

## **Miniature Multi-Sensor Array for air quality measurement using drones or balloons.**

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### **Abstract:**

The miniature Multi-Sensor Array (mini-MSA) is a compact, flight ready, air quality sensor system under development for balloons and drones. Mini-MSA, version 1.0, had an external gas board designed specifically for this application. Signal noise was overwhelming the sensor signal. Sensor calibration was a challenge and assembly was difficult because the sensors were small. A new Winsen sensor board, model ZPHS01B, has become available that measures CO<sub>2</sub>, PM<sub>1.0</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>, CH<sub>2</sub>O, O<sub>3</sub>, CO, TVOC, NO<sub>2</sub>, temperature, and %RH. Preliminary tests show that the Winsen board has numerous calibration issues that we intend to correct using software. Using this already fabricated sensor system solves many of the problems encountered in mini-MSA version 1.0.

Mini-MSA, version 2.0, uses a Raspberry Pi to communicate with the ZPHS01B and we are adding a GPS. A separate power board has been designed and constructed to test the components. Mini-MSA version 2.1 will be built onto the existing power board PCB replacing the Raspberry Pi with a dedicated 16bit PIC microcontroller. This version will have a GPS, absolute pressure measurement, the Winsen sensor board, onboard data logging to a micro-SD card, and XBee radio for live telemetry. The goal is to have a robust assembly that is user friendly, lightweight, easy to build, and will cost approximately \$500. The Mini-MSA will be able to be deployed anywhere.

As part of preliminary testing, Northrup Grummen is working with high school students as beta-testers using four mini-MSAs to study automobile idling exhaust measurements at a school drop off site in Brigham City, UT.

A total of six Winsen multi-sensor assemblies were tested. These were compared to each other for consistency and with independent sensors both in the laboratory and colocated at Utah Division of Air Quality monitoring stations.