

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 ($T_a = 25^\circ\text{C}$)

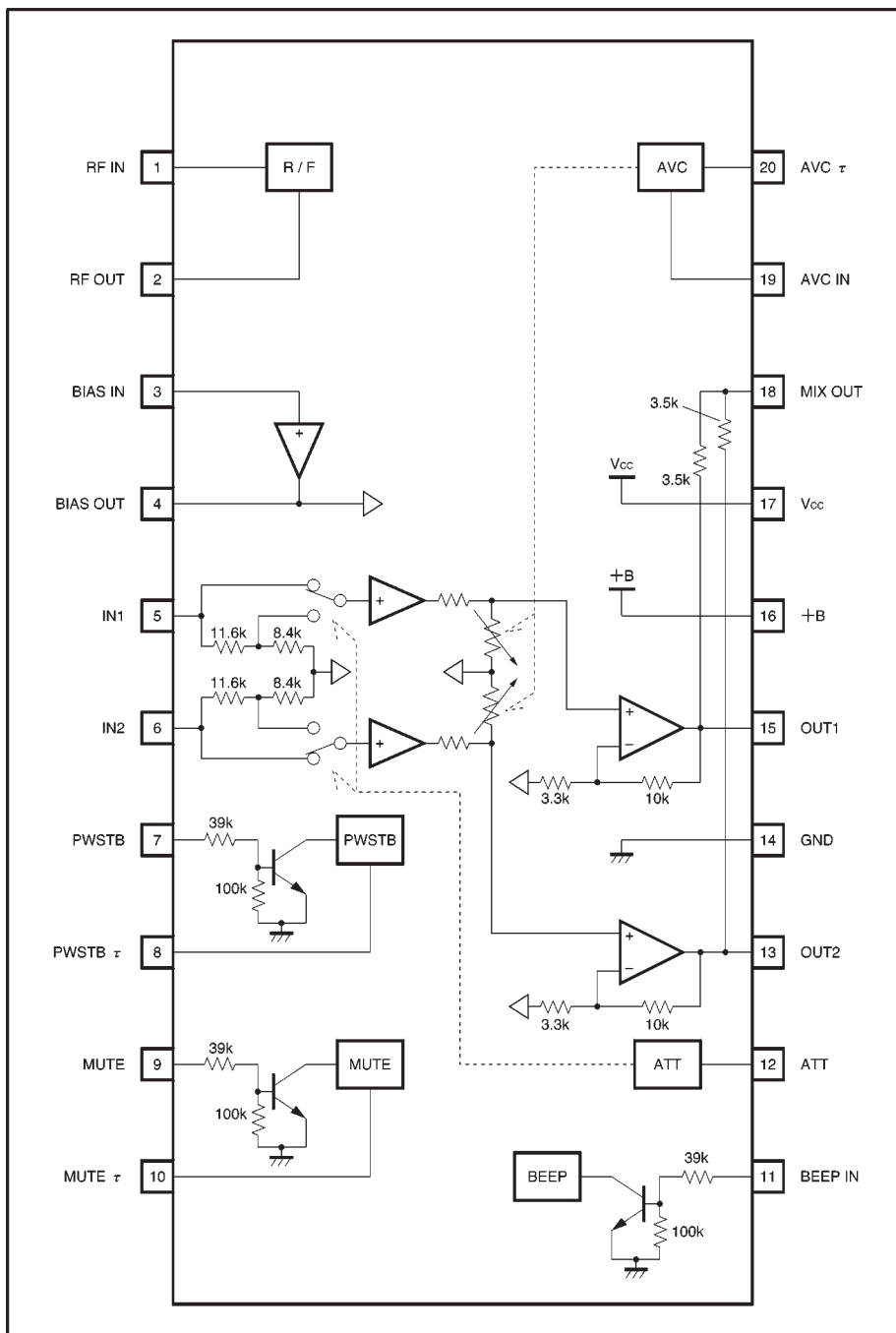
Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	4.5	V
	+B	6.0	V
Power dissipation	P_d	650*1	mW
Operating temperature	T_{opr}	$-15 \sim +60$	$^\circ\text{C}$
Storage temperature	T_{stg}	$-55 \sim +125$	$^\circ\text{C}$

*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, Ta = 25°C, V_{CC} = 3.0V, +B = 2.4V, f = 1kHz, R_L = 16Ω, 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} =0.5mW
+B operating current	I _{IN2}	—	6.8	10.2	mA	P _{O1,2} =0.5mW
+B leak current	Δ I _B	—	—	5.0	μA	+B input current when V _{CC} =0V
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 =0.1V _{rms}
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	kΩ	—
Channel separation	CS	63	73	—	dB	R _g =0, V _O =0.1V _{rms} , 1kHz BPF
Mute level	ML	—	−105	−95	dBV	V _{IN} =−30dBV, MUTE ON, 1kHz BPF
AVC level	V _{AVC}	−43.5	−40.5	−37	dBV	V _{IN} =−30dBV, AVC=ON
Ripple rejection 1	RR ₁	60.8	67.8	—	dB	With R _g =0, f _R =100Hz, and 100Hz BPF V _R =−20dBm applied to V _{CC} only
Ripple rejection 2	RR ₂	66.5	74.5	—	dB	With R _g =0, f _R =100Hz, and 100Hz BPF V _R =−20dBm applied to +B only
Ripple rejection 3	RR ₃	37.0	44.0	—	dB	With R _g =0, f _R =100Hz, and 100Hz BPF V _R =−20dBm applied to V _{CC} only 1MΩ connected between R / F _{IN} and V _{CC} V _{CC} =2.6V
BEEP pin input current	R _{BP}	—	50	100	μA	I ₁₁ when V ₁₁ =V _{CC}
BEEP output voltage	V _{BP}	1.9	2.84	3.7	mV _{rms}	V _{BPIN} =3.0V _{P-P} , f=1kHz
PWSTB OFF pin voltage	V _P	—	1.0	1.5	V	V ₇ to make V ₈ ≥ 0.5V
PWSTB OFF pin input current	I _P	—	50	100	μA	I ₇ when V ₇ =V _{CC}
MUTE ON pin voltage	V _M	—	1.0	1.5	V	V ₉ to make V ₁₀ ≤ 0.5V
MUTE ON pin input current	I _M	—	50	100	μA	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

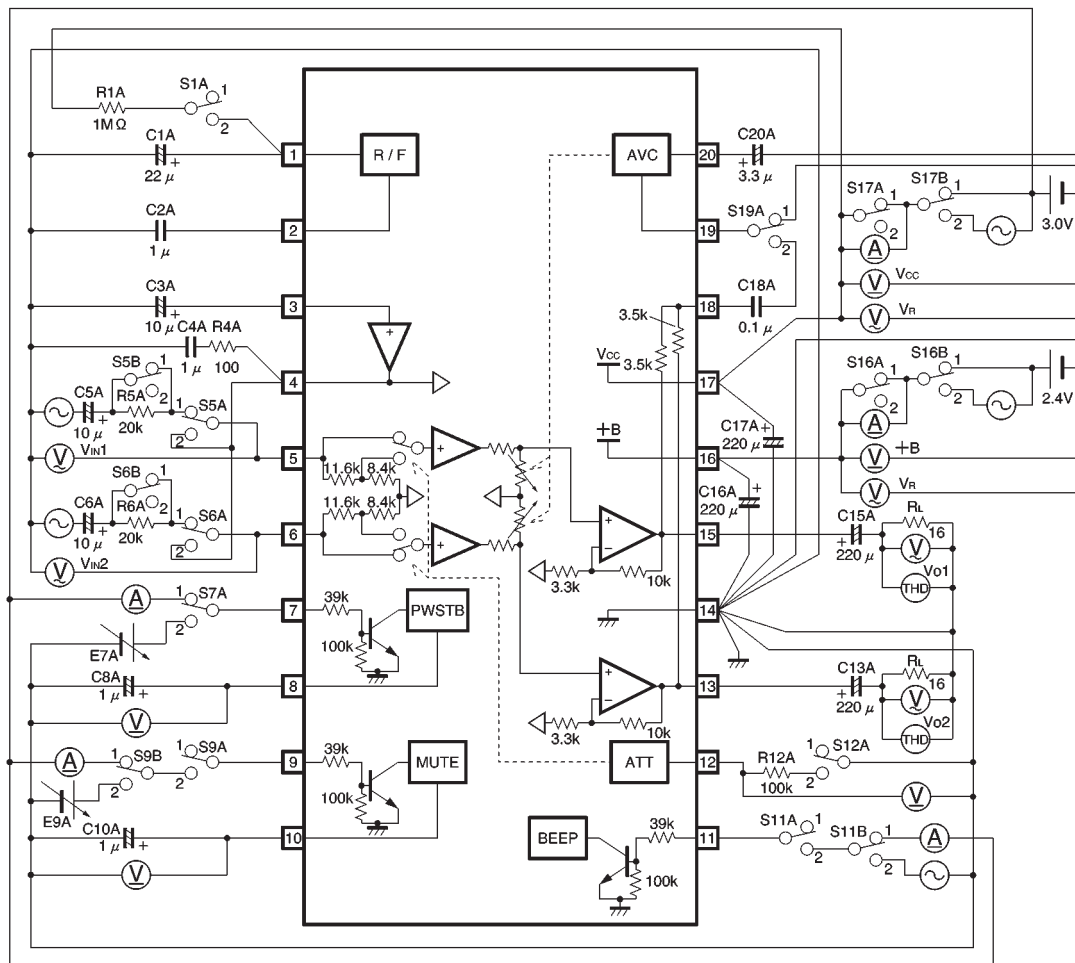


Fig.1

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

Measurement conditions

Parameter	Symbol	S1A	S5A	S5B	S6A	S6B	S7A	S9A	S9B	S11A	S11B	S12A	S16A	S16B	S17A	S17B	S19A
Quiescent V_{CC} current	I_{Q1}	1	2	1	2	1	1	1	1	1	1	1	1	1	2	1	1
Quiescent $+B$ current	I_{Q2}	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓	↓
V_{CC} current during operation	I_{IN1}	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	↓	2	↓	↓
$+B$ current during operation	I_{IN2}	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓	↓
$+B$ leak current	ΔI_B	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Voltage gain 1	G_{V1}	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	↓	↓	↓	↓
Voltage gain 2	G_{V2}	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	↓	↓	↓	↓
Total harmonic distortion	THD	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	↓	↓	↓	↓	↓
Rated output	P_O	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Output noise voltage	V_{NO}	↓	2	↓	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Input resistance	R_{IN}	↓	1	2	1	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Channel separation	CS	↓	1 / 2	1	2 / 1	1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Mute level	ML	↓	1	↓	1	↓	↓	2	↓	↓	↓	↓	↓	↓	↓	↓	↓
AVC level	V_{AVC}	↓	↓	↓	↓	↓	↓	1	↓	↓	↓	↓	↓	↓	↓	↓	2
Ripple rejection 1	RR_1	↓	2	↓	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	1
Ripple rejection 2	RR_2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
Ripple rejection 3	RR_3	2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
BEEP pin input current	R_{BP}	1	1	↓	1	↓	↓	↓	↓	2	↓	↓	↓	1	↓	↓	↓
BEEP output voltage	V_{BP}	↓	↓	↓	↓	↓	↓	2	↓	↓	2	↓	↓	↓	↓	↓	↓
PWSTB OFF pin voltage	V_S	↓	↓	↓	↓	↓	2	1	↓	1	1	↓	↓	↓	↓	↓	↓
PWSTB OFF pin input current	I_S	↓	↓	↓	↓	↓	1	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
MUTE ON pin voltage	V_M	↓	↓	↓	↓	↓	↓	2	2	↓	↓	↓	↓	↓	↓	↓	↓
MUTE ON pin input current	I_M	↓	↓	↓	↓	↓	↓	2	1	↓	↓	↓	↓	↓	↓	↓	↓
Voltage when ATT ON	V_A	↓	↓	↓	↓	↓	↓	1	↓	↓	↓	↓	↓	↓	↓	↓	↓

●Application example

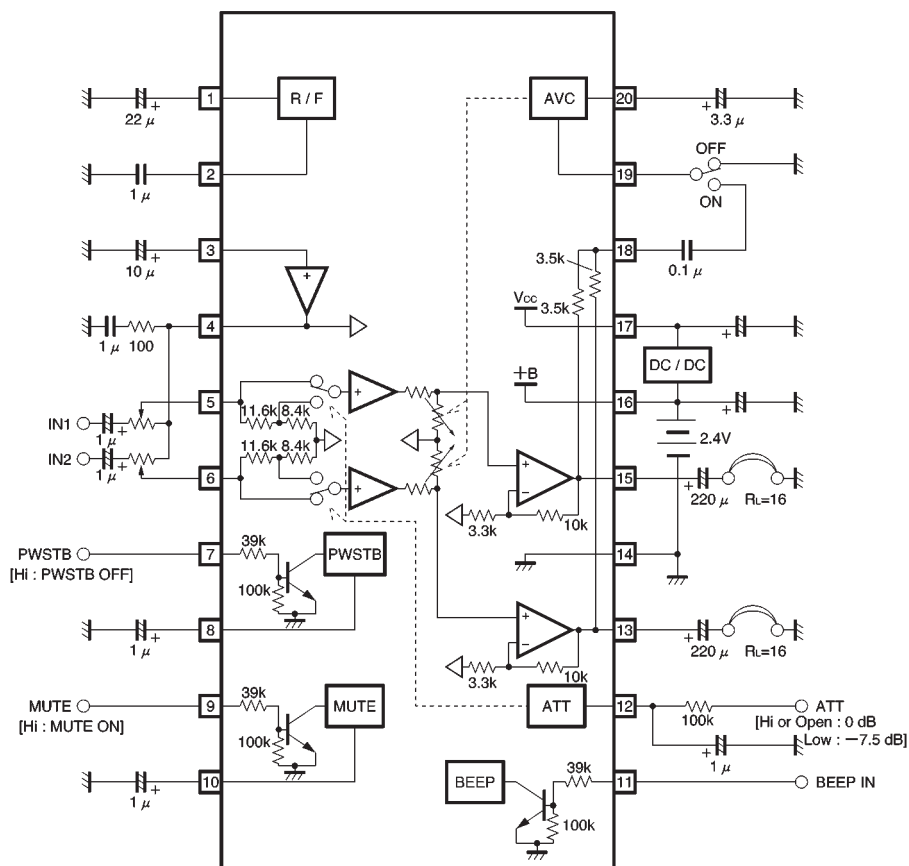


Fig.2

●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.

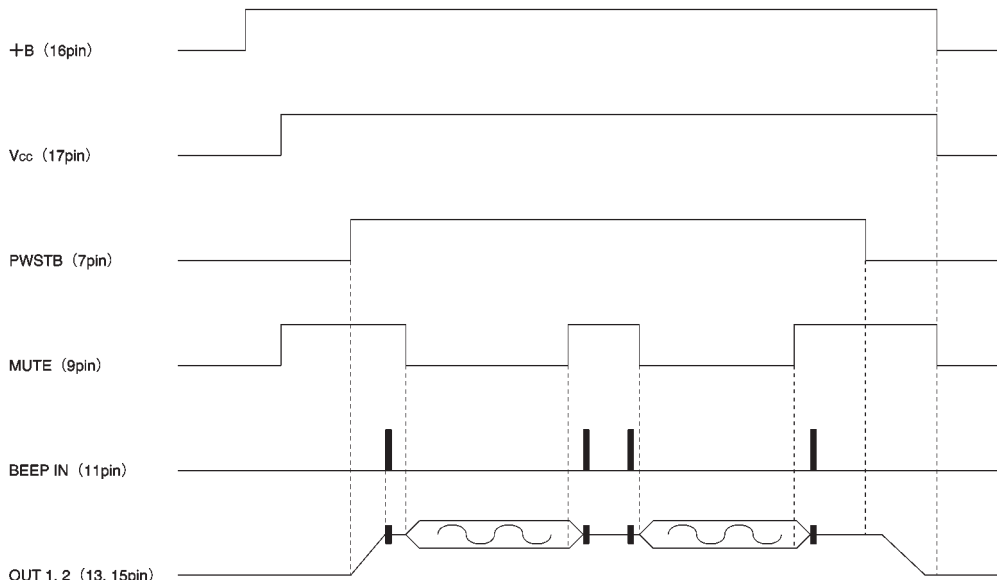
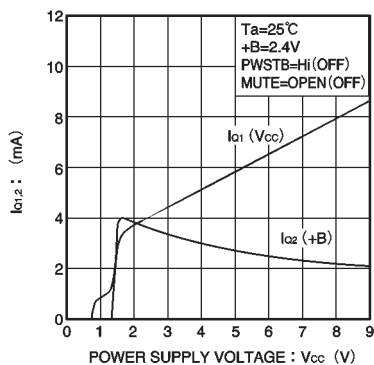
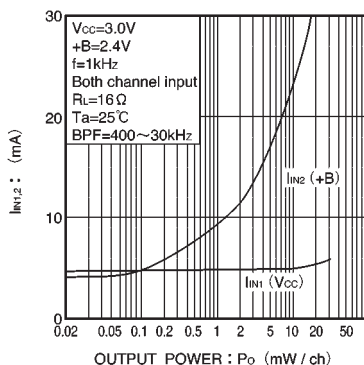
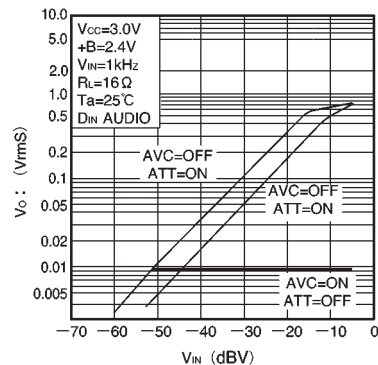


Fig.3

(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 V_{CC} (with respect to ground) to BEEP IN (pin 11).

●Electrical characteristics curves

Fig.4 I_{q1} — V_{CC}
 I_{q2} Fig.5 I_{in1} — P_o
 I_{in2} Fig.6 $V_o - V_{in}$

●External dimensions (Units: mm)

