HASP Payload Specification and Integration Plan

Payload Title: High Altitude Radiation Detector (HARD)

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

Payload ID: 2013-02 (*aka*, GU-HARD-PL03)

Institution: Gannon University

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I. Mechanical Specifications:

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

Module name	**Status**	**Mass (g)**	**Uncertainty (g)**	**Comments**
Detector Module	Measured	220	±5	(Measured last year) 2 of 4, multiplied by 2
Rotator	Measured	61	±1	
GPS unit	Measured	170	±1	
Microprocessor and SD memory	Measured	40	±1	
Frame - Styrofoam	Measured	138	±2	
Frame – aluminum + hardware	Estimated	607	±100	Estimated based on last year
Comparator and ±2.5V DC-DC converter	Estimated	40	±10	Estimate based on existing circuit boards of similar size
5 V and 60V DC-DC converters	Measured	40	±10	Measured one unit, there are two
TTL to RS232 serial converter	Estimated	40	±10	Estimate based on existing circuit boards of similar size
Wiring/misc.	Estimated	50	±20	Probably an overestimate
TOTAL		1406	±160	

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:

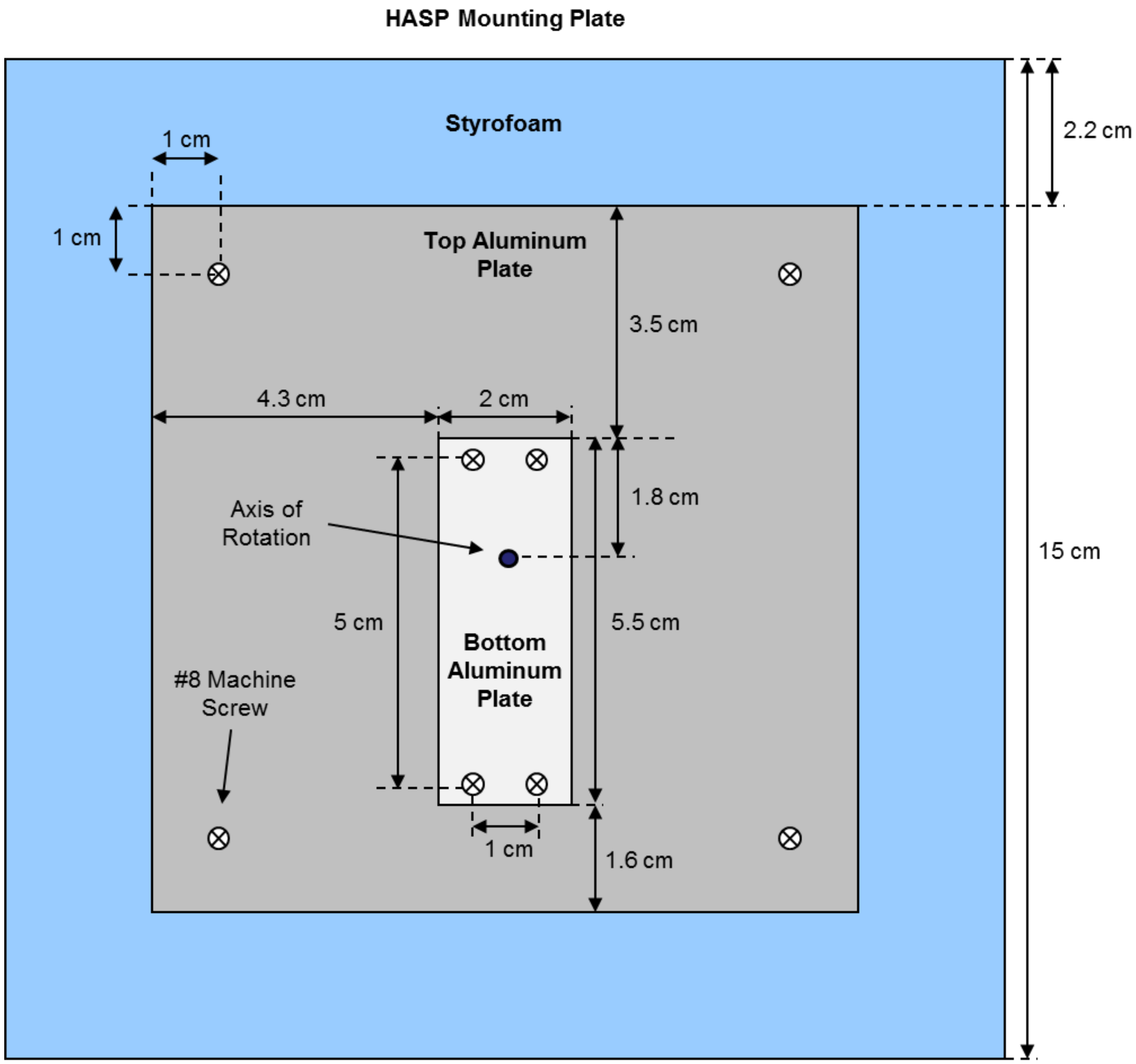


Figure 1 – The (empty) payload frame as viewed from above. While most of the frame is constructed of styrofoam, two aluminum plates will also be employed. The bottom plate will rest on top of the HASP mounting plate, while the top plate is cut out to allow room for the rotator motor (positioned to center the axis of rotation). Aluminum spacers will be used to prevent the styrofoam layer between the two plates from being crushed.

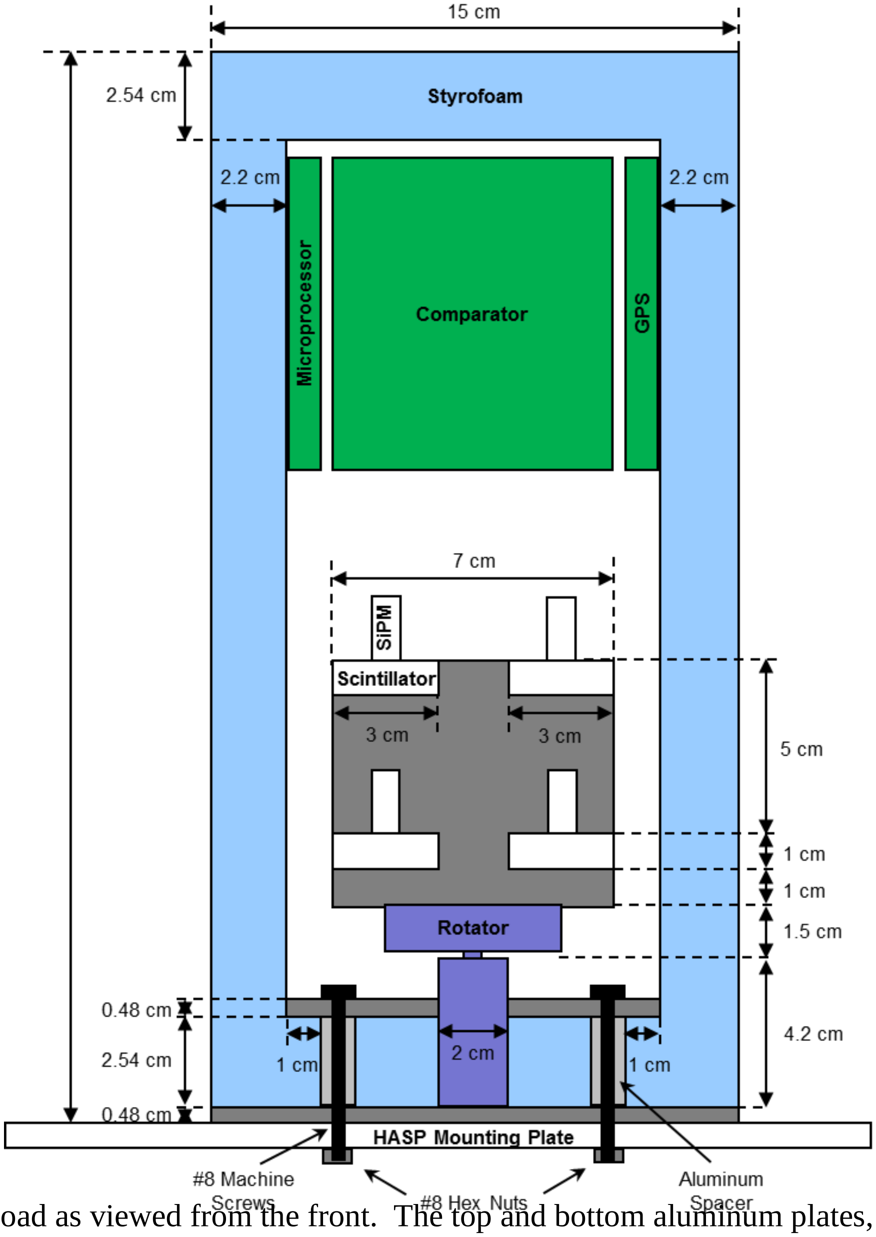


Figure 2 – Payload as viewed from the front. The top and bottom aluminum plates, as well as the aluminum spacers, are clearly visible. Four machine screws protrude from the bottom of the HASP plate, and are secured in place with hex nuts. The rotator is attached similarly, but the screws are not shown to make the drawing less cluttered. Electronics boards will be attached to the sides of the frame, near the top to avoid interfering with the rotation of the detector array.

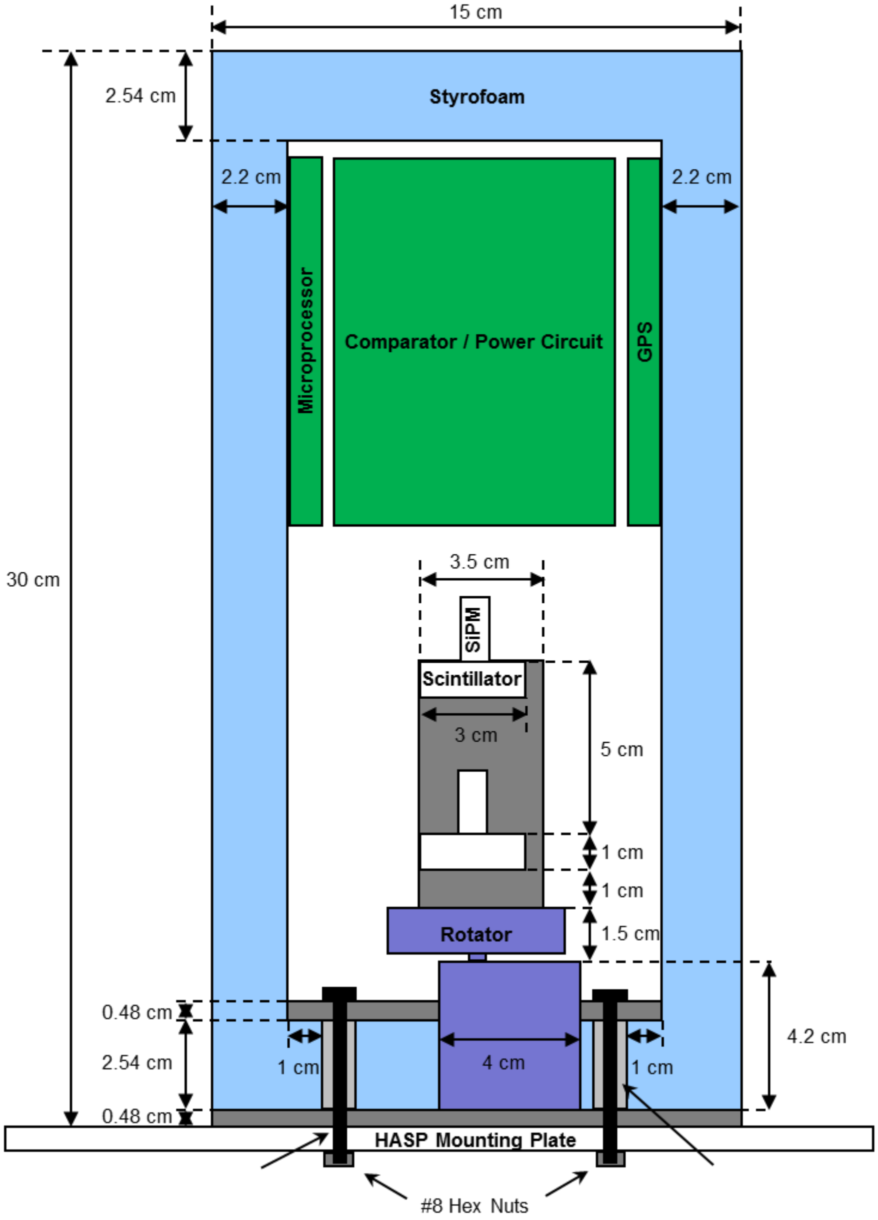


Figure 3 – Similar to Figure 2, except the payload is viewed from the side. Again, the screws to secure the rotator motor to the bottom aluminum plate have been omitted.

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 material

D. Other relevant mechanical information

None

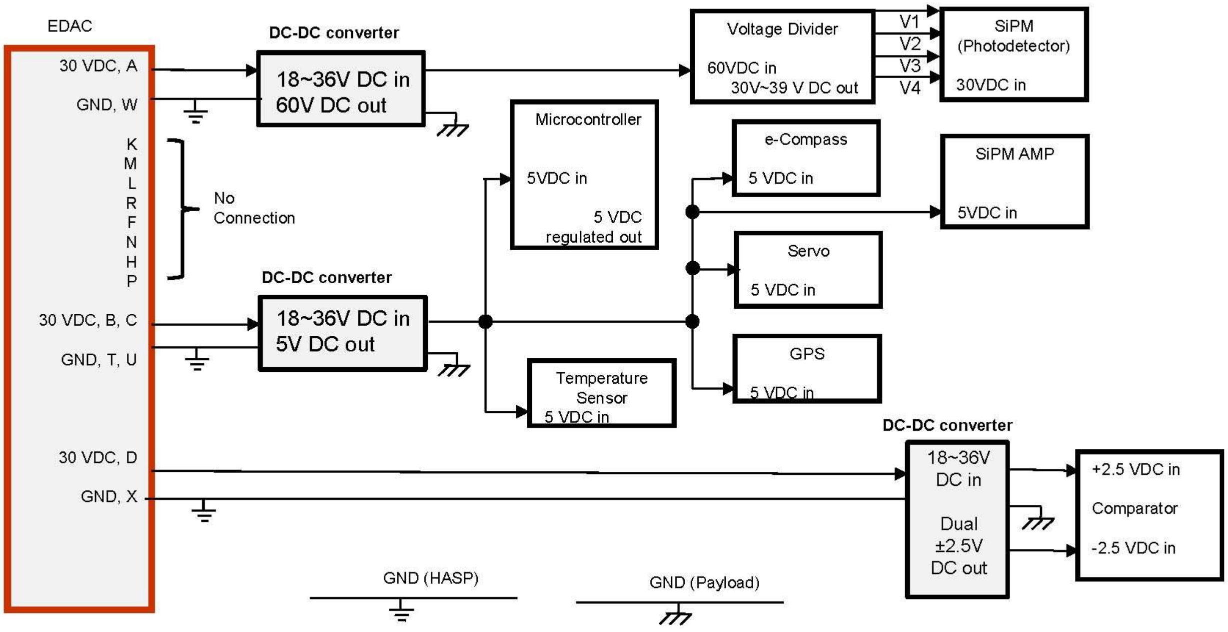
II. Power Specifications:

A. Measured current draw at 30 VDC

Module name	Current (mA)	Voltage (V)	Power (W)
60 Vdc out	69	30	2.07
5 Vdc out	48 (nominal)/ 127 (max)	30	1.44/3.81
±2.5 Vdc out	13	30	0.39
Total (Nominal)	130	30	3.9
Total (Max.)	209	30	6.27

* Max current is when the servo rotates.

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.



[Notes]

- GND (HASP) and GND (Payload) are not to be connected as they are separated by the isolated DC-DC converters.
- All ground pins of the subsystems of the payload shall be connected to GND (Payload).
- The common ground of the dual power supply (for the Comparator) shall be connected to GND (Payload).

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)

8 bps, i.e., one string of average 60 characters per min.

➔ 60 [characters]*8 [bits/char] / 60 [sec] ~ 8 [bps]

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

Data field	# bytes	Comments
Header ('A,' GU GPS time, HASP GPS time, PDU length, 'F',)	27 bytes	2 characters for PDU length to represent max PDU length of 64 characters (after "F," in the header)
Event number	11 bytes	To count up to 2^32-1 (32-bit integer) represented as a

		character string and ‘,’
Number of downward events	11 bytes	
Number of East events	11 bytes	
Number of West events	11 bytes	
Number of sideways events	11 bytes	
e-compass angle in degrees	4 bytes	To count 0~360 degrees and ‘,’
Temperature (inside)	4 bytes	-50 ~ +125 degrees Celsius and ‘,’
End of PDU indicator	1 byte	Character ‘Z’
Total	**91 bytes**	**Maximum; average expected is about 60 bytes**

* All data collected will be transmitted as “characters” (i.e., string of average 60 characters per minute) through the serial link from the payload to the ground (8 bps for downlink transmission as noted above).

D. Number of analog channels being used:

Zero

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

Zero

F. Number of discrete lines being used:

Zero

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

None used

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

No

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*)

No commands to be sent if the payload downlink data indicate normal operation.

If it is necessary to test the operation of the payload during the flight, we prefer to send about 3-5 commands per hour during the testing.

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

Command	Description	Hexadecimal Value
Reboot (silent)	Reboot the Microprocessor	0x00 0x00
Reboot (with confirmation)	Reboot the microprocessor and the payload sends a confirmation of “Reboot command received”	0xB3 0x3F
Ping	Ping the microprocessor and the payload returns “Ping”.	0x41 0x41
Send data	For a manual request to the payload to send a data string (command issued as needed)	0x41 0x00
Auto-rotation OFF	Turn off auto-rotation	0x00 0xF0
Auto-rotation ON	Turn on auto-rotation	0x00 0x0F
Rotate X	Rotate the rotator by X degrees	0xF**X** 0x**XX** [see notes]

[Notes] 1. “XXX” (i.e., “0xF**X” and** 0x**XX**”) represents an integer in hexadecimal format for degrees ranging from 0 to 359 degrees. (These 12 binary bits include 9 bits to represent the angle and 3 leading 0’s).

2. After sending a “Rotate X” command, the “Auto-rotation ON” command must be sent to resume automatic orientation of the payload.

3. Other than “Reboot (silent)”, all commends are acknowledged by the payload with a specific message put on the serial.

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

No

F. Other relevant uplink commanding information.

None

V. Integration and Logistics

A. Date and Time of your arrival for integration:

The team (of 4 student members) will arrive on 7/28/2013.

B. Approximate amount of time required for integration:

If all goes well, half day for payload finalization on site.

1 hour for physical integration (mounting, etc.).

C. Name of the integration team leader:

Aaron Neiman

D. Email address of the integration team leader:

neiman001@knights.gannon.edu

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

Aaron Neiman,	neiman001@knights.gannon.edu
Joseph Bennett,	bennett025@knights.gannon.edu
Codi Wasser,	wasser002@knights.gannon.edu
Kelvin Joefield,	joefield001@knights.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 & 4 successfully performed during & after the T& P test (including analysis of data received through the serial on the downlink to ensure data quality – see details below)

G. List all expected integration steps:

The payload will not be sealed until integration is successfully completed. All unit and integration tests for payload components will be successfully completed before shipping the payload to the launch site.

- 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 to ensure proper payload operation
- Seal the payload with “Rocket” tape.

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

- Ensure proper operation of Detector Module by collecting cosmic-ray events for ~5 minutes to ensure the rate is consistent with previous measurements.

➔ **Data analysis**: the cosmic ray arrival rate is about 3~4 events per minute in the lab. For integration testing, data will be collected for 5 min and the rate of events compared with previous observations.

- Ensure operation of the rotator module and electronic compass through uplink commands

➔ **Data analysis:** Send a command to rotate "30" degrees and read the eCompass heading from the string the payload returns through the downlink serial to verify payload rotation.
➔ After this test, send the "auto-rotate ON" command to the payload (or one of the two Reboot commands) and observe the heading from the string (it should return to ±10 degrees).

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

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

- 30 Volt DC power supply
- 2 Multimeters
- two (2) 2-Channel Oscilloscopes with cables and probes
- Tools for securing payload to the HASP frame