



# LPN Multisense

## User Guide (English)

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November 2020



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## Versions

Version	Date	Author	Details
1	17/09/2020	Swisscom, mb	Initial version Valid for devices of the pre-release, with Firmware-version v01.xxx
2	02/11/2020	Swisscom, mb	Minor firmware changes for the first productive series: - Additional byte on port 100 for the choice of the transmission power level! - Battery lifetime adapted for the highest power setting. Valid for devices of the release v02.xxx

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## 1. Introduction and Scope

This document will guide you through the setup of Multisense, please read it carefully and get back to us in case of questions.

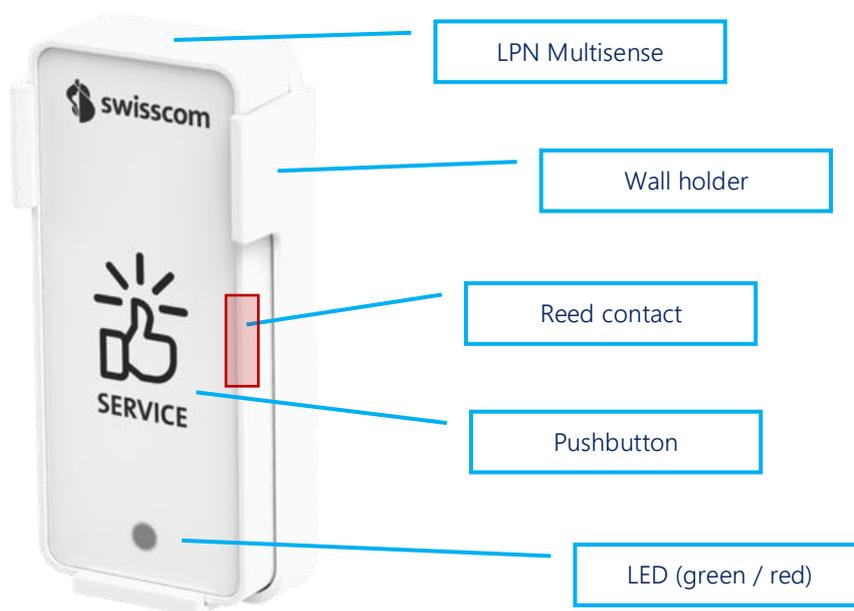
## 2. The LPN Multisense device

### 2.1. Scope of Delivery

The following parts are included in the box:

- LPN Multisense device, battery already included and not removable
- Wall holder (optional)
- Neodym magnet, for installation as described in the guide
- 2 strips of double-sided tape for the installation

### 2.2. Overview



#### 2.2.1 Start of operation

With the Data as a Service offering, your device is already provisioned out-of-the box. To start the device, you need to press the button for at least 3 seconds. The device starts to join the network, which is indicated by a short blink sequence in green. If the join was successful, the sequence will be followed by a long green blink. If the join failed, this will be indicated with a red blink.

With a button press of 3s or longer, a restart of the device can be initiated at any time.

## 2.2.2 QR code definition

The QR code on the back follows the LoRa Alliance Technical Recommendation for LoRaWAN QR code onboarding (basic).

The QR code on the device contains 48 bytes of data as follows:

LW:D0:1122334455667788:AABBCCDDEEFF0011:AABB1122

The information in the example represent:

- JoinEUI of 11-22-33-44-55-66-77-88
- DevEUI of AA-BB-CC-DD-EE-FF-00-11
- ProfileID of AABB-1122
  - AABB: VendorID
  - 1122: VendorProfileID



## 2.3. Pre-defined modes

Together with the Data as a Service starter-kit, we offer the following 5 pre-defined modes to cover most of the applications. Custom modes can be created using the payload description in the end of this guide. We also program customer specific firmware on request.

If you don't use our Data as a Service offering, you can still configure those modes by sending the device-specific pin-code, followed by the mode payload marked in "Downlink payload" to the device on Port 100, more info see 7.2.

Update for firmware v02.xxx: All battery lifetimes are estimated with the highest power setting.

### 2.3.1 Service Button (Default)

This mode will trigger a network-confirmed uplink message for each button press. If the button isn't pressed within 24 hours, the device will trigger a life sign message to report it is still working and under network coverage.

Use-cases: Customer satisfaction, service request, indication of problems, product order, doorbell, panic button, voting, etc...

Button behavior: Button presses will trigger a confirmed uplink message sequence, indicated by the LED as described below.

LED behavior: During the transmission of the message, the device will emit a short blinking sequence in green. A successful transmission will be indicated with a long green blink. An unsuccessful transmission will be indicated with a short red blinking sequence.

Battery lifetime: Depends on network coverage and typical number of button presses per day.

Scenario	SF7 coverage	SF9 coverage	SF12 coverage
1x button press per day	>10 years	>10 years	>10 years
10x button presses per day	>10 years	>10 years	~3.95 years
200x button presses per day	~5.22 years	~1.89 years	~0.25 years

Downlink payload: [PINCODE]b8a710030000000080817f7f000000000000

## 2.3.2 Workplace occupancy

This mode will use the internal accelerometer to measure the occupation of a desk by the vibrations on that surface. The occupancy or usage of any other object could also be measured, however the configuration of this mode is matched for the workplace occupancy.

Use-cases: Flexible workspaces, KPI reporting, desk finder, employee satisfaction, maximum office occupancy supervision, etc...

Button behavior: The button is activated and will report button presses and extend the inactivity timer.

LED behavior: Only button presses and the restart procedure will be indicated on the LED.

Standard timing:

- 5min reaction time to a new desk occupation
- 30min interval during usage to check if the desk is still in use
- 1h inactivity timer to report that the workplace is not used any more.  
(This message is generated by the platform and not by the device!)

Battery lifetime: Depends on the network coverage and office activity.

Scenario	SF7 coverage	SF9 coverage	SF12 coverage
9h desk activity per day	>10 years	~10 years	~3.43 years

Downlink payload: [PINCODE]082710030100050607

## 2.3.3 Temperature & Humidity monitoring

This mode reports the temperature and relative humidity of the sensor in regular intervals.

Use-cases: Indoor climate, energy optimization, smart building IoT retrofit, supply chain monitoring, logistics, etc...

Button behavior: Off

LED behavior: Off except restart procedure

Sensor accuracy: Typical accuracy of  $\pm 2\%RH$  and  $\pm 0.3^{\circ}C$ , for more detailed information please refer to the Sensirion SHT31 datasheet.

Standard timing:

- 30min interval for temperature and humidity reporting

Battery lifetime: Depends on the network coverage, message timing and ambient temperature.

Scenario	SF7 coverage	SF9 coverage	SF12 coverage
30min interval @ 20°C	~6.06 years	~2.21 years	~0.32 years
30min interval @ 0°C	~4.55 years	~1.66 years	~0.24 years
30min interval @ -20°C	~3.03 years	~1.11 years	~0.16 years

Downlink payload: [PINCODE]0827100300001e0130007f7f000000000000

### 2.3.4 Reed / Door counter

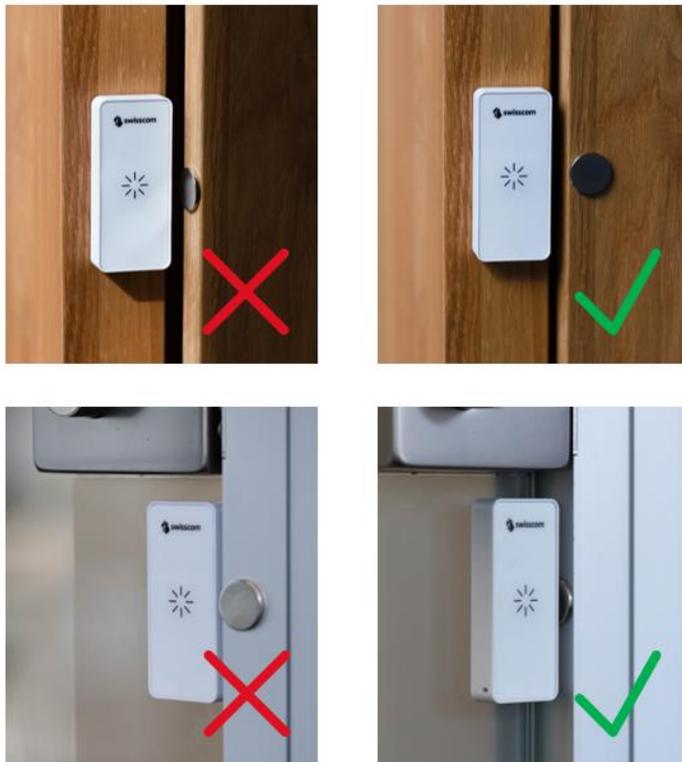
This mode counts the number of times a magnet has approached the reed contact on the device. With a correct installation, this can be used to count door openings or other cycles of mobile parts.

Use-cases: Door cycles, predictive maintenance, monitoring moving parts, etc...

Button behavior: Off

LED behavior: Off except restart procedure

Installation: Check the position of the reed sensor in the overview picture (2.2), which is positioned in the middle of the right side, *on top* of the device. The magnet and the device need to be positioned on the door such that the distance between the reed and the magnet is around 2-3mm in closed state.



Test mode: For a better experience during the installation, the mode "*Reed installation & test*" can be used. In this mode, each reed event will trigger a message and a LED signal.

Attention: For battery life considerations, the test mode must be deactivated immediately after the installation, as it can trigger a lot of messages and quickly drains the battery.

Standard timing:

- 1h interval for reed counter reports

Battery lifetime: Depends on the network coverage, message timing and ambient temperature.

Scenario	SF7 coverage	SF9 coverage	SF12 coverage
Standard: 1h interval @ 20°C	>10 years	~9.31 years	~1.90 years

Downlink payload: [PINCODE]0827100300003c0140a17f7f000000000000

### 2.3.5 Vibration counter

This mode counts the number of times an acceleration is detected above the defined threshold, no matter the directionality.

Use-Cases: Predictive maintenance, object usage, motion detection, thief protection, etc...

Button behavior: Off

LED behavior: Off except restart procedure

Standard timing:

- 1h interval for vibration counter reports

Accelerometer default threshold: 160 mg

Battery lifetime: Depends on the network coverage, message timing and ambient temperature.

Scenario	SF7 coverage	SF9 coverage	SF12 coverage
Standard: 1h interval @ 20°C	>10 years	~6.80 years	~1.47 years

Downlink payload: [PINCODE]0827100300003c0108007f7f0000000a2000

### 2.3.6 Demo mode (all sensors on)

This mode is only for demo purpose and enables all sensors for an immediate feedback on the device while demonstrating. The demo mode is not intended for a productive use and might drain the battery quickly. After using the demo mode, please reset the device to a standard mode.

Button behavior: On, confirmed uplinks

LED behavior: On

Standard timing: 24 hours if no other event occurs

Accelerometer default threshold: 160mg on counter, 500mg on axis

Accelerometer: On (counter and immediate reporting on orientation change)

Reed / magnet sensor: On (counter and immediate reporting)

Temperature / humidity: On, transmitted only together with other events

Workpace occupancy: Off (the accelerometer is already used differently in this mode)

Downlink payload: [PINCODE]0880640300000001f8e17f7f0000000ae555

## 3. Introduction to LoRaWAN coverage

Here is a very quick guidance to understand how the network coverage of the sensors works with the Swisscom LPN network (LoRaWAN). More detailed information can be obtained by contacting [Support.LPN@swisscom.com](mailto:Support.LPN@swisscom.com) or by visiting our LoRaWAN bootcamp, for example.

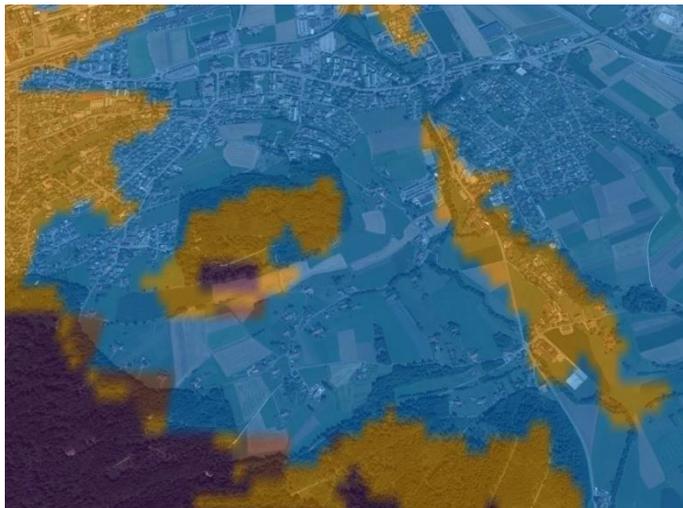
The main advantages of the LoRaWAN technology in this context are:

- Easy onboarding: Wherever the device is activated, it connects to the same network. No complicated on-site pairing or configuration process is needed.
- Good penetration: Compared to IoT technologies like BLE and Zigbee, the penetration in the building is much better, which is due to the sensitivity of the LoRa modulation.
- Flexible coverage: The Swisscom LPN network already covers 97% of the Swiss population. This includes light indoor coverage in most urban areas. However you can easily improve the coverage by using our plug-and-play indoor gateway. This will improve the battery lifetime of your devices, and it can generate coverage in difficult circumstances (building with thick walls, basements, ...)

### 3.1. Outdoor coverage

A detailed coverage map for Google Earth can be [downloaded from here](#): Click on the download link below the coverage map. You can install the overlay in Google Earth Pro, and you will see 3 colors to estimate the coverage in different regions.

Important: Every building is different. Therefore we cannot make a statement for indoor coverage. Also please note that this is only a model and some deviations might occur. Before a productive installation, the coverage should be measured on-site (see 3.4).



Blue (125 dBm pathloss)  
The outdoor coverage is good and will also penetrate 1-2 walls if the building is not shielded too much.

Orange (135 dBm pathloss)  
This is still a good outdoor coverage and might also reach indoor installations.

Purple (141 dBm pathloss)  
Outdoor coverage is available, but indoors will be difficult.

### 3.2. Indoor gateways

Wherever the coverage needs to be extended, we offer a plug-and-play indoor gateway. It connects to our Network Server over 4G, the SIM-card is already included. Therefore you just need to plug it in and place it somewhere in your building where 4G coverage is available. Usually one gateway covers multiple floors and only a few gateways are needed, even for a large office building.



### 3.3. Battery lifetime of the device

In the pre-defined mode descriptions (2.3), you will find battery lifetime indications based on the LoRaWAN Spreading Factor (SF). Spreading factors from SF7 to SF12 are available, where SF7 offers the best battery lifetime and SF12 the best sensitivity (distance and building penetration).

Multisense uses the LoRaWAN Adaptive Data Rate algorithm and automatically adapts the SF according to the network coverage. If you see SF7 values in your data, you have probably installed an indoor gateway or your device is placed close to an outdoor gateway. If you see values like SF11 or SF12, the device will still work, but the battery lifetime is impacted.

The decision to install an indoor gateway or not, will probably depend on the number of devices installed in a certain place. In a smart office context, hundreds or thousands of devices are installed in the same building. Installing an indoor gateway to get 10 years of battery life will be probably the most cost-effective option.

When only few sensors are installed in a building, it might be better to use a different method to fine-tune the battery life (e.g. sending data less frequently).

### 3.4. Field test device



To measure the coverage in the field before or during installation, this Field Test Device is available for purchase. It costs CHF 250.- including lifetime connectivity and can be ordered from [IoT.SPOC@swisscom.com](mailto:IoT.SPOC@swisscom.com).

## 4. The Management platform

**INFO:** Only valid for our offering including device management. For hardware-only see 7.2.

If you don't use Multisense on your existing Swisscom IoT Cloud platform, you have received a link to activate your account. Choose the correct timezone, which will define the time axis on your graphs! Then login on <https://www.iotcloud.swisscom.com>

The image shows two side-by-side screenshots from the management platform. The left screenshot is titled 'View password rules' and contains a form with fields for Password, Repeat password, First name, Last name, Company, Title, Office phone number, and Mobile phone number. A red box highlights a dropdown menu for 'Europe/Zurich' with a 'Submit' button below it. The right screenshot is titled 'Live updates for Things' and contains explanatory text about live updates, a note about API usage, a checked checkbox for 'Enable live update for things', a 'Frequency' dropdown menu set to '5 seconds', and an 'Update' button. A red arrow points from the 'Europe/Zurich' dropdown in the first screenshot to the 'Enable live update for things' checkbox in the second.

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If you want your things to be updated dynamically without reloading the page, click on "Enable live updates for things" and choose your frequency.

### 4.1. Things list

In Things > Table, you can get an overview of all your Multisense devices.

The image shows a screenshot of the 'Things' management interface. At the top, there is a navigation bar with 'swisscom', 'Dashboards', 'Things' (highlighted with a red box), 'Developer', and 'Help'. Below the navigation bar is a search bar and a 'Things' title. The main content area shows a table with 4 things found. A red arrow points to a gearwheel icon in the top left corner of the table. The table has columns for Name, Key, Def Name, and Last Seen. The data rows are:

Name	Key	Def Name	Last Seen
Multisense S002004	70b3d5ff9ebfab1	LPN Multisense	1 hour, 3 minutes ago
Multisense S002005	70b3d5ff9ebfab2	LPN Multisense	1 hour, 3 minutes ago
Multisense S002006	70b3d5ff9ebfab3	LPN Multisense	1 hour, 3 minutes ago
Settings	settings	Global Settings	1 hour, 3 minutes ago

With a click on the gearwheel icon, you can adapt the information on your dashboard.

### Customize Columns

Order	Name	Include
↑ ↓	Name	<input checked="" type="checkbox"/>
↑ ↓	Key	<input checked="" type="checkbox"/>
↑ ↓	Last seen	<input checked="" type="checkbox"/>
↑ ↓	Tags	<input checked="" type="checkbox"/>
↑ ↓	Alarms	<input checked="" type="checkbox"/>

By choosing Name, Key, Last seen, Tags and Alarms, you get the following view:

	Multisense S001003	70b3d5f5feb6b0bc	7 minutes ago	No changes pending   Nothing to push	lpr_multisense   temperature_humidity	<input checked="" type="checkbox"/>
	Multisense S001004	70b3d5f5feb6a3f	1 minute ago	Custom configuration active   Nothing to push	lpr_multisense	<input checked="" type="checkbox"/>

## 4.2. Thing overview

By clicking on the eye symbol in the list, you can navigate into each individual Multisense thing. Two alarm states are defined:

- Mode changes: Pending mode changes (requiring a device uplink message) will be shown
- External API Status: Problems with your API connection can be detected

### Multisense S001004

**Overview** | **Details** | LoRaWAN | Attributes | Methods | **Actions** ▼

**Id** See7564f77207964e46aa286

**Thing definition** LPN Multisense FW0.05

**Key** 70b3d5f5feb6a3f

**Last seen** 2 minutes ago

**Tags** lpr\_multisense

**Security Tags**

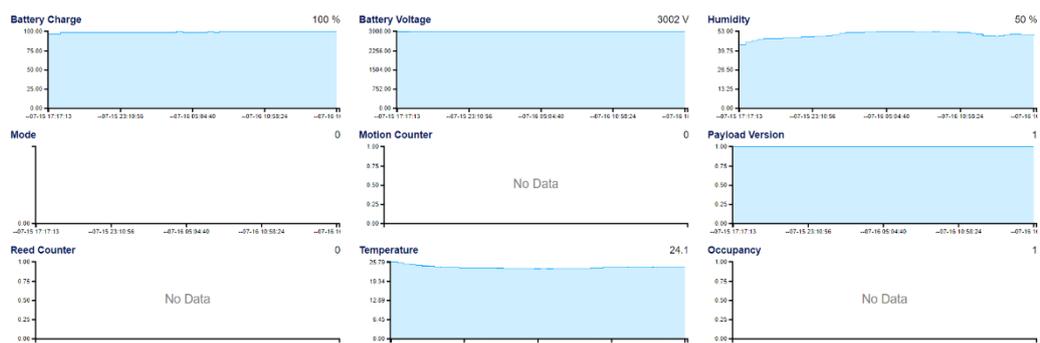
**Location** Müllerstrasse  
Zurich, Zurich 8021 CH (History)

**Identity** Unlocked

#### Alarms

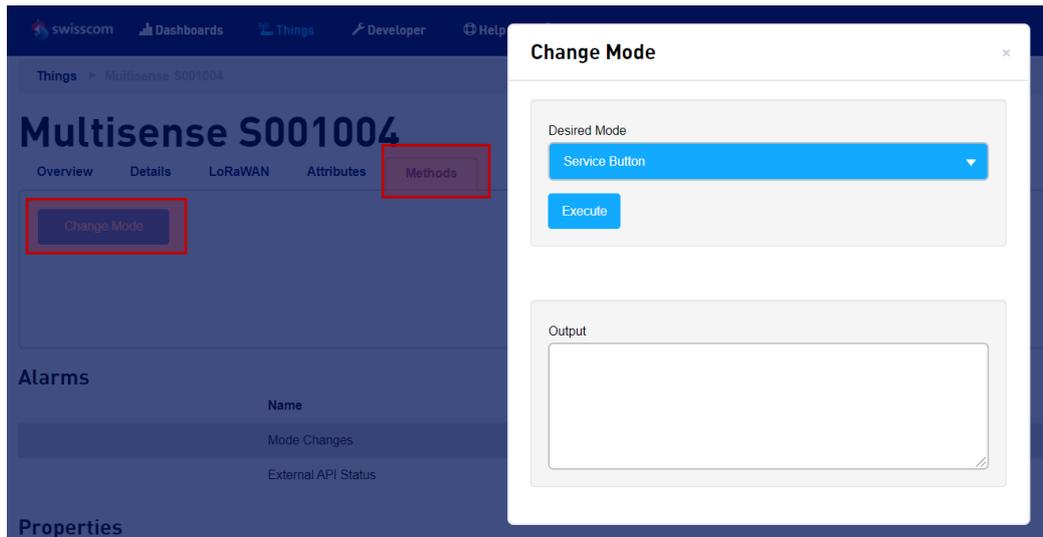
Name	State	Message	Timestamp
Mode Changes	Custom configuration active		2020-07-16 13:47:11 +0200
External API Status	Nothing to push		2020-07-16 16:52:09 +0200

All the thing properties will be listed below, depending on the mode, some of them will have no values. This data is retained for 14 days on your starter kit.



### 4.3. Changing the data mode

The mode of the device can be changed using the selection fields in the *Methods* tab. Click on the button *Change Mode*, select one of the 6 default modes and click *Execute*. The correct downlink command to your device is automatically arranged including your device PIN and queued to the LoRaWAN network server.



As long as the device sends no uplink, the alarm state *Mode Changes* remains on *Waiting for device uplink*. You can accelerate the mode change by triggering an uplink on the device (button press or restart, depending on the selected mode)

Name	State	Message	Timestamp
Mode Changes	Waiting for device uplink		2020-07-16 16:57:37 +0200
External API Status	Nothing to push		2020-07-16 16:57:09 +0200

You can even compute a custom mode from the downlink command manual (7.2) and your device's PIN code, and send it on *Port 100* in the tab *LoRaWAN > Send Downlink*. This custom configuration is described in 7.1

## 5. The REST API interface (towards application)

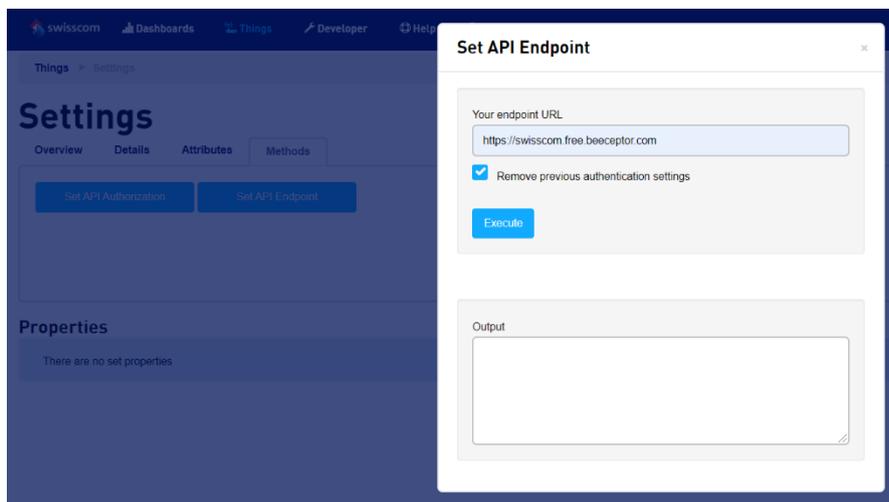
This section describes the standard API interface that is provided with the Multisense management portal for demo purposes. The method is REST API / HTTP POST with optional Basic Authentication. Other communication protocols (MQTT, direct connection to public clouds, etc...) are available on request.

An API call is triggered whenever a device reports an event.

### 5.1. Changing the endpoint URL

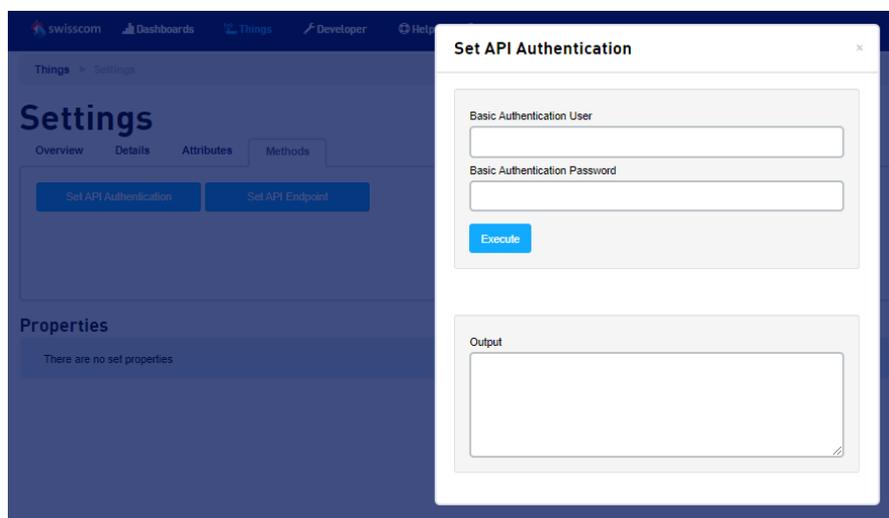
The URL where the data will be sent to, has been defined during the onboarding, and can be changed in the IoT Cloud portal, on the device called Settings:

Choose Methods > Set API Endpoint



By checking "Remove previous authentication settings", basic auth can be removed again.

It is recommended to set also an authentication in Settings > Methods > Set API Authentication:



## 5.2. Standard fields

The standard fields are always present in the HTML body, no matter the mode of the Multisense device. The following list provides an overview.

Key	Value
batteryLevel (value)	The approximate battery level estimation as a percentage, valid for a temperature range of 23°C +- 2°C. <a href="#">Example: 98.3</a>
dataMode (String)	Mode configured on the device. It can be one of the following values: <i>serviceButton</i> , <i>workplaceOccupancy</i> , <i>temperatureHumidity</i> , <i>reedCounter</i> , <i>vibrationCounter</i> , <i>reedTest</i> , <i>customMode</i> .
devEUI (String)	The unique EUI of the reporting device, used for LoRaWAN and present in the QR code on the back of the device. <a href="#">Example: 70b3d5fffeb6a3f</a>
eventType (String)	Reports the type of event which triggered the message on the device. It can be one of the following values: <i>buttonEvent</i> , <i>timedEvent</i> , <i>reedEvent</i> , <i>temperatureEvent</i> , <i>humidityEvent</i> , <i>motionEvent</i> , <i>lifeSignEvent</i> , <i>usageStart</i> , <i>inUse</i> , <i>usageEnd</i> .
lastUplinkTimestamp (String)	UTC Timestamp of the last device uplink. Corresponds to the timestamp of the reported event in most of the cases, except the workplace occupation timeout, which is triggered without any device message. <a href="#">Example: 2020-07-09T09:06:07.311Z</a>
payloadVersion (value)	Payload version of the device. Used for debugging. <a href="#">Example: 1</a>
serialNumber (String)	The unique serial number of the reporting device, as written on the back. <a href="#">Example: S001004</a>
signalRSSI (value)	LoRaWAN-related parameter, can be used to estimate the quality of the signal and approximate battery lifetime. <a href="#">Example: -110</a>
signalSNR (value)	LoRaWAN-related parameter, can be used to estimate the quality of the signal and approximate battery lifetime. <a href="#">Example: -7.2</a>
spreadingFactor (value)	LoRaWAN-related parameter, can be used to estimate the quality of the signal and approximate battery lifetime. <a href="#">Example: 9</a>

When implementing your application server, please mind that additional fields may always be added in future.

### 5.3. Mode-specific fields

Some modes set on the device trigger additional fields being added to the payload.

#### serviceButton

No mode-specific fields are added. Allowed event types are:

- buttonEvent
- lifeSignEvent

#### workplaceOccupancy

accelerometerThreshold (value)	The current accelerometer threshold setting on the device in mG. Used to assure the comparability of results. Example: 160
-----------------------------------	--

Allowed event types are:

- buttonEvent
- lifeSignEvent
- usageStart
- inUse
- usageEnd: This event type is triggered by a platform-timer and not by a device uplink. The lastUplinkTimestamp field differs from the actual event timestamp.

#### temperatureHumidity

humidity (value)	The relative humidity reported by the SHT31 sensor on the device. Example: 48.6
temperature (value)	The temperature reported by the SHT31 sensor on the device. Example: 24.3

Allowed event types are:

- timedEvent: In this mode, all uplinks are triggered by a regular timer.

#### reedCounter

reedCounterTotal (value)	The total value of the reed counter since the last reset. Example: 1834
reedCounterChange (value)	The change to the reed counter during the last transmission interval. If this value is 0, there was no reed activity recorded by the device during the last transmission interval. Example: 3
reedSettings (String)	The current reed trigger setting on the device One of the following values: <i>risingEdge</i> : Triggers on approaching magnet <i>fallingEdge</i> : Triggers on removing magnet

Allowed event types are:

- `timedEvent`: In this mode, all uplinks are triggered by a regular timer.

#### vibrationCounter

vibrationCounterTotal (value)	The number of times an acceleration above the threshold was detected, since the last reset. Example: 1834
vibrationCounterChange (value)	The change of arbitrary vibration counting units during the last transmission interval. Can be correlated to the amount of activity or magnitude of activity recorded by the device. If this value is 0, there was no vibration activity recorded by the device during the last transmission interval. Example: 3
accelerometerThreshold (value)	The current accelerometer threshold setting on the device in mG. Used to assure the comparability of results. Example: 160

Allowed event types are:

- `timedEvent`: In this mode, all uplinks are triggered by a regular timer.

#### reedTest

This mode should only be used for installation and testing of the device. It reports the additional fields of the `reedCounter` mode.

Allowed event types are:

- `lifeSignEvent`
- `reedEvent`
- `buttonEvent`

#### demoMode

This mode has most of the sensors enabled for demo purpose, but will report only the standard fields to the application server.

#### customMode

This mode is reported whenever a non-standard mode is set on the device. It doesn't report any additional fields by default. In the scope of a project, we can design any other reporting mode of course.

## 5.4. Examples

### serviceButton

Sample HTML body:

```
{
  "batteryLevel": 96,
  "dataMode": "serviceButton",
  "payloadVersion": 0,
  "devEUI": "70b3d5fffeb6a3f",
  "serialNumber": "S001004",
  "spreadingFactor": 12,
  "signalRSSI": -44,
  "signalSNR": 8.5,
  "eventType": "buttonEvent",
  "lastUplinkTimestamp": "2020-07-09T09:06:07.311Z"
}
```

### workplaceOccupancy

Sample HTML body:

```
{
  "batteryLevel": 96,
  "dataMode": "workplaceOccupancy",
  "payloadVersion": 0,
  "devEUI": "70b3d5fffeb6a3f",
  "serialNumber": "S001004",
  "spreadingFactor": 12,
  "signalRSSI": -48,
  "signalSNR": 7.5,
  "eventType": "usageStart",
  "lastUplinkTimestamp": "2020-07-09T09:15:53.89Z",
  "accelerometerThreshold": 112
}
```

### temperatureHumidity

Sample HTML body:

```
{
  "batteryLevel": 96,
  "dataMode": "temperatureHumidity",
  "payloadVersion": 0,
  "devEUI": "70b3d5ffffebf6a3f",
  "serialNumber": "S001004",
  "spreadingFactor": 7,
  "signalRSSI": -50,
  "signalSNR": 10,
  "eventType": "timedEvent",
  "lastUplinkTimestamp": "2020-07-09T09:20:10Z",
  "temperature": 25.44,
  "humidity": 53
}
```

### reedCounter

Sample HTML body:

```
{
  "batteryLevel": 93.6,
  "dataMode": "reedCounter",
  "payloadVersion": 0,
  "devEUI": "70b3d5ffffebf6a3f",
  "serialNumber": "S001004",
  "spreadingFactor": 12,
  "signalRSSI": -118,
  "signalSNR": -9.25,
  "eventType": "timedEvent",
  "lastUplinkTimestamp": "2020-07-09T09:48:41.896Z",
  "reedCounterTotal": 42,
  "reedCounterChange": 3,
  "reedSettings": "risingEdge"
}
```

## vibrationCounter

Sample HTML body:

```
{
  "batteryLevel": 88.8,
  "dataMode": "vibrationCounter",
  "payloadVersion": 0,
  "devEUI": "70b3d5ffffebf6a3f",
  "serialNumber": "S001004",
  "spreadingFactor": 7,
  "signalRSSI": -44,
  "signalSNR": 11.25,
  "eventType": "timedEvent",
  "lastUplinkTimestamp": "2020-07-09T09:59:23.047Z",
  "vibrationCounterTotal": 42,
  "vibrationCounterChange": 6,
  "accelerometerThreshold": 160
}
```

## 6. Configuration API (back from application)

All the actions on the previously described platform can also be performed with API calls. Here are some examples how to automate certain processes or fetch data, to be used as a backend for an end application for example.

### 6.1. API endpoint

The following requests will be sent to the endpoint: <https://api.iotcloud.swisscom.com/api>

### 6.2. Authentication

Request body (HTTP POST)

```
{
  "auth" : {
    "command" : "api.authenticate",
    "params" : {
      "username": "username@example.com",
      "password": "swordfish"
    }
  }
}
```

Response

```
{
  "auth" : {
    "success" : true,
    "params": {
      "orgKey": "YOURCOMPANY",
      "sessionId": "52e17675d15a7030f800000b"
    }
  }
}
```

The session ID is to be used in the following calls, either as a header parameter called "sessionId", or as a separate auth object as follows:

```
{
  "auth" : {
    "sessionId" : "52e17675d15a7030f800000b"
  },
  "1" : {
    "command" : "mycommand"
  }
}
```

## 6.3. Change mode

The mode of each device can be changed with the "method.exec" command.

**Hint:** You can send multiple commands in the same call by wrapping them as follows ("1", "2"...)

```
{
  "auth" : {
    "sessionId" : "5f50aef64e5637714e616731"
  },
  "1": {
    "command": "method.exec",
    "params": {
      "thingKey": "70b3d5fffeb6a3f",
      "method": "change_mode",
      "params": {
        "desired_mode": "mode_1"
      }
    }
  }
}
```

### Variable parameters

thingKey: Your device EUI, in lowercase letters

desired\_mode: One of the following values

- mode\_1 Service Button
- mode\_2 Workplace Occupancy
- mode\_3 Temperature and Humidity monitoring
- mode\_4 Reed Counter
- mode\_5 Vibration Counter
- mode\_91 Reed installation and test
- mode\_92 Demo mode (all sensors on)

### Response

```
{
  "1": {
    "success": true
  }
}
```

## 7. Advanced information

### 7.1. Custom configuration

The device can be set to any custom configuration using LoRaWAN Downlink commands on Port 100. The PIN-Code of each device is found in the device attributes.

The screenshot displays the Swisscom IoT platform interface for a device named 'Multisense S001003'. The 'LoRaWAN' tab is active, showing details such as Device EUI (70B3D5FFFE6B6B), Activation type (otaa), and Provider type (actility). A 'Send downlink' dialog is open, allowing configuration of a downlink command. The dialog includes a 'Payload format' dropdown set to 'Hex', a 'Payload' field containing the template '[PINCODE][CONFIGURATION]', a 'Target port' field set to '100', a 'Confirmable' dropdown set to 'False', a 'Serialize' dropdown set to 'Nothing selected', and a 'Validity' field. 'Send' and 'Cancel' buttons are at the bottom of the dialog. In the background, the 'Alarms' section is visible, showing a table with columns for Name and a list of alarm types: 'Mode Changes' and 'External API Status'. Below the alarms, a 'Properties' section shows a graph for 'Accelerometer X-Axis' with a value of -24 and a 'No Data' status.

In the alarms will be visible which devices have a non-standard configuration:

The screenshot shows two sections: 'Alarms' and 'Tags'. The 'Alarms' section has two entries, each with a blue 'Custom configuration active' button and a green 'Nothing to push' button. The 'Tags' section has two entries, each with a grey 'lpr\_multisense' button.

### 7.1.1 Detailed LED behavior

Red LED blinking profiles	Green LED blinking profiles	Meaning
	1 x 1 second pulse	Device in NORMAL mode (Device active)
ON forever		Startup test failed, ERROR HANDLER reached.
	1x 25 ms pulse every second	When LoRaWAN activity carried out and LED on TxRx option ON
	1x 300 ms pulse	LoRaWAN activity carried out successfully (Joining, Tx/Rx) and LED on TxRx option ON
1x 300 ms pulse		LoRaWAN activity failed (Joining, Tx/Rx) and LED on TxRx option ON
	2x 25 ms pulses	BUTTON action detected and BUTTON EVENT UL started.
2x 25 ms pulses		BUTTON action detected, but device is busy. BUTTON EVENT carried out as soon as possible.

## 7.2. Payload Structure for Hardware-only mode

You will need the following payload structure, if you purchase Mulsense without Data as a Service offering. In this case, you will need to write your own payload decoder.

Mulsense supports Uplinks and Downlinks in the following LoRaWAN ports:

- PORT 3: APP Uplink
- PORT 100: CFG Uplink/Downlink
- PORT 101: INFO Uplink/Downlink
- PORT 102: REMOTE REJOIN Downlink

All Uplinks include the same exact "header" (see first four bytes in orange in the definitions below).

**Firmware logics of mode 0 (OPEN SENSORS):** Basically, two things can be set: The uplink reason and the uplink data. Whenever an uplink is triggered due to the reasons set (motion, temperature alarm, etc...), an uplink will be sent containing the defined measurement data. This embedded logic allows for almost any use-case to be configured over the air.

## 7.2.1 Uplink Port 3 APP

The application data sent on LoRaWAN port 3 is structured as follows

Byte Nr	Function	Remarks
0	Payload Version	UINT8
1	Mode	UINT8 0 -> Normal Mode (OPEN SENSORS) 1 -> Workplace Detection Mode (RFU, max. 255)
2	Status (depends on MODE and Uplink type)	Mode 0: TIMED EVENT   BUTTON EVENT   REED EVENT   TEMP EVENT   HUM EVENT   MOTION EVENT   LIFE SIGN EVENT   0 TIMED EVENT: Event fired by measurement Interval BUTTON EVENT: Event fired by Button REED EVENT: Event fired by REED TEMP EVENT: Event fired by MIN/MAX TEMP thresholds HUM EVENT: Event fired by MIN/MAX HUM thresholds MOTION EVENT: Event fired by DELTA AXIS thresholds LIFE SIGN EVENT: Event fired only if no message has been sent in the last 24 hours Mode 1: USAGE START EVENT   USAGE CHECK EVENT   BUTTON EVENT   LIFE SIGN EVENT   0   0   0   0 USAGE START EVENT: Event fired when first motion was detected at workplace USAGE CHECK EVENT: Event fired by inactivity multiplier BUTTON EVENT: Event fired by Button LIFE SIGN EVENT: Event fired only if no message has been sent in the last 24 hours
3	Battery Voltage	UINT8 6mV steps, where 0 equals 2V or less. Max. Value @ 254 -> 3524mV. 0xFF if ERROR
4	Payload ID	UINT8, see chapter 5.1.1 for more details
5 - X	Payload DATA	See chapter 5.1.1 for more details
X+1 - Y	Payload ID	UINT8, see chapter 5.1.1 for more details
Y+1 - Z	Payload DATA	See chapter 5.1.1 for more details

## 7.2.2 Payload IDs

The payload ID defines length and type of data that is sent afterwards. Multiple data types can follow each other no matter the order, as described previously.

Payload ID (HEX)	Function	Structure	Size in Bytes w/ ID
01	Temperature	- 2 Bytes: INT16 MSB First, 0.01°C steps. 0x7FFF if ERROR.	3
02	Humidity	- 1 Byte: UINT8 (0 to 200), 0.5% steps. 0xFF if ERROR.	2
03	REED Counter	- 2 Bytes: UINT16 MSB First, single steps. Overflow @ 65535.	3
04	MOTION Counter	- 2 Bytes: UINT16 MSB First, single steps. Overflow @ 65535.	3
05	Accelerometer	- 2 Bytes: ACC X-Axis - 2 Bytes: ACC Y-Axis - 2 Bytes: ACC Z-Axis All ACC values are INT16 MSB First, 1 mg steps. 0x7FFF if ERROR.	7
06	Temperature History	- 2 Bytes: Temperature NOW - 2 Bytes: Temperature NOW – 1* Measurement Interval - 2 Bytes: Temperature NOW – 2* Measurement Interval - 2 Bytes: Temperature NOW – 3* Measurement Interval - 2 Bytes: Temperature NOW – 4* Measurement Interval - 2 Bytes: Temperature NOW – 5* Measurement Interval - 2 Bytes: Temperature NOW – 6* Measurement Interval - 2 Bytes: Temperature NOW – 7* Measurement Interval All Temperature values are INT16 MSB First, 0.01°C steps. 0x7FFF if ERROR, 0x7FFE if not used/empty. <i>* If History option activated, History ID is sent only on TIMED EVENTS</i>	17
07	Humidity History	- 1 Byte: Humidity NOW - 1 Byte: Humidity NOW – 1* Measurement Interval - 1 Byte: Humidity NOW – 2* Measurement Interval	9

		- 1 Byte: Humidity NOW – 3* Measurement Interval - 1 Byte: Humidity NOW – 4* Measurement Interval - 1 Byte: Humidity NOW – 5* Measurement Interval - 1 Byte: Humidity NOW – 6* Measurement Interval - 1 Byte: Humidity NOW – 7* Measurement Interval All Humidity values are UINT8 (0 to 200), 0.5% steps. 0xFF if ERROR, 0xFE if not used/empty. * If History option activated, History ID is sent only on TIMED EVENTS	
--	--	--	--

### 7.2.3 Uplink payload examples

UPLINK IDs ALL, NO HISTORY ACTIVE (RAW):

000080A701090B0250030005040103050000FFFAFC17

00: Payload Version

00: MODE 0

80: TIMED EVENT

A7: Battery Voltage:  $167 \rightarrow 2000\text{mV} + 167 * 6 \text{ mV} \rightarrow 3002 \text{ mV}$

01090B: Payload ID 01

Temperature:  $2315 \rightarrow 2315 * 0.01 \text{ }^\circ\text{C} \rightarrow 23.15 \text{ }^\circ\text{C}$

0250: Payload ID 02

Humidity:  $80 \rightarrow 80 * 0.5\% \rightarrow 40.0 \%$

030005: Payload ID 03

REED Counter  $\rightarrow 5$

040103: Payload ID 04

MOTION Counter  $\rightarrow 259$

050000FFFAFC17: Payload ID 05

ACC X-Axis  $\rightarrow 0 \text{ mg}$

ACC Y-Axis  $\rightarrow -6 \text{ mg}$

ACC Z-Axis  $\rightarrow -1001 \text{ mg}$

UPLINK IDs ALL, TEMP HISTORY ACTIVE (RAW):

000080A70250030005040103050000FFFAFC1706090B090B090B090B090B090B090B

00: Payload Version

00: MODE 0

80: TIMED EVENT

A7: Battery Voltage:  $167 \rightarrow 2000\text{mV} + 167 * 6 \text{ mV} \rightarrow 3002 \text{ mV}$

0250: Payload ID 02

Humidity:  $80 \rightarrow 80 * 0.5\% \rightarrow 40.0 \%$

030005: Payload ID 03

REED Counter  $\rightarrow 5$

040103: Payload ID 04

MOTION Counter  $\rightarrow 259$

050000FFFAFC17: Payload ID 05

ACC X-Axis  $\rightarrow 0 \text{ mg}$

ACC Y-Axis  $\rightarrow -6 \text{ mg}$

ACC Z-Axis  $\rightarrow -1001 \text{ mg}$

06090B090B090B090B090B090B090B090B: Payload ID 6

Temp NOW – 0:  $2315 \rightarrow 2315 * 0.01 \text{ }^\circ\text{C} \rightarrow 23.15 \text{ }^\circ\text{C}$  / Temp NOW – 1:  $2315 \rightarrow 2315 * 0.01 \text{ }^\circ\text{C} \rightarrow 23.15 \text{ }^\circ\text{C}$

Temp NOW – 2:  $2315 \rightarrow 2315 * 0.01 \text{ }^\circ\text{C} \rightarrow 23.15 \text{ }^\circ\text{C}$  / Temp NOW – 3:  $2315 \rightarrow 2315 * 0.01 \text{ }^\circ\text{C} \rightarrow 23.15 \text{ }^\circ\text{C}$

Temp NOW – 4:  $2315 \rightarrow 2315 * 0.01 \text{ }^\circ\text{C} \rightarrow 23.15 \text{ }^\circ\text{C}$  / Temp NOW – 5:  $2315 \rightarrow 2315 * 0.01 \text{ }^\circ\text{C} \rightarrow 23.15 \text{ }^\circ\text{C}$

Temp NOW – 6:  $2315 \rightarrow 2315 * 0.01 \text{ }^\circ\text{C} \rightarrow 23.15 \text{ }^\circ\text{C}$  / Temp NOW – 7:  $2315 \rightarrow 2315 * 0.01 \text{ }^\circ\text{C} \rightarrow 23.15 \text{ }^\circ$

UPLINK IDs ALL, HUM HISTORY ACTIVE (RAW):

000080A701090B030005040103050000FFFAFC17075050505050505050

00: Payload Version

00: MODE 0

80: TIMED EVENT

A7: Battery Voltage:  $167 \rightarrow 2000\text{mV} + 167 * 6 \text{ mV} \rightarrow 3002 \text{ mV}$

01090B: Payload ID 01

Temperature:  $2315 \rightarrow 2315 * 0.01 \text{ }^\circ\text{C} \rightarrow 23.15 \text{ }^\circ\text{C}$

030005: Payload ID 03

REED Counter  $\rightarrow 5$

040103: Payload ID 04

MOTION Counter  $\rightarrow 259$

050000FFFAFC17: Payload ID 05

ACC X-Axis  $\rightarrow 0 \text{ mg}$

ACC Y-Axis  $\rightarrow -6 \text{ mg}$

ACC Z-Axis  $\rightarrow -1001 \text{ mg}$

07505050505050505050: Payload ID 07

Humidity NOW – 0:  $80 \rightarrow 80 * 0.5\% \rightarrow 40.0 \%$  / Humidity NOW – 1:  $80 \rightarrow 80 * 0.5\% \rightarrow 40.0 \%$

Humidity NOW – 2:  $80 \rightarrow 80 * 0.5\% \rightarrow 40.0 \%$  / Humidity NOW – 3:  $80 \rightarrow 80 * 0.5\% \rightarrow 40.0 \%$

Humidity NOW – 4:  $80 \rightarrow 80 * 0.5\% \rightarrow 40.0 \%$  / Humidity NOW – 5:  $80 \rightarrow 80 * 0.5\% \rightarrow 40.0 \%$

Humidity NOW – 6:  $80 \rightarrow 80 * 0.5\% \rightarrow 40.0 \%$  / Humidity NOW – 7:  $80 \rightarrow 80 * 0.5\% \rightarrow 40.0 \%$

UPLINK IDs ALL, TEMP/HUM HISTORY ACTIVE (RAW):  
000080A7030005040103050000FFFAFC1706090B090B090B090B090B090B090B090B075050505  
050505050  
00: Payload Version  
00: MODE 0  
80: TIMED EVENT  
A7: Battery Voltage: 167 -> 2000mV + 167 \* 6 mV -> 3002 mV  
030005: Payload ID 03  
REED Counter -> 5  
040103: Payload ID 04  
MOTION Counter -> 259  
050000FFFAFC17: Payload ID 05  
ACC X-Axis -> 0 mg  
ACC Y-Axis -> -6 mg  
ACC Z-Axis -> -1001 mg  
06090B090B090B090B090B090B090B: Payload ID 6  
Temp NOW – 0: 2315 -> 2315 \* 0.01 °C -> 23.15 °C / Temp NOW – 1: 2315 -> 2315 \* 0.01 °C ->  
23.15 °C  
Temp NOW – 2: 2315 -> 2315 \* 0.01 °C -> 23.15 °C / Temp NOW – 3: 2315 -> 2315 \* 0.01 °C ->  
23.15 °C  
Temp NOW – 4: 2315 -> 2315 \* 0.01 °C -> 23.15 °C / Temp NOW – 5: 2315 -> 2315 \* 0.01 °C ->  
23.15 °C  
Temp NOW – 6: 2315 -> 2315 \* 0.01 °C -> 23.15 °C / Temp NOW – 7: 2315 -> 2315 \* 0.01 °C ->  
23.15 °C  
075050505050505050: Payload ID 07  
Humidity NOW – 0: 80 -> 80 \* 0.5% -> 40.0 % / Humidity NOW – 1: 80 -> 80 \* 0.5% -> 40.0 %  
Humidity NOW – 2: 80 -> 80 \* 0.5% -> 40.0 % / Humidity NOW – 3: 80 -> 80 \* 0.5% -> 40.0 %  
Humidity NOW – 4: 80 -> 80 \* 0.5% -> 40.0 % / Humidity NOW – 5: 80 -> 80 \* 0.5% -> 40.0 %  
Humidity NOW – 6: 80 -> 80 \* 0.5% -> 40.0 % / Humidity NOW – 7: 80 -> 80 \* 0.5% -> 40.0 %

UPLINK IDs 01, 04 (RAW): 000020A701090B040103  
00: Payload Version  
00: MODE 0  
20: REED EVENT  
A7: Battery Voltage: 167 -> 2000mV + 167 \* 6 mV -> 3002 mV  
01090B: Payload ID 01  
Temperature: 2315 -> 2315 \* 0.01 °C -> 23.15 °C  
040103: Payload ID 04  
MOTION Counter -> 259

UPLINK IDs NONE (EVENT ONLY) (RAW): 000040A7

00: Payload Version

00: MODE 0

40: BUTTON EVENT

A7: Battery Voltage: 167 -> 2000mV + 167 \* 6 mV -> 3002 mV

## 7.2.4 Uplink Port 100 active configuration

This message is usually sent after a join or mode change, to report the currently configured parameters.

Byte Nr	Function	Remarks
0	Payload Version	UINT8
1	Mode	UINT8 0 -> Normal Mode (OPEN SENSORS) 1 -> Workplace Detection Mode (RFU, max. 255)
2	Status (depends on MODE and Uplink type)	DEFAULT: STARTUP EVENT   GET EVENT   SET EVENT   0   0   0   0   0 STARTUP EVENT: CFG sent at startup (mode switches are also taken as startup into account) GET EVENT: CFG sent as a response of a GET CFG request SET EVENT: CFG sent as a response of a SET CFG request
3	Battery Voltage	UINT8 6mV steps, where 0 equals 2V or less. Max. Value @ 254 -> 3524mV. 0xFF if ERROR
4-7	DEV CFG LoRa	BYTE 4: Bit 7: CONFIRMED/UNCONFIRMED (1 for confirmed, 0 for unconfirmed uplinks, not valid for TIMED EVENTS, TIMED EVENTS are always sent unconfirmed) Bits 6-4: CONFIRMED Tries (0 to 7, where 0 equals 1 try, 1 equals 2 tries and so on, max. Tries 8) Bit 3: ADR ON/OFF (1 for ON, 0 for off) Bits 2-0: Datarate when ADR OFF (0 to 5, where 0 equals SF12, 1 equals SF11 and so on, max. Datarate SF7) BYTES 5-6: Bit 15: LEDOnTxRx (1 LEDs are used to signalize ongoing and finished TXRX, 0 LEDs not used for TXRX signalization) Bit 14: RFU

		Bits 13-0: Rejoining Trigger, number of uplinks needed to fire a rejoin on next uplink. 0 for no automatic Rejoin function, max. 16384 (14 bits, MSB first) BYTE 7: Bits 7-2: RFU Bits 1-0: RF POWER LEVEL (1 to 3, where 1 equals LOW POWER, 2 equals MEDIUM POWER and 3 equals HIGH POWER)
8	MODE SELECTOR	UINT8, see chapter 5.2.1 for more details
9-X	DOWNLINK MODE	See chapter 5.2.1 for more details

## 7.2.5 Downlink MODEs

The available modes for configuration are described here. For the according downlink message, check chapter 7.2.7

DOWNLINK MODE (HEX)	Function	Structure	Size in Bytes w/ MODE
00	Normal Mode (OPEN SENSORS)	- 2 Bytes: Measurement Interval (UINT16) Measurement Interval in minutes (0 for no interval) - 1 Byte: TX/RX Trigger (UINT8) Multiple of measurement interval on which a TIMED EVENT uplink will be fired (0 for no TIMED EVENT uplink) - 1 Byte: ACTIVE SENSORS Bit 7: BUTTON ON/OFF (1 if ON [which also turns on its event], 0 if OFF) Bit 6: REED ON/OFF (1 for ON, 0 for OFF) Bit 5: TEMPERATURE ON/OFF (1 for ON, 0 for OFF) Bit 4: HUMIDITY ON/OFF (1 for ON, 0 for OFF) Bit 3: MOTION ON/OFF (1 for ON, 0 for OFF) Bits 2-0: RFU - 1 Byte: REED Options Bit 7: REED DETECTION RISING/FALLING (1 for RISING, 0 for FALLING) Bit 6: REED EVENT ON/OFF (1 for ON, 0 for OFF) Bit 5: REED COUNTER ON/OFF (1 for ON, 0 for OFF) Bits 4-0: REED Debounce time (0 to 31, in 100ms steps) - 2 Bytes: TEMPERATURE Options	14

		<p>MSB Byte: (INT8) TEMP HIGH EVENT Threshold in °C, where 0x7F means OFF</p> <p>LSB Byte: (INT8) TEMP LOW EVENT Threshold in °C, where 0x7F means OFF</p> <p>- 2 Bytes: HUMIDITY Options</p> <p>MSB Byte: (UINT8) HUM HIGH EVENT Threshold in %, max. Value 99%, min. Value 1%. Any value outside range means OFF.</p> <p>LSB Byte: HUM LOW EVENT Threshold in %, max. Value 99%, min. Value 1%. Any value outside range means OFF.</p> <p>- 1 Byte: TEMPERATURE/HUMIDITY History Options</p> <p>Bits 2-7: RFU</p> <p>Bit 1: HUMIDITY History ON/OFF</p> <p>Bit 0: TEMPERATURE History ON/OFF</p> <p>- 3 Bytes: MOTION Options</p> <p>MSB Byte: (UINT8) MOTION Threshold in 16 mg steps, max. Value 2000 mg (125), 0 for OFF.</p> <p>NEXT Byte:</p> <p>Bit 7: MOTION EVENT ON/OFF</p> <p>Bit 6: MOTION TX RAW ON/OFF</p> <p>Bit 5E: MOTION COUNTER ON/OFF</p> <p>Bit 4: RFU</p> <p>Bits 3-0: DELTA X AXIS EVENT Threshold in 100mg steps, 0 for OFF</p> <p>LSB Byte:</p> <p>Bits 7-4: DELTA Y AXIS EVENT Threshold in 100mg steps, 0 for OFF</p> <p>Bits 3-0: DELTA Z AXIS EVENT Threshold in 100mg steps, 0 for OFF</p>	
01	Workplace Detection Mode	<p>- 2 Bytes: Measurement Interval (UINT16) Measurement Interval in minutes (0 for no interval), acts also as USAGE START EVENT trigger when needed.</p> <p>- 1 Byte: Motion Check Multiplier (UINT8) Multiple of measurement interval on which a USAGE CHECK EVENT is carried out when needed.</p> <p>- 1 Byte: MOTION Options (UINT8) MOTION Threshold in 16 mg steps, max. Value 2000 mg (125), 0 for OFF.</p>	5

## 7.2.6 Uplink Port 100 active configuration examples

UPLINK CFG MODE 0 (RAW): 000080A70827100300000F01F8A17F7FFFFF00066000

00: Payload Version

00: MODE 0

80: STARTUP EVENT

A7: Battery Voltage: 167 -> 2000mV + 167 \* 6 mV -> 3002 mV

082710: LoRa CFG

UNCONFIRMED Uplinks, CONFIRMED Tries 1 (DON'T CARE), ADR ON, default DR 0 (SF12, DON'T CARE)

03: TX Power level HIGH

Rejoining Trigger -> 10000 counts

00000F01F8A17F7FFFFF00066000: Mode Selector 00 -> MODE 0

Measurement Interval -> 15 minutes

TX/RX Trigger -> 1

ACTIVE SENSORS -> BUTTON ON, REED ON, TEMP ON, HUM ON, MOTION ON

REED Options -> Detection RISING, REED Event OFF, REED Counter ON, REED Debounce 100ms

TEMPERATURE Options -> TEMP HIGH Thres -> 127 -> OFF, TEMP LOW Thres -> 127 -> OFF

HUMIDITY Options -> HUM HIGH Thres -> 255 -> OFF, HUM LOW Thres -> 255 -> OFF

TEMPERATURE/HUMIDITY History Options -> TEMP History OFF, HUM History OFF

MOTION Options -> MOTION Thres -> 6 -> 6 \* 16 mg -> 96mg

MOTION Options -> MOTION Event OFF, MOTION TX RAW ON, MOTION COUNTER ON

MOTION Options [DON'T CARE, OFF] -> DELTA X AXIS OFF, DELTA Y AXIS OFF, DELTA Z AXIS OFF

UPLINK CFG MODE 0, BUTTON ONLY (RAW):

000080A7082710030000000080A17F7FFFFF00066000

00: Payload Version

00: MODE 0

80: STARTUP EVENT

A7: Battery Voltage: 167 -> 2000mV + 167 \* 6 mV -> 3002 mV

082710: LoRa CFG

UNCONFIRMED Uplinks, CONFIRMED Tries 1 (DON'T CARE), ADR ON, default DR 0 (SF12, DON'T CARE)

03: TX Power level HIGH

Rejoining Trigger -> 10000 counts

00000F01A1FFFFF0066000: Mode Selector 00 -> MODE 0

Measurement Interval -> 0 minutes, no interval

TX/RX Trigger -> 0, no TIMED EVENT

ACTIVE SENSORS -> BUTTON ON, REED OFF, TEMP OFF, HUM OFF, MOTION OFF

REED Options [DON'T CARE, OFF] -> Detection RISING, REED Event OFF, REED Counter ON, REED Debounce 100ms

TEMPERATURE Options [DON'T CARE, OFF] -> TEMP HIGH Thres -> 127 -> OFF, TEMP LOW Thres -> 127 -> OFF

HUMIDITY Options [DON'T CARE, OFF] -> HUM HIGH Thres -> 255 -> OFF, HUM LOW Thres -> 255 -> OFF

TEMPERATURE/HUMIDITY History Options [DON'T CARE, OFF] -> TEMP History OFF, HUM History OFF

MOTION Options [DON'T CARE, OFF] -> MOTION Thres -> 6 -> 6 \* 16 mg -> 96mg

MOTION Options [DON'T CARE, OFF] -> MOTION Event OFF, MOTION TX RAW ON, MOTION COUNTER ON

MOTION Options [DON'T CARE, OFF] -> DELTA X AXIS OFF, DELTA Y AXIS OFF, DELTA Z AXIS OFF

UPLINK CFG MODE 1 (RAW): 000180A70827100301000A0C06

00: Payload Version

01: MODE 1

80: STARTUP EVENT

A7: Battery Voltage: 167 -> 2000mV + 167 \* 6 mV -> 3002 mV

082710: LoRa CFG

UNCONFIRMED Uplinks, CONFIRMED Tries 1 (DON'T CARE), ADR ON, default DR 0 (SF12, DON'T CARE)

03: TX Power level HIGH

Rejoining Trigger -> 10000 counts

01000A0C06: Mode Selector 01 -> MODE 1

Measurement Interval -> 10 minutes

Motion Check Multiplier -> 12 -> 12 \* 10 minutes -> 120 minutes

MOTION Options -> MOTION Thres -> 6 -> 6 \* 16 mg -> 96mg

## 7.2.7 Downlink Port 100 Config

This message structure will be used to configure the device, based on the downlink modes described in 7.2.5. Two different payload structures are supported depending on the PL size. If payload size > 1, then the downlink sent must have a SET CFG structure. Whereas if the payload size = 1, then the downlink sent must have a GET CFG structure.

### SET CFG STRUCTURE

Byte Nr	Function	Remarks
0-3	DEV PIN CODE	First 2 and last 2 bytes of device's AppKEY
4-6	DEV CFG LoRa	BYTE 4: Bit 7: CONFIRMED/UNCONFIRMED (1 for confirmed, 0 for unconfirmed uplinks, not valid for TIMED EVENTS, TIMED EVENTS are always sent unconfirmed) Bits 6-4: CONFIRMED Tries (0 to 7, where 0 equals 1 try, 1 equals 2 tries and so on, max. Tries 8) Bit 3: ADR ON/OFF (1 for ON, 0 for off) Bits 2-0: Datarate when ADR OFF (0 to 5, where 0 equals SF12, 1 equals SF11 and so on, max. Datarate SF7) BYTES 5-6: Bit 15: LEDOnTxRx (1 LEDs are used to signalize ongoing and finished TXRX, 0 LEDs not used for TXRX signalization) Bit 14: RFU Bits 13-0: Rejoining Trigger, number of uplinks needed to fire a rejoin on next uplink. 0 for no automatic Rejoin function, max. 16384 (14 bits, MSB first) BYTE 7: Bits 7-2: RFU Bits 1-0: RF POWER LEVEL (1 to 3, where 1 equals LOW POWER, 2 equals MEDIUM POWER and 3 equals HIGH POWER)
8	MODE SELECTOR	UINT8, see chapter 5.2.1 for more details
9-X	DOWNLINK MODE	See chapter 5.2.1 for more details

Note that changes in the settings will not take effect until the next uplink (due to Class A, RX only after TX).

### GET CFG STRUCTURE

Byte Nr	Function	Remarks
0	GET CFG	VALUE MUST BE TRUE -> any value != 0x00

Note that changes in the settings will not take effect until the next uplink (due to Class A, RX only after TX).

## 7.2.8 Downlink Port 100 configuration examples

SET CFG MODE 0 (RAW): 0A3412FE0827100300000F01F8A17F7FFFFF00066000

0A3412FE: DEV Pin Code -> must match internal device pin code (First 2 and last 2 bytes of appKEY)

082710: LoRa CFG

UNCONFIRMED Uplinks, CONFIRMED Tries 1 (DON'T CARE), ADR ON, default DR 0 (SF12, DON'T CARE)

03: TX Power level HIGH

Rejoining Trigger -> 10000 counts

00000F01F8A17F7FFFFF00066000: Mode Selector 00 -> MODE 0

Measurement Interval -> 15 minutes

TX/RX Trigger -> 1

ACTIVE SENSORS -> BUTTON ON, REED ON, TEMP ON, HUM ON, MOTION ON

REED Options -> Detection RISING, REED Event OFF, REED Counter ON, REED Debounce 100ms

TEMPERATURE Options -> TEMP HIGH Thres -> 127 -> OFF, TEMP LOW Thres -> 127 -> OFF

HUMIDITY Options -> HUM HIGH Thres -> 255 -> OFF, HUM LOW Thres -> 255 -> OFF

TEMPERATURE/HUMIDITY History Options -> TEMP History OFF, HUM History OFF

MOTION Options -> MOTION Thres -> 6 -> 6 \* 16 mg -> 96mg

MOTION Options -> MOTION Event OFF, MOTION TX RAW ON, MOTION COUNTER ON

MOTION Options [DON'T CARE, OFF] -> DELTA X AXIS OFF, DELTA Y AXIS OFF, DELTA Z AXIS OFF

SET CFG MODE 1 (RAW): 0A3412FE0827100301000A0C06

0A3412FE: DEV Pin Code -> must match internal device pin code

082710: LoRa CFG

UNCONFIRMED Uplinks, CONFIRMED Tries 1 (DON'T CARE), ADR ON, default DR 0 (SF12, DON'T CARE)

03: TX Power level HIGH

Rejoining Trigger -> 10000 counts

01000A0C06: Mode Selector 01 -> MODE 1

Measurement Interval -> 10 minutes

Motion Check Multiplier -> 12 -> 12 \* 10 minutes -> 120 minutes

MOTION Options -> MOTION Thres -> 6 -> 6 \* 16 mg -> 96mg

GET CFG (RAW): 01

01: Get CFG TRUE

## 7.2.9 Uplink Port 101 INFO

Getting the device info is useful to calculate a correct, temperature compensated battery level.

Byte Nr	Function	Remarks
0	Payload Version	UINT8
1	Mode	UINT8 0 -> Normal Mode (OPEN SENSORS) 1 -> Workplace Detection Mode (RFU, max. 255)
2	Status (depends on MODE and Uplink type)	DEFAULT: STARTUP EVENT   GET EVENT   0   0   0   0   0   0   0 STARTUP EVENT: INFO sent at device startup GET EVENT: INFO sent as a response of a GET INFO request
3	Battery Voltage	UINT8 6mV steps, where 0 equals 2V or less. Max. Value @ 254 -> 3524mV. 0xFF if ERROR Example:
4	APP Main Version	UINT8
5	APP Minor Version	UINT8
6-7	Temperature	INT16 MSB First, 0.01°C steps. 0x7FFF if ERROR.

## 7.2.10 Uplink Port 101 INFO examples

Device INFO (RAW): 000040A70000090B

00: Payload Version

00: MODE 0

40: GET EVENT

A7: Battery Voltage: 167 -> 2000mV + 167 \* 6 mV -> 3002 mV

00: APP Main Version 00

00: APP Minor Version 00

090B: Temperature: 2315 -> 2315 \* 0.01 °C -> 23.15 °C

## 7.2.11 Downlink Port 101 INFO

Byte Nr	Function	Remarks
0	GET DEVICE INFO	VALUE MUST BE TRUE -> any value != 0x00

Note that changes in the settings will not take effect until the next uplink (due to Class A, RX only after TX).

## 7.2.12 Downlink Port 101 INFO examples

Get Device INFO (RAW): 01

01: GET DEVICE INFO TRUE

### 7.2.13 Downlink Port 102 remote rejoin

Some special cases (account migration, debugging, device re-location with ADR on) might require your device to restart and rejoin.

Byte Nr	Function	Remarks
0	REJOIN SET	VALUE MUST BE TRUE -> any value != 0x00

Note that changes in the settings will not take effect until the next uplink (due to Class A, RX only after TX).

### 7.2.14 Downlink Port 102 example

REMOTE REJOIN (RAW): 01

01: REJOIN SET TRUE



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