1B-06

# Voltage Overshoot Reduction with Parallel RLC Network for Inductor Type Buck Converter in Mobile Applications

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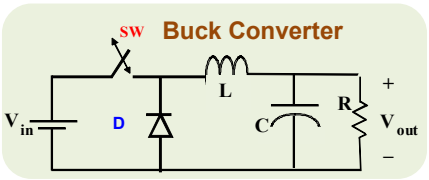
## 1. Research Objective

**Solving problems:**

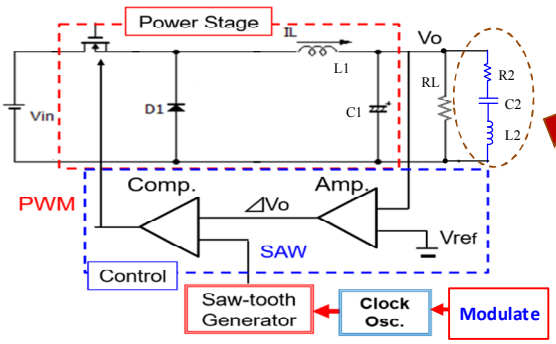
- **Output voltage overshoot**
- **Output voltage ripple**




## 2. Research Background

- **Conventional method of overshoot reduction : a feedback loop [1]**
- **Ripple reduction: spread spectrum of pulse width modulation (PWM)[2]**
- **Proposed overshoot reduction technique: a parallel RLC network**

## 3. Proposed Design of Buck Converter




**"Proposed parallel RLC network"**

**Spread spectrum**

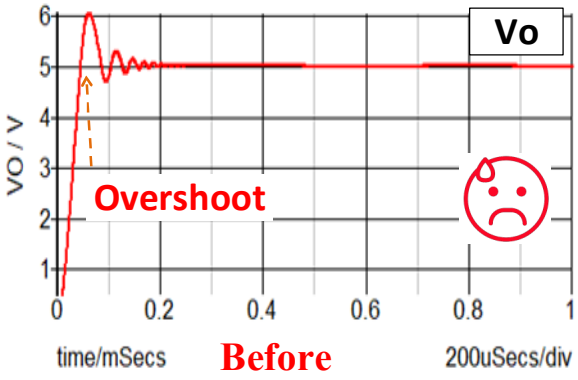
**Table.1: Operation parameters**

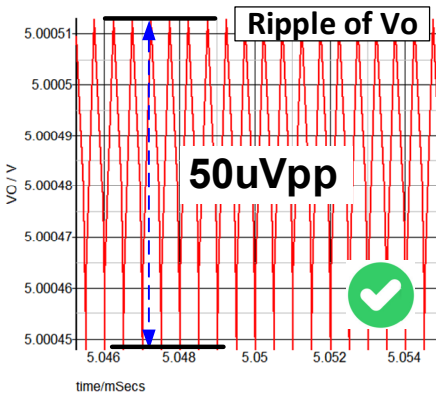
| | |
|---|---|
| Input Voltage (Vin) | 12V |
| Output Voltage (Vo) | 5.0V |
| Output Current (Io) | 1A |
| Clock Frequency (Fck) | 200kHz |

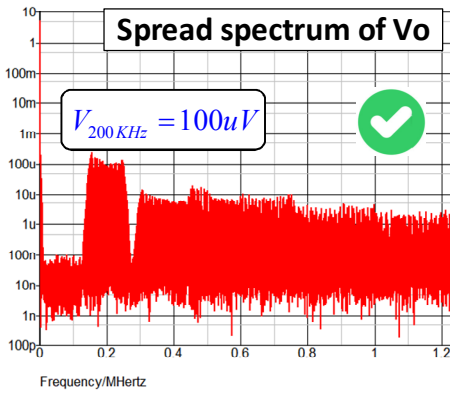
## 4. Simulation Results

- **Overshoot reduction: 1Vpp → 0.1Vpp**
- **Small ripple: 50μVpp → Low spectrum:100μV**

**Conventional design**

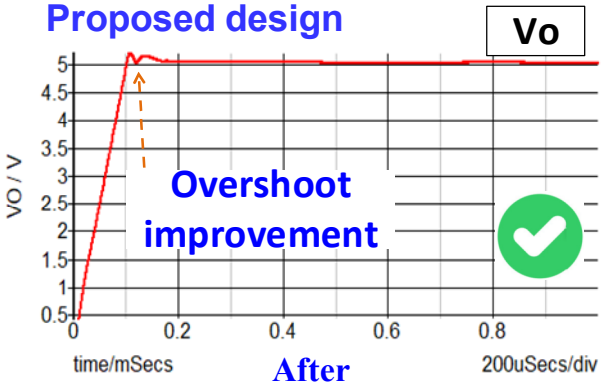



**with parallel RLC**

**Proposed design**




## 5. Summary

- **Voltage overshoot is improved by a parallel RLC (< 0.1Vpp).**
- **Ripple is kept very small (50μVpp) based on spread spectrum of PWM.**
- **Ripple spectrum are very low (100μV).**

## References

[1] H. Kobayashi, T. Nabeshima (Editors), Handbook of Power Management Circuits, Pan Stanford Publisher (2016).

[2] Minh Tri Tran, N. Miki, Y. Sun, Y. Kobori, H. Kobayashi, "EMI Reduction and Output Ripple Improvement of Switching DC-DC Converters with Linear Swept Frequency Modulation", IEEE 14th International Conference on Solid-State and Integrated Circuit Technology, (Qingdao, China) Nov. 2018.