2020「中技社科技獎學金」

2020CTCI Foundation Science and Technology Scholarship

創意獎學金

Innovation Scholarship

應用於前瞻音訊裝置之低電磁干擾、極低靜態電流消耗、高傳真D類音訊放大器晶片

A Low-EMI Ultra-Low-Quiescent-Current High-Fidelity Class-D Audio Amplifier for Prospective Audio Applications

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創意重點

For the prospective portable/wearable, IoT, and smart home devices, the high-quality audio performance as well as the extended battery usage time have become more and more important. In addition, to achieve the high system integration, the electromagnetic interference (EMI) should also be well-considered. Audio amplifiers, which determines above-mentioned performances, play the key role in the development of these applications. In this project, three techniques, including frequency-equalized PWM-residual-aliasing reduction (FE-PRAR), output common-mode (V_{CM}) correction and narrow-pulse-free (NPF) CMFBD, are proposed for high-efficiency Class-D audio amplifiers to achieve high-fidelity, low-EMI while consuming ultra-low quiescent current, thereby making Class-D amplifiers more suitable for prospective applications.

創意成果

A. FE-PRAR Technique:

Break the trade-off between low THD+N and low quiescent current (I_Q), permitting Class-D amplifiers to achieve both high fidelity and long battery usage time.

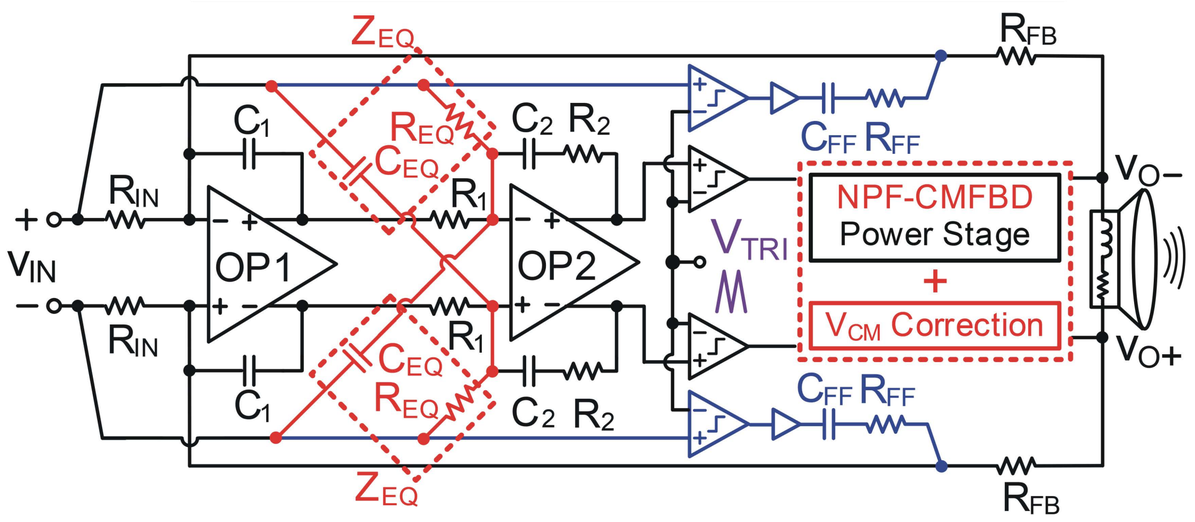
B. V_{CM} Correction Technique:

Reduce the V_{CM} spikes resulted from the circuit mismatch to achieve low common-mode EMI.

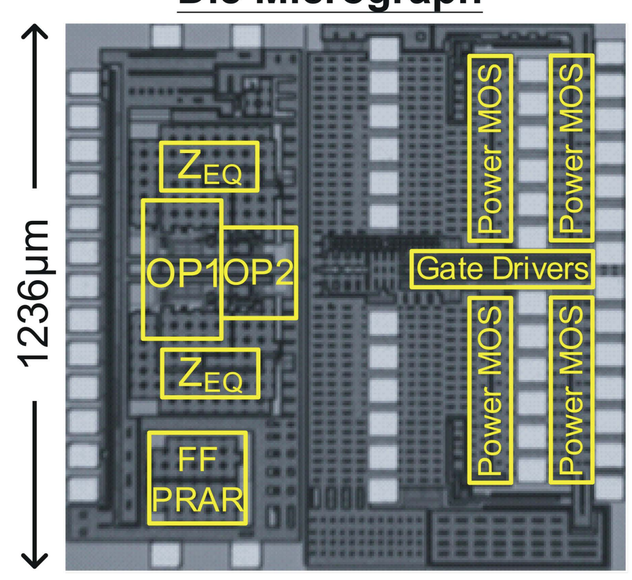
C. NPF-CMFBD Modulation:

Eliminate the narrow pulses stemming from the CMFBD modulation for low-input magnitude to suppress distortions.

System Diagram with Proposed Techniques



Die Micrograph



Achievements:

This work's Class-D amplifier has been manufactured by TSMC and verified to achieve a competitive THD+N of -100.8dB and a 13-dB EMI margin beyond FCC standard with **the world's lowest I_Q of 0.41mA.**

Publications: 2020 *IEEE ISSCC* highlighted paper

2021 *IEEE JSSC* paper (under revision)

國研院台灣半導體研究中心(TSRI) 特別設計獎(100萬優良晶片優惠)

創意心得

由衷謝謝評審們及中技社給予肯定讓我獲得創意獎學金這份殊榮，也感謝指導教授郭泰豪老師、成功大學與我的父母提供我研究與學習的環境並給予我鼓勵，使我能夠在碩士期間能夠順利完成D類音訊放大器相關研究並發表至頂尖文獻，未來將持續在晶片設計領域發展，期許自己能夠把所學技術回饋國家、社會與家庭。