BA3910B

Power supply, standard voltage

The BA3910B is a power supply used in car audio systems.

Features

- available in an SIP-M12 package
- multiple voltages available from the same IC
  - — 5.6 V (microcontroller)
  - — 8.7 V (×3; FM, AM, and COM)
- internal overflow voltage protection circuit provides protection from surges from the ACC or BACKUP supply pins
- all output circuits use a PNP transistor with a low saturation voltage
- internal output overload protection circuit prevents damage to the IC in the event the load is short circuited
- internal thermal overload also protects the IC

Applications

- car audio systems

Dimensions (Units : mm)

BA3910B (SIP-M12)
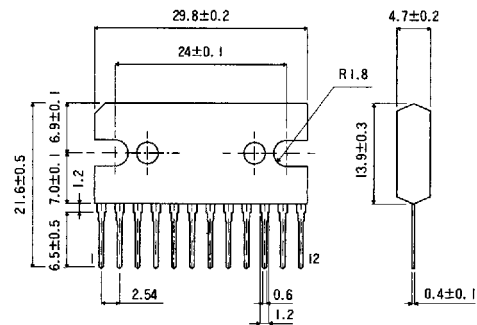
Block diagram
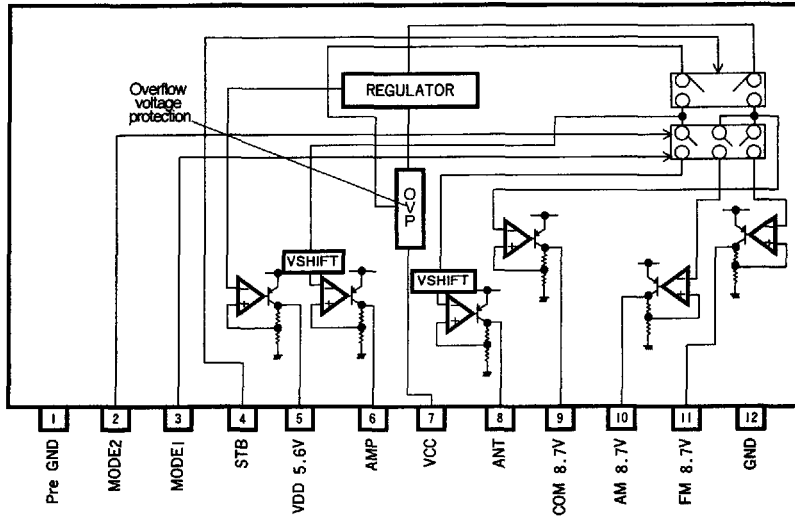
Table 1 Pin description

Pin no.	Pin name	Function
1	Pre GND	Small current ground
2	MODE1	AM output, ANT output rise pin
3	MODE2	FM output or AM output switch pin
4	STB	COM output, AMP output rise pin
5	VDD 5.6 V	VDD, 4.5 V output pin
6	AMP	Remote amplifier driving power supply (V_{CC} in series)
7	VCC	Power supply pin
8	ANT	Antenna driving power supply (V_{CC} in series)
9	COM 8.7 V	Common power supply for the power system, electronic synchronization and variable capacitance COM 8.7 V output
10	AM 8.7 V	AM reception power supply, 8.7 V
11	FM 8.7 V	FM reception power supply, 8.7 V output
12	GND	Large current system, substrate GND

Figure 1 Input and output equivalent circuits
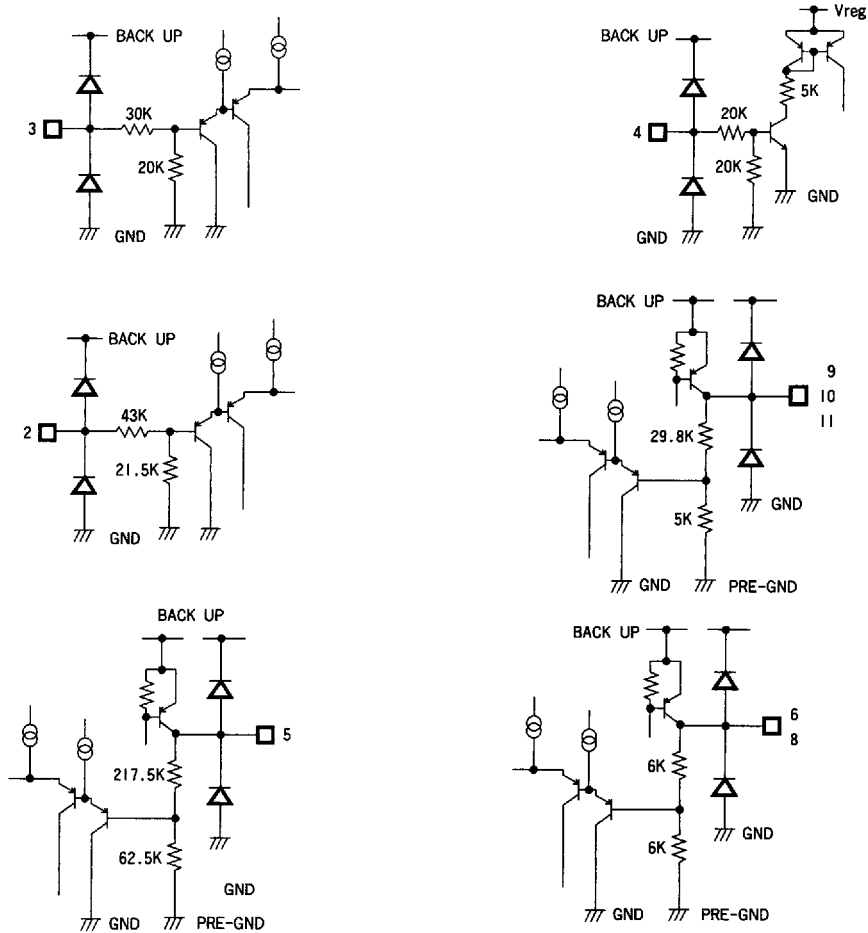
Absolute maximum ratings (T_a = 25°C)

Parameter	Symbol	Limits	Unit	Conditions
Applied voltage	V_{CC}	24	V	
Power dissipation	P_d	3000	mW	Reduce power by 30 mW/°C for each degree above 25°C.
Peak applied voltage	V_{CC} PEAK	50	V	tr ≥ 1 ms, maximum supply time is < 200 ms
Operating temperature	T_{opr}	−30 ~ +85	°C	
Storage temperature	T_{stg}	−55 ~ +150	°C	

Recommended operating conditions (T_a = 25°C)

Parameter	Symbol	Range	Unit
Power supply voltage	V_{CC}	10 ~ 16	V

Electrical characteristics (unless otherwise noted, T_a = 25°C, V_{CC} = 13.2 V)   (Sheet 1 of 2)

Parameter	Symbol	Min	Typical	Max	Unit	Conditions	Test figure
Standby circuit current	I_{st}		0.55	0.80	mA	Stand by pin = 0 V	2
Output 1 (V_{DD})							
Output voltage	V_{O1}	5.30	5.60	5.90	V	I_{O1} = 80 mA	
Line regulation	ΔV_{O11}		100	200	mV	Back up= 10 ~ 16 V, I_{O1} = 80 mA	2
Load regulation	ΔV_{O12}		30	150	mV	I_{O1} = 0 ~ 80 mA	
Dropout voltage	ΔV_{O13}		0.3	0.7	V	I_{O1} = 80 mA	
Output current	I_{O1}	100	150		mA	$V_{O1} \geq 5.3$ V	
Ripple rejection ratio	$R.R_1$	43	47		dB	f = 100 Hz, V_{RR} = −10 dBV	3
Output 2 (COM)							
Output voltage	V_{O2}	8.25	8.70	9.15	V	I_{O2} = 120 mA	
Line regulation	ΔV_{O21}		100	200	mV	V_{CC} = 10 ~ 16 V, I_{O2} = 120mA	2
Load regulation	ΔV_{O22}		50	180	mV	I_{O2} = 0 ~ 120 mA	
Dropout voltage	ΔV_{O23}		0.4	0.7	V	I_{O2} = 120 mA	
Output current	I_{O2}	150	200		mA	$V_{O2} \geq 8.25$ V	
Ripple rejection ratio	$R.R2$	40	45		dB	f = 100 Hz, V_{RR} = −10 dBV	3
Output 3 (AMP)							
Line regulation	ΔV_{O31}		0.5	0.9	V	I_{O3} = 400 mA	
Load regulation	ΔV_{O32}		300	600	mV	I_{O3} = 0 ~ 400 mA	2
Output current	I_{O3}	500	650		mA	$V_{O3} \geq 12.3$ V	
Output 4 (ANT)							
Line regulation	ΔV_{O41}		0.5	0.9	V	I_{O4} = 400 mA	
Load regulation	ΔV_{O42}		300	600	mV	I_{O4} = 0 ~ 400 mA	2
Output current	I_{O4}	500	650		V	$I_{O4} \geq 12.3$ V	

ctrical characteristics (unless otherwise noted, T$_a$ = 25°C, V$_{CC}$ = 13.2 V)   (Sheet 2 of 2)

Parameter	Symbol	Min	Typical	Max	Unit	Conditions	Test figure
tput 5 (AM)							
tput voltage	V$_{O5}$	8.25	8.70	9.15	V	I$_{O5}$ = 120 mA	2
e regulation	ΔV$_{O51}$		100	200	mV	V$_{CC}$ = 10 ~ 16 V, I$_{O5}$ = 120 mA	
d regulation	ΔV$_{O52}$		50	180	mV	I$_{O5}$ = 9 ~ 120 mA	
pout voltage	ΔV$_{O53}$		0.4	0.7	V	I$_{O5}$ = 120 mA	
put current	I$_{O5}$	150	200		mA	V$_{O5}$ ≥ 8.25 V	
le rejection ratio	R.R5	40	45		dB	f = 100 Hz, V$_{RR}$ = −10 dBV	3
put 6 (FM)							
put voltage	ΔV$_{O6}$	8.25	8.70	9.15	V	I$_{O6}$ = 200 mA	2
e regulation	ΔV$_{O61}$		100	200	mV	V$_{CC}$ = 10 ~ 16 V, I$_{O6}$ = 200 mA	
d regulation	ΔV$_{O62}$		50	180	mV	I$_{O6}$ = 0 ~ 200 mA	
pout voltage	ΔV$_{O63}$		0.4	0.7	V	I$_{O6}$ = 200 mA	
put current	I$_{O6}$	250	350		mA	V$_{O6}$ ≥ 8.25 V	
le rejection ratio	R.R6	40	45		dB	f = 100 Hz, V$_{RR}$ = −10 dBV	3
ndby input							
ndby level	V$_{th1-1}$			1.1	V		2
ve level	V$_{th1-2}$	1.7			V		
t current, high	I$_{in1}$	100	175	250	μA	V$_{th1}$ = 5 V	
le 2 SW input							
ndby level	V$_{th2-1}$			1.6	V		2
ve level	V$_{th2-2}$	2.4			V		
t current, high	I$_{in2}$	40	90	140	μA	V$_{th2}$ = 5 V	
le 1 SW input							
ON level	V$_{th3-1}$			1.1	V		2
ON level	V$_{th3-2}$	2.7			V		
t current, HIGH	I$_{in3}$	50	100	150	μA	V$_{th3}$ = 5 V	

Note: Ensure circuit output current is less than the maximum value

Test circuits

Figure 2 Test circuit for each pin
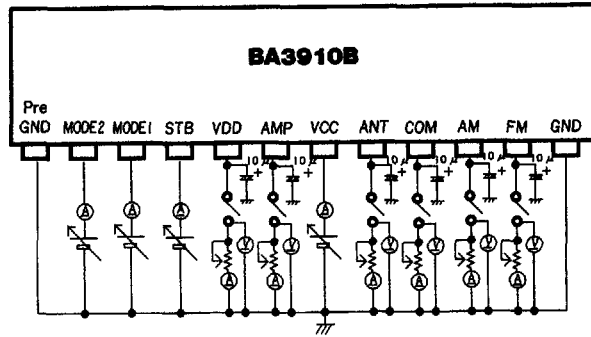
Figure 3 Ripple rejection rate test circuit

R. R=20log (Vout／Vin)

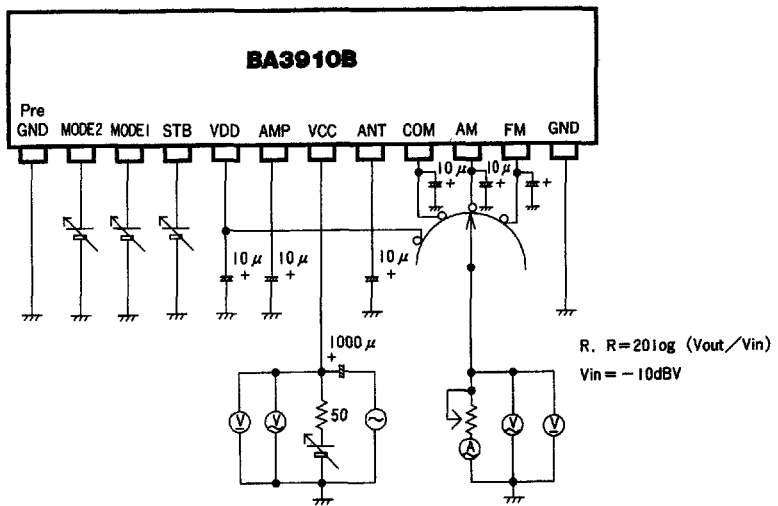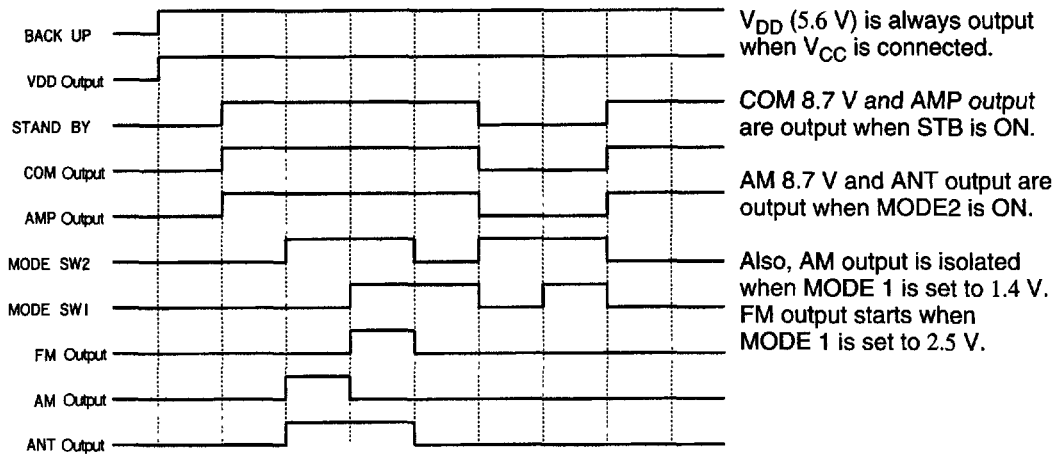Vin = − I0dBV

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Figure 4 Application example
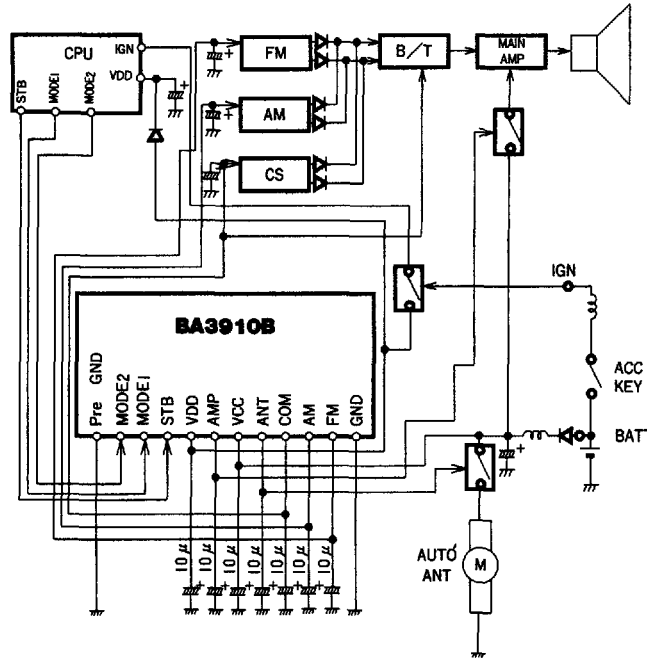
cuit operation

Figure 5 Timing chart

V_{DD} (5.6 V) is always output when V_{CC} is connected.

COM 8.7 V and AMP *output* are output when STB is ON.

AM 8.7 V and ANT output are output when MODE2 is ON.

Also, AM output is isolated when MODE 1 is set to 1.4 V. FM output starts when MODE 1 is set to 2.5 V.

Figure 6 Determining maximum power consumption (P_{max})
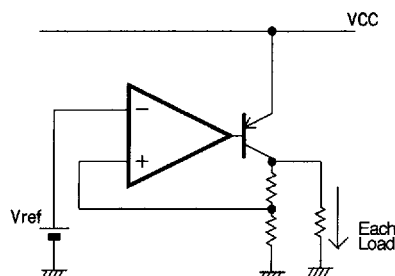
Power consumed by V_{DD} (5.6 V)

$$P_1 = (A - 5.6) \times I_1 + \left(\frac{I_1}{20} + \frac{I_1}{10}\right)A$$

Power consumed by COM8.7 V

$$P_2 = (A - 8.7) \times I_2 + \left(\frac{I_2}{30} + \frac{I_2}{10}\right)A$$

Power consumed by AMP

$$P_3 = (0.5 \times I_3) \times I_2 + \left(\frac{I_3}{100} + \frac{I_3}{10}\right)A$$

Power consumed by ANT

$$P_4 = (0.5 \times I_4) \times I_2 + \left(\frac{I_4}{100} + \frac{I_4}{10}\right)A$$

Power consumed by AM8.7 V

$$P_5 = (A - 8.7) \times I_5 + \left(\frac{I_5}{30} + \frac{I_5}{10}\right)A$$

Power consumed by FM8.7 V

$$P_6 = (A - 8.7) \times I_6 + \left(\frac{I_6}{50} + \frac{I_6}{10}\right)A$$

Power consumed internally by each circuit
(circuit current $\cong 5$ mA)

$$P_7 = V_{CC} \times \text{circuit current}$$

$P_{max} = P_1 + P_2 + P_3 + P_4 + (P_5$ or P_6, whichever is larger)
where A = maximum output voltage for V_{CC}
I_1 = maximum output current for V_{SS}
I_2 = maximum output current for COM
I_3 = maximum output current for AMP
I_4 = maximum output current for ANT
I_5 = maximum output current for AM
I_6 = maximum output current for FM

Precautions for use

Application example

The application circuit in Figure 4 is recommended for use. Make sure to confirm the adequacy of the characteristics. When using the circuit with changes to the external circ constants, make sure to leave an adequate margin for external components including st and transitional characteristics as well as dispersion of the IC. Note that ROHM cannot provide adequate confirmation of patents.

Operating power supply

When operating at normal voltages and at ambient temperature, most circuit functions c guaranteed. The characteristic values cannot be absolutely guaranteed for all paramete However, there are no sudden changes of the characteristics within these ranges.

Voltage overload protection circuit

The voltage overload protection circuit turns OFF the output when the potential difference between V_{CC} (pin 7) and GND (pin 12) exceeds about 26 V (at normal temperature). Make sure to use the IC within this range.

Preventing oscillation at each output and the ripple filter capacitor

To prevent oscillation, connect a capacitor between the V_{DD} (pin 5), AMP (pin 6), ANT (pin 8), COM (pin 9), AM (pin 10), and FM (pin 11) output pins and the GND. ROHM recommends using a tantalum capacitor with a low thermal characteristic.

Current overload protection circuit

A current overload protection circuit is installed on the V_{DD} (pin 5), AMP (pin 6), ANT (pin 8), COM (pin 9), AM (pin 10), and FM (pin 11) outputs based on their respective current capacity. This prevents damage to the IC in the event that the load is short circuited.

This protection circuit limits the current in the form of a "7" (see Figures 8 and 9). It is designed with a margin so that even if a large current suddenly flows through the large capacitor in the IC, the current is restricted and latching is prevented.

However, these protection circuits are only good for preventing accidental damage. Make sure your design does not cause the protection circuit to operate continuously (for instance: clamping at an output of 1 Vf or greater: below 1 Vf, the overload circuit operates). The capacitor has negative temperature characteristics.

Thermal overload

A thermal overload circuit is installed to prevent thermal damage. When the thermal overload circuit operates, all outputs, except V_{DD}, are put in the OFF state. When the temperature drops about 25°C, the circuit is restored.

Circuit structure of each output

The V_{DD} (pin 5), AMP (pin 6), ANT (pin 8), COM (pin 9), AM (pin 10), and FM (pin 11) outputs consist of PNP power transistors. A protection circuit ensures that when the V_{CC} (pin 7) voltage falls, the IC is not damaged, even if the output voltage from the external output capacitor is greater than the V_{CC} voltage.

Grounding

The ground shown in the application circuit has an adequately short pattern for the GND (pin 12) pin. Make sure to arrange these traces and other outputs in a pattern that prevents mutual interference.

ASO

Although this IC has many types of protection circuits built in, the ASO may still be exceeded under certain conditions. When ASO is exceeded, the IC will be destroyed. Be careful never to exceed the ASO.

Electrical characteristic curves
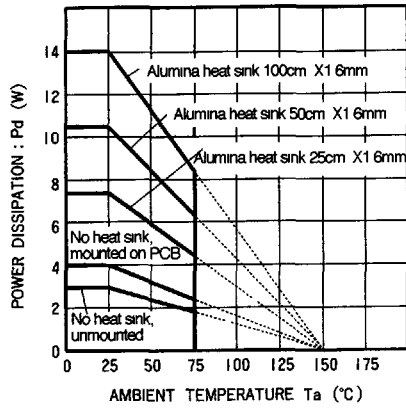
Figure 7
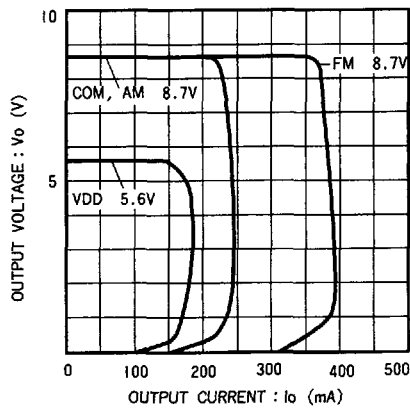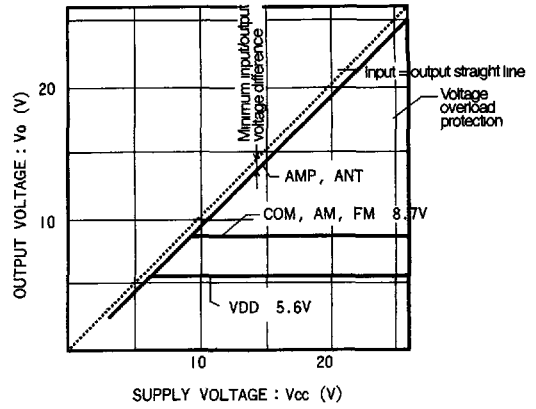
Figure 8

Figure 9

Figure 10

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