

# System power supply for CD player-equipped audio systems

## BA3963

With 5V and 7V outputs and a reset output that detects the 5V output, the BA3963 power supply IC is best suited for CD player-equipped audio systems.

### ●Applications

CD player-equipped audio systems

### ●Features

- 1) A 5V output, a 7V output, and a reset output are built in.
- 2) All output circuits use a PNP transistor with a low saturation voltage.
- 3) Current limit circuit protects the IC against short-circuiting damage.
- 4) Thermal protection circuit prevents heat damage to the IC.
- 5) Compact SIP-M12 package allows a large power dissipation.

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

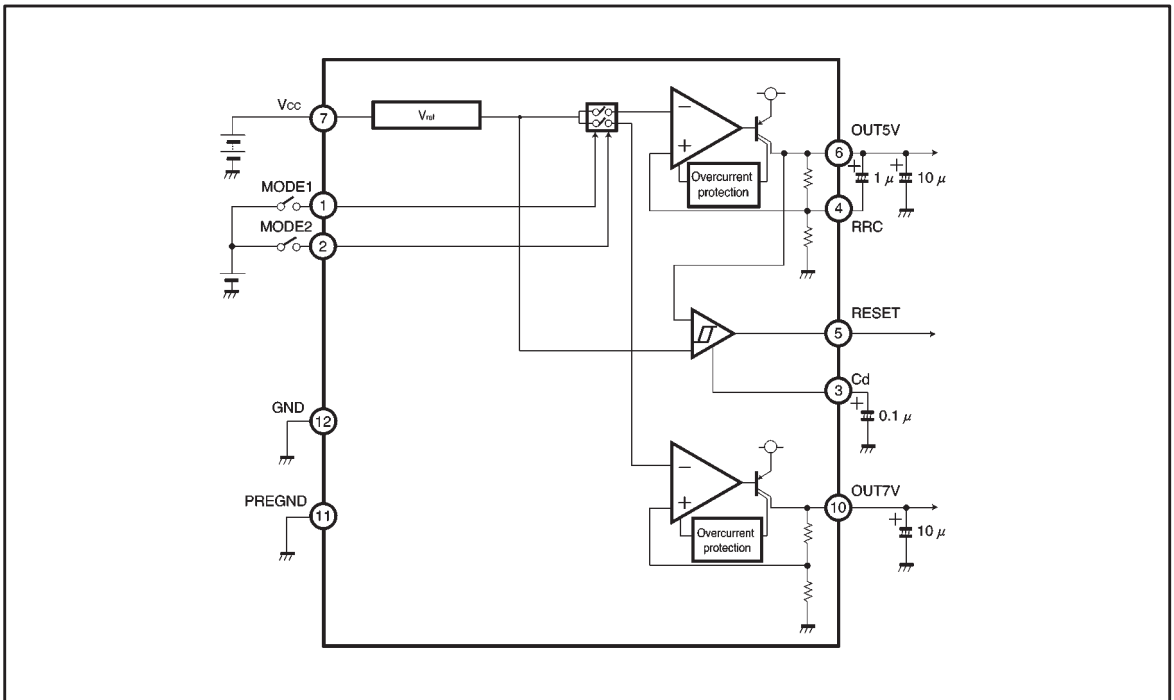
| Parameter             | Symbol           | Limits     | Unit |
|-----------------------|------------------|------------|------|
| Power supply voltage  | V <sub>CC</sub>  | 23         | V    |
| Power dissipation     | P <sub>d</sub>   | 3000*      | mW   |
| Operating temperature | T <sub>opr</sub> | -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> | 5.6  | 12   | 22   | V    |

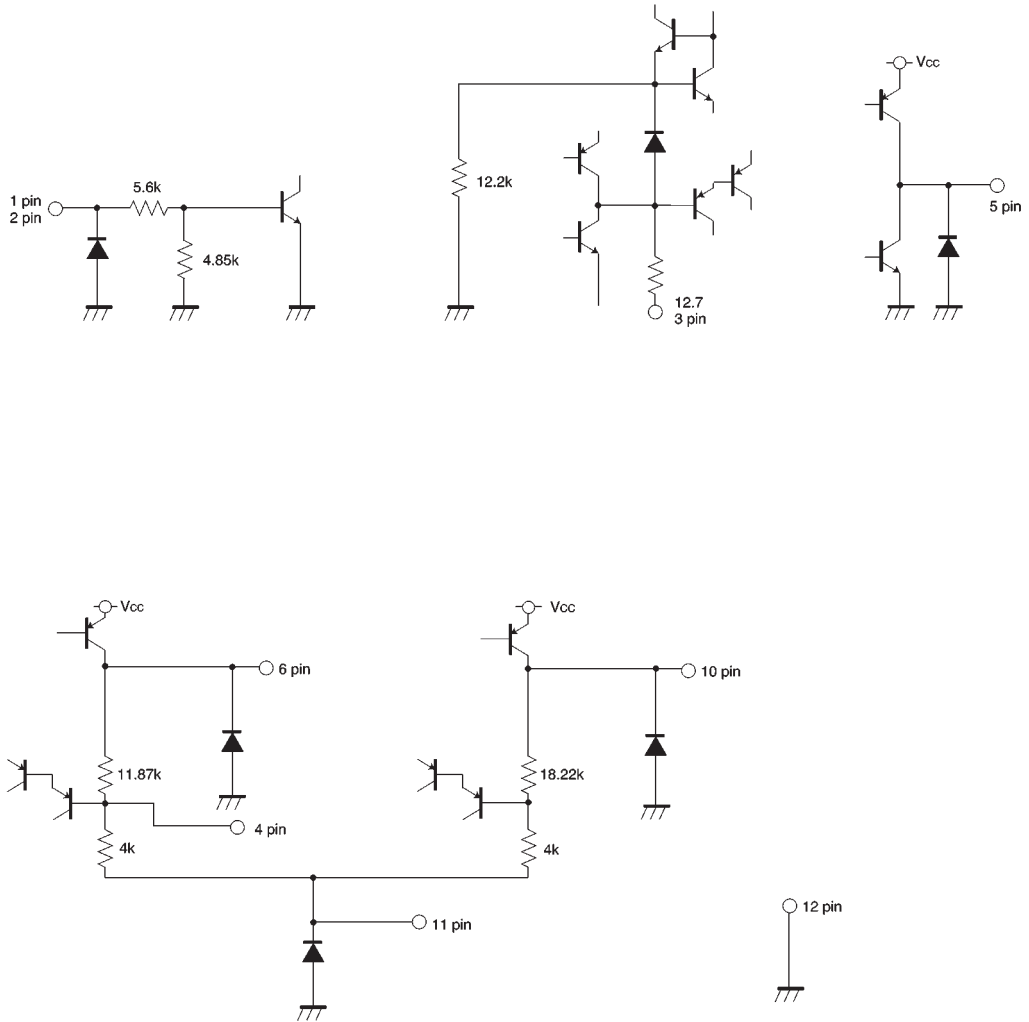
## ● Block diagram



## ● Pin descriptions

| Pin No. | Pin name     | Function   |
|---------|--------------|--|
| 1       | MODE1        | 5V output ON/OFF switching                       |
| 2       | MODE2        | 7V output ON/OFF switching                       |
| 3       | C            | Capacitor pin for setting the delay time         |
| 4       | RRC          | Capacitor pin for improving the ripple rejection |
| 5       | Reset output | Power supply output current (1mA)                |
| 6       | 5V output    | Power supply output current (400mA)              |
| 7       | Vcc          | DC power supply input                            |
| 8       | N. C.        | —  |
| 9       | N. C.        | —  |
| 10      | 7V output    | Power supply output current (1A)                 |
| 11      | PRE GND      | Small current GND                                |
| 12      | GND          | Large current GND                                |

● Input / output circuits



Units: R [Ω]

●Electrical characteristics (unless otherwise noted, Ta = 25°C and V<sub>CC</sub> = 12V)

| Parameter                        | Symbol            | Min. | Typ. | Max. | Unit | Conditions                              |
|----------------------------------|-------------------|------|------|------|------|---|
| Standby supply current           | I <sub>ST</sub>   | —    | 720  | 900  | μA   | V <sub>TH1</sub> , V <sub>TH2</sub> =0V |
| 〈5 V output section〉             |                   |      |      |      |      |   |
| Output voltage 1                 | V <sub>O1</sub>   | 4.75 | 5.0  | 5.25 | V    | I <sub>O1</sub> =320mA                  |
| Voltage regulation               | ΔV <sub>O11</sub> | —    | 70   | 200  | mV   | I <sub>O1</sub> =320mA                  |
| Load regulation                  | ΔV <sub>O12</sub> | —    | 65   | 200  | mV   | I <sub>O</sub> =0~320mA                 |
| Minimum I/O voltage differential | ΔV <sub>O13</sub> | —    | 0.7  | 1.0  | V    | I <sub>O1</sub> =320mA                  |
| Output current capacity          | I <sub>O1</sub>   | 400  | —    | —    | mA   |   |
| Ripple rejection ratio           | R.R11             | 50   | 64   | —    | dB   | f=120Hz, I <sub>O</sub> =320mA          |
| Ripple rejection ratio *         | R.R12             | 60   | 74   | —    | dB   | f=120Hz, I <sub>O</sub> =320mA          |
| 〈7 V output section〉             |                   |      |      |      |      |   |
| Output voltage 2                 | V <sub>O2</sub>   | 6.65 | 7.0  | 7.35 | V    | I <sub>O2</sub> =800mA                  |
| Voltage regulation               | ΔV <sub>O21</sub> | —    | 65   | 200  | mV   | I <sub>O1</sub> =800mA                  |
| Load regulation                  | ΔV <sub>O22</sub> | —    | 140  | 300  | mV   | I <sub>O1</sub> =0~800mA                |
| Minimum I/O voltage differential | ΔV <sub>O23</sub> | —    | 0.7  | 1.0  | V    | I <sub>O1</sub> =800mA                  |
| Output current capacity          | I <sub>O2</sub>   | 1.0  | —    | —    | A    |   |
| Ripple rejection ratio           | R.R2              | 50   | 57   | —    | dB   | f=120Hz, I <sub>O</sub> =800mA          |
| 〈Reset section〉                  |                   |      |      |      |      |   |
| Output voltage when HIGH         | V <sub>res1</sub> | 4.7  | 4.95 | 5.2  | V    | I <sub>load</sub> =1mA                  |
| Output voltage when LOW          | V <sub>res2</sub> | —    | 0.1  | 0.2  | V    | I <sub>sink</sub> =0.5mA                |
| Threshold voltage                | V <sub>reth</sub> | 3.95 | 4.2  | 4.45 | V    |   |
| Hysteresis voltage               | V <sub>hys</sub>  | 50   | 150  | 250  | mV   |   |
| Reset output delay time          | T <sub>d</sub>    | 7.5  | 10   | 12.5 | ms   | C <sub>d</sub> =0.1 μF                  |
| 〈Output control section〉         |                   |      |      |      |      |   |
| MODE 1 threshold voltage         | V <sub>TH1</sub>  | 1.1  | 1.4  | 1.7  | V    |   |
| MODE 2 threshold voltage         | V <sub>TH2</sub>  | 1.1  | 1.4  | 1.7  | V    |   |
| Input high level current         | I <sub>m</sub>    | 0.46 | 0.77 | 1.1  | mA   | V <sub>TH1</sub> , V <sub>TH2</sub> =5V |

\* Asterisked ripple rejection ratio corresponds to the case where capacitors (1 μF) are used between pins 4 and 6.

©Not designed for radiation resistance.

● Circuit operation

OUT 5V rises when MODE 1 is 1.4V (Typ.), and OUT 7V rises when MODE 2 is 1.4V (Typ.). The reset output rises with a delay time ( $t_d$ ) when OUT 5V is 4.2V (Typ.), and rises when OUT 5V is 4.1V (Typ.).

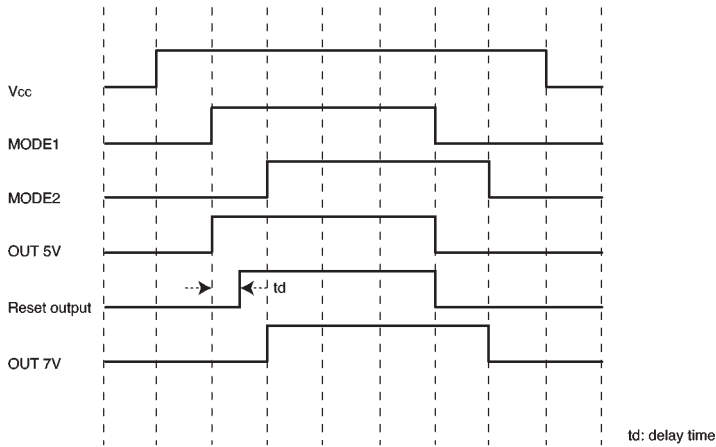


Fig.1 Timing chart

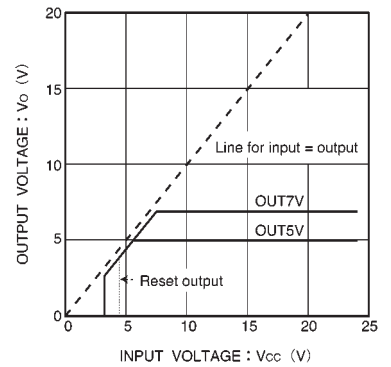


Fig.2 Input voltage vs. output voltage

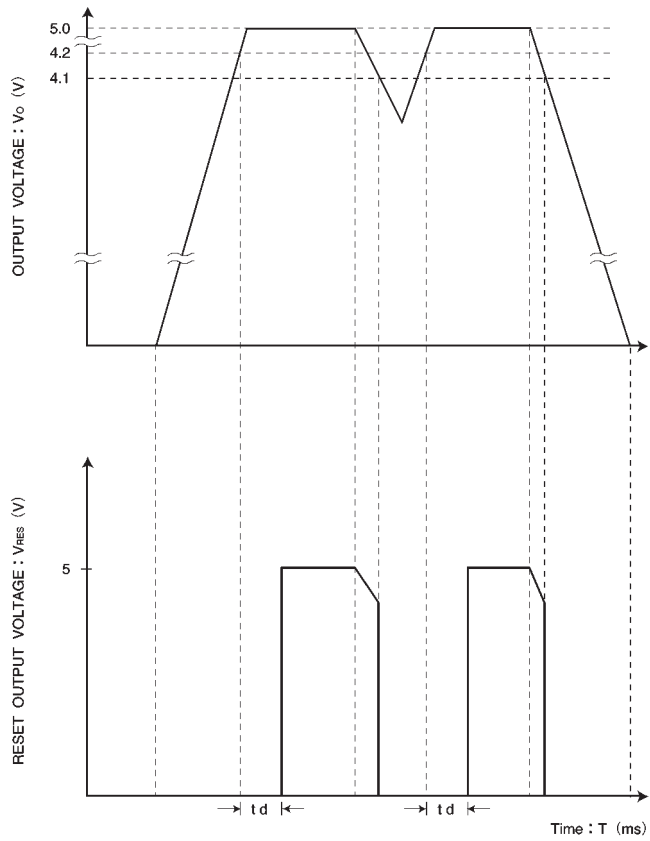


Fig.3 Timing of reset operation

## ●Application example

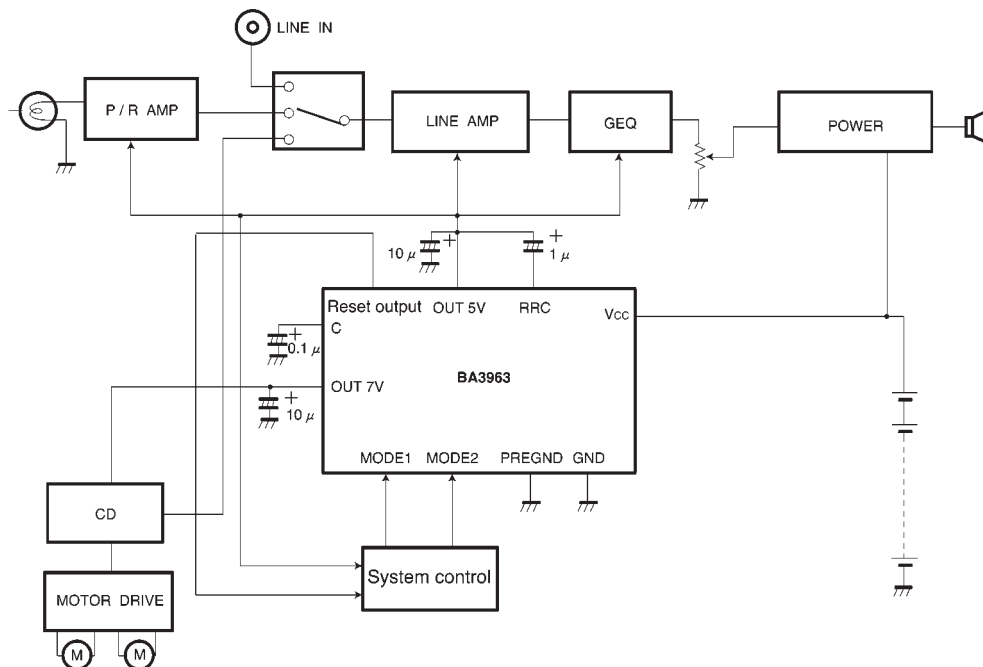


Fig.4

## ●Operation notes

## (1) Operating power supply voltage

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 curves (Fig. 5) 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 10µF or greater between GND and each output pin. Also, the 5V output ripple rejection is improved by connecting a capacitor having a capacitance of 1µF or greater between pins 4 and 6. When connecting the capacitors, be sure to connect the polarities correctly. Oscillation of output 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  $1V_F$  or higher, short mode circuit operates at  $1V_F$  or lower). 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) Grounding

To minimize the variation of output voltage due to variations in load current, the GND (pin 12, for large current) and the PRE GND (pin 11, for small current) pins are separately provided. Make sure to connect circuits to correct pins.

## ● Thermal derating curve

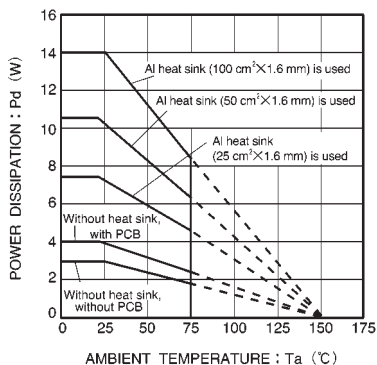


Fig.5

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

- Power consumed by OUT 5V  $P_1 = (V_{CC} - 5V) \times \text{maximum output current of OUT 5V}$
- Power consumed by OUT 7V  $P_2 = (V_{CC} - 7V) \times \text{maximum output current of OUT 7V}$
- Power consumed by the reset output  $P_3 = (V_{CC} - 4.95V) \times \text{maximum output current of the reset output}$
- 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)

