System power supply for CD radio cassette players

BA3936

The BA3936 is a system power supply for use in CD radio cassette players. With two 8V outputs, two 5V outputs, one 7.8V output, one POWER CONTROL output, the IC is best suited for CD radio cassette players.

●Applications

CD radio cassette players

●Features

1) Two 8V outputs, two 5V outputs, one 7.8V output, and a POWER CONTROL output are built in.
2) Precise output voltage is obtained by using external reference voltage input (only AUDIO 8V and LIMIT 7.8V outputs have an internal reference voltage system).
3) Output current limit circuit protects the IC against short-circuiting damage.
4) Compact SIP-M12 package allows a large power dissipation.

●Absolute maximum ratings (Ta = 25°C)

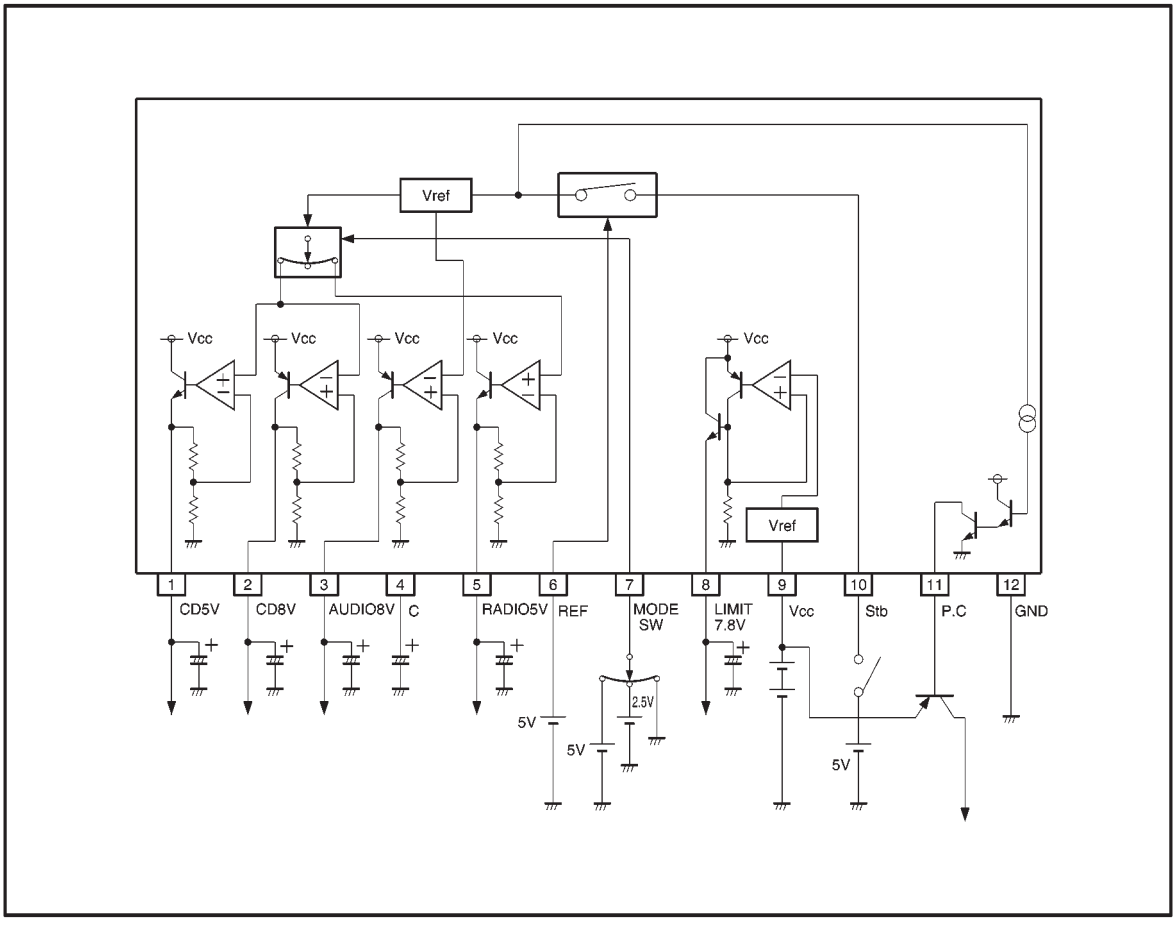
Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	23	V
Power dissipation	Pd	3000*	mW
Operating temperature	Topr	−25～+75	℃
Storage temperature	Tstg	−55～+150	℃

* Reduced by 24mW for each increase in Ta of 1℃ over 25℃.

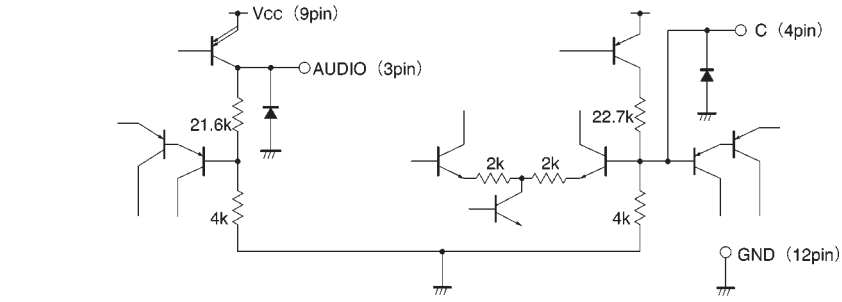
●Recommended operating conditions (Ta = 25°C)

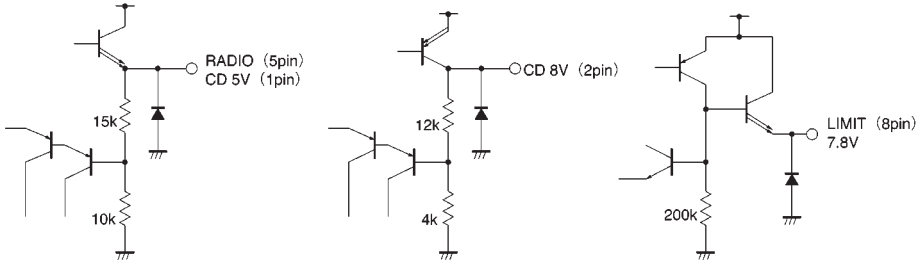
Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V_{CC}	6.5	—	22	V

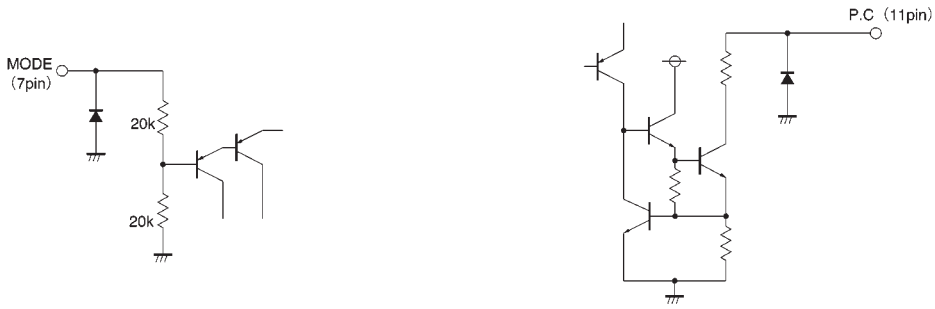
●Block diagram

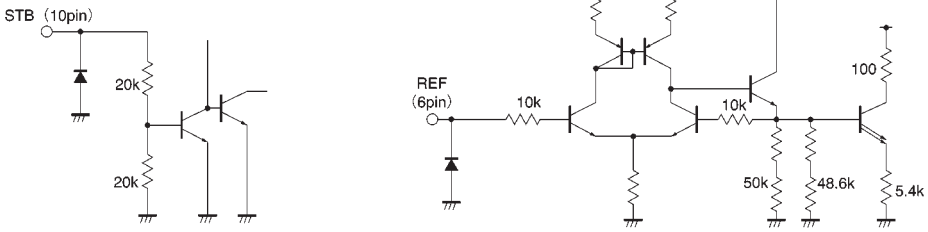


●Input / output circuits









Units : R (Ω)

●Electrical characteristics (unless otherwise noted, Ta = 25°C, V_{CC} = 12.0V, and REF = 5V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Standby supply current	I_{ST}	—	320	450	μA	STB, MODE=0V
Output voltage (7.8V Limit)	V_{O1}	7.3	7.8	8.3	V	I_{O1}=50mA
Voltage regulation	ΔV_{O11}	—	70	200	mV	V_{CC}=10V~22V, I_{O1}=50mA
Load regulation	ΔV_{O12}	—	250	400	mV	I_{O1}=10μA~50mA
Minimum I/O voltage differential	ΔV_{O13}	—	1.0	1.2	V	I_{O1}=50mA
Output current capacity	I_{O1}	60	110	—	mA	V_O≧7.3V
Ripple rejection ratio	R.R1	32	42	—	dB	f=100Hz V_{RR}=−10dBV
Output reverse current	I_{IN1}	—	0	10	μA	V_{CC} - GND SHORT, Output=7V applied
Output voltage (AUDIO 8.0V)	V_{O2}	7.5	8.0	8.5	V	I_{O2}=250mA
Voltage regulation	ΔV_{O21}	—	40	200	mV	V_{CC}=10V~22V, I_{O2}=250mA
Load regulation	ΔV_{O22}	—	60	200	mV	I_{O2}=0mA~250mA
Minimum I/O voltage differential	ΔV_{O23}	—	0.55	1.0	V	I_{O2}=250mA
Output current capacity	I_{O2}	300	550	—	mA	V_O≧7.5V
Ripple rejection ratio	R.R2	50	54	—	dB	f=100Hz V_{RR}=−10dBV
Output voltage (CD 8V)	V_{O3}	7.5	8.0	8.5	V	I_{O3}=400mA
Voltage regulation	ΔV_{O31}	—	40	200	mV	V_{CC}=10V~22V, I_{O3}=400mA
Load regulation	ΔV_{O32}	—	70	250	mV	I_{O3}=0mA~400mA
Minimum I/O voltage differential	ΔV_{O33}	—	0.4	1.0	V	I_{O3}=400mA
Output current capacity	I_{O3}	0.8	1.2	—	A	V_O≧7.5V
Ripple rejection ratio	R.R3	40	50	—	dB	f=100Hz V_{RR}=−10dBV
Output voltage (CD 5V)	V_{O4}	4.9	5.0	5.1	V	I_{O4}=180mA
Voltage reguration	ΔV_{O41}	—	20	200	mV	V_{CC}=6.5V~22V, I_{O4}=180mA
Load reguration	ΔV_{O42}	—	20	200	mV	I_{O4}=0mA~180mA
Minimum I/O voltage differential	ΔV_{O43}	—	1.0	1.5	V	I_{O4}=180mA
Output current capacity	I_{O4}	220	350	—	mA	V_O≧4.9V
Ripple rejection ratio	R.R4	50	60	—	dB	f=100Hz V_{RR}=−10dBV
Output voltage (RADIO 5V)	V_{O5}	4.9	5.0	5.1	V	I_{O5}=80mA
Voltage reguration	ΔV_{O51}	—	20	200	mV	V_{CC}=6.5V~22V, I_{O5}=80mA
Load reguration	ΔV_{O52}	—	20	200	mV	I_{O5}=0mA~80mA
Minimum I/O voltage differential	ΔV_{O53}	—	0.8	1.5	V	I_{O5}=80mA
Output current capacity	I_{O5}	100	200	—	mA	V_O≧4.9V
Ripple rejection ratio	R.R5	50	57	—	dB	f=100Hz V_{RR}=−10dBV

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
POWER CONTROL voltage, LOW	Vp.c.	0.2	0.5	0.8	V	When Ip.c.=5mA
POWER CONTROL current	Ip.c.	10	20	—	mA	
〈Input (MODE SW)〉						
Voltage when RADIO MODE ON	V_{MTHH}	1.1	1.4	1.7	V	RADIO output voltage when ON
Voltage when RADIO MODE OFF	V_{MTHL}	2.9	3.2	3.5	V	RADIO output voltage when OFF
Voltage when CD MODE ON	V_{RTHH}	2.9	3.2	3.5	V	CD5V, CD8.0V output voltage when switched to HIGH
Input high level current	I_{IH1}	80	110	140	μA	MODE=5V
〈Input (REF)〉						
Input high level current	I_{ref}	—	0	10	μA	STB=5V
〈Input (STB)〉						
Standby switching voltage	V_{ST}	1.1	1.4	1.7	V	
Input high level current	I_{STB}	140	215	290	μA	STB=5V

◎Not designed for radiation resistance.

●Circuit operation

LIMIT 7.8V rises regardless of VREF, STB, and MODE SW.

AUDIO 8V and POWER CONTROL rises when STB is HIGH, regardless of MODE SW (V_{ref} 5V is also required for POWER CONTROL).

RADIO 5V rises when MODE SW is 1.4V (Typ.), and CD 5V and CD 8V rise when MODE SW is 3.2V (Typ.).

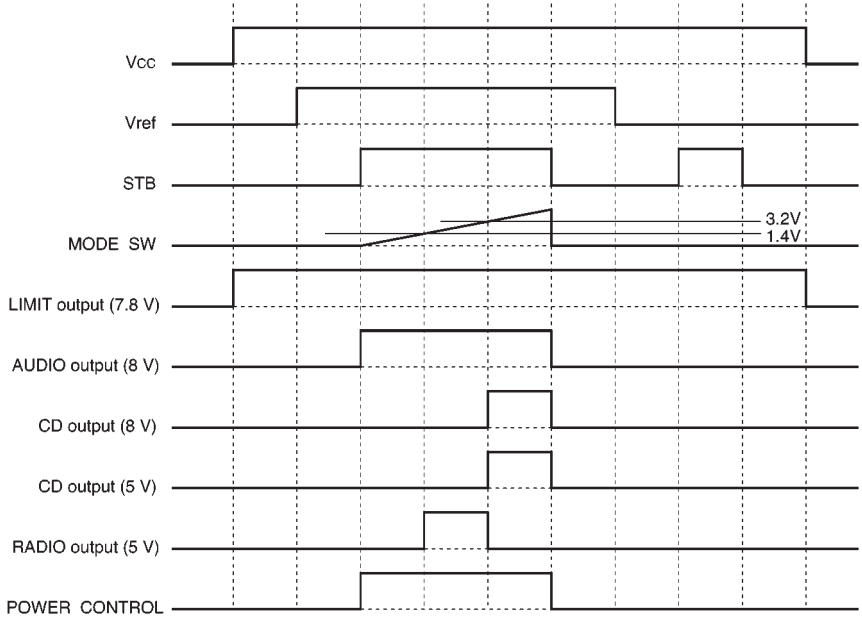


Fig.1 Timing chart

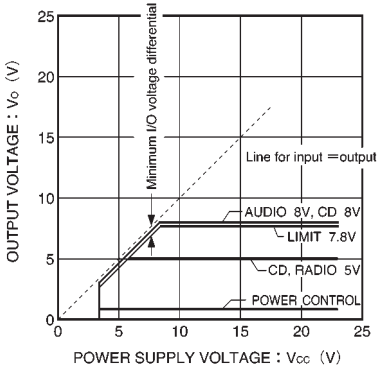


Fig.2 Output voltages vs. power supply voltage

●Estimate of allowable power dissipation

Except under transitional conditions, the power dissipation of this IC is 3W per unit at 25°C. See Fig. 5 for thermal derating curve, including some cases where heat sinks are used.

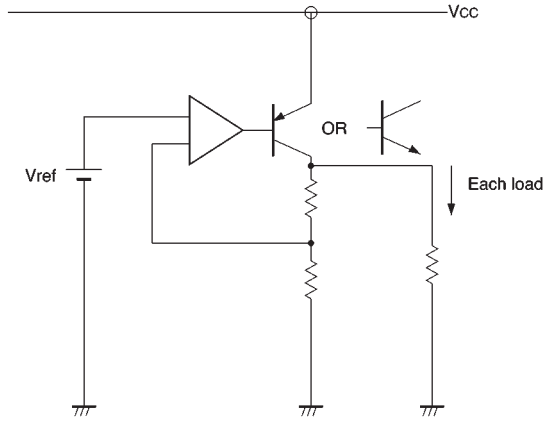


Fig.3

- Power consumed by LIMIT 7.8V — $P_1 = (V_{CC} - 7.8V) \times$ maximum output current of LIMIT 7.8V
- Power consumed by AUDIO 8.0V — $P_2 = (V_{CC} - 8.0V) \times$ maximum output current of AUDIO 8.0V
- Power consumed by CD 8.0V — $P_3 = (V_{CC} - 8.0V) \times$ maximum output current of CD 8.0V
- Power consumed by CD 5.0V — $P_4 = (V_{CC} - 5.0V) \times$ maximum output current of CD 5.0V
- Power consumed by RADIO 5.0V — $P_5 = (V_{CC} - 5.0V) \times$ maximum output current of RADIO 5.0V
- Power consumed internally by each circuit — $P_6 = V_{CC} \times$ circuit current

$P_{MAX.} = P_1 + P_2 + (P_3 + P_4$ or P_5, whichever is greater$) + P_6$

●Application example

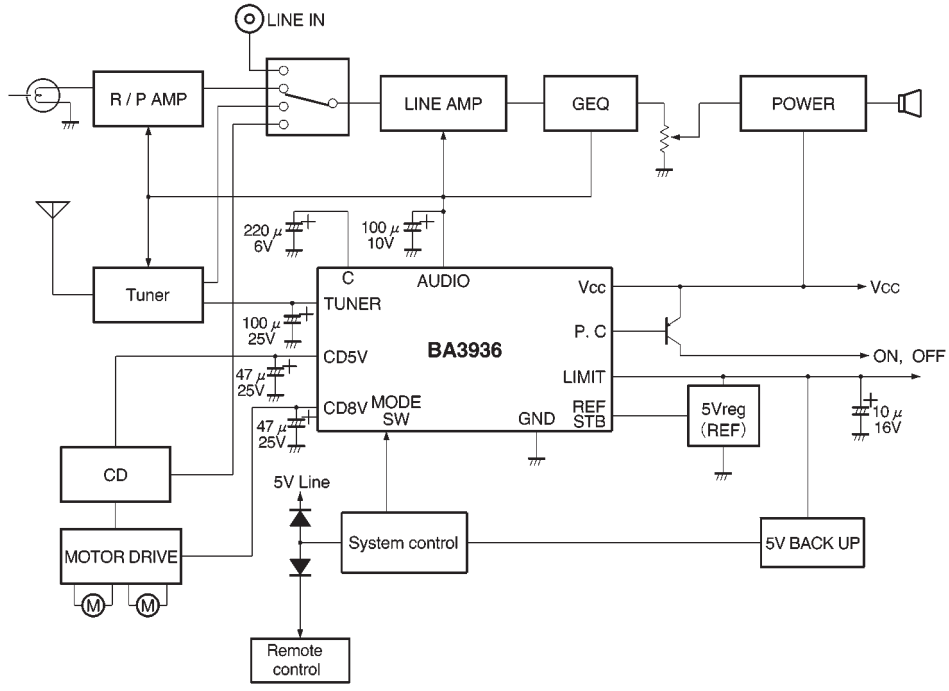


Fig.4

●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 characteristics (Fig. 5) and the rough estimation of IC power dissipation given on a separate page. Make sure to use the IC within the allowable power dissipation with a sufficient margin.

(3) Preventing oscillation at each output and installing a ripple filter capacitor

To stop oscillation of output, make sure to connect a capacitor between GND and each of the AUDIO 8V (pin 3), RADIO (pin 5), CD 5V (pin 1), CD 8V (pin 2), and LIMIT 7.8V (pin 8) output pins. We recommend using a tantalum electrolytic capacitor having a capacitance of 10μF or greater (100μF or greater for AUDIO 8V) with minimal temperature susceptibility. A minimum capacitance value recommended for each electrolytic capacitor is shown in the application circuit. Also, sudden deterioration of the AUDIO 8V ripple rejection during a power drop can be prevented by connecting a capacitor (220μF or greater recommended) to the C pin (pin 4).

(4) Overcurrent protection circuit

An overcurrent protection circuit is installed on the AUDIO 8V (pin 3), RADIO (pin 5), CD 5V (pin 1), CD 8V (pin 2), and LIMIT 7.8V (pin 8) outputs, 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, if output is clamped at $1V_F$ or higher, short mode circuit operates at $1V_F$ or lower).

(5) Reference voltage

Because output voltage is dependent on the input reference voltage, unstable input results in output wavering and degradation of ripple rejection. Take care when setting the reference voltage power supply. Note that the AUDIO 8V and LIMIT 7.8V outputs, which have a built-in reference voltage system, are not affected by the external reference voltage.

(6) Thermal protection circuit

A built-in thermal protection circuit prevents thermal damage to the IC. All outputs except LIMIT 7.8V are switched OFF when the circuit operates, and revert to the original state when temperature drops to a certain level.

(7) Grounding

Each ground line in the application circuit must be adequately short regarding the GND (pin 12) pin. Make sure to arrange the ground lines, the AUDIO system, and other outputs in a pattern that prevents electric interference.

●Thermal derating curve

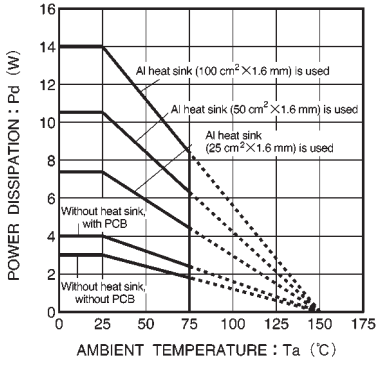
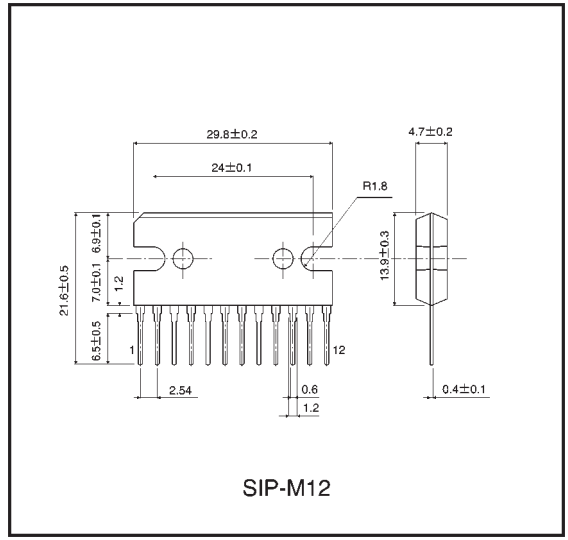


Fig.5

●External dimensions (Units: mm)



SIP-M12