YOSENSI.IO

# YO 360

User guide v1.0

# Release notes

| Released | Version | Key changes |
|---|---|---|
| 25.08.2022 | 1.0 | Initial release. |

# Content

# Product description

## Overview

YO 360 measures temperature and humidity and sends information about its own position on the x, y and z axes (built-in accelerometer). Its small size, battery power supply and long data transmission range allow the device to be used in virtually any place. Depending on the selected option, the enclosure is suitable for indoor and outdoor use.

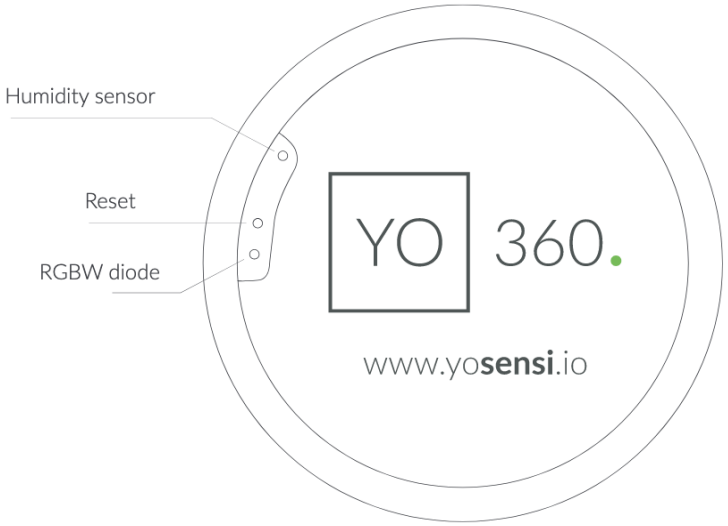


*Figure 1 Device top view.*

Device sticker placed on the bottom of the device enclosure contains information about model, version, LoRaWAN region and 3 parameters important in case of device identification and configuration:

- DEV EUI: unique device identifier required to connect via OTAA activation type to LoRaWAN.
- DEV ADDR: address required to connect via ABP activation type to LoRaWAN.
- BLE MAC: bluetooth physical address.


*Figure 2 Device sticker.*

## Physical interfaces

### LEDs

YO 360 communicates its current behaviour to the user by RGBW LED placed on the top.

DIODE STATUES INTERPRETATION

| BEHAVIOUR | COLOUR | DEVICE STATUS |
|---|---|---|
| Single flash | Green | **General:** device is working correctly (power and memory). |
| Single flash | Red | **General:** device is working incorrectly (power and memory). **LoRaWAN communication:** failed to receive an acknowledgement from LoRaWAN Server within specified timeout. |
| Single flash | White | **LoRaWAN communication:** LoRaWAN frame sent \ confirmation from LoRaWAN Server after receiving the frame. |
| Slow flashing | Blue | **BLE communication:** connection to the device via BLE (configuration). |
| Rapid flashing | Blue | **LoRaWAN communication:** connecting to LoRaWAN network. |

### Buttons

YO 360 is equipped with one reset button inside the device on the PCB board next to the RGBW LED diode. It is shown on figure number 1 it is possible to press it with a thin stick.

# Specifications

## Physical

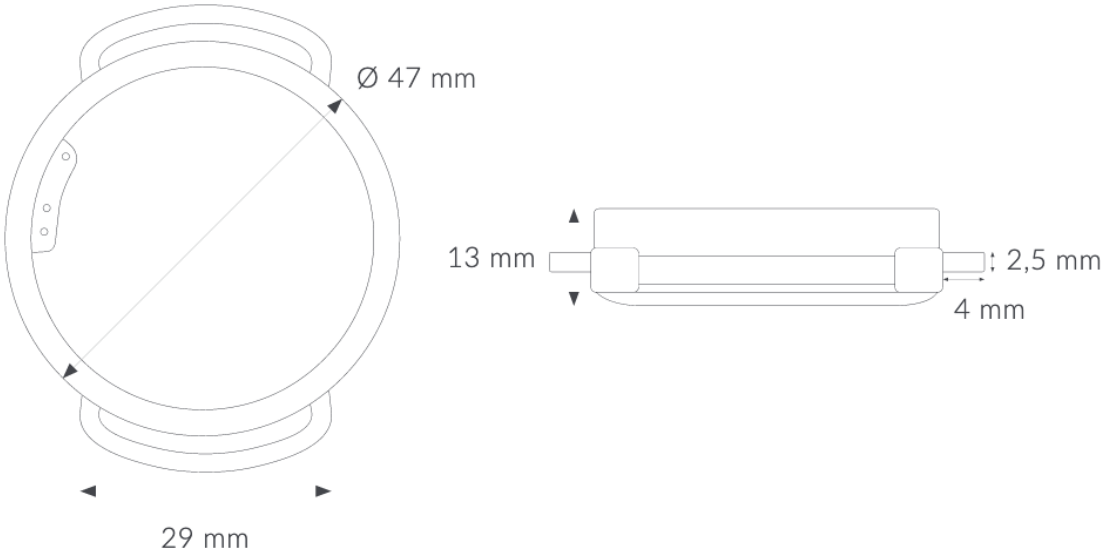


*Figure 3 Dimensions of the device.*

| PHYSICAL SPECIFICATION | |
|---|---|
| Dimensions | Diameter: 47mm<br>Height: 13mm |
| Colour | Light grey<br>Black |
| Mounting method | Chose from:<br>• No handles<br>• One handle (mounting hole)<br>• Two oval handles<br>• Strap |
| Enclosure material | ABS |
| Level of protection | IP40<br>IP67 - sealed with epoxy ring |
| Weight | 18,6 g |

## Operating conditions

| OPERATING CONDITIONS | |
|---|---|
| Temperature | 0° to 70°C |
| Humidity | 0 to 90% |
| Placement | Indoor use |

| | |
|---|---|
| Power supply | Battery CR2450 3 V |
| Power consumption | Maximum: 110 mA DC (3 V DC) |

## Measured values

### MEASUREMENT RANGES

| Parameter | Measuring range | Accuracy |
|---|---|---|
| Temperature (internal) | -40°C to 125°C | ±0,2°C (from 5°C to 60°C ) |
| Relative humidity | 0% to 100% | ±2% (at 20% to 80% ) |
| Accelerometer | ±180 ° on X, Y, Z axes | ±0,1° (from -40°C to 85°C) |

### Internal Temperature and relative internal humidity

Temperature and relative humidity are measured by sensors placed inside the device enclosure. These measurements can be used to monitor if the device is working in recommended conditions.

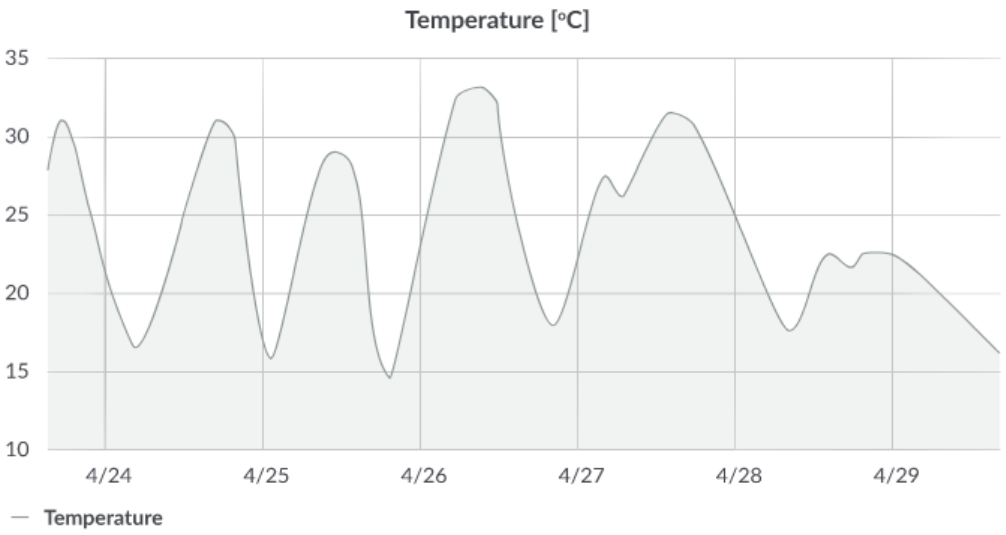


*Figure 4 Exemplary internal temperature monitoring chart.*

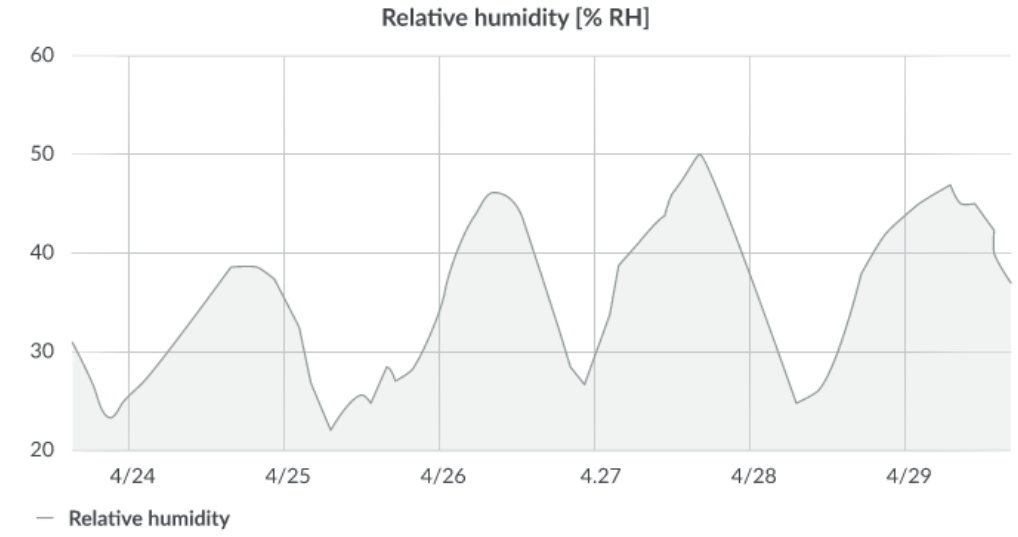


*Figure 5 Exemplary relative humidity monitoring chart.*

## Accelerometer

The accelerometer sensor is providing position of a device in X, Y, Z axes and stores data about what time it was moved to another location. Accelerometer informs in which position measurements of temperature and humidity were done.

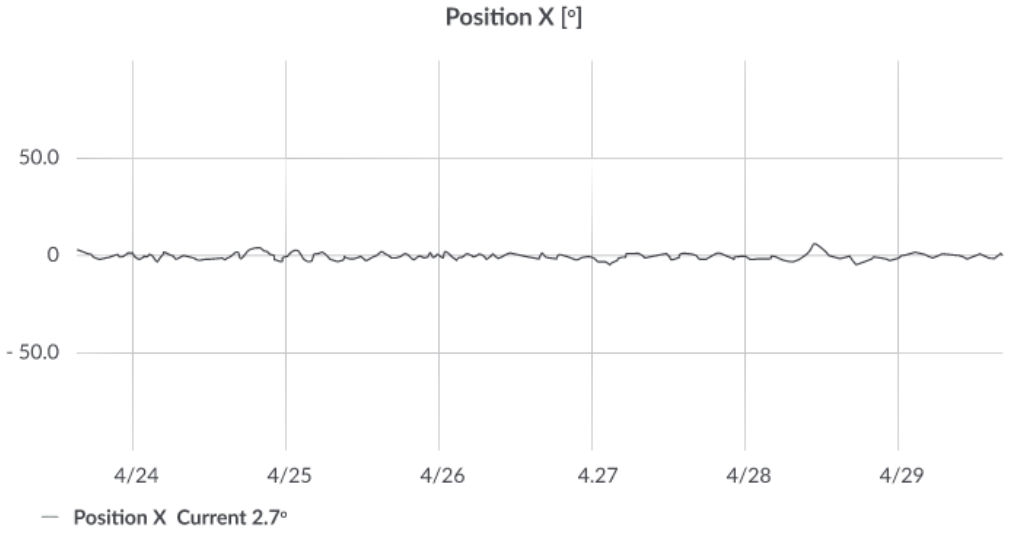


*Figure 6 Exemplary accelerometer monitoring chart position X.*

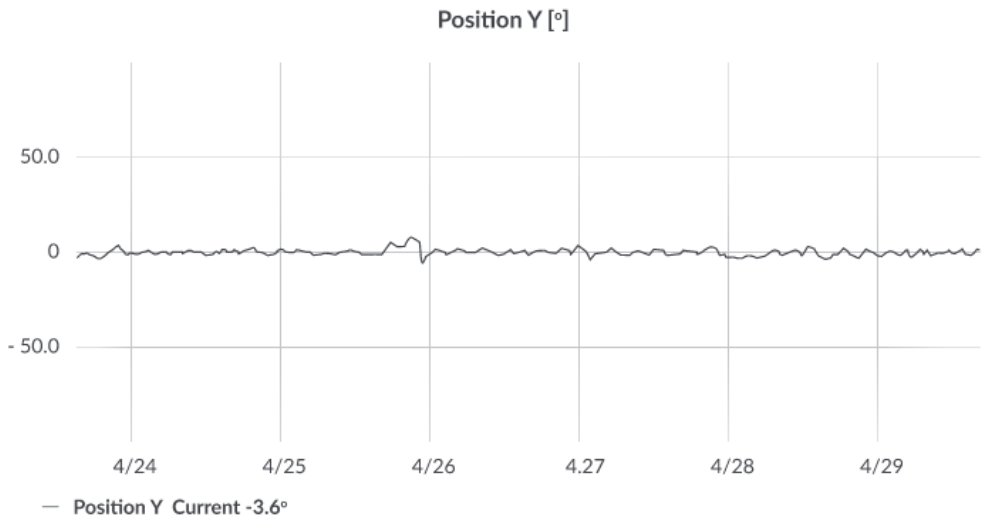


*Figure 7Exemplary accelerometer monitoring exemplary chart position Y.*

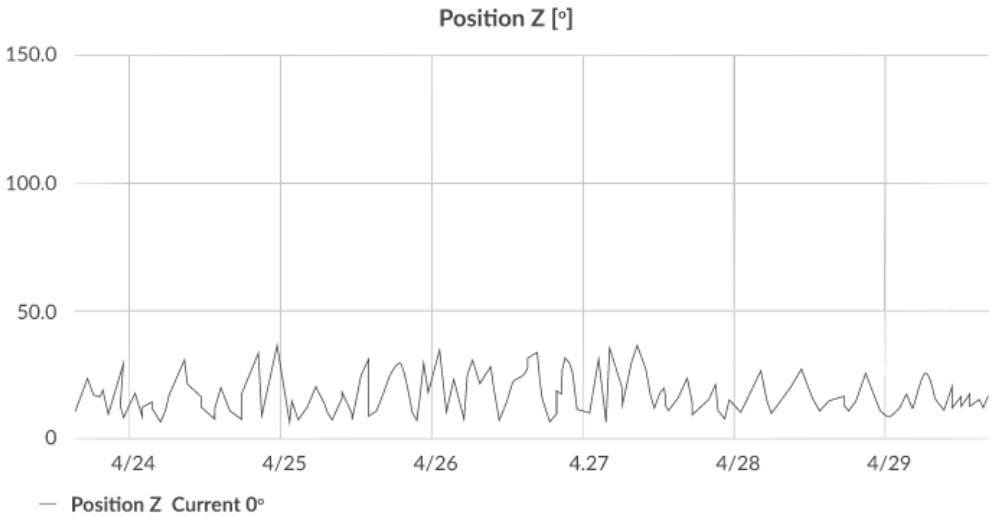


*Figure 8 Accelerometer monitoring exemplary chart position Z.*

## Battery condition

Battery voltage is used to monitor its condition – to spot anomalies (like sudden drop) or its current condition based on voltage drop over time in comparison to initial voltage rating.

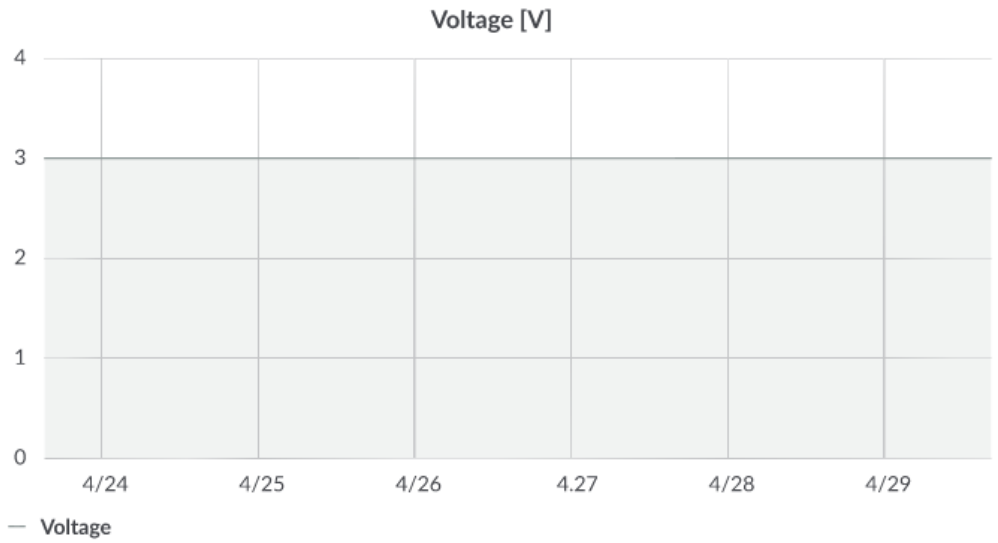


*Figure 9 Battery voltage exemplary chart.*

# Installation

## Package contents

1. Device (without batteries).
2. Warranty card.

## Safety precautions

SAFETY PRECAUTIONS

| SYMBOL | DESCRIPTION |
|---|---|
|  | Device is marked with a symbol saying that electrical and electronic products may not be mixed with unsorted household waste. Remember that batteries used to power the device must be treated at a specialized treatment facility. |
|  | Remember about possible electrostatic discharge when replacing battery, connecting input or doing some other operations near inside electronics. |
|  | Be careful while handling the device – dropping it may cause damage that will affect the sensors and other electronics inside. |
|  | When installing the device on the wall remember to wear adequate protective equipment. |
|  | To maintain the level of protection device cover screws must be properly tightened. Device shouldn't be used without cover. |
|  | Any actions inside the device's enclosure (excluding replacing batteries) must be performed by trained personnel only. |
|  | Clean the device only with damp cloth. |
|  | Device is intended for outdoor and indoor use. Make sure that device is not exposed for long term UV rays and in an environment in the immediate vicinity of water which may flood the device |

## Installation guide

1. Unscrew the device: remove 4 screws from the enclosure.

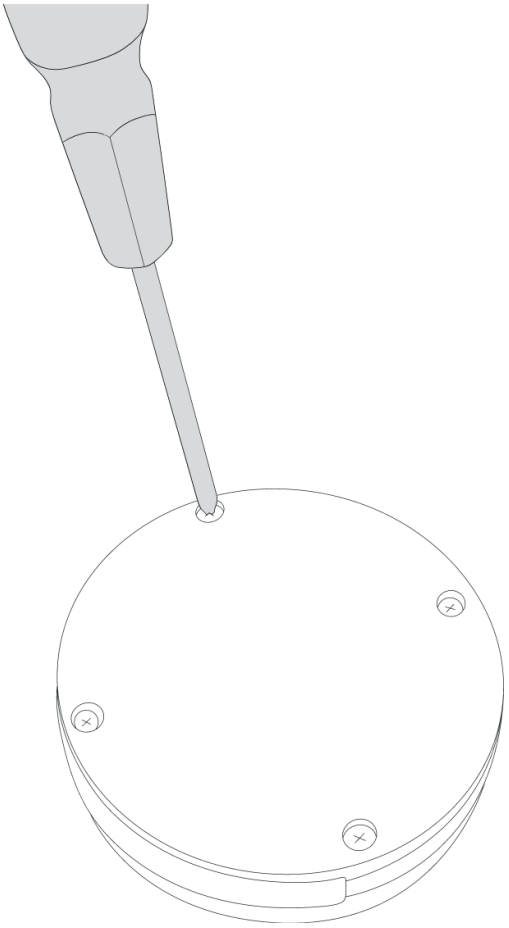

*Figure 10 Device opening instructions.*

2. Place CR2450 3 V battery in the device according to the polarity.

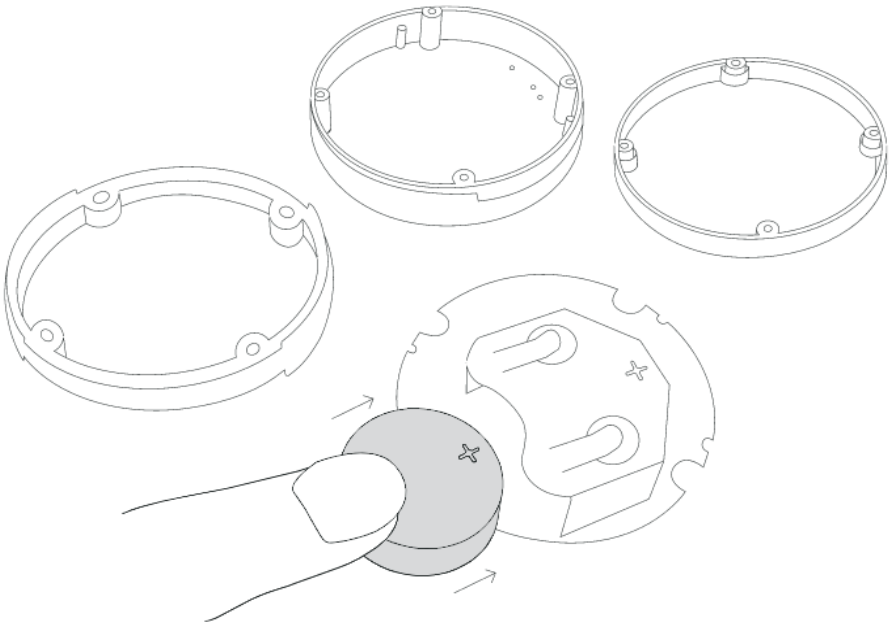

*Figure 11 Device battery assembling instructions.*

3. Assemble the device. The order of the elements is important:

- Place the PCB (B) at the top of the enclosure (A)
- Then insert the seal (C)
- Fit the bottom part of the enclosure (D)

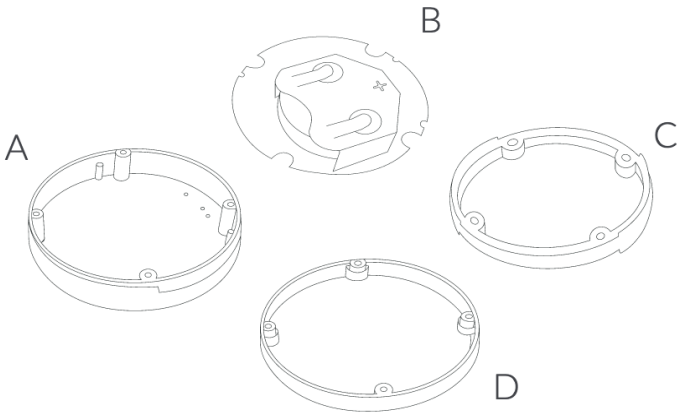


*Figure 12 Assemble device instruction.*

4. Match the PCB (marked components) to the enclosure according to the diagram. Place the PCB in the enclosure with the battery basket facing up

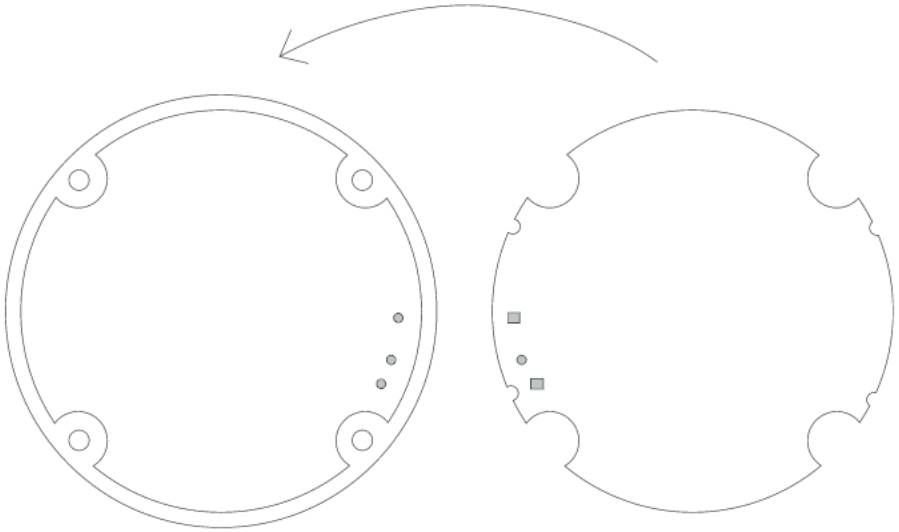

*Figure 13 Matching the PCB to the enclosure instructions.*

5. The device is on. Screw it back together.


*Figure 14 Assembled device top view.*

# Operation

## IoT system components

Typical IoT systems consist of 3 main elements *(Figure 15)*, brief described below. In order to set communication, each element must be properly configured.

1. **Node** – device with sensors and a wireless communication module that gathers data, forms the payload and sends it to the gateway.
2. **Gateway** – device similar to routers, equipped with a LoRa concentrator, that receives LoRa packets and send them to the Internet-connected server.
3. **Server** – in most cases, a cloud-based service where data is processed, stored, analysed, and presented in user-friendly ways (via a user interface); Yosensi default and recommended tools are Yosensi Management Platform (for IoT structure management) and Grafana (for data presentation).

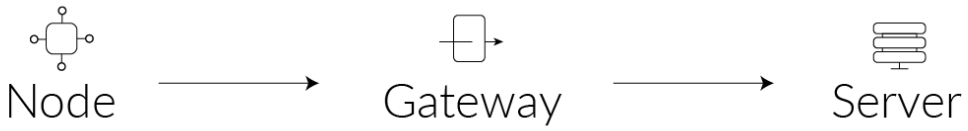


*Figure 15 IoT system components.*

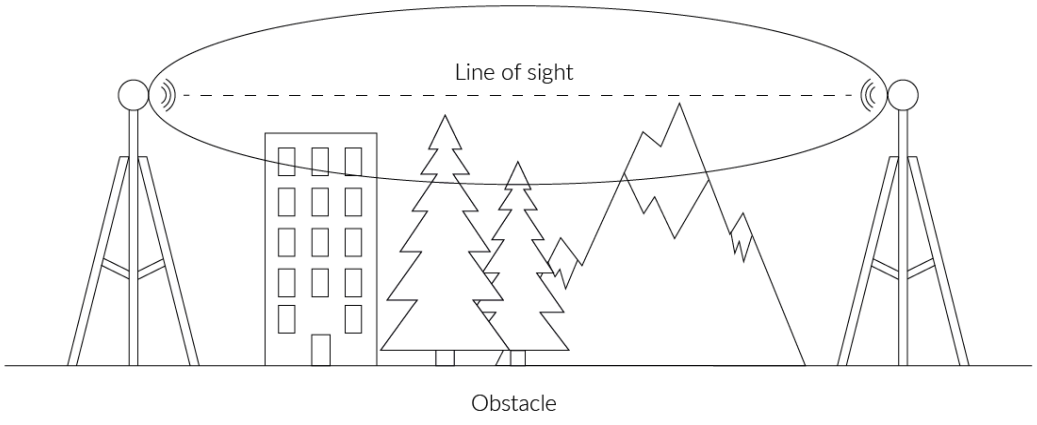


*Figure 16 Fresnel zone where communication between two antennas can occur.*

# Device configuration

## Configurable parameters

A few parameters must be set in order to send data to the gateway. The default firmware is configured in OTAA connection type with predefined *deveui*, *appkey* (OTAA) and *appskey*, *nwkskey* (ABP).

Configuration of the device is stored in a JSON format file divided into sections:

- **info** (generic, read only): information about the device,
- **lorawan** (generic): configuration data required to connect to the LoRaWAN,
- **ble** (generic): bluetooth settings,
- **device** (dynamic): individual configuration for a specific device (the structure of this section is different for each device).

Sample configuration file for the YO 360 device.

```
{
        "info": {
                "devmodel": "LNPC",
                "fwver": "3.2.0",
                "loraradio": "SX1261",
                "lorawanver": "1.0.2",
                "loraregion": "EU868",
                "blemacaddr": "0123456789ab"
        },
        "lorawan": {
                "subband": 1,
                "nwktype": "public",
                "acttype": "otaa",
                "otaa": {
                        "deveui": "0123456789abcdef",
                        "appeui": "fedcba9876543210",
                        "appkey": "000102030405060708090a0b0c0d0e0f",
                        "trials": 3
                },
                "abp": {
                        "devaddr": "01234567",
                        "nwkskey": "0123456789abcdef0123456789abcdef",
                        "appskey": "000102030405060708090a0b0c0d0e0f"
                }
        },
        "ble": {
                "power": 0,
                "interval": 1600
        },
        "device": {
                "measinterval": 7200
                "uptime": 3600
                "pwr": 00
                "advinterval": 9000
        }
}
```

## GENERICS PARAMETERS

| SECTION | NAME | DESCRIPTION | POSSIBLE VALUES | DEFAULT VALUE | READ/ WRITE |
|---|---|---|---|---|---|
| info | devmodel | Device name | - | LNPC | R |
| | fwver | Firmware version | - | 3.2.0 | R |
| | loraradio | Radio chipset model | - | SX1261[1] | R |
| | lorawanver | LoRaWAN stack version | - | 1.0.2 | R |
| | loraregion | LoRaWAN region | - | EU868[1] | R |
| | blemacaddr | Bluetooth LE address | - | predefined | R |
| lorawan | subband | Uplink subband number | Table[2] | predefined | R/W |
| | nwktype | Network type | public, private | public | R/W |
| | acttype | Activation type | otaa, abp | otaa | R/W |
| lorawan -otaa | deveui | Device EUI (Extended Unique Identifier) | 8 B (HEX) | predefined | R/W |
| | appeui | Application EUI | 8 B (HEX) | predefined | R/W |
| | appkey | Application Key | 16 B (HEX) | predefined | R/W |
| | trials | Join request trials | 1-9 | 3 | R/W |
| lorawan -abp | devaddr | Device Address | 4 B (HEX) | predefined | R/W |
| | nwkskey | Network Session Key | 16 B (HEX) | predefined | R/W |
| | appskey | Application Session Key | 16 B (HEX) | predefined | R/W |
| ble | power | Bluetooth LE transmit power | 0[4] | 0 dBm | R/W |
| | interval | Bluetooth LE advertising interval [ms] | MS_INPUT[3] | 1600 | R/W |

[1] LoRa radio chipset used defines the LoRaWAN region: SX1261 - EU868; SX1262 - AU915, US915, AS923
[2] Uplink subband list for specific LoRaWAN regions - UPLINK SUBBAND Table.
[3] Calculation formula: MS_INPUT = INTERVAL_MS × 1.6.
[4] Change currently not supported.

DEVICE PARAMETERS

| NAME | DESCRIPTION | POSSIBLE VALUES | DEFAULT VALUE | READ/ WRITE |
|---|---|---|---|---|
| measinterval | Measuring and sending interval LoRa [s] | 1–999999 | 7200 | R/W |
| uptime | Time that device is working before go to sleep mode [s] | 1–999999 | 3600 | R/W |
| pwr | Power of the Bluetooth Low energy device | 0-99 | 0 | R/W |
| advinterval | The Advertising Interval is the period between two consecutive advertisements of a Bluetooth Low Energy peripheral | 10-9999 | 9000 | R/W |

Parameters description

- ***nwktype:*** used for setting the device in public or private network type.
- ***acttype:*** used for setting the device in ABP or OTAA mode.
- ***deveui, … , appskey:*** predefined addresses and keys, these parameters are generated using multiple IDs specific to the particular MCU and are unique for each device.; they can be changed if needed.
- ***interval:*** determines the interval of sending broadcast packets, used to connect to every BLE receiver around the device.
- ***subband:*** used for setting the communication frequency sub-band in LoRaWAN.
- ***measinterval:*** interval of sending each LoRa payload.
- ***uptime:*** YO 360 device has an additional function for saving battery life. After a disconnection of the device from the bluetooth network, it changes advertising time from 1,6 second to 9 second. It helps devices to work longer on one battery.
- ***pwr:*** Power of the Bluetooth Low Energy device.
- ***advinterval:*** The Advertising Interval is the period between two consecutive advertisements of a Bluetooth Low Energy peripheral

UPLINK SUBBAND

| REGION | DESCRIPTION | POSSIBLE VALUES | DEFAULT VALUE | READ/ WRITE |
|---|---|---|---|---|
| **EU868** | Sub-band 1; 867.1 - 868.5 MHz; channels 0-7 | 1 | 1 | R |
| **US915** | Sub-band 1; 902.3 - 903.7 MHz; channels 0-7 | 1 | 2 | R/W |
| | Sub-band 2; 903.9 - 905.3 MHz; channels 8-15 | 2 | | |
| | Sub-band 3; 905.5 - 906.9 MHz; channels 16-23 | 3 | | |
| | Sub-band 4; 907.1 - 908.5 MHz; channels 24-31 | 4 | | |
| | Sub-band 5; 908.7 - 910.1 MHz; channels 32-39 | 5 | | |
| | Sub-band 6; 910.3 - 911.7 MHz; channels 40-47 | 6 | | |
| | Sub-band 7; 911.9 - 913.3 MHz; channels 48-55 | 7 | | |
| | Sub-band 8; 915.5 - 914.9 MHz; channels 56-63 | 8 | | |
| **AU915** | Sub-band 1; 915.2 -916.6 MHz; channels 0-7 | 1 | 2 | R/W |
| | Sub-band 2; 916.8 - 918.2 MHz; channels 8-15 | 2 | | |
| | Sub-band 3; 918.4 - 919.8 MHz; channels 16-23 | 3 | | |
| | Sub-band 4; 920.0 - 921.4 MHz; channels 24-31 | 4 | | |
| | Sub-band 5; 921.6 - 923.0 MHz; channels 32-39 | 5 | | |
| | Sub-band 6; 923.2 - 924.6MHz; channels 40-47 | 6 | | |
| | Sub-band 7; 924.8 - 926.2 MHz; channels 48-55 | 7 | | |
| | Sub-band 8; 926.4 - 927.8 MHz; channels 56-63 | 8 | | |
| **AS923** | Sub-band 1; 922.0 -923.2 MHz; channels 0-8 | 1 | Not supported | R/W |
| | Sub-band 2; 923.2 - 924.5 MHz; channels 9-17 | 2 | | |

### Configuration via CLI

Connect to the device following these instructions:

1. Read the macBLE address from the sticker on the device. Alternatively, you can identify the device by RSSI parameter (which correlates with distance between transmitter and receiver).
2. Make sure you have your Bluetooth LE adapter turned on and working properly.
3. Download and run the CLI tool in the terminal/console application.
4. Make sure you have placed batteries in the Yo 360 device.
5. Run `yosensi-cli-tool_vX.X.X_WIN.exe list` to scan for Bluetooth devices. You can see all commands by typing `yosensi-cli-tool_vX.X.X_WIN.exe --help` or add `-h` to your current command to see all needed parameters.
6. If you find your MAC address in the `list` command results, you can connect and reconfigure the device by using one of the available commands. You should use the *upload_dev_config* subcommand to change device settings. Additional information, including the commands supported by the CLI, are available at https://yosensi.io/support/CLI_datasheet.pdf.

Command help view:

```
.\yosensi-cli-tool_v3.1.0_win.exe upload_dev_config --help
usage: yosensi-cli-tool upload_dev_config [-h] mac

positional arguments: mac Bluetooth public MAC address

optional arguments: -h, --help show this help message and exit
```

Example of use:

```
.\yosensi-cli-tool_v3.1.0_win.exe upload_dev_config 80:e1:26:1c:f9:e9
It will take up to 120s to find and start uploading configuration data to the device from file, please
wait ...
Searching for a device ...
Trying to connect to the device LNPC-3.1.0 ...
Downloading the configuration file ...
Downloading the configuration file is complete.
Checksum of the downloaded configuration data is correct.
The configuration data has been written to the file.
```

After node reconfiguration, you need to have access to the gateway and server.

**NOTE** **The firmware update process is described in CLI tool manual, *firmware_upload subcommand* section. Visit https://yosensi.io/support to see all available documentation.**

## Connecting node with network

According to the LoRaWAN architecture, to transmit data on the network there should be a configured Gateway and Network Server.. We'll go through an example in our recommended Yosensi Management Platform software.

### Yosensi Management Platform configuration

Before you can make the node visible, you'll need an **organization** and an **application**. The organization is your own space, at the highest level of IoT systems management (like the root directory in operating systems). It can be created only by Yosensi staff, and all clients using Yosensi Management Platform have it created for them by default (in case of any problems you can find us on support@yosensi.io). The application is a representation of each system and, together with nodes definitions, are created by customers. Basic integration of a Node and Yosensi Management Platform is described below.

**NOTE** **A subscription is needed to use Yosensi Management Platform. Contact us on contact@yosensi.io for more information and pricing.**

Yosensi Management Platform integration instructions:

1. Go to app.yosensi.io and log in.
2. You'll see the default organization view. To switch to another organization, click on the user avatar in the right top corner and select 'Switch Organization'.
3. To create an application, press the bottom right '+' button. Fill in the 'Name' and 'Description' fields and 'Select Application Profile' which is the region definition.

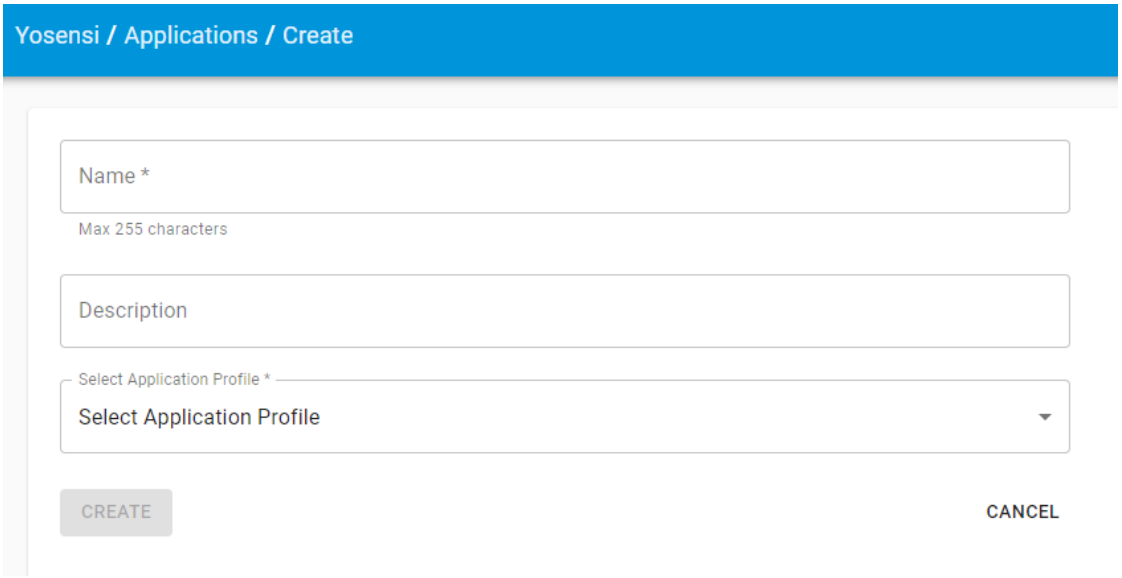


*Figure 17 Application creation form.*

4. Proceed to the application by clicking its name on the list, and press the '+' button to add a node. Select **'Lora'** or **'Helium'** if you want to connect to Helium network in 'Node Type' field. Set the 'Name', 'Description' fields and fill in 'Node ID' (*deveui*) and 'OTAA Key' (otaa section - *appkey*) **which can be found using the CLI tool (*download_dev_config*).** Select a model that is compatible with your device—it affects the number of charts, its placement and data source (YO 360). You can also set the node's 'Location', if locations have been pre-defined. If you haven't defined a suitable location, leave this field set at <None>.

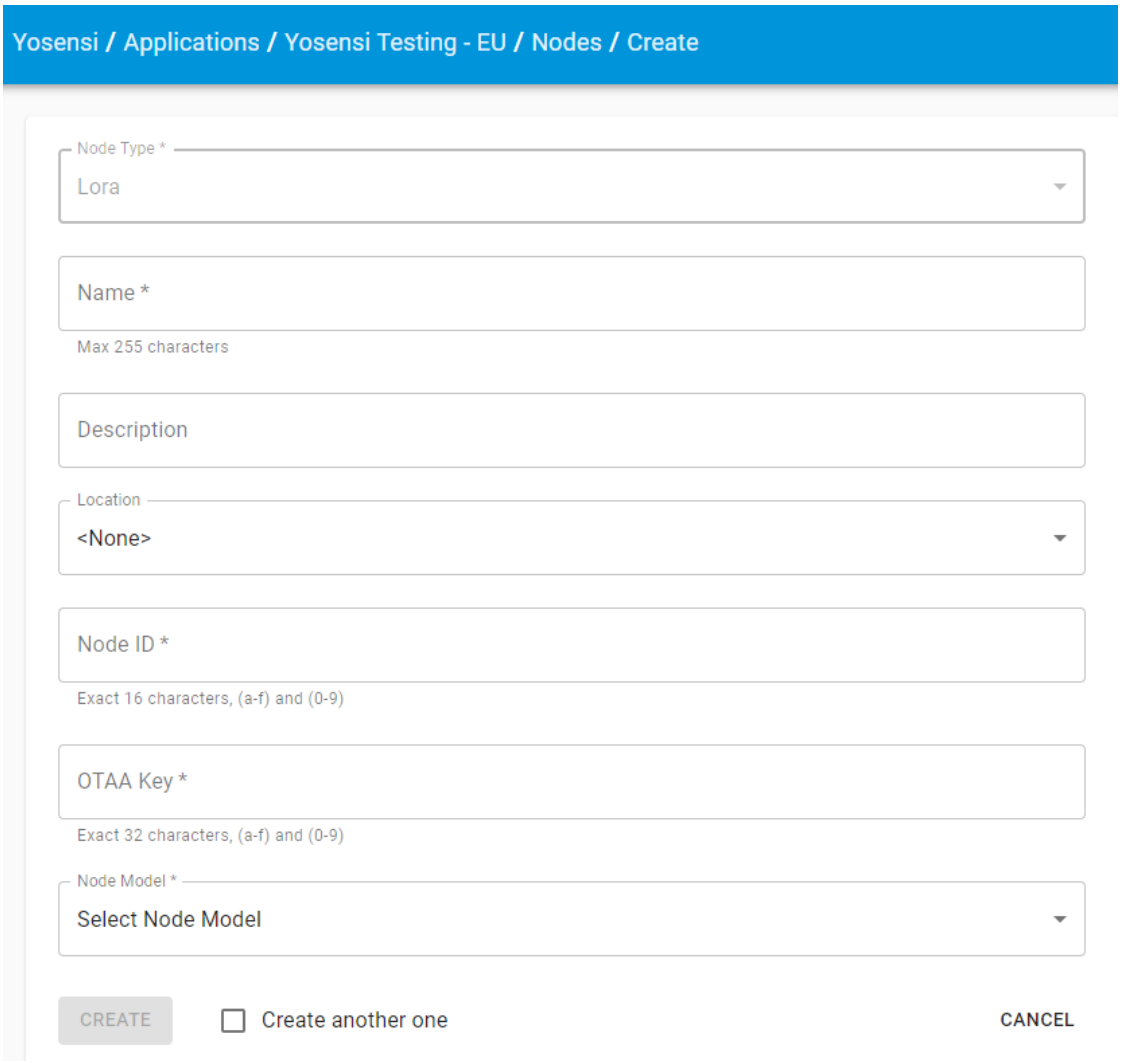


*Figure 18 Node creation form.*

5. **Every new node must be added in OTAA mode**. You must then switch its type to ABP after activation in Yosensi Management Platform by changing the Node configuration. Click on the link in the 'Node Name' column. Go to the 'KEYS' tab and switch 'Lora Type' from OTAA to ABP, and fill in the 'Device Address' (*devaddr*), 'Application Session Key' (*appskey*) and 'Network Session Key' (*nwkskey*) with **values from the CLI tool,** and press UPDATE.

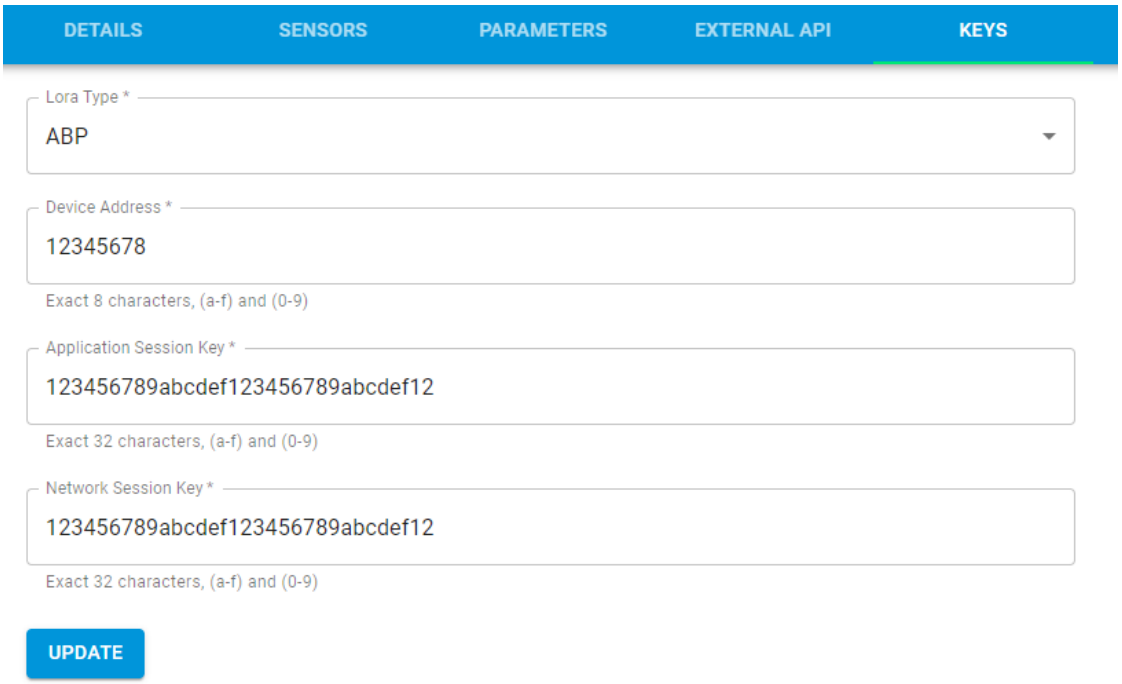


*Figure 19 Node LoRa type configuration form.*

6. When data are received by the server, you'll notice that the 'Last Seen' column ('NODES LIST' tab) status changes from 'never' to 'a few seconds ago'.
7. Open charts by clicking on the 'OPEN' button in Dashboard columns or by entering the node's 'DETAILS' tab ('Node Name' column link) and clicking 'CHARTS'.

## Payload description

If you want to connect to your own server you have to decode the payload specific to each device. To do this you need a payload decoder which can be downloaded from Payload decoder. Extended documentation of the protocol can be found at Payload description.. An exemplary payload produced by YO 360 is presented below with division into each measurement marked together with decoded values whose interpretation is described in the Payload description document.

Example of YO 360 payload with description:

02:00:00:00:08:00:01:0b:62:0d:00:01:00:f6:10:00:00:2f:41:00:15:19:ff:f9:00:1e:00:5b

| **Payload header** | | | | **First measurement (battery voltage)** | | | | |
|---|---|---|---|---|---|---|---|---|
| 0x02 | 0x00 | 0x00 | 0x00 | 0x08 | 0x00 | 0x01 | 0x11 | 0xCE |
| ver = 2 | cnt = 0 | pct [s] = 0 | | type = 2<br>prec = 0 | md [s] = 0 | addr_len = 0<br>meas_len = 2 | val = 2914<br>(2914[mV]) | |

**Second measurement (temperature)**

| 0x0D | 0x00 | 0x01 | 0x00 | 0xF6 |
|---|---|---|---|---|
| type = 3<br>prec = 1 | md [s] = 0 | addr_len = 0<br>meas_len = 2 | val = 246<br>(24,6[°C]) | |

**Third measurement (relative humidity)**

| 0x10 | 0x00 | 0x00 | 0x2F |
|---|---|---|---|
| type = 4<br>prec = 0 | md [s] = 0 | addr_len = 0<br>meas_len = 1 | val = 47<br>(47[%]) |

**Fourth measurement (accelerometer - angles )**

| 0x41 | 0x00 | 0x15 | 0x19 | 0xFF | 0xF9 | 0x00 | 0x1E | 0x00 | 0x5B |
|---|---|---|---|---|---|---|---|---|---|
| type = 16,<br>prec = 1 | md [s] = 0 | addr_len = 1,<br>meas_len = 6 | addr=19 | val = -7<br>(-0,7[°]) | | val = 30<br>(3,0 [°]) | | val = 91<br>(9,1 [°]) | |

# Revision history

| Date | Version | Changes |
|---|---|---|
| 25.08.2022 | 1.0 | Initial release. |