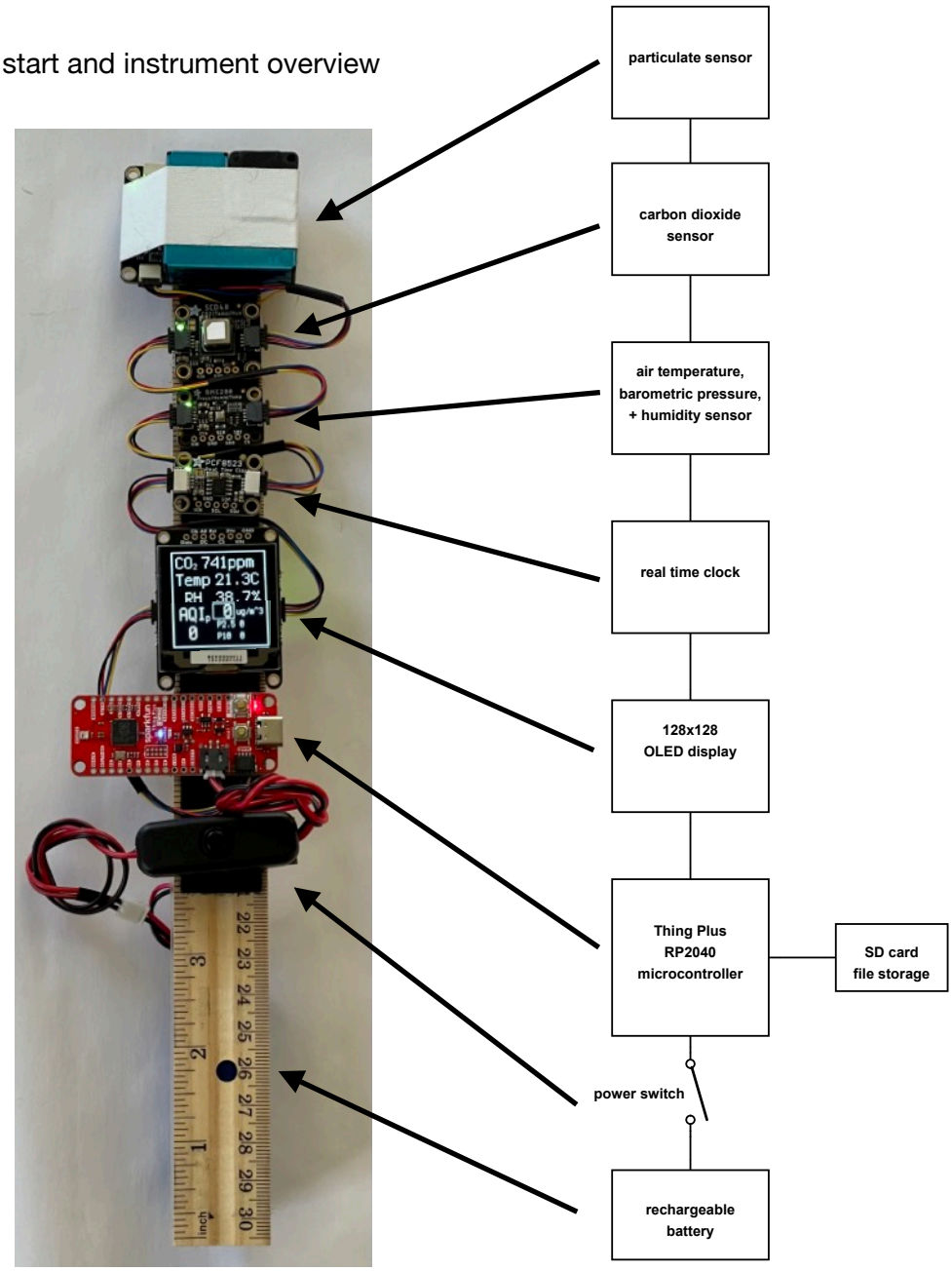
Section 1. Introduction

Hello and welcome to STELLA, Science and Technology Education for Land/ Life Assessment! STELLA is a science and engineering outreach program developed by NASA Landsat Science to promote scientific literacy through low-cost, easy to build instrumentation.

The STELLA-AQ instrument measures some parameters of Air Quality. This instrument can be assembled using off the shelf components and cables, without the need for soldering. Programming the instrument is a copy-paste operation, and the software is open source. The cost for the components that make up this instrument is approximately $200.

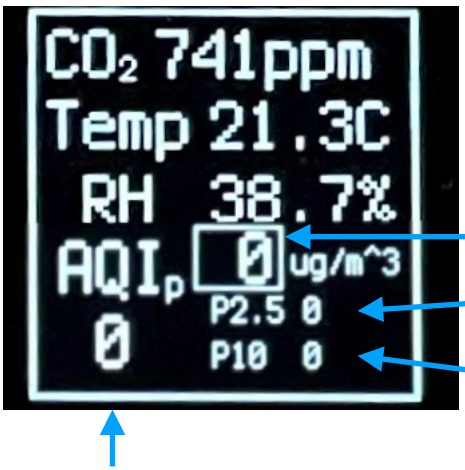
Section 2. Quick start and instrument overview



For this quick start section, we'll assume that you have a working instrument. For shopping, assembly, testing, and programming, jump to Section 3.

B. To power on the instrument, press the power switch (see the diagram above). It's a mechanical button, so it clicks once to turn on, and clicks again to turn it off. The software takes a few seconds to start up, and then shows some welcome screens that we'll describe shortly.

C. The main instrument screen shows a summary of the scientific data measured by the instrument.



carbon dioxide partial pressure in parts per million

air temperature in degrees Celsius

relative humidity in percent

record keeping batch number

2.5 micron size particle concentration in micrograms per meter cubed

10 micron size particle concentration in micrograms per meter cubed

Instantaneous Air Quality Index for particulates only (does not include ozone, carbon monoxide, sulfur dioxide, or nitrogen dioxide)

The instrument records the sensor readings, along with the date and time, the unique identification number of the instrument, and the record keeping batch number. These data are recorded as a line in the file named data.csv on the micro SD card.

D. The record keeping batch number is recorded with the sensor readings in the instrument datafile so that you can reference that number in your field notes for a given set of measurements. For example:

"Batch 0, indoors in a classroom with 10 people, windows open, doors closed."

The batch number increments by 1 each time you start the instrument on a given day. On the next day, the batch number restarts at 0. To change the batch number, turn the instrument off, and then turn it on again, so that the instrument increments the batch number.

E. On startup, the instrument shows two welcome screens, shown below:

Science and Technology Education for Land/ Life Assessment

Air Quality instrument

Unique identifier for this particular instrument

Instrument software version number

Date: YYY-MM-DD

Time: HH:MM:SS Z designates UTC time

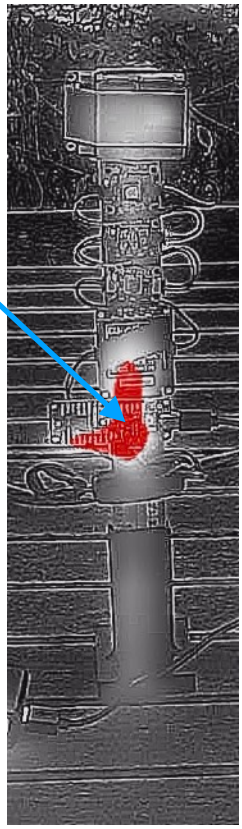
Record keeping batch number

Main battery state of charge, percent charged

Clock battery state of charge, OK or LOW
(Replace clock battery if LOW)

F. To set the real time clock, use the test code “06. real time clock interactive console” and follow the serial dialogue prompts. For step by step instructions, see section: 5D. Testing the devices by using the test codes.

G. To charge the battery, turn the instrument on, and then plug it into a computer or USB power supply. The small amber LED in the middle of the board will light while the battery is charging. If the LED is dim, or off, the battery is not charging. Unfortunately, the battery will not charge while the instrument is off. This compromise is a side-effect of building a device with connectors only, an assembly method that does not require soldering.



The sensors and display screen draw about 300mA, so the voltage regulator (between the 3.3V pin and the battery connector) will be warm to the touch. The 2200 mAh battery, the cylindrical kind, will provide 7 hours of use from a full charge. If you want to take data for longer periods of time, plug the instrument into a USB power supply. It takes about 5 hours to fully charge the battery. During charging, you can prolong the life of the display by disconnecting it at the Qwiic connector (which will also disconnect the downstream devices), while the processor remains on, connected to both the battery and the USB connection.

The clock battery should last for more than a year.

H. The instrument records data onto a micro SD card, which connects in a slot on the back of the microcontroller. Using any commercially available adapter, the micro SD card will show as a USB drive on your computer.
The main instrument data file is called “data.csv”. The instrument records a full line of sensor readings, along with the batch number and timestamps, once every second, to that file. The instrument also records a reduced data file named “AQ_reduced_data_ah_bp.csv”, where *a* is the duration in hours between the samples, and *b* is the number of samples that it averages to create the reading. The settings for the duration and number of samples is set in the file named “STELLA-AQ_reduce_config.txt”, which you can edit to change those settings.

The instrument uses a scratch file called “batch.txt” to track the batch number and date. There is no user settable data in that file.

I. Application notes for reliable operation.

Open air access to CO2, WX, and particulates.

Fan ports on the particulate detector.

Blinking power LEDs.