

# System power supply for CD radio cassette players

## BA3940A

With built-in 9V, 7V, and 5V outputs, the BA3940A system power supply IC is best suited for use in CD radio cassette players.

### ●Applications

CD radio cassette players

### ●Features

- 1) One 9V output, two 7V outputs (switched by MODE SW, only one output is available at the same time) and one 5V output are built in.
- 2) Output current limit circuit protects the IC against short-circuiting damage.
- 3) Thermal protection circuit prevents heat damage to the IC.
- 4) Compact SIP-M12 package allows a large power dissipation.

### ●Absolute maximum ratings (Ta = 25°C)

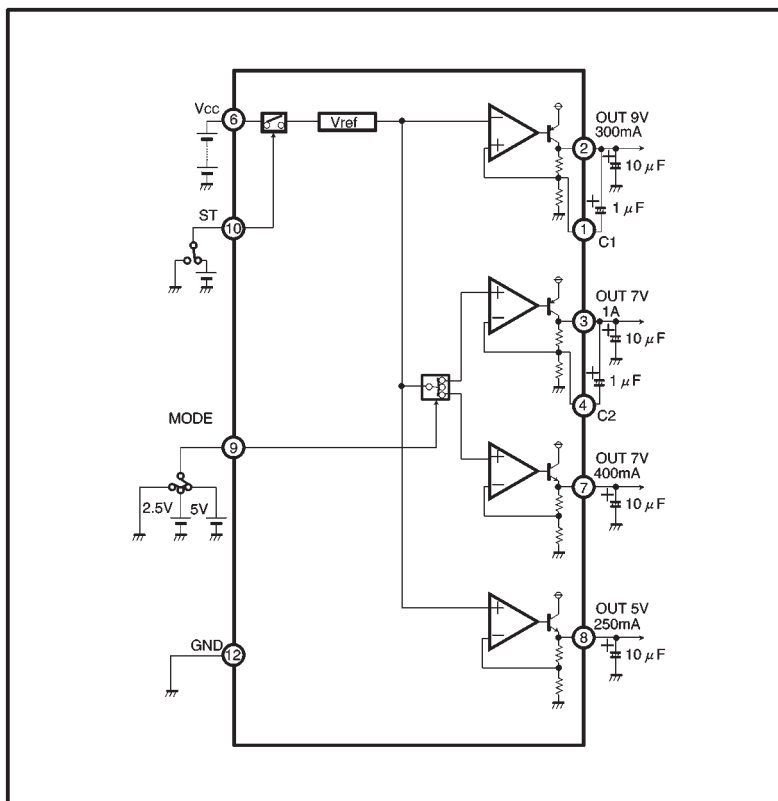
Parameter	Symbol	Limits	Unit
Power supply voltage	V <sub>CC</sub>	23	V
Power dissipation	P <sub>d</sub>	3000*	mW
Operating temperature	T <sub>opr</sub>	-25~+75	°C
Storage temperature	T <sub>stg</sub>	-55~+150	°C

\* Reduced by 24mW for each increase in Ta of 1°C over 25°C.

### ●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V <sub>CC</sub>	6.5	15	22	V

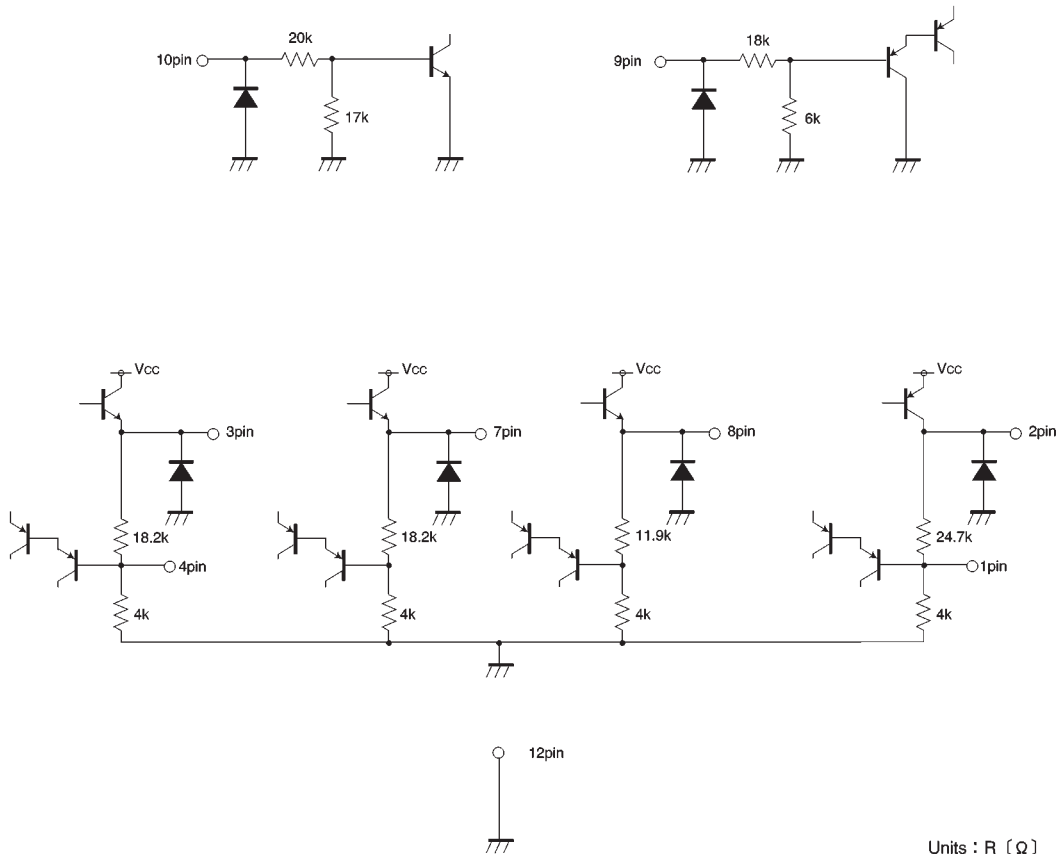
## ● Block diagram



## ● Pin descriptions

Pin No.	Pin name	Function
1	C1	Capacitor pin for improving the 9V output ripple rejection
2	OUT9V	9V output
3	OUT7V	7V output (current capacity = 1A)
4	C2	Capacitor pin for improving the 7V (1A) output ripple rejection
5	N. C.	Not used
6	Vcc	Vcc input
7	OUT7V	7V output (current capacity = 400mA)
8	OUT5V	5V output
9	MODE	Switch pin for 7V outputs
10	ST	Standby switch
11	N. C.	Not used
12	GND	GND

## ● Input / output circuits



●Electrical characteristics (unless otherwise noted, Ta = 25°C and V<sub>CC</sub> = 15V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Standby supply current	I <sub>ST</sub>	—	0	10	μA	V <sub>TH - st</sub> =0V MODE=0V
<9 V output section>						
Output voltage	V <sub>O1</sub>	8.55	9.0	9.45	V	I <sub>O1</sub> =240mA
Voltage regulation	ΔV <sub>O11</sub>	—	40	200	mV	I <sub>O1</sub> =240mA
Load regulation	ΔV <sub>O12</sub>	—	75	200	mV	I <sub>O1</sub> =0~240mA
Minimum I/O voltage differential	ΔV <sub>O16</sub>	—	0.5	1.0	V	I <sub>O1</sub> =240mA
Output current capacity	I <sub>O1</sub>	300	—	—	mA	
Ripple rejection ratio	R.R11	45	56	—	dB	f=100Hz I <sub>O1</sub> =240mA
* Ripple rejection ratio	R.R12	60	70	—	dB	f=100Hz I <sub>O1</sub> =240mA * C <sub>1</sub> =1 μF
<7 V output section>						
Output voltage	V <sub>O2</sub>	6.5	7.0	7.5	V	I <sub>O2</sub> =800mA
Voltage regulation	ΔV <sub>O21</sub>	—	30	200	mV	I <sub>O2</sub> =800mA
Load regulation	ΔV <sub>O22</sub>	—	140	550	mV	I <sub>O2</sub> =0~800mA
Minimum I/O voltage differential	ΔV <sub>O23</sub>	—	0.5	1.0	V	I <sub>O2</sub> =800mA
Output current capacity	I <sub>O2</sub>	1.0	—	—	A	
Ripple rejection ratio	R.R21	45	55	—	dB	f=100Hz I <sub>O2</sub> =800mA
* Ripple rejection ratio	R.R22	60	70	—	dB	f=100Hz I <sub>O2</sub> =800mA * C <sub>2</sub> =1 μF
<7 V output section>						
Output voltage	V <sub>O3</sub>	6.5	7.0	7.5	V	I <sub>O3</sub> =320mA
Voltage regulation	ΔV <sub>O31</sub>	—	30	200	mV	I <sub>O3</sub> =320mA
Load regulation	ΔV <sub>O32</sub>	—	130	260	mV	I <sub>O3</sub> =0~320mA
Minimum I/O voltage differential	ΔV <sub>O33</sub>	—	1.0	1.5	V	I <sub>O3</sub> =320mA
Output current capacity	I <sub>O3</sub>	400	—	—	mA	
Ripple rejection ratio	R.R3	50	60	—	dB	f=100Hz I <sub>O3</sub> =320mA
<5 V output section>						
Output voltage	V <sub>O4</sub>	4.75	5.0	5.25	V	I <sub>O4</sub> =200mA
Voltage regulation	ΔV <sub>O41</sub>	—	20	200	mV	I <sub>O4</sub> =200mA
Load regulation	ΔV <sub>O42</sub>	—	30	200	mV	I <sub>O4</sub> =0~200mA
Minimum I/O voltage differential	ΔV <sub>O43</sub>	—	1.0	1.5	V	I <sub>O4</sub> =200mA
Output current capacity	I <sub>O4</sub>	250	—	—	mA	
Ripple rejection ratio	R.R4	50	60	—	dB	f=100Hz I <sub>O4</sub> =200mA
<Input section>						
Voltage when standby OFF	V <sub>TH - st</sub>	—	—	1.0	V	V <sub>O1</sub> =V <sub>O4</sub> =OFF (MODE=0V)
Voltage when standby ON	V <sub>TH - st</sub>	1.8	—	—	V	V <sub>O1</sub> =V <sub>O4</sub> =ON (MODE=0V)
Input high level current	I <sub>ST</sub>	140	220	300	μA	V <sub>TH - st</sub> =5V
<MODE SW section>						
MODE voltage 1	V <sub>TH - m1</sub>	—	—	1.1	V	When V <sub>TH - st</sub> =5V, V <sub>O2</sub> =ON and V <sub>O3</sub> =OFF
MODE voltage 2	V <sub>TH - m2</sub>	3.9	—	—	V	When V <sub>TH - st</sub> =5V, V <sub>O2</sub> =OFF and V <sub>O3</sub> =ON
Input high level current	I <sub>M</sub>	140	220	300	μA	MODE=5V

\* Asterisked ripple rejection ratio corresponds to the case where capacitors (1 μF) are used between pins 1 and 2 and between pins 3 and 4 to improve ripple rejection.

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### ●Circuit operation

V<sub>01</sub>, V<sub>02</sub> and V<sub>04</sub> rise when ST pin is 1.8V. With voltage applied on ST, the V<sub>02</sub> output turns OFF when MODE is 1.6V (typical), and V<sub>03</sub> turns ON when MODE is 3.2V (typical).

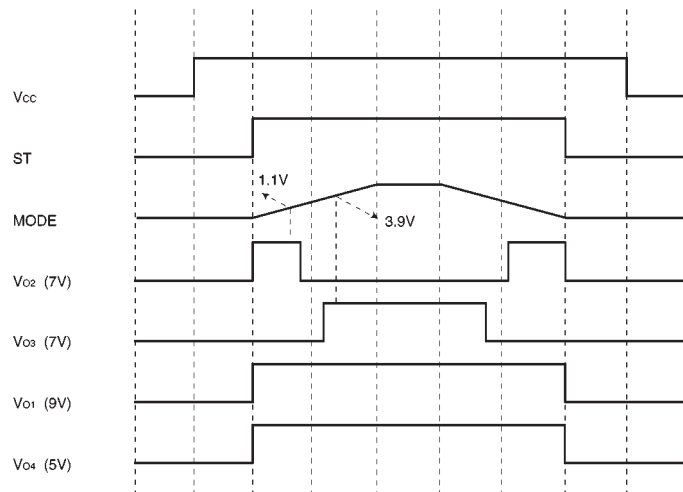


Fig.1 Timing chart

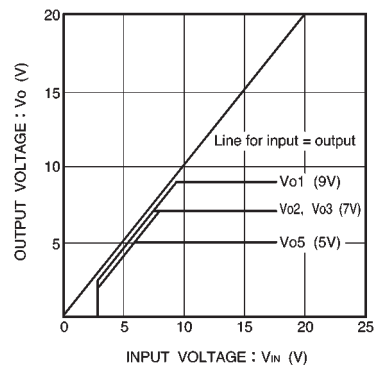


Fig.2 Input voltage vs. output voltage

### ●Application example

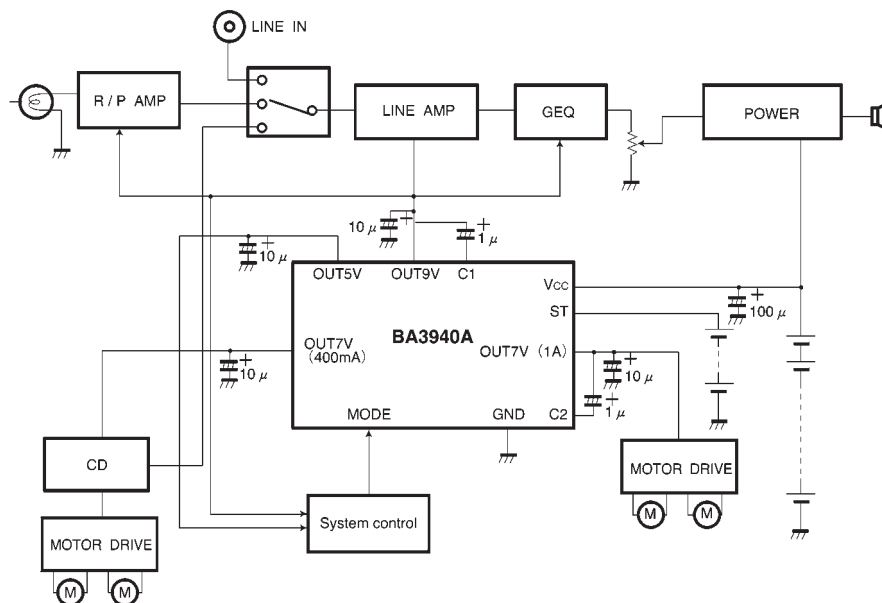


Fig.3

**● Operation notes****(1) Operating power supply**

When operating within proper ranges of power supply voltage and ambient temperature, most circuit functions are guaranteed. Although the rated values of electrical characteristics cannot be absolutely guaranteed, characteristic values do not change drastically within the proper ranges.

**(2) Power dissipation (Pd)**

Refer to the thermal derating curve (Fig. 4) and the rough estimation of IC power dissipation given on a separate page. If power dissipation exceeds the allowable limit, the functionality of IC will be degraded (such as reduction of current capacity by increased chip temperature). Make sure to use the IC within the allowable range of power dissipation with a sufficient margin.

**(3) Preventing oscillation at each output**

To stop oscillation of output, make sure to connect a capacitor having a capacitance of 1 $\mu$ F or greater between GND and each output pin. (To avoid the noise effect, lay out the grounding close to the IC) Oscillation can occur if capacitance is susceptible to temperature. We recommend using a tantalum electrolytic capacitor with minimal changes in capacitance.

**(4) Overcurrent protection circuit**

An overcurrent protection circuit is installed in each output system, based on the respective output current. This prevents IC destruction by overcurrent, by limiting the current with a curve shape of "7" in the voltage-current graph. The IC is designed with margins so that current flow will be restricted and latching will be prevented even if a large current suddenly flows through a large capacitor. Note that these protection circuits are only good for preventing damage from sudden accidents. Make sure your design does not cause the protection circuit to operate continuously under transitional conditions (for instance, when output is clamped at 1V<sub>F</sub> or higher). Note that the circuit ability is negatively correlated with temperature.

**(5) Thermal protection circuit**

A built-in thermal protection circuit prevents thermal damage to the IC. All outputs are switched OFF when the circuit operates, and revert to the original state when temperature drops to a certain level.

**(6) Improving ripple rejection by capacitors**

Ripple rejection of the 9V and 7V (current capacity = 1A) outputs can be improved by installing a capacitor that reduces the AC gain.

**(7) Malfunction in intense electric fields**

Note that bringing the IC into an intense electric field (such as a radio relay station) may result in malfunction.

● Thermal derating curve

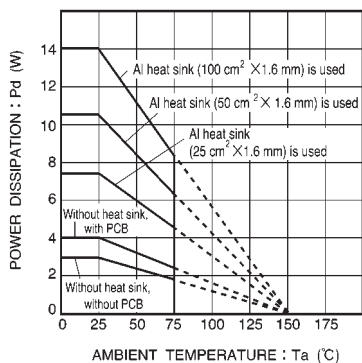


Fig.4

Estimate of allowable power dissipation ( $P_{MAX.}$ )

- Power consumed by OUT 7V  $P_1 = (V_{CC} - 7V) \times \text{maximum load current of OUT 7V}$
- Power consumed by OUT 5V  $P_2 = (V_{CC} - 5V) \times \text{maximum load current of OUT 5V}$
- Power consumed by OUT 9V  $P_3 = (V_{CC} - 9V) \times \text{maximum load current of OUT 9V}$
- Power consumed internally by each circuit  $P_4 = V_{CC} \times \text{supply current}$

$$P_{MAX.} = P_1 + P_2 + P_3 + P_4$$

● External dimensions (Units: mm)

