# Answers to questions for UND-UNF HASP2010 payload

(1) What is the detailed reason for the failure of the sensor temperature control loop during HASP2009 at high altitude? How will you address this failure during HASP2010?

The mounting connection of the temperature sensor may have become loose during the flight, which gave a fluctuation in the temperature measurement. We will take care to secure the temperature sensor mounting connection during HASP2010. In addition, we will perform several calibrations of the temperature sensor under varying low pressure conditions. The RTD and heater will be supplied to the UND team during the first week of March 2010 so that they can start to work on it.

(2) What is the sensor response if the temperature is not held to 30°C? What are your plans for handling this in your data analysis?

The nanocrystalline ITO gas sensor has a negative temperature coefficient (TCR). The variation of the sensor resistance in the temperature range of -20$^{o}$C to 75$^{o}$C is within ± 4.85 %. If sensor is kept at a constant temperature 30°C, the value of the sensor resistance will be stable. For HASP2010, sensor arrays will be fabricated using nanocomposite ITO materials. Two materials (ITO and other organic or inorganic films) will have nearly the same and opposite temperature coefficients of resistance. Hence, any temperature variations will be canceled out or remain less than ± 1.00%.

(3) Fans do not function well in a low pressure environment. They can overheat and burn out. In addition, the number of air molecules pushed by the fan will vary as a function of pressure which might affect your ozone concentration calculation.

There were no problems with the fan during the HASP2008 and HASP2009 flights. After recovering the payload, the fan was tested and found to be in good working condition. The function of the fan with the heater is to push out the possible formation of ice condensation on the surface of the sensor arrays when the payload passes through the cold temperature zone of the troposphere.

(4) In fact how do you calculate your ozone concentration as the environmental pressure varies? If I understand your sensor correctly you are actually measuring an absolute number of ozone molecules interacting with your detector rather than measuring a ratio.

Yes, you are right. We are actually measuring the absolute number of ozone molecules interacting with sensor arrays rather than measuring a ratio.

(5) Start the software design and implementation immediately. Lack of appropriate software for data analysis and assessing the payload performance in near-real time was a major problem for you during HASP2009.

Both the UND and UNF team will take care of the design and data analysis software ahead of time for HASP2010.

(6) Small payloads are authorized for up to 1200 baud data communication speed. Are you requesting a waiver?

The UND team will reply to you and may request it.

(7) What is your data format and expected bit rate? Note that 1200 baud is the speed at which individual bits are sent on a serial line. This is **not** the bit rate which is the volume of data (number of bits in the data format times the number of times the data record is sent per unit time) per second.

The UND team will reply you to regarding this question.

(8) What modifications to the software for interfacing with HASP need to be done?

The UND team will reply you to regarding this question.

(9) Need a drawing of the connections from the HASP EDAC and RS232 connector into your circuit schematic.

We will send you the new drawing as early as possible. Meanwhile, you can refer to Fig. 6 of our proposal for the RS232, and Fig. 7 for the EDAC connections.

(10) Your previous flight experience has shown that linear voltage regulators are a potential problem. We suggest that DC/DC converters be used instead.

We believed that the voltage regulator problem was due to the use of a tantalum capacitor, which was connected with the voltage regulator. A tantalum capacitor has low tolerance, and is very accurate, but is also very sensitive to static charges. During the handling of a circuit board, a large amount of static charges might be stored on the capacitor. When the static charges exceeded its threshold value, the oxide layer of the tantalum capacitor broke down and failed to work. Consequently, the voltage regulator connected with it also failed. We are going to perform further testing of our hypothesis in the lab. We may replace a tantalum capacitor by another type of a capacitor or use DC/DC converters as suggested by you.