

# Amplification of Ultra-Low Frequency Using Class D Topology

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**Abstract-** The application is to be suitable for in-home as well as automotive use. The input can be stereo or mono from any low impedance audio signals such as a compact disc or MP3 player. It's a power amplifier that uses a class D geography for matching current range of class AB amplifiers, surpassing all other class D evaluation boards and chipsets when operated in a domestic surrounding. A class D amplifier is defined by the output transistors which is being hard switched between conducting and non-conducting or vice-versa. This differs from the other amplification classes that is operate from the output transistors in the linear operating range. The input should not exceed the maximum voltage level, since audio quality cannot be guaranteed at such levels. Different amplifiers of class D type have an inaccurate frequency response output, when they are connected to different loads and are only optimized for one load impedance. Other than this type of amplifier use feedback after the reconstruction filter to correct for this. Using feedback after the reconstruction filter creates a huge phase shift in the feedback and has a very negative effect on the amplifiers performance when playing musical signals and can cause them to become unstable, oscillate and distort. During initial stage of power up of the class D amplifier, the circuit actively measures the high frequency impedance of the load connected to the amplifier and adjusts its high level of frequency output level to ensure that the audio output response is always accurate. Finally, the chosen design performs almost perfectly to specifications, but under actual construction there is crystal clear output

## I. INTRODUCTION

During the history of audio registration and reproduction, which started more than a century ago, there has been a steady improvement in quality. The old age player, which was in fact a rotating drum with used only the mechanical excitation of the needle to produce sound. For amplifying the sound mechanically excited needles was transferred to the diaphragm of the which was truly forming an 'audio amplifier'. After a year, later in time, the mechanical operation of the needle and drum was transformed into electrical signals. Vacuum tubes where used to amplify this Electrical signals and fed to the loudspeaker. Vacuum tubes

where replaced with the transistor, when transistors were invented, and later by integrated circuits. These developments led to audio amplifiers with less weight, using less power and sounding better. (Regarding this last aspect, it is quite unfortunate that many people are misled by the term 'warm feeling of tube amplifiers', thinking it refers to sound quality rather than to dissipation). At the same time, the quality of storage media improved. The Phonograph was succeeded by the Gramophone. Analogue magnetic recording developed from steel wire to tape. Noise reduction techniques increased the dynamic range. Over the past years, audio in the consumer domain has essentially become digital. Audio is stored on media like CD which is known as Compact Disc, DAT which is known as Digital Audio Tape, DCC which is known as Digital Compact Cassette, Mini Disk its short from is MD, or Digital Versatile Disc its short from is DVD. Formats included such as PCM (Pulse Code Modulation) up to frequency of 96kHz 24 bit, DSD (Direct Stream Digital), multichannel sound up to 6 channels, and psycho acoustic codec's like Dolby AC-3 (Audio Coding 3), MPEG (Motion Picture Expert Group) layer 1-3 and MPEG-4 AAC (Advanced Audio Coding). With the introduction of DAB (Digital Audio Broadcasting) and HDTV (High Definition Television), the audio amplifier is one of the few remaining analogue components in the audio chain. This not only means that it must fulfill different high end requirements on parameters like distortion, slew-rate, power supply rejection, etc. Simple class AB amplifiers with high peak power, but have very poor efficiency at average signal levels. Also, powerful bass procreation is getting more and more crucial, necessary for more power of the amplifier. At the identical stage, dimensions have become smaller. Mini sets, car multimedia player and PC multimedia apparatus have only minor space available, leading to an increasing clash between manageable power dissipation and market requirements for high output power and many output channels. Also, more and more apparatus becomes portable. In these cases, low power consumption is necessary to increase time span of battery life. To arrange these demands, extremely integrated power saving audio amplifiers are essential.

It is an electronic amplifier in which the amplifying devices such as transistors, usually metal-oxide semiconductor

field-effect transistor are controlled as switches electronic, and not as linear gain gadgets such as used in other amplifiers. The signal to be amplified is a sequence of persistent amplitude pulses, so the active devices switch speedily back and forth between a fully conductive and nonconductive state. The amplified signal is then converted in to a series of pulses by pulse width modulation, pulse density modulation or other method before being applied to the amplifier. After amplification, the output sequence pulse can be reversed back into an analog signal by flow stream through a passive low pass filter consisting of inductors and capacitors. The maximum advantage of a class-D amplifier is that it can be more efficient consumption of power than other analog amplifiers, with less energy dissipated as heat in the active device.

**II. CONCEPT**

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**III. BASIC WORKING PRINCIPLE**

Class D amplifier is perfect choice for powering sub woofers. This type of amplifier is switching amplifier, it switches either fully on or fully off as per the activation and deactivation of circuit. Which significantly prevents the power losses in the output devices. Which tends to increase I the Efficiencies of circuit by 90% to 95%. PWM carrier signal modulate with the sound signal which is used to helps to drives the output circuit devices, with the end stage being a low pass filter to remove the high frequency PWM carrier frequency

**IV. PROPOSED METHOD**

**A. LM 833**

The IC LM833 is a standard low cost monolithic dual general purpose operational amplifier engaging bipolar technology with high tech performance concepts for audio systems appliances, With the high-end frequency PNP transistors, the LM833 offers less voltage noise. The output stage does not exhibit dead band crossover distortion and large output voltage swing. The advantage of this IC is excellent phase and gain margins and has low open loop high frequency output impedance and symmetrical source or sink AC frequency response.

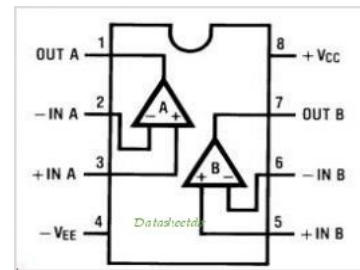


Figure 1.

**B. PAM 8403**

The IC is a class-D audio amplifier. It offers low total harmonic distortion plus noise which tends to achieve high-quality music reproduction. This new filter less configuration allows the circuit to drive the speaker directly without any need of low-pass output filters, thus saving system cost and PCB area. The efficiency of this much better choice than that of Class-AB Families. It helps to enhance the battery life, which makes it well-suited for portable applications.

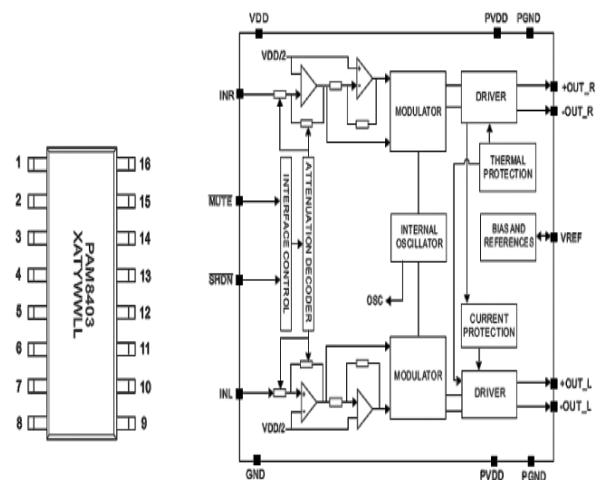


Figure 2.

**V. PROPOSED METHOD WORKING PRINCIPLE**

Block Diagram

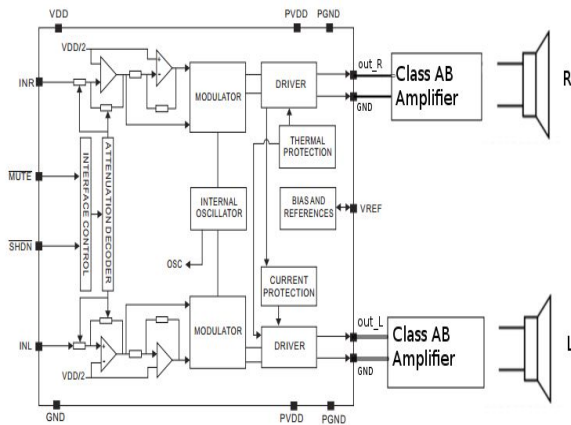


Figure 3.

Sinusoidal signal is sampled and converted to digital signal, either pulse width modulation or pulse amplitude modulation or both. output signal is digital and signal has a dc shift of above 0.7 volts and o/p voltage ranging between 2-3 volts. thus, even if we use class b amplifier at the final stage there is no distortion in the circuit. since our circuit is low noise amplifier our signal consist of woofer, bass and music signals and voice signals are eliminated in circuit. for loud bass of woofer, the wavelength is high and for silent or less bass or woofer wavelength is low.

PAM IC accordingly adjust the wavelength as well as amplitude of signal, which is required for the bass or woofer sound. There are four switches in the circuit used for changing class of amplifier such as if first two switch is on and other two switch are off circuit will operate in class D mode and if first two switch is of and other two switch are off circuit will operate in class AB mode. Only one mode can be switch on at a time if we try operate two mode on two different channels circuit will be blown so to protect it IC are used. Class D consist of two gain control pots as shown in circuit. We will use only gain control pot 1 for class d amplifier and no gain control for final stage of the amplifier to reduce the noise in the output.

## VI. EXPECTED RESULT

Output signal is digital and signal has a DC shift of above 0.7 volts and O/P voltage ranging between 2-3 volts. Thus, even if we use class b amplifier at the final stage there is no distortion in the circuit. There are four switches in the circuit used for changing class of amplifier such as if first two switch is on and other two switch are off circuit will operate in class D mode. Sinusoidal signal is sampled and converted to digital signal, either PWM or PAM or both. Output signal is digital and signal has a DC shift of above 0.7 volts and O/P

voltage ranging between 2-3 volts. PAM IC accordingly adjust the wavelength as well as amplitude of signal, which is required for the bass or woofer sound.

## VII. ADVANTAGES AND MERITS

- 1) The lower power dissipation produces less heat.
- 2) Saves circuit board space and cost.
- 3) Extends battery life in portable systems.
- 4) The output is very much impressive.
- 5) Less in complexity.
- 6) Can be widely used in automotive field,
- 7) Can be used only for special category speakers.
- 8) Requires a very clean and stable power supply.

## VIII. APPLICATIONS

1. Only for woofers & subwoofers.
2. Can be used in modern HI-FI music systems.
3. Can be used in 2 channel as well as 3 channel multipurpose music systems.
4. Can be used in automotive sectors.

## IX. CONCLUSION

In this research, we studied various aspects of Class D amplifier. Class D amplifiers can perform very well in the domestic environment but only if they have been optimized to do so. Innovations in technologies are increasing the use of Class D amplifiers usage due to improvements in higher efficiency, increased power density and better audio performance with lesser power consumption.

## REFERENCES

- [1] W. Minsheng, J. Xicheng, S. Jungwoo, and T. L. Brooks, "A 120 dB dynamic range 400mW class-D speaker driver with fourth-order PWM modulator," *IEEE J. Solid-State Circuits*, vol. 45, pp. 1427–1435, 2010.
- [2] K. Nielsen, "A review and comparison of pulse-width modulation (PWM) methods for analog and digital input switching power amplifiers," in *Proc. 102nd Audio Eng. Soc. Conv., Munich, Germany, Mar. 1997*, paper 4446.
- [3] P. Balmelli et al., "A low-EMI 3-W audio class-D amplifier compatible with AM/FM radio," *IEEE J. Solid-State Circuits*, vol. 48, pp. 1771–1782, 2013.
- [4] M. A. Rojas-Gonzalez and E. Sanchez-Sinencio, "Low-power high-efficiency class D audio power amplifiers," *IEEE J. Solid-State Circuits*, vol. 44, pp. 3272–3284,

2009.

- [5] Technical White Paper – Development of Class D Power Amplifiers for HiFi Issue 1.0 Cyrus Audio Ltd.