

**SUBJECT :** User guide  
**PRODUCT :** 50-70-064(101)-000 LoRaWAN Ventil'O  
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### History

DATE	REVISION	OBJET	AUTHOR
06/06/18	0	Creation	NJC

## Contents

<b>1.</b>	<b>ABOUT THIS DOCUMENT</b>	<b>3</b>
<b>2.</b>	<b>REFERENCE DOCUMENTS</b>	<b>3</b>
<b>3.</b>	<b>DEVICE CHARACTERISTICS</b>	<b>3</b>
<b>4.</b>	<b>INSTALLATION</b>	<b>3</b>
<b>5.</b>	<b>UTILIZATION</b>	<b>7</b>
5.1.	UI COMPONENTS	7
5.2.	SET THE SENSOR IN WORKING MODE	7
5.2.1.	Set the sensor in the working mode	7
5.2.2.	Pairing to a network	7
5.3.	SET THE SENSOR IN STORAGE MODE	7
5.4.	FACTORY RESET	7
5.5.	PAIRING RESET	8
5.6.	TEST MODE: CHECK WHETHER A SENSOR IS IN WORKING OR STORAGE MODE	8
5.7.	CONFIGURATION OF THE APPLICATION LAYER	8
<b>6.</b>	<b>DATA PROCESSING</b>	<b>9</b>
6.1.	HOW REPORTS WORK	9
6.2.	HOW TO READ THE REPORT FRAMES	10
6.2.1.	ZCL-like report	10
6.2.2.	Batch report	11
6.2.3.	ZCL-like threshold report (alarm)	11
6.3.	UNCOMPRESS BATCH REPORTS WITH BR_UNCOMPRESS	11
6.3.1.	Download the needed piece of software	11
6.3.2.	Use the br_uncompress piece of software	11
6.3.3.	Example 1: the 12h preiodic Batch frame of a 50-70-064(101)-000	12
6.3.4.	Example 2: 12h preiodic Batch frame of a 50-70-064(101)-000 including the weekly battery voltage	13

	<b>USER GUIDE</b>	<b>50-70-064(101)-000_GUIDE</b>	
	<i>LoRaWAN Ventil'O</i>	Revision: 0	Page 3/14

## 1. ABOUT THIS DOCUMENT

This user guide contains some useful informations, characteristics about the device, and examples of use. The aim is to provide the new user with essential knowledge in order to make the device work quickly. This user guide is not exhaustive. Please refer to the reference documentation for more information. This user guide is provided for informational purposes only. It is not a contractual nor a technical reference. Characteristics and features of the device can change at any time without notice.

## 2. REFERENCE DOCUMENTS

Reference documentation for this device:

50-70-064\_SPG\_Capteur\_VMC\_Gaz\_outdoor\_LoRaWAN\_ICT\_V0\_X\_Y.pdf

LoRaWAN\_Sensors\_Application\_Layer\_Addon\_001\_V1\_X.pdf

You will find more support on:

<http://support.nke-watteco.com/>

For example, detailed documentation on the Differential pressure measurement cluster:

<http://support.nke-watteco.com/differential-pressure-measurement-cluster/>

## 3. DEVICE CHARACTERISTICS

This sensor is designed to monitor CMV (Controlled Mechanical Ventilation). Main features are:

- Measure of the differential pressure. Calculation of the mean, minimum and maximum values. This 3 values are reset each time they are read. All of these values are reportable and can be configured.
- Reports on thresholds of differential pressure or [Option]temperature.
- [Option] Monitoring of a pressure switch (through one digital input), that measures and send the differential pressure when triggered. Only available on the 50-70-064-000.
- [Option] Measure of the ambient temperature. Reports can be configured.

**Note:** the digital input of this sensor is exclusively designed to be used with a pressure switch to trigger a measure and a report of the differential pressure. It is not designed for any other purposes.

## 4. INSTALLATION

Metallic objects/surfaces are likely to reduce or disrupt radio frequency signals. The sensor must be fixed to at least one meter from any metallic object or surface.

There is how the LoRaWAN Ventil'O sensor looks like:

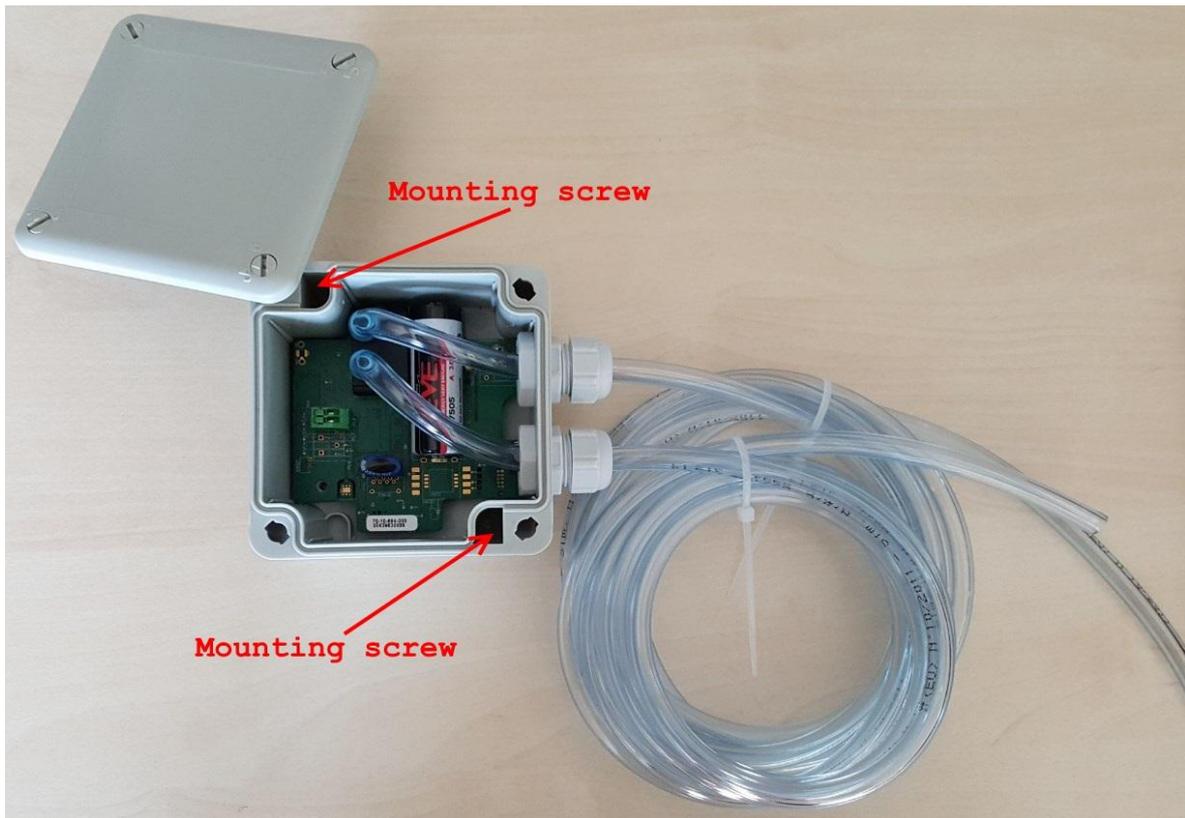


Picture 1 General overview of the sensor

The 2 hoses for the differential pressure measurement are preinstalled on the sensor. You must not alter the connection between these 2 hoses and the sensor. If you purchased sensor with an S0 input (to monitor a pressure switch), you will have to set up the connection between your cable and the sensor, through the gland at the bottom on the sensor.

Nota : Check the radio coverage before installing the sensor. The radio coverage can be disrupt or reduced by various obsacles between the LoRa gatteway and the sensor (buildings, embankments, hills, etc.).

The sensor SHALL be set up under shelter to avoid too fast temperature changes (direct sunlight, wind, waterfalls, etc.) that can impair measurement. Fix the sensor with 2 screws (not provided)(the 2 holes for the mounting screws are shown on picture 2) on a non-metallic vertical wall. The sensor SHALL be set up vertically with the two hose glands at the right side, as shown on the picture 1. This is important because the radio-frequency antenna is optimized to give the best performances in that position. The sensor SHALL be taken away form any metallic surface/object, and in particular from the ventilation's metal box, that are likely to disrupt the radio frequency signals.



Picture 2 Shows the 2 holes for the mounting screws (not provided)

Now, use the provided mounting kit shown on picture 3 to set up the 2 hoses.



Picture 3 Hoses mounting kit : 2 connectors, 2 hose clamps, 4 screws

Plug each hose on the short tip of one connector, secure it with a hose clamp.

The hoses SHALL go up all the way, from the fixation point to the sensor, and NEVER back down. Otherwise, water condensation might impair measurement. The hoses SHALL be shorter than 3 meters (provided hoses are about 2 meters). Cut off any surplus hose.

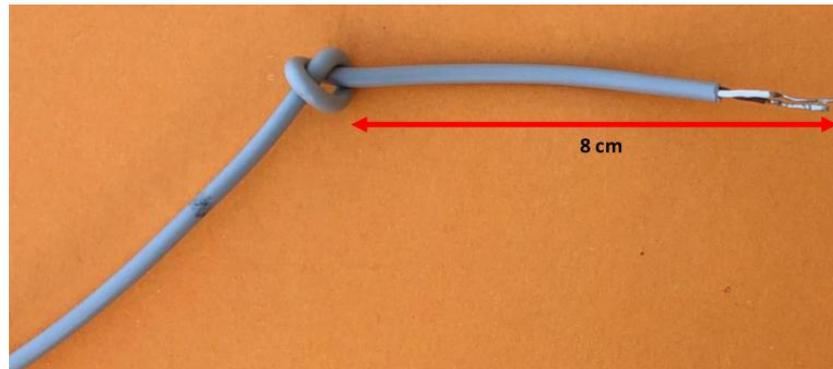
Drill an 8mm-hole at the higher part of the depressed ventilation pipe (the one to be monitored). Take one of the two connectors and sink its longest part for at least 50mm in

the hole you've just drilled. Fix it with 2 screws. The hose SHALL NOT be pinched or crushed. The finished assembly SHALL be hermetic.

Following the same steps, set up the other connector on a case, into the ventilation box, so that it is exposed at the atmospheric pressure but in a draft-free place.

**[Option 50-70-064-000 Ventil'O sensor with a pulse S0 input]**

The cable is not provided. We recommend using a moulded (to ensure waterproofing) 2-single-wire-threads AWG20 to AWG26 cable, like the one shown on picture 4.



Picture 4 Example of cable to use with the S0 input

The cable SHALL be shorter than 3 meters. Connect one end of your cable to the pressure switch to be monitored. At the other end of the cable, we recommend to strip each threads on 5mm to 6mm to ensure a good contact. Pass the cable through the M12-gland located at the bottom of the sensor's case. Make a knot at 8cm of the extremity of the cable as shown on picture 4. Connect the 2 striped threads on the green connector. You should get an assembly as shown on picture 5.



Picture 5 The sensor with an S0 cable set up

Close the lid of the sensor box and lock the 4 quarter turn screws. Their indicator MUST be facing the locked padlock.

	<b>USER GUIDE</b>	<b>50-70-064(101)-000_GUIDE</b>	
	<i>LoRaWAN Ventil'O</i>	Revision: 0	Page 7/14

## 5. UTILIZATION

### 5.1. UI components

This sensor includes the following UI components:

- Reed switch (ILS).
- Buzzer.

When a magnet is placed in front of the « ILS » mark, the sensor produces a slightly intermittent feedback sound that signifies the reed switch is being activated. The location of the reed switch noticed by an « ILS » tag on the top of the sensor case.

### 5.2. Set the sensor in working mode

If you are using a private network, you should start up your gateway as a first step. If you don't know it, you should familiarize yourself with it before starting the sensor. We advise to provision the network with the sensor's identification information before you start up the sensors. This aims to reduce the time taken by the pairing procedure.

#### 5.2.1. Set the sensor in the working mode

Place a magnet in front of the reed switch for 1 second.

A tune is played during around 1 second: 2 short tones, the first is low-pitched and the second high-pitched.

#### 5.2.2. Pairing to a network

Then, the sensor launches the pairing process: the buzzer emits a short bip every 2 seconds until the end of the pairing process. The pairing process won't stop until the sensor is successfully paired to a network. When the sensor successfully pairs to a network, a tune is played during around 1 second: 2 short tones, the first is deep and the second middle-pitched, played twice in a row. Then, the sensor is in the working mode. The buzzer stays mute.

See the « Test mode: check whether a sensor is switched on or off » section to determine if the sensor is in storage mode or in working mode.

### 5.3. Set the sensor in storage mode

Place a magnet in front of the reed switch for 5 second.

A tune is played during around 1 second: 2 short tones, the first is high-pitched and the second is low-pitched.

See the « Test mode: check whether a sensor is switched on or off » section to determine if the sensor is in storage mode or in working mode.

### 5.4. Factory reset

The reset factory feature resets the network and the application parameters at their initial value as defined by the manufacturer. E.g. : data about the paired network are deleted and attribute values like counters are reset to 0.

Make the following sequence, by activating the reed switch with a magnet:  
2 short activations + one long activation of 7 seconds (at least).

Remark: make this 3 activations (2 short + 1 long) without a pause during all the sequence. If the sequence is fragmented, it will not work.

The factory reset is confirmed by a tune: 3 tones, from low-pitched to high-pitched, played 3 times. Then the sensor reboots.

### 5.5. Pairing reset

The pairing reset feature resets the pairing state and launch a new pairing process. The application parameters are kept.

Make the following sequence, by activating the reed switch with a magnet:  
3 short activations.

The sensor launches the network pairing process, like it does when it is set in working mode.

### 5.6. Test mode: check whether a sensor is in worling or storage mode

You can check whether the sensor is in working or storage mode by activating the reed switch with a magnet, following this sequence:  
One short activation.

If the sensor is in storage mode, nothing happens: the sensor stays in storage mode.

If the sensor is in working mode, it switches in test mode:

- The sensor sends one void frame (heartbeat) per minute.
- The reports are temporarily deactivated during the test mode. Next report is postponed of the duration the test mode has been activated.
- The buzzer sounds 2 quite loud high-pitched tones (with the second that persists a little bit more than the first) every 3 seconds.
- The first void frame (heartbeat) is sent 10 seconds after activating the test mode.
- The test mode automatically turns off after 10 minutes if it is not deactivated before by the user.

The characteristic bips emited during this test mode happens only if the sensor is in worling mode. That enables to check directly the current mode (working or storage) of the sensor.

To deactivate the test mode, repeat the same sequence than to activate it.

### 5.7. Configuration of the application layer

To know how work the sensor « out of the box » see the « DATA PROCESSING > How reports work » section.

The application layer, and in particular the report configuration, can be modified through ZCL-like commands sent to the sensor. See the support website at:  
<http://support.nke-watteco.com/>

This sensor embeds the following clusters:

- Basic
- Configuration
- LoRaWAN
- Differential pressure measurement
- Temperature measurement
- Binary input (for the pressure switch input)

Here is an example of reconfiguring the sensor:

ZCL-like command	Description
------------------	-------------

115000500203	Configuration cluster: remove all the existing configuration.
1106800800000029803C803C0000	Differential pressure measurement cluster: report the Measured value attribute every 1 hour.
1106040200000029803C803C0000	Temperature measurement cluster: report the Measured value attribute every 1 hour.
1106000F000055108001000001	Binary input: report the Present value attribute when its value change (boolean) and at a maximum of once per minute.
1106040298000029800A0000B10000003201	Temperature measurements cluster: sends a low threshold report when the Measured value falls under the threshold, and at a maximum of one per 10 minutes. <ul style="list-style-type: none"> <li>• Threshold : 0x0000 = 0 Celsius degrees</li> <li>• Hysteresis : 0x0032 = 50 = 0.5 Celsius degrees</li> <li>• Send a ZCL-like report only when a threshold is reached (alarm reports) : 0x0000.</li> <li>• A this threshold report is sent at a maximum of once per 10 minutes, 0xA = 10 ; 8 signifies « minutes ».</li> <li>• 0xB1 : this is a low threshold. The report is sent when the Measured value falls under the Threshold - Hysteresis.</li> </ul>
1106040298000029800A0000D20190003201	Temperature measurements cluster: sends a high threshold report when the Measured value exceeds the threshold, and at a maximum of one per 10 minutes. <ul style="list-style-type: none"> <li>• Threshold : 0x0190 = 400 = 4 Celsius degrees</li> <li>• Hysteresis : 0x0032 = 50 = 0.5 Celsius degrees</li> <li>• Send a ZCL-like report only when a threshold is reached (alarm reports) : 0x0000.</li> <li>• A this threshold report is sent at a maximum of once per 10 minutes, 0xA = 10 ; 8 signifies « minutes ».</li> <li>• 0xD2 : This is a high threshold. The report is sent when the Measured value exceeds Threshold + Hysteresis.</li> </ul>

**Every change on the default configuration must respect the legal duty cycle (for example the most restrictive in EU is 0.1%, so in SF12 it is around 1 frame each hour).**

A factory reset removes any personalized configuration and set the default Batch configuration again.

Please note that this is a Class A LoRaWAN sensor. The command frames will be sent to the sensor only successively to the reception of a frame from the sensor. To speed up this process you can use the « test mode ».

## 6. DATA PROCESSING

### 6.1. How reports work

The measurements of the sensor are transmitted through an applicative communication protocol. The LoRaWAN nke Watteco sensors are endowed with two different applicative communication protocols, the "Batch" and the "ZCL-like". The "Batch" is a nke Watteco proprietary protocol that features compression and aggregation. It is usefull if you want the sensor to wait several measurements before transmitting them all together, or if you want to transmit all together measurements of different kind -depending on the sensor's capabilities/options-. The compression algorithm makes it very hard to directly understand the frame's content. Please refer "DATA PROCESSING > Uncompress Batch reports with br\_uncompress". The "ZCL-like"

is a protocol based on the ZCL standard, but with some proprietary differences. Contrary to the Batch, it is much more easy to directly read the report frames in order to extract the transmitted data. But each measurement is transmitted separately. Please refer to our documents and website listed in the "REFENRECE DOCUMENTS" section for more information. On this sensor, the default report configuration is described below:

	Reported value (unit)	Report kind (details)
1	Mean differential pressure since last value (Pascal)	Batch (a record/12h, a transmission/12h)
2	Minimal differential pressure since last value (Pa)	Batch (a record/12h, a transmission/12h)
3	Maximal differential pressure since last value (Pa)	Batch (a record/12h, a transmission/12h)
4	Battery voltage (mV)	Batch (a record/7j, a transmission/7j)
5	Differential pressure (Pa)	ZCL-like low/high threshold report when the value falls under/exceeds 100Pa, with an hysteresis of -/+10Pa
6	Differential pressure (Pa)	ZCL-like low/high threshold report when the value falls under/exceeds 400Pa, with an hysteresis of -/+10Pa
7	Battery voltage (mV)	Batch record when the value falls under (low threshold) 3000mV, with an hysteresis of -/+100mV. Doesn't trigger the transmission of the current Batch. The Batch will be sent as usual and will carry this record, in addition usual records.

Remark: a record corresponds to measurement of the physical value, temporarily saved for further transmission. It can also be called a sample.

To summarise the table shown above, the sensor transmits a Batch frame every 12 hours containing 1,2 and 3. Once a week, the transmitted Batch frame contains also 4 in addition. If the low threshold of the battery voltage is reached, the 12h-transmitted Batch frame will also contain 7. **The first Batch frame is sent 12 hours after the sensor successfully paired with a network.** When the sensor executes a measurement, if a threshold is reached, then a ZCL-like threshold report is immediately transmitted. In addition to these applicative-Batch or ZCL-like- frames, the sensor can send void frames. These frames are beacons / heartbeats usefull to the network.

## 6.2. How to read the report frames

### 6.2.1. ZCL-like report

A ZCL-like report can be identified by the value of the second byte of the frame: 0x0A.

Here is an example of such a report: 110A040200002907D0

- 0x0A: This is a ZCL-like report
- 0x0402: Temperature measurement cluster
- 0x0000: Measured value attribute
- 0x07D0: The value of the temperature when the frame was issued. 0x7D0 = 2000 = 20°C.

An other example with the differential pressure : 110A80080000290190

- 0x0A: This is a ZCL-like report
- 0x8008: Differential pressure measurement cluster
- 0x0000: Measured value attribute
- 0x0190: The value of the measurement when the frame was issued. 0x190 = 400Pa.

	<b>USER GUIDE</b>	<b>50-70-064(101)-000_GUIDE</b>	
	<i>LoRaWAN Ventil'O</i>	Revision: 0	Page 11/14

### 6.2.2. Batch report

Every single bit of a Batch report is optimized to get the best data size/frame size ratio. As a consequence, trying to parse or read directly the report is hardly feasible. Please refer to the “DATA PROCESSING > Uncompress Batch reports with br\_uncompress” section below.

### 6.2.3. ZCL-like threshold report (alarm)

A ZCL-like threshold report can be identified by the value of the second byte of the frame: 0x8A.

Here is an example of such a report (the default configuration does not include a configuration that triggers this kind of frame, but you could configure it yourself):

118A040200002901C298D2

- 0x8A: This is a ZCL-like threshold report
- 0x0402: Temperature measurement cluster
- 0x0000: Measured value attribute
- 0x01C2: The value of the temperature when the frame was issued. 0x1C2 = 450 = 4.50°C.
- 0xD2: This enables to link this threshold report to one of the threshold report configurations of the sensor. Here, this is the high threshold report configured on the second slot: this report is sent when the Measured value exceeds the Threshold (4°C) + Hysteresis (0.5°C)

An other example with the differential pressure: 118A8008000029009A98B2

- 0x8A: This is a ZCL-like threshold report
- 0x8008: Differential pressure measurement cluster
- 0x0000: Measured value attribute
- 0x009A: The value of the differential pressure when the frame was issued. 0x9A = 154Pa.
- 0xB2: This enables to link this threshold report to one of the threshold report configurations of the sensor. Here, this is the low threshold report configured on the second slot: this report is sent when the Measured value falls under the Threshold (400Pa) - Hysteresis (10Pa). This byte enables to construe the frame as an end of alarm of the default's high threshold (400Pa) configuration.

## 6.3. Uncompress Batch reports with br\_uncompress

### 6.3.1. Download the needed piece of software

The br\_uncompress piece of software enables to uncompress the Batches reports. It can be downloaded here:

<http://support.nke-watteco.com/downloads/>

The zip contains:

- br\_uncompress-WIN.exe: a pre-compiled executable for Windows shell
- wtc-br\_uncompress-aaaamdd.zip: the source code of the br\_uncompress piece of software

If you want to use the piece of software on a system that is not compatible with the pre-compiled executable, you can compile your own executable from the source code. The needed compilation ligne can be found in the header of the br\_uncompress.c source file.

### 6.3.2. Use the br\_uncompress piece of software

The br\_uncompress piece of software enables to uncompress Batch frames sent by LoRaWAN nke Watteco sensors.

**Remark: this piece of software can't uncompress encrypted frames. The frames must be decrypted by the network before being uncompress by this piece of software.**

Some parameters are needed to describe the content of the Batch frames that will be uncompress:

When the sensor is configured with a Batch report, a label is affected to each Batch report configured. This label enables to identify each values carried in a Batch frame. When buliding a sensor's configuration from scratch, the labels can be arbitrarily affected to each measured value to report. However, as the sensor has a factory default configuration, and also to enable the sensor to work quickly with public networks (and to prevent to have to make some additional configurations on the network interface before the whole thing works), we strongly recommend using the labels defined here :

For this sensor, these parameters are: « 3 0,1,7 1,1,7 2,1,7 3,1,6 4,10,7 5,1,7 6,1,10 7,1,1 »

The first number of each triplet is the label of a corresponding measured value as described below :

Label	Corresponding measured value
0	Mean_differential_pressure_since_last_report
1	Minimal_differential_pressure_since_last_report
2	Maximal_differential_pressure_since_last_report
3	BatteryLevel
4	Temperature
5	Differential_pressure
6	S0_Counter
7	S0_State

If there is no report configuration of some of these measured values on your sensor, or if a Batch frame doesn't contain any record for a configured value, the measured value and its corresponding label are simply ignored during uncompression.

### 6.3.3.Example 1: the 12h preiodic Batch frame of a 50-70-064(101)-000

Here, the frame contains measured values corresponding to that the default configuration would produce. However, for the example, the measurement and transmission frequencies have been reduced. This explains why the timestamps below have loe values.

```
$ echo "3607008000f780c3ec01d8b517105900" | ./br_uncompress.exe -a 3 0,1,7 1,1,7 2,1,7 3,1,6 4,10,7 5,1,7 6,1,10 7,1,1
Scan args:
  S00: 0,1.000000,7
Scan args:
  S01: 1,1.000000,7
Scan args:
  S02: 2,1.000000,7
Scan args:
  S03: 3,1.000000,6
Scan args:
  S04: 4,1.000000,7
Scan args:
  S05: 5,1.000000,7
nb_of_type_measure: 3
batch requested: 0
no sample: 1
cnt: 7
  tag: 0, index 0 timestamp: 494 Measure: 391
  tag: 1, index 1 bi: 0 sz: 7 timestamp: 494 Measure: 236
  tag: 2, index 2 bi: 0 sz: 7 timestamp: 494 Measure: 546
TimeStamp of the sending
bi: 1 sz: 5 raw: 0 timestamp: 495

UNCOMPRESS SERIE
cnt: 7
495
494 0 391

494 1 236

494 2 546
```

In that example, the frame to uncompress is: 3607008000f780c3ec01d8b517105900

The command ligne used in the shell to uncompress the frame is:

```
$ echo "3607008000f780c3ec01d8b517105900" | ./br_uncompress.exe -a 3 0,1,7 1,1,7 2,1,7 3,1,6 4,10,7 5,1,7 6,1,10 7,1,1
```

The next lignes are the result of the frame decompression.

In the last lignes, we can observe:

```
UNCOMPRESS SERIE
cnt: 7 Sequence number of this batch (cyclic, form 0 to 7)
495 Timestamp of when the frame was sent
```

494 0 391 Timestamp, label and value for the sole record for the mean differential pressure. P = 391Pa  
 494 1 236 Timestamp, label and value for the sole record for the minimal differential pressure. P = 236Pa  
 494 2 546 Timestamp, label and value for the sole record for the maximal differential pressure. P = 546Pa

Timestamps are given in seconds from the start up of the sensor (timestamp = 0 seconds when the sensor starts up). Each timestamp gives a relative date for an event, like, in the above example, for when the frame was sent or for each record. This is especially useful to give an absolute date to each record when the Batch frame holds several records of the same measured value (depending on the configuration of the sensor).

Here, the timestamp of the frame (when the frame was sent) is 495 seconds. If we make the hypothesis the frame has been immediately received by the network (no disrupt), then this timestamp can be linked with the absolute date of the receipt of the frame (for example, 07/18/2017-17h31m0s corresponds with 495s). Then we can determine an absolute date for each other timestamp (then, for example, 07/18/2017-17h30m59s corresponds with 494s). Furthermore, the timestamp is not reset from a Batch to another, so we could determine an absolute date for previous or further Batch frames (and its included records).

Note that in the case of this default configuration, the relative timestamp is not essential to use the values: there is only one record of each value in one Batch frame, and as the measurements had been completed one second (timestamp = 494 seconds) before the frame was sent, then it is easier to use the (absolute) date of the receipt of the frame to date each record.

The label (also named tag) identifies the measured value's kind. E.g., the label 0 identifies the Mean differential pressure.

#### 6.3.4.Example 2: 12h preiodic Batch frame of a 50-70-064(101)-000 including the weekly battery voltage

In that example, the Batch frame contains the measured physical values of the sensor we saw in « Example 1 », and also the battery voltage that is transmitted weekly. We use the same parameters to uncompress the frame. Indeed these parameters already include that is needed to uncompress the battery voltage. The br\_uncompress program just ignores the parameters for which there is no data to uncompress, like it is the case in « Example 1 ».

```
$ echo "4631000001b30648ec0138b20720d01ea06601" | ./br_uncompress.exe -a 3 0,1,7 1,1,7 2,1,7 3,1,6 4,10,7
5,1,7 6,1,10 7,1,1
Scan args:
S00: 0,1.000000,7
Scan args:
S01: 1,1.000000,7
Scan args:
S02: 2,1.000000,7
Scan args:
S03: 3,1.000000,6
Scan args:
S04: 4,1.000000,7
Scan args:
S05: 5,1.000000,7
nb_of_type_measure: 4
batch requested: 0
no sample: 1
cnt: 1
tag: 3, index 3 timestamp: 614 Measure: 3472
tag: 0, index 0 bi: 0 sz: 7 timestamp: 614 Measure: 28
tag: 1, index 1 bi: 0 sz: 7 timestamp: 614 Measure: 4
tag: 2, index 2 bi: 0 sz: 7 timestamp: 614 Measure: 53
TimeStamp of the sending
bi: 1 sz: 5 raw: 0 timestamp: 615

UNCOMPRESS SERIE
cnt: 1
615
614 0 28

614 1 4

614 2 53
```

	USER GUIDE	50-70-064(101)-000_GUIDE	
	LoRaWAN Ventil'O	Revision: 0	Page 14/14

614 3 3472

The uncompression result is very similar to that we saw in « Example 1 ». There is just the battery voltage in addition, on the last line:

614 3 3472 Timestamp, label and value for the unique record of the battery voltage. Up = 3,472V