HASP Payload Specification and Integration Plan

Payload Title: HELIOS II

Payload Class: Large

Payload ID: 10

Institution: University of Colorado Boulder

Contact Name: Caleb Lipscomb

Contact Phone: 419-508-2824

Contact E-mail: caleb.lipscomb@colorado.edu

Submit Date: 6/21/2013

I. Mechanical Specifications:

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

10.687 kg

Weight Budget:

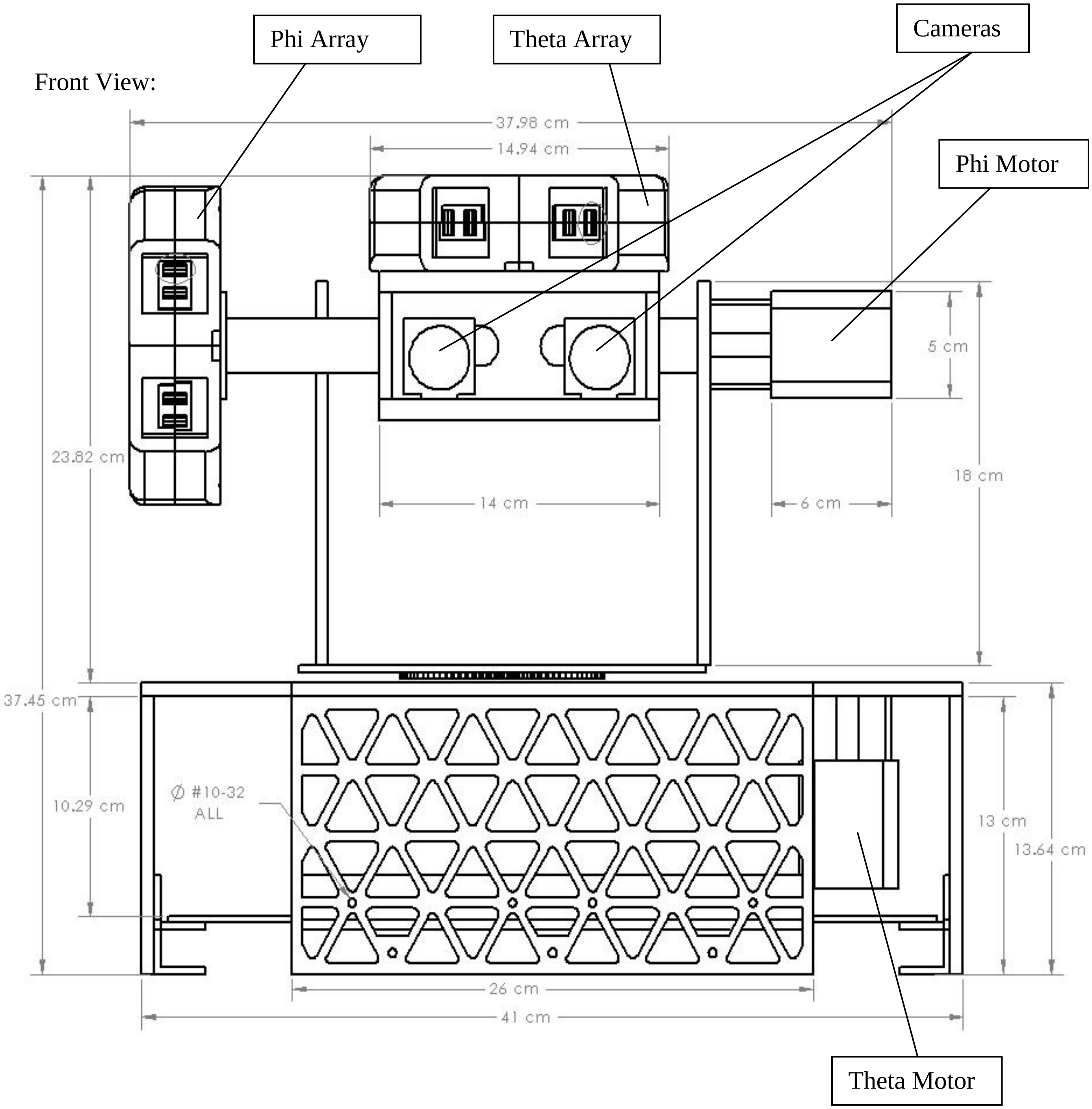
System	Part	Weight (kg)	Quantity	Part Total (kg)
ADCS	USB Cable	0.03	1	0.03
ADCS	Arduino DUE	0.035	1	0.035
ADCS	Op Amp and Diode	0.003	12	0.036
ADCS	Motor	0.352	2	0.704
ADCS	Motor Driver	0.009	2	0.018
ADCS	Photodiode Array	0.161	2	0.322
ADCS Subtotal (kg)				1.145
C&DH	Pandaboard	0.082	1	0.082
C&DH	SSD	0.128	1	0.128
C&DH	Humidity sensor	0.005	1	0.005
C&DH	MPU - 6050	0.001	1	0.001
C&DH	Pressure Sensor	0.018	1	0.018
C&DH	Cables	0.06	1	0.06
C&DH	Logic Gate	0.003	1	0.003
C&DH Subtotal (kg)				0.297
SWIS	DMK 72BUC02 CMOS Cameras	0.07	2	0.14
SWIS	USB Cable	0.06	2	0.12
SWIS	ADCS Barrel	0.042	1	0.042

SWIS	Science Barrel	0.167	1	0.167
SWIS	Fasteners	0.005	4	0.02
SWIS Subtotal (kg)				0.489
EPS	DE-SWADJ 3 Buck Converter	0.01	4	0.04
EPS	SPX Semiconductor	0.001	5	0.005
EPS	Heat Sink	0.027	5	0.135
EPS	Arduino DUE	0.036	1	0.036
EPS	Current Sensors	0.001	3	0.003
EPS	MOSFET	0.001	3	0.003
EPS	Capacitors	0.001	18	0.018
EPS	Resistors	0.001	24	0.024
EPS	40V 3A Schottky Diode	0.001	2	0.002
EPS	LED	0.001	5	0.005
EPS	Arduino power cord	0.039	3	0.117
EPS	connectors	0.005	5	0.025
EPS	D-SubMin Connector	0.07	1	0.07
EPS	PCBs	0.1	1	0.1
EPS Subtotal (kg)				0.583
Structure	Base Structure	4.418	1	4.418
Structure	Camera Housing	3.441	1	3.441
Structure	Bushing and Sprocket	0.314	1	0.314
Structure Subtotal (kg)				8.173
Payload Total (kg)				10.687

System	Subtotal (kg)	Payload Total (kg)
ADCS	1.145	10.687
C&DH	0.297	
SWIS	0.489	
EPS	0.583	
Structure	8.173	

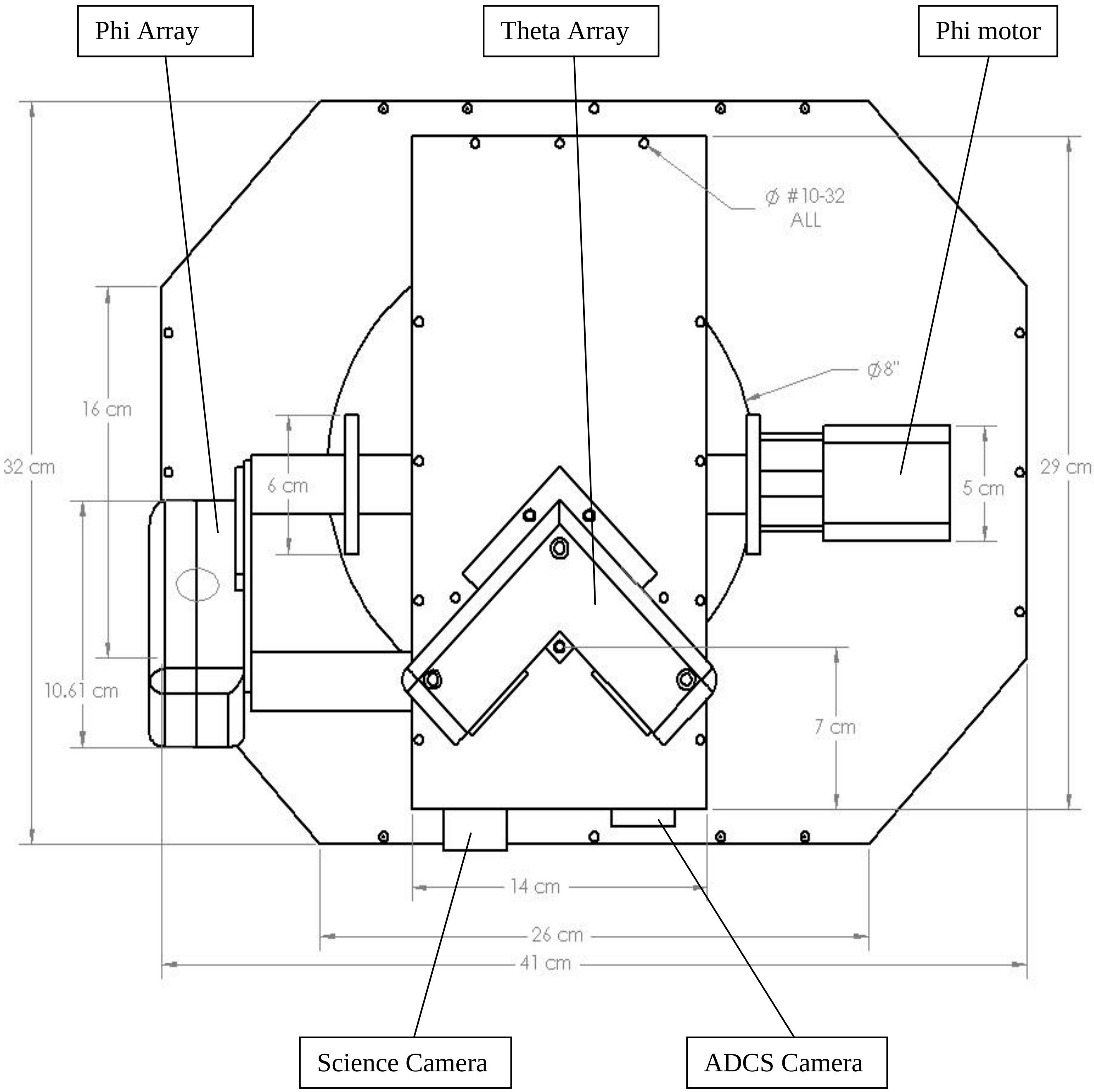
B. Provide a mechanical drawing detailing the major components of your payload and specifically how your payload is attached to the payload mounting plate

Front View:

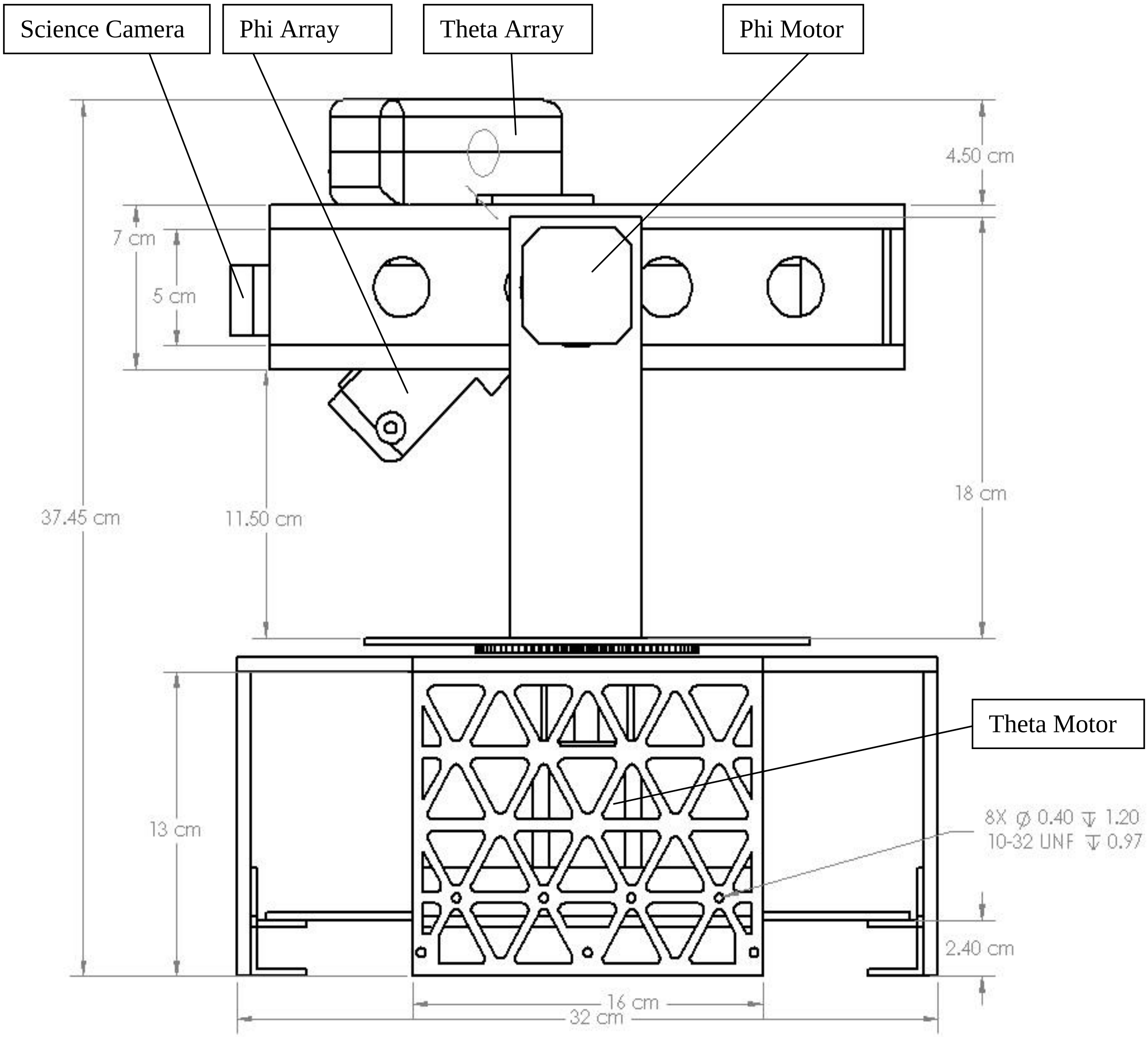


Phi Array
Theta Array
Cameras
Phi Motor
37.98 cm
14.94 cm
5 cm
18 cm
14 cm
6 cm
23.82 cm
37.45 cm
10.29 cm
Ø #10-32
ALL
13 cm
13.64 cm
26 cm
41 cm
Theta Motor

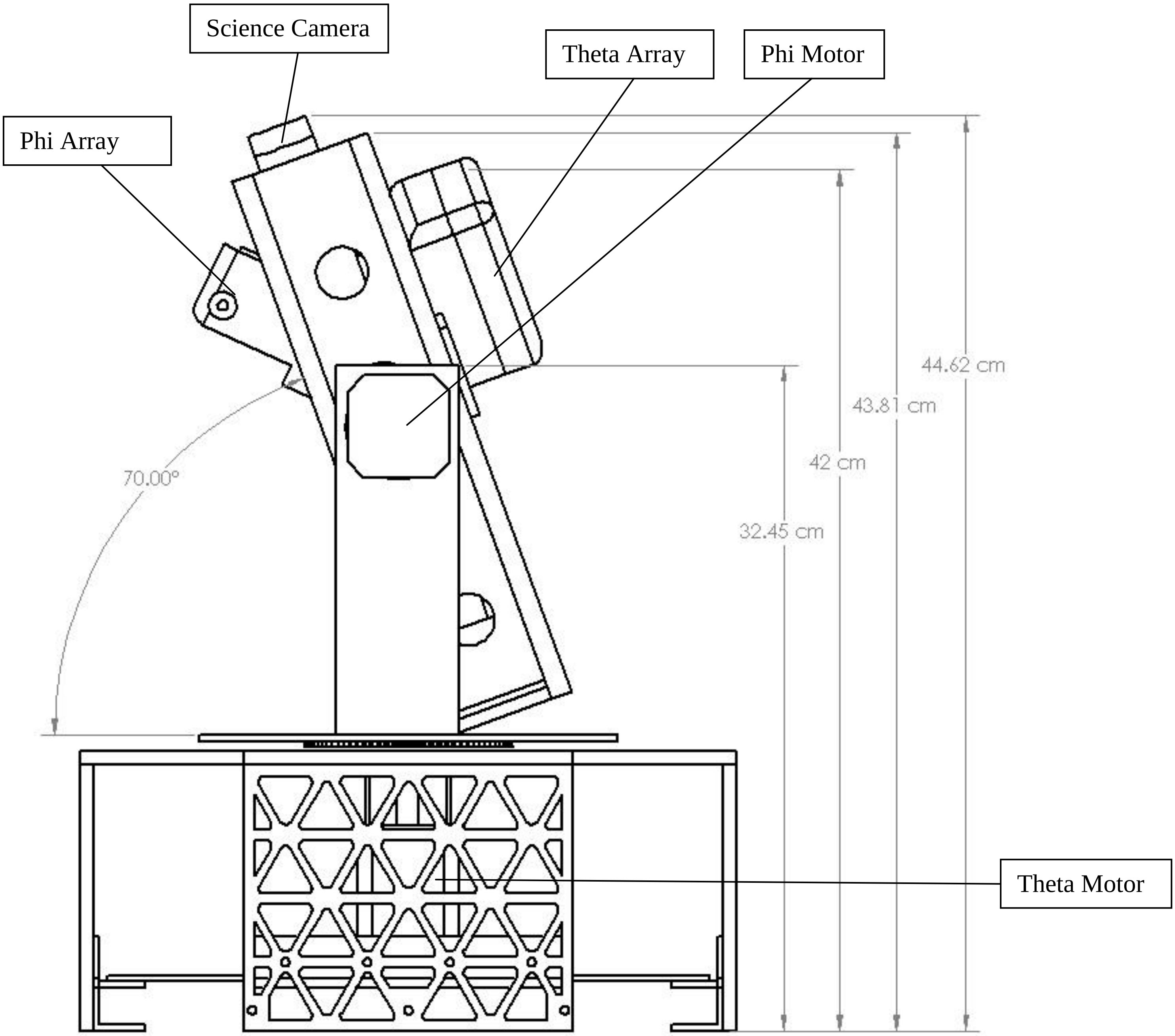
Top View:


Phi Array
Theta Array
Phi motor
Ø #10-32
ALL
Ø8"
32 cm
16 cm
6 cm
10.61 cm
5 cm
29 cm
7 cm
14 cm
26 cm
41 cm
Science Camera
ADCS Camera

Side View:


Science Camera
Phi Array
Theta Array
Phi Motor
Theta Motor
4.50 cm
7 cm
5 cm
18 cm
37.45 cm
11.50 cm
13 cm
8X ∅ 0.40 ↧ 1.20
10-32 UNF ↧ 0.97
2.40 cm
16 cm
32 cm

Side View at full camera tilt:



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…)

N.A.

D. Other relevant mechanical information

N.A.

II. Power Specifications:

A. Measured current draw at 30 VDC

Measured Max Current Draw: 2.21 A

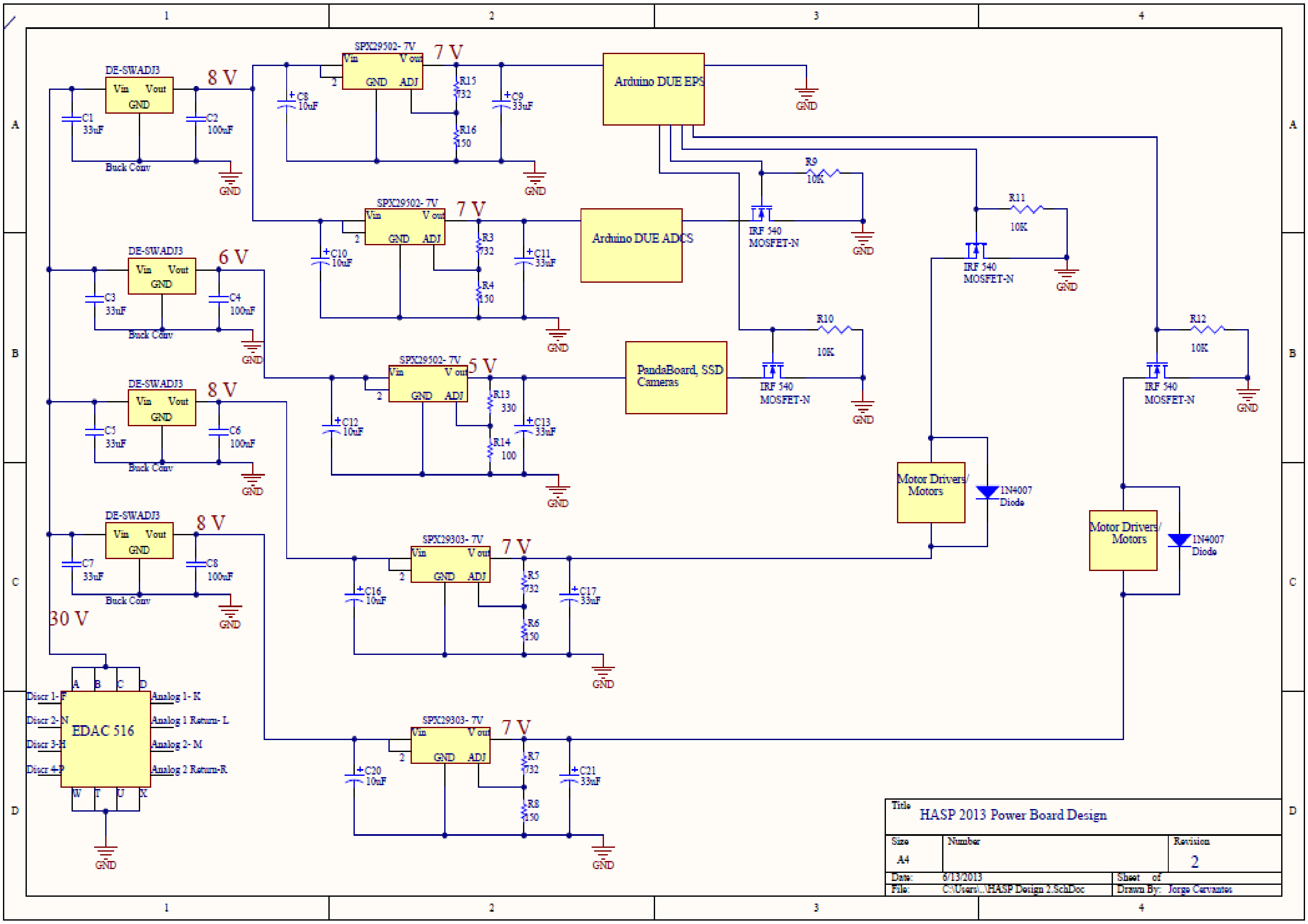
Measured Nominal Current Draw: 1.68 A

INSTRUMENT	VOLTAGE (V)	CURRENT (A)	# of sensors/pins used at one time	POWER (W)
Arduino DUE-EPS	7	0.009	16	1.008
5 volt pin	5	0.8	1	4
3.3 volt pin	3.3	0.8	1	2.64
CPU	5	0.7	1	3.5
Solid State Drive	5			
Camera 1	5	0.5	1	2.5
Camera 2	5	0.5	1	2.5
Stepper Motor1	7	1.7	1	11.9
Stepper Motor2	7	1.7	1	11.9
Arduino DUE-ADCS	7	0.009	12	0.756
5 volt pin	5	0.8	1	4
3.3 volt pin	3.3	0.8	1	2.64
Motor Driver1	7	0.03	1	0.21
Motor Driver2	7	0.03	1	0.21
OpAmp	5	1.00E-12	20	1E-10
Total Max Power Draw				47.764

Power Budget

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.

HELIOS II circuit diagram:



C. Other relevant power information

N.A.

III. Downlink Telemetry Specifications:

A. Serial data downlink format: Packetized

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

   4800 baud

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

   Data record size: 7.41 megabytes.

   The data record will contain temperature sensor readings, photodiode readings, current sensor readings, and 10 pictures, compressed in a zip file, from the ADCS camera.

D. Number of analog channels being used: 2

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

   Downlinking data collected from thermocouples and data on the temperature of the motor drivers HELIOS II

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

I. Other relevant downlink telemetry information.

   N.A

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*)

   Expected to uplink 0 to 3 total commands

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

Uplink Command Table		
Use	2-byte hexadecimal command coding.	
ADCS restart	4a	J as a string and 1001010 as bits. This serial command shall restart the ADCS
ADCS change diode	4b	K as a string and 1001011 as bits. This serial command shall change which pair of diodes the ADCS uses to track sun.
Initialize pan mode	4c	L as a string and as 1001100 as bits. This serial command shall initialize back-up pan mode should ADCS not function properly.

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:

July 29th, 3:00 pm

B. Approximate amount of time required for integration:

2.5 hours

C. Name of the integration team leader:

Caleb Lipscomb

D. Email address of the integration team leader:

Caleb.lipscomb@colorado.edu

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

1. Jorge Cervantes(Jorge.cervantes@colorado.edu)
2. Anthony Lima (Anthony.lima@colorado.edu)
3. Jonathan Sobol (jonathan.sobol@colorado.edu)
4. Kristen Hanslik (kristen.hanslik@gmail.com)
5. Ashley Zimmerer (Ashley.Zimmer@colorado.edu)
6. Caleb Lipscomb (caleb.lipscomb@colorado.edu)
7. Chris Koehler (Koehler@colorado.edu) (Tentative)

F. Define a successful integration of your payload:

Ensure all systems are functioning individually and HELIOS II payload is operating as a whole. Normal operations include: Cameras are able to capture images, store the captured images onto the solid state drive, ADCS is able to find and track the sun or strong artificial light source, EPS provides power to all systems, C&DH successfully downloads information, and the structure is correctly attached to the HASP platform. HELIOS II shall successfully complete a day in the life test in a Thermal Vacuum Chamber and survive all temperature extreme tests.

G. List all expected integration steps:

1. Attach HELIOS II and PVC baseplate assembly to the HASP platform
2. Connect all Electronic Power System power lines to EDAC 516
3. Connect all Command and Data Handling communication lines to DB9 connector pins 2,3, and 5
4. Confirm all data and power line to the CPU,EPS microprocessor ADCS microprocessor, ADCS photodiode arrays, motors, motor drivers, environmental sensors, and cameras are correctly connected
5. Run ADCS test. ADCS locates and tracks sun (strong artificial light source). ADCS re-orients cameras to face the light source
6. Take test images with cameras
7. Run abbreviated mission simulation:
    1. Power on payload
    2. Run boot-up sequence
    3. Run normal mission operations:
        a. ADCS tracks “sun”, a strong artificial light source
        b. Cameras capture images
        c. C&DH sends health and status reports and stores images on solid state drive
        d. EPS successfully provides power to all components
    4. Power down payload.
    5. Retrieve and analyze payload data
8. Day in life test in thermal vacuum test
    1. Perform normal mission operations in extreme thermal conditions
    2. Perform normal mission operations in a Vacuum
    3. Retrieve and analyze payload data after thermal vacuum test

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

   1. Check to ensure HELIOS II is secure to base plate and PVC base plate is secure to HASP platform
   2. Measure voltage and current outputs of EPS power lines, ensure readings are at correct values
   3. Check communication between C&DH CPU and HASP platform; send health and status information from CPU to HASP platform downlink
   4. Check voltages on all power lines within HELIOS II, ensure all wires are correctly connected and secured.
   5. Use artificial light source as sun, and run test ADCS operation. Ensure ADCS identifies and tracks sun; re-orienting cameras to face the sun.
   6. Capture test images with cameras, download images from solid state drive and review images on Caleb's computer
   7. Ensure payload correctly powers on, runs mission operations, and powers off.
   8. HELIOS II operates successfully and accomplishes checks 1 through 7 in vacuum and extreme thermal conditions

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.