HEATING CONTROL MX - USER MANUAL

FOR THE MODEL:
HEATING CONTROL MX (HCMX 01/08/23)

INSTRUCTIONS FOR THE INSTALLATION AND SETUP OF THE DEVICE

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Manufacturer: SOLAR controls s.r.o.

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GENERAL INFORMATION

Heating Control Mx is a programmable controller of heating involving multiple sources and multiple points of consumption. After the correct installation and setup, the controller will manage the heating of your house or possibly your pool and it can also provide other control functions. A storage tank is always necessary for the correct functioning of certain control blocks. The setup and monitoring of the controller functions always requires an Ethernet connection.

Basic characteristics of the Heating Control Mx device:

- Fully programmable with the option of the individual setting of inputs, outputs and control blocks.

- 8 digital temperature inputs for sensors DS18B20 or DS18S20.

- 4 analog temperature inputs for NTC type sensors or PT1000 type sensors.

- 4 binary inputs.

- 2 relay outputs with the maximum load of 230VAC/10A.

- 3 external outputs with the option of generating fast PWM for the control of suitable types of heat pumps or circulation pumps with continuous control.

- 3 external outputs with the option of generating 0-10V signal to control suitable types of heat pumps or circulation pumps with continuous control.

- 1 control block of the outdoor unit of the heat pump with direct power control and condensation in the storage tank.

- 1 control block of the solid fuel boiler or hot-water fireplace inserts.

- 2 control blocks of the heating circuit with the optional connection of an external room thermostat or an internal temperature sensor.

- 1 control block of the pool heating when a pool heat exchanger is used.

- 1 control block of the storage tank cooling.

- 4 blocks of status duplicate.

- 2 blocks of differential controllers for regulation of the solar circuit, etc.

- Integration with the WATTrouter M or Mx system, which, together with a suitable type of heat pump, enables an efficient combination of heating on the basis of excess energy from the photovoltaic source with heating according to the requirements of the internal control.

- An integrated web interface allowing comfortable configuration and monitoring of the controller activity by means of a standard Internet browser.

- A real-time module with a lithium battery backup for the time control of the individual blocks.

- Daily, weekly, monthly and yearly statistics of the selected quantities of the individual blocks, a configurable chart for monitoring the selected quantities.

- Firmware updating.

PACKAGING CONTENTS

The packaging includes:

1 pc of a Heating Control Mx device

1 pc of a USB cable

1 pc of a short manual with references to this manual, software and firmware updates.

SAFETY WARNINGS

After receiving the product, check that the packaging has not been damaged. After opening the packaging, check that the controller has not been damaged. Do not install the controller if it shows signs of mechanical damage!

Always have the controller installed by a person with the appropriate electrical qualifications. It is absolutely necessary that you read this manual carefully and that you observe all safety warnings specified in it.

The controller must be installed in a dry room without excessive levels of dust. The place must be protected from direct sunlight and the ambient temperature must not exceed the range provided in the chapter Technical specifications. Do not place the controller or any other electrical components of the system in the vicinity of flammable objects!

It is necessary to prevent the access of unauthorized persons, especially children, to the place where the controller is installed. There is a serious risk of electric shock!

Only equipment which is specified in this manual and whose manufacturer does not expressly forbid connection via a switching element may be connected to the controller outputs!

The manufacturer is not responsible for any damage in the case of unprofessional installation and operation of the device! The owner of the device is fully responsible for the operation of the entire system.

INSTRUCTIONS FOR THE INSTALLATION OF THE DEVICE

The Heating Control Mx device can be installed into a standard secondary electrical distribution board by fixing it on a 35mm DIN rail or by screwing it to a wall with two screws with round or countersunk heads of up to 6 mm in diameter.

Use a conductor with a minimum cross-section of 0.5 mm^2, e.g. CYKY 1.5, for connecting the controller power supply (terminals L, N).

Use a shielded 3-core cable with a core cross-section of 0.5 to 1 mm^2 for connecting the digital temperature sensors to GND terminals (earth), +5V (power supply) and T1-8 (data bus also designated as D/Q). Always connect the sensor shielding to the GND terminal as close as possible to the controller. When connecting the digital sensors to the bus, always also connect the shielding. When extending the bus, always use a separate shielded cable; do not combine the shielding, for example, with the shielding of the analog temperature sensors, binary inputs or Ext1-6 outputs! The total length of the bus, including all breakouts (sensor cables), should not exceed 50 m.

Use a shielded 2-core conductor with a core cross-section of 0.5 to 1 mm^2 to connect the analog temperature sensors between the GND terminal and the T9 terminal (T10, T11, T12). Always connect the sensor shielding to the GND terminal as close as possible to the controller. When extending the power supply, always use a separate shielded cable; do not combine the shielding, for example, with the shielding of the digital temperature sensors, binary inputs or Ext1-6 outputs!

If possible, connect the binary inputs by means of a shielded 2-core conductor with the core cross-section of 0.5 to 1.5 mm^2 between the GND terminal and the I1 (I2, I3, I4) terminal. Always connect the shielding to the GND terminal as close as possible to the controller. When extending the power supply, always use a separate shielded cable; do not combine the shielding, for example, with the shielding of the analog or digital temperature sensors or Ext1-6 outputs!

If possible, connect the external devices to Ext1-6 outputs by means of a shielded 2-core conductor with a core cross-section of 0.5 to 1.5 mm^2 between the +5V or +12V terminal and the Ext1-6 terminal. Always connect the shielding to the GND terminal as close as possible to the controller. When extending the power supply, always use a separate shielded cable; do not combine the shielding, for example, with the shielding of the analog or digital temperature sensors or binary inputs!

Connect the pumps, contactors, etc. to the Re1-2 outputs by means of conductors with a cross-section corresponding to the input power of the connected equipment.
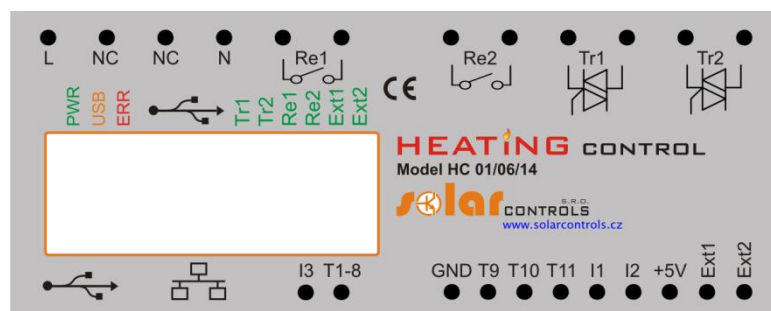

Figure 1: Description of the connectors and LEDs (a view from above).

Description of the controller terminals:
Upper left terminal block (this only accepts mains voltage!):
- L – controller power supply, 230VAC/50Hz (it must be always connected)
- N – neutral conductor (it must always be connected)
- Re1 – relay output 1 – switching contact

- Re2 – relay output 1 – switching contact

Upper right detachable terminal block:

- GND – negative electrode for connecting digital and analog temperature sensors and binary inputs
- Ext1- – external output 1 – negative electrode (PWM, open collector)
- Ext2- – external output 2 – negative electrode (PWM, open collector)
- Ext3- – external output 3 – negative electrode (PWM, open collector)
- Ext4- – external output 4 – negative electrode (0-10V, Sallen-Key amplifier)
- Ext5- – external output 5 – negative electrode (0-10V, Sallen-Key amplifier)
- Ext6- – external output 6 – negative electrode (0-10V, Sallen-Key amplifier)
- +12V – positive electrode for external outputs (+12V against GND)
- +5V – positive electrode for external outputs and the power supply of digital temperature sensors (+5V against GND)

Communication connectors on the bottom left:

- USB – USB interface connector (USB B)
- LAN – Ethernet interface connector (RJ45, 10/100 Mbit/s)

Lower left detachable terminal block:

- RS485 A – non inverting RS485-line
- RS485 B – inverting RS485-line
- T1-8 – data bus for digital temperature sensors T1-8

Lower right detachable terminal block:

- NC – an unmarked terminal, do not connect anything here!
- I2 – binary input 2
- I3 – binary input 3
- I4 – binary input 4
- T9 – analog input for analog temperature sensor T9
- T10 – analog input for analog temperature sensor T10
- T11 – analog input for analog temperature sensor T11
- T12 – analog input for analog temperature sensor T12
- I1 – binary input 1

Description of LEDs:

- PWR – LED indication of controller power supply (green)
- COM – LED indication of communication via the USB interface (yellow)
- ERR – LED indication of an error status (red)
- Ext1 – LED indication of activity of external output 1
- Ext2 – LED indication of activity of external output 2
- Ext3 – LED indication of activity of external output 3
- Ext4 – LED indication of activity of external output 4
- Ext5 – LED indication of activity of external output 5
- Ext6 – LED indication of activity of external output 6
- Re1 – LED indication of activity of relay output 1
- Re2 – LED indication of activity of relay output 2
- RJ45 connector – indication of Ethernet interface connection (left LED – carrier frequency, right LED – connection speed)
- Wireless PWR – SC-Gateway power LED (optional accessories)
- Wireless LINK – SC-Gateway link LED (optional accessories)

Other connectors:

- Micro SD slot – it is located inside the controller and contains integrated MicroSD card

Connect the controller according to the sample connection configurations in the below given figures:

- Configuration A: an outdoor unit of a heat pump with an electrical bivalent system, an add-on solid fuel boiler, a storage tank, hot service water heating, heating and pool heating
- Configuration B: an outdoor unit of a heat pump with a gas bivalent system, an add-on solid fuel boiler, a storage tank, hot service water heating, heating and pool heating
- Configuration C: an outdoor unit of a heat pump with an electrical bivalent system, a storage tank, hot service water heating and heating (minimum effective configuration)
- Configuration D: an outdoor unit of a heat pump with an electrical bivalent system, a storage tank, hot service water heating, heating, in combination with the management of excess energy from the photovoltaic power station by means of the WATTrouter Mx.

If the basic principles are observed, the connection can be combined in various ways. Various numbers of devices can be connected to any outputs, various number of analog and digital temperature sensors, etc.

CONFIGURATION A

Figure 2: Electrical diagram of configuration A. A PAST® storage tank is used; the heat sources primarily include an outdoor unit of a heat pump with direct condensation in the tank and a bivalent electrical heat source and also a solid fuel boiler without its own electronic control; heat consumers include flow heating of hot water in the tank, one heating circuit with classic radiators and one heating circuit for heating the pool by means of a pool heat exchanger. The power of the outdoor unit is controlled by a 0-10 V signal via a PWM/0-10V converter. The temperature of the heated premises is controlled by a room thermostat with PI control. The circulation pump of the solid fuel boiler is switched on directly by the controller; the same applies to the circulation pump of the heating circuit. The circulation pumps of the pool heating circuits are switched on by the KM1 auxiliary relay. The bivalent heat source in the storage tank is switched on by the KA1 4-pole contactor, which at the same time switches off all work conductors on the basis of protection by an independent mechanical Ts thermostat mounted in the upper part of the storage tank (as described in EN 60335-1). A total of 7 digital temperature sensors are connected.

Heat source	Storage tank	Heat consumption
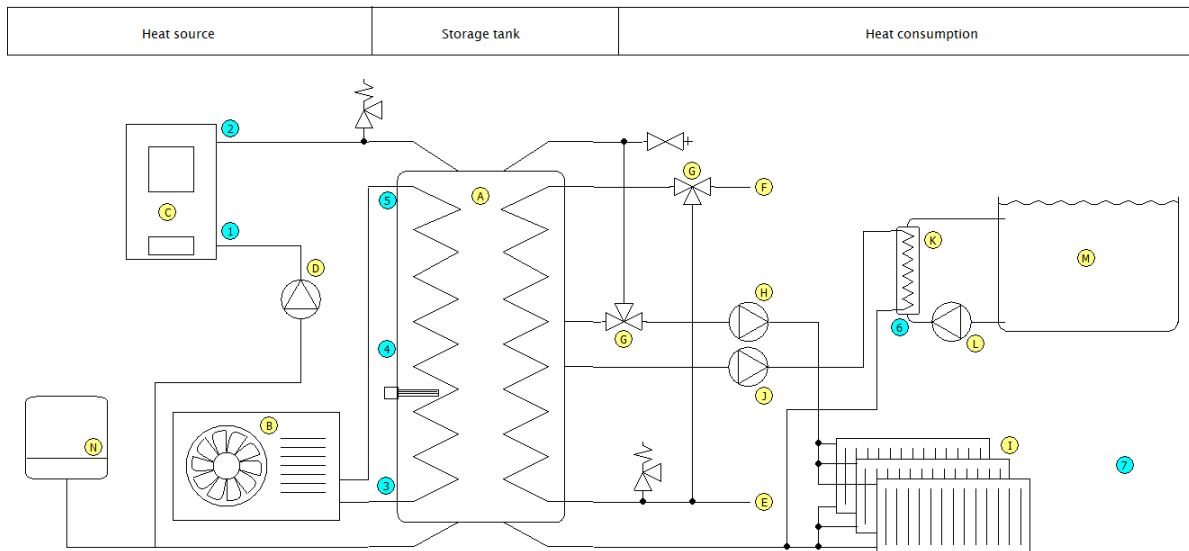
Figure 3: Simplified heating diagram of configuration A. The yellow letters refer to explanatory notes of the function blocks, the blue letters refer to explanatory notes of the temperature sensors. The outdoor unit of the heat pump is connected to the exchanger in the storage tank by means of the refrigerant distribution in the direct condensation mode. The temperature of hot service water is controlled automatically by a thermostatic mixing valve and it does not have to be controlled by the controller in any way. A thermostatic valve for heat offtake for the radiators is not essential; nevertheless it can adjust the temperature of the heating water in case of overheating of the storage tank. We always place the outside temperature sensor out of the flow of air cooled by the outdoor unit.

Blocks:

A – PAST® storage tank

B – outdoor unit of the heat pump

C – solid fuel boiler

D – circulation pump of the solid fuel boiler

E – cold water input

F – hot service water output

G – thermostatic mixing valve

H – circulation pump of the heating circuit

I – radiators

J – circulation pump of the pool heating circuit

K – pool heat exchanger

L – circulation pump of the pool water

M – pool

N – expansion tank

Temperature sensors:

1 – solid fuel boiler – heating water input

2 – solid fuel boiler – heating water output

3 – storage tank – bottom of the tank

4 – storage tank – middle of the tank

5 – storage tank – top of the tank

6 – pool heat exchanger – pool water input

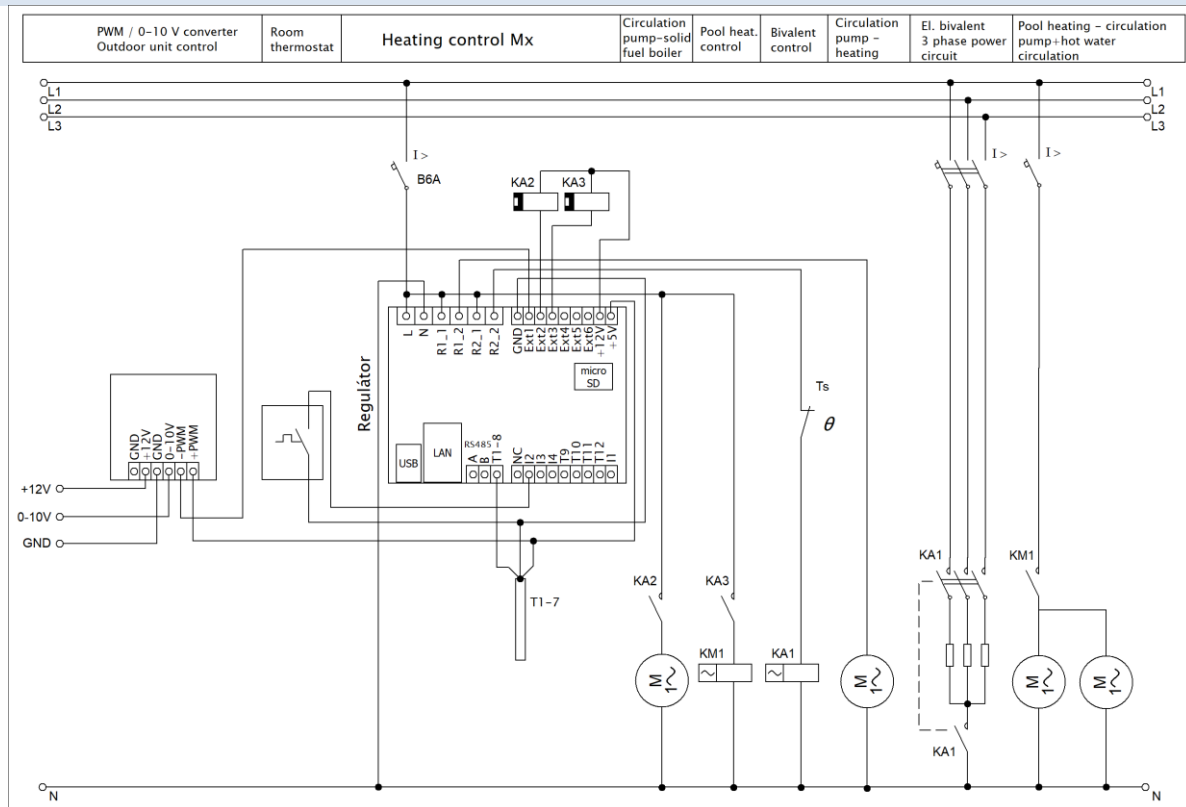7 – outside temperature sensor

CONFIGURATION B
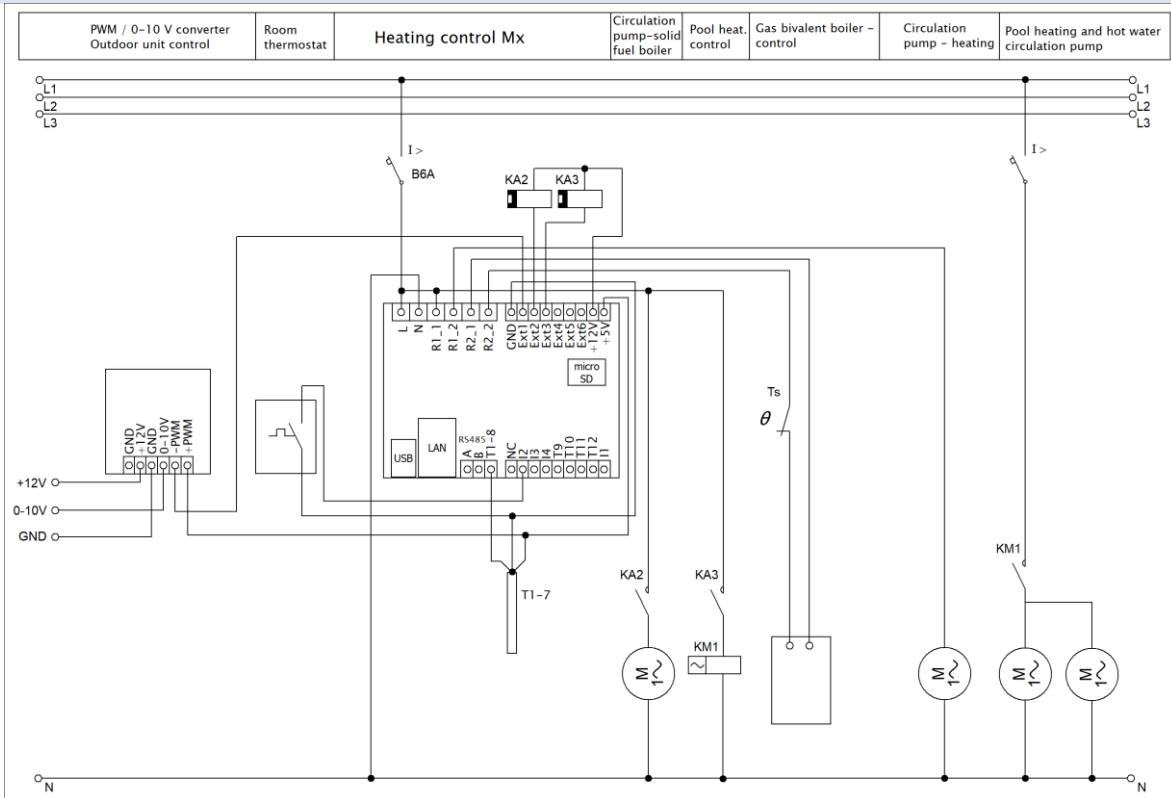
Figure 4: Electrical diagram of configuration B. A PAST® storage tank is used; the heat sources primarily include an outdoor unit of a heat pump with direct condensation in the tank and a bivalent gas boiler and also a solid fuel boiler without its own electronic control; the heat consumers include flow heating of hot water in the tank, one heating circuit with classic radiators and one heating circuit for heating the pool by means of a pool heat exchanger. The connection differs from configuration A only in replacing the electrical bivalent system with a gas boiler. The switching of the gas boiler can always be done directly by means of a relay output of the controller because this output is potential-free. **If the gas boiler manual prescribes a requirement for switching by a potential-free contact, only relay output Re1 or Re2 can be used, the external outputs cannot be used!**

Figure 5: Simplified heating diagram of configuration B. The explanatory notes are identical with configuration A. Block O refers to the gas boiler.

CONFIGURATION C

Figure 6: Electrical diagram of configuration C. A PAST® storage tank is used; the heat source is an outdoor unit of a heat pump with direct condensation in the tank and a bivalent electrical heat source; heat consumers include flow heating of hot water in the tank and one heating circuit with classic radiators. The explanatory notes are identical with configuration A.

Figure 7: Simplified heating diagram of configuration C. The explanatory notes are identical with configuration A.

CONFIGURATION D
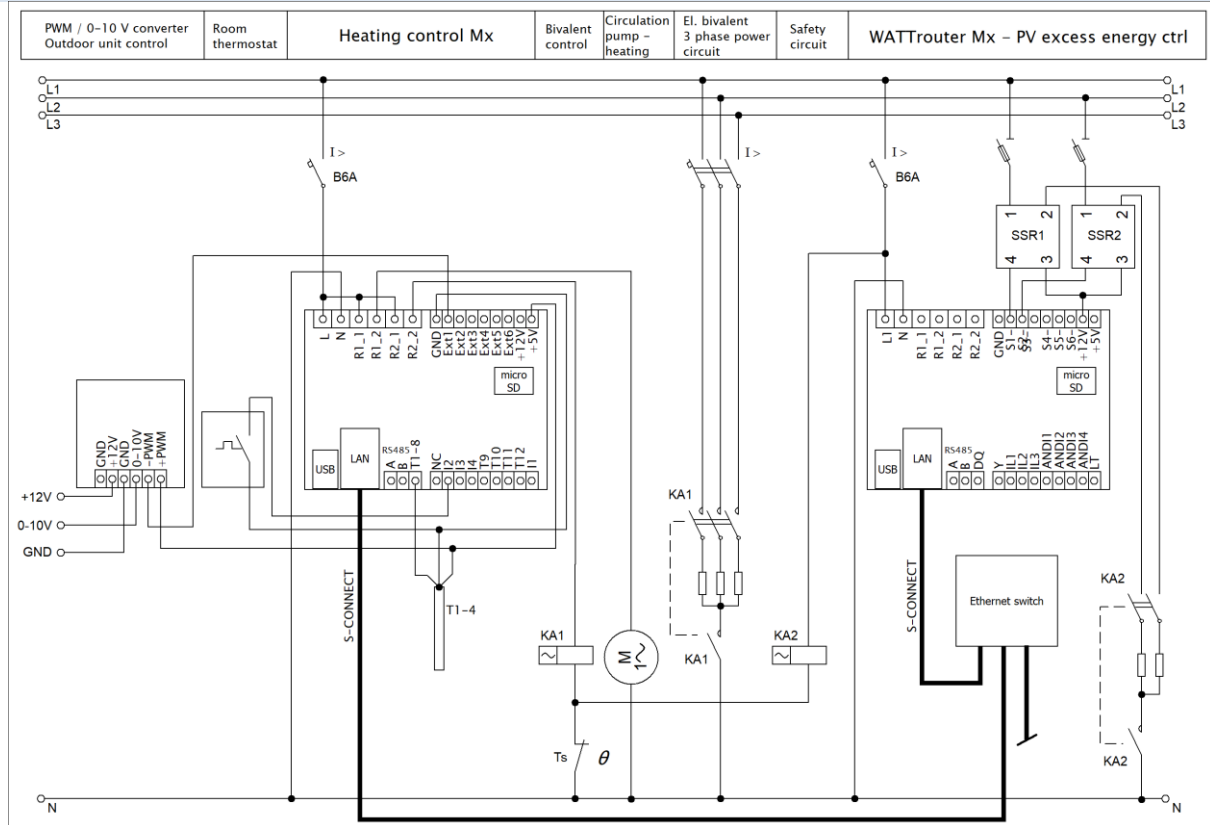
Figure 8: Electrical diagram of configuration D. This configuration demonstrates the interconnection of the Heating Control Mx device with the WATTrouter Mx system thanks to which the outdoor unit of the heat pump can be used not only for meeting the present heating needs but also for the very advantageous transformation of excess energy from the photovoltaic power station into heat. The diagram is based on the connection of configuration C. Heating Control Mx communicates with the WATTrouter Mx by means of the LAN network. The figure also shows two more heating coils connected to the SSR outputs of the WATTrouter. These heating elements are used for the utilization of the excess energy in the storage tank when the outdoor unit of the heat pump is not in operation or when the excess energy is higher than the present input power of the outdoor unit. Only 2 coils of the usually three-phase cartridge are shown in the figure. When choosing the power supply phases of the individual heating elements, we should pay attention to the rules specified in the WATTrouter handbook and we must also take into account the size of the main circuit breaker and the input power and the number of phases of the outdoor unit of the heat pump.
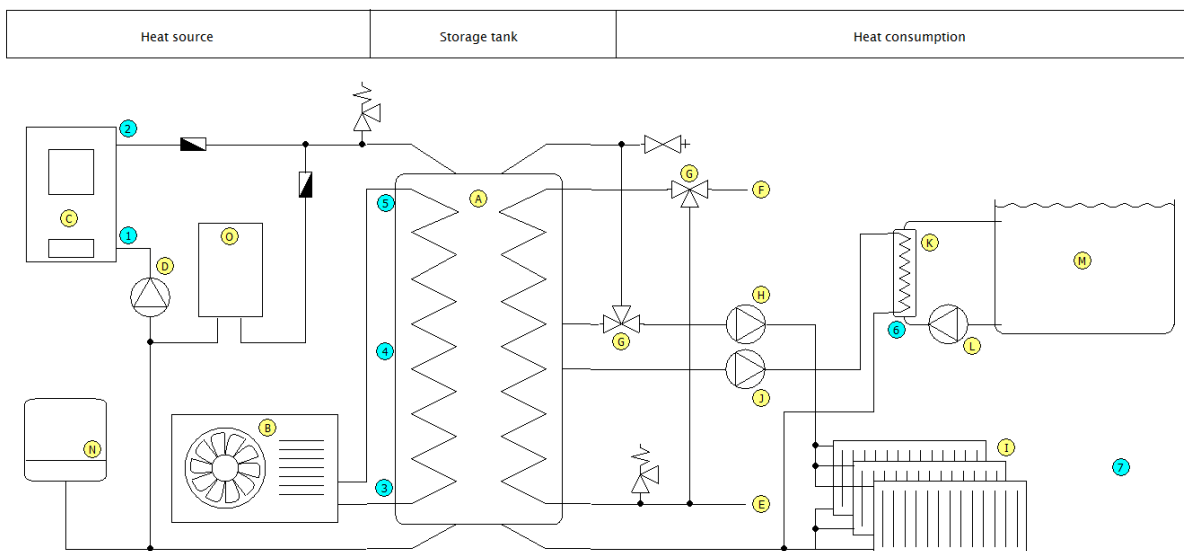

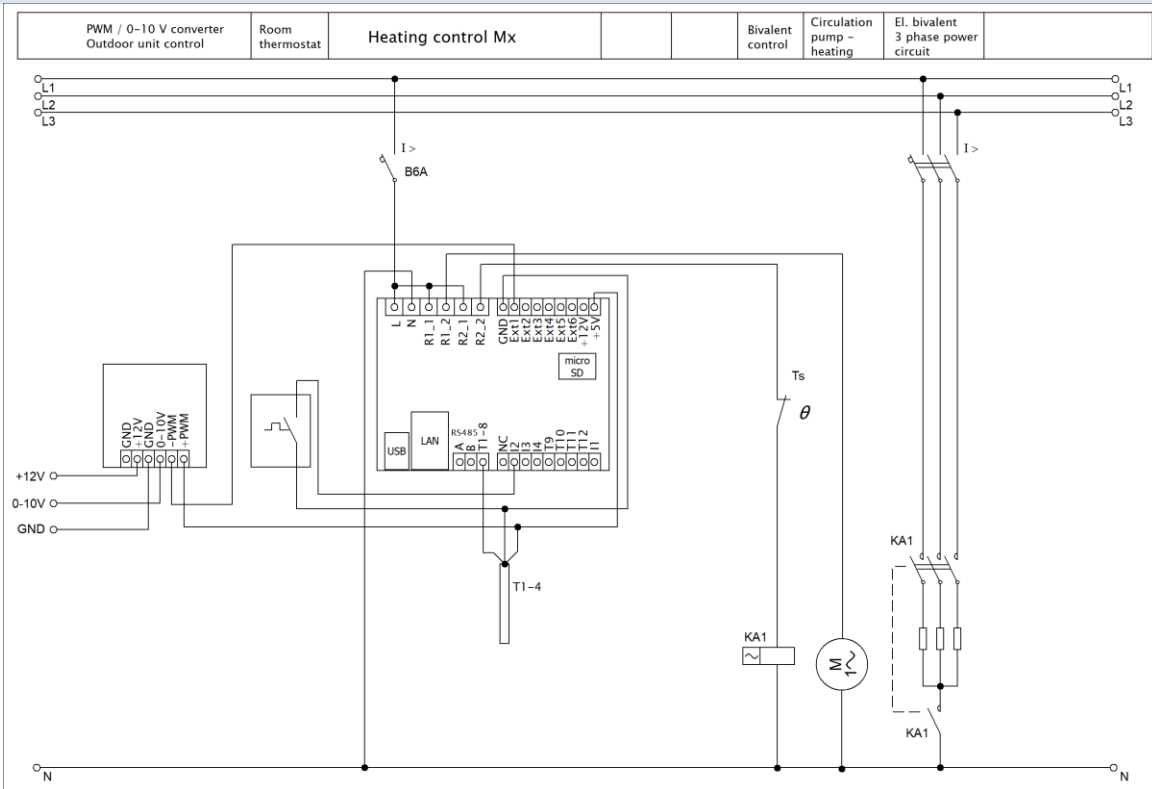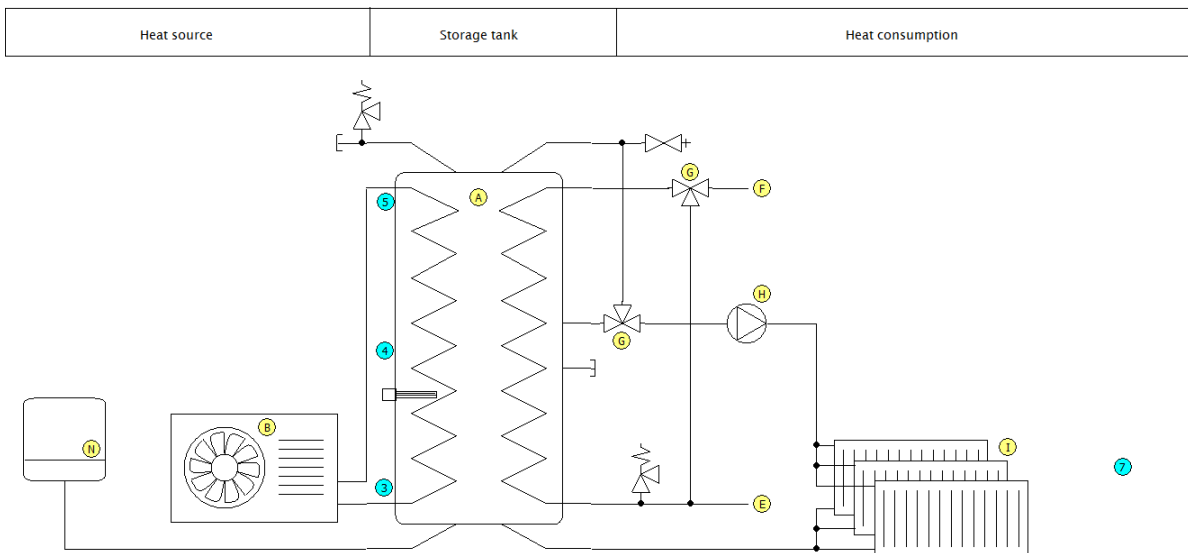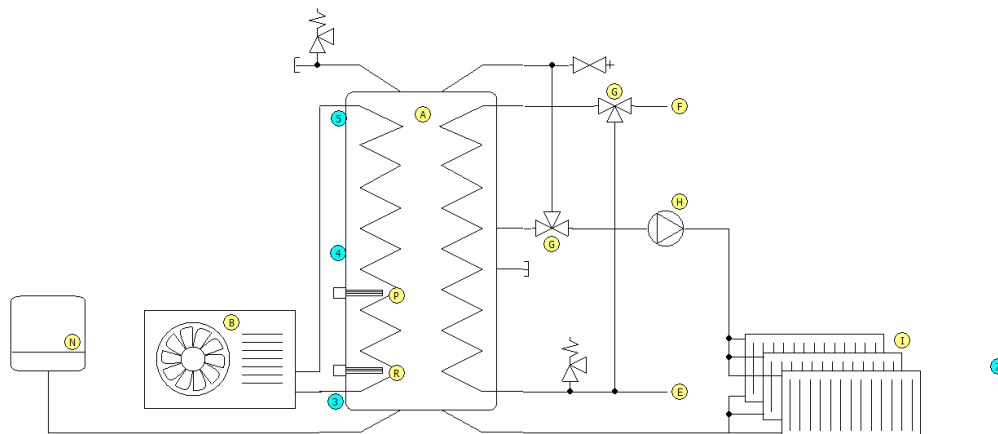Figure 9: Simplified heating diagram of configuration D. The explanatory notes are identical with configuration A. Block P refers to a three-phase electrical cartridge heater used as a bivalent heat source and block R refers to a three-phase electrical cartridge heater

intended for using the excess energy by means of the WATTrouter. This cartridge heater is located in the bottom part of the storage tank so that most of the tank volume can be used for the accumulation of the excess energy.

CONNECTION OF THE OUTDOOR UNITS OF THE HEAT PUMPS
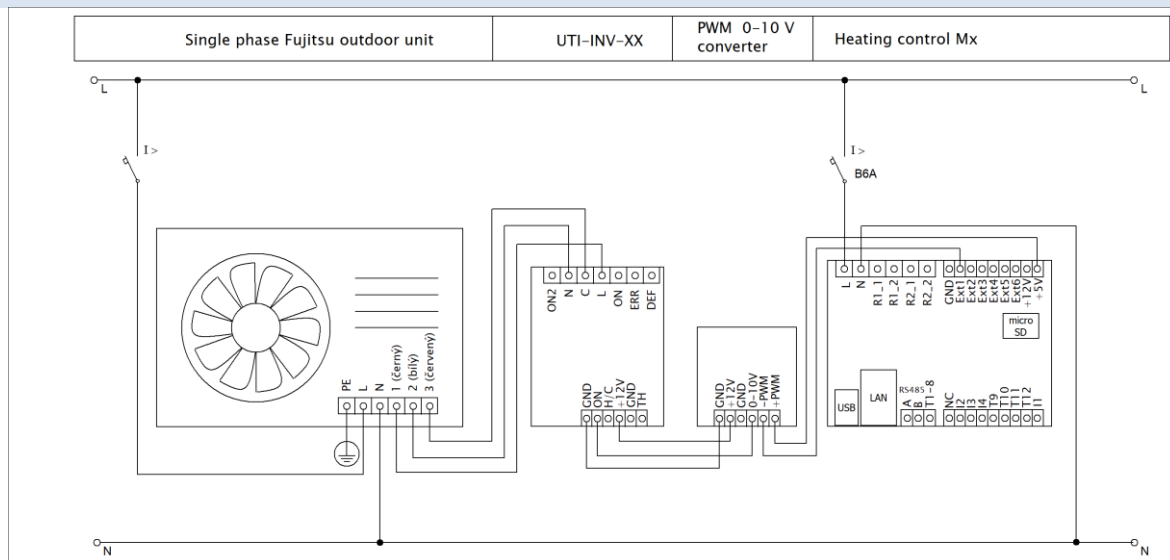
Figure 10: Electrical diagram showing the connection of the controller with a single-phase Fujitsu outdoor unit via the UTI-INV-XX control module from the company Impromat Klima s.r.o. The connection of a three-phase unit is analogous, see the installation handbook for the device. Caution: This diagram is illustrative, it is necessary to always perform the connection according to the installation handbook for the control module of the outdoor unit, the connection may change!
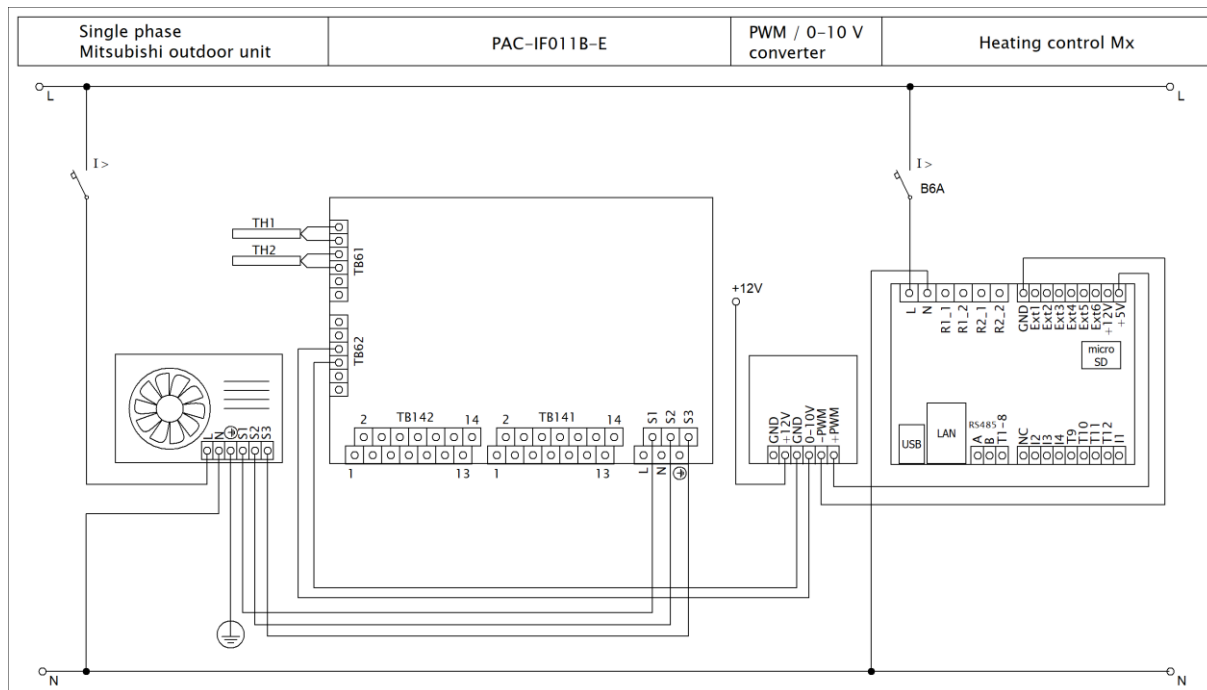
Figure 11: Electrical diagram showing the connection of the controller with the single-phase Mitsubishi outdoor unit via the PAC-IF011B-E control module. The proper function of the connection requires the correct setting of the DIP switches according to the documentation for this module. The connection of a three-phase unit is analogous, see the installation handbook for the device. Caution: This diagram is illustrative, it is necessary to always perform the connection according to the installation handbook for the control module of the outdoor unit, the connection may change!

OTHER CONNECTION OPTIONS
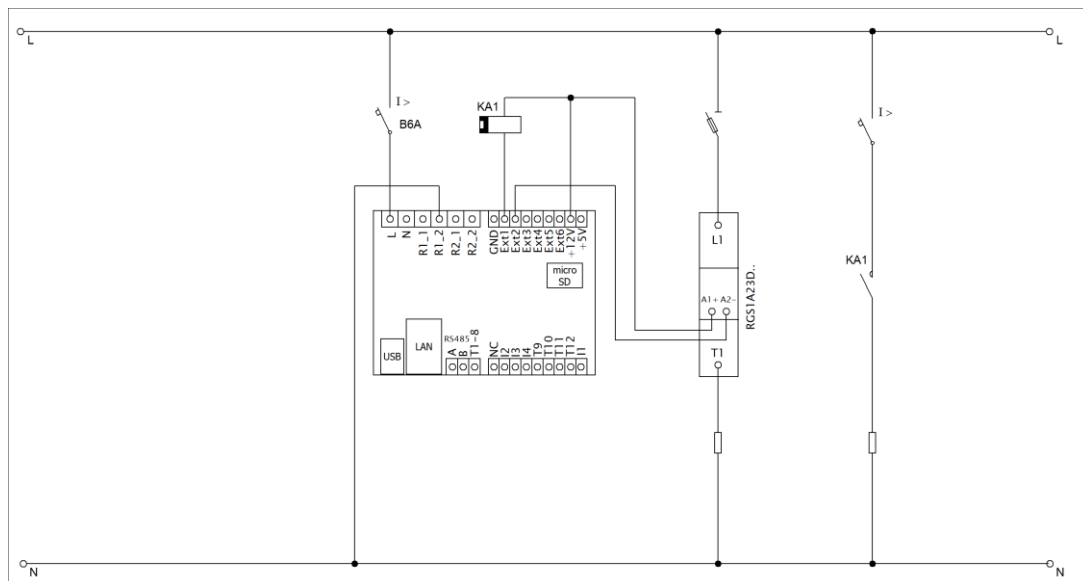
Figure 12: Expansion of the number of power outputs by means of a common electromagnetic relay with 12VDC coil, which can be connected to the EXT1-3 outputs, or with a solid state RGS1A relay with direct-current control, manufactured by Carlo Gavazzi, which can be connected to the EXT1-6 outputs. Other SSRs with similar parameters (see the chapter Technical specifications) can also be used. The outputs cannot be actuated by the fast PWM mode in this case, but only in the relay (ON/OFF) mode! Common electromagnetic relays or contactors cannot be connected to EXT4-6 outputs!

INSERTING THE SC-GATEWAY OR SC-ROUTER MODULE

The SC-Gateway module is an optional accessory that provides wireless communication with wireless end-points. Insert the module to sockets in the regulator according to the images below. Before insertion you must lift the regulator cover with a small screwdriver or similar tool.

Make sure the regulator is turned off before inserting the module!

Keep the proper orientation of the module. Reverse orientation can damage the module! Insert the module gently, without unusual force!
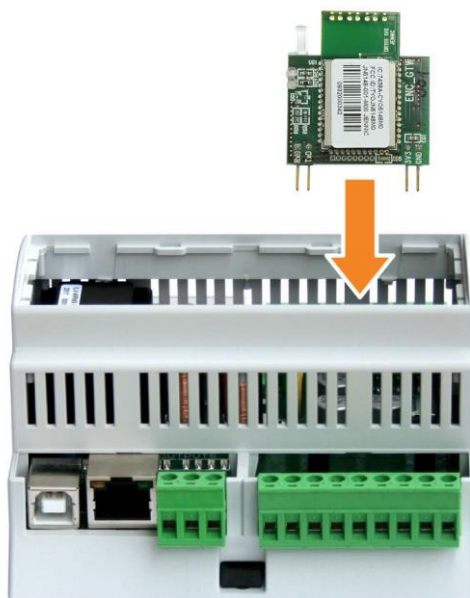
Figure 13: Insert the module to sockets on regulator mainboard, use vertical movement as the arrow indicates.

Figure 14: Resulting position of the module inside the regulator.

After regulator power on, the blue LED on the module must indicate the module initialization sequence, refer to chapter LED Statuses. In case that does not happen, refer to chapter Troubleshooting.

FINISHING THE ASSEMBLY

The controller may be connected only in alternating power distribution networks with 230 V AC, 50 Hz parameters. The controller must be protected with a circuit breaker of the recommended B6A size, the connected equipment and/or appliances must also be appropriately protected! During assembly, the power supply leading to the point of assembly must be switched off (distribution board)!

After completing the assembly, carefully check the regulator wiring. Mains voltage or voltage outside the tolerances specified in the chapter Technical specifications MUST NOT be connected to any pluggable terminal blocks! Regular electromagnetic relays MUST NOT be connected to Ext4-6 outputs! It is not allowed to connect appliances with more than the maximum permitted power input! Failure to do so will almost certainly destroy the regulator and void the warranty!

The heating distribution and refrigerant distribution must be prepared by a professional plumbing company so that the entire installation will be secured against possible accidents. This warning primarily concerns the correct installation of pressure relief valves and safety mechanical thermostats. In the case of the storage tank installation, it is necessary to observe the relevant safety warnings. The controller itself does not solve and even cannot solve all accident states!

If the regulator is constantly connected to PC via USB interface (mostly if long cable is used), we strongly recommend using an USB isolator!

After a careful inspection of the controller connection, switch off the circuit breakers/fuse cutouts of the connected equipment and switch on the main circuit breaker and also the circuit breaker of the controller. The LED PWR (power supply indication) will light up. If it fails to light up or if the light is not ON continuously or if the LED ERR (error status) starts to flash, proceed according to the chapter Troubleshooting. No output is active in the default state and no connected equipment will therefore be switched on.

The controller is installed now and ready for setup.

DEVICE CONFIGURATION

In order to configure the device you will need a laptop or possibly a standard PC (placed close enough to the controller) and a USB interface and connection to the computer network by means of the Ethernet, Wi-Fi, etc. (hereinafter referred to as the computer). The configuration is done by means of the controller web interface. The first configuration of the network usually has to be done through the USB interface by means of the HC Downloader Mx program which can be downloaded from the manufacturer's website. You can find the description of the program in the chapter HC Downloader Mx software**Chyba! Nenalezen zdroj odkazů.**. After the first configuration, you can use any mobile device which runs a modern web browser supporting the HTML5 standard.

If it is not possible to proceed further in the configuration due to any reason, follow the instructions in the chapter Troubleshooting.

CONFIGURATION OF THE CONNECTION TO THE CONTROLLER

Heating Control Mx allows monitoring and configuration exclusively by means of the Ethernet port. In order to start the communication it is necessary to configure the network connection correctly.

Always have the network and the controller access configured by a person with the appropriate qualifications. The manufacturer does not provide any technical support for the problems associated with the network configuration, except in the case of a provable malfunction of the network interface of the controller.

It is advisable to carry out the first configuration of the network in the controller through connection to the USB interface by means of the HC Downloader Mx software (in the case of connection via the Ethernet port the connection will almost always be lost after a change of the parameters).

Knowledge of your local network parameters is the basis for a successful configuration. It is necessary to know this data:

- the IP address of your router, or possibly of another access point to your local network (if it is installed),
- the free range of IP addresses, i.e. addresses which do not belong in the range of dynamically assigned addresses in the case of the switched-on DHCP server and at the same time they are not static addresses of other devices in your local network,
- the subnet mask of your local network which is used by all devices connected to it.

The above applies to connection settings using a fixed (static) IP address, which must be set manually in the controller. The controller also allows even a dynamic setting of the IP address and other parameters that are automatically assigned to it by the DHCP server. For more information about this mode, see chapter Network settings.

CONFIGURATION OF THE CONNECTION TO A LOCAL NETWORK

The network connection is configured in the "Settings" tab in the "**Network settings**" group.

If the connection parameters are set using a DHCP server, the IP address, Mask and Default gateway parameters are not set, they are assigned to the controller automatically.

Caution: The network setting will only be effective after the controller has been reset (the option "Reset unit on config. write")!

- **IP address**: Set the IP address in such a way that it will not collide with another device in your local network. For example, if the address of your router is **192.168.2.1**, you can set **192.168.2.10** if this address does not already belong to another device in your local network and if this address is not within the range of dynamically assigned addresses by the DHCP server in your local network (it is usually active in your router so be sure to check this). The default IP address in the controller is 192.168.2.200.

- **Subnet mask**: Enter the mask of your local network. In the overwhelming majority of cases the value is **255.255.255.0.** This is also the pre-set subnet mask in the controller.

- **Default gateway**: Set the IP address of the device which will be used for sending controller requests outside the local network. In the overwhelming majority of cases it is the IP address of your router. In the given example the address will be **192.168.2.1.** This is also the pre-set IP address of the default gateway in the controller. If you do not have such a device, enter a different unused IP address in your local network. In this case, however, requests directed outside the local network will not be acknowledged.

- **Controller MAC address**: Enter the physical/MAC address of your controller. Change this value only if there is another device with the same physical address in your local network.
  Note: The Heating Control Mx controllers are assigned their own registered address range with the IEEE. When changing the MAC address, it is necessary to respect the specific rules which apply to these addresses!

- **UDP port**: Enter the value of the UDP port to which UDP communication from the HC Downloader Mx program will be directed. We recommend that you change this value only if there are more UDP servers in your local network (which should be accessible from the Internet) or if you wish to improve the protection of the connection. If you change the UDP port in the controller, it is also necessary to change the UDP port settings in the configuration of the connection driver via LAN/UDP of the HC Downloader Mx software. The default value pre-set in the controller is 50000.

- **HTTP port**: Enter the value of the HTTP port where the controller will listen to requests of the HTTP protocol, i.e. of the web interface. We recommend that you change this value only if there are more web servers in your local network (which should be accessible from the Internet) or if you wish to improve the protection of the connection. The default value pre-set in the controller is 80.

CONFIGURATION OF THE INTERNET CONNECTION

In order to connect to the Internet it is recommended that you have an active public static IP address. If you have only a dynamically assigned IP address, this address can be found from the settings of your router. A dynamic public IP address can be also used, but depending on the Internet connection provider this address can change with varying frequency. Therefore, if the controller is not accessible from the Internet, always check the global WAN network configuration in your router first.

The controller can be accessed from the Internet only through routers or other access points which include the **NAT** function (Native Address Translation) or another similar function, which is used for translating IP addresses into the local network.

The following text describes a sample Internet connection configuration using the Zyxel P660 router for both TCP and UDP protocols. The procedure is as follows:

- Click to open the drop-down list "*Service name*" in the "**Network/NAT/Port forwarding**" tag and select the "*User Define*" item.
- Fill in the row in the routing table according to the figure and press "*Apply*", this will write the setting in the router.
- Repeat the procedure for both rows of the table (protocol TCP and UDP).

#	Active	Service Name	Start Port	End_Port	Port Translation Start Port	End_Port	Server IP Address	Modify
1	☑	TCP HC	8080	8080	80	80	192.168.2.201	▦ 🗑
2	☑	UDP HC	50001	50001	50000	50000	192.168.2.201	▦ 🗑

The setting of the NAT function is similar for other routers.

If your global (static or currently used dynamic) IP address is, for example, **80.200.50.6**, then simply enter ***http://80.200.50.6:8080*** in your web browser (we recommend that you create a bookmark in the browser) in order to access the controller from the Internet by means of the HTTP protocol.

SETTING UP THE CONTROL FUNCTIONS

The controller configuration consists of several steps of varying significance – the setting of inputs, outputs, activation and the setting of function blocks and other presets.

- After the web interface has been displayed in the browser, we can proceed to set the temperature inputs. If the temperature inputs are connected to the controller, the relevant temperatures and green indicators signaling the function of the sensor should already be shown. If more sensors (especially digital sensors) are used, we will probably not recognize at first sight which sensor belongs to which function and therefore we will proceed in the following way for every sensor:

  a) we will heat the sensor by touching or in another way
  b) from the temperature change in the web interface we will find out which sensor it is and we will write the caption on the right side next to the sensor designation (T1-11).

  If all physically connected digital sensors are not shown or if we have other doubts, we will use the button "Search for digital temperature sensors" in the "Settings" tag. The controller will again try to find the available sensors on the bus.

  Caution: If we add or remove a digital sensor, the function "Search for digital temperature sensors" will order the sensors according to internal priorities and therefore after every such change it will be necessary to check the assignment of the captions to the sensors and the assignment of the sensors to the individual control blocks (see point 4)!

  Immediately after completing the configuration, we will write the assigned captions in the controller by means of the button "Write".

- We proceed in an analogous way when setting the digital inputs. If we do not remember the connection, it will be necessary to activate the input temporarily, this will switch on the blue indicator of the input connection and we will be able to assign a caption. After finishing the configuration, we will again write the assigned captions in the controller by the button "Write".

- When setting the outputs, we can use the "Output test" function in the "Settings" tab. **Before doing so we should, however, again check the connection of the outputs according to the instructions specified in the chapter Instructions for Installation of the Device.** We will test the individual outputs and assign the captions. After completing the configuration of the outputs, we will again write the assigned captions in the controller with the "Write" button.

- After setting the inputs and outputs, we can proceed to the activation and setting of the individual control blocks. Every block is activated by a ticking box located on the left next to the name of the block, e.g. on the left next to the text "Heat pump 1" in the "Heat pumps" tab. By ticking this box the entire block will change its color and the configuration field will become open to changes. In addition, it is necessary to assign the inputs and outputs in every block; this is done by means of drop-down menus designated as "*Input – xxx*" or "*Output – xxx*". In the drop-down menus the inputs and outputs are already designated with captions, it is therefore advisable to have all the inputs and outputs

designated appropriately before starting the configuration of the blocks. **A control block will not work correctly or it will not work at all, if it is not activated and if incorrect inputs and outputs have been assigned.** The same input and output can be assigned to 2 or more drop-down menus in different control blocks, in the case of the output the resulting state is then a logical sum (function OR), or possibly in the case of the actuation of the output in the PWM mode (see the note below) it is a maximum (function MAX), of the function output of the relevant control blocks. After we have assigned the inputs and outputs, we can change other configuration fields of the control block if the default values do not suit us, and in the end we will again write the block configuration in the controller with the "Write" button.

Note: All outputs can be driven by two states (ON/OFF) or in the PWM mode. In the case of the external Ext1 to Ext3 outputs the PWM mode will cause fast PWM at the output with the carrier frequency from 200 Hz to 10 kHz (according to the PWM frequency settings on the Settings tab), in the case of the external Ext4 to Ext6 outputs it will produce varying voltage in the range 0-10VDC, and in the case of relay outputs a slow PWM with the carrier frequency of 0.002 Hz (it corresponds to the period of 500 s). The way respective outputs will be driven depends on the configuration of the individual control blocks.

- After the configuration of the control blocks, we can change the general options in the "Settings" tab, for example low tariff signal source, setting of the outside temperature, etc. We will again write these changes in the controller with the "Write" button.

- In the "Statistics" tab it is possible to change the loading period of the online chart and to select values which should be monitored. We will again write these changes in the controller with the "Write" button.

- Save the configuration on the computer disk with the "Save" button. It can be loaded again by means of the "Open" button. Due to the security restrictions of browsers, saving is usually allowed only in the folder designated for downloading ("Downloaded items", etc.).

S-CONNECT PROTOCOL SETTINGS

The device supports the S-Connect device sharing protocol. The following paragraphs describe the basic principles of the protocol. For more detailed information on setting up this communication, see chapter S-Connect tab.

Note: The S-Connect protocol is not public, so only the principles of the protocol are described, not the protocol itself.

DESCRIPTION OF THE S-CONNECT PROTOCOL

The S-Connect protocol allows you to share devices via any physical communication layer. The SOLAR controls s.r.o. controllers currently support device sharing via 2 physical layers (if available):

a) Over the existing network architecture, ie Ethernet or WIFI. This is only possible if the device is connected to an Ethernet network. Therefore, it cannot be used for WATTrouter ECO.

b) Over the wireless architecture. This is only possible if a SC-Gateway or SC-Router module is inserted in the device. Therefore, it cannot be used for WATTrouter M and Heating Control.

Attention: In the case of ad a) communication is provided by UDP and TCP protocols. Regarding the requirements for the UDP protocol, see chapter Pairing of stations to the access point. Port 50160 is used for TCP communication. For communication to work, this port must not be blocked on the network. In order for the communication to work without problems, the local network must not be excessively overloaded with other communication, eg by downloading large files, videos, etc.

Attention: Communication in case of ad a) is not secured. It may take place only in the local network or in a network that is sufficiently secured against unauthorized access!

Attention: Communication in case of ad b) only transmits information about the status of the outputs, due to limited data throughput. Therefore, the states of the inputs (binary inputs, temperatures, powers) and the states of the memory cells are not transmitted!

The term device means hardware device that a controller supports and that holds certain status information, or measure certain physical quantities.

In the current version, the S-Connect protocol allows you to transfer information from the following devices:

   a) Binary input. Status information 0 (off) or 1 (on).
   b) Temperature. The temperature data is transmitted with a resolution of 0.1 ° C.
   c) Performance. The instantaneous active power data with a resolution of 1W is transmitted. In addition, some auxiliary data is transmitted, such as the daily and total energy measured by the respective device.
   d) Output. The output excitation data in the range of 0 to 1000 is transmitted, where 0 means the output is switched off and 1000 means the output is fully switched on. In addition, some auxiliary data is transmitted, such as the output hardware type, the assigned output function, or the possible output restriction.
   e) Memory. The memory cell status is transferred. The memory cell can hold any status information described in the previous points.

The S-Connect protocol works based on the access point's communication with remote stations, similar to how computers connect to a WIFI access point. The access point is always 1 device that the user chooses.

The access point controls the communication with remote stations and their pairing. There cannot be 2 access points in one S-Connect network, but there can be several S-Connect networks, ie several access points, within a local Ethernet network.

Example 1: A typical example of an access point is the Wattrouter Mx controller, which provides power measurement on phases L1 to L3 and also switches the connected appliances (loads) according to the photovoltaic excess energy. Another Wattrouter Mx controller is then connected to it as a remote station, which only serves as an output expansion module. The S-Connect protocol is transmitted via the Ethernet network.

Example 2: Another example of an access point is the Heating Control Mx controller, which controls the building heating. The Wattrouter Mx controller then connects to it as a remote station and shares information about the low tariff, temperature data, or excitation of the output needed to optimize the operation of a heat pump according to the photovoltaics excess energy (heat pump that is connected to Heating Control Mx). The S-Connect protocol is transmitted via the Ethernet network.

Example 3: Another example of an access point is again the Wattrouter Mx controller, which provides power measurement on phases L1-L3 and switches the connected appliances and at the same time it has the SC-Gateway module installed. A wireless socket is then connected to it as a remote station. The S-Connect protocol is transmitted over the wireless network.

PAIRING OF STATIONS TO THE ACCESS POINT

If the station is not connected to an access point, it sends a pairing request. This request is implemented differently depending on the physical layer used:

   a) Ethernet connection: The station sends a request periodically every 10 s. The station sends a UDP broadcast, which the access point receives if it is connected to the same local network. This UDP

broadcast uses IP 255.255.255.255 and port 50161. For the request to arrive, this port must not be blocked on the network and the UDP broadcast function must not be blocked either.

b) Wireless connection: The station registers in the wireless network managed by the SC-Gateway module and the request is then sent from the SC-Gateway module to the unit to which the module is connected and which always acts as an access point. The wireless device must be within range of the SC-Gateway for the request to arrive. If the request does not arrive and even after a longer period of time (1 minute or more) and the information below is not displayed, then the station is probably out of range. Then proceed according to chapter Troubleshooting. The request arrives only once, to show the request again station restart is needed (switch it off and on again).

The station pairing request is then displayed to the user in the access point control interface, and the user must decide whether or not to allow the station to pair with the access point.

The pairing request then looks like this:
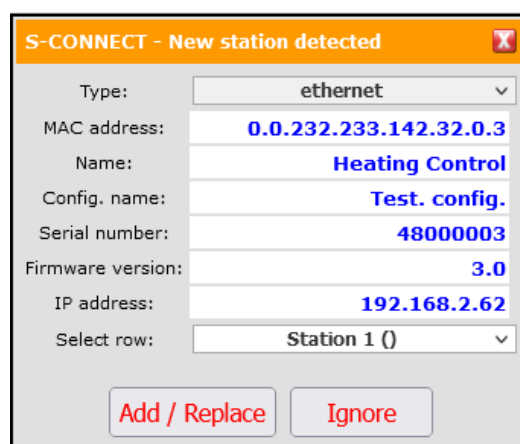
Figure 15: A dialog box showing the new station pairing request.

The user can then acknowledge the request and add the station to the specified row of the station table or reject the request, then add the station to the internal list of ignored stations so that the next time the access point ignores its repeated request.

To confirm the pairing or reject the station, it is necessary to write the configuration to the controller.

As soon as a station is added to the station table of the access point, the access point starts communicating with that station immediately.

This is also reflected in the station control interface, where the given access point appears in the first row of the station table.

This completes the pairing.

Note: In the case of ad a), if the connection between the station and the access point is interrupted, the station will start transmitting pairing requests again periodically. This is because the connection may have been lost due to a change in the station's IP address if, for example, the station uses DHCP for IP assignment. The pairing request is therefore also used to communicate the current valid IP address of the station to the access point.

Note: In case of ad a), if there are more access points in one local network, ie more independent S-Connect networks, the pairing request will be displayed in all access points. The user can try to pair the station with multiple access points, but communication can only take place with only one access point at a time, depending on where the first pairing took place. If a station has a specific access point assigned to it, it will refuse to communicate with another access point. Pairings with other access points will be invalid. If a pairing request is

displayed at an access point where you do not want to pair the station, the request must be rejected, and the access point will continue to ignore that station.

CANCEL STATION PAIRING

If the pairing needs to be canceled, this is done in the control interface of the access point and possibly the station.

For an access point, the appropriate command (Clear entry button) removes the stations from the access point station table. This will also delete the station from the access point, end the communication and delete all mapped devices from the device mapping table.

The access point remains assigned in the station control interface. It can either be deleted in the same way or left in case we want to re-pair this station with the same access point later.

DEVICE PAIRING

After pairing the station with the access point, in order to share the device, it is necessary to assign the source (physical) devices of the remote unit to the destination (logic) device of the local unit. This assignment is called mapping and can be done both in the user interface of the access point and at the station.

Source devices can be selected from the device map, which is transmitted by the respective remote unit. The destination devices can be selected from the available logic devices of the local unit.

The mapping is performed in a device mapping table, where each row of the table maps one source device to one destination device. The principle of mapping is best illustrated by the following figure:

S-CONNECT - a device sharing protocol   *) local control
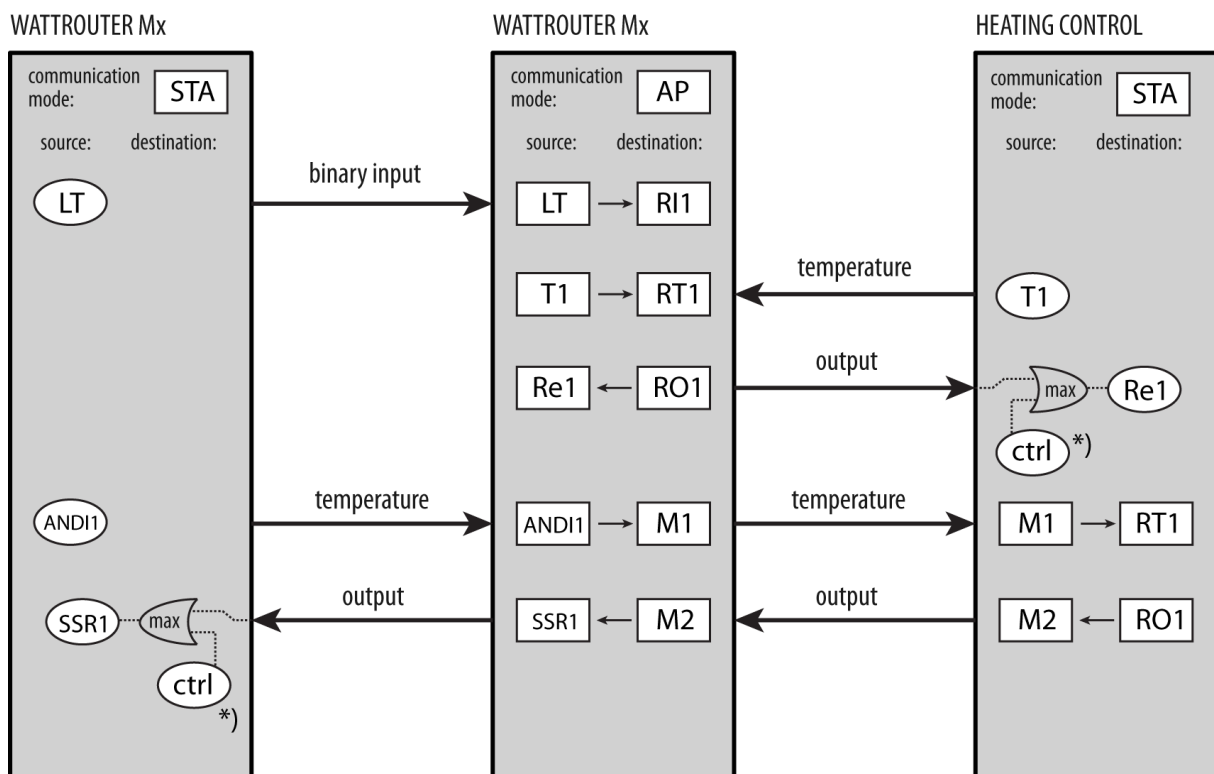
Figure 16: Device sharing in the S-Connect protocol. The communication mode of the given device is marked in the upper part, the relevant mappings of source devices to destination devices are marked in the rectangular fields below. The oval fields indicate the

source physical devices available in the device. To excite (switch) the physical outputs, the maximum excitation of the local control of the given device and the excitation received from the remote station is always used. The figure also shows the sharing of devices between individual stations using the memory cells of the access point.

Only after the mapping is completed, logic (remote) devices can be used in the local unit. These can be selected in various places in the control interface of the local unit as well as their physical devices.

PROTOCOL LIMITATIONS IN THE HEATING CONTROL MX

The S-Connect protocol has the following limitations in the device:

- The Ethernet protocol version has no limitations.
- The wireless protocol version only works with the inserted SC-Gateway or SC-Router.
- Only remote outputs can be mapped due to limited data throughput, when using the wireless protocol version. Therefore, the states of the inputs (binary inputs, temperatures, powers) and the states of the memory cells are not transmitted.

DESCRIPTION OF WEB INTERFACE ITEMS

This chapter describes all items of the controller web interface in which all values and states of inputs, outputs and other operational values are shown clearly and the states and settings of the control blocks are shown in the individual tabs.

The web interface is implemented by means of the AJAX/XML technology, Javascript must therefore be allowed in the web browser.

Authorization of write requests to the controller is not performed using standard HTTP authentication, but by sending username and password data directly in each data write request. It is also possible to send a more secure hash instead of username and password. This way can be configured by checking the Require better HTTP security option in the Settings tab.

DIGITAL TEMPERATURE INPUTS

- T1-8 – input designation.

- Name field – it shows an input caption and makes it possible to enter this caption. The text can have a maximum of 16 characters in the ASCII code.

- Status indicator – green light if the sensor is connected and working.

- Value – it shows the measured temperature in tenths of °C.

ANALOG TEMPERATURE INPUTS

- T9-12 – input designation.

- Name field – it shows an input caption and makes it possible to enter this caption. The text can have a maximum of 16 characters in the ASCII code.

- Status indicator – green light if the sensor is connected and working.

- Value – it shows the measured temperature in tenths of °C.

BINARY INPUTS

- I1-4 – input designation.

- Name field – it shows an input caption and makes it possible to enter this caption. The text can have a maximum of 16 characters in the ASCII code.

- Status indicator – blue light if the sensor at the input is switched on.

OUTPUTS

- Ext1-6, Re1-2 – output designation.

- Name field – it shows an output caption and makes it possible to enter this caption. The text can have a maximum of 16 characters in the ASCII code.

- Output status indicators – they inform the user about the cause of switching or possibly about a restriction of the output. There are five indicators:

    a) blue indicator – it shows only when the output is switched on by a control block.
    b) green indicator – it shows when a time schedule enforces the output to be switched on.
    c) red indicator – it shows when a time schedule restricts the output.

d) purple indicator - it shows when the output is switched on in protection mode, see chapter Output protection dialog.

e) green indicator – appears when the outputs are forced externally by the S-Connect protocol.

Note: Unlike, for example, the WATTrouter controllers, time schedules have extended options and therefore all indicators can be shown at the same time depending on the configuration of the control blocks.

ERROR AND INFO STATUS

These indicators are grey in the inactive status, red in the active status.

- Some temperature sensor Txx failed – some sensor from the T1 to T12 range which is at the same time assigned to the control block and which is necessary for its perfect operation is not working. Check the assignment of the temperature sensors and their functionality. This error does not block the operation of the controller in control blocks for which all assigned sensors are functional.

- DC source overload –Voltage level of the internal DC source drops below +8,0V relative to GND. This malfunction can occur when the internal DC voltage source is heavily loaded. The firmware checks this and eventually signals this failure. This malfunction lasts for the duration of the cause and for a further 60s afterwards. Typically, this failure occurs when all 8 internal outputs are used or there is overload on the +5V terminal (e.g. through damaged digital temp. sensors). Please check that the +5V terminal is not overloaded. The error blocks the operation of all control blocks.

- S-Connect: device error - this error is reported if any device mapped in the S-Connect tab is not functional or the station that provides it is not connected. Which device is affected can be determined by the Ping [ms] value and the device activity indicator on the S-Connect tab. This fault does not block any functions of the controller, except for functions that depend on faulty shared devices.

- Output test is active – it informs the user about a state in which one of the outputs is activated by the TEST button.

- Low tariff – if the low tariff signal is detected according to the Low tariff configuration in the Settings tab, the red light is on.

- Summer time – it informs the user about the summer time. The summer time period is from 2:00 AM CEST on the last Sunday in March to 3:00 AM CEST on the last Sunday in October. If the Use summer time option is not ticked in the Settings tab, the indicator will stay inactive.

- SC-Gateway/SC-Router present – informs the user about the presence of the SC-Gateway or SC-Router module in the controller.

Other states:

- Firmware version – it shows the firmware version in the controller.

- Serial number- displays serial number and it is unique for each regulator.

- Day of week – shows the current day of week, which is obtained from the controller date.

- Outside temperature – it shows the outside temperature if it is configured in the Settings tab.

- Date (controller) – it shows the real time running in the controller (date).

- Time (controller) – it shows the real time running in the controller (time).

Note: The real time in the controller is backed up with a built-in lithium battery so it continues to run even if the controller power supply is switched off.

- Date (client) – it shows the real time running in the client, i.e. on the PC (date).

- Time (client) – it shows the real time running in the client, i.e. on the PC (time).

HEAT PUMPS TAB

It includes the control blocks for managing outdoor units of heat pumps.

Outdoor units can be of two versions:

a) inverter units with the option of PWM power control by an external signal, e.g. by voltage 0-10 V.
b) units which cannot be controlled externally (with or without an inverter), they can be only switched on and off.

Note: *Heating Control Mx is generally unable to control configurations of heat pumps (outdoor and indoor unit). These configurations have their own control usually located in the indoor unit and without the option of external switching. Heating Control Mx is designed primarily for controlling outdoor units and the indoor unit is replaced with direct condensation in the storage tank. Using indoor units in the multi-source heating mode where storage tank is utilized is not convenient and therefore these configurations are not and will not be supported by the manufacturer. If, nevertheless, you wish to make use of, for example, your existing heat pump and you wish to control it by means of the Heating Control Mx device, you should always consult compatibility with the manufacturer or supplier of your heat pump.*

The heat pump can be operated in 2 modes:

- **Internal control** – the power of the heat pump is controlled according to the difference between the required temperature and the current control temperature, in other words it is the required power according to the heating requirement for the building.
- **External control** – the power of the heat pump is determined directly by an external device, in the current version it is WATTrouter M or Mx.

In addition, Heating Control Mx can combine both these modes. The output power of the heat pump is determined as the maximum of the internally and externally required power:

$$P = Max(P_{int}, P_{ext})$$

This method does not limit the heat comfort in the building and, at the same time, it enables heat accumulation in the case of control by an external device, i.e. the WATTrouter, if the current excess energy from the photovoltaic power station is higher than the power required for the optimal heating of the building.

This block also includes functions for the control of up to two bivalent heat sources (2nd level). The bivalent sources are switched on only if the outside temperature drops under the limit specified by the parameter "Max. outside temperature to run bivalents". A gas boiler or an electrical cartridge heater in the storage tank can constitute a 1st level bivalent source. 2 electrical cartridge heaters in the storage tank or possibly only one cartridge heater whose heating coils are switched on separately in a certain ratio (typ. 2:1) can constitute a 2nd level bivalent source.

The 1st level bivalent source is switched on when the heat pump is running in the internal control mode for the period set by the "Bivalent 1st level on-delay" parameter and at the same time the current control temperature does not reach the required value decreased by a quarter of the proportional band (this decrease eliminates possible temperature overshoots of the heating water).

The 2nd level bivalent source is switched on when the 1st level bivalent source is running for the period specified by the "Bivalent 2nd level on-delay" parameter.

Description of configuration and status elements:

- "Input – control temperature" – a temperature sensor according to which the power of the outdoor unit will be controlled. Typically it is located in the center of the storage tank, near the offtake of the heating water into the system. Always obligatory.

- "Output – heat pump request" – an output which is used to switch on or possibly to control the power of the heat pump. Ext1 to Ext6 outputs must be used in the case of the type according to a).

- "Output – bivalent 1st level" – this output switches on the 1st level of the bivalent heat source if it is connected. Not obligatory.

- "Output – bivalent 2nd level" – this output switches on the 2nd level of the bivalent heat source if it is connected. Not obligatory.

- "Proportional control" – tick only if you have an inverter heat pump connected which is controlled proportionally by the Ext1 to Ext6 output, therefore the type according to a). A PID controller will be used for controlling. A two-state controller with hysteresis will be used for other heat pumps, i.e. types according to b).

- "Allow external control (WATTrouter)" – it allows you to receive information about the requested power from the external device, mainly from a WATTrouter controller. In order to use the external control according to the excess energy from the photovoltaic power station by means of the WATTrouter it is necessary to have a proportionally controlled inverter heat pump connected, i.e. the type according to a).

- "Heat pump in low tariff only" – upon request of the internal control, the heat pump output activates only when the low tariff is active. This option does not affect external control or time schedules.

- "Bivalents in low tariff only" – upon request of the internal control, the outputs of the bivalent sources activate only when the low tariff is active. This option does not affect external control or time schedules.

- "Limit internal control when no heating" – it limits the internal control if the heating indicator is not active in any heating circuit in the "Heating circuits" tab. It can be used in summer when the storage tank is heated only from an external request in the case of connection to the WATTrouter.

- "Enable a temporary increase of the control temperature" – it activates the function of the temporary increase of the control temperature by 2 °C, if one of the heating circuits indicates insufficient heating and the current control temperature already reaches the required temperature (in the band ± 2°C). The temporary increase is activated 30 minutes after one of the heating circuits indicates insufficient heating and it is deactivated immediately after this condition ceases to exist in all heating circuits. This function makes it possible to respond to an increased heating request, for example, in long lasting frosts, when the pre-set equithermal or constant temperature of the heating water may not be sufficient for heating the house. In the case of a constant request for increased heating power it is necessary to change the pre-set equithermal curve or constant temperature; however, you should proceed carefully because every increase will be reflected in higher electricity consumption.

- "Internal control request" – the internal control requires operation of the heat pump.

- "Delayed internal control request" – ditto, delayed by the "Internal control request off-delay" item.

- "External control request" – the external control (e.g. WATTrouter) requires operation of the heat pump.

- "Bivalent 1st level request" – the internal control requires the operation of the 1st level of the bivalent heat source.

- "Bivalent 2nd level request" – the internal control requires the operation of the 2nd level of the bivalent heat source.

- "Control temperature temporarily increased" – it indicates a state of a temporarily increased control temperature by 2 °C according to the "Enable temporary increase of control temperature" setting.

- "Max. temperature reached" – the control temperature reached a limit set by the "Maximum temperature" item, the heat pump and the bivalent heat source will switch off.

- "Internal control limited" – a limitation set by the "Limit internal control when no heating" option.

- "Current control temperature" – the current control temperature read by the temperature sensor, typically in the storage tank.

- "Requested control temperature" – the temperature provided by a request according to the selected internal control mode.

- "Internal requested power" – it shows the value of the internally requested power of the heat pump in %.

- "External requested power" – it shows the value of the externally requested power of the heat pump in %.

- "Requested output power" – it shows the maximum values of the internally and externally requested power in %. This value represents the actual requested power of the heat pump. In the case of proportional control it ranges from 0 to 100%, in the case of two-state control it is either 0% or 100%.

- "Internal control off-timer" – it shows the remaining time until the heat pump is switched off if it has been activated by the internal control.

- "Bivalent 1st level on-timer" – it shows the time until the 1st level of the bivalent heat source is switched on if it is requested by the internal control.

- "Bivalent 2nd level on-timer" – it shows the time until the 2nd level of the bivalent heat source is switched on if it is requested by the internal control.

- "Internal control mode" – selection of the mode of determining the requested control temperature:

    1. "Constant temperature" – it is determined by the constant given below.

    2. "Equithermal control" – it is determined by the equithermal curve which can be displayed or adjusted in the "Equithermal curve" dialog.

- "Constant temperature" – it shows the requested control temperature in the internal control mode ad 1.

- "Maximum temperature" – it shows the limit of the control temperature; when this limit is exceeded, the heat pump and the bivalent heat source switch off.

- "Min. outside temperature to run heat pump" – the heat pump switches on only if the outside temperature is higher than this value. Otherwise only the bivalent heat source is active.

- "Max. outside temperature to run bivalents" – the bivalent heat source switches on only if the outside temperature is lower than this value. Otherwise (in higher temperatures) only the heat pump runs.

- "Temp. hits./proportional band" – it has 2 roles depending on the type of control:

    1. In the proportional control mode (types according to a) it shows the proportional band. If the current control temperature is lower than the requested temperature minus the proportional

band, the heat pump runs on 100 %. If it is higher than this limit, the PID control runs. We recommend that you choose the values 4 to 5 °C.

2. In the two-state control mode (types according to b) it shows temperature hysteresis of the switching of the heat pump. If the current control temperature is lower than the requested temperature, the heat pump switches on. If the current control temperature is higher than the requested temperature plus hysteresis, the heat pump switches off. We recommend that you choose values 2 to 3 °C.

- "Internal control request off-delay" – it shows the delay of the heat pump switching off if it is activated by the internal control.

- "Bivalent 1st level on-delay" – it shows the delay of the switching of the 1st level of the bivalent heat source from the moment when the internal control evaluates the conditions for its switching on.

- "Bivalent 2nd level on-delay" – it shows the delay of the switching of the 2nd level of the bivalent heat source from the moment when the internal control evaluates the conditions for its switching on.

- "Minimum inverter power" – it shows the minimum possible inverter input power for heat pumps according to a), as percentage. This value is used as protection against unwanted switching off of the heat pump in the course of the internal control.

- "PWM range" –these values can be used to limit physical PWM output of a proportionally controlled heat pump to given subrange. The parameter can be used to create a subrange from the full range of 0-100% duty that some types of heat pumps may require.

- "Time schedules" – it shows a dialog with the setting of time schedules – see the chapter Time schedules dialog.

  1. The temperature mode can be used for time-limited setting of the requested control temperature.

  2. The restricted mode concerns all outputs (heat pump and bivalent source).

  3. The enforced mode concerns only the heat pump control output.

- "Equithermal curve" – it shows a dialog with the setting of the equithermal curve – see the chapter Equithermal curve dialog.

- "Output protection" - optionally protects pumps or similar devices connected to any configurable outputs of this block from jamming. See chap. Output protection dialog.

SOLID FUELS TAB

It includes control blocks for solid fuel boilers or possibly fireplace inserts which do not have their own electronic control.

The boiler is controlled in 2 ways which can mutually overlap or complement each other:

a) Control according to the output temperature steepness – it is used for seizing the rise of the output temperature during the start of heating or the following operation of the boiler. The steepness (1st derivation) of the output temperature must exceed the set limit. It will be useful especially if we have only the output temperature sensor at the boiler.

b) Control according to temperature difference – it is used in the subsequent boiler operation. The circulation pump switches on only when the difference between the output and input temperature exceeds a certain limit and it switches off when the difference drops under a certain limit. It will be useful only if both temperature sensors are connected.

Description of configuration and status elements:

- "Input – input temperature" – the temperature sensor on the pipe entering the boiler. It is not obligatory, but its use is recommended. If it is not used, only the control according to a) will be used.

- "Input – output temperature" – the temperature sensor on the pipe exiting the boiler. Obligatory in all cases.

- "Output – circulation pump" – it switches on the circulation pump of the boiler.

- "PWM-controlled circulation pump" – tick if you use a circulation pump whose power is proportionally controlled (usually) by means of the PWM signal. In this case the Ext1 to Ext3 outputs must be used. As the power supply of this pump is usually separated from the signal conductor, it is possible to use the "Status duplicate" block in the "Others" tab for switching on the power supply on the basis of the switching of the Ext1 to Ext3 output. PWM control requires both temperature sensors.

- "Run on output temp. sensor error" – tick if you want to switch on the circulation pump in the case of a defect on the output temperature sensor. This function treats a possible accident state involving the overheating of the boiler if the output temperature sensor is not functional and the controller cannot react to the behavior of the boiler. The boiler must be protected with a safety valve, nevertheless this option allows you to secure a state in which the controller is working but the sensor is not.

- "Output temp. steepness request" – the control according to a) requires the operation of the circulation pump.

- "Delayed output temp. steepness request" - ditto, delayed by the "Output temp. steepness request off – delay" item.

- "Differential thermal control request" – the control according to b) requires the operation of the circulation pump.

- "Delayed diff. thermal control request" - ditto, delayed by the "Diff. thermal control request off – delay" item.

- "Circulation pump request" – logical sum (function OR) of both requests for the operation of the circulation pump.

- "Input temperature" – the temperature of water entering the boiler.

- "Output temperature" – the temperature of water exiting the boiler.

- "Output temperature steepness" – it shows the steepness (change) of the output temperature in half-minute intervals. This value is used only for the control according to a).

- "Temp. steepness control off-timer" – in the case of a) it shows the time until the expiration of the request for the operation of the circulation pump.

- "Diff. thermal control off-timer" – in the case of b) it shows the time until the expiration of the request for the operation of the circulation pump.

- "Circulation pump power" – if a PWM-controlled circulation pump is used, it shows its current power in %.

- "Minimum power of circulation pump" – it shows the minimum power of the PWM-controlled circulation pump if it is used and if its operation is requested.

- "PWM range" –these values can be used to limit physical PWM output of a proportionally controlled circulation pump to given subrange. The parameter can be used to create a subrange from the full range of 0-100% duty that some types of circulation pumps may require.

- "Minimum output temperature to switch on" – the circulation pump is activated only when the output temperature is higher than this limit. Set it according to the requirements of the connected boiler.

- "Minimum output temperature steepness to switch on" – the control according to a) is activated only when the output temperature steepness exceeds this limit.

- "Thermal diff. to switch on" – the control according to b) is activated only when the difference between the output and input temperatures exceeds this limit.

- "Thermal diff. to switch off" – the control according to b) is deactivated when the difference between the output and input temperatures drops under this limit.

- "P-component" – in the case of a PWM-controlled circulation pump it shows the P-component of the controller of the circulation pump power. You should increase the value only if the pump power for the given temperature difference is insufficient and if high temperature overshoots occur when the heating of the boiler is started.

- "Output temp. steepness request off-delay" – it shows the delay in the switching off of the circulation pump when it is switched on by the control according to a).

- "Diff. thermal control request off-delay" – it shows the delay in the switching off of the circulation pump when it is switched on by the control according to b).

- "Output protection" - optionally protects the circulating pump from jamming. See chap. Output protection dialog.

HEATING CIRCUITS TAB

It includes control blocks for controlling the circulation pumps of independent heating circuits. Further contains control blocks for the control of mixing valves.

BASIC SETTINGS

Every heating circuit can be controlled in 2 ways:

    a) A room thermostat connected to a binary input – this method will make it possible to use the existing room thermostat to which the user is accustomed. Due to the higher heat comfort we recommend using a room thermostat with PI control because it is more or less able to maintain a constant temperature in a room. We do not recommend using cheaper room thermostats which have only a two-state control with hysteresis. The room thermostat must have a potential-free switching contact (relay or optocoupler output).

    b) An internal temperature sensor – in this way the function of the room thermostat is taken over by the controller and only the internal temperature sensor is placed in the room. In this method of heating control we do not have to buy a room thermostat, but the disadvantage is that the requested temperature can be changed only in the web interface of the controller and not by a control element in the room. We can use the sensor supplied by the manufacturer as the internal temperature sensor and place it in a suitable installation box or we can use a sensor with the same parameters from other manufacturers (see the chapter Technical specifications).

⚠️ **Caution: If a storage tank is used, at least one heating circuit must be activated and functional so that the emergency cooling of the storage tank will be functional! For more information about the cooling of the storage tank see the chapter Storage Tank Block.**

⚠️ **Caution: You cannot use both control ways together!**

Description of configuration and status elements:

- "Input – heat source temperature" – a temperature sensor located near the heat offtake from the storage tank into the heating circuit – typically in the middle of the storage tank. Obligatory for control according to b).

- "Input – room temperature" – a temperature sensor located in the heated room. Obligatory for control according to b).

- "Input – thermostat" – a binary input to which the room thermostat contact is connected. Obligatory for control according to a).

- "Output – circulation pump" – an output which switches on the circulation pump.

- "Run in low tariff only" – the circulation pump runs only when the low tariff is active.

- "Thermostat request" – the room thermostat requires the operation of the circulation pump, control according to a).

- "Delayed thermostat request" – ditto, delayed by the "Thermostat request off-delay" item. This delay is especially useful if the distances between the storage tank and the heated rooms are longer. Control according to a).

- "Tank cool down request" – the storage tank requires cooling down into the heating circuit.

- "Thermal control request" – the control according to b) requires the switching of the circulation pump.

- "Circulation pump request" – one of the controls requires the switching of the circulation pump.

- "Low heat source temperature" - the temperature of the heat source (heating water in the storage tank) is not sufficient for the circulation pump to run. In this state, the circulation pump is switched off even though the thermostat or internal control requires heating. The status is signaled if any of the following conditions are true:

  1. The heat source temperature is less than the value set by the "Min. heat source temperature for the pump to run" parameter.

  2. The heat source temperature is less than or equal to the value set by the "Requested room temperature" parameter.

- "Low heat power indicator" – it indicates probable insufficient heating power in the given heating circuit. This indicator shows in the case of control according to a) when the thermostat continues to be switched on for more than 30 minutes and in the case of control according to b) when the measured room temperature is lower than the required temperature minus 1 °C again for more than 30 minutes.

- "Heating indicator" – it informs the other control blocks about the current or recent request for heating. This indicator is always activated by the switching of the circulation pump and it is deactivated after the time set by the "Heating indicator off-delay" item has passed.

- "Heat source temperature" – it shows the temperature of the heat source, typically near the heat offtake from the storage tank into the heating circuit in the case of control according to b).

- "Room temperature" – it shows the room temperature in the case of control according to b).

- "Requested room temperature" – in the case of control according to b), it shows the temperature set by the time schedules. If no time schedule is active, it shows the default temperature of 20 °C.

- "Thermostat request off-timer" – in the case of control according to a), it shows the time until the expiration of the thermostat request delayed by the "Thermostat request off-delay" item.

- "Requested power by thermal control" – in the case of control according to b), it shows the internally set requested power of the circulation pump. As the circulation pump of the heating is usually not PWM-controlled and it is connected to a relay output, slow PWM with the carrier frequency of 0.002 Hz (it corresponds to the period of 500 s) will be used for power modulation. This method of modulation is basically the same as in the case of a room thermostat with PI control.

- "Heating indicator off-timer" – it shows the remaining time until the deactivation of the heating indicator.

- "Proportional band" – in the case of control according to b), it shows the proportional band of the internal PI control. If the current measured room temperature is lower than the requested temperature minus the proportional band, the circulation pump continues to run. If it is higher than this limit, the internal PI control takes place. We recommend you choose the values 2 to 3 °C.

- "Thermostat request off-delay" – in the case of control according to a), it shows the switching-off delay of the circulation pump if it was switched on by a thermostat request.

- "Heating indicator off-delay" – it shows the delay necessary for the deactivation of the heating indicator.

- "Min. heat source temperature for the pump to run - indicates the lowest possible heat source temperature, i.e. temperature of the heating water in the storage tank, which can be accepted for circulating pump operation of this heating circuit. If the temperature of the heat source (= heating water) falls below this limit, the circulation pump switches off even though the thermostat or internal control requires heating. The parameter prevents the circulation pump from running permanently in case no or not enough heat is supplied to the storage tank.

- „Max. temp. for tank cool down" - indicates the maximum permissible room temperature that can be accepted when cooling the storage tank into this heating circuit. Emergency tank cool down is not affected by this option.

- "Time schedules" – it shows a dialog with the setting of time schedules – see the chapter Time schedules dialog.

  1. The temperature mode can be used for the time-limited setting of the requested room temperature in the case of control according to b).

  2. The restricted mode concerns the circulation pump output.

  3. The enforced mode concerns the circulation pump output.

- "Output protection" - optionally protects the circulating pump from jamming. See chap. Output protection dialog.

MIXING VALVE SETTINGS

Mixing circuit is optional part of every heating circuit. Mixing valve control block is activated by assigning input sensing output temperature from the mixing valve and outputs for closing and opening the valve.

Mixing valve control operates in the following steps:

1. Initialization - the valve closes until fully closed. The circulation pump is not operating. Initialization time is identical to the valve slew time.
2. Setup - starts after finishing initialization and there is also a requirement to run the heating circuit (switching the thermostat, etc.). Circulation pump starts and subsequently the valve is roughly adjusted to a position which should correspond to the required heating water temperature ±5 °C. Setup phase uses two-state differential controller with hysteresis and dynamic constraint of output temperature steepness.
3. Regulation – periodical fine adjusting of mixing valve position with a period of 60 seconds. This phase uses an incremental PID controller. The constants of the controller are set automatically with respect to the slew time of the valve.
4. Re-initialization - starts after the end of any heating requirement (if no requirement to run the heating circuit is indicated), and after the time expires as given by the parameter "Valve re-initialization timeout". Re-initialization is functionally identical to the initialization ad 1), then again follows setup phase ad 2) etc. Re-initialization ensures predictable behavior of the heating circuit after a long period of inactivity.

⚠ **Caution: You have to use mixing valve according to chapter Technical specifications. The output temperature sensor must be placed 0.2 to 0.5 m away from the mixing valve, at the output pipe from the mixing valve.**

⚠ **Caution: Mixing valve control actions may lead to significant over- or undershooting of the requested heating water temperature (±10 °C). These phenomena cannot be fully avoided. However, the controller will adjust the current output temperature in few moments. But your heating system must be tolerant to such excesses of the heating water temperature!**

Description of configuration and status elements:

- "Input – output temperature" – a temperature sensor located at the output pipe from the mixing valve. It measures the temperature of the mixed heating water.

- "Output – mixing valve (close)" – output that switches a closing contact of the mixing valve.

- "Output – mixing valve (open)" – output that switches an opening contact of the mixing valve.

- "Closing valve" – the controller is closing the mixing valve right now.

- "Opening valve" – the controller is opening the mixing valve right now.

- "Valve closed" – this is internal software indicator that the valve is fully closed. This indicator avoids infinite valve closing attempts in miscellaneous operating and error states.

- "Valve opened" – this is internal software indicator that the valve is fully opened. This indicator avoids infinite valve opening attempts in miscellaneous operating and error states.

- "Initializing valve" – valve is being initialized according to step ad 1).

- "Valve setup" – valve is being roughly setup according to step ad 2).

- "Maximum output temperature exceeded" – output temperature is higher than the maximum temperature for more than 30 minutes and there is also a circulation pump run request. This error status switches off the circulation pump and initializes the mixing valve.

- "Current output temperature" – current temperature of the heating water.

- "Desired output temperature" – requested temperature of the heating water.

- "Time to end initialization" – time to end valve initialization according to step ad 1).

- "Time to start re-initialization" – time to start valve re-initialization according to step ad 4).

- "Estimated valve position (0%: closed, 100%: open)" –indicates the expected angle (position) of the mixing valve. This position is calculated by the controller from the sum of the opening and closing times of the valve and is not measured in any way. A value of 0% means complete closure (cold water only), a value of 100% means complete opening (hot water only).

- "Control mode" – selection of the mode of determining the requested output temperature:

    a) "Constant temperature" – it is determined by the constant given below.

    b) "Equithermal control" – it is determined by the equithermal curve which can be displayed or adjusted in the "Equithermal curve" dialog.

- "Constant temperature" – it shows the requested output temperature in the control mode ad a).

- "Maximum temperature" – it shows the limit of the output temperature to indicate "Maximum output temperature exceeded".

- "Valve slew time" – it shows the time required to put the valve from the fully closed state to the fully open state (or vice versa, these times should be roughly equal). Use a value specified for the valve in its user manual or switch the valve in the output test mode and measure this time with stopwatch.

- "Valve re-initialization timeout" – it shows the time needed to re-initialize the valve according to step ad 4).

- "Dead band" – this parameter limits the control actions on the valve in the fine tuning mode ad 3) and extends the lifetime of switching elements and the valve positioning motor. When the current output temperature moves nearby the requested temperature (nearer than this margin) the valve won't be switched at all.

- "Equithermal curve" – it shows a dialog with the setting of the equithermal curve – see the chapter Equithermal curve dialog.

POOLS TAB

It includes control blocks for managing the pool heating and filtration pump and also pool water replenishment.

POOL HEATING

The pool heating is controlled on the basis of periodical determination of the temperature of the pool water and the subsequent heating of the pool by means of a pool heat exchanger and 2 circulating pumps that circulate the water in the primary and secondary circuit of the exchanger (heating circuit pump from the storage tank and pool water circulation pump). The water temperature is determined using the same technical means which are used in the subsequent heating, i.e. by switching on the pool water circulation pump. When determining the water temperature, the pool water circulation pump is switched on only for a short time and with long delays because the changes of the pool water temperature take place very slowly. On account of too long time constants the temperature control of the pool water is conducted by means of a two-state control with hysteresis. The temperature control will switch on only if the heat source (heating water in the storage tank) has sufficient temperature.

Description of configuration and status elements:

- "Input – water temperature" – a temperature sensor which measures the pool temperature. It can be located on a hose or a pipe supplying the pool water into the pool heat exchanger or it can also be located directly on the heat exchanger where the pool water flows around the heat exchanger wall. As the heat exchanger is usually made of noble metal, we will achieve better heat contact than in the case of a plastic pipe. A special sink for the sensor, etc. can be also used. Always obligatory.

- "Input – heat source temperature" – a temperature sensor located near the heat offtake from the storage tank into the heating circuit of the pool – typically in the middle of the storage tank. Always obligatory.

- "Output – circulation pump" – an output which switches on the circulation pump of the pool heating circuit from the storage tank.

- "Output – pool water pump" – an output which switches on the circulation pump of the pool water.

Note: If the pool heat exchanger is included in the pool filtration circuit, then assign the circulation pump of the heating circuit from the storage tank to the menu "Output - circulation pump" and pool water filtering pump assign to the menu "Output – pool water pump". Each pump must have a separate control circuit. If also pool filtering is required to be controlled with this control block, set the same filtering pump in the menu "Output - filtering pump" in the Pool filtering group. The filtering pump then switches on when there is a heating request as well as when there is a pool filtration request.

- "Block when heating" – it blocks the pool heating during heating the house (which might be controlled through one of the Heating circuits).

- "Required temperature condition" – the last determined temperature of the pool water is lower than the required temperature.

- "Heat source temperature condition" – the temperature of the heat source corresponds to the conditions provided by the "Thermal diff. to switch on" and "Thermal diff. to switch off" parameters in a way that makes it meaningful to heat the pool.

- "Checking water temperature – condition" – the time interval for determining the water temperature is running.

- "Checking water temperature" – the temperature of the water is being determined. Apart from the time condition given in the previous point, other conditions must also be met (the validity of the measured temperatures, the output is not restricted by a time schedule). This function only switches the pool water circulation pump and not the heating circuit circulation pump from the storage tank.

- "Water temperature determined" – it signals that the checking of the water temperature has been completed. This indicator is lit practically non-stop, it is only not active after the reset of the controller or possibly at the time when the outputs are restricted by the time schedule.

- "Thermal control request" – the thermal control requires the operation of both circulation pumps. Apart from the required temperature condition, other conditions must also be met (the pool heating is not blocked due to heating of the house, the low tariff must be active if the "Run in low tariff only" option has been ticked, etc.).

- "Tank cool down request" – the storage tank requires cooling down into the pool. This state always activates both circulation pumps, regardless of options "Block when heating", "Run in low tariff only" etc.

- "Circulation pump request" – it signals the operation of the pool heating circulation pump.

- "Pool water pump request" –it signals the operation of the pool water circulation pump.

- "Pool heating indicator" – it informs the other control blocks about a current or recent request for pool heating. This indicator is always activated by the switching on the circulation pump(s) as a result of thermal control and it is deactivated after the time which is set by the "Pool heating indicator off-delay" item has passed.

- "Measured water temperature" – the currently measured water temperature by the sensor. If the pool water pump is not running, it shows the temperature of water in the vicinity of the sensor, but this temperature does not have to correspond to the real temperature of the water in the pool.

- "Heat source temperature" – it shows the heat source temperature, typically near the offtake of heat from the storage tank into the pool heating circuit.

- "Last determined water temperature" – it shows the last determined water temperature in the pool. If the pool water pump is running, the last determined water temperature corresponds to the measured temperature of the water in the pool.

- "Checking water temperature – timer" –if the water temperature is not being detected, it displays the time remaining until the next water temperature detection. If the water temperature is being detected, it displays the time until the end of the detection.

- "Pool heating indicator off-timer" – it shows the remaining time until the deactivation of the pool heating indicator.

- "Required water temperature" – it shows the required temperature of the pool water. If we wish to heat the pool only during the warm season (summer), in autumn we reduce the temperature to the value at which it does not freeze (3-5°C) and at the beginning of summer we re-set it to the required value. In the case of winterizing the pool we do not have to set anything, we only disconnect the pumps or switch off their circuit breakers.

- "Temperature hysteresis" – it shows the temperature hysteresis for controlling the pool water temperature. If the current temperature of the pool water is lower than the required temperature, the circulation pump will switch on. If the current temperature of the pool water is higher than the required temperature plus hysteresis, the circulation pump will switch off. We recommend that you

choose the values from 0.5 to 1 °C. Due to the required precision and the probable long distance of the temperature sensor from the controller we recommend that you choose a digital sensor for monitoring the pool water temperature.

- "Thermal diff. to switch on" – the thermal control is activated only when the difference between the heat source temperature and the pool water temperature exceeds this limit.

- "Thermal diff. to switch off" – the thermal control is deactivated only when the difference between the heat source temperature and the pool water temperature drops under this limit.

- "Max. water temp. for tank cool down" – maximum pool temperature that allows normal tank cool down. The function prevents the pool from overheating on hot summer days. Emergency tank cool down is not affected by this option.

- "Checking water temperature – period" – this value sets the intervals in which the pool water temperature is determined.

- "Checking water temperature – time" – this value sets the time for which the pool water temperature is determined. The time of checking the water temperature must always be (proportionally) shorter than the period of checking the water temperature.

- "Pool heating indicator off-delay" – it shows the delay necessary for deactivating the pool heating indicator.

POOL FILTERING

The pool filtration is controlled according to the pool water temperature. The period required for the pool filtration is set by linear interpolation between 2 adjustable times: the time required for the filtration of the pool when the pool water temperature is 10°C and the time required for the filtration of the pool when the pool water temperature is 30°C. In addition, it is possible to set the moment at which the filtration will be started every day. The filtration time for the current date is set on the basis of the last determined pool water temperature prior to the moment at which the filtration is started.

- "Output – filtering pump" – an output which switches on the pool filtering pump.

- "Filtering pump request" – it signals the operation of the filtering pump.

- "Current filtering time" – it shows the current filtering time relevant for the last determined water temperature.

- "Filtering time at 10°C" – this value specifies the filtering time when the pool water temperature is 10°C.

- "Filtering time at 30°C" – this value specifies the filtering time when the pool water temperature is 30°C.

- "Starting time for filtering" – the time when pool water filtering is started each day.

POOL FILLING

Heating Control Mx can also automatically supply water to the pool. Filling requires a water level sensor and a solenoid valve which, when switched on, allows water from the water supply line or from the well into the pool.

Description of configuration and status elements:

- "Input – water level sensor" - binary input that switches on when the level in the pool is high enough and is otherwise turned off.

- "Output - filling valve" - output which switches the filling valve.

- "Manually refill pool" - immediately starts water replenishment if all conditions for water replenishment are met, except for non-zero value in the field Filling min. period – timer. With this function, water can be replenished sooner, i.e. before this periodic timer expires. This can be useful in various extraordinary events.

- "Water level high enough" - signals the current status of the water level sensor.

Note: If a water level sensor is assigned that is not switched on (ie a low water level is signaled), the controller restricts the switching of the pool water circulation and filtering pump outputs, see item Restricted operation of pool pumps. water.

- "Water filling condition" – when active then the water replenishment condition is true, ie if the water level is not high enough and at the same time the "Filling min. period – timer" is zero.

- "Filling valve request" – when active then filling valve is switched on. The filling valve switches on when the time set by the "Filling on-delay" has elapsed since the water replenishment condition was met.

- "Pool water pumps restricted" – when active then the pool water pumps (pool water circulation pump and filtering pump) are restricted due to low pool water level. The purpose of this restriction is to prevent the pumps from running dry, ie without pool water. This restriction is canceled 3 minutes after the water level sensor again reports a sufficient water level. If no water level sensor is assigned, the operation of the pumps is not restricted in any way.

Attention: This limitation is also signaled for the given output, just as the output would be limited by the time schedule!

- "Filling run on-timer" - shows the time remaining from the moment where the water replenishment condition got valid until the filling valve being switched on. Zero is displayed if the water replenishment condition is not met or if the filling valve is already switched on.

- "Filling run – timer" - shows for how long the filling valve is switched on. If the filling valve is not switched on, zero is displayed.

- "Filling min. period – timer" - shows the time remaining until the end of the minimum filling period, ie the smallest possible interval between two fillings.

- "Filling on-delay" - specify the delay from the moment when the condition for water replenishment occurs to the moment when filling valve should be actually switched on. The purpose of this delay is to prevent the water replenishment from being switched on falsely, for example when the pool water surface ripples. This can cause the level sensor to disconnect repeatedly when there is still enough water in the pool.

- "Filling off-delay" - specify the delay from the moment when the condition for water replenishment ceases to apply, ie the level rises so much that the level sensor is switched on again, to the moment when filling valve should be actually switched off. The purpose of this delay is to ensure that a little more water is added to the pool so that the water level sensor then remains securely switched on.

- "Filling max. time" - indicates the maximum possible time of one filling. This is a safety feature that prevents water wastage in the event of a level sensor failure.

- "Filling min. period" - indicates the smallest possible interval between two fills. This is again a safety function that prevents water wastage in the event of a level sensor failure.

COMMON SETTINGS

- "Run in low tariff only" – it switches the heating and filtration on only during the period when the low tariff is active.

- "Time schedules" – it shows a dialog with the setting of time schedules – see the chapter Time schedules dialog.

    1. The temperature mode can be used for time-limited setting of the required pool water temperature.

    2. The restricted mode affects all outputs for heating circulation pumps and filtering pump. It does not affect pool filling.

    3. The enforced mode affects only the circulation pumps for pool heating.

OTHERS TAB

It includes control blocks of the storage tank, status duplicate and differential controller type.

TANK BLOCK

This control block monitors the storage tank and controls it's cooling down. The storage tank may require cooling down in various situations, e.g. in the case of controlling the heat pump according to excess energy from the photovoltaic power station, in the case of overheating the tank by the solid fuel boiler, etc.

Description of configuration and status elements:

- "Input – temperature top" – a temperature sensor located at the top of the tank. It is usually used for monitoring the temperature in this part of the tank, it can also be used for the controlled destratification of the tank by the differential controller – see the chapter Differential Controller Block. Not obligatory[1].
- "Input – temperature center" – a temperature sensor located in the central part of the tank. It is usually used for measuring the control temperature in the case of heating by a heat pump or it shows a reference temperature of the heat source for pool heating. It also monitors the temperature in this part of the tank. Not obligatory1.
- "Input – temperature bottom" – a temperature sensor located at the bottom of the tank. It is usually used for monitoring the temperature in this part of the tank. It can also be used as a substitute for the temperature sensor of water returning to the solid fuel boiler. Not obligatory1.
- "Input – cool down temperature" – a temperature sensor which determines the reference temperature for cooling down the tank. It is usually chosen as follows:
  1. When the outdoor unit of the heat pump is used, it is equal to the "Input – temperature bottom" sensor because it is necessary to maintain the low temperature of the return refrigerant for the correct functioning of the heat pump.
  2. When the solid fuel boiler or the gas boiler are used, it is equal to the "Input – temperature top" sensor because the heating water is the hottest in the top part of the tank if the sources are connected correctly in the tank.
  3. When the outdoor unit of the heat pump is used together with the solid fuel boiler or the gas boiler, it is equal to the "Input – temperature bottom" sensor and we must not choose a too high temperature limit for the solid fuel (usually max. 70°C). The selection of this limit also depends on the power of the circulation pump of the boiler and the size of the storage tank so that the top part of the tank will not be overheated.
- "Cool down active" – informs about tank cool down activity.
- "Temperature top" – shows the temperature at the top of the tank if the corresponding sensor is assigned.
- "Temperature center" – shows the temperature at the center of the tank if the corresponding sensor is assigned.
- "Temperature bottom" – shows the temperature at the bottom of the tank if the corresponding sensor is assigned.
- "Cool down temperature" – shows the reference temperature for tank cool down if the corresponding sensor is assigned.
- "Current cool down limit" – it shows the current temperature limit for cooling down. If the circulation pump of the solid fuel boiler is running, the temperature limit for solid fuel is applicable; otherwise the limit for heat pumps is set if the heat pump is switched on.

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[1] At least one of the sensors on the tank (bottom, centre, top) is obligatory for this block.

- "Cool down off-timer" - displays the remaining time until cooling is turned off when the cooling temperature condition expires. The default time is given by the parameter "Cool down off-delay".
- "Cool down target" – it shows the target of cooling down the storage tank:
    1. "None" – cooling down is switched off.
    2. "Heating" – cooling down is directed to the heating. Following a cool down request the circulation pumps of all active heating circuits will be switched on.
    3. "Pool" – cooling down is directed to the pool. Following a cool down request the circulation pump of the pool heating circuit and the circulation pump of the pool water will be switched on.
    4. "Auto" – cooling down is directed either to the heating circuits or to the pool. The cool down target is determined according to the outside temperature and the "Upper limit for cool down to heating (auto mode)" item. If the outside temperature is not measured, the cool down target is always the heating circuit.

Important: Apart from the given working modes of cooling down, emergency cooling down is always active. It switches on if any of the measured temperatures of the heating water in the tank exceeds the "Emergency cool down limit" value. Emergency cooling down is always directed into all active heating circuits of which at least one must be activated and functional!

- "Cool down limit for solid fuels" – it shows the temperature limit for cooling down the storage tank in the case of heating by a solid fuel boiler.
- "Cool down limit for heat pumps" – it shows the temperature limit for cooling down the storage tank in the case of heating by a heat pump.
- "Upper limit for cool down to heating (auto mode)" – it shows the upper limit of the outside temperature for cooling down to heating in the automatic cooling-down mode of the tank. If this limit is exceeded, cooling down proceeds to the pool.
- "Cool down off-delay" – this ensures the minimum time for tank cooling down. It is needed to cool down the entire relevant tank volume, because the reference cool down temperature might only be relevant for small volume of water present around the sensor.
- "Emergency cool down limit" - indicates the temperature limit for starting emergency cool down. If this temperature is exceeded by the temperature measured by one of the sensors in the tank, emergency cooling is started.

- "Time schedules" – it shows a dialog with the setting of time schedules – see the chapter Time schedules dialog.

    1. The temperature mode can be used for time-limited setting of the required cool down temperature.

    2. The restricted and enforced modes are not available.

STATUS DUPLICATE BLOCK

This control block is very simple and it enables an output to switch on only on the basis of the status of another binary input or output. It will be useful when we need to adjust the switching logic of other control blocks – e.g. when we need to switch on the power supply circuit of PWM-controlled circulation pumps or when we need to connect a bivalent source (gas boiler) directly to a thermostat contact in the case of a heat pump shutdown.

Description of configuration and status elements:

- "Conditional status" – a binary input or output which is conditional for switching on of an output.
- "Output – conditioned" – an output which will be switched on after the condition for its switching on has been met.

- "Always full scale" – if the conditional status is an output which is switched on in the PWM mode (either fast or slow), the conditioned output will always be permanently switched on.
- "Condition met" – it signals a met condition for the switching of the conditioned output.

DIFFERENTIAL CONTROLLER BLOCK

This control block is also simple and it allows you to control, for example, the solar circuit, the storage tank destratification circuit or other control automatisms on the basis of a difference between two temperatures.

Description of configuration and status elements:

- "Input – input temperature" – a temperature sensor at a place with lower temperature. The last item is the constant temperature option. In this case the value given in the "Constant temperature" box will be used instead of the temperature sensor.

- "Input – output temperature" – a temperature sensor at a place with higher temperature. The last item is the constant temperature option. In this case the value given in the "Constant temperature" box will be used instead of the temperature sensor.

- "Output – circulation pump" – it switches on the circulation pump of the control circuit.

- "PWM-controlled circulation pump" – tick if you use a circulation pump whose power is proportionally controlled (usually) by means of the PWM signal. In this case the Ext1 to Ext3 outputs must be used. As the power supply of this pump is usually separated from the signal conductor, it is possible to use the "Status duplicate" block in the "Others" tab for switching on the power supply via other relay output. This auxiliary relay output switches when the corresponding Ext output is active.

- "Circulation pump request" – the differential controller is active and requires the operation of the circulation pump.

- "Input temperature" – water/medium temperature at a place with lower temperature.

- "Output temperature" – water/medium temperature at a place with higher temperature.

- "Circulation pump power" – if a PWM-controlled circulation pump is used, it shows its current power in %.

- "Constant temperature" – this value will be used for setting either the input temperature or the output temperature if it is required that any of these temperatures should be constant instead of a temperature sensor (constant temperature option in the relevant inputs). Do not use the constant temperature option for both the input and output temperatures at the same time, because this does not make any sense and the differential controller will not work at all.

- "Max. input temperature" – the control will activate only when the input temperature is under this limit. If you use a constant as the input temperature, always set this limit higher than the "Constant temperature" item, otherwise the control will never work.

- "Min. output temperature" – the control will activate only when the output temperature is above this limit. If you use a constant as the output temperature, always set this limit lower than the "Constant temperature" item, otherwise the control will never work.

- "Thermal diff. to switch on" – the control will activate only when the difference between the input and output temperatures exceeds this limit.

- "Thermal diff. to switch off" – the control will deactivate when the difference between the input and output temperatures drops under this limit.

- "P-component" – in the case of a PWM-controlled circulation pump it shows the P-component of the controller of the circulation pump power. You should increase the value only if the pump power for the given temperature difference is insufficient and if high temperature overshoots occur during the control.

- "PWM range" –these values can be used to limit physical PWM output of a proportionally controlled circulation pump to given subrange. The parameter can be used to create a subrange from the full range of 0-100% duty that some types of circulation pumps may require.

- "Output protection" - optionally protects the circulating pump from jamming. See chap. Output protection dialog.

SETTINGS TAB

It includes configuration elements for setting the controller.

CONTROL SETTINGS

- "PWM frequency" –set the desired frequency for outputs with PWM function. This frequency is always the same for all outputs (and cannot be set individually by hardware).

- "Internal DC source" - informs about the voltage value of the internal DC source of the controller. This value is used to check for eventual overloading of the internal power supply, which may lead to the "DC source overload" fault. See chapter Error and info status for details.

- "Output test timeout" - this item is used to limit the duration of the TEST mode activity. If the entry is zero, the TEST mode is unlimited. If the item is non-zero, the TEST mode will be limited to the specified time. The value is the same for all outputs. This new function can be used, for example, to temporarily switch an output in manual mode, if it is necessary to quickly force a certain output to switch on for a limited period of time.

DIGITAL TEMPERATURE SENSORS

- "Digital sensor type" – select the type of connected digital temperature sensors. All sensors must be of the same type.

- "Search for digital temperature sensors" - starts searching for digital sensors connected to the DQ bus (T1-8 input). If all connected sensors do not appear after performing this function, make sure that the data bus connection is correctly wired and that the shielding is also connected and working. Frequent errors in communicating with sensors occur especially at longer distances and incorrect shielding. The feature is password protected against unauthorized access.

ANALOG TEMPERATURE SENSORS

- "Sensor type for T9-T12" – select the type of connected analog temperature sensor. Sensors on individual inputs may be of the different type.

NETWORK SETTINGS

It sets the parameters of the controller Ethernet connection.

- "Controller IP address" – the IP address saved in the controller. The controller will listen to all UDP and TCP/IP (HTTP) requests at this address.

- "Subnet mask" – the mask of the subnet to which the controller is connected.

- "Default gateway" – the IP address of the default gateway. We recommend that you use the IP address of your router.

- "DNS server IP address" - enter the IP address of your preferred DNS server.

- "Controller MAC address" – the physical (MAC) address of the controller. Change this address only if there is a conflict of physical addresses in your local network.

- "UDP port" – the port at which the controller will listen to UDP requests (HC Downloader Mx software).

- "HTTP port" – the port at which the controller will listen to HTTP requests (web interface).

- "DHCP mode" - selects the mode of automatic configuration of network connection via DHCP:

    a) none – DHCP is inactive, entire network settings have to be input manually.

    b) DNS – DHCP is only used to obtain the IP address of the DNS server (the device will use only the DHCP inform request or the DHCP discover request).

    c) all – DHCP is used for complete network setup. Note that in this mode the IP address of the controller can be changed at any time, which may lead to loss of its accessibility e.g. from the Internet (NAT routing stops working). Recommended only for experienced users!

Caution: The network settings will be effective after the controller has been reset (the "Reset controller on config. write" option)!

DATE AND TIME SETTINGS

- "Synchronize date and time with the client" - check this field if you want to synchronize the controller date and time with the actual time running in your PC. The date and time will be synchronized when the configuration is subsequently written.

- "Synchronize date and time with time server" - check this box if you want the controller to synchronize the date and time once a week with the time server on the Internet. In order for synchronization to work, the controller must be connected to the Internet, a valid time server IP address must be set and the default gateway IP address must also be set correctly. The moment of synchronization is calculated from the serial number of the controller and is different for each controller.

In order for the time server synchronization function to work, the controller must be connected to the Internet, the time server IP address or its domain name must be valid and the default gateway IP address must be set correctly!

- "Time server (hostname)" - time Server domain name. The time server name is stored directly in the controller and its IP is obtained automatically using the DNS protocol. Then, the IP address of the time server is ignored. The default and recommended name is pool.ntp.org, which is a service that automatically assigns the IP address of a particular time server, based on the load of individual time servers and other criteria.

- "Time server IP address" - time server IP address stored in the controller. The IP address of the time server does not need to be set and detected, just use a valid time server domain name. However, in case the IP of a time server cannot be found from its name, an attempt will be made to contact the time server specified by this IP. Therefore, it is possible to use this field as a backup solution to the specified domain name.

- "Use summer time" - check this field if you want the controller to perform automatic switching between summer and winter time. Based on EU recommendations only summer time is supported, which starts at 2:00 CET on the last Sunday in March and ends at 3:00 CEST on the last Sunday in October. The summertime information is used to automatically modify the current time.

- "Time zone" - specify the time zone based on your country. The default value uses Central European time. This value is used to compute date and time returned by the time server. Time zones outside of multiples of full hours are not supported.

LOW TARIFF

It sets the low tariff signal source. The low tariff signal can be connected either to the binary input (via an auxiliary switching relay) or it can be received from a remote station through the S-Connect protocol.

- "Input – low tariff" – it shows the binary input which will be used for detecting the low tariff. It is possible to enter any input I1-I4 or, when activating the S-Connect protocol, also any logical input RI (thus the low tariff information can be transferred from any remote station).

WARM WATER (DOMESTIC HOT WATER - DHW)

This option assigns a specific temperature sensor to the general DHW temperature indicator. It is only a DHW temperature indicator to which no control is associated (i.e. no control block). The DHW temperature control depends on the technical design of the DHW storage or flow heating and must be provided accordingly by the other control blocks or completely outside the controller.

• Input – warm water temperature - indicates the temperature input that monitors the DHW temperature.

• Warm water temperature - DHW temperature display.

OUTSIDE TEMPERATURE

It assigns a specific temperature sensor to the general function "Outside temperature" which is used by some control blocks for determining the outside temperature.

- "Input – outside temperature" – it shows the temperature input which monitors the outside temperature.
- "Outside temperature" – outside temperature display.

OTHER SETTINGS

It includes other options.

- "Default tab" – select a tab which should be displayed after the loading of the web interface.
- "Default stat. tab" –set the subtab on Statistics tab which should be displayed after the loading of the web interface.
- "Reset controller on config. write" – tick this field if you want to restart the controller after every configuration write. The resetting is necessary for the controller to change the network settings.
- "Erase configuration" – tick this field if you want to erase the configuration from the EEPROM of the controller and to restore the controller to its factory settings. This option will always reset the controller.
- "Erase statistics" – tick this field if you want to erase all statistics saved in the EEPROM of the controller.

AUTHORIZATION SETTINGS

- "New username" - write a new username to authorize writing data to the controller via Ethernet interface.
- "New password" - write a new password to authorize writing data to the controller via Ethernet interface.

Note: These settings won't be shown when "Require better HTTP security" option is checked for this controller in HC Downloader Mx software.

Note: New login data is written to the controller and can only be used after the configuration is written to the controller.

OUTPUT TEST

It enables the testing or the enforcing of the switching on of some output independently of its assignment to the control blocks. It will be useful in verifying the correct connection and assigning captions to the outputs and if it is necessary to switch on an output in a non-standard way. The function is protected by authorization against unauthorized access.

- "TEST OFF/ON" – Use this button to switch a specific output on or off. The text and color of the button change depending on the status of the test.

S-CONNECT TAB

The S-Connect protocol can be configured on this tab.

For more information on the S-Connect protocol itself, see chapter S-Connect protocol settings.

- Communication mode - selects the protocol mode for this unit:
  a) Turned off - the protocol is not used. If the protocol is switched off from the previous active state, its entire configuration (station table and device mapping) is deleted and the data exchange with the unit is terminated.
  b) Access Point (AP) - the unit acts as an access point that controls the operation of remote stations and their pairing.
  c) Station (STA) - the unit acts as a station that responds to access point messages.

Note: If the S-Connect protocol is activated (ie AP or STA modes), then the configuration options of logic devices are displayed in the control interface of the device.

Note: Activating the S-Connect protocol does not block other functions of the device. It is thus solely the user's choice which function of the device to use. If the device is only used as a station for expanding the number of outputs, it is recommended not to activate local control functions, which themselves affect the switching of outputs, unless the user has a good reason to do so.

- Delete ignored stations – when checked, this will clear all stations that were previously rejected by the user, ie the request to pair them was rejected (Ignore button). This option will allow you to re-pair previously rejected stations. The option is only enabled if some previously rejected stations are stored in the controller. For this option to be effective, the configuration must be written to the controller.

Remote station table:

This table shows the essential data of the paired stations. The number of table rows varies depending on the communication mode. In the case of an access point, the table has 6 rows, so a maximum of 6 remote stations can be added. In the case of a station, the table has only 1 row, which is reserved for access point information.

- Type – indicates the type of station, which can be:
  a) Not used – the table row is not used
  b) Ethernet – (AP only) the station communicates via a computer network (Ethernet or WIFI)
  c) Wireless – (AP only) the station communicates wirelessly via the embedded SC-Gateway
  d) Access point – (STA only) this is the access point
- MAC address – the MAC address of the station is displayed in this field. For stations communicating via Ethernet this is the Ethernet MAC address (last 6 bytes, the first 2 bytes are zero), for stations communicating via the SC-Gateway wireless interface this is the wireless MAC address (8 bytes).
- Name – in this field you can name the station. If the name is not filled in by the user, it is pre-filled in from the station identification data if these are transmitted via the S-Connect protocol (for stations communicating via Ethernet, the station name is transmitted, for wireless sockets it is not transmitted).
- Configuration name – this field displays the name of the station's configuration, if this information is supported by the station and has been filled in.
- Serial Number – this field displays the station's serial number, if supported by the station.
- IP Address – (Ethernet only) this field displays the IP address that is currently assigned to the station.
- LQI – this field displays information about the signal quality of the station's connection. For stations communicating via Ethernet, 100% is always displayed because this physical layer does not communicate the relevant data. For stations communicating via the wireless interface, the signal

quality between the station and the nearest access point is displayed (this is either the SC-Gateway or the nearest signal repeater).

- Message counter – this field shows the number of messages that have been sent to the respective station. If the number of messages exceeds 2^{32}, the messages are counted again from zero.
- Ping – this field displays the station response in milliseconds. The term response refers to the actual response of the station from the moment a message is sent to the station to the receipt of the response, increased by a pause in the communication which is inserted by the access point. Communication pauses are necessary to maintain communication stability and to optimize the use (non-overloading) of the controller's network interface.

Note: The access point operates all stations of the same type cyclically. The response thus increases in proportion to the increasing number of stations of the same type in the station table. For example, if all 6 stations are occupied and all are of the same type (eg Ethernet), then the response will usually be 6 times longer than the response of one station (if we consider a similar response for all stations). If a station is unavailable, then the station response increases by a preset response timeout.

- Station status indicator – is displayed in green when the station is connected.
- Clear entry button – removes the station, ie cancels the pairing. For the change to take effect, it is necessary to write the configuration to the controller.

Device mapping table:

In this table, the source devices of the station are assigned to the destination (logic) device of the controller. Each line defines one usable device. New mapping can be added by pressing the Add entry button. A maximum of 32 devices can be mapped in total.

- Station – in this field the remote station is selected from the station table.
- Device type – in this field the device type is selected.
- Source device – the source device is selected in this field. If the source device cannot be selected, then the station either does not publish any physical device for the type, or a map of available devices has not yet been retrieved from the station. The source devices are generally named with identical names as the respective inputs and outputs of the station.
- Direction – this field displays the direction of data flow between the source and destination devices. For input devices (binary input, temperature, power) the data is transferred from the source to the destination, for output devices (output) it is the other way around. For memory cells, the direction depends on what value is stored in it.
- Destination device – in this field the destination device is selected. If the destination device cannot be selected, then the controller (local unit) does not publish any logic device for that type. The destination (logic) devices are the following:
  a) RI - remote binary input
  b) RT - remote temperature input
  c) RP - remote power meter (remote power)
  d) RO - remote output
  e) M - memory cell
- Label – this field displays the label of the source device. These labels are also transmitted via the S-Connect protocol, with the exception of its wireless version (through SC-Gateway).

Note: Labels are used to better identify source devices when assigning them to control blocks.

- Value – this field displays the current value of the source device that is transmitted via the S-Connect protocol. The value is displayed in the given units, the excitation in percent is displayed for the outputs.

- Ping – this field displays the response of the source device in milliseconds. The term response here means the cumulative response on the entire communication path from source to destination. If the source-destination communication does not take place via memory cells, but directly, the response of the device is equal to the response of the station. If memory cell communication is involved, then the device response is the sum of the responses of all participating stations.
- Device status indicator – is displayed in green when the device is connected and working.
- Clear entry button – removes the device, ie cancels the mapping. For the change to take effect, it is necessary to write the configuration to the controller.

If an invalid or duplicate mapping is stored by the user, then the controller will delete it itself after writing the configuration. Invalid mapping is that one where some data is not selected correctly. Duplicate mapping is that one where the same source output is used in 2 or more mappings or the same destination device is used in 2 or more mappings.

Figure 17: Example of access point configuration in WATTrouter Mx controller. 3 stations are paired, one of which (another WATTrouter Mx in the 2nd position in the station table) is disconnected. The device table maps 3 devices, 2 logic outputs RO1, RO2 and one logic temperature input RT1.

Important information for input mapping

If the device is not functional, or the corresponding mapping has been disconnected or canceled, then the default values are used for the respective input logic devices. They are:

a) RI - logic 0 is used, ie input is disconnected.
b) RT - temperature 0 °C is used.
c) RP - power 0W is used.

Important information for output mapping

For output logic devices, the physical outputs of the source (remote) station are mapped to the logic outputs of the destination (local) station. The destination outputs are abbreviated RO (previously these outputs were intended for wireless communication only and were abbreviated WLS). Within the SOLAR controls s.r.o. product range they can have different types and can have different functions assigned to them.

The supported output types in the current version of the S-Connect protocol are as follows:

a)   Relay - the output is an electromechanical relay. An example is the relay output of any wattrouter.
b)   PWM - semiconductor output that allows relay switching or pulse width modulation. An example is the Ext output of the Heating Control Mx controller.
c)   SPC - semiconductor output that allows relay switching or zero switch proportional control. An example is the triac output of the Wattrouter M controller.
d)   PWM_SPC - semiconductor output that allows relay switching, zero switch proportional control and pulse width modulation. An example is the SSR output of any wattrouter.

The output type is transmitted by the S-Connect protocol from the source (physical) to the destination (logic) device and can be used by the local unit to determine the compatibility of the given control algorithm with the respective output type.

Caution: Not all devices support all types of outputs! For example, the Wattrouter Mx does not support the SPC type because it does not have built-in triacs like the Wattrouter M. In contrast, the Heating Control Mx controller does not support SPC and PWM_SPC outputs because it does not contain algorithms for proportional control. It is necessary to keep this in mind when expanding the number of outputs and selecting the appropriate expansion unit!

The Heating Control Mx controller does not distinguish between output types, but the device checks the validity of the received values for switching the outputs. If the received value for the relay or triac output is different from the off and on state, the relay switches in slow pulse width modulation mode with a period of 10 minutes.

The supported output functions in the current version of the S-Connect protocol are as follows:

a)   Relay - the output can only be switched off or on.
b)   SPC - the output performs zero switch proportional control.
c)   PWM - the output switches in pulse width modulation mode.

The output function is transmitted by the S-Connect protocol from the destination (logic) device to the source (physical) device, and the source unit can use it to determine the switching algorithm of the output if the output allows multiple algorithms.

Example 1: The source and destination units are both Wattrouter Mx. The source unit only provides output expansion for the destination unit, which provides basic control of PV excess energy. The source wattrouter uses the S-Connect protocol to inform the destination wattrouter that it has an SSR1 output, which is of the PWM_SPC type, thus enabling 3 algorithms for switching. The user maps this output in the destination wattrouter to the logic output RO1 and all 3 functions (relay, continuous control, PWM) are displayed in the Function field of RO1. The user selects the function, eg proportional control. The function is transferred back to the source device via the S-Connect protocol, which will then switch the SSR1 output in proportional control mode.

Example 2: The source unit is Heating Control Mx, the destination unit is Wattrouter Mx. The source unit only provides output expansion for the destination unit, which provides basic control of PV excess energy. The source wattrouter uses the S-Connect protocol to inform the target that it has an Ext1 output, which is of the PWM type, so it allows only 2 algorithms for switching (relay or PWM). The user maps this output in the destination wattrouter to the logic output RO1 and only 2 functions (relay and PWM) are displayed in the Function field of

RO1. The user selects the function, eg PWM. The function is transmitted back via the S-Connect protocol to the source device, which then switches the Ext1 output in pulse width modulation mode.

STATISTICS TAB

This tab shows:

      a)   A fully configurable online chart which makes it possible to monitor temperature curves in real time, etc.

      b)   Daily, weekly, monthly and yearly statistics of selected parameters of the control blocks.

ONLINE CHART

In this line chart it is possible to select up to 7 rows which can show temperature progress or states of binary inputs and outputs. It is possible to choose the period of loading values in the chart in the range from 1 s to 10 minutes. The maximum number of points on the time axis of the chart is 144 (if a ten-minute period is selected, this corresponds to 1 day). This chart is not saved in the non-volatile EEPROM memory and therefore after reset or a power failure of the controller the data will be erased. The data will also be erased after every change of the configuration of this chart.

Description of the configuration and status elements:

- Period – it states the period of loading values in the chart.
- Row 1-7 – drop-down menus configure the input or output which should be read in the relevant chart row. If the S-Connect protocol is activated, any logic input or output can be displayed in the graph, which contains data on the temperature or excitation of the binary input or output.

DAY

It shows daily statistics on the current day or optionally for at least seven days back. The option is specified in the relevant drop-down list. The selected data from the main control blocks are shown.

Description of the types of shown values:

- Temperature type item – it shows the minimum and maximum temperature on the given day and the arithmetic mean for the relevant day. The data is only read if the temperature is valid.
- Power type item – it shows the minimum and maximum power (of the pump, etc.) and the arithmetic mean for the relevant day. In order to provide more objective information the data is only read if the device power is not zero.
- Counter type item – it shows the counter signaling the time of switching on or activity of the given device for the relevant day.

Caution: The daily statistics are always reset immediately after midnight, i.e. at 12:00 am. At the same time the values of the just finished day are transferred to the history. When you change the date in the controller, the saved history may be irretrievably erased!

WEEK

It shows a subset of selected data (temperatures) for the last week in a graphic representation.

MONTH

It shows monthly statistics in the current month or optionally for up to 12 months back. The option is specified in the relevant drop-down list. It shows selected data from the main control blocks.

Description of the types of shown values:

- Temperature type item – it shows the minimum and maximum temperature in the given month and the arithmetic mean for the relevant month. The data is only read if the temperature is valid.

- Power type item – it shows the minimum and maximum power (of the pump, etc.) and the arithmetic mean for the relevant month. In order to provide more objective information the data is only read if the device power is not zero.
- Counter type item – it shows the counter signaling the time of switching on or the activity of the given device for the relevant month.

Note: The current day will be shown in the year history (current month) only after it has been saved in the history (after midnight).

YEAR

It shows a subset of selected data (temperatures) for the last 12 months in a graphic representation.

OPTIONS AND BUTTONS

A description of the buttons follows at the bottom part of the web interface and also of other configuration elements:

- "Open" – it opens a configuration from the disk.

- "Save" – it saves a configuration on the disk. Due to the security restrictions of browsers saving is usually permitted only in the folder designated for downloading ("Downloaded Items", etc.).

- "Read" – it reads a configuration from the controller.

- "Write" – it writes a configuration in the controller and optionally it resets the controller. The write is protected against unauthorized access by authorization.

- "Reload" – in the case of a communication failure in some cases it can help reload the connection with the controller faster.

- "Configuration/object name" – it is used for assigning a name to the building with the installation or possibly also to the current configuration. The text can have a maximum of 16 characters in the ASCII code.

TIME SCHEDULES DIALOG

This dialog is available in various control blocks and it enables optimizing the management of a specific block according to the time, day of the week, etc.

Every time schedule is placed on one line in the dialog.

Description of configuration and status elements:

- "Mode" – it allows you to select the mode of a time schedule. 4 modes are available:

  - "Not used" – the time schedule is not used.

  - "Temperature" – the time schedule will set a specific temperature requirement (see the relevant control block) in the set time.

  - "Restricted" – the time schedule will restrict the switching on of specific outputs of the control block to a set limit in the defined time. Using this schedule you can, for example, restrict the power of the heat or circulation pump to a certain limit. The restriction has the highest priority and it is valid in the set time regardless of the other simultaneously set time schedules of the "Enforced" type or the internal requirements of the control block.

  - "Enforced" – the time schedule will enforce the switching on of specific outputs of the control block to a set value in the defined time. This schedule can, for example, enforce a certain power of the heat or circulation pump or the full switching of the output. Enforcing has the second highest priority, but only if the control block does not require higher power for the given outputs (or full switching).

- "From" – the start time of the time schedule. If the "From" time is later than the "To" time, then the time schedule is active from the "From" time until midnight and then on the second day from midnight until the "To" time.
- "To" – the finish time of the time schedule. If the "From" time is later than the "To" time, then the time schedule is active from the "From" time until midnight and then on the second day from midnight until the "To" time.
- "M, T, W, T, F, S, S" – these fields can be used to configure on which days the time schedule will be active.
- Value field (without a caption) – It shows a value depending on the setting of the time schedule mode:
  - "Not used" – the field is hidden.
  - "Temperature" – the field allows you to enter a temperature request for the given time interval.
  - "Restricted" – the field allows you to enter the maximum allowable power of the specific output(s). If the value 0% is used, the output is completely restricted; if the value 100% is used, the output is not restricted at all and the time schedule is not effective.
  - "Enforced" – the field allows you to enter the minimum required power of the specific output(s). If the value 100% is used, the output is switched on completely/permanently; if the value 0% is used, the output is not enforced at all and the time schedule is not effective.

EQUITHERMAL CURVE DIALOG

This dialog is available in certain control blocks and it allows you to optimize the control of heating water temperature on the basis of an equithermal curve.

Description of configuration and status elements:

- "Outside temperature" – a row referring to the fixed values corresponding to the horizontal coordinate of the equithermal curve.

- "Heating water temperature" – a row referring to the optional values corresponding to the vertical coordinate of the equithermal curve.

- "Chart" – it shows the current equithermal curve – the horizontal axis shows the outside temperature and the vertical axis shows the requested temperature of the heating water.

- "Radiators" – by means of this button you can pre-set the original curve for radiators in the "Heating water temperature" row. This button does not write any values directly in the controller, it is used only for pre-setting the initial values!

- "Floor heating" – by mean of this button you can pre-set the original curve for floor heating in the "Heating water temperature" row. This button does not write any values directly in the controller, it is used only for pre-setting the initial values!

OUTPUT PROTECTION DIALOG

This dialog is available in certain control blocks and allows you to turn on the protection of pumps or valves from jamming during long-term shutdown, e.g. out of heating season. This protection always works on the basis of short-term switching of the given output at a specific time in a weekly interval, if in the previous week the output was not switched by another condition within the relevant control block.

Description of configuration and status elements:

- Output -… - activates output protection when checked. By checking this field the duration of the protection mode is automatically set to 1 minute (minimum), unchecking sets it back to 0 and deactivates the protection. When checked you may edit other options otherwise they are grayed.

- Start time - indicates the time when the protection should start.

- Duration - indicates the duration of the protection, in minutes. Entering 0 deactivates the protection (equals to unchecking the option at the beginning of the line).

- Day of week - specifies the day of the week when the protection should start.

- Remaining time - displays the remaining time until the protection is activated. If the displayed time is non-zero, the output will NOT switch in this protection mode even if the Start time and Day of week match with current date and time. If it is zero and the current date and time agree with the settings given by these parameters, the protection will start and the corresponding output turns on for the time specified by the Duration setting.

- Switching indicator - indicates in purple the switching of the output in this protection mode. Switching in this mode is further indicated by the same color next to the output in the main output table.

LED STATUS

The following table lists the possible states of the indication LEDs of the controller.

LED	Status	Note
LED PWR (green)	On	The controller is under voltage, no input is active (switched on).
	Flashing	The controller is under voltage, some output is active (switched on).
	Flashing fast	The controller is under voltage, the booting mode.
	Off	The controller is without voltage or there is a fault.
LED COM (yellow)	Off	Communication with the computer via USB has not been established.
	On or flashing fast	Communication with the computer via USB has been established.
LED ERR (red)	Off	No error state is detected.
	Flashing short-short-long)	One of the used temperature inputs does not work. Proceed according to the chapter Error and info status.
	Flashing long-long-short	DC source overload. Proceed according to the chapter Error and info status.
	Flashing long-short-long	S-Connect: device failed. Proceed according to the chapter Error and info status.
LED Ext1-6, Re1-2	Off	The relevant output is not active.
	On (or flashing)	The output is active (switched on).
LED on the LAN connector - right	Off	The Ethernet carrier signal is not indicated.
	On	The Ethernet carrier signal is indicated.
	Flashing	Active data transfer.
LED on the LAN connector - left	Off	Speed 10 Mbit/s.
	On	Speed 100 Mbit/s.

CONFIGURATION EXAMPLES

Due to the high number of the various possible configurations examples of setting are available only online on the website of the manufacturer.

HC DOWNLOADER MX SOFTWARE

The HC Downloader Mx program can be used for the (first) configuration of the network connection and access data and for loading firmware updates in the controller. All these activities can be performed by means of the Ethernet interface and by means of the USB interface. If you are connected via the USB port, the program does not require access data during the writing of the configuration and therefore this program can be used for recovering a user name and password if you have forgotten your access data to the controller.

Tip: After setting the Ethernet connection, it is possible to perform all configurations, including firmware updating, by means of the Ethernet interface. The USB interface does not have to be used at all if the parameters of the connected LAN are the same as the original controller parameters and if at the same time there is not a conflict of IP addresses or possibly a conflict of physical MAC addresses.

Before you use the HC Downloader Mx software in the USB connection mode, it is necessary to install a USB connection driver.

In order to connect to the USB interface by means of the upper port, switch off the circuit breaker of the controller and remove the semitransparent controller cover. In order to connect to the USB interface by the side port, it is necessary to switch off the entire distribution board during your work in it.

INSTALLATION OF THE USB CONNECTION DRIVER

The device uses an FTDI chip for connection via the USB port. The drivers for these chips support the Windows 7 operating system and later. If the connection driver is not already installed on the computer, the operating system will automatically install the driver from the Internet after the first connection of the controller to the computer. The installation procedure is as follows:

1. Insert the supplied USB cable in the USB connector of the controller and in the computer.

2. A yellow LED USB (communication indication) will flash, the USB device will be registered in the computer.

3. After a certain time, a message about the installation of a new device appears on the computer screen, followed by a message that the device is ready for use.

4. You can check whether the driver is installed correctly in the device manager (Control Panel -> System -> Device Manager). The connection to the device is identified as a USB serial converter in the Universal Serial Bus controllers folder and a USB serial port in the Ports (COM & LPT) folder.

If the automatic driver installation fails, follow these steps:

1. Download the latest driver - drivers can be downloaded from https://ftdichip.com/drivers/vcp-drivers/. The downloaded driver file must first be unzipped (unpacked) into an auxiliary directory, for example in the Documents folder. The version for 32-bit and 64-bit systems tends to have the same content, but the manufacturer provides separate links, so download according to your version of Windows. The driver is continuously updated by the manufacturer.

2. If an older driver is installed or the previous installation did not proceed correctly and communication does not work, and even after connecting the device to the computer, the operating system does not offer the option of installing a new driver, it is necessary to first uninstall the old driver from the operating system.

3. This is done again in the device manager. To uninstall, right-click the USB serial converter/USB serial port item and select Uninstall device from the menu.

4. Reinsert the USB cable into the controller's USB connector and into the computer.

5. The Windows operating system detects the new device and starts searching for a driver.

6. If it does not find it, it will offer the option to choose the path to the driver.

7. Select the path to the auxiliary directory where you previously unzipped the downloaded file.

8. The driver will be installed.

9. If the connection still does not work, i.e. the device USB serial port or USB Serial converter is not created in the device manager, nor does the yellow LED on the device flash, it is possible to try other USB ports of the computer, another USB cable and restart the computer.

10. If this does not help either, then it is also possible to try another computer, another version of the Windows operating system, etc.

INSTALLATION OF THE HC DOWNLOADER MX PROGRAM

1. Download the software from the website of the manufacturer.

2. Start the program HCDownloader_Mx_Setup_x86_64.exe.

3. Follow the instructions on the screen.

STARTING THE HC DOWNLOADER MX PROGRAM

1. Start the HC Downloader Mx program in the "START" menu. The main window of the program will appear.

2. Make sure that the controller is switched on and connected to the computer. Check if the USB interface driver is installed correctly.

3. Select the mode of connection via the USB interface (the window next to the "Connect" button).

4. Click on the "Connect" button. The controller should now be connected and the connection indicator (band) should be green. If this is not the case and an error message appears, wait until the USB driver in the PC is ready for use or check the settings in the window "USB device driver configuration". You can open this window by pressing the "Connection configuration" button.

DESCRIPTION OF FUNCTIONS OF THE HC DOWNLOADER MX PROGRAM

The following chapters provide a description of all windows of the application.

MAIN WINDOW OF THE APPLICATION

Description of configuration and status elements:

*   "Connect through" – the option allows you to choose connection via USB or LAN.

*   "Connect" – it connects the computer to the controller.

*   "Disconnect" – it disconnects the computer from the controller.

*   "Configure connection" – it shows a window with the active connection configuration.

*   "Read" – it will read a configuration from the controller.

*   "Write" – it will write a configuration (network or access data configuration) in the controller.

*   "Network configuration" – it allows you to configure the Ethernet in the same way as through the web interface – for a description of the items see the chapter Network settings.

- "Other settings" – allows you to enter other settings in the same way as via the web interface - see chapter Other settings.

    - "Language" - changes the communication language of the HC Downloader Mx software.

- "Authorization settings" – allows you to enter authorization settings in the same way as via the web interface - see chapter Authorization settings.

    - "Require better HTTP security" –check this to disallow passing plain text username and password in HTTP requests that affect the behavior of the controller (configuration, output test, digital sensor search) via the web interface. If checked the authorization will be made using a hash and username and password cannot be changed via web interface anymore. This security option does not replace advanced cryptographic systems used by banks etc. as these are not possible to implement in the controller hardware. However, it will prevent unauthorized access via the HTTP protocol, especially if the device is accessible from the Internet.

- "Other status" – shows serial number and firmware version of the connected controller.

- "Log" – a window in which error and information communication reports are shown.

- "Reset to defaults" - restores all configurable items in the main window to their default settings. These can then be written to the controller with the Write button. This command does not delete the entire configuration as the Erase configuration field; it only applies to configurable items in this software.

- "Update firmware" – it allows you to update the firmware of this product. If you are our registered customer who bought this product, you automatically have access to the Downloads section on our website. If there is an update, you can download it and install it. The progress of the update is shown and its duration depends on the type and speed of your connection from 20 s to 60 s. Updating via the LAN interface is protected against unauthorized access by authorization.

Updating of the original firmware is completely safe. The system fully checks the integrity of the update file and the integrity of the data after loading them in the unit. If a power failure occurs during updating, it is possible to load the firmware again at any time after the power supply is switched on. If possible, you should load the software via USB or ONLY from the local network (if an error occurs during loading an update, the controller remembers the network configuration only for about 2 minutes). It is forbidden to change the file of a downloaded update in any way. Otherwise, in spite of the integrity check, the product may be damaged and your warranty will be void!

- "Export statistics" - exports all statistics except the real-time chart to a * .csv file, which can be loaded e.g. in MS Excel. The function is not implemented in the web interface due to its higher complexity, so it is only available in the HC Downloader Mx software.

- "Import statistics" - imports all statistics except the real-time chart from the *.csv file. The file must contain statistics stored in HC Downloader Mx 2.0 or later. This function can be used to transfer statistics from another device. The function is not implemented in the web interface due to its higher complexity, so it is only available in the HC Downloader Mx software.

- "Clear log" –use this button to clear log contents.
- "Save log" –use this button to save the log as text file on your PC hard drive.
- "Write detailed communication info" - check this option to see more detailed information about communicating with the controller, for example for diagnostics. Additional information may help the technical support to detect possible problems in connection configuration etc.

- "Finish" – it will close the program.

USB/COM DRIVER CONFIGURATION WINDOW

In this window you can configure the options which relate to the connection to the controller via the USB interface.

Port configuration:

- "Port" – if the driver is properly installed and the controller is connected to the computer, the appropriate COMx port can be found in the pop-up menu. If multiple or none ports are shown, make sure that the USB serial port driver installation in Device Manager is correct. Here, you can also find out which port is used for communication. The communication parameters are fixed: 38400 Bd, 8N1.

Timeouts:

- "Default read timeout" – the total timeout for receiving responses from the controller. Change (increase) the value only if you experience communication problems.

Buttons:

- "Default" – it sets the default communication parameters.

- "OK", "Cancel" – standard confirmation and cancellation of a dialog.

LAN/UDP DRIVER CONFIGURATION WINDOW

In this window you can configure options which concern connection to the controller by means of the UDP protocol via the Ethernet.

UDP protocol settings:

- "Select profile" - it is used to select connection profile. Connection profiles are used to quickly configure connection settings. They are useful e. g. for connections from local and public networks where you must switch between two IP addresses. New profile may be created by pressing the "New" button. The new profile stores the current IP address and UDP port settings. Created profiles may be deleted by the Delete button.

- "IP address or URL" – the IP address used to access the controller. You can enter the local IP address of the controller, or, if NAT is appropriately configured in your router, you can enter the public IP address of your controller. If you wish to change the IP address, it is necessary to first change the IP address setting directly in the controller – see the "Settings" tag.

- "UDP port" – the UDP port used by the program to access the controller. The default value is 50000.

Note: If you have problems with establishing communication, connect via USB and find out the current LAN settings.

Timeouts:

- "Default read timeout" – the total timeout for receiving responses from the controller. Change (increase) the value only if you experience communication problems.

- "Timeout after reset" – if you are connected via LAN, the "reestablishment" of the connection after the controller reset takes longer than if you are connected via USB. Change (increase) the value only if you experience communication problems after the reset of the controller (typically after you have loaded new firmware in the controller).

Buttons:

- "Default" – it sets the default communication parameters.

- "OK", "Cancel" – standard confirmation and cancellation of a dialog.

TROUBLESHOOTING

The following table shows the most common causes of problems and their solutions:

Problem description	Possible causes	Solution
The controller has been installed according to the instructions, but after you switch on the circuit breaker, no LED lights up or flashes.	The circuit breaker is on, but there is no supply voltage.	Check or measure if the mains voltage is really connected to the L and N terminals.
	Controller fault	Replace the controller.
The controller has been installed according to the instructions, but after you switch on the circuit breaker, the green LED flashes quickly, the controller does not work and the web interface cannot be loaded.	The controller is switched on in the boot mode without any application firmware.	Use the HC Downloader Mx program to install the latest version of the application firmware or the version you prefer. In this case you have to install the application via the USB interface which is not blocked by the controller access authorization.
The controller does not communicate with the computer.	The controller is not under voltage	Check if the green LED PWR is on and if the controller is powered.
	The computer is not connected correctly with the controller.	Check the USB/network cable connection, try using a different network cable or try the existing cable on a different device (e.g. a printer). In the case of network connection there can be a problem in the router or in other network components. Try restarting the device or connecting the network cable to another port. The device may also be incorrectly configured; the same applies to the local network configuration. If you experience any problems, contact a computer or network expert.
	The computer does not detect the connected controller	Check the USB/network cable connection. When the USB device is being registered, the yellow LED COM must flash quickly. If your network cable is connected correctly, at least 1 LED on the controller network connector must be on.
	The USB interface driver has not been installed correctly in the computer.	Check that the USB interface driver is installed correctly and that the PC device manager detects it as a USB serial converter.
	The USB interface driver is not configured correctly.	Use the USB interface driver configuration window in the HC Downloader Mx program to configure all parameters to the default values.
	The LAN/UDP interface driver is not set correctly.	Use the LAN/UDP interface driver configuration window in the HC Downloader Mx program to check the

		validity of the IP address and the UDP port. Connect to the controller by the HC Downloader Mx program by means of USB in order to determine the current network configuration in the controller. IP addresses and UDP ports must have the same configuration.
	Overloaded Ethernet	Your local network or Internet connection is temporarily out of order or impassable (overloaded with other transfers, etc.). Try to reconnect later or ask a computer network expert for connection optimization and technical advice.
	Controller fault	Replace the controller or take it to repair.
The low tariff signal is missing	The low tariff signal is not connected.	Connect the low tariff signal to the binary input and configure the low tariff function according to the chapter Low Tariff. The signal must be connected to the binary input via an auxiliary relay according to these instructions.
	The low tariff signal is not active.	Wait for the signal to become active or test it by manually switching on the auxiliary relay (some types of relay offer this option).
	Controller fault	Replace the controller or take it to repair.
Some digital temperature input is not working	The sensor is not connected correctly.	Check the connection of the sensor (power supply and connection to the data bus, correct connection of shielding).
	The sensor is not supported.	The sensor uses a different communication protocol or it is not a digital sensor.
	The temperature is not measured correctly.	Check that the power supply of the sensor is within the tolerance values.
	Sensor or controller fault	Replace the sensor or the controller or take the controller to repair.
Some analog temperature sensor is not working	The sensor is not connected correctly.	Check the connection of the sensor (power supply and connection to the controller, correct connection of shielding).
	The sensor is not supported.	The sensor is not a supported analog temperature sensor.
	The temperature is not measured correctly.	The sensor is not a supported analog temperature sensor or the connection is incorrect. Check the connection of the sensor. It may be caused by high voltage drops on the connecting cable. The precision of

		analog temperature sensors depends on the supply impedance.
	Sensor or controller fault	Replace the sensor or the controller or take the controller to repair.
Some binary input is not working	The signal from the output is not a supported binary signal.	Use only output potential-free contacts (relay outputs or an optocoupler with open collector).
	The open collector output is connected inversely.	Change the terminals at the device output.
	Controller fault	Replace the controller.
The TEST button cannot switch on some connected device	The device is not connected or it is connected incorrectly.	Check the connection of the relevant device and switch on the relevant circuit breaker or fuse switch disconnector.
	The device is connected correctly but it cannot be switched on.	Check if the device does not have, for example, built-in thermal protection.
	The output LED is not on or another controller fault.	Replace the controller or take it to repair.
The outputs do not switch on as they should	The output is not activated	Activate the output in the relevant control block.
	The control block is not activated	Activate the control block and wait for the conditions to be met for activating the output.
	Incorrectly configured control block	Check the configuration of the control block.
The external outputs do not switch on the connected solid state relays (SSR)	Incorrect connection of the relay	Check that the connection is correct and check the polarity of the terminals, it must always be observed.
	Incompatible relay	Always use a relay which switches on at zero and which is operated by low direct-current voltage >4VDC.
	Controller fault	Replace the controller or take it to repair.
Application firmware cannot be loaded even after repeated attempts	Incorrect or damaged file *.scf	Load only original firmware for the Heating Control Mx device.
	Communication errors	Make sure that there are no problems in the connection of the PC to the controller or in the PC itself (viruses, etc.).
	Controller fault	Replace the controller or take it to repair.
The red LED is flashing	An error status has been detected	Follow the instructions in the chapter LED Status.
Statistics do not correspond to reality	It is not a fault	The data is only for reference and is based on the measured data.
Statistics have been erased suddenly	It is not a fault	The date in the controller has been changed or there was a power failure while the history was being written in the EEPROM memory.
House heating is inadequate	The heat pump does not	Have the heat pump functionality and

	have the necessary power	amount of refrigerant in the circuit checked by the refrigeration service. Alternatively, set different conditions for the bivalent heat source; change the "Max. outside temperature to run bivalents" and "Bivalent 1st level on-delay" parameters.
	The bivalent heat source does not have the necessary power	In the case of electrical bivalence add the 2nd level or replace the cartridge heater with a different one with a higher rated input power.
	Low power of the heating circuit circulation pump	Increase the power of the circulation pump by setting a higher differential pressure. The circulation pump must be able to transport the required amount of heat to all rooms. At the same time, however, do not set the differential pressure too high. This would unnecessarily increase the electrical consumption of the pump and the too high flow would also cause undesirable destratification of the heating water in the storage tank.
	Too low requested control temperature	If you are using a heat pump for heating, activate the function "Enable temporary increase of control temperature".
	Unsuitable setting of the equithermal curve or the requested constant temperature of the heating water	If you use a heat pump for heating, increase the requested heating water temperature in the equithermal curve setting for the given outside temperature or the constant temperature setting.
The power of the heat pump is constantly changing	It is not a fault	Fluctuations of the required power are normal in the proportional control and they are connected, for example, with the periodic cycles of defrosting of the outside temperature or with other sources of fluctuations in the control temperature in the storage tank. Changes in the required power are necessary during the control and they do not affect the life of the heat pump.
The solid fuel boiler gets overheated	Incorrect position of the output temperature sensor	Place the output temperature sensor as close as possible to the boiler so that it will be able to react to the heating of the boiler on time.
	Insufficient power of the circulation pump	Replace the circulation pump with another type with sufficient power.
	Incorrect value of the P-	If you have a continuously controlled

	component	circulation pump (by the PWM signal), increase the value of the P-component, this will result in increasing the pump power.
Cannot pair units via Ethernet using the S-Connect protocol	The units do not have S-Connect activated	Activate S-Connect on all units, one unit must be access point (AP) and the other units must be stations (STA).
	The units are not connected to the same local network	Connect all units to the same local network. Note: Pairing requests do not pass from one subnet to another, you must use the same subnet.
	The units have either incorrect network configuration or are disconnected	Make sure all units are accessible on local network (use PING command).

MAINTENANCE AND REPAIRS OF THE DEVICE

The controller has been designed as a maintenance-free device provided that it is configured correctly and installed in accordance with these instructions. We recommend inspecting the operation of the entire system in regular intervals (at least once a month); this applies especially to checking the functionality of the switching of the individual devices within the entire heating system.

Should you discover a defect which cannot be repaired according to instructions specified in the Troubleshooting chapter, contact your distributor (applies both to warranty and post warranty repairs).

Never attempt to repair the device by yourself! If you do so, you expose yourself to the risk of electric shock and your warranty will be void in its full extent!

TECHNICAL SPECIFICATIONS

Parameter	Value, notes
Main parameters	
Supply voltage	230V~, 50Hz
Power consumption – stand-by mode	<3VA
Power consumption – 1 relay output	0.4W
Power consumption – all outputs switched on and loaded with maximum allowable currents	5W
Parameters of inputs and outputs	
Inputs T1-8:	Data bus of sensors compatible with series DS1820. The sensors are always connected to terminals GND (ground), +5V (power supply) and T1-8 (data). The precision of temperature measurement is given by the sensor documentation, in most cases ±0.5 °C.
Inputs T9 to T12	0 to 5 V DC against GND, galvanic isolation from the power grid. Inputs for connection of analog sensors, type NTC, with resistance of 10 kΩ at 25°C (B25/85=3977) or PT1000 sensors. The sensors are always connected against GND. The precision of temperature measurement ±2 °C decreases when using long connection cables.
Inputs I1 to I4	0 or 5 V DC against GND, galvanic isolation from the power grid. It can switched by standard potential-free relay outputs and outputs with an open collector, always against GND.
Relay outputs Re1, Re2	230 V~, 50 Hz, max. 10 A, 2300 W (it is recommended to connect load with cos (Φ) ≠ 1 via an independent contactor)
Ext1 to Ext3 External outputs	0 or 12 V DC against GND, galvanic isolation from the power grid. Parameters of fast PWM: carrier frequency of 200 Hz to 10 kHz, duty cycle 0-100% in one percent steps. Connection parameters of external SSRs: Connect the positive anode to the +12V terminal, the negative to the corresponding Ext1-3 terminal. SSRs must have DC control of at least 4 V DC and they must switch at zero (zero switch design). Parameters for connecting external electromagnetic relays: Connect the control coil between the +12V terminals and the corresponding Ext1-3 terminal. The relay must have 12VDC control with a coil current of max. 50mA.
Ext4 to Ext6 External outputs	2 to 12 V DC to GND, max. 10mA, galvanically isolated

	from the power supply network. External SSR connection parameters: Connect the positive anode to the +12V terminal, the negative one to the corresponding Ext4-6 terminal. SSR must have DC control min. 4VDC and must switch at zero (zero switch design). 0-10V signal connection parameters: Connect the positive pole to the +12V terminal, the negative pole to the Ext4-6 output. The common terminal for several devices is the positive pole (+12V). The voltage varies in one percent increments. External electromagnetic relays cannot be connected.
USB connection	USB 1.1/ USB 2.0, galvanic isolation from the power grid and additional optical isolation
LAN connection	10/100 Mbit/s, galvanic isolation from the power grid and additional galvanic isolation according to IEEE 802.3
Other parameters	
Maximum length of sensor data bus T1-8	50 m
Maximum length of external equipment or SSR control by means of outputs EXT1 to EXT6	10 m
Mixing valve powering unit	Slew rate between 1 and 8 minutes, three point type (separate opening and closing circuits)
Working position	Any
Mounting	DIN 35mm or 2 screws with round or countersunk heads with a diameter of up to 6 mm.
Overvoltage category	III
Electric strength	4 kV / 1 min (power supply (L, N)-output, output – output, power supply temperature input, binary input, external output, etc. (GND,T1-8,T9-T12,I1-I4,+5V,+12V,Ext1-Ext6)
Pollution degree	2
Operational temperature range	-20°C to +60°C
Storage temperature range	-40°C to +80°C
Circuit breaker	B6A
Protection	IP 20
Dimensions (WxHxD)	106x110x64mm (6M)
Weight	Controller: 350g
Battery for real-time back-up	CR2032 lithium, usual lifetime > 6 years
Warranty period	36 months

BATTERY FOR REAL TIME BACKUP

The regulator contains a CR2032 type battery for real time backup. If the controller shows an incorrect date and time after a power failure, then the battery is discharged. The battery can be replaced.

The battery is located in the case. This battery can be replaced by yourself without having to disassemble the device. Remove the battery with a suitable tool, for example a plastic clamp, after removing the regulator lid. Insert the spare battery in the same way.

Important notice: *It is absolutely necessary to respect the polarity of the battery. If you insert the battery the other way round, the main microprocessor will be damaged! When replacing the battery, do not use metal tools that could short-circuit the battery!*

RECYCLING

After the product life is over the product may be disassembled, recycled or disposed of at a safe dumpsite.

Legal regulations regarding electronic waste treatment have to be observed in respective country.

Before product disposal, remove real time backup battery (if possible).

Do not dispose in regular household waste!

EC DECLARATION OF CONFORMITY

Company:

SOLAR controls s.r.o. (manufacturer name)**, Company Reg. No.: 29109795**
Brojova 25, Plzeň, 32600, Czech Republic (registered office of the manufacturer)

hereby declares at its full responsibility that the product:

Heating Control Mx (product name)
HC 01/08/23 (type/model)
for control of multi-source heating (function)

is safe under the conditions of the standard and intended use as specified in the instructions for use and that measures have been taken which ensure the conformity of all products launched on the market with technical documentation, with the basic regulations of the applicable government decrees and with the requirements of the technical regulations provided in the following paragraph.

The stated product conforms to the production documentation and parameters specified in it, furthermore it conforms to European directives and technical standards which were used in assessing the conformity:

Directives:
- LVD Directive 2006/95 EC
- EMC Directive 2004/108 EC

Standards:
- EN 61010-1 ED.2
- EN 61000-4-2 ED.2
- EN 61000-4-4 ED.3
- EN 61000-4-5 ED.3
- EN 61000-4-11 ED.3
- EN 61000-6-3 ED.2

The assessment of the product conformity was carried out pursuant to Act No.: 22/1997 Sb., on technical requirements on products, as subsequently amended, and pursuant to Government Decree No.: 17/2003 Coll., which stipulates technical requirements on electrical low-voltage equipment and Government Decree No.: 616/2006 Coll., which stipulates technical requirements on products from the point of view of their electromagnetic compatibility.

Year of affixing the CE marking: 2023

Place and date of issue of the declaration:
Plzeň, 1 May 2023

Ing. Tomáš Krýsl, Executive Director of the Company

(name, position and signature of the responsible person of the manufacturer)