HASP Payload Specification and Integration Plan

Payload Title: Scarlet Hawk II

Payload Class: **Small** Large (circle one)

Payload ID: 2014 - 05

Institution: **Illinois Institute of Technology**

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Submit Date: 25/04/2014

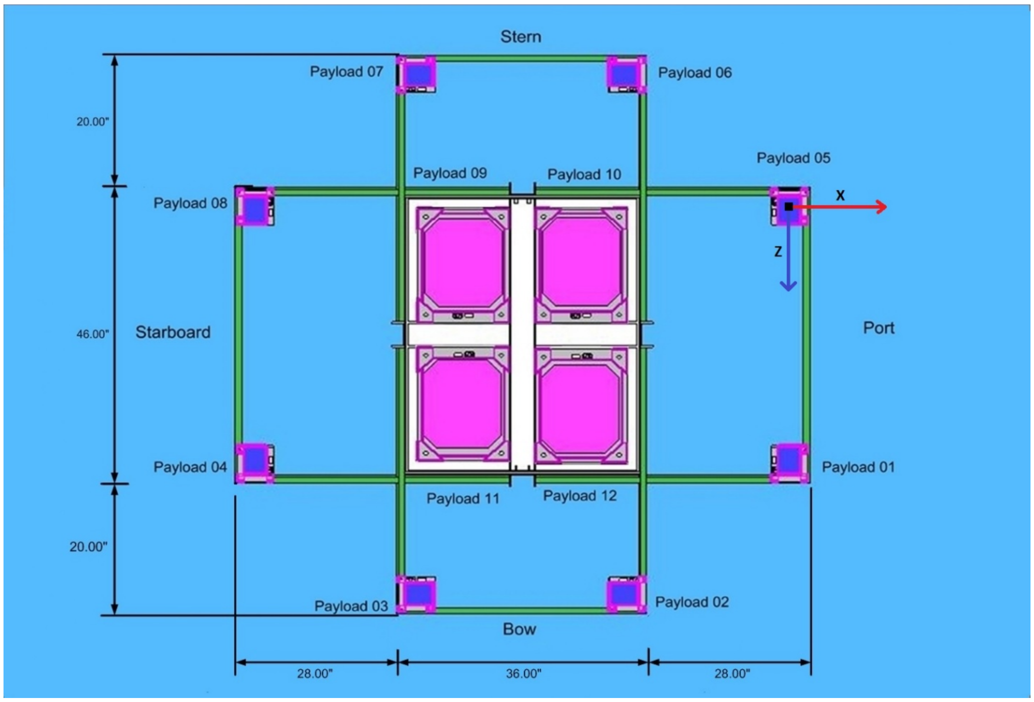
I. Mechanical Specifications:

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

Component	Mass (grams)	Measured or estimated mass
Aluminum frame	220.6	Measured
FRP panels w/glue	415	Measured
Fasteners	30	Estimated
Battery	82.6	Measured
FRP upper cover	50.3	Measured
Cameras (both)	66.1	Measured
Arduino PCB	140	Measured
Solar cells	64	Measured
IPS PCB	300	Estimated
Miscellaneous	300	Estimated
TOTAL	**1668.6**	**Estimated**

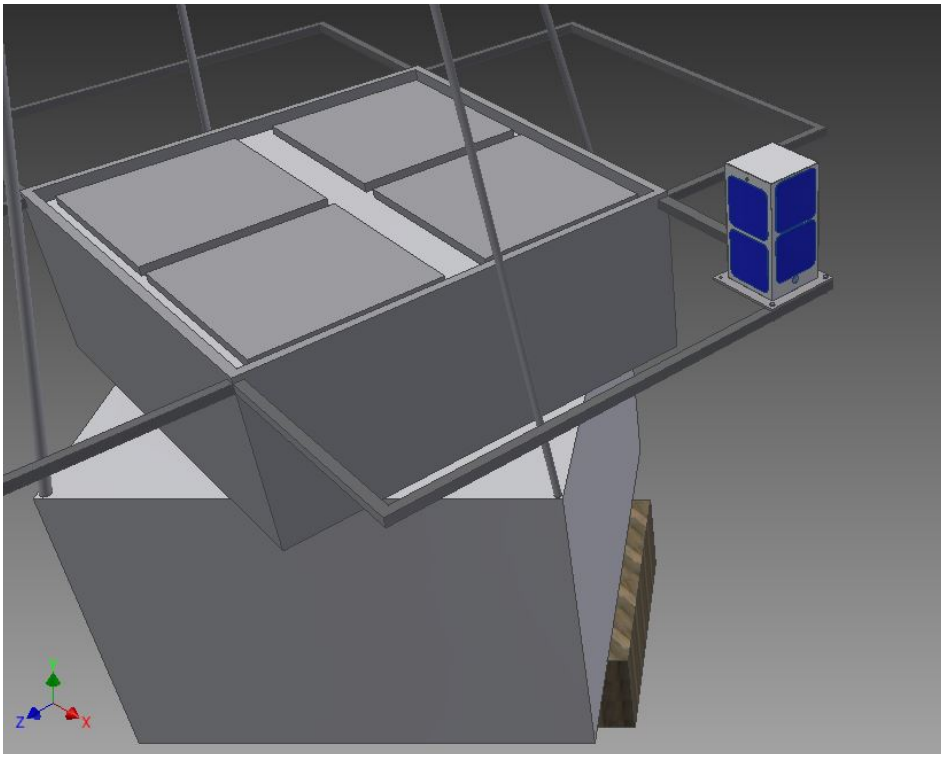
B. Provide a mechanical drawing detailing the major components of your payload and specifically how your payload is attached to the payload mounting plate

- The payload will be oriented in a manner such that the side with the outer connectors faces HASP directly, while the side of the payload with the camera points away from HASP. This can be represented graphically as follows:

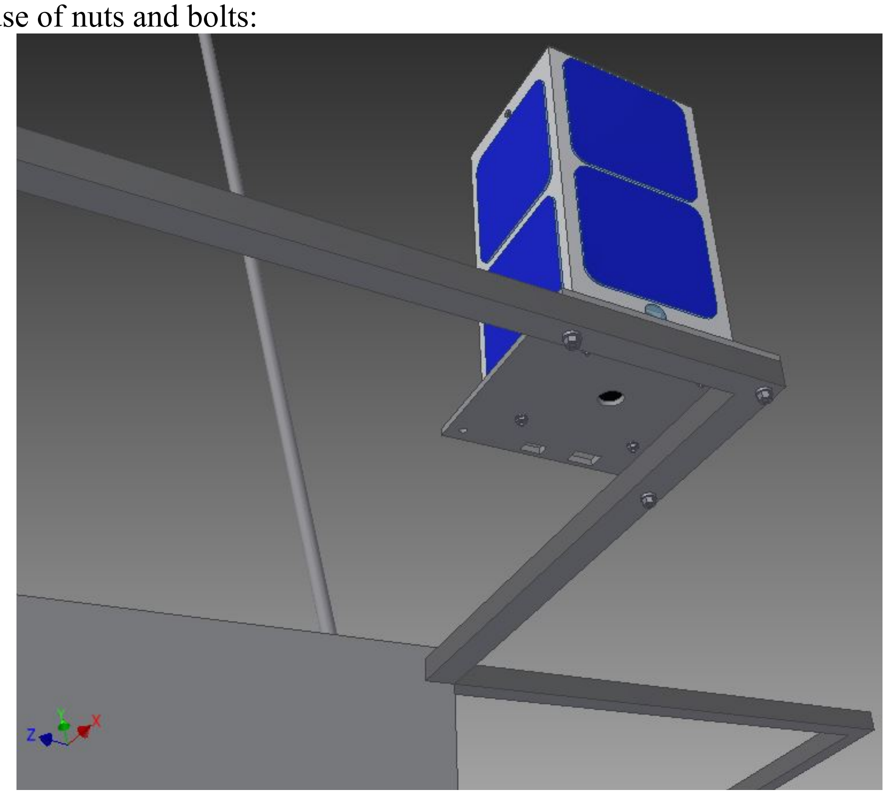


Looking at Payload 05 in the drawing above, it can be seen that the side of the payload with the side-facing camera will be pointed along the x-axis to obtain an unobstructed view of the surroundings. The side of the payload with connectors will be facing HASP directly (opposite direction of the x-axis).

The image below shows the positioning of the payload when mounted on HASP, from a 3D perspective:

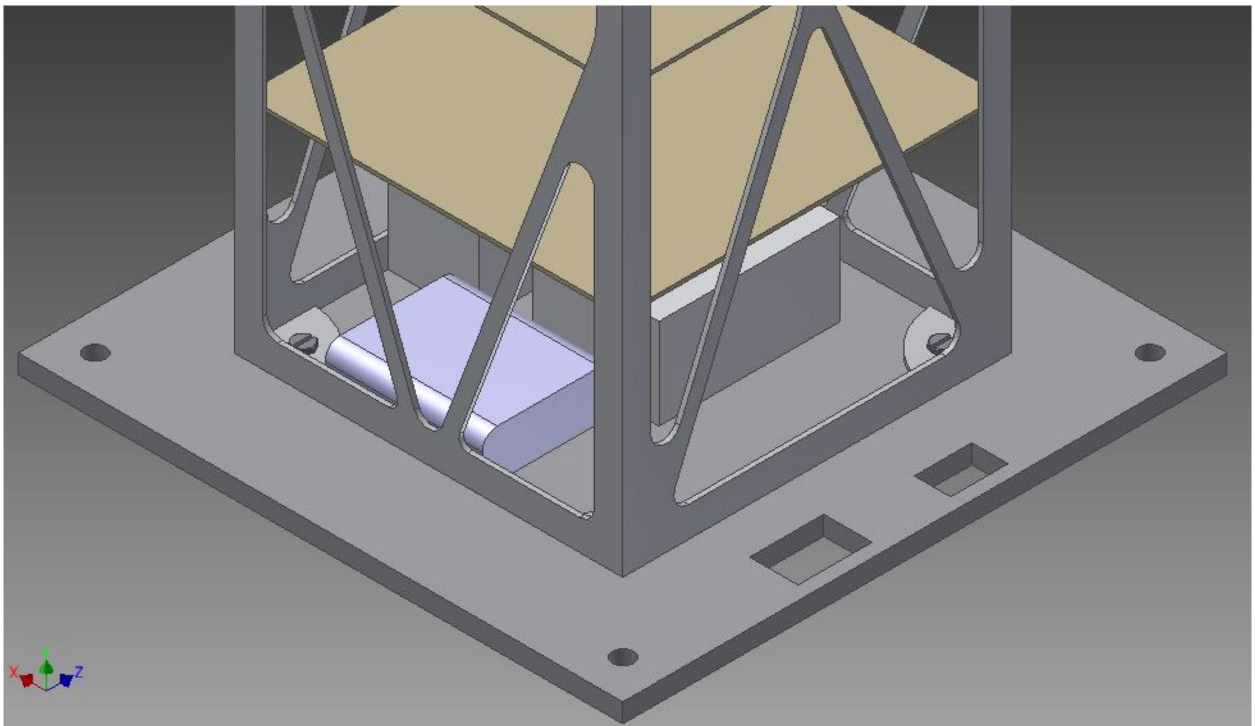


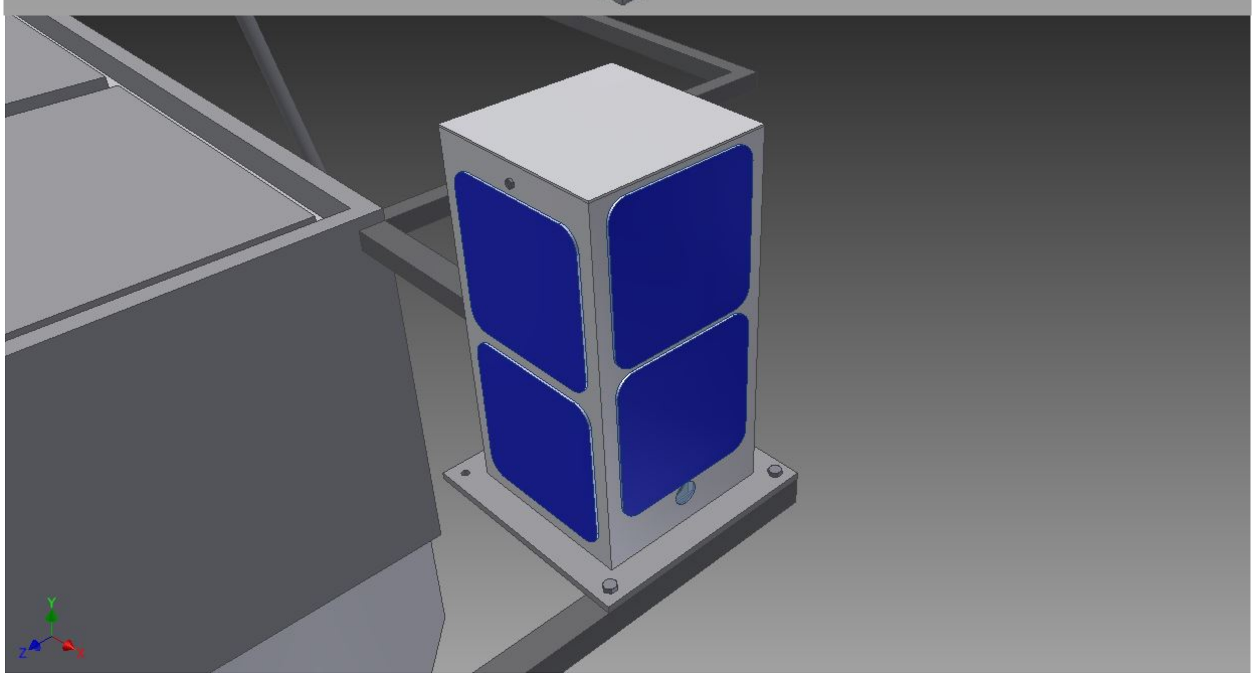
The picture below allows to get a better view of how the payload is connected to HASP with the use of nuts and bolts:

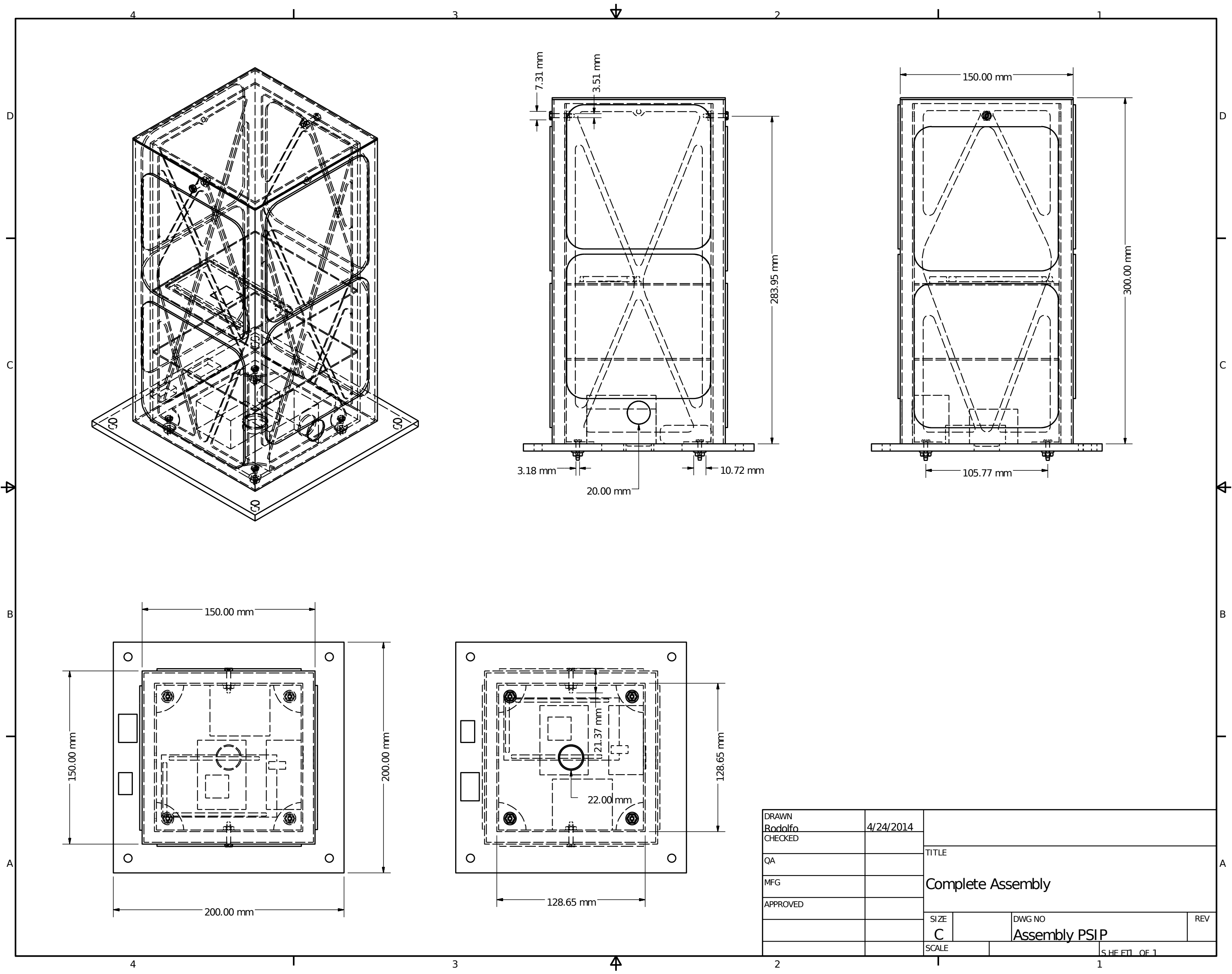


In both of the previous pictures, notice the orientation of the coordinate system on the bottom left corner.

The picture below allows to see how the aluminum frame is attached to the baseplate using nuts and bolts (the outer cover of the payload is removed to allow a better view of the inside). From this angle, only two of the bolts are visible; there is one bolt on each corner of the aluminum frame.







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

- Our solar panels are fairly fragile so care should be taken when manipulating the payload.

II. Power Specifications:

A. Measured current draw at 30 VDC

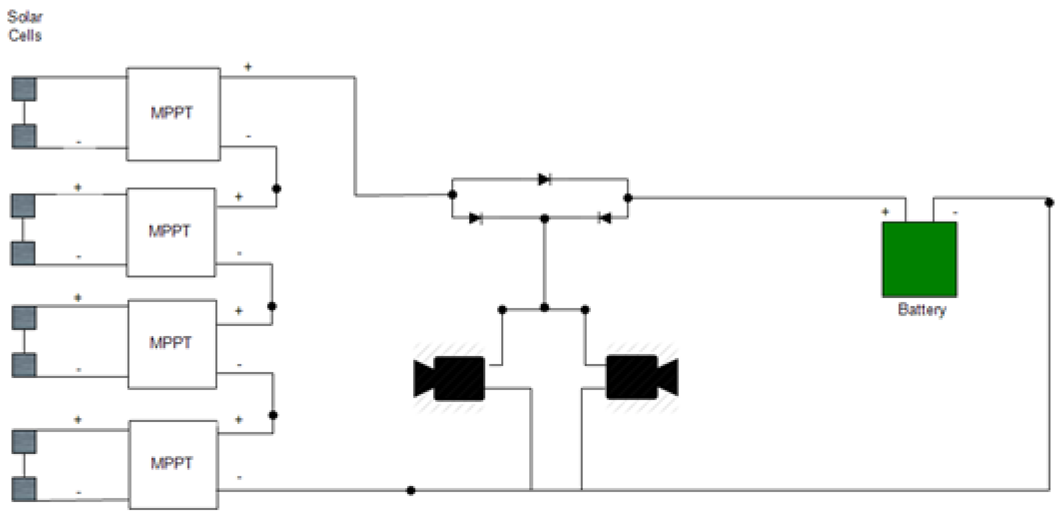
- The maximum power drawn from the EDAC connector measured on the current system is 0.3W (0.06A @ 5V)

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 system is a simple 30 to 12 V DC/DC (muRata 7812R-C) power converter plugged between the EDAC connector and the Arduino microcontroller.

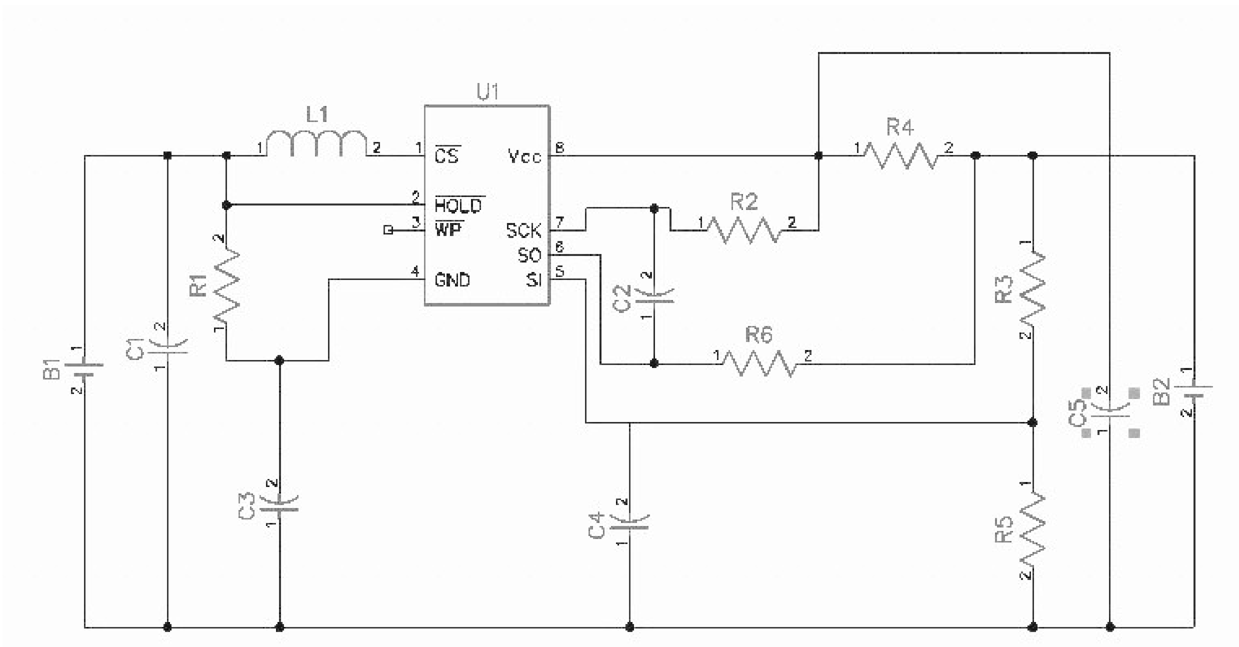
C. Other relevant power information

- The final schematics of the **independent** power system is as follows:



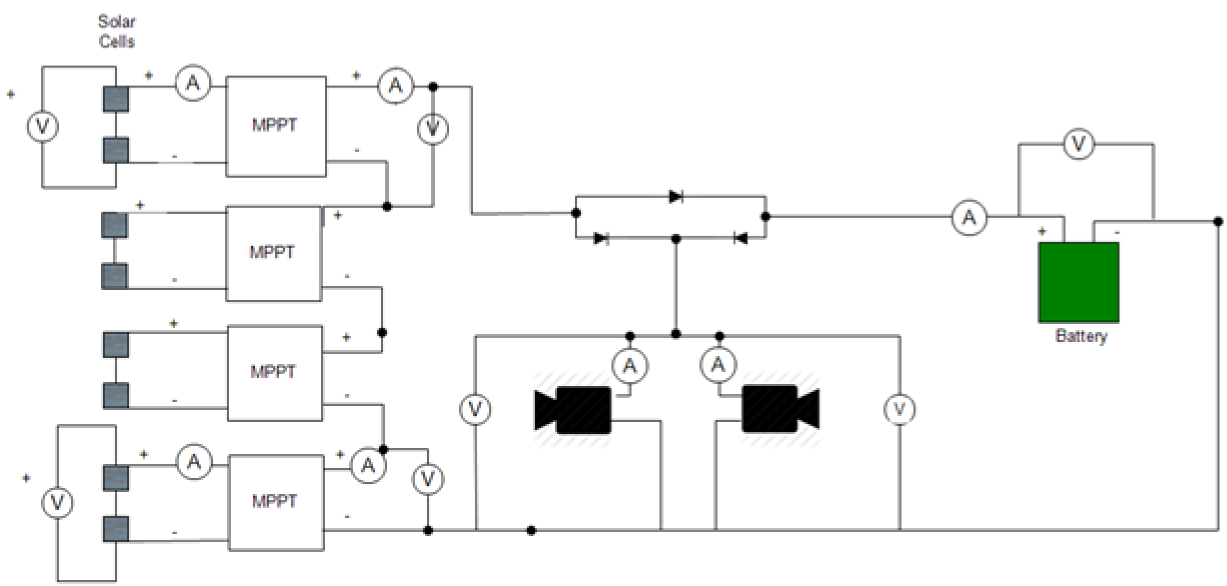
The three-diode system acts as a controller among the three parts: it provides power to the battery to charge when its level is low, avoids current to feed back to the solar cells and let current flow to the cameras.

The MPPT is a Maximum Power Point Tracker for the solar cells. It assures the maximum power transfer from the solar cells to the system by adapting the impedance. The schematics for the MPPT are:



Where U1 correspond to the spv 1040 microchip.

Previously, we have also mentioned the sensors which will be monitoring the system. These sensors are current and voltage sensors, located in the circuit:



D. Power Budget of the independent power system

SOLAR CELLS

The power of the solar cells will vary depending on the solar intensity and their position respect the sun. Consequently, for the power calculation we first estimated the mean power of all solar cells during flight and the power provided by a side of the pilot (two solar cells)

- Estimated mean power during flight

Using 8 solar cells of 15625 mm2 (125x125mm) and an efficiency of 19%.

Max power = 4.71 W

- 2 cells in series connection (which represents one side of the payload)

Estimated power

Max Estimated power (cell pointing perpendicular to the sun) =3.706 W

Voltage ~0.6V

Measured power

Voltage: from 0.59 V to 0.9V (depending on the solar intensity)

Estimated power:

Generally - power <= 3.706W

Max power supplied (for 1 V) < 6 W

MPPT

The MPPT output values depend on the input values, in this case, the solar panels values. For the power estimation we have calculated the maximum value (the maximum power the MPPT can provide) and the expected value (the power the MPPT will provide given the power supplied by solar panels most of he time)

Estimated power

Max output current = 1.8 A
Max output voltage = 5.5V
Max power = 9.9 W

BATTERY

The battery will be charged by the solar cells and will be the supply source of the cameras. For that reason, we will focus on the power the battery can provide. This power will be also modified, as the cameras consume it and the solar cells regenerate it. Consequently, we measured the maximum power and the power they will provide most of the time.

Specifications of the battery component:

Voltage: 3.6V
Current: 2 A
Max. Power supplied: 7.2 W

Measured voltage:

Full charged, the voltage supplied is: 3.79 V

CAMERAS

Cameras will be the consumers of the power. For that reason, we focused on the power they need and the minimum voltage at which the cameras work.

Specifications of Go Pro Camera

Voltage: 3.7 V

Power consumed: 3.885 W

Measurements

Min voltage: 3.6 V

III. Downlink Telemetry Specifications:

A. Serial data downlink format: Stream **Packetized** (circle one)

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

- The downlink rate should be around 150 bits per second, which correspond to a packet every 2 seconds.

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

- The serial downlink will include

#	Data	size	Content
0	Header	1B	!
1	<V_{sp}1>	2B	Voltage solar panel assembly 1
2	<A_{sp}1>	2B	Amps solar panel assembly 1
3	<V_{sp2}>	2B	Voltage solar panel assembly 2
4	<A_{sp}2>	2B	Amps solar panel assembly 2
5	<V_{mppt}1>	2B	Voltage MPPT 1
6	<A_{mppt}1>	2B	Amp MPPT 1
7	<V_{mppt}2>	2B	Voltage MPPT 2
8	<A_{mppt}2>	2B	Amp MPPT 2
9	<V_{cam}1>	2B	Voltage camera 1
10	<A_{cam}1>	2B	Amp camera 1

11	<V_{cam}2>	2B	Voltage camera 2
12	<A_{cam}2>	2B	Amp camera 2
13	<V_{bat}>	2B	Voltage battery
14	<A_{bat}>	2B	Amp battery
15	<checksum>	2B	Checksum for data integrity
16	<cr>	1B	New line character
-	**Total**	**32B**	**-**

Which is a 32 bytes long record.

The checksum is there to ensure the integrity of the data.

D. Number of analog channels being used:

- No analog channel used.

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

F. Number of discrete lines being used:

- No discrete line 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.

- No on-board transmitter.

I. Other relevant downlink telemetry information.

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*)

- There should be only 3 commands sent during the flight. First before take off the cameras are going to be put into fast mode. Then another command will be send to put the camera into normal mode for most of the duration of the flight. Depending on the battery level, a last command might be sent before termination to get more pictures of the descent.

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	Command
1	0	F	Take pictures at a low frequency (power saving mode)
2	F	0	Take pictures at normal frequency
3	F	F	Take pictures at hugh frequency
4	0	0	Stop taking picture

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

- No on board receivers

F. Other relevant uplink commanding information.

V. Integration and Logistics

A. Date and Time of your arrival for integration:

- The expected arrival time is 5PM on August 4th.

B. Approximate amount of time required for integration:

- The team expects to take approximately 4h for payload integration at the facility.

C. Name of the integration team leader:

- David Finol

D. Email address of the integration team leader:

- dfinolbe@hawk.iit.edu

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

- David Finol (dfinolbe@hawk.iit.edu)
- Lou Grimaud (lgrimaud@hawk.iit.edu)
- Caterina Lazaro (clazarom@hawk.iit.edu)
- Aritra Dasgupta (adasgup4@hawk.iit.edu)

F. Define a successful integration of your payload:

- Successful integration of SCARLET HAWK II with HASP platform includes connecting power, downlinking sensor and camera data, sending required commands and confirming the functionality of individual sensors. The payload must then function normally while undergoing thermal-vacuum testing.

G. List all expected integration steps:

1. Connect the EDAC and DB9 to the SCARLET HAWK II payload.
2. Turn on payload power
3. Confirm successful downlink of sensor data
4. Confirm successful uplink of each serial command
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 baseplate to the HASP gondola structure
8. Turn on the payload power
9. Re-confirm successful downlink of sensor data
10. Check power produced by the solar cells
11. Re-confirm the successful uplink of each serial command

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

1. Nominal downlink and uplink communication
2. Nominal power consumption and production
3. Successful camera operation

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