

The BA3913 is a power supply for use in car audio systems.

Features

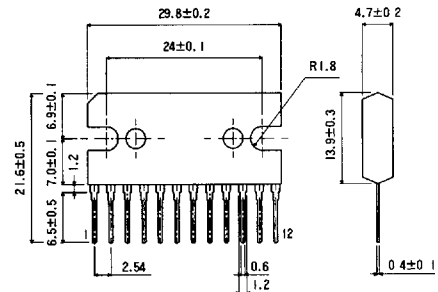
- available in an SIP-M12 package
- multiple voltages available from the same IC
 - 5.6 V (microcontroller power supply)
 - 8.3 V (three; one for FM and one for AM radio, and a common)
- all output circuits use a PNP transistor with a low saturation voltage
- AM and FM band selection switch included together with a standby switch which shuts down the IC when OFF
- internal output overload protection circuit prevents damage to the IC in the event the load is short circuited
- overvoltage protection circuit provides protection against surges from the ACC or BACKUP inputs
- internal thermal overload also protects the IC

Applications

- car audio systems

Dimensions (Units : mm)

BA3913 (SIP-M12)



Block diagram

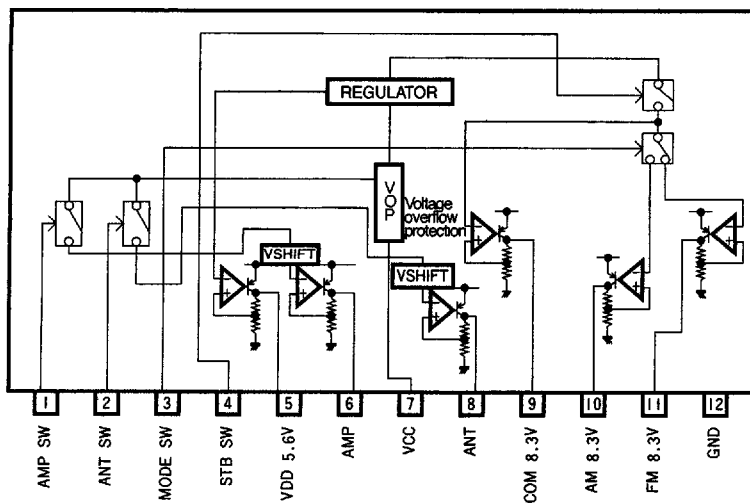
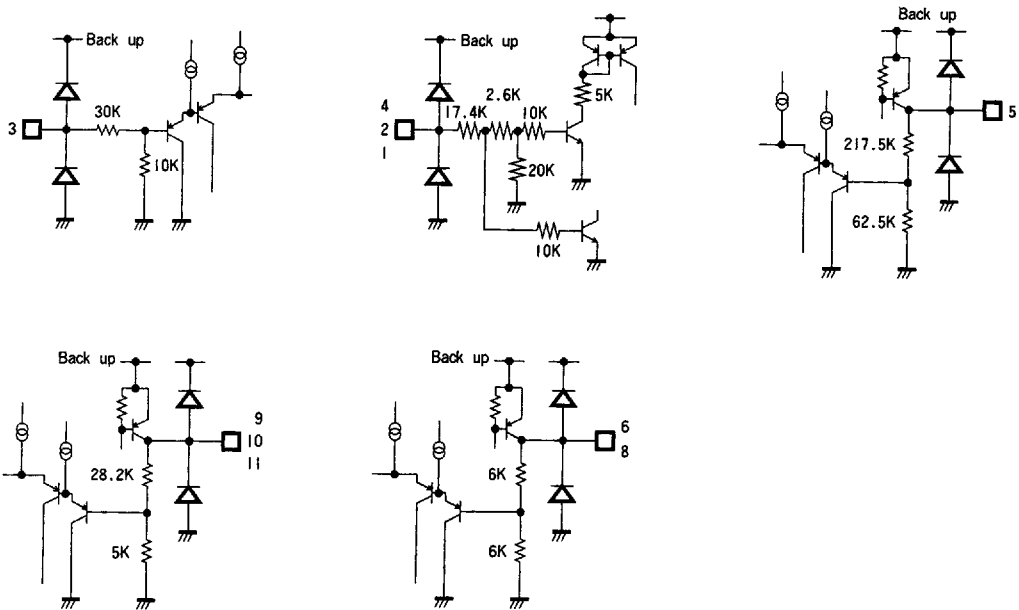


Table 1 Pin description

Pin no	Pin name	Function
1	AMP SW	AMP output switch pin
2	ANT SW	ANT output switch pin
3	MODE SW	FM output and AM output switch pin
4	STB SW	COM output and AM output switch pin
5	VDD 5.6V	VDD, 5.6 V output pin
6	AMP	Remote amplifier activation power supply (V_{CC} in series)
7	VCC	Power supply pin
8	ANT	Antenna driving power supply (V_{CC} in series)
9	COM 8.3 V	Common power supply for the power system, electronic synchronization and variable capacitance COM 8.3 V output
10	AM 8.3 V	AM reception power supply, 8.3 V output
11	FM 8.3 V	FM reception power supply, 8.3 V output
12	GND	Large current system, small current system, substrate GND

Figure 1 Input and output equivalent circuits



Absolute maximum ratings ($T_a = 25^\circ\text{C}$)

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

Recommended operating conditions ($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Min	Typical	Max	Unit
Power supply voltage	V_{CC}	10		16	V

Electrical characteristics (unless otherwise noted, $T_a = 25^\circ\text{C}$, BACKUP = 13.2 V)
(Sheet 1 of 2)

Parameter	Symbol	Min	Typical	Max	Unit	Conditions	Test fig
Standby 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	$I_{O1} = 80\text{mA}$	2
Line regulation	ΔV_{O11}		100	200	mV	$V_{CC} = 10 \sim 16\text{ V}$, $I_{O1} = 80\text{ mA}$	
Load regulation	ΔV_{O12}		30	150	mV	$I_{O1} = 0 \sim 80\text{ mA}$	
Dropout voltage	ΔV_{O13}		0.3	0.7	V	$I_{O1} = 80\text{ mA}$	
Output current	I_{O1}	100	200	270	mA	$V_{O1} \geq 5.3\text{ V}$, the max value for the current output is theoretical.	
Ripple rejection ratio	R.R ₁	43	47		dB	$f = 100\text{ Hz}$, $V_{RR} = -10\text{ dBV}$	3
COM (2)							
Output voltage	V_{O2}	7.90	8.30	8.70	V	$I_{O2} = 120\text{ mA}$	2
Line regulation	ΔV_{O21}		100	200	mV	$V_{CC} = 10 \sim 16\text{ V}$, $I_{O2} = 120\text{ mA}$	
Load regulation	ΔV_{O22}		50	180	mV	$I_{O2} = 0 \sim 120\text{ mA}$	
Dropout voltage	ΔV_{O23}		0.4	0.7	V	$I_{O2} = 120\text{ mA}$	
Output current	I_{O2}	150	300	410	mA	$V_{O2} \geq 7.90\text{ V}$, the max value for the current output is theoretical.	
Ripple rejection ratio	R.R ₂	40	45		dB	$f = 100\text{ Hz}$, $V_{RR} = -10\text{ dBV}$	3
AMP (3)							
Output voltage	V_{O31}		0.5	0.9	V	$I_{O3} = 400\text{ mA}$	2
Load regulation	ΔV_{O32}		300	600	mV	$I_{O3} = 0 \sim 400\text{ mA}$	
Output current	I_{O3}	500	800	1350	mA	$V_{O3} \geq 12.3\text{ V}$, the max value for the current output is theoretical.	
ANT (4)							
Dropout voltage	ΔV_{O41}		0.5	0.9	V	$I_{O4} = 400\text{ mA}$	2
Load regulation	ΔV_{O42}		300	600	mV	$I_{O4} = 0 \sim 400\text{ mA}$	
Output current	I_{O4}	500	800	1350	mA	$I_{O4} \geq 12.3\text{ V}$	

Electrical characteristics (unless otherwise noted, $T_a = 25^\circ\text{C}$, BACKUP = 13.2 V)
(Sheet 2 of 2)

Parameter	Symbol	Min	Typical	Max	Unit	Conditions	Test fig
AM (5)							
Output voltage	V_{O5}	7.90	8.30	8.70	V	$I_{O5} = 120\text{ mA}$	2
Line regulation	ΔV_{O51}		100	200	mV	$V_{CC} = 10 \sim 16\text{ V}$, $I_{O5} = 120\text{ mA}$	
Load regulation	ΔV_{O52}		50	180	mV	$I_{O5} = 0 \sim 120\text{ mA}$	
Dropout voltage	ΔV_{O53}		0.4	0.7	V	$I_{O5} = 0 \sim 120\text{ mA}$	
Output current	I_{O5}	150	300	410	mA	$V_{O5} \geq 7.90\text{ V}$, the max value for the current output is theoretical.	
Ripple rejection ratio	R.R5	40	45		dB	$f = 100\text{ Hz}$, $V_{RR} = -10\text{ dBV}$	3
FM (6)							
Output voltage	ΔV_{O6}	7.90	8.30	8.70	V	$I_{O6} = 240\text{ mA}$	2
Line regulation	ΔV_{O61}		100	200	mV	$V_{CC} = 10 \sim 16\text{ V}$, $I_{O6} = 240\text{ mA}$	
Load regulation	ΔV_{O62}		50	180	mV	$I_{O6} = 0 \sim 240\text{ mA}$	
Dropout voltage	ΔV_{O63}		0.4	0.7	V	$I_{O6} = 240\text{ mA}$	
Output current	I_{O6}	300	550	820	mA	$V_{O6} \geq 7.90\text{ V}$, the max value for the current output is theoretical.	
Ripple rejection ratio	R.R6	40	45		dB	$f = 100\text{ Hz}$, $V_{RR} = -10\text{ dBV}$	3
Standby input							
Stand by level	V_{th1-1}			1.1	V		2
Active level	V_{th1-2}	1.7			V		
Input current, high	I_{in1}	100	175	250	μA	$V_{th1} = 5\text{ V}$	
AMP SW							
Stand by level	V_{th2-1}			1.1	V		2
Active level	V_{th2-2}	1.7			V		
Input current, high	I_{in2}	100	175	250	μA	$V_{th2} = 5\text{ V}$	
ANT SW							
Stand by level	V_{th3-1}			1.1	V		2
Active level	V_{th3-2}	1.7			V		
Input current, high	I_{in3}	100	175	250	μA	$V_{th3} = 5\text{ V}$	
Mode SW							
AM ON level	V_{th4-1}			1.1	V		2
FM ON level	V_{th4-2}	3.9			V		
Input current, high	I_{in4}	50	100	150	μA	$V_{th4} = 5\text{ V}$	

Note: Make sure to set the current voltage to less than the minimum output current capacity.

Test circuits

Figure 2 Test circuit for each pin

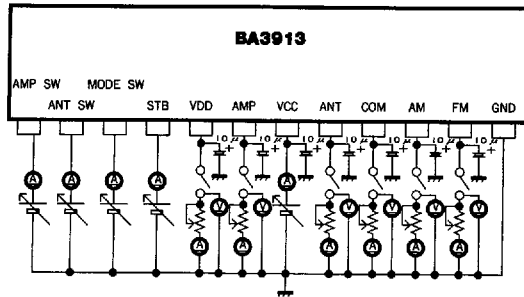


Figure 3 Ripple rejection rate test circuit

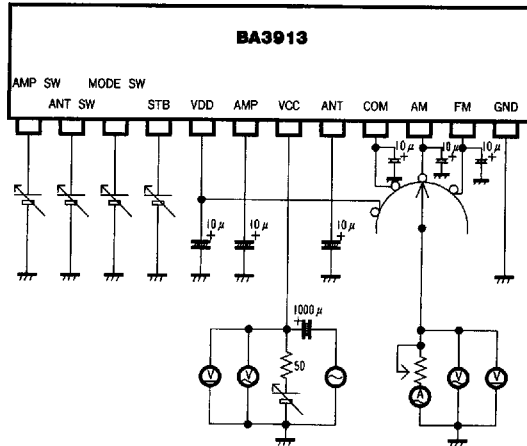
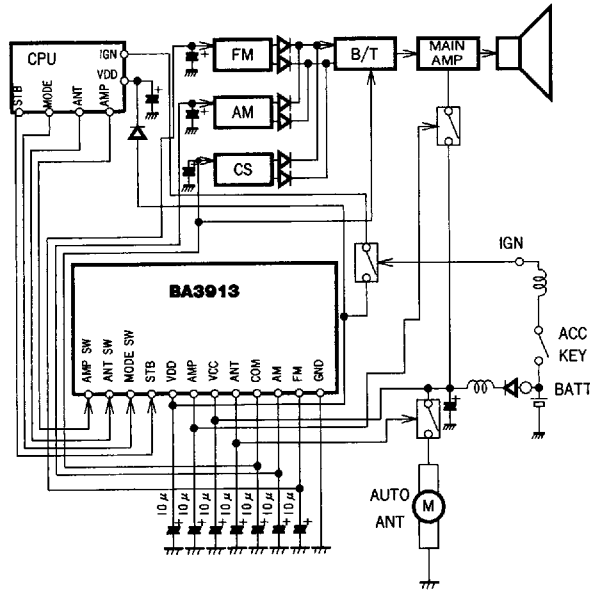
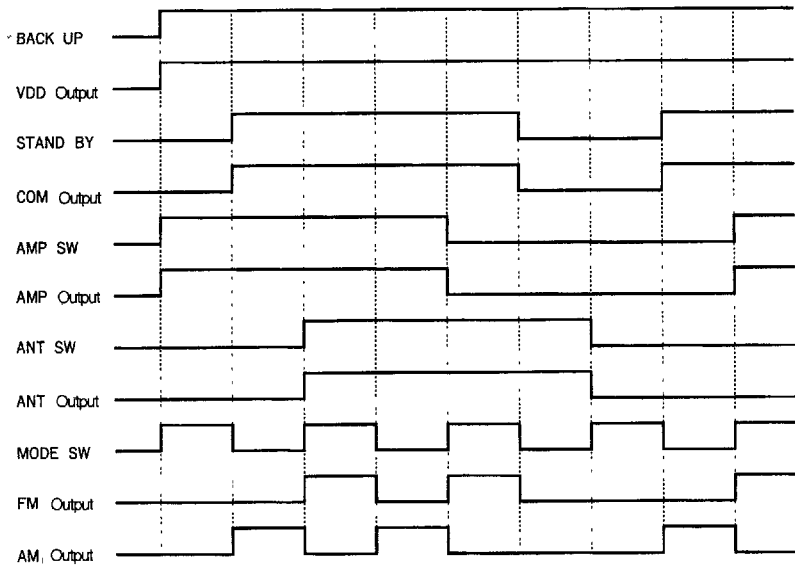


Figure 4 Application example



Circuit operation

Figure 5 Timing chart

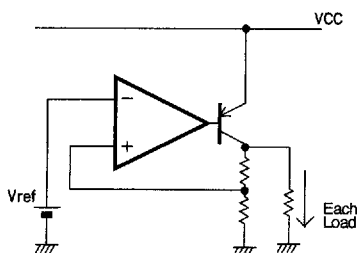


COM 8.3 V and AMP 8.3 V are output when STB is ON.

AMP and ANT output are output when AMPSW and ANT SW are ON.

Also, AM output is isolated when MODESW drops below 3.6 V. FM output is isolated when MODESW rises from 1.4 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

$$P_2 = (A - 8.3) \times I_2 + \left(\frac{I_2}{30} + \frac{I_2}{10} \right) A$$

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 AM8.3 V

$$P_5 = (A - 8.3) \times I_5 + \left(\frac{I_5}{30} + \frac{I_5}{10} \right) A$$

Power consumed by FM8.7 V

$$P_6 = (A - 8.3) \times I_6 + \left(\frac{I_6}{60} + \frac{I_6}{10} \right) A$$

Power consumed internally by each circuit

$$P_7 = V_{CC} \times \text{circuit current, circuit current is about 5 mA}$$

$$P_{max} = P_1 + P_2 + P_3 + P_4 + (P_5 \text{ or } P_6, \text{ whichever is larger}) + P_7$$

where A = maximum output voltage for V_{CC}

I_1 = maximum output current for V_{DD}

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 circuit constants, make sure to leave an adequate margin for external components including static 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 are guaranteed. The characteristic values cannot be absolutely guaranteed for all parameters. 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) exceed 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 ($> 10 \Omega$) 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 9 and 10). 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). Note that 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

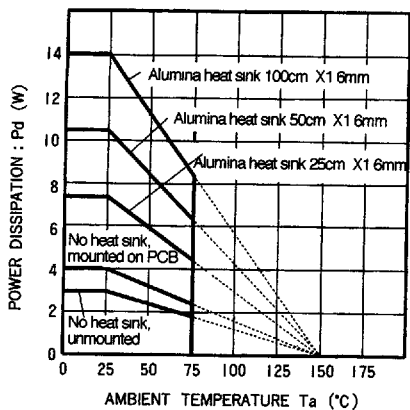


Figure 7

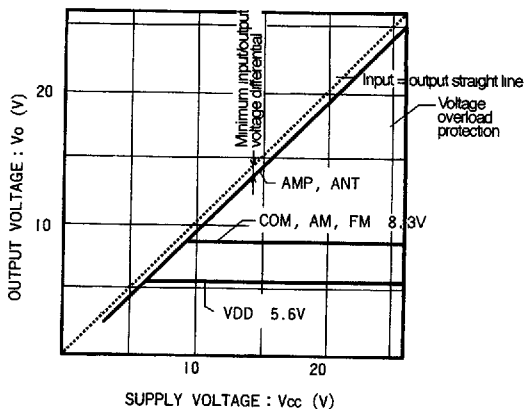


Figure 8

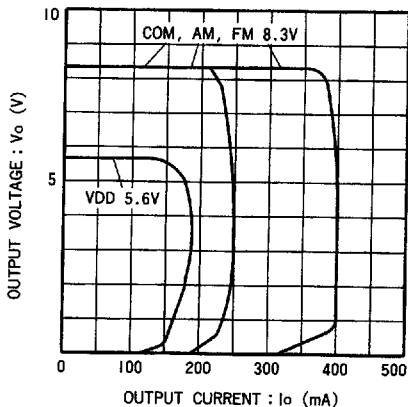


Figure 9

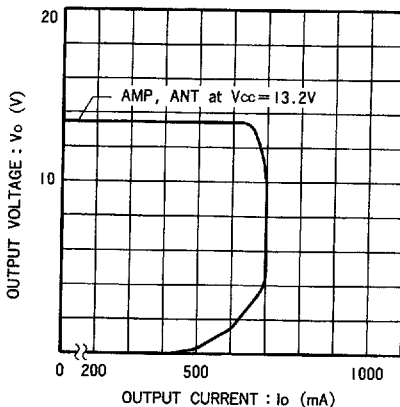


Figure 10

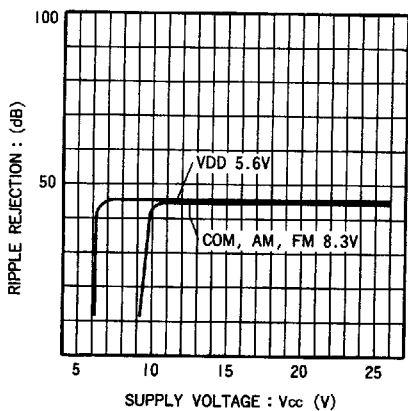


Figure 11