Smart MPPT

User guide

AQUIDIS

Version: 0.9

Content

1.Safety Instructions

To ensure your safety, please read this instruction manual carefully before installing and using the Smart MPPT controller (hereafter referred to as “the regulator”) and keep it for future reference.

This manual contains detailed instructions for installing and operating the regulator. The regulator may only be installed by a person with the necessary qualifications and authorization to install photovoltaic systems. The installation information in this manual is intended for professional use.

Neither the manufacturer nor the seller bears any responsibility for any damage caused by using the product in a way other than that specified in this manual, i.e. in particular by its incorrect use, inappropriate connection or disregard of recommendations and warnings. Any other use or connection of the product, apart from the procedure and connection specified in the manual, is considered incorrect and the manufacturer bears no responsibility for the consequences caused by such actions.

The manufacturer is not responsible for damage to property, health or damage, or destruction of the product caused by inappropriate location or unprofessional installation, incorrect operation or use of the product contrary to this user manual.

1.1.Instructions

- Carefully read all instructions, warnings, and safety precautions in this manual before beginning installation.
- Before installation and subsequent use of the controller, make sure that the controller is complete, including all accessories, and is not damaged in any way, e.g. due to liquid penetration or falling.
- It is not allowed to disassemble the regulator for maintenance or repair. Do not attempt to repair the regulator yourself. All repairs must be entrusted to an authorized service center or a professionally qualified person.
- Do not modify the device.
- Make sure all wiring is disconnected from the controller before installing or moving it.
- Use appropriate tools with the required insulation when connecting the wiring.
- Do not wear jewelry, watches, or other metal and conductive objects when installing the regulator.
- All wiring in terminal boxes must be tightly tightened and secured against movement or pulling out to prevent it from overheating or catching fire due to a loose connection or imperfect contact.
- Use wires and securing elements in accordance with applicable legislative requirements and standards at the installation site.
- Keep this information for future reference, and if you pass the device on to another person, pass this information on to them as well.
- Do not use the device in any way other than as described in this manual.
- Keep the device and all its loose parts out of the reach of children, pets and unauthorized persons.
- If the device is damaged in any way, stop using it immediately.

2. General Information

Photovoltaic water heating represents one of the most efficient ways of using solar energy for households and recreational facilities with a quick return on investment. Installation is simple - just mount the photovoltaic panels on the roof and connect them to the Smart MPPT, which will then be connected to the boiler. This ensures water heating using solar energy.

Smart MPPT is a key part of this system. This is a regulator that enables the most effective and safe connection of photovoltaic panels with the boiler. The controller uses smart software to monitor sunlight, current water temperature and other factors to optimize energy consumption for water heating. The system tries to use as much solar energy as possible, even in variable conditions.

Thanks to the Wi-Fi connection, you also have access to an online user interface where you can monitor all important parameters in real time. In the user account, you can find information about the current water temperature, the power supplied from the photovoltaic panels, and you can also view energy consumption statistics on a daily, weekly, monthly or yearly basis. The boiler can be controlled both directly using the LCD display on the control unit and online via the user application.

This system is user-friendly and designed to be as simple as possible to operate and to maximize the use of renewable energy sources. Predefined working modes are available to the user, which can be easily adapted to different situations without the need to make complex settings.

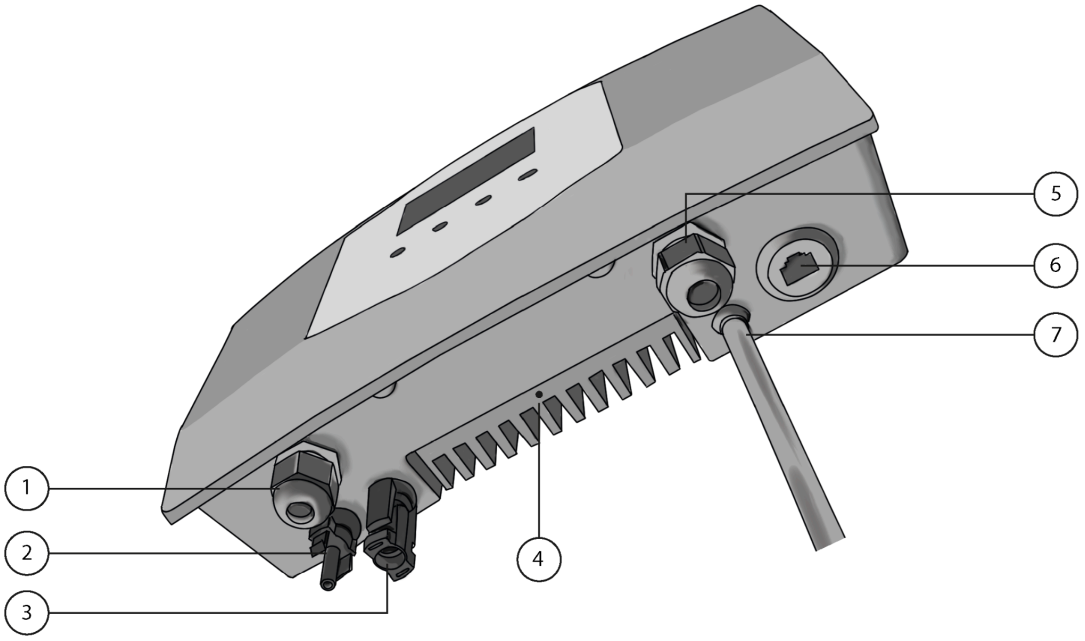
In this way, you can effectively save on electricity costs, while the whole system is simple to install and use.

2.1. Parameters

- hot water heating from 4 photovoltaic panels
- parallel operation of heating from PV panels and from the distribution network
- remote management of the controller using a Wi-Fi network and a web application
- graphic display showing: output from the panels, water temperature, working mode
- 3x temperature sensor integrated into the boiler for smart thermostat functions
- island operation support, heating only from PV panels
- 6 working modes
- quiet operation thanks to passive cooling
- high efficiency of MPPT controller more than 99%
- integrated electronic thermal fuse that protects the boiler against overheating
- protection against overheating of the regulator
- protection against scalding
- additional contact for signaling DHW heating
- boiler anti-freeze protection

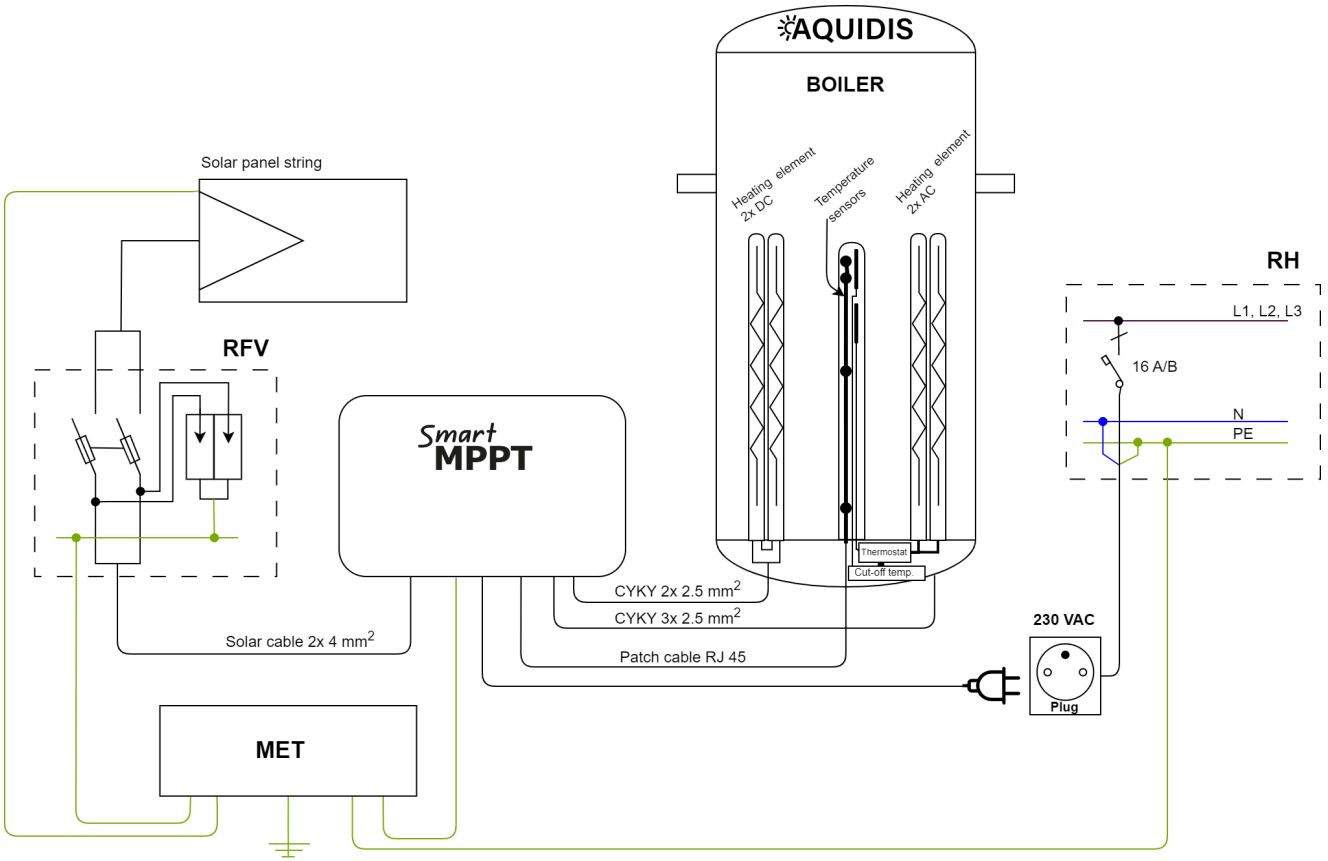
3. Connection and description of connectors

3.1. Description of connectors



1. DC OUT - output for DC heating rods in the boiler
2. IN - minus input from photovoltaic panels
3. IN + plus input from photovoltaic panels
4. PE - ground wire connection
5. AC OUT - output for AC heating rods in the boiler
6. SENSORS - input for temperature sensors (RJ 45 connector)
7. Input 230 VAC from the mains

3.2.System wiring diagram



For better protection against lightning, we recommend adding fuses and surge protection to the wires leading from the solar panels to the device.

We recommend entrusting the connection and installation of the system to a person with the appropriate qualifications.

The regulator cannot be used in parallel with another regulator or generator!

3.3.Photovoltaic panels

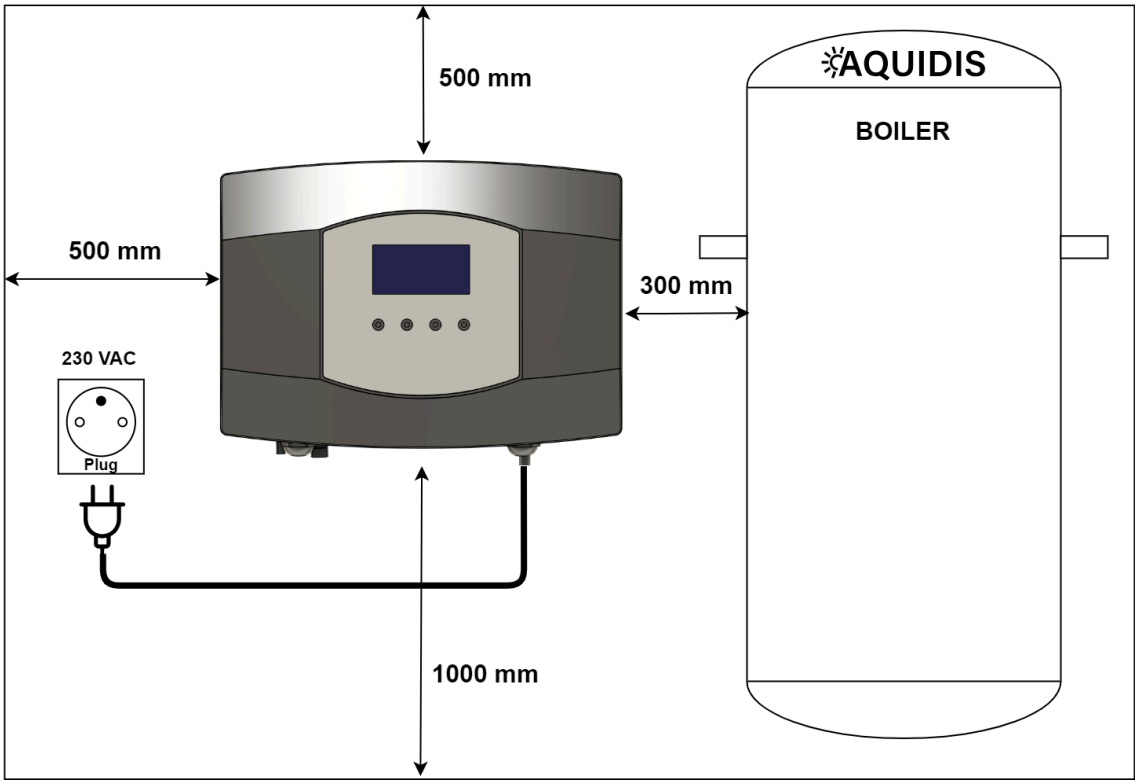
The number of connected panels in one string depends on the minimum / maximum voltage of the regulator and the connected boiler input. The recommended number of connected panels is 4 - 6 panels in one string with an open-circuit voltage of 50 V / panel. The performance of the string depends on the type of heating element connected.

Recommended connection for the Aquidis boiler

Number of panels	Panel power	Array power	No-load string tension
4x	550 W	2200 W	200 V
5x	450 W and above	2250 W and higher	250 V
6x	350 W and above	2100 W and higher	300 V

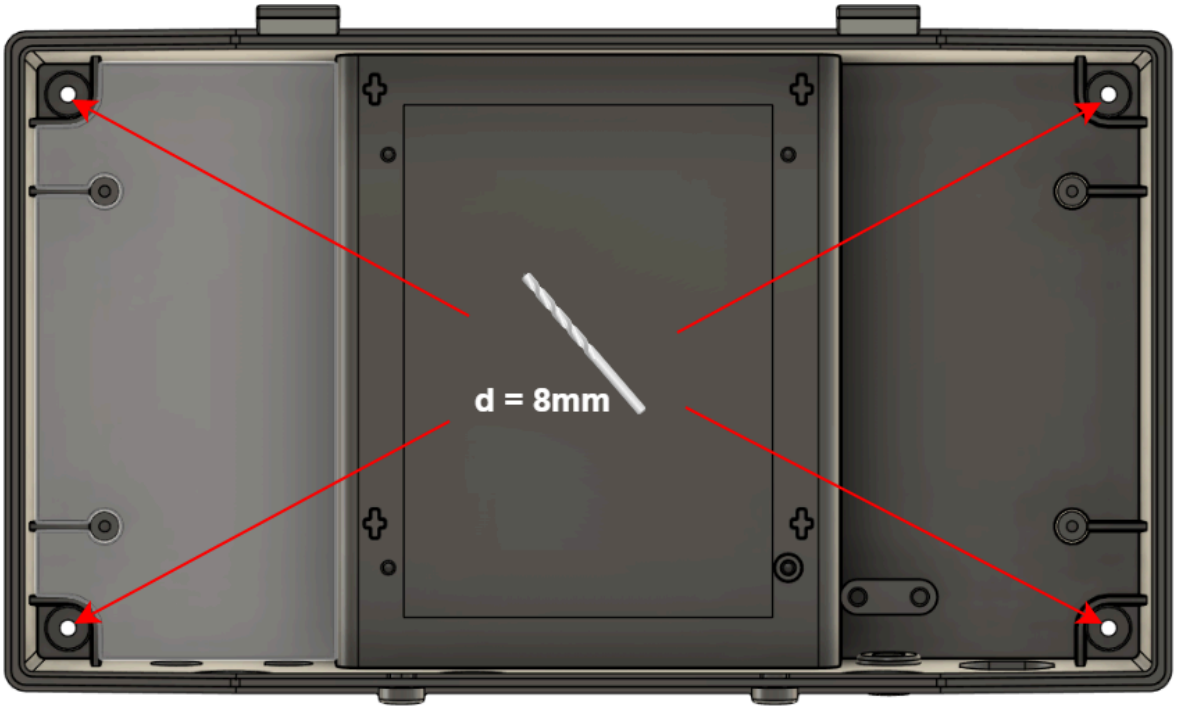
4.Construction

The optimal place for placing the regulator is a dry environment, preferably near the place where the electric boiler is installed. The regulator heats up during its operation, so it is necessary to maintain a minimum distance from surrounding objects, walls and the ceiling in order to ensure air circulation through the cooler. Poor air circulation can cause the regulator to overheat and reduce its lifespan.
The regulator must be placed perpendicular to the mounting surface. If the installation angle deviates from the vertical direction by more than 45°, poor heat dissipation and unstable controller behavior will occur.
The substrate for mounting and fixing the regulator must be able to safely support its weight and prevent possible detachment, in order to avoid damage to the regulator due to a fall or personal injury.



Never install the controller in a closed cabinet!

The wall mounting kit is part of the controller package. Mark the position of the holes with a pencil. Then drill four holes for dowels with a diameter of 8 mm. Insert dowels into the drilled holes, then attach the regulator and fasten it to the wall with 6 x 60 mm screws.



5.Working modes

5.1. Eco

Heating hot water only from PV panels to the temperature set by the user. The maximum adjustable temperature is 80 °C.

5.2. Combi

It combines hot water heating from PV panels and the distribution network. Due to the fact that the regulator has two separate galvanically separated circuits, one for the photovoltaic part and the other for heating from the distribution network, it is equipped with two independent thermostats.

5.3. Comfort *

Smartly combines energy from PV panels and the grid. The preparation of hot water is carried out according to the set time schedule. The user sets the desired water temperature and the time for which the water should be prepared. Each day of the week can be set separately and up to 5 time entries can be set for each day. The regulator primarily uses photovoltaic energy, and if there is a shortage of energy, it starts heating from the distribution network. Heating from the distribution network is started sufficiently in advance so that the water is heated to the

required temperature at the required time. The mode is only available if the controller is connected to the Cloud.

5.4. Smart *

Smart monitors the consumption of hot water during the weekly cycle and tries to prepare hot water in the required amount for the same time the following week. The mode automatically combines energy from PV and the grid. The mode also includes the weather forecast in its calculations so that PV energy is used as efficiently as possible. If the user has different VT and NT electricity tariffs, this parameter will also be taken into account when heating hot water from the distribution network. You will need to enter the location and tariff in the application settings. The mode is only available if the controller is connected to the Cloud.

5.5. Boost

This is a one-time rapid heating of water to the required temperature. This mode is activated temporarily. As soon as the water is heated to the required temperature, the controller returns to the previous mode. Heating takes place at the maximum possible output from the PV panels and at the same time from the distribution network.

5.6. Holiday

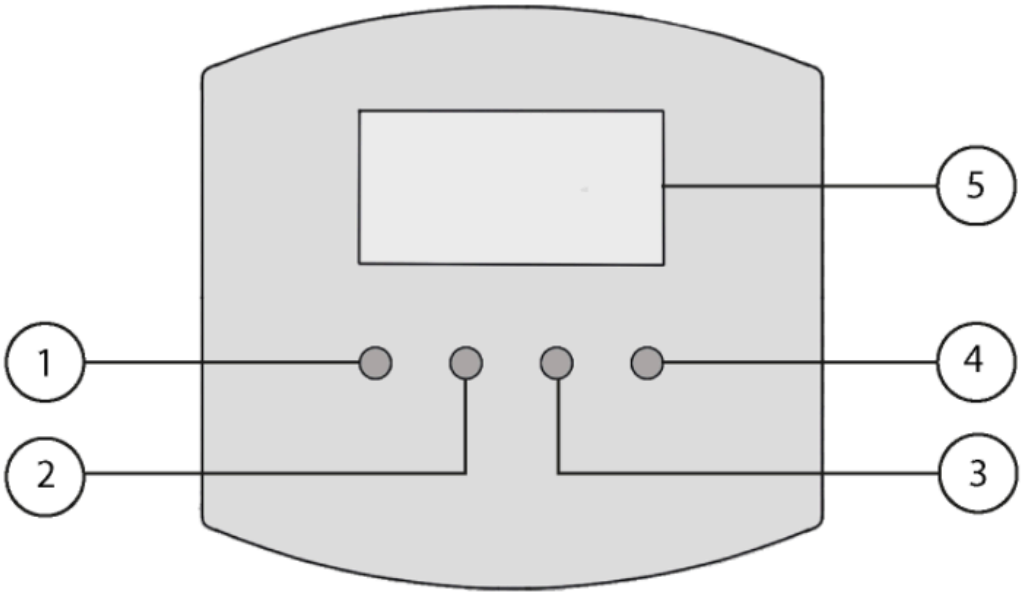
In holiday mode, the user sets the maximum water temperature to which the controller should heat it. Heating is realized only from PV panels and heating from the distribution network is blocked. The only exception is the Anti-Freeze function.

The user sets the vacation interval using the calendar in the application. It is set to whole days and it is possible to schedule multiple independent intervals. After the holiday is over, the unit will automatically go back to the previous mode. Due to the reduction of the desired temperature during the holiday, the lifetime of the entire system is saved.

* features will be available during 2025

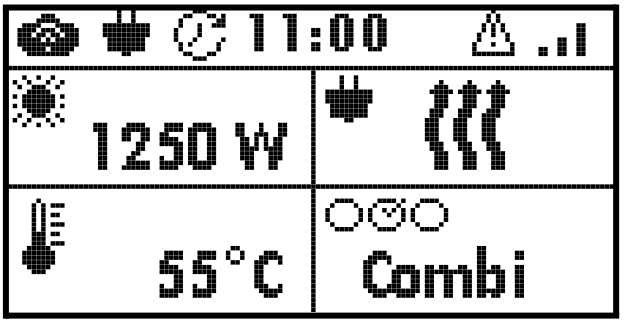
6. Controls and menus

6.1. Description of controls



1. Back button
2. Up arrow
3. Down arrow
4. Enter button
5. LCD display

6.2. Main screen




The controller is connected to the Cloud.


The regulator is connected to the 230 VAC mains.


Firmware update available.


Firmware update is downloading.


Firmware update is being installed.


Declared error in the controller. Details on errors are in the chapter Error states.


The signal strength of the customer Wi-Fi to which the controller connects.

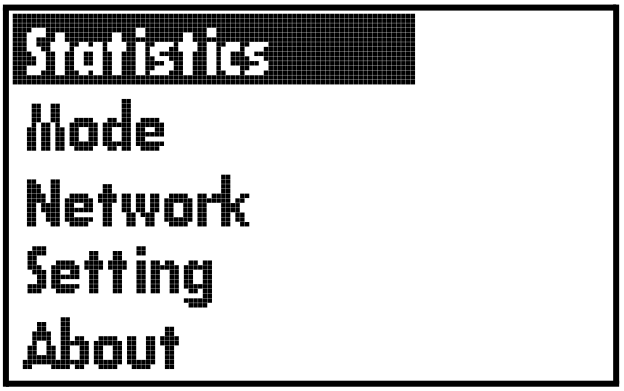

Delivered solar power.


Boiler water temperature.


Water heating from the distribution network.


Selected working mode, see chapter Working modes.

6.3. Menu

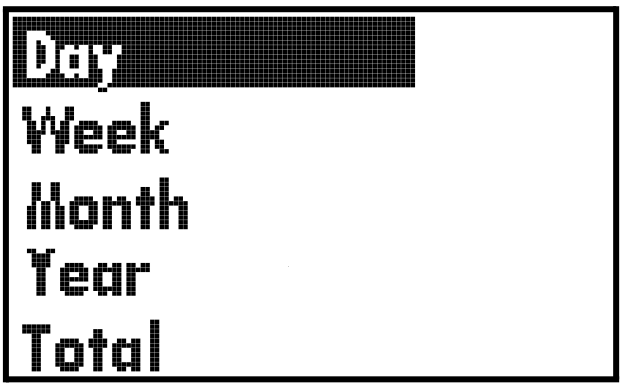


6.3.1. Statistics

Here are the statistics of energy consumption from photovoltaic panels and from the grid. They show how much energy the boiler used to heat hot water from the photovoltaic panels and how much energy from the distribution network. Current and previous periods can be viewed in each statistics tab. For example, this week and last week.

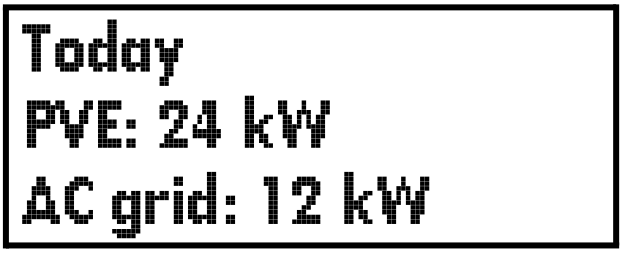
Period overview:

- Per day (Day)
- Per week (Week)
- Per month (Month)
- Per year (Year)
- Total since commissioning (Total)



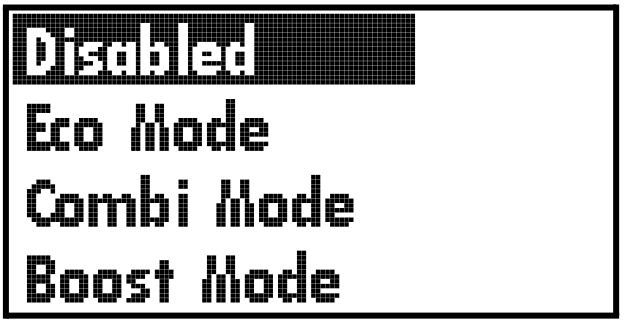
Overview of quantities:

- Today, Yesterday - today, the previous day
- PVE - produced / consumed energy from photovoltaic panels
- AC grid - energy consumed from the grid

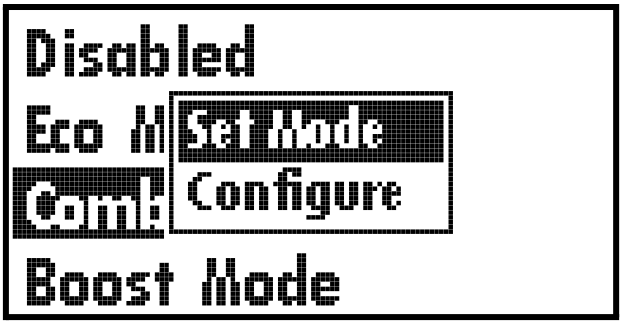


6.3.2. Mode

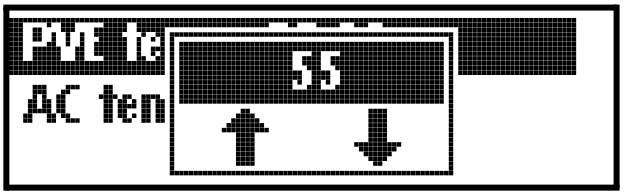
Here is the selection of the working mode of the regulator. We select the working mode with the up / down arrows and confirm the selection by pressing the Enter button. A selection window will then appear *Set Mode* (select mode) or *Configure* (mode settings). We select the mode by confirming the item *Set Mode*. To set the working mode, we select an item *Configure*.
The description of individual modes is in the chapter Working modes.



Setting the working mode includes setting the desired water temperature in the boiler. For example, the Combi mode offers the possibility to set the maximum temperature of water heated from photovoltaic panels and the maximum temperature of water heated from the distribution network.



Use the arrows to select the temperature we want to set, and after pressing the Enter button, a window for changing the temperature will appear. Use the arrows to change the temperature and confirm with Enter.



6.3.3. Network

Here is the information about the network interface.

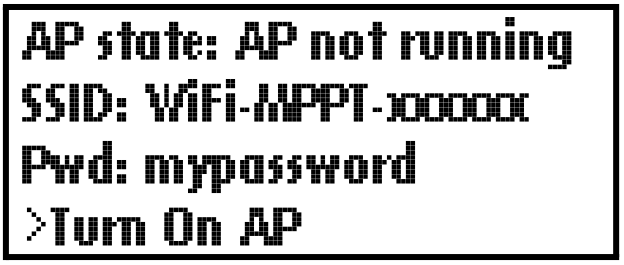
State:

Bookmark State contains the controller's network connection status.

- **Wifi mode** - shows the set Wi-Fi mode
  - STA - client mode, when the controller is connected to the home Wi-Fi network
  - AP - the controller creates a connection point to which you can connect using a PC or mobile phone
  - STA + AP - both of the above modes are active at the same time
- **STA state** - shows the connection status to the home Wi-Fi network
  - Connected - connected
  - Disconnected - disconnected
- **AP state** - displays the activation status of the Wi-Fi access point
  - AP running - the connection point is active and can be connected to the Wi-Fi network of the controller
  - AP not running - the Wi-Fi access point is disabled

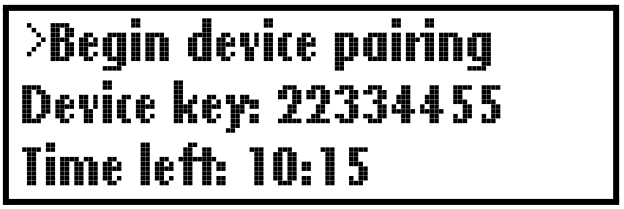
AP config:
Bookmark AP config contains hotspot settings and a button to start Wi-Fi hotspot.

- **AP state** - displays the activation status of the Wi-Fi access point
  - AP running - the connection point is active and can be connected to the Wi-Fi network of the controller
  - AP not running - the Wi-Fi access point is disabled
- **SSID** - name of the Wi-Fi network of the controller, the default name is **WiFi-MPPT-**xxxxxx (production number)
- **Pwd** - password for connecting to the Wi-Fi network of the controller, the default password is **mypassword**
- **Turn On AP** - button to start the connection point



Cloud:
Bookmark Cloud is used to generate a pairing key with a user account in the web application. By clicking the button **>Begin device pairing** a pairing key is generated that is valid for 30 minutes. If you do not have time to pair the controller with the account in the application during the validity period of the key, you need to generate a new pairing key.

- **Device key** - pairing key
- **Time left** - validity period of the pairing key

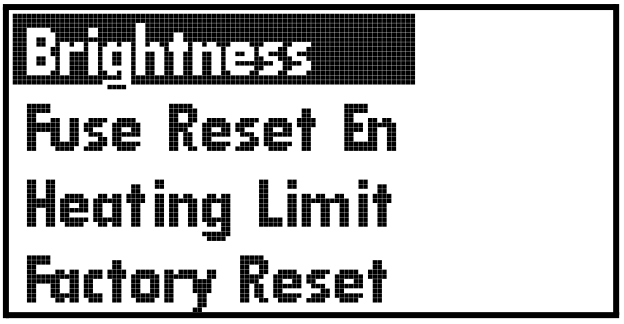


Pairing to the web application is described in the chapter Add controller.

6.3.4. Settings

Here is the basic controller setup.

- **Brightness** - sets the intensity of the backlight of the LCD display
- **Fuse Reset One** - allows the reset of the electronic thermal fuse using a magnet, the description of the reset is in the chapter Thermal fuse
- **Heating Limit** - activates / deactivates protection against scalding, the description of the function is in the chapter Protection against scalding
- **Factory Reset** - resets the controller to factory settings, all user settings and statistics will be deleted

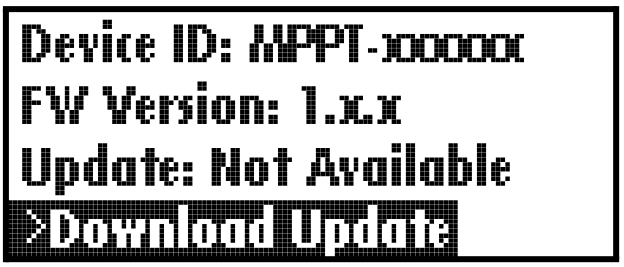


6.3.5. About

Here is the information about the controller.

Device Info

- **Device ID** - serial number of the regulator
- **FW Version** - current firmware version
- **Update** - firmware update status
  - Not Available - the update is not available, the controller works with the latest firmware version
  - Available - available firmware update
  - Downloading - downloading the firmware update
  - Updating - installing a firmware update
- **>Download Update** - firmware download button, use the up or down arrow to select an item and then press Enter to confirm the controller update



Device Errors

The Device Errors tab contains warnings and errors reported by the device. During normal operation, when everything is working, the tab is empty. The list of individual warnings and errors is in the chapter Error states.

- ERR: xxx - error, xxx indicates the error number from the list
- WARN: xxx - warning, xxx indicates the error number from the list

6.4. Wi-Fi

The controller is equipped with an integrated Wi-Fi module for connecting to the Cloud. In order to be able to control the controller using a web application, it is necessary to connect the controller to the Internet using Wi-Fi. The controller has two modes:

- **AP** - is intended for setting up the connection to the home network and diagnosing the controller
- **STA** - this is the client mode, when the controller connects to the set home Wi-Fi network and then connects to the Cloud via the Internet

The description of the web application is in the chapter Web application.

6.4.1. AP mode - connection to the controller

After switching on the controller, AP mode is active for the next 5 minutes (default setting). The status of the mode can be monitored in *Menu / Network / State / AP state*. If the AP is not active, it can be activated in *Menu / Network / AP Config / Turn On AP*. AP mode is automatically turned off if no device is connected to the controller for more than 5 minutes.

We can search for nearby Wi-Fi networks on a mobile phone or computer. A network with a name appears in the list **WiFi-MPPT-xxxxxx** (xxxxxx = serial number of the device).

Default settings:

- SSID: **WiFi-MPPT-xxxxxx** (xxxxxx = serial number of the device)
- Password: **mypassword**

After logging in to the Wi-Fi network of the controller, a portal will pop up on your Captiv device, where the login page for configuring the controller will be displayed. If the Captiv Portal does not invoke it, you can use one of the fallback options:

- URL: http://smart_mppt.home
- IP: **192.168.5.1**

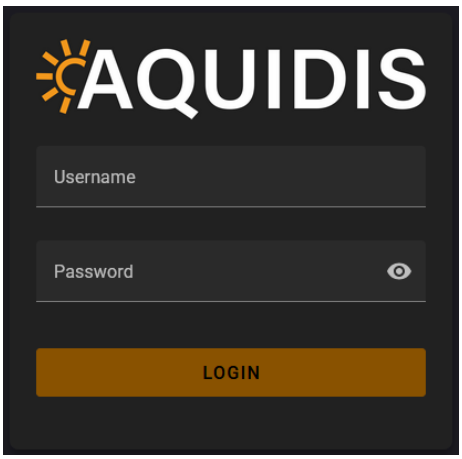
Note:

If you have a computer or mobile phone connected to the Internet while connecting to the controller, the Portal routing and URL may not work correctly. **We recommend turning off other data connections during configuration.**

Apple: For Apple products, a notification pops up that contains the information that the network does not have an Internet connection. Choose an option for the proper functioning of the portal **Cancel**.

6.4.2.Login to the controller

First, you need to log in to the Web configuration of the controller.

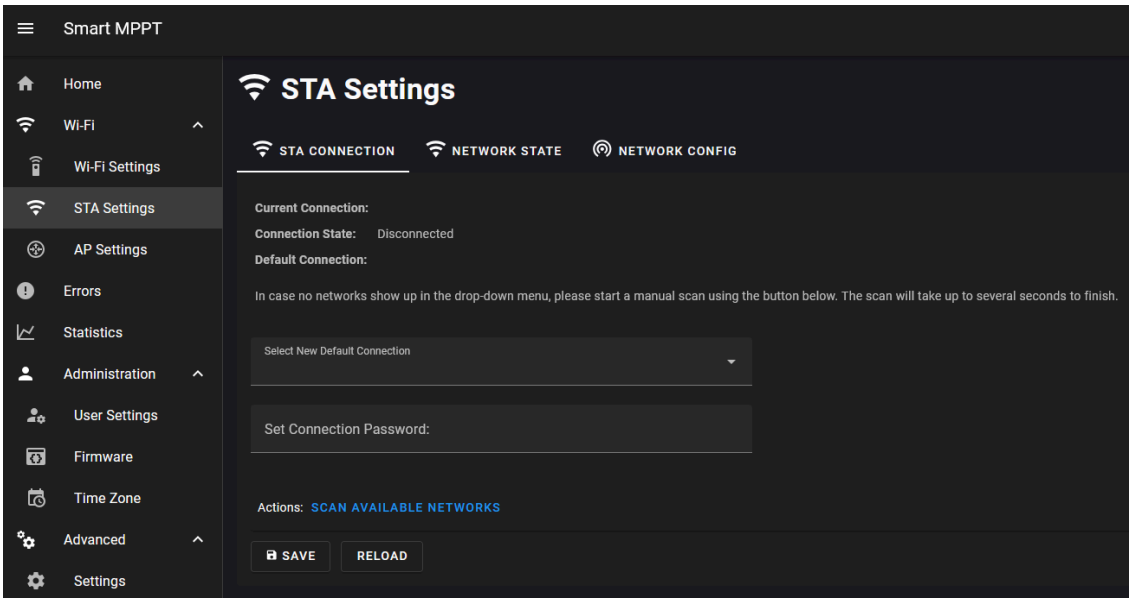


Default credentials:
Username: **user**
Password: **user**

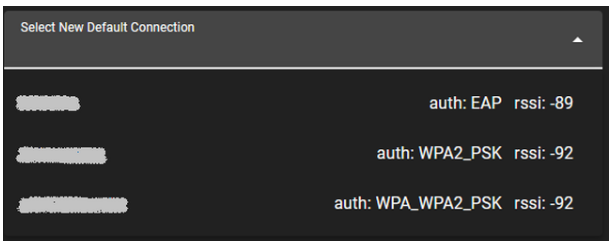
6.4.3.Connection to home Wi-Fi - STA Setting

6.4.3.1. STA Connection

We select bookmarks *Wi-Fi / STA Setting / STA CONNECTION*, where we click on the link: **SCAN AVAILABLE NETWORKS**.



The controller scans the surrounding Wi-Fi networks within its range. Subsequently, you select your home Wi-Fi network in the Select New Default Connection menu.



In the Set Connection Password text box, enter the password for your home Wi-Fi network. Save the settings with the button *Save* SAVE.
The controller will rescan the surrounding Wi-Fi networks and try to connect to the selected network based on the settings. This operation may take several tens of seconds. The connection status can be checked in the items:

- Current Connection - the name of the network to which the controller is connected is displayed here
- Connection State - is the state of the connection
  - Connected - connected
  - Disconnected - disconnected
- Default Connection - set Wi-Fi network to which the controller should connect

By default, the controller obtains an IP address from the home DHCP server (home router). If you need to set a static IP address, go to the tab Network config.

We will check the connection to the Cloud on the controller display, where the Cloud icon lights up in the upper left corner .

Common problems:

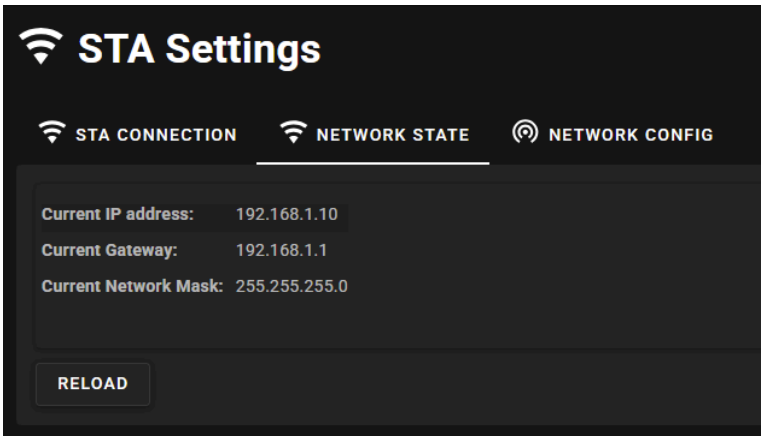
- **The controller does not connect to the home Wi-Fi:** item *Current Connection* is empty. Item *Connection State* is most of the time *Disconnected*. The controller repeatedly tries to connect to the client Wi-Fi network and the connection is rejected by the AP connection point. When a connection is attempted, item *Connection State* will change to Connected.
  - Check the entered password.
- **The controller does not connect to the Cloud:** item *Connection State* is *Connected* and item *Current Connection* is filled with the name of the client Wi-Fi network. The controller is connected to a Wi-Fi AP. The Cloud icon is not lit on the main screen.
  - Check the IP address assignment from your router. Open the bookmark *Wi-Fi / STA Setting / Network state,* where the IP address is visible. Must be out of home network range. Must not be 0.0.0.0.
  - Check your home router's Internet connection.
  - If the controller has been reset to factory settings (*Factory Reset*), then the pairing key between the controller and the cloud server has been lost. In this case, contact the manufacturer's service center podpora@aquidis.cz. Prepare the serial number of the MPPT-xxxxxx controller.

6.4.3.2. Network state

The tab contains the currently used network settings of the controller. In the default state of the controller, the assignment of an IP address from the home DHCP server is allowed.

Items:

- **Current IP address** - currently used IP address in the local network
- **Current Gateway** - currently used default gateway in the local network
- **Current Network Mask** - currently used netmask

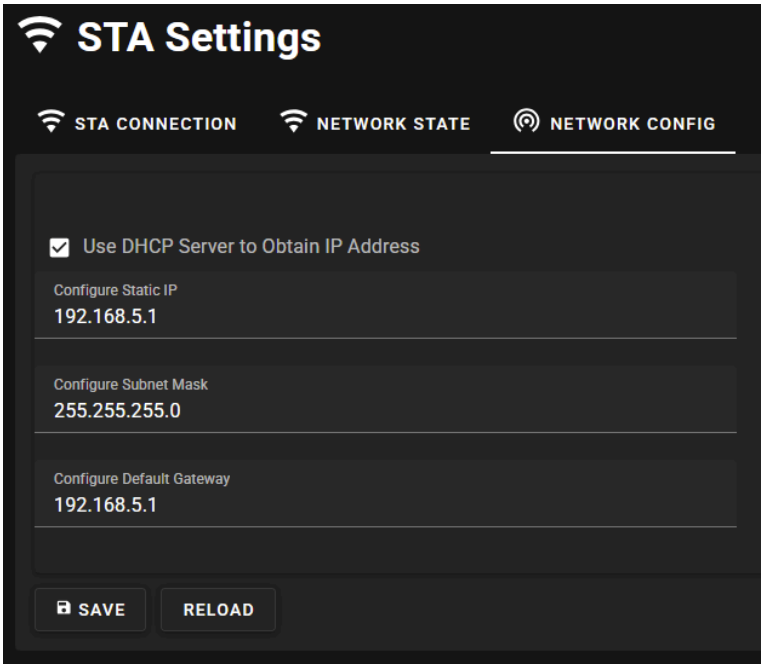


6.4.3.3. Network config

The tab contains network settings. By default, assignment of network settings from the local DHCP server is enabled. So the static network settings are ignored.

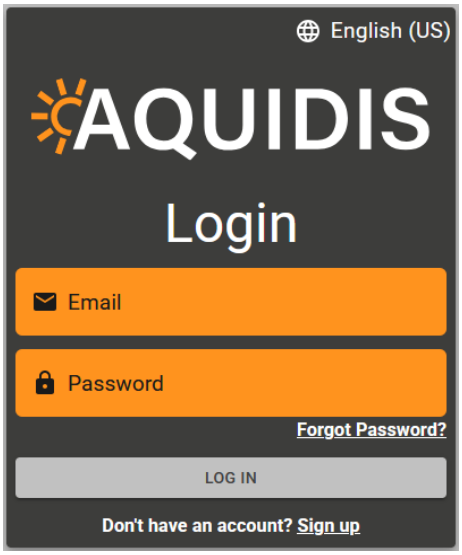
Settings items:

- **Use DHCP Server to Obtain IP Address** - use of a DHCP server to obtain an IP address
  - Checked - the controller requests the local DHCP server to assign network settings, static settings are suppressed
  - Unchecked - the controller uses static network settings
- **Configure Static IP** - required static IP address
- **Configure Subnet Mask** - required static netmask
- **Configure Default Gateway** - required static default gateway



7.Web application

You can log in to the web application for remote controller management on the website www.aquidis.cz, by clicking the button **Log**.



7.1. User account registration

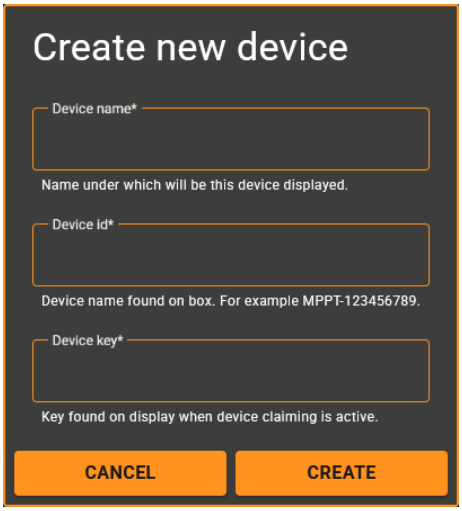
On the web application login screen, click the button at the bottom **Register**. Enter your email, password and password confirmation in the registration form. Password must be at least 8 characters long. Next, click the button **REGISTER**, then the system will send you an activation email with a link that is valid for a maximum of 24 hours. To complete the registration, you need to click on the link in the email. Once the registration is complete, you can log into your account to manage the Smart MPPT controller.

7.2. Add controller

Select an item in the left column **Device**. A column will then appear on My devices, where click on **Add**. A form for creating a new device will appear.

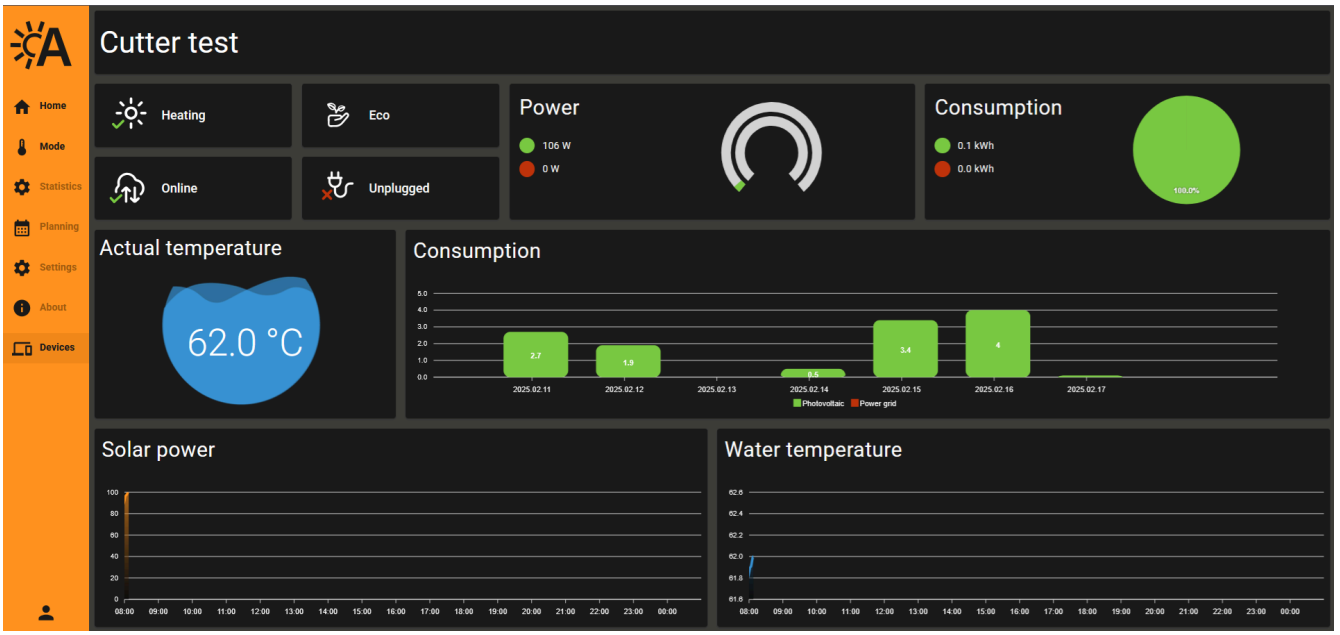
Filling out the form:

- **Device name** - name of the controller that will be displayed in the main overview. The user can freely choose the name.
- **Device Id** - serial number of the regulator. You can find the number on the label of the box or on the label of the regulator. The id is in MPPT-xxxxxx format. Example: **MPPT-123456**
- **Device key** - pairing key generated by the controller. Generation is done in *Menu / Network / Cloud / Begin device pairing*, where the pairing key will appear on the display. A detailed description of key generation is provided in the chapter Network / Cloud.



After filling in all the items, click the button **CREATE**. A confirmation of adding the controller will then appear.

7.3. Home page of the application



8. Additional features

8.1. Anti-freeze

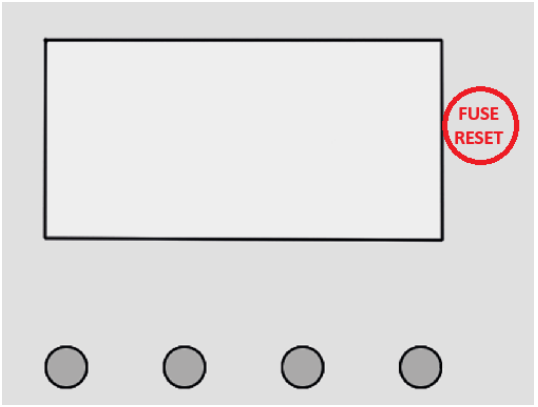
Anti-freeze will be permanently active if the unit is connected to a 230 VAC mains. The function serves to prevent the water in the heater from freezing. This also applies if the controller is switched off using the control panel. If the temperature drops below 5 °C, water heating to 8 °C is activated.

8.2. Thermal fuse

The thermal fuse will be equipped:

- when the heater overheats above 90 °C
- when disconnecting the temperature sensors from the controller

It is possible to reset the thermal fuse when the heater has cooled down to a temperature of at least **50 °C**. We will perform the reset by enabling the reset in *Menu / Setting / Fuse reset En* and then placing the magnet to the right of the display. See below in the picture for an example of the location of the magnet.



The thermal fuse can also be reset with the FUSE RESET button, which is located on the PCB inside the controller. **Disassembly of the cover and work on the electrical equipment may only be carried out by a person with the relevant qualifications.**

8.3. Protection against scalding

Anti-scald protection is designed to limit the maximum temperature of water that enters the facility and is available at the sink faucet. Protects household members from scalding when washing.

By default, protection is active. Limits the thermostat setting to a maximum temperature of 55 °C. It can be turned off in *Menu / Setting / Heating Limit*.

ATTENTION when switching off the protection, health damage may occur!
If the protection is disabled, installation of a mixing valve at the outlet of the heater is required.

8.4. Antilegionella

Legionella is a bacterium that multiplies in water at a temperature of 20°C to 45°C. It will not survive at higher water temperatures. The Antilegionella function neutralizes the bacteria in a very simple way. Elimination occurs in all modes by scheduled water heating to 65°C, triggered every 30 days. This is a one-time heating to the specified temperature, which is sufficient to eradicate bacteria from the interior of the heater.

The function is active by default, it can be turned off only in the web settings of the controller on the page *Advanced / Settings / Thermostat / Antilegionella State*.

9. Error states

Status code	Status type	Description
10	Error	Unidentified error.
16	Error	Data corruption in internal memory.
17	Error	Firmware update failure.
18	Error	MPPT controller overload. An incorrect load resistance has been detected.
30	Error	Hourly timer setting. The controller does not have the date and time set. The reason may be a long time of disconnecting the regulator from the power supply. The error will be removed after connecting the controller to the Cloud.
60	Error	Maximum DC input voltage limit exceeded. The reason may be the high number of photovoltaic panels connected in series.
61	Error	Equipped with a short-circuit fuse on the DC output. It is necessary to remove the short circuit on the DC output and reset the regulator.
200	Error	Failed to enable Wi-Fi Station mode.
201	Error	Failed to turn off Wi-Fi Station mode.
203	Error	Failed to turn on Wi-Fi AP.
204	Error	Failed to turn off Wi-Fi AP.
205	Error	Disconnected from the user's Wi-Fi network.
206	Error	Loss of IP address.
210	Error	Failed to scan nearby Wi-Fi networks.
300	Error	Temperature sensor failure.
301	Error	Equipped with thermal fuse.
330	Warning	Faulty or disconnected AC heating rod.
340	Warning	Defective or disconnected DC heating rod.
352	Warning	The controller is not connected to the Cloud.

10. Technical parameters

Technical parameters	
DC input voltage	150 – 350 VDC
AC input voltage	230 VAC
Maximum output power from the panels	3000W
Maximum installed solar power of the panels	4000 Wp
Maximum AC output power	3000W
Maximum solar current	16 A
Minimum load resistance	10 R
Operating voltage of MPPT regulation	80-300 V
MPPT efficiency	>99 %
Connecting PV panels	2x MC4
Regulated PV output	terminal block
Power grid connection	mains cable 230 VAC
AC output	terminal block
Connection of temperature sensors	RJ-45
Degree of coverage	IP52
Temperature range	0 to +40 °C
Dimensions	200×270×80 (V×Š×H)
Weight	2 kg