

# Dual preamplifier

## BA328 / BA328F

The BA328 and BA328F are monolithic, dual-preamplifier ICs designed for car-audio systems. They require few external components and allow compact set designs while reducing the number of assembly processes.

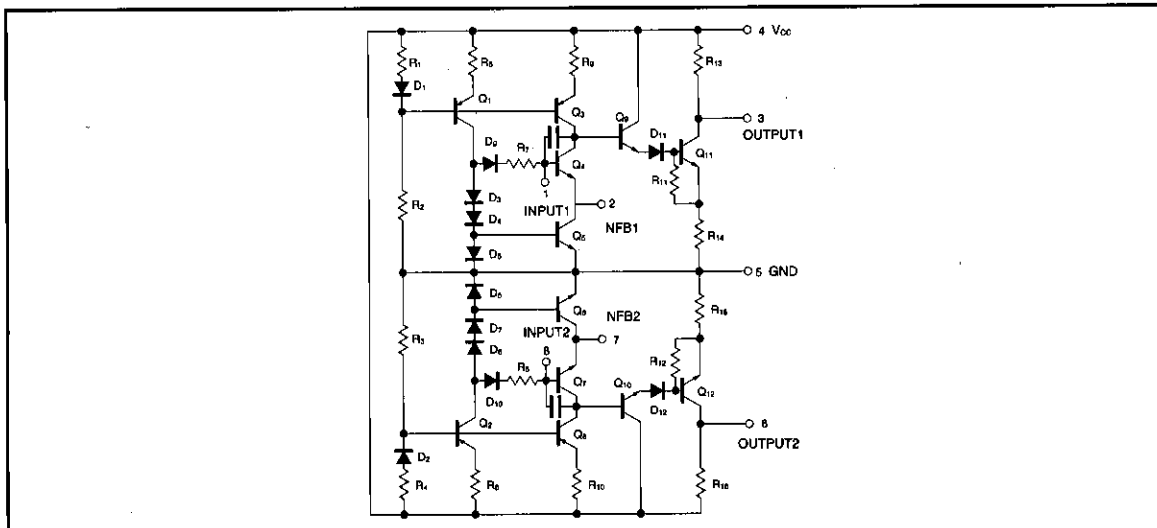
●Applications

Car and home stereos

●Features

- 1) Low noise.
- 2) Wide operating voltage range.
- 3) Built-in bias circuit minimizes the number of external components required.
- 4) High open-loop gain.
- 5) Good channel balance.

●Internal circuit diagram



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● Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Supply voltage	V <sub>CC</sub>	18	V
Power dissipation	BA328	Pd	mW
	BA328F		
Operating temperature	T <sub>opr</sub>	-25~75	°C
Storage temperature	T <sub>stg</sub>	-55~125	°C

\*1 Reduced by 9.0mW for each increase in Ta of 1°C over 25°C.

\*2 Reduced by 5.0mW for each increase in Ta of 1°C over 25°C. (When mounted on a 50mm x 50mm x 1.6mm glass-epoxy PCB)

● Recommended operating voltage range (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	V <sub>CC</sub>	6	8	16	V

● Electrical characteristics (unless otherwise specified Ta = 25°C, V<sub>CC</sub> = 8V, f = 1kHz, R<sub>L</sub> = 10kΩ and R<sub>E</sub> = 100Ω)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Quiescent circuit current	I <sub>Q</sub>	2	5	8	mA	V <sub>IN</sub> =0V <sub>rms</sub>	Fig.4
Open-circuit voltage gain	G <sub>VO</sub>	65	80	—	dB	V <sub>OUT</sub> =0.3V <sub>rms</sub> , R <sub>E</sub> =0Ω	Fig.4
Maximum output voltage	V <sub>OM</sub>	1.0	1.5	—	V <sub>rms</sub>	THD=1%	Fig.4
Input resistance	R <sub>IN</sub>	50	—	—	kΩ	—	Fig.4
Total harmonic distortion	THD	—	0.1	0.3	%	V <sub>OUT</sub> =0.3V <sub>rms</sub>	Fig.4
Input conversion-noise voltage	V <sub>NIN</sub>	—	1.2	2.0	μV <sub>rms</sub>	R <sub>g</sub> =2.2kΩ BPF (30Hz~20kHz)	Fig.4
Crosstalk level	CT	—	-65	-50	dB	Other channel V <sub>OUT</sub> =0.3V <sub>rms</sub> , R <sub>g</sub> =2.2kΩ	Fig.4
Channel balance	CB	—	0	1.5	dB	V <sub>OUT</sub> =0.3V <sub>rms</sub>	Fig.4

● Electrical characteristics curves

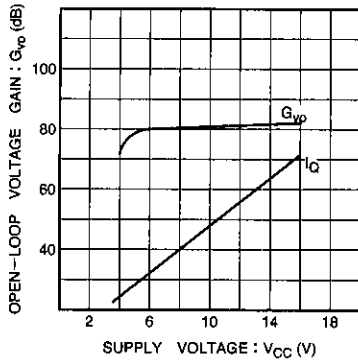


Fig. 1 Quiescent current and voltage gain vs. supply voltage

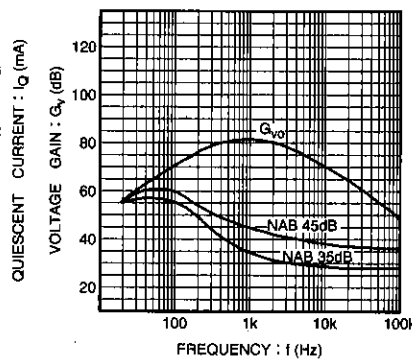


Fig. 2 Voltage gain vs. frequency

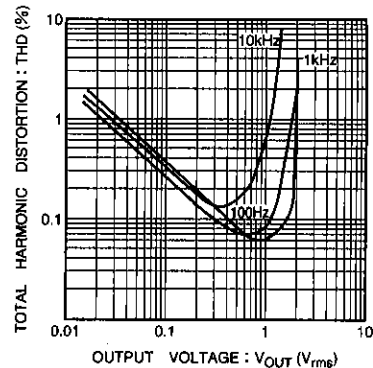


Fig. 3 Distortion vs. output voltage

Pre-amplifiers

Low-frequency amplifiers

● Measurement circuit

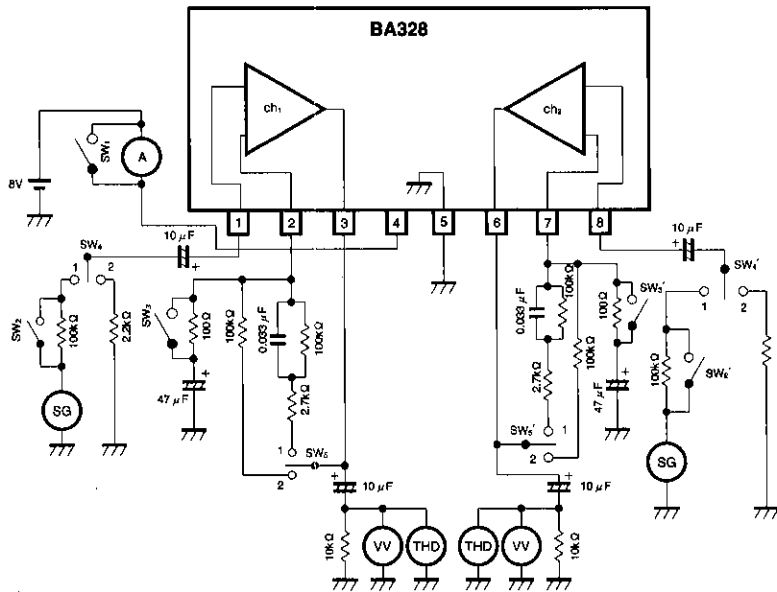


Fig. 4

● Description of external components

$C_{IN}$  : input coupling capacitor

The recommended value is  $10 \mu F$ . If the value of the capacitor is too small the characteristics at power on will deteriorate.

$C_O$  : Output coupling capacitor

No particular requirements. A value of 4.7 to  $22 \mu F$  is appropriate.

$C_E$  : AC signal bypass capacitor

The recommended value is  $47 \mu F$ . This capacitor sets the bass gain.

If a capacitor larger than the recommended value is used, the bass-region gain will increase, but the characteristics at power on will deteriorate. If the value of the capacitor is made smaller than the recommended value, the bass-region gain will be lower, but the power on characteristics will improve.

$C_1$  and  $R_1$  Ripple filter components

The larger  $R_1$  and  $C_1$  are made, the better the ripple rejection ratio will be. However, if  $R_1$  is made too large, the voltage drop that results will influence the maximum output.

Feedback pin : The closed-loop gain is roughly  $Z_n / R_E$ .

Item	SW <sub>1</sub>	SW <sub>2</sub> SW <sub>2</sub> '	SW <sub>3</sub> SW <sub>3</sub> '	SW <sub>4</sub> SW <sub>4</sub> '	SW <sub>5</sub> SW <sub>5</sub> '
I <sub>Q</sub>	OFF	ON	OFF	2	1
G <sub>VO</sub>	ON	ON	ON	1	2
V <sub>OM</sub>	ON	ON	OFF	1	1
R <sub>IN</sub>	ON	ON · OFF	OFF	1	1
THD	ON	ON	OFF	1	1
V <sub>NIN</sub>	ON	ON	OFF	2	1
CT	ON	ON	OFF	2(1)	1
CB	ON	ON	OFF	1	1

Note: Bandpass filter used (30Hz to 20kHz).

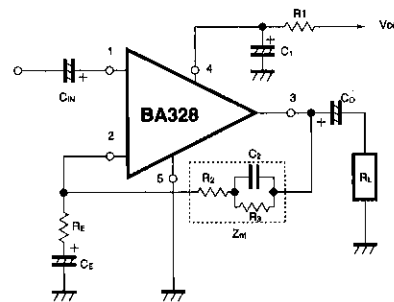


Fig. 5

●Application example

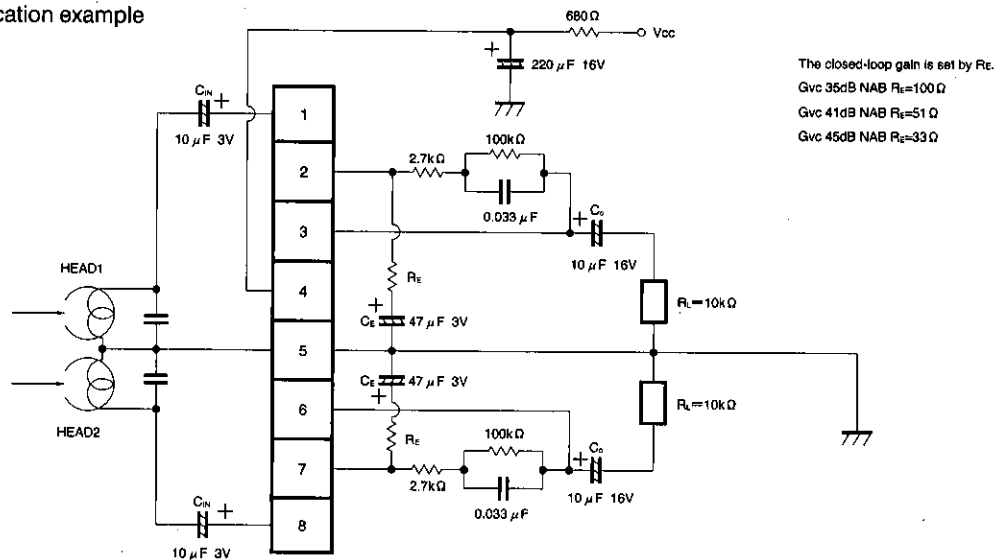


Fig. 6 Car stereo application

●Operation notes

Determining the DC output voltage (see Fig. 7)

The DC output voltage is determined as follows :

$$V_{ODC} = (R_{nt} \times I_o) + V_{P2} (7)$$

$V_{P2} (7)$  : DC voltage on pin 2 (7)

$R_{nt}$  : DC feedback resistance

$I_o$  is set internally.

In other words, pin 7 is a fixed current source, and when that current flows into the feedback pin, the voltage generated becomes the DC voltage.  $V_{P2} (7)$  is fixed at about 0.8V. When  $V_{ODC}$  is about 1/2 the supply voltage,  $V_{OM}$  is maximized.

$I_o$  is fixed regardless of the supply voltage. Therefore, it is possible to set the DC feedback resistance after considering the required dynamic range and the minimum voltage applied to pin 4 ( $V_{CC}$ ).

The recommended value is 100kΩ for a supply voltage of 6V to 16V.

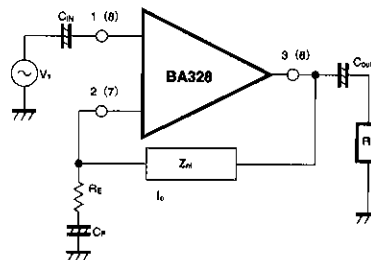
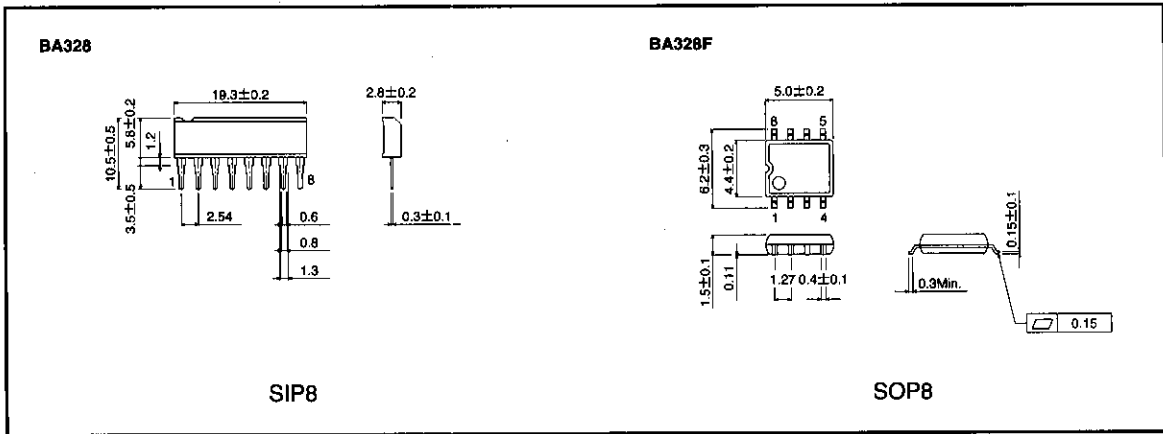


Fig. 7

Preamplifiers

Low-frequency amplifiers

●External dimensions (Unit: mm)



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