

# Low power consumption headphone driver for digital audio

## BA3577FS

The BA3577FS is a headphone driver developed for portable digital audio equipment that supports a voltage of 1.5V.

### ● Applications

Portable MD players and others

### ● Features

- 1) 1.5V supported.
- 2) Low current consumption  
(At  $P_o = 0.5\text{mW} / \text{ch}$ ,  $V_{cc}$  inflow current = 3.3mA, and  
+B inflow current = 6.8mA (Typ.)).
- 3) Output coupling capacitor of  $100\mu\text{F}$  produces  $f_c = 45\text{Hz}$  ( $R_L = 16\Omega$ ).
- 4) Internal muting switch.
- 5) Internal ripple filter.
- 6) Internal BEEP circuit.

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

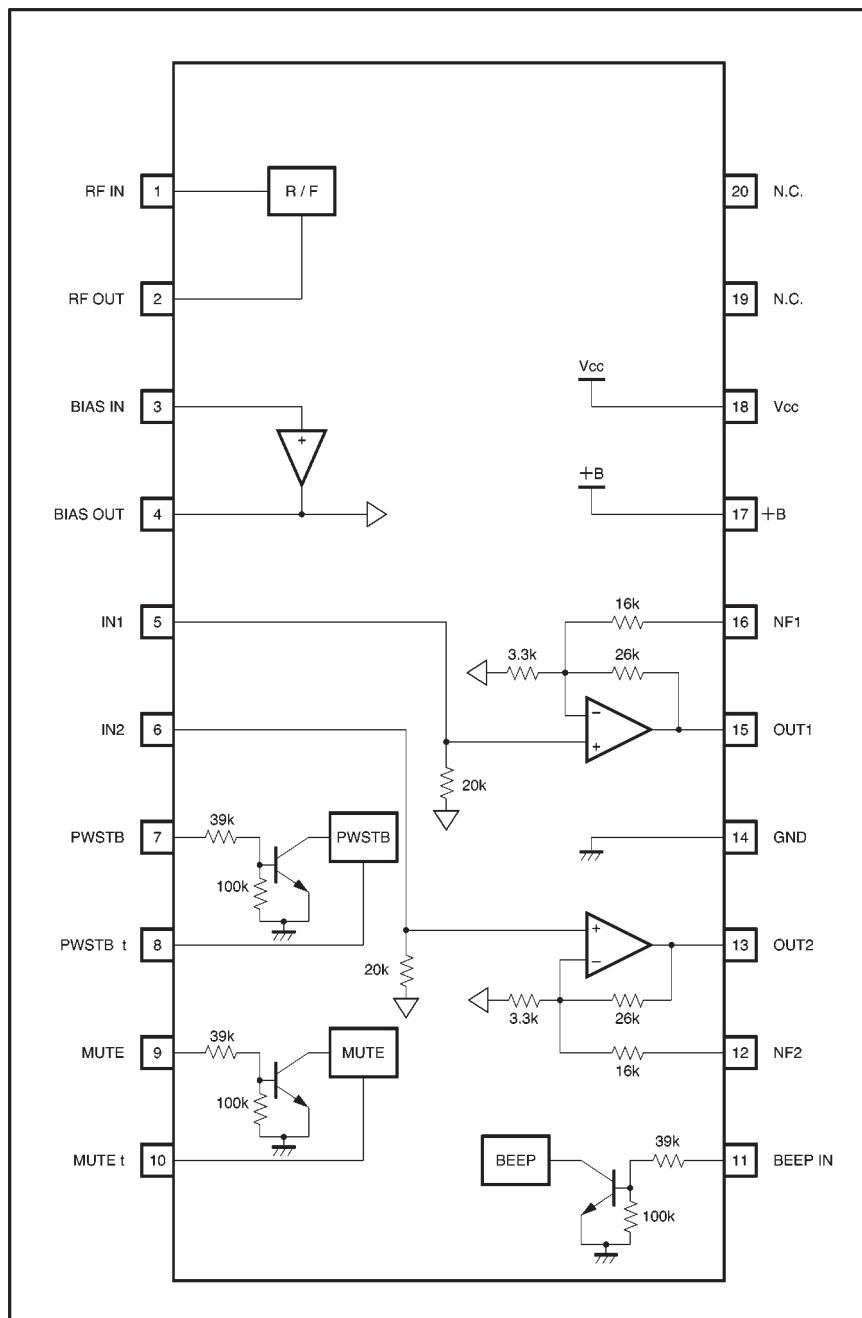
Parameter	Symbol	Limits	Unit
Power supply voltage	$V_{cc}$	4.0	V
	+B	9.0	V
Power dissipation	$P_d$	600*1	mW
Operating temperature	$T_{opr}$	-15~+60	°C
Storage temperature	$T_{stg}$	-55~+125	°C

\*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	$V_{cc}$	2.2	2.8	3.6	V
	+B	0.8	1.2	4.0	V

## ● Block diagram



## ● Pin descriptions

Pin No.	Pin name	I / O	Equivalent circuit	Function
1	RF IN	I		Ripple filter amplifier input
2	RF OUT	O		Ripple filter amplifier output
3	BIAS IN	I		Bias amplifier input
4	BIAS OUT	O		Bias amplifier output
7	PWSTB	I		Power standby switch High : Standby canceled Low : Standby
8	PWSTB t	I / O		Constant pin for power standby switching
9	MUTE	I		Power muting switch High : Muted Low : Muting canceled
10	MUTE t	I / O		Constant pin for power muting switching

Pin No.	Pin name	I / O	Equivalent circuit	Function
5	IN1	I		Power amplifier input
6	IN2	I		Power amplifier output
15	OUT1	O		
13	OUT2	O		
16	NF1	I		Feedback pin in low-pass range This corrects attenuation in the low pitch range caused by the output coupling capacitor.
12	NF2	I		
11	BEEP IN	I		BEEP amplifier input
14	GND	I		Ground
17	+B	I		Battery power supply (power supply for terminal stage of power amplifier)
18	Vcc	I		Booster power supply

●Electrical characteristics (unless otherwise noted,  $T_a = 25^\circ\text{C}$ ,  $V_{cc} = 2.8\text{V}$ ,  $+B = 1.2\text{V}$ ,  $PWSTB = 2.8\text{V}$ ,  $MUTE = 0\text{V}$ ,  $R_L = 16\Omega$ ,  $f = 1\text{kHz}$ , DIN AUDIO)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
$V_{cc}$ quiescent current	$I_{01}$	—	3.2	5.0	mA	$V_{IN1,2}=0$
$+B$ quiescent current	$I_{02}$	—	3.3	6.4	mA	$V_{IN1,2}=0$
$V_{cc}$ operating current	$I_{IN1}$	—	3.3	5.2	mA	$P_{01,2}=0.5\text{mW}$
$+B$ operating current	$I_{IN2}$	—	6.8	9.8	mA	$P_{01,2}=0.5\text{mW}$
$+B$ leak current	$\Delta I_{+B}$	—	0	3.0	$\mu\text{A}$	$+B$ input current when $V_{cc}=0\text{V}$
Voltage gain	$G_v$	9.6	11.6	13.9	dB	—
Frequency characteristic 1	$\Delta G_{v1}$	1.1	3.3	5.5	dB	$G_v(1\text{kHz}) - G_v(50\text{Hz})$
Frequency characteristic 2	$\Delta G_{v2}$	0	0.5	3.0	dB	$G_v(1\text{kHz}) - G_v(20\text{kHz})$ , 80kHz LPF
Total harmonic distortion	THD	—	0.1	0.5	%	$V_o=0.1\text{Vrms}$
Rated output	$P_o$	5.6	10.0	—	mW	THD=10%
Output noise voltage	$V_{NO}$	—	-98	-92	dBm	$R_g=0$ , IHF A
Input resistance	$R_{IN}$	15	20.7	25	k $\Omega$	—
Channel separation	CS	60	77	—	dB	$R_g=0$ , $V_o=0.2\text{Vrms}$ , 1kHz BPF
Muting level	ML	—	-98	-92	dBm	$V_{IN}=-30\text{dBV}$ , $V_g=2.8\text{V}$ , 1kHz BPF
Ripple rejection 1	$RR_1$	62	72	—	dB	$R_g=0$ , $f_R=100\text{Hz}$ , 100Hz BPF $V_R=-20\text{dBm}$ applied only to $V_{cc}$
Ripple rejection 2	$RR_2$	63	73	—	dB	$R_g=0$ , $f_R=100\text{Hz}$ , 100Hz BPF $V_R=-20\text{dBm}$ applied only to $+B$
BEEP IN pin inflow current	$I_{BP}$	—	50	100	$\mu\text{A}$	$I_1$ when $V_{11}=V_{cc}$
BEEP output voltage	$V_{BP}$	2.6	6.0	10.0	$\text{mV}_{P-P}$	$V_{BPIN}=2.8\text{V}_{P-P}$  , $f=1\text{kHz}$
PWSTB OFF pin voltage	$V_s$	—	0.95	1.4	V	$V_7$ when $V_8 \geq 0.5\text{V}$
PWSTB OFF pin inflow current	$I_s$	—	52	100	$\mu\text{A}$	$I_7$ when $V_7=V_{cc}$
MUTE ON pin voltage	$V_M$	—	0.95	1.4	V	$V_9$ when $V_{10} \geq 0.5\text{V}$
MUTE ON pin inflow current	$I_M$	—	52	100	$\mu\text{A}$	$I_9$ when $V_9=V_{cc}$

©Not designed for radiation resistance.

## ● Measurement circuit

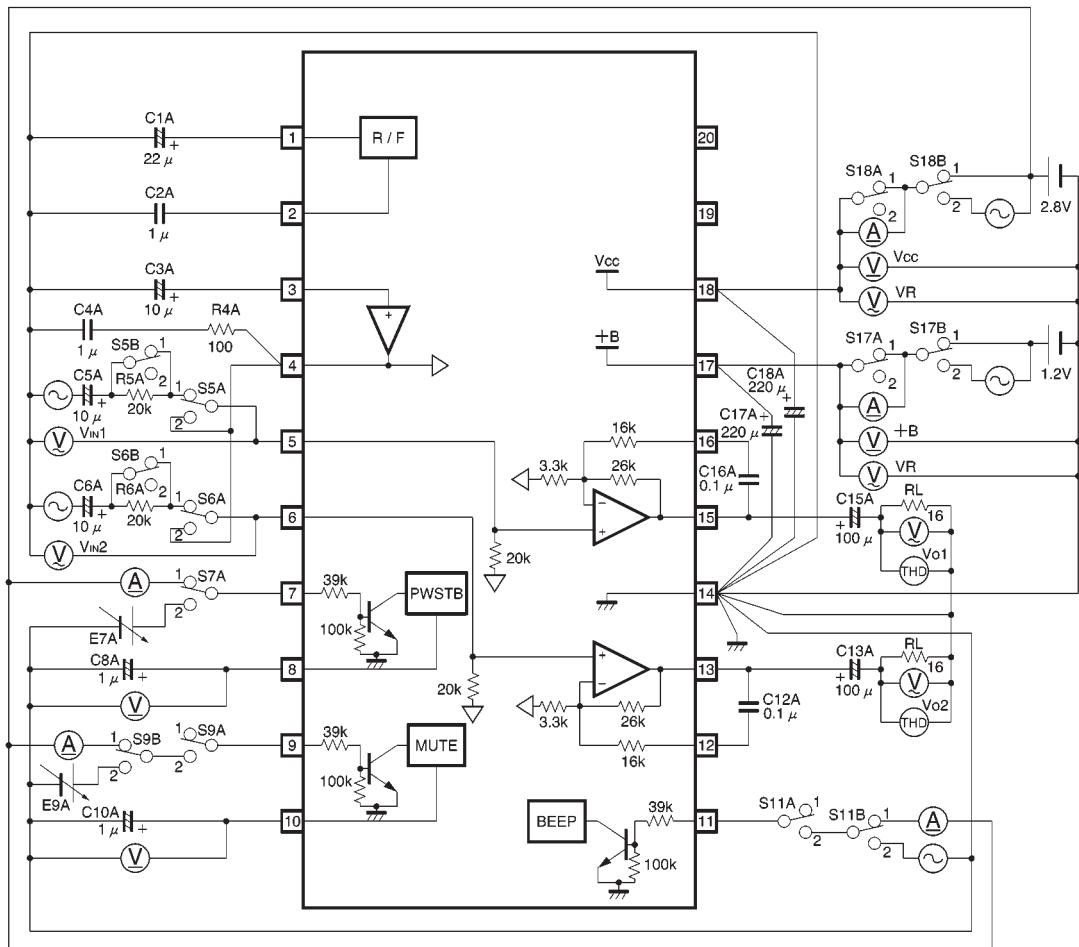


Fig.1

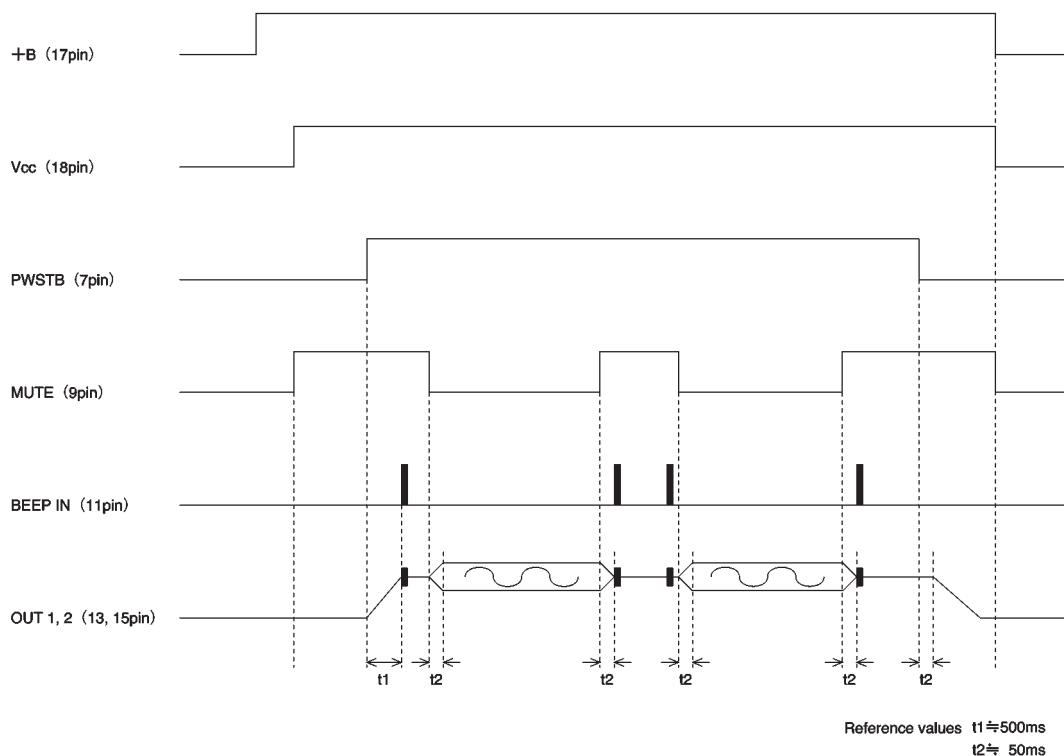
Units  
 Resistance :  $\Omega$  (±1%)  
 Capacitance (film) :  $F$  (±1%)  
 Capacitance (electrolytic) :  $F$  (±5%)

## Measurement conditions

Parameter	Symbol	S5A	S5B	S6A	S6B	S7A	S9A	S9B	S11A	S11B	S17A	S17B	S18A	S18B
$V_{CC}$ quiescent current	$I_{Q1}$	1	1	1	1	1	1	1	1	1	1	1	2	1
$+B$ quiescent current	$I_{Q2}$	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
$V_{CC}$ operating current	$I_{IN1}$	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	↓	2	↓
$+B$ operating current	$I_{IN2}$	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
$+B$ leak current	$\Delta I_{+B}$	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
Voltage gain	$G_V$	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	↓	↓	↓
Voltage gain deviation 1	$\Delta G_{V1}$	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Voltage gain deviation 2	$\Delta G_{V2}$	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Total harmonic distortion	THD	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
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	↓	↓	↓	↓	↓	↓	↓	↓	↓
Muting level	ML	1	↓	1	↓	↓	2	↓	↓	↓	↓	↓	↓	↓
Ripple rejection 1	$RR_1$	2	↓	2	↓	↓	1	↓	↓	↓	↓	↓	↓	2
Ripple rejection 2	$RR_2$	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1
BEEP IN pin inflow current	$I_{BP}$	1	↓	↓	↓	↓	↓	↓	2	↓	↓	↓	↓	↓
BEEP output voltage	$V_{BP}$	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	↓	↓	↓
PWSTB OFF pin voltage	$V_S$	↓	↓	↓	↓	2	↓	↓	1	↓	↓	↓	↓	↓
PWSTB OFF pin inflow current	$I_S$	↓	↓	↓	↓	↓	1	↓	↓	↓	↓	↓	↓	↓
MUTE ON pin voltage	$V_M$	↓	↓	↓	↓	↓	2	2	↓	↓	↓	↓	↓	↓
MUTE ON pin inflow current	$I_M$	↓	↓	↓	↓	↓	2	1	↓	↓	↓	↓	↓	↓

## ● Circuit operation

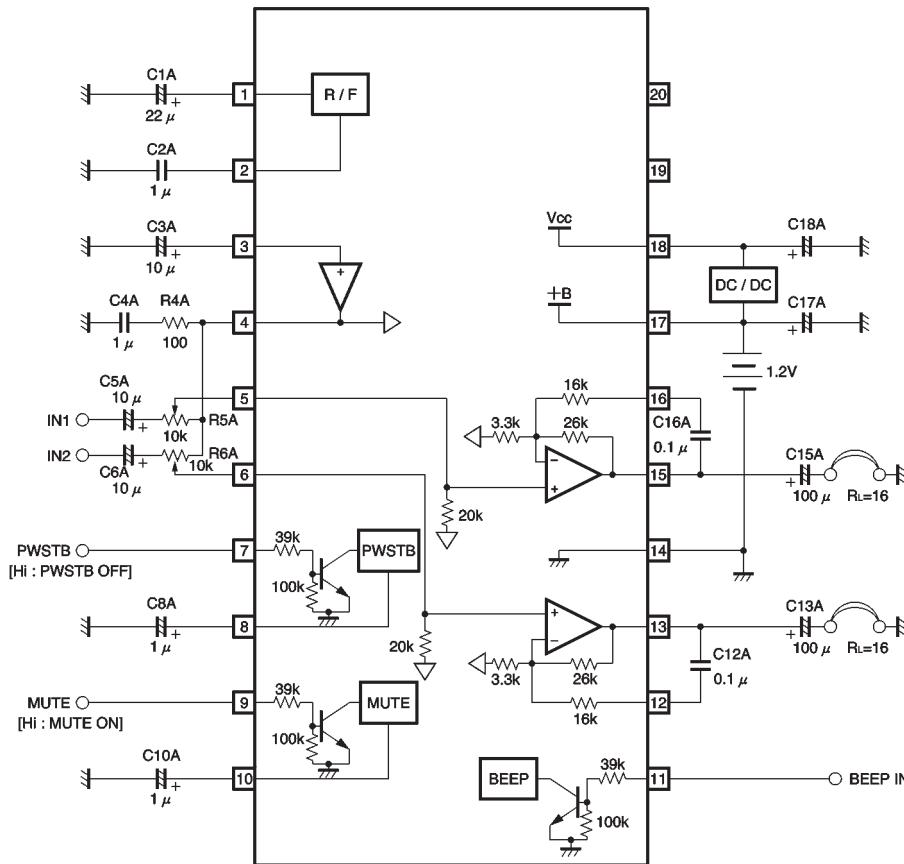
(1) The BA3577FS operates at the timing chart shown below, which prevents popping noises in the headphone output.



(2) The ripple filters (pins 1 and 2) and bias amplifiers (pins 3 and 4) of the BA3577FS cannot be used as external power supplies or reference voltages.

(3) The BA3577FS outputs a BEEP signal only when the PWSTB pin (pin 7) and the MUTE pin (pin 9) are HIGH. Also, input a rectangular waveform of 500Hz to 5kHz with an amplitude from the GND to  $V_{cc}$  to the BEEP IN pin (pin 11).

## ● Application example



Units:  
 Resistance :  $\Omega$  ( $\pm 5\%$ )  
 Capacitance (film) :  $F$  ( $\pm 10\%$ )  
 Capacitance (electrolytic) :  $F$  ( $\pm 20\%$ )

Fig.2

## ● Electrical characteristic curves

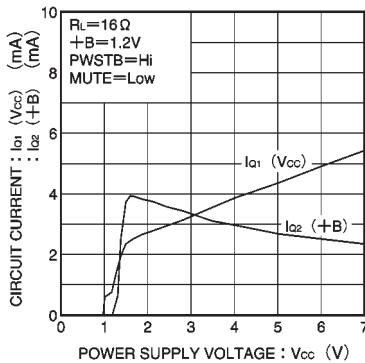


Fig.3 Quiescent current vs. power supply voltage

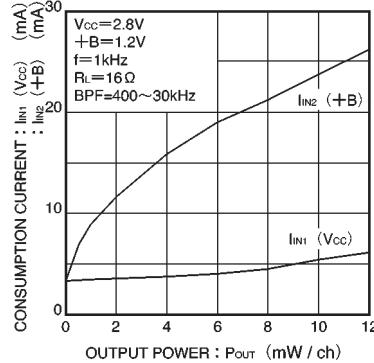


Fig.4 Current consumption vs. output power

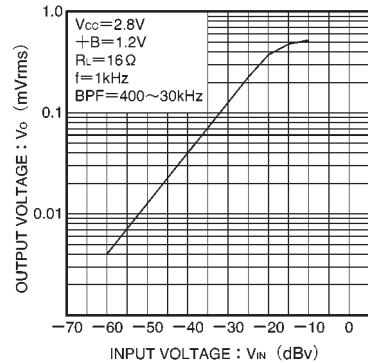


Fig.5 Output voltage vs. input voltage

## ● External dimensions (Units: mm)

