HASP Payload Specification and Integration Plan

Payload Title: SMITH LSU

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

Payload ID: 11

Institution: Louisiana State University

Contact Name: Noelle Bryan

Contact Phone: 225-326-4628

Contact E-mail: nbryan5@lsu.edu

Submit Date: 6/22/12

I. Mechanical Specifications:

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

The payload is estimated to be 35lbs (~15.87kg) based on the component weights and estimated housing weight. Its center of mass will be near the center of the interface plate and the height will be below 6 inches of the plate itself. These are all estimates based on mechanical drawings and will be defined further as the payload is developed.

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 mounted to the interface plate with 4 ¼" screws. Their positions are shown in Figure 1 below. The overall outline of the payload is shown as well and is completely contained in within the keep out line.

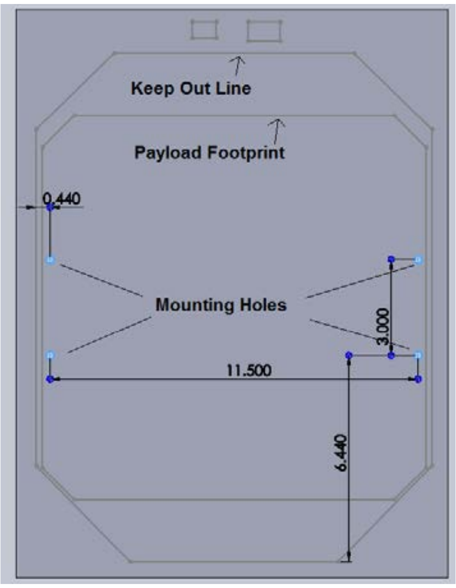


Figure 1: SMITH payload and mounting configuration.

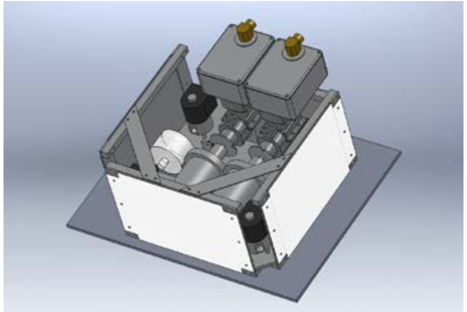


Figure 2: Inside view of SMITH payload.

The payload will consist of 2 DC motors, 2 model airplane engines, 4 solenoid valves, 2 filters, and the electronics. Everything except the electronics will be mounted on the lower half of the payload and is shown in Figure 2. The side panels will detach from the frame to allow easy access to the inside when assembling and bolting to the interface plate. They are then reattached and the whole system will be fully assembled before the interface plate is attached to HASP. The frame as well as the component mounting plates will be made completely of aluminum. The electronics will be attached above the frame and contained within its own housing. This housing will be insulated aluminum to maintain the temperature of the electronics while still providing protection. The entire footprint is 12 x 12 inches and will be less than 36 inches tall.

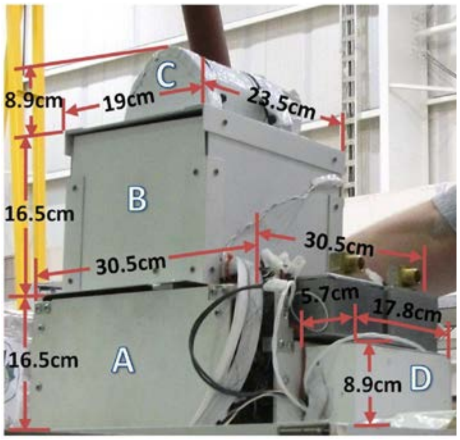


Figure 3: Dimensions of SMITH 2011 will serve as a guide for SMITH 2012.

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 will be flown.

D. Other relevant mechanical information

The sealed payload will contain biological samples recovered from 36 km. It is imperative that the SMITH capture device seal shall not be compromised.

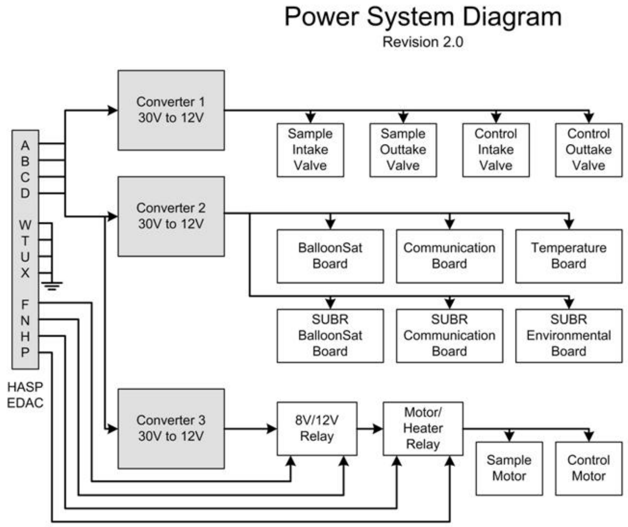
II. Power Specifications:

A. Measured current draw at 30 VDC:

Type of DC/DC Converter	Efficiency (%)
30 V-12 V (Converters 1)	94
30 V-12 V (Converters 2)	85
30 -3.3V	83

Table 1: Measured current draw at 30 VDC

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 power system diagram details the power system wiring diagram from the HASP EDAC 516 pins to the SMITH payload.

Function	EDAC Pins	Wire Color	Purpose
+30 VDC	A, B, C, D	White with red stripe	Power SMITH
Power Ground	W, T, U, X	White with black stripe	GND SMITH
Discrete 1	F	Brown	DC Converter 3 Outputs 8V
Discrete 2	N	Green	DC Converter 3 Outputs 12V
Discrete 3	H	Red with white stripe	Allows the Motors to be turned on
Discrete 4	P	Black with white stripe	Allows Heaters to be turned on

Table 2: EDAC Pin Layout

Pins A-D, will be used in parallel to provide the appropriate power supply of 2.5 Amps at 30 VDC to the payload. SMITH requires three DC/DC converters to step down voltages from 30 VDC to 12 VDC. Besides the motors, heaters, and valves, all the other components will be powered throughout the duration of the flight. Table 3 shows the voltage, current, duty cycle, power, and power consumed for each component. The power usage of each component is determined multiplying the voltage by the current: $V * I$. The total power calculated is the maximum power the payload draw if all components were active at the same time (with the exception of the control pump system). The duty cycles were calculated using the results from the previous flight: $total\ run\ time / total\ flight\ time$. The power consumed is determined as follows: $I * duty\ cycle * total\ flight\ time$. For the total flight time used in the calculations was 16 hours, based on HASP 2011 data.

Component	**Voltage (V)**	**Current (mA)**	**Duty Cycle Over Entire Flight (%)**	**Power (W)**	**Power Consumed (Amp hours)**
Sample/Control Pump	8	2200	54	17.6	19
Sample/Control Pump	12	2400	26	28.8	10.0
Heaters	12	1500	5	18	1.2
Intake Valve	12	190	80	2.28	2.4
Outtake Valve	12	190	80	2.28	2.4
BalloonSat 1	12	55	100	0.66	0.9
Communication Board 1	12	20	100	0.24	0.3
Temperature Board	12	48	100	0.576	0.8
BalloonSat 2	12	55	100	0.66	0.9
Communication Board 2	12	20	100	0.24	0.3
Sensor Board	12	48	100	0.576	0.8
			Total	**71.912**	**39.0**

Table 3: Power Budget

B. Other relevant power information

Type of DC/DC Converter	**Purpose**	**Efficiency (%)**
Converter 1: 30V to 12V	Solenoid Valves	95
Converter 2: 30V to 12V	Boards	95
Converter 3: 30V to 12V	Motors & Heaters	86

Table 4: Converter Efficiency

The DC/DC converters we will be using are not 100% efficient; during voltage reduction process they dissipate heat causing power to be lost. Therefore, the total power consumed becomes $P_{in} * efficiency$. The efficiency of each converter is listed in Table 4. These efficiencies are already taken into account in Table 3.

III. Downlink Telemetry Specifications:

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

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

20 bps

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

Record Format	**Size (Bytes)**
Label	1
Real Time Clock – Day	1
Real Time Clock – hour	1
Real Time Clock – Minute	1
Real Time Clock – Second	1
Sample pump temp sensor	1
Sample motor temp sensor	1
Sample pressure sensor	1
Sample flow sensor	1
Sample RPM counter HIGH byte	1
Sample RPM counter LOW byte	1
Sample State: • Flow • Pump	½ byte
Control pump temp sensor	1
Control motor temp sensor	1
Control pressure sensor	1
Control flow sensor	1
Control RPM counter HIGH byte	1
Control RPM counter LOW byte	1
Control State: • Flow • Pump	½ byte
Total	**18**

Table 5: Record Format for Every 10 seconds

Record Format	**Size (Bytes)**
Label	1
Real Time Clock – Day	1
Real Time Clock – hour	1
Real Time Clock – Minute	1
Real Time Clock – Second	1
UV Sensor 1	1
UV Sensor 2	1
UV Sensor 3	1
Ambient Temperature	1
Ambient Pressure	1
Ambient Humidity	1
Total:	**11**

Table 6: Record Format for every 1 minute

C. Number of analog channels being used: 2

D. If analog channels are being used, what are they being used for? Ultraviolet (UV) radiation sensors

E. Number of discrete lines being used: 4

F. If discrete lines are being used what are they being used for? Turning on/off heating system for sampling pump, turning on/off DC motors

G. Are there any on-board transmitters? If so, list the frequencies being used and the transmitted power. none

H. Other relevant downlink telemetry information.

NA

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*)

Two commands are required to be uplinked during flight, but heaters may be required to turn on (only when DC motor is off for power purposes) as well as commands to change the voltage provided to the DC motor. These are expected at a rate of roughly 1 command per hour.

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

List of commands for sampling chamber:
1. Open Intake Valve
2. Close Intake Valve
3. Open Exhaust Valve
4. Close Exhaust Valve
5. Turn on pump
6. Turn off pump
7. Turn on heaters
8. Turn off heaters
9. Begin sampling
10. Stop sampling
List of commands for control chamber:
1. Open Intake Valve
2. Close Intake Valve
3. Open Exhaust Valve
4. Close Exhaust Valve
5. Turn on pump
6. Turn off pump
7. Turn on heaters
8. Turn off heaters
9. Begin sampling
10. Stop sampling

Table 7: Commands to be uplinked to SMITH 2012

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

None will be used.

F. Other relevant uplink commanding information.

NA

V. Integration and Logistics

A. Date and Time of your arrival for integration: Arrival to Palestine, Texas on Sunday July 29, 2011

B. Approximate amount of time required for integration: 6 h

C. Name of the integration team leader: N. Bryan

D. Email address of the integration team leader: nbryan5@lsu.edu

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

Noelle Bryan, nbryan5@lsu.edu

F. Define a successful integration of your payload:

Payload is bolted down on the HASP plate

Payload is receiving power from HASP EDAC connecter

Payload is receiving commands from team member

Payload is streaming data to team member

G. List all expected integration steps:

1. Attach sample chamber to main payload
2. Power verification
3. Communication verification
4. Begin sampling procedures
5. Turn on pump
6. Verify pump functioning at various pressures and temperatures
7. Turn off pump
8. Close valves in proper order
9. Remove sample chamber
10. Verify sample chamber remains sealed
11. Power down

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

Payload is bolted down on the HASP plate

Payload is receiving power from HASP EDAC connecter

Payload is receiving commands from team member

Payload is streaming data to team member

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…):

Holiday Inn Express Palestine, TX

J. List any LSU supplied equipment that may be needed for a successful integration: none