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An Efficient RF-DC Rectifier Design for RF Energy Harvesting Systems

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OVERVIEW

The advantage of the RF energy harvesting system is that it overcomes the limitation of space and time. At present, one main development direction of the RF energy harvesting system is to further increase its efficiency. In addition, for various reasons, the efficiency of the rectifier circuit is the lowest. This study will mainly focus on maximizing the overall rectifier module efficiency, including the rectifier circuit and the impedance matching network. The design has a maximum RF-DC conversion efficiency of 78.7%. To use different simulation methods, multiple software assistance such as MATLAB, Keysight Advanced Design System and LTSpice were used during the design process.

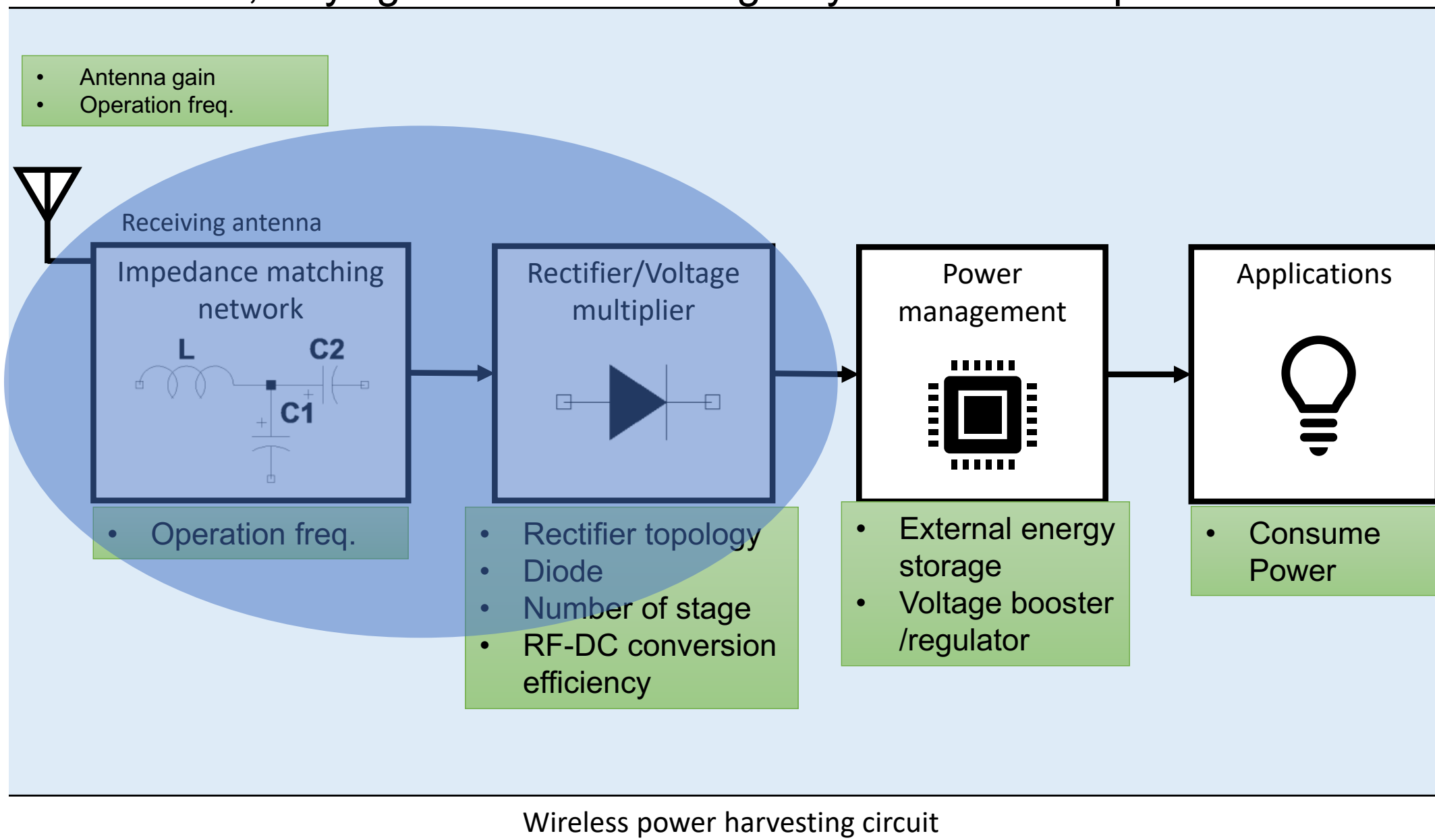


Figure 1: Block diagram for a typical RF energy harvesting system, shadowed the focus part of this study, reconstructed from [1]

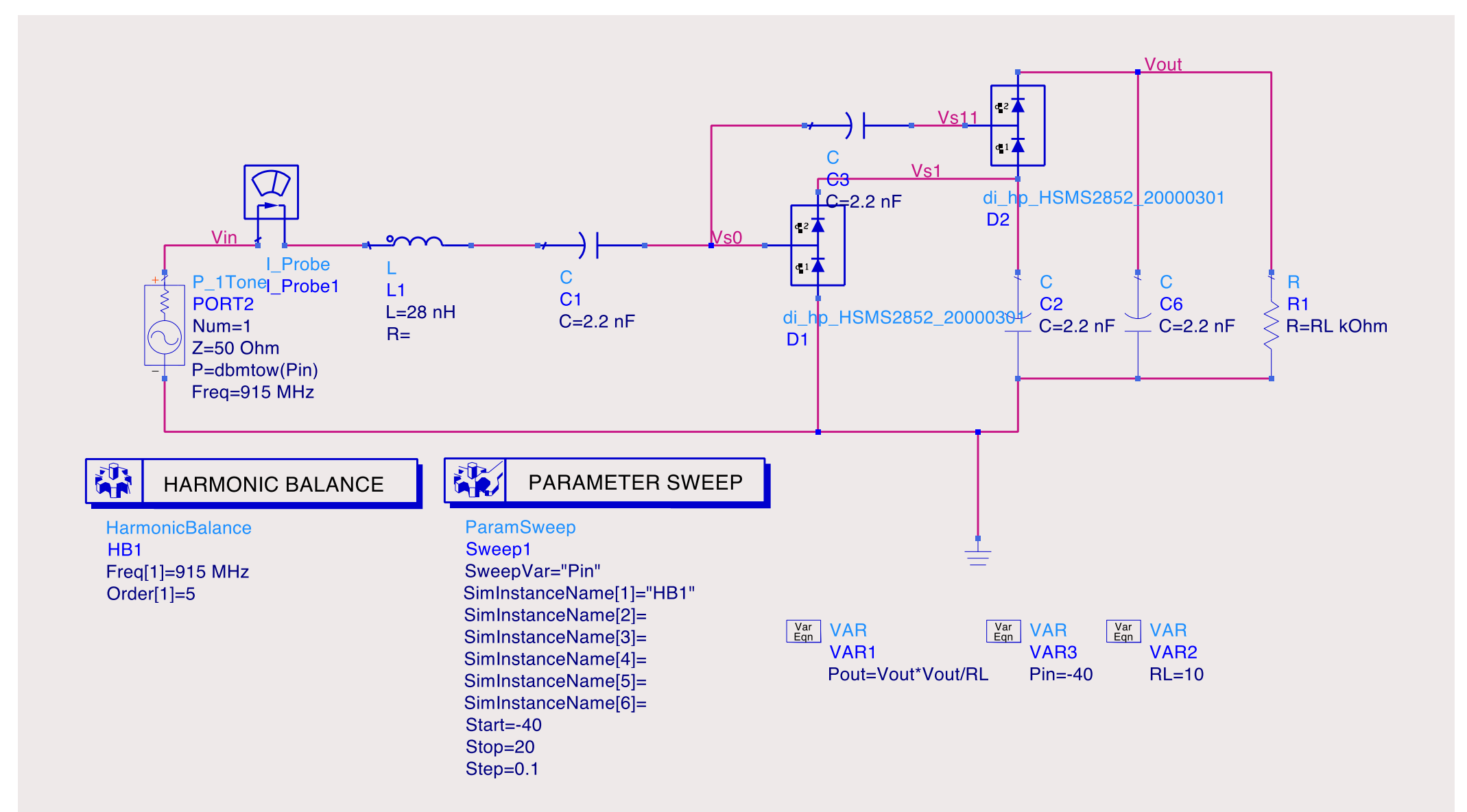


Figure 2: Final design schematic & simulation parameter in Advanced Design System software

METHODS & SIMULATION RESULTS

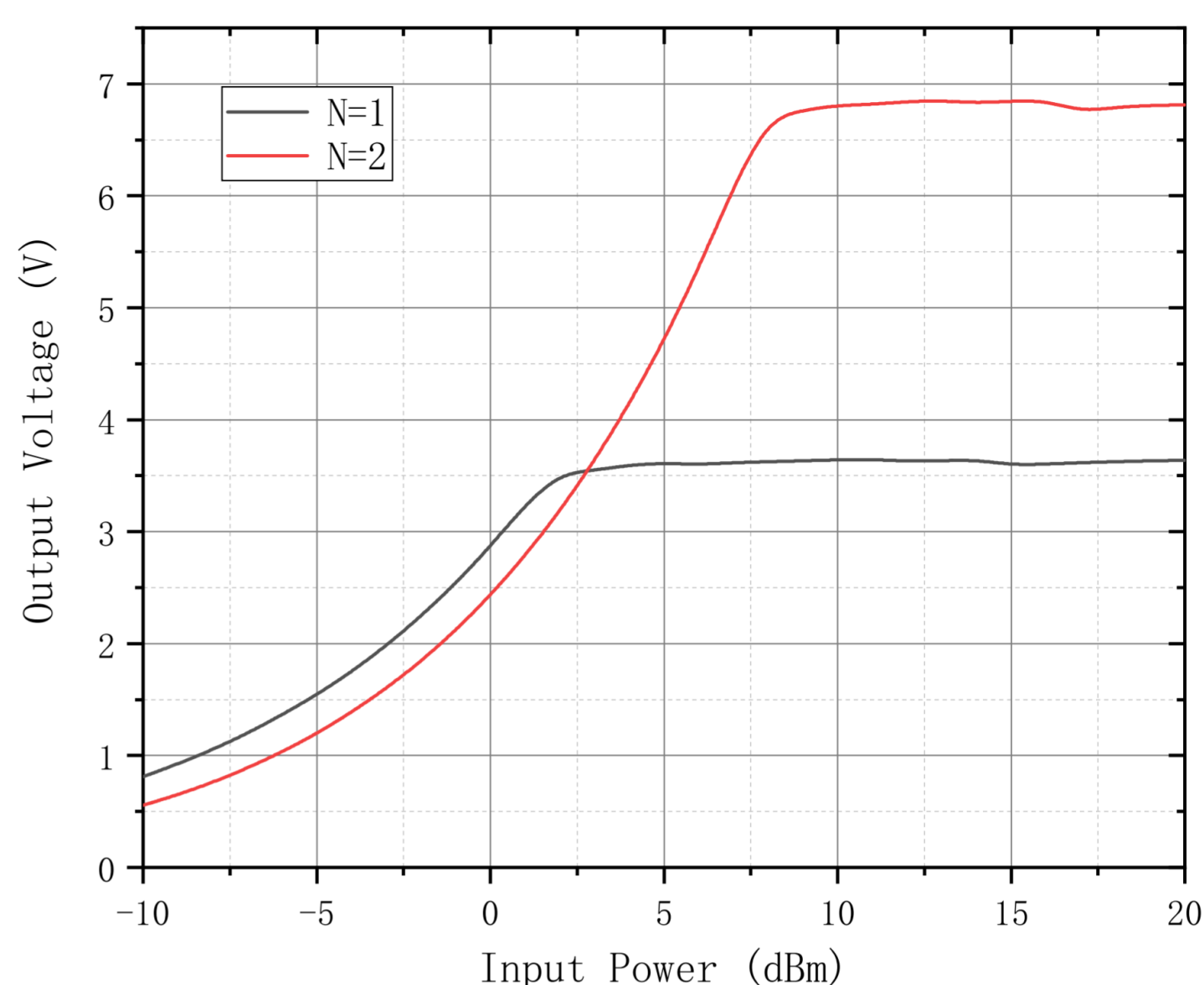


Figure 3: Output voltage simulation using transient analysis method

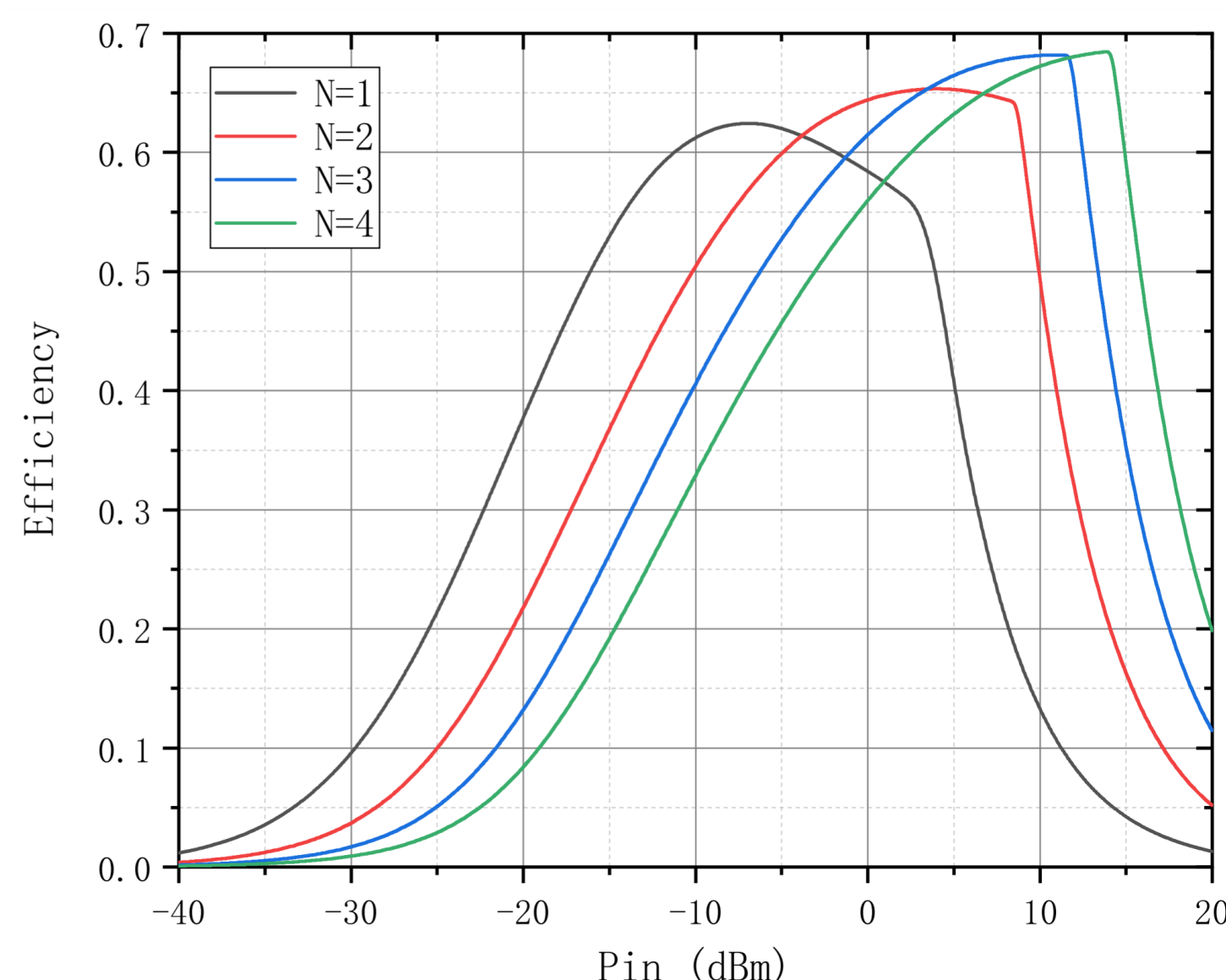


Figure 4: Efficiency simulation using harmonic balance method

This research follow these design steps:

1. Investigate the topological structures and choose those which are suitable for our research.
2. Determine the specific model of the rectifier diode.
3. Design the impedance matching network, combine it with the previously designed rectifier, and simulate to get their performance.
4. If there are multiple design solutions, repeat step 2 and 3 to select the best performance among them.

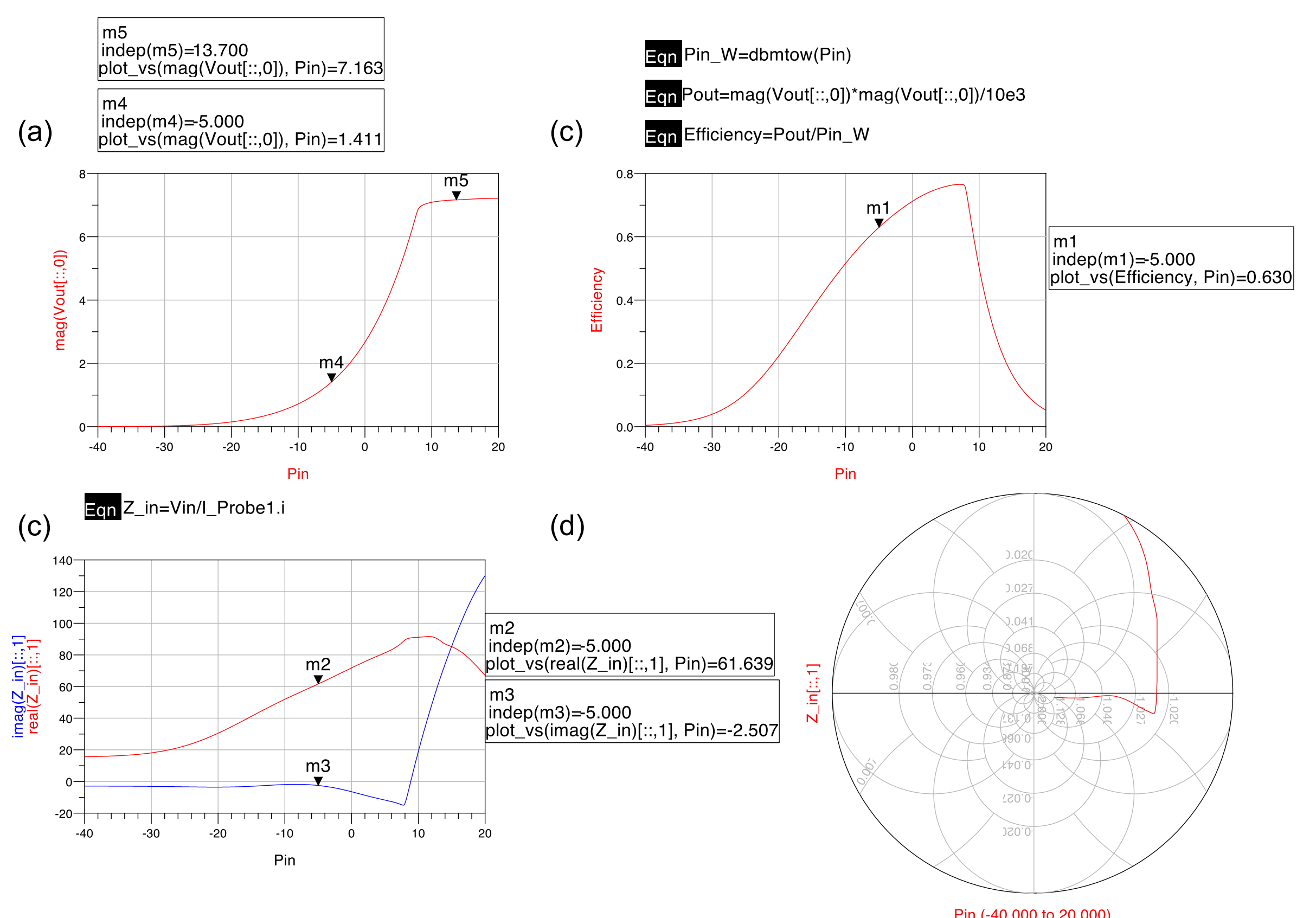


Figure 5: Simulation results for final design; (a) output voltage, up to 7.2 V; (b) efficiency, no less than 63% in typical operation range and up to 78.7%; (c, d) impedance measurement, no significant impedance mismatch in typical operation range.

REFERENCES

- [1]: L.-G. Tran, H.-K. Cha, and W.-T. Park, "RF power harvesting: a review on designing methodologies and applications," Micro and Nano Systems Letters, vol. 5, no. 1, feb 2017

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