HASP Payload Specification and Integration Plan

Payload Title: Gannon University's Cosmic-Ray Calorimeter (GU-CRC2)

Payload Class: Small [✓ Large] (circle one)

Payload ID: GU-CRC2

Institution: Gannon University

Contact Name: Kaitlyn Babiarz; Dr. W. Lee

Contact Phone: (770) 597- 2344 (cell) for Babiarz; (814) 871-7630 for Dr. Lee

Contact E-mail: babiarz001@knights.gannon.edu; lee023@gannon.edu

Submit Date: 4/24/15

I. Mechanical Specifications

A. Measured weight of the payload (not including payload plate) 15.0 Kg

B. Provide a mechanical drawing detailing the major components of your payload and specifically how your payload is attached to the payload mounting plate

Refer to Figures 1 ~ 3 below:

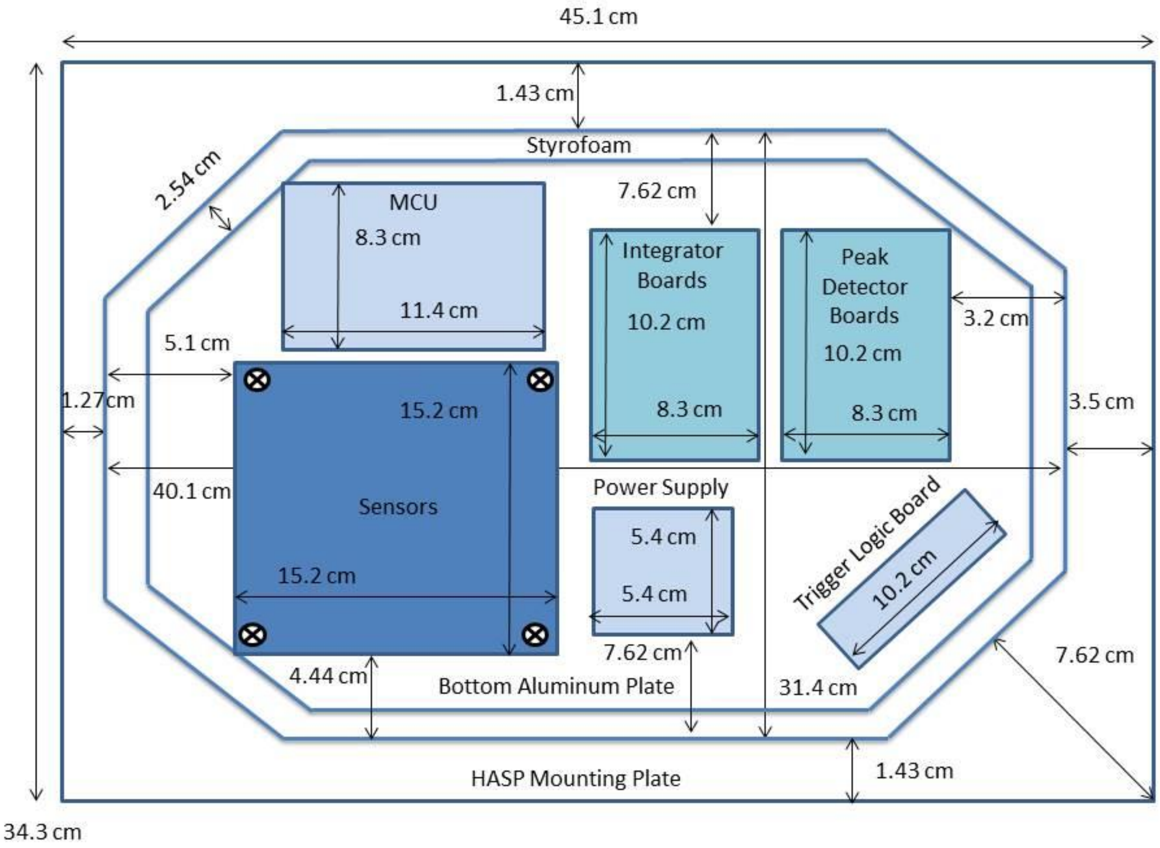

Figure 1 – The payload frame as viewed from above. The frame consists of an aluminum bottom plate and aluminum side and top plates. The side and top aluminum plates are surrounded by an inch of styrofoam. The bottom plate rests on top of the HASP mounting plate. The sensors, MCU, intergrator boards, peak detector boards, power supply, and trigger logic board are all arranged on the mounting plate, as shown. The HASP mounting plate is secured to the payload by screws that go from the electronic components through the bottom aluminum plate and the HASP mounting plate.

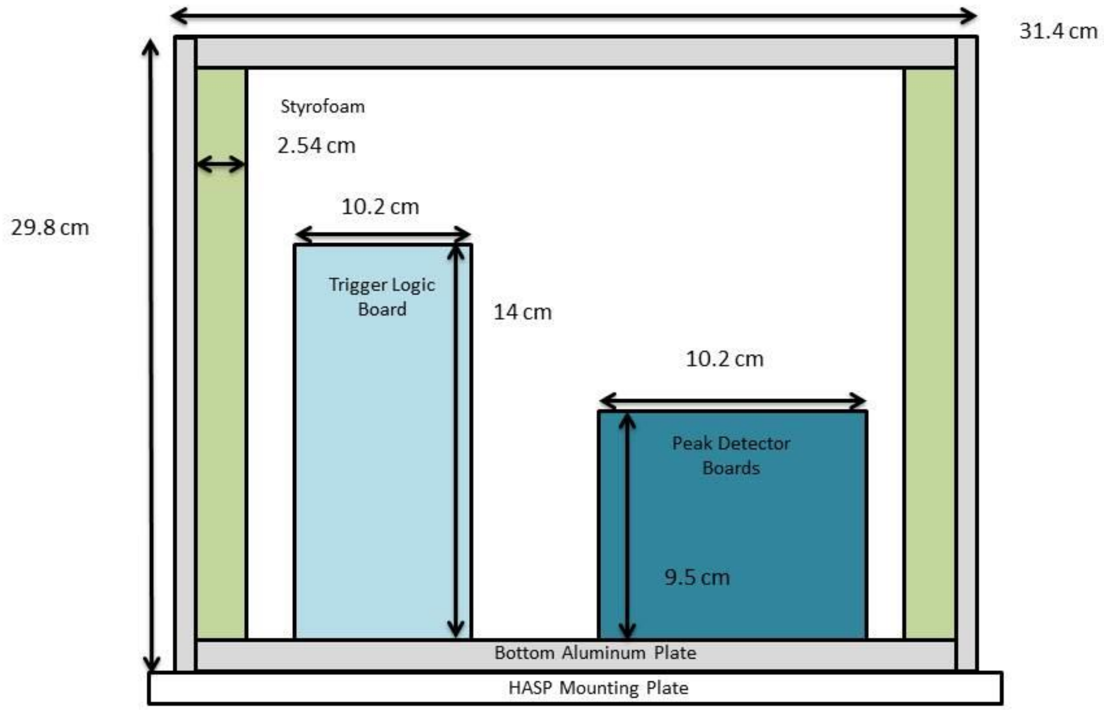

Figure 2 – Payload as viewed from the front. The bottom and side aluminum plates, as well as the styrofoam, are clearly visible. The electronics are connected using screws that go into the bottom aluminum plate.

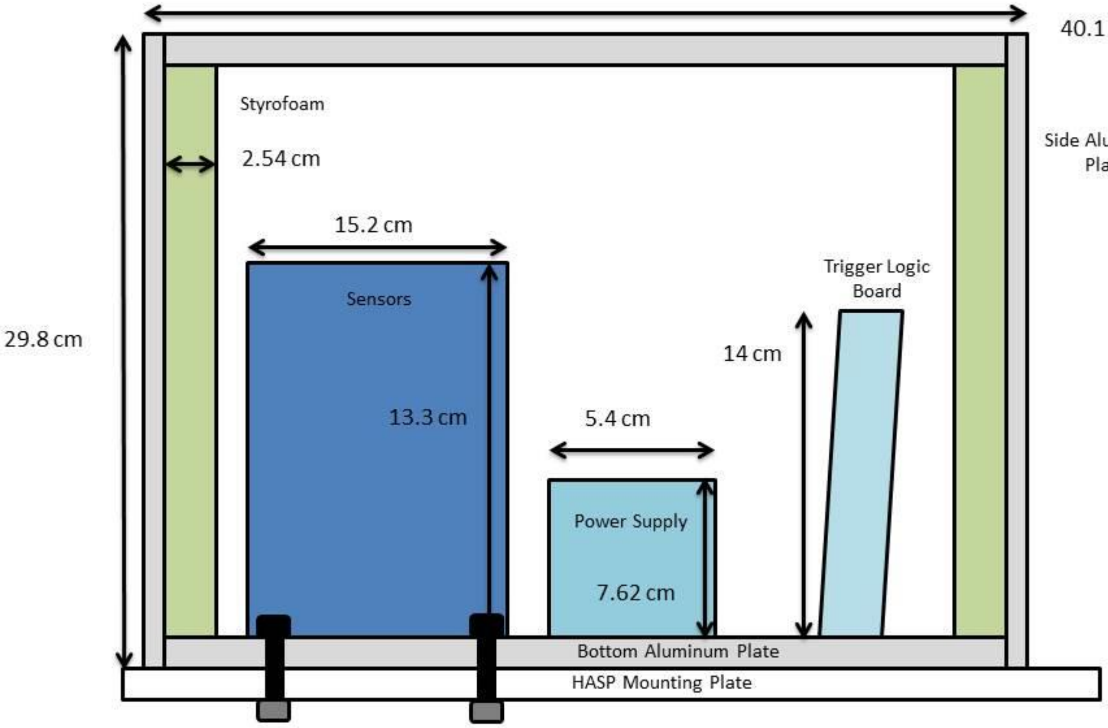

Figure 3 – Similar to Figure 2, except the payload is viewed from the side. Four machine screws protrude from the bottom of the HASP plate, and are secure the senors and the payload in place with hex nuts. The remaining electronics are connected to the payload with screws that go into the bottom aluminum plate.

C. If you are flying anything that is potentially hazardous to HASP or the ground crew before or after launch, please supply all documentation provided with the hazardous components (i.e. pressurized containers, radioactive material, projectiles, rockets…)

No hazardous materials

D. Other relevant mechanical information

None

II. Power Specifications

A. Measured current draw at 30 VDC

266 mA

B. If HASP is providing power to your payload, provide a power system wiring diagram starting from pins on the student payload interface plate EDAC 516 connector through your power conversion to the voltages required by your subsystems.

See Figure 4 below.

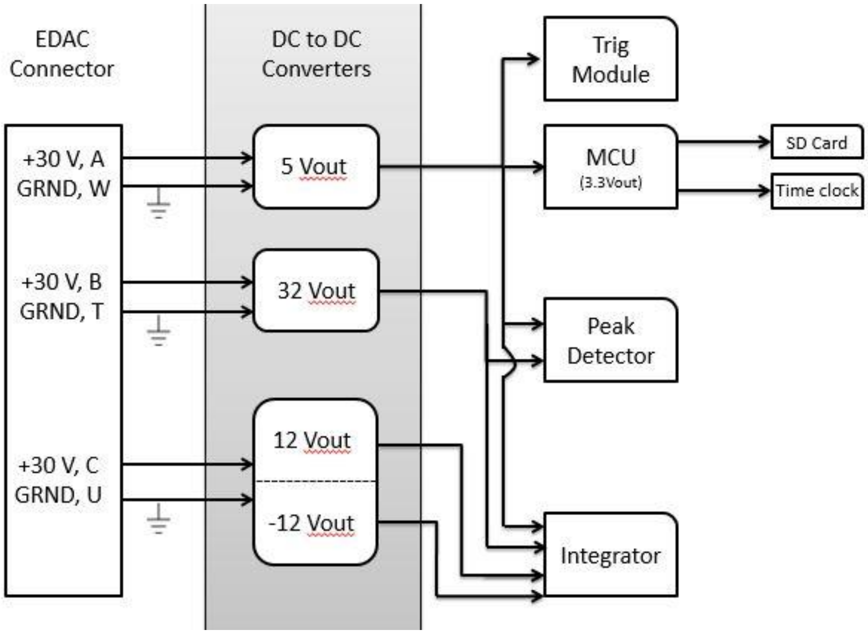

Figure 4 – Power system wiring diagram

C. Other relevant power information

None

III. Downlink Telemetry Specifications

A. Serial data downlink format: Stream [✓ Packetized] (circle one)

B. Approximate serial downlink rate (in bits per second)

The serial downlink rate will vary depending on data record length. Values will range as indicated below.

Minimum value: 39 bps

Maximum value: 83 bps

Typical value: 60 bps

C. Specify your serial data record including record length and information contained in each record byte.

The serial data record is a string of ASCII characters formatted as indicated in the table below. Data records are separated by a comma, which is included in the record length. The serial string will be sent once every 30 seconds to verify payload functionality. Only a small subset of the data will be telemetered.

Item	Record Length (bytes)	Description
Record Type Indicator	2	Indicates the type of data record. (‘A’)
Record Length	4	Length of data record (in bytes) not including header
Header End Indicator	2	Indicates the end of the packet header (‘F’)
Event Number	2-11	Length will vary. As an unsigned integer, event number can be as large as 4,294,967,295. In practice, the event number should be less than ~500,000 for the duration of the flight.
Date and time	18	Date and time (Eastern Standard Time)
Calorimeter data	60-150	Length will vary. Calorimeter ADC values. There are 30 12-bit ADC values, which range from 0-4095. In ASCII, this is 1-4 bytes, plus the separating comma.
Charge Detector data	50-125	Length will vary. Charge Detector ADC values. There are 25 12-bit ADC values, which range from 0-4095. In ASCII, this is 1-4 bytes, plus the separating comma.
Temperature sensor 1	4	Temperature of the detector module in Celsius
Temperature sensor 2	4	Temperature of the power converter in Celsius
End of Record	1	Indicates the end of the data record (‘Z’)
Total	**147-310**	**Total Record length will vary, but average length is expected to be around 225 bytes.**

D. Number of analog channels being used:

No analog channels will be used

E. If analog channels are being used, what are they being used for?

None

F. Number of discrete lines being used:

No discrete lines will be used

G. If discrete lines are being used what are they being used for?

None

H. Are there any on-board transmitters? If so, list the frequencies being used and the transmitted power.

None

I. Other relevant downlink telemetry information.

None

IV. Uplink Commanding Specifications

A. Command uplink capability required: [✓ Yes] No (circle one)

B. If so, will commands be uplinked in regular intervals: Yes [✓ No] (circle one)

C. How many commands do you expect to uplink during the flight (can be an absolute number or a rate, i.e. *n commands per hour*)

If payload operates as expected, no commands will need to be sent during the flight other than power on prior to launch and power off prior to or during descent. If there is a malfunction, a few commands per hour may be required to diagnose and remedy the issue.

D. Provide a table of all of the commands that you will be uplinking to your payload

Command	**Value**	**Description**
Reset	0xYY 0x01	Quick reset the microprocessor
Reboot with confirmation	0xYY 0x02	Reboot the microprocessor and send downlink data to show initialization status.
Check flags	0xYY 0x04	Check status of SD card
Reset SD Card	0xYY 0x05	Reset SD card
Ping	0xYY 0x09	Request response to verify system operation
Verify ReadIn	0xYY 0x0A	Check Trigger Logic ReadIn signal and reinitialize if necessary
Verify AllDone	0xYY 0x0B	Check Trigger Logic AllDone signal and reinitialize if necessary
Request timestamp	0xYY 0x0C	Request current timestamp from system clock
Request debug	0xYY 0x0D	Run with serial debug commentary to manually verify system operation
Request Reset	0xYY 0x0F	Reset the debugging mode
Request event	0xYY 0x0E	Request last event written to SD card
Set event interval	0xYY 0xXX	Adjust interval at which event data is sent through downlink.

- (YY) represents the 4 least significant checksum digits for uplink command and payload ID number.

- (XX) represents an integral number between 16 and 255 which will be converted to a time interval between 3 – 720 seconds in intervals of 3 seconds.

E. Are there any on-board receivers? If so, list the frequencies being used.

No onboard receivers

F. Other relevant uplink commanding information.

None

V. Integration and Logistics

A. Date and Time of your arrival for integration: 8/2/2015

B. Approximate amount of time required for integration:

If all goes well, a half day will be required for payload check out on site to verify that there has not been any damage during transit.

Physical and electrical integration and testing will require ~1 hour.

C. Name of the integration team leader:

Kaitlyn Babiarz

D. Email address of the integration team leader:

babiarz001@knights.gannon.edu

E. List **ALL** integration participants (first and last names) who will be present for integration with their email addresses:

Kaitlyn Babiarz, babiarz001@knights.gannon.edu

Donovan Starks, starks003@knights.gannon.edu

Joshua Ott, ott011@knights.gannon.edu

Wookwon Lee, lee023@gannon.edu

F. Define a successful integration of your payload:

Successful integration of our payload requires:

1. Successful mounting the payload onto the HASP frame
2. Proper connection of EDAC 516 and DB9 connectors to the payload
3. Successful operation of the payload using the 30 Vdc HASP power
4. Successful communication with the SIP on up- and downlink
5. Passing thermal & pressure (T&P) test with a select set of test cases from steps 3 and 4 successfully performed during and after the T&P test, including analysis of data received through the downlink serial and SD card to ensure data quality. (Note: this will require removing the SD card after the T&P test to download the data.)

G. List all expected integration steps:

All unit and integration tests for payload components will be successfully completed before shipping the payload to the launch site. A few select integration tests will be used prior to integration with HASP structure to verify payload functionality.

- Connect the EDAC 516 connector to the payload.
- Connect the DB9 Serial Connector to the payload.
- Test power on and off of the payload through the HASP-provided commands
- Test serial communication through DB9 pins 2 and 3
- Examine data transmitted through serial and stored in onboard SD card to ensure proper payload operation. (Note: this will require removing the SD card after successful integration to download the data.)

H. List all checks that will determine a successful integration:

- Payload powers on and off
- Data strings are being transmitted at expected intervals and are consistent with previous measurements.

I. List any additional LSU personnel support needed for a successful integration other than directly related to the HASP integration (i.e. lifting, moving equipment, hotel information/arrangements, any special delivery needs…):

None is anticipated

J. List any LSU supplied equipment that may be needed for a successful integration:

- Dual Power Supply (32Vdc),
- One 4-channel oscilloscope with cables and probes,
- Two(2) Multimeters