
# RF to DC Rectifier

## Project Proposal

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10/6/15

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# Agenda

- Past Project
- Problem Background
- Constraints
- Design Approach
- Subsystem Block Diagram
- Nonfunctional Requirements
- Functional Requirements
- Economic Analysis
- Scheduling
- Societal and Environmental Impacts
- Conclusion

# Problem Background (Bradley)

- Project from 2014
- Sergio Sanchez, Tyler Hoge, & Elie Baliss
- Dr. Prasad Shastry
- Wireless Power Transfer System
- Commercial Parts
- 915MHz frequency
- 2 Meters between antennas

# Bradley Cont.

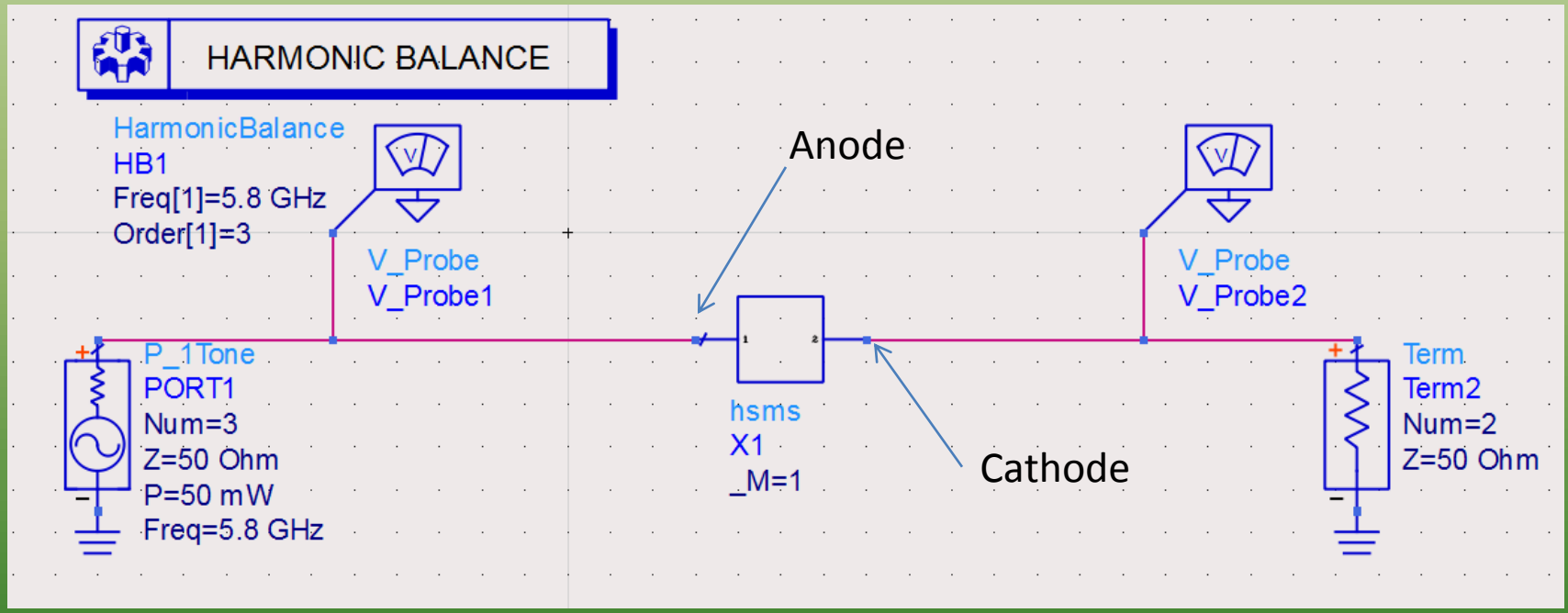
- Second system design of rectenna
- Functioned at 5.8 GHz
- 1 Watt power transferred
- Was not completed
- Closely related

# Constraints

- Must output DC
- Must connect to an antenna at its input terminal
- Must operate in frequency range between 5.725GHz and 5.875GHz

# Design Approach

- HSMS -2860 Schottky Detector Diode



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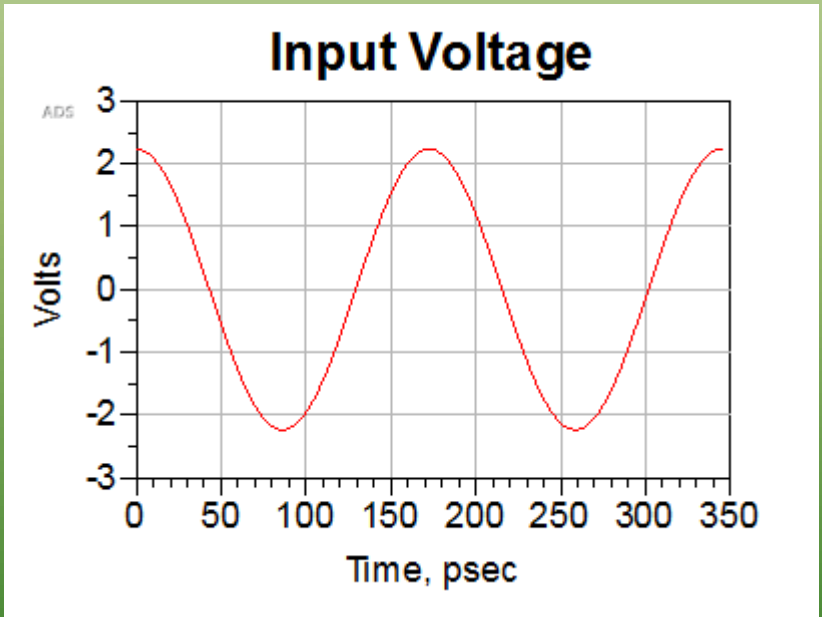


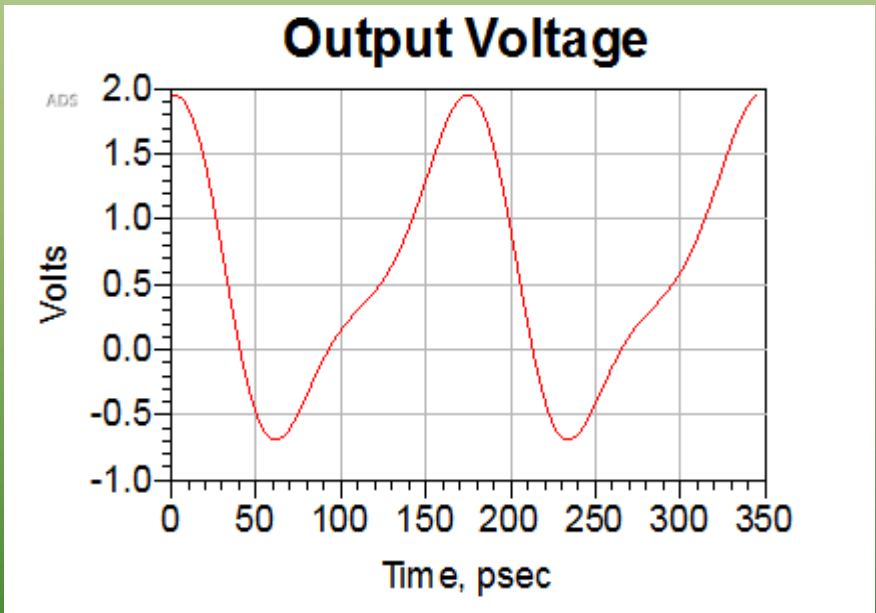

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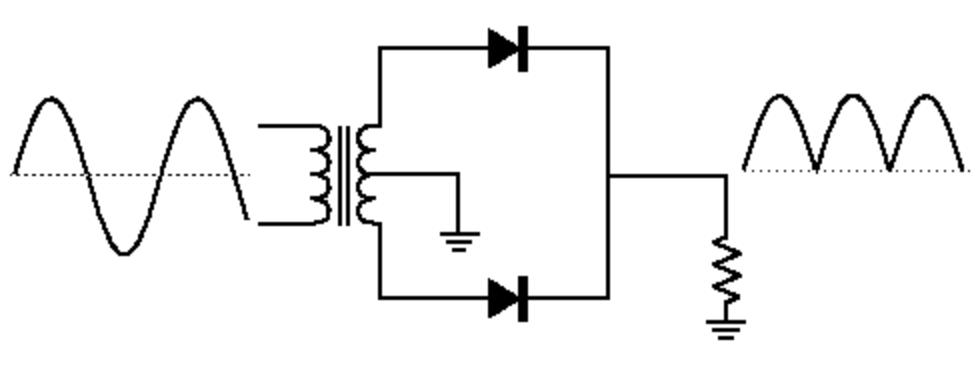
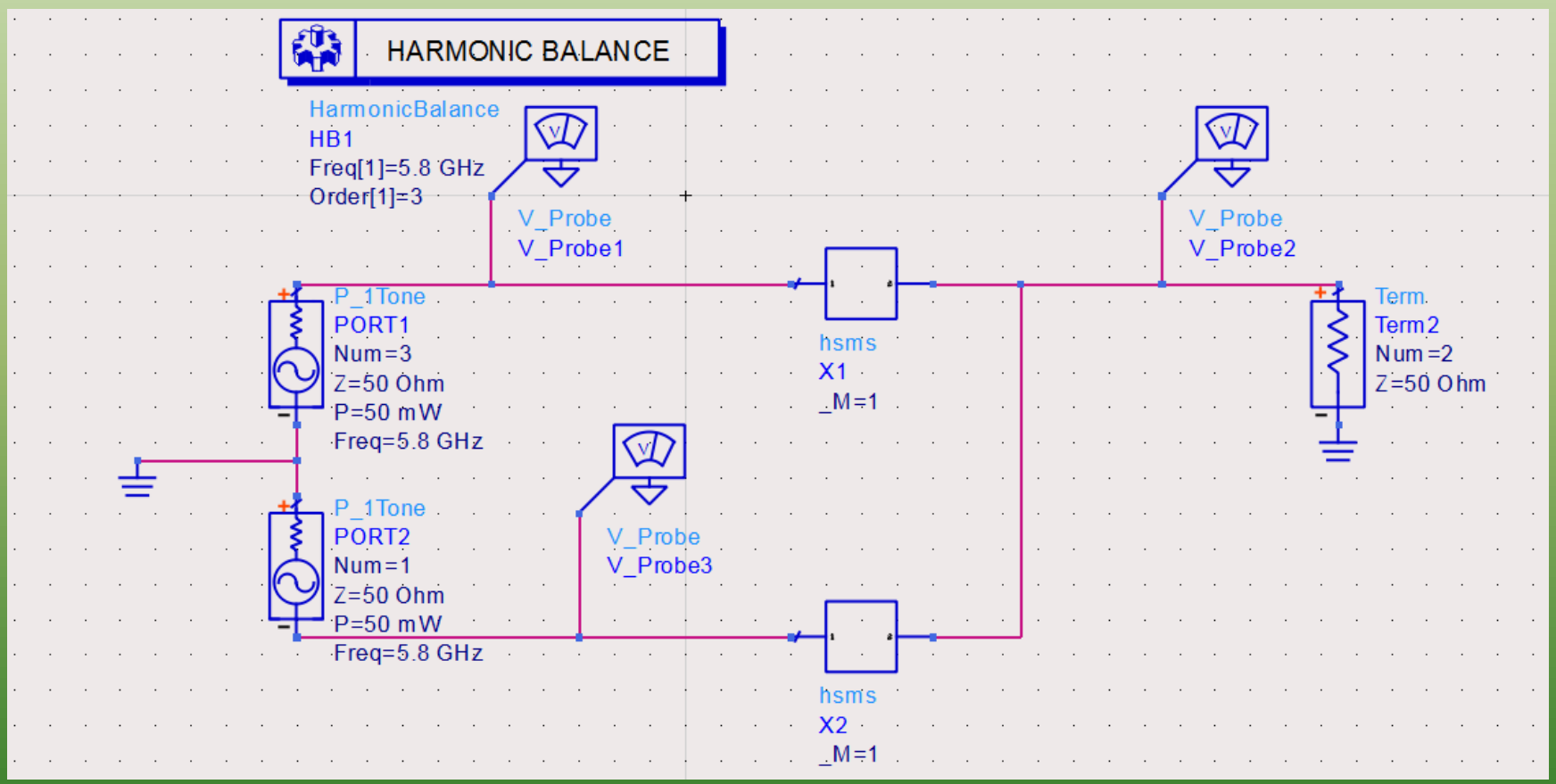


**Two Diode Full Wave Rectifier**

# Design Approach



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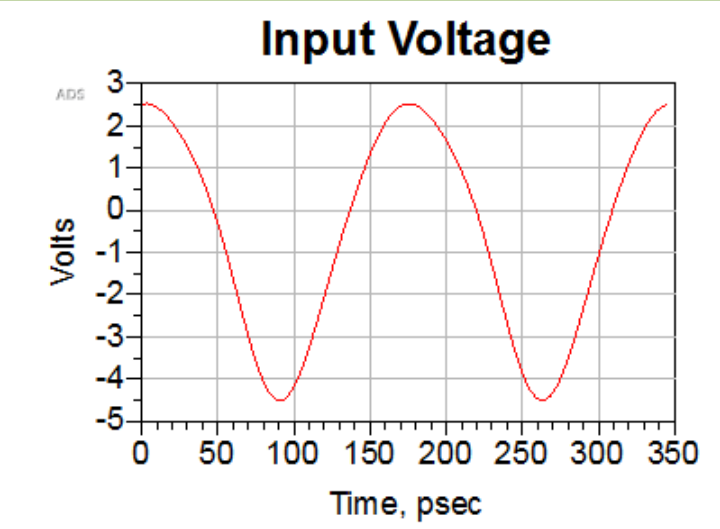


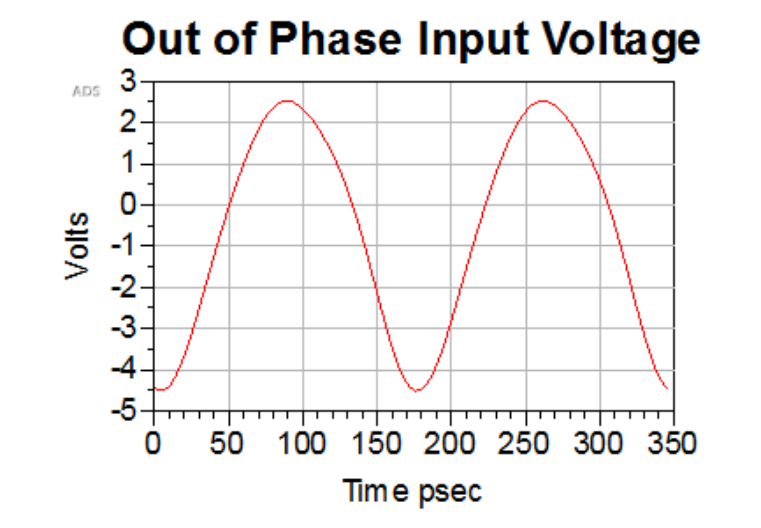


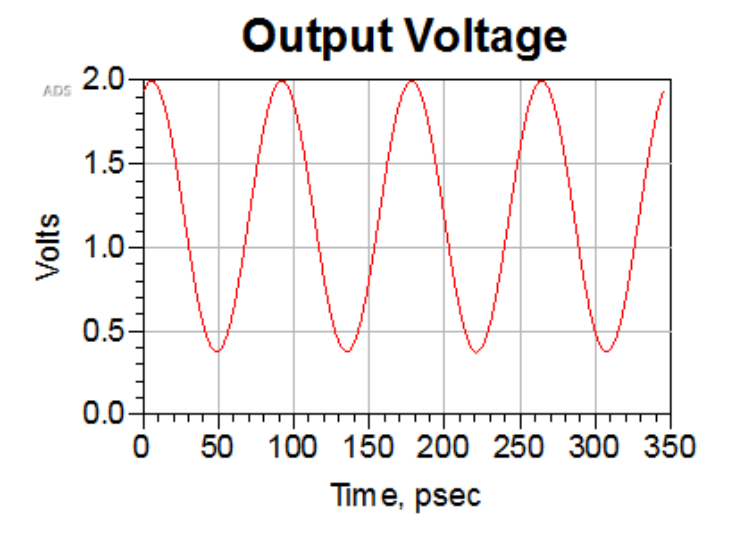

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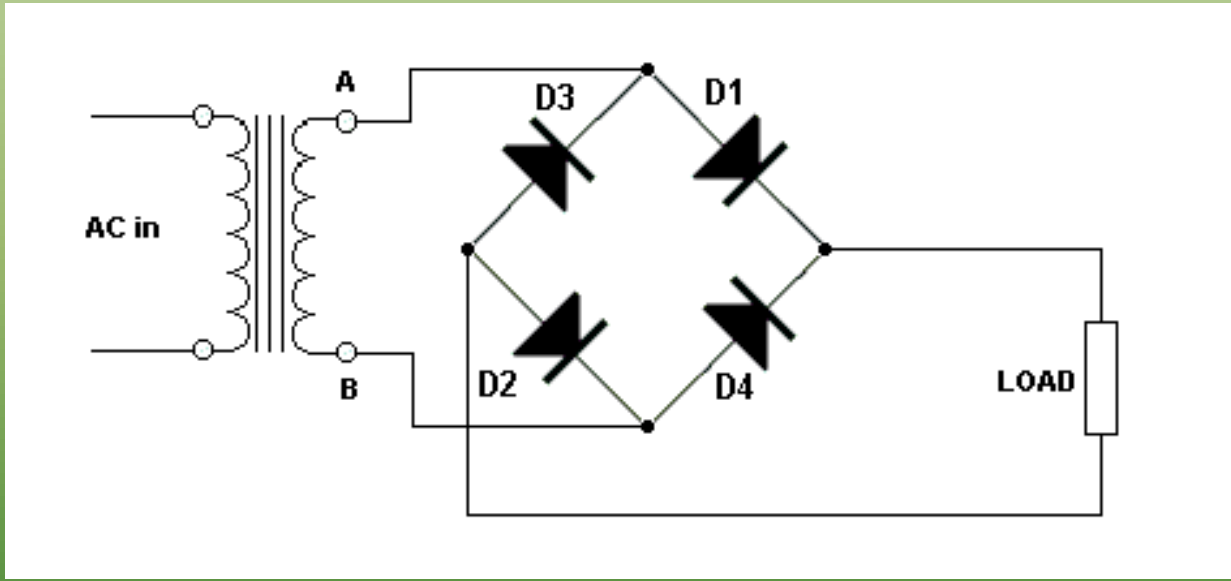
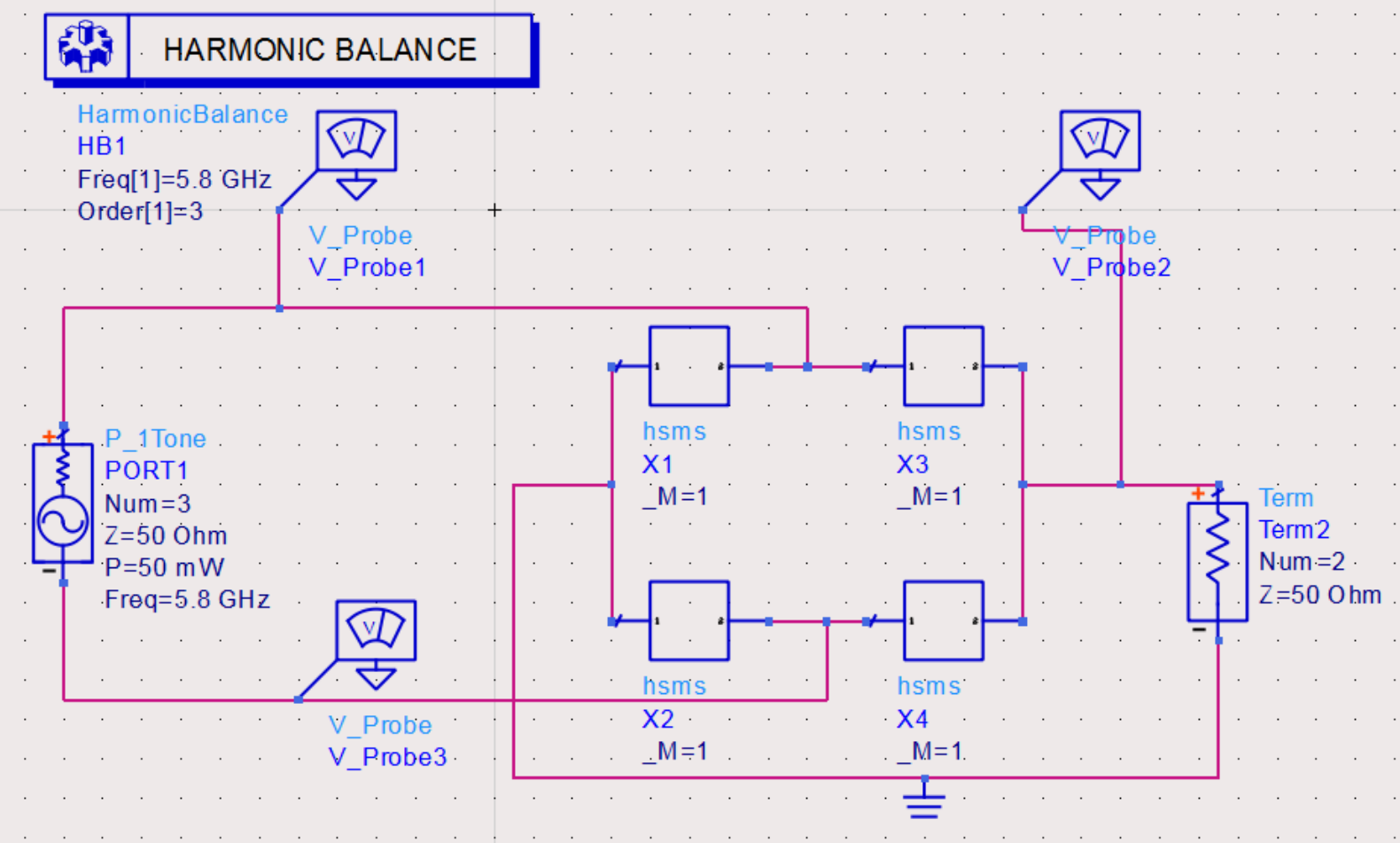



**Diode Bridge Circuit**

# Design Approach



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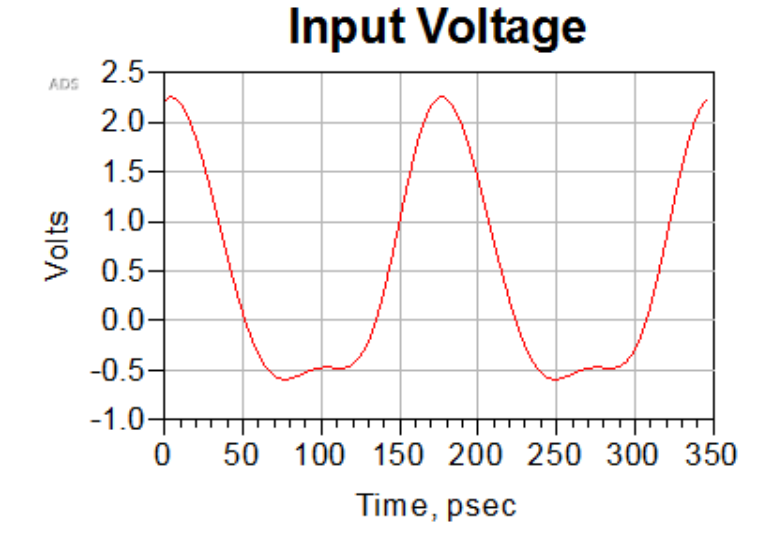


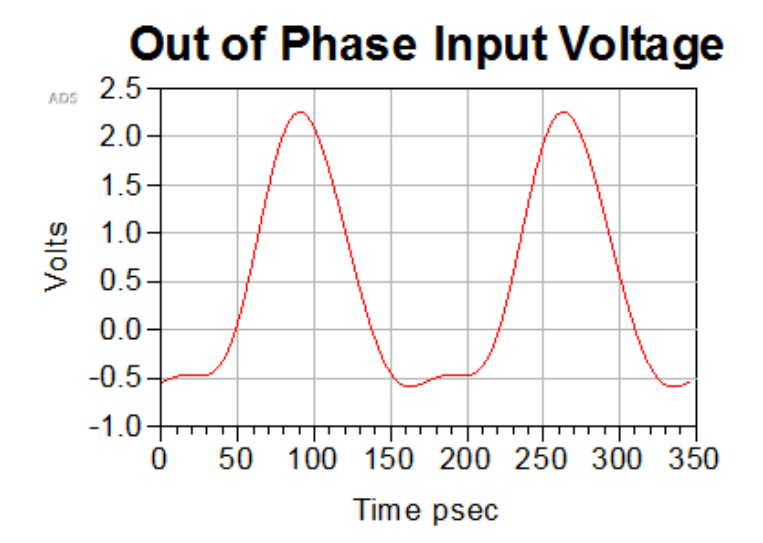


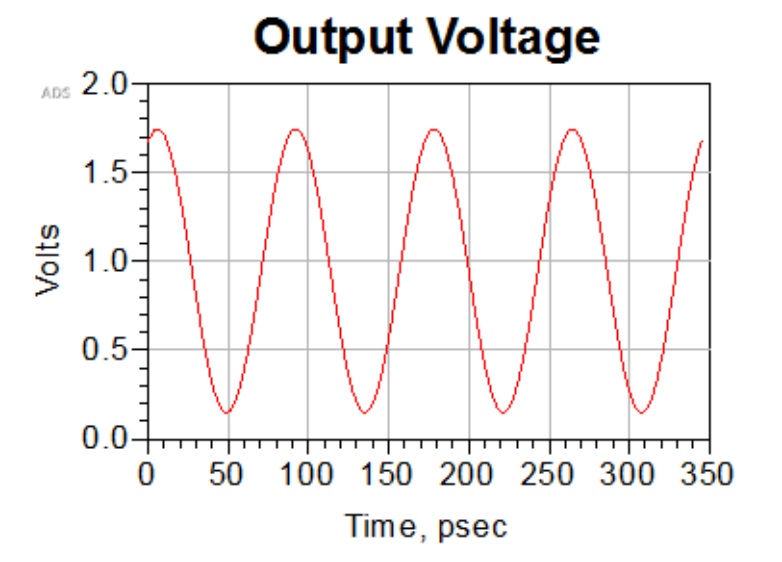

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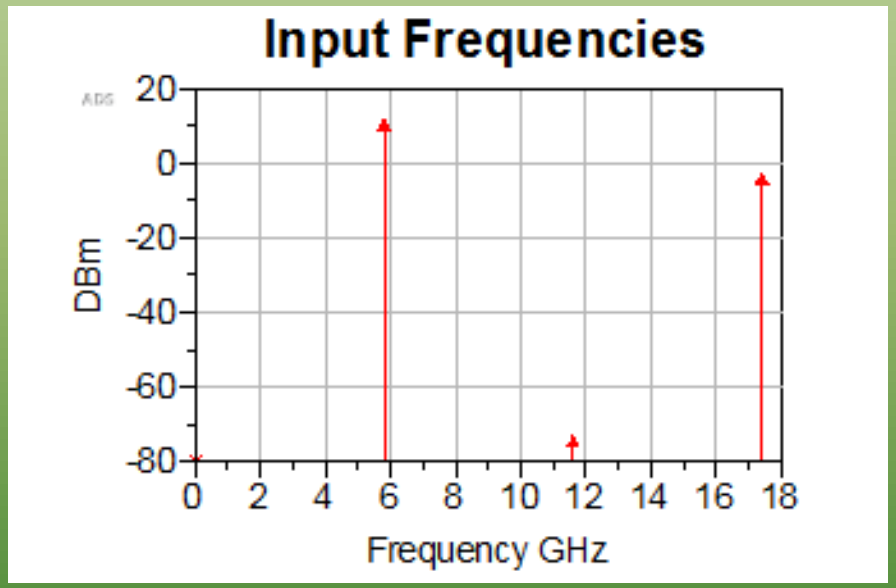


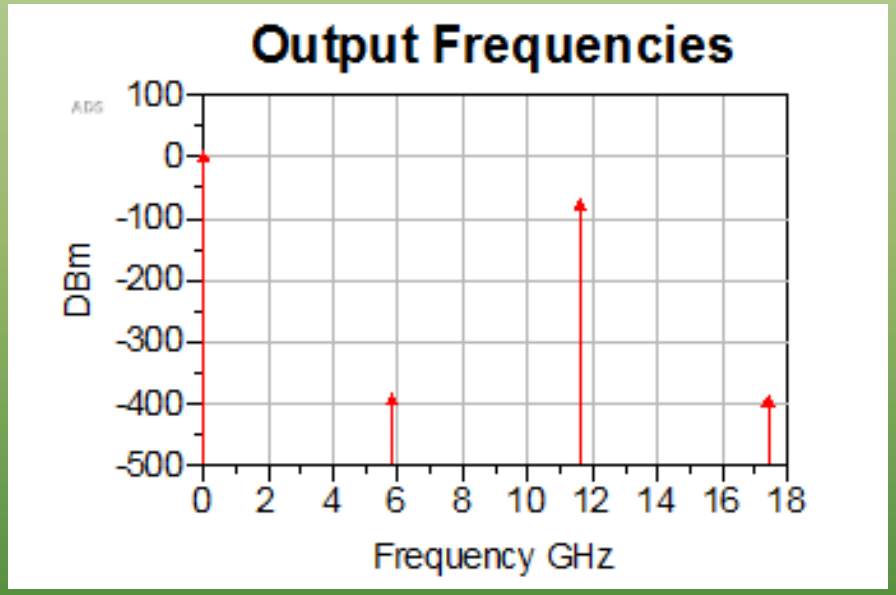

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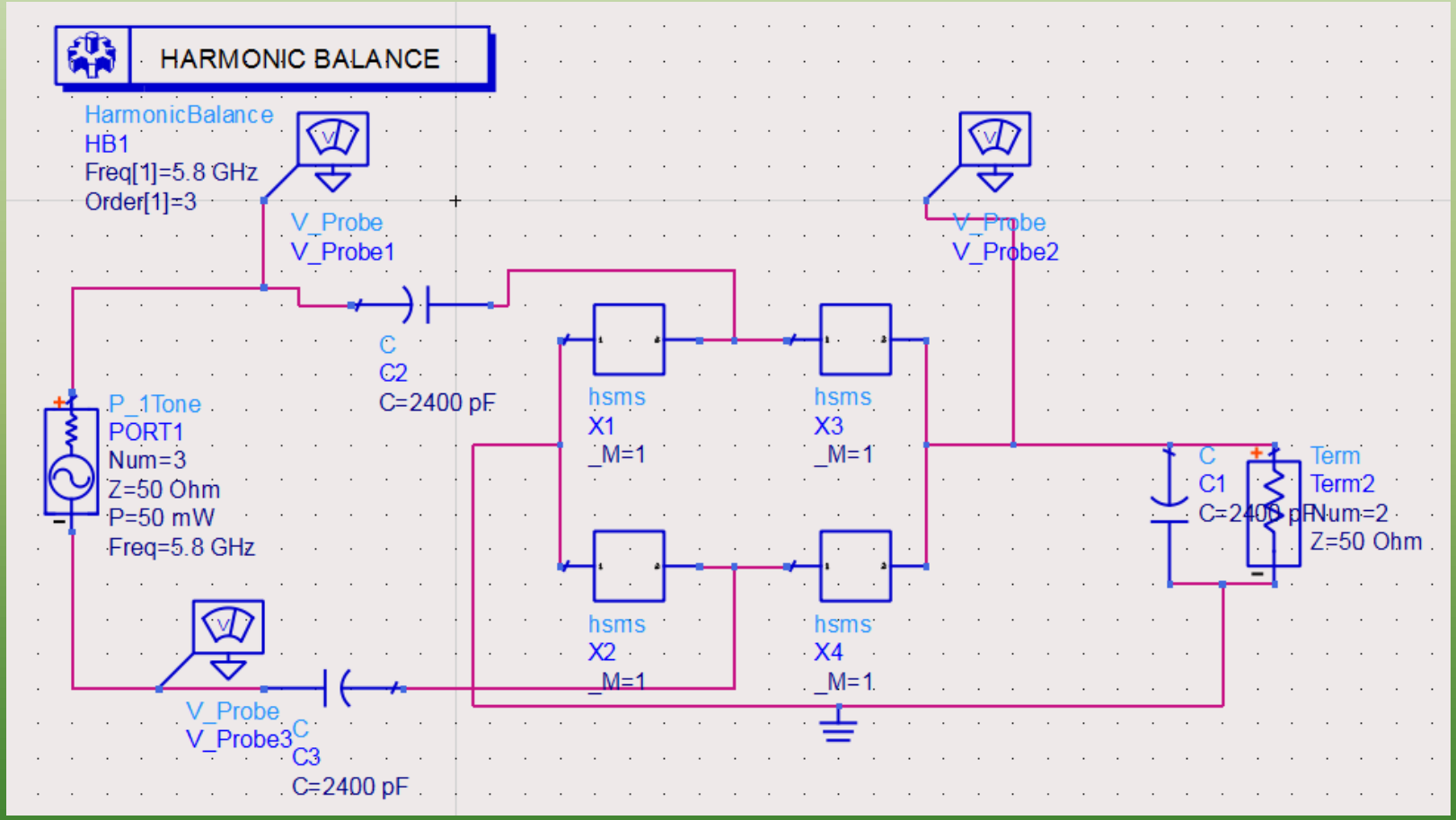

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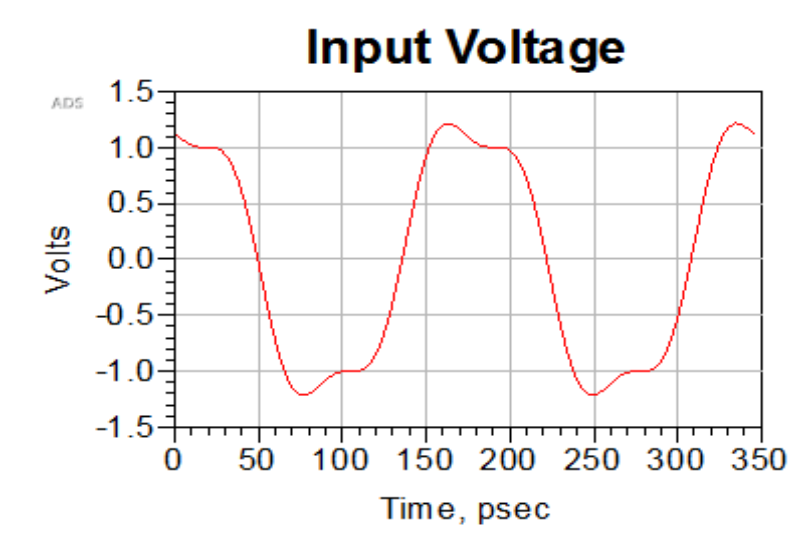


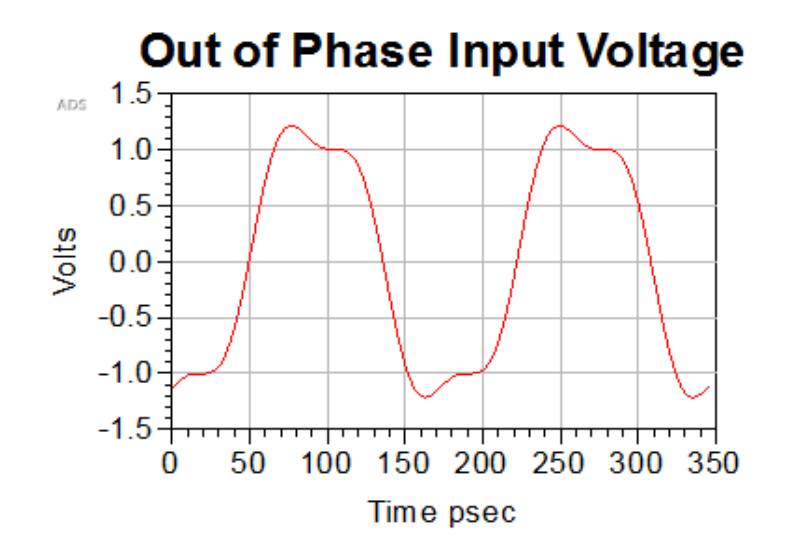


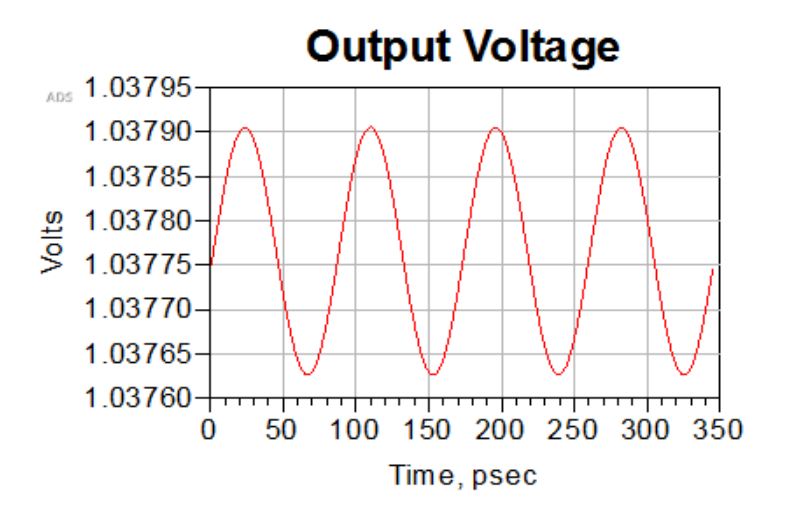


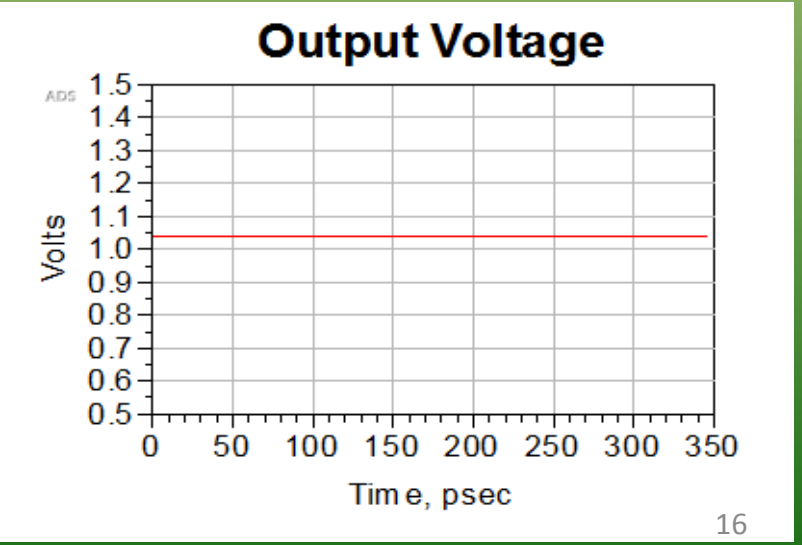

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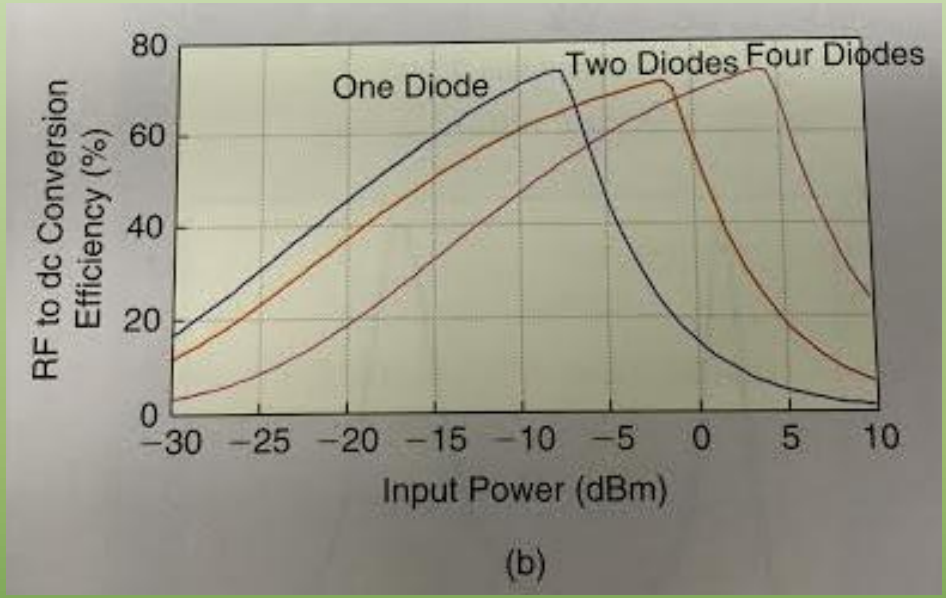


**Efficiency Chart**

$$P_r = P_t + G_t + G_r + 20\log_{10}\left(\frac{\lambda}{4\pi R}\right)$$

**Friis Transmission Formula**

# Design Approach


**Subsystem Block Diagram**

# Nonfunctional Requirements

- Objectives list for RF to DC converter:
- Conversion should be efficient
- Should be small
- Should be safe to use
- Should be cost efficient to produce

# Functional Requirements

- Functions for RF to DC converter:
- Should convert RF to DC
- Should filter out harmonic frequencies generated by rectifier circuit
- DC output filter should create a DC output
- Should be matched to antenna input impedance

# Functional Requirements

- Specifications for RF to DC converter:
- Will work in the frequency range of 5.725GHz to 5.875GHz
- Will attach to an antenna at its input

# Economic Analysis

- Feasible to produce at a low cost
- Cheap components being used in design
- Massive market
- Not ready for commercial use yet

# Schedule

| ID | Task Name | Start | Finish | Duration | Spring 2015 - Spring 2016 |
|---|---|---|---|---|---|
| 1 | Research | Spring 2015 | Spring 2016 | 40 Weeks | |
| 2 | Diode Selection | Fall 2015 | Fall 2015 | 1 Week | |
| 3 | Diode Configuration | Fall 2015 | Mid Fall 2015 | 6 Weeks | |
| 4 | Filter Design | Mid Fall 2015 | Mid Fall 2015 | 6 Weeks | |
| 5 | Impedance Matching | Mid Fall 2015 | End Fall 2015 | 6 Weeks | |
| 6 | Purchase Parts | End Fall 2016 | End Fall 2015 | 1 Day | |
| 7 | Circuit Implementation | Beginning Spring 2016 | Mid Spring 2016 | 12 Weeks | |
| 8 | Contact Manufacturor | Mid Spring 2016 | End Spring 2016 | 1 Week | |
| 9 | Test Product | End Spring 2016 | End Spring 2016 | 3 Weeks | |

# Societal and Environmental Impacts

- Convenience
- Safe
- Potential to be used in the future
- Less efficient than wired power transfer
- Trade-off

# Conclusion

- RF to DC rectifier
- Continuation of 2014 project
- Design Approach
- Efficiency
- Endless Possibility

# Questions?

# Metrics for Objectives

- 0 – 5 point scale
- 5 highest
- 0 lowest
- Efficiency
- Size
- Safety
- Cost

# References


- [1] Boaventura, Alirio, et al. "Optimum Behavior." *IEEE Microwave Magazine* Mar.-Apr. 2013: 26-35. Print.
- [2] Flynn, Brian W., and Kyriaki Fotopoulou. "Rectifying Loose Coils." *IEEE Microwave Magazine* Mar.-Apr. 2013: 48-54. Print.
- [3] Lin, James C. "Wireless Power Transfer for Cell Phones or Other Mobile Communication Devices and Biological Implications." *IEEE Microwave Magazine* July-Aug. 2013: 18-22. Print.
- [4] Scheeler, Robert, Sean Korhummel, and Zoya Popovic. "A Dual-Frequency Ultralow-Power Efficient 0.5-g Rectenna." *IEEE Microwave Magazine* Jan.-Feb. 2014: 109-14. Print.
- [5] Shinohara, Naoki. *Wireless Power Transfer via Radiowaves*. Hoboken: ISTE, 2014. Print.
- *[6] Wireless Power Transfer System* (2014). Print.