

Controllers

User's manual ST-979

EN



I. Safety

Before using the device for the first time the user should read the following regulations carefully. Not obeying the rules included in this manual may lead to personal injuries or controller damage. The user's manual should be stored in a safe place for further reference. In order to avoid accidents and errors it should be ensured that every person using the device has familiarized themselves with the principle of operation as well as security functions of the controller. If the device is to be sold or put in a different place, make sure that the user's manual is there with the device so that any potential user has access to essential information about the device.

The manufacturer does not accept responsibility for any injuries or damage resulting from negligence; therefore, users are obliged to take the necessary safety measures listed in this manual to protect their lives and property.



WARNING

- **High voltage!** Make sure the regulator is disconnected from the mains before performing any activities involving the power supply (plugging cables, installing the device etc.)
 - The device should be installed by a qualified electrician.
- Before starting the controller, the user should measure earthing resistance of the electric motors as well as the insulation resistance of the cables.
 - The regulator should not be operated by children.



WARNING

- The device may be damaged if struck by a lightning. Make sure the plug is disconnected from the power supply during storm.
 - Any use other than specified by the manufacturer is forbidden.
- Before and during the heating season, the controller should be checked for condition of its cables. The user should also check if the controller is properly mounted and clean it if dusty or dirty.

Changes in the merchandise described in the manual may have been introduced subsequent to its completion on August 25th 2016. The manufacturer retains the right to introduce changes to the structure. The illustrations may include additional equipment. Print technology may result in differences in colours shown..



We are committed to protecting the environment. Manufacturing electronic devices imposes an obligation of providing for environmentally safe disposal of used electronic components and devices. Hence, we have been entered into a register kept by the Inspection For Environmental Protection. The crossed-out bin symbol on a product means that the product may not be disposed of to household waste containers. Recycling of wastes helps to protect the environment. The user is obliged to transfer their used equipment to a collection point where all electric and electronic components will be recycled.

II. Description of the device

ST-979 controller is intended to be used with pellet-fired CH boilers with a fuel feeder and a supply air fan. Thanks to advanced software, the regulator fulfils a wide range of functions:

- Controlling the igniter
- Controlling the feeder and the internal feeder
- Controlling the grate and the ash remover
- Controlling the supply air fan
- Controlling the central heating pump (CH)
- Smooth control of two mixing valves
- Controlling DHW pump
- Controlling two additional pumps (additional CH, DHW, floor, circulating or CH boiler protection pump)
- Weather-based control
- Weekly control
- Cooperation with a room regulator offering traditional (two-state) communication or RS communication
- Possibility of connecting ST-65 GSM module which enables the user to control certain functions via a mobile phone
- Possibility of connecting ST-505 Ethernet module which enables the user to view certain parameters and control certain functions via the Internet
- Possibility of connecting two additional valve-controlling modules (e.g. ST-61 or ST-431N) which enable the user to control two additional valves

III. Controller installation

The controller should be installed by a qualified person.



WARNING

Risk of fatal electric shock from touching live connections. Before working on the controller switch off the power supply and prevent it from being accidentally switched on.

IV. How to use the controller

IV.a) Principle of operation - Lambda sensor

Additionally, the controller operation depends on LAMBDA sensor readings which provide the information about the proportion of oxygen in the flue gas. On the basis of this value, the efficiency of the burning process is assessed. If the amount of oxygen is different from the pre-set value, the regulator adjusts the fan speed as well as the amount of fuel fed to the boiler in order to make the process more efficient.

IV.b) Operation stages:

Parameters of particular operation stages of the CH boiler are configured by the user. Fire-up and damping are multi-stage processes described below. Once the fire-up process is conducted properly, the controller enters Operation mode or Modulation mode - it depends on the operation algorithm selected by the user in *Fitter's menu / Operation algorithm select*.

Fire-up

Fire-up process does not depend on the current operation algorithm. This phase is initialized by the user in the main menu, or by the controller software in certain situations (e.g. after periodical cleaning of the furnace during controller operation). There are four stages of the fire-up process:

1. Blow-by

In this stage the fan works at full speed in order to clean the furnace.

2. Initial fuel feeding

In this stage the blow force decreases to its minimum value - 1%. The feeder is enabled and operates throughout the whole stage. Feeding time is set by the user in the main menu - *Fitter's menu / Fire-up parameters*.

3. Heater

In the following stage of the fire-up process the igniter is enabled. It remains active until the flue gas temperature increases by a pre-set value. The feeder is inactive whereas the fan operates at the speed defined by the user - *Fitter's menu / Fire-up parameters*.

4. Delay

Delay is the final stage of the fire-up process, when the controller parameters stabilize. In this stage the feeder operates according to operation time and pause time settings. The fan operates at the speed defined by the user - *Fitter's menu / Fire-up parameters*. Duration of this stage is also defined by the user.

Standard operation algorithm:

1. Operation

The main aim of this stage is reaching the pre-set CH boiler temperature. Fan and feeder operation is regulated according to user's settings - *Main menu / Operation settings*. Once the pre-set temperature is reached, the controller switches to sustain mode.

2. Sustain

Fuel feeding process slows down in order to smoothly reduce the temperature. The fan and the feeder operate according to customized settings - *Main menu / Operation settings*.

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Modulation operation algorithm:

After successful fire-up the controller switches to modulation mode. It consists of 3 stages depending on current temperature.

1. 100% modulation

In this stage the fan and the feeder operate according to user's settings - *Main menu / Modulation settings / 100% modulation*. The controller switches to the next modulation stage when the CH boiler reaches the pre-defined value - *Main menu / Modulation settings / 100% modulation / Range from set temp*.

2. 60% modulation

In this stage the fan and the feeder operate according to user's settings - *Main menu / Modulation settings / 60% modulation*. The controller switches to the next modulation stage when the CH boiler reaches the pre-defined value - *Main menu / Modulation settings / 60% modulation / Range from set temp*.

3. 30% modulation

It is the last modulation stage. Its aim is to maintain the pre-set CH boiler temperature. The fan and the feeder operate according to user's settings - *Main menu / Modulation settings / 30% modulation*.

Damping

Damping process is independent of the current operation algorithm. It may be activated by the user in the main menu or by the software in certain circumstances (e.g. before automatic cleaning procedure or after a sudden temperature increase of 5°C).

Damping process consists of two stages whose duration time may be adjusted by the user - *Fitter's menu / CH boiler settings / Damping parameters*:

1. Damping protection

The first stage involves damping protection when the feeder is disabled and the fan speed is adjusted by the user - *Fitter's menu / CH boiler settings / Damping parameters*.

2. Damping delay

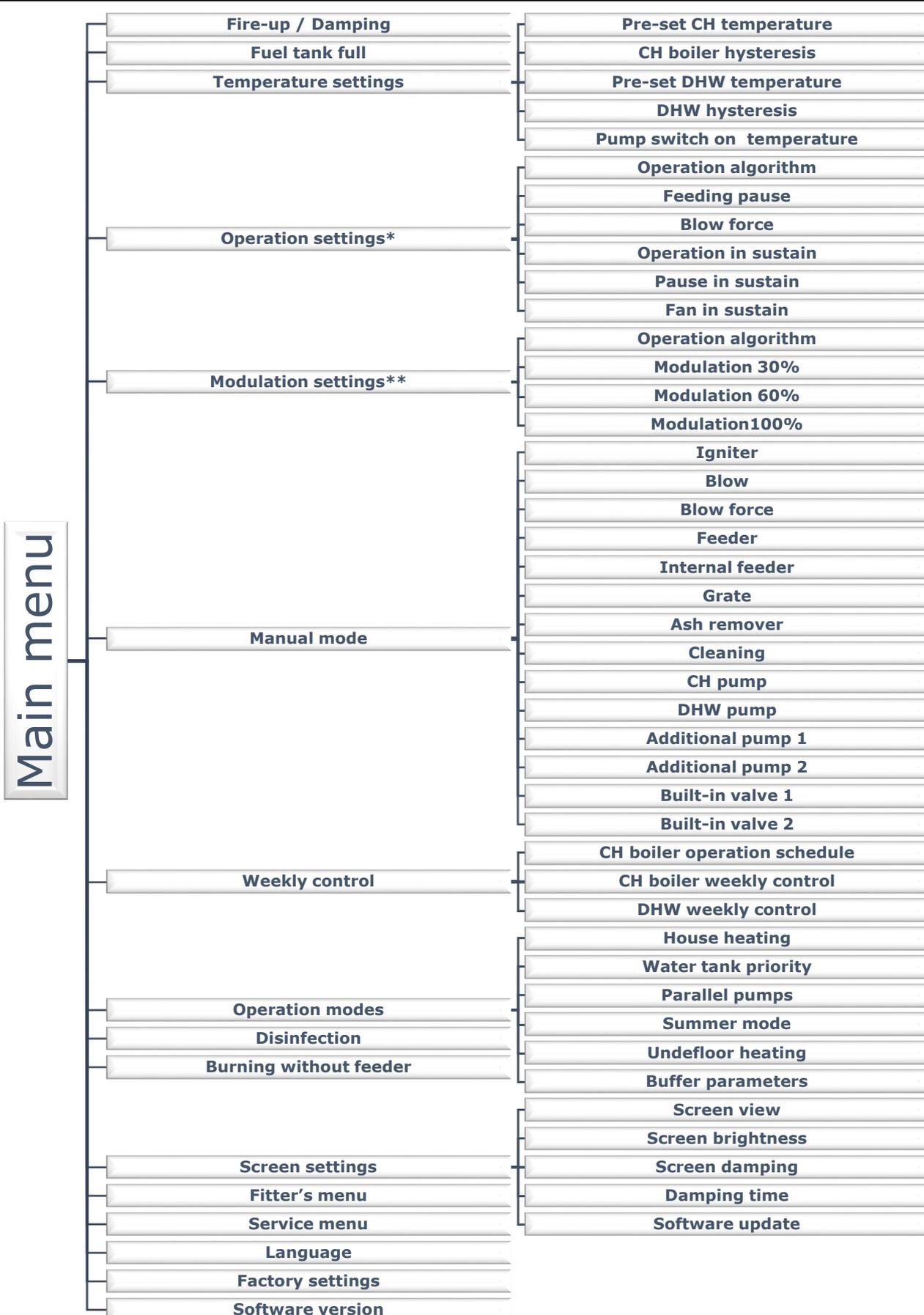
Once the delay time elapses, the fan starts operating at full speed for a certain period of time. It is the damping delay stage.

V. Controller functions – main menu

Due to multiple functions fulfilled by the controller, the menu is divided into Main menu and Fitter's menu.

The main menu includes basic options such as parameters of built-in valves and pumps, operation modes, time setting, screen view settings etc.

V.a) Block diagram - Main menu



*Parameters available only when Standard operation algorithm is selected.

**Parameters available only when Modulation operation algorithm is selected.

V.b) Fire-up

Once this option is selected, the fire-up process is initiated. The following stages of this process are described in part IV.b.

V.c) Fuel tank full

This function should be used after the fuel tank has been fully filled, in order to reset the fuel consumption percentage to 100%.

NOTE: Before using this function for the first time it is necessary to calibrate the fuel feeder operation in the *Fitter's menu/ Calibration*.

V.d) Temperature settings

Tap on *Temperature settings* icon to adjust the pre-set temperature and the hysteresis for both the CH boiler and DHW tank.

V.d.1) Pre-set CH temperature

This option is used to define the pre-set temperature of the CH boiler. The setting range available is 45°C to 80°C.

V.d.2) CH boiler hysteresis

This option is used to set the hysteresis of the pre-set CH temperature. It is the difference between the temperature of entering the sustain mode and the temperature of restoring operation mode (for example: when the pre-set temperature is 60 °C, the hysteresis is 3°C, entering sustain mode takes place at the temperature of 60 °C whereas returning to the operation mode takes place at 57 °C).

V.d.3) Pre-set DHW temperature

This function is used to define the pre-set temperature of domestic water. Once the water in the DHW tank has reached the pre-set temperature, the controller disables DHW pump. It will be activated again when the temperature drops below the pre-set value by DHW hysteresis (DHW sensor reading).

V.d.4) DHW hysteresis

This option is used to define the hysteresis of the pre-set water tank temperature. It is the maximum difference between the pre-set temperature (desired temperature of DHW tank) and the temperature of restoring operation.

Example: if the pre-set temperature is 55°C and the hysteresis value is 5 °C, the DHW pump is switched off when the set temperature of 55°C is reached and it is activated again when the temperature drops to 50 °C.

V.d.5) Pump switch on temperature

This option is used to define the temperature of CH pump and DHW pump activation (temperature measured at the CH boiler). Below this temperature value both pumps remain inactive whereas above this value the pumps are enabled and operate according to the current operation mode (see: pump operation modes).

V.e) Operation settings

This submenu is available only when Standard operation algorithm is selected.

Tap on *Operation settings* icon in order to adjust CH boiler operation settings.

V.e.1) Operation algorithm

In this submenu the user may choose between Standard operation algorithm and Modulation. Once Modulation is selected, *Operation settings* submenu changes into *Modulation settings* submenu.

V.e.2) Feeding pause

This option is used to set the pause time of the feeder. The length of the pause should be adjusted to the type of fuel used.

Incorrect pause time may result in inefficient operation of the CH boiler, i.e. unburnt coal left or failure to reach the pre-set temperature of the CH boiler. Appropriate pause time ensures efficient operation of the CH boiler.

V.e.3) Blow force

This function is used to control the fan speed. The setting range is 1-100%. The higher the gear is, the faster the fan works. 1% is the minimum fan speed whereas 100% is the maximum fan speed.

V.e.4) Operation in sustain mode

This option is used to set the operation time of the feeder and the fan when the CH boiler operates in sustain mode (i.e. above the pre-set temperature).

V.e.5) Pause in sustain mode

This option is used to set the feeder pause time when the CH boiler operates in sustain mode (operating above the pre-set temperature).



WARNING:

Incorrect pause time may result in further temperature increase! The user should make sure that the pause time in sustain mode is not too short.

V.e.6) Fan in sustain mode

This option is used to set the fan operation and pause time in sustain mode.

V.f) Modulation settings

This submenu is available only when Modulation operation algorithm is selected.

V.f.1) Operation algorithm

In this submenu the user may select Modulation as the CH boiler operation mode. Then, *Operation settings* submenu changes into *Modulation settings* submenu.

V.f.2) Modulation 30%, Modulation 60%, Modulation 100%

Tap on *Modulation settings* in order to adjust CH boiler operation settings.

The user may adjust operation time, feeder activation frequency and blow force for the following modulations stages.

In the case of 100% and 60% modulation, the user also sets *Range from set temp.* parameter which defines the moment of switching to another modulations stage.

Example:

Pre-set CH boiler temperature: 55°C

Range from set temp. for 100% modulation: 20°C

Range from set temp. for 60% modulation : 10°C

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After successful fire-up, the controller switches to 100% modulation. When the CH boiler reaches 35°C (55°C-20°C=35°C), it switches to 60% modulation. When the CH boiler reaches 45°C (55°C-10°C=45°C), it switches to 30% modulation.

If the controller cooperates with Lambda sensor, the user also needs to define the pre-set proportion of oxygen in flue gas for each stage of modulation. Feeder and fan operation is additionally modified according to Lambda sensor readings.

V.g) Manual mode

For the user's convenience, the regulator offers manual mode function. In this function, each executive device may be activated and deactivated independently of others. It is an easy way of checking if the following devices work properly: igniter, feeder, internal feeder, blow (fan), grate, ash remover, CH pump, DHW pump, additional pumps, built-in valves or additional valves (these valves may be opened or closed in manual mode).

Additionally, the user may adjust the fan speed in manual operation mode using *blow force* function.

V.h) Weekly control

The controller enables the user to control the CH boiler operation in a weekly cycle. It is possible to program daily changes of the CH boiler temperature as well as DHW temperature. For this function to work correctly, it is necessary to set current time and date. There are three types of weekly control available:

V.h.1) CH boiler operation schedule

This type of weekly control enables the user to set the periods of CH boiler operation on particular days of the week, with the accuracy of 30 minutes. During the periods of inactivity, the CH boiler remains damped regardless of other factors (e.g. signal from the room regulator).

V.h.2) CH boiler weekly control

Weekly control function enables the user to program changes of the pre-set CH boiler temperature for particular hours and days of the week.

In order to activate this function, select mode 1 or mode 2. Detailed settings of each mode are available further in the submenu: *Set mode 1* and *Set mode 2*.

Once a given mode is selected, the main screen displays the value of current temperature deviation (below the pre-set CH temperature, alternately with *Pre-set*) informing the user that the function is active.

How to adjust weekly control settings:

APC2 ADAPTIVE CONTROL controller enables the user to program weekly control function in two modes:

MODE 1 – the user sets the temperature deviations for each day of the week separately;

MODE 2 – the user sets the temperature deviations for all working days (Monday-Friday) and for the weekend (Saturday-Sunday) separately.

How to configure mode 1:

In order to configure mode 1, select *Set mode 1* – the display shows the panel with particular days of the week.

Once a given day of the week is selected, the screen shows the editing panel – the upper line shows current deviation. Use ◀ and ▶ to change the time period. In order to edit the deviation value, use ▼ and ▲.

In order to copy the setting for the next time period, use ●. Once the temperature changes for a given day are ready, tap on CONFIRM icon - the screen will display a screen allowing the user to copy the settings for other days.

Example:

Monday

set: 3⁰⁰ AM, temp -10⁰C (weekly control setting- 10⁰C)

set: 4⁰⁰ AM, temp -10⁰C (weekly control setting- 10⁰C)

set: 5⁰⁰ AM, temp -10⁰C (weekly control setting- 10⁰C)

In this case, if the pre-set temperature of the CH boiler is 60⁰C, from 3⁰⁰ AM to 6⁰⁰ AM on Monday the pre-set temperature will drop by 10⁰C, so it will be 50⁰C.

How to configure mode 2:

In order to configure mode 2, select *Set mode 2* – the display shows a panel with two day groups – Monday-Friday and Saturday-Sunday. Select the group to be edited and follow the same procedure as with mode 1.

Example:

Monday-Friday

set: 3⁰⁰ AM, temp -10⁰C (weekly control setting - 10⁰C)

set: 4⁰⁰ AM, temp -10⁰C (weekly control setting - 10⁰C)

set: 5⁰⁰ AM, temp -10⁰C (weekly control setting - 10⁰C)

Saturday-Sunday

set: 4⁰⁰ PM, temp 5⁰C (weekly control setting +5⁰C)

set: 5⁰⁰ PM, temp 5⁰C (weekly control setting +5⁰C)

set: 6⁰⁰ PM, temp 5⁰C (weekly control setting +5⁰C)

In this case, if the pre-set temperature of the CH boiler is 60⁰C, on each weekday (Monday – Friday) from 3⁰⁰AM to 6⁰⁰AM the pre-set temperature will drop by 10⁰C, so it will be 50⁰C. During the weekend, from 4⁰⁰ PM to 7⁰⁰ PM the pre-set temperature of the CH boiler will increase by 5⁰C, so it will be 65⁰C.

**NOTE**

In order for the weekly control to function properly it is necessary to set current time and day of the week in Fitter's menu >> Time settings.

Delete

This function enables the user to delete all previous weekly control settings.

V.h.3) DHW weekly control

This function enables the user to program daily DHW temperature changes. The temperature deviation setting range is +/-10⁰C. To configure DHW weekly control settings follow the steps described in *CH boiler weekly control*.

V.i) Operation modes

The user may choose one of the following operation modes depending on individual needs:

V.i.1) House heating

When this function is selected, only the house is heated. CH pump is activated when the temperature is above the pump activation threshold. Below this temperature value (minus 2⁰C – *hysteresis*) the pump is disabled.

V.i.2) Water tank priority

In this mode, the water tank (DHW) pump is activated first and it operates until the pre-set DHW temperature is reached (the valves close to the maximum and the valve pumps are switched off). After the pre-set temperature has been reached, the pump is switched off and the mixing valves are activated (along with the pumps – according to their settings).

The valves operate continuously until the water tank temperature drops below the pre-set value minus *hysteresis*. Then, the valve pumps are disabled and the DHW pump is activated.

V.i.3) Parallel pumps

In this mode, all active pumps and valves operate simultaneously. The valves maintain the pre-set temperature and the water tank is heated to the pre-set temperature.

V.i.4) Summer mode

In this mode, the **CH valves** are closed to prevent unnecessary house heating. In the case when the CH boiler temperature is too high, the valve will be opened as an emergency procedure (it requires activation of return protection!)

In this mode the water tank pump and the floor valves operate normally according to their settings.

V.i.5) Floor heating

This function is used to deactivate control of the underfloor heating system.

Once this option is deselected, the controller closes all the valves which have been assigned the underfloor type (see: valve parameters in Fitter's menu). In default settings the function is active.

V.i.6) Buffer parameters

These parameters are used to adjust the controller operation in the case of heating system with a buffer.

- **Buffer**

Once buffer function is activated (by selecting *ON*) in the controller menu, CH pump serves as pump of the buffer in which two sensors are installed: upper (C1) and lower (C2). The pump remains active until the pre-set temperature of buffer bottom is reached. When the temperature drops below the pre-set buffer top temperature, the pump is activated again.

- **Pre-set temperature top**

This function enables the user to define the pre-set temperature for the upper part of the buffer (sensor should be placed in the upper part of the tank). After this value is reached, the pump is disabled (provided that the *pre-set buffer temperature bottom* has also been reached).

- **Pre-set temperature bottom**

This function enables the user to define the pre-set temperature for the lower part of the buffer (sensor should be placed in the lower part of the tank).

- **DHW function**

If buffer is used in the heating system, it is necessary to specify how the water tank is connected:
- from CH boiler – the heating system in which DHW tank is connected directly to the CH boiler (a separate circuit).

- from buffer – the heating system in which DHW tank is built in or connected to the buffer.

V.j) Thermal disinfection

Thermal disinfection involves DHW and it may be activated only in *Water tank priority* mode or *Parallel pump* mode.

It involves raising the temperature of water in the DHW circuit to the minimum of 60 °C (required disinfection temperature).

Current regulations require adjusting the DHW installation to enable thermal disinfection carried out in the temperature of at least 60°C (recommended temperature: 70°C). Piping, fittings and technological design of the DHW system need to meet this requirement.

DHW disinfection aims to eradicate *Legionella pneumophila* – bacteria which lower the cell-mediated immunity. The bacteria often multiplies in hot water reservoirs (optimum temperature: 35°C), which often happens in water tanks.

After this function is activated, the water boiler is heated until the pre-set temperature reached. The temperature is maintained for the whole disinfection time (e.g. 10 minutes). Next, the standard operation mode is restored.

Disinfection temperature needs to be reached within 60 minutes from its activation (default setting) Otherwise, the function will be automatically deactivated.

Any changes concerning this function may be introduced only in service mode.

V.k) Burning without feeder

Select this option if the CH boiler is to operate without the feeder function. Once selected, the feeders are disabled and the fans operate according to the parameters saved in service menu.

V.l) Screen settings

Main screen settings may be customized to satisfy individual user's needs.

V.l.1) Screen view

The user may change the main screen view choosing between the panel view which displays current parameters of the controller operation or manufacturer's screen which displays detailed information.

V.l.2) Screen brightness

This function is used to adjust the screen brightness within the range of 50 - 100%.

V.l.3) Screen blanking

This function enables the user to adjust the brightness of the blank screen within the range of 3 - 50%.

V.l.4) Blanking time

This function enables the user to set the screen blanking time.

V.l.5) Software update

USB port enables the user to update the software. In order to do it, save the latest software version on a memory stick, insert it into USB port and activate *Software update* function.

V.m) Fitter's menu

Fitter's menu functions are described in detail in the following sections of this manual.

V.n) Service menu

Access to the service menu is restricted to qualified service staff and therefore it is secured with a code available at TECH company.

V.o) Language

This function is used to select the language version.

V.p) Software version

This function is used to view the software version.

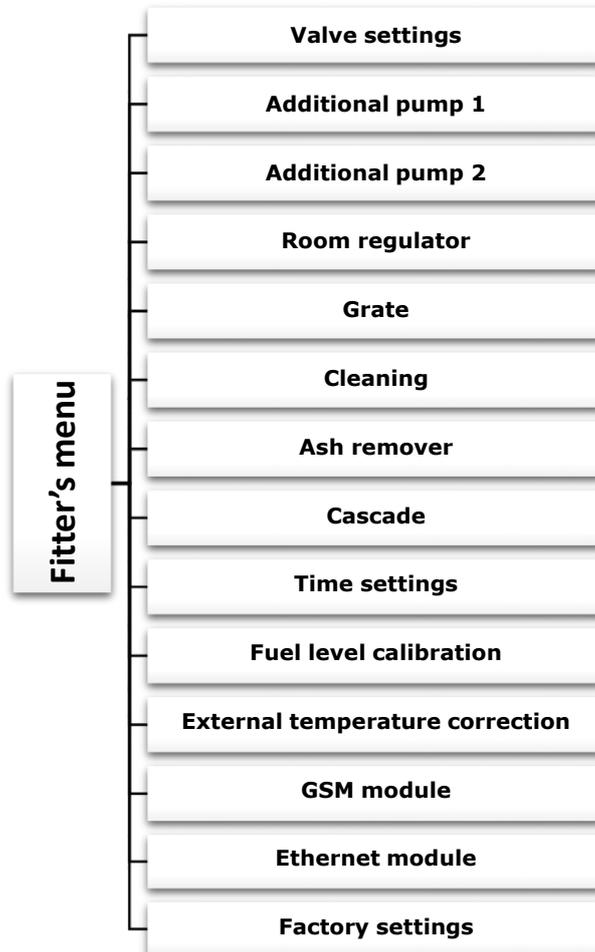
V.q) Factory settings

This function enables the user to restore the factory settings saved by the manufacturer.

VI. Controller functions – Fitter's menu

Fitter's menu should be accessed by a qualified person. It is intended for adjusting additional functions of the controller, such as the CH boiler parameters, the additional valves, the additional pumps etc. It also enables the user to access advanced settings of the basic functions (e.g. parameters of the built-in valves).

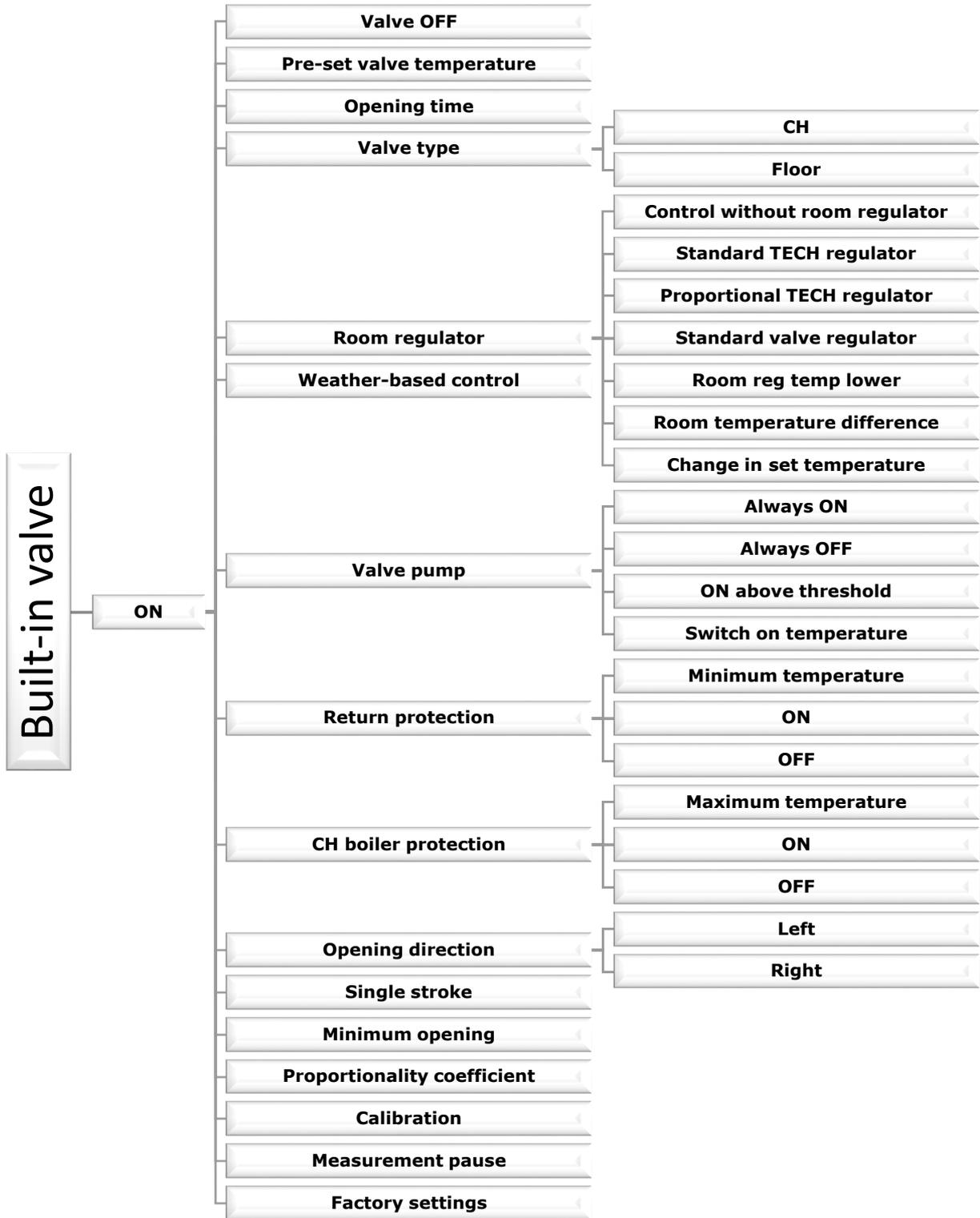
A simplified block diagram of the fitter's menu is presented below:

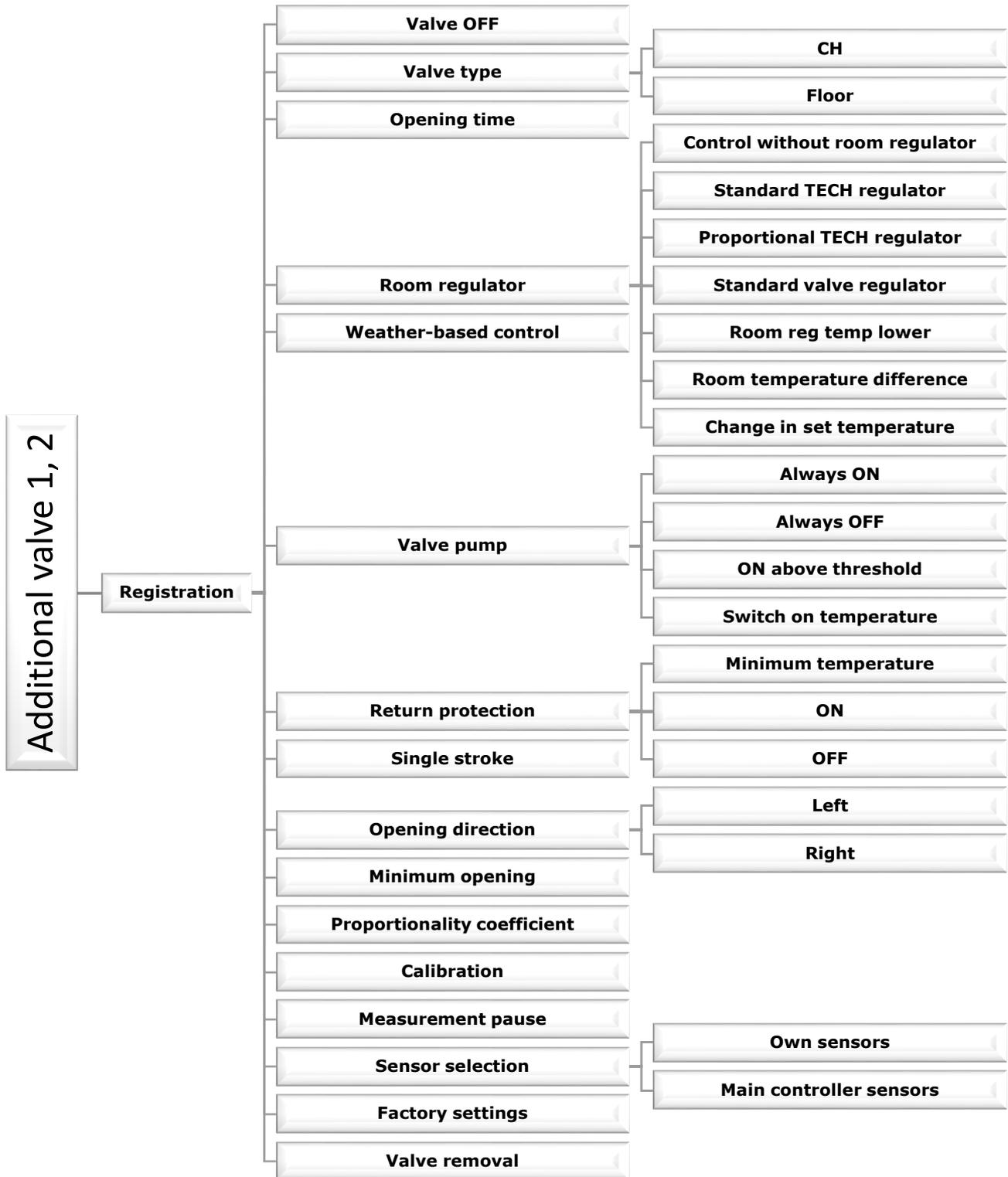


VI.a) Valve settings

ST-979 controller has a built-in module controlling the mixing valve. It is possible to connect two additional modules for controlling valves (e.g. ST-431N). There is a range of parameters allowing the user to adjust the valve operation to individual needs. Once a given valve is activated, the display shows an additional menu offering a range of valve parameters to be configured.

Both the built-in valve parameters and additional valve parameters are similar, as illustrated by the following block diagrams:





VI.a.1) Pre-set valve temperature

This parameter defines the desired temperature which the valve should maintain. During proper operation the temperature of water behind the valve approaches the pre-set value.

VI.a.2) Opening time

This parameter defines the time needed for the valve actuator to open the valve from 0% to 100% position. This value should be adjusted to the value given on the actuator rating plate.

VI.a.3) Valve type

By means of this setting the user selects the type of controlled valve:

- *CH* – selected if the user wants to control the CH circuit temperature.
- *FLOOR*- selected if the user wants to control the temperature of the underfloor heating circuit. It protects the underfloor heating installation against dangerous temperature. If the user selects CH as the valve type and connects it to the underfloor heating system, the fragile floor installation may be damaged.

VI.a.4) Room regulator

This function enables the user to select and configure the operation of the room regulator which will control the valve.

- Control without room regulator

This option should be selected if the user does not want the room regulator to influence the valve operation.

- Standard TECH regulator

This option should be selected if the valve will be controlled by a room regulator with RS communication. Once this function is selected, the controller operates according to *Room reg temp lower* parameter.

- Proportional TECH regulator

When this type of room regulator is selected, the valve is controlled according to *Change in set temperature* and *Room temperature difference* parameters. Activating this room regulator enables the user to monitor current temperature of CH boiler, water tank and the valves. The regulator should be connected to RJ (telephone) socket of ST-979 controller using a four-core cable with appropriate plugs (for RS socket).

- Standard valve regulator

This option should be selected if the valve will be controlled by a two-state room regulator (without RS communication).

- Room reg temp lower

This function is active only if TECH standard regulator or Standard valve regulator is selected. The user defines the value of valve temperature reduction which will be performed when the room regulator reaches the pre-set temperature.

- Room temperature difference

This setting is used to define the single unit change in the current room temperature (with the accuracy of 0.1°C) at which a predefined change in the pre-set temperature of the valve will be introduced (function available only with TECH room regulator with RS communication).

Example:

setting: room temperature difference 0,5°C

setting: change in pre-set valve temperature 1°C

setting: pre-set temperature of the valve 40°C

setting: pre-set temperature of *the room regulator* 23°C

Case 1. If the room temperature rises to 23.5°C (0.5°C above the pre-set room temp.), the valve closes to such an extent as to have 39°C as the pre-set value (temp. reduction of 1°C).

Case 2. If the room temperature drops to 22°C (1°C below the pre-set room temp.), the valve opens to such an extent as to have 42°C as a pre-set value (temp. increase of 2°C).

- Change in set temperature

This setting determines by how many degrees the valve temperature is to increase or decrease with a single unit change in room temperature (see: *Room temperature difference*) This function is active only with TECH room regulator and it is closely related to the *Room temperature difference* parameter.

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VI.a.5) Weather-based control

For the function of weather control to be active, the external sensor mustn't be exposed to sunlight or influenced by the weather conditions. After it is installed in an appropriate place, *weather control* function needs to be activated in the controller menu.

For the valve to operate correctly, the user defines the pre-set temperature (behind the valve) for 4 intermediate external temperatures: -20°C, -10°C, 0°C and 10°C.

The user selects external temperature value using LEFT and RIGHT arrows and defines a corresponding pre-set temperature value using DOWN and UP arrows. Subsequently, the display shows the heating curve.

Heating curve – it is a curve according to which the pre-set controller temperature is determined, on the basis of external temperature. In our controller, this curve is constructed on the basis of four pre-set temperatures for respective values of external temperatures.

The more points constructing the curve, the greater its accuracy, which allows its flexible shaping. In our opinion, four points seem a very good compromise ensuring decent accuracy and easiness of setting the course of this curve.

VI.a.6) Valve pump

This option enables the user to select the working mode of the pump out of the following:

- **always ON** - the pump operates all the time, regardless of temperatures,
- **always OFF**- the pump is permanently deactivated and the regulator controls only the valve operation,
- **ON above the threshold** - the pump is activated above the pre-set *switch on temperature*. If the pump is to be activated above the threshold, the user should also define the threshold **temperature of pump activation**.

VI.a.7) Return protection

This function enables the user to set boiler protection against too cool water returning from the main circulation, which could cause low-temperature boiler corrosion. The return protection involves closing the valve when the temperature is too low, until the short circulation of the boiler reaches the appropriate temperature. Once activated, the user presets the minimum acceptable return temperature.

VI.a.8) CH boiler protection

NOTE

Function available only for a built-in valve

The protection against too high return temperature serves to prevent the hazardous growth in CH boiler temperature. The user sets the maximum acceptable return temperature. In case of the hazardous growth in temperature, the valve begins to open in order to cool the CH boiler down. This function is activated permanently (it may be deactivated only in the service menu).

VI.a.9) Opening direction

If the user notices, after connecting the valve to the controller, that it is connected the other way round, then the power supply cables do not have to be switched. Instead, it is enough to change the opening direction in this parameter:

LEFT or *RIGHT*.

VI.a.10) Single stroke

This is a maximum single stroke (opening or closing) that the valve may make during one temperature sampling. If the temperature is near the pre-set value, the stroke is calculated on the basis of *PROP_COEFF* parameter value. The smaller the single stroke, the more precisely the set temperature can be achieved. However, it takes longer for the set temperature to be reached.

VI.a.11) Minimum opening

The parameter determines the smallest valve opening. Thanks to this parameter, the valve may be opened minimally, to maintain the smallest flow.

VI.a.12) Proportionality coefficient

Proportionality coefficient is used for defining valve stroke. The closer the pre-set temperature, the smaller the stroke. If the coefficient value is high, the valve takes less time to open but at the same time the opening degree is less accurate. The following formula is used to calculate the percent of a single opening:

$$(\text{PRE-SET_TEMP} - \text{SENSOR_TEMP}) * (\text{PROP_COEFF} / 10)$$

VI.a.13) Calibration

This function enables the user to calibrate a given built-in valve at any time. During this process the valve is restored to its safe position – in the case of CH valve it is fully opened whereas in the case of floor valve it is closed.

VI.a.14) Measurement pause

This parameter determines the frequency of water temperature measurement (control) behind the CH or DHW valve. If the sensor indicates a change in temperature (deviation from the pre-set value), the electric valve will open or close by the pre-set stroke, in order to return to the pre-set temperature.

VI.a.15) Factory settings

This function enables the user to restore the factory settings for a particular valve.

VI.a.16) Valve registration**NOTE**

Function available only for additional valves.

In the case of built-in valves, it is necessary to register the valve by entering the module number (found on the module housing e.g. ST-61N) in order to configure its parameters.

VI.a.17) Sensor selection**NOTE**

Function available only for additional valves.

This option concerns the return sensor and the external sensor. It allows the user to decide which sensors should provide data for controlling the operation of the additional valve (the sensors of the valve module or the sensors of the main controller).

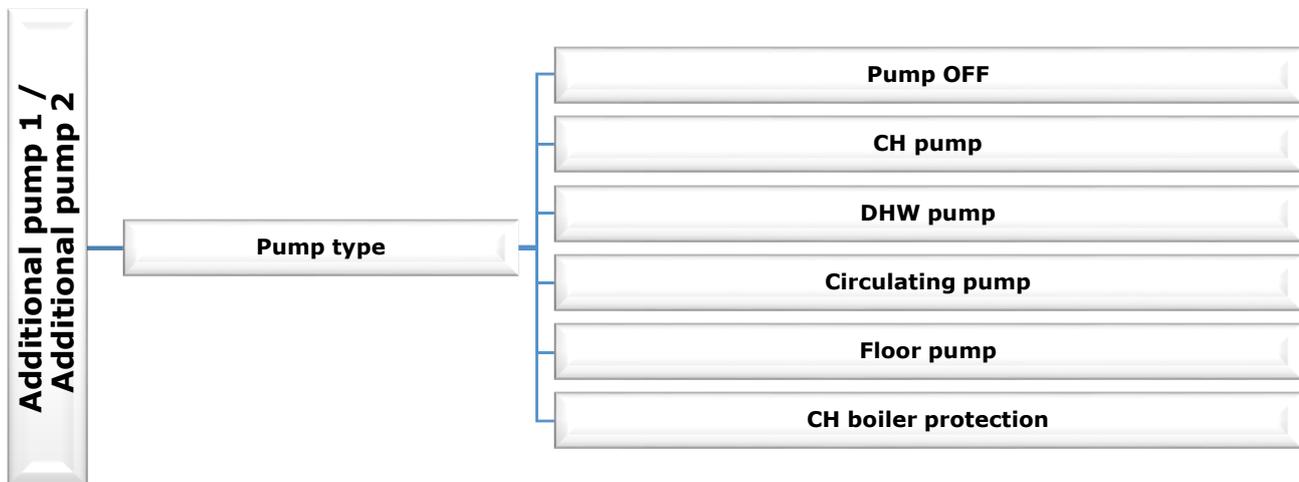
VI.a.18) Valve removal**NOTE**

Function available only for additional valves.

This option is used to remove the valve from the controller memory. *Valve removal* is used e.g. at disassembling the valve or module replacement (re-registration of a new module is necessary).

VI.b) Additional pump 1, Additional pump 2

This submenu includes parameters of an additional pump connected to the controller. Once the type of additional pump is selected in the additional pump submenu (next to Pump type function), the following parameters appear in the menu, enabling the user to configure the pump operation.



VI.b.1) CH pump

Once this option is selected, the additional pump serves as the CH pump. The pump is activated when the sensor temperature exceeds the temperature threshold. The following parameters need to be configured for this function to work correctly:

- **Pump switch on temperature**

This parameter defines the activation time of the additional pump which serves as the CH pump. When a selected sensor reaches this temperature, the pump is activated.

- **Hysteresis**

This parameter defines the hysteresis of the additional CH pump threshold temperature. It is the difference between the threshold temperature and the temperature of deactivation.

Example: the threshold temperature is 40°C and hysteresis is 5°C. When the threshold temperature is reached, CH pump is activated. It is switched off when the temperature drops to 35°C.

- **Sensor selection**

It allows the user to decide which sensor should provide data for activation of the additional CH pump.

- **Room regulator**

This option enables the user to select the room regulator which will automatically disable the additional pump serving as CH pump once the regulator pre-set temperature is reached.

VI.b.2) DHW pump

When this function is active, the additional pump serves as DHW pump. The pump is activated when the sensor 1 temperature exceeds the temperature threshold. It remains active until the temperature measured by sensor 2 reaches the pre-set value. Additionally, it is possible to set the alarm temperature for sensor 2. When this value is reached, the emergency procedure is activated. The following parameters need to be configured for DHW pump to work correctly:

- **Pump switch on temperature**

This option is used to set the DHW pump activation temperature (the temperature measured by sensor 1 which reads the temperature of the heat source – the CH boiler). Below this temperature the pump remains inactive whereas above this temperature it is enabled and operates until the pre-set temperature is reached.

- **Hysteresis**

This option is used to define the hysteresis of the pre-set temperature.

When the pre-set temperature is reached, the pump is switched off. It is switched on again when the temperature on the sensor drops below the pre-set value minus hysteresis.

For example, if the pre-set temperature is 60°C and the hysteresis value is 3 °C, the DHW pump is switched off when the set temperature of 60°C is reached, and it is activated again when the temperature drops to 57 °C.

- **Pre-set temperature**

This option is used to set the pre-set temperature of the device. When the temperature is reached, the device is switched off. The temperature is measured by sensor 2.

- **Maximum temperature**

This option is used to set the maximum temperature of sensor 1 (it reads the temperature from the heat source). When the temperature is reached, the device is switched on regardless of the current temperature on the sensor 2. It protects the installation against overheating.

- **Sensor 1 selection**

This option is used to select which temperature sensor should be used to provide data for controlling the operation of the device connected to the additional contact – the heat source (activation threshold).

- **Sensor 2 selection**

This option is used to select which temperature sensor should be used to provide data for controlling the operation of the device connected to the additional contact – (pre-set temperature).

VI.b.3) Circulating pump

Once this option is selected, the additional pump serves as the circulating pump. The pump controls the valve which mixes the hot water between the CH boiler and the DHW receivers. The following parameters need to be configured for the circulating pump to work correctly:

- **Operation time**

This parameter defines the time of pump operation during its activity.

- **Pause time**

This parameter defines the frequency at which the circulating pump is enabled during its activity.

- **Operation schedule**

The user may program a daily schedule of pump operation and inactivity, with the accuracy of 30 minutes. The pump is enabled at the frequency defined in *Pause time* parameter and remains active for the time defined as *Operation time*. For the user's convenience, it is possible to copy a given time setting.

VI.b.4) Floor pump

Once this option is selected, the additional device serves as a floor pump controlling the underfloor heating pump. The following parameters are used to configure the pump operation:

- **Pump switch on temperature**

This parameter defines the temperature of floor pump activation (temperature read from sensor 1).

- **Maximum temperature**

This parameter defines the temperature of pump deactivation (temperature read from sensor 2).

- **Floor sensor**

This function is used to select the sensor which will provide data for floor pump deactivation (it concerns *Maximum temperature* parameter).

VI.b.5) Return protection

Once this option is selected, the additional device serves as return protection (protecting against too low temperature of CH boiler return water). The pump is activated when the CH boiler reaches pre-defined temperature and it is deactivated when the return temperature reaches a satisfactory level. The following parameters need to be configured:

- **Pump switch on temperature**

This parameter defines the temperature of return pump activation (CH boiler temperature read from sensor 1).

- **Return temperature**

This parameter defines the temperature of pump deactivation (temperature read from sensor 2).

- **Sensor 1 selection**

This option is used to select which temperature sensor should be used to provide data for return pump activation.

- **Sensor 2 selection**

This option is used to select which temperature sensor should be used to provide data for return pump deactivation.

VI.c) Room regulator

This function enables the user to set the operation parameters of the room regulator connected to the pellet-fired boiler controller. It is necessary to activate the cooperation with the room regulator after it has been connected, by selecting an appropriate type of room regulator. It is possible to connect up to three room regulators to the controller.

VI.c.1) TECH regulator

Select this option if you connect a room regulator with RS communication. Such a regulator enables the user to view current CH boiler parameters and change certain settings e.g. pre-set CH boiler temperature, pre-set DHW temperature.

VI.c.2) Standard regulator 1/ Standard regulator 2

Select this option if you connect a two-state regulator. Such a regulator sends a signal to the main controller informing if the pre-set room temperature has been reached or not.

VI.c.3) Room regulator CH pump

If this function is active, the CH pump is deactivated when the room regulator sends a signal informing that the pre-set room temperature has been reached.

VI.c.4) Fire-up function

If this function is active, the damping process is initialized when the room regulator sends a signal informing that the pre-set room temperature has been reached. The CH boiler remains damped until the room temperature drops – the room regulator sends a signal to the main controller informing about too low room temperature.

VI.d) Grate

This function enables the user to configure grate operation after it has been connected to the device.

Select ON to activate the grate to be controlled. It is enabled during every periodical cleaning (function configured in service menu which should be accessed only by qualified service staff). It is necessary to define the complete operation time of the grate (opening and closing) using *Opening time* function.

- **Grate - operation mode**

When this function is selected, the grate is active during CH boiler operation. The user defines the frequency of grate activation (*Pause time* parameter) and its duration (*Operation time* parameter). During grate operation the fan speed should be higher - use *Increase fan revolutions* parameter to set the value. Return to normal speed should take place some time after deactivation of the grate - *Fan delay* parameter.

- **Grate - damping**

When this function is selected, the grate is always activated after the damping procedure. It will operate according to *Opening time* parameter. The user defines the fan speed during grate operation after damping.

VI.e) Cleaning

The user may activate cleaning of the CH boiler exchanger. For this function to operate properly, it is necessary to set the following parameters:

- **Number of repetitions**

This parameter defines how many times the cleaning procedure will be repeated every time the function is activated.

- **Operation schedule**

This parameter is used to define days and time of cleaning procedure activation.

- **Manual mode**

This function enables the user to check if the cleaning device works properly by activating it for a specified period of time.

VI.f) Ash remover

Ash removing procedure is activated once *ON* option is selected. The user defines the frequency of ash removing procedure (*Pause time* parameter) and its duration time (*Operation time* parameter).

VI.a) Cascade

Parameters in this submenu are used to configure cascade CH boiler systems.



NOTE

Before start-up or editing any parameters, all CH boilers must be connected to ST-503 module using RS cable.

Select *ON* in order to activate cascade control.



NOTE

It must be done separately in all CH boiler controllers constituting the cascade.

Next, select the number of CH boilers in cascade - the maximum number is 4.



NOTE

The number of CH boilers also specifies the number of panels which may be used to introduce changes in the cascade parameters. By default the number of CH boilers is 1. Therefore, it must be edited in the panel of the CH boiler which is connected to socket no 1.

From now on all changes introduced in the cascade settings are automatically updated in all the remaining controllers. It also applies to the pre-set temperature of the CH boiler - if the value is changed in any of the CH boilers, the pre-set temperature of all the remaining CH boilers is changed likewise.

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- **Operation modes**

The controller may supervise the CH boilers operation in one of the two modes: weather-based control (control based on external temperature value) and modulation (control based on the pre-set CH boiler temperature).



NOTE

CH temperature and external temperature is sent only from the boiler connected to socket no 1 (the first one on the left).

- **Weather-based control**

In this mode the CH boilers operation is controlled on the basis of the external temperature value. The user defines the number of boilers activated at a particular temperature using the following parameters: *Boilers 3 switch-on temperature*, *Boilers 2 switch-on temperature*, *Boiler 1 switch-on temperature* and *Hysteresis*.

Boiler activation in the case of external temperature decrease:

Number of boilers active	
1	Operates regardless of the external temperature
2	Activated when the external temperature drops to the level defined in <i>Boiler 1 activation temperature</i> minus <i>Hysteresis</i> value.
3	Activated when the external temperature drops to the level defined in <i>Boiler 2 activation temperature</i> minus <i>Hysteresis</i> value.
4	Activated when the external temperature drops to the level defined in <i>Boiler 3 activation temperature</i> minus <i>Hysteresis</i> value.

Boiler deactivation in the case of external temperature increase:

Number of boilers active	
4	Deactivated when the external temperature reaches the value of <i>Boilers 3 activation temperature</i> .
3	Deactivated when the external temperature reaches the value of <i>Boilers 2 activation temperature</i> .
2	Deactivated when the external temperature reaches the value of <i>Boiler 1 activation temperature</i> .
1	Operates regardless of the external temperature.

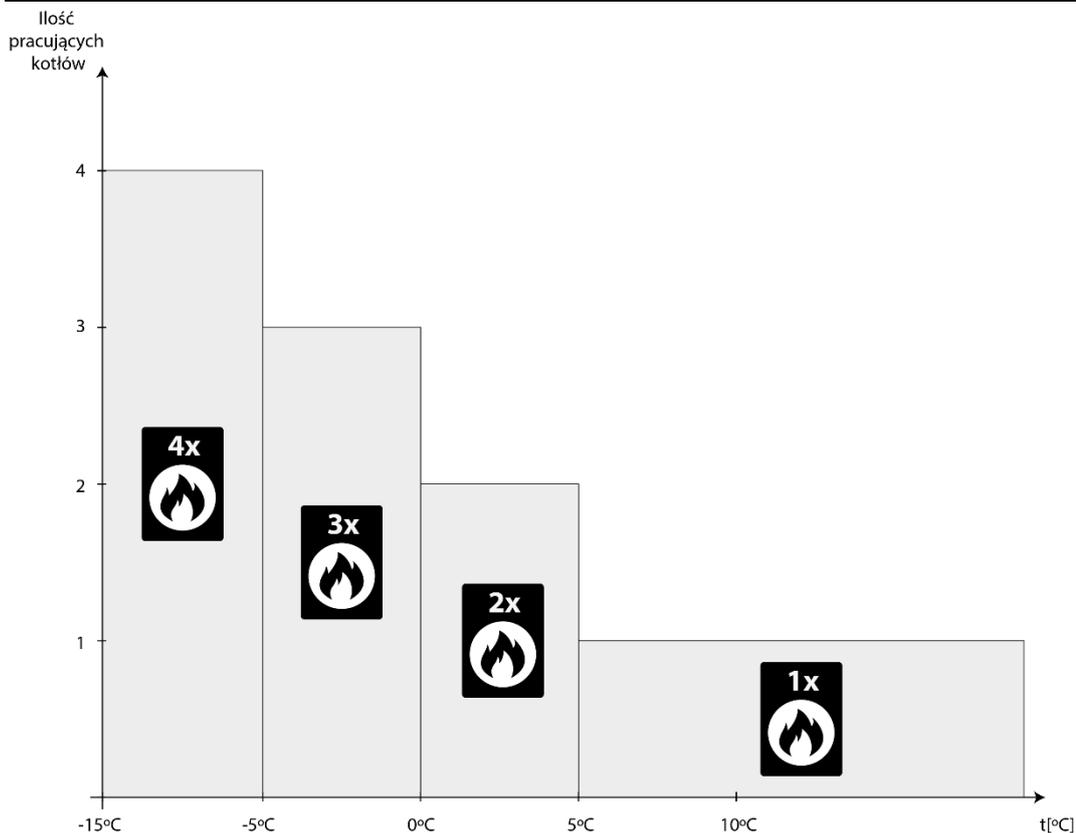
Example:

Boiler 1 activation temperature: 5°C

Boilers 2 activation temperature: 0°C

Boilers 3 activation temperature: -5°C

The following graph illustrates the activation process of the boilers operating according to the external temperature value:



• Modulation

In this mode Cascade controls CH boilers operation in order to reach the pre-set temperature. First, one boiler is activated. Once its maximum is reached, the user-defined waiting time elapses (*Waiting time* parameter). If the pre-set temperature is not reached within this time, another boiler is enabled. If the pre-set temperature is still not reached despite both boilers operating at full speed, it is followed by another waiting time period and another boiler is enabled. The procedure is repeated until the pre-set temperature is reached or until all boilers are active.

Once the pre-set temperature is reached, the boilers are selectively disabled every 20 minutes. The deactivation procedure is repeated until one of these conditions is met:

1. CH temperature drops below the pre-set temperature by hysteresis value;
2. only one boiler remains active.



NOTE

Regardless of the mode selected, boilers operation time is registered in order to ensure even wear of the boilers. This information is used by the cascade controller to decide which boiler should be enabled or disabled.

VI.b) Time settings

This function is used to set current time. This setting is essential for the weekly control to work correctly.

VI.b.1) Clock settings

This parameter is used to set current time.

VI.b.2) Date settings

This parameter is used to set current date.

VI.a) Fuel level calibration

Conducting fuel level calibration properly enables the user to view the current level of fuel on the controller screen. The first step involves filling the fuel tank up and selecting the option *Fuel tank full*. The controller remembers the level as full (100%).

When there is no fuel left in the tank after a period of CH boiler operation, the user should select the option *Fuel tank empty*. In this way the fuel tank is calibrated and the controller will automatically inform the user about the current fuel level. After a fuel level panel is selected in the main screen, the display shows the estimated amount of fuel left (%) and the expected time needed for the fuel to be used up (days and hours).

Such calibration is usually performed only once. When the fuel tank is filled again, it is enough to select the option *Fuel tank full* in the user's menu.

VI.a) External temperature correction

External sensor calibration should be performed during installation or after a longer period of using the regulator when the temperature measured by the sensor is different from actual temperature. The range of regulation is from -10 °C to +10 °C.

Averaging time parameter defines the frequency of sending temperature data from the sensor to the controller.

VI.b) GSM module



NOTE

This type of control is available only after purchasing and connecting an additional controlling module ST-65 which is not included in the standard controller set.

GSM Module is an optional device which, cooperating with the controller, enables the user remote control of the CH boiler operation via mobile phone. The user is sent an SMS each time an alarm occurs. Moreover, after sending a certain text message, the user receives feedback on the current temperature of all the sensors. Remote change of the set temperatures is also possible after the authorisation code is entered.

GSM Module may operate independently of the CH boiler controller. It has two additional inputs with temperature sensors, one contact input to be used in any configuration (detecting closing/opening of contacts) and one controlled output (e.g. a possibility of connecting an additional contractor to control any electric circuit)

When any of the temperature sensors reaches the pre-set maximum or minimum temperature, the module automatically sends an SMS message with such information.

A similar procedure is used in the case of opening or closing of the contact input, which may be used as a simple means of property protection.

If ST-979 controller is equipped with GSM module, it should be activated by selecting ON option (MENU>Fitter's menu>GSM Module>ON).

VI.c) Internet module



NOTE

This type of control is available only after purchasing and connecting an additional controlling module ST-505 which is not included in the standard controller set.

Internet module is a device enabling the user remote control of the CH boiler via the Internet at www.emodul.pl. The user controls the status of all CH boiler system devices on the home computer screen and the operation of each device is presented in the form of animation.

Apart from the possibility to view the temperature of every sensor, the user can change the set temperature values for both the pumps and the mixing valves etc.

The installation process is intuitive. Connect the module and go to Fitter's menu of the main controller to activate the Internet module (Menu>>Fitter's menu>>Internet module>>ON).

Once Registration option is selected, the device generates a code which must be entered on the website.

**NOTE**

The code is valid for 60 minutes. If the user fails to register on the website within this time, a new code must be generated.

Internet module parameters such as IP address, IP mask, gate address etc may be set manually or by selecting DHCP option.

VI.a) Factory settings

This function enables the user to restore factory settings saved by the manufacturer.

VII. Protections

In order to ensure safe and failure-free operation, the regulator has been equipped with a range of safeguards. In case of alarm, a sound signal is activated and the display shows an appropriate message.

In order for the controller to return to the operation mode, press **MENU**. In the case of '**CH temperature too high**' alarm, it is necessary to wait until the temperature drops below the alarm value.

VII.a) Thermal protection of CH boiler

The controller is equipped with a bimetallic mini-sensor (placed next to CH boiler temperature sensor), which automatically disconnects the fan from the power supply when the alarm temperature of 90°C is exceeded. It prevents the water in the installation from boiling in case of CH boiler overheating or controller damage. After this protection has been activated and the temperature has dropped to a safe level, the sensor automatically unlocks itself. In the case when this sensor is damaged or overheated, the fan is also disconnected.

In the case of CH boiler protection in a closed system, a STB type temperature limiter is used instead of a bimetallic mini-sensor.

VII.b) Automatic sensor control

If one of the temperature sensors (CH, DHW) is damaged, an alarm sound is activated and the display message informs about the failure; e.g.: '**CH sensor damaged**'. The fan is disabled and the pump is enabled regardless of the current temperature.

If the CH sensor is damaged, the alarm is active until a new sensor is installed. In the case of DHW sensor damage, the alarm should be switched off by pressing **MENU** button – the controller will restore operation with one pump (CH). A new sensor should be installed so that all modes of CH boiler operation could be available.

VII.c) Thermal protection of CH boiler (STB)

In a closed CH system, the controller is equipped with STB safety thermostat which protects the CH boiler against an excessive temperature increase. When the temperature exceeds the pre-set 'switch off' value (default setting: 95°C), the contacts in the fan power supply circuit are opened. The fan may be activated again only manually by pressing 'reset' button on the safety thermostat casing after the sensor cools down.

VII.d) Fuse

The regulator has a WT 6.3A tube fuse-link protecting the network. Higher amperage fuse should not be used as it may damage the controller.

VIII. Technical data

No	Specification	Unit	
1	Supply voltage	V	230V/50Hz +/-10%
2	Power consumption	W	9
3	Ambient temperature	°C	10÷50
4	Circulating pump output load	A	0,5
5	Fan output load	A	0,6
6	Range of temperature measurement	°C	0÷85
7	Accuracy of measurement	°C	1
8	Range of temperature setting	°C	45÷80
9	Thermal resistance of the sensor	°C	-25÷90
10	Fuse link	A	6,3

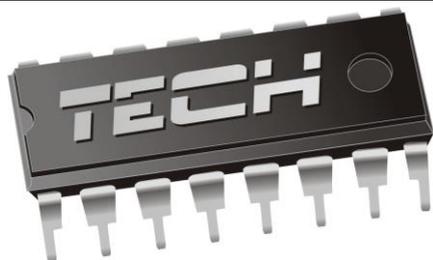
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EU Declaration of conformity

Hereby, we declare under our sole responsibility that **ST-345** room regulator manufactured by TECH, headquartered in Wieprz Biała Droga 31, 34-122 Wieprz, is compliant with:

- Directive 2014/35/EU of the European Parliament and of the Council of February 26, 2014 on the harmonisation of the laws of Member States relating to **the making available on the market of electrical equipment designed for use within certain voltage limits (EU Journal of Laws L 96, of 29.03.2014, p. 357)**,
- Directive 2014/30/EU of the European Parliament and of the Council of February 26, 2014 on the harmonisation of the laws of Member States relating to **electromagnetic compatibility** (EU Journal of Laws L 96 of 29.03.2014, p.79),
- Directive **2009/125/EC** establishing a framework for the setting of ecodesign requirements for energy-related products,
- the regulation by the Ministry of Economy of May 8, 2013 concerning the essential requirements as regards *the restriction of the use of certain hazardous substances in electrical and electronic equipment*, implementing provisions of **RoHS** directive 2011/65/EU.

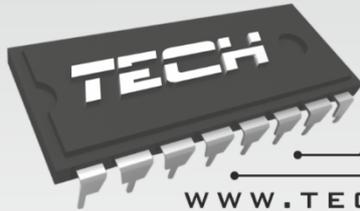
For compliance assessment, harmonized standards were used:

PN-EN 60730-2-9:2011, PN-EN 60730-1:2016-10


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