HASP Payload Specification and Integration Plan

Payload Title: Scarlet Hawk IV

Payload Class: Small Large (circle one)

Payload ID: 2016-05

Institution: Illinois Institute of Technology (IIT)

Contact Name: James Henry

Contact Phone: 224.374.6621

Contact E-mail: jhenry2@hawk.iit.edu

Submit Date: 4/29/2016

I. Mechanical Specifications:

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

Component Name	Mass (grams)
Electronics	
Arduino	35
HackHD Camera	~20
Sensors (x7), 3g each	21
Components	~5
Cables and Connectors	~15
PCB	135
Antenna	~50
Amplifier	~75
Batteries	~200
	Total ~556g
Structure	
Angle Frame	194
Internal Structure	180
Small Metal X Plates x3	147
Large Metal X Plates x4	369.5
All Screws and Hex Nuts	30
FRP 4 Sides & Top	~450
	Total ~ 1,370.5
Miscellaneous	300
NET TOTAL	~ 2226.5g±50g

Note: *(~) indicates estimate rather than measurement. All masses rounded to the nearest half-gram.*

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

- As with our last structure, the payload will be oriented such that the side with the outer connectors faces the platform, while the side with the cameras points counter to it. This can be represented graphically as follows:

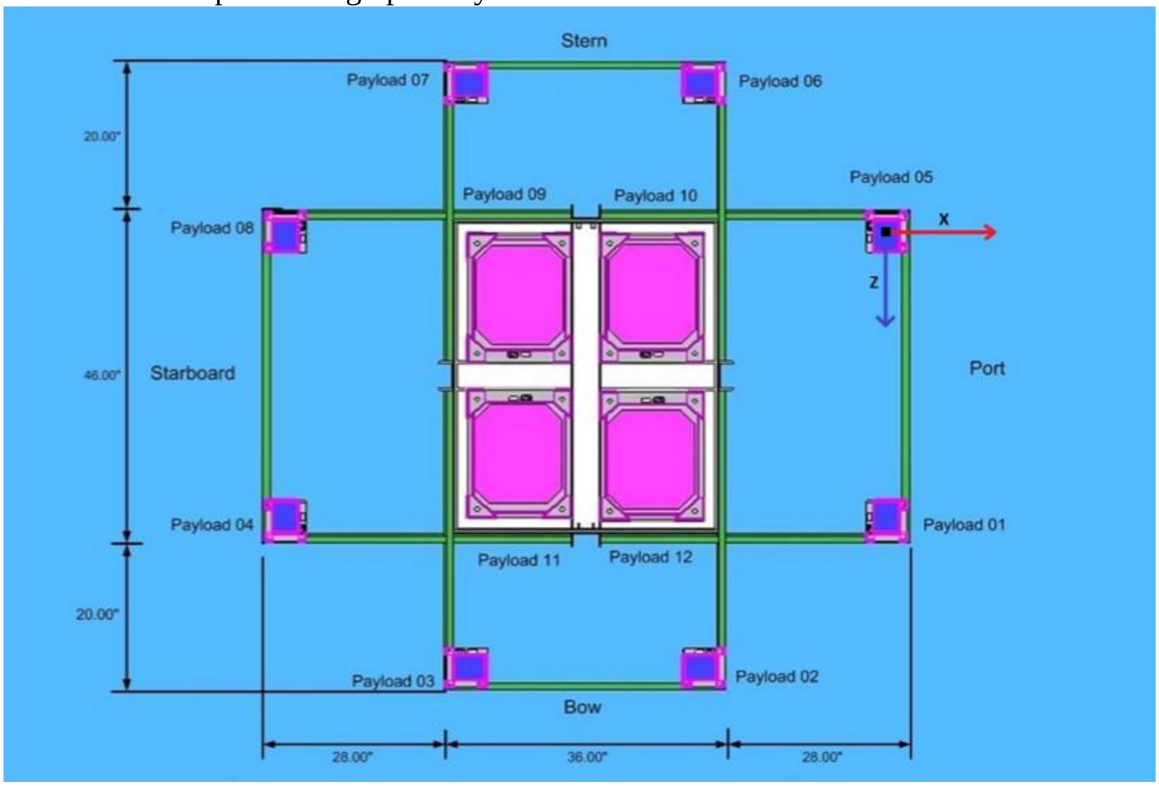


Figure 1: *Location and orientation of the payload. ID 05*

Looking at Payload 05 in the drawing above, the payload's side-facing camera will be pointed along the x-axis to obtain an unobstructed view of its surroundings. The side of the payload with connectors will be facing HASP directly.

The image below shows the positioning of the payload when mounted on HASP. Note that the first photo is from the payload two years ago. With the exception of the solar panels, this year's payload will be identical. The secondary photos identify what is unique to this year's/last year's payload—its attachment to both baseplate and HASP platform.

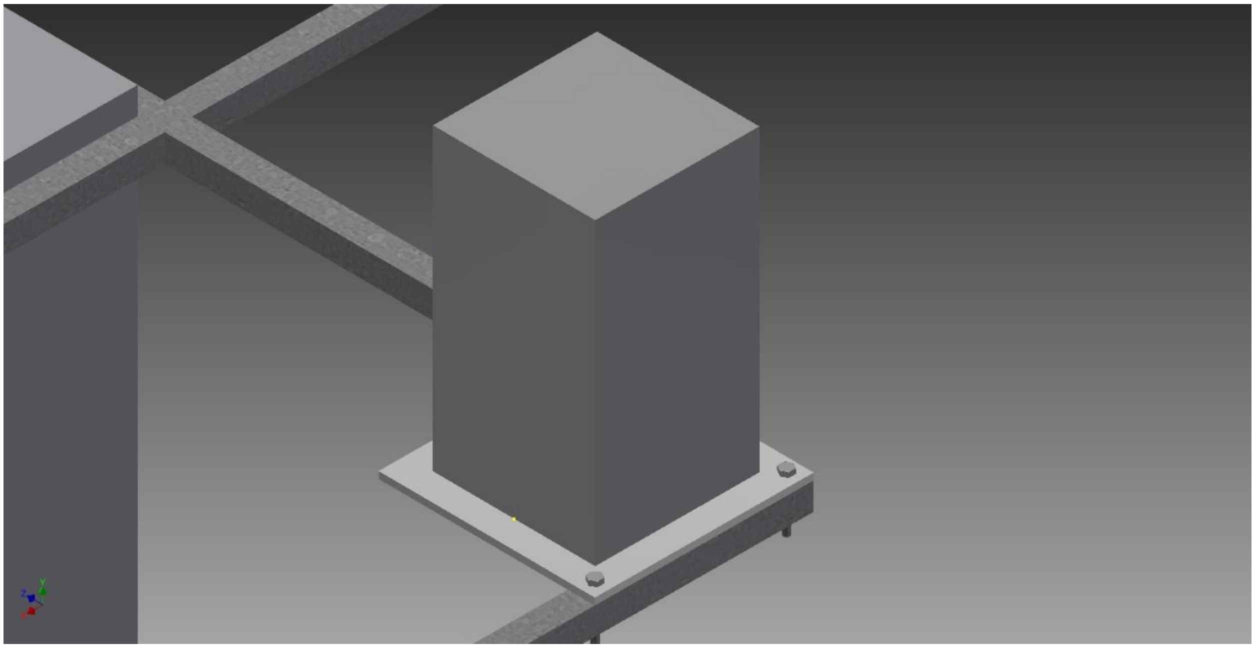


Figure 2: *Similar to last year*

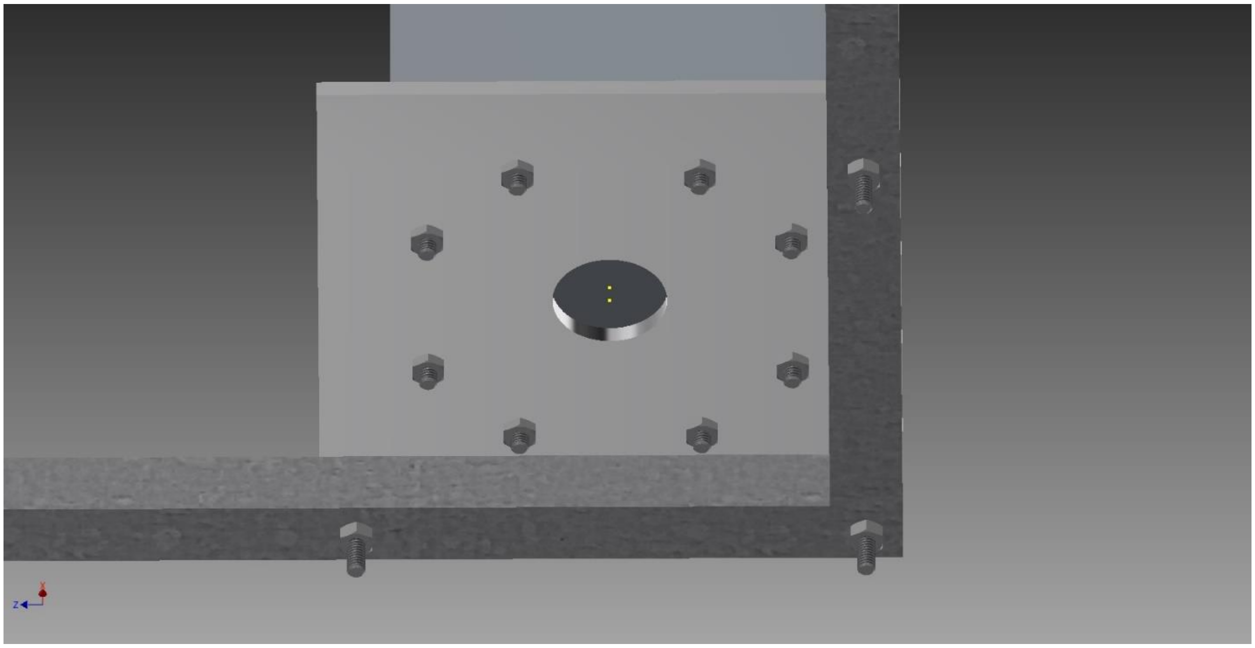


Figure 3: *Baseplate attachment to platform, as well as payload attachment to plate*
(*) The hole in the baseplate has a 4cm diameter

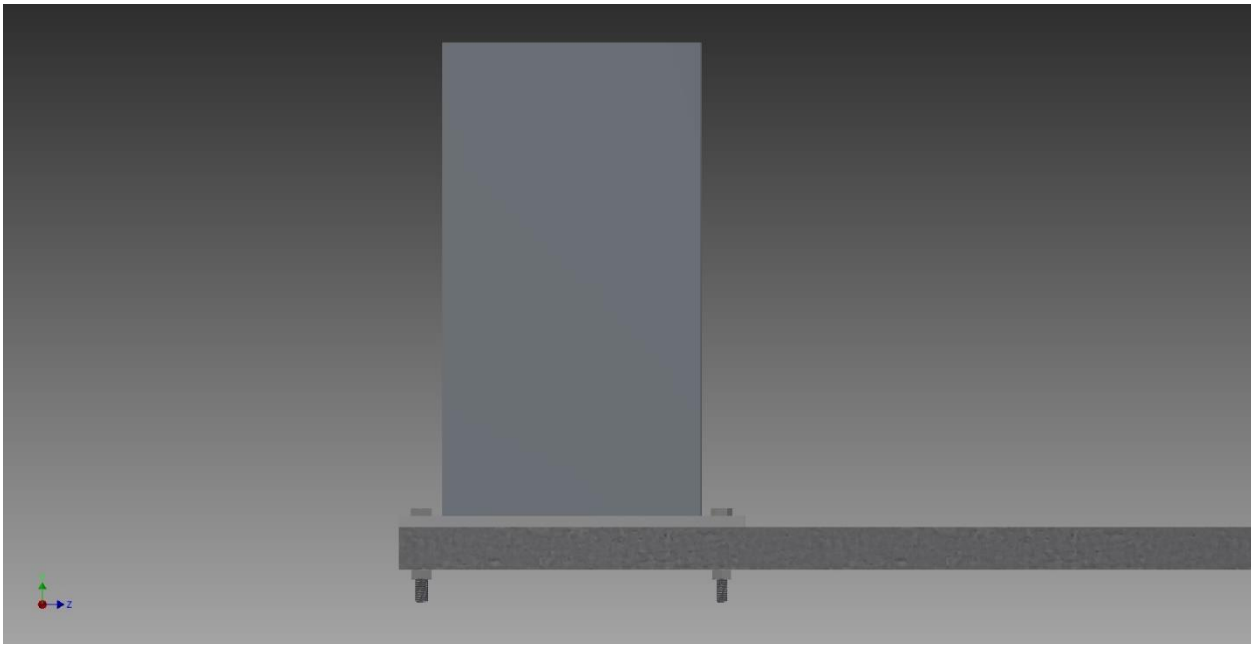


Figure 4: *Attachment as seen from the side*

The next images will show the dimensions of the structure and its different parts

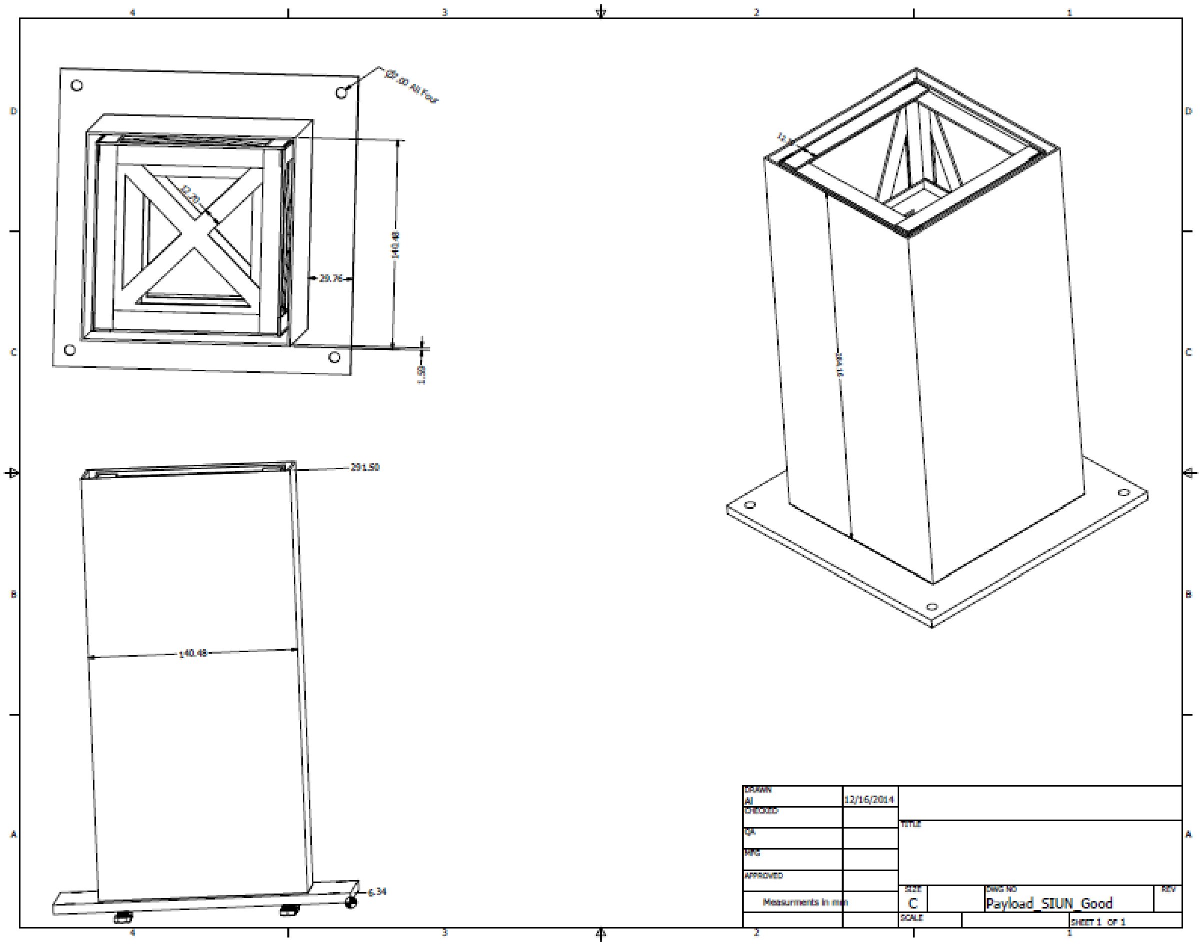


Figure 5: *Small payload dimensions*

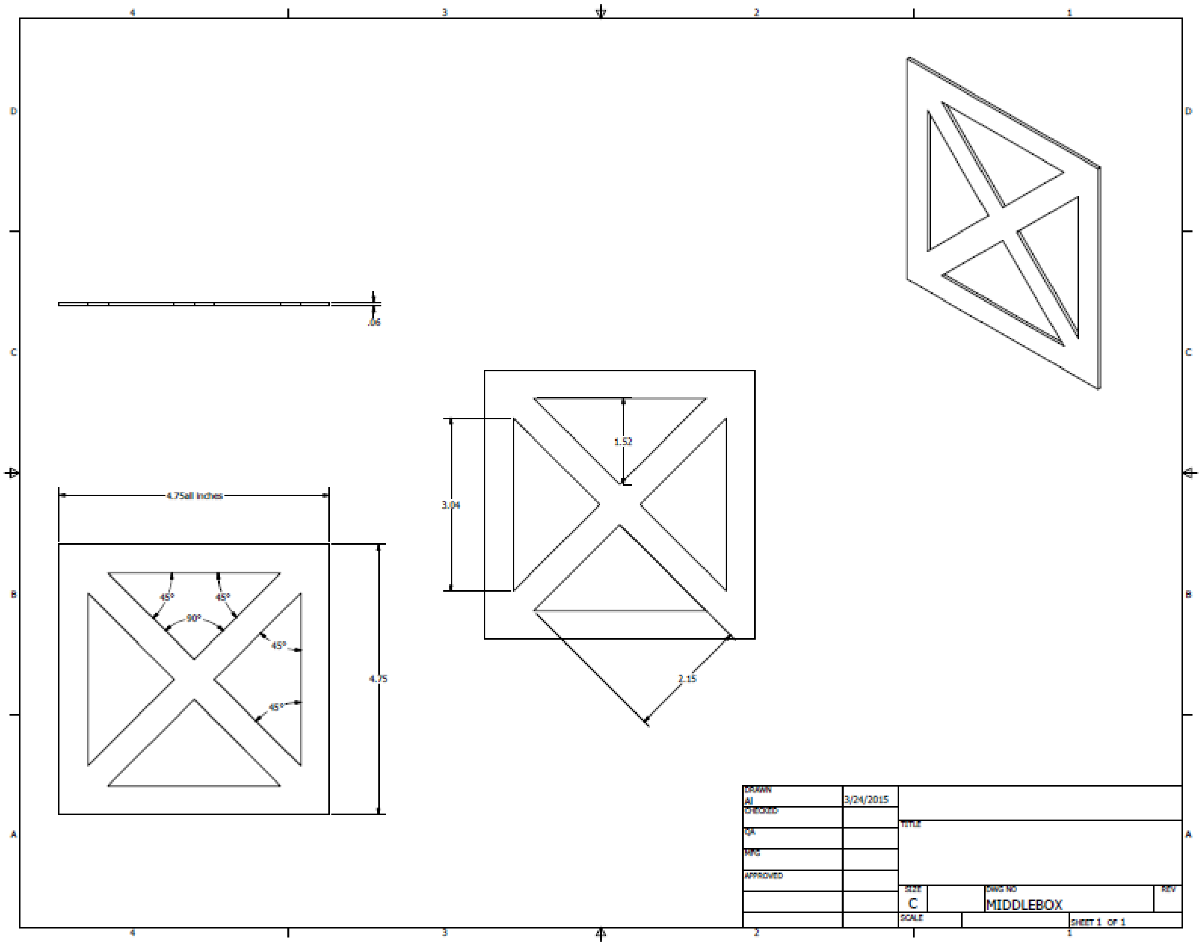


Figure 5: *Detail of the top and bottom face*

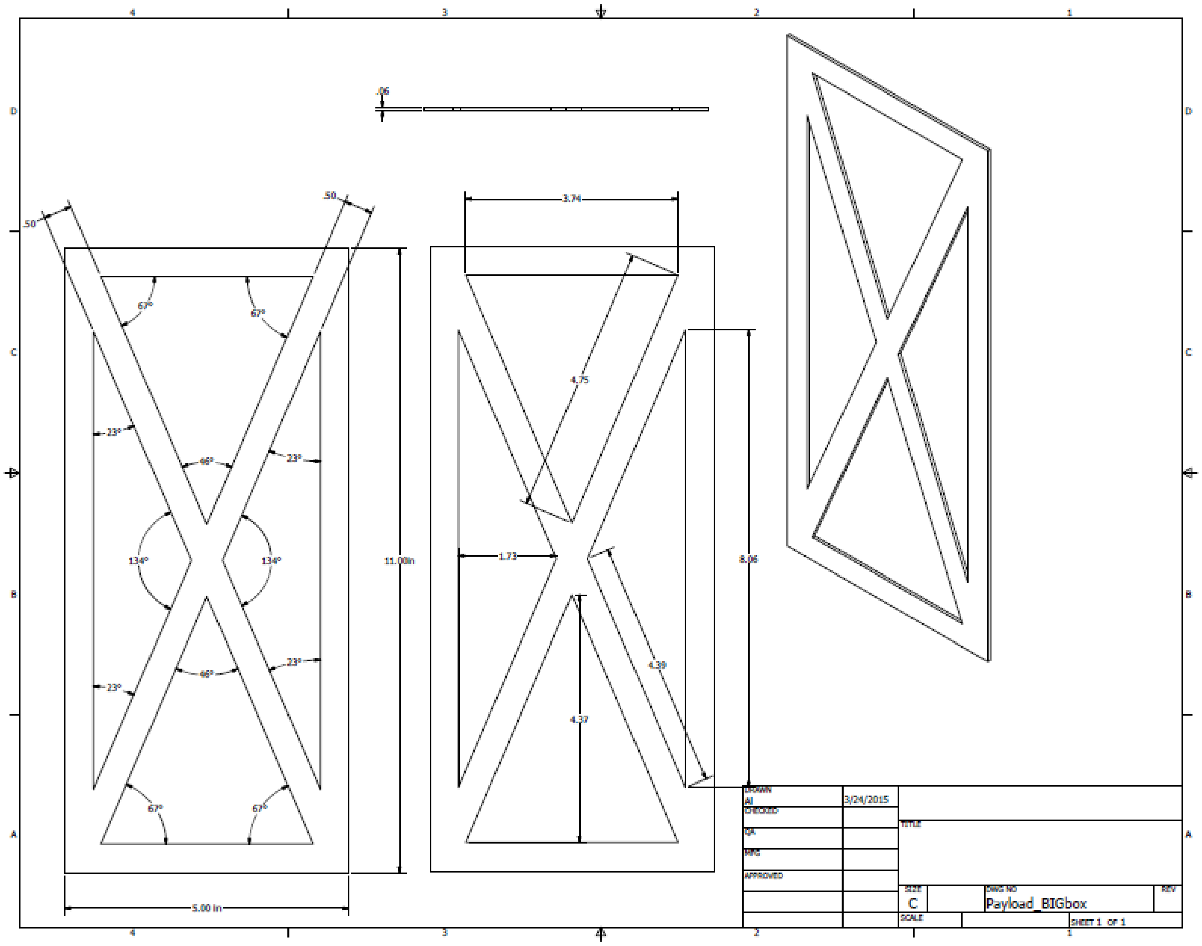


Figure 6: *Detail of one lateral face*

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 will be on board

D. Other relevant mechanical information

- Though not shown, there will be additional punctures made to the FRP for camera and antenna. There will also be additional holes made to the baseplate as components dictate.
- With the successful structure of last year, we would like to ensure that the structure continues to remain usable for the future

II. Power Specifications:

A. Estimated current draw at 30VDC

Since we have not completed board assembly yet, the following are estimated calculations. Real measurements should be available for the final PSIP document.

For Arduino and sensors the current draw is as follows:

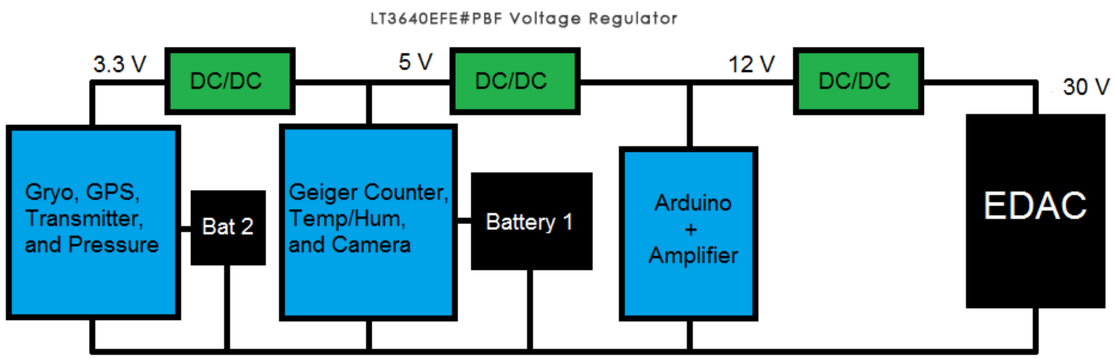
Component	Quantity	Voltage	Current (Max)	Power
HIH6130	x1	5.0 V	1.0 mA	0.005 W
MS5803-14BA	x1	3.3 V	1.4 mA	0.005 W
Geiger Tube	x1	5.0 V	30 mA	0.150 W
GPS Module	x1	3.3 V	44 mA	0.145 W
Gyro/Acc	x1	3.3 V	3.9 mA	0.015 W
Hack HD Camera	x1	5.0 V	1.0 mA	0.005 W
Amplifier	x1	12.0 V	300 mA	3.600 W
Arduino	x1	12.0 V	80 mA	1.040 W
Transmitter	x1	3.3 V	75 mA	0.250 W
Total		**N/A**	**536.3 mA**	**5.185 W**

(*) The current draw @30V will be less than the one showed in this table. The total maximum current should be greater than 0.5A, but multiple components will be run on battery power to compensate for this.

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.

The connection to the EDAC 516 connector is a simple connection using 3 DC/DC converters to downgrade from 30V and get 12V, 5V and 3.3V to supply all the components, in addition to batteries powering certain components (most likely transmitter and camera).

The power diagram looks as follows:



C. Other relevant power information

III. Downlink Telemetry Specifications:

A. Serial data downlink format: Stream <u>Packetized</u> (circle one)

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

30 bits per second.

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

<Head><$S_{Tmp/hum}$>< S_{Gyro}><$S_{Pressure}$>< S_{Geiger}><S_{GPS}><S_{Camera}>
<f_{com}><Time><Checksum><Footer> (18 Bytes = 144 bits)

Byte #	Data	Function
1	Header	Flag for the beginning of the packet
2	$S_{Tmp/Hum}$	Values of the temp/hum sensor
4	$S_{Pressure}$	Values of the pressure sensors
6	S_{Gyro}	Values from gyroscope
8	S_{Camera}	Camera ON/ OFF flag
10	S_{GPS}	Value from GPS
12	F_{com}	Frequency used by comm system
13	Time	Time in milliseconds
17	Footer	Flag for end of packet

D. Number of analog channels being used:

No analog channels used.

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

F. Number of discrete lines being used:

No discrete lines are used.

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

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

Frequency located on the 70cm band (420 - 450 MHz). Real value not specified since the frequency will be varied depending on noise condition. The frequency used by the system in all cases will be allocated far enough from the frequencies used by the HASP balloon based on interaction with them. This transmitter will be used to send the data from the payload as a simple test of a homebrew communications system.

I. Other relevant downlink telemetry information.

IV. Uplink Commanding Specifications:

A. Command uplink capability required: <u>Yes</u> No (circle one)

B. If so, will commands be uplinked in regular intervals: Yes <u>No</u> (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*)

2 If necessary, hopefully none

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

Command number	**Command byte 1**	**Command byte 2**	**Function**
1	0x00	0x00	Reset Arduino
2	0xAA	0xFF	Disable Communications

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

Yes, The frequency will be the same as the transmitter. Most likely around 433MHz depending on noise conditions (can be adjusted to comply with requirements of CSBF)

F. Other relevant uplink commanding information.

V. Integration and Logistics

A. Date and Time of your arrival for integration:

Monday, August 1st at 2pm

B. Approximate amount of time required for integration:

We estimated 5h for payload integration in the facility

C. Name of the integration team leader:

James Henry

D. Email address of the integration team leader:

Jhenry2@hawk.iit.edu

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

We plan on having 4 integration participants:

- James Henry (jhenry2@hawk.iit.edu)
- Kevin Hardin (olivine8910@gmail.com)
- Jacob Freeman (jfreeman@hawk.iit.edu)
- Alan Grossman (agrossm5@hawk.iit.edu)

F. Define a successful integration of your payload:

Successful integration of SCARLET HAWK IV with HASP platform includes: Connecting power and uplink/downlink as well as attaching the payload to the platform. In addition, we would like to have a working downlink for sensors and communication data and an uplink for the required commands.

Confirming the functionality of individual sensors (the data makes sense) and camera (the SD card has the images recorded). The independent communication link will also be confirmed, and verifying that we receive same downlink data in our ground station as the gondola sends.

Confirming the same functionality while undergoing thermal-vacuum testing. We expect to have some communication issues in this case: as the vacuum chamber is a closed metal isolated environment, our antennas may not be able to radiate through it or have some additional attenuation.

G. List all expected integration steps:

1. Connect the EDAC and DB9 to the SCARLET HAWK IV payload.

2. Turn on payload power
3. Confirm successful downlink of sensor data
4. Confirm successful communication system:
    - 5.a Downlink: sensor data received in our ground station
    - 5.b Uplink: commands sent to the payload station
    - 5.c Communication modes: check the communication system changes to the desired frequency
        - Test multiple frequencies (433MHz, 443MHz, 425MHz)
5. Turn off the payload power
6. Close up the payload and check the mechanical interface between the base plate and the payload structure
7. Attach the payload base-plate to the HASP gondola structure
8. Turn on the payload power
9. Re-confirm successful downlink of sensor data
10. Re-confirm the successful uplink of each serial command
11. Re-confirm communication

H. List all checks that will determine a successful integration:
1. Nominal downlink and uplink communication.
2. Nominal power consumption.
3. Successful independent communication link.
4. Successful camera operation.
5. Successful completion of thermal and vacuum tests.

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…):

N/A

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

N/A