INSTRUCTIONS FOR THE UF SMART DEVICES:

The module entitled "SMART DEVICES" as part of the "Innovative Smart System" PTP includes:

- a course/TD on sensors and measurement chains to be followed online (SPOC version),
- a training period to develop a gas sensor based on nanoparticles (internship at AIME),
- TPs relating to the design of an analog circuit to interface the gas sensor produced to the AIME
- a TP on Git and the GitHub platform
- a course/TD/TP on microcontrollers and open source hardware
- a course/TP on the production of electronic cards under KiCad

Thanks to all these lessons, you will be able to achieve the final objective of the UF: **design and build a smart device based on the combination of a gas sensor and an electronic card to communicate information over a low speed network (through a LoRa connection on The Thing Networks for example).**

Please note that all necessary resources are available on the UF Moodle:
https://moodle.insa-toulouse.fr/course/view.php?id=935#section-3
and
http://moodle.insa-toulouse.fr/course/view.php?id=494.

In particular, you can access the SPOC version of the sensor course at the following addresses:
Introduction : https://moodle.insa-toulouse.fr/mod/resource/view.php?id=47747
Chapter I: https://moodle.insa-toulouse.fr/mod/resource/view.php?id=47744
Chapter II: https://moodle.insa-toulouse.fr/mod/resource/view.php?id=47745
Chapter III: https://moodle.insa-toulouse.fr/mod/resource/view.php?id=47746
Chapter IV: https://moodle.insa-toulouse.fr/mod/resource/view.php?id=47927

In addition, you will be able to review the KiCad course sessions filmed last year in the MOODLE section:
INTRODUCTION AU PROTOTYPAGE RAPIDE DE PCB

The PTP ISS draws its strength from all your educational origins (GP, AE, IR, MSIOT...), at the same time it is not possible to bring you to the same level of skills. Our objective is therefore to increase your skills regardless of your initial skills. This is why we suggest that you choose the pedagogical elements that you feel capable of following from among all the resources.
To make, your choice, we have concocted a color code that will allow you to estimate the difficulty of the pedagogical element:
Green: very easy, suitable for beginners
Blue: easy to medium
Red: medium to difficult
Black: the most difficult

Depending on your skills in the field, we suggest you choose either:
1 - to carry out the TPs noted TP1 Program => TP5 Program
To do so, follow the following links:
https://moodle.insa-toulouse.fr/course/view.php?id=494#section-4
https://moodle.insa-toulouse.fr/course/view.php?id=494#section-5
https://moodle.insa-toulouse.fr/course/view.php?id=494#section-7
https://moodle.insa-toulouse.fr/course/view.php?id=494#section-8
https://moodle.insa-toulouse.fr/course/view.php?id=494#section-9

2 - to carry out in semi-autonomy, the mini-project LoRa below

To do so, follow the following link:

https://moodle.insa-toulouse.fr/course/view.php?id=494#section-10

Be aware that, whether it is the typical TP series or the mini-project, you will be able to choose the difficulty (green, blue, red, black...) that it seems affordable to you according to your initial skills.

Evaluation of the UF:

To validate the UF, we then propose you to proceed in THREE TIME!

You are free to use at any time, when it seems useful, the GitHub of the UF Smart Devices https://github.com/orgs/MOSH-Insa-Toulouse/ available for you.

To do this you will need to create an account on the GitHub platform at https://github.com/join and send your "Username" to Arnauld.Biganzoli@insa-toulouse.fr

1 - FIRST OF ALL:

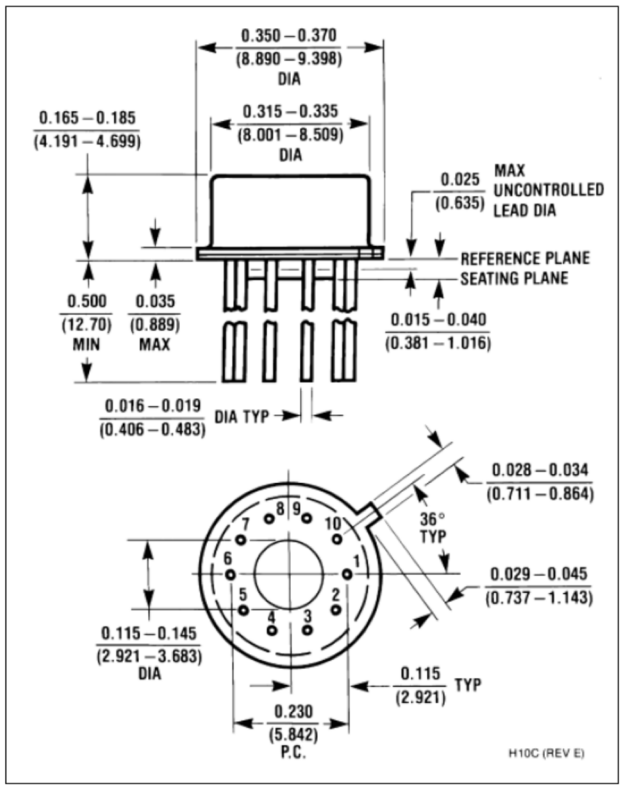
- STEP 1 :

You will have to create the KiCad design files incorporating the instrumentation stage of the gas sensor presented during Jean-Louis Noullet's TPs (the components required for this are located in a small plastic bag on the Arduino shelf!)

For the KiCAD part, you will use the TD sessions with Arnauld Biganzoli and the links to the course videos: *https://moodle.insa-toulouse.fr/course/view.php?id=494#section-3*

NB :

- 1 - The gas sensor will be placed on a TO5 box of the same type as the one of the AIME: **http://fr.rs-online.com/web/p/photodiodes/7378098/**



Note: 1 - Your knowledge of the gas sensor at AIME will allow you to design the best possible circuit to connect the poly-silicon heating element, the Aluminium element and the nanoparticle sensitive layer.

STEP 2: we suggest that you choose one of the following topics:

- GREEN TRACK: design the KiCad files of a shield for Arduino containing the sensor of your choice (e.g. a gas sensor with "GROVE" connection available in the instrumentation room), possibly a buzzer and a push button and which should be able to send information about the TTN network (The Thing Networks : https://www.thethingsnetwork.org/). This shield should be able to be plugged into an ARDUINO UNO card (like that of your TPs).

- BLUE TRACK: take the previous KiCad files (green track) and add a connector to insert the PCB containing the RN2483 chip, and also the possibility to connect the gas sensor to the AIME. The first GROVE sensor will allow you to calibrate the entire assembly. This shield should be able to be plugged into an ARDUINO UNO card (like that of your TPs).

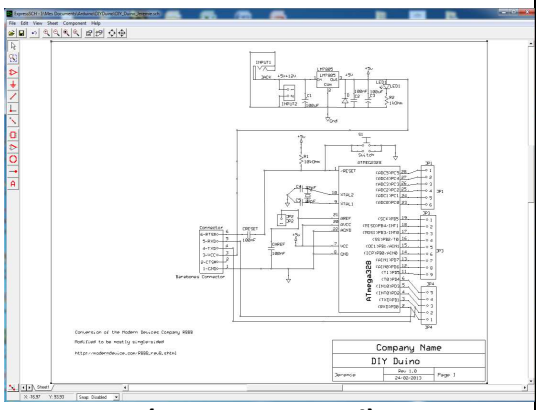
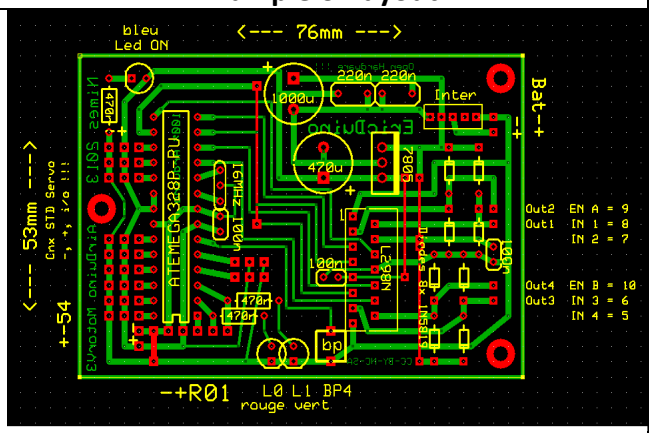
- RED TRACK: resume the previous KiCad files (blue track) and directly integrate the AIME gas sensor into them

- BLACK TRACK: take the previous KiCad files (red track) and directly integrate a "clone" of the Arduino UNO, excluding the FTDI programming chip. Optional: you can integrate OLED mentioned in paragraph TP6 of the MOODLE
- The following components are available (available in the TP cabinet):

The pouch contains all the components required to create an Arduino UNO base, except the FTDI or ATMEL component used to program it via the USB port. The programming of your platform will therefore be done using an external USB hub from Sparkfun, also available in the cupboard of the instrumentation room of the Department of Physical Engineering, on the Arduino shelves. Some design rules: Inside the pocket are two voltage regulators, it is up to you to choose the one you prefer according to its characteristics. You will take care to examine their respective datasheets. A 5-pin male header containing the RX, TX, GND, 5V and RESET

signals must be output on the rapid prototyping plate in order to be able to program the platform, if possible in the same order as the usb programming hub. Feel free to come and see the hub in the instrumentation room.
- NB: you will not need a 3.3V controller to power your RN2483 chips, you just need to build a divider bridge from the 5V controller used to power the ATMEGA 328.

TO DELIVER TO US IN THIS PART: KiCad DESIGN FILES

Example of schematic	Example of layout
	
(non contractuel)	(non contractuel)

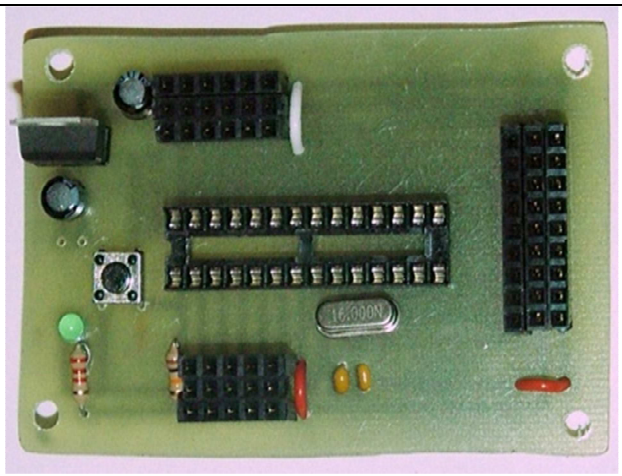
You will send your KiCad design files (schematic and layout) to
Arnauld.Biganzoli@insa-toulouse.fr
jeremie.grisolia@insa-toulouse.fr,
catherine.crouzet@insa-toulouse.fr;
benjamin.mestre@scalian.com

2 - IN A SECOND TIME:

We will organize a presentation session of your KiCad design files and you will select by an anonymous vote the 5 best designs that will then be drawn and welded to become the final prototype. The students of the 5 best achievements will then meet with catherine.crouzet@insa-toulouse.fr for the PCB drawing.

From the PCB, you will make an appointment again with Catherine CROUZET to access the soldering station.

Prototype



Example of prototype (non contractuel ;-))

3 - IN A THIRD TIME:

The spirit of this UF is resolutely oriented towards Open Source Hardware. If you can develop the aspects described in the two phases described above, it is partly thanks to the contribution of the community that makes resources and software available (KiCAD, Arduino, GitHub...). It is therefore very important that you can in return enrich the community with your work.

We therefore ask you at the end of the module to write a document that will describe your approach and provide all the necessary resources (source code, design files...) so that others can reuse your work.

We ask you to prepare the documents to be returned according to the chosen route and to DEPOSIT them on the github of the UF Smart Devices https://github.com/orgs/MOSH-Insa-Toulouse/.
We ask you to write on the README.md file, which is located at the root of your repository (github MOSH), a complete documentation of what you have developed, keeping in mind that this documentation must allow a third party to fully understand and know how to redo your project.

BE CAREFUL, WITHOUT THE RESOURCES AVAILABLE, YOU WILL NOT BE ABLE TO GET A SCORE!

This document will then be used to fill in the PORTFOLIO with skills that you will have to return to us at the end of the semester in order to validate the UF's skills.

For any request for details, do not hesitate to contact us:
Jérémie GRISOLIA : jeremie.grisolia@insa-toulouse.fr

Arnauld BIGANZOLI : Arnauld.Biganzoli@insa-toulouse.fr
Catherine CROUZET : catherine.crouzet@insa-toulouse.fr
Benjamin MESTRE : benjamin.mestre@scalian.com

We remain at your disposal for further details.