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 Po = 0.5mW 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 (Ta = 25°C)

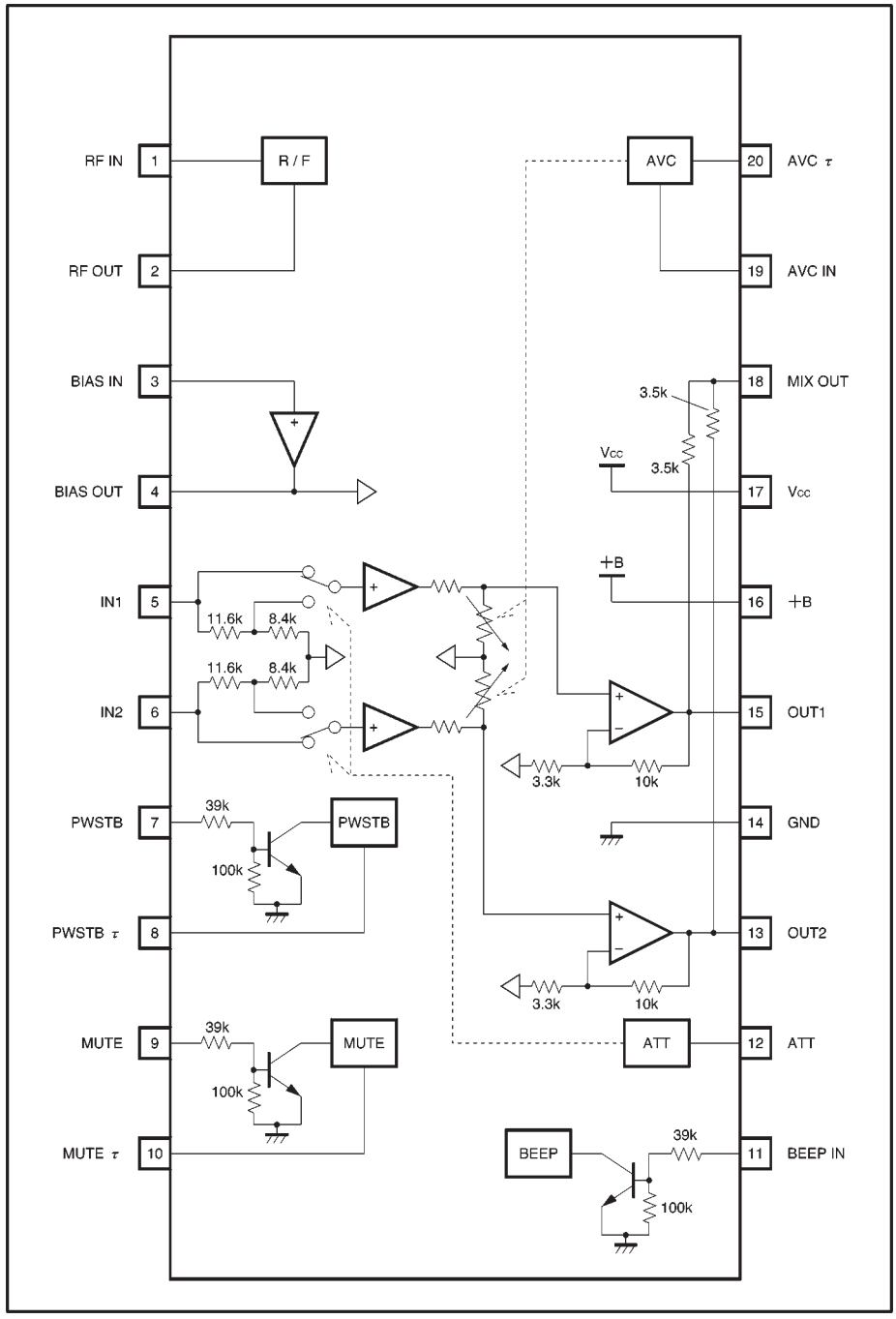
Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	4.5	V
	+B	6.0	V
Power dissipation	Pd	650*1	mW
Operating temperature	Topr	−15～+60	℃
Storage temperature	Tstg	−55～+125	℃

*1 Reduced by 6.5mW for each increase in Ta of 1℃ over 25℃.

●Recommended operating conditions (Ta = 25°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

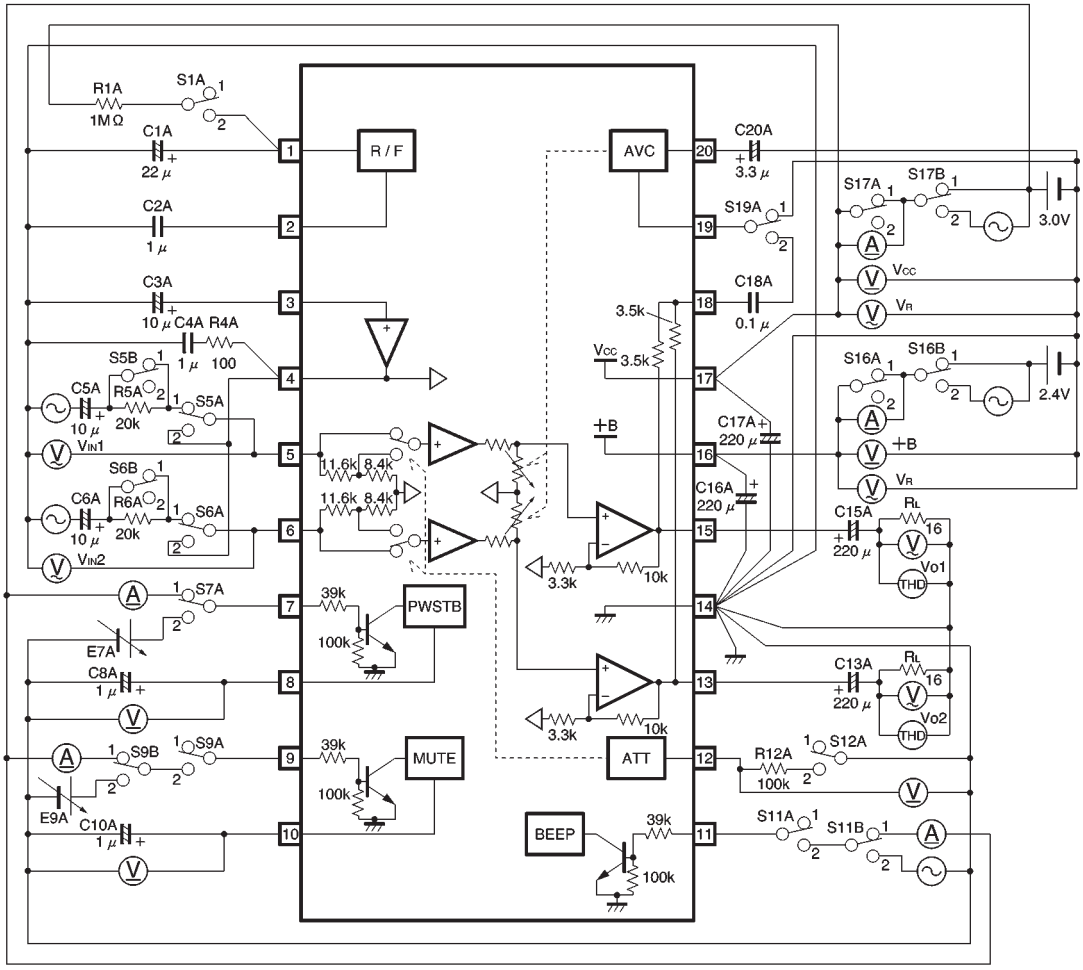


●Electrical characteristics (unless otherwise noted, Ta = 25°C, V_{CC} = 3.0V, +B = 2.4V, f = 1kHz, R_L = 16Ω, DIN AUDIO PWSTB = 3.0V, MUTE = 0V, ATT = OFF and AVC = OFF)

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	ΔI_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=0.1Vrms
Rated output	P_O	15	25.6	—	mW	THD=10%
Output noise voltage	V_{NO}	—	−99	−91	dBV	Rg=0, JIS A
Input resistance	R_{IN}	15.0	19.0	23.0	kΩ	—
Channel separation	CS	63	73	—	dB	Rg=0, V_O=0.1Vrms, 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 Rg=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 Rg=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 Rg=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	mVrms	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



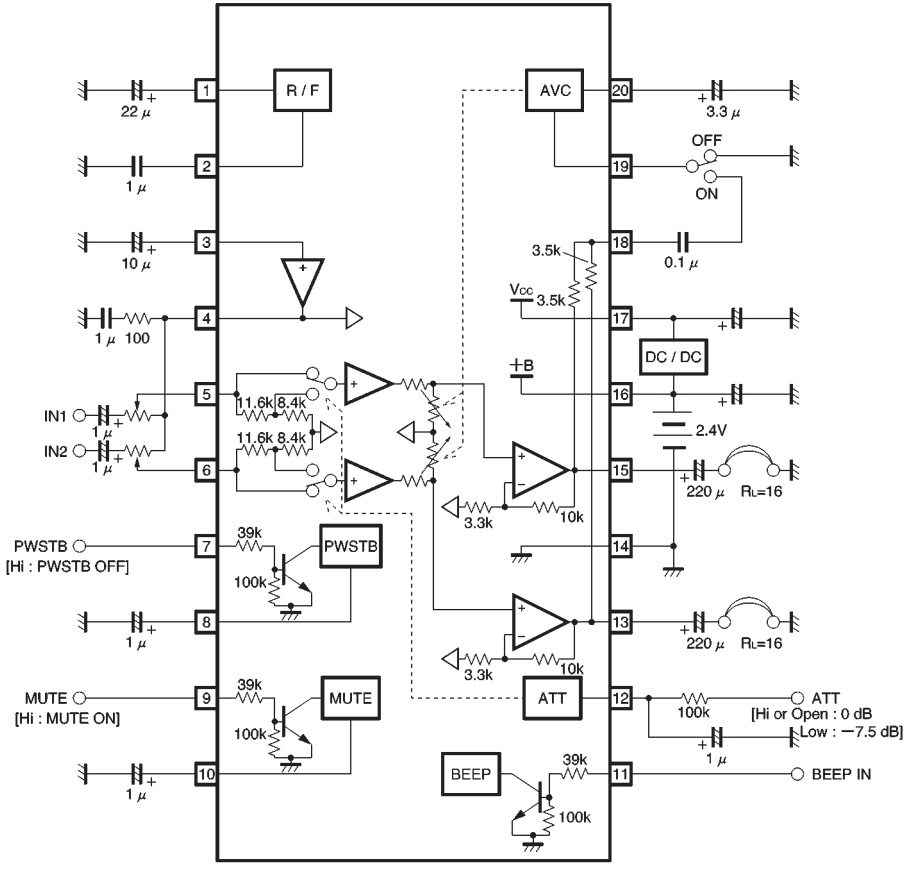
Units:
Resistance : Ω (±1%)
Capacitance (film) : F (±1%)
Capacitance (electrolytic) : F (±5%)

Fig.1

Measurement conditions

Parameter	Symbol	S1A	S5A	S5B	S6A	S6B	S7A	S9A	S9B	S11 A	S11 B	S12 A	S16 A	S16 B	S17 A	S17 B	S19 A
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



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.

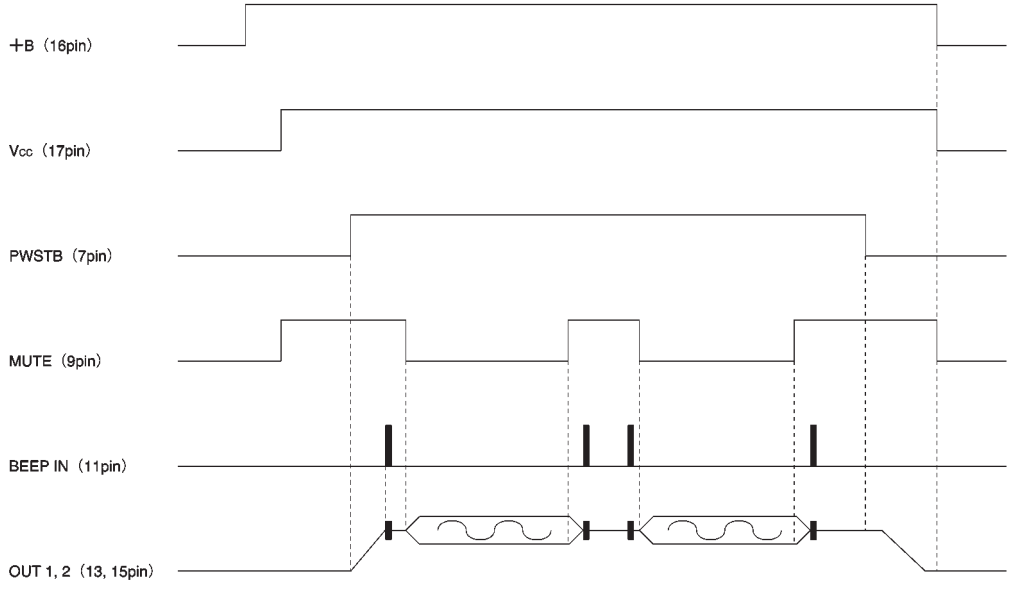


Fig.3

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

●Electrical characteristics curves

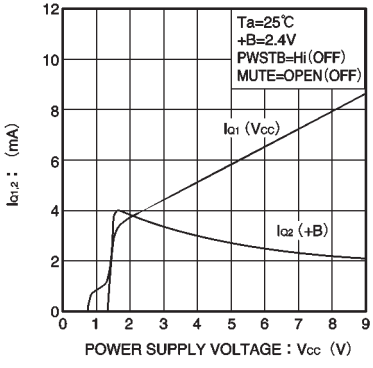


Fig.4 $\frac{I_{Q1}}{I_{Q2}}$ —V_{CC}

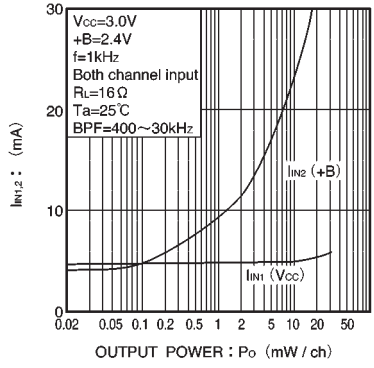


Fig.5 $\frac{I_{IN1}}{I_{IN2}}$ —P_O

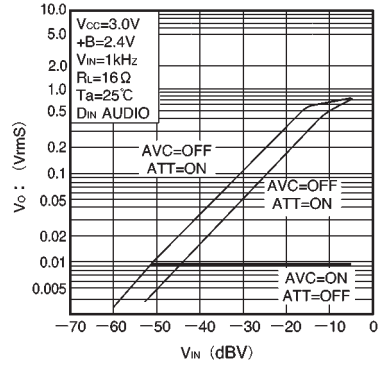


Fig.6 V_O—V_{IN}

●External dimensions (Units: mm)