USER GUIDE FOR SIGFOX-READY PRECISION FUEL LEVEL SENSOR WSSFC-CAP10

THIS IS **OBSOLETE** MANUAL

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

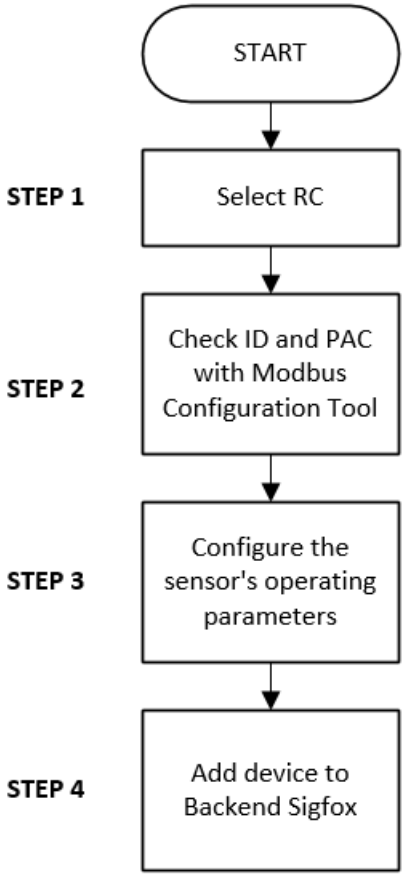
WSSFC-CAP10-MN-EN-01	FEB-2022

This document is applied for the following products

SKU	WSSFC-G4F-NH3	**HW Ver.**	1.1	**FW Ver.**	1.0
Item Code	WSSFC-CAP10-8-1500	SIGFOX HIGH PRECISION CAPACITANCE FUEL LEVEL SENSOR FOR DIESEL OIL, VEGETABLE OIL, LUBRICANT, 1500MM, FIELD CUTTABLE, INTERNAL ANTENNA, TYPE AA BATTERY 1.5VDC, IP67, RC1 ZONE			
	WSSFC-CAP10-9-1500	SIGFOX HIGH PRECISION CAPACITANCE FUEL LEVEL SENSOR FOR DIESEL OIL, VEGETABLE OIL, LUBRICANT, 1500MM, FIELD CUTTABLE, INTERNAL ANTENNA, TYPE AA BATTERY 1.5VDC, IP67, RC2-RC4 ZONES			
	CAP10PROEXT0700	CAP10 PROBE EXTENSION LENGTH 700 MM			
	CAP10PROEXT1000	CAP10 PROBE EXTENSION LENGTH 1000 MM			
	CAP10PROEXT1500	CAP10 PROBE EXTENSION LENGTH 1500 MM			

0. Configuration Check List

0.1 Configuration Sigfox Sensor



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 6**
STEP 4: Add device to Backend Sigfox	
refer to section 6.2 for details	
STEP 5: Installation	
refer to section 9 for details	

0.2 Setup Fuel Sensor

Default communication of CAP10CNR RS485:

Baudrate : **19200**
Data bit : **8**
Stop bit : **1**
Parity : **None**
Modbus Slave address : **30**



See more how to configure CAP10CNR here

1. Functions Change Log

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

2. Introduction

WSSFC-CAP10 is a Sigfox fuel level sensor that utilizes the 10-year experience of Daviteq in digital capacitance measuring technique. It delivers high accuracy and stability with 0.1% of span. Ultra-low power design and smart firmware allow the complete Wireless and Sensor package to run on 2 x AA battery 1.5V for 2-5 years with 15 minutes updates. It can support the following regions RC1, RC2, & RC4.

Typical Applications: Monitoring fuel level and fuel consumption in fuel tanks of Genset, Boiler, Heavy equipment or machinery...

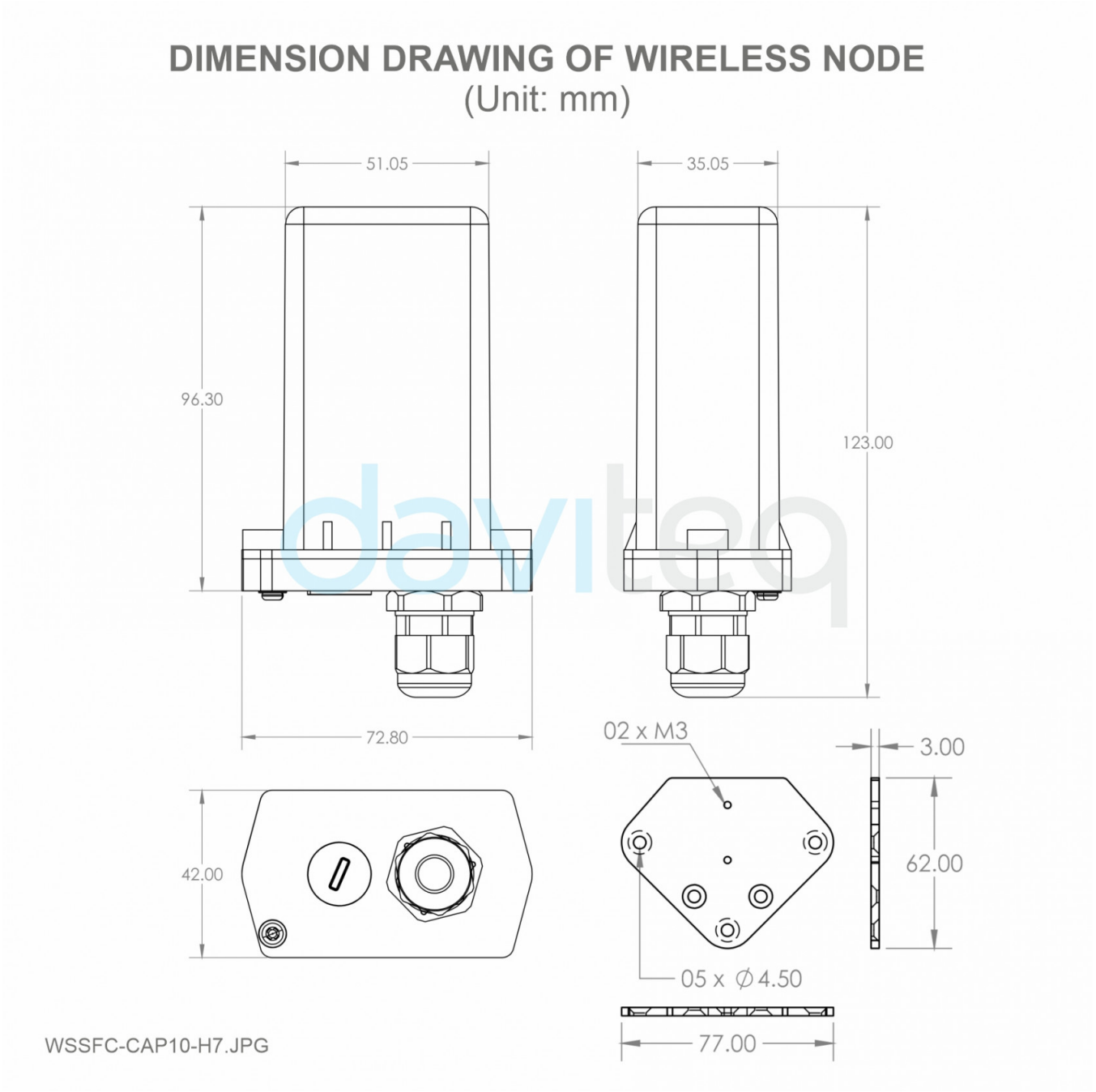


3. Specification

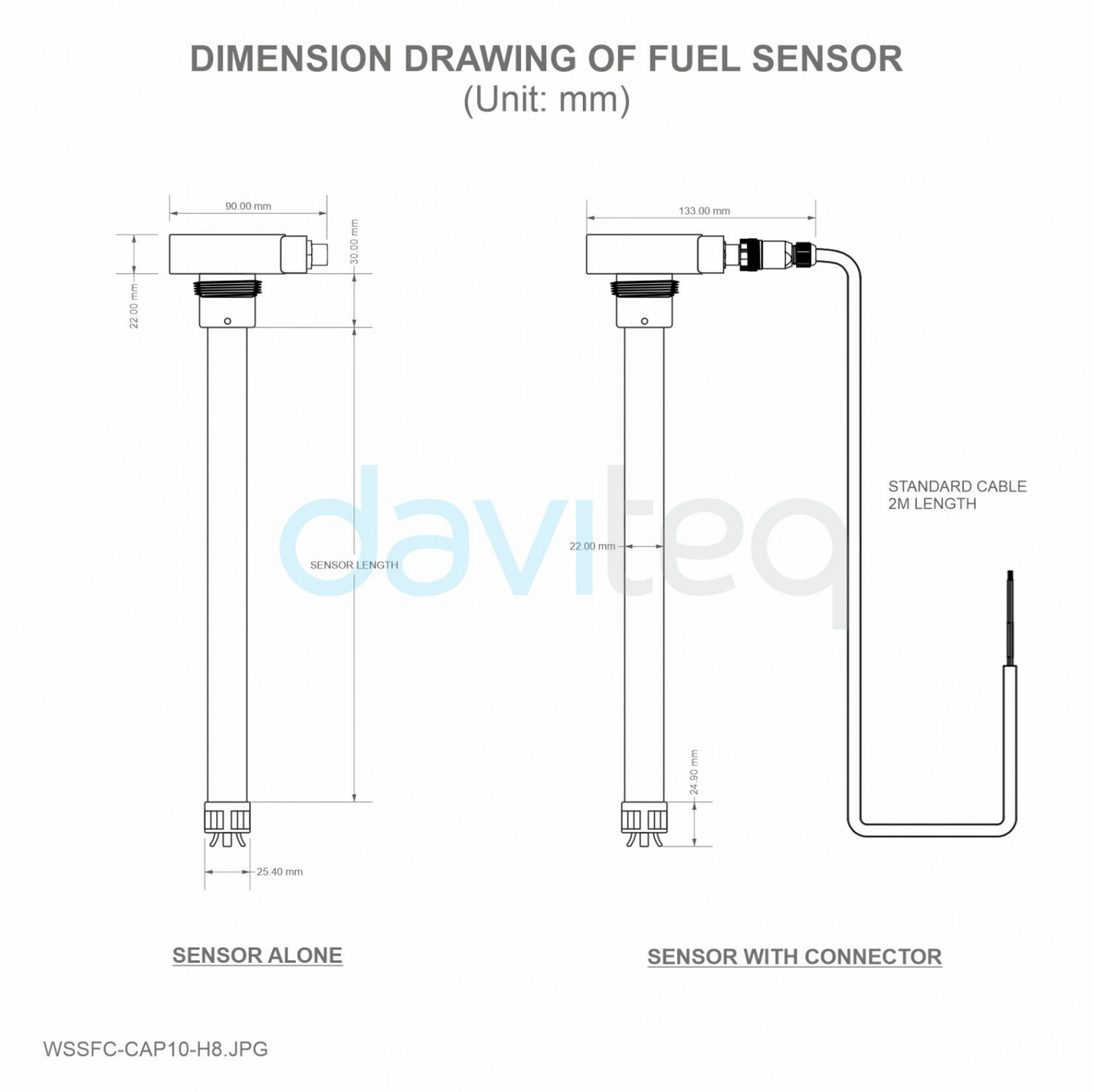
SENSORS SPECIFICATION:	
Measurement Range (mm)	Standard Range: 700, 1000, 1500, can be extended up to 4000
Accuracy / Resolution / Repeatability	±0.1% of Span / 0.1% / ±0.1% of span
Thermal drift	< +0.03% of span per 10oC
Connector	M12 male, 4-pin, Coding A
Sensor MTBF	More than 10 years
Sensor wetted materials	Aluminum and engineering plastic
Operating Temperature Range	-40 to 85 °C
Operating Humidity Range	0-100% RH
Sensor rating	IP67, outdoor
Certification	CE-Marking per EN61236-1 (with test report)
Standard accessories	Filter footer, flange, gasket, o-ring, self-tapping screws
Sigfox SPECIFICATION:	
Sigfox zones	select RC1-RC2-RC4
Antenna	Internal Antenna 2 dbi
Configuration	via Downlink or offline USB cable (PC software is supplied at free)
Battery	02 x AA Type 1.5VDC
RF Module complies to	CE, FCC, ARIB
Working temperature	-40°C..+60°C (using Energizer Lithium Ultimate AA battery)
Dimensions and Net-weight	H140xW73xD42, 250 grams (Sigfox Device only)
Housing	Polycarbonate, IP67
Mounting	Wall mount bracket
Sensor cable	2m sensor cable with M12-male connector

4. Dimensions

4.1 Dimensions of the Sigfox sensor



4.2 Dimensions of the Fuel Sensor



5. Scope of delivery

- Sigfox Sensor - Bracket
- Fuel Sensor
- Installation tool



6. Operation Principle

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

After that, Sigfox node will send the first message to 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.



EVENT	PRE-CONDITION	ACTION	LED STATUS	BUZZER STATUS	ACTIVITIES	POST-CONDITION
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
PARAMETERS_UPDA	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 15s. if shorter than 15s, there will be no data sending and you will not hear the beep sound.





the push button can only be used for the first**60 seconds** after powering up.

6.1 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.

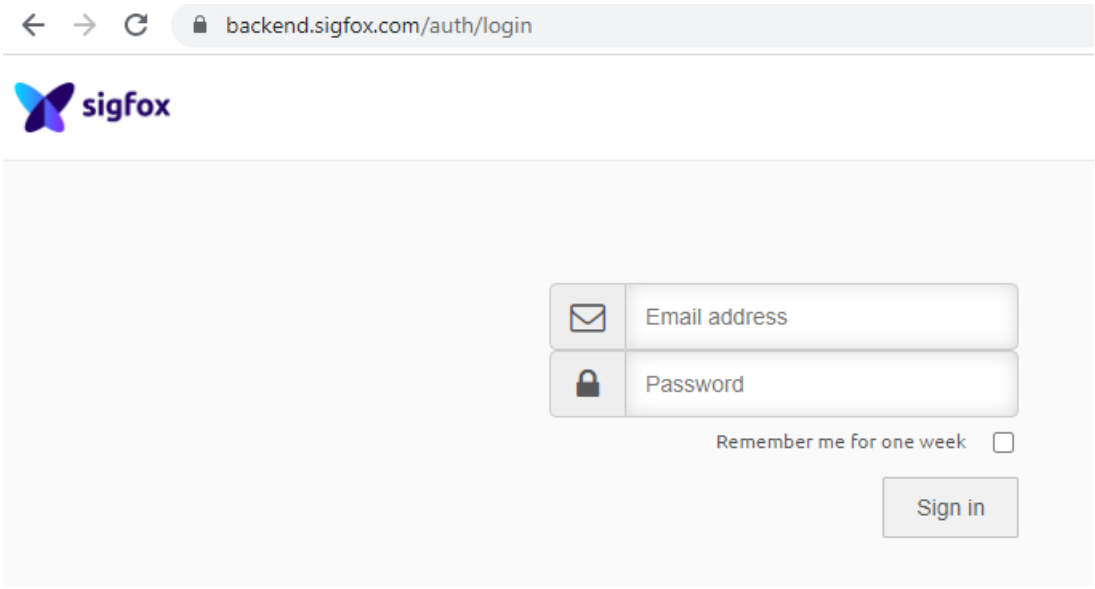
Sigfox's high limit EIRP recommendation is included in each column although regulations sometimes allow for more radiated power than the Sigfox recommendation.

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

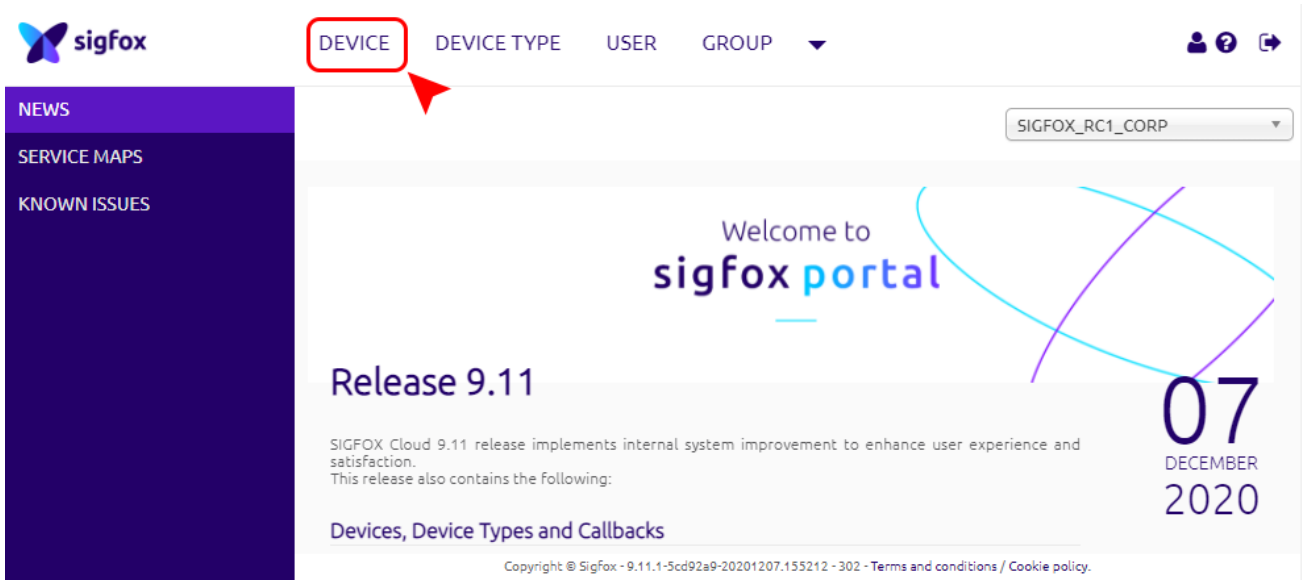
- Low current consumption
- Balanced link budget between uplink and downlink communication

6.2 Add a device to the Backend Sigfox

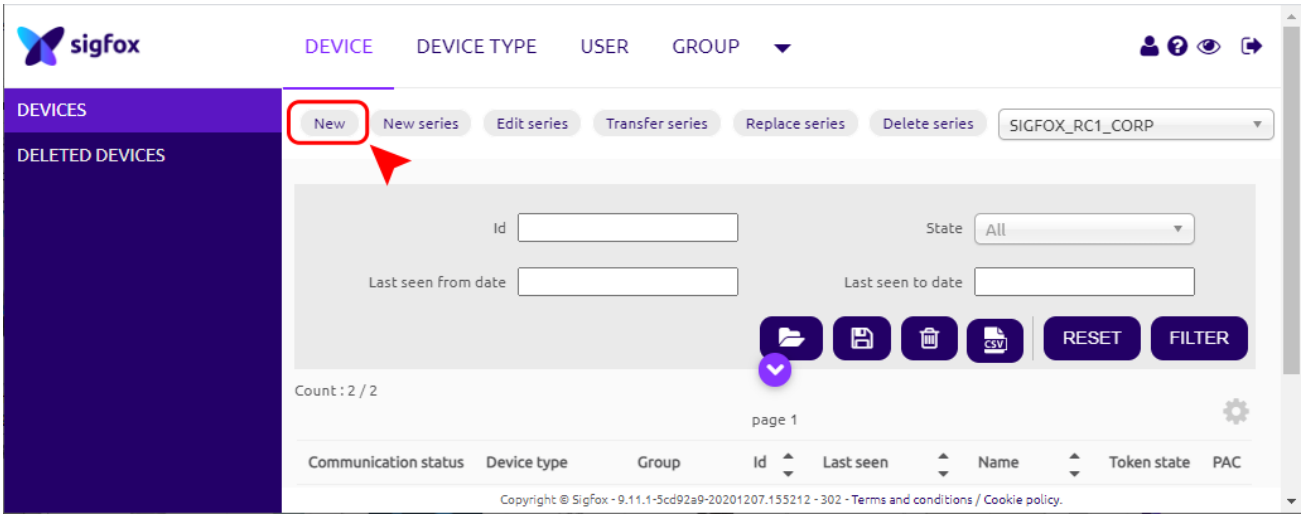
Step 1: Log in to the sigfox backend website



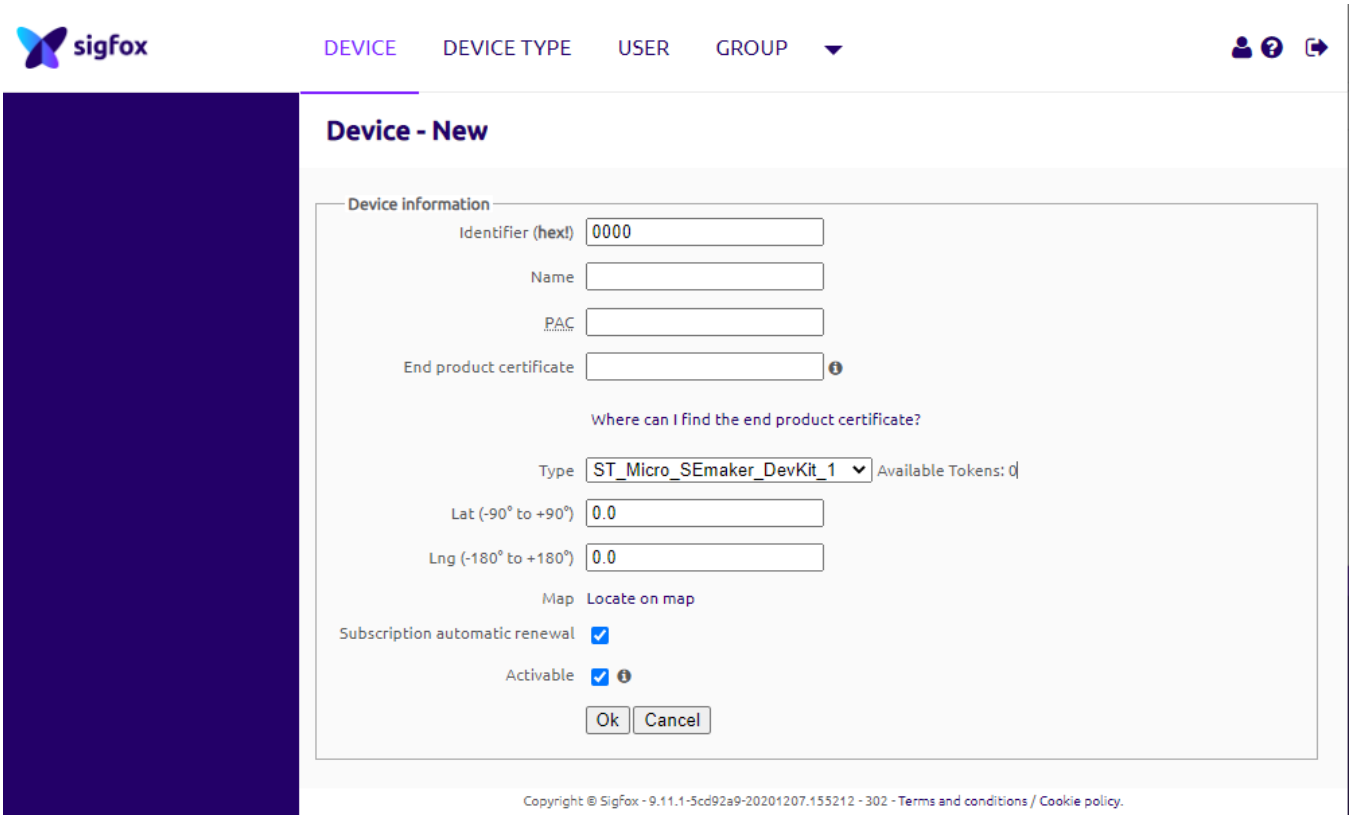
Step 2: Click on Device



Step 3: Click New → Select a group

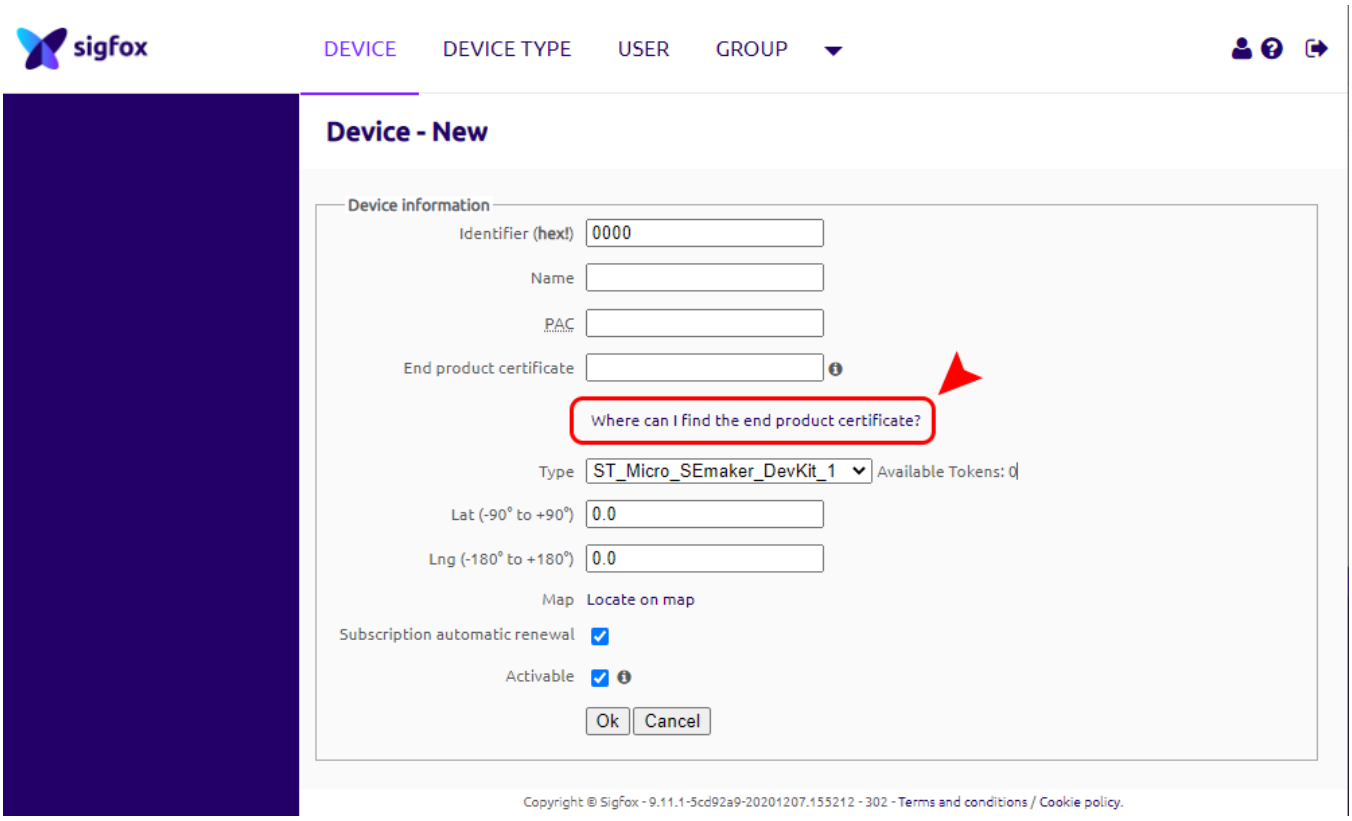


Step 4: Fill in the required information

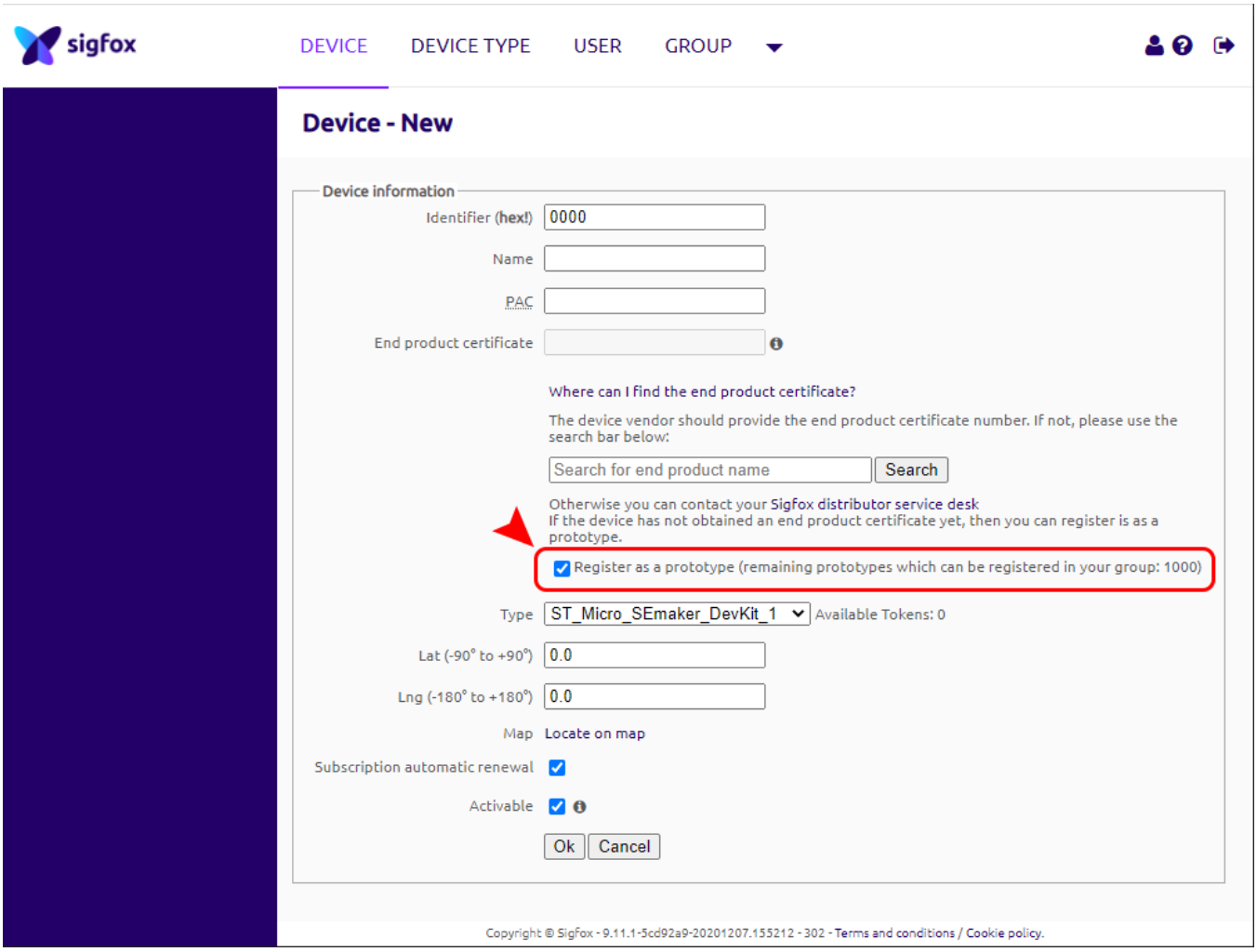


Note: Some of our products may not have end product certification in time, to add the product to Backend Sigfox please follow the steps below.

Click on the text as shown below



Check the box as shown below to register as a prototype



6.3 Measurement principle of Sigfox Sensor

When the sensor sampling time interval is reached, for example 2 minutes, the Sigfox node will wake up and switch ON

the power supply to supply the energy to external sensor to start the measurement. Depends on the type and characteristic of external sensor, the sensor will take a certain time to finish the measurement.

Once reading the value, it can be scaled to any engineering value by the following formula:

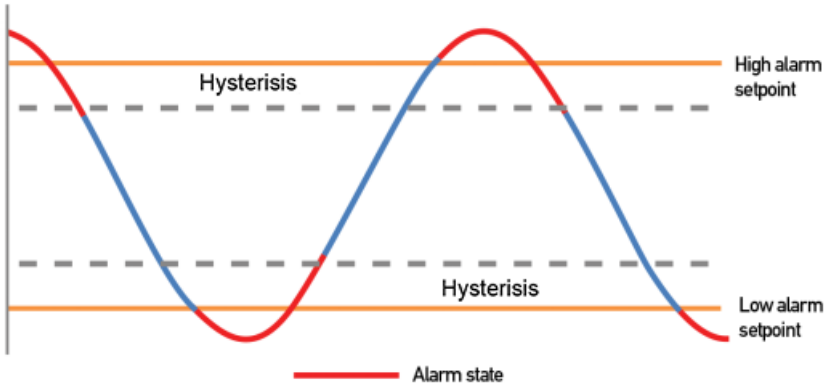
$$Y = aX + b$$

Where:

- X: the raw value from sensor
- Y: the calculated value will be sent to Sigfox base station in the payload data.
- a: constant (default value is 1)
- b: constant (default value is 0)

So, if there is no user setting for**a** and **b** ==> **Y** = **X**

The **Y** value will be compared with Lo and Hi threshold. Please refer below the graph of alarm processing.



Here is the information about CAP10CNR

6.4 Configuration Parameters

Parameter	Description	Possible values	Default value
HIGH_ALARM_SETPOINT	High alarm setpoint for calculated value	32-bit float	1000000000
LOW_ALARM_SETPOINT_FACTOR	Low alarm setpoint for calculated value	8-bit unsigned integer LOW_ALARM_SETPOINT = HIGH_ALARM_SETPOINT * LOW_ALARM_SETPOINT_FACTOR / 200	0
ALARM_ENABLE	Enable/Disable ALARM event	0b0 = ALARM event is OFF 0b1 = ALARM event is ON	0b0 = ALARM event is OFF
ALARM_PERIOD	Period of time to send ALARM event	0b000 = every 10min 0b001 = every 30min 0b010 = every 1h 0b011 = every 2h 0b100 = every 3h 0b101 = every 6h 0b110 = every 12h 0b111 = every 24h	0b000 = every 10min
LED_BUZZER_ENABLE	Enable/Disable LEDs and Buzzersinteractions for action not triggered by the reed switch	0b0 = LEDs and Buzzers are OFF 0b1 = LEDs and Buzzers are ON	0b1 = LEDs and Buzzers are ON
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 days) 0b101 = every 72h (3 days) 0b110 = every 120h (5 days) 0b111 = every 240h (10 days)	0b011 = every 24h (1 day)

MEASURE_PERIOD	Period of time to measure sensor	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	0b1100 = every 1h
TX_REPEAT	Sigfox TX repeat	0b0 = Send RF 1 time 0b1 = Send RF 3 time	0b1 = Send RF 3 time
CYCLIC_DATA_PERIOD	Period of time to send CYCLIC_DATA event	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
DEVICE_RESET	Once this parameter is set, the device shall restart once after having received the Downlink.	0b1010 = 0xA = force device reset others = do nothing	0b0000 = do nothing
DOWNLINK_TYPE	Downlink type	4-bit unsigned integer See Sigfox Downlink tab	0b0000

6.5 Payload Fields

Data name	**Description**	**Encoding or Possible values**	**Length (in bits)**
EVENT_ID	Unique ID identifying the device event	4-bit unsigned integer 0 = START_UP 1 = HEARTBEAT 2 = PARAMETERS_UPDATE 3 = FORCE_DATA 4 = CYCLIC_DATA 5 = ALARM	**4**
HW_VERSION	Indicate HW version	4-bit unsigned integer 1..15	**4**
FW_VERSION	Indicate FW version	8-bit unsigned integer 1..255	**8**
LATEST_SIGFOX_DOWNLINK	Latest received and valid sigfox downlink frame = Current configuration	64-bit encoded field See Sigfox Downlink tab	**64**
HW_ERROR	HW error	0b0 = no error 0b1 = error	**1**
ALARM	Alarm	0b00 = no alarm 0b01 = low alarm 0b10 = high alarm 0b11 = not used	**2**
BATTERY_LEVEL	Battery level	2-bit unsigned integer 0..3	**2**
RAW_VALUE	Raw value of CAP10-RS485	16-bit unsigned integer	**16**
SCALED_VALUE	Scaled value of CAP10-RS485	16-bit signed integer	**16**
TENTATIVE	Tentative number	8-bit unsigned integer Formula: (8-bit_Tentative +1)= real_tentative # Range: 1 to 256 Accuracy: 1 Example: 0b00000111 = 0x7=7=> 7+1 =>tentative # 8	**8**

6.6 Sigfox Uplink Frame Format

Sigfox Frame software for Sigfox Sensor

Size					
	START_UP	*(led blink **WHITE**)*			
	Payload	**EVENT_ID**	**HW_VERSION**	**FW_VERSION**	**LATEST_SIGFOX_DOWNLINK**
10.0	**bits**	**4**	**4**	**8**	**64**
	Value	*0b0000 = 0*	*yes*	*yes*	*yes*
	HEARTBEAT	*(led blink **GREEN**)*			
	Payload	**EVENT_ID**	**HW_VERSION**	**FW_VERSION**	**LATEST_SIGFOX_DOWNLINK**
10.0	**bits**	**4**	**4**	**8**	**64**
	Value	*0b0001 = 1*	*yes*	*yes*	*yes*
	PARAMETERS_UPDATE	*(led blink **PURPLE**)*			
	Payload	**EVENT_ID**	**HW_VERSION**	**FW_VERSION**	**LATEST_SIGFOX_DOWNLINK**
10.0	**bits**	**4**	**4**	**8**	**64**
	Value	*0b0010 = 2*	*yes*	*yes*	*yes*

Size										
	FORCE_DAT	(led blink **SKY BLUE**)								
	Payload	**EVENT_ID**	**HW_ERROR**	**reserved**	**ALARM**	**BATTERY_L**	**reserved**	**RAW_VALU**	**SCALED_VA**	
6.0	**bits**	**4**	**1**	**3**	**2**	**2**	**4**	**16**	**16**	
	Value	0b0011 = 3	yes	zeros	yes	yes	zeros	yes	yes	
	CYCLIC_DA	(led blink **SKY BLUE**)								
	Payload	**EVENT_ID**	**HW_ERROR**	**reserved**	**ALARM**	**BATTERY_L**	**reserved**	**RAW_VALU**	**SCALED_VA**	**TENTATIVE**
7.0	**bits**	**4**	**1**	**3**	**2**	**2**	**4**	**16**	**16**	**8**
	Value	0b0100 = 4	yes	zeros	yes	yes	zeros	yes	yes	yes

	ALARM	(led blink **RED**)								
	Payload	**EVENT_ID**	**HW_ ERROR**	**reserved**	**ALARM**	**BATTERY_L**	**reserved**	**RAW_VALU**	**SCALED_VA**	**TENTATIVE**
7.0	**bits**	**4**	**1**	**3**	**2**	**2**	**4**	**16**	**16**	**8**
	Value	0b0101 = 5	yes	zeros	yes	yes	zeros	yes	yes	yes

6.7 Sigfox Downlink Frame Format

Sigfox Frame software for Sigfox Sensor

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**!!!

Downlink Frame Format:

Size						
	DOWNLINK_TYPE = 0					
	Payload	**HIGH_ALARM_SETI**	**LOW_ALARM_SETP**	**ALARM_ENABLE**	**ALARM_PERIOD**	**LED_BUZZER_ENAI**
8.0	**bits**	**32**	**8**	**1**	**3**	**1**
	Value	*yes*	*yes*	*yes*	*yes*	*yes*
	HEARTBEAT_PERIC	**MEASURE_PERIOD**	**TX_REPEAT**	**CYCLIC_DATA_PER**	**DEVICE_RESET**	**DOWNLINK_TYPE**
	3	**4**	**1**	**3**	**4**	**4**
	yes	*yes*	*yes*	*yes*	*yes*	*0b0000 = 0*
Size						
	DOWNLINK_TYPE = 5					
	Payload	**PRM_ADDRESS**	**PRM_LENGTH**	**PRM_VALUE**	**reserved**	**DOWNLINK_TYPE**
8.0	**bits**	**8**	**8**	**16**	**28**	**4**
	Value	yes	0x02 = 2	yes	zeros	0b0101 = 5

	Payload	PRM_ADDRESS	PRM_LENGTH	PRM_VALUE	reserved	DOWNLINK_TYPE
8.0	**bits**	**8**	**8**	**32**	**12**	**4**
	Value	*yes*	*0x04 = 4*	*yes*	*zeros*	*0b0101 = 5*

7. Modbus Memmap

7.1 Data table

Modbus Register (Decimal)	Modbus Register (Hex)	Function Code	# of Registers	Description	Range	Default	Format	Property	Comment
2	2	3	4	FW_VERSION			string	Read	
6	6	3	2	HW_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

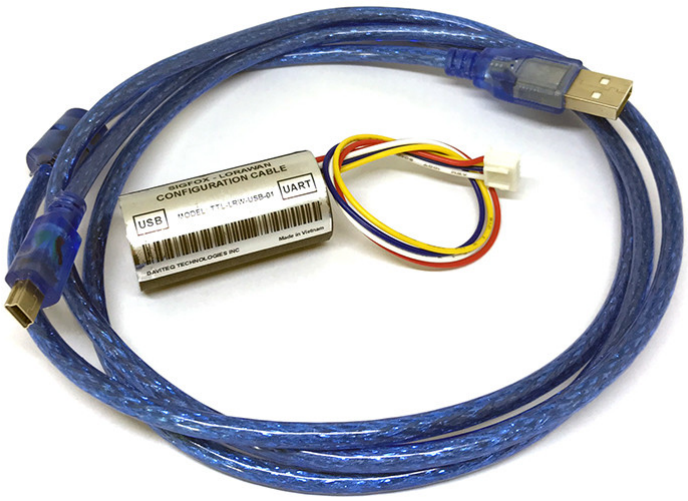
7.2 Configuration table

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_CO			uint16	Read/Write	0: Send to Sigfox Network 1: Send to Dongle
276	114	3	16	1	RADIO_CON	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_		0.06666	float	Read/Write	Constant a for scaling measured value
280	118	3	16	2	CONSTANT_		-1,113.33	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		0	float	Read/Write	Low cut value for calculated value

286	11E	3	16	2	SENSOR_BO		800	uint32	Read/Write	Boot time of sensor/input in ms
306	132	3	16	1	CAP10_BAUI	0-1	1	uint16	Read/Write	0: 9600, 1:19200
307	133	3	16	1	CAP10_NUM	1-20	2	uint16	Read/Write	Number of cap10 sensor reading samples to get average

8. 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

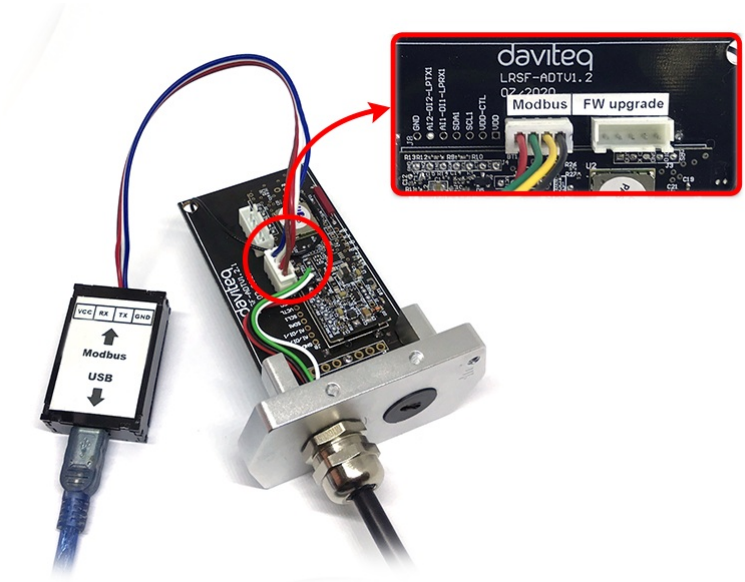
How to use the Modbus configuration software

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



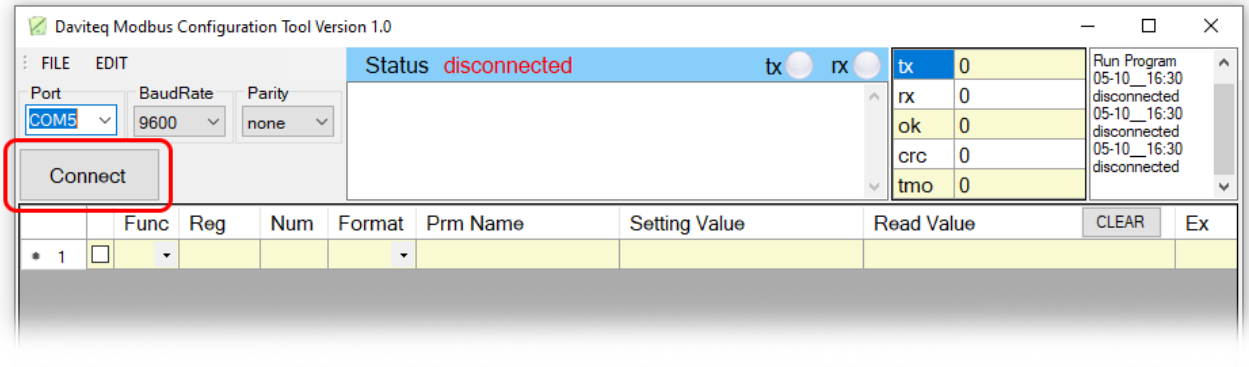
Step 3: Open the housing;

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 CONFIGURATION TEMPLATE FILE FOR SIGFOX CAP10 SENSOR FW1.0.csv (***in the link below***). Then click **Connect**;

CONFIGURATION TEMPLATE FILE FOR WSSFC-CAP10



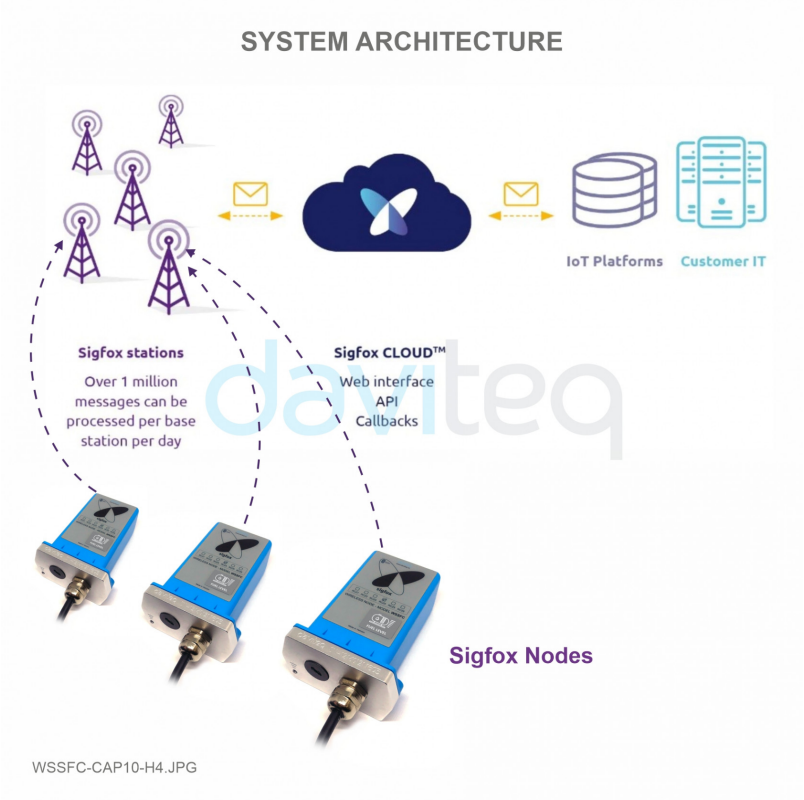
9. Installation

9.1 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.

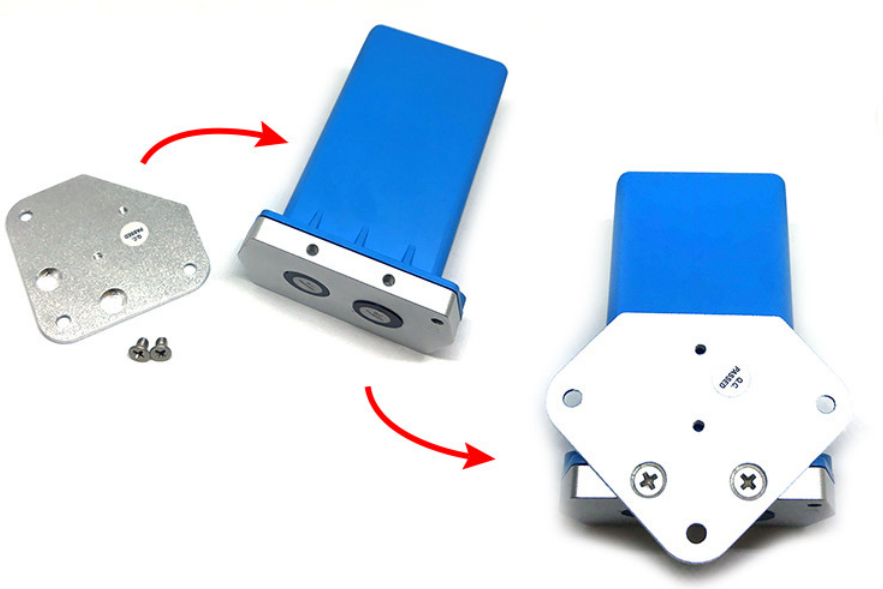
ATTENTION:

⚠ **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.



9.2 Mounting

9.2.1 Bracket installation



9.2.2 Site installation

> ⚠ **WARNING:** The sensor must be securely fixed near the measuring area.

Sigfox sensor connected to fuel sensor via M12 . connection cable

> **Default communication of CAP10CNR RS485:**

Baudrate : **19200**
Data bit : **8**
Stop bit : **1**
Parity : **None**
Modbus Slave address : **30**



> **Refer here for installation instructions for cap10**



WSSFC-CAP10-H2.JPG

9.3 Battery installation



WSSFC-LPC-H5.PNG

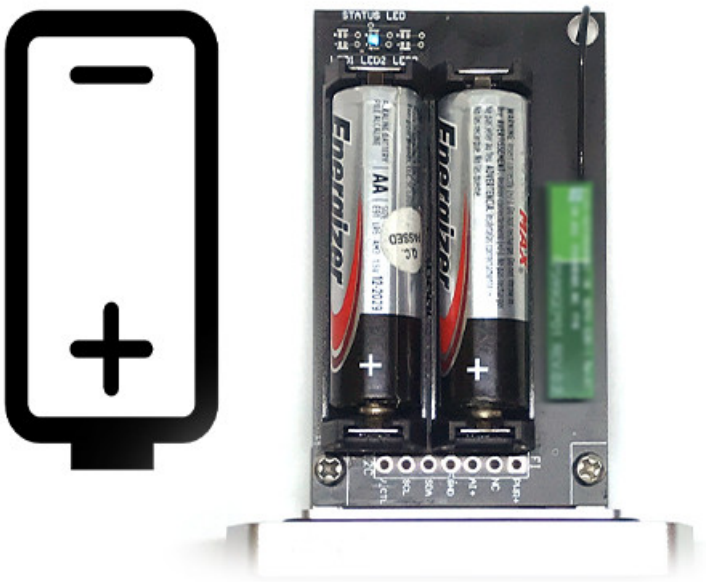
Steps for battery installation:

Step 1: Open the cover by using flat head screwdriver



Step 2: 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 and locking by L hex key

> **ATTENTION:** When reinstalling the cover, pay attention to put the PCB edge into the middle slot of the box inside as shown below)



10. 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 location of Sigfox node and distance to base station • Check the antenna connector in the PCB

11. Support contacts

Manufacturer

Daviteq Technologies Inc
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