

# Low power consumption headphone driver for digital audio

## BA3576FS

The BA3576FS is a headphone driver developed for use in 3.0V portable digital audio equipment.

### ●Applications

Portable CD and MD players.

### ●Features

- 1) Low power consumption (when  $P_o = 0.5\text{mW}$  per channel, the power supply current is 4.7mA, and the +B current is 6.8mA (Typ.)).
- 2) High S / N ratio (96dB).
- 3) AVC circuit.
- 4) Beep output function
- 5) Mute circuit.

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

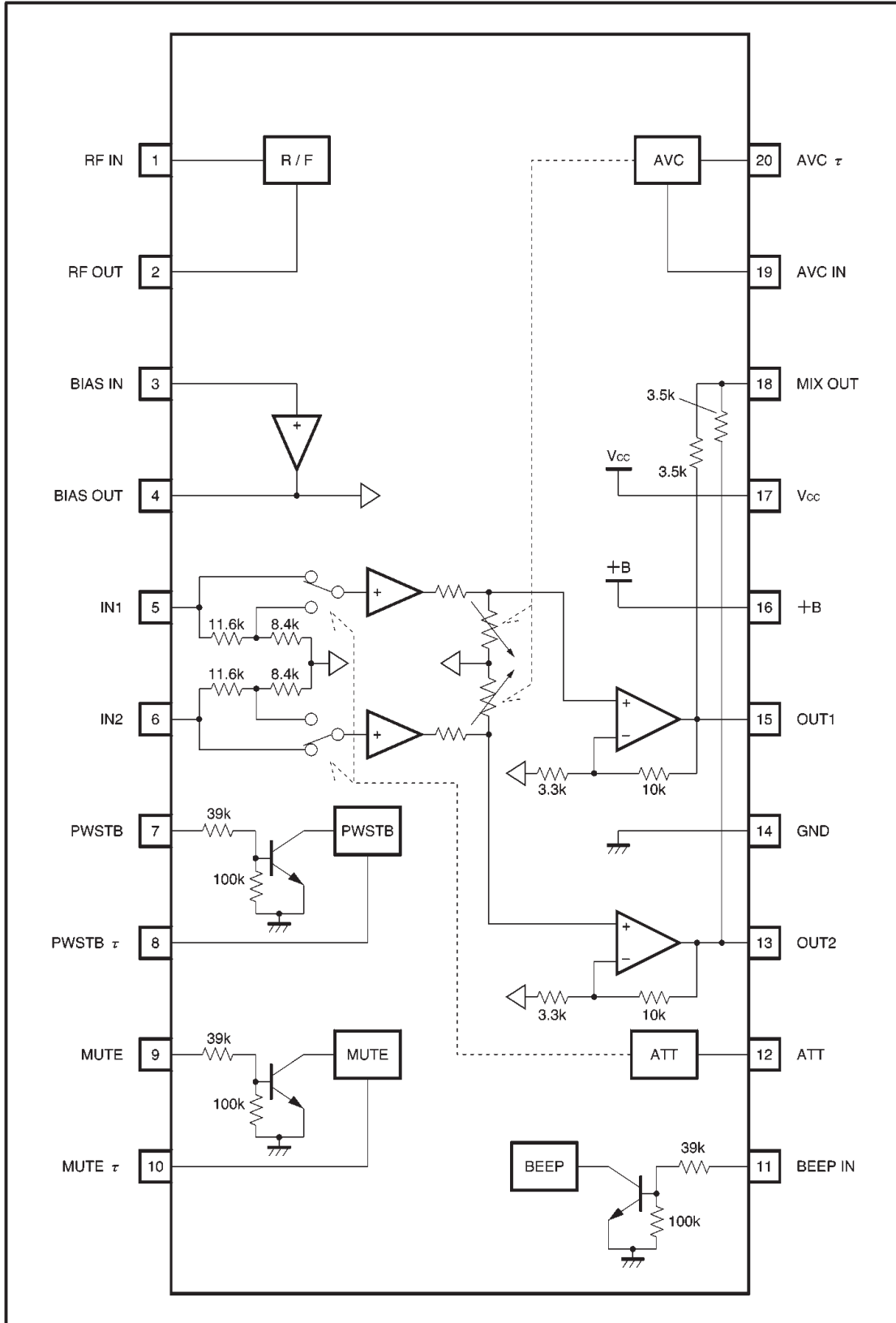
Parameter	Symbol	Limits	Unit
Power supply voltage	$V_{CC}$	4.5	V
	+B	6.0	V
Power dissipation	$P_d$	650*1	mW
Operating temperature	$T_{opr}$	-15~+60	°C
Storage temperature	$T_{stg}$	-55~+125	°C

\*1 Reduced by 6.5mW for each increase in  $T_a$  of 1°C over 25°C.

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

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	$V_{CC}$	2.6	3.0	3.6	V
	+B	1.5	2.4	5.0	V

●Block diagram

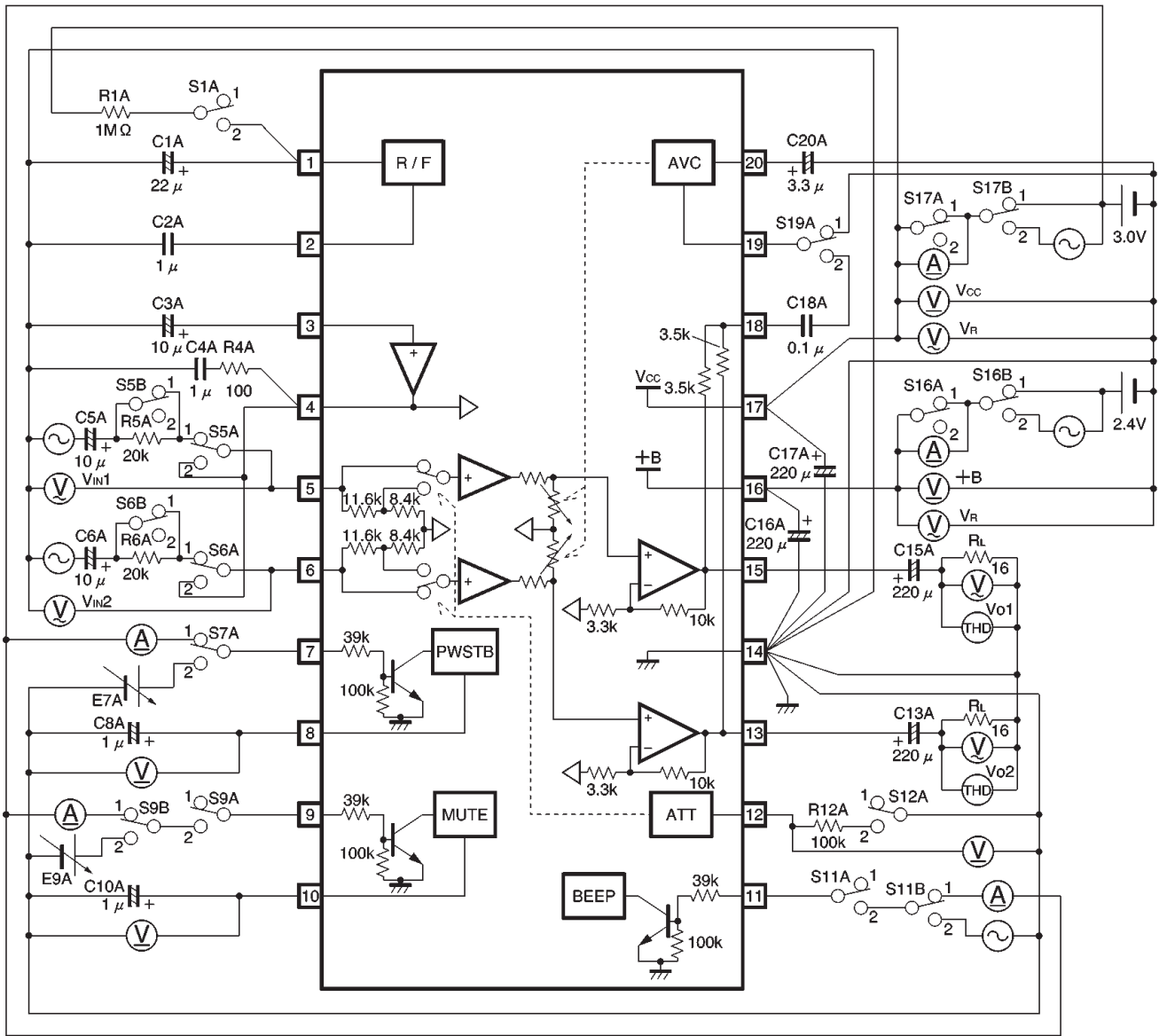


●Electrical characteristics (unless otherwise noted,  $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 3.0\text{V}$ ,  $+B = 2.4\text{V}$ ,  $f = 1\text{kHz}$ ,  $R_L = 16\Omega$ ,  
DIN AUDIO PWSTB = 3.0V, MUTE = 0V, ATT = OFF and AVC = OFF)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Coniditions
Quiescent $V_{CC}$ current	$I_{Q1}$	—	4.5	8.0	mA	$V_{IN1,2}=0$
Quiescent $+B$ current	$I_{Q2}$	—	3.4	6.8	mA	$V_{IN1,2}=0$
$V_{CC}$ current during operation	$I_{IN1}$	—	4.7	8.2	mA	$P_{O1,2}=0.5\text{mW}$
$+B$ operating current	$I_{IN2}$	—	6.8	10.2	mA	$P_{O1,2}=0.5\text{mW}$
$+B$ leak current	$\Delta I_B$	—	—	5.0	$\mu\text{A}$	$+B$ input current when $V_{CC}=0\text{V}$
Voltage gain 1	$G_{V1}$	9.0	11.5	14.5	dB	—
Voltage gain 2	$G_{V2}$	1.5	4.0	7.0	dB	ATT ON
Total harmonic distortion	THD	—	0.1	0.9	%	$V_O=0.1\text{Vrms}$
Rated output	$P_O$	15	25.6	—	mW	THD=10%
Output noise voltage	$V_{NO}$	—	-99	-91	dBV	$R_g=0$ , JIS A
Input resistance	$R_{IN}$	15.0	19.0	23.0	k $\Omega$	—
Channel separation	CS	63	73	—	dB	$R_g=0$ , $V_O=0.1\text{Vrms}$ , 1kHz BPF
Mute level	ML	—	-105	-95	dBV	$V_{IN}=-30\text{dBV}$ , MUTE ON, 1kHz BPF
AVC level	$V_{AVC}$	-43.5	-40.5	-37	dBV	$V_{IN}=-30\text{dBV}$ , AVC=ON
Ripple rejection 1	$RR_1$	60.8	67.8	—	dB	With $R_g=0$ , $f_R=100\text{Hz}$ , and 100Hz BPF $V_R=-20\text{dBm}$ applied to $V_{CC}$ only
Ripple rejection 2	$RR_2$	66.5	74.5	—	dB	With $R_g=0$ , $f_R=100\text{Hz}$ , and 100Hz BPF $V_R=-20\text{dBm}$ applied to $+B$ only
Ripple rejection 3	$RR_3$	37.0	44.0	—	dB	With $R_g=0$ , $f_R=100\text{Hz}$ , and 100Hz BPF $V_R=-20\text{dBm}$ applied to $V_{CC}$ only 1M $\Omega$ connected between R / $F_{IN}$ and $V_{CC}$ $V_{CC}=2.6\text{V}$
BEEP pin input current	$R_{BP}$	—	50	100	$\mu\text{A}$	$I_{11}$ when $V_{11}=V_{CC}$
BEEP output voltage	$V_{BP}$	1.9	2.84	3.7	mVrms	$V_{BPIN}=3.0\text{V}_{P-P}$ , $f=1\text{kHz}$
PWSTB OFF pin voltage	$V_P$	—	1.0	1.5	V	$V_7$ to make $V_8 \geq 0.5\text{V}$
PWSTB OFF pin input current	$I_P$	—	50	100	$\mu\text{A}$	$I_7$ when $V_7=V_{CC}$
MUTE ON pin voltage	$V_M$	—	1.0	1.5	V	$V_9$ to make $V_{10} \leq 0.5\text{V}$
MUTE ON pin input current	$I_M$	—	50	100	$\mu\text{A}$	$I_9$ when $V_9=V_{CC}$
Voltage when ATT ON	$V_A$	—	0.72	0.9	V	$V_{12}$ when ATT ON

©Not designed for radiation resistance.

● Measurement circuit



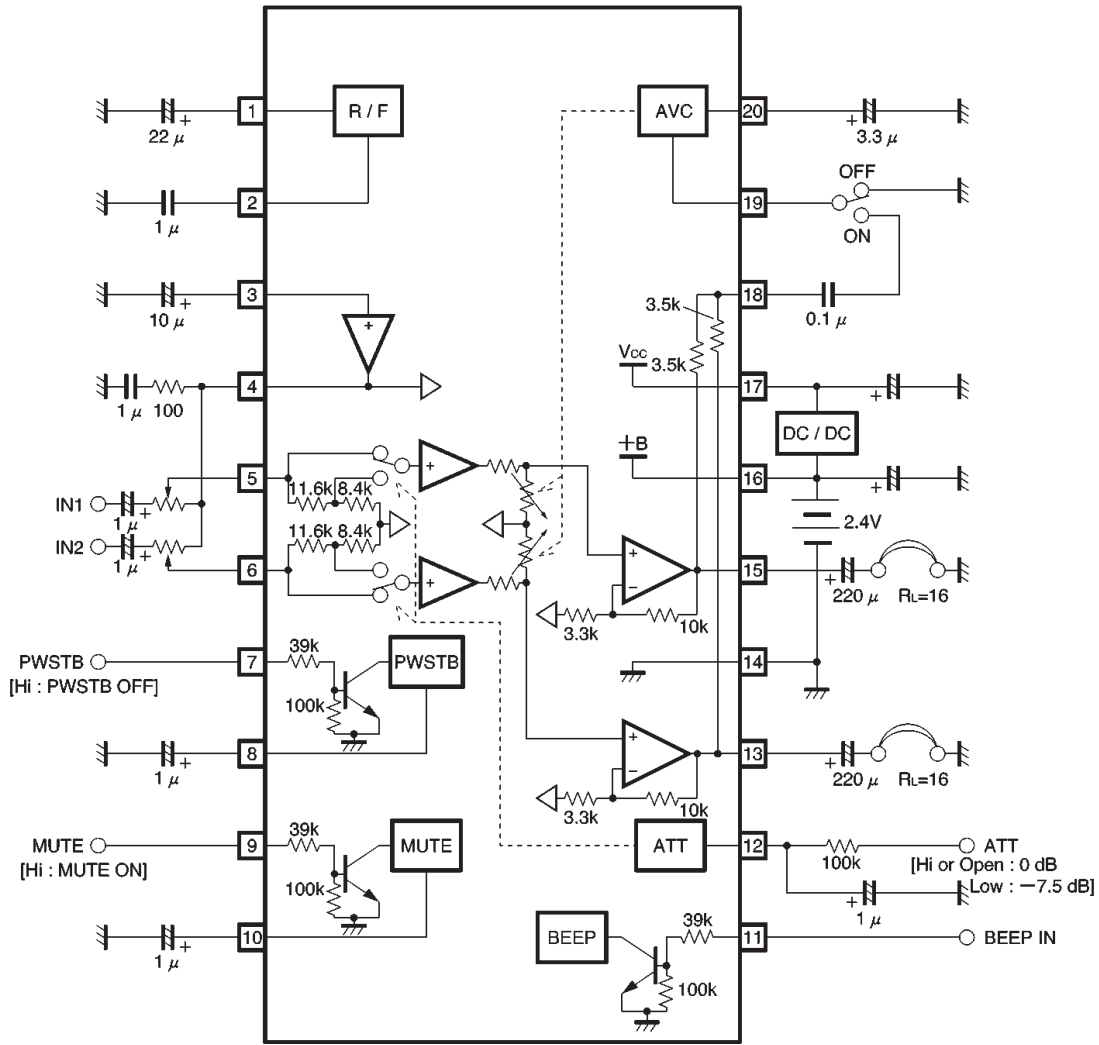
Units:  
 Resistance : Ω (±1%)  
 Capacitance (film) : F (±1%)  
 Capacitance (electrolytic) : F (±5%)

Fig.1

Measurement conditions

Parameter	Symbol	S1A	S5A	S5B	S6A	S6B	S7A	S9A	S9B	S11A	S11B	S12A	S16A	S16B	S17A	S17B	S19A
Quiescent Vcc current	I <sub>Q1</sub>	1	2	1	2	1	1	1	1	1	1	1	1	1	2	1	1
Quiescent +B current	I <sub>Q2</sub>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓	↓
Vcc current during operation	I <sub>IN1</sub>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	↓	2	↓	↓
+B current during operation	I <sub>IN2</sub>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓	↓
+B leak current	ΔI <sub>B</sub>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Voltage gain 1	G <sub>V1</sub>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	↓	↓	↓	↓
Voltage gain 2	G <sub>V2</sub>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	↓	↓	↓	↓
Total harmonic distortion	THD	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	↓	↓	↓	↓	↓
Rated output	P <sub>O</sub>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Output noise voltage	V <sub>NO</sub>	↓	2	↓	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Input resistance	R <sub>IN</sub>	↓	1	2	1	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Channel separation	CS	↓	1 / 2	1	2 / 1	1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Mute level	ML	↓	1	↓	1	↓	↓	2	↓	↓	↓	↓	↓	↓	↓	↓	↓
AVC level	V <sub>AVC</sub>	↓	↓	↓	↓	↓	↓	1	↓	↓	↓	↓	↓	↓	↓	↓	2
Ripple rejection 1	RR <sub>1</sub>	↓	2	↓	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	1
Ripple rejection 2	RR <sub>2</sub>	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
Ripple rejection 3	RR <sub>3</sub>	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
BEEP pin input current	R <sub>BP</sub>	1	1	↓	1	↓	↓	↓	↓	2	↓	↓	↓	1	↓	↓	↓
BEEP output voltage	V <sub>BP</sub>	↓	↓	↓	↓	↓	↓	2	↓	↓	2	↓	↓	↓	↓	↓	↓
PWSTB OFF pin voltage	V <sub>S</sub>	↓	↓	↓	↓	↓	2	1	↓	1	1	↓	↓	↓	↓	↓	↓
PWSTB OFF pin input current	I <sub>S</sub>	↓	↓	↓	↓	↓	1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
MUTE ON pin voltage	V <sub>M</sub>	↓	↓	↓	↓	↓	↓	2	2	↓	↓	↓	↓	↓	↓	↓	↓
MUTE ON pin input current	I <sub>M</sub>	↓	↓	↓	↓	↓	↓	2	1	↓	↓	↓	↓	↓	↓	↓	↓
Voltage when ATT ON	V <sub>A</sub>	↓	↓	↓	↓	↓	↓	1	↓	↓	↓	↓	↓	↓	↓	↓	↓

●Application example



Units:  
 Resistance : Ω (±5%)  
 Capacitance (film) : F (±10%)  
 Capacitance (electrolytic) : F (±20%)

Fig.2

●Operation notes

(1) By operating the BA3576FS according to the timing chart shown in Fig.3, it is possible to suppress generation of "pop" noise in the headphone output.

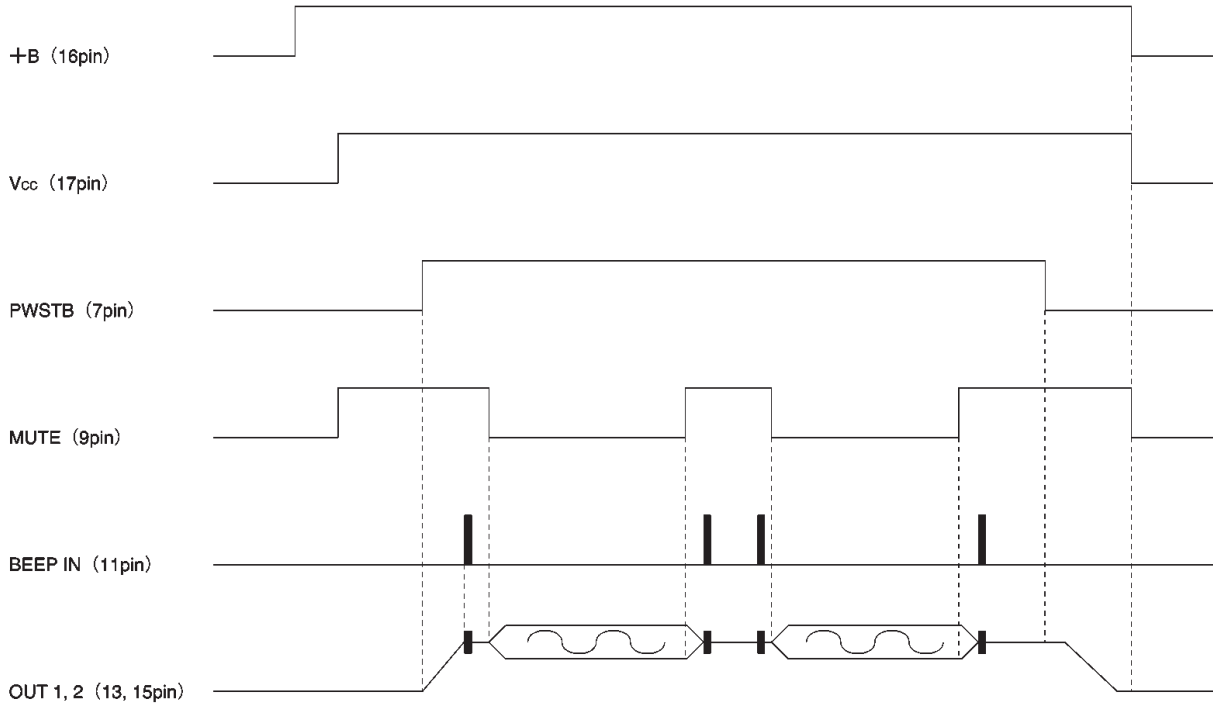


Fig.3

(2) The BA3576FS ripple filter pins (1 and 2) and the bias amp pins (3 and 4) cannot be used as external power supplies or reference voltages.

(3) The BEEP signal is only output when PWSTB (pin 7) and MUTE (pin 9) are high level. Also, input a rectangular wave of between 500Hz and 5kHz and with an amplitude of Vcc (with respect to ground) to BEEP IN (pin 11).

●Electrical characteristics curves

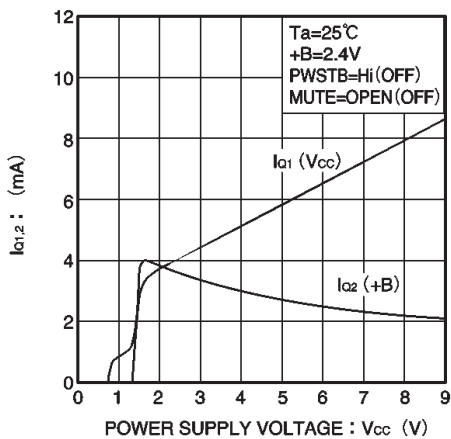


Fig.4  $I_{a1}$   $I_{a2}$  —  $V_{cc}$

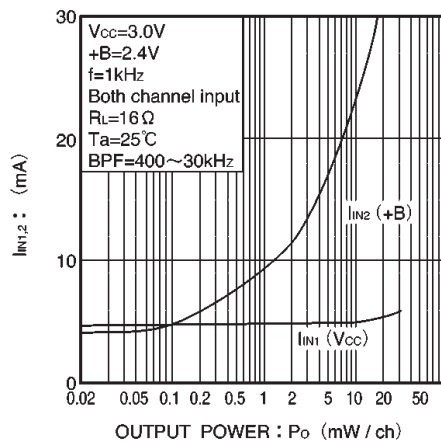


Fig.5  $I_{in1}$   $I_{in2}$  —  $P_o$

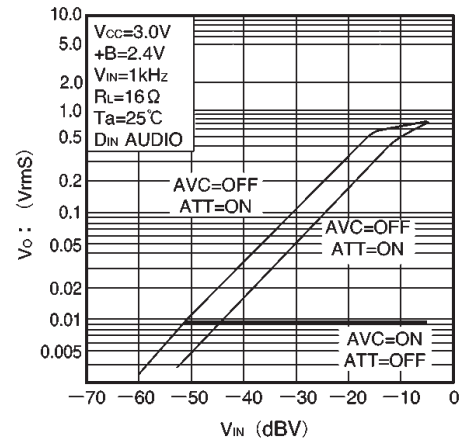


Fig.6  $V_o$  —  $V_{in}$

● External dimensions (Units: mm)

