HASP Payload Specification and Integration Plan

Payload Title: EagleSat

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

Payload ID: 2015-01

Institution: **Embry-Riddle Aeronautical University**

Contact Name: Zach Henney

Contact Phone: (707) 570-611

Contact E-mail: henneyz@my.erau.edu

Submit Date: 24 April 2015

1) Mechanical Specifications:

A. The measured and estimated weight of the payload (not including payload plate), as of 21 April 2015, is given in Table 1 below. This table includes a margin for all parts that still have estimated masses, and will be updated in the final PSIP to include all measured values for all components that will be flying on HASP 2015.

	Component	Mass (g)	Margin (g)	Measured	Estimated
EagleSat	Payloads	125	50		yes
	Electrical Power System	60	30		yes
	Super Capacitors	174	50		yes
	Communications	136	20		yes
	On-Board Computer	98	10		yes
	Solar Panels	228	0	yes	
	Antennas	192	0	yes	
	Structure	200	0	yes	
Nest	GPS	27	0	yes	
	Thermal Management	250	100		yes
	Arduino	35	0	yes	
	Electrical Management	150	15		yes
	Structure	290	0	yes	
	Total	1965	275		
	Total, with margin	2240			
	Mass allowance	3000			

Table 1. Preliminary Mass Budget

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

See attached appendix for mechanical drawings.

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…)

There will be no hazardous materials within our payload.

D. Other relevant mechanical information

No other information at this time.

2) Power Specifications:

A. Measured current draw at 30 VDC is based off data collected after the 2014 HASP flight, and is given in Table 2 below. An updated table will be included with the final PSIP, at which point all fabrication will have been completed. Note that for EagleSat, due to the complexity within the system, an overall current draw is given, while for the Nest, current is shown at the major component level.

	Component	Current (mA)
EagleSat		
	System	250
Nest		
	Arduino	120
	Total	370
	Allowable Current Draw	500

Table 2. Estimated Current Draw

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.

See appendix for wiring diagram.

C. Other relevant power information

None at this time.

3) Downlink Telemetry Specifications:

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

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

Downlink is estimated to be around 6 bps.

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

Data will be downlinked in two distinct formats, the first being a status check of the EagleSat OBC, the second serving as a GPS downlink. Data from the OBC check will be downlinked once per minute, while the GPS downlink will come three times per minute. Data will be in the following format for the OBC:

Byte	Value	Description
1-18	OBC Time	Time as reported by the on-board computer
19-36	OBC Date	Date as reported by the on-board computer
37-59	EagleSat Voltage	Voltage of the EagleSat capacitor array
60-64	Checksum	Checksum for data string

Table 3. EagleSat OBC Downlink Format

The data for the GPS downlink will be in the following format, repeated three times per minute:

Byte	Value	Description
1-7	GPS Format	Reports the format of GPS data
8-19	UTC Time	Record time, in UTC, with checksum
20-32	Latitude	Latitude, in format DEG MIN.MIN
32-45	Longitude	Longitude, in format DEG MIN.MIN
46-47	GPS Fix	Reports the status of GPS fix
48-50	Satellite	Number of Satellites in View
51-54	HDOP	Relative accuracy of horizontal position
55-64	Altitude	Altitude above sea level, meters
65-73	Geoid height	Height of geoid above WGS84 ellipsoid
74-87	Checksum	Checksum

Table 4. EagleSat GPS Format

D. Number of analog channels being used:

No analog channels are in use at this time.

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

Not in use.

F. Number of discrete lines being used:

No discrete lines will be utilized by this payload.

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

Not in use.

H. Are there any on-board transmitters? If so, list the frequencies being used and the transmitted power.

The communications system will be downlinking on 436.5 MHz at 500 mW of power.

I. Other relevant downlink telemetry information.

The EagleSat payload will be simultaneously transmitting information through HASP and over the radio to create a duplicate data log in case data is lost from either source.

4) 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*)

During normal operations, there will be a maximum of 2 commands per hour sent through HASP. Most commanding of the payload will take place through radio.

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

The anticipated commands list for EagleSat are given below in Table 5:

Name	Bytes	Description	Critical	Determination	Contingency	Ramification
TRANSMIT INHIBIT	A 0	Deactivates EagleSat radio	Yes	Radio shuts off	Resend command	If interrupting CSBF radios, payload must be disabled
TRANSMIT ENABLE	A 1	Activates EagleSat radio	Yes	Radio begins broadcasting	Resend command	Radio remains off for duration of flight.
ACTIVATE RELAY	B 1	Sends power to EagleSat	Yes	EagleSat reports full voltage	Resend command	EagleSat may power down during the flight.
DEACTIVATE RELAY	B 0	Switches EagleSat to solar	Yes	EagleSat displays non-standard voltage drop	Resend command	EagleSat remains on HASP power.
STATUS	C 1	Asks payload for status	No	Payload responds "Still working"	Resend command	Payload will only send data updates.

Table 5. Uplink Command Format

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

The payload will be receiving on 436.5 MHz.

F. Other relevant uplink commanding information.

No other information.

5) Integration and Logistics

A. Date and Time of your arrival for integration:

It is anticipated that the team will arrive in Palestine in the afternoon of 3 August, 2015, and arrive at CSBF in the morning of 4 August, 2015.

B. Approximate amount of time required for integration:

Integration is expected to take at most two hours, but could be shorter if radio compatibility testing takes place at the flight line in Ft. Sumner.

C. Name of the integration team leader:

Clayton Jacobs

D. Email address of the integration team leader:

Jacobsc6@my.erau.edu

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

Blake Games (gamesb@my.erau.edu)

Clayton Jacobs (jacobsc6@my.erau.edu)

Christina Halverson (halversc@my.erau.edu)

Shawn Thompson (thomps16@my.erau.edu)

F. Define a successful integration of your payload:

Successful integration can be defined as:

- Powering on without any faults, including blown fuses on HASP, blown voltage regulators on EagleSat, or any short circuits.
- Downlink of correct data via radio once the capacitor bank has reached the minimum voltage for transmission to begin.
- Successful telemetry with HASP – full serial communication, no swapped RX/TX lines, and no ungrounded serial lines.
- Passing radio compatibility checks.
- Successful operation during thermal vacuum tests, with no corrupted data or unplanned payload downtime.

G. List all expected integration steps:

1. Mount the payload plate to the HASP test rig.
2. Connect payload to HASP serial through the DB9 connector.
3. Connect payload to HASP power through the EDAC connector.
4. Power on the payload.
5. Look for startup data sent through the serial line to verify connection.
6. If data does not automatically send, send the payload the STATUS command to receive data.
7. (If available during integration) Verify that the transmitters on-board EagleSat do not interfere with CSBF radios.
8. Power down and disconnect payload from connectors.
9. Report to thermal vacuum chamber.
10. Mount and secure the payload to HASP for thermal vacuum test.
11. Connect payload to HASP serial through the DB9 connector.
12. Connect payload to HASP power through the EDAC connector.
13. Repeat steps 5, 6, and 7 to ensure proper operations prior to test.
14. Perform the thermal vacuum test with the payload running normal operations.
15. After payload has been removed from the thermal vacuum chamber, disconnect the serial and EDAC connectors.
16. Remove payload from HASP.
17. Begin post-test data analysis.

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

1. Data has been logged through both HASP and radio telemetry, and appears to be normal and consistent with test environment.
2. Power use remains in normal, HASP-allowable region, and does not go over 500 mA at any point in time.
3. EagleSat can communicate through on-board radios as well as through HASP serial.
4. EagleSat does not interfere with CSBF radios.

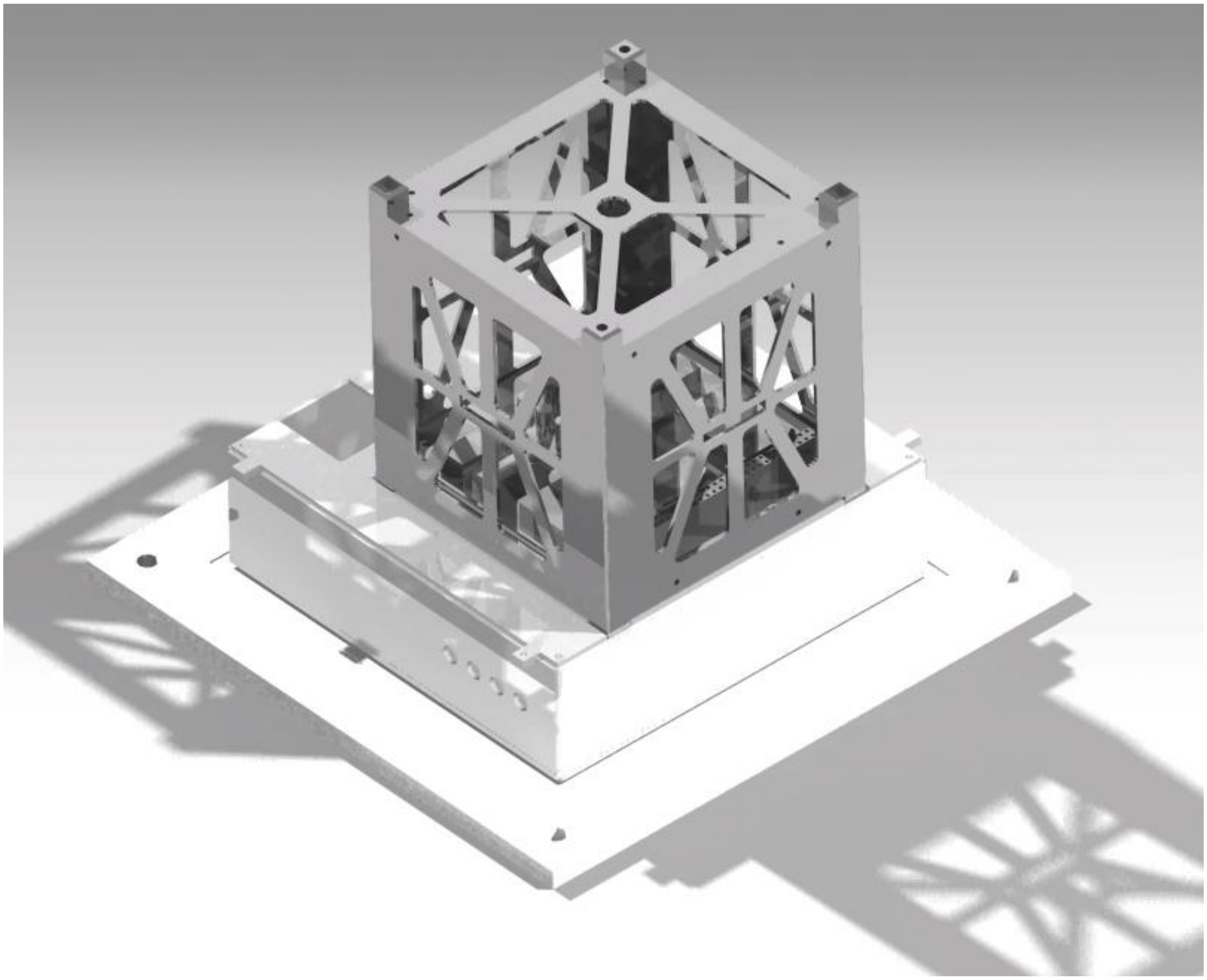
I. List any additional LSU personnel support needed for a successful integration other than directly related to the HASP integration (i.e. lifting, moving equipment, hotel information/arrangements, any special delivery needs…):

None at this time.

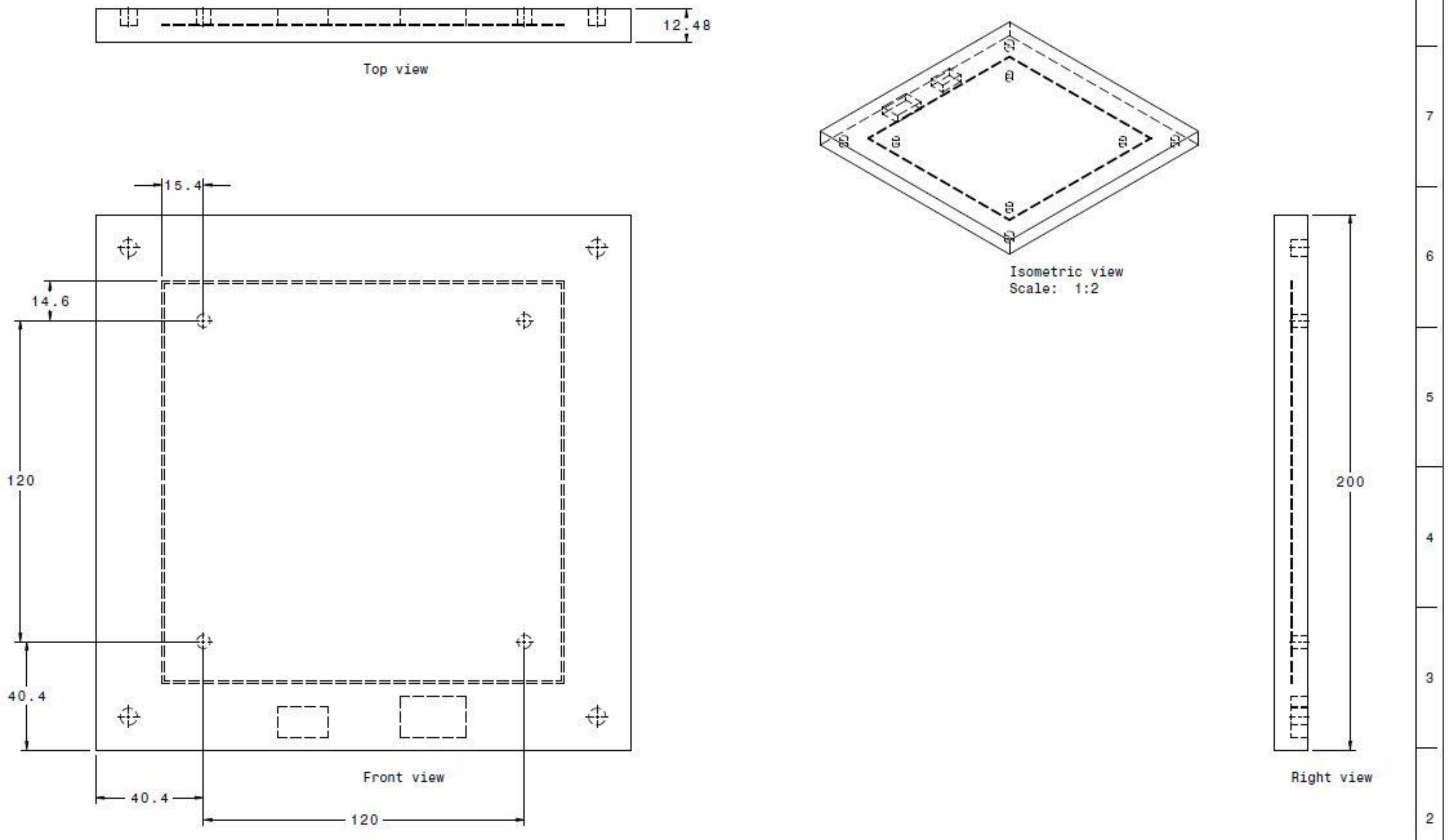
J. List any LSU supplied equipment that may be needed for a successful integration:

If problems arise during integration, access to oscilloscopes and soldering equipment may be necessary.

APPENDIX

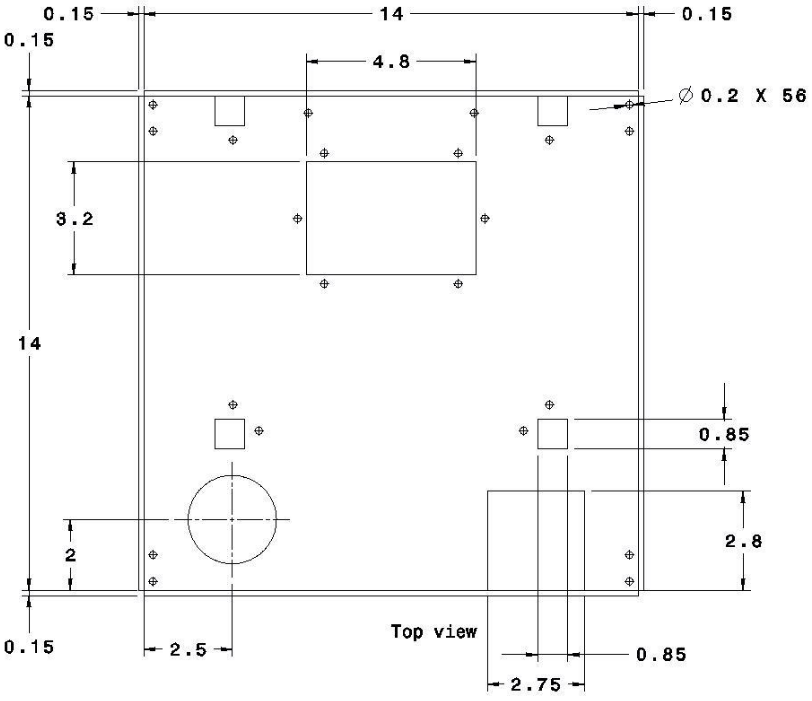


Scale rendering of EagleSat and Nest. As seen in this rendering, EagleSat is bolted to the top of the Nest module, which in turn is bolted to the HASP mounting plate. The HASP mounting holes can be seen in the following drawing of the mounting plate, then again in the drawing of the Nest bottom plate. Finally, the EagleSat/Nest mounting holes are visible in the drawing of Nest as a whole module, as well as the drawing of the Nest top.

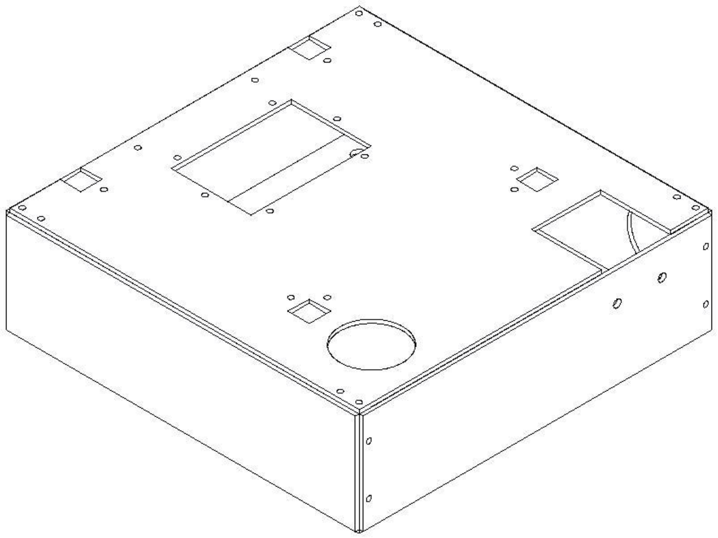


Created for NEST integration module to support ERAU EagleSat on HASP 2014.
Note: all dimensions = mm.

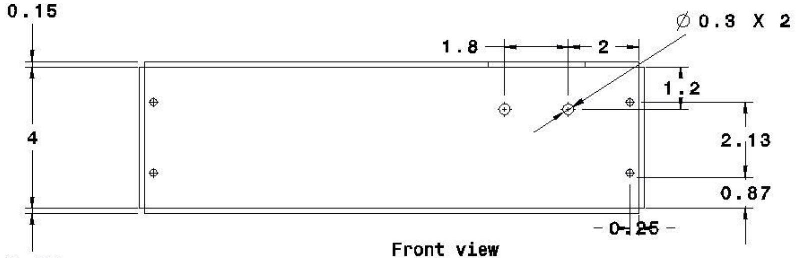
DRAWN BY Zach Henney	DATE 4/21/2014	ERAU PRESCOTT NASA SPACE GRANT					
		DRAWING TITLE HASP Mounting Plate					
CHECKED BY XXX	DATE xxx	SIZE C	DRAWING NUMBER 1				REV 1
DESIGNED BY Zach Henney	DATE xxx	SCALE	1:1	WEIGHT(kg)	0.01	SHEET	1/1



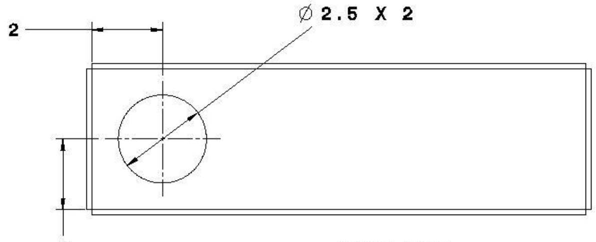
Top view



Isometric view
Scale: 1:1



Front view



Right view

All units in centimeters

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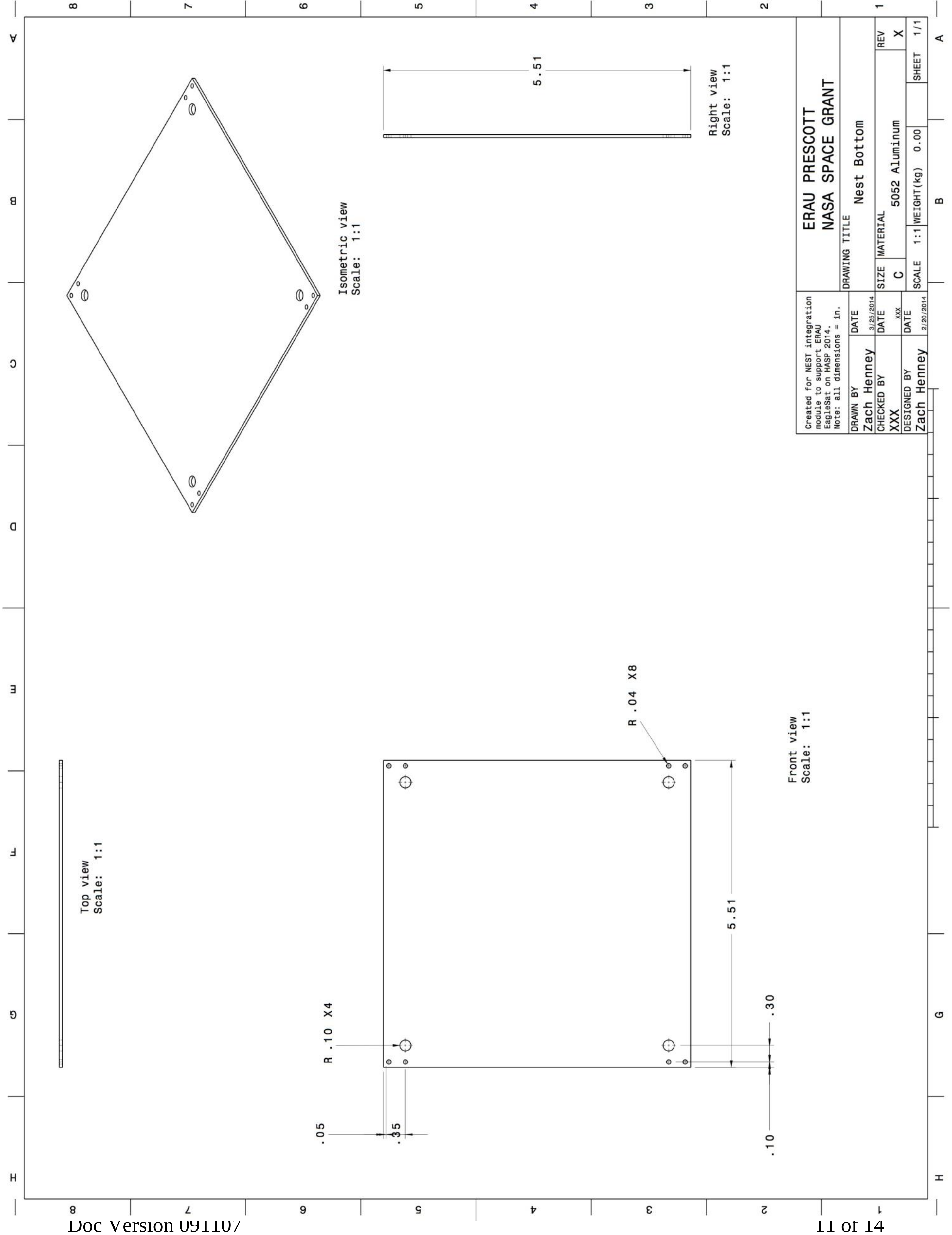
DRAWN BY Mo Sabliny	DATE 5/21/2013	ERAU NASA SPACE GRANT	
CHECKED BY Zach Henney	DATE 2/20/2015	DRAWING TITLE NEST INTEGRATION MODULE	
DESIGNED BY Zach Henney	DATE 5/21/2013	SIZE C · DRAWING NUMBER 004	REV D
		SCALE 1:1 · WEIGHT(kg) XXX	SHEET 1/1


ERAU PRESCOTT
NASA SPACE GRANT
DRAWING TITLE
Nest Bottom
SIZE C
MATERIAL 5052 Aluminum
REV X
SCALE 1:1
WEIGHT(kg) 0.00
SHEET 1/1
Created for NEST integration module to support ERAU EagleSat on HASP 2014.
Note: all dimensions = in.
DRAWN BY Zach Henney
DATE 3/25/2014
CHECKED BY XXX
DATE XXX
DESIGNED BY Zach Henney
DATE 2/20/2014
Isometric view
Scale: 1:1
Right view
Scale: 1:1
5.51
Top view
Scale: 1:1
Front view
Scale: 1:1
R .04 X8
R .10 X4
5.51
.30
.10
.05
.35
A
B
C
D
E
F
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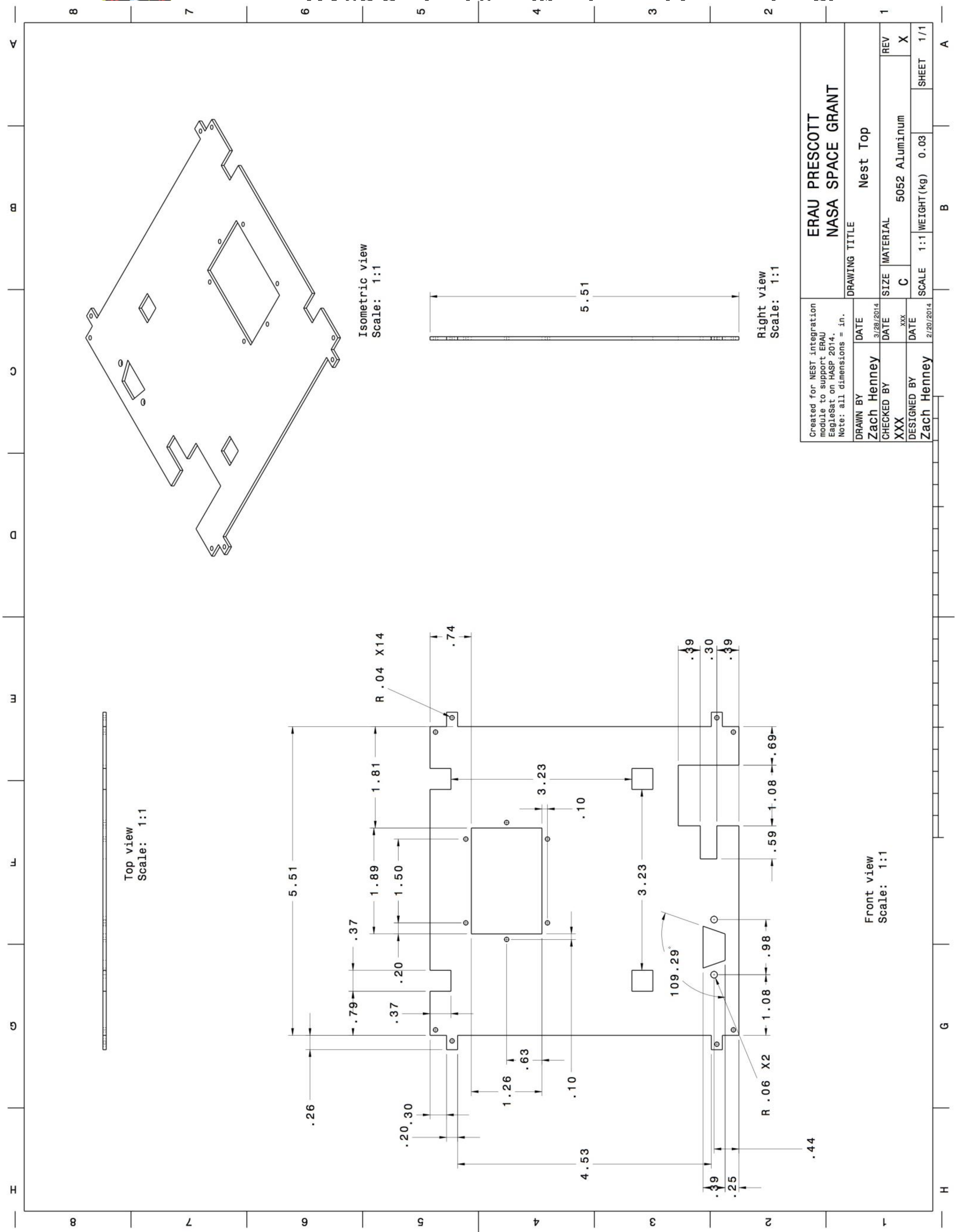
2
3
4
5
6
7
8


ERAU PRESCOTT
NASA SPACE GRANT
Created for NEST integration module to support ERAU EagleSat on HASP 2014.
Note: all dimensions = in.
DRAWN BY
Zach Henney
DATE
3/28/2014
CHECKED BY
XXX
DATE
XXX
DESIGNED BY
Zach Henney
DATE
2/20/2014
DRAWING TITLE
Nest Top
SIZE
C
MATERIAL
5052 Aluminum
REV
X
SCALE
1:1
WEIGHT(kg)
0.03
SHEET
1/1
Isometric view
Scale: 1:1
Right view
Scale: 1:1
Top view
Scale: 1:1
Front view
Scale: 1:1
5.51
R .04 X14
.74
.39
.30
.39
.69
1.08
.59
1.81
3.23
.10
1.89
1.50
3.23
.37
.20
.79
.37
109.29°
.98
1.08
R .06 X2
.26
.63
1.26
.10
.20
.30
4.53
.44
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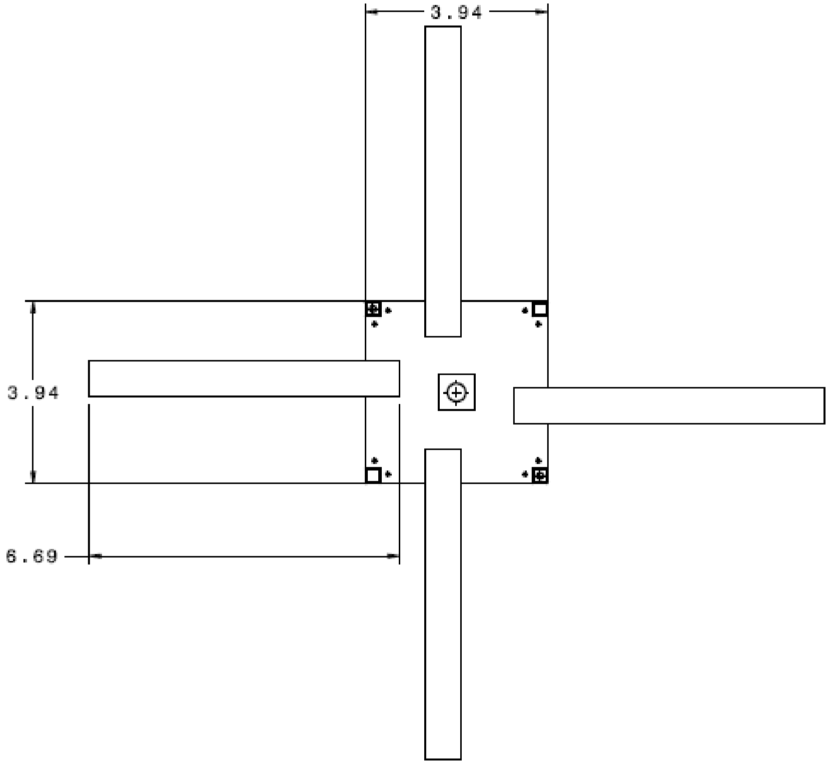
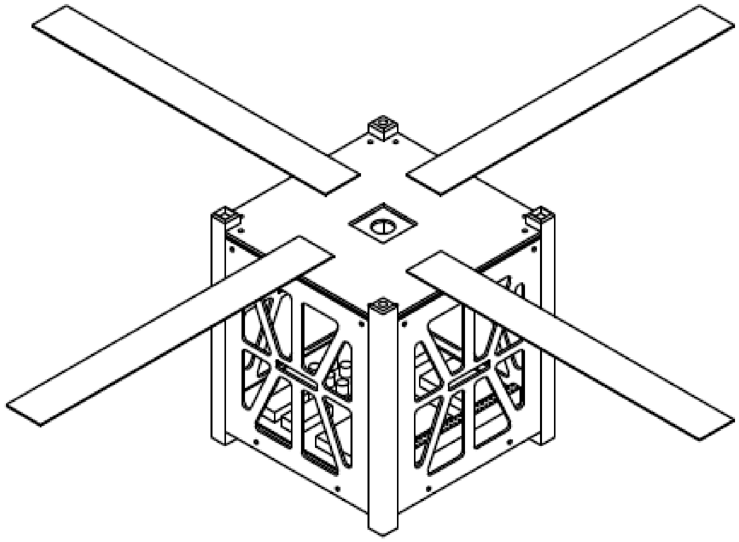
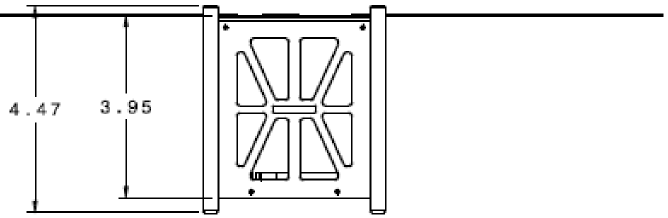


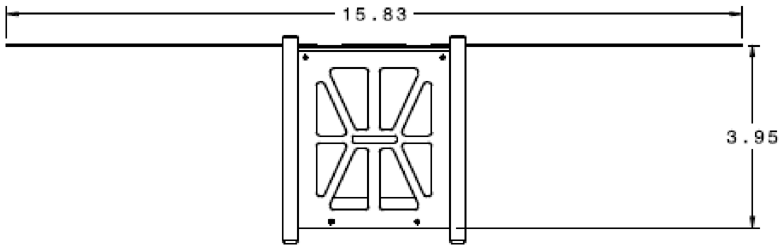
Top view
Scale: 1:2



Isometric view
Scale: 2:3



Front view
Scale: 1:2



Right view
Scale: 1:2

All units in centimeters

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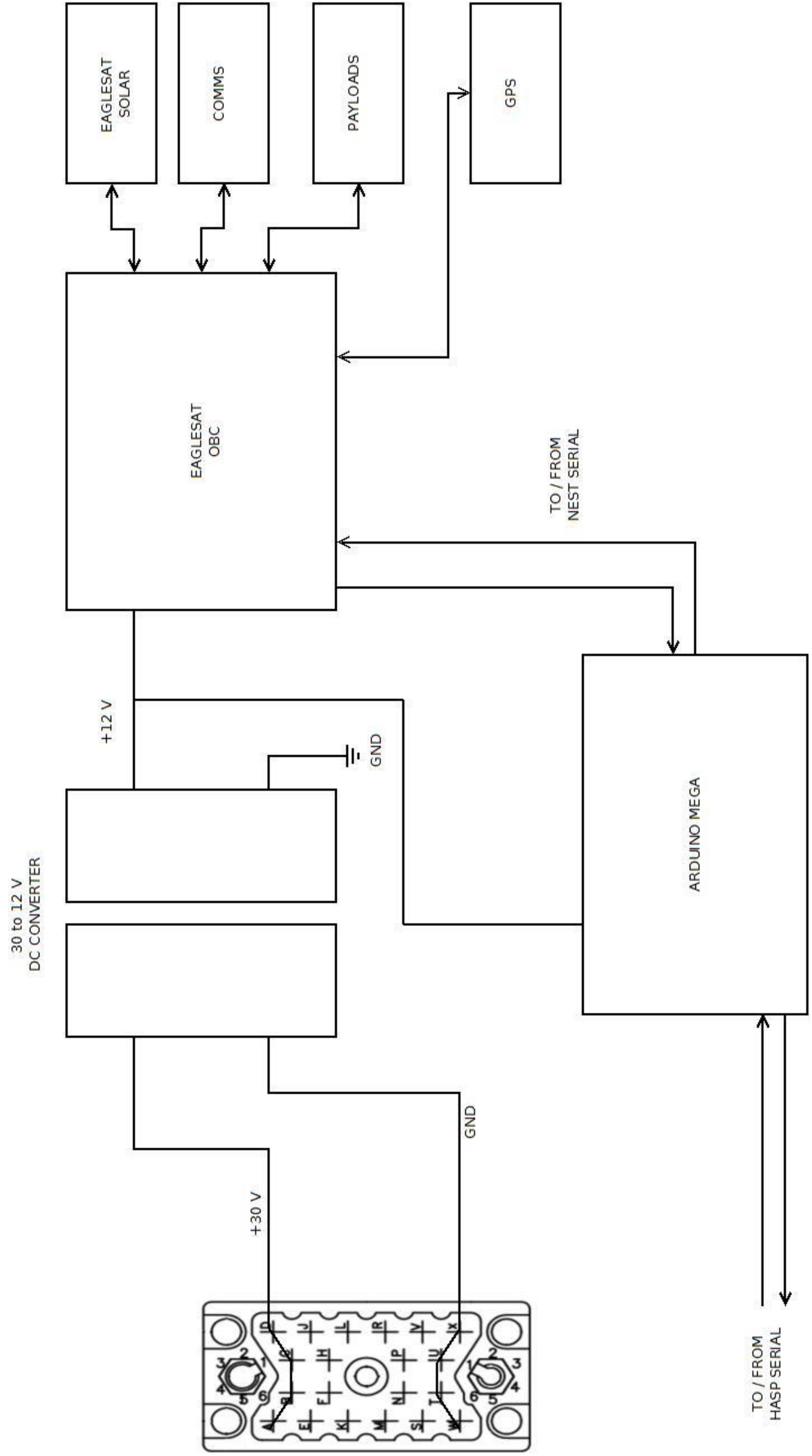
DRAWN BY Mo Sabliny	DATE 5/21/2013	DRAWING TITLE EagleSat	
CHECKED BY Zach Henney	DATE 5/21/2013	SIZE C	DRAWING NUMBER 002
DESIGNED BY	DATE	SCALE 1:2	WEIGHT(kg) XXX

REV B

SHEET



EagleSat wiring diagram, showing interconnected nature of Nest and EagleSat systems.