HASP 2014

University of North Dakota- University of north Florida (UND-UNF) Payload

Preliminary Payload Specification and Integration Plan (PSIP)

Corrected Version (v2)

Payload Title: Development of free flying payload to measure ozone profile in the stratosphere and pollutant gases in atmosphere and troposphere using nanocrystalline sensors on a high altitude balloon platform.

Payload Class: Small Payload
Payload ID: 7

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

Contact Name:
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Submit Date: April 25, 2014

Mechanical Specifications: The measured weight budget of various parts of the payload is given in the table-1.

Table-1 Payload weight and dimension budget

Item:	**Dimension**	**Mass (g)**
8 Ozone sensors box #1 (including fan, heater, box)	3 x 2 x 1 inch	200.00 g
8 Ozone sensors box #2 (including fan, heater, box)	3 x 2 x 1 inch	200.00 g
8 Pollutant sensors box#3 (including fan, heater, box)	3 x 2 x 1 inch	200.00 g
Microcontroller PCB with mounted components	4 x 6 inch	300.00 g
Payload body, top plate and thermal blanket	11 x 6 x 6 inch	1265.00 g
Few Cables, 1 GPS, 2 LEDs, 3 Photodiodes, nuts and bolts		250.00 g
HASP mounting plate		550.00 g
Total		**2965.00 g**

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

The 2014 payload body is similar to the 2013 and 2012 payload body. The important features of our newly designed payload body are easy to open and close the payload, easy access of PCB and sensor boxes, low rate of outgassing under low pressure, better stability with thermal and impact, and also reusable. The payload metal parts were procured payload from the supplier www.onlinemetals.com and are listed in the table-2.

Table-2 Payload metal parts

Name	Size	Purpose
Aluminum Extruded Square Tube Part #6063-T52	height 11” w x d: 6” x 6” 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”x 1”	Internal support of payload with base plate and lid

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 (i).

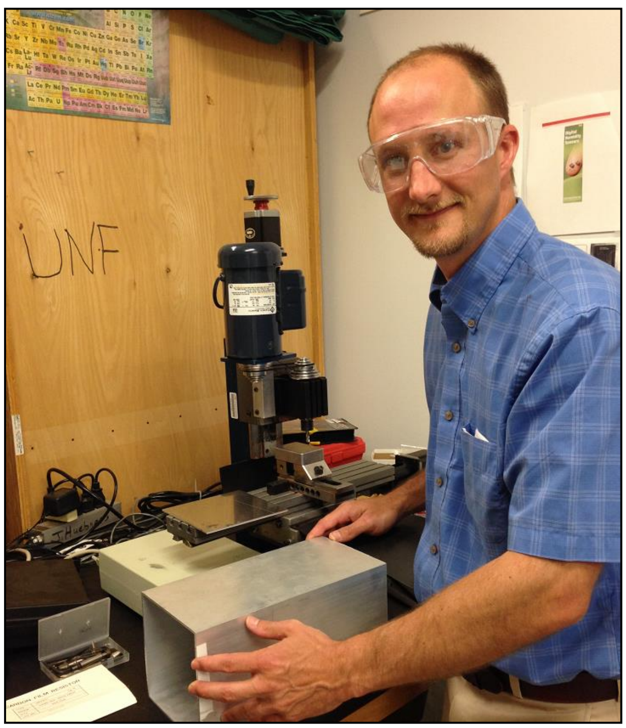


Fig.1 Ken Emanuel (UNF) is working over the fabrication of payload using the Desktop CNC Machining System, Model: Micromill 2000, http://www.microproto.com/micromill2000.htm

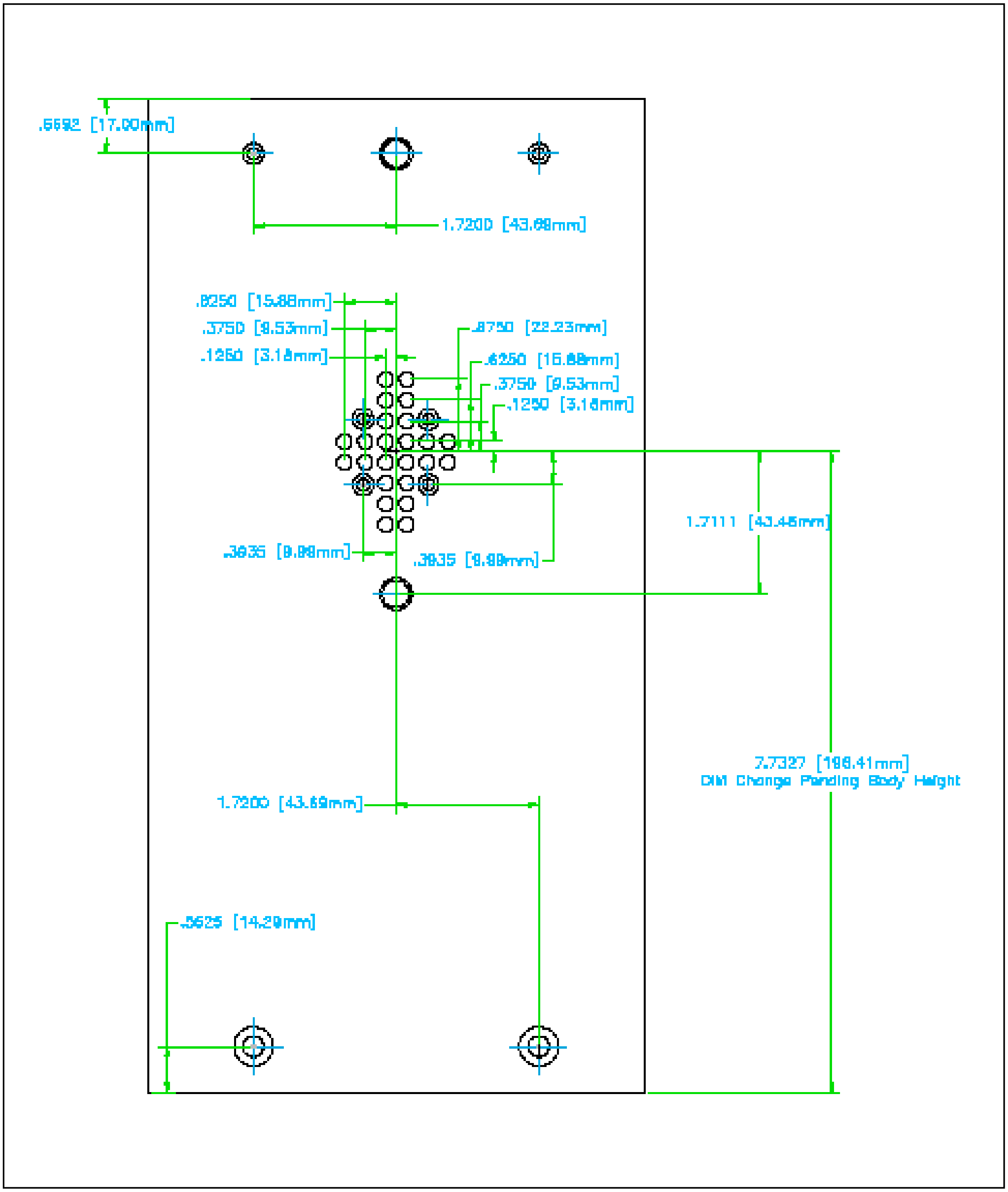


Fig.1 (b) Design for holes on two opposite sides (Side #1 and 3) of payload body

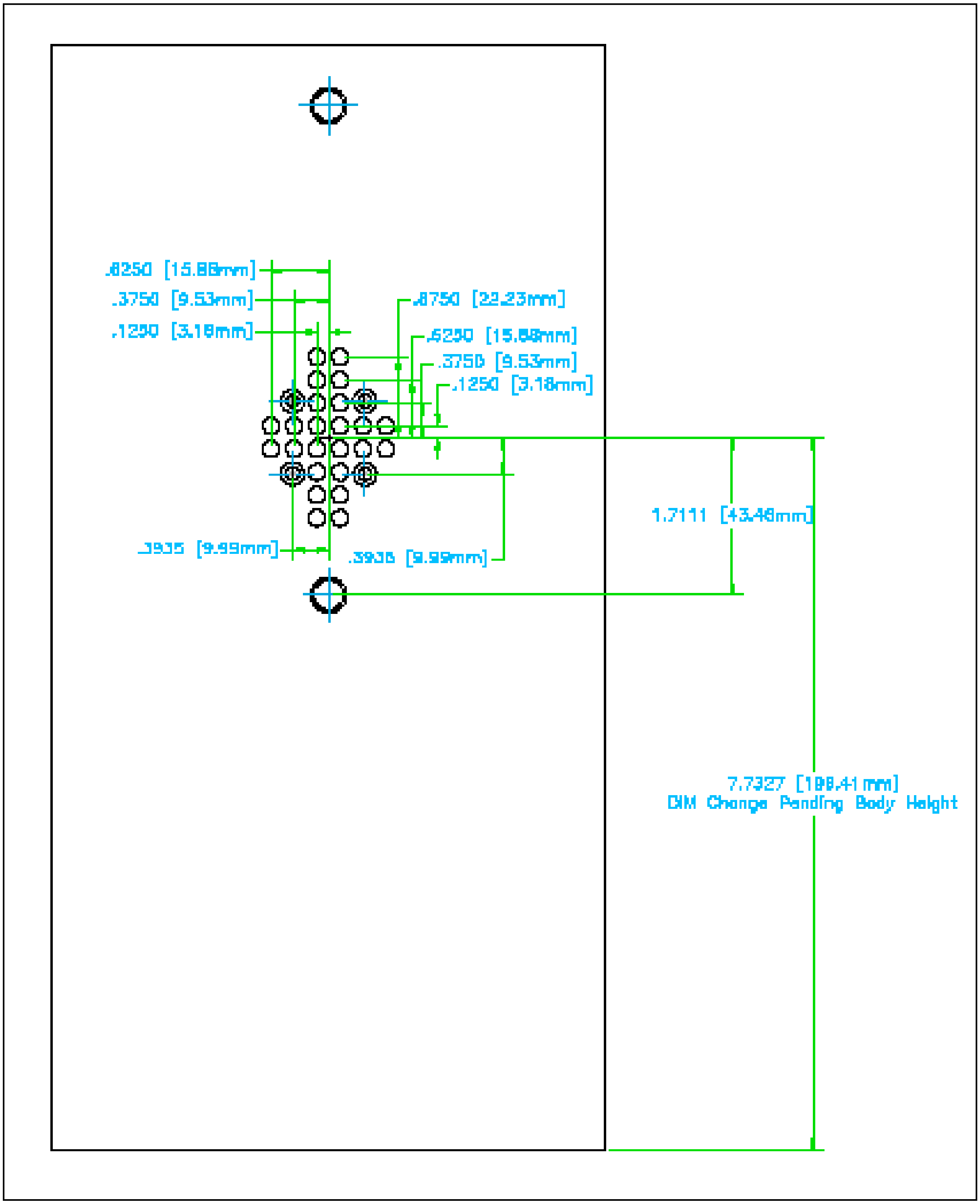


Fig.1 (c) Design for holes on Side # 2 of payload body

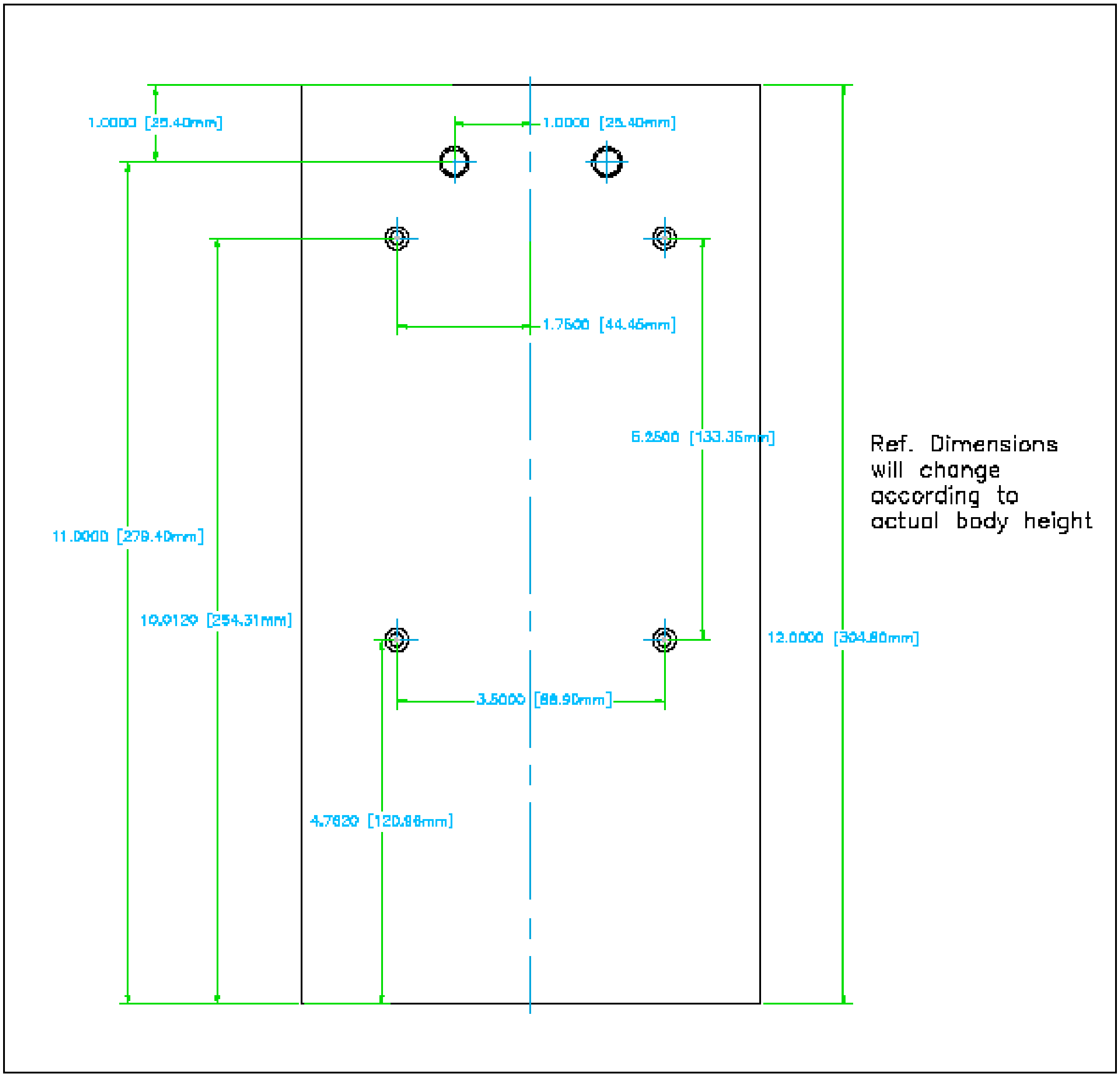


Fig.1 (d) Design for holes on fourth side (Side #4) of payload body for mounting microcontroller PCB

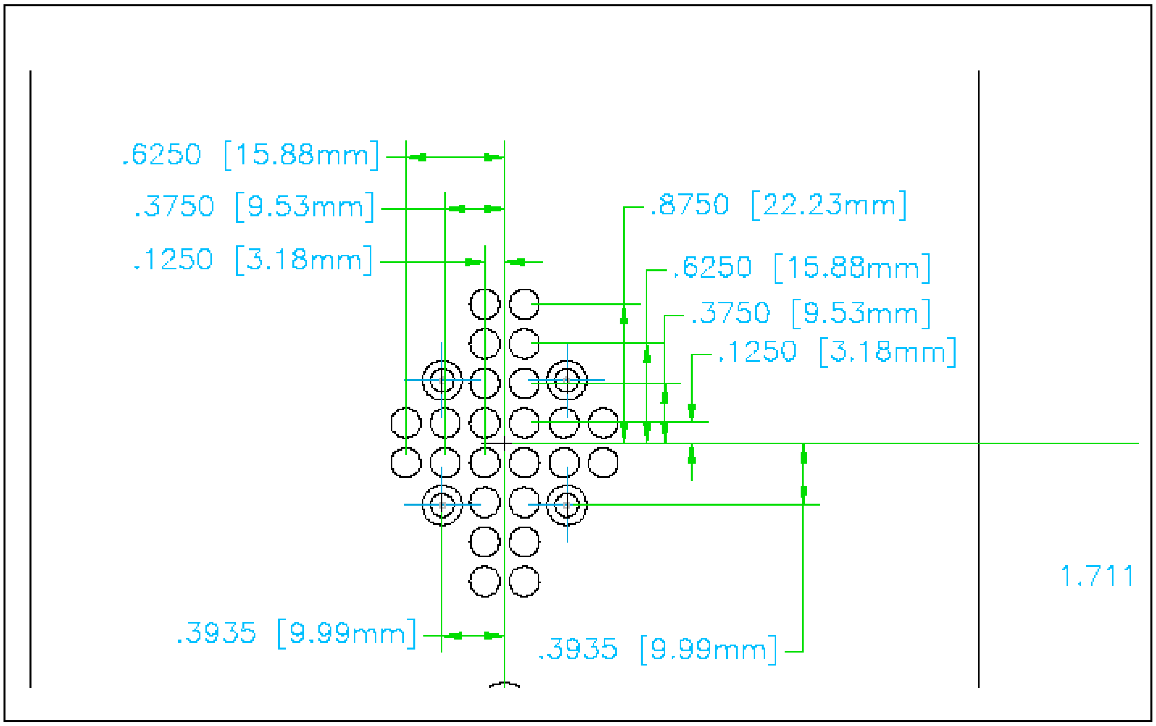


Fig.1 (e) Details of design for holes on three sides of payload body for fan and air inlet

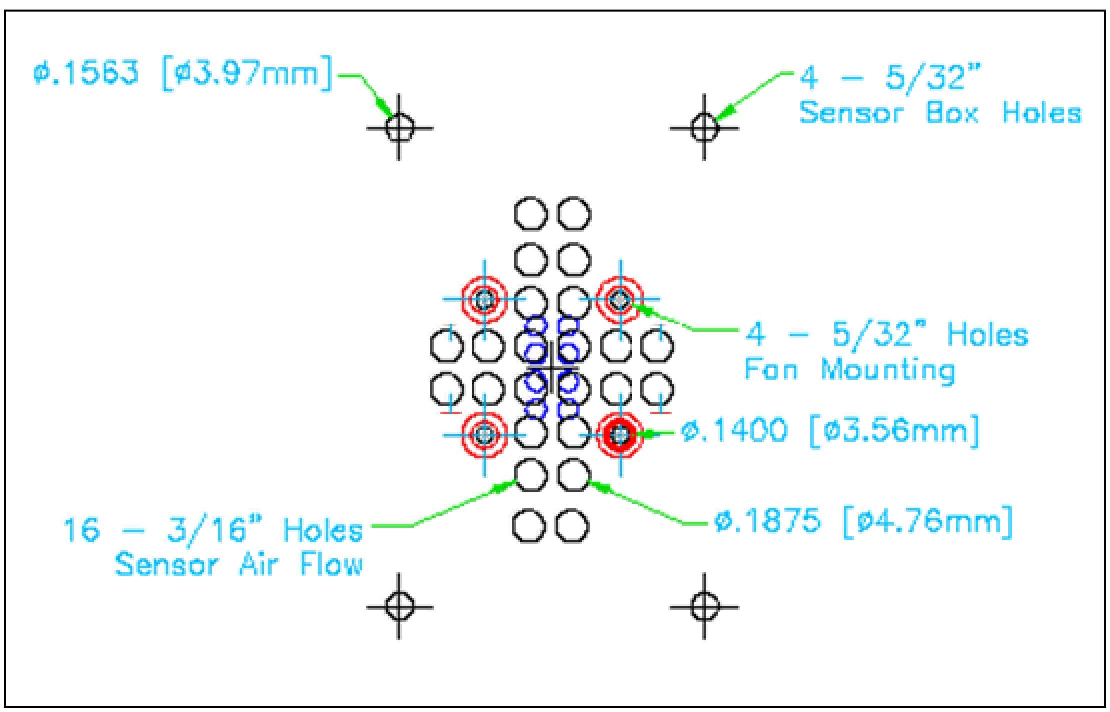


Fig.1 (f) Details of design for holes on three sides of payload body and sensor box

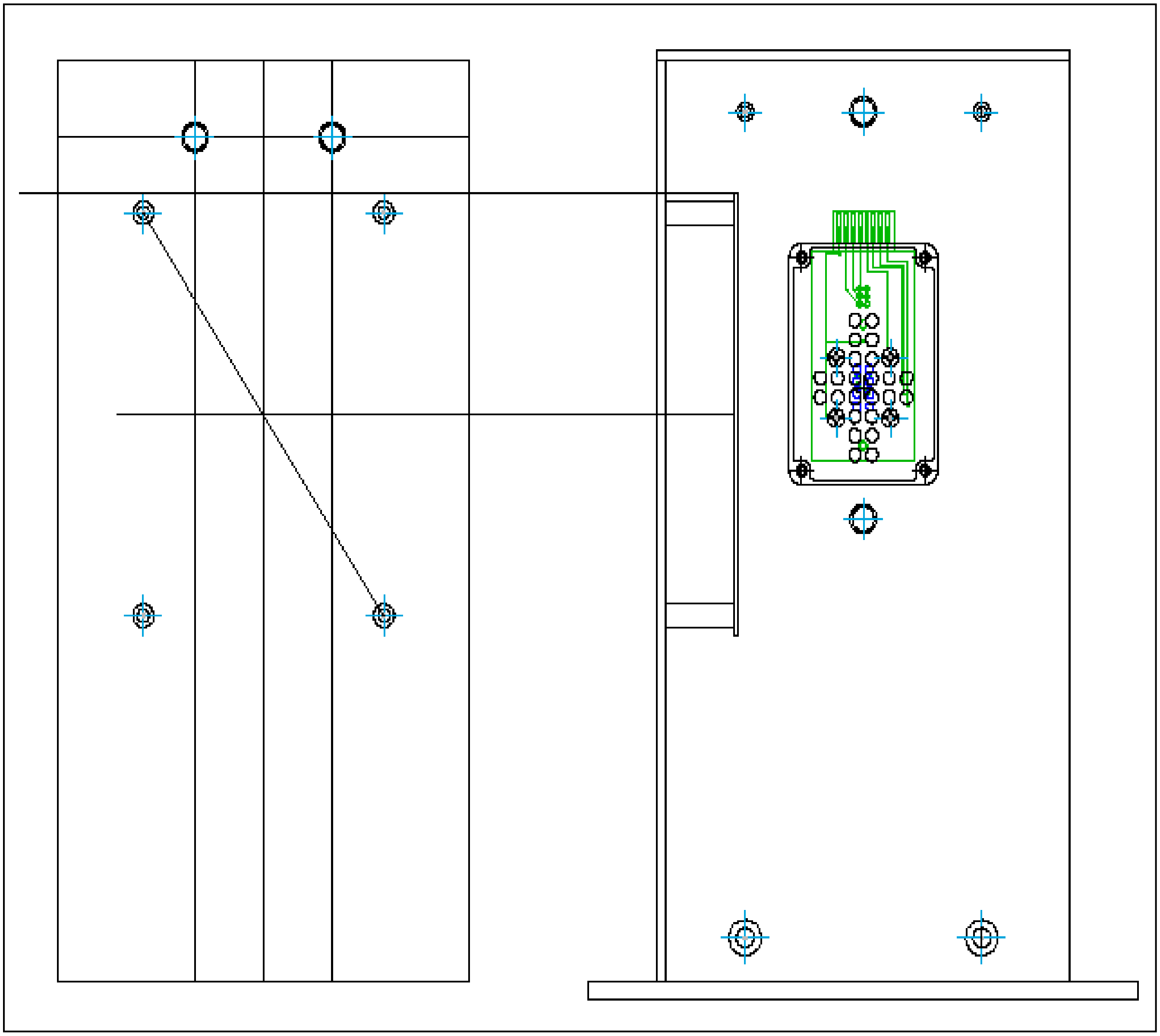


Fig.1 (g) Design for holes on payload body for mounting microcontroller PCB and sensor box

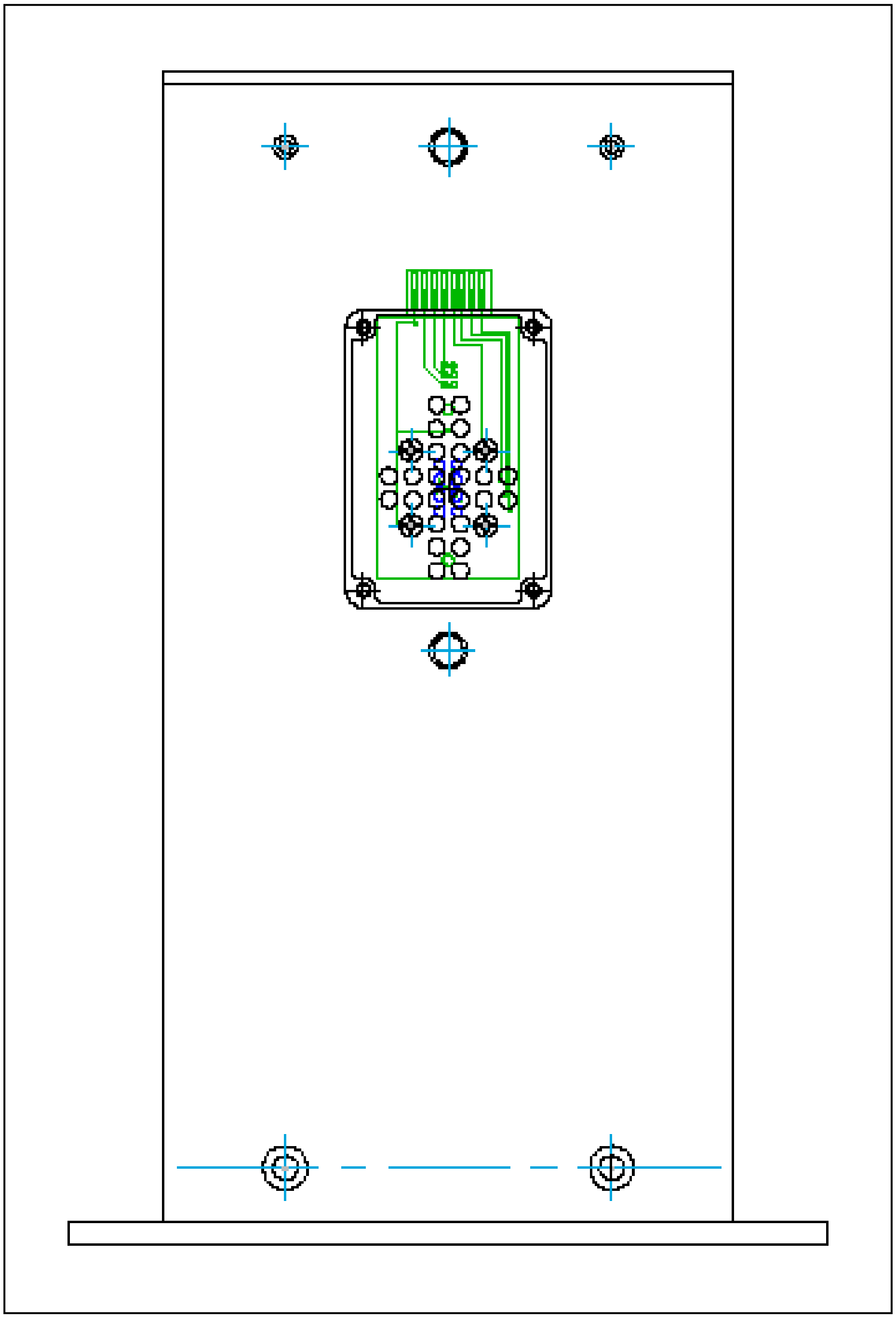


Fig.1 (h) Design for holes on payload body for mounting of sensor box, LED, Light sensor and HASP mounting plate

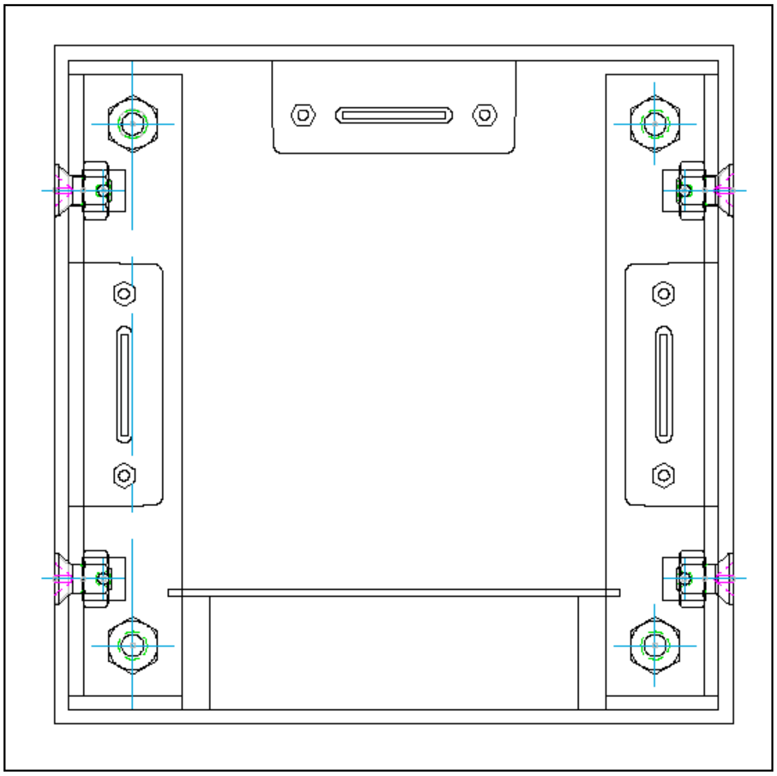
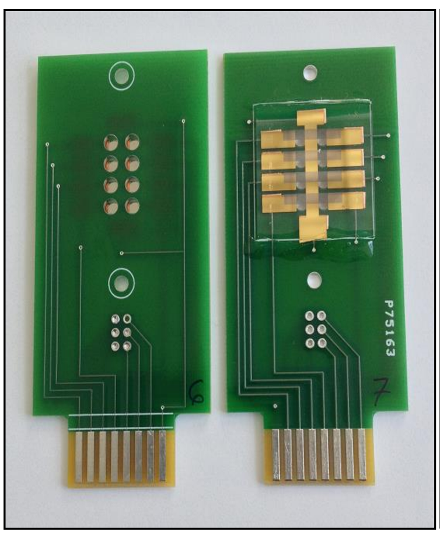


Fig.1 (i) Top view of payload

Fig.2 (a) shows the 8 sensors array mounted on the printed circuit board (PCB). These sensors (US Patent Pending) will be fabricated, tested and calibrated by the student's team of UNF in the Dr. Patel's sensors laboratory. The sensor PCB is mounted in the metal box (Fig. 2b) along with one heater, fan and temperature sensor.



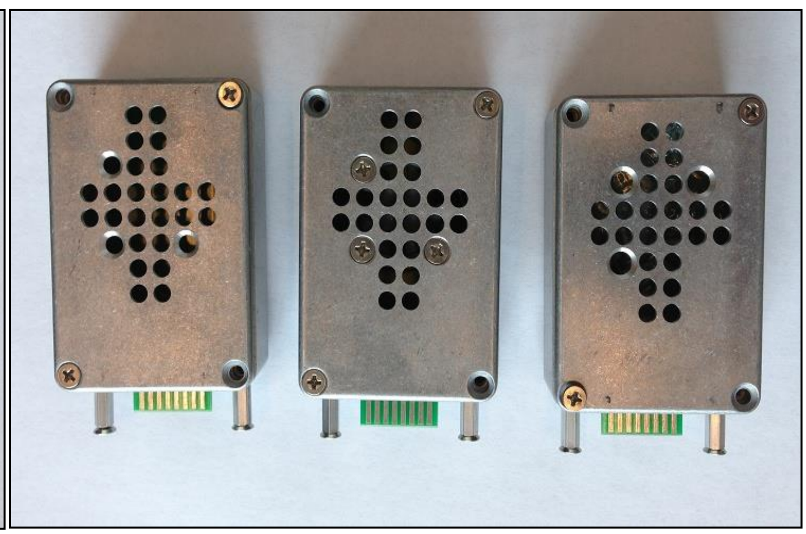


Fig. 2 (a) Sensors mounted on PCB and (b) Sensors boxes

The sensor box will be mounted on each side of the payload. The purpose of each sensor box is listed in the table-3.

Table-3 Purpose of sensors

Sensors Box#	Sensor Materials	Purpose
1	Nanocrystalline Indium tin Oxide (ITO) thin film	To detect ozone gas in the stratosphere
2	Nanocomposite of Zinc Oxide (ZnO) and Indium tin Oxide (ITO) thin film	To detect ozone gas in the stratosphere
3	Nanocomposite of WO_3+SnO_2 thin film	To detect pollutant gases in the troposphere

B. 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…)

Not Applicable

Other relevant mechanical information

(i) The payload will be mounted on the HASP mounting plate with 4 bolts, washers and nuts.

(ii) Thermal blanket made of aluminized heat barrier having adhesive backed (Part No. 1828-12x24) (Make: www.PegasusAutoRacing.com) will be applied on the outer surface of the payload for the improvement of thermal stability. The high reflective surface of the material is capable of withstanding radiant temperatures in excess of 1000^{o}C.

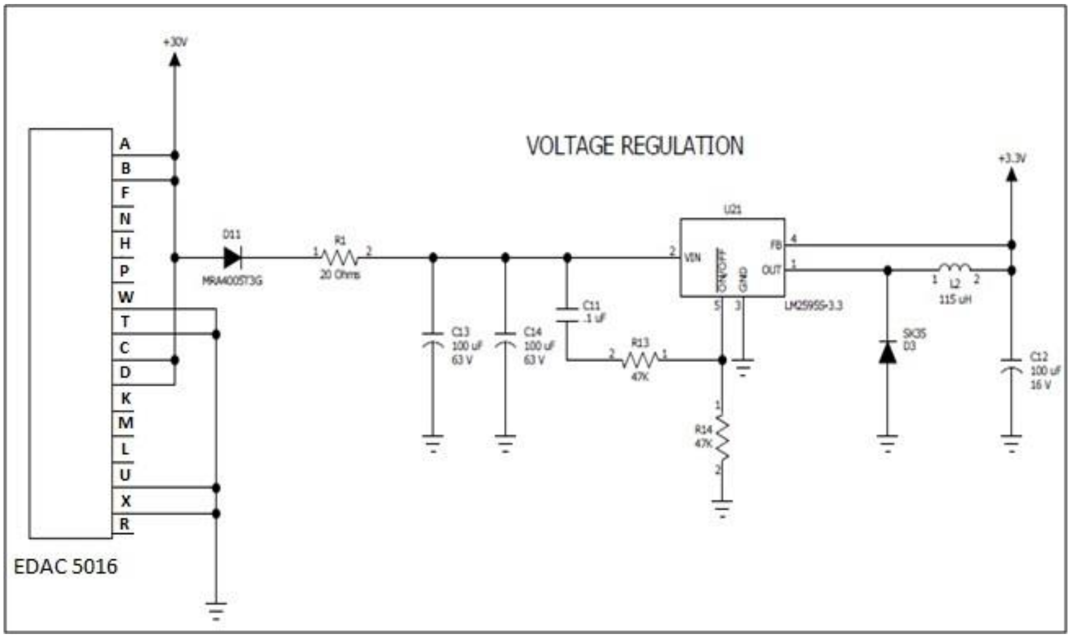
II. Power Specifications:

A. Measured current draw at 30 VDC for different function of circuit operation is listed in the table-4.

Table-4 Current Draw

Circuit Function	Current draw (mA)
Payload Power ON, but all heaters OFF	30±5
Payload Power ON and Heater #1 ON	140±5
Payload Power ON, Heater #1 and 2 ON	250±5
Payload Power ON, Heater #1, 2 and 3 ON	350±5

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

None

III. Downlink Telemetry Specifications:

A. Serial data downlink format:

Packetized- Record +/- 232 bytes transmitting in 5 second intervals

B. Approximate serial downlink rate

372 bps

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

11 bytes for data packet synchronization
6 bytes GPS source indicator
10 bytes for UTC time
7 bytes for MLS altitude
24x6 bytes for filtered ozone data
3x6 bytes for local sensor temperature
3x6 bytes for photo-cell
6 bytes CPU temp
6 bytes MCU power rail voltage
6 bytes MCU power rail current
6 bytes for atmospheric pressure in mbar
6 bytes for heater status

D. Number of analog channels being used:

   0

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

   Not Applicable

F. Number of discrete lines being used:

   0

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

   Not Applicable

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

   NO

H. Other relevant downlink telemetry information.

   Not Applicable

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 up linking to your payload

Table 5: Uplink Commands

#	Command Description	Cmd. Code	Checksum	Confirmation/Notes
1	Reset	0x71	0x31	"HELLO" upon reset
2	Erase data in flash	0x72	0x32	"ERASING FLASH"…"COMPLETE"
3	Upload data in flash	0x73	0x33	"NO DATA"
4	n/a	n/a	n/a	n/a
5	Master Heater Override Switch On	0x75	0x35	Heater Status (default)
6	Master Heater Override Switch Off	0x76	0x36	Heater Status
7	On Board Data Logging On	0x77	0x37	Data (default)
8	On Board Data Logging Paused	0x78	0x38	Data empty
9	Stream UBLOX data	0x79	0x39	"HASP 2014 UBLOX"
10	Stream HASP GPS data	0x7A	0x3A	"HASP 2014"

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

   NO

F. Other relevant uplink commanding information.

   None

G. <u>Request</u>: UND-UNF Team is requesting the HASP to provide us the GPS strings from the HASP gondola every 1 second.

V. Integration and Logistics

A. Date and Time of your arrival for integration:

   7/27/2014 Time: TBD

B. Approximate amount of time required for integration:

   3 - 4 Hours

C. Name of the integration team leader:

   Ken Emanuel (UNF)

D. Email address of the integration team leader:

   k.emanuel@unf.com

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

   Ken Emanuel (UNF) - k.emanuel@unf.com

   Brittany Nassau (UNF) - Brittany.Nassau@gmail.com

   Dr. Nirmal Patel (UNF) – npatel@unf.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 the final preflight testing (the thermal vacuum testing).

G. List all expected integration steps:

   1. Successfully interface the payload to platform.

      a. Mount the payload to the HASP platform

b. Connect and interface the payload with the power system and the 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 all sensors data readings, pressure, photo voltage of light sensors and ambient temperature.

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…):

No. Thank you very much. But, your blessings are always solicited.

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 soldering station, oscilloscope and heat gun.