Intelligent Irrigation System for Low-cost Autonomous Water Control in Small-scale Agriculture

Intel-IrriS

Building the Intel-IrriS IoT platform
Part 1: soil sensor device

PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

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UNIVERSITÉ DE PAU ET DES PAYS DE L'ADOUR

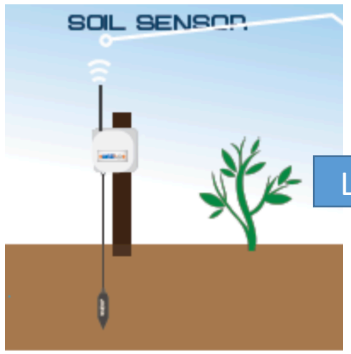
LIUPPA

WAZIup
IoT – from idea to reality
WAZIhub

Review: Technology components

Sensor part

Intel-IrriS



LPWAN

Control part

Embedded Database

Software updates

Embedded User Interface

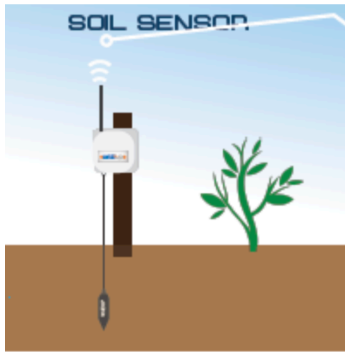
Wifi

SMS

Review: Low-cost sensors

Sensor part

Intel-IrriS



- Build on low-cost, low-power IoT expertise
- Increase accuracy of low-cost sensors by automatic and remotely controlled procedures for advanced calibration
- Enable deployment of several complementary low-cost sensors
- Include agricultural models / knowledge with corrective & predictive analytics

Review: Smart embedded control

- Build on low-cost embedded & open IoT gateway expertise
- Implement the “Intelligent Irrigation in-the-box” with "plug-&-sense" approach
- Model complex water-soil-plant interaction
- Embed Decision Support System (DSS) and disruptive Artificial Intelligence (AI)
- Integration of various knowledge streams
- Fully autonomous

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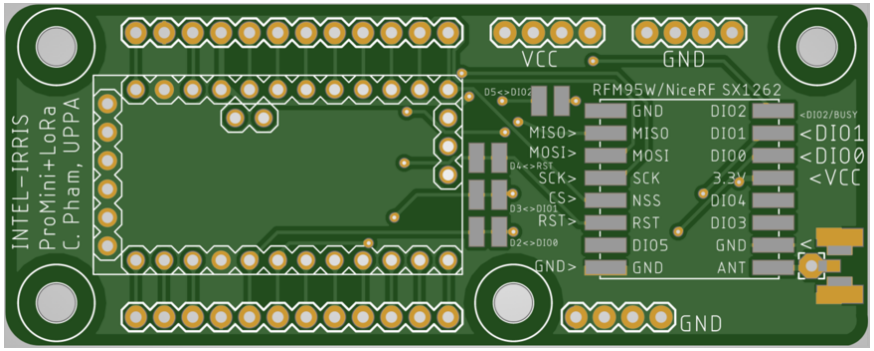
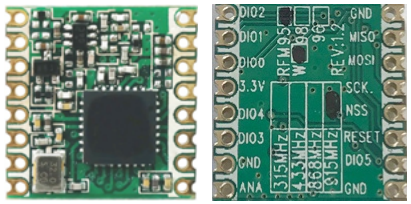
Review: Starter-kits

- "Intelligent Irrigation in-the-box", "plug-&-sense"
- At least 100 starter-kit will be distributed

Soil sensor: electronic parts

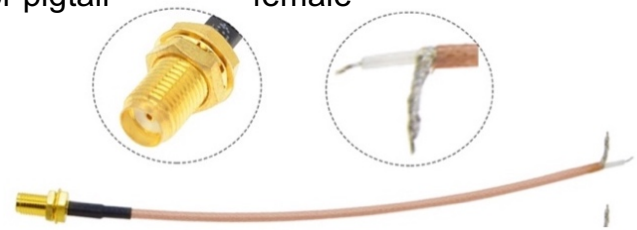


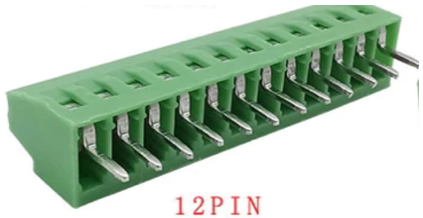


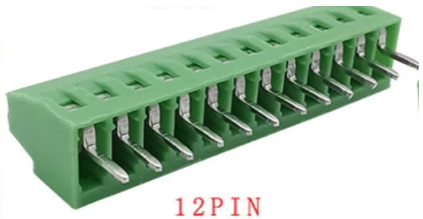
RFM95W (868MHz)
RFM96W (433MHz)
NiceRF SX1262 (868MHz)
NiceRF SX1268 (433MHz)

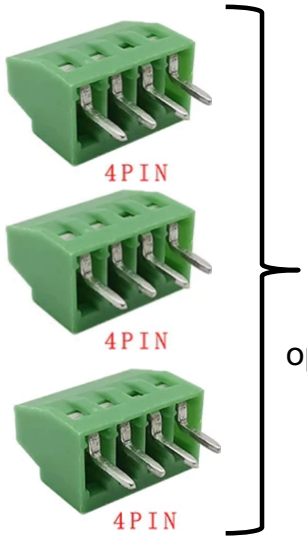
PCB mount
or pigtail

SMA
female







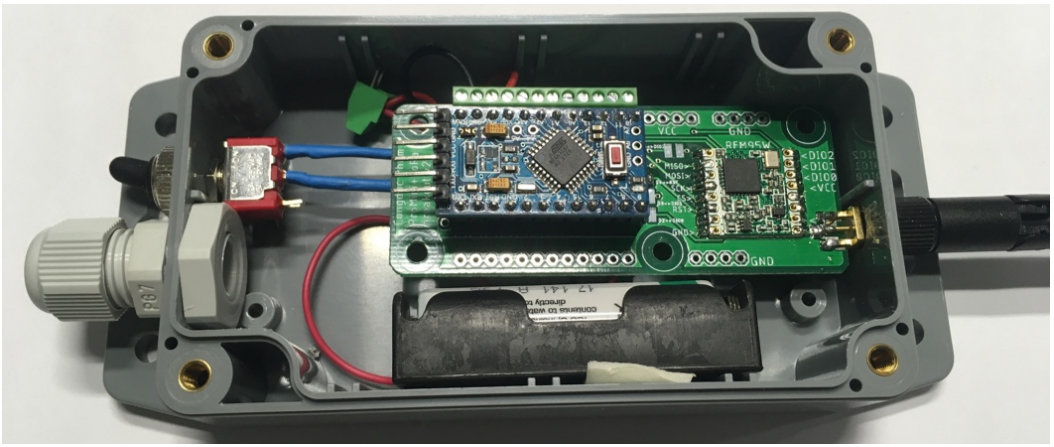


optional

SMA
male

Soil sensor: casing parts & integration

proof-of-concept



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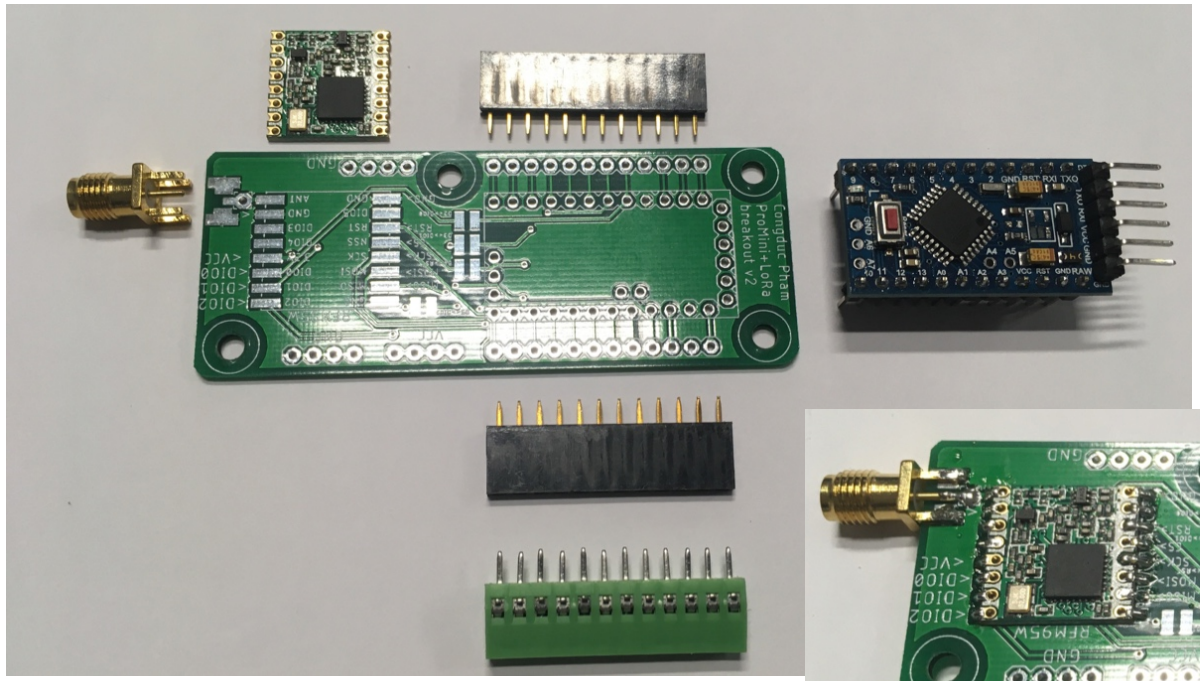
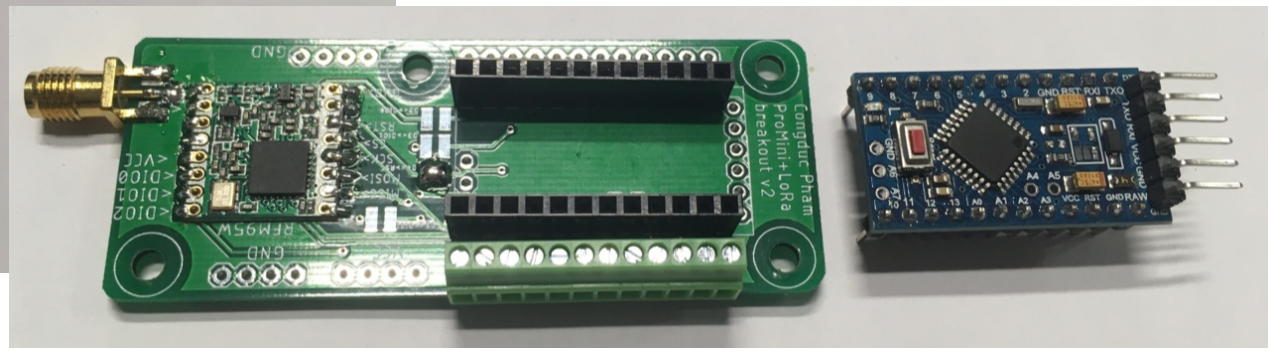
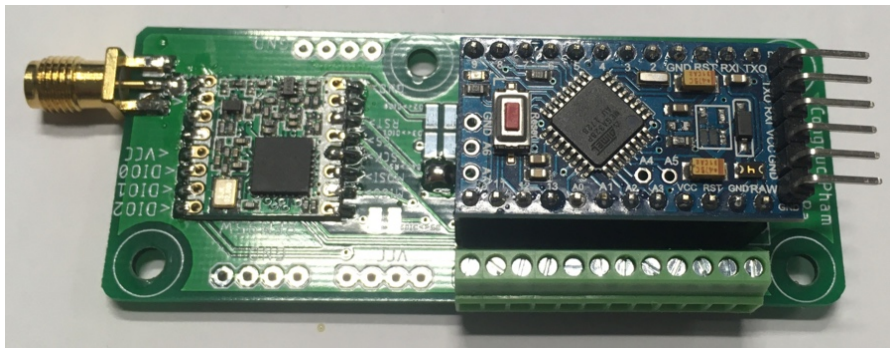
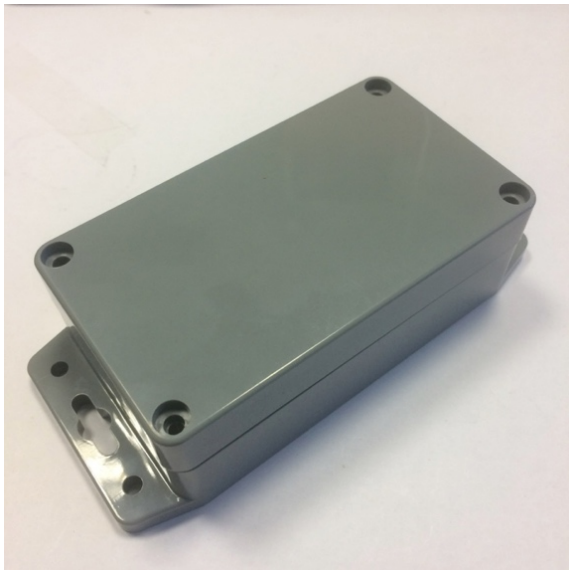
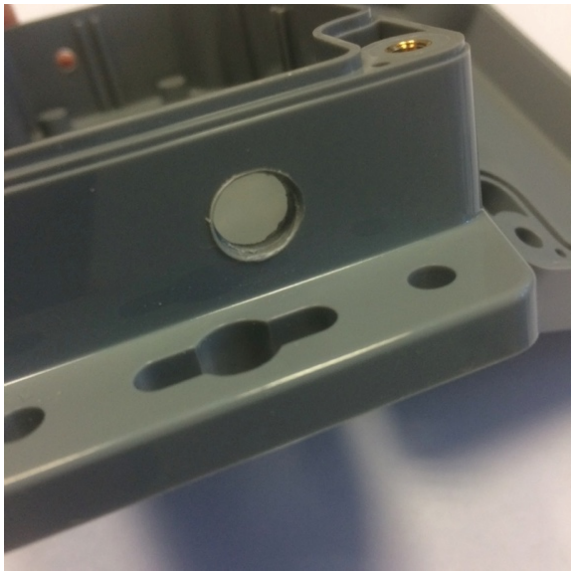
Assembling PCB board







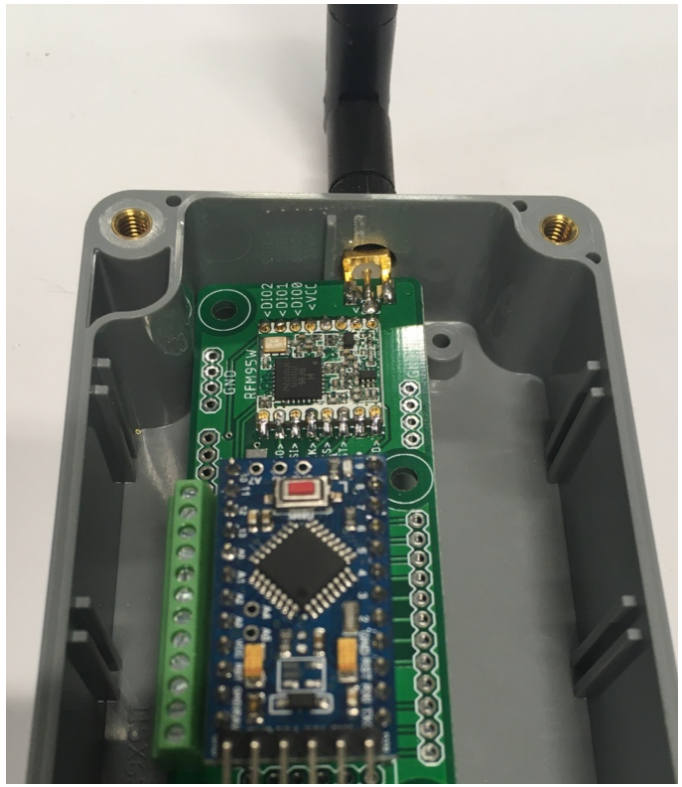
Get a case for outdoor usage

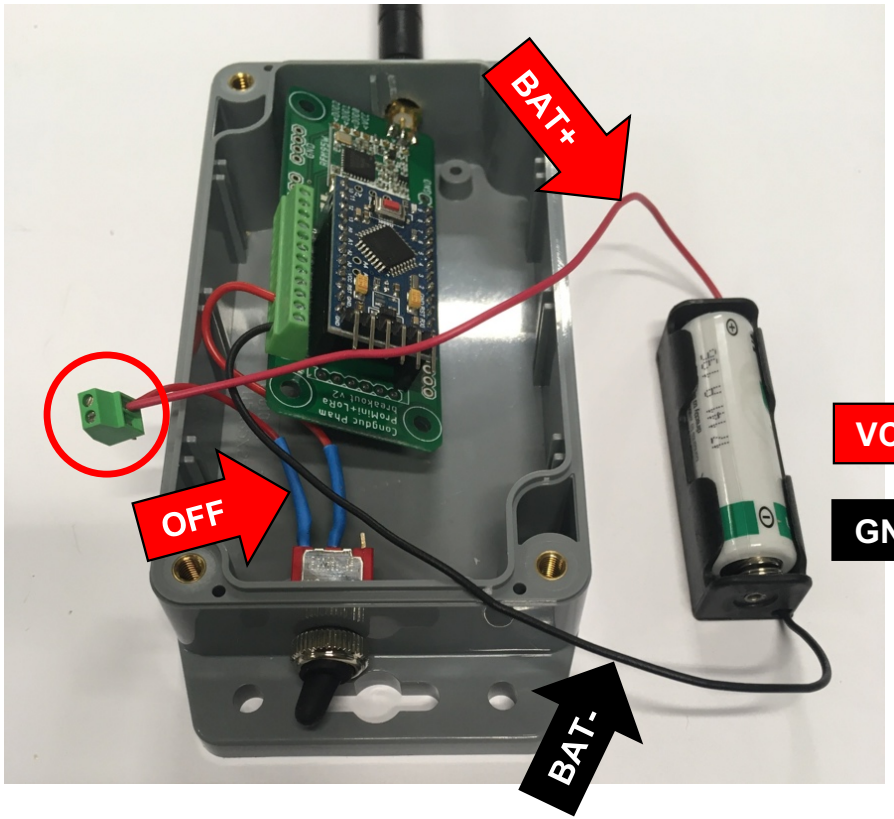



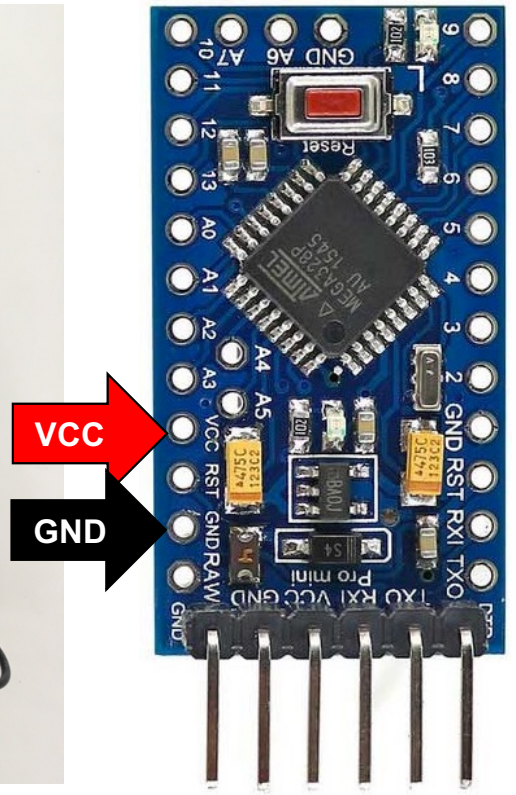

Here, it is an IP65 box which dimension is 115 x 65 x 40mm.

First, drill a 7mm hole for the SMA female connector.

Installing the PCB board

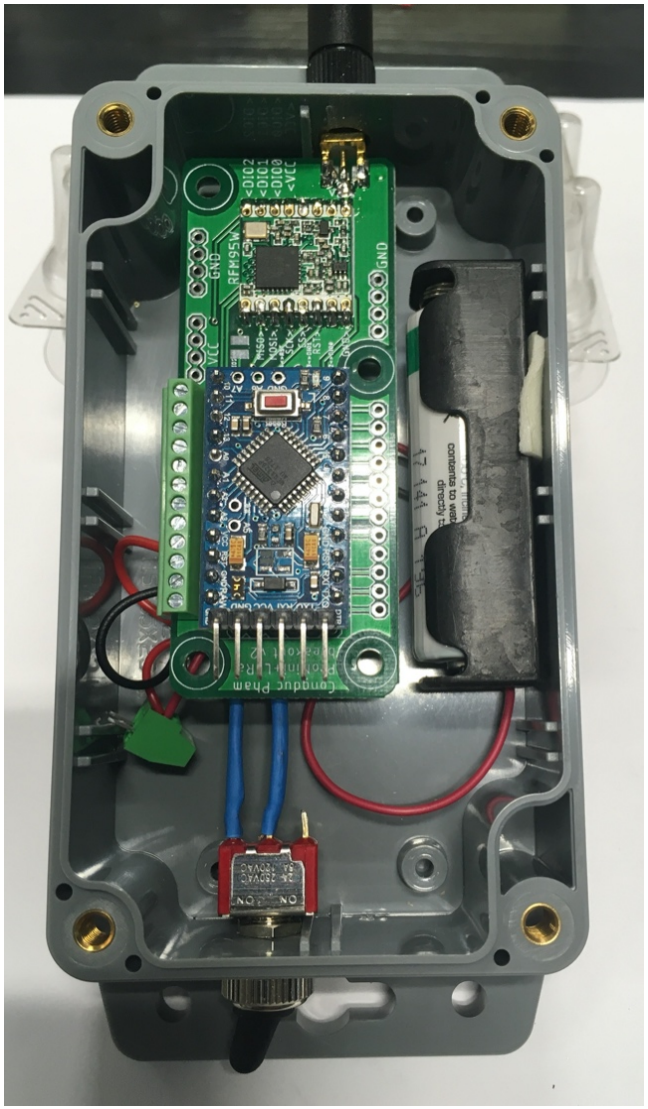






Connect together switch "off" pin (left) with BAT +
Connect switch "on" pin (middle) to board's VCC
Connect BAT – to board(s GND
Toggling the switch will then power the board

Putting it altogether



Here we use a 1xAA battery pack
Fix the battery pack with double-side tape
e.g. those used to fix mirrors on wall
Then we use a 3.6V Lithium battery

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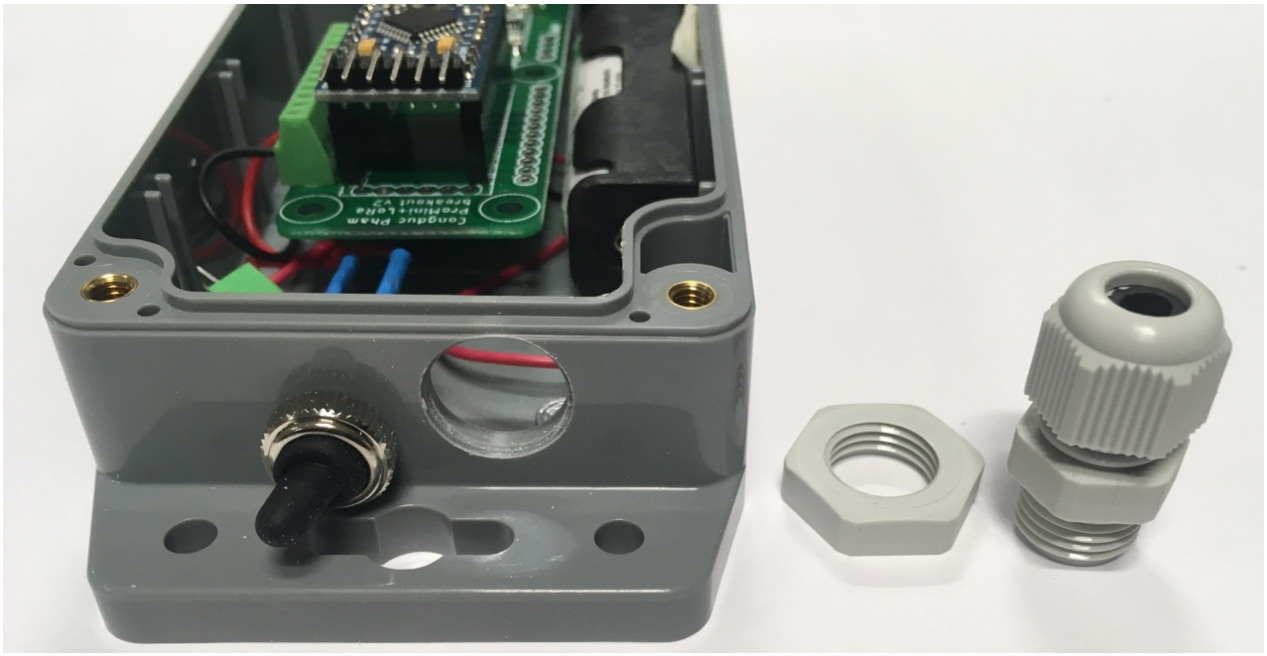
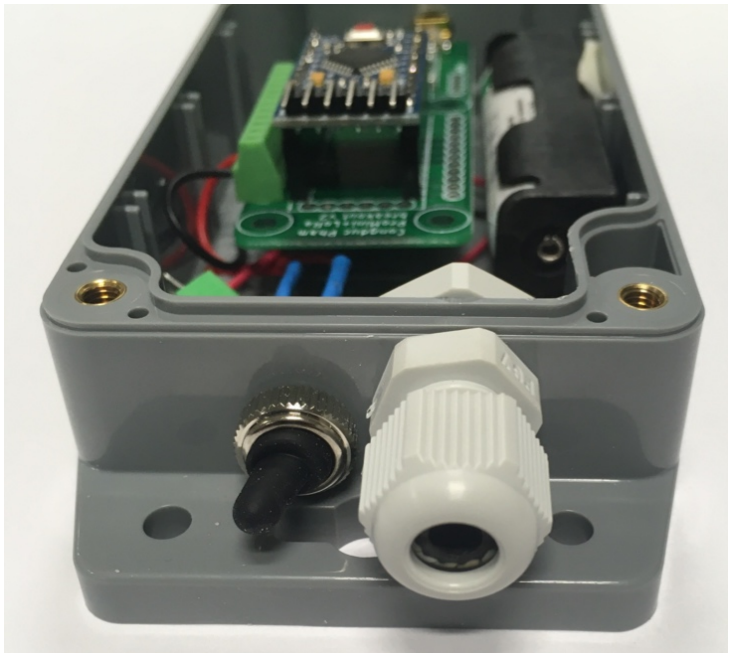
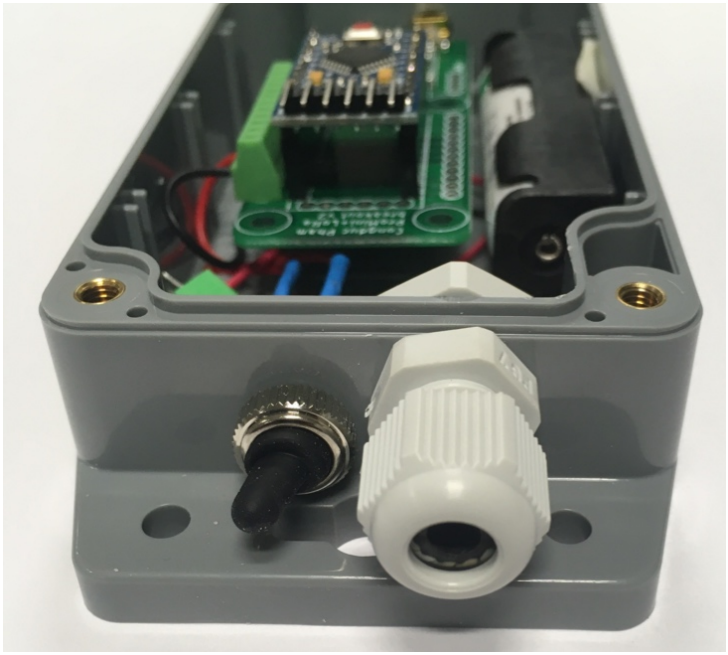
Installing your own cable gland

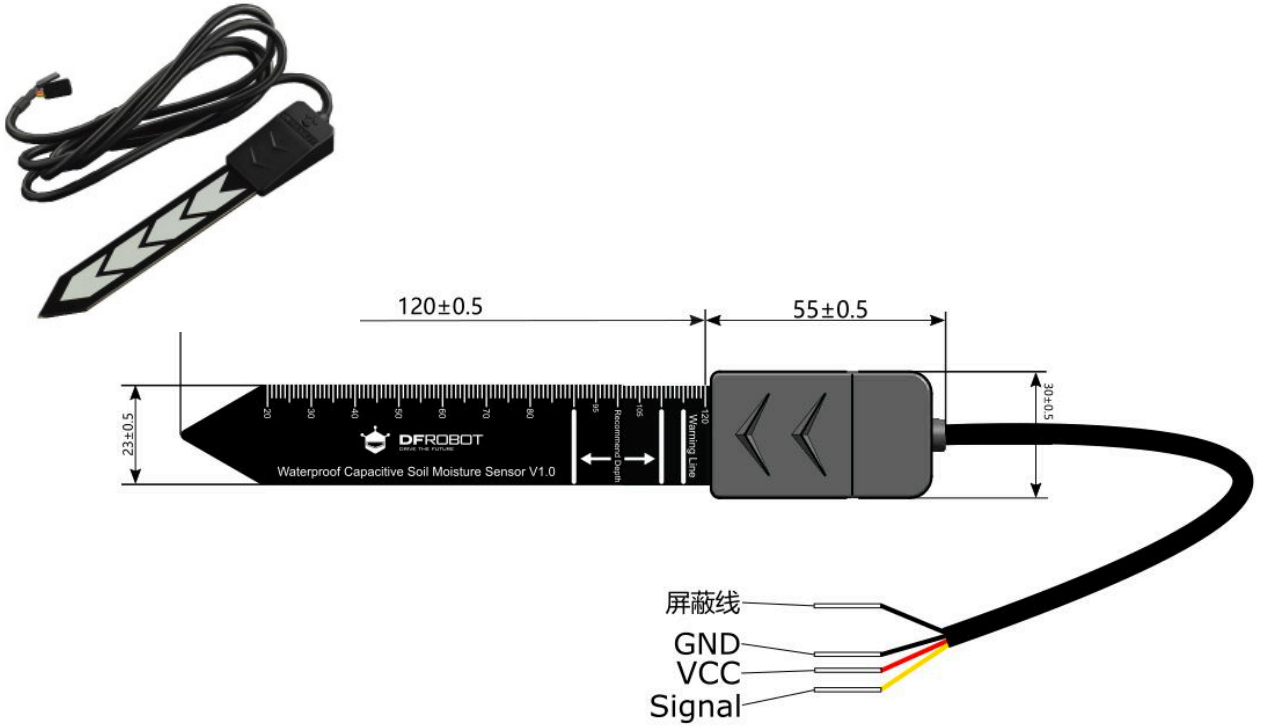




- Drill a hole depending on the gland diameter
- Here PG7, 12mm, so a hole of 13mm

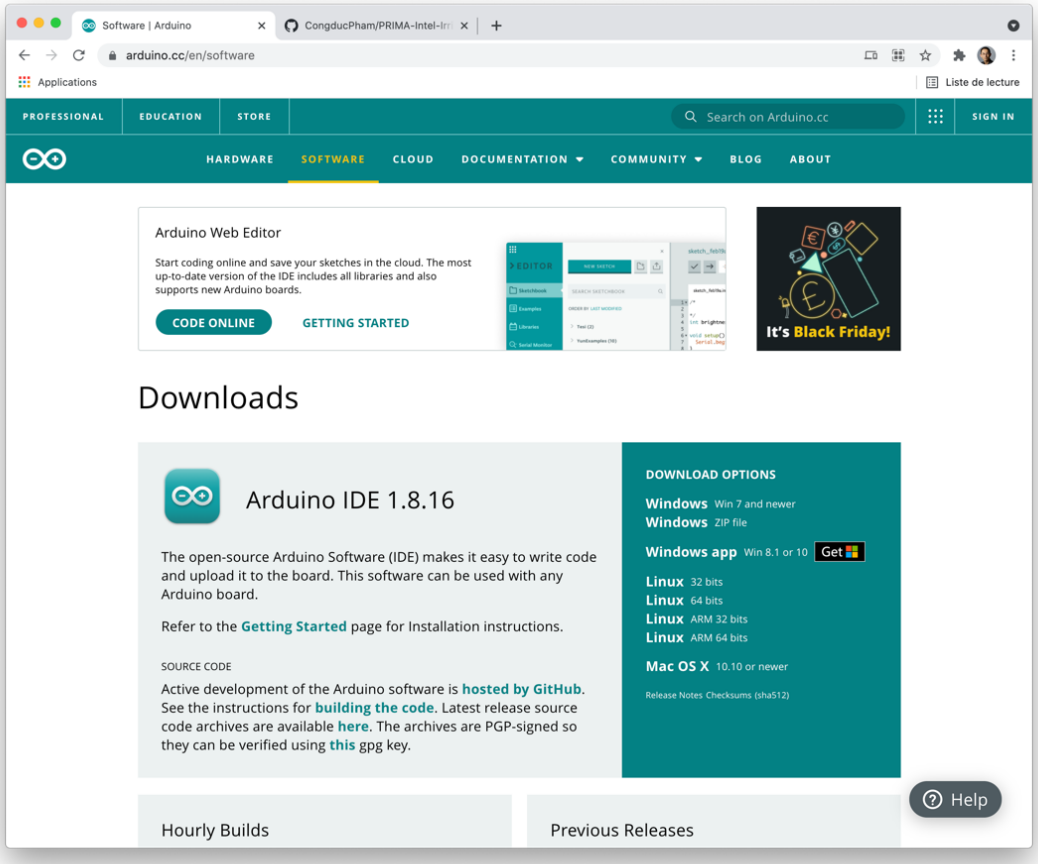
Last step: connect the SEN0308

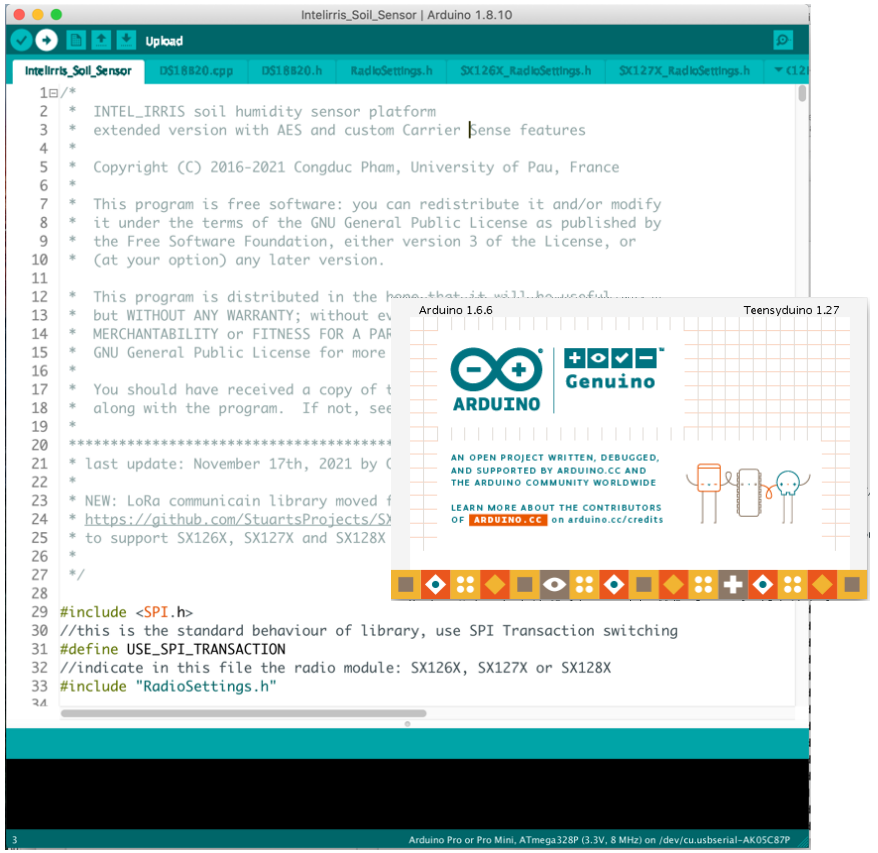




Insert sensor's wire through cable gland
Connect SEN0308 wires to board:
- **VCC to board's A1**
- **GND to board's GND**
- **Signal to board's A0**

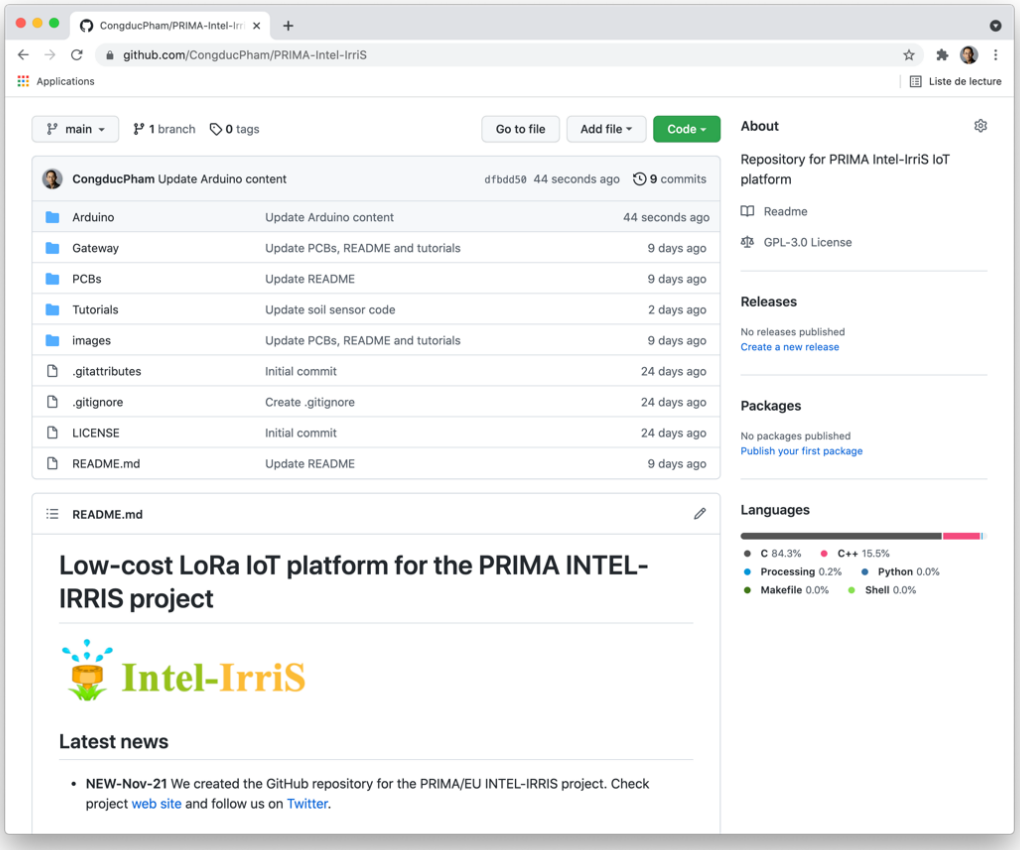
Getting the software: Arduino IDE





Install latest version of Arduino IDE from
https://www.arduino.cc/en/software

Getting the software: Intel-IrriS code



On your computer, create a `sketch` folder

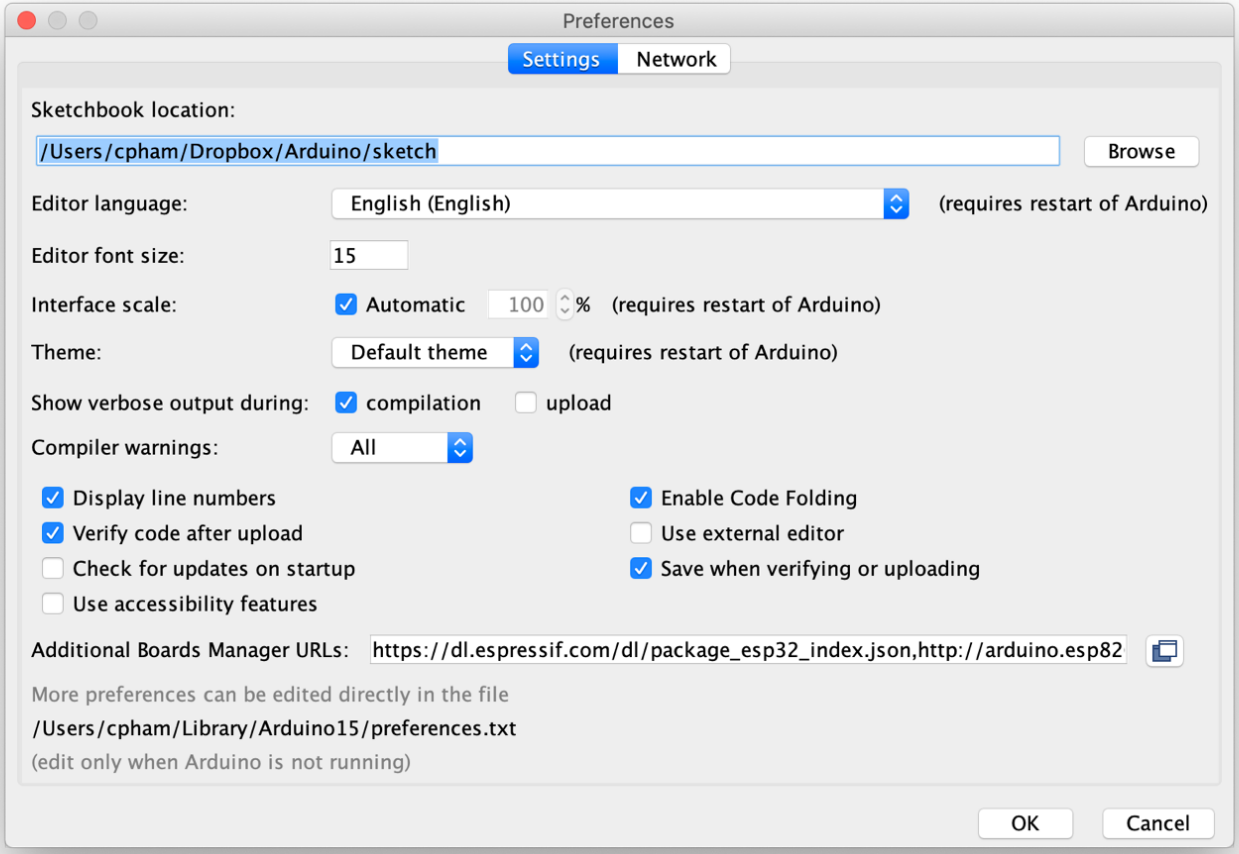
Then download the whole repository as ZIP file

Unzip the file and copy the whole `Arduino` folder into your `sketch` folder

The entire Intel-IrriS GitHub repository is hosted here
https://github.com/CongducPham/PRIMA-Intel-IrriS

GitHub

Setting your Arduino IDE



Run Arduino IDE, open Preferences
Indicate your `sketch` folder in Sketchbook location

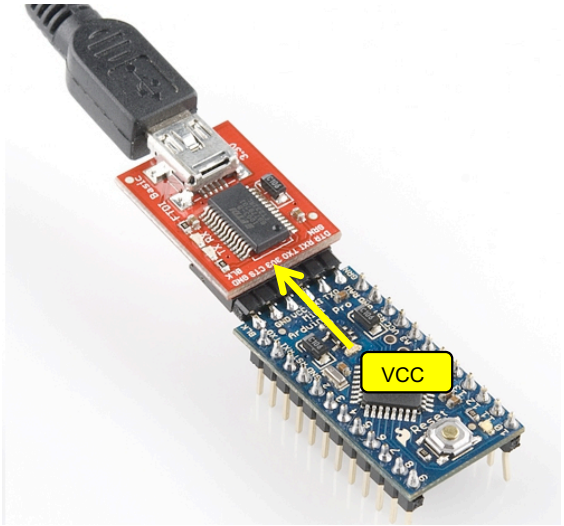
Compiling the soil sensor code

Open the Intelirris_Soil_Sensor sketch

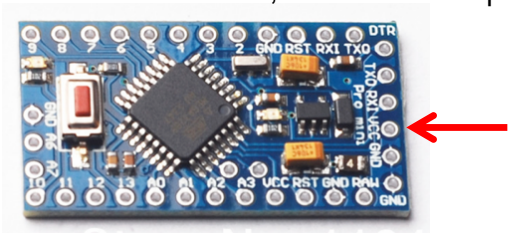
Select the ProMini board, 3.3V and 8MHz version

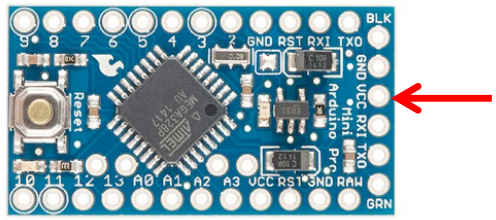
Then click on the "verify" button

Connecting with an FTDI cable

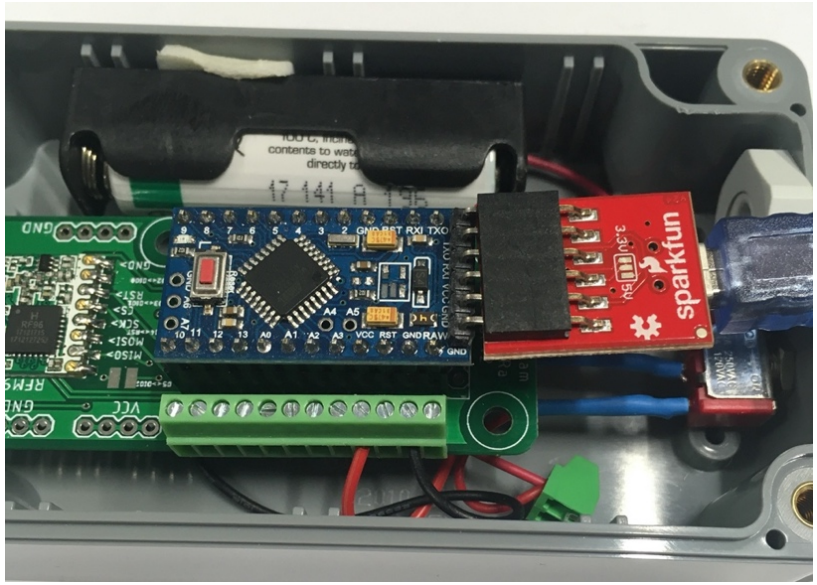


Some clone version, check the VCC pin





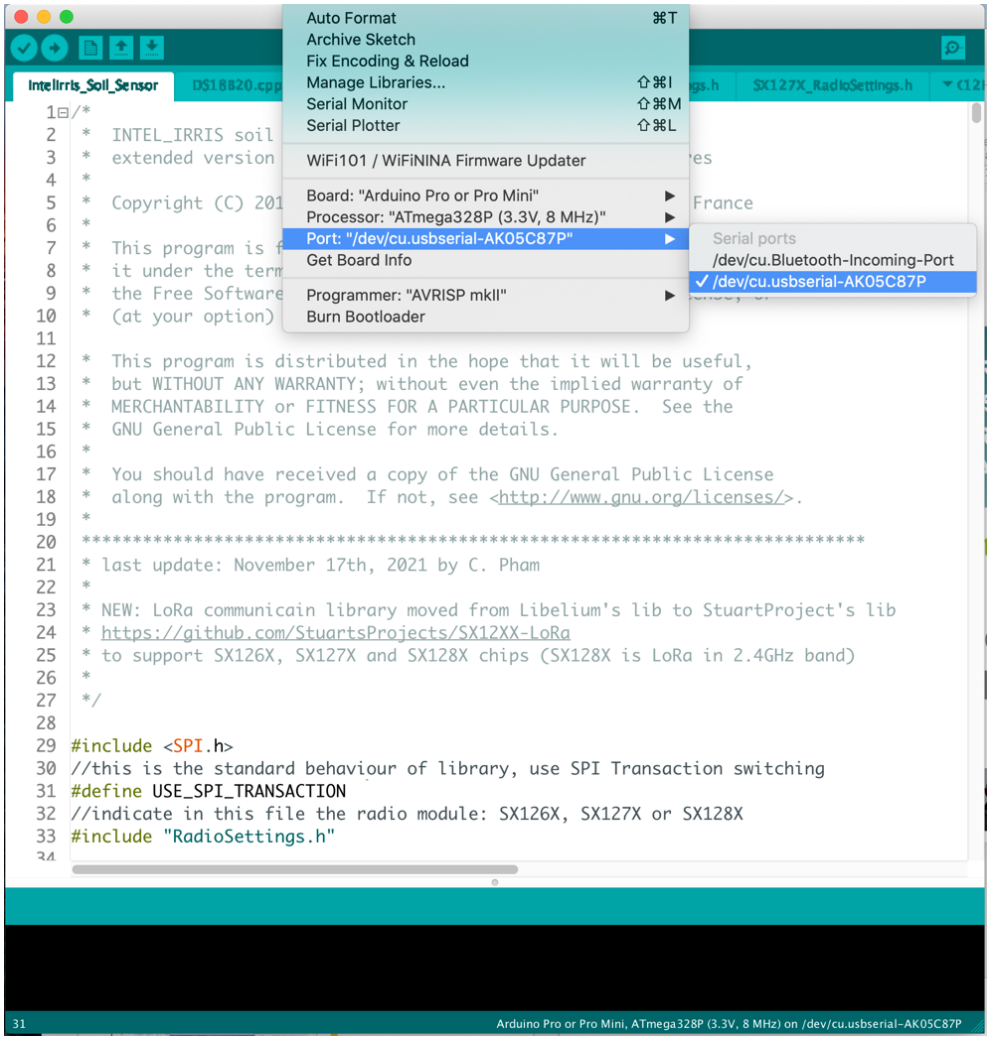
Original Sparkfun version



For the ProMini, you need to have an FTDI breakout cable working at 3.3v

Check the VCC pin position and make it to correspond to the VCC pin of the FTDI breakout.

Select serial port for uploading



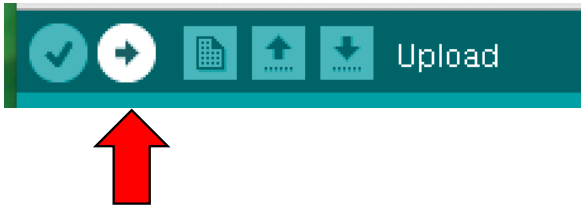
After connecting the cable to your computer/laptop USB port, try to find the serial port

If you don't find it, you may need to install specific drivers

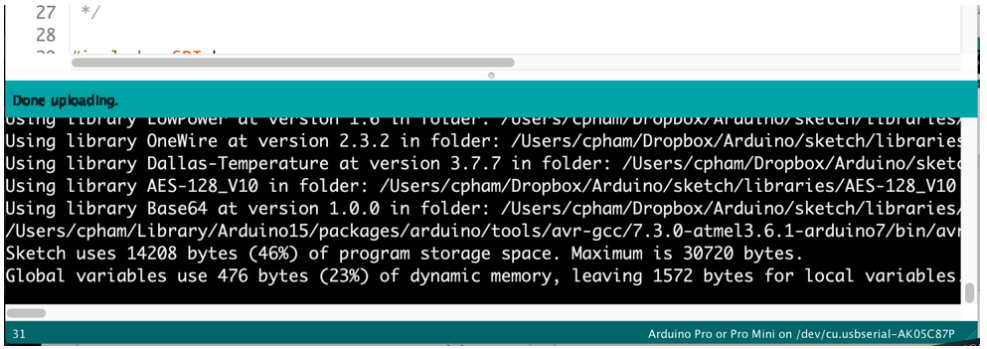
https://learn.sparkfun.com/tutorials/how-to-install-ch340-drivers/all

Uploading to your board

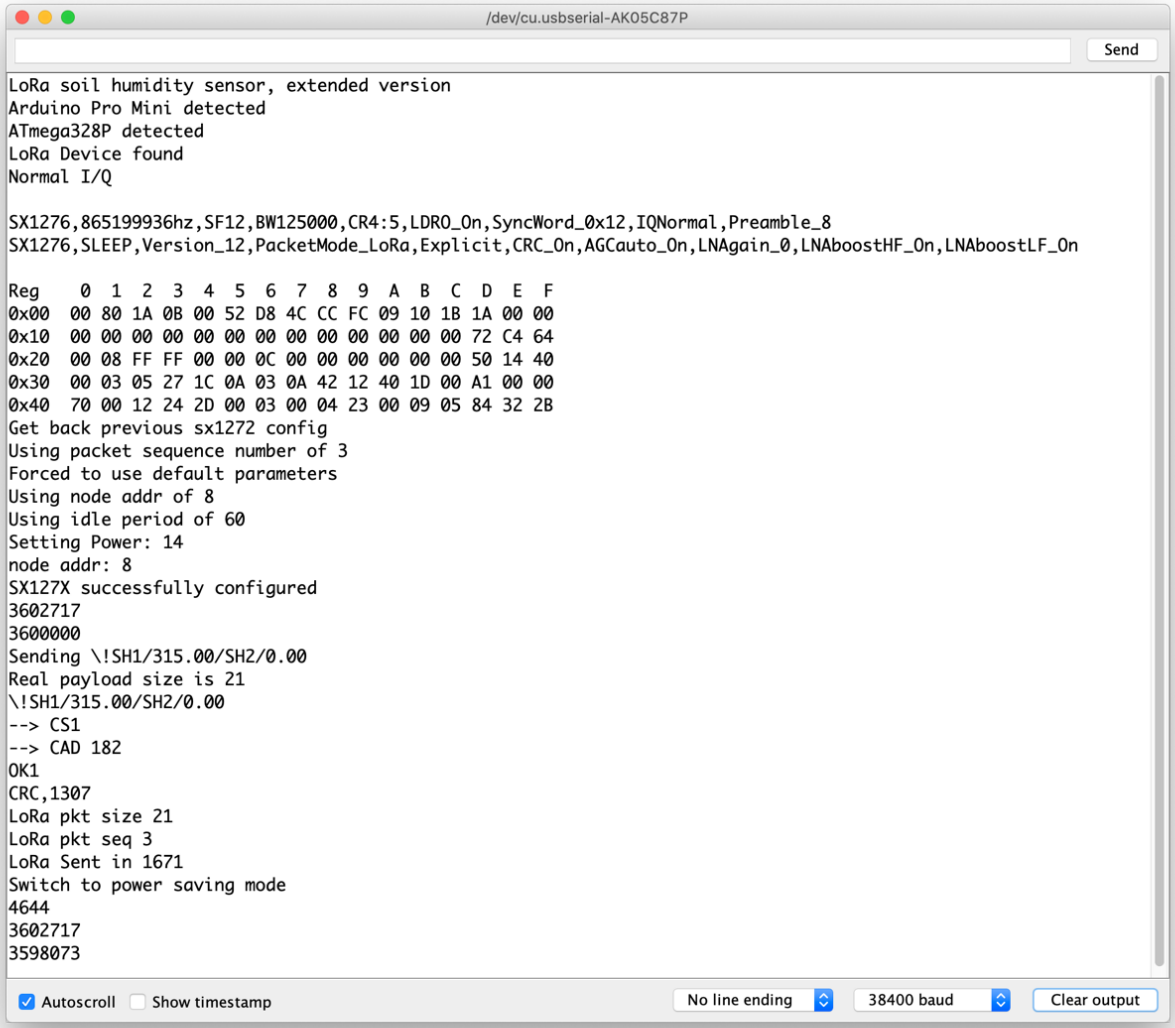
Click on the "upload" button



And wait until upload is completed



Checking that device is operational

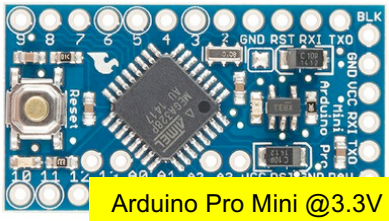


- Open serial monitor
- Set baud rate to 38400
- See output from board
- Check that transmission is OK

Generic & cyclic behavior

2 soil sensors can be attached

Physical sensor management



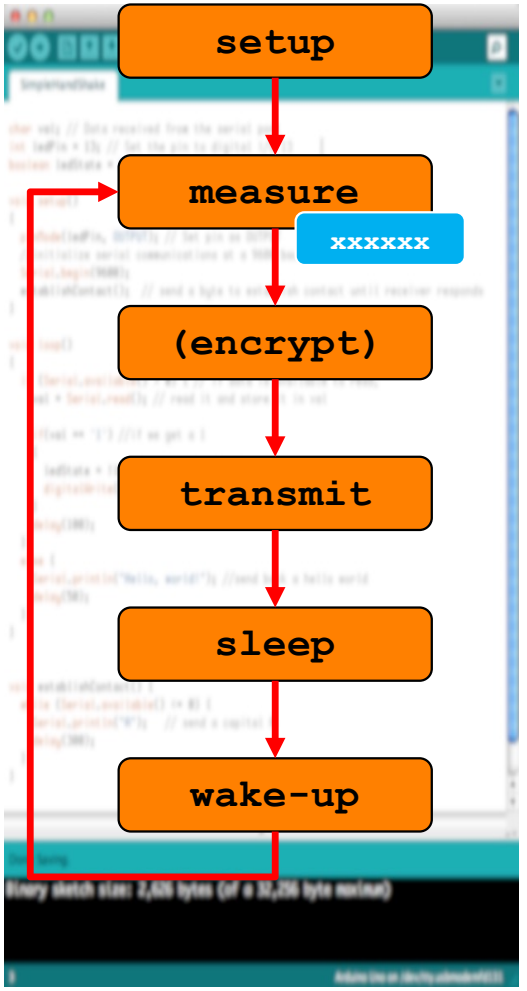
Arduino Pro Mini @3.3V

Activity duty-cycle, low power

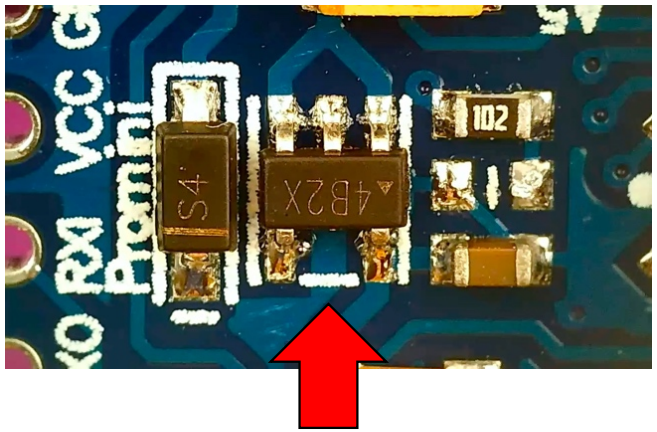
AES encryption

Long-range transmission

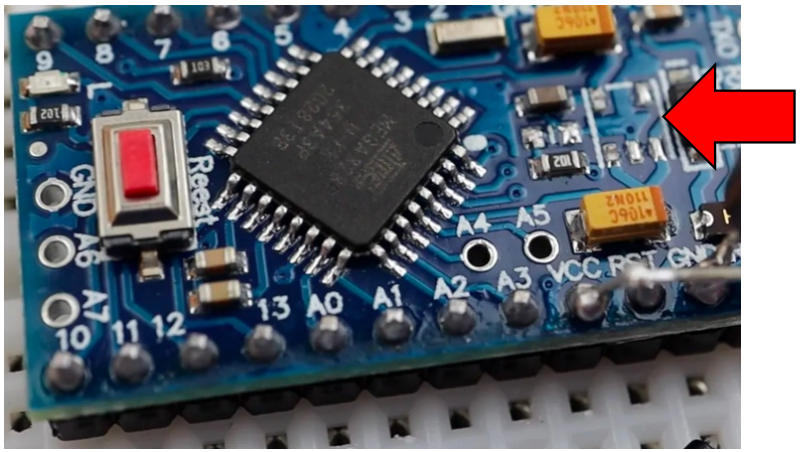
Logical sensor management



Reducing power consumption

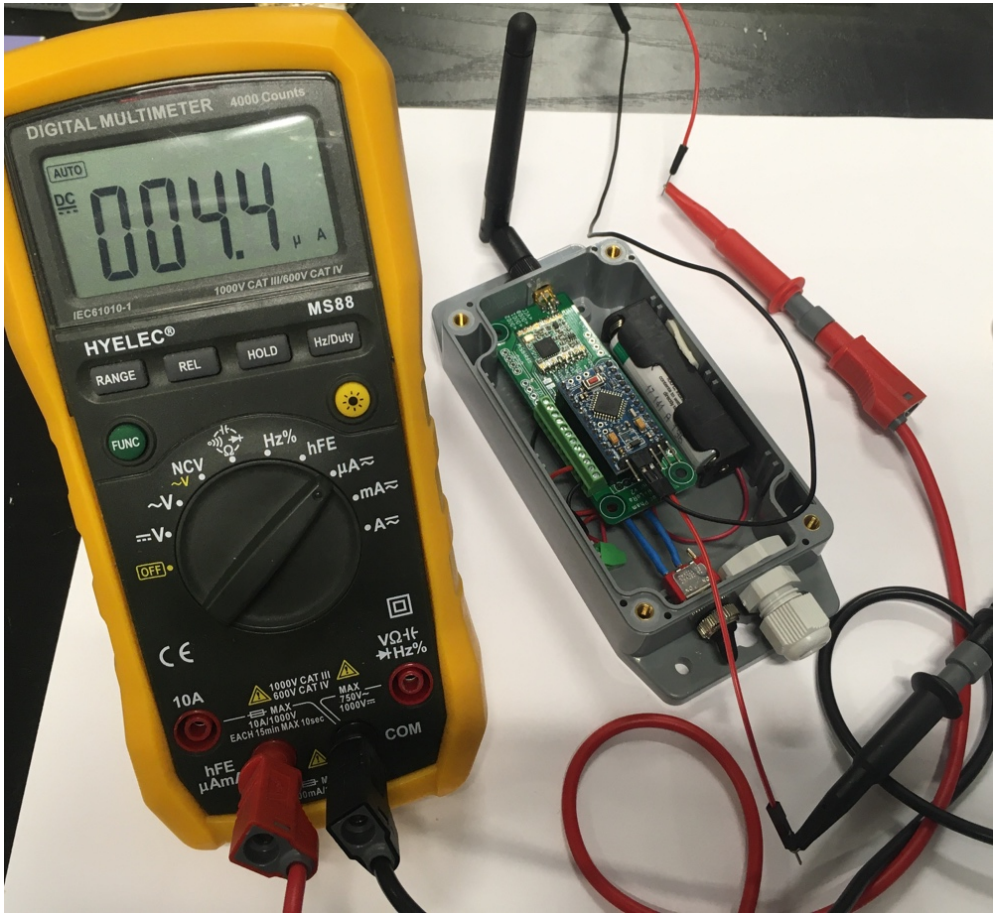


- Remove the power LED by just clipping it off with some wire cutters
- Remove the voltage regulator with a small plier
- Only inject up to 3.6V through the VCC pin
- 5uA in deep sleep mode



https://www.the-diy-life.com/making-an-ultra-low-power-arduino-pro/

Power consumption deep sleep



Measured below 5uA in deep sleep, between 2 active periods with transmissions

Expected autonomy with 1 transmission / hour:

over 2 years with either 2 AA batteries or 1 AA 3.6V Lithium battery