HASP Payload Specification and Integration Plan

Balloons over Volcanoes Team

June 22, 2014

Payload Title: Quantifying Atmospheric Infrasound with a Free Flying Acoustic Array

Payload Class: Small

Payload ID: 2014-02

Institution: UNC Chapel Hill

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Submit Date: June 22, 2014

1 Mechanical Specifications

1.1 Weight of Payload

The total weight of the UNC experiment is a combination of the data logger system attached to the HASP mounting plate (see Table 1) and instrumentation on balloon rigging (see Table 2). The weight supported by the payload interface plate will be 1528 grams; the maximum allowed is 3000 grams. The weight supported by balloon rigging will be 4792 grams.

1.2 Mechanical Drawings

Mechanical drawings with dimensions are shown in Appendix A. Units for A-1 (payload box) and A-2 (payload attachment detail) are in millimeters. Units for A-3 (array rigging) are in feet. Figure A-3 shows both the acoustic array stretched to its full length as well as a diagram of the microphones attached to the suspension ladder. Array cabling is approximately double the length of the HASP gondola to the top of the suspension ladder per CSBF's request. See Figure 1 for a top view of the internal contents of the payload box and Figure 2 for a side view of the internal contents of the payload box. An axometric view of the payload enclosed within the payload box is shown in Figure 3. The payload box will be attached to the interface plate using threaded eyes, hex nuts, and washers (see Figure A-2 in Appendix A). The DataCube logger will be securely attached to each eye using zip ties, preventing it from shifting during flight. Blocks of foam will surround the DataCube to provide thermal insulation, and cutouts in these foam blocks will hold the DC step down and the GPS antenna.

1.3 Potential Hazards

No hazardous materials or operations are anticipated.

1.4 Other Relevant Mechanical Information

None at this time.

2 Power Specifications

2.1 Measured Current Draw

A series of tests were performed to measure the current draw of the payload in different configurations; these tests are summarized in Table 3. The current of the payload was tested for approximately thirty minutes using a 12 volt source and with the DataCube configured for maximum power draw (continuous GPS, high resolution logging, 400 Hz sample rate). The measured current was 31.6 mA. The current draw was tested again using a 33 volt power source and a DC DC buck voltage step down with output at 16 volts; see Figure 5. The DataCube was configured for continuous GPS and high resolution logging at 400 Hz; a GPS lock was not acquired during the test. The power draw was 21.7 mA. The DC DC buck voltage step down consumes 7.64 mA with a 37.4 volt power source. When the data cube was connected to the DC DC buck voltage step down converter and configured for continuous GPS and high resolution logging at 400 Hz, the payload system consumed 19.4 mA with a 37.4 volt power source and 28.9 mA with a 25 volt power source. A GPS lock was present during these tests. This series of tests encompassed the ranges of voltages and data logger configurations expected during the flight. At no time did the power draw exceed one tenth of the maximum allowed power consumption of 500 mA. Each microphone will draw current from dedicated battery packs that will allow up to several days of continuous operation.

2.2 Power System Wiring Diagram

The DataCube data logger draws power through HASP, utilizing a Rio Rand LM2596 DC DC buck converter step down module power supply output to reduce the input of 28-32 volts to 16 volts (Figure 5). This converter has been tested in the lab using inputs of 37 and 24 volts. Each microphone draws power from 8 lithium AA batteries (Figure 4).

2.3 Other Relevant Power Information

None at this time.

3 Downlink Telemetry Specifications

No downlink telemetry will be used.

4 Uplink Commanding Specifications

No uplink commands will be used.

5 Integration and Logistics

5.1 Date and Time of Arrival

Our team will arrive on July 28 at the CSBF facility in Palestine, Texas. The team will depart on August 2.

5.2 Approximate Amount of Time Required

The integration of the data logger with the HASP payload should take about one hour. The integration of the acoustic array with the balloon rigging should take about three hours. Acoustic array integration will take place at the CSBF facility in New Mexico.

5.3 Integration Team Leader Name and Email

Daniel Bowman (daniel.bowman@unc.edu)

5.4 Integration Participants

Daniel Bowman (daniel.bowman@unc.edu)

5.5 Definition of Successful Integration

The payload must fall under 3 kg and not exceed a current draw of 0.5 A in order to be integrated with HASP. We will consider initial integration successful if the payload box is firmly attached to the interface plate, if the DataCube is firmly attached to the payload box, if the DataCube powers up when HASP power comes on line (verified by the ACQ LED flashing at 1 Hz), and microphones register a 10 Pa pressure drop when lifted 1 m. We will consider the payload ready for flight if and when the DataCube continues to record microphone input throughout the duration of the thermal/vacuum test.

5.6 List all Integration Steps

1. Verify that payload weight and current draw are within HASP specifications (≤ 3 kg, ≤ 0.5 A).
2. Attach payload box to interface plate.
3. Place DataCube inside payload box, attach power, GPS, and signal cable, then attach logger to payload box with zip ties through eye bolts.
4. Attach DC step down to HASP power input.
5. Apply power to payload, verify that DataCube is logging on all three channels, and check to see if lifting each microphone 1 m produces a 10 Pa signal.
6. Place foam insulation around DataCube and DC step down.
7. Close and latch payload box.
8. Switch off HASP power.

5.7 Checks to Determine Successful Integration

- Measured weight is below 3 kg and measured current is below 0.5 A.
- DataCube automatically begins acquisition sequence (ACQ LED is flashing at 1 Hz).
- Lifting each microphone 1 m gives a corresponding 10 Pa signal on the DataCube.
- DataCube acquires and stores infrasound signals from microphones throughout thermal/vacuum testing.

Upon arrival at the CSBF facility in New Mexico, the acoustic array will be attached the the balloon rigging. All cables will be securely connected and the connectors wrapped in duct tape. The microphone power supplies will be connected no more than 24 hours prior to the anticipated launch time.

5.8 Additional LSU Personnel

We do not anticipate requiring additional assistance.

5.9 LSU Supplied Equipment that May Be Required

We plan on bringing all the equipment we require.

6 Tables

Table 1: Weight of Instrumentation on HASP Mechanical Interface Plate

Component	Quantity	Weight (per item) g	Weight (total) g	Method
DataCube	1	711	711	Measured
GPS Antenna	1	73	73	Measured
Power Cable	1	35	35	Measured
Signal Cable	1	98	98	Measured
DC DC Step Down	1	11	11	Measured
Payload Box	1	100	100	Estimated
Attachment System	1	500	500	Estimated
Total			**1528**	

Table 2: Weight of Infrasound Array on Balloon Rigging

Component	Quantity	Weight (per item) g	Weight (total) g	Method
Microphone 1	1	259	259	Measured
Microphone 2	1	321	321	Measured
Microphone 3	1	320	320	Measured
8 AA Battery Pack	3	360	1080	Estimated
Microphone Enclosure	3	395	1185	Measured
Payload to Array Cable	1	405	405	Measured
Array Riser Cabling	1	1222	1222	Measured
Total			**4792**	

Table 3: Power Draw

Component	Supplied Voltage V	Power Draw mA
Microphone 1	8.59	2.6
Microphone 2	8.39	2.3
Microphone 3	8.35	1.9
DataCube	12	31.6
DataCube	16	23.1
DC Step Down	37.4	7.64
DataCube and DC Step Down	37.4	19.4[a]
DataCube and DC Step Down	25.0	28.9[b]
Maximum Power Draw		**31.6**
Maximum Allowed		**500**

[a]No GPS fix
[b]GPS fix

7 Figures

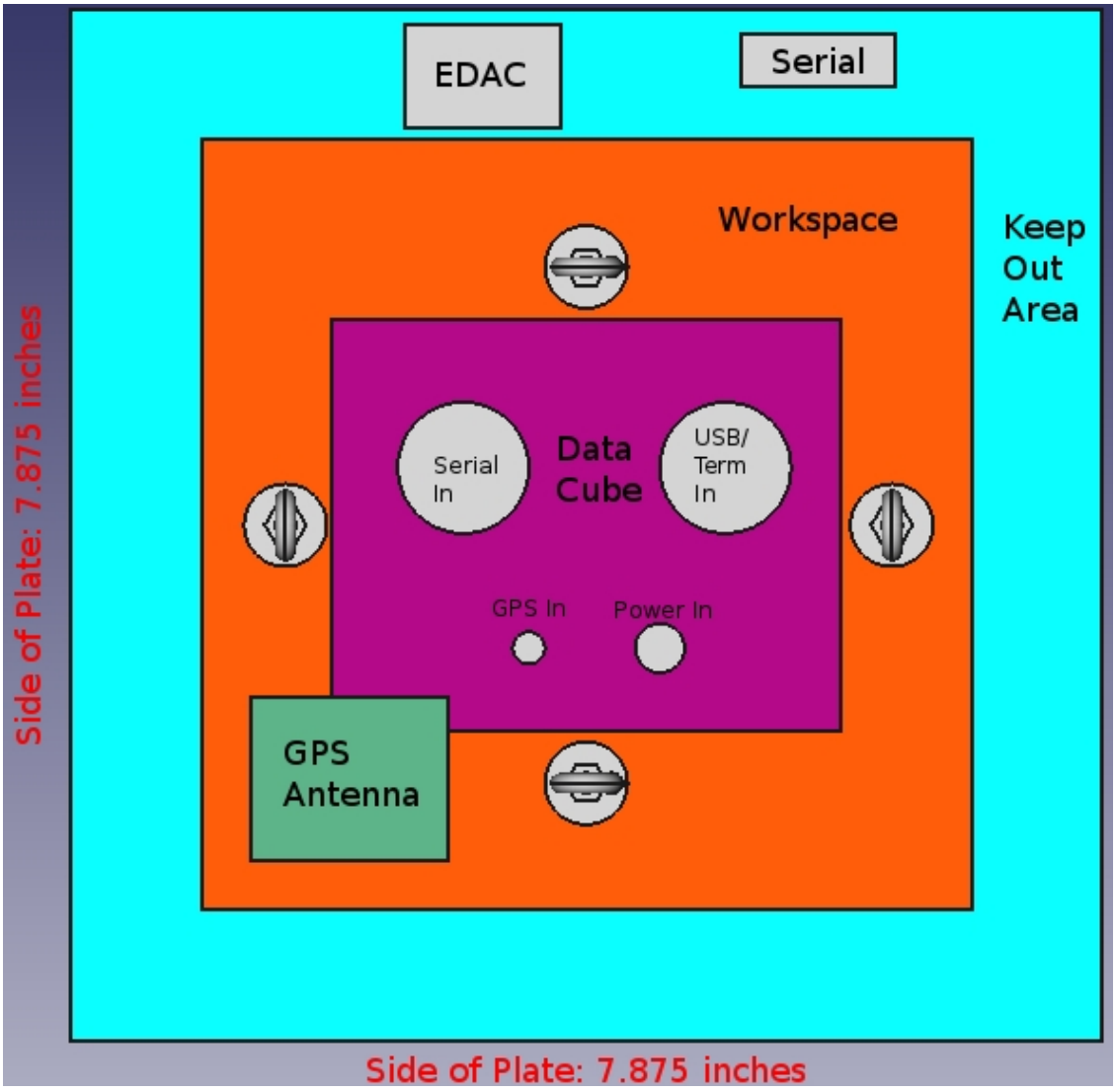


Figure 1: Top view of HASP payload without payload box.

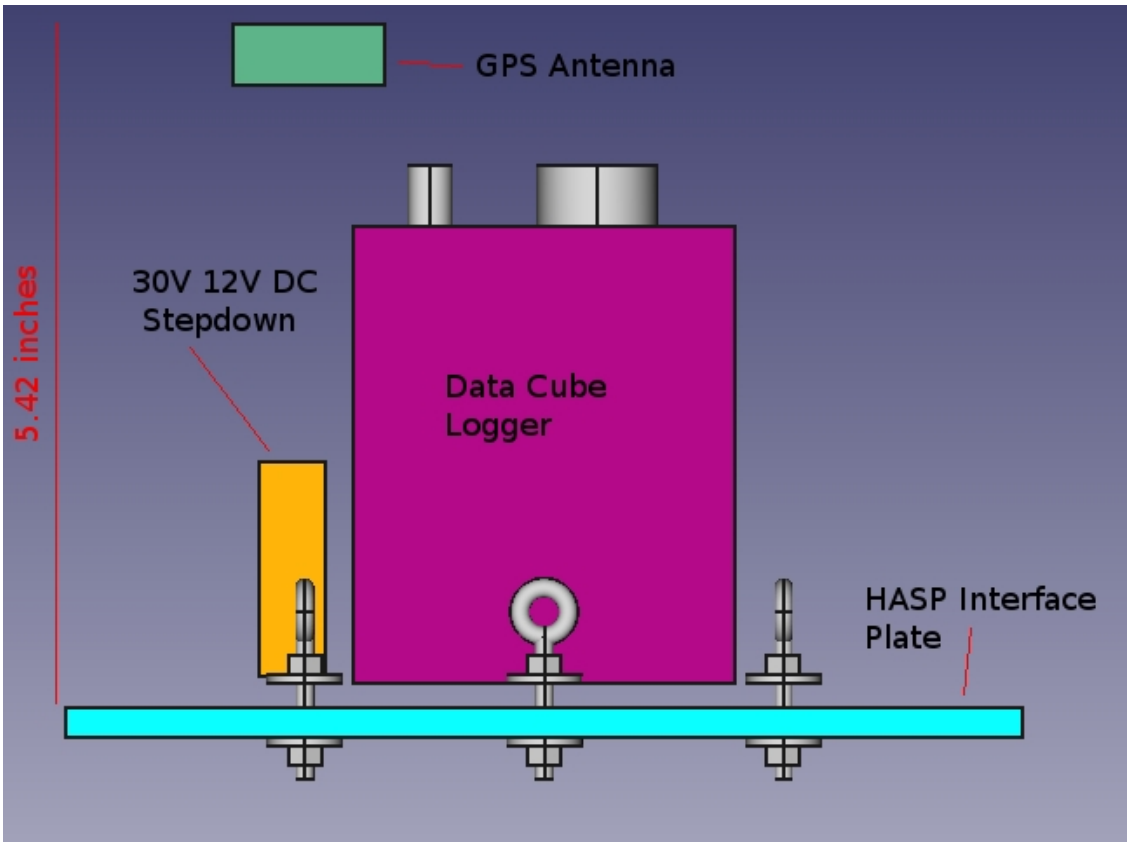


Figure 2: Front view of HASP payload without payload box.

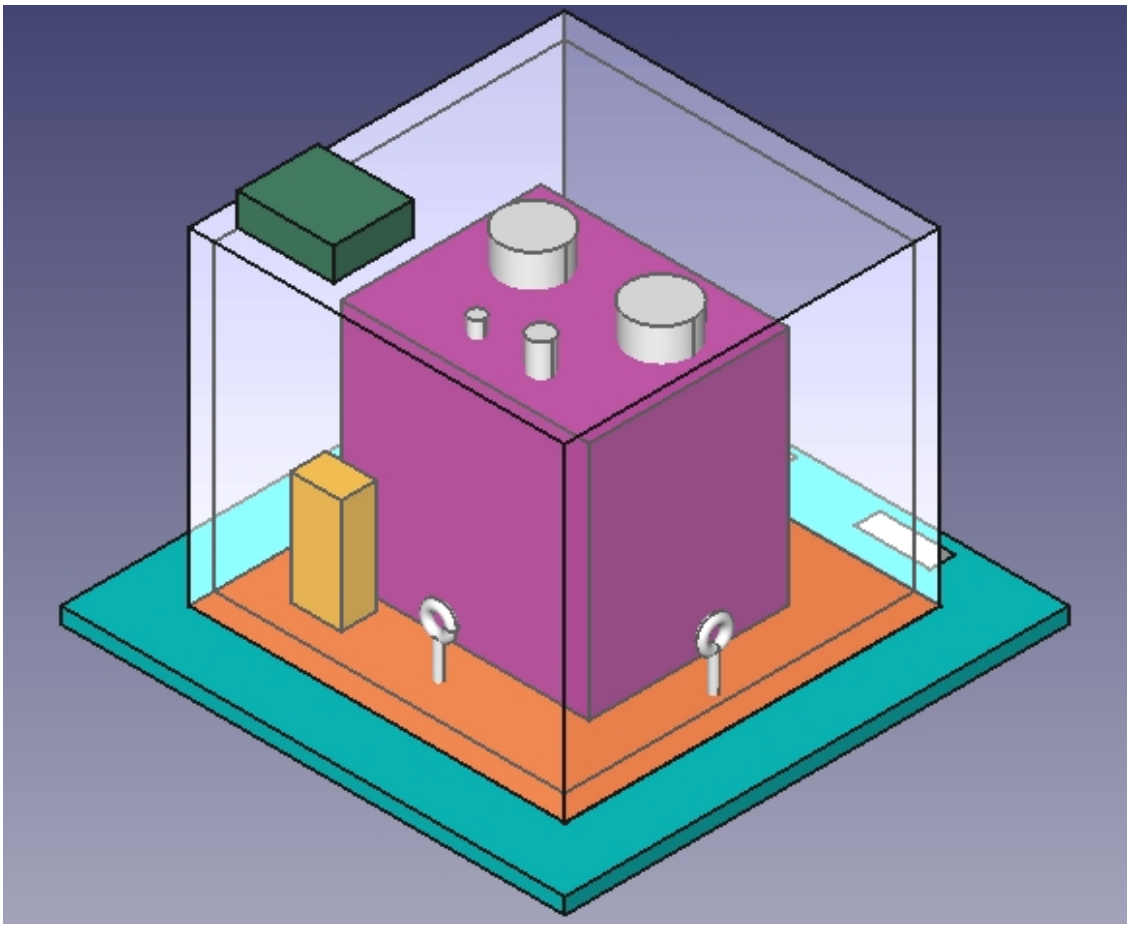


Figure 3: Axometric view of UNC HASP payload enclosed within the payload box (transparent for visibility).

Figure 4: Microphone power circuit diagram.

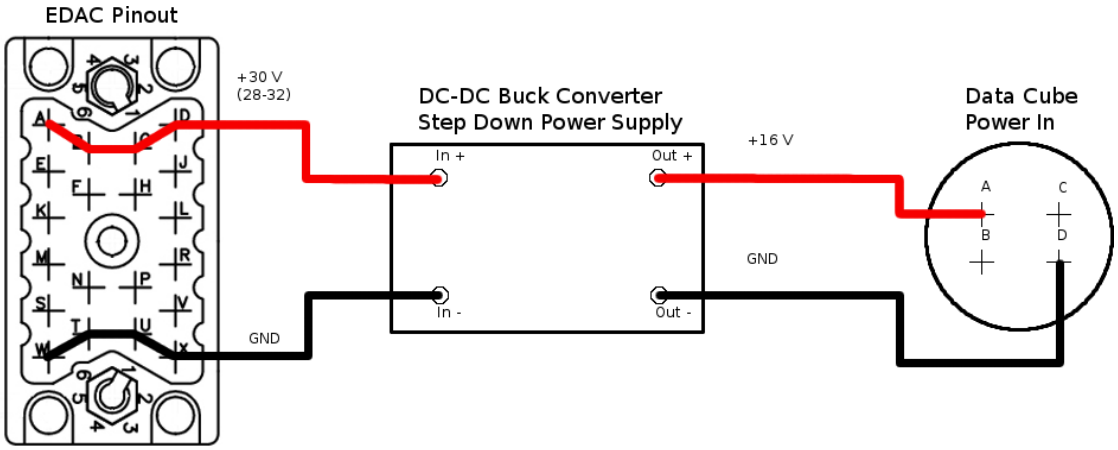
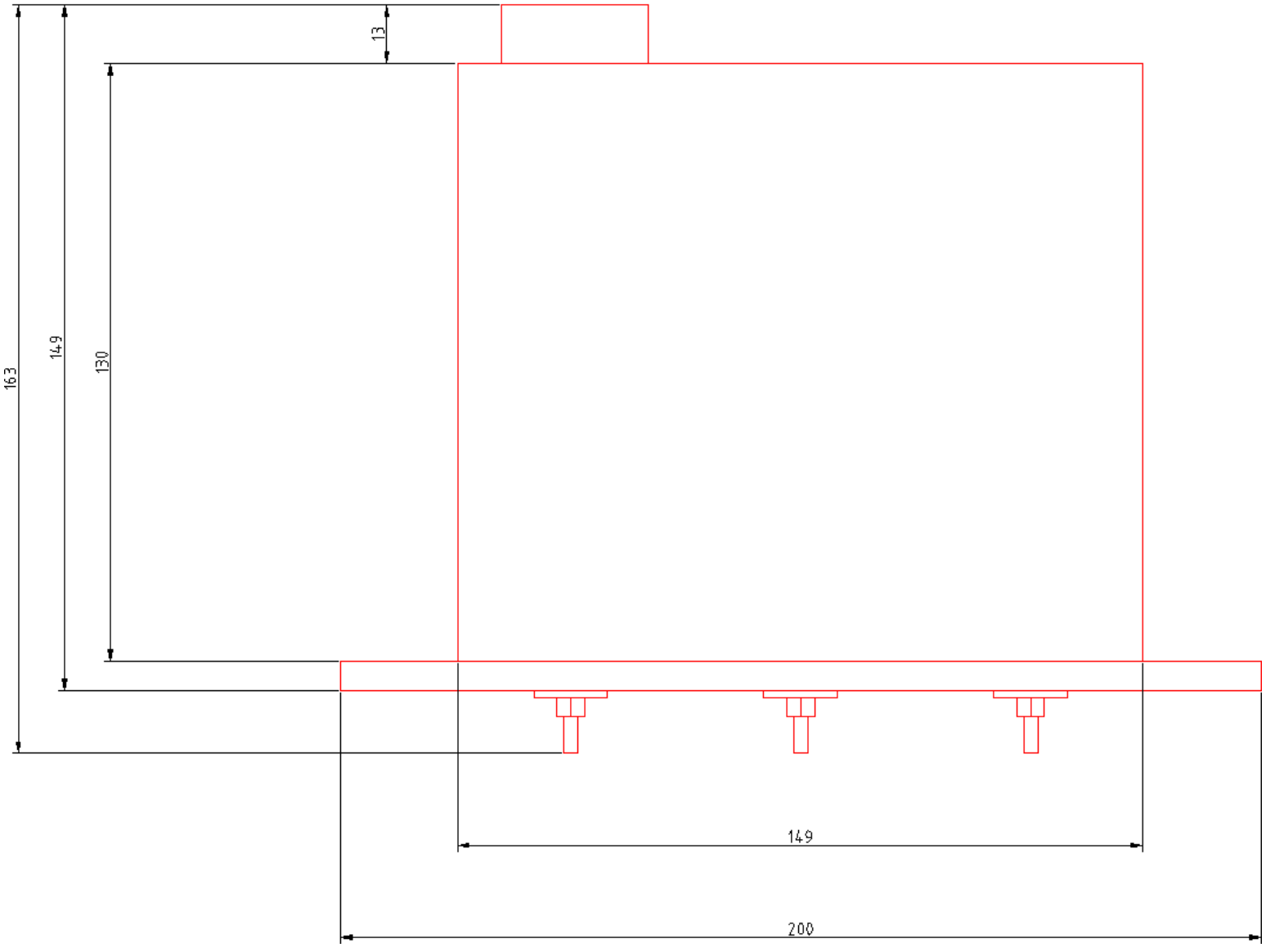


Figure 5: Data logger power circuit diagram.

8 Appendix A: Mechanical Drawings

A – 1

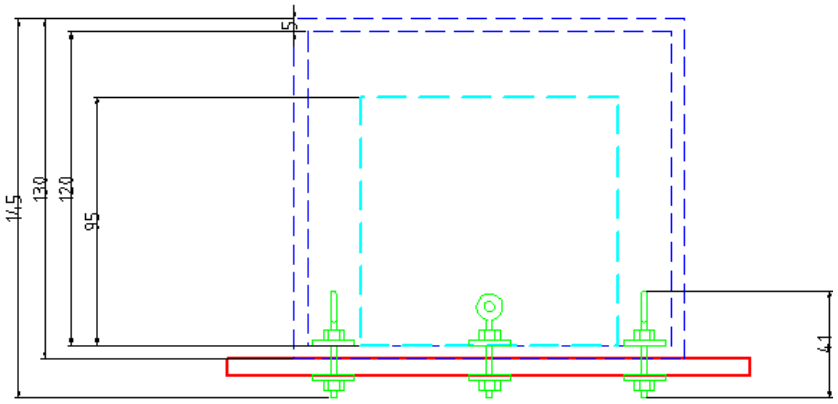
Payload Box on Mounting Plate
Side View
Dimensions in Millimeters



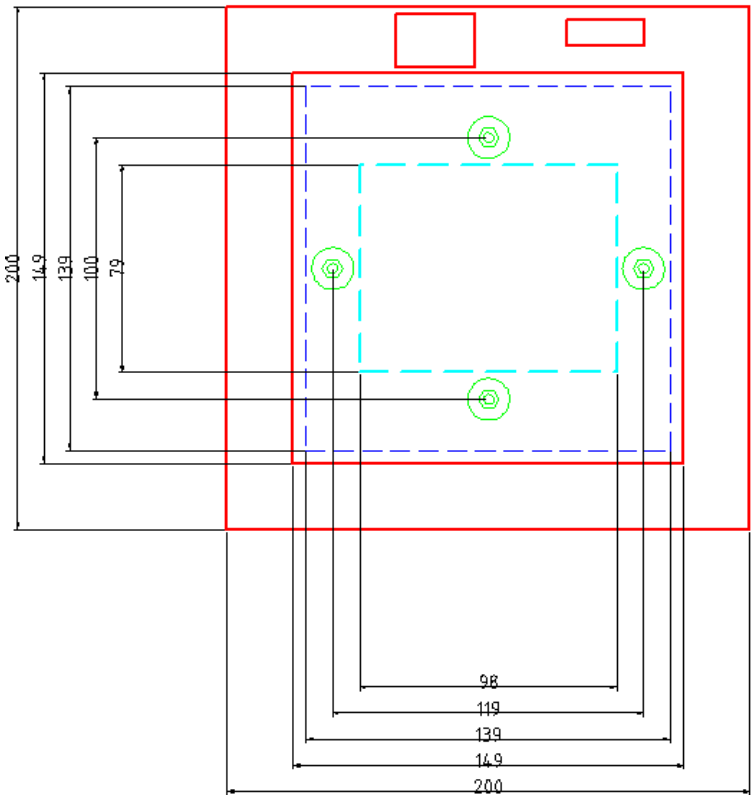
A-2

Payload Attachment System
Dimensions in Millimeters

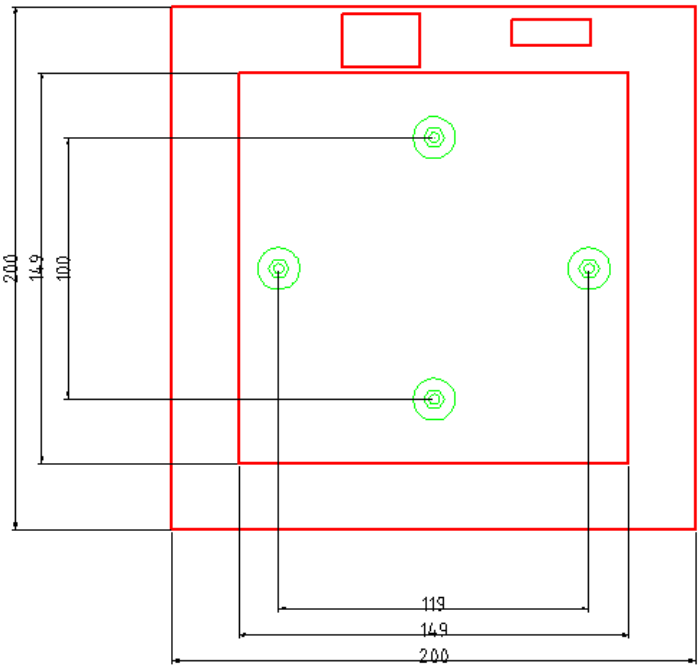
Payload Attachment
Side View



Payload Attachment
Top View

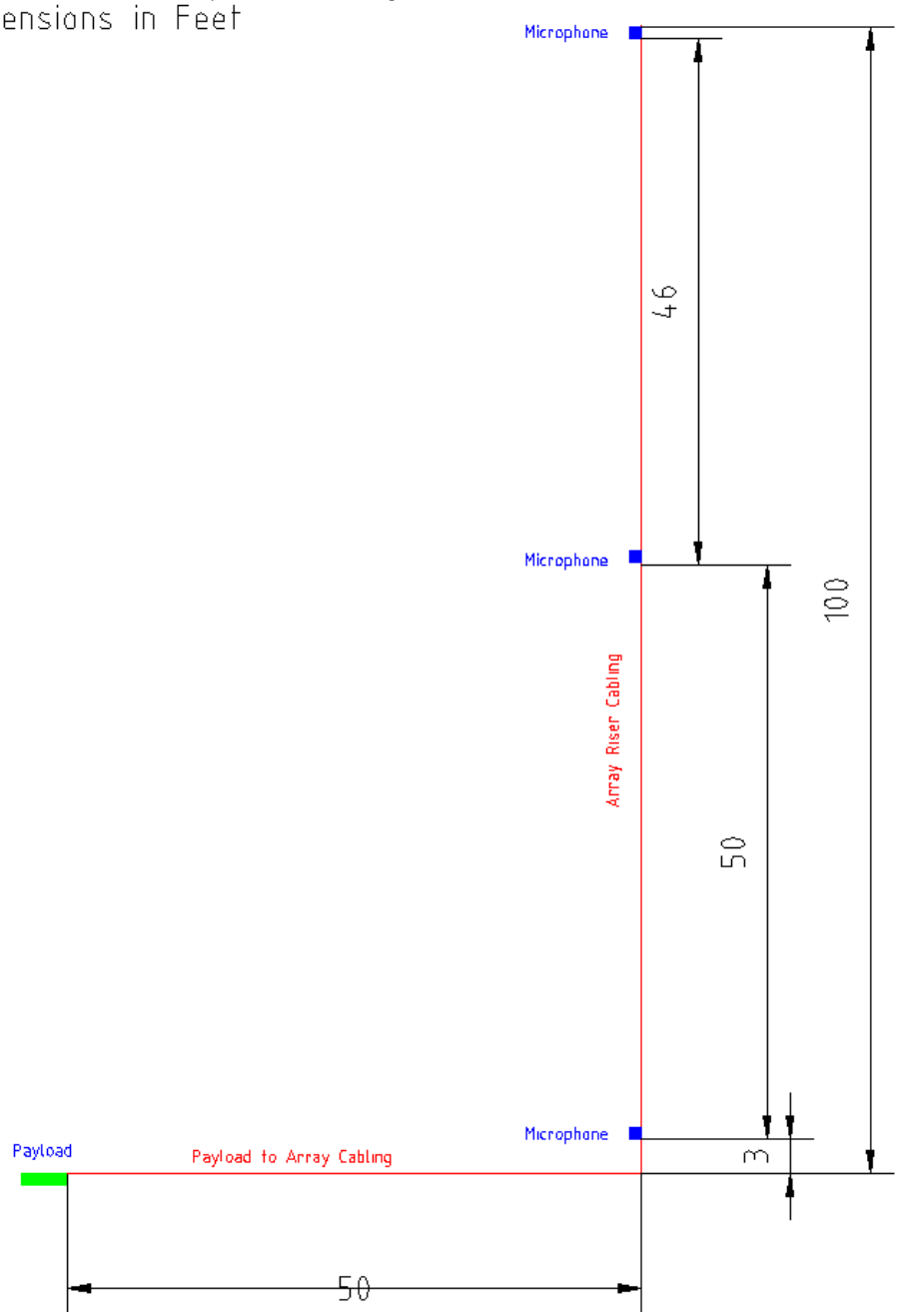


Payload Attachment
Bottom View



A-3

Infrasound Microphone Array
Dimensions in Feet



Microphones on
Suspension Ladder