# Headphone driver for digital audio
## BA3578FS / BA3579FS

The BA3578FS and BA3579FS are headphone drivers with internal an LPF and fixed bass boost circuit for multi-bit D / A converters.

●Applications
Portable CD players

●Features
1) Suitable for use in digital audio equipment (line-out output noise voltage: 18μVrms, S / N = 95dB Typ.).
2) Internal LPF for multi-bit D / A converters (fc = 34kHz, −12dB / oct. Typ.).
3) Headphone mute function.
4) Internal BB (bass boost) circuit.
5) Internal supply current for line-mute transistor.
6) No need for output oscillation preventive measures.
7) Internal standby switch.

●Absolute maximum ratings (Ta = 25°C)

| Parameter | Symbol | Limits | Unit |
|---|---|---|---|
| Power supply voltage | $AV_{DD}$ | 5.5 | V |
| | $PV_{CC}$ | 5.5 | V |
| Power dissipation | Pd | 600*1 | mW |
| Operating temperature | Topr | −20～+60 | ℃ |
| Storage temperature | Tstg | −55～+125 | ℃ |

*1 Reduced by 6mW for each increase in Ta of 1℃ over 25℃.

●Recommended operating conditions

| Parameter | Symbol | Limits | Unit |
|---|---|---|---|
| Power supply voltage | $AV_{DD}$ | 3.6 | V |
| | $PV_{CC}$ | 3.6 | V |

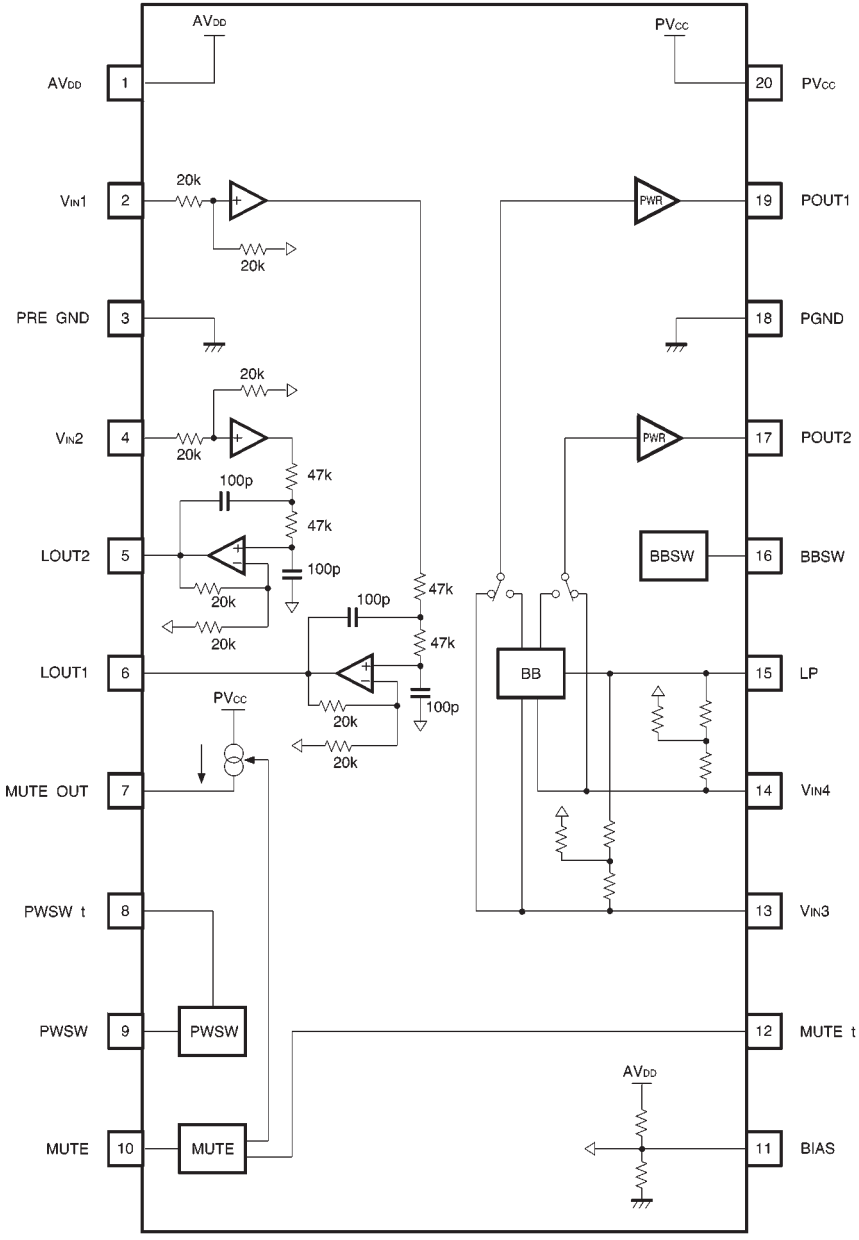
●Recommended operating range

| Parameter | Symbol | Limits | Unit |
|---|---|---|---|
| Power supply voltage | $AV_{DD}$ | 2.8～5.0 | V |
| | $PV_{CC}$ | 2.8～5.0*2 | V |

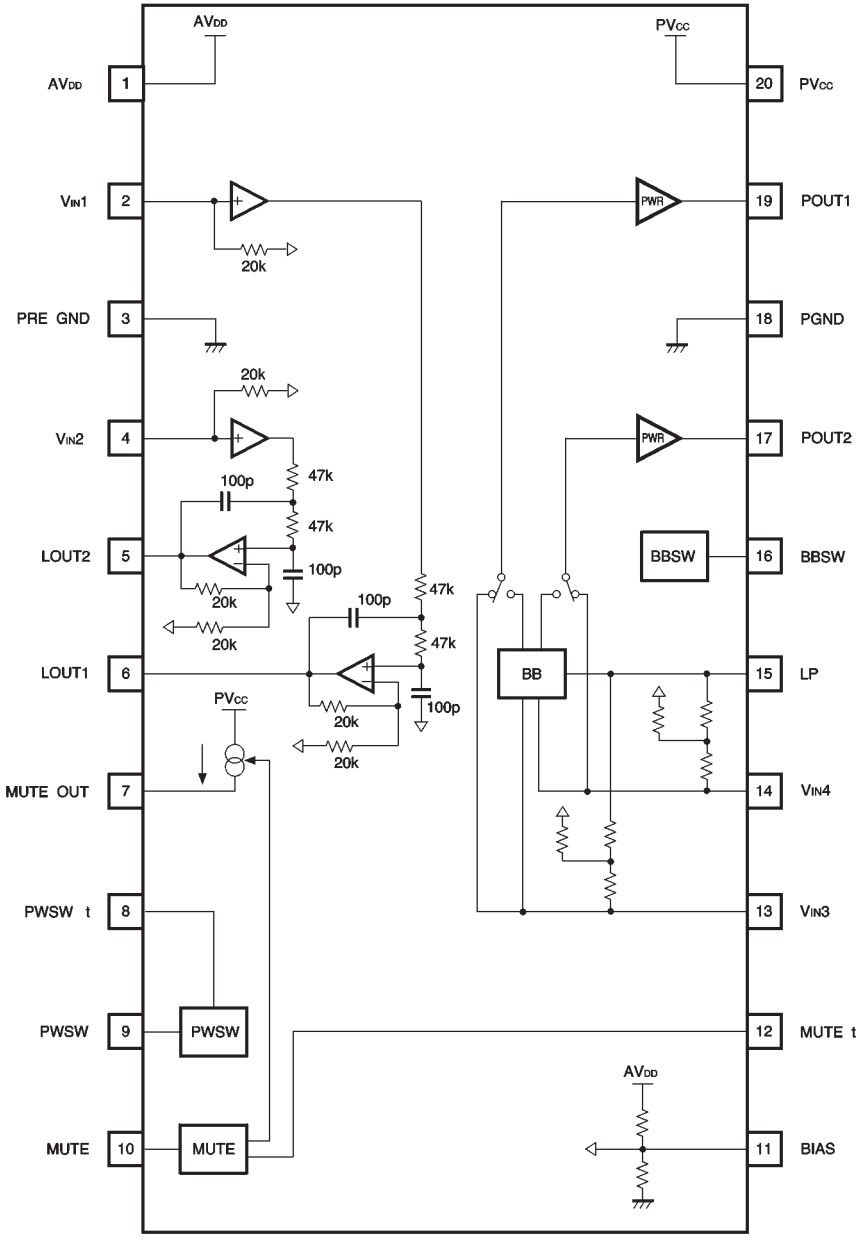
*2 In order to use the headphone output to its optimum performance, have the power supply voltage such that $PV_{CC} \geqq AV_{DD} - 0.3V$

●Block diagram

BA3578FS



BA3579FS


AVDD
PVCC
AVDD 1
VIN1 2
PRE GND 3
VIN2 4
LOUT2 5
LOUT1 6
MUTE OUT 7
PWSW t 8
PWSW 9
MUTE 10
20 PVCC
19 POUT1
18 PGND
17 POUT2
16 BBSW
15 LP
14 VIN4
13 VIN3
12 MUTE t
11 BIAS
20k
47k
100p
PWR
BBSW
BB
PWSW
MUTE

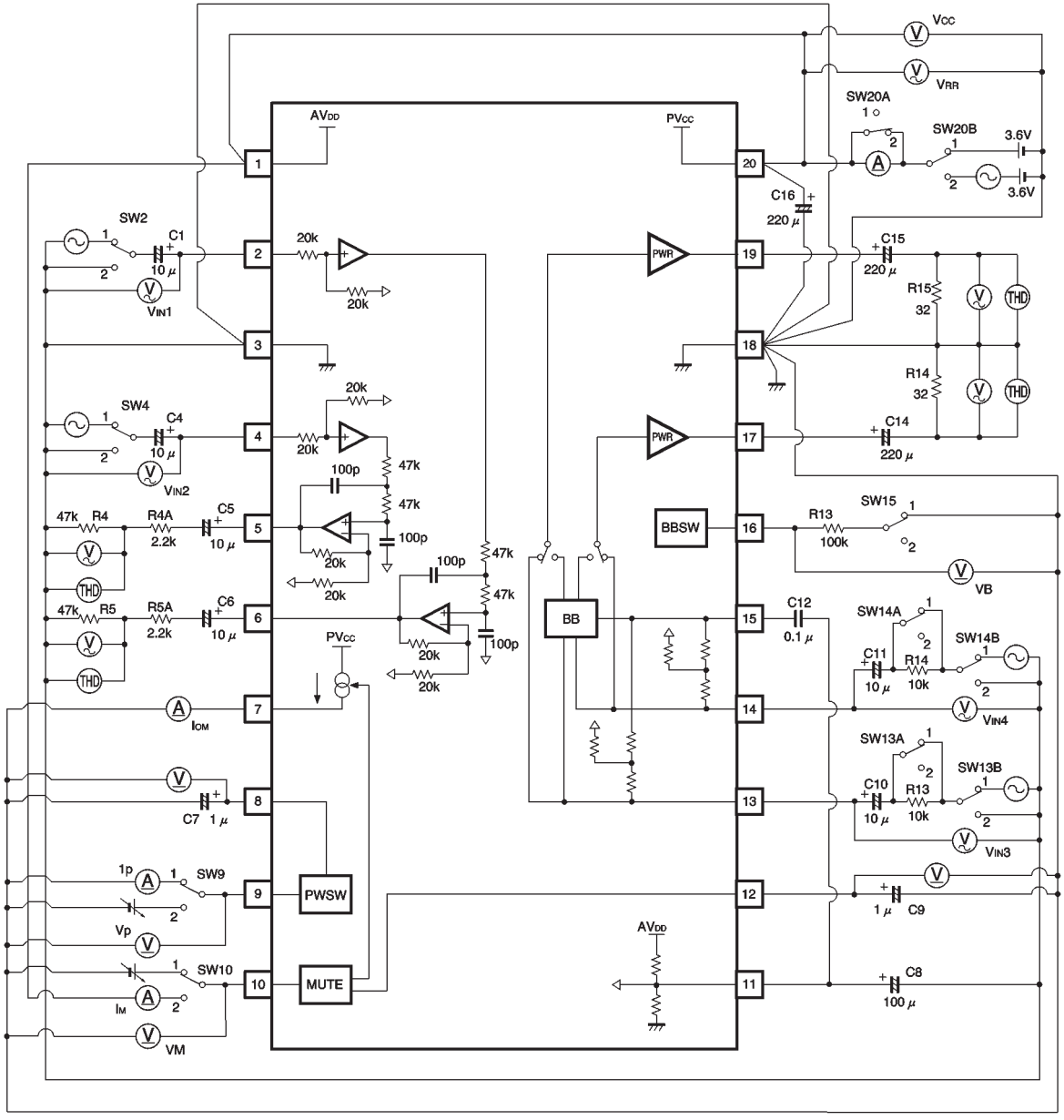
●Electrical characteristics (Unless otherwise noted, Ta = 25°C, $PV_{CC}$ = $AV_{DD}$ = 3.6V, f = 1kHz, PwSw = ON, MUTE = OFF, BB = OFF, Line $R_{L1}$ = 47kΩ, headphone $R_{L2}$ = 32Ω, filter = DIN AUDIO, line-out measurements are with $V_{IN}$3 and 4 = 0V)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Coniditions |
|---|---|---|---|---|---|---|
| Circuit current | $I_{CC}$ | 4.5 | 7.5 | 11.5 | mA | $V_{IN}$=0 |
| Power ON voltage | $V_P$ | 2.0 | 2.8 | — | V | |
| Power ON pin current | $I_P$ | — | 60 | 110 | μA | $V_{PWSW}$=0V |
| Mute ON voltage | $V_M$ | — | 0.8 | 1.4 | V | |
| Mute pin current | $I_M$ | — | 110 | 190 | μA | $V_{MUTE}$=$AV_{DD}$ |
| Mute output current | $I_{OM}$ | 1.0 | 2.0 | — | mA | $V_{MUTE}$=$AV_{DD}$ |
| Bass boost OFF voltage | $V_B$ | 0.5 | 0.7 | — | V | |
| 〈Line-out〉 (BA3578FS) | | | | | | |
| Voltage gain | $G_{V1}$ | −2.4 | −0.4 | 1.6 | dB | $V_{IN}$1, 2=0.8Vrms |
| Voltage gain difference | ΔGv | −2.1 | −0.3 | 1.2 | dB | $G_{V1}$ (f=1kHz) −$G_{V1}$ (f=10kHz) |
| Total harmonic distortion 1 | $THD_1$ | — | 0.05 | 0.2 | % | $V_{IN}$1, 2=0.8Vrms |
| Maximum output voltage 1 | $V_{OM1}$ | 0.8 | 1.1 | — | Vrms | THD=0.2% |
| Output noise voltage 1 | $V_{NO1}$ | — | −96 | −90 | dBV | Rg=0 |
| Channel separation 1 | $CS_1$ | 68 | 78 | — | dB | $V_{IN}$1, 2=0.8Vrms, Rg=0 |
| Ripple rejection 1 | $RR_1$ | 37 | 47 | — | dB | $V_{RR}$=−20dBV, $f_{RR}$=1kHz, Rg=0 |
| 〈Line-out〉 (BA3579FS) | | | | | | |
| Voltage gain | $G_{V1}$ | 3.6 | 5.6 | 7.6 | dB | $V_{IN}$1, 2=0.4Vrms |
| Voltage gain difference | ΔGv | −2.1 | −0.3 | 1.2 | dB | $G_{V1}$ (f=1kHz) −$G_{V1}$ (f=10kHz) |
| Total harmonic distortion 1 | $THD_1$ | — | 0.05 | 0.2 | % | $V_{IN}$1, 2=0.4Vrms |
| Maximum output voltage 1 | $V_{OM1}$ | 0.8 | 1.1 | — | Vrms | THD=0.2% |
| Output noise voltage 1 | $V_{NO1}$ | — | −96 | −90 | dBV | Rg=0 |
| Channel separation 1 | $CS_1$ | 68 | 78 | — | dB | $V_{IN}$1, 2=0.4Vrms, Rg=0 |
| Ripple rejection 1 | $RR_1$ | 37 | 47 | — | dB | $V_{RR}$=−20dBV, $f_{RR}$=1kHz, Rg=0 |
| 〈Headphone out〉 | | | | | | |
| Voltage gain 2 | $G_{V2}$ | 10.2 | 12.2 | 14.2 | dB | $V_{IN}$3, 4=−20dBV |
| Total harmonic distortion 2 | $THD_2$ | — | 0.1 | 0.5 | % | $V_{IN}$3, 4=−20dBV |
| Rated output | $P_O$ | 20 | 32 | — | mW | THD=10% |
| Output noise voltage 2 | $V_{NO2}$ | — | −90 | −84 | dBV | Rg=0 |
| Channel separation 2 | $CS_2$ | 59 | 69 | — | dB | $V_{IN}$3, 4=−20dBV, Rg=0 |
| Channel separation 3 | $CS_3$ | 11 | 14 | — | dB | $V_{IN}$3, 4=−20dBV, Rg=0, BB ON |
| Channel separation 4 | $CS_4$ | 25 | 35 | — | dB | $V_{IN}$3, 4=−20dBV, Rg=10kΩ |
| Mute attenuation | $ATT_M$ | 59 | 69 | — | dB | $V_{IN}$3, 4=−20dBV, MUTE ON |
| Bass boost | BB | 6.1 | 9.1 | 12.1 | dB | $V_{IN}$3, 4=−30dBV, f=100Hz, BB ON |
| Ripple rejection 2 | $RR_2$ | 26 | 36 | — | dB | $V_{RR}$=−20dBV, $f_{RR}$=1kHz, Rg=0 |

◎Not designed for radiation resistance.

●Measurement circuits

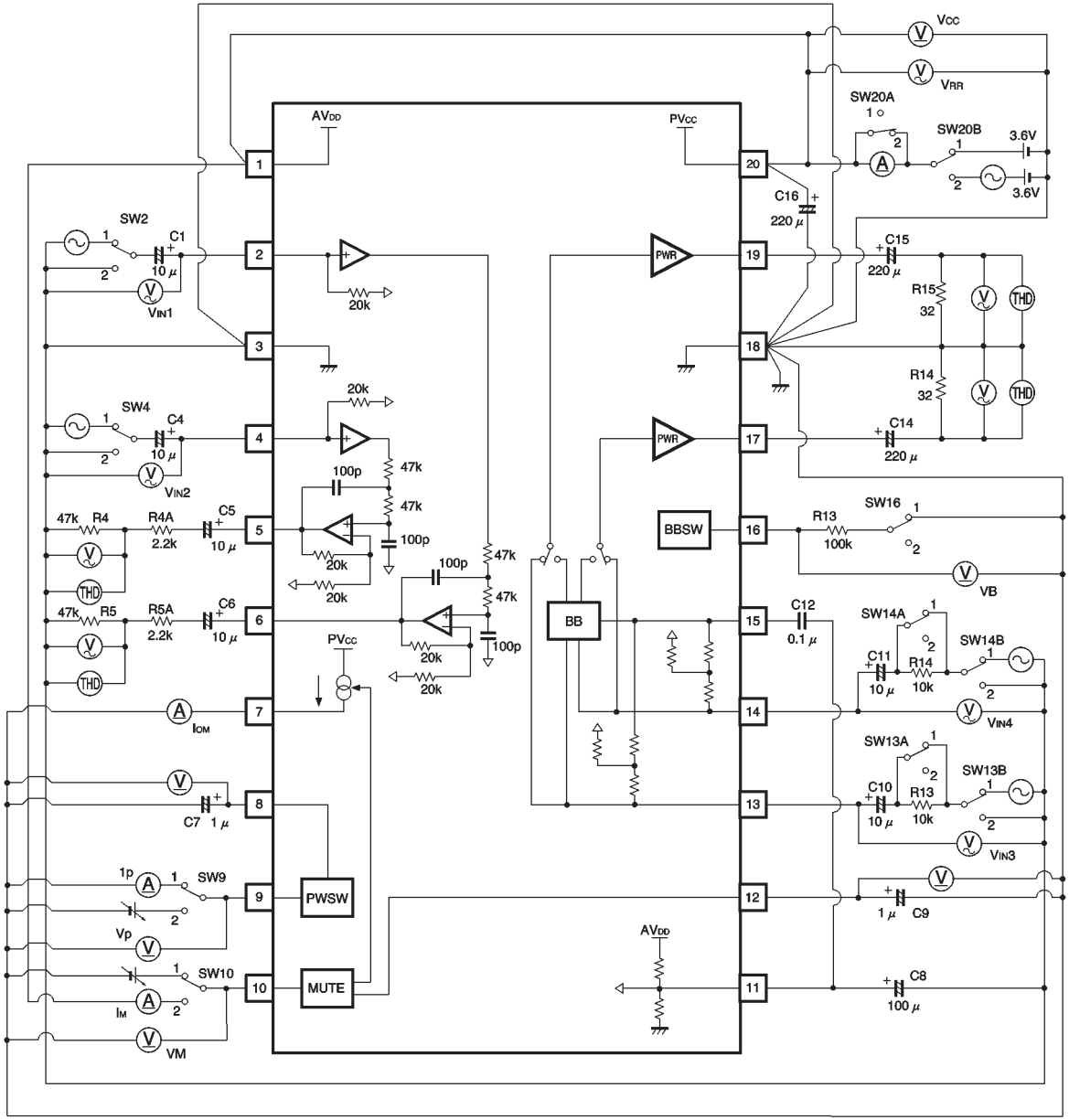
**BA3578FS**




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

Fig.1

**BA3579FS**




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

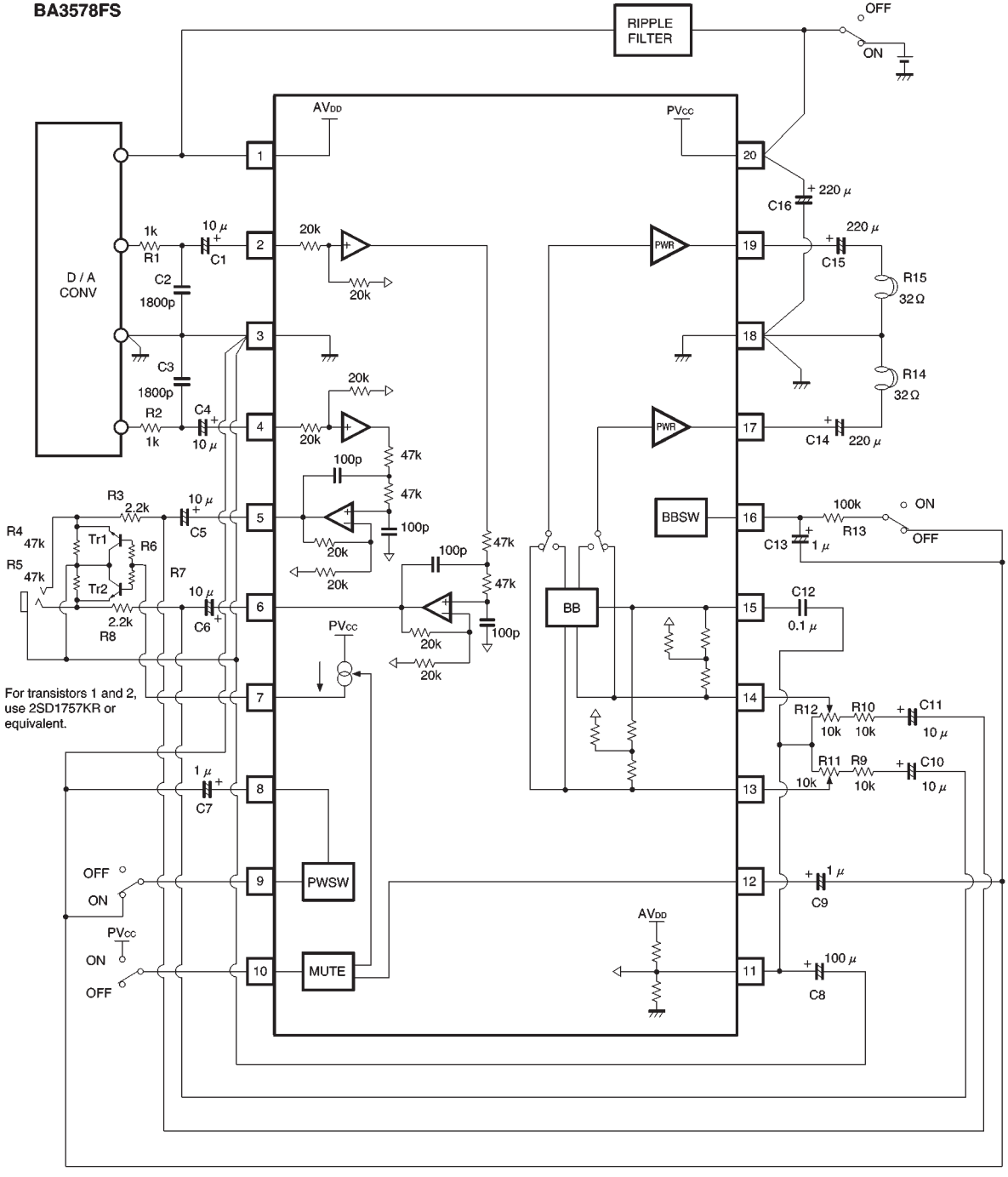
Fig.2

Measurement conditions

| Parameter | Symbol | SW2 | SW4 | SW9 | SW10 | SW13 A | SW13 B | SW14 A | SW14 B | SW16 | SW20 A | SW20 B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Circuit current | $I_{CC}$ | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 |
| Power ON voltage | $V_P$ | ↓ | ↓ | 2 | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | 2 | ↓ |
| Power ON pin current | $I_P$ | ↓ | ↓ | 1 | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| Mute ON voltage | $V_M$ | ↓ | ↓ | ↓ | 2 | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| Mute pin current | $I_M$ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| Mute output current | $I_{OM}$ | ↓ | ↓ | ↓ | 1 | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| Bass boost OFF voltage | $V_B$ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| 〈Line-out〉 | | | | | | | | | | | | |
| Voltage gain 1 | $G_{V1}$ | 1 | 1 | ↓ | ↓ | ↓ | 2 | ↓ | 2 | ↓ | ↓ | ↓ |
| Voltage gain difference | $\Delta G_V$ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| Total harmonic distortion 1 | $THD_1$ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| Maximum output voltage 1 | $V_{OM1}$ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| Output noise voltage 1 | $V_{NO1}$ | 2 | 2 | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| Channel separation 1 | $CS_1$ | 1 / 2 | 2 / 1 | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| Ripple rejection 1 | $RR_1$ | 2 | 2 | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | 2 |
| 〈Headphone out〉 | | | | | | | | | | | | |
| Voltage gain 2 | $G_{V2}$ | 2 | 2 | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | 1 |
| Total harmonic distortion 2 | $THD_2$ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| Rated output | $P_O$ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| Output noise voltage 2 | $V_{NO2}$ | ↓ | ↓ | ↓ | ↓ | ↓ | 2 | ↓ | 2 | ↓ | ↓ | ↓ |
| Channel separation 2 | $CS_2$ | ↓ | ↓ | ↓ | ↓ | ↓ | 1 / 2 | ↓ | 2 / 1 | ↓ | ↓ | ↓ |
| Channel separation 3 | $CS_3$ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | 2 | ↓ | ↓ |
| Channel separation 4 | $CS_4$ | ↓ | ↓ | ↓ | ↓ | 2 / 1 | ↓ | 1 / 2 | ↓ | 1 | ↓ | ↓ |
| Mute attenuation | $ATT_M$ | ↓ | ↓ | ↓ | 2 | 1 | 1 | 1 | 1 | 1 | ↓ | ↓ |
| Bass boost | BB | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | 2 | ↓ | ↓ |
| Ripple rejection 2 | $RR_2$ | 1 | ↓ | ↓ | ↓ | ↓ | 2 | ↓ | 2 | 1 | ↓ | 2 |

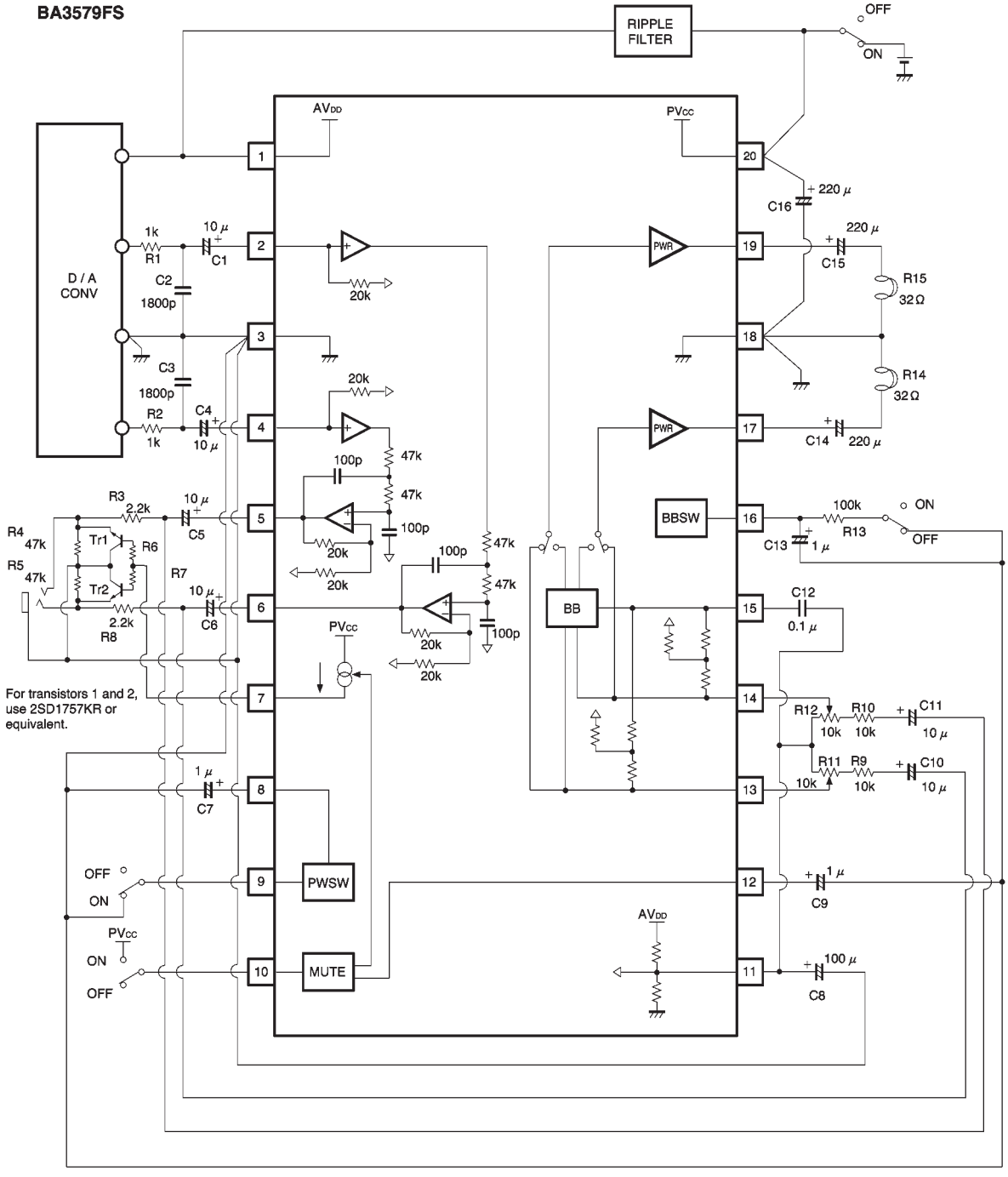
●Application examples

**BA3578FS**




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

Fig.3




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

Fig.4

●Circuit operation

(1) By operating the BA3578FS and BA3579FS according to the timing chart shown in Fig. 5, it is possible to suppress generation of “pop” noise in the headphone output.

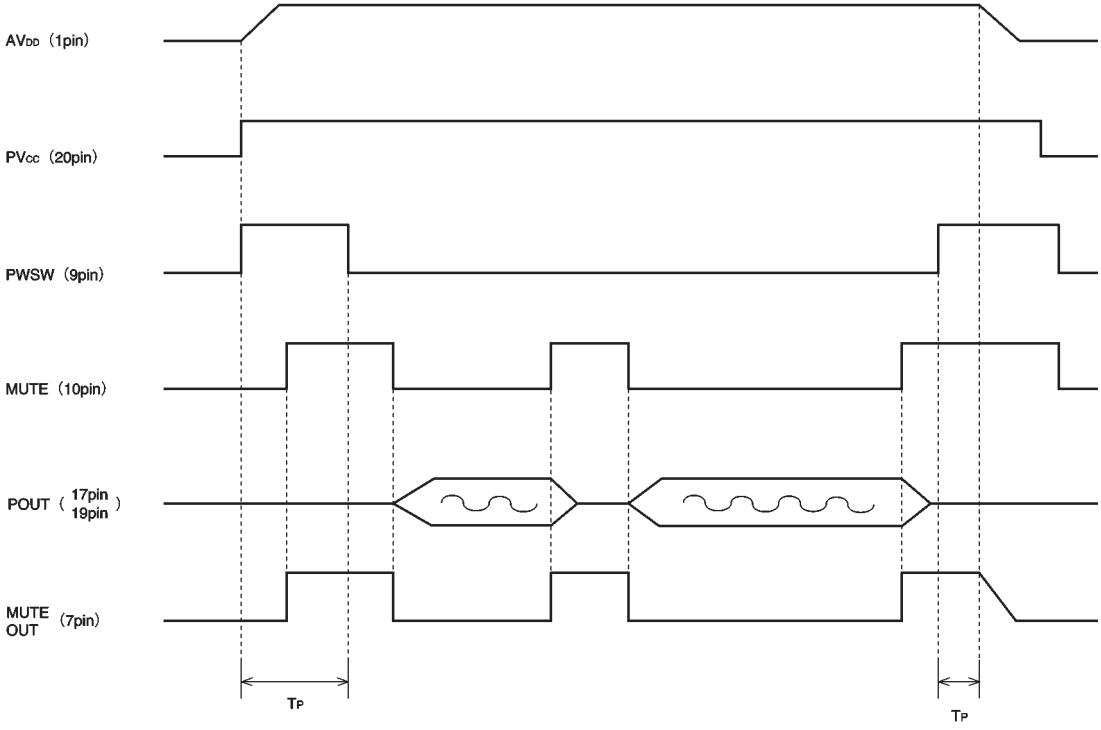



Fig.5 Timing chart

TP 100msec.

(2) The voltage of the BIAS pin (pin 11) for the BA3578FS and BA3579FS is the voltage divided from the AVDD pin (pin 1). There is no current carrying capacity, so do not use it as an operating point for external circuits.

●Electrical characteristic curves

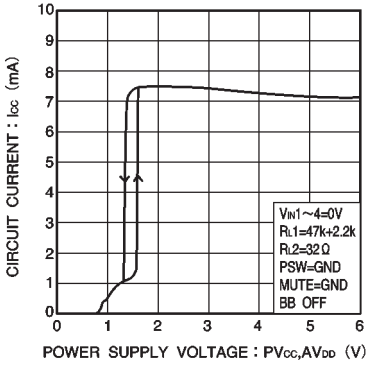



Fig.6 Circuit current vs. power supply voltage

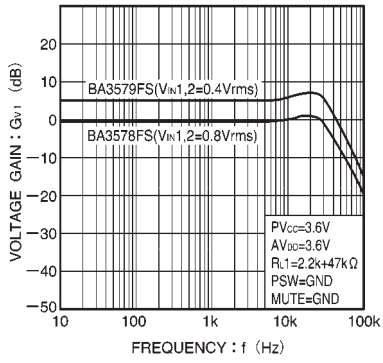



Fig.7 Voltage gain vs.power supply voltage (line-out)

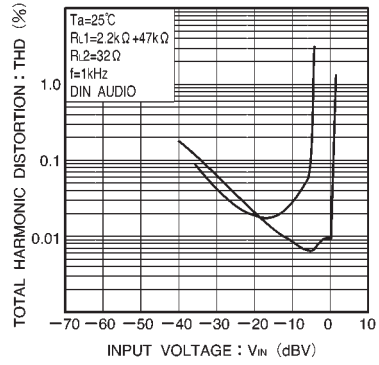



Fig.8 Total harmonic distortion vs. input voltage (line-out)

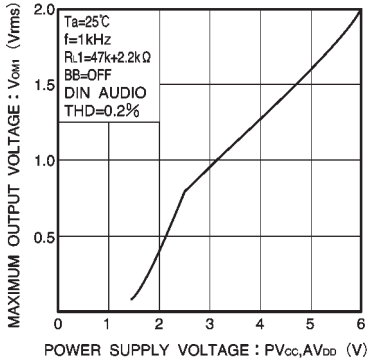



Fig.9 Maximum output voltage vs. power supply voltage (line-out)

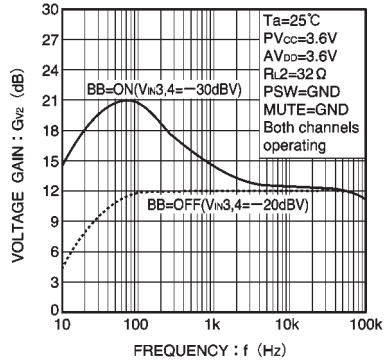



Fig.10 Voltage gain vs. frequency characteristics (headphone-out)

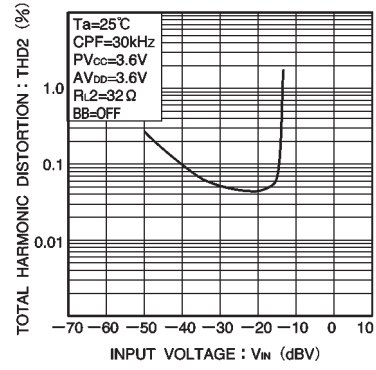



Fig.11 Total harmonic distortion vs. input voltage (headphone-out)

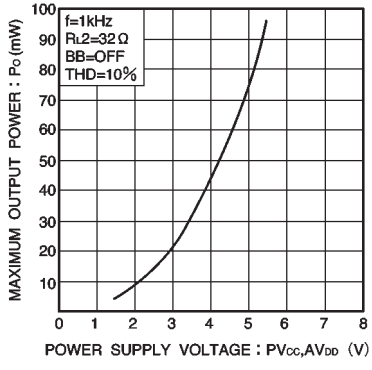



Fig.12 Maximum output voltage vs. power supply voltage (headphone-out)

●External dimensions (Unit: mm)