# 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)<br>750 (SDIP-30A) | mW |

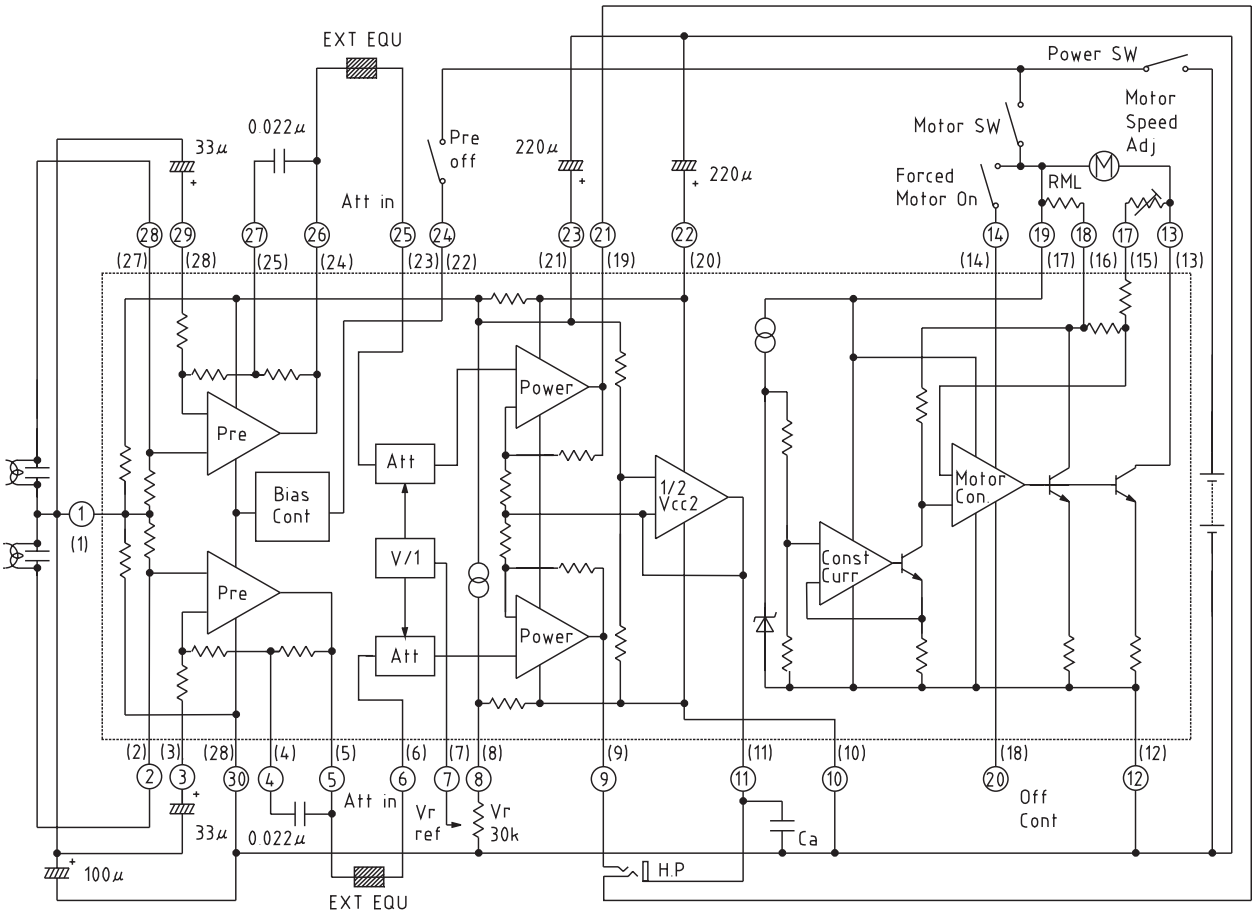
## Electrical Characteristics (Except where noted otherwise, Ta=25°C)

| Item | Symbol | Measurement conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Consumption current (excluding motor speed controller unit) | ICC | VIN=0V, IM=0mA | | 18 | 25 | mA |
| Preamp unit (Ta=25°C) | | | | | | |
| Open-circuit gain | Gvo | Vo=–10dBm, RL=∞ | | 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 | VOUT=400mVrms | | 0.05 | 0.5 | % |
| Output noise voltage | Vno | VIN=0V, Rg=2.2kΩ, BPF=30Hz~20kHz | | 150 | 300 | μVrms |
| Input impedance | Zin | VOUT=–10dBm | 18 | 22 | | kΩ |
| Crosstalk between channels | C · T | Rg=2.2kΩ, VOUT=–10dBm | 30 | | | dB |
| Output voltage with preamp off | Vooff | VIN=100mVrms | | | –50 | dB |
| Output resistance with preamp off | Rooff | | | 10 | | kΩ |
| Input resistance with preamp 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 | Zia | | 15 | 20 | | kΩ |
| Control pin input resistance | Zicot | | | 100 | | kΩ |
| Power amp unit (Ta=25°C) | | | | | | |
| Voltage gain | Gv | POUT=5mW | 26 | 28 | 30 | dB |
| Voltage gain difference between channels | ⊿Gv | Vcont=max. | | 0 | 3 | dB |
| Maximum output power Ⅰ | Pom | THD=10%, RL=32Ω | 20 | 28 | | mW |
| Maximum output power Ⅱ | Pom | THD=10%, RL=16Ω | 30 | | | mW |
| Total harmonic distortion ratio | THD | POUT=5mW | | 0.2 | 2.0 | % |
| Crosstalk between channels | C · T | POUT=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 | VIN=0V, Rg=2.2kΩ, Vcont=max. | | 6 | 9 | 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 2.0 and 5.0V * | | 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 | $K=\frac{\Delta V_{RL}}{R_1 \quad \Delta I_M}$ | 32 | 38 | 43 | |
| Current coefficient fluctuation Ⅰ | ⊿K1 | VCC between 2.0 and 6.5 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 60°C | | 0.02 | | %/°C |
| Output voltage on forced on | VCEsa | TM=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: VCC=3.0 V, IM = 100 mA Motor: M25E-7 (Mitsumi model)

*Voltage drift between pins 17 and 13

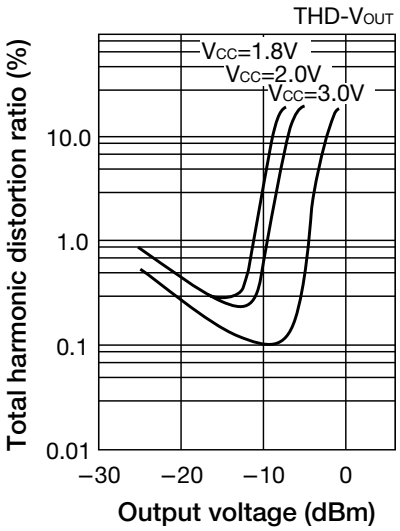
## Block Diagram



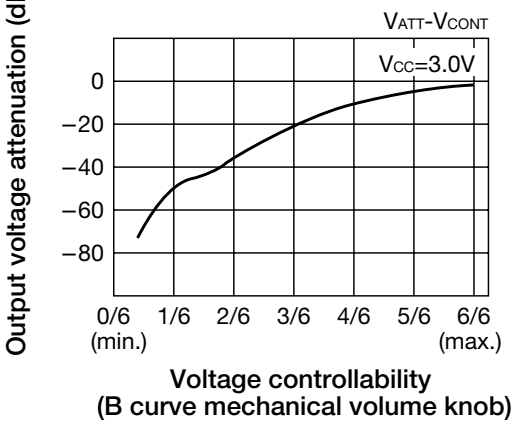

1: The motor speed potentiometer is 1.5 kΩ (assuming the motor used is Mitsumi M25E-7; if the optimal adjustment range is not obtained using a different motor, add a fixed resistance).
2: RML = motor load correction resistance
3: Connecting the preamp off pin to +Vcc turns the preamp circuits off.
4: 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

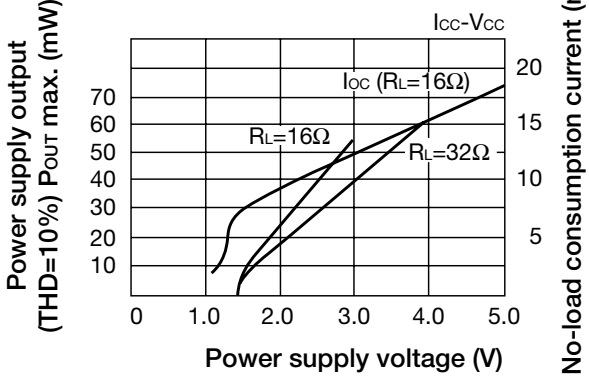
### Preamp



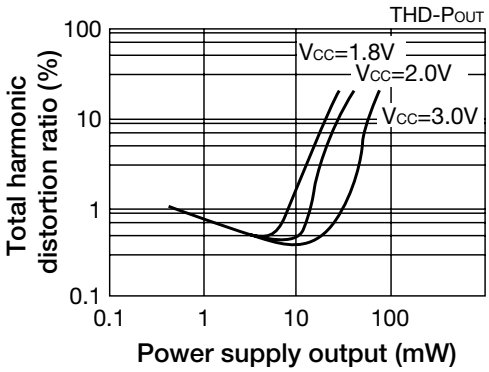

### Attenuator



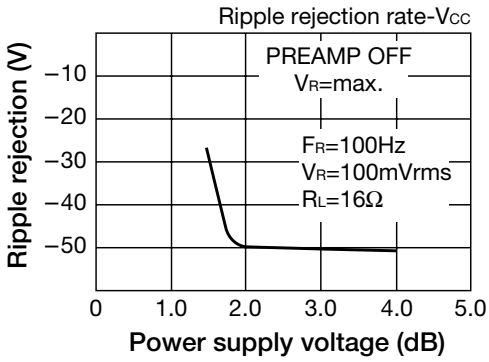

### POUT.



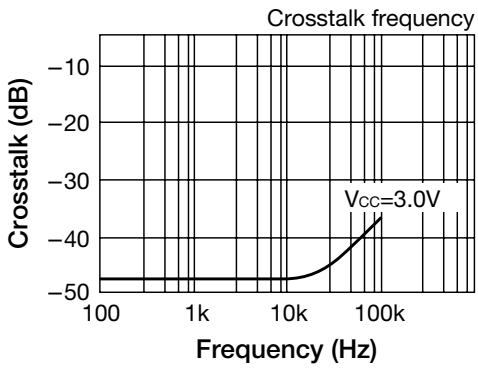

### Power amp




### Power amp




### Power amp




### Voltage gain vs. Frequency