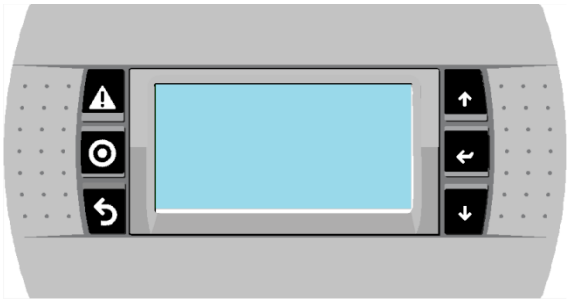
Operating instructions
Control for heat pumps



SmartHeat heat pump

/
date of commissioning / release code
(to enter during the commissioning)

machine number
(to enter during the commissioning)

Tel.
service partner
(to enter during the commissioning)

SmartHeat

Caution

Please read before installation and use of the device the instructions carefully!

Non-compliance can cause damage to man and machine and void the warranty!
Keep the instructions at a safe place

Table of content

1 General information

The SmartHeat heat pump controller is used in SmartHeat heat pumps. While the user menu system is limited strictly to important functions, adapting the controller and its properties to the many optional use cases and usage conditions requires thorough examination of this manual. The successful operation of a heat pump system is substantially dependent on setting the right controller and system parameters.

The control system is designed to supply power for four Generators. The sources could be either heat pumps, heating boilers or electric heaters. For special tariff shut-off, the separate switch-on and switch-off conditions must be noted.

The system consists of the following functional units (partly optional equipment):

- Water heating
- Heating
- Cooling
- Mixer control unit
- screed heating programme
- Solar system control
- Seasonal Performance Factor (optional)
- Service:
  - Logging of operating hours for all Generators
  - Access rights provided by different password levels
  - Fault input analysis
  - Energy-saving function
  - Flow monitoring on the source and sink side
  - Reference room temperature control
  - Expansion valve control

1.1 Operating unit

The user has a clearly-laid out operating unit for checking and adjusting the system parameters. The operating unit can also be operated remotely from the control unit. The maximum distance is 30m. The operating unit is connected to the RJ12 port.

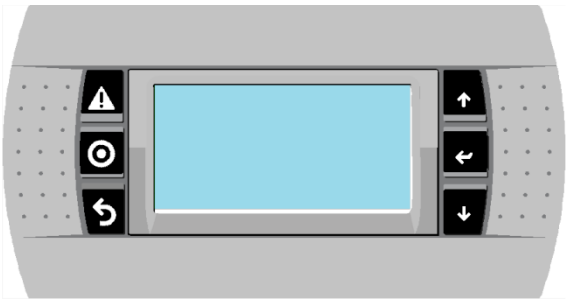


Figure 1Operating unit

Only disconnect or connect it in a de-energised state. Otherwise you will cause malfunctions to the operating and control units

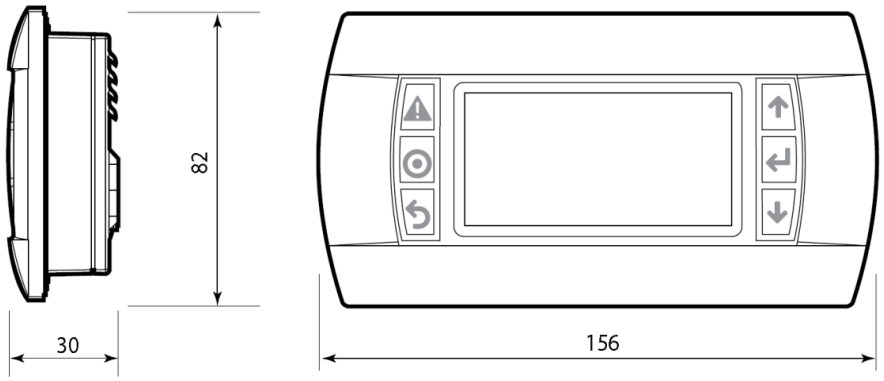


Figure 2 Operating unit dimensions

1.2 Control unit

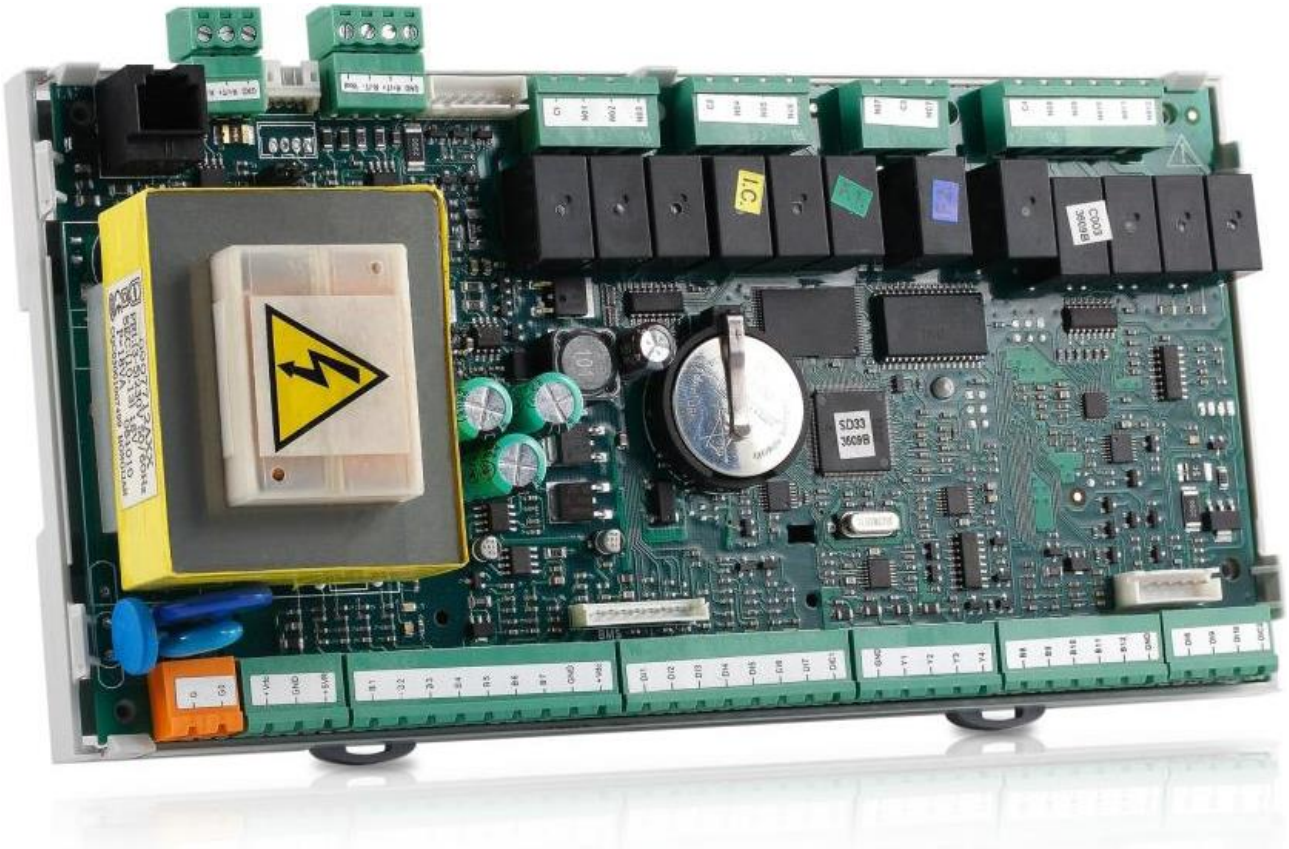


Figure 3 Control unit

All ports use plug connectors with screwed connection.

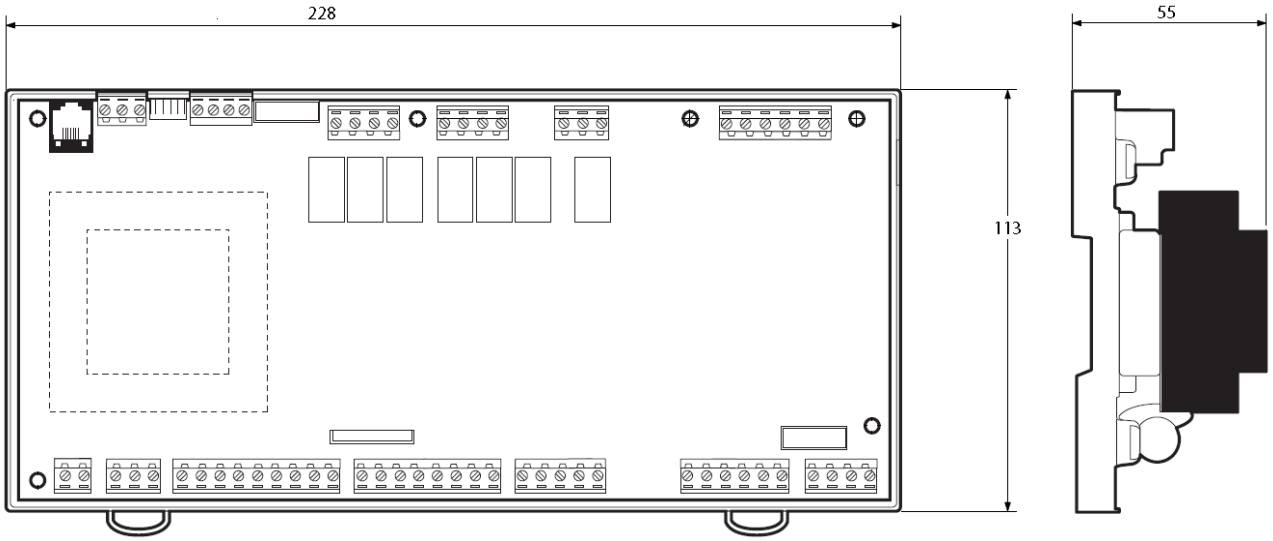


Figure 4 Control unit dimensions

2 Symbols and abbreviations

Explanation of the graphical symbols used in this operating manual:

Caution!

The symbol indicates possible hazards and faults.

Caution: 230V voltage!

The symbol indicates hazards due to life-threatening high voltages.

- List

i Information on operation / particular features

3 Safety instructions

All installation and wiring tasks on the controller may only be carried out when it is in a de-energised state. An external disconnection device must be provided.

Connection and commissioning of the SmartHeat controller may only be undertaken by specialist personnel, adhering to the applicable safety regulations, primarily VDE 0100.

Before carrying out installation or wiring work on the electrical equipment, always fully disconnect the device from the operating voltage.

Make sure you never confuse the SELV (safety extra low voltage) connectors (sensor, flow sensor) with the 230V connectors. The destruction of the device and life-threatening voltages are possible, on the device and on connected sensors and devices.

Heat pump systems can reach high temperatures. There is a risk of burns!

Install the controller in such a way that, for example, heat sources do not cause an impermissible operating temperature (below 0°C and above 50°C) or excessive humidity (80% non-condensing).

The system should not be put into operation if any damage can be discerned to the controller, cables or to the connected pumps and valves.

Check that the materials used for the piping, insulation and the pumps and valves are suitable for the temperatures which occur in the system.

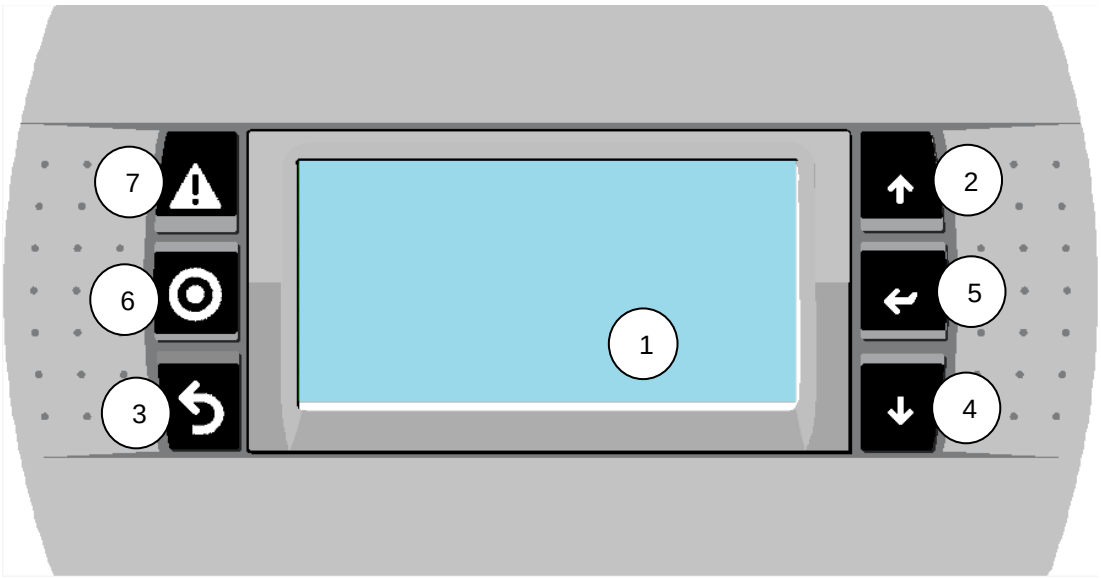
Avoid water getting on any and all electrical and electronic components.

Do not allow conductive metallic objects to get on or inside electrical modules.

Connect the power supply cable according to the connection diagram. Note the phase sequence.

4 Operation

4.1 Overview of the operating unit



Number	Description
1	Display, dims together with the LEDs in buttons 2 to 5 after 5 minutes with no interaction.
2	Scroll Up / + operating button
3	Exit / Cancel / ESC operating button
4	Scroll Down / – operating button
5	Select / Confirm / Enter operating button
6	On / Off function button
7	Alarm menu function button

4.2 Button functions

The controller can be operated simply and conveniently with four operating buttons and two function buttons.

The operating buttons are used to:

- call up display values
- configure device settings

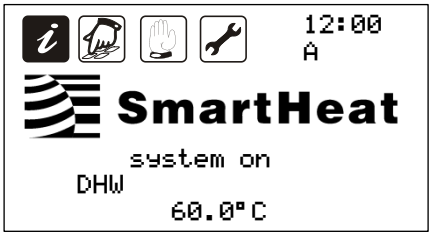
The graphical display easily guides you through the operating structure on screen and displays the current menu items, display values and parameters in a clear manner.

The operating and function buttons have the following functions:

Button*		Function	Description
		Up +	• Scroll up in the menu • Change values: incrementally increase the displayed value • Pressing and holding the button raises the value continuously
		Down –	• Scroll down in the menu • Change values: incrementally decrease the displayed value • Pressing and holding the button reduces the value continuously
		Exit Cancel	• Exit a menu • Exit a menu item • Cancel a value change without saving
		Select Confirm	• Select a menu item • Confirm a value change and save
		Alarm message Reset	• LED flashes red when faults are pending • LED is permanently lit red for faults which have been viewed but not reset
		On/Off	• Switches the control function on/off, not the device power supply • Button LED lights up when controller is switched off

* Buttons as seen on the operating unit

4.3 Main screen



4.4 Explanation of graphical symbols

Graphical symbou	Menü
	Information
	Programme
	Manual mode
	Basic settings

To enable clear operation of the device, the device, operation and display functions are arranged into four menus. These menus are represented by the graphical symbols.

Depending on the configuration of the heat pump, the menus may contain submenus. The menus and submenus can display information or be used to change setting values.

The dark version of the symbol shows that this is the currently selected menu. Button 5 is used to open the menu. When a menu is open, the corresponding light version of the symbol is displayed.

Menu	Overview of the functions contained (excerpt)
Information 	Main menu for automatic control of the heat pump system: • Display the current measured values • Display the system status • Display the history (system message memory) • Display the operating hours
Programm 	Change and adjust the programmable setting values (parameters): • Setpoint in heating, cooling, and hot water mode • Day/week programme for heating, cooling, exhaust air, hot water • Set date and time • Service information **Note**: Changes can have an influence on system functions!
Manual mode 	Switch the connected pump, valves and Generators on and off in manual mode. **Note**: This should only be done by trained specialists, after entering a password! **This will put all functions of the controller out of operation! See Chapter 13 Special applications!**

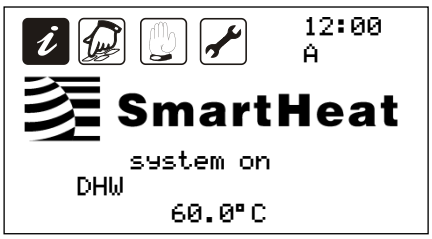
Basic settings 	Information on the basic settings for the functioning of the system Without entering a password, certain parameters can be viewed but not modified. Depending on the configuration, the following submenus are available: • Options • Generators • Additional heating • Mixer settings • Pump operating hours • Screed heating programme • Various safety functions • Save and restore settings **Note**: Password-protected settings and changes may only be undertaken by specialist personnel!

5 Operation

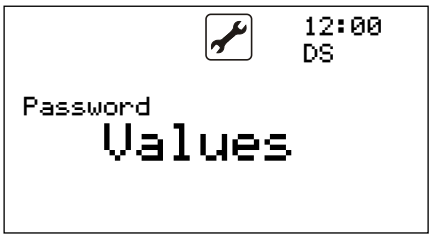
5.1 Password entry

Entering a password allows the device differentiate between users, who are then able to make adjustments to control parameters according to their competency. A distinction is made between Release, Maintenance, Installer and Manufacturer levels. When a password is entered, access is maintained for five minutes after the last button press, after which it is reset automatically.

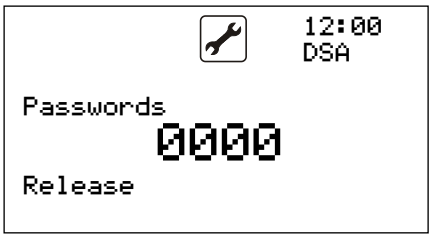
Explanation based on the "Release" password:



Scroll with ↓ until the dark version of the 🔧 symbol is shown, then confirm with ↵.



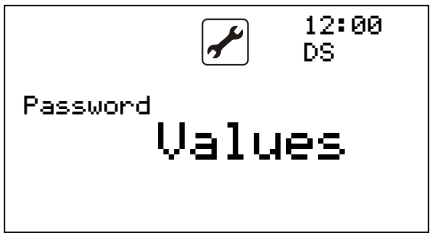
Scroll with ↓ until "Password values" appears on the display, then confirm with ↵.



Scroll with ↓ until "Release password" appears on the display, then confirm with ↵.

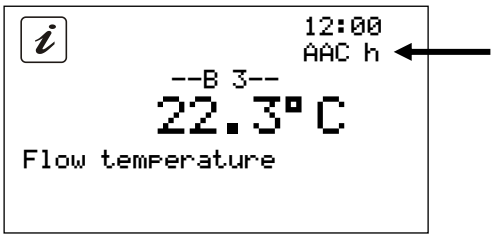
(1000 is used here as an example release code. You can obtain the release code for the heat pump from the first page of this operating manual.)

↵ causes the cursor to jump to the first numbers; you can enter an appropriate value using ↓ and ↑. ↵ causes the cursor to jump to the next numbers; you can enter an appropriate value using ↓ and ↑. The remaining numbers must be entered accordingly.

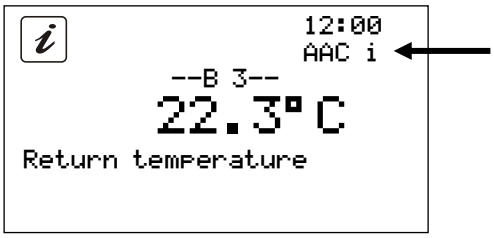


Once all numbers have been entered and the password has been judged to be correct, "Password values" appears on the display.

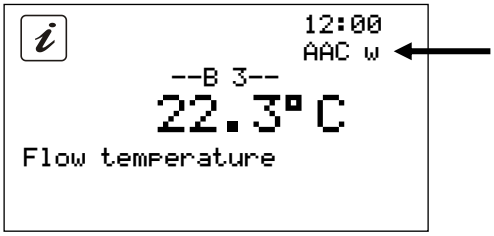
A small letter under the time displays the current password mode. This affects the following passwords:



h…Manufacturer mode



i…Installer mode



w…Maintenance mode

All three modes are activated by entering a password and may only be used by trained specialists, as the wrong settings could cause injury, and damage to the system. No separate character is displayed for the release code.

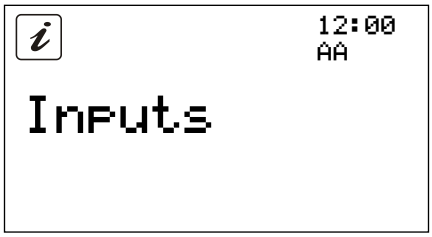
5.2 Information menu

The following steps are necessary to call up the Information menu:

In the main menu, press ↑ or ↓ until the dark version of the *i* symbol is shown, then confirm with ↵.

↑ or ↓ is used to select the appropriate submenu and then ↵ to confirm.
There are four submenus available: Inputs, Outputs, Generators and History

Inputs submenu:



The Inputs submenu shows the values for the analogue and digital inputs. Analogue values include temperatures and pressure values. Digital values include switching statuses of safety devices.

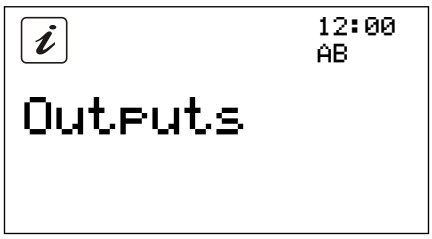
The arrow buttons ↑, ↓ can be used in the submenu to access all of the active analogue and digital inputs:

- Analogue input B1, B2, B3,...,B12
- Digital input DI1, DI2, DI3,...,DI10

To exit the submenu or menu, press Esc until the main menu appears.

i **Only values specific to the system and the values for activated additional functions are displayed!**

Outputs submenu:



The Outputs submenu shows the values for the analogue and digital outputs. Analogue values include 0-10V or PWM. Digital values include control signals for the Generators (compressor).

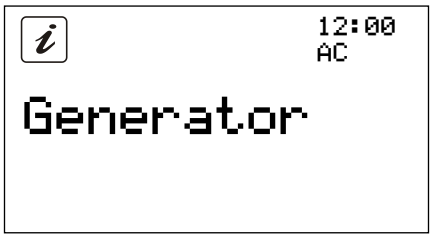
The arrow buttons ↑, ↓ can be used in the submenu to access all of the analogue and digital outputs:

- Analogue output Y1, Y2, Y3, Y4
- Digital output NO1, NO2, NO3,...,NO12

To exit the submenu or menu, press Esc until the main menu appears.

i **Only values specific to the system and the values for activated additional functions are displayed!**

Generator submenu:



The Generator submenu serves to display the statuses of the Generators. The appearance of this information differs depending on the type and number of Generators.

The arrow buttons , can be used in the submenu to access all information about the:

- Generator 1, 2, 3, 4

To exit the submenu or menu, press Esc until the main menu appears.

i **Only values specific to the system and the values for activated additional functions are displayed!**

History submenu:

The History submenu stores messages about safety shutdowns and other messages concerning fault statuses. It stores the last 50 messages.

The arrow buttons , can be used in the submenu to access up to 50 stored system messages:

- History (system message memory)

The messages are numbered according to the time they occurred. The most recent message is displayed first and has the highest message number. When the memory is full, the oldest message is overwritten. Various data on each message is also saved. The date and time that a message occurred can be seen at a glance. You can bring up additional information on the individual messages by pressing . The arrow buttons , can be used to switch between messages.

To exit the submenu or menu, press Esc until the main menu appears.

Note: The message memory is used by installation and maintenance personnel to analyse the sequence of the programme.

5.3 Programme menu

The following steps are necessary to call up the Programme menu:

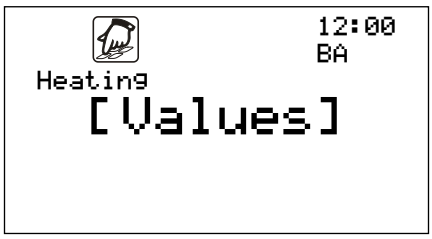
In the main menu, press ↑ or ↓ until the dark version of the  symbol is shown, then confirm with ↵.

↑ or ↓ is used to select the appropriate submenu and then ↵ to confirm.

These submenus are available:

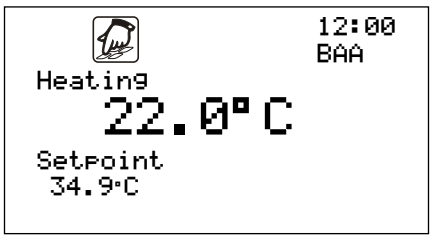
- Heating
- Cooling (optional function)
- Hot water
- Mixer 1 (optional function)
- Mixer 2 (optional function)
- Data logging
- Date and time
- Service
- Source control
- Sink control

Examples of the procedure are described in Chapter 5.4!



The Heating submenu allows you to programme the functions for heating mode. Certain settings can only be modified if you have the appropriate rights. A password must be entered first. The scope of available settings is the same as for cooling.

↵ takes you to the programming screen or ↓ to additional functions



The setpoint relates to a reference value for the flow temperature and indirectly represents the room temperature.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

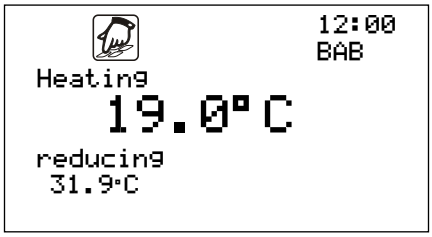
Heating

- Set the desired room temperature
- Usually 20–24°C
- *Default 22°C*

Cooling

- Set the desired room temperature
- Usually 18–20°C
- *Default 20°C*

Press ↓ to proceed



The reduction specifies which room temperature is adopted between the time frames on the weekly schedule.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

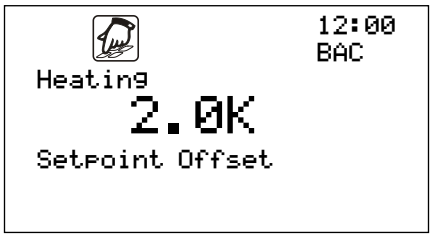
Heating

- Set the desired room temperature for the reduction
- Usually 3K below the desired room temperature
- *Default 19°C*

Cooling

- Set the desired room temperature for the reduction
- Usually 2K above the desired room temperature
- *Default 22°C*

Press ↓ to proceed



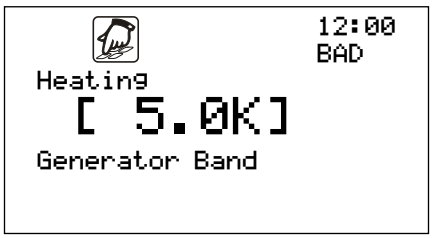
The Offset Setpoint is used to calculate the switch-on and switch-off point relating to a request for heating or cooling

A request is deemed to have been satisfied once the actual value is greater than or equal to the setpoint plus the offset setpoint.

A request is triggered once the actual value is less than or equal to the setpoint minus the offset setpoint.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

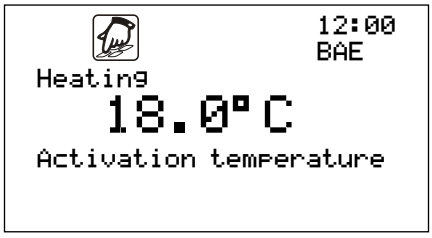
Press ↓ to proceed



- Generator modulation specifies how soon the output should be reduced before the end of the request.
- This function is used on multi-stage and inverter-operated systems.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

Press ↓ to proceed



The activation temperature specifies from what outdoor temperature the heating or cooling function is available, according to the activation period.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

Heating

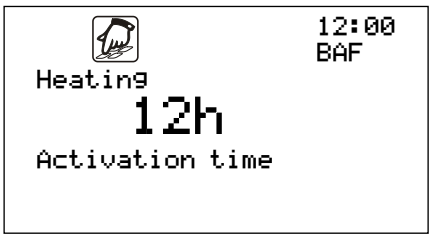
- Set the outdoor temperature which the temperature must drop below to activate heating mode
- Usually 18-20°C

- *Default 18°C*

Cooling

- Set the outdoor temperature which the temperature must exceed to activate cooling mode
- Usually 22-24°C
- *Default 22°C*

Press ↓ to proceed



The activation period specifies how long the outdoor temperature must be maintained to enable the heating or cooling function.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

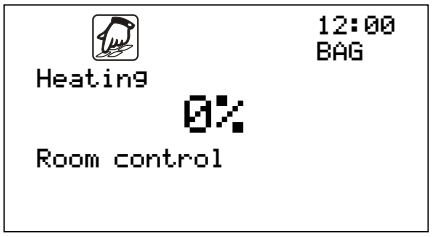
Heating

- Set the period
- The unit can be set in seconds, minutes, hours and days
- *Default 12 hours*

Cooling

- Set the period
- The unit can be set in seconds, minutes, hours and days
- *Default 12 hours*

Press ↓ to proceed



The room control allows the control variable to be switched from outdoor temperature to a reference room temperature.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

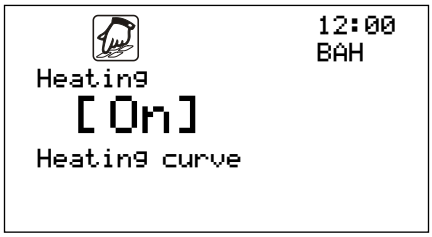
Heating

- 0% outdoor temperature-based control
- 50/50 outdoor and room temperature control
- 100% room temperature-based control
- *Default 0%*

Cooling

- 0% outdoor temperature-based control
- 50/50 outdoor and room temperature control
- 100% room temperature-based control
- *Default 0%*

Press ↓ to proceed



The heating or cooling curve depicts the adaptation of the flow temperature to the current control temperature variable (outdoor temperature or reference room temperature). If the curve is deactivated, a fixed value is used.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

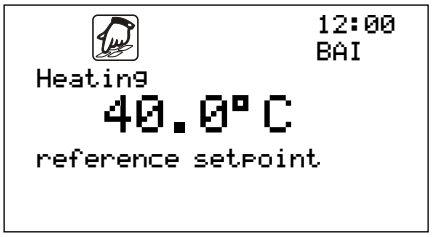
Heating

- On or Off

Cooling

- On or Off

Press ↓ to proceed



The reference setpoint relates to the flow temperature for a setpoint of 20°C

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

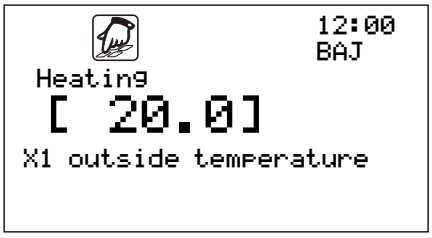
Heating

- Not shown when the heating curve is activated
- Direct assignment:
  - Room temperature or flow temperature dependent on the room control
- *Default 40°C*

Cooling

- Not shown when the cooling curve is activated
- Direct assignment:
  - Room temperature or flow temperature dependent on the room control
- *Default 10°C*

Press ↓ to proceed



X1 outdoor temperature defines the first point of the heating or cooling curve as the outdoor temperature.*

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

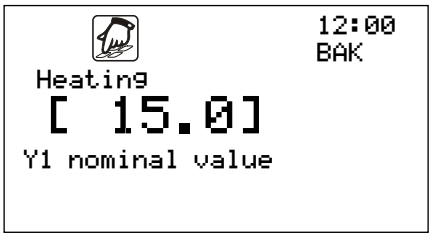
- Input value for calculation point X1 of the heating curve
- Only shown when the heating curve is activated

Cooling

- Input value for calculation point X1 of the cooling curve
- Only shown when the cooling curve is activated

Press ↓ to proceed

*For further information, see point 12



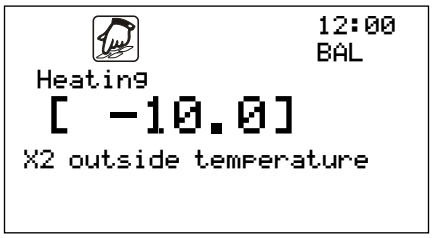
Y1 nominal value defines the first point of the heating or cooling curve as the flow temperature with reference to the setpoint or the reduction value.*

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

- Output value for calculation point Y1 of the heating curve
  Only shown when the heating curve is activated Cooling
- Output value for calculation point Y1 of the cooling curve
- Only shown when the cooling curve is activated

Press ↓ to proceed

*For further information, see point 12



X2 outdoor temperature defines the second point of the heating or cooling curve as the outdoor temperature.*

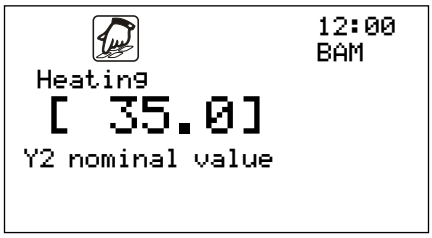
Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

- Input value for calculation point X2 of the heating curve
- Only shown when the heating curve is activated

Cooling

- Input value for calculation point X2 of the cooling curve
- Only shown when the cooling curve is activated

Press ↓ to proceed *For further information, see point 12

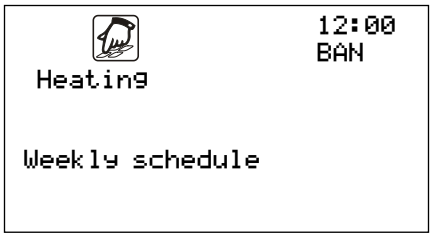


Y2 nominal value defines the first point of the heating or cooling curve as the flow temperature with reference to the setpoint or the reduction value.*

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

- Output value for calculation point Y2 of the heating curve
- Only shown when the heating curve is activated CoolingOutput value for calculation point Y2 of the cooling curve
- Only shown when the cooling curve is activated

Press ↓ to proceed *For further information, see point 12



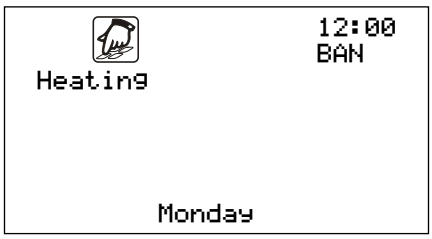
In the weekly schedule two time frames, to which the set target value applies, are defined for each day. Outside of these time frames, the reduction value is applied. The weekly schedule is available for heating, cooling, and hot water.

Heating

- Create the weekly schedule for heating cycles with two time frames
- A start time and stop time can be set for each time frame
- The master day overwrites all days of the week

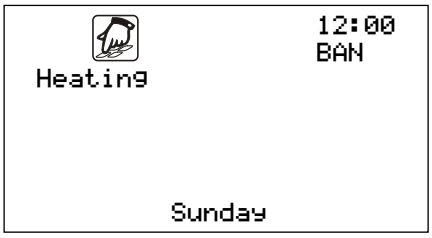
Cooling

- Create the weekly schedule for cooling cycles with two time frames
- A start time and stop time can be set for each time frame
- The master day overwrites all days of the week

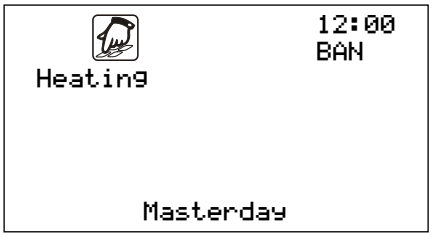


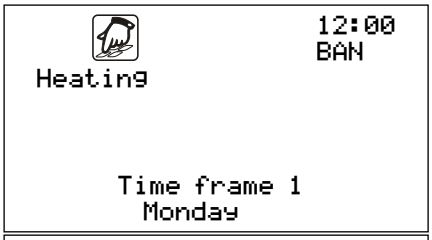
Proceed to select the day of the week by pressing ↵.

Select the day of the week by pressing ↑ or ↓



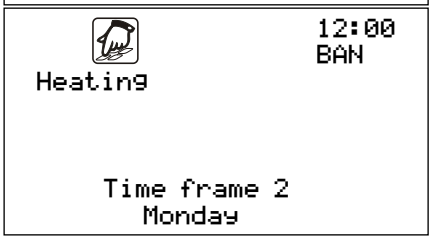
Proceed to confirm the day of the week by pressing ↵.

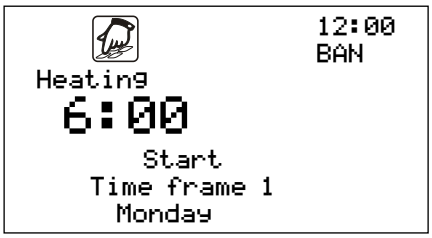




Select the time frame by pressing ↑ or ↓

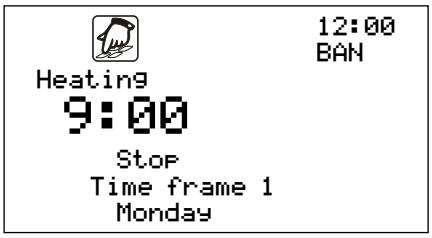
Proceed to confirm the time frame by pressing ↵.





Select the start or stop time by pressing ↑ or ↓

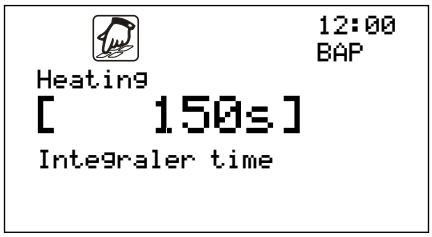
Proceed to confirm the start or stop time by pressing ↵.



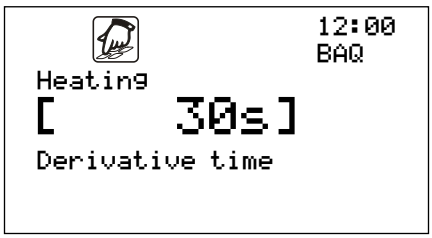
↵ is used to activate the cursor and ↑ or ↓ to set the desired value for the hours. Press ↵ twice to confirm and ↑ or ↓ to set the desired value for the minutes. Press ↵ twice to confirm. Press Esc once to set the stop time, for example, or Esc twice to set the next time frame or Esc three times to select the next day of the week, or Esc four times to exit the weekly schedule.

The control type defines the type of speed control for the compressor. The choice of control has a direct influence upon achieving the setpoint. This setting is also important for the cooling function. You can choose from P, PI, and PID.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.



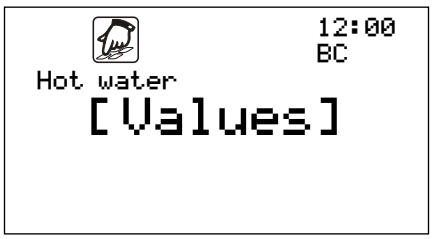
Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.



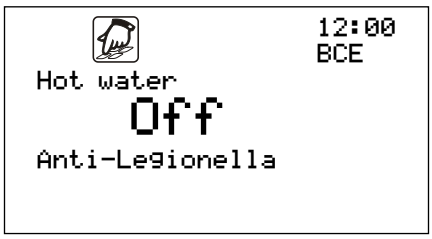
Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

Inverter speed defines the maximum speed at which the function can be carried out. This also serves to limit the power.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

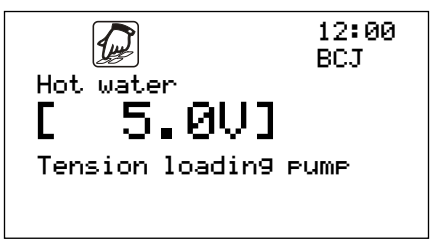


With the exception of the heating curve (since it is based on a fixed value), hot water is programmed in exactly the same way as heating or cooling.



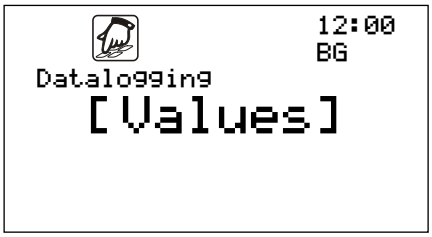
An additional anti-legionella function can be activated.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

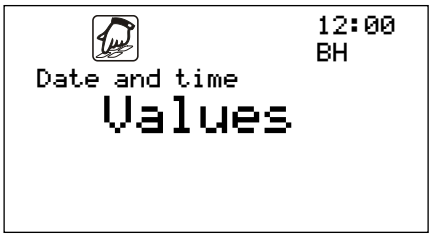


For an output-controlled charging pump, the speed can be adjusted using a continuous signal.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

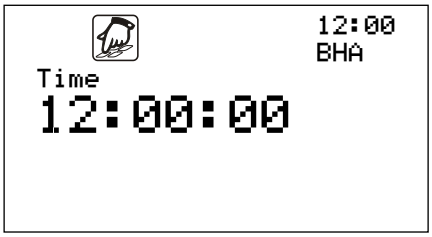


The Data logging function is not currently supported. The function can however be covered by an additional module.



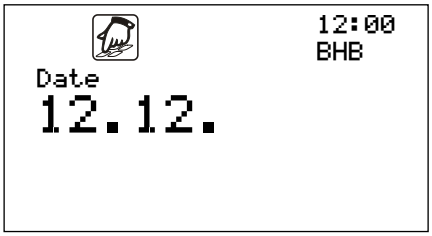
The date and time are entered in the format hh:mm:ss and dd/mm/20yy

Proceed to set the time by pressing ↓ or ↵



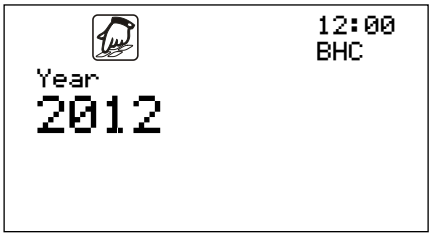
To set the time, press ↵; the cursor is activated.

Then press ↓ or ↑ to set the hours, and press ↵ twice to confirm. The cursor jumps to the minutes. Press ↓ or ↑ to set the minutes, and press ↵ twice to confirm. It is not possible to set the seconds. Press ↓ to proceed



To set the day and month, press ↵; the cursor is activated.

Then press ↓ or ↑ to set the days, and press ↵ twice to confirm. The cursor jumps to the month. Press ↓ or ↑ to set the month, and press ↵ twice to confirm. Press ↓ to proceed

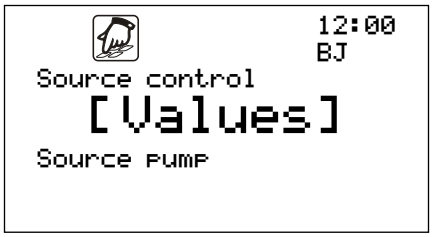


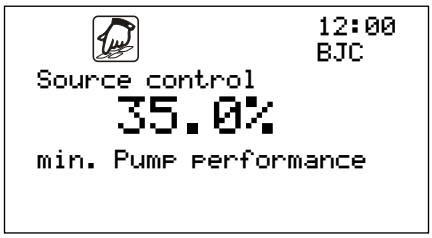
To set the year, press ↵; the cursor is activated.

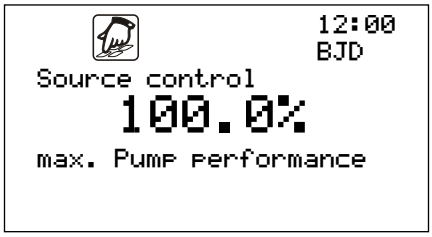
Then press ↓ or ↑ to set the year, and press ↵ twice to confirm.

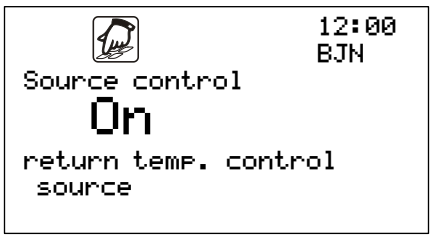
Press Esc twice to exit.

In the Service submenu you can store the telephone number for your service representative, which is shown on the main screen when a disabling message is displayed. This function is not yet available.









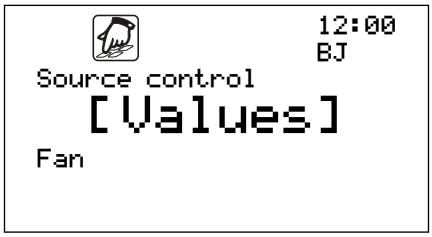
The source control is adjusted in accordance with the machine type and differentiates among different functions and working modes.
In this case, Type 2 with pump.

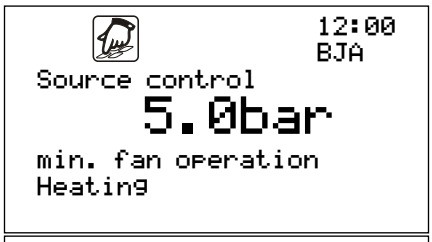
Proceed to the submenus by pressing  . The settings can only be configured once a password for the corresponding access level is entered.

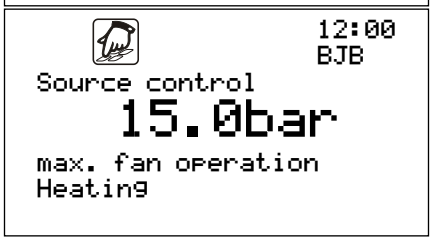
If a heating / cooling / WW requirement is the source pump is actuated. The pump start for the "pump lead time + compressor minimum duration + 30s" with 100% (10V) output. During normal operation the unit is controlled in dependence of compressor output (inverter speed). This is the max. speed set for the operating mode (eg. WW = 90rps) equal to 100% pump output. If no heating / cooling / WW requirement longer exists, the control is set minimum pump performance (Bsp.35% = 3.5V). The maximum and minimum shared pump performance can be set in the software.

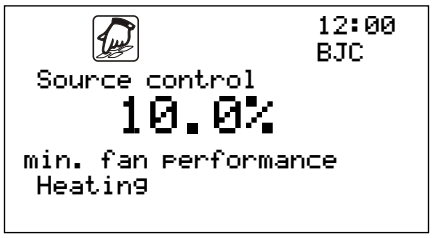
Alternatively, you can regulate the source pump by the source return temperature. This function must be switched on in the "BJN" mask. Then you can parameterize the PID parameters in the following masks and thus influence the control behavior of the pump. The controlled variable is the adjustable minimum source start temperature in the mask "BJA".

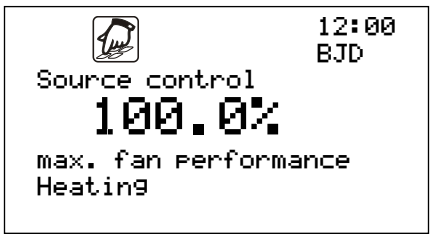
The minimum and maximum pump power continues to be the limits for pump speed control.

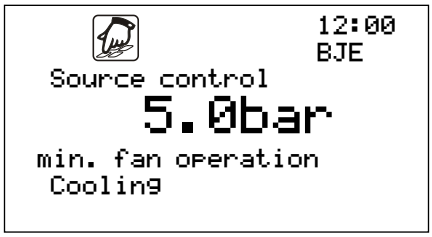


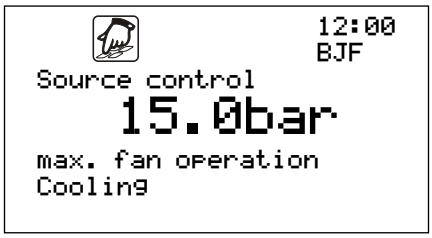








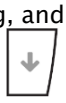


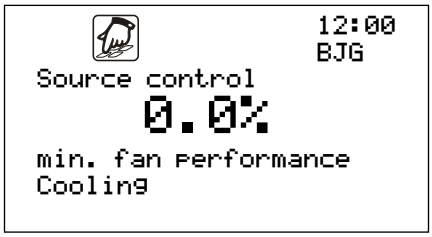


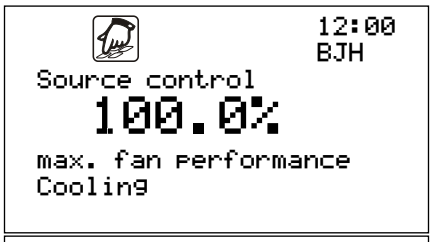
The source control is adjusted in accordance with the machine type and differentiates among different functions and working modes.
In this case, Type 1 with fan.

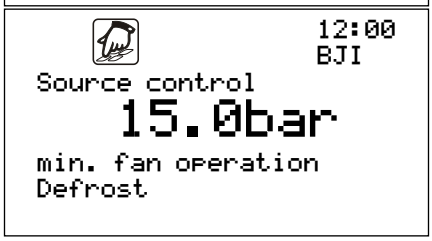
Proceed to the submenus by pressing  . The settings can only be configured once a password for the corresponding access level is entered.

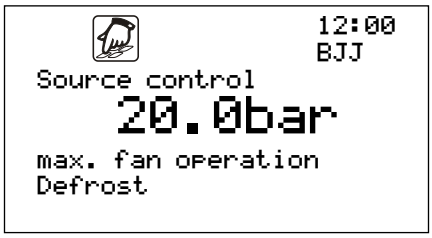
Defining four points establishes a characteristic curve, on the basis of which source control is performed.
If the source unit is a pump, it is only possible to define one characteristic curve.
For a fan, heating, cooling, and defrosting differ.

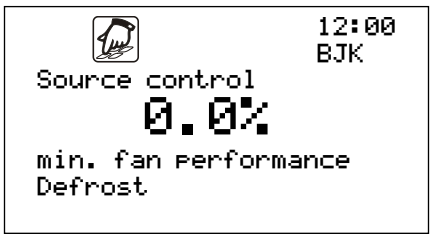
Press  , then  or  to set the desired value, and press  twice to confirm.

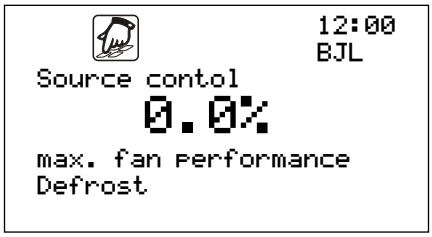


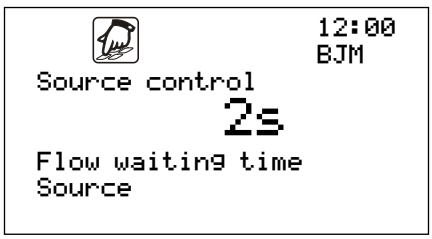






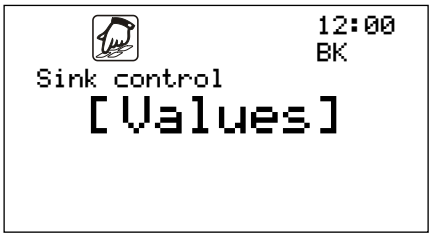




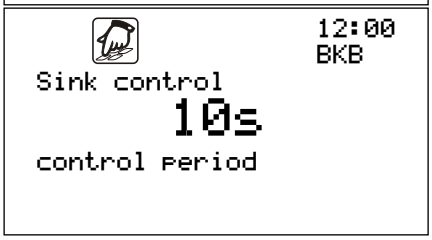


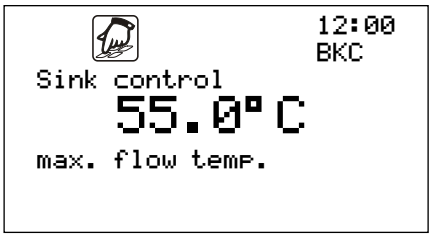
The Flow waiting time specifies how long monitoring of the flow rate can be interrupted once the source pump (for example) has been activated.

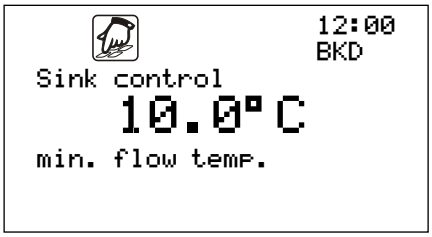
Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

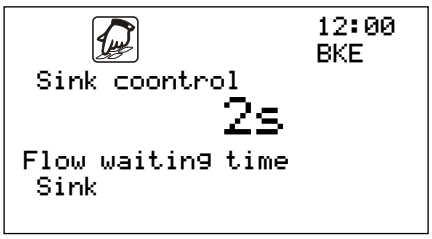


Proceed to the submenus by pressing ↵. The settings can only be configured once a password for the corresponding access level is entered.







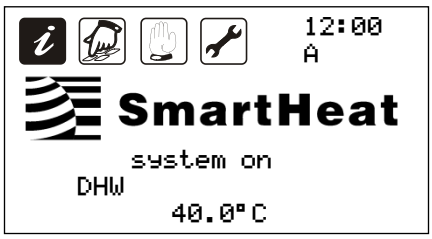


5.4 Example

Once you have familiarised yourself with the descriptions of the menus from this chapter and the preceding steps, you may perform some operating steps with the system as an exercise. An example operating procedure is illustrated below.

The starting position is the main menu.

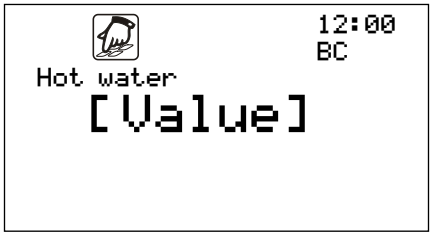
Objective: Change the parameter "Hot water reduction value" from 40°C to 35°C in the Programme menu.



Scroll right as far as the Programme menu.

The dark version of the  symbol is shown.

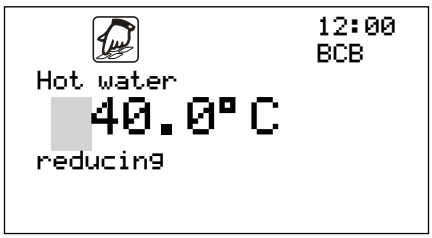
Press Enter to proceed.



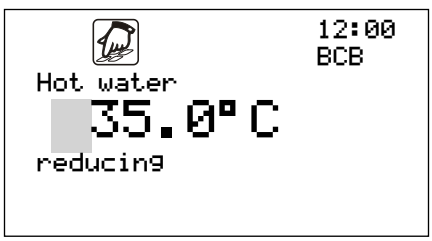
Scroll through the Programme menu
until the Hot water submenu is displayed

to set the reduction

Scroll through the submenu
until Reduction is displayed.

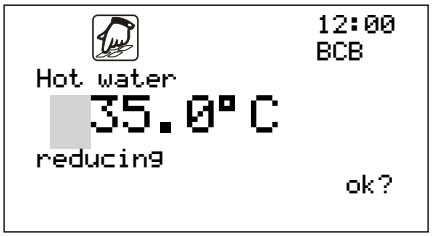


Select value: Reduction
The cursor then starts to flash



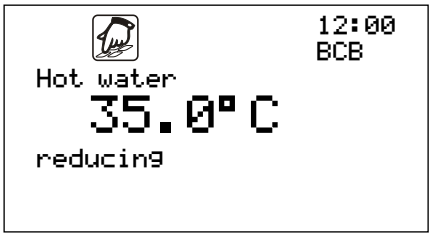
Reduce the value until the desired value is achieved. The value continues flashing.

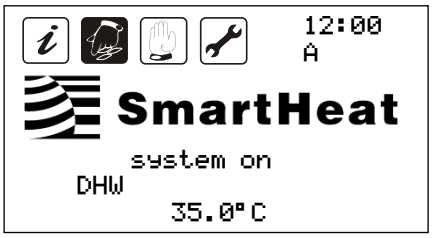
Select "Confirm value"



"**OK?**" is displayed
Confirm the change with Enter;
the change is accepted.

or
Exit with Esc:
the change is not accepted



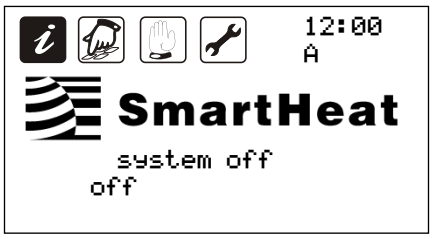


2x

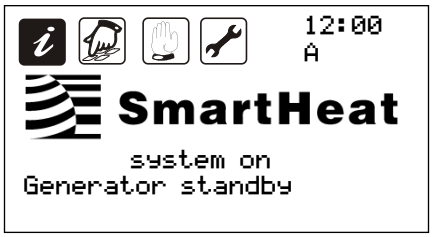
Exit the Hot water submenu
Exit the Programme menu
Return to the main menu

5.5 Statements on the main menu

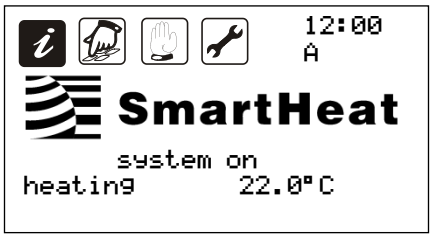
The following chapter shows possible statements on the main menu and describes their meanings for the heat pump controller.



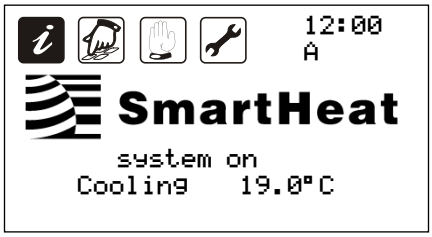
The system has been switched off via function button 6.



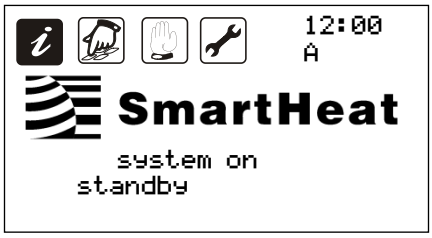
The system does not have a Generator available, possibly blocking time have not yet elapsed or temperature ranges have not yet been reached.



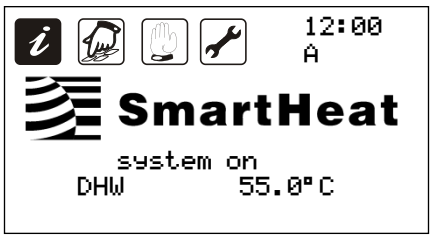
The system is in heating mode with a setpoint of 22°C.



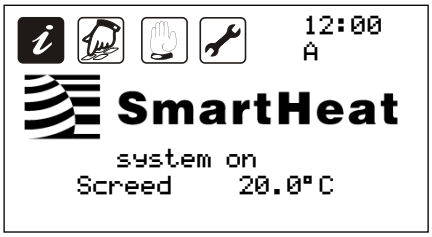
The system is in cooling mode with a setpoint of 19°C.



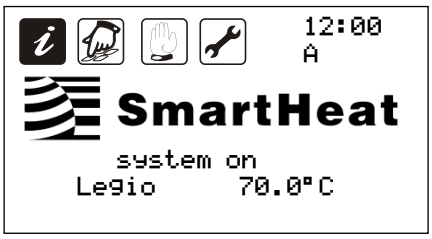
The system is in standby mode, as there is no request.



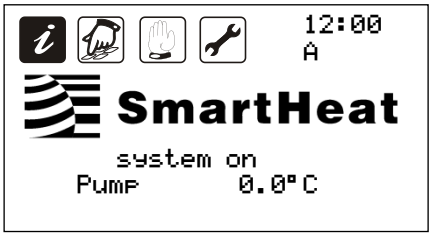
The system is in hot water mode with a setpoint of 55°C.



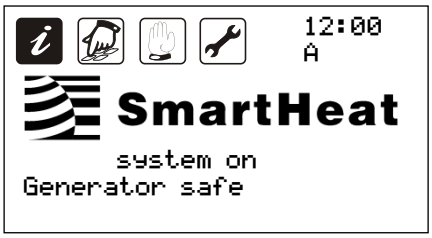
The system is running the screed heating programme, with a current target value of 20°C.



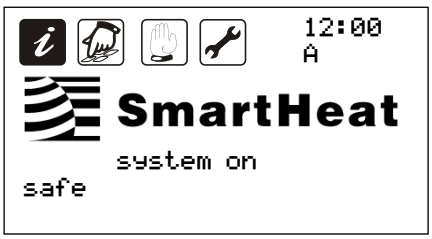
The system is running the anti-legionella programme, with a current target value of 70°C.



The pump protection system is off. There is no setpoint.



The system has detected a fault in Generator operation. The Generators are disabled by this fault.



The system has detected an operating fault. The system is disabled by this fault.

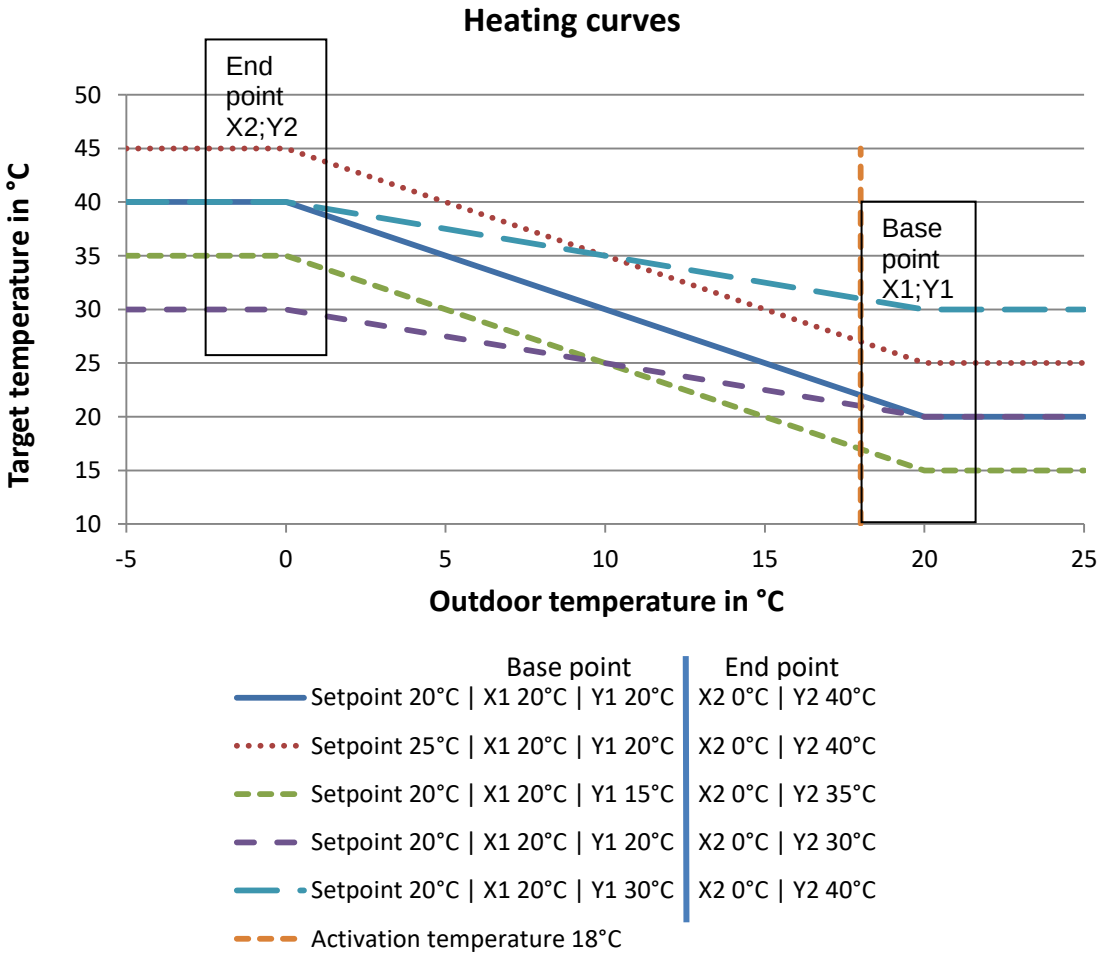
6 Heating curves

The default heating or cooling curve adapts the setpoint according to the outdoor temperature, in order to counteract unnecessary heat and energy loss. The characteristic values for adapting the curves are located under the Programme menu in the respective Heating or Cooling areas. Together, the fixed points form a linear function, a maximum and minimum limit. The linear function is defined by points X1 and the associated Y1, and X2 and the associated Y2. X1 and X2 serve as outdoor temperature values. Y1 and Y2 refer to the corresponding setpoints. Before and after the values of X1 and X2, the calculated values assume the set values of Y1 and Y2. This means outside of the range of Y1 and Y2 no further adaptation to the outdoor temperature occurs.

The setpoint and the reduction value should not be taken as the actual room temperature. Rather the should be set on a room thermostat. The setpoint rather serves to set the system temperatures. As a point of reference, for a setpoint of 20°C a system temperature of 40°C is stored. The serves in turn as a switch-on and switch-off criterion for the heat pump.

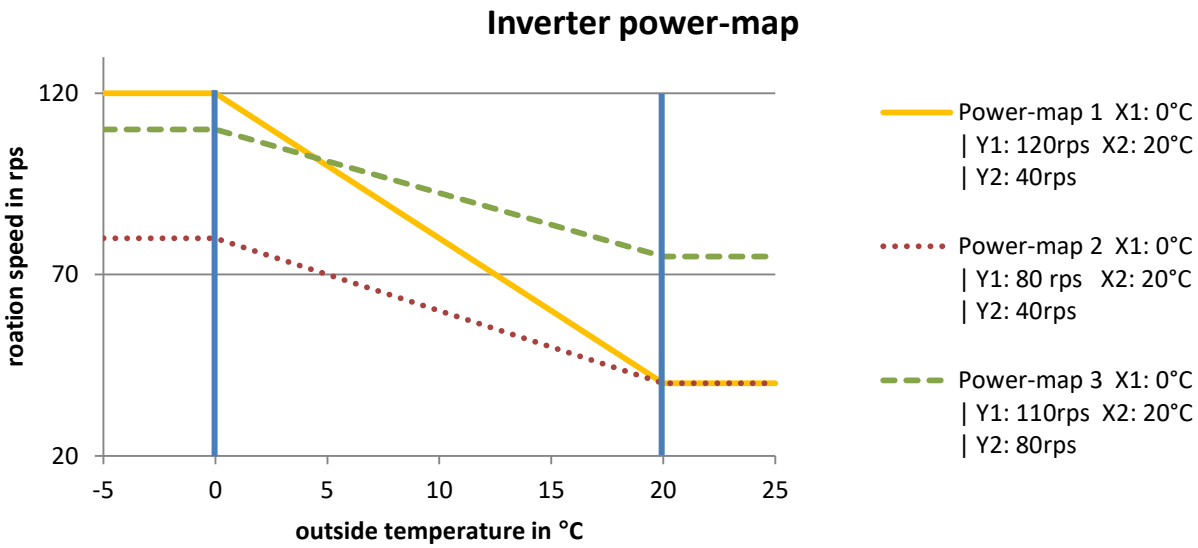
The calculation for cooling works in an equivalent manner to the diagram shown for the heating curve.

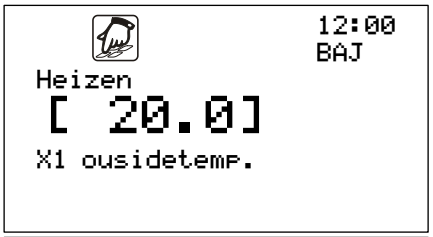
Modifications can only be made to the heating and cooling curve with Maintenance access rights and above.



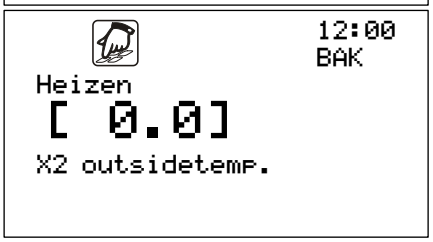
6.1 Inverter power-map

In dependence of the outside temperature is a power adaptation of the inverter over the min. or maximum rotation speed possible. The limit of the rotation speed is referring to the outside temperature (X1 / X2) settings in the heating curve. As an example you see in the followed diagram the dependence of outside temperature and rotation speed.





X1 outside temperature define the first point of the heating curve.



X2 outside temperature define the second point of the heating curve.

The values X1 and X2 are adapted to heating curve and Inverter power-map

7 Safety shutdowns/ faults during system operation

It is necessary to differentiate between two general categories of potential safety shutdowns/ faults:

- Faults which are detected by the heat pump controller itself and can therefore be reported

  The LED behind the  button indicates that there is a safety shutdown because of differences, defects or incorrect settings in the system or in the heat pump.

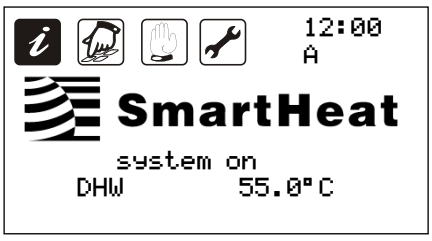
- Faults which cannot be detected by the controller.

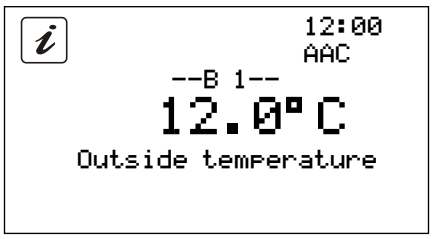
From this we can generally assume that the heat pump and its source system upstream, as well as the downstream heating surface system and all its elements are working properly. Their function is monitored by the heat pump controller depending on the connected sensor. However, it is never possible to completely rule out irregularities, such as a cable break on a sensor site or air in a fluid circuit, etc.

Permanent or repeated deviations from the standard operation of the system, including on the source and heating system as well as the heat pump, are indicated on the display of the controller. If a high-priority fault occurs, the system switches to an emergency function and attempts to carry out its heating role with the additional heating (generally an integrated electric heating element). If the fault is such that even this emergency operation is not possible, the system switches off. This would be the case, for instance, if the heating pump is faulty and the heat cannot be discharged. Faults which can be traced back to permanent errors in the system must be rectified with the help of the installer.

If there is a safety shutdown with a high priority, then this may be reset only once. If the same safety shutdown occurs again, is necessarily a specialized company to consult.
Please note that the frequent resetting and the failure to correct the underlying cause can result in damage or even total loss by itself.

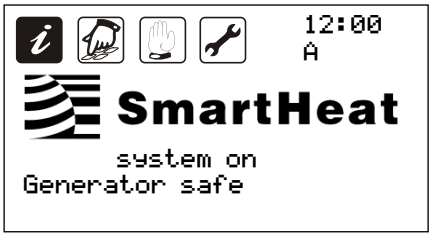
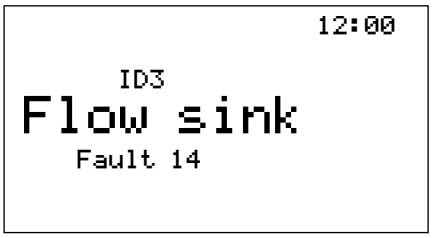
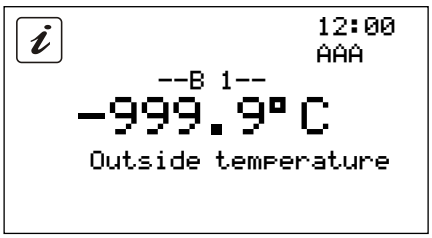
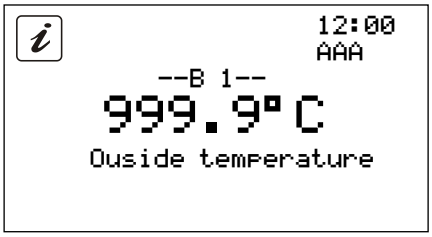
7.1 Screen for proper operation of the system

Display	Possible cause
	Display on the main menu: The system is in hot water mode with a setpoint of 55°C.



Display in the Information menu:
Intact temperature sensor at an outdoor temperature by 12°C

7.2 Fault messages from the controller

Display	Possible cause	Action[1]
	Display on the main menu: There is a controller-detected fault. The operating button flashes.	Press the operating button.
	When is pressed, the precise information for the fault is displayed. In this case we can see that flow monitoring has been triggered	• Check the flow switch • Check the cable
	Display in the Information menu: The activated outdoor temperature sensor is not connected, there is a cable break in the sensor line, or the sensor is below its measuring range.	• Check sensor resistance • Check line • Replace sensor if necessary
	Display in the Information menu: The activated outdoor temperature sensor is above its measuring range.	• Check sensor resistance • Check line • Replace sensor if necessary

[1] The safety instructions and Chapter 3 must be followed!

7.3 Fault monitoring

The following table lists messages of the controller, describes reactions to these messages, and specifies possible causes. An audible signal is only present on certain operating units.

Fault number	Fault	Reaction	Possible cause	Priority
Fault 1 - Alarm B1	Outdoor temperature sensor	0°C as a fixed outdoor temperature	Sensor not connected, sensor faulty	Low
Fault 2 - Alarm B2	Hot water temperature sensor	Hot water deactivated	Sensor not connected, sensor faulty	Low
Fault 3 - Alarm B3	Sink flow temperature sensor	Return temperature as flow temperature	Sensor not connected, sensor faulty	Low
Fault 4 - Alarm B4	Sink return temperature fault	Flow temperature as return temperature	Sensor not connected, sensor faulty	Low
Fault 5 - Alarm B5	Source return temperature sensor		Sensor not connected, sensor faulty	Low
Fault 6 - Alarm B6	Mixer circuit 1 temperature sensor		Sensor not connected, sensor faulty	Low
Fault 7 - Alarm B7	Mixer circuit 2 temperature sensor / collector temperature sensor		Sensor not connected, sensor faulty	Low
Fault 8 - Alarm B8	Limit temperature sensor / room temperature sensor / storage tank temperature sensor		Sensor not connected, sensor faulty	Low
Fault 9 - Alarm B9	Hot gas temperature sensor		Sensor not connected, sensor faulty	Low
Fault 10 - Alarm B10	Suction gas temperature sensor		Sensor not connected, sensor faulty	Low
Fault 11 - Alarm B11	High-pressure pressure sensor	System safety shutdown	Sensor not connected, sensor faulty	Low
Fault 12 - Alarm B12	Low-pressure pressure sensor	System safety shutdown	Sensor not connected, sensor faulty	High
Fault 13 - Input ID1	Safety chain	Compressor safety shutdown	Flow absent or low on the sink or source side, insufficient power decrease on the sink side	High
Fault 14 - Input ID3	Sink fault	System safety shutdown	Flow absent or low on the sink side, drop in pressure in the connected pressure monitor	High
Fault 15 - Input ID6	Actuator monitoring	System safety shutdown	Overload of the connected pumps by the fault message	High
Fault 16 - Input ID4	Additional heating, safety temperature limiter	Additional heating safety shutdown	Air on the sink side or in the additional heating; no or insufficient flow on the sink side	Low
Fault 17 - Input ID5	Compressor overload	Compressor safety shutdown	Internal / external motor protection triggered and reported via the fault contact	Low
Fault 18 -	Source fault	System safety shutdown	Flow absent or low on the source side,	High

Input ID2			drop in pressure in the connected pressure monitor	
Fault 19	Heating request fault			Low
Fault 20	Cooling request fault			Low
Fault 21	Generator disabled fault			Low
Fault 22	Hot gas maximum fault	System safety shutdown	System operation outside of the area of operation, Defrost setting inappropriate for air/water systems	Low
Fault 23	Expansion valve fault		General fault which occurs together with faults 33-50	Low
Fault 24	Constant fault			Low
Fault 25	Hot gas delta fault	System safety shutdown	System operation outside of the area of operation	Low
Fault 26	Modbus connection error	System safety shutdown	Connection to BMS lost	Low
Fault 27	Inverter Alarm 1			Low
Fault 28	Inverter offline alarm		Inverter is not being supplied at the tariff	Low

Fault number	Fault	Reaction	Possible cause	Priority
Fault 29	High delta P	System safety shutdown	Inappropriate system conditions or inadequate expansion valve settings	Low
Fault 30	Compressor off alarm			Low
Fault 31	Envelope alarm		System operation outside of the area of operation	Low
Fault 32	Inverter start fault		System operation outside of the area of operation	Low
Fault 33	Alarm S1	Compressor safety shutdown	System operation outside of the area of operation, sensor not connected, sensor faulty	Low
Fault 34	Alarm S2	Compressor safety shutdown	System operation outside of the area of operation, sensor not connected, sensor faulty	Low
Fault 35	Alarm S3	Compressor safety shutdown	System operation outside of the area of operation, sensor not connected, sensor faulty	Low
Fault 36	Alarm S4	Compressor safety shutdown	System operation outside of the area of operation, sensor not connected, sensor faulty	Low
Fault 37	Control alarm A	Compressor safety shutdown		Low
Fault 38	Control alarm B	Compressor safety shutdown		Low
Fault 39	Low SH alarm A	Compressor safety shutdown	System operation outside of the area of operation, inappropriate system conditions	Low
Fault 40	Low SH alarm B	Compressor safety shut-	System operation outside of the area of	Low

		down	operation, inappropriate system conditions	
Fault 41	System alarm	Compressor safety shutdown		Low
Fault 42	LOP alarm A	Compressor safety shutdown	System operation outside of the area of operation, inappropriate system conditions	Low
Fault 43	LOP alarm B	Compressor safety shutdown	System operation outside of the area of operation, inappropriate system conditions	Low
Fault 44	High pressure alarm A	Compressor safety shutdown	System operation outside of the area of operation, inappropriate system conditions	Low
Fault 45	High pressure alarm B	Compressor safety shutdown	System operation outside of the area of operation, inappropriate system conditions	Low
Fault 46	Low suct. alarm A	Compressor safety shutdown	System operation outside of the area of operation, inappropriate system conditions	Low
Fault 47	Low suct. alarm B	Compressor safety shutdown	System operation outside of the area of operation, inappropriate system conditions	Low
Fault 48	Evo tunes alarm A	Compressor safety shutdown		Low
Fault 49	Extensionboard		pLAN connection lost	Low
Fault 50	HiT cond. alarm	Compressor safety shutdown		Low
Fault 51	High pressure via transmitter	Compressor safety shutdown	System operation outside of the area of operation, inappropriate system conditions	High
Fault 52	Low pressure via transmitter	Compressor safety shutdown	System operation outside of the area of operation, inappropriate system conditions	High
Fault 54	Fault in other pLAN circuit		Master reports an error in other circuit	Low
Fault 55	Hot gas delta fault	System safety shutdown	System operation outside of the area of operation	Low
Fault 56	High delta P	System safety shutdown	Inappropriate system conditions or inadequate expansion valve settings	Low
Fault 57	Leakage warning		Maybe a leakage is available, please check it	Low
Fault 58	Leakage alarm	System safety shutdown	Leakage is occured	High
Fault 59	Maintenence Sensor	Deactivation of leakage monitoring	Leakage Sensor must be calibrated	Hoch
Fault 60	Source temperature outside parameters	Compressor safety shutdown	Source temperature - to high - to low	Niedrig

The audible signal can be acknowledged by pressing  **! This also takes you to the Alarm menu, where alarms whose cause has been resolved can be reset**

(cleared) with a long press on  .

In the case of serious alarms, it is necessary to reset them to resume operation of the system.

The audible signal will only sound in the period from 5:30am to 10:00pm.

If there is a safety shut down with a high priority, then this may be reset only once. If the same safety shutdown occurs again, is necessarily a specialized company to consult.
Please note that the frequent resetting and the failure to correct the underlying cause can result in damage or even total loss by itself.

7.4 Faults with no fault message

Faults and malfunctions which are not indicated can be checked using the following table, to establish possible causes and the source of the fault. If the fault cannot be rectified using the description, contact the installer.

Faults pertaining to the 230V/AC mains power may only be repaired by qualified specialists!

Fault	Possible causes	Action[2]
Display no functioning	• No 230V mains power	• Switch on or connect the controller • Inspect the house fuse for the connection
	• Device faulty	• Consult the installer
Controller not working	• Controller in manual mode	• Exit "Manual" menu
	• Switch-on condition not fulfilled	• Wait until the switch-on condition is fulfilled
Displayed temperature fluctuates wildly at short intervals	• Sensor lines routed close to 230V cables	• Route sensor lines a different way, shield sensor lines
	• Long sensor lines extended without shielding	• Shield sensor lines
	• Device faulty	• Consult the installer
	• Loose line connection	• Retighten line connection

[2] The safety instructions and Chapter 3 must be followed!

8 Electrical connection

Please observe the safety instructions in Chapter 3!

The device may only be opened when the mains voltage has been shut off and secure against reconnect!

8.1 General connection instructions

On all connection lines, strip the cable jacket to a length of approx. 6-8 cm and the ends of the wires to a length of approx. 10 mm.

In the case of flexible lines, a strain relief must be provided, either inside or outside of the device. The wire ends should be provided with ferrules.

All protective conductors must be secured to the terminals labelled "PE" (Protective Earth).

8.2 230V connections

There are max. twelve 230V/50Hz outputs (NO1, NO2, NO3,..., NO12). The exception is output NO7/NC7. This is used primarily as a potential-free fault message contact. Note the following points regarding the 230V connections:

It must be possible to disconnect the mains supply for the controller outside of the heat pump with a main switch.

The controllers are intended for operation on a 230V /50Hz grid. The pumps and valves which are connected must be designed for this voltage!

All protective conductors must be connected to the terminals labelled "PE"

Outputs may not be supplied with power from an external source, as this could cause damage to the board.

8.3 Connecting sensors

The controllers operate exclusively with temperature sensors of type NTC, NTC HT or ratiometric 0-5 V. The following inputs and outputs are available:

- 10 temperature inputs
- 2 pressure transducer inputs
- 4 analogue outputs

Installation/wiring of the temperature sensors

Install the sensors in their intended location on the heat pump, storage tank, external wall. When doing so, make sure there is good temperature transfer and if necessary use thermally conductive paste. If necessary, insulate the measuring points in order to avoid disrupting influences on the sensor.

The lines of the temperature sensors can be extended. Up to 15m in length, a cross-section of 2 x 0.5mm² is necessary, and up to 50m of 2 x 0.75 mm². In the case of long connections (e.g. collector) shielded extension cables must be used. On the sensor side, do not connect the shield if there is no shielding present, but rather trim and insulate!

The temperature sensors are connected in accordance with the system diagram. When it comes to temperature sensors, there is no need to observe the polarity of the two wires.

Sensor lines must be routed separately from 230V and 400V lines, because under unfavourable circumstances not doing so could result in interference. The distance between the two lines must be at least 15cm.

All electrical lines are connected to a module in the connection unit or the transfer terminals provided for the purpose.

8.4 Assignment of the analogue inputs

I/O	Specification	Function
B1	NTC, -50°C...105°C	Outdoor temperature
B2	NTC, -50°C...105°C	Hot water temperature
B3	NTC, -50°C...105°C	Sink flow temperature
B4	NTC, -50°C...105°C	Sink return temperature
B5	NTC, -50°C...105°C	Source return temperature
B6	NTC, -50°C...105°C	Mixer circuit temperature 1, Flow temperature Hot gas exchanger, Hot gas temperature Compressor 2
B7	NTC, -50°C...105°C	Mixer circuit temperature 2/ Collector temperature [3]
B8	NTC, -50°C...105°C/ NTC HT 0°C...120°C	Limit, room or solar storage tank temperature [4]
B9	NTC HT, 0°C...120°C	Hot gas temperature
B10	NTC, -50°C...105°C	Suction gas temperature
B11	0-5V	High pressure transducer
B12	0-5V	Low pressure transducer

8.5 Assignment of the digital inputs

I/O	Specification	Function
DI1	Digital input, potential free to GND	Safety chain LP/HP
DI 2	Digital input, potential free to GND	Source flow/pressure monitor
DI 3	Digital input, potential free to GND	Sink flow/pressure monitor

[3, 4] The controller in pre-configured in the respective heat pump by the factory for its intended function. This means, according to the configuration of the parameters, that other functions may apply to the analogue inputs.

DI 4	Digital input, potential free to GND	Additional heating / safety temperature limiter
DI 5	Digital input, potential free to GND	Generator overload, e.g. motor circuit breaker
DI 6	Digital input, potential free to GND	Actuator monitoring, e.g. pump overload
DI 7	Digital input, potential free to GND	Reserve
DI 8	Digital input, potential free to GND	Remote On/Off
DI 9	Digital input, potential free to GND	Smart grid 1 /
DI 10	Digital input, potential free to GND	Smart grid 2 / Möhlenhoff signal

8.6 Assignment of the digital outputs

I/O	Specification	Max. switching capacity	Function
NO1	230V/50Hz, max. 1A	Max. 3A in total	Source request
NO2	230V/50Hz, max. 1A		Heating request
NO3	230V/50Hz, max. 1A		Hot water request
NO4	230V/50Hz, max. 1A	Max. 3A in total	Cooling/heating contact
NO5	230V/50Hz, max. 1A		Four-way valve
NO6	230V/50Hz, max. 1A		Additioan heating
NC7	230V/50Hz, max. 1A	Max. 1A	Collective fault message
NO8	230V/50Hz, max. 1A	Max. 5A in total	Operation/ Storage tank charging
NO9	230V/50Hz, max. 1A		Generator 1
NO10	230V/50Hz, max. 1A		Generator 2
NO11	230V/50Hz, max. 1A		Generator 3
NO12	230V/50Hz, max. 1A		Generator 4 / Solar pump

8.7 Assignment of the analogue outputs

I/O	Specification	Function
Y1	0 – 10V, max. 5mA	Fan / Brine pump [5]
Y2	0 – 10V, max. 5mA	Heating pump
Y3	0 – 10V, max. 5mA, PWM max. 10mA	Mixer 1 activation
Y4	0 – 10V, max. 5mA, PWM max. 10mA	Mixer 2 activation

9 Type key

The type key is used to activate typical functions for the machine or deactivate unnecessary ones.

Type1: SmartHeat aero-series air/water heat pumps
Type2: SmartHeat classic, bravour and Titan-series brine/water (BW) and water/water (WW) heat pumps

[5] The controller in pre-configured in the respective heat pump by the factory for its intended function. This means, according to the configuration of the parameters, that other functions may apply to the analogue outputs.

10 Logic of particular control functions

10.1 Water heating

Inputs and outputs used

Inputs	Name
B2	Hot water temperature

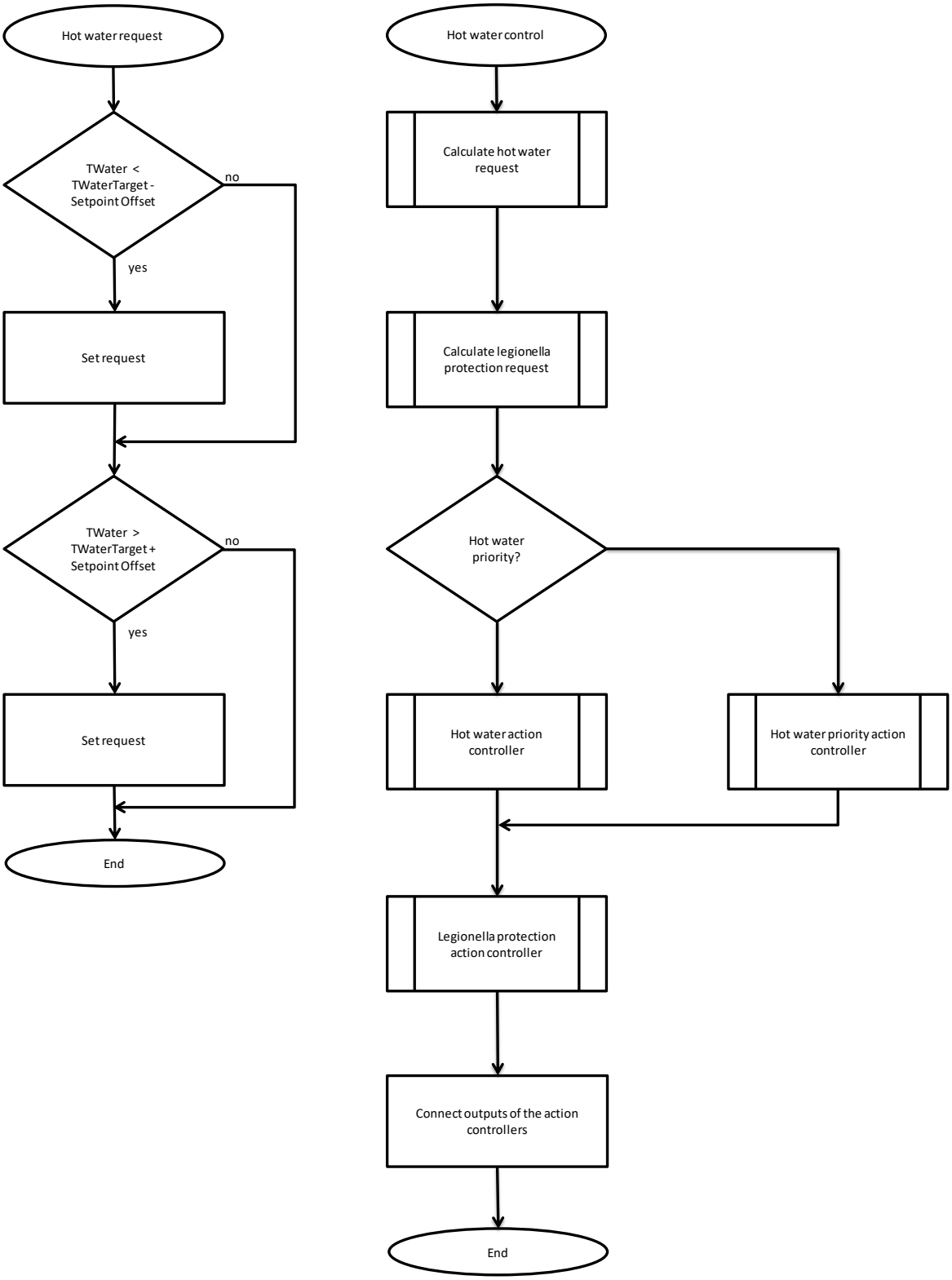
Outputs	Name
NO1	Source pump
NO2	Heating pump (only for WW valve, not for WW pump)
NO3	Hot water valve or pump

Parameters used

Menu	Term	Description	Min	Max	Factory sett.
AAB	Hot water	Hot water temperature	-	-	
BCA	Setpoint	Hot water target value	-20°C	90°C	45°C
BCB	Reduction value	Hot water reduction target value	-20°C	90°C	40°C
DQB	WW pump/valve	Select between hot water pump and hot water valve	Valve	Pump	Valve
DOA	Priority	Hot water priority before heating	Off	On	Off
DQE	Lead time	Time between switching on the pump and switching on the Generator	1s	300s	30s
DQF	Shut-off delay	Time between switching off the Generator and switching off the pumps	1s	300s	30s

Control algorithms

When the hot water temperature is below the setpoint, one or more energy sources starts up in order to achieve the setpoint. Using the weekly and daily programmes, you can define two time frames for operation for each day. Outside of these time frames the energy-saving programme with the reduced target values comes into effect.



Fault handling

Fault	Description	Adoption for emergency operation	Display

Outdoor temperature	Outdoor temperature sensor defective	Yes	Short-circuit / cable break Information menu, temperature gauge
Water temperature	Water temperature sensor defective	No	Short-circuit / cable break Information menu, temperature gauge
Flow temperature	Flow sensor defective	Yes	Short-circuit / cable break Information menu, temperature gauge
Return temperature	Return sensor defective	Yes	Short-circuit / cable break Information menu, temperature gauge
LP HP Opt.safety circuit	Switch off the heat pump	Yes	Red. source Red. system Source

10.2 Heating

Inputs / Outputs

Inputs	Name
B1	Outdoor temperature
B3	Flow temperature
B4	Return temperature
B8	Room temperature

Outputs	Name
NO1	Source pump
NO2	Heating pump

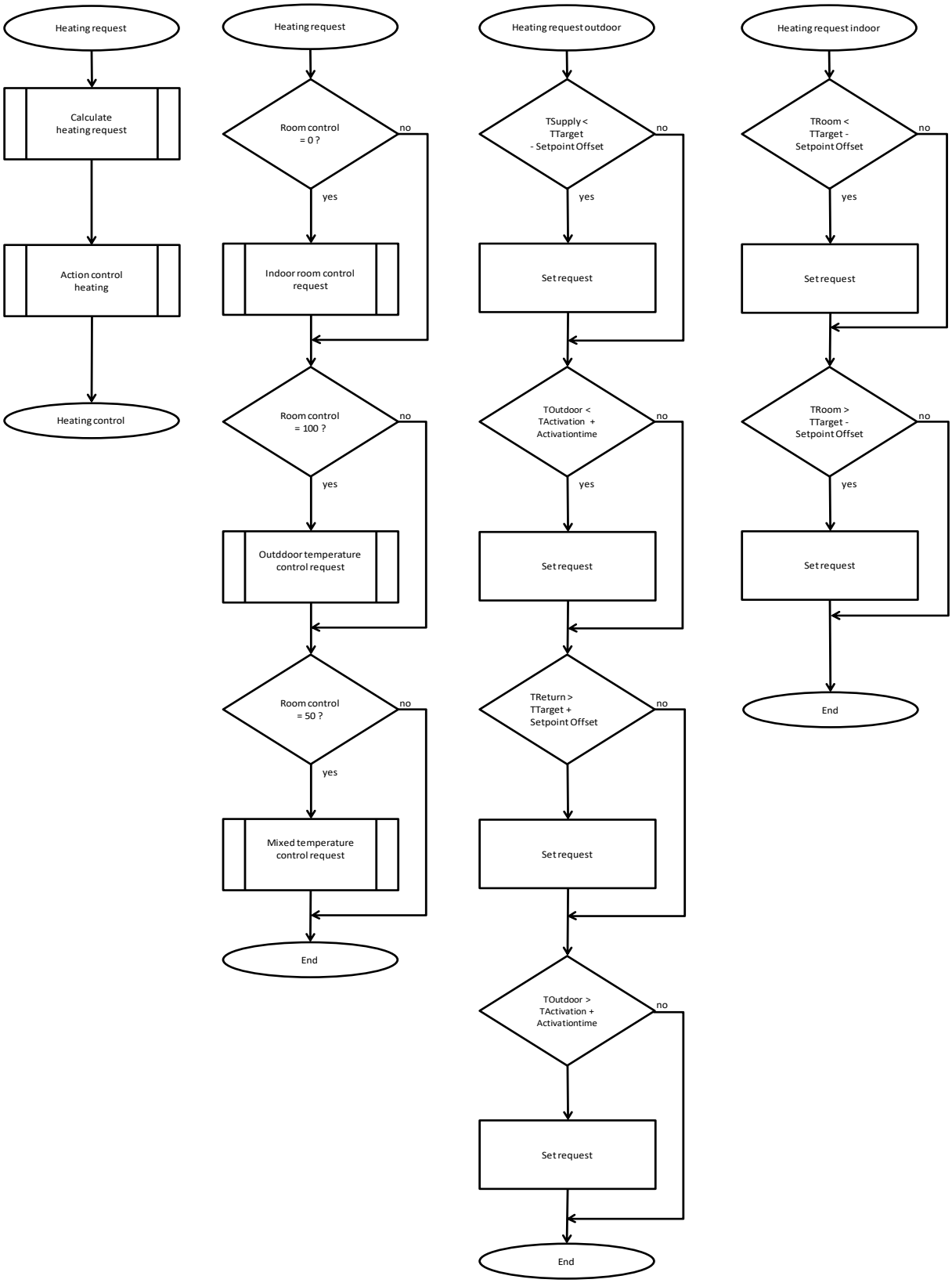
Parameters

Menu	Term	Description	Min	Max	Factory sett.
AAA	Outdoor temperature	Display outdoor temperature	-	-	
AAC	Flow temperature	Display flow temperature	-	-	
AAD	Return temperature	Display return temperature	-	-	
AAH	Room temperature	Display room temperature	-	-	
BAA	Setpoint	Target value for heating	-20	90	22
BAB	Reduction value	Target value for heating reduction time	-20	90	19
BAE	Activation temp.	Activation temperature, below which heating control is switched on	10	Cooling activ.temp.	18
BAF	Activation period	Activation period if the temperature drops below the activation temperature	1s	60 days	12 hrs
BAG	Room control	Room temperature control	0	100	0
BAH	heating curve	Dynamic setpoint calculation	Off	On	On
BAI	Flow reference setpoint	Fixed assignment between the flow target temperature and the reference room target temperature of 20°C	-20	90	40

BAJ	X1 TOutdoor	Input value for the first fixed point of the target value characteristic curve	-20	90	20
BAK	Y1 nominal value	Output value for the first fixed point of the target value characteristic curve	-20	90	20
BAL	X2 TOutdoor	Input value for the second fixed point of the target value characteristic curve	-20	90	0
BAM	Y2 nominal value	Output value for the second fixed point of the target value characteristic curve	-20	90	40
BAN	Weekly schedule				

Control algorithms

If the outdoor temperature for the set activation period is below the activation temperature, the heating circuit is activated. Using the weekly and daily programmes, you can define two time frames for operation for each day. Outside of these time frames the energy-saving programme with the reduced target values comes into effect.



The heating is activated by TFlow, and deactivated again by TReturn.

Fault handling

Fault	Description	Emergency operation	Display
Outdoor temperature	Outdoor temperature sensor defective	Yes	Short-circuit / cable break, Information menu, temperature gauge
Flow temperature	Flow sensor defective	Yes	Short-circuit / cable break, Information menu, temperature gauge
Return temperature	Return sensor defective	Yes	Short-circuit / cable break, Information menu, temperature gauge
LP HP Opt. safety circuit	Switch off the heat pump	Yes	Red. source Red. system Source

Reference room temperature control (RRT) and outdoor temperature control

The explanation on adjustment can be found under point 5.2 "Room control".

0%	If no room temperature sensor is active Heating control occurs normally, as before. Activation is triggered by the flow temperature. Deactivation is triggered by the return temperature. **Outdoor temperature-based control**
50%	A target flow temperature is calculated by the controller. The Generator(s) run until the RRT is reached. Then the switch-off temperature is calculated from the flow temperature achieved at this point. When the room temperature is reached in the reference room, another reheating cycle occurs. The only limit is TSPmax. **Outdoor temperature control and room temperature control are combined**
100%	Heating control occurs via a reference room temperature sensor. If the temperature drops below the reference value the Generator(s) is/are switched on, and then off again if it is exceeded. When the target room temperature is reached in the reference room, the Generators are switched off. **Room temperature-based control** Request occurs when TRoom < TRoomTarget Switch-off occurs when TRoom > TRoomTarget Only the min. and max/ flow temperature of Generator E1 is monitored.

10.3 Cooling

Inputs / Outputs

Inputs	Name
B1	Outdoor temperature
B3	Flow temperature
B4	Return temperature
B8	Room temperature

Outputs	Name
NO1	Source pump
NO2	Heating pump
NO4	Cooling/heating contact
NO5	Four-way valve

Parameters

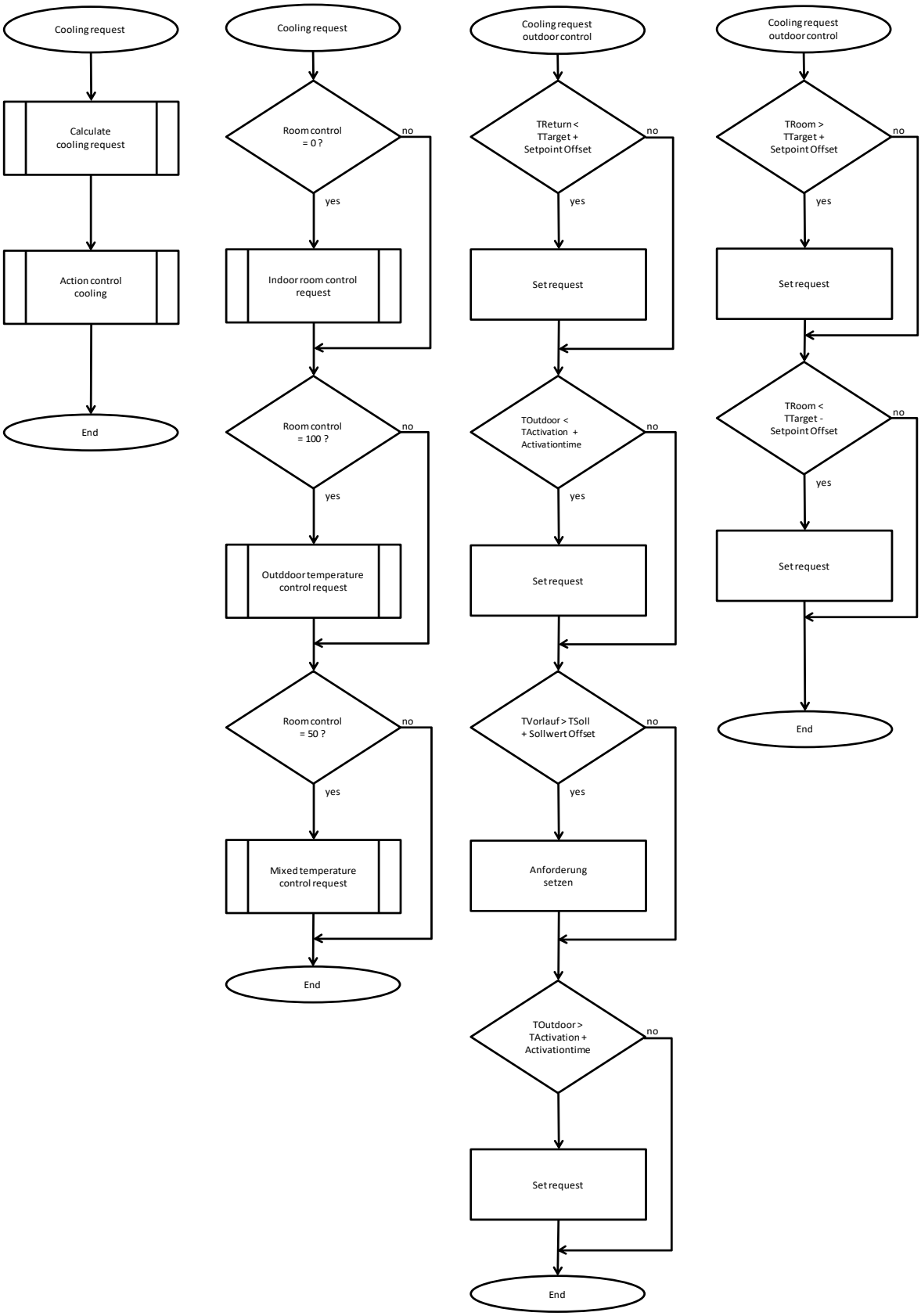
Menu	Term	Description	Min	Max	Factory sett.
AAA	Outdoor temperature	Display outdoor temperature	-	-	
AAC	Flow temperature	Display flow temperature	-	-	
AAD	Return temperature	Display return temperature	-	-	
AAH	Room temperature	Display room temperature	-	-	
BBA	Setpoint	Target value for cooling	-20	90	22
BBB	Reduction target value	Setpoint for cooling reduction	-20	90	24
BBE	Activation temp.	Activation temperature, below which cooling control is switched on	Heating activation temp.	30	22
BBF	Activation period	Activation period if the temperature drops below the activation temperature	1s	60 hrs	12 hrs
BBG	Room control	Room temperature control	0	100	0
BBH	Cooling curve	Dynamic setpoint calculation	Off	On	On
BBI	Flow reference target value	Fixed assignment between the flow target temperature and the reference room target temperature of 20°C	-20	90	10
BBJ	X1 TOutdoor	Input value for the first fixed point of the target value characteristic curve	-20	90	20
BBK	Y1 nominal value	Output value for the first fixed point of the target value characteristic curve	-20	90	20
BBL	X2 TOutdoor	Input value for the second fixed point of the target value characteristic curve	-20	90	40
BBM	Y2 nominal value	Output value for the second fixed point of the target value characteristic curve	-20	90	0
BBN	Weekly schedule				

	Term	Description	Optional factory settings

Basic setting	Optional cooling	Switch cooling function on/off	Active/Passive/Off

Control algorithms

If the outdoor temperature for the set activation period is above the activation temperature, the cooling circuit is activated. Using the weekly and daily programmes, you can define two time frames for operation for each day. Outside of these time frames the energy-saving programme with the reduction target values comes into effect.



Fault handling

Fault	Description	Adoption for emergency operation	Display

Outdoor tempera-ture	Outdoor temperature sensor defective	Outdoor temperature 0°C	Short-circuit / cable break, Information menu, temperature gauge
Flow temperature	Flow sensor defective	Flow temperature = Return temperature	Short-circuit / cable break, Information menu, temperature gauge
Return temperature	Return sensor defective	Return temperature = Flow temperature	Short-circuit / cable break, Information menu, temperature gauge
LP HP Opt. safety circuit	Switch off the heat pump	Reduced cooling mode to approx. 75%	Red. source Red. system Source

With no cooling mode, there must be a "Cooling off" option.

10.4 Mixer control

Inputs / Outputs

Inputs	Name
B6	Mixer 1 TFlow
B7	Mixer 2 TFlow

Outputs	Name
Y3	Mixer 1
Y4	Mixer 2

Parameters

Menu	Term	Description	Min	Max
AAF	Flow Mixer 1	Temperature Mixer 1	-	-
AAG	Flow Mixer 2	Temperature Mixer 2		
DLA	Mixer 1	Switching on the mixer control for mixer 1 and activating further setting parameters in the mask "BE"	off	on
DLB	Control period	Minimum control time for adjusting the mixer control	10s	60s
DMA	Mixer 2	Switching on the mixer control for mixer 1 and activating further setting parameters in the mask "BF"	off	on
DMB	Control period	Minimum control time for adjusting the mixer control	10s	60s
BEA	Mixer 1 activated	Refelxion of the "DLA" mask, if this parameter is switched off, the mixer can only be activated via the "DLA"	off	on
BEB	Increase heating	Raises the calculated setpoint value from the mixer's own heating curve by the set value (only activated and visible if the heating curve is switched on)	-3,0	10,0
BEC	Heating Setpoint	Mixer setpoint independently of the outside temperature is always approached firmly. (Only activated and visible if heat-ing curve is switched off)	0	70,0
BED	Heating curve	Activates the own heating curve for mixer 1. Operation is identical to the standard heating curve for heating mode.	off	on

BEE	X1-TOutside heating	Point1 (outdoor temperature) for heating setpoint calculation	-30,0	40,0
BEF	Y1-flow Setpoint-heating	Point1 Desired flow setpoint at outside temperature X1	-30,0	40,0
BEG	X2- TOutside heating	Point2 (outdoor temperature) for heating setpoint calculation	-30,0	40,0
BEH	Y2- flow Setpoint-heating	Point2 Desired flow setpoint at outside temperature X2	-30,0	40,0
BEI	Increasing cooling	Raises the calculated setpoint value from the mixer's own cooling curve by the set value (only activated and visible if the cooling curve is switched on)	-3,0	10,0
BEJ	cooling Setpoint	Mixer setpoint independently of the outside temperature is always approached firmly. (Only activated and visible if cooling curve is switched off)	0,0	70,0
BEK	Cooling curve	Activates the own cooling curve for mixer 1. Operation is identical to the standard cooling curve for cooling mode.	off	on
BEL	X1- TOutside cooling	Point1 (outdoor temperature) for cooling setpoint calculation	-30,0	40,0
BEM	Y1- flow Setpoint cooling	Point1 Desired flow setpoint at outside temperature X1	-30,0	40,0
BEN	X2- TOutside cooling	Point 2 (outdoor temperature) for cooling setpoint calculation	-30,0	40,0
BEO	Y2- flow Setpoint cooling	Point2 Desired flow setpoint at outside temperature X2	-30,0	40,0
BEP	Mode	Desired operating mode for the mixer. Automatic switching of the heating and cooling modes based on the set values under "BA" and "BB" or permanently set mode: heating only / cooling only.	automatic	Only heating /only cooling
BEQ	Logic	Configure mixer logic 0V = open - 10V = closed or 0V = closed - 10V = open	default	reversed
BER	Consumer regulation	If activated, the higher setpoint of the heat pump is always set to the highest set value (for heating) and lowest value (for cooling). That If a mixer set point is above the set or calculated setpoint in, for example, "BAA", the setpoint is taken by the mixer as switch-on and switch-off condition (value applies to mixer 1, mixer 2 as well as heating and cooling.	off	on
BFA	Mixer 2	Functions identical to mixer 1		

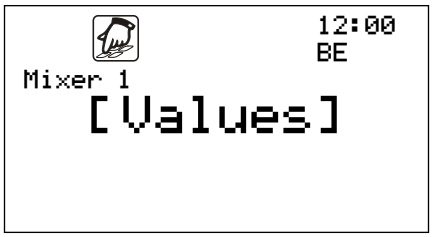
Control algorithms

The mixer is activated when TFlow mixer < (Setpoint heating value)
The mixer is activated when TFlow mixer > (Setpoint cooling value)

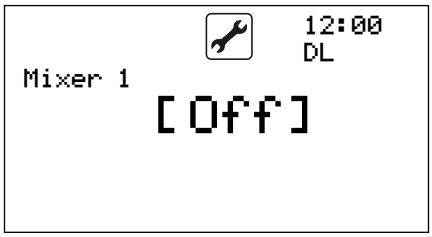
TFlow mixer is monitored during the set control period.

Via the analogue output a mixer is activated according to a 0V - 10V signal. If the deviation is more than 7K, the adaptation occurs in 1V increments. If the deviation from the setpoint is less than this, the adaptation occurs in 0.5V increments.

Mixer setting



Set the Setpoint for the mixer control in the menu



Switch on the mixer control and set the control period in the menu

10.5 Pump protection function

Inputs / Outputs

Outputs	Name
NO1	Source pump
NO2	Heating pump
NO3	Hot water pump (if valve is not set)

Parameters

Menu	Term	Description	Min	Max	Factory sett.
DD	Pump protec-tion	Switch on the pump protection function	Off	On	Off

Control algorithms

When pump protection is activated, every three days at 12:00am, the pumps are activated for one minute, to avoid seizing.

10.6 Anti-legionella function

Inputs / Outputs

Inputs	Name
B2	Hot water temperature

Outputs	Name
NO1	Source pump
NO2	Heating pump (only for WW valve, not for WW pump)
NO3	Hot water valve or pump

Parameters

Menu	Term	Description	Min	Max	Factory sett.
DEA	Legionella protection	Switch on the legionella protection function	Off	On	Off
DEB	Duration	Maximum duration for the function	0:00	2:00	1:30
DEC	Temperature	Temperature to which the water is heated	40	80	60
DED	Interval		Daily	Weekly	Weekly

Control algorithms

Depending on the setting for "Interval", the hot water system is heated up once a day (at 12:00am) or once a week (on Mondays at 12:00am) to the set legionella protection temperature, provided that legionella protection is set to "On". The function is activated for no longer than the set duration.

10.7 Solar support

Inputs / Outputs

Inputs	Name
B7	Collector temperature
B8	Lower storage tank temperature

Outputs	Name
NO12	Solar pump

Parameters

Menu	Term	Description	Min	Max	Factory sett.
AAG	Collector	Collector temperature	-	-	-
AAH	↓ storage	Lower storage tank temperature	-	-	-

	tank				
DNA	Solar	Activation of the solar circuit	Off	On	Off
DNB	Maximum	Storage tank maximum temperature	15	90	60
DNC	Start	Switch-on temperature difference	3	40	7
DND	Stop	Switch-off temperature difference	2	39	3

Control algorithms

If the temperature of the collector is greater than the temperature of the storage tank by the factor of the switch-on temperature difference, the output for the solar pump (NO12) is activated. Provided that the temperature difference between storage tank and collector is less than the switch-off temperature difference, the output (NO12) is deactivated.

10.8 Screed heating programme

Inputs / Outputs

Inputs	Name
B1	Outdoor temperature
B3	Flow temperature
B4	Return temperature

Outputs	Name
NO1	Source pump
NO2	Heating pump (only for WW valve, not for WW pump)

Parameters

Menu	Term	Description	Min	Max	Factory sett.
DPA	Screed heating	Switch on the floor heating programme	Off	On	Off
DPB	Start	Start temperature for the function	10	40	20
DPC	Stop	Stop temperature for the function	10	40	30
DPD	Delta T	Temperature level for the function	1	10	1
DPE	Duration	Duration of a temperature level in hours	1	60	1

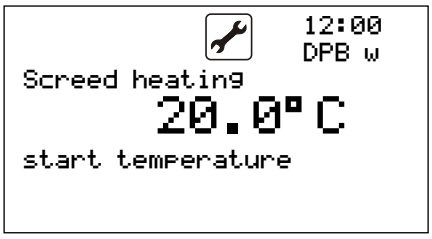
Control algorithms

Based on the start temperature the heating setpoint is increased incrementally by amount Delta T, until the stop temperature is reached. Once the stop temperature is reached, the process is reversed, and the target temperature is reduced again incrementally to the start temperature. The duration for one level is defined by the parameter Duration.

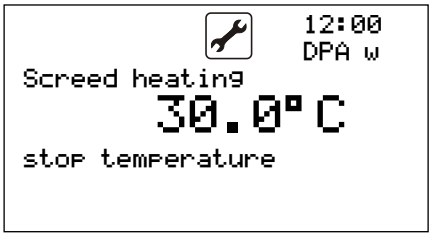
Caution! The heating programme takes precedence over the other control programmes and must be set to "OFF" again after completion.

Floor heating programme settings

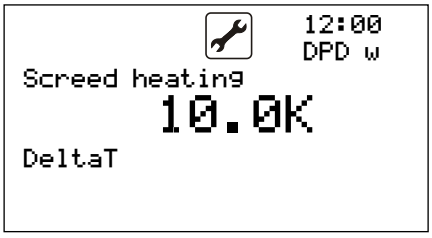
To activate the heating programme, the function is activated (after entering the password).



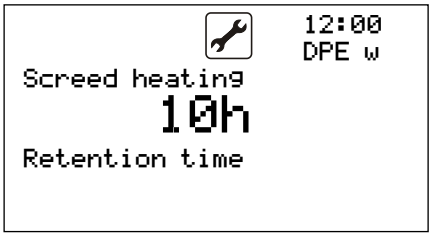
Set the start temperature.



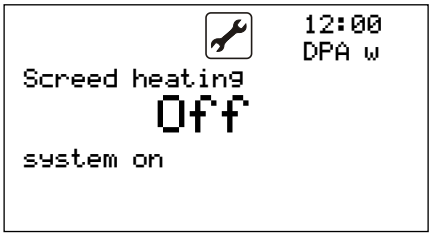
Set the stop temperature, then the system heats back up to the start temperature in this same period.



Set the Delta T temperature levels for each step.



Set the duration of each step.



Once the heating programme has ended, set it to "Off" again here. Otherwise only a frost protection programme is running.

10.9 Generator control

Inputs / Outputs

Inputs	Name
B1	Outdoor temperature
B3	Flow temperature
B4	Return temperature
B8	Limit temperature

Outputs	Name
NO6	Additional heating
NO8	Operation
NO9	Generator1
NO10	Generator2
NO11	Generator3
NO12	Generator4

Parameters

Menu	Term	Description	Generator 1		Generator 2		Generator 3		Generator 4	
			Min	Max	Min	Max	Min	Max	Min	Max
AAA	Outdoor temperature	Outdoor temperature	–	–	–	–	–	–	–	–
AAC	T flow	Flow temperature	–	–	–	–	–	–	–	–
AAD	T return	Return temperature	–	–	–	–	–	–	–	–
AAH	T limit		–	–	–	–	–	–	–	–
ACA	Status	Current status of the controller and the Generators	–	–	–	–	–	–	–	–
	For each Generator									
*A	Generator x	Switch the Generator on/off								
*D	T outdoor min.	Minimum outdoor temperature above which the Generator is switched on	-60	60	-60	60	-60	60	-60	60
*C	T outdoor max.	Maximum outdoor temperature below which the Generator is switched on	-60	60	-60	60	-60	60	-60	60
*E	Delay	Delay time until the system advances to the next Generator	0	180	0	180	0	180	0	180
*F	Blocking time	Off-period for the Generator after switch-off	0	120						
*G	T flow min.	Minimum flow temperature	5	80	10	80	10	80	10	80
*H	T flow max.	Maximum flow temperature	10	80	10	80	10	80	10	80
*I	Min. runtime	Minimum runtime for the Generator	0	120	0	120	0	120	0	120
*L	Operating hours	Enter the old number after making changes to the hardware or software								

(*) Generator menu: Generator1: DF; Generator2: DG; Generator3: DH; Generator4: DI

Control algorithms

The energy sources are switched on in the sequence 1 – 4 as required. During this process, the switch-on conditions of the Generator are first checked (temperatures, faults, etc.). If demand has not been satisfied after the defined delay time, the respective following energy source is switched on. For each Generator, a minimum runtime and reactivation block are monitored.

All four Generators are also switched off for tariff shut-offs. If external energy sources are to be activated by the controller, this should be taken into account.

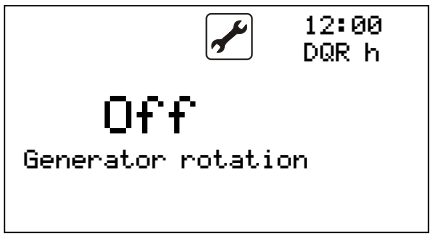
11 Special applications

11.1 Operation with electric heating element only

To deactivate the heat pump and establish operation using the electric heating element only, all Generators must be set to "Off". The additional heating must be activated. Moreover, additional heating automatically ensures use of emergency operation whenever an alarm occurs. It has two basic modes:

- Emergency operation: Heating circuit is heated up to a flow temperature of 25°C.
- Normal operation: Additional heating operates in hot water and heating mode and uses the setpoint setting.

11.2 Alternating Generator activation



If two, three or four compressors are working as Generators, you can release alternating activation. Then upon each activation, the operating hours are used to determine which Generator to switch on first.

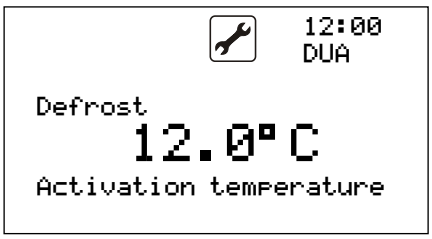
The operating hours can be viewed in the Information menu.

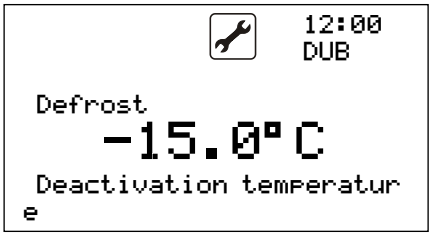
11.3 Defrost functions

Defrost function type 1

Under the  Basic settings menu item you can configure the Defrost screen. The defrost function enables the register on an air/water machine to be defrosted.

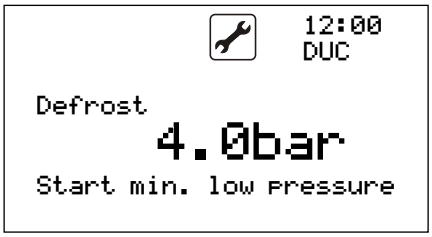
The defrost function is controlled by the pressure and outdoor temperature. Depending on the outdoor temperature, the defrost cycle can be activated and completed according to the settings, using a low pressure value and/or a temperature difference between the suction gas temperature and the outdoor temperature. The defrost phase only ends once the high pressure setpoint is reached or the max. defrost period is exceeded.

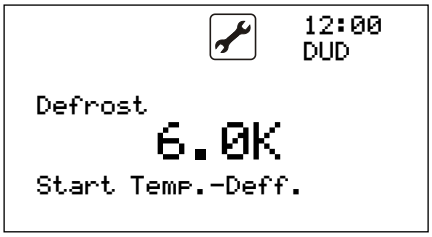




The activation temperature is the outdoor temperature from which the defrost function can be used. The deactivation temperature is the outdoor temperature from which the defrost function can no longer be used. These temperatures define a range within which the defrost function is activated.

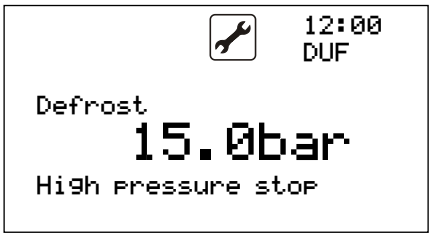
Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.





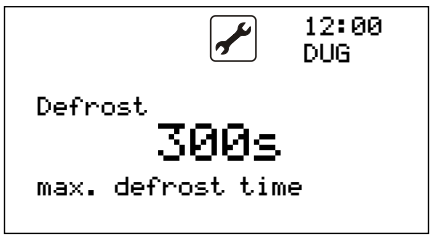
The set low pressure value or temperature difference specifies the operating point from which defrosting should start. The operating point must be present at least for the set control time, in order to fulfil the defrost condition.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.



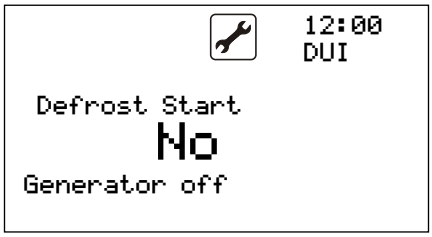
The set high pressure value ends the defrost cycle once the value is reached, though not before the set time has elapsed.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.



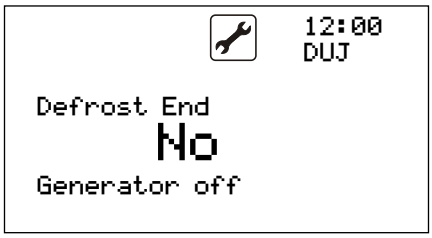
The blocking time specifies how long the period of time between two defrost cycles should be. Within this off-period, no defrost cycles are started, even if the conditions are in place.

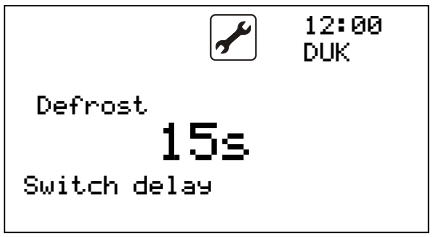
Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.



The defrost cycles can be started or ended by running Generator

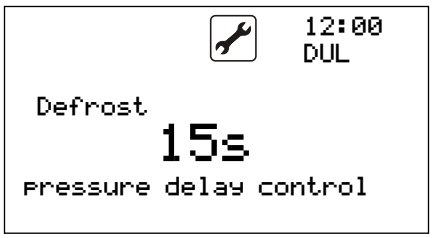
Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.





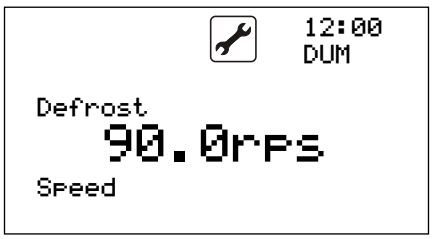
The switching delay specifies how long the four-way valve will remain in its initial state before being switched, after "Generator off" or after the minimum speed is reached.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.



When initiating the defrost cycle, low pressure monitoring of the sensor can be suppressed for the set period of time.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.



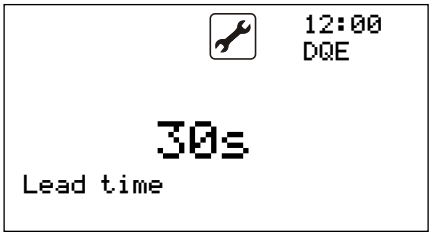
This parameter is the max. speed at which the compressor can run in defrost cycle.

Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

11.4 Lead time and shut-off delay

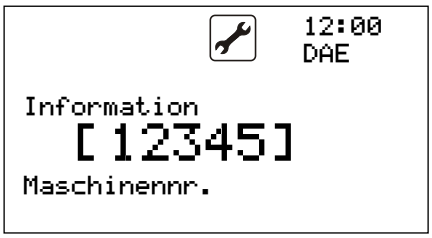
I

n the Basic settings, under "Options", you can set lead time and shut-off delay for the source and sink units.



Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

11.5 Serial number

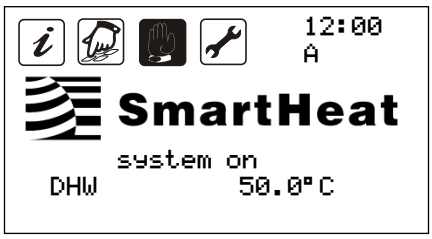


The serial number is entered in the factory and can be viewed in the Basic settings.

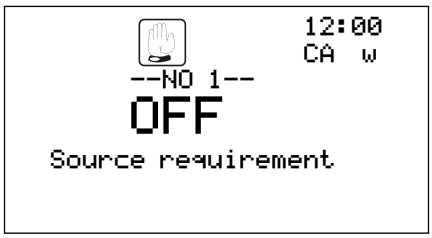
11.6 Manual mode

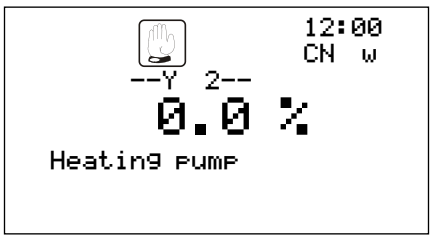
Manual mode is a function used exclusively for fault rectification and may only be employed by trained specialists. Activating manual mode bypasses or deactivates all control functions

Manual mode is activated by confirming selection of the  menu by pressing ↵. All connected outputs can be switched on and off manually.



Activate by pressing ↵. The outputs are all deactivated. Select the desired output with ↑ or ↓. Press ↵ once to enable the cursor. Cancel with Esc or press ↵ twice to confirm.





Press Esc to exit manual mode and reverse all manual settings.

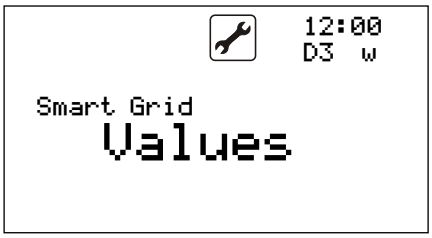
11.7 Smart Grid

The control unit provides the option to connect with Smart Grid systems. Two inputs are provided for this purpose which, depending on the switching state, will cause a modification of the operating parameters.

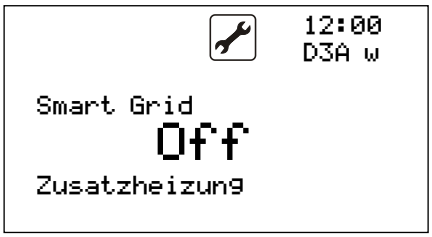
Smart Grid 1 (DI 9)	Smart Grid 2 (DI10)	Effects on the operating parameters
0	0	The control operates without making changes to the set parameters.
1	0	The control disables the system. This state is used for an energy supplier shut-off.
0	1	The control operates with the first increase of the setpoints is stored in the Basic settings.
1	1	The control operates with the second increase of the setpoints is stored in the Basic settings. This operating state also makes it possible to distinguish whether the electric additional heating should be used to fulfil the demand. This option is defined in the Basic settings.

0…Contact closed*
1…Contact open*

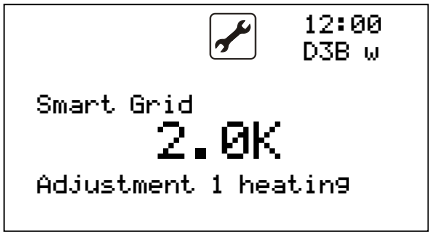
* Depending on the configuration of the digital inputs (masks: "DQOU" & "DQOV")

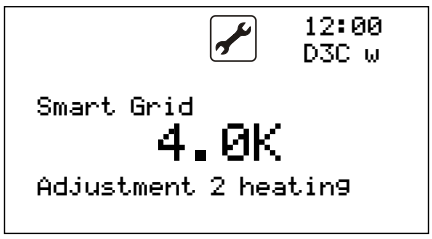


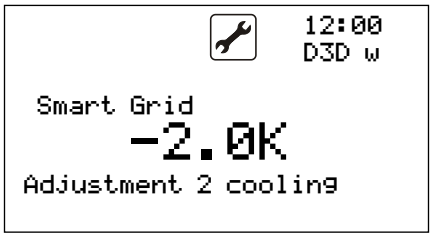
Select the desired setting values by pressing ↵ and then ↑ or ↓.

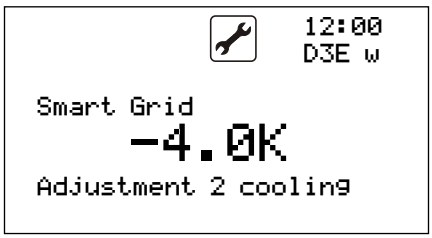


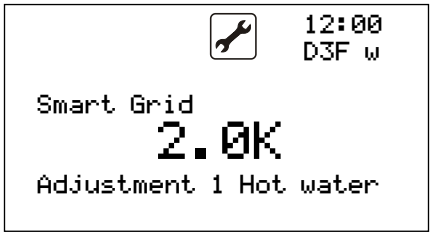
Press ↵, then ↑ or ↓ to set the desired value, and press ↵ twice to confirm.

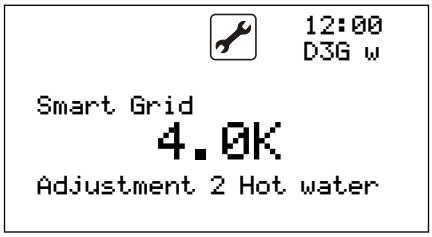












11.8 Pump control with hot gas heat exchanger

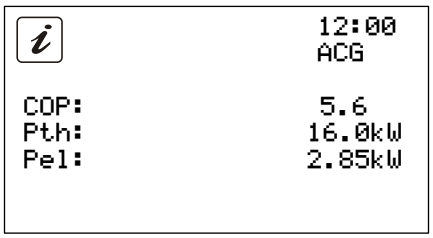
If the heat pump is addition equipped with a hot gas heat exchanger, then there is a possibility to charge the DHW tank with modulation 0-10V pump.

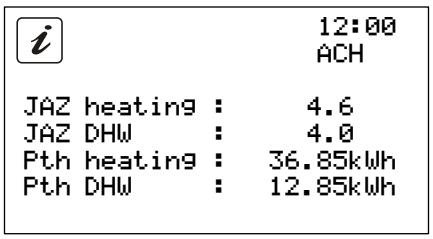
Is the function in the controller activated then the additional “hot gas heat exchanger”- pump will start at a settable hot gas temperature with minimum rotation speed. Is the hot gas flow temperature exceeded the configured hot gas flow temperature setpoint, then the pump will speed up all “x” seconds and increased by 0,5V. Falls the hot gas flow temperature below the hot gas flow temperature setpoint, then the pump speed will be decrease till the minimum allowed pump speed is reached. Is the flow temperature of hot gas temperature lower then setpoint of “hot gas flow temperature” or the setpoint of the heat pump is reached or the heat pump will be disabled then the controlling of the pump will be disabled with a “pump shut off time”.

This function works in heat, cooling and hot water mode. If this function will be used, then the function mixer1 will be disabled.
To parametrize this function see mask “DK”.

11.9 Seasonal Performance Factor (optional)

There are optional possibilities to display the different Power-maps about the heat pump. This are showed, if they are activated in the information mask “ACG” and “ACH”





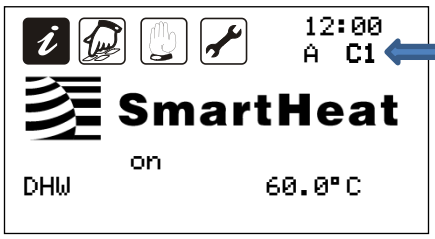
This function will be activated in the manufactory or by a specific release code.

You can activate it in the mask „DSA“ if you got the code

For release you need to contact manufacturer.

11.10 Machines compound

The controller offers the function of operating several controllers in the network via the native bus system. This makes it possible to transfer values of the sensor inputs from the master to the following controllers. The controller with the pLAN address 1 is automatically the master. Each controller can be configured as a master, but there may only be one per bus system.



C1 means Unit 1 / Circuit 1

C2 means Unit 2 / Circuit 2

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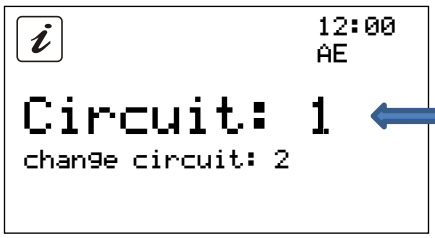


You can change the channel in the information menu on the "AE" screen

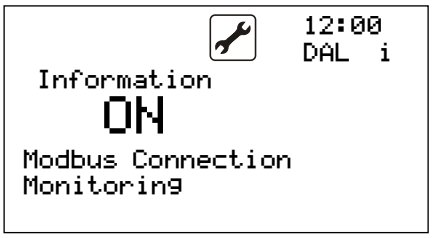
Here, the circle currently activated in the view is displayed.
To change press the "Enter" button:
Value = 1 circle1
Value = 2 circle2
Value = 3 circle3 ...

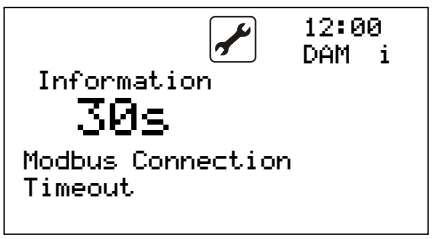
Values transfer:
If a combination of machines with the same software version exists, it is possible to transfer the sensor inputs. The sensor values are only transferred from the master (pLAN address1) to the other controllers. It is not possible to transfer "slave" machines (pLAN address> 1) to the master.

To do this, the pLAN transfer must be switched on in the Options menu under Configuration Inputs.

If the pLAN connection is disconnected, the controller's own input is automatically evaluated.

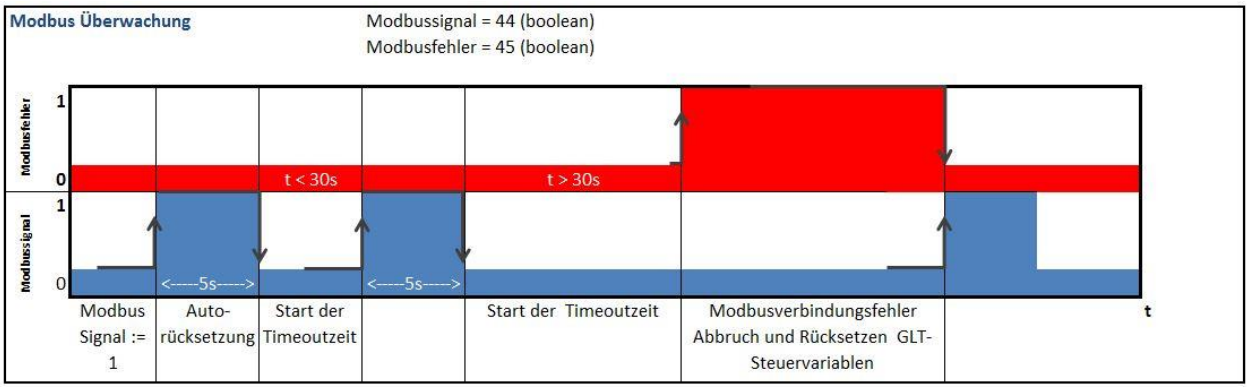
11.11 Modbus monitoring





You can integrate the heatpump controller in a **B**uilding **M**anagment **S**ystem (BMS) and because of this; you need maybe a Modbus connection monitoring.

That the monitoring function works, you need to activate it in mask “DAL”.After this, the BMS must set all 5-6second a modbus check variable to value true. (see supervisor list). The value will automatically reset to false to check the Modbus connection. Will the Modbus check variable set not set back to “true” then it will occurred a alarm message auf a Alarm delay (Mask “DAM”)



11.12 Extensionboard

The Extensionboard allow to use a lot of additional function. To use this you must connect both controllers with the pLAN connection.

11.12.1 Extensionboard – Leakage Sensor

It is possible to integrate a leakage sensor over the extensionboard. The leakage sensor will measure the refrigerant concentration in the air. The measuring range is from 20 to 2000ppm.
The leakage sensor must activate in mask “DQ2A”. In the following masks you can set the first warning value and the alarm value. The default setting for warning value is 1500ppm. If this value is exceed it will occurred a warning message and an entry in a history mask. If the alarm value is exceeded then it will occurred a alarm message, an entry in history mask and a activation of the external suction pump. The pump will activated till the low- and high pressure is under 0,0Bar.For a premature deactivation of the suction pump you can open the digital input 1 (ID1). The actual measure leakage sensor value you can read in mask “DAW”. The pLAN connection must always be active; otherwise it occur an error message.
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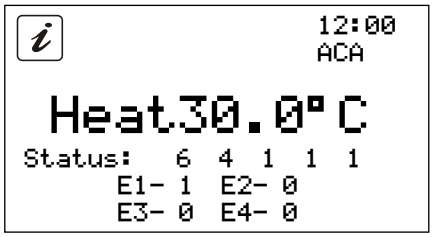
12 Status indicator

You can obtain comprehensive information about the current status of the heat pump from the status indicator in the Information menu; here, for example, is the indicator for a standard compressor:



		Generator 1	Generator 2	Generator 3	Generator 4
Status	**6**	**4**	**1**	**1**	**1**

	0 Switch off	0- Switch off
	1 Off	*1- Off*
	2 Flow	2- Delay for advance
	3 Hot water	3- Wait for minimum runtime <Minimum runtime still in progress
	5 Legionella protection	*4- Normal operation*
	6 Heating	6- Outside of temperature window (see below)
	8 Cooling	8- Fault
	10 Pump protection	9- Switch-on delay
	12 Run-on	10- Defrost

HEAT 30°C

HW	*Hot water*	*Setpoint 45°C*
Heat	Heating	*Setpoint* 30°C
Legi	Legionella protection	*Setpoint* 60°C
Screed	Screed programme	*Setpoint* 30°C
	No tariff	

E1: 1	**E2: 0**	**E3: 0**	**E4: 0**

0 Off	-1 Outside of outdoor temperature window
1 On	-2 Outside of limit temperature window
3 Defrost	-3 Outside of Flow temperature window
	-4 Fan off
	-8 Delay time
	-9 Fault

13 Reset

The controller has a processor, just like a computer. Incorrect operation or overload can cause it to "hang". In such a case, it is possible to reboot the control by briefly disconnecting it from the power supply.

14 Resistance tables

Please use only the sensors prescribed by us, as other sensors can cause deviation in the measured values, thus significantly influencing the operation of the system.

Temperature in °C	Resistance in kΩ	Temperature in °C	Resistance in kΩ
-50	329.5	**25**	**10**
-45	247.7	30	8.31
-40	188.5	35	6.94
-35	144.1	40	5.83
-30	111.3	45	4.91
-25	86.43	50	4.16
-20	67.77	55	3.54
-15	53.41	60	3.02
-10	42.47	65	2.59
-5	33.9	70	2.23
0	27.28	75	1.92
5	22.05	80	1.67
10	17.96	85	1.45
15	14.69	90	1.27
20	12.09	95	1.11

Table 1 NTC resistance values

Temperature in °C	Resistance in kΩ	Temperature in °C	Resistance in kΩ
0	161.638		
5	126.023	65	10.443
10	98.99	70	8.778
15	78.31	75	7.41
20	62.372	80	6.281
25	**50**	85	5.345
30	40.332	90	4.566
35	32.726	95	3.916
40	26.706	100	3.369
45	21.913	105	2.909
50	18.074	110	2.52
55	14.982	115	2.191
60	12.479	120	1.91

Table 2 NTC HT resistance values

Voltage in V	Pressure in bar (sensor up to 9.3 bar)	Pressure in bar (sensor up to 34.5 bar)	Pressure in bar (sensor up to 17.3 bar)	Pressure in bar (sensor up to 45 bar)
0	-1	0	0	0
0.5	0.03	3.45	1.73	4.5
1	1.06	6.9	3.46	9
1.5	2.09	10.35	5.19	13.5
2	3.12	13.8	6.92	18
2.5	4.15	17.25	8.65	22.5
3	5.18	20.7	10.38	27
3.5	6.21	24.15	12.11	31.5
4	7.24	27.6	13.84	36
4.5	8.27	31.05	15.57	40.5
5	**9.3**	**34.5**	**17.3**	**45**

Table 3 Pressure transmitter values, 0-5V