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

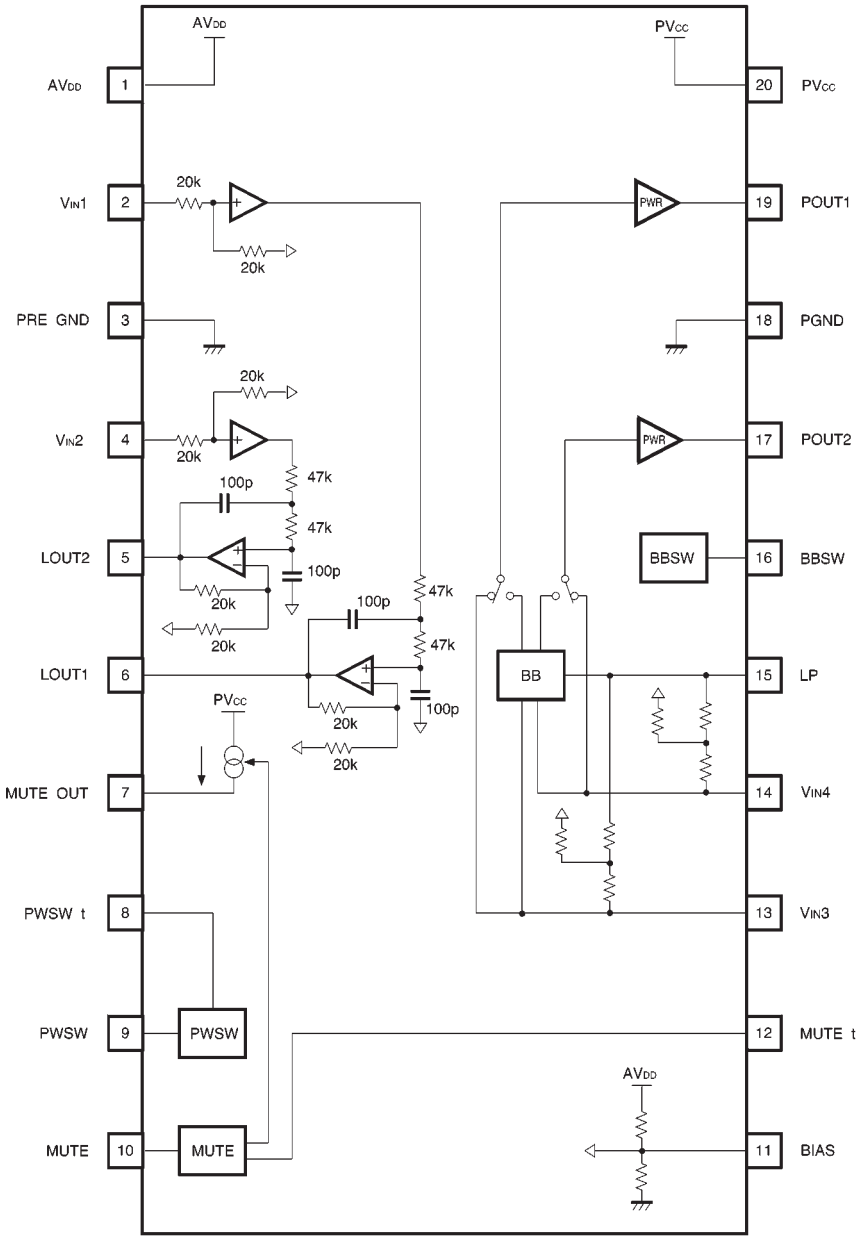
●Recommended operating range

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

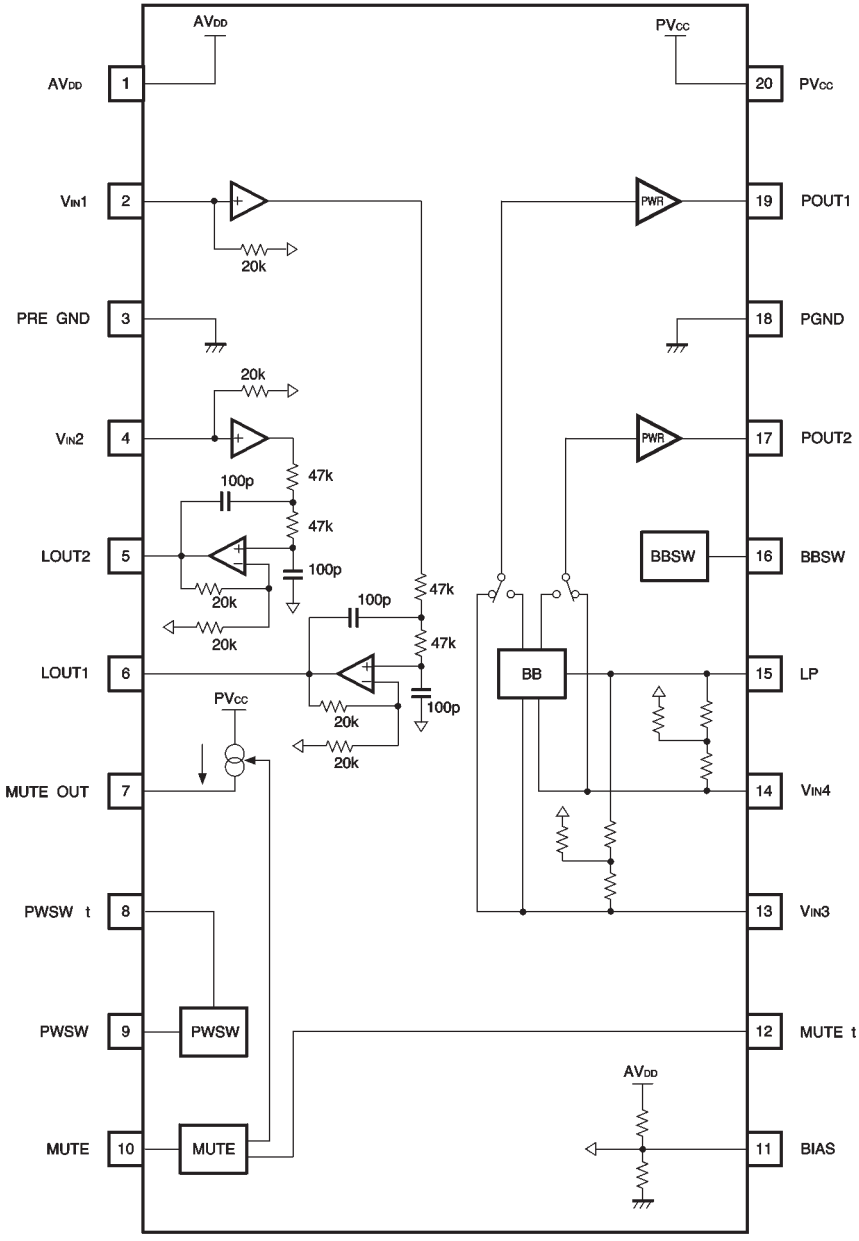
*2 In order to use the headphone output to its optimum performance, have the power supply voltage such that $PV_{CC} \geqq AV_{DD} - 0.3V$

●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

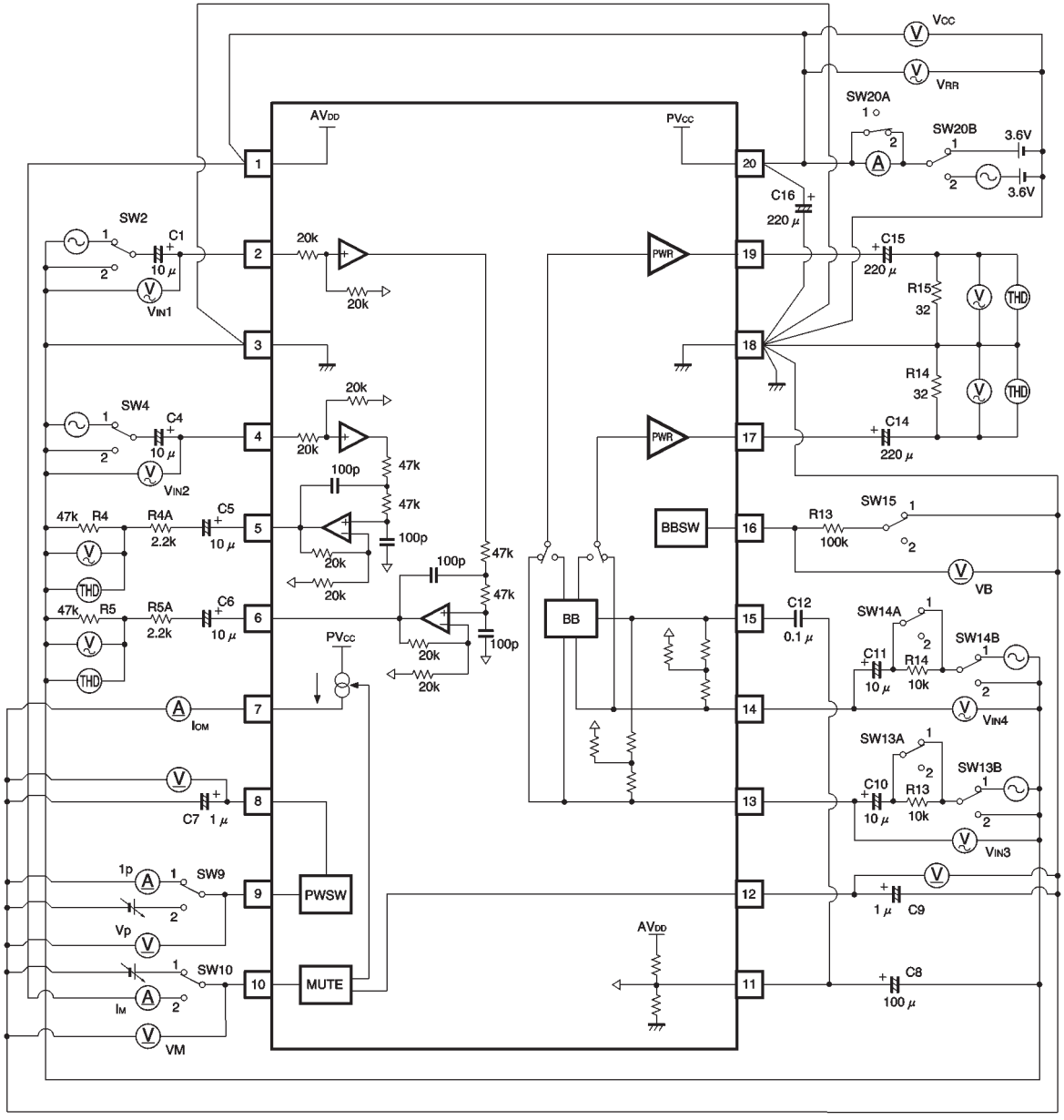
●Electrical characteristics (Unless otherwise noted, Ta = 25°C, PV_{CC} = AV_{DD} = 3.6V, f = 1kHz, PwSw = ON, MUTE = OFF, BB = OFF, Line R_{L1} = 47kΩ, headphone R_{L2} = 32Ω, filter = DIN AUDIO, line-out measurements are with V_{IN}3 and 4 = 0V)

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

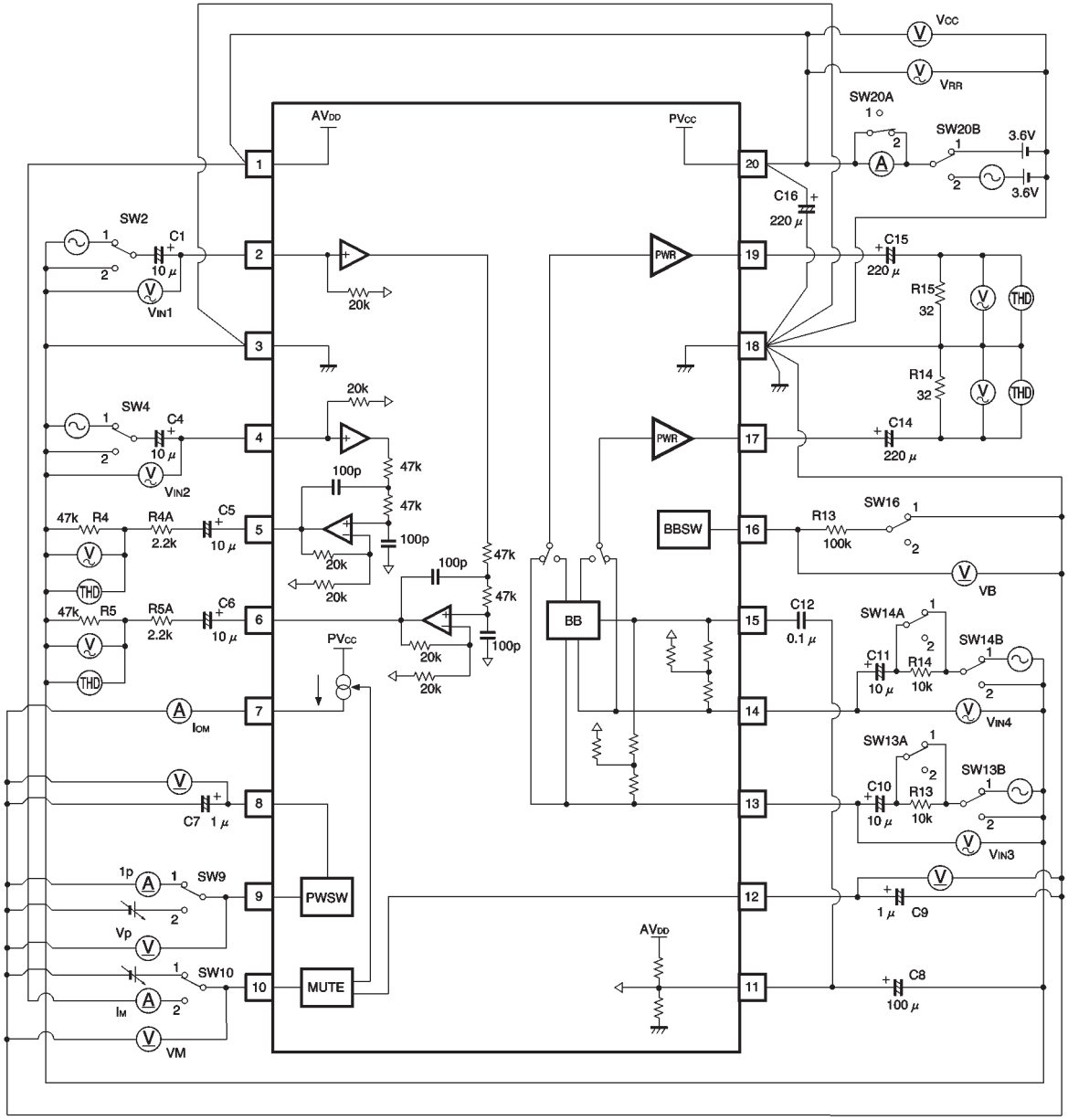
BA3578FS



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%)

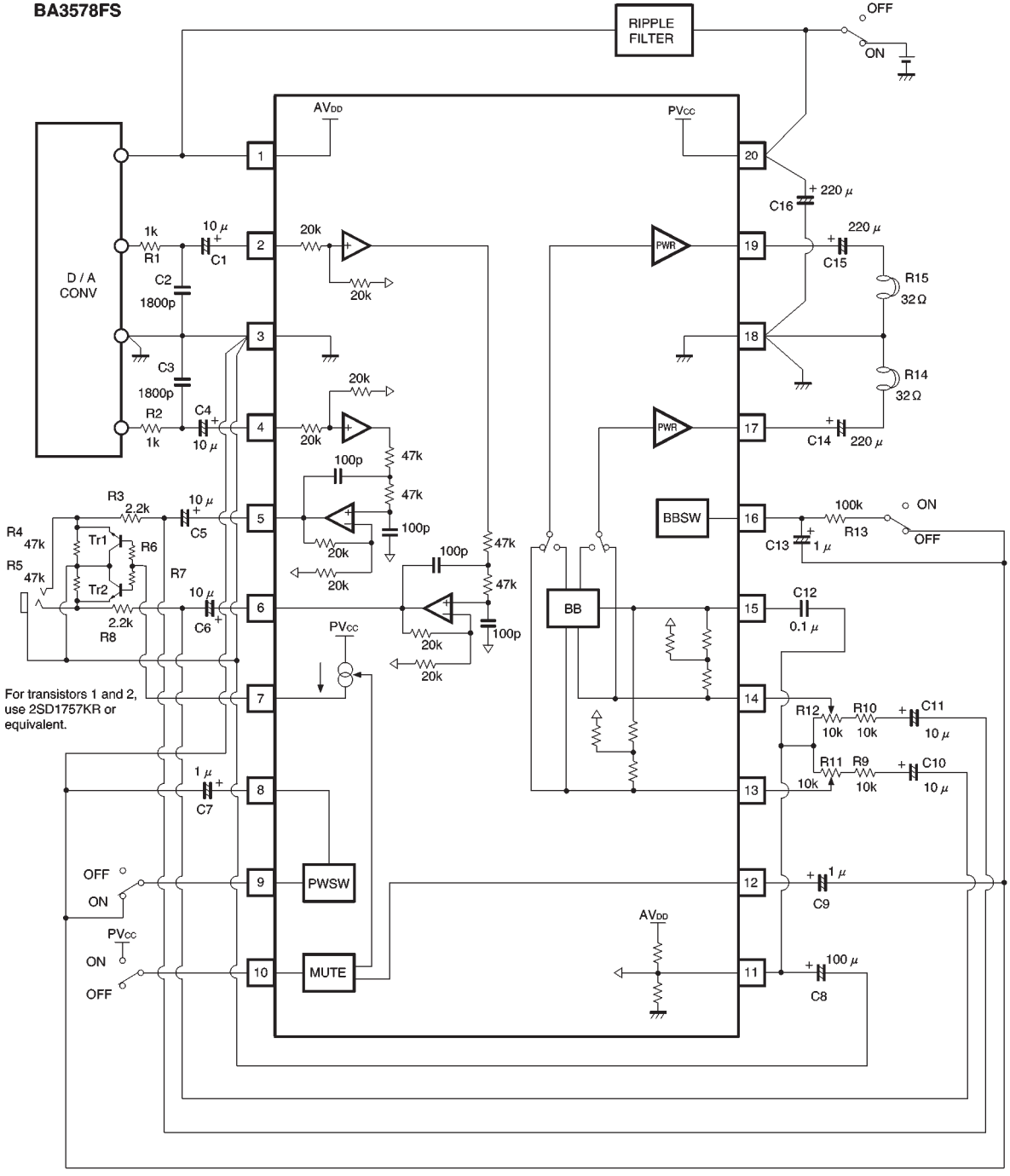
Fig.2

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	ΔG_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

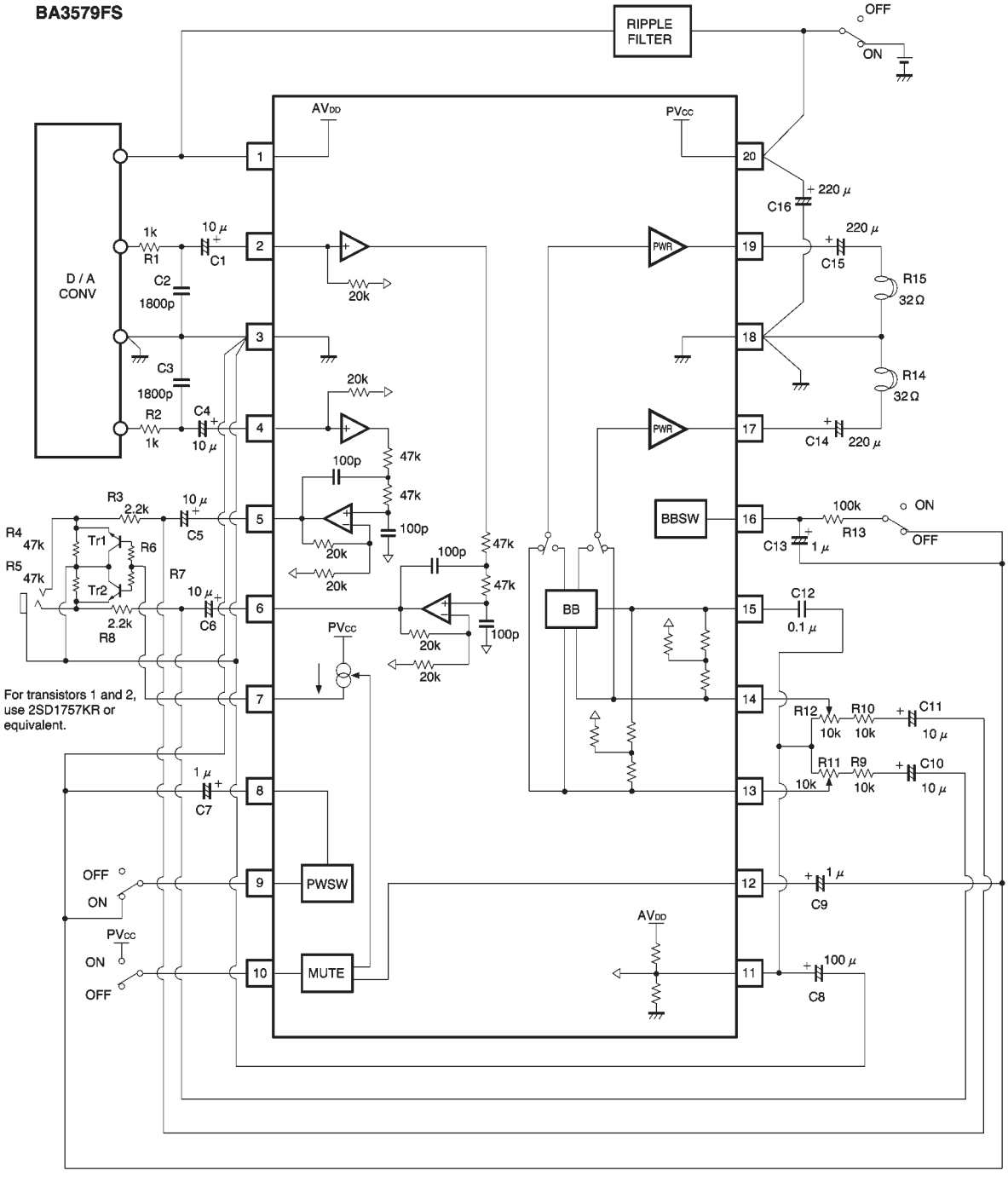
BA3578FS



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

Fig.3

BA3579FS



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.

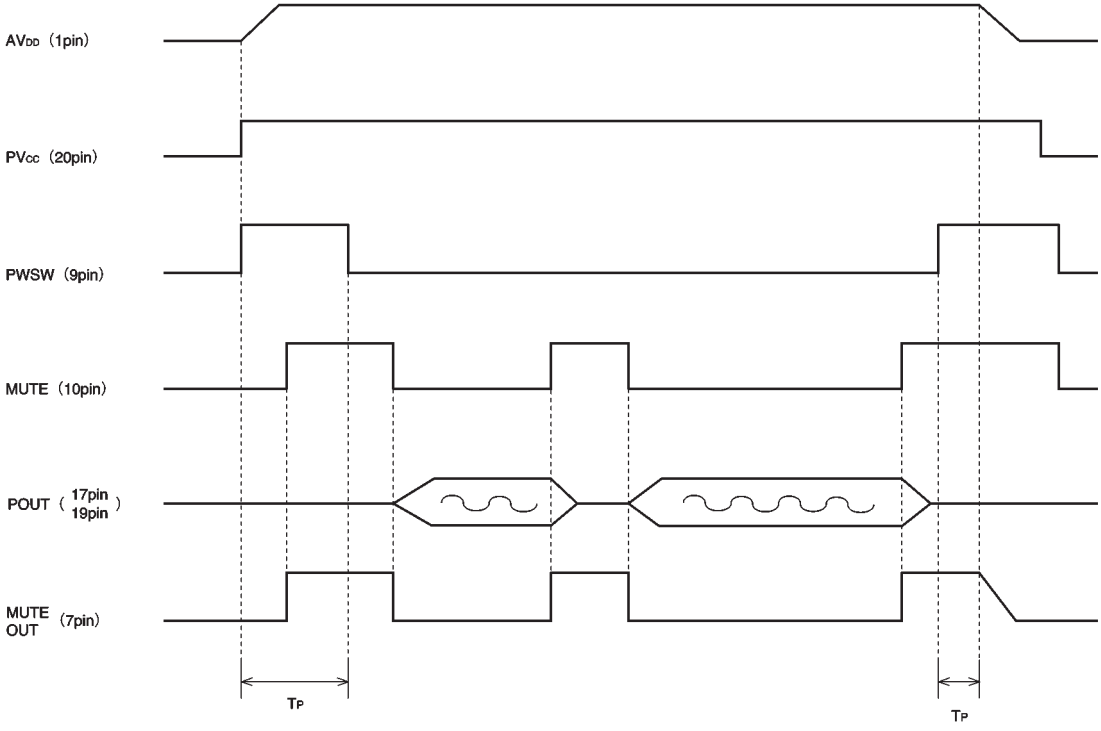


Fig.5 Timing chart

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

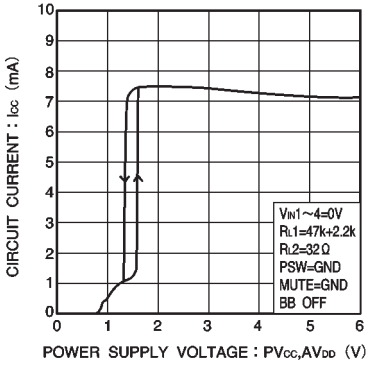


Fig.6 Circuit current vs. power supply voltage

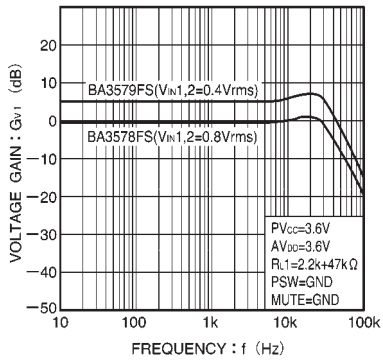


Fig.7 Voltage gain vs.power supply voltage (line-out)

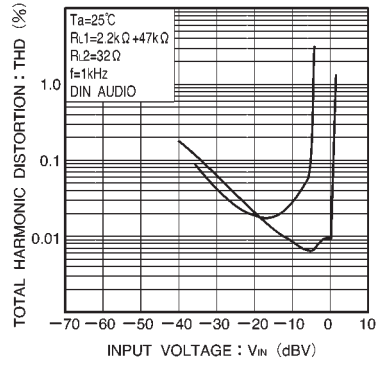


Fig.8 Total harmonic distortion vs. input voltage (line-out)

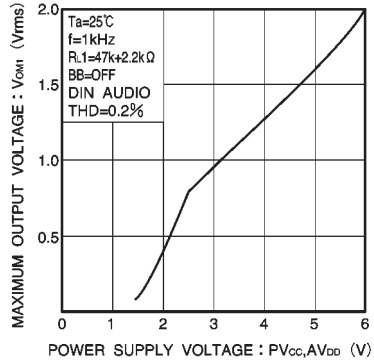


Fig.9 Maximum output voltage vs. power supply voltage (line-out)

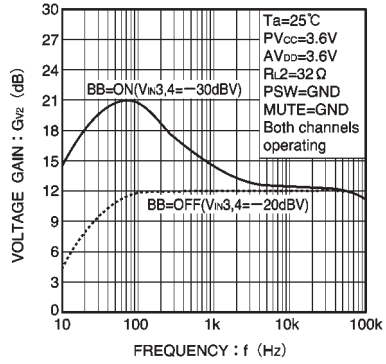


Fig.10 Voltage gain vs. frequency characteristics (headphone-out)

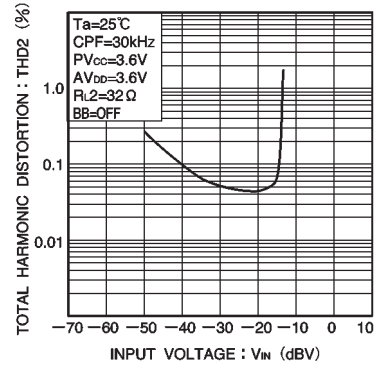


Fig.11 Total harmonic distortion vs. input voltage (headphone-out)

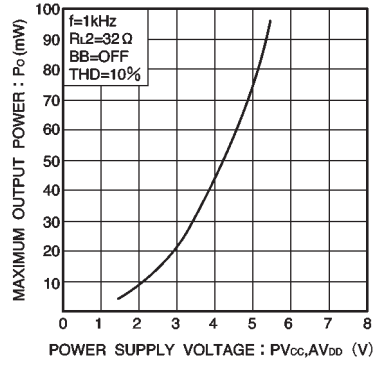


Fig.12 Maximum output voltage vs. power supply voltage (headphone-out)

●External dimensions (Unit: mm)