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DYNAMIC AMPLIFIER BASED ON FIELD TRANSISTORS

Abstract: *Nowadays, semiconductor structures have great potential for a variety of new applications. Transistor-type amplification devices from this point of view, their temperature, 324 light radiation, pressure, etc. showed that it can record . In this article, certain works on the physical basis of temperature and light sensitivity of diode and transistor structures, as well as on the issues of controlling their properties through constructive and schematic technical solutions are considered.*

Key words*: semiconductor structures, transistor amplifier, diode, transistor, light radiation, effect of signal on power supply switching, energy efficiency of sound amplifiers.*

Embedded systems such as MP3 players, mobile phones, PDAs and GPS integrate increasingly complex functions and therefore consume more energy. The performance time of these embedded systems directly depends on the battery technology used, as well as the total power consumption. Among these functions, the audio part accounts for a third of the power consumption in a mobile phone. Therefore, reducing the power consumption of the embedded audio system is a key factor in improving the autonomy of the embedded system. It is important to improve the energy efficiency of audio amplifiers. Our article is about reducing the power consumption of audio amplifiers for earphones [1]. Runtime is one of the main areas to improve the runtime of the headset in mobile phones.

Since 1915, when the first generation of valve amplifiers provided audio amplification, great advances have been made in electronics with the advent of transistors and related architectures such as the linear AB amplifier. They made it possible to reproduce the audio signal with excellent linearity and relatively low implementation. However, Class AB amplifiers have limited efficiency in the relationship between the RMS voltage of the VOUT signal and the power supply VDD.

$$\eta_{AB} = \frac{\pi}{4} \times \frac{V_{OUT}}{V_{DD}}$$

This expression is valid for pure sinusoidal signals with negligible quiescent current. In practice, the efficiency will be lower in real working conditions [2]. In fact, the required sound level is never maximum, and the shape of audio signals differs from a sinusoidal wave with a high dynamic range (with a peak factor of 5 to 20 dB). The nominal power delivered to the headphones is less than the maximum power, typically 100 μW (about 30 mW into 32 Ω at 1 Vrms). Therefore, the output amplitude is very low relative to the voltage resulting in only a few percent efficiency. Other structures have been explored to improve the efficiency of amplifiers used in hearing aids. Switched amplifiers, i.e. Class D [1] show high efficiency. Hybrid structures were introduced to combine the advantages of switched architecture (small conduction losses) and linear architecture (small static losses and good linearity). Parallel hybrid amplifiers (class-K) [1-2] have low efficiency at only 100 μW due to high static consumption.

A Class-G or H-type series hybrid amplifier is an architecture that significantly increases nominal efficiency with high linearity. They include a class AB amplifier supplied by one or two switching voltage converters controlled by a level detector (Fig. 1). A negative voltage regulator is used to center the common mode of the output signal to zero, thus avoiding the use of external AC coupling indicators. The principle is to provide a linear amplifier dynamically as a function of signal amplitude to reduce conduction losses. The current Class-G topology is shown in Figure 1. Five blocks can be optimized to improve efficiency: battery cell, linear amplifier, speaker, DC/DC converter and power supply switching algorithm (PSSA) implemented.

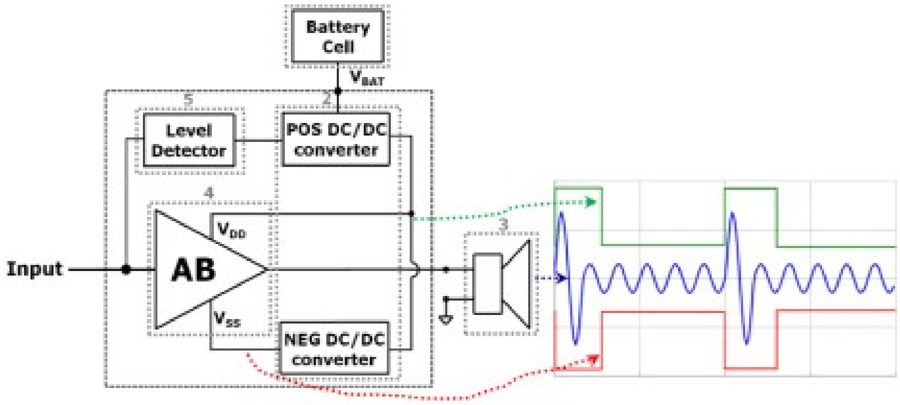

Figure 1. Class-G topological signal transient amplification diagram.

METHODS.

1. Class G amplifiers with more than 5000 transistors [require weeks of computation to simulate transients of a few milliseconds at the transistor level. To reduce this computational time and enable longer transient simulations, a fast and accurate model is proposed.

2. Based on the current most used Class-G architecture. It consists of a Class-AB amplifier with two switching DC/DC converters connected to a level detector to control the level of the power supplies. The purpose of this level detector is to move the power supplies as close as possible to the output signal without clipping it to reduce losses in the class AB amplifier [3]. Therefore, it changes the reference of the two converters as a function of the amplitude of the input signal. However, the change in amplitude of the signal may be faster than the time it takes to reach the next power supply value, which causes the output signal to be cut off. Furthermore, current class G stand-alone amplifiers [4-5]

with their analog-type inputs do not allow any delay between decision making and signal amplification. A difference between the output signal amplitude and the power supply is introduced to avoid any final clipping.

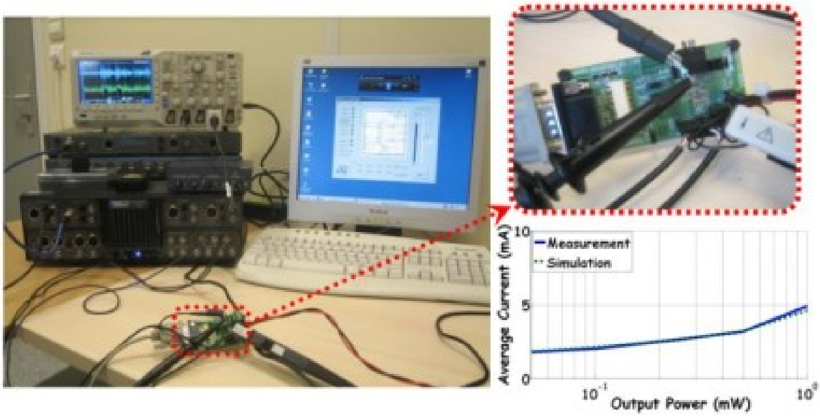

Figure 2 Model/measurement comparison.

Two class G2 amplifiers [6,7] were used to validate our model. The input parameters of the model were found from the measurements. The simulation results were then compared with the different power characteristics of these circuits. Figure 2 shows the comparison result for the test bench and circuit [8,9]. The configuration used here is a 47 Ω pure resistive charge, with various audio test signals at 3.6V. The relative error in consumption is 5% to 10% over the entire tested power range. Thus, these results confirm the reliability of our modeling.

Effect of signal on switching power supply Figure 3, we compare the consumption given by the simulated from the model for three test signals. Therefore, the signal used in consumption depends on the selected PSSA. For example, a power increase of 10 mW for signal #1 is |aVSS| has to be achieved. The power supply switches to its second value. For audio signals (No. 2 and No. 3), the crack becomes more progressive as the crest factor is increased. PSSA therefore acts at a lower power than observed [10,11].

CONCLUSION.

In conclusion, this paper presented a PSSA strategy study for a series hybrid amplifier dedicated to headphones to reduce power consumption. First, behavioral modeling was performed to simulate consumption and reconfiguration, as a function of PSSA, to predict sound quality [12]. This modeling made it possible to significantly reduce the computational time, thus allowing the simulation of real signals of several seconds. The model is also validated in two existing schemes. In addition, it can be easily adapted to other electrical architectures.

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