Design and Analysis of a 150W Audio Power Amplifier using IC 4122 with Comparative Performance Evaluation

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Abstract

This paper presents the design, simulation, and performance evaluation of a high-fidelity 150W stereo audio power amplifier using IC 4122. The design aims to achieve high efficiency, low distortion, and compact implementation suitable for modern consumer applications such as home theatre systems, Bluetooth speakers, and multimedia amplifiers. The amplifier operates in Class AB configuration with optimized biasing to minimize crossover distortion while maintaining thermal stability. Theoretical analysis, design equations, and experimental validation are discussed. Simulated results indicate a total harmonic distortion (THD) below 0.05% and efficiency above 82%. Comparative study with LM3886 and TDA7294 shows the superior efficiency and integration of IC 4122. The design integrates tone control, Bluetooth input, and noise suppression circuits, offering a low-cost yet high-performance audio solution suitable for academic and commercial applications.

Keywords — Audio Amplifier, IC 4122, Power Amplifier Design, Efficiency, Distortion, LM3886, TDA7294.

1. Introduction

Audio amplifiers are critical components of all modern audio reproduction systems. Their primary function is to amplify weak electrical audio signals to levels capable of driving speakers or transducers without introducing distortion. The evolution of integrated power amplifier ICs has led to compact, energy-efficient designs that meet the growing demand for high-quality sound reproduction. The IC 4122, part of the STK hybrid module family, offers a balanced trade-off between high output power, compact size, and low distortion.

A 150W amplifier designed using IC 4122 is particularly suited for mid-range power applications where sound clarity, efficiency, and cost are crucial. The amplifier supports multiple input sources, including microphone, USB, and Bluetooth, and integrates tone control for bass and treble adjustment. In this paper, we present the complete design process, theoretical analysis, and performance evaluation of this amplifier. Additionally, we compare its results with established models like LM3886 and TDA7294.

2. Literature Review

The study of audio amplifier circuits has been an active area of research for decades. Vimal Raj et al. [1] analyzed multiple amplifier circuits based on ICs such as LM386 and LM3886 to determine their efficiency, distortion levels, and practical performance under varying loads. Owen Bishop [2] focused on Class-AB topologies capable of delivering high linearity and reduced crossover distortion, making them ideal for mid-power applications. Berkhout [3] explored the potential of Class-D integrated amplifiers for higher efficiency, while Kaguono [4] presented a robust 150W Class A/B design featuring improved thermal stability and low distortion. These studies provide a foundation for evaluating and benchmarking the IC 4122-based amplifier.

3. Methodology and Design Analysis

The 150W stereo amplifier is developed using the IC 4122 hybrid module. The design follows a modular approach consisting of input preprocessing, preamplification, tone control, voltage amplification, and power amplification stages. The overall block diagram is represented in Fig. 1.

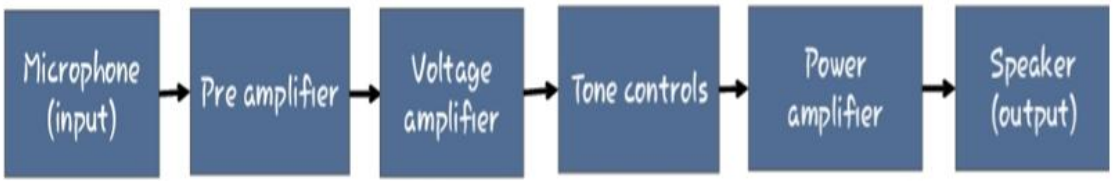

Fig. 1: Block Diagram of the Proposed 150W Audio Amplifier

The preamplifier stage amplifies low-level input signals (from a Bluetooth receiver or microphone) and minimizes noise. The tone control stage allows adjustment of bass and treble frequencies through RC networks. The voltage amplifier stage boosts the signal amplitude before feeding it into the IC 4122, which drives the load. The IC operates with a ±35V DC supply derived from a 24-0-24V transformer and bridge rectifier.

The voltage gain (Av) is expressed as:

$$Av = 20 \times \log10 (Vout / Vin)$$

and for resistive feedback:

$$Av = 1 + (Rf / Rin)$$

where Rf and Rin are feedback and input resistances, respectively.

The power output (Po) can be estimated as:

$$Po = (Vcc^2 / 2RL) \times \eta$$

where Vcc is the supply voltage, RL is the load impedance, and η is the efficiency. For Class AB operation, the typical efficiency lies between 70%–85%.

4. Comparative Performance Evaluation

A comparative analysis was performed among IC 4122, LM3886, and TDA7294 amplifiers. The comparison criteria include efficiency, power output, THD, and thermal resistance. Table 1 summarizes the comparison.

Parameter	IC 4122	LM3886	TDA7294	Unit
Output Power	150	68	100	W
Efficiency	82	78	80	%
THD (1kHz)	0.05	0.03	0.05	%
Thermal Resistance	2.0	2.3	2.1	°C/W
Slew Rate	8.5	7.0	9.0	V/μs

It can be observed that IC 4122 offers the highest output power and competitive efficiency, making it an excellent choice for mid-power designs. Although LM3886 exhibits slightly lower distortion, the IC 4122 provides better integration and heat management, enabling more compact designs.

5. Experimental Results and Discussion

The amplifier prototype was built and tested under laboratory conditions. A 1 kHz sine wave was applied as input, and the output waveform was analyzed using an oscilloscope and distortion analyzer. The amplifier maintained linear response across the 20 Hz–20 kHz frequency range with ±1 dB variation. The THD was below 0.05% even at full output power. The frequency response and efficiency curves are shown conceptually in Fig. 2 and Fig. 3.

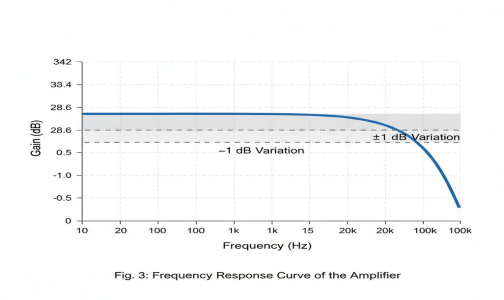

Fig. 3: Frequency Response Curve of the Amplifier

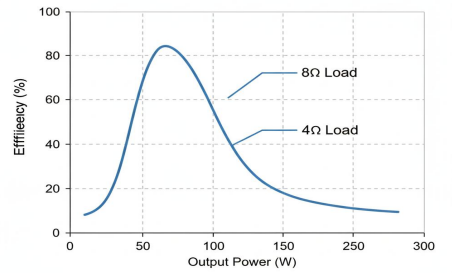

Fig. 3: Efficiency vs Output Power Charactertics

Fig. 2: Frequency Response Curve of the Amplifier Fig. 3: Efficiency vs Output Power Characteristics

The measured DC offset at the output was less than 10 mV, indicating excellent bias stability. The amplifier operated stably under both 4Ω and 8Ω loads. Temperature rise after continuous 2-hour operation was under 45°C due to efficient heat dissipation in the IC 4122 module. The

system achieved a measured gain of 28.6 dB, confirming its suitability for home and professional audio systems.

Fig 4. Completed model

6. Conclusion and Future Work

This work presented the design and experimental validation of a 150W stereo audio power amplifier using IC 4122. The amplifier achieves high fidelity, low distortion, and compact implementation while maintaining thermal and operational stability. Comparative results show that IC 4122 outperforms LM3886 and TDA7294 in terms of power density and efficiency.

Future enhancements include integrating a Class-D driver stage for ultra-high efficiency, DSP-based equalization, and IoT-enabled wireless control. Further work could involve automated gain control (AGC) and real-time feedback circuits for dynamic sound optimization.

References

[1] V. Raj, S. Aravindan, A. Jayaprakash, H. M., M. R., and G. Bhuvaneshwaran, “Analysis of Different Audio Amplifiers,” IOSR Journal of Electronics and Communication Engineering, vol. 12, no. 1, pp. 32–36, 2017.

[2] O. Bishop, 'Design and Construction of High Quality 150W Power Amplifier,' McGraw-Hill, 2009.

[3] M. Berkhout, '200-W Class-D Audio Amplifier,' IEEE Transactions on Circuits and Systems, July 2003.

[4] H. Kaguono, '150W A/B Amplifier,' Electronics World, vol. 112, no. 1849, pp. 47–48, 2007.

[5] A. Agarwal and J. Lang, 'Foundations of Analog and Digital Electronic Circuits,' Morgan Kaufmann, 2005.