

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 μF 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 ($T_a = 25^\circ\text{C}$)

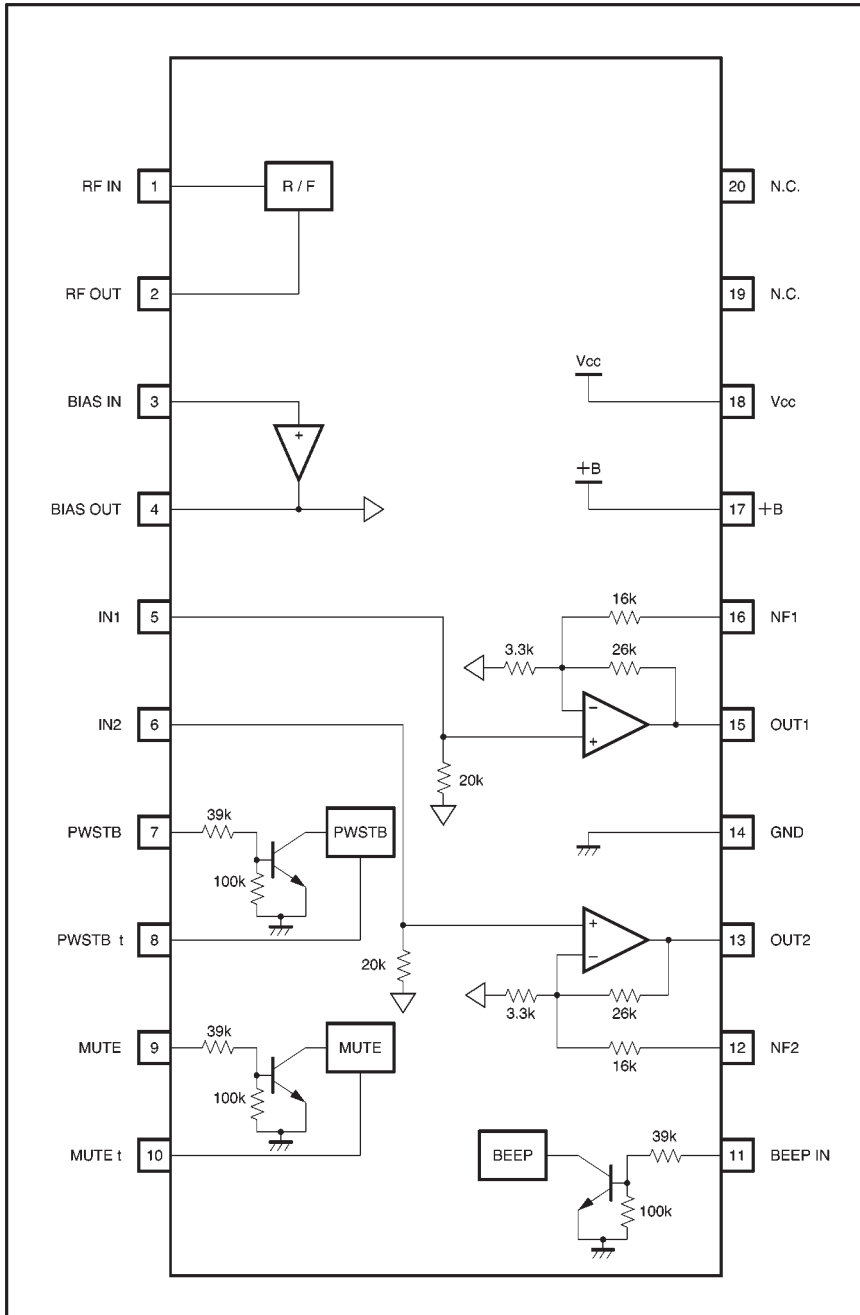
Parameter	Symbol	Limits	Unit
Power supply voltage	V_{cc}	4.0	V
	+B	9.0	V
Power dissipation	P_d	600*1	mW
Operating temperature	T_{opr}	-15~+60	$^\circ\text{C}$
Storage temperature	T_{stg}	-55~+125	$^\circ\text{C}$

*1 Reduced by 6.5mW for each increase in T_a of 1 $^\circ\text{C}$ over 25 $^\circ\text{C}$.

●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		<p>Feedback pin in low-pass range This corrects attenuation in the low pitch range caused by the output coupling capacitor.</p>
13	OUT2	O		
16	NF1	I		
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	V _{CC}	I		Booster power supply

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Coniditions
V_{CC} quiescent current	I_{O1}	—	3.2	5.0	mA	$V_{IN1,2}=0$
$+B$ quiescent current	I_{O2}	—	3.3	6.4	mA	$V_{IN1,2}=0$
V_{CC} operating current	I_{IN1}	—	3.3	5.2	mA	$P_{O1,2}=0.5\text{mW}$
$+B$ operating current	I_{IN2}	—	6.8	9.8	mA	$P_{O1,2}=0.5\text{mW}$
$+B$ leak current	ΔI_{+B}	—	0	3.0	μA	$+B$ input current when $V_{CC}=0\text{V}$
Voltage gain	G_V	9.6	11.6	13.9	dB	—
Frequency characteristic 1	ΔG_{V1}	1.1	3.3	5.5	dB	$G_V(1\text{kHz}) - G_V(50\text{Hz})$
Frequency characteristic 2	ΔG_{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	%	$V_O=0.1\text{V}_{\text{rms}}$
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 Ω	—
Channel separation	CS	60	77	—	dB	$R_g=0$, $V_O=0.2\text{V}_{\text{rms}}$, 1kHz BPF
Muting level	ML	—	-98	-92	dBm	$V_{IN}=-30\text{dBV}$, $V_9=2.8\text{V}$, 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	μA	I_{11} when $V_{11}=V_{CC}$
BEEP output voltage	V_{BP}	2.6	6.0	10.0	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	μA	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	μA	I_9 when $V_9=V_{CC}$

◎Not designed for radiation resistance.

● Measurement circuit

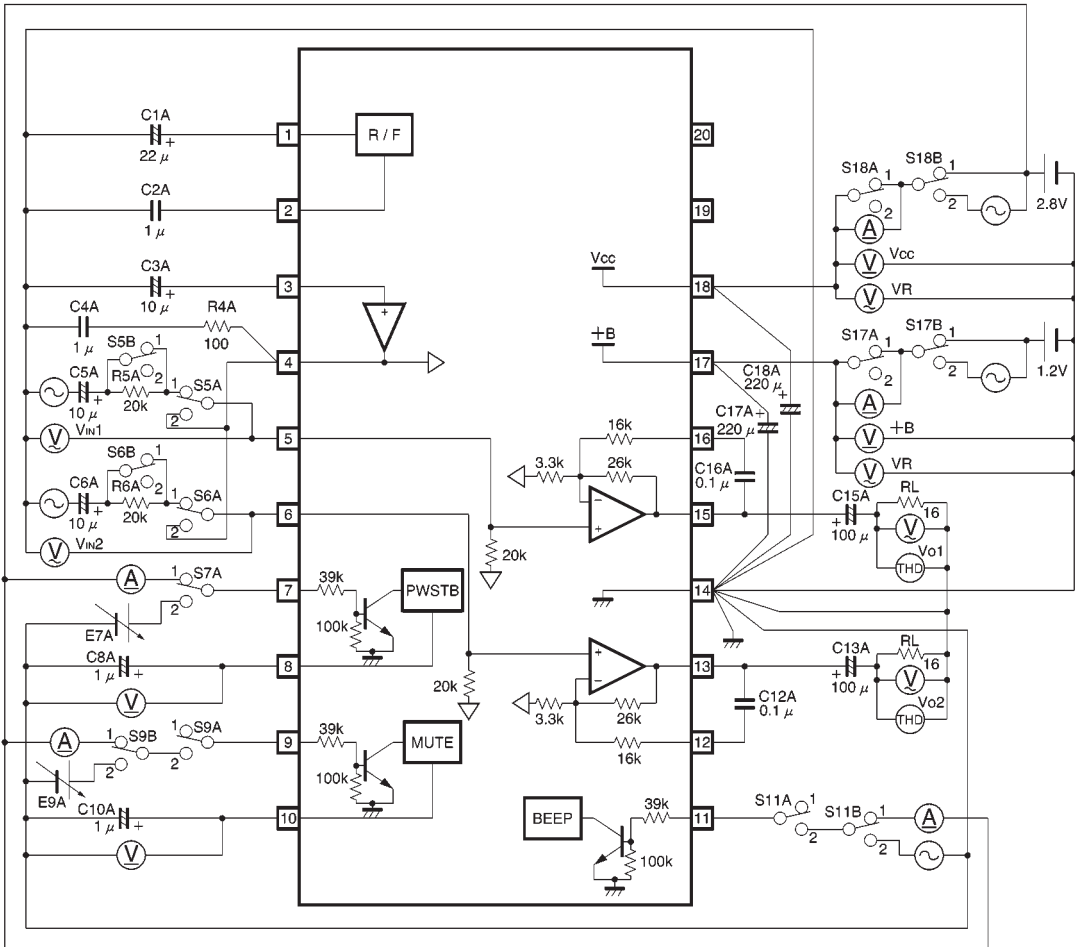


Fig.1

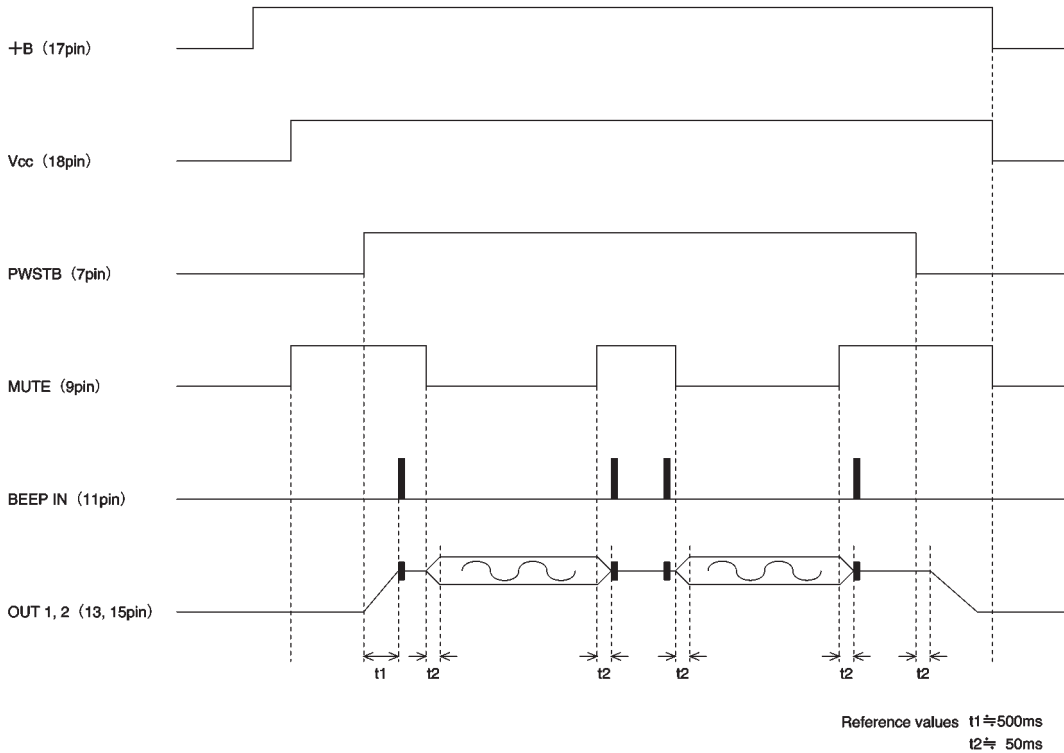
Units
 Resistance : Ω (±1%)
 Capacitance (film) : F (±1%)
 Capacitance (electrolytic) : F (±5%)

Measurement conditions

Parameter	Symbol	S5A	S5B	S6A	S6B	S7A	S9A	S9B	S11A	S11B	S17A	S17B	S18A	S18B
V _{CC} quiescent current	I _{O1}	1	1	1	1	1	1	1	1	1	1	1	2	1
+B quiescent current	I _{O2}	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
V _{CC} operating current	I _{IN1}	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	↓	2	↓
+B operating current	I _{IN2}	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
+B leak current	ΔI _{+B}	↓	↓	↓	↓	↓	↓	↓	↓	↓	2	↓	1	↓
Voltage gain	G _V	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	↓	↓	↓
Voltage gain deviation 1	ΔG _{V1}	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
Voltage gain deviation 2	ΔG _{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

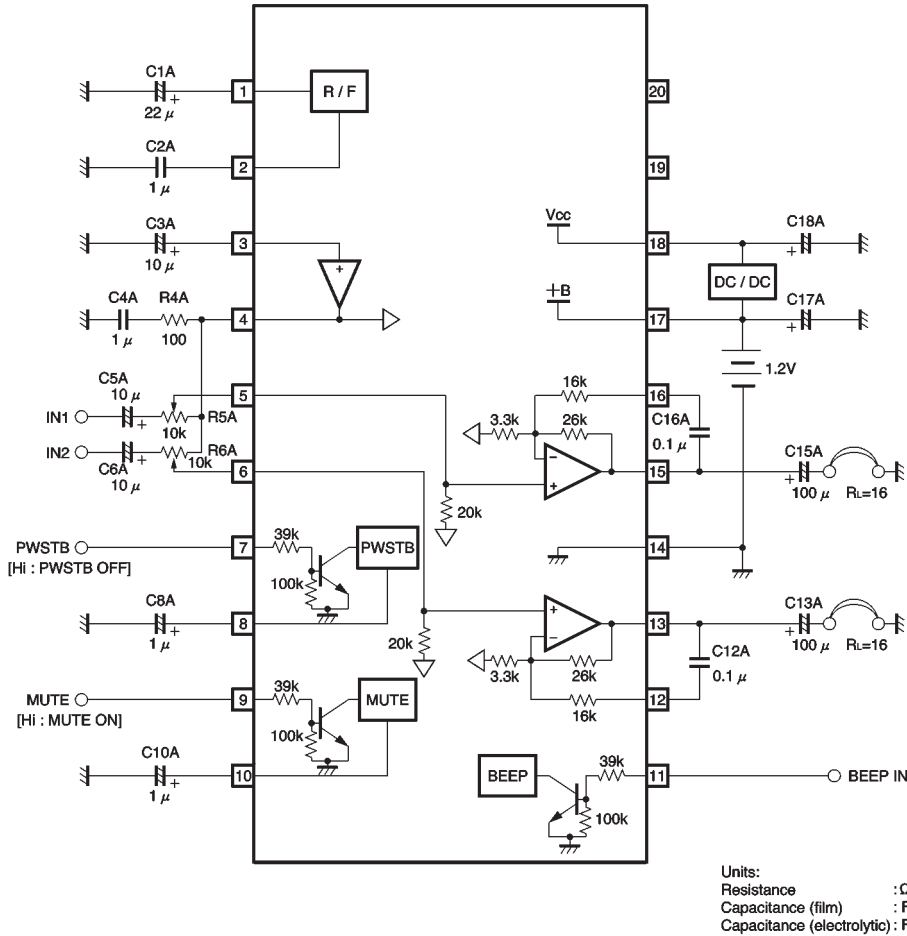


Fig.2

● Electrical characteristic curves

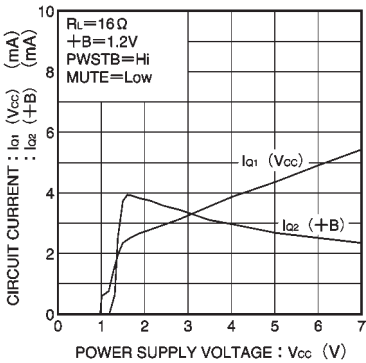


Fig.3 Quiescent current vs. power supply voltage

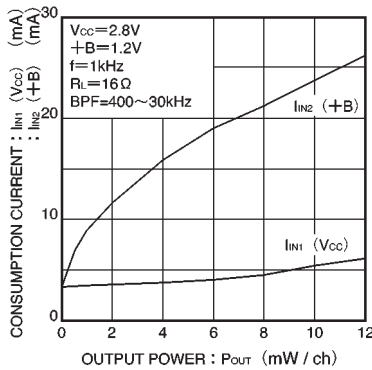


Fig.4 Current consumption vs. output power

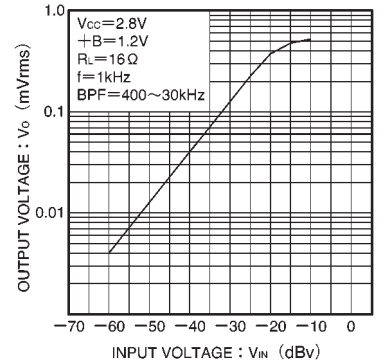


Fig.5 Output voltage vs. input voltage

● External dimensions (Units: mm)

