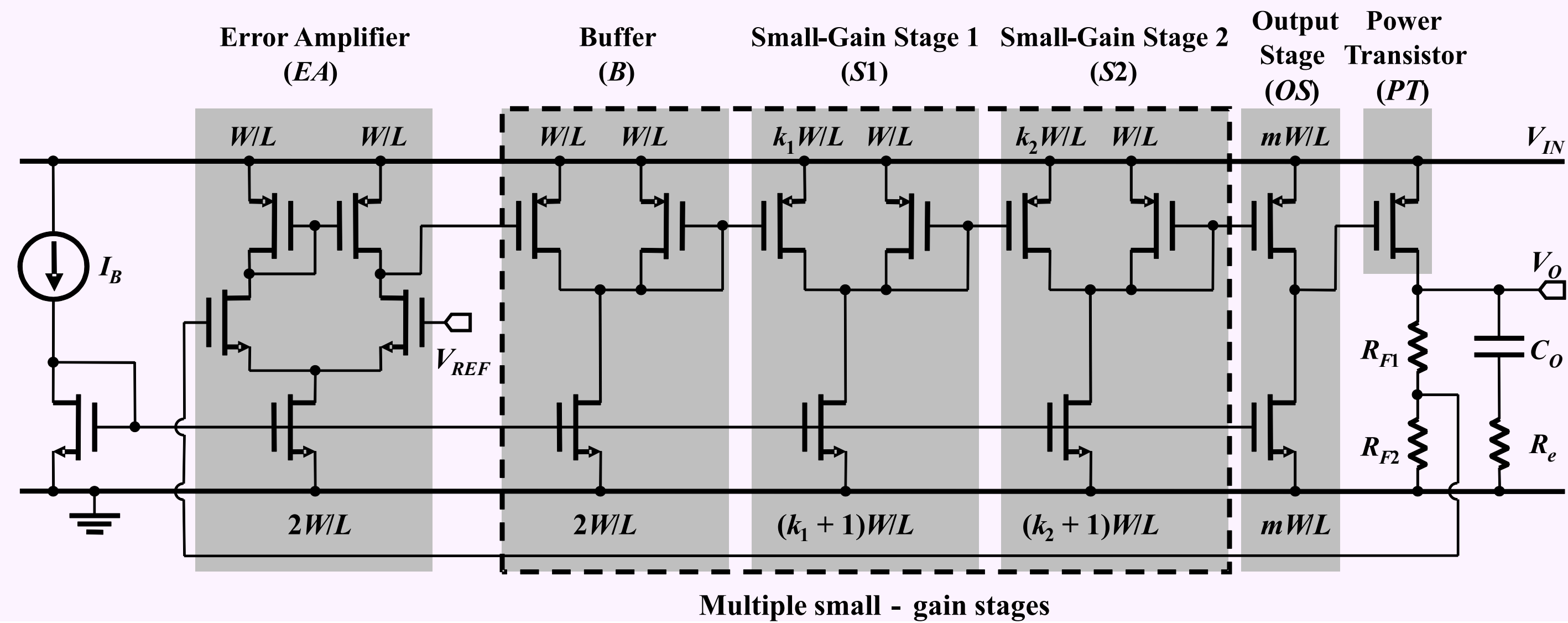
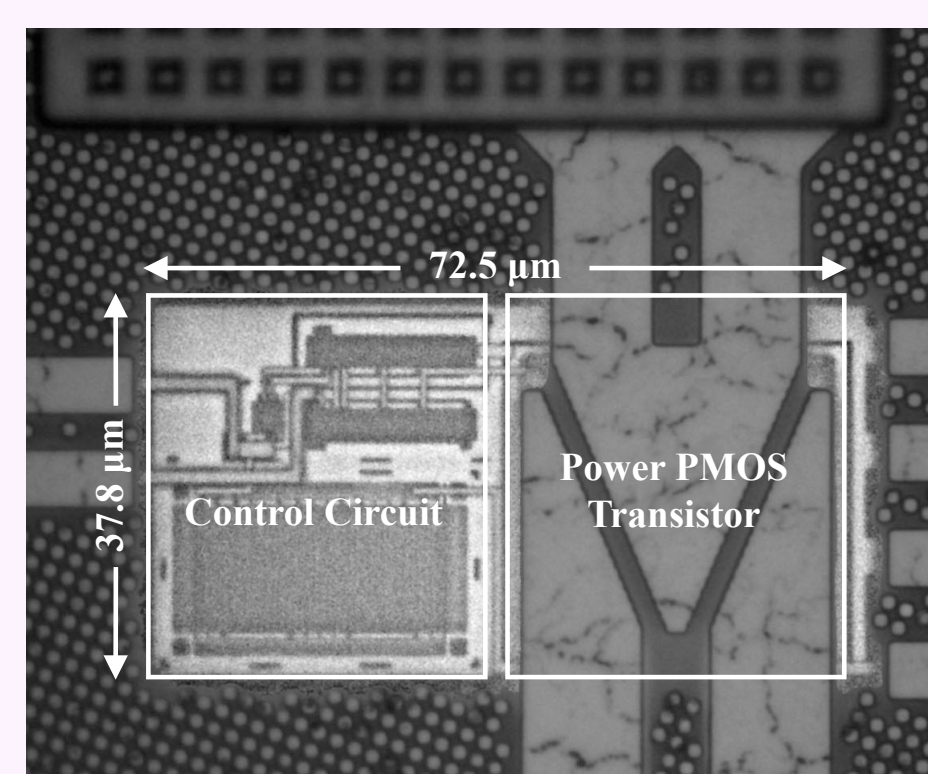


## Main Stream Research Projects

- Fast-transient low-dropout regulators (LDOs)
- Output capacitor-less low-dropout regulators (LDOs)
- Single-inductor multiple-output (SIMO) switched-mode DC-DC converters
- High-efficiency charge pumps

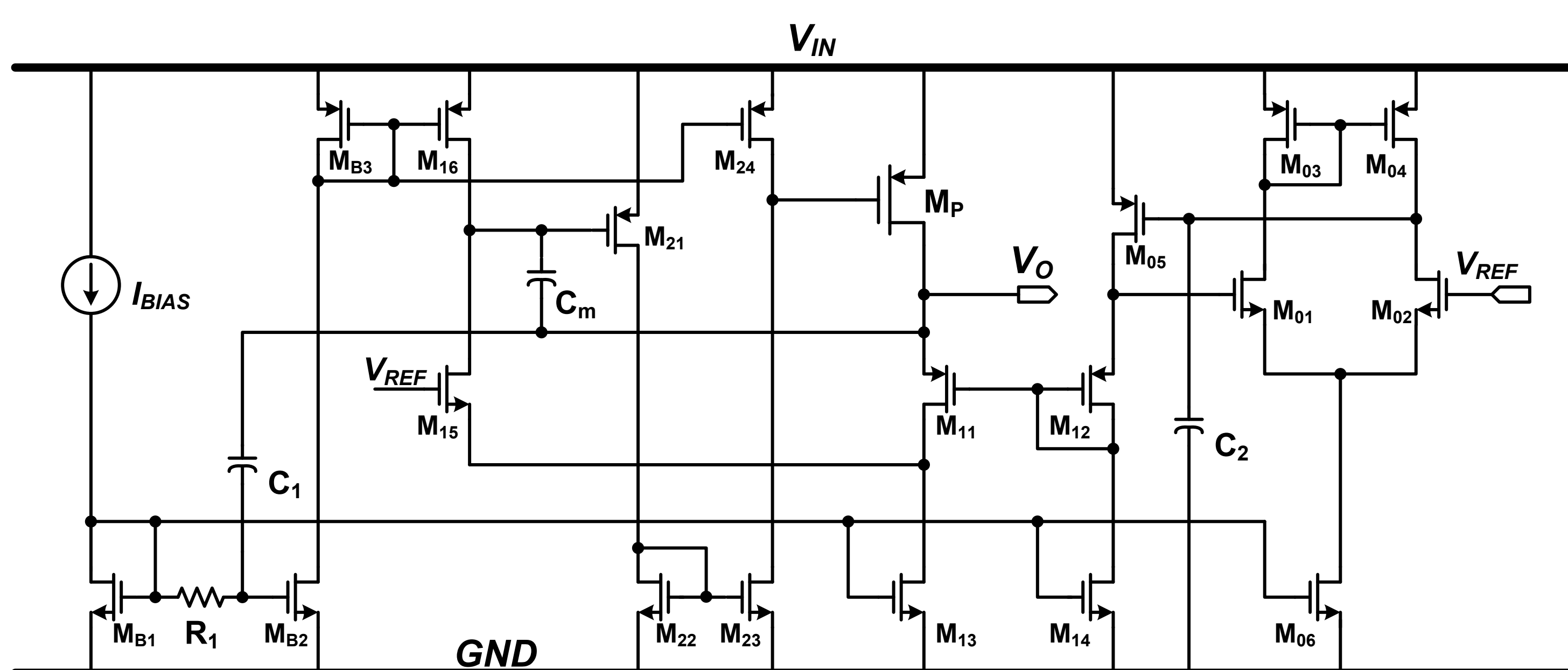
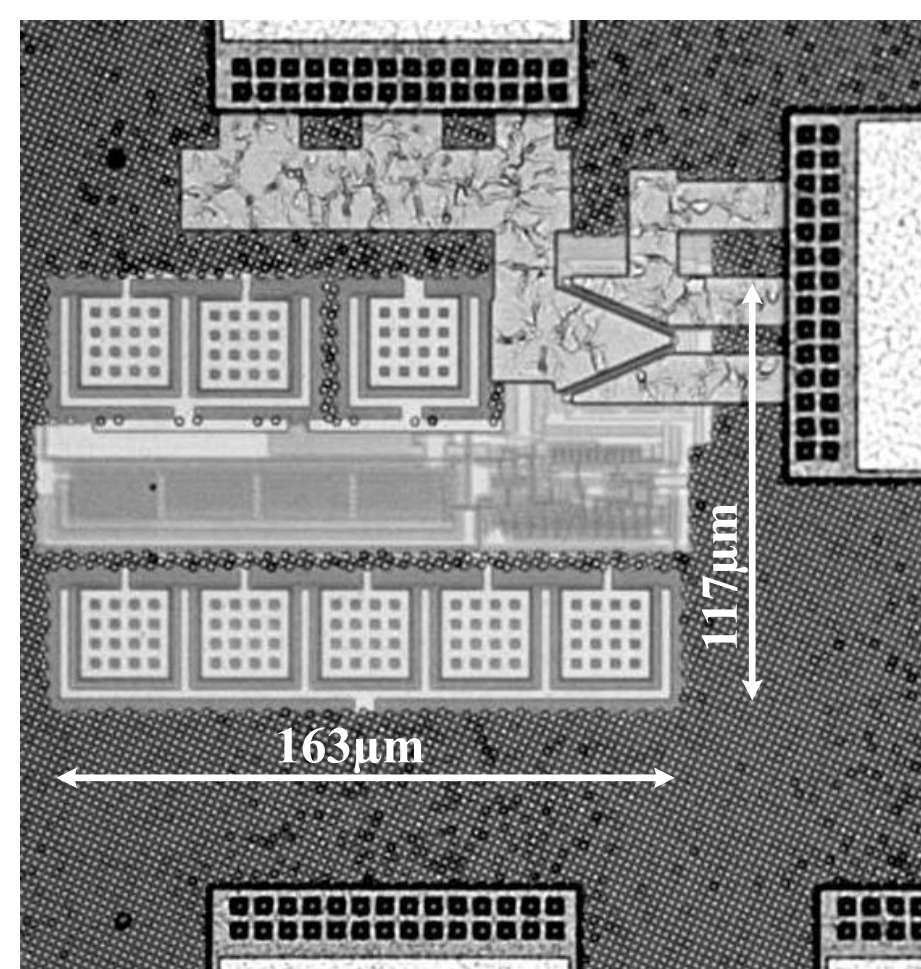
## Fast-transient low-dropout regulators (LDOs)

- Loop-bandwidth enhancement
- Loop-gain enhancement
- Channel-resistance-insensitive small-gain-stage
- No on-chip compensation capacitor
- 9.3  $\mu\text{A}$  quiescent current



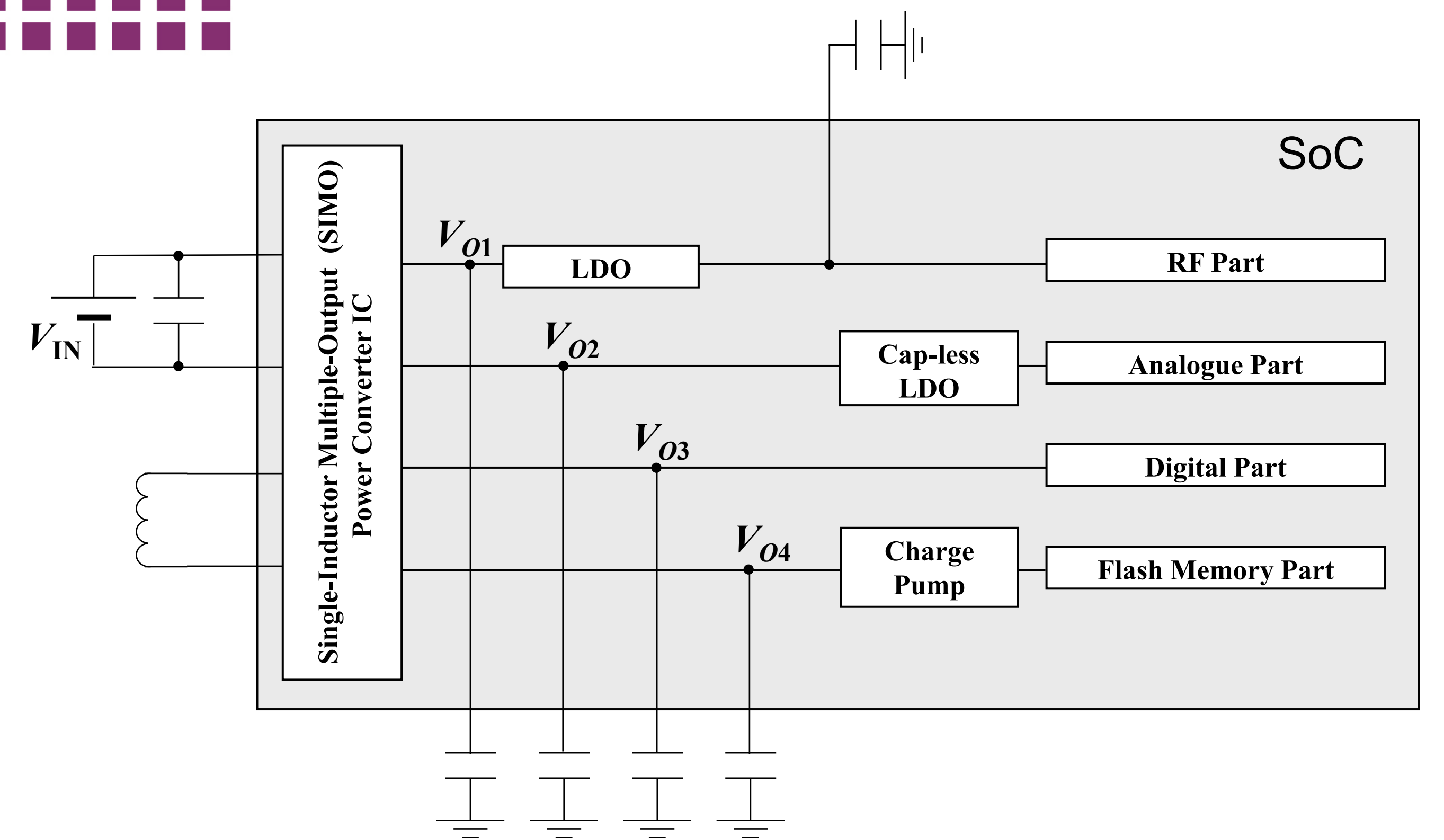
## Output capacitor-less low-dropout regulators (LDOs)

- Single compensation capacitor for two-stage voltage flipped follower
- Dynamic biasing for slew rate enhancement
- Stable for capacitive load from 0 to 50 pF
- 100 mA load capability
- 6  $\mu\text{W}$  under a 0.75V supply



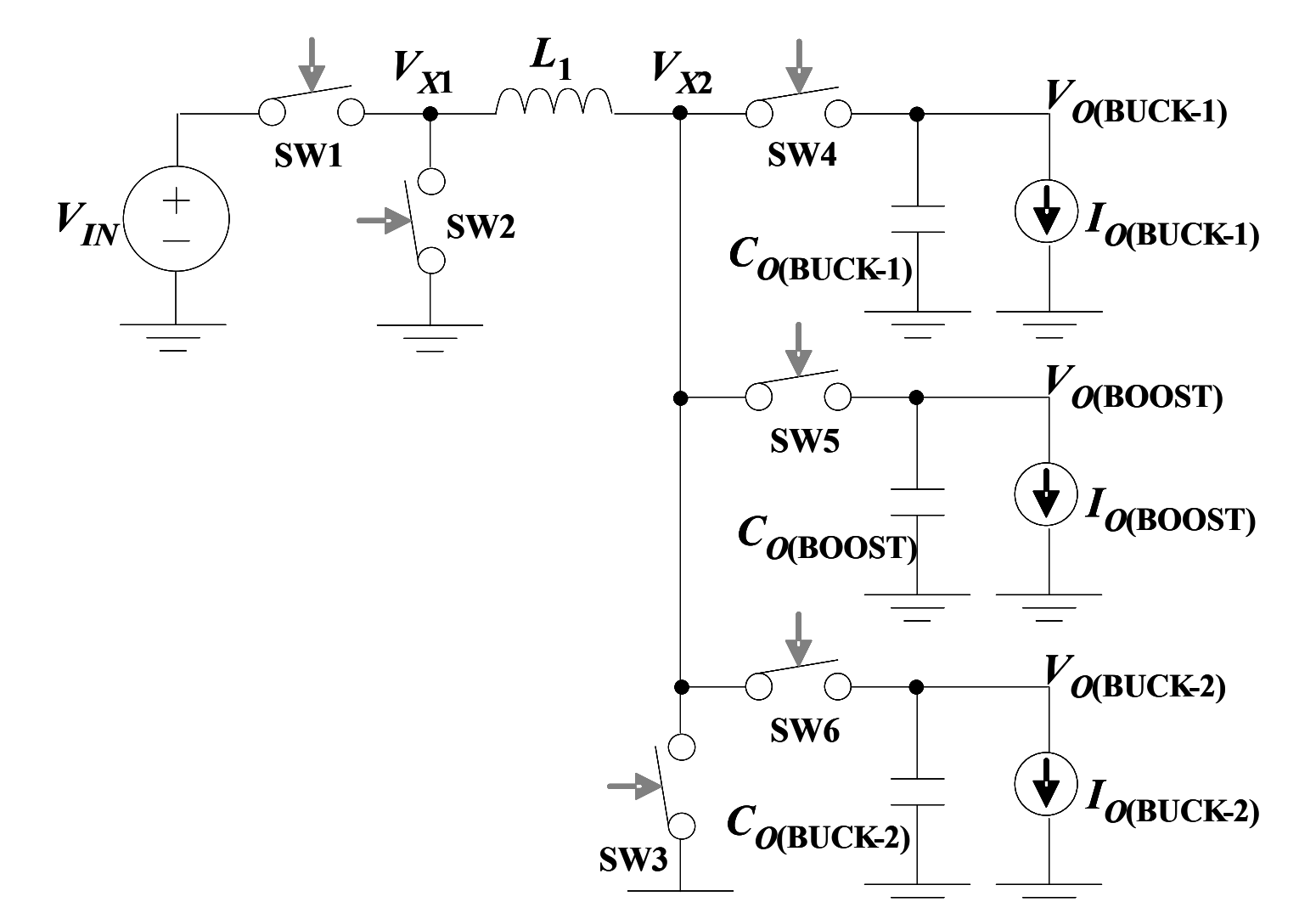
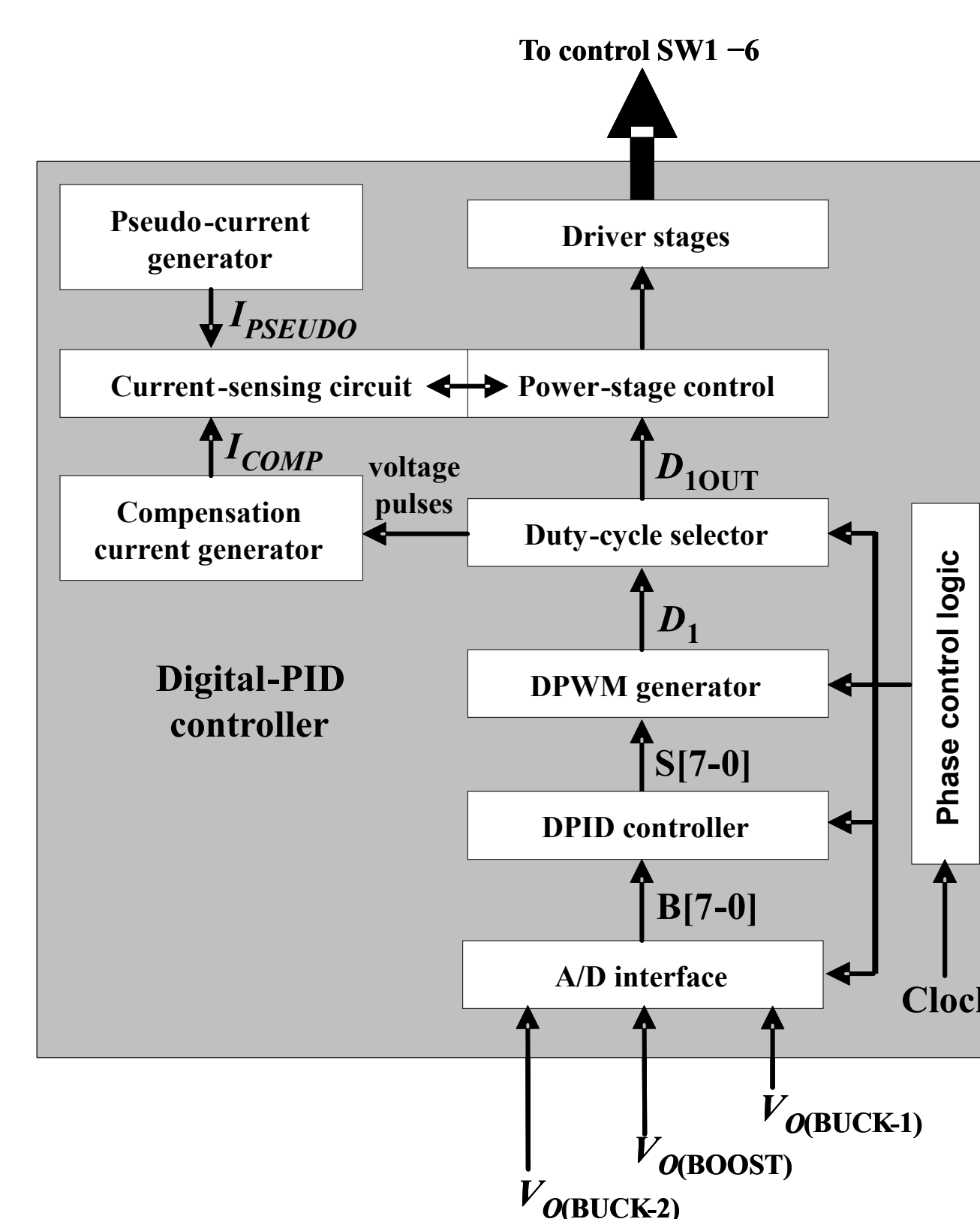
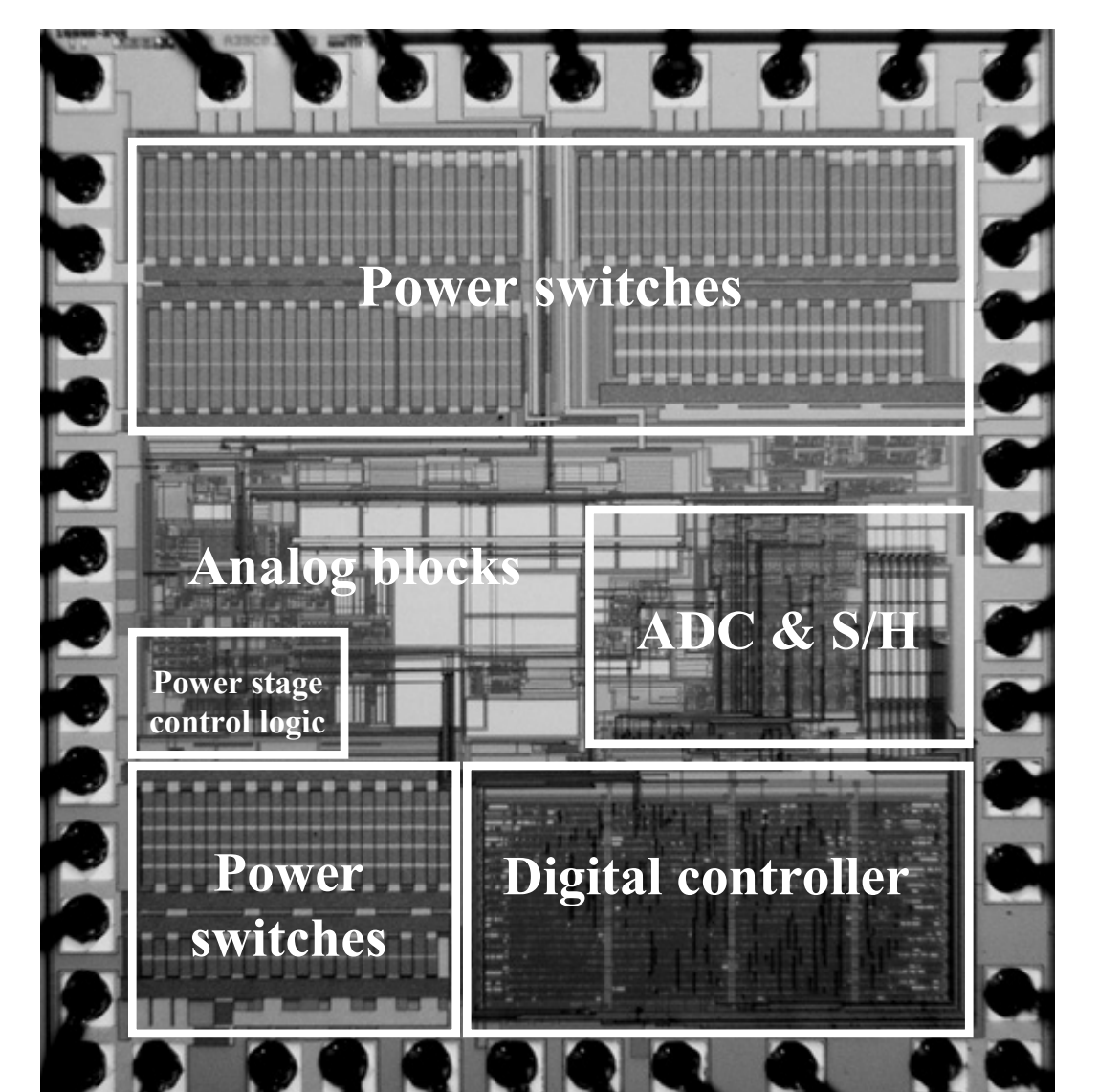
## References

- M. Ho, K. N. Leung and K. L. Mak, "A Low-Power Fast-Transient 90-nm Low-Dropout Regulator with Multiple Small-Gain Stages," *IEEE Journal of Solid-State Circuits*, Vol. 45, No. 11, pp. 2466-2475, Nov. 2010.
- J. P. Guo and K. N. Leung, "A 6-uW Chip-Area-Efficient Output-Capacitorless LDO in 90-nm CMOS Technology," *IEEE Journal of Solid-State Circuits*, Vol. 45, No. 9, pp. 1896-1905, Sept. 2010.
- J. B. Jia and K. N. Leung, "A Digital-Control Single-Inductor Triple-Output DC-DC Converter with Pre-Sub-Period Inductor-Current Control," *IEEE Transactions on Power Electronics*, Vol. 27, No. 4, pp. 2028-2042, Apr. 2012.
- T. W. Mui, M. Ho, K. H. Mak, J. P. Guo, H. Chen and K. N. Leung, "An Area-Efficient 96.5%-Peak-Efficiency Cross-Coupled Voltage Doubler With Minimum Supply of 0.8V," *IEEE Transactions on Circuits and Systems II*, accepted for publication.



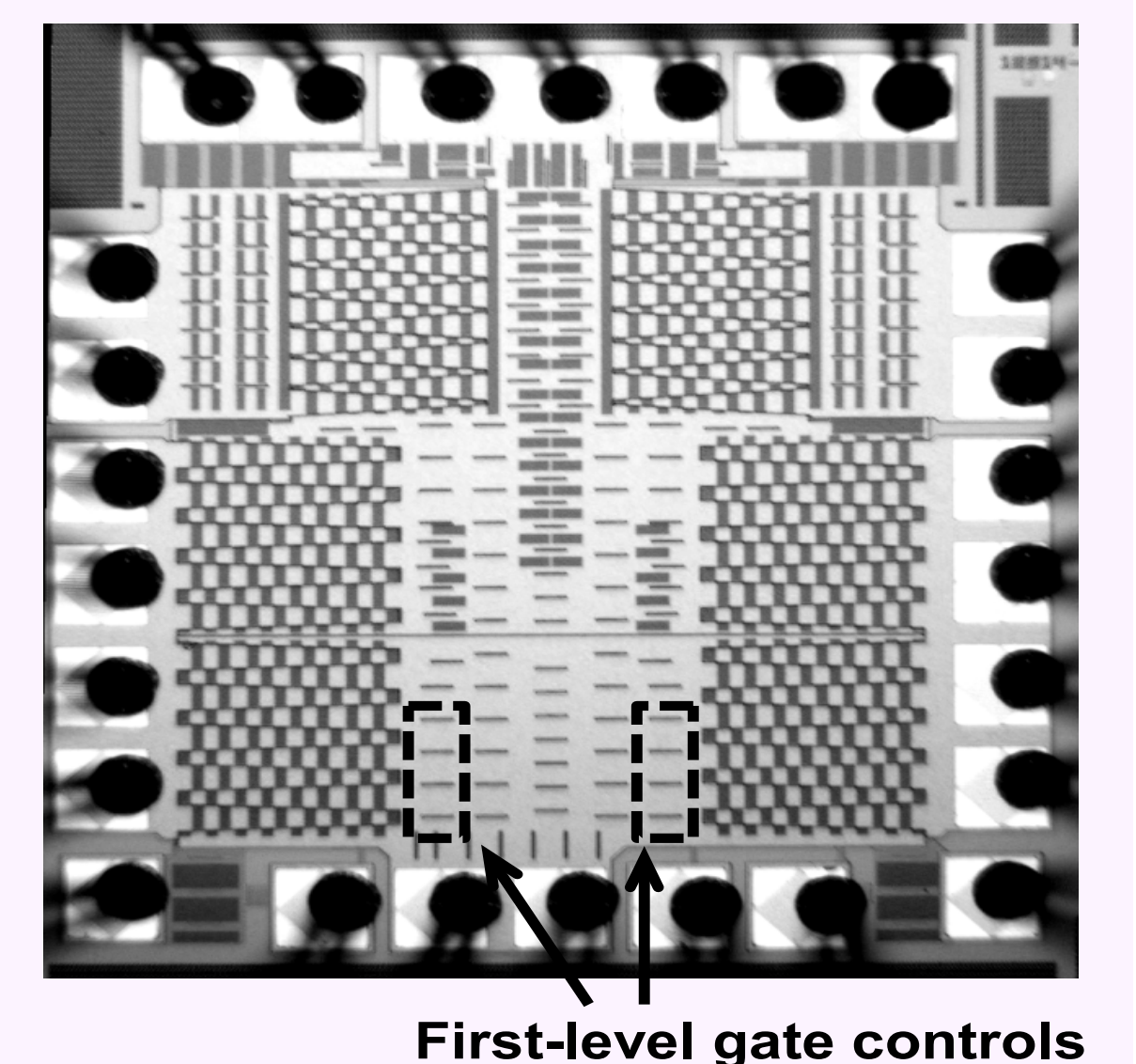
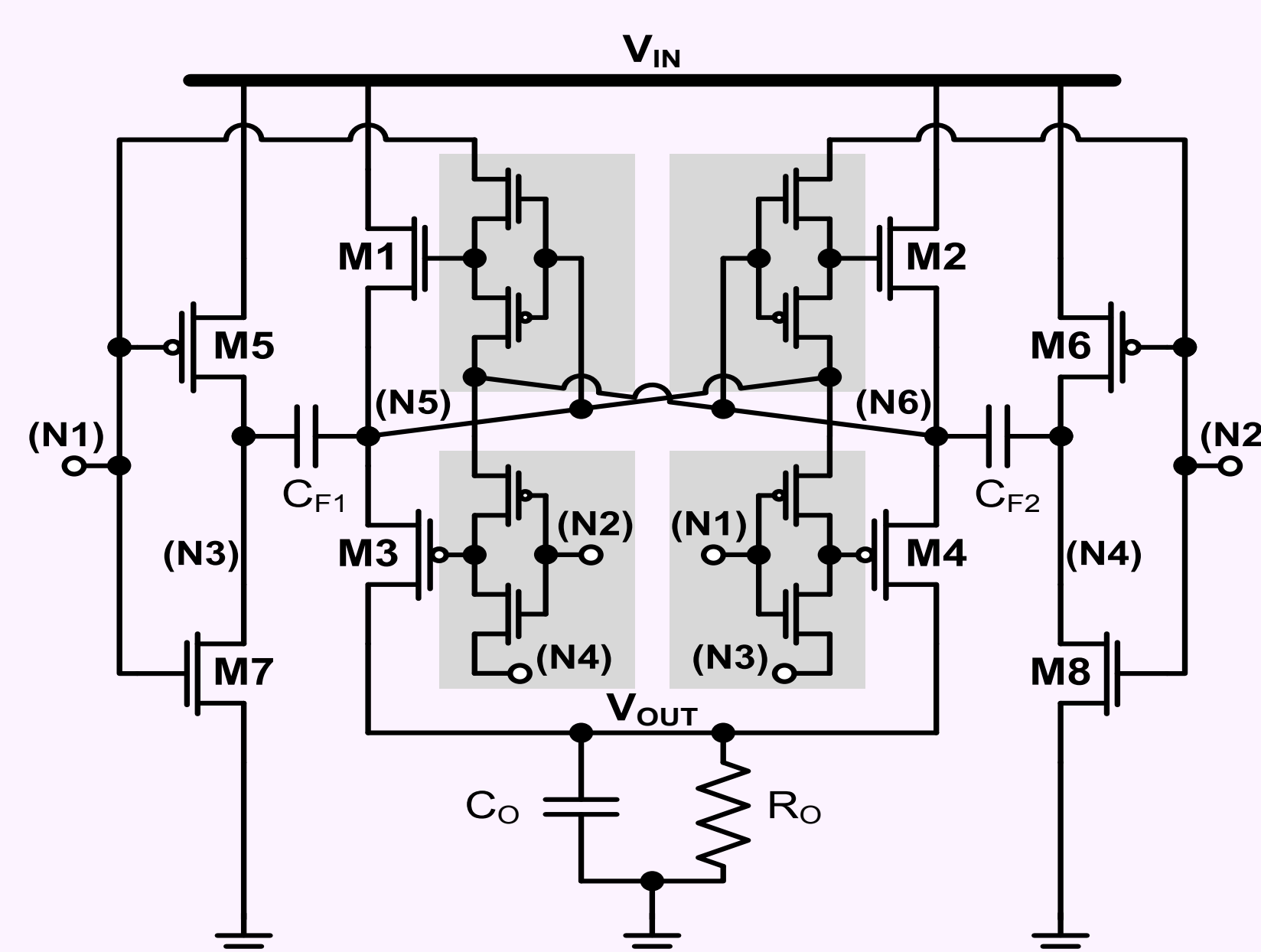
## Single-inductor multiple-output (SIMO) switched-mode DC-DC converters

- Single-inductor triple-output
- 83.5% power efficiency
- Proposed pre-sub-period inductor-current control
- Two buck subconverters and one boost subconverter configurable



## High-efficiency charge pumps

- No reversion loss using first-level gate-control
- Supports 0.8V Minimum voltage
- Higher than 90% power efficiency
- No area-consuming resistors or extra power MOSFETs and buffers required



First-level gate controls