YOSENSI.IO

YO Thermostat

User guide v1.0

Release notes

Released	Version	Key changes
12.06.2024	1.0	Initial release.

Content

Product description

Overview

The YO Thermostat provides valuable insight into room conditions and enables precise temperature regulation based on the output signal from its PID controller. Designed to measure temperature, humidity, illuminance, and CO_2 (optional) levels. It also has an infrared presence sensor, which is equipped with a built-in occupancy counter, enabling it to track the number of people presence in the room in real-time.

The device measures the room temperature using a built-in sensor and compares it to a desired setpoint. The PID controller continuously fine-tunes the state in response to the ambient temperature, ensuring consistent and precise temperature control. Based on the controller output signal an on or off state is passed via LoRaWAN. Device regulation states received via the LoRaWAN network should be used to control actuators. YO Thermostat **is not an actuator** - to control the heater, HVAC, etc. it requires a relay that will open/close the circuit, such as **YO Relay Switch**.

The YO Thermostat device is an ideal solution for assessing and maintaining optimal indoor environments, enhancing occupant comfort, productivity, and overall well-being. Additionally, it is a wireless battery-operated device.

Figure 1 **Device top view.**

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

- **DEV EUI:** 64-bit unique device identifier in a LoRaWAN network,
- **DEV ADDR:** address required to connect via ABP activation type to LoRaWAN
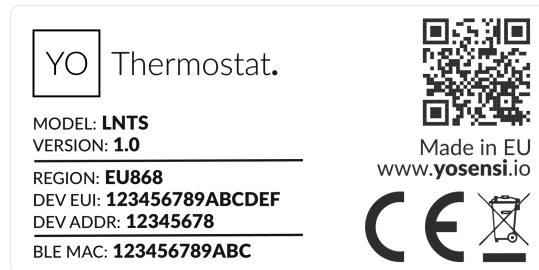- **BLE MAC:** bluetooth physical address.

Figure 2 Device label.

Physical interfaces

LEDs

YO Thermostat communicates its current behaviour to the user by RGBW LED placed next to the reset button. Figure 3 indicates its location.

DIODE STATUES INTERPRETATION

BEHAVIOUR	COLOUR	DEVICE STATUS
Single flash	Green	**General:** device is working correctly (power and memory). The device detected and counted a person nearby
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 Thermostat is equipped with a reset button inside the device. Figure number 3 indicates its location. To reset the device you need a thin stick to push the button.

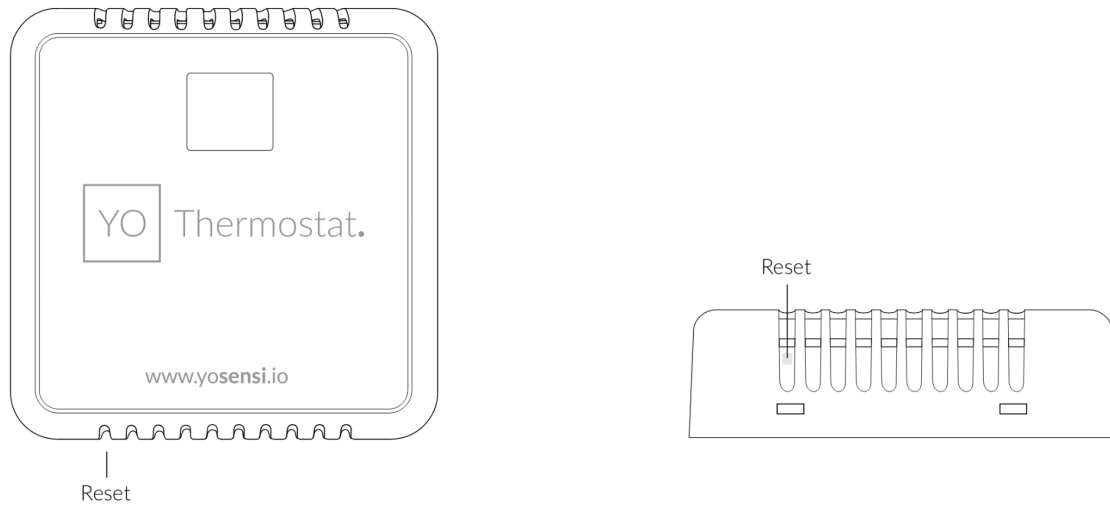*Figure 3 Device reset button location.*

Specifications

Physical
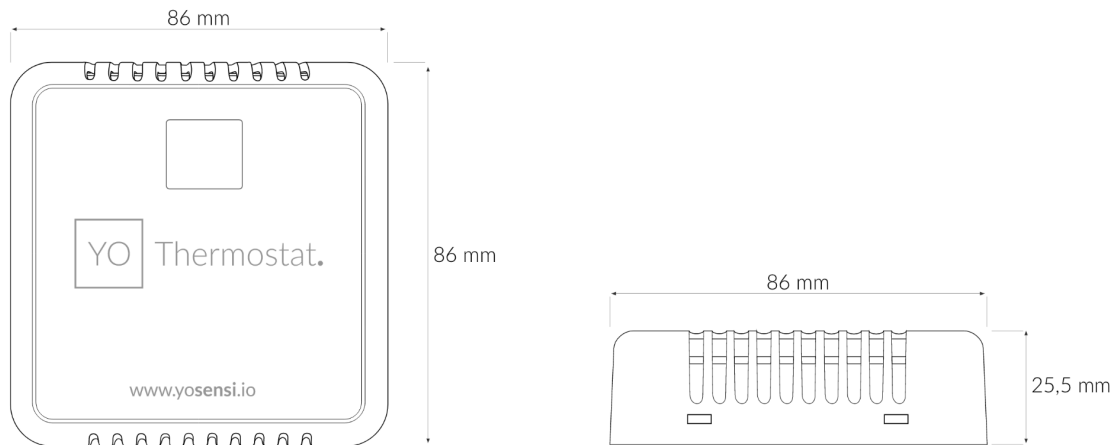
Figure 4 Dimensions of the device.

PHYSICAL SPECIFICATION

Dimensions	Height: 25.5 mm Width: 86 mm Depth: 86 mm
Colour	white
Mounting method	Horizontal Vertical (can be screwed to the wall)
Enclosure material	ABS
Level of protection	IP40, UL94-V0
Weight	82,5 g

Operating conditions

OPERATING CONDITIONS

Temperature	0° to 70°C
Humidity	0 to 90%
Placement	Indoor use
Power supply	3 x LR6 (AA) battery (3 x 1,5 V)
Power consumption	Maximum 120 mA DC (4,5 V DC)

Measured values

MEASUREMENT RANGES

Parameter	Measurement range	Accuracy
Temperature	-40° to 125°C	±0.2°C (5° to 60°C)
Relative humidity	0% to 100%	±2% (20% to 80%)
CO_2	0 to 40 000 ppm	±(40 ppm+5%) from 400 ppm to 5000 ppm
	Recommended working conditions: -10° to 60 °C	
Illuminance	0 to 120 klx	±10% at 25°C
Infrared presence sensor	0 to 4.5 metres, 80° field of view	

Temperature and relative humidity

Temperature and relative humidity are measured by sensors placed inside the device enclosure, effectively monitoring the ambient conditions (see Recommended conditions).
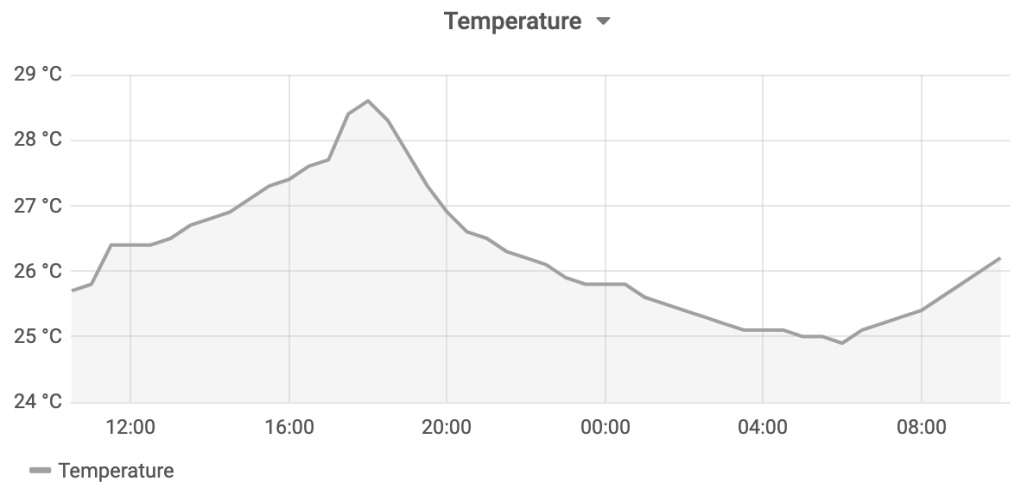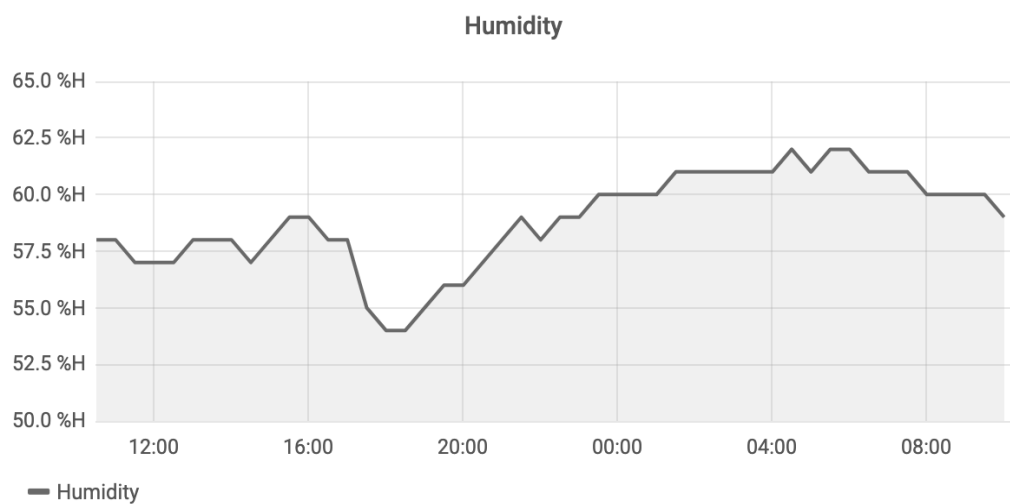

Figure 5 Internal temperature example chart.

Figure 6 Internal humidity example chart.

Illuminance

The illuminance sensor measures the value of light intensity, which is used to determine if there is a proper amount of light in the room.
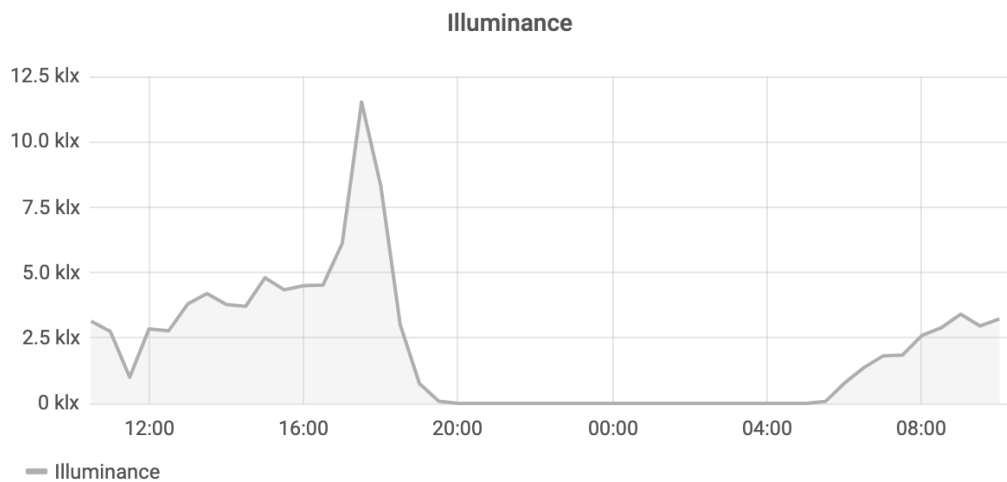

Figure 7 Example of illuminance monitoring chart.

CO_2 sensor

The CO_2 level is a critical indoor environment parameter because it affects human health. For example, high levels within a short duration can reduce concentration and increase heart rate.
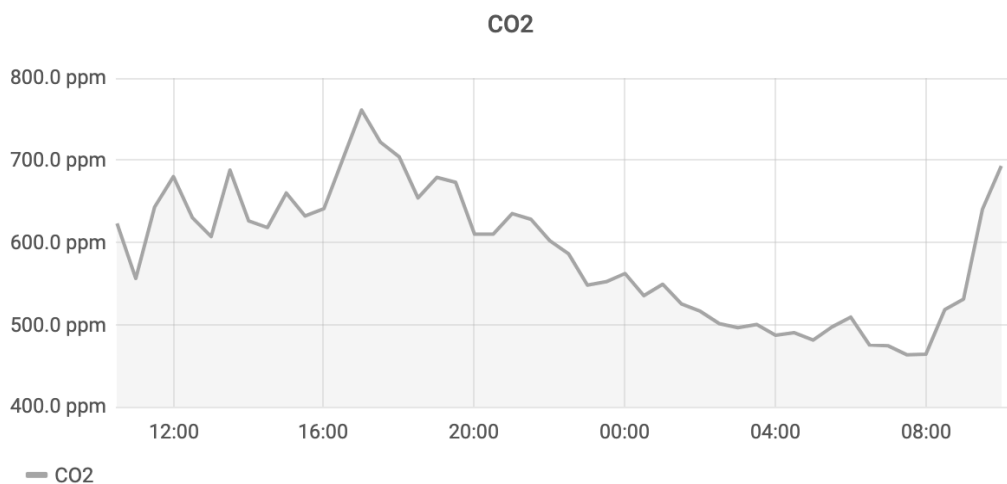
Figure 8 Example of CO_2 monitoring chart.

Infrared occupancy sensor

Infrared motion sensor is equipped with a built-in occupancy counter, enabling it to count the passes of people to the room where the sensor is located.

Figure 9 Occupancy monitoring exemplary chart.

Battery condition

Battery voltage is used to monitor the device condition and spot anomalies (e.g., a sudden drop) or determine the current condition based on the voltage drop over time compared with the initial voltage rating.
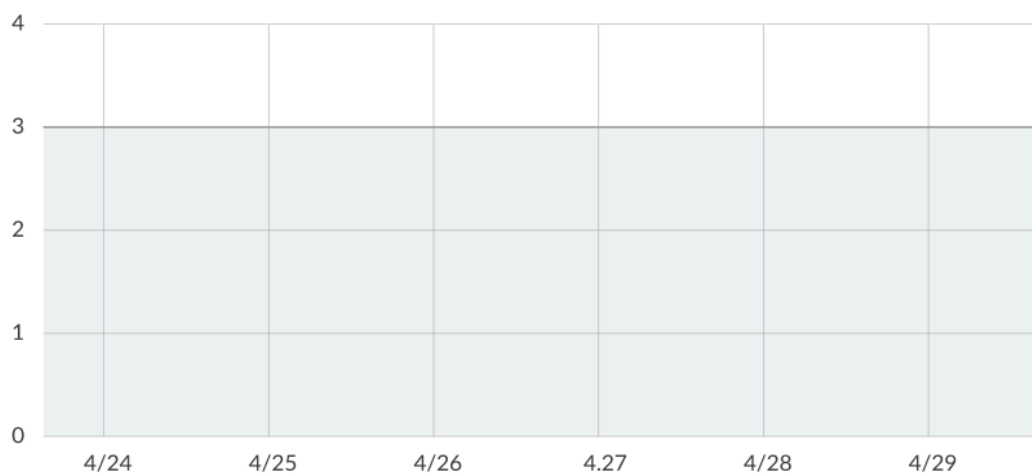
Figure 10 Battery voltage exemplary chart.

Thermostat output signal status

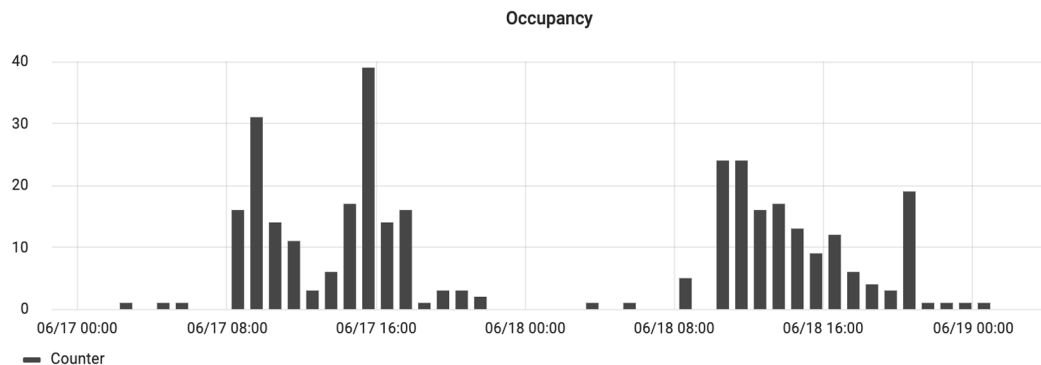The YO Thermostat features an on-off output signal controlled by a PID controller that continuously adjusts based on ambient temperature feedback. This integration allows for nuanced control, reducing overshooting, and providing a more stable and accurate response to environmental changes.

Figure 11 Thermostat output state status monitoring chart.

Figure 12 Temperature monitoring chart with comfort set point at 28.0 ° C.

Installation

Package contents

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

Safety precautions

SAFETY PRECAUTIONS

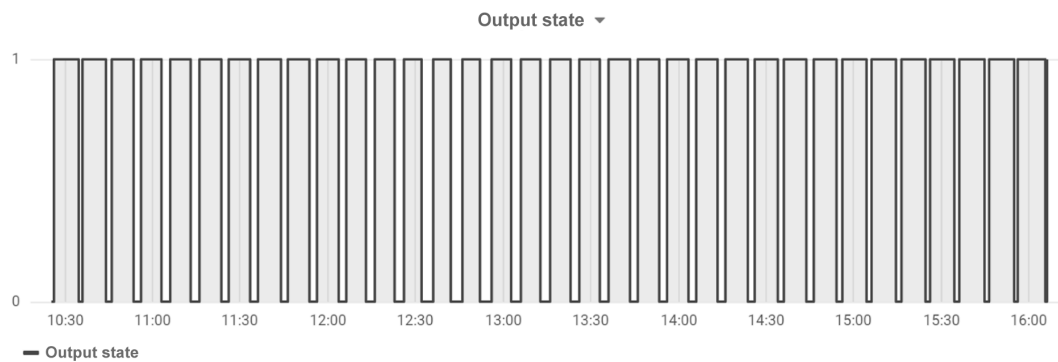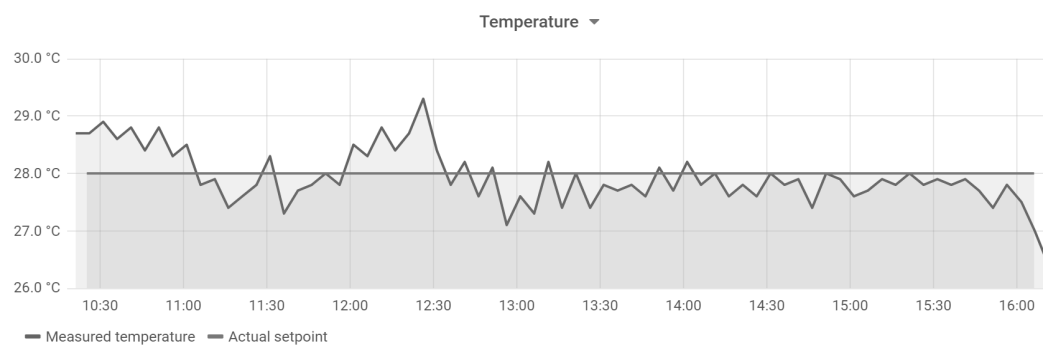| SYMBOL	DESCRIPTION
	Device is marked with a symbol saying that electrical and electronic products may not be mixed with unsorted household waste. Remember that batteries used to power the device must be treated at a specialized treatment facility.
	Remember about possible electrostatic discharge when 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 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. To open the enclosure, peel off the lower part, as shown in Figure 9.
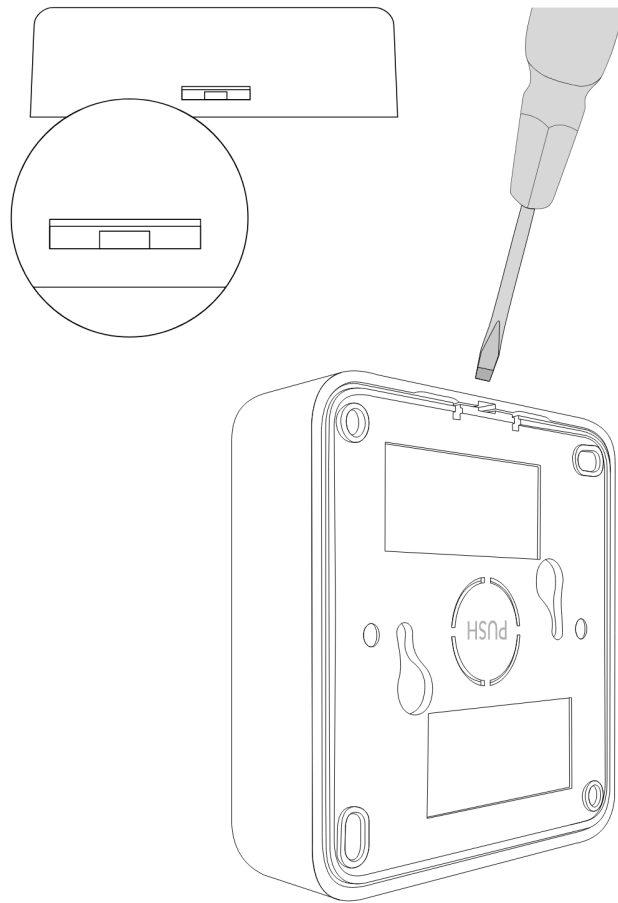
Figure 13 Device opening instructions.

2. Place three LR6 batteries in the device according to the polarity indicated on the battery holder.
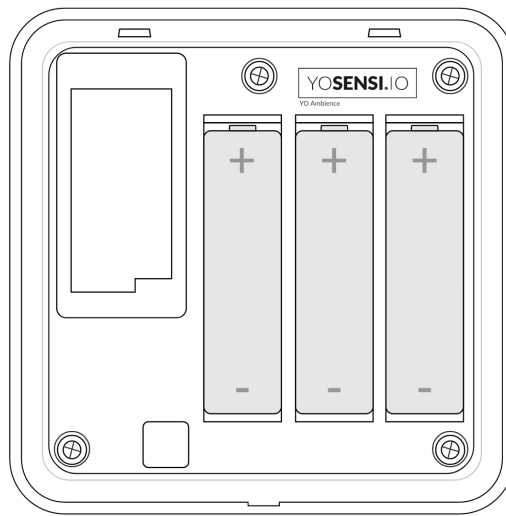
Figure 14 **Device with placed batteries.**

3. There are two ways to mount the device into a wall.
    A. Install the bottom part of the enclosure and mount four screws in each corner to the wall.
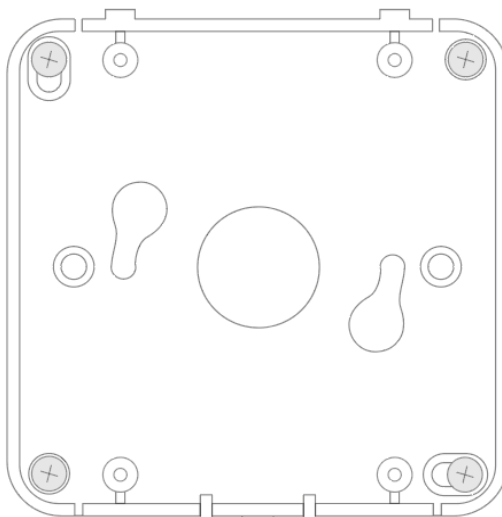
Figure 15 **Mounting the device using four screws.**

    B. Fit two mounting screws into the centre of the bottom case. Then, angle the bottom of the enclosure and turn it clockwise.
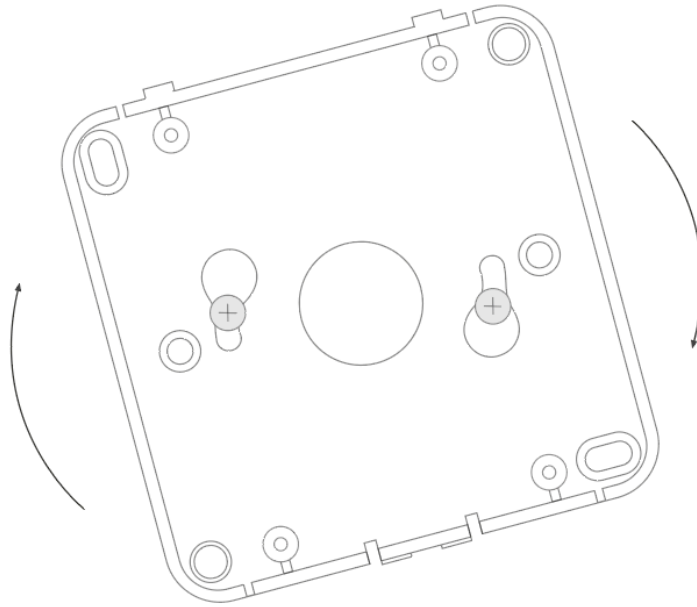
Figure 16 Mounting the device using two screws at an angle.
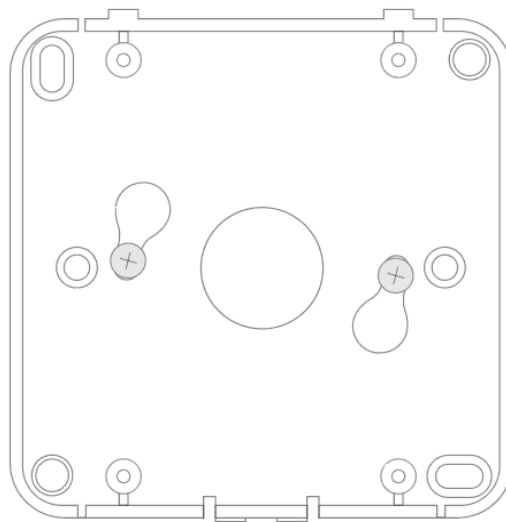
Figure 17 Mounting the device using two screws after a clockwise turn.

4.   Place the upper part of the device enclosure on the bottom part mounted on a wall.
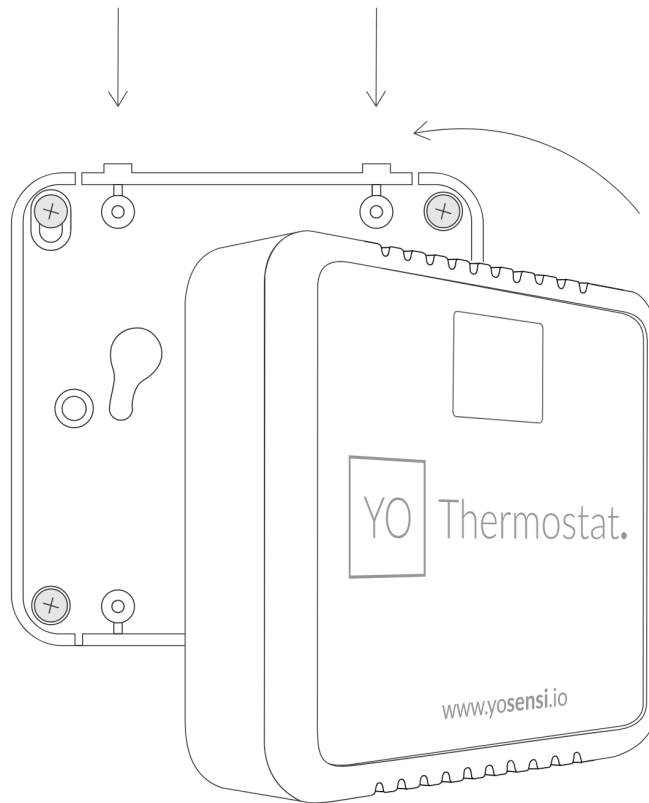
Figure 18 **Placing device on the wall.**

Operation

IoT system components

Typical IoT systems consist of 3 main elements *(Figure 18)*, 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 sends 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).
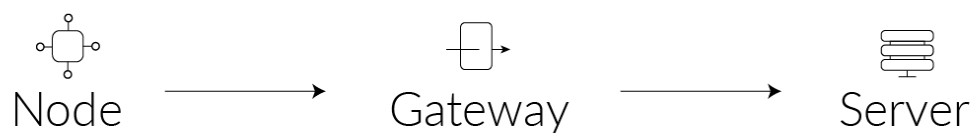
Figure 19 IoT system components.
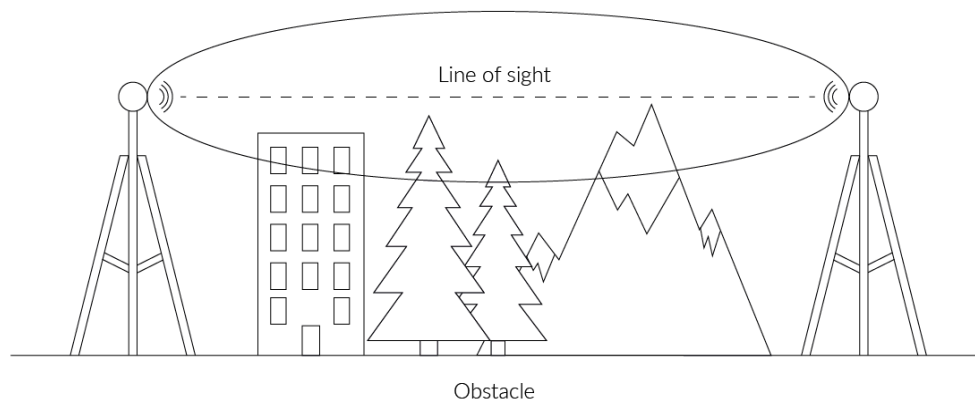
Figure 20 Fresnel zone where communication between two antennas can occur.

Device configuration

Configurable parameters

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

Configuration of the device is stored in a JSON file divided into the following sections:
- **info** (generic, read only): information about the device,
- **lorawan** (generic): configuration data for LoRaWAN connection,
- **ble** (generic): bluetooth settings,
- **device** (dynamic): individual configuration for a specific device (this section's structure differs for each device),

Sample configuration file for the YO Thermostat device.

```json
{
    "info": {
        "devmodel": "LNTS",
        "fwver": "1.0.0",
        "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": 3600,
        "co2calibval": 0,
        "tempoffset": 0,
        "illuminancecoeff": 1.6,
        "thermostat": {
            "comfortsetpoint": 21,
            "standbyoffset": -2,
            "economyoffset": -4,
            "frostprotsetpoint": 7,
            "oprmodeafterreset": 5,
            "cycletime": 900,
            "computinginterval": 60,
            "regkp": 5,
            "regki": 2,
            "regkd": 0.5
        }
    }
}
```

GENERICS PARAMETERS

SECTION	NAME	DESCRIPTION	POSSIBLE VALUES	DEFAULT VALUE	READ/ WRITE
info	devmodel	Device name	-	LNTS	R
	fwver	Firmware version	-	1.0.0	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
	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 [dBm]	0[4]	0	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]	60*–999999	3600	R/W
co2calibval	Calibration value of CO_2 sensor [ppm]	0 - 9999	0	R/W
tempoffset	Temperature offset in [°C]	-20.0 - 20.0	0	R/W
iluminancecoeff	Illuminance coefficient	0.0 - 10.0	1.6	R/W
comfortsetpoint	Comfort set point	7.0 - 40.0	21.0	R/W
standbyoffset	Standby offset	-0.1 - (-8.0)	-2.0	R/W
economyoffset	Economy offset	-0.1 - (-10.0)	-4.0	R/W
frostprotsetpoint	Frost protection set point	7.0 - 40.0	7.0	R/W
opermodeafterreset	Operating mode after reset	0, 1, 2, 3, 4, 5	5	R/W
cycletime	Cycle time [s]	600 - 9999	900	R/W
computinginterval	Computing interval	1 - 300	60	R/W
regkp	Regulator proportional gain	1 - 8	5.0	R/W
regki	Regulator integral gain	0 - 6	2.0	R/W
regkd	Regulator derivative gain	0 - 4	0.5	R/W

60 - OTAA minimum 60 [s], ABP minimum 120 [s]*

Parameters description

- **nwktype:** used for setting the device as a 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 also be changed if needed.

- **interval:** determines the interval for 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 for sending device sensors data LoRa payload.

- **co2calibval**: calibration value of the CO_2 sensor. This parameter provides high initial and long-term accuracy. It enables the sensor to immediately restore the highest accuracy with the assistance of a CO_2 reference value. This parameter is used if the measurement stability deviates. A value of 0 means that calibration is disabled.

- **tempoffset**: the offset value adjusted to the temperature measurement.

- **illuminancecoeff**: parameter that tunes the illumination intensity sensor to account for the attenuation of the light beam travelling through the optical fibre. This parameter is predefined.

- **comfortsetpoint**: comfort temperature set point is the target room temperature that a thermostat maintains for optimal comfort.

- **standbyoffset**: standby offset parameter. When standby operating mode is active this parameter determines how many degrees the comfort set point temperature will be shifted. In e.g. when comfort set point is 21.0 and "**standbyoffset**" is -2.0 the new comfort set point temperature will be 19.0.

- **economyoffset**: economy offset parameter. When economy mode is active this parameter determines how many degrees the comfort set point temperature will be shifted. In e.g. when comfort set point is 21.0 and "**economyoffset**" is -4.0 the new comfort set point temperature will be 17.0.

- **frostprotsetpoint**: frost protection set point. When protection mode is activated this parameter determines the temperature set point.

- **oprmodafterresset**: operating mode after reset. There are 6 modes, corresponding to 6 different room temperature control parameters to which different setpoints are assigned.

  - Value 0 - disable thermostat feature.
  - Value 1 - activates comfort mode.
  - Value 2 - activates standby mode. This will set the room temperature thus saving heating or cooling energy in the process.
  - Value 3 - activates economy mode. During the night hours or during a longer absence it is often best to adjust the room temperature to cooler temperatures for heating systems (e.g. in bedrooms). In this case cooling systems can be adjusted to higher temperature values, if climate control is not required (e.g. in offices). For this purpose the economy mode can be activated.
  - Value 4 - activates protection mode. Used if the room temperature must not fall below critical values when the window is open or when temperature must not rise in a warm environment due to external influences.
  - Value 5 - activates last before reset, mode that was activated before a reset will be readjusted after the initialization phase of the device.

- **cycletime**: cycle time between changing controller output state.

- **computinginterval**: computing interval of PID regulator. This parameter determines the predictive adjustment of the controller's output signal to prevent temperature overshoot (oscillation).

- **regkp**: Regulator proportional gain of relay switch. This value is predefined.

- **regki**: Regulator integral gain of relay switch. This value is predefined.

- **regkd**: Regulator derivative gain of relay switch. This value is predefined.

Downlink message

It is possible to change the measurement interval (**measinterval**) by using downlink. Information about changing parameter will be sent from server via gateway when Example of downlink message must include:

- Prefix: 0x03
- Measurement index: 0x06
- Data up to 4 bytes in hex

0x03060258 - sample downlink with 600 seconds [10 min] measurement interval.

Update Comfort setpoint

It is possible to change Comfort setpoint temperature by using downlink. Example of downlink message include:

- Prefix: 0x03
- Measurement index: 0x07
- String data converted to hex:
    - Temperature range: 7.0 to 40.0

0x030732312e30 - sample downlink to set Comfort setpoint temperature as 21.0 [°C]

Update Standby offset

It is possible to change Standby offset temperature by using downlink. Example of downlink message include:

- Prefix: 0x03
- Measurement index: 0x08
- String data converted to hex:
    - Temperature range: -7.0 to -0.1

0x03082d322e30 - sample downlink to set Standby offset temperature as -2.0 [°C]

Update Economy offset

It is possible to change Economy offset temperature by using downlink. Example of downlink message include:

- Prefix: 0x03
- Measurement index: 0x09
- String data converted to hex:
    - Temperature range: -10.0 to -0.1

0x03092d342e30 - sample downlink to set Standby offset temperature as -4.0 [°C]

Update Frost protection setpoint

It is possible to change Frost protection setpoint temperature by using downlink. Example of downlink message include:

- Prefix: 0x03
- Measurement index: 0x0a
- String data converted to hex:
  - Temperature range: 7.0 to 15.0

0x030a372e30 - sample downlink to set Frost protection setpoint temperature as 7.0 [°C]

Update Operation mode

It is possible to change Operation mode by using downlink. Example of downlink message include:

- Prefix: 0x03
- Measurement index: 0x0b
- Operating modes data in hex:
  - Comfort: 0x01
  - Standby: 0x02
  - Economy: 0x03
  - Protect: 0x04
  - Disable: 0x05

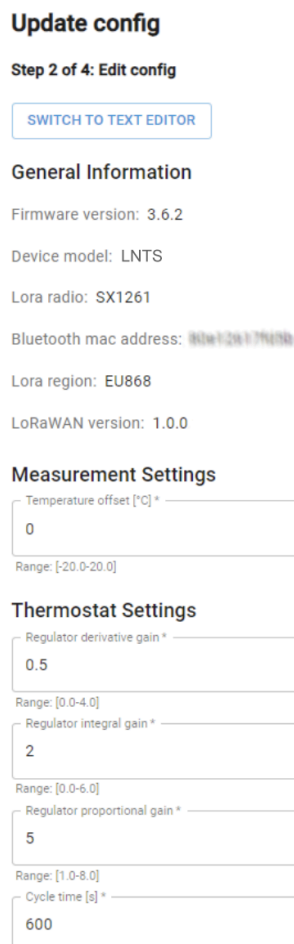**0x030b01** - sample downlink to set Comfort operation mode

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	1	R/W
	Sub-band 2; 923.2 - 924.5 MHz; channels 9-17	2*		

2* change is not supported

Configuration node with Yosensi Management Platform

Connect to the device as follows
1. Log in at app.yosensi.io
2. You'll see the dashboard organization view. Go to the Application section in the sidebar.
3. Select application, locate and select the device by looking for the DEV EUI on the device label.
4. Select the Firmware section. For the configuration of the device, you can see three different buttons:
   - Configure – here, you can change and upload the device parameters.
   - Update firmware – here, you can update the firmware to version 1.0.0 and newer.
   - Recover device – this section restores the firmware of the device. This button helps if you lose the connection while uploading firmware.
5. Once the "Configure" button has been selected and the node has been paired with the computer, the next step is configuring parameters. You will see 2 different display options for the configuration. The first recommended is "Form-based-editor" and the second is "Text editor". Possible values with the description of each parameter can be found in the device configuration.

Figure 21 Update configuration section view.
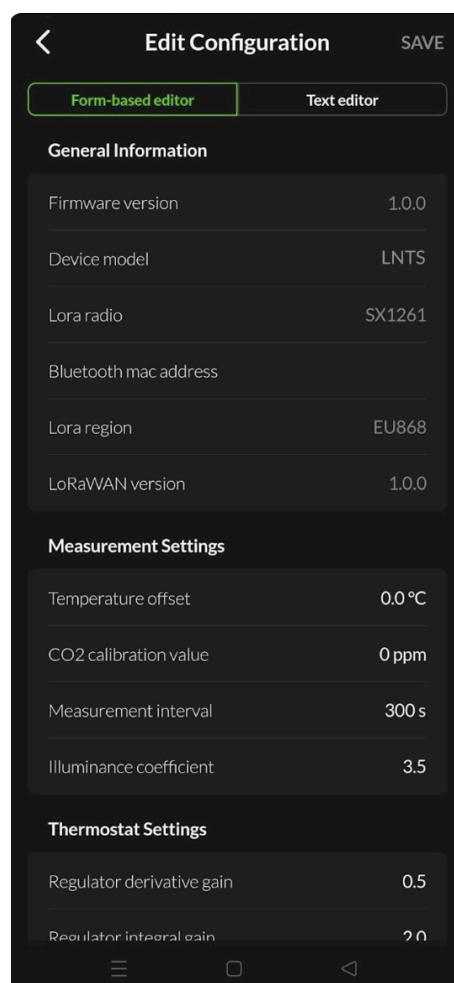
6. Press the upload button and wait.

> **NOTE** Additional information including device configuration can be found in <u>Yosensi configuration web tool</u>.

Configuration node with Yosensi mobile app

Connect to the device using Yosensi app as follows:

1. Login to Yosensi App using your credentials.
2. Go to the Devices section and choose the device you want to configure. If you can not see the device ensure that you are in the correct organization. Alternatively you can also scan the QR code placed on the node. It will redirect you right to the device details.
3. After selecting the device go to the "configuration" option in device details. Now wait, your mobile will pair with the node.
4. You will see 2 different display options of the configuration, first recommended is "Form-based-editor" second "Text editor". Possible values with description of each parameter can be found in the device configuration.

Figure 22 Configuration view in mobile app.

5. After changing parameters, press the "Save" button.

Connecting node with network

The LoRaWAN architecture requires a configured Gateway and Network Server. We'll go through an example in our recommended Yosensi Management Platform software.

Yosensi Management Platform configuration
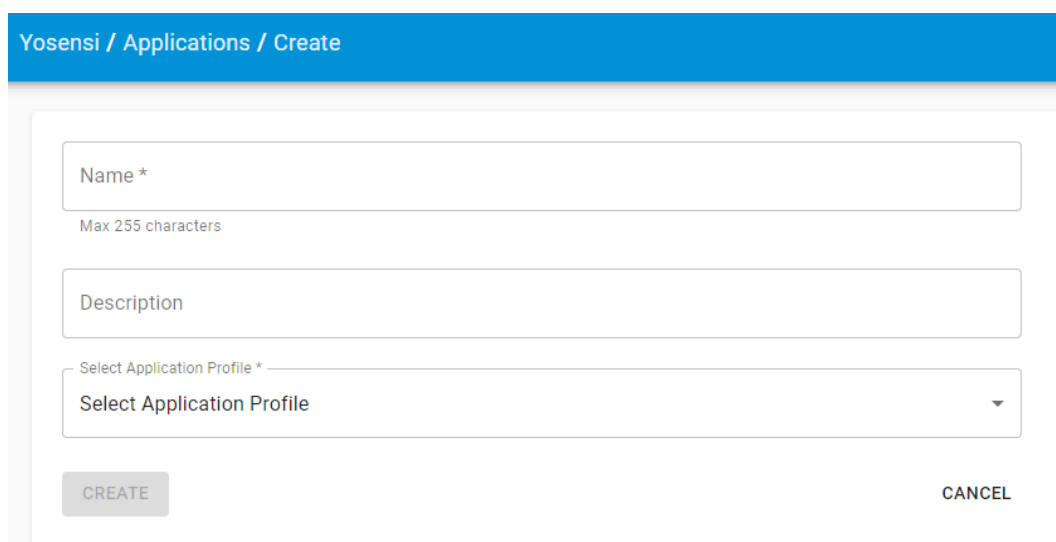
Before you can make the node visible, you'll need an **organization** and an **application**. The organization is your own space, at the highest level of IoT systems management (like the root directory in operating systems). It can be created only by Yosensi staff, and all clients using Yosensi Management Platform have one created for them by default. In case of any questions, you can find us at support@yosensi.io. The application is a representation of each system and, together with the node definitions, is created by customers. The basic integration of a node into the Yosensi Management Platform is described below. Nodes can be added manually or via Bluetooth.

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

Adding a node manually

Yosensi Management Platform integration instructions:

1. Log in to app.yosensi.io.
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 a new application, press the bottom right '+' button. Fill in the 'Name' and 'Description' fields and select an 'Application Profile', which is the region definition.

Figure 23 Application creation form.

4. Proceed to the application by clicking its name on the list, then press the '☰' button to add a node. Click '**Add manually**'. Set the node's 'Name' and 'Description' fields, and fill in 'DEV EUI' and 'OTAA Key' (otaa section – *appkey*). **All device identifiers are provided by Yosensi Support when you order the nodes.**

Select a model that is compatible with your device — this choice affects the number of charts and data source. 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 24 Adding node to the Yosensi Management Platform section view.

Figure 25 Node creation form.

5. **New nodes must be added in OTAA mode**. Nodes can be switched to ABP mode after activation in the 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 blank spaces, then press update. The identifiers 'Device Address' (*devaddr*), 'Application Session Key' (*appskey*) and 'Network Session Key' (*nwkskey*) are provided by Support, or can be found in the device's configuration pane while connected to the node in the firmware section.

Figure 26 Node LoRa type configuration form.

6. When the server receives data from the device, 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'

Adding node via Bluetooth

1. Log in at app.yosensi.io.
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, click the bottom right '+' button. Fill in the 'Name' and 'Description' fields and select the 'Application Profile', which is the region definition.
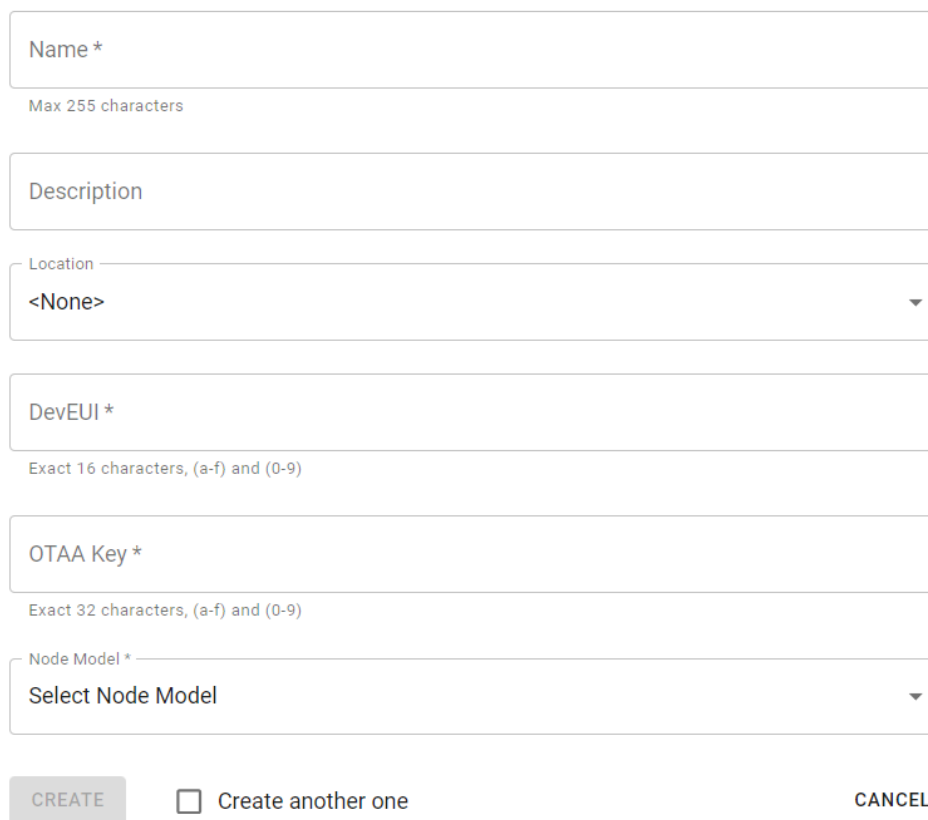4. Proceed to the application by clicking its name on the list, and press the '≡'' button to add a node. Click '**Add via Ble**'. Select the device to add. Then, the list with devices available to connect to the application will appear. The name of the node will be generated automatically from the device model and DEV EUI, with OTAA key and DEV EUI filled in, press create.
5. When the server receives data, you'll notice that the 'Last Seen' column (NODES LIST' tab) status changes from 'never' to a few 'seconds ago'.
6. 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 decoder

If you want to connect to your own server, it is necessary to decode the specific payload for each device. To accomplish this, a payload decoder is required, which can be downloaded using the following link: Payload decoder. Extended documentation of the protocol can be found in the Payload description on our website. An example payload produced by YO Thermostat is presented below with divisions for each measurement and marked with decoded values, whose interpretation is described in the Payload description.

Example of YO Thermostat payload with description:

First frame (uplink) scheduled by "measinterval" parameter (3600 s default):
02:7d:00:00:08:00:01:10:80:0d:00:01:01:06:10:00:00:3b:6c:00:01:02:f3:1a:00:01:01:39

Payload header				First measurement (battery voltage)				
0x02	0x7d	0x00	0x00	0x08	0x00	0x01	0x10	0x80
ver = 2	cnt = 125	pct [s] = 0		type = 2 prec = 0	md [s] = 0	addr_len = 0 meas_len = 2	val = 4224 (4224 [mV])	

Second measurement (temperature)

0x0d	0x00	0x01	0x01	0x06
type = 3 prec = 1	md [s] = 0	addr_len = 0 meas_len = 2	val = 262 (26,2 [°C])	

Third measurement (relative humidity)

0x10	0x00	0x00	0x3b
type = 4 prec = 0	md [s] = 0	addr_len = 0 meas_len = 1	val = 56 (56 [%])

Fourth measurement (CO2 [ppm])

0x6c	0x00	0x01	0x02	0xf3
type = 27 prec = 0	md [s] = 0	addr_len = 0 meas_len = 2	val = 755 (755 [ppm])	

Fifth measurement (Illuminance [klx])

0x1a	0x00	0x01	0x01	0x39
type = 6 prec = 2	md [s] = 0	addr_len = 0 meas_len = 2	val = 313 (3,13 [klx])	

Sixth measurement (Occupancy [cnt])

0x60	0x00	0x01	0x00	0x02
type = 24 prec = 0	md [s] = 0	addr_len = 0 meas_len = 2	val = 2 (2 [cnt])	

Second frame (uplink) scheduled by "cycletime" parameter (1800 s default):

02:7e:00:00:fd:00:11:07:00:d2:fd:00:11:08:ff:ec:fd:00:11:09:ff:d8:fd:00:11:0a:00:46:fc:00:10:0b:0
1:fd:00:11:0c:00:d2:fc:00:10:0d:00

Payload header

0x02	0x7e	0x00	0x00
ver = 2	cnt = 126	pct [s] = 0	

First measurement (Thermostat Comfort setpoint)

0xfd	0x00	0x11	0x07	0x00	0xd2
type = 63 prec = 1	md [s] = 0	addr_len = 1 meas_len = 2	addr = 7	val = 210 (21,0 [°C])	

Second measurement (Thermostat Standby offset)

0xfd	0x00	0x11	0x08	0xff	0xec
type = 63 prec = 1	md [s] = 0	addr_len = 1 meas_len = 2	addr = 8	val = 210 (-2,0 [°C])	

Third measurement (Thermostat Economy offset)

0xfd	0x00	0x11	0x09	0xff	0xd8
type = 63 prec = 1	md [s] = 0	addr_len = 1 meas_len = 2	addr = 9	val = -20 (-4,0 [°C])	

Fourth measurement (Thermostat Frost protection setpoint)

0xfd	0x00	0x11	0x0a	0x00	0x46
type = 63 prec = 1	md [s] = 0	addr_len = 1 meas_len = 2	addr = 10	val = 70 (7,0 [°C])	

Fifth measurement (Thermostat Operating mode)

0xfc	0x00	0x10	0x0b	0x01
type = 63 prec = 0	md [s] = 0	addr_len = 1 meas_len = 1	addr = 11	val = 1 (Comfort mode)

Sixth measurement (Thermostat Actual setpoint)

0xfd	0x00	0x11	0x0c	0x00	0xd2
type = 63 prec = 1	md [s] = 0	addr_len = 1 meas_len = 2	addr = 12	val = 210 (21,0 [°C])	

Seventh measurement (Thermostat Output state)

0xfc	0x00	0x10	0x0d	0x00
type = 63 prec = 0	md [s] = 0	addr_len = 1 meas_len = 1	addr = 13	val = 0 (Output state off)

Compliance statements

CE

EC DECLARATION OF CONFORMITY
No. 03/2024/EN

with the European Directives: EMC 2014/30/UE; RED 2014/53/UE; RoHS 2011/65/UE

Yosensi Sp. z o.o., ul. Żurawia 71A, lok. 1.50, 15-540 Białystok

On our sole responsibility, we hereby declare that the product:

Name	**YO Thermostat**
Technical data	**Voltage 4,5 V DC; current max 120mA; IP40**

to which this declaration of conformity applies is consistent with legal acts:

The Directive EMC 2014/30/UE	Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (Official Journal of the European Union L 96/79 of 29.3.2014)
The Directive RED 2014/53/UE	Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC(Official Journal of the European Union L 153/62 of 22.5.2014)
The Directive RoHS 2011/65/EU and 2015/863/EU	Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (Official Journal of the European Union L 174/88 of 1.7.2011) and Commission Delegated Directive (EU) 2015/863 of 31 March 2015 amending Annex II to Directive 2011/65/EU

Harmonised standards applied to the product to which this Declaration of Conformity relates:

EN 50401:2017	Product standard to demonstrate the compliance of base station equipment with radiofrequency electromagnetic field exposure limits (110 MHz - 100 GHz), when put into service
EN IEC 61326-1:2021	Electrical equipment for measurement, control and laboratory use -- EMC requirements -- Part 1: General requirements (IEC 61326-1:2020)
EN IEC 61000-6-1: 2019	Electromagnetic compatibility (EMC) -- Part 6-1: Generic standards -- Immunity standard for residential, commercial and light-industrial environments (IEC 61000-6-1:2016)
EN IEC 61000-6-3: 2021	Electromagnetic compatibility (EMC) -- Part 6-3: Generic standards -- Emission standard for equipment in residential environments (IEC 61000-6-3:2020)
EN IEC 61000-6-2: 2019	Electromagnetic compatibility (EMC) -- Part 6-2: Generic standards -- Immunity standard for industrial environments (IEC 61000-6-2:2016)
EN IEC 61000-6-4: 2019	Electromagnetic compatibility (EMC) -- Part 6-4: Generic standards -- Emission standard for industrial environments (IEC 61000-6-4:2018)
ETSI EN 301 489-3 V2.1.1:2019	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU
ETSI EN 300 220-2 V3.2.1:2018	Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz; Part 2: Harmonised Standard for access to radio spectrum for non specific radio equipment
ETSI EN 300 328 V2.2.2:2019	Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz band; Harmonised Standard for access to radio spectrum
EN IEC 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

The last two digits of the year in which the CE marking was affixed to the product: 24

Founder/R&D Director
Paweł Popławski

Białystok, 2024-06-12

....
Place and date of issue   Name, surname and signature of the authorized person

YOSENSI.IO

CE

UNITED KINGDOM CONFORMITY ASSESSED
No. 03/2024/UKCA

with the European Directives: EMC 2014/30/UE; RED 2014/53/UE; RoHS 2011/65/UE

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BS EN IEC 61000-6-1: 2019	
BS EN IEC 61000-6-3: 2021	Electromagnetic compatibility (EMC) -- Part 6-1: Generic standards -- Immunity standard for residential, commercial and light-industrial environments (IEC 61000-6-1:2016)
BS EN IEC 61000-6-2: 2019	
BS EN IEC 61000-6-4: 2019	Electromagnetic compatibility (EMC) -- Part 6-3: Generic standards -- Emission standard for equipment in residential environments (IEC 61000-6-3:2020)
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Founder/R&D Director
Paweł Popławski

Białystok, 2024-06-12

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