Pre / power amplifier for 1.5V headphone stereos

BA3632K

The BA3632K is a dual-channel pre / power system IC designed for 1.5V headphone stereos. There is no need for DC/DC conversion, and the system can operate off a single battery. The IC draws low current (I_{CC} = 2.6mA) to allow long set life.

●Applications

1.5V headphone stereos.

●Features

1) Dual pre-amplifiers with auto reverse compatibility.
2) Dual power amplifiers.
3) Bass boost circuit (variable bass boost).
4) AMS circuit (on chip comparator).
5) Ripple filter.
6) Low power consumption (I_{CC} = 6.8mA, 0.5W × 2ch, R_L = 32Ω).

●Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	3.0	V
Power dissipation	Pd	400*1	mW
Operating temperature	Topr	−10～+60	℃
Storage temperature	Tstg	−55～+125	℃

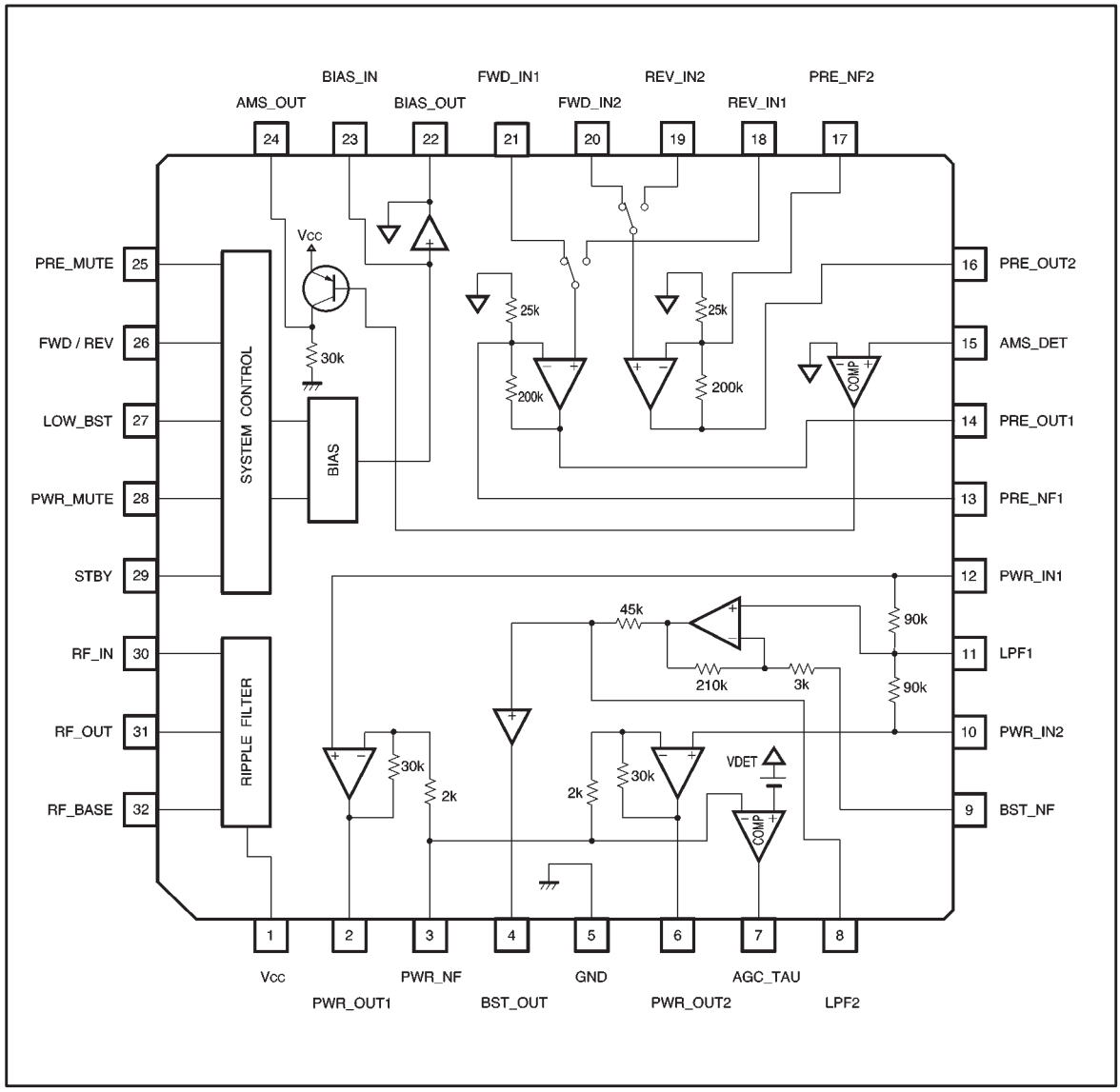
*1 Reduced by 4.0mW for each increase in Ta of 1℃ over 25℃.

●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	0.95 (0.98) ～2.2*	V

* The range V_{CC}=0.95V to 0.98V is the operating range for which oscillation will not occur. The ripple rejection for the ripple filter is stipulated for V_{CC} =1.1V.

●Block diagram



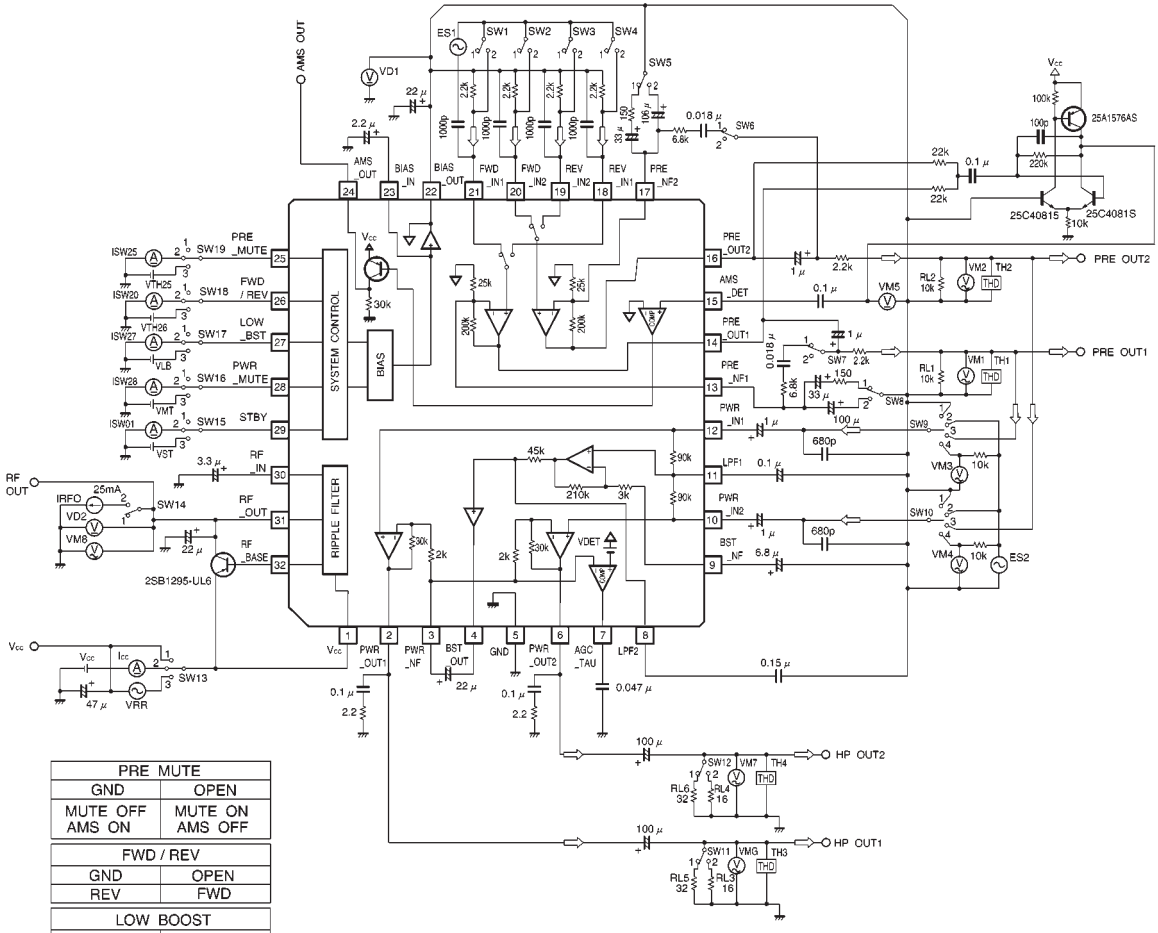
●Electrical characteristics (unless otherwise noted, Ta = 25°C, V_{CC} = 1.2V, f= 1kHz, R_L = 10kΩ (pre-amplifier), RL = 32Ω (power amplifier), L.BOOST OFF, 0dBm = 0.775Vrms)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Coniditions
〈Pre+power amplifier〉						
Voltage gain	GVTTL	54	57	60	dB	V_O=−20dBm
Circuit current 1	I_{CC1}	—	2.6	4.2	mA	V_{IN}=0, Rg=2.2kΩ
Circuit current 2	I_{CC2}	—	2.6	4.1	mA	L.BOOST ON, V_{IN}=0, Rg=2.2kΩ
Circuit current 3	I_{CC3}	—	6.8	10.3	mA	P_{OUT}=0.5mW×2ch, Rg=32Ω
Circuit current 4	I_{CC4}	—	5	20	μA	STBY OFF
〈Pre-amplifier〉						
Open-circuit voltage gain	G_{VO}	61	73	—	dB	V_O=−20dBm
Closed-circuit voltage gain	G_{VC}	33.5	35	36.5	dB	V_O=−20dBm
Maximum output voltage	V_{OM}	120	210	—	mV	THD=1%, DIN AUDIO
Total harmonic distortion	THD	—	0.2	0.6	%	V_O=−20dBm, G_{VC}=35dB (NAB), DIN AUDIO
Input conversion noise voltage	V_{NIN}	—	1.5	3	μV	Rg=2.2kΩ, G_{VC}=35dB (NAB), DIN AUDIO
Channel separation	CS	37	46	—	dB	Single-channel input, Rg=2.2kΩ V_O=−20dBm
FWD / REV REV crosstalk	CT_{F-R}	51	59	—	dB	Single-channel input, Rg=2.2kΩ V_O=−20dBm
Ripple rejection	RR	43	53	—	dB	Rg=2.2kΩ, V_{RR}=−30dBm, f_{RR}=100Hz I_{RFO}=25mA, BPF : 100Hz 1/4 OCT
Mute output voltage	V_{MUTE}	—	−110	−90	dBm	V_{IN}=−40dBm, PRE MUTE ON
〈Bass+power amplifier〉						
Voltage gain 1	G_{V1}	21.5	23.5	25.5	dB	V_O=−20dBm
Voltage gain 2	G_{V2}	21.7	23.7	25.7	dB	L.BOOST ON, V_O=−20dBm
Voltage gain 3	G_{V3}	31	35	39	dB	L.BOOST ON, f=100Hz, V_O=−20dBm
Rated output power	P_{OUT}	5	9	—	mW	THD=10%, DIN AUDIO, R_L=16Ω
Total harmonic distortion	THD	—	0.35	1.3	%	P_{OUT}=1mW, DIN AUDIO
Channel separation 1	CS1	33	40	—	dB	Single-channel input, Rg=0 V_O=−20dBm
Channel separation 2	CS2	35	45	—	dB	Single-channel input, L.BOOST ON, Rg=0, V_O=−20dBm
Output noise voltage 1	V_{NO1}	—	24	40	μV	Rg=0
Output noise voltage 2	V_{NO2}	—	48	80	μV	L.BOOST ON, Rg=0
Ripple rejection 1	RR1	64	74	—	dB	Rg=0, V_{RR}=−30dBm, f_{RR}=100Hz I_{RFO}=25mA, BPF : 100Hz 1/4 OCT
Ripple rejection 2	RR2	42	51	—	dB	L.BOOST ON Rg=0, V_{RR}=−30dBm, f_{RR}=100Hz I_{RFO}=25mA, BPF : 100Hz 1/4 OCT
Input resistance	R_{IN}	7.5	10	13	kΩ	—
Channel balance	CB	−1.5	0	1.5	dB	V_O=−20dBm
Mute output voltage	V_{MUTE}	—	−110	−90	dBm	V_{IN}=−30dBm
AGC level	V_{AGC}	−14.1	−12.5	−10.9	dBm	V_{IN}=43dBm, f=100Hz, R_L=16Ω AGC level measured at the end of the 16Ω resistor

Parameter	Symbol	Min.	Typ.	Max.	Unit	Coniditions
〈Ripple filter block〉				—		
Ripple rejection	RR	33	39	—	dB	V_{CC}=1.1V, V_{RR}=−30dBm, f_{RR}=100Hz I_{RFO}=25mA, BPF : 100Hz 1/4 OCT
DC output voltage	V_{RF}	0.89	0.94	—	V	V_{CC}=1.0V, I_{RFO}=25mA
〈Bias block〉						
DC output voltage	V_{BIAS}	0.68	0.76	0.83	V	V_{CC}=1.0V
〈AMS block〉						
Song detect level 1	VBS	−23.6	−22	−20.4	dBV	POWER MUTE ON When V_{24PIN}=0.6V_{P-O}
Song detect level 2	VMS	−39.6	−38	−36.4	dBV	POWER MUTE OFF When V_{24PIN}=0.6V_{P-O}
〈AMS-Ta characteristics〉						
Ambient temperature	Ta	−10	+25	+50	℃	—
Song detect level 3	ΔVBS	−1.1	0	+0.6	dB	POWER MUTE ON When V_{24PIN}=0.6V_{P-O}
Song detect level 4	ΔV_{MS}	−1.1	0	+0.6	dB	POWER MUTE OFF When V_{24PIN}=0.6V_{P-O}
〈Control block〉						
Standby on voltage	V_{STON}	—	—	0.4	V	“L” : POWER ON
Standby off voltage	V_{STOFF}	0.9	—	—	V	“H” / OPEN : POWER OFF
Standby pin current	I_{STBY}	—	23	45	μA	V_{29PIN}=0V
Power mute on threshold	V_{MTON}	—	—	0.05	V	“L” : POWER MUTE ON
Power mute off threshold	V_{MTOFF}	0.3	—	—	V	“H” / OPEN : POWER MUTE OFF
Power mute pin current	I_{SW28}	—	0.3	0.9	μA	V_{28PIN}=0.1V
FWD/REV low threshold	V_{TH26}	—	—	0.4	V	“L” : REV
FWD/REV pin current	I_{SW26}	—	3	6	μA	V_{26PIN}=0.2V
Low boost off threshold	V_{LBOFF}	—	—	0.1	V	“L” : L.BOOST OFF
Low boost on threshold	V_{LBON}	0.4	—	—	V	“H” / OPEN : L.BOOST ON
Low boost pin current	I_{SW27}	—	0.3	0.9	μA	V_{27PIN}=0.1V
Pre-mute low threshold	V_{TH25}	—	—	0.4	V	“L” : PRE MUTE OFF
Pre-mute pin current	I_{SW25}	—	3	6	μA	V_{25PIN}=0.2V

◎Not designed for radiation resistance.

●Measurement circuit



PRE MUTE	
GND	OPEN
MUTE OFF AMS ON	MUTE ON AMS OFF

FWD / REV	
GND	OPEN
REV	FWD

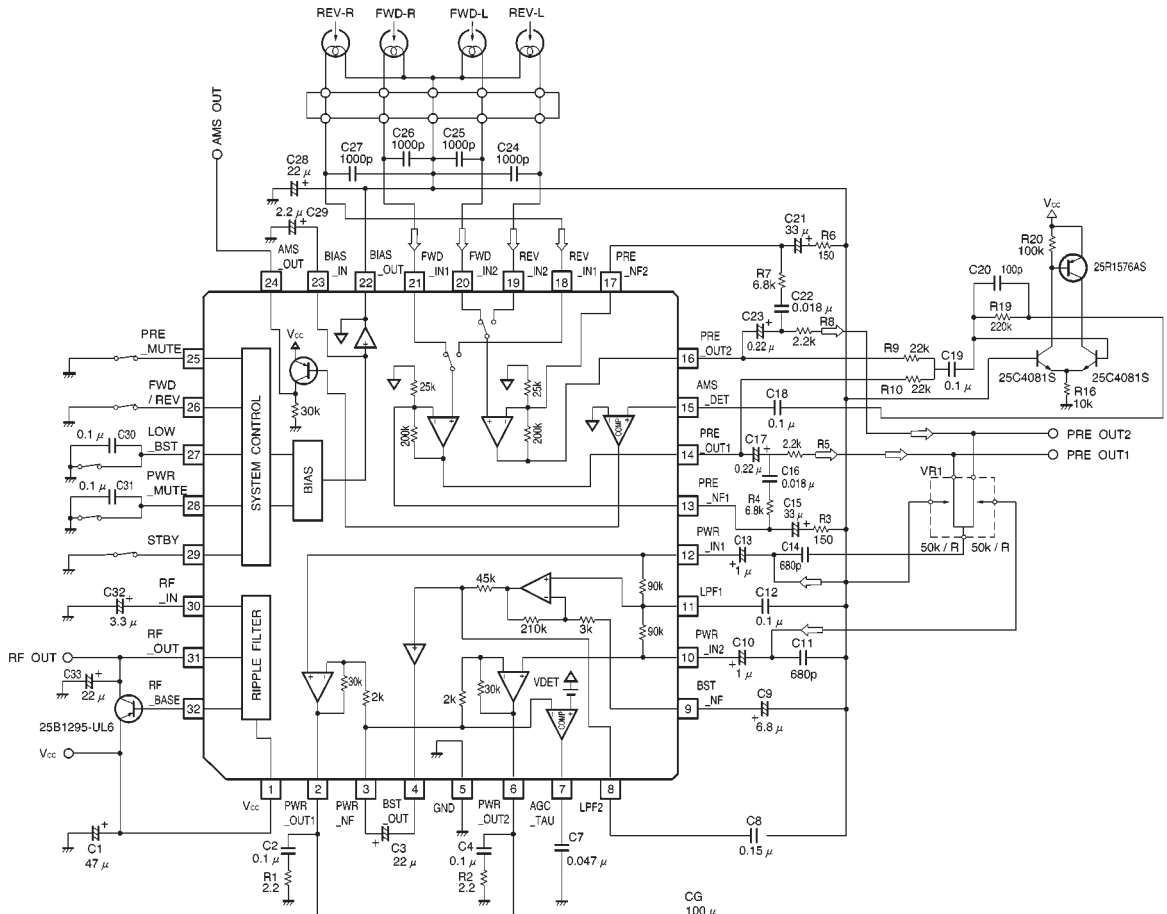
LOW BOOST	
GND	OPEN
OFF	ON

PWR MUTE	
GND	OPEN
MUTE ON AMS BS	MUTE OFF RMS MS

STBY	
GND	OPEN
POWER ON	POWER OFF

Fig.1

●Application example



PRE MUTE	
GND	OPEN
MUTE OFF AMS ON	MUTE ON AMS OFF

FWD / REV	
GND	OPEN
REV	FWD

LOW BOOST	
GND	OPEN
OFF	ON

PWA MUTE	
GND	OPEN
MUTE ON RMS BS	MUTE OFF RMS MS

STBY	
GND	OPEN
POWER ON	POWER OFF

Fig.2

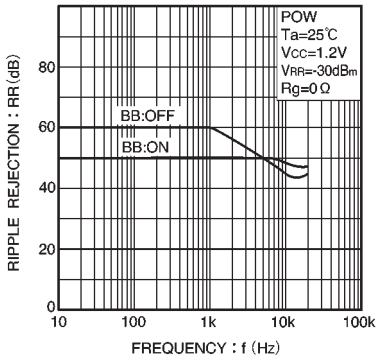


Fig.12 Ripple rejection vs. frequency

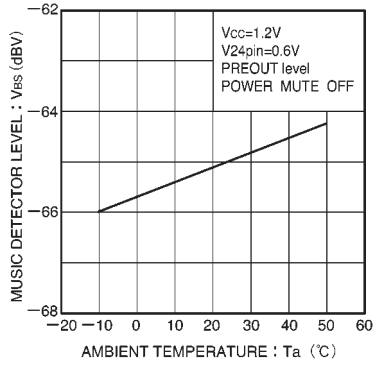


Fig.13 Song detect 3 vs. temperature

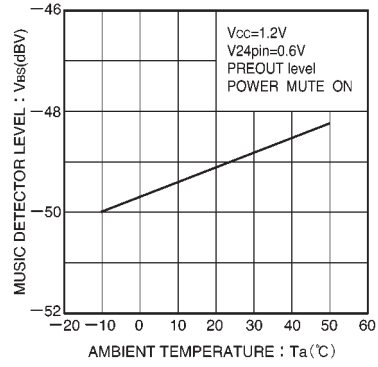


Fig.14 Song detect level vs. temperature

●External dimensions (Unit:s mm)