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Class-AB Speaker Amplifiers

1W+1W Stereo

Speaker / Headphone Amplifier



BH7884EFV

No.10077EAT06

●Description

The BH7884EFV is a low voltage, low noise, high output speaker and headphone amplifier drive, in which a Bi-CMOS process is used. This IC supports: headphone amplifier gain adjustment, active/suspend switching, speaker amplifier stereo/monaural switching, and amplifier mute switching. All functions are controllable from a microcontroller. Built-in digital noise reduction circuits eliminate digital noise and BEEP sounds.

●Features

- 1) Built-in 1W+1W stereo speaker amplifier ($V_{CC}=5V$, $R_L=8\Omega$, THD=10%)
- 2) Built-in stereo headphone amplifier
- 3) Built-in bass boost function for speaker amplifier
- 4) Built-in low noise VCA (electronic volume) for headphone
- 5) Built-in mute circuit
- 6) Built-in standby circuit
- 7) Low current consumption specifications (9 mA TYP. in ACTIVE mode, 0.2 μA TYP. in SUSPEND mode)

●Applications

Notebook computers, LCD TVs, etc.

●Absolute maximum ratings($T_a=25^\circ C$)

Parameter	Ratings	Unit
Supply voltage	+6.0	V
Power dissipation	1100 *1	mW
Storage temperature	-55 ~ +125	$^\circ C$
Operating temperature	-10 ~ +70	$^\circ C$

*1 Reduced by 11 mW/ $^\circ C$ at $25^\circ C$ or higher, when mounting on a 70mmX70mmX1.6mm PCB board).

●Operating Conditions ($T_a=25^\circ C$)

Parameter	Ratings	Unit
Supply voltage	+3.0~+5.5	V

* This IC is not designed to be radiation-resistant.

● **Electrical characteristics** (Unless otherwise noted, $V_{CC}=3.3V$, $T_a=25^{\circ}C$, $f=1kHz$)

Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
■ 1 CHIP						
Circuit current ACTV	IA	-	9.0	18.0	mA	No signal ACTIVE
Circuit current SPND	Is	-	0.2	10.0	μA	No signal SUSPEND
■ SP AMP						
Voltage gain1	G_{SP1}	9.0	12.0	15.0	dB	SE, $V_{in}=-18dBV, R_L=8\Omega$
Voltage gain2	G_{SP2}	15.2	18.2	21.2	dB	BTL, $V_{in}=-18dBV$
Distortion	D_{SP}	-	0.1	1.0	%	BTL, $V_{in}=-18dBV$
Maximum output level	V_{OSP}	2.2	5.2	-	dBV	BTL, DSP=1%
Output noise level	V_{NSP}	-	-97	-80	dBV	SE, DIN-Audio
Cross talk	CT_{SP}	-	-90	-80	dBV	SE, $V_{in}=-18dBV$, DIN-Audio
Output level on mute	MT_{SP}	-	-102	-80	dBV	BTL, $V_{in}=-18dBV$
■ HP AMP						
Voltage gain 3	G_{HP}	2.6	5.6	8.6	dB	VOL:MAX, $R_L=10k\Omega, V_{in}=-12dBV$
Voltage gain 4	G_{HP}	-10	-7	-4	dB	VOL:MAX, $R_L=32\Omega, V_{in}=-12dBV$
Distortion	D_{HP}	-	0.025	0.1	%	VOL:MAX, $R_L=32\Omega, V_{in}=-8dBV$
Variable width of volume	ΔG_{HP}	70	100	-	dB	VOL:MIN ~ MAX, $R_L=32\Omega$
Maximum output level	V_{OHP}	-2.0	1.0	-	dBV	VOL:MAX, DHP=1%, $R_L=10k\Omega$
Output noise level	V_{NHP}	-	-98	-80	dBV	VOL:MAX, $R_L=32\Omega$, DIN-Audio
Cross talk	CT_{HP}	-	-98	-80	dBV	VOL:MAX, $R_L=32\Omega, V_{in}=-12dBV$ DIN-Audio
Output level on mute	MT_{HP}	-	-110	-80	dBV	VOL:MAX, $R_L=32\Omega, V_{in}=-12dBV$ DIN-Audio
■ BEEP AMP						
Output voltage level	V_{BP}	0.8	1.25	-	Vpp	$V_{in}=1.3dBV, f=1kHz, 20MHzLPP$
■ BIAS						
Output voltage level	V_{BIAS}	1.4	1.7	2.0	V	No Signal
■ CTRL						
ACTIVE mode	V_{11H}	$V_{CC}-0.3$	-	V_{CC}	V	Active mode. Hold Voltage of 11pin.
SUSPEND mode	V_{11L}	GND	-	0.3	V	Suspend mode. Hold Voltage of 11pin.
SP/ON mode	V_{2H}	$V_{CC}-0.3$	-	V_{CC}	V	SP / ON mode. Hold Voltage of 2pin.
SP/OFF mode	V_{2L}	GND	-	0.3	V	SP/OFF mode. Hold Voltage of 2pin.
BASS-BOOST/ON mode	V_{4H}	$V_{CC}-0.7$	-	V_{CC}	V	SP / Bass Boost mode. Hold Voltage of 4pin.
BASS-BOOST/OFF mode	V_{4L}	GND	-	0.7	V	SP / Non Boost mode. Hold Voltage of 4pin.
STEREO mode	V_{3H}	$V_{CC}-0.7$	-	V_{CC}	V	SP / STEREO mode. Hold Voltage of 3pin.
MONO mode	V_{3L}	GND	-	0.7	V	SP / MONO mode. Hold Voltage of 3pin.
ACTIVE mode	V_{10H}	$V_{CC}-0.7$	-	V_{CC}	V	HP / Active mode. Hold Voltage of 10pin.
MUTE mode	V_{10L}	GND	-	0.7	V	HP / MUTE mode. Hold Voltage of 10pin.
■ PSRR						
Ripple rejection ratio	G_{PR}	-	-64	-	dBV	$f=100Hz, 0.3V_{pp}$, SIN Input SPOUT monitor, DIN-Audio

●Block diagram

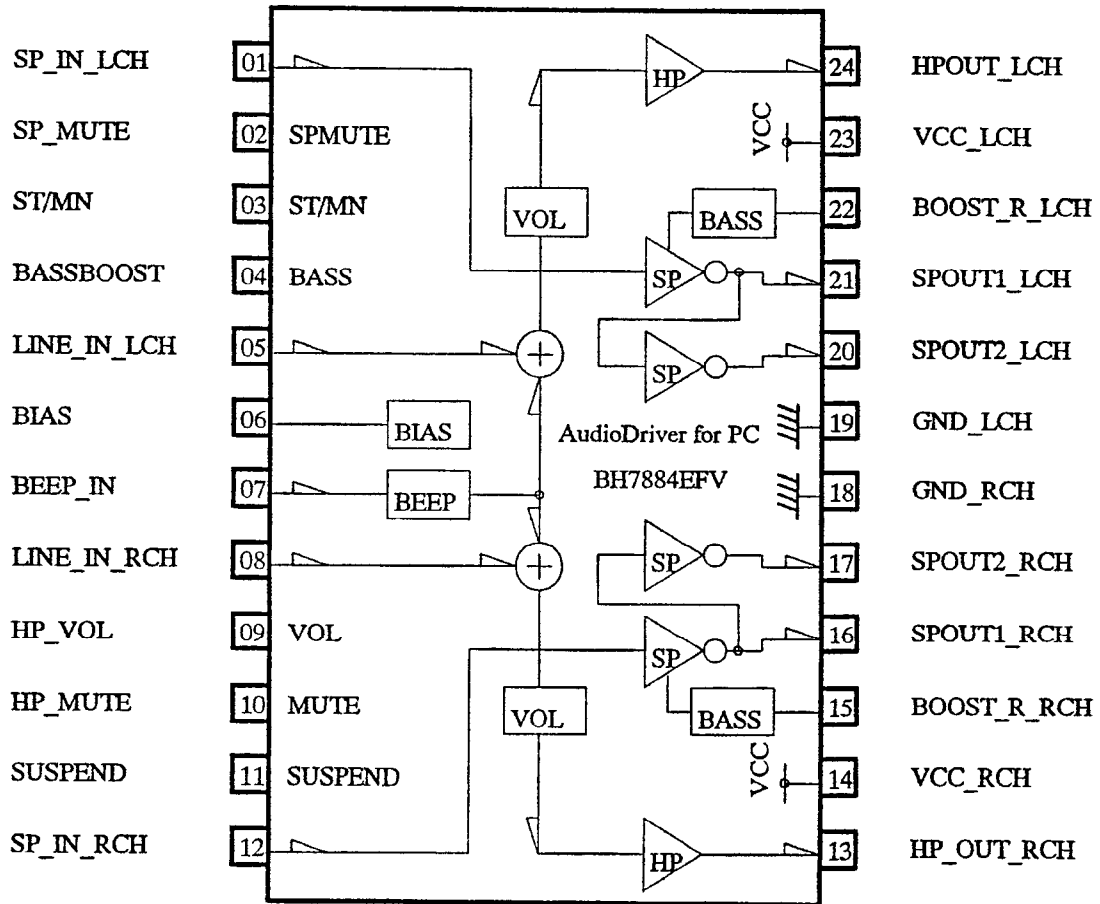


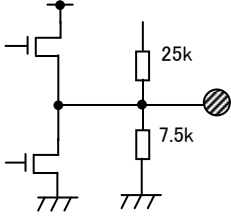
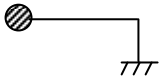
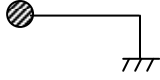
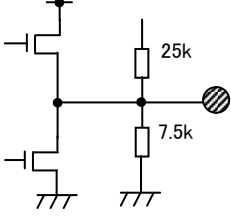
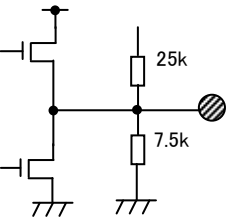
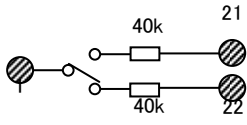
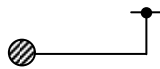
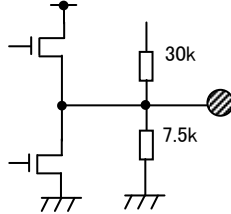
Fig.1

●Control pin settings

SP MUTE PIN:2PIN		
H	SP ACTIVE	SPAMP is in active state
L	SP MUTE	SPAMP is in suspend state
STEREO/MONO PIN:3PIN		
H	STEREO	For SPAMP, LCH and RCH both are in active state
L	MONO	For SPAMP, LCH is in active state and RCH is in suspend state
BASSBOOST PIN:4PIN		
H	BASS BOOST	For SPAMP, bass is boosted
L	NON -BOOST	For SPAMP, bass is not boosted
MUTE PIN:10PIN (The SPAMP mute function is realized by connecting HP_OUT to SP_IN)		
H	ACTIVE	HPAMP is in active state
L	MUTE	HPAMP is in mute state
SUSPEND PIN:11PIN		
H	ACTIVE	The IC is in active state
L	SUSPEND	The IC is in suspend state

●Equivalent circuit

PIN1	SP_IN_LCH	PIN2	SP_MUTE	PIN3	ST/MN	PIN4	BASS BOOST
PIN5	LINE_IN_LCH	PIN6	BIAS	PIN7	BEEP_IN	PIN8	LIHE_IN_RCH
PIN9	HP_VOL	PIN10	HP_MUTE	PIN11	SUSPEND	PIN12	SP_IN_RCH
PIN13	HP_OUT_RCH	PIN14	VCC_RCH	PIN15	BOOST_R_RCH	PIN16	SPOUT1_RCH

PIN17	SPOUT2_RCH	PIN18	GND_RCH	PIN19	GND_LCH	PIN20	SPOUT2_LCH
							
PIN21	SPOUT1_LCH	PIN22	BOOST_R_LCH	PIN23	VCC_LCH	PIN24	HP_OUT_LCH
							

● Application circuit

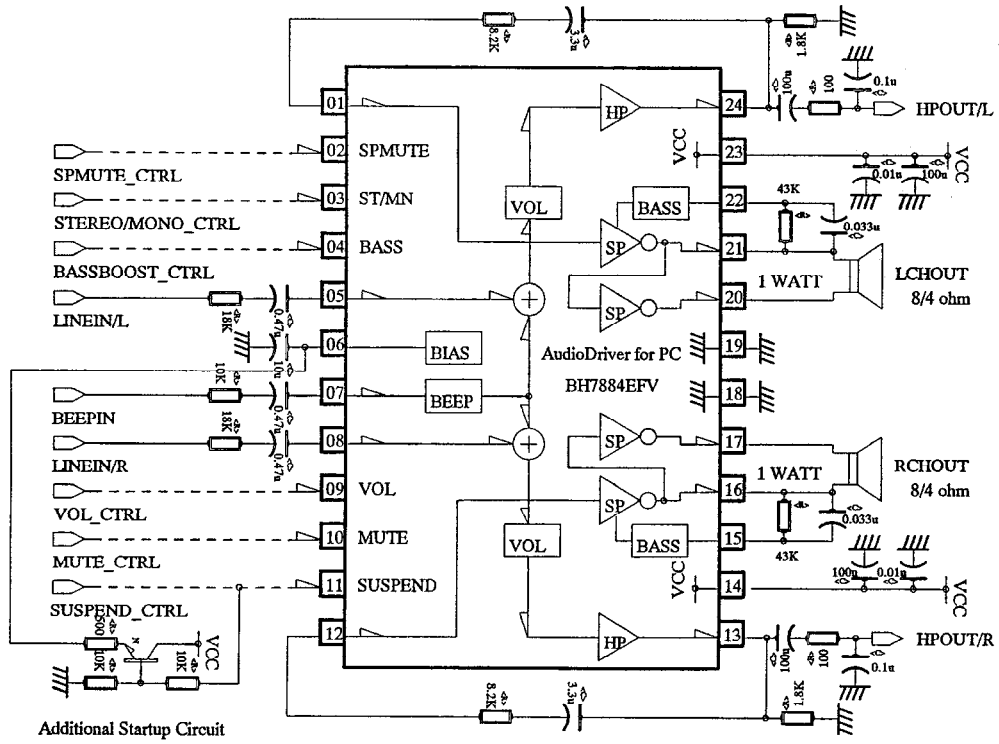


Fig.2

●Description of operations

1) LINEIN (5,8PIN) ~ HPOUT (13,24PIN) voltage gain

The voltage gain at EVRMAX is generally calculated by the following equation:

$$G_{HP} = 20 \times \log \frac{40k}{R_5(\text{or } R_8)} \quad (\text{dB})$$

The above gain attenuates according to the DC voltage of the VOL pin (9PIN).
By connecting multiple resistances (R), mixing input can be handled.

2) BEEPIN (7PIN) ~ HPOUT (13,24PIN)

When a pulse waveform is input at the BEEPIN pin, a pulse wave is output at HPOUT (24,13PIN).

The output level, determined by the resistance of 7PIN, has default values as follows:

HP OUT level	Vcc=5V	Vcc=4V	Vcc=3.3V
1Vpp<	<56k	<91k	<120k
0.5Vpp	68k	110k	160k
0.25Vpp	75k	130k	200k

*(Unit: Ω)

To obtain the default setting output (approx. 1.2 Vpp output), make R7=10 kΩ.

The variation in output levels is small.

Signals below a certain level are determined to be noise, by IC internals, and are not output at HPOUT.

3) SP IN (1,12PIN) ~ SP OUT (21, 20, 16,17PIN) voltage gain

The voltage gain in BASSBOOST is generally calculated by the following equation:

$$G_{SPB} = 20 \times \log \frac{40k + R_{21-20}(\text{or } R_{16-15})}{R_1(\text{or } R_{12})} \quad (\text{dB})$$

The cut-off frequency in BASSBOOST is generally calculated by the following equation:

$$f_{CB} = \frac{1}{2\pi C_{21-22}(\text{or } C_{16-15}) \times R_{21-20}(\text{or } R_{16-15})}$$

The voltage gain in NONBOOST is generally calculated by the following equation:

$$G_{SP} = 20 \times \log \frac{40k}{R_1(\text{or } R_{12})} \quad (\text{dB})$$

4) EVR control characteristic

HP AMP gain is controlled by the ratio of voltage to resistance between VCC and GND.

Note: A resistance (RN), shown above, is the resistance that is connected to pin N.

A capacitance (CN), shown above, is the capacitance that is connected to pin N.

The numeric values above are design reference values, whose values are not guaranteed.

● Operation Notes

1. Numbers and data in entries are representative design values and are not guaranteed values of the items.
2. Although ROHM is confident that the example application circuit reflects the best possible recommendations, be sure to verify circuit characteristics for your particular application. Modification of constants for other externally connected circuits may cause variations in both static and transient characteristics for external components as well as this Rohm IC. Allow for sufficient margins when determining circuit constants.
3. Absolute maximum ratings
Use of the IC in excess of absolute maximum ratings, such as the applied voltage or operating temperature range (Topr), may result in IC damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. A physical safety measure, such as a fuse, should be implemented when using the IC at times where the absolute maximum ratings may be exceeded.
4. GND potential
Ensure a minimum GND pin potential in all operating conditions. Make sure that no pins are at a voltage below the GND at any time, regardless of whether it is a transient signal or not.
5. Thermal design
Perform thermal design, in which there are adequate margins, by taking into account the permissible dissipation (Pd) in actual states of use.
6. Short circuit between terminals and erroneous mounting
Pay attention to the assembly direction of the ICs. Wrong mounting direction or shorts between terminals, GND, or other components on the circuits, can damage the IC.
7. Operation in strong electromagnetic field
Using the ICs in a strong electromagnetic field can cause operation malfunction.
8. Pop noise when switching power ON/OFF
To prevent pop noise when switching VCC ON/OFF or switching SUSPEND ON/OFF, use SUSPEND (11PIN=L), HP MUTE (10PIN=L), and SUSPEND (2PIN=L) for noise control, as shown below.

(VCC OFF→ON)

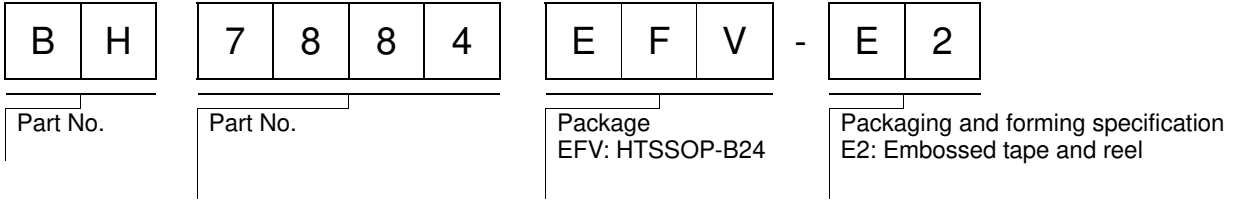
	VCC	SPND	HPMT	SPMT
1)	OFF	L	L	L
2)	ON	L	L	L
3)	ON	H	L	L
4)	ON	H	H	L
5)	ON	H	H	H

(VCC ON→OFF)

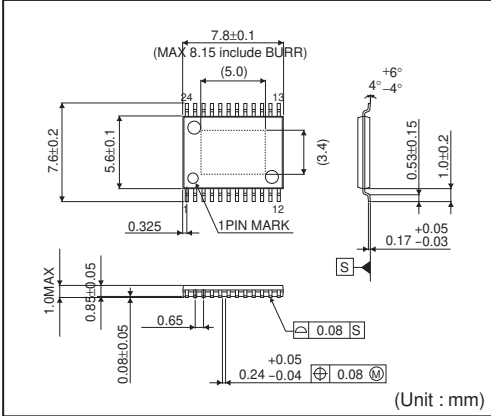
	VCC	SPND	HPMT	SPMT
1)	OFF	H	H	H
2)	ON	H	H	L
3)	ON	H	L	L
4)	ON	L	L	L
5)	ON	L	L	L

9. Power supply bypass capacitor
Place the bypass capacitor close to the VCC ~ GND pins.
10. Mode switching
Do not apply a voltage that exceeds VCC or a voltage that is less than GND, at a control pin.
11. Power package
Ensure heat dissipation by connecting the heatsink to the back of the IC and to the GND board. Ensure that the GND area is large.
12. HPOUT
Connect resistance (100 Ω is recommended) to the output for SPAMP input level adjustment and to prevent HPAMP oscillation.
13. Capacitive load
Do not connect a capacitive load to SPAMP or HPAMP output as it may cause oscillation.
14. Startup time at low temperature and reduced power
Use the following methods to eliminate longer start up time at low temperatures (less than about -10°C) and reduced power (less than about 3.0 V):
 - 1) Start in SPMUTE state and then cancel SPMUTE.
 - 2) Add to transistor and resistance, as shown in the application circuit diagram.

●Ordering part number

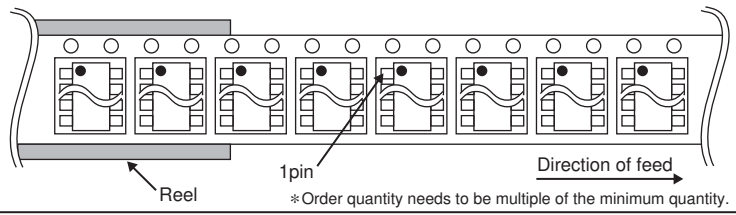


HTSSOP-B24



<Tape and Reel information>

Tape	Embossed carrier tape (with dry pack)
Quantity	2000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



Notes

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