atim cloud wireless™
PRODUCT LINE

Atim Cloud Wireless®

Temperature, humidity and air quality sensor (CO2, VOC)

User Guide

Affected models:

ACW/LW8-THAQ

ACW/SF8-THAQ

LoRaWAN™

sigfox ready

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Table of Contents

This user guide is applicable to the following references

	Product references	Product Version (Visible on the product label)
LoRaWAN	ACW/LW8-THAQ	A.8
Sigfox	ACW/SF8-THAQ	A.8

Version history of this document

Version	Date	Description	Author	Affected software version
0.1	23/11/2020	Creating the document	AC	V0.0.1
0.2	10/12/2020	Descriptive correction frame downlink datalogging	AC	V0.0.1
1.0	15/02/2021	Addition of Air quality (sensor, config, frames) + description of Downlink frames for temperature compensation	AC	V0.0.2
1.1	29/03/2021	Addition of CO2	AC	V0.0.2
1.2	12/05/2021	Addition of Downlink frame for the configuration of the $CO_{2\ sensor}$ + update of the configurator chapter + explanation of the air quality indicator	AC	V0.0.3
1.3	22/06/2021	Addition of an explanatory note on the order of the samples in the measurement frame Description of the compatibility mode with the LoRa/LoRaWAN and FSK/Sigfox repeater Changed the description of how LEDs work when searching for a network.	AC	V0.0.4
1.4	27/09/2021	Added information about new product features Adding a descriptive configuration of the new settings	AC	V1.0.0
1.5	10/03/2022	Various corrections and additives	FR	V1.0.0
1.6	15/03/2022	Patches	MD	V1.0.0
1.7	11/04/2022	Addition of CO2 sensor calibration	YL	V1.0.6
1.8	27/01/2023	Patches	FR	V1.0.6
1.9	07/11/2024	Clarification on the period of issuance. Added setting for automatic CO2 sensor calibration	YL	V1.0.10
1.10	05/05/2024	Correction sensor activation control	YL	V1.0.10

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Declaration of Conformity

All ACW (Atim Cloud Wireless®) products comply with the regulatory requirements of Directives 2014/53/EU (RED) and 2011/65/EU (RoHS):

CE

1 Safety (Article 3.1a of Directive 1999/5/EC)

NF EN60950-1 2006/A1:2010/A11:2009/A12:2011/A2:2013 (*health*)

EN 62311:2008 (power > 20mW) EN50385 EN50581

2 Electromagnetic compatibility (Article 3.1b of Directive 1999/5/EC)

EN 301489-3 V2.1.0, EN 301489-1 V2.1.1

3 Efficient use of the radio frequency spectrum (Article 3.2 of Directive 1999/5/EC)

ETSI EN300 220-2 V3.1.1

Environmental recommendations

a. Environment

Observe the storage and operating temperature ranges of the products. Failure to do so could disrupt operation and even damage the equipment.

This equipment is not designed for an outdoor environment!

Follow the precautions and instructions listed below to ensure your safety and the safety of your environment and to prevent damage to your device.

General Hazard *– If instructions are not followed, there is a risk of damage to equipment.*

WARNING *: Do not install equipment near a heat source or near a source of moisture.*

This symbol on the product or on its packaging indicates that this product should not be disposed of with your other household waste. Instead, it is your responsibility to dispose of your waste by taking it to a designated collection point for the recycling of electrical and electronic devices. Collecting and recycling your waste separately at the time of disposal will help conserve natural resources and ensure recycling that is environmentally friendly and human-friendly. For more information about the recycling centre closest to your home, contact the nearest town hall, the household waste disposal service or the shop where you purchased the product.

b. Radio

The ACW series modems are part of the radio communication modems using the ISM (Medical Scientific Industry) bands that can be used freely (free of charge and without permission) for industrial, scientific and medical applications.

Technical characteristics

a. Product

Size	80 x 80 x 35 mm	
Antenna	Built-in (1/4 wave)	
Temperature	-20°C to +55°C (Operating)	
	-40°C to +70°C (storage)	
Fixation	Wall	
Package	Home automation	
Feeding	1 x 3.6V / 7.2 Ah battery pack	
Weight	100 g	
Frequency	863 – 870 MHz	
Power	25 mW (14 dBm)	
Debit	Sigfox: 100 bits/s	
	LoRaWAN: 300 bit/s to 10 Kbit/s	
Consumption	Sigfox	LoRaWAN
Mode Tx	60 mA	55 mA
Standby mode	60 µA	60 µA
Mode Rx	50 mA	25 mA

b. Functions of the integrated sensors

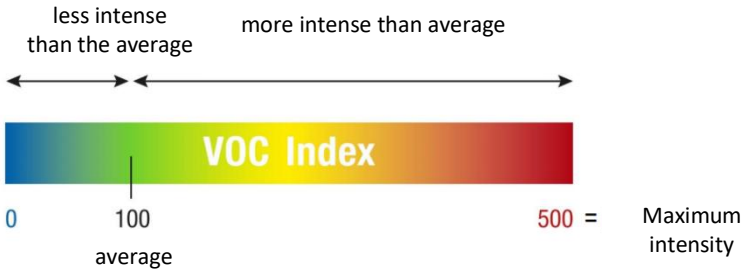
Temperature sensor	
Beach	-40°C to +125°C
Resolution	0.01°C
Accuracy between -40°C and +80°C	+/- 0.2°C

Humidity sensor	
Beach	0 to 100%RH
Resolution	0.01%RH
Accuracy between 0%RHC and 100%RH (Operating Range)	+/- 2 %HR

VOC sensor	
Beach	0 to 500
Resolution	1

IMPORTANT NOTE
The VOC index represents the overall concentration of all VOCs (volatile organic compounds) and not a specific concentration of a given compound. The index is defined on a scale from 0 to 500 (0 for a near-zero VOC concentration and 500 for a very high VOC concentration). The scale above provides an approximate representation based on colors) above provides a representation of the

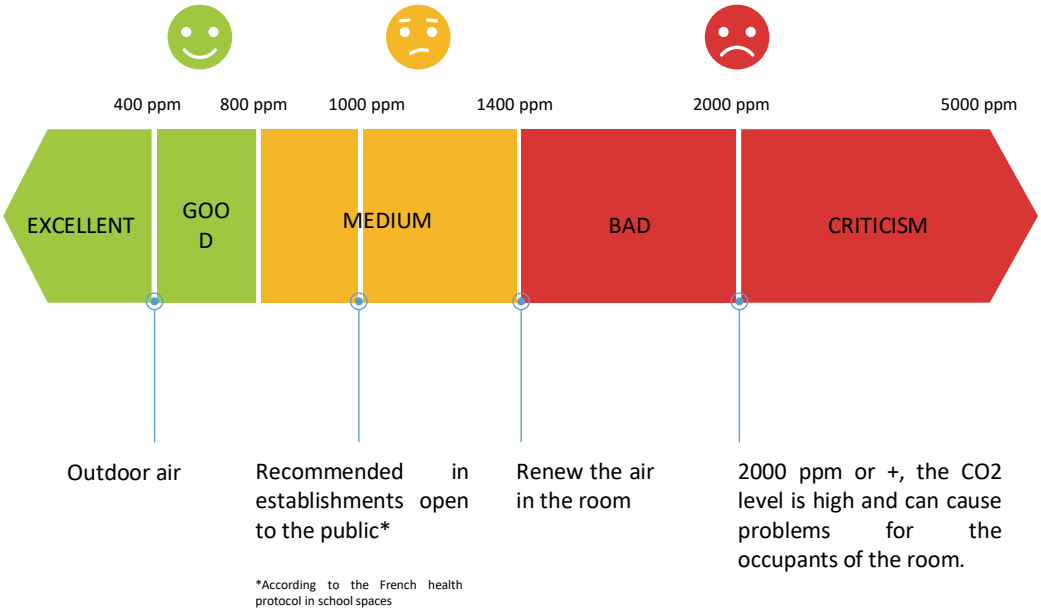
The scale (without approximate units based on colors):



CO2 sensor	
Beach	0 to 40,000 ppm (particles/million)
Resolution	1 ppm
Accuracy between 400 ppm and 5000 ppm	± 40 ppm (+5% of measured value)

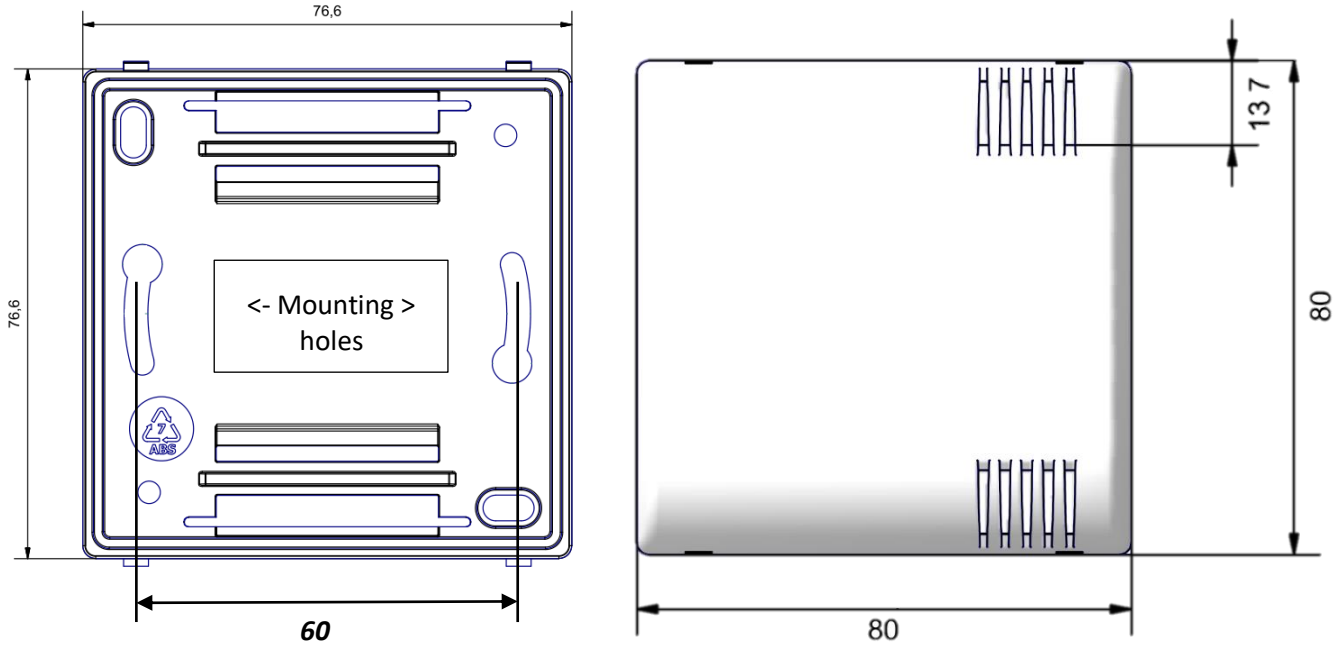
IMPORTANT NOTE
The CO2 measurement represents the concentration of carbon dioxide in the ambient air. In general, the measurement will rarely fall below 400 ppm, this value being the minimum detection limit in outdoor air.

Here is an indicative table on air quality according to CO2 concentration:



Case

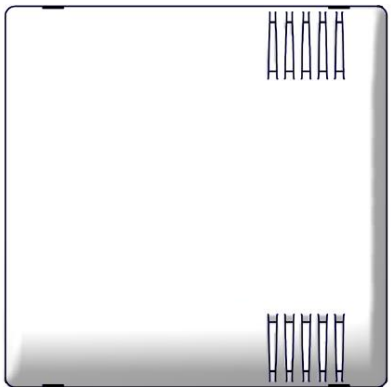
a. Traffic congestion



b. Fixation

The ACW-THAQ is attached to a wall by two screws that fit into the two mounting holes on the back of the case.

The lid vents must be on the right, in the same direction as the photo opposite.



Match the pivots at the top of the base of the case with their respective locations on the back.

To disassemble both sides, place a screwdriver in one of the two mounting areas at the bottom* of the front panel and press inward until the base cover is released.

* It is imperative to open the case from the bottom; opening from the top can damage the circuitry.

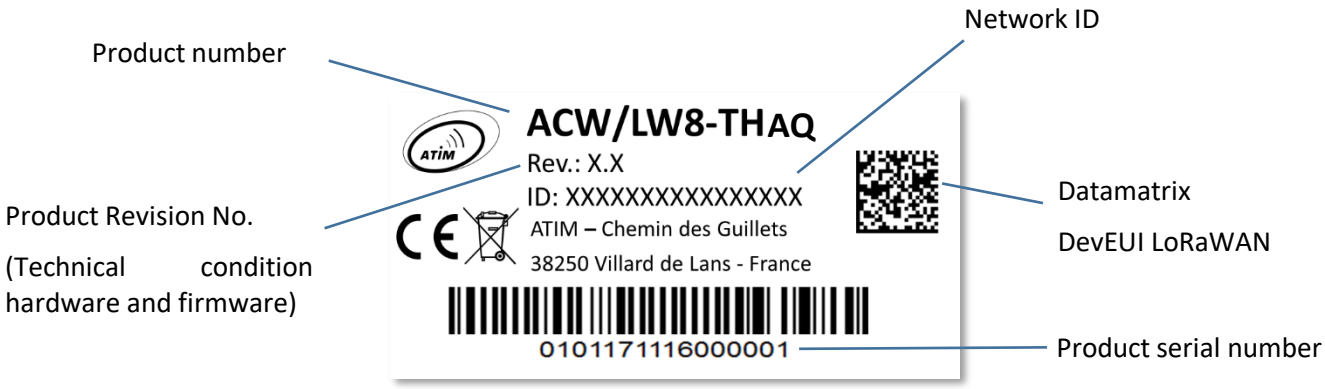
c. Installation

For optimal results, it is recommended to install the box without environmental obstructions and to place it at a height of about 1m50. For information, the antenna is integrated into the box. It should be mounted on a vertical stand, or attached to a wall.

d. Identification

The Sigfox or LoRaWAN identifier of the product is visible on the outer label on the back of the product, on the inside on the electronic board, and in the status bar of the ACW configurator.

For LoRaWAN modems, the communication keys are automatically given by the network (pairing by "Over The Air Activation", or OTAA).



ACW-THAQ Label

Operation

a. How it works

The 2020 new generation ACW (Atim Cloud Wireless®) products are all based on the same internal software (Firmware) and bring exciting new features such as selecting and visualizing their mode of operation. To find out the state of the product, simply run a magnet briefly (<2 sec) against the QRCODE label, which causes the LED indicator light to light up in the corresponding colour:

Deep Sleep Mode : When you take the product out of its packaging, it is in this deep sleep mode by default, which optimizes battery life by preventing battery oxidation. The product does not emit and waits patiently for it to be woken up.

Network Pairing Mode: This mode is active when the product wakes up from deep sleep mode and allows pairing to a network (automatic in case of battery change).

Configuration mode: this mode is active **5 minutes** after waking from deep sleep mode and allows the product to be configured via **Bluetooth** using the PC configurator or the ATIM mobile app. During these 5 minutes, messages are sent by radio every minute (5 "radio frames"), which allows you to check that the product is working well, for example after placing it under a cast iron manhole. After this period, the product goes into operation mode and Bluetooth is disabled (it can be reactivated via **Downlink**).

Operation Mode : This is the default mode after the product startup phase. In this mode, the module periodically sends measurements depending on the configuration applied (if the product has never been configured, the factory configuration applies, cf. Factory Configuration).

Internal Fault Mode: This mode allows the normal operation of the module to be interrupted when a critical event occurs. The nature of the event can be multiple:

- Empty battery (Battery voltage< 2.2V)
- Internal error of the radio module
- System Error

Entry into this "Internal Fault" mode is indicated by a RED flashing of the product LED

If the error is not from the radio module, the product will send 3 radio frames every 24 hours containing the error code(s) (see Frame Format chapter for error codes). In addition, the product will emit a light warning depending on the nature of the event.

Once in this mode, the module must be restarted (by disconnecting and then reconnecting the battery, by Downlink command or with the magnet) to return to normal operation.

b. Product Commissioning

Unless otherwise requested, ACW products are delivered with connected batteries and put into "deep sleep" mode.

To place the product in its operating mode, hold a magnet against the QRCODE label for **6 seconds**. During these six seconds, the product's LED should flash **WHITE** and then **GREEN** at the end of the six seconds to indicate that the product has started successfully.

The ACW then enters the network peering phase. During this phase, a **FUSCHIA** light signal with a fade effect indicates that the research phase is in progress.

In case of successful connection, the product will emit a light signal indicating the quality of the network:

- GREEN light signal : good network quality
- YELLOW light signal : average network quality
- ORANGE light signal : poor network quality
- WHITE light signal : no information on network quality

The module will then enter its operating mode and start to send the information back to the network depending on the configuration.

NOTE
The LoRaWAN version, in case of connection failure, will go into simple sleep and make a next pairing attempt the next day and every day until it succeeds in joining the network.

Special case

For a Sigfox product

- To have information on the quality of the Sigfox network (GREEN, YELLOW or ORANGE light signal), it is necessary to provision a Sigfox Downlink. It is this that will make it possible to rule on the quality of the network. The product emits a test uplink at startup as described in the Classic Frame (0x02 Frame Type) chapter. If a Sigfox Downlink is provisioned, the information on the network quality will then be reported by the ACW (light signal). If no downlink is provisioned, then the ACW will always show the WHITE light signal at the end.
- If a WHITE light signal at the end of the 5 minutes of the pairing phase is emitted by the product and a Downlink has been provisioned, it means that the Network is not accessible.
- If a WHITE light signal at the end of the 5min of the pairing phase is emitted by the product without a downlink having been provisioned, this has no significance for the quality of the network. The quality of the network can be good or bad (or non-existent).

For a LoRAWAN product

- In the default LoRAWAN Class A operating mode, (see Radio Parameter chapter), if at the end of the 5 minutes of the pairing phase, no network has been joined, then the product goes to sleep and will restart a 5-minute

pairing phase 24 hours later. Thus, if the product is placed in an area not yet covered by a network, the product will join it when connectivity is possible. There is no need to intervene on the product for it to join the network.

- In the LoRa/LoRAWAN Repeater Compatibility operating mode, (see Radio Parameter chapter), if at the end of the 5 minutes of the pairing phase, no network has been joined, then the product emits a WHITE light signal and enters its nominal operating mode. Even if no network has been joined, it is assumed with this mode that a nearby ATIM LoRa/LoRAWAN repeater will be able to repeat the Local frames emitted by the LoRAWAN frame product on the network that the repeater has joined.

c. Sending a test frame

When the product is in its operating mode **(and only in this mode),** it is possible to emit a test frame (which avoids waiting for the next measurement frame) including a measurement sample.

To do this, simply hold the magnet close to the QRCODE label, which lights up the LED GREEN and wait for it to turn off before immediately removing the magnet. The successful sending of the test frame will be indicated by a CYAN light signal.

d. Deep Sleep

When transporting or storing the ACW-THAQ, it is best to place it in its deep sleep mode to limit unnecessary energy consumption.

From any operating mode (except in fault mode), bring a magnet close to the QRCODE on the case for **6 seconds**.

During these six seconds, the product's LED will flash with the color corresponding to the operating mode and then the end of the sequence will be indicated by a WHITE fade acknowledging that the product has been put to sleep. The magnet can therefore be removed.

e. Radio Module Activity

Any radio frame emission is normally indicated by three short flashes of GREEN color from the LED. This feature is disabled by default on all products with an LED on the front panel, such as the ACW-THAQ and ACW-WL.

f. Threshold exceedance

When thresholds have been configured using the configurator and the measurement values exceed these thresholds, the LED of the product emits an ORANGE periodic flash to notify this. This feature is disabled by default on all products with an LED on the front panel, such as the ACW-THAQ and ACW-WL.

g. Magnet substitution

It is possible to use the push button on the ACW-THAQ board to perform the same actions as the magnet (turn the product on or off, turn Bluetooth on/off).

To do this, open the case and press the push button twice simultaneously. A white blink indicates that the button is now acting as the magnet (**button pressed = magnet approached**, refer to the chapters Product Commissioning, Sending a Test Frame and Deep Sleep above for information on how to use the button).

WARNING
Once the manipulations are complete, press the button twice again simultaneously so that it returns to its main function. A white flash indicates that the manipulation was successful.

h. Passivation of batteries

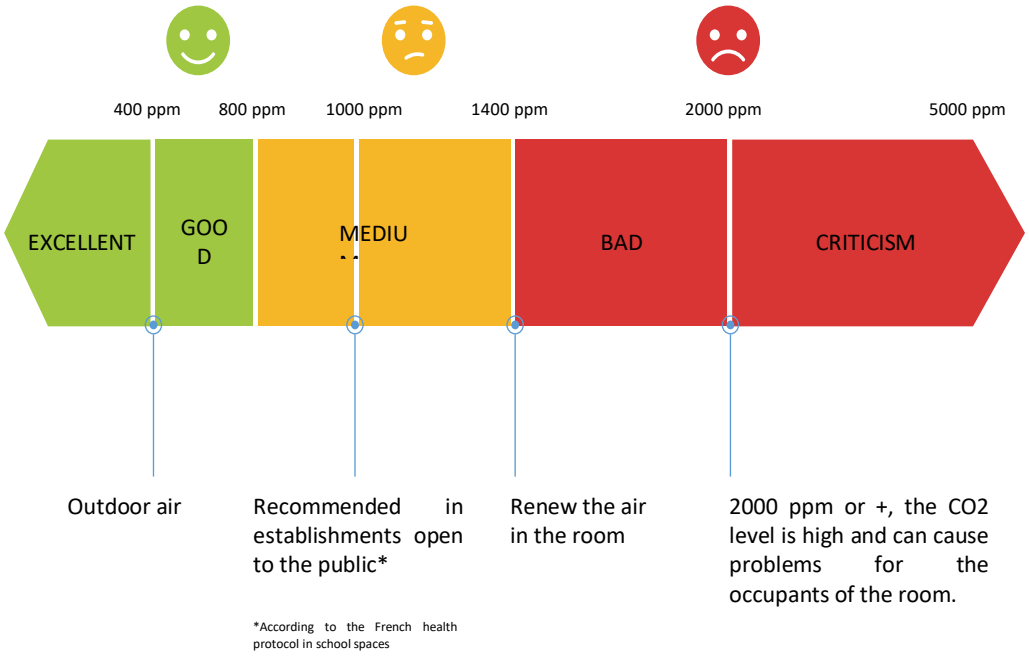
All new generation ACW products incorporate a battery depassivation feature, preventing battery oxidation during prolonged deep sleep phases. This feature is automatically activated when the product enters its deep sleep mode. The product will then be woken up once a day to start the battery passivation sequence, and then the product will return to deep sleep on its own.

i. Air quality indication

When the product enters operation mode, a short, periodic (every 5 seconds) flashes is emitted to give an indication of the CO2 concentration in the room. Other LED indications are automatically deactivated.

If the CO_2 level is below **800 ppm**, the flashing is **GREEN**, between **800 ppm** and **1400 ppm**, the flashing is **ORANGE** and above **1400 ppm** the flashing is **RED**.

However, it is possible to re-set these thresholds using the **ACW Configurator** desktop application (see next chapter).



j. Night mode

The ACW-THAQ incorporates a mode that allows radio transmissions to be stopped during a given and configurable time slot. The primary goal of this feature is to reduce the consumption of the sensor over a day in order to increase its autonomy.

In operation, the sensor will therefore automatically stop these radio emissions from the start time configured for this mode and will restart, again automatically, at the configured end time.

In addition, this mode can be turned on or off at any time during the sensor's operating cycle.

Activation/deactivation as well as configuration of start and end times can be done via the **ACW Configurator desktop application** or via **Downlink**.

ACW Configurator

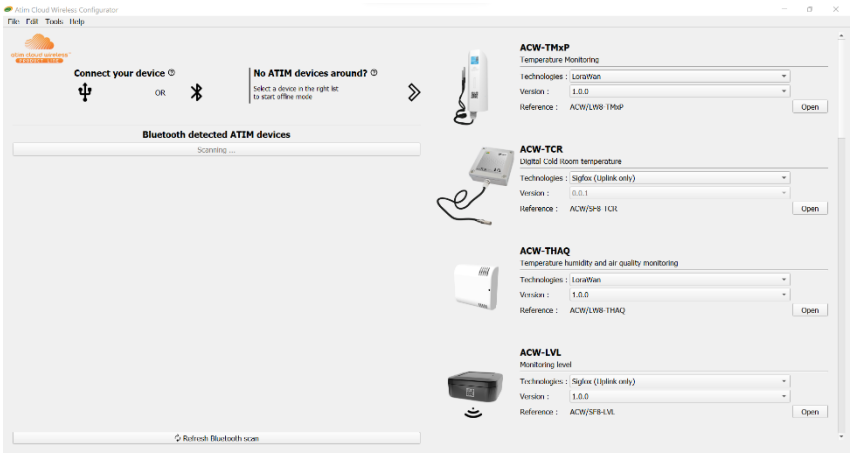
a. Compatible configurator versions

For a THAQ with the following application software version	Use the ACW Configurator version
Sigfox: V1.0.6 LoRaWAN: V1.0.6	V5.2.6 or higher

Download and install the ''setupACW.exe'' configuration software at:

https://www.atim.com/wp-content/uploads/documentation/CONFIGURATEUR/ACW/configurateur-acw.exe

NOTE
The product must be in its Configuration mode in order to be detected by the configurator. As a security measure, configuration is only possible for 5 minutes after the product is started. First of all, you have to put the product in deep sleep mode (close magnet 6 seconds), wait about twenty seconds for the deep sleep to be effective, then wake up the product (magnet 6 seconds again). The product can then be configured.



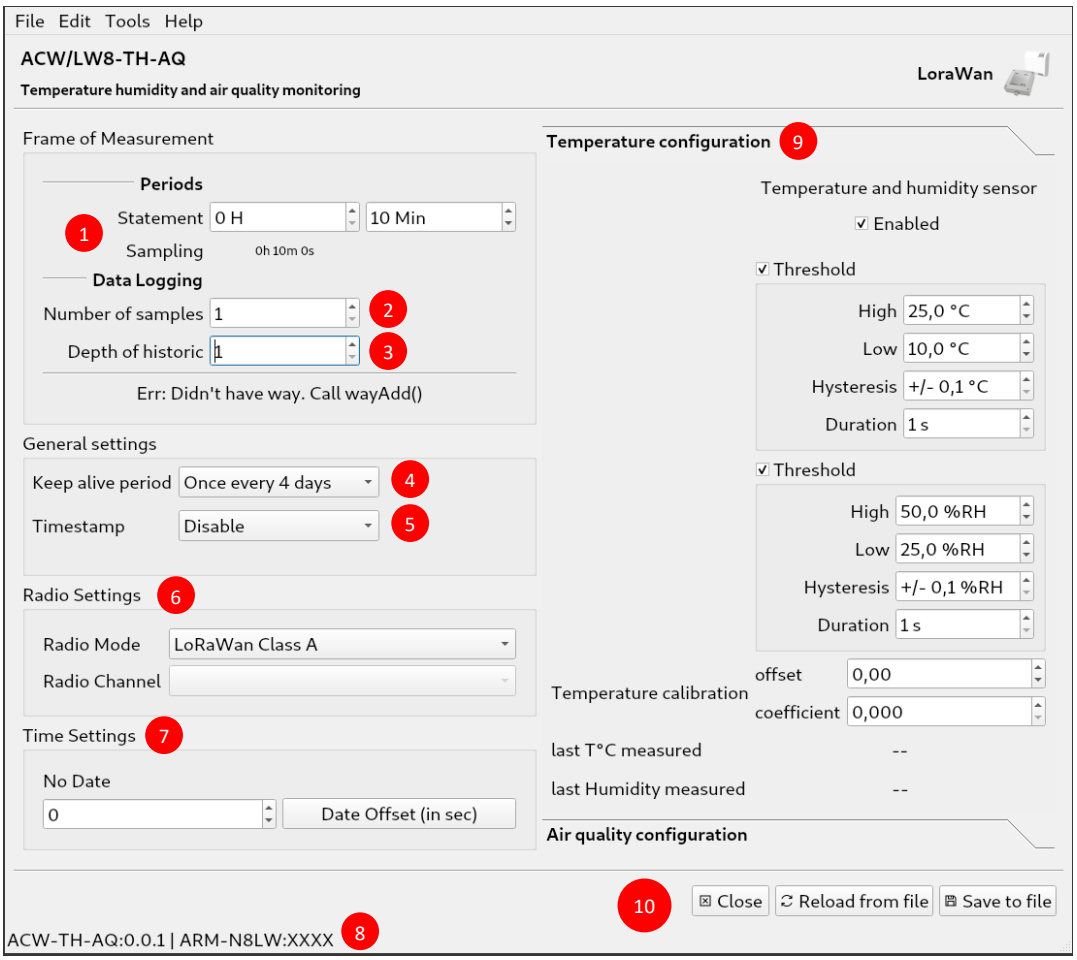
When you launch the ACW Configurator, the waiting window is displayed on the screen.

Pairing the ACW-THAQ with the configurator can be done in two ways:

- **By USB**: open the ACW-THAQ case and connect it to a computer with a micro-USB cable.
- **By Bluetooth**: make sure Bluetooth is enabled

WARNING
Do not leave the product connected to the configurator (via USB or Bluetooth) unnecessarily, as this will significantly degrade the autonomy of the product.

b. Configuring the ACW-THAQ



Emission period and samples in the frame

The transmission period 1 corresponds to the time interval between each sending of a measurement frame.

The minimum emission period is 1min.

The maximum emission period depends on the number of samples in the frame. It is equal to the number of hours corresponding to the number of samples per frame.

For example, if the product configuration provides for a frame with 4 samples per frame, then the maximum emission period will be 4 hours.

NOTE
The sampling period is set at a maximum of 1 hour for reasons of overall autonomy of the product. Since the product needs 48 consecutive measurements without a power cut at the CO2 sensor, in order to be able to perform a CO2 self-calibration, the longer the 48 measurements, the shorter the service life of the product.

As soon as the auto-calibration is carried out, the CO2 sensor is then cut between 2 measurements until the next calibration, which greatly increases the autonomy of the product.

Example: in the case of one sampling per hour, and a self-calibration period of 1 week, the CO2 sensor will remain on for 2 days. The remaining 5 days, it will be extinguished between 2 measures.

It is possible to configure the number of samples in a frame 2. Thus, several measurements will be made before the frame that will contain all these measurements is sent.

For example, with an emission period of 1 hour and a sample count of 4, a measurement will be made every 15 minutes and the 4 samples will be sent into the measurement frame every hour.

Finally, it is possible to apply data redundancy 3, which means that samples that have been sent in frame n-1, n-2 or n-3 can be sent again in frame n following the new measurement samples (the most recent sample first in the frame and the least recent last).

For example, for a history depth of 3, the data from the last 2 frames will be sent, in addition to the new data, in the next frame.

Period of the life frame

A life frame can be emitted periodically 4. This frame will contain the supply voltage of the product.

The value of this period can be configured from 1 hour to 1 month. By default, the value is set to 4 days.

Frame timestamp

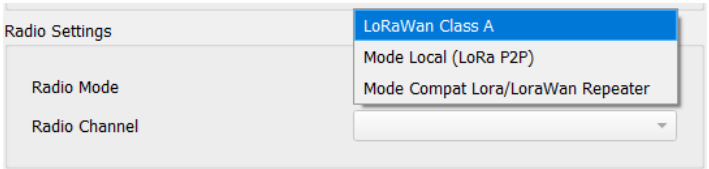
It is possible to disable/enable the timestamp of all radio frames 5.

WARNING
This option, when enabled, takes up 4 bytes in the frame that cannot be used for payload data.

Configuration du module Radio

It is possible for the product to work in three different ways 6 in both **LoRaWAN** and **Sigfox** :

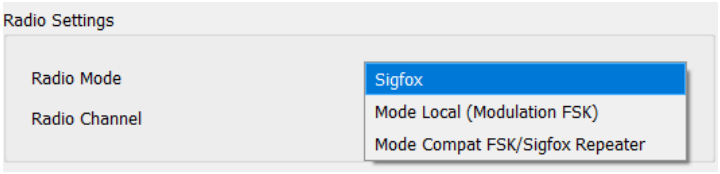
For a **LoRaWAN type product**



1. **LoRAWAN Class A** : The modulation of the product is done in LoRa and uses the LoRAWAN Class A protocol. This mode requires a LoRAWAN (Private Gateway) private network, or an operated network in order to view the data sent by the product.
2. **Local mode**: The modulation of the product remains LoRa modulation. However, there is no LoRAWAN overlay. In this mode, you have to choose the radio channel on which the product will transmit. In order to be able to receive the frames of the product, a radio modem with the same parameters is required. This mode does not yet have a real concrete use case, but future developments of this mode will allow for interesting point-to-point features.
3. **Compatibility mode with the ATIM LoRa/LoRAWAN Repeater**: This mode is to be selected when you want to operate in classic LoRAWAN, but no network (private or operated) is accessible. This mode, combined with the ATIM LoRa/LoRAWAN Repeater, then allows you to join the LoRAWAN network through this repeater. In this mode, if the network is not joined (no JOIN_ACCEPT), then the product will transmit its frames locally. The LoRa/LoRAWAN repeater then relays these frames over the network it has joined (the repeater must be placed at a location with connectivity to the desired network).

IMPORTANT NOTE
If the product has access to the LoRAWAN network, the default mode of operation (LoRAWAN Class A) should be preferred. If this mode is chosen, while the network is accessible, the product will still send a frame over the LoRAWAN network and the same frame in Local mode to the Repeater, which will consume battery unnecessarily.

For a Sigfox-type product



1. **Sigfox** : Modulation and Sigfox protocol used. This is the default mode of the product. This mode requires access to the Sigfox network to work.
2. **Local Mode**: Frame modulation switches to FSK. In this mode, you have to choose the radio channel on which the product will transmit. In order to be able to receive the frames of the product, a radio modem with the same parameters is required. This mode does not yet have a real concrete use case, but future developments of this mode will allow for interesting point-to-point features.
3. **Compatibility mode with the ATIM FSK/Sigfox Repeater**: This mode is to be selected when you want to operate in Sigfox, but the network is not accessible. This mode, combined with the ATIM FSK/Sigfox Repeater, then allows you to join the Sigfox network with this repeater. In this mode, the product emits these frames both on the Sigfox network and also locally (FSK modulation). The FSK/Sigfox repeater then relays these frames on the Sigfox network: the repeater must be placed at a location in which the Sigfox network is accessible.

IMPORTANT NOTE
If the product has access to the Sigfox network, the default mode of operation (Sigfox) should be preferred. If this mode is chosen, the product will always send a frame over the Sigfox network and the same frame in Local mode to the Repeater, which will consume battery unnecessarily.

Product Clock

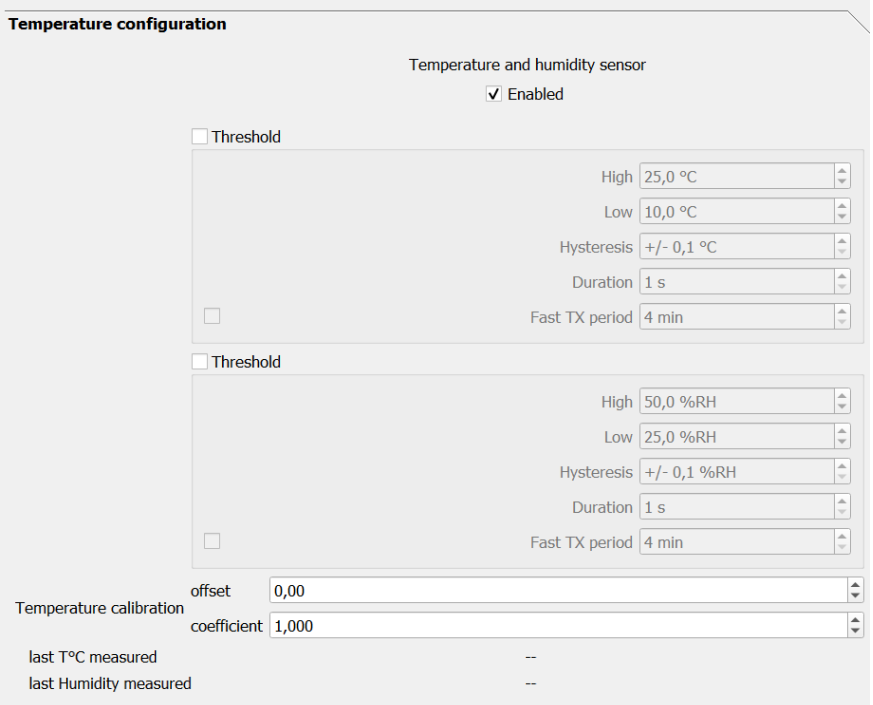
Each time the configurator is connected, the product's clock is updated (based on the computer's clock) and displayed 7. In addition, a second offset can be applied if needed.

Product versions

Upon connection with the product, the configurator retrieves all the software versions of the product (product software and radio module software) as well as the network identifier 8.

Sensor Configuration

Temperature and humidity



On the ACW-THAQ, there is a built-in temperature and humidity sensor.

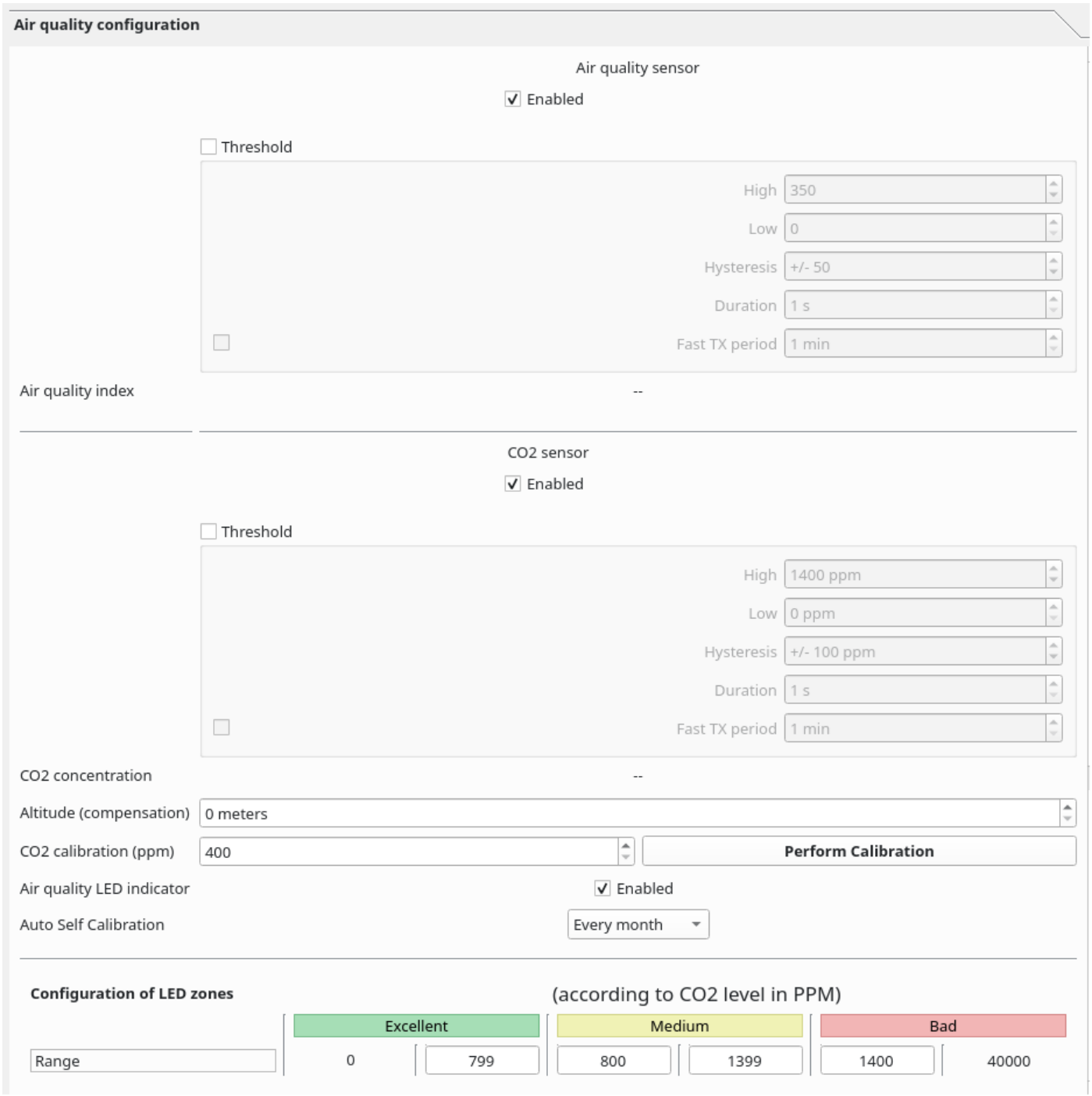
Here are the configuration parameters available for this sensor 9 :

- Sensor activation/deactivation.
- Temperature and humidity thresholds
- Temperature compensation at two points

The thresholds can be set by a high and low threshold according to a configurable hysteresis and exceedance duration. When a measurement reaches a threshold, a radio frame will be sent (see the chapter Alert frame for details on the format of the frame).

In addition, the temperature and humidity values of the sensor are visible in real time when the product is connected to the configurator (these values are refreshed every 2 seconds).

Air quality (VOCs and CO2)



Two sensors are present for air quality measurement: one for the measurement of CO2 concentration, the second for the measurement of VOCs (Volatile Organic Compounds).

For each one, you will find the following configuration items:

- Sensor Activation/Deactivation.
- Configuring alert high and low thresholds.

It is also possible to see in real time the value measured by each of the sensors.

In addition, for the CO2 sensor, it is possible to configure the altitude at which the sensor will be installed to improve the accuracy of the CO2 measurement, as well as to activate/deactivate the air quality indication via the LED on the front.

The auto-calibration algorithm for the CO2 measurement can also be configured. It can be deactivated or activated with different possible periods ranging from once a week to once every 2 months.

Finally, it is possible to configure the thresholds of the LED indicator for air quality ("Excellent" => green color, "Medium" => orange color and "Bad" => red color).

NOTE
It is advisable to fill in the threshold on the far right first and continue from right to left.

CO2 sensor calibration

Automatic configuration

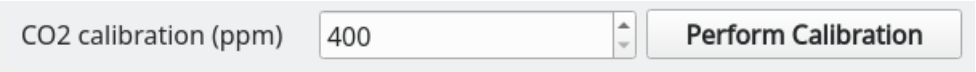
In the event that auto-calibration is activated, the product will make a periodic auto-calibration (period adjustable from once a week to once every 2 months) after 48 measurements.

For example, in the case of a periodic self-calibration once a week and one measurement per hour, the product will self-calibrate every week after 48 hours

WARNING
For automatic calibration to be effective, the sensor must be exposed to CO2 concentrations of around 420ppm (fresh outdoor air) between two automatic calibrations, i.e. every 48 measurements.

Manual configuration

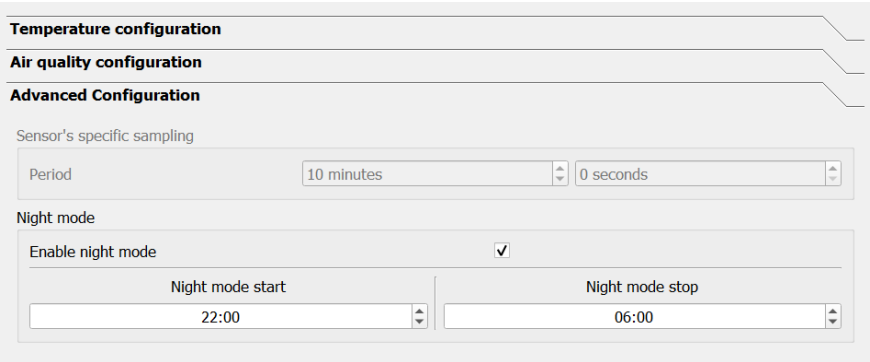
In addition to automatic calibration, the product has manual calibration. This is done from the configurator using the following interface



WARNING
For manual calibration to be effective, the product must be left connected to the configurator for at least 3 min in a constant and stable environment in terms of CO2 concentration before starting manual calibration.

For example, it is not advisable to stand too close to the sensor (< 1 meter) during the calibration process so as not to destabilize the stability of the medium.

Advanced Configuration



A final tab provides access to the advanced configuration setting of the product.

For the "Period" field, it is advisable to leave the default value.

Otherwise, there is a checkbox to enable or not the night mode (checkbox = night mode activated).

For the moment the time slot for activating this mode is only configurable by Downlink, the configuration from the application will be possible very soon.

However, the default time range is as follows:

- Mode Activation: 20:00 UTC
- Mode Off: 4:00 AM UTC

Configuration validation

After filling in all the configuration settings, it is imperative to click on the "Apply to ACW" button to send the configuration to the product (10).

It is also possible to read the current product configuration at any time, which will update the settings on the configurator or reset the product to its default configuration.

c. Factory Setup

Radio Frame Settings

- Radio Broadcast Period: 30 minutes
- Number of Samples: 1
- History Depth: 1

General Settings

- Period of sending the life story: 1 time per day
- Timestamp: Disabled
- Radio parameters: LoRaWAN Class A (for a LoRAWAN product) / Sigfox (for a Sigfox product)
- Night Mode: Off

Sensor parameters

Temperature and humidity sensor

- Status: Enabled
- Temperature threshold: inactive
- Humidity threshold: inactive

VOC sensor

- Status: Off
- Threshold: Inactive

CO2 sensor

- Status: Enabled
- Threshold: Inactive
- Air Quality Light Indicator: Active
- Auto-calibration: Enabled with a period of once a month.

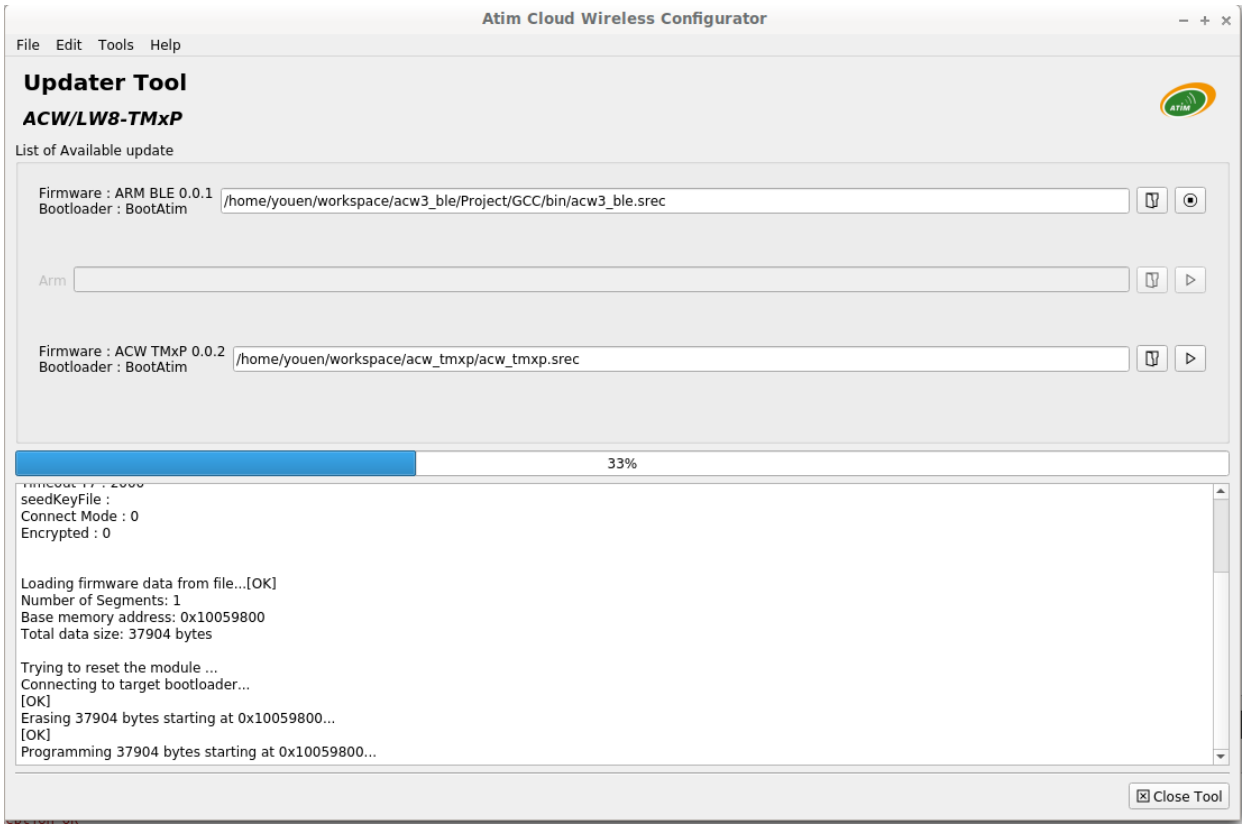
LED thresholds

- **Excellent**: 420 to 800 ppm
- **Medium**: 800 to 1400 ppm
- **Poor**: 1400 to 5000 ppm

d. ACW Update

When connected to the product via Bluetooth Low Energy, it is possible to update the various software that makes it up.

To do this, you have to go to the Tools *->Updater menu (CTRL+U*)



UPLINK Frame Format

a. Description

Uplink Frame			
Byte 1	**Byte 2**	**. . .**	**Byte n**
Frame header	Frame-specific data		

There are three types of frames:

- **Classic frame; New generation** : Very similar to the old frames, the difference is that you can activate the timestamp. These are, for example, the life frame, the error frame, the response to configuration frames, etc. These latter frames are common to all ACWs, but it is also possible to have other independent frames for each of the ACWs.

- **Weft measure; Next generation** : These frames are made up of samples of the different values of each of the channels that can be recorded by an ACW. Beforehand, the number of samples and the depth of the history will be inserted in the header.

NOTE
The number of samples and the depth of the history are common for all the channels of the frame.

- **Alert framework (threshold exceedance); Next generation** : These screens combine a classic screen and a measurement frame. They consist of a header warning that a threshold has been exceeded, followed by samples from each of the channels for which a threshold has been exceeded.

Classic frame

Byte 1 - header							
Bit 7	Bit 6	5 bit	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Next generation = 1	Timestamp = 1 - enabled 0 - Disabled	Measured frame = 0	Reserved = 0	Type of frame (see below)			

If the Timestamp is enabled, 4 bytes with the value of the Timestamp will be preceded by the header (byte 1).

The different types of frames

Frame Type	Data size	Description of the frame
0x00	--	Reserved
0x01	4 bytes	A framework of life.
0x02	0 bytes	Request for downlink for network testing.
0x03	--	Reserved
0x04	--	Reserved
0x05	1 byte	Test frame with counter.
0x06	Variable	(Cfg box) Response to a configuration frame.
0x07	Variable	(Cfg box) Response to an order frame.
0x08	Variable	(Cfg box) Response to an erroneous plot.
0x09	--	Reserved
0x0a	--	Reserved
0x0b	--	Reserved
0x0c	--	Reserved
0x0d	Variable	Alert frames, follow-up of samples of alert channel measurements
0x0e	TBD	General error - TBD (memory, ...)
0x0f	Variable...	Subframe for ACW. Depending on the ACW

Measuring frame

Byte 1 - Leading							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
New generation = 1	Timestamp (Off = 0, On = 1)	Measured frame = 1	History Depth (-1) Max: 4		Number of Samples (-1) Max: 8		

If the Timestamp is enabled, 4 bytes with the value of the Timestamp will be preceded by the header (byte 1).

WARNING
If the History Depth or Sample Counts field is greater than 1, the period of transmission of a frame (in minutes) will be added after the header and will occupy 2 bytes (Big Endian encoding, MSB first)

For each of the channels, a header is inserted in a row and is constituted as follows:

Byte 2 Header Way							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved = 0		Track number		Type of Measurement			

Type of possible action

Type of Measurement	Units	Data size	Data type	Descriptions
0x08	T°C	2 bytes (**Big Endian - MSB**)	Whole signed	Temperature in **hundredths** of a degree Celsius • Resolution: 0.01°C • Max value: 125°C • Min value: -40°C
0x09	%HR	2 bytes (**Big Endian - MSB**)	Whole signed	Relative humidity in **hundredths** of a percentage relative humidity (%RH) • Resolution: 0.01%RH • Max value: 100%RH • Min value: 0%RH
0x0C	-	2 bytes (**Big Endian - MSB**	Unsigned integer	VOC Index: • Resolution: 1 • Max value: 500 • Min value: 0
0x0D	Ppm	2 bytes (**Big Endian – MSB first**)	Unsigned integer	CO2 concentration: • Resolution: 1 ppm • Max value: 40,000 ppm • Min value: 0 ppm

This is followed by data from the measurement sample(s) (depending on the product configuration).

NOTE
When a frame has more than one sample per channel (number of samples > 1 or history depth > 1), the samples are organized from newest to oldest.

The number of bytes sent can be determined in the following way:
(Measurement byte size) * (number of samples) * (history depth)

EXAMPLE
For the 0x08 measurement type (the size of a value is two bytes) with a history depth of 2 and a sample count of 3, the size of the data to be read would be 12 bytes (2x2x3).

WARNING
A received temperature of 0x8000 corresponds to a measurement error. This is often due to a poorly connected cable.

Measurement alert frame

Byte 1 - Leading							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
New generation = 1	Timestamp (Off = 0, On = 1)	Measured frame = 0	Reserved = 0	Alert frame (= 0x0d)			

If the Timestamp is enabled, 4 bytes with the value of the Timestamp will be preceded by the header (byte 1).

For each of the channels in alert, a header is inserted and is constituted as follows:

Byte 2 Header Way							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Alert Type		Track number		Type of Measurement			

The **alert type field** allows you to identify whether it is an exceedance of the high threshold, the low threshold or a return between the thresholds.

These values are defined as follows:

Value	Description
0x00	Back between thresholds
0x01	Exceeding the high threshold
0x02	Exceeding the low threshold
0x03	Reserved

The measurement type field here is identical to that of the measurement frame (i.e. 0x08, 0x09, 0x0C or 0x0D in hexadecimal for the ACW-THAQ).

The sample that caused the alert is then inserted in a row (with Big **Endian** – MSB encoding first)

Fabric of life

The life frame is sent at regular intervals depending on the configuration applied (default 4 days) and contains the battery levels of the empty (the product is not doing anything) and charging (the product is emitting a radio frame).

Byte 1 - Header							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
New generation = 1	Timestamp = 0	Weft Measure = 0	Reserved = 0	Life frame = 0x01			

Following this header is 4 bytes, 2 for the empty battery level and 2 for the charging battery level.

The plot is therefore divided as follows: 0xAABBBBCCCC

0xAA is the header of the frame (always equal to 0x81), 0xBBBB the no-load battery level (millivolt value, MSB encoding) and 0xCCCC the battery level under load (millivolt value, MSB encoding).

EXAMPLE
0x81 0d24 0c68
0d24 : no-load battery level = 3364 mV or 3.364 V
0c68 : battery level under load = 3176 mV or 3.176 V

General Error and Alarm Frame

Byte 1 - Header							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Next Generation = 1	Timestamp = 0	Weft Measure = 0	Reserved = 0	Error frame = 0x0e			

If the Timestamp is enabled, 4 bytes with the value of the Timestamp will be preceded by the header (byte 1).

For each of the error messages, a header is inserted and is constituted as follows:

Byte 2 - Header Error Message							
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Message Index			Error Message Length				

The **message index** field is used to prioritize messages when multiple errors occur.

The **error message length field** indicates the size in bytes of the error message.

The following byte identifies the nature of the error or alarm that occurred:

Byte 3 - Header Error Message		
Error Code	Nature of the error	Description
0x81	ERR_UNKNOWN	
0x82	ERR_BUF_SMALLER	The data table is full, unable to write additional data to it
0x83	ERR_DEPTH_HISTORIC_OUT_OF_RANGE	The depth of history is too large or too small for the frame
0x84	ERR_NB_SAMPLE_OUT_OF_RANGE	The sample number is too large or too small for the frame
0x85	ERR_NWAY_OUT_OF_RANGE	The number of channels in the header of the frame is too large or too small
0x86	ERR_TYPEWAY_OUT_OF_RANGE	The measurement type in the header of the frame is too large or too small
0x87	ERR_SAMPLING_PERIOD	Poor sampling period structure
0x88	ERR_SUBTASK_END	End of a subtask after exiting an infinite loop
0x89	ERR_NULL_POINTER	Pointer with "NULL" value
0x8A	ERR_BATTERY_LEVEL_DEAD	Critical battery level
0x8B	ERR_EEPROM	EEPROM is corrupted
0x8C	ERR_ROM	ROM is corrupted
0x8D	ERR_RAM	RAM is corrupted

0x8E	ERR_ARM_INIT_FAIL	Radio module initialization failed
0x8F	ERR_ARM_BUSY	The module is already busy (possibly not initialized)
0x90	ERR_ARM_BRIDGE_ENABLE	The module is in bridge mode, impossible to send data by radio
0x91	ERR_RADIO_QUEUE_FULL	The radio line is full
0x92	ERR_CFG_BOX_INIT_FAIL	Error initializing the black box
0x93	ERR_KEEP_ALIVE_PERIOD	Poor structure of life frame period
0x94	ERR_ENTER_DEEP_SLEEP	The product has entered deep sleep mode
0x95	ERR_BATTERY_LEVEL_LOW	Low battery level
0x96	ERR_ARM_TRANSMISSION	A transmission was initialized but an error occurred
0x97	ERR_ARM_PAYLOAD_BIGGER	The size of the message is too large for the capacity of the network
0x98	ERR_RADIO_PAIRING_TIMEOUT	Unable to pair with a network before time runs out
0x99	ERR_SENSORS_TIMEOUT	A timeout has been reached on the sensor
0x9A	ERR_SENSOR_STOP	The sensor did not return a value during a reading
0x9B	ERR_SENSORS_FAIL	The sensor has stopped working
0x9C	ERR_BOX_OPENED	Opening the case
0x9D	ERR_BOX_CLOSED	Closing the case

Only the 0x8A and 0x95 codes are followed by additional data corresponding to the battery level in millivolts. This value is encoded in two bytes, the high-order byte first (MSB).

WARNING
For codes ranging from 0x81 to 0x92, the product will enter its FAULT mode and will no longer perform its measurement function. For codes ranging from 0x93 to 0x9D, these correspond only to alarms, so the product continues to function normally.

b. Examples of frames

Measuring frame

With the timestamp of disabled, no history and a sample count of 1 (Temperature and humidity only):

Byte						
1	2	3	4	5	6	7
0xA0 (new generation measurement frame, no history, 1 sample)	0x08 (channel 0, measurement type: temperature)	0x08	0x85	0x09 (channel 0, type of measurement: hygrometry)	0x17	0xDE

The product returns values of 0x0885 (21.81°C) for temperature and 0x17DE (61.10 %RH)

With the timestamp disabled, no history and a sample count of 1 (Temperature, Humidity and VOC):

Byte									
1	2	3	4	5	6	7	8	9	10
0xA0 (new generation measurement frame, no history, 1 sample)	0x08 (channel 0, measurement type: temperature)	0x08	0x85	0x09 (channel 0, type of measurement: hygrometry)	0x17	0xDE	0x0C (channel 0, measurement type: VOC)	0x00	0xA0

The product returns values of 0x0885 (21.81°C) for temperature, 0x17DE (61.10 %RH) for humidity and 0x00A0 (160) for VOCs.

Now with a sample count of 2:

Byte											
1	2 and 3	4	5	6	7	8	9	10	11	12	13
0xA1 (new generation measurement frame, no history, 2 samples)	0x003C (period of issue)	0x08 (channel 0, measurement type: temperature)	0x01	0x2C	0x08	0xA4	0x09 (channel 0, type of measurement: hygrometry)	0x22	0x13	0x17	0xDE

Bytes 2 and 3 indicate the period of transmission, in this case 60 minutes (so a sample is measured every 30 minutes).

- The first sample is 0x012C (3°C) / 0x2213 (8723%RH)
- The second is 0x08A4 (22.12°C) / 0x17DE (61.10 %RH)

NOTE
This example is valid for the product with a LoRaWAN module. In the case of Sigfox, the size of an Uplink is 12Bytes and therefore this frame is divided in two.

Measurement alert frame

For a high threshold exceedance on channel 1 (virtual probe), the frame will be:

Byte			
1	2	3	4
0x8D (New generation alert framework)	0x58 (Exceedance of high threshold channel 1, temperature measurement)	0x02	0xC9

The sample that triggered the threshold is 0x02C9 (7.13 °C)

Downlink

This feature is available on ACW-THAQ if you meet the following requirements:

	Application Software	Radio Firmware
Version Sigfox	V0.0.1	V5.9.3.2
Version LoRaWAN	V0.0.1	V5.1.1

The operation of the Downlink is explained in document ATIM_ACW-DLConfig_UG_FR_v1.4, relating to the version V1.2.0 of the ATIM Downlink Protocol (see this document for all parameters and commands common to all products).

The parameters specific to ACW-THAQ are as follows:

a. Configuration of the frame parameters (sending period, number of samples, etc.)

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
Parameter code	Frame size	Index	Parameter value	Parameter value	Parameter value
0xD4	0x04	0x00	0b00YY0ZZZ	0xYY	0xZZ

For byte 4, the two YY bits correspond to the value of the history depth – 1 (max = 3) and the three ZZZ bits correspond to the number of samples per frame -1 (max = 7).

Bytes 5 and 6 correspond to the period of sending a frame (= 0xZZYY) ranging from 1 minute to 255 hours (15300 minutes).

EXAMPLE
Byte 4 = 0x13
4 samples per frame + addition of the four samples sent to the previous frame.
Byte 5 = 0x3C and Byte 6 = 0x00
Sending period = 0x003C = 60 minutes

b. Sensor activation

Byte 1	Byte 2
Parameter code	Parameter value
0x15	0b0000X0YZ

For byte 2, the value of the x, y, and z bits indicates whether a sensor is enabled or not.

When one of these bits is set to 1, the sensor is activated; When it is at zero, the sensor is disabled.

The **Z** field allows you to enable/disable the temperature-humidity sensor.

The **Y** field allows you to enable/disable the air quality sensor.

The X-field allows the CO2 sensor to be turned on/off.

c. Setting thresholds

Byte										
1	2	3	4	5	6	7	8	9	10	11
Parameter code **0xD6** (temperature threshold) **0xD7** (humidity threshold) **0xDA** (VOC threshold) **0XDE** (CO2 threshold)	0x09	0x00	High threshold value		Low threshold value		Hysteresis		Duration	Tx threshold

High threshold value **field**: value (in hundredths of a °C or %RH) triggering the high threshold (**Little Endian encoding**)

Low threshold value **field** : The value (in hundredths of a second °C or %RH) triggering the low threshold (**Little Endian encoding**)

Hysteresis **field**: margin of uncertainty of thresholds (in hundredths °C or %RH - **Little Endian encoding**)

Duration field : The minimum amount of time the alert must be triggered after the threshold is exceeded. Possible values range from **1 to 10 seconds** (whole numbers only). To disable the threshold, this field will need to be set to **0**.

Threshold tx field **:** period of emission of periodic frames during a threshold exceedance**.** This value allows periodic frames to be sent more regularly when a threshold is exceeded. However, the frame sent will contain only one sample per active channel. This value must be between **4 minutes and the product's base issuance period** (set up when setting up the product). To disable this feature, this field will need to be set to **0**.

d. Setting up Temperature Compensation

Temperature compensation can be done at two points:

- **Offset**: adding or subtracting a given value from the temperature measured by the sensor.
- **Coefficient**: multiplication of a given value to the temperature measured by the sensor.

These two compensation points can obviously be combined.

Offset

Parameter Code (Byte 1)	Byte 2	Byte 3
0x58 (temperature offset)	Value	

The temperature offset is represented by the "Value" field in the table above. The offset value must be sent in **Little Endian** encoding and can be between 10000 and -10000 (hundredths of a °C).

EXAMPLE
For a temperature offset of 2°C, the value to be sent will be 200 = 0xC800.
For an offset of -1°C, the value will be -100 = 0x9CFF.

Coefficient

Parameter Code (Byte 1)	Byte 2	Byte 3
0x59 (temperature coefficient)	Value	

The multiplication coefficient is represented by the "Value" field in the table above. The coefficient value must be sent in **Little Endian** encoding and can be between 0 and 10000 (this value is divided by 1000 by the product).

EXAMPLE
For a coefficient of 0.1, the value to be sent will be 100 = 0x6400.
For a coefficient of 1, the value will be 1000 = 0xE803.

e. Altitude configuration (CO2 sensor compensation)

Byte 1	Byte 2	Byte 3
Parameter code	Parameter value	Parameter value
0x5D	0xZZ	0xYY

The elevation value (in meters) is encoded as follows: 0xYYZZ.

EXAMPLE
To configure the parameter at an altitude of 1000m (0x03E8 in hexadecimal), the frame will be 0x5D E8 03.

f. Configuring the Air Quality Indicator

Byte 1	Byte 2
Parameter code	Parameter value
0x1C	value

The **value** field can only be set to "1" (indicator on) or "0" (indicator off).

g. Setting LED Indicator Thresholds

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Parameter code	Parameter value	Parameter value	Parameter value	Parameter value
0x9F	0xaa	0xbb	0xcc	0x00

The value of byte 2 represents the boundary between the GREEN and YELLOW flashing.
The value of byte 3 represents the boundary between the YELLOW and ORANGE flash.
The value of byte 4 represents the boundary between the ORANGE and RED flashes.

NOTE
All the values are in tens of PPM, to configure a threshold of 500 you will have to send 50 (or 0x32 in hexadecimal).

EXAMPLE
For the 0x9F3250C800 framework:
For the first threshold, we have 0x32 i.e. 50 in decimal and 500 ppm, 0x50 for the second i.e. 80 in decimal and 800ppm and for the last 0xC8 i.e. 200 and 2000ppm.

The flashes according to the CO2 level will follow the following operation:
0 to 499 ppm: GREEN flashing
500 to 799 ppm: flashing YELLOW
800 to 1999 ppm: ORANGE flashing
More than 2000 ppm: RED flashing

h. Setting up night mode

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Parameter code	Frame size	Index	Parameter value	Parameter value	Parameter value	Parameter value	Parameter value
0xE0	0x06	0x00	0xaa	0xbb	0xcc	0xdd	0xee

Bytes from 1 to 3 have a fixed value for night mode configuration.
Byte 4 corresponds to minutes while byte 5 corresponds to hours for the departure time.
Byte 6 is minutes and byte 7 is hours for the night mode end time.

The minutes and hours are to be encoded in BCD (first 4 bits for the tens and the last 4 bits for the unit).

Finally, byte 8 can take two values: 0x00 to disable night mode or 0xFF to enable night mode.

EXAMPLE
If the mode's start time is 8:45 p.m. and the end time is 6:15 a.m., the corresponding values for bytes 4 through 7 will be:
Byte 4 => 0x20 / Byte 5 => 0x45 for departure time
Byte 6 => 0x06 / Byte 7 => 0x15 for end time

i. Reserved codes for future developments

Byte 1	Byte 2
Parameter code	Parameter value
0x10	0x08
0x11	0x00

WARNING
Do not change these values.

Technical Support

For any information or technical questions, we invite you to open a ticket on our dedicated support web page.