HASP Payload Specification and Integration Plan

Payload Title: High Altitude X-Ray Detector Testbed

Payload Class: Small Large (circle one)

Payload ID: 3

Institution: University of Minnesota – Twin Cities

Contact Name: Patrick Doyle

Contact Phone: 314-276-1944

Contact E-mail: doyle174@umn.edu

Submit Date: April 20, 2012

I. Mechanical Specifications:

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

The current measured mass of available components is 457 g, which includes the flight computer, IMU, GPS, power conversion circuit and all wiring and connectors. The current mass estimate of the payload structure from 3-D modeling is 544 g. The current mass estimate of the x-ray detector system is 500g. It should be noted that this mass is relatively uncertain. A sample of scintillator material (~50g) has been obtained that verifies our estimate of 500g to be acceptable. Preliminary mass calculation of the thermal insulation (polyfoam) has yielded a mass of 147 g. If it is found that the detector causes the payload's current draw to exceed the allowed 500mA, then a battery will be used to power the detector system and another 1 kg will be added to the total payload mass.

Thus, two masses have been calculated:

Total estimated payload mass with a battery is 2.648 kg.

Total estimated payload mass sans a battery is 1.648 kg.

For the worst-case scenario of having to incorporate a battery, this leaves an allowable uncertainty of 352 g to account for the unknown mass of the x-ray detector system.

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

Currently mechanical drawings are not complete. However, Figures 1 and 2 below are images showing the anticipated base plate (10cm x 10 cm) that interfaces with the mounting plate in 5 locations (note: 4 small holes are also shown for mounting components within the structure) and the assembled structure. This plate will be mounted with vibration and shock dampers such that the structure will withstand the maximum allowable loads. Drawings with dimensions will be completed by the May monthly status report as the final structure design will be complete by that time.

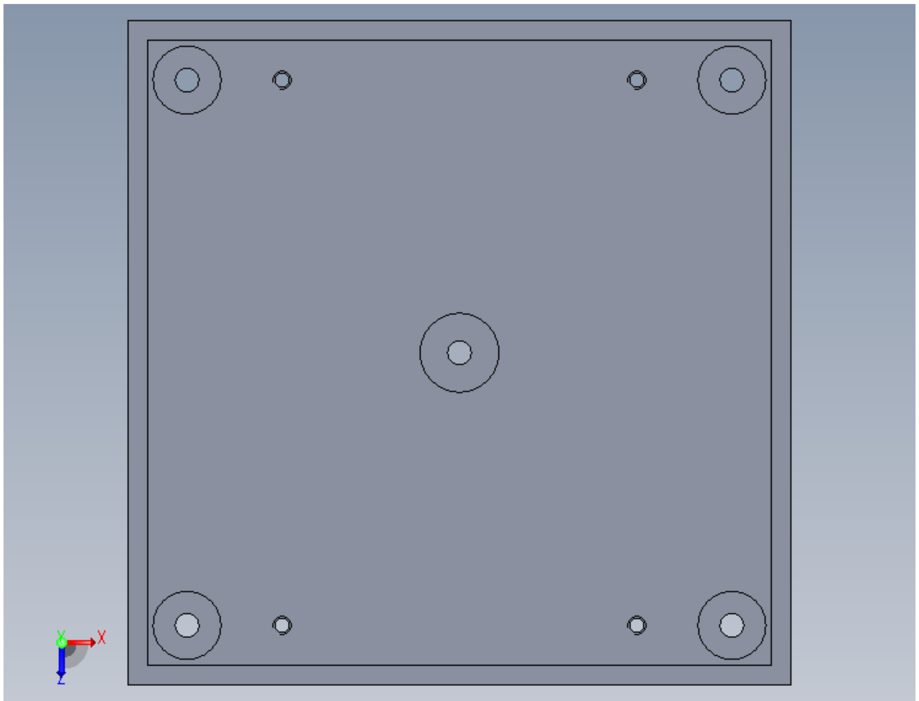

Figure 1. Payload base with 10cm by 10cm square dimensions that will attach to the mounting plate via bolts through the single inner hole and four outer holes.

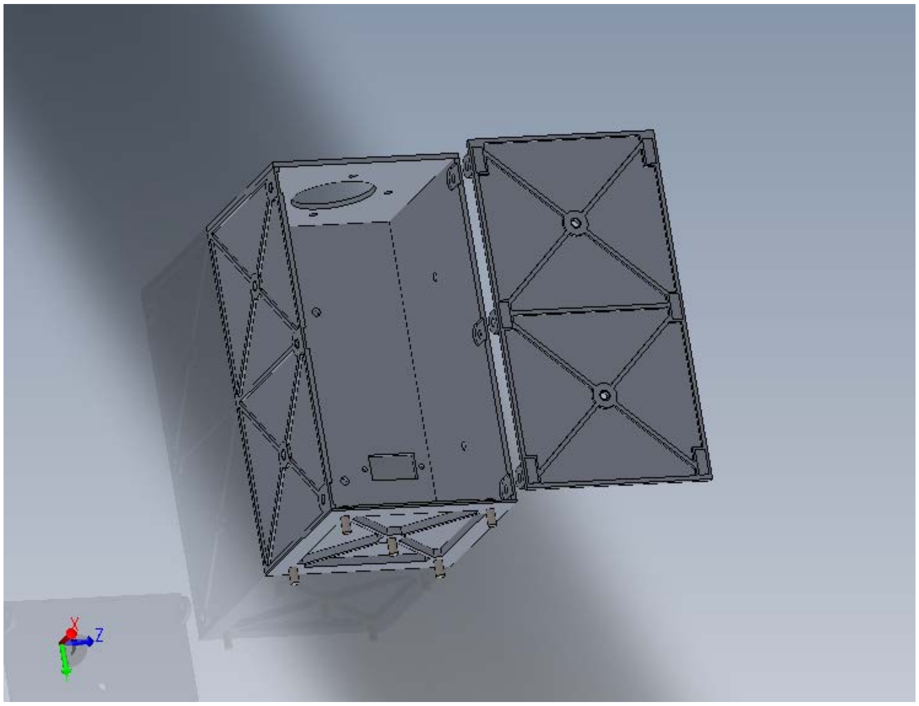

Figure 2. Model of assembled structure. The current design calls for an aluminum alloy to be used for all components. The circular opening at the top of the structure allows for servos to be installed for future missions to point the detector at x-ray sources.

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…)

   We may fly a lithium sulfur dioxide battery. Attached (separately) is the material safety data sheet for the anticipated battery.

D. Other relevant mechanical information

   All masses and structural drawings have only passed a preliminary design review.

II. Power Specifications:

A. Measured current draw at 30 VDC

   The flight computer and ancillary sensors draw 356mA from a 30V power supply. This includes the consumption from the power regulation circuit, IMU, GPS and flight computer. The x-ray detector power draw is still uncertain at this time. However, if it is found that the current draw with the x-ray detector connected to the flight computer exceeds 500mA, a battery will be purchased to power the detector.

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.

   Figure 3 below shows pins from the EDAC 516 connector tied together, which provides the 30 VDC supply to our power supply buffer and voltage regulator as schematically shown in Figure 4. Although a further DC voltage conversion is performed via the daughter board for its peripheral systems, this is not dependent on the power system's first stage as shown in Figure 4.

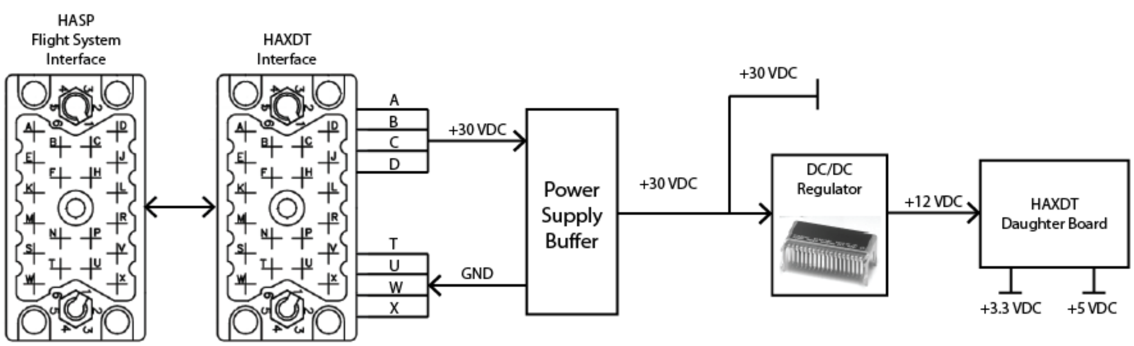

Figure 3. HASP EDAC516 connector interface with the payload.

The payload is isolated from reverse polarity of input voltage and limits the current draw of the circuit to 495mA to prevent in-rush current spikes. A green LED indicates stable 12.8V source for GPS system, flight computer and x-ray detector.

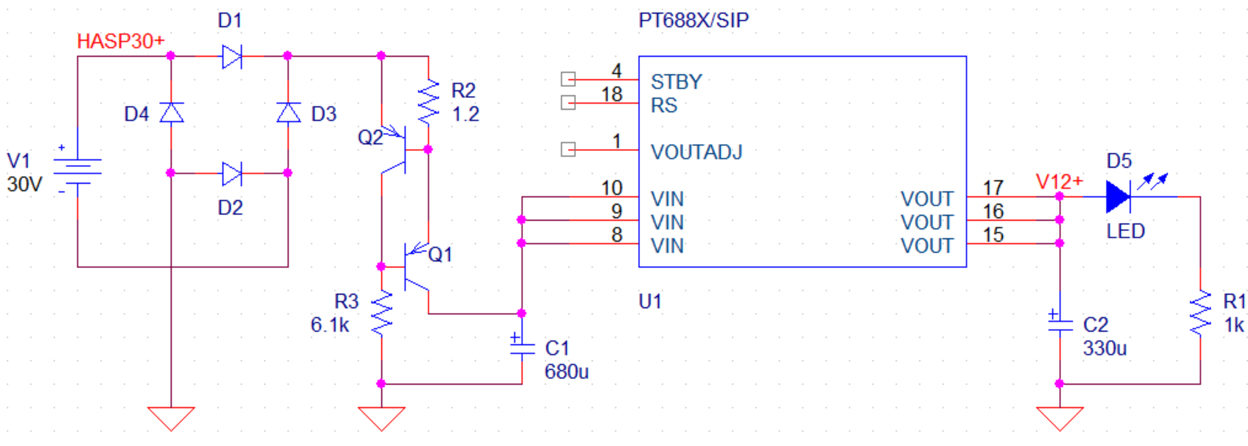

Figure 4. Power regulation and protection circuit.

C. Other relevant power information

A battery may be used to power the x-ray detector, but this will not be determined until we perform testing of the detector system at Lockheed Martin Space and Missle Systems in Sunnyvale, CA. Testing is scheduled to occur in early June.

III. Downlink Telemetry Specifications:

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

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

1200 bps

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

Header = 0xAA	Payload Status Packet 148 bytes	Footer = 0x55

This data record is 150 bytes long, which can be transmitted once every second without exceeding the 1200 bps allowed.

The status packet will contain GPS position and basic sensor information such as number of data packets collected, temperature, and voltage (if a battery is used).

D. Number of analog channels being used: 2

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

Interior payload temperature and battery voltage monitoring.

F. Number of discrete lines being used: 2

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

It is our understanding that the discrete lines are used to turn on and off the payload power. These lines will also be used to reset the system if the payload status packet indicates that the computer has frozen and is no longer collecting data.

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*)

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

No uplink commands anticipated

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

The payload includes a GPS receiver and antenna. The frequency of the GPS signal is 1.57542 GHz and a bandwidth of ±2 MHz. We will also be detecting pulsars from deep space that have a frequency in the range of 10^{17} Hz and energies exceeding 20 keV.

F. Other relevant uplink commanding information.

None

V. Integration and Logistics

A. Date and Time of your arrival for integration: 9:00 am on July 27, 2012

B. Approximate amount of time required for integration: 8 hours

C. Name of the integration team leader: Patrick Doyle

D. Email address of the integration team leader: doyle174@umn.edu

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

Patrick Doyle doyle174@umn.edu

Curtis Albrecht albre128@umn.edu

There may be two additional students in attendance, but it is uncertain at this time which team members will be required to participate.

There may also be one faculty advisor in attendance depending on availability.

F. Define a successful integration of your payload:

All payload systems power on, the flight computer successfully stores and transmits data in a simulated flight environment, and the payload resets and continues to collect data under the same simulated conditions.

G. List all expected integration steps:

i. Attach payload to HASP gondola

ii. Connect EDAC 516 and RS 232 interfaces to payload

iii. Remove one panel on payload structure to visually monitor interior components

iv. HASP gondola provides power to payload

v. Check that all available LED indicators are on and indicating successful operation

vi. Allow payload to continuously collect and transmit data for 30 minutes

vii. Intentionally reset (turn power off and on) the system and allow it to collect data for an additional 15 minutes.

viii. Power down and review transmission logs and on board storage

ix. Troubleshoot any issues and repeat steps iv – viii if necessary

x. Place payload and HASP gondola in thermal vacuum chamber and repeat steps iv – viii above with all payload panels installed to simulate exposure to the extreme environments encountered during HASP flight operations

xi. Review data and payload systems operation and repeat tests if any flaws are found and time allows

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

i. Payload successfully interfaces with HASP gondola

ii. Payload powers on

iii. Power can be turned on and off to reset system

iv. Payload successfully stores data

v. Payload successfully transmits status packets

vi. Payload operates (remains on, stores, transmits data, and resets) in simulated environment

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 anticipated

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

It is anticipated that thermal and vacuum chamber testing will be provided