

YO**SENSI**.IO

YO Power

User guide v1.0

Release notes

| Released | Version | Key changes |
|------------|---------|------------------|
| 11.06.2021 | 1.0 | Initial release. |

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Product description

Overview

YO Power measures AC flowing through devices connected to the electricity grid. With one device it is possible to measure the current simultaneously (e.g., in two three-phase, six single-phase, one three-phase and three single-phase devices, etc.).

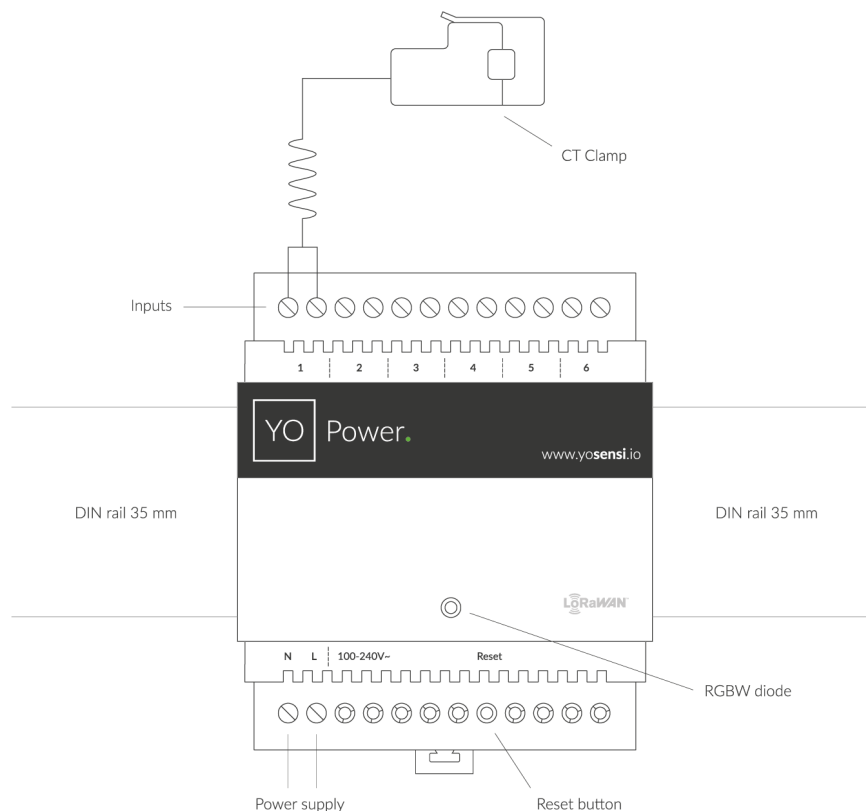


Figure 1 Device top view.

Visible device elements:

- CT clamps inputs,
- power supply connectors,
- reset button,
- RGBW diode.

Applications

By means of the application algorithm developed by the Yosensi Team, and despite the limitations of data transfer in the LoRaWAN network, it is possible to establish accurate mapping of current and power consumption.

IoT system components

Typical IoT systems consist of 3 main elements (Figure 2), 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 push them to the Internet-connected server.
3. Server – in most cases, a cloud-based service where data are processed, stored, analysed, and presented in user-friendly ways (via a user interface); Yosensi default and recommended tools are YO Suite (for IoT structure management) and Grafana (for data presentation).

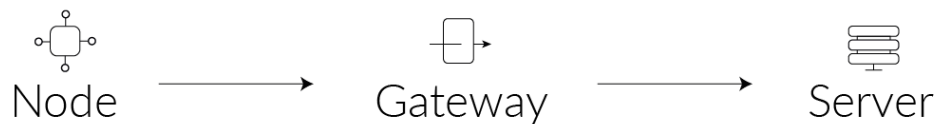


Figure 2 IoT system components.

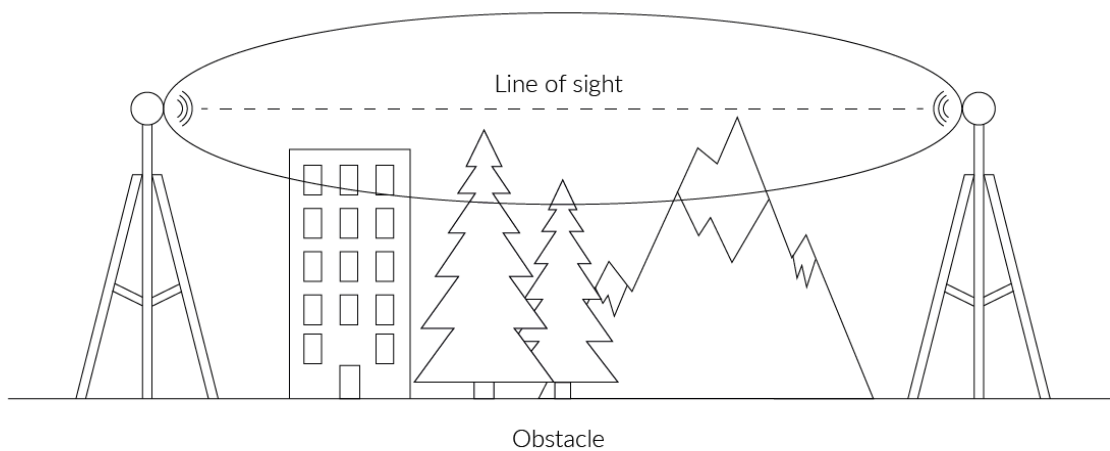


Figure 3 Fresnel zone where communication between two antennas can occur.

Device configuration

Configurable parameters

A few parameters must be set in order to send data to the gateway. The default firmware is configured in ABP connection type with predefined *deveui*, *appkeyota*, *keyotaa* and *nwkskey* by MCU.

CONFIGURABLE PARAMETERS

| NAME | DESCRIPTION | POSSIBLE VALUES | DEFAULT VALUE | READ/ WRITE |
|-----------|--|--|---------------|-------------|
| devname | Device name | LNPW | LNPW | R |
| conntype | Connection type | 0 – OTAA, 1 – ABP | 1 | R/W |
| deveui | Device address EUI | 8 B (HEX) | predefined | R/W |
| appkeyota | OTAA application EUI | 8 B (HEX) | predefined | R/W |
| keyotaa | OTAA key | 16 B (HEX) | predefined | R/W |
| addrabp | ABP 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 |
| advble | Interval advertising Bluetooth [s] | MS_INPUT ¹ | 1600 | R/W |
| measinter | Measuring and/or sending interval LoRa [s] | 1–999999 | 300 | R/W |
| measlevel | Measuring threshold [%] ² | 1–9999 | 10 | R/W |
| input1 | CT-clamp type on input 1 | | 1 | R/W |
| input2 | CT-clamp type on input 2 | | 1 | R/W |
| input3 | CT-clamp type on input 3 | 1 – CT 100 A 50 mA 2 – CT 160 A 40 mA | 1 | R/W |
| input4 | CT-clamp type on input 4 | | 1 | R/W |
| input5 | CT-clamp type on input 5 | | 1 | R/W |
| input6 | CT-clamp type on input 6 | | 1 | R/W |

¹ Calculation formula: MS_INPUT = INTERVAL_MS × 1.6.

² Sets the threshold that is used to save the peak timestamp and value that is between regular.

Parameters description:

1. Connection type (*conntype*)

Used for setting the device in ABP – value “1” or OTAA – value “0” mode.

2. Predefined addresses and keys (*deveui, appkeyota, keyotaa, addrabp, nwkskey, appskey*)

These parameters are generated using multiple IDs specific to the particular MCU and are unique for each device. They can be changed if needed.

3. Interval advertising Bluetooth (*advble*)

Determines the interval of sending broadcast packets, used to connect to every BLE receiver around the device.

4. Measuring threshold (*measlevel*)

YO Power is checking for changes in signal **every 2 s**. If consecutive measurement readings differ by more than specified by this parameter (see equation below) the present value and timestamp will be saved and prepared for transmission to the server (see figure 4).

$$|a - b| > b \cdot th$$

where:

a – current measurement

b – immediately preceding measurement

th – threshold value [%]

5. Measuring and/or sending interval in seconds (*measinter*)

Interval of sending each LoRa payload (t_{ii} on figure 4). It can be dynamically changed due to the amount of peaks in buffer (threshold exceed) in order to keep server updated with the latest data. For example if payload can hold 4 points and we have 6 points to send the algorithm will send these 4 points first and reduce the time interval of future payloads (see figure 4).

6. CT-clamp inputs (*input1, ..., input6*)

You can set the device to work with 2 types of CT-clamps:

- value “1” – current up to 100 A (max output current = 50 mA, CT ratio = 2000:1)
- value “2” – current up to 160 A (max output current = 40 mA, CT ratio = 4000:1)

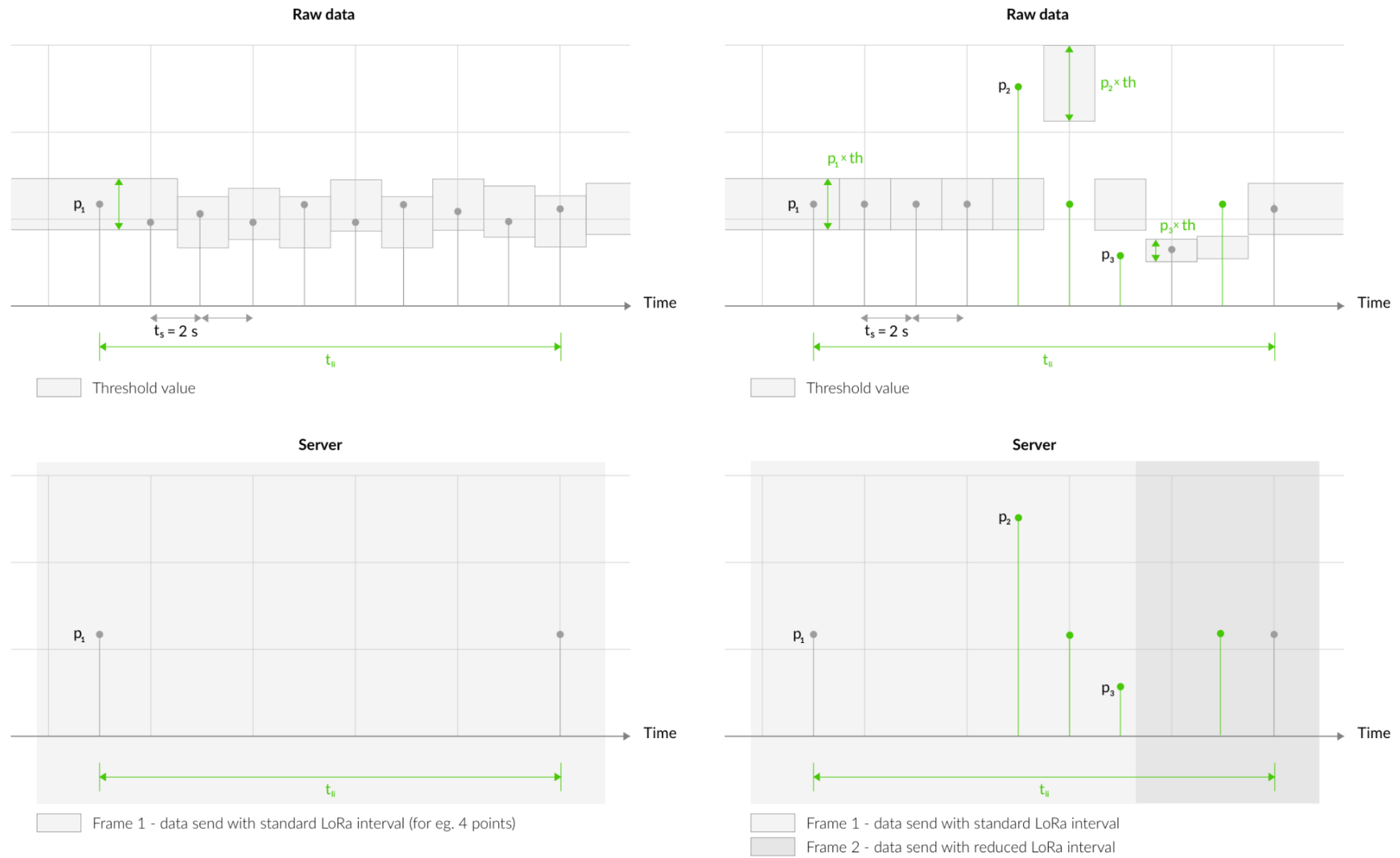


Figure 4 Threshold algorithm visualisation.

t_{ii} - measinter, t_s - time between consecutive measurements, $p_1 \dots p_3$ - measurements values, th - measlevel [%]

Quick start guide

Required equipment/software:

- PC with Bluetooth adapter (USB dongle or built-in),
- power supply 100–240 V AC,
- Yosensi CLI tool.

NOTE Yosensi CLI tool works only with YO Power default Yosensi firmware. For official firmware updates, contact us on support@yosensi.io.

Node configuration

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).

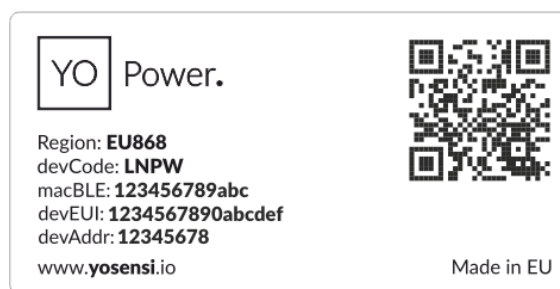


Figure 5 Device information sticker/nameplate example.

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. Connect power supply pins (input - N, L) of the YO Power device. See Quick Installation Guide for step by step instructions.
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 `change_dev_params` subcommand to change device settings. Additional information, including the commands supported by the CLI, are available at <https://yosensi.io/support>.

Command help view:

```
.\yosensi-cli-tool_vX.X.X_WIN.exe change_dev_params --help
usage: yosensi-cli-tool change_dev_params [-h] mac dev_param [dev_param ...]

positional arguments:
  mac          Bluetooth public MAC address
  dev_param    device parameter(s) name and value, in format 'name=value'
```

Example of use:

```
.\yosensi-cli-tool_vX.X.X_WIN.exe change_dev_param 80:e1:26:1d:2a:33 conntype=0 measinter=1000
It will take up to 180s to find and write new device param(s) into memory, please wait ...
Searching for a device ...
Trying to connect to the device ...
Updated 'conntype' device parameter: SUCCESS
Updated 'measinter' device parameter: SUCCESS
```

After node reconfiguration, you need to have access to the gateway and server. Remember that LoRaWAN network can be set in either of **public** or **private** (default) mode. If you have your gateway prepared and configured, you can start to customize the server side. We'll go through an example in our recommended YO Suite software.

NOTE The firmware update process is described in CLI tool manual page 13. Visit <https://yosensi.io/support> to see all available documentation.

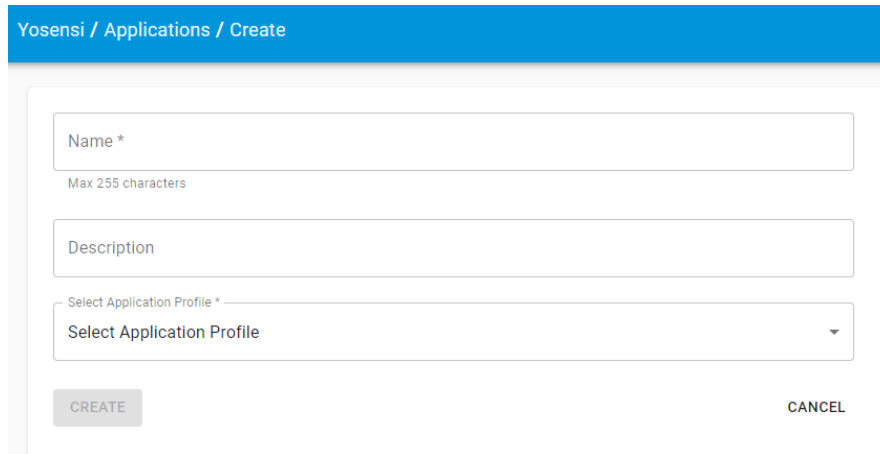
YO Suite configuration

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 YO Suite 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 YO Suite is described below.

NOTE A subscription is needed to use YO Suite. Visit <https://yosensi.io/> for more information and pricing.

YO Suite 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.

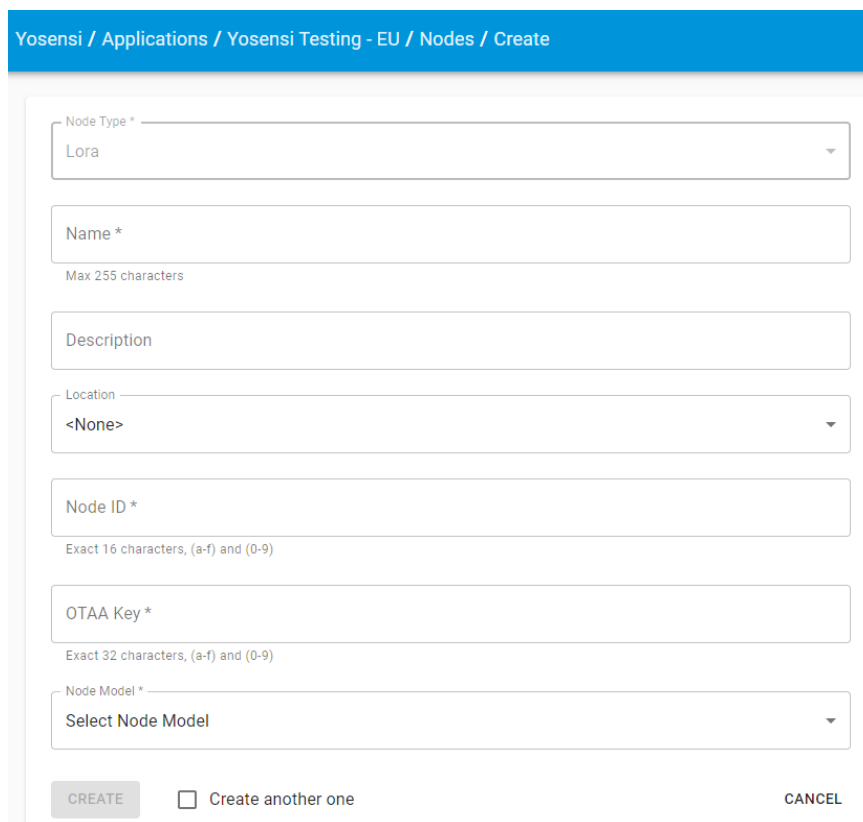


The screenshot shows the 'Application creation form' in the Yosensi interface. The breadcrumb navigation at the top reads 'Yosensi / Applications / Create'. The form contains the following fields and controls:

- Name ***: A text input field with a maximum length of 255 characters.
- Description**: A text input field.
- Select Application Profile ***: A dropdown menu with the text 'Select Application Profile' and a downward arrow.
- CREATE**: A button to submit the form.
- CANCEL**: A button to cancel the form.

Figure 6 Application creation form.

- Proceed to the application by clicking its name on the list, and press the '+' button to add a node. Select 'Lora' in 'Node Type' field. Set the 'Name', 'Description' fields and fill in 'Node ID' (*deveui*) and 'OTAA Key' (*keyotaa*) **which can be found using the CLI tool (*list_dev_params*)**. Select a model that is compatible with your device—it affects the number of charts, its placement and data source (YO Power model). 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>.



The screenshot shows the 'Node creation form' in the Yosensi interface. The breadcrumb navigation at the top reads 'Yosensi / Applications / Yosensi Testing - EU / Nodes / Create'. The form contains the following fields and controls:

- Node Type ***: A dropdown menu with 'Lora' selected.
- Name ***: A text input field with a maximum length of 255 characters.
- Description**: A text input field.
- Location**: A dropdown menu with '<None>' selected.
- Node ID ***: A text input field with a requirement of 'Exact 16 characters, (a-f) and (0-9)'. This field is highlighted in red.
- OTAA Key ***: A text input field with a requirement of 'Exact 32 characters, (a-f) and (0-9)'. This field is highlighted in red.
- Node Model ***: A dropdown menu with the text 'Select Node Model' and a downward arrow.
- CREATE**: A button to submit the form.
- Create another one**: A checkbox to create another node.
- CANCEL**: A button to cancel the form.

Figure 7 Node creation form.

5. **Every new node must be added in OTAA mode.** You must then switch its type to ABP after activation in YO Suite 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' (*addrabp*), 'Application Session Key' (*appskey*) and 'Network Session Key' (*nwkskey*) with **values from the CLI tool**, and press UPDATE.

The screenshot shows a configuration form for a node's LoRa type. The form is titled 'KEYS' and has tabs for 'DETAILS', 'SENSORS', 'PARAMETERS', 'EXTERNAL API', and 'KEYS'. The 'KEYS' tab is active. The form contains four input fields:

- Lora Type ***: A dropdown menu with 'ABP' selected.
- Device Address ***: A text input field containing '12345678'. Below it, a note says 'Exact 8 characters, (a-f) and (0-9)'.
- Application Session Key ***: A text input field containing '123456789abcdef123456789abcdef12'. Below it, a note says 'Exact 32 characters, (a-f) and (0-9)'.
- Network Session Key ***: A text input field containing '123456789abcdef123456789abcdef12'. Below it, a note says 'Exact 32 characters, (a-f) and (0-9)'.

At the bottom of the form is a blue 'UPDATE' button.

Figure 8 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 need the payload decoder which can be found at <https://yosensi.io/support>.

Example of YO Power payload with description:

```
02:00:00:07:2e:00:11:01:00:00:2e:00:11:02:00:28:2e:00:11:03:00:9e:2e:00:11:04:01:70:2e:00:11:05:01:e6:2e:00:11:06:00:f1
```

| Payload header | | | | First measurement | | | | | |
|----------------|---------|-------------|------|------------------------|------------|-------------------------------|----------|----------------------|------|
| 0x02 | 0x00 | 0x00 | 0x07 | 0x2E | 0x00 | 0x11 | 0x01 | 0x00 | 0x00 |
| ver = 2 | cnt = 0 | pct [s] = 7 | | type = 11, prec = 2 | md [s] = 0 | addr_len = 1, meas_len = 2 | addr = 1 | val = 0 (0,0 [A]) | |

| Second measurement | | | | | |
|------------------------|------------|-------------------------------|----------|-----------------------|------|
| 0x2E | 0x00 | 0x11 | 0x02 | 0x00 | 0x28 |
| type = 11, prec = 2 | md [s] = 0 | addr_len = 1, meas_len = 2 | addr = 2 | val = 40 (0,4 [A]) | |

| Third measurement | | | | | |
|------------------------|------------|-------------------------------|----------|-------------------------|------|
| 0x2E | 0x00 | 0x11 | 0x03 | 0x00 | 0x9E |
| type = 11, prec = 2 | md [s] = 0 | addr_len = 1, meas_len = 2 | addr = 3 | val = 158 (1,58 [A]) | |

| Fourth measurement | | | | | |
|------------------------|------------|-------------------------------|----------|-------------------------|------|
| 0x2E | 0x00 | 0x11 | 0x04 | 0x01 | 0x70 |
| type = 11, prec = 2 | md [s] = 0 | addr_len = 1, meas_len = 2 | addr = 4 | val = 368 (3,68 [A]) | |

| Fifth measurement | | | | | |
|------------------------|------------|-------------------------------|----------|-------------------------|------|
| 0x2E | 0x00 | 0x11 | 0x05 | 0x01 | 0xE6 |
| type = 11, prec = 2 | md [s] = 0 | addr_len = 1, meas_len = 2 | addr = 5 | val = 486 (4,86 [A]) | |

| Sixth measurement | | | | | |
|------------------------|------------|-------------------------------|----------|-------------------------|------|
| 0x2E | 0x00 | 0x11 | 0x06 | 0x00 | 0xF1 |
| type = 11, prec = 2 | md [s] = 0 | addr_len = 1, meas_len = 2 | addr = 6 | val = 241 (2,41 [A]) | |

Revision history

| Date | Version | Changes |
|------------|---------|-----------------|
| 11.06.2021 | 1.0 | Initial release |