

24 Single Inductor Dual Output DC-DC Boost Converter with Serial Control

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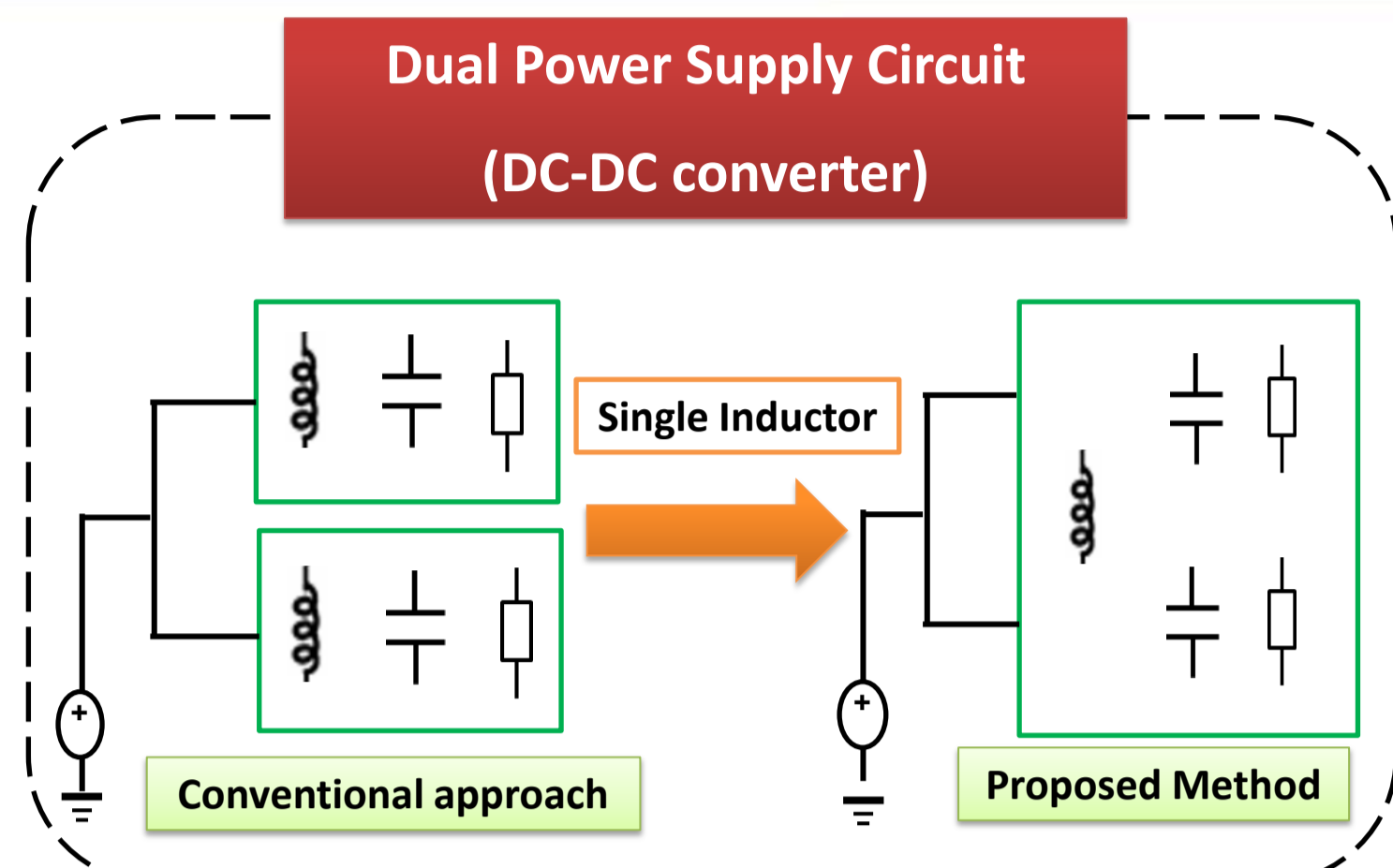
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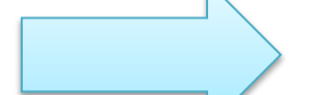
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Introduction



Reduce inductor

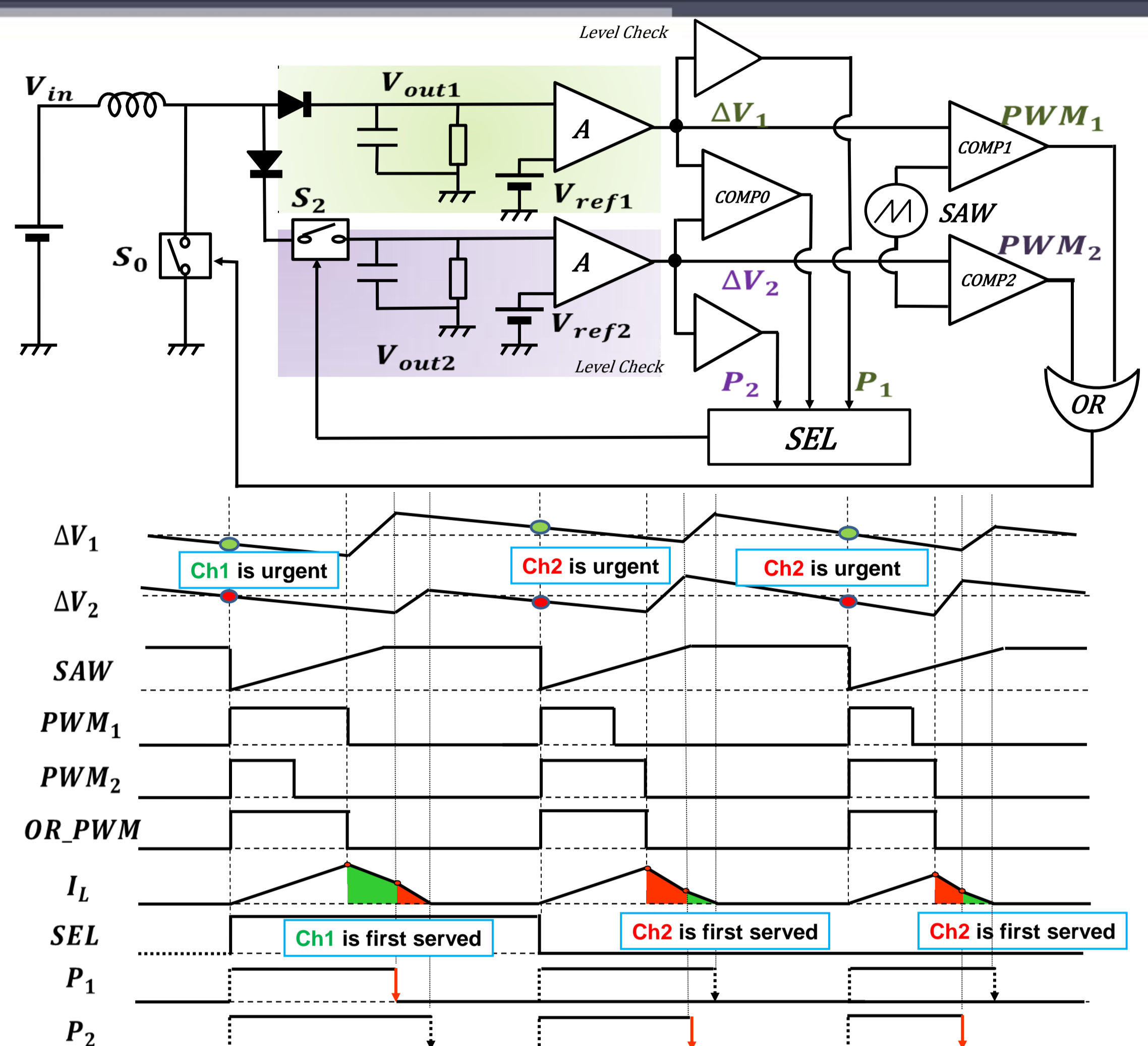


Reduce cost
Reduce volume

Research Objective

- Single Inductor Dual Output Converter
 - Development of simple, low cost control method.
- Serial Control Proposal
 - Both ch1 and ch2 control serially in one period, **an urgent channel is first served**.
 - Only a few additional components.
 - No current sensor.

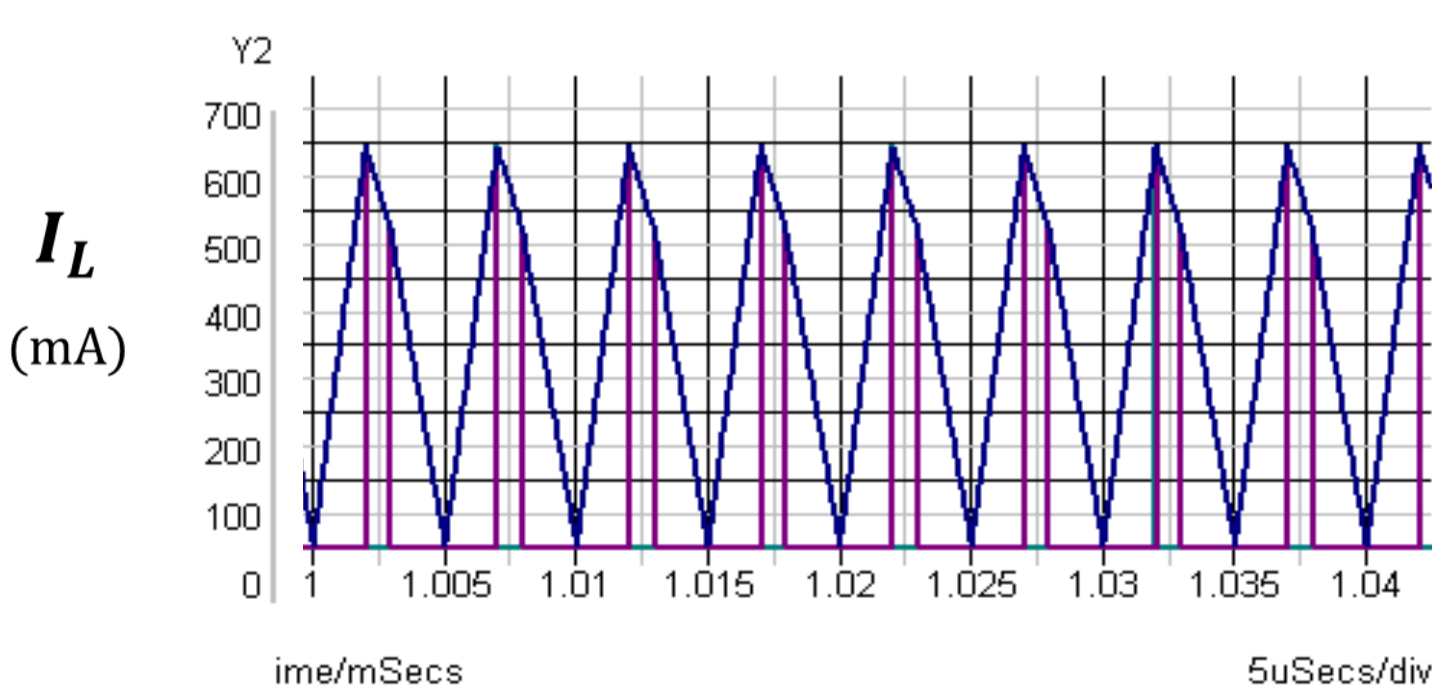
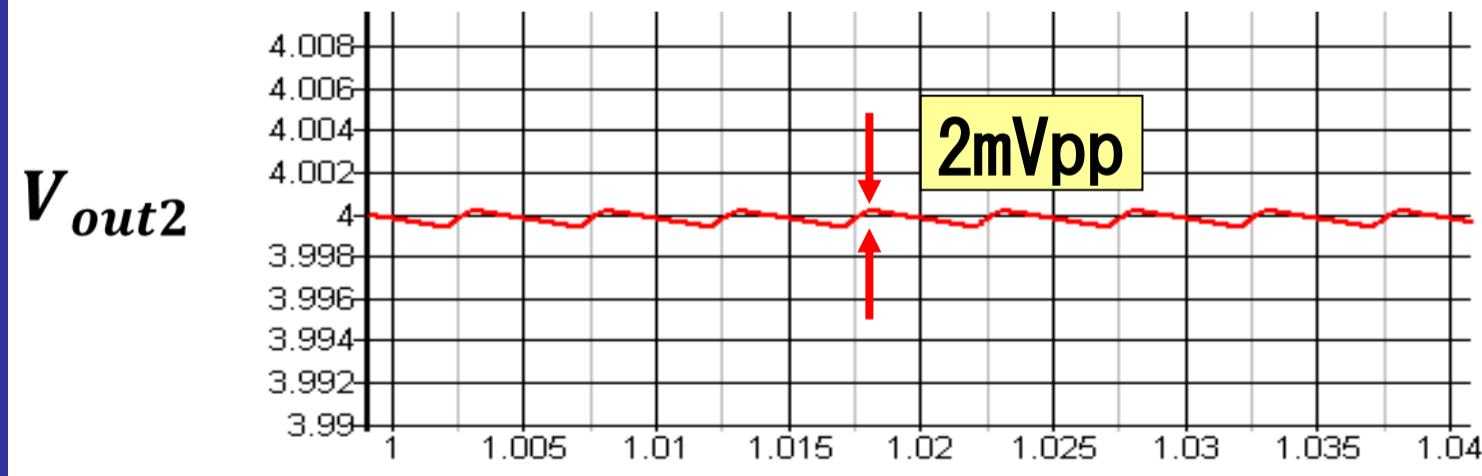
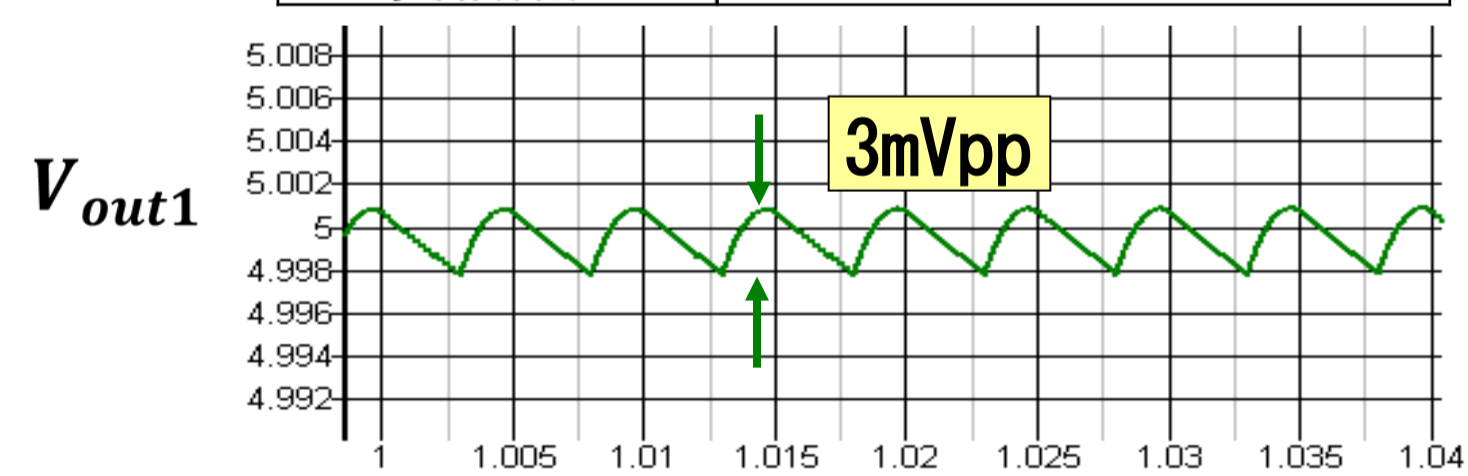
Proposed SIDO Boost Converter



Simulation of Serial Control SIDO Boost Converter

I Simulation under DCM or BCM

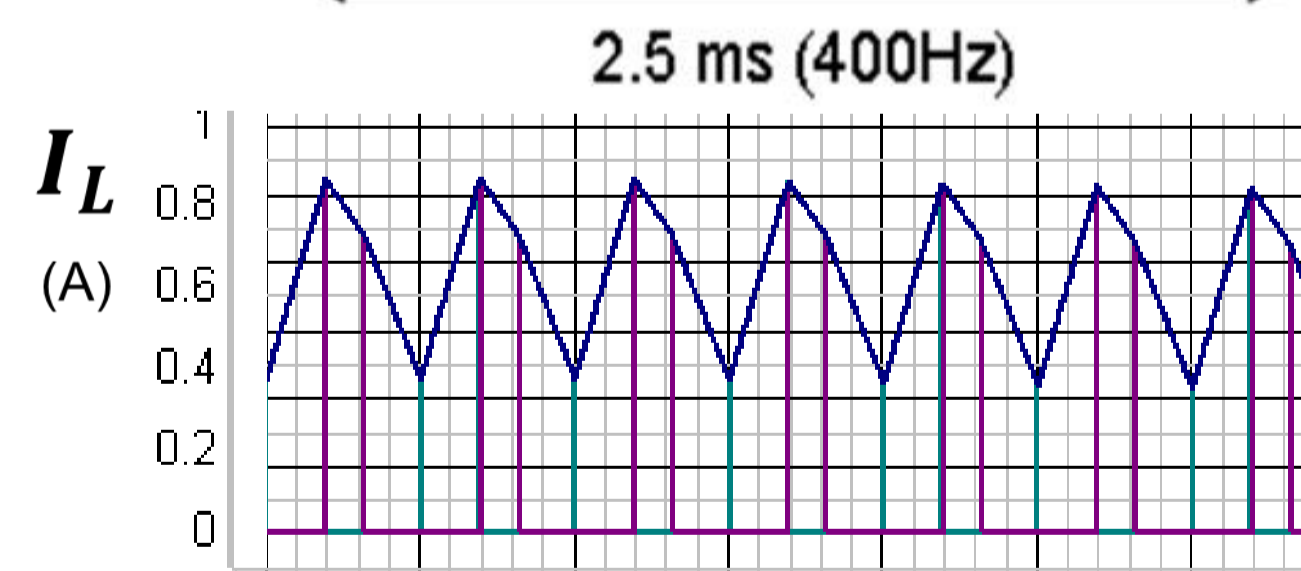
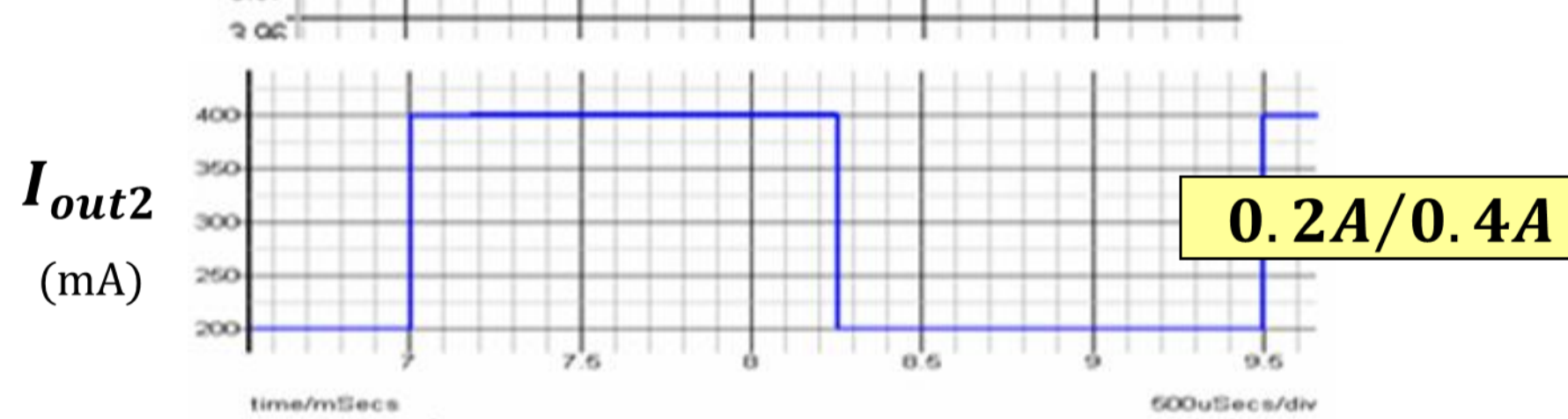
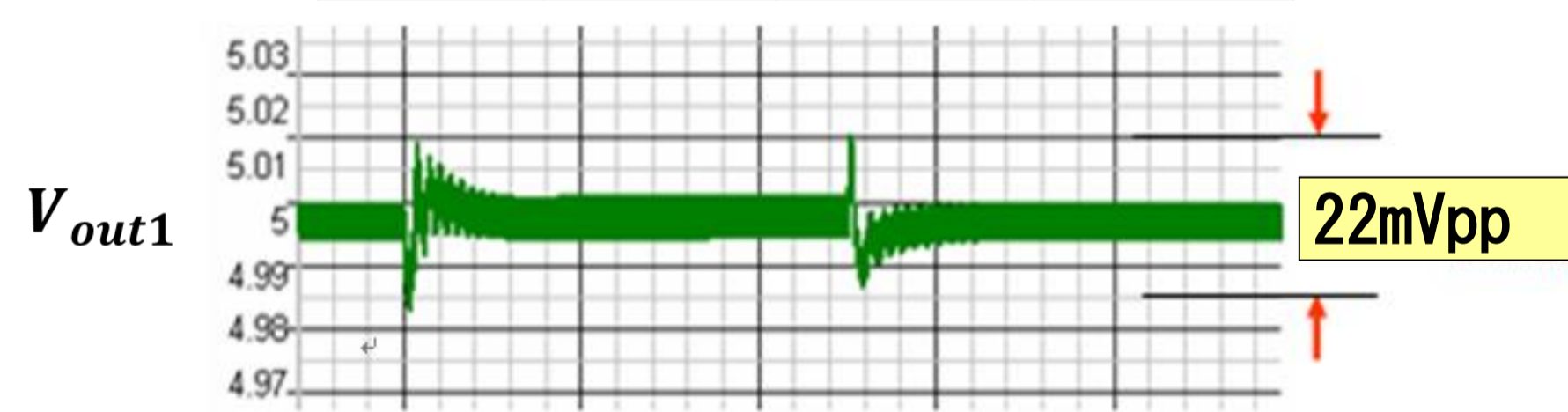
V_{in}	3.0 V
V_{out1}	5.0 V
V_{out2}	4.0 V
I_{out1}	0.1A
I_{out2}	0.1A
L	10 μ H
C	100 μ F
f_{switch}	200 kHz



Work in BCM at light load ($I_{out1} = I_{out2} = 0.1A$), voltage ripple of two output both are small.

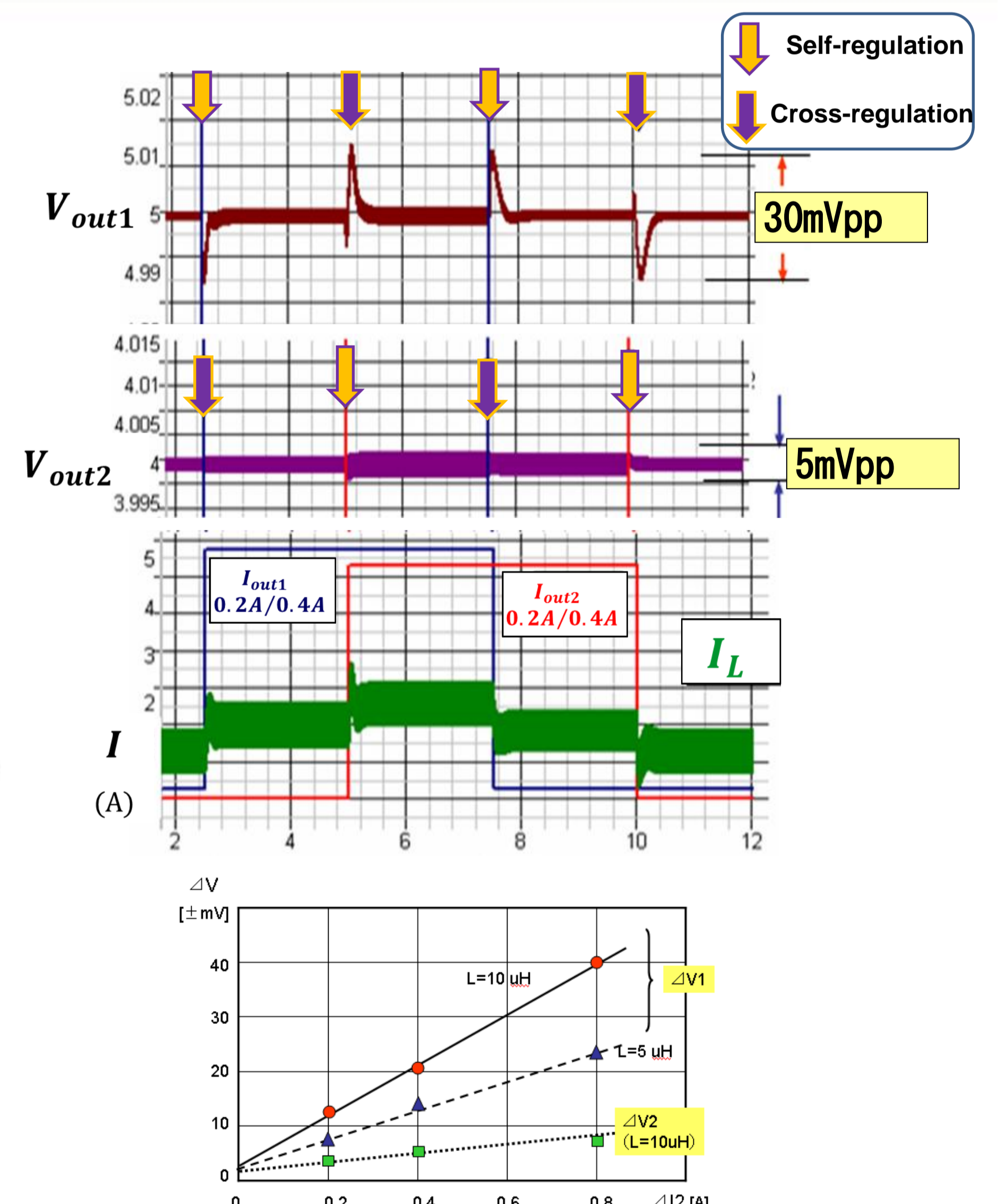
II Simulation under CCM

	BCM	CCM
I_{out1}	0.1A	0.2A
I_{out2}	0.1A	0.2A / 0.4A



- Work in CCM at heavy load ($I_{out1} = I_{out2} = 0.2A$), voltage ripple of two output both increase.
- When load is changed (only $I_{out2} = 0.2A \rightarrow 0.4A$), cross-regulation of channel 1 is big, self-regulation of channel 2 is small.

III Load Current and Load Regulation



- Bigger filter capacitor ($C = 500\mu F$) reduce voltage ripple at heavy load, but make the regulation characteristics of channel 1 further deterioration.
- Regulation characteristics of channel 2 is OK.
- Load current and load regulation are proportional.

Conclusion

- Propose SIDO DC-DC boost converter with serial control, then confirm by simulation.

Simple, low-cost, high performance SIDO DC-DC converter can be realized.

Further work: Optimize regulation characteristics of output1, suppress overshoot and undershoot

References

- 1) 津志田健吾, 他, "単一インダクタンス2出力DC-DCコンバータの検討", 第22回 回路とシステム軽井沢ワークショップ (2010年4月)
- 2) 小堀康功, 他, "単一インダクタンス2出力DC-DCコンバータにおける新制御方式", 電気学会栃木群馬支部大会 (2012年2月)
- 3) Y. Kobori, et. al., "Single Inductor Dual Output DC-DC Converter Design with Exclusive Control", IEEE APCCAS, Kaohsiung, Taiwan (Dec. 2012)