YOSENSI.IO

YO Meter Reader 2.0

User guide v1.0

Release notes

Released	Version	Key changes
26.03.2024	1.0	Initial release.

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Product description

Overview

YO Meter Reader 2.0 is a LoRaWAN device for reading data from a dedicated LED pulse detector. The sensor enables remote reading of e.g. electricity or water consumption by reading LED pulses on energy, water meters. In addition, the YO Meter Reader 2.0 has built-in temperature and humidity sensors.

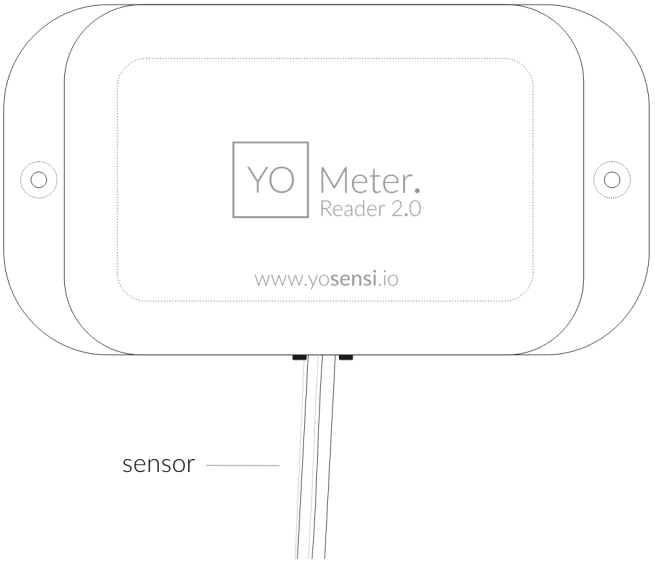

Figure 1 Device top view.

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 sticker.

Physical interfaces

LEDs

YO Meter Reader 2.0 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

The YO Meter Reader 2.0 has a button for resetting the device. Figure 3 shows its placement (next to the LED). To reboot the device, press the reset button for a moment, e.g. with a thin stick.

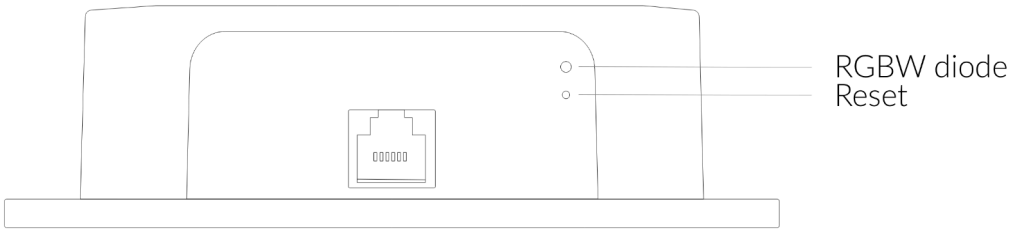

Figure 4 Reset button.

Specifications

Physical

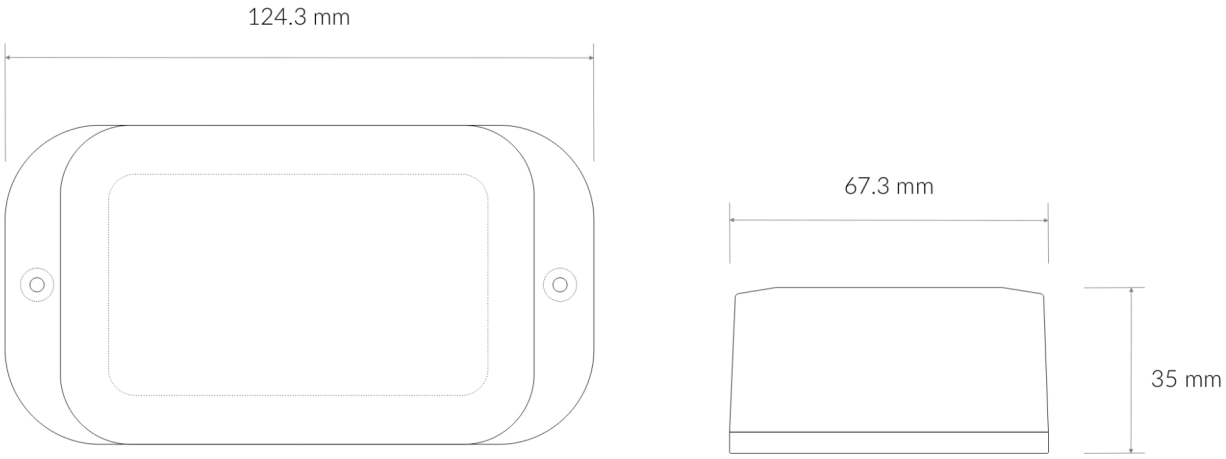

Figure 4 Dimensions of the device.

PHYSICAL SPECIFICATION	
Dimensions	Height: 35 mm Width: 67,3 mm Depth: 124,3 mm
Colour	White
Mounting method	Horizontal Vertical (can be screwed to the wall)
Enclosure material	ABS
Level of protection	IP40
Weight	106 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%)
Periodic counter	0-2147483647 (int32)	-
Persistent counter	0-2147483647 (int32)	-
Utilities (energy, water, gas) consumption [kWh], [J], [m3]...	0-214748364.7 (int32, precision 1)	-

The YO Meter Reader is a device with an external port for connecting a meter to use the LED pulse detector function.

Device is equipped with two counters: periodic and persistent. In addition, the device has a converter for pulses per unit. It is useful for quick conversion of raw data to specific units read from meter.

Periodic counter counts pulses cyclically with time interval defined by LoRa sending interval. The periodic counter counts the pulses within the time interval specified by the measurement interval parameter which also specifies the time at which a LoRaWAN data payload is sent.

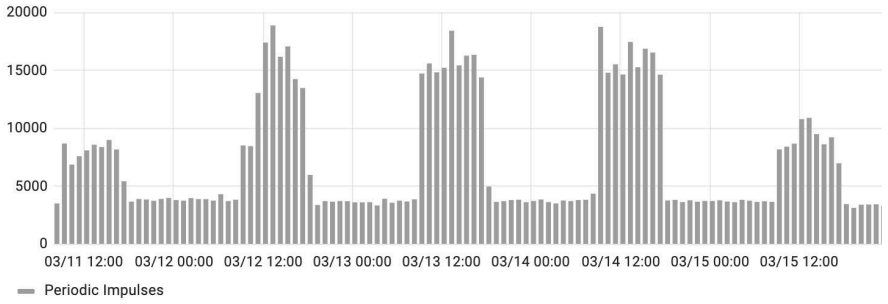

Figure 5 Example of periodic impulses monitoring chart.

Persistent counter accumulates pulses and stores them in non-volatile memory - this counter can be reset (cleared) using one of the parameters via BLE.

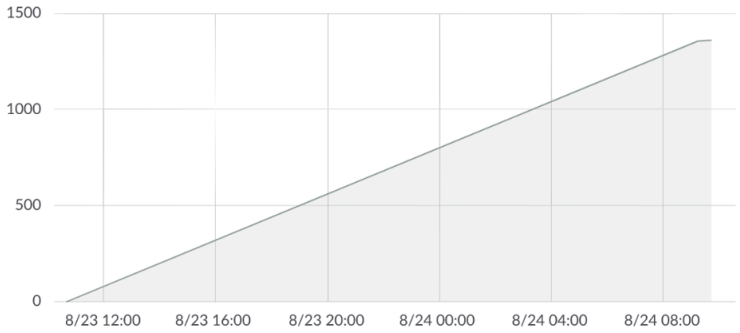

Figure 6 Example of total impulses monitoring chart.

Total utilities (energy, water, gas) consumption [kWh], [J], [m3] are calculated based on the **Persistent counter** and configuration parameter "**impkwh**" - this data is cleared with Persitent counter.

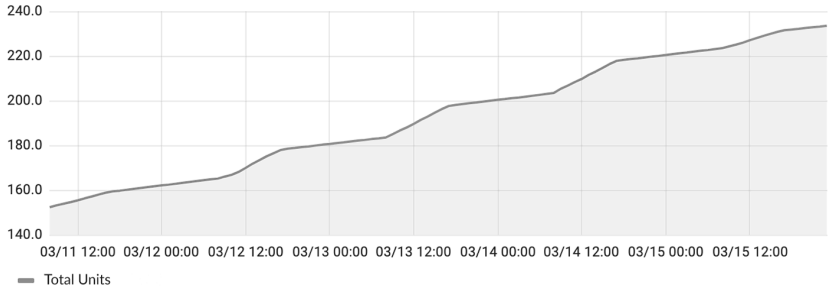

Figure 7 Total energy exemplary chart.

Temperature and relative 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.

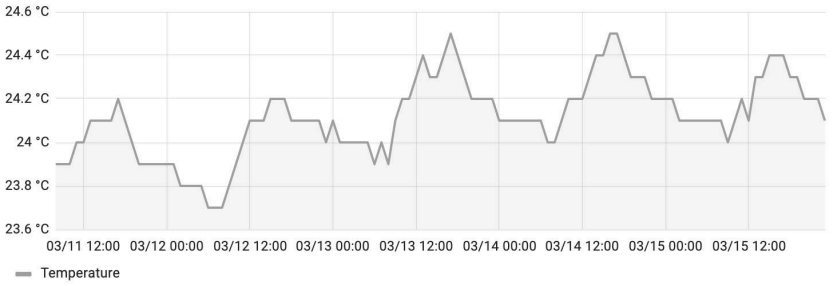

Figure 8 Internal temperature exemplary chart.

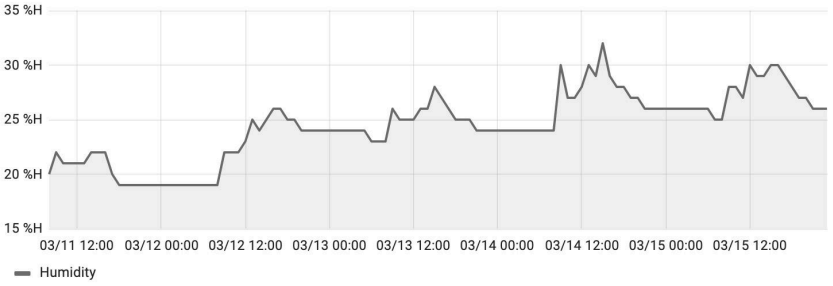

Figure 9 Internal humidity exemplary chart.

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.

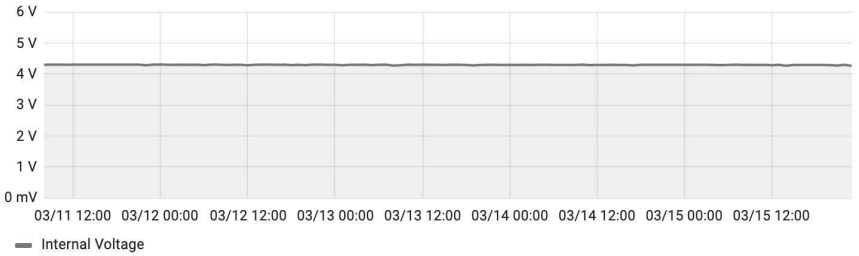

Figure 10 Battery voltage exemplary chart.

Installation

Package contents

1. Device (without batteries).
2. External meter (selected when ordered).
3. 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. Connect the sensor to the RJ12 socket in the device.

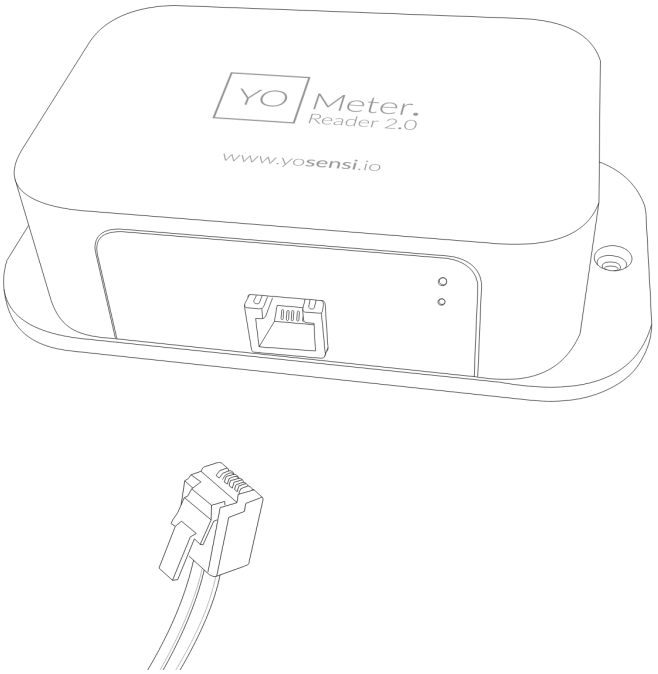

Figure 11 Connecting sensor to the device.

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

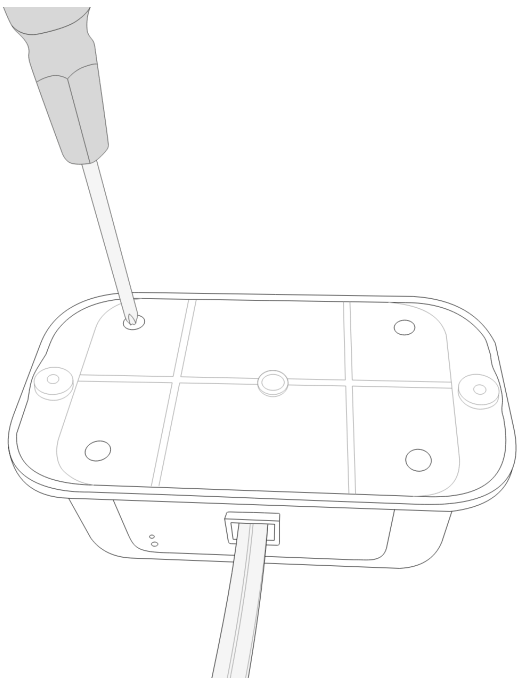

Figure 12 Back view of the device.

3. Place three LR6 (AA) batteries in the device according to the polarity indicated on the battery holder.

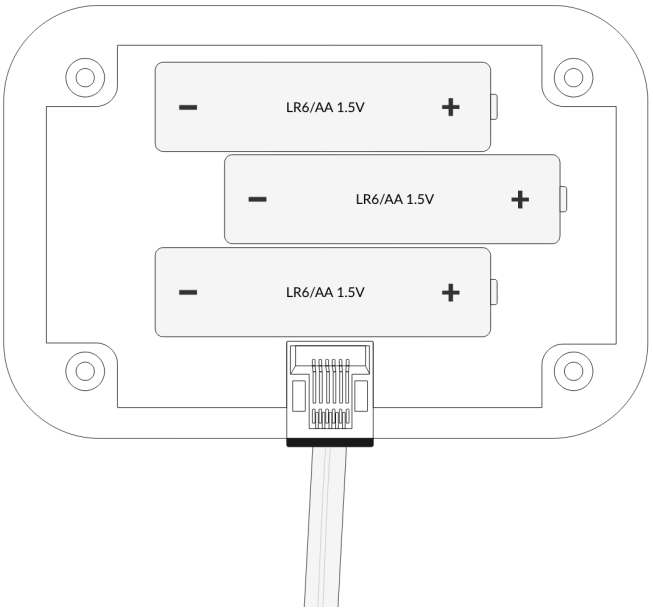

Figure 13 Battery placement instructions.

4. Assemble the device and screw it back together.

Operation

IoT system components

Typical IoT systems consist of 3 main elements *(Figure 14)*, 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).

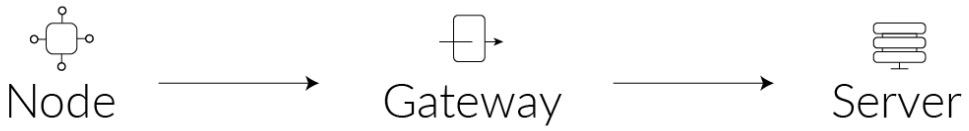

Figure 14 IoT system components.

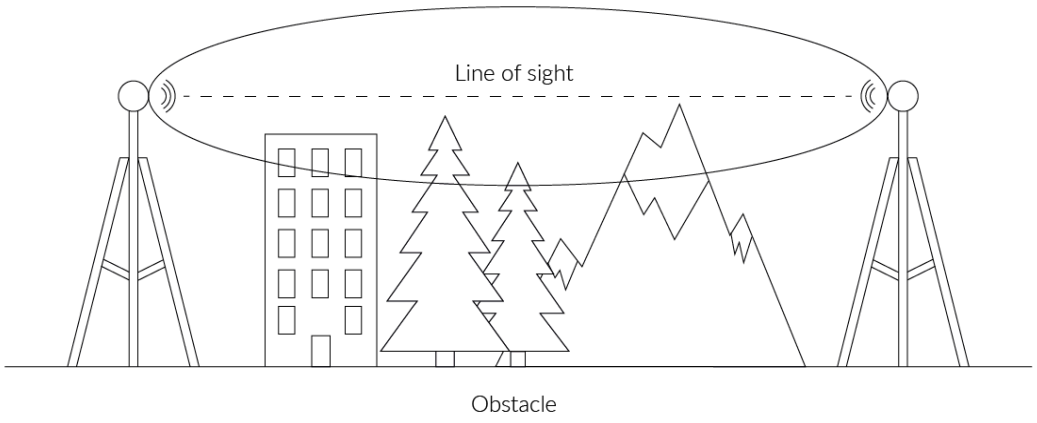

Figure 15 Fresnel zone where communication between two antennas can occur.

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 Meter Reader device.

```
{
        "info": {
                "devmodel": "LNMR",
                "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,
                "lightthreshold": 200,
                "pulsetime": 20,
                "impkwh": 1000,
                "activeledtimer": 1,
                "clearcnt": "no"
        }
}
```

GENERICS PARAMETERS

SECTION	NAME	DESCRIPTION	POSSIBLE VALUES	DEFAULT VALUE	READ/ WRITE
info	devmodel	Device name	-	LNMP	R
	fwver	Firmware version	-	3.6.2	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 [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]	120–999999	3600	R/W
lightthreshold	LED detection pulse threshold [lx]	0–107374	200	R/W
pulsetime	Integration time of LED pulse counter [ms]	1–999999	20	R/W
impkwh	Utilities (energy, water, gas) consumption [kWh], [J], [m3]...	1–999999	1000	R/W
activeledtimer	Timer of active LED indicator [h]	0–24	1	R/W
clearcnt	Clear the persistent pulse counter	no, yes	no	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:*** measurement interval [s] between sending LoRa packets.
- ***lightthreshold:*** used to set the light threshold [lx] for the LED pulse counter sensor.
- **pulsetime:** integration time [ms] of LED pulse counter. Parameter determine maximum frequency for LED pulse counter.
- **impkwh:** determines calculation of Total units payload measurement. It calculates the units based on the measured impulses based on the following formula:
  Total units = (Persistent counter)/impkwh.
- **activeledtimer:** determines the timer of active LED indicator in LED pulse counter sensor. Expressed in hours. Can be deactivated by setting value equals 0.
- ***clearcnt:*** device keeps a persistent counter in EEPROM where it stores the total number of pulses counted; this counter can be cleared using this parameter.

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*

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: 0x00
- Data up to 4 bytes in hex

0x03000258 - sample downlink with 600 seconds [10 min] measurement interval.

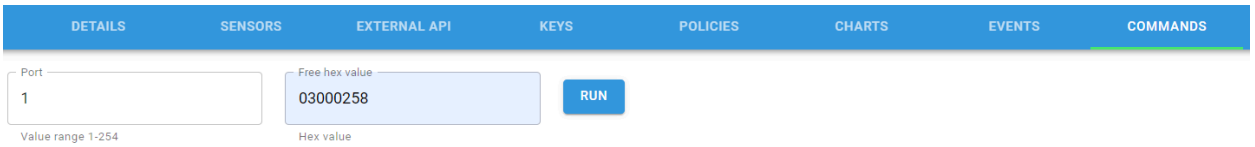

Figure 16 Downlink message example.

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.
    - 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 to configure parameters. 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.

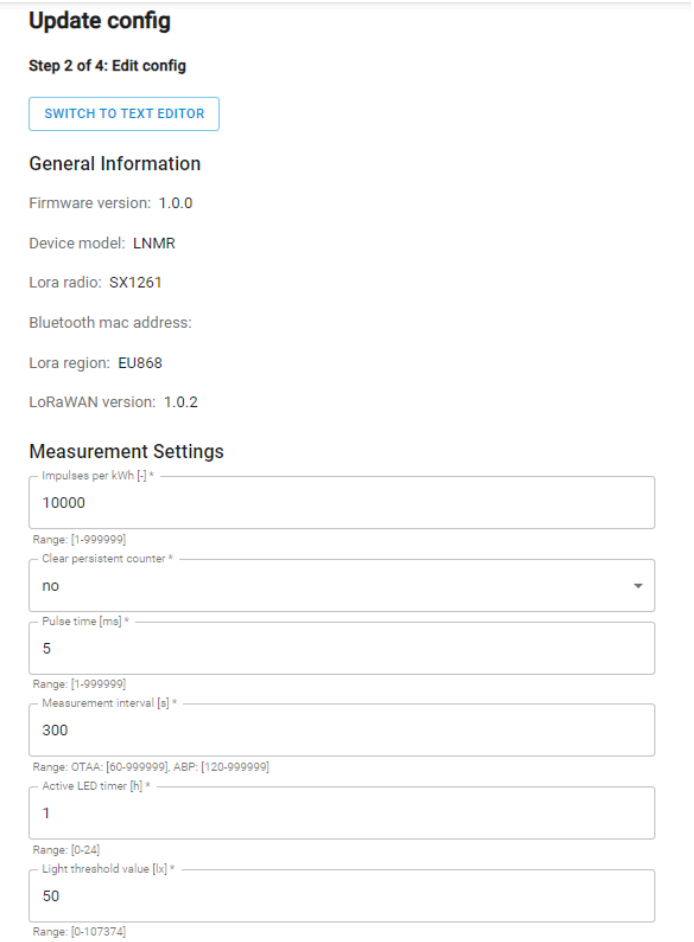

Figure 17 Update configuration section view.

6. Press the upload button and wait.

NOTE **Additional information including device configuration can be found in Yosensi configuration web tool.**

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.

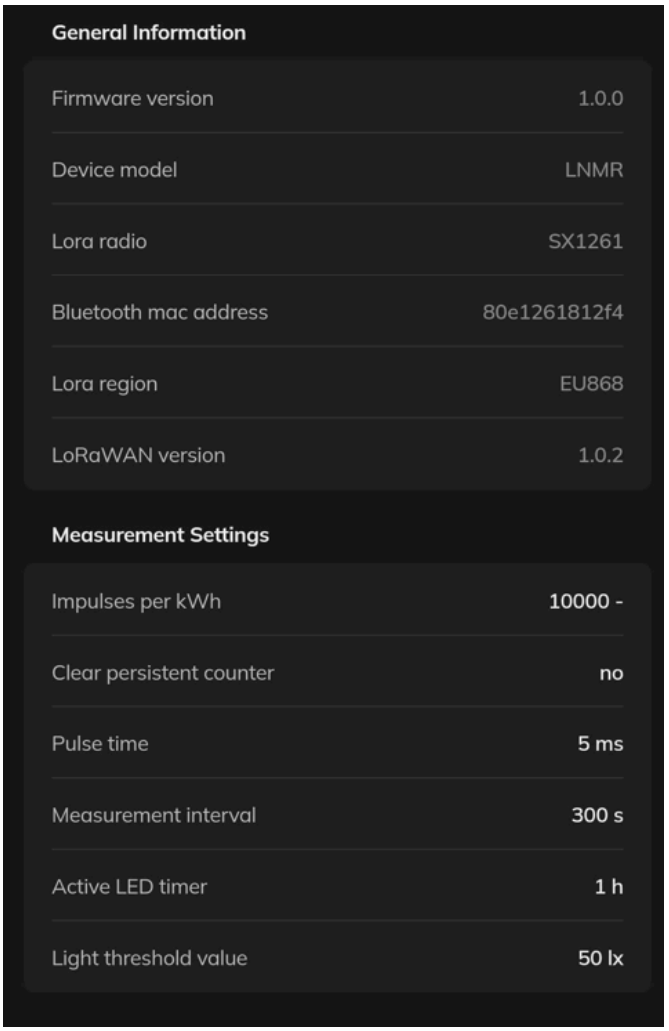

Figure 18 Configuration view in mobile app.

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.

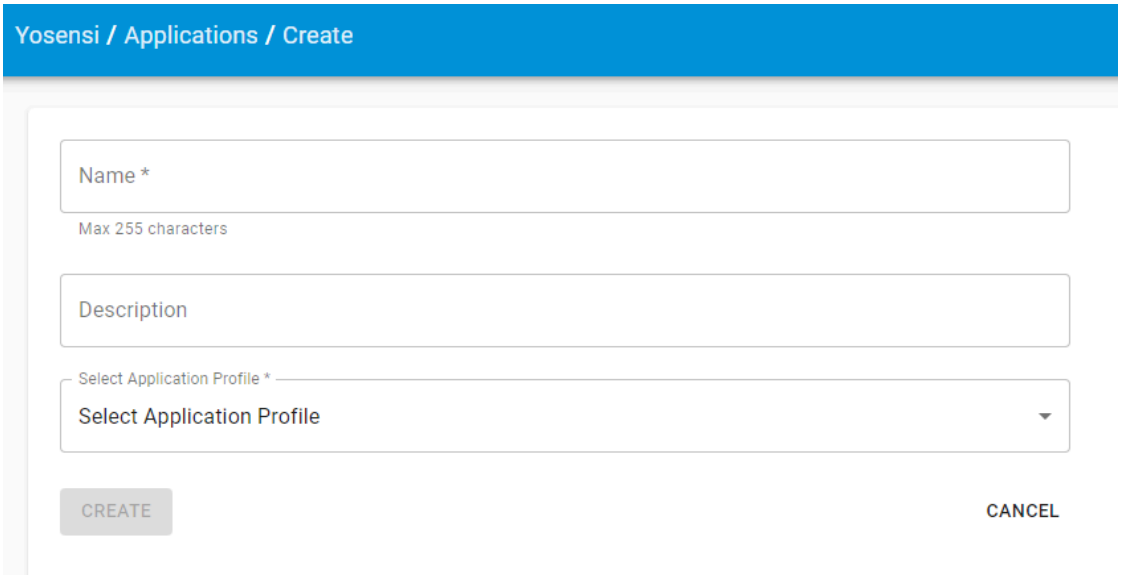

Figure 19 Application creation form.

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 (YO Meter Reader). 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>.

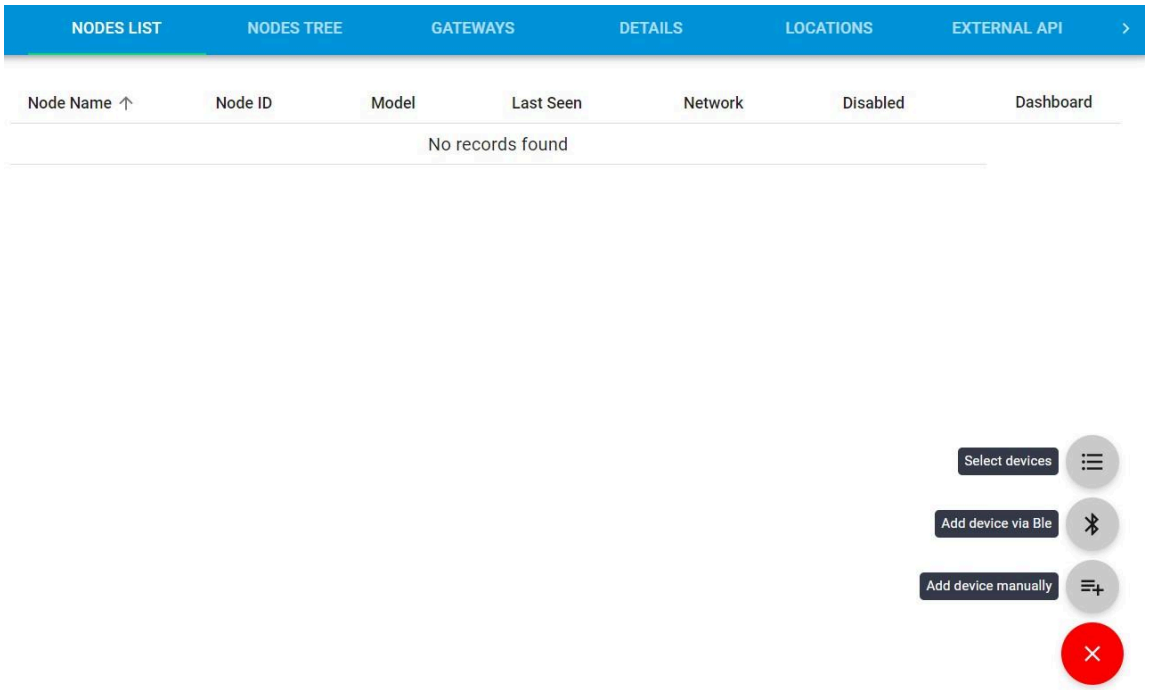

Figure 20 Adding node to the Yosensi Management Platform section view.

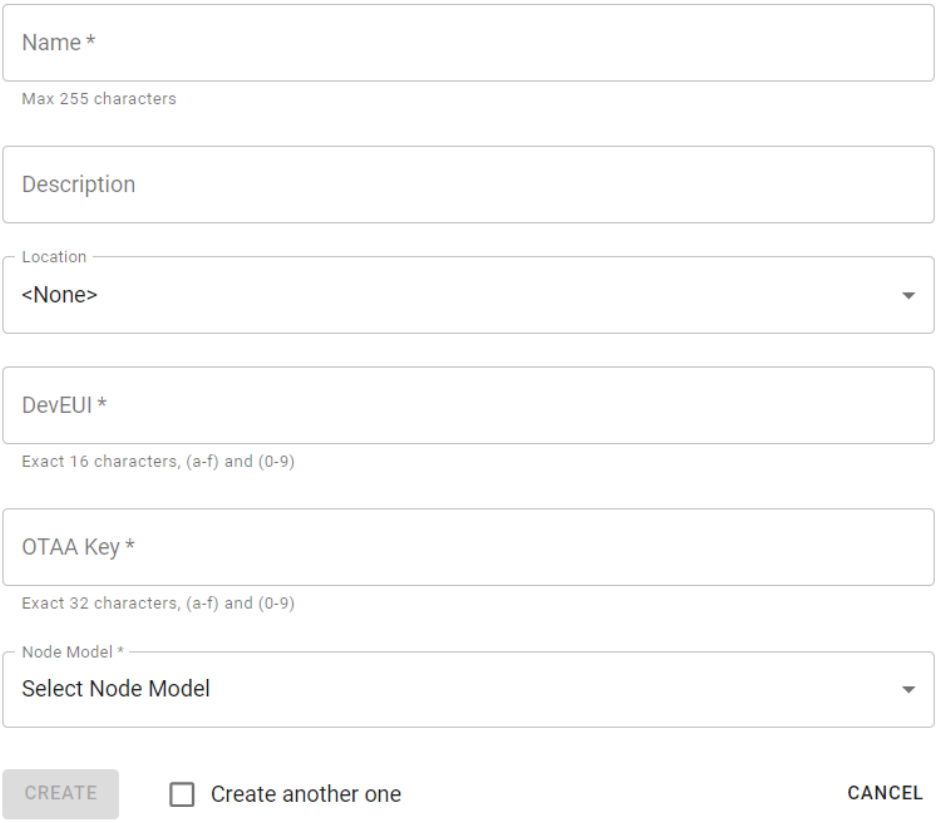

Figure 21 Node creation form.

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.

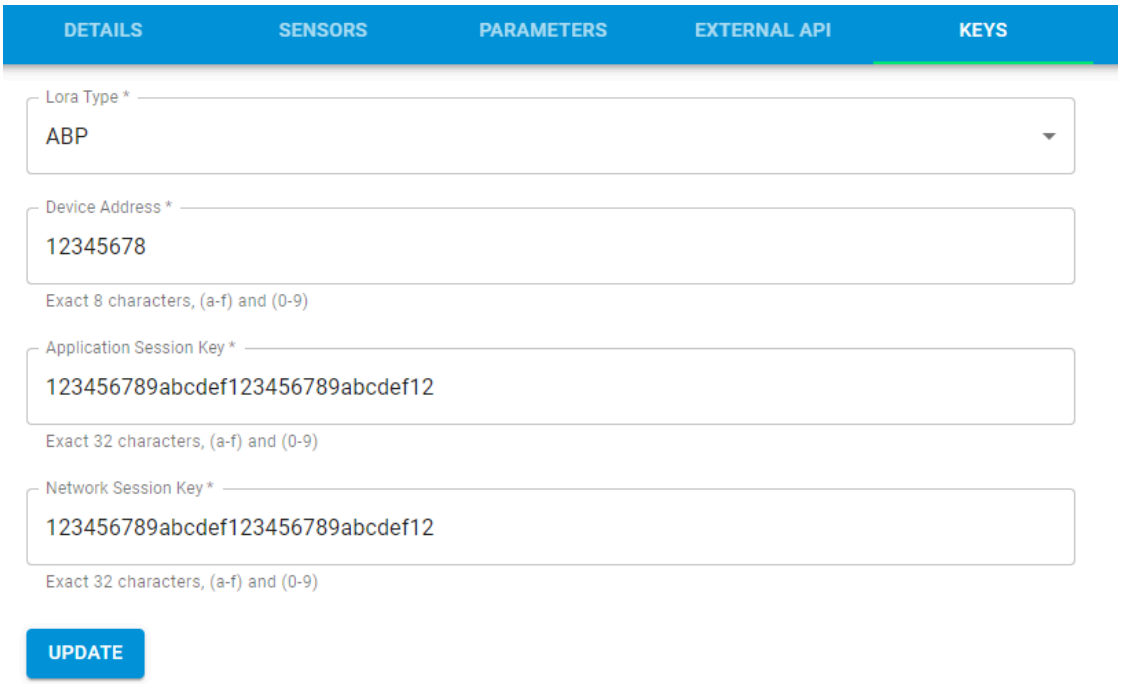

Figure 22 Node LoRa type configuration form.

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 Meter Reader is presented below with divisions for each measurement and marked with decoded values, whose interpretation is described in the Payload description.

Example of YO Meter Reader payload with description:

02:3e:00:01:08:00:01:11:98:0d:00:01:00:f3:10:00:00:20:5c:00:07:00:00:02:41:00:00:9e:6d:99:00:03:00:00:00:29

Payload header

0x02	0x3e	0x00	0x01
ver = 2	cnt = 62	pct [s] = 1	

First measurement (battery voltage)

0x08	0x00	0x01	0x11	0x98
type = 2 prec = 0	md [s] = 0	addr_len = 0 meas_len = 2	val = 4504 (4504 [mV])	

Second measurement (temperature)

0x0D	0x00	0x01	0x00	0xF3
type = 3 prec = 1	md [s] = 0	addr_len = 0 meas_len = 2	val = 243 (24,3 [°C])	

Third measurement (relative humidity)

0x10	0x00	0x00	0x20
type = 4 prec = 0	md [s] = 0	addr_len = 0 meas_len = 1	val = 32 (32 [%])

Fourth measurement (pulse counter - periodic and persistent)

0x5C	0x00	0x07	0x00	0x00	0x02	0x41	0x00	0x00	0x9e	0x6d
type = 23 prec = 0	md [s] = 0	addr_len = 0 meas_len = 8	val = 577 (577 [-])				val = 40557 (40 557 [-])			

Fifth measurement (Total units)

0x99	0x00	0x03	0x00	0x00	0x00	0x29
type = 38 prec = 1	md [s] = 0	addr_len = 0 meas_len = 4	val =57 (5.7 [units])			

Compliance statements

CE

EC DECLARATION OF CONFORMITY
No. 01/2024/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 Meter Reader 2.0**
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 L153/62of 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

Harmonized 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 61000-6-2: 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, 2024-03-26

Place and date of issue

Name, surname and signature of the authorized person

YOSENSI.IO

CE

UNITED KINGDOM CONFORMITY ASSESSED
No. 01/2024/UKCA

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

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