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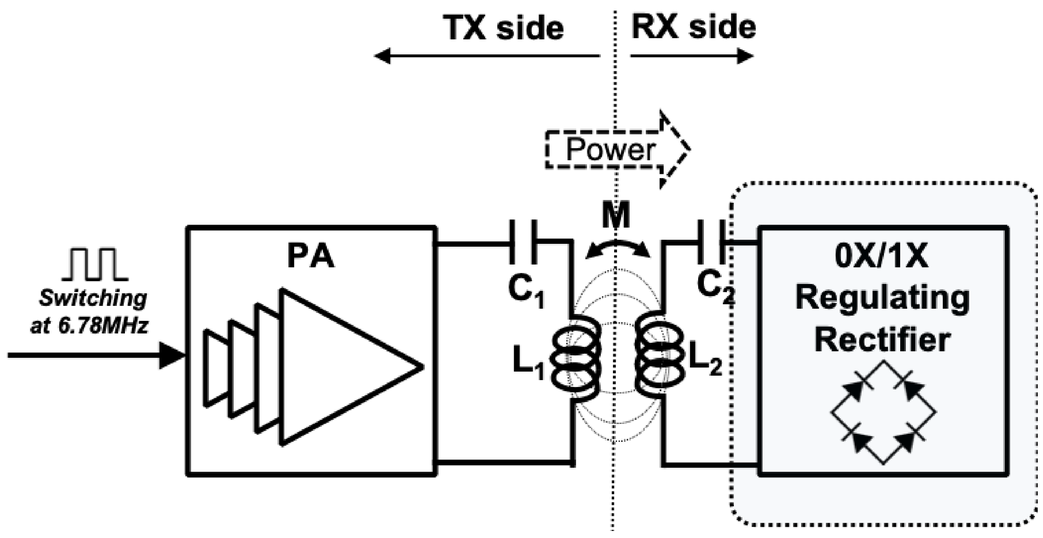
Dual-Output Regulating Rectifier with Automatic Digital Offset Compensation

Chen-Yu Wen and Po-Hung Chen

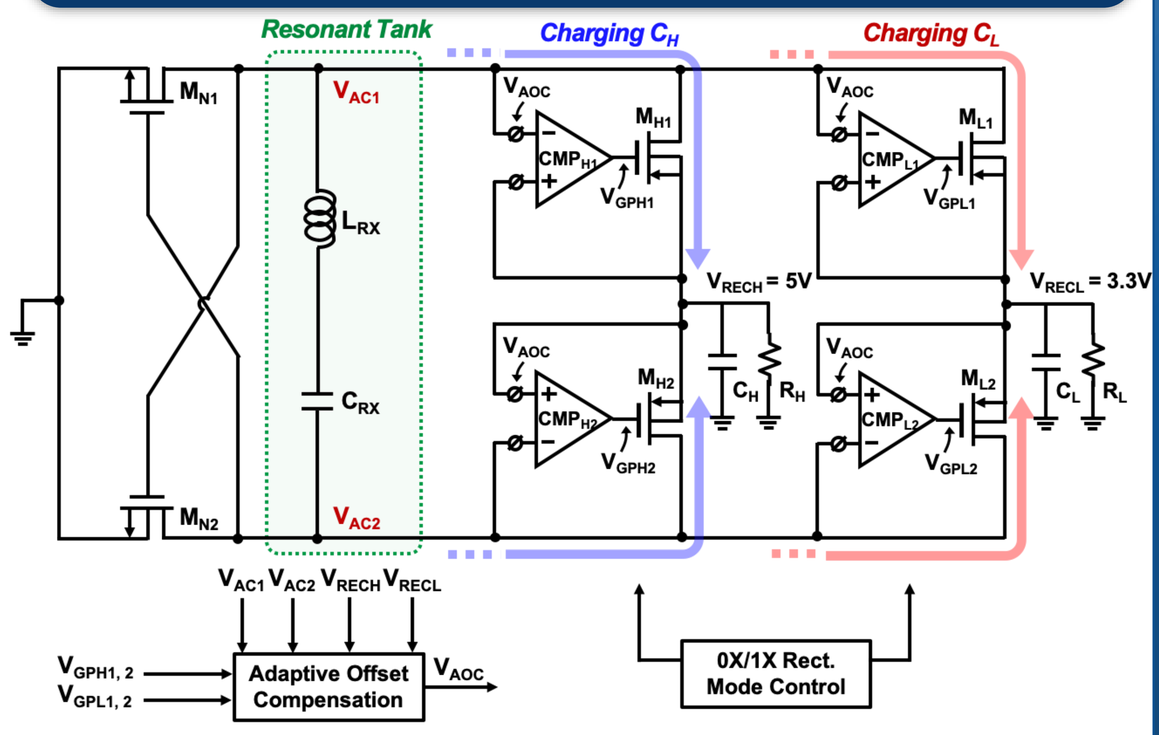
Institute of Electronics, National Yang Ming Chiao Tung University, Hsinchu, Taiwan.

Introduction

- The proposed regulating rectifier has the following characteristics
  - Dual outputs: 5V and 3.3V
    - Stimulating voltage and analog circuit power supply
  - oX/1X regulating with PSM control
    - Provide regulated voltages for sub-circuits
  - Automatic digital offset compensation(ADOC)
    - On-time compensation: deal with insufficient conduction time
    - Off-time compensation: minimize reverse current

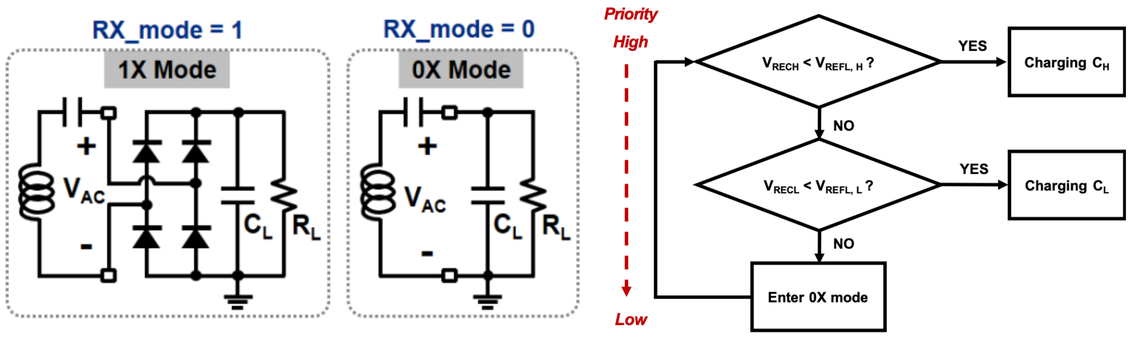


System Architecture

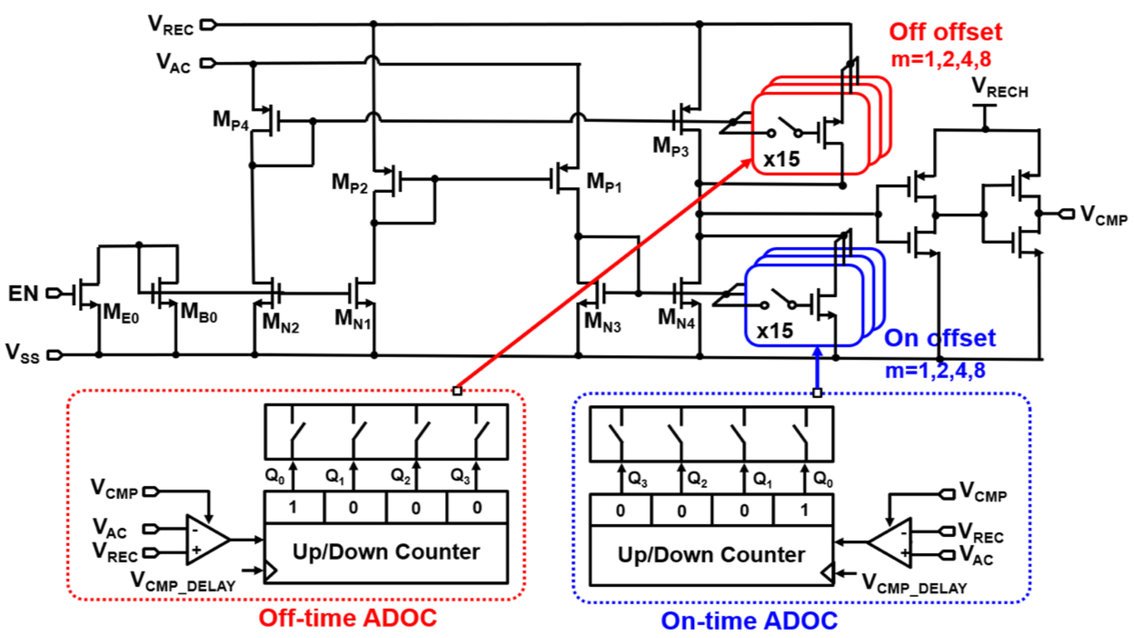


- One gate cross-coupled NMOS pair MN1 and MN2
- Two pair PMOS active diodes MH1, MH2 and ML1, ML2 with the comparator control.
- The resonant tank consists of L_{RX} and C_{RX} in series and it operates at 6.78-MHz

Characteristics



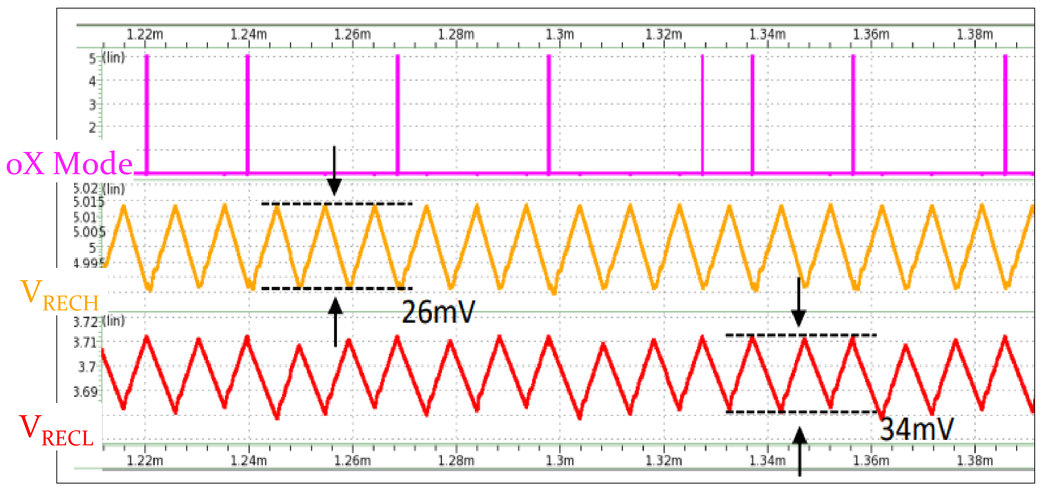
- By utilizing the PSM technique with hysteresis window, it can regulate desired output voltages.
- V_{RECH} has higher priority than V_{RECL}, if both V_{RECH} and V_{RECL} are enough, system will enter oX mode.



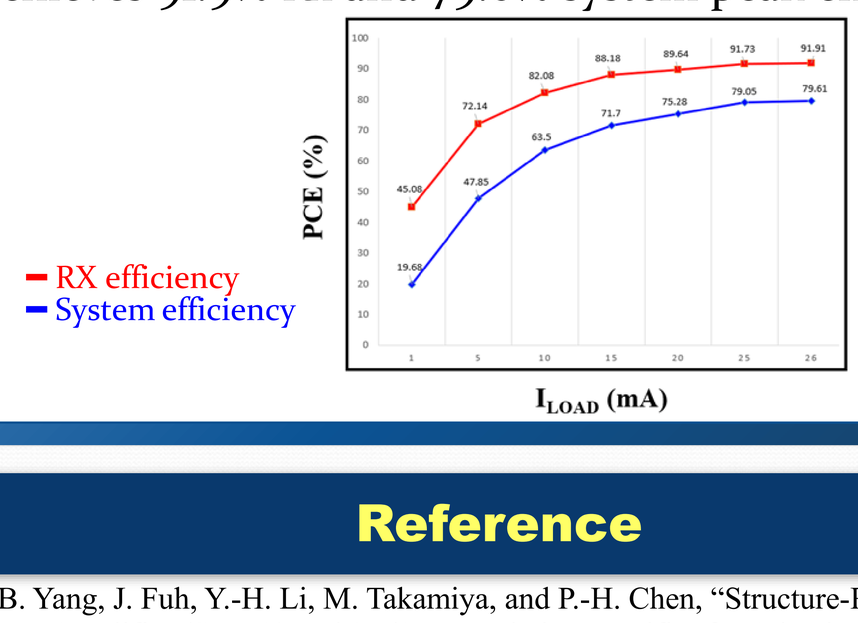
- This work realizes turn-on and turn-off offset compensation mechanism by comparing V_{REC} and V_{AC}. and controls the offset current automatically.
- The compensation reaches an appropriate value through bit-by-bit calibration.

Simulation Results

- Simulated waveform of dual-output voltages



- The proposed dual-output regulated WPT system achieves 91.9% Rx and 79.6% system peak efficiency.



Reference

1. F.-B. Yang, J. Fuh, Y.-H. Li, M. Takamiya, and P.-H. Chen, "Structure-Reconfigurable Power Amplifier (SR-PA) and 0X/1X Regulating Rectifier for Adaptive Power Control in Wireless Power Transfer System," *IEEE J. Solid-State Circuits*, vol. 56, no. 7, pp. 2054–2064, Jul. 2021.
2. F.-B. Yang, J. Fuh, and P.-H. Chen, "A 13.56MHz wireless power transfer system with dual-output regulated active rectifier for implantable medical devices," in *Proc. IEEE 61st Int. Midwest Symp. Circuits Syst. (MWSCAS)*, Aug. 2018, pp. 440–443.

Acknowledgement

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