

Wake-up Harvester Design for Batteryless IoT System

sdmay21-14 (3/15 - 3/29)

Client & Advisor: Prof. Duwe

Team Members:

Edmund (Eddie) Duan - Powercast Harvester Team, Project Lead

Jacob Bernardi - MCU Team

Douglas Zuercher - Transceiver Team

Kwanghum (Ted) Park - MCU Team

Bryce Staver - Powercast Harvester Team

Zacharias (Zack) Komodromos - Transceiver Team

Weekly Summary

Over the past two weeks, we continued to debug the transceivers and have consulted help from other faculty including our advisor to see what the issue could be. In addition, we have ordered the PCB and are planning to test the number of successful communications between the MCU and harvester in the meantime. We are also working on the final report and poster.

Past week accomplishments

Transceiver Team (Zack and Douglas)

The below achievements were contributed to evenly by Zack and Douglas. Work was done together, at the same time, so contribution is approximately 50/50.

This week we conducted multiple tests to rule out reasons why the transceivers are not communicating. Using this information, with the help of Dr. Duwe and other experienced faculty members, we will see if we can get any insight into the issues and see if any equipment is available to help us confirm communication.

Setup:

We have a CC1352 MCU and AX5043 transceiver wired together so that the MCU can communicate with the transceiver through SPI. The MCU sets register values to configure the transceiver.

For all tests, we start by confirming that we can actually program the transceiver with SPI (achieved by writing and reading from a test register) and also testing the interrupt function (by telling the transceiver to trip its interrupt pin and waiting on the MCU). This allows us to confirm that SPI and interrupts are not causing us to fail tests. Further, when we write to the transceiver over SPI, we read the register written to immediately after to confirm a miscommunication did not occur.

What we have tried:

- Configuring both AX5043 transceivers for FSK modulation with 9600 baud rate and frequency deviation of 3kHz. One was set to keep transmitting and the other was set to throw an interrupt when it receives any data (the internal FIFO is not empty). Our transmitter sends a preamble of 0x55 for 20 bytes, followed by a data set. We had CRC on for this set of tests.
 - 1) We initially tried sending a 6 byte message
 - 2) We also tried filling up the transmitter's data FIFO until it was full. We checked a flag to confirm if the FIFO was full, committed the data, and then instructed the transmitter to send the data. Once transmission was complete, we checked the flag register again to confirm that the FIFO was completely empty.

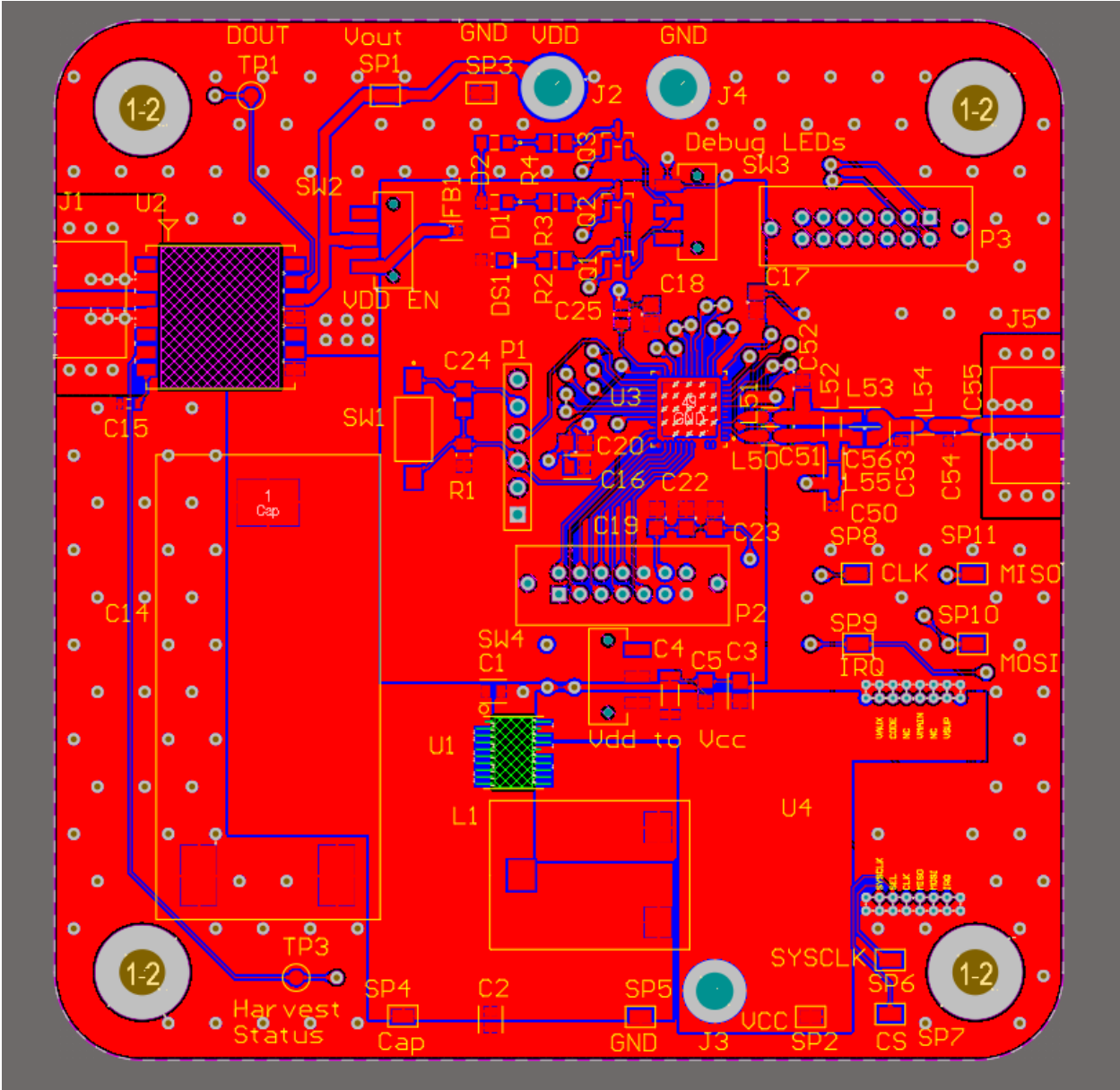
- a) Seeing the FIFO go from full to empty is one reason we believe we are able to transmit data, and that our problems are on the receiver.
- 3) Reading the FIFO on the receiver yielded zeros, and reading the number of bytes received also yielded zero.
- Configuring both AX5043 transceivers for FSK modulation with 9600 baud rate and frequency deviation of 9kHz. We had CRC off for this set of tests, and the receiver was just saving the raw received bits.
 - We increased the frequency deviation because we thought 3kHz was too constrained.
- Configuring a CC1352 MCU LaunchPad to act as an FSK receiver with a 9600 baud rate and frequency deviation of 9kHz. We confirmed the LaunchPad's receiving functionality by configuring another LaunchPad as a transmitter and testing communication. Then, we used the receiver to try to receive data from an AX5043 configured as a transmitter.
 - The goal here was to prove that we actually were transmitting data. However, the API used by the CC1352 MCU includes additional features (such as sync word) that we are not sure we correctly implemented. So, this test has not yielded meaningful results. The problem could either be our AX5043 isn't transmitting or our Tx/Rx have different configurations.
- We changed the setup so that both are in receive mode and are able to transmit by pressing a button. This was mostly a convenience factor, but also allowed us to confirm that our process of going from one state (Tx/Rx) to the other (Rx/Tx) is correct.
- We are in the process of using the values from [here](#) since they are using the AX5043 successfully but with a different MCU. We know this project worked for the author, so we're just trying to match transceiver configurations. We've very close to having this done. If this works, then we can slowly change configurations bit-by-bit until we are configured in the fashion that we want.

Altium Work (Bryce, Ted, Jacob and Eddie)

- PCB reworked with added transceiving capability on MCU
- Ordered PCB
- Completed component selection and bill of materials

Project Poster and Final Report (Ted, Eddie, Bryce and Jacob)

- Continued work on report and poster, need to add details regarding testing results, security, and operation manual



Final PCB layout

Pending issues

- We haven't been able to receive our transmitted signal using the transceivers.

Individual contributions

The below hours include a rough estimate of hours worked over the last week.

<u>NAME</u>	<u>Individual Contributions</u> (Quick list of contributions. This should be short.)	<u>Hours this week</u>	<u>Hours cumulative</u>
Bryce Staver	Altium PCB layout, Doc work	33	90
Douglas Zuercher	Debugged AX5043 Tx/Rx capabilities Debugged CC1352 LaunchPad Tx/Rx Worked on implementing new configurations which match with what others have done successfully Reviewed Tx/Rx config code and cross-checked it with programming resources Helped in fixing last week's issue of one of the transceivers not operating correctly	12	73
Edmund Duan	Final Report and Poster	12	66
Jacob Bernardi	Helped finish BOM, PCB and worked on project documentation	12	65
Zack Komodromos	Worked on the code for the MCUs to act as TX and RX devices Helped testing and debugging the existing transceiver code Helped in fixing last week's issue of	12	84

	one of the transceivers not operating correctly		
Kwanghum Park	Altium PCB layout, Document work	12	59

Plans for the upcoming week

MCU / Transceiver Testing (Douglas, Zack and Jacob)

- Continue debugging the current Tx/Rx code to determine why we cannot transmit and receive between the project transceivers
 - Test Tx capability using a transceiver that we know works
 - Test Rx capability using a transceiver that we know works
- Set up the MCUs to act as the RX and TX devices in order to offer a functioning device and have an idea of the number of successful transactions in the life cycle of the charge

Project Poster and Final Report (Ted, Eddie, Bryce and Jacob)

- Make necessary updates and changes to final report
- Work on poster