Student Payload First Flight (SPIFF) Payload Team Monthly Status Report

Boston University / New Mexico Institute of Mining and Technology / Georgia Institute of Technology

February 24, 2012

Boston University

The past few weeks have largely been spent preparing schematics, importing them to PCB layout tools (currently using Altium design software), and routing the boards. As of February 24, three boards have passed the design for manufacturability test offered by 4pcb.com, and have been ordered. An image of a current testing board is shown below. The test board is intended to allow simultaneous functional testing of three separate subsystem PCBs including Power, C&DH, and an instrument. Additionally, because BUSAT's PCB design includes stack-through connectors, several more PCBs can be tested in parallel to the three mounted directly to the testing board.

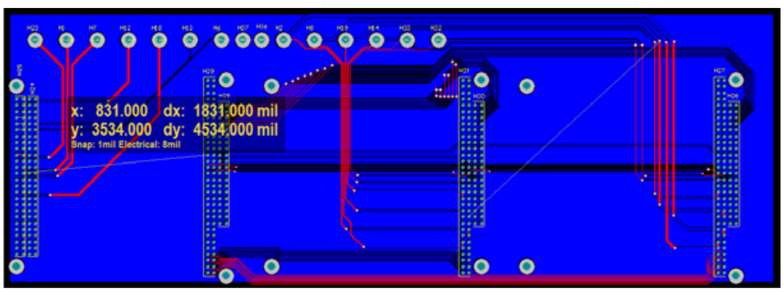


Figure 1: Image of Testing Board CAD layout in Altium

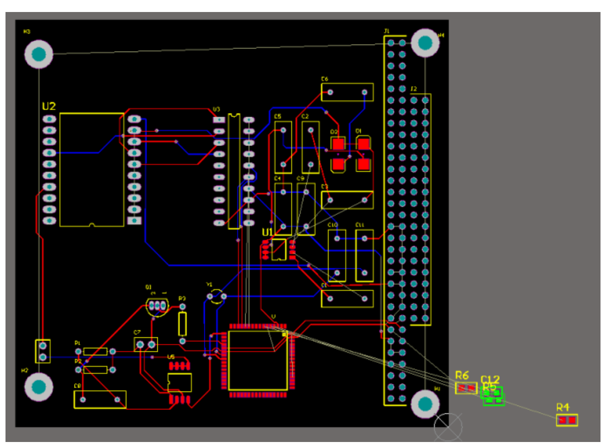


Figure 2: Image of Magnetometer board layout under development

Issues encountered during payload design / development

The largest challenge encountered during this month's development was inexperience with a new PCB design tool, Altium Designer. Several of the team's members had previous knowledge of the Cadence software suite, but because of licensing issues the team was unable to secure consistent access to this CAD tool. While similar issues have come up with Altium (BU only has limited access), it has proven to be a better choice and the team has learned how to effectively use the software.

Delivery of the ClydeSpace EPS has been delayed until the end of March, which shortens testing time somewhat. This setback affects the design cycle for BUSAT's upcoming CDR, but not the SPIFF launch.

Georgia Tech

1) Part Selection

Over the last weeks, the Georgia Tech development group has evaluated options for a microcontroller for the Electrical Field Mill. The group has familiarity with and easy access to development tools for the following three units: ATmega328, MSP430F2274, and PIC16F88. The Analytical hierarchy Process used followed the format described in Ford, R. and Coulston, C. [2007]. Table (1) shows the variables considered. From Table (2), the decision matrix, while all options scored relatively close to each other, it is evident that the MSP430 represents the best option.

	Amega328	MSP430F2274	PIC16F88
Cost	3.83 USD	6.74 USD	2.1 USD
Architecture	8 bits	16 bits	8
Supply Voltage (3.3)	1	1	1
Flash size	32 KB	32 KB	3.5 KB
AD resolution	10-bit	10-bits	10-bits
AD channels	8	12	11
PWM Hardware	1	1	1
SPI Hardware	1	1	1
I2C Hardware	1	1	1
Number of People Familiar with HW	1	2	1

Table (1) Variables under consideration

	Weights	ATmega328	MSP430F2274	PIC16F88
Cost	0.002372	0.000717039	0.000393155	0.0012618
Architecture	0.009252	0.002312903	0.004625806	0.0023129
Voltage	0.007357	0.002452451	0.002452451	0.0024525
Flash Size	0.036906	0.017496082	0.017496082	0.0019136
AD Resolution	0.054627	0.018208897	0.018208897	0.0182089
AD Channels	0.035468	0.009153137	0.013729706	0.0125856
PWM Hardware	0.209425	0.069808441	0.069808441	0.0698084
SPI Hardware	0.209425	0.069808441	0.069808441	0.0698084
I2C Hardware	0.209425	0.069808441	0.069808441	0.0698084
Familiarity	0.225742	0.056435535	0.112871069	0.0564355
	1	**0.316201366**	**0.379202488**	**0.3045961**

Table (2) Decision matrix

2) Testing

Having chosen the correct microcontroller, the GT has begun implementing the SPA protocol using two EZ430RF2500 development boards, which utilize the MSP430F2274. Additionally, these boards include a number high quality debugging tools as wells as wireless capabilities. Simple I2C packet transmission and reception has been implemented using the EZ430 boards and a terminal program called RealTerm. A photograph of two boards communicating over I2C is shown in Figure (1).

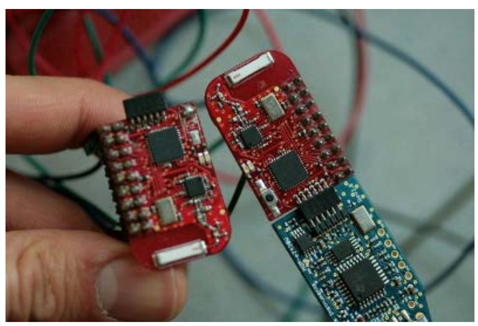


Figure (1) Testing of partial SPA-I transmissions

Finally, the GT group has compiled created a top level functional block diagram of the E-field mill instrument (See Figure (2)). Schematic for the analog front end is under way based on the design of Trostel *et al* (2010). Some of the larger components such as the stepper motor, motor driver and GPS unit have been purchased.

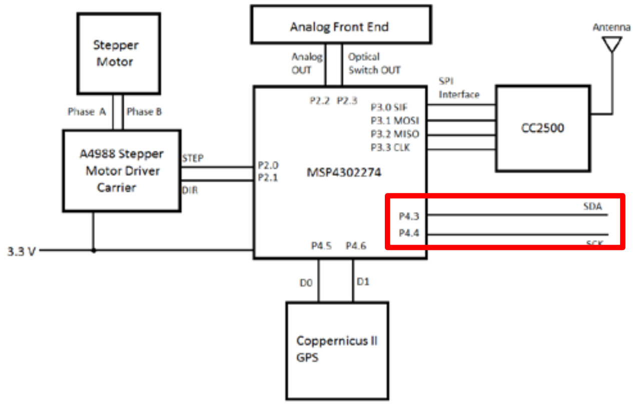
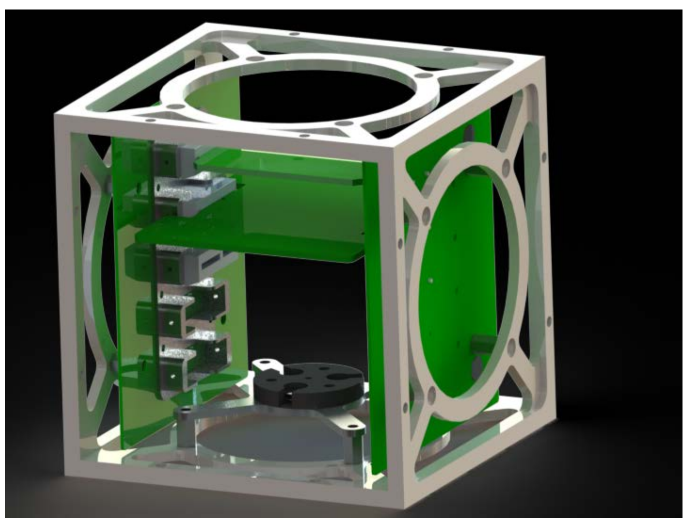


Figure (2) Level 1 block diagram of EFM. Red box denotes SPA lines

New Mexico Tech

The following outlines work done over the last month (February);

- Completed majority of weight reduction in the cube frame itself
    - Weight went from 750g to 406g



- Developed 15-pin connector interface
- Developed proto-board to test impendence measurement circuit
    - Layout completed
    - Sent to manufacture
    - Testing will begin upon delivery of proto-board
- PZT characterization
    - Sensors placement was determined
    - These sensors were then characterized
    - New frequency ranges were determined

    - Failure scenarios were developed and are under investigation
- Wire harnesses
    - Developed system for securement of PZT wiring

Current team leads and team members:

- BU: Nate Darling, Chris Hoffman, Nima Badizadegan, Pantelis Thomadis, Nick Pobat
- GaTech: Josh Mendez, John Trostel
- New Mexico Tech: Jordan Klepper, Matt Landavazzo