

# 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)

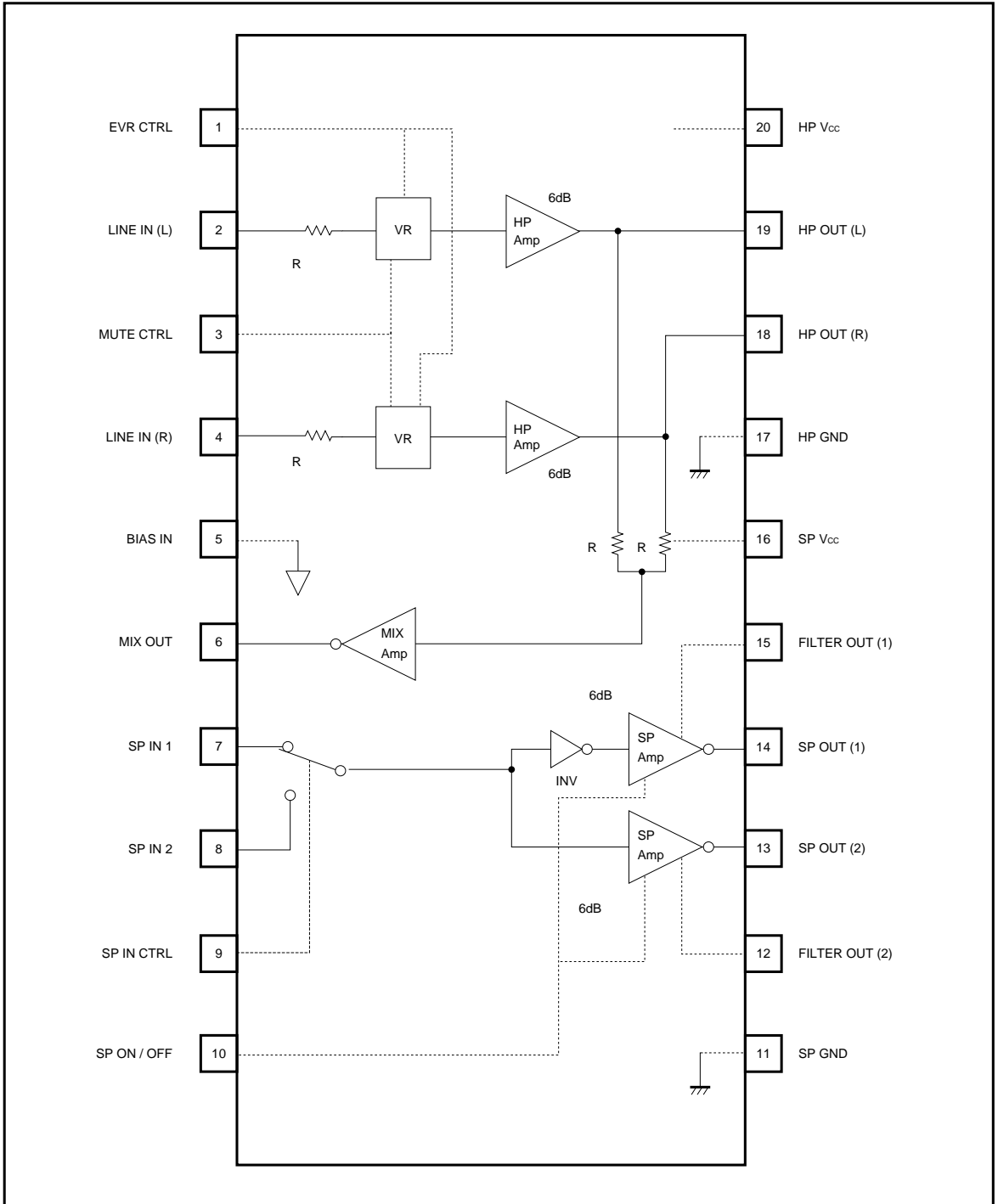
Parameter	Symbol	Limits	Unit
Power supply voltage	V <sub>CC</sub>	18	V
Power dissipation	P <sub>d</sub>	750*	mW
Operating temperature	T <sub>opr</sub>	- 10 ~ + 70	°C
Storage temperature	T <sub>stg</sub>	- 55 ~ + 125	°C

\* Reduced by 7.5mW for each increase in Ta of 1°C over 25°C.  
When mounted on a 90 × 50 × 1.6mm glass epoxy board.

### ●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	SP / HP V <sub>CC</sub>	3.0	—	6.0	V

●Block diagram



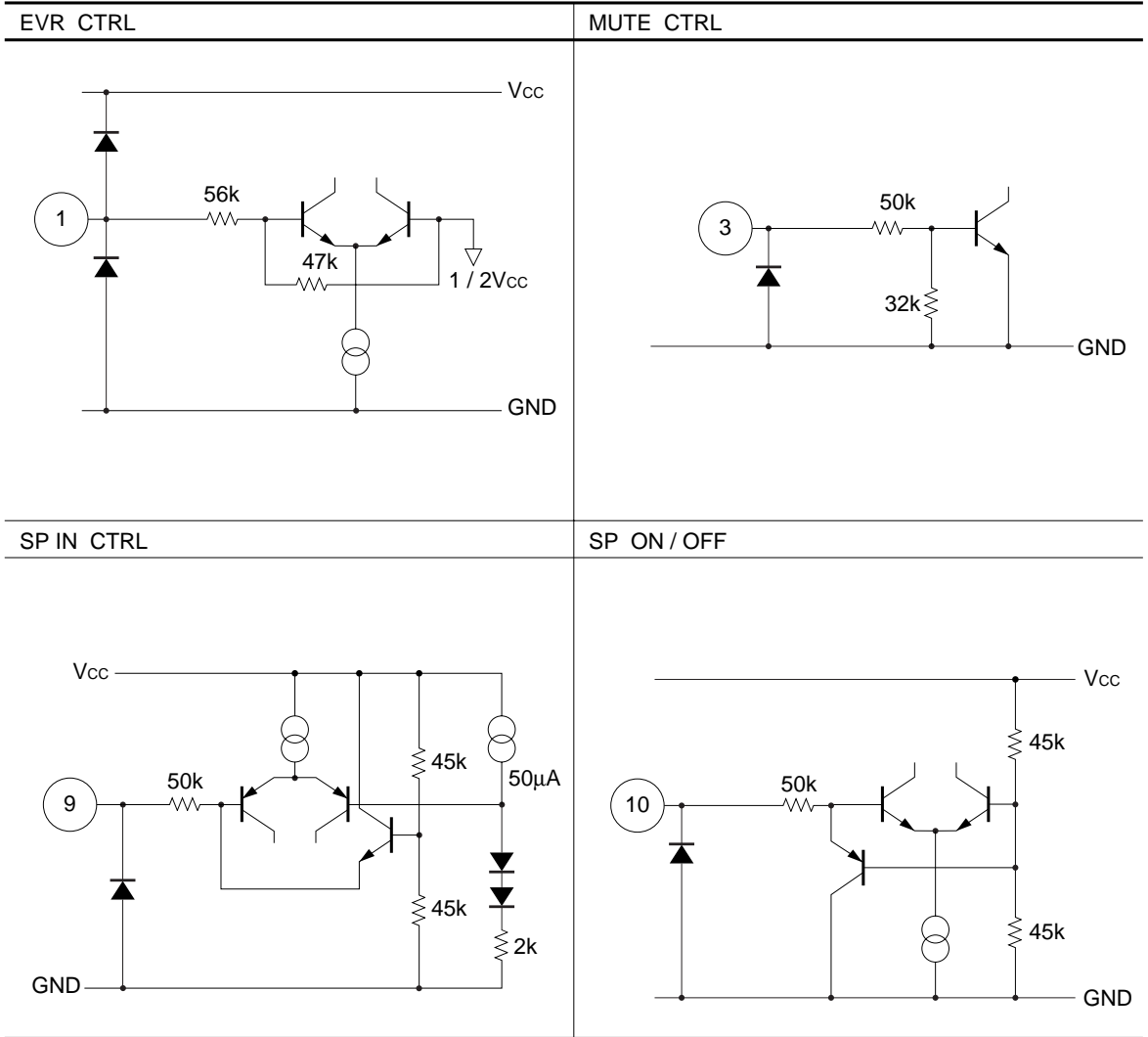
## ● Pin descriptions

Pin No.	Pin name	Function	Voltage	Type
1	EVR CTRL	EVR control input. Maximum gain at V <sub>cc</sub> .	—	B (NPN)
2, 4	LINE IN L, R	Headphone input L, R Z <sub>IN</sub> = 30kΩ	1 / 2V <sub>cc</sub>	B (PNP)
3	MUTE CTRL	Input for controlling the muting of headphone output	—	B (NPN)
5	BIAS IN	Bias buffer input	1 / 2V <sub>cc</sub>	B (NPN)
6	MIX OUT	Output of the headphone output mixing amplifier	1 / 2V <sub>cc</sub>	PP
7, 8	SP IN 1, 2	Speaker inputs 1 and 2 Switched with SP IN CTRL (9pin) Z <sub>IN</sub> = 50kΩ	1 / 2V <sub>cc</sub>	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 <sub>cc</sub>	B (NPN)
13, 14	SP OUT 1, 2	BTL speaker outputs 1 and 2	1 / 2V <sub>cc</sub>	PP
16	SP V <sub>cc</sub>	Speaker output V <sub>cc</sub>	V <sub>cc</sub>	—
17	HP GND	Ground for the headphone, mixing amplifier, inputs and controls	GND	—
19, 18	HP OUT L, R	Headphone amplifier output	1 / 2V <sub>cc</sub>	PP
20	HP V <sub>cc</sub>	V <sub>cc</sub> for the headphone, amplifier, mixing amplifier, inputs and controls	V <sub>cc</sub>	—

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

All figures are standard values.

● Input / output circuits



## ●Electrical characteristics

· Unless otherwise noted, measurement conditions are as follows.

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

$T_a = 25^{\circ}C$

EVR control (EVR CTRL pin 1) : Max. (HP  $V_{CC}$ )

Mute control (MUTE CTRL pin 3) : LOW (MUTE OFF)

Speaker input control (SP IN CTRL pin 9) : LOW (SP IN1)

Speaker on / off control (SP ON / OFF CTRL pin 10) : 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
Supply current	I	7.8	12.0	18.5	mA	No input
Supply 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	$G_{EVR}$	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

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〉						
SP IN1 holding voltage	$V_{TH9L}$	0.0	—	0.5	V	
SP IN2 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

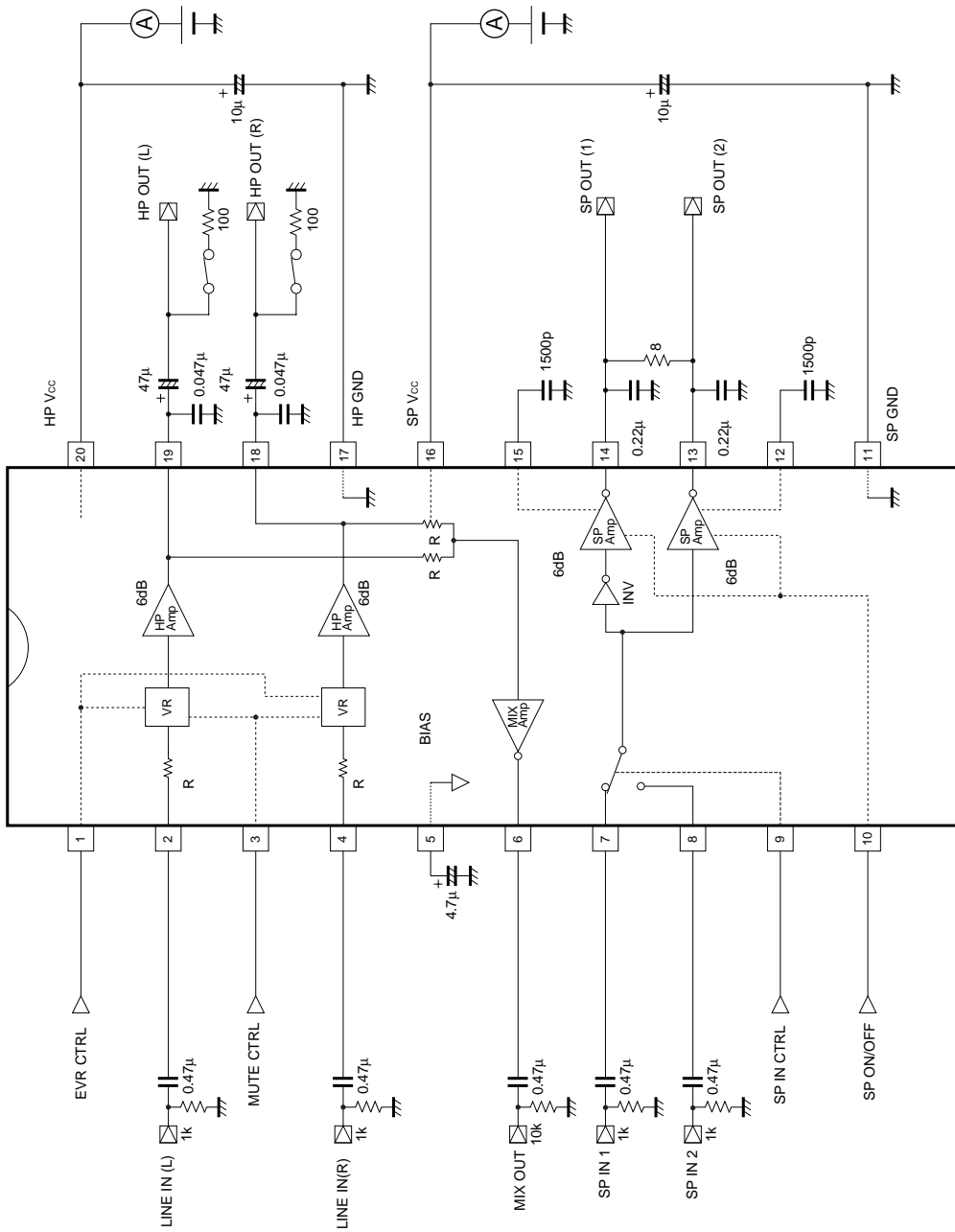


Fig.1

### ●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 SP IN1 and SP IN2.

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 50k $\Omega$ .

### ●Attached components

Use capacitors with low temperature coefficient and low variation for oscillation prevention for pins 13, 14, 18 and 19 (0.47 $\mu$ F and 0.1 $\mu$ F), and for phase correction for pins 12 and 15 (1800pF). If capacitors with high variation or temperature coefficient are used (B characteristics, etc.), be sure to compensate with an according capacitance. Also use 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<sub>CC</sub> (pin 20) and SP V<sub>CC</sub> (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<sub>CC</sub> (pin 20) and SP V<sub>CC</sub> (pin 16) should be as low as possible. A large common impedance could cause oscillation.



●External dimensions (Units: mm)

