GENERAL SPECIFICATIONS

ICT Sigfox Remote Outdoor Temperature Sensor

Document revision history

DATE	REVISION	OBJECT	Author
26/11/2015	0	Creation	PLG
07/03/2016	1	Management of UDD measurement added and instant measurements and UDD measurements deactivation flags added	MC
07/09/2017	2	Precision regarding temperature conditions for the battery's theoretical service life	MC

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1. OBJECT OF THE DOCUMENT

Describe the operation and technical characteristics of the product "**SigFox remote outdoor temperature sensor**" (temperature measurement with remote probe and SigFox radio technology).

2. APPLICABLE DOCUMENTS - REFERENCE DOCUMENTS

- General specifications of the SigFox outdoor temperature sensor: 50-09-008_SPG_Outdoor_Temperature_Sensor.pdf
- Detailed software specifications - SigFox sensors data exchanges: 50-09_SigFox_SPDL_Sensor.docx

3. DEFINITIONS - TERMINOLOGY

SigFox: the SigFox technology provides low bandwidth, long range, secured UNB (Ultra Narrow Band) radio communication with very low energy consumption. The star network covers an end-to-end transmission, from the equipment to the information system.

Differential coding: (also called **delta compression**) is a lossless data compression technique that consists in transforming data through the series of differences between successive data. This method based on the simplified Huffman coding is only interesting if the data to be compressed are subject to little change.

4. BACKGROUND AND OBJECTIVES OF THE STUDY

The SigFox remote outdoor temperature sensor has been developed based on new electronics that incorporate the SigFox technology.

Important: the sensor must be placed under coverage of the SigFox public network.

Readings serve as an indication; they cannot be associated with a billing process for example.

Important: the costs associated with network access (subscription and volume) are borne by the customer.

5. GENERAL STRUCTURE OF THE PRODUCT

5.1 Mechanical presentation

The SigFox remote outdoor temperature sensor board is housed in a grey ABS enclosure.

The sensor must be sheltered so as not to be subjected to excessive external stresses or excessively fast changes in ambient conditions (sun radiation, wind, rainfall, etc.) that may be detrimental to the quality of the measurements.
It must be placed at least 1 metre away from any metal element that can constitute a ground plane that significantly attenuates the radio signal.
When the sensor is installed indoors, extra attention must be paid to the SigFox network coverage, which is greatly reduced in this case.
In order to be installed outdoors, the sensor enclosure is that of the Impulse model.

The enclosure is disassembled by unscrewing the fixing screws located on the front shell.

A cable gland allows the passage of an NTC (Negative Temperature Coefficient) remote temperature probe designed to measure the temperature outside the enclosure. The measurement range is -40°C to +90°C with a 0.2°C resolution and a +/- 1°C accuracy between -20°C and +40°C.
The NTC active element is offset by 5 metres so as to be "immersed" in an environment where the temperature is not within the operating range of the product.
The sensor is intended to be attached to a vertical wall (using screws & bushings) at a height great enough to be sufficiently inaccessible (there is no provision for tearing detection).

The sensor incorporates a SigFox radio transceiver associated with an antenna.

The external dimensions are approximately 84 x 82 x 55 mm.
The IP55 enclosure complies with flammability standard UL94-V0 HB (no flame propagation).

There is no provision for tearing detection.

5.2 Power supply

The SigFox remote outdoor temperature sensor board is powered by a lithium battery. The electronics are designed in such a way as to obtain a very low standby current that allows for a low lithium battery capacity.
The battery's theoretical service life is approximately 9 years based on one measurement every hour and one radio transmission every 24 hours for temperature measurements when the data sent are not compressed, and one radio transmission every 24 hours for uncompressed UDD measurements.
In the case where the data for temperature measurements are compressed, the battery's theoretical service life is approximately 12 years provided that the data do not fluctuate too much (less effective data compression).
For any other configuration with a lower measurement or transmission period, the service life will be reduced.
The battery is replaced at the factory.
This theoretical lifetime of the battery is valid for the operating temperature range of +10 °C to +25 °C.

5.3 Information frame and power supply self-test

Sensor information frames are sent during the period of radio transmission of these information frames set in the product configuration but also 5 minutes after the sensor is activated, and at every change in software or product configuration. These information frames can be deactivated by specifying "0" for the corresponding parameter in the configuration. The information sent in these frames are: the battery voltage measurement, the number of radio transmissions, the software and product configuration version and subversion.

Indeed, the board measures the supply voltage of its battery and sends the measurement during the period of radio transmission of sensor information frames set in the product configuration. The sensor is capable of detecting a low battery information. If the voltage drops below a minimum threshold, an alarm is sent to the network after the data has been transmitted.

The number of radio transmissions corresponds to the number of radio transmissions that the sensor has made since leaving the factory.

The software and product configuration versions and subversions have the following formats:

- Software: 01.00 (version: 01 and subversion: 00)
- Configuration: 02.05 (version: 02 and subversion: 05)

5.4 Configuration settings for SigFox remote outdoor temperature sensor

The sensor is supplied with factory settings, defined at the time of the order, and for a minimum volume of 100 sensors:

- Minimum interval between two measurements: 1 to 48 hours, in 1 hour increments,
- Interval between two radio transmissions of measurement frames: 2 to 48 hours, in 1 hour increments,
- Interval between two radio transmissions of sensor information frames (measured battery voltage, number of radio transmissions, software and configuration version and subversion): 0 to 30 days, in 1 day increments ("0": deactivation of sensor information frame transmission)
- Alarm thresholds:
  - Minimum battery level for threshold overrun alarm (from 1 to 36 1/10V, i.e. from 0.1 V to 3.6 V)
  - Minimum and maximum temperature for threshold overrun alarm (-400 to 900 1/10°C, i.e. -40°C to +90°C)
- Alarm thresholds deactivation flag: "0" → Alarm thresholds activated and "1" → Alarm thresholds deactivated (does not concern the battery voltage)
- Data compression type: "0" Data compression deactivated and "1" → nke "Delta compression" type activated
- Instant temperature measurement deactivation flag: "0" → Instant temperature measurement activated and "1" → Instant temperature measurement deactivated
- UDD measurement deactivation flag: "0" → UDD measurement activated and "1" → UDD measurement deactivated

Later versions will allow these configuration settings to be updated locally using a micro SD card (connector present on the board) on which a configuration file that specifies the new values of these settings will be loaded.
The embedded software will also be updated locally using a micro SD card.

The settings of the sensor configuration file are specified in the document "50-09_SigFox_SPDL_Sensor.docx".

5.5 Instant temperature measurements

At regular intervals, the sensor wakes up to perform a measurement. The latter is then stored in the memory, after which the sensor is placed in standby mode.
These measurements are then sent during the period of radio transmission of measurements via the SigFox network.
The microcontroller manages its consumption optimally according to its measurement period.
A configuration setting allows instant temperature measurements to be activated or not (see: Configuration settings for the SigFox remote outdoor temperature sensor).

5.6 UDD measurement

Every 24 hrs, prior to every UDD measurement data transmission, the system deduces a minimum, a maximum and an average - useful values for calculating the UDD.
N.B. : in order to lock onto full 24-hour days and assuming that the products are activated on average around noon, we wait 12 hours after this activation to perform the temperature measurements which are useful for

calculating the UDD from midnight onwards. Therefore, the first UDD measurement frame will be transmitted 36 hours (12 hours waiting for midnight and 24 hours of UDD measurement) after the system has been activated (activation alarm), then every 24 hours.
A configuration setting allows instant temperature measurements to be activated or not (see: Configuration settings for the SigFox outdoor temperature sensor).

5.7 Microcontroller

A Flash memory inside the microcontroller supports:

- the software: the sensor is supplied with the current version of the software (later versions will allow local updates via a micro SD card).
- the configuration settings for the operating profile (later versions will allow local updates via a micro SD card).

A RAM memory inside the microcontroller allows the measurements to be saved until the next radio transmission. Once the transmission is complete, the memory is erased.

5.8 NFC tag

An NFC tag attached to the sensors (inside the enclosure) includes a product type, as well as a unique internal identification code in order to simplify any intervention by the installer, who will retrieve this information by "tagging" the product.

6. FUNCTIONS OF THE PRODUCT IN INSTALLATION AND USE

6.1 Operation and communication

A magnetic sensor (reed switch) activated by a magnet and an embedded confirmation buzzer allow the sensor to be taken out of storage mode and to initiate communication with the network (start "alarm"). Similarly, the system can be stopped by reactivating the magnetic sensor (reed switch). When the sensor is stopped, it also transmits a stop "alarm".

The sensor sends the measurements made during each period of radio transmission of measurements. "Low battery" alerts are sent during the period of radio transmission of information that follows their detection, if this function is activated.

6.2 Data transfer period and reference date

The data transfer rate (measurements or alarms, if any) of the SigFox remote outdoor temperature sensor is one of the parameters of its configuration.
Transmission dates are calculated from a first transmission date and by adding the transfer period.
The data structure (format of each measurement) of this sensor is specified in the document "50-09_SigFox_SPDL_Sensor.docx".

6.3 Measurement data

Temperature measurements are stored in 1/10 °C and are sent according to a period set in the configuration.

To optimise the number of data frames, with a view to minimising consumption and thereby increasing the product's autonomy, the data will be compressed using the differential coding method (delta compression).

6.4 Alarm data

Important: between two measurements, the sensor goes into standby mode. No alarm shall be detected (e.g. low battery voltage). It is not until the next measurement that a possible alarm will be detected and sent immediately.

The different types of alarms are:
- Product activation/deactivation alarms
- Power supply alarms (low battery)
- Physical quantity alarms (temperature)

7. MANUFACTURABILITY

In order to limit production costs, the electronic boards will have to follow a conventional manufacturing process involving a mix of SMD and through-hole components wave soldered onto FR4 epoxy printed circuit board with metallised holes.
In compliance with EMC standards and despite the additional cost generated, a 4-layer CAD with the most significant ground plane possible shall be favoured. The finish of printed circuit boards shall comply with the latest Lead Free / RoHS specifications.

7.1 Testability

An in situ test (or one similar in performance) is carried out at 100% once the components are inserted.
A functional check is performed by a test software embedded in each SigFox remote outdoor temperature sensor and specific tooling.
Mounting pads for test probes shall be arranged on the traces of strategic signals. A PC software shall be used for programming the microcontroller and shall use a plug-in connector.

7.2 Identification-Traceability

Products are identified individually. Each board is programmed with a unique serial number.
Each sensor bears a unique internal identification code visible on the product identification label.

This label allows traceability and indicates:
- the NKE product group code (50-09-062-xxx)
- a unique NKE code for determining the manufacturing order (MO) number and the product number in the MO
- the serial number

7.3 Packaging

Each board is delivered mounted in an enclosure.
When shipped, the SigFox remote outdoor temperature sensors are grouped in batches, in a cardboard box capable of withstanding transport constraints.

8. MAINTAINABILITY

There is no provision for preventive maintenance operations.
The product must be returned to the factory to carry out after-sales service or to replace the battery.

9. DESIGN CONSTRAINTS

9.1 Operating temperature

Operating range comprised between ~~-40°C and +90°C~~ -20°C and +60°C.

9.2 Storage temperature

Storage range comprised between -10°C and +30°C (limited by the battery) and less than 75% relative humidity.

9.3 Power supplies

Power is provided by a lithium battery.

9.4 Tightness - IP rating

IP55.

9.5 Autonomy

See paragraph above.

9.6 Mechanical stress - shocks - vibrations

Measures are taken during wiring to prevent the tool used (e.g. screwdriver) from tearing off a component if it slips.

10. NORMATIVE REQUIREMENTS

10.1 Electromagnetic compatibility

For CE marking purposes, products comply with the general EMC regulations for electronics. NKE takes care of the testing necessary to ensure the compatibility of its products
The selected radio component complies with standards EN 300-220 / EN 301-489.

10.2 Electrical Safety

N/A

10.3 Standards and regulations specific to the business segment

NF EN-60335-1
Products are designed and manufactured in accordance with Directive 2002/96/EC on Waste Electrical and Electronic Equipment and Directive 2002/95/EC on the Restriction of Hazardous Substances (RoHS).

11. MARKETING SPECIFICATIONS

11.1 Product service life

7 years minimum

11.2 Pricing structure

The applicable pricing conditions are those set out in the applicable commercial offerings.

11.3 Guarantee

Products are guaranteed 24 months from the date of delivery by NKE, subject to implementation in accordance with the rules set out in the technical specifications.

11.4 Maintenance

N/A. Except for battery replacement, which requires the product to be returned to the factory.

11.5 Product documentation requirements

Customer's responsibility.