USER MANUAL
PWM REGULATOR OF THE HEATER POWERED FROM SOLAR PANELS ACTii AC7392
FIRMWARE VIEW: F1.0

1. SAFETY CONSIDERATIONS

- Before starting it for the first time, please read this instruction manual.
- All connections and changes should be made with the voltage disconnected from the panels.
- Proper operating conditions must be ensured, in accordance with the specification of the device, such as: supply voltage, temperature, maximum current consumption.
- Installation and setting of the device require appropriate skills, so they can only be done by qualified people, after reading the instruction manual in full.
- An incorrectly connected device may be damaged.
- The responsibility for the correct installation lies with the person assembling. Make sure that you meet all the guidelines and standards in force in your country.
- Electrostatic discharge can damage the device. Appropriate safeguards shall be in place.
- It is necessary to protect the installation from discharges by disconnecting the regulator from the panels during the storm.
- Any unauthorized alterations, modifications and attempts at repairs will void the warranty.
- The regulator must be absolutely disconnected from the panels when we leave the apartment for more than a day!!!
- The power plant must be equipped with fuses mounted on both wires from the panels. It should be possible to quickly disconnect the panels in the event of a failure.

2. DESCRIPTION AND CHARACTERISTICS OF THE PRODUCT

The heater regulator is used to regulate the load of the panels by changing the PWM filling factor, and in combination with the charge buffer as an active load. This allows the panels to work at the MPPT point, i.e. the largest power factor.   The condition for proper operation and the highest energy yields is to ensure the appropriate load for the regulator. The regulator should be loaded with a heater with a strong nominal adapted to the power of the panels and a voltage appropriate to the MPPT voltage of the panels. The regulator is an element that reduces the load on the panels in the event of insufficient sunlight, and thus allows the panels to be maintained at an optimal point of operation.

The regulator also acts as a thermostat preventing the boiler from overheating.

In the case of insufficient cooling (e.g. in the case of contamination of the heatsink), an additional protection was used in the form of an emergency shutdown at a temperature of 60 degrees, which is to protect the actuators from damage by high temperature. The device also monitors the supply voltage, and when it is too low (insufficient to put transistors into saturation mode) I activate the procedure for turning off the transistors. This prevents operation in active conduction mode and thus exposure to the secretion of too much heat, which could lead to damage to the actuators.

The device has been equipped with an additional relay output (without potential), enabling notification of external devices that water heating has been completed (reaching the set temperature) or entering the emergency mode (failure of the actuating element) ER.1. As additional safety elements, the SSR DC relay is used, which gives the possibility of emergency shutdown of water heating in the event of a puncture of the actuating element.

Such a solution guarantees the safety of the solar power plant.

3. INSTALLATION AND CONNECTION

The device for proper operation requires proper connection. The final place of installation is the wall inside the building. The regulator should be mounted near the boiler so that there is no need to extend the temperature sensor cable.

The recommended connection system of the regulator is below. It does not present the possibility of using an additional RELAY output used, for example, to disconnect panels (via SSR DC relay) in the event of a regulator failure.

The regulator should be connected as in the figure below.
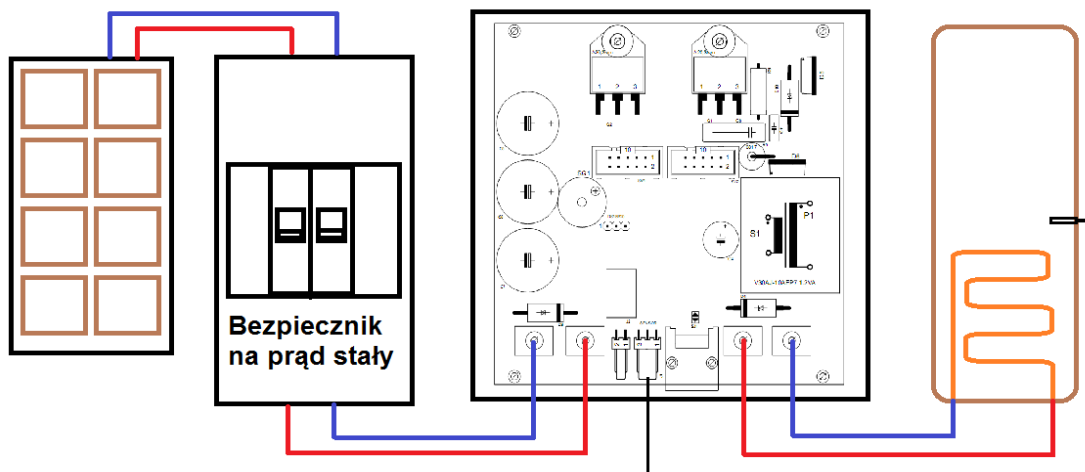
4.KONFIGURACJA

The configuration consists in setting the set temperature to be reached by utility water. This is done by pressing the MENU button until an intermittent sound from the controller appears. Then the inscription "S.tE" appears on the top display, which means setting the set temperature. It is possible to reduce the voltage of the regulator to work, however, this option is recommended when using an external power source. The start voltage can be reduced by holding down the minus button until an intermittent signal appears from the buzzer. The default start voltage is 150V.

Turning the regulator on and off:

The regulator can be switched off by short pressing the MINUS button (the voltage on the heater is no longer supplied)

Switching on is done by short pressing the PLUS button.

By default, when the power is turned on, the regulator automatically takes up work (supplying current to the heater) if the voltage exceeds the minimum value. The regulator can only work with photovoltaic installations, *it cannot be used for* wind *turbines.*

The controller, apart from the above-described settings, does not require additional maintenance. Adjustment of operating parameters takes place automatically and depends on the capabilities of the panels and the load. The regulator should be absolutely loaded ONLY with heaters used in boilers. Do not use air resistance heaters or other electronic devices.

5 COMMUNICATION:

The heater controller enables communication via **RS485** interface in **ASCII**mode. A description of the RJ45 socket pins is provided below.
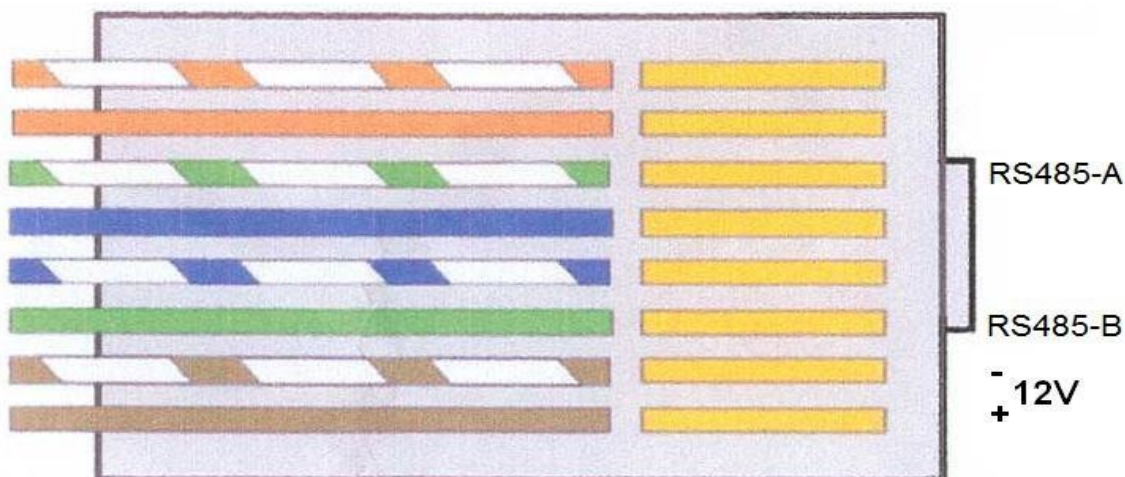
The RJ45 socket can also be used to power the controller when there is no voltage from the panels.

The method of communication is not related to any communication protocol. In order to read the operating parameters, a query should be sent to the regulator in the form of one byte of data.

Transmission parameters are: 9600 8n1.

Sending one byte to the driver with the following information: **ASCII 'a' (97 decimals)**

results in the answer:

AA; Current power (in watts); Current CWU temperature(should be divided by 10); Current power gain from device start or data reset (kWh); Current work status (value 1 when working or 0 when not working)

Send one byte to the driver with the following information: **ASCII 'S' (83 decimal)**
results in the answer:

SR; Current voltage from the panels (in Volts); Current current (divide by 10 to be in amperes); Current power (in watts), The maximum power that has been achieved in the history of this device (in watts); Maximum temperature that was measured in the device (in degrees Celsius);Number of operations of the low voltage detector of control transistors; Current PWM value(0-255); Current heatsink temperature (divide by 10 to be in Celsius)

Send one byte to the driver with the following information: **ASCII 'W' (87 decimal)**
results in **stopping the work of** the **regulator.**

Sending one byte to the driver with the following information: **ASCII 'Q' (81 decimal)**
results in **the resumption of regulator operation.**

Send one byte to the driver with the following information: **ASCII 'R' (82 decimals)**
results in **resetting the accrued kilowatt**hours.

<div align="center">

REMARK!!!
The changed settings are saved in the non-volatile memory and are still active after the device is restarted.

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During normal operation, the following parameters, current power and CWU temperature are displayed on the display. Flashing out LED indicates that power is feeding to the heater.

RESTORE FACTORY SETTINGS

To perform a factory reset, hold the MENU button when you turn on the device and hold until "dEF" appears on the top display. This feature will erase all user settings.

5. TECHNICAL DATA

Secondary supply voltage	11 V to 14V
Panel tension	From 120V to 350V DC
Panel current	From 13A
Maximum heater power	3kW
Maximum power of the panels	3kW
Dimensions	140 x 120 x 130mm
Input power	< 5 W
Temperature measurement accuracy	0.1 degrees

6. SERVICE INFORMATION

REMARK!!
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The inscription ER.0 indicates an emergency shutdown of the controller due to too low supply voltage, which could lead to damage to the transistor controlling the heater.

REMARK!!
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ER.1 Means damage to the control transistor, immediately disconnect the regulator and send it back to the service. At the time of displaying this error, the heater is constantly powered from the panels and the regulator is not able to turn it off!
Leaving the regulator with this error can lead to its melting and even fire.

REMARK!!
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ER.2 Means an unstable supply voltage or damage to the power supply of the device. It can also mean damage to the filter capacitors.

The CE symbol on the device indicates the compliance of the device with the Electromagnetic Compatibility Directive EMC 2004/108/EC (Electromagnetic Compatibility Directive).

This mark on the device informs about the prohibition of placing the used device together with other waste. The equipment must be handed over to designated disposal points. (In accordance with the Waste Electronic Equipment Act of 29 July 2005)