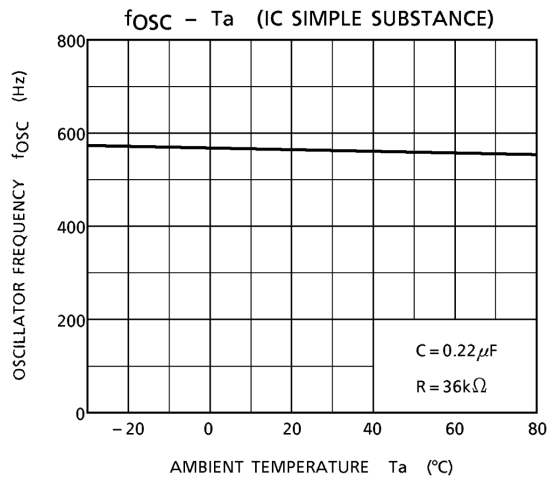
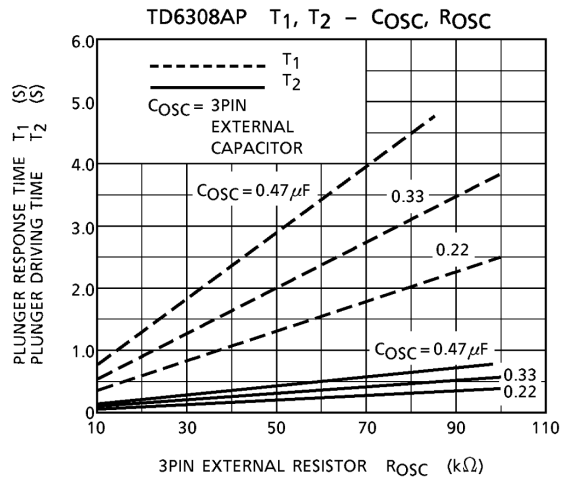
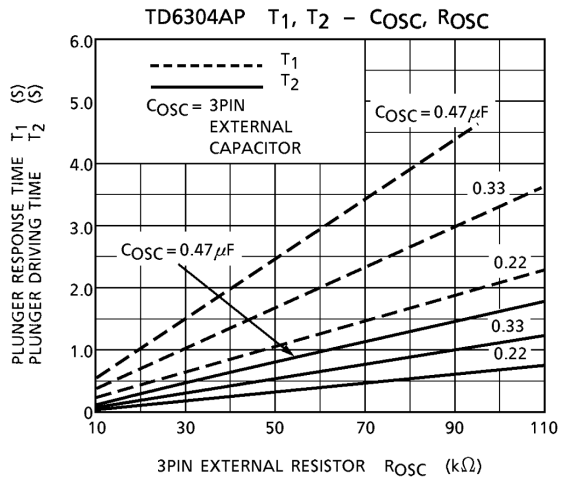
6.  $V_{IH}, V_{IL}$

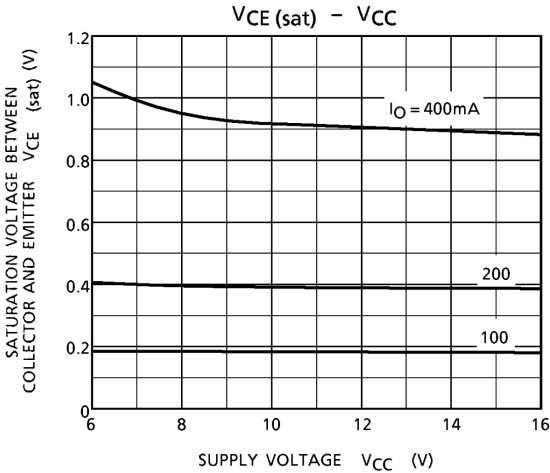
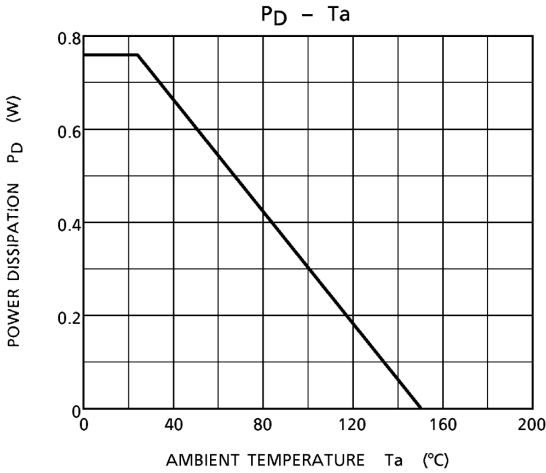


(Note) Add the following pulse to  $V_{IN}$ .



Adding  $V_{IN}$  pulse to no.2 pin, check if LED is illuminated.



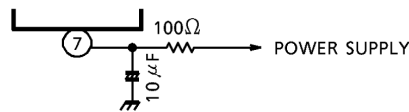




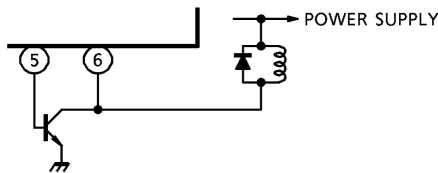
## Cautions In Use

To prevent troubles during use and improve reliability, following cautions shall be observed.

1. This IC shall be used within max. Rating. In particular, when there is the possibility for applicating of surge voltage, this IC shall be so protected that it is kept in max. rating.
2. Except no.4 pin (GND terminal), all terminals shall be used in a range of positive potential against no.4 pin.
3. A capacitor externally mounted to no.3 pin (OSC terminal) should have excellent temperature and frequency characteristics.
4. To protect IC from surge voltage on power line, a resistor ( $100\Omega$  or above) and capacitor ( $10\mu\text{F}$  or above) shall be connected to no.7 pin.

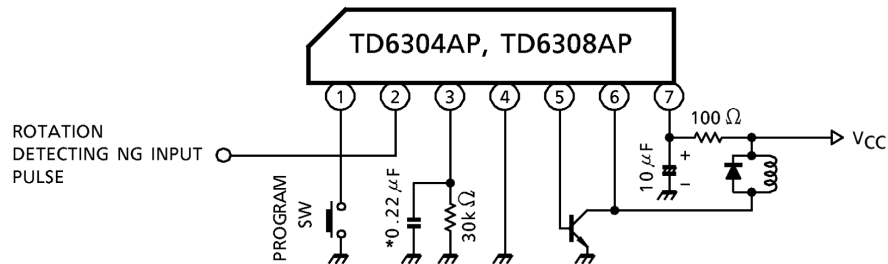


5. When the plunger is connected to the output circuit, diode shall be connected to both leads of the plunger to protect IC from counter electromotive force when power is turned off.

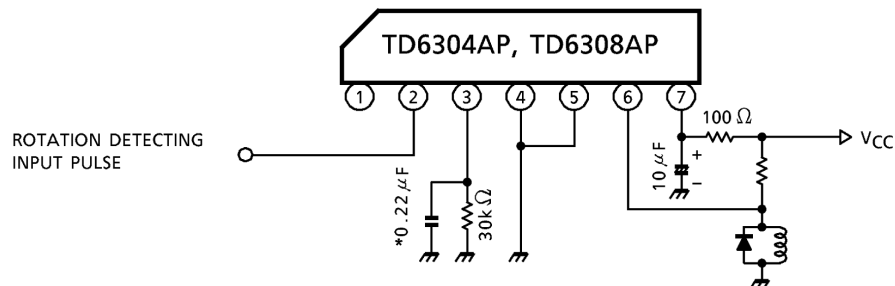


## Application Circuit

1. Auto reverse



2. Auto eject

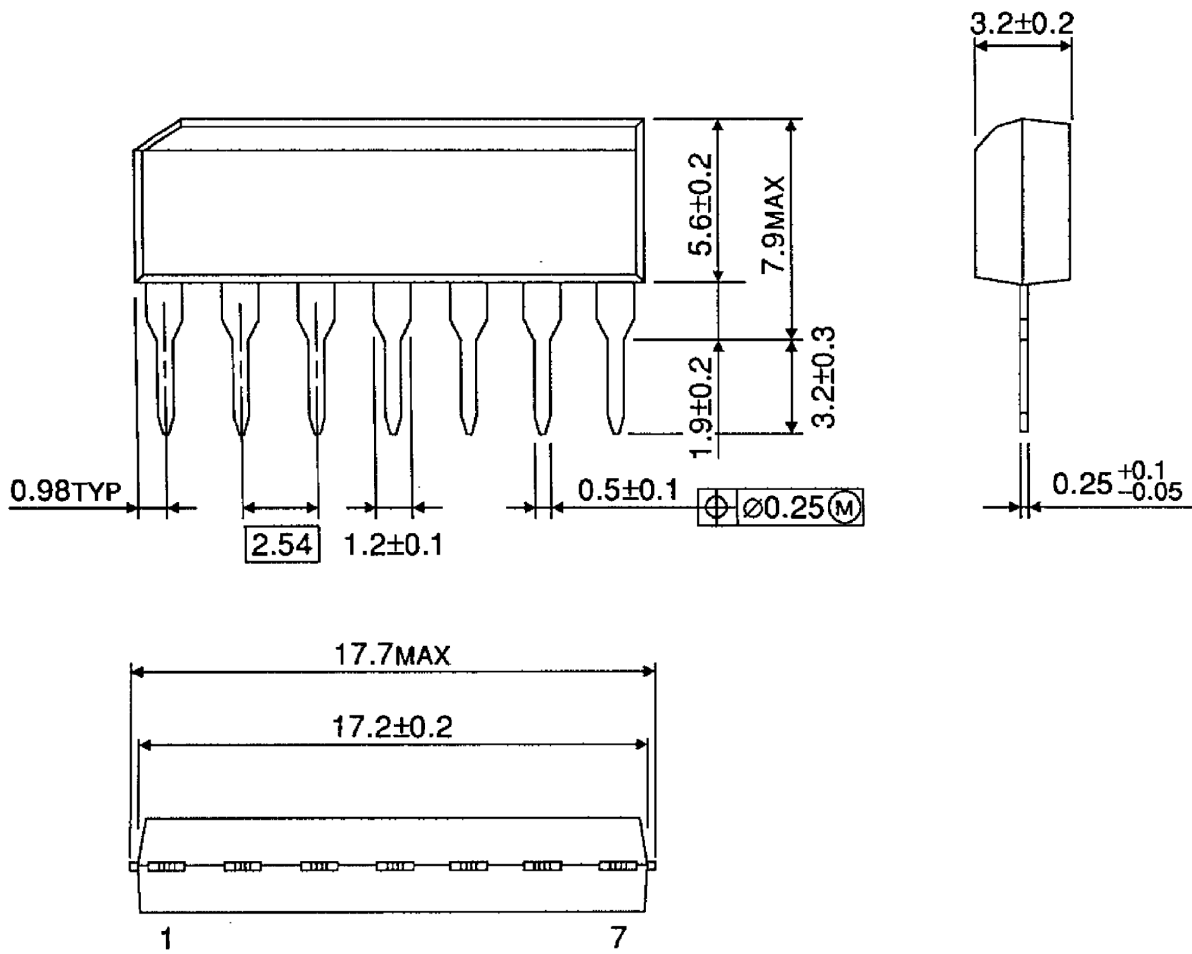


(\*) External mounted capacitor with less equivalent series resistance is recommended.

## Package Dimensions

SIP7-P-2.54A

Unit : mm



Weight: 0.7g (typ.)

**RESTRICTIONS ON PRODUCT USE**

000707EBA

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