HASP Payload Specification and Integration Plan

Payload Title: HADES: High Altitude Device for Entrapping Samples

Payload Class: Small Large (circle one)

Payload ID: 11

Institution: **Louisiana State University**

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Submit Date: April 19, 2013

I. Mechanical Specifications:

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

Table 1: Hades Weight Table			
Part Name	(oz)	(lbs)	(g)
W Top Door with clevis	2.8	0.175	79
W Bottom Door with clevis	2.8	0.175	79
W Chamber with orings and filter	3.8	0.238	108
W Rail Right	1.3	0.081	37
W Rail Left	1.3	0.081	37
W Holder Sleeve A.	0.6	0.038	17
W Holder Sleeve A.	0.6	0.038	17
W Holder Half1 5Up	0.1	0.006	3
W Holder Half2 5Up	0.2	0.013	6
W Holder Half1 (Bottom)	0.1	0.006	3
W Holder Half2 (Bottom)	0.2	0.013	6
W Spacer with 2 corner attachments and 6 screws	0.9	0.056	26
W Right Connecting Bracket (short)	0.6	0.038	17
W Left Connecting Bracket (short)	0.6	0.038	17
W Ground Plate with rubber	0.8	0.050	23
E Top Door with clevis	2.8	0.175	79
E Bottom Door with clevis	2.8	0.175	79
E Chamber with orings and filter	3.8	0.238	108
E Rail Right	1.3	0.081	37
E Rail Left	1.3	0.081	37

E Holder Sleeve B.	0.6	0.038	17
E Holder Sleeve B.	0.6	0.038	17
E Holder Half1 7Up	0.1	0.006	3
E Holder Half2 7Up	0.2	0.013	6
E Holder Half1 (Bottom)	0.1	0.006	3
E Holder Half2 (Bottom)	0.2	0.013	6
E Spacer with 2 corner attachments and 6 screws	1.0	0.063	28
E Right Connecting Bracket (short)	0.6	0.038	17
E Left Connecting Bracket (short)	0.6	0.038	17
Top X Brace	1.4	0.088	40
Bottom X Brace	1.4	0.088	40
Top Square with rivets	4.9	0.306	139
Bottom Square with Rivets	5.2	0.325	147
Bottom Motor Box	20	1.250	567
Lazy Susan	6	0.375	170
Slip Ring	2	0.125	57
HASP Mounting Angles	4	0.250	113
Center Post with clevises and top and bottom screws	3.6	0.225	102
Foam	2.6	0.163	74
26 8-32 Wing Nuts	2.9	0.181	82
24 1/4" 8-32 Screws	1.3	0.081	37
Estimate For 16 8-32 3/5" screws and 16 8-32 locking nuts 16/24 * weight(24 1/4" 8-32 Screws + 26 8-32 wing nuts)	2.8	0.175	79
160 Greased Glass Rods	1.49	0.093	42.4
8 Carabeaners	1.1	0.069	31
8 AA Battery Pack	4.8	0.300	136
LiSO2 Battery Pack	2.7	0.169	77
8 Linear Acutuators	15.4	0.963	437
H-Bridge with power connector	1.8	0.113	51
Antenna	0.7	0.044	20
Arduino and Shield	3.1	0.194	88
Electric D/C Motor	16	1.000	454
Total Weight:	138	8.6	3900

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

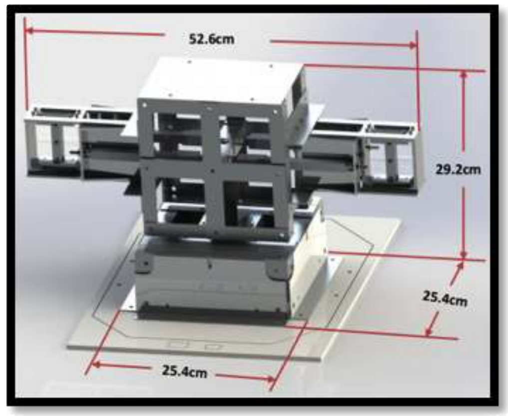


Figure 1: HADES payload dimensions

The payload base (Figure 1) houses the control, flight data, storage, flight monitoring and GPS communication electronics, rotational device, and the center post. The base is made of Aluminum 6061 alloy and is insulated with 3/4" foam to keep the internal electronics box warm during cold flight temperatures. The base will be attached to the interface plate using four bolts. The sampling chamber consists of the Aluminum 6061 side rails, doors, chambers, and the microbial capture devices (plastic rods coated with silicone grease). The chambers doors open by extending and retracting the linear actuators. Each actuator has a base connected to the center post and an end connected to a door. A Teflon coating is used to reduce the friction on the side rails when the doors slide. Red silicon O-rings create a vacuum tested seal at the openings of the chamber when the doors are closed. Each chamber is equipped with 0.22-μm filter to allow pressure to equilibrate within the chamber. Wing nuts are used to allow for quick and easy attachment and removal of the chamber arms from the electronics box. During flight preparation base will be attached to the interface plate. The rotation device will attach to the interface plate.

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…)

None

D. Other relevant mechanical information

The sealed payload will contain biological samples recovered from float altitudes. It is imperative that the HADES capture device seal shall not be compromised.

II. Power Specifications:

A. Measured current draw at 30 VDC

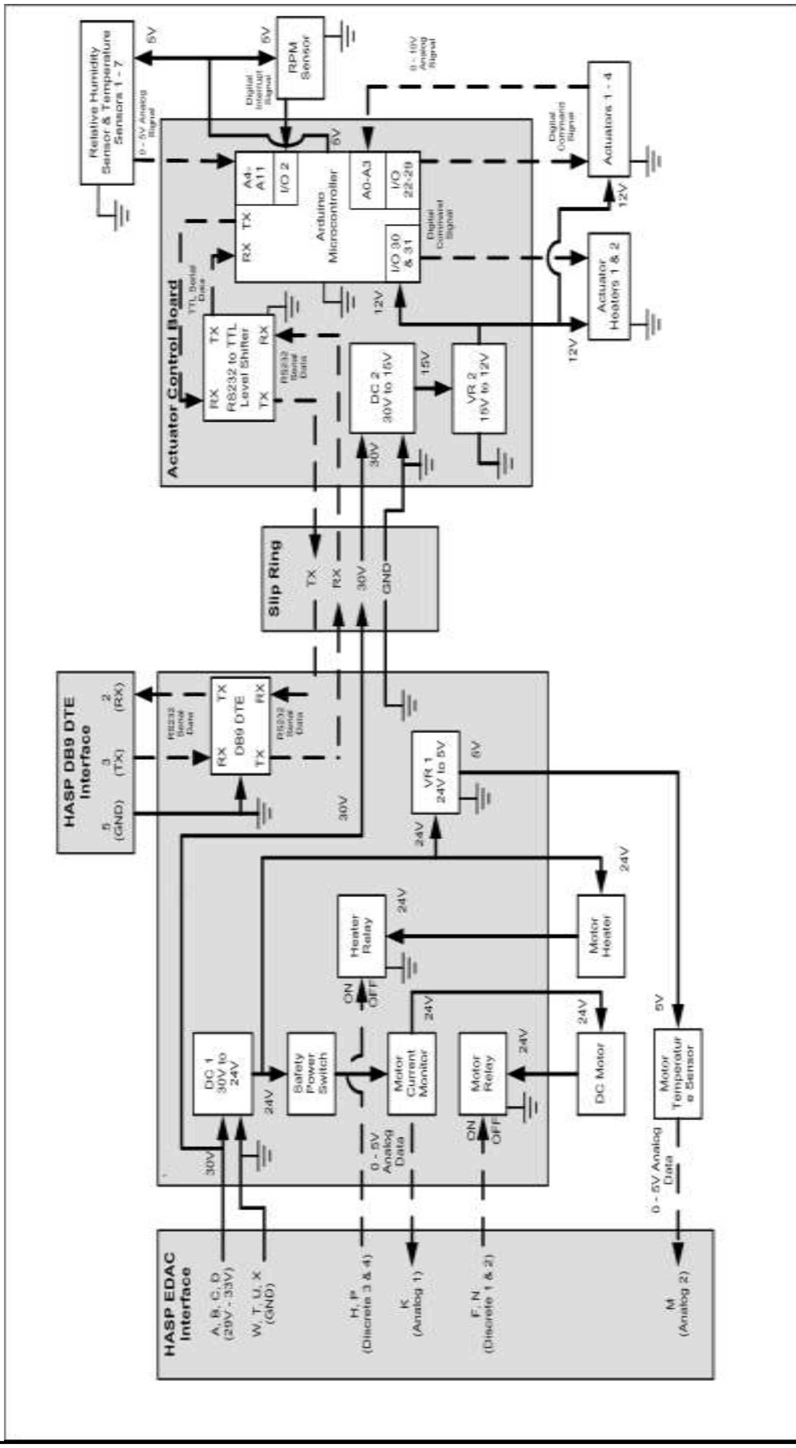
Table 2: Power Budget

Component	**Voltage (V)**	**Current (mA)**	**Duty Cycle Over Entire Flight (%)**	**Power (W)**	**Power Consumed (Amp hours)**
Rotational DC Motor	24	1000	75	24	12
Linear Actuators (4)	12	840	0.1	10.8	0.45
Heaters (3)	12	1800	25	21.6	7.2
LAMB Shield	12	48	100	0.58	0.53
Arduino	12	55	100	0.70	0.37
GPS Shield	3.3	70	100	0.23	0.17
Total				57.91	20.72

Table 3: DC/DC Converters

Type of DC/DC Converter	**Purpose**	**Part Number (Digikey)**	**Efficiency (%)**
Converter 1: 30V to 24V	Rotational DC Motor Power	811-1889-5-ND	89
Converter 2: 30V to 15V	Actuator and Microcontroller Power	102-2552-ND	87

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.



EDAC Pin Assignments

Function	EDAC Pins	Wire Color	Purpose
+30 VDC	A, B, C, D	White with red stripe	Power payload
Power Ground	W, T, U, X	White with black stripe	Ground payload
Discrete 1	F	Brown	Motor On
Discrete 2	N	Green	Motor Off
Discrete 3	H	Red with white stripe	Motor Heater On
Discrete 4	P	Black with white stripe	Motor Heater Off
Analog 1	K	TBD	Motor Current Monitor
Analog 2	M	TBD	Motor Temperature Sensor

C. Other relevant power information

None

III. Downlink Telemetry Specifications:

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

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

20 bps

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

Downlink Telemetry Specifications: Record format for every 10 seconds		
Record Format	**Description**	**Size (Bytes)**
Label	Record of flight logging information such as: Flight Number, File Name	1
Real Time Clock – Day	Record of day of flight	1
Real Time Clock - Hour	Record of hour of event	1
Real Time Clock – Minute	Record of minute of event	1
Real Time Clock – Second	Record of second of event	1
Temperature Sensor – Actuator 1st Top	Record of temperature of the 1st Top Actuator during event	1
Temperature Sensor – Actuator 1st Bottom	Record of temperature of the 1st Bottom Actuator during event	1
Temperature Sensor – Actuator 2nd Top	Record of temperature of the 2nd Top Actuator during event	1
Temperature Sensor – Actuator 2nd Bottom	Record of temperature of the 2nd Bottom Actuator during event	1
Temperature Sensor – Inside Electronics Box	Record of temperature inside of HADES electronic box during event	1
Temperature Sensor – Microcontroller	Record of temperature of the microcontroller during event	1
Temperature Sensor – Outside	Record of temperature outside of payload during event	1
Motor Temperature Sensor	Record of the temperature of the rotating DC motor	1
Motor Current Sensor	Record of the current being drawn by the rotating DC motor	1
Relative Humidity Sensor	Record of the relative humidity outside of payload during event	1
RPM Counter HIGH byte	Record of the HIGH byte of the payload RPM counter	1
RPM Counter LOW byte	Record of the LOW byte of the payload RPM counter	1
1st Top Actuator Position	Record of the position of the 1st Top Actuator	2

	during event	
1st Bottom Actuator Position	Record of the position of the 1st Bottom Actuator during event	2
2nd Top Actuator Position	Record of the position of the 2nd Top Actuator during event	2
2nd Bottom Actuator Position	Record of the position of the 2nd Bottom Actuator during event	2
Total		**25**

D. Number of analog channels being used: 2

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

Current monitor

Motor temperature system

F. Number of discrete lines being used: 4

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

Turning on/off heating system

Turning on/off motor

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:

J. Command uplink capability required: Yes No (circle one)

K. If so, will commands be uplinked in regular intervals: Yes No (circle one)

L. 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 the rotation device is off for power purposes) as well as commands to change the voltage provided to the rotation device. These are expected at a rate of roughly 1 command per hour.

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

Uplink Command Specifications		
Command	**HEX Value**	**Description**
Retract 1st Top Actuator	1	Opens the Top Door of the 1st Sample Chamber
Retract 1st Bottom Actuator	2	Opens the Bottom Door of the 1st Sample Chamber
Retract 2nd Top Actuator	5	Opens the Top Door of the 2nd Sample Chamber
Retract 2nd Bottom Actuator	6	Opens the Bottom Door of the 2nd Sample Chamber
Extend 1st Top Actuator	3	Closes the Top Door of the 1st Sample Chamber
Extend 1st Bottom Actuator	4	Closes the Bottom Door of the 1st Sample Chamber
Extend 2nd Top Actuator	7	Closes the Top Door of the 2nd Sample Chamber
Extend 2nd Bottom Actuator	8	Closes the Bottom Door of the 2nd Sample Chamber
Retract 1st Top Actuator - Nudge	9	Nudges Open the Top Door of the 1st Sample Chamber
Retract 1st Bottom Actuator – Nudge	A	Nudges Open the Bottom Door of the 1st Sample Chamber
Retract 2nd Top Actuator – Nudge	D	Nudges Open the Top Door of the 2nd Sample Chamber
Retract 2nd Bottom Actuator – Nudge	E	Nudges Open the Bottom Door of the 2nd Sample Chamber
Extend 1st Top Actuator – Nudge	B	Nudges Close the Top Door of the 1st Sample Chamber
Extend 1st Bottom Actuator – Nudge	C	Nudges Close the Bottom Door of the 1st Sample Chamber
Extend 2nd Top Actuator – Nudge	F	Nudges Close the Top Door of the 2nd Sample Chamber
Extend 2nd Bottom Actuator – Nudge	10	Nudges Close the Bottom Door of the 2nd Sample Chamber
1st Actuators Heater On	11	Turns the Heater for the 1st Sample Chamber Actuators On
1st Actuators Heater Off	12	Turns the Heater for the 1st Sample Chamber Actuators Off
2nd Actuators Heater On	13	Turns the Heater for the 2nd Sample Chamber Actuators On
2nd Actuators Heater Off	14	Turns the Heater for the 2nd Sample Chamber Actuators Off
Force Packet Down	15	Manual push of information to from payload to HASP

Reboot System	15	Manual Reboot of HADES Actuator Control System

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

None

O. Other relevant uplink commanding information.

None

V. Integration and Logistics

P. Date and Time of your arrival for integration: July 28, 2013

Q. Approximate amount of time required for integration: 2 hours

R. Name of the integration team leader: Noelle Bryan

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

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

Noelle Bryan: nbryan5@lsu.edu
Scott Burke: sburke8@lsu.edu
David Branch: dbb1231@tigers.lsu.edu

U. 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.

Payload operates within the temperature and pressure ranges experienced during the thermal vacuum testing.

V. List all expected integration steps:

1. Attach sample chamber to main payload
2. Power verification
3. Communication verification
4. Begin sampling procedures (opening chambers)
5. Turn on rotation device
6. Verify rotation device functioning at various pressures and temperatures
7. Turn off rotation device
8. Close chambers in proper order

9. Remove sample chamber
10. Verify sample chamber remains sealed
11. Power down

W. 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.

Payload operates within the temperature and pressure ranges experienced during the thermal vacuum testing.

Accurate measurements of temperature, pressure, and relative humidity will be recorded during integration. The data record shall verify all commands were completed as directed during the testing procedures (all doors opened and closed, the payload rotated, the heaters operated.

X. 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

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

None