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IC for Headphone Stereos
Monolithic IC LAG673

Outline

This IC was developed for use in 3 V headphone stereos. It incorporates dual preamp, power amp, electronic volume and motor control circuits; because it requires extremely few external components, it can be used in a simple circuit configuration.

Features

1. Broad operating voltage range of 2.0 to 5.0 V
2. Few external components required
3. Well-balanced electronic VR, A-curve attenuation characteristic obtained with B-curve VR
4. Internal motor control circuit, with noise from motor driving unit suppressed
5. Fast forward possible using the forced-on pin

Package

SOP-28B (LAG673F)
SDIP-30A (LAG673D)

Absolute Maximum Ratings

Item	Symbol	Ratings	Units
Operating temperature	T_{OPR}	–20~+65	℃
Storage temperature	T_{STG}	–40~+125	℃
Power supply current	V_{CC}	–0.3~+7.5	V
Operating voltage	Vop	2.0~5.0	V
Power consumption	Pd	450 (SOP-28B) 750 (SDIP-30A)	mW

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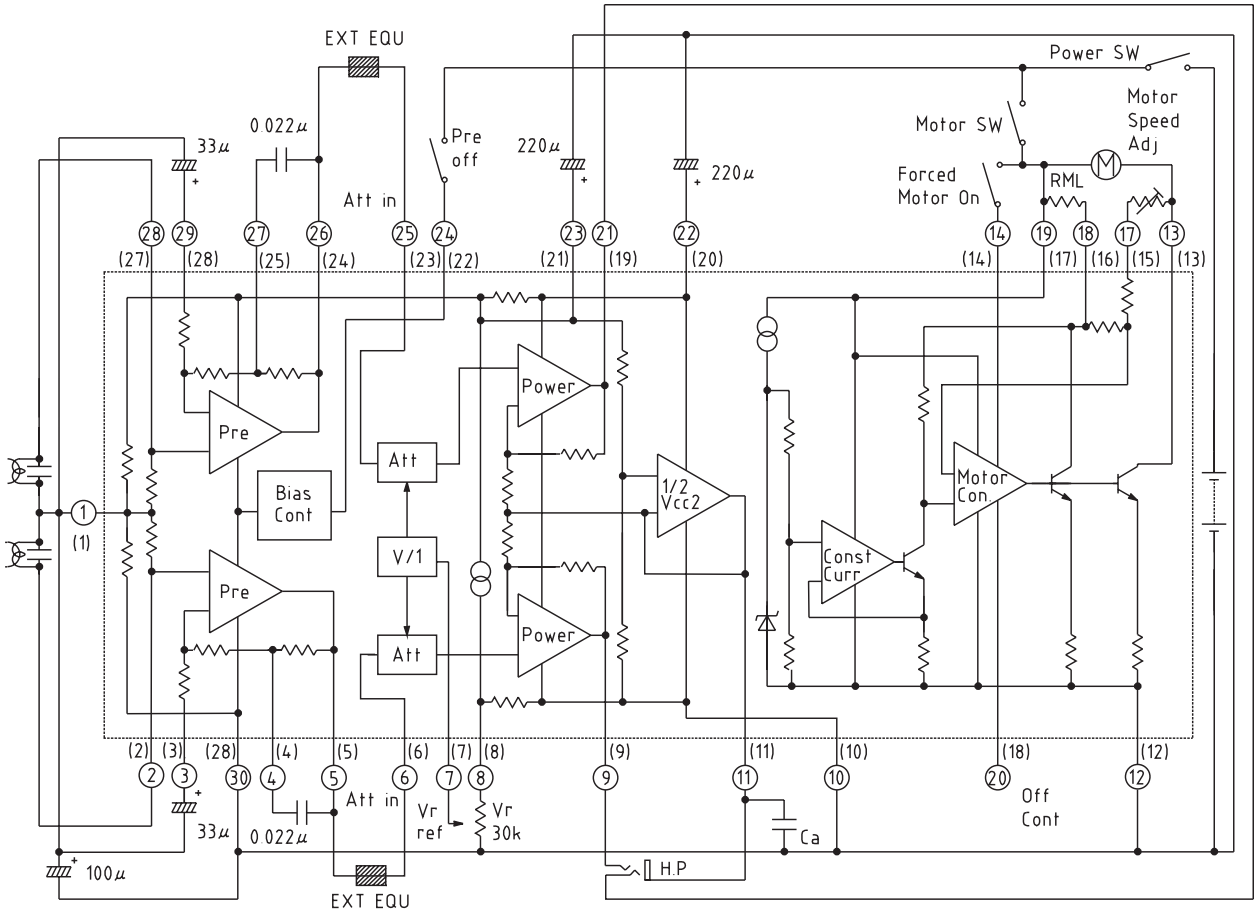
Electrical Characteristics (Except where noted otherwise, Ta=25℃)

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
Consumption current (excluding motor speed controller unit)	I_{CC}	V_{IN}=0V, I_M=0mA		18	25	mA
Preamp unit (Ta=25℃)						
Open-circuit gain	Gvo	Vo=–10dBm, R_L=∞		72		dB
Closed-circuit gain	Gvc	Vo=–10dBm	40	42	44	dB
Maximum output voltage	Vom	THD=10%	0.30	0.45		Vrms
Total harmonic distortion ratio	THD	V_{OUT}=400mVrms		0.05	0.5	%
Output noise voltage	Vno	V_{IN}=0V, Rg=2.2kΩ, BPF=30Hz~20kHz		150	300	μVrms
Input impedance	Zin	V_{OUT}=–10dBm	18	22		kΩ
Crosstalk between channels	C · T	Rg=2.2kΩ, V_{OUT}=–10dBm	30			dB
Output voltage with preamp off	Vooff	V_{IN}=100mVrms			–50	dB
Output resistance with preamp off	Rooff			10		kΩ
Input resistance with preamp off	Rioff			10		kΩ
Attenuator unit (Ta=25℃)						
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	Zia		15	20		kΩ
Control pin input resistance	Zicot			100		kΩ
Power amp unit (Ta=25℃)						
Voltage gain	Gv	P_{OUT}=5mW	26	28	30	dB
Voltage gain difference between channels	⊿Gv	Vcont=max.		0	3	dB
Maximum output power Ⅰ	Pom	THD=10%, R_L=32Ω	20	28		mW
Maximum output power Ⅱ	Pom	THD=10%, R_L=16Ω	30			mW
Total harmonic distortion ratio	THD	P_{OUT}=5mW		0.2	2.0	%
Crosstalk between channels	C · T	P_{OUT}=5mW	45	55		dB
Output noise voltage	Vn	Rg=2.2kΩ, Vcont=min.		0.25	1.0	mVrms
Ripple rejection	RR	100Hz, 100mVp–p	42	50		dB
Noise of preamp + power amp	Vnto	V_{IN}=0V, Rg=2.2kΩ, Vcont=max.		6	9	mVrms
Motor control unit (Ta=25℃)						
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	V_{CC} between 2.0 and 5.0V *		0.05		%/V
Reference voltage fluctuation Ⅱ	⊿Vref2	I_M between 25 and 250 mA		0.01		%/mA
Reference voltage fluctuation Ⅲ	⊿Vref3	Ta between –10 and 50℃		0.01		%/℃
Current coefficient	⊿K	$K=\frac{\Delta V_{RL}}{R_1 \ \Delta I_M}$	32	38	43	
Current coefficient fluctuation Ⅰ	⊿K1	V_{CC} between 2.0 and 6.5 V		0.5		%/V
Current coefficient fluctuation Ⅱ	⊿K2	I_M between 25 and 250 mA		0.05		%/mA
Current coefficient fluctuation Ⅲ	⊿K3	Ta between –10 and 60℃		0.02		%/℃
Output voltage on forced on	VCEsa	T_M=200mA			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: V_{CC}=3.0 V, I_M = 100 mA Motor: M25E-7 (Mitsumi model)

*Voltage drift between pins 17 and 13

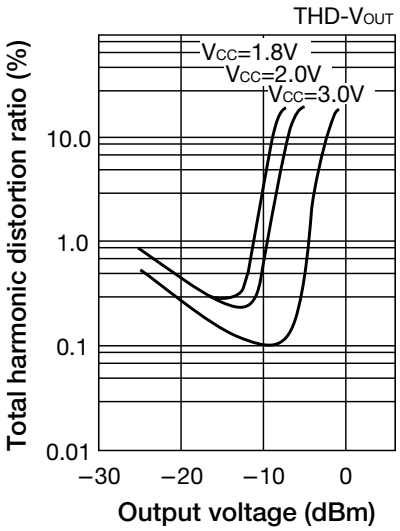
Block Diagram



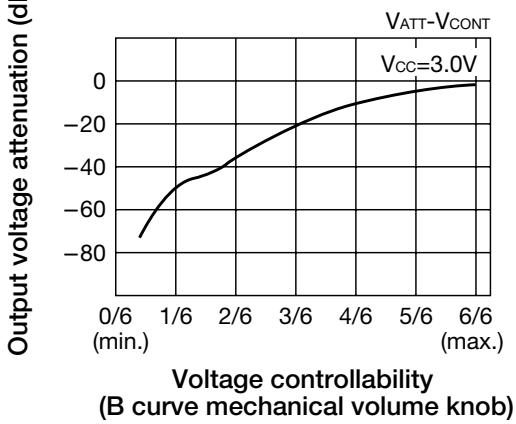
1: The motor speed potentiometer is 1.5 kΩ (assuming the motor used is Mitsumi M25E-7; if the optimal adjustment range is not obtained using a different motor, add a fixed resistance).
2: RML = motor load correction resistance
3: Connecting the preamp off pin to +Vcc turns the preamp circuits off.
4: Connecting the motor forced-on pin to +Vcc turns the motor on (no control).
5: in circles are pin numbers for a DIP-30P package; numbers in parentheses ( ) are for an SOP-28B package.
6: In the DIP-30P package, pins 15 and 16 are NC.
7: Ca is a 100,000 pF capacitor used to prevent oscillation of the 1/2 Vcc amp circuit.

Characteristics

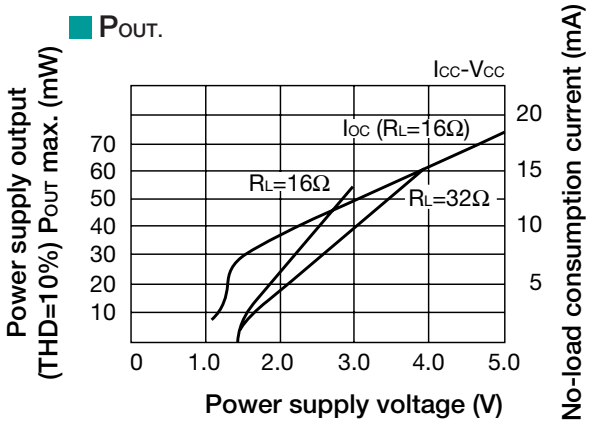
Preamp



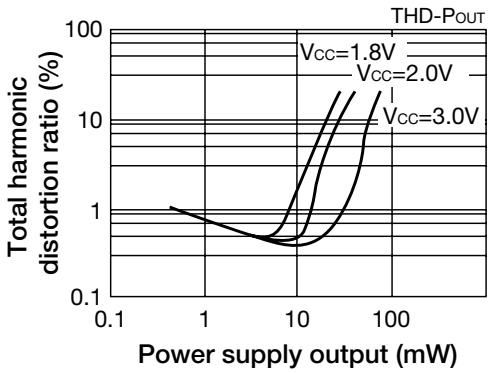
Attenuator



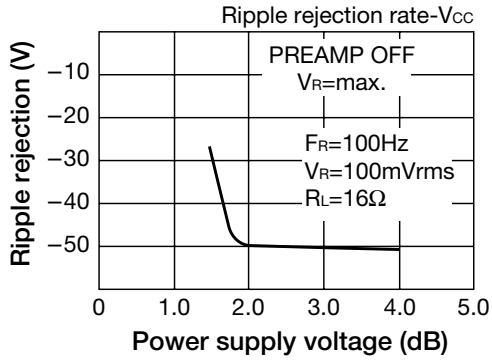
POUT.



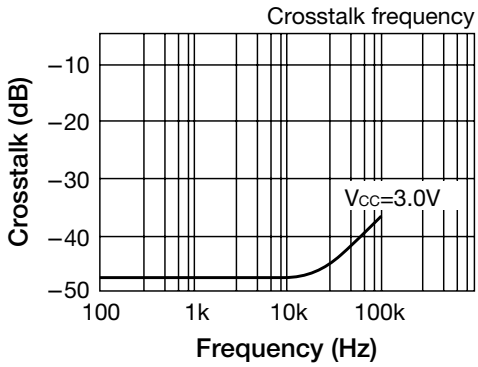
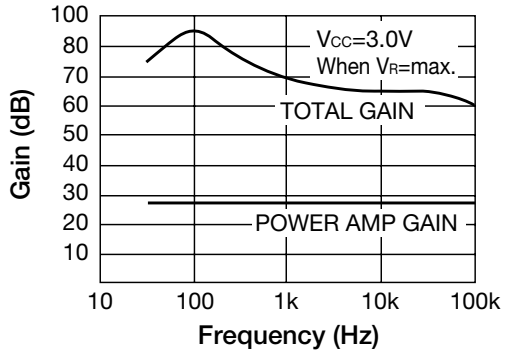
Power amp



Power amp



Power amp



Voltage gain vs. Frequency