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Single-Inductor Dual-Output DC-DC Converter Design with Exclusive Control

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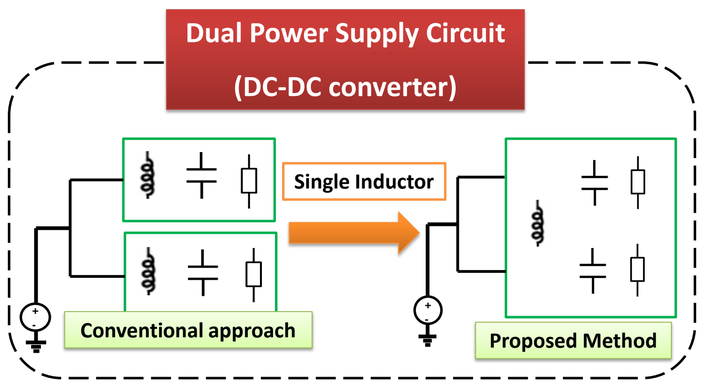
Introduction

In many applications, multiple output voltages are required

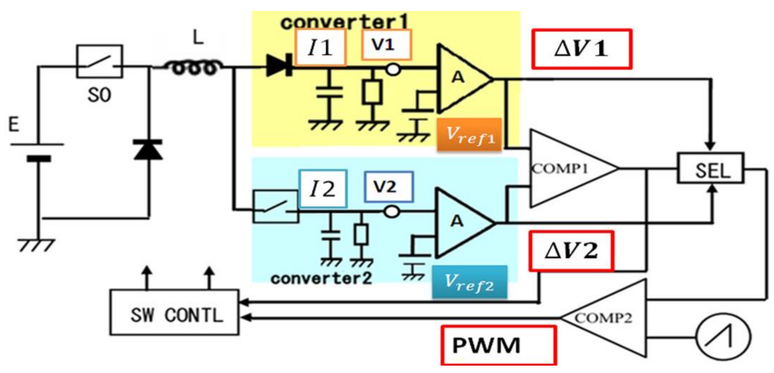


Reduce number of inductors → • Reduce cost • Reduce volume

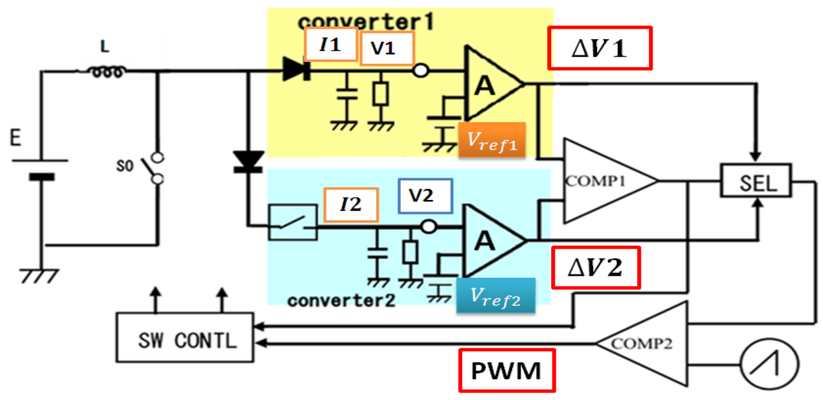
Research Objective

- Single Inductor Dual Output Converter
  - ➢ Development of simple, low cost control method.
- Proposal of exclusive control
  - ➢ Either ch1 or ch2 control in one period
  - ➢ Only a few additional components
  - ➢ No current sensor

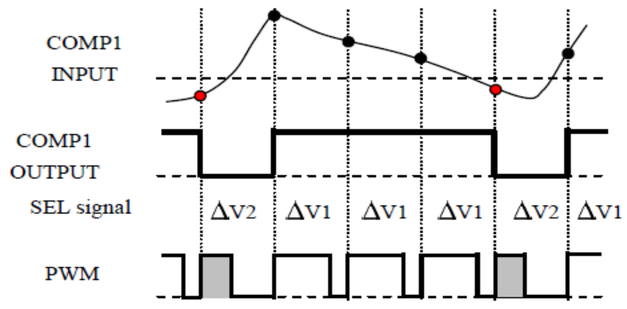
Proposed Control of SIDO



Proposed Control of SIDO with Two Buck Converters



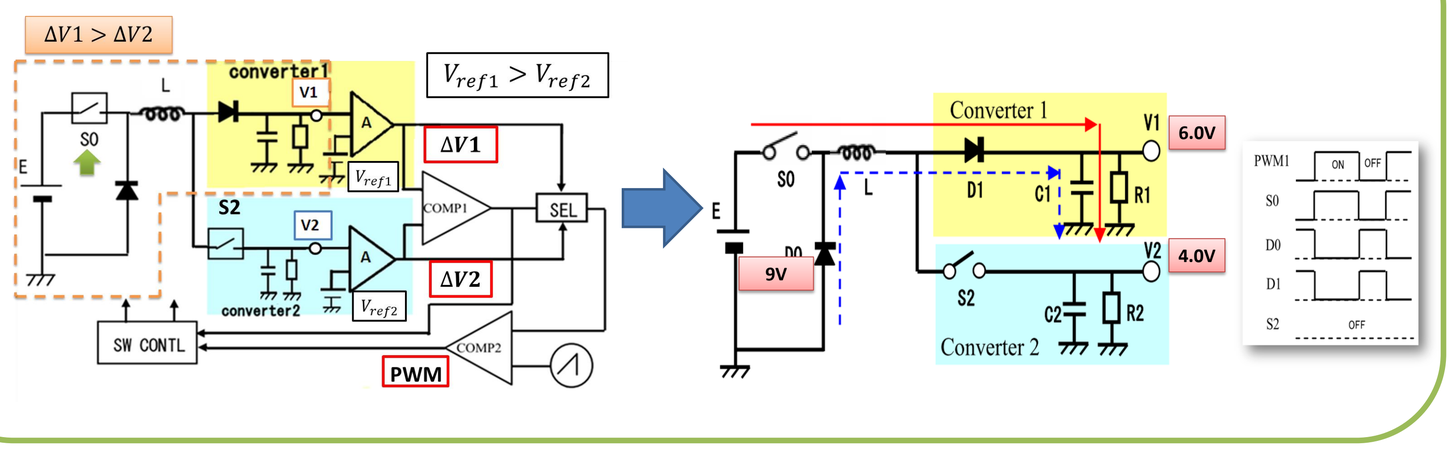
Proposed Control of SIDO with Two boost Converters



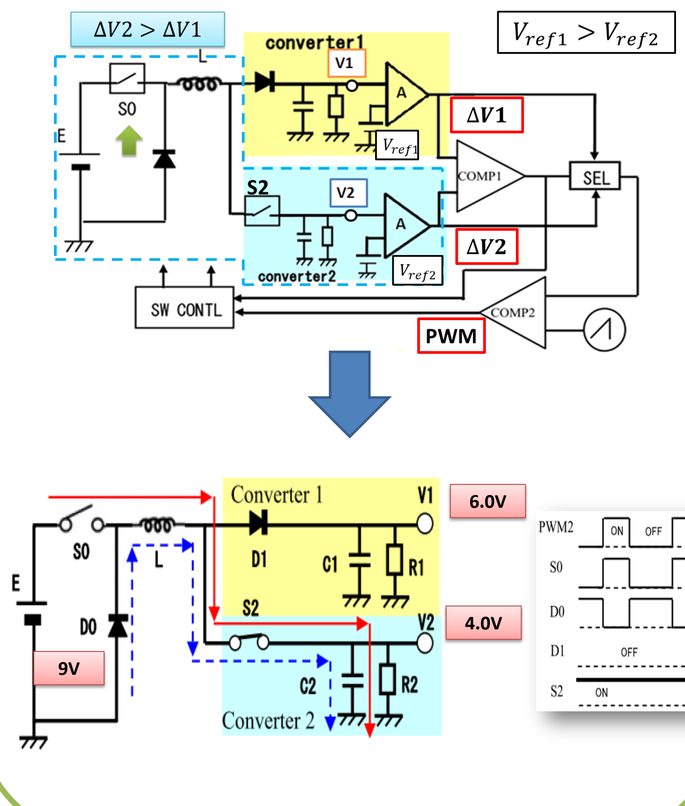
Timing chart

Proposed Control of SIDO with Two Buck Converters

Converter 1 control



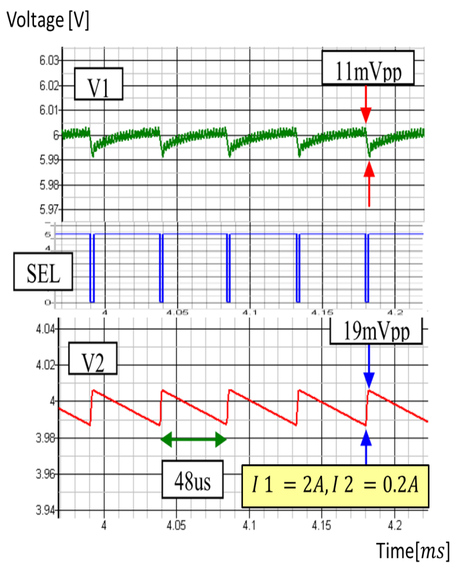
Converter 2 control



Simulation

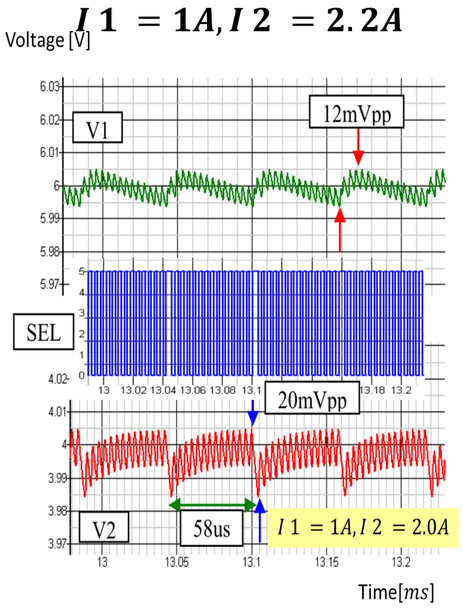
SIDO Buck Converter

$I1 = 2A, I2 = 0.2A$



SIDO Buck Converter

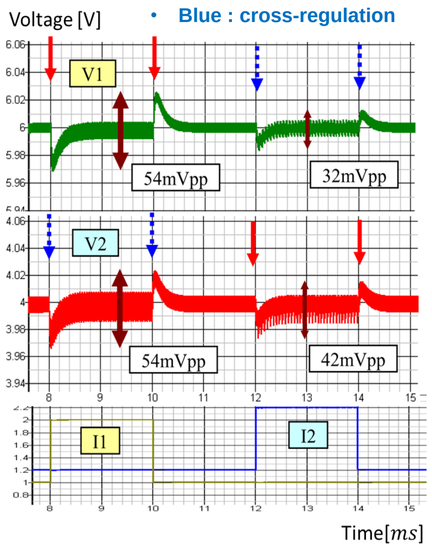
$I1 = 1A, I2 = 2.2A$



Transient Responses

V 1 and V 2

- Red : self-regulation
- Blue : cross-regulation



Conclusion

Simple Design:

- Single inductor dual output (SIDO) converter
- Proposed exclusive control
  - ➢ Simple control
  - ➢ Low cost control
- Verified its operation & performance with simulation

Reference

[1] Y. Kobori, F. Zhao, Q. Li, M. Li, S. Wu, Z. Nosker,S. N. Mohyar, N. Takai, H. Kobayashi, T. Odaguchi, I. Nakanishi, K. Ueda, J. Matsuda, "Single Inductor Dual Output Switching Converter using Exclusive Control Method", IEEE International Conference on Power Engineering, Energy and Electrical Devices, Istanbul, Turkey (May 2013).

[2] Y. Kobori, F. Zhao, Q. Li, M. Li, S. Wu, Z. Nosker,S. N. Mohyar, N. Takai, H. Kobayashi, T. Odaguchi, I. Nakanishi, K. Ueda, J. Matsuda, "Single Inductor Dual Output Switching Converter using Exclusive Control Method", IEEE Asia Pacific Conference on Circuits and Systems, Kaohsiung, Taiwan (Dec. 2012).

[3] K. Takahashi, H. Yokoo, S. Miwa, K. Tsushida, H. Iwase, K. Murakami,et al, "Single inductor DC-DC Converter With Bipolar Outputs Using Charge Pump," IEEE Asia Pacific Conference on Circuits and Systems, pp. 460 –463, Kuala Lumpur, Malaysia (Dec. 2010)