AN7504SB

Pre-amp. and power amp. IC for 1.5 V headphone stereo

■ Overview

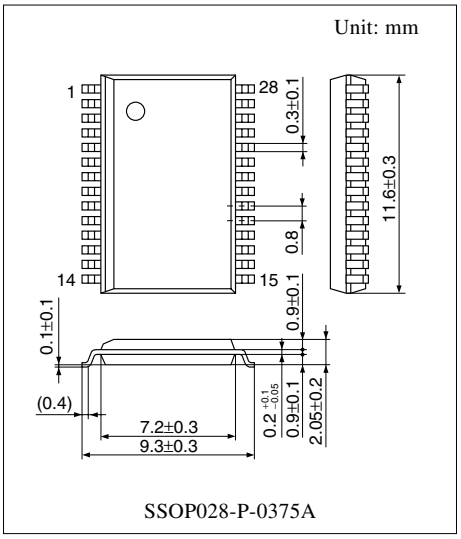
The AN7504SB is a low voltage operation headphone amp. IC for headphone C-cassette stereo. It incorporates tape selector, pre-amp. , soft AGC bass-boost circuit, etc.

■ Features

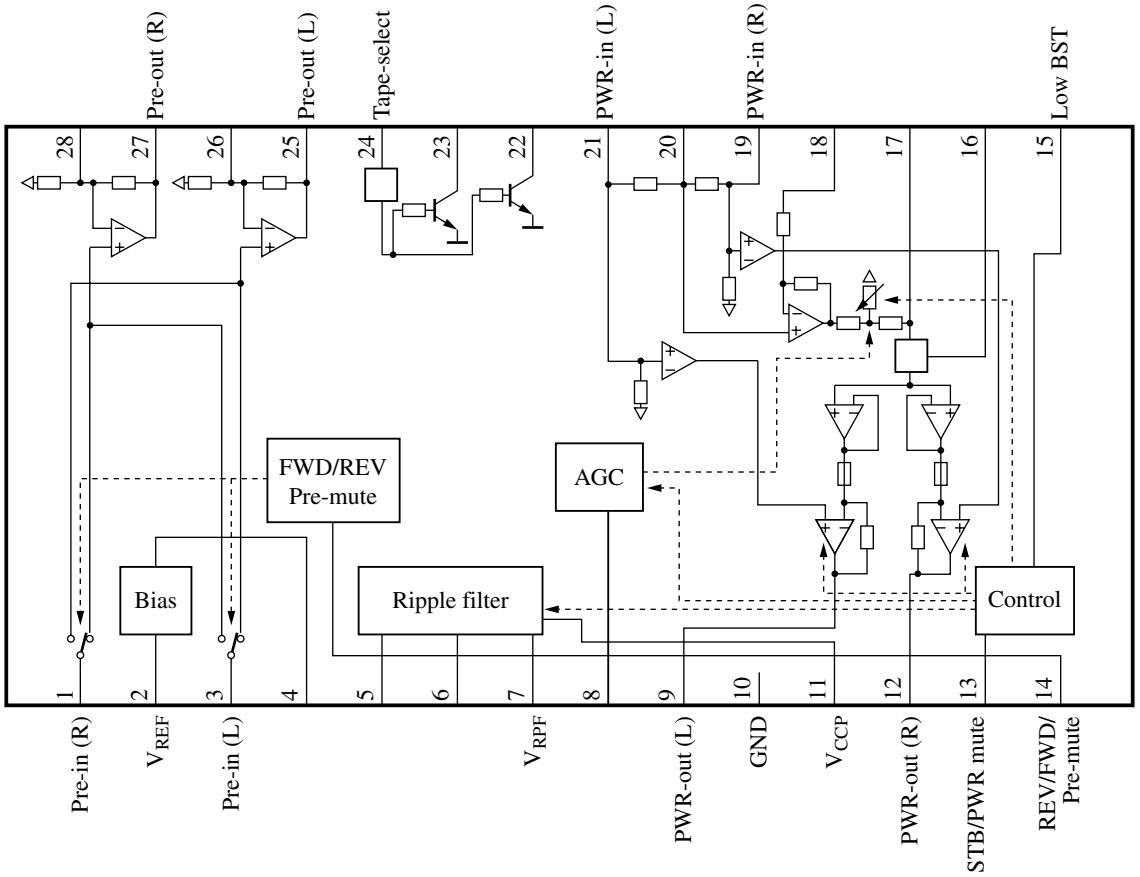
- Low voltage operation (0.98 V to 2.0 V)
- Tape selector switch built-in
- Low frequency boost function with soft AGC

■ Applications

- Headphone stereo



■ Block Diagram



■ Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	2.1	V
Supply current	I_{CC}	20	mA
Power dissipation *2	P_D	42	mW
Operating ambient temperature *1	T_{opr}	−20 to +70	°C
Storage temperature *1	T_{stg}	−55 to +125	°C

Note) *1: Except for the operating ambient temperature and storage temperature, all ratings are for T_a = 25°C.
Keep V_{CC} (0.95 V to 0.98 V) free from any abnormal operation such as oscillation.
*2: The power dissipation shown is the value for T_a = 75°C. For the independent IC without a heat sink.

■ Recommended Operating Range

Parameter	Symbol	Range	Unit
Supply voltage	V_{CC}	0.98 to typ. 1.2 to 2.0	V

■ Electrical Characteristics at V_{CC} = 1.2 V, f = 1 kHz, R_L = 32 Ω, T_a = 25°C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Voltage gain	G_V	V_O = −22.2 dBV	54	57	60	dB
Circuit current 1	I_{CC1}	V_{IN} = 0, R_G = 2.2 kΩ, LBST off	—	2.2	5.3	mA
Pre-amp. block						
Closed circuit voltage gain	$G_{VC(PB)}$	V_O = −22.2 dBV	32.5	34	35.5	dB
Max. output voltage	$V_{Omax(PB)}$	THD = 1%, 30 kHz LPF on	120	210	—	mV
Total harmonic distortion	$THD_{(PB)}$	V_O = 22.2 dBV, 30 kHz LPF on G_{VC} = 35 dB (NAB)	—	0.2	0.6	%
Output noise voltage	$V_{NO(PB)}$	R_G = 2.2 kΩ, 1HF-A	—	−90	−76	dBV
Mute attenuation	$G_{MUTE(PB)}$	Ratio as V_O = −22.2 dBV Pre-mute on	—	−85	−70	dB
Boost low sound and power amp. block						
Voltage gain 1	$G_{V1(PW)}$	V_O = −22.2 dBV	21	23	25	dB
Voltage gain 2	$G_{V2(PW)}$	LBOOST on, V_O = −22.2 dBV	21.4	23.4	25.4	dB
Rating output power	P_{OUT}	THD = 10%, 30 kHz LPF on	2.5	4.5	—	mW
Total harmonic distortion	$THD_{(PW)}$	P_{OUT} = 1 mW, 30 kHz LPF on	—	0.35	1.3	%
Output noise voltage 1	$V_{NO1(PW)}$	R_G = 0.1, 1HF-A	—	−91	−86	dBV
Output noise voltage 2	$V_{NO2(PW)}$	LBOOST on, R_G = 0, 1HF-A	—	−86	−82	dBV
Channel balance	$CB_{(PW)}$	V_O = −22.2 dBV	−1.5	0	1.5	dB
Mute output voltage	$V_{MUTE(PW)}$	V_{IN} = −32.2 dBV	—	−96	−90	dBV
AGC level	V_{AGC}	V_{IN} = −45.2 dBV, f = 100 Hz R_L = 32 Ω AGC level: 32 Ω edge measure	−17.3	−14.7	−13.1	dBV

■ Electrical Characteristics at V_{CC} = 1.2 V, f = 1 kHz, R_L = 32 Ω, T_a = 25°C (continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Ripple filter block						
Ripple rejection ratio	RR	V_{CC} = 1.1 V, V_{RR} = −32.2 dBV f_{RR} = 100 Hz, I_{RFO} = 15 mA BPF: 100 Hz, 1/4 OCT	24	30	—	dB
DC output voltage	V_{RPF}	V_{CC} = 1.0 V, I_{RFO} = 15 mA	0.89	0.94	—	V
Bias block						
DC output voltage	V_{REF}	V_{CC} = 1.0 V	0.68	0.76	0.83	V
Control block						
Threshold voltage at standby on	V_{STON}	Low: Power off	—	—	0.1	V
Threshold voltage at standby off	V_{STOFF}	Open: Power on (Power mute on) $V_{STOFF} = 1/2V_{CC} - V_{13}$	− 0.2	—	0.2	V
Bias voltage at power mute off	V_{MTOFF}	Open: Power mute off $V_{MTOFF} = V_{CC} - V_{13}$	—	—	0.1	V
Low threshold at FWD/REV/pre-mute	V_{TH1L}	Low: REV	—	—	0.1	V
High threshold at FWD/REV/pre-mute	V_{TH1H}	High: Pre-mute on $V_{THIH} = V_{CC} - V_1$	—	—	0.1	V
Low threshold at low boost off	V_{LBOFF}	Low: LBOOST off	—	—	0.3	V
Low threshold at tape select off	V_{TPOFF}	Low: Tape-select off	—	—	0.3	V

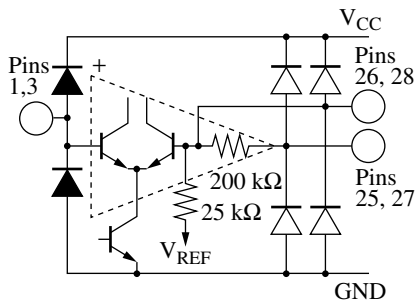
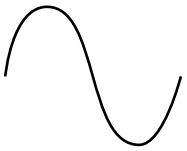
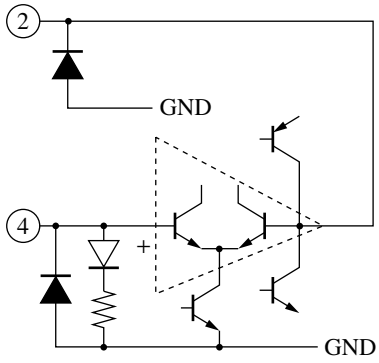
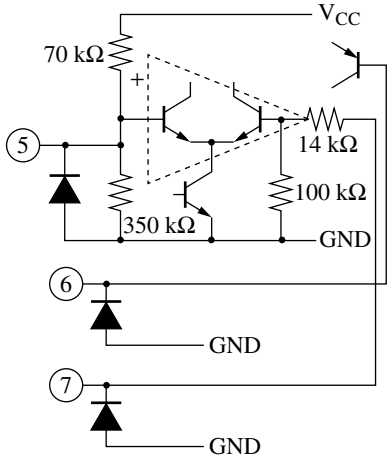
• Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Circuit current 2	I_{CC2}	P_{OUT} = 0.5 mW, × 2-ch., R_L = 32 Ω	—	6.5	11.2	mA
Boost low sound and power amp. block						
Input resistance	$R_{IN(PW)}$	—	7.2	9.5	12	kΩ

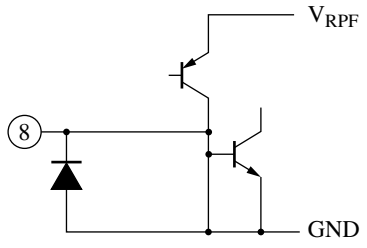
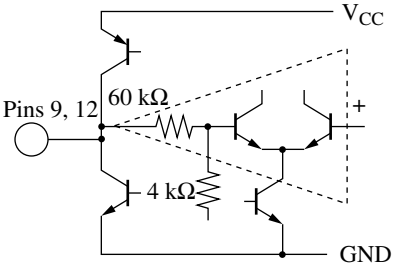
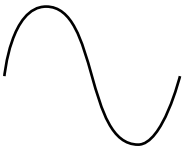
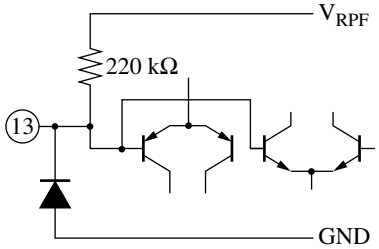
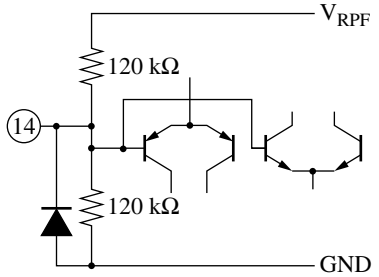
■ Terminal Equivalent Circuits

Note) The values mentioned below are the typical ones and is subject to change due to application condition and dispersion of IC.

Pin No.	Equivalent circuit	Description	Waveform (typ.)
1		PB-in (R): Playback amp. input	 DC 0.78 V AC –66.2 dBV
2		V_{REF}: Reference voltage output	DC 0.78 V
3	Refer to pin 1	PB-in (L): Playback amp. input	Refer to pin 1
4	Refer to pin 2	V_{REF}-in: Reference voltage input	DC 0.78 V
5		RF-in: Ripple filter reference voltage input	DC 1.0 V
6		RF-base: Ripple filter	DC 0.47 V
7		V_{RPF}: Ripple filter reference voltage output	DC 1.13 V

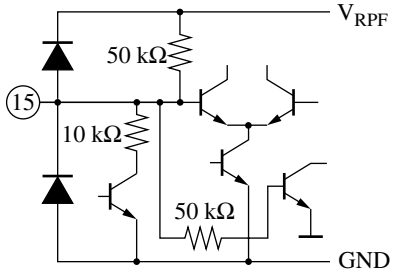
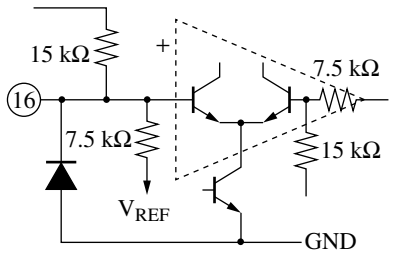
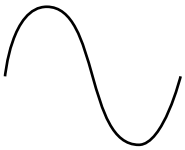
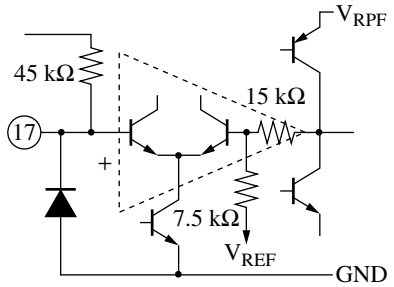
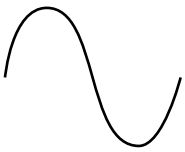
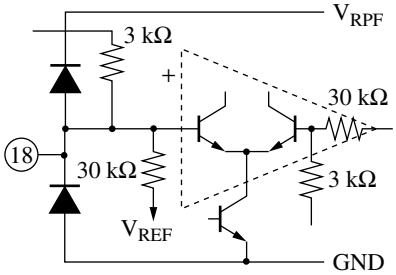
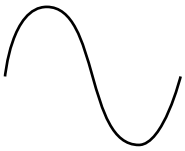
■ Terminal Equivalent Circuits (continued)

Note) The values mentioned below are the typical ones and is subject to change due to application condition and dispersion of IC.

Pin No.	Equivalent circuit	Description	Waveform (typ.)
8		AGC-TAU: AGC time constant	—
9		PWR-out (L): Power amp. voltage output	 DC 0.6 V AC −8.8 dBV
10	—	GND: GND pin	0 V
11	—	V_{CC}: Power supply pin	1.2 V
12	Refer to pin 9	PWR-out (R): Power amp. voltage output	Refer to pin 9
13		STBY, PWR mute CNT: PWR-mute off Pin open: $V_{CC} - V_{13} < 0.1$ V PWR-mute on -0.2 V $< 1/2V_{CC} - V_{13} < 0.2$ V STBY on $V_{13} < 0.1$ V	—
14		FWD/REV/Pre-mute: FWD/REV/pre-mute control Pre-mute Voltage high: $V_{CC} - 0.1 < V_{14\text{-}19}$ FWD Pin open REV Voltage low: $V_{14\text{-}19} < 0.1$	—

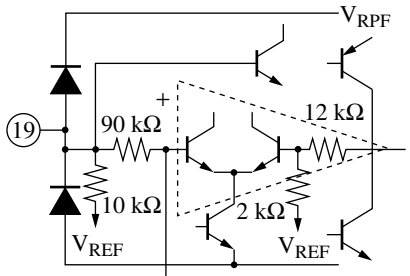
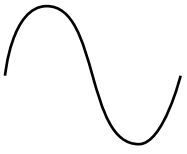
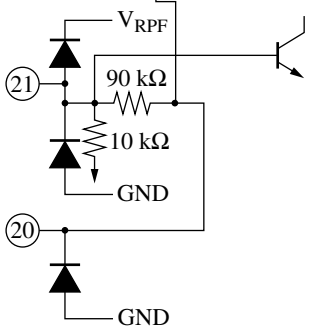
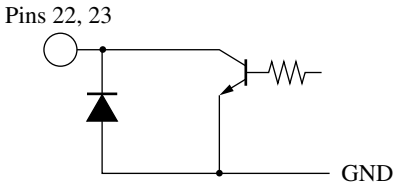
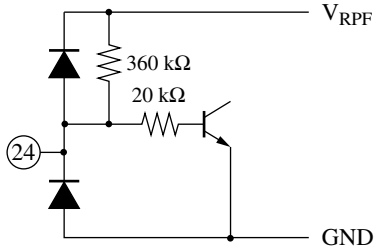
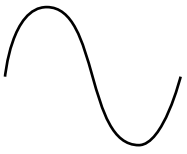
■ Terminal Equivalent Circuits (continued)

Note) The values mentioned below are the typical ones and is subject to change due to application condition and dispersion of IC.

Pin No.	Equivalent circuit	Description	Waveform (typ.)
15		L-BST CNT: Low boost on/off control L-BST on Pin open L-BST off Voltage low: $-0.3\ V < V_{11\text{-}19} < 0.3\ V$	DC 0 V
16		L-BST C: Low boost Capacitor pin	 DC 0.78 V
17		LPF2-C: LPF2 Capacitor pin	 DC 0.78 V
18		L-BST C1: Low boost Capacitor pin	 DC 0.78 V

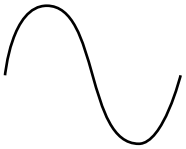
■ Terminal Equivalent Circuits (continued)

Note) The values mentioned below are the typical ones and is subject to change due to application condition and dispersion of IC.

Pin No.	Equivalent circuit	Description	Waveform (typ.)
19		PWR-in (R): Power amp. input	 DC 0.78 V AC −32.2 dBV
20		LPF1-C: LPF C pin	DC 0.78 V
21		PWR-in (L): Power amp. input	Refer to pin 19
22		Tape-select on/off: Tape select driver	—
23		Tape-select on/off: Tape select driver	—
24		Tape-select on/off CNT: Tape select driver Driver on Voltage high Driver off V_{24} < 0.3 V	—
25	Refer to pin 1	PB-out (L): Playback amp. output	 DC 0.6 V AC −32.2 dBV

■ Terminal Equivalent Circuits (continued)

Note) The values mentioned below are the typical ones and is subject to change due to application condition and dispersion of IC.

Pin No.	Equivalent circuit	Description	Waveform (typ.)
26	Refer to pin 1	PB-NF(L): Playback amp. negative feedback input	 DC 0.78 V
27	Refer to pin 1	PB-OUT(R): Playback amp. input	Refer to pin 25
28	Refer to pin 1	PB-NF(R): Playback amp. negative feedback input	Refer to pin 26

■ Application Notes

1. Operation logic of control pin

Pin 24	Low	High or Open
Tape select control	Off (Pins 22, 23 High)	On (Pins 22, 23 Low)

Pin 14	Low	Open	High
Pre-amp. system control	Reverse	Forward	Mute
	Input pin → Output pin	Input pin → Output pin	
	Pin 1 → Pin 25	Pin 1 → Pin 27	
	Pin 3 → Pin 27	Pin 3 → Pin 25	

Pin 13	Low 1	Low 2	High
Power amp. system control	Standby on	Standby off, Mute on	Mute on

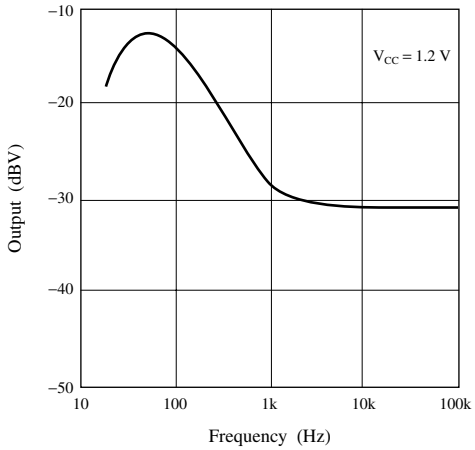
Low 1: Short-circuit to GND

Low 2: 0.6 V application or short circuit to GND with 220 kΩ

■ Application Notes (continued)

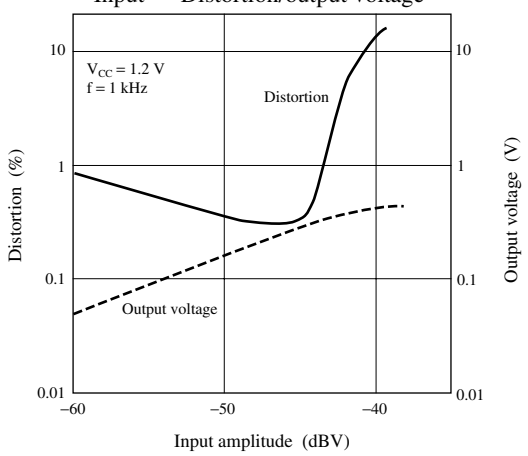
2. Main characteristics

1. Pre-amp. output frequency characteristics



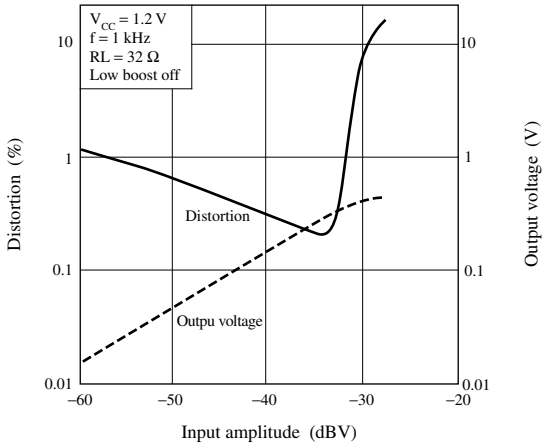
2. Distortion and amplitude at pre-amp. output

Input — Distortion/output voltage



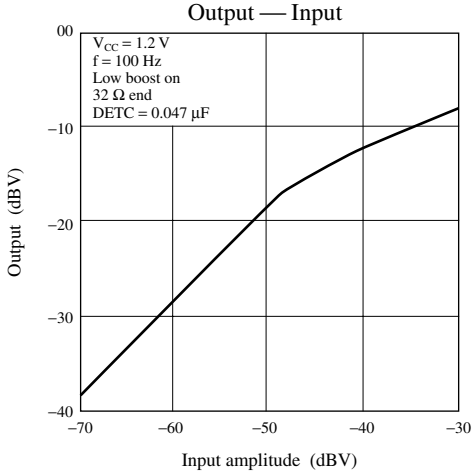
3. Distortion and amplitude characteristics of headphone amp.

Input — Distortion/output voltage



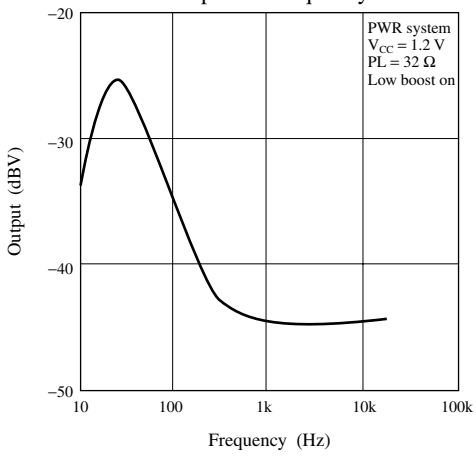
4. Headphone amp.

Output — Input



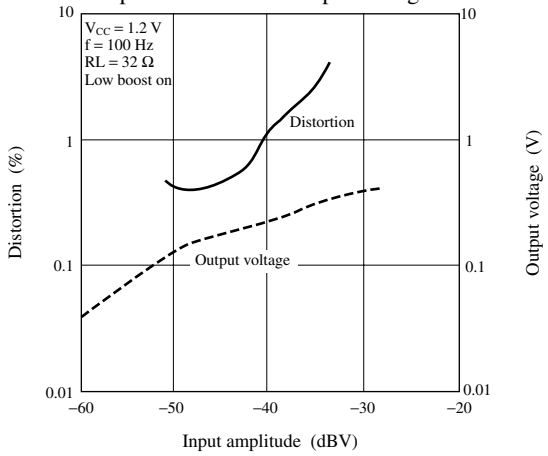
5. Headphone amp.

Output — Frequency



6. Distortion and amplitude at headphone amp. output

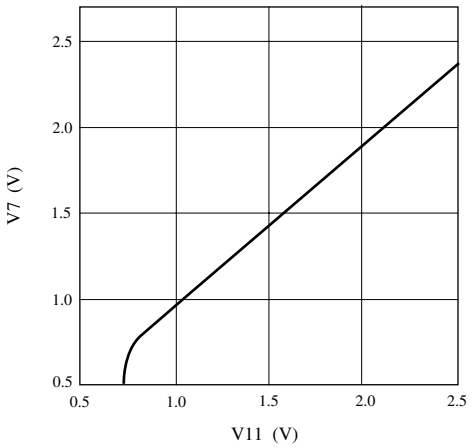
Input — Distortion/output voltage



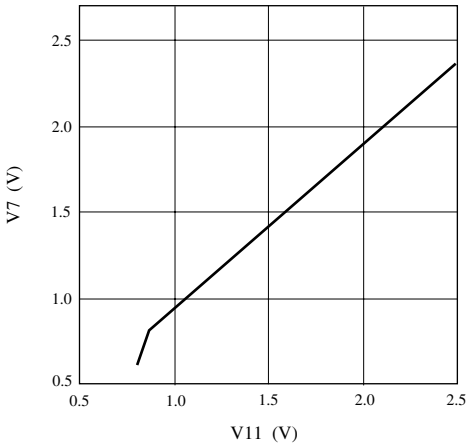
■ Application Notes (continued)

2. Main characteristics (continued)

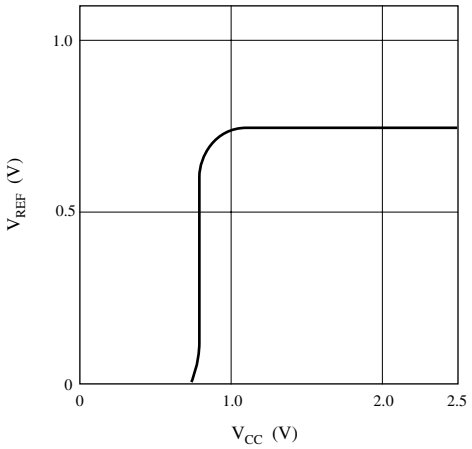
7. Ripple filter output voltage (pin 7)



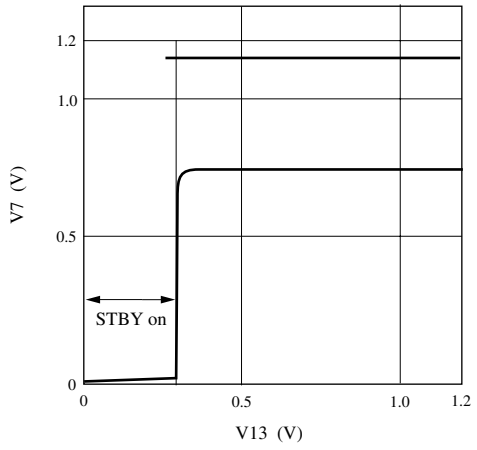
8. Ripple filter output voltage (Using at 15 mA of current)



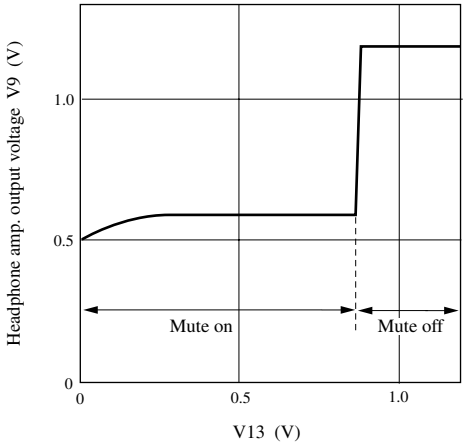
9. V_{CC} — V_{REF}



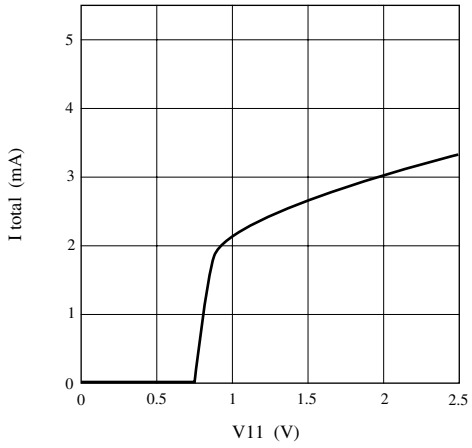
10. Pin 2 (V_{REF}) at standby on/off and voltage at pin 7 (Ripple filter)



11. Headphone amp. at mute on/off (Pin 9) output voltage

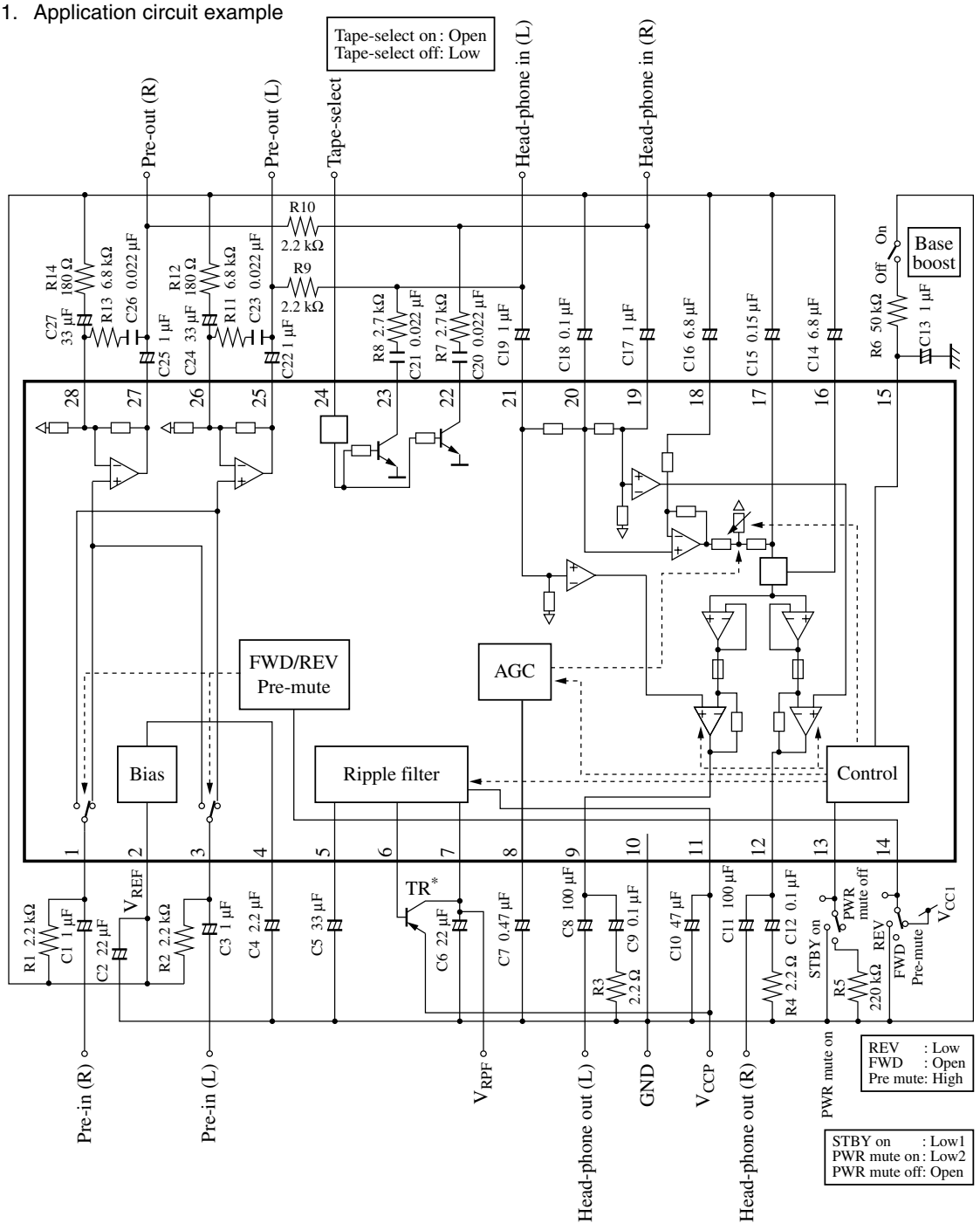


12. V_{CC} — I total



■ Application Circuit Examples

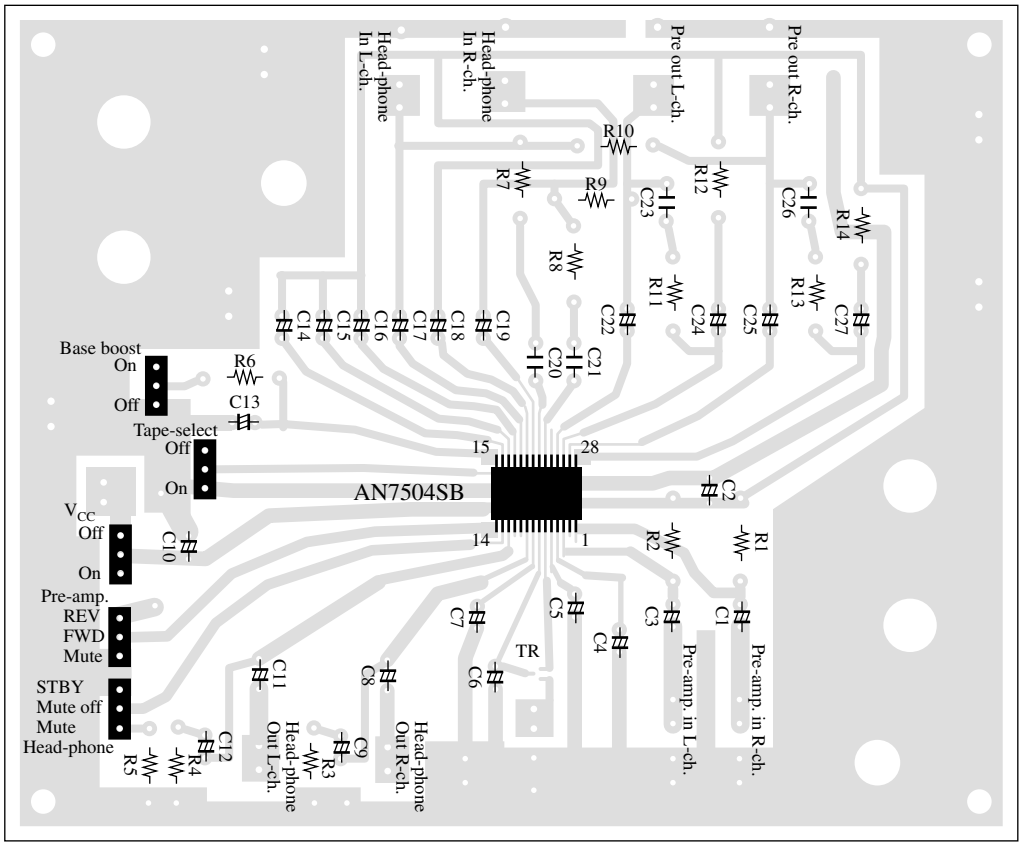
1. Application circuit example



Note) ∗: The low $V_{CE(SAT)}$ PNP TR be used as TR.

■ Application Circuit Examples (continued)

2. Evaluation board



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