

# A Customized Integrated Circuit for Active EMI Filter

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## Introduction

This paper proposes an active EMI filter (AEF) realized by a customized integrated circuit (IC) to reduce conducted emission (CE) noises. A fully transformer-isolated feedforward current-sense current-compensation (CSCC) structure is selected as a base topology of the AEF. The operation of the proposed AEF is theoretically demonstrated, and practical design guidelines for the IC part and nearby components are developed. The designed IC is fabricated by a 0.18  $\mu\text{m}$  bipolar-CMOS-DMOS (BCD) process. The fabricated IC is implemented in a compact printed circuit board (PCB) for application to a three-phase inverter motor system. The performance, stability, and surge immunity of the AEF are experimentally demonstrated.

## Result and Discussion

As shown in Fig. 1, a customized IC for an AEF has been proposed. A transformer-isolated FF-CSCC is selected as a base topology to achieve robustness from temperature and product variation. A current amplifier has been designed in an IC, including BJTs, biasing diodes, and biasing resistors. The layout of the IC components are shown in Fig. 2. The fabricated IC has been implemented in a compact PCB and installed at the 1stage C-L AEF for the application to a three-phase inverter motor system. The reduction of the CM CE noises by utilizing the proposed AEF is demonstrated a real product power system of an inverter motor. When AEF is supplied by 12V dc, IC works the noise compensation operation, and CE noise become reduced. Fig. 3 shows the CM CE measurement results with the proposed AEF. The CM CEs with the AEF shows a better reduction than with Y-capacitors by 16dB to 20dB in the frequency range from 150kHz to 3MHz.

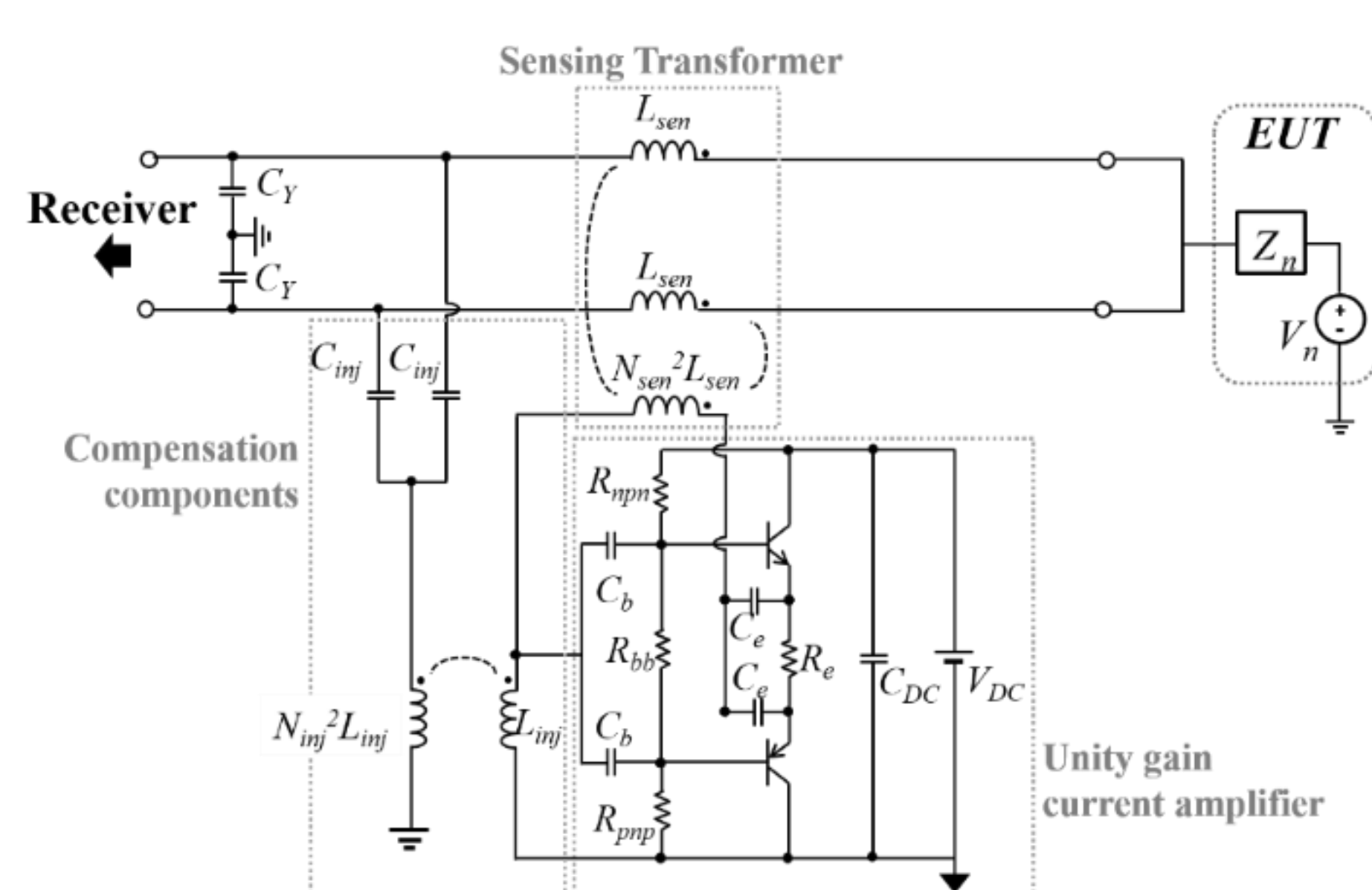


Fig.1.Circuit configuration of the proposed AEF IC

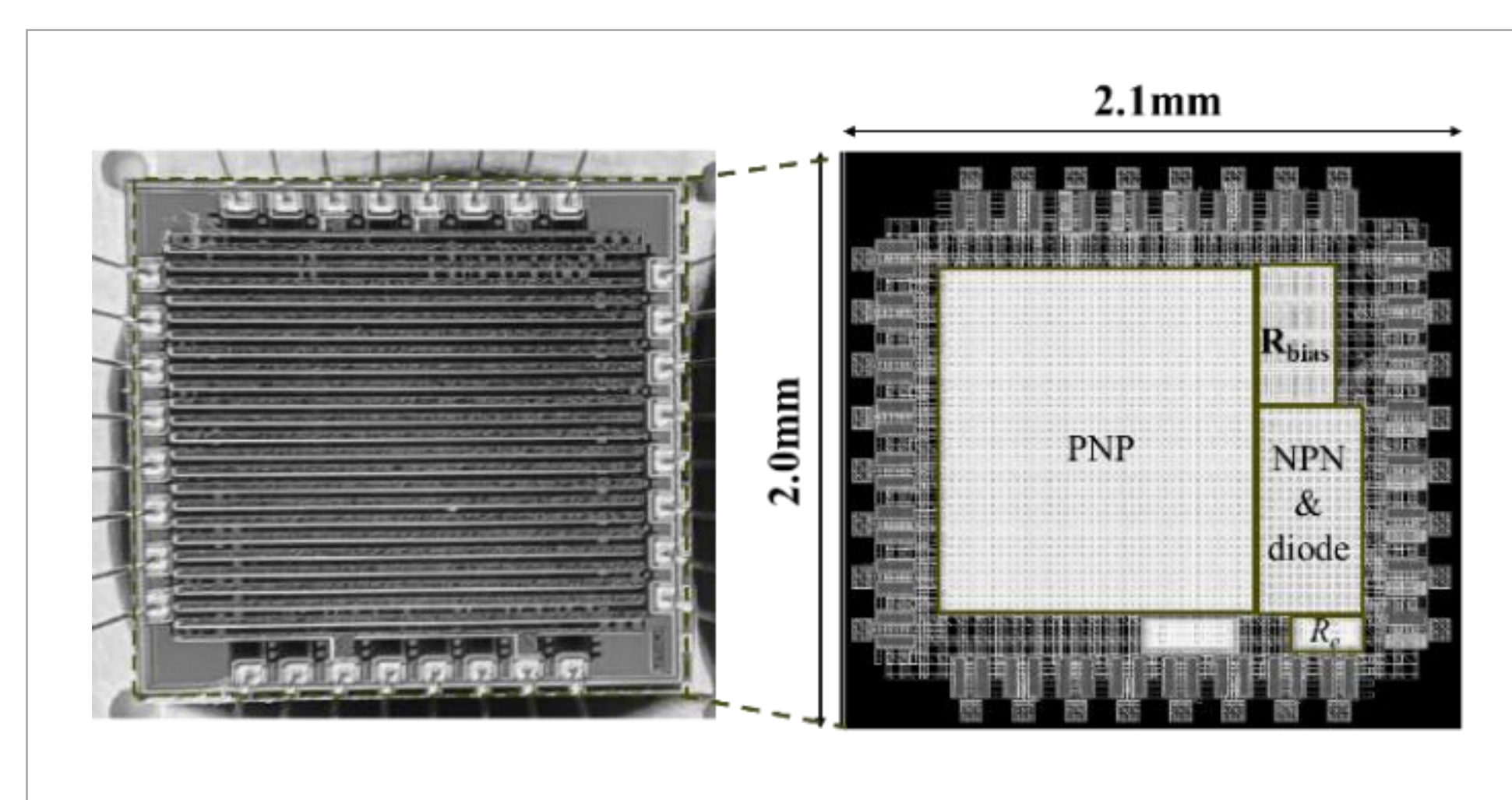


Fig.2. Photograph of the designed layout

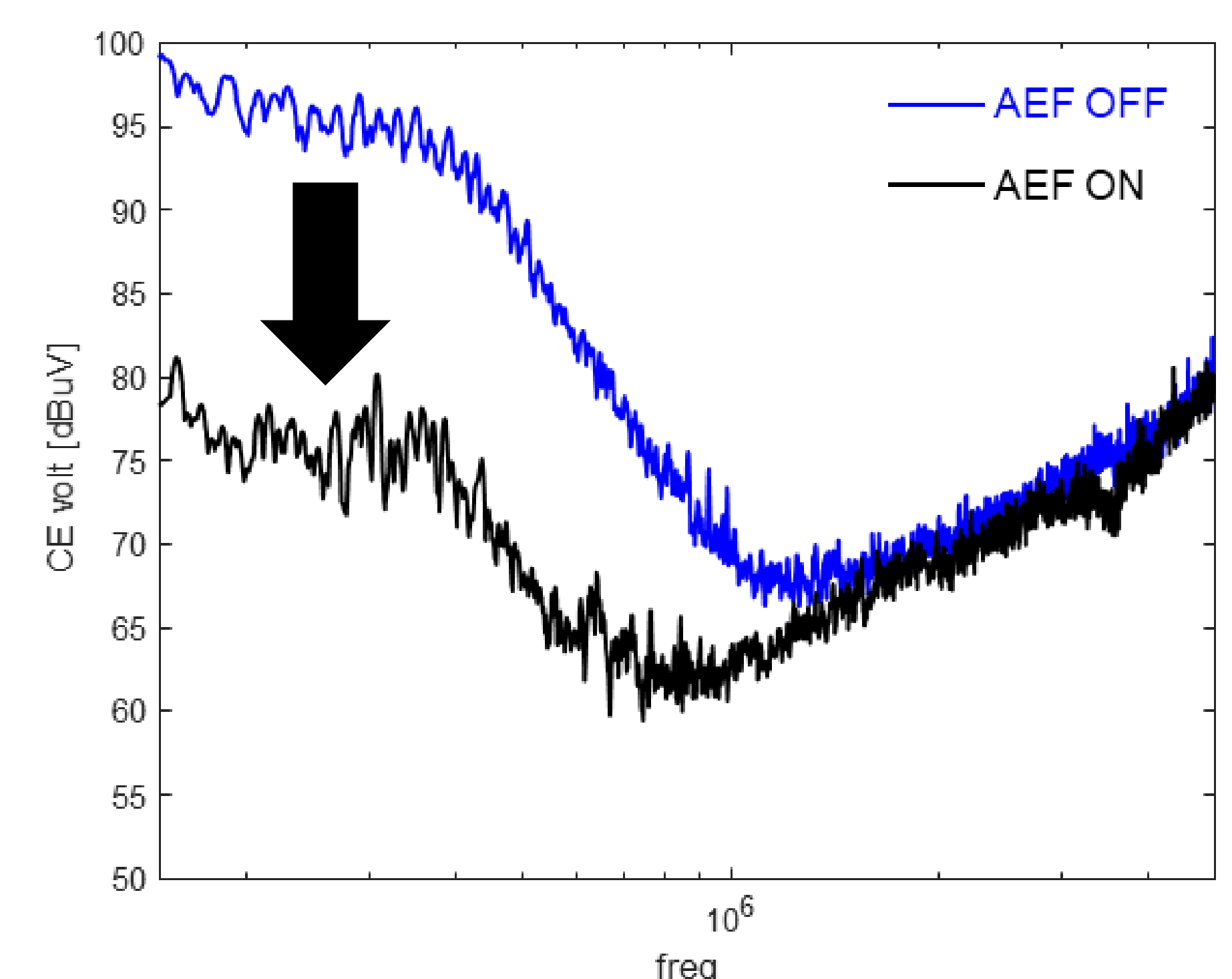


Fig.3. CE measurement results with AEF IC.

## Conclusion

Transformer-isolated feedforward CSCC AEF has been proposed. The amplifier part is implemented by the customized IC, where the designed IC is fabricated by 180nm BCD process. The proposed AEF is fully isolated so that the internal low supply voltage in the power system can be available from the control board of the main power system with low risk of EOS and EMS problems. As a further work, the noise attenuation performance of the transformer-isolated AEF will be improved by adjusting the accuracy of the amplifier gain.

## Reference

[1] B. Narayanasamy and F. Luo, "A Survey of Active EMI Filters for Conducted EMI Noise Reduction in Power Electronic Converters," IEEE Trans. Electromag. Compat. vol. 61, no. 6, pp. 2040-2049, Dec. 2019.

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