

# Erasmus+

EU programme for education, training, youth and sport



Research & innovAtive Development International Offices  
networking for upscaling research capacities and  
encouragement of multidisciplinary studies

## Erasmus+ Enriching lives, opening minds

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# Training & Capacity Building with UPPA's Generic Sensor Platform



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networking for upscaling research capacities  
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IN RESPONSE TO THE GROWING SOCIETAL DEMANDS FOR UNIVERSITIES TO ACTIVELY ADDRESS CRUCIAL ISSUES LIKE CLIMATE CHANGE, THE RADIO PROJECT EMERGES AS A POWERFUL CATALYST FOR TRANSFORMATIVE CHANGE. THROUGH THE ESTABLISHMENT OF REINFORCEMENT OF RESEARCH AND DEVELOPMENT INTERNATIONAL OFFICES (RIOS) ACROSS SIX PARTNER UNIVERSITIES, RADIO CULTIVATES AN ENVIRONMENT WHERE ACADEMICS AND STUDENTS COLLABORATE TO TRANSLATE KNOWLEDGE INTO IMPACTFUL SOLUTIONS. BY ESTABLISHING A DYNAMIC MULTIDISCIPLINARY RESEARCH HUB ENCOMPASSING THE FIELDS OF BIOLOGY, PLANNING, AGRICULTURE AND ENGINEERING, RADIO AIMS TO DELIVER INNOVATIVE SOLUTIONS THAT TRANSCEND TRADITIONAL DISCIPLINARY BOUNDARIES. ULTIMATELY, RADIO STANDS AS A TESTAMENT TO THE POWER OF COLLABORATIVE, MULTIDISCIPLINARY RESEARCH IN EMPOWERING UNIVERSITIES TO BECOME POTENT FORCES FOR POSITIVE CHANGE IN THE PURSUIT OF A MORE SUSTAINABLE FUTURE.

### DELIVERABLES OBJECTIVES

- ACADEMIC Collaboration
- INDUSTRIAL Collaboration
- RESEARCHERS TRAINING
- SPECIALIZED DIGITIZATION
- ENHANCED PUBLICATION
- KNOWLEDGE TRANSFER



### PROJECT PARTNERS



GRANTING AUTHORITY: EUROPEAN EDUCATION AND CULTURE EXECUTIVE AGENCY - PROJECT NUMBER: 1011291958 - NOV 2024 - 2027



# Online Arduino & Sensor tutorial

- ◉ <https://cpham.perso.univ-pau.fr/LORA/HUBIQUITOUS/solution-lab/arduino-lora-tutorial>

The screenshot shows a web browser displaying an online tutorial for connecting a DS18B20 digital temperature sensor to an Arduino. The page has a dark theme and a sidebar menu on the left with categories like Introduction, Microcontrollers, Arduino IDE, Sensors, and Advanced boards. The 'Sensors' category is expanded to show 'Digital DS18B20'. The main content area features a wiring diagram of an Arduino Uno with a DS18B20 sensor connected to pin 2. A 4.7KΩ pull-up resistor is connected between the sensor's data pin and the 5V supply. Below the diagram is a 'Code example' section with the following code:

```
/*  
 * DS18B20 temperature sensor tester  
 * https://create.arduino.cc/projecthub/TheGadgetBoy/ds18b20-digital-temperature-sensor-and-arduino  
 *  
 */  
  
// First we include the libraries  
#include <OneWire.h>  
#include <DallasTemperature.h>  
  
// Data wire is plugged into pin 2 on the Arduino
```

Prof. Congduc Pham  
<http://www.univ-pau.fr/~cpham>



# Discover the Arduino ecosystem

- Understand microcontrollers & their architecture
- Discover the most advanced boards with WiFi capabilities
- Get to know how to program microcontrollers with Arduino IDE
- Then, step-by-step tutorial on connecting various sensors

Prof. Congduc Pham  
http://www.univ-pau.fr/~cpham

**INTRODUCTION TO ARDUINO IDE**

The Arduino IDE (Integrated Development Environment) is used to write the computer code and upload this code to the physical board. The Arduino IDE is very simple and this simplicity is probably one of the main reason Arduino became so popular. We can certainly state that being compatible with the Arduino IDE is now one of the main requirements for a new microcontroller board. Over the years, many useful features have been added to the Arduino IDE and you can now managed third-party libraries and boards from the IDE, and still keep the simplicity of programming the board. The main window of the Arduino IDE is shown below, with the simple simple Blink example.

Upload button

Serial Monitor button

Compilation button

```
sketch_new01a $
1 // Blink example
2 // Turns an LED on for one second, then off for one second, repeatedly.
3
4 // Most Arduino boards have an on-board LED you can control. On the Uno, it is attached to
5 // digital pin 13.
6 //
7 //
8 // the setup function runs once when you press reset or power the board
9 void setup()
10 {
11   pinMode(LED_BUILTIN, OUTPUT); // initialize digital pin LED_BUILTIN as an output.
12 }
13
14 // the loop function runs over and over again forever
15 void loop()
16 {
17   digitalWrite(LED_BUILTIN, HIGH); // turn the LED on (HIGH is the voltage level)
18   delay(1000); // wait for a second
19   digitalWrite(LED_BUILTIN, LOW); // turn the LED off by making the voltage LOW
20   delay(1000); // wait for a second
21 }
```

## Navigate and read:

- Introduction
- Microcontrollers
- Arduino IDE
  - Introduction to Ardui...
  - Adding new libraries

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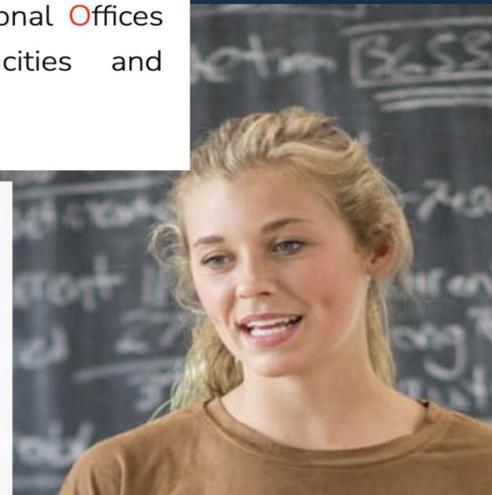


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# LAB ACTIVITY



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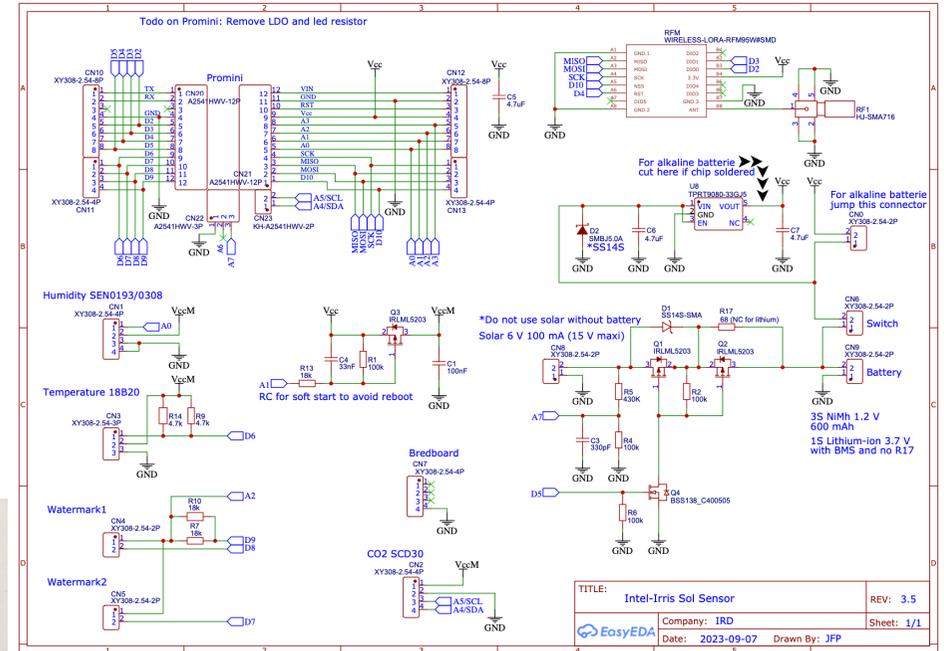
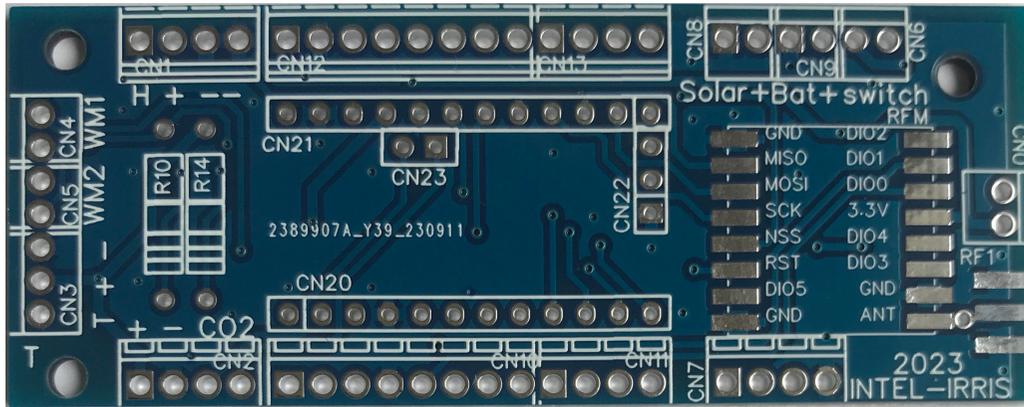
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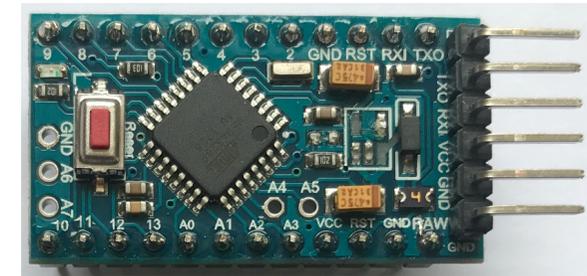
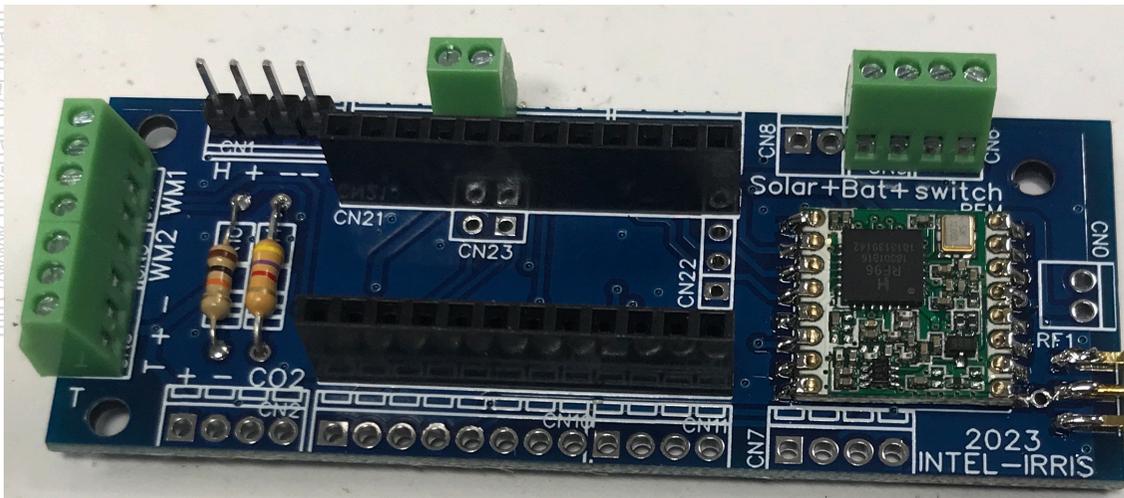


# The IRD PCB v4 (raw version)



Prof. Congduc Pham

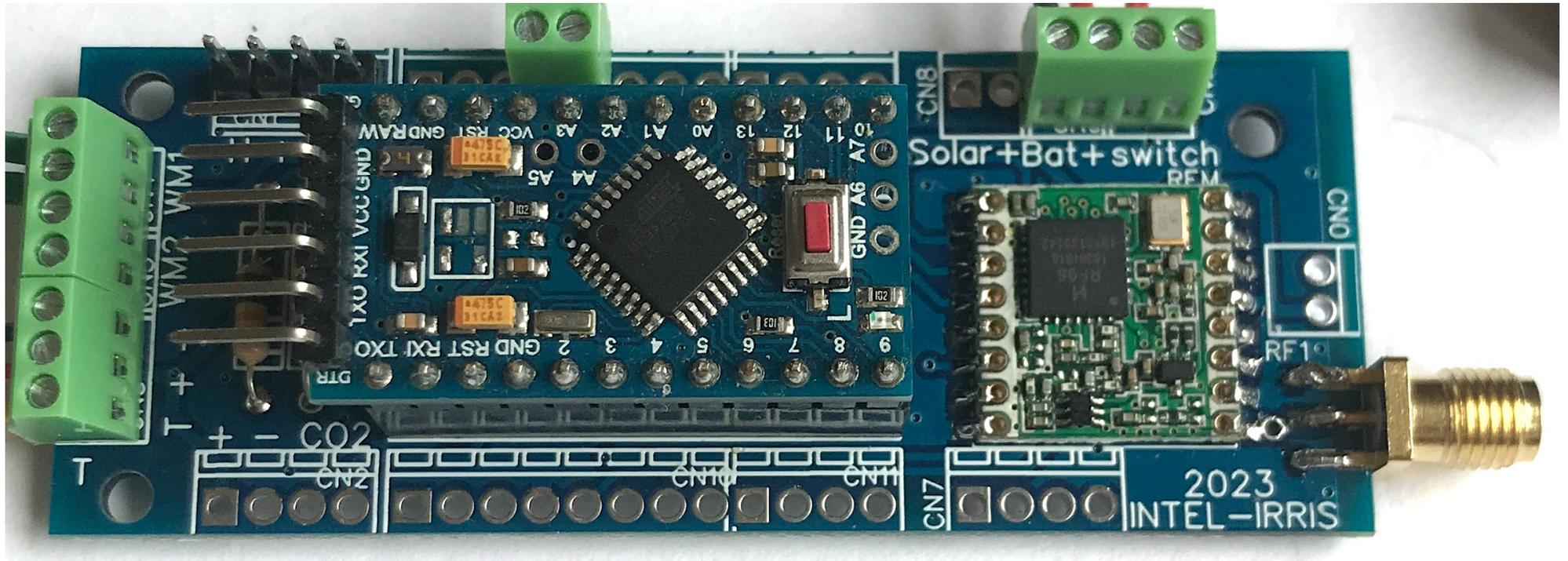
http://www.univ-nantes.fr/~cnbam



Arduino Pro Mini

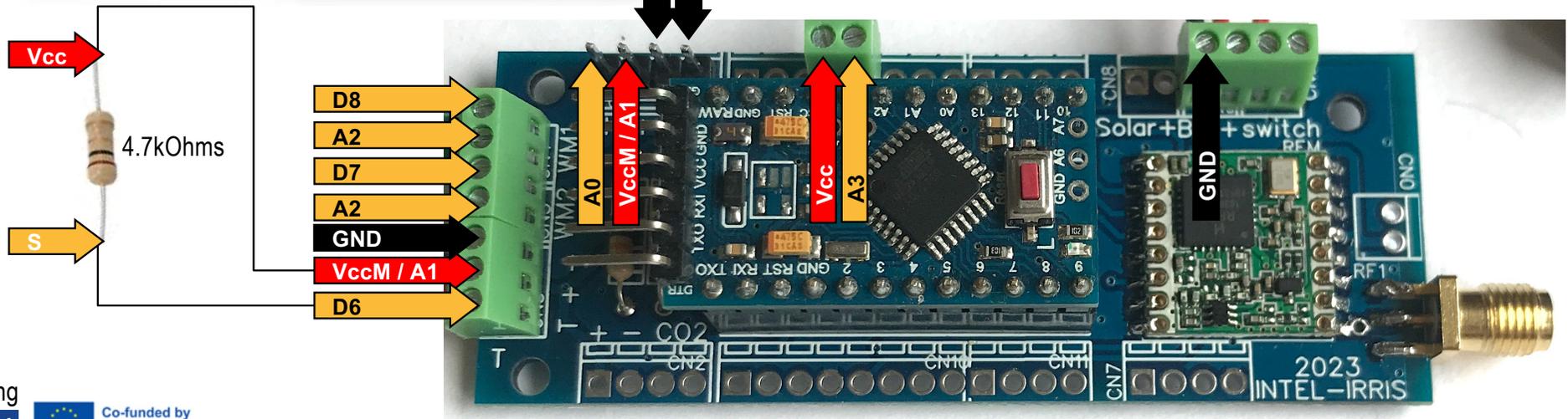
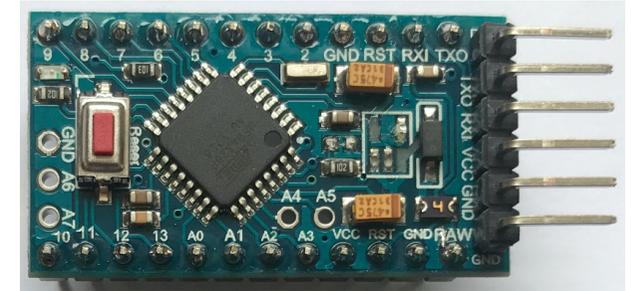
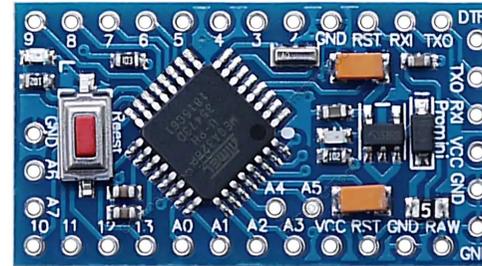
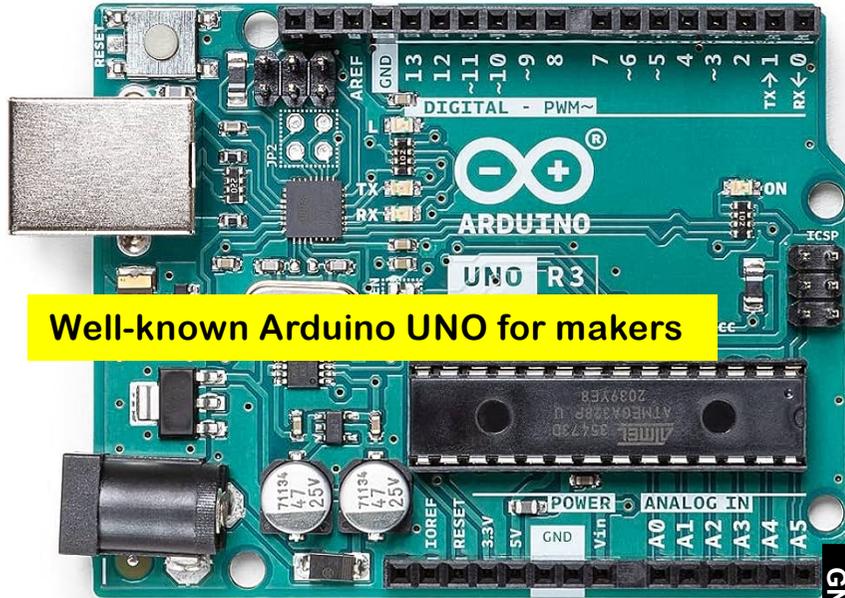


# The IRD PCB v4: close-up view



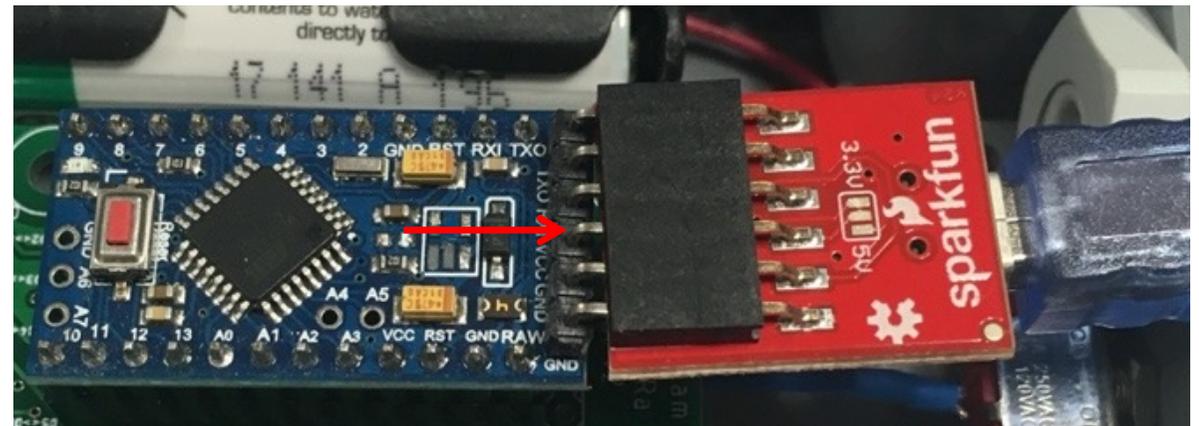
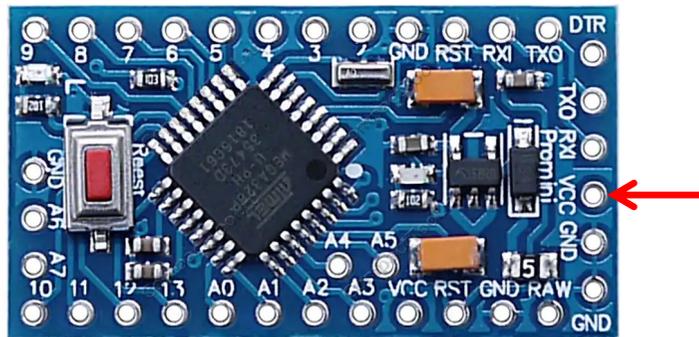
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# Arduino pins exposed on the PCB



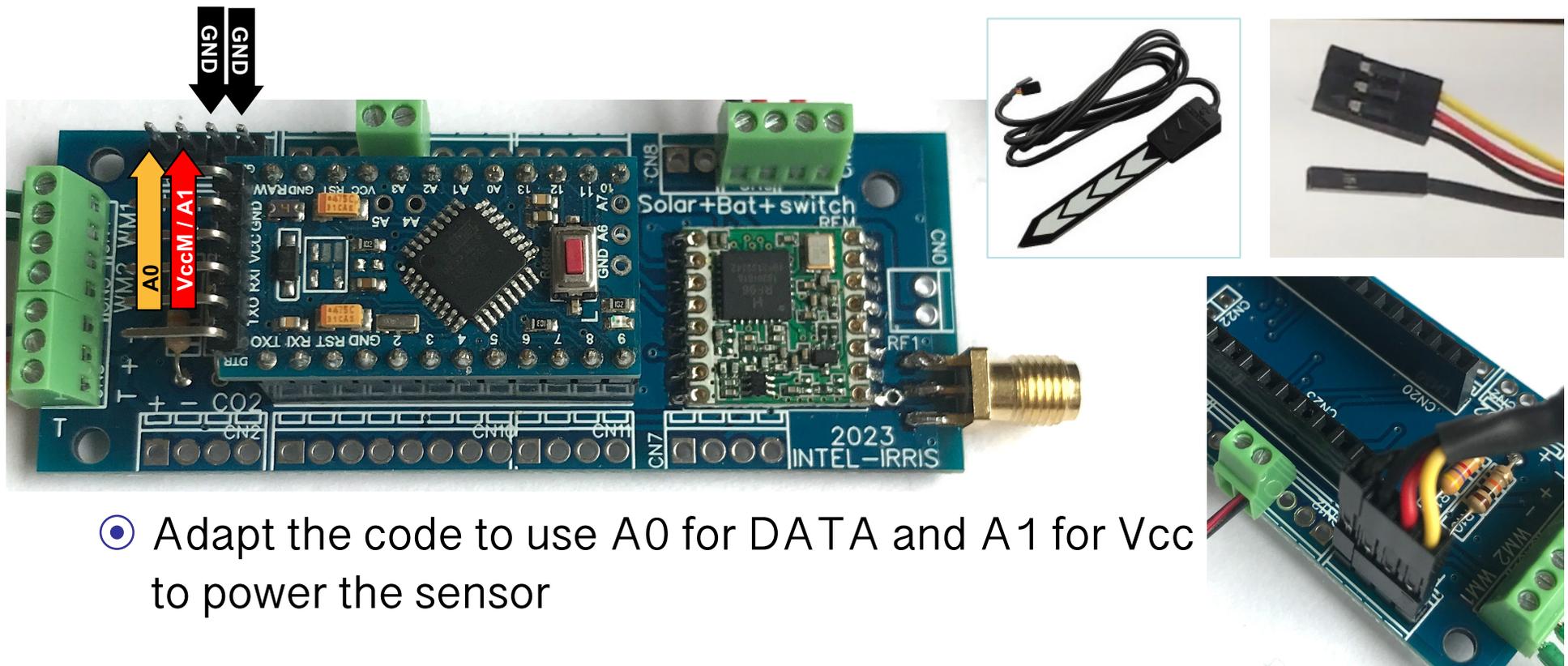
# Programming the microcontroller

Most Chinese clone version,  
check the VCC pin



# 1<sup>st</sup> example: read from analog

- <https://cpham.perso.univ-pau.fr/LORA/HUBIQUITOUS/solution-lab/arduino-lora-tutorial/sensors/humidity/soil-humidity/>

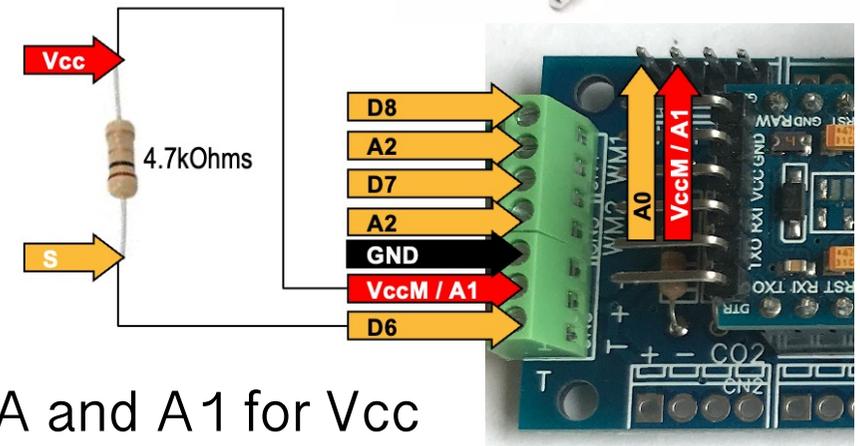
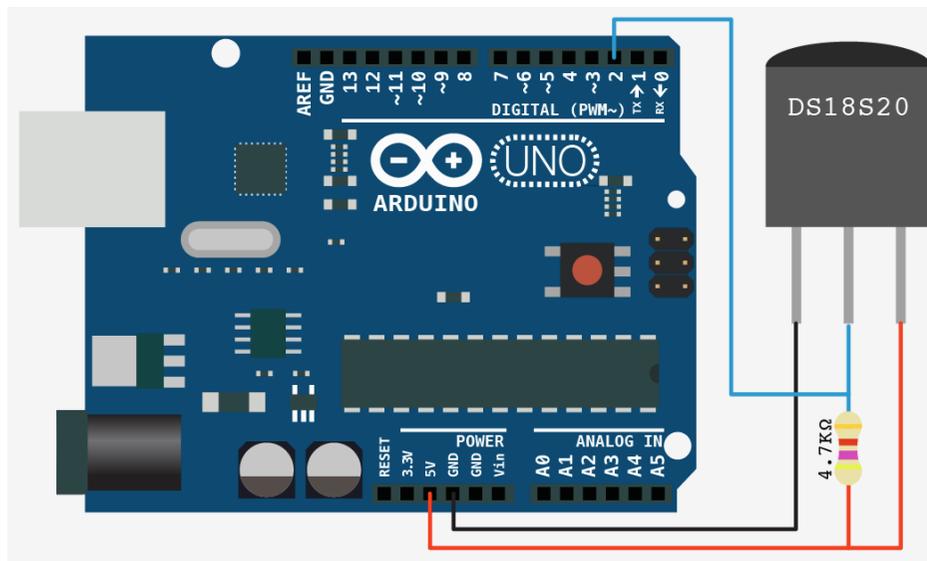


- Adapt the code to use A0 for DATA and A1 for Vcc to power the sensor



# 2<sup>nd</sup> example: read from digital, 1-wire

- <https://cpham.perso.univ-pau.fr/LORA/HUBIQUITOUS/solution-lab/arduino-lora-tutorial/sensors/temperature/ds18b20/>
- Use a digital temperature sensor DS18B20



- Adapt the code to use D6 for DATA and A1 for Vcc to power the sensor



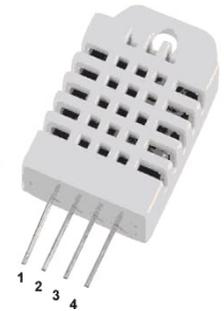
# Connecting DS18B20 in image



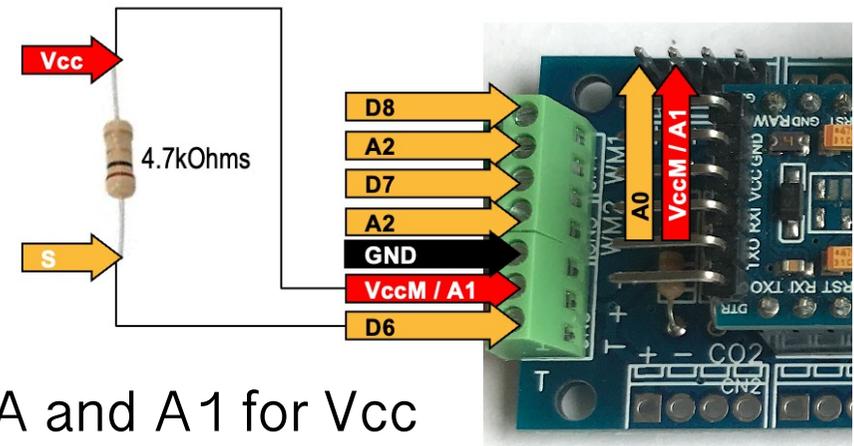
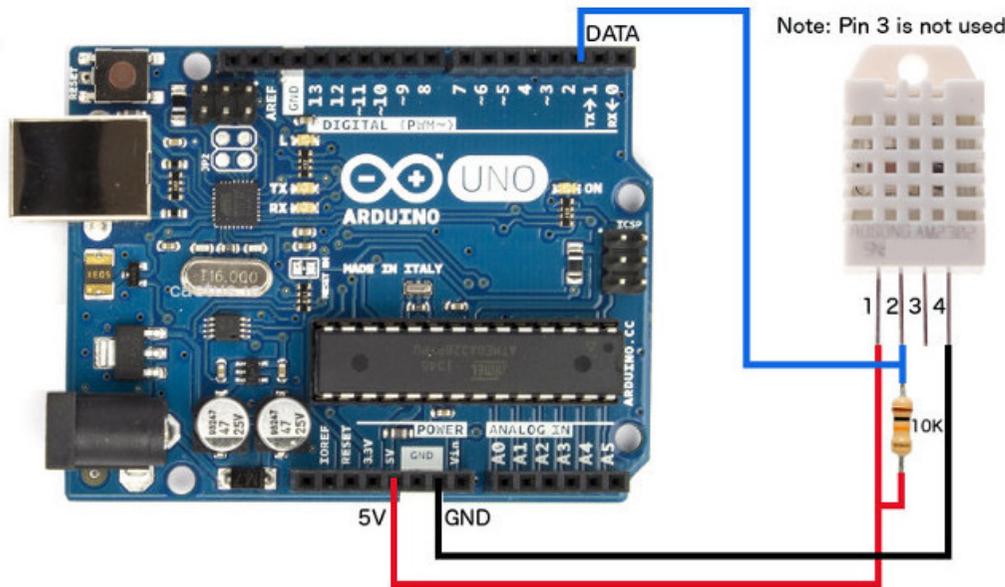
# 3rd example: read from digital DHT22

- DHT22: combined temperature & humidity sensor
- [https://cpham.perso.univ-pau.fr/LORA/HUBIQUITOUS/solution-lab/arduino-lora-tutorial/sensors/temp\\_hum/dht22/](https://cpham.perso.univ-pau.fr/LORA/HUBIQUITOUS/solution-lab/arduino-lora-tutorial/sensors/temp_hum/dht22/)

DHT22 pins	
1	VCC
2	DATA
3	NC
4	GND



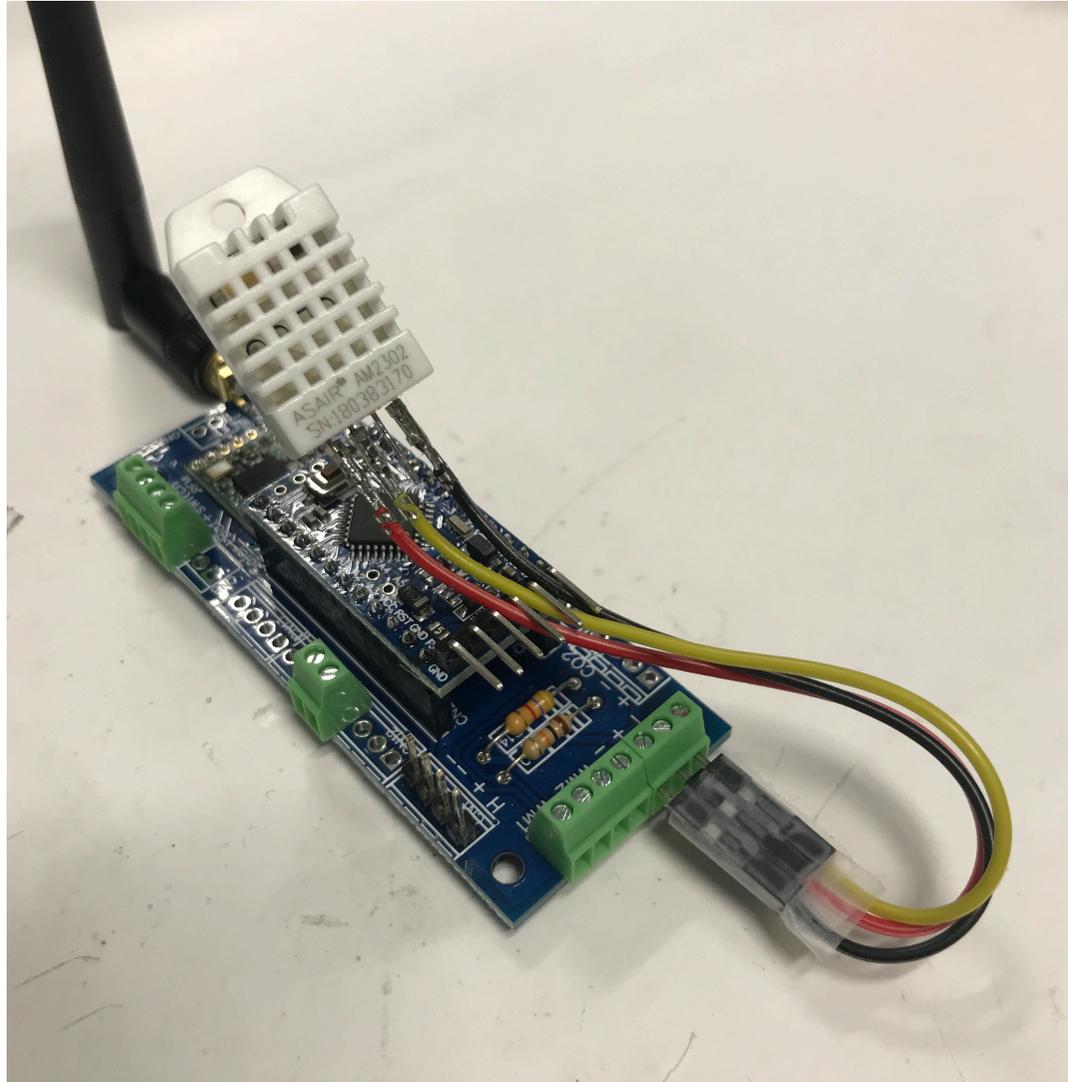
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- Adapt the code to use D6 for DATA and A1 for Vcc to power the sensor



# Connecting DHT22 in image



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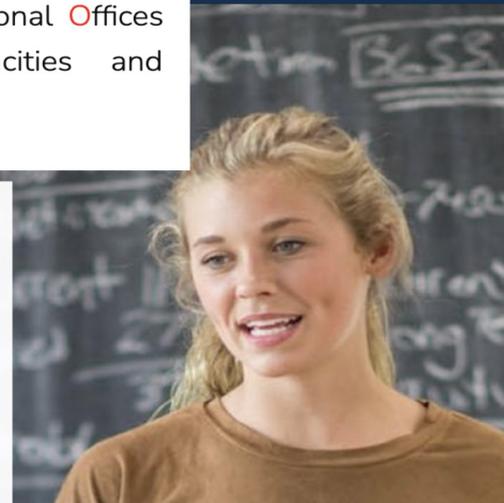


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# BUILDING THE STARTER KIT



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- ACADEMIC  
Collaboration
- INDUSTRIAL  
Collaboration
- RESEARCHERS  
TRAINING
- SPECIALIZED  
DIGITIZATION
- ENHANCED  
PUBLICATION
- KNOWLEDGE  
TRANSFER



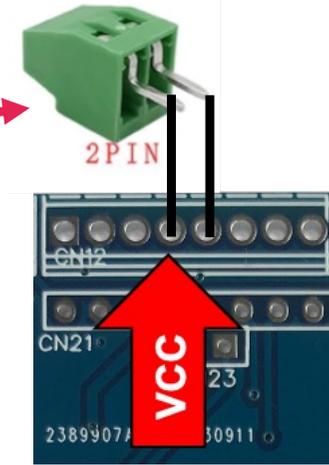
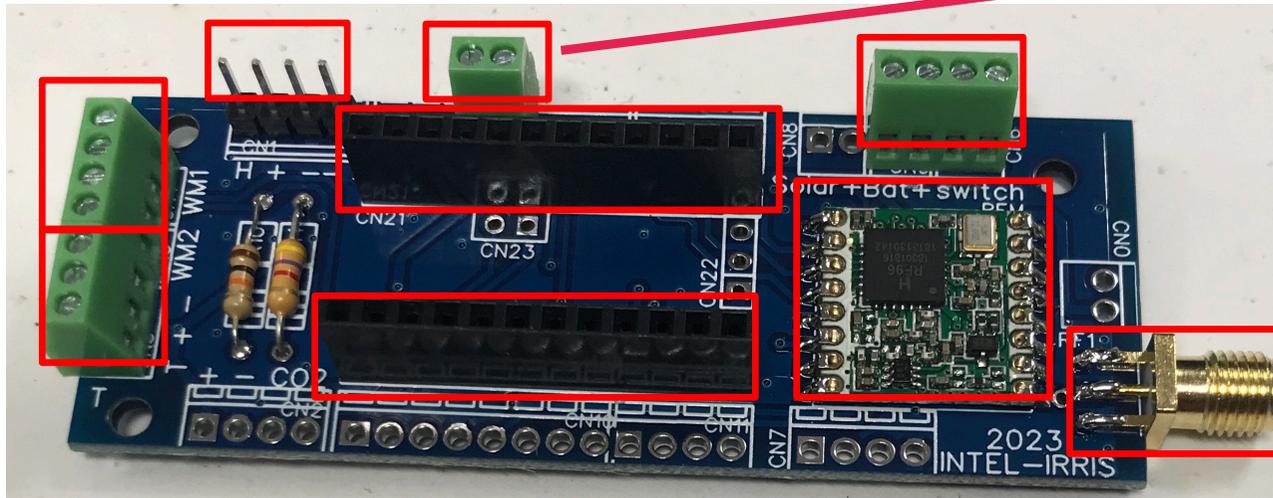
### PROJECT PARTNERS



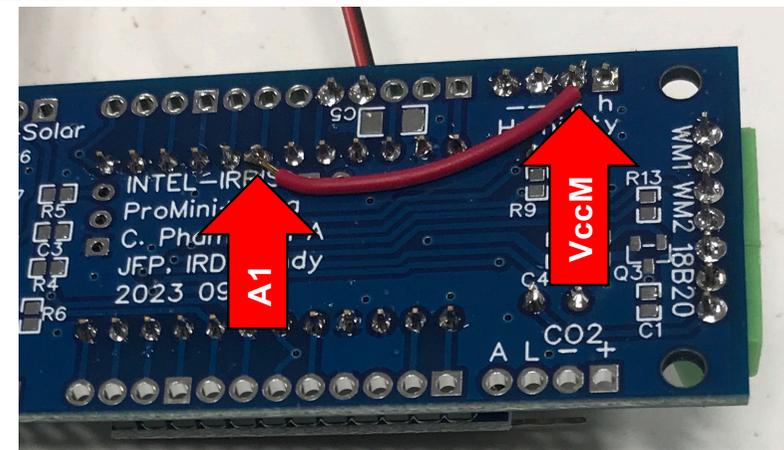
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NUMBER: 1011291958 - NOV 2024 - 2027

# Wiring with IRD PCB v4 (raw version)

- First, solder the various components

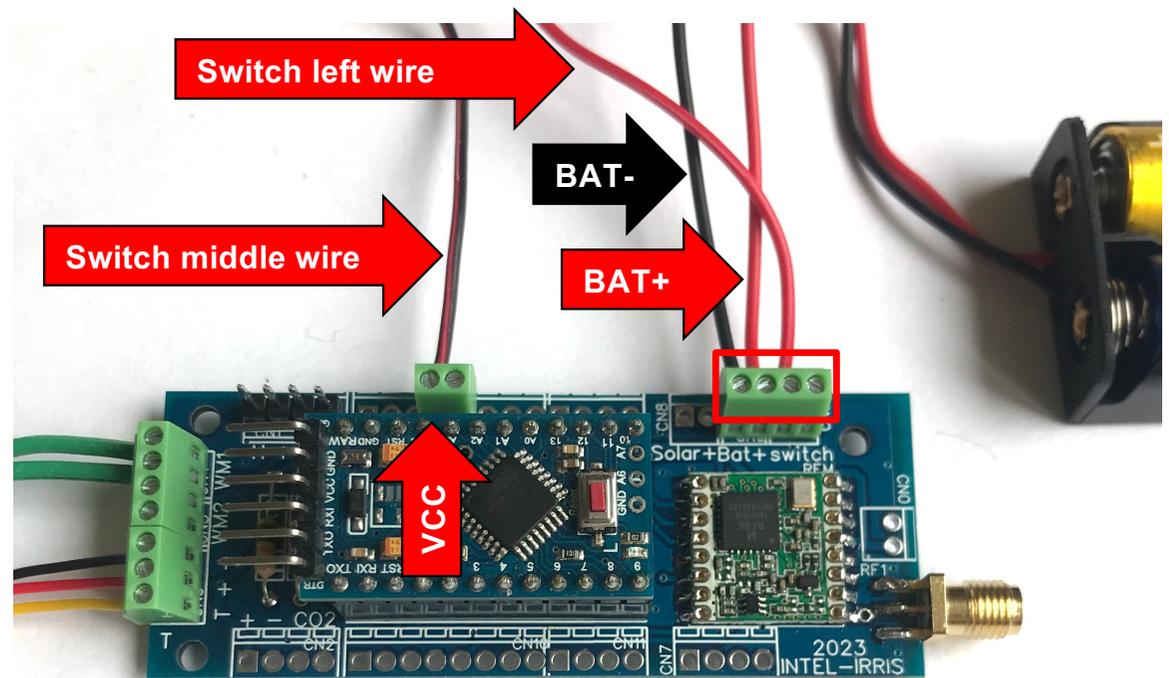
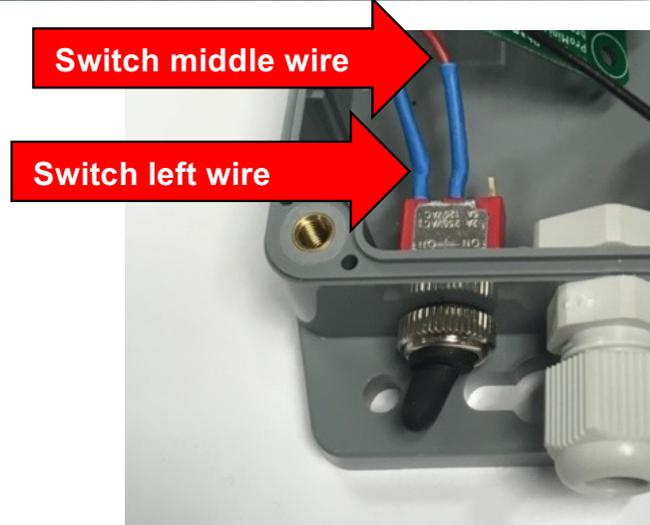
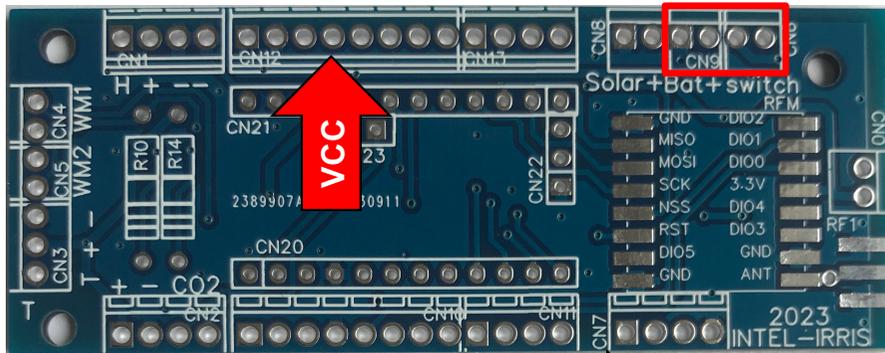


- For the raw PCB (no circuit for solar), need to link A1 to VccM on the back side of the PCB
- VccM can be taken on the + of the soil humidity sensor



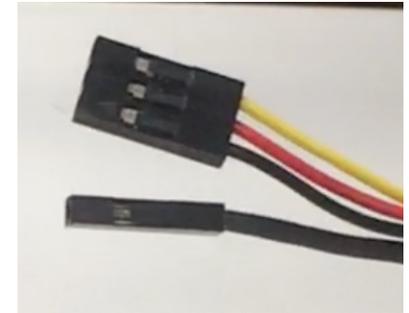
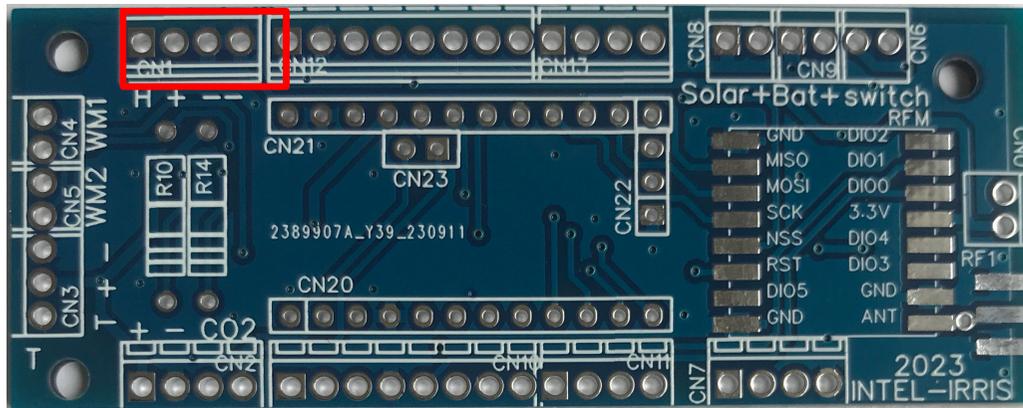
# Wiring with IRD PCB v4 (raw version)

## Power wires

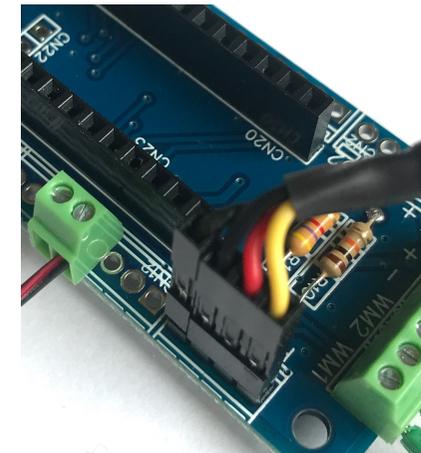
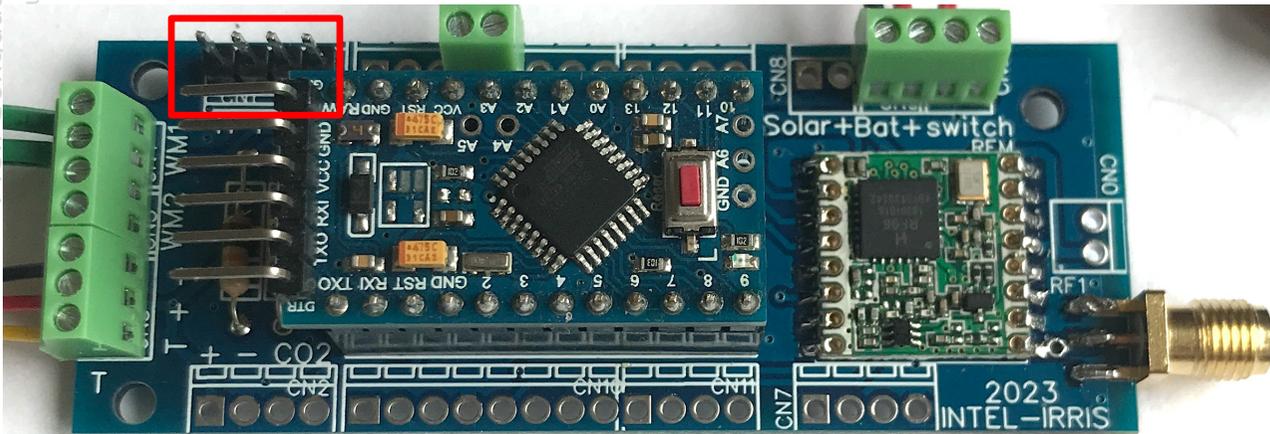


# Wiring with IRD PCB v4 (raw version)

- SEN0308 capacitive



Just connect the sensor in the dedicated header  
 -- are the 2 black wires  
 + is red and H is yellow

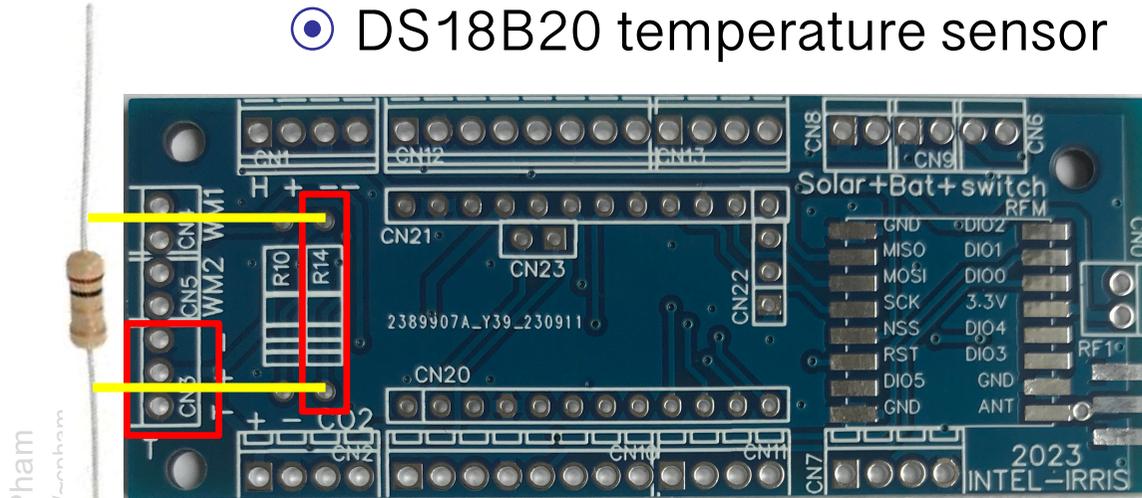


# Wiring with IRD PCB v4 (raw version)

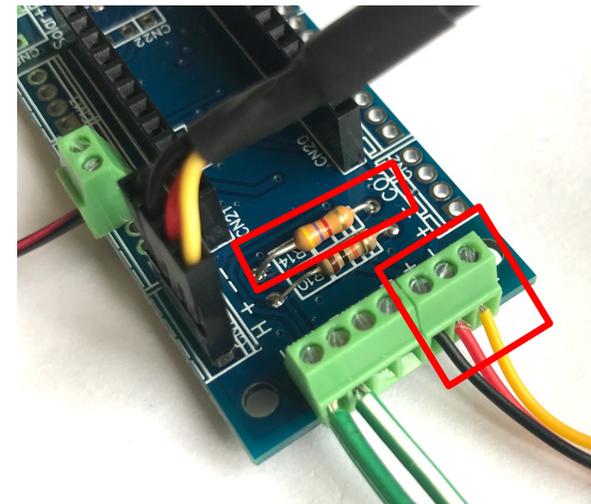
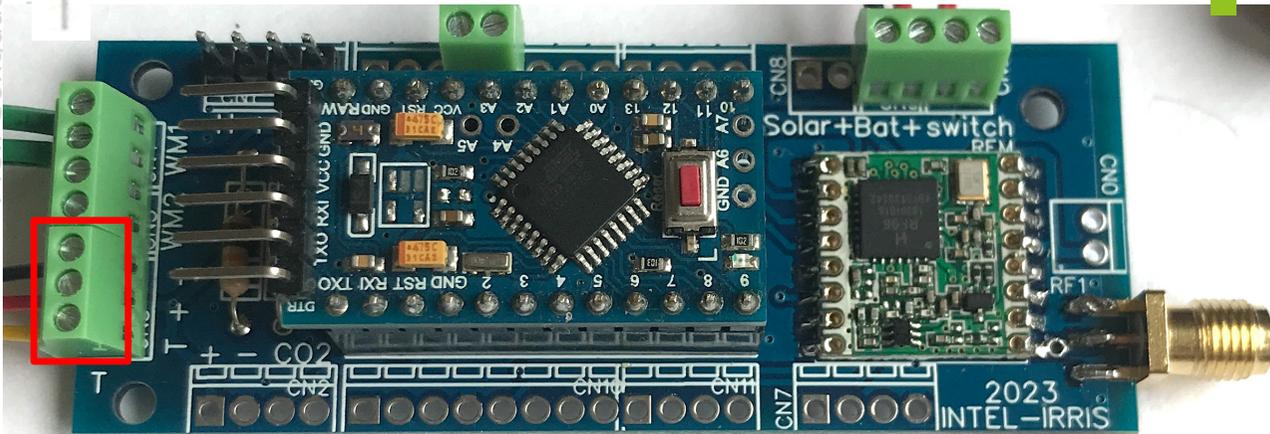
- DS18B20 temperature sensor



Solder a 4.7kOhms resistor then wire in the dedicated terminal block  
T+ - : Yellow, Red, Black wires

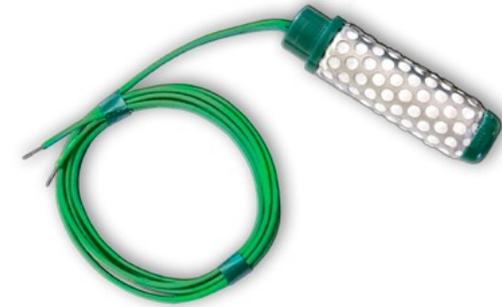


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u.fr/anhem

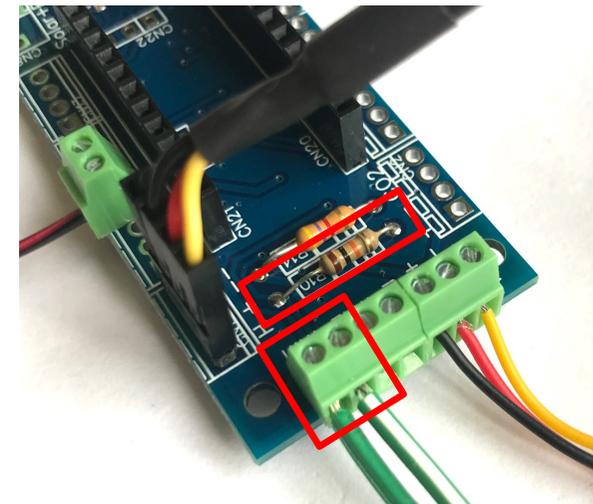
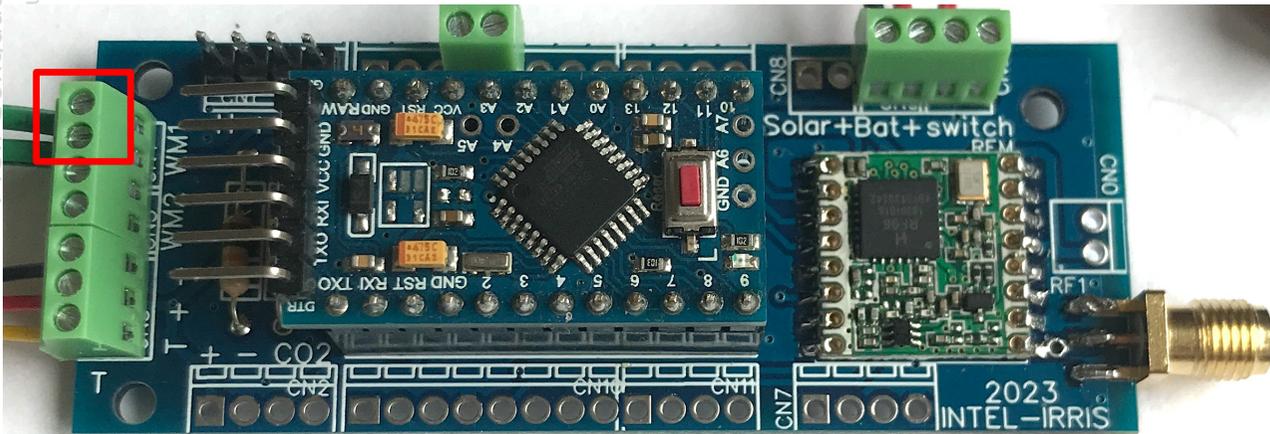
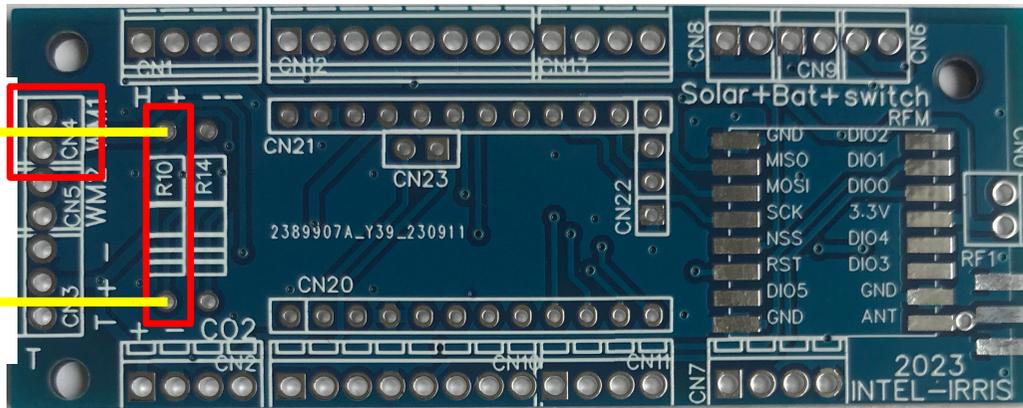


# Wiring new IRD PCB v4 (raw version)

## ◉ First Watermark

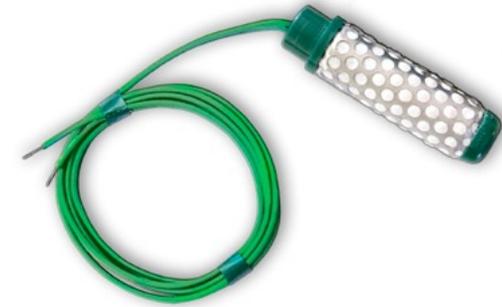


Solder a 10kOhms resistor then wire in the dedicated WM1 terminal block

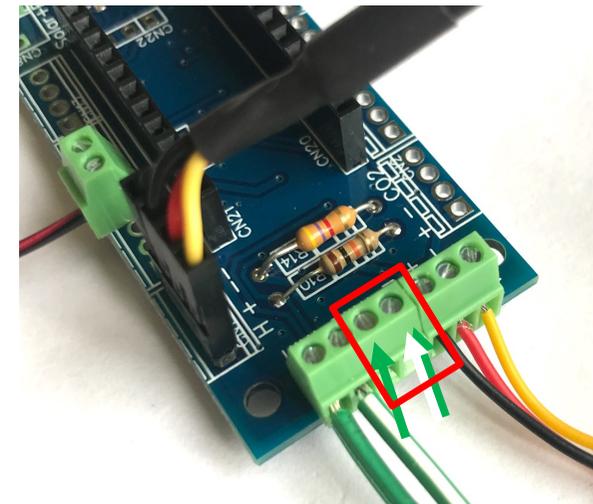
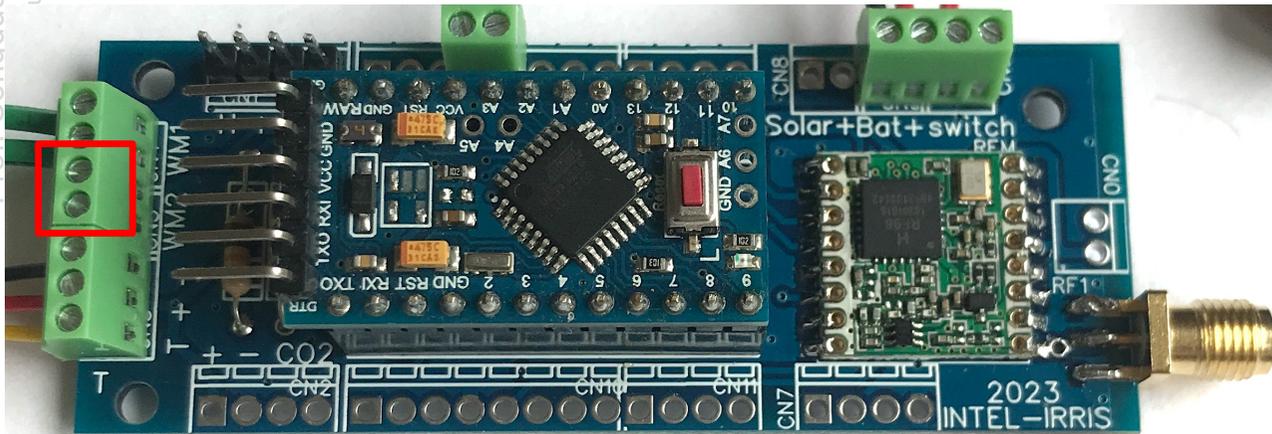
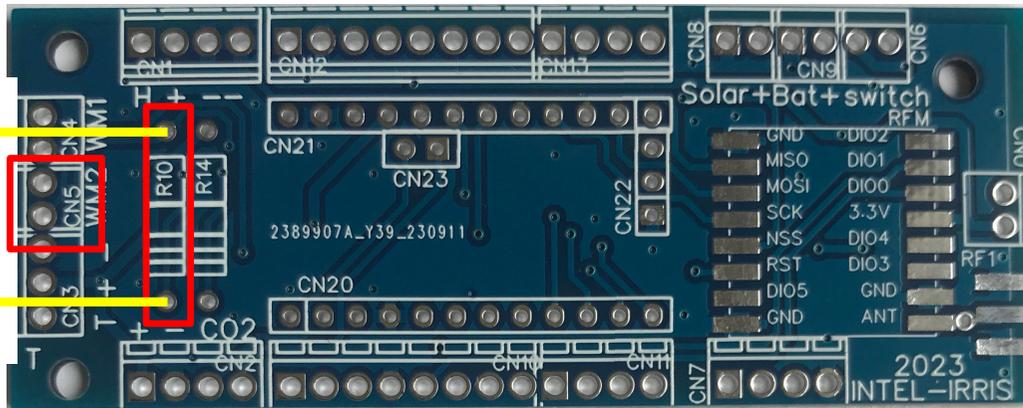


# Wiring with IRD PCB v4 (raw version)

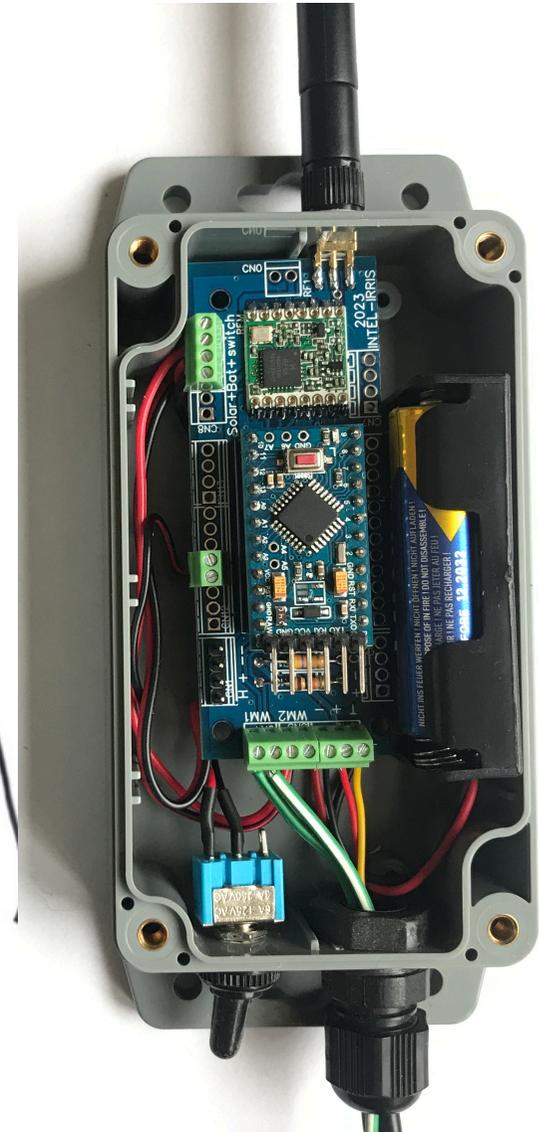
## ◉ Second Watermark



No additional resistor  
just wire in the dedicated WM2  
terminal block



# Final result with casing & sensors



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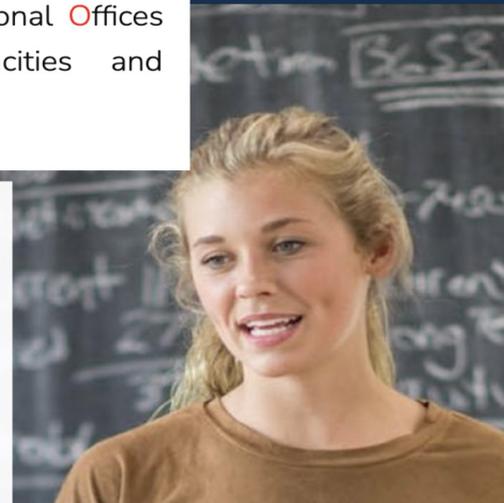


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# TRANSMISSION TO GATEWAY



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# Transmission to gateway



LoRa parameters

Limited LoRaWAN

SF12BW125

868.1MHz

ABP mode

Dev addr is 26011DAA

1 msg/60mins

1 sensor

XLPP data



This dedicated video will show all these steps, from connecting the SEN0308 to testing transmission to the gateway

Video n°4: <https://youtu.be/j-1Nk0tv0xM>





# Live demo

The dashboard is divided into several sections:

- Left Sidebar:** Contains navigation options: Logout, Intel-Irris WaziApp, Dashboard, Sync, Settings, Apps, Help, and User Profile.
- Dashboard Header:** Shows 'Dashboard' and a 'W' logo.
- Gateway Cards:**
  - Gateway: b827ebd1b236cab8, ID b827ebd1b236cab8
  - (NEW) Gateway: b827ebd1b236cab8, ID dca6325c2a7a0000
- SOIL-AREA-1 Card:**
  - Soil Humidity Sensor: Raw value from SEN0308, 164.5 (15 minutes ago)
  - Soil Temperature Sensor: degree Celsius, -99 (5 months ago)
  - Battery voltage: 3.46
- Home Assistant Panel:**
  - Overview (selected)
  - Energy
  - Map
  - Logbook
  - History
  - Configurator
  - Media
  - Developer Tools
  - Settings
  - Notifications (1)
  - inteliris
- Farm Panel:**
  - inteliris (Unknown)
  - Capacitive Sensor:
    - SOIL-AREA-1/Raw value from SEN0308: 164.5 (16 minutes ago)
    - SOIL-AREA-1/Soil Temperature Sensor: -99 °C (2 weeks ago)
    - SOIL-AREA-1/Battery voltage: 3.46 Volts (16 minutes ago)
  - Tensiometer Sensor:
    - SOIL-AREA-2/centibars from WM200: 24 cbar (18 minutes ago)
    - SOIL-AREA-2/resistance value from WM200: 4,287 Ohms (18 minutes ago)
    - SOIL-AREA-2/Soil Temperature Sensor: 17.9 °C (18 minutes ago)
    - SOIL-AREA-2/Battery voltage: 2.77 Volts (4 hours ago)
  - Visualizations:
    - Gauge: 164.5 (SOIL-AREA-1/Raw value from SEN0308)
    - Gauge: 17.9 °C (SOIL-AREA-2/Soil Temp...)
    - Gauge: 24 cbar (SOIL-AREA-2/centibars from WM200)
    - Line chart: SOIL-AREA-2/Soil Temp...
    - Gauge: 4 (SOIL-AREA-2/soil value index)
    - Line chart: SOIL-AREA-2/soil condi...

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