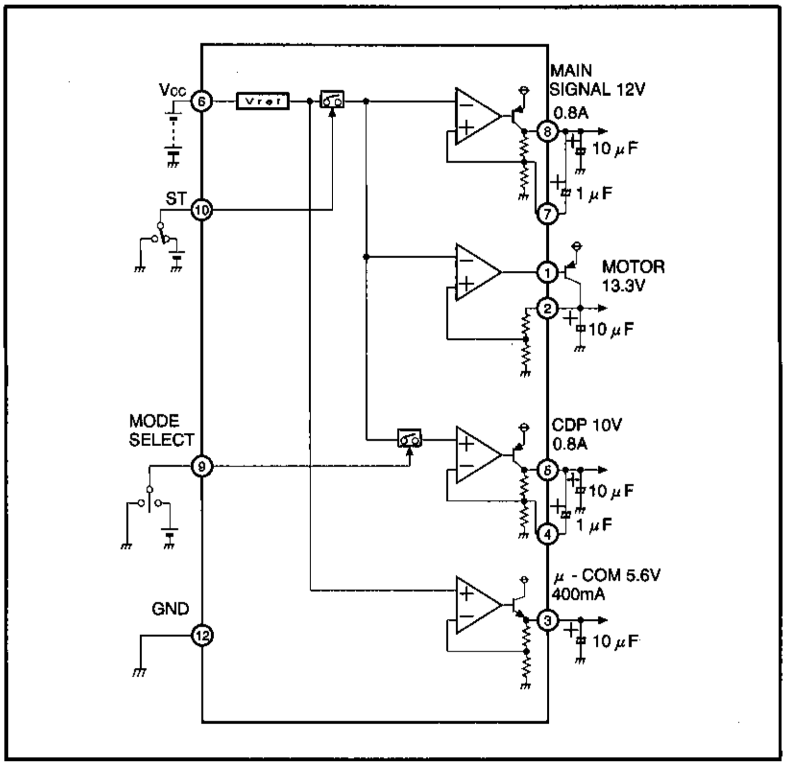
System power supply for CD player-equipped audio systems
BA3950A

With 13.3V (external transistor required), 12V, 10V, and 5.6V outputs, the BA3950A power supply IC is best suited for CD player-equipped audio systems.

●Applications
CD player-equipped audio systems

●Features
1) 13.3V (external transistor required), 12V, 10V, and 5.6V outputs are built in (one output for each voltage).
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



●Absolute maximum ratings (Ta=25℃)

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	℃

* Reduce power by 24mW for each degree above 25 ℃.

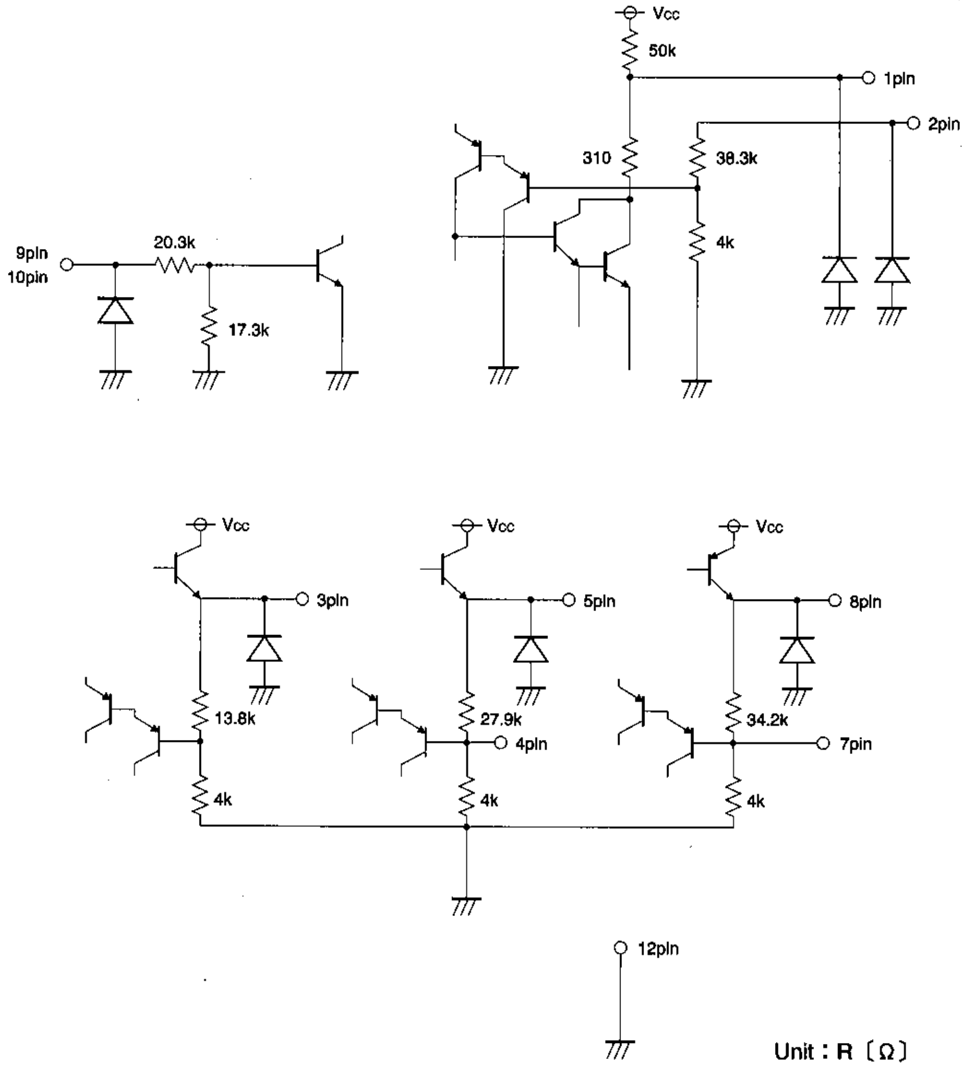
●Recommended operating conditions (Ta=25℃)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	V_{CC}	6.5	18	22	V

●Pin descriptions

Pin No.	Pin name	Function
1	MOTORB	Pin for external transistor base
2	MOTORC	Pin for external transistor collector
3	μ - COM	5.6 V output pin
4	C1	Capacitor pin for improving the 10 V output ripple rejection
5	CDP	10 V output pin
6	V_{CC}	V_{CC} input pin
7	C2	Capacitor pin for improving the 12 V output ripple rejection
8	MAIN	12 V output pin
9	MODE	Mode switching pin
10	ST	Standby switching pin
11	N. C	Not used
12	GND	GND pin

● Input / output circuits



●Electrical characteristics (unless otherwise noted, Ta=25℃ and Vcc=8V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Standby circuit current	Ist	–	1.7	3.4	mA	Vth−ST=0V
[MOTOR section]						
Output voltage	VoM	12.6	13.3	14.0	V	Load current = 550 mA, external transistor (2SB1185, F-rank)
Base current driving capacity	IoB	10	–	–	mA	
[MAIN SIGNAL section]						
Output voltage	Vo1	11.4	12.0	12.6	V	Io1=640mA
Voltage variation	ΔVo11	–	55	200	mV	Io1=640mA
Load variation	ΔVo12	–	140	440	mV	Io1=0~640mA
Minimum I/O voltage differential	ΔVo13	–	0.5	1.0	V	Io1=640mA
Output current capacity	Io1	0.8	–	–	A	
Ripple rejection ratio	R. R11	45	56	–	dB	f=100Hz Io1=640mA
* Ripple rejection ratio	R. R11	60	70	–	dB	f=100Hz Io1=640mA *C2=1 μF
[CDP section]						
Output voltage	Vo2	9.5	10.0	10.5	V	Io2=480mA
Voltage variation	ΔVo21	–	40	200	mV	Io2=480mA
Load variation	ΔVo22	–	130	440	mV	Io2=0~480mA
Minimum I/O voltage differential	ΔVo23	–	0.5	1.0	V	Io2=480mA
Output current capacity	Io2	800	–	–	mA	
Ripple rejection ratio	R. R2	45	54	–	dB	f=100Hz Io2=480mA
* Ripple rejection ratio	R. R2	60	70	–	dB	f=100Hz Io2=480mA *C1=1 μF
[μ-COM section]						
Output voltage	Vo3	5.3	5.6	5.9	V	Io3=200mA
Voltage variation	ΔVo31	–	25	200	mV	Io3=200mA
Load variation	ΔVo32	–	40	200	mV	Io3=0~200mA
Minimum I/O voltage differential	ΔVo33	–	1.0	1.5	V	Io3=200mA
Output current capacity	Io3	400	–	–	mA	
Ripple rejection ratio	R. R3	50	60	–	dB	f=100Hz Io3=200mA
[Input section]						
Voltage when standby OFF	Vth−s1	–	–	1.0	V	MAIN SIGNAL, MOTOR OFF
Voltage when standby ON	Vth−s2	1.8	–	–	V	MAIN SIGNAL, MOTOR ON
Input current when HIGH	Ist	140	240	340	μA	Vth−s2=5V
[MODE SW section]						
Voltage when MODE OFF	Vth−m1	–	–	1.0	V	CDP OFF when Vth - s2 is ON
Voltage when MODE ON	Vth−m2	1.8	–	–	V	CDP ON when Vth - s2 is ON
Input current when HIGH	Im	140	240	340	μA	MODE=5V

* Asterisked ripple rejection ratio corresponds to the case where capacitors (1 μF) are used between pins 4 and 5 and between pins 7 and 8 to improve ripple rejection

◎ Not designed to be radiation tolerant.

● Circuit operation

The MAIN, MOTOR, and μ-COM outputs rise when ST is 1.4V (Typ).

The CDP output rises when MODE is 1.4V (Typ) and ST is 1.4V (Typ).

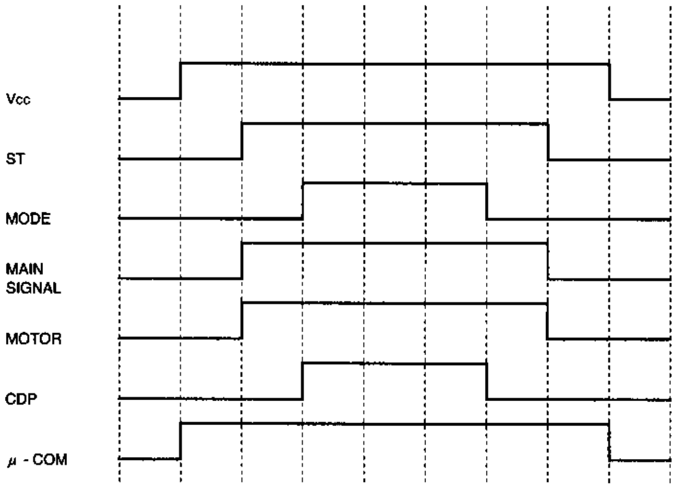


Fig.1 Timing chart

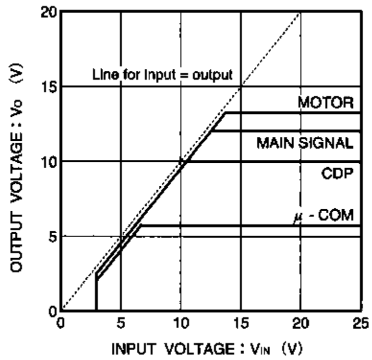


Fig.2 Input voltage vs. output voltage

●Application example

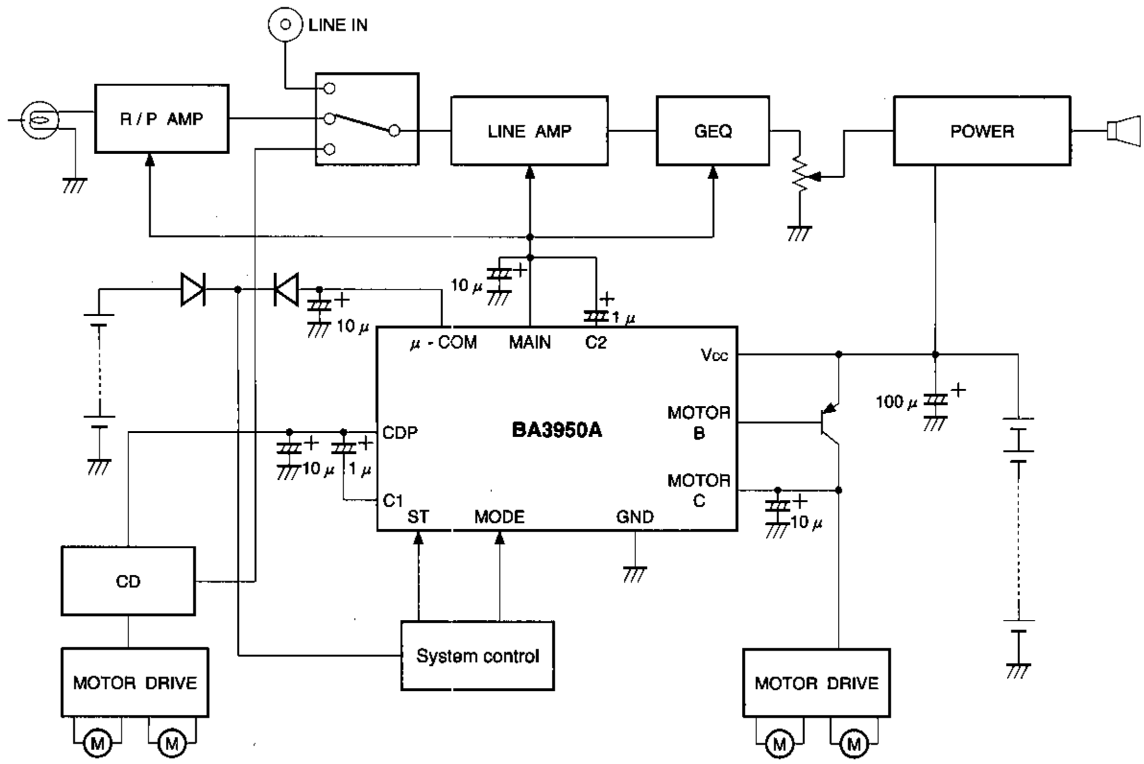


Fig.3

●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 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 μF or greater between GND and each output pin. Also, be sure to connect a bypass capacitor between Vcc and GND for further stabilization of output. (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 1 V_F 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 CDP and MAIN 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 characteristics

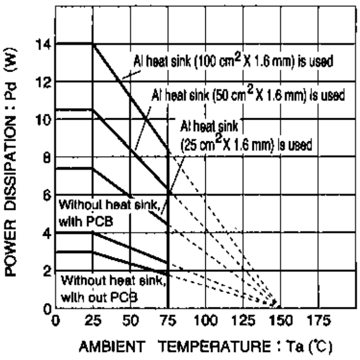


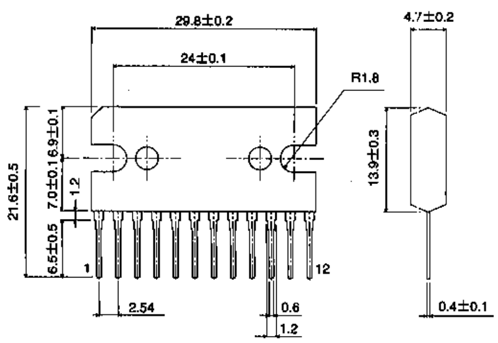
Fig.4 Thermal derating curves

Rough estimation of IC power dissipation ($P_{MAX.}$)

- Power consumed by CDP: P_1 = (V_{CC} − CDP) × maximum load current of CDP
- Power consumed by μ-COM: P_2 = {V_{CC} − (μ-COM)} × maximum load current of μ-COM
- Power consumed by MAIN: P_3 = (V_{CC} − MAIN) × maximum load current of MAIN
- Power consumed internally by each circuit: P_4 = V_{CC} × circuit current

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

●External dimensions (Units: mm)



SIP-M12

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