HASP Payload Specification and Integration Plan

Payload Title: Development of a free flying payload to measure the ozone profile in the stratosphere using ir

Payload Class: Small

Payload ID: 7

Institution: University of North Dakota and University of North Florida (UND/UNF)

Contact Name: UND –Marissa Saad, J.Wade Snarr, Dr. Ronald Fevig
UNF – Ken Emanuel, Dr. Nirmal Patel

Contact Phone: Marissa: (617) 462-0610, Wade (435) 503-2548,
Ron (520) 820-3440, Nirmal (904) 200-2855

Contact E-mail: mrzhasaad@gmail.com, wade@speedhut.com, k.emauel@unf.com,
rfevig@aero.und.edu, npatel@unf.edu

Submit Date: June 21, 2013

I. Mechanical Specifications:

A. Measured weight of the payload

#	Item	Mass (Grams)	Uncertainty (Grams)	Dimension (mm)	Uncertainty (mm)
1	Metal Box for sensors	112.0	2.0	127.0x56.0x 56.0	0.1x0.1x0.1
2	Sensor Circuit board	15.0	0.2	130.0x 42.0x2.00	
3	24 Sensors array	5.0	0.2	75 x 25 x1	
4	6 binder clips	8.4	0.5		
5	Fan with wires	12.0	1.0		
6	25 pin cable	35.0	2.0		
7	heater with wire	1.6	0.1		
8	Temperature sensor	3.0	0.1		
11	Screws and nuts	10.0	1.0		
12	LEDs	5.0	0.1		
13	extra washers and Hot glue	10.0	1.0		
Total mass of sensors box(#1 to13)		215.0	7.9		
Payload Body		1595.0	10.0	296x 141x141	2x1x1
Thermal blanket		18.0	1.0		
Base Mounting Plate & Cables		560.0	1.0		
Circuit board with components		185.0	5.0	Expected	
Total mass of the payload including mounting plate		2790.0	25.0		

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

The 2013 payload body is similar to the 2012 payload body. The main features of our newly designed payload body are easy to open and close payload, easy access of PCB and sensor boxes, low rate of outgassing under low pressure, better stability with thermal and impact, and reusable. The following parts were procured for the payload body from supplier www.onlinemetals.com.

Name	Size	Purpose
Aluminum Extruded Square Tube Part #6063-T52	height 11” w x d: 6” x6” wall thickness: 0.125”	Payload body
Aluminum Sheet Part#3003-H14	6” X 6” Thickness:1/8”	Top lid
Aluminum Finished Rectangles Part#2024-T351	0.625”X1”	Internal support of payload with base plate and lid

The payload will be mounted on the top side of the payload plate similar to the 2012 payload mounting with 3 bolt, washer, and nut assemblies. (See photo below)

The addition of a ½ wave whip antenna will be mounted on the bottom-side of the payload plate, pointing downward.

Ken Emanuel made design drawing and fabricated payload body in the workshop of Department of Engineering of UNF. Design diagrams are shown in Fig. 1 (a) to (h).

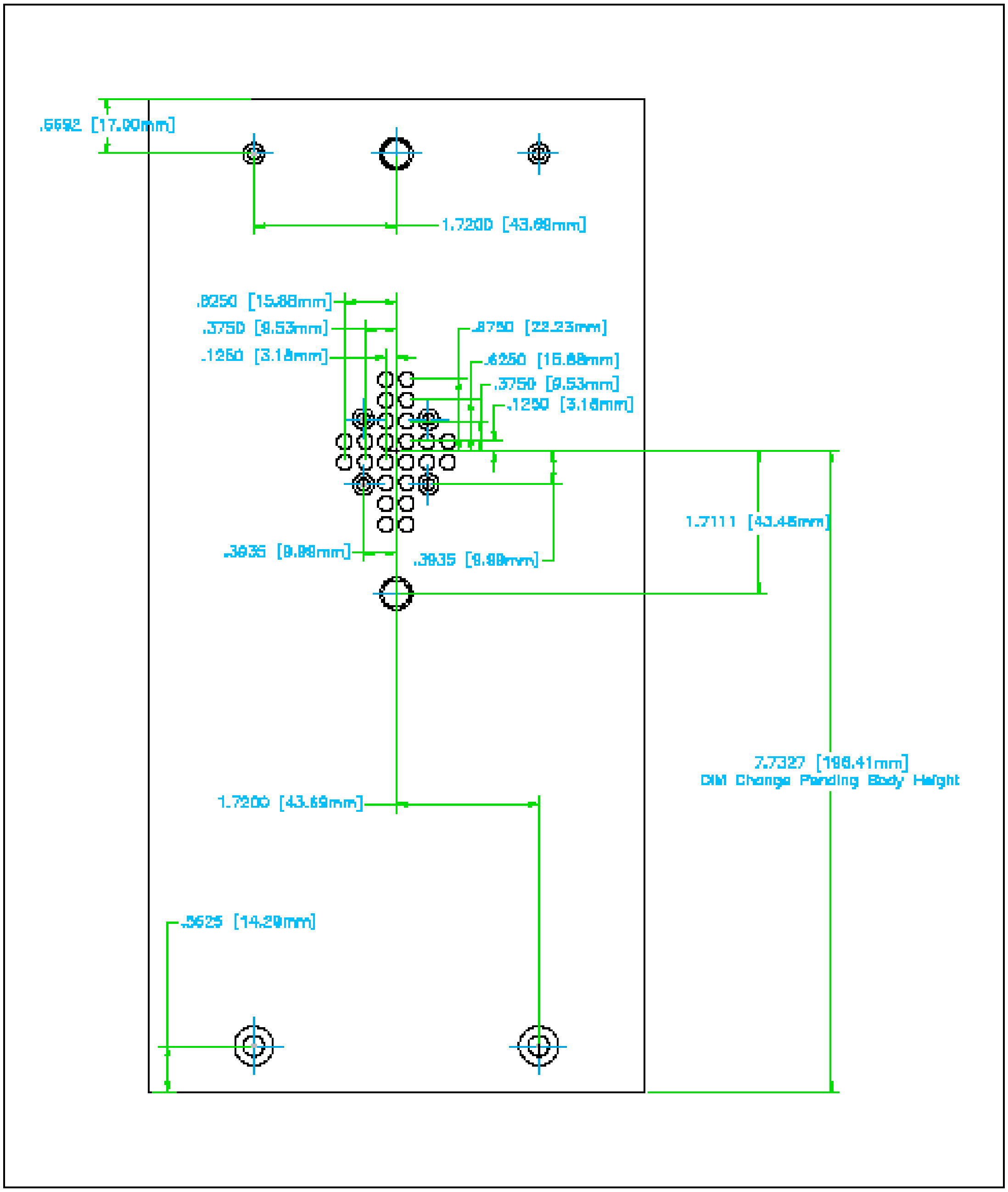


Fig.1 (a) Design for holes on two opposite sides (Side #1 and 3) of payload body

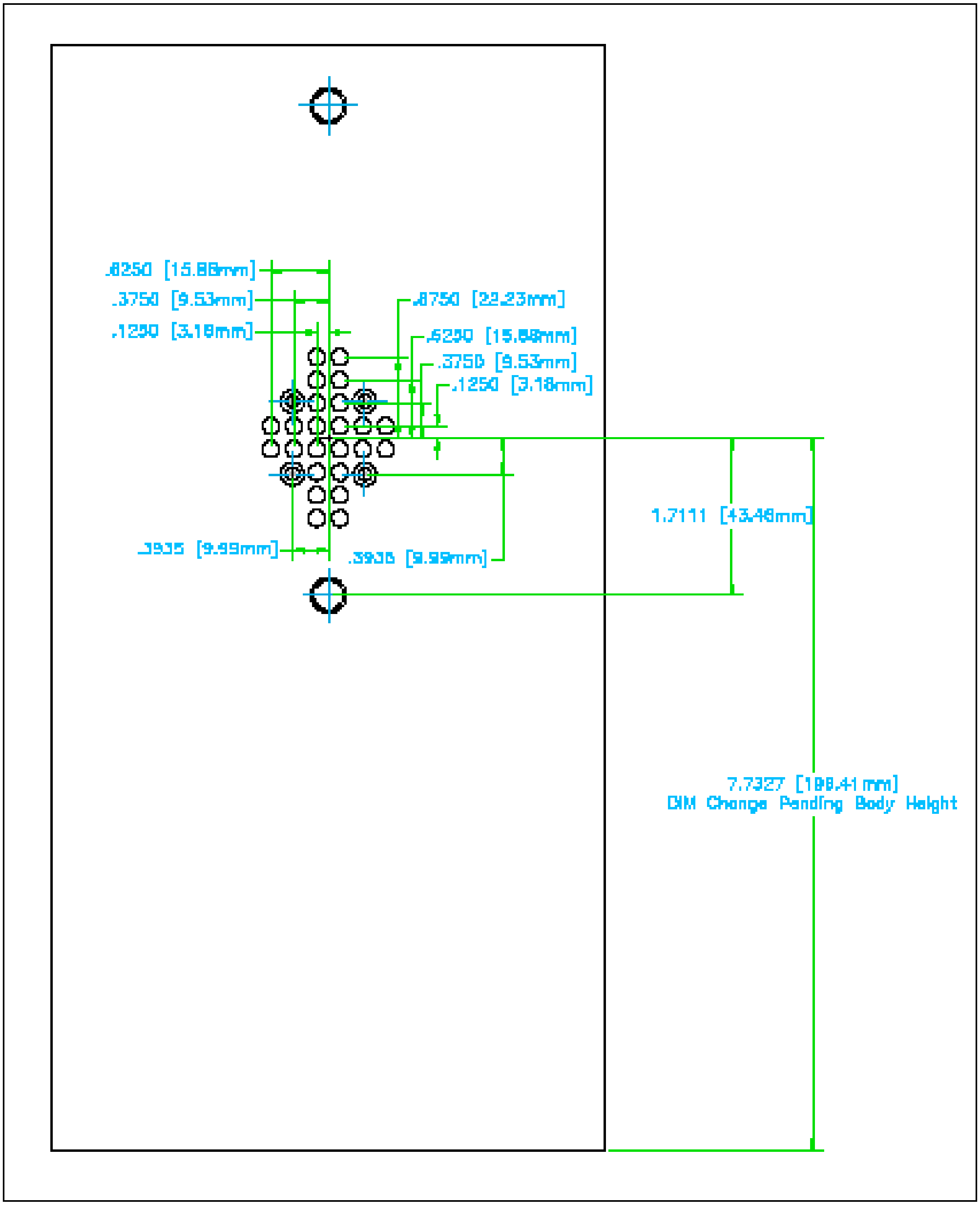


Fig.1 (b) Design for holes on Side # 2 of payload body

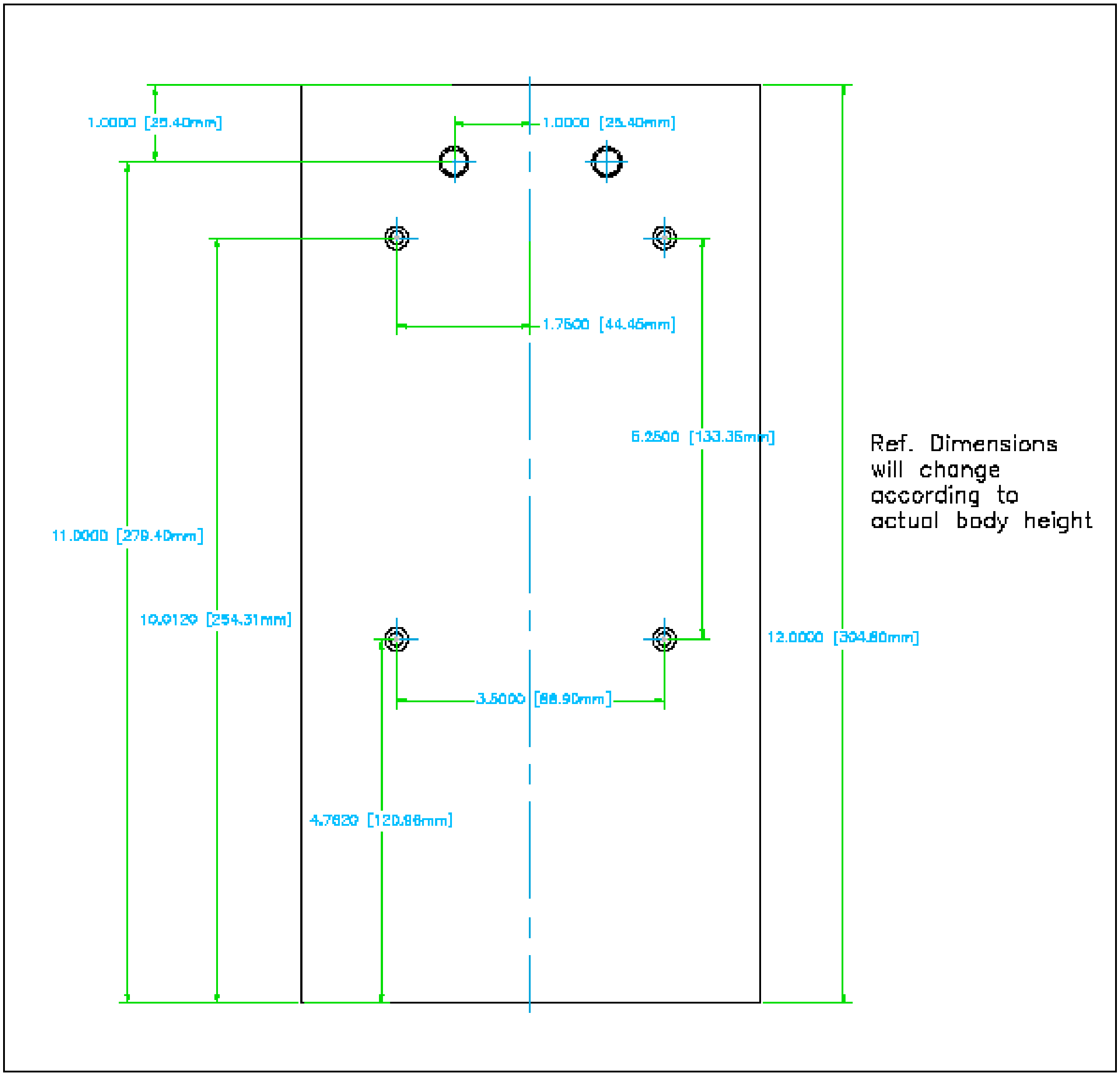


Fig.1 (c) Design for holes on fourth side (Side #4) of payload body for mounting microcontroller PCB

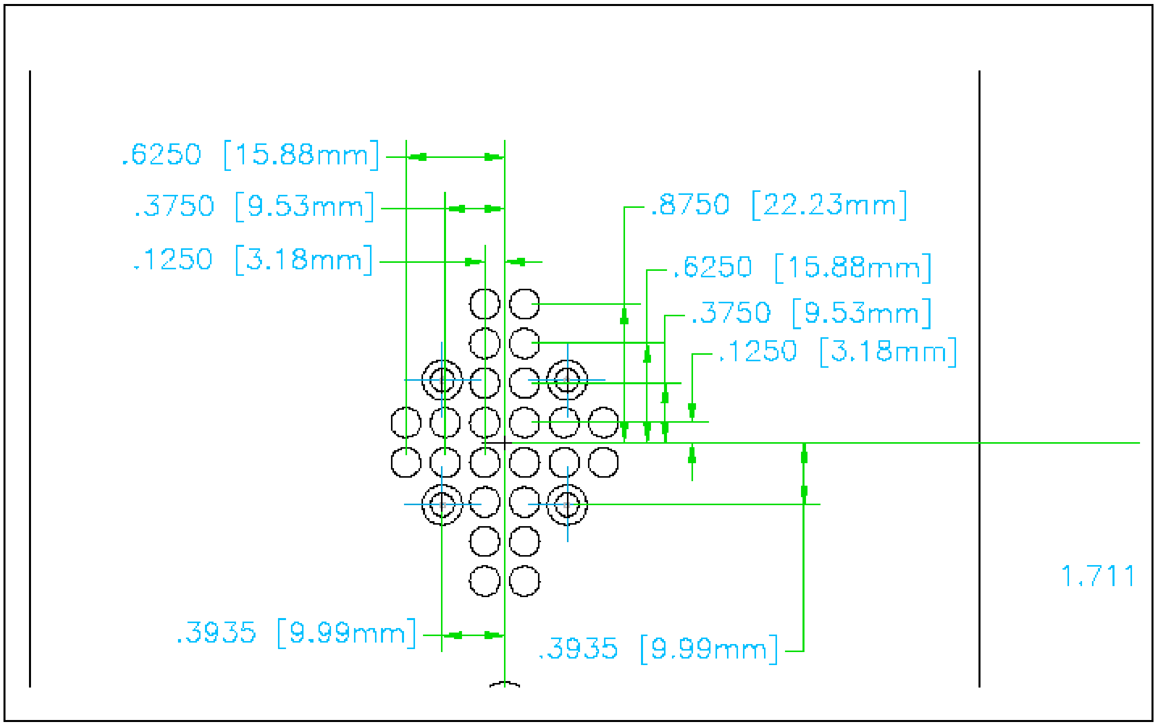


Fig.1 (d) Details of design for holes on three sides of payload body for fan and air inlet

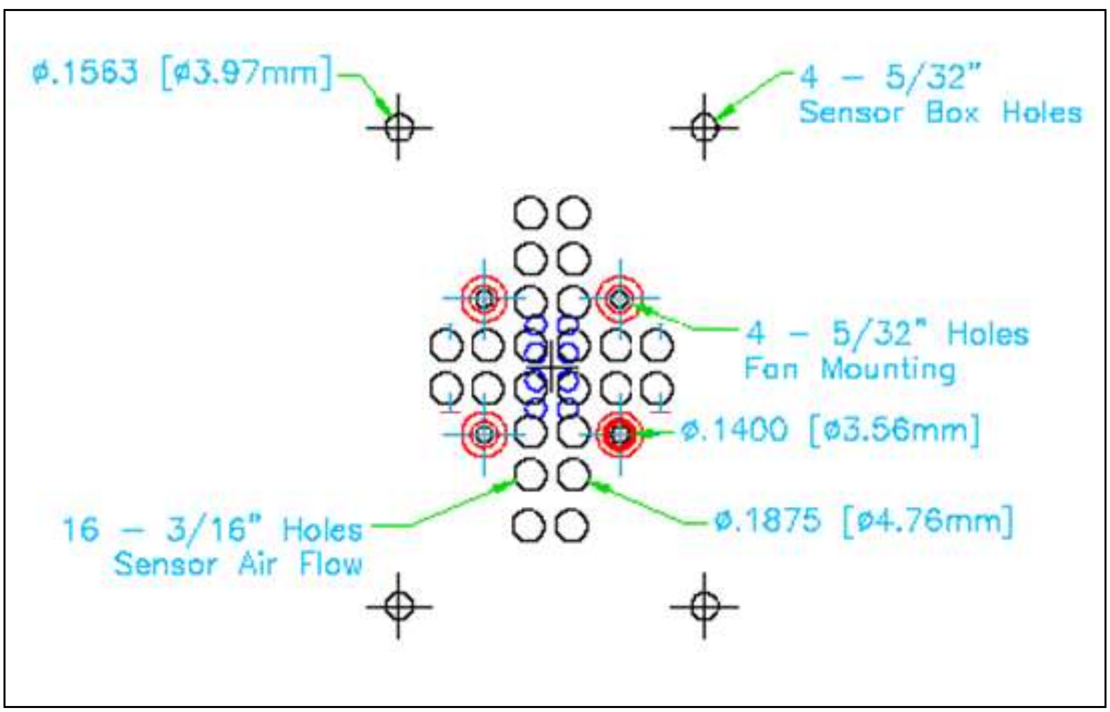


Fig.1 (e) Details of design for holes on three sides of payload body and sensor box

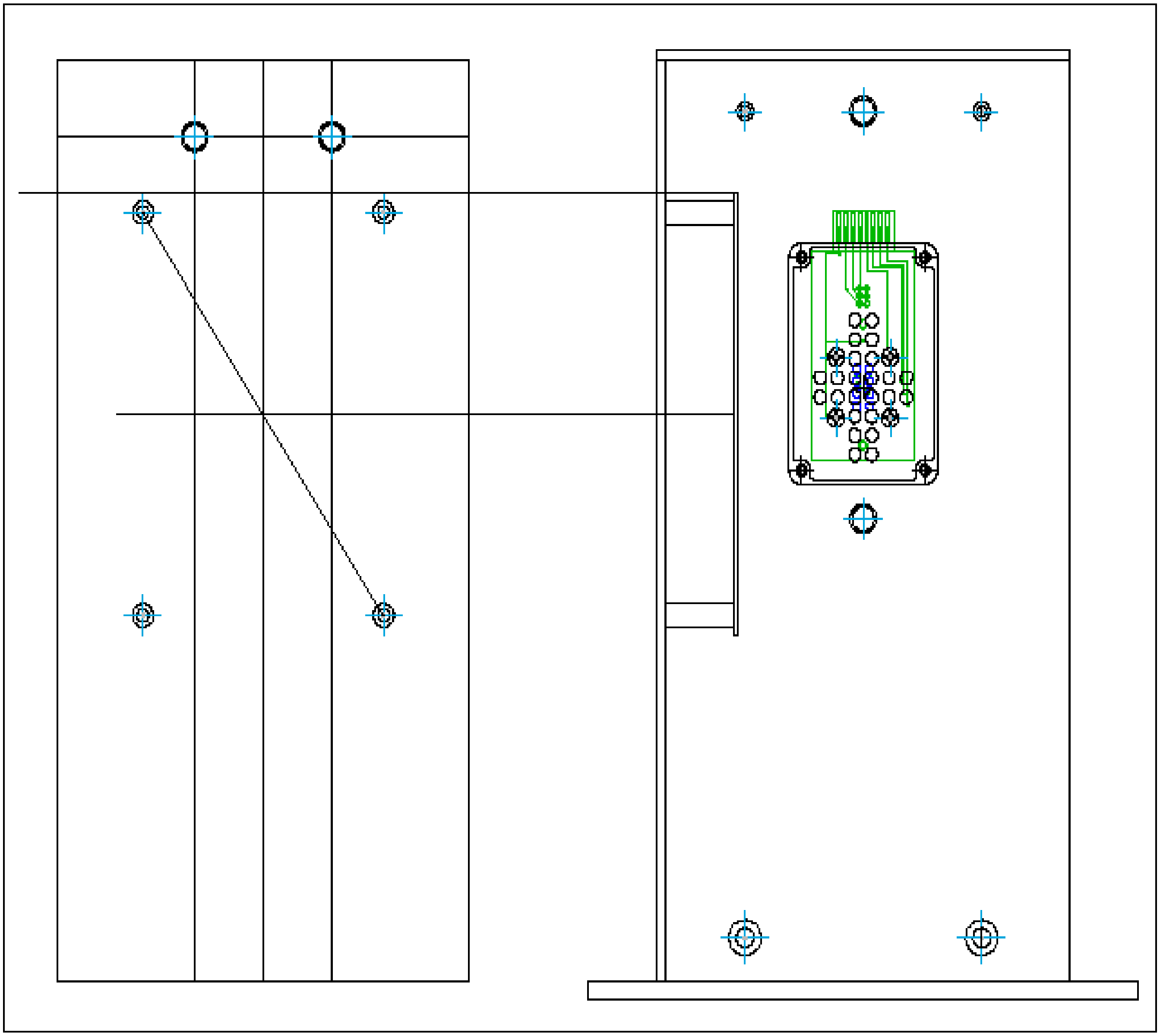


Fig.1 (f) Design for holes on payload body for mounting microcontroller PCB and sensor box

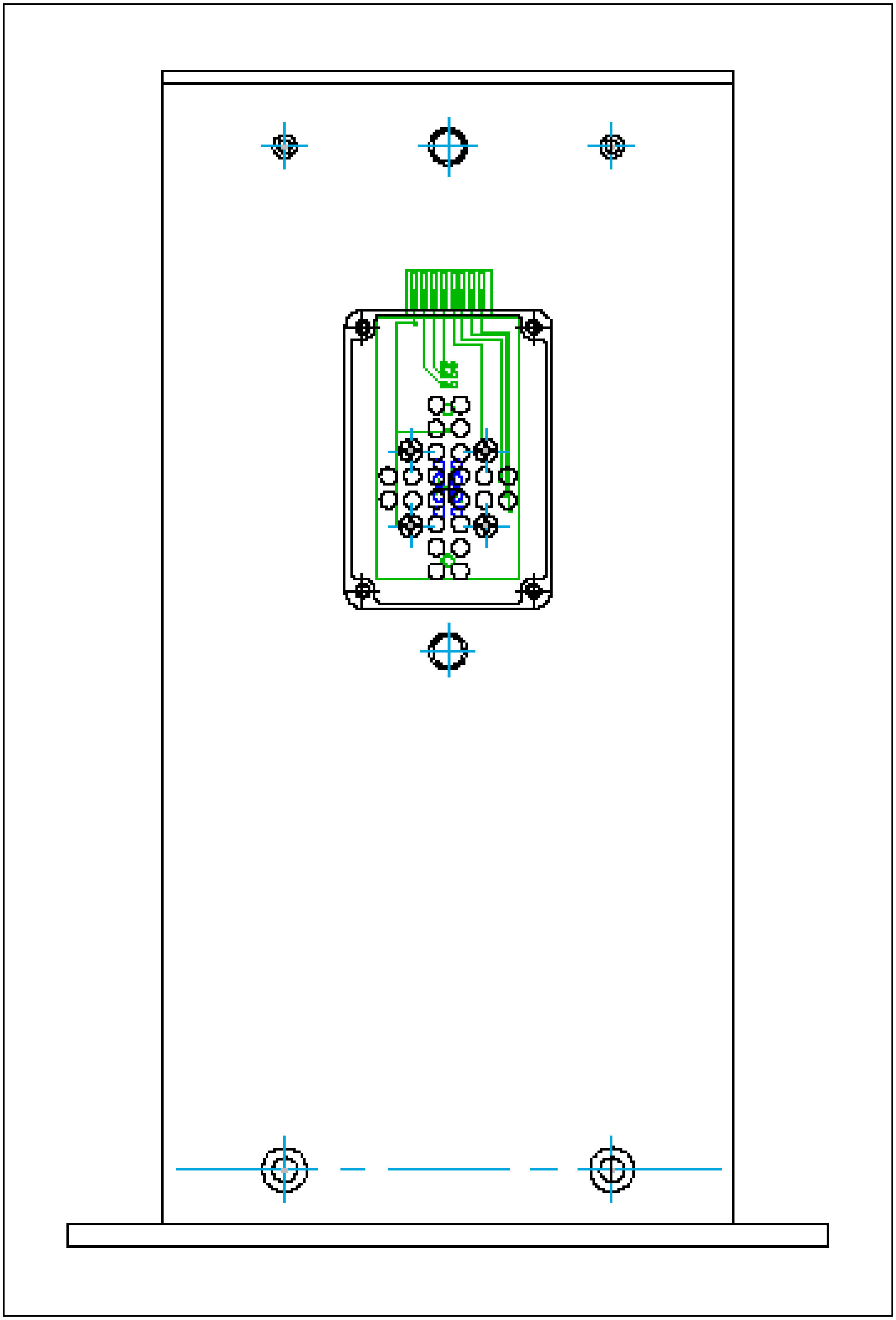


Fig.1 (g) Design for holes on payload body for mounting of sensor box, LED, Light sensor and HASP mounting plate

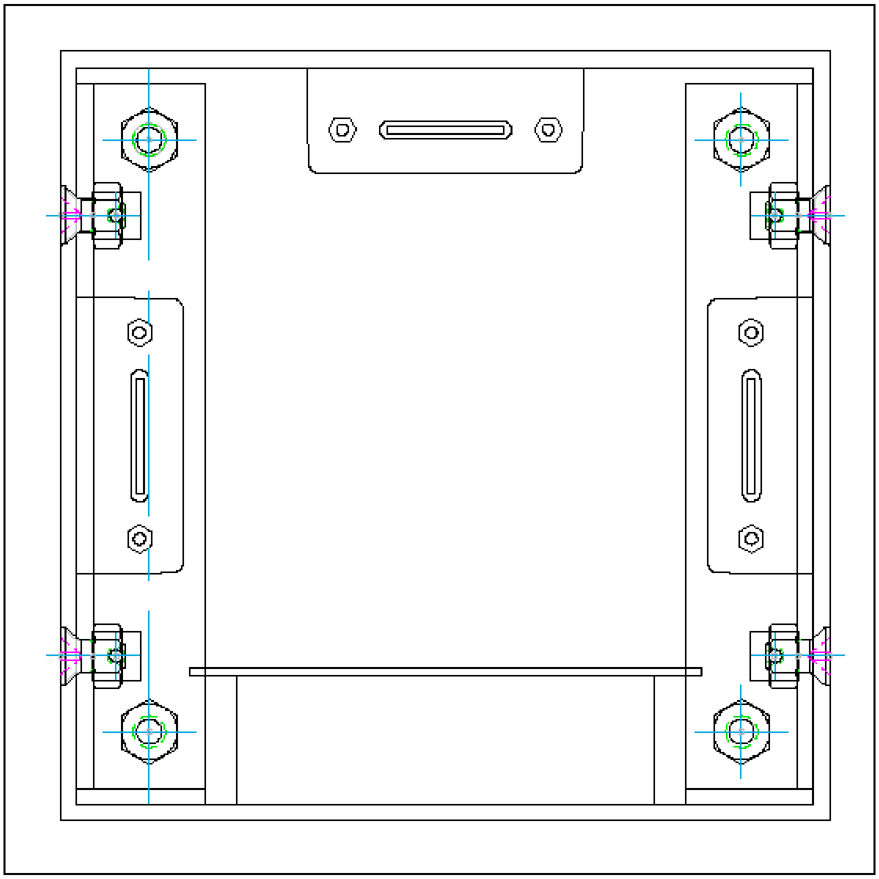


Fig.1 (h) Top view of payload

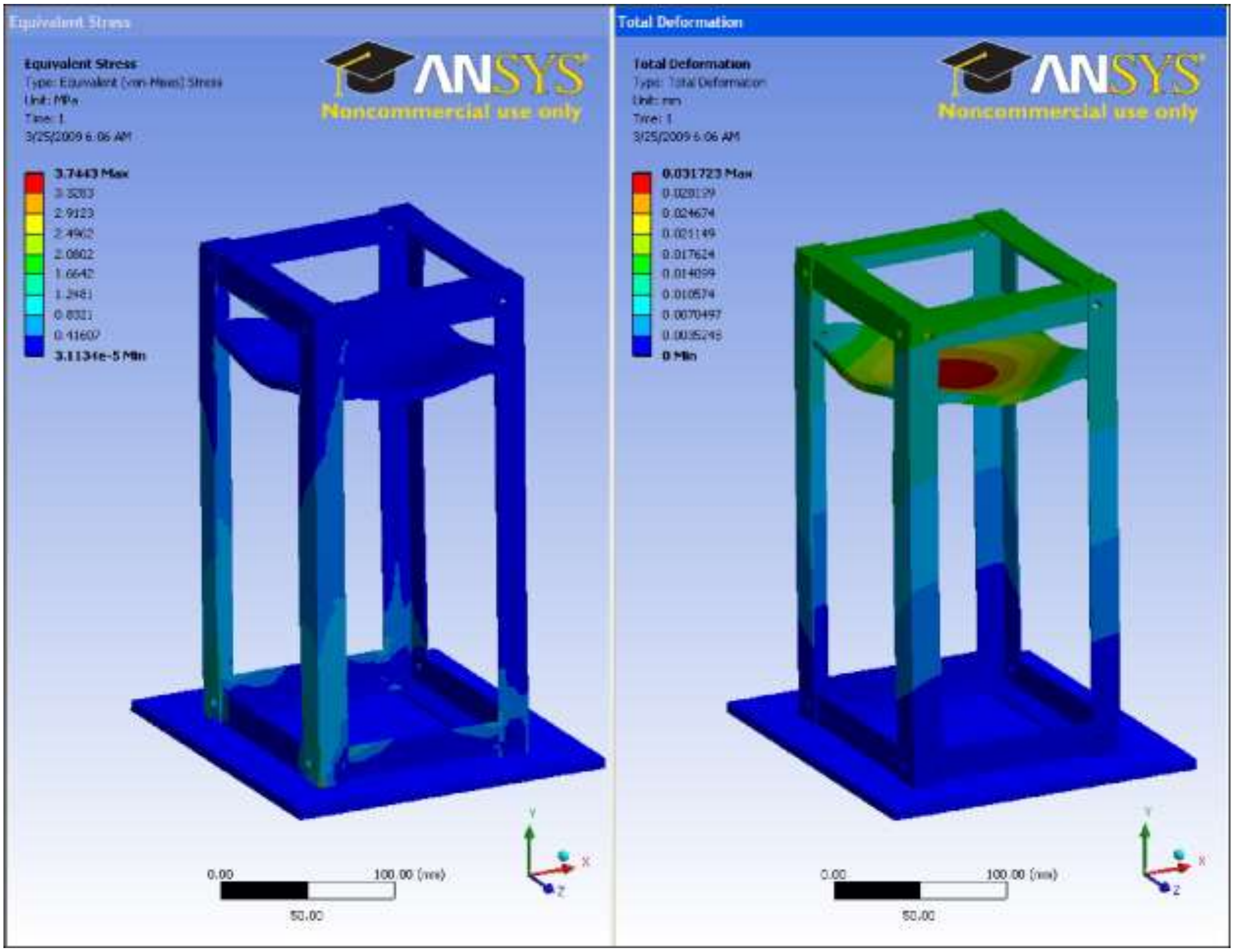
C. If you are flying anything that is potentially hazardous to HASP or the ground crew before or after launch, please supply all documentation provided with the hazardous components (i.e. pressurized containers, radioactive material, projectiles, rockets…)

N/A

D. Other relevant mechanical information

The inner surface of payload assembly will be wrapped up with multiple layers of Mylar (space) blanket for insulation. The insulation will have reflective silver surface facing inside to assure maximum thermal insulation.

Please refer the attached stress analysis images of deformation and stress gradient satisfying 10 g vertical and 5 g horizontal accelerations.



II. Power Specifications:

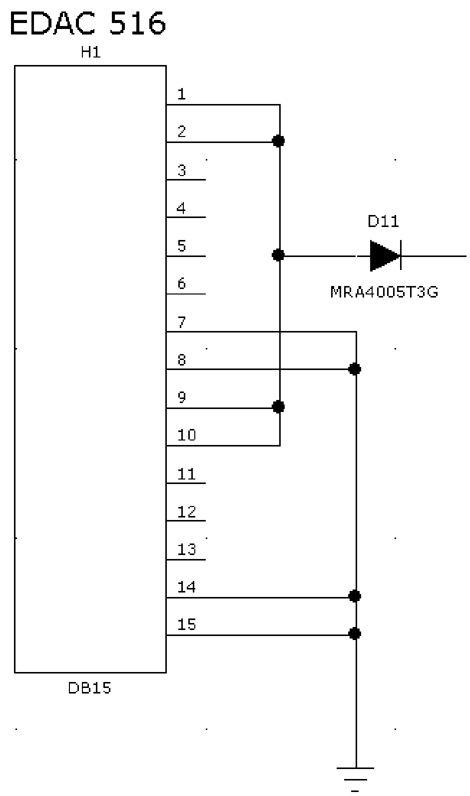
A. Measured current draw at 30 VDC

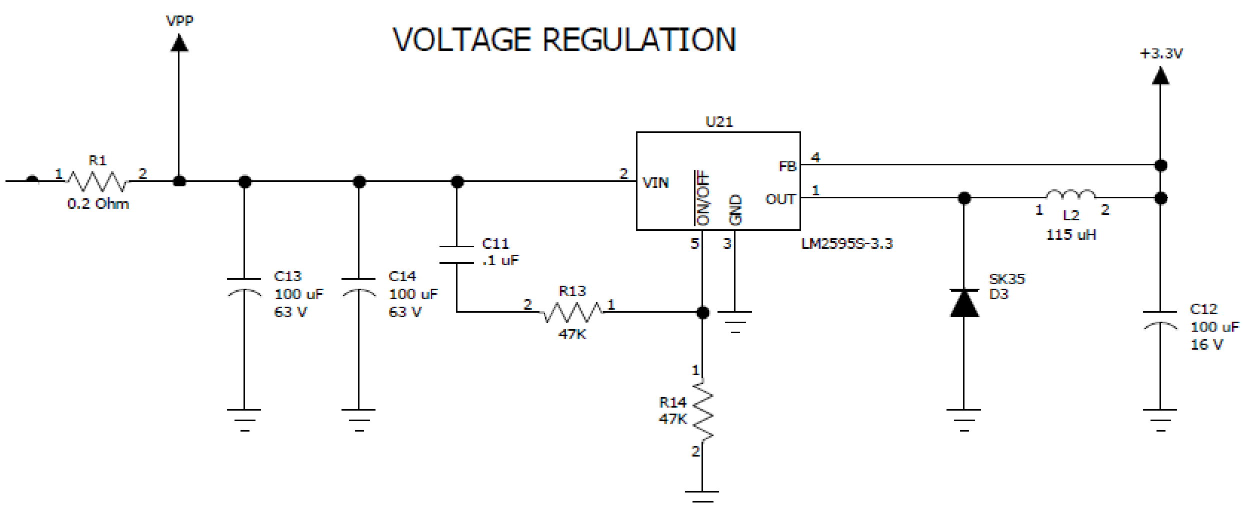
450 mA (measured system max).

400 mA (heater off, and other systems functioning).

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.

Below is the switching power supply circuit UND/UNF has embedded in the past 2 payloads. It has performed flawlessly. It will once again be embedded in the 2013 payload. It is based around a National Semiconductor LM2905-3.3 switcher with ramp up voltage capability provided by C11, R13, and R14. 30 volts from the EDAC connector is provided via its 4 connections to a reverse protection diode, D11. A current limiting resistor, R1, is in series with D11. The 30 volt supply is then reduced to 3.3 volts via the buck switching power supply U21 and supporting components.





C. Other relevant power information

None

III. Downlink Telemetry Specifications:

A. Serial data downlink format:

   Packetized

B. Approximate serial downlink rate

   193 bps

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

   15 bytes for data packet synchronization (“HASP2013 UBLOX,”)
   10 bytes for UTC time
   7 bytes for MLS altitude
   24x6 bytes for filtered ozone date
   3x6 bytes for sensor module temperatures
   3x6 bytes for photo diode voltages
   6 bytes for CPU temperature
   6 bytes for system voltage
   6 bytes for system current draw
   6 bytes for atmospheric pressure in milli-bar
   5 bytes for heater on/off status

   Total record length: 241 bytes

D. Number of analog channels being used:

   0

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

   NA

F. Number of discrete lines being used:

   0

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

   NA

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

   ISM 902-928 FHSS – 915 MHz, 1W

I. Other relevant downlink telemetry information.

   The onboard Transceiver will mimic the downlink data sent through the HASP gondola to the HASP ground station. It is UND/UNF’s desire to determine the range capability and data transmission integrity of the chosen radio set for future free flying payloads.

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*)

1-2 commands per hour maximum

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

Byte	Hex Value	Description
1	0x01	SOH
2	0x02	STX
3	0x71	Checksum for 0x31
	0x72	Checksum for 0x32
	0x73	Checksum for 0x33
	0x74	Checksum for 0x34
	0x75	Checksum for 0x35
	0x76	Checksum for 0x36
	0x77	Checksum for 0x37
4	0x31	System Reset
	0x32	Erase Flash
	0x33	Upload Data
	0x34	Stream Sensor Readings
	0x35	Heaters on
	0x36	Heaters off
	0x37	Logging on
	0x38	Logging off
	0x39	Stream UBLOX
	0x3A	Stream HASP GPS
	0x3B	XTend Radio Enable
	0x3C	XTend Radio Disable
5	0x03	ETX
6	0x0D	CR
7	0x0A	LF

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

ISM 902-928 FHSS – 915 MHz, 1W

F. Other relevant uplink commanding information.

None

G. Request: Team is requesting the HASP to provide the GPS strings from the gondola every 10 seconds

V. Integration and Logistics

A. Date and Time of your arrival for integration:

July 29, 2013, 10:00 am

B. Approximate amount of time required for integration:

6 Hours

C. Name of the integration team leader:

Marissa Saad

D. Email address of the integration team leader:

mrzhasaad@gmail.com

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

Marissa Saad - mrzhasaad@gmail.com

Jonathan Snarr – jonathan.snarr@und.edu

Nirmalkumar Patel – npatel@unf.edu

Ron Fevig - rfevig@aero.und.edu

F. Define a successful integration of your payload:

Payload successfully mounts to platform, both mechanically and electronically. Payload successfully performs a sensor/communication check, and systems health checks to ensure proper data/headers formatting. After an initial test sequences a steady 1 Hz flashing STATUS LED indicates a sound system. After initial system testing is complete the system will successfully packet and send data to HASP computer and ground station computer will decipher and provides data plots of ozone concentration in real-time during final preflight testing (thermal vacuum testing).

G. List all expected integration steps:

1. Successfully interface the payload to platform.
   a. Mount to platform
   b. Interface with power system and communication bus

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

a) Perform communication and data checks.

b) Successfully execute command set.

c) Monitor system to ensure proper operation via real time data stream of sensor readings, pressure, and ambient temperature from both HASP gondola communication and onboard transceiver to base station.

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…):

NA

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

Team will carry all required equipment and tools. We may need standard set of wrenches, soldering station, oscilloscope, and heat gun.