

EE/CPRE/SE 491 WEEKLY REPORT 5

INTRODUCTION

Date: March 11 - March 15

Group Number: 21

Project Title: Battery-less IoT Devices

Advisor: Dr. Henry Duwe

Clients: Dr. Nathan Neihart, Dr. Daji Qiao

Team Members:

Derek Nash – *Meeting Scribe, Power Systems Engineer, Test Engineer*

Matt Goetzman – *RF Systems Engineer, Test Engineer*

Mohamed Gesalla - *RF Systems Engineer, Test Engineer*

Adithya Basnayake – *Report Manager, Power Systems Engineer, Test Engineer*

Mohammed-Al-Mukhaini – *Meeting Facilitator, Embedded Systems Engineer, Test Engineer*

Bradley Rhein – *Embedded Systems Engineer, Test Engineer*

WEEKLY SUMMARY

During this week, we met as a group to set goals for the upcoming weeks. In this meeting all of us agreed that by the end of spring break, we should put in the maximum effort to get a final decision on whether using Wi-Fi to power our IoT device is feasible. The antenna team continued testing the antennas they built and the strength of Wi-Fi to have an idea of what kind of antenna design would be the best to power the MSP430 microcontroller. The power circuit team worked on getting practice with the Advanced Design System (ADS) tool to simulate the Greinacher doubler circuit. The embedded systems team did further research on learning about the power requirements and other functionalities of the MSP430 microcontroller by going through its data sheets.

PAST WEEK ACCOMPLISHMENTS

Embedded Systems Team

During this week the embedded system team focused on researching about the power requirements of the MSP430 and learning about FRAM and SRAM in MSP430. We researched the steps required to write to flash memory with

the development board we're currently using and how it differs from writing to FRAM which is what our future prototypes will use.

RF and Antenna Team

This week we validated the measurements we took earlier with our phones. We managed to get similar values with a TP-Link WN722N USB Wifi Antenna with Netspot Free Edition, a wifi signal strength testing program. Our results were in line with our phone measurements. The signal strength of the antenna was roughly -30dB at 1 meter and -40dB at 3 Meters. Our estimate is that it would produce a signal strength of approximately -20dB at 1 foot away from the router. All tests were done at a 45 degree angle from beneath the router. We believe that it's at least feasible to remotely charge a low power device with a wifi-router broadcasting to a populated room. We plan on creating a PIFA antenna array over spring break.

Power Circuit Team

During this week the power circuit team focused on getting practice with the Advanced Design System (ADS) to model the doubler and rectifier circuit. Several simple rectifier circuits were modeled before modeling the actual Greinacher voltage doubler circuit to familiarize ourselves with the software. Following shows on the rectifier circuits we modelled with a RF signal using circuit envelope.

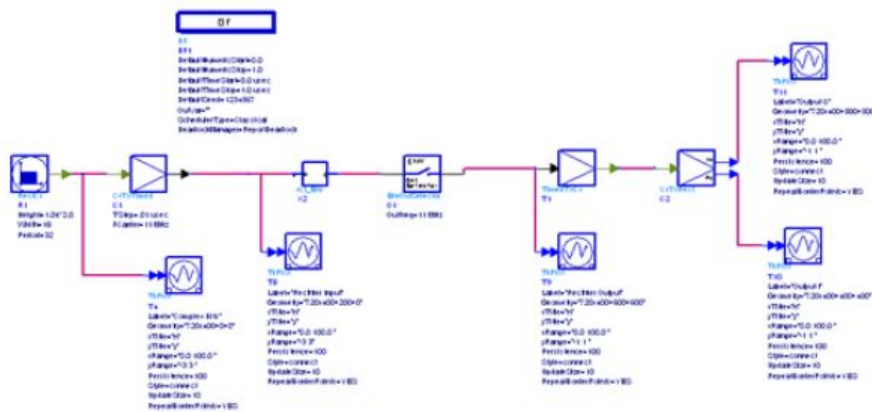


Figure 01 : Cosimulation of a modulated RF signal with a rectifier circuit

Following shows the graphical result when a pulse signal is inputted

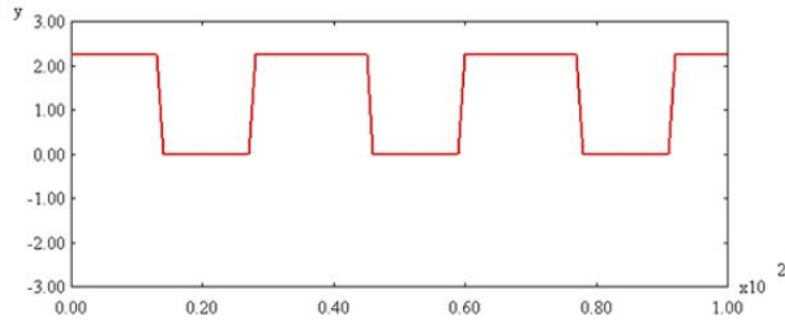


Figure 02 : Rectangular Pulse train signal

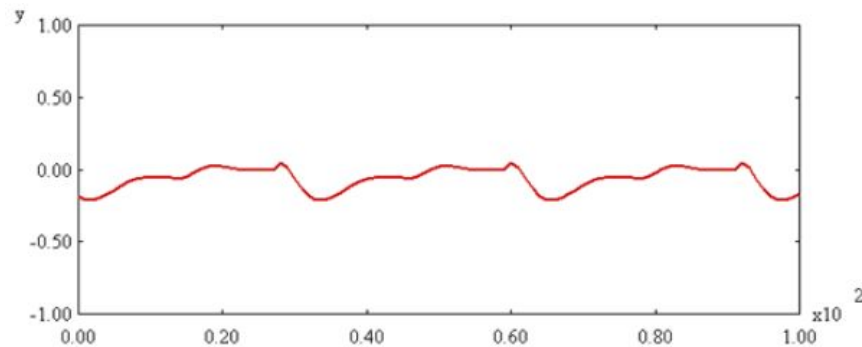


Figure 03 : Rectified Output signal

In this model, a rectangular pulse train is placed onto a RF carrier and inputted to a simple diode rectifier circuit. This was just one of our trials to get some practice with the ADS tool. The Greinacher voltage doubler circuit that we will be modelling requires schottky diodes. Although ADS has libraries with series of schottky diodes, we need to make sure the schottky diodes we are modelling have similar specifications to the DST2045AX DigiKey schottky diodes we will be using to build the rectifier circuit. After talking with one of the team members who had experience with ADS, we found out that we can directly use the spec sheet of the schottky diodes we are using in ADS.

PENDING ISSUES

The power circuit team needs to learn how to use spec sheet directly in ADS and simulate the Greinacher Voltage doubler circuit in ADS. The antenna team needs to further assess the parameters necessary for including an “F” antenna on a PCB.

INDIVIDUAL CONTRIBUTIONS

Team Member	Contribution	Weekly Hours
Derek Nash	Researched rectifiers from similar WiFi harvesting projects, and tried to contact a past research group from Ohio State University.	3
Matt Goetzman	Validated Antenna Tests	3
Mohamed Gesalla	Conducted antenna tests to validate previous measurements	
Adithya Basnayake	Researched and practiced to get familiarized with the ADS tool. Wrote the weekly report.	5
Mohammed-AI-Mukhaini	Researched on the functionalities of the MSP430 and minimum power requirements to run MSP430 looking for optical protocols	3
Bradley Rhein	Researched FRAM and Flash memory. Wrote test code for writing and preserving data to flash memory.	3

PLANS FOR THE UPCOMING WEEK

After the spring break, the power circuit team needs to have a finished simulation of the Greinacher Voltage doubler circuit in ADS and should plan on building the circuit based on the ADS model.

RF team will attempt to create a PIFA antenna array over spring break.

SUMMARY OF WEEKLY ADVISOR MEETING

In our meeting with Dr. Duwe, we discussed the use of FRAM and SRAM in the MSP430 and each one's power demands. We also discussed the power team's thought process behind the diodes ordered and the plans to simulate and manufacture the circuit in the future. The antenna team discussed the idea of a planar "F" antenna, which could be printed right on the rectifier PCB.