IC for Headphone Stereos (bass boost)
Monolithic IC LAG 668

Outline

This IC was developed to provide bass boost functions without deviating from the basic design concept of Mitsumi's LAG665, which is highly regarded for applications in headphone stereos for overseas markets in particular.
Bass boost functions are widely adopted in models for overseas markets as well. However, because of stringent cost constraints, there has been a need for an IC which is simple and inexpensive. This IC can provide bass boost functions simply by adding three resistors and one capacitor (per channel).
Moreover, it has the same pinout as the LAG665, so that by making selective use of set features, a product lineup can be developed without changes to the printed circuit board.

Features

1. Configuration: pre and power amps, motor control, E. VR, bass boost
2. Preamp off function convenient for use in models with radios
3. Independent motor control circuit
   1. Motor noise is effectively suppressed
   2. With motor on/off pin (motor can be stopped easily when radio is in use)
   3. With fast forward pin
4. Bass boost frequency characteristic can be changed simply by changing the resistance multiplier.
5. Well-balanced E. VR circuit
   1. L, R channels variable using a single VR
   2. A-curve can be reproduced using B-curve VR
6. Few external components

Package

SOP-28B (LAG668F)
SDIP-30A (LAG668D)

Absolute Maximum Ratings

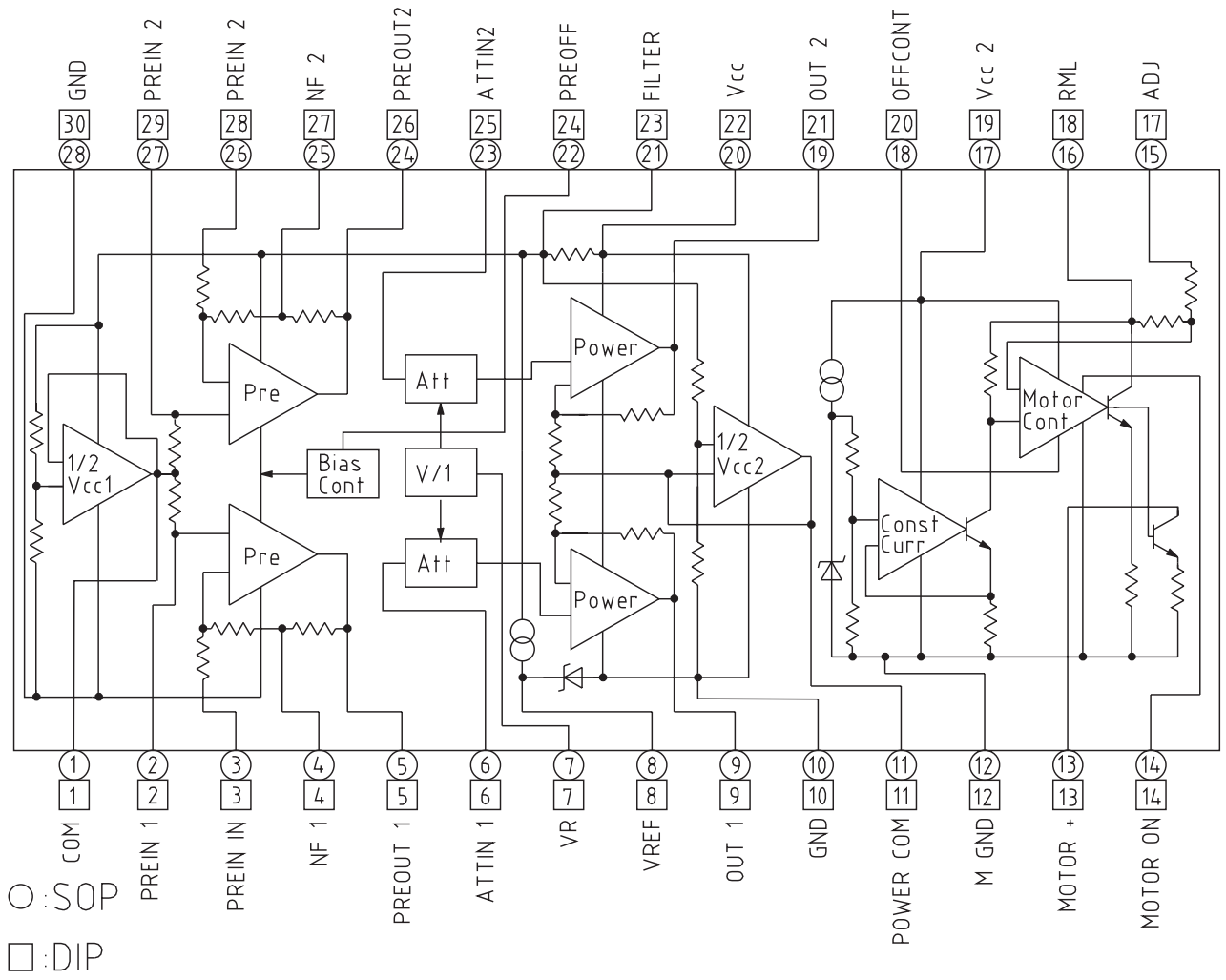
Item	Symbol	Ratings	Units
Operating temperature	T_{OPR}	–20~+65	℃
Storage temperature	T_{STG}	–40~+125	℃
Power supply current	V_{CC} max.	–0.3~+7.5	V
Power consumption	Pd	DIP : 750, SOP : 450	mW
Operating voltage	Vop	+2.0~+5.0	V

Electrical Characteristics (Except where noted otherwise, Ta=25°C)

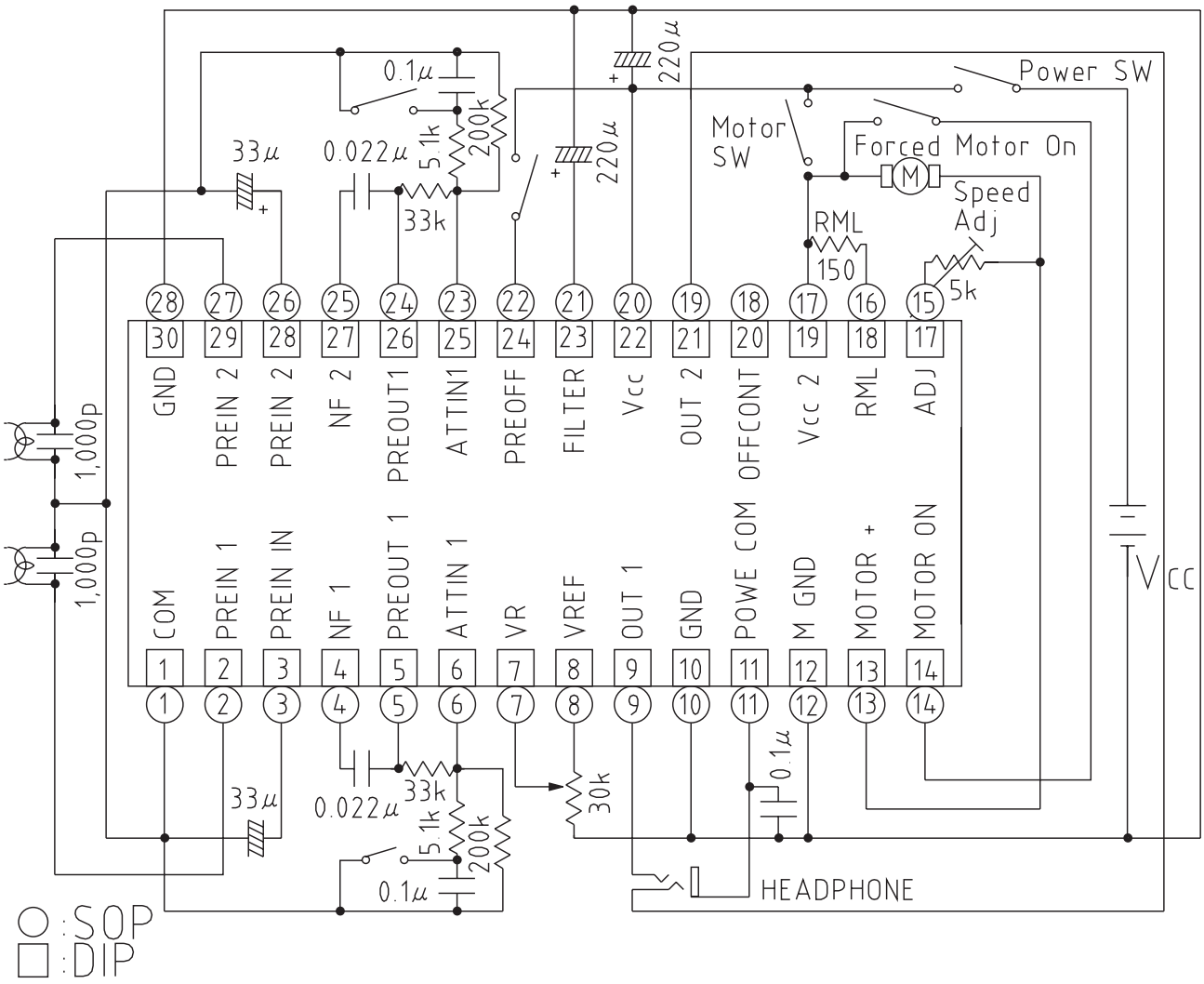
Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
Consumption current	Icc	VIN=0v, IM=0mA		18	25	mA
Preamp unit (Ta=25°C)						
Open-circuit gain	Gvo	VO=–10dBm, RL=infinite		72		dB
Closed-circuit gain	Gvc	VO=–10dBm	40	42	44	dB
Maximum output voltage	Vom	THD=10%	0.45	0.6		Vrms
Total harmonic distortion ratio	THD	VOUT=400mVrms		0.05	0.5	%
Output noise voltage	Vno	VIN=0, Rg=2.2k, BPF (30~20kHz)		150	300	μVrms
Input impedance	ZIN	VOUT=–10dBm	18	22		kΩ
Crosstalk between channels	C.T	Rg=2.2k, VOUT=–10dBm	30			dB
Output voltage with pre off	Vooff	VIN=100mVrms			–50	dB
Output resistance with pre off	Rooff			10		kΩ
Input resistance on pre off	Rioff			10		kΩ
Attenuator unit (Ta=25°C)						
Maximum input voltage	Vi max.		0.2			Vrms
Maximum attenuation	Va max.	Vcont=min.	66			dB
Attenuation error	Vaerr	Vcont=max.		0		dB
Input impedance	ZIN		200			kΩ
Control pin input resistance	Zicot		100			kΩ
Power amp unit (Ta=25°C)						
Voltage gain	Gv	POUT=5mW	36	38	40	dB
Voltage gain difference between channels	⊿Gv	Vcont=max.		0	3	dB
Maximum output power Ⅰ	Pom1	THD=10%, RL=32Ω	20	28		mW
Maximum output power Ⅱ	Pom2	THD=10%, RL=16Ω	30			mW
Total harmonic distortion ratio	THD	POUT=5mW		0.5	2.0	%
Crosstalk between channels	C.T	POUT=5mW	20	30		dB
Output noise voltage	Vn	Rg=2.2k, Vcont=max.		1.0	2.0	mVrms
Ripple rejection	RR	VCC=3V, 100Hz, 100mVp–p	31	37		dB
Noise of preamp + power amp + B.B.	Vnto	VIN=0, Rg=2.2k, Vcont=max. ∗1		3.0	6.0	mVrms
Motor control unit (Ta=25°C)						
Consumption current	IMC			3.0	5.0	mA
Startup current	IMS		500			mA
Reference voltage	Vref	Between RML–ADJ pins	0.72	0.80	0.87	V
Reference voltage fluctuation Ⅰ	Vref1	VCC between 2.1 and 5.0 V		0.05		%/V
Reference voltage fluctuation Ⅱ	Vref2	IM between 25 and 250 mA		0.01		%/mA
Reference voltage fluctuation Ⅲ	Vref3	Ta between –10 and 50°C		0.01		%/°C
Current coefficient	K		32	38	43	
Current coefficient fluctuation Ⅰ	K1	VCC between 2.1 and 5.0 V		0.5		%/V
Current coefficient fluctuation Ⅱ	K2	IM between 25 and 250 mA		0.05		%/mA
Current coefficient fluctuation Ⅲ	K3	Ta between –10 and 50°C		0.02		%/°C
Output voltage on forced on	VCEsa	IM=200mA, 14PIN=VCC			0.6	V
Input resistance on forced on	Rion			5.6		kΩ
Leakage current on forced off	IML				200	μA
Input resistance on forced off	Ricon			33		kΩ

∗Conditions unless stated otherwise
Amp unit: VCC=3.0V, f=1kHz, RL=16Ω, Pre OFF=OPEN
Motor unit: VCC=3.0V, IM=100mA, Motor unit: (Mitsumi model)
Note 1: Bass boost circuit constants are based on application circuit diagrams.
Note 2: Motor pin voltage fluctuations

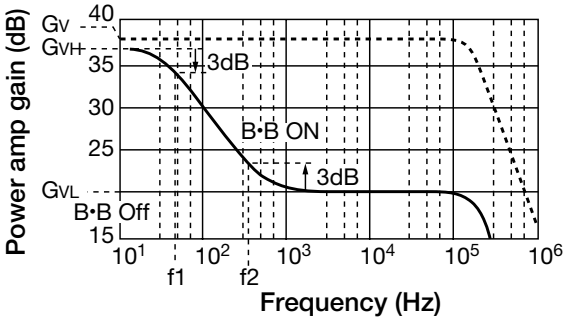
Block Diagram



Application Circuits



Bass Boost Power Amp Gain



Gv : Power amp gain

GvH : Bass boost power amp gain (high level)

GvL : Bass boost power amp gain (low level, or boost off)

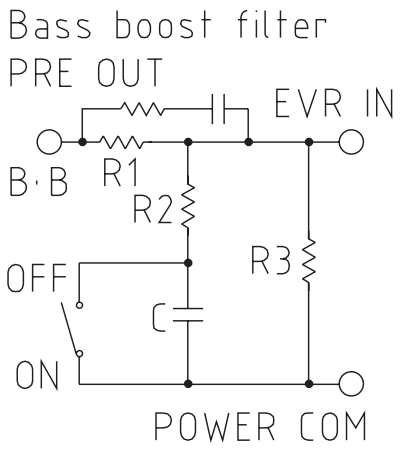
f1, f2: Cutoff frequencies

$$G_{VH}=G_V+20\log\left(\frac{R3}{R1+R3}\right)\ (dB)$$

$$G_{VL}=G_V+20\log\left(\frac{R2//R3\times R1}{R2//R3+R1}\right)\ (dB)$$

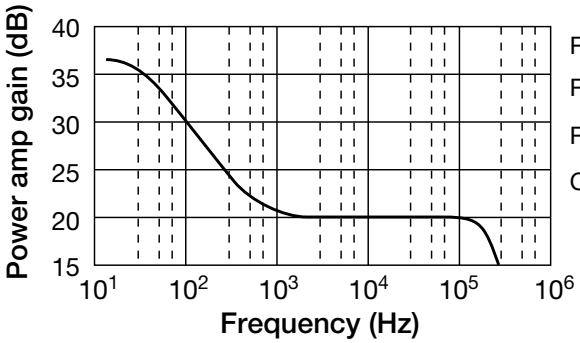
$$f1=\frac{1}{2\pi\left((R_1//R_3)+R_2\right)C}\ (Hz)$$

$$f2=\frac{1}{2\pi R_2 C}\ (Hz)$$



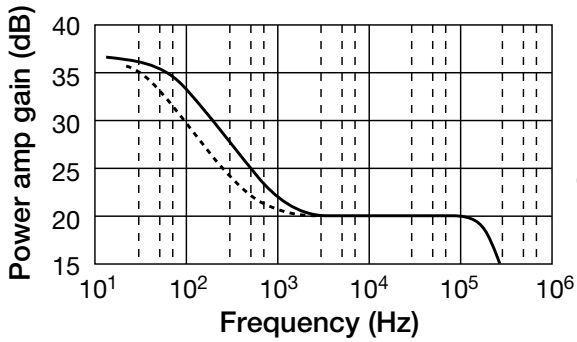
Characteristics (Bass boost)

Recommended constants



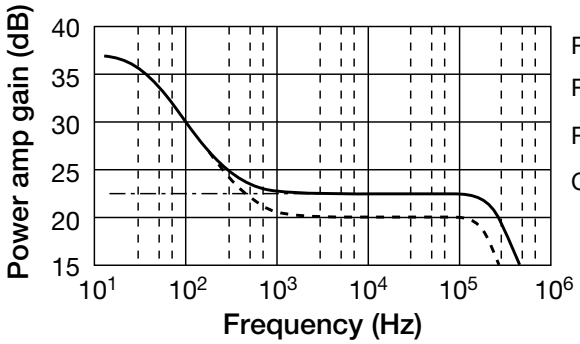
R1=33kΩ GVH=37dB
R2=4.7kΩ GVL=20dB
R3=180kΩ f1=50Hz
C=0.1μF f2=340Hz
No R4 or C2

Bass boost efficiency



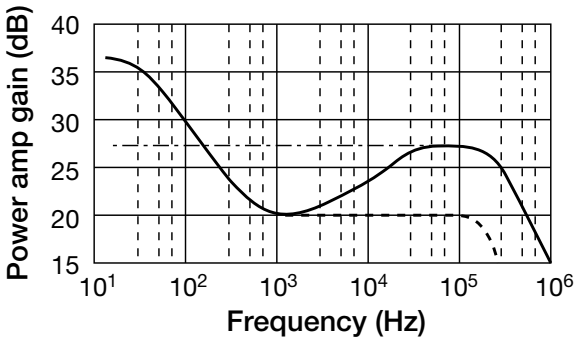
R1=12kΩ GVH=37dB
R2=2.2kΩ GVL=20dB
R3=180kΩ f1=130Hz
C=0.1μF f2=720Hz
No R4 or C2

Response for poor headphone and cassette head characteristics



R1=33kΩ GVH=37dB
R2=6.8kΩ GVL=23dB
R3=180kΩ f1=50Hz
C=0.1μF f2=230Hz
No R4 or C2

Bass + treble boost



R1=33kΩ GVH=37dB
R2=4.7kΩ GVL=20dB
R3=180kΩ f1=50Hz
C=0.1μF f2=340Hz
R4=20kΩ GVH=27dB
C2=390pF