

SUBJECT : User guide of the LoRaWAN indoor TH(Temperature) sensor

PRODUCT : 50-70-053(085)-000 LoRaWAN indoor TH(Temperature)

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History

DATE	REVISION	OBJET	AUTHOR
07/02/18	0	Creation	NJC
12/02/18	1	« Configuration of the application layer » section added	NJC
18/05/18	2	Add information and examples for the Threshold report feature + some minor fixes.	NJC
15/06/18	3	Add the two options: 50-70-053 TH and 50-70-085 Temperature only	NJC

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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 :
50-70-053_SPG_Capteur_TH_LoRaWAN_ICT_V0_X_Y.pdf
LoRaWAN_Sensors_Application_Layer_Addon_001_V1_X.pdf

You can find more informations on the technical aspects of the device on:
<http://support.nke-watteco.com/>

3. DEVICE CHARACTERISTICS

Depending the device you purchased, your device has the following features

The 50-70-053-000 LoRaWAN indoor TH sensor is designed to :

- Measure the ambient temperature
- Measure the hygrometry

The 50-70-085-000 LoRaWAN indoor Temperature sensor is designed to :

- Measure the ambient temperature

These sensors are designed for an indoor usage (e.g.: private housing, offices, ...).

Therefore, the hygrometry measurement will be treated as an option below, and will be marked with the tag **[option]**.

4. INSTALLATION

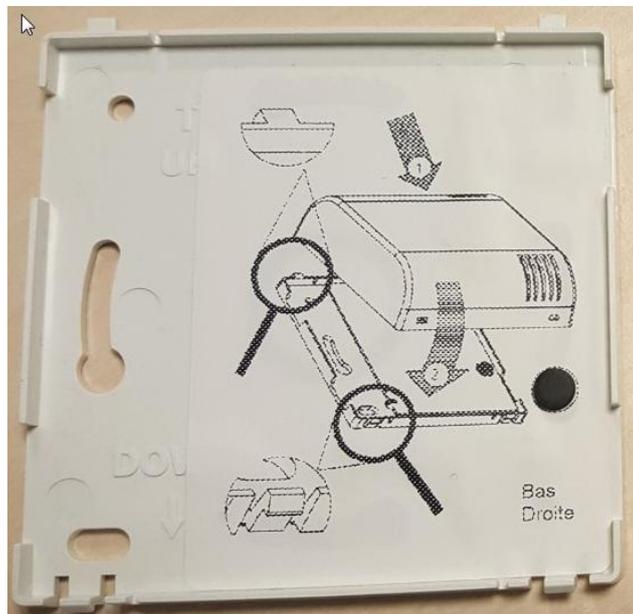
Metallic objects/surfaces are likely to reduce or disrupt radio frequency signals. The sensor must be fixed to at least one meter form any metallic object or surface.

There is how the LoRaWAN indoor TH sensor looks like:



Picture 1 Sensor fixed on a vertical wall

First, fix the lid of the sensor to the wall using the screw kit provided. Then fix the case holding the electronic card to the lid, following the instructions shown on the tag into the lid:



Picture 2 Lid of the case to fix with the screw kit, showing mounting instructions

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

5. UTILIZATION

5.1. UI components

This sensor includes the following UI components:

nke ☎(33).02.97.36.10.12 Fax (33).02.97.36.55.17

Fichier modèle : QPE.dot du 02/11/1999 (MAJ éditions normes)

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- Reed switch (ILS).
- Buzzer.
- Green LED, glowing through the top-right opening.

When a magnet is placed in front of the « ILS » mark, the sensor produce a slightly intermittent feedback sound that signifies the reed switch is beeing activated. The location of the reed switch noticed by an « ILS » tag on the right 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, 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 deep and the second high-pitched.

5.2.2. Pairing to a network

Then, the sensor launches the pairing process: the green LED blinks 250 milliseconds each 5 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, the green LED is switched on for 3 seconds to confirm the sensor has been successfully paired to a network. Then, the sensor is in the working mode. The green LED and the buzzer stay switched off.

Remark 1: we use a green LED instead of the buzzer to signal a network pairing is in process. This enables to avoid noise pollution when this sensor is set up in an occupied room.

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 deep.

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 manufacuter. 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.

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The factory reset is confirmed by a tune: 3 tones, from deep 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
- Relative humidity measurements
- Temperature measurements
- Binary input (for the open/close case alarm feature)

Here is an example of reconfiguring the TH sensor:

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

nke	☎(33).02.97.36.10.12	Fax (33).02.97.36.55.17
-----	----------------------	-------------------------

Fichier modèle : QPE.dot du 02/11/1999 (MAJ éditions normes)

115000500203	Configuration cluster: remove all the existing configuration
110604020000029803C803C0000	Temperature measurement cluster: report the Measured value attribute every 1 hour.
110604050000021803C803C0000	Relative humidity 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.
110604029800029800A0000B1000003201	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"> • Threshold : 0x0000 = 0 Celsius degrees • Hysteresis : 0x0032 = 50 = 0.5 Celsius degrees • Send a ZCL-like report only when a threshold is reached (alarm reports) : 0x0000. • A this threshold report is sent at a maximum of once per 10 minutes, 0xA = 10 ; 8 signifies « minutes ». • 0xB1 : this is a low threshold. The report is sent when the Measured value falls under the Threshold - Hysteresis.
110604029800029800A0000D20190003201	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"> • Threshold : 0x0190 = 400 = 4 Celsius degrees • Hysteresis : 0x0032 = 50 = 0.5 Celsius degrees • Send a ZCL-like report only when a threshold is reached (alarm reports) : 0x0000. • A this threshold report is sent at a maximum of once per 10 minutes, 0xA = 10 ; 8 signifies « minutes ». • 0xD2 : This is a high threshold. The report is sent when the Measured value exceeds Threshold + Hysteresis.

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

Depending the kind of data to report, the nke Watteco LoRaWAN sensors use an nke Watteco proprietary compression and aggregation protocol named « Batch » or a ZCL-like protocol (based on the ZCL standard, but with some differencies). On this sensor, the reports are described as follow:

Reported value (unit)	Report kind (details)
Ambiant temperature (1/100 of Celsius degrees)	Batch (a record/30min, a transmission/h)

[option] Hygrometry (1/100 of %)	Batch (a record/30min, a transmission/h)
Battery voltage (mV)	Batch (a record/7j, a transmission/7j)
State of the opening/closing case detector (boolean)	ZCL-Like (a transmission on event, and max once per minute)
Ambiant temperature (1/100 of Celsius degrees)	ZCL-like low threshold report when the temperature falls under 7°C, with an hysteresis of -/+1°C
Ambiant temperature (1/100 of Celsius degrees)	ZCL-like high threshold report when the temperature exceeds 25°C, with an hysteresis of -/+1°C
[option] Hygrometry (1/100 of %)	ZCL-like low threshold report when the hygrometry falls under 1%rH, with an hysteresis of -/+1%rH
[option] Hygrometry (1/100 of %)	ZCL-like high threshold report when the temperature falls under 70%rH, with an hysteresis of -/+1%rH

Remark 1: to summarise the table shown above, the sensor transmits a Batch frame every hours. The first Batch frame is sent one hour after the pairing with the network is successfully done. In the case the sensor case is opened / close by pulling out / putting back the lid, a ZCL-like frame (alarm) is sent. In addition to these Batch frames, the sensor can send void frames. These frames are beacons / heartbeats usefull to the network.

Remark 2: a record corresponds to a sample of the measured physical value. It can also be called a sample.

6.2. How to read the report frames

6.2.1.ZCL-like report

A ZCL-like report can be identified y 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.

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.

6.2.3.ZCL-like threshold report (alarm)

A ZCL-like threshold report can be identified y the value of the second byte of the frame: 0x8A. Here is an example of such a report: 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)

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-aaaammdd.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 form 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. In the case of the indoor TH sensor, these parameters are :

- For the TH 50-70-053-000 : « -a 2 0,1,7 1,1,6 2,1,6 »
- For the TH 50-70-053-001 : « -a 2 0,10,7 1,100,6 2,1,6 »
- For the Temperature 50-70-085-000 : « -a 2 0,1,7 2,1,6 »
- For the Temperature 50-70-085-001 : « -a 2 0,10,7 2,1,6 »
-

6.3.3. Example 1: hourly preiodic Batch frame

Here, the frame contains measured values of the TH sensor.

```
$ echo "220000C081938297B457C0140108D009645E1968B707" | ./br_uncompress.exe -a 2 0,1,7 1,1,6 2,1,6
Scan args:
S00: 0,1.000000,7
Scan args:
S01: 1,1.000000,6
Scan args:
S02: 2,1.000000,6
nb_of_type_measure: 2
batch requested: 0
no sample: 0
cts: 1
cnt: 0
tag: 0, index 0 timestamp: 1870 Measure: 2654 Coding type: 2, Coding table 0
tag: 1, index 1 bi: 0 sz: 7 timestamp: 1870 Measure: 2712 Coding type: 2, Coding table 0
common time stamp
number of sample: 2
TimeStamp Coding(0-A/1-B/2-C): 0
bi: 0 sz: 2 timestamp: 1870
bi: 10 sz: 11 raw: 777 timestamp: 3670
tag: 0 index: 0
0. available: 1 coding table: 0 bi: 0 sz: 2
1. available: 1 coding table: 0 bi: 4 sz: 4 Rawvalue: 7 value: 2632 TimeStamp: 3670
tag: 1 index: 1
0. available: 1 coding table: 0 bi: 0 sz: 2
1. available: 1 coding table: 0 bi: 8 sz: 8 Rawvalue: 118 value: 2339 TimeStamp: 3670
TimeStamp of the sending
bi: 0 sz: 7 timestamp: 3670

UNCOMPRESS SERIE
cnt: 0
3670
1870 0 2654
3670 0 2632

1870 1 2712
3670 1 2339
```

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In that example, the frame to uncompress is: 220000C081938297B457C0140108D009645E1968B707

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

```
$ echo "220000C081938297B457C0140108D009645E1968B707" | ./br_uncompress-WIN.exe -a 2 0,1,7 1,1,6 2,1,6
```

The next lignes are the result of the frame decompression.

In the last lignes, we can observe:

UNCOMPRESS SERIE

cnt: 0 Sequence number of this batch (cyclic, form 0 to 7)

3670 Timestamp of the frame

1870 0 2654 Timestamp, tag and value for the 1st record of the ambient temperature. T = 26,54C

3670 0 2632 Timestamp, tag and value for the 2nd record of the ambient temperature. T = 26,32C

1870 1 2712 [option] Timestamp, tag and value for the 1st record of the hygrometry. rH = 27,12%

3670 1 2339 [option] Timestamp, tag and value for the 2nd record of the hygrometry. rH = 23,39%

The timestamp corresponds to the relative date in seconds (0 correspond with the start up of the sensor) when the frame has been sent. If we make the hypothesis the frame has been immediately received by the network (no disrupt), then the timestamp can be linked with the absolute date of the receipt of the frame. This enables to determine an absolute date for each record of the Batch.

The timestamp of each record corresponds to the relative date in seconds when the record has been done, in the same way than for the timestamp of the frame.

For example, if we receive this frame on 07/18/2017-17h31, we can consider the relative clock of the sensor was 3670 (=timestamp of the frame).

If we take a closer look at the records of the ambian temperature:

The first record has been done at 1870. This timestamp is consistently lower than the timestamp of the frame as it has been done before the frame was sent. By computing the difference, we can determine the delay to subtract to the absolute date. This way, we obtain the absolute date of the record:

3670 - 1870 = 1800 seconds = 30 minutes.

We deduce that the absolute date of the record is 07/18/2017-17h01.

The same calculation can be done with timestamps form different frames. For example, it is possible to compute the delay between the first record of this Batch frame and the last record of the previous Batch frame.

The tag identifies the kind of the value. E.g., the tag 1 identifies an hygrometry value.

6.3.4.Example 2: hourly preiodic Batch frame including the weekly battery voltage

In that example, the Batch frame contains the measured physical values of the TH sensor we saw in « Example 1 », and alsì the battery voltage that is transmitted weekly. We use the same parameters to uncompress the frame. Indeed these parameters already include that is neede 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 "320200004198C08DB457680EFF0E212100F9E496282B" | ./br_uncompress.exe -a 2 0,1,7 1,1,6 2,1,6
```

Scan args:

S00: 0,1.000000,7

Scan args:

S01: 1,1.000000,6

Scan args:

S02: 2,1.000000,6

nb_of_type_measure: 3

batch requested: 0

no sample: 0

cts: 1

cnt: 2

tag: 0, index 0 timestamp: 1121 Measure: 567 Coding type: 2, Coding table 0

tag: 1, index 1 bi: 0 sz: 7 timestamp: 1121 Measure: 2765 Coding type: 1, Coding table 0

tag: 2, index 2 bi: 4 sz: 3 raw: 15 timestamp: 1151 Measure: 3617 Coding type: 1, Coding table 0

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Fichier modèle : QPE.dot du 02/11/1999 (MAJ éditions normes)

```

common time stamp
number of sample: 2
TimeStamp Coding(0-A/1-B/2-C): 0
bi: 0 sz: 2 timestamp: 1121
bi: 4 sz: 4 raw: 15 timestamp: 1151
tag: 0 index: 0
0. available: 1 coding table: 0 bi: 0 sz: 2
1. available: 1 coding table: 0 bi: 2 sz: 2 RawValue: 2 Value: 562 TimeStamp: 1151
tag: 1 index: 1
0. available: 1 coding table: 0 bi: 0 sz: 2
1. available: 1 coding table: 0 bi: 0 sz: 2 Value: 2765 TimeStamp: 1151
tag: 2 index: 2
0. available: 0
1. available: 1 coding table: 0 bi: 0 sz: 2
TimeStamp of the sending
bi: 1 sz: 5 raw: 1 timestamp: 1153

```

UNCOMPRESS SERIE

```

cnt: 2
1153
1121 0 567
1151 0 562

```

1121 1 2765 [option]

1151 1 2765 [option]

1151 2 3617

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:

1151 2 3617 Timestamp, tag and value for the unique record of the battery voltage. Up = 3,617V