HASP Payload Specification and Integration Plan

Payload Title: ASTRO

Payload Class: Small

Payload ID: 2013 - 06

Institution: MIT

Contact Name: Jessica Sandoval

Contact Phone: 916 – 337 - 2263

Contact E-mail: jsand@mit.edu

Submit Date: 2013 June 21

I. Mechanical Specifications:

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

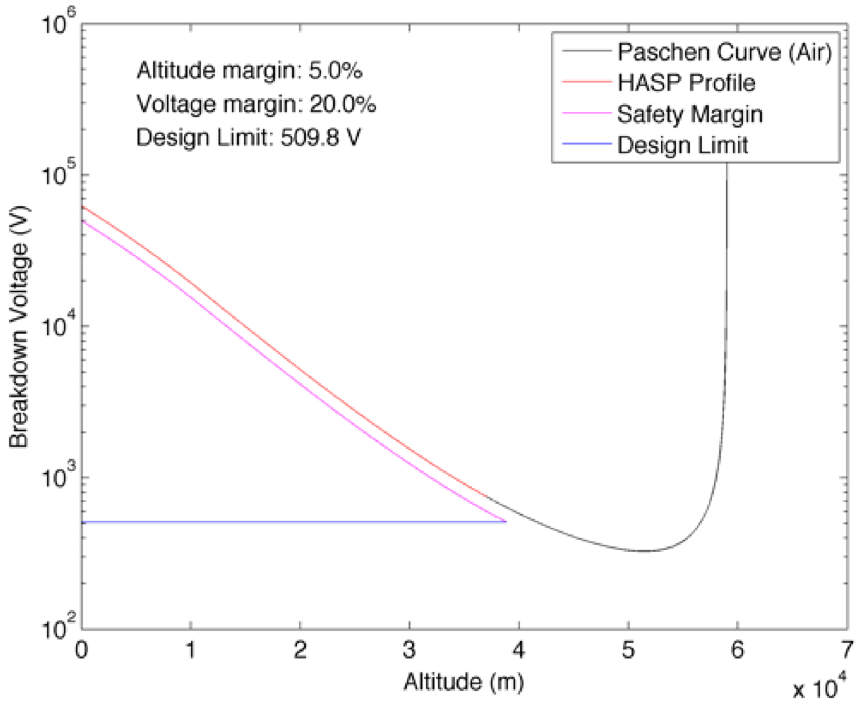
Please see attached spreadsheet. Also note, there are a few unknown weights since we have yet to machine those specific parts. Please take into consideration that we had two major design changes over the course of the past 5 months, most recently one in June before the preliminary PSIP. Therefore, we have gone through a prototype of PVC (which is not intended to be our final material). The measured weights shown on the budget are from the final parts, machined out of Delrin or PTFE, depending on the part. The Solid Works diagram shown in this PSIP is final, except for minor changes, such as a vertical support design

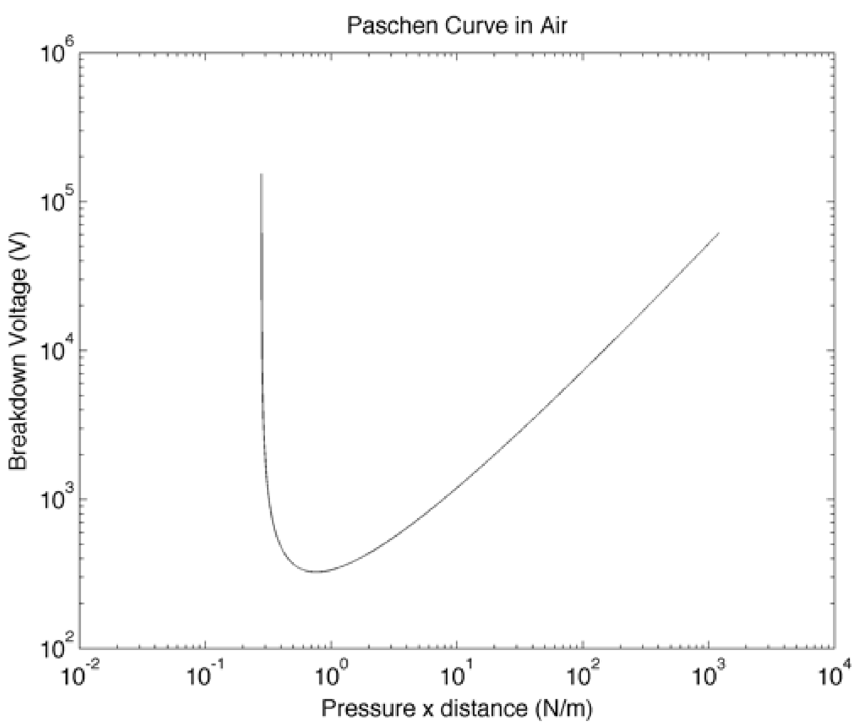
B. Provide a mechanical drawing detailing the major components of your payload and specifically how your payload is attached to the payload mounting plate

Please refer to Solid Works schematic near end of document.

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…)

Our new design includes a minimum 1.2 cm gap between the high voltage electrodes (electrode surface to inside of cylinder). We chose an electrode voltage that is always below the worst case Paschen breakdown voltage of 509.8 V, assuming a 5% altitude margin and a 20% voltage margin (see figure below). Two HVM Technologies UMHV0505N HVDC sources will be used to charge the electrodes to -500 V. These parts have been used on CubeSat payloads, so vacuum compatibility is not a major concern. They will be housed within the end cap of the cylinder, with external wires carrying only 5V signals. Each collection tube is fitted with its own UMHV device so as to eliminate the need to switch high voltage. The return path for HV current will be routed directly to the main ground, or to the HASP chassis if necessary to prevent static buildup.





D. Other relevant mechanical information

Custom part materials: We are using Delrin and PTFE. Delrin is durable to the low temperature of -50˚C and is static dissipative. PTFE is a thermoplastic, as well, and is durable to -200 degrees Celsius.

II. Power Specifications:

A. Measured current draw at 30 VDC

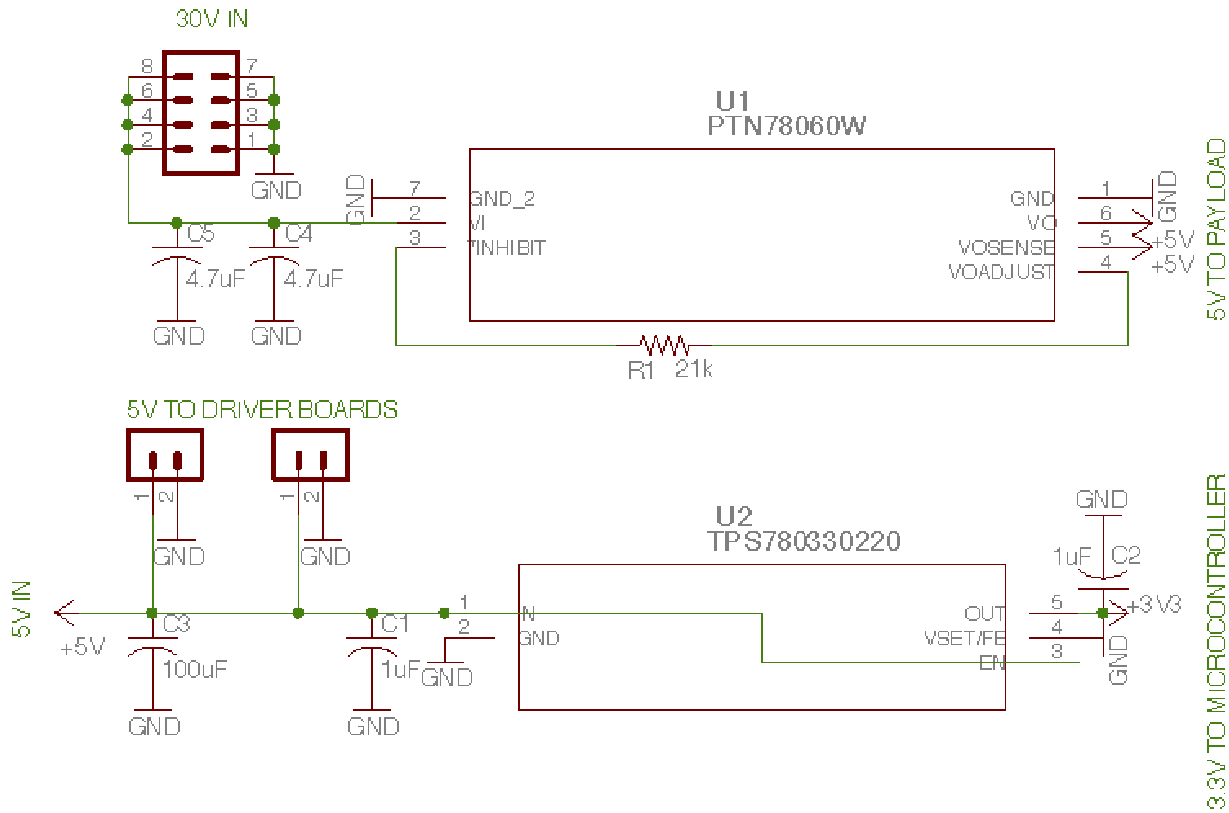
The electronics are not yet fully assembled for testing. We will provide measured current draw as soon as possible next week. The estimates provided in the preliminary PSIP are reproduced below for reference:

Component	Mfg/part #	Max power dissipated (W)
3.3V power supply	TI TPS780330220	0.0187
Microcontroller	TI MSP430F2274MRHATEP	0.0033
RS-232 level converter	TI MAX3221MDBREP	0.033
5V power supply	TI PTN78060W	1.4
Stepper motors	Portescap 42L048D1U	9.6
HVDC Source	HMV UMHV0505N	0.875

The sum of these power draws is 11.9W, well below the allowed 15W (0.5A at 30V.) It remains to replace these estimates with measurements and ensure that increased current draw at low temperatures does not cause power consumption to exceed the limit. A Kapton heater may also be added for active thermal management if necessary. It will not be run at the same time as the steppers or HVDC sources and will not exceed 10 W, so it does not factor in the calculation of maximum power consumption.

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.

A TI PTN78060 switching regulator steps the ~30V HASP power bus down to 5V for use by the outputs. A TI TPS780 LDO linear regulator steps the 5V rail down to 3.3V for use by the microcontroller. The power supply is shown on the next page.



C. Other relevant power information

III. Downlink Telemetry Specifications:

A. Serial data downlink format: Stream

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.

10 bytes

Byte	**Bits**	**Description**
0-3	0-31	Milliseconds since microcontroller was turned on.
4-7	0-31	Latest recorded height.
8	0-7	Record of action performed

		00: Check if alive 02: Motor #1 moved 04: Motor #2 moved 05: shutdown
9	0-7	Parity Byte checksum

D. Number of analog channels being used: 2

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

Temperature measurements independent of the payload, except they are excited by the +5V rail. Thermistor circuits are not represented in the electrical schematic.

F. Number of discrete lines being used: 0

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

H. Are there any on-board transmitters? If so, list the frequencies being used and the transmitted power. No/None

I. Other relevant downlink telemetry information.

IV. Uplink Commanding Specifications:

A. Command uplink capability required: Yes

B. If so, will commands be uplinked in regular intervals: No

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*) 4 commands

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

Command	**Description**
0x0606	Check if alive (should respond in downlink)
0x0202	Sample with container #1
0x0404	Sample with container #2
0x0505	Shutdown all systems

E. Are there any on-board receivers? If so, list the frequencies being used. No

F. Other relevant uplink commanding information. N/A

V. Integration and Logistics

A. Date and Time of your arrival for integration:

We will be flying into Dallas, Texas the weekend before integration starts. We will arrive at the integration facility on Monday, July 29.

B. Approximate amount of time required for integration:

For the entire integration process, would anticipate testing (and inspection) and mounting to take 2 days, but we will allow for additional time in our travel plans.

C. Name of the integration team leader: Jessica Sandoval

D. Email address of the integration team leader: jsand@mit.edu

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

Christopher Carr	*chrisc@mit.edu*
Jessica Sandoval	*jsand@mit.edu*
Ethan DiNinno	*dininno@mit.edu*
Jeremey Kaplan	*jdkaplan@mit.edu*
Rodrigo Gomes	*rgomes@mit.edu*

F. Define a successful integration of your payload

1. We obtained an Integration Certification
2. Our tests (defined below) are successfully completed. The most pertinent test is the thermal vacuum test. Successful operation of the instrument throughout all modes, including for example the opening and closing of the sample cylinder and turning on and off the electrodes.
3. We have successfully sterilized our collection tubes.
4. We have connected our electrical cables and Payload 06 Mounting Plate to HASP mainframe.

G. List all expected integration steps

5. Perform thermal vacuum test, perform shock test, and weigh our payload.
6. Obtain Integration Certification

7. We will want to test our payload with the following tests: GPS telemetry, downlink and uplink commands, this will also include testing basic rotation of collection chambers, and application of power to the electrode.
8. Sterilization of collection tubes. Sterilization will include either UV Sterilization or 90 percent ethanol and flame sterilization. Our material for the collection chambers is PTFE, and can therefore withstand extreme temperatures (temperature range is -200 deg C and 300 deg C) imposed by flame sterilization.
9. Once we have completed our testing, connect electrical cables and Payload 06 Mounting Plate to HASP mainframe

H. List all checks that will determine a successful integration

1. Horizontal and Vertical shock tests do not cause any loss of structural integrity that could cause contamination
2. Current draw under simulated flight conditions does not exceed limits
3. GPS telemetry, uplink commands work as expected
4. Overall preliminary run (tube rotation, power application) successful
5. No arcing when tested in vacuum
6. Resterilization of canisters, post testing, completed by use of UV radiation or flaming. Alternatively, if possible, we would like to bring tested canisters back with us for ethylene oxide gas sterilization with reinstallation before flight. If this is not possible, we will use UV or flame sterilization.

I. List any additional LSU personnel support needed for a successful integration other than directly related to the HASP integration

Not applicable

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

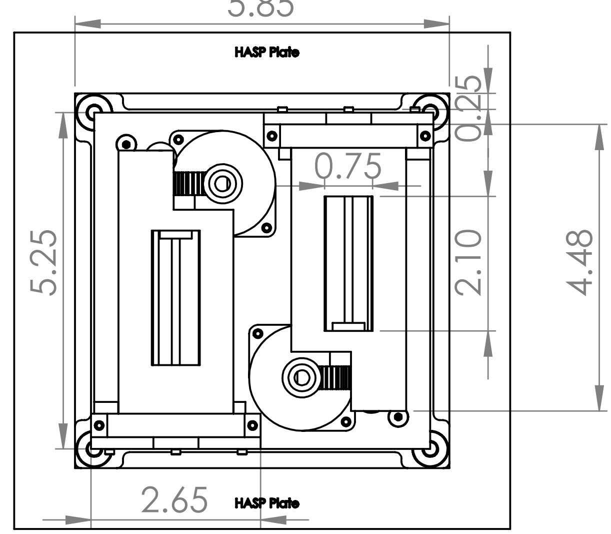
Out of the generosity of Noelle Bryan, we will be sharing her laminar flow work station, equipped with a UV sterilizer and portable air filter in a low traffic room in order to ensure that there is minimal background contamination that occurs.

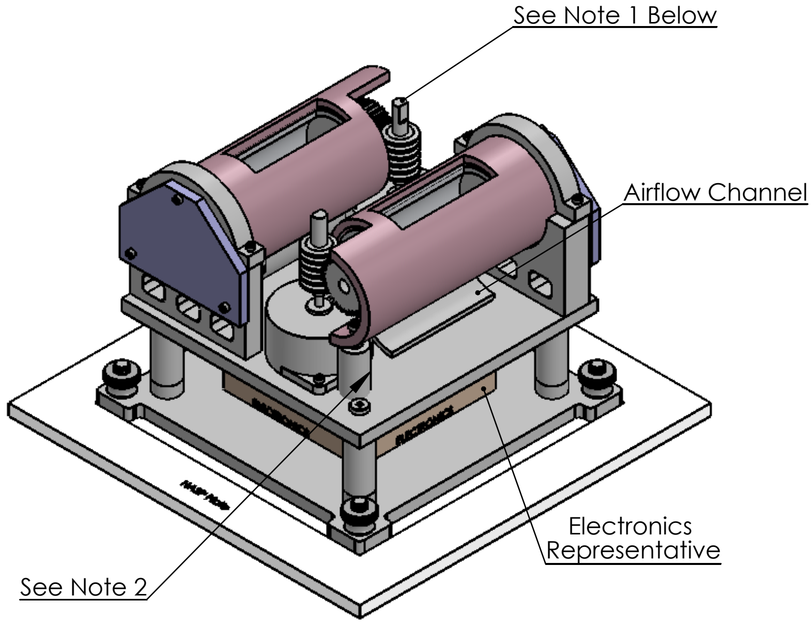
Mass Budget

Item	Mass (g) Measured	Estimated	Quantity	Subtotal	Notes
Payload Structure & Mounting Hardware	442		1	442	2 plates, 4 mounting bolts + thumb nuts, four spacers and bolts.
Electrostatic Collector Assemblies (Quantities reflect 2 assemblies in the payload)					
Inner + Outer Cylinder Assembly	208	25	2	466	Cylinders,electrode,UMHV, mounting brackets, estimated potting
Stepper Motor	115		2	230	
Worm Gear Assembly	59		2	119	Both worm gear parts (cylinder and motor shaft)
Air inlet/outlet		100	2	200	
Electronics					
Power Regulation and Headers Board		50	1	50	
Microcontroller Board	3		1	3	
Driver Board	15		2	31	
Thermal Insulation		200	1	200	
Heater		50	1	50	
Cables		250	1	250	Final cabling/connectors not yet available
Thermal Protection Outer Layer		500	1	500	Outer TPS system, not yet available for weighing
TOTAL	843	1175		**2541**	
ALLOCATION				3000	
MARGIN				**459**	**15%**
HASP Base Plate with Wiring Harness	533		1	533	
Total Payload Weight with HASP Base Plate				3073	HASP Base Plate + TOTAL

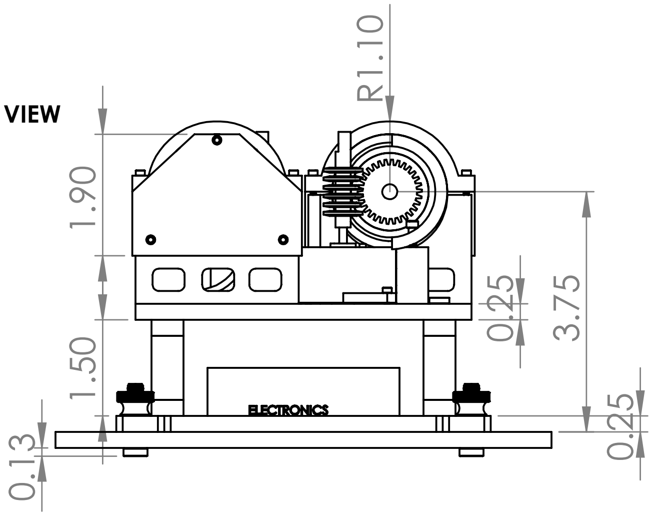
ASTRO Payload 06
Summer 2013

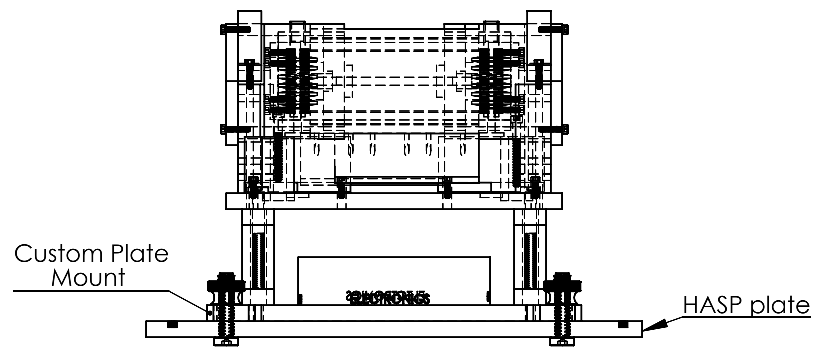
TOP VIEW



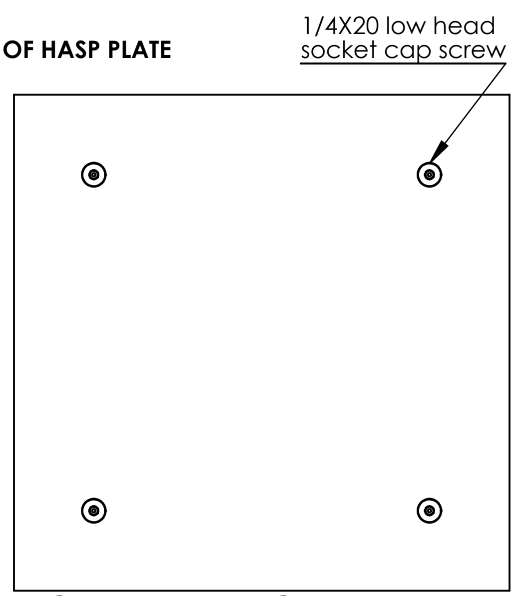


SIDE VIEW





BOTTOM OF HASP PLATE



NOTES

1) We plan to encapsulate our entire system, leaving only four milled slots allowing for air flow. Two milled mounts on the top of the encapsulating thermal insulation (not shown)will secure down the (2) motor shafts from figure above

2) We are redesigning the support for the motor end of the canisters. In current design, a spacer supports the canister end securing in the y direction.

3) In order to mount to HASP plate, we are using (4) 1/4X20 low head socket cap screws tightened from top by thumb nuts. This allows for easy mounting and disassembly of payload. HASP plate alterations are (4) 1/4 clearance holes for mounting of Payload 06.

4)Electronics is represented as 3 in. X 3 in. X 0.75 in. box. Electronics will not be contained within a box as represented.