Payload Title: Hazardous Gases for Harsh Environments LED Sensor

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

Payload ID: 09

Institution: University of Central Florida

Contact Name: Michael Villar

Contact Phone: (561) 512-3953

Contact E-mail: mvillar@knights.ucf.edu

Submit Date: 4/29/2016

I. Mechanical Specifications:

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

The weight of the payload as of 4/24/2016 is as shown in the component breakdown below. The total comes to 8±1.243 kg with uncertainty due to unfinished structural hardware. The LEDs, Detector, Optics, DAQ and Driving Electronics are all weighed directly while the Structure is estimated by calculations using SolidWorks models.

Component	Mass (g)	Mass Uncertainty (g)
LED + TEC x3	30	3
Detector + TEC	100	5
Optics	100	20
Structure	5260	1000
DAQ	2400	200
Driving Electronics	110	15
Total	8000	1243

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

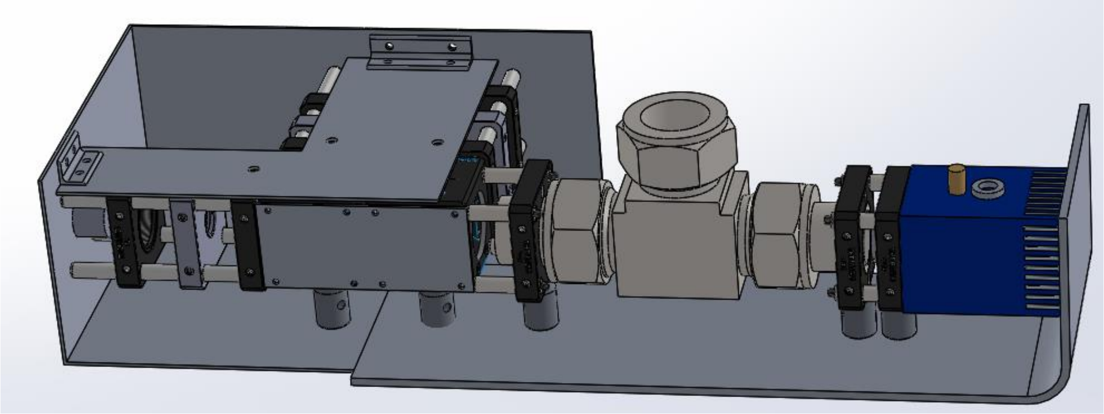

Figure 1: The unit under investigation, the LED CO/CO2 sensor. From left to right: the LEDs and collimating optics, the gas cell, the photovoltaic detector.

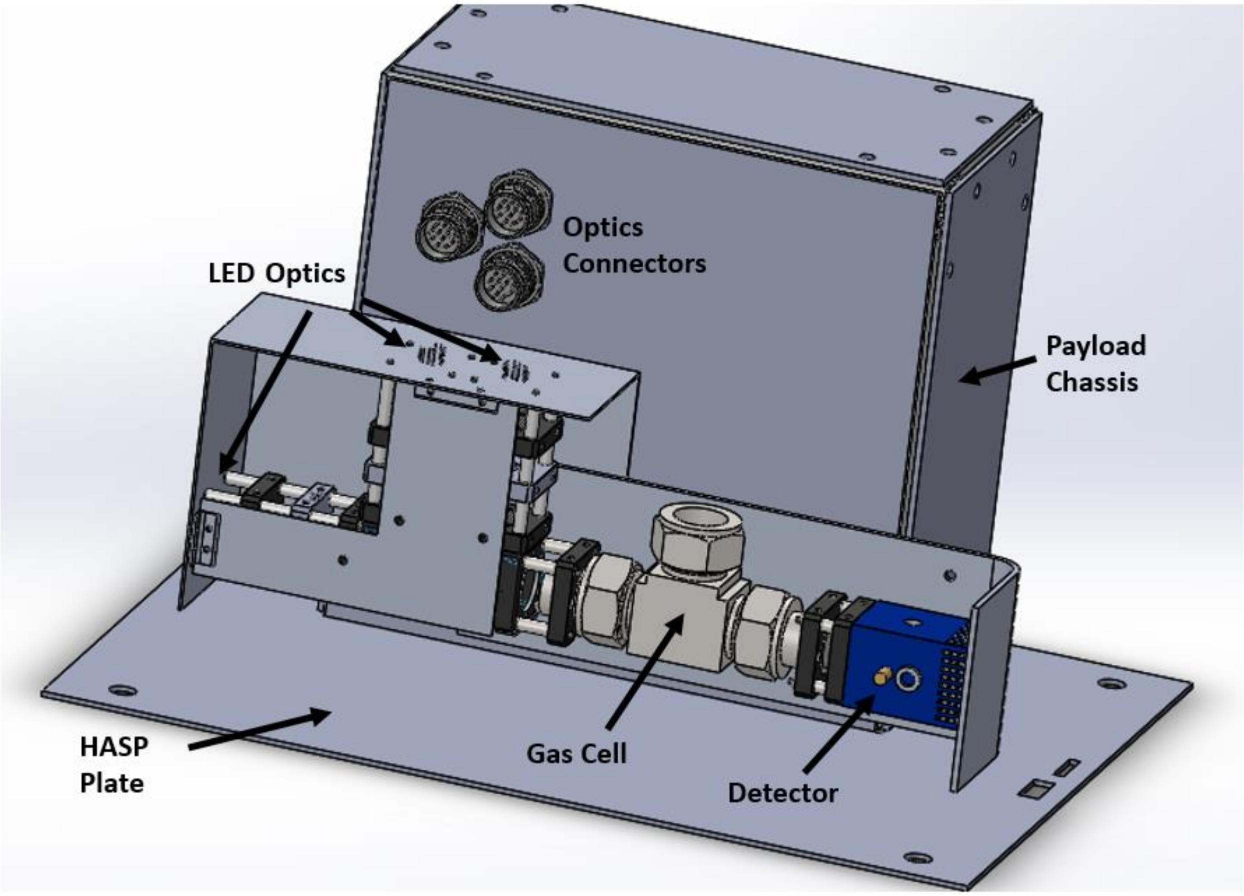

Figure 2: Alternate View of Payload on HASP Mechanical Interface Plate

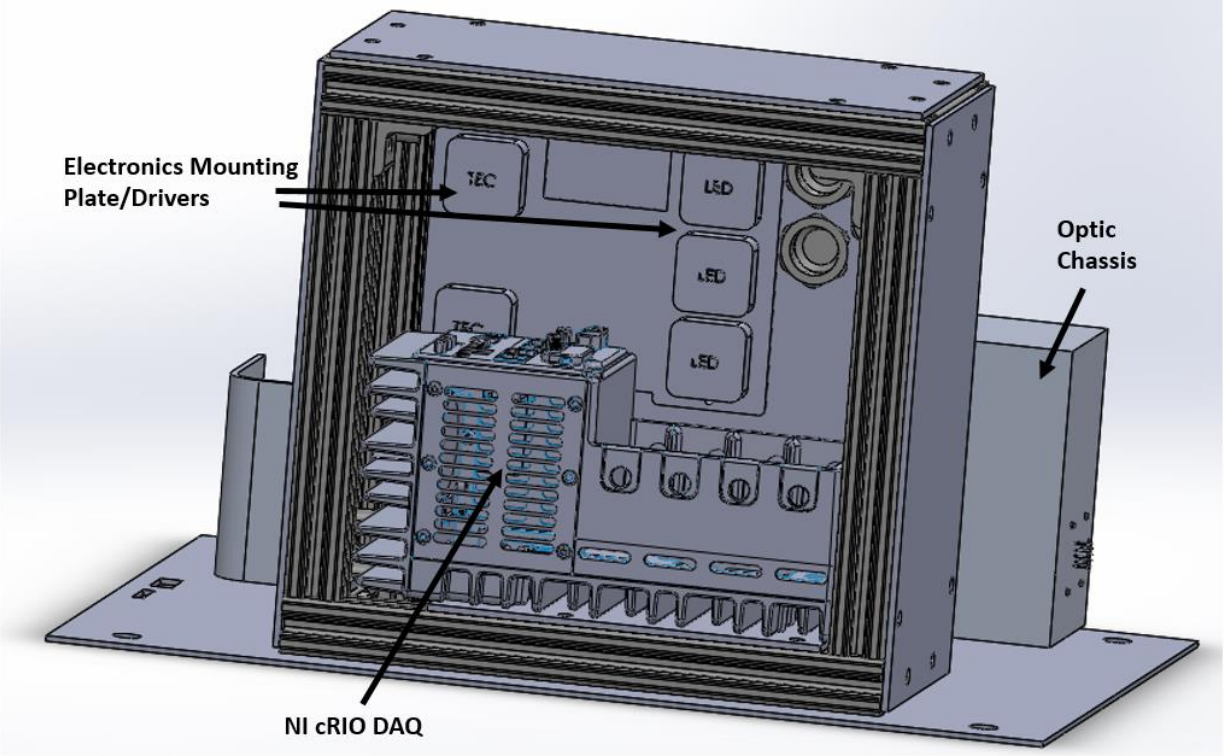

Figure 3: Payload attached to HASP Mechanical Interface Plate

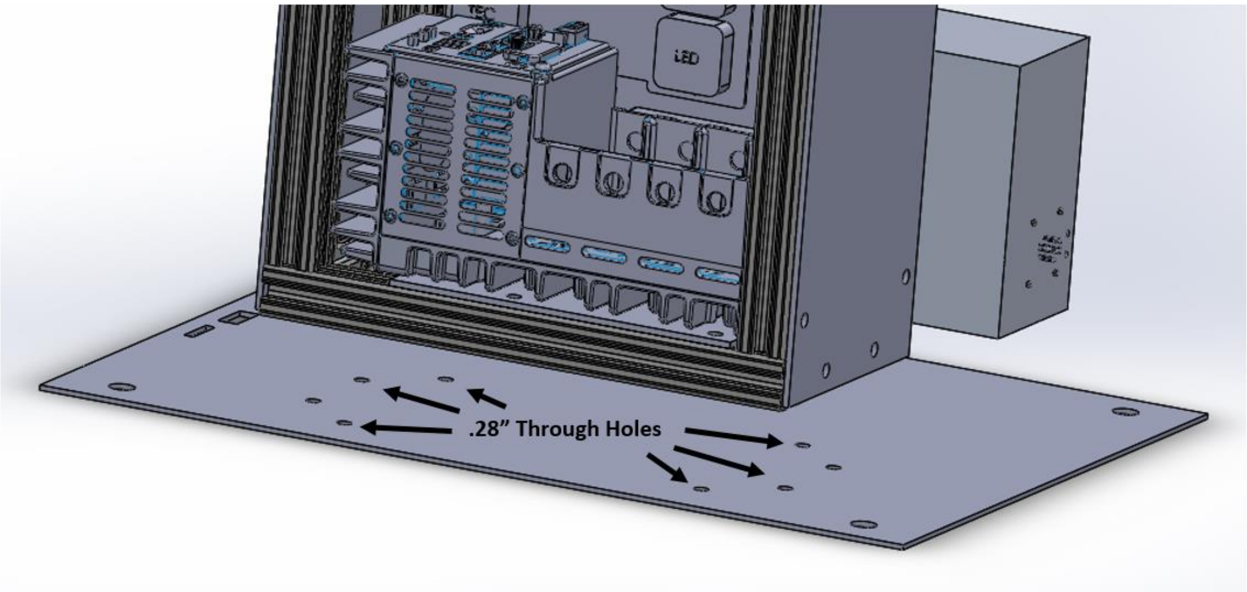

Figure 4: Payload attachment locations on HASP Mechanical Interface Plate

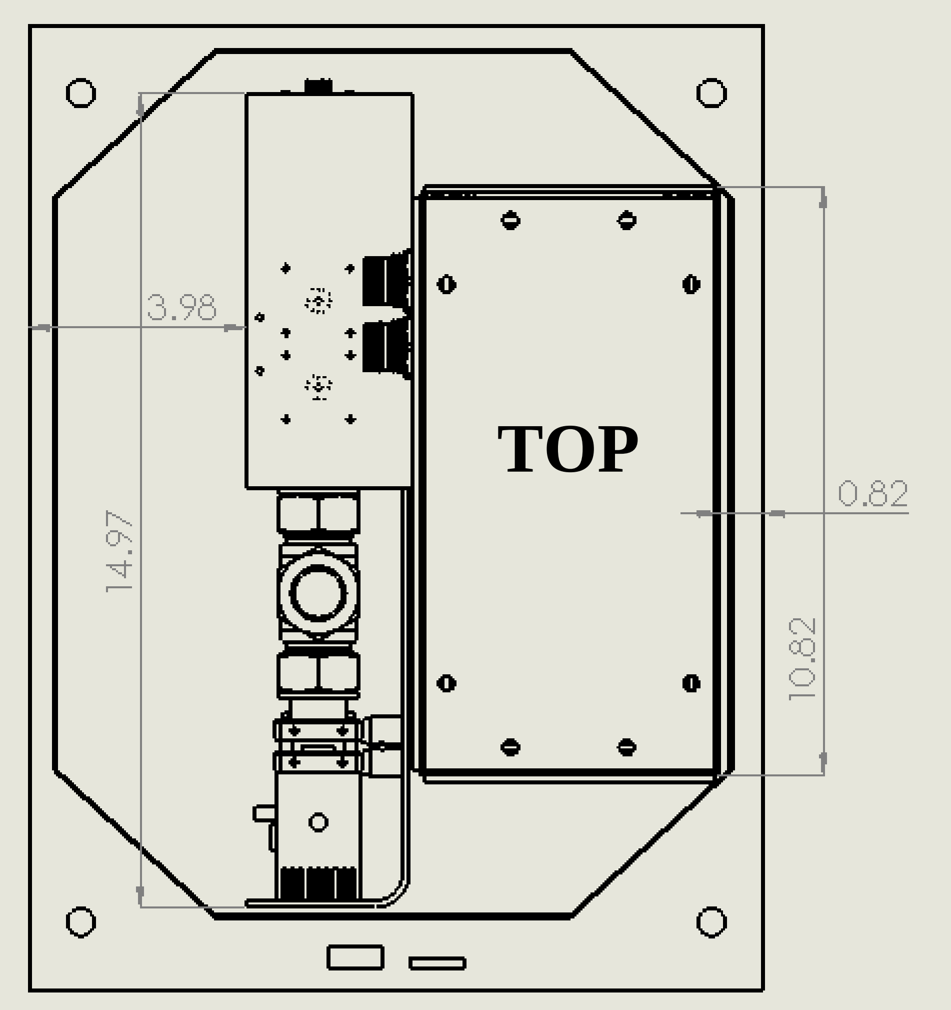

Figure 5: Top down view of payload on HASP Mechanical Interface Plate (units shown are in inches)

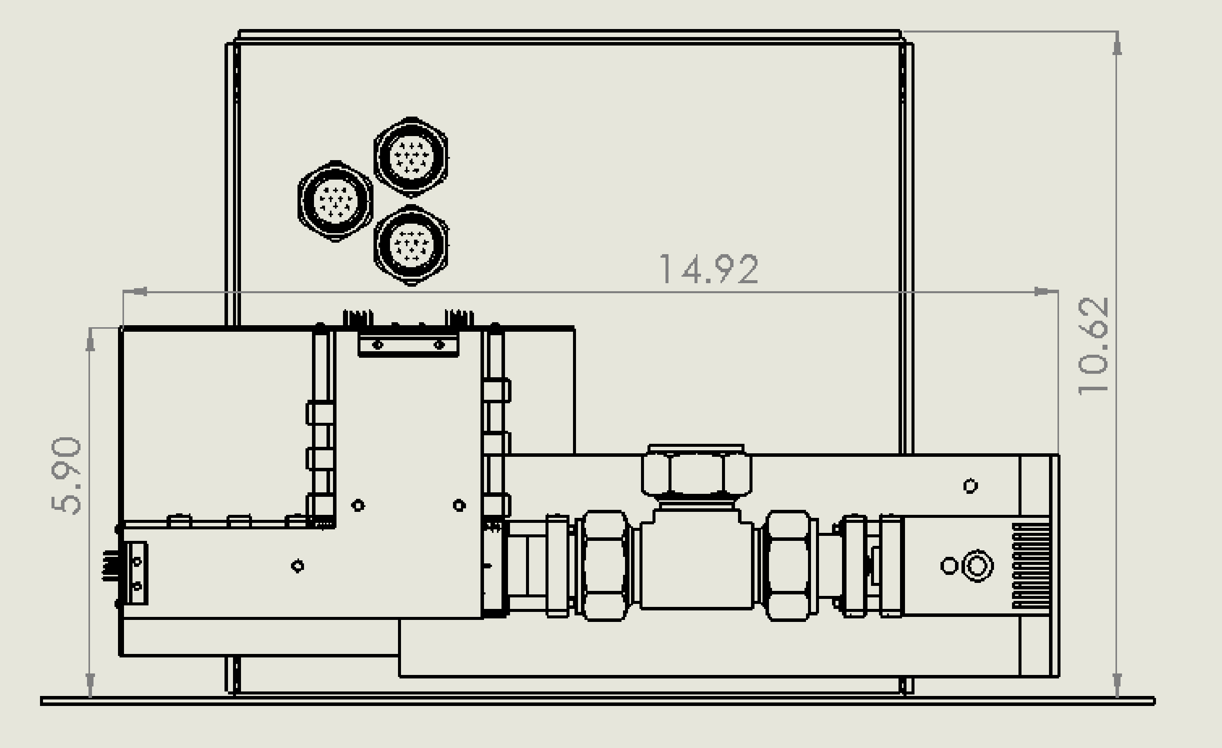

Figure 6: Side View of Payload on HASP Mechanical Interface Plate (units shown are in inches)

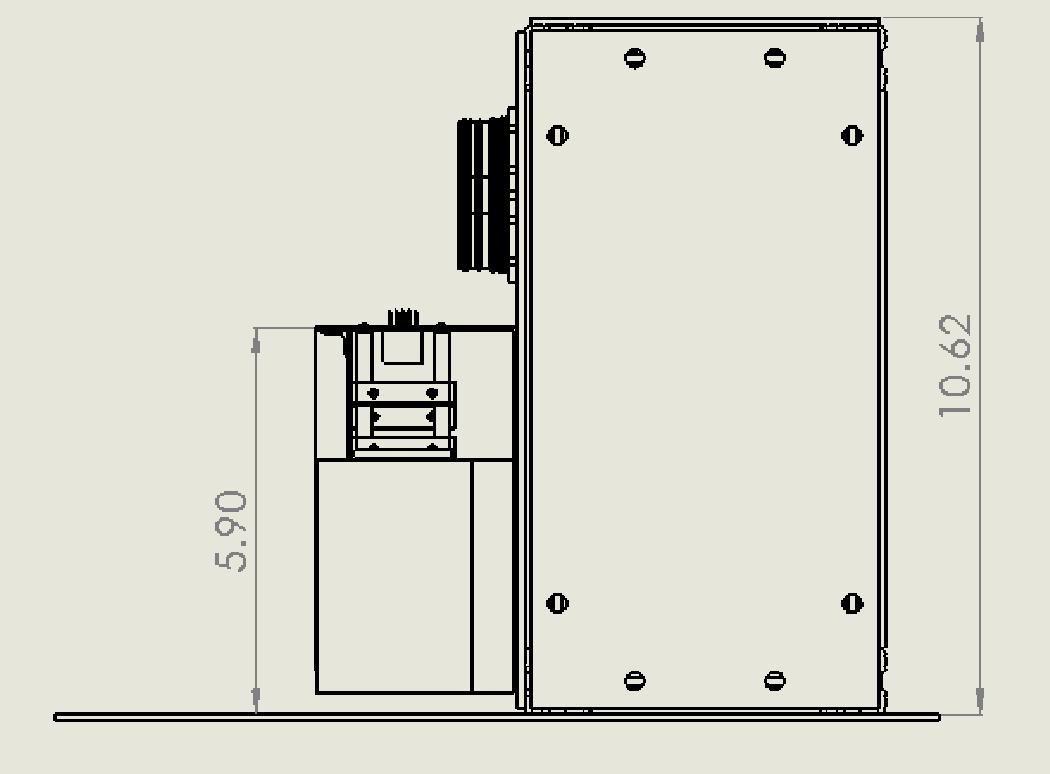

Figure 7: Side View of Payload on HASP Mechanical Interface Plate (units shown are in inches)

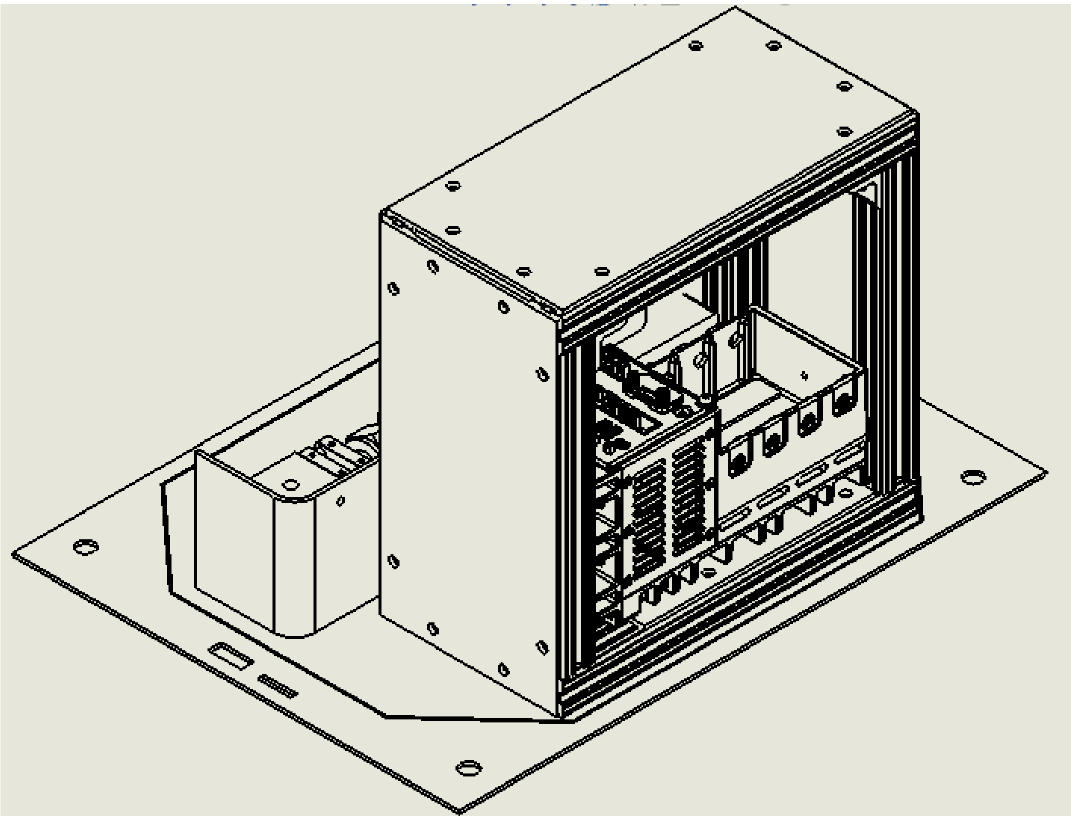

Figure 8: Isometric View of Sensor Payload on HASP Mechanical Interface Plate

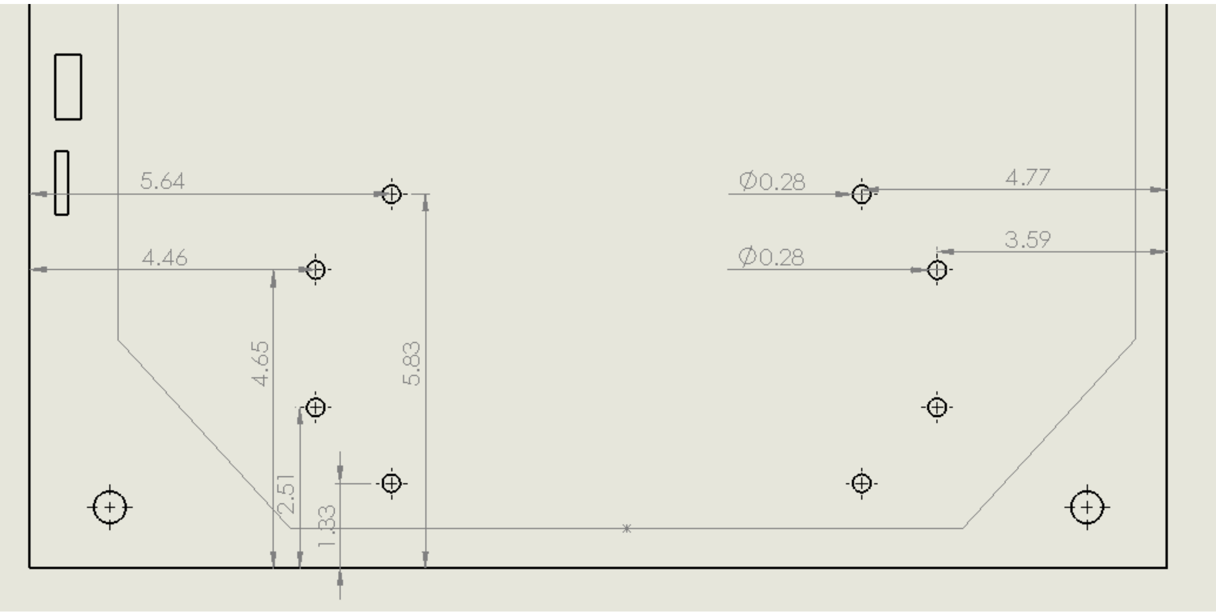

Figure 9: HASP Mechanical Interface Plate Connection Locations

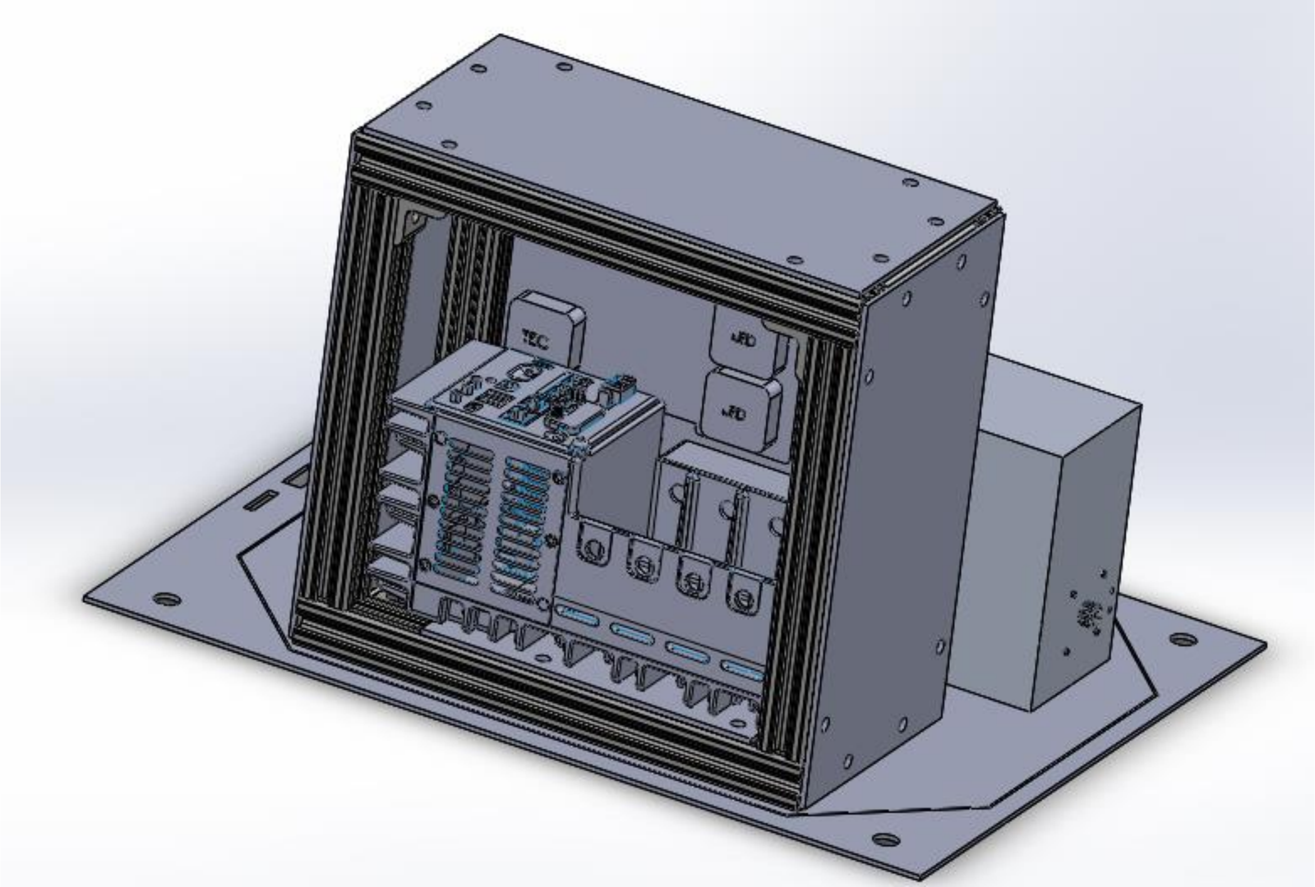

Figure 10: HASP System Isometric View

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…)

The test cell depicted in the mechanical drawing from Section I Part B will be filled and sealed with a gas mixture of 90% N_2, 5% CO_2, and 5% CO. The test cells volume is 1.7948 in^3 and will be filled to 1atm at ground. This minute amount of CO should not pose a hazard to HASP or the ground crew but is noted for reference. The cell has a built in diaphragm that keeps internal cell pressure and ambient pressure equal, this allows for varying pressure measurements throughout the duration of the flight and removes the issue of having a pressurized cell at flight altitudes.

D. Other relevant mechanical information

No other relevant mechanical information.

II. Power Specifications:

A. Measured current draw at 30 VDC

Shown below in Section II Part B is the general interface between the HASP provided power source and the sensor payload HASP provides ~ +30 VDC that will be down regulated to +24 VDC to power NI-cRIO DAQ. This is then further regulated down to +12VDC to power the LED/TEC Electronics Board and the Detector Board. The Figure below shows the overall circuit schematic for LED/TEC control. The +12 VDC powers the LEDs and TECs directly. LED/TEC Signal control is powered and modulated by a regulated +5 VDC line from the NI-cRIO DAQ. Table 1 shows the power draw breakdown (in watts as well as volts and current) per component as well as the total maximum power consumption of the payload.

Table 1: Power Breakdown

Component	Voltage	Current	Power	Note
Detector	5V	1.1A (2 stage TEC) or .43A (3Stage)	5.5W	Max, including TEC operation
LED	0.45V	900mA	0.405W	Per LED, no TEC operation
TEC on LED	2.78V	1A	2.78W	Per embedded TEC, max conditions
Driving Electronics	12V	1.67A	24W	Max draw, full operation
cRIO-9031	12V	.8A	10W	Max draw, full operation
Overall System	**24V**	**2.05A**	**49.055W**	**Draw of entire system from Power Supply**

Table 2: For HASP system

Component	Quantity	Unit Power, W	Total Comp Power, W
Detector	1	5.5	5.5W
LED	3	.405	1.215W
TEC for LED	3	2.78	8.34W
Driving Elec.	1	24	24W
cRIO-9031	1	10	10W
		Total:	**49.055W**

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.

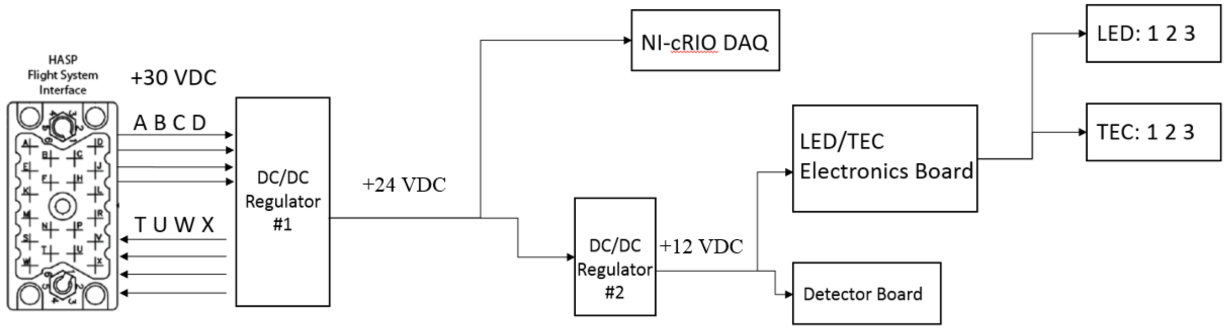

Figure 11: Schematic of HASP EDAC516 connector interface with Sensor payload power system

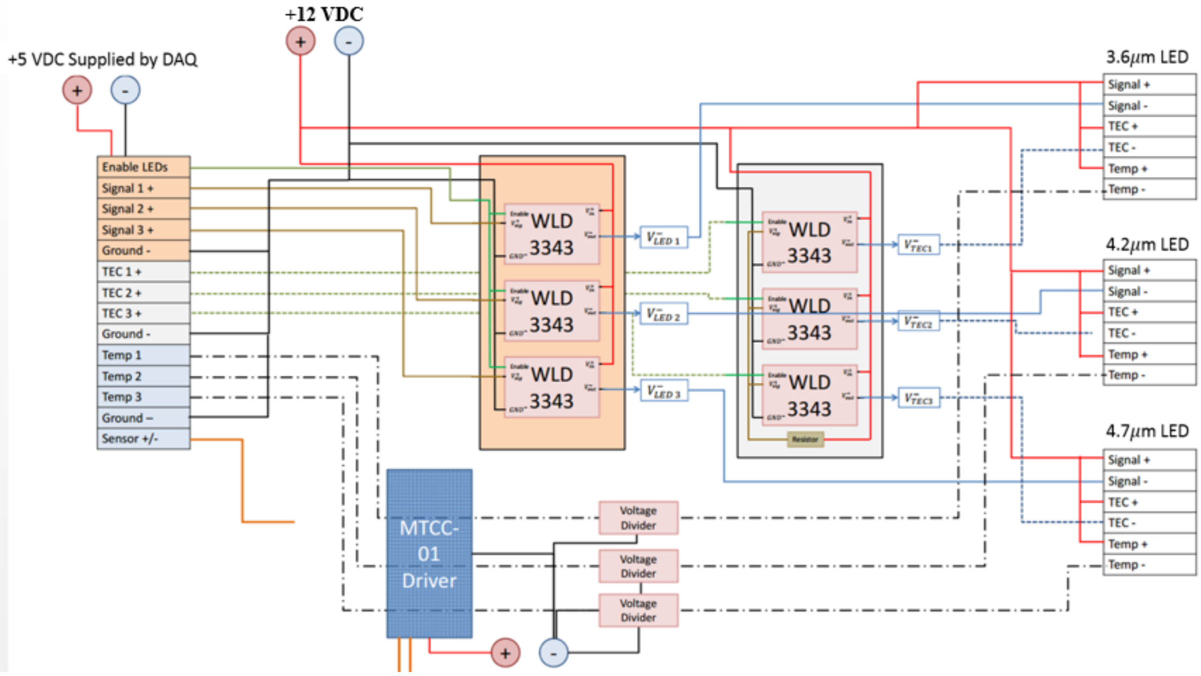

Figure 12: LED/TEC Electronics Board as shown in Power Schematic of Figure 1

C. Other relevant power information

DC/DC Regulator	Manufacturer	Input Voltage	Output Voltage	Max Power Output
CBS3502424-RT	Cosel	20-36 V	24 V	> 350 W
CBS3502412	Cosel	18-36 V	12 V	> 350 W

III. Downlink Telemetry Specifications:

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

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

NA

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

NA

D. Number of analog channels being used:

1

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

A steady 5V output on the NI DAQ will be generated in the running VI and will be used to determine healthy system operation. If all systems are operational the VI will generate a 5V signal to be read by Analog Channel 1 (Pin K and L). In event of system or component failure, the VI will cease its 5V output resulting in a zero reading. If 5V signal ceases a power off/on command will be given to restart/reboot system.

F. Number of discrete lines being used:

NA

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.

No

I. Other relevant downlink telemetry information.

It is requested that HASP GPS Time and Position Data be streamed to the payload via the serial connection in a continual interval of 30 seconds. This data will be read by the NI cRIO-9031 DAQ via an adapter to a RJ-50 10-position modular jack and saved with primary collected data during flight operation.

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*)

NA

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

NA

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

NA

F. Other relevant uplink commanding information.

NA

V. Integration and Logistics

A. Date and Time of your arrival for integration:

Date of Arrival: August 1st, 2016 Time: 10 AM
Date of Departure: August 5th, 2016 Time: 7 PM

B. Approximate amount of time required for integration:

Estimation of 1 hour (Integration time is expected to be much less than 1 hour as system will already be attached to payload plate and will only require plate attachment to HASP system and connection of the RS-232 Serial Connector and EDAC 516 Connector)

C. Name of the integration team leader:

Michael Villar

D. Email address of the integration team leader:

mvillar@knights.ucf.edu

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

Michael Villar (mvillar@knights.ucf.edu)
Justin Urso (justin.urso13@knights.ucf.edu)
Akshita Parupalli (akshita.parupalli@Knights.ucf.edu) (Tentative attendance)

F. Define a successful integration of your payload:

Successful integration of the Hazardous Gases for Harsh Environments LED Sensor with the HASP platform includes: successful mechanical attachment of Payload 09 to the HASP system and connection of HASPs Power system; confirming the functionality of individual LED operation, TEC control and Thermocouple readings; proper signal collection via the detector and data storage in the National Instruments cRIO DAQ;

secondary confirmation of same functionality while undergoing thermal-vacuum testing and successful completion of thermal vacuum test.

Mechanical system:

☐ Successful mechanical fit to the platform

Electrical system:

☐ Successful power up
☐ Current draw lies within expectations

Communication system:

☐ Successful communication with HASP Platform
☐ Verification of Data Collection and Storage

Environmental System Check:

☐ Successful thermal vacuum test

G. List all expected integration steps:

☐ Mechanically mount the payload to the platform
☐ Connect power cable
☐ Verify Current and Voltage draw to:
    ☐ NI cRIO DAQ
    ☐ LEDs 1-3
    ☐ Detector
    ☐ Driving Electronics
☐ Connect communication cable
☐ Verify that the communication with the platform is working
☐ Verify proper Data Collection and Storage
☐ Successfully complete Thermal Vacuum Test

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

All Steps are covered in parts F/G

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 currently.

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

Wrenches, Pliers, Wire Cutters/Strippers, Hex Keys