

# 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.

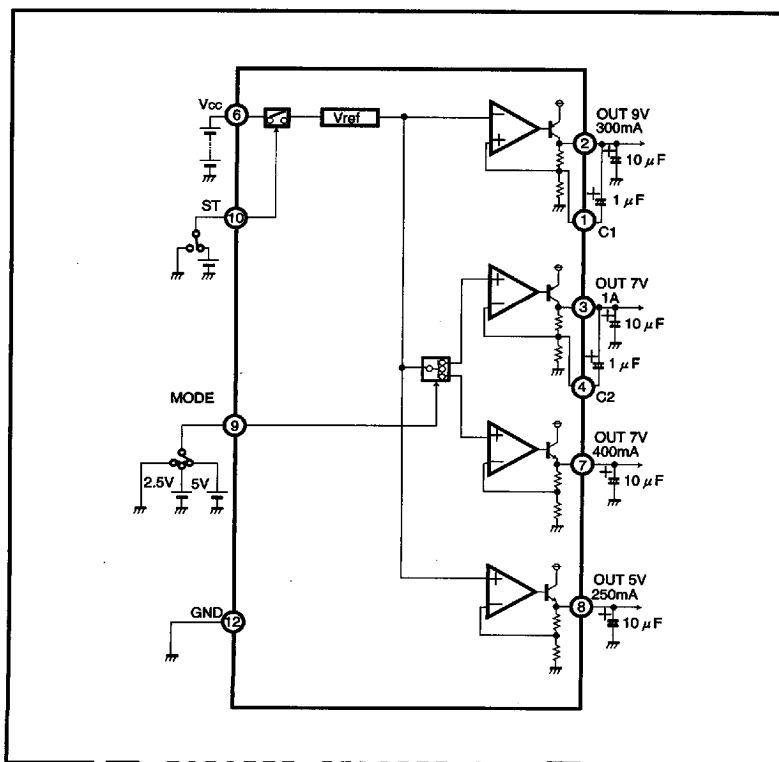
### ●Applications

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 5-V 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.

### ●Block diagram



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● 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   |

\* Reduce power 24mW for each above 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    |

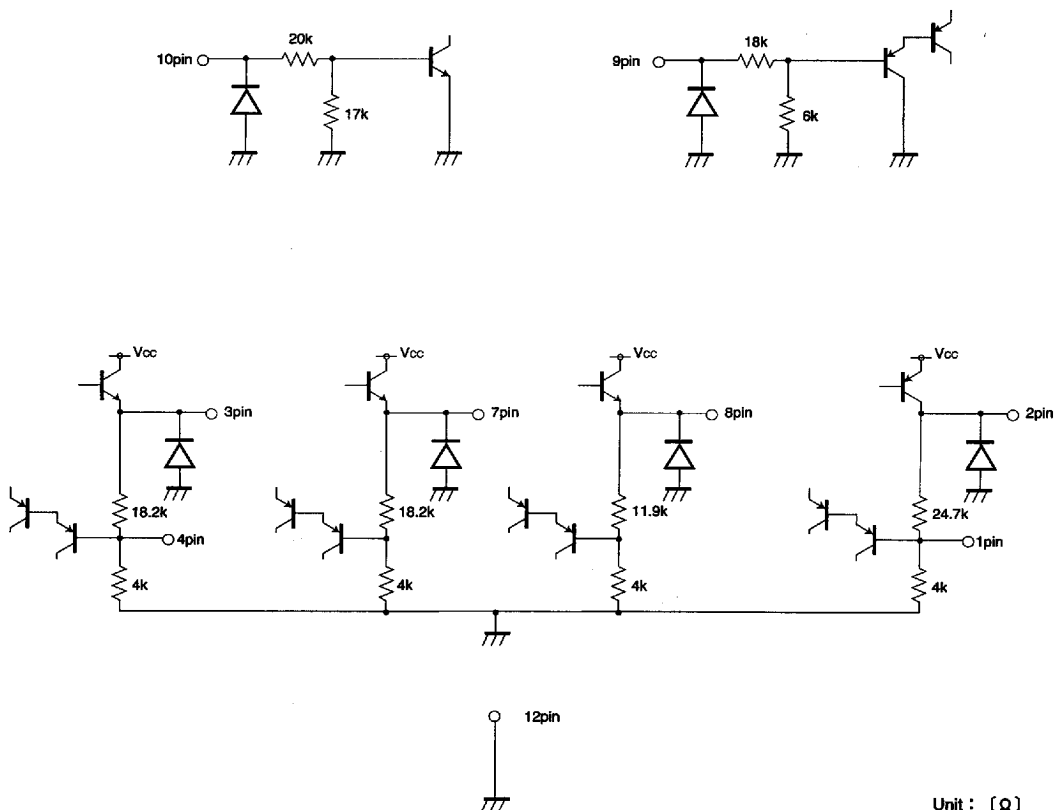
● Pin descriptions

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

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## ● Input/output circuits



Unit : (Ω)

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

| Parameter                        | Symbol             | Min. | Typ. | Max. | Unit | Conditions                                                                   |
|----------------------------------|--------------------|------|------|------|------|------------------------------------------------------------------------------|
| Standby circuit 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 variation                | ΔV <sub>o11</sub>  | —    | 40   | 200  | mV   | I <sub>o1</sub> =240mA                                                       |
| Load variation                   | ΔV <sub>o12</sub>  | —    | 75   | 200  | mV   | I <sub>o1</sub> =0~240mA                                                     |
| Minimum I/O voltage differential | ΔV <sub>o13</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 *C1=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 variation                | ΔV <sub>o21</sub>  | —    | 30   | 200  | mV   | I <sub>o2</sub> =800mA                                                       |
| Load variation                   | 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 *C2=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 variation                | ΔV <sub>o31</sub>  | —    | 30   | 200  | mV   | I <sub>o3</sub> =320mA                                                       |
| Load variation                   | 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 variation                | ΔV <sub>o41</sub>  | —    | 20   | 200  | mV   | I <sub>o4</sub> =200mA                                                       |
| Load variation                   | 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]                  |                    |      |      |      |      |                                                                              |
| Standby voltage when OFF         | V <sub>th-st</sub> | —    | —    | 1.0  | V    | V <sub>o1</sub> =V <sub>o4</sub> =OFF (MODE=0V)                              |
| Standby voltage when ON          | V <sub>th-st</sub> | 1.8  | —    | —    | V    | V <sub>o1</sub> =V <sub>o4</sub> =ON (MODE=0V)                               |
| Input current when HIGH          | 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 current when HIGH          | I <sub>m</sub>     | 140  | 220  | 300  | μA   | MODE=5V                                                                      |

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

© Not designed to be radiation tolerant.

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### ●Circuit operation

Vo2 and Vo4 rise when ST pin is 1.8V. With voltage applied on ST, the Vo2 output turns OFF when MODE is 1.6V (typical), and Vo3 turns ON when MODE is 3.2V (typical).

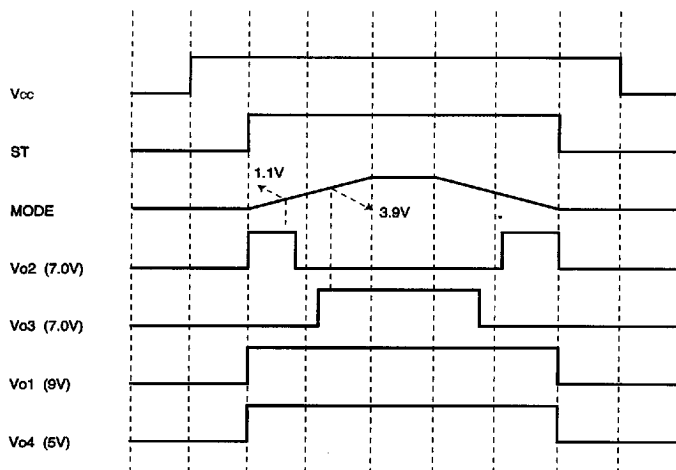


Fig.1 Timing chart

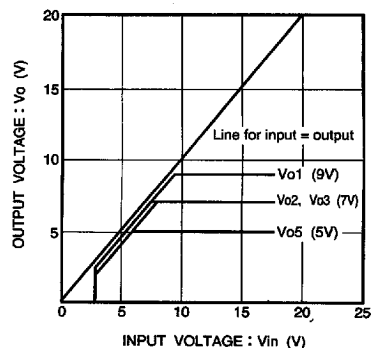


Fig.2 Input voltage vs. output voltage

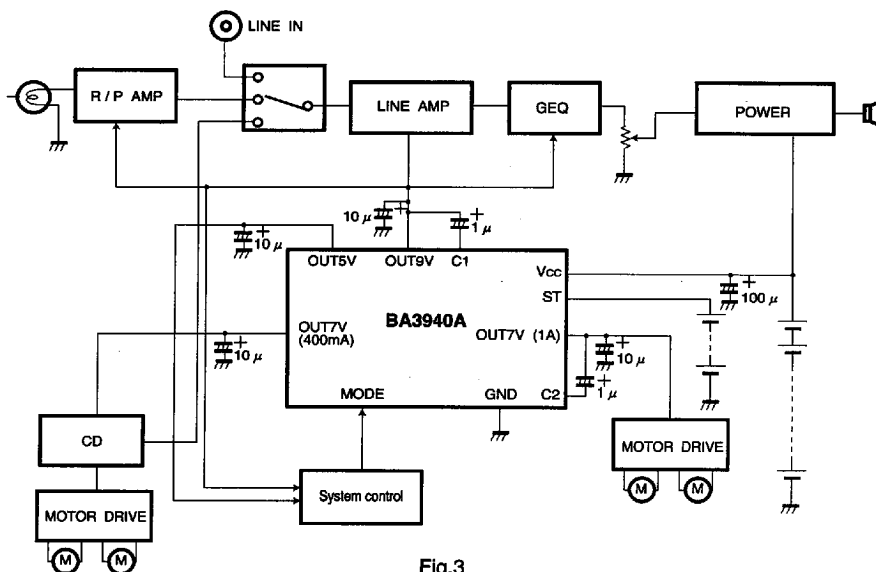


Fig.3

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### ● 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 heat reduction characteristics (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 curves

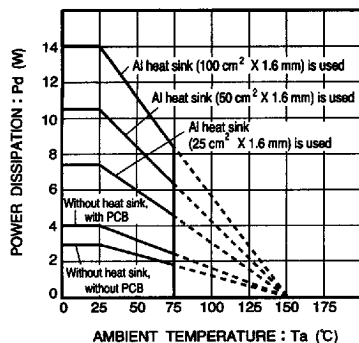


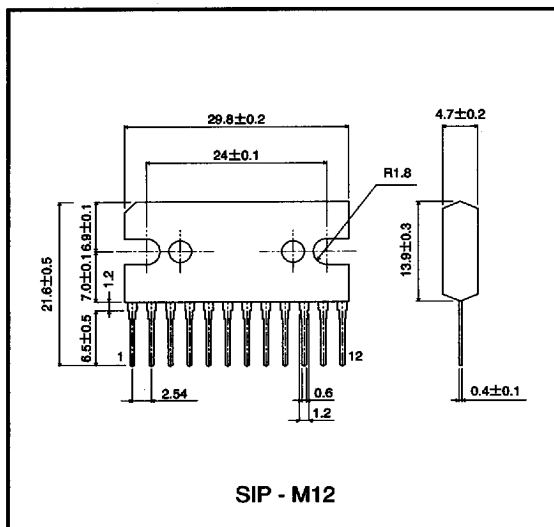
Fig.4 Thermal derating characteristics

### Rough estimation of IC 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  $P_4 = V_{CC} \times \text{circuit current}$

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

### ● External dimensions (Units: mm)



SIP - M12

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