

# One-chip Active EMI Filter and Analyzing Circuit

Sangyeong Jeong<sup>1,2</sup> and Jinguok Kim<sup>1,2</sup>

<sup>1</sup>Ulsan National Institute of Science and Technology., <sup>2</sup>EM coretech, inc.

## Introduction

This paper proposes the integrated circuit to reduce the conductive noise generated in the high-power power converter, where the integrated circuit amplifies the sensed voltage and current to the injection part, which is designed as a one-chip IC. A common-mode (CM) electromagnetic interference (EMI) filter is usually designed using a large CM choke and a Y-capacitor, and there is a limit in that price and size of the CM choke, especially in a high-power and high-current system. To solve this problem with the minimum size, the proposed integrated circuit was designed. This circuit also include the malfunction analyzing circuit to check that malfunction of the AEF by using digital logic

## Result and Discussion

Fig.1 shows the layout of the active EMI filter with malfunction analyzing circuit. NPNs and PNPs take most of areas to achieve high current swing level and noise injection capacity. The malfunction analyzing circuit is located at the right above side of the overall chip and take relatively small area compared to overall system. The below figure in Fig. 6 shows the magnified figure of malfunction analyzing circuit layout. Fig. 2 shows the measured CE results with quasi-peak and average value from 150kHz to 30Mhz, which corresponds to CE regulation. The testing target was inverter motor system operating with 34kW power rating. The noise emitted before AEF operation is measured upto 75dB in average measurement.

Fig. 3 shows the voltage waveform of flag output signal at malfunction analyzing circuit, with varying each condition when Vdd is induced as 5V. Depending on the logic signal of two comparators, the logic circuit make flag voltage to the LED driving MOSFET. To reduce the power consumption on the LED in normal state, the logic table shows that the 0 signal is generated on the normal state to turn-off the outside LED, while the logic signal turn-on in case of the normal situation

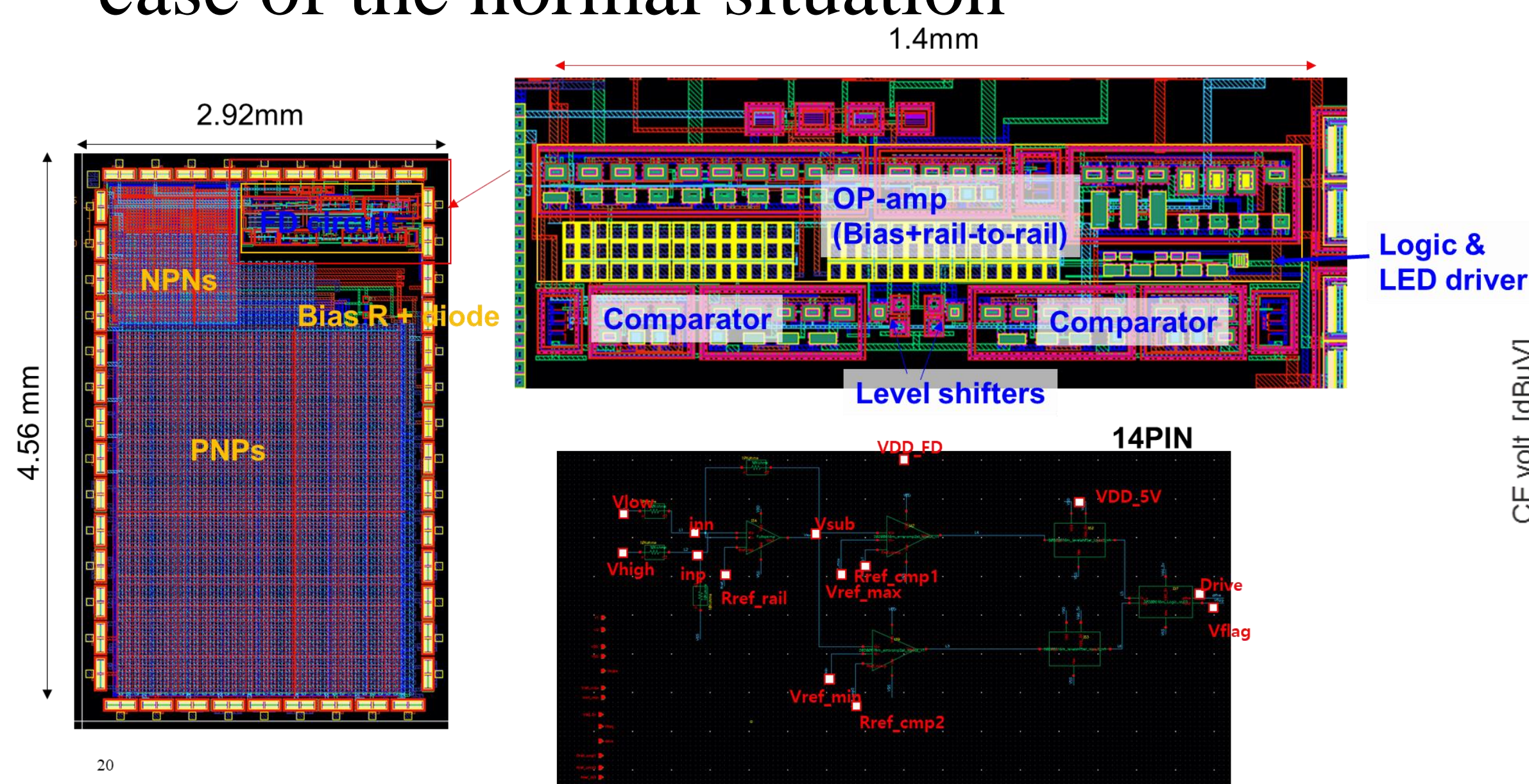


Fig.1. Layout of the AEF with malfunction analyzing circuit

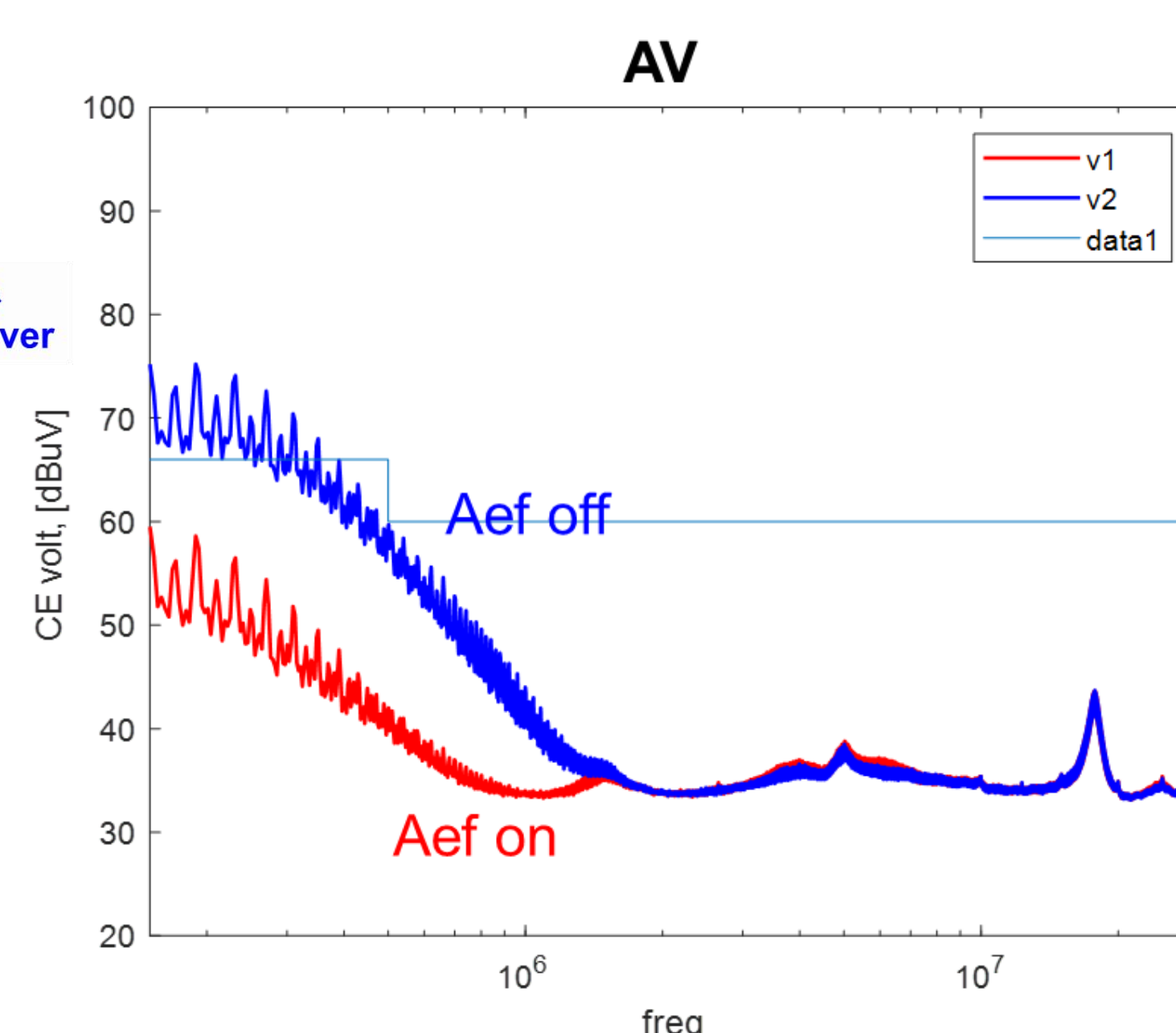


Fig.2. Measured CE Results

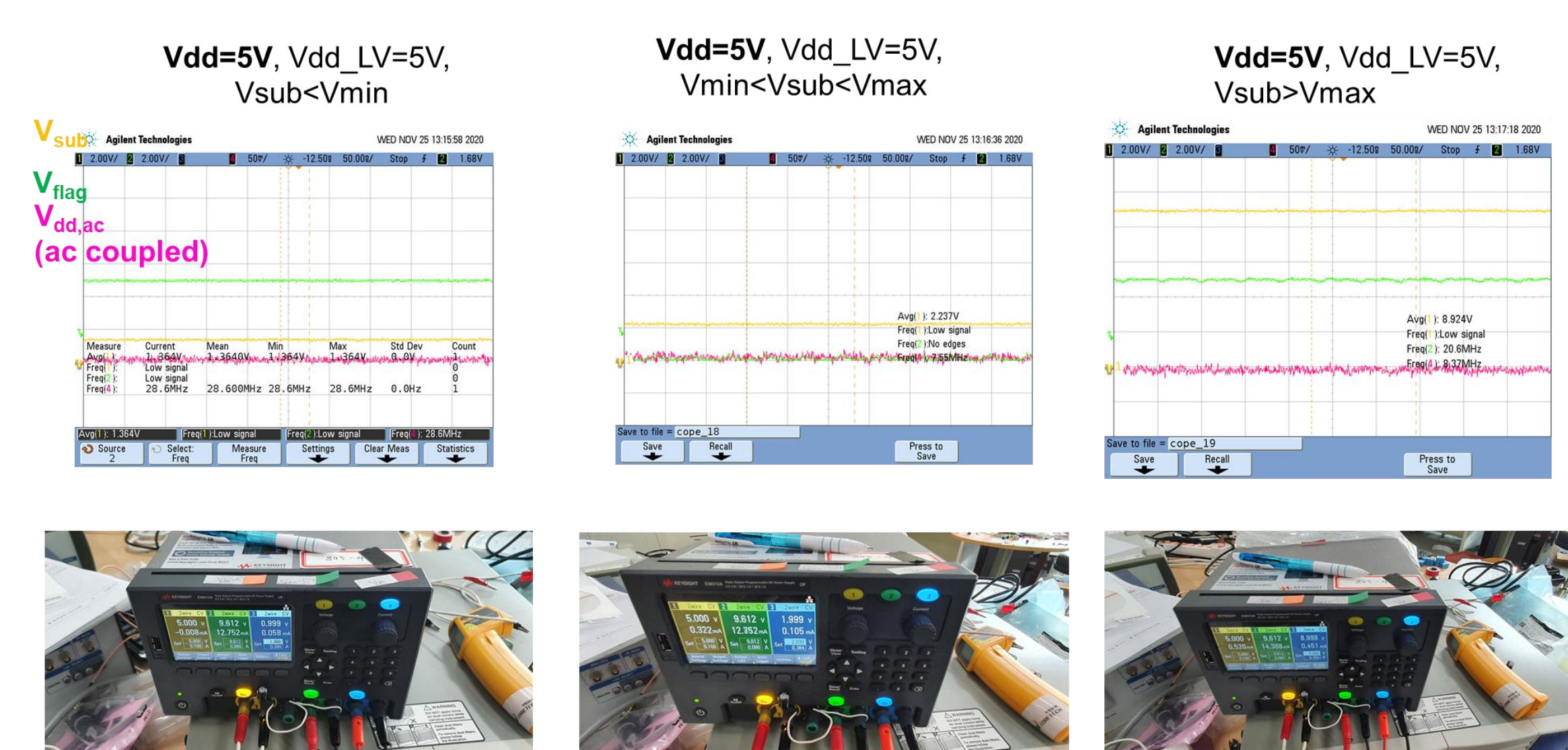


Fig.3. Measured waveform of the malfunction analyzing circuit with different conditions

## Conclusion

This chip is designed to reduce the conductive noise generated in the high-power power converter, where the integrated circuit amplifies the sensed voltage and current to the injection part, which is designed as a one-chip IC. In addition, this circuit also include the malfunction analyzing circuit to check that malfunction of the AEF by using digital logic. The operation in CE measurement set-up is well checked and 20dB noise was reduced. Malfunction analyzing circuit is still available, but it was found that the abnormal oscillation happens at several weak conditions. This weak point of stability on start-up circuit will be improved at future IC design.

## Reference

- [1] K. Mainali, R. Oruganti., "Conducted EMI mitigation techniques for switch-mode power converters: a survey," IEEE Trans.Power Electron., vol.25, no.9, pp.2344-2356, Sept. 2010.

**Acknowledgments** : The chip fabrication was supported by the IC Design Education Center(IDEDEC), Korea..