



iJiNUS
GROUPE CLAIRE

User guide:

Measurement of H₂S concentrations with the gas sensor LOGAZ-H2S



Battery powered and communication by radio

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1. Introduction

This solution is an IJINUS product, so it combines the measurement of H₂S concentrations by electrochemistry and temperature. In addition to their measurement, these sensors can also be paired with others or used as data concentrators (in the case of a version with 2G, 3G or Sigfox communication).

2. A logger and a gas cartridge plug & play with two ranges of measurement (according to maximum concentration to be measured)

Logger with radio and 3G communication, fitted with gas cartridge



Logger with radio communication, fitted with gas cartridge



Gas cartridge
0-200 or 0-2.000 ppm



3. Necessary equipment (4 configuration examples)

a. Temporary Installation (as a measurement campaign):

A Lithium battery powered solution to measure H₂S concentration (by electrochemistry) and temperature, local data acquisition (sensor = logger) with on-site data retrieval (by radio with Wiji).



b. Permanent installation (permanent H₂S diagnosis type) of a single wireless sensor:

An autonomous solution (Lithium battery) to measure H₂S concentration (by electrochemistry) and temperature, Gsm/Gprs, 3G communication (depending on the model).



c. Permanent installation (H₂S diagnosis type or self-monitoring) with association of several wireless sensors or loggers:

An autonomous solution (Lithium battery) to measure H₂S concentration (by electrochemistry) and temperature, in addition with a Gsm/Gprs logger.



Logger communicating with an external antenna and a H₂S sensor.

d. Other configurations

Currently, the communication protocols available with our devices are:

- Radio for a wireless configuration of the device on-site: WIJI
- Wireless communication for remote monitoring: 2G (for Sms), GPRS, 3G, Sigfox, NB-IoT
- In the process of integration: 4G, 6LPWPAN



Example of a Sigfox sensor

4. Cartridge to measure H₂S and its calibration

Cartridges containing the gas measurement cell are designed to be interchangeable from one Ijinus logger to another. They are simply dismantled and reassembled with a scroll wheel on the base of the cartridge. Each cartridge contains different parts (see below) but especially its calibration and history. Apart from the filter, disassembling the rest is not advisable because this cartridge is a functional unit dedicated to being changed in its entirety only.

Each cartridge includes:

- The cell itself (two measuring ranges to choose from 0-200ppm or 0-2.000ppm, and two cells suppliers, see the datasheet chapter at the end of document),
- A protective filter specifically for H₂S gas,
- An electronic card containing calibration parameters (gas type, offset, calibration date, ...) and an ambient temperature sensor.



Alphasens cell



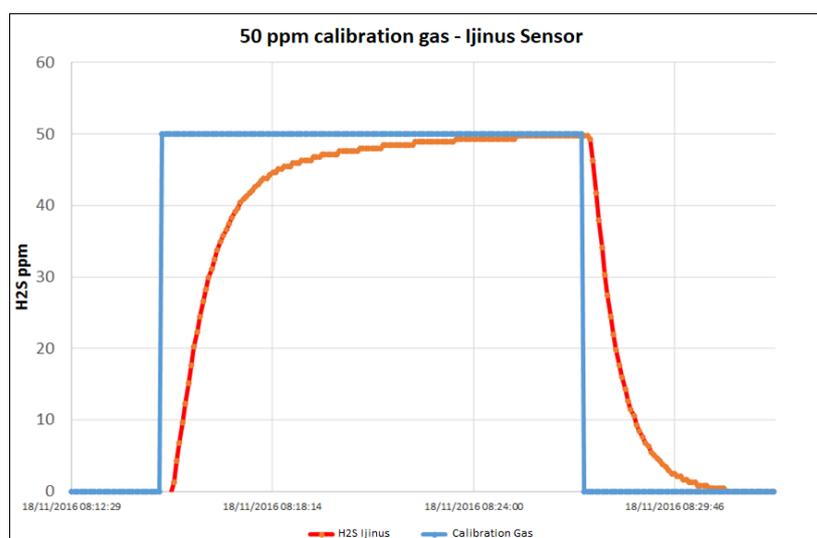
a filter



View of the cell from inside and outside the cartridge



With this model, the user can easily change himself the cartridge of the logger. For each cartridge, the calibration is done at Ijinus, Mellac, France, respecting special procedures and conditions. The general principal is to inject standard gas, to check cell dynamic and to adjust the calibration depending to the specificity of the standard gas used. The illustration below is shown as an example:



In its configuration the user has access to information but can't modified the calibration of the cartridge.

Two measuring ranges are available:

- The 0-200ppm cells are under manufacturer's warranty up to 500ppm,
- The 0-2.000ppm cells are under manufacturer's warranty up to 10.000ppm, but it is possible to use the data only to 6.000 ppm,

Finally, in the actual product version, values from the sensors are voluntarily formatted to ppm unit and compatible with SCADA such as Areal Topkapi (SMS/GPRS/3G), Lerne (V3 for SMS and V4 pour SMS/ GPRS), and Panorama from Codra (SMS).

The gas cells are therefore delivered already calibrated, ready to use. However, it is advised for the new cell to start their recording few hours before their first use on-site. It is important to ensure that elements are properly tightened.



In some applications, the range 0-200 ppm could be enough if the H₂S is not very often upper 200 ppm. In wastewater network (especially downstream of a lift station pressure pipe), the range 0-2.000 ppm seems the most adapted.

These sensors are often in a harsh environment and especially wet, so it is then essential to check:

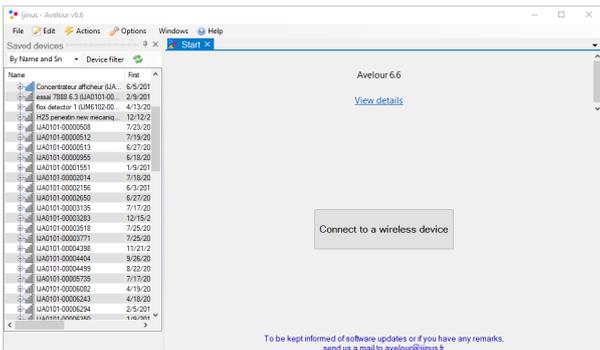
- tightening the cartridge on the logger
- tightening the piece holding the filter
- the general state of the filter: degradation, waste, humidity

5. Quick configuration with the Avelour software

We show here the classical version of the system configuration: H₂S concentrations (by electrochemistry) and temperature measurements and data sending by GSM/GPRS/3G.

a. Necessary equipment

- Avelour software in 6.6 version minimum
- An USB/HF configuration “Wiji kit” or “Wiji stick”



Avelour



Wiji kit



Wiji stick

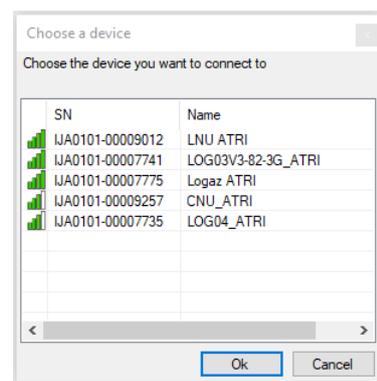
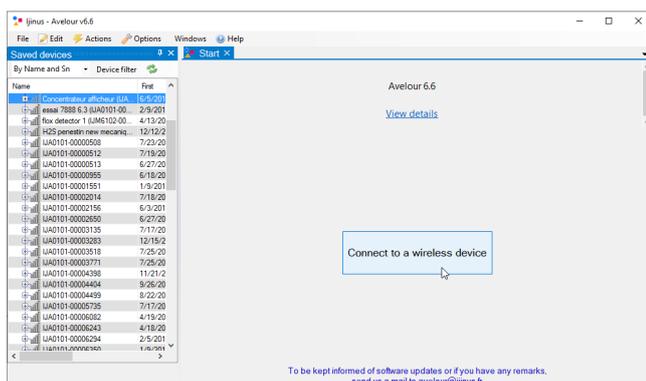
b. Prerequisite

- The material is considered to be directly functional (battery OK...)
- All indications contained in this document correspond to programming with Avelour in 6.6 version

c. First step: Run Avelour and connect to the sensor to configure

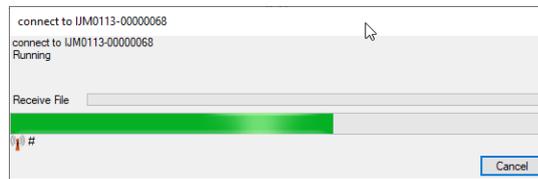
After connection of the Wiji kit equipped with its antenna (or the Wiji stick) on your laptop or PC USB port, run the software Avelour 6.6 version minimum. Click on the button “Connect to a wireless device” then the sensor or logger will be directly visible by its serial number (ex: IJA0101-0000 3559) without the need to activate anything else on the device. Locate the sensor's serial number (SN) on the sensor label and click "OK".

On the first connection with the sensor only the serial number will appear. The following connections will show also the name of the installation site or another name that you define.

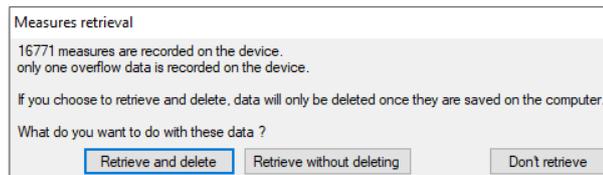


d. Second step: Selection of the sensor to configure, eventually a firmware update would be suggested

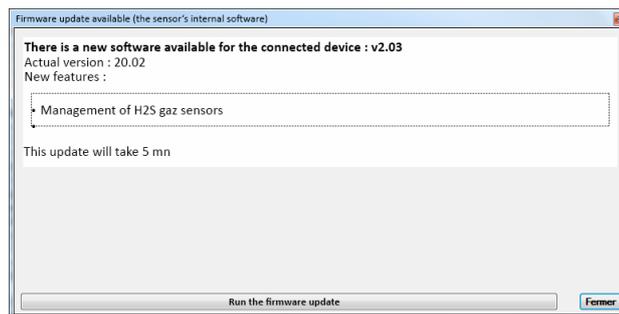
During its connection with the sensor, the following pop up appears:



When connected, and only if the sensor already has measures in memory, the following options will suggest you to retrieve the measures:

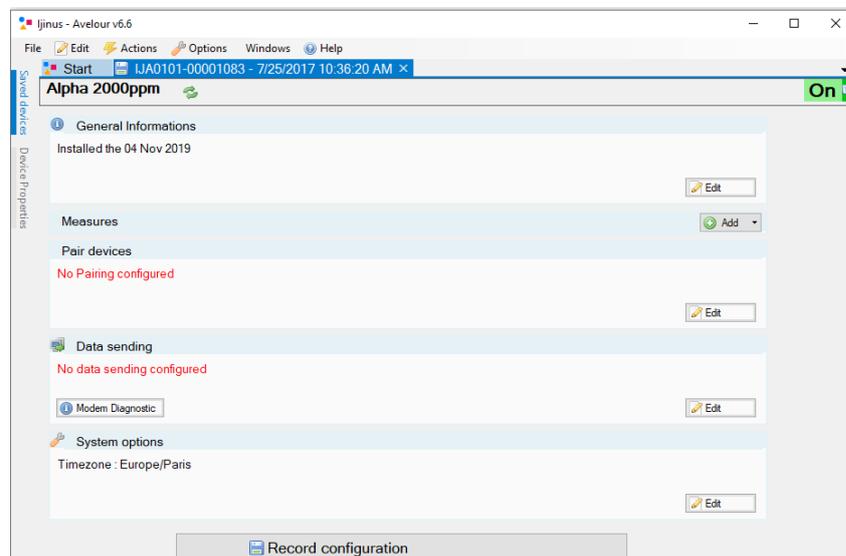


Then if the gas logger is not up to date (case of new firmware developed since your last connection, or a new version of the software), the bellow pop up appears. It is strongly advised to read carefully the different messages.



An update can take some time, so it is advised to do it at the office. On-site, prefer the best radio communication available (avoid doing it while the manhole cover is close).

Once the sensor is ready to be configured the following figure appears:



e. Third step: Configuration of H₂S concentration measurement

The configuration screen shown above is divided in several paragraphs. Each part will be detailed.

General information

This part is useful to describe the measurement point. The most important information would be the name that will help you to find your sensor at a future connection.

Measures

Choice of the measure to configure

This part is the most important, it allows you to configure your sensor. First, click on the button “Add”, then choose “H₂S concentration measure”.

Choice of the measure period

In this new menu, select the period you want the sensor to measure (in this example every 15min). To the right of the measure period selector, two little icons allowing a deferred programming according to the time period and day of the week you can choose from.

Choice of the working mode of H₂S concentration – case of Instant measure

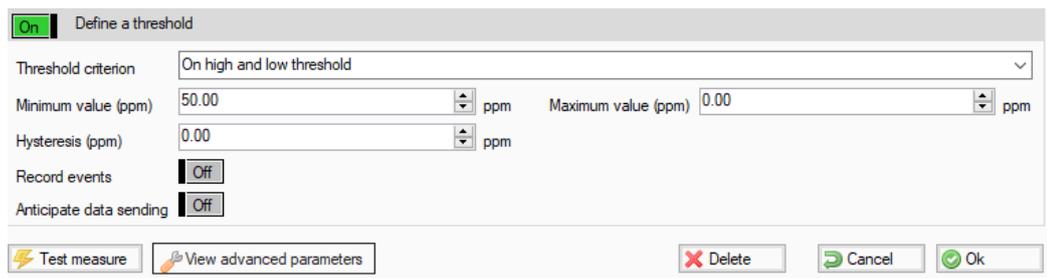
The most common and adapted mode for a measuring campaign is named “Instant measure”. You only need to keep this default selection and to press on OK. Here temperatures are also recorded by default.



Like for most Ijinius sensors, you can activate an option named “define a threshold”. You define it by:

- The choice of activation: under a value/above/on rise of at least xx ppm/On lowering of at least xx ppm/ On rise or on lowering of at least xx ppm/ On high and low threshold.
- Choice of the event recording, or choice of record as data. For example, “1” if the threshold is reached, and “0” if not or if this threshold is deactivated.

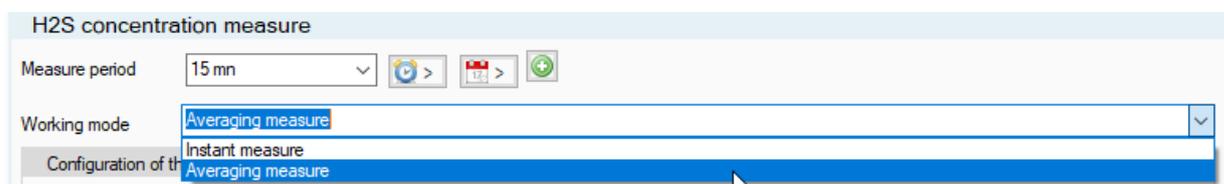
Finally, if your sensor as remote communication, anticipate data sending each time you have an event.



An advanced mode is available and let you manage memory recording mode (like looping memory), H₂S recording resolution.

Choice of the working mode of H₂S concentration – case of Averaging measure

In that case choose in the drop-down menu the option “Averaging measure” (average based on several measures before each measuring period).

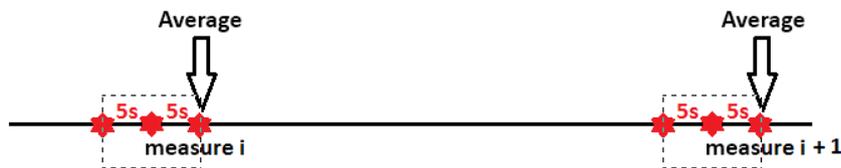


An explanatory diagram under this menu explain the principles of average calculation and the choice of the duration for its calculation.

The below example shows a measure period every 15 minutes, the sensor records the average of concentrations every 10 previous seconds. During this period some measures are done every 5 seconds (not changeable).

Configuration example :

Average on 10 secondes = 3 samples generated at 5 secondes interval, then averaged.



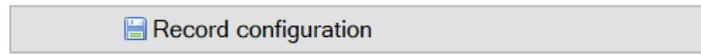
Finally, if you opt in this mode to “View the advanced parameters”, you have access to the number and type of integration (average, minimum or maximum), the option to consider negative concentration as null and the recording resolution.

Verification

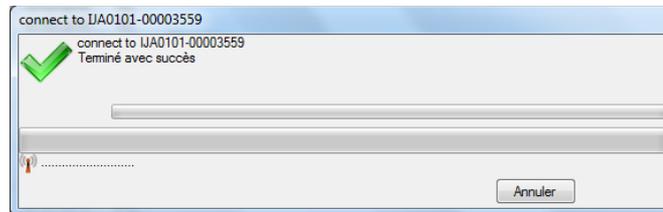
Once this configuration is done, a resume summarizes the different elements as shown below:

Finalizing the configuration: saving the parameters in the sensor

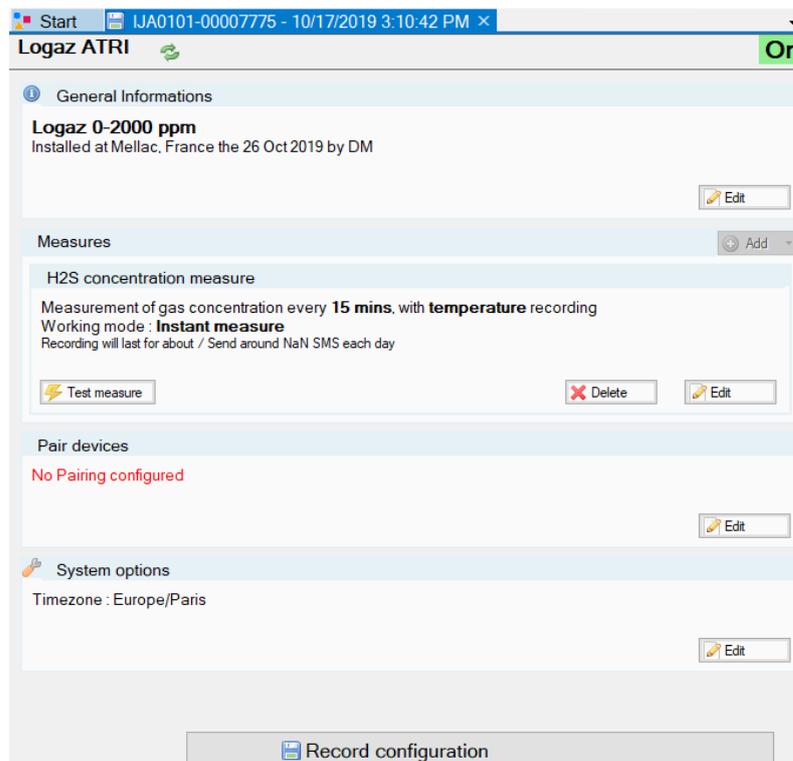
This operation is quite simple as the “Record configuration” button has to be clicked, but absolutely essential to send it to the sensor.



This operation opens a pop up showing this process.



A final check can be done: summaries are shown and the “On” green box at the upper right meaning the sensor is measuring according to your actual configuration.



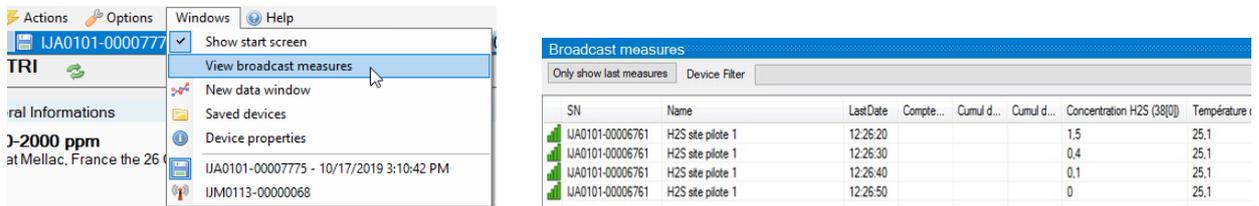
A functionality allows you to quickly stop the sensor (and also to restart it) for measuring and for data sending.

To do so, you need to click on the STOP logo on the top right. A Re-Start device button will appear.



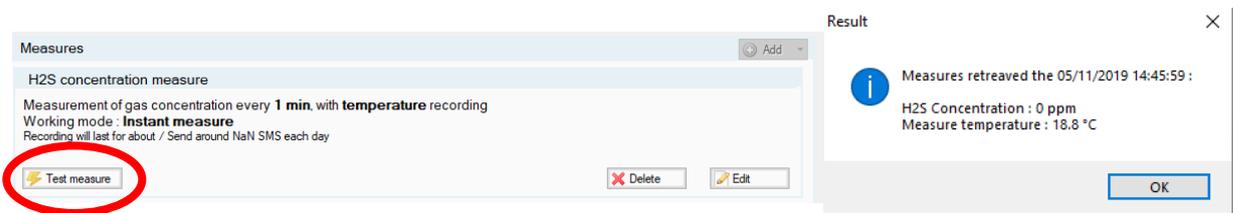
f. Fourth step: Data reading in real time

Traditionally, there are two possibilities for real-time reading: either by pressing the "Test measure" button or by selecting from the top menu, under "Windows", "View broadcast measures". This new window will show you the different measurement.



« Test measure »

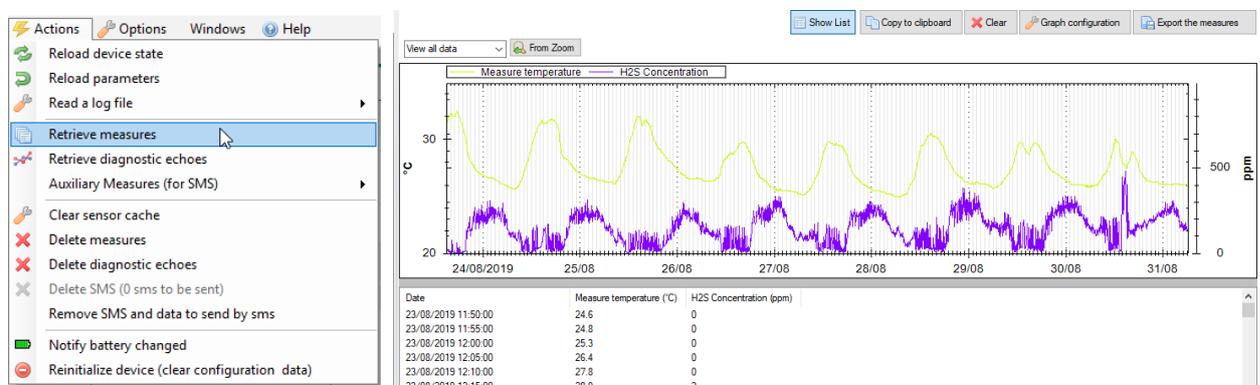
In the case of Instantaneous measurements, the value is proposed after few seconds.



g. Fifth Step: Retrieve and see locally your data by radio (without GPRS communication)

When connected to a sensor, the software directly asks you if you want to retrieve data. You can also find this command from the main menu: Menu > Actions > Retrieve measures.

You can view the data, even offline, on graph and list. A graph configuration module allows you to change colors, thickness of lines, ..., but also to apply statistical filters and formula to your data.



h. Sixth Step: Data export

From The graph and/or list of data you find the tab “Export the measures” with the choice of different files format and style of reports, from date to date, by month, or simply all data.



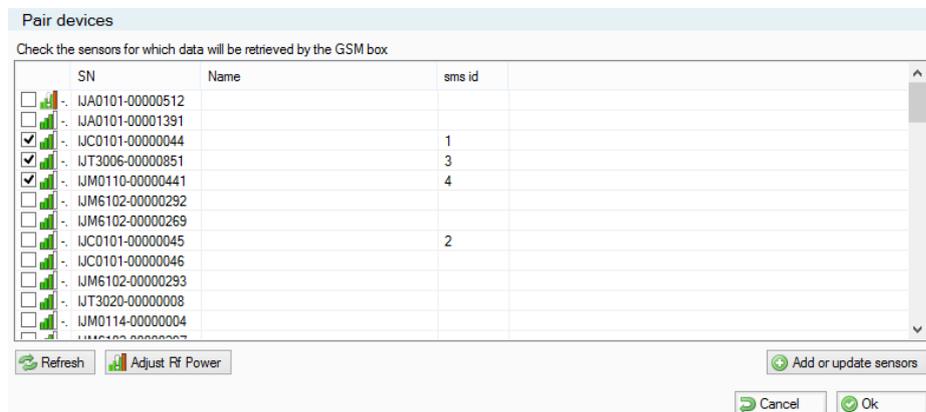
i. Seventh step: Pair devices

A sensor can be used, in addition to its main function to measure concentrations, as an access point (or master sensor). It can recover data wirelessly by radio from another sensor, at about 60m (i.e. in free field without obstacles), or if one of them is under a manhole cover and the other outside (in this case the distance rarely exceeds 5 to 6 m). The access point then retrieves the data from a sensor named slave. This possibility is called pairing and is performed from the sensor that retrieves the data from the other.

To do this you need to check in Avelour what devices this sensor can see around it. In the Pair devices part, click the Edit button.



Then you need to click the “Refresh” button to run the test. Simply tick the boxes corresponding to the devices you want to associate. The signal quality is shown while your cursor is over each signal bar. This radio quality signal doesn’t construe as the GSM/GPRS quality: -70 dBm is a bad signal quality for radio while excellent for GSM.



In the case of the wanted sensor is not available, you can refresh adjust the radio strength.

Pay close attention to the data meant to be sent to SCADA (Lerne, Topkapi for example):

- The channel number used by some SCADA to associate device data is by default (so not changeable by software) 0 for a logger/access point or a single sensor (measure and integrated communication),
- Then channel numbers for the paired sensors are set by "sms id" (1 in the above example for the first sensor). Each paired sensor has a unique « sms id ».

Most of the SCADA have configuration templates but usually 2 configuration types: sensor with communication (often named V3) set to channel 0, and the logger with communication (set to channel 0) paired to a single sensor (set to channel 1). In the case of a sensor is set in channel other than 1, we invite you to contact your SCADA referent to ensure a good data decoding.

j. Eighth step: Data sending

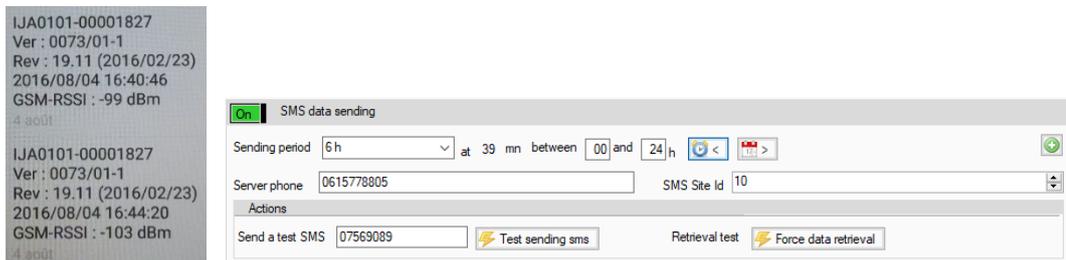
As mentioned at the beginning of the document, various sending types are available, in particular SMS and GPRS/3G/Ftp. In this part we get a closer look at the sending configuration. Advices on the operator choice, the antenna, positioning, will not be detailed here. **Kept in mind that if the selected operator does not allow to phone or send a text message in surface, it will be even worse under the manhole cover.**

Sending by SMS (2G)

After ticking "SMS data sending", which now appears in green, the configuration can start.

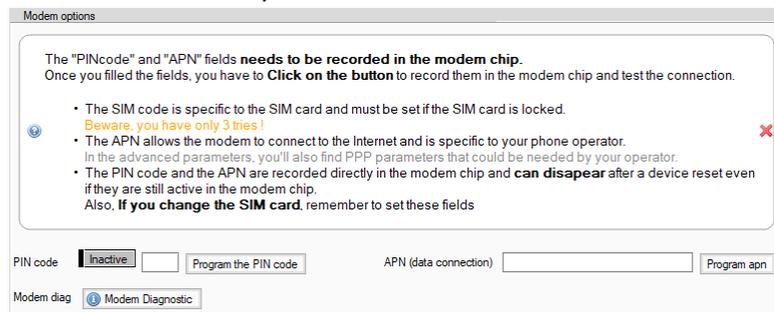
SMS sending has the following options:

1. Choice of the sensing period, and the number of SMS sent per day. You can also define hourly periods and particular days to send data,
2. The number of the server where you send the data,
3. In the case of sending data to a SCADA using sites identification, you have to set the “SMS site id”
4. “Test sending sms”: after typing your mobile number, press the button once your sensor is installed under the manhole cover (closed). The received SMS shows the GSM signal strength like in bellow example (Gsm RSSI between -99 and -103 dBm with several sending). This test is not meant to send data to your mobile, but basic information about the sensor serial number, firmware version, GSM signal strength, and date and time.
5. Finally, the test named “Retrieval test” allows to check the point 1 to 4, to directly send data to the server number. This test is only useful if there are already some data in the sensor. It must be checked with data present on the server/SCADA.

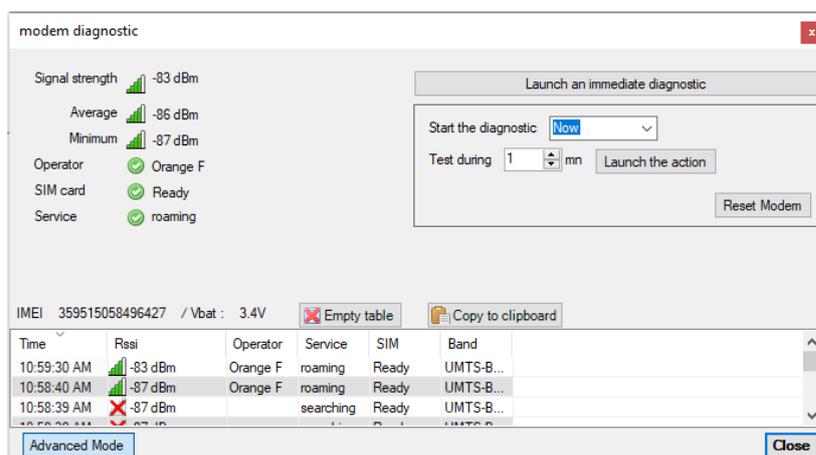


Modem options enable:

- To activate/disactivate PIN code if necessary



- To launch a “Modem diagnosis”: this test is particularly important as it provides the reception quality of your SIM card operator. A longer diagnosis (choice of duration) will allow for example to test different antenna positions on the top of the manhole by visualizing the gain or loss of signal quality.



Without detailing this part, some important points:

- This test must be done before and after installation,
- It can also be used for testing different antennas, at different positions or directions, ...
- An encrypted RSSI result (like -95 dBm) without an operator name, is most often the signal quality of a cellular network called emergency: it will not allow data sending.

Finally, two particularly useful options in the "Advanced parameters":

- 1) Add a front-end number in "Second server" offers the possibility of sending sms to two SCADA (therefore in duplicate): often for verification purposes for example a doubt about the front number of a supervisor,
- 2) The "number of attempts" to send sms (here by default to 3): in case of bad communication during the first data sending, the sensor retries 3 times in a row.

As in previous paragraphs, once this configuration is validated by clicking "OK", check the synthesis, ...

... and press the "record configuration" button to send it to the sensor's memory.

Sending by GPRS / 3G / FTP (excluding sending in .csv format)

After ticking “GPRS / 3G / FTP data sending”, which now appears in green, the configuration can start.

Like we have seen for in the SMS data sending chapter, choose the sending period (s) and:

- An FTP username (or use the one programmed by default that send data to our web service **ijitrack.com**). It is a necessary parameter to connect to a data server. This name has to be configured on this server, you can ask your administrator. Note that currently only non-secured FTP is accessible directly. In case of other FTP type, please contact us for another solution.
- The APN: You can get it from your phone provider sim card.

When you pass over the word APN, the main French operators APNs are reminded for your information:

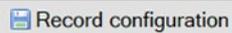
- Matooma : matooma
- Matooma Business Everywhere : m2mdata
- Orange Business : internet-entreprise
- Orange M2M : orange.m2m
- Orange : orange.fr ou orange
- Free : free
- Bouygues Pro : b2bouygtel.com, mmsbouygtel.com ou a2bouygtel (PPPUser=a2b,PPPpass=acces)
- Bouygues : ebouygtel.com
- SFR M2M : m2minternet
- SFR : s2sfr, websfr, slsfr, wapsfr

The “Alert parameters” allow to configure a minimum security time between each alert, to trigger alerts depending on a state of another sensor, present in its radio field.

Depending on the configuration of your receiving server, you can specify other connection options, to see them, click "View advanced parameters". These are generic FTP options that the server administrator will be able to provide to you.

The advanced GPRS / Network options are only there to solve specific problems when connecting. It is not recommended to modify them without asking your technical support.

As for the previous paragraphs, once the configuration validated by a click on "OK", it is necessary to check the synthesis, then press on "Programming the equipment".

 Record configuration

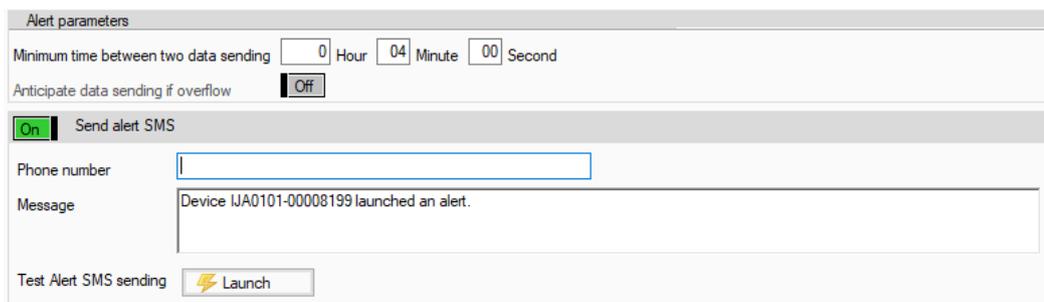
Data sending by GPRS / 3G / FTP in *.csv format

To use this feature, you need a tick the "Sending data via GPRS / 3G / FTP" box, then program the different elements, press the button "View advanced settings". In the "Sent files options" you can activate "Send as CSV files" to "On", and possibly modify the separator.



Sending SMS alert on the mobile phone of an operator (like a person on-call duty)

It is now possible to send a text message directly to a mobile phone as for anticipated data sending. To do this, change to "Yes" the option "Send SMS alert", enter the mobile of this person then the message to send. The "Launch" button allows you to test it. Have a try.



6. Elements for good practice and installation examples

Regarding measurement principles, good practices such as installation, maintenance or servicing, we propose here, and without being exhaustive, only a few key elements such as:

- The H₂S gas can be dangerous for the health, it is therefore advisable for the user to take all the precautions of use,

- H₂S gas is heavier than air so the concentrations of a sensor (and therefore a detector too) positioned at different levels can give significantly different results. This is all the more notable when installed in a site with air displacement (just as it is downstream of a backflow),

- According to the sites, H₂S concentrations can change very quickly. As a comparison, if the time taken to measure the water level in the sewerage network is often 5 minutes, in H₂S the measuring period of unknown sites for H₂S are generally rather between 30 s and 1 min. A time step that is too big with instantaneous measurements may not be enough to understand the operation of the site, so that it does not have representative measurements. The choice of the measuring period is therefore an essential element during the installation,

- In the case of communicating sensors, if the measuring periods are small as mentioned below, it is necessary both to optimize the communication (good reception level) and to have suitable sending delays (for example some main measures every 30s must correspond to a data sending every 3 hours maximum),

- Even if the current sensors include a filter (adapted to H₂S gas, so specific) to both filter the air and make the measurement more effective, it can also load moisture and make the measurement less reliable. The good practices with respect to moisture are as follow:
 - a. In the case of sites with very high ambient humidity: plan to check the sensor at weekly rate, mainly the humidity of the filter. In doubt, let the sensor dry in an office environment for example, or change the filter with attention to check that there is no moisture under the filter,
 - b. In the most common cases in sanitation, so with a moderate humidity environment, a verification rhythm between 1 and 3 months seems sufficient. The check, drying or filter change is the same as before,
 - c. In all other cases, an on-site verification or laboratory calibration should be done every 6 months on average,
 - d. Finally, all sensors that have been exposed to significant and regular concentrations (>200ppm) and / or temperatures (> 30 ° C) should be checked more regularly.



Pictures of an unused cartridge, filter and cell



Pictures of a sensor placed too close from a waterfall (outlet of a pumping station): the filter on the left and the cell on the right part. The cell cannot be used anymore.

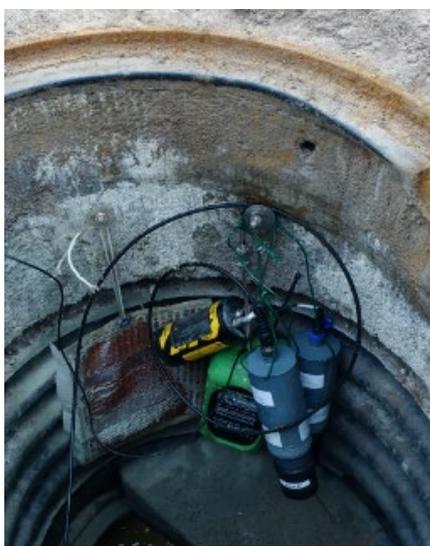
- The head of the measuring cartridge must of course be cleaned of the different wastes,
- Calibration or verification of the gas cartridge is essential. The most common frequency (classical urban sanitation, moderate humidity, moderate exposure, etc.) of this calibration / verification is between 6 months (recommended) and 12 months (not to be exceeded). In case of high humidity, higher concentrations, this period will obviously be reduced. This is all the more crucial in the case of measurement on industrial effluents.
- If the date of the last calibration is more than 6 months old, then Avelour will display an alert message. This alert will not avoid the sensor to measure the H₂S concentration. Furthermore, the cumulative number of days since the last calibration is sent when sending data by SMS or GPRS.
- As on the entire Ijinus range of sensors, batteries are interchangeable on sites. It is always difficult to provide battery autonomy because it depends on the conditions, measuring periods, sending periods and especially the network quality during sending. As an indication here are some elements for sensors equipped with a double battery 3.6V 34 Ah, whose autonomy is about 2.5 years:
 - a. For a non-communicating logger, and measurements every minute,
 - b. For a communicating logger, sending data in GPRS every 6 hours, and measurements every 3 minutes.

Finally, some illustrations of installed sensors (most of the photos come from our 8 pilot sites which allowed the comparison and validation of the results of our sensors compared to others on the market):

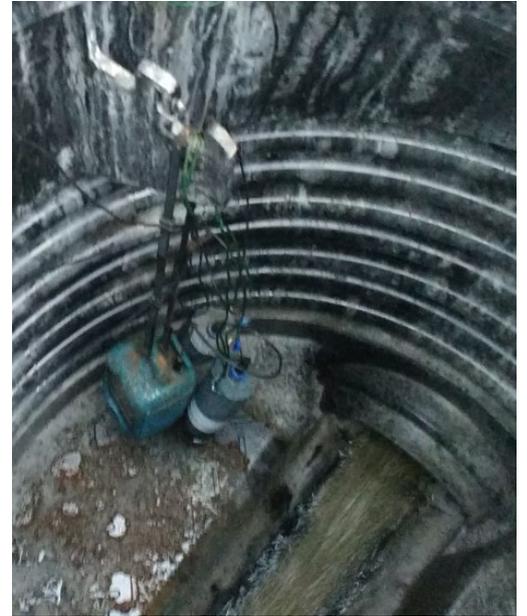
Suspended from a ladder rung, with a cable or stainless-steel sling.



Hanging from an anchor positioned in the concrete, usually in the last part of manhole under the cover. In this case, fasteners with slings made of stainless steel or other chains are commonly used.



Suspended to an existing fixation or support in the case of HDPE manhole. In this case, fasteners with slings made of stainless steel or other chains are commonly used.



7. Datasheets

For the measuring range 0-200 ppm:

Hydrogen Sulphide CiTiceL® Specification



7H/LM CiTiceL®

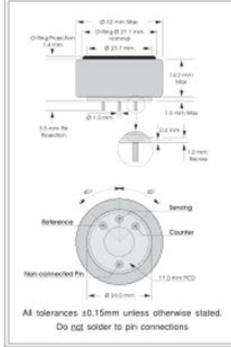
Performance Characteristics

- Nominal Range: 0-200ppm
- Maximum Overload: 1000ppm
- Expected Operating Life: Two years in air
- Output Signal: $0.37 \pm 0.07 \mu\text{A/ppm}$
- Resolution: 0.25ppm
- Temperature Range: -40°C to +50°C
- Pressure Range: Atmospheric $\pm 10\%$
- Pressure Coefficient: $0.008 \pm 0.002 \%$ signal/mBar
- T_{90} Response Time: ≤ 35 seconds
- Relative Humidity Range: 15 to 90% non-condensing
- Typical Baseline Range (pure air): -0.6 to +1.9ppm equivalent
- Maximum Zero Shift (+20°C to +40°C): 2ppm equivalent
- Long Term Output Drift Resistor: $< 2\%$ signal loss/month
- Recommended Load Resistor: 10k Ω
- Bias Voltage: Not required (See Application Note #7)
- Repeatability: 1% of signal
- Output Linearity: Linear

N.B. All performance data is based on conditions at 20°C, 50%RH, and 1013mBar

Physical Characteristics

- Colour of Top: Dark Blue
- Weight: 12g
- Position Sensitivity: None
- Storage Life: Six months in CTL container
- Recommended Storage Temperature: 0-20°C
- Warranty Period: 12 months from date of despatch



All tolerances $\pm 0.15\text{mm}$ unless otherwise stated. Do not solder to pin connections.

IMPORTANT NOTE: Connection should be made via PCB sockets only. Soldering to the pins will render your warranty void.

TESTING: 7H/LM Hydrogen Sulphide CiTiceLs should be tested monthly to confirm sensitivity and response time are adequate.

For the measuring range 0-2.000 ppm:



H2S-BE Hydrogen Sulfide Sensor

High Concentration



PATENTED

Technical Specification

Figure 1 H2S-BE Schematic Diagram



All dimensions in millimetres ($\pm 0.1\text{mm}$)

PERFORMANCE			
Sensitivity	nA/ppm in 200ppm H ₂ S	80 to 115	
Response time	t ₉₀ (s) from zero to 200ppm H ₂ S	< 50	
Zero current	ppm equivalent in zero air	< ± 3	
Resolution	RMS noise (ppm equivalent)	< 0.5	
Range	ppm H ₂ S limit of performance warranty	2,000	
Linearity	ppm error at 2000ppm, linear at zero and 400ppm H ₂ S	< 30	
Overgas limit	maximum ppm for stable response to gas pulse	10,000	
LIFETIME			
Zero drift	ppm equivalent change/year in lab air	< 0.25	
Sensitivity drift	% change/year in lab air, monthly test	< 3	
Operating life	months until 80% original signal (24 month warranted)	> 24	
ENVIRONMENTAL			
Sensitivity @ -20°C	% (output @ -20°C/output @ 20°C) @ 200ppm	83 to 92	
Sensitivity @ 50°C	% (output @ 50°C/output @ 20°C) @ 200ppm	102 to 112	
Zero @ -20°C	ppm equivalent change from 20°C	< ± 4	
Zero @ 50°C	ppm equivalent change from 20°C	< ± 4	
CROSS SENSITIVITY			
NO ₂ sensitivity	% measured gas @ 10ppm	NO ₂	< -25
Cl ₂ sensitivity	% measured gas @ 10ppm	Cl ₂	< -12
NO sensitivity	% measured gas @ 50ppm	NO	< -10
SO ₂ sensitivity	% measured gas @ 20ppm	SO ₂	< -20
CO sensitivity	% measured gas @ 400ppm	CO	< -4
H ₂ sensitivity	% measured gas @ 400ppm	H ₂	< -0.2
C ₂ H ₄ sensitivity	% measured gas @ 400ppm	C ₂ H ₄	< -0.25
NH ₃ sensitivity	% measured gas @ 20ppm	NH ₃	< -0.1
KEY SPECIFICATIONS			
Temperature range	°C	-30 to 50	
Pressure range	kPa	80 to 120	
Humidity range	% rh continuous	15 to 90	
Storage period	months @ 3 to 20°C (stored in sealed pot)	6	
Load resistor	Ω (recommended)	10 to 47	
Weight	g	< 13	

At the end of the product's life, do not dispose of any electronic sensor, component or instrument in the domestic waste, but contact the instrument manufacturer, Alphasense or its distributor for disposal instructions.

None of sensors are tested at standard environmental conditions, with 10 day lead resistor, unless otherwise stated. An application of use are outside our control, the information provided is given without legal responsibility. Customers should test under their own conditions, to ensure that the sensors are suitable for their own requirements.

Alphasense UK Sensor Technology House, 380 Avenue West, Skipton, UK, Great Wharfedale, G87 7AA, UK
Telephone: +44 (0) 1753 558 755 Fax: +44 (0) 1753 558 999 E-mail: sensor@alphasense.com Website: www.alphasense.com

8. Document history

Date	Revisions	Writer(s)	Evolution
06/20/2017	A01	M. Zug	Creation
11/02/2017	02A1	D. Mahé	Translation
11/19/2019	03A1	A. Triballier	Update