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6.78-MHz Wireless Power Transfer System with Structure-Reconfigurable Power Amplifier and 0X/1X Regulating Rectifier

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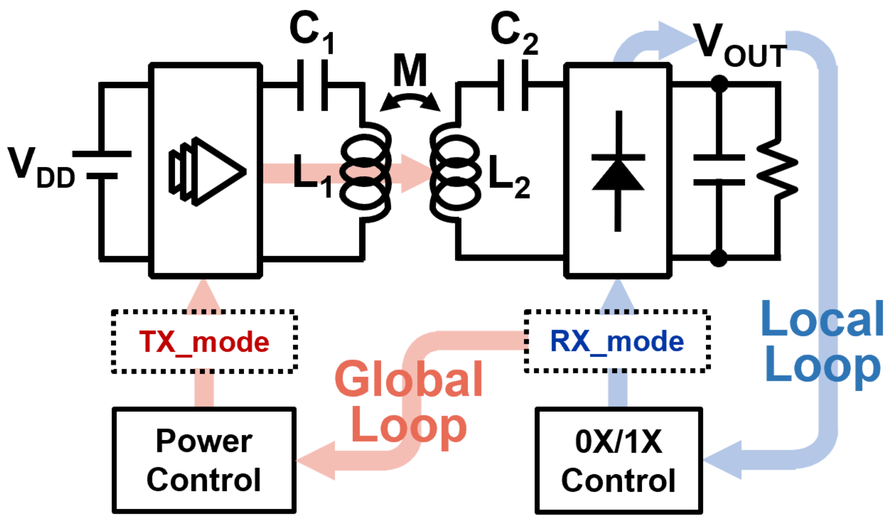
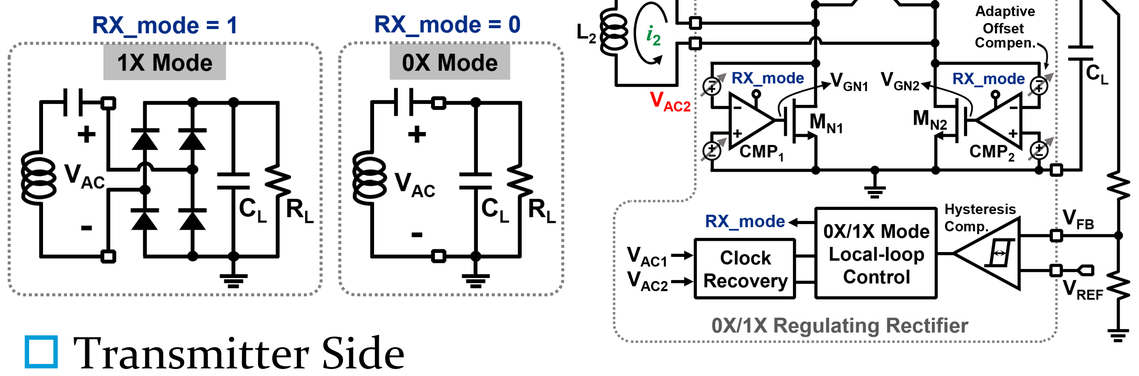
Introduction

- The proposed regulating rectifier performs
  - Local-loop Control by oX/1X Mode Switching
    - Realize voltage rectification and regulation.
    - Avoid encountering the overvoltage issue.
  - Global-loop Control by Structure-Reconfigurable PA
    - Extend output power.
    - Maintain high system efficiency under a wide load range.

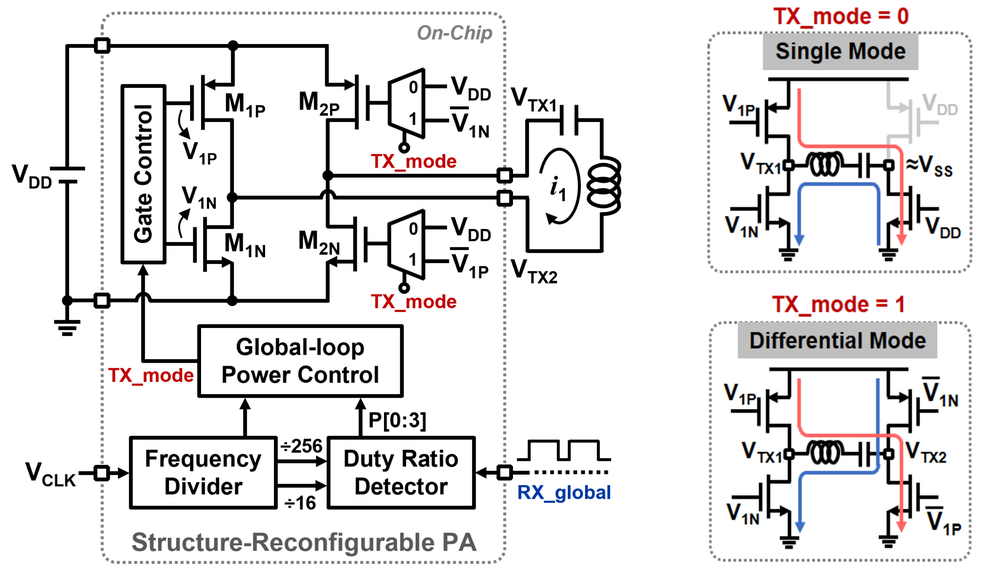


System Architecture

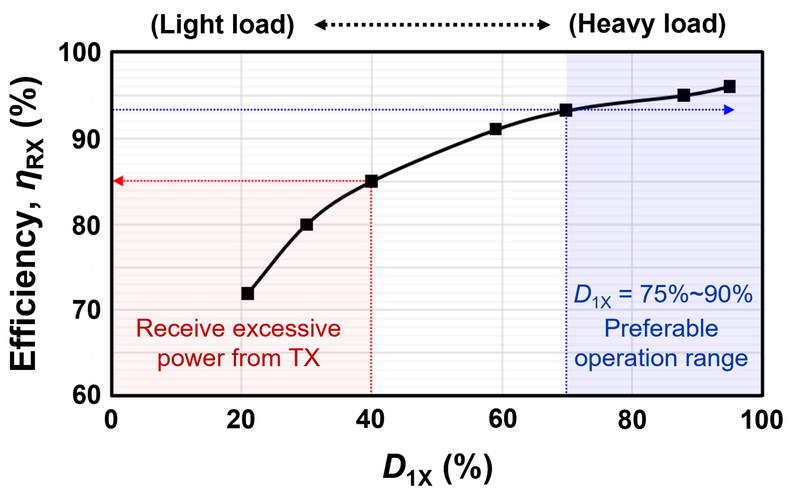
- Receiver Side



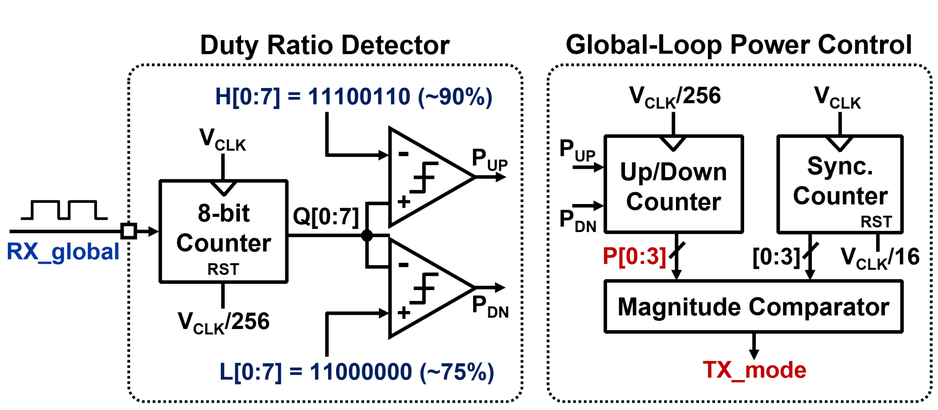
- Transmitter Side



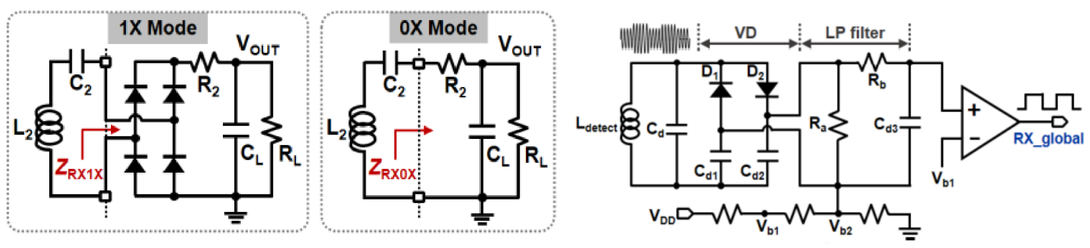
Characteristics



- D_{1X} implies η_{RX}. Transmitter can perceive the load condition and further adjust the transmission power by utilizing duty ratio detector.



- An in-band wireless data link is necessary to feedback the receiver information to the transmitter for global-loop power control.



Measurement Results

- The proposed WPT system has maximum receiver efficiency of 92.9%, and the maximum system efficiency of 71.5% at a 400-mW output power.
- Comparison to recently reported works

	[26] JSSC'15	[27] TBCAS'15	[28] JSSC'15	[29] JSSC'17	[30] ISSCC'17	[31] TVLSI'18	**This work**
Technology	CMOS 0.35 μm	CMOS 0.35 μm	CMOS 0.35 μm	CMOS 0.35 μm	CMOS 0.35 μm	CMOS 0.18 μm	**CMOS 0.25 μm**
Resonant Frequency	13.56 MHz	13.56 MHz	2 MHz	6.78 MHz	1 MHz	125kHz –250kHz	**6.78 MHz**
Receiver Structure	R^3 Rectifier	R^3 Rectifier	Rectifier + LDO	3-Mode Rectifier	VM/CM Rectifier	On/Off Rectifier	**0X/1X Rectifier**
Regulation Site	Receiver & Transmitter	Receiver & Transmitter	Receiver	Receiver	Receiver	Receiver	**Receiver & Transmitter**
Transmission Power Control	ΣΔ Modulator	Buck Converter	N/A	N/A	N/A	N/A	**Structure Reconfiguration**
Data Link	In-band Wireless	In-band Wireless	N/A	N/A	N/A	N/A	**In-band Wireless**
V_{OUT}	3.6 V	3.7 V	3 V	5 V	3.2V	1.8–2.2V	**5 V**
Max. P_{OUT}	102 mW	234 mW	1.45 W	6 W	32mW	80mW	**400 mW**
Peak Receiver Efficiency	92.6%	92.5%	76% (Rectifier)	92.2%	77%	93.48%	**92.9%**
Peak System Efficiency	50%	62.4%	N/A	N/A	N/A	10.47%	**71.5%**

Reference

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.

Acknowledgement

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