HASP Payload Specification and Integration Plan

Payload Title: HELIOS IV

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

Payload ID: 10

Institution: **University of Colorado Boulder**

Contact Name: Paige Arthur

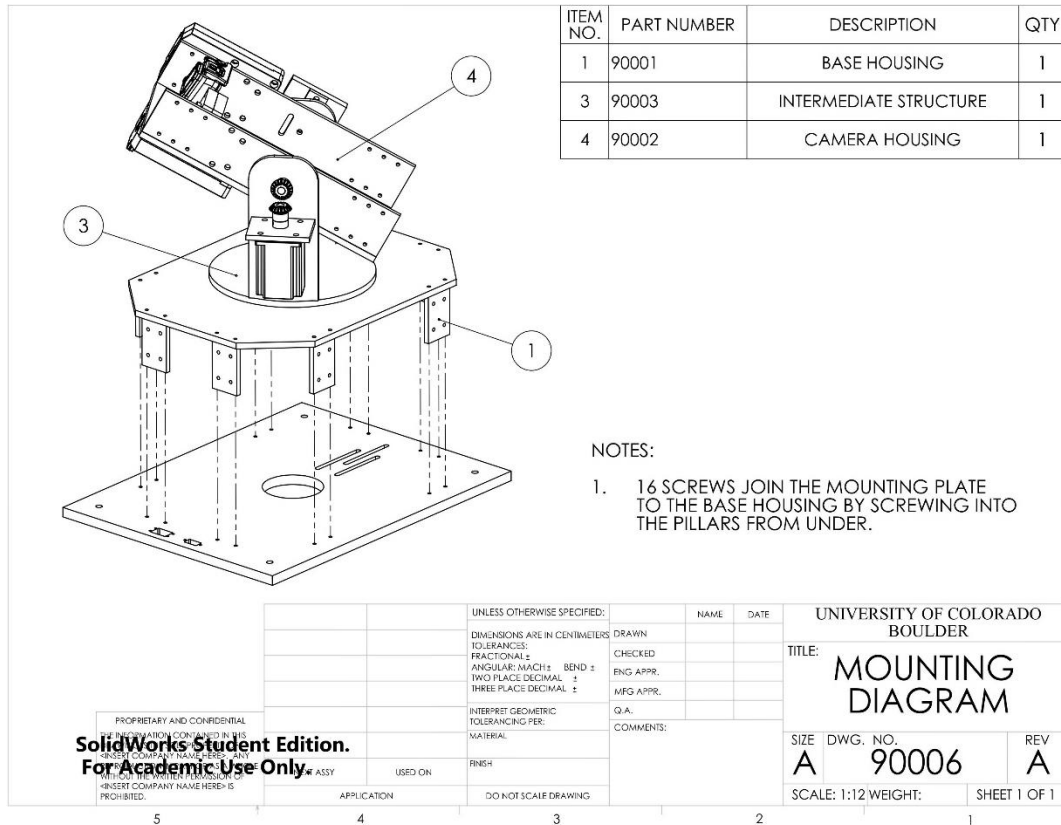**Contact Phone:** (303) 957-7360

Contact E-mail: paige.arthur@colorado.edu

Submit Date: April 24, 2015

I. Mechanical Specifications:

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

   19.7 kg including the custom aluminum baseplate, 18.25 kg subtracting the standard baseplate weight.

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

ITEM NO.	PART NUMBER	DESCRIPTION	QTY
1	90001	BASE HOUSING	1
3	90003	INTERMEDIATE STRUCTURE	1
4	90002	CAMERA HOUSING	1

NOTES:

1. 16 SCREWS JOIN THE MOUNTING PLATE TO THE BASE HOUSING BY SCREWING INTO THE PILLARS FROM UNDER.

UNIVERSITY OF COLORADO BOULDER

TITLE: **MOUNTING DIAGRAM**

SIZE: A   DWG. NO. 90006   REV: A

SCALE: 1:12   WEIGHT: SHEET 1 OF 1

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…)

A potential hazard to the ground crew is the usage of razor blades as aperture limiters in the two photodiode arrays. The usage of razor blades as edges of the aperture allows for light to pass through the aperture without any light pollution being produced by light bouncing off the edge of the aperture, as the blade is almost a zero thickness edge. The array is designed to limit this hazard as much as possible. The exposed edges of the razors are minimized and the gap between them is very small, reducing the chance of contact (see below figure for dimensions. The edge of the array around the aperture will also be marked red to provide a visual warning of the exposed blade edges.
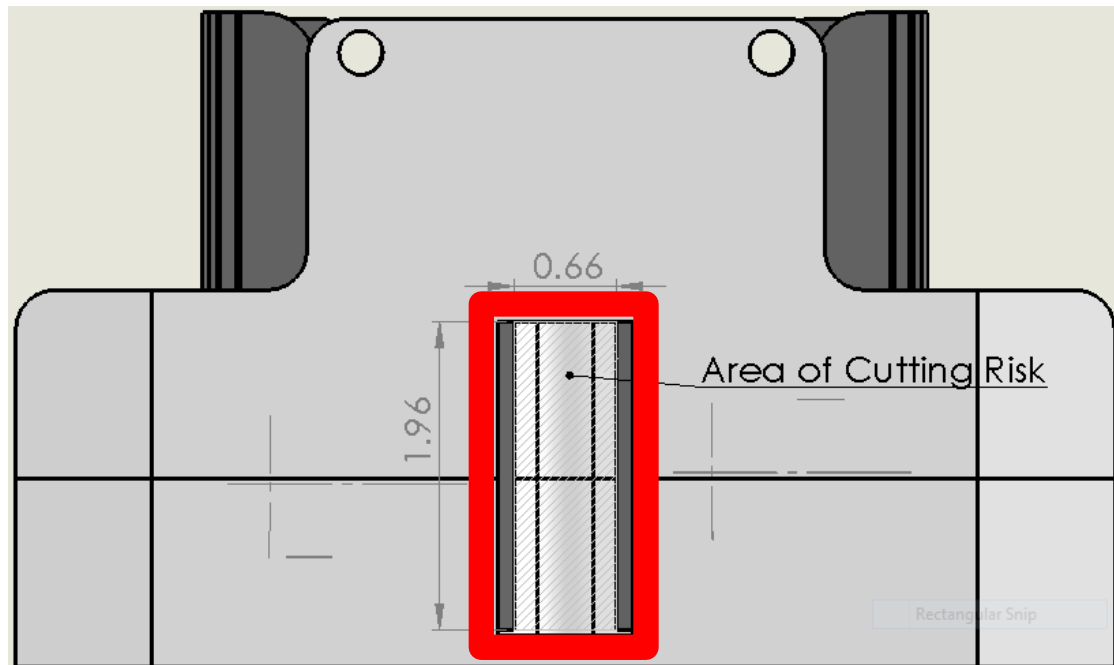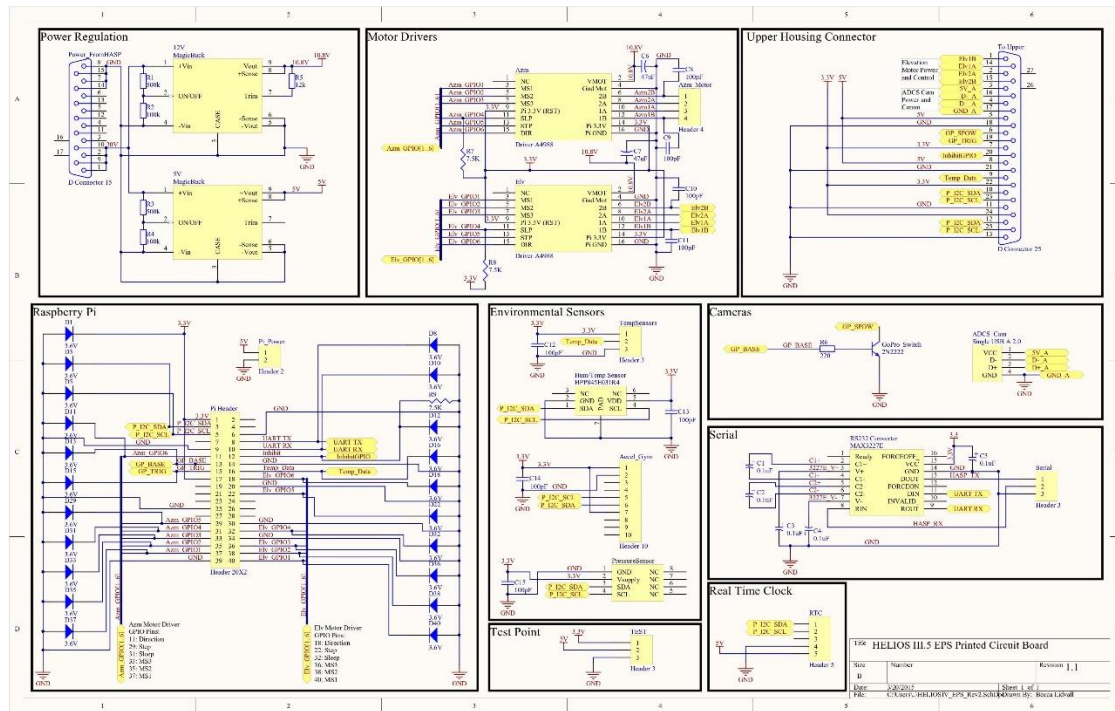
II. Power Specifications:

A. Measured current draw at 30 VDC

HELIOS IV draws 1.0 A during boot-up and then draws 0.75 A during normal operation

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.

III. Downlink Telemetry Specifications:

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

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

   1600 bps

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

Bytes	Content	Example
0	Start Header	0x01
1-6	Payload Identifier	CU HE
7-9	Thread Identifier*	EX
10-12	Record Type*	EX
13-23	Timestamp (from epoch)	1400019944
23-26	Length of data string	37
26-30	Adler32 Checksum	-71889546
31	Start Transmission	0x02
32-(N-1)	Data*	The red fox jumped over the brown log.
N	End Transmission	0x03
* Possible combinations in table below		

Sender	ID	Record	ID	Content	Typical Data

Uplink	UP	Bootup	BU		uplk
		Error	ER	Invalid target and cmd	<2 bytes>
Downlink	DW	Bootup	BU		dwnl
Sensors	SE	Bootup	BU		sens
		Temperature	T11	Data from temperature sensors	Data package
		Pressure	PR	Pressure	Data package
		Humidity	HU	% R.H.	Data package
		Accel/Gyro	AG	Acceleration and rotation on X, Y, and Z axis	Data package
ADCS	AD	Bootup	BU		adcs
		Motor Counts	MC	Azimuth and Elevation step count	Data package
		Diode Readings	DI	Azimuth and Elevation diode readings	Data package
		Ack	AC	Command executed	<1 byte>
		Error	ER	Command with error	<1 byte>
Analysis	AN	Bootup	BU		anly
		Ack	AC	Command executed	<1 byte>
		Error	ER	Command with error	<1 byte>
		Model Success	MS	Model polynomial	[#x+#, #x+#]
		Model Data	MD	Data points (V, °) theta, phi	(#, #), (#, #)
		Model Failure	MF	No suns detected or multiple	"=0" or ">1"

    D. Number of analog channels being used:

       None

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

       N/A

    F. Number of discrete lines being used:

       None

    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.

       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*)

HELIOS IV will require commanding during flight to assist tracking, which will require at most 20 commands during flight.

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

System	Target Byte	Command Byte	Payload Command
UPLK	0xAA		Ping System
ADCS	0xBB	0xFA	Enter Panning Mode
		0xFB	Exit Panning Mode
		0xA1	Switch Azimuth Array
		0xA0	Switch Elevation Array
	0xC0	0x00-0xB4 (0-180°)	Nudge Azimuth Positive
	0xC1	0x00-0xB4 (0-180°)	Nudge Azimuth Negative
	0xD0	0x00-0x41 (0-65°)	Nudge Elevation Positive
	0xD1	0x00-0x41 (0-65°)	Nudge Elevation Negative
ANLY	0xEE	0x00	Reset Analysis

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

N/A

V. Integration and Logistics

A. Date and Time of your arrival for integration:

The morning of August 3rd

B. Approximate amount of time required for integration:

It is estimated that the HELIOS IV team will need 4 hours to check all of the items listed in the checks list below as well as address any issues that may have been produced during transportation of the payload, and complete a test to ensure that the

payload performs as expected. After tests are completed we will be able to mount onto the HASP platform.

C. Name of the integration team leader:

Paige Arthur

D. Email address of the integration team leader:

Paige.arthur@colorado.edu

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

Name	Email
Cooper Benson	cooper.benson@colorado.edu
Paige Arthur	paige.arthur@colorado.edu
Kristen Hanslik	kristen.hanslik@colorado.edu
Brandon Boiko	brandon.boiko@colorado.edu
Ryan Cutter	ryan.cutter@colorado.edu
Dylan Richards	dylan.richards@colorado.edu

F. Define a successful integration of your payload:

Successful integration of the HELIOS IV payload includes being tested to ensure the payload is functioning properly, able to downlink payload data to the HASP platform and ground station, capable of sending a response to uplinked serial commands, and able to withstand Thermal Vacuum testing.

G. List all expected integration steps:

    i.   Arrive with payload assembled

    ii.   Ensure that all components are intact after transportation

    iii.   Test payload to ensure proper functionality

        1. Perform test outside to allow for sun-tracking

        2. Power on and let run through start-up

        3. Determine that sun-tracking capability is functional

        4. Check SD card to ensure the system captured images from both cameras

        5. Recalibrate/Realign system if determined necessary

        6. Repeat steps 1-3 if necessary

7. Add physical circuit break to phi motor to prevent motion during T-Vac test

8. Repeat steps 1-3

iv. Deliver payload to be weighed and have serial communication capability confirmed

v. Deliver payload to be integrated on the platform

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

    i. During T-Vac

        1. Look in data packets for startup notification downlink

        2. Data is downlinked from the payload and the following can be seen in the data logs:

            a. Photodiode readings (from both theta and phi arrays)

            b. Accelerometer readings

            c. Gyroscope readings

            d. Temperature readings

            e. Pressure sensor readings

            f. Humidity sensor readings

            g. Current sensor readings

        3. Graphs of downlinked sensor data made during T-Vac show nominal results. Graphs of downlinked environmental data taken by the payload approximately correspond with graphs of environmental data taken by the HASP platform.

        4. Uplink to payload the command 0xAAAA which will ping the payload as documented in the uplink commands table. Look for response from payload in the downlinked payload data.

        5. Monitor temperature of components as they should not fall outside of nominal ranges.

    ii. After T-Vac

        1. Remove the physical circuit break to the phi motor.

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