Automation System TROVIS 5400
Heating and District Heating Controller
TROVIS 5431

Mounting and operating instructions

EB 5431 EN

Firmware Version 1.20

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TROVIS® Electronics from SAMSON

CE

Contents

1 General

The TROVIS 5431 Heating and District Heating Controller is designed for weather-compensated flow temperature control of heating systems. These "Mounting and operating instructions" describe how to operate the controls including the controller switches and keys as well as describe the electrical connection and the mechanical installation. In addition, they describe the comprehensive configuration and parameterization options. Please note, however, that you require expert knowledge to change the configuration and parameterization of the heating control system. Once you have connected it to the mains and the controller is supplied with auxiliary power, it is basically ready for operation. Since its operation is based on time schedules, however, it is absolutely required that you set the current time and date. To do this, follow the step-by-step instructions starting on page 20.
The controller stores configuration and parameterization data even over prolonged periods of storage without being connected to a power supply source. Only time, date and year must be reset after an extended power failure.
The factory default is set to heating operation from 7 a.m. to 10 p.m. and, if applicable, to provide hot drinking water twenty-four hours a day. (The heating and district heating controller does not necessarily control the drinking water heating in all systems!) If you want different operating times, you have to change the time-of-use. For a detailed description of how to change the time-of-use, refer to page 23 ff.
The index in the back makes it easier for you to quickly access information on a specific subject.
To simplify reading, the device is referred to as "heating controller" instead of "heating and district heating controller" hereafter.

1.1 What's new compared to the previous version?

For Version 1.20, the external request function was revised (see chapter 5.4.4.).

2 Warning

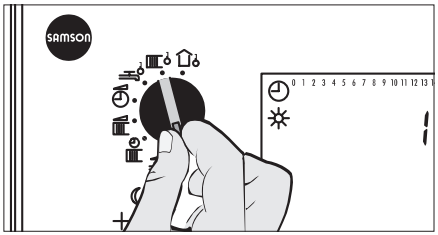
- Assembly, start-up and operation of the device may only be performed by trained and experienced personnel familiar with this product. Proper shipping and appropriate storage are assumed.
- The heating controller is designed for use in power installations. For connection and maintenance you are required to observe the relevant safety regulations.
- In automatic operating mode (time-controlled operation), the device ensures that all protective functions that are vital for the system are monitored. Safety features, such as frost protection monitoring and excess temperature monitoring, however, are not active in the following cases: defective heating controller and failure of functions; defective or not connected sensors, or sensors which were not deactivated; missing auxiliary power supply to the heating controller.
- The installation of the controller and its electrical connection described in the following, must be carried out by authorized personnel only.
- In addition, changing function blocks and function block parameters (see chapter 3.3.4 and Appendix A) requires specialized knowledge of heating systems and should only be performed by an expert.

3 Operation

For an easier understanding of how to operate this controller, please unfold the last page of these "Mounting and operating instructions"! Switches and keys are used to operate the controller. You can access them by opening the transparent front door. Use switch (B) to change operating modes. Use switch (A) and keys (E) and (F) to prompt parameters such as temperature and setpoint as well as to determine the selectable controller functions and parameters. This will take you to different levels which are described in chapter 3.3. All the entered settings and the information you require are represented by symbols in the display (D).
You have the option of feeding the controller with configuration and parameterization data using a memory pen (see chapter 6).
The individual switches and keys as well as the operation on the different levels are described in the following chapters.

3.1 Operating controls on the front panel

3.1.1 Control switch (A)

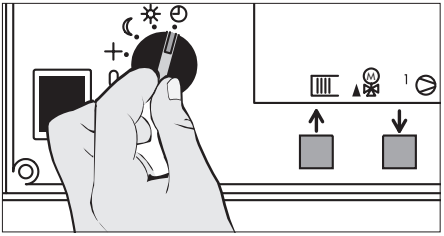


Use this switch to prompt several temperature values and set the most important parameters.

For a detailed description on the functions of this switch, refer to the Quick Guide KA 5431 EN.

- Displays **outdoor temperature**
- Displays **flow and return flow temperature of the heating circuit**
- Displays **storage temperature and charging temperature of the drinking water circuit** depending on the configuration
- Displays and changes the **time and date**
- Displays and changes the **parameters of the heating circuit**, depending on the configuration
- Displays and changes the **time schedule of the heating circuit**
- Displays and changes the **parameters of the drinking water circuit**, depending on the configuration
- **Standard operation via menus**, operation via arrow and enter keys, see chapter 3.3.

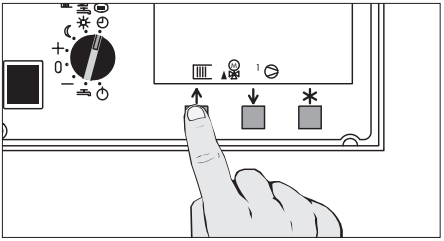
3.1.2 Mode selector switch (B)



Use this switch to select the operating mode:

- **Automatic operation:** The controller operates on a time schedule and switches between heating and set-back mode. Select this mode as default switch position!
- **Rated operation:** The controller continuously operates in heating mode.
- **Reduced operation:** The controller continuously operates in set-back mode.
- \+ / 0 / – **Manual operation:** The control valve is operated in manual mode:
  \+ open, 0 maintain, – close
  Use these switch positions for start-ups and repairs only!
- **Drinking water heating operation:** The drinking water is heated up according to the demand. The heating system is off.
- **Standby:** Heating and drinking water heating systems are off. The frost protection is active.

3.1.3 Arrow keys and enter key (E, F)



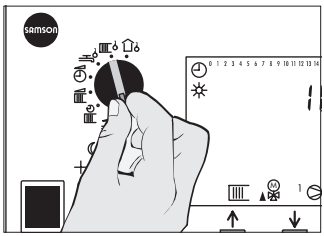
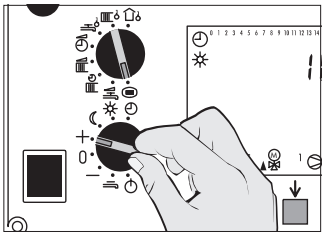
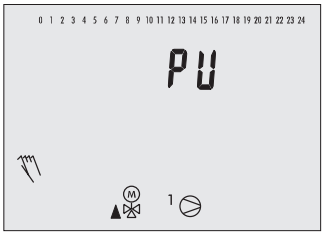
- ↓ ↑ Use the **arrow keys** to access the different levels up and down, select parameters and function blocks, increase and decrease values
- ✳ Use the **enter key** to activate levels, parameters, function blocks, to acknowledge changed values

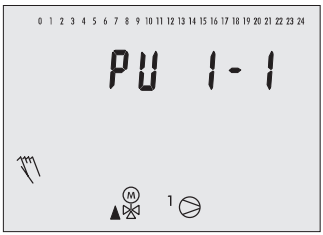
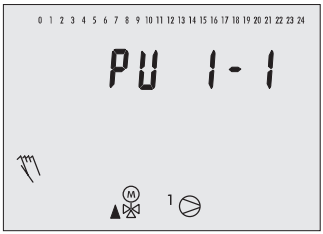
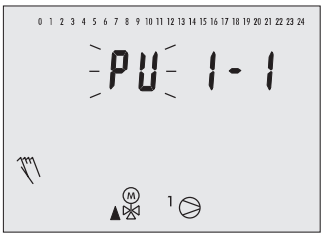
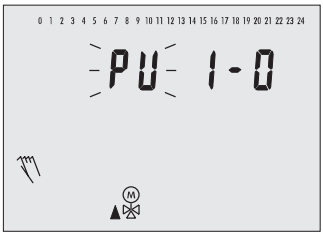
3.2 Manual operation

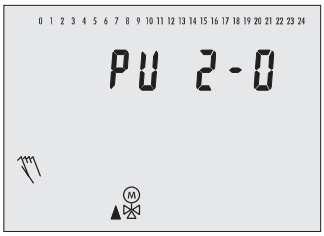
CAUTION

In manual operation, all outputs can be manipulated by the operator as desired. When you enter the manual operating mode, all limiting temperature values and logic interlock signals are inactive. The operator is responsible for the interaction between all outputs and the outcome!

Accessing the manual level

Press	Display	Comment
Set the control switch (A) to ▬		If you want to operate the control valve only, this switch position is not required. To manually operate the pumps, however, you must select this switch position to gain access.
Set the mode switch (B) to +, 0 or –		This allows you to operate the control valve (open, maintain position, or close). At the same time, the manual symbol appears on the display.
↑ until		You reach the pump level.

Press	Display	Comment
✳		You now have access to this level. On the display, you can see the heating pump HCP (PU 1). In this example, the pump is active: -1
either ↑ or ↓		Use the arrow keys to select the output you want to activate: PU 2 Heat exchanger charging pump HEP PU 3 Storage charging pump SCP PU 4 Circulation pump CP PU 5 Binary output BO1 PU 6 Binary output BO2 PU 7 Binary output BO3
✳		You have activated the selected output, PU blinks.
either ↑ or ↓		Activate the desired output, observing the following: Activate pump/binary output, display indicates, e.g. PU 1-1 or Deactivate pump/binary output, display indicates, e. g. PU 1-0.

Press	Display	Comment
✳		The settings are acknowledged. The display does not blink anymore. The equipment changed remains in this set position as long as the manual mode is active. If you want to activate more outputs, proceed with step 5; or exit the manual level as described below.

Exiting the manual level

Press	Display	Comment
Turn the mode switch (B) to leave position +, 0, -		You are now exiting the manual mode. The pump level, too, cannot be accessed anymore. The manual symbol disappears from the display.
or, if required, both ↑↓		To exit the pump level only, press both arrow keys together. The manual operating mode, however, remains active!

3.3 Control levels

CAUTION
Changes on the COPA level (configuration level) may cause defects in the system. Changes on this level should therefore only be made by trained staff!

Fig. 1 shows the level structure of the TROVIS 5431 Heating Controller. In addition, you can see which steps to follow in order to access the individual levels. These levels can only be accessed when the control switch (A) is set to ⬭. The controller has two main levels, the INFO level and the COPA level.
The INFO level comprises the operating level and the information levels. In the manual operating mode, you can also access a pump level and, in case of faults, the error level.
You can only access the COPA level, if you know the code number. It contains the parameter levels, the system code number levels and the configuration levels.
The information, parameter and configuration levels are marked with one of the following indices: 1, 2 or SYS. The indices are the same on all three levels. For instance, INFO 1, PA 1 and CO 1 (index 1) always refer to the heating circuit data; INFO 2, PA 2 and CO 2 (index 2) always refer to the drinking water heating circuit.
The heating controller's default setting is the operating level, indicated in Fig. 1 by the time "10:00". In addition, the display indicates the operating mode and the operating status with symbols. For an overview of the the most important symbols, refer to page 99.
NOTE: Two minutes after the last entry, the heating controller switches from the COPA level back to the operating level.

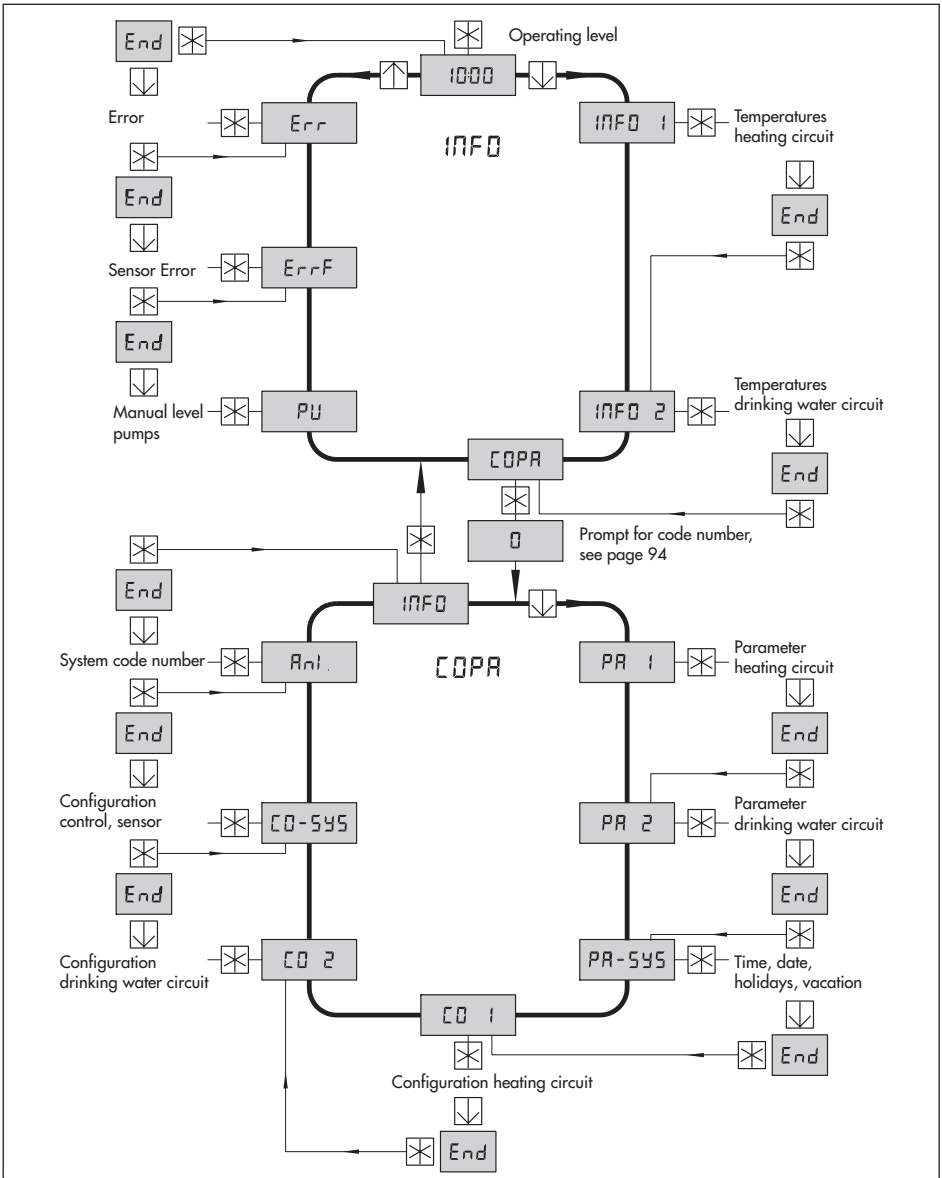


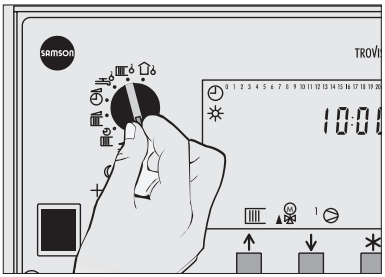
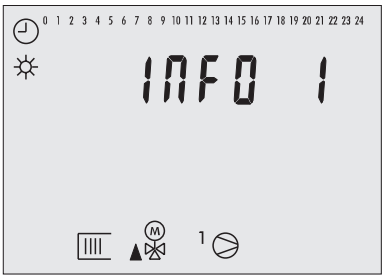
Fig. 1 · Control levels

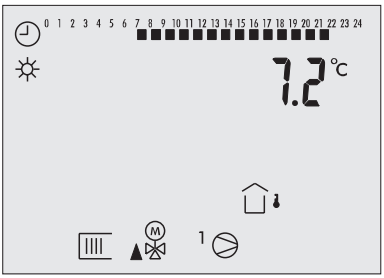
3.3.1 Info levels

The info levels (INFO 1, INFO 2) are used to indicate temperatures, for instance the flow temperature, return flow temperature and the storage temperatures. Which temperatures are indicated depends on the system code number and the configuration. For an overview of the symbols indicated on the display as well as their meaning, refer to page 82 ff.

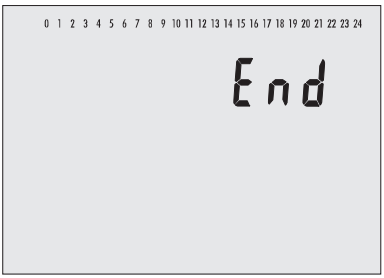
You cannot make any changes on the info levels.

Accessing an info level

Press	Display	Comment
Set the control switch (A) to ⊜		
↓ until		Press the arrow key until INFO 1 or INFO 2 appears on the display!

Press	Display	Comment
✳		You have accessed the selected info level. The display indicates the first temperature. This example shows the outdoor temperature.

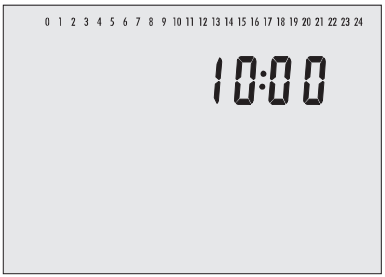
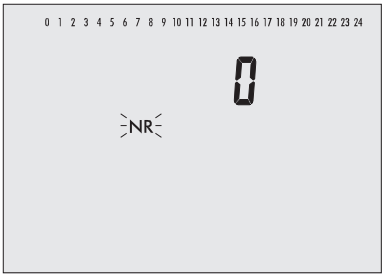
Exiting a level

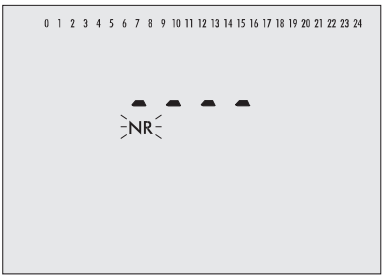
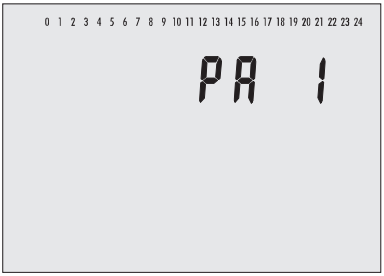
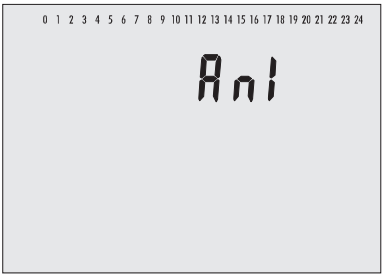
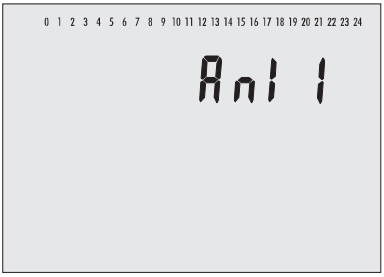
Press	Display	Effect
↑↓ both	Any	The display indicates the next level. **NOTE**: Should this function not work, a symbol blinks in the display, i. e. a function block or a parameter has been activated. In this case, you must first press the enter key.
	or	
✳		Each level ends with End. When you have reached End, press the enter key. The display indicates the next level.

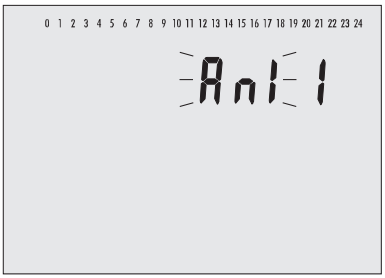
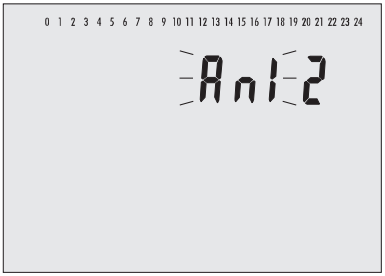
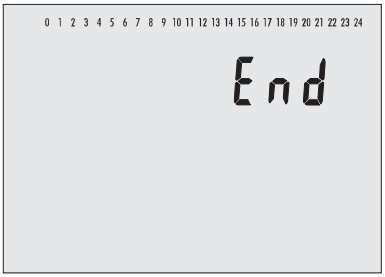
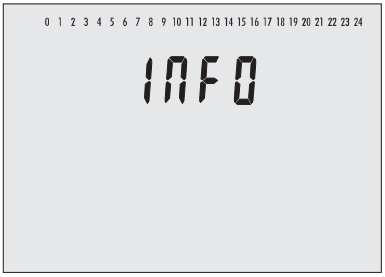
3.3.2 Changing the system code number

The heating controller differentiates between five system types which have been assigned system code numbers ranging from 1 to 5. These are determined in the configuration level under Anl (system code number). It not only identifies the heating controller inputs and outputs, but also determines the selectable function blocks and parameters. For an overview of the system types and the associated system code number, refer to chapter 4.

To change the system code number you must know the code number, proceeding as follows:

Press	Display	Effect
Set the control switch (A) to ⬭		The display should mirror this image, otherwise press both arrow keys together (several times, if required)
↑ until		The display indicates COPA! This is the gateway to the configuration level.
✳		This appears on the display. You are required to enter the code number.

Press	Display	Effect
↓ until		You reach the service code number, see page 97! **NOTE:** The longer you press the arrow key, the faster the displayed number changes.
✳		This confirms the code number! If you have entered the proper code number, PA1 appears in the display; otherwise, the display returns to “COPA”.
↑ twice		You have reached the system code number level with the display looking like this.
✳		The system code number level opens. The current system code number is indicated, in this example it is 1.

Press	Display	Effect
✳		You now activate the system code number. 'Anl' blinks.
↑ or ↓		Use the arrow keys to select your new system code number, which is 2 in this example.
✳		You confirm your new system code number.
✳		You exit the system code number level.

3.3.3 Parameter levels

On the parameter levels, you can change parameters that have been released by the configuration. The heating controller differentiates up to 3 parameter levels, depending on the system code number. These parameter levels are indicated by PA1, PA2 and PA-SYS. The indices 1, 2 and SYS match the indices used on the info levels and the configuration levels, i.e. index 1 for the heating system, index 2 for the drinking water heating system and the index SYS for system functions. The parameters are marked by a combination of display symbols. Refer to Appendix B for an overview. The most important parameters, such as date, time, times-of-use or the heating characteristic can be changed using the control switch. The operation with this switch is described in Quick Guide KA 5431 EN. You can only change parameters on the parameter levels when you know the code number.
For start-ups, you should change the parameters in the parameter levels because only here all parameters can be accessed.

If you want to change parameters, proceed as follows:

1. In Appendix B, look for the required parameter symbol(s), noting the index of the parameter level!
2. Access the COPA level and then the required parameter level PA1, PA2 or PA-SYS as described under 'Opening a parameter level'!
3. Change the parameter(s) as described under 'Changing a parameter'!
4. Exit the COPA level as described under 'Exiting the configuration level'!

Opening a parameter level (from the INFO level)

⬭ Set the control switch (A) to this symbol.
↑ Press the arrow key until the display indicates COPA. This is the gateway to the configuration level.
✳ Press the enter key. NR and 0 appear in the display. Here, you are expected to enter the code number.
↑ ↓ Use the arrow keys to set the code number.
NOTE: The longer you press the arrow keys, the faster the display changes.
✳ Acknowledge the code number with the enter key. PA1 appears in the display.
↓ Continue to press the arrow key until parameter level PA2 or PA-SYS appears in the display!
✳ Press the enter key! The level you selected is opened. The first parameter appears.

Changing a parameter

Access the parameter level as previously described!

↑ or ↓ Press the arrow key until the desired parameter appears!

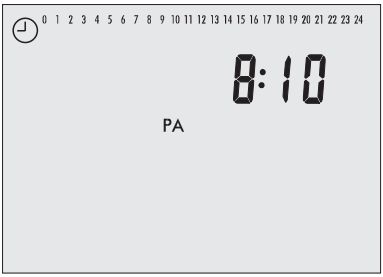
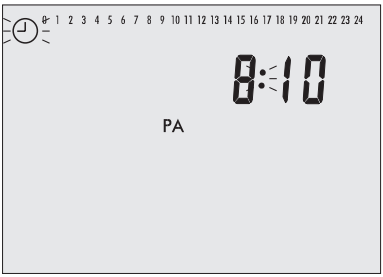
✳ Press the enter key to activate the parameter. A symbol blinks in the display. You can now change the parameter.

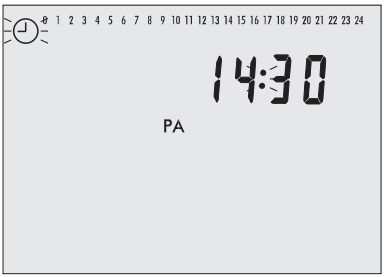
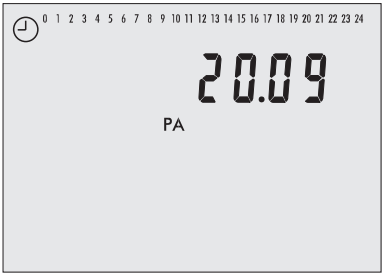
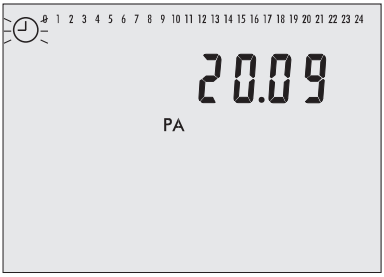
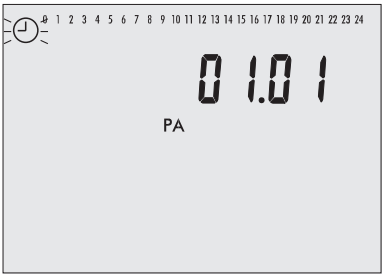
↑ or ↓ Use the arrow keys to set the new parameter value!
The longer you press an arrow key, the faster the value changes.

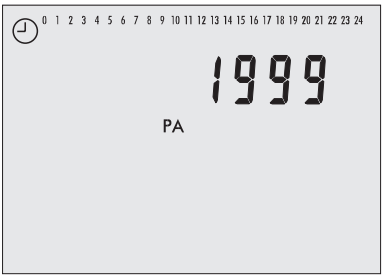
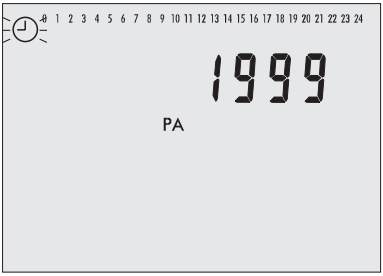
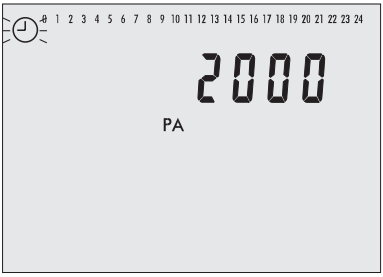
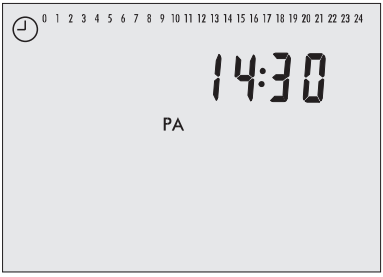
✳ Press the enter key to acknowledge the new value!

↑↓ both Press both arrow keys simultaneously to exit the COPA level.

Setting the time, date and year

Press	Display	Effect
Set the control switch (A) to 🕒		The display indicates the time. **NOTE**: You can also set the time, date and year in PA-SYS.
✳		Accesses the time so that you can change it. The small clock symbol in the top lefthand corner and the colon are blinking. You can now change the time.

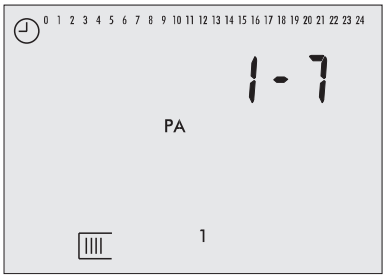
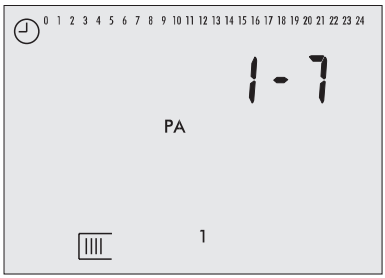
Press	Display	Effect
↑ ↓		Sets the current time. **NOTE**: The longer you press on the arrow key, the faster the display changes.
✳		Acknowledges the set time. The adjusted date appears on the display indicating day.month (20.09).
✳		Pressing the enter key activates the date for entering changes. The small clock symbol in the top lefthand corner blinks. You can now change the date.
↑ ↓		Sets the current date.

Press	Display	Effect
✳		Acknowledges the set date. The year set appears on the display.
✳		Pressing the enter key activates the year to change it. The small clock symbol in the top lefthand corner blinks. You can now change the year.
↑ ↓		Sets the new year.
✳		Acknowledges the set year. The (newly set) time appears. You have returned to your starting point after having updated time and date.

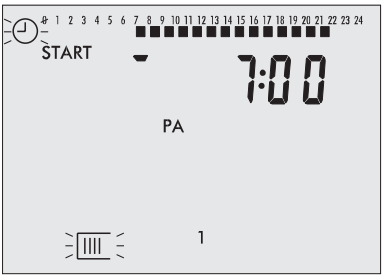
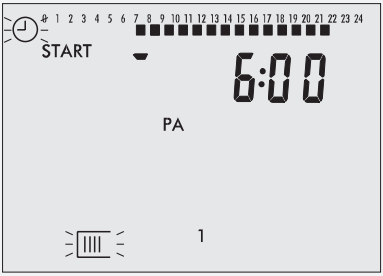
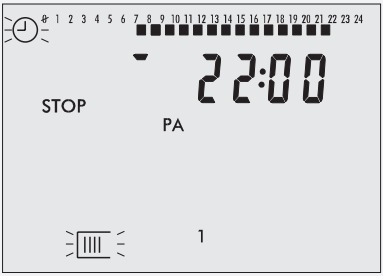
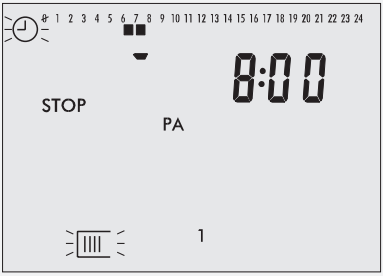
Changing the times-of-use

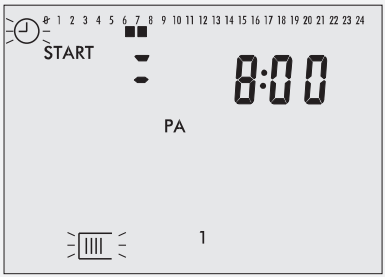
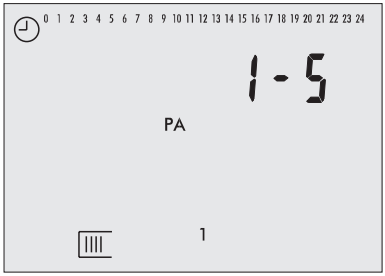
You can set the times-of-use separately for the heating system, the drinking water heating system and the circulation pump. You can directly access the time-of-use for the heating system via the control switch (A). The times-of-use for drinking water heating and the circulation pump are set on the parameter level PA2. For the symbols, refer to page 79. For all other adjustments, proceed as described below.
You can set three different periods for the time-of-use for each of the above systems.

Example: You want to change the times-of-use for all days of a week. Up to now, the period set for the time-of-use was 7:00 (a.m.) to 22:00 (10 p.m., factory setting). Now, you want to change the times-of-use to the following setting: 6:00 (a.m.) to 8:00 (a.m.), from 12:00 (p.m.) to 14:00 (2 p.m.) and from 19:00 (7 p.m.) to 23:00 (11 p.m.). To enter these settings, proceed as follows:

Press	Display	Effect
Set the control switch (A) to		**NOTE**: You can also adjust times-of-use on levels PA1 and PA2.
(either ↑ or ↓)		Pressing the arrow keys (up or down) lets you choose the day(s) for which you want to change the time-of-use: 1-7 (all days of a week), 1-5 (Monday to Friday), 6-7 (Saturday and Sunday) or 1, 2, …, 7 (Monday, Tuesday, …, Sunday). For this example, select 1-7.

NOTE: When selecting 1-7, 1-5 or 6-7, the times-of-use on those days are reset to factory default. Therefore, do not use these menus to check the times-of-use settings! To check, use the individual days 1, 2, ...7 only!

Press	Display	Effect
✳		The display indicates the start time for the first period-of-use, i.e. 7:00 (a.m.) The clock symbol and the heating symbol are both blinking!
↑ or ↓		Adjusts the start time for the first period 6:00 (a.m.). **NOTE**: Times-of-use can only be adjusted in 30-minute intervals. At the edge of the display, the adjusted times (full hours) are represented as black squares.
✳		Pressing the enter key confirms the new start time. The display now indicates the stop time for the first period-of-use, i.e. 22:00 (10 p.m.).
↑ or ↓		Adjusts the stop time for the end of the first period-of-use, i.e. 8:00 (a.m.).

Press	Display	Effect
✳		Pressing the enter key acknowledges the new stop time. The display now indicates the start time for the second period-of-use, i.e. 8:00 (a.m.) in this example, which is the stop time from the previous period-of-use.
		Repeat this procedure for the second period-of-use from 12:00 (p.m.) to 14:00 (2 p.m.) and for the third from 18:00 (6 p.m.) to 23:00 (11 p.m.) exactly as for the first period; these steps are gray-shaded. You can recognize the second period by the two black bars in front of the time, the third period by three black bars. The display then indicates 1-5.

NOTE: If you only want to use one or two periods, proceed as follows: press the enter key to acknowledge START and STOP for the second and/or third period, with the time remaining the same.

3.3.4 Configuration levels

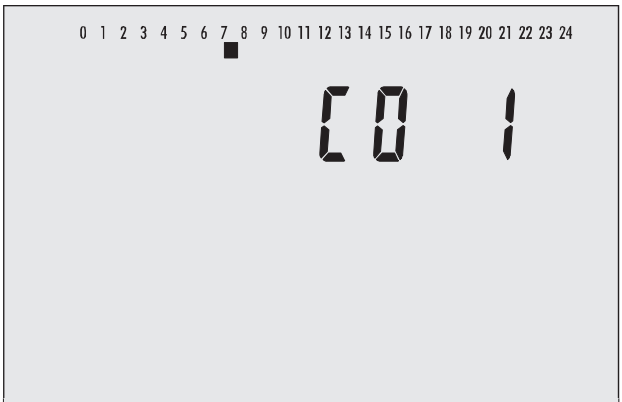


Fig. 2 · Representation of function blocks on the display

The heating controller has different configuration levels. Certain functions have been summarized on one level. Each configuration level consists of function blocks. The configuration levels are marked CO1, CO2 and CO-SYS, the function blocks are F01 to F13. On the CO1 level, you can determine the functions concerning the heating circuit, on CO2 for the drinking water heating circuit and on CO-SYS you can determine interconnecting system functions.
You can either activate or deactivate the function blocks. Activated function blocks are designated "-1", e.g. F01-1, deactivated function blocks with "-0", i.e. F01-0. For some function blocks, you are additionally required to adjust function block parameters. For the function block parameters, refer to Appendix A. When you access a CO level, the active function blocks are displayed on the top of the display as a black square, positioned offset to the right below its (function block) number, see Fig. 2.

To change function blocks, proceed as follows:

1. Refer to Appendix A to find the required function block. Make sure, the index matches the required CO level!
2. Access the COPA level, then access the required CO level as described under 'Accessing a CO level'!
3. Change the function block as described under 'Changing function blocks'!
4. Exit the configuration level as described under 'Exiting the COPA level'!

Accessing a CO level (from the operating level)

⊖ Set the control switch (A) to this symbol!

↑ Press the arrow key until the display indicates COPA!

✳ Press the enter key! NR and 0 appear in the display. Here, you are expected to enter the code number.

↑ or ↓ Use the arrow keys to set the code number!

✳ Press the enter key to acknowledge the code number! PA1 appears on the display if you entered the correct code number.

↑ or ↓ Use the arrow keys to select CO1, CO2 or CO-SYS!

NOTE: When CO1, CO2 and CO-SYS appear on the display, the top part of the display shows you which function blocks are active (black squares on the right below the number).

✳ Acknowledge using the enter key! The first function block appears.

Changing function blocks

Access the CO level as described above!

↑ or ↓ Continue to press the arrow key until the required function block Fxx appears!

✳ Press the enter key, activating the function block. The function block now blinks in the display, i. e. you can now change it.

↑ or To **activate** the function block, press the arrow key ↑.

↓ To **deactivate** the function block, press the arrow key ↓.

✳ Press the enter key and acknowledge this setting! Depending on how the function block is set, a square appears in the display on the top right below the F number (F is activated) or it disappears (F is deactivated). In addition, either the next function block appears in the display or a function block parameter. Changing function block parameters works the same as changing parameters on the PA levels, like this:

(if req.) Press the enter key to activate the function block parameter. The display should now indicate at least one blinking symbol.

↑ or ↓ Use the arrow keys to set the new value.

✳ Press the enter key to acknowledge the new value. The next function block parameter or 'End' appears on the display.

Change the next function block parameter as described, or exit the function block when 'End' appears on the display by pressing ✳. If necessary, edit more function blocks as described, or exit the CO level as folllows!

Exiting a CO level or a function block

↑ ↓ both — Press both arrow keys simultaneously! The display indicates the next level or the next function block.

NOTE: The display should not blink. If the display blinks, you must first press the enter key.

or

✳ Once you have reached 'End', press the enter key! The display indicates the next level or the next function block.

Exiting the COPA level

↑ ↓ both until — The display indicates the time.

or

Turn the control switch (A) briefly from its position ⬭.

---

4 System descriptions

The heating controller is designed to control five different system types which the device differentiates by means of a system code number. The system code number is determined on the configuration level under 'Anl'. Factory setting is 1. How to change the system code number is described in chapter 3.3.2. The following table lists the basic differences between the system types.
On the following pages, you will find a general introduction to each system type. In the diagrams, all safety equipment that may be required is represented by dot-dash lines.

If a temperature controller (TC) or a safety temperature monitor (STM) or an additional pressure limiter (PL) is required, you must use a control valve with safety function acc. to DIN 32730.
On the side of the heater, you are required to install a TC/STM combination, if required by DIN 4747 Part 1.
A pressure limiter (PL) must be installed, if DIN 4751 requires it.
You are required to install a TC/STM combination in a primary drinking water heating circuit, if required by DIN 4753.

System code no.	Description	Comments
1	Weather-compensated flow temperature control system with variable return flow temperature limitation	Without drinking water heating
2	Weather-compensated flow temperature control system with variable return flow temperature limitation and drinking water heating in a storage tank system	Storage tank charging optionally with storage charging pump SCP or via changeover valve with the heating circuit pump
3	Weather-compensated flow temperature control system with variable return flow temperature limitation and drinking water heating in a storage tank charging system	
4	Weather-compensated flow temperature control system with variable return flow temperature limitation and drinking water heating from the primary circuit with self-operated regulators	
5	Weather-compensated heating control system with drinking water heating system designed as instantaneous water heater	

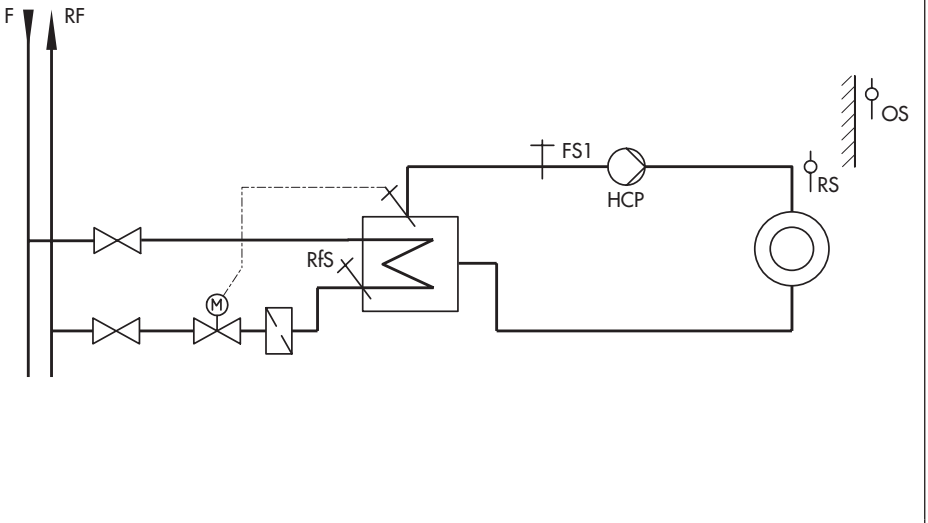


Fig. 3 · System code number 1

System code number 1
Weather-compensated heating control system without drinking water heating

- In rated operation, the heating circuit circulation pump (HCP) is running. The flow temperature set point value is determined according to the gradient of the heating characteristic or a 4-point setting of the heating characteristic, see chapter 5.4.1
- In reduced operation, the heating circuit circulation pump (HCP) is running. The flow temperature set point is reduced by the set back difference(s), see chapter 5.4.2

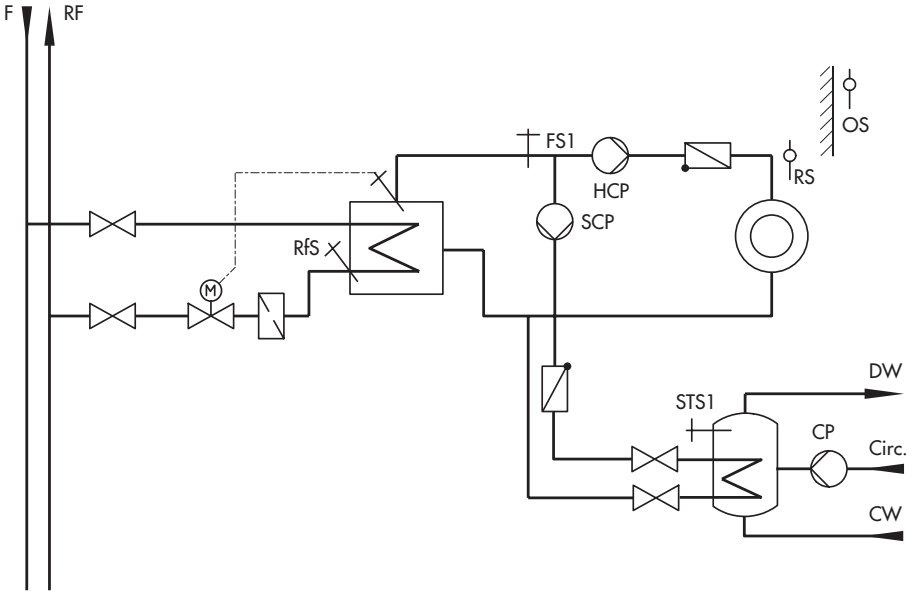


Fig. 4 · System code number 2

System code number 2
Weather-compensated heating control system with drinking water heating in a storage tank system

- Heating system as for system code number 1
- Drinking water heating system can be optionally equipped with one or two storage tank sensors or a storage tank thermostat, see chapter 5.5.1
- The storage charging pump (SCP) is controlled depending on the flow temperature
- Option of generating the required charging temperature via return flow sensor (RfS), see chapter 5.5.5
- Option of intermediate heating when the charging of the drinking water storage tank takes a long time, see chapter 5.5.3
- Option of parallel pump operation of circulation pump (HCP) (pump in the heating circuit) and the SCP, see chapter 5.5.8
- Optional activation of heating circulation pump (HCP) while the storage tank is being charged, see chapter 5.5.7

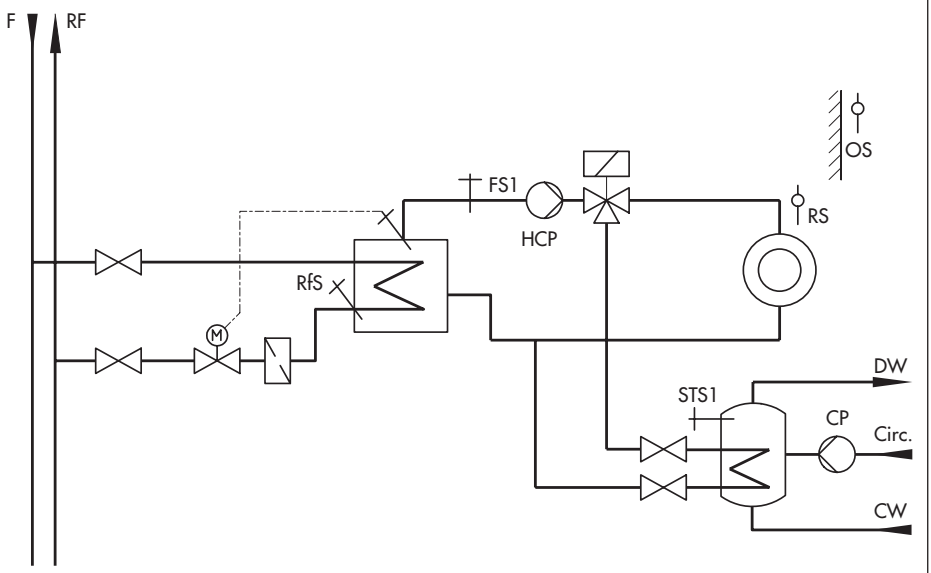


Fig. 5 · System code number 2 with changeover valve

System code number 2 with changeover valve
Weather-compensated heating control system with drinking water heating in a storage tank system with changeover valve

- Select this version of system 2 by choosing 2 in Co2 F06. The changeover valve must be a solenoid valve and connected to terminal 20.
- The control of the changeover valve depends on the flow temperature
- Drinking water heating system optionally available with one or two storage tank sensors or a storage tank thermostat, see chapter 5.5.1
- Generation of required charging temperature via return flow sensor (RfS), see chapter 5.5.5
- Option of intermediate heating when the charging of the drinking water storage tank takes a long time, see chapter 5.5.3
- Option of parallel pump operation of HCP and SCP, see chapter 5.5.8
- Optional activation of heating pump (HCP) while the storage tank is being charged, see chapter 5.5.7

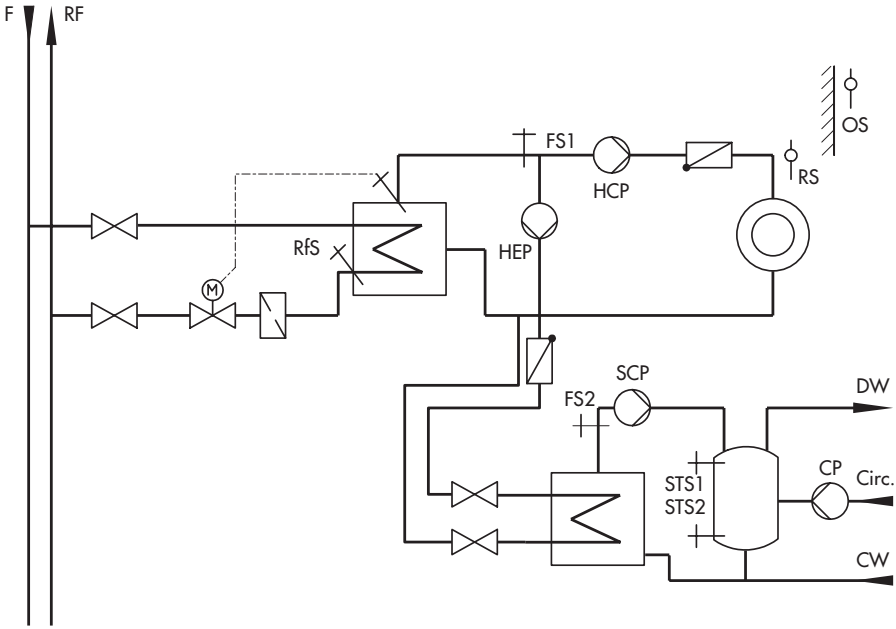


Fig. 6 · System code number 3

System code number 3
Weather-compensated heating control system with drinking water heating in a storage tank charging system

- Drinking water heating system optionally available with one or two storage tank sensors or a storage tank thermostat, see chapter 5.5.1
- The control of the heat exchanger pump (HEP) and the storage charging pump (SCP) depend on the the flow temperature at FS1
- Switchover of control to flow sensor FS2 for the drinking water heating , see chapter 5.5.4
- Option of intermediate heating when the charging of the drinking water storage tank takes a long time, see chapter 5.5.3
- Option of parallel pump operation of HCP and SCP, see chapter 5.5.8
- Optional activation of heating pump (HCP) while the storage tank is being charged, see chapter 5.5.7

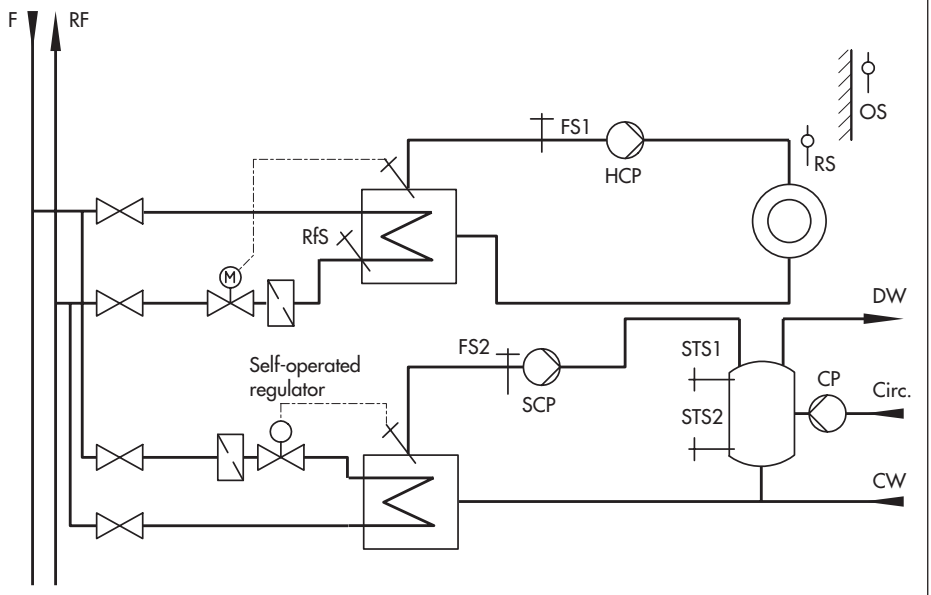


Fig. 7 · System code number 4

System code number 4
Weather-compensated heating control system with drinking water heating in a storage tank charging system

- Optional priority function for the drinking water heating circuit designed as reverse control or set-back control, see chapter 5.5.6
- If the system is not equipped with storage tank sensor(s), the storage tank temperature is regulated by the mechanical temperature regulator (self-operated regulator). The storage charging pump operates on a time schedule.
- If the system is equipped with storage tank sensor(s), the drinking water heating system operates according to the requests issued by the storage tank sensors. If the temperature in the storage tank falls below the limit value for start-up, the storage charging pump is activated. If the temperature in the storage tank exceeds the value for deactivation of the system, the storage charging pump is deactivated and finishes the charging process. The self-operated temperature regulator then regulates the charging temperature.

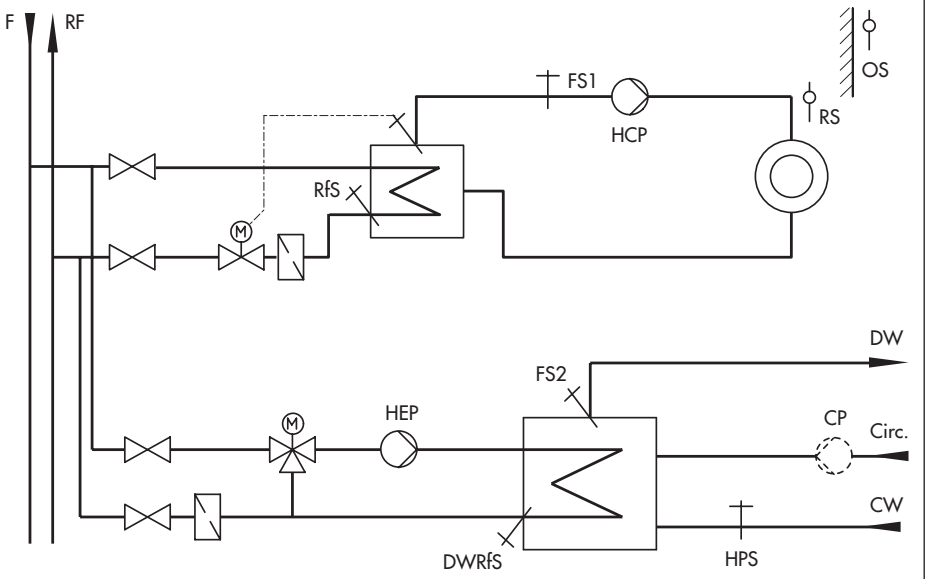


Fig. 8 · System code number 5

System code number 5
Weather-compensated heating control system with drinking water heating system designed as instantaneous water heater

- Drinking water heating via FS2 or thermostat, see chapter 5.5.12
- Heat exchanger pump is running when drinking water is demanded
- Option of increasing the control quality due to the system's feature of recognizing when drinking water is being tapped by means of a hydraulic pressure switch (HPS) or a drinking water return flow sensor (DWRfS), see chapter 5.5.13
- Option of improving the response behavior when using HPS or DWRfS through the following function: "Recharging the heat exchanger", see chapter 5.5.13
- Optional priority circuit for the drinking water heating system designed as reverse control or set-back control system, see chapter 5.5.6
- **NOTE**: For FS2, you must always use a quick-responding Pt 1000 sensor, independent of the other sensors. Only when the system is equipped with the option "BO3 only" can you activate the heating circulation pump (HCP).

5 Functional descriptions

It is absolutely required that you be familiar with the operation of the controller and know how to adjust function blocks, function parameters and parameters.

5.1 Inputs

5.1.1 Selecting the sensor (CO-SYS F02)

The heating controller can process either sensor signals from PTC sensors or from Pt 1000 sensors. You are required to determine the sensor used in function block CO-SYS F02.

Activation, i.e. F02-1, means you are using PT 1000 sensors; deactivation, i.e. F02-0, means you are using PTC sensors.

5.1.2 Calibrating the sensor (CO-SYS F08)

You can adjust the measured values of all connected sensors. When calibrating a sensor, the currently displayed sensor value must be changed to match the temperature value (reference value) measured directly at the point of measurement. To calibrate the sensor, proceed as follows.

1. On the CO-SYS level, select function block F08-1!
2. ✳ Press the enter key. The outdoor sensor is indicated together with its temperature value.
3. ↑ ↓ Use the arrow keys to select the sensor you want to calibrate (sensor symbol is indicated on the display, see page 85).
5. ✳ Press the enter key. This lets you access the calibration mode for the selected sensor. The sensor symbols are now blinking!
6. ↑ ↓ Use the arrow keys to set the reference value!
7. ✳ Press the enter key. This acknowledges the new value, and the next sensor symbol appears on the display.
8. Repeat steps 3. to 6., if you need to calibrate other sensors.
9. Exit the CO-SYS level!

5.1.3 Binary input for storage tank thermostat

See chapter 5.5.1.

5.1.4 Analog input AI (CO1 F08; CO-SYS F10, F11)

You can either connect the outdoor temperature or an external set point (external request) to the analog input AI. If you activate function block CO1 F08-1, the outdoor

temperature connected to AI is used, not the temperature at the outdoor sensor. The value range from 0 to 10 V corresponds to an outdoor temperature range from –40 to 50 °C.

CO1 F08 can only be activated when CO-SYS F10-0 and F11-0 are deactivated. For the processing of an external set point, refer to chapter5.4.4.

5.2 Outputs

5.2.1 Outputs to the control valve (CO-SYS F05, F15)

The heating controller can control the valve either by means of a three-step signal or an on-off signal. For systems 1 to 4, access the CO-SYS level, function block F05, to determine the appropriate signal output. In system 5, two control valves are being controlled, with function block F05 being used to determine the output or the heating circuit and F15 to determine the output for the drinking water circuit.

Activate function blocks CO-SYS F05 and F15 to generate a three-step signal. After activation of the function blocks, you are required to determine the following function block parameters: gain K_P, reset time T_N and the control valve's transit time T_Y. For system 5 in function block F15 additionally the derivative-action time T_V as well as the gain of the derivative-action component KpTv must be determined

If you want to generate an on-off signal, deactivate CO-SYS F05 and F15. For this output, you are required to additionally determine the following function block parameters: differential gap, minimum on-time and minimum off-time.

Connect control valves with on-off input to terminal 23 (system 1 to 4 and system 5 drinking water circuit) or to terminal 20 (system 5 heating circuit).

5.2.2 Limiting the system deviation for OPEN signal (CO-SYS F06, F16)

For three-step control, you can limit the system deviation of the OPEN signal by activating the function block CO-SYS F06 for the systems 1 to 5, and F16 for system 5 for the drinking water circuit. With the function block parameter 'maximum system deviation' (default 2 °C), the controller's reaction to set point changes which cause the control valve to open, is limited. Especially for steam pressure control and to simplify the start-up of such systems, it is recommended to activate this function.

5.2.3 Transmitting the outdoor temperature (CO-SYS F12)

Via analog output AO (0 to 10 V), the outdoor temperature can be transmitted to another controller, regardless of whether it is measured with a sensor or received via analog input AI (0 to 10 V). Activate CO-SYS F12-1, to enable this function. This is only possible if CO-SYS F10-0, i. e. request for an externally required signal off, and, if C01 F07-1, i. e. outdoor temperature on.

5.2.4 Pump management (CO1 F09)

You can use the optional binary outputs BO1 and BO2 to control a two-stage heating circuit pump. In the periods of non-use, the heating circuit pump is reduced to its minimum rotational speed.
The binary outputs BO1 and BO2 have the following function:

- BO1: Heating circuit pump on/off
- BO2: Activate rotational speed

The contact positions of BO1 are determined as follows: if the heating pump is to run, BO1 is closed.
You can configure the binary output BO2 like this:
CO1 F09-1: BO2 = Off when not used (binary output open)
CO1 F09-0: BO2 = On when not used
For the switching positions of the pumps, please refer to the installation manual of the relevant pump manufacturer.
Note: BO1 to BO3 are optional. They cannot be retrofitted.

5.2.5 Collective error message (CO-SYS F13)

If you activate function block CO-SYS F13-1, binary output BO3 is set in case of an error. Errors are also displayed on the information level on level " Err ". For an overview of the error messages, refer to page 62.
Note: BO1 to BO 3 are optional. They cannot be retrofitted.

5.3 Time-controlled functions

5.3.1 Time, date, year (PA-SYS)

The heating controller is basically ready for operation with the factory settings, however, you are required to enter the current time and date. How to enter the time and date is described on page 20 ff.

5.3.2 Delayed outdoor temperature adaptation (CO1 F05)

Use the function block CO1 F05 to activate/deactivate the delayed outdoor temperature adaptation. This function helps to prevent heating center overloads in combination with overheated buildings, or temporarily insufficient heating due to short-term outdoor temperature variations, e.g. caused by warm winds or excessive solar radiation to the outdoor temperature sensors.
For the temperature adaptation, a 'calculated outdoor temperature' is used: If the outdoor temperature changes within very short periods, these variations are considered only to a certain degree which is defined by the function block parameter 'Delay'. If this function block parameter is set to 3 °C/h (factory setting) and the outdoor temperature changes, for instance, by 4 °C within one hour, a vari-

ation of only 3 °C is considered for this period. The calculated outdoor temperature therefore changes slower than the measured outdoor temperature.
In case you have activated this function using CO1 F05-1, you can choose between two options: for temperature adaptation only when the outdoor temperature drops, choose "1"; for temperature adaptation independent of the outdoor temperature, choose "2". Following this, you must determine the function block parameter 'Delay' in a range from 1 to 6 °C/h.
When the described function has been activated, the outdoor temperature indicated on the InFo 1 level is the 'calculated outdoor temperature', if you keep the enter key ✳ pressed.

5.3.3 Automatic clock reset summer time/winter time (CO-SYS F03)

When you activate the function block CO-SYS F03-1, the heating controller automatically resets the clock to change between summer time and winter time as follows: On the last Sunday in March, the clock is set from 2:00 to 3:00 a.m., and on the last Sunday in October, from 3:00 to 2:00 a.m.

5.3.4 Summer time operation (PA1, CO1 F06)

In summer time operation, the control valve is automatically closed and the heating pump is switched off. The controller now reacts only to drinking water demands. On the display, you can recognize summer time operation by the symbol ☼.
The heating controller differentiates between two different summer time operating modes: the exclusively temperature-controlled summer time operation and the temperature-/time-controlled summer time operation. These two modes may have an overlapping effect as follows:

- The temperature-controlled summer time is directly activated, when the outdoor temperature exceeds the parameter 'Outdoor temperature limit for summer time operation' (PA1). When this limit value is not reached, heating operation immediately starts up again.
- The temperature-/time-controlled summer operation only becomes active, when CO1 F06-1 has been activated. The function block parameters connected to this function block are the following: 'Start of the summer period' and 'End of the summer period' (default 1/6 to 30/9) are used to determine the time period in which summer operation is permissible. If the average daily temperature between 7:00 (a.m.) and 22:00 (10 p.m.) exceeds the 'outdoor temperature limit value' (default 18 °C) on the adjusted 'number of days for start' (default 2 days), summer operation is initiated on the following day. Heating operation will not start again, unless the average daily temperature drops below the 'outdoor temperature limit value' again on the adjusted 'number of days for end' (default 1 day).

5.3.5 Public holidays and vacations (PA-SYS, CO2 F07)

On the PA-SYS level, you can enter public holidays and vacations. There is no default setting for public holidays and vacations.
On public holidays, the heating system operates based on the data entered for Sundays. During vacations, the heating system runs in the reduced operating mode. With the 'optimum' adjusted, the system runs in the operating mode which is intended for periods of non-use, see chapter 5.4.5.

Vacations and public holidays also apply to the drinking water heating system when you activate function block CO2 F07-1. On public holidays, the drinking water heating system then operates with the time data entered for Sundays, and it is not active during vacations.
The adjusted vacations and public holidays only become effective in automatic operating mode.

5.3.6 Times-of-use (PA1, PA2)

You can preset times-of-use, i.e. the times when the heating system is in operation and hot drinking water is produced, for three periods separately for each the heating system, drinking water heating system and the circulation pump. The circulation pump ensures that hot water continuously circulates in the hot water pipe which can be tapped immediately on demand.
Please note that the set times apply in automatic operating mode only!
The default time-of-use for the heating system is daily from 7:00 (a.m.) to 22:00 (10 p.m.), for the drinking water heating system as well as the circulation pump daily from 0:00 (midnight) to 24:00 (midnight). For a description on how to adjust the time-of-use, refer to page 23 ff.
You can enter the time settings for Monday to Sunday (1-7), for Monday to Friday (1-5), for Saturday and Sunday (6-7), or separately for every single day (1, 2 … 7 = Mon, Tue, … Sun). You can adjust three different times-of-use, each beginning with a START time and ending with a STOP time. This allows you, for example, to activate the heating in the morning (1st time-of-use), at noon (2nd time-of-use) and then again in the evening (3rd time-of-use). If you want to enter one time-of-use only, e.g. you want the heating system to continuously operate from the morning until the evening, you are required to adjust the second and third START and STOP times exactly like the first STOP time. The three times-of-use you entered are indicated on the display by one, two or three black bars.
NOTE: Each time you access the block settings 1-7, 1-5 and 6-7, the times-of-use are immediately reset to factory settings! Therefore, you should only review the data you entered for the individual weekdays 1, 2 … 7.

5.4 Control functions

5.4.1 Characteristic (CO1 F04)

The heating controller is designed for weather-compensated control of plants and is either based on a 4-point heating characteristic or the heating characteristic gradient. Factory setting uses the heating characteristic gradient. For your choice, select CO1 F04-0 for the gradient-based characteristic, or select F04-1 for the 4-point characteristic. The selected characteristic applies to both the flow and the return flow characteristic.

Depending on the selected characteristic, parameters listed below appear on the PA1 level or when the control switch is set to . For the maximum flow temperature and the minimum return flow temperature, the limit values can be defined on the PA1 level. These values are absolute limits which are used to limit the set points of the selected characteristic.

Gradient of heating characteristic (C01 F04-0, PA1)

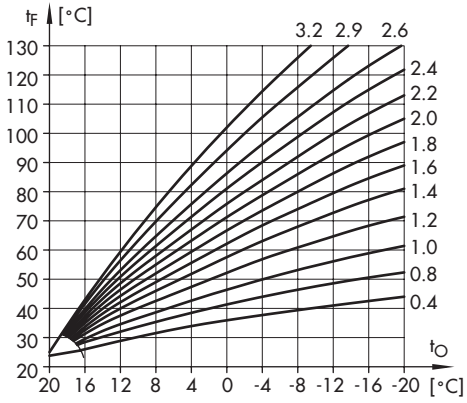


Fig. 9 · Gradient of heating characteristic

The heating characteristic gradient is determined by the parameter 'Gradient of heating characteristic' in a range from 0.2 to 3.2, see also Fig. 9. Use the parameter 'Level' to reach a parallel displacement of the characteristic. Positive values mean displacement upwards, negative values mean displacement downwards. In reduced operating mode, the flow temperature is reduced by the parameter 'Set-back of the flow temperature in reduced operation'.

4-point heating characteristic (C01 F04-1, PA1 or via control switch)

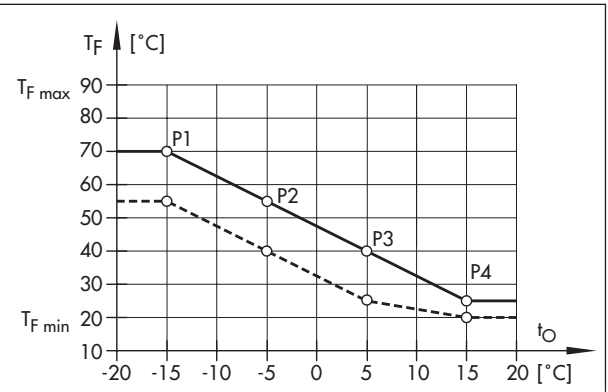


Fig. 10 · 4-point heating characteristic

For the 4-point characteristic, you must determine 4 points which indicate the correlation between the outdoor and the flow temperature. When you have selected the return flow sensor, you can also determine the return flow temperature for each point. This setting, however, is only possible on the PA1 level, and not via the control switch.
The points are determined with flow/return flow temperatures t_F / t_{RF} of 20 to 120 °C and outdoor temperatures t_O of –20 to 50 °C. Fig. 10 shows an example (factory setting of flow characteristic).
In the reduced operating mode, the characteristic is set-back by the 'set-back temperature'. For this, you must enter a set-back temperature for the points P1 and P2 as well as an additional set-back temperature for P3 and P4. The factory setting then shows the displayed dashed characteristic curve.

Outdoor temperature (CO1 F07, F08)

The outdoor temperature can be applied to input OS via temperature sensor or to analog input AI via a 0 to 10 V signal. The outdoor temperature is used, when you activate CO1 F07-1.
Without the outdoor temperature (C01 F07-0), the maximum flow set point value is used during the times-of use. In the times of non-use, this value is set back (reduced operation), unless you set 'processing of externally required signal' (CO-SYS F11-1).
Use function block CO1 F08 to indicate whether you are using the outdoor temperature at the OS (F08-0) or at the AI (F08-1).

5.4.2 Reduced operation (PA1)

During the times of non-use, a reduced flow set point value is used (reduced operation). This value is the flow set point reduced by the parameter 'Set-back of flow temperature for reduced operation' (default value 15 °C).
If the outdoor temperature exceeds the 'Out-

door temperature limit value for deactivation in reduced operation' (default value 15 °C), the heating system is deactivated by the closing of the control valve and deactivation of the heating circulation pump HCP after the 'Lag time' (PA1, default value 180 s) has elapsed. If the outdoor temperature falls below the 'Limit value for reactivation of rated operation in reduced operation' (PA1, default value 15 °C) , the flow set point is not set-back during the times of non-use.

5.4.3 Limitation of return flow temperature (CO-SYS F01)

A return flow sensor must be connected for this function.
With the function block setting F01-1, the return flow temperature can be limited. If the measured return flow temperature exceeds the value calculated on the basis of the selected return flow characteristic, e.g. by 2 °C, the flow set point is reduced by 2 °C multiplied with the parameter 'Return flow limitation factor' (default value 1.0). As a result, the primary flow rate is reduced with the effect that the return flow temperature drops. In case of the limitation, the flow set point indicator as well as the measured return flow temperature value blink in the display.

5.4.4 External request (CO-SYS F10, F11)

Use the following functions in complex heating systems to pass on the flow set point temperature values from one controller to the next controller (request for externally required signal), or to define one controller as the primary control valve's controller which controls the highest requested flow set point of all downstream controllers (processing of externally required signal).

Request for externally required signal (CO-SYS F10, F11)

This function can be selected for all systems. It is activated via CO-SYS F10-1. The external flow set point of the preceding controller is supplied to the analog input AI. In this case, 0 to 10 V correspond to 120 °C. The controller compares the supplied value to its own set point and the higher value is then passed on to the next controller at the analog output. If this function is set, we recommend that the flow sensor FS2 is used for the drinking water heating.

Processing of externally required signal (CO-SYS F11-1)

This function can be selected for systems 1, 4, and 5. By using CO-SYS F11-1, the heating controller is configured as primary controller for controlling the primary valve. It is supplied with the signalled request (analog input AI), compares it to its own flow set

point and controls the higher value plus an additional value which you can determine by using the function block parameter 'Temperature correction factor' (default: 0.0 K). The temperature correction factor improves the control behavior of the downstream valves in the heating circuit and compensates for line losses. The information level shows only the flow set point that is controlled.
If an external request is in the process of being controlled, the ↕ symbol appears in the operating level.
The following operating cases are differentiated:

- Without outdoor sensor (CO1 F07-0): The TROVIS 5431 Heating Controller exclusively controls the external request for downstream controllers as shown in Fig. 11. During this operation, you cannot set any times of non-use. The set point is set in accordance with the 'request for externally required signal' between maximum and minimum flow temperature. Input signal values smaller than 1 V (12 °C) mean no external request, the primary valve is closed and the circulation pump is deactivated.

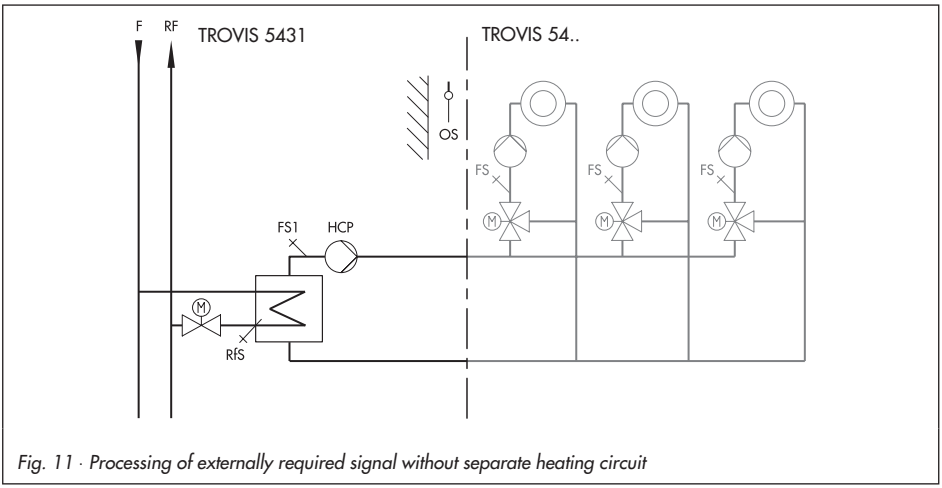


Fig. 11 · Processing of externally required signal without separate heating circuit

- With outdoor sensor (CO1 F07-1): The TROVIS 5431 Heating Controller controls a separate heating circuit (for system code numbers 4 and 5 also a separate drinking water heating circuit) and the external request for downstream controllers as shown in Fig. 12. During this procedure, you can set the times of use. Maximum and minimum flow temperature only limit the set point for the controller's own heating circuit. Higher set points of downstream controllers are controlled, with the separate heating circuit overheating. Requests for externally required signals smaller than 1 V (12 °C) mean no external request. The set point depends on the controller's own heating circuit.

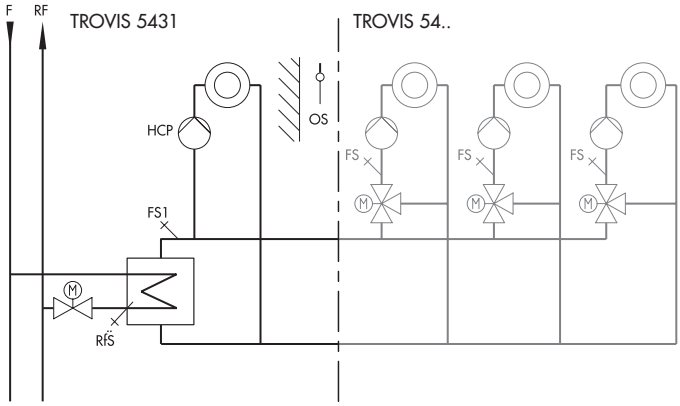


Fig. 12 · Processing of externally required signal with separate heating circuit

5.4.5 Optimize (CO1 F02)

If the function 'Optimize' has been activated, the heating controller determines the most favorable time points for activation/deactivation in order to already reach the desired temperatures just when the time-of-use starts and to maintain the temperature just until the end of the time-of-use. For this function, the controller either uses stored data about the building characteristic or a preset maximum preheating time. During the preheating time, requests for drinking water are not processed. To activate the 'Optimize' function, select function block Fb02-1 on the configuration level CO1. After this, you must select one of the three optimizing modes described below (1, 2, or 3). If you did not select a room sensor, i.e. CO1 Fb01-0, you can only choose Optimizing mode 1.

Optimizing mode 1 (without room sensor)

The activation point of time of the heating system depends on the outdoor temperature. For this, you are required to adjust the maximum permissible 'Preheating time' (function block parameter) at an outdoor temperature of –12 °C, factory setting is 120 min. When higher outdoor temperatures prevail, the preheating time is reduced. During the time of non-use, the heating controller is in reduced operation as described in chapter 5.4.2.

Optimizing mode 2 (only with CO1 F01-1, i.e. with room sensor)

The activation point of time of the heating system depends on the outdoor temperature. Exactly as for optimizing mode 1, you are required to adjust the maximum permissible 'Preheating time' (function block parameter). The deactivation point of time of the heating system is selected by the heating controller so that the temperature does not significantly drop below the 'Room set point' (PA1) prior to the end of rated operation. Solar radiation may increase the room temperature, thus causing the heating system to be deactivated prematurely. The deactivation point of time can be as early as 2 hours before the adjusted time-of-use. During the time of non-use, the heating system is deactivated at first. The 'Reduced room set point' (PA1) is monitored. If the temperature falls below this value, the flow temperature is controlled for reduced operation.

Optimizing mode 3 (only with CO1 F01-1, i.e. with room sensor)

Activation/deactivation of the heating system depends on the room sensor. The heating controller determines the required preheating time automatically, so that the room set point (PA1) is reached at the start of the time-of-use in the reference room. The preheating time varies, depending on the time of the year and the climatic conditions, taking up to 6 hours. This is the case, for example, when the 'Optimize' function is used for the first time and the heating controller has not yet stored any information about the building characteristic. The heating system is deactivated in such a way that the temperature does not drop below the 'Room set point' (PA1) until the end of the time-of-use, i.e. maximum 2 hours before, however, not later than the end of the time-of-use. During the time of non-use, the room temperature is monitored. If midnight lies within this time period, the 'Sustained temperature' (PA1) is monitored. If midnight is not within this period, the 'Reduced room set point' (PA1) is monitored. As long as the temperature does not fall below these limit values, the maximum flow set point is used for heating.

5.4.6 Flash adaptation (CO1 F03, only with room sensor)

The 'Flash adaptation' function CO1 F03-1 is used to compensate for room temperature variations by up to ± 30 °C during the time-of-use by means of parallel displacement of the heating characteristic. During this process, the heating controller compares the room temperature to the 'Room set point' (PA1) in fixed intervals. The intervals are determined with the function block parameter 'Cycle time' (default 10 min). As soon as the room temperature deviates by more than 0.5 K from the set point, the characteristic is displaced by ±1 K each time. The displacement is reset during the time of non-use. With the remote control (option for Type 5244 or 5257-4), you can additionally change the room set point by ± 5 K.

NOTE: Cooling loads, such as drafts or open windows influence the control! Rooms may be briefly overheated once the cooling load is eliminated.

5.5 Drinking water heating system (systems 2 to 5)

5.5.1 Storage tank sensor/Storage tank thermostat (CO2 F01, F02)

With systems 2 to 4, the drinking water heating system can be optionally equipped with one or two storage tank sensors, or with one storage tank thermostat.
If F01-1 and F02-0 are set, you have selected **one storage tank sensor STS1**. For this version, you are required to set the parameters 'Drinking water demand ON', 'Differential gap' and 'Charging set point' on the parameter level PA2. The parameter 'Drinking water demand ON' determines the temperature at which the charging of the storage tank starts. If this temperature plus the differential gap are exceeded, the storage tank charging process ends. The parameter 'Charging set point' determines the set point during the drinking water heating process. Depending on the configuration, this can be the set point either for FS1 or FS2.
To select **two storage tank sensors STS1 and STS2**, set F01-1 and F02-1. On the parameter level PA2, you are required to set the parameters 'Drinking water demand ON', 'Drinking water demand OFF' and 'Charging set point'. The parameter 'DW demand OFF' indicates the temperature at which the storage tank charging ends.
First set F02-0 and then F01-0 to select the **storage tank thermostat**. It is connected to the STS1 connection and activates/deactivates the storage tank charging process. On the PA2 level, you only have to define the parameter 'Charging set point'.

5.5.2 Forced charging of drinking water storage tank

Systems 2 and 3 are equipped with this function, provided that at least one storage tank sensor exists (CO2 F01-1). If the time-of-use of the drinking water heating system and the beginning of the heating system's time-of-use overlap, the forced charging of the drinking water storage tank is initiated one hour prior to the start of the heating system's time-of-use (i.e. prior to the start of the preheating phase in Optimize mode), provided that the storage tank is not fully charged.

5.5.3 Intermediate heating for drinking water charging (CO2 F10)

This function can be selected for systems 2 and 3. During the heating of drinking water, the heating circuit is normally deactivated, provided that you did not configure the controller for parallel pump operation. To prevent the heating circuit from cooling down entirely during prolonged storage tank charging processes, you can set function block CO2 F10-1. This interrupts the storage tank charging process after 20 minutes and initiates the heating operation for 10 minutes.
For underfloor heating circuits, we recommend that intermediate heating be deactivated with CO2 F10-0, since these do not cool down as quickly as radiator circuits and the storage tank charging process is completed faster without intermediate heating phases.

5.5.4 Switchover of control for drinking water heating in the storage tank charging system (CO2 F03)

For this function, you require the flow sensor FS2. It can only be selected for system 3. Setting CO2 F03-1 releases the switchover of control from flow sensor FS1 to FS2. This allows the flow temperature to be controlled directly at the heat exchanger for the drinking water heating. One minute after the storage charging pump has been activated, the control loop's reference variable is switched over from flow sensor FS1 to flow sensor FS2. At the flow sensor FS1, the controller monitors the 'Heat exchanger limitation temperature during charging' (PA2, default 120 °C). When this value is reached, the switchover of control ends and the value is used as set point for control. If the temperature at FS2 now exceeds the charging set point by more than 5 K, the control is switched over again.

5.5.5 Build-up of charging temperature via the return flow sensor with deactivated heating circuit (CO2 F08)

This function requires one return flow sensor. It can only be selected for system 2. Normally, the charging temperature for the storage tank is built up via the heating circuit. If the heating circuit is deactivated and the function block CO2 F08-1 is set, the storage tank charging pump is only activated for the charging of the storage tank when the temperatures at the return flow sensor RfS and at the storage tank sensor STS1 are identical. This prevents cold water from entering the tank when the charging process starts. The return flow temperature limitation is set to the flow temperature set point for this time.

5.5.6 Priority of drinking water heating system (CO2 F09)

This function can be selected for systems 4 and 5 and requires the flow sensor FS2. The drinking water heating system which is implemented in the primary circuit, can be granted priority by selecting Co2 F09-1. You are required to determine the priority procedure by selecting option 1 or 2 as follows: Selecting option 1 means 'adaptive priority' (reverse control). The set point of the heating circuit is reduced according to the current requirements so that thedrinking water heating system can reach its set point. Selecting option 2 means 'specific priority' (set-back control). The set point of the heating circuit is reduced by a defined value. The priority function becomes active only after the time schedule has released the drinking water heating system and the heating system is in operation. Priority ends when the time schedule for the drinking water heating system ends.

Reverse control (CO2 F09 -1, option "1")

If the temperature at the flow sensor FS2 falls below the charging set point (PA2) by more than 5 K and for longer than the 'Idle time' (function parameter, CO2 F09), the consumption of the heating circuit is reduced by decreasing the set point. The set point of the heating circuit is reduced in increments of 5 K to enable the heating up of drinking water. This reduction may attain the value in the parameter 'Minimum flow temperature'. If the flow temperature of the heating circuit is below its set point when reverse control commences, the set point is reduced by 5 K to accelerate the heating up of drinking water.
If the charging temperature at the flow sensor FS2 is up to 5K below the charging set point, the current set point of the heating circuit is maintained. If the charging temperature at the flow sensor FS2 exceeds its set point, the heating circuit set point is increased.

Set-back control (CO2 F09 -1, option "2")

If the temperature at the flow sensor FS2 falls below the charging set point (PA2) by more than 5 K and for longer than the 'Idle time' (function parameter, CO2 F09), the heating circuit is set to reduced operating mode for 20 minutes. This reduces the consumption of the heating circuit.

5.5.7 Circulation pump for storage tank charging (CO2 F04)

This function can be selected for systems 2 and 3.
The circulation pump CP is switched off when the storage charging pump SCP is activated (factory setting). After switching off the storage charging pump SCP, the circulation pump CP operates according to the defined time schedule. If you select CO2 F04-1, however, the circulation pump continues to operate in parallel with the storage charging pump.

5.5.8 Parallel pump operation (CO2 F06)

Select this function for systems 2 and 3.
Should the total available capacity be sufficiently high to operate both the heating system and charge the drinking water storage tank, you can configure the controller for parallel pump operation. Select CO2 F06 -1, and for system 2 additionally select: 1 (parallel pump operation). The heating circulation pump then continues to operate during the storage tank charging as long as the charging temperature does not exceed the current set point for the heating circuit by more than 10 K and the max. permissible flow temperature is not exceeded. If the system deviation of the charging temperature is higher than 5 K after the adjusted time 'Waiting time until HCP off' (default 600 sec), the heating circulation pump is switched off for 10 minutes.

5.5.9 Thermal disinfection of drinking water storage tank (CO2 F05)

This function can be selected for systems 2 and 3, if one or two storage tank sensors are configured. In conjunction with a storage tank thermostat (CO2 F01-0), thermal disinfection cannot be used. On the configuration level CO2, therefore, function block F01-1 must be set for one storage tank sensor, or function blocks F01-1 and F02-1 must be set for two storage tank sensors.
Activate thermal disinfection with CO2 F05-1. It protects the drinking water in the storage tank from excessive contamination with legionella. For this purpose, the drinking water is strongly heated up. The day of the week, the storage tank set point, the start time and the stop time for this process can be selected after you have activated the thermal disinfection function (function block parameter). Factory setting is for the thermal disinfection to start Wednesdays at 0:00 (midnight), with a storage tank set point of 70 °C, and to end at the very latest at 4:00 (a.m.), even when the set point in the drinking water storage tank has not been reached yet.

5.5.10 Times-of-use for the drinking water heating system (PA2)

See chapter 5.3.6

5.5.11 Vacation and public holidays for drinking water heating (CO2 F07)

This function can be selected for systems 2 to 5. If you set CO2 F07-1, the vacation and public holidays entered for the heating circuit apply to the drinking water heating system as well. On public holidays, the times-of-use for the drinking water heating system are then based on Sundays. During the vacation, the drinking water heating system is deactivated.

5.5.12 Control in systems with an instantaneous water heater (CO2 F11)

This function can only be selected for system 5. The control of the drinking water heating system requires that FS2 be used (CO2 F11-1). FS2 always requires a fast responding Pt1000 sensor, regardless of which sensor was selected in CO-SYS F02. If FS2 is deactivated (CO2 F11-0), a thermostat can be used instead. It controls the primary on-off valve directly.

5.5.13 Recognition of drinking water tapping in systems with an instantaneous water heater (CO2 F12)

This function can only be selected for system 5 with the control via FS2 (CO2 F11-1).
The control quality can be improved for this system, if drinking water tapping is registered independently of FS2, either via hydraulic pressure switch (HPS) in the cold water supply line or via return flow sensor for the drinking water (RfSDW). For this purpose, you must activate CO2 F12-1, and then select "1" for the HPS or "2" for the RfSDW.
The optimum setting is with the HPS because it registers both the beginning and the end of the drinking water tapping. It issues a binary signal: contact is made when drinking water is tapped, otherwise it is open. The HPS is connected to clamps 14 and 7.
When using a RfSDW, the end of the drinking water tapping is recognized. At the same time, the controller limits the return flow temperature.

5.6 Controller response in case of faults

5.6.1 Defective sensor and malfunctions

Defective sensors and malfunctions are indicated on the operating level by the error message " Err ". Additionally, the symbol ⚠ blinks. On the error level, the defective sensors are represented by symbols. Malfunctions are represented as a number. For more details, refer to the overview in chapter 9, Appendix D.
In case of defects, the heating controller responds as follows:

- Outdoor temperature sensor OS: If the outdoor sensor is defect, the controller either controls a flow temperature set point of 50 °C or the max. flow temperature, provided it is smaller than 50 °C.
- Flow temperature sensor FS1: If this flow sensor fails, the controller continues to operate in the last position the valve assumed.
- Flow temperature sensor drinking water storage tank FS2: If this sensor fails, the flow set point for the drinking water heating (charging set point) is controlled via FS1 only. In system 5, drinking water heating is not carried out anymore.
- Return flow temperature sensor RfS: If the return flow sensor is defect, the control works without return flow temperature limitation.
- Room temperature sensor RS: If this sensor fails, the controller works according to the settings for operation without room sensor, e.g. it switches from the optimizing mode to the reduced operating mode. If flash adaptation has been activated, the heating characteristic last determined is not changed anymore.
- Storage tank sensors STS1 and STS2: If one of the two sensors fails, storage tank charging is not carried out anymore.

5.6.2 Setting the default values (CO-SYS F09)

All parameters and function block parameters are adjusted according to the factory settings if you select CO-SYS F09-1. After you confirm this setting with the Enter key ✳, the next function block F10 appears and the reset function has been carried out. Function block CO-SYS F09 is now automatically deactivated. The device is ready for operation with default settings.

5.6.3 Monitoring the temperature (CO-SYS F14)

With this function, you can monitor the flow temperature, the room temperature and the return flow temperature. However, if these values deviate from their set points within a defined range, an error message is generated. The following deviations are considered to be errors:

- The flow temperature deviates from the set point for longer than 30 minutes by ± 10 K.
- The room temperature is below the set point for longer than 30 minutes by more than 2 K.
- The return flow temperature limitation is in operation for longer than 30 minutes.

The display indicates one of these errors as Err6. If the collective error message is active (CO-SYS F13), the binary output BO3 is set as well.

5.7 Protective functions

5.7.1 Frost protection

When the heating system is deactivated, the automatic frost protection function is initiated in the following cases:

- The outdoor temperature is below 3 °C, a flow set point of 20 °C is controlled, the heating circulation pump and the circulation pump are activated.
- The flow temperature is below 5 °C, a flow set point of 20 °C is controlled for 5 minutes.
- The storage tank temperature is below 5 °C while the drinking water storage tank is charged up to 10 °C.

CAUTION! No frost protection in manual operating mode!

5.7.2 Blocking manual operation (CO-SYS F04)

You can block manual operation by selecting CO-SYS F04-1. In addition, configuration and parameterization are protected against modifications. The mode switch positions +, 0 and – have no function then. If the switch is set to any of these positions, the heating controller will operate in automatic mode.

5.7.3 Forced operation of the pumps

If the connected pumps are not activated for 24 hours, they are force-operated for one minute each as follows: The circulation pump then runs at 12:00 p.m., storage charging pump, heat exchanger pump and circulation pump will run at 12:01 p.m.

6 Memory pen

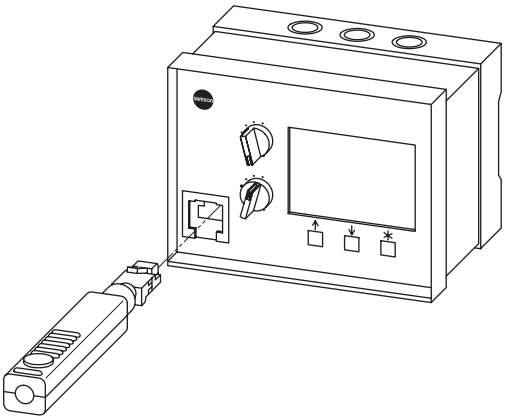


Fig. 13 · Connecting the memory pen to the heating controller

Use the memory pen to copy configuration data and parameters from one device to another device of the same type to simplify configuration and parameterization.

6.1 Data exchange between heating controller and memory pen

Follow the instructions below to exchange data between the heating controller and the memory pen:

1. Insert the memory pen in the connector as shown in Fig. 13. The following message appears on the display: SP-31. In this configuration, the data is uploaded from the memory pen (SP) to the heating controller (31).
2. If you want to download the data from the heating controller to the memory pen, press the arrow key ↓. The following message appears: 31-SP.
3. Press the enter key ✳. The data are transmitted as long as you can see the bar graph running across the top section of the display.
4. Once the bar graph disappears, disconnect the memory pen carefully!

NOTE: If you insert the memory pen, and 31-SP appears on the display, the pen is either empty or it contains data from another SAMSON device. In this case, you cannot change the direction of the data exchange. All you can do is download the data from the heating controller!

7 Installing the heating controller

The device is made up of the controller casing which contains the electronics components and the rear casing section with the terminal blocks. Depending on the ordered version, the rear section can either be flat or deep in design. It is suitable for panel mounting, wall mounting, and the version with a deep rear casing design can also be mounted to a top hat rail (see Fig. 14).

For **panel mounting**, proceed as follows:

1. Loosen both screws (1).
2. Separate the controller casing from the rear casing section.
3. Make a panel cut-out with the dimensions 138^{+1} x $92^{+0.8}$ mm (W x H).
4. Push the controller casing through the panel cut-out.
5. Insert the fastening clips (2) supplied with the controller left and right and turn the threaded bolt in the direction of the control panel using a screw driver so that the casing is pressed against the control panel.
6. Establish the electrical connection on the rear section as described in chapter 9.
7. Reposition the rear casing section.
8. Fasten both screws (1).

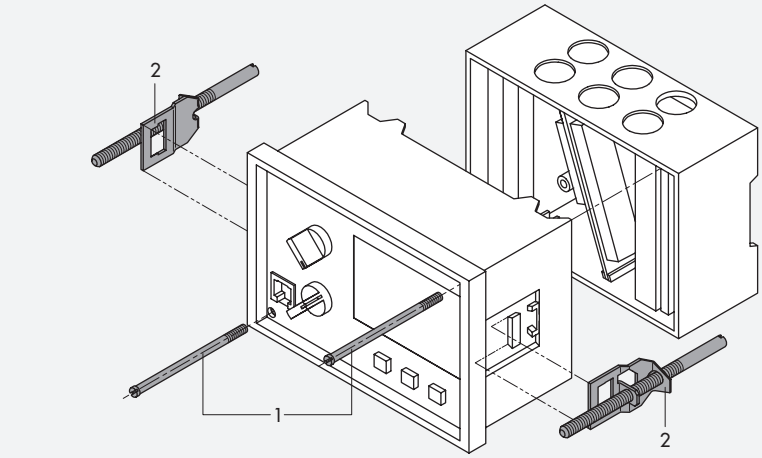
For **wall mounting**, proceed as follows:

1. Loosen both screws (1).
2. Separate the controller casing from the rear casing section.
3. Note the different drilling dimensions depending on the design of the rear casing section. Drill the holes in the respective positions according to the dimensions indicated.
4. Fasten the rear casing section using three screws.
5. Establish the electrical connection on the rear section as described in chapter 9.
6. Attach the controller casing.
7. Fasten both screws (1).

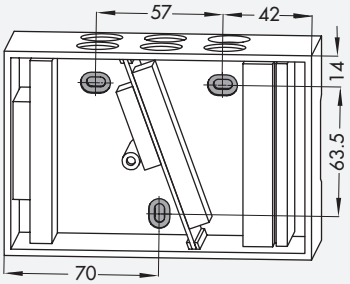
For **top hat rail mounting** (applicable for deep rear casing designs only), mount the device as follows:

The rear casing section is designed with two built-in hooks (5) and one spring-mounted hook (4).

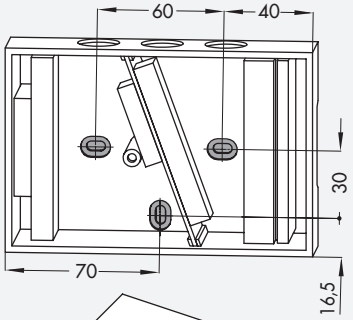
1. Fasten the spring-mounted hook (4) to the bottom of the top hat rail (3). Push the heating controller slightly upwards and push the built-in top hooks (5) over the top hat rail.



Deep version



Flat version



1 Screws
2 Fastening clip
3 Top hat rail
4 Spring-mounted hook
5 Built-in hooks

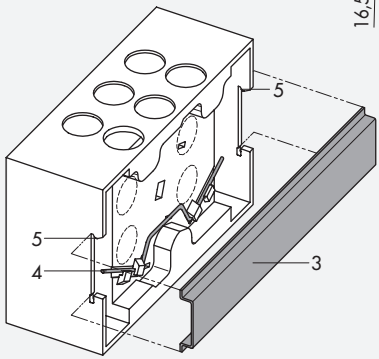


Fig. 14 · Mounting

8 Electrical connection

CAUTION!
For the wiring and connection of the controller, you are required to observe the VDE regulations and the regulations of the local power supply company. For this reason, this type of work must be carried out by a specialist.

When installing the electrical lines, please note the following:

- Use separate cables for the 230-V supply lines and the signal lines! To increase the noise immunity observe a minimum distance of 10 cm between the cables! This separation in space is also applicable to the cables within a control cabinet!
- Also use separate cables for the digital signal lines (bus lines) and the analog signal lines (sensor lines, analog outputs).
- For systems with a high electromagnetic noise level, we recommend that shielded cables be used for the analog signal lines. Ground the shield one-sided at the inlet or outlet of the control panel, using large-area contacts! The central grounding point must be connected to the grounding conductor via a cable ≥ 10 mm^2 using the shortest possible route.
- Inductances in the control cabinet, e.g. contactor coils, must be equipped with suitable interference suppressors (RC elements)!
- Control cabinet elements with a high field strength, e.g. transformers or frequency converters, should be shielded by means of separators that have good chassis ground.

Surge protection measures

- If signal lines are routed outside buildings or over large distances, you are required to take suitable surge protection measures! For bus lines, such measures are essential.
- The shield of signal lines that are routed outside buildings, must have current carrying capacity and grounded on both sides.
- The surge diverters must be installed at the control cabinet inlet.

Connecting the controller

Electrical connections must be carried out on the basis of the terminal diagrams of the relevant system code numbers (Figs. 15 to 18). For the connection of the cables, you must open the casing, see also chapter 7. For the cable ducts, break through the marked openings on top, bottom or in the rear casing section and insert the enclosed cable glands.

Connecting the sensors

You can connect cables with a minimum cross section of 2 x 0.5 mm^2 to the terminal block on the rear casing section.

Connecting the actuator

Connect the lines as damp-proof cables with a minimum cross section of 1.5 mm^2 to the terminals of the controller output. During start-up check the direction of rotation, i.e. whether connections have been made properly, by setting the mode switch (B) to + or –, thus opening and closing the valve.
NOTE: If actuators by other manufacturers are connected to the controller, the controller needs to be protected against initial high currents.

Connecting the pumps

Connect all cables with a minimum cross-section of 1.5 mm^2 to the controller terminals (Figs. 15 to 18) according to the applicable terminal diagram (system code number 1, 2, 3, 4 or 5).

Terminal diagrams

The terminal diagrams (Figs. 15 to 18) contain all possible input and output connections for the respective system code number. If input or output connections are to remain unassigned, this must be defined on the configuration levels (CO1 to CO-SYS). Room sensor RS: CO1 F01; outdoor sensor OS: Co1 F07, F08; storage tank sensors STS1, STS2: CO2 F01, F02; return flow sensor RfS: CO-SYS F01; flow sensor FS2: for system 3 CO2 F03, for system 4 CO2 F09.
Terminals 5, 6, 7 and GNDS must be jumpered. Terminals 5, 6, 7 are already jumpered internally. L_{CL} must be supplied externally.

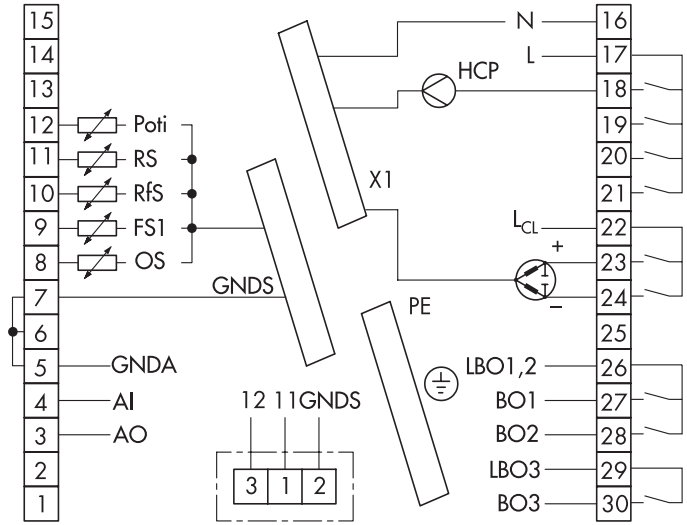


Fig. 15 · Terminal diagram system code number 1

AO	*Analog output 0 …10 V*
AI	*Analog input 0 …10 V*
OS	*Outdoor sensor*
BO1, 2, 3	*Binary outputs*
HPS	*Hydraulic pressure switch*
Poti	*Potentiometer (terminal 3 for Type 5244 or 5257-4)*
GNDS	*Sensor ground*
LBO1,2,3	*Supply binary outputs*
L_{CL}	*Voltage supply for actuator*
PE	*Grounding conductor*
RS	*Room sensor (terminal 1 for Type 5244 or 5257-4)*
RfS	*Return flow sensor heating circuit*
RfSDW	*Return flow sensor drinking water circuit*
STS1,STS2	*Storage tank sensors 1, 2*
SCP	*Storage charging pump*
HEP	*Heat exchanger charging pump*
HCP	*Heating circuit circulation pump*
FS1; FS2	*Flow sensor 1 heating, flow sensor 2 drinking water (or system 5 thermostat)*
CP	*Circulation pump*

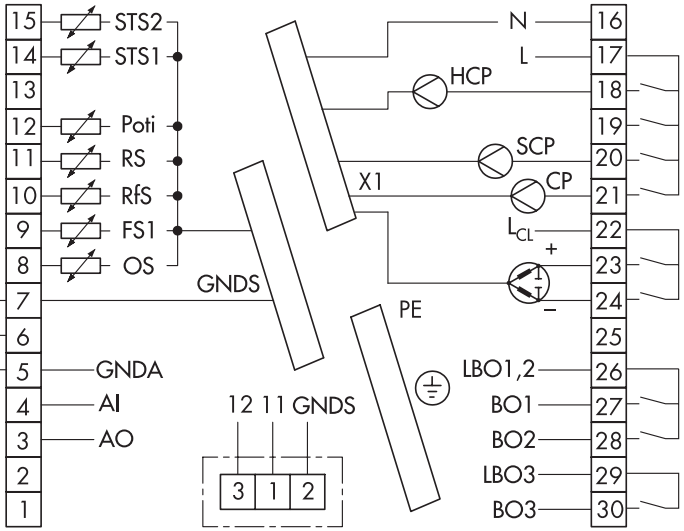


Fig. 16 · Terminal diagram system code number 2

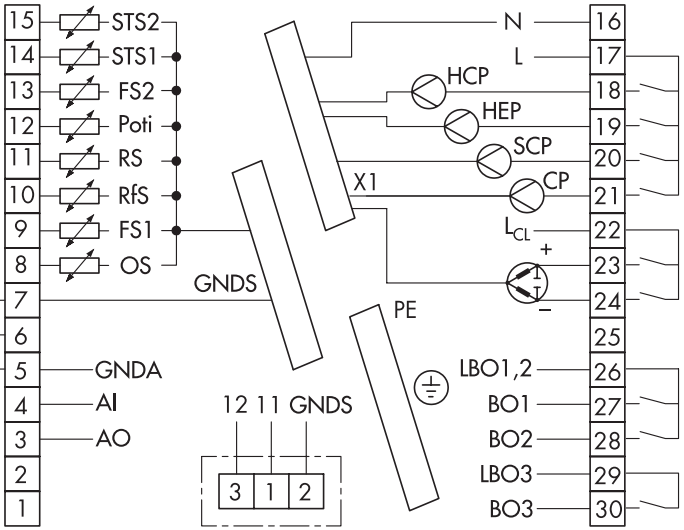


Fig. 17 · Terminal diagram system code numbers 3 and 4

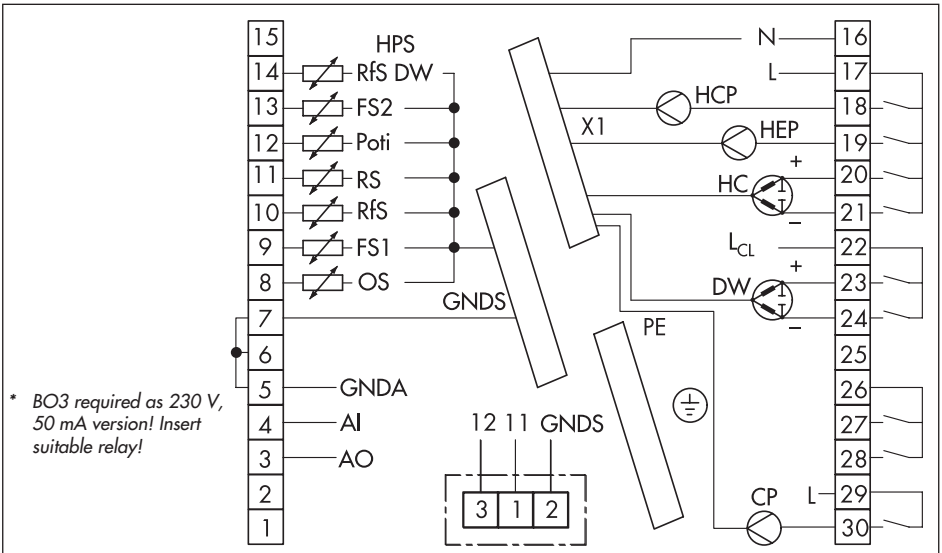


Fig. 18 · Terminal diagram system code number 5

AO	*Analog output 0 …10 V*
AI	*Analog input 0 …10 V*
OS	*Outdoor sensor*
BO1, 2, 3	*Binary outputs*
HPS	*Hydraulic pressure switch*
Poti	*Potentiometer (terminal 3 for Type 5244 or 5257-4)*
GNDS	*Sensor ground*
LBO1,2,3	*Supply binary outputs*
L_{CL}	*Voltage supply for actuator*
PE	*Grounding conductor*
RS	*Room sensor (terminal 1 for Type 5244 or 5257-4)*
RfS	*Return flow sensor heating circuit*
RfSDW	*Return flow sensor drinking water circuit*
STS1,STS2	*Storage tank sensors 1, 2*
SCP	*Storage charging pump*
HEP	*Heat exchanger charging pump*
HCP	*Heatin circuit circulation pump*
FS1; FS2	*Flow sensor 1 heating, flow sensor 2 drinking water (or system 5 thermostat)*
CP	*Circulation pump*

9 Technical data

Inputs	Depending on which system code number has been selected
Sensor inputs	Max. 7 configurable inputs for temperature sensors (PTC or Pt1000) 2-phase circuit 2 flow temperature sensors 1 room temperature sensor 1 outdoor temperature sensor 1 return flow temperature sensor 2 storage tank temperature sensors
Binary inputs	Storage tank thermostat
Additional inputs	Input for potentiometer or room sensor with set point correction and mode switch
Analog input	0 to 10 V, (Ri= 20 kΩ)
Outputs	Depending on how the controller has been configured
Control signal	Three-step signal: load rating: 20 to 250 V AC; 0.5 A AC On-off signal: load rating: 20 to 250 V AC; 0.5 A AC
Binary outputs optional	4 outputs for controlling the pump non-floating: 230 V AC, 2 A AC (cos φ >0.5) 3 outputs (BO1 to BO3) for pump management and collective error message: 30 V, 100 mA AC/DC or BO3 only: 230 V 50 mA AC/DC
Analog output	0 to 10 V, load > 2 kΩ
Auxiliary power	230 V AC (+10%, -15%), 48 to 62 Hz, power consumpt. appr. 3 VA
Ambient temperature	0 to 50 °C (operation) –10 to 60 °C (transportation and storage)
Degree of protection	IP 40 according to IEC 529
Class of protection	I according to VDE 0106
Degree of contamination	2 according to VDE 0110
Overvoltage category	II according to VDE 0110
Humidity rating	F according to VDE 40040
Noise immunity	According to EN 50082 Part 1
Noise emission	According to EN 50081 Part 1
Weight	Approx. 0.6 kg

Appendix A Function block lists

Appendix A.1 Function block list for heating circuit CO1

F	Function	FS	Sys.	Name *(default values in italics)*
01	Room sensor (RS)	Off	1-5	On = RS active, option 1/2 *1*: Room sensor with remote control for Type 5244 or Type 5257-4 2: Standard sensor and poti 1 to 2 kΩ
02	Optimize see page 45	Off	1-5	On = active, option 1/2/3, (2/3, only if CO1 F01-1; 1/2 only if CO1 F07-1) *1*: On acc. to t_O, Off acc. to time schedule, Parameter: Preheating time *(120 min)* 2: On acc. to t_O, Off acc. to room sensor, Parameter: Preheating time *(120 min)* 3: On and Off acc. to room sensor
03	Flash adaptation see page 46	Off	1-5	On = active, only if CO1 FO1-1 Parameter: Cycle time *(10 min)*
04	Characteristic see page 41	Off	1-5	Off = Characteristic acc. to gradient On = 4-point setting of heating characteristic
05	Delayed outdoor temperature adaptation see page 38	Off	1-5	On = active, only if CO1 F07-1; option 1/2 *1*: Delay only when t_O decreases 2: Delay when t_O decreases/increases Parameter: Delay (3 °C/h)
06	Summer time operation (time and temperature-controlled) see page 39	Off	1-5	On = active, Parameter: Start of the summer period *(01.06.)*, Number of days for start *(2)*, End of the summer period *(30.09.)*, Number of days for end *(1)*, Outdoor temperature limit value *(18 °C)*
07	Outdoor temperature t_O see page 42	On	1-5	On = activate outdoor temperature Off = no outdoor temperature, maximum t_F
08	Outdoor temperature 0 to 10 V at the input AI see page 42	Off	1-5	Off = t_O at input OS On = t_O at input AI; only if CO1 F07-1, CO-SYS F10-0 and CO-SYS F11-0
09	Pump management BO2 see page 38	Off	1-4	On = BO2 inactive for non-use, Off = BA2 active for non-use

Appendix A.2 Function block parameters CO1

Parameter	Symbol	F	FS	Unit	Value range
Preheating time	START	02	120	min	0 … 360
Cycle time		03	10	min	1 … 100
Delay		05	3	°C/h	1 to 6
Start of the summer period	START	06	1.06.	-	1.1. … 31.12.
Number of days for start	START NO	06	2	-	1 … 3
End of the summer period	STOP	06	30.09.	-	1.1. … 31.12.
Number of days for end	STOP NO	06	1	-	1 … 3
Outdoor temperature limit value		06	18.0	°C	0.0 … 50.0

Appendix A.3 Function block list for drinking water heating circuit CO2

F	Function	FS	Sys.	Comment
01	Storage tank sensor STS1 see page 47	On Off	2,3 4	On = Storage tank sensor STS1on Off = Storage tank thermostat, only if CO2 F02-0
02	Storage tank sensor STS2 see page 47	On Off	3 2, 4	On = Storage tank sensor STS2 on, if CO2 F01-1 Off = Only STS1
03	Switchover of control for DW heating see page 48	Off	3	On = Switchover to the sensor downstream of the heat exchanger for DW heating (FS2)
04	Circulation pump runs acc. to time schedule during storage charging see page 50	Off	2, 3	On = Depends on time schedule whether CP runs during drinking water heating
05	Thermal disinfection see page 50	Off	2, 3	On = Only if CO2 F01-1 Parameter: Day of disinfection *(3)*, storage tank set point *(70.0 °C)*, start time *(0:00)*, stop time *(4:00)*
06	Parallel pump operation see page 50	Off	2, 3	On = active, only if CO2 F10 Off for system 2 additional option of control type: *1*: Parallel pump operation with CP and SCP 2: Control of changeover valve and CP For sys. 2 and option =1 or sys 3 additional parameter: Waiting time until HCP Off (*600 s*)
07	Copy vacation and public holidays for DWH see page 40	Off	2, 3, 4, 5	On = Copy vacation and public holidays from PA-SYS
08	Build-up of charging temperature via RfS when heating circuit Off see page 48	Off	2	On = Only if CO-SYS F01-1
09	Priority of drinking water heating system see page 49	Off	4, 5	On = active, selection of the type of control *1*: Reverse control 2: Set-back control Parameter: Idle time (*300 s*)

F	Function	FS	Sys.	Comment
10	Intermediate heating after 20 min for 10 min see page 48	On	2, 3	On = active, only if CO2 F06-0 Off = Priority of drinking water heating system
11	FS2 Control sensor see page 51	On	5	On = FS2 Control sensor for system with instantaneous water heater (Pt 1000) Off = Processing thermostat, parameter: control valve transit time (*15 s*)
12	Recognition of drinking water tapping see page 51	Off	5	Off = Recognition DW tapping with FS2 On = Recognition DW tapping, only if CO2 F11-1, Option: *1*: Hydraulic pressure switch (HPS) 2: Return flow sensor drinking water (RfSDW)

Appendix A.4 Function block parameter CO2

Parameter	Symbol	F	FS	Unit	Value range
Day of thermal disinfection		05	3	0...*7* (daily, Mon...Sun)	
Storage set point thermal disinfection		05	70.0	°C	60.0 … 90.0
Start time thermal disinfection	START	05	0:00		0:00 … 23:30
Stop time thermal disinfection	STOP	05	4:00		0:00 … 23:30
Waiting time until HCP Off	STOP	06	600	s	120 … 600
Idle time		09	300	s	60 … 600
Control valve transit time		11	15	s	10 … 240

Appendix A.5 Function block list CO-SYS

F	Function	FS	Sys.	Comment
01	Return flow sensor for primary circuit see page 43	On	1-5	On = Activate limitation of return flow temperature, Parameter: Return flow temperature limitation factor *(1.0)*
02	Sensor selection see page 36	Off	1-5	On = Pt 1000 sensor Off = PTC sensor
03	Automatic clock reset summer/winter time see page 39	On	1-5	On = Automatic reset Aff = No reset
04	Blocking manual operation, see page 54	Off	1-5	On = Manual operation not possible Off = Manual operation possible
05	Selection of heating circuit control (control parameter) see page 37	On	1-5	On = Three-step control Parameter: Kp *(2.0)*; Tn *(120 s)*, Ty *(90 s)* Off = On-off control Parameter: Differential gap *(5 °C)*, min. on-time *(120 s)*, min. off-time *(120 s)*
06	Limitation of system deviation for OPEN signal (heating circuit), see p. 37	Off	1-5	On = Limitation only if CO SYS F05-1 Parameter: max. system deviation *(2 °C)*
07	Release continuous signal	Off	1-5	On = Release continuous signal heating circuit
08	Sensor calibration, see page 36	Off	1-5	On = Parameter: calibration value (measuring value) for all connected sensors acc. to the configuration
09	Parameter default values see page 52	Off	1-5	On = Set all parameters to factory settings
10	External request, request for externally required signal, see page 43	Off	1, 2, 3, 5	On = activate only if CO1 F08-0, CO-SYS F11-0 and CO-SYS F12-0
11	External request, processing of externally required signal, see p. 43	Off	1, 4, 5	On = Primary control, only if CO-SYS F10-0 and CO1 F08-0 Parameter: Temperature correction factor *(0.0 °C)*
12	Transmitting the outdoor temperature, 0 to 10 V see page 37	Off	1-5	On = activate only if CO-SYS F10-0 and CO1 F07-1

F	Function	FS	Sys.	Comment
13	Collective error message see page 38	Off	1-4	On = In case of an error, BO3 is set
14	Temperature monitoring see page 53	Off	1-5	On = Temperature monitoring of FS, RS and RfS
15	Selection of drinking water heating control (control parameter) see page 37	On	*5*	On = Three-step control Parameter: Kp *(2.0)*; Tn *(15 s)*, T_V *(1 s)*, KpTv (*1*), Ty *(15 s)* Off = On-off control Parameter: Differential gap *(5 °C)*, min. on-time *(120 s)*, min. off-time *(120 s)*
16	Limitation of system deviation for OPEN signal (drinking water circuit) see page 37	Off	*5*	On = Limitation only if CO SYS F15-1 and CO2 F11-1 Parameter: max. system deviation *(2 °C)*
17	Release continuous signal	Off	*5*	On = Release continuous signal DW circuit

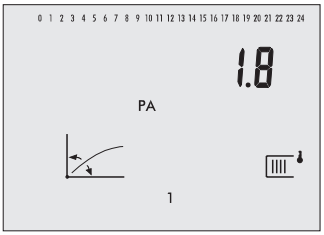
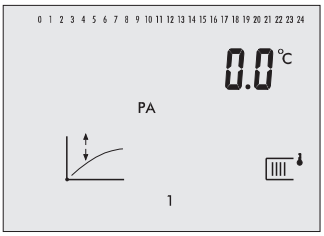
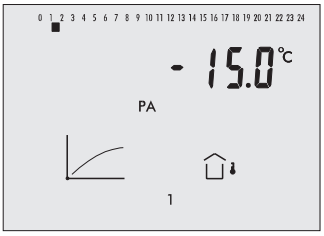
Appendix A.6 Function block parameters CO-SYS

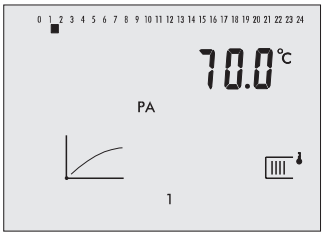
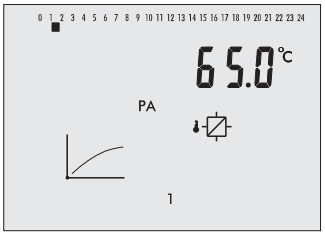
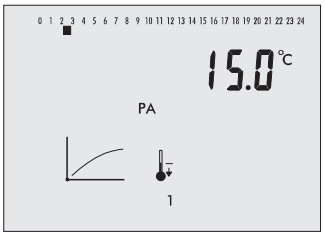
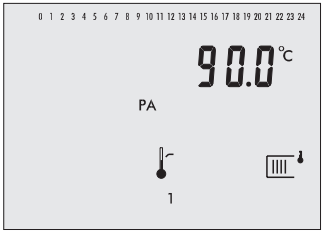
Parameter	Symbol	F	FS	Unit	Value range
Return flow temperature limitation factor		01	1.0	-	0.1...10.0
Gain Kp	K_P	05	2.0	-	0.1 ... 50.0
Reset time Tn	T_N	05	120	s	0 ... 999
Control valve transit time Ty		05	90	s	10 ... 240
Differential gap		05	*5*	°C	2 ...10
Minimum on-time	START	05	120	s	0 ... 600
Minimum off-time	STOP	05	120	s	0 ... 600
Maximum system deviation		06	2	°C	2 ... 10
Calibration value room sensor RS		08		°C	±10 K
Calibration value flow sensor FS1		08		°C	±10 K
Calibration value storage tank sensor STS1		08		°C	±10 K
Calibration value outdoor sensor OS		08		°C	±10 K

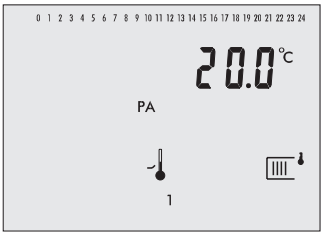
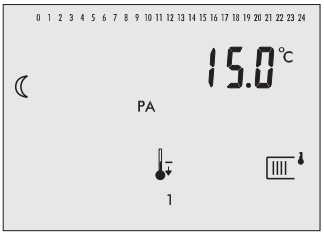
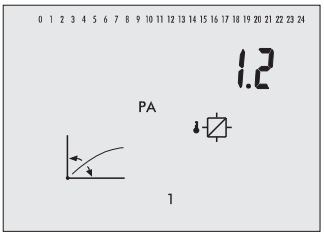
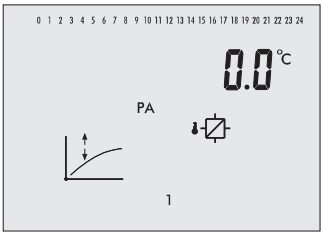
Parameter	Symbol	F	FS	Unit	Value range
Calibration value storage tank sensor STS2		08		°C	±10 K
Calibration value return flow sensor RfS		08		°C	±10 K
Calibration value flow sensor FS2 (sys. 3,4)		08		°C	±10 K
Calibration value return flow sensor RfSDW		08		°C	±10 K
Calibration value flow sensor FS2 (sys. 5)		08		°C	±10 K
Temperature correction factor	CO	11	0.0	°C	0.0 … 30.0
Gain Kp	K_P	15	2.0	-	0.1 … 50.0
Reset time Tn	T_N	15	15	s	0 … 999
Derivative-action component T_V	Tv	15	1	s	0 … 999
Gain of derivative-action component K_pT_V	$K_p T_V$	15	1.0	-	0 … 50.0
Control valve transit time Ty		15	15	s	10 … 240
Differential gap		15	5.0	°C	2 …10
Minimum on-time	START	15	120	s	0 … 600
Minimum off-time	STOP	15	120	s	0 … 600
Maximum system deviation		16	2.0	°C	2 … 10

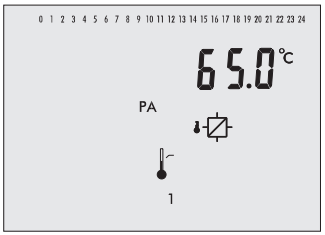
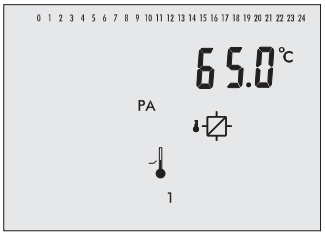
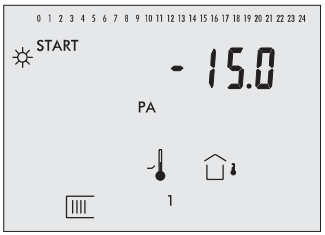
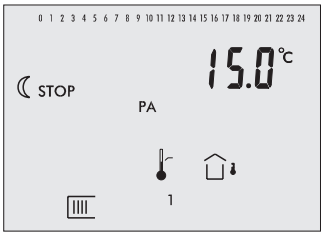
Appendix B Parameters

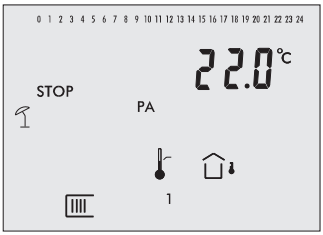
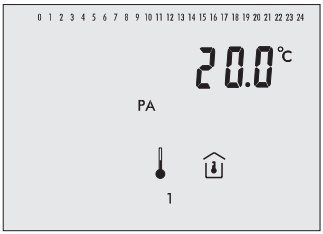
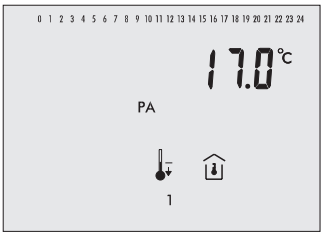
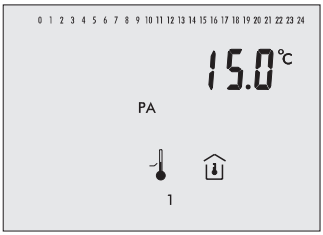
Appendix B.1 Level PA1 (heating circuit) parameters

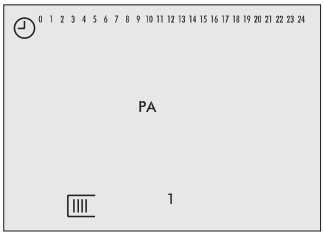
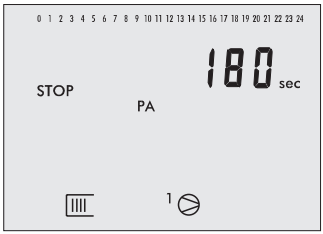
Symbols and factory settings	Parameter (range of values)	After pressing the Enter key
Characteristic optional	Gradient of characteristic (CO1 F04-0)	
	Heating characteristic gradient (0.2 … 3.2)	
	Level of heating characteristic (–30 … +30°C)	
Optional characteristic	4-point characteristic (CO1 F04-1)	
	Outdoor temperature 1st point (–30 … +50°C) Outdoor temperature value of the next point limits the upper limit for 2nd to 4th point: square bar on top right under 2 to 4	

Symbols and factory settings	Parameter (range of values)	After pressing the Enter key
	Flow temperature 1st point (20 … 130 °C) For 2nd to 4th point: square bar on top right under 2 to 4	
	Return flow temperature 1st point (20 … 90 °C) Only with return flow sensor (CO-SYS F01-1) For 2nd to 4th point : square bar on top right under 2 to 4	
	Set-back difference point 1 and 2 (0…50 °C) Set-back difference for point 3 and 4: square bar on top right under 3	
	Maximum flow temperature (20 … 130 °C)	

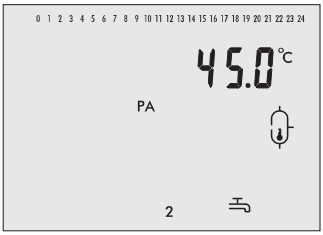
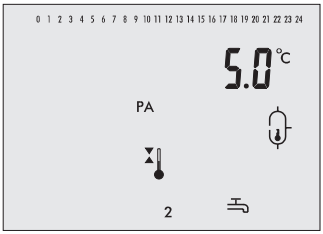
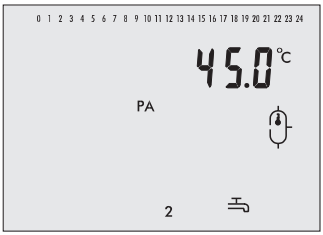
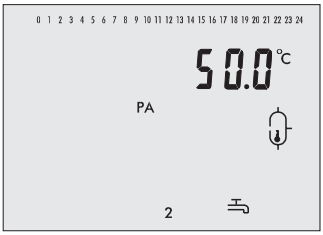
Symbols and factory settings	Parameter (range of values)	After pressing the Enter key
	Minimum flow temperature (20 … 130 °C)	
	Set-back of flow temperature in reduced operation (0 … 50 °C) Only for gradient of heating characteristic (CO1 F04-0)	
	Level of return flow characteristic (0.2 … 3.2) Only for gradient of heating characteristic (CO1 F04-0) and return flow sensor (CO-SYS F01-1)	
	Level of return flow characteristic (–30 … 30 °C) Only for gradient of heating characteristic (CO1 F04-0) and return flow sensor (CO-SYS F01-1)	

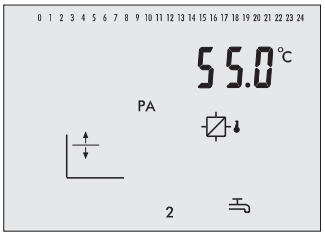
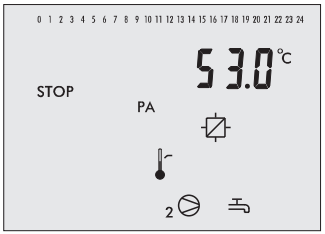
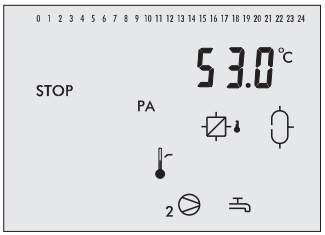
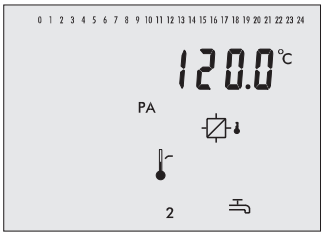
Symbols and factory settings	Parameter (range of values)	After pressing the Enter key
	Maximum return flow temperature (20 … 90 °C) Cannot be adjusted below the minimum return flow temperature only for gradient of heating characteristic (CO1 F04-0) and return flow sensor (CO-SYS F01-1)	
	Minimum return flow temperature (20 … 90 °C) Only for gradient of heating characteristic (CO1 F04-0) and return flow sensor (CO-SYS F01-1)	
	Limit value of outdoor temperature for return to rated operation when in reduced operation (–30 °C … limit value of outdoor temperature for deactivation when in reduced operation) Below this limit value, the heating system operates continuously, no reduction of flow temperature	
	Limit value of outdoor temperature for deactivation when in reduced operation (Limit value of outdoor temperature for return to rated operation when in reduced operation … 50 °C) Above the limit value, the heating the system is deactivated in times of non-use.	

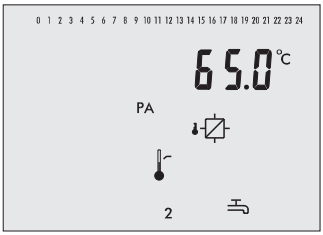
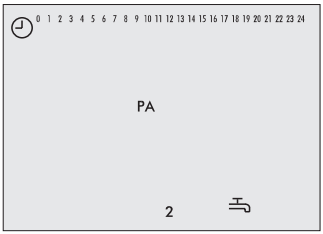
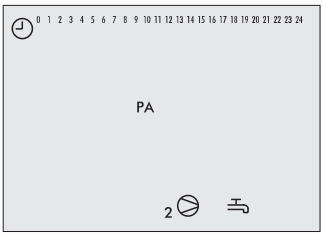
Symbols and factory settings	Parameter (range of values)	After pressing the Enter key
	Limit value of outdoor temperature for summer operation (0 … 50 °C)	
	Room set point (10 … 40 °C) Only with optimizing modes 1, 2, 3 (CO1 F02-1) or flash adaptation (CO1 F03-1) or temperature monitoring (C0-SYS F14-1)	
	Reduced room set point (10 … 40 °C) Only with room sensor (CO1 F01-1) and optimizing modes 2, 3 (CO1 F02-1)	
	Sustained temperature (10 … 40 °C) Only with room sensor (CO1 F01-1) and optimizing mode 3 (CO1 F02-1)	

Symbols and factory settings	Parameter (range of values)	After pressing the Enter key
	Times-of-use (three times-of-use adjustable with start and stop) Factory setting: 7:00 (a.m.) … 22:00 (10 p.m.)	blockwise or individual days 1-7 (Monday … Sunday); 1-5 (Monday … Friday) 6-7 (Saturday and Sunday); 1, 2, … , 7 (Mon, Tue, …, Sun)
	Lag time of the heating circulation pump (15 ... 2400 s)	

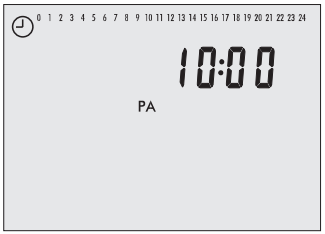
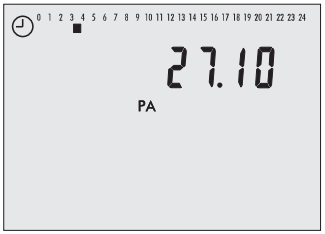
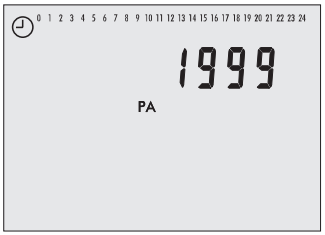
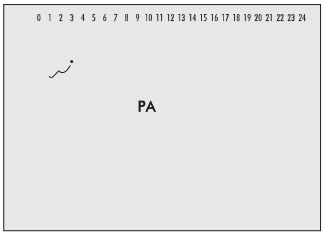
Appendix B.2 Level PA2 (drinking water heating circuit) parameters

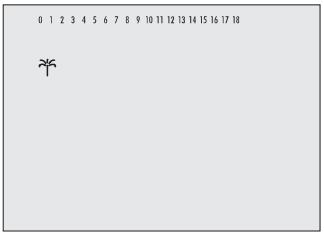
Symbols and factory settings	Parameter (range of values)	After pressing the Enter key
	Drinking water demand ON (20 … 90 °C) (Systems 2, 3 and 4 with only one storage tank sensor, i.e. CO2 F01-1, F02-0)	
	Differential gap (0 … 30 °C) (Systems 2, 3 and 4 with only one storage tank sensor, i.e. CO2 F01-1, F02-0)	
	Drinking water demand ON (20 … 90 °C) (Systems 2, 3 and 4 with two storage tank sensors STS1 and STS2, i.e. CO2 F01-1, F02-1)	
	Drinking water demand OFF (20 … 90 °C) (Systems 2, 3 and 4 with two storage tank sensors STS1 and STS2, i.e. CO2 F01-1, F02-1)	

Symbols and factory settings	Parameter (range of values)	After pressing the Enter key
	Charging set point (20 … 90 °C) (Flow set point during the drinking water heating process)	
	End charging process (20 … 90 °C) (Maximum value for deactivation of the storage charging pump SCP for system 2 or heat exchanger charging pump HEP for system 3, temperature-controlled lag time of the SCP or HEP)	
	Max. value for deactivation of the storage charging pump in system 3, provided that FS2 has been activated (CO2 F03-1) (20 … 90 °C)	
	Heat exchanger limitation temperature during charging (20 … 120 °C) In system 3, provided that FS2 has been activated (CO2 F03-1)	

Symbols and factory settings	Parameter (range of values)	After pressing the Enter key
	Return flow limitation temperature during the drinking water heating process (20 … 90 °C) Only if return flow sensor has been activated (CO-SYS F01-1)	
	Times-of-use for drinking water heating (Three times-of-use adjustable with start and stop) Factory setting: 0:00 … 24:00 (24 hours)	Blockwise or individual days 1-7 (Monday … Sunday); 1-5 (Monday … Friday) 6-7 (Saturday and Sunday); 1, 2, … , 7 (Mon, Tue, …, Sun)
	Times-of-use circulation pump CP (Three times-of-use adjustable with start and stop) Factory setting: 0:00 … 24:00 (24 hours)	Blockwise or individual days 1-7 (Monday … Sunday); 1-5 (Monday … Friday) 6-7 (Saturday and Sunday); 1, 2, … , 7 (Mon, Tue, …, Sun)

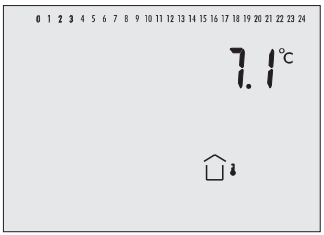
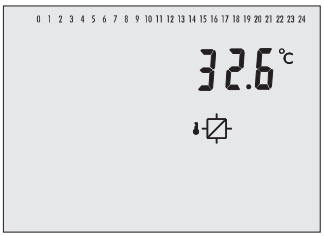
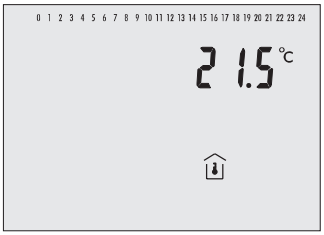
Appendix B.3 Level PA-SYS parameters

Symbol and factory settings	Parameter (range of values)	After pressing the Enter key
	Time	
	Date (Day.Month)	
	Date (Year)	
	Public holidays (Maximum 20 days possible) No holidays preset	Date If the display indicates ----, you can either enter or delete holidays (---- is between 31.12. and 1.1.)

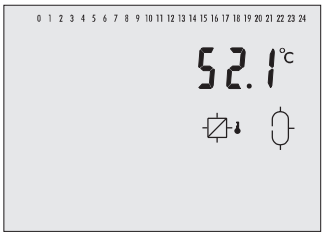
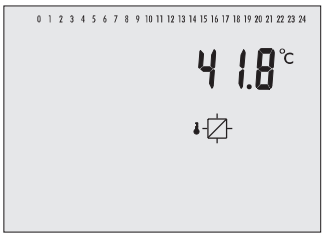
Symbol and factory settings	Parameter (range of values)	After pressing the Enter key
	Vacation (Maximum 10 time periods possible)	Start and stop date (START and STOP) If the display indicates ——, you can either enter or delete vacations, (—— is between 31.12. and 1.1.)

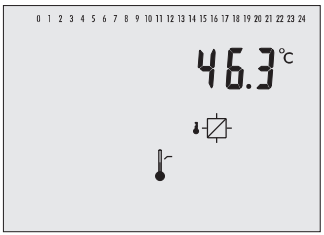
Appendix C Info levels

Appendix C.1 InFO 1 level

Symbols and factory settings	Parameter (range of values)	After pressing the Enter key
	Current outdoor temperature	Calculated outdoor temperature, (Only if CO1 F05-1)
	Current flow temperature at FS1	Set point of flow temperature (For sys. 2 and 3 the following appears for DWH: --.-)
	Current return flow temperature at RfS (when active)	Set point of return flow temperature (For sys. 2 and 3 the following appears for DWH: --.-)
	Current room temperature at RS (when active)	Set point of room temperature

Appendix C.2 InFO 2 level

Symbols and factory settings	Parameter (range of values)	After pressing the Enter key
	Current charging temperature at FS1 (systems 2,3) at FS2 (system 5)	Charging set point In heating operation the following appears: --.-
	Current flow temperature at FS2 (systems 3, 4 if active)	Charging set point In heating operation the following appears: --.-
	Current return flow temperature at RfS (if active)	Set point of return flow temperature In heating operation the following appears: --.-
	Current storage tank temperature at STS1(one storage tank sensor) or current storage tank temperature at STS2 (two storage tank sensors)	Drinking water demand ON for one storage tank sensor or Drinking water demand OFF for two storage tank sensors

Symbols and factory settings	Parameter (range of values)	After pressing the Enter key
	Current storage tank temperature at STS1 (two storage tank sensors)	Drinking water demand ON
	Current temperature at RfSDW (For system 5, provided that CO2 F12-1 Option 2 is set)	

Appendix D Error messages

In case of an error, the display indicates the symbol . The information level now allows you to select the error level "Err"or "Err F" by using the arrow keys. Press the ✳ key to access the error level. The error is then displayed in more detail according to the list below. More errors are displayed, if applicable, when you press the arrow key ↓. To exit the error level, press both arrow keys simultaneously.

Error level Err	Error
Err 0	Hardware error
Err 1	Default values were reentered. Acknowledge with the ✳ key.
Err 2	Storage tank set point not reached during thermal disinfection. Acknowledge with the ✳ key.
Err 3	Device not calibrated. Acknowledge with the ✳ key.
Err 4	The mode or control switch was more than 10 s in an invalid position, e.g. between two positions of rest, or it is defective.
Err 5	The maximum flow temperature is exceeded at flow sensor FS2 for system 3 with switchover of control. Acknowledge with the ✳ key.
Err 6	Flow temperature, room temperature or return flow temperature limitation outside the permissible range during temperature monitoring (CO-SYS F14)

Error level Err F	Error
|‾|	Sensor … short-circuited, for sensor symbols see the following table
| |	Sensor … disconnected, for sensor symbols see the following table

Sensor symbols

Symbol	Description	Symbol	Description
	Outdoor sensor		Storage tank sensor STS1
	Room sensor RS		Storage tank sensor STS2
	Return flow sensor RfS		Flow sensor FS1
	Return flow sensor drinking water RfSDW		Flow sensor FS2 (systems 3, 4)
			Flow sensor VS2 (system 5)

Appendix E Resistance values of temperature sensors

Resistance thermometer with PTC component

Outdoor temperature sensor: Type 5224, to measure flow and return flow temperature: Type 5264 and 5265,
to measure storage tank temperature: Type 5264

°C	–20	–10	0	+10	+20	+25	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120
Ω	694	757	825	896	971	1010	1050	1132	1219	1309	1402	1500	1601	1706	1815	1925

Sensor for room temperature with remote control Type 5244

°C	+10	+15	+20	+25	+30	
Ω	679	699	720	741	762	

Resistance thermometer with Pt 1000 component

Outdoor temperature sensor: Type 5227, to measure flow and return flow temperature: Types 5207-21, 5207-26, 5207-27, 5277 (thermowell required) and 5267 (contact sensor with cable of 3 m length), to measure storage tank temperature: Types 5207-46, 5207-47 and 5207-48, room temperature sensor: Type 5257 and room temperature sensor with remote control: Type 5257-4.

°C	–35	–30	–25	–20	–15	–10	–5	0	5	1
Ω	862.5	882.2	901.9	921.6	941.2	960.9	980.4	1000.0	1019.5	1039.0
°C	15	20	25	30	35	40	45	50	55	60
Ω	1058.5	1077.9	1097.3	1116.7	1136.1	1155.4	1174.7	1194.0	1213.2	1232.4
°C	65	70	75	80	85	90	95	100	105	110
Ω	1251.6	1270.7	1289.8	1308.9	1328.0	1347.0	1366.0	1385.0	1403.9	1422.9
°C	115	120	125	130	135	140	145	150		
Ω	1441.7	1460.6	1479.4	1498.2	1517.0	1535.8	1554.5	1573.1		

Appendix F Configured data

Station	
Operator	
Responsible SAMSON office	
System code number	

Function block setting

	CO1	CO2	CO-SYS
F01			
F02			
F03			
F04			
F05			
F06			
F07			
F08			
F09			
F10	–		
F11			
F12			
F13		–	
F14			
F15			
F16			
F17			

Parameter settings

Heating circuit parameters (PA1, CO1)

Parameter	Current setting				Unit	Range of values
Gradient of characteristic						
Heating characteristic gradient						0.2 … 3.2
Set-back of flow temperature for reduced operation					°C	0.0 … 50.0
Level of heating characteristic					°C	–30.0 … +30.0
Level of return flow character.						0.2 … 3.2
Level of return flow character.					°C	–30.0 … 30.0
4-point characteristic	Point 1	Point 2	Point 3	Point 4		
Outdoor temperature					°C	–30.0...+50.0
Flow temperature					°C	20.0 … 130.0
Return flow temperature					°C	20.0 … 90.0
Set-back difference					°C	0.0 … 50.0
Maximum flow temperature					°C	20.0 … 130.0
Minimum flow temperature					°C	20.0 … 130.0
Maximum return flow temperature					°C	20.0 … 90.0
Minimum return flow temperature					°C	20.0 … 90.0
Limit values of the outdoor temperature						
~ to return to rated operation when in reduced operation					°C	–30.0 … ~for deactivation when in reduced operation
~ for deactivation when in reduced operation					°C	~ to return to rated operation when in reduced operation … 50.0
~ for summer operation					°C	0.0 … 50.0
Room temperature set points						
Room set point					°C	10.0 … 40.0

Parameter	Current setting	Unit	Range of values
Reduced room set point		°C	10.0 … 40.0
Sustained temperature		°C	10.0 … 40.0
Lag time of heating circulation pump		s	15 ... 2400
Optimize (F02)			
Preheating time		min	0 … 360
Flash adaptation (F03)			
Cycle time		min	1… 100
Delayed outdoor temperature adaptation (F05)			
Delay		°C/h	1.0 to 6.0
Summer operation (F06)			
Start of summer period			1.1. … 31.12.
Number of days for start			1 … 3
End of summer period			1.1. … 31.12.
Number of days for end			1 … 3
Outdoor temperature limit		°C	0.0…50.0

Times-of-use	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Start 1							
Stop 1							
Start 2							
Stop 2							
Start 3							
Stop 3							

Drinking water heating circuit parameters (PA2, CO2)

Parameter	Current setting	Unit	Range of values
One storage tank sensor			
Drinking water demand On		°C	20.0 … 90.0
Differential gap		°C	0.0 … 30.0
Two storage tank sensors			
Drinking water demand On		°C	20.0 … 90.0
Drinking water demand Off		°C	20.0 … 90.0
Charging set point		°C	20.0 … 90.0
End charging process		°C	20.0 … 90.0
Max. value for deactivation of the storage charging pump in system 3		°C	20.0 … 90.0
Heat exchanger limitation temperature during charging		°C	20.0 … 120.0
Return flow limitation temperature during the drinking water heating		°C	20.0 … 90.0
Thermal disinfection (F 05)			
Day of the disinfection			0 … 7
Storage tank set point		°C	60.0 … 90.0
Start time			0:00 … 23:30
Stop time			0:00 … 23:30
Parallel pump operation (F06)			
Waiting time until HCP Off		s	120 ... 600
Priority drinking water heating (F09)			
Idle time		s	60 ... 600

Times-of-use drinking water heating	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Start 1							
Stop 1							
Start 2							
Stop 2							
Start 3							
Stop 3							

Times-of-use circulation pump CP	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Start 1							
Stop 1							
Start 2							
Stop 2							
Start 3							
Stop 3							

Parameters of the PA-SYS and CO-SYS levels

Parameter	Current setting	Unit	Range of values
Public holidays (maximum of 20)			1.1. ... 31.12.
Vacations (max.10 time periods)			
Start date			1.1. ... 31.12.
Stop date			1.1. ... 31.12.
Return flow limitation factor (F01)			0.1 ... 10.0
Gain Kp (F05)			0.1 ... 50.0
Reset time Tn (F05)		s	0 ... 999
Control valve transit time Ty (F05)		s	10 ... 240
Differential gap (F05)		°C	2.0 ... 10.0
Minimum on-time (F05)		s	0 ... 600
Minimum off-time (F05)		s	0 ... 600
Max. system deviation (F06)		°C	2.0 ... 10.0
Temperature correction factor (F11)		°C	0.0 ... 30.0
Gain Kp (F15)			0.1 ... 50.0
Reset time Tn (F15)		s	0 ... 999
Derivative-action component T_V (F15)		s	0 ... 999
Gain of derivative-action component K_pT_V (F15)			0 ... 50.0
Control valve transit time Ty (F15)		s	10 ... 240
Differential gap (F15)		°C	2.0 ... 10.0
Minimum on-time (F15)		s	0 ... 600
Minimum off-time (F15)		s	0 ... 600
Max. system deviation (F16)		°C	2.0 ... 10.0

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A

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I

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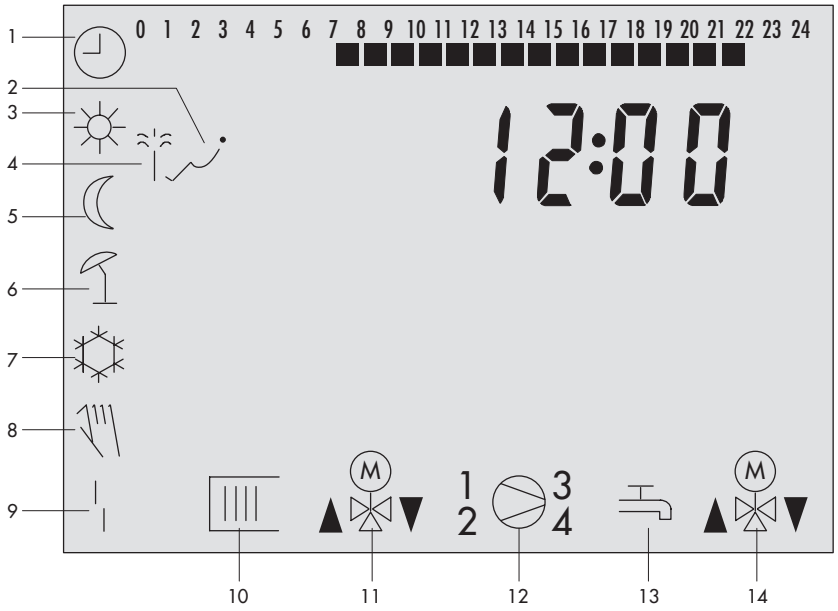
V

W

Code number

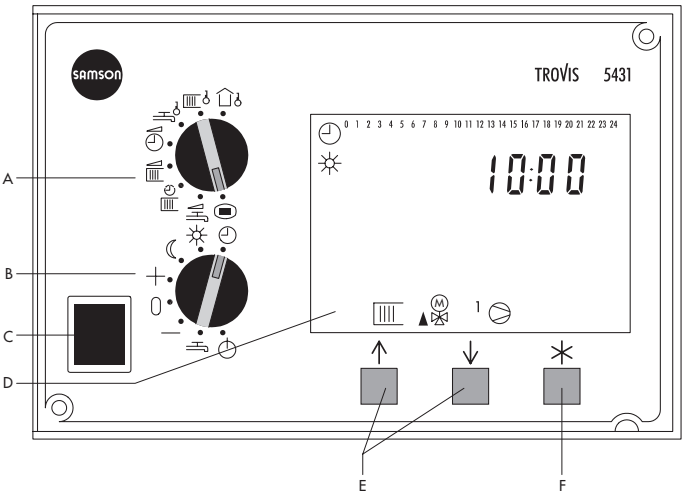
1732

Important display symbols



1 *Automatic mode*
2 *Holidays*
3 *Rated operation*
4 *Vacation*
5 *Reduced operation*
6 *Summer operation*
7 *Frost protection*
8 *Manual operation*
9 *Malfunction*
10 *Heating circuit demand*
11 *Valve control loop 1*
Open (left arrow)
Closed (right arrow)
12 *Status of pumps*
1 Heating circuit pump HCP
2 Heat exchanger pump HEP
3 Storage charging pump SCP
4 Circulation pump CP
13 *Drinking water demand*
14 *Valve control loop 2*
Open (left arrow)
Closed (right arrow)

Front view



A *Control switch*
B *Mode switch*
C *Connection for memory pen*
D *Display*
E *Arrow keys*
F *Enter key*

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