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

- 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.

Parameter	Symbol	Limits	Unit
Power supply voltage	Vcc	23	V
Power dissipation	Pd	3000*	mW
Operating temperature	Topr	-25~+75	ĉ
Storage temperature	Tstg	-55~+150	Ĉ

•Absolute maximum ratings (Ta = 25° C)

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

• Recommended operating conditions (Ta = 25° C)

Parameter	Symbol	Min.	Тур.	Max.	Unit
Power supply voltage	Vcc	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





Regulator ICs

●Electrical characteristics (unless otherwise noted, Ta = 25°C and Vcc = 15V)

Parameter	Symbol	Min.	Тур.	Max.	Unit	Conditions
Standby supply current	lsт	-	0	10	μA	VTH-st=0V MODE=0V
(9 V output section)						
Output voltage	Vo1	8.55	9.0	9.45	V	Io1=240mA
Voltage regulation	ΔV011	-	40	200	mV	Io1=240mA
Load regulation	Δ V 012	-	75	200	mV	lo1=0~240mA
Minimum I/O voltage differential	ΔV016	_	0.5	1.0	V	Io1=240mA
Output current capacity	lo1	300	_	-	mA	
Ripple rejection ratio	R.R11	45	56	-	dB	f=100Hz lo1=240mA
* Ripple rejection ratio	R.R12	60	70	—	dB	f=100Hz lo1=240mA * C1=1 μF
(7 V output section)						
Output voltage	Vo2	6.5	7.0	7.5	V	Io2=800mA
Voltage regulation	∆ V021	_	30	200	mV	lo2=800mA
Load regulation	∆ V022	_	140	550	mV	lo2=0~800mA
Minimum I/O voltage differential	∆ V023	-	0.5	1.0	V	lo2=800mA
Output current capacity	I O2	1.0	-	_	A	
Ripple rejection ratio	R.R21	45	55	—	dB	f=100Hz lo2=800mA
* Ripple rejection ratio	R.R22	60	70	—	dB	f=100Hz lo2=800mA * C2=1 µ F
(7 V output section)						
Output voltage	V03	6.5	7.0	7.5	V	Io3=320mA
Voltage regulation	Δ V031	-	30	200	mV	Io3=320mA
Load regulation	Δ V032	-	130	260	mV	lo3=0~320mA
Minimum I/O voltage differential	Δ V033	-	1.0	1.5	V	Io3=320mA
Output current capacity	Юз	400	-	-	mA	
Ripple rejection ratio	R.R3	50	60	—	dB	f=100Hz lo3=320mA
(5 V output section)						·
Output voltage	Vo4	4.75	5.0	5.25	V	Io4=200mA
Voltage regulation	Δ V041	_	20	200	mV	Io4=200mA
Load regulation	ΔV042	-	30	200	mV	lo4=0~200mA
Minimum I/O voltage differential	ΔV043	—	1.0	1.5	V	Io4=200mA
Output current capacity	I 04	250	—	—	mA	
Ripple rejection ratio	R.R4	50	60	-	dB	f=100Hz lo4=200mA
<pre>(Input section)</pre>						
Voltage when standby OFF	VTH - st	-	-	1.0	V	V ₀₁ =V ₀₄ =OFF (MODE=0V)
Voltage when standby ON	Vth - st	1.8	_	_	V	V01=V04=ON (MODE=0V)
Input high level current	lsт	140	220	300	μA	VTH - st=5V
(MODE SW section)						
MODE voltage 1	VTH - m1	_	_	1.1	V	When VTH - st=5V, Vo2=ON and Vo3=OF
MODE voltage 2	Vтн - m2	3.9	-	—	V	When VTH - st=5V, Vo2=OFF and Vo3=OI
Input high level current	Ім	140	220	300	μA	MODE=5V

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

ONot designed for radiation resistance.

Regulator ICs

Circuit operation

 $V_{o1},\,V_{o2}$ and V_{o4} rise when ST pin is 1.8V. With voltage applied on ST, the V_{o2} output turns OFF when MODE is 1.6V (typical), and V_{o3} turns ON when MODE is 3.2V (typical).





Fig.2 Input voltage vs. output voltage











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 1μ 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 $1V_F$ 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 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





Estimate of allowable power dissipation (PMAX.)

- Power consumed by OUT 7V
- Power consumed by OUT 5V
- Power consumed by OUT 9V
- Power consumed internally by each circuit $P_4 = V_{CC} \times supply current$

 $\begin{array}{l} \mathsf{P}_1 = (\mathsf{V}_{\mathrm{CC}} - \mathsf{7V}) \times \text{maximum load current of OUT 7V} \\ \mathsf{P}_2 = (\mathsf{V}_{\mathrm{CC}} - \mathsf{5V}) \times \text{maximum load current of OUT 5V} \\ \mathsf{P}_3 = (\mathsf{V}_{\mathrm{CC}} - \mathsf{9V}) \times \text{maximum load current of OUT 9V} \\ \mathsf{P}_4 = \mathsf{V}_{\mathrm{CC}} \times \text{supply current} \end{array}$

$$P_{MAX.} = P1 + P2 + P3 + P4$$

External dimensions (Units: mm)

