OPERATING INSTRUCTIONS

Controller TCS.2 –
thermofin® control system 2nd generation
V1.5

(from TCS.2 software version TCS.2_A09_v20231214)

Original version
These operating instructions were produced in several languages. The German version is the original version of the instructions. All other languages are translations of the original version.

Disclaimer
In the event of problems related to the assembly and/or operation of the device, which are not described in these instructions, the operator/installer is obligated to contact thermofin® immediately. The further assembly and/or operation of the device is not permitted until complete clarification of the facts.

thermofin® cannot accept any liability for damage resulting from failure to observe this warning. Furthermore, thermofin® reserves the right to reject any further warranty claims on this device that can be traced to this.

In case of further questions, please contact the company thermofin GmbH.

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1. GENERAL NOTES

The operating instructions are for optimal handling and parametrization of the TCS.2. They are intended to allow the user to set the unit according to ecological and economical aspects and to ensure trouble-free operation.

Caution:
Read and observe the safety instructions in the device manual before use.

1.1 Principles

These operating instructions relate to devices in the following series:

→ TCS.2: thermofin® control system, 2nd generation

and to all associated device components delivered by the manufacturer. Regardless of whether wired or wireless, or defined as standard or as a special solution with the additional designation "X".

The binding technical data can be found in the relevant catalogue sheets, the associated device specifications and in the information on the corresponding type plates.

For control cabinets, control and regulating devices, the information on the identification plates applies first and foremost.

1.2 Introduction

Recoolers, condensers and evaporators require a suitably complex control system for optimal adaptation of their performance to the amount of heat to be dissipated or absorbed at the time, taking environmental conditions into consideration. Modern control systems not only permit an operation precisely adapted to the conditions of the cooling unit, but are also characterised by particularly high energy efficiency. Helpful additional functions increase comfort when operating the unit and permit rapid communication with higher-level control systems. The use of high value components allows the fans to run completely smoothly and the fan drives to be handled gently and with minimal disruption.

With the 2nd generation thermofin® control system **(TCS.2)**, the user receives a fully-fledged control and regulation unit. It provides control, regulation and monitoring of commercially available EC fans as well as electronic speed adjustment of fan motors in connection with corresponding inverters and voltage regulators. Furthermore, the TCS also regulates and controls all water-side components in hybrid and evaporative cooling systems.

The TCS is also used in thermofin® industrial cooling products. In penthouse, air and insulated coolers, it regulates and monitors all flap movements and defrosting processes in addition to the speed of the fans.

Communication between the TCS and the fans or the power controllers can be done using a MODBUS connection. Conventional information transmission using analog signals is also possible with the TCS. Up to 126 CAN I/O fieldbus components can be connected via the system bus. A web or master terminal permits decentralised operation and visualisation.

The TCS is a modern control unit with all necessary input and output systems. For a convenient overview, there is a 4.3” TFT display with touch function. This allows all operating and system settings to be made in a user-friendly and intuitive way.

As standard, the TCS is located in a weather-protected switch box directly on the housing of the corresponding heat exchanger. If the TCS is assembled in a different location for structural reasons, it can be placed in a separate control cabinet or in the machine room of the cooling system without any problems.

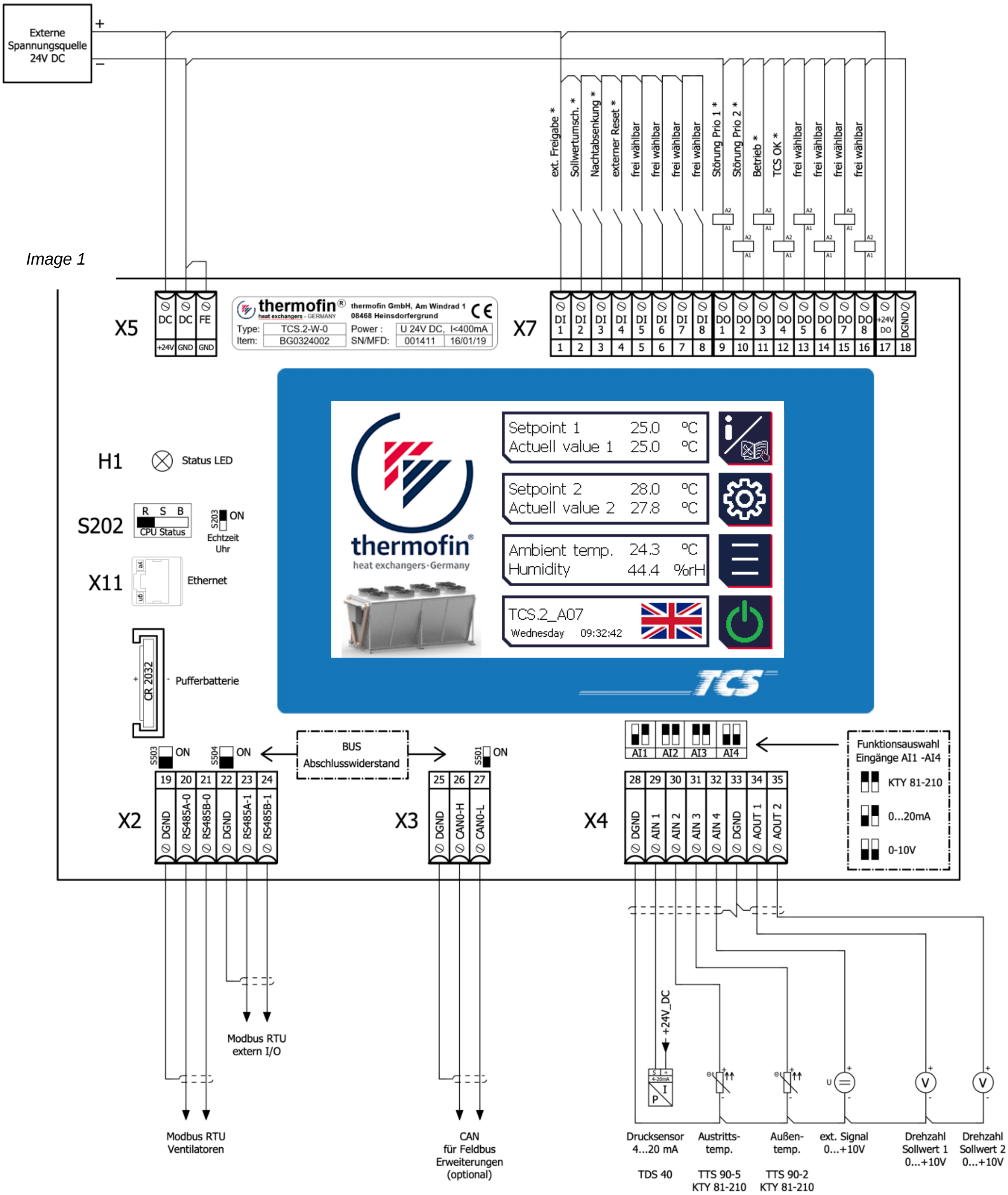
1.3 Area of application

In modern and energy-efficient cooling and air conditioning systems, the TCS takes over the regulation, control and monitoring of heat exchangers and their fans including all necessary additional devices and fittings.

Without a correspondingly classified control cabinet, control units in the TCS series can only be operated in dry, weather-protected and properly air-conditioned spaces. Thermofin®® control cabinets meet all important criteria for placement in the open air and therefore also permit trouble-free operation with the integrated TCS.

1.4 Circuit diagram TCS.2

Image 1

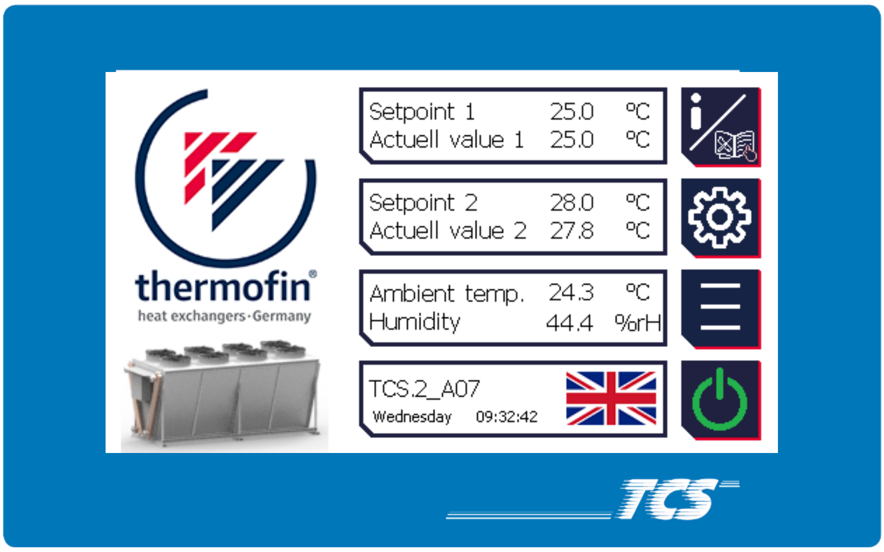


Standard configuration, may vary. Example configuration of inputs and outputs.

2. STRUCTURE / NAVIGATION

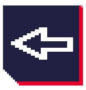
2.1 Circuit diagram TCS.2

Image 2

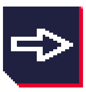


2.2 Navigation / button functions

HOME / start screen
This button is on various main and sub-menus. Selecting it always brings the user directly to the start screen.



Back
Jump back one menu level



Forwards
Jump forward one menu level

Confirm
The current input or error message is acknowledged

Confirm all
All currently present error messages are acknowledged

Alarm history
This button brings the user to a list of past error messages, sorted from new to old with the indication of when they occurred and when they were removed.

Delete
The list of saved alarms is deleted. This function requires the manufacturer's password to be entered (see chapter 2.4 “*Passwords*”).

Undo
The input is returned to the previous state.

Monitor
Direct jump to the “Monitor” sub-menu, in which all important setpoints and actual values for controller optimisation are shown.

Control parameters
Jump directly to the sub-menu “Control parameters” The proportional factor k_p and the reset time T_n of the thermofin® PI controller are set here.

Modbus fan status
This icon is only shown during fan control via Modbus, and leads to a sub-menu listing any fan operating, status and error messages.

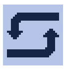
STOP / RUN
The STOP button stops the fan Modbus. This is a precondition for starting the fan parametrising process. After leaving the parametrising menus, the Modbus is automatically started again.

Writing parameters in the fan
All preselected parameters and addresses are loaded in the respective Modbus fan(s).

Manual operation

Depending on the type of device, the user is taken from here to an operating interface where all relevant flaps, valves and pumps can be manually actuated or adjusted.

Licence manager
Overview of installed licences



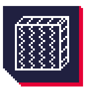
Manual/automatic switcher
During commissioning or troubleshooting, the user can select the “Automatic” and “Manual” operating modes using this button. If a digital output or an analog output is switched to “Manual”, this will be shown on the start screen. If the control is returned to automatic mode, the output assumes the original value (from before switching to manual).

Manual mode

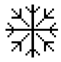
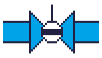
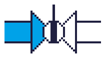
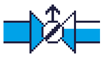
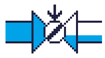
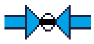
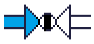
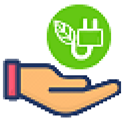
Automatic mode

The following icons/symbols are only used with wetted/humidified device types:

effSLIDE settings
The limit values (switching on and off conditions for mat humidification) for the “water-saving” or “energy-saving” modes are set here.



Mat system
Device-specific settings for all devices in which the input air is pre-cooled with mats (adiabatic pads).

	Summer mode		Winter mode
	Main or spray valve is OPEN		Main or spray valve is CLOSED
	Main or spray valve OPENING		Main or spray valve CLOSING
	Regulating valve is OPEN		Regulating valve is CLOSED
	Regulating valve is partially open (With % indication)		Neutral setting
	All parameters for switching the humidification on and off are set to “energy-saving”		All parameters for switching the humidification on and off are set to “water-saving”

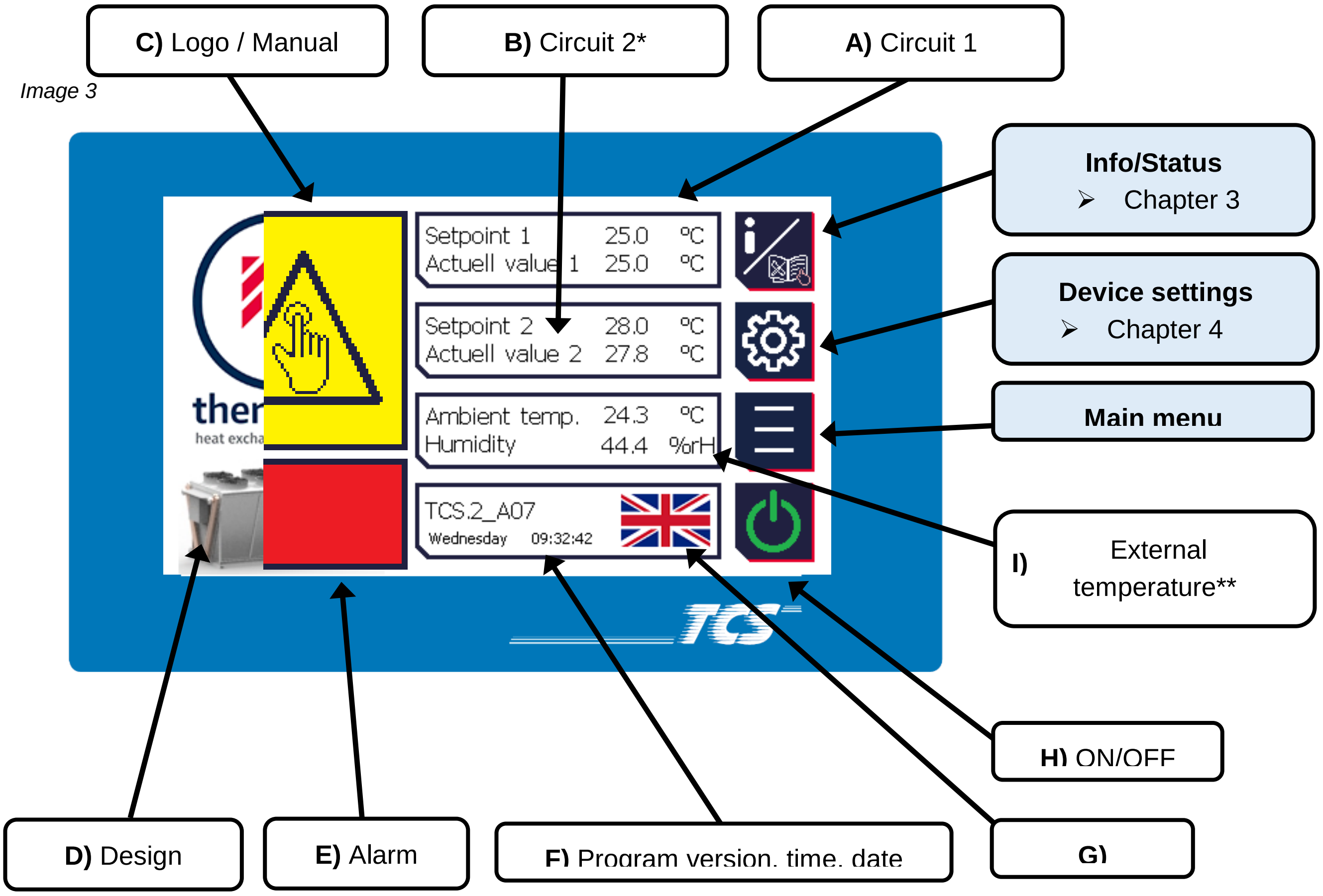
2.3 Menu structure

2.3.1 Start screen

After switching the control voltage on, the thermofin® logo appears on the screen with the address of the head office in Heinsdorfergrund.

The installed program is then loaded with the following start screen:

Image 3



* only visible if a dual circuit device is selected

** only visible if a wetted or humidified device is selected or an external temperature was selected as the analog input.

*** only visible if a thermofin® adiabatic pad device is selected

Four main function buttons are found in the right display halves. These are described in a separate chapter. All other symbols and displays are explained briefly below:

A) Circuit 1

Devices that only have one hydraulic line with the corresponding sensor (temperature or pressure) are designated as “single circuit”. The selection of the sensor is made automatically when the factory settings are loaded (chapter 4.1.3). This marked display “circuit 1” represents the **setpoint** (can be edited in the main menu → Setpoints (chapter 5.7) and the **actual value** (measured by the sensor) for this line. Both values influence internal regulator 1.

If the “slave mode” operating mode is selected, the “control value” (given in percent) is shown rather than the setpoint. The actual value display remains.

To switch the slave mode on or off, two settings must be made in the “control” menu:

- *Device settings* → *Control* → *Slave* setpoint →
  “select desired control signal” (chapter 4.2.5)
- *Device settings* → *Control* → Inputs/outputs → *Analog IN* basic device →
  Analog IN 3 → “Speed Slave 1” (chapter 4.3.3)

B) Circuit 2

If a dual or multiple circuit device is selected, the **setpoint** and **actual value** for the second hydraulic line is displayed under the display of the first circuit. The selection of the sensors is made automatically when the factory settings are loaded (chapter 4.1.3). This setpoint can also be edited in Main menu → Setpoints (chapter 5.7). The setpoint and actual value from of Circuit 2 influence internal regulator 2.

If the “slave mode” operating mode is selected, the “control value” (given in percent) is shown rather than the setpoint. The actual value display remains.

To switch the slave mode on or off, two settings must be made in the “control” menu:

- *Device settings* → *Control* → *Slave setpoint* →
  select desired control signal (chapter 4.2.5)
- *Device settings* → Inputs/outputs →
  Analog IN basic device → Analog IN 4 “Speed *Slave 2*” (chapter 4.3.3)

C) Logo / Manual

In normal mode, the thermofin® logo is displayed here. However, if the manual mode of a digital or analog output is activated, a hand symbol highlighted in yellow appears, indicating the output that is currently set to manual mode.

By selecting the information window highlighted in yellow, the user is brought directly to the corresponding output, which is still activated.

D) Design

Device design given as an example. This is selected at the factory. See also chapter 4.1.2 (Selection of device design). These are shown as an example in the selection and at the start screen. In the case of individual device types (e.g. insulated coolers or hybrid coolers), selecting the image brings you directly to the system overview (monitor).

E) Alarm / Warning message window

If there are no warnings or alarms, or these have not been acknowledged, this window is not visible. As soon as a current fault occurs, whether high priority (alarm) or low priority (warning), the device design and the date/time window are hidden. A fault message window blinking red and green opens with a plain text display indicating the most recent message (see also 5.5“).

Selecting the message window brings the user directly to the Main menu to the sub-item “Alarm” (see also chapter 5.5 “Alarms”.)

F) Program version, time, date

- TCS.2 – device generation
- _A01 – Version status in short form, full version number in first main window: “Status / Info” (see chapter 3)
- Weekday, can be edited in *Main menu* → *“Time/Date”* (see chapter 5.10 “*Time/date*”)
- Time in hh:mm:ss format, can be edited in *Main menu* → *“Time/Date”* (see chapter 5.10 “*Time/date*”)

G) Language

Directly selecting the “country flag” brings the user to the language menu. Here, the user can currently switch between the following languages:

- German
- English
- French
- Spanish

H) ON / OFF

This button is primarily used to turn the device on and off. This means that even if an external release (request) is present, the device remains switched off until there is a switch-on instruction via the display button. The status is indicated by the highlighted colour:

RED → OFF
- to switch the device on, select this button quickly
- display switches to green

GREEN → ON
- to switch the device off, the user must press the button down for 5 seconds
- this should prevent the device from being switched off unintentionally
- display switches to red

I) External temperature / air humidity

External temperature:
If an external temperature is selected, this is also displayed in the Start screen in °C or °F. The indication of °C or °F can be changed in Main menu → "SI/IMP" (see also chapter "SI/IMP".0). The external sensor can be selected in the program in the following way:

- The factory settings of a humidified or wetted device are loaded.
- In the menu *Device settings → Inputs / outputs → Analog IN selection → "Analog IN 2, 3 or 4*" (see also chapter "Analog IN basic device" 4.3.3)
- If the demand for analog temperature inputs increases past 4 (these are available as standard on the basic device), the external sensor is automatically placed on an analog IN CAN extension (see chapter D) "*Assignment of analog I/O* extensions").

Air humidity:
To calculate the maximum evaporation precisely, a relative air humidity sensor is installed on thermofin® adiabatic pad devices. If this kind of device is selected, the air humidity is also shown in the Start screen. The following options exist for selecting a humidity sensor in the program:

- The factory settings of a thermofin® adiabatic pad device are loaded.
- In the menu *Device settings → Inputs / outputs → Analog IN* selection → "Analog IN 3 or 4" (see also chapter "Analog IN basic device" 4.3.3)
- If the demand for analog inputs increases past 4 (these are available as standard on the basic device), the humidity sensor is automatically placed on an analog IN CAN extension (see chapter D) "*Assignment of analog I/O* extensions").

2.4 Passwords

For security reasons, the device settings and the editable parameters are password protected. The following three access levels are distinguished here:

2.4.1 Manufacturer's password

This password protects basic factory settings. Parameters like the device type, design, extension module, operation hour counter, addressing fans, etc., are not accessible for users.

2.4.2 Admin device password

The password for the device settings  should be requested from the manufacturer or supplier of the TCS if required.

2.4.3 User parameter password (editable)

The pre-set password for parameter changes (setpoints, control parameters, time/date, etc.) is “**3333**”. This can be changed by the operator to an individual password that only they know.

The parameter password can be changed in the following way:

Image 4

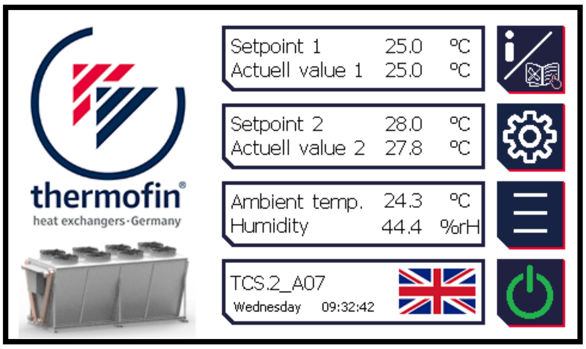
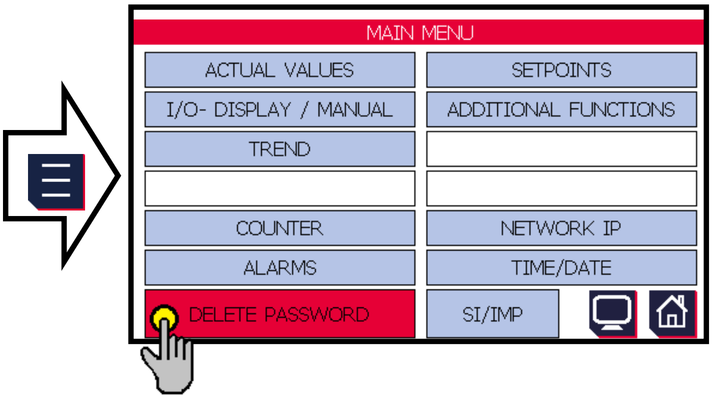


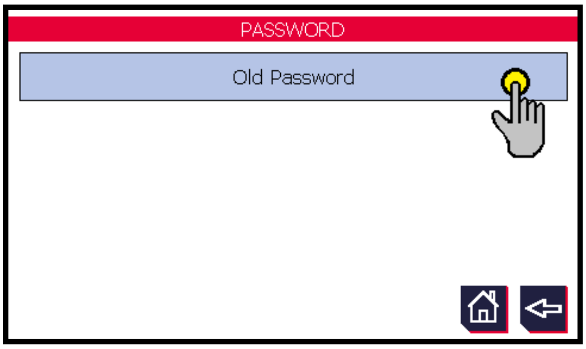
Image 5



➔ Keep the button “DELETE PW INPUT” pressed for 5 seconds (Image 5)

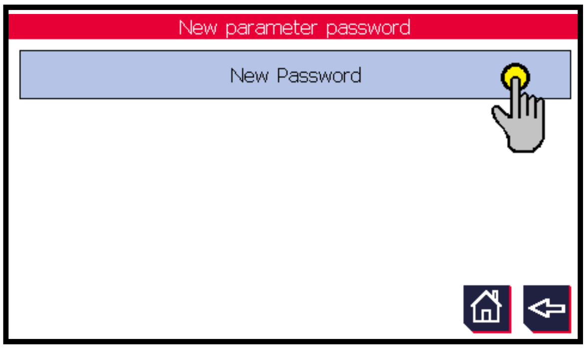
The following window then opens. If the system password has already been entered, this step is skipped (22a)

Image 6



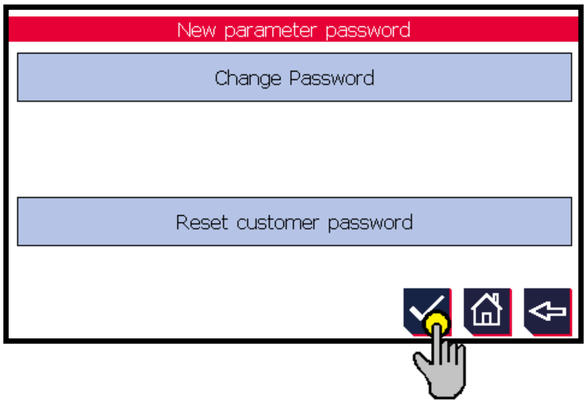
- ➔ Enter the current (old) user parameter password (Image 6)
- ➔ This password is factory set as: “3333”

Image 7



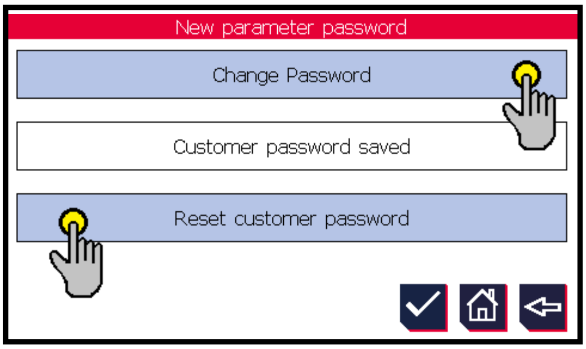
- ➔ A new 4-digit password can now be entered (Image 7)
- ➔ **CAUTION:** Keep this password safe. If this password is lost, the password for the device settings (admin password) will be needed for further parameter adjustments. This must be requested from the manufacturer or supplier of the TCS.

Image 8



- ➔ After entering the new password, confirm the entry with the tick (Image 8)

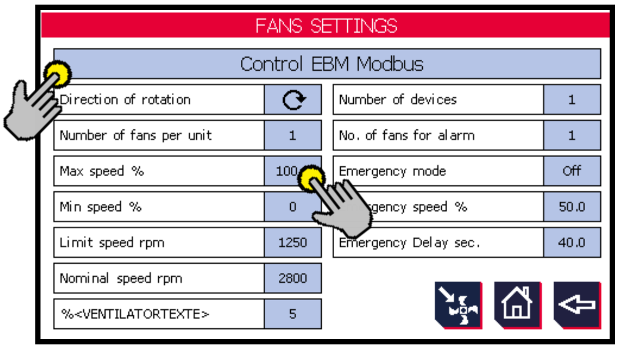
Image 9



- ➔ The message “Password saved” appears (Image 9)
- ➔ After this process, the process can be repeated using the current password (Image 9)

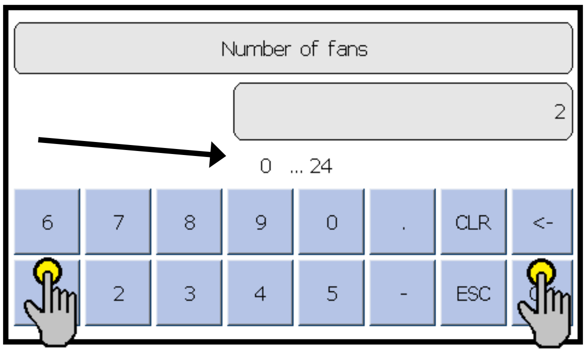
2.5 Change (edit) values

Image 10



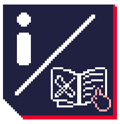
To change a value (parameter) or a status in a menu, directly select the box with a light blue background. All boxes with a white background are purely displays and cannot be edited. The following sub-menu is an example (see Image 10): “Fan settings”

Image 11



After selecting a box with a light blue background with a digit, an input window with numbers or letters opens. The desired value or amount can be entered here and then confirmed with OK or cancelled with ESC. The minimum and maximum values to be entered are displayed over the keypad (see Image 11).

3. INFO/STATUS



All relevant manufacturer's information as well as the software and hardware versions can be found here. This information is urgently required in order to provide the best possible assistance with any support requests (see Image 12).

Image 12

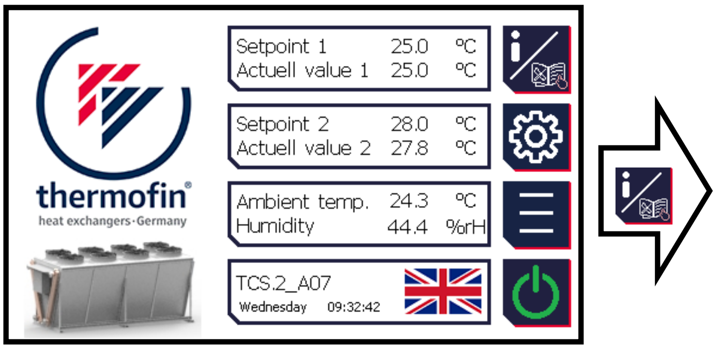
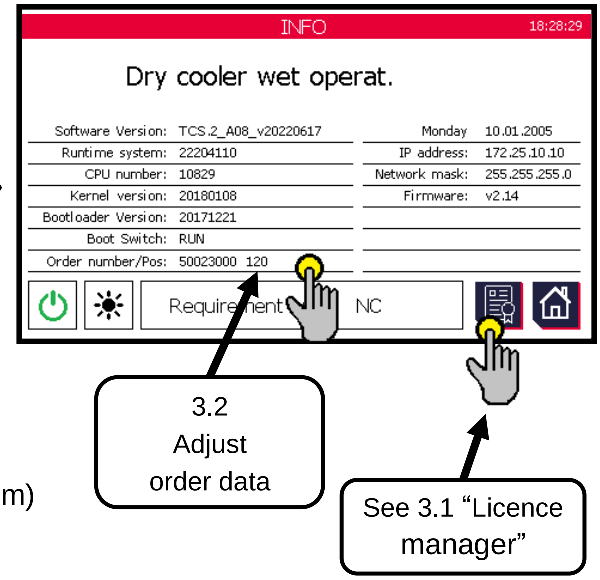


Image 13



Status display with the following content:

- Currently loaded software version
- Runtime system version (operating system)
- CPU serial number
- Kernel version
- Bootloader version
- Position of the boot switch
- Order number thermofin®/Item in order
- Date and time
- Currently set IP address
- Network mask
- Firmware version
- Summer or winter mode
- Status and type of request (enable)

➔ **Off:** Device has no external release (see chapter 4.2.1: *Control -> Request*) or is switched off locally (symbol red)
NC: Enable active, **N**ormal **C**ooling

➔ **FC**: Enable active, **F**ree **C**ooling (setpoint switching active, see chapter 4.2.2: Control -> Setpoint switching)

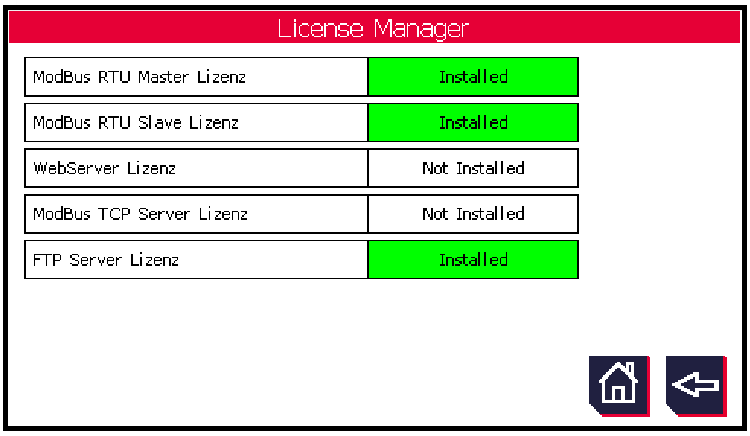
➔ **HR**: Enable active, **H**eat **R**ecovery – only for condensers (setpoint switching active, see chapter 4.2.2: Control -> Setpoint switching)

➔ **HP**: Heat pump operation active (see 4.2.19 Control heat pump operation circuit 1/2: Control -> Heat pump operation)

3.1 Licence manager

Overview of currently installed licences.

Image 14

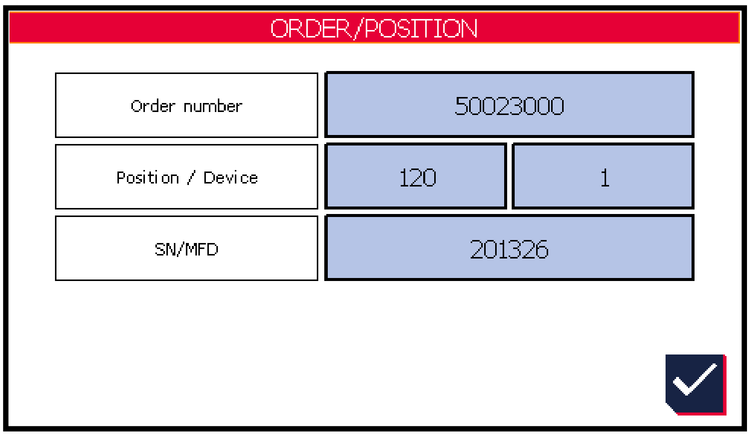


3.2 Order / Item

By pressing the “Order number/Item” box for at least 5s (see Image 13), the following window opens (Image 15), in which the customer-specific order data and the serial number of the TCS.2 controller are entered.

This function cannot be used by the customer (manufacturer's password necessary).

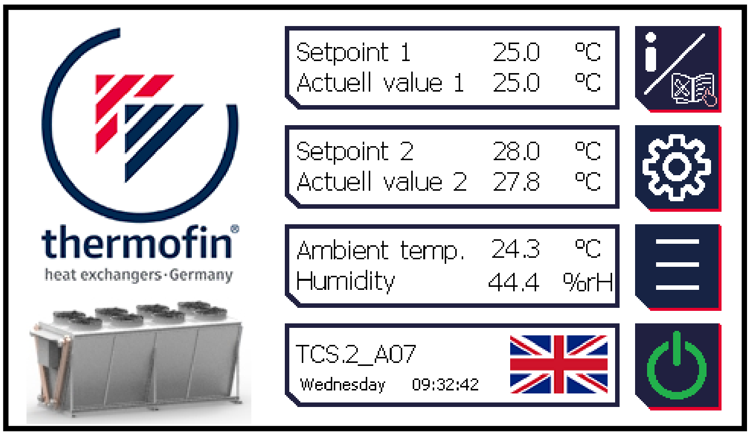
Image 15



4. DEVICE SETTINGS

This area is protected by a device password (see chapter 2.4 “*Passwords*”). In the device settings, it is possible for the manufacturer or supplier of the heat exchanger system to adapt the TCS to its tasks for the respective customer application.

Image 16



Device
password

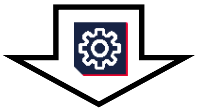
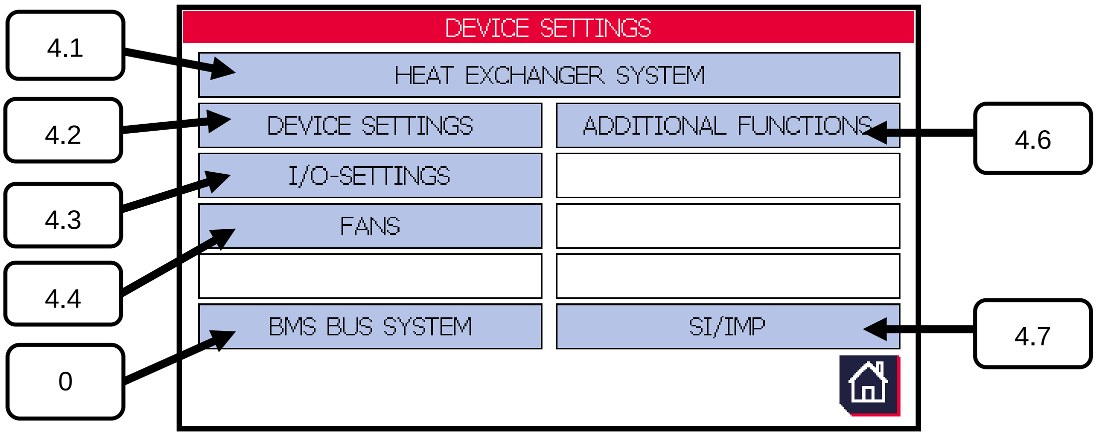


Image 17

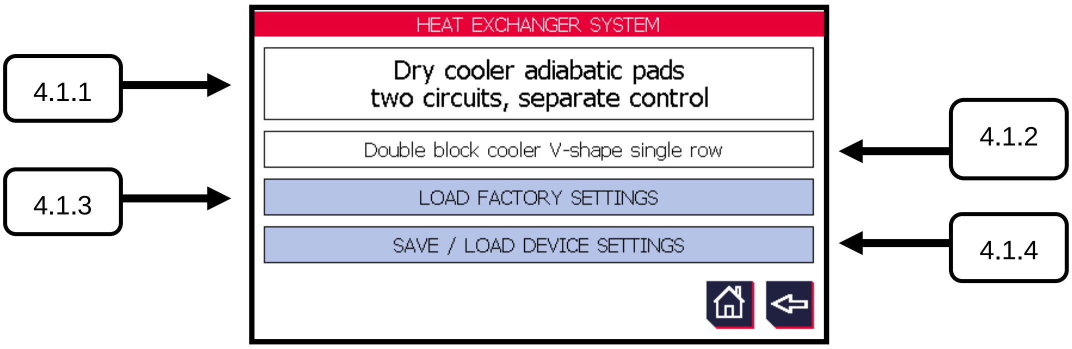


Leaving Device settings, incl. its sub-menu, is done using the Back or HOME buttons.

The marked sub-menus are described below. The outlined digits indicate the chapter number.

4.1 Heat exchanger system

Image 18



4.1.1 Selection of heat system / explanation of terms

This function is presented in white and cannot be adjusted by the customer (manufacturer's password necessary).

The following device types can be selected from the factory:

1. Condenser dry
2. Condenser sprayed
3. Condenser dry, multi-circuit, max. selection
4. Condenser sprayed, multi-circuit, max. selection
5. Condenser dry, dual circuit, separated control
6. Condenser sprayed, dual circuit, separated control

7. Recooler dry
8. Recooler sprayed
9. Recooler dry, dual circuit, max. selection
10. Recooler sprayed, dual circuit, max. selection
11. Recooler dry, dual circuit, separated control
12. Recooler sprayed, dual circuit, separated control

13. Condenser adiabatic pads
14. Condenser adiabatic pads, dual circuit, separated control

15. Recooler adiabatic pads
16. Recooler adiabatic pads, dual circuit, separated control

17. Evaporative condenser
18. Evaporative recooler

19. Insulated cooler
20. Penthouse cooler

21. Air cooler

22. Hybrid condenser
23. Hybrid recooler

In the selection of the heat system, it is determined whether the TCS functions as a cooling tower manager (several slave devices controlled) or takes over control and regulation for one device and its fans as standard. See also chapter 11.1 “Adjustments in Device settings” and chapter 11.2 “Adjustments in Main menu → Additional functions → Cooling tower manager”

Explanation of terms:

Condenser:
An air-cooled condenser is an important component in the cooling system. Compressed coolant (refrigerant vapour) is condensed by releasing heat into the ambient air using fans.

Recooler:
Waste heat occurs in different ways in industrial and cooling processes. This is transferred to a carrier medium in the form of water, a water-glycol mixture, steam or thermal oil. Recoolers dispel this waste heat into the ambient air.

Dry:
With a dry cooler or condenser, it is not possible to cool the carrier medium below the ambient air temperature. The cooling limit distance in this case is the difference between the medium outlet and air inlet temperature. For dry recoolers, a cooling limit distance of 7-8 °C is still economical.

Evaporator:
In evaporators, the tube bundle heat exchanger is sprinkled with the coolant water. In counterflow, the air flows through the tube bundle and is therefore in direct contact with the coolant water. The heat is dissipated using a combined material and heat transfer process. In this process, about 2/3 of the heat flow is dissipated into the ambient air through evaporation, and only 1/3 through convection.

Air cooler:
Air coolers suck the heated room air on one side and lead this through a finned heat exchanger containing water or a water-glycol mixture. In this way, heat is absorbed from the room air flowing through it. See also chapter 5.8.2 “Medium functions”.

Insulated cooler:
Insulated coolers are recirculating coolers in a container design, which are mounted in front of corresponding openings in the external walls of refrigeration rooms and control the temperature of the connected refrigeration room from there. The insulated cooler also has an opening on the side against the wall, through which the refrigeration room air is sucked, cooled and blown in again. Both openings are coordinated in size. The opening is provided with a horizontal defrost flap. When opened, this separates the intake and outlet air, closed refrigeration room and the inner space of the insulated cooler. Fans for transporting air are mounted directly on the cooler or evaporator block. These are dimensioned according to the desired air quantity and pressure.

Sprayed:
These devices are dry recoolers or condensers, which are additionally fitted with one or more nozzle sticks. Depending on the design, these are arranged under or next to the finned heat exchanger. If needed, the water is sprayed into or against the direction of air flow, in which there is a precooling

effect of the air sucked in due to the evaporation of the water. Part of the sprayed water also reaches the fin surface and wets it. This results in a further evaporation effect that allows cooling below the ambient air temperature. Dry recoolers and condensers are generally designed for dry operation. Wet mode with spraying is only for peak load coverage.

Adiabatic pads:
Recoolers or condensers with adiabatic precooling systems have wetting mats, through which the external air is sucked in. The air flows through the mats that are humidified with water, where they are cooled through evaporation (withdrawal of evaporation enthalpy) before entering the heat exchangers. This increases the temperature difference of the heat exchange, and return or condensing temperatures below ambient temperature are even possible. As no water is placed directly on the heat exchanger, but rather only precooled air, the possible duty cycle of the humidification is significantly higher than with the sprayed systems.

Hybrid:
Hybrid devices cool the medium with ambient air and with water evaporation. At the low temperature range, the heat is exchanged convectively (dry cooling). At high temperatures, the surface of the finned heat exchanger is wetted with water. The heat is then released to the ambient air partially convectively, partially in latent form as invisible steam.

Dual circuit / multi-circuit:
These devices have two to max. four hydraulically separated circuits that are installed in one or two separated, finned heat exchangers. For this reason, each circuit has a separate pressure or temperature sensor.

Max. selection:
This function relates to dual or multi-circuit devices that work with only one internal regulator and multiple sensors. The circuit with the higher value at the sensor (pressure or temperature) generally becomes the controlled variable in the TCS and thereby determines the control variable (speed of fans).

Separated control:
Both lines of a dual circuit device are not only considered as separate hydraulically, but also in terms of control. For this reason, there are also two internal controllers whose control variable corresponds to two different fan groups. Two different coolants or heat transfer media are possible.

4.1.2 Selection of device design

This function is also presented in white and cannot be changed by the customer (manufacturer's password necessary). The following device designs can be selected from the factory. These are shown as an example in the selection and in the start screen.

1. Table cooler horizontal single row
2. Table cooler horizontal two-row
3. Table cooler vertical single row
4. Table cooler vertical two-row
5. Double block cooler V-shape single row
6. Double block cooler V-shape two-row
7. Evaporator single row
8. Evaporator two-row
9. Hybrid device single row
10. Hybrid device two-row

In the case of the “insulated cooler” and “penthouse cooler” heating systems, there are special device designs/flap variants. *See also chapter* 10.1 “*Selection of heat exchanger* system – insulated cooler*”.*

4.1.3 Load factory settings

After selection of the heating system, the factory settings must be loaded during commissioning. The system sets all device-specific standard settings and setpoints, and configures the inputs and outputs.

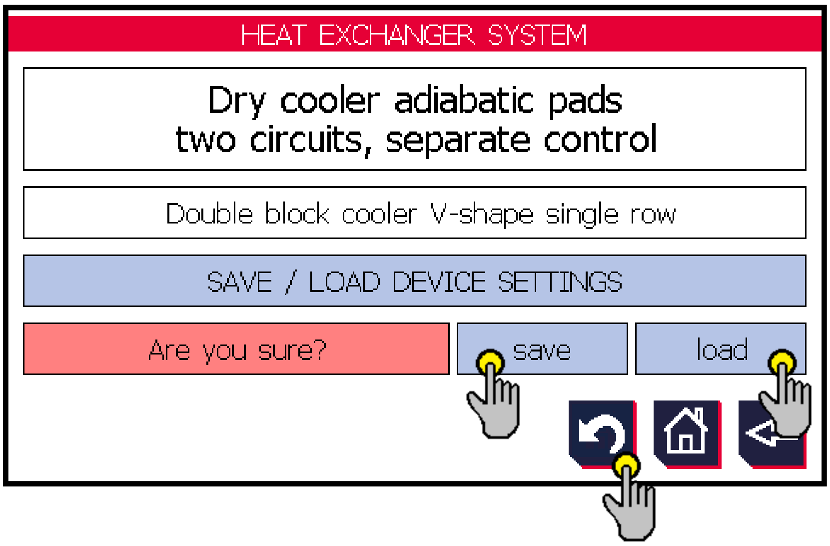
Caution! All previous parameter adjustments and customer settings will be lost. It is essential to compare the set parameters with the parameter list on the circuit diagram beforehand!

4.1.4 Save/load device settings

All settings and parameters are automatically saved in a fail-safe manner after entry. However, if a new program or an update is loaded, the A: drive is cleaned and all data are lost.

To prevent this, the user has the option to save their settings and parameter on an internal B: drive. For this reason, please respond to the security prompt: “Are you sure?” with “save”.

Image 19



After a new program version has been recorded, the process can be repeated and the security prompt can be answered with “load”.

Now the saved data from B: drive are loaded back into A: drive. If the process needs to be interrupted, this is possible at any time with the “Back” button.

4.2 Control

In the sub-menu, the user determines the signal used to control or activate the respective signal. The right arrow button takes the user to the expanded con⇨menu (from chapter 4.2.7. Hygiene circuit).

The following is a list of setting options:

4.2.1 Request (enable)

In addition to switching on locally via the display in the start screen (see chapter 2.3.1 ON /OFF), there is a second condition for putting the device into operation. The request (enable) must be set externally or permanently via the menu. The following setting options in the menu exist for this purpose (right and left arrow keys):

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ via terminal *	+ 24 VDC at terminal X7.1 (DI-1), see chapter 1.4 (Circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings → GLT bus system*. *See also chapter* 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system*"* The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Register 1, Bit 0 (Bool), (Register value 1) **Message from TCS (read from TCS):** Register 141, Bit 6 (Bool), (Register value 64)
	→ SW1 fixed ON **	The request is permanently activated (ON). Internal setpoint 1 (NC – normal cooling) is applied to the controller.
	→ SW2 fixed ON **	The request is permanently activated (ON). Internal setpoint 2 (FC – free cooling or HR –- heat recovery) is applied to the controller.
	* Factory settings	

	** These settings are typically used for the functional test and for commissioning. If e.g. no external release has been sent by the GLT.

4.2.2 Control setpoint switching

The program differentiates between two editable setpoints. Adjustable in *Main menu → Setpoints* (see also chapter 5.7 “*Setpoints*”). These are “setpoint 1 – NC – normal cooling” and “setpoint 2 – FC – free cooling” or “setpoint 2 – HR –-, heat recovery” for condensers.

Signal type:	→ binary	0 = NC - normal cooling 1 = FC – free cooling / HR – heat recovery
Selection options:	→ via terminal *	+ 24 VDC at terminal X7.2 (DI-2), see chapter 1.4 (Circuit diagram TCS.2)
	→ via AT (Außentemperatur, external temperature)	The setpoint changeover is controlled by the external temperature. The switching thresholds are set in *Main menu → Setpoints → Setpointsw. AT*. However, this is only displayed after selecting “via AT” (see also chapter B)
	→ via bus	The type of communication bus is set in *Device settings → GLT bus system. See also chapter* 0 “*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system*”* The following parameters exist for direct communication via MODBUS: **Write:** Register 1, Bit 1 (Bool), (Register value 2) **Read NC1 (Normal cooling 1) active:** Register 164, Bit 0 (Bool), (Register value 1) **Read NC2 (Normal cooling 2) active:** Register 164, Bit 1 (Bool), (Register value 2) **Read FC1 (Free cooling 1) active:** Register 164, Bit 2 (Bool), (Register value 4)

		Read FC2 (Free cooling 2) active: Register 164, Bit 3 (Bool), (Register value 8) **Read HR1 (Heat recovery 1) active:** Register 164, Bit 4 (Bool), (Register value 16) **Read HR2 (Heat recovery 2) active:** Register 164, Bit 5 (Bool), (Register value 32)
	→ via dT, AT-ET	The setpoint changeover is controlled via the temperature difference (inlet/external temperature). The switching thresholds are set in *Main menu* → *Setpoints* → *Setpointsw*. *AT-ET* See also chapter
	→ Off	Function deactivated.
	* Factory settings	

4.2.3 Night limit control

With this function, the maximum fan speed is limited to a value in order to reduce the noise emissions to a minimum at certain times (at least at night). Adjustable in *Main menu* → *Setpoints* (see also chapter 5.7.4 “*Night* limitation”).

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ via terminal *	+ 24 VDC at terminal X7.3 (DI-3), see chapter 1.4 (Circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings* → *GLT bus system*. *See also chapter* 0 “*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system” The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Register 1, Bit 2 (Bool), (Register value 4)
	→ Off	Function deactivated.

	* Factory settings

4.2.4 Control setpoint shifting

This function allows the operator to adjust the condensing pressure or the outlet pressure to certain operating conditions. All relevant values for this are set in *Main menu* → *Setpoints* → *Setpoint shifting.* However, this is only displayed after selecting a control (see also chapter 5.7.3 "*Setpoint* shifting") The following control options are available:

Signal type:	→ analog	0 – 100 %
Selection options:	→ Off *	Function deactivated.
	→ via terminal 0 – 10 V	0 – 10 V signal at terminal X4.31 (AI-3) or X4.32 (AI-4) with dual circuit devices, see chapter 1.4 (circuit diagram TCS.2)
	→ via terminal 2 – 10 V	2 – 10 V signal at terminal X4.31 (AI-3) or X4.32 (AI-4) with dual circuit devices, see chapter 1.4 (circuit diagram TCS.2)
	→ via terminal 0 – 20 mA	0 – 20 mA signal at terminal X4.31 (AI-3) or X4.32 (AI-4) with dual circuit devices, see chapter 1.4 (circuit diagram TCS.2)
	→ via terminal 4 – 20 mA	4 – 20 mA signal at terminal X4.31 (AI-3) or X4.32 (AI-4) with dual circuit devices, see chapter 1.4 (circuit diagram TCS.2)
	→ via AT (Außentemperatur, external temperature)	The shifting starts to raise the setpoint at a certain external temperature. All relevant values for this can be set in Main menu → Setpoints → "Setpoint shifting" (see also chapter 5.7.3 "*Setpoint* shifting")

	→ via bus	The type of communication bus is set in *Device settings → GLT bus system* (see also chapter 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system"). The following parameters exist for direct communication via MODBUS: Circuit 1: Register 4 (INT), (Register value: -250 to 250→ -25.0°C to +25.0°C or -450 to +450 → for -45.0°F to +45.0°F) Circuit 2: Register 5 (INT), (Register value: -250 to 250→ -25.0°C to +25.0°C or -450 to +450 → for -45.0°F to +45.0°F)
	* Factory settings	

4.2.5 Control slave setpoint

The internal controller(s) will be deactivated. The fan speed is influenced 100 % by the slave setpoint. The following signal sources can be selected here:

Signal type:	→ analog	0 – 100 %
Selection options:	→ Off *	Function deactivated.
	→ via terminal 0 – 10 V	0 – 10 V signal at terminal X4.31 (AI-3) or X4.32 (AI-4) with dual circuit devices, see chapter 1.4 (circuit diagram TCS.2)
	→ via terminal 2 – 10 V	2 – 10 V signal at terminal X4.31 (AI-3) or X4.32 (AI-4) with dual circuit devices, see chapter 1.4 (circuit diagram TCS.2)
	→ via terminal 0 – 20 mA	0 – 20 mA signal at terminal X4.31 (AI-3) or X4.32 (AI-4) with dual circuit devices, see chapter 1.4 (circuit diagram TCS.2)
	→ via terminal 4 – 20 mA	4 – 20 mA signal at terminal X4.31 (AI-3) or X4.32 (AI-4) with dual circuit devices, see chapter 1.4 (circuit diagram TCS.2)

	→ via bus	The type of communication bus is set in Device settings → GLT bus system. *See also chapter* 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system*"* The following parameters exist for direct communication via MODBUS: Circuit 1: Register 6 (INT), (Register value: 0 to 1000 → 0.0 – 100.0 %) Circuit 2: Register 7 (INT), (Register value: 0 to 1000 → 0.0 – 100.0 %)
	→ via terminal 2 – 10 V with emergency operation	2 – 10 V signal at terminal X4.31 (AI-3) or X4.32 (AI-4) with dual circuit devices, see chapter 1.4 (circuit diagram TCS.2) In the event of signal loss (< 2V), the control switches to autonomous operation when using the sensors connected to the TCS.
	→ via terminal 4 – 20 mA with emergency operation	4 – 20 mA signal at terminal X4.31 (AI-3) or X4.32 (AI-4) with dual circuit devices, see chapter 1.4 (circuit diagram TCS.2) In the event of signal loss (< 4mA), the control switches to autonomous operation when using the sensors connected to the TCS.
	→ internal	The control signal is specified by an internally generated value. For the insulated cooler, for example, this can be a set fixed speed during normal cooling. See also chapter *10.4.10 "Fan fixed* speed*"*
	→ without signal	The fans are controlled externally, but directly and not via the TCS.2
	* Factory settings	

4.2.6 Control winter mode

This function is only relevant for humidified or wetted devices, and can be set in the Main menu.

To prevent frost damage to the hydraulic system, the device switches from summer mode (normal mode) to winter mode from a set external temperature. The pipeline system in the area subject to frost is emptied. The current status is presented in different sub-menus as a sun or ice crystal (see below). All relevant settings are made in *Main menu* → *Wet mode* → “*Winter mode”* (see also chapter 6.4.1 “*Winter mode* / Summer mode”). The following options exist to activate this function:

Signal type:	→ binary	0 = OFF → Summer mode 1 = ON → Winter mode
Selection options:	→ Internal *	The TCS records the external temperature with the installed external sensors. The function is switched on and off using the set parameters in *Main menu* → *Wet mode* → “*Winter mode”.*
	→ via terminal	+ 24 V DC at terminal X7.5 (DI-5) or terminal X7.8 (DI-8), can be selected in Device settings → *Inputs* / Outputs → “*Digital IN basic device*” see chapter 1.4 “circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings* → *GLT bus system* (see also chapter 0 “*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system”). The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Register 1, Bit 13 (Bool), (Register value 8192) **Message from TCS (read from TCS):** Winter mode active Register 144, Bit 11 (Bool), (Register value 2048)

	→ Off	Function deactivated.
	* Factory settings	

4.2.7 Control hygiene circuit circuit 1 / 2

For reasons of hygiene, stagnating water in the pipe should be avoided. The hygiene circuit is for emptying the water pipe from the main water valve to the device (see also chapter 6.4.6 "*Hygiene* circuit").

This function must be set to "ON" in Device settings → *System* → *Wetting* → "*Hygiene switching*". Otherwise, the control has no effect!

The following options for control exist:

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Internal *	With the adiabatic switched off (no water demand), the function is activated after the set waiting time in *Main menu* → *Wet mode* → "*Hygiene circuit".* The function is only deactivated again once the humidification / wetting has been requested again.
	→ via terminal	+ 24 V DC at terminal X7.7 (DI-7), can be selected in *Device settings* → *Inputs / Outputs* → *"Digital IN basic device"* see also chapter 1.4 (circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings* → *GLT bus system* (see also chapter 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system"). The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Circuit 1: Register 1, Bit 14 (Bool), (Register value 16384) Circuit 2: Register 2, Bit 12 (Bool), (Register value 4096) **Message from TCS (read from TCS):** Hygiene function circuit 1 active: Register 144, Bit 9 (Bool), (Register value 512) Hygiene function circuit 2 active: Register 146, Bit 4 (Bool), (Register value 16)

	→ Off	Function deactivated.
	* Factory settings	

4.2.8 Control master mode external

This function is used with devices that are controlled in a group of several devices in slave mode or by a master (enable via bus, speed control, winter/summer mode, external actual value). As long as the master sends an "OK" signal, the TCS reacts to the signals named. If the master fails, the device changes to autonomous control and obtains the required values via terminals.

Signal type:	→ binary	0 = OFF → external master inactive 1 = ON → external master active
Selection options:	→ Off *	Function deactivated.
	→ via terminal	+ 24 V DC at terminal X7.5 (DI-5) or X7.7 (DI-7) *"External master OK"* *Device settings → Inputs / Outputs → "Digital IN basic device"* Digital output X7.15 (DO-7) *"Master OK"* *Device settings → Inputs / Outputs → "Digital OUT basic device"* see also chapter 1.4 (circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings → GLT bus system* (see also chapter 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system"). The following parameters exist for direct communication via MODBUS: **Master live write to TCS:** Register 1, Bit 12 (Bool), (Register value 4096)
	→ via Bus with Lifebit	The following parameters exist for direct communication via MODBUS: **Life Bit write to TCS:** Register 3, Bit 15 (Bool), (Register value 32768) The TCS expects a pulse from the GLT (depending on the set time out time) in order to monitor the function of the master. If the pulse remains off, no external control via bus is

		possible. The TCS then works autonomously and obtains the required signals (e.g. enable) via terminal.
	→ via active bus	The bus activity shows the TCS slave that the communication with the master TCS is OK.
	* Factory settings	

4.2.9 Control reversal of the direction of rotation

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ via terminal	+ 24 V DC at terminal X7.5 (DI-5) *"Reversal of the direction of rotation"* *Device settings* → *Inputs / Outputs* → *"Digital IN basic device"* see also chapter 1.4 (circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings* → *GLT bus system* (see also chapter 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system"). The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Register 1, Bit 15 (Bool), (Register value 32767) **Message from TCS (read from TCS):** Register 141, Bit 13 (Bool), (Register value 9192)
	* Factory settings	

4.2.10 Control low load control

See also chapter 4.6.5 "*Low* load settings" and chapter 5.8.5 "*Low* load".

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options: * Factory settings	→ Off *	Function deactivated.
	→ internal	The switching thresholds for the individual levels are automatically calculated by the program based on the step count and the limit value. These can be set under: Device settings → Additional functions → "Low load" (chap. 0) or in Main menu → Additional functions → "Low load" (chap. 5.8.5)
	→ via terminal	A max. 2-level control is possible. The first (basic load level) remains switched on, the second is activated with the following DI. + 24 V DC at terminal X7.6 (DI-6) *"External low load level 1"* *Device settings → Inputs / Outputs → "Digital IN basic device" (chap.* 0) → see also chapter 1.4 (circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings → GLT bus system* (see also chapter 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system"). The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Register 2 Low load control level 1, Bit 0 (Bool), (Register value 1) Low load control level 2, Bit 1 (Bool), (Register value 2) Low load control level 3, Bit 2 (Bool), (Register value 4) Low load control level 4, Bit 3 (Bool), (Register value 8) Low load control level 5, Bit 4 (Bool), (Register value 16)

		Message from TCS (read from TCS): **(SL = Schwachlast, low load)** Register circuit 1: 165 SL basic load lev. 1 in operation, Bit 0 (Bool) SL basic load lev. 1 in operation, Bit 1 (Bool) SL basic load lev. 2 in operation, Bit 2 (Bool) SL basic load lev. 3 in operation, Bit 3 (Bool) SL basic load lev. 4 in operation, Bit 1 (Bool) SL basic load lev. 5 in operation, Bit 5 (Bool) Register circuit 2: 165 SL basic load lev. 1 in operation, Bit 6 (Bool) SL basic load lev. 7 in operation, Bit 7 (Bool) SL basic load lev. 8 in operation, Bit 8 (Bool) SL basic load lev. 9 in operation, Bit 9 (Bool) SL basic load lev. 10 in operation, Bit 10 (Bool) SL basic load lev. 11 in operation, Bit 11 (Bool)

4.2.11 Control Roller control

See also in the following chapters:
Device settings → Additional functions → "Roller control settings (chapter 4.6.6)
Main menu → Additional functions → "Roller control menu" (chapter 5.8.6)

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ via terminal	There is currently no digital input provided to control the roller.
	→ via bus	The type of communication bus is set in *Device settings → GLT bus system* (see also chapter 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system"). The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Close roller 1 Register 3, Bit 11 (Bool), (Register value 2048) Close roller 2 Register 3, Bit 12 (Bool), (Register value 4096) (The respective bit = false means open roller) **Message from TCS (read from TCS):** Roller 1 open Register 177, Bit 0 (Bool), (Register value 1) Roller 1 closed Register 177, Bit 2 (Bool), (Register value 4) Roller 2 open Register 177, Bit 8 (Bool), (Register value 256) Roller 2 closed Register 177, Bit 10 (Bool), (Register value 1024)

		For further roller messages via bus, see chapter 5.8.6 “*Roller control* menu”
	→ via release	This function is currently unavailable.
	→ via wet operation	The roller closes automatically when the wet mode is internally activated. Activation conditions for wet mode include e.g. reaching the external temperature threshold, the speed of the fans or the possible pre-cooling (depending on parametrising).
	* Factory settings	

4.2.12 Control free cooler valve(e)

See also in Main menu → Additional functions → “Free cooling valve” (chapter 5.8.4)

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ via setpoint changeover	The temperature difference between inlet temperature and external temperature determines whether the free cooler mode is activated. See also: Main menu → Additional functions → “*Free* cooling valve” (chap. 5.8.4)
	→ via bus	The type of communication bus is set in *Device settings* → *GLT bus system* (see also chapter 0 “*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system”). As soon as the bit mentioned below is set, the corresponding valves switch as descrived under “*Free* cooling valve” (chap. 5.8.4). **Request to TCS (write to TCS):** Free cooler valve (free cooling function) Register 1, Bit 4 (Bool), (Register value 8) **Message from TCS (read from TCS):** Bypass valve Register 164, Bit 10 (Bool), (Register value 1024) Inlet valve Register 164, Bit 11 (Bool), (Register value 2048) Three-way valve Register 164, Bit 12 (Bool), (Register value 4096)
	* Factory settings	

4.2.13 Control lock wet mode

If active, the main water valve or control valve is closed, so no water is used (e.g. water tank is empty).

Signal type:	→ binary	0 = OFF, 1 = Wet lock active
Selection options:	→ Off	Same function as "internal"
	→ Internal *	The adiabatic is switched on or off through the parameters in the wet menu "external temperature adiabatic ON" and the "adiabatic speed ON/OFF".
	→ via terminal	In addition to the internal deactivation conditions for wet mode, the adiabatic can be locked via the following inputs: + 24 V DC at terminal X7.5 (DI-7) or X7.8 (DI-8), can be selected in *Device settings → Inputs / Outputs → "Digital IN basic device"* see also chapter 1.4 (circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings → GLT bus system* (see also chapter 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system"). The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Lock wet mode 1 Register 2, Bit 13 (Bool), (Register value 8192) Lock wet mode 2 Register 2, Bit 14 (Bool), (Register value 16384) **Message from TCS (read from TCS):** Lock wet mode 1 active Register 144, Bit 15 (Bool), (Register value 32768) Lock wet mode 2 active Register 145, Bit 15 (Bool), (Register value 32768)

	* Factory settings

4.2.14 Source actual value

Reference source for the reference variable of the internal controller.

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ via terminal	The actual value is recorded via a sensor connected to the TCS (e/g/ temperature or pressure). See also: Analog inputs → Inputs/outputs [see also chapter 4.3.3 “Analog IN basic device”]
	→ via bus	The type of communication bus is set in *Device settings* → *GLT bus system* (see also chapter 0 “*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system”). The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** External actual value 1 in temperature °C Register 16 (INT), (Register value -500 - 1000) External actual value 2 in temperature °C Register 17 (INT), (Register value -500 - 1000)
	* Factory settings	

4.2.15 Control spray pump

See also in Main menu → Additional functions → “Spray pump” (chapter 8.2.1)

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ internal	If the release (request circuit 1 DI-1) has been set and the conditions in the menu “Spray pump” have been met, the pump switches on. See also: Main menu → Additional functions → “Spray pump” (chap. 8.2.1)
	→ via terminal	There is currently no digital input provided for the activation of the spray pump. The pump is also switched on via the release (external request, DI-1) as with “internally”.
	→ via bus	The type of communication bus is set in *Device settings → GLT bus system* (see also chapter 0 “*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system”). As soon as the bit named below has been set and the conditions in the menu “Spray pump” have been met, the pump switches on. The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Spray pump 1 Register 2, Bit 5 (Bool), (Register value 32) Spray pump 2 Register 2, Bit 6 (Bool), (Register value 64) **Message from TCS (read from TCS):** Spray pump 1 Register 144, Bit 12 (Bool), (Register value 4096) Spray pump 2 Register 144, Bit 13 (Bool), (Register value 8192)
	* Factory settings	

4.2.16 Control Defrosting, draining time and pre-cooling

The type of control selected here relates to two signals. On the one hand, the “request defrosting” and on the other the “request draining and pre-cooling time”.

See also:
Chapter 10.3.1 “*Defrosting, draining time and pre-cooling*”

Chapter 5.8.9 “Air cooler / evaporator” in e.g. heat pump operation

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off	Function deactivated.
	→ via terminal *	**Request defrosting:** + 24 V DC at terminal X7.2 (DI-2) **Request draining/pre-cooling time** + 24 V DC at terminal X7.3 (DI-3) see chapter 1.4 “circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings* → *GLT bus system* (see also chapter 0 “*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system”). The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Request defrosting: Register 1, Bit 1 (Bool), (Register value: 2) Request draining/pre-cooling time Register 2, Bit 1 (Bool), (Register value: 4) **Message from TCS (read from TCS):** Defrosting active: Register 158, Bit 1 (Bool), (Register value: 1) Draining time active: Register 158, Bit 1 (Bool), (Register value: 2) Pre-cooling time active:

		Register 158, Bit 4 (Bool), (Register value: 16384)
	→ via schedule	In addition to the options to start the defrosting manually (via terminal or bus), there is also the option of automatic defrosting according to schedule. A maximum of 4 times per day can be set for this (see 10.4.13 "*Schedule defrosting*").
	* Factory settings insulated cooler	

4.2.17 Control fans off

See also chapter 10.3.2 "Fans OFF (feedback standstill fans)*"*

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ internal	The fans are controlled by the TCS. This means that the information about the standstill is available internally.
	→ via terminal	Feedback notifications of external fans are off: + 24 V DC at terminal X7.6 (DI-6) or + 24 V DC at terminal X7.7 (DI-7) see chapter 1.4 "circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings* → *GLT bus system* (see also chapter 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system"). The following parameters exist for direct communication via MODBUS: **Feedback to TCS (write to TCS):** Register 3, Bit 3 (Bool), (Register value 8) **Message from TCS (read from TCS):** Register 158, Bit 12 (Bool), (Register value 4096)

	* Factory settings

4.2.18 Control standby

A condition for activating the standby mode is that the device is switched off. See also chapter 10.6.2 "*Functional diagram* standby" *and* chapter 10.3.3 "*Standby*".

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ via terminal	Request standby: + 24 V DC at terminal X7.5 (DI-5) see chapter 1.4 "circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings → GLT bus system* (see also chapter 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system"). The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Register 3, Bit 0 (Bool), (Register value 1) **Message from TCS (read from TCS):** Register 158, Bit 13 (Bool), (Register value 8192)
	* Factory settings	

4.2.19 Control heat pump operation circuit 1/2

For switching the operating sense of the TCS controller from cooling to heating.

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ via terminal	Request heat pump operation: + 24 V DC at terminal X7.3 (DI-3) see chapter 1.4 “circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings → GLT bus system* (see also chapter 0 “*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system”). The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Heat pump operation circuit 1: Register 1, Bit 7 (Bool), (Register value: 128) Heat pump operation circuit 2: Register 1, Bit 8 (Bool), (Register value: 256) **Message from TCS (read from TCS):** Register 164, Bit 6-7 (Bool), (Register value 64/128)
	* Factory settings	

4.2.20 Control biocide dosing

See also chapter 9.2.2 “*Biocide* dosing”

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ internal	The TCS starts the vaccination automatically after set intervals.
	→ via terminal	Request biocide external: + 24 V DC at terminal X7.5, X7.6, X7.7, X7.8 (DI-5 bis DI-8) see chapter 1.4 (circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings* → *GLT bus system* (see also chapter 0 “*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system”). The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Register 2, Bit 15 (Bool), (Register value 32768) **Message from TCS (read from TCS):** Biocide program active Register 181, Bit 4 (Bool), (Register value 8) Biocide valve open Register 181, Bit 5 (Bool), (Register value 16)

4.2.21 Control lock circuit 1/2

Options to stop the fans in circuit 1/2 (lock):

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ via terminal	Request lock circuit 1/2: Circuit 1 → + 24 V DC at terminal X7.5 (DI-5) Circuit 2 → + 24 V DC at terminal X7.5 (DI-6) see chapter 1.4 (circuit diagram TCS.2)
	→ via bus	The type of communication bus is set in *Device settings → GLT bus system* (see also chapter 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system"). The following parameters exist for direct communication via MODBUS: **Request to TCS (write to TCS):** Lock circuit 1: Register 1, Bit 5 (Bool), (Register value 32) Lock circuit 2: Register 1, Bit 6 (Bool), (Register value 64) **Message from TCS (read from TCS):** Circuit 1 ON: Register 141, Bit 6 (Bool), (Register value 64) Circuit 2 ON: Register 141, Bit 7 (Bool), (Register value 128)
	→ Via terminal UTW	Same function as "via terminal". However, the internally generated message "Temperature too low – warning" is simultaneously suppressed. This function is used e.g. with H2O-operated recoolers, which are drained when the heat load is too low in winter. When draining, the fans must be locked and the low temperature warning suppressed.

	→ via bus UTW	Same function as “via bus”. However, the internally generated message “Temperature too low – warning” is simultaneously suppressed. This function is used e.g. with H2O-operated recoolers, which are drained when the heat load is too low in winter. When draining, the fans must be locked and the low temperature warning suppressed.
	* Factory settings	

4.2.22 Control forced cycle

See also chapter 5.8.3 “*Forced and cleaning* cycle”

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ internal	The TCS starts the fans automatically after a set standstill time,

4.2.23 Control cleaning cycle

See also chapter 5.8.3 “*Forced and cleaning* cycle”

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ internal	The TCS automatically starts a cleaning cycle after completion of the set operating days.

4.2.24 Control media pump 1/2

Conveying the medium in the heat-releasing secondary circuit. See also chapter 5.8.2 “Medium functions”.

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ via release	Pump start via device request (enable) see chapter 4.2.1 “Request (enable)”
	→ Via outlet temperature 2	Pump start via outlet temperature 2. (see chapter 4.3.3 “Analog IN basic device”) For setting the associated activation and deactivation thresholds, see chapter 5.8.2 “Medium functions”
	→ via room temperature	Pump start via room temperature. (see chapter 4.3.3 “Analog IN basic device”) For setting the associated activation and deactivation thresholds, see chapter 5.8.2 “Medium functions”
	* Factory settings	

4.2.25 Control medium valve(s)

Introduction of the refrigerant carrier into the cold-releasing secondary circuit. See also chapter 5.8.2 “Medium functions”.

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ via release	Fan actuation via device request (enable) see chapter 4.2.1 “Request (enable)”

	→ Via outlet temperature 2	Valve actuation via outlet temperature 2. (see chapter 4.3.3 “Analog IN basic device”) For setting the associated activation and deactivation thresholds, see chapter 5.8.2 “Medium functions”
	→ via room temperature	Valve actuation via room temperature. (see chapter 4.3.3 “Analog IN basic device”) For setting the associated activation and deactivation thresholds, see chapter 5.8.2 “Medium functions”
	* Factory settings	

4.2.26 Control glycol

Glycol monitoring
See also chapter 5.8.8 “Glycol monitoring”

Signal type:	→ binary	0 = OFF, 1 = ON
Selection options:	→ Off *	Function deactivated.
	→ via terminal	Request glycol OK external: + 24 V DC at terminal X7.5, X7.6, X7.7, X7.8 (DI-5 bis DI-8) see chapter 1.4 (circuit diagram TCS.2)
	→ internal	The TCS acts as a monitoring unit for glycol leaks. Glycol sensors or pressure sensors are connected to the basic device or I/O extensions, and are evaluated.
	* Factory settings	

4.3 Inputs/outputs

The configuration of the digital and analog inputs and outputs is described below. In addition to changing the factory settings, various additional functions can be selected and deselected. The selection is made using the arrow keys.

4.3.1 Digital IN basic device

Input	Nr	Function	
DI - 1 (X7.1)	0	not used	
	1	External release	

DI - 2 (X7.2)	0	not used	
	1	Setpoint changeover circuit 2	
	2	External defrost release	
	3	Fault fan-/group 1	
	4	Ext. emerg. Stop	

DI - 3 (X7.3)	0	not used	
	1	Night time reduction	
	2	Drip and pre-cooling time	
	3	Fault fan-/group 2	
	4	Heat pump modus	
	5	Setpoint changeover circuit 2	
	6	External winter operation (Inverse)	

DI - 4 (X7.4)	0	not used	
	1	External reset	
	2	External winter operation	

DI - 5 (X7.5)	0	not used	
	1	Fault fan-/group 1	
	2	Repair schwitch fan-/group 1	
	3	Lock circle 1	
	4	Rotation reversal	
	5	FB Drain valve 1	
	6	FB Shut-off valve 1	
	7	FB Free cooler inlet valve	
	8	FB Louver flap 1	
	9	FB Defrost flap closed	
	10	Lock wet operation, circuit 1	

	11	Fault catch basin	
	12	External Master OK	
	13	External winter operation	
	14	Flow sensor	
	15	FB fresh water valve	
	16	Stand by	
	17	External defrost release	
	18	Ext. emerg. Stop	
	19	Hygiene 1 requirement external	
	20	Biocide requirement External	
	21	Heat pump modus, circuit 1	
	22	Glycol message external	
	23	External Forced run	

DI - 6 (X7.6)	0	not used	
	1	Fault fan-/group 2	
	2	Repair schwitch fan-/group 2	
	3	Lock circle 2	
	4	External low load level 1	
	5	FB Main water valve 1	
	6	FB Spray valve	
	7	FB Free cooler bypass valve	
	8	FB Louver flap 1	
	9	FB Defrost flap opened	
	10	FB Medium valve	
	11	Spray pump fault	
	12	nn	
	13	Fresh water meter	
	14	FB external fans off	
	15	Adiabatic pad CV 1, forced ON	
	16	Fuse/s	
	17	FB storage container	
	18	FB Shut-off valve 1	
	19	FB Free cooler three-way valve	
	20	Hygiene 1 requirement external	
	21	Hygiene 2 requirement external	
	22	Biocide requirement External	
	23	Heat pump modus, circuit 1	
	24	Heat pump modus, circuit 2	
	25	Glycol message external	
	26	External Forced run	

DI - 7 (X7.7)	0	not used	
	1	Fault fan-/group 3	
	2	Repair schwitch fan-/group 3	
	3	FB external fans off	
	4	FB Spray valve	
	5	FB Storage container	
	6	FB Dry cooler three-way valve	
	7	Fuse/s	
	8	External Master OK	
	9	Ext. emerg. stop 1	
	10	Subcooler fan 1	
	11	nn	
	12	Fresh water meter	
	13	Rotation reversal	
	14	FB Wastewater valve	
	15	Adiabatic pad CV 2, forced ON	
	16	Lock wet operation, circuit 1	
	17	FB Shut-off valve 1	
	18	Hygiene 1 requirement external	
	19	Hygiene 2 requirement external	
	20	Biocide requirement External	
	21	Heat pump modus, circuit 1	
	22	Heat pump modus, circuit 2	
	25	FB Medium pump 1	
	26	Glycol message external	
	26	External Forced run	

DI - 8 (X7.8)	0	not used	
	1	Fault fan-/group 4	
	2	Repair schwitch fan-/group 4	
	3	FB pressure increase	
	4	FB storage container	
	5	Fault dry run	
	6	Frost protection monitor	
	7	Door switch	
	8	Ext. winter operation	
	9	Ext. emerg. Stop	
	10	Ext. emerg. stop 2	
	11	Subcooler fan 2	
	12	NH3 keeper	

	13	Rotation reversal	
	14	Lock wet operation, circuit 2	
	15	Fuse/s	
	16	Setpoint changeover circuit 2	
	17	Lock wet operation, circuit 1	
	18	Hygiene 1 requirement external	
	19	Hygiene 2 requirement external	
	20	Biocide requirement External	
	21	Heat pump modus, circuit 1	
	22	Heat pump modus, circuit 2	
	23	Safety thermostat, coil	
	24	FB Medium pump 2	
	25	Glycol message external	
	26	External Forced run	

4.3.2 Digital OUT basic device

Output	Nr	Function	
DO - 1 (X7.9)	0	not used	
	1	Warning = low priority	
	2	Fault circuit 1	

DO - 2 (X7.10)	0	not used	
	1	Alarm = high priority	
	2	Fault circuit 2	
	3	Operation	

DO - 3 (X7.11)	0	not used	
	1	Operation	
	2	Operating circuit 1	
	3	Fan ring heater	
	4	Heat pump modus active	
	5	Pre-cooling time active	

DO - 4 (X7.12)	0	not used	
	1	TCS OK	
	2	Free cooling	
	3	Rep. Switch message	
	4	Operating circuit 2	
	5	Frost warning	

	6	Defrost flap/s closed	
	7	Humidification active	
	8	Defrost active	
	9	Reset active	

DO - 5 (X7.13)	0	not used	
	1	Fan level 1	
	2	Fault fan-/group 1	
	3	Repair schwitch fan-/group 1	
	4	Low load level 1	
	5	Cascade Level 1	
	6	Rotation reversal active	
	7	Drain valve 1	
	8	Shut-off valve 1	
	9	Free cooler inlet valve	
	10	Louver flap 1	
	11	Defrost flap/s opened	
	12	Wetting active, circuit 1	
	13	Fresh water valve	
	14	Mess. winter operation	
	15	Free cooling, circuit 1	
	16	Reset active	
	17	not used	
	18	Biocide vaccination active	
	19	Mess. Hygiene 1 circuit active	
	20	Biocide program active	
	21	Heat pump modus, circuit 1 active	
	22	Alarm circuit 1 = high priority	

DO - 6 (X7.14)	0	not used	
	1	Fan level 2	
	2	Fault fan-/group 2	
	3	Repair schwitch fan-/group 2	
	4	Low load level 2	
	5	Cascade Level 2	
	6	Main water valve 1	
	7	Spray valve	
	8	Free cooler bypass valve	
	9	Louver flap 2	
	10	Defrost flap start	
	11	Medium valve	

	12	Spray pump	
	13	Ambient air damper closed	
	14	Free cooling, circuit 2	
	15	Recirculation damper closed	
	16	Wetting active, circuit 2	
	17	Reservoir requirement	
	18	Shut-off valve 1	
	19	Free cooler three-way valve	
	20	Mess. Hygiene 1 circuit active	
	21	Mess. Hygiene 2 circuit active	
	22	Biocide program active	
	23	Heat pump modus, circuit 1 active	
	24	Heat pump modus, circuit 2 active	
	25	Louver flap heater	
	26	Reset active	
	27	Alarm circuit 2 = high priority	

DO - 7 (X7.15)	0	not used	
	1	Fan level 3	
	2	Fault fan-/group 3	
	3	Low load level 3	
	4	Cascade Level 3	
	5	Spray valve	
	6	Reservoir requirement	
	7	Defrost flap dir. of travel	
	8	Master OK	
	9	Main cont. 1 = emerg. stop	
	10	Subcooler fan 1	
	11	Message Flushing active	
	12	Wastewater valve	
	13	Ambient air damper open	
	14	Recirculation damper open	
	15	TCS OK	
	16	Free cooling circuit 1	
	17	Shut-off valve 1	
	18	Mess. Hygiene 1 circuit active	
	19	Mess. Hygiene 2 circuit active	
	20	Biocide program active	
	21	Heat pump modus, circuit 1 active	
	22	Heat pump modus, circuit 2 active	
	25	Tray heater	

	26	Reset active	
	26	Medium pump 1	
	27	Mess. winter operation (Inverse)	

DO - 8 (X7.16)	0	not used	
	1	Fan level 4	
	2	Fault fan-/group 4	
	3	Low load level 4	
	4	Cascade Level 4	
	5	Pressure increase request	
	6	Reservoir requirement	
	7	Dry-running warning	
	8	Frost warning	
	9	Message door 1 open	
	10	Mess. winter operation	
	11	Main cont. = emerg. stop	
	12	Main cont. 2 = emerg. stop	
	13	Oil return solenoid valve	
	14	Tray heater	
	15	Subcooler fan 2	
	16	Message door open	
	17	Biocide vaccination active	
	18	Mess. Hygiene 1 circuit active	
	19	Mess. Hygiene 2 circuit active	
	20	Biocide program active	
	21	Heat pump modus, circuit 1 active	
	22	Heat pump modus, circuit 2 active	
	23	Coil heater	
	24	Reset active	
	25	Medium pump 2	

4.3.3 Analog IN basic device

A) Possible configuration

Selecting the right arrow button permits the selection of the following functions:

Input	Nr	Function	
AI - 1 (X4.29)	0	not used	
	1	Pressure sensor 1	KTY 81-210
	2	Outlet sensor 1	KTY 81-210
	3	Ambient sensor	KTY 81-210
	4	Room sensor	KTY 81-210
	5	nn	KTY 81-210
	6	Current sensor lifting motor 1	(0 - 10V)
	7	Speed slave 1	(0 - 10V/ 4-20mA)

AI - 2 (X4.30)	0	not used	
	1	Pressure sensor 2	(4- 20mA)
	2	Outlet sensor 2	KTY 81-210
	3	Inlet sensor 1	KTY 81-210
	4	Ambient sensor	KTY 81-210
	5	Coil sensor T2.1	KTY 81-210
	6	Current sensor lifting motor 2	(0 - 10V)
	7	Conductivity	(4- 20mA)
	8	Pressure sensor 1	(4- 20mA)
	9	Outlet sensor 1	KTY 81-210
	10	Position feedback Three-way valve	(2 - 10V)
	11	Speed slave 1	(0 - 10V)

AI - 3 (X4.31)	0	not used	
	1	Pressure sensor 3	(4- 20mA)
	2	Inlet sensor 1	KTY 81-210
	3	Ambient sensor	KTY 81-210
	4	Drip tray sensor 1	KTY 81-210
	5	Setpoint shifting 1	(0 - 10V/ 4-20mA)
	6	Speed slave 1	(0 - 10V/ 4-20mA)
	7	Current sensor lifting motor 3	(0 - 10V)
	8	Humidity Sensor	(4- 20mA)
	9	Water level sensor	KTY 81-210
	10	Core tube sensor T1.1	KTY 81-210

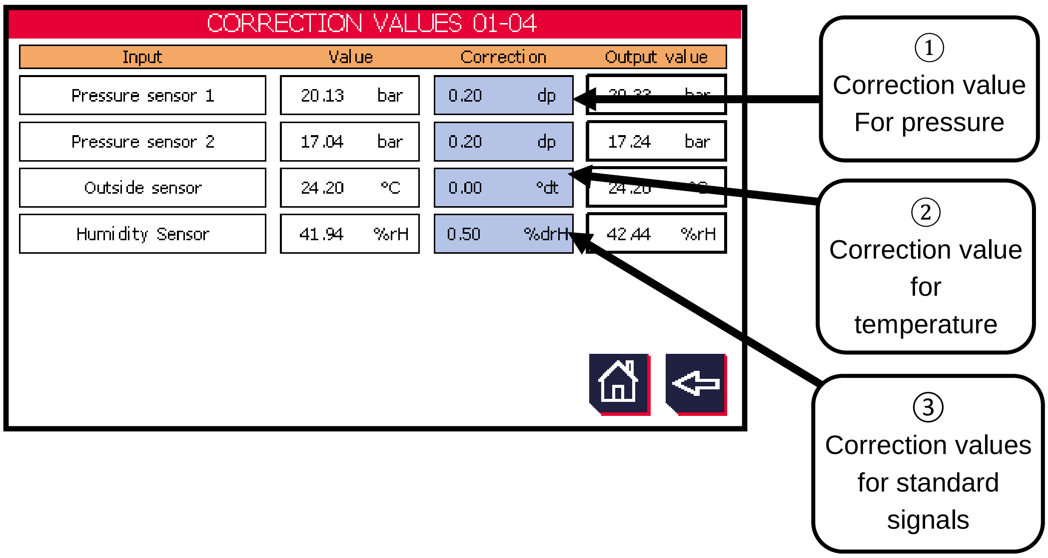
AI - 4 (X4.32)	0	not used	
	1	Pressure sensor 4	(4- 20mA)
	2	Inlet sensor 2	KTY 81-210
	3	Ambient sensor	KTY 81-210
	4	Cell sensor	KTY 81-210
	5	Setpoint shifting 2	(0 - 10V/ 4-20mA)
	6	Speed slave 2	(0 - 10V/ 4-20mA)
	7	Current sensor lifting motor 4	(0 - 10V)
	8	Humidity Sensor	(4- 20mA)
	9	Feedback, Control valve 1	(2 - 10V)
	10	Drip tray sensor 2	KTY 81-210
	11	Return flow sensor	KTY 81-210
	12	FB Free cooler three-way valve	(2 - 10V)
	13	FB Dry cooler three-way valve	(2 - 10V)

B) Correction values

If the displayed actual value deviates too much from the actual value, a correction factor can be added to or subtracted from the actual value (see example in Image 20).

By selecting the “Correction values” box, the user reaches the following overview:

Image 20



All blue boxes are activated and can be operated.

① **<u>Correction value for pressure in bar/PSI</u>**

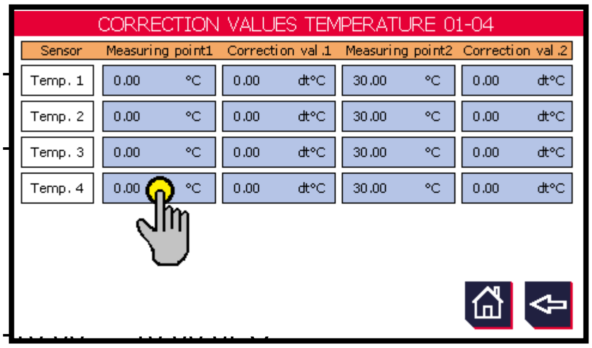
The analog inputs for pressure sensors are adjusted to absolute bar (dp ≙ delta p – pressure).

Can be edited from -1.00 bar to 1.00 bar

② **<u>Correction value for temperature in °C / °F</u>**

For temperature values, two corresponding correction values can be determined using two different measurement points. This adjusts the characteristic curve to the not perfectly linear curve of the temperature sensors (see Image 21).

Image 21



Can be edited from …to:

Measurement point 1:
-60.00 … 70.00 °F
Correction value 1:
-20.00 … 20.00 dt°F

Measurement point 2:
70.00 … 140.00 °F
Correction value 2:
-20.00 … 20.00 dt°F

③ **<u>Correction values for standard signals in %</u>**

Analog voltage or current inputs (0-10 V, 2-10 V, 0-20 mA, 4-20 mA) are corrected by percentage.

Can be edited from -5.00% to 5.00%

4.3.4 Analog OUT basic device

Selecting the right arrow button permits the selection of the following functions:

Output	Nr		
AO - 1 (X4.34)	0	not used	
	1	Rot. speed circuit 1, 0-10V	(0 - 10V)
	2	Rot. speed circuit 1, 2-10V	(0 - 10V)
	3	Wetting pump 1 speed	(0 - 10V)
	4	Control valve 1	(2 - 10V)

AO - 2 (X4.35)	0	not used	
	1	Rot. speed circuit 1, 0-10V	(0 - 10V)
	2	Rot. speed circuit 2, 0-10V	(0 - 10V)
	3	Rot. speed circuit 1, 2-10V	(2 - 10V)
	4	Rot. speed circuit 2, 2-10V	(2 - 10V)
	5	Outlet temperature cycle 1	(0 - 10V)
	6	Control valve 1	(2 - 10V)
	7	Control valve 2	(2 - 10V)
	8	Pressure circuit 1, 0-10V	(0 - 10V)
	9	Wetting pump 1 speed	(0 - 10V)
	10	Wetting pump 2 speed	(0 - 10V)
	11	Free cooler, three-way controle valve, 2-10V	(2 - 10V)
	12	Condenser, three-way control valve, 2-10V	(2 - 10V)
	13	Subcooler fan circuit 1	(0 - 10V)
	14	Ambient temperature	(0 - 10V)
	15	Low load level 1, 2-10V	(2 - 10V)

4.3.5 IN/OUT extensions

Changing these settings is reserved for the manufacturer.

In the case of devices with an extended functional scope (e.g. Thermofin® adiabatic pad cooler or thermofin® hybrid cooler), the digital and analog I/Os of the TCS basic device are not sufficient. They are then extended with external I/O modules via CAN bus. After loading the factory settings, these are automatically selected or deselected. Depending on the demand and the heat exchanger system, this default setting can still be adjusted in the following menu.
Device settings → INPUTS/OUTPUTS→ IN OUT extensions

Image 22

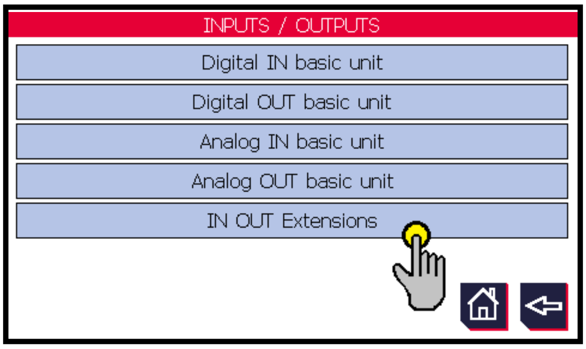
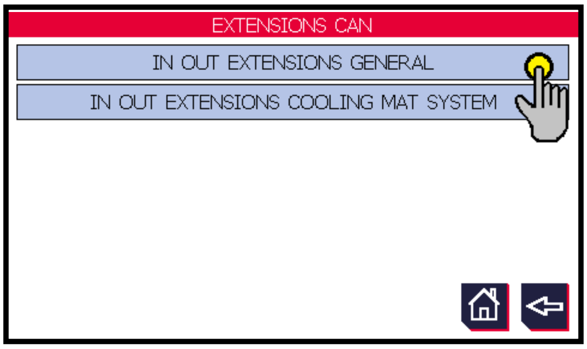
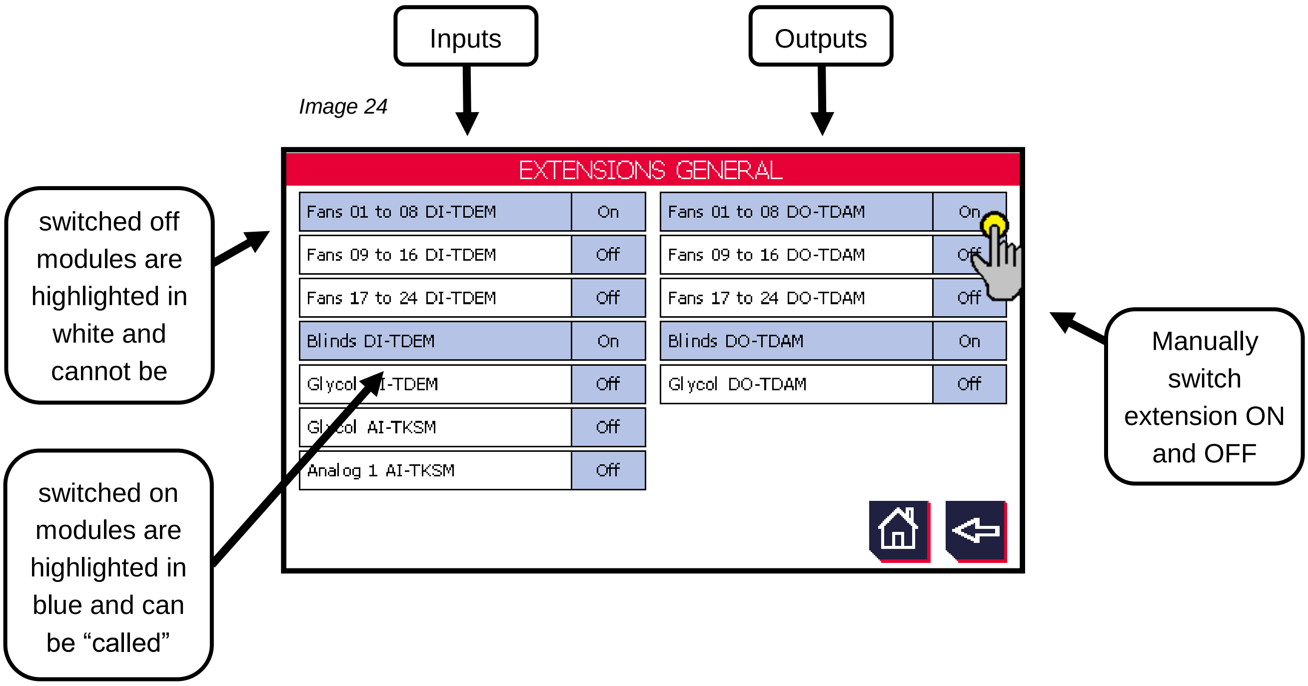


Image 23



A) Extensions general

Image 24



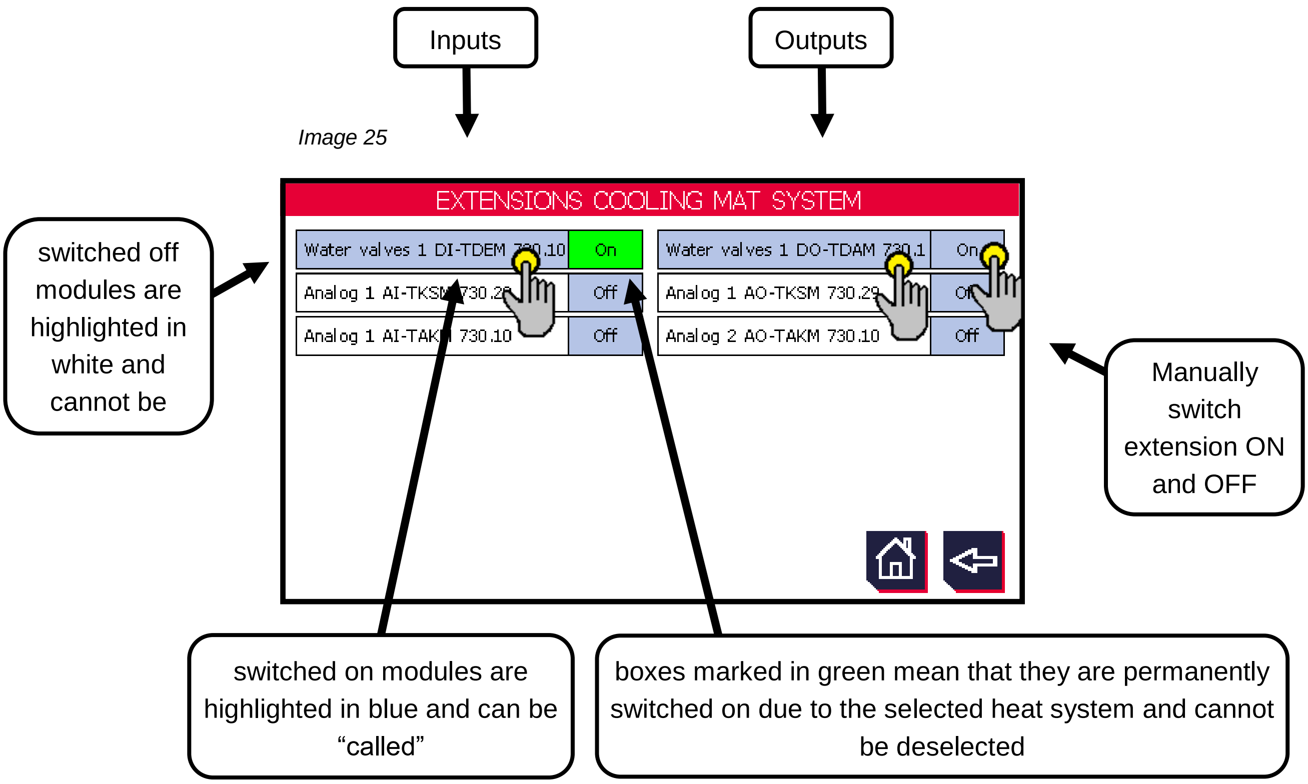
In the example in Image 24, all extensions that are not dependent on configured heat systems are visible.

- ➔ 8 fans are monitored via data inputs e.g. a thermal contact is connected) → extension digital inputs DI-01 to 08
- ➔ A fault message is issued via the digital output for each fan → extension digital outputs DO-01 to 08
- ➔ Roller control DIs and DOs switched on

B) Extensions system-specific (e.g. mat cooler)

- ➔ Water valve → extension digital inputs and outputs DI and DO
- ➔ Extension for analog inputs and outputs (temperature, rel. humidity, control valves)

Image 25

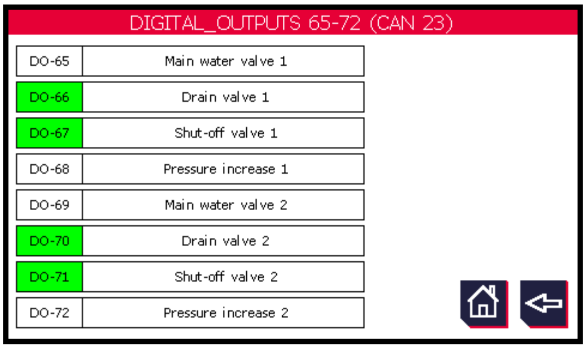


C) Assignment of digital I/O extensions

By selecting e.g. the box “Water valve DO” (Image 26), the user reaches the next level, the assignment and status display of the respective I/O module.

The green marking immediately shows which of the inputs or outputs are currently switched on or activated (logic high).

Image 26

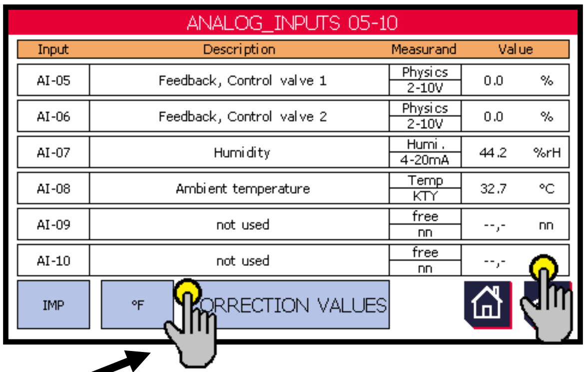


D) Assignment of analog I/O extensions

By selecting e.g. the box “Analog module AI/AO-KSM“, the user reaches the next level, the status display of the respective I/O module.

The current configuration of the analog inputs (AI-05 to AI-10) on the extension module is visible here. In addition to the name and the respective unit, the measured value can be read on the right hand side.

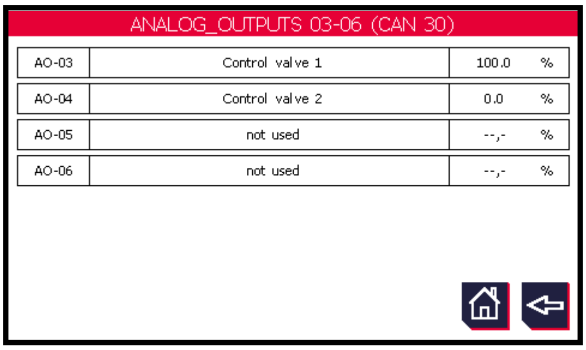
Image 27



See 1.1.1E) “*Correction* values”

Selecting the right arrow key displays the assignment of the analog outputs (AO-03 to 06) and their current value.

Image 28

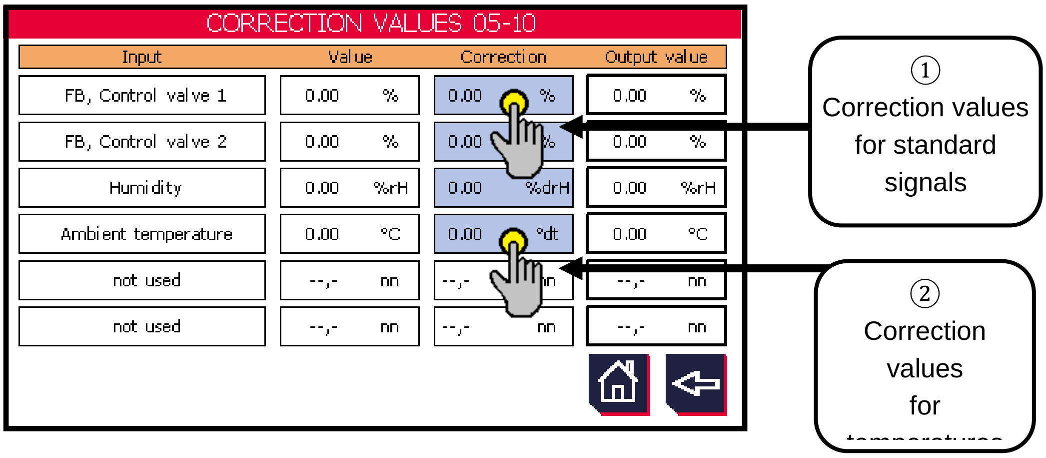


Manual operation of the outputs is <u>not</u> possible in this sub-menu. These can be operated according to the function in the respective sub-menu (e.g. valves or pumps in the “Wet mode” menu – see chapter 5.8.1 “*Wet*”).

E) Correction values extensions

Similarly to the analog inputs to basic device TCS.2 (see chapter 4.3.3 "*Analog IN basic* device"), correction values can be entered for the inputs of an analog extension. Selecting the "Correction values" box (see Image 27) takes the user to the following overview:

Image 29



All blue boxes are activated and can be operated.

① **<u>Correction values for standard signals in %</u>**

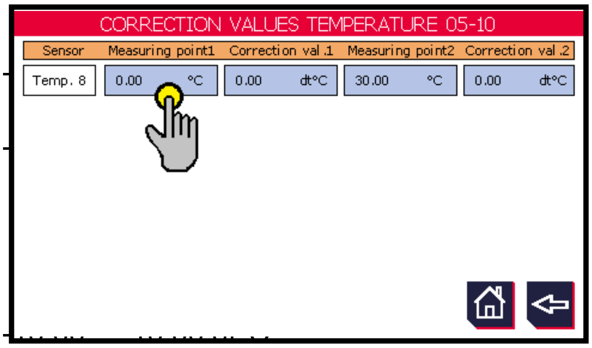
Analog voltage or current inputs (0-10 V, 2-10 V, 0-20 mA, 4-20 mA) are corrected by percentage.

Can be edited from -5.00% to 5.00%

② **<u>Correction values for temperature in °C / °F</u>**

For temperature values, two corresponding correction values can be determined using two different measurement points. This adjusts the characteristic curve to the not perfectly linear curve of the temperature sensors (see Image 30).

Image 30



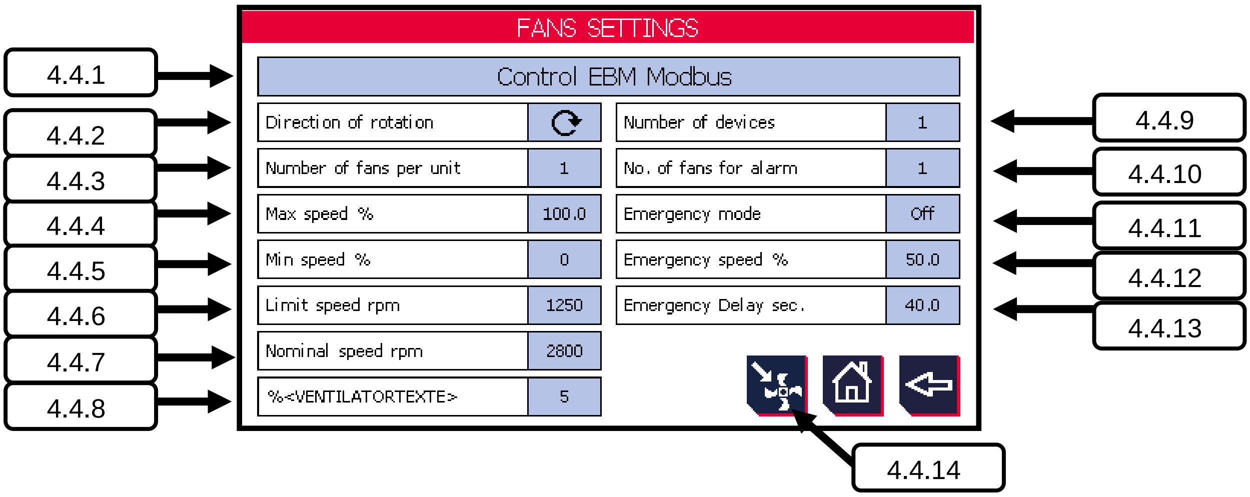
Can be edited from …to:

Measurement point 1:
-60.00 … 70.00 °F
Correction value 1:
-20.00 … 20.00 dt°F

Measurement point 2:
70.00 … 140.00 °F
Correction value 2:
-20.00 … 20.00 dt°F

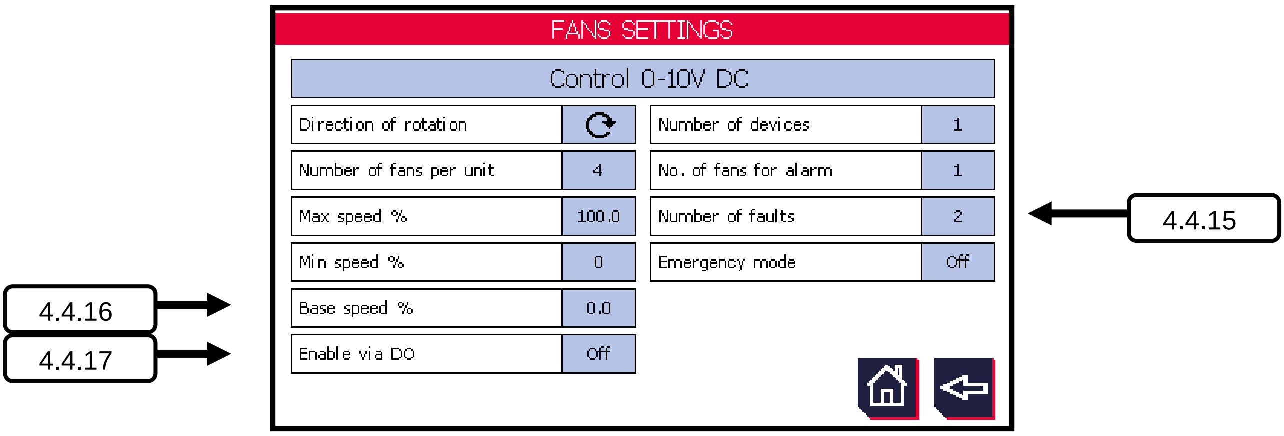
4.4 Fan setting(s)

Image 31



Depending on the type of fan control, the necessary parameters necessary for this change (see Image 31). In the “step switching” or “0 - 10 V DC” control, various setting options are hidden and a further option is displayed [see chapter 4.4.15 “*Number of* fault inputs” (Image 32)].

Image 32



4.4.1 Fan control

The setpoint source of the fans is determined here. The following options for selection exist:

Setpoint source	Explanation
Control EBM Modbus*	The setpoint, status and fault messages are transmitted via Modbus. All registers are written and read according to ebm-Papst specifications. For setting the communication parameter, see chapter 0 “*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system”.
Control ZA Modbus	The setpoint, status and fault messages are transmitted via Modbus. All registers are written and read according to Ziehl-Abegg specifications. For setting the communication parameter, see chapter 0 “*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system”.

Control EBM Modbus wireless	The setpoint, status and fault messages are transmitted via Modbus. All registers are written and read according to ebm-Papst specifications. The data transfer is carried out by the TCS wireless system rather than a signal cable. For setting the communication parameter, see chapter 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system".
Control ZA Modbus wireless	The setpoint, status and fault messages are transmitted via Modbus. All registers are written and read according to Ziehl-Abegg specifications. The data transfer is carried out by the TCS wireless system rather than a signal cable. For setting the communication parameter, see chapter 0 "*Possible settings:* *ON* - OFF Factory settings: OFF GLT (Gebäudeleittechnik, building control system) bus system".
Control 0 – 10 V DC	The setpoint is transferred via an analog 0 - 10 V DC standard signal. The fault signal relay outputs of the fans are connected to a digital input. With up to 4 fans, this is possible on the TCS basic device (DI-5 to DI-8) see also chapter 0 " *Digital IN* basic device ". With more than 4 fans, no digital inputs on the TCS basic device are used, but rather one or more digital CAN extensions (see also chapter 4.3.5 "*IN/OUT extensions*").
Step switching ➔ Chap. 5.8.7	Unregulated AC fans are used, which are controlled with a contactor circuit via digital outputs in up to 12 steps. With up to 4 fan groups or ext. fault inputs, this is possible on the TCS basic device (DI-5 to DI-8) see also chapter 0 " *Digital IN* basic device ". With more than 4 fault inputs, no digital inputs on the TCS basic device are used, but rather one or more digital CAN extensions (see also chapter 4.3.5 "*IN/OUT extensions*").
* Factory settings	

4.4.2 Fan direction

This function allows the user to blow sucked-in leaves or other contaminants away from the heat exchanger by reversing the direction of rotation of the fans. The control is via terminal or bus. See also chapter 4.2.9 "*Control reversal* of the direction of rotation*"* or 5.7.7 "*Speed direction reversal* (DRU)*".*

The following two options are available to select:

⟳	*	Clockwise rotation in normal operation. As soon as “reverse rotation direction” is activated, the fan rotates counter-clockwise.
⟲		Counter-clockwise rotation in normal operation. As soon as “reverse rotation direction” is activated, the fan rotates clockwise.

* Factory settings

4.4.3 Number of fans per device

Number of installed fans in device. The selection options are:

Single row: 1-12 fans **two-row**: 2-24 fans

Factory settings: 1/2 fans, depending on the heat system selected

4.4.4 Maximum speed in %

cannot be edited with step switching (see also chapter 4.4.1 “*Fan control*”)

Percentage upper speed limit with respect to limit speed. The controller outputs this entered value as a maximum.

Factory settings: 100 %

In principle, the percentage limit of the speed output can also be sent via the bus (adjustment from 10...10 %). The value entered in the menu is always the upper limit here. If e.g. the maximum speed in the menu has been set at 80 %, a value of 10...80 % can be sent via the bus. If the sent value is outside of the permitted range, the user receives a message “values outside of the permitted range”. If the register remains unwritten (register value: 0), there is no error message either.

Register	Register value (INT)	Maximum speed in %
12 “Maximum speed day”	100 ... 1000*	10.0 ... 100.0 %*

* A maximum register value of 1000 (≙ 100 %) is possible if the value set in the “Setpoints” menu is also at 100 %. If this value is lower, this represents the upper limit for the value sent via the bus.

4.4.5 Min. speed in %

Cannot be edited with step switching (see also chapter 4.4.1 “*Fan control*”).

Percentage lower speed limit with respect to limit speed. The controller outputs this entered value as a minimum.

Factory settings: 0 %

4.4.6 Limit speed in U/min

Not displayed with step switching or fan control 0 - 10 V DC (see also chapter 4.4.1 “*Fan control*”).

Maximum speed upper limit at 100 % control, which is written in the EC fan (see also chapter 4.4.14 “*Write parameters to fan*” Absolute speed in U/min).

Factory settings: 1250 U/min

Upper limit: Rated speed of the fan

4.4.7 Rated speed in U/min

Not displayed with step switching or fan control 0 - 10 V DC (see also chapter 4.4.1 “*Fan control*”).

Non-editable, stamped speed on the type plate of the fan, which is read out directly via the bus. Absolute speed in U/min.

Factory settings: 2800 U/min

4.4.8 Fan rows

Determination of the number of rows in which the fans are arranged. Minimum one, maximum two rows.

Factory settings: 1/2 fan rows, depending on the heat system selected

4.4.9 Number of devices

Number of installed devices to be controlled and regulated by this TCS.

Factory settings: 1 device

4.4.10 Number of fans alarm / circuit

The minimum number of faulty fans needed to trigger an alarm (DO-2 alarm → high priority) is given in this parameter. (DO-2 drops out)

Below the specified number of faulty fans, only a warning is recorded and the digital output 1 (DO-1 warning → low priority) drops out.

Lower limit: 1 *
Upper limit: Number of installed fans in device

* Factory settings

4.4.11 Emergency cycle

Cannot be edited with step switching (see also chapter 4.4.1 "*Fan control*").

For the case of a failure of the signal source of installed fans, there is an emergency cycle function in the EC fan. It is independent of the TCS or upstream controls and must be activated in the EC fan (parametrised). The electronics integrated in the fan monitors the bus communication or the signal height of the analog signal.

If the bus communication or the analog signal is interrupted and needs longer than the time set (4.4.13 *"Emergency cycle delay"*), the emergency cycle speed is activated by the internal electronics in the fan. The level is determined in the following parameter: 4.4.12 "*Emergency cycle speed* in %"

An emergency cycle when monitoring the analog signal can then only take place with control over 2 - 10 V. If the analog signal is under 1.9 V, the emergency cycle speed is activated after the set waiting time.

Possible settings: OFF
ON *

* Factory settings

4.4.12 Emergency cycle speed in %

Cannot be edited with step switching (see also chapter 4.4.1 "*Fan control*")

Adjustable speed in percent on loss of signal source. This value relates to the maximum speed (see chapter 4.4.4 "*Maximum speed in* %").

Possible settings: 10 to 100% of the max. speed

Factory settings: 50 %

4.4.13 Emergency cycle delay in seconds

Cannot be edited with step switching (see also chapter 4.4.1 "*Fan control*")

Waiting time on loss of signal source until emergency cycle is activated.

Possible settings: 5 to 60 seconds

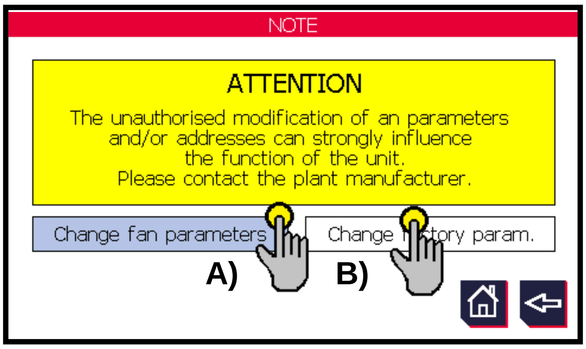
Factory settings: 20 seconds

4.4.14 Write parameters to fan *

* This button or this function is only visible with a fan control via Modbus.

If all settings and changes have been made, these must be loaded in the fan. To do this, the “Write parameters to fan” button (see left) must be selected. The following notification window then opens:

Image 33

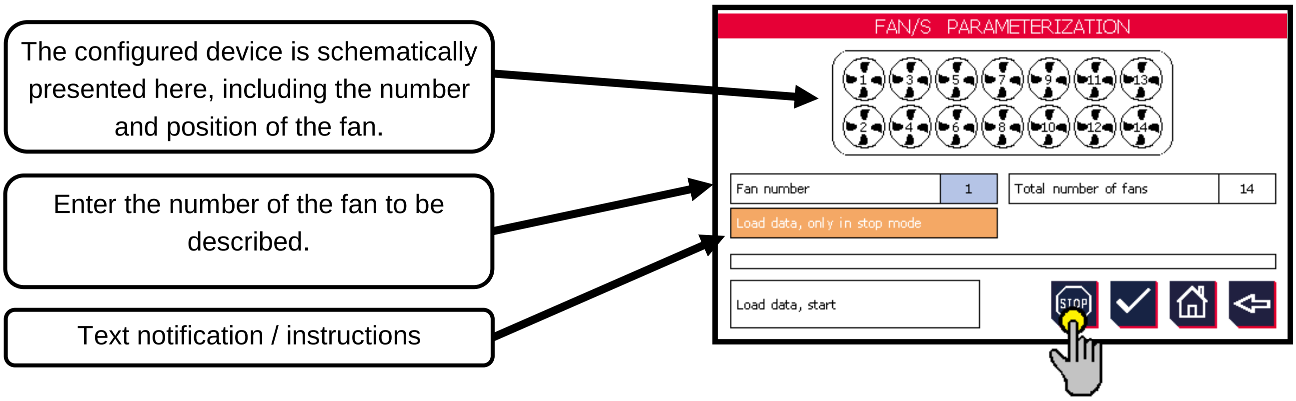


All further steps influence the function of the device and can strongly influence it. Only trained or instructed personnel should make changes here.

B) Changing the factory parameters (fan addresses, etc.) is only possible with the manufacturer's password (see also chapter 2.4.1 “*Manufacturer's* password”).

A) Change fan parameters

Image 34



To start “Load data”, the bus must be stopped. To do this, press the “Stop” button.

Image 35

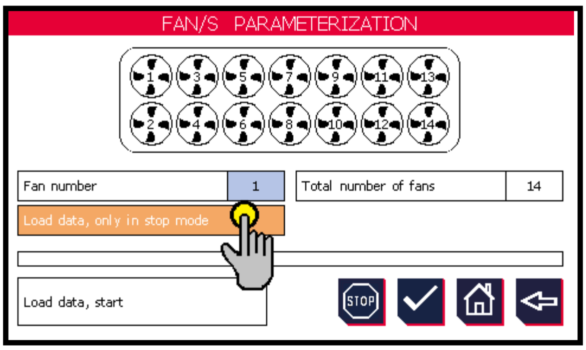
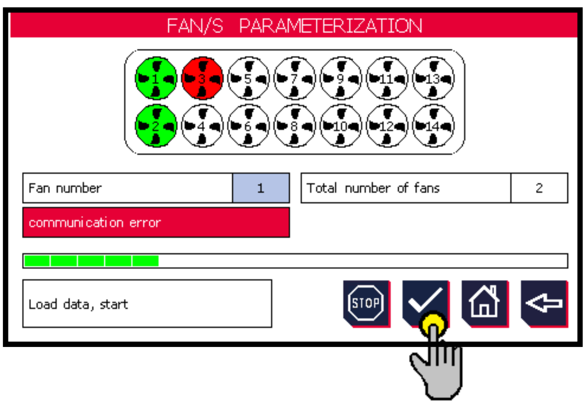


Image 36



As soon as the bus has been stopped, the following symbol appears: “Write parameters to fan“. The process starts after the button is pressed. All in chap. 4.4 “Fan setting(s)” are written to the fan.

The status bar shows the progress of the loading process.

<u>Colour codes fans:</u>

<u>Red:</u> Parametrising faulty, please check text notification and correct. The loading process is stopped. The process is continued when the “Tick” or “Acknowledge” button is pressed. → Repeat process.
(Possible error: Limit speed is higher than rated speed; communication interrupted; no voltage at fan)

<u>Green:</u> Parametrising successful.

<u>White:</u> Fan not yet parametrised.

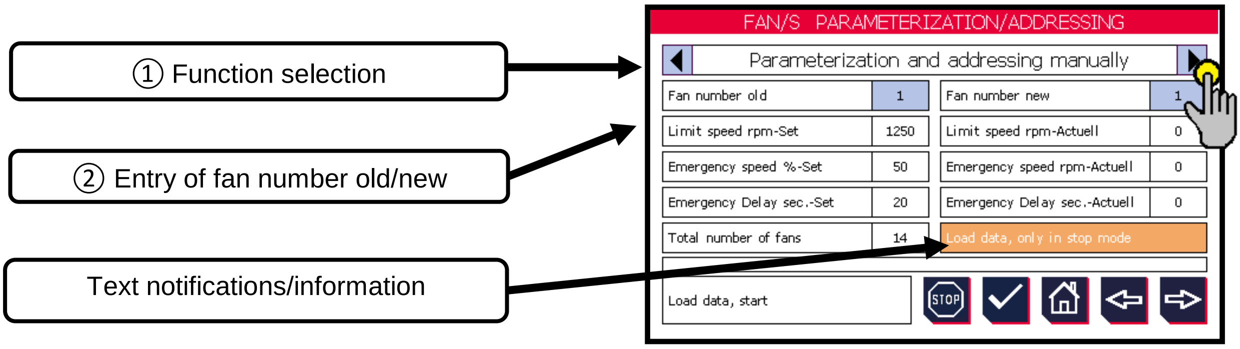
On leaving the menu, the bus is automatically set to RUN again.

B) Change factory parameters

Access to this area is reserved for the manufacturer, and it is protected by the manufacturer's password.

On this level, the fan can not only be parametrised (as in **A**), but also readdressed, or the address can be reset to factory settings.

Image 37



<u>① Function selection:</u>

➔ **"Parametrising and addressing manual"**
- All parameters set in chap. 4.4(Fan setting(s)) are written to the fan.
- The manually entered addresses (see ②) are written to the fan.

➔ **"Parametrising and addressing automatic"**
- All parameters set in chap. 4.4(Fan setting(s)) are written to the fan.
- The fans are readdressed. The "New fan number" (see ②) is automatically incremented after each successful addressing process. Starting at 1 to the edited "number of fans per device" (see chapter 4.4.3 "*Number of fans* per device").

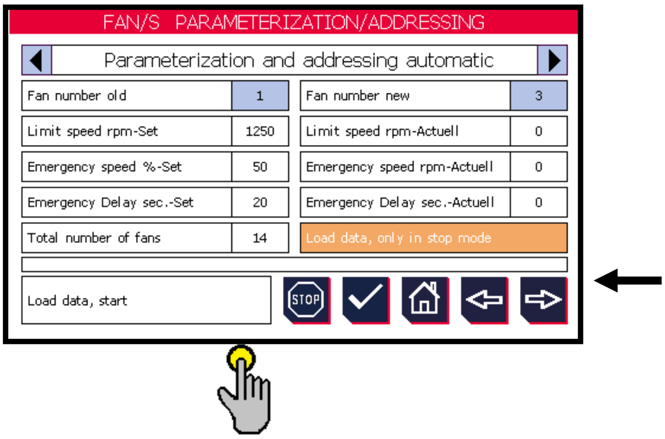
➔ **"Fan(s) – only parametrising"**
- All parameters set in chap. 4.4(Fan setting(s)) are written to the fan.
- The address set in each case is not changed.

➔ **"Reset fan address(es)"**
- The addresses of all fans connected to the bus and supplied with voltage are reset to "factory settings".

To start the function in ①, the bus must be stopped. To do this, press the “Stop” button (see Image 38).

Caution! If two or more fans have the same Modbus address, these must be disconnected from the mains. Only the fan to be newly addressed can be connected!

Image 38



As soon as the bus has been stopped, the following symbol appears: “Write parameters to fan“.

After pressing the  button, the function selected in ① is carried out.

The status bar shows the progress of the loading process.

On leaving the menu, the bus is automatically set to RUN again.

4.4.15 Number of fault inputs

Only effective with control with 0-10 V DC and step switching.

Editable number of digital inputs that report an OK message or fault. These can be occupied by an individual fan or a group of signalling contacts connected in series, as required.

<u>Upper limit:</u>	Number of fans in device (max. 1 fault input per fan)
<u>Lower limit:</u>	0 fault inputs

4.4.16 Base speed %

Adjustable minimum speed in percent

<u>Possible settings:</u>	0.0 – 100 %
<u>Factory settings:</u>	0.0 %

4.4.17 Enable via DO (Digital output)

From a fan setpoint greater than 2%, the respective digital output (fan speed ...) is switched. This can be used e.g. as a FU release. This is possible on the basic device from fan 1 to 4. More than 4 fans are than released via the CAN16 DO module.

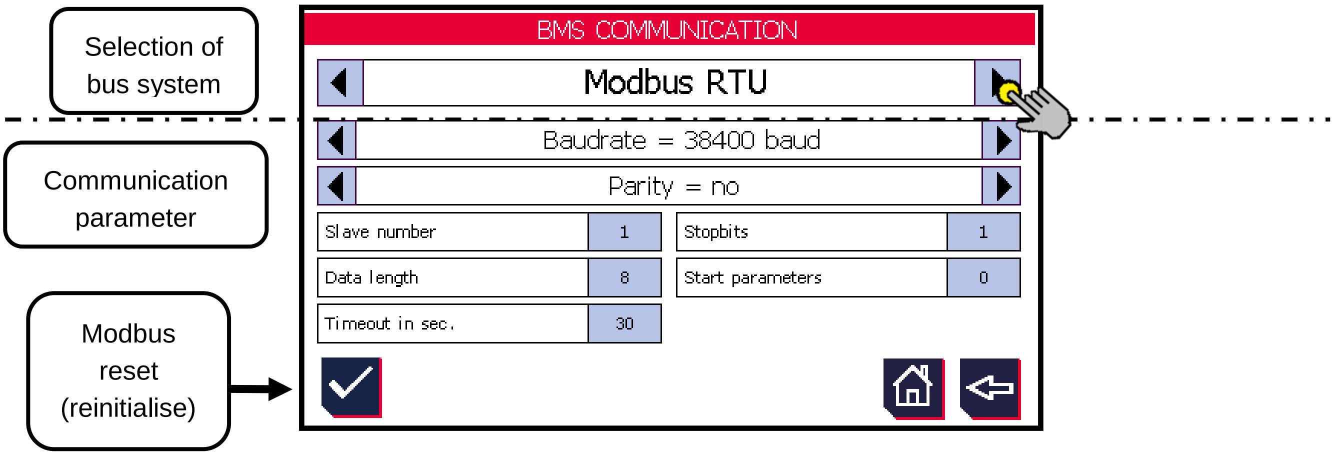
<u>Possible settings:</u> ON - OFF

<u>Factory settings:</u> OFF

4.5 GLT (Gebäudeleittechnik, building control system) bus system

The desired bus system is selected in the upper part of the menu. All necessary parameters for the respective communication type appear in the lower part.

Image 39



4.5.1 Modbus RTU (slave)

The minimum waiting time of the master between two requests (inter scan delay) must be at least 200 ms!

The baud rate, parity and stop bit settings must agree with the values of the “master”. The following communication settings can be edited:

Baud rate: 1200, 2400, 4800, 9600, 19200 baud

Parity bit: no → no parity
Even → even parity
Odd → odd

With activated parity testing (even or odd), either through the selection of even or odd parity, the set of all characters in the data content of all transmitted characters is counted. The parity bit is then set as “0” or “1”, to generate an even or odd result.

Slave number: Enter the desired slave device address to be used by the master (1 to 247). The address 0 is reserved for broadcast mode.

Data length bits: Length of the data bits to be transmitted. Contains the information to be transmitted. This field is subdivided into registers, number of registers to be transmitted and, if necessary, information to be read or saved.

Stop bits: 1 stop bit if parity is used; 1 or 2 bits if no parity is used.

Start parameter: Contrary to the definition by the MODBUS protocol, some substations use the MODBUS register start address in the MODBUS telegram on the line starting from “1” rather than the one starting from “0”.

Timeout in sec.: Minimum waiting time of the slave (TCS) for a signal from the master (GLT).

4.5.2 Modbus TCP (server)

See also chapter 5.9 “Network IP”

IP address: Factory settings: 172.25.10.10

Network mask: Factory settings: 255.255.255.0

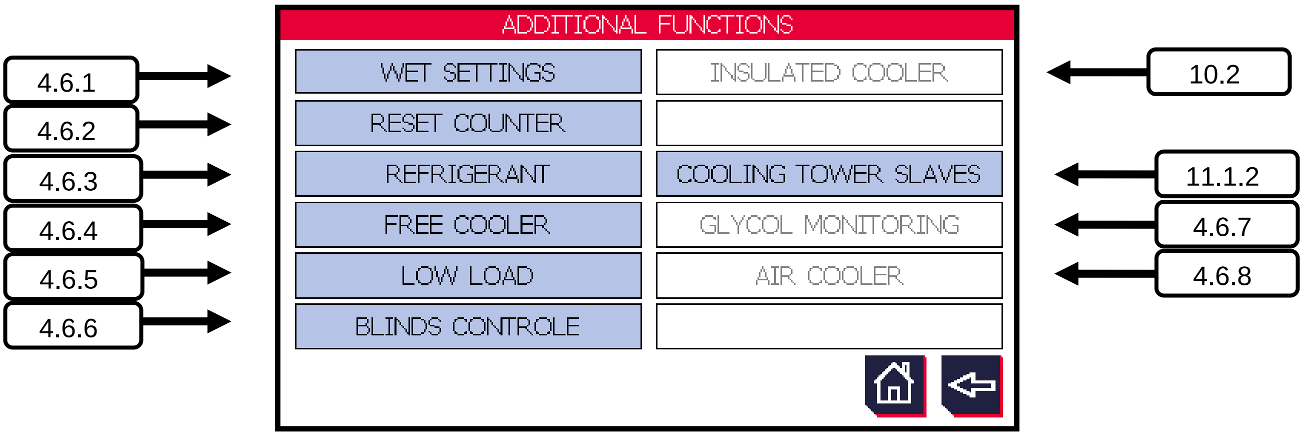
Standard gateway: Factory settings: 0.0.0.0

TCP server port: Factory settings: 502

4.6 Additional functions

Contrary to the standard, there are various functions and setting levels that are not listed in the following sub-menu. All non-activated functions are greyed out (with a white background).

Image 40



4.6.1 Wet settings

This menu item can only be selected with wetted or humidified devices (with a blue background).

For more detailed explanations and operating instructions, see:

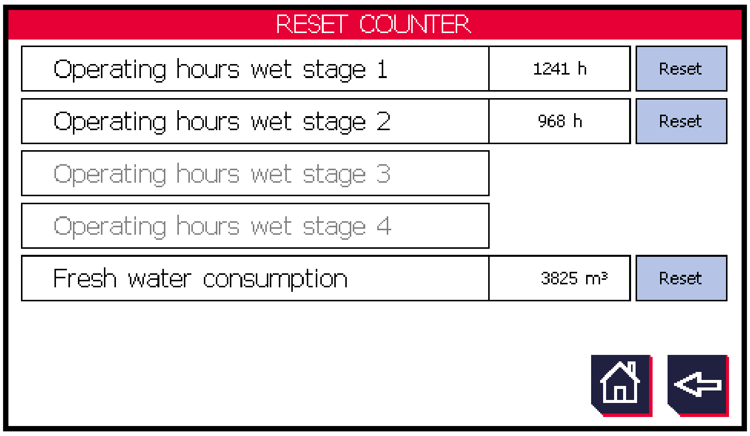
- Chapter 6.1 “*Adaptations in: Device settings* → *Additional functions* → Wet settings Spraying”
- Chapter 7.1 “*Adaptations in: Device settings* → *Additional settings* → Wet settings Mat”
- Chapter 8.1 “Adjustments in Device settings → Additional functions → Wet settings Evaporator”
- Chapter 9.1 “Adjustments in Device settings → Additional functions → Wetting system”

4.6.2 Reset counter

Resetting all installed usage and operating hour counters is reserved for the manufacturer. The “Counter reset” box in the “Additional functions” menu (Image 40) has a blue background and can be selected only after the corresponding password has been entered. The user reaches the following window (Image 41).

A plain display of these counters can be found in Main menu → “Counters”. This menu is not password protected and is therefore freely accessible. See also 5.4 “*Counter*”.

Image 41

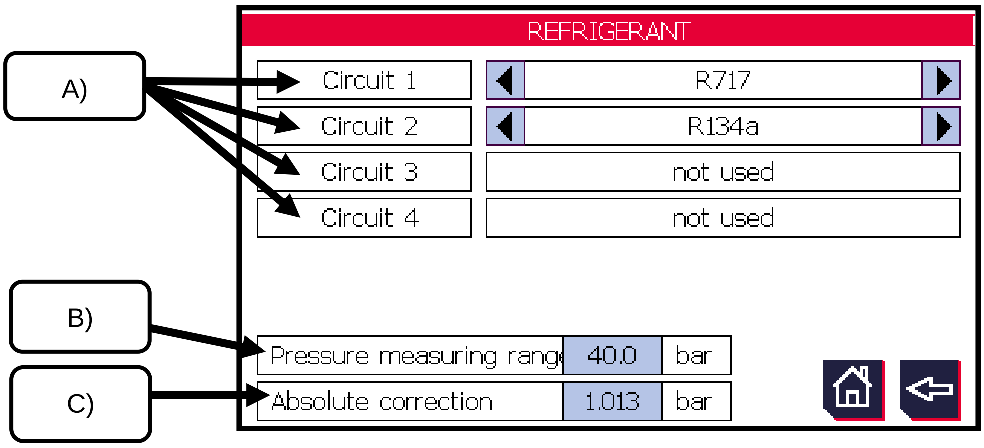


All greyed-out displays are inactive and are not used.

4.6.3 Coolant

This sub-menu item can only be selected (blue background) if a condenser was selected as the device type.

Image 42



A) Selection of coolant / possible types

Up to 4 different coolant circuits can be selected in the menu (here a dual circuit device as an example). The correspondingly used coolant can be selected separately for each circuit. Circuits 3 and 4 are also made selectable by assigning an additional pressure sensor to input 3 or 4 in the "Analog IN" sub-menu.

The following coolant can be selected by the user:

Coolant	Name
R22	HFCKW (contains chlorine, partially halogenated)
R717	Ammonia NH_3 (single substance, natural coolant)
R134a	FKW / HFKW (single substance, chlorine-free)
R404A	FKW / HFKW (mixture, chlorine-free)
R410A	FKW / HFKW (mixture, chlorine-free)
R507	FKW / HFKW (mixture, chlorine-free)
R290	Propane (single substance, natural coolant)
R723	Ammonia / DME (mixture, natural coolant)
R407C	FKW / HFKW (mixture, chlorine-free)
R407F	FKW / HFKW (mixture, chlorine-free)
R744	CO_2 (single substance, natural coolant)
R449A	FKW / HFKW (mixture, chlorine-free)
R513A	FKW / HFKW (mixture, chlorine-free)
R422D	FKW / HFKW (mixture, chlorine-free)
R1234ze	HFO (partially halogenated fluoro-olefins)
R1270	Propene (single substance, natural coolant)
R455A	Mixture of R1234yf, R32 and CO_2
R448A	Mixture
Pressure	Display in bar

If a coolant which is not available for selection is to be used, the unit “bar” should be set. All displays in the TCS are then in “bar absolute” If the coolant used is listed here and is selected, all displays are then in °C. The actual value is then the condensing temperature.

B) Pressure measurement range

The standard pressure measurement range is 0-40 bar relative pressure with thermofin® pressure sensors. If you use other pressure sensors, the pressure measurement range of the TCS should be adjusted to the pressure sensor used. However, only pressure sensors whose output signal is a standardised 4...20 mA signal and whose zero point is at 0 bar relative pressure can be used.

Lower pressure measurement range limit: 5 bar relative pressure
Upper pressure measurement range limit: 100 bar relative pressure

C) Absolute correction (air pressure)

For the conversion of pressure to coolant temperature, the absolute rather than the relative pressure is required. For this reason, the air pressure in hPa (mbar) at the installation location of the device is used as the necessary correction value.

Factory settings 1.013 bar = 1013 mbar (hPa) → air pressure at sea level

4.6.4 Free cooler valves

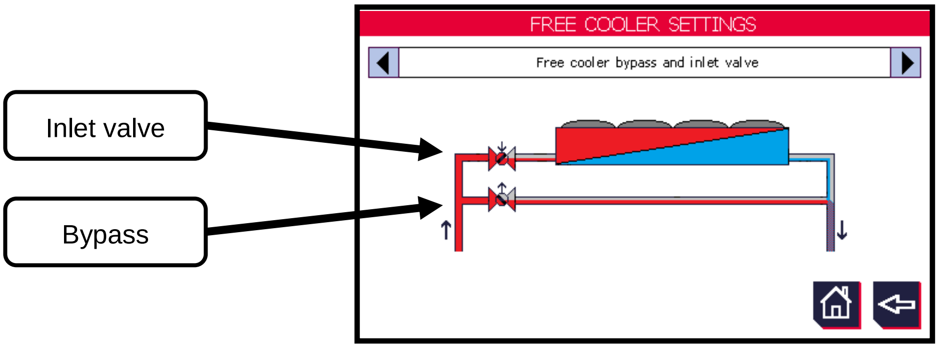
These are for controlling and regulating the refrigerant carrier in the heat-releasing **secondary circuit**.

For setting the setpoints and changeover thresholds, see chapter 5.8.4 “Free cooling valve”

A) Variant:1 x inlet valve, , 1 x bypass valve

Inlet valve = globe valve (status open - closed)
Bypass valve = globe valve (status open - closed)

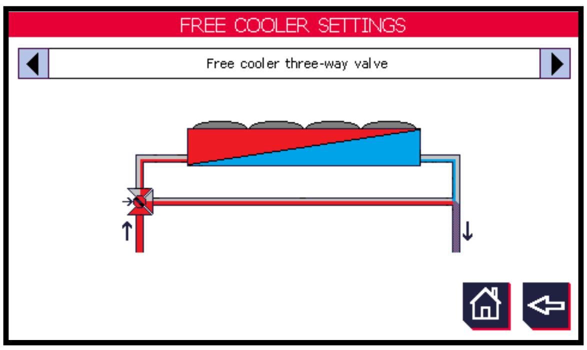
Image 43



B) Variant: 1 x free cooler three-way valve

Three-way valve = diverter valve unregulated (status: not actuated – actuated)

Image 44

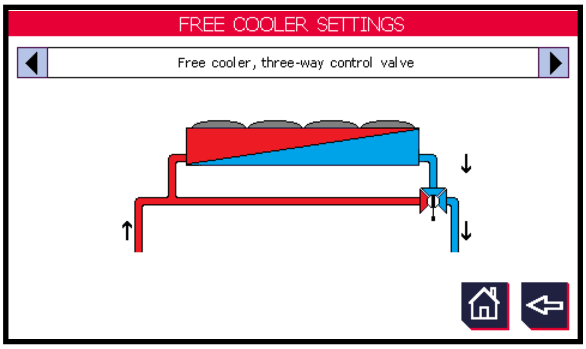


C) Variant: 1 x free cooler three-way control valve

Frost protection function for plate heat exchanger in secondary circuit (heat side). Setpoint factory settings 4°C

Three-way control valve = infinitely variable valve 0-100% (2-10V)

Image 45



Activating this function requires the following additional steps:

- Device settings → Control → Free cooling valves must be set to “internal”, “via terminal” or “via bus”. See chapter 4.2.12 “Control free cooler valve(e)”
- An inlet sensor is required (before the branch – see Image 45). Configurable, see chapter 4.3.3 “Analog IN basic device”
- Install and configure “return” temperature sensor (after the control valve). See chapter 4.3.3 “Analog IN basic device”. This serves as a feedback variable in the control circuit for the three-way control valve.
- The “free cooler three-way valve, 2-10V” must be selected on an analog output (see chapter 4.3.4 “Analog OUT basic device”)

4.6.5 Low load settings

This function allows a fan or group of fans to be switched off in stages at low load. The following control options exist (see also chapter 4.2.10 "*Control low* load control"):

Not all types of control have the same functional range. When controlling via terminal and via bus, only one two-stage regulation is possible.

If the direction of rotation is reversed (via terminal or BUS), the low load control is deactivated for this time. All fans are then active to the same extent.

A) Control (activation)

➔ **Low load control "internal"** (the switching thresholds for the individual levels are automatically calculated by the program based on the step count and the limit value)
2 to 6 possible steps

➔ **Low load control "via terminal"** (the first basic load step remains switched on, the second is externally activated with the DI-6)
2 possible steps

➔ **Low load control "via bus"** (the first basic load step remains switched on, the second is externally activated with the DI-6)
2 possible steps

The following values exist for direct communication via MODBUS:

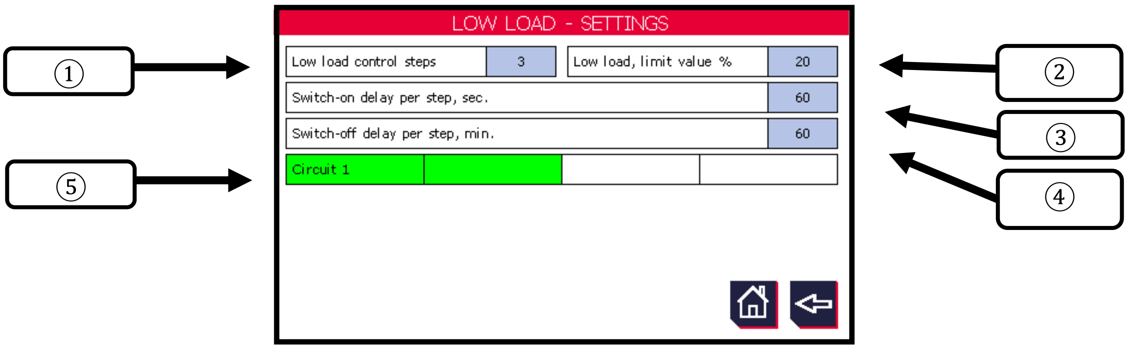
Register	Bit	Designation	Meaning	Register value
2	**0**	Low load control level 1	TRUE = Request low load control level 1	Write 1
164	**4**	Low load control level 1 active	TRUE = Low load control level 1 active	Read 16
	5	Low load control level 2 active	TRUE = Low load control level 1 active	Read 32
	6	Low load control level 3 active	TRUE = Low load control level 1 active	Read 64
	7	Low load control level 4 active	TRUE = Low load control level 1 active	Read 128
	8	Low load control level 5 active	TRUE = Low load control level 1 active	Read 256

This function is activated in Device settings -> Control (see chap. 4.2.10 "*Control low* load control").

B) Editable values

Once a control selection has been made, the “Low load” box in the “Additional functions” menu appears blue and can be activated (see Image 46). The user is brought to the “Low load settings”.

Image 46



① **Low load control levels**

Number of desired low load levels (consisting of at least one fan or fan group). The first level is always the regulated basic load level, which is not switched off. As can be seen in the example Image 46, there is on basic load level and three further control levels with 4 low load levels. These are explained and presented under ⑤. The number of possible low load levels depends on the total number of fans owned by the device (see 4.4.3 “*Number of fans* per device”).

In the case of dual circuit devices, the number of low load levels is the same for both circuits. For all devices from single to two-row and from 2 to 24 fans, there is a precisely determined allocation of fans/groups to the individual levels. There may also be unequal groups depending on the device.

Editable with internal control: 2 … 6 low load levels, depending on the number of fans

Editable with control via terminal / BUS: 2 low load levels

Factory settings: 2 low load levels

② Low load limit value %

A low load regulation only takes place below this limit value. If the speed setpoint falls below this edited value, it is switched off level by level (depending on the number of levels), after completed deactivation delay (④). Above this limit value, the fans or fan groups are switched on in stages. The activation thresholds are based on the number of control levels and the limit value set here.

See following example:

Example 1:
Low load – device levels: 4 (≙ 3 control levels)
Low load – limit value: 20 %

Activation threshold: = 20 % + (20 % / 3 control levels) = 26.66 % (rounded down 26 %)

On reaching a speed setpoint of 26%, the control levels are switched on again in stages after a completed activation delay (③).

Example 2:
Low load – device levels: 2 (≙ 1 control levels)
Low load – limit value: 40 %

Activation threshold: = 40 % + (40 % / 1 control levels) = 80 %)

On reaching a speed setpoint of 80 %, the control level is switched on again after a completed activation delay (③).

Can be edited from …to: 10… 75 %

Factory settings: 20 %

③ Activation delay per level (in seconds)

After completion of the time set here and on reaching the activation threshold, the control levels are switched on in stages.

It is recommended to have as short times as possible to prevent overpressure or overheating of the system. The times should be optimised appropriately after commissioning.

Can be edited from …to: 1 … 600 s

Factory settings: 60 s

④ **Activation delay per level (in minutes)**

After completion of the time set here and on reaching the low load limit, the control levels are switched on in stages.

The deactivation times should be set as long as possible so that there is no constant switching between low load and nornal control. The times should be optimised appropriately after commissioning.

Can be edited from …to: 1 … 1440 min

Factory settings: 60 min

⑤ **Display low load levels**

Both circuits are displayed separately in bars (see Image 46). The subdivision is governed by the edited low load device levels (①). Locked levels are white and unlocked levels are green.

C) Low load setpoint output

➔ **Via bus**

As standard, all speed setpoints are transmitted to the fans via MODBUS when using the low load control. It is thus also possible for individual fans or fan groups to be selected and deselected.

➔ **Via analog output**

A second option (where bus communication with the fans is not present) is a speed output for two low load device levels over both analog outputs of the basic device TCS.2. The following steps are necessary to activate this function:

1. Select a type of control Device settings -> Control (see chapter 4.2.10 "*Control low* load control*"*).
2. In the menu "Fan settings", select "Control 0-10 V DC" (see chapter 4.4.1 "*Fan control*").
3. In the menu "Analog OUT basic device", set both analog outputs to "speed circuit 1, 0-10 V" or "Speed circuit 1, 2-10 V" (see chapter 4.3.4 "*Analog OUT basic* device").

With these settings, the first analog output (AO-1) works as a low load basic level and the second analog output (AO-2) as a low load control level.

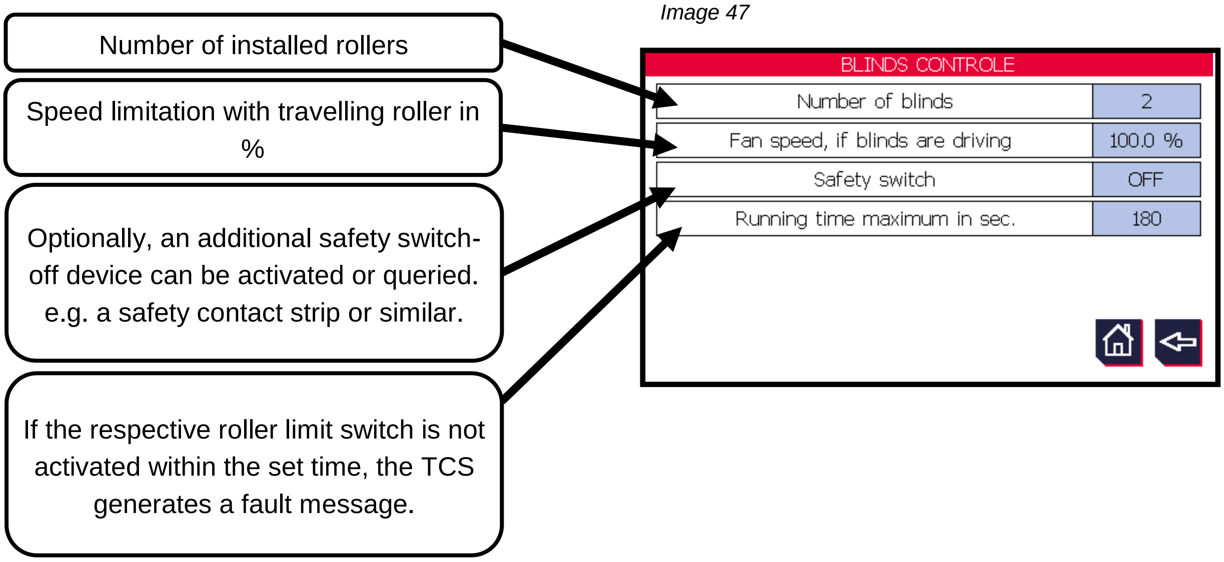
For this reason, both analog outputs must also be separately wired with the corresponding fans or fan groups.

4.6.6 Roller control settings

This menu item can only be selected after selecting a type of control (with a blue background in Image 40). For explanations for control, see chapter 4.2.11 “*Control* ”.

Regardless of the selected heating system, installed rollers can be configured in this sub-menu.

Image 47



For manual operation / commissioning, see chapter 5.8.6 “*Roller control* menu”.

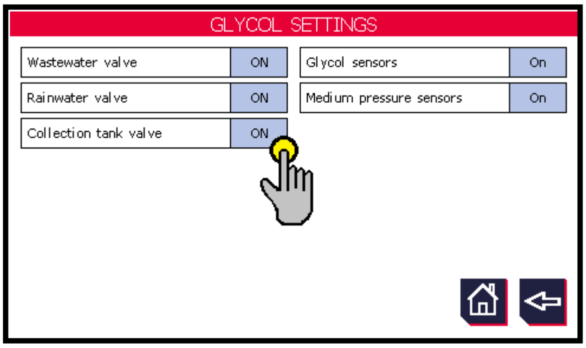
4.6.7 Glycol monitoring

This menu item can only be selected after selecting a type of control (with a blue background in Image 40). For explanations for control, see chapter 4.2.11 “*Control* ”.

The following valves can be selected and deselected:

- Waste water valve (opened in wet mode of the cooler – the thickened water is fed into the waste water system during the blow-down process)
- Rainwater valve (opened in dry mode / winter mode – the rainwater collected in the empty tank is fed into a rainwater tank)
- Collecting tank valve (opened in glycol error case – Contaminated water is fed into the waste water tank)

Image 48



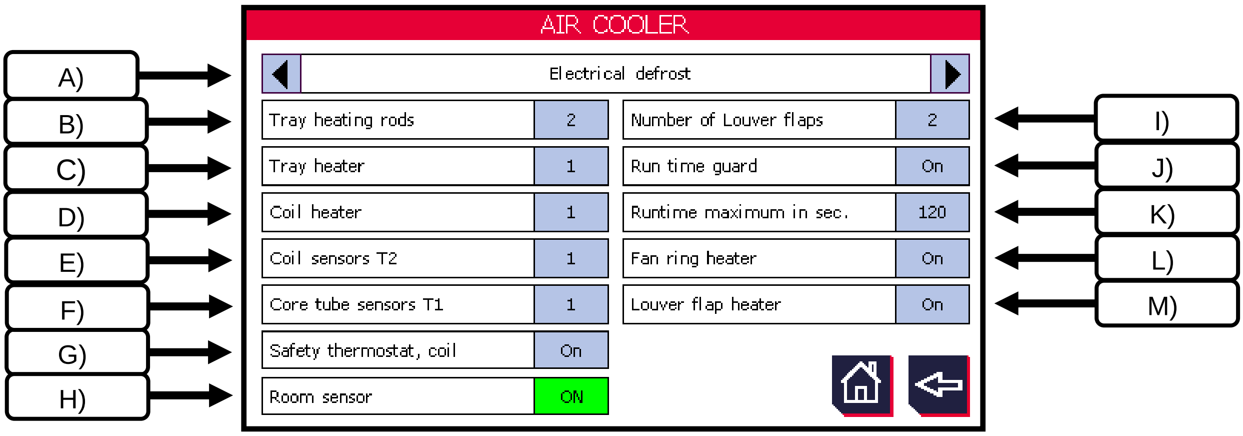
- Glycol sensors (Query of whether glycol sensors were used in the application to detect a leak)
- Medium pressure sensors (Query of whether glycol sensors were used in the application to detect a leak)

For editing switching thresholds / displaying fan settings and manual operation – see chapter 5.8.8 “Glycol monitoring”

4.6.8 Air cooler / evaporator

The menu item "air cooler" or evaporator (Image 49) can only be selected after selecting the respective heat exchanger system (with blue background). For explanations for control, see chapter 4.1.1 "Selection of heat system / explanation of terms".

Image 49



A) Type of defrosting

➔ Circulation defrosting
The iced-up lamella pack (heat exchanger) is defrosted with the ambient air. Possible with positive refrigeration room temperatures.

➔ External air defrosting
The iced-up lamella pack (heat exchanger) is defrosted with the external air.

➔ Electrical defrosting
The iced-up lamella pack (heat exchanger) is defrosted electrically.

Factory settings: Circulation defrosting

B) Tank heating elements

Number of tank heating elements in the insulating or penthouse coolers, which are monitored, controlled and regulated by the TCS.2 One tank temperature measurement takes place per tank heating element.

Can be edited from …to: 0 … 4 tank heating elements
Factory settings: 2 tank heating elements

C) Tank heatings

Number of tank heating levels that are controlled by the TCS.2

Can be edited from …to: 0 … 2 tank heating levels
Factory settings: 1 tank heating level

D) Block heatings

Number of block heating levels that are controlled by the TCS.2

Can be edited from …to: 0 … 2 block heating levels
Factory settings: 2 block heating levels

E) Block sensors T2

Number of control sensors for the electric block defrosting.

Can be edited from …to: 0 … 2 block sensors
Factory settings: 2 block sensors

F) Core tube sensors T1

Number of installed core tube temperature sensors. These control the start of defrosting (coolant is extracted) and the

Can be edited from …to: 0 ... 2 core tube sensors
Factory settings: 2 core tube sensors

G) Safety thermostat block

A safety thermostat that is installed in the finned heat exchanger protects it from impermissibly high temperatures and consequential damage within the radiator. Here is the query of whether this kind of thermostat will be installed in the block and evaluated via the TCS.2.
After activation, the DI-95 input will be automatically assigned on the CAN module 12.

Factory settings: Off

The following parameters are applicable for querying via bus:

Register	Bit	Fault code	Designation	Meaning	Register value
162	**0**	I05	Safety thermostat block	TRUE = block temperature, safety thermostat triggered	read 1

H) Room sensor

Display whether a temperature sensor is installed in the room to be cooled and is connected to the TCS.2
The room sensor at basic device AI-1 is selected. See also chapter *4.3.3 Analog IN basic* device.

I) Number of multileaf dampers

Number of multileaf dampers that are controlled and monitored by the TCS.2.

Can be edited from …to: 0 … 2
Factory settings: 0

J) Runtime monitoring

Activation of the blind runtime monitoring. The TCS expects feedback in the end position.

Editable: OFF/ ON
Factory settings: OFF

K) Runtime maximum in seconds

Adjustable time window from start signal until end position of flap. If this time is exceeded, the TCS.2 generates a fault message. See also chapter *12.5 Flap messages – Fault code* K...

Can be edited from …to: 10 … 300 s
Factory settings: 20 s

L) Fan ring heating

Activation control ring heating via the TCS.

Editable: OFF/ ON
Factory settings: OFF

M) Flap heating

Activation control ring heating via the TCS.

Editable: OFF/ ON
Factory settings: OFF

4.7 SI / IMP Changing units

The temperature and pressure units can be changed independently of each other from **SI** (international unit system) to **IMP** (Anglo-American unit system).

	SI	**IMP**
Pressure	Bar	psi
temperature	°C	°F

5. MAIN MENU

The following menu items can be called up in the main menu at a minimum. Some sub-menus or menu items are added and displayed depending on the system configuration and requirement. Menu options that are not selected via Device settings / Heating system or are not required, are not displayed.

Image 50

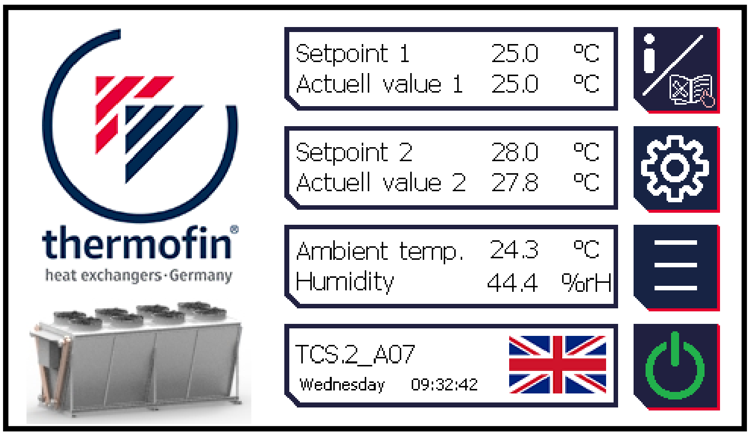
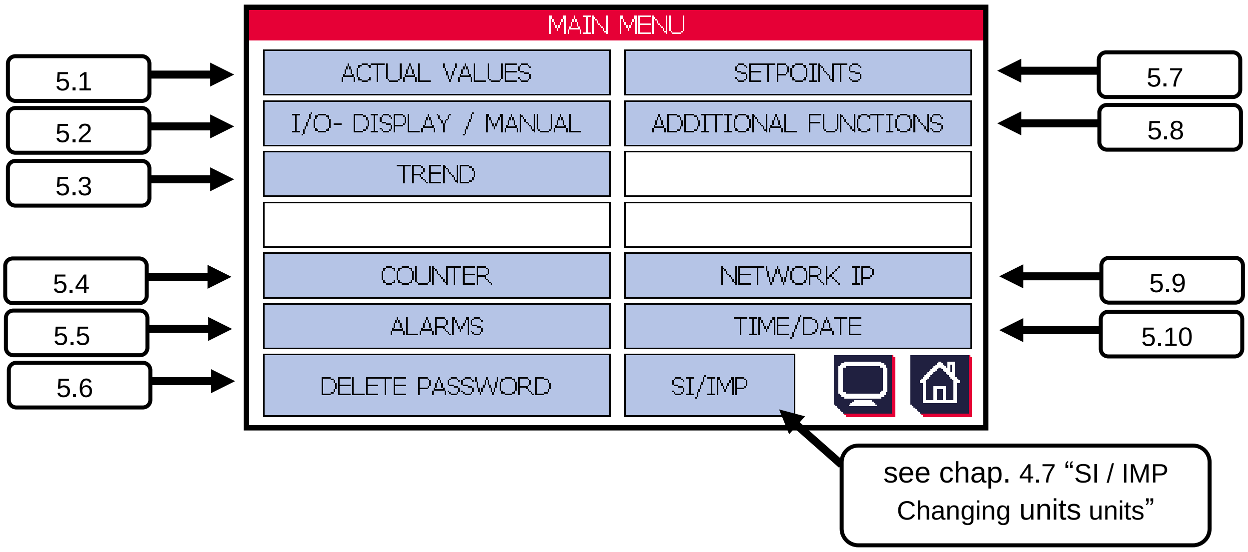


Image 51



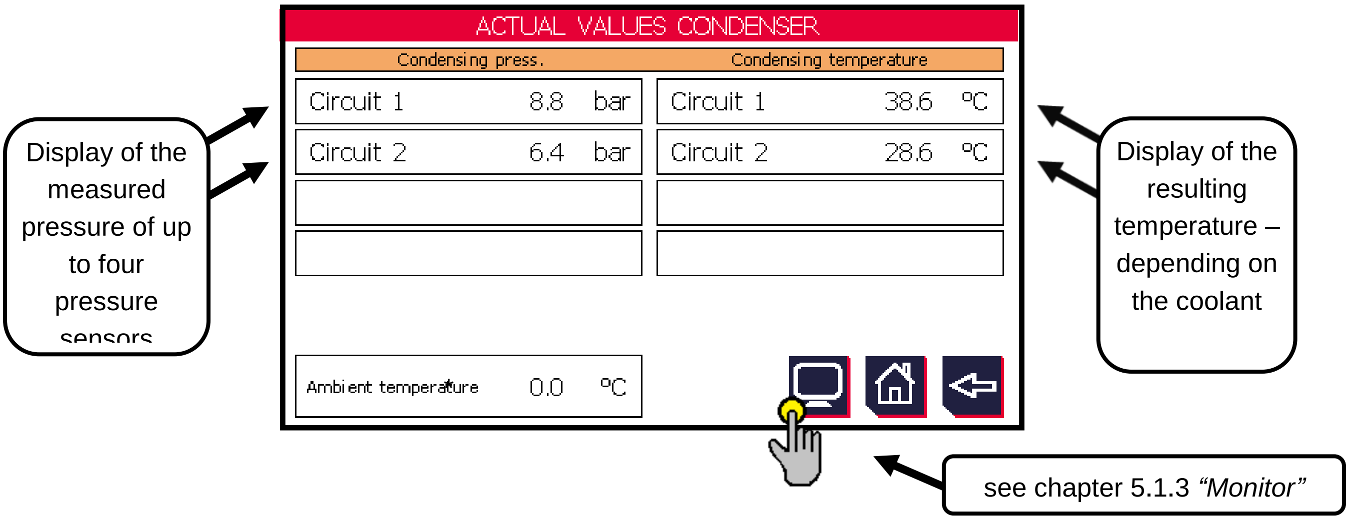
The sub-menus arranged to the right of the main menu are secured with a parameter password. Trained persons receive this password from suppliers of the TCS. See chapter: 2.4 “Passwords”.

5.1 ACTUAL values

This overview of the current values of the system are displayed differently for condensers and recoolers.

5.1.1 Display for condensers

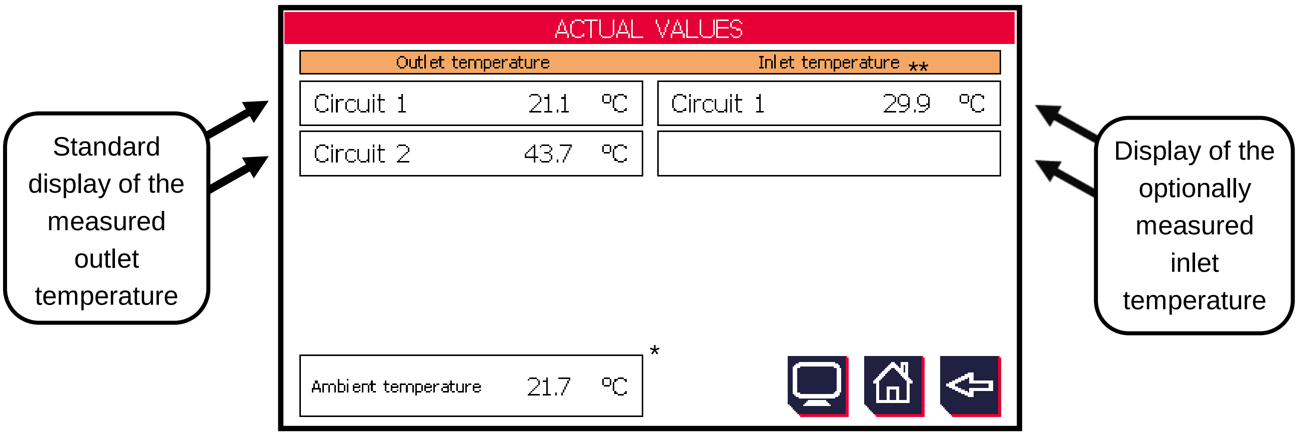
Image 52



* The external temperature is only displayed if a humidified or wetted device has been selected.

5.1.2 Display for recoolers

Image 53



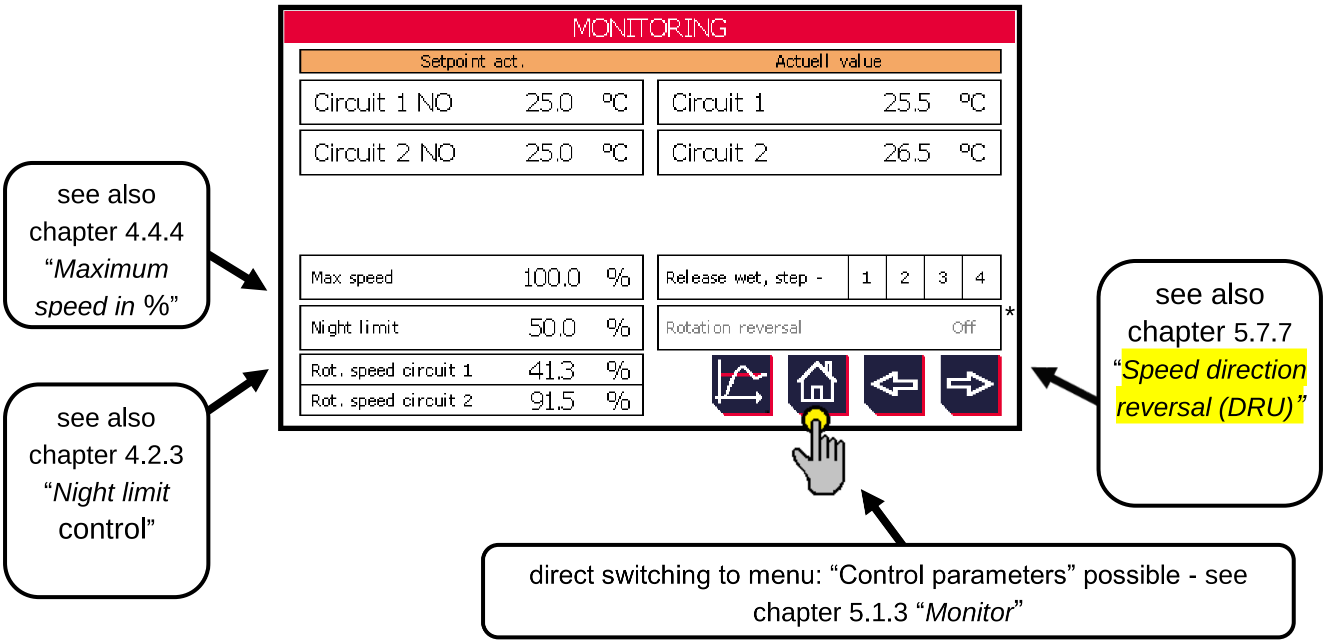
* The external temperature is only displayed if a humidified or wetted device has been selected.

** The inlet temperature is only displayed after selection of a corresponding inlet sensor. See menu *Device settings* → *Inputs / outputs* → *Analog IN* selection → “Analog IN 3 or 4” *(see also chapter “Analog IN basic device”* 4.3.3)

5.1.3 Monitor

This display window “Monitor” contains all current target and actual temperatures, the output speed setpoint and other helpful displays for commissioning and servicing purposes.

Image 54

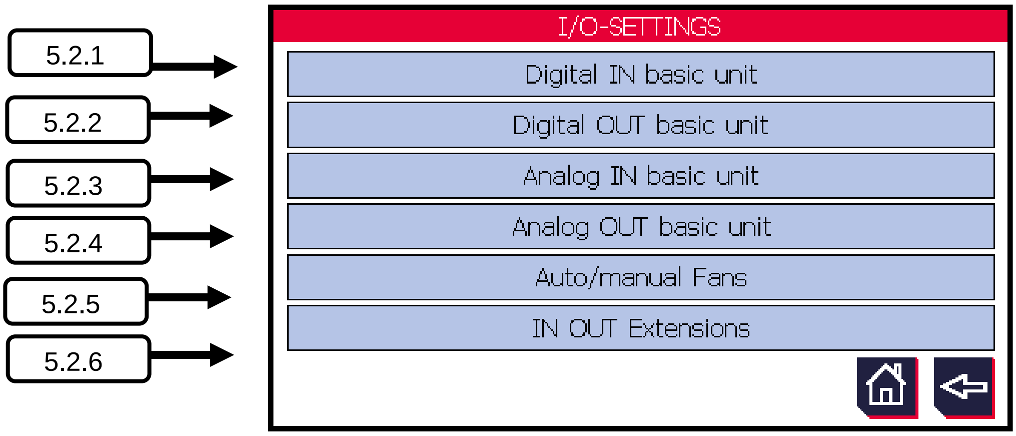


* Greyed-out functions are not displayed in Display settings.

5.2 E / A (Eingänge [inlets] / Ausgänge [outlets]) – display / manual

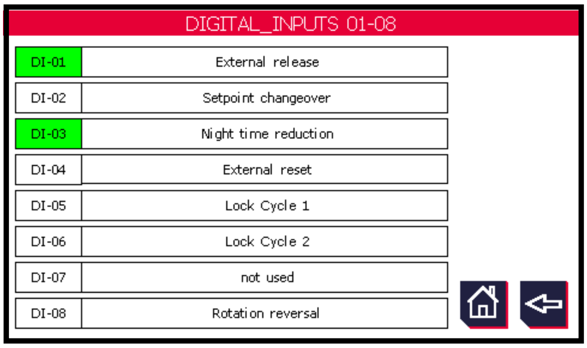
This sub-menu contains all digital and analog inlets and outlets of the basic device (TCS.2) and the CAN extensions. After selecting the category, the current status is displayed. The outlets can be switched to “Manual mode” and confirmed. These functions are helpful during commissioning, servicing or troubleshooting.

Image 55



5.2.1 Digital IN basic device

Image 56



Overview and status display of all digital inputs to basic device TCS.2.

The assignment of the respective function can be modified in Device settings -> INPUTS/OUTPUTS (see also chapter 0 “
Digital IN basic device
”).

Activated inputs (+24 V DC at input) are shown in green (see Image 56 DI-1 and DI-3).

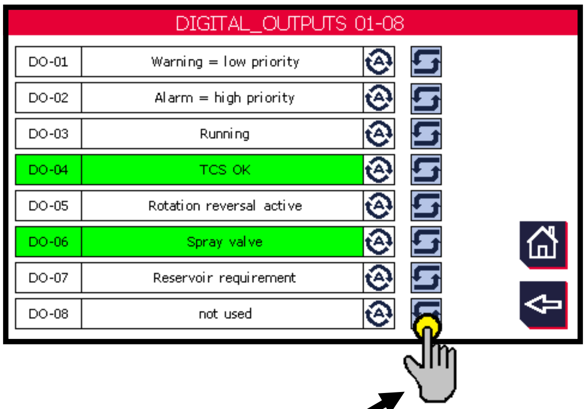
5.2.2 Digital OUT basic device

Overview and status display of all digital outputs to basic device TCS.2.

The assignment of the respective function can be modified in Device settings -> INPUTS/OUTPUTS (see also chapter 0 “
Digital OUT basic device”).

Activated outputs (+24 V DC at output) are shown in green (see Image 57 DO-4 and DO-6).

Image 57



Selecting the “manual-auto switch button” switches the corresponding outlet to manual mode.

Image 59

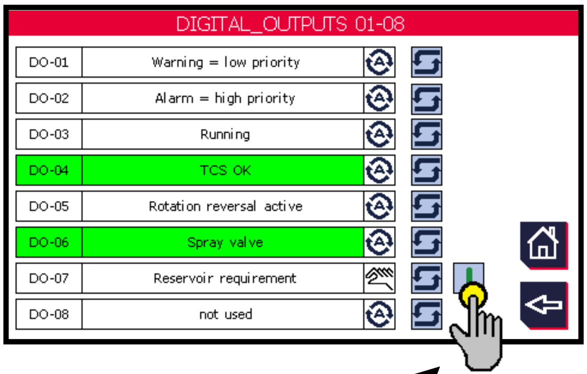
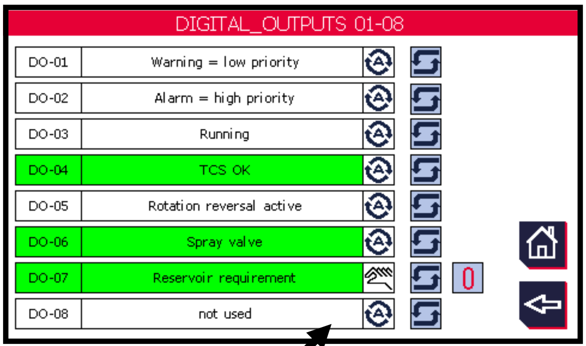


Image 58

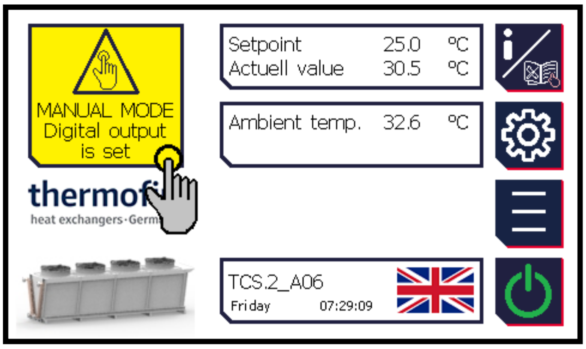


The hand symbol appears.
Now the output can be manually switched on and off.

The outlet is now set to manual and also has a green background.

Selecting the “manual-auto switch button” again switches the corresponding outlet back to manual mode. It changes back to the status that it normally had in automatic mode.

Image 60

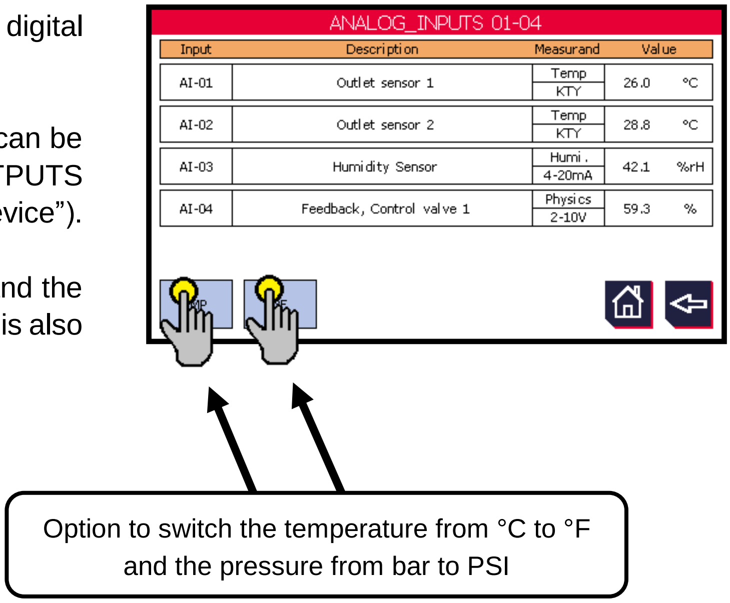


If the user uses the option to leave a particular output permanently in manual mode, this will always be displayed on the start screen. This function can have a major impact on system safety and the failure-safe operation of the device. The operator will therefore always be informed that there is an output in manual mode.

Selecting the yellow information window brings the user directly to the corresponding sub-menu in which the manual mode was activated (see Image 60).

5.2.3 Analog IN basic device

Image 61



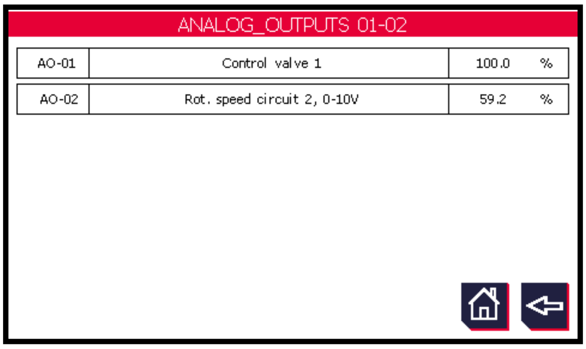
Overview and status display of the four digital inputs to basic device TCS.2.

The assignment of the respective function can be modified in Device settings -> INPUTS/OUTPUTS (see also chapter 4.3.3 "*Analog IN basic* device").

In addition to the designation of the input and the associated measured value, the signal type is also displayed (e.g. KTY, 0-10 V or 4-20 mA).

5.2.4 Analog OUT basic device

Image 62



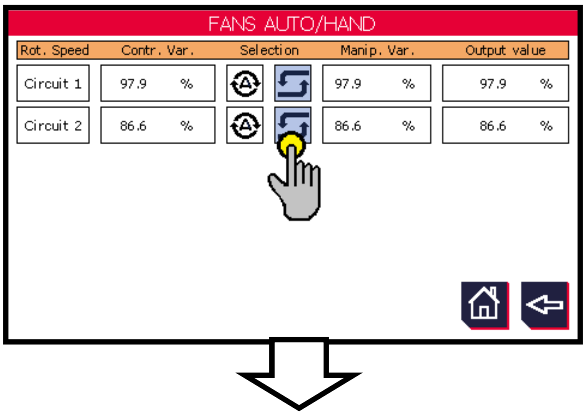
Overview and status display of the two analog outputs to basic device TCS.2.

The assignment of the respective function can be modified in Device settings -> INPUTS/OUTPUTS (see also chapter 4.3.4 “*Analog OUT basic* device”).

Manual operation of the analog outputs in the basic device is not possible in this location. The fans (speed outlets 1 and 2) can be manually controlled in the following sub-menu (see chapter 5.2.5 “*Auto / manual fans*”). All further outlets can be operated according to the function in the respective sub-menu (e.g. valves or pumps in the “Wet mode” menu – see chapter 6.4.8 “*Manual* mode”).

5.2.5 Auto / manual fans

Image 63

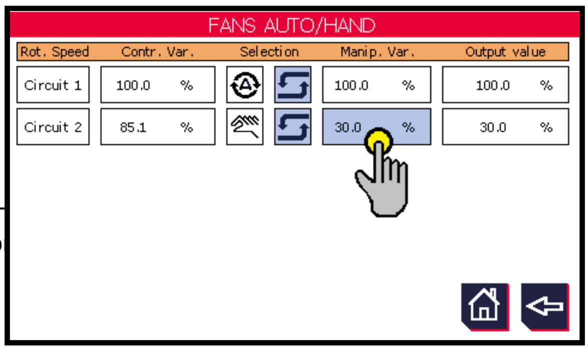


Status display and option for manual mods of the setpoint outputs from circuit 1 and circuit 2 if applicable.

The actual setpoint output can be via an analog output or the bus. Depending on the type of fan control (see also chapter 4.4.1 “*Fan control*”).

Selecting the “manual/auto switch button” switches the corresponding outlet to manual mode (see Image 63).

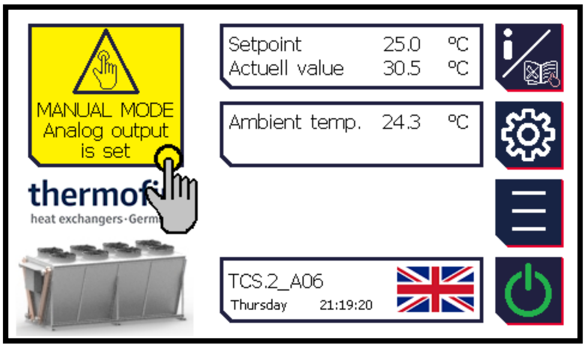
Image 64



The hand symbol appears. The control variable (with blue background) can now be freely edited. The calculated controlled variable from the control remains unchanged. However, the selected manual control variable (see Image 64: 30 %) is sent to the speed output.

Selecting the “manual/auto switch button” again switches the corresponding outlet back to manual mode. The control variable takes the value of the controlled variable again.

Image 65



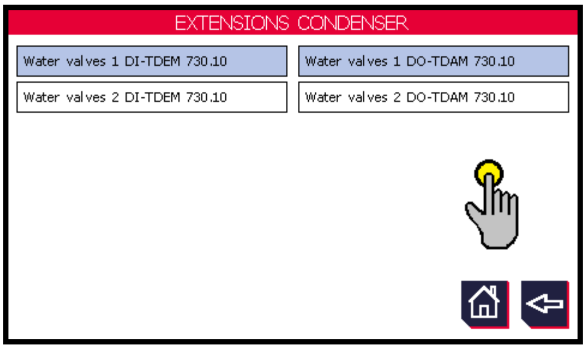
If the user uses the option to leave a speed output permanently in manual mode this will always be displayed on the start screen. This function can have a major impact on system safety and the failure-safe operation of the device. The operator will therefore always be informed that there is an output in manual mode.

Selecting the yellow information window brings the user directly to the corresponding sub-menu in which the manual mode was activated (see Image 65).

5.2.6 IN/OUT extensions

In the case of devices with an extended functional scope (e.g. Thermofin® adiabatic pad cooler or thermofin® hybrid cooler), the digital and analog I/Os of the TCS basic device are not sufficient. They are then extended with external I/O modules via CAN bus. Depending on the need and heat exchanger system, this is activated in Device settings (see chapter 4.3.5 "*IN/OUT extensions*").

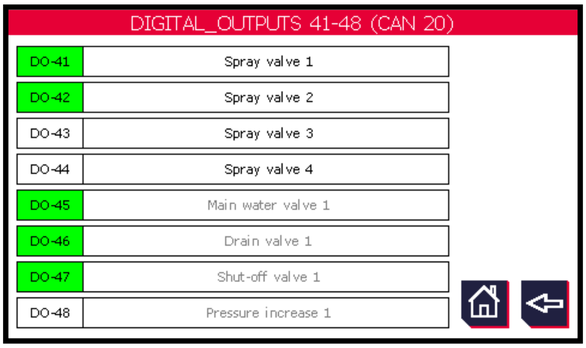
Image 66



Here, for example, all possible IN/OUT CAN extensions of a condenser

However, only the expansions "DI water valves" and "DO water valves" are activated in Device settings. These have a blue background and can thereore be "called".

Image 67



By selecting e.g. the box "Water valve DO", the user reaches the next level, the status display of the respective I/O module.

The green marking shows which of the inputs or outputs are currently switched on or activated (logic high).

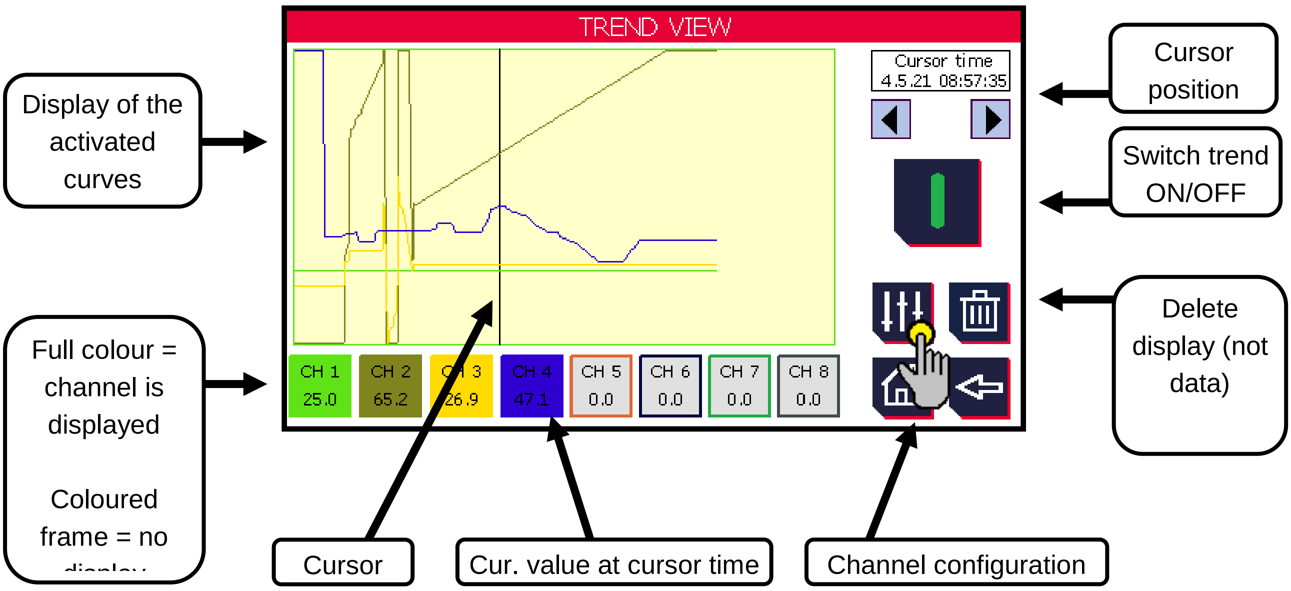
Manual operation of the outputs is <u>not</u> possible in this sub-menu. These can be operated according to the function in the respective sub-menu (e.g. valves or pumps in the "Wet mode" menu – see chapter 5.8.1 "*Wet*").

5.3 Trend

In the sub-menu “Trend”, up to 8 channels can be recorded at the same time and their progress over time displayed. This function is helpful during commissioning, troubleshooting and when adjusting various controls.

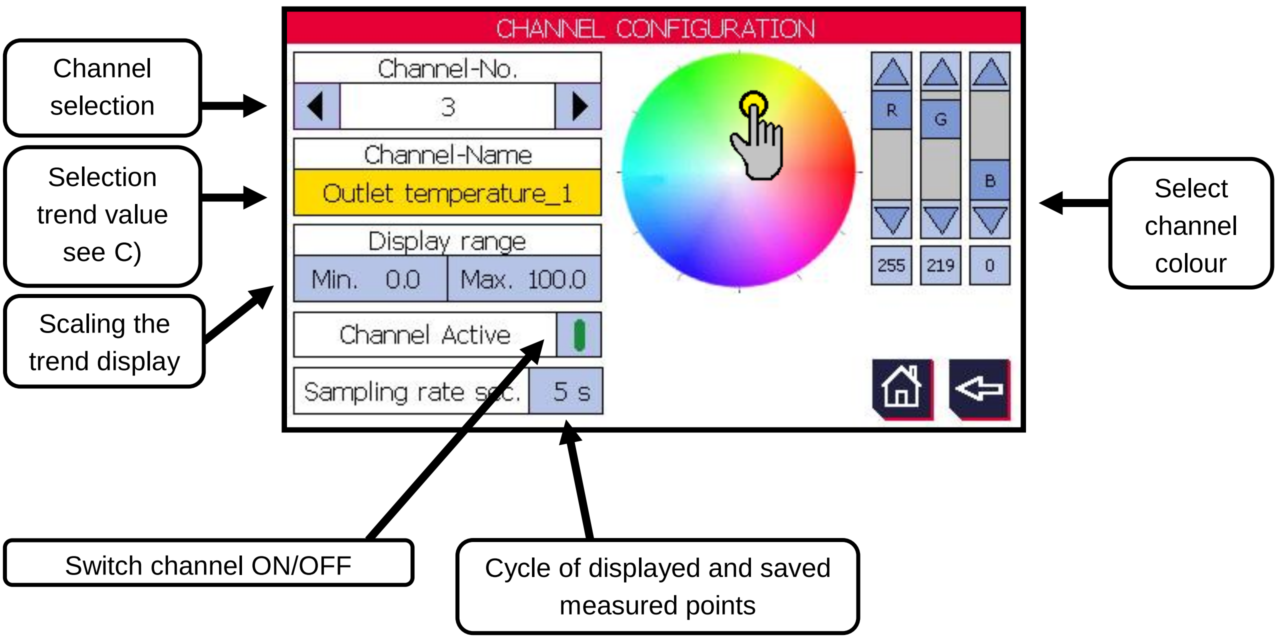
A) Trend view

Image 68



B) Channel configuration

Image 69



C) Possible trend values

	Trend data points				
	Name	Meaning		Name	Meaning
1	EINKr1	Circuit 1 switched on	51	Benetz_Pumpe_1	1 = Wetting pump 1 ON
2	EINKr2	Circuit 2 switched on	52	Benetz_Pumpe_2	1 = Wetting pump 2 ON
3	Sollwert_Akt1	Current setpoint circuit 1	53	Benetz_Pumpe_3	1 = Wetting pump 3 ON
4	Sollwert_Akt2	Current setpoint circuit 2	54	Benetz_Pumpe_4	1 = Wetting pump 4 ON
5	Drehzahl_Kreis1		55	BiocideOn	Biocide dosing switched on
6	Drehzahl_Kreis2		56	Room temperature	
7	Verfluessigungsdruck_1		57	Cell temperature	
8	VerfluessigungsTemp_1		58	Blocktemperatur1	
9	Verfluessigungsdruck_2		59	Block_temp2	
10	Condensing_temp_2		60	Tank_temp1	
11	Outlet_temp_1		61	Tank_temp2	
12	Outlet_temp_2		62	Tank_temp3	
13	Inlet_temp_1		63	Tank_temp4	
14	Inlet_temp_2		64	StromAbtauklappe1	
15	Three_way_valve_targ	Setpoint three-way valve	65	StromAbtauklappe2	
16	Three_way_valve_act	Actual value three-way valve	66	StromAussenluftklappe1	
17	Inlet_valve	1 = OPEN; 0 = CLOSED	67	StromAussenluftklappe2	
18	Bypass_valve	1 = OPEN; 0 = CLOSED	68	StromUmluftklappe1	
19	Medium_valve	1 = OPEN; 0 = CLOSED	69	StromUmluftklappe2	
20	Three_way_valve	1 = OPEN; 0 = CLOSED	70	AbtK_1_is_open	1 = defrosting flap is OPEN
21	MediumPump1	1 = ON; 0 = OFF	71	AbtK_1_is closed	1 = defrosting flap 1 is closed
22	MediumPump2	1 = ON; 0 = OFF	72	AbtK_2_is_open	1 = defrosting flap 2is OPEN
23	External temperature		73	AbtK_2_is closed	1 = defrosting flap 2 is closed
24	Winter mode	1 = ON; 0 = OFF	74	AuLK_1_is_open	1 = outside air flap 1 is open
25	Wet1	Wet stage 1 is active	75	AuLK_1_is closed	1 = outside air flap 1 is closed
26	Wet2	Wet stage 2 is active	76	AuLK_2_is_open	1 = outside air flap 2 is open
27	Wet3	Wet stage 3 is active	77	AuLK_2_is closed	1 = outside air flap 2 is closed
28	Wet4	Wet stage 4 is active	78	UmK_1_is_open	1 = air circulation flap 1 is OPEN
29	Hygiene1On	Hygiene circuit circuit 1 active	79	UmK_1_is closed	1 = air circulation flap 1 is closed
30	Flushing1On	Rinsing circuit circuit 1 active	80	UmK_2_is_open	1 = air circulation flap 2 is OPEN
31	Hygiene2On	Hygiene circuit circuit 2 active	81	UmK_2_is closed	1 = air circulation flap 2 is closed
32	Flushing2On	Rinsing circuit circuit 2 active	82	Fan release NC	1 = Valv. normal cooling releas.
33	Conductivity_value1		83	Fan release TA	1 = Valv. defrosting speed releas.
34	Conductivity_value2		84	Fan release	1 = Valv. released
35	Fill level		85	Fan stop	1 = Fans stopped
36	rel_humidity		86	Defrosting_active	
37	Wet_bulb_temp		87	Drain_time_active	
38	Spray_Valve_1	1 = spraying valve 1 OPEN	88	Precooling_time_active	
39	Spray_Valve_2	1 = spraying valve 2 OPEN	89	Flap release	Fans are OFF
40	Spray_Valve_3	1 = spraying valve 3 OPEN	90	Tank_heating1	1 = tank heating 1 is ON
41	Spray_Valve_4	1 = spraying valve 4 OPEN	91	Tank_heating2	1 = tank heating 2 is ON
42	FWV_valve	1 = fresh water valve OPEN	92	Block_heating1	1 = block heating 1 ON
43	AWValve_1	1 = blowdown valve 1 OPEN	93	Block_heating2	1 = block heating 2 ON
44	AWValve_2	1 = blowdown valve 2 OPEN	94	Roller_1_is_open	
45	Spraying_pump1	1 = spraying pump 1 ON	95	Roller_1_is closed	

46	Spraying_pump2	1 = spraying pump 2 ON	96	Roller_2_is_open	
47	Control_valve_mat1_targ		97	Roller_2_is closed	
48	Control_valve_mat1_act				
49	Control_valve_mat2_targ				
50	Control_valve_mat2_act				

D) Read trend CSV data

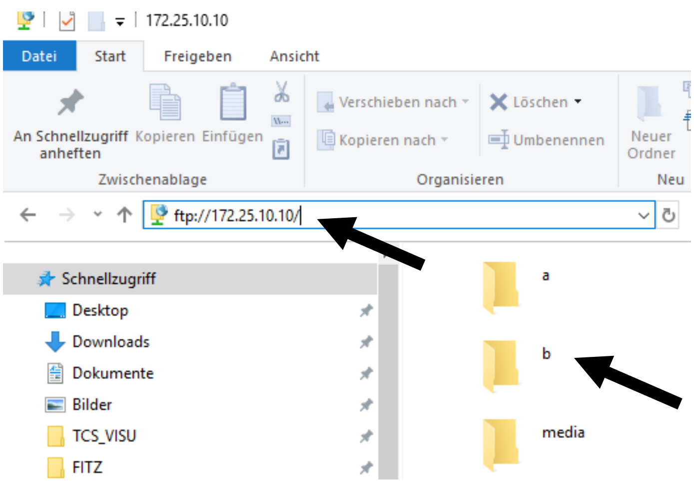
After the trend recording has been paused or stopped, the TCS automatically generates a CSV file in the internal drive b:\. The file name is composed of “data_current_date_index” (example: “data_2021-05-04_0.csv”). The data are then available to the user in individual columns for each activated channel.

The following steps are required to read out the CSV trend file:

➔ **Read current IP address from the TCS**
Main menu → Network IP (factory settings: 172.25.10.10)

➔ **enter the address read in the command line in Windows Explorer**
Example: ftp://172.25.10.10 (see Image 70)

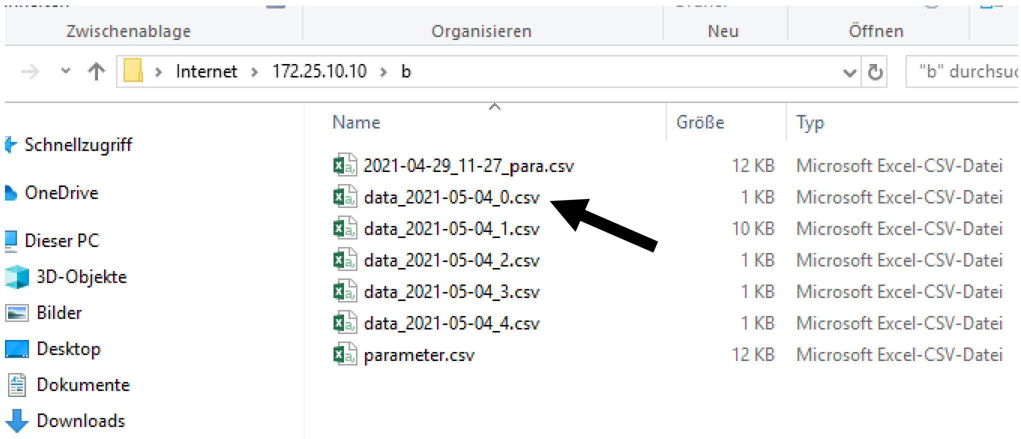
Image 70



➔ Open b:\ drive

➔ Copy the desired file to a local folder (Image 71)

Image 71

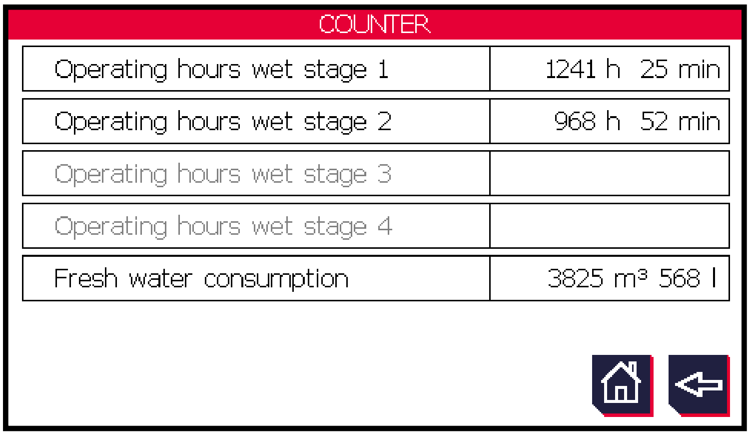


5.4 Counter

For precise recording of operating and usage data, there is an overview of the installed usage and operating hour counters in this display, including the current values. This menu is not password protected and is therefore freely accessible.

A counter reset is reserved for the manufacturer and is only possible in Device settings → Additional functions → “Counter reset”. *See also chapter* 4.6.2 “*Reset”.*

Image 72



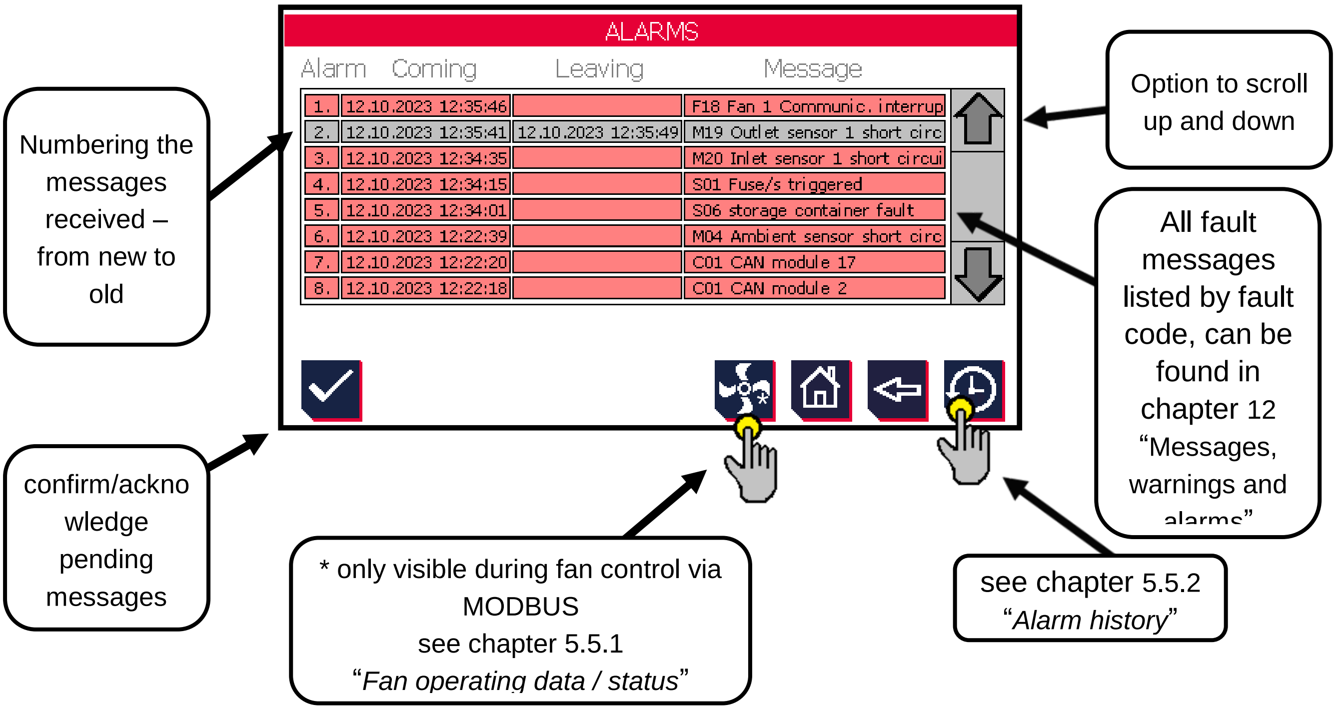
All greyed-out displays are inactive and are not used.

5.5 Alarms

Notifications of an incorrect operating condition (warning/alarm) are shown in the display. This is done directly on the start screen under the thermofin® logo in a red-green flashing window (see chapter 2.3.1 “*Start* screen”).

All messages are saved. This means that, after correction of the fault or after a fault has been reset automatically, the display does not delete itself. Selecting the fault message window (flashing red-green) or going through Main menu -> Alarms brings the user to the list of current notifications.

Image 73



The already resolved warnings (in grey) can be acknowledged with the button or an “external reset” (see chapter 0 “
Digital IN basic device
”) and removed from the list. The user can also use this button to confirm the warnings with a red background (still active) as registered. This does not correct the fault, it only switches off the blinking display on the start screen and reactivates output 1 (DO 1) when the warning is acknowledged.

➔ New value and first value notification

The warning signal output (Digital Output 1) is an output with a new value and first value notification. In OK status, if there is no fault, the output is switched off. If a fault occurs at the TCS.2, the TCS.2 signals this by switching off output 1.

Service or monitoring personnel on site can read this fault on the TCS.2 display and acknowledge it by pressing the button.

This switches on output 1 again and another fault can be sent via it without the first cause of the fault having to be eliminated first.

A first minor fault does not prevent a further, possibly critical, fault message from occurring later.

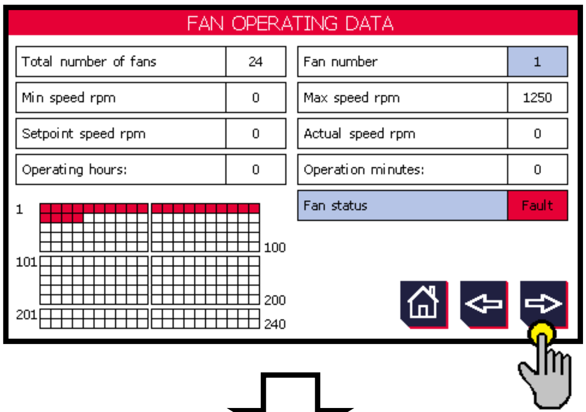
This acknowledgement can be done several times in a row without limitation. In addition, all individual faults are recorded in the alarm history in a fail-safe manner with the text, time and date (see chapter 5.5.2 "*Alarm history*").

The notifications via outputs 1 and 2 are independent of any existing connection of a control room to the TCS.2 via data bus.

5.5.1 Fan operating data / status

This function in the "Alarms" menu can only be selected if the installed fans are controlled via MODBUS and there is currently a fan fault. Only then do the electronics report all details in the windows below to the TCS.2.

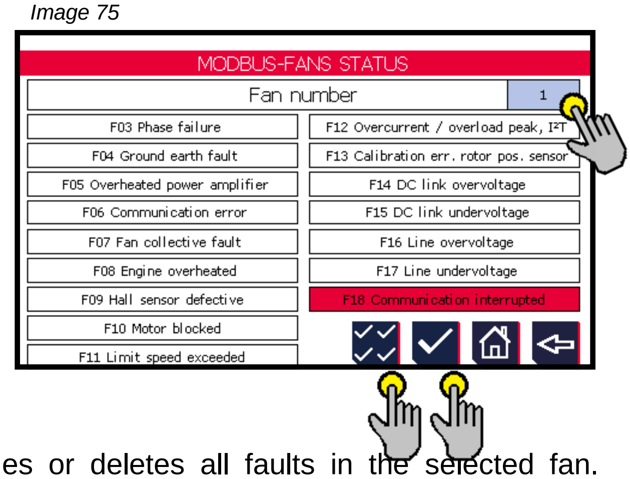
Image 74



This window gives a general overview of the fan operating data.

All faulty fans are indicated with a red box in the lower left of the window. (White -> fan OK, red -> fan fault) In the example here, all 24 fans currently have a fault. A maximum of 240 fans can be displayed.

Image 75



The detailed cause of the fan fault and the associated fault code can be read one level lower.

In the example here, F18 with a red background

To display the status of the faulty fan, the corresponding number must be entered in the top right. (see Image 66)

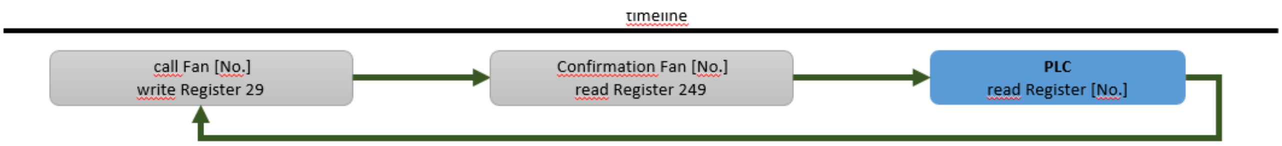
Selecting the "Confirm" button acknowledges or deletes all faults in the selected fan. Selecting the "Confirm all" button resets the faults of all fans.

The list of all fault codes, their meaning and the possibilities for correction are described in chapter 12 “Messages, warnings and alarms”.

The following status messages are output via bus:

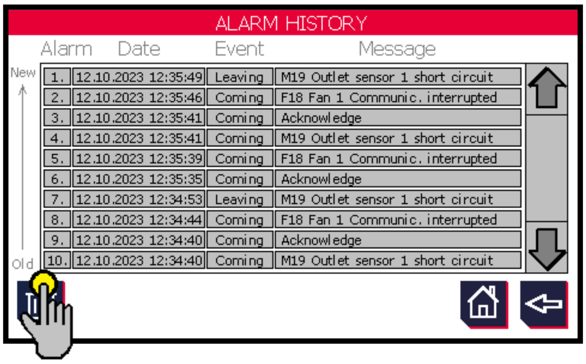
Register	Bit	Designation	Meaning	Register value
29	-	Fan number	Call up fan number for status query in (register 130)	write
126	**-**	Feedback fan number	Fan number currently called up	read
127	**-**	Fan speed	Current speed of fan from (register 126)	read
128	**-**	Operating minutes fan	Current runtime of the fan (register 126) in minutes	Read 0-59 min
129	**-**	Operating hours fan	Current runtime of the fan (register 126) in hours	Read 0-65535 h
130	**0**	F03 Phase failure	See chapter 12.2	Read 1
130	**2**	F05 Output stage overheated	See chapter 12.2	Read 4
130	**3**	F06 Communication error	See chapter 12.2	Read 8
130	**4**	F07 Fan combined fault	See chapter 12.2	Read 16
130	**5**	F08 Motor overheated	See chapter 12.2	Read 32
130	**6**	F09 Hall sensor faulty	See chapter 12.2	Read 64
130	**7**	F10 Motor blocked	See chapter 12.2	Read 128
130	**8**	F11 Limit speed exceeded	See chapter 12.2	Read 256
130	**10**	F13 Calibration error rotor position sensor	See chapter 12.2	Read 1024
130	**12**	F14 Link undervoltage	See chapter 12.2	Read 4096
130	**15**	F18 Communication interrupted	See chapter 12.2	Read 32768

<u>Progress over time fan status query:</u>



5.5.2 Alarm history

Image 76



All messages and exceptional operating cases are recorded in the “Alarm history” sub-menu.

The newest entry is at the top. All messages in the protocol are saved with the fault code, text, date and time. Selecting the “Up” and “Down” arrows allows the user to go through all entries.

The list saves 200 entries at a time. If the lists are filled with 200 entries, the oldest entry is deleted when a new entry is written. The entries in these protocol lists can be deleted with this button. However, this function requires the manufacturer's password and is  therefore reserved for the manufacturer.

5.6 Delete PW (password) entry

If a user enters a password, it will remain active for 30 minutes after the screen was last touched. Once this time has run out, the password entry is automatically deleted and the control returns to the start screen. If the user now wants to carry out further protected device settings, the necessary password for this (see chapter 2.4 “*Passwords”)* must be entered again.

If the operator wishes to delete the password immediately for security reasons, for example, because they have completed the commissioning, they can do this using the button in the main menu (delete PW entry).

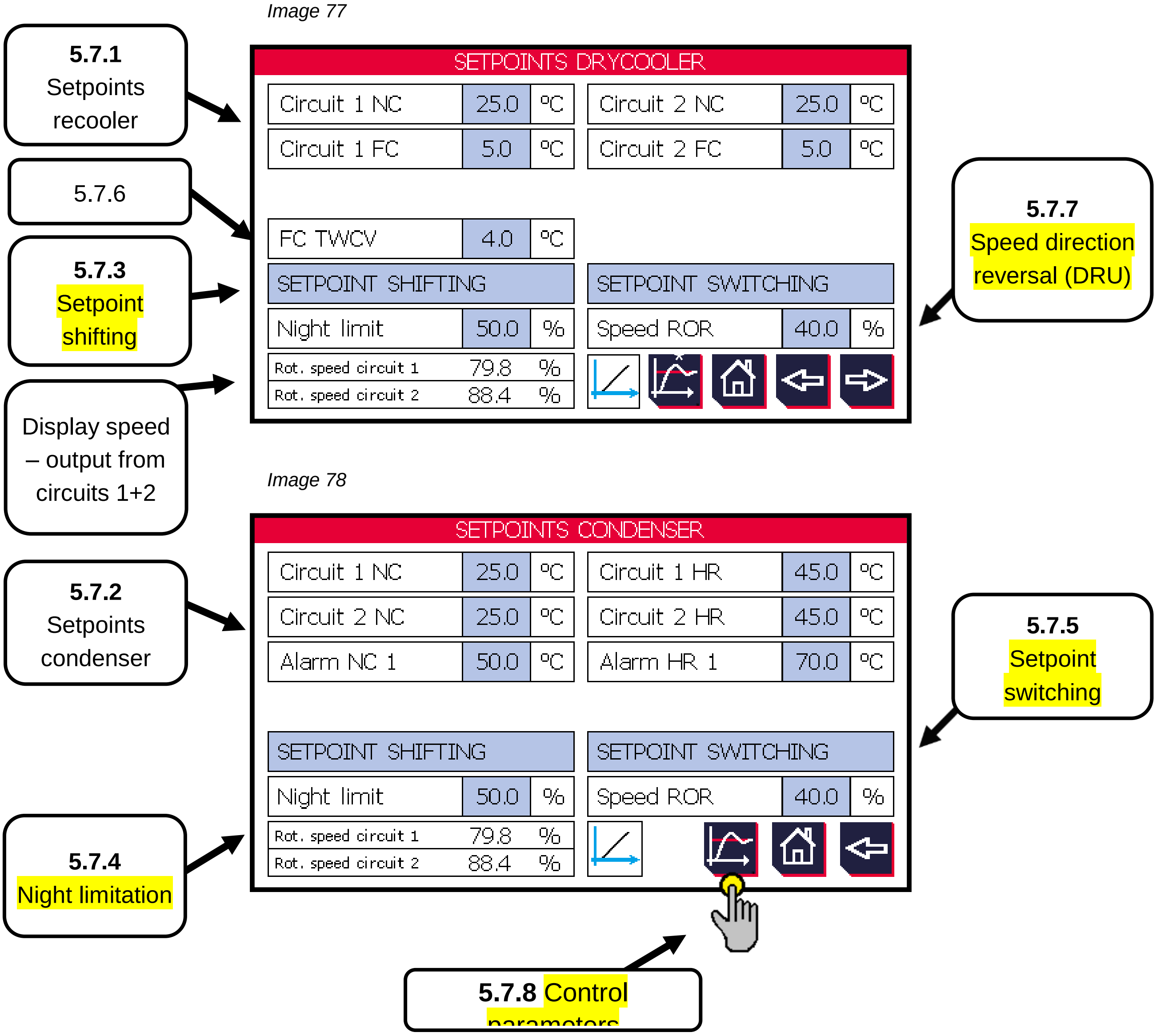
5.7 Setpoints

Depending on the heating system selected in Device settings (see chapter 4.1.1 "*Selection of heat system* / explanation of terms"), the user can view and edit all relevant setpoints on this page. See Image 77 and Image 78. As an example, a single circuit recooler and a dual circuit condenser are shown. All white boxes are dieplays and blue boxes can be operated or adjusted. All text shown in grey are possible functions that have not been activated in Device settings -> Control (see chapter 4.2 "*Control*") or by the selected heating system.

For a more detailed description of the individual areas, see the following chapter:

Image 77

Image 78



5.7.1 Setpoints recooler

Setpoints and alarm values for “NC” – normal cooling

Setpoint temperature* °C:	Editable from 0 ... 90 °C	Factory settings: 25 °C
Setpoint temperature* °F:	Editable from 30 ... 200 °F	Factory settings: 25 °F

Alarm Overtemperature* °C:	Editable from 20 ... 90 °C	Factory settings: 50 °C
Alarm Overtemperature* °F:	Editable from 70 ... 200 °F	Factory settings: 50 °F

* in the case of dual circuit devices, separately editable for circuit 1 and circuit 2

If setpoint switching is activated (see chapter 4.2.2 “*Control setpoint* switching”), the following setpoint will be active:

Setpoints and alarm values for “FC” – free cooling[1]

[1] If the external temperature falls below the external temperature, the cooling can take place without the use of the cooling unit.

Setpoint temperature* °C:	Editable from 0 ... 90 °C	Factory settings: 5 °C
Setpoint temperature* °F:	Editable from 30 ... 200 °F	Factory settings: 5 °F

Alarm Overtemperature* °C:	Editable from 5 ... 90 °C	Factory settings: 20 °C
Alarm Overtemperature* °F:	Editable from 40 ... 200 °F	Factory settings: 20 °F

* in the case of dual circuit devices, separately editable for circuit 1 and circuit 2

Setpoints for “WP” – Wärmepumpenbetrieb [heat pump operation]

Setpoint temperature* °C:	Editable from 0 ... 90 °C	Factory settings: 15 °C
Setpoint temperature* °F:	Editable from -35 ... 200 °F	Factory settings: 15 °F

* in the case of dual circuit devices, separately editable for circuit 1 and circuit 2

5.7.2 Setpoints condenser

Setpoints and alarm values for “NC” – normal cooling

Setpoint temperature* °C:	Editable from 0 ... 90 °C	Factory settings: 25 °C
Setpoint temperature* °F:	Editable from 30 ... 200 °F	Factory settings: 25 °F

* in the case of dual circuit devices, separately editable for circuit 1 and circuit 2

Alarm Overtemperature** °C:	Editable from 20 ... 90 °C	Factory settings: 50 °C
Alarm Overtemperature** °F:	Editable from 70 ... 200 °F	Factory settings: 50 °F

** editable alarm value applies equally to circuit 1 and 2

If setpoint switching is activated (see chapter 4.2.2 “*Control setpoint* switching”), the following setpoint will be active:

Setpoints and alarm values for “HR” – heat recovery[2]

[2] system operates at a significantly higher condensing temperature, e.g. for domestic water heating. The coolant is mainly heated in an upstream heat exchanger, and must not then be overly cooled down in the consdenser.

Setpoint temperature* °C:	Editable from 0 … 90°C	Factory settings: 45 °C
Setpoint temperature* °F:	Editable from 30 … 200 °F	Factory settings: 45 °F

* in the case of dual circuit devices, separately editable for circuit 1 and circuit 2

Alarm Overtemperature** °C:	Editable from 30 ... 90 °C	Factory settings: 20 °C
Alarm Overtemperature** °F:	Editable from 90 ... 200 °F	Factory settings: 20 °F

** editable alarm value applies equally to circuit 1 and 2

Setpoints for “WP” – Wärmepumpenbetrieb [heat pump operation]

Setpoint temperature* °C:	Editable from 0 ... 90 °C	Factory settings: 15 °C
Setpoint temperature* °F:	Editable from -35 ... 200 °F	Factory settings: 15 °F

5.7.3 Setpoint shifting

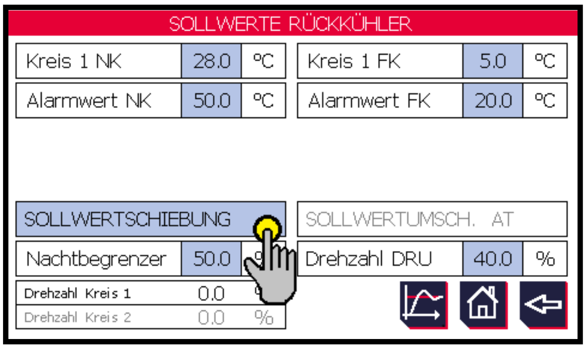
The operator often wants to adjust the condensing pressure or the outlet pressure to certain operating conditions. The TCS.2 offers three control options. These are explained in detail below. The selection is made in Device settings -> Control (see chapter 4.2.4 “*Control setpoint* shifting”).

A) Setpoint shifting via external standard signal

The setpoint shifting can be done via analog signal on the AI-3 input for circuit 1 or AI-4 for circuit 2 (see also chapter 4.3.3 “*Analog IN basic* device”).

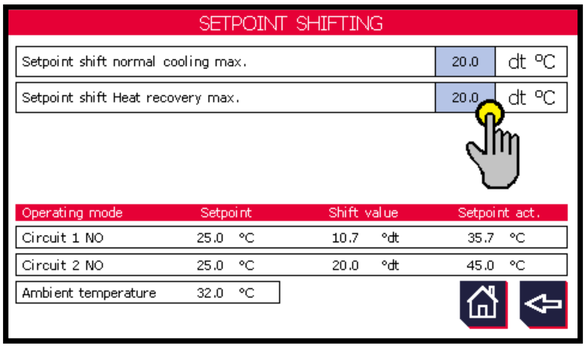
The following standard signals are possible: 0-10 V, 2-10 V, 0-20 mA, 4-20 mA

Image 79



This function is activated in Device settings -> Control (see chapter 4.2.4 “*Control setpoint* shifting”). As soon as a type of control has been selected, the “Setpoint shifting” button in the “Setpoints” menu will have a blue background and can be pressed. The user reaches the following setting window: Image 79.

Image 80



The value edited here will be added to the setpoint with 100 % analog signal. Depending on whether a condenser (as shown here in Image 80) or a recooler was chosen as a heating system, both setpoints (NC – normal cooling + FC – free cooling or HR – heat recovery) have a single value for the maximum setpoint shifting. Both setpoints react to a single analog input (AI-3 with circuit 1 and AI-4 with circuit 2).

<u>“Setpoint”:</u> set temperature setpoint (25°C)

<u>“Shifting value”:</u> Corresponds to the value of the analog input (0-100 %) of the maximum set shifting value (in example Image 80 dt 20°C).

<u>“Setpoint cur.”:</u> Addition of setpoint and shifting value
Circuit 1: (25 + 10.7 °C = 35.7 °C) → analog input 3 (0-10 V) 5.3 V ≙ 10.7 °C
Circuit 2: (25 + 20°C = 45°C) → analog input 4 (0-10 V) 10 V ≙ 20.0°C

<u>Adjustable parameters:</u>

	Can be edited from ... to	Factory settings
Setpoint shifting NC – normal cooling max.	0 ... 50.0°C	20.0 °C
	0 ... 70.0 °F	20.0 °F
Setpoint shifting FC – free cooling max.	0 ... 20.0 °C	10.0 °C
	0 ... 40.0 °F	10.0 °F
Setpoint shifting HR – heat recovery max.	0 ... 50.0°C	20.0 °C
	0 ... 70.0 °F	20.0 °F

B) Setpoint shifting via external temperature

A further option is setpoint shifting via external air temperature. An external air temperature sensor is necessary for this. The temperature sensor TTS-90 is used as a sensor (see chapter 6.3.1 “*Temperature sensors TTS*” in the device manual).

This function is restricted to the setpoint for “normal cooling” (NC). It is not possible to adjust the setpoint for free cooling and heat recovery. Other than this, circuit 1 and 2 are treated the same. The shifting value acts the same on both circuits (see Image 82).

This function is activated in Device settings -> Control (see chapter 4.2.4 "*Control setpoint* shifting"). If "via AT" has been selected, the "Setpoint shifting" button in the "Setpoints" menu will have a blue background and can be pressed. The user reaches the following setting window: (Image 81)

Image 81

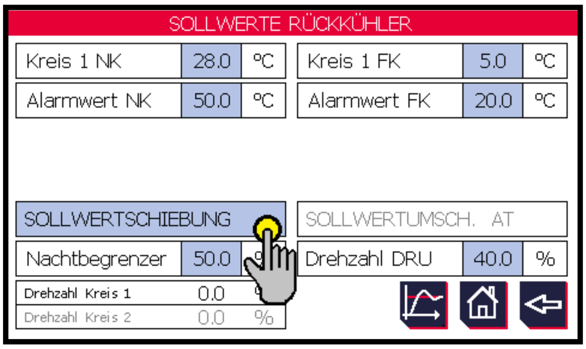
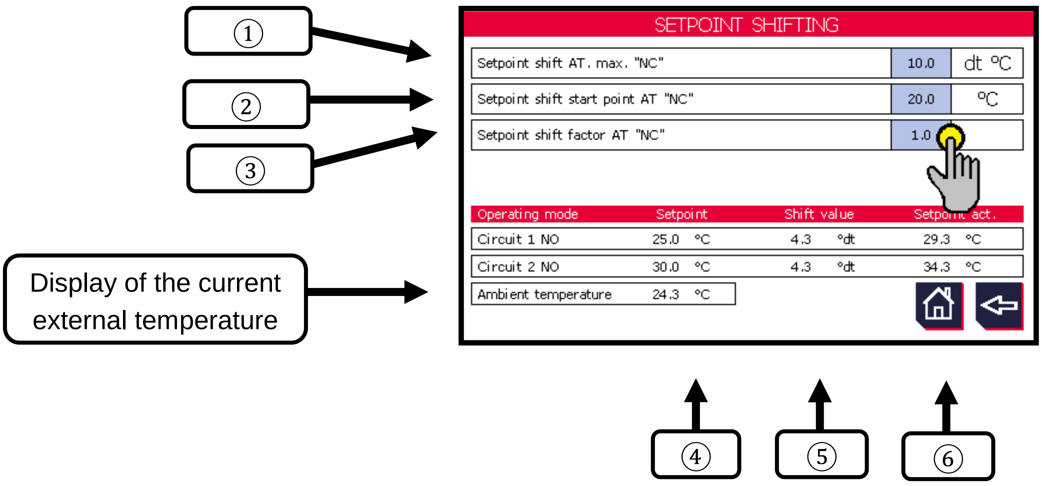


Image 82



① "Setpoint shifting external temperature max":

The value edited here will be added to the setpoint with a rising external temperature. The amount that the external temperature must rise for this maximum value depends on shifting value ③.

② "Setpoint shifting start point external temperature":

External temperature value at which the setpoint shift starts. Below this temperature, the setpoint remains unchanged.

③ "Setpoitn shifting factor external temperature":

The shifting factor quantifies the shifting effect per Kelvin of change in external air temperature. At a factor of 1.0, the setpoint is shifted by 1K with an external temperature increase of 1K.

④ "Setpoint":

Set temperature setpoint of circuit 1 (25°C) and circuit 2 (30°C)

⑤ "Shifting value":

Difference between the current external temperature and ② “setpoint shifting start point external temperature”

⑥ “Setpoint cur.”:
Addition of ④ setpoint and ⑤ shifting value

Circuit 1: (25.0 + 4.3°C = 29.3°C)
→ Start point shifting ② is at 20°C
→ Current external temperature: 24.3 °C
→ corresponds to a difference of 4.3°C to the start point.
→ with a shifting factor ③ of 1.0°C per Kelvin AT, the setpoint increases by 4.3°C (⑤) to 29.3°C

Circuit 2: (30.0 + 4.3°C = 34.3 °C)
→ Start point shifting ② is at 20°C
→ Current external temperature: 24.3 °C
→ corresponds to a difference of 4.3°C to the start point.
→ with a shifting factor ③ of 1.0°C per Kelvin AT, the setpoint increases by 4.3°C (⑤) to 34.3 °C

With setpoint shifting via the external air temperature, it must be ensured that it is only shifted upwards. The setpoint without the shifting signal influence is set to the lowest permissible value of the system. As long as this value is not listed in the system documentation, this information can be supplied either by the responsible cooling system manufacturer or the responsible engineering firm.

Adjustable parameters:

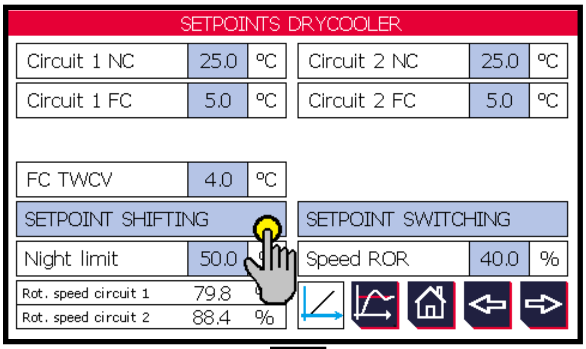
	Can be edited from ... to	Factory settings
Setpoint shifting external temperature max.	0 ... 50.0°C	10.0 °C
	0 ... 70.0 °F	20.0 °F
Setpoint shifting start point external temperature.	0 ... 50.0°C	25.0 °C
	30 ... 120.0 °F	10.0 °F
Setpoint shifting factor external temperature max.	0.5 ... 2.0 K_{SW}/K_{AT}	1.0 K_{SW}/K_{AT}

C) Setpoint shifting via bus

Similarly to setpoint shifting via a standard signal → (see A), control via bus is also possible.

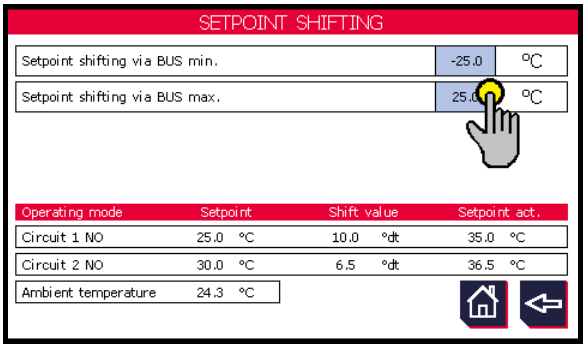
The type of communication bus is set in *Device settings → GLT bus system* (see also chapter 0). Contrary to the setpoint shifting via the external temperature, the setpoint can be shifted up and down via bus.

Image 83



This function is activated in Device settings -> Control (see chapter 4.2.4 "*Control setpoint* shifting"). If "via BUS" has been selected, the "Setpoint shifting" button in the "Setpoints" menu will have a blue background and can be pressed. The user reaches the following setting window: (Image 83)

Image 84



With these two values, the user provides lower and upper limitson the possible shifting. Depending on the requested setpoint (NC – normal cooling + FC – free cooling or HR – heat recovery), both setpoints react to the same shifting value from the bus.

The written value from the bus (divided by 10) is added to the setpoint. In the example here Image 84, Register 4 (SWS circuit 1) has a 100 ≙ 10.0°C, and register 5 (circuit 2) has a 65 ≙ 6.5°C.

With direct communication via MODBUS, the following setting values and limitations apply (same for circuit 1 + circuit 2:

Circuit	Register	Register value (signed integer)	Converted to °C/°F
1	**4** "Setpoint shifting circuit 1"	-250 ... 250	-25.0 ... 25.0 °C
		-450 ... 450	-45.0 ... 45.0°F
2	**5** "Setpoint shifting circuit 2"	-250 ... 250	-25.0 ... 25.0 °C
		-450 ... 450	-45.0 ... 45.0°F

5.7.4 Night limitation

With this function, the control variable of the fans (fan output) is restricted to a maximum value. The goal is to reduce the noises during quiet times, especially during the night and on Sundays and public holidays. The following 3 control options are available to the user:

In principle, the percentage limit of the speed output can also be sent via the bus (adjustment from 40...100 %). This applies to all three types of control. The value entered in the menu is always the upper limit here. Consequently, as can be seen in the example in Image 85, a value of 40 ... 50 % can be sent via the bus. If the sent value is outside of the permitted range, the user receives a message “values outside of the permitted range”. If the register remains unwritten (register value: 0), there is no error message either.

Register	Register value (INT)	Night limitation in %
13 “Maximum speed night”	400 ... 1000*	40.0 ... 100.0 %*

* A maximum register value of 1000 (≙ 100 %) is possible if the value set in the “Setpoints” menu is also at 100 %. If this value is lower, this represents the upper limit for the value sent via the bus (see Image 85).

A) Night limitation via terminal

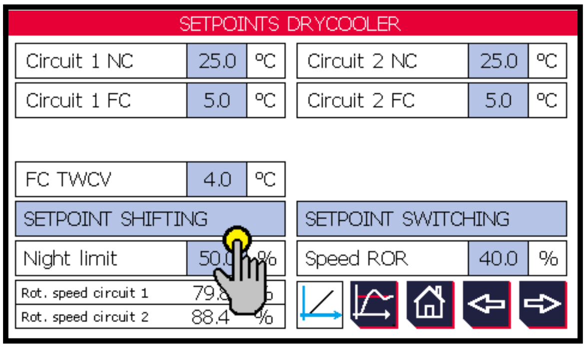
Two steps are necessary to activate the function “Night limitation via terminal”:

- ➔ The digital input DI-3 must be configured to “Night limitation” (see also chapter 4.3.1 “Digital IN basic device”.
- ➔ The type of control, see Device settings -> Control (see chapter 4.2.3 “*Night limit* control*”),* must be set to “via terminal”. Subsequently, the percentage of the night limitation has a blue background in the Setpoints menu and can therefore be pressed (Image 81).

The speed is now limited to the percentage set here with a “high” signal of the corresponding digital input. (related to the max. speed)

<u>Editable</u>: from 40 % to 100 %

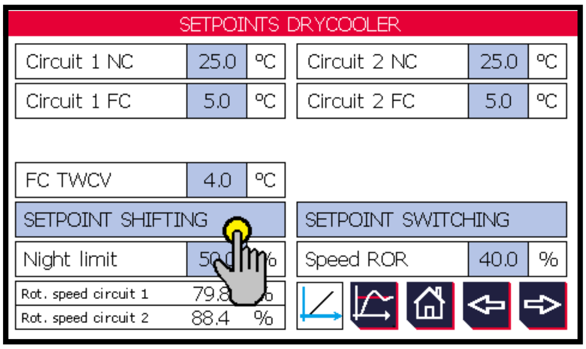
<u>Factory settings</u>: 50 %



B) Night limitation via bus

This function is activated in Device settings -> Control (see chapter 4.2.3 “*Night limit* control”). As soon as “via bus” is selected, the percentage of the night limitation in the Setpoints menu has a blue background and can be pressed (Image 81).

Image 86



The speed is limited to the percentage set here when setting the corresponding bit (see table below). (related to the max. speed)

Editable: from 40 % to 100 %

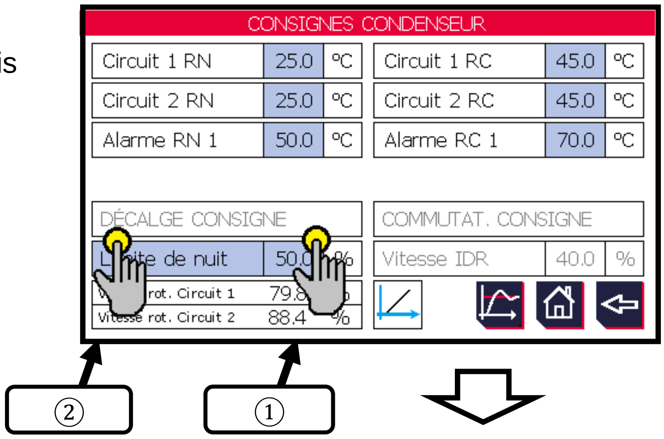
Factory settings: 50 %

Register	Bit	Meaning	Register value
1 “Night limitation”	**2**	TRUE = Night limitation active	4

C) Night limitation via internal clock

This function is activated in Device settings -> Control (see chapter 4.2.3 “*Night limit* control”). As soon as “via internal clock” is selected, the “Night limitation” box and the percentage value in the “Setpoints menu have a blue background and can be pressed (Image 81).

Image 87

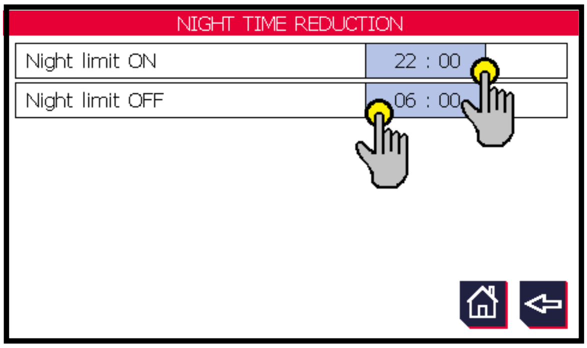


① During the time set in (②), the speed is limited to the percentage set here. (related to the max. speed)

Editable: from 40 % to 100 %

Factory settings: 50 %

Image 88



② If the “Night limitation” button is pressed, the following window opens. See Image 88. The switch-on and switch-off time for the night limitation can be adjusted here.

Can be edited from …to:
Night limitation ON: 6 PM - 11 PM
Night limitation OFF: 1 AM - 10 AM

Factory settings:
Night limitation ON: 10 PM
Night limitation OFF: 6 AM

5.7.5 Setpoint switching circuit 1 / 2

This function allows switching between two fixed setpoints for the controller. The TCS.2 offers three control options for this. Depending on whether a condenser (as shown here in Image 89) or a recooler was chosen as a heating system, switching from NC – normal cooling to FC – free cooling or HR – heat recovery) is possible.

A) Setpoint switching via terminal

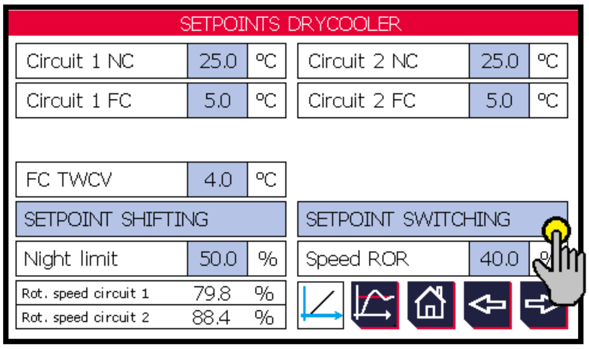
Two steps are necessary to activate the function “Setpoint switching via terminal”:

- ➔ The digital input DI-2 must be configured to “Setpoint switching”. See also 4.3.1 “Digital IN basic device”.
- ➔ The type of control, see Device settings -> Control (see chapter 4.2.2 “*Control setpoint* switching*”),* must be set to “via terminal”.

B) Setpoint shifting via AT (external temperature)

A corresponding external temperature must be installed and configured.

Image 89



This function is activated in Device settings -> Control (see chap. 4.2.2 “*Control setpoint* switching”). If “via AT” has been selected, the “Setpoint shifting AT button in the “Setpoints” menu will have a blue background and can be pressed (see Image 89).

NC → FC/HR:
If the external temperature of the value edited here is reached or fallen below, the NC (normal cooling) setpoint switches to FC (free cooling) or HR (heat recovery with condensers).

Editable: from 0.0 … 30.0°C

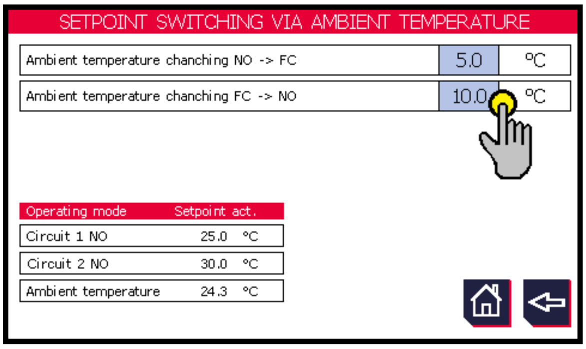
Factory settings: 5 °C

FC/HR → NC:
If the external temperature of the value edited here is reached or exceeded, the FC (free cooling) or HR (heat recovery) setpoint switches to NC (normal cooling).

Editable: from 6.0 … 50.0°C

Factory settings: 10 °C

Image 90



C) Setpoint switching via bus

This function is activated in Device settings -> Control (see chapter 4.2.2 "*Control setpoint* switching").

- → Select control "via bus"
- → If the corresponding bit via bus is set to "true" (see table), the setpoint switches from NC (normal cooling) to FC (free cooling) or HR (heat recovery with condensers).
- → The following parameters exist for direct communication via BUS:

Register	Bit	Designation	Meaning	Register value
1	**2**	Setpoint switching	TRUE = Request setpoint switching	Write 2
164	**0**	Normal cooling NC active	TRUE = Normal cooling NC active	Read 1
	1	Free cooling FC active	TRUE = Free cooling FC active	Read 2
	2	Heat recov. HR active	TRUE = Heat recovery HR active	Read 4

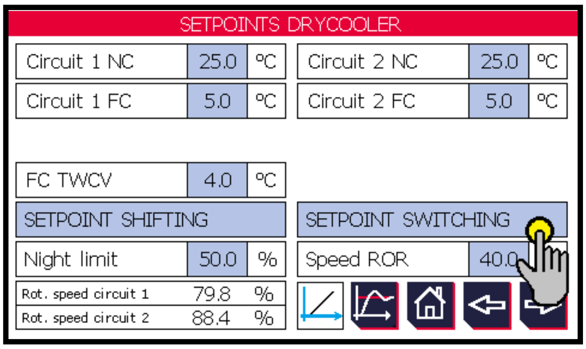
D) Setpoint switching via dT, AT-ET

This function is activated in Device settings -> Control (see chapter 4.2.2 "*Control setpoint* switching").

➔ Select control "via dT, AT-ET"

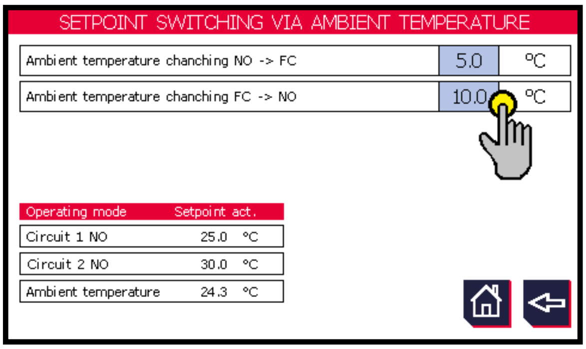
A corresponding external temperature and an inlet temperature must be installed and configured. See also chapter 4.3.3 "Analog IN basic device".

Image 91



This function is activated in Device settings -> Control (see chapter 4.2.2 "*Control setpoint* switching"). If "via dT, AT-ET" has been selected, the "Setpoint shifting dT, AT-ET" button in the "Setpoints" menu will have a blue background and can be pressed (see Image 91).

Image 92



NC → FC/HR:
If the temperature difference between the external and inlet temperature of the value edited here is reached or fallen below, the NC (normal cooling) setpoint switches to FC (free cooling) or HR (heat recovery with condensers).

<u>Differential temperature free cooling ON</u>
<u>Editable</u>: from -20.0 … -2.0 °C

<u>Factory settings</u>: -5.0 °C

FC/HR → NC:
If the temperature difference between the external and inlet temperature of the value edited here is reached or exceeded, the FC (free cooling) or HR (heat recovery) setpoint switches to NC (normal cooling).

<u>Differential temperature free cooling OFF</u>
<u>Editable</u>: from -4.0 … -1.0 °C

<u>Factory settings</u>: -1.0 °C

5.7.6 Setpoint FC TWCV (free cooler three-way control valve)

Setpoint for the desired return temperature after the control valve (mixer). See also chapter 5.8.4 C) “Variant three-way control valve”. Serves as frost protection function for downstream plate heat exchangers.

Editable: from 0.0 … 4.0 °C

Factory settings: 4.0 °C

5.7.7 Speed direction reversal (DRU)

After the “Reverse direction of rotation” request, the direction of rotation of the fans is changed to the percentage value set here (related to the max. speed). Depending on the preselection in Device settings → Fans (see also chapter 4.4.2 “*Fan* direction”), the fan direction switches from right to left or in reverse. The following control options are available to the user: (See also chapter 4.2.9 “*Control reversal* of the direction of rotation”)

A) Reverse direction of rotation via terminal

Two steps are necessary to activate the function “Reverse direction of rotation via terminal”:

➔ One of the following digital inputs must be configured to “Reverse direction of rotation”. DI-5, DI-7 and DI-8. See also chapter 4.3.1 “Digital IN basic device”.

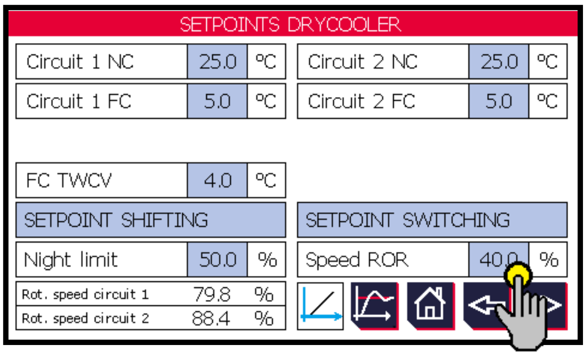
➔ The type of control, see Device settings -> Control (see chapter 4.2.9 “*Control* reversal of the direction of rotation*”),* must be set to “via terminal”.

After the steps above have been carried out, the value “Reverse direction of rotation RDR” in the “Setpoints” menu is given a blue background and can be freely edited. See Image 93.

Editable: from 0.0 … 30.0°C

Factory settings: 100 %

Image 93



B) Reverse direction of rotation via bus

The following steps are necessary to activate the function “Reverse direction of rotation via bus”:

➔ Select control “via bus”. Device settings -> Control (see chapter 4.2.9 “*Control* reversal of the direction of rotation*”)*

➔ If the corresponding bit via bus is set to “true” (see table), the setpoint switches from NC (normal cooling) to FC (free cooling) or HR (heat recovery with condensers).

Register	Bit	Designation	Meaning	Register value
1	**15**	Reverse direction of rotation	TRUE = Request reverse direction of rotation	Write 32768
143	**8**	Reverse direction of rotation Feedback	TRUE = Reverse direction of rotation active	Read 256

5.7.8 Control parameters

If needed, the parameters of the thermofin® PI controller can be adapted. In addition to the existing setpoint (see chapter 5.7 “*Setpoints*”), to which the system is to be adjusted, two other important parameters are necessary. This is a proportional factor “Kp” and the reset time “Tn”. These two parameters, along with the speed and precision, are responsible for the stability of the desired control process.

A) Reset time “Tn”

If the factory settings for these parameters do not correspond to a controlled process, this may result in the system being controlled too slowly. This can result in the delayed condenser pressure control leading to an impermissible pressure increase in the system. This condition can lead to the system switching off automatically via the corresponding high pressure safety equipment. This cause can normally be corrected by reducing the excessive reset time “Tn”.

The controller can also react too sensitively or too quickly, so that the system is always oscillating around the setpoint with the condensing pressure or the outlet temperature. As the system does not find a constant operating point and the fan speed constantly varies, the thermal contacts of the fan drives may protect the fans from overheating by switching them off, possibly also causing a fault. If no constant operating point is set, the reset time “Tn” is often set too short and must be extended by appropriate readjustment.

B) Proportional factor “Kp”

The proportional factor “Kp” also influences the stability conditions of a controller. The greater the amplification, the more sensitive the controller becomes, and the system may tend to oscillate. The smaller the amplification, the more sluggish the controller will become. However, this is not a sluggishness caused by a time constant of the controller. The apparent sluggishness is related to the control gain.

The value of the control deviation (deviation of the actual value from the setpoint) is determined and multiplied by the control gain. The result is the control variable, which determines the speed of the fans. The greater the control gain, the greater the control signal (control variable) per unit of control deviation. This effect therefore makes the control process appear faster or slower, as the actual value changes do not occur immediately but are delayed due to the system. The PI and P controller both work with the “Kp value”, which is why the aforementioned behaviour can be observed with both control modules.

At a “Kp value” that is too low, the control process can last too long. If this occurs, the “Kp value” must be increased. With pure P controllers with a too low “Kp value” the permanent control deviation can be too large. In this case, the “Kp value” should also be increased. If the “Kp value” is set too high, the controller usually reacts too strongly and brings the system into oscillation. In these cases, the “Kp value” should be reduced.

C) Setting aids

At this point, a simple and sufficiently precise procedure is explained, which enables the technician to determine the parameters for a properly functioning controlled system during operation.

It should be constantly monitored to see whether the changes made improve or worsen the control process.
If improvements have been made, the values can be further adapted in small steps in the same direction.
If the controlled process worsens, the last step can be reversed and the values changed in the opposite direction.

Steps to set Kp:

- ➔ To simplify adjustment, the reset time “Tn” is switched off by setting it to the value “0”.
- ➔ With dual circuit devices, set both “Kp values” the same. Now both controllers work as pure P controllers with the same parameters.
- ➔ Increase the “Kp value(s)” until the system becomes unstable and tends to oscillate.
- ➔ Once this value has been determined, the “Kp values are taken back a little so that the controlled system works stably. This is the optimal (adjusted) proportional factor for the system.

After the determination and setting of the proportional factor, the reset time “Tn” is determined.

Steps to set Tn:

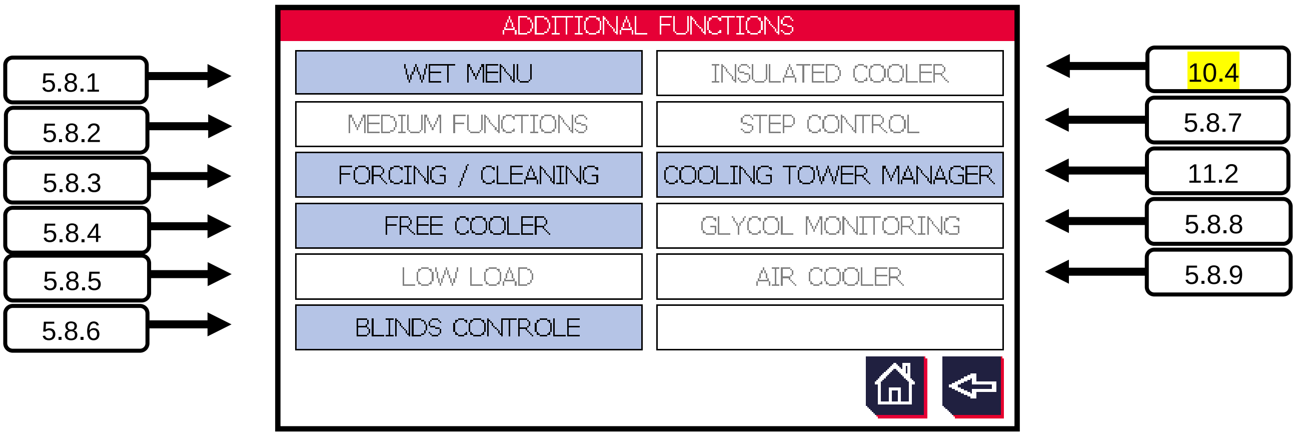
- ➔ Switch off cooling system.
- ➔ Set the “Tn” value to approx. 60 seconds.
- ➔ Switch on the cooling system again after a few minutes and monitor the behaviour of the controller or the fans.
- ➔ If the pressure or temperature increases quicker than the controller starts up the fans, then “Tn” is too high. Reduce this value accordingly.
- ➔ If the fans start up quicker than the pressure or temperature increases, then “Tn” is too small. The value must be increased.

Ideally, the speed of the control behaviour is precisely the speed at which the pressure or temperature changes. With a controller adjusted to its control system in this way, system oscillations are ruled out and the fastest possible reaction to changes in the cooling system is reached. The controller now works with the lowest control deviation and therefore ensures an optimal system operation.

5.8 Additional functions

Contrary to the standard, there are various functions and setting levels that are not listed in this sub-menu item. All non-activated functions in the Device settings are greyed out with a white background.

Image 94



5.8.1 Wetmenu

Depending on the selected heating system in: “Device settings” → “Heat exchanger system” is subdivided into three categories in the sub-menu “wet mode” The following list shows all available variants with the corresponding cross-references:

- **Wet menu for sprayed devices**
  (see chapter 6.4 “*Adjustments in Main menu* → *Additional functions* → Wet menu Spraying”)

- **Wet menu for devices with cooling mats (thermofin® Adiabatic Pads)**
  (*see chapter 7.3 “Adjustments in Main menu* → *Additional functions* → Wet menu mat*”)*

- **Wet menu hybrid cooler**
  (see chapter **9.2** “Adjustments in Main menu → Additional functions → Wet mode*”)*

- **Wet menu evaporators (cooling tower)**
  (see chapter 8.2 “Adjustments in Main menu → Additional functions → Wet menu evaporator*”)*

5.8.2 Medium functions

A) Medium valve

Application with air coolers or recoolers with a water/glycol mixture or flow-ice.

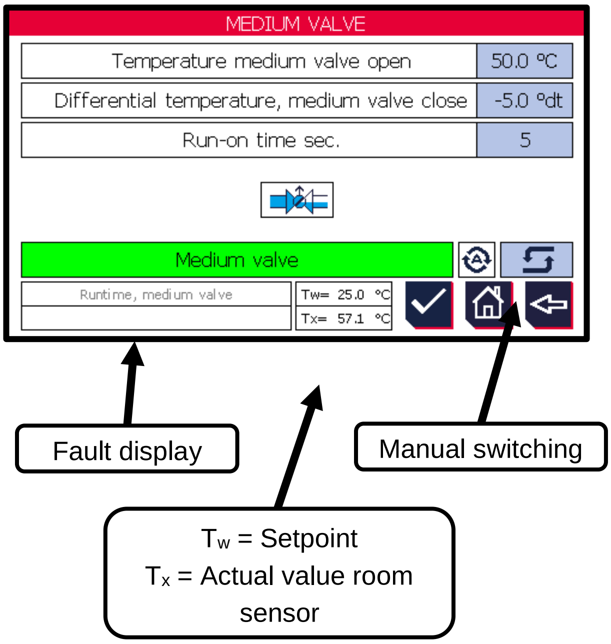
The “Medium functions” function is activated as follows:

Select Device settings → INPUTS/OUTPUTS → Digital IN → DI-6 → “RM medium valve” (see chapter 0)
Select Device settings → INPUTS/OUTPUTS → Digital OUT → DO-6 → “Medium valve” (see chapter 0)

If the medium valve is to be switched with the release of the cooler (DI-1), all subordinate parameters should be set to “0”. No further entry is necessary.

If a temperature sensor should switch the valve, this should be selected as follows:

Select Device settings → INPUTS/OUTPUTS → Analog IN → AI-1 → “Room sensor” (see chapter 4.3.3)



Temperature medium valve open
<u>Can be edited from …to</u>: -40.0 … 50.0 °C
<u>Factory settings:</u> 0.0 °C

Differential temperature medium valve closed
<u>Can be edited from …to</u>: -10.0 … 10.0 °C
<u>Factory settings</u>: 0.0 °C

Run-on time in seconds
<u>Can be edited from …to:</u> 0 … 1800 s
<u>Factory settings:</u> 600 s

Status display
Green → medium valve open

The following status messages are output via bus:

Register	Bit	Designation	Meaning	Register value
164	**13**	Medium valve open	TRUE = open	Read 8192
166	**11**	Medium valve, runtime error	TRUE = fault	Read 2048

B) Medium pump 1 / 2

Application with air coolers or recoolers with a water/glycol mixture or flow-ice. Used to convey the medium from cold-releasing or heat-releasing secondary circuit.

The “Medium functions” function is activated as follows:

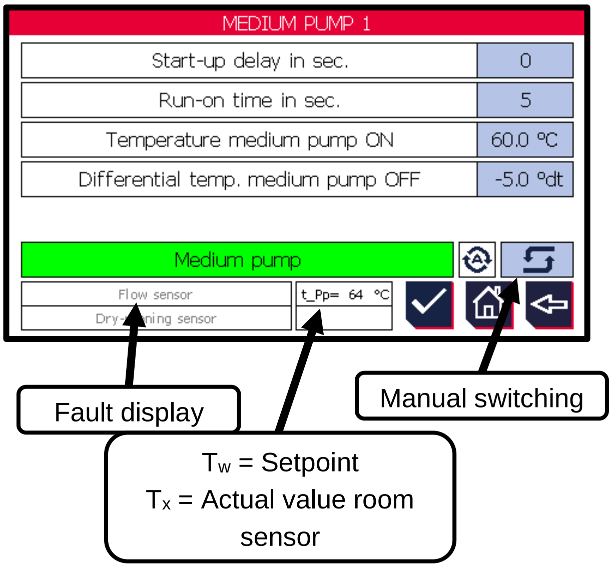
Select Device settings → INPUTS/OUTPUTS → Digital IN → DI-6 → “RM medium pump 1” (see chapter 0)

Select Device settings → INPUTS/OUTPUTS → Digital OUT → DO-6 → “Medium pump 1” (see chapter 0)

If the medium pump is to be switched with the release of the cooler (DI-1), all subordinate parameters should be set to “0”. No further entry is necessary.

If a temperature sensor should switch the pump, this should be selected as follows:

Select Device settings → INPUTS/OUTPUTS → Analog IN → AI-1 → “Room sensor” (see chapter 4.3.3)



Start-up delay in seconds
Can be edited from …to: 0 … 1800 s
Factory settings: 0 s

Run-on time in seconds
Can be edited from …to: 0 … 1800 s
Factory settings: 60 s

Temperature medium pump open
Can be edited from …to: -40.0 … 90.0 °C
Factory settings: 60.0 °C

Differential temperature medium pump closed
Can be edited from …to: -20.0 … 20.0 °C
Factory settings: -5.0 °C

Status display
Green → medium pump open

The following signals can be written and read out via bus:

Register	Bit	Designation	Meaning	Register value
2	**7**	Medium pump 1	TRUE = Pump ON	write 128

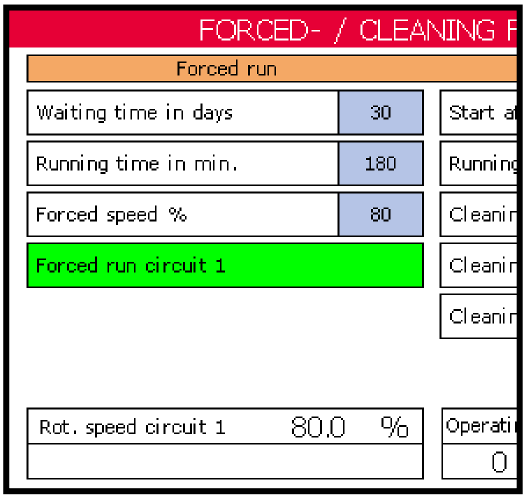
2	**8**	Medium pump 2	TRUE = Pump OFF	write 256
164	**8**	Medium pump 1 active	TRUE = active	Read 256
164	**8**	Medium pump 1 active	TRUE = active	Read 512
166	**4**	Fault medium pump 1	TRUE = fault	Read 16
166	**5**	Fault flow medium pump 1	TRUE = fault	Read 32
166	**6**	Fault medium pump 2	TRUE = fault	Read 64
166	**7**	Fault flow medium pump 2	TRUE = fault	Read 128

5.8.3 Forced and cleaning cycle

A) Forced cycle

The forced cycle function is used to maintain the running cycles required by the fan manufacturer during long downtimes.

The function “Forced cycle” is selected or deselected in Device settings → Control → Forced run. See also chapter 4.2.22.



Waiting time in days
Can be edited from …to: 1 … 45 days
Factory settings: 30 days

Runtime in minutes
Can be edited from …to: 15 … 360 min
Factory settings: 180 min

Forced speed
Can be edited from …to: 50… 100 %
Factory settings: 80 %

Status display
Green → forced cycle active

The following status messages are output via bus:

Register	Bit	Designation	Meaning	Register value

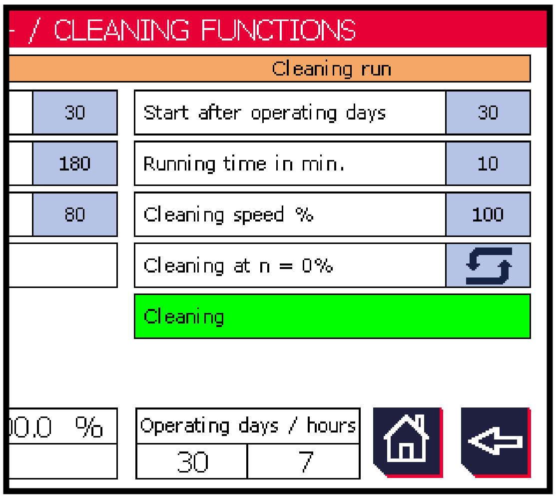
164	**14**	Forced cycle active	TRUE = active	read 16384

B) Cleaning cycle

The cleaning cycle starts the fans in the opposite direction after the parametrised number of operating days. The lamella pack is cleaned of sucked in particles (leaves, rubbish, ...).

The function “Cleaning cycle” is selected or deselected in Device settings → Control → Cleaning run. See also chapter 4.2.23.

The following parameters can be edited:



Start after operating days
<u>Can be edited from …to</u>: 1 … 150 days
<u>Factory settings</u>: 30 days

Runtime in minutes
<u>Can be edited from …to</u>: 0 … 10 min
<u>Factory settings</u>: 2 min

Cleaning speed
<u>Can be edited from …to</u>: 0… 100 %
<u>Factory settings</u>: 80/100%

Cleaning at n = 0%
After the time has elapsed, the controller output of the TCS must be at 0%. After this, a cleaning cycle starts.

Cleaning at n < 30%
After the time has elapsed, the controller output of the TCS must be at < 30%. After this, a cleaning cycle starts. With this variant, the cleaning speed is fixed at 100% to ensure sufficient cooling during the cleaning cycle.

Status display
Green → forced cycle active

If a cooling power from the respective device is requested during the cleaning cycle, and the speed - controller output is 0% / > 30%, the cleaning cycle is immediately interrupted and the regular operation is continued.
After reaching the parameter again (speed < 0% / < 30%), the cleaning mode is automatically started again. The operating hour counter is only reset after a completed cleaning cycle.

The following status messages are output via bus:

Register	Bit	Designation	Meaning	Register value
164	**15**	Cleaning cycle active	TRUE = active	read 32768

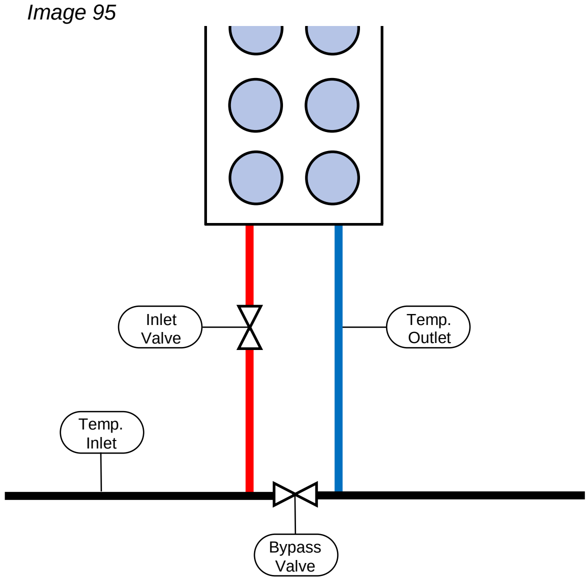
5.8.4 Free cooling valve

Free cooling valves are for controlling and regulating the refrigerant carrier in the heat-releasing **secondary circuit**.

The following variants of free cooling valves can be controlled.

A) Variant bypass and inlet valve

Image 95



- ➔ Free cooling **bypass valve** and free cooling **inlet valve** (see Image 95)
- ➔ Both valves are actuated via the **setpoint shifting** or bus

	Valve statuses	
Setpoint		

➔ The following parameters exist for direct communication via MODBUS:

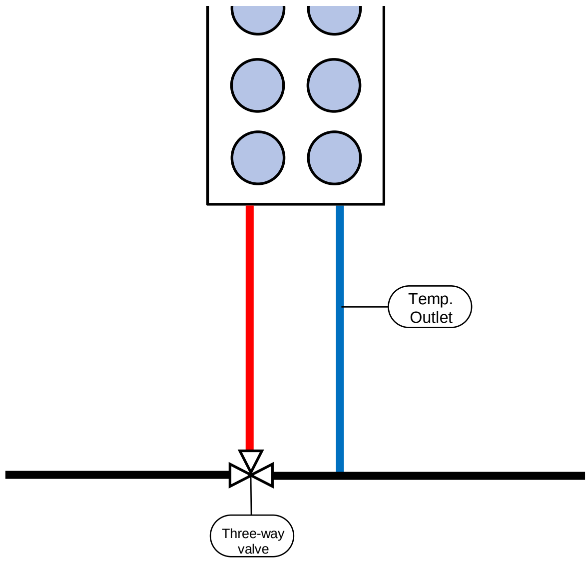
Register	Bit	Designation	Meaning	Register value
1	**4**	Free cooling operation	TRUE = Free cooling operation activated (bypass closed, inlet valve open, three-way valve actuated)	Write 8
164	**10**	Bypass valve	TRUE = Bypass valve open	Read 1024
	11	Inlet valve	TRUE = Inlet valve open	Read 2048

B) Variant three-way valve

Image 96

➔ Free cooling **three-way** valve (see Image 96)

➔ The three-way valve is actuated via the **setpoint shifting** or bus



	Valve statuses	
Setpoint		

➔ The following parameters exist for direct communication via MODBUS:

Register	Bit	Designation	Meaning	Register value
1	**4**	Free cooling operation	TRUE = Free cooling operation activated (bypass closed, inlet valve open, three-way valve actuated)	Write 8

164	**10**	Bypass valve	TRUE = Bypass valve open	Read 1024
	11	Inlet valve	TRUE = Inlet valve open	Read 2048

The free cooling operation when controlling via bus (see chapter 4.2.12 “Control free cooler valve”) is switched via the following bit.

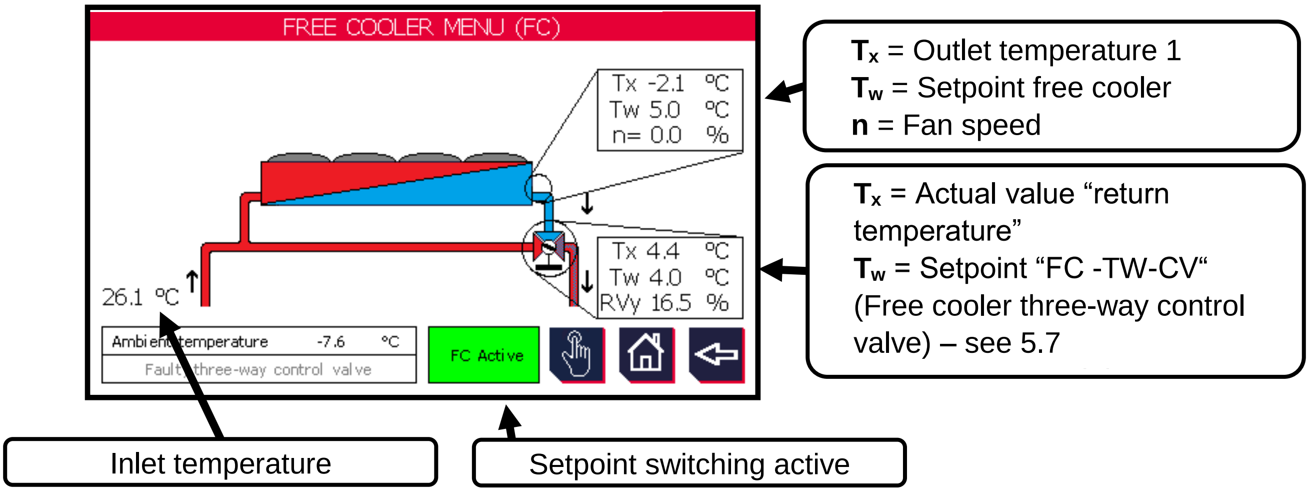
		Valve statuses	
	Free cooling		

C) Variant three-way control valve

Frost protection function for plate heat exchanger in heat dissipating secondary circuit..
Setpoint factory settings 4°C

Three-way control valve = infinitely variable valve 0-100% (2-10V)

Image 97



Activating this function requires the following additional steps:

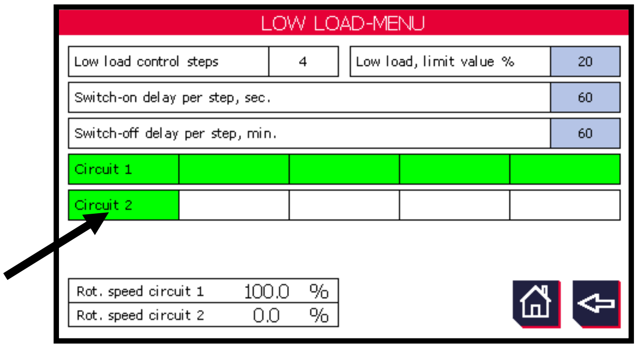
- Device settings → Control → Free cooling valves must be set to “internal”, “via terminal” or “via bus”. See chapter 4.2.12 “Control free cooler valve(e)”

- An inlet sensor is required (before the branch – see Image 45). Configurable, see chapter 4.3.3 “Analog IN basic device”
- Install and configure “return” temperature sensor (after the control valve). See chapter 4.3.3 “Analog IN basic device”. This serves as a feedback variable in the control circuit for the three-way control valve.
- The “free cooler three-way valve, 2-10V” must be selected on an analog output (see chapter 4.3.4 “Analog OUT basic device”)

5.8.5 Low load menu

This function allows a fan or group of fans to be switched off in stages at low load.

Image 98



In the low load menu, all relevant parameters can be edited, including the low load device levels. For a precise functional description, **see chapter 4.6.5 “Low** load settings**”**.
Apart from this, the bars show active (green) or not active (white) low load levels from circuit 1 and circuit 2 if applicable. The left and first step is the so-called basic load step. It remains controlled and is not switched off. All further stages are “control levels”.

5.8.6 Roller control menu

Rollers on heat exchangers have different tasks depending on the area of use.

➔ **Roller shutters as a fresh air bypass**

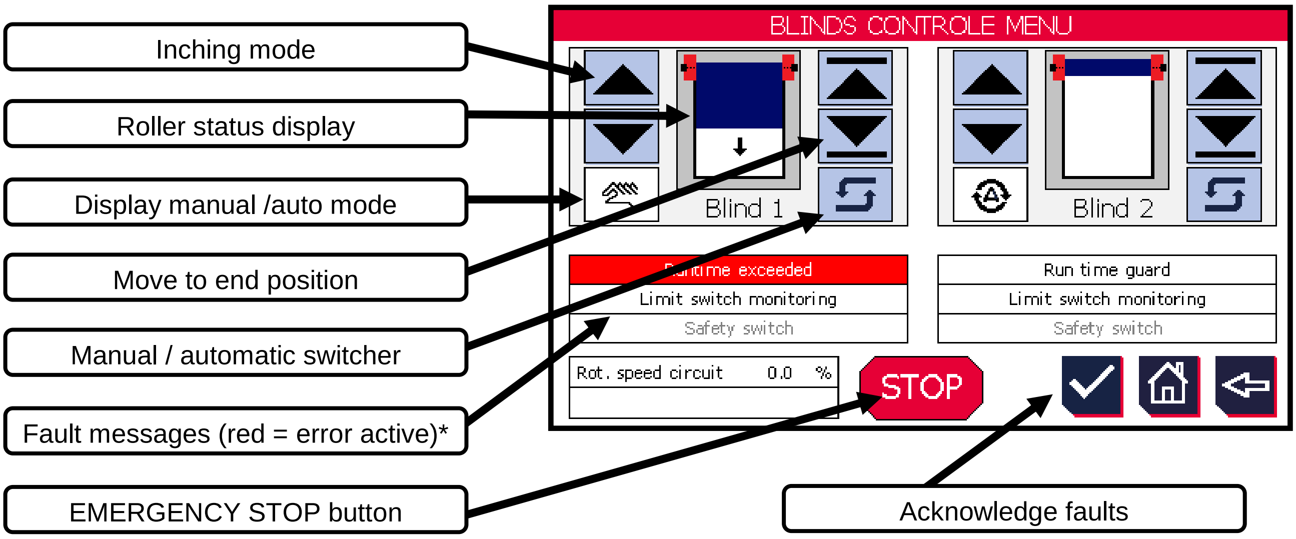
In e.g. a table device with AdiabaticPads, roller shutters function as a bypass flap that guides the fresh air past the pads to the heat exchanger in dry mode. This means that the cooling mats do not need to be removed during cold months. Furthermore, the bypass creates an energy saving through the lower pressure loss to the fans.

➔ **Roller shutters as frost protection**

Function is still under development...

In “*roller control menu*” (Image 99), the user has the option both of manual operation and also of moitorign the statuses and fault messages, e.g. during commissioning.

Image 99



* Greyed-out functions are not activated or selected in Display settings.

➔ **Roller control via bus**

This function is activated in Device settings -> Control (see chapter 4.2.11 “*Control* ”).

- ➔ Select control “via bus”
- ➔ If the corresponding bit via bus is set to “true” (see table), the respective roller closes. On a “false”, the roller opens.

➔ The following parameters exist for direct communication via MODBUS:

Register	Bit	Designation	Meaning	Register value
2	11	Close roller 1	TRUE = Roller 1 is closed	Write 2048
	12	Close roller 2	TRUE = Roller 2 is closed	Write 4096
177	0	Roller 1 open	TRUE = Roller 1 is open	Read 1
	1	Roller 1 closes	TRUE = Roller 1 closes	Read 2
	2	Roller 1 closed	TRUE = Roller 1 is closed	Read 4
	3	Roller 1 opens	TRUE = Roller 1 opens	Read 8
	4	Roller 1 manual mode	TRUE = Roller 1 in manual mode	Read 16
	5	Roller 1 runtime error	TRUE = Roller 1 runtime error	Read 32
	6	Roller 1 limit switch	TRUE = Roller 1 both limit switches actuated	Read 64
	7	Roller 1 safety switch	TRUE = Roller 1 safety switch triggered	Read 128
	8	Roller 2 open	TRUE = Roller 2 is open	Read 256
	9	Roller 2 closes	TRUE = Roller 2 closes	Read 512
	10	Roller 2 closed	TRUE = Roller 2 is closed	Read 1024
	11	Roller 2 opens	TRUE = Roller 2 opens	Read 2048
	12	Roller 2 manual mode	TRUE = Roller 2 in manual mode	Read 4096
	13	Roller 2 runtime error	TRUE = Roller 2 runtime error	Read 8192
	14	Roller 2 limit switch	TRUE = Roller 2 both limit switches actuated	Read 16384
	15	Roller 2 safety switch	TRUE = Roller 2 safety switch triggered	Read 32768

5.8.7 Step control

If AC fans are controlled via individual contactors, there is the option to control them via stages that can be switched on and off. In the “Step control” sub-menu, all necessary settings can be made and statuses can be monitored. See also chapter 4.4.1 *“Fan control”.*

Image 100

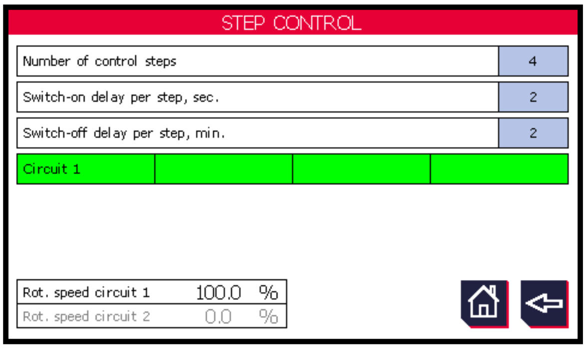
Number of control levels: 1 … 4

Activation delay per stage: 1 … 600 s

Deactivation delay per stage: 1 … 600 s

Display of stages (green = active)

Display speed circuits 1/ 2

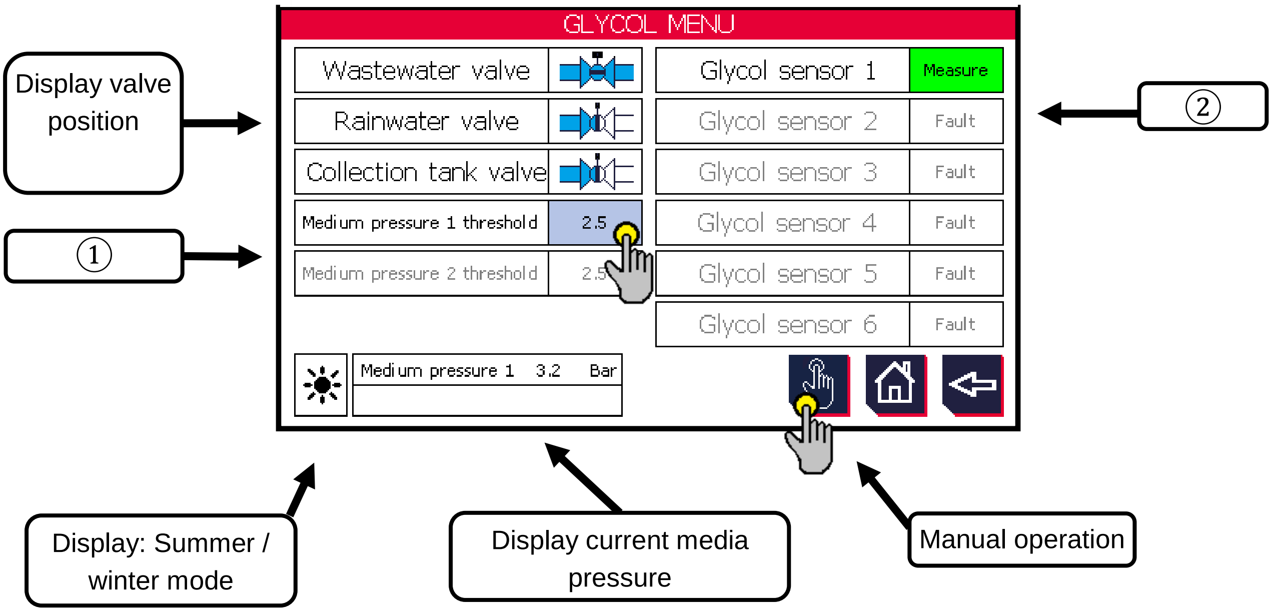


5.8.8 Glycol monitoring

exceeded. The following parameters can be edited:

The value can be edited by selecting the buttons with blue backgrounds.

Image 101



① **Medium pressure 1/2 threshold**

If the set threshold is exceeded for min. 5 seconds, the TCS generates a fault message. One is the “M26 glycol alarm” as a collective alarm. Another is the “M27 glycol sensor [No] fault”. See also chapter 12.6 “Measured value messages – Fault code M...”.

<u>Can be edited from …to</u>: 0.0 … 10.0 bar

<u>Factory settings</u>: 2.5 bar

The following information is output for direct communication via bus:

Register	Bit	Designation	Meaning	Register value
192	-	Medium pressure sensor 1	INT	1000= 10.0 bar
193	**-**	Medium pressure sensor 2	INT	1000= 10.0 bar
150	**14**	M25 medium pressure sensor 1 wire break	TRUE = fault	Read 16384
	15	M25 medium pressure sensor 2 wire break	TRUE = fault	Read 32768

② Glycol sensor [No] status

The following messages are output.

- Measure (measurement active)
- Heat (the sensor is being heated – preparation for correct measurement)
- Alarm (glycol detected)

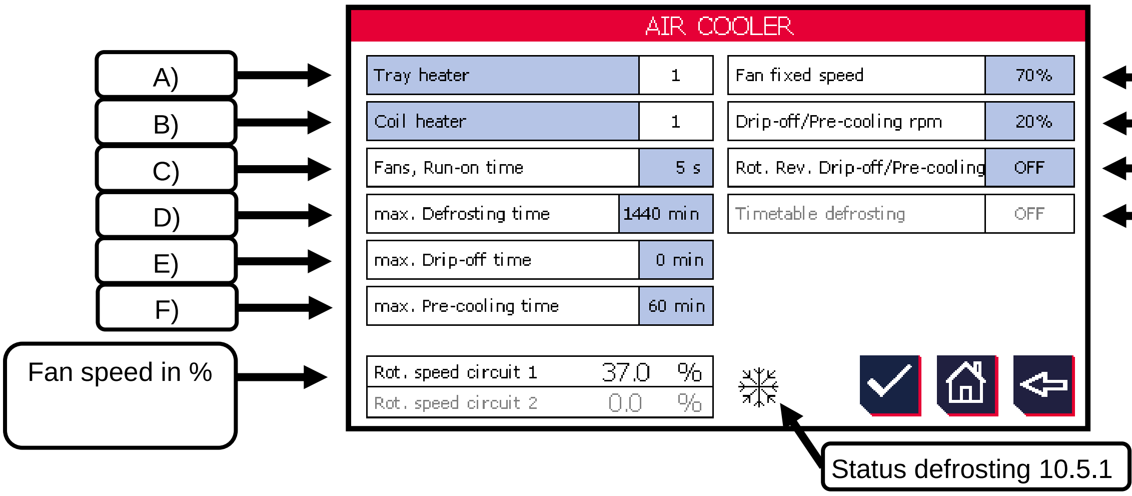
The following information is output for direct communication via bus:

Register	Bit	Designation	Meaning	Register value
240	0	Glycol sensor 1 OK - measurement active	TRUE = active	Read 1
	1	M26 Glycol sensor 1 - glycol alarm	TRUE = alarm	Read 2
	2	M27 Glycol sensor 1 - fault	TRUE = alarm	Read 4
	3	Glycol sensor 2 OK - measurement active	TRUE = active	Read 8
	4	M26 Glycol sensor 2 - glycol alarm	TRUE = alarm	Read 16
	5	M27 Glycol sensor 2 - fault	TRUE = alarm	Read 32
	6	Glycol sensor 3 OK - measurement active	TRUE = active	Read 64
	7	M26 Glycol sensor 3 - glycol alarm	TRUE = alarm	Read 128
	8	M27 Glycol sensor 3 - fault	TRUE = alarm	Read 256
	9	Glycol sensor 4 OK - measurement active	TRUE = active	Read 512
	10	M26 Glycol sensor 4 - glycol alarm	TRUE = alarm	Read 1024
	11	M27 Glycol sensor 4 - fault	TRUE = alarm	Read 2048
	12	Glycol sensor 5 OK - measurement active	TRUE = active	Read 4096
	13	M26 Glycol sensor 5 - glycol alarm	TRUE = alarm	Read 8192
	14	M27 Glycol sensor 5 - fault	TRUE = alarm	Read 16384

5.8.9 Air cooler / evaporator

This function allows iced-up heat exchangers to be defrosted during the heat pump operation. Depending on whether an air cooler or an evaporator was selected in the heat exchanger system, this is displayed as the menu heading.

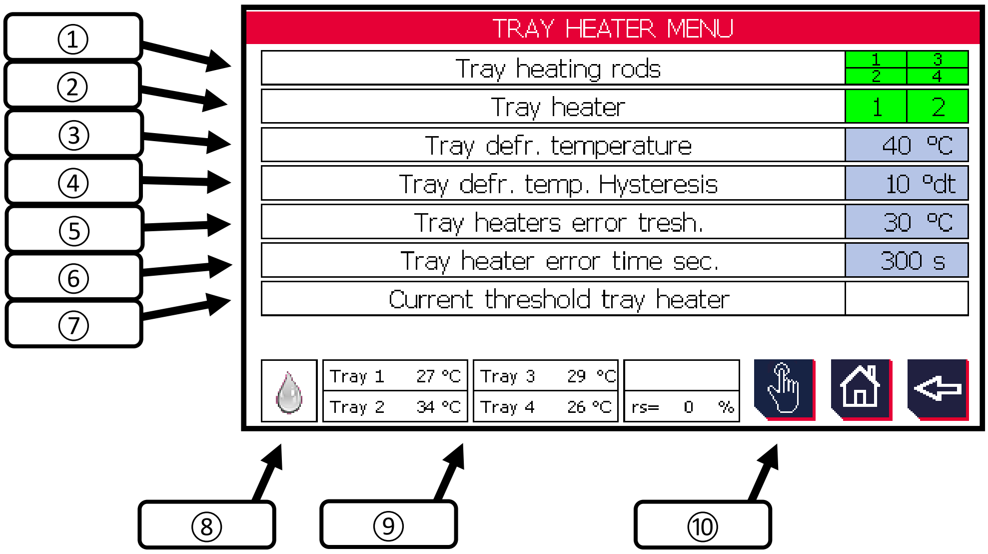
Image 102



A) Tank heating

The number of configured tank heating stages is displayed. Pressing the blue “Tank heating” button takes you to the following sub-menu (Image 180).

Image 103



① **Tank heating elements**

Status display of tank heating elements in the insulating or penthouse coolers, which are monitored, controlled and regulated by the TCS.2.

White background → switched off
Green background → switched on

② **Tank heatings**

Status display of tank heating levels that are controlled by the TCS.2.

White background → switched off
Green background → switched on

③ **Tank defrosting temperature**

A 2-point controller takes over the switching on and off of the tank heating elements. This parameter is the upper deactivation point. If several tank heating elements are used for each tank heating stage, the mean of all actual tank temperatures is formed internally, which leads to the respective heating stage being switched off.

Can be edited from …to: 0 … 80 °C / °F

Factory settings: 10°C

④ **Tank defrosting temperature hysteresis**

The "tank defrosting temperature" (③) minus the hysteresis that can be edited here results in the lower deactivation point of the 2-point controller. See following example:

Tank defrosting temperature: 40°C
Tank defrosting temperature hysteresis: 10°C

Activation point 2-point controller: 40°C
Deactivation point 2-point controller: 40 – 10°C = 30°C

Can be edited from …to: 1 … 20°C

Factory settings: 10°C

⑤ **Threshold monitoring heating elements**

If the temperature threshold set here is not achieved in the time set under point ⑥, a fault message for the respective heating element will be generated.

Can be edited from …to: -10 … 50°C

Factory settings: 5 °C

⑥ **Warming time monitoring heating elements seconds**

If the temperature set under point ⑤ is not achieved in the time set, a fault message for the respective heating element will be internally generated.

Can be edited from …to: 120 … 600 s

Factory settings: 480 s

⑦ **Current threshold tank heating**

Adjustment option only present if current of the tank heating is recorded via a transformer (see also chapter 10.4 “Adjustments in Main menu → Additional functions → Insulated cooler”). If this is the case, a current threshold can be set here for each heating element/heating element group. If this is exceeded, the TCS.2 generates a fault message.

Can be edited from …to: 0.0 … 15.0 A
Factory settings: 1.0 A

⑧ **Status message air cooler**

See chapter *10.5.1 “Status* messages*”.*

⑨ **Tank temperatures**

Current measured temperature value of the tank at the respective heating element

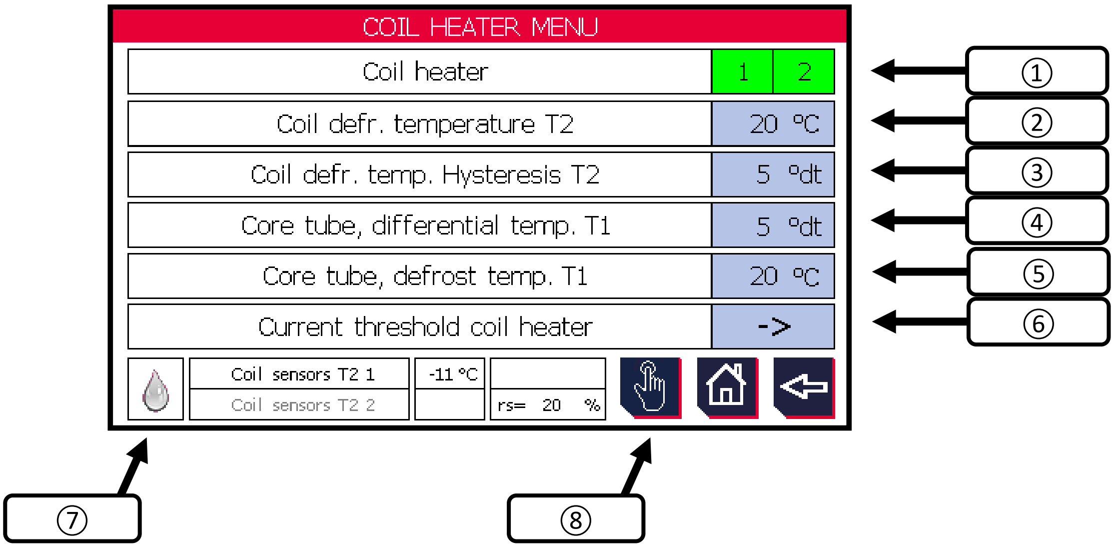
⑩ **Manual operation electrical defrosting**

Option to manually switch the electric block and tank heating elements on/off

B) Block heating

The number of configured block heating stages is displayed. Selecting the blue “Block heating” button takes you to the following sub-menu:

Image 104



① **Block heatings**

Status display of the installed block heatings, which are monitored, controlled and regulated.

White background → switched off
Green background → switched on

② **Block defrosting temperature T2**

A 2-point controller takes over the switching on and off of the electrical block heating. This parameter is the upper deactivation threshold.

<u>Can be edited from …to</u>:	10.0 … 50.0°C / °F
<u>Factory settings</u>:	20.0 °C

③ Block defrosting temperature hysteresis T2

The “Block defrosting temperature T2” (②) minus the hysteresis that can be edited here results in the lower deactivation point of the 2-point controller. See following example:

Tank defrosting temperature: 20°C
Tank defrosting temperature hysteresis: 5°C

Activation point 2-point controller: 20°C
Deactivation point 2-point controller: 20 – 5°C = 15°C

Can be edited from …to: 1.0 … 10.0°C

Factory settings: 5.0°C

④ Core tube differential temperature T1

This condition for the start of defrosting is activated if a “fan run-on time” > 0s is set. See chapter 10.4.4 “Fans run-on time”. In the time set here, the core tube sensor expects the temperature drop set here. This measurement allows it to be ensured that no liquid refrigerant remains in the core tube. If the differential is reached, the defrosting is initiated. If the set temperature differential in the run-on time is not reached, the TCS gives a fault message “I11 Defrosting blocked”. See chapter 12.3 “

Fehler-code	Art	Error text	Fault explanation	Fault remedy	MODBUS	
					Reg.	Bit
H01		Medium pump faulty [Nr]	- general message that the medium pump is faulty - motor protection - overheating protection	- motor line(s) interrupted / check wiring - check terminal points - check protections - mechanically check pump		
H02						
H03	A	Fault, wetting pump [Nr]	- general message that the wetting pump is faulty - motor protection - overheating protection	- motor line(s) interrupted / check wiring - check terminal points - check protections - mechanically check pump	180	10, 11

H04	A	Dry run, wetting pump [Nr]	- insufficient water available to operate the wetting pump - water supply failed - valves closed - line blocked - refill valve faulty - water pressure too low	- check water supply - clean pipelines - check valves	181	0 bis 3
H05	W	Fault in UVC disinfection [Nr]	- UVC module fault	- check UVC module	181	9, 11
H06	W	Time max. UVC disinfection [Nr]	- UVC lamp is worn out (max. operating time reached).	- replace UVC lamp	181	10, 12
H07	W	Circulation water tub, empty	- empty message circulating water	- fresh water line not carrying any water - check valves - check level sensor	180	15
H08	W	Hardness stabilizer, cont. empty	- hardness stabiliser container empty	- fill hardness stabiliser	181	7
H09	W	Biocide, container empty	- biocide empty - biocide message cable break	- fill up biocide - check cable	181	6
H10	W	Entrance door opened	- entry door on hybrid cooler open	- reset only possible on TCS, no external reset	181	13
H11	W	Dry run, logic error	- message from limit switch the fill level probe does not correspond with the actual fill level	- check fill level probe, replace if necessary	181	14

Insulated cooler messages – Fault code I".

Can be edited from …to: 1.0 … 20.0°C

Factory settings: 10.0°C

⑤ Core tube defrosting temperature T1

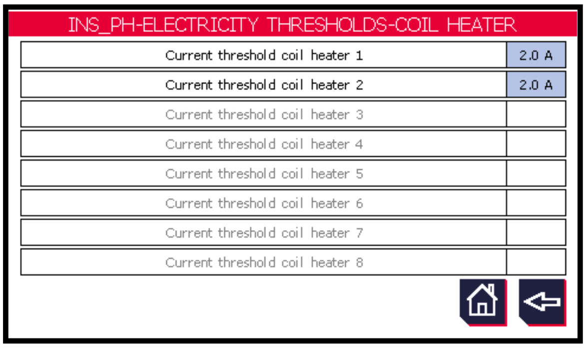
If the temperature threshold set here is reached, or the set defrosting time (10.4.5) has elapsed, the defrosting phase is ended.

Can be edited from …to: 1.0 … 30.0°C

Factory settings: 20.0°C

⑥ Current threshold block heating

If the temperature set under point ⑤ is not achieved in the time set, a fault message for the respective heating element will be internally generated.



Can be edited from …to: 0.0 … 20.0 s

Factory settings: 2.0 s

⑦ Status display defrosting

See chapter *10.5.1 "Status* messages*"*.

⑧ **Manual operation electrical defrosting**

Option to manually switch the electric block heating elements on/off

C) Fans run-on time

The fan run-on time is a condition for the start of defrosting, if a run-on time > 0s is set. In the time set here, the core tube sensor T1 (see 10.4.3 ⑤) expects a temperature drop set in 10.4.3 ④. The run-on time should ensure that no liquid refrigerant remains in the core tube. If the run-on time is finished and the differential temperature is reached, the defrosting is initiated. If the set temperature differential in the run-on time is not reached, the TCS gives a fault message "I11 Defrosting blocked". See chapter 12.3 "

Fehler-code	Art	Error text	Fault explanation	Fault remedy	MODBUS	
					Reg.	Bit
H01		Medium pump faulty [Nr]	- general message that the medium pump is faulty - motor protection - overheating protection	- motor line(s) interrupted / check wiring - check terminal points - check protections - mechanically check pump		
H02						
H03	A	Fault, wetting pump [Nr]	- general message that the wetting pump is faulty - motor protection - overheating protection	- motor line(s) interrupted / check wiring - check terminal points - check protections - mechanically check pump	180	10, 11
H04	A	Dry run, wetting pump [Nr]	- insufficient water available to operate the wetting pump - water supply failed - valves closed - line blocked - refill valve faulty - water pressure too low	- check water supply - clean pipelines - check valves	181	0 bis 3
H05	W	Fault in UVC disinfection [Nr]	- UVC module fault	- check UVC module	181	9, 11

H06	W	Time max. UVC disinfection [Nr]	- UVC lamp is worn out (max. operating time reached).	- replace UVC lamp	181	10, 12
H07	W	Circulation water tub, empty	- empty message circulating water	- fresh water line not carrying any water - check valves - check level sensor	180	15
H08	W	Hardness stabilizer, cont. empty	- hardness stabiliser container empty	- fill hardness stabiliser	181	7
H09	W	Biocide, container empty	- biocide empty - biocide message cable break	- fill up biocide - check cable	181	6
H10	W	Entrance door opened	- entry door on hybrid cooler open	- reset only possible on TCS, no external reset	181	13
H11	W	Dry run, logic error	- message from limit switch the fill level probe does not correspond with the actual fill level	- check fill level probe, replace if necessary	181	14

Insulated cooler messages – Fault code I".

Can be edited from …to: 0 … 1800 s

Factory settings: 0 s

D) Maximum defrosting time

There are three options to determine the length of the defrosting process for the heat exchanger (see also chapter *10.6.1* "*Functional diagram* defrosting").

- activating the draining/pre-cooling time **via DI-3 or bus** (Register 3 Bit 2)
- a defined **block temperature is reached**
- the **maximum defrosting time** editable under this menu item **has elapsed**

However, for safety reasons, the last option **"Maximum defrosting time"** restricts all variants to a maximum duration of the defrosting process. For this reason, this time should be set appropriately high when using the first two variants.

When using the option **"Schedule defrosting"**, this parameter determines the duration of the defrosting time (see also chapter J) "Schedule defrosting").

During the defrosting time, the fans run to ensure even distribution of the heat to the set "defrosting/precooling speed" (see also chapter H) "Defrosting/precooling speed").

Can be edited from …to: 0 … 1440 min

Factory settings: 1440 min

Status symbol: 

Selecting the reset button or reset external input for 10s cancels the defrosting program sequence.

E) Draining time

Defines the time after the defrosting process, in which the melt water from the heat exchanger should drain. This must have elapsed before the pre-cooling time can begin. During this process, the fans are stopped.

Can be edited from …to: 0 … 60 min

Factory settings: 0 min

Status symbol: - - blinking

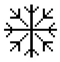
See also chapter *10.6.1 Functional diagram* defrosting.

F) Precooling time

Defines the time during which the internal space heated by the defrosting process is precooled to “cool room temperature”. Once this time has elapsed, the defrosting flap(s) must open again and the system must return to regular cooling operation.

Can be edited from …to: 0 … 60 min

Factory settings: 60 min

Status symbol: -  -

See also chapter *10.6.1 Functional diagram* defrosting.

G) Fan fixed speed

Adjustable speed in percent for the normal cooling mode, related to the maximum speed (see also fan settings, chapter *4.4.4* “*Maximum speed in* %”).

If the user wishes to use this function, the speed setpoint source (slave setpoint) must be set to “internal” in advance (see also chapter *4.2.5* “*Control slave* setpoint”).

Can be edited from …to: 10… 100 %

Factory settings: 70 %

H) Defrosting/precooling speed

Adjustable speed in percent for the defrosting and precooling process, related to the maximum speed. A slight air circulation accelerates the respective process and distributes the warmth/coldness evenly in the cooling cell.

See also chapter *10.6.1 Functional diagram* defrosting.

Can be edited from …to: 10… 60 %

Factory settings: 20 %

I) RDR (Reverse direction of rotation) defrosting/precooling speed

Determines whether the normal direction of rotation of the fans will be reversed during the defrosting and precooling time. Depending on the design of the fans, this can ensure a better circulation.

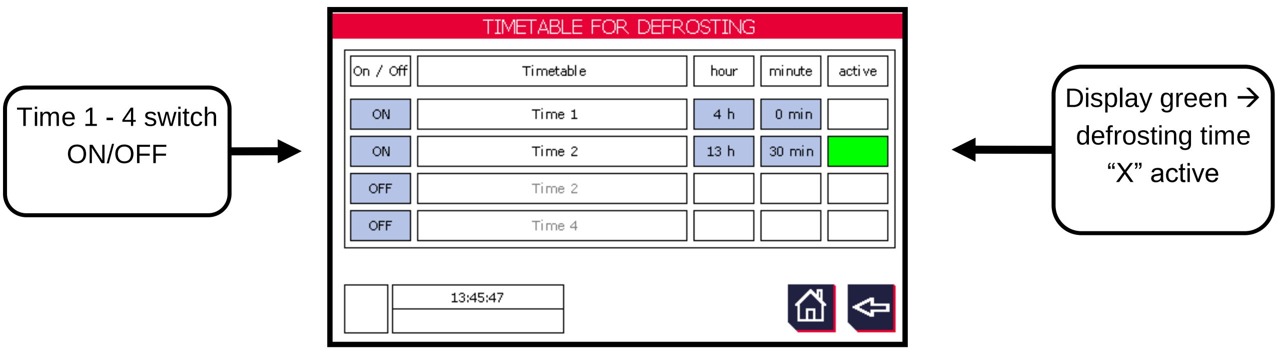
Factory settings: OFF

J) Schedule defrosting

In addition to the options to start the defrosting manually (via terminal or bus), there is also the option of automatic defrosting according to schedule. A maximum of 4 times per day can be set for this (see Image 105).

Factory settings: OFF

Image 105



5.9 Network IP

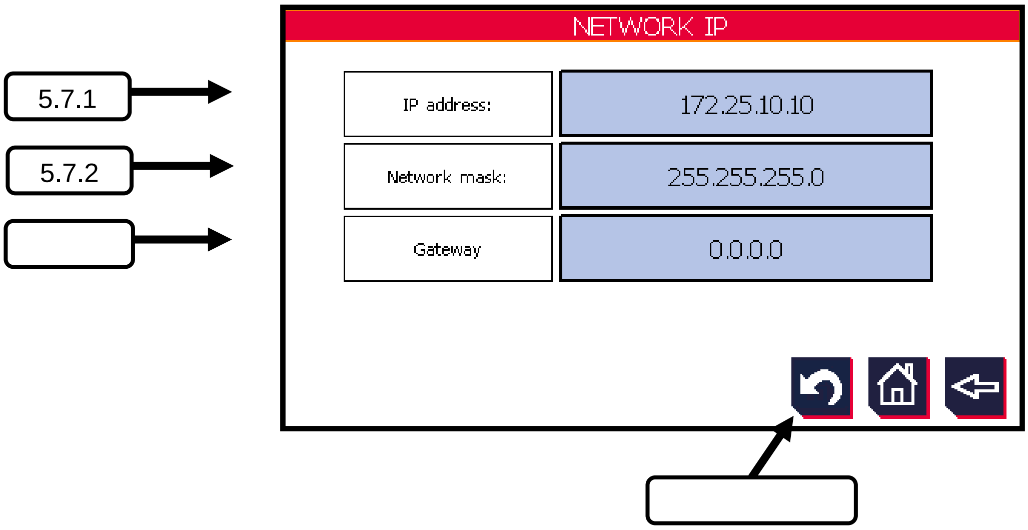
This menu contains all relevant network variables for the X11 Ethernet interface at the basic device TCS.2 (see also chapter 1.4 "*Circuit diagram TCS*.2")

As standard, the X11 interface is used for playing programs, updates or for communication with the thermofin® WEB terminal.

Depending on the activated licence in the TCS.2, the RJ45 port (X11) also serves as an interface for the following IP-based bus systems:

- ➔ Ethernet IP (standard)
- ➔ Modbus TCP
- ➔ FTP server (standard)
- ➔ WebVisu

Image 106



5.9.1 IP address

Adjustment of the network address (have a suitable address assigned by the responsible administrator)

<u>Factory settings</u>: 172.25.10.10

5.9.2 Network mask/subnet mask

The subnet mask (also called network mask) separates an IP address: into a network and a host address. The device addresses are designated as host addresses. The advantage of subnet masks is that the user can separate an available address space into separate subnets.

There can be different reasons for this:

- ➔ Only a certain address space is available, which is not fully utilised. Through the separation, two or more autonomous networks are created.
- ➔ Individual departments of a company can be logically separated from one another, e.g. for security reasons.
- ➔ Routing decisions can be made quicker.

Factory settings: 255.255.255.0

5.9.3 Standard gateway

If a TCP/IP computer has to communicate with a host in a different network, it normally communicates via a device, which is designated as a router. In the TCP/IP technology, a router that is assigned to a host and links the host subnet with other networks is called a **standard gateway**.

If a host attempts to communicate with another device over TCP/IP, it performs a comparison with the defined subnet mask and the target IP address in comparison with the subnet mask and its own IP address. The result of this comparison shows the computer whether the target is a local host or a remote host.

If the result of this process determines that the target is a local host, the computer simply sends the package in the local subnet. If the result of the comparison determines that the target is a remote host, the computer forwards the packet to the **standard gateway** defined in the TCP/IP properties. The router is then responsible for forwarding the packet to the correct subnet.

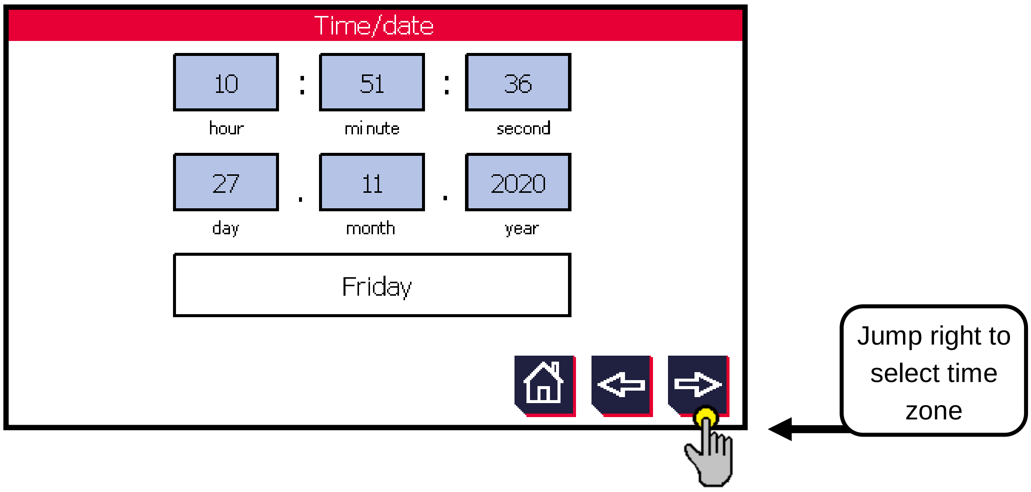
Factory settings: 0.0.0.0

5.10 Time/date

5.10.1 Set time/date

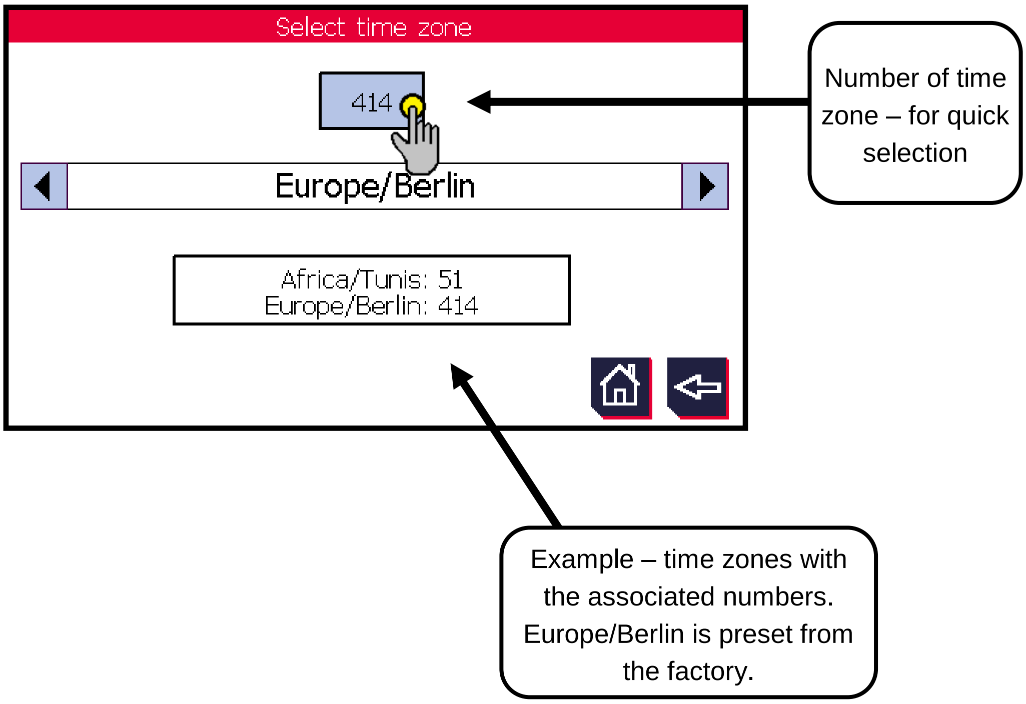
Editing the time and the date is normally not required. The TCS has a real-time clock that is battery-buffered. The TCS is delivered with the current date and time values. The summer and winter time changeover is done automatically. However, this is only if the control is connected to 24 V DC at the time of changeover. The changeover takes place during the night from the last Saturday to the last Sunday in March or October of every year. If, for any reason, the control was not energised at that time, it will be necessary to edit the time. It may also happen that the time no longer functions due to a completely empty buffer battery and additional loss of power. After such incidents, the buffer battery should first be replaced, see chapter 6.1.2 in the device manual "Replacing the buffer battery", and then the user can set the time and date to the current value when the TCS.2 is switched on.

Image 107



5.10.2 Select time zone

Image 108



In the event that daylight saving is abolished in Germany, a new runtime system would normally have to be installed on the TCS.2. To avoid this expense, the time zone “Africa/Tunis” can be selected. In Tunisia, daylight saving was abolished in 2008 and it therefore has Central European Time (CET) throughout the year.

6. SPRAYED DEVICES

The thermofin® spraying system on condensers or recoolers is used to cover peak loads at high ambient temperatures. All necessary settings for this are explained in the following chapter.

6.1 Adaptations in: Device settings → Additional functions → Wet settings Spraying

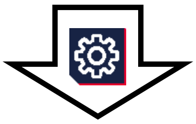
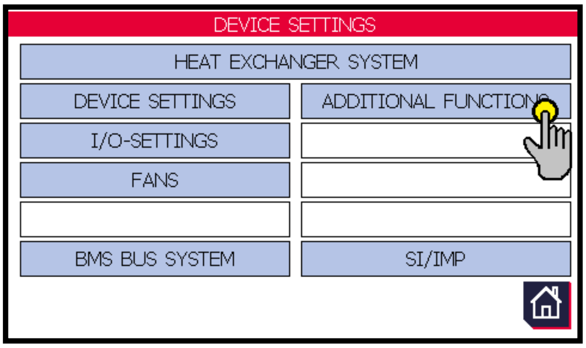


Image 109



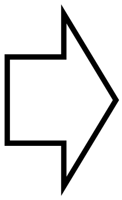
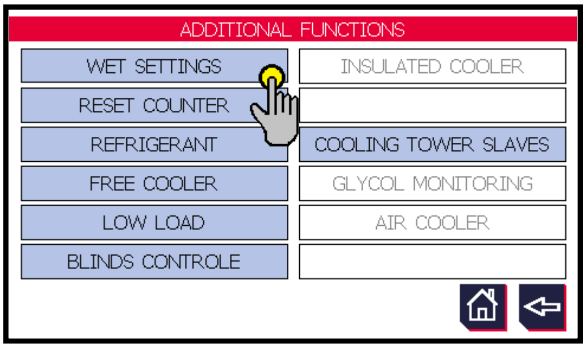


Image 110



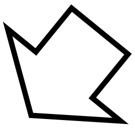
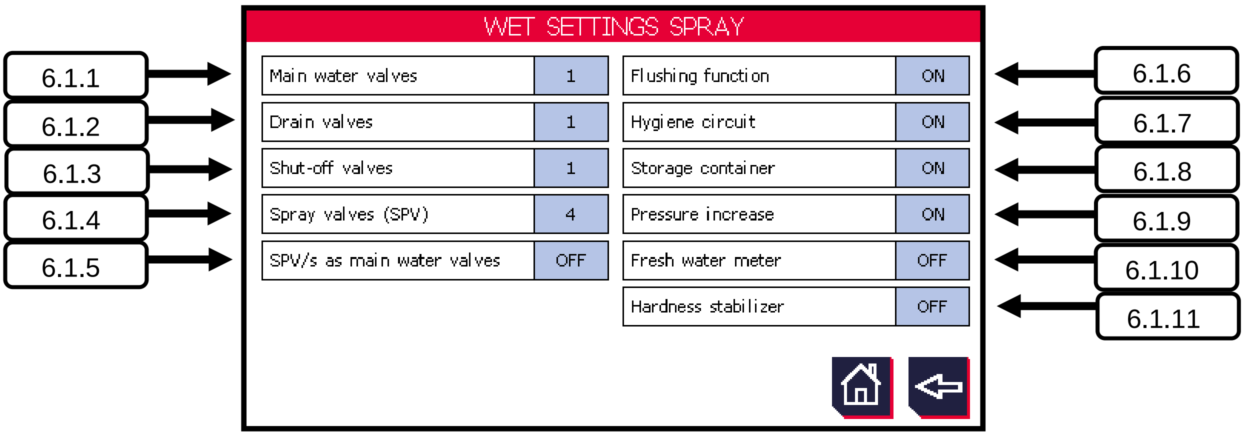


Image 111



6.1.1 Main water valve

Selection of a ball valve with actuator in the water supply line, which should be controlled and monitored by the TCS.2. The following requirements apply for these:

- Installation in a branch line that is as short as possible to rule out stagnation
- If connected to the drinking water network, the relevant standards must be met
- Emergency position closed in the event of power failure

6.1.2 Draining valve

Selection of a ball valve with actuator, which should be controlled and monitored by the TCS.2 as a drain valve. Draining is essential in the event of frost and long downtimes (danger of Legionella formation). For these valves, which are usually provided separately, the following requirements apply:

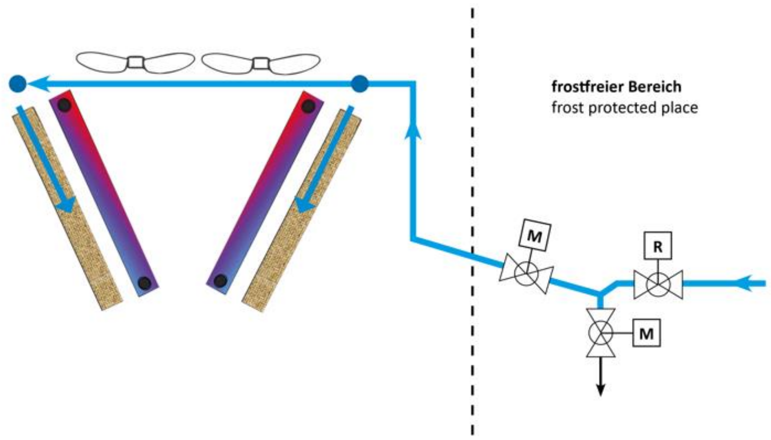
- Installation at the lowest point in the system, to guarantee complete drainage of the pipes
- Emergency position open in the event of power failure

6.1.3 Stop valve

Selection of a ball valve with actuator, which should be controlled and monitored by the TCS.2 during the draining of the system as a stop valve. This is necessary if the branch line should be flushed in dry or winter mode.

- Installation on the water line to the cooler, near the draining valve (see Image 112)
- Emergency position open in the event of power failure
- must be installed in a frost-free area!

Image 112



6.1.4 Spraying valve (SV)

Selection of the number of ball valves with actuators that should be controlled and monitored by the TCS.2 as spray stages.

Can be edited from …to: 1 … 4 spraying valves

Factory settings: 4 spraying valves

If only one spray valve is used, this can simultaneously be used as a main water valve [see chapter 6.1.5 "*Spraying valve (SV) as main* water valve"].

6.1.5 Spraying valve (SV) as main water valve

Spraying valve 1 simultaneously works as a main water valve. This option is possible when using only one spray stage (valve). Any selected main water valve is automatically deselected. The following requirements apply for these:

- Installation in a branch line that is as short as possible to rule out stagnation
- If connected to the drinking water network, the relevant standards must be met
- Emergency position closed in the event of power failure
- must be installed in a frost-free area!

Can be edited from …to: ON / OFF
Factory settings: OFF

6.1.6 Flushing circuit

To impede the formation of biofilms on the internal wall of the pipe, long sections of pipe with wetting water that remains stagnating for long periods should be avoided.
Observe the relevant regulations and standards for immission control at the installation location. For usage cases in which there is a long branch line to the main water valve, this can be flushed by the TCS, provided there is also a stop valve (see 6.1.3) installed.
The **flushing circuit** is used to prevent stagnating water in the branch of the water line up to the main water valve. If the spraying is out of order, the flushing circuit is repeatedly triggered in the set time interval. The water is drained via the draining valve. After activation, these parameters can be edited in Main menu → Additional functions → Wet mode → Rinse cycle (see also chapter 6.4.7 "*Flushing* circuit").

6.1.7 Hygiene circuit

The **hygiene circuit** should prevent Legionella formation and stagnation in the supply line of the thermofin® spray system. As soon as the adiabatic is switched off, the counter starts to record the waiting time. If the set time has been reached, the draining valve opens and the entire water line up to the main water valve is drained. The valve remains open until the device requests water again.

After activation of this function, the wait time can be edited in Main menu → Additional functions → Wet mode → Hygiene cycle (see also chapter 6.4.6 "*Hygiene* circuit").

6.1.8 Storage tank

After activation of the **Storage tank** function, the fill level of a water reservoir for the spraying system is monitored via the TCS.2 The following I/Os are used for input and output:

- ➔ **Digital input DI-6, DI-7 or DI-8** ["FB (feedback) storage tank"]
  After activating this function, the input must be "true", otherwise the TCS outputs a fault message "S06 Fault storage tank".
  See also chapter 4.3.1 "Digital IN basic device".
- ➔ **Digital output DI-6, DI-7 or DI-8** ("Storage tank request")
  These outputs are permanently set in summer mode (winter mode deactivated). They signal a possible water demand in the wetting system.
  See also chapter 0 "
  Digital OUT basic device*".*

- ➔ **Messages via bus**
  The following status messages are output via bus

Register	Bit	Designation	Meaning	Register value
144	**8**	Storage tank request	TRUE = Request storage tank	read 256
145	**8**	Fault storage tank	TRUE = Fault storage tank	read 256

6.1.9 Pressure increase

After activation of the **Pressure increase** function, the pump(s) for the spraying system is/are monitored via the TCS.2 The following I/Os are used for input and output:

➔ **Digital input DI-8** [“FB (feedback) pressure increase”]
After activating this function, the input must be “true”, otherwise the TCS outputs a fault message “S07 Fault pressure increase”.
See also chapter 4.3.1 “Digital IN basic device”.

➔ **Digital output DO-8** (“Pressure increase request”)
This output is set as soon as a wet stage (spray stage) is active.
See also chapter 0 “
Digital OUT basic device*”.*

➔ **Messages via bus**
The following status messages are output via bus:

Register	Bit	Designation	Meaning	Register value
144	**7**	Pressure increase request	TRUE = Request pressure increase	read 128
145	**7**	Fault pressure increase	TRUE = Fault pressure increase	read 128

6.1.10 Fresh water counter

After activating the **Fresh water counter** function, the impulses at the corresponding digital input are counted (1 imp./litre), and the quantity of water consumed is displayed by the TCS.2 in litres and m^3 (see also chapter 5.4 “*Counter*”). The following inputs are used:

➔ **Digital input DI-6 or DI-7** (“Fresh water counter”)
See also chapter 4.3.1 “Digital IN basic device”.
Request impulse: + 24 V DC ≥ 50 ms

➔ **Messages via bus**
The following values are output via bus:

Register	Word	Designation	Meaning	Register value
81	**HI**	Fresh water consumption	Fresh water consumption in m^3	Cubic metres
82	**LO**			

6.1.11 Hardness stabiliser

After activating this function, the fill level of the hardness stabiliser container is monitored via the TCS.2.

6.2 I/O settings valves

As standard, the following I/Os are used for requesting or receiving feedback from the valves:

Main valve	Variants	Basic device		Extension	
		DI	DO	DI (CAN Addr. 6)	DO (CAN Addr. 20)
Main water valve	1 spray stage	-	-	-	-
	2- 4 spray stages	-	-	45	45
Draining valve	1 spray stage	6	6	-	-
	2- 4 spray stages	-	-	46	46
Stop valve	1 spray stage	-	-	-	-
	2- 4 spray stages	5	5	-	-

Spraying valves	Variants	Basic device		Extension	
		DI	DO	DI (CAN Addr. 6)	DO (CAN Addr. 20)
Spraying valve 1	1 spray stage	5	5	-	-
	2- 4 spray stages	-	-	41	41
Spraying valve 2	1 spray stage	-	-	-	-
	2- 4 spray stages	-	-	42	42
Spraying valve 3	1 spray stage	-	-	-	-
	2- 4 spray stages	-	-	43	43
Spraying valve 4	1 spray stage	-	-	-	-
	2- 4 spray stages	-	-	44	44

6.3 Bus parameter valves

Feedback via Modbus:

Register	Bit	Designation	Meaning	Register value
144	**0**	Main water valve 1 open	TRUE = main water valve open	read 1
145	**0**	V01 Main water valve 1 runtime error	TRUE = main water valve runtime error	read 1
146	**0**	Main water valve 2 open	TRUE = main water valve open	read 1
145	**3**	V01 Main water valve 2 runtime error	TRUE = main water valve runtime error	read 8
144	**1**	Draining valve 1 open	TRUE = draining valve open	read 2
145	**3**	V02 draining valve 1 runtime error	TRUE = draining valve runtime error	read 8
146	**1**	Draining valve 2 open	TRUE = draining valve open	read 2
145	**4**	V02 draining valve 2 runtime error	TRUE = draining valve runtime error	read 16
144	**6**	Stop valve 1 open	TRUE = stop valve open	read 64
145	**2**	V03 stop valve 1 runtime error	TRUE = stop valve runtime error	read 4
146	**2**	Stop valve 2 open	TRUE = stop valve open	read 4
145	**5**	V03 stop valve 2 runtime error	TRUE = stop valve runtime error	read 32

Register	Bit	Designation	Meaning	Register value
144	**2**	Spraying valve 1 open	TRUE = spraying valve 1 is open	read 4
145	**11**	V04 spraying valve 1 runtime error	TRUE = spraying valve 1 runtime error	read 2048
144	**3**	Spraying valve 2 open	TRUE = spraying valve 2 is open	read 8
145	**12**	V04 spraying valve 2 runtime error	TRUE = spraying valve 2 runtime error	read 4096
144	**4**	Spraying valve 3 open	TRUE = spraying valve 3 is open	read 16
145	**13**	V04 spraying valve 3 runtime error	TRUE = spraying valve 3 runtime error	read 8192
144	**5**	Spraying valve 4 open	TRUE = spraying valve 4 is open	read 32
145	**14**	V04 spraying valve 4 runtime error	TRUE = spraying valve 4 runtime error	read 16384

6.4 Adjustments in Main menu → Additional functions → Wet menu Spraying

Image 113

Image 114

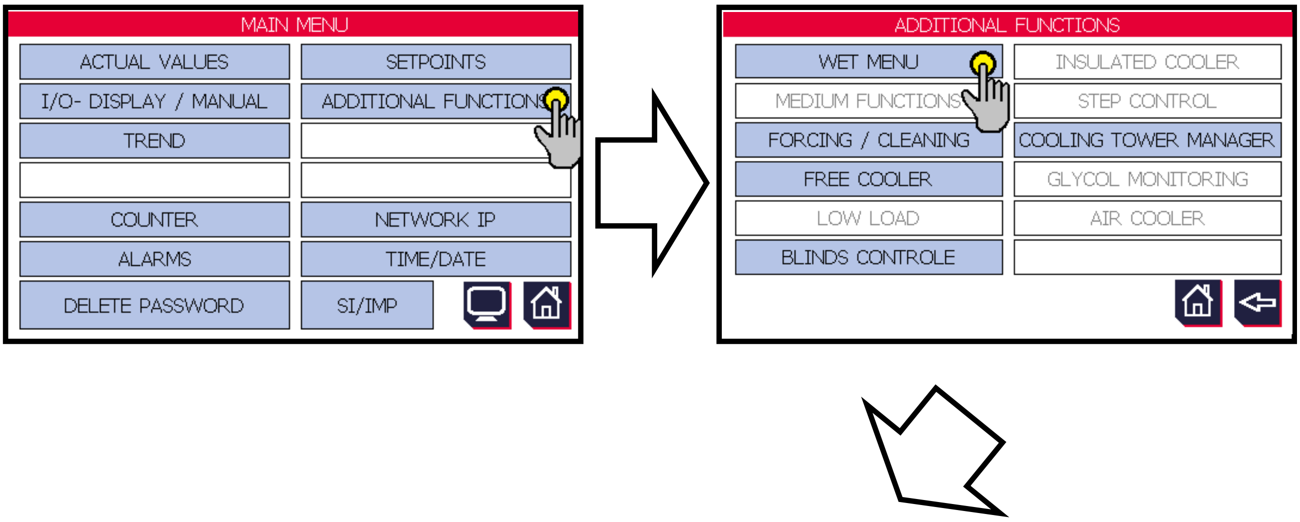
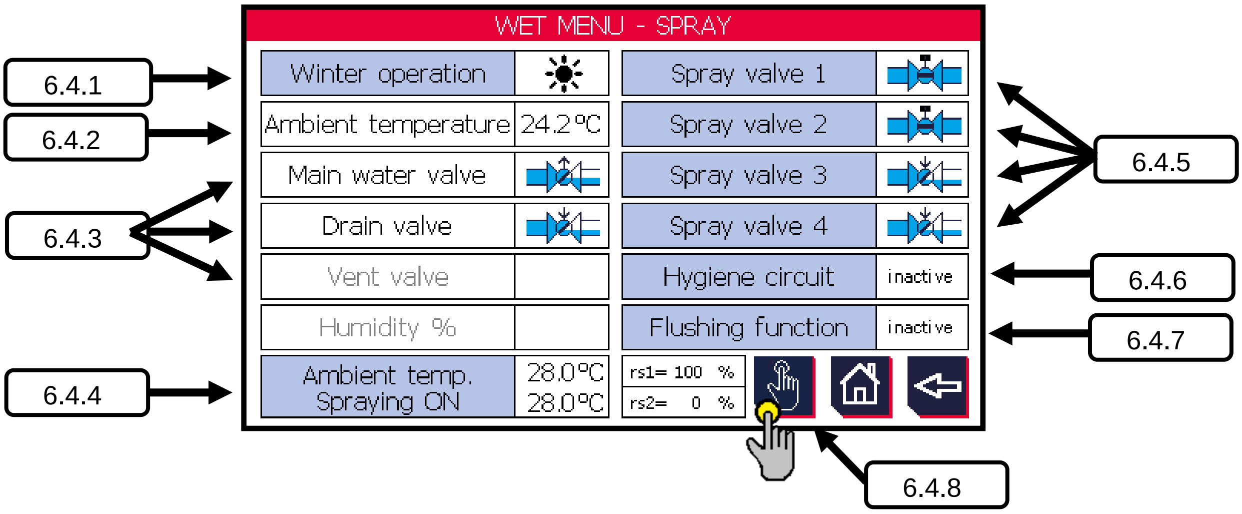


Image 115

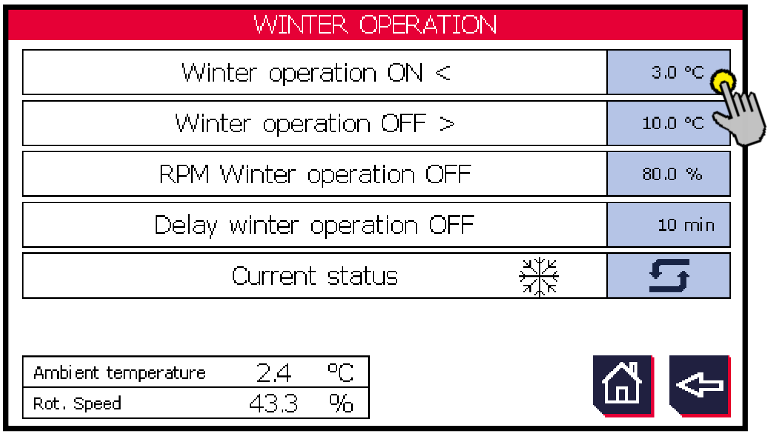


6.4.1 Winter mode / Summer mode

The **winter mode** is used to protect all water-carrying parts from frost damage. In winter mode, among other things, valve settings are changed and water lines are emptied. The use of the spraying function is not possible in winter mode. When the "Winter mode" menu is selected, a sub-menu opens with the associated settings.

The settings can be edited by selecting the buttons with blue backgrounds.

Image 116



Winter mode ON <: Temperature limit from which the device switches to winter mode.

<u>Can be edited from …to</u>: 3.0 … 30.0 °C

<u>Factory settings</u>: 3.0 °C

Winter mode OFF >: Temperature limit from which the device switches to summer mode (winter mode deactivated). The switch-off temperature must be at least 1 °C above the switch-on temperature.

<u>Can be edited from …to</u>: 4.0 … 40.0 °C

<u>Factory settings</u>: 10.0 °C

Speed winter mode OFF: A further switch-off condition, which switches the winter mode off from a particular speed (in %).

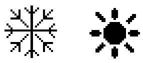
<u>Can be edited from …to</u>: 0… 100 %

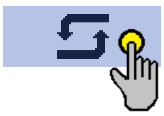
Factory settings: 80 %

Delay winter mode OFF: Specifies a delay in minutes during which both the temperature (winter mode OFF >) and also the “speed winter mode OFF” must have exceeded the set switching thresholds in order to deactivate winter mode. This delay prevents the winter mode from constantly switching on and off when reaching the switching values.

Can be edited from …to: 0 … 600 min

Factory settings: 10 min

Current status:  Winter or summer mode active.



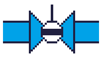
Allows switching between summer and winter mode using the switching symbol. This function is intended for commissioning and testing purposes. If the external temperature falls below the lower temperature limit, switching off the winter mode is no longer possible for safety reasons.

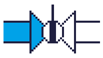
6.4.2 Display external temperature

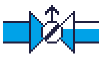
Current measured external temperature. Helpful for commissioning and adjustment of the settings.

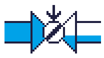
6.4.3 Display / manual operation of the main valves

Status display of the main valve settings and manual operating level. The following symbols are used on the display:

 Valve is OPEN

 Valve is CLOSED

 Valve is OPENING

 Valve is CLOSING

The following status messages are output via bus:

Register	Bit	Designation	Meaning	Register value
144	**0**	Main water valve 1, open	TRUE = open	read 1
144	**1**	Draining valve 1, open	TRUE = open	read 2
144	**6**	Stop valve 1, open	TRUE = open	read 32
145	**0**	Main water valve 1, runtime error	TRUE = fault	read 1
145	**1**	Draining valve 1, runtime error	TRUE = fault	read 2
145	**2**	Stop valve 1, runtime error	TRUE = fault	read 4

6.4.4 External temperature spraying ON

The spraying is released from the external temperature set here. For further activation conditions, see chapter 6.4.5 “*Spraying* valves”.

Point of use "shifted" via bus, to which the spraying is released [see following chapter 1.1.1A) "*Shifting signal external temperature* wetting ON"].

A) Shifting signal external temperature wetting ON

Option to adjust the point of use of the spraying upwards and downwards
The previously edited value forms the starting point. The "shifted" value is displayed under the edited value (see Image 115). The following parameters apply with direct communication via Modbus:

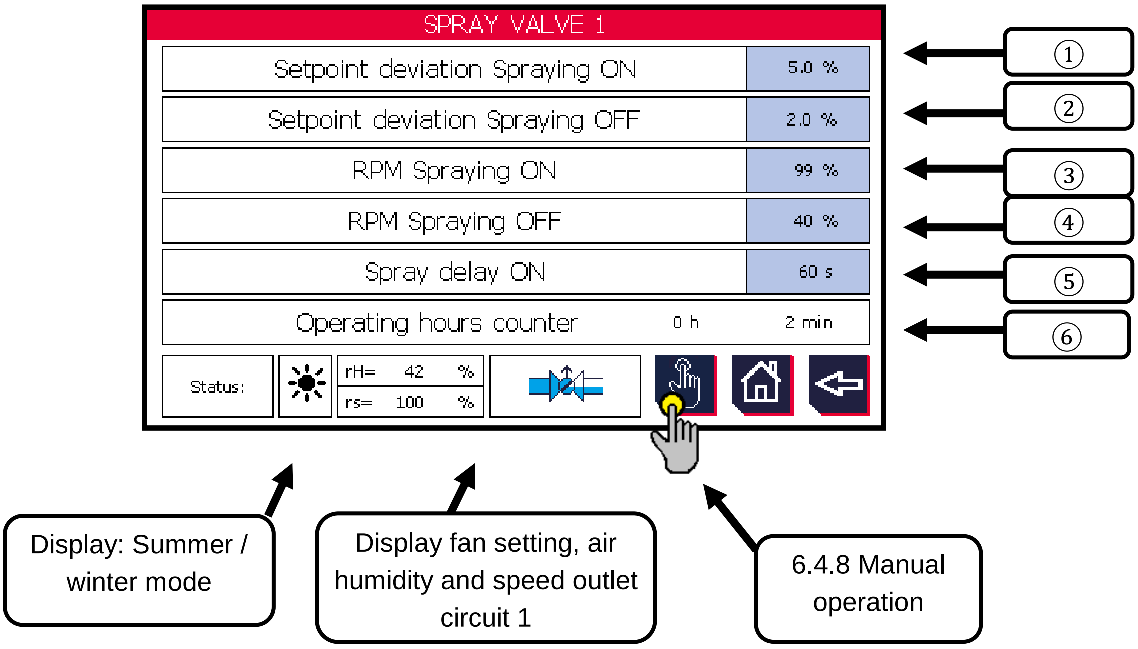
Register	Name	Register value (signed integer)	Converted to °C/°F
8	"Shifting signal external temp. wetting ON"	-250 ... 250	-25.0 ... 25.0 °C
		-450 ... 450	-45.0 ... 45.0°F

6.4.5 Spraying valves

In the **Spraying valve [No]** sub-menu, the current switch-on and switch-off thresholds for the respective spraying stage are displayed (see Image 117). However, the spraying is only activated if the external temperature limit (see 6.4.4 "*External temperature spraying* ON") is exceeded. The following parameters can be edited:

The value can be edited by selecting the buttons with blue backgrounds.

Image 117



① **Setpoint (SP) deviation spraying ON**

Switch-on condition for spray stage [No]. This is met if the actual value is higher than the setpoint by the percentage value set here. If all switch-on conditions are met, the respective spraying stage switches ON.

Can be edited from …to:	0.0… 20.0 %
Factory settings:	5.0 %

② **Setpoint (SP) deviation spraying OFF**

Switch-off condition for spray stage [No]. This is met if the actual value is smaller or greater than the setpoint by the percentage value set here (depending on the prefix of the edited value). If all switch-off conditions are met, the respective spraying stage switches OFF.

Can be edited from …to: -20.0… 15.0 %

Factory settings: (Stage 1 … 4) 2.0 %, 2.0 %, 4.0 %, 4.0 %

③ **Speed spraying ON**

Switch-on condition for spray stage [No]. If the current speed setpoint exceeds the % value edited here, the start-up delay (⑤) starts. If this time has elapsed, and all other switch-on conditions are met, the spray stage [No] switches ON.

Can be edited from …to: 80 … 100 %

Factory settings: 100 %

④ **Speed spraying OFF**

Switch-off condition for spray stage [No]. This is met if the current speed setpoint falls below the % value edited here. If all other switch-off conditions are met, the spray stage [No] switches OFF.

Can be edited from …to: 30 … 90 %

Factory settings: 40 %

⑤ **Delay spraying ON**

Switch-on condition for spray stage [No], which sets a delay after fulfilling prior conditions (① and ③) in minutes. This delay prevents the spray stages from constantly switching on and off, and gives the controller the necessary time to "level off".

Can be edited from …to: 1 … 600 s

Factory settings: 60 s

⑥ **Operating hour counter**

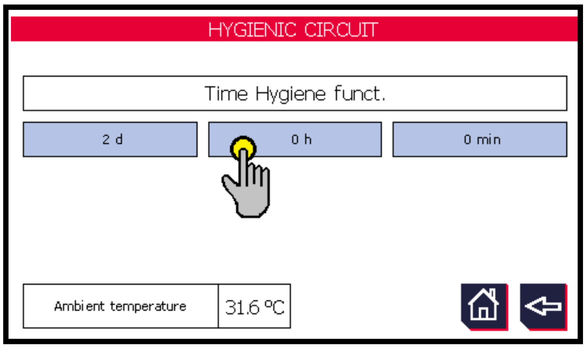
Display of operating hours and minutes of the respective spray stage. Helpful for monitoring and evaluating dry and wet mode of the system.

6.4.6 Hygiene circuit

The **hygiene circuit** should prevent Legionella formation and stagnation in the supply line of the thermofin® spray system. As soon as the adiabatic is switched off, the counter starts to record the waiting time. If the set time has been reached, the draining valve opens and the entire water line up to the main water valve is drained. The valve remains open until the device requests water again.

Selecting the "Hygiene circuit" button with a blue background (see Image 118) allows the wait time to be edited as follows:

Image 118



	from ... to	Factory settings
Day	0 … 7	2
Hour	0 … 23	0
Minute	0 … 59	0

6.4.7 Flushing circuit

To impede the formation of biofilms on the internal wall of the pipe, long sections of pipe with wetting water that remains stagnating for long periods should be avoided.
Observe the relevant regulations and standards for immission control at the installation location. For usage cases in which there is a long branch line to the main water valve, this can be flushed by the TCS, provided there is also a stop valve installed.

The **flushing circuit** is used to prevent stagnating water in the branch of the water line up to the main water valve. If the spraying is out of order, the flushing circuit is repeatedly triggered in the set time interval.

The function differentiates between the **flushing wait time** until the next flush is triggered, and the **flushing impulse time**. This indicates how long the main water valve remains open to flush the branch line.

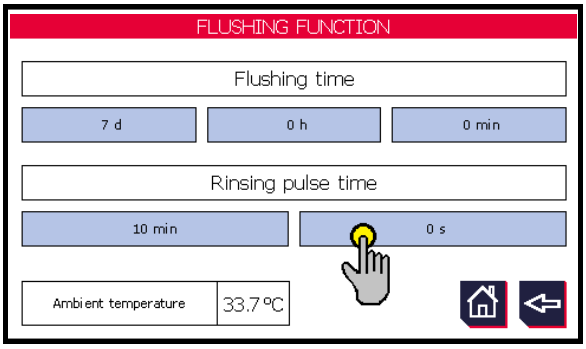
Rinse cycle in wet mode:
The draining valve is first closed so that the water can also flush the lines to the device and the spray nozzles. After half of the flushing impulse time, the draining valve opens. If the main water valve is closed again after the time has elapsed, the line drains by itself.

Flushing circuit in dry or winter mode:
The control and draining valve opens during the **flushing impulse time**, the stop valve is closed. The branch line is flushed and the flushing water is drained via the draining valve. This means that no water gets outside the frost-free area and AdiabaticPads or spray nozzles are not wetted.

Flushing wait time		
	from ... to	**Factory settings**
Day	0 … 7	7
Hour	0 … 23	0
Minute	0 … 59	0

Flushing impulse time		
	from ... to	**Factory settings**
Minute	0 … 30	10
Seconds	0 … 59	0

Image 119

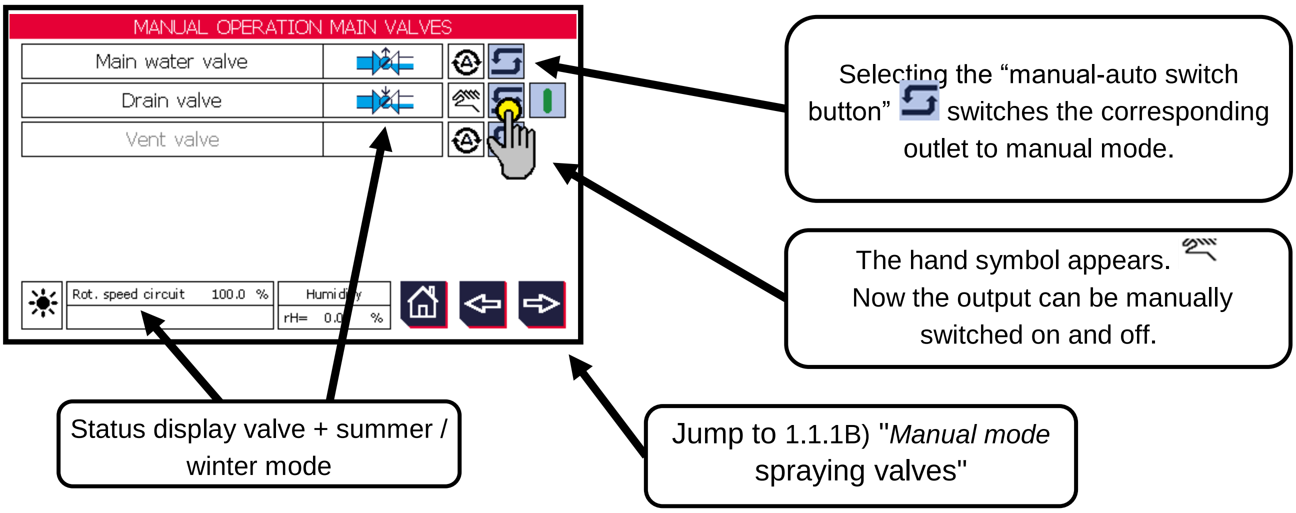


6.4.8 Manual mode

All greyed-out valves in the display are not selected in Device settings → Additional functions → Wetting.

A) Manual mode main valve

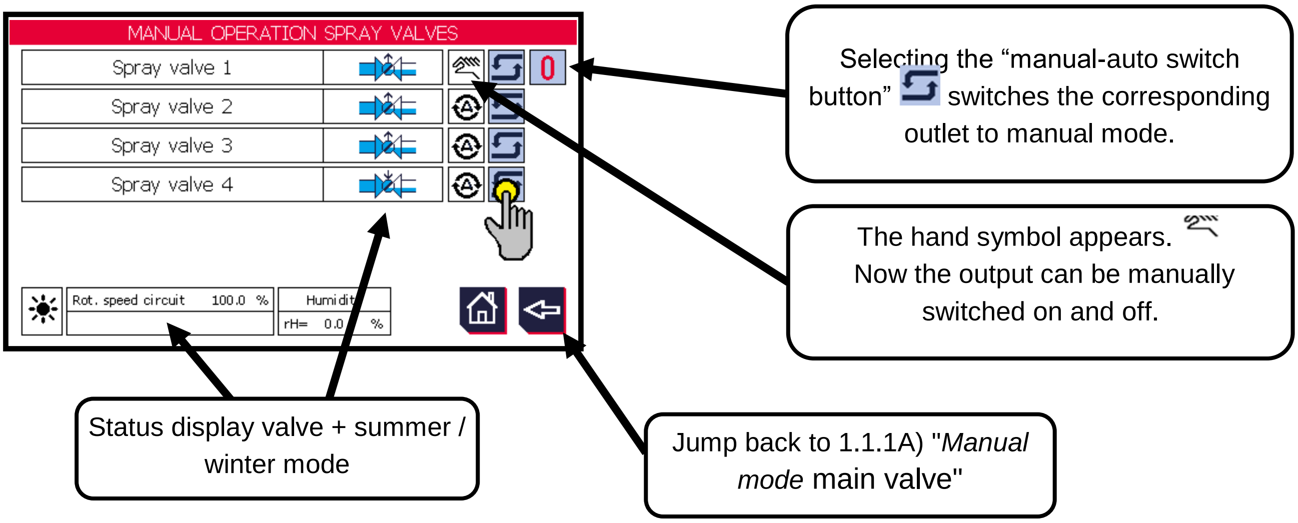
Image 120



Selecting the "manual-auto switch button" again switches the corresponding outlet back to manual mode. It changes back to the status that it normally had in automatic mode.

B) Manual mode spraying valves

Image 121



Selecting the "manual-auto switch button" again switches the corresponding outlet back to manual mode. It changes back to the status that it normally had in automatic mode.

7. DEVICES WITH COOLING MAT (ADIABATICPADS)

Devices with cooling mats (thermofin® AdiabaticPads) are for pre-cooling the ambient air using a wetted humidification element located immediately in front of the fin block. The cooling mat becomes saturated with water. In the air stream, part of the water evaporates and cools the inlet air. The TCS.2 calculates the air cooling and the necessary quantity of water. The flow of water that is currently necessary is constantly introduced to teh device through a control valve with a flow meter.

All necessary settings for this are explained in the following chapter.

7.1 Adaptations in: Device settings → Additional settings → Wet settings Mat

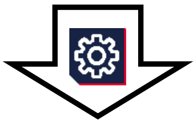


Image 122

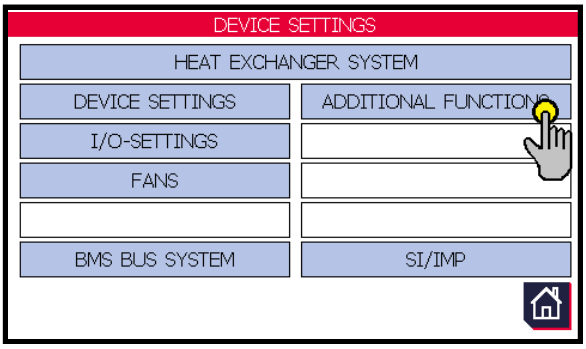


Image 123

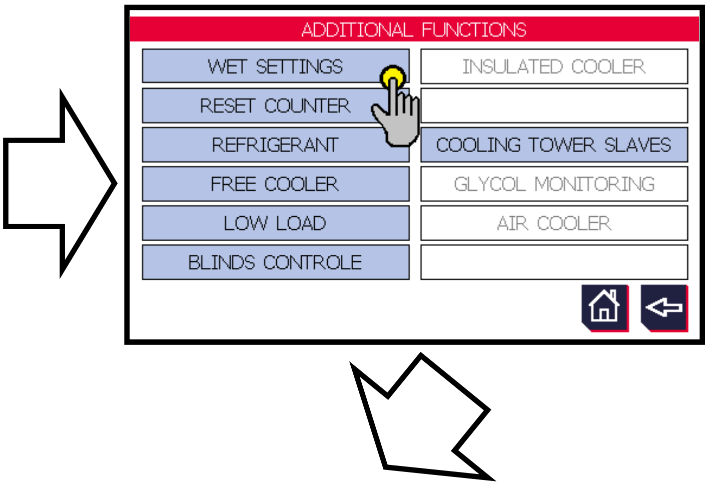
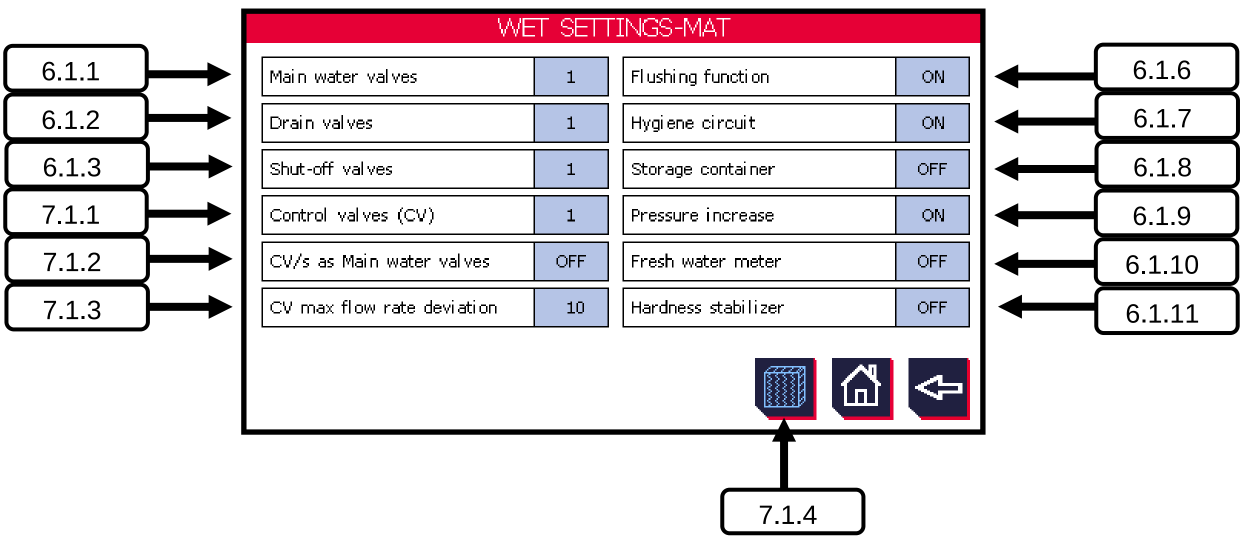


Image 124



7.1.1 Control valve (CV)

Selection of the number of control valves for mat wetting that should be controlled and monitored by the TCS.2.

Can be edited from …to: 1 … 2 spraying valves
Factory settings: 2 spraying valves

If only one control valve is used, this can simultaneously be used as a main water valve [see chapter 7.1.2 "*Control valve (CV) as main* water valve"].

7.1.2 Control valve (CV) as main water valve

Control valve 1 simultaneously works as a main water valve. This option is possible when using only one wetting stage (CV). Any selected main water valve is automatically deselected. The following requirements apply for these:

- Installation in a branch line that is as short as possible to rule out stagnation
- If connected to the drinking water network, the relevant standards must be met
- Emergency position closed in the event of power failure
- must be installed in a frost-free area!

7.1.3 CV max. flow deviation

Permissible control deviation between water demand and actual flow through the control valve (CV), until the TCS generates the following fault: "V09 Adiabatic valve [No] flow <>". See also chapter 12.9 "Valve messages – Fault code V...".

Can be edited from …to: 10… 100%
Factory settings: 10%

7.1.4 Mat system

The user reaches the **Mat system** sub-menu by pressing the mat symbl (see Image 125). If the main water valve is open, the symbol will have a light blue background. This shows whether the adiabatic is in operation.

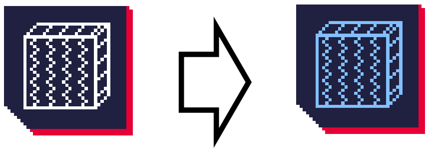
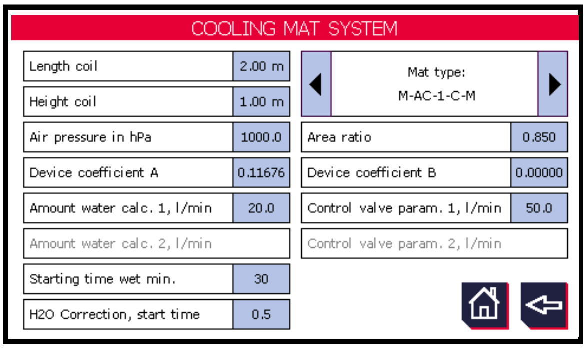


Image 125

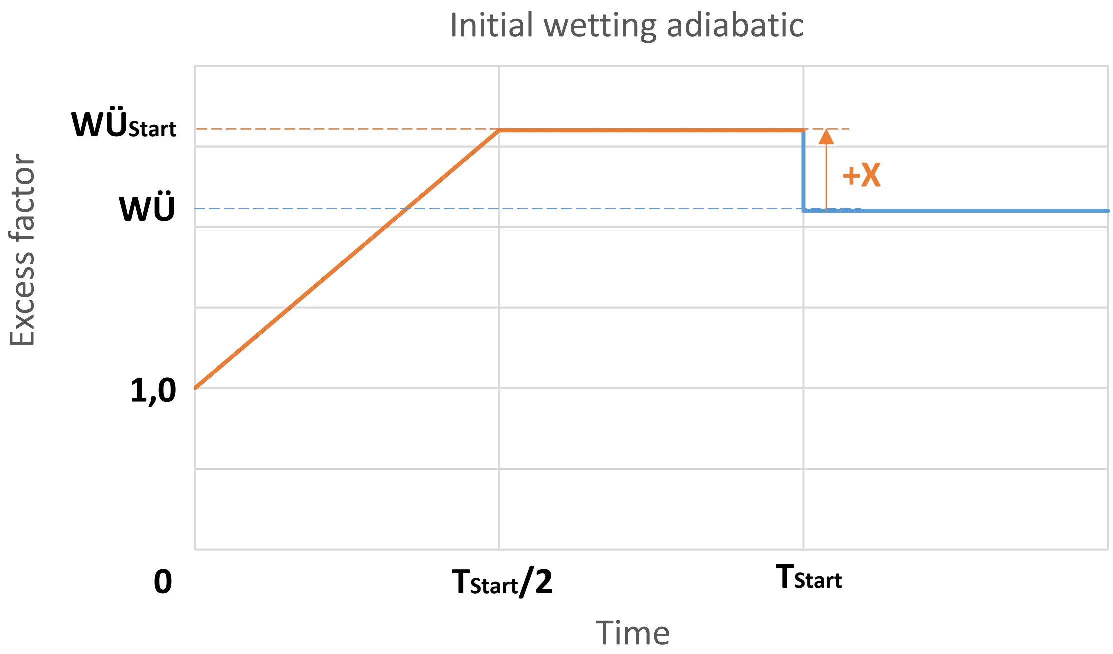


Device parameters needed by the TCS to calculate the water quantity and switching points correctly can be set under **Mat system**.
The **mat type** is selected on the right. The dimensions of the block as well as the air pressure at the installation site are entered on the left in hPa. The area ration corrects the ration of the block area to the mat area.
The **device coefficients** are used to calculate the quantity of air.
Water quantity nominal designates the required flow of water at the design point.
Water quantity max is the maximum possible flow on which the control vavle is parametrised at the factory.
The initial wetting can be set under **Start-up time wet** in minutes. Factory settings: 30 min
The additional excess water factor during the start-up time can be adapted under **H2O correction start-up time**. Factory settings: 0.5

7.1.5 Initial wetting adiabatic mats

The initial wetting phase is for the most complete wetting possible of the mat surfaces. The excess water factor $W\ddot{U}$ is increased by one summand X during this time. The mat also receives more water than in normal operation. This is necessary so that the cellulose sheets can be fully saturated. The time of the initial wetting T_{Start} can be edited by the customer, as well as the increasing the excess X and the water excess factor$W\ddot{U}$ itself.

$$W\ddot{U}_{Start} = W\ddot{U} + X$$



After the start wetting is complete, the excess factor jumps back to the set baseline $WÜ$. Excessive cooling at the start of the wetting can lead the fans to overdrive under certain operating conditions. If the speed falls below the switch-off threshold for wet mode, the adiabatic will switch off independently. To prevent this, the excess factor is gradually increased from 1.0 to the target value $WÜ_{Start}$ during the first half of the initial wetting.

Parameter	Formula symbol	Standard value	Adjustable in TCS
Duration of initial wetting	T_{Start}	30min	yes
Water excess factor normal operation	$WÜ$	2.1	yes
Water excess factor at start	-	1.0	no
Increase excess factor	X	0.5	yes

7.2 I/O settings valves

As standard, the following I/Os are used for requesting or receiving feedback from the valves:

Designation	Variants	Basic device		Extension	
		DI	DO	DI (CAN Addr. 9)	DO (CAN Addr. 23)
Main water valve	1 control valve	-	-	-	-
	2 spraying valves	-	-	45	45
Draining valve	1 control valve	6	6	-	-
	2 spraying valves	-	-	46	46
Stop valve	1 control valve	-	-	-	-
	2 spraying valves	5	5	-	-

When using extension module KSM 730.29 (CAN address 30):

Designation	Variants	Basic device		Extension CAN addr. 30	
		AI	AO	AI	AO
Control valve 1	with 1 control valve	4	2	-	-
	with 2 control valves	-	-	5	3
Control valve 2	with 2 control valves	-	-	6	4
Air humidity	with 1 control valve	3	-	-	-
	with 2 control valves	-	-	7	-
External temperature	with 1 control valve	2	-	-	-
	with 2 control valves	-	-	8	-

When using extension module AKM 730.10 (optionally selectable CAN address 31):

Designation	Variants	Basic device		Extension CAN addr. 31	
		AI	AO	AI	AO
Control valve 1	with 1 control valve	4	2	11	7
	with 2 control valves	4	2	11	7
Control valve 2	with 2 control valves	-	-	12	8
Air humidity	with 1 control valve	3	-	13	-
	with 2 control valves	3	-	13	-
External temperature	with 1 control valve	2	-	-	-
	with 2 control valves	2	-	8	-

Bus parameter valves
Feedback via Modbus:

Register	Bit	Designation	Meaning	Register value
144	**0**	Main water valve 1 open	TRUE = main water valve open	read 1
145	**0**	V01 Main water valve 1 runtime error	TRUE = main water valve runtime error	read 1
146	**0**	Main water valve 2 open	TRUE = main water valve open	read 1
145	**3**	V01 Main water valve 2 runtime error	TRUE = main water valve runtime error	read 8
144	**1**	Draining valve 1 open	TRUE = draining valve open	read 2
145	**3**	V02 draining valve 1 runtime error	TRUE = draining valve runtime error	read 8
146	**1**	Draining valve 2 open	TRUE = draining valve open	read 2
145	**4**	V02 draining valve 2 runtime error	TRUE = draining valve runtime error	read 16

144	**6**	Stop valve 1 open	TRUE = stop valve open	read 64
145	**2**	V03 stop valve 1 runtime error	TRUE = stop valve runtime error	read 4
146	**2**	Stop valve 2 open	TRUE = stop valve open	read 4
145	**5**	V03 stop valve 2 runtime error	TRUE = stop valve runtime error	read 32

Register	Bit	Designation	Meaning	Register value / type	Output
10	**-**	Control valve 1	Control valve setpoint circuit 1	INT 0 … 1000	Write 0.0… 100.0 %
91	**-**		Setpoint	Word	Read 0… 100%
92	**-**		Actual value	Word	Read 0… 100 %
145	**9**	V09 Control valve 1 Flow <>	TRUE = Control valve adiabatic pads, flow <> circuit 1	read 512	-
152	**0**	V08 Control valve 1 Wire break	TRUE = Control valve adiabatic pads, wire break circuit 1	read 1	-
11	**-**	Control valve 2	Control valve setpoint circuit 2	INT 0 … 1000	Write 0.0… 100.0 %
93	**-**		Setpoint	Word	Read 0… 100 %
94	**-**		Actual value	Word	Read 0… 100 %
145	**10**	V09 Control valve 2 Flow <>	TRUE = Control valve adiabatic pads, flow <> circuit 2	read 1024	-
152	**1**	V08 Control valve 2 Wire break	TRUE = Control valve adiabatic pads, wire break circuit 2	read 2	-

7.3 Adjustments in Main menu → Additional functions → Wet menu mat

The **Wet menu** sub-menu is available for settings. It is protected with the user parameter password [see also chapter 2.4.3 “User parameter password (editable)”].

Image 126

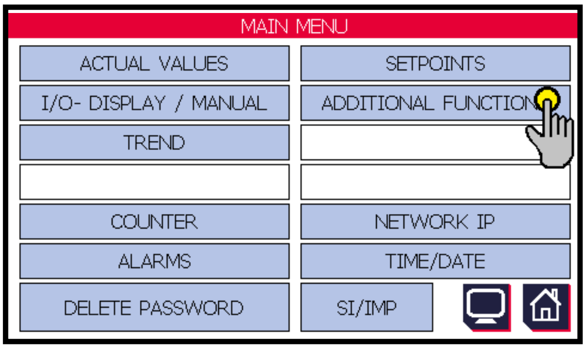


Image 127

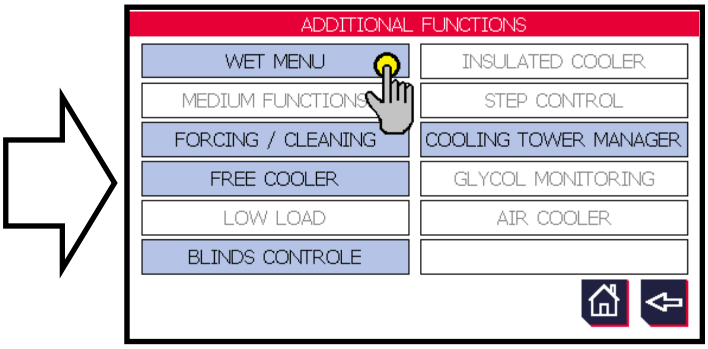
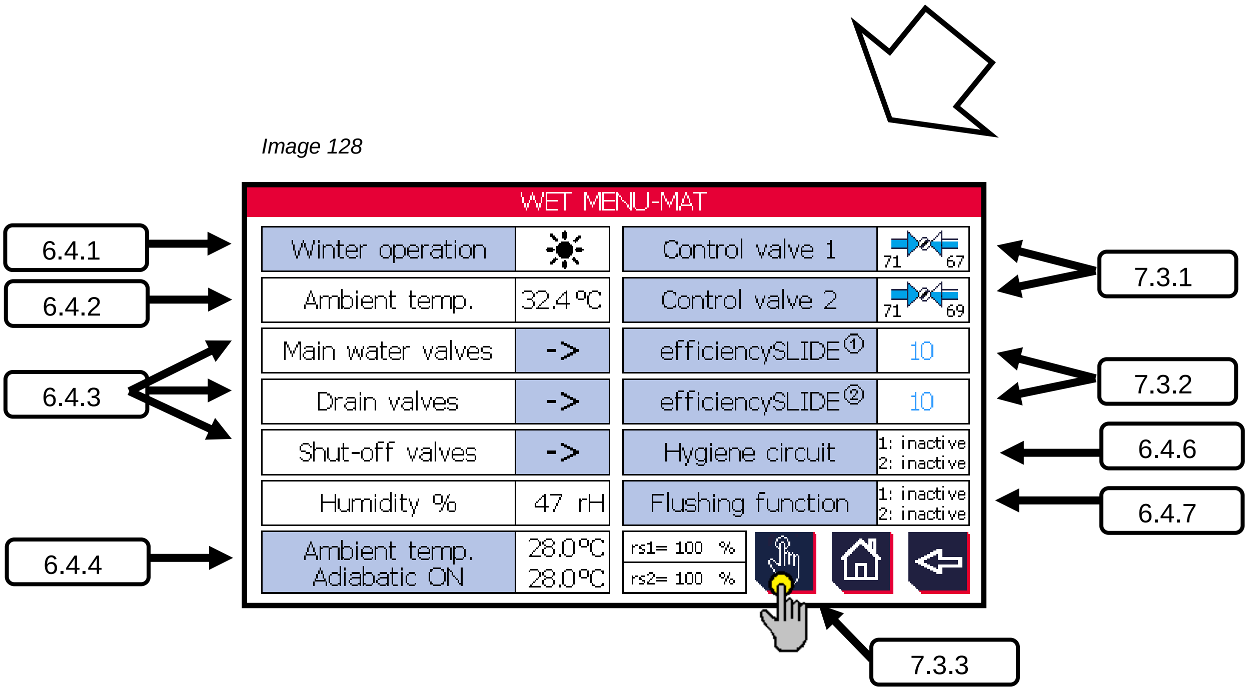


Image 128



Greyed-out functions are not activated or selected in Display settings.

7.3.1 Control valve 1 / 2

In the **Control valve [No]** sub-menu, the current switch-on and switch-off thresholds for the adiabatic function are displayed. However, the adiabatic is only activated if the external temperature limit (see 6.4.4. “External temperature spraying ON”) is exceeded. The menu is closely linked with the **efficiencySLIDE** menu, elthough the **efficiencySLIDE** menu is higher level.

The switch-on and switch-off thresholds are determined by the speed and possible air precooling. They are dependent on each other in a ratio that can be adjusted in the "efficiencySLIDE" sub-menu. For this reason, all main settings must be made there (see 7.3.2 "*efficiencySLIDE*"). The **efficiencySLIDE** setting is displayed in the mat menu (see Image 128).

If the user changes one of the four switching thresholds for the adiabatic operation in the **Control valve** menu, all other values automatically change with it. The **efficiencySLIDE** is thereby indirectly shifted. For example, changing the switch-on speed of the adiabatic shifts all other switching thresholds (see Image 130 and Image 131).

Image 129

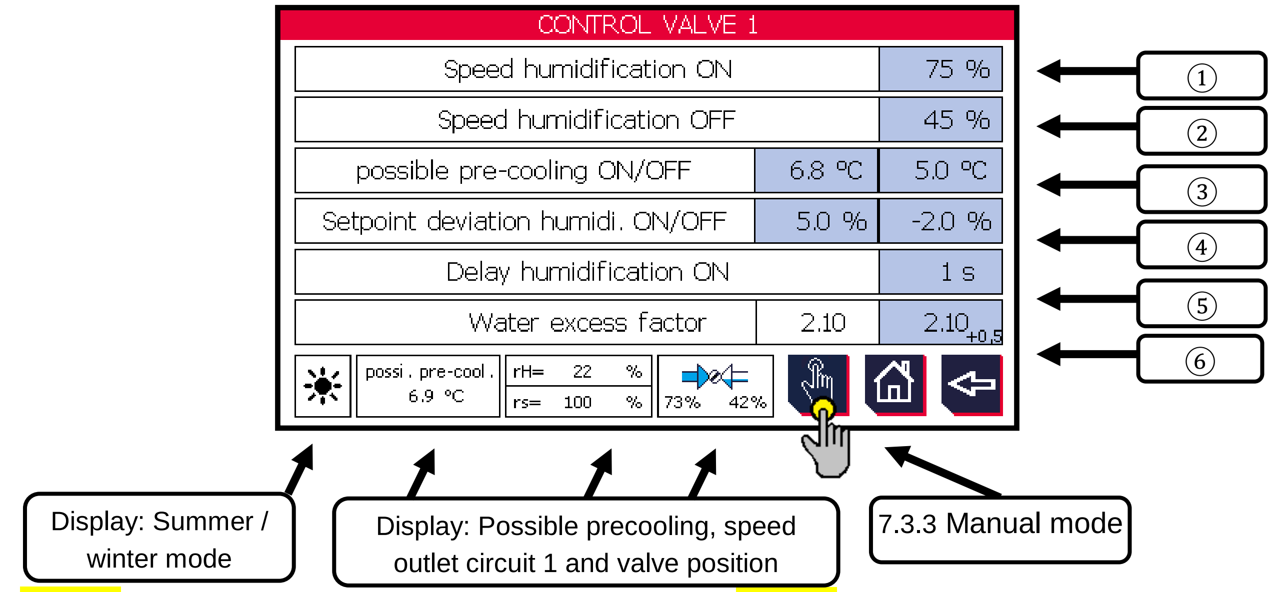
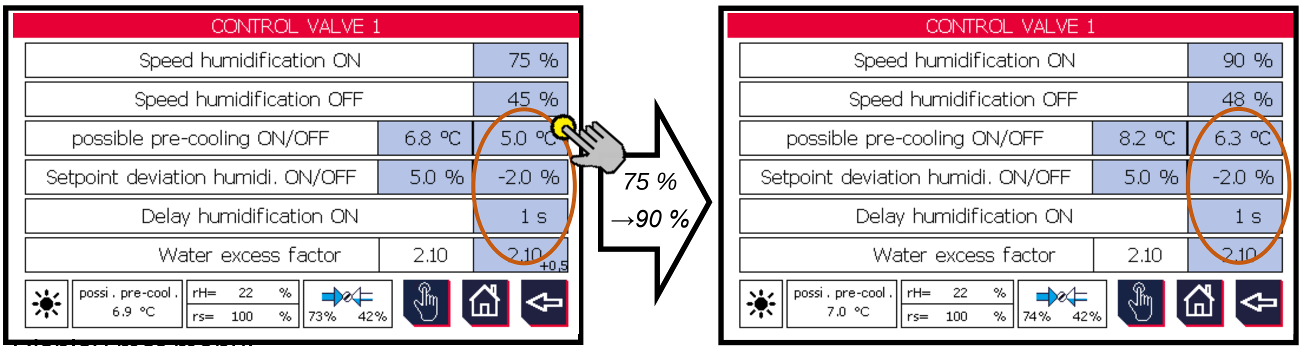


Image 131 *Image 130*



Display mat menu:

efficiencySLIDE①	N

efficiencySLIDE①	6

① Speed humidification ON

Switch-on condition for wetting stage [No]: If the current speed setpoint exceeds the % value edited here, the start-up delay (⑤) starts. If this time has elapsed, and all other switch-on conditions are met, the wetting stage [No] switches ON.

Can be edited from …to: 65 … 100 %

Factory settings: 99 %

② Speed humidification OFF

Switch-off condition for wetting stage [No]: This is met if the current speed setpoint falls below the % value edited here. If all other switch-off conditions are met, the wetting stage [No] switches OFF.

Can be edited from …to: 40 … 50 %

Factory settings: 50 %

③ possible precooling ON

Switch-on condition for wetting stage [No]: With the help of the ambient conditions (air pressure, air humidity, temperature) and the device utilisation, a **possible precooling** of the sucked-in air with humidified mats is calculated in °C. If this exceeds the value edited here, the start-up delay starts (⑤). If this time has elapsed, and all other switch-on conditions are met, the wetting stage [No] switches ON.

Can be edited from …to: depending on the setting in "efficiencySLIDE"

Factory settings: 0 °C

④ possible precooling OFF

Switch-off condition for wetting stage [No]: With the help of the ambient conditions (air pressure, air humidity, temperature) and the device utilisation, a **possible precooling** of the sucked-in air with humidified mats is calculated in °C. If this falls below the value edited here, and all other switch-off conditions are met, the wetting stage [No] switches OFF.

Can be edited from …to: depending on the setting in "efficiencySLIDE"

Factory settings: 0 °C

⑤ Delay humidification ON

Switch-on condition for spray stage [No]: Which sets a delay after fulfilling prior conditions (① and ③) in minutes. This delay prevents the spray stages from constantly switching on and off, and gives the controller the necessary time to "level off".

Can be edited from …to: 1 … 600 s

Factory settings: 60 s

⑥ **Water excess factor**

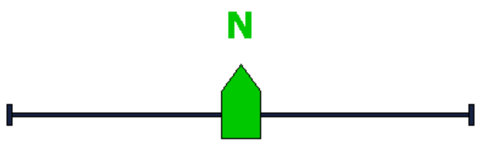
Sets the value by which the necessary evaporation water quantity will be multiplied. This is necessary to guarantee the long-term humidification of the mats and to limit the risk of deposits and contamination due to drying out. The factor can be edited within the range of 1.0 to 3.0.

If the adiabatic is activated, it needs more water in the initial phase as the paper mats must first be fully saturated. For this reason, the water excess must be set to 2.5 in the first 30 minutes. If the excess is generally over 2.5, it remains unchanged.

7.3.2 efficiencySLIDE

The **efficiencySLIDE** generally controls how often and how long the adiabatic will be used during the year. At **water saving** setting, the adiabatic is only activated at peak load, when the fan speed limit has been reached. During **energy saving** mode, the adiabatic switches on earlier and is also active for longer and more often. The slide can be shifted between these points as much as required. Its colour indicates the mode and a number value (0-10) indicates the position. The position of the slide is also displayed in the **Mat menu** (7.3).

A precise pre-setting of the switch-on and switch-off thresholds and the relationship between (speed – possible precooling) in the efficiencySLIDE settings is very important for using the slide properly!

Mode of operation	**Display in efficiencySLIDE menu**	**Display in mat menu**
energy saving		efficiencySLIDE① 7
neutral		efficiencySLIDE① N
water saving		efficiencySLIDE① 9

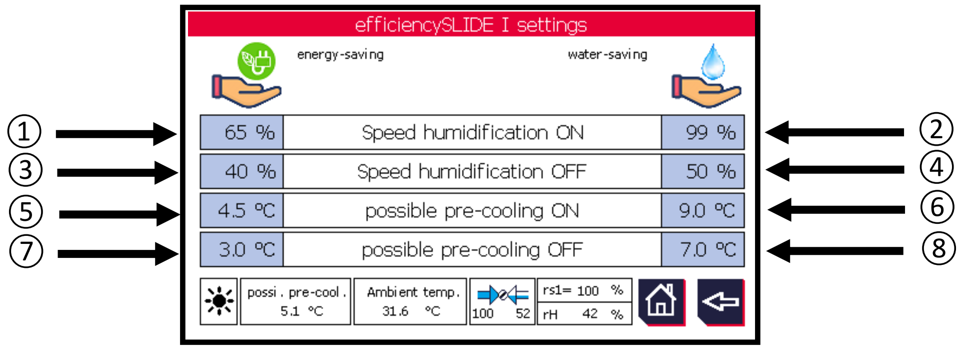
efficiencySLIDE settings: Determining the switching thresholds for the energy and water saving modes.

In general, there are two options for switching the adiabatic on and off automatically.

- ➔ Using the **speed regulator** (the adiabatic is switched on and off depending on the usage of the device). This criterion does not ask whether humidifying the mats at this point actually makes sense and cools the air.
- ➔ Using the **possible precooling** of the air. The TCS.2 calculates this based on the external temperature, the air pressure, the relative air humidity and the current flow rate. This means, for example, that at a very high air humidity, the adiabatic will only switch on relatively late or not at all, as this would cause hardly any or no cooling of the air.

Both switching thresholds can also be combined. Careful commissioning and contorl of the effect is essential to ensure an environmentally friendly operation (energy or water saving).

Image 132



The switch-off thresholds can generally not be over the switch-on thresholds, and the thresholds in energy saving mode cannot be higher than in water saving mode.

Setting range speed limits (%):

① energy saving: 30 to 55 %	**speed humidification ON**	② water saving: 70 – 100 %
③ energy saving 20 to ①-5 %	**speed humidification OFF**	② water saving: 50 to ②-5 %

It must be ensured with the speed regulation that the switch-off threshold is significantly over the switch-on threshold. Precooling the air reduces the necessary air flow, which lowers the fan speed. If the switch-off threshold has already been reached with this process, the adiabatic switches off again and the regulation oscillates.

Setting range limits of air cooling (°C):

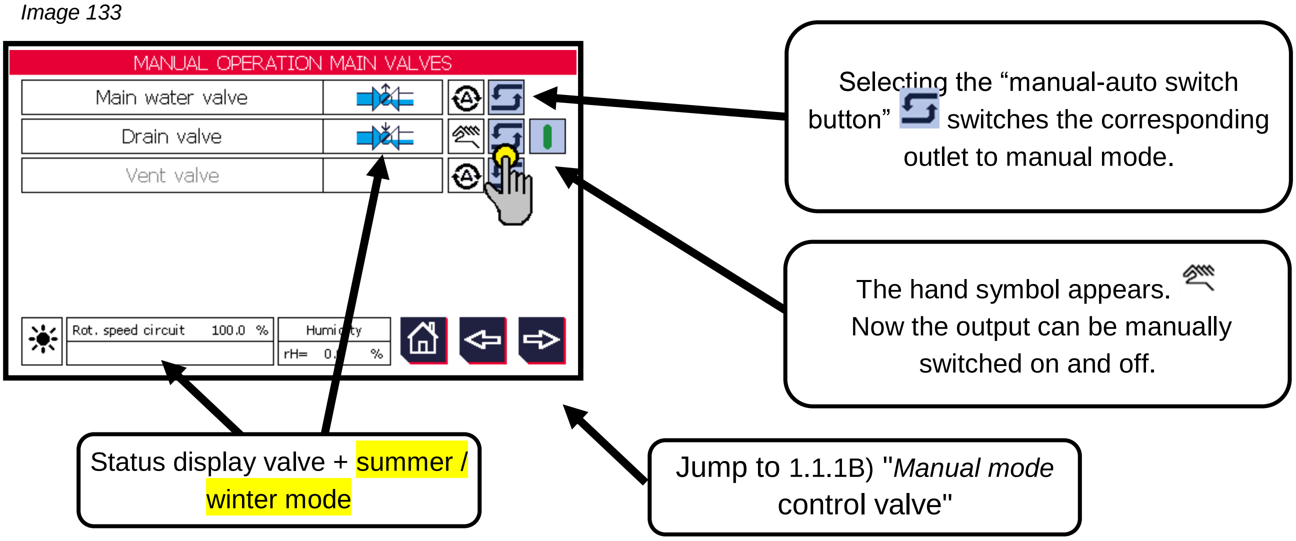
⑤ energy saving 0.0 to ⑥	**possible precooling ON**	⑥ water saving: 0.0 to 20.0
⑦ energy saving 0.0 to ⑤	**possible precooling OFF**	⑧ water saving: 0.0 to ⑥

7.3.3 Manual mode

All greyed-out valves in the display are not selected in Device settings → Additional functions → Wetting.

A) Manual mode main valve

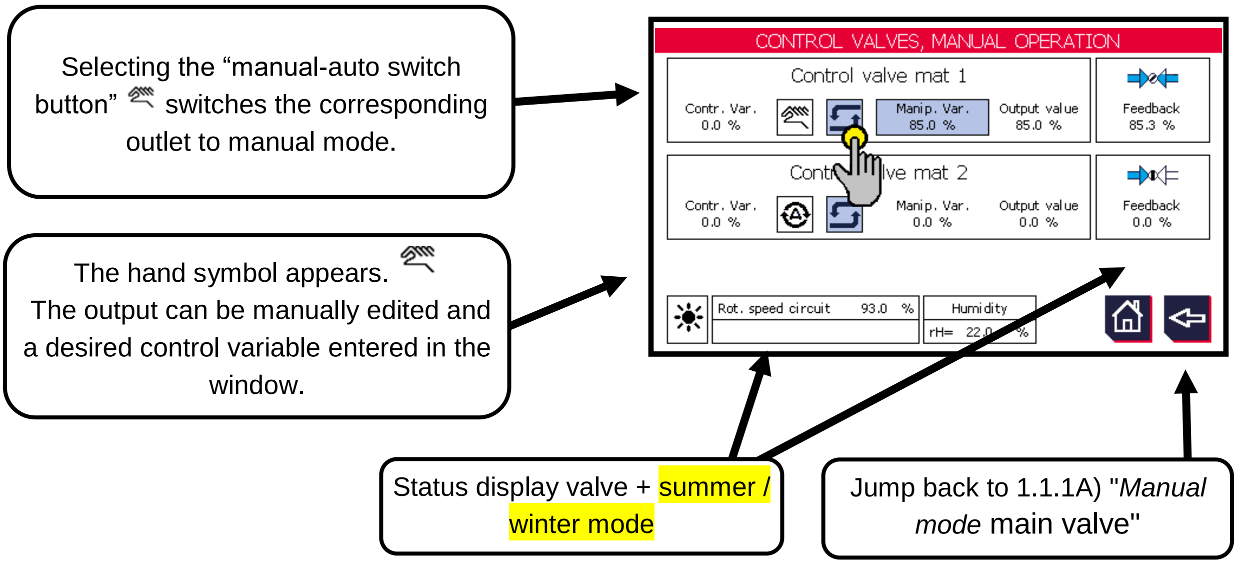
Image 133



Selecting the “manual-auto switch button” again switches the corresponding outlet back to manual mode. It changes back to the status that it normally had in automatic mode.

B) Manual mode control valve

Image 134



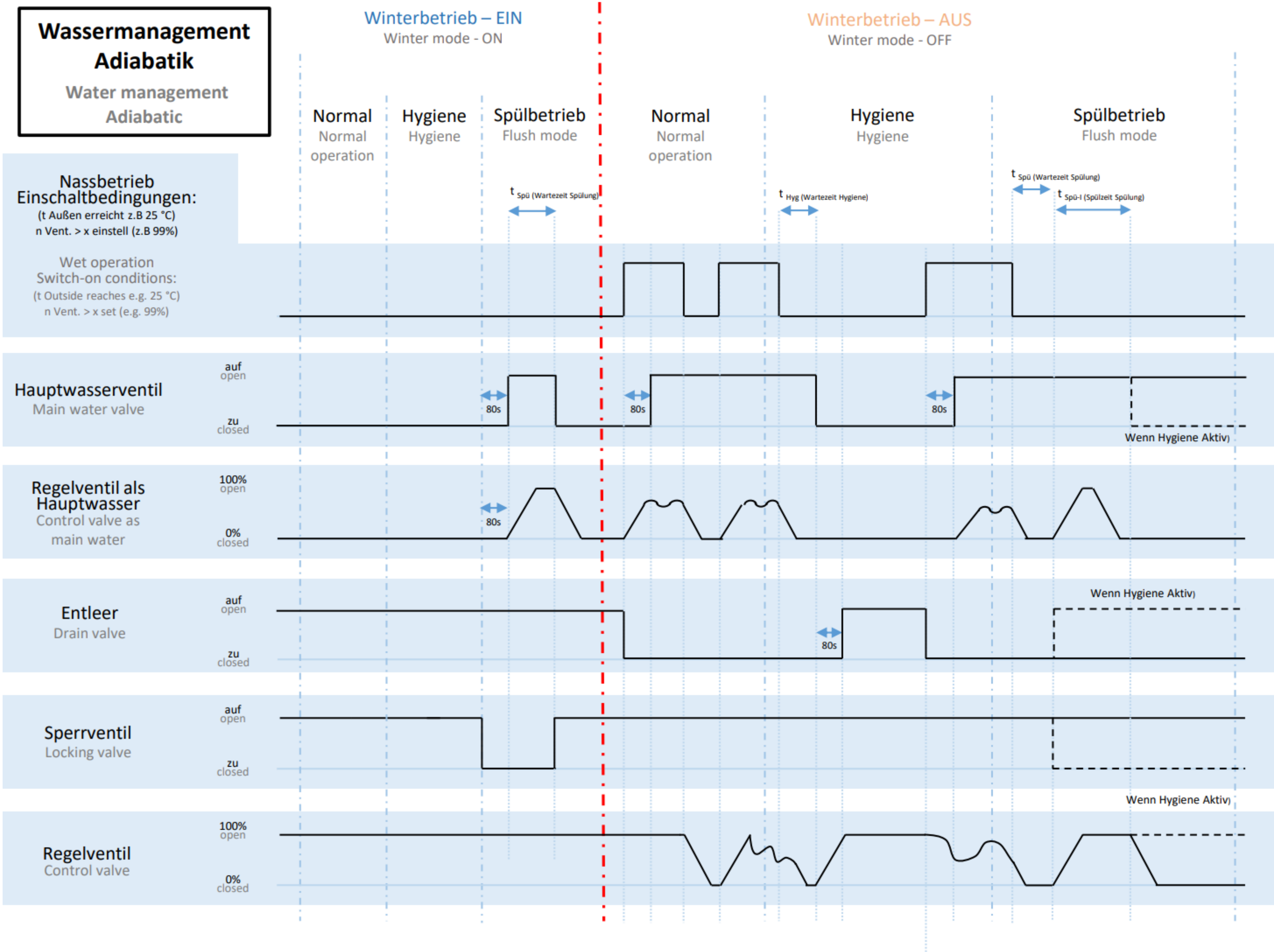
Selecting the "manual-auto switch button" again switches the corresponding valve back to manual mode. The control variable takes on the value of the controlled variable again.

7.4 Cool mat attachments

7.4.1 Functional diagram water management adiabatic cooler

Schematic presentation of different operating statuses (winter, hygiene circuit, flushing circuit). See Image 135.

Image 135


Wassermanagement Adiabatik
Water management Adiabatic
Winterbetrieb – EIN
Winter mode - ON
Winterbetrieb – AUS
Winter mode - OFF
Normal
Normal operation
Hygiene
Hygiene
Spülbetrieb
Flush mode
Normal
Normal operation
Hygiene
Hygiene
Spülbetrieb
Flush mode
t Spü (Wartezeit Spülung)
t Hyg (Wartezeit Hygiene)
t Spü (Wartezeit Spülung)
t Spü-I (Spülzeit Spülung)
Nassbetrieb Einschaltbedingungen:
(t Außen erreicht z.B 25 °C)
n Vent. > x einstell (z.B 99%)
Wet operation Switch-on conditions:
(t Outside reaches e.g. 25 °C)
n Vent. > x set (e.g. 99%)
Hauptwasserventil
Main water valve
auf open
zu closed
80s
Wenn Hygiene Aktiv)
Regelventil als Hauptwasser
Control valve as main water
100% open
0% closed
Entleer
Drain valve
Sperrventil
Locking valve
Regelventil
Control valve

8. EVAPORATOR (COOLING TOWER)

8.1 Adjustments in Device settings → Additional functions → Wet settings Evaporator

Image 136

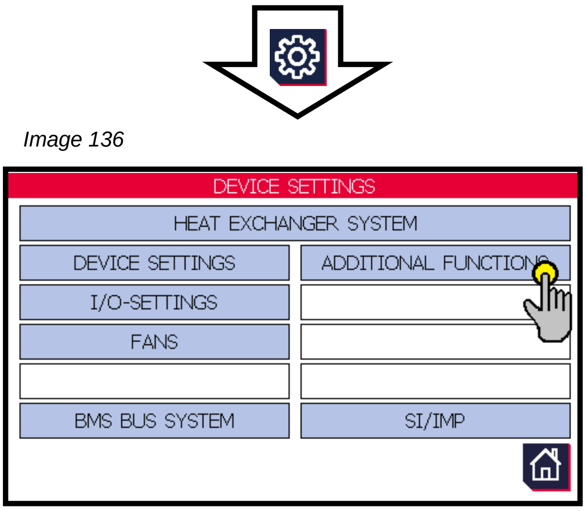


Image 137

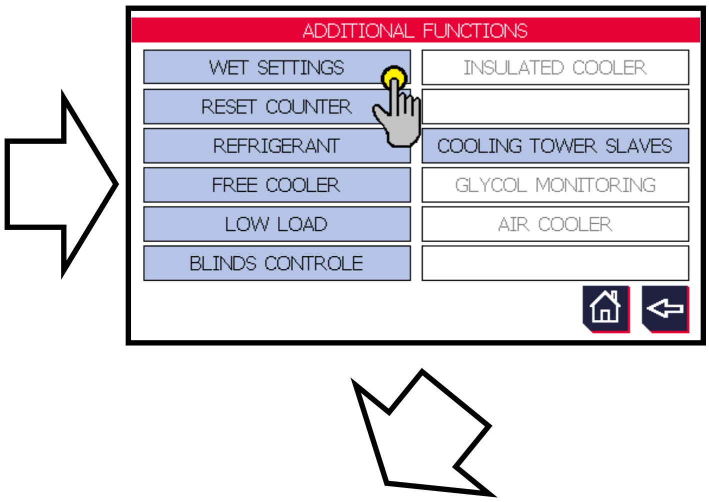


Image 138

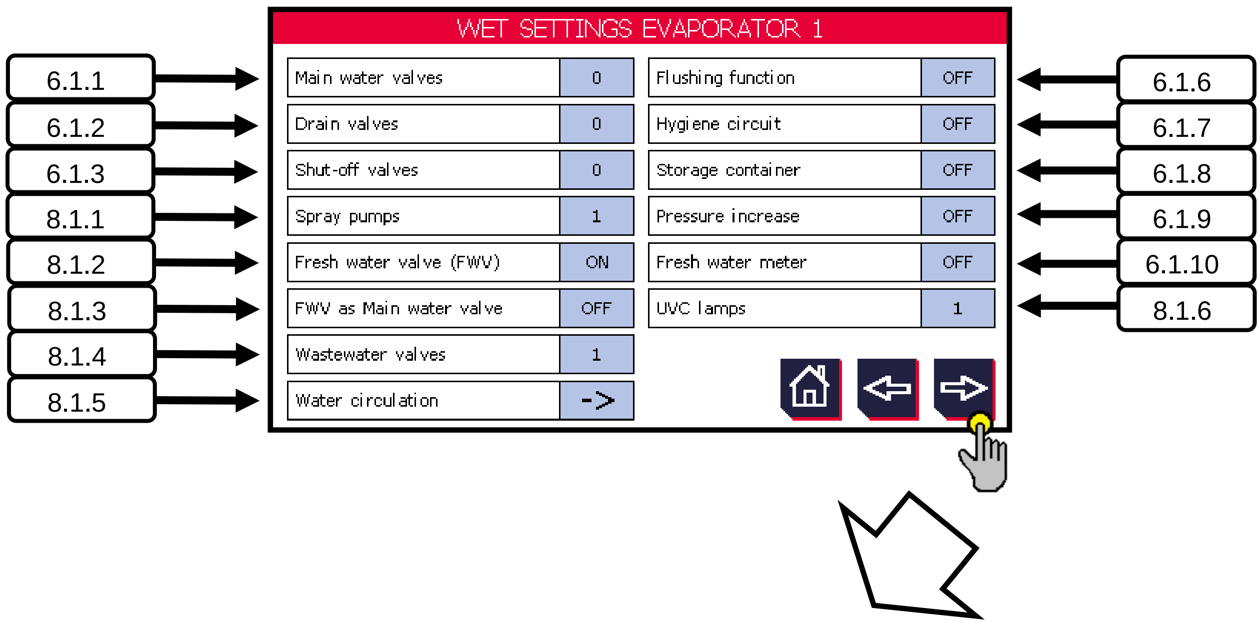
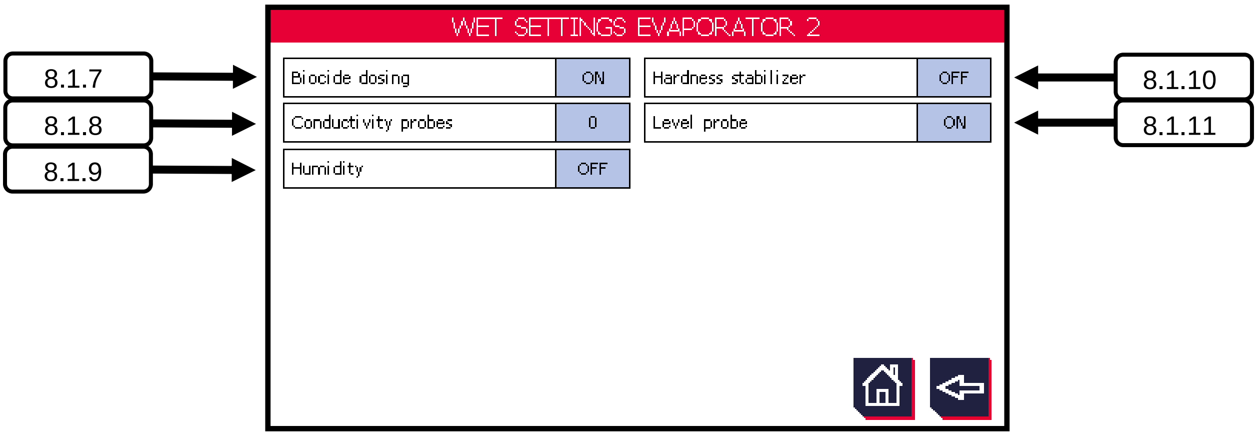


Image 139



8.1.1 Spray pump

Selection of the number of spraying valves for wetting the heat exchanger that should be controlled and monitored by the TCS.2.

Can be edited from …to: 1 … 2 spray pumps
Factory settings: 1 spray pump

8.1.2 Fresh water valve

Selection of whether a fresh water valve for automatic replenishment of the circulation basin should be controlled and monitored by the TCS.2.

Can be edited from …to: ON / OFF
Factory settings: ON

8.1.3 Fresh water valve as main water valve

The fresh water valve simultaneously works as a main water valve. Any selected main water valve is automatically deselected. The following requirements apply for these:

- Installation in a branch line that is as short as possible to avoid stagnation
- If connected to the drinking water network, the relevant standards must be met
- Emergency position closed in the event of power failure
- must be installed in a frost-free area!

Can be edited from …to: ON / OFF
Factory settings: OFF

8.1.4 Blowdown valves

Selection of how many blowdown valves for automatic hardness regulation should be controlled and monitored by the TCS.2 .

Can be edited from …to: 1 … 2 blowdown valves
Factory settings: 1 blowdown valve

8.1.5 Water circulation settings

Conductivity probe measuring range: (Enter maximal value of the measuring range of the conductivity probe here)

Can be edited from …to: 500 … 10000 µs/cm
Factory settings: 2000 µs/cm

Fill level probe active measuring length: (see type plate / datasheet of the probe)

Can be edited from …to: 100 … 500 mm
Factory settings: 100 mm

Fill level probe zero point: Typing on the value window with a blue background starts a teach-in function. The actual water level (zero point) is displayed as "ACTUAL = ...". This can be accepted with the tick symbol. 

Factory settings: 2182

Fill level probe zero point: Typing on the value window with a blue background starts a teach-in function. The actual water level (max. point) is displayed as "ACTUAL = ...". This can be accepted with the tick symbol. 

Factory settings: 3829

8.1.6 UVC lamps

Selection of the number of UVC lamps for sterilising the circulating water should be controlled and monitored by the TCS.2.

Can be edited from …to: 0 … 2 UVC lamps – (groups)
Factory settings: 0 UVC lamps

8.1.7 Biocide dosing settings

Selection of whether a biocide vaccination should be controlled and monitored by the TCS.2.

Can be edited from …to: ON / OFF
Factory settings: ON

8.1.8 Conductivity probes

Selection of whether a conductivity probe should be evaluated and monitored by the TCS.2.

Can be edited from …to: 0 … 1 conductivity probes
Factory settings: 0 conductivity probes

8.1.9 Air humidity

Selection of whether an air humidity sensor should be evaluated and monitored by the TCS.2.

Can be edited from …to: ON / OFF
Factory settings: OFF

8.1.10 Hardness stabiliser

After activating this function, the fill level of the hardness stabiliser container is monitored via the TCS.2.

Can be edited from …to: ON / OFF
Factory settings: OFF

8.1.11 Fill level probe

After activating this function, the fill level is evaluated and monitored by the TCS.2 via a probe. For further adjustable basic parameters for the level probe, see chapter 8.1.5 “Water circulation settings”.

Can be edited from …to: ON / OFF
Factory settings: ON

8.2 Adjustments in Main menu → Additional functions → Wet menu evaporator

Image 140

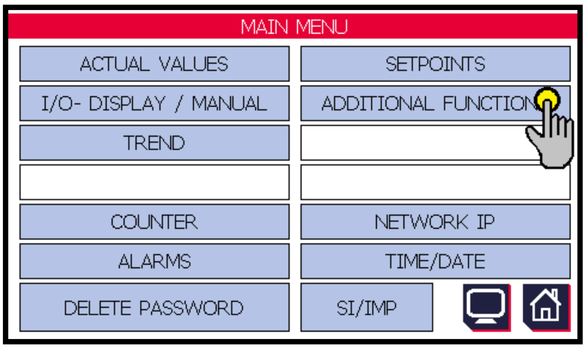
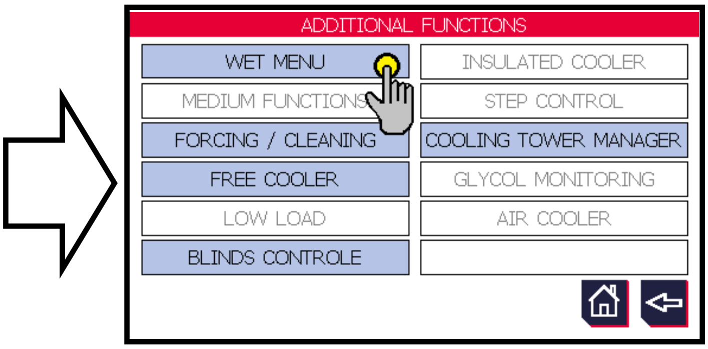


Image 141



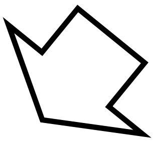
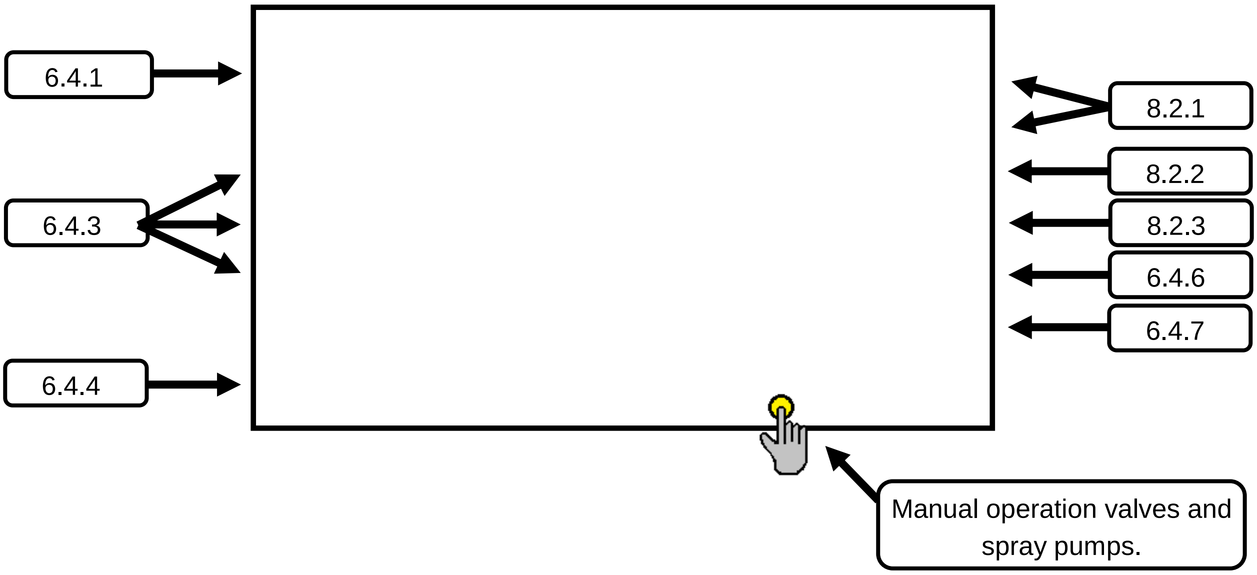


Image 142



8.2.1 Spray pump

This function makes it possible to control a circulation pump, which would be used e.g. with evaporators. It pumps water for wetting the pipe bundles.

Function only for single circuit devices
For dual circuit devices, the pumping function only applies to circuit 1.

A) Control (activation)

In principle, the following steps for activating this function should be observed:

1. Set digital input (DI-6) to "Fault spray pump" (see also chapter 5.2.1 “Digital IN basic device”).
   Logically "high" (+ 24 V DC at input) ≙ pump OK
   Logically "low" (0 V DC at input) ≙ Fault pump
   e.g. for motor protection

2. Set digital output (DO-6) to "Spray pump" (see also chapter 5.2.2 “*Digital OUT basic* device”)
   Logically "high" (+ 24 V DC at output) ≙ request spray pump
   Logically "low" (0 V DC at output) ≙ no request

3. A type of control must be selected. The following options exist (see also chapter 4.2.15 “*Control spray* pump”):

   ➔ **Spray pump control “internal”**
   - If the release (request circuit 1 DI-1) has been set and the conditions in the menu “Spray pump” have been met, the pump switches on.
   - see all switch-on and switch-off conditions below (in point **B**).

   ➔ **Spray pump control "via terminal"**
   - There is currently no digital input specifically provided for the activation of the spray pump.
   - Pump is also switched on and off via the release (external request, DI-1) and the conditions in the menu (see **B**) as with “internally”.

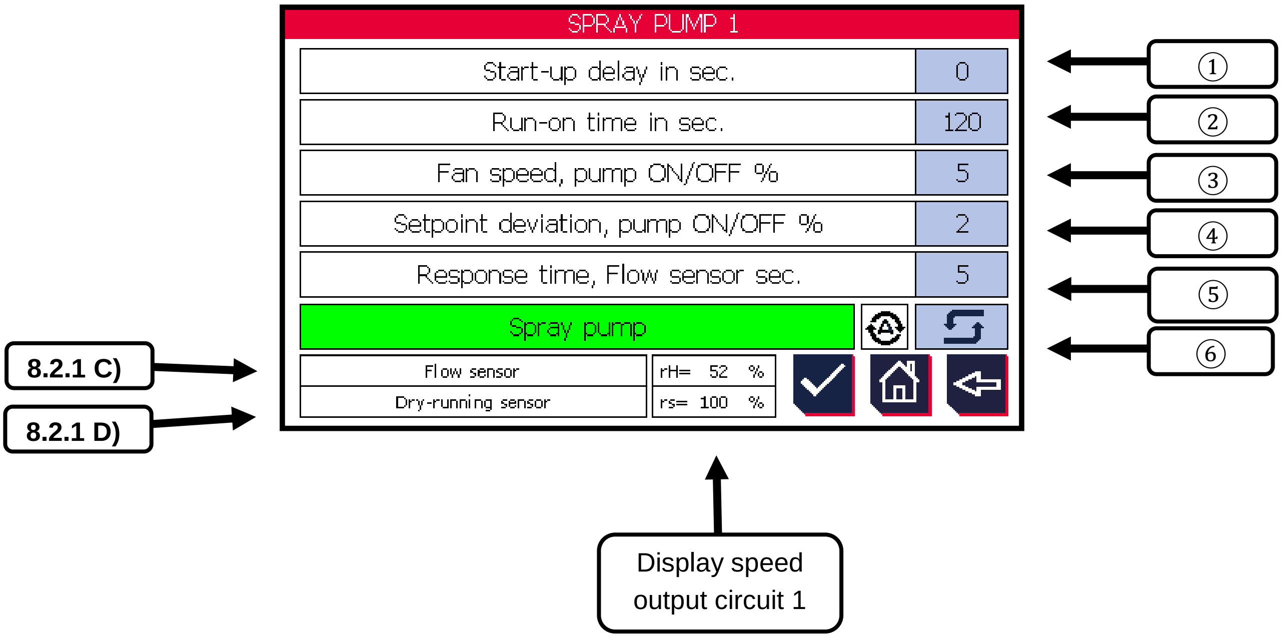
   ➔ **Spray pump control "via bus"**
   As soon as the bit named below has been set and the conditions in the menu “Spray pump” have been met, the pump switches on.
   - The following values exist for direct communication via MODBUS:

Register	Bit	Designation	Meaning	Register value
2	**1**	Spray pump	TRUE = Spray pump 1	Write 2
143	**9**	"Spray pump" Feedback	TRUE = Spray pump 1 active	Read 512

B) Editable values

Once a control selection has been made, the “Spray pump” box in the “Additional functions” menu appears blue and can be activated (Image 94). The "Spray pump" editing level opens.

Image 143



① **Start-up delay in seconds**

If the current speed setpoint (⑦) exceeds the "pump ON, fan speed %" value (③), the time set here starts. If this has elapsed, the spray pump switches ON.

Can be edited from …to: 0 … 600 s

Factory settings: 0 s

② **Run-on time in seconds**

If the current speed setpoint (⑦) falls below the "pump OFF, fan speed %" value (③), the time set here starts. If this has elapsed, the spray pump switches OFF.

Can be edited from …to: 0 … 1800 s

Factory settings: 120 s

③ **Pump ON, fan speed in %**

If the current speed setpoint (⑦) exceeds the % value edited here, the start-up delay (①) starts. If this has elapsed, the spray pump switches ON.

Can be edited from …to: 0… 50 %

Factory settings: 5 %

④ **Pump OFF, fan speed in %**

If the current speed setpoint (⑦) exceeds the % value edited here, the run-on time (②) starts. If this has elapsed, the spray pump switches OFF.

Can be edited from …to: 0… 3 %

Factory settings: 2 %

⑤ **Response time of flow monitor in seconds**

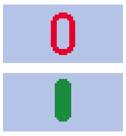
Directly after the start-up of the pumps, the flow monitor often does not work without errors and tends to "flutter". In addition, air present in the system at the start should not immediately generate a fault message. The time edited here delays the fault message "S09 Flow fault" after switching on the spray pump.

Can be edited from …to: 0 … 60 s

Factory settings: 5 s

⑥ Manual/automatic switcher / status spray pump

During commissioning or troubleshooting, the user can switch between the “Automatic” and “Manual” operating modes using this button. If a digital output or an analog output is switched to “Manual”, this will be shown on the start screen. If the control is returned to automatic mode, the output assumes the original value (from before switching to manual).



After the change from "Automatic" to "Manual" operating mode, the spray pump can be switched on and off with this button.

Manual mode active

Automatic mode active

The following spray pump operating statuses are displayed:

Spray pump switched off, no fault

Spray pump switched on, no fault

Spray pump switched on, motor protection triggered or no signal to DI-6 (see also chapter 4.3.1 “Digital IN basic device”).

C) Flow monitor spray pump

After activation, the flow of the spray line is shown, which is measured after the spray pump. Querying a possible error takes place only after the "Response time of flow monitor" [see chapter 8.2.1 "Spray pump"].

The following steps are necessary to monitor the function of the spray pump (or the flow of the associated line) in the TCS.2:

➔ Install a suitable flow monitor with the following output signal:
+ 24 V DC at output ≙ line flow
0 V DC at output ≙ no flow

➔ Configure digital input DI-5 to "Flow monitor".
See also chapter 4.3.1 “Digital IN basic device”.

The following statuses from the flow monitor are displayed:

Strömungswächter	Flow monitor deactivated.
Strömungswächter	Flow monitor active, line flow.
S09 Störung Strömung	Flow monitor active, flow interrupted. *See also chapter* 12.8 “*Signals external messages – Fault code S...”*

The following parameters exist for direct communication via MODBUS:

Register	Bit	Designation	Meaning	Register value
143	**11**	Fault flow monitor	TRUE = flow interrupted	Read 2048

D) Dry running sensor spray pump

After activation, it is shown here that not enough water is present to operate the spray pump.

The following steps are necessary to monitor the water level in the TCS.2, and thus prevent damage to the spray pump:

➔ Install a suitable sensor or float switch with the following output signal:
+ 24 V DC at output ≙ water level OK
0 V DC at output ≙ water level too low

➔ Configure digital input DI-8 to "Fault dry running".
See also chapter 4.3.1 “Digital IN basic device”.

The following statuses from the dry running sensor are displayed:

Dry running sensor deactivated.

Dry running sensor active, water level OK.

Dry running sensor active, water level too low.
See also chapter 12.8 “*Signals external messages – Fault code S...*”

The following parameters exist for direct communication via MODBUS:

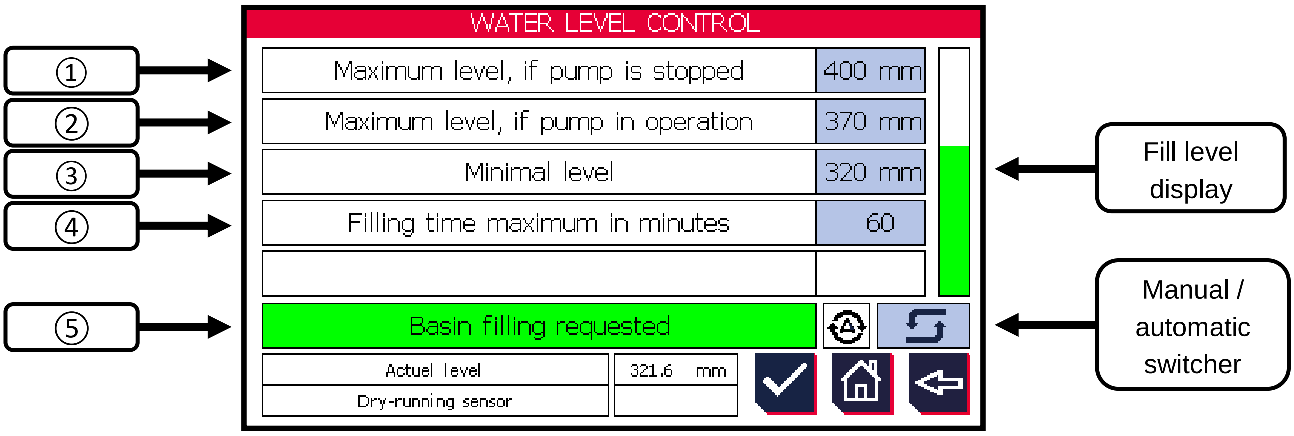
Register	Bit	Designation	Meaning	Register value
143	**12**	Dry running spray pump	TRUE = Dry running spray pump	Read 4096

8.2.2 Biocide dosing

See chapter 9.2.2 “Biocide dosing”

8.2.3 Water circulation

A) Water level controller (2-point controller)



① **Maximum fill level without pump operation**

Upper fill level limit with pump switched off. On reaching this fill level, the fresh water valve closes.

Can be edited from …to:	380 … 400 mm
Factory settings:	400 mm

② **Maximum fill level with pump operation**

Upper fill level limit with pump switched on. On reaching this fill level, the fresh water valve closes.

Can be edited from …to:	330 … 380 mm
Factory settings:	370 mm

③ **Minimum fill level**

Lower fill level limit. On reaching this fill level, the fresh water valve opens.

Can be edited from …to:	320 … 360 mm

<u>Factory settings</u>: 320 mm

④ **Maximum filling time in minutes**

Expected maximum time in which the basin is being filled. After reaching this time, a fault message is output.

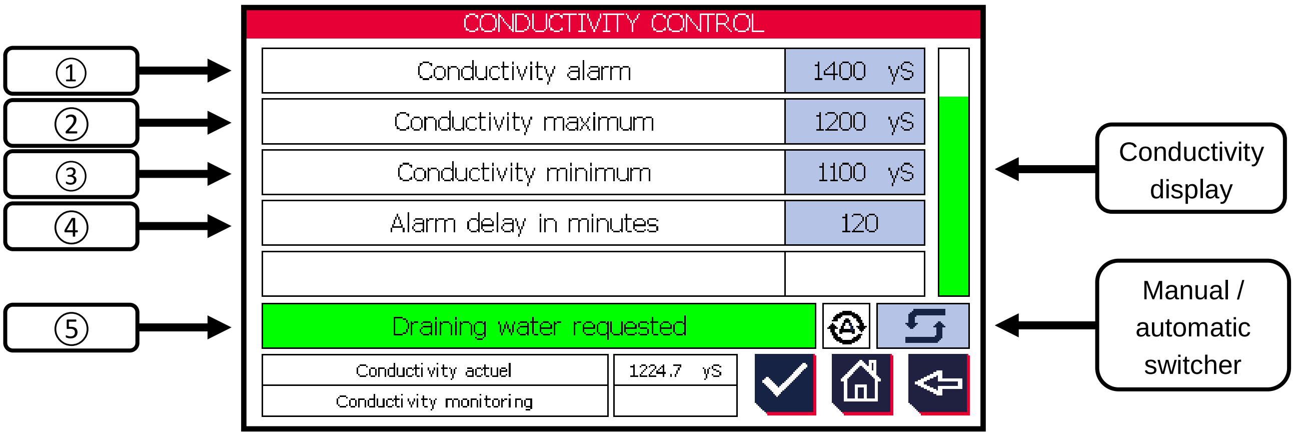
<u>Can be edited from …to</u>: 1 … 120 min

<u>Factory settings</u>: 60 min

⑤ **Status display basin filling**

Green → basin filling requested, fresh water valve open
White → no request, fresh water valve closed

B) Conductivity controller (2-point controller)



① **Conductivity alarm**
Upper conductivity limit. The alarm message is output after the time in ④ has elapsed.

<u>Can be edited from …to</u>: 1250 … 1950 µs/cm

<u>Factory settings</u>: 1400 µs/cm

② **Maximum conductivity**
On reaching this conductivity, the blow-down function is activated. The blowdown valve and the fresh water valve are opened.

Can be edited from …to: 1150 … 1900 µs/cm

Factory settings: 1200 µs/cm

③ **Minimal conductivity**
On reaching this conductivity, the blow-down function is deactivated. The blowdown valve and the fresh water valve are closed.

Can be edited from …to: 100 … 19850 µs/cm

Factory settings: 1100 µs/cm

④ **Alarm delay in minutes**

Time delay to trigger the alarm (see ①)

Can be edited from …to: 1 … 120 min

Factory settings: 120 min

⑤ **Status display blow-down**

Green → blow-down requested, blowdown valve and fresh water valve open
White → no request, blowdown valve and fresh water valve closed

9. HYBRID COOLER

9.1 Adjustments in Device settings → Additional functions → Wetting system

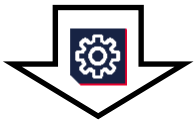


Image 144

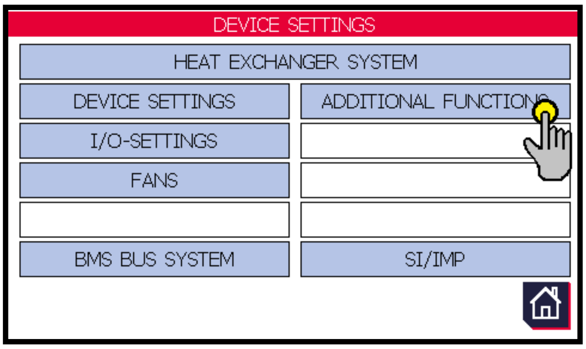


Image 145

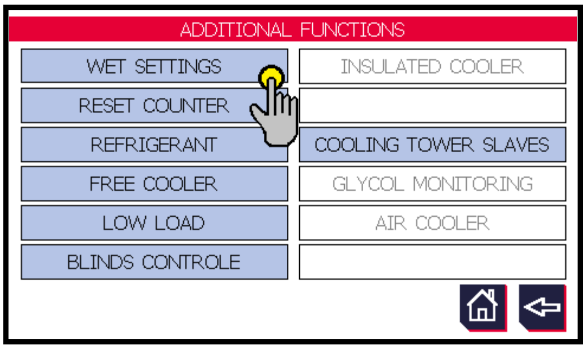


Image 146

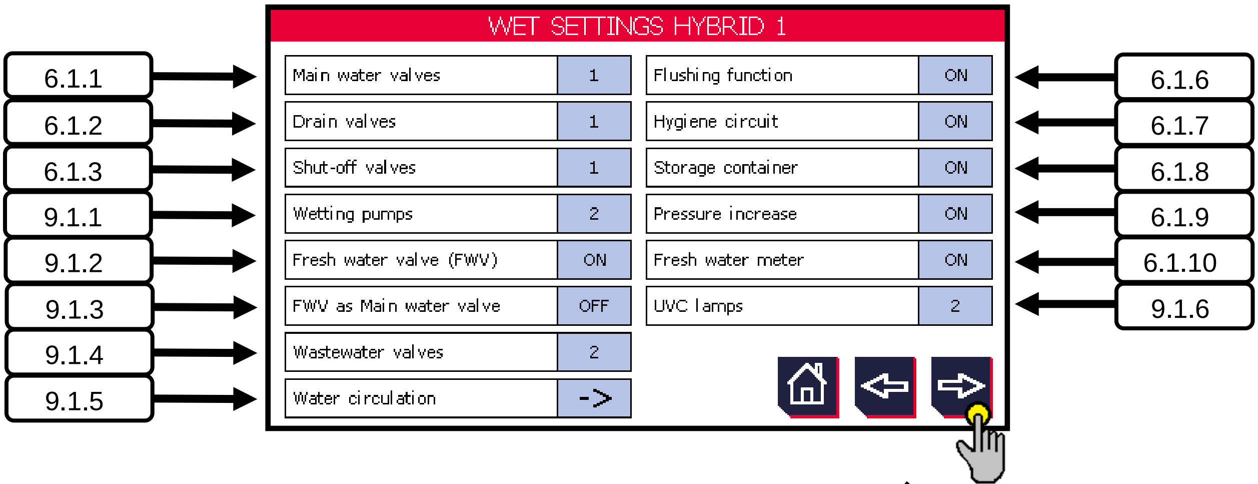
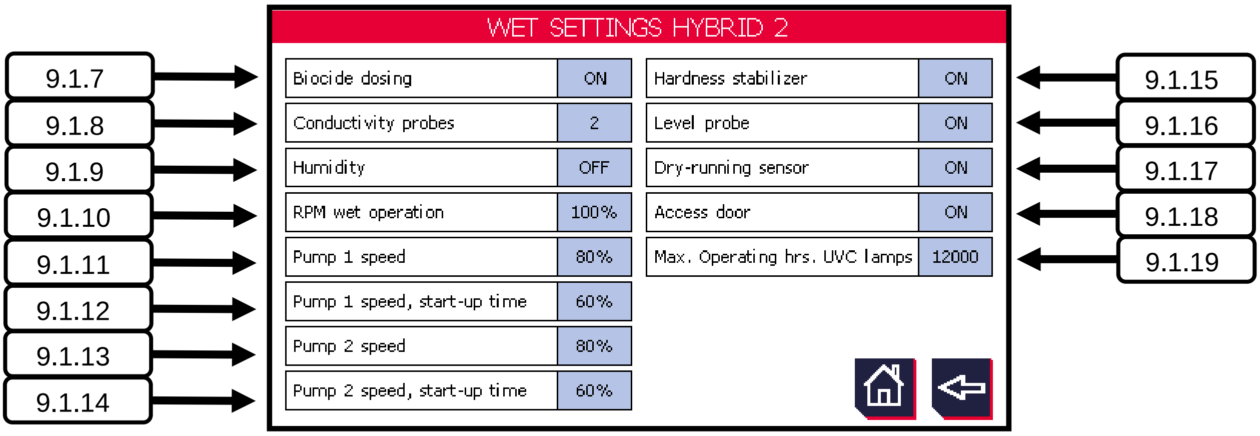


Image 147



9.1.1 Wetting pump(s)

Selection of the number of wetting pumps for the water circuit that should be controlled and monitored by the TCS.2.

Can be edited from …to: 1 … 2 wetting pumps
Factory settings: 1 wetting pump

9.1.2 Fresh water valve

Selection of whether a fresh water valve for automatic replenishment of the circulation basin should be controlled and monitored by the TCS.2.

Can be edited from …to: ON / OFF
Factory settings: ON

9.1.3 Fresh water valve as main water valve

The fresh water valve simultaneously works as a main water valve. Any selected main water valve is automatically deselected. The following requirements apply for these:

- Installation in a branch line that is as short as possible to avoid stagnation
- If connected to the drinking water network, the relevant standards must be met
- Emergency position closed in the event of power failure
- must be installed in a frost-free area!

Can be edited from …to: ON / OFF
Factory settings: OFF

9.1.4 Blowdown valves

Selection of how many blowdown valves for automatic hardness regulation should be controlled and monitored by the TCS.2 .

Can be edited from …to: 1 … 2 blowdown valves
Factory settings: 1 blowdown valve

9.1.5 Water circulation settings

Conductivity probe measuring range: (Enter maximal value of the measuring range of the conductivity probe here)

Can be edited from …to: 500 … 10000 µs/cm
Factory settings: 2000 µs/cm

Fill level probe active measuring length: (see type plate / datasheet of the probe)

Can be edited from …to: 100 … 500 mm
Factory settings: 100 mm

Fill level probe zero point: Typing on the value window with a blue background starts a teach-in function. The actual water level (zero point) is displayed as "ACTUAL = ...". This can be accepted with the tick symbol. 

Factory settings: 2182

Fill level probe zero point: Typing on the value window with a blue background starts a teach-in function. The actual water level (max. point) is displayed as "ACTUAL = ...". This can be accepted with the tick symbol. 

Factory settings: 3829

9.1.6 UVC lamps

Selection of the number of UVC lamps for sterilising the circulating water should be controlled and monitored by the TCS.2.

Can be edited from …to: 0 … 2 UVC lamps (groups)
Factory settings: 0 UVC lamps

9.1.7 Biocide dosing

Selection of whether a biocide vaccination should be controlled and monitored by the TCS.2.

Can be edited from …to: ON / OFF
Factory settings: ON

9.1.8 Conductivity probes

Selection of whether a conductivity probe should be evaluated and monitored by the TCS.2.

Can be edited from …to: 0 … 1 conductivity probes
Factory settings: 0 conductivity probes

9.1.9 Air humidity

Selection of whether an air humidity sensor should be evaluated and monitored by the TCS.2.

Can be edited from …to: ON / OFF
Factory settings: OFF

9.1.10 Speed wet mode

Maximum permissible speed while the fins are exposed to water. A drop centreline crack should be avoided here.

Can be edited from …to: 30… 100 %
Factory settings: 80 %

9.1.11 Speed pump 1

Speed of wetting pump 1 in %.
Can be edited from …to: 40… 100 %
Factory settings: 80 %

9.1.12 Speed pump 1 start-up

Specified speed of the wetting pump during the start-up time.
Can be edited from …to: 60… 100 %
Factory settings: 60 %

9.1.13 Speed pump 2

Speed of wetting pump 2 in %.
Can be edited from …to: 40… 100 %
Factory settings: 80 %

9.1.14 Speed pump 2 start-up

Specified speed of the wetting pump during the start-up time.
Can be edited from …to: 60… 100 %
Factory settings: 60 %

9.1.15 Hardness stabiliser

After activating this function, the fill level of the hardness stabiliser container is monitored via the TCS.2.

Can be edited from …to: ON / OFF
Factory settings: OFF

9.1.16 Fill level probe

After activating this function, the fill level is evaluated and monitored by the TCS.2 via a probe. For further adjustable basic parameters for the level probe, see chapter 8.1.5 “Water circulation settings”.

Can be edited from …to: ON / OFF
Factory settings: ON

9.1.17 Dry running sensor

After activating this function, dry running in the dirt trap basket is monitored with float switches for each wetting pump.

Can be edited from …to: ON / OFF
Factory settings: ON

9.1.18 Entrance door

After activating this function, the status of an entrance door is evaluated and monitored by the TCS.2.

Can be edited from …to: ON / OFF
Factory settings: ON

9.1.19 Max. operating hours UVC lamps

Useful life of UVC lights according to manufacturer.

Can be edited from …to: 5,000 … 20,000 h
Factory settings: 12,000 h

9.2 Adjustments in Main menu → Additional functions → Wet mode

Image 148

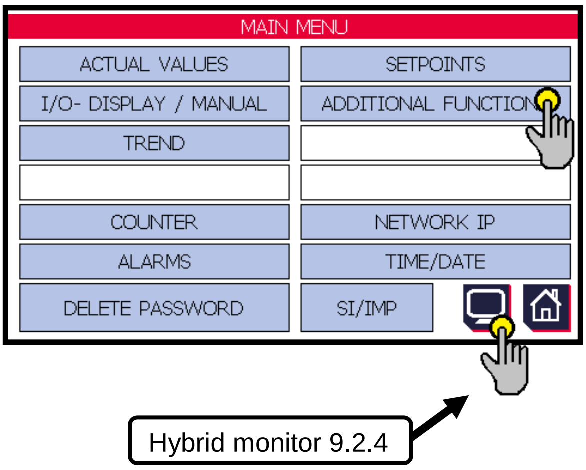
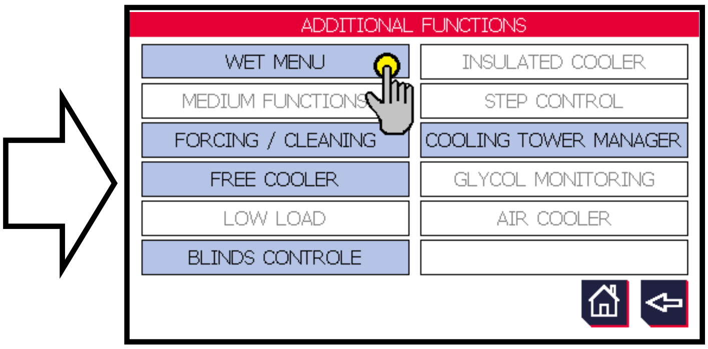


Image 149



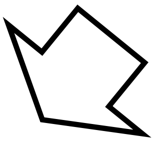
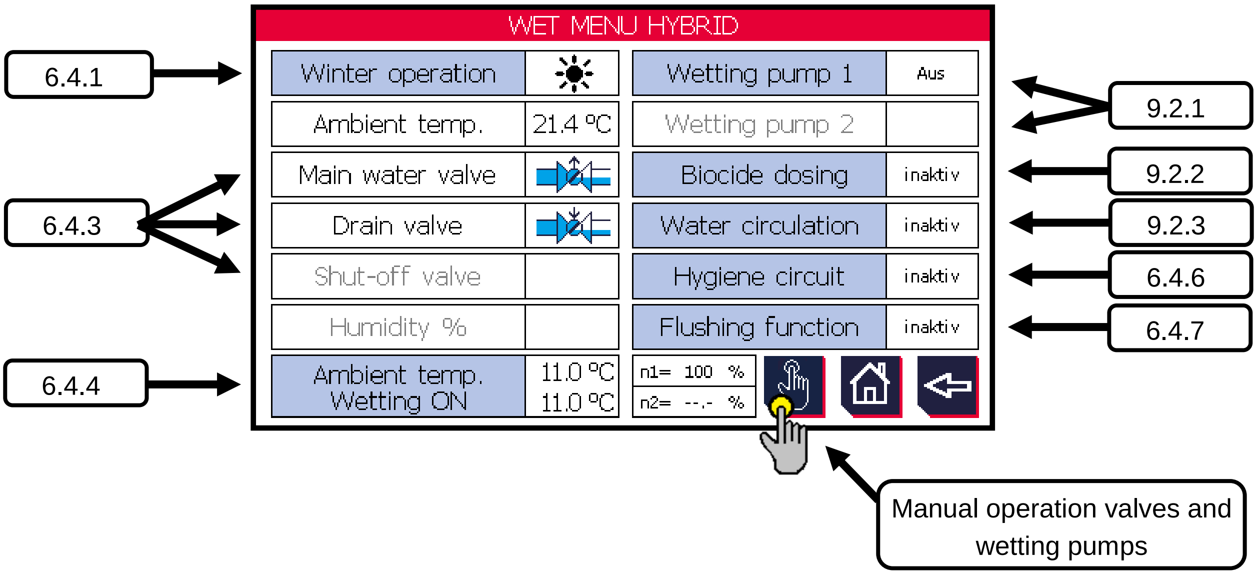


Image 150



9.2.1 Wetting pump(s)

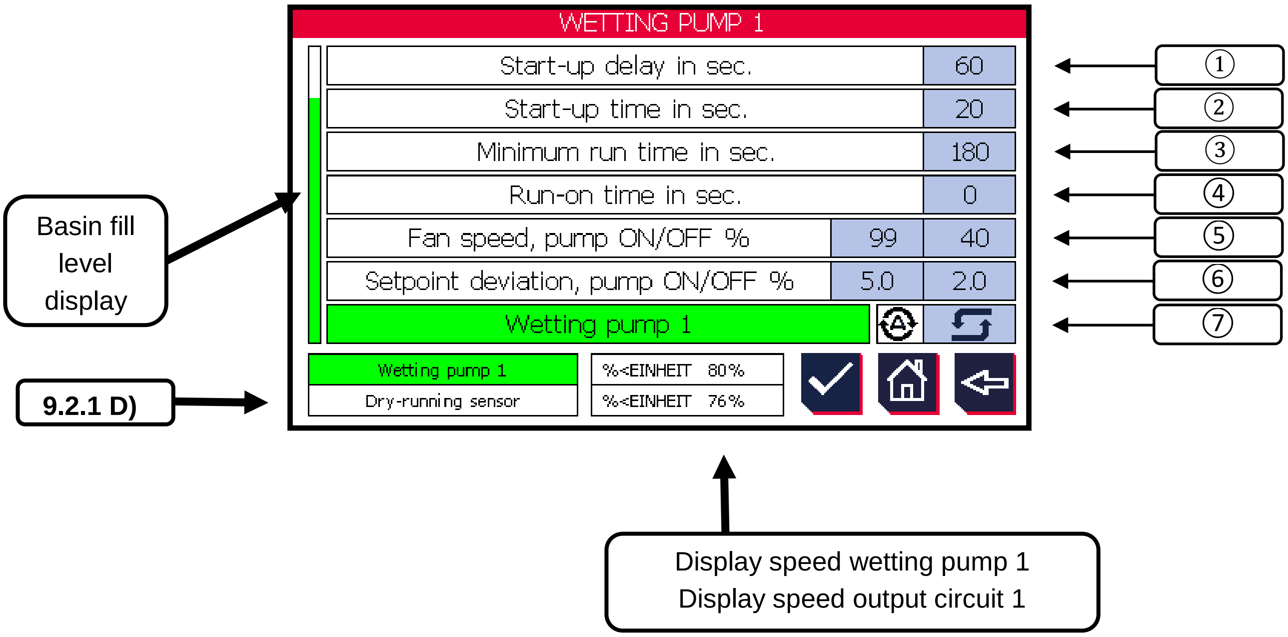
Wetting pumps are used to feed water for hybrid dry coolers and condensers. The pumps are automatically controlled via the TCS. Manually switching the pumps is possible in manual mode. Only the number of wetting pumps as have been activated in the wet settings hybrid (chapter 9.1.1) are shown in the wet menu. To prevent frost damage to the hydraulic system, the pumps are generally switched off in winter mode and can only be started in summer mode.
The switching conditions for starting the pumps are found in point A) "Editable values".

Function only for single circuit devices. For dual circuit devices, the pumping function only applies to circuit 1.

A) Editable values / Manual mode

Once a control selection has been made, the “Wetting pump 1 / 2” box in the “Additional functions” menu appears blue and can be activated (Image 150). The "Wetting pump" editing level opens.

Image 151



① **Start-up delay in seconds**

If the fan speed exceeds the "fan speed, pump ON %" level (⑤), the time set here starts. If this has elapsed, the wetting pump switches ON.

Can be edited from …to: 0 … 1800 s

Factory settings: 60 s

② **Start-up time in seconds**

During the time set here, the pump speed can be increased or reduced. The speed can be edited in "Wet settings – Hybrid. See chapter 9.1.12 “Speed pump 1 start-up”.

Can be edited from …to: 0 … 600 s

Factory settings: 20 s

③ **Minimum running time in seconds**

Adjustable time in seconds in which the wetting pump remains switched on. This also applies if all other switch-off conditions are met.

Can be edited from …to: 30 … 1800 s

Factory settings: 180 s

④ **Run-on time in seconds**

If the fan speed falls below the "pump OFF, fan speed %" level (⑤), the time set here starts. If this has elapsed, the wetting pump switches OFF.

Can be edited from …to: 0 … 1800 s

Factory settings: 0 s

⑤ Fan speed pump ON in %

Switch-on condition:
If the fan speed exceeds the % value edited here, the start-up delay (①) starts. If this has elapsed, the wetting pump switches ON.

Can be edited from …to: 40… 100 %

Factory settings: 99 %

Fan speed pump OFF in %

Switch-off condition:
If the fan speed exceeds the % value edited here, the run-on time (④) starts. If this has elapsed, the spray pump switches OFF.

Can be edited from …to: 0… 60 %

Factory settings: 40 %

⑥ Setpoint deviation pump ON in %

Switch-on condition:
This is met if the target / actual value deviation is greater than the percentage value set here. If all switch-on conditions are met, the respective wetting pump switches ON.

Can be edited from …to: 0.0… 20.0 %

Factory settings: 5.0 %

Setpoint deviation pump OFF in %

Switch-off condition:
If the current speed setpoint (⑦) exceeds the % value edited here, the run-on time (②) starts. If this has elapsed, the spray pump switches OFF.

Can be edited from …to: -20.0… 15.0 %

Factory settings: 2.0 %

⑦ Manual / automatic switcher / status wetting pump

During commissioning or troubleshooting, the user can switch between the “Automatic” and “Manual” operating modes using this button. If a digital output or an analog output is switched to “Manual”, this will be shown on the start screen. If the control is returned to automatic mode, the output assumes the original value (from before switching to manual).

0
I

After the change from "Automatic" to "Manual" operating mode, the spray pump can be switched on and off with this button.

Manual mode active

Automatic mode active

B) Control (I/Os used)

CAN nodes	Type	Port	Name
Basic device	AO-1	-	Wetting pump 1 speed
32	AO	11	Wetting pump 1 speed
32	AO	12	Wetting pump 2 speed
40	DI	121	Fault wetting pump 1
40	DI	122	Fault wetting pump 2
40	DI	123	Dry running wetting pump 1
40	DI	124	Dry running wetting pump 2
45	DO	121	Wetting pump 1 (enable)
45	DO	122	Wetting pump 2 (enable)
Basic device	DO-5	-	Wetting circuit 1 active
Basic device	DO-6	-	Wetting circuit 2 active

C) Bus parameter

Register	Bit	Designation	Value	r/w
71		Wetting pump 1 speed	0 – 100 %	read
72		Wetting pump 2 speed	0 – 100 %	read
83 - 84		Operating hours wetting pump 1	LO/HI word - h	read
85 - 86		Operating hours wetting pump 2	LO/HI word - h	read
180	3	Wetting pump 1, ON	true = Pump ON	read
180	4	Wetting pump 2, ON	true = Pump ON	read
180	10	Wetting pump 1, fault	true = Fault	read
180	11	Wetting pump 2, fault	true = Fault	read
181	0	H04 Wetting pump 1 dry running warning	true = Dry running	read
181	1	H04 Wetting pump 2 dry running warning	true = Dry running	read

D) Dry running sensor wetting pump

After activation in Device settings (chapter 9.1.17), the wetting pump is monitored by a float switch for possible dry running. This is positioned directly next to the pump in the dirt trap basket.

The following statuses from the dry running sensor are displayed:

Dry running sensor	Dry running sensor deactivated.
Dry running sensor	Dry running sensor active, water level OK.
H04 Dry running wetting pump 1	Dry running sensor active, water level too low. See also chapter 12.3 “Hybrid / pump messages – Fault code H...”

The following parameters exist for direct communication via MODBUS:

Register	Bit	Designation	Meaning	Register value
181	**0**	H04 Dry running wetting pump 1	TRUE= Dry running wetting pump 1	Read 1
181	**1**	H04 Dry running wetting pump 2	TRUE= Dry running wetting pump 2	Read 2

9.2.2 Biocide dosing

The biocide dosing is used to vaccinate the circulating water of a hybrid cooler or evaporator (cooling tower) with biocides to suppress the growth of algae or legionella, etc. For this purpose, a defined quantity of biocide must be added in intervals to the circulating water during summer mode (system is filled with circulating water). The type and quantity as well as the number of vaccinations during a set period are dependent on many factors. Follow the operating manual of the hybrid cooler or evaporator (cooling tower) to do this. All parameters are freely adjustable over a very wide range, so the system can always be set to an optimal operating range.

Vaccinating the circulating water is done via a request to a vaccination station with voltage-free relay contacts. If desired, a solenoid valve can be directly controlled. However, the biocide supply must be under an appropriate and even pressure for this. Normally, the biocide stations all have feed pumps. As soon as the request is made from the ***TCS*** to the biocide station, the pumps start to feed the biocide. This is fed via the vaccine line and the vaccine pipe, which are next to the auxiliary water valve. The duration of the vaccination results from the vaccine and the quantity of circulating water. After finishing the vaccination, the wetting pump(s) switch on for a set time to ensure that the biocide reach all parts of the cooler that are in contact with water, so that they can have their effect there. This circulation time can also be freely adjusted in the ***TCS***. During the entire process and for some time after this, the circulating water must not be blown down. This is true even if the conductivity measurement makes this necessary due to an excessive conductivity value. This blow-down locking time is freely adjustable.

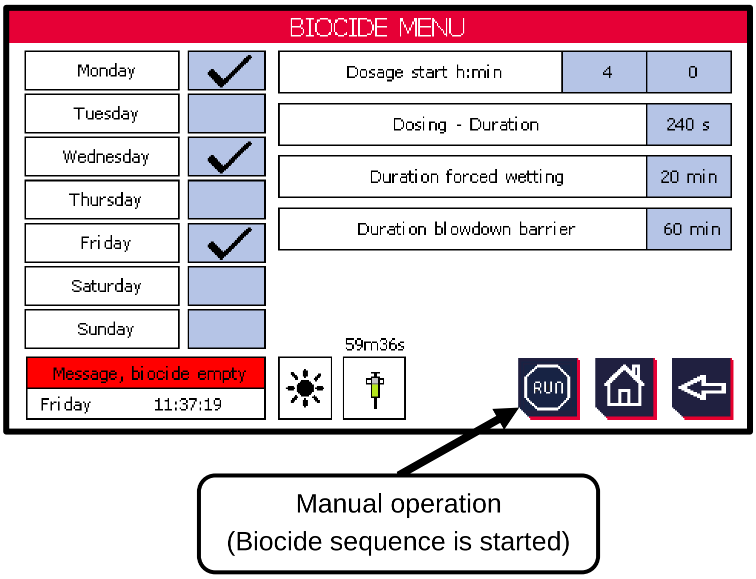
The frequency and time for starting the biocide vaccination depends strongly on the sunshine and biocide used. Ask the supplier of the cooler and the biocidal agent how often and in what dosage (vaccination period) the vaccination should be done. Later adjustments are certainly necessary, as it is not possible to predict the exact demand for biocide at each location.

The necessary settings for days of the week on which the vaccination should start, and also the starting time, should be made in the TCS.
The start of vaccination should be given as a time of the day so that the vaccination does not occur during the main operating time of the cooler.
Normally, the vaccination should take place during night hours.

For activation of the function, see chapter 9.1.7 **“**Biocide dosing**”**

A) Adjustable parameters

Image 152



Days of the week:

<u>Can be edited from …to</u>:	Monday to Sunday
<u>Factory settings</u>:	Monday, Wednesday, Friday

Dosing start:

<u>Can be edited from …to</u>:	0 AM - 11 PM -- 0-59 min
<u>Factory settings</u>:	4 AM

Dosing duration

<u>Can be edited from …to</u>:	0 … 600 s
<u>Factory settings</u>:	240 s

Duration of forced wetting:

<u>Can be edited from …to</u>:	5 … 60 min
<u>Factory settings</u>:	20 min

Duration of blow-down lock:

<u>Can be edited from …to</u>:	25 … 180 min
<u>Factory settings</u>:	60 min

A) Control via terminal / bus parameter

In addition to the internal weekly timer, the biocide program can also be requested via terminal or bus. See chapter 4.2.20 "Control biocide dosing"

The following status messages are output for direct communication via bus:

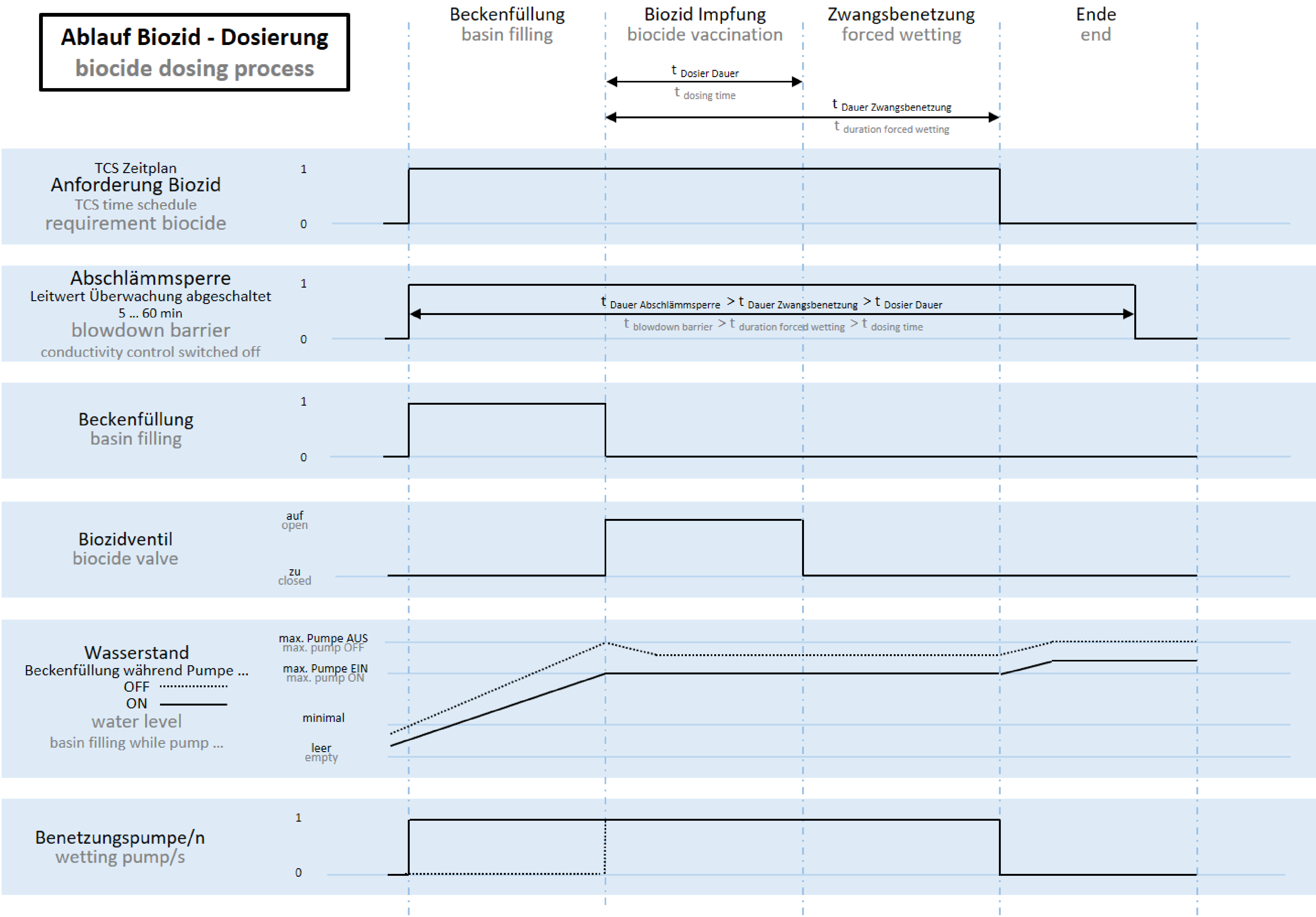
Register	Bit	Designation	Meaning	Register value
181	**4**	Biocide – program active	TRUE = active	read 8
181	**5**	Biocide – valve open	TRUE = open	read 16
181	**6**	H09 Biocide tank empty notification	TRUE = Tank empty	Read 32

The biocide program is interrupted if the reset buttton (external or local) is pressed for 10s.

B) Biocide functional diagram

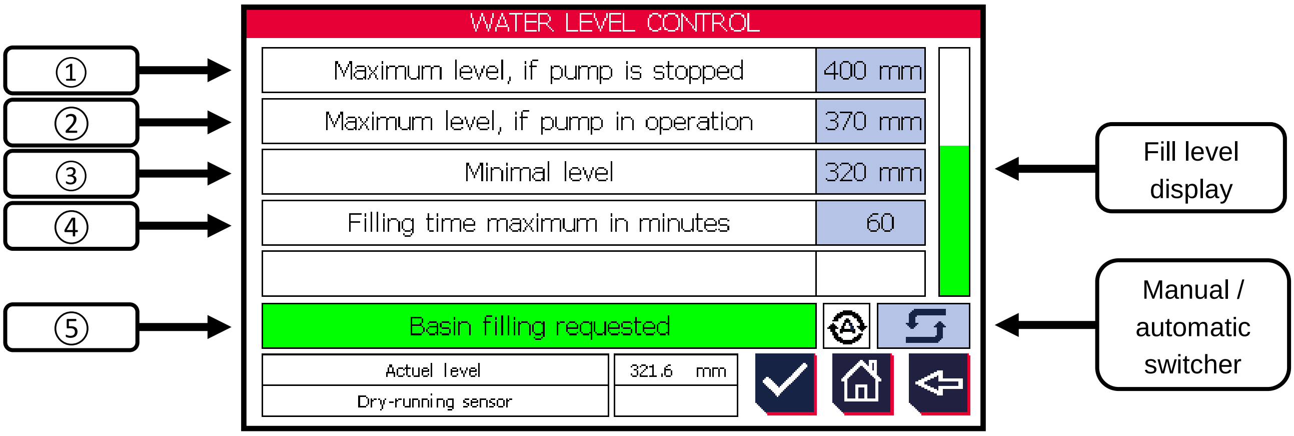
See Image 153.

Image 153


Ablauf Biozid - Dosierung
biocide dosing process
Beckenfüllung
basin filling
Biozid Impfung
biocide vaccination
Zwangsbenetzung
forced wetting
Ende
end
t Dosier Dauer
t dosing time
t Dauer Zwangsbenetzung
t duration forced wetting
TCS Zeitplan
Anforderung Biozid
TCS time schedule
requirement biocide
1
0
Abschlämmsperre
Leitwert Überwachung abgeschaltet
5 ... 60 min
blowdown barrier
conductivity control switched off
t Dauer Abschlämmsperre > t Dauer Zwangsbenetzung > t Dosier Dauer
t blowdown barrier > t duration forced wetting > t dosing time
Beckenfüllung
basin filling
Biozidventil
biocide valve
auf
open
zu
closed
Wasserstand
Beckenfüllung während Pumpe ...
OFF
ON
water level
basin filling while pump ...
max. Pumpe AUS
max. pump OFF
max. Pumpe EIN
max. pump ON
minimal
leer
empty
Benetzungspumpe/n
wetting pump/s

9.2.3 Water circulation

A) Water level controller (2-point controller)



① **Maximum fill level without pump operation**

Upper fill level limit with pump switched off. On reaching this fill level, the fresh water valve closes.

Can be edited from …to:	380 … 400 mm
Factory settings:	400 mm

② **Maximum fill level with pump operation**

Upper fill level limit with pump switched on. On reaching this fill level, the fresh water valve closes.

Can be edited from …to:	330 … 380 mm
Factory settings:	370 mm

③ **Minimum fill level**

Lower fill level limit. On reaching this fill level, the fresh water valve opens.

Can be edited from …to:	320 … 360 mm

Factory settings: 320 mm

④ **Maximum filling time in minutes**

Expected maximum time in which the basin is being filled. After reaching this time, a fault message is output.

Can be edited from …to: 1 … 120 min

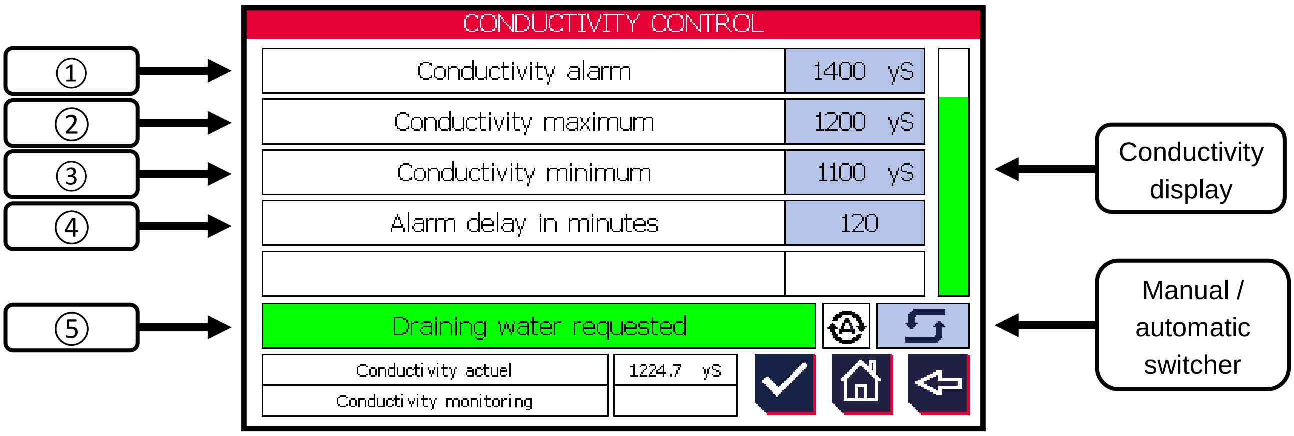
Factory settings: 60 min

⑤ **Status display basin filling**

Green → basin filling requested, fresh water valve open
White → no request, fresh water valve closed

B) Conductivity controller (2-point controller)

Image 154



① **Conductivity alarm**
Upper conductivity limit. The alarm message is output after the time in ④ has elapsed.

Can be edited from …to: 1250 … 1950 µs/cm

Factory settings: 1400 µs/cm

② **Maximum conductivity**

On reaching this conductivity, the blow-down function is activated. The blowdown valve and the fresh water valve are opened.

Can be edited from …to: 1150 … 1900 µs/cm

Factory settings: 1200 µs/cm

③ **Minimal conductivity**

On reaching this conductivity, the blow-down function is deactivated. The blowdown valve and the fresh water valve are closed.

Can be edited from …to: 100 … 19850 µs/cm

Factory settings: 1100 µs/cm

④ **Alarm delay in minutes**

Time delay to trigger the alarm (see ①)

Can be edited from …to: 1 … 120 min

Factory settings: 120 min

⑤ **Status display blow-down**

Green → blow-down requested, blowdown valve and fresh water valve open
White → no request, blowdown valve and fresh water valve closed

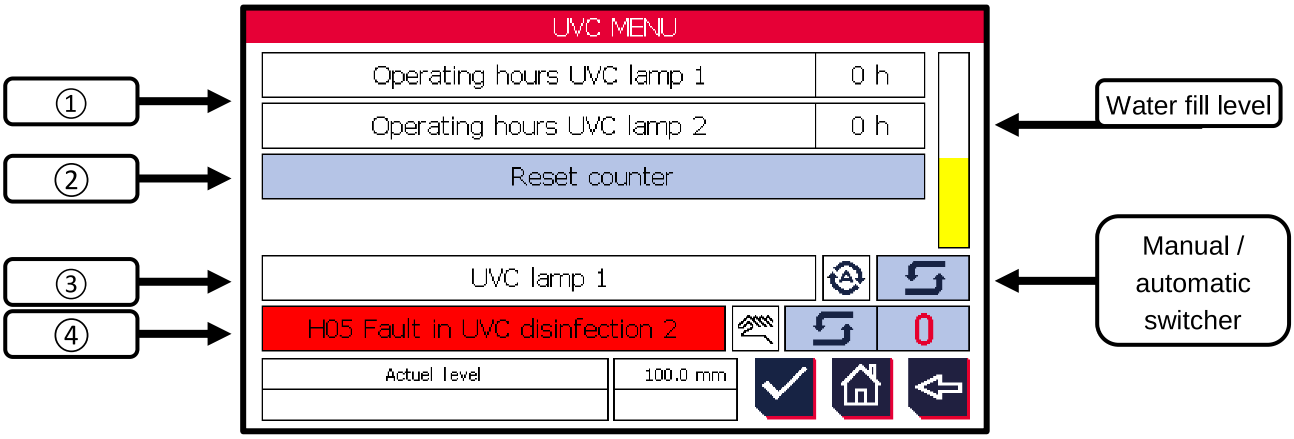
The following status messages are output via bus:

Register	Bit	Designation	Meaning	Register value
79	**-**	Conductivity value	Word, holding reg.	0 … 2000 µs/cm

C) UVC menu

UVC lamps are for environmentally friendly sterilisation of the circulating water. To prevent deposits on the lamp body, this must always be under water. The minimum water level must be high enough for it to be over the lamp body.
The display, control and monitoring can be selected and deselected in the Hybrid wet settings (chapter 9.1.6).

Image 155



① **Display operating hours**
If the maximum operating hours have been reached, an alarm message is output after the time in ④ has elapsed.

② **Reset operating hours after lamp change**

③ **Status display**
White background → lamp switched off
Green background → lamp switched on

④ **Display of possible fault messages H05 and H06.**
See chapter 12.3 “Hybrid / pump messages – Fault code H...”

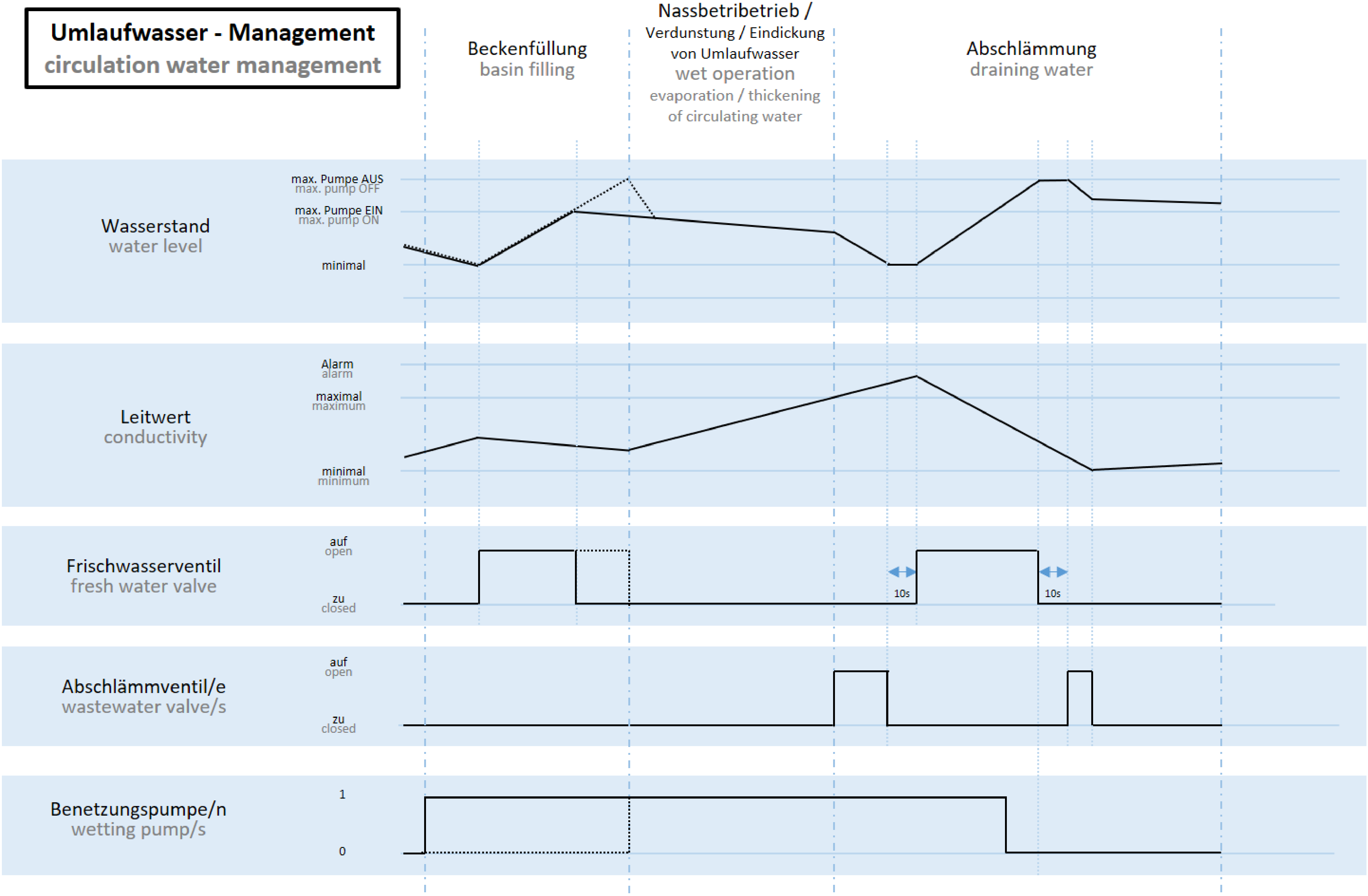
The following status messages are output via bus:

Register	Bit	Designation	Value
243 - 244	HI + LO word	Operating hours UVC disinfection lamp 1	Read h
245 - 246	HI + LO word	Operating hours UVC disinfection lamp 2	Read h
181	9	H05 fault UVC lamp / group 1	Read 512
181	10	H06 runtime reached UVC lamp / group 1	Read 1024
181	11	H05 fault UVC lamp / group 2	Read 2048
181	12	H06 runtime reached UVC lamp / group 2	Read 4096

D) Functional diagram (circulating water management)

See Image 156

Image 156



Umlaufwasser - Management
circulation water management
Beckenfüllung
basin filling
Nassbetribetrieb /
Verdunstung / Eindickung
von Umlaufwasser
wet operation
evaporation / thickening
of circulating water
Abschlämmung
draining water
Wasserstand
water level
max. Pumpe AUS
max. pump OFF
max. Pumpe EIN
max. pump ON
minimal
Leitwert
conductivity
Alarm
alarm
maximal
maximum
minimal
minimum
Frischwasserventil
fresh water valve
auf
open
zu
closed
10s
10s
Abschlämmventil/e
wastewater valve/s
auf
open
zu
closed
Benetzungspumpe/n
wetting pump/s
1
0

9.2.4 Hybrid monitor

The hybrid monitor provides a central overview and management of all functions of the hybrid cooler.

From the main menu and various other sub-menus, the hybrid monitor can be reached directly by  selecting the monitor button (see Image 159). The user can observe all relevant conditions and status messages of the hybrid cooler from here.

It also acts as a central manual operating interface.

Image 157

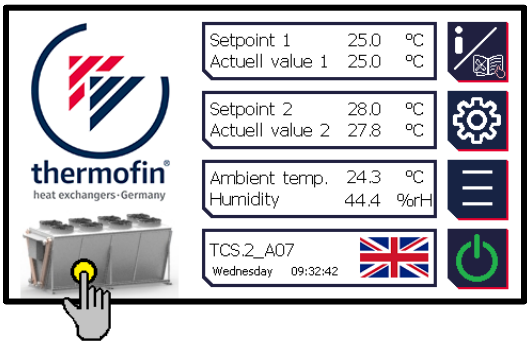
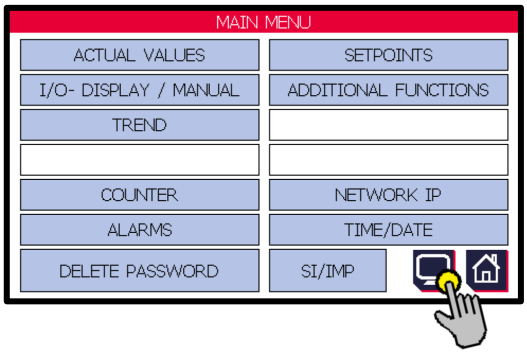
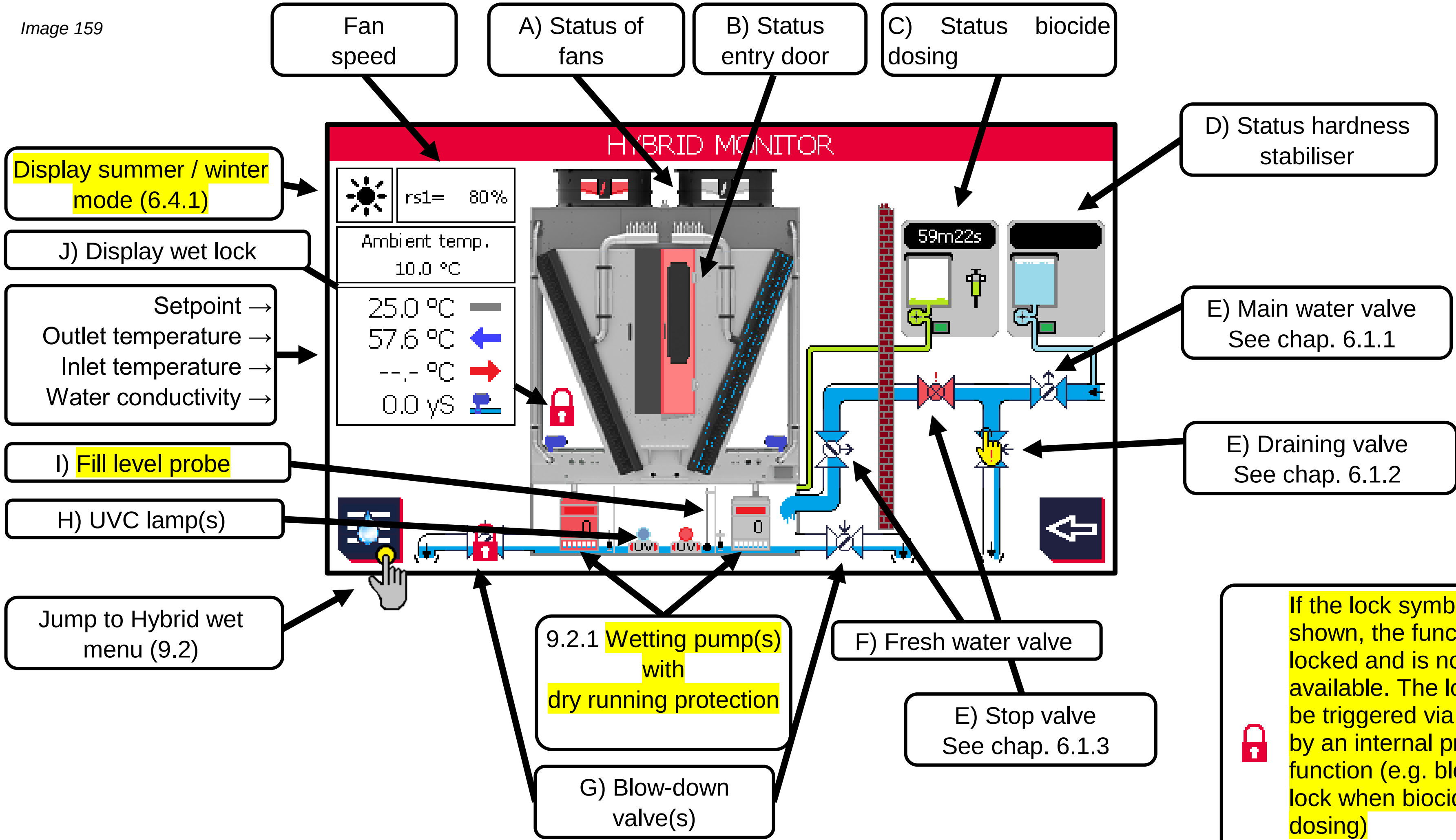


Image 158



Manual operation. This symbol appears if the manual mode is active for a function.

Image 159



If the lock symbol is shown, the function is locked and is not available. The lock can be triggered via bus or by an internal program function (e.g. blowdown lock when biocide dosing)

A) Status of fans

In the event of a fan fault → select the status message for detailed information

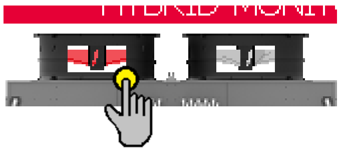


Image 160

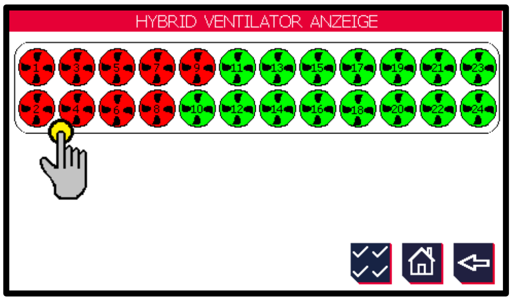
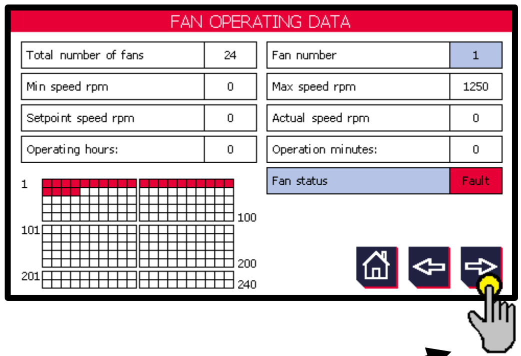


Image 161



See also: 5.5.1 – "Fan operating data / status"

B) Status entry door

Status display of entry door. This can be selected and deselected in the Hybrid wet settings (chapter 9.1.18). The open door is indicated with blinking red display. All fans are also stopped immediately via the door contact switch.

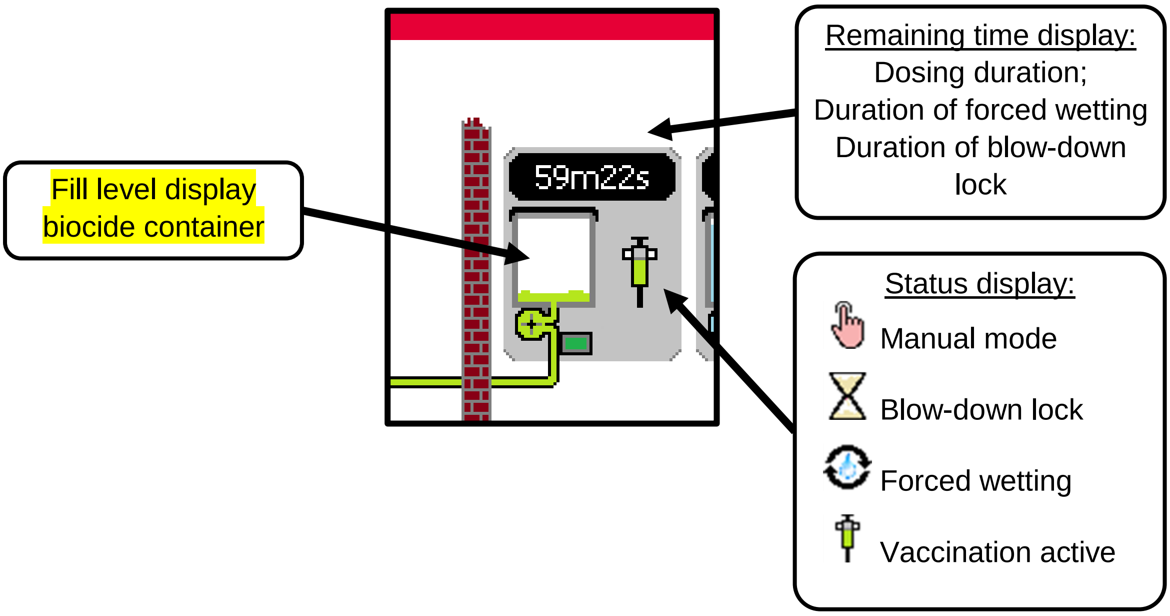
The following status messages are output via bus:

Register	Bit	Designation	Meaning	Register value
181	**13**	Entry door hybrid cooler, open	TRUE = door open	read 8192

C) Status biocide dosing

Status and remaining time display of biocide dosing. The display, control and monitoring of the biocide dosing can be selected and deselected in the Hybrid wet settings (chapter 9.1.7).

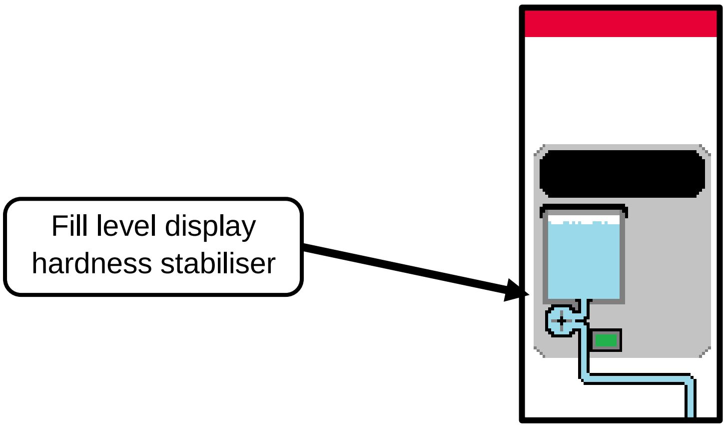
Image 162



D) Status hardness stabiliser

Fill level display of hardness stabiliser container. The display and monitoring can be selected and deselected in the Hybrid wet settings (chapter 9.1.15).

Image 163



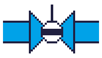
The following status messages are output via bus:

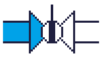
Register	Bit	Designation	Meaning	Register value
181	**7**	H08 Hardness stabiliser tank empty notification	TRUE = Tank empty	read 64

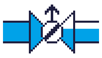
E) Status display water valves

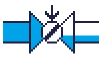
When the respective valve is actuated, a small window with detailed information opens. Operation can be switched to manual mode there.

The following symbols are used on the display:

 Valve is OPEN

 Valve is CLOSED

 Valve is OPENING

 Valve is CLOSING

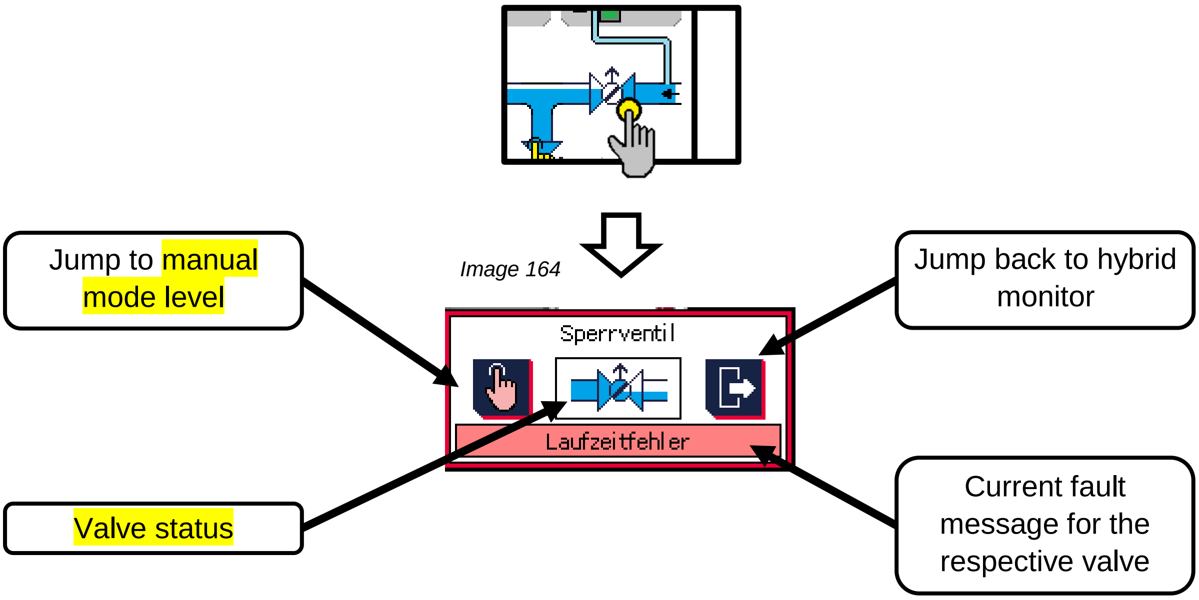


Image 164

The following status messages are output via bus:

Register	Bit	Designation	Meaning	Register value
144	**0**	Main water valve 1, open	TRUE = open	read 1
144	**1**	Draining valve 1, open	TRUE = open	read 2
144	**6**	Stop valve 1, open	TRUE = open	read 32
145	**0**	Main water valve 1, runtime error	TRUE = fault	read 1
145	**1**	Draining valve 1, runtime error	TRUE = fault	read 2
145	**2**	Stop valve 1, runtime error	TRUE = fault	read 4

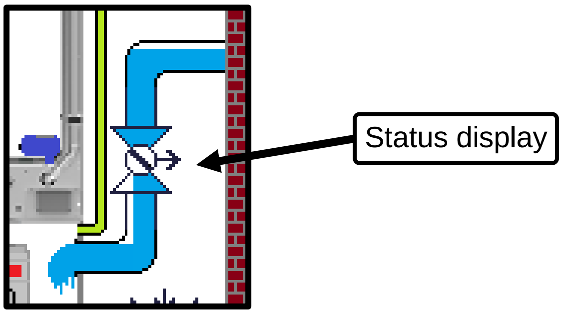
F) Fresh water valve

The "Fresh water valve" (motor ball valve) is located in the fresh water line, which is supplied from the water processing. In combination with the fill level probe, it is for storing water in the tub. The display, control and monitoring can be selected and deselected in the Hybrid wet settings (chapter 9.1.7).

<u>Monitoring the filling time:</u>
To prevent uncontrolled refilling of fresh water in the event of a fault in the water system, the opening duration of the fresh water valve is monitored.
The motor valve should not be open for longer than 60 minutes for refilling fresh water. If this happens anyway, this will be indicated with a warning message = "filling time too long".
The maintenance personnel must then identify and correct the fault.

The fresh water valve can also optionally function as a main water valve. See chapter 9.1.3 “Fresh water valve as main water valve”.

Image 165



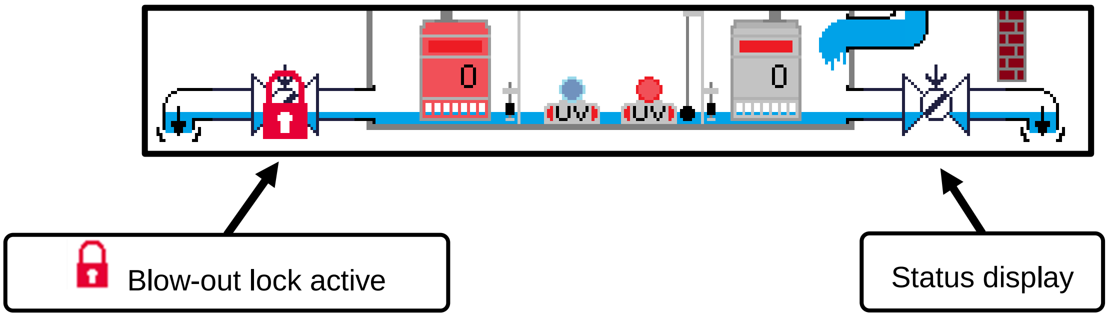
The following status messages are output via bus:

Register	Bit	Designation	Meaning	Register value
180	**0**	Fresh water valve open	TRUE = open	read 1
181	**7**	V10 Fresh water valve, runtime error	TRUE = open	read 64
181	**14**	V12 Fresh water valve open too long	TRUE = fault	read 16384

G) Blow-down valve(s)

Evaporating the wetting water leaves residual minerals and salts as well as contaminants in the circulating water. After some refilling processes, the proportion of these undesirable deposits and thickening of the wetting water with minerals and salts increases to a maximum value that should not be exceeded.

If the maximum value (measured at the conductivity probe) has been reached, the water is drained out of the tank with one or two blow-out valves (motor ball valves), and new water is added. The display, control and monitoring can be selected and deselected in the Hybrid wet settings (chapter 9.1.4).



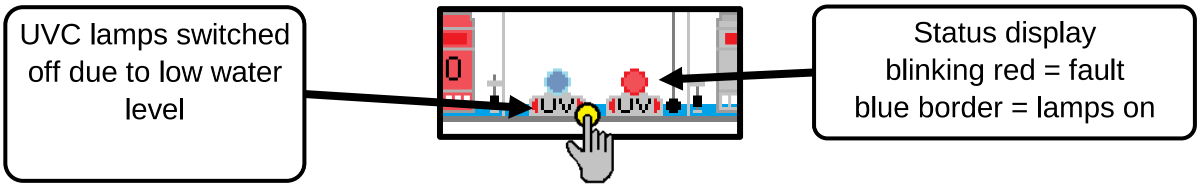
The following status messages are output via bus:

Register	Bit	Designation	Meaning	Register value
79	**-**	Conductivity value	Word, holding reg.	0 … 2000 µs/cm
180	**1**	Blow-out valve 1 open	TRUE = open	read 2
180	**2**	Blow-out valve 2 open	TRUE = open	read 4
181	**8**	V11 Blow-out valve 1 runtime error	TRUE = open	read 128
181	**9**	V11 Blow-out valve 2 runtime error	TRUE = open	read 256

H) UVC lamp(s)

Display of installed UVC lamps and their status. If the lamps are actuated directly, the UVC menu opens (see chapter C). Manual operation is also possible from the UVC menu.

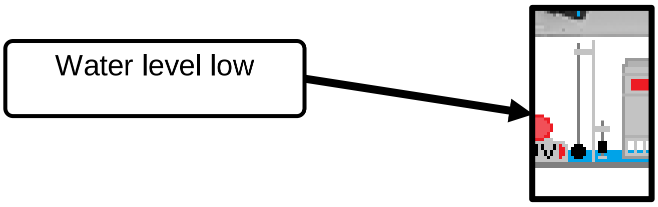
Image 166



The following status messages are output via bus:
See chapter (9.2.3 C) “UVC menu”.

I) Fill level probe

Image 167



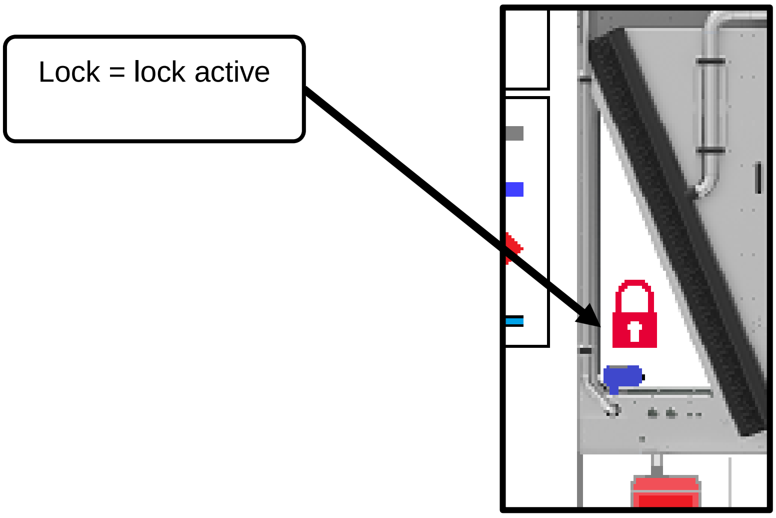
The following status messages are output via bus:

Register	Bit	Designation	Meaning	Register value
80	**Word**	Water level fill level probe	0 … 600 mm	read
151	**13**	M17 fill level probe wire break	TRUE = wire break	read 8192
151	**14**	M18 fill level probe short circuit	TRUE = wire break	read 16384

J) Display wet lock

In addition to the internal switch-on and switch-off conditions, there is the option to prevent water from being fed to the heat exchangers.
See also chapter 4.2.13 “Control lock wet mode”.

Image 168



The following status messages are output via bus:

Register	Bit	Designation	Meaning	Register value
2	**13**	Lock wet mode circuit 1	TRUE = circuit 1 locked	write 8192
2	**14**	Lock wet mode circuit 2	TRUE = circuit 2 locked	write 16384
144	**15**	External lock wet mode 1 active	TRUE = active	read 32768
145	**15**	External lock wet mode 2 active	TRUE = active	read 32768

10. INSULATED / PENTHOUSE COOLER

10.1 Selection of heat exchanger system – insulated cooler

Contrary to the other device designs, there is a special selection of possible designs for insulated and penthouse coolers. See Image 170 and Image 171.

Image 169

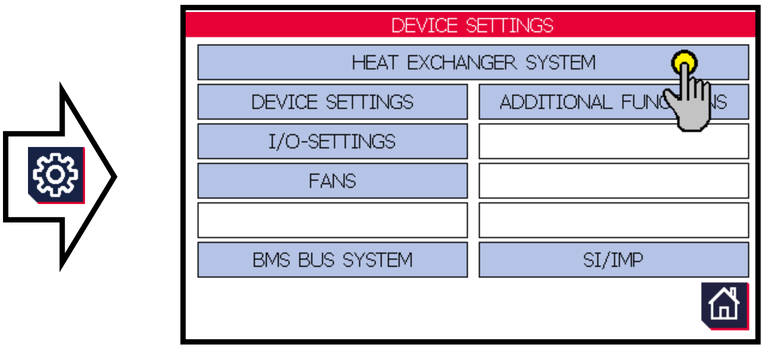


Image 170

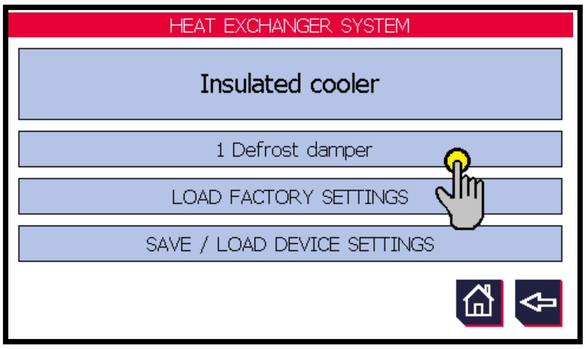
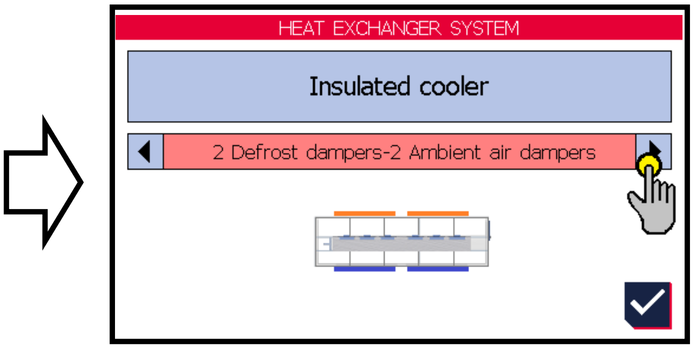


Image 171



The following selection is available:

- 1 defrosting flap
- 2 defrosting flaps
- 1 defrosting flap – 1 external air flap
- 1 defrosting flap – 1 ambient air flap
- 2 defrosting flaps – 1 external air flap
- 2 defrosting flaps – 2 external air flaps
- 2 defrosting flap – 2 ambient air flaps

Please select the appropriate application.

10.2 Adjustments in Device settings → Additional functions Insulated cooler

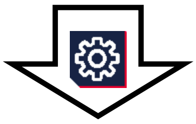
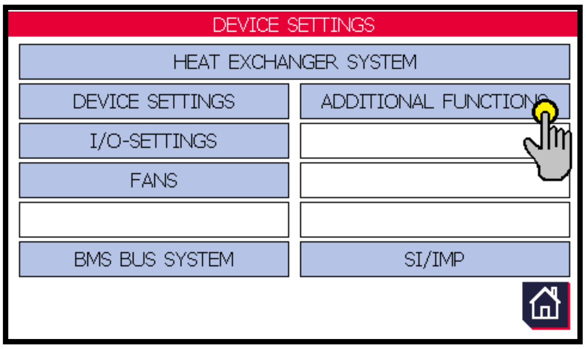


Image 172



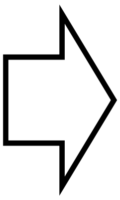
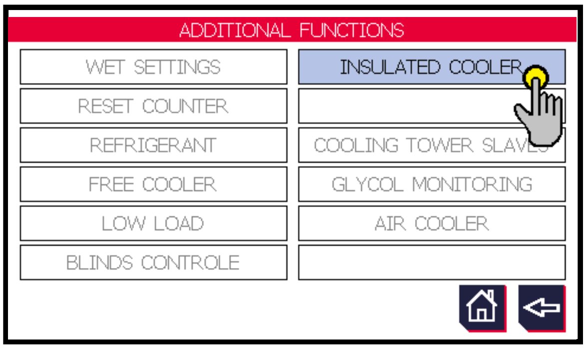


Image 173



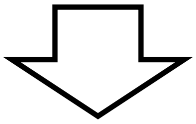
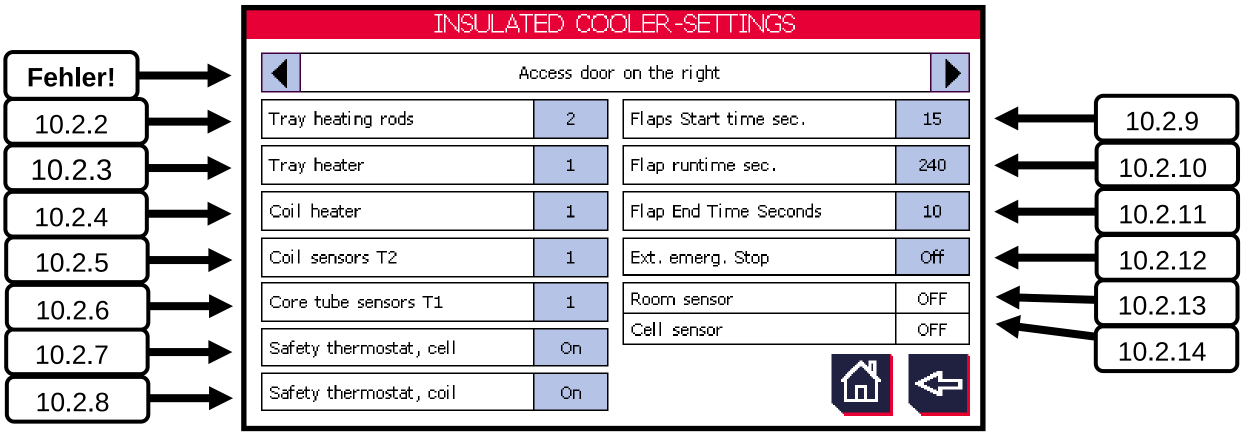


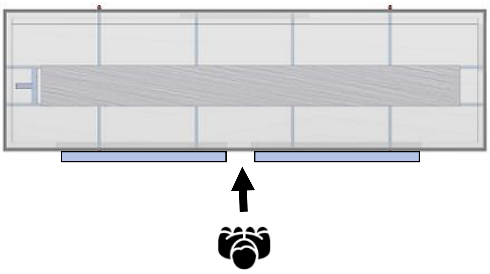
Image 174



10.2.1 Number / position of access doors

The number and position of access doors is determined using the arrow. This is for the correct presentation on the insulated cooler view **(view: view of the defrosting flap(s) Image 175).** The following options exist:

Image 175



- no door
- Door right
- Door left
- Door rear right
- Door rear left
- Door left and right
- Door rear left and right

Factory settings: Door right

10.2.2 Tank heating elements

Number of tank heating elements in the insulating or penthouse coolers, which are monitored, controlled and regulated by the TCS.2 One tank temperature measurement takes place per tank heating element.

Can be edited from …to: 0 … 4 tank heating elements
Factory settings: 2 tank heating elements

10.2.3 Tank heatings

Number of tank heating levels that are controlled by the TCS.2

Can be edited from …to: 0 … 2 tank heating levels
Factory settings: 1 tank heating level

10.2.4 Block heatings

Number of block heating levels that are controlled by the TCS.2

Can be edited from …to: 0 … 2 block heating levels
Factory settings: 0 block heating levels

10.2.5 Block sensors T2

Number of control sensors for the electric block defrosting.

Can be edited from …to: 0 … 2 block sensors
Factory settings: 0 block sensors

10.2.6 Core tube sensors T1

Number of installed core tube temperature sensors. These control the start of defrosting (coolant is extracted) and the

Can be edited from …to: 0 ... 2 core tube sensors
Factory settings: 0 core tube sensors

10.2.7 Safety thermostat cell

A safety thermostat in the cell protects it from impermissibly high temperatures and consequential damage within the cold cell Here is the query of whether this kind of thermostat will be installed in the cell and evaluated via the TCS.2.
After activation, the DI-94 input will be automatically assigned on CAN module 12.

Factory settings: Off

The following parameters are applicable for querying via bus:

Register	Bit	Fault code	Designation	Meaning	Register value
162	**1**	I06	Safety thermostat cell	TRUE = cell temperature, safety thermostat triggered	read 2

10.2.8 Safety thermostat block

A safety thermostat that is installed in the finned heat exchanger protects it from impermissibly high temperatures and consequential damage within the cold cell. Here is the query of whether this kind of thermostat will be installed in the block and evaluated via the TCS.2.
After activation, the DI-95 input will be automatically assigned on the CAN module 12.

Factory settings: Off

The following parameters are applicable for querying via bus:

Register	Bit	Fault code	Designation	Meaning	Register value
162	**0**	I05	Safety thermostat block	TRUE = block temperature, safety thermostat triggered	read 1

10.2.9 Flap start time seconds

Adjustable time window from start of the flap from the end position until leaving the limit switch. If this time is exceeded, the TCS.2 generates a fault message (... no start ..., K11, K12, K13, K14). See also chapter *12.5 Flap messages – Fault code* K....

Can be edited from …to: 5 … 20 s
Factory settings: 15 s

10.2.10 Flap runtime seconds

Adjustable time window from leaving the start limit switch until reaching the target limit switch. If this time is exceeded, the TCS.2 generates a fault message (... Lz-runtime error ..., K03, K04, K06, K07). See also chapter *12.5 Flap messages – Fault code* K....

Can be edited from …to: 60 … 300 s
Factory settings: 240 s

10.2.11 Flap end time seconds

Adjustable time window from reaching the target limit switch until end position. If this time is exceeded, the TCS.2 generates a fault message (... no start ..., K05, K08). See also chapter *12.5 Flap messages – Fault code* K...

Can be edited from …to: 5 … 20 s
Factory settings: 10 s

10.2.12 External emergency stop

Monitoring an external emergency stop signal. After activation, the DI-96 input will be automatically assigned on the CAN module 12. Input= true = -> OK, input = false -> emergency stop activated.

Factory settings: Off

The following parameters are applicable for querying via bus:

Register	Bit	Fault code	Designation	Meaning	Register value
141	**14**	S04	Emergency stop	TRUE = OK FALSE = emergency stop triggered	read 16384

10.2.13 Room sensor

Display whether a temperature sensor is installed in the room to be cooled and is connected to the TCS.2
The room sensor at basic device AI-1 is selected. See also chapter *4.3.3 Analog IN basic* device.

10.2.14 Cell sensor

Display whether a temperature sensor is installed in the cell and is connected to the TCS.2. The cell sensor at basic device AI-4 is selected. See also chapter *4.3.3 Analog IN basic* device.

10.3 Adjustments in Device settings → Control

10.3.1 Defrosting, draining time and pre-cooling

The type of control selected here relates to two signals. On the one hand, the “request defrosting” and on the other the “request draining and pre-cooling time”

See chapter 4.2.16 “*Control Defrosting, draining time and* pre-cooling”

Selecting the reset button or reset external input for 10s cancels the defrosting program sequence.

Register	Bit	Designation	Meaning	Register value
3	**1**	Defrosting	TRUE = defrosting process started	write 2
3	**2**	Draining pre-cooling time	TRUE = draining pre-cooling time started	write 4
158	**0**	Defrosting ON	TRUE = defrosting active	read 1
158	**1**	Draining pre-cooling time ON	TRUE = draining pre-cooling time active	read 2

10.3.2 Fans OFF (feedback standstill fans)

To prevent damage to the flaps of an insulated cooler, it must be ensured that hte fans are at a standstill while the flaps are opening or closing. As the fans are sometimes controlled directly – and not via the TCS.2, this information must be forwarded from externally to the TCS.2. The following three options exist for this:

- **Internal** (fans are controlled via the TCS) ← standard
- **Via terminal** (information via digital input (DI-6 "RM fans off")
- **Via bus** (information from higher level building control system)

For the selection of the respective option, see chapter 4.2.17 “Control fans off”

The following parameters exist for communication via bus:

Register	Bit	Designation	Meaning	Register value
3	**3**	Feedback external fans OFF	TRUE = fans are off (standstill)	write 16
158	**12**	Notification fans OFF	TRUE = fans are off (standstill)	read 4096

10.3.3 Standby

A condition for activating the standby mode is that the device is switched off (see chapter 10.6.2 "*Functional diagram* standby").

When switched off, all flaps are closed. The device is not immediately ready for operation. If the standby function is now requested, the defrosting flap(s) open. The insulated cooler is now immediately ready for operation, if a "cool" request is present.

For the selection of the options for control, see chapter 4.2.18 *"Control standby*"

The following parameters exist for communication via bus:

Register	Bit	Designation	Meaning	Register value
3	**0**	Standby	TRUE = activate standby	write 1
158	**13**	Standby active	TRUE = standby was requested	read 8192

10.4 Adjustments in Main menu → Additional functions → Insulated cooler

The Insulated cooler sub-menu is available for adaptations in the mode of operation. It is protected with the user parameter password [see also chapter 2.4.3 “User parameter password (editable)”].

Image 176

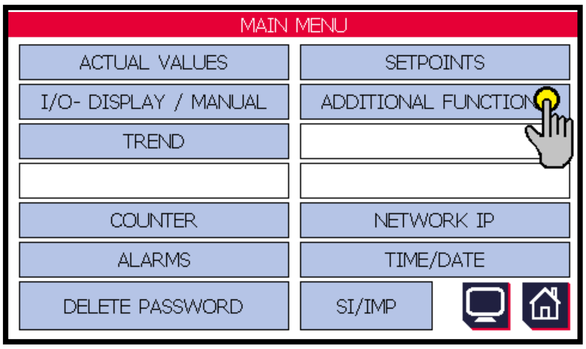


Image 177

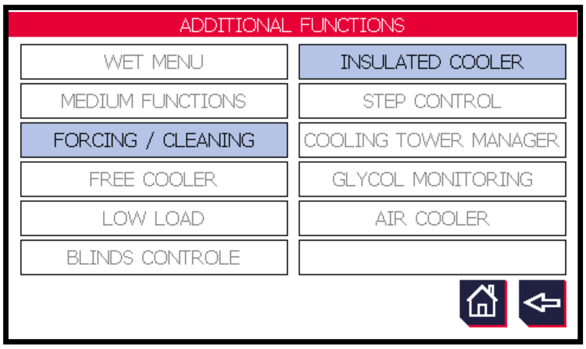
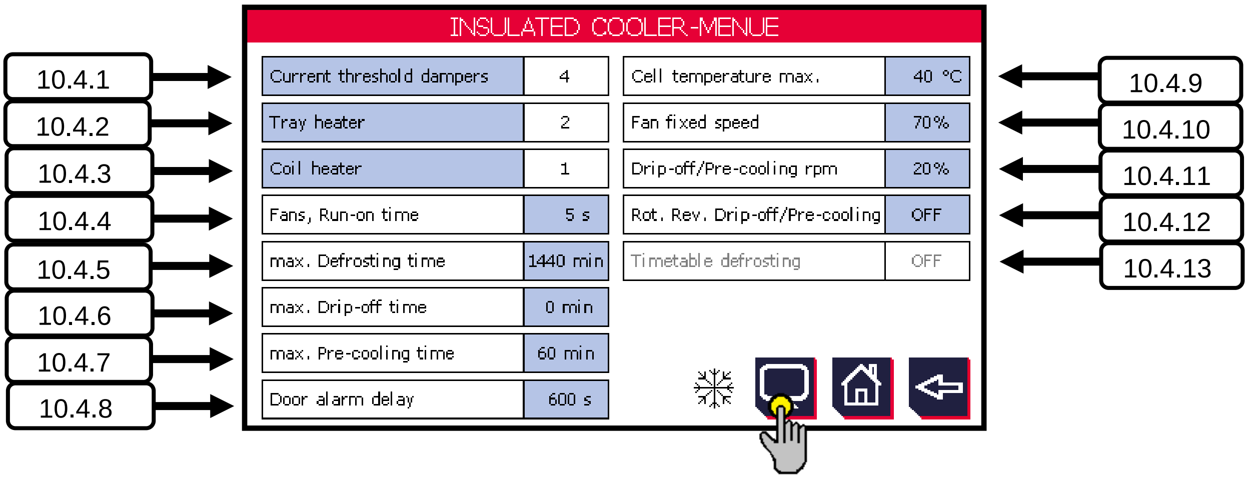


Image 178

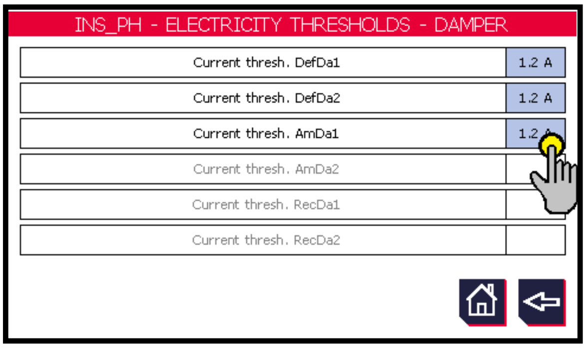


Greyed-out functions are not activated or selected in Display settings.

10.4.1 Current threshold flaps

The total number of configured flaps is displayed. Selecting the blue “Current threshold flaps” button takes you to the following sub-menu (Image 179):

Image 179



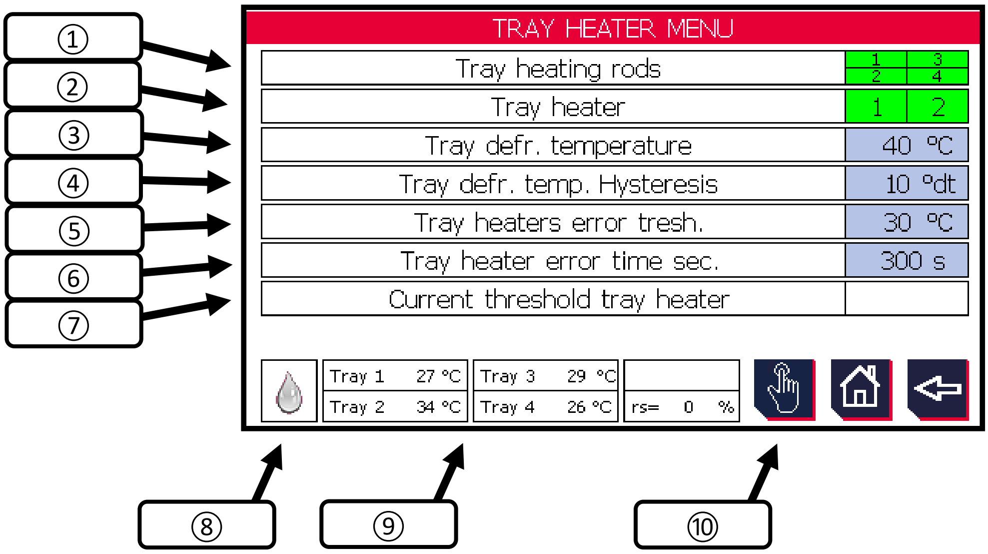
A current threshold (switch-off threshold) can be stored here for each flap. Reaching this current is defined by the TCS.2 as limit stop. The higher the threshold is set, the greater the adaptation pressure at the respective end position. This value is dependent on the size and weight of the respective flap.

Can be edited from …to: 0.5 … 2.5 A
Factory settings: 1.2 A

10.4.2 Tank heating

The number of configured tank heating stages is displayed. Selecting the blue “Tank heating” button takes you to the following sub-menu (Image 180).

Image 180



① **Tank heating elements**

Status display of tank heating elements in the insulating or penthouse coolers, which are monitored, controlled and regulated by the TCS.2.

White background → switched off
Green background → switched on

② **Tank heatings**

Status display of tank heating levels that are controlled by the TCS.2.

White background → switched off
Green background → switched on

③ **Tank defrosting temperature**

A 2-point controller takes over the switching on and off of the tank heating elements. This parameter is the upper deactivation point. If several tank heating elements are used for each tank heating stage, the mean of all actual tank temperatures is formed internally, which leads to the respective heating stage being switched off.

<u>Can be edited from …to</u>: 10 … 80 °C / °F

<u>Factory settings</u>: 40°C

④ **Tank defrosting temperature hysteresis**

The “tank defrosting temperature” (③) minus the hysteresis that can be edited here results in the lower deactivation point of the 2-point controller. See following example:

Tank defrosting temperature: 40°C
Tank defrosting temperature hysteresis: 10°C

Activation point 2-point controller: <u>40°C</u>
Deactivation point 2-point controller: 40 – 10°C = <u>30°C</u>

<u>Can be edited from …to</u>: 1 … 20°C

<u>Factory settings</u>: 10°C

⑤ Threshold monitoring heating elements

If the temperature threshold set here is not achieved in the time set under point ⑥, a fault message for the respective heating element will be generated.

Can be edited from …to: 10 … 100°C

Factory settings: 30°C

⑥ Warming time monitoring heating elements seconds

If the temperature set under point ⑤ is not achieved in the time set, a fault message for the respective heating element will be internally generated.

Can be edited from …to: 120 … 600 s

Factory settings: 300 s

⑦ Current threshold tank heating

Adjustment option only present if current of the tank heating is recorded via a transformer (see also chapter 10.4 “Adjustments in Main menu → Additional functions → Insulated cooler”). If this is the case, a current threshold can be set here for each heating element/heating element group. If this is exceeded, the TCS.2 generates a fault message.

Can be edited from …to: 0.0 … 15.0 A
Factory settings: 1.0 A

⑧ Status message insulated cooler

See chapter *10.5.1 “Status* messages*”.*

⑨ Tank temperatures

Current measured temperature value of the tank at the respective heating element

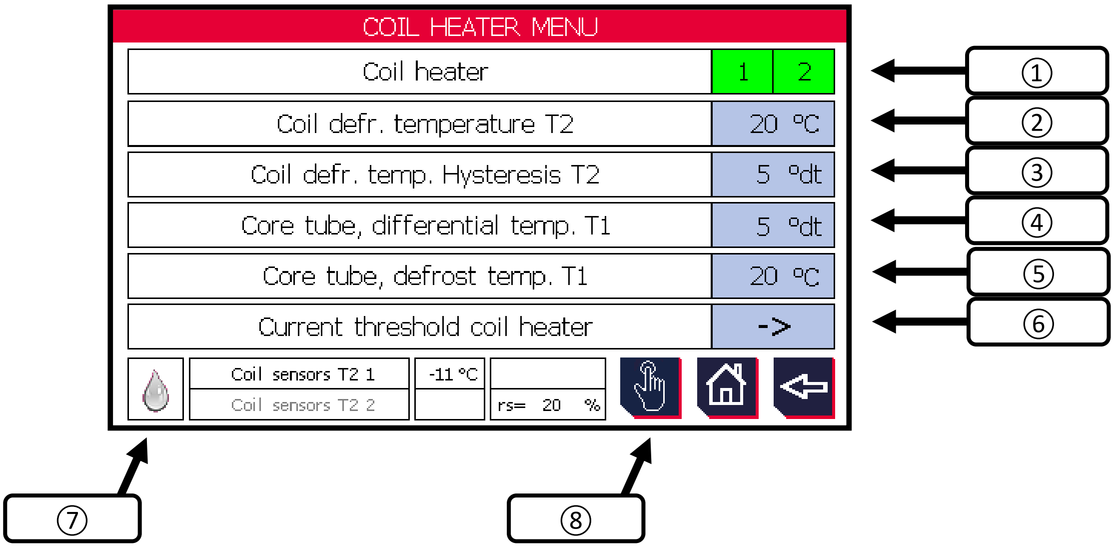
⑩ Manual operation electrical defrosting

Option to manually switch the electric block and tank heating elements on/off

10.4.3 Block heating

The number of configured block heating stages is displayed. Selecting the blue "Block heating" button takes you to the following sub-menu:

Image 181



① **Block heatings**

Status display of the installed block heatings, which are monitored, controlled and regulated.

White background → switched off
Green background → switched on

② **Block defrosting temperature T2**

A 2-point controller takes over the switching on and off of the electrical block heating. This parameter is the upper deactivation threshold.

Can be edited from …to:	10.0 … 50.0°C / °F
Factory settings:	20.0 °C

③ Block defrosting temperature hysteresis T2

The “Block defrosting temperature T2” (②) minus the hysteresis that can be edited here results in the lower deactivation point of the 2-point controller. See following example:

Tank defrosting temperature: 20°C
Tank defrosting temperature hysteresis: 5°C

Activation point 2-point controller: 20°C
Deactivation point 2-point controller: 20 – 5°C = 15°C

Can be edited from …to: 1.0 … 10.0°C

Factory settings: 5.0°C

④ Core tube differential temperature T1

This condition for the start of defrosting is activated if a “fan run-on time” > 0s is set. See chapter 10.4.4 “Fans run-on time”. In the time set here, the core tube sensor expects the temperature drop set here. This measurement allows it to be ensured that no liquid refrigerant remains in the core tube. If the differential is reached, the defrosting is initiated. If the set temperature differential in the run-on time is not reached, the TCS gives a fault message “I11 Defrosting blocked”. See chapter 12.3 “

Fehler-code	Art	Error text	Fault explanation	Fault remedy	MODBUS Reg.	MODBUS Bit
H01		Medium pump faulty [Nr]	- general message that the medium pump is faulty - motor protection - overheating protection	- motor line(s) interrupted / check wiring - check terminal points - check protections - mechanically check pump		
H02						
H03	A	Fault, wetting pump [Nr]	- general message that the wetting pump is faulty - motor protection - overheating protection	- motor line(s) interrupted / check wiring - check terminal points - check protections - mechanically check pump	180	10, 11

H04	A	Dry run, wetting pump [Nr]	- insufficient water available to operate the wetting pump - water supply failed - valves closed - line blocked - refill valve faulty - water pressure too low	- check water supply - clean pipelines - check valves	181	0 bis 3
H05	W	Fault in UVC disinfection [Nr]	- UVC module fault	- check UVC module	181	9, 11
H06	W	Time max. UVC disinfection [Nr]	- UVC lamp is worn out (max. operating time reached).	- replace UVC lamp	181	10, 12
H07	W	Circulation water tub, empty	- empty message circulating water	- fresh water line not carrying any water - check valves - check level sensor	180	15
H08	W	Hardness stabilizer, cont. empty	- hardness stabiliser container empty	- fill hardness stabiliser	181	7
H09	W	Biocide, container empty	- biocide empty - biocide message cable break	- fill up biocide - check cable	181	6
H10	W	Entrance door opened	- entry door on hybrid cooler open	- reset only possible on TCS, no external reset	181	13
H11	W	Dry run, logic error	- message from limit switch the fill level probe does not correspond with the actual fill level	- check fill level probe, replace if necessary	181	14

Insulated cooler messages – Fault code I”.

Can be edited from …to: 1.0 … 20.0°C

Factory settings: 10.0°C

⑤ Core tube defrosting temperature T1

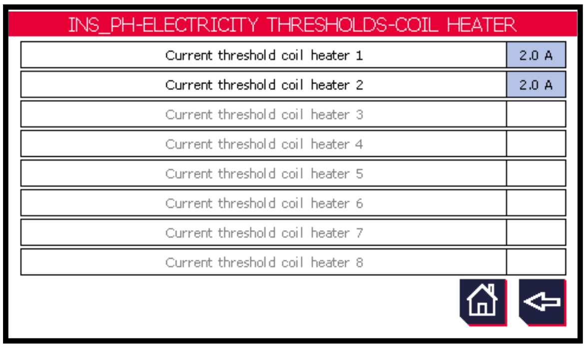
If the temperature threshold set here is reached, or the set defrosting time (10.4.5) has elapsed, the defrosting phase is ended.

Can be edited from …to: 1.0 … 30.0°C

Factory settings: 20.0°C

⑥ Current threshold block heating

If the temperature set under point ⑤ is not achieved in the time set, a fault message for the respective heating element will be internally generated.



Can be edited from …to: 0.0 … 20.0 s

Factory settings: 2.0 s

⑦ Status display defrosting

See chapter *10.5.1 “Status* messages*”.*

⑧ Manual operation electrical defrosting

Option to manually switch the electric block heating elements on/off

10.4.4 Fans run-on time

The fan run-on time is a condition for the start of defrosting, if a run-on time > 0s is set. In the time set here, the core tube sensor T1 (see 10.4.3 ⑤) expects a temperature drop set in 10.4.3 ④. The run-on time should ensure that no liquid refrigerant remains in the core tube. If the run-on time is finished and the differential temperature is reached, the defrosting is initiated. If the set temperature differential in the run-on time is not reached, the TCS gives a fault message "I11 Defrosting blocked". See chapter 12.3 "

Fehler-code	Art	Error text	Fault explanation	Fault remedy	MODBUS	
					Reg.	Bit
H01		Medium pump faulty [Nr]	- general message that the medium pump is faulty - motor protection - overheating protection	- motor line(s) interrupted / check wiring - check terminal points - check protections - mechanically check pump		
H02						
H03	A	Fault, wetting pump [Nr]	- general message that the wetting pump is faulty - motor protection - overheating protection	- motor line(s) interrupted / check wiring - check terminal points - check protections - mechanically check pump	180	10, 11
H04	A	Dry run, wetting pump [Nr]	- insufficient water available to operate the wetting pump - water supply failed - valves closed - line blocked - refill valve faulty - water pressure too low	- check water supply - clean pipelines - check valves	181	0 bis 3
H05	W	Fault in UVC disinfection [Nr]	- UVC module fault	- check UVC module	181	9, 11

H06	W	Time max. UVC disinfection [Nr]	- UVC lamp is worn out (max. operating time reached).	- replace UVC lamp	181	10, 12
H07	W	Circulation water tub, empty	- empty message circulating water	- fresh water line not carrying any water - check valves - check level sensor	180	15
H08	W	Hardness stabilizer, cont. empty	- hardness stabiliser container empty	- fill hardness stabiliser	181	7
H09	W	Biocide, container empty	- biocide empty - biocide message cable break	- fill up biocide - check cable	181	6
H10	W	Entrance door opened	- entry door on hybrid cooler open	- reset only possible on TCS, no external reset	181	13
H11	W	Dry run, logic error	- message from limit switch the fill level probe does not correspond with the actual fill level	- check fill level probe, replace if necessary	181	14

Insulated cooler messages – Fault code I”.

Can be edited from …to: 0 … 1800 s

Factory settings: 0 s

10.4.5 Maximum defrosting time

There are three options to determine the length of the defrosting process for the heat exchanger (see also chapter *10.6.1* “*Functional diagram* defrosting”):

- Activating the draining/pre-cooling time **via DI-3 or bus** (Register 3 Bit 2)
- a defined **block temperature is reached**
- the **maximum defrosting time** editable under this menu item **has elapsed**

However, for safety reasons, the last option **“Maximum defrosting time”** restricts all variants to a maximum duration of the defrosting process. For this reason, this time should be set appropriately high when using the first two variants.

When using the option **“Schedule defrosting”**, this parameter determines the duration of the defrosting time (see also chapter 10.4.13).

During the defrosting time, the fans run to ensure even distribution of the heat to the set “defrosting/precooling speed” (see also chapter *10.4.11* “*Defrosting/precooling speed*”).

Can be edited from …to: 0 … 1440 min

Factory settings: 1440 min

Status symbol: 

Selecting the reset button or reset external input for 10s cancels the defrosting program sequence.

10.4.6 Draining time

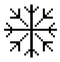
Defines the time after the defrosting process, in which the melt water from the heat exchanger should drain. This must have elapsed before the pre-cooling time can begin. During this process, the fans are stopped.

Can be edited from …to:	0 … 60 min
Factory settings:	0 min
Status symbol:	-  - blinking

See also chapter *10.6.1 Functional diagram* defrosting.

10.4.7 Precooling time

Defines the time during which the internal space heated by the defrosting process is precooled to “cool room temperature”. Once this time has elapsed, the defrosting flap(s) must open again and the system must return to regular cooling operation.

Can be edited from …to:	0 … 60 min
Factory settings:	60 min
Status symbol:	-  -

See also chapter *10.6.1 Functional diagram* defrosting.

10.4.8 Delay door alarm

Adjustable duration in which the access door(s) can be opened when running, without the alarm message being generated.

Can be edited from …to: 10 … 3600 s

Factory settings: 600 s

The following requests via bus are possible:

Register	Bit	Fault code	Designation	Meaning	Register value
161	**14**	I07	Access door 1 alarm	TRUE = access door 1 has been open for too long	read 16384
161	**15**	I07	Access door 2 alarm	TRUE = access door 2 has been open for too long	read 32768
158	**10**	I08	Access door 1 open	TRUE = access door 1 is open	read 1024
158	**11**	I08	Access door 2 open	TRUE = access door 2 is open	read 2048

10.4.9 Cell temperature maximum

If the temperature set in the cool cell is exceeded, all heating elements controlled via the TCS are switched off and the following fault message is output: "I01 – overtemperature cell".

This menu item can only be selected if a cell sensor at analog input 4 (AI-4) has been selected (see also chapter *4.3.3* "*Analog IN basic* device").

Can be edited from …to: 40 … 70 °C

Factory settings: 40 °C

The following requests via bus are possible:

Register	Bit	Fault code	Designation	Meaning	Register value
162	**2**	I01	Overtemperature cell	TRUE = cell temperature too high	read 4

10.4.10 Fan fixed speed

Adjustable speed in percent for the normal cooling mode, related to the maximum speed (see also fan settings, chapter *4.4.4* "*Maximum speed in* %").

If the user wishes to use this function, the speed setpoint source (slave setpoint) must be set to "internal" in advance (see also chapter *4.2.5* "*Control slave* setpoint").

Can be edited from …to: 10… 100 %

Factory settings: 70 %

10.4.11 Defrosting/precooling speed

Adjustable speed in percent for the defrosting and precooling process, related to the maximum speed. A slight air circulation accelerates the respective process and distributes the warmth/coldness evenly in the cooling cell.

See also chapter *10.6.1 Functional diagram* defrosting.

Can be edited from …to: 10… 60 %

Factory settings: 20 %

10.4.12 RDR (Reverse direction of rotation) defrosting/precooling speed

Determines whether the normal direction of rotation of the fans will be reversed during the defrosting and precooling time. Depending on the design of the fans, this can ensure a better circulation.

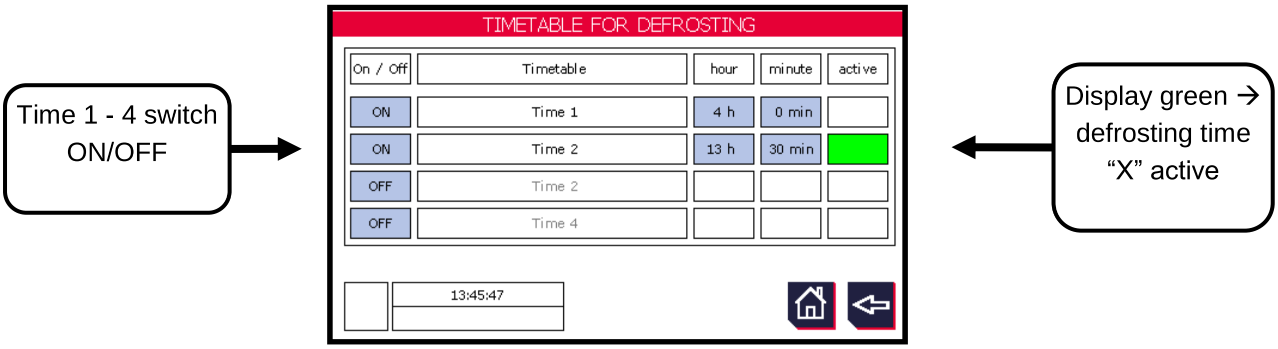
Factory settings: OFF

10.4.13 Schedule defrosting

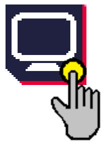
In addition to the options to start the defrosting manually (via terminal or bus), there is also the option of automatic defrosting according to schedule. A maximum of 4 times per day can be set for this (see Image 182).

Factory settings: OFF

Image 182

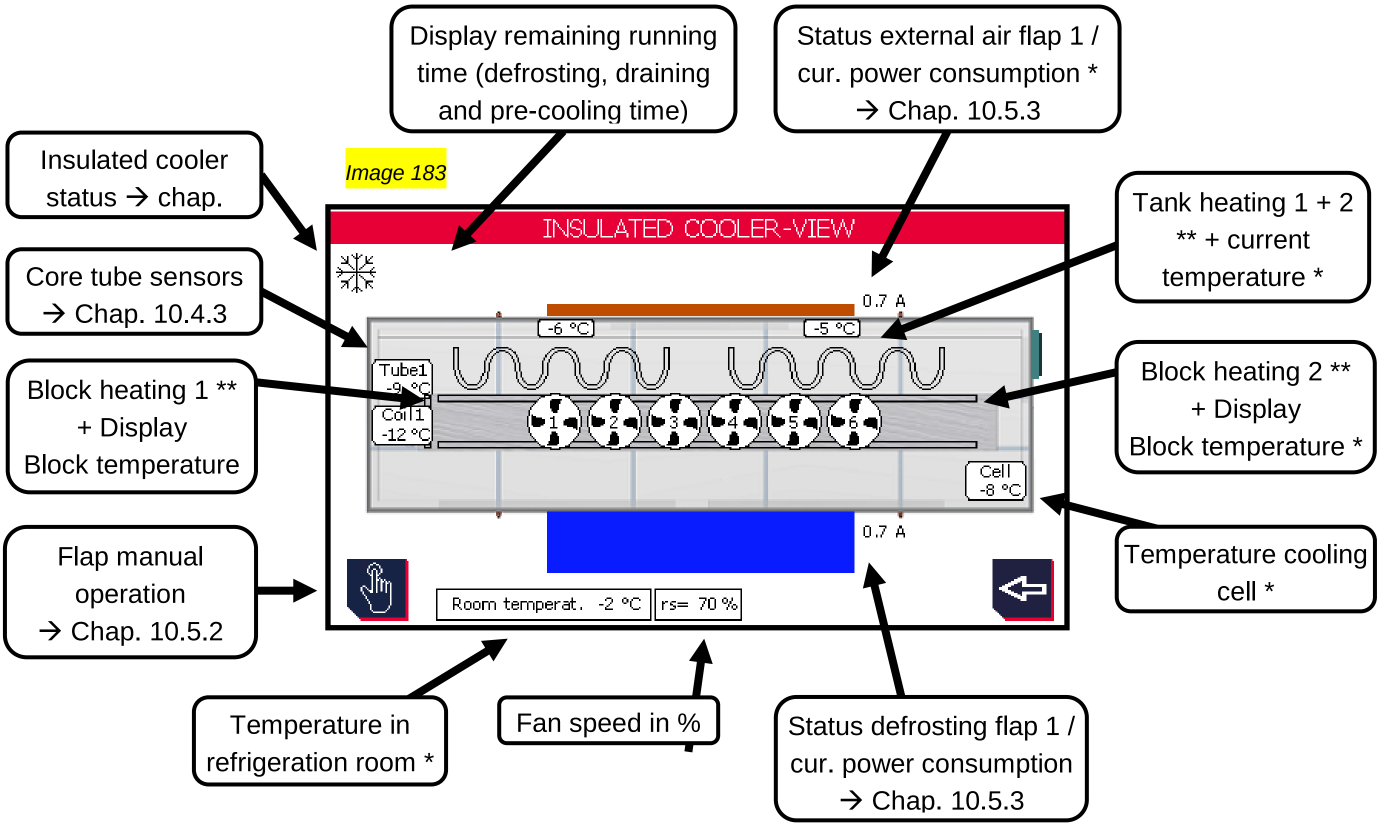


10.5 Insulated cooler view



From the main menu, the insulated cooler menu and various other sub-menus, the Insulated cooler view can be reached directly by pressing the monitor button (see Image 183). The user can observe all relevant conditions and status messages of the insulated cooler from here.

Image 183

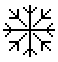


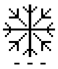
* only displayed when activated in Device settings

** symbol with black border → switched off; symbol with green fill → switched on

10.5.1 Status messages

The following messages are used both in the "Insulated cooler view" and also in various sub-menus to present the current operating status of the cooling cells:

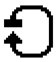

Cooling operation (normal cooling)

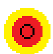

blinking
Pre-cooling time active – see chapter 10.4.7


Defrosting active – see chapter 10.4.5


blinking
Draining time active – see chapter 10.4.6


Device is switched off (no release via DI-1 / BUS) – see chapter 4.2.1


Flaps travelling to basic position


EMERGENCY STOP was actuated externally – see chapter 10.2.12


Standby active – see chapter 10.3.3


Defrosting via schedule active – see chapter 10.4.13

10.5.2 Flap manual operation

Selecting the hand symbol in the "Insulated cooler view" (Image 184) takes you to the manual operating level for the flaps (Image 185).

Image 184

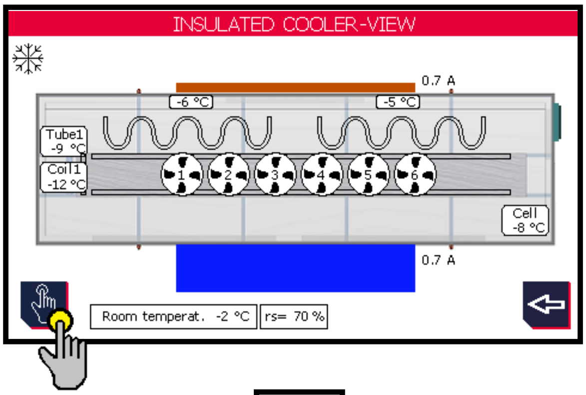
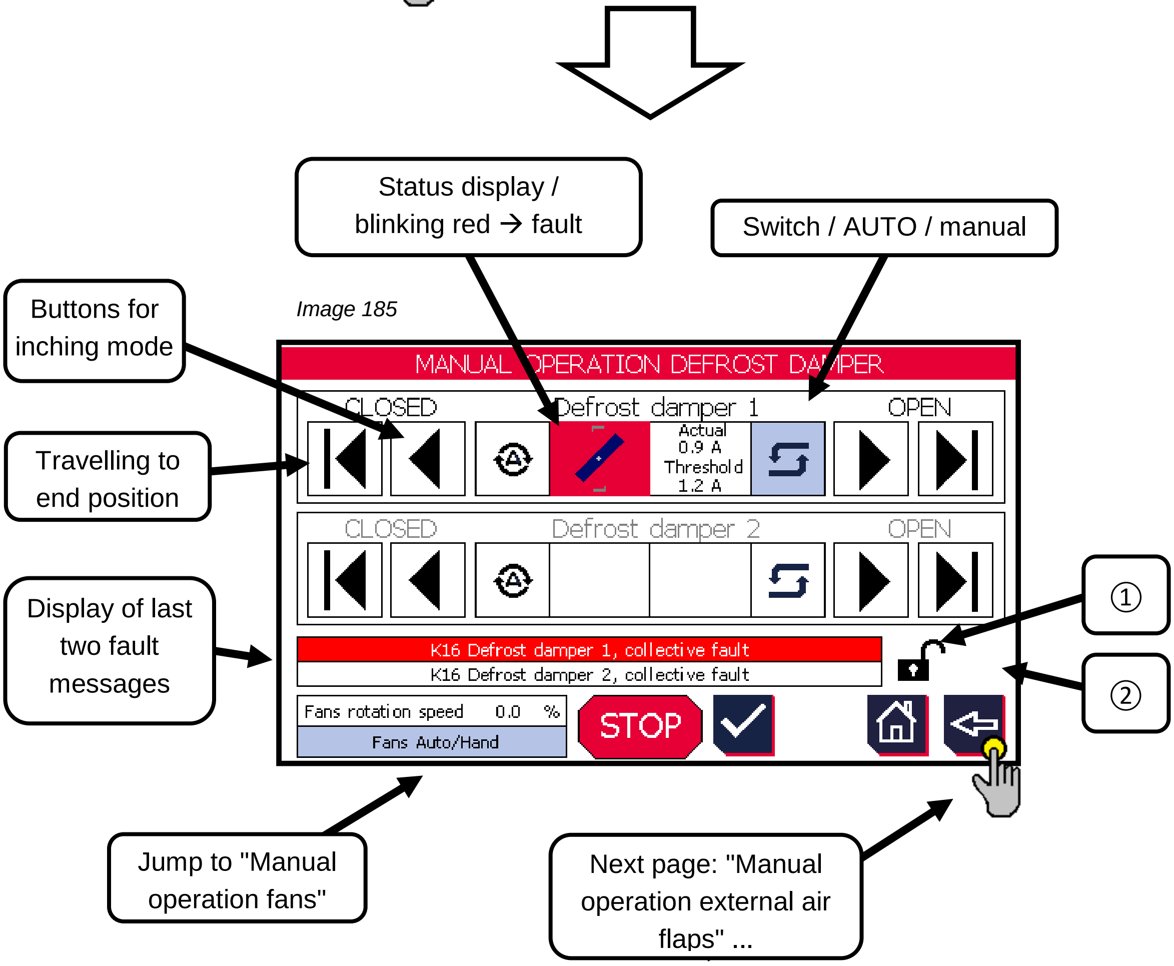


Image 185



① The lock symbol signals whether manual mode is unlocked or locked for the flaps. If fans are in operation, moving the flaps is not permitted.

② Status display – see chapter *10.5.1* “*Status* messages”

10.5.3 Flaps status

The following graphics are used to visualise the position / status of the flaps:

	Flap closed
	Flap is opening
	Flap is open
	Flap is closing
	Flap is closed

10.6 Insulated cooler attachments

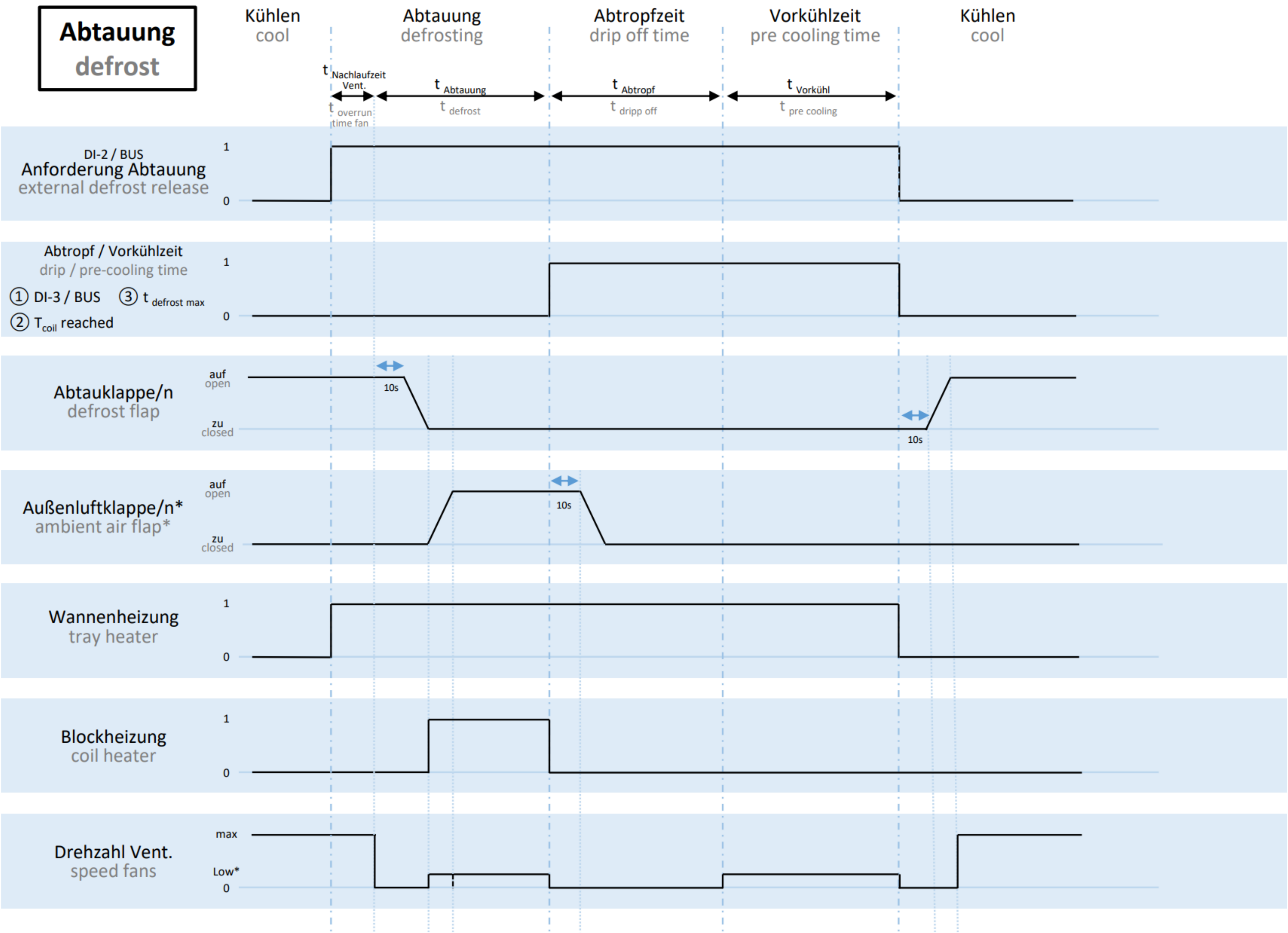
10.6.1 Functional diagram defrosting

Schematic representation of a defrosting process (see Image 186).

10.6.2 Functional diagram standby

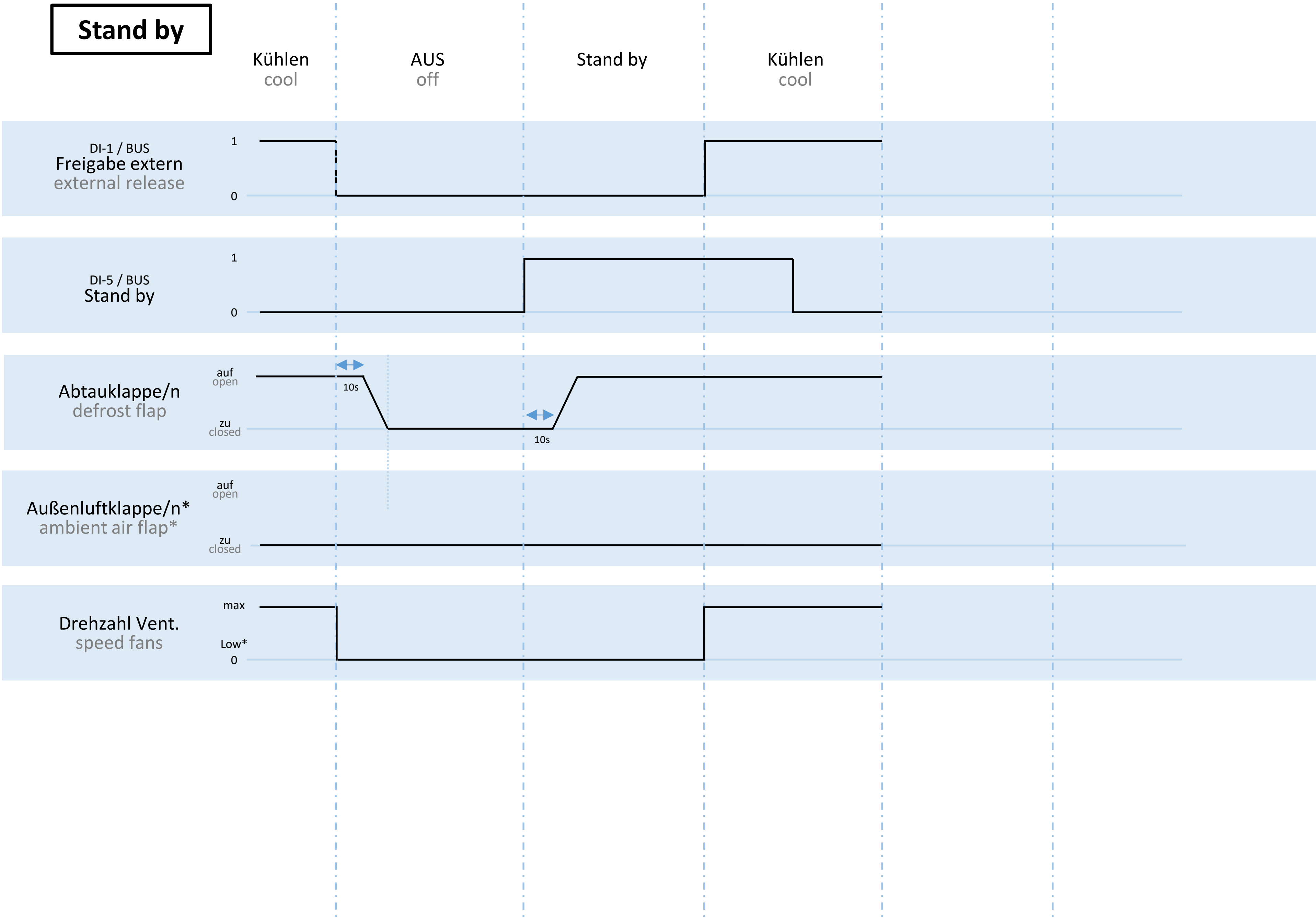
Schematic representation from "OFF" and "Standby" status (see Image 187).

Image 186



Abtauung
defrost
Kühlen
cool
Abtauung
defrosting
Abtropfzeit
drip off time
Vorkühlzeit
pre cooling time
Kühlen
cool
t Nachlaufzeit Vent.
t overrun time fan
t Abtauung
t defrost
t Abtropf
t dripp off
t Vorkühl
t pre cooling
DI-2 / BUS
Anforderung Abtauung
external defrost release
Abtropf / Vorkühlzeit
drip / pre-cooling time
① DI-3 / BUS ③ t defrost max
② T coil reached
Abtauklappe/n
defrost flap
auf
open
zu
closed
10s
Außenluftklappe/n*
ambient air flap*
Wannenheizung
tray heater
Blockheizung
coil heater
Drehzahl Vent.
speed fans
max
Low*
1
0

Image 187


Stand by
Kühlen
cool
AUS
off
Stand by
Kühlen
cool
DI-1 / BUS
Freigabe extern
external release
1
0
DI-5 / BUS
Stand by
1
0
Abtauklappe/n
defrost flap
auf
open
zu
closed
10s
10s
Außenluftklappe/n*
ambient air flap*
auf
open
zu
closed
Drehzahl Vent.
speed fans
max
Low*
0

11. COOLING TOWER MANAGER

11.1 Adjustments in Device settings

11.1.1 Function activate cooling tower manager

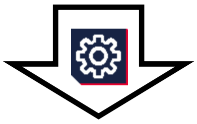


Image 188

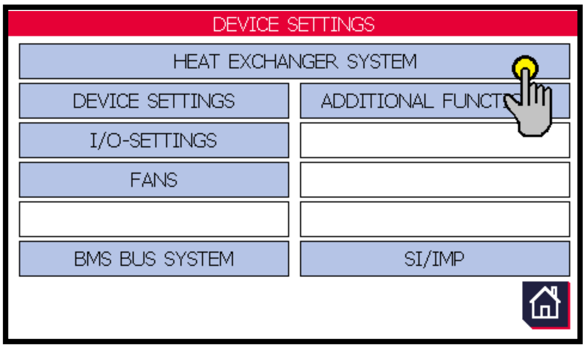
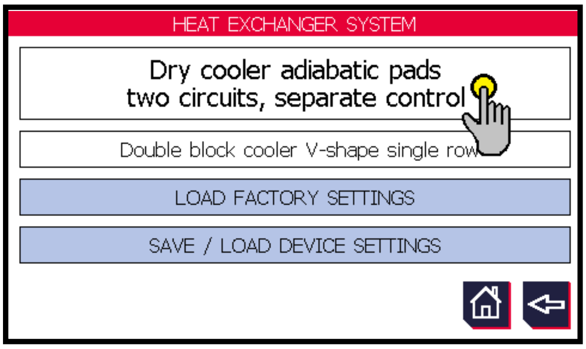
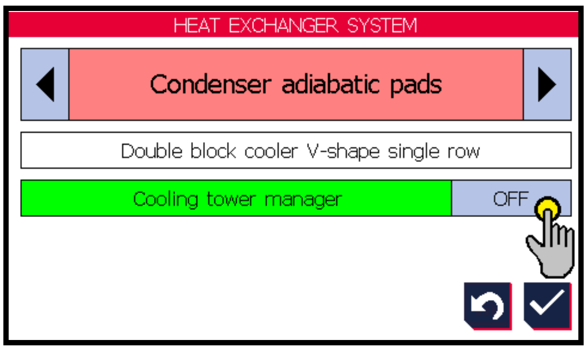


Image 189



This setting requires the manufacturer's password. Please contact thermofin GmbH Germany.

Image 190



In the selection of the heat system, it is determined whether the TCS functions as a cooling tower manager (<u>several</u> slave devices controlled) or takes over control and regulation for <u>one</u> device and its fans as standard. See also chapter 11.2 "Adjustments in Main menu → Additional functions → Cooling tower manager".

11.1.2 → Additional functions → Cooling tower slaves

Image 191

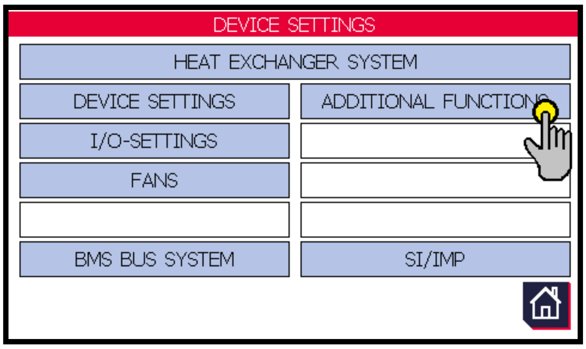
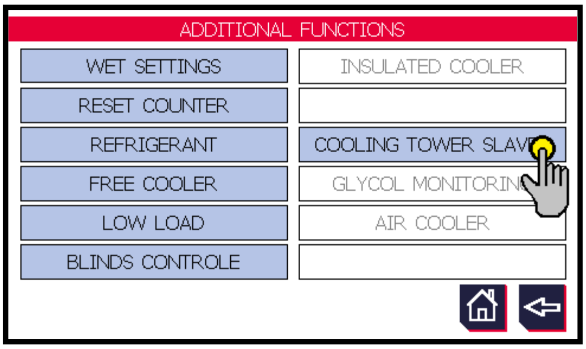
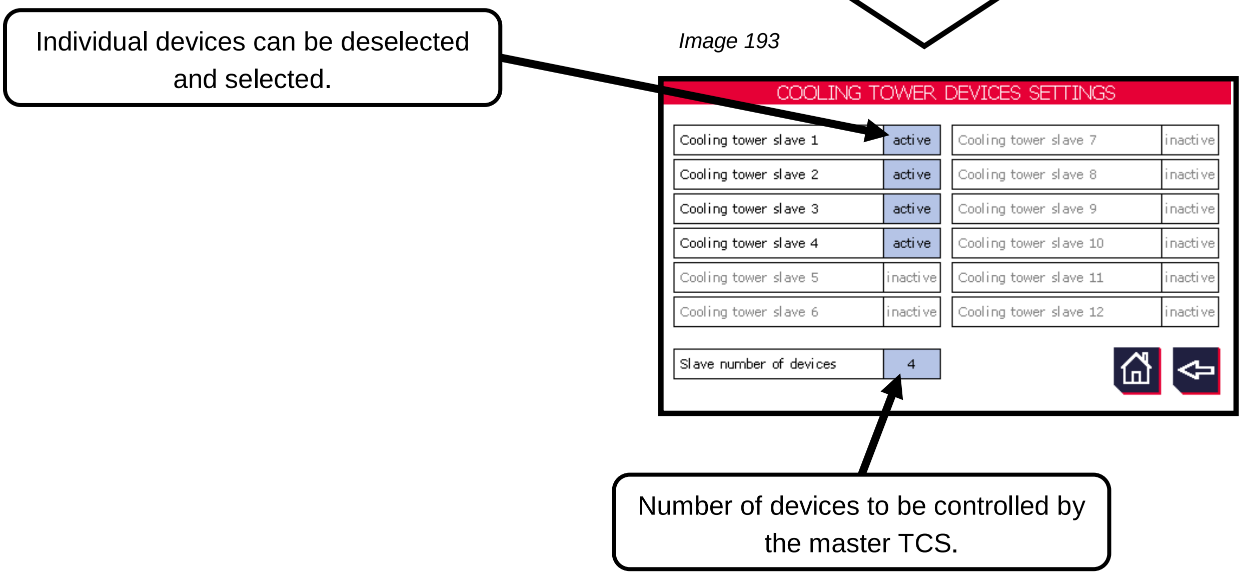


Image 192



This menu item can only be selected after selecting "Cooling tower manager" in the heating system selection (11.1.1) (with a blue background, see Image 40).

Image 193



11.2 Adjustments in Main menu → Additional functions → Cooling tower manager

Image 194

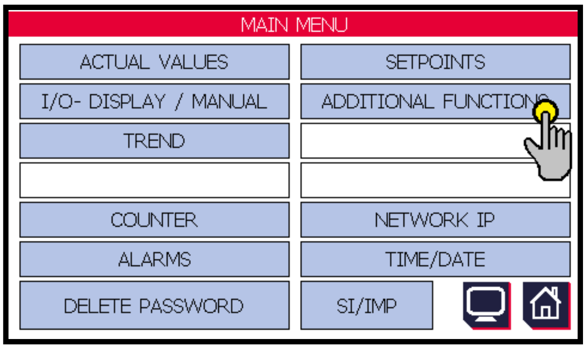
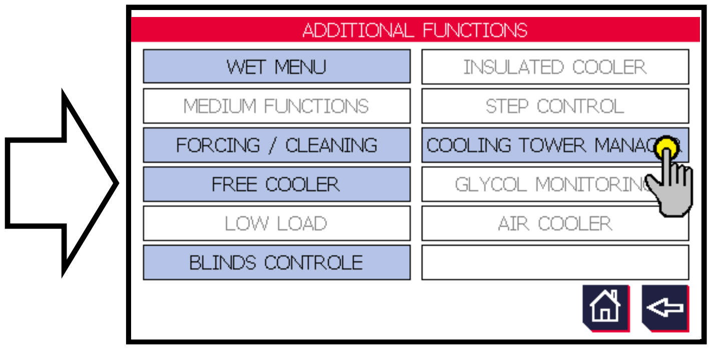
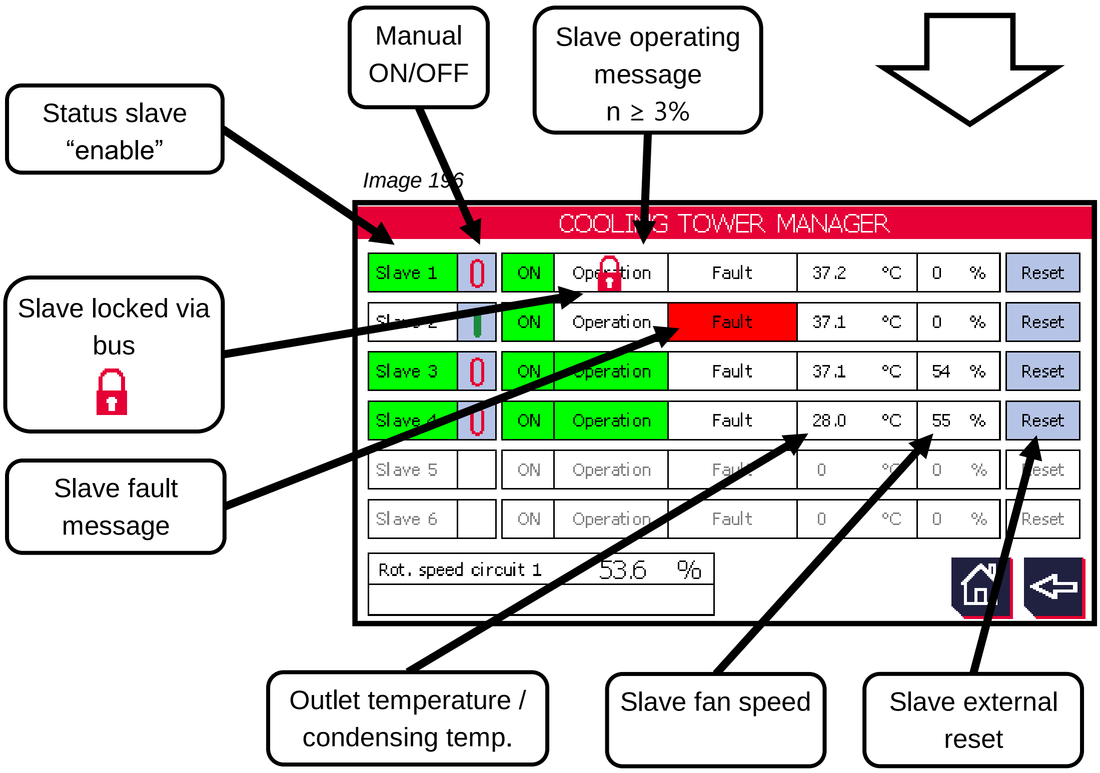


Image 195



This menu item can only be selected after selecting "Cooling tower manager" in the heating system selection (11.1.1) (with a blue background, see Image 40).

Image 196



11.3 Communication parameters for modbus slave devices

The modbus master communication parameters at the TCS (terminal X2.22-24) cannot be changed. For this reason, all modbus slave devices (TCS) must be parametrised with the following values:

Image 197

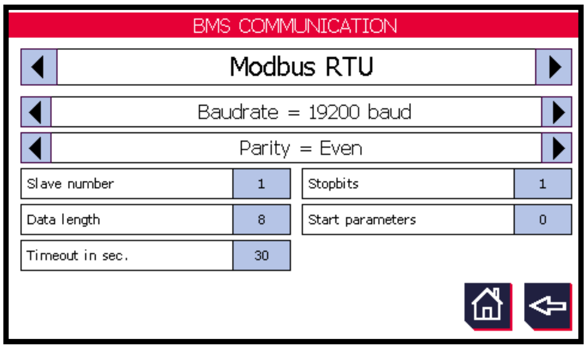
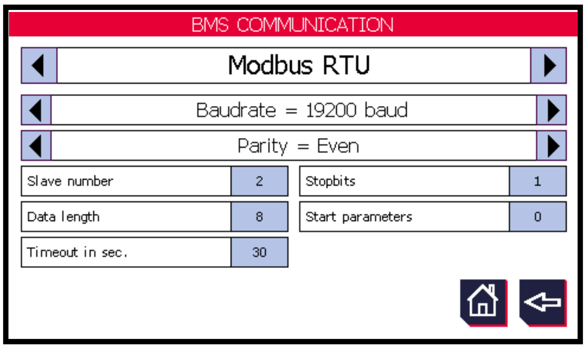


Image 198



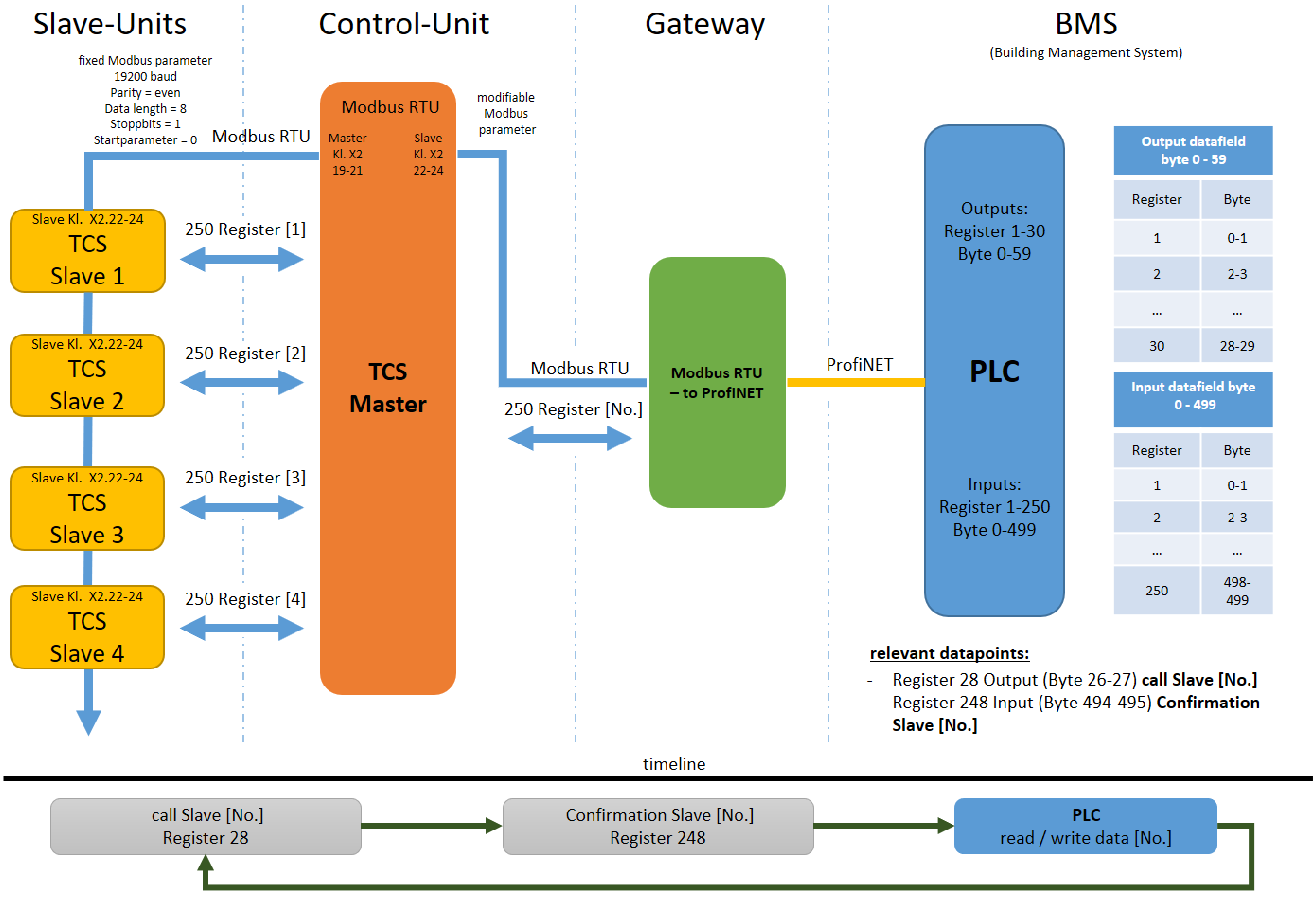
11.4 Master - slave management

See Image 199.

In this example, a ProfiNET gateway was used. Other modbus gateways can also be used (e.g. BacNET IP …)

Image 199

Master – Slave Management



11.5 Relevant modbus register for TCS Master - GLT communication

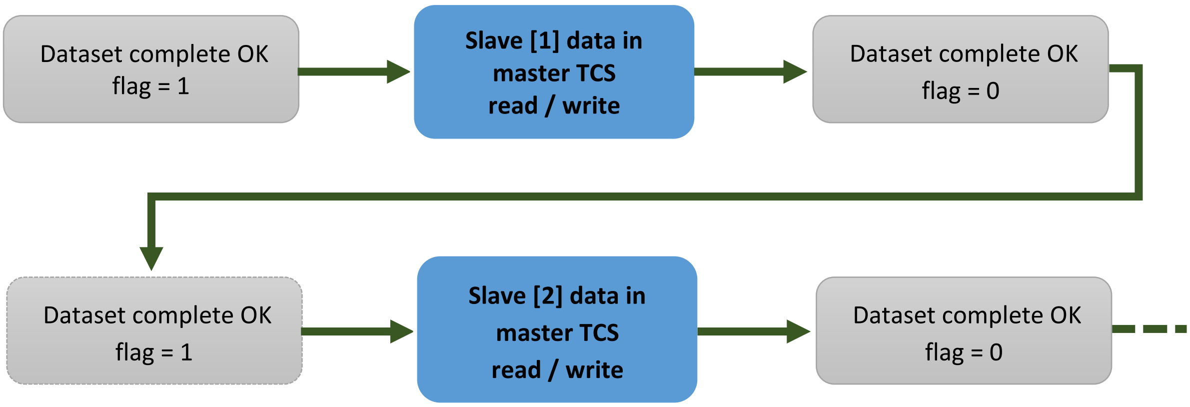
11.5.1 Locking individual slaves via bus

The following bits in register 130 must be used to lock individual slave devices via bus:

Register	Bit	Designation	Meaning	Register value
30	0	Lock slave device 1	TRUE = slave 1 locked	Write 1
	1	Lock slave device 2	TRUE = slave 2 locked	Write 2
	2	Lock slave device 3	TRUE = slave 3 locked	Write 4
	3	Lock slave device 4	TRUE = slave 4 locked	Write 8
	4	Lock slave device 5	TRUE = slave 5 locked	Write 16
	5	Lock slave device 6	TRUE = slave 6 locked	Write 32
	6	Lock slave device 7	TRUE = slave 7 locked	Write 64
	7	Lock slave device 8	TRUE = slave 8 locked	Write 128
	8	Lock slave device 9	TRUE = slave 9 locked	Write 256
	9	Lock slave device 10	TRUE = slave 10 locked	Write 512
	10	Lock slave device 11	TRUE = slave 11 locked	Write 1024
	11	Lock slave device 12	TRUE = slave 12 locked	Write 2048
	12	Lock slave device 13	TRUE = slave 13 locked	Write 4096
	13	Lock slave device 14	TRUE = slave 14 locked	Write 8192
	14	Lock slave device 15	TRUE = slave 15 locked	Write 16384
	15	Lock slave device 16	TRUE = slave 16 locked	Write 32768

11.5.2 Sequence read/write data in master TCS

The cycle time per slave (read / write process) lasts approx. 18s.



Register	Designation	Value	Register value
248	Slave number: of cur. dataset	1 … [Number of slave devices]	read
249	Dataset complete (OK flag)	1 = data fully loaded 2 = data incomplete	read

12. MESSAGES, WARNINGS AND ALARMS

All messages are categorised into the following areas:

Fault code	Category	Chapter
C…	CAN module messages	12.1
F… (fan)	Fan messages	12.2
H …	Hybrid / pump messages	12.3
I …	Insulated cooler / PH cooler messages	12.3
K…	Flap messages	12.5
M…	Measured value messages	12.6
R…	Roller messages	12.7
S…	Signals external messages	12.8
V…	Valve messages	12.9

Type: W = Warning, A = Alarm, see chapter 5.5 “*Alarms*”

Abbreviation	Meaning
I >	Flap current greater than current threshold
I <	Flap current lower than current threshold
I=OK	Current reached current threshold
LZ	Runtime

12.1 CAN module messages – Fault code C...

Fehler-code	Art	Error text	Fault explanation	Fault remedy	MODBUS	
					Reg.	Bit
C01	W	CAN module [Nr]	Communication with the respective CAN - I/O extension is interrupted.	- check power supply to the extension module - check CAN bus wiring - check terminal points - check set CAN address (see also device manual, chapter 5.1.13 “Set CAN address”)	154 bis 156	
C02	W	Attention! Max. write operations exceeded	maximum possible write operations (9000) in b:\ drive exceeded	Normal controller functions are still available. A further trend recording is not possible with this hardware. If desired, replace the TCS.		

12.2 Fan messages – Fault code F...

Fehler-code		Error text	Fault explanation	Fault remedy	MODBUS Reg.	MODBUS Bit
F01	W*	Fan/Group [Nr]	- general fan or fan group fault, which was reported via a digital input. - logically high (+24 V DC) = fan OK - logically low (0 R20T11V) = fan fault - typically, these inputs are connected to thermocontacts of the fans/groups, motor protection switch H1 or fault signalling outputs of frequency inverters (see also chapter 5.4.1 Fan operating data / status)	- check whether the signal is reaching the input - if yes – digital input faulty (please contact the manufacturer) - if no – check the connected thermocontact, motor protection switch or other - check sensor line / wiring - check terminal points	142 143	
F02	W*	Fan [Nr]	- general fan fault, which was reported via the bus - a more detailed fault description can be found in the sub-menu “MODBUS fan status” - see also chapter 5.4.1 Fan operating data / status	- please follow the instructions in the more detailed fault description from the MODBUS fan status	168 169	
F03	W*	Phase failure	- at least one phase failed (with 3~ devices) - mains undervoltage with 1~ devices	- check whether all necessary phases are present at the device - replace faulty fuses - eliminate cause of short circuit (faulty fan ...)	130	0
F04	W*	Ground earth fault	- faulty motor winding - cable crushed - faulty cable sheath on housing - water ingress in housing	- check wiring - check terminal points - replace fan (please contact the manufacturer)	130	1
F05	W*	Overheated power amplifier	- ambient temperature too high - ball bearings are tight - rotor imbalanced - electronics housing dirty	- follow operating and environmental conditions of the manufacturer - improve cooling - manual reset required	130	2

F06	W*	Communication error	- internal communication fault between the microcontrollers in the fan	- switch off mains voltage - service - switch on again	130	3
F07	W*	Fan collective fault	- general fan fault sent via MODBUS	- observe further status messages	130	4
F08	W*	Engine overheated	- ambient temperature too high - ball bearings are tight - rotor imbalanced - rotor blocked - electronics faulty	- follow operating and environmental conditions of the manufacturer - after eliminating causes, allow motor to cool down - lower ambient temperature - correct operating point - manual reset required	130	5
F09	W*	Hall sensor defective	- a speed or position detection that is necessary for the EC fan is missing or faulty.	- switch off mains voltage - service - switch on again - replace fan (please contact the manufacturer)	130	6
F10	W*	Motor blocked	- fan blades iced up - other dirt is preventing the fan from starting up	- switch off, establish and confirm absence of voltage - eliminate cause of motor blockage - check fan blades for possible faults - balance rotor	130	7
F11	W*	Limit speed exceeded	- fixed maximum speed exceeded	- check set parameter - reparametrise if necessary	130	8
F12	W*	Overcurrent/overload peak, I^2T	- the actual motor current or the current calculated over time is too high - if a set limit is exceeded, the system is switched off	- reduce volume flow - reduce speed - clean rotor - replace faulty bearing if necessary	130	9
F13	W*	Calibration err. rotor pos. sensor	- faulty initialisation	- an automatic restart occurs	130	10
F14	W*	DC link overvoltage	- the DC link voltage has exceeded a set value - input voltage too high - braking too fast (regenerative operation)	- check power supply - increase ramp times	130	11
F15	W*	DC link undervoltage	- the DC link voltage has fallen below a set value	- mains phase missing - check power supply	130	12

F16	W*	Line overvoltage	- mains voltage too high	- check set mains voltage	130	13
F17	W*	Line undervoltage	- mains voltage too low	- check set mains voltage	130	14
F18	W*	Communication interrupted	- no communication possible between TCS.2 and fan	- check communication bus wiring - check terminal points - check power supply of fan	130	15
F19	W*	Slave [Nr] fault	- collective fault message of a slave device, where there is a fault message present or the communication is disrupted / interrupted.	- check bus wiring - check power supply to slave device - eliminate fault(s) on slave device	247	0-5
F20	W*	Rep. switch fan/group [Nr]	- fan [no] / group was switched off by repair switch - logically high (+24 V DC) = repair switch switched on - logically low = repair switch off)	- check whether the signal is reaching the input - if yes – digital input faulty (please contact the manufacturer) - if no – check the connected repair switch / auxiliary contact or other - check terminal points	143	8 bis 11
F21	A	Switch-off service life	- Service life of ball bearing exceeded. Abnormal operating condition. Risk of machine damage	- Replace fan	131	0

12.3 Hybrid / pump messages – Fault code H...

Fehler-code	Art	Error text	Fault explanation	Fault remedy	MODBUS Reg.	MODBUS Bit
H01		Medium pump faulty [Nr]	- general message that the medium pump is faulty - motor protection - overheating protection	- motor line(s) interrupted / check wiring - check terminal points - check protections - mechanically check pump		
H02						
H03	A	Fault, wetting pump [Nr]	- general message that the wetting pump is faulty - motor protection - overheating protection	- motor line(s) interrupted / check wiring - check terminal points - check protections - mechanically check pump	180	10, 11
H04	A	Dry run, wetting pump [Nr]	- insufficient water available to operate the wetting pump - water supply failed - valves closed - line blocked - refill valve faulty - water pressure too low	- check water supply - clean pipelines - check valves	181	0 bis 3
H05	W	Fault in UVC disinfection [Nr]	- UVC module fault	- check UVC module	181	9, 11
H06	W	Time max. UVC disinfection [Nr]	- UVC lamp is worn out (max. operating time reached).	- replace UVC lamp	181	10, 12
H07	W	Circulation water tub, empty	- empty message circulating water	- fresh water line not carrying any water - check valves - check level sensor	180	15
H08	W	Hardness stabilizer, cont. empty	- hardness stabiliser container empty	- fill hardness stabiliser	181	7
H09	W	Biocide, container empty	- biocide empty - biocide message cable break	- fill up biocide - check cable	181	6
H10	W	Entrance door opened	- entry door on hybrid cooler open	- reset only possible on TCS, no external reset	181	13

H11	W	Dry run, logic error	- message from limit switch the fill level probe does not correspond with the actual fill level	- check fill level probe, replace if necessary	181	14

12.4 Insulated cooler messages – Fault code I

Fehler-code	Art	Error text	Fault explanation	Fault remedy	MODBUS Reg.	MODBUS Bit
I01	A	Over temperature, cell	The maximum cell temperature set in the insulated cooler menu was exceeded. All electr. heating units are switched off. Flaps not tight --> warm external air flowing into the cell.	Check control / regulation of the defrosting heating.	162	2
I02	W	Tray heater rod [Nr] Fault T	The parametrised threshold temperature at the heating element was not reached in the set time (see tank heating menu).	- check supply line for cable break - check heating element, replace if necessary - check heating element fuse(s)	161	0 bis 3
I03		Tray heater [Nr] Fault	One of more tank heating units faulty.	Check control / regulation of the defrosting heating.	161	12
I04		Coil heater [Nr] Fault	One of more block heating units faulty.	Check control / regulation of the defrosting heating.	161	13
I05		Coil heater, temperature limiter	Block has exceeded the temperature value set on the safety thermostat. Electr. block heating units are switched off (if controlled via TCS).	Check block heating sensors for proper function, check heating contactor for proper function.	158	10
I06		Cell, temperature limiter	Internal cell temperature has exceeded the temperature set on the safety thermostat. All electr. heating units are switched off.	Check control / regulation of the defrosting heating.	158	12
I07		Access door [Nr] alarm	Access door open, door sensor faulty or cable break.	Close door, replace sensor or investigate cable break.	161	14 15
I08		Access door [Nr] opened	Access door is open.	Close access door.	158	10 11
I09		Tray heater rod [Nr] Fault C	The parametrised heating element threshold temperature was not reached (see tank heating menu).	- check supply line for cable break - check heating element, replace if necessary - check heating element fuse(s)	161	0 bis 3

12.5 Flap messages – Fault code K...

Fehler-code	Art	Error text	Fault explanation	Fault remedy	MODBUS	
					Reg.	Bit
K01		Flap [Nr] closing, stop by overcurrent	- fault when closing defrosting flap [no] - flap blocked - switched off due to exceeding current threshold - no flap end position detected	- flap / drive sluggish - frame iced over - end position sensor faulty - check end position sensor, eliminate flap blockage - check current threshold	169 bis 175	0
K02		Flap [Nr] opening, stop by overcurrent	- fault when opening defrosting flap [no] - flap blocked - switched off due to exceeding current threshold - no flap end position detected	- flap / drive sluggish - frame iced over - end position sensor faulty - check end position sensor, eliminate flap blockage - check current threshold	169 bis 175	1
K03		Flap [Nr] closing, RT fault, current OK	- fault when closing defrosting flap [no] - runtime between the end positions exceeded - power consumption OK	- flap drive faulty - replace flap motor	169 bis 175	2
K04		Flap [Nr] closing, RT fault, current <	- fault when closing defrosting flap [no] - runtime between the end positions exceeded - circuit interrupted (no current flow)	- motor faulty - cable break motor supply line - check motor for proper function and investigate lines for cable break if necessary	169 bis 175	3
K05		Flap[Nr] closing, RT fault, stop finish	- fault when closing defrosting flap [no] - motor current does not reach end value (set current threshold) in closed state (limit switch actuated) - motor in end position – no switching off by TCS	- no mechanical connection between motor and flap - check flap mechanics (screws, bolts, bearings, etc.)	169 bis 175	4
K06		Flap [Nr] opening, RT fault, current OK	- fault when opening defrosting flap [no] - runtime between the end positions exceeded - power consumption OK	- flap drive faulty - replace flap motor	169 bis 175	5

K07		Flap [Nr] opening, RT fault, current <	- fault when opening defrosting flap [no] - runtime between the end positions exceeded - circuit interrupted (no current flow)	- motor faulty - cable break motor supply line - check motor for proper function and investigate lines for cable break if necessary	169 bis 175	6
K08		Flap [Nr] opening, RT fault, stop finish	- fault when opening defrosting flap [no] - motor current does not reach end value (set current threshold) in open state (limit switch actuated) - motor in end position – no switching off by TCS	- no mechanical connection between motor and flap - check flap mechanics (screws, bolts, bearings, etc.)	169 bis 175	7
K09		Flap [Nr] closing, no start current OK	- fault when closing defrosting flap [no] - motor closes, but no mechanical connection between motor and flap - flap therefore remains in OPEN position - power consumption OK	- check flap mechanics (screws, bolts, bearings, etc.)	169 bis 175	8
K10		Flap [Nr] closing, no start, current <	- fault when closing defrosting flap [no] - flap remains in OPEN position - circuit interrupted (no current flow)	- motor faulty - cable break motor supply line - check motor for proper function and investigate lines for cable break if necessary	169 bis 175	9
K11		Flap [Nr] closing, no start, current >	- fault when closing defrosting flap [no] - flap remains in OPEN position - switched off due to exceeding current threshold	- flap tight --> check mechanics	169 bis 175	10
K12		Flap [Nr] opening, no start, current OK	- fault when opening defrosting flap [no] - motor closes, but no mechanical connection between motor and flap - flap therefore remains in CLOSED position - power consumption OK	- check flap mechanics (screws, bolts, bearings, etc.)	169 bis 175	11
K13		Flap [Nr] opening, no start, current <	- fault when opening defrosting flap [no] - flap remains in CLOSED position - circuit interrupted (no current flow)	- motor faulty - cable break motor supply line - check motor for proper function and investigate lines for cable break if necessary	169 bis 175	12

K14		Flap [Nr] opening, no start, current >	- fault when opening defrosting flap [no] - flap remains in CLOSED position - switched off due to exceeding current threshold	- flap tight --> check mechanics	169 bis 175	13
K15		Flap [Nr] both end switch closed	- flap OPEN and CLOSED feedback present simultaneously.	- initiator(s) faulty, loose objects in the refrigeration cell	169 bis 175	14
K16	W	Defrost damper [Nr], collective fault	- general fault message of the defrosting flap(s)	- more detailed information under “flap status”	158 159	7 5
K17	W	Ambient air damper [Nr], collective fault	- general fault message of the external air flap(s)	- more detailed information under “flap status”	159 160	11 1
K18	W	K18 Recirc air damper [Nr], collective fault			160	7 13

12.6 Measured value messages – Fault code M...

Fehler-code	Art	Error text	Fault explanation	Fault remedy	MODBUS Reg.	MODBUS Bit
M01	A	Pressure sensor [Nr] wire break	- the signal at the analog input does not correspond to a suitable pressure sensor - resistance is significantly too high - incorrect configuration of the analog input (jumper setting)	- sensor line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace pressure sensor - analog input may be faulty, please contact the manufacturer	150	0 bis 3
M02	A	Outlet sensor [Nr] wire break	- the resistance at the analog input does not correspond to a suitable outlet sensor - resistance is significantly too high - incorrect configuration of the analog input (jumper setting)	- sensor line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace outlet sensor - analog input may be faulty, please contact the manufacturer	150	4 6
M03	A	Ambient sensor wire break	- the resistance at the analog input does not correspond to a suitable external sensor - resistance is significantly too high - incorrect configuration of the analog input (jumper setting)	- sensor line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace external sensor - analog input may be faulty, please contact the manufacturer	150	8
M04	A	Ambient sensor short circuit	- the resistance at the analog input does not correspond to a suitable external sensor - resistance at the input is significantly too low - incorrect configuration of the analog input (jumper setting)	- sensor line short circuited / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace external sensor - analog input may be faulty, please contact the manufacturer	150	9

M05	W	Inlet sensor [Nr] wire break	- the resistance at the analog input does not correspond to a suitable inlet sensor - resistance is significantly too high - incorrect configuration of the analog input (jumper setting)	- sensor line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace inlet sensor - analog input may be faulty, please contact the manufacturer	150	10 12
M06	W	Room sensor wire break	- the resistance at the analog input does not correspond to a suitable room sensor - resistance is significantly too high - incorrect configuration of the analog input (jumper setting)	- sensor line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace room sensor - analog input may be faulty, please contact the manufacturer	150	14
M07	W	Room sensor short circuit	- the resistance at the analog input does not correspond to a suitable room sensor - resistance is significantly too low - incorrect configuration of the analog input (jumper setting)	- sensor line short circuited / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace room sensor - analog input may be faulty, please contact the manufacturer	150	15
M08	W	Coil sensor [Nr] wire break	- the resistance at the analog input does not correspond to a suitable block sensor - resistance is significantly too high - incorrect configuration of the analog input (jumper setting)	- sensor line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace block sensor - analog input may be faulty, please contact the manufacturer	151	0

M09	W	Coil sensor [Nr] short circuit	- the resistance at the analog input does not correspond to a suitable block sensor - resistance is significantly too low - incorrect configuration of the analog input (jumper setting)	- sensor line short circuited / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace block sensor - analog input may be faulty, please contact the manufacturer	151	1
M10	W	Drip tray sensor [Nr] wire break	- the resistance at the analog input does not correspond to a suitable tank sensor - resistance is significantly too high - incorrect configuration of the analog input (jumper setting)	- sensor line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace tank sensor - analog input may be faulty, please contact the manufacturer	151	2
M11	W	Drip tray sensor [Nr] short circuit	- the resistance at the analog input does not correspond to a suitable tank sensor - resistance is significantly too low - incorrect configuration of the analog input (jumper setting)	- sensor line short circuited / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace tank sensor - analog input may be faulty, please contact the manufacturer	151	3
M12	W	Cell sensor wire break	- the resistance at the analog input does not correspond to a suitable cell sensor - resistance is significantly too high - incorrect configuration of the analog input (jumper setting)	- sensor line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace cell sensor - analog input may be faulty, please contact the manufacturer	151	4

M13	W	Cell sensor short circuit	- the resistance at the analog input does not correspond to a suitable cell sensor - resistance is significantly too low - incorrect configuration of the analog input (jumper setting)	- sensor line short circuited / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace cell sensor - analog input may be faulty, please contact the manufacturer	151	5
M14	W	Humidity Sensor wire break	- a current < 4mA is flowing at the corresponding analog input - this does not correspond to a suitable air humidity sensor (4-20mA) - resistance is significantly too high - incorrect configuration of the analog input (jumper setting)	- sensor line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace air humidity sensor - analog input may be faulty, please contact the manufacturer	151	15
M15	A	Over temperature [Nr]	- depending on the selected setpoint (NC – normal cooling, FC – free cooling or HR – heat recovery), it is shown here that the actual temperature value is above the alarm value (CAUTION, possible risk from overpressure in the unit) - the alarm values can be adjusted in the setpoint menu (see also in the operating instructions, chapter 5.5 “Setpoints”) - on dual circuit devices, the corresponding index number 1 or 2 is also displayed	- control lone interrupted / check wiring - check terminal points - faulty functioning of the fans - alarm values set too low - ambient temperature too high	166	0 1

M16	A	conductivity sensor [Nr] wire break	- a current < 4 mA is flowing at the corresponding analog input - this does not correspond to a suitable air humidity sensor (4-20 mA) - resistance is significantly too high - incorrect configuration of the analog input (jumper setting)	- sensor line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace air humidity sensor - analog input may be faulty, please contact the manufacturer	151	11 bis 12
M17	A	Water level sensor wire break	- a current < 4 mA is flowing at the corresponding analog input - this does not correspond to a suitable air humidity sensor (4-20 mA) - resistance is significantly too high - incorrect configuration of the analog input (jumper setting)	- sensor line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace air humidity sensor - analog input may be faulty, please contact the manufacturer	151	13
M18	A	Water level sensor short circuit	- the resistance at the analog input does not correspond to a suitable fill level probe - resistance is significantly too low - incorrect configuration of the analog input (jumper setting)	- sensor line short circuited / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace cell sensor - analog input may be faulty, please contact the manufacturer	151	14
M19	A	Outlet sensor [Nr] short circuit	- the resistance at the analog input does not correspond to a suitable outlet sensor - resistance at the input is significantly too low - incorrect configuration of the analog input (jumper setting)	- sensor line short circuited / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace outlet sensor - analog input may be faulty, please contact the manufacturer	150	5 7

M20	A	Inlet sensor [Nr] short circuit	- the resistance at the analog input does not correspond to a suitable inlet sensor - resistance at the input is significantly too low - incorrect configuration of the analog input (jumper setting)	- sensor line short circuited / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace inlet sensor - analog input may be faulty, please contact the manufacturer	150	11 13
M21		NH3 Alarm			166	2
M22		Glycol alarm			166	3
M23		Over pressure circuit [Nr]			167	0 bis 1
M24	A	Low temperature, circuit [Nr]	- DANGER OF FREEZING! - the outlet temperature has fallen below the alarm threshold – danger of frost damage to heat exchanger - the alarm values can be adjusted in the setpoint menu (see also in the operating instructions, chapter 5.5 “Setpoints”)	- control lone interrupted / check wiring - check terminal points - lacking thermal load - alarm values set too high - ambient temperature too low	167	2 3
M25	A	Medium pressure sensor [Nr] wire break	- the signal at the analog input does not correspond to a suitable pressure sensor - resistance is significantly too high - incorrect configuration of the analog input (jumper setting)	- sensor line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - replace pressure sensor - analog input may be faulty, please contact the manufacturer	150	14 15
M26		Alarm glycol sensor [Nr]			240	6 bis 11
M27		Glycol sensor [Nr] malfunction			240	0 bis 5
M28		Collective fault Medium pressure			240	12 13

M29		Air outlet sensor [Nr] wire break				
M30		Air outlet sensor [Nr] short circuit				
M31		Conductivity alarm			181	8

12.7 Roller messages – Fault code R...

Fehler-code	Art	Error text	Fault explanation	Fault remedy	MODBUS Reg.	MODBUS Bit
R01		Blind [Nr] opening, runtime fault	Opening the rollers exceeds the set runtime, roller is stuck, roller has jumped out of guide, motor faulty, roller end positions set incorrectly	Check mechanics and/or electrics	177	5
R02		Blind [Nr] closing, runtime fault	Opening the rollers exceeds the set runtime, roller is stuck, roller has jumped out of guide, motor faulty, roller end positions set incorrectly	Check mechanics and/or electrics	177	5
R03		Blind [Nr] both end switch closed	End position sensors faulty	Replace sensors	177	6
R04		Blind [Nr] safety switch activated	Roller stops operation	-	177	7

12.8 Signals external messages – Fault code S...

Fehler-code	Art	Error text	Fault explanation	Fault remedy	MODBUS Reg.	MODBUS Bit
S01	W	Fuse/s triggered	- no signal at data input 7 - the control voltage supply at the digital inputs is interrupted	- check control voltage Control voltage fuse of the digital inputs (F692 if necessary) - check wiring in the control cabinet or externally - check terminal points - check configuration of DI-7	141	12
S02	W	Setpoint shifting [Nr] wire break	- this fault message is only active with signal type 4-20 mA or 2-10 V - a current < 4mA is flowing at the corresponding analog input or there is a voltage < 2 V - incorrect configuration of the analog input (jumper setting)	- control line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - analog input may be faulty, please contact the manufacturer	151	6 bis 7

S03	A	Speed slave [Nr] wire break	- this fault message is only active with signal type 4-20 mA or 2-10 V - a current < 4mA is flowing at the corresponding analog input or there is a voltage < 2 V - incorrect configuration of the analog input (jumper setting)	- control line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - analog input may be faulty, please contact the manufacturer	151	8 bis 9
S04	W	Ext. emerg. Stop	- an external emergency stop was actuated - on dual circuit devices, the corresponding index [1 or 2] is also displayed	- control line interrupted / check wiring - check terminal points	141	14
S05						
S06	W	storage container fault	- general message that the domestic water storage tank is faulty - if this function is not desired, either a wire jumper can be installed at the respective terminals, or the function is deactivated in the “Control” menu	- control line interrupted / check wiring - check terminal points - eliminate fault on storage tank	145	8
S07	W	pressure increase fault	- general message that the domestic water pressure increase is faulty - if this function is not desired, either a wire jumper can be installed at the respective terminals, or the function is deactivated in the “Control” menu	- control line interrupted / check wiring - check terminal points - eliminate fault on pressure increase pump	145	7
S08	A	Spray pump fault	- general message that the spray pump is faulty - motor protection - overheating protection	- motor line(s) interrupted / check wiring - check terminal points - check protections - mechanically check pump	143	10
S09	A	Flow error	- despite circulating pump being switched on, the monitored line has no flow - pump not working correctly - blockage in the line - valves faulty - flow monitor faulty	- control line interrupted / check wiring - check terminal points - check functioning of the circulation pump - replace flow monitor	143	11

S10	W	Dry-running spray pump	- insufficient water available to operate the pump - water supply failed - valves closed - line blocked - refill valve faulty water pressure too low	- check water supply - clean pipelines - check valves	143	12
S11	A	External Master faulty	- communication to ext. master interrupted - master (TCS) switched off	- switch on master - control line interrupted / check wiring - check incoming signal	167	15

12.9 Valve messages – Fault code V...

Fehler-code	Art	Error text	Fault explanation	Fault remedy	MODBUS	
					Reg.	Bit
V01	W	Runtime main water valve [Nr]	- the fixed maximum runtime of opening or closing the main water valve (2:30 min) was exceeded - supply voltage to the valve interrupted - no feedback	- control line interrupted / check wiring - check terminal points - check power supply to the valve - check feedback (limit switch) of the valve - check valve control	145	0
V02	W	Runtime drain valve [Nr]	- the fixed maximum runtime of opening or closing the draining valve (2:30 min) was exceeded - supply voltage to the valve interrupted - no feedback	- control line interrupted / check wiring - check terminal points - check power supply to the valve - check feedback (limit switch) of the valve - check valve control	145	1
V03	W	Runtime Shut-off valve [Nr]	- the fixed maximum runtime of opening or closing the ventilation valve (2:30 min) was exceeded - supply voltage to the valve interrupted - no feedback	- control line interrupted / check wiring - check terminal points - check power supply to the valve - check feedback (limit switch) of the valve - check valve control	145	6

V04	W	Runtime spray valve [Nr]	- the fixed maximum runtime of opening or closing the spray valve (2:30 min) was exceeded - supply voltage to the valve interrupted - no feedback	- control line interrupted / check wiring - check terminal points - check power supply to the valve - check feedback (limit switch) of the valve - check valve control	145	11 bis 14
V05	W	Runtime inlet valve	- the fixed maximum runtime of opening or closing the inlet valve was exceeded - supply voltage to the valve interrupted - no feedback	- control line interrupted / check wiring - check terminal points - check power supply to the valve - check feedback (limit switch) of the valve - check valve control	166	9
V06	W	Runtime bypass valve	- the fixed maximum runtime of opening or closing the bypass valve was exceeded - supply voltage to the valve interrupted - no feedback	- control line interrupted / check wiring - check terminal points - check power supply to the valve - check feedback (limit switch) of the valve - check valve control	166	8
V07	W	Runtime Three-way valve	- the fixed maximum runtime of opening or closing the 3-way valve was exceeded - supply voltage to the valve interrupted - no feedback	- control line interrupted / check wiring - check terminal points - check power supply to the valve - check feedback (limit switch) of the valve - check valve control	166	10
V08	W	Control valve [Nr] wire break	- there is a voltage < 2 V at the corresponding analog input (standard signal type 2-10 V) - incorrect configuration of the analog input (jumper setting) - no feedback	- control line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - analog input may be faulty, please contact the manufacturer	152	0 1

V09	W	Control valve [Nr], Flow rate <>	- the reported actual value of the control valve does not match the output setpoint - deviation greater than +/- 10 % - supply voltage of the valve interrupted - incorrect configuration of the analog input (jumper setting) - control valve faulty	- control line interrupted / check wiring - check terminal points - check configuration of the respective analog input (see device manual, chapter 3.6.4) - analog input or control valve may be faulty, please contact the manufacturer	145	9 10
V10	A	Runtime fresh water valve	- the fixed maximum runtime of opening or closing the waste water valve was exceeded - supply voltage to the valve interrupted - no feedback	- control line interrupted / check wiring - check terminal points - check power supply to the valve - check feedback (limit switch) of the valve - check valve control	241	3
V11	A	Runtime wastewater valve [Nr]	- the fixed maximum runtime of opening or closing the rainwater valve was exceeded - supply voltage to the valve interrupted - no feedback	- control line interrupted / check wiring - check terminal points - check power supply to the valve - check feedback (limit switch) of the valve - check valve control	241	4
V12	A	Filling time fresh water valve	- the fixed maximum runtime of opening or closing the collection tank valve was exceeded - supply voltage to the valve interrupted - no feedback	- control line interrupted / check wiring - check terminal points - check power supply to the valve - check feedback (limit switch) of the valve - check valve control	241	5

13. FINAL COMMENTS

These operating instructions make no claims to completeness. If necessary, please request the current version from the manufacturer of the control unit. The control unit is always kept up to date. This relates to the hardware and also the software. The TCS.2 is continually expanded with new functions. The manufacturer reserves the right to adapt the software and hardware to technical requirements at any time. In principle, care is taken to ensure that new versions are backwards-compatible. This means that new software versions can replace older versions without any loss in functionality. Care is also taken to ensure that older versions can be replaced without any changes in the wiring.