HASP Payload Specification and Integration Plan

Payload Title: High Altitude Cosmic Radiation (HACR) Detector

Payload Class: Small (Large) (circle one)

Payload ID: 08

Institution: West Virginia University

Contact Name: John Brewer / Dr. John Kuhlman

Contact Phone: (304)290-8652 / (304)293-3111 ext. 2328

Contact E-mail: brewerj2@asme.org / John.Kuhlman@mail.wvu.edu

Submit Date: May 31, 2007

I. Mechanical Specifications:

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

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

D. Other relevant mechanical information

II. Power Specifications:

A. Measured current draw at 28 VDC <200 mA

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.

C. Other relevant power information

III. Downlink Telemetry Specifications:

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

B. Approximate serial downlink rate (in bits per second) 214

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

D. Number of analog channels being used: 0

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

F. Number of discrete lines being used: 0

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

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

I. Other relevant downlink telemetry information.

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*)

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

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

F. Other relevant uplink commanding information.

V. Integration and Logistics

A. Date and Time of your arrival for integration:

B. Approximate amount of time required for integration:

C. Name of the integration team leader:

D. Email address of the integration team leader:

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

F. Define a successful integration of your payload:

G. List all expected integration steps:

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

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…):

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

West Virginia University
High Altitude Cosmic Radiation (HACR) Detector
Payload Specification and Integration Plan

Small Class Payload #8

Department of Mechanical and Aerospace Engineering
West Virginia University, Morgantown, WV 26506/6106

5/23/2007

Submitted by: WVU Team HACR

Dr. John Kuhlman
Dr. Mike Palmer
John Brewer
Nicholas Hansford
Jeremy Hill

Table of Contents:

List of Figures

List of Tables

I. Mechanical Specification

(A) The weight of the payload is currently estimated to be 0.8 kg. An exact weight is unavailable at this time because the payload has yet to be constructed because the scintillation detector to be used has not arrived from the manufacturer.

(B) Figure 1 is a mechanical drawing showing the major components and their size and placement within the payload container. Figure 2 is a drawing of the HASP mounting plate with areas where the plate will be altered for attachment of the payload denoted. Mounting will be completed using a combination of epoxy resin between the payload bottom and the plate and high tensile strength cable ties, such as McMaster-Carr #7130K652, around the payload and through the plate. The payload electronics will be directly secured to the HASP mounting plate using standard nylon standoffs.

(C) Assuming the payload remains sealed there is no risk to anyone. However, if the payload is opened while power is supplied, there is a potential risk of electrical shock as the onboard electronics will contain a 1250V regulated power supply operating at approximately 1 mA. A second hazard that may be present post flight are pieces of glass from photomultiplier tubes should they shatter. However, the manufacturer of these tubes states that they are capable of surviving burst loads of 100g's, which is significantly greater than those expected during this flight.

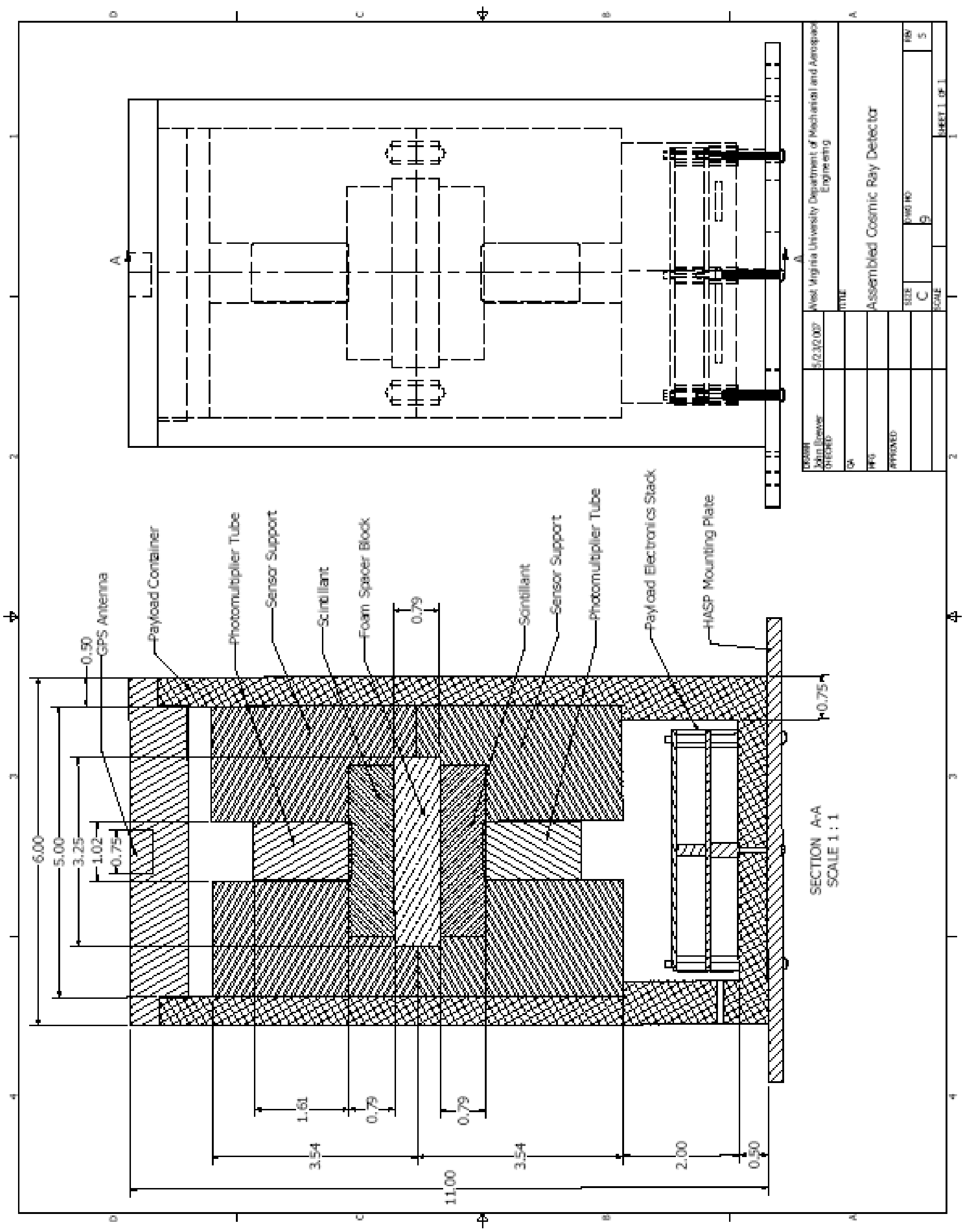

Figure 1: Assembled Cosmic Ray Detector Payload

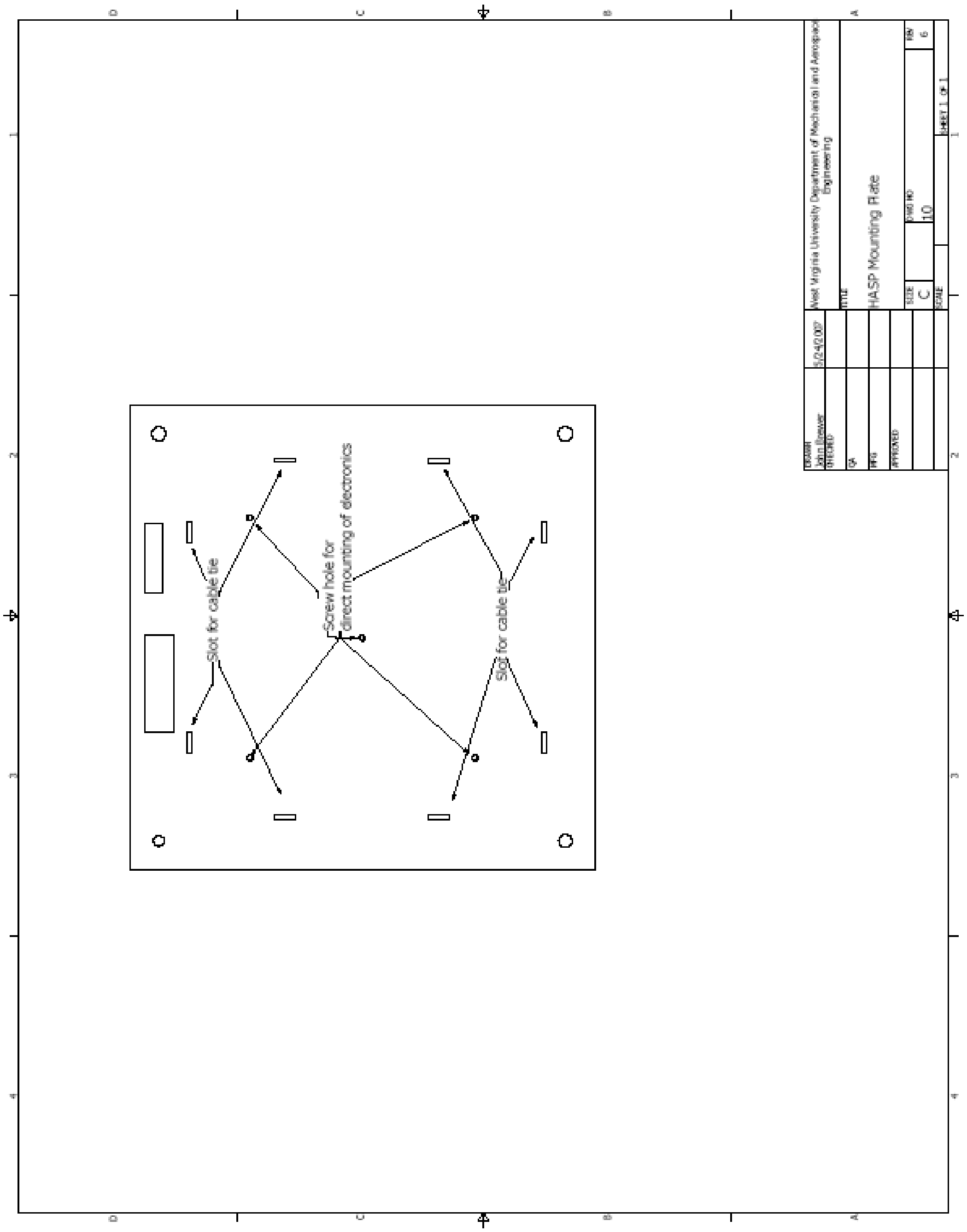

Figure 2: Altered HASP Mounting Plate

II. Power Specifications

(A) The estimated current drawn by the payload is less than 200mA. Thus far current draw has been measured at 110mA with no load on the high voltage circuit. Figure 3 shows the current power system wiring schematic under development for the payload. Figure 4 shows the current circuit layout for the payload electronics. As the mounting locations of each regulator and power supply on the payload electronics board may change, this may not be the exact layout used during the flight. Table 1 is a listing of the components used on the payload controller board. Figures 5 and 6 are photographs of the top and bottom of the payload controller board, respectively. Figure 7 is a photo of the GPS board, which will be used during the flight.

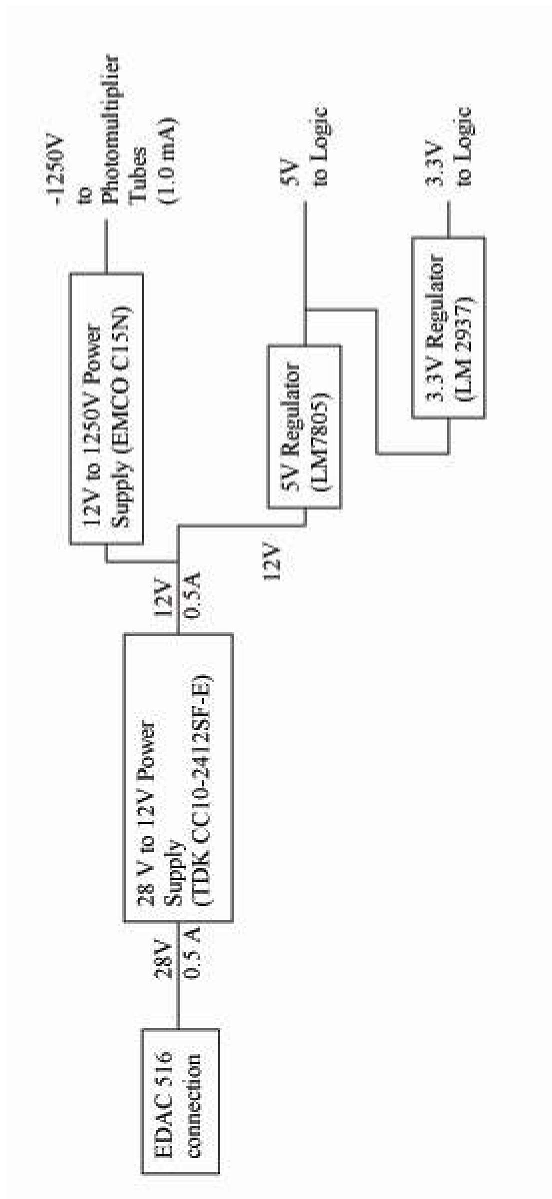

Figure 3: Basic WVU HASP Power Schematic (B)

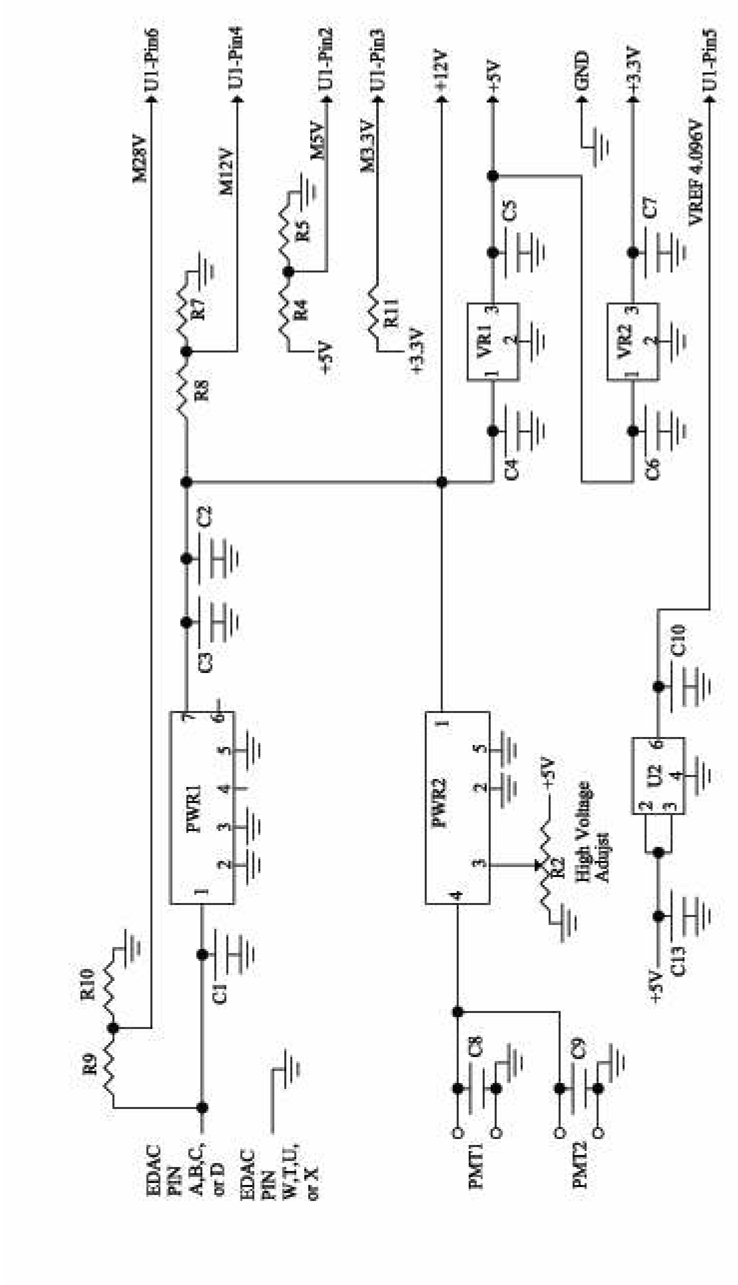

Figure 4: Current Power Diagram of WVU HASP Electronics (B)

Table 1: WVU HASP Power Components

Capacitors	
C1, C3, C13	0.1µf / 50V
C2, C4, C5, C6, C7, C10	1µf / 16V TAN
C8, C9	0.01µf / 2KV
Resistors	
R2	10KΩ 15 Turn Pot.
R4-R5, R8, R9, R11	10 KΩ, 1%
R7	3.33KΩ, 1% (3-10K in parallel)
R10	1200Ω, 5%
Power Supplies, Voltage Regulators, and Other	
PWR1	TDK Model CC10-2412SF-E Pin1: Vin Pin2: RC Pin3: Ground Pin4: No Connection Pin5: -Vout Pin6: No Connection Pin7: +Vout
PWR2	EMCO Model C15N Pin1: Vin Pin2: Ground Pin3: High Voltage Adjust Pin4: High Voltage Out Pin5: Case
U2	REF 198 (4.096V) Pin2: Vin Pin3: Pin4: Ground Pin6: Vout
VR1	LM2931 AT5.0 (5V) Pin1: Vin Pin2: Ground Pin3: Vout
VR2	LM2937BT-3.3 (3V) Pin1: Vin Pin2: Ground Pin3: Vout

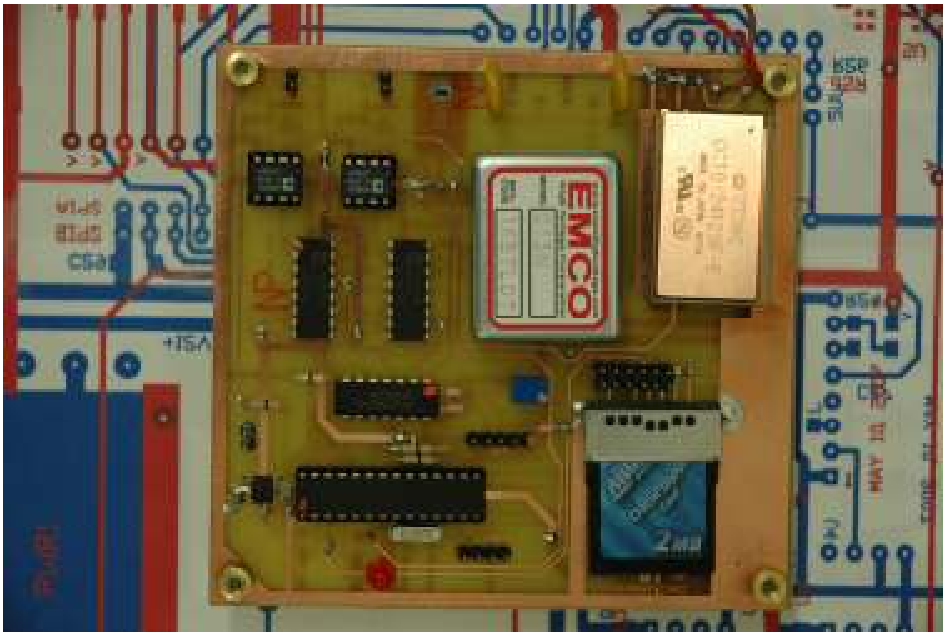

Figure 5: Top View of WVU HASP Controller Board

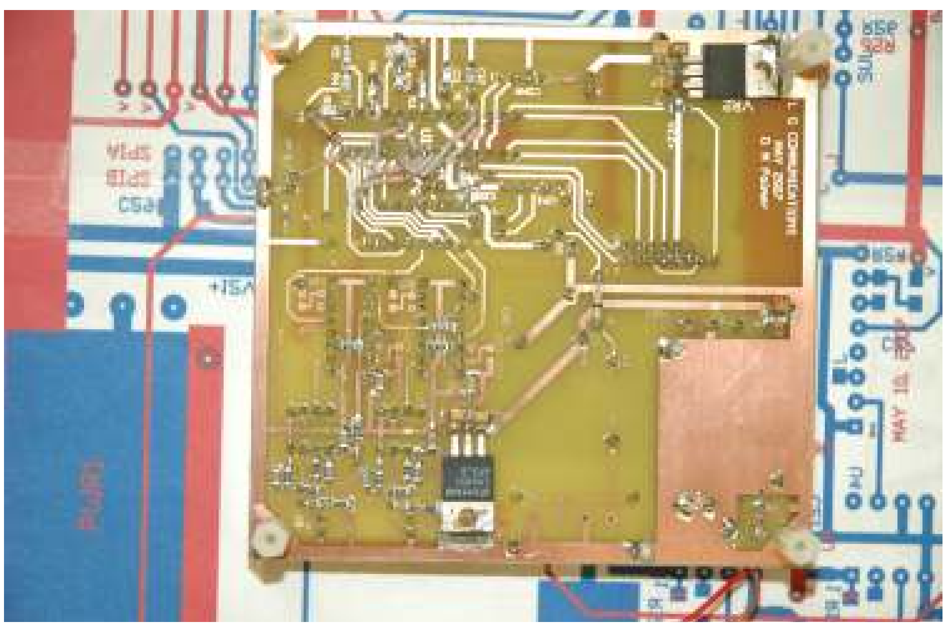

Figure 6: Bottom View of WVU HASP Controller Board

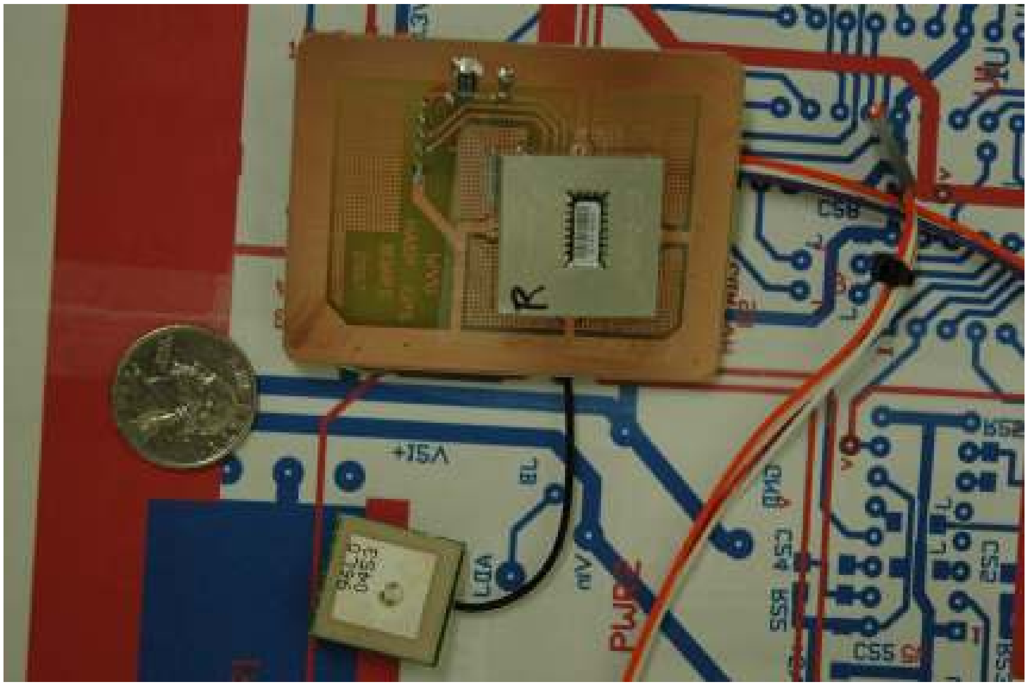

Figure 7: WVU HASP GPS Board and Antenna

III. Downlink Telemetry Specification

(A) The serial downlink format used by this payload will be packetized in an ASCII format. **(B)**The approximate serial downlink rate will be 214 bps. **(C)** Each data record will be 214 bytes in length, will be transmitted every 10 seconds for the duration of the flight, and will be formatted as shown in Table 1. The data will also be comma separated. A sample output string is shown below in Figure 8. **(D-G)** None of the supplied analog channels or discrete lines will be used by the payload. **(H)** There will not be any transmitters onboard.

WVU HASP PROJECT 2007 VER. 1.0, 1, 0, 0, 0, 0, 0, 639, 824, 754, 0,$GPRMC,,V,,,,,,,,,,N*53

Figure 8: Sample Output String from WVU HASP Controller Board

Table 2: WVU Payload Data Packet Format (C)

Field	Data			Size (bytes)
1	Payload Identifier			32
2	Point Number			8
3	Channel A count			8
4	Channel B count			8
5	Channel A*B count			8
6	CPU Temperature (˚C)			8
7	Internal Payload Temperature (˚C)			8
8	ADC code 5V Buss			8
9	ADC code 3.3V Buss			8
10	ADC code 12V Buss			8
11	ADC code 28V Buss			8
12	GPS data			100
13	Carriage Return – Linefeed			2
			Total Size:	214

IV. Uplink Command Specifications

(A) Command uplink capability is not currently required for this payload. However, a payload reset command to be issued in the event of power loss could be included if HASP management believes this capability to be practical for a successful flight. **(E)** The payload will contain an onboard GPS receiver operating on the standard civilian L1 band (1575.42 MHz), as shown in Figure 7.

V. Integration and Logistics

(A) The team would like to request to integrate their payload at the Columbia Scientific Balloon Facility (CSBF) during any of the following dates, in order of preference, July 23-24, July 22-23, July 26-27, or July 27-28. The team plans to arrive in the afternoon or evening the day before integration is to take place. The exact time and date of arrival remains flexible as travel arrangements have not yet been made. **(B)** Integration should take the team between four and six hours depending on any problems that may be discovered during the integration and testing process. The team will also allow for a second day in the event problems discovered on the first day of integration are not completely corrected. **(C, D)** The payload integration team will be under the leadership of Dr. G. Michael Palmer (gmichaelpalmer@comcast.net) and John Brewer (brewerj2@asme.org). Table 2 lists the names and email addresses for all those who currently plan to be present for payload integration.

Table 3: Name and Email Address for All WVU HASP Integration Participants (E)

Name	Email Address
Dr. John Kuhlman	John.Kuhlman@mail.wvu.edu
Dr. Michael Palmer	gmichaelpalmer@comcast.net
John Brewer	brewerj2@asme.org
Nicholas Hansford	Nick.Hansford@gmail.com
Jeremy Hill	Jeremy.C.Hill@gmail.com

(F) Successful payload integration will be defined as reaching flight ready status before departure from the CSBF. **(G, H)** Table 3 lists the expected integration steps for the payload; many of these steps will be used as checkpoints to determine the success of integration, and may not be performed in the order listed. **(I)** The team will require that the payload be shipped to either LSU or the CSBF prior to integration. **(J)** The team may require small hand tools be borrowed from LSU for integration; however, the team is planning on supplying their own tools.

Table 4: Expected Integration Steps and Checkpoints (G, H)

Payload shipment and confirmation of receipt by LSU/CSBF personnel
Integration team arrival at CSBF
Install package on HASP platform
Power on payload and look at serial output
Verify stable power using ADC output
Verify restart command by repeated cycling payload power
Expose the payload to a Cobalt-60 radiation check source to verify proper function of detector
Verify proper function of CPU and payload temperature sensors
Confirm that integration calibration data closely matches calibration data taken before shipment