

Headphone/Speaker Amplifier

BA7785FS

The internal linear audio circuits of the BA7785FS include a stereo headphone amplifier, BTL monaural speaker amplifier, and an electronic volume circuit, making this IC ideal for LCD TVs and notebook computers.

●Applications

LCD TVs, notebook computers, and wordprocessors, etc.

●Features

- 1) Internal stereo headphone amplifier that allows for mixed input, along with a BTL monaural speaker amplifier.
- 2) Internal anti-pop circuit, which prevents popping sounds when the power is turned on.
- 3) Internal electronic volume and mute circuit.
- 4) Low-voltage operation (3.3V).
- 5) Internal input switch that also allows for the input of computer beeps.

●Absolute maximum ratings (Ta=25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V _{cc}	18	V
Power dissipation	P _d	750*	mW
Operating temperature range	T _{opr}	-10~70	°C
Storage temperature range	T _{stg}	-55~125	°C

* Reduced by 7.5 mW for each increase in Ta of 1°C over 25°C.

When mounted to a 90 × 50 × 1.5 mm glass epoxy board.

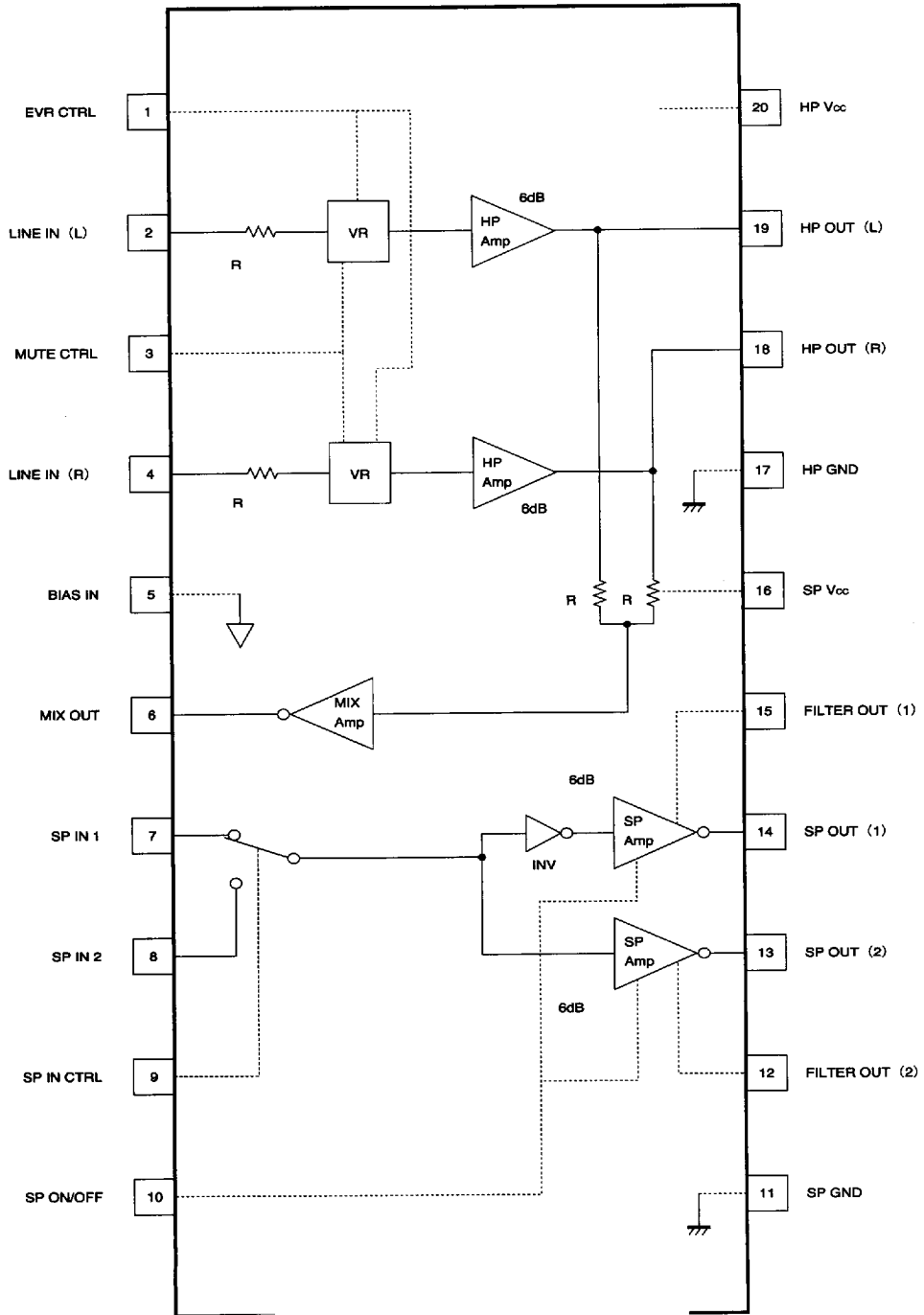
●Recommended operating conditions (Ta=25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	SP / HP V _{cc}	3.0	—	6.0	V

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● Block diagram



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● Pin descriptions

Pin No.	Pin name	Function	Voltage	Type
1	EVR CTRL	EVR control input. Maximum gain at V_{CC} .	—	B (NPN)
2, 4	LINE IN L, R	Headphone input L, R $Z_{IN}=30K\Omega$	1 / $2V_{CC}$	B (PNP)
3	MUTE CTRL	Input for controlling the muting of headphone output	—	B (NPN)
5	BIAS IN	Bias buffer input	1 / $2V_{CC}$	B (NPN)
6	MIX OUT	Output of the headphone output mixing amplifier	1 / $2V_{CC}$	PP
7, 8	SP IN 1, 2	Speaker inputs 1 and 2 Switched with SP IN CTRL (9pin) $Z_{IN}=50K\Omega$	1 / $2V_{CC}$	B (NPN)
9	SP IN CTRL	SP IN1/SP IN2 input selection control	—	B (PNP)
10	SP ON / OFF	Speaker on/off (power saving mode) control	—	B (NPN)
11	SP GND	Speaker output ground	GND	—
12, 15	FILTER OUT 1, 2	Connecting the oscillation prevention capacitor	1 / $2V_{CC}$	B (NPN)
13, 14	SP OUT 1, 2	BTL speaker outputs 1 and 2	1 / $2V_{CC}$	PP
16	SP V_{CC}	Speaker output V_{CC}	V_{CC}	—
17	HP GND	Ground for the headphone mixing amplifier, inputs and controls	GND	—
19, 18	HP OUT L, R	Headphone amplifier output	1 / $2V_{CC}$	PP
20	HP V_{CC}	V_{CC} for the headphone amplifier, mixing amplifier, inputs and controls	V_{CC}	—

Note: Pin types: P-P = push-pull, B = base, C = collector.

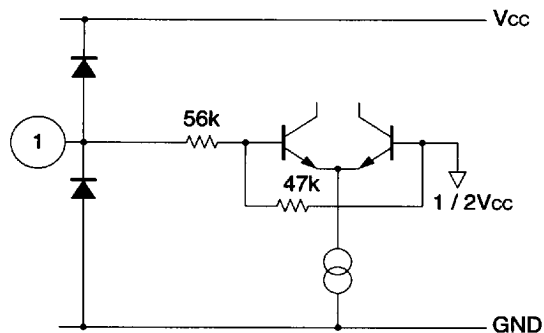
All figures are standard values.

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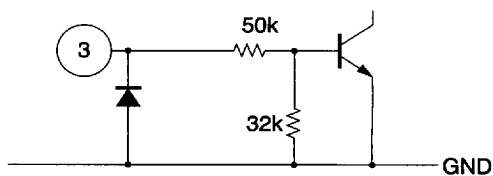
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● Input/output circuits

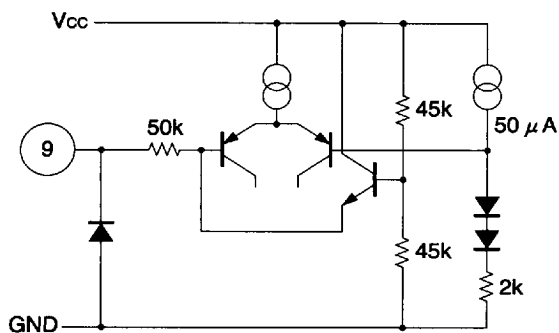
EVR CTRL



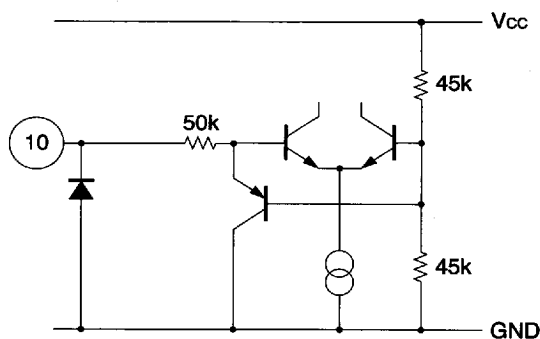
MUTE CTRL



SP IN CTRL



SP ON / OFF



●Electrical characteristics

- Unless otherwise indicated, measurement conditions are as follows.

HP $V_{CC} =$ SP $V_{CC} = 5V$

$T_a = 25^{\circ}C$

EVR control	(EVR CTRL 1pin)	: Max. (HP V_{CC})
Mute control	(MUTE CTRL 3pin)	: LOW (MUTE OFF)
Speaker input control	(SP IN CTRL 9pin)	: LOW (SP IN1)
Speaker on/off control	(SP ON/OFF CTRL 10pin)	: HIGH (SP ON)

Signal frequency = 1kHz

HP amp : $R_L = 100\Omega$

SP amp : $R_L = 8\Omega$, BTL = operating

*1 : DIN AUDIO

*2 : IHF A

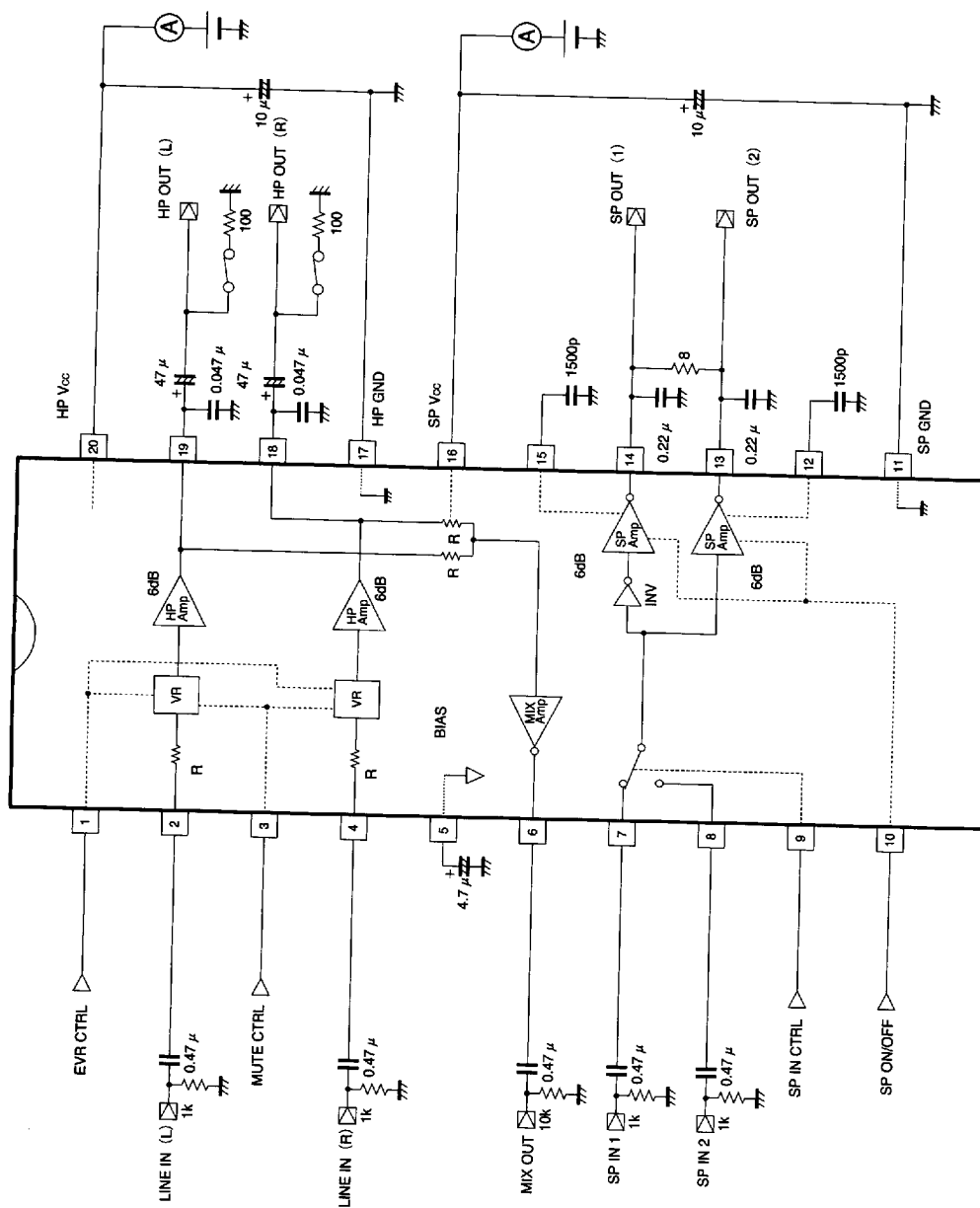
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Circuit current	I	7.8	12.0	18.5	mA	No input
Circuit current Power Save	I_{PS}	3.5	5.4	8.3	mA	No input, SP ON/OFF : L
<HP Amp> (INPUT : LINE IN L / R, OUTPUT : HP OUT L / R)						
Output voltage level	V_{OHP}	-5.0	-3.5	-2.0	dBV	$V_{IN} = -10.0\text{dBV}$,
Channel balance	CB_{HP}	-1.0	0.0	1.0	dB	$V_{IN} = -10.0\text{dBV}$,
EVR range	GE_{VR}	70.0	88.0	—	dB	$V_{IN} = -10.0\text{dBV}$, EVR Max-Min difference
Distortion	THD_{HP}	—	0.3	1.0	%	$V_{IN} = -10.0\text{dBV}$, *1
Maximum rated output voltage	H_{HP}	8.0	10.0	—	mW	$V_{CC} = 3.0V$, $THD = 10\%$
Output residual noise	V_{ONHP}	—	-81.0	-73.0	dBV	$R_g = 1k\Omega$, *2
Interchannel crosstalk	CT_{HP}	—	-78.0	-70.0	dBV	$V_{IN} = -6.5\text{dBV}$, *1
Muting level	MT_{HP}	—	-95.0	-84.0	dBV	$V_{IN} = -6.5\text{dBV}$, *1
<MIX Amp> (INPUT : LINE IN L / R, OUTPUT : MIX OUT)						
Output level	V_{OMIX}	-15.5	-13.5	-11.5	dBV	$V_{IN} = -20.0\text{dBV}$
<SP Amp(BTL)> (INPUT : SP IN 1 / 2, OUTPUT : SP OUT 1 / 2, BTL measurement)						
Speaker output level	V_{OSP}	-0.25	1.25	2.75	dBV	$V_{IN} = -10.0\text{dBV}$
Distortion	THD_{SP}	—	0.6	1.5	%	$V_{IN} = -10.0\text{dBV}$,
Maximum rated output power	P_{SP}	250	300	—	mW	$V_{CC} = 3.0V$, $THD = 10\%$
Residual output noise	V_{ONSP}	—	-98.0	-90.0	dBV	$R_g = 1k\Omega$, *2
Speaker-off level	V_{OSPOFF}	—	-108.0	-85.0	dBV	$V_{IN} = -7.0\text{dBV}$, *1, when SP is off

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Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
〈Control mode holding voltage〉						
MUTE CTRL						
Mute-off holding voltage	V_{TH3L}	0.0	—	0.5	V	
Mute-on holding voltage	V_{TH3H}	2.0	—	V_{CC}	V	
SP IN CTRL						
SPIN1 holding voltage	V_{TH9L}	0.0	—	0.5	V	
SPIN2 holding voltage	V_{TH9H}	2.2	—	V_{CC}	V	
Speaker on/off control						
Speaker-off holding voltage	V_{TH10L}	0	—	$0.2V_{CC}$	V	
Speaker-on holding voltage	V_{TH10H}	$0.8V_{CC}$	—	V_{CC}	V	

● Measurement circuit



Multimedia audio

Speaker and headphone amplifiers for portable equipment

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●Circuit operation

Control pins

- There are three control pins, described below.

(1) Mute control (MUTE CTRL, pin 3)

- Stops headphone output and mixing output.

Mode	Control signal	Note
MUTE OFF	L	
MUTE ON	H	Mutes the line.

Note: This pin should always be at the high level (muted) when the power is turned on or off.

(2) Speaker input control (SP IN CTRL, pin 9)

- Switches speaker input between SPIN1 and SPIN2.

Mode	Control signal	Note
SP IN1	L	
SP IN2	H	

(3) Power saving control (SP ON/SP OFF CTRL, pin 10)

- Turns the speaker on and off.

Mode	Control signal	Note
SP OFF	L	Power saving mode
SP ON	H	Normal speaker operation

* Power saving mode: The speaker amplifier is stopped. To begin output, pull up to bias at 50 k Ω .

●Attached components

Use capacitors with low temperature change and low variation for oscillation prevention for pins 13, 14, 18 and 19 (0.47 μ F and 0.1 μ F), and for phase correction for pins 12 and 15. If capacitors with high variation or temperature change are used (B characteristics, etc.), be sure to compensate with an according capacitance. Also set the capacitance for the electrolytic capacitors for pins 5, 16 and 20 (among others) according to the characteristic changes caused by temperature change.

●Operation notes

(1) Use the same supply voltage for HP V_{CC} (pin 20) and SP V_{CC} (pin 16). Using different supply voltages could result in output voltage drops or circuit malfunctioning.

(2) The common impedance of the two power lines for HP V_{CC} (pin 20) and SP V_{CC} (pin 16) should be as low as possible. A large common impedance could cause oscillation.

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● External dimensions (Units: mm)

