EE/CPRE/SE 491 WEEKLY REPORT 07

INTRODUCTION

Date: 4/12/2019
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*

PAST WEEK ACCOMPLISHMENTS

Embedded Systems Team

The FRAM launchpad was ordered and received by the end of the week. We also now have a solid understanding of which low power modes are appropriate for the program. This launchpad will enable us to use energy trace for optimal energy tracking and data interpretation.

Our launchpad of 3 clock sources that further derive 3 more clock signals. These clock modules would be vital in leaning in using different low power modes. This will change our energy consumption and data conversion rate.

One of our main approaches that would be used to wake the MSP430 from any of the low-power operating modes is by enabling interrupts. Furthermore, our program flow would be:

1) Entering interrupt service routine
    a) PC and SR are stored on the stack
    b)
2) Options for returning from the interrupt service routine
    a) Original SR is pooped from the stack, restoring the previous operating mode.

Thinking deeper about our approach, we try to break down our thought process on why interrupts would be the best way to react to our inputs. Unlike polling, interrupts have the advantage of being highly efficient not wasting any time looking for events. Moreover, knowing that we might turn off our processor due to our lack of energy. Efficiency energy consumption due to its minimal energy requirements to operate.

Using the MSP430 comes with a variety of features for peripheral in low-power:

1. ADC10 reference buffer automatically controlled
2. ADC10, ADC12, SD16 cores automatically controlled
3. Auto-scan ADC modes
4. Timer-triggered data conversion
5. I2C and USCI modules automatically enable clock
6. DAC and OA have speed vs. power settings

RF and Antenna Team

Matt led a session on Advanced Design System with the goal of simulating our rectifier circuit. Assisting him were Derek and Adi. Matt also met with Dr. Neihart to discuss the merits of separating the patch antenna and rectifier into separate PCB's, connected by SMA ports.
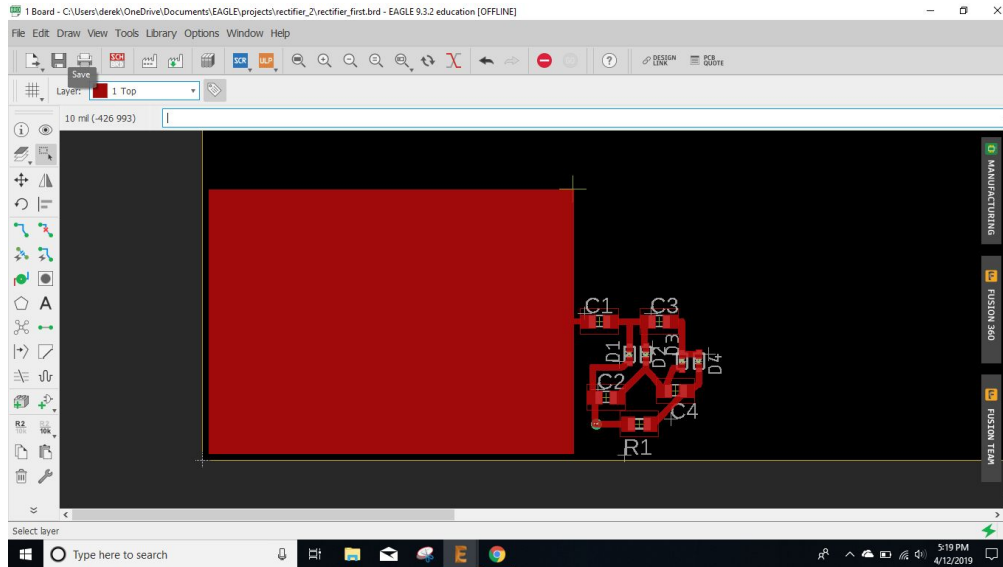

Power Circuit Team

The team designed a different circuit, the Cockroft-Walton multiplier, after debating a change in design.
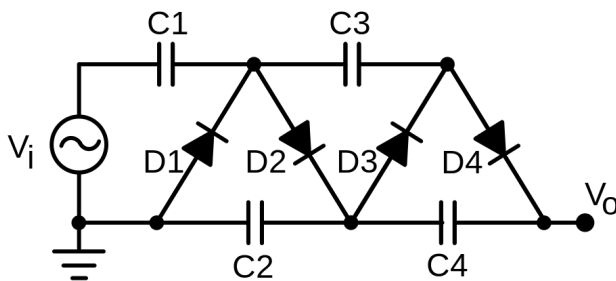
(Above) Cockroft-Walton multiplier. 4 stages

(Below) Eagle board file of the Cockroft-Walton multiplier and patch antenna.

The above Eagle design is temporary, as the connected antenna will be replaced with an SMA female connector.

PENDING ISSUES

We need to create lumped port models for the diode, capacitors, and possibly inductors. Diodes will be an issue as we need multiple specific parameters for the diode model.

INDIVIDUAL CONTRIBUTIONS

Team Member	Contribution	Weekly Hours
Derek Nash	Designed another PCB for the new rectifier. Learned more about Eagle and assisted with ADS efforts.	3
Matt Goetzman	Led the ADS session to simulate the rectifier. Met with Dr. Neihart.	6
Mohamed Gesalla	Was out of town attending a conference	0
Adithya Basnayake	Learned about using ADS to simulate rectifier circuits	3
Mohammed-Al-Mukhaini	Further inquiry and development in low power modes and energy trace applications.	5

Bradley Rhein	Researched EnergyTrace and ordered new launchpad for development.	3

Embedded Systems Team

Now that our FRAM board has arrived we can begin testing code much closer to our desired final product. Once we have this code tested and working we can begin using EnergyTrace to give the power circuit team a better idea of the MCUs power requirements.

Power Circuit Team

We plan to split the rectifier into 2 different boards: the antenna with an SMA connector and the rectifier circuit with an SMA connector. We'll also troubleshoot the ADS simulation to get the diode package to work.

RF Team

Make lumped port models for components that will be taking an AC voltage as well as multiple antenna prototypes. Talk to ETG for help getting access to FR4 boards and chemical etching.

SUMMARY OF WEEKLY ADVISOR MEETING

We postponed the meeting to next week, as Dr. Duwe was in Washington, D.C., this week.