Telemetry solutions
Sensor - Data Logger - Web Services

TELEDYNE ISCO

USER GUIDE

Flow measurement (Area Velocity)

Battery operated & wireless communication solution

Summary

1. Introduction

This solution results of the experience of ISCO in term of instrumentation (Mainly in velocity sensor by Doppler effect), and Ijinus integration concerning energy management, measurement quality (smart time control of the measurement stabilization) and wireless communication.

2. Necessary equipment (3 types of configurations)

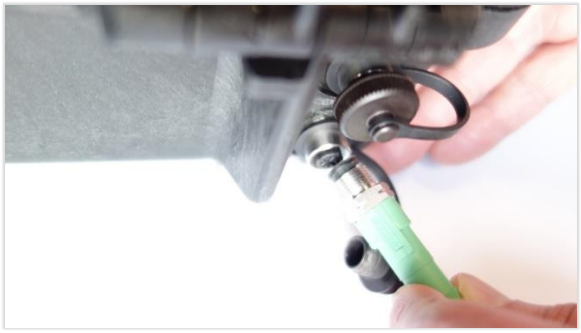
a. Temporary installation (Measurement campaign)

For autonomous (Lead battery) liquid level measures using an internal differential pressure transducer, velocity (Doppler), local data acquisition (Logger) with on-site data download (Wiji radio protocol).

VLI sensor with cable and atmospheric pressure valve

Energy case and connector

Inside view
Logger and battery

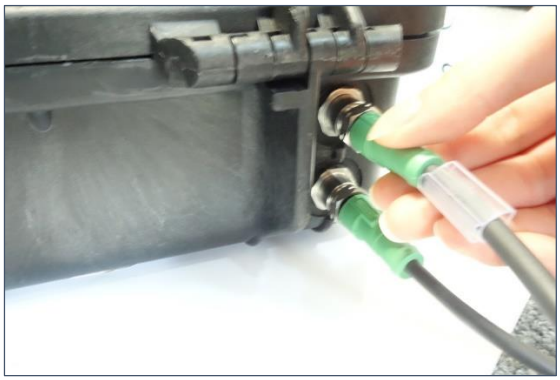


VLI connection on le battery pack

Whole connected system

b. Permanent installation (for application like sewers permanent diagnostic) : For autonomous (Lead battery or Lithium) liquid level measures using an internal differential pressure transducer, velocity (Doppler), local and remote data acquisition GSM/GPRS (deported logger).

Supplementary material: logger GPRS, connection cord battery pack connection et eventually a deported antenna GPRS



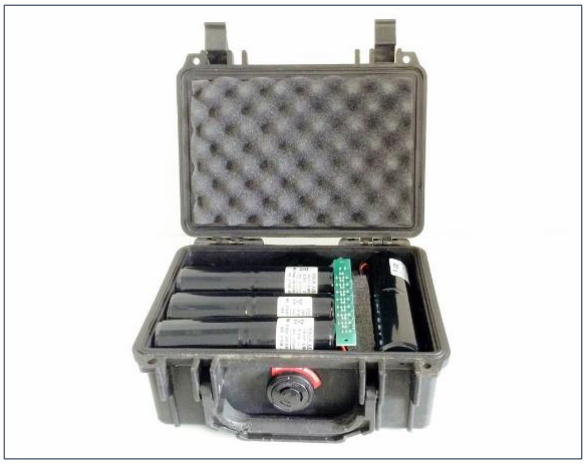
Logger connection on le battery pack (Top connector)

Full mounted system

c. Permanent installation (for application like sewers permanent diagnostic), this time with additional ultrasonic level measurement:

For a velocity measurement (doppler), with lead or lithium battery, a logger HF, and an ultrasonic level sensor with built-in GSM/GPRS modem.

Supplementary material: logger GPRS, ultrasonic sensor, and external GPRS antenna



Lithium battery case

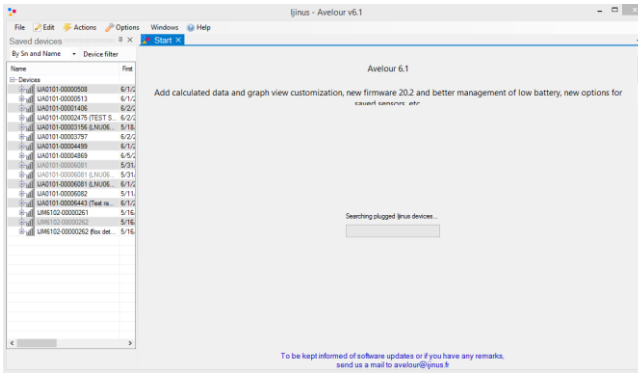
Full mounted system

3. Quick programing using the software Avelour

We will program the simplest system focus on height measurements, velocity, flow, Doppler signal quality of the VLI sensor.

a. Necessary equipment

- Software Avelour 6.XXX
- Either the programming kit Wiji or Wiji key



Software Avelour

Wiji Kit

Wiji key

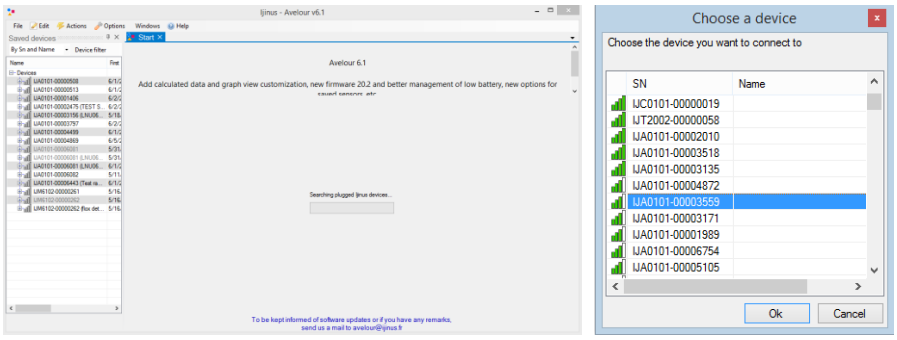
b. Prerequisite

i. The equipment is considered to be directly working, battery and connection ok
ii. The whole indications in this document correspond to a programming using Avelour 6. In case of problem please read its manual

c. STEP 1 : Run Avelour and find the sensor to configure

After connecting the USB cable to the Wiji kit and PC/laptop, screw the Wiji antenna (or plug the Wiji key), run the software Avelour 6. If the sensors and loggers are close and compatible (in term of RFID code), they will be automatically detected without the need of activate anything else (ex IJA0101-0000 3559). Find on the sensors label its product number (for rental equipment check the battery case), them click "**Connect to a wireless device**"

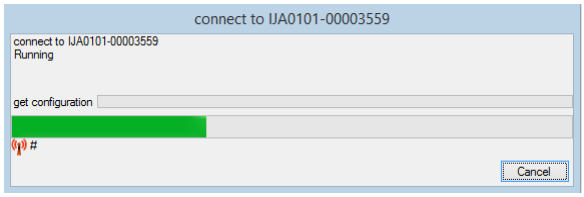
Postscript: : At your first sensor connection, only the PN is visible. The PN and the name (site location, …) that you will define later will appear at the following connections.



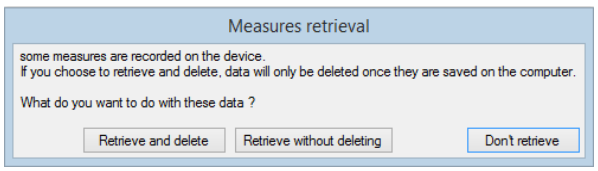
If you can't find your sensor in the list, refear to the software manuel.

d. STEP 2 : Selection of the sensor to configure, eventually update the sensor firmware is asked.

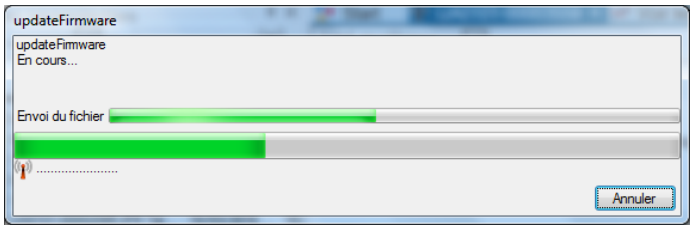
During connection to the sensor, the following pop up will shows up :



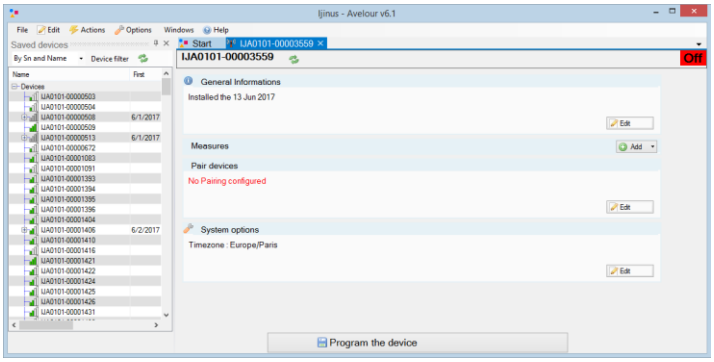
While connected and if the sensor has already measures in memory, the following pop up ask you if you want to retrieve data or not :



Then if the sensor is not up to date, Avelour ask you if you want to update it. It is highly recommended to read carefully the different message while doing it.



The update can last a bit so it is advised to do it at office. On-site prefer the best communication available, so not with a sensor under a manhole cover closed. Once the sensor is ready to be configured, the software windows looks like this.

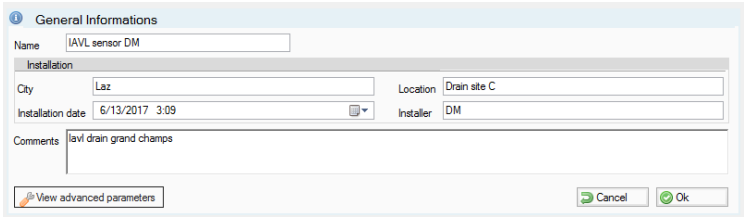


e. STEP 3 : Configuration of the VLI sensors

The screen is composed of different parts that will be described.

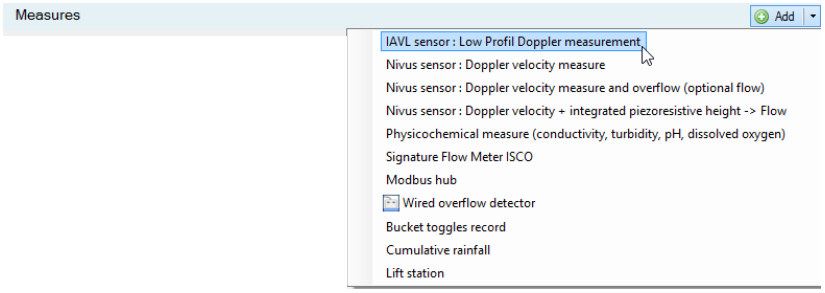
General informations part

This part is mainly used to provide informations on the installation. An important field to fill is the **Name** that will be used for your next connections. It will make your sensor easier to find this way.



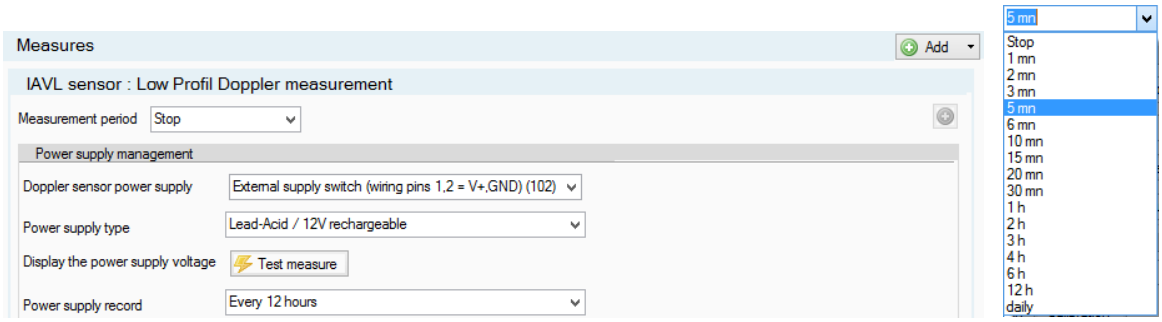
Measures part

This part is the most important, it is used to configure your area velocity sensor. First of all click on the **Add button**, and choose "**IAVL sensor: Low Profil Doppler measurement**"



Choice of the Measuring period

Select your **Measuring period** from the drop down menu, here 5 mn for example. Concerning **Doppler sensor power supply**, Choose « External supply » (External batteries are used in most cases). Also select the type of battery (Lead-acid or Lithium)



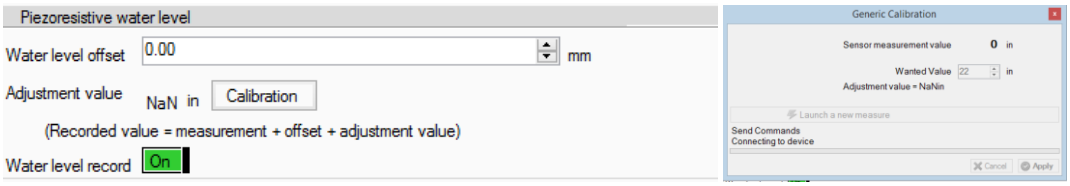
The Doppler effect measures is energy intensive so you should record the external battery supply voltage.

Adjustment and calibration available for water height

User has two possibilities:

- Integrate a **Water level offset**: This can be used when the sensor is not at the bottom of the invert but on its side to avoid dirt for example. The value can be configured here

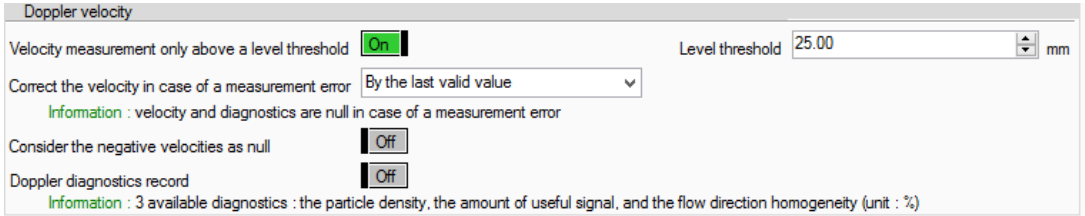
- **Calibration** of the height: If the water height isn't the one really measured by yourself, you can adjust it the calibration window on the **Wanted Value**.



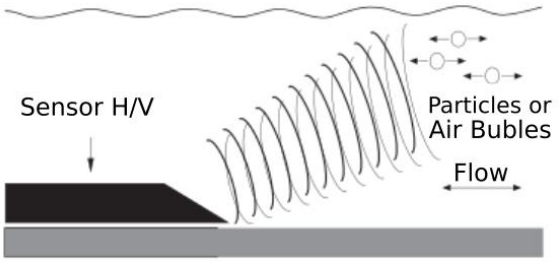
Configuration of the velocity measurement

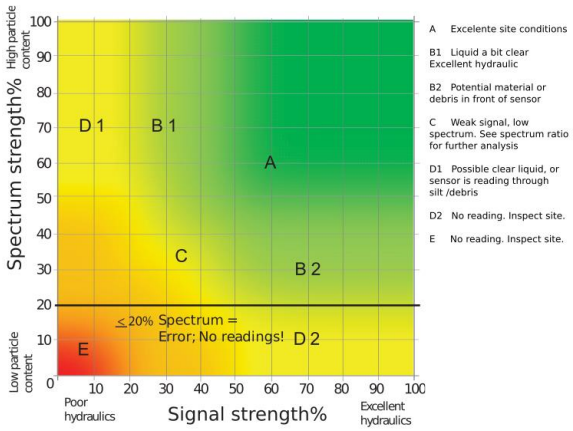
User has three possibilities:

- Choice of the height the sensor will provide velocity. Advice minimum value by default 25.00 mm.
- A possibility to swap non valid measure by: last valid value, or a value to define.
- Finally the log of the signal quality concerning Doppler measurement. It is 3 quality types you can get from Isco equipment: the particle density, the amount of useful signal, and the flow direction homogeneity. This record is highly advised. Example shown below:



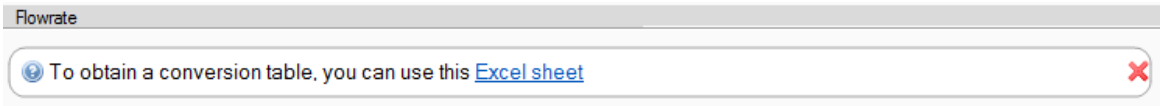
Quick programing using the software Avelour



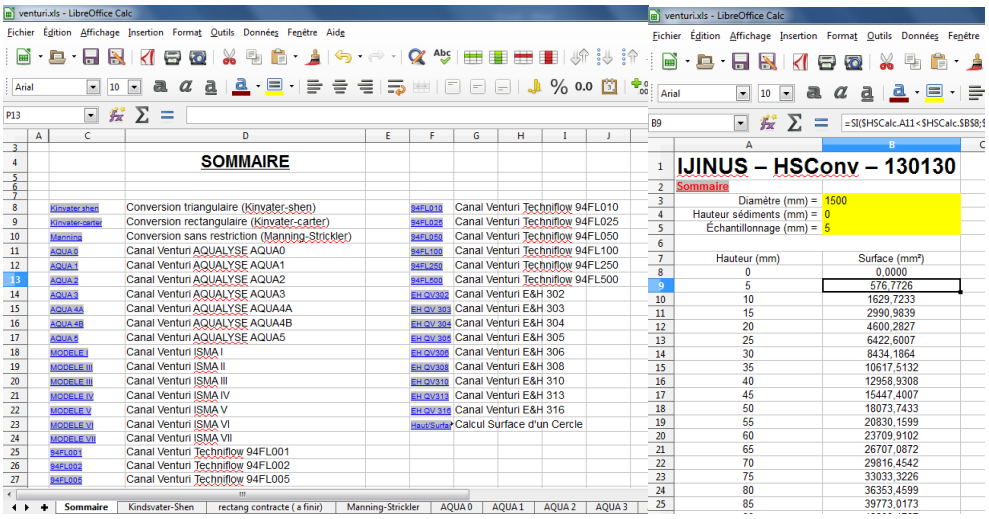


Configuration for flow calculation from water height and velocity.

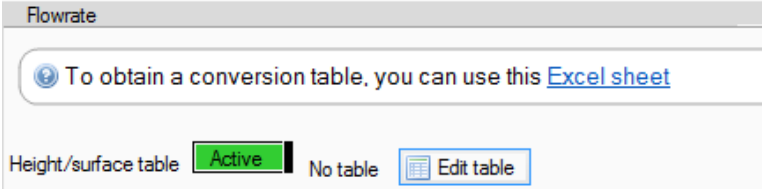
This part comprises mainly tools and options to transform the measured water height in wet surface according to the collector shape in which is installed the sensor. Please click the "**Excel sheet**" link.



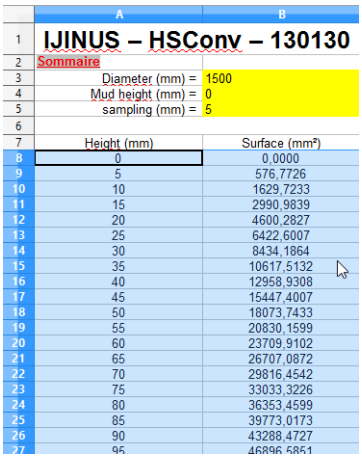
An Excel file will then open with in summary the different type of use. For example in case of circular collector, the sheet called Height/surface - circle allows you to generate a value table (mm) / yet Surface (mm^2) for a circular collector (here for 1500 mm) with the possibility to integrate mud height, this for a scale every 5 mm). Only the yellow cells have to be filled, conversion is done automatically.



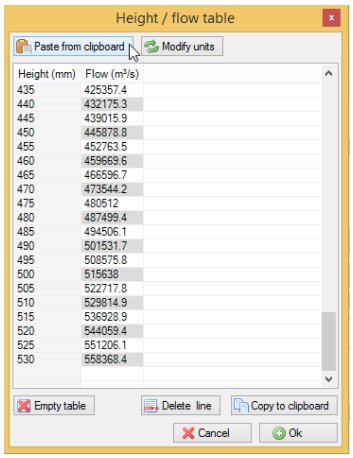
You need to select, copy the bloc Height/Surface in Excel (bellow example) then after activated the Height/flow table in Avelour, paste the data from clipboard. Final validation is done by pressing the OK button



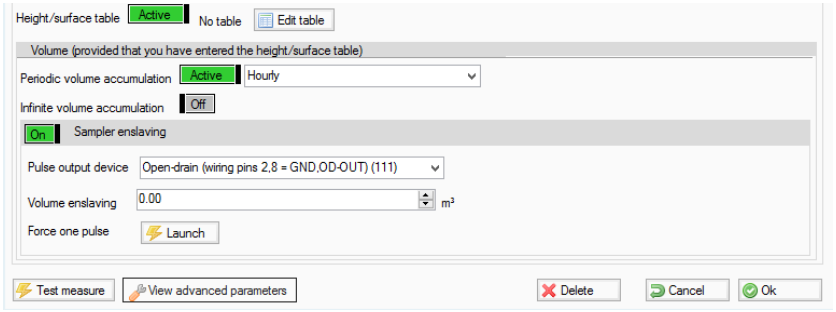
Quick programing using the software Avelour



	A	B
1	IJINUS – HSConv – 130130	
2	Sommaire	
3	Diameter (mm) =	1500
4	Mud height (mm) =	0
5	sampling (mm) =	5
6		
7	Height (mm)	Surface (mm²)
8	0	0,0000
9	5	576,7726
10	10	1629,7233
11	15	2990,9839
12	20	4600,2827
13	25	6422,6007
14	30	8434,1864
15	35	10617,5132
16	40	12958,9308
17	45	15447,4007
18	50	18073,7433
19	55	20830,1599
20	60	23709,9102
21	65	26707,0872
22	70	29816,4542
23	75	33033,3226
24	80	36353,4599
25	85	39773,0173
26	90	43288,4727
27	95	46896,5851

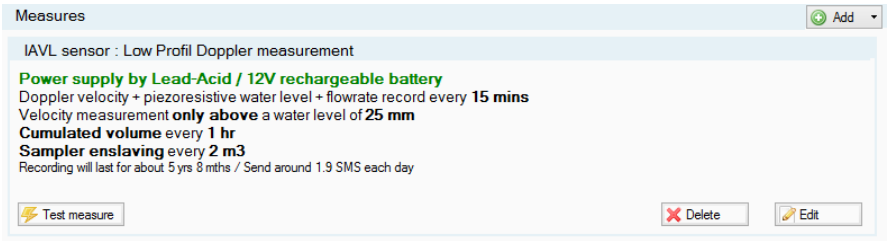


This operation validate the input of these data in the table by displaying the number of lines, then can activate, depending on calculation needs, flow logs and eventually to control a water sampler.

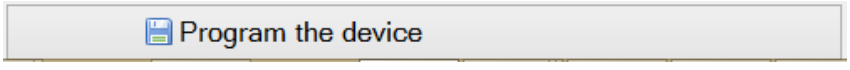


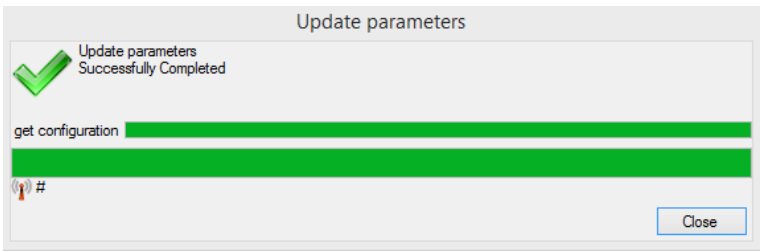
Review

Once these operations are completed, a resume appears with your configurations:

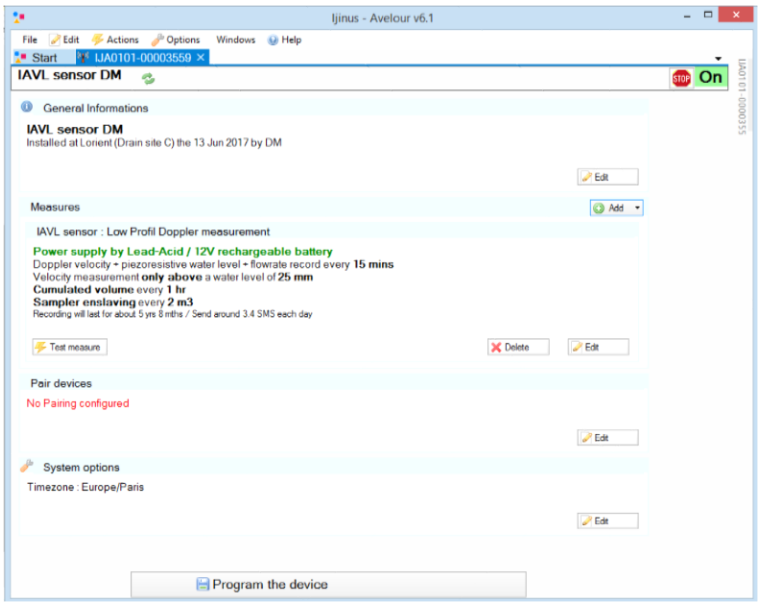


Finishing of the programming : you have to validate with the "Program the device" button to send the configuration to the sensor memory :





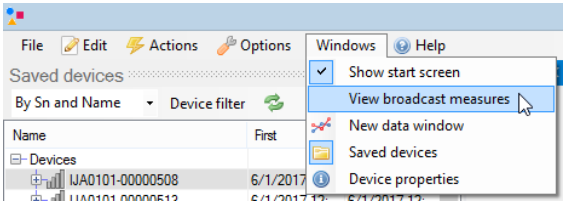
After the saving operation is done please check that you have at the top right corner the green sign showing that the sensor is working and recording. You can stop it measuring by pressing the red Stop icon, if needed.

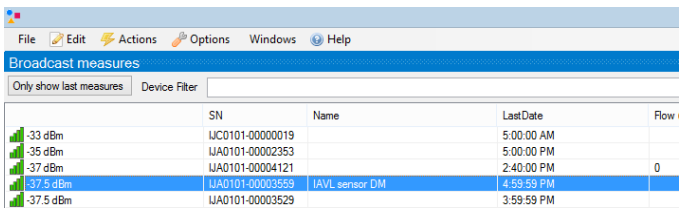


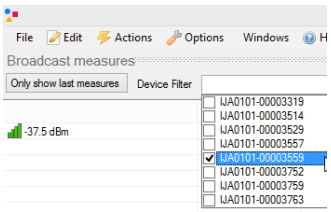
f. STEP 4 : Reading data in real time

It is interesting to keep in mind that the programmed transmitter managed itself, in an optimal manner, the Doppler measurement to get as stable measures as possible. Indeed the system manage a consistent measurement and at the same time limits power supply time, to optimize energy autonomy.
Traditionally it exists two different way to read in real time: either by pressing the **Test measure** button, or by choosing in the main menu to **View broadcast measures**.
For the VLI sensor, we suggest to verify on-site by RF, each measure last 30s and if you respect this timing you will get more accurate measures.

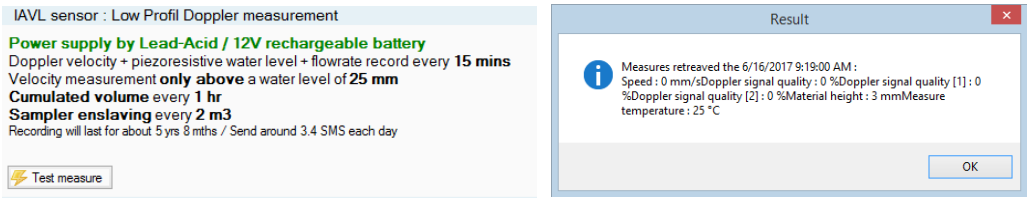
View broadcast measures:
Main menu > Windows > View broadcast measures
This option give to you locally the devise measurements at each cycle.







Force a measure (**Test measure** button): not advice in this case



Values provided by the sensor are as follow:

- Standard measurements: height, velocity and temperature
- 3 quality indicators for the velocity measurement by Doppler :
    a. Density of the particles (%) shown as Doppler signal quality,
    b. Signal quality (%) shown as Doppler signal quality [1],
    c. Direction of flow homogeneity (%) shown as Doppler signal quality [2],

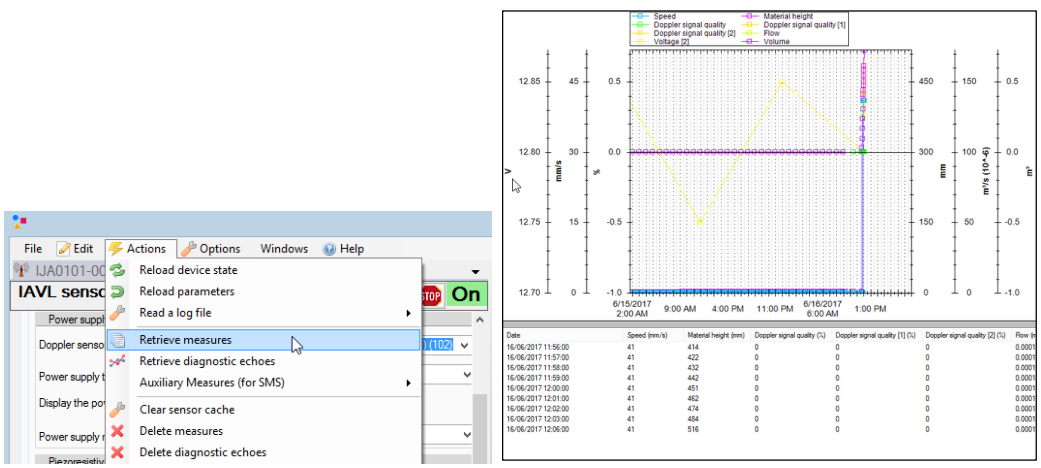
The 3 signal quality percentages enable us to know if the sensor physically positioned on-site in liquid is able to provide coherent results. ISCO's experience in this field then proposes the following favorable limits:

- Density of the particles > 30 % : if inferior quality, the sensor risk of having a non-coherent velocity due to the lack of particles or too fin particles in the effluent.
- Useful signal quality > 30 % : if inferior quality, the sensor may have a distorted velocity due to not sufficient information returned to the sensor (link with particle density), a sign of a hydraulic system that is not well suited to the immersed Doppler measurement, a non-coherent velocity due to the lack Particles or too fine particles in the effluent.
- Direction of flow homogeneity >70 %. If inferior quality, the sensor may have a distorted velocity due to the flow which is not sufficiently homogeneous.

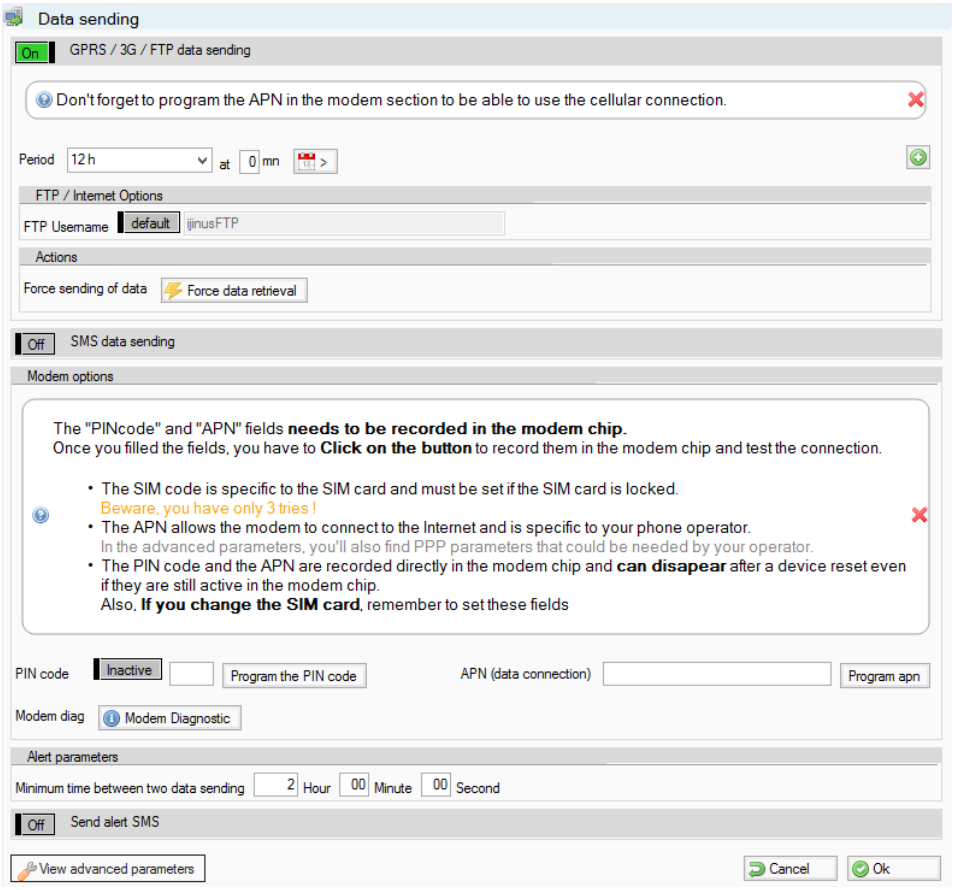
If the signal quality conditions are not met, it is strongly recommended to modify the installation, as there may be inconsistent measurements..

g. STEP 5 : Retrieve data locally (available without GPRS communication)

When you connect to the sensor, the software offers to retrieve the measurements, but once connected it is still possible to do so by clicking on "**Actions**" and then "**Retrieve the measures**". The "Data" window provides access to the graphical data. Note that a table view is also available by clicking on "View List".

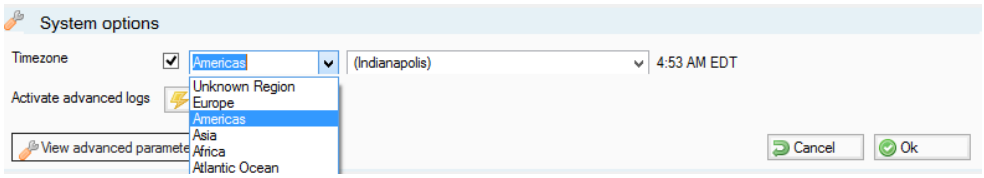


h. STEP 5 : Data sending by GPRS

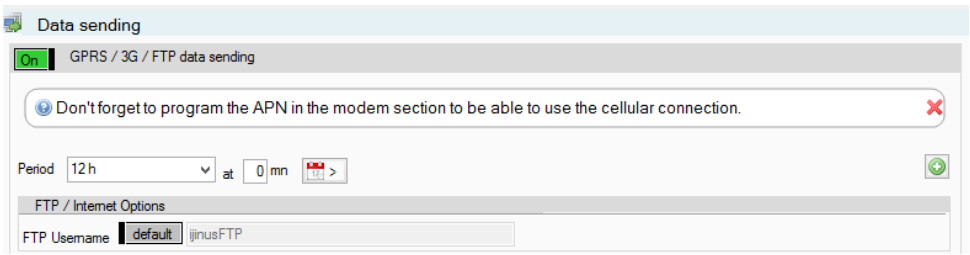


First of all you need to:

- Insert in the sensor sim holder a regular size data sim card with at least 5MO/month on your plan. While buying the card please ask the APN of the operator, as well as the Pin code if any. We will need these informations. The GSM/GPRS antenna has also to be connected to the connector on top of the sensor.
- Set now your timezone in the **System options** menu:

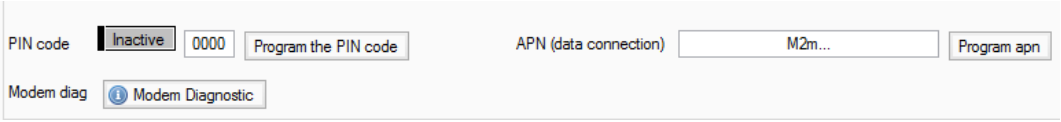


- After clicking the Edit button, choose the sending period, define to send every day or only some of them. You can define several periods by clicking on the green + icon. Depending on your configuration you may need to choose a minimum delay between 2 anticipated data sending.



- If the sim card id locked, please enter your code (if any) and press the **Inactive** button (that will turn green, and become **Active**) and **Program the pin code** button.

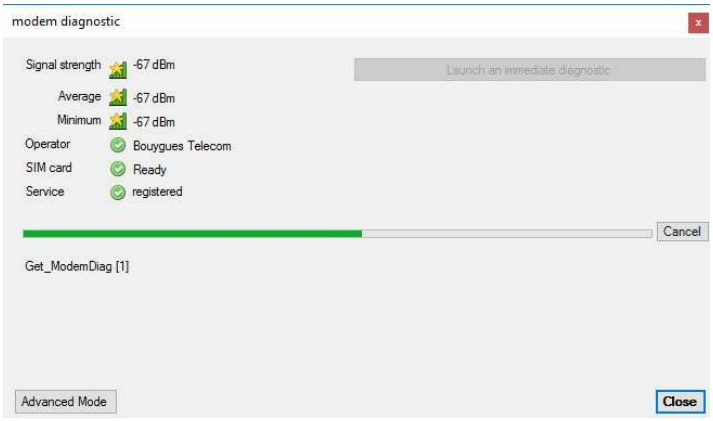
- Enter **your** APN code and press the **Program APN** button.
A message will confirm the success for each operations.



By default the parameters are set to send the data to our server as we propose a **web platform V2.ijitrack.com** with different services to manage them. So **if you choose this option, you don't have to change the FTP Username**.

At this stage you can run a sending test by pressing the **Force data retrieval** button and check on v2.ijitrack.com, in your account, if the sensors data appears. Off course if your account is already created. Please ask otherwise our customer service to do so for you. You should also write the **Rfid product number** on the label of the sensor, the **address of the installation**, you will need them later to set up the sensor on our web platform.

The **modem diagnostic** button available on the modem configuration allows a better diagnostic of the GPRS / 3G reception by doing multiple measurements.



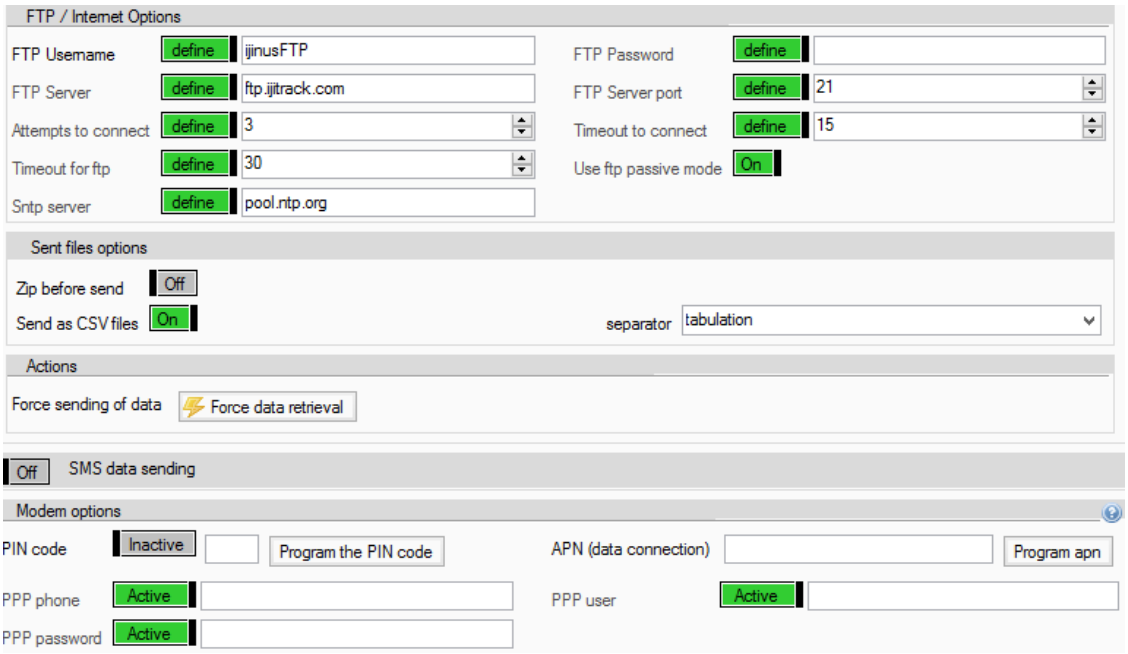
If you use the advanced mode, you also do continuous modem measurements on a longer period. These options are practical to know on what side of the manhole to place the antenna before drilling everywhere in the concrete under the cover plate and inserting it.

Advanced parameters

If you need to send the data to **your server**, first click the "View advanced parameters", then the FTP / internet Options will appear as well PPP options in the modem options.

You need to fill in **your own information details** regarding your server access. Your server administrator can provide to you those information.

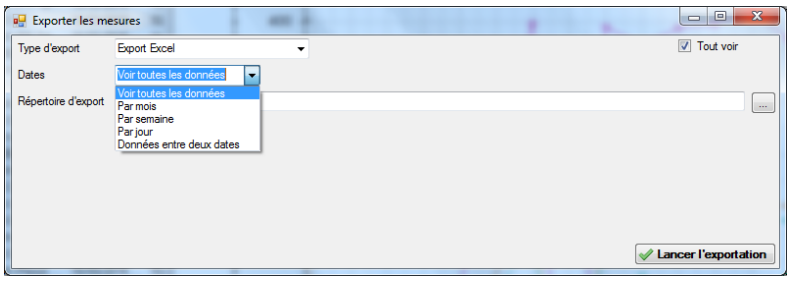
Some good practice and other installation examples.



After completing this chapter please press the Program the devise button, the configuration will be sent by radio to the sensor.

i. STEP 6 : Export data

You find in the graphical data window the **Export the measures** button.



4. Some good practice and other installation examples.

Concerning the measurement principles, good practices such as installation, service or maintenance, the reader can consult the book " Mesures en hydrologie Urbaine et Assainissement ", Editions Tec & Doc which serves as a reference document.
We propose here, and without being able to be exhaustive, only a few elements, such as:

i. The first element of choice of a velocity measurement technique is the water height: in our case, the value of 2.5 is a minimum, below which the measurements will not be consistent,

Some good practice and other installation examples.

j. It is not easy to provide ideal sanitation recommendations, but here are some elements:

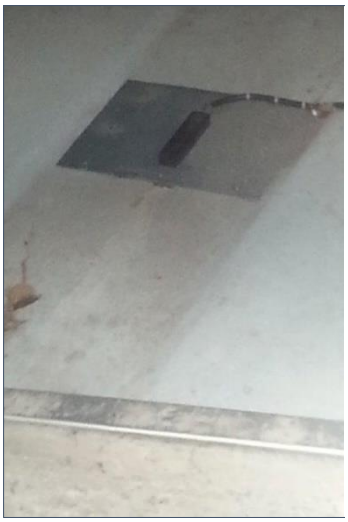
i. Foster collectors without deposits, or to defer the sensor of side,

ii. Prefer the upstream and downstream lengths as straight as possible (Generally evoked 5 times the diameter), as well as the absence of side entrances,

iii. The liquid to be measured must have a "minimum turbidity" or enough particles or other air bubbles to make the measurement coherent

k. The choice of the measurement site is therefore essential for the success of the measurements!

Installation examples:



5. Document history

Date	Revision	Writer(s)	Changes
21/04/2016	K0J2601A01	M. Zug	Creation
16/07/2017	K0J2602A01	D. Mahé	Translation and updates