USER GUIDE FOR SIGFOX-READY AMMONIA GAS SENSOR WITH BLE WSSFCB-NH3

THIS IS **OBSOLETE** MANUAL

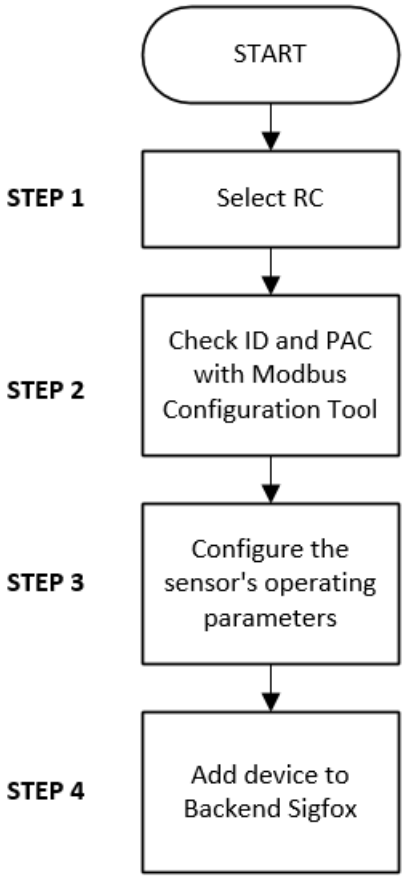
Please access https://www.iot.daviteq.com/wireless-sensors for updated manual

WSSFC- NH3-MN-EN-01	AUG-2021

This document is applied for the following products

SKU	WSSFCB-NH3	**HW Ver.**	1.1	**FW Ver.**	1.0
Item Code	WSSFCB-NH3-8-01	Wireless Sigfox Ammonia Gas Sensor with BLE, Internal antenna, Type AA battery 1.5VDC, IP67, RC1 zone			
	WSSFCB-NH3-9-01	Wireless Sigfox Ammonia Gas Sensor with BLE, Internal antenna, Type AA battery 1.5VDC, IP67, RC2-RC4 zones			

0. Configuration Check List



STEP 1: Select RC	
1. Select RC zone	RC zones selection 1, 2, 4,... is RCZ1, RCZ2, RCZ4,... (refer to **section 6**)
STEP 2: Check ID and PAC	
Use Modbus Configuration Cable to read the ID and PAC values	Refer to register address 8 and 10 (DEC)
STEP 3: Configure the sensor's operating parameters	
Configure parameters like cycle send data, alarm, a, b,...	Refer to the configuration **section 5**
STEP 4: Add device to Backend Sigfox	
refer to section 5.2 for details	
STEP 5: Installation	
refer to section 8 for details	

1. Functions Change Log

HW Ver.	FW Ver.	Release Date	Functions Change
1.1	1.0	DEC-2020	

2. Introduction

WSSFC-NH3 is a Sigfox-ready electrochemical-type gas sensor which has high sensitivity to low concentrations of ammonia gas, high selectivity, and a stable baseline. Integrated ambient humidity and temperature so the sensor can be measured by special algorithm expertise through modelling and compensating of external heat sources without the need of any additional components. With Ultra-low power design and smart firmware allow the complete Wireless and Sensor package run on 1 x AA battery 3.6V for 2-5 years with 15 minutes update. It can support all regions of Sigfox network in over the World, RC1, RC2, & RC4.

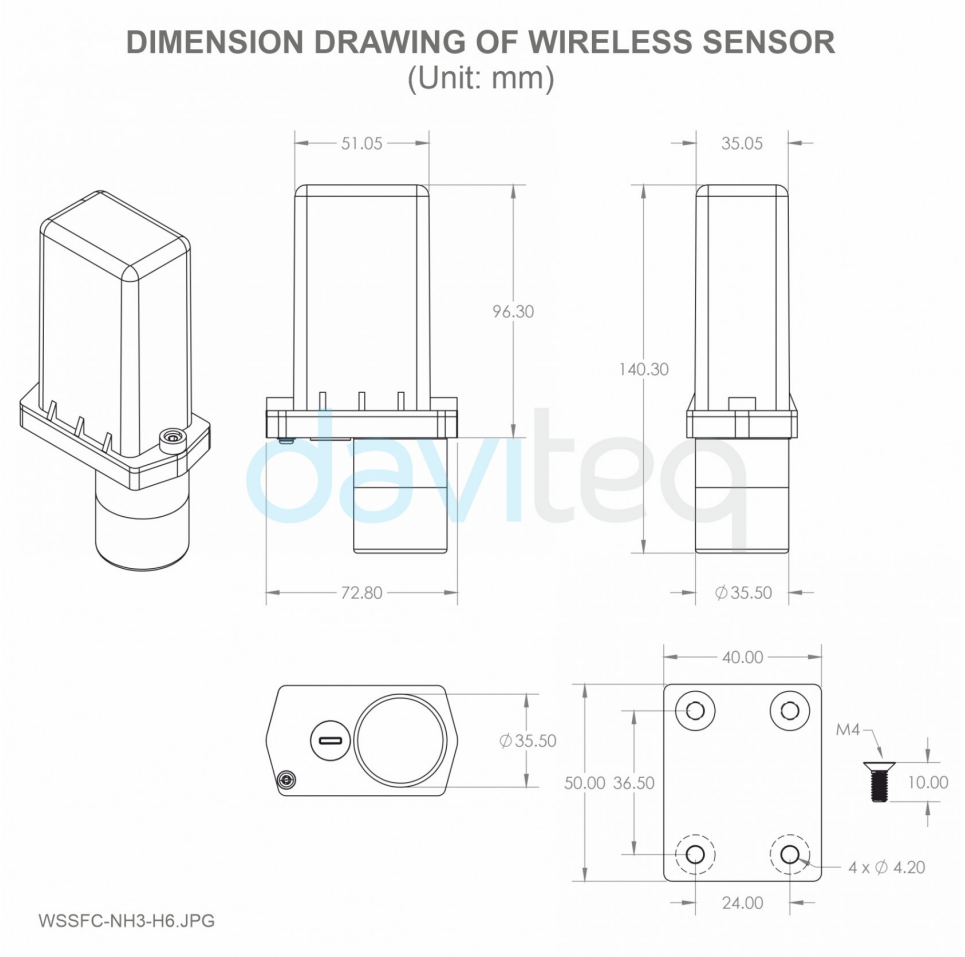
Typical Applications: Monitor leakage of Ammonia gas for Refrigerator, monitor Ammonia in private or public toilets,...

WSSFC-NH3-H1.JPG

3. Specification

SENSORS SPECIFICATION:	
NH3 sensor	electrochemical-type gas sensor
Measuring range for NH3	0..100 ppm
Max detecting concentration	200 ppm
Repeatability / Resolution / Stability per month	< 10% of Reading value / 1 ppm / < 2% of Reading value
Zero stability	+/- 2 ppm
Working atmospheric pressure	101.3 Kpa +/- 10%
Sensor life	> 2 years
Humidity and Temperature sensor	Digital type, factory calibrated
Humidity measuring range / accuracy / resolution	0 .. 100 %RH, ± 2.0% / 0.1%
Temperature measuring range / accuracy / resolution	-40 .. + 85°C / ± 0.2°C / 0.1°C
Working temperature and humidity	-30 .. + 50°C, 15 .. 90% RH
Sensor housing / Rating	SS316/SS304 housing with 316SS sintered filter / for Indoor use
Sigfox SPECIFICATION:	
Sigfox zones	select RC1-RC2-RC4
Antenna	Internal Antenna 2dbi
Battery	02 x AA Type 1.5VDC, working time up to 10 years (depends on configuration)
RF Module complies to	CE, FCC, ARIB
Working temperature	-40°C..+60°C (using Energizer Lithium Ultimate AA battery)
Housing/Protection	Aluminum + Polycarbonate / IP67
Dimension / Net weight	H180xW73xD42 / < 400 grams

4. Dimensions



5. Operation Principle

Upon power on, the Sigfox node has **60 seconds** to wait for **off-line** configuration (via **cable** with **ModbusRTU** protocol)

After 1 minute 30 seconds later the device will send the first data packet and at the same time wait for the downlink packet from the Base Station.

Then during the operation, there are 03 cases of sending data to base station:

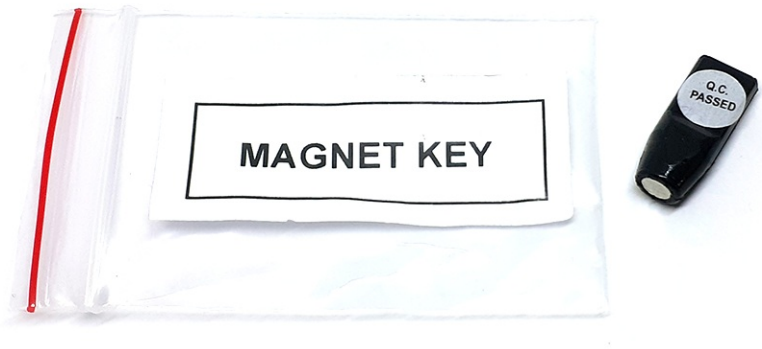
1. When the sensor sampling time interval is reached, the Sigfox node will read the data from Input or sensor and performing the calculation. After that it will check calculated value with alarm thresholds. If the calculated was out off the threshold values (Lo or Hi), called alarm, and the number of times of alarm did not pass the limit of number of alarms, then it will send data to Base station immediately;

NOTE:

Once sending the data to base station by this alarm event, the timer of sending time interval will be reset;

2. When the sending time interval is reached, it will send data to Base station immediately, regardless of value;

3. By using the magnet key, the Sigfox node can be triggered to send data to base station immediately. There will be a beep sound from the buzzer meaning the data has been sent.



REED SWITCH	EVENT	PRE-CONDITION	ACTION	LED STATUS	BUZZER STATUS	ACTIVITIES	POST-CONDITION
2	START_UP	Any state	Move Magnet Key to contact point of REED SWITCH and hold 5s. Buzzer beep 1 long time.	Blink **WHITE**	Beep 1 long time	See FW specs	Device reset
1	FORCE_DATA	Any state	Move Magnet Key to contact point of REED SWITCH. Buzzer beeps 1 time, move Magnet Key away.	Blink **SKY BLUE**	Beep 1 time	See FW specs	Back to previous state
1	PARAMETERS_UPI	Any state	Move Magnet Key to contact point of REED SWITCH. Buzzer beeps 1 time, hold Magnet Key 5s. Buzzer beeps 2 times.	Blink **PURPLE**	Beep 2 times	See FW specs	Back to previous state

NOTE:

Once sending the data to base station by the magnet key, the timer of sending time interval will be reset;

The shortest time interval between the two manual triggers is **5s**. if shorter than **5s**, there will be no data sending.

5.1 RC technical details

The RF transmit power will be automatically set as the max value as allowed by the Zone.

Sigfox Radio Configuration (RC) defines the radio parameters in which the device shall operate: Sigfox operating frequencies, output power, spectrum access mechanism, throughput, coexistence with other radio technologies, etc.

Each radio configuration includes 4 uplink classes: 0u, 1u, 2u, and 3u.

The Sigfox network globally works within the ranges from 862 to 928 MHz. But not all RCs require such a wide range of operation.

	RC1	RC2	RC3	RC4	RC5	RC6	RC7
Uplink center frequency (MHz)	868.130	902.200	923.200	920.800	923.300	865.200	868.800
Downlink center frequency (MHz)	869.525	905.200	922.200	922.300	922.300	866.300	869.100
Uplink data rate (bit/s)	100	600	100	600	100	100	100
Downlink data rate (bit/s)	600	600	600	600	600	600	600
Sigfox recommended EIRP (dBm)	16	24	16	24	14	16	16
Specifics	Duty cycle 1% *	Frequency hopping **	Listen Before Talk ***	Frequency hopping **	Listen Before Talk ***		Duty cycle 1% *

* **Duty cycle** is 1% of the time per hour (36 seconds). For an 8 to 12 bytes payload, this means 6 messages per hour, 140 per day.

** **Frequency hopping**: The device broadcasts each message 3 times on 3 different frequencies. Maximum On time 400 ms per channel. No new emission before 20 s.

*** **Listen Before Talk**: Devices must verify that the Sigfox-operated 200 kHz channel is free of any signal stronger than −80 dBm before transmitting.

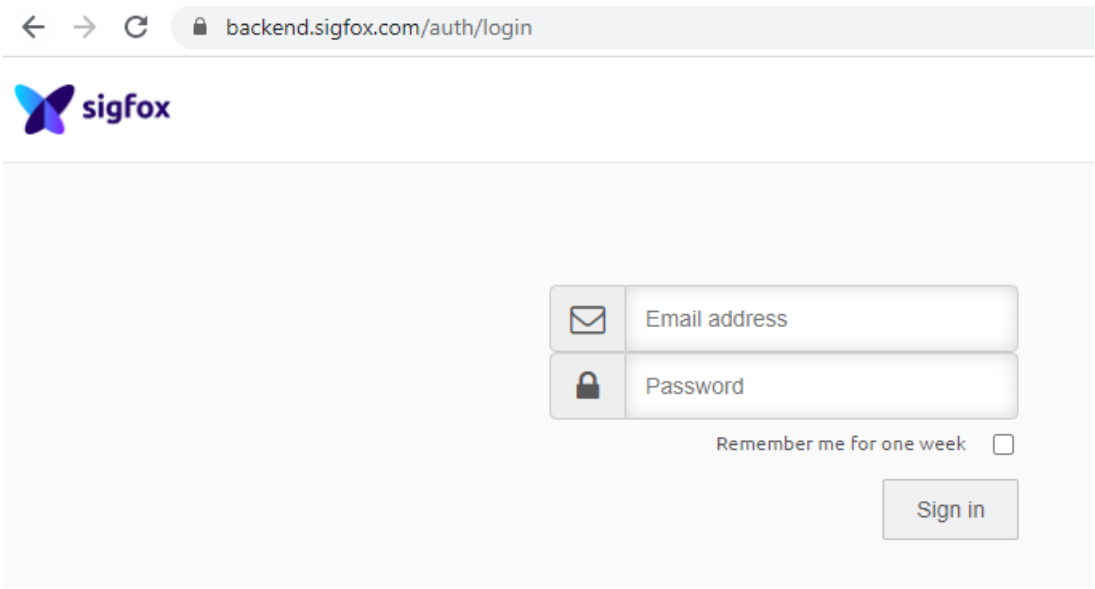
Sigfox's high limit EIRP recommendation is included in each column although regulations sometimes allow for more radiated power than the Sigfox recommendation.

Sigfox's recommendation is set to comply with the Sigfox technological approach of:

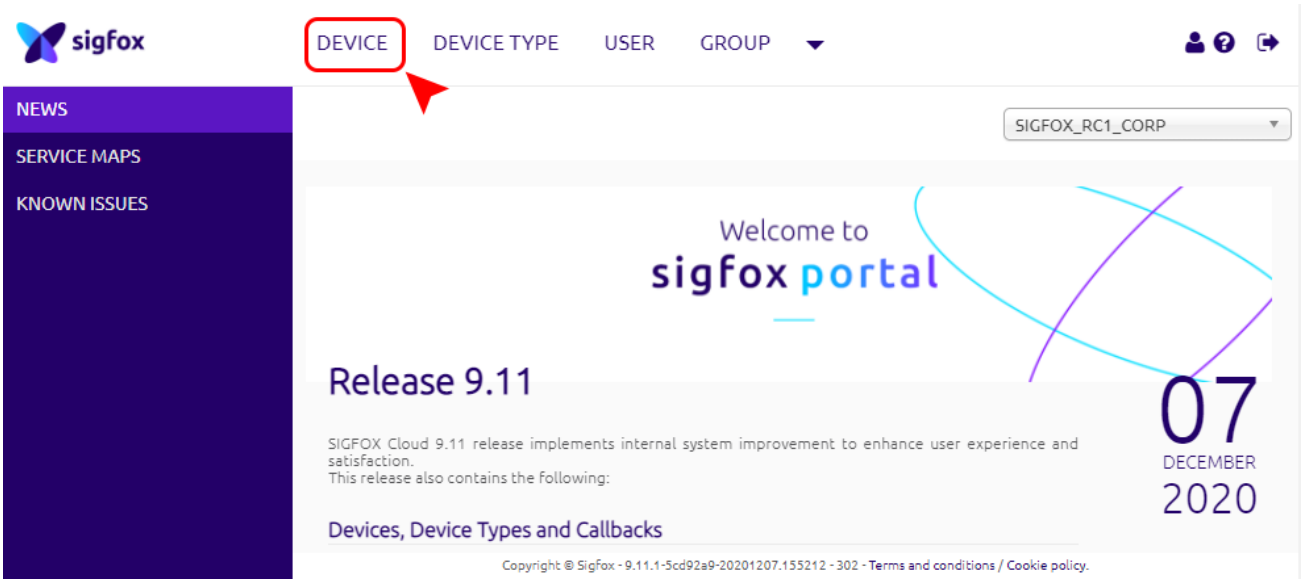
- Low current consumption
- Balanced link budget between uplink and downlink communication

5.2 Add a device to the Backend Sigfox

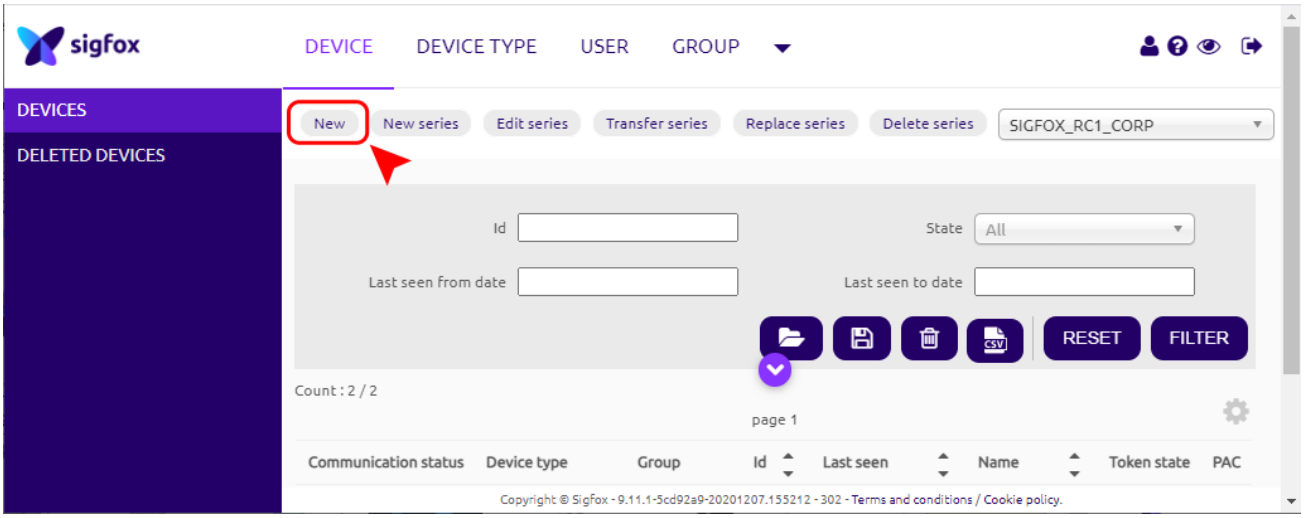
Step 1: Log in to the sigfox backend website



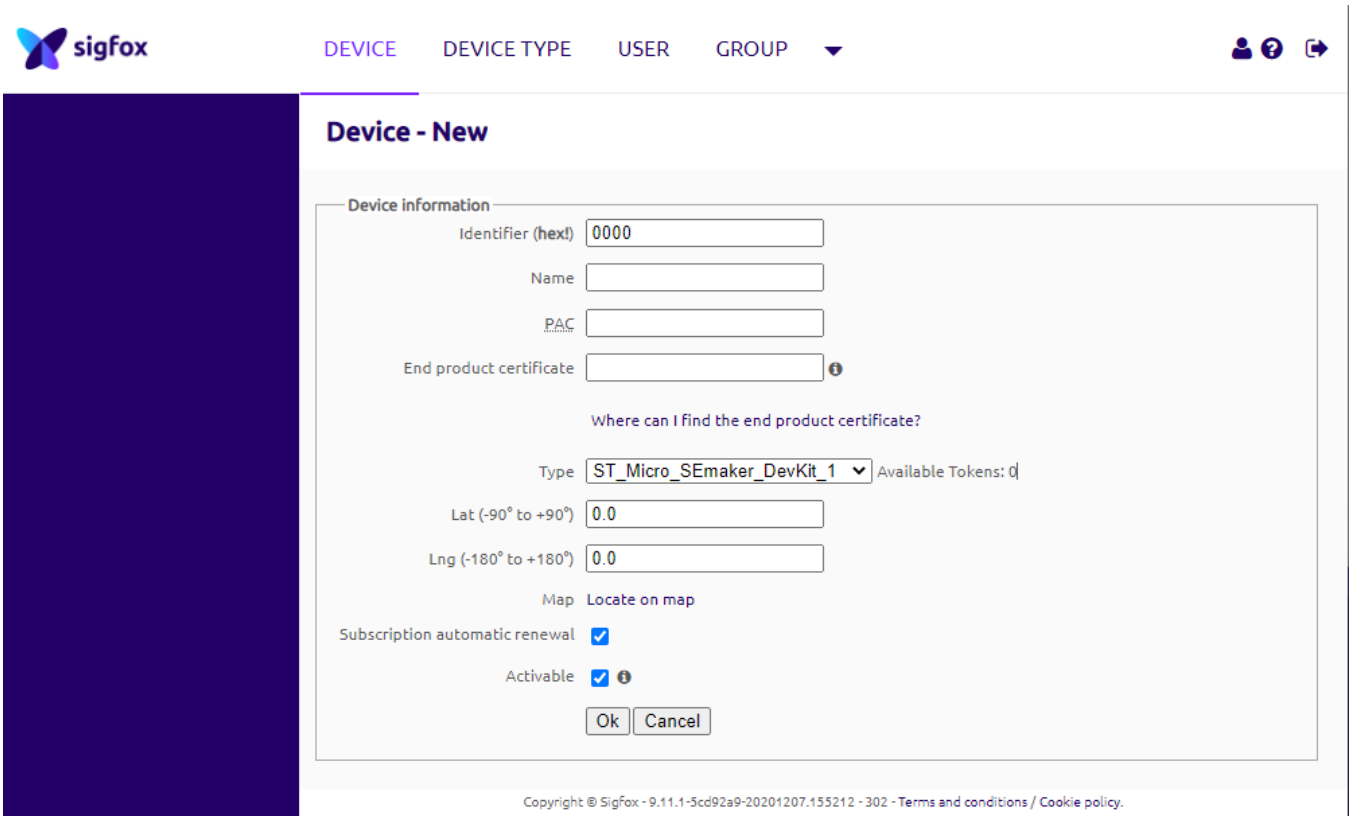
Step 2: Click on Device



Step 3: Click New → Select a group

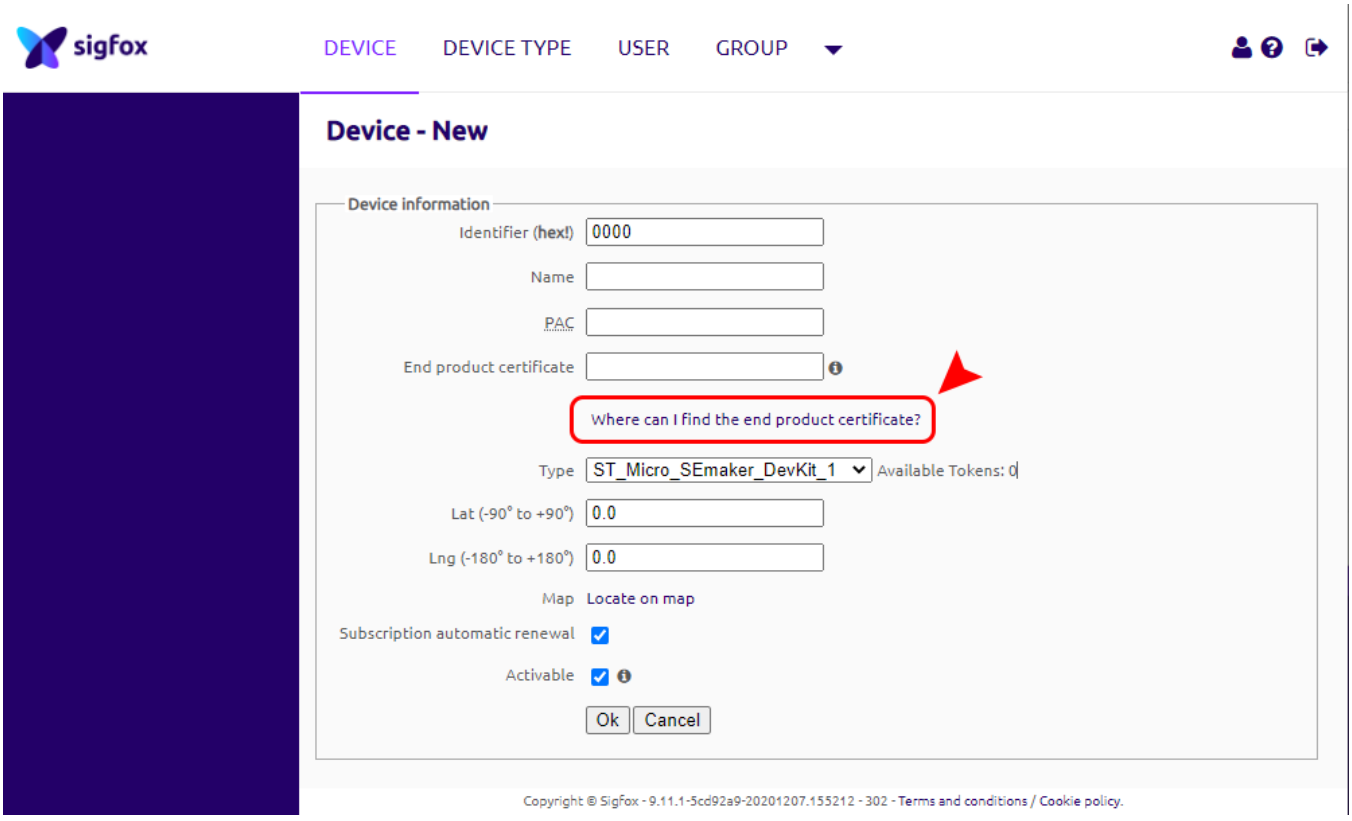


Step 4: Fill in the required information

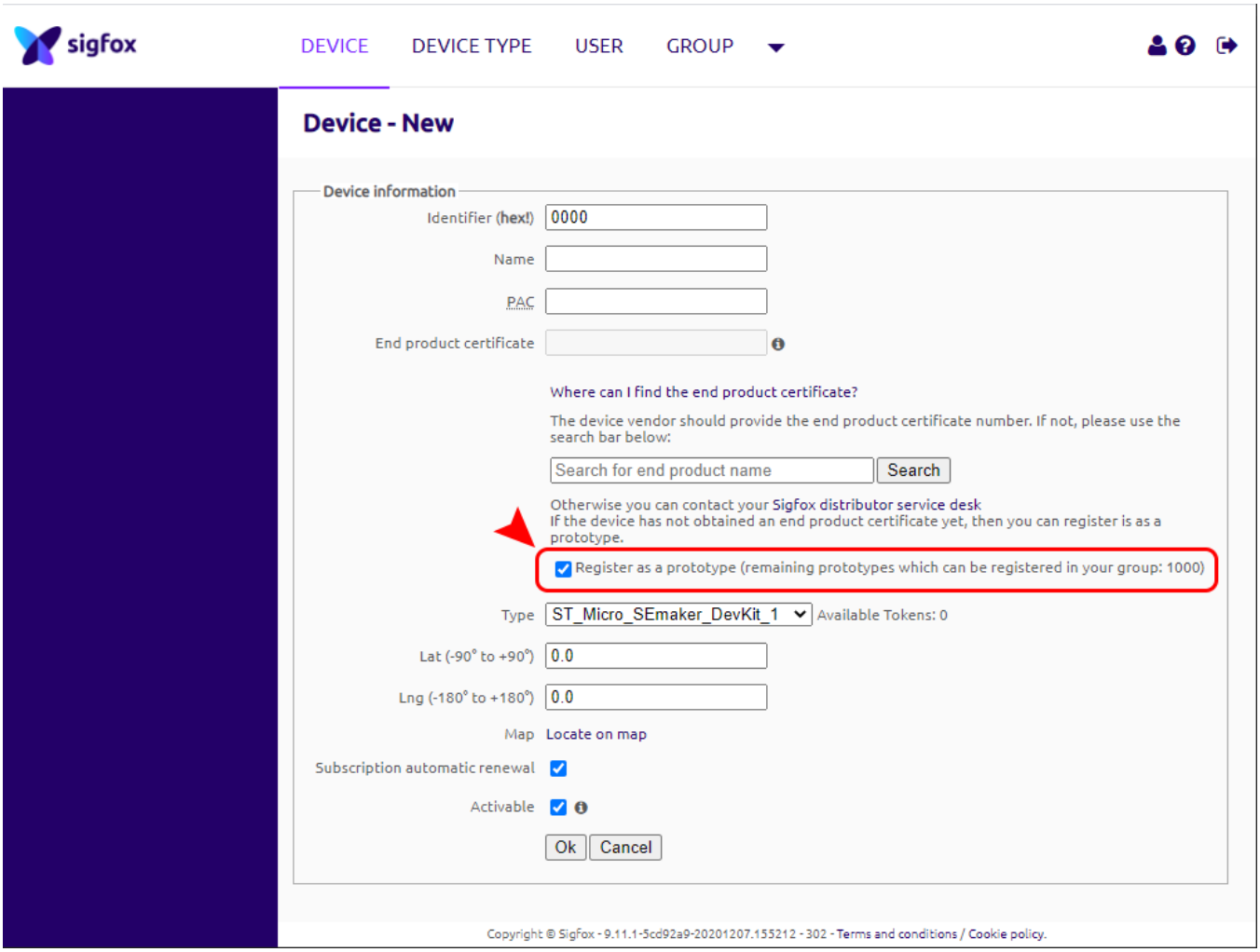


Note: Some of our products may not have end product certification in time, to add the product to Backend Sigfox please follow the steps below.

Click on the text as shown below



Check the box as shown below to register as a prototype



5.3 Device behavior & Firmware Specification of NH3 Sensor

Please read *sections 5.5* to 5.8 carefully for a better understanding of the configuration

5.3.1 Start-up features

5.3.1.1 Payload fields

- EVENT_TYPE

5.3.1.2 Description

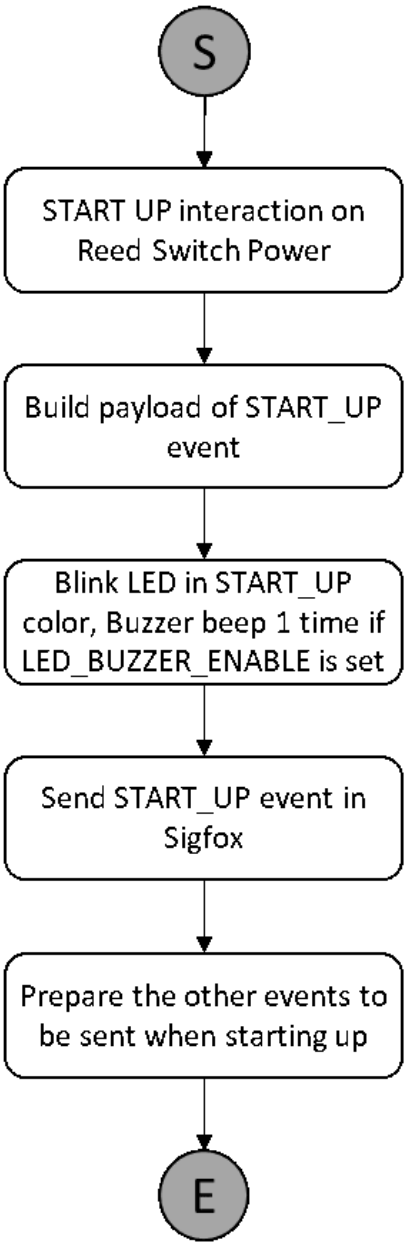
START_UP event is prepared every time the device is starting up. It can be either if the device is starting for the first time, or when the device is being reset. The device can be reset by two possible ways, one is thanks to the reed power switch , the other thanks to the DEVICE_RESET flag set in a downlink message.

5.3.1.3 Frame

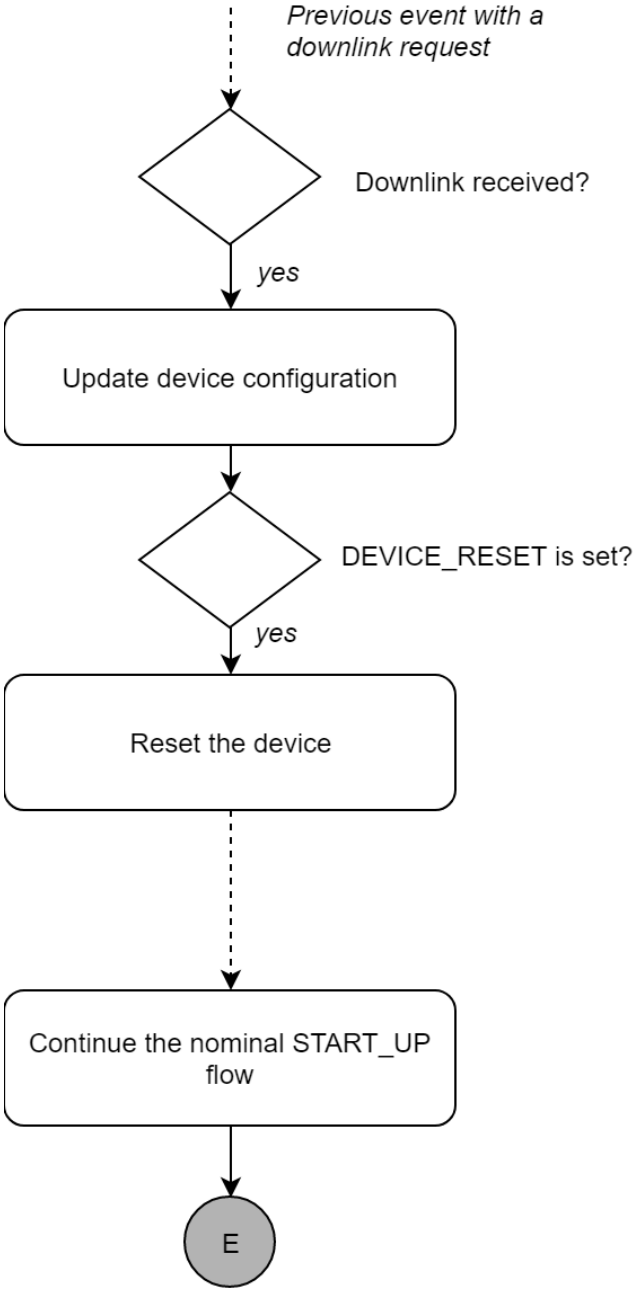
Event Type *bits*	EVENT_ID *4*	HW_VERSION *4*	FW_VERSION *8*	CURRENT CONFIGURATION *64*
Payload data format	*EVENT_ID*	*HW_VERSION*	*FW_VERSION*	*LATEST_SIGFOX_DOWNLINK*
START_UP	yes	yes	yes	yes

5.3.1.4 Flowchart

- **Nominal flow:**



- **Flow when coming from downlink:**



5.3.2 Heartbeat feature

5.3.2.1 Parameters

- HEARTBEAT_PERIOD

5.3.2.2 Payload fields

- EVENT_TYPE
- HW_VERSION
- FW_VERSION
- LATEST_SIGFOX_DOWNLINK

5.3.2.3 Description

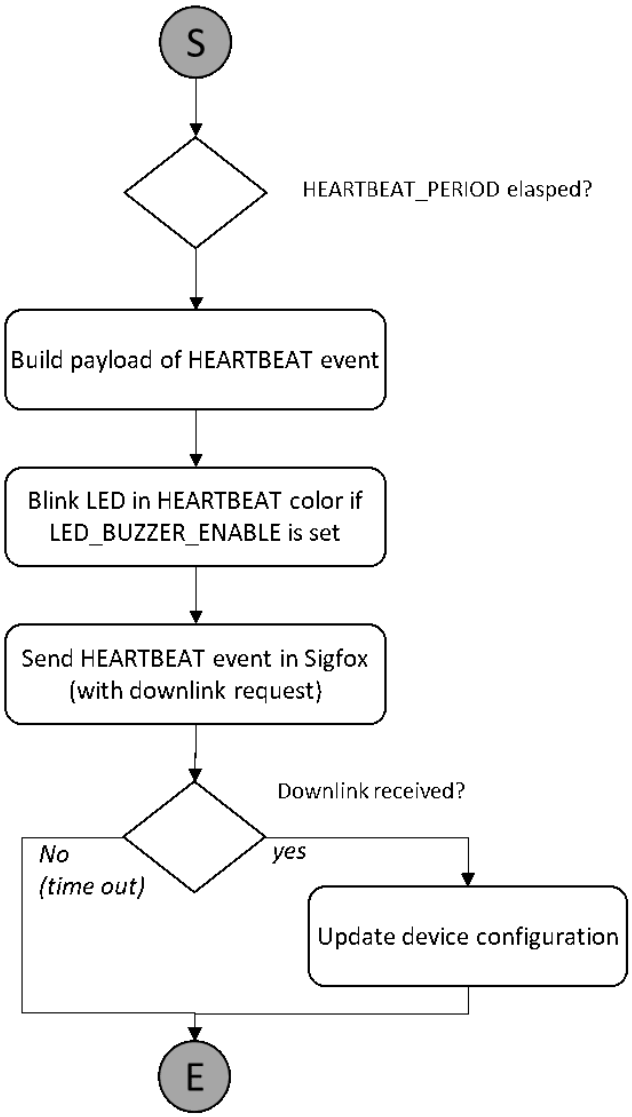
HEARTBEAT event is prepared every HEARTBEAT_PERIOD. When the uplink message of the HEARTBEAT event is prepared, the latest valid configuration that the device has received is provided through the LATEST_SIGFOX_DOWNLINK field.

The HEARTBEAT event is a Sigfox downlink exchange. Thanks to the downlink message, pre-defined parameters of the device can be modified in order to change the device behavior.

5.3.2.4 Frame

Event Type *bits*	EVENT_ID *4*	HW_VERSION *4*	FW_VERSION *8*	CURRENT CONFIGURATION *64*
Payload data format	*EVENT_ID*	*HW_VERSION*	*FW_VERSION*	*LATEST_SIGFOX_DOWNLINK*
HEARTBEAT	*yes*	*yes*	*yes*	*yes*

5.3.2.5 Flowchart



5.3.3 Parameters update feature

5.3.3.1 Payload fields

- EVENT_TYPE
- LATEST_SIGFOX_DOWNLINK

5.3.3.2 Description

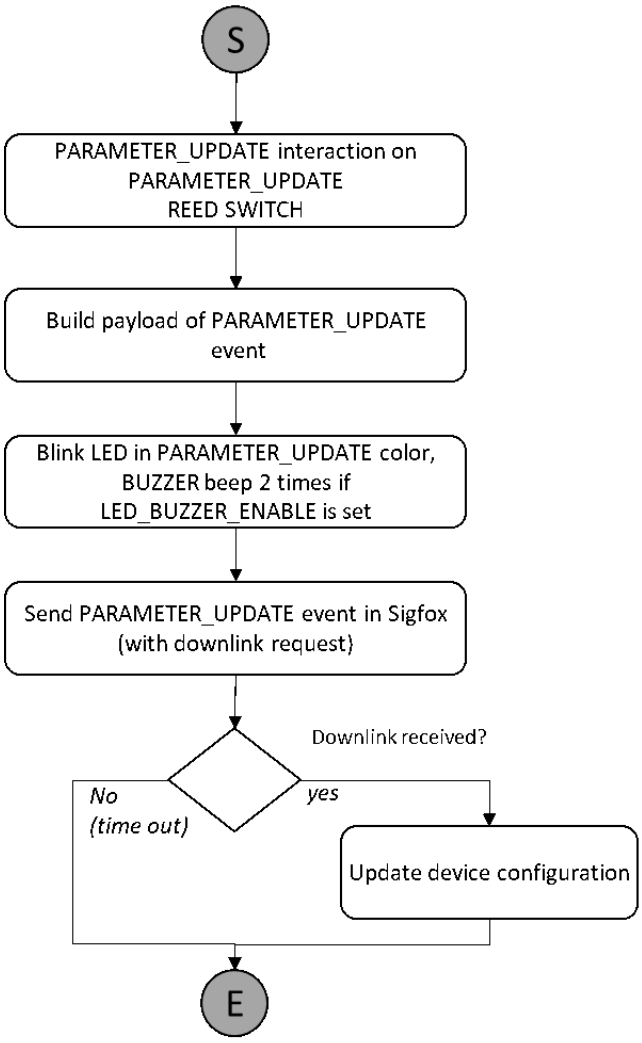
When the appropriate action is done by the user on the Reed Switch 2, a PARAMETERS_UPDATE event is generated. When the uplink message of the PARAMETERS_UPDATE event is prepared, the latest valid configuration that the device has received is provided through the LATEST_SIGFOX_DOWNLINK field.

The PARAMETERS_UPDATE event is a Sigfox downlink exchange. Thanks to the downlink message, pre-defined parameters of the device can be modified in order to change the device behavior.

5.3.3.3 Frame

Event Type *bits*	EVENT_ID *4*	HW_VERSION *4*	FW_VERSION *8*	CURRENT CONFIGURATION *64*
Payload data format	*EVENT_ID*	*HW_VERSION*	*FW_VERSION*	*LATEST_SIGFOX_DOWNLINK*
PARAMETERS_UPDATE	yes	yes	yes	yes

5.3.3.4 Flowchart



5.3.4 NH3 feature

5.3.4.1 Parameters (DLK)

For NH3 measurement

- NH3_ENABLE
- NH3_MEASURE_PERIOD

For NH3 message feature

- NH3_EVENT_ENABLE
- NH3_EVENT_PERIOD

For ALERT feature

- NH3_ALERT_ENABLE
- NH3_ALERT1_MAX_THRESHOLD
- NH3_ALERT2_MAX_THRESHOLD

For BLE advertizing

- ALERT_FLAG_reset
- BLE_BROADCAST_ENABLE
- BROADCAST_PERIOD_normal (TBC)

- BROADCAST_PERIOD_alert(TBC)
- BLE_RF_OUTPUT_POWER

5.3.4.2 Payload fields

- EVENT_ID
- …

5.3.4.3 Description

- **NH3 SENSING and EVENT**

The NH3 sensing is enabled thanks to the NH3_ENABLE flag.

The NH3 event is enabled thanks to the NH3_EVENT_ENABLE flag.

New NH3 values are taken every NH3_MEASURE_PERIOD.

NH3 event is prepared every NH3_EVENT_PERIOD. Before sending the event, all statistics (minimum, average and maximum for NH3 levels) are computed since the last NH3 event.

- **NH3 ALERT**

The NH3 alert feature is enabled thanks to the NH3_ALERT_ENABLE flag.

The NH3 sensing check against NH3_ALERT1_MAX_THRESHOLD and NH3_ALERT2_MAX_THRESHOLD, is done anytime a NH3 measurement is performed.

If the check reports that the measured level is above NH3_ALERT1_MAX_THRESHOLD or NH3_ALERT2_MAX_THRESHOLD, an ALERT procedure will start. The NH3 measured value will be recorded during the alert as well as the alert duration.

The ALERT message will be sent right after the alert is detected with a DLK request. When alert message is received at Sigfox server, this will initiate to send an available downlink (DLK) at Sigfox server to device.
The message will be sent again until a DLK is received every 10 minutes and until the level goes back to a normal level.
After a DLK is received, the device will keep sending Alert message every 10 minutes until the alert is over.

During the ALERT procedure, all other Sigfox events are cancelled. Only NH3 measurements is performed and BLE advertising are maintained.

- **BLE advertising**

When the BLE_BROADCAST_ENABLE flag is set to true, the device will broadcast a BLE beacon signal. The signal broadcasted will change according to the following rules:

The BLE NORMAL frame is broadcasted every BROADCAST_PERIOD_normal when the alert_type flag is set to 0.

The BLE ALERT 1 frame is broadcasted every BROADCAST_PERIOD_alert when the alert_type flag is set to 1.

The BLE ALERT 2 frame is broadcasted every BROADCAST_PERIOD_alert when the alert_type flag is set to 2.

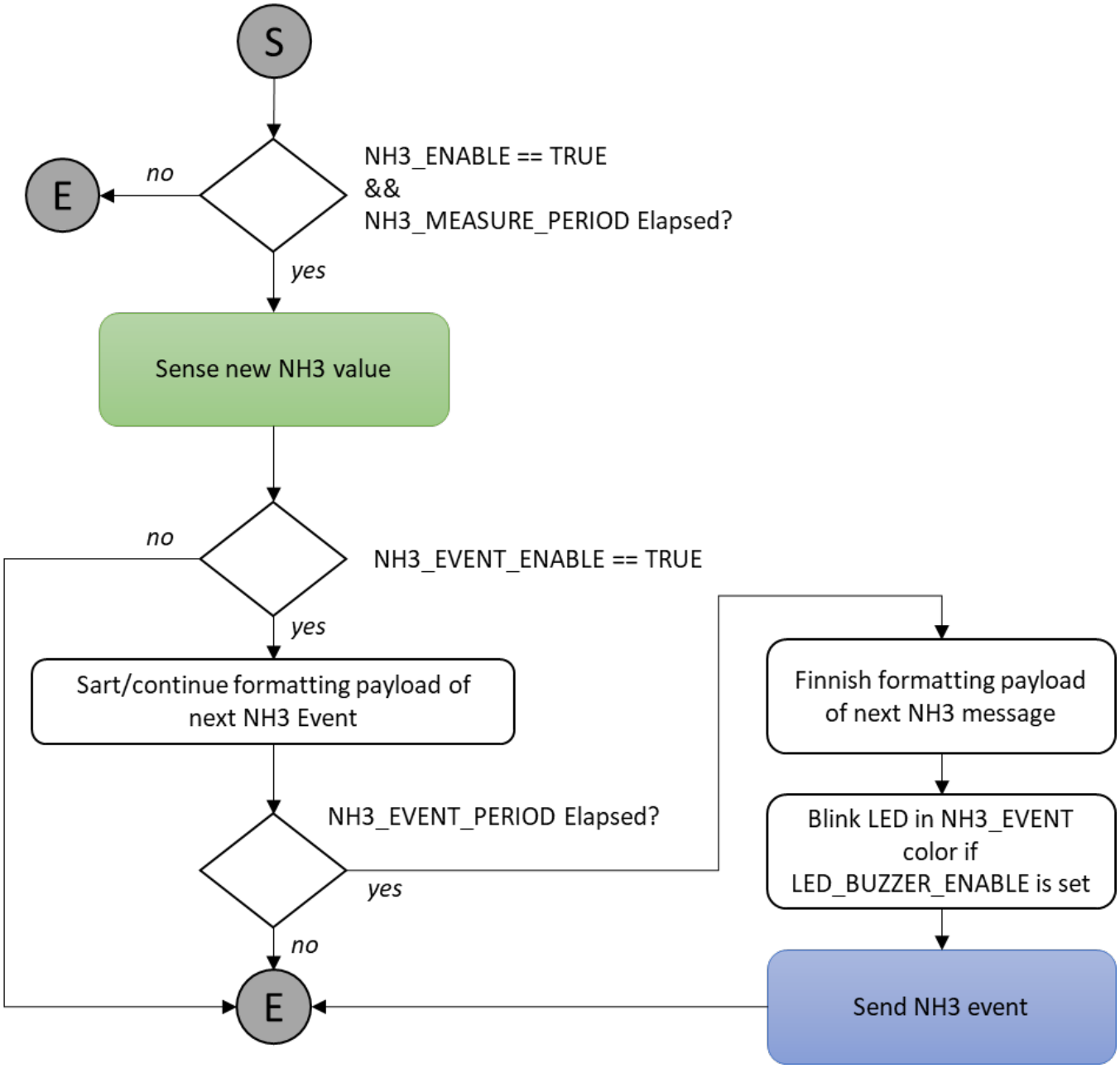
5.3.4.4 Frames

Event Type *bits*	EVENT_ID *4*	RESERVED *4*	NH3 *8*	MIN_NH3 *8*	AVG_NH3 *8*	MAX_NH3 *8*
Payload data format	*EVENT_ID*	*-*	*NH3*	*NH3*	*NH3*	*NH3*
NH3	*yes*	*zeros*	*yes*	*yes*	*yes*	*yes*

Event Type *bits*	EVENT_ID *4*	RESERVED *2*	ALERT_TYPE *2*	EXTREME_NH3 *8*	ALERT_ DURATION *8*	TENTATIVE *8*
Payload data format	*EVENT_ID*	*-*	*ALERT_TYPE*	*NH3*	*ALERT_ DURATION*	*TENTATIVE*
NH3_ALERT	*yes*	*zeros*	*yes*	*yes*	*yes*	*yes*

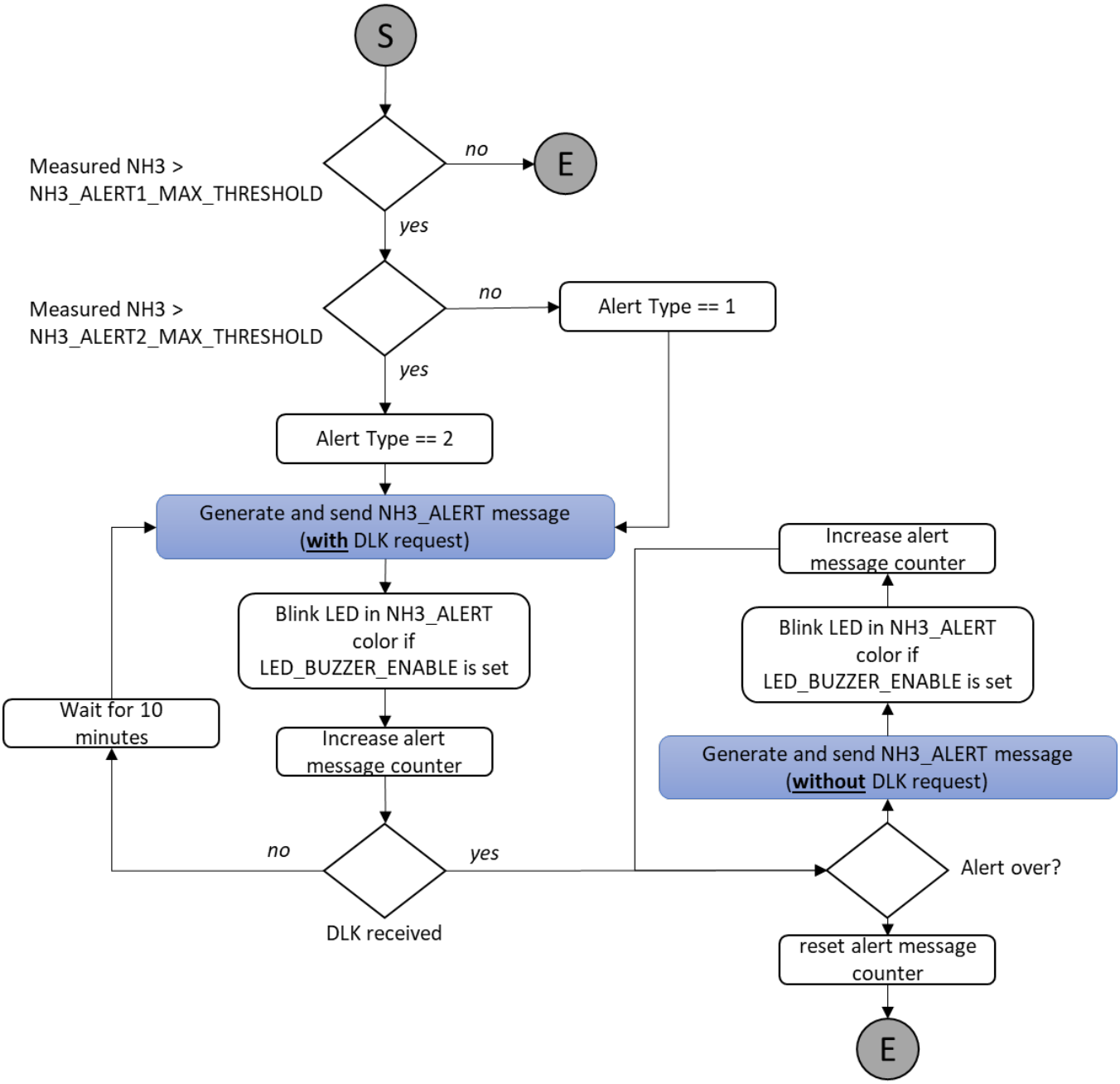
5.3.4.5 Flowchart

- **Sigfox Normal mode**

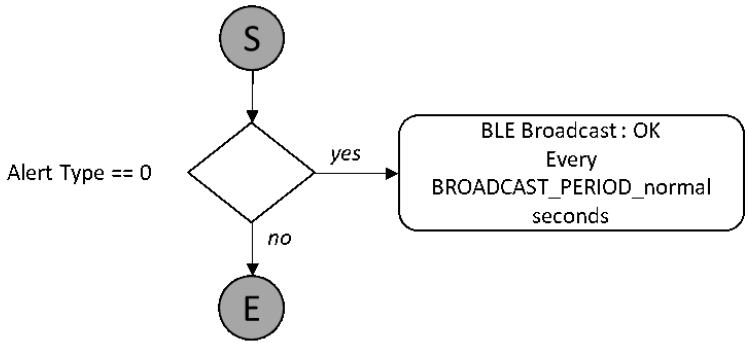


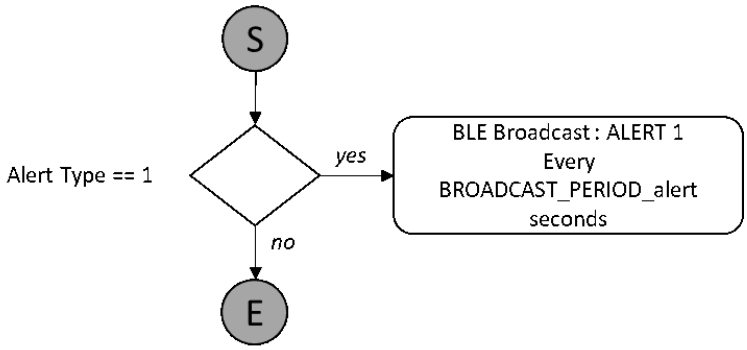
- **Sigfox Alert mode**

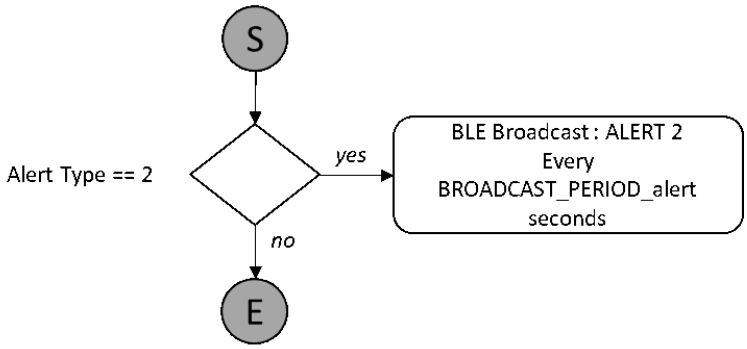
If the message counter reaches a value above the maximum possible tentative field value (255) in the NH3_ALERT message, the tentative value should be kept at the maximum (255).



- **BLE broadcast**







- **BLE broadcast format**

5.4 Light and sound indicator

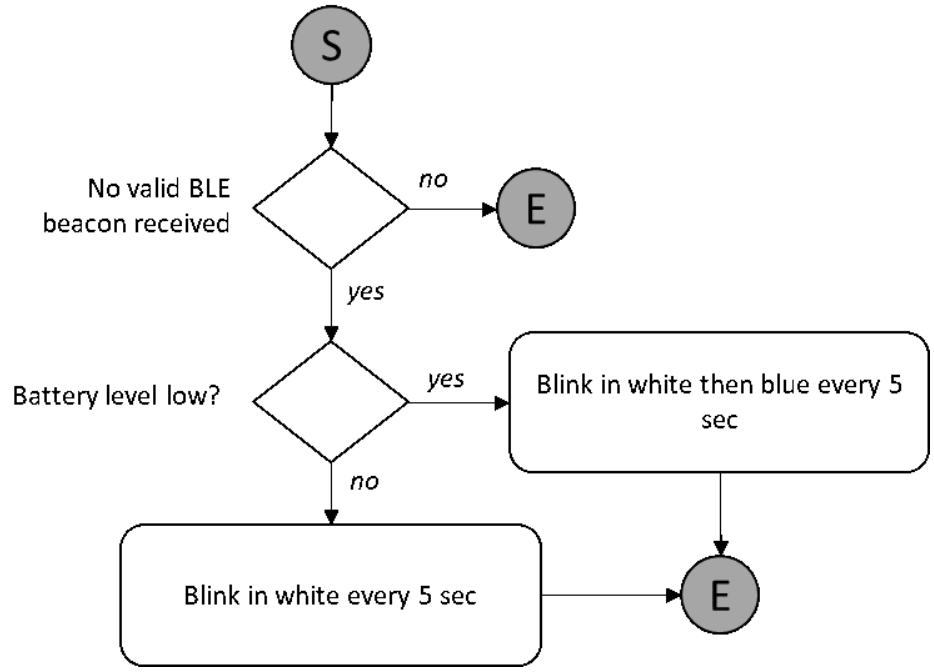
The light indicator is always in RF listening mode and searching for a beacon signal from the sensor it is attached to.

The indicator device will be able to identify the beacon signal transmitted by the NH3 sensor it is attached to and only consider the beacon signal from that specific sensor.

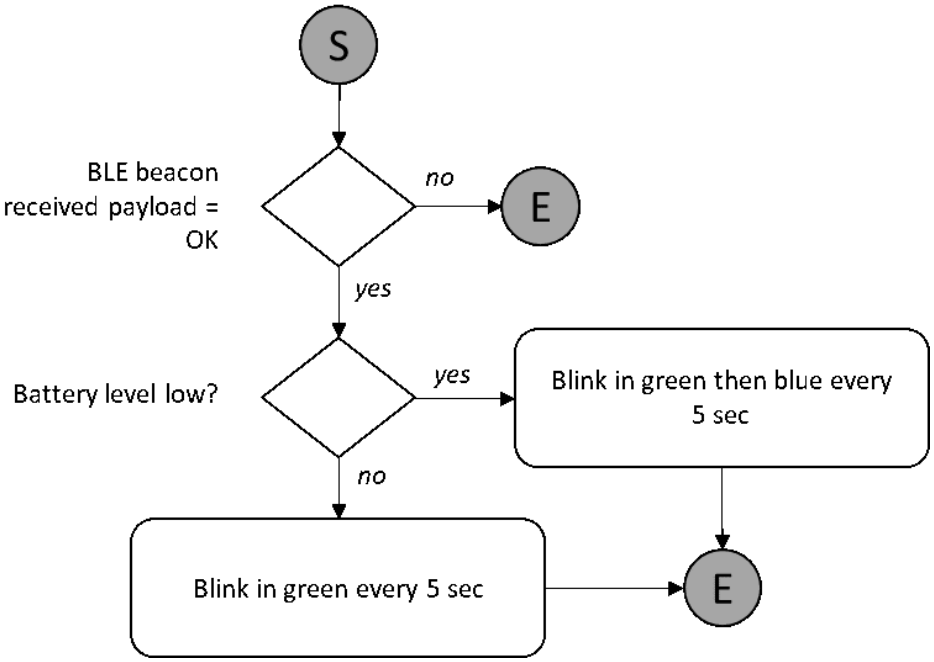
Some simple synchronization mechanisms will be implemented in order to minimize the power consumption of the receiver to an acceptable level.

Depending on the beacon received, the indicator device will have the behavior described in the following flowcharts:

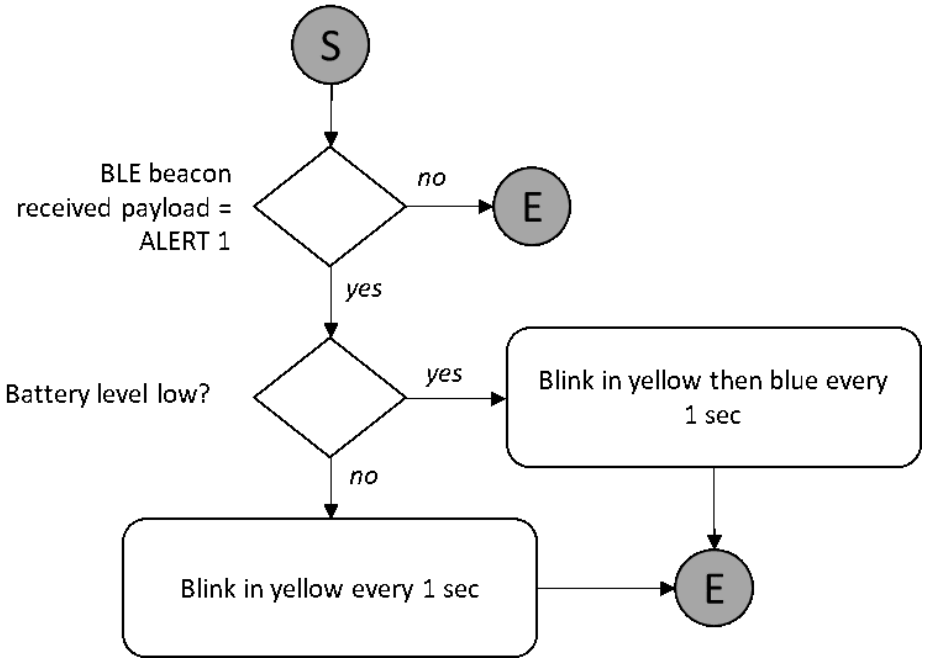
No Signal:



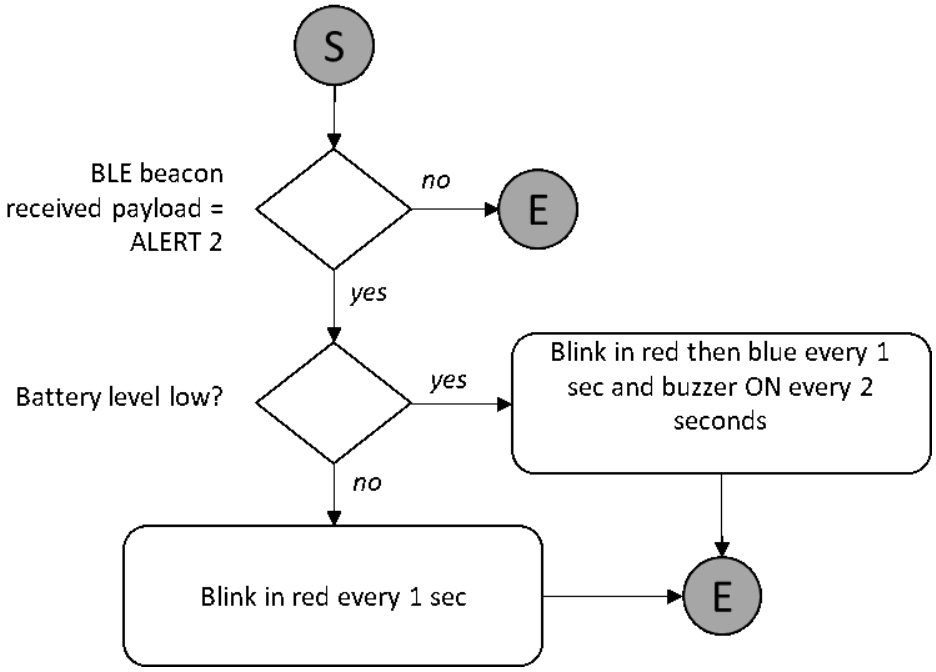
Signal received « OK »:



Signal received « ALERT 1 »:



Signal received « ALERT 2 »:



5.5 Pairing with BLE Indicator

Insert the batteries into Sigfox NH3-BLE device, wait**1 minute** for configuration stage end, then Sigfox NH3-BLE will broadcast BLE data.

Then **insert the batteries** into BLE Indicator, place it**near** to Sigfox NH3BLE

- When BLE Indicator has got ID**NOT MATCH** with ID from Sigfox NH3-BLE, BLE Indicator will beep**2 times.** So you need to clear that ID before pairing the BLE Indicator with the new Sigfox device. To clear the ID in BLE Indicator, place magnet key to reed switch area (marked as a magnet on the nameplate), the BLE indicator will beep **1 time,** and the status led (the led on side of the board) blink**WHITE**.

It is recommended that when adding an ID to a BLE Indicator you should clear the ID first.

- After clearing the ID of the BLE Indicator, you may wait for up to 1 minute for it to pair with the new Sigfox device. When pairing is successful, you can hear 1 beep sound;
- When BLE Indicator have ID **MATCH** with ID from Sigfox NH3BLE , BLE Indicator will operation normal (details in Firmware Specifications Sound and light indicator)

5.6 Event ID

Event Type bits	**EVENT_ID** 4	**COLOR**
START_UP	0	**WHITE**
HEARTBEAT	1	**GREEN**
PARAMETERS_UPDATE	2	**PURPLE**
NH3_FORCE_DATA	3	**SKY BLUE**
NH3	4	**SKY BLUE**
NH3_ALERT	5	**RED**
Not used	6	
Not used	7	
Not used	8	
Not used	9	
Not used	10	
Not used	11	
Not used	12	
Not used	13	
Not used	14	
Not used	15	

5.7 Configuration Parameters

Should not change the value in the **Blue** cells

Category	Parameter	Description	Possible values	Default value	Length (in bits)
DEVICE	LED_BUZZER_ENABLE	Flag to enable/disable LED and Buzzer interactions for action not triggered by the button.	0b0 = false, LEDs are OFF 0b1 = true, LEDs are ON	0b0 = false	1
DEVICE	DEVICE_RESET	Once this parameter is set, the device shall restart once after having received the DL.	0b1010 = 0xA = Force device reset others = do nothing	others = do nothing	4
DEVICE	TX_REPEAT	Number of Sigfox frames	0b0 = 1 frames 0b1 = 3 frames	0b0 = 1 frames	1
HEARTBEAT	HEARTBEAT_PERIOD	Period of time to send HEARTBEAT event	0b000 = every 1h 0b001 = every 6h 0b010 = every 12h 0b011 = every 24h (1 day) 0b100 = every 48h (2 day) 0b101 = every 72h (3 day) 0b110 = every 120h (5 day) 0b111 = every 240h (10 day)	0b100= every 48h (2 days)	3
NH3	NH3_ENABLE	Enable NH3 sensing	0b0 = false, NH3 sensing is disabled 0b1 = true, NH3 sensing is enabled	0b1 = true	1
NH3	NH3_MEASURE_PERIOD	Interval of time between two consecutive NH3 values are acquired	0b0000 = every 1s 0b0001 = every 2s 0b0010 = every 5s 0b0011 = every 10s 0b0100 = every 20s 0b0101 = every 30s 0b0110 = every 1min 0b0111 = every 2min 0b1000 = every 5min 0b1001 = every 10min 0b1010 = every 20min 0b1011 = every 30min 0b1100 = every 1h 0b1101 = every 2h 0b1110 = every 3h 0b1111 = every 6h	0b0010 = every 5s	4
NH3	NH3_EVENT_ENABLE	Enable NH3 event	0b0 = false, NH3 event is disabled 0b1 = true, NH3 event is enabled	0b1 = true	1
NH3	NH3_EVENT_PERIOD	Interval of time between two consecutive NH3 events	0b000 = every 10min 0b001 = every 30min 0b010 = every 1h 0b011 = every 2h 0b100 = every 3h 0b101 = every 6h 0b110 = every 12h 0b111 = every 24h	0b010 = every 1h	3

NH3	NH3_ALERT ENABLE	Enable NH3_ALERT event	0b0 = false, NH3 ALERT feature is disabled 0b1 = true, NH3 ALERT feature is enabled	0b0 = false, NH3 ALERT feature is disabled	1
NH3	NH3_ALERT1_MAX_THRE	Threshold #1 on the temperature to trig a NH3_ALERT event	8-bit unsigned integer Formula: (8-bit_NH3ppm*2)= real_NH3_level_in_ppm Range: 0 to 100ppm Accuracy: 0.5ppm Example: 0b01110100 = 0x74 = 116 => (116 / 2) = 58ppm	0b00001010 = 5ppm	8
NH3	NH3_ALERT2_MAX_THRE	Threshold #2on the temperature to trig a NH3_ALERT event	8-bit unsigned integer Formula: (8-bit_NH3ppm*2)= real_NH3_level_in_ppm Range: 0 to 100ppm Accuracy: 0.5ppm Example: 0b01110100 = 0x74 = 116 => (116 / 2) = 58ppm	0b00010100 = 10ppm	8
NH3	ALERT_FLAG_reset	Flag to reset the BLE broadcast mechanism and set it back to normal.	0b1010 = 0xA = leave BLE alert mode others = do nothing	others = do nothing	1
BLE	BLE_BROADCAST_ENAB	Enable BLE advertising functionality	0b0 = false, BLE advertising feature is disabled 0b1 = true, BLE advertising feature is enabled	0b1 = true, BLE advertising feature is enabled	1
BLE	BROADCAST_PERIOD_nc	Broacasting period when the device is in normal mode	0b000 = every 1s 0b001 = every 2s 0b010 = every 5s 0b011 = every 10s 0b100 = every 30s 0b101 = every 1 min 0b110 = every 2 min 0b111 = every 5 min	0b011 = every 10s	3
BLE	BROADCAST_PERIOD_al	Broacasting period when the device is in alert mode	0b000 = every 1s 0b001 = every 2s 0b010 = every 5s 0b011 = every 10s 0b100 = every 30s 0b101 = every 1 min 0b110 = every 2 min 0b111 = every 5 min	0b001 = every 2s	3
BLE	BLE_RF_OUTPUT_POWEI	Transmit power level	0b000 = -20dBm 0b001 = -10dBm 0b010 = 0dBm 0b011 = 5dBm	0b000 = -20dBm	3

5.8 Payload Data

The following is the format of payload data that will be sent to the Sigfox server.

5.8.1 Payload Fields

Category	Data name	Description	Encoding or Possible values	Length (in bits)
DEVICE	**EVENT_ID**	Unique ID identifying the device event	4-bit unsigned integer Possible values: As defined in Event ID tab	4

DEVICE	**LATEST_SIGFOX_DOWNLIN**	The Latest received and valid Sigfox downlink frame	64-bit encoded field See Sigfox Downlink tab	64
DEVICE	**HW_VERSION**	Indicate HW version	4-bit unsigned integer HW_VERSION = HW_VERSION value in EEPROM set in production if Value unknown, default value will be 0	4
DEVICE	**FW_VERSION**	indicate FW version	8-bit unsigned integer Refer to FW release note	8
NH3	**NH3**	NH3 level of the surrounding environment of the device	16-bit unsigned integer Formula: (16-bit_NH3ppm/100)= real_NH3_level_in_ppm Range: 0 to 100ppm Accuracy: 0.01ppm Example: 0x16B7 = 5815 => (5815 / 100) = 58.15ppm	16
Type	**ALERT_TYPE**	Type of alert	2-bit unsigned integer 0b0 = Not used 0b1 = Alert type 1 0b10 = Alert type 2 0b11 = Not used	2
TIME	**ALERT_DURATION**	Alert duration in hours	8-bit unsigned integer Formula: 8-bit_Alert_duration = real_TempAlert_duration_in_h Range: 0 to 255 hours Accuracy: 1 hour Example: 0b00100000 = 0x20 = 32 => 32 hours	8
Tentative	**TENTATIVE**	Tentative number	8-bit unsigned integer Formula: (8-bit_Tentativve +1)= real_tentative # Range: 1 to 256 Accuracy: 1 Example: 0b00000111 = 0x7=7=> 7+1 =>tentative # 8	8

5.8.2 Sigfox Uplink Frame Format

For more details, you can download the file **HERE**

Size					
	Event Type	**EVENT_ID**	**HW_VERSION**	**FW_VERSION**	**CURRENT CONFIGURATION**
10.0	bits	4	4	8	64
	Payload data format	EVENT_ID	HW_VERSION	FW_VERSION	LATEST_SIGFOX_DOWNLINK
	START_UP	yes	yes	yes	yes
	Event Type	**EVENT_ID**	**HW_VERSION**	**FW_VERSION**	**CURRENT CONFIGURATION**
10.0	bits	4	4	8	64
	Payload data format	EVENT_ID	HW_VERSION	FW_VERSION	LATEST_SIGFOX_DOWNLINK
	HEARTBEAT	yes	yes	yes	yes
	Event Type	**EVENT_ID**	**HW_VERSION**	**FW_VERSION**	**CURRENT CONFIGURATION**
10.0	bits	4	4	8	64
	Payload data format	EVENT_ID	HW_VERSION	FW_VERSION	LATEST_SIGFOX_DOWNLINK
	PARAMETERS_UPDATE	yes	yes	yes	yes

	Event Type	EVENT_ID	HW_NH3_ERROR	RESERVED	NH3
3.0	bits	4	1	3	16
	Payload data format	EVENT_ID	HW_NH3_ERROR	-	NH3
	NH3_FORCE_DATA	yes	yes	zeros	yes

	Event Type	EVENT_ID	HW_NH3_ERR	RESERVED	NH3	MIN_NH3	AVG_NH3	MAX_NH3
9.0	bits	4	1	3	16	16	16	16
	Payload data format	EVENT_ID	HW_NH3_ERRO	-	NH3	NH3	NH3	NH3
	NH3	yes	yes	zeros	yes	yes	yes	yes
	Event Type	**EVENT_ID**	**HW_NH3_ERR**	**RESERVED**	**ALERT_TYPE**	**EXTREME_NH**	**ALERT_ DURATION**	**TENTATIVE**
5.0	bits	4	1	1	2	16	8	8
	Payload data format	EVENT_ID	HW_NH3_ERRO	-	ALERT_TYPE	NH3	ALERT_ DURATION	TENTATIVE
	NH3_ALERT	yes	yes	zeros	yes	yes	yes	yes

5.8.3 Sigfox Downlink Frame Format.

⚠ The Sigfox node is only able to receive max 04 downlinks a day, each downlink will be waiting in every 06 hours.

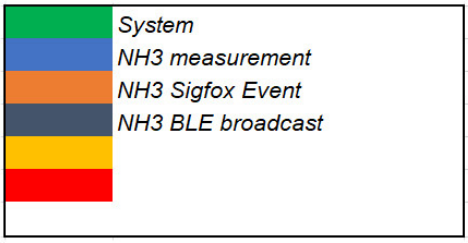
User can set the down link data in Sigfox back-end system in advance, whenever the Sigfox node connected to base stations and with downlink waiting is enable at that time (one time in 6 hours), the downlink data will be loaded to Sigfox node.

The downlink data can be any configuration parameter.

Please pay attention when send downlink data. If there was a mistake in sending wrong data, it would cause the Sigfox node not working properly and user need to configure it by **offline cable**!!!

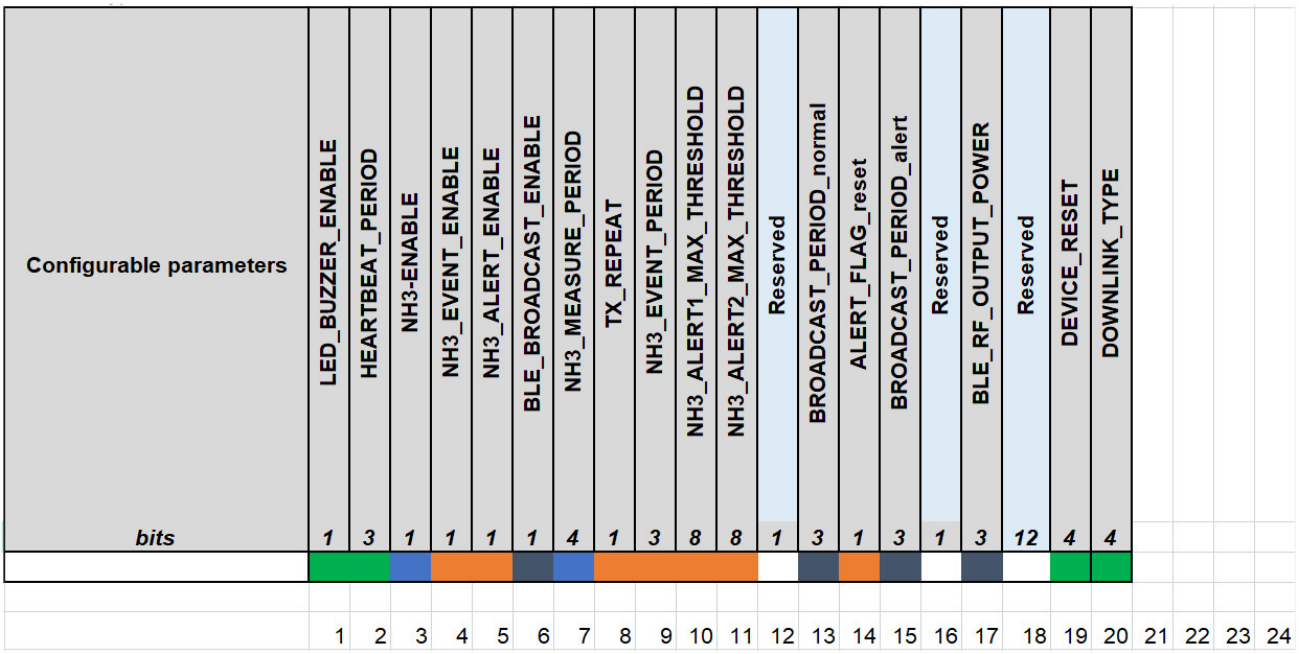
For more details, you can download the file HERE

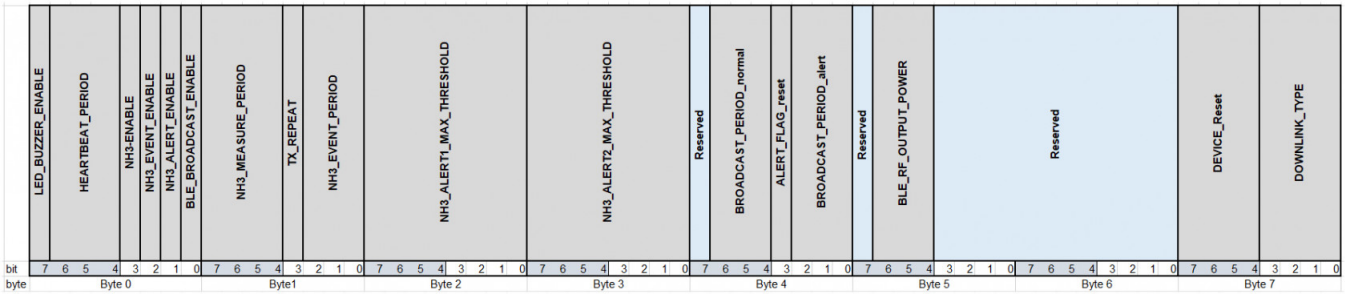
Downlink Frame Format:



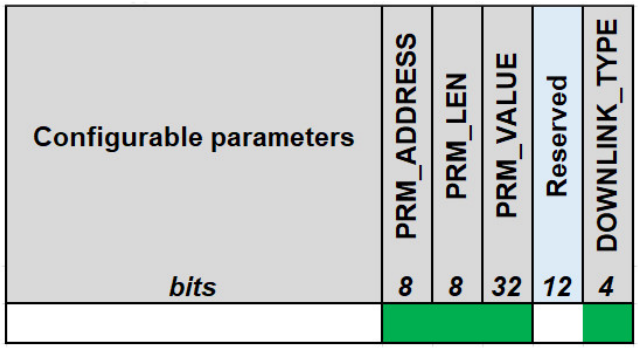
Note : Reserved fields must be set to 0. If not, then the Downlink received will not be taken into account by the device and the received parameters will not be applied.

Downlink type= **0b0000**





Downlink type= **0b0101**



5.9 BLE Broadcast Format

Size										
	Broadcast Type	**EDDYSTON HEADER**	**DEVICE_ID**	**ALERT_TYP**	**ALERT_ FLAG_ reset**	**HW_ NH3_ ERROR**	**HW_ VERSION**	**FW_ VERSION**	**CURRENT CONFIGURA**	**NH3**
28.0	bits	96	32	2	1	1	4	8	64	16
	Payload data format	***EDDYSTON HEADER***	***DEVICE_ID***	***ALERT_TYP***	***ALERT_ FLAG_ reset***	***HW_ NH3_ ERROR***	***HW_ VERSION***	***FW_ VERSION***	***LATEST_ SIGFOX_ DOWNLINK***	***NH3***
	BLE Broadcast: OK ALERT_TYPE = 0	0x02010403	yes	yes	yes	yes	yes	yes	yes	yes

Size										
	Broadcast Type	**EDDYSTON HEADER**	**DEVICE_ID**	**ALERT_TYP**	**ALERT_ FLAG_ reset**	**HW_ NH3_ ERROR**	**HW_ VERSION**	**FW_ VERSION**	**CURRENT CONFIGURA**	**NH3**
28.0	bits	96	32	2	1	1	4	8	64	16
	Payload data format	***EDDYSTON HEADER***	***DEVICE_ID***	***ALERT_TYP***	***ALERT_ FLAG_ reset***	***HW_ NH3_ ERROR***	***HW_ VERSION***	***FW_ VERSION***	***LATEST_ SIGFOX_ DOWNLINK***	***NH3***
	BLE Broadcast: OK ALERT_TYPE = 1 or 2 ALERT_FLAG = 1	0x02010403	yes	yes	yes	yes	yes	yes	yes	yes

Size										
	Broadcast Type	**EDDYSTON HEADER**	**DEVICE_ID**	**ALERT_TYP**	**ALERT_ FLAG_ reset**	**HW_ NH3_ ERROR**	**HW_ VERSION**	**FW_ VERSION**	**CURRENT CONFIGURA**	**NH3**
28.0	bits	96	32	2	1	1	4	8	64	16
	Payload data format	***EDDYSTON HEADER***	***DEVICE_ID***	***ALERT_TYP***	***ALERT_ FLAG_ reset***	***HW_ NH3_ ERROR***	***HW_ VERSION***	***FW_ VERSION***	***LATEST_ SIGFOX_ DOWNLINK***	***NH3***
	BLE Broadcast: ALERT 1 ALERT_TYPE = 1 ALERT_FLAG = 0	0x02010403	yes	yes	yes	yes	yes	yes	yes	yes

Size										
	Broadcast Type	**EDDYSTON HEADER**	**DEVICE_ID**	**ALERT_TYP**	**ALERT_ FLAG_ reset**	**HW_ NH3_ ERROR**	**HW_ VERSION**	**FW_ VERSION**	**CURRENT CONFIGURA**	**NH3**
28.0	bits	96	32	2	1	1	4	8	64	16
	Payload data format	***EDDYSTON HEADER***	***DEVICE_ID***	***ALERT_TYP***	***ALERT_ FLAG_ reset***	***HW_ NH3_ ERROR***	***HW_VERSI***	***FW_VERSIO***	***LATEST_ SIGFOX_ DOWNLINK***	***NH3***
	BLE Broadcast: ALERT 2 ALERT_TYPE = 2 ALERT_FLAG = 0	0x02010403	yes	yes	yes	yes	yes	yes	yes	yes

6. Modbus Memmap

6.1 Data table

Modbus Register (Decimal)	Modbus Register (Hex)	Function Code	# of Registers	Description	Range	Default	Format	Property	Comment
2	2	3	4	firmware version			string	Read	

6	6	3	2	hardware version			string	Read	
8	8	3	2	device ID			hex	Read	Product ID
10	A	3	4	device PAC			hex	Read	Product PAC
14	E	3	1	SENSOR_TYPE	1-255		uint16	Read	Sensor or Input Type

6.2 Configuration table

Modbus Register (Decimal)	Modbus Register (Hex)	Function Code (Read)	Function Code (Write)	# of Registers	Description	Range	Default	Format	Property	Comment
270	10E	3	16	4	CURRENT_C			hex	Read/Write	
274	112	3	16	1	SERVER_COI			uint16	Read / Write	0: Send to Sigfox Network 1: Send to Dongle
276	114	3	16	1	RADIO_CONI	1, 2, 4	4	uint16	Read / Write	RC zones selection 1, 2 ,4 is RCZ1, RCZ2, RCZ4
277	115	3	16	1	TX_POWER		20	int16	Read / Write	RF Tx power
278	116	3	16	2	CONSTANT_		1	float	Read / Write	Constant a for scaling measured value
280	118	3	16	2	CONSTANT_		0	float	Read / Write	Constant b for scaling measured value
282	11A	3	16	2	HIGH_CUT		1E+09	float	Read / Write	High cut value for calculated value
284	11C	3	16	2	LOW_CUT		-1E+09	float	Read / Write	Low cut value for calculated value
286	11E	3	16	2	SENSOR_BO		200	uint32	Read / Write	Boot time of sensor/input in ms
306	132	3	16	2	SYSTEM_SEN		11	float	Read / Write	The sensitivity of the circuit (mV/ppm)

7. Offline configuration

Using the configuration cable to connect to the sensor as below picture.

Serial port configuration on computer: **9600** baud, **None** parity, **1** stop bit.

Reading data by **Function 3.**

Writing data by **Function 16**.

During connection with Modbus configuration tool, the Sigfox node will send all data in realtime: Battery, Battery level, Vref, Button status, reed switch status, PCB temperature, Measured value, alarm status.

Step to configure & check data:

NOTE:

The Modbus configuration can be done in the first **60s** after power up the Sigfox node. After 60s, if user can not finish the configuration, user need to reset the power of Sigfox node again, by removing battery in at least 15s.

Step 1: Install the Modbus Configurator Software in the link below

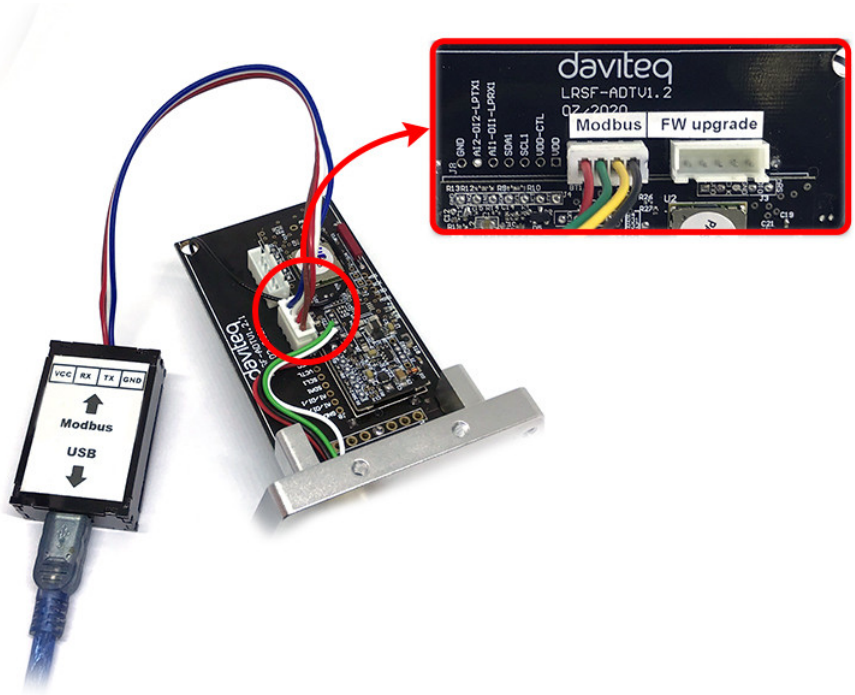
https://filerun.daviteq.com/wl/?id=yDOjE5d6kqFlGNVVlMdFg19Aad6aw0Hs

How to use the Modbus configuration software

Step 2: Plug the configuration cable to Computer via **USB** port;

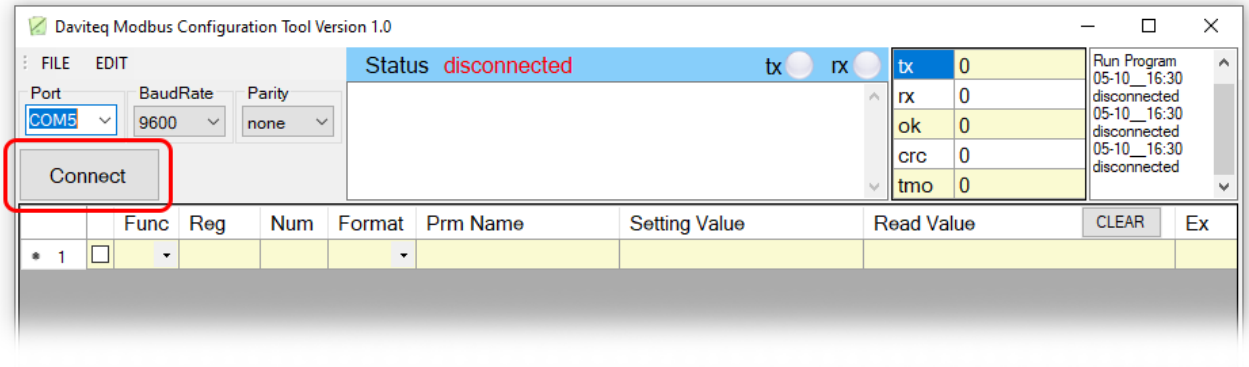
Step 3: Open the housing;

Step 4: Plug the connector to the configuration port;



Step 5: Import the configuration file by importing the csv file: Go to MENU:**FILE / Import New /** => select the file with name NH3 Sensor-2021.10.30-Template-V1.2.csv (***in the link below***). Then click **Connect**;

CONFIGURATION TEMPLATE FILE FOR SIGFOX WSSFC-NH3



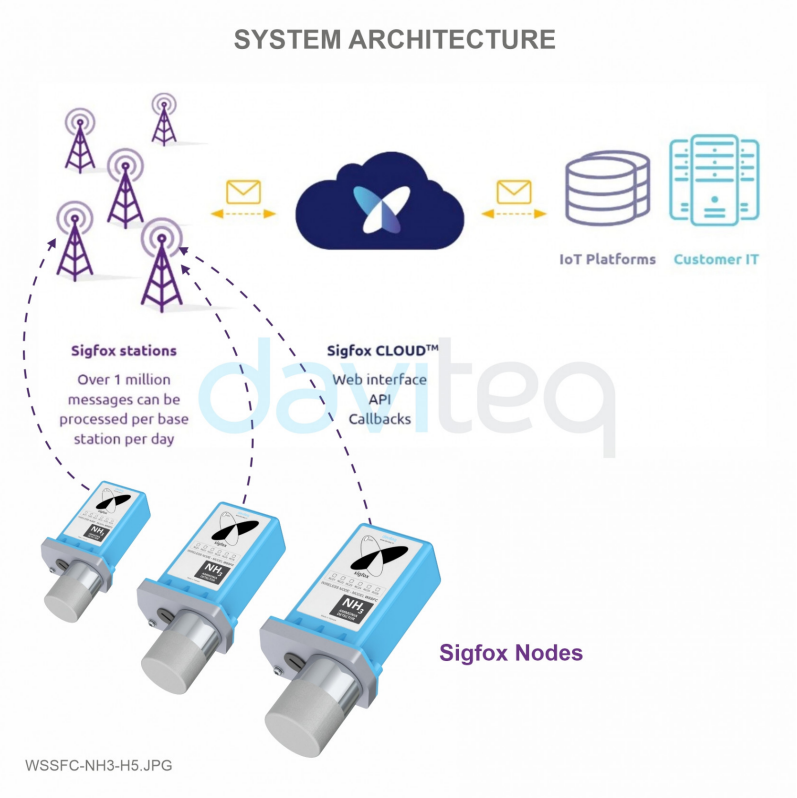
8. Installation

8.1 Locate the good place for Radio signal

To maximize the distance of transmission, the ideal condition is Line-of-sight (LOS) between the Sigfox sensor and Base station. In real life, there may be no LOS condition. However, the Sigfox sensor still communicate with Base station, but the distance will be reduced significantly.

ATTENTION:

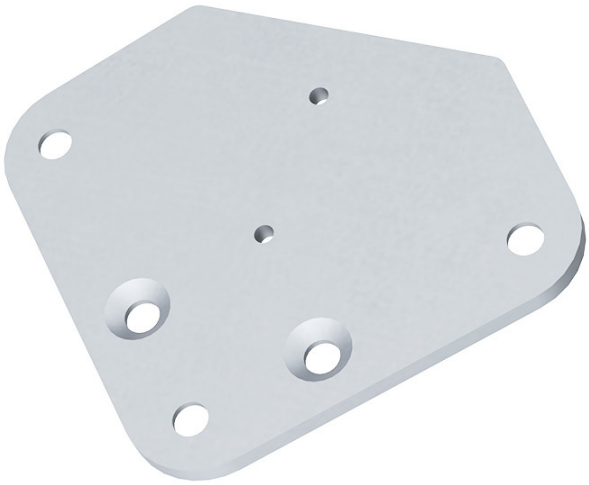
DO NOT install the Sigfox sensor or its antenna inside a completed**metallic** box or housing, because RF signal can not pass through metallic wall. The housing is made from Non-metallic materials like plastic, glass, wood, leather, concrete, cement...is acceptable.



8.2 Mounting

Installation method: Mount to the wall

The mounting bracket is made from hard metallic material



8.3 Battery installation

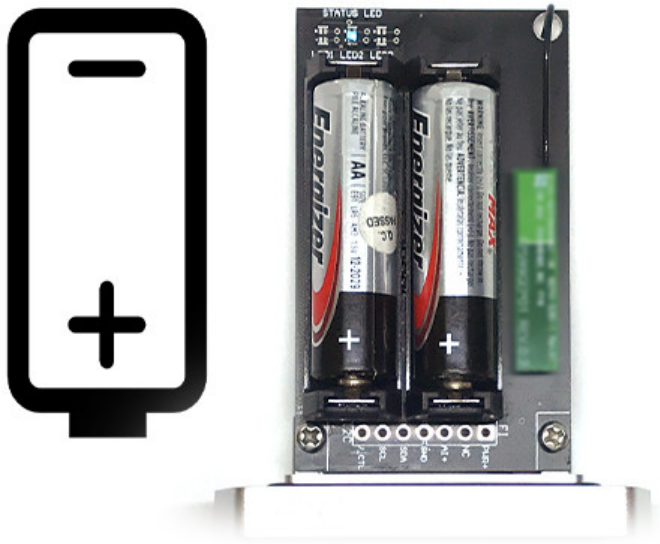
WSSFC-LPC-H5.PNG

Steps for battery installation:

Step 1: Using M4 Hex key to open the cover

Step 2: Open the housing, then insert 02 x AA 1.5VDC battery, please take note the poles of the battery

> **ATTENTION:**
>
> **REVERSED POLARITY OF BATTERIES IN 10 SECONDS CAN DAMAGE THE SENSOR CIRCUIT!!!**



Step 3: Insert the top plastic housing **(Please note the 2 reed joint)**

9. Troubleshooting

No.	Phenomena	Reason	Solutions
1	Node does not send RF to base station periodically, LED does not blink	• No power supply or battery ran out • Configuration sending cycle is incorrect	• Check that the battery is empty or not installed correctly • Check the power supply • Check the send cycle configuration
2	Node does not send RF to base station according to the alarm, LED does not blink	• The alarm configuration is incorrect • Running out of the number of alarms set for the day	• Check alarm configuration • Check the configuration for the maximum number of alarms per day
3	Node does not send RF to base station when activated by the magnetic switch, LED does not blink	• Magnetic switch has malfunctioned • Or place the Magnet key not right position	• Locate the correct position for magnet key • Read the status of the magnetic switch via modbus (when powering or attaching the battery) to see if the magnetic switch is working.
4	Node has blinked LED when sending RF but the base station cannot received	• Out of the number of RF packages of uplink per day (140 packages / day)	• Check on the base station whether the event message exceeds the number of RF packets
5	Node has sent RF but the LED does not blink	• LED malfunction	• Contact manufacturer
6	The measurement values from sensor do not change, keep constant values for long time	• Sensor got failure • Sensor cable broken • Sensor connector is not connected firmly	• Check sensor cable and connector • If the issue is still exist, please contact manufacturer for warranty or replace new sensor

7	The node does not send RF and the RF module is hot	• Insert the battery in the wrong direction • Electronics got problem	• Check battery polarity
8	RSSI is weak and often loses data	• Distance between Node and Base station is far or there are many obstructions • Connection to Antenna problem	• Check the location of Sigfox node and distance to the base station • Check the antenna connector in the PCB

10. Sensor calibration

The output value of NH3 is calculated from the formula: Y= AX + B

Where:

X = measured value of NH3 from sensor and electronics circuit

Y = output value of NH3 which is sent by the Uplink

A: Constant_A at address 278 in Memmap of sensor

B: Constant_B at address 280 in Memmap of sensor

The default values are: A = 1 and B = 0 ==> Y = X

After a period of time of working the sensor output will be drifted about < 1% of the reading value per month.

So depending on what accuracy you require, you can define how long the sensor needs to be re-calibrated again.

For general application, the cycle of calibration would be 3 or 6 months. For the highest accuracy, the cycle would be 1 or 2 months.

To re-calibrate the sensor, you need to re-calculation the new values of A and B. How can it be done?

By applying the standard Zero and Span Gas. Please follow these steps:

10.1 Apply zeroing gas standard:

> Before applying zeroing process, please do this step first: place the sensor in a Pure air environment from 20-25 oC in at least 1h. The sensor must be powered and running at the time.

Zeroing can be done in 1 of 2 ways as below:

- Pure air can be used as a Zero standard for NH3 calibration. Simply place the sensor in a clean environment with pure air. The ambient temperature should be from 20 to 25 oC.

- Or using high purity Nitrogen gas (99.999%) as a zero standard gas. Attach the calibration cap into the sensor and turn on the Valve to provide the N2 flow into the sensor.

Waiting for the zero gas to enter completely into the sensor for at least 15 minutes, then using the magnet key to activate the SW1. This action will force the sensor to send the new measured data to the Sigfox backend, you got the measured value Y_o.

10.2 Apply span gas standard:

As the sensor has the maximum measurement range is 100ppm, you can use any standard NH3 gas cylinder with a concentration from 25ppm to 100ppm for calibration. Please follow the steps below:

- Attach the calibration cap into the sensor and turn on the Valve of the cylinder to provide the span gas flow into the sensor.

Waiting for the span gas to enter completely into the sensor for at least 5 minutes, then using the magnet key to activate the SW1. This action will force the sensor to send the new measured data to the Sigfox backend, you got the measured value Y_s.

10.3 Calculate the new value A and B

From the existing A and B values and the measured value Y_o and Y_s and the 0ppm (zero standards) and 25ppm (for example using 25ppm NH3 standard gas), you can calculate the new value of A and B as below formula.

Ex: We have values

Two calibration points	Standard value	The value read from Sigfox device
1	50	70
2	1000	1100

The old A configuration	1
The old B configuration	0

We have:

$$A = (1000-50) / (1100-70) = 0.92233$$

From the formula: Y = AX + B. Then B = Y - AX = 1000 - 0.92233 x 1100 = -14.56311

The new A configuration	0.92233
The new B configuration	-14.56311

10.4 Set the new value A and B by Downlink

As the A and B values are separated values in the memmap of the sensor, we need to use 02 downlink messages to send to the sensor. Each message will send 1 value of A or B.

For example: A = 1.1 and B = 0.2. Here are the downlink message for setting A & B

Parameter	PRM_ADDRESS	PRM_LENGTH	PRM_VALUE	DOWNLINK_TYPE	Full Downlink
(bytes)	1	1	4	2	8
CONSTANT_A	0x16	0x04 = 4	0x3F8CCCCD = 1.1	0x0005	16043F8CCCCD0005
CONSTANT_B	0x18	0x04 = 4	0x3E4CCCCD = 0.2	0x0005	18043E4CCCCD0005
HIGH_CUT	0x1A	0x04 = 4	0x447A0000 = 1000	0x0005	1A04447A00000005
LOW_CUT	0x1C	0x04 = 4	0x00000000 = 0	0x0005	1C04000000000005
SENSOR_BOOT_TIME	0x1E	0x04 = 4	0x000000C8 = 200	0x0005	1E04000000C80005
SYSTEM_SENSITIVITY	0x32	0x04 = 4	0x41300000 = 11	0x0005	3204413000000005

11. Sensor module replacement:

11.1 Remove old sensor module:

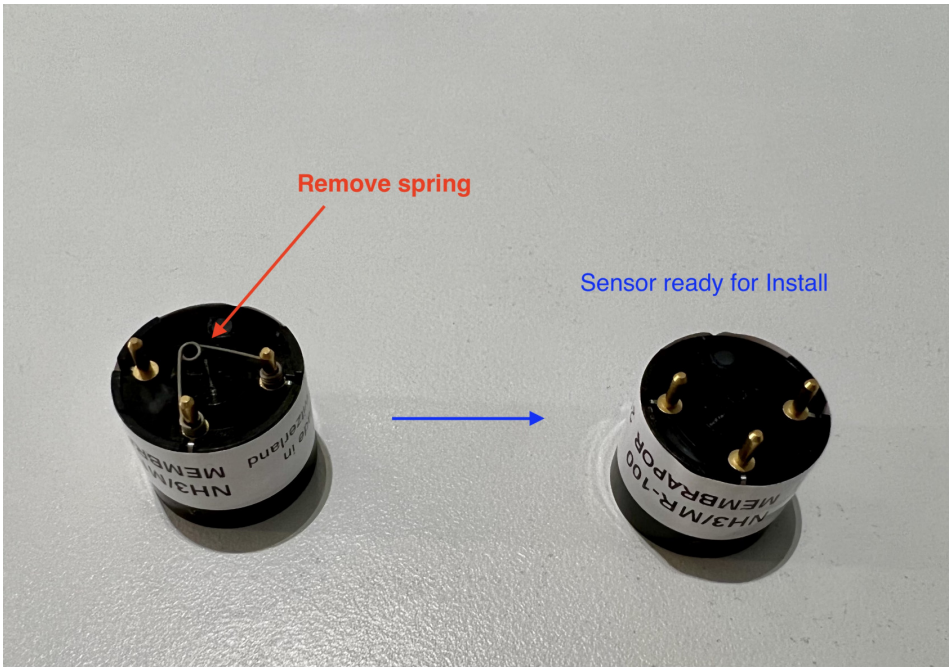
- Carefully remove the filter;

- Remove the exiting sensor module by using your finger to grip and pull it out;

11.2 Install new sensor module:

- Unbox the new sensor in the box;

- Carefully remove the spring between the 02 pins of the sensor, as below picture;



- Plug the sensor module into the device. Make sure the 03 pins of the sensor are completely inserted inside the sockets. Please see the below picture.

- Place the filter again and tighten it.

12. Support contacts

Manufacturer

Daviteq Technologies Inc
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