Operating Manual

SINGLE Smart Controller
SINGLE Smart Controller *plus*

Translation of original instruction

Legal notice

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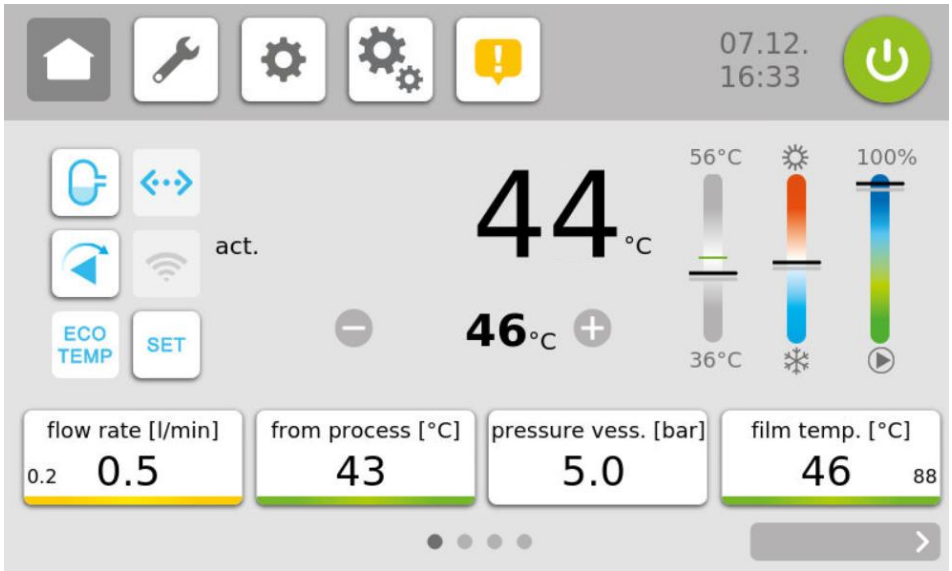
1 About this manual

This operating manual describes the functionality and operation of the Smart Controller and the Smart Controller plus.
Compared with the Smart Controller, the Smart Controller plus comes with additional inputs and outputs. The Smart Controller plus software provides parameters for these additional inputs. The corresponding functions are indicated in the description.
This manual covers the full range of functions of the controller. In the temperature control devices, some of these functions are optional features. The actual range of functionality is based on the SINGLE customer order and the technical specifications.
The range of functions is defined via parameters in the factory settings that can only be accessed by SINGLE. These affect the operation of the controller and also the display on the screen. Some buttons and parameters for non-enabled functions are hidden; this can result in discrepancies between the images shown in this manual and the output on your system.
The retroactive activation of functions is usually not possible as corresponding components for the functionality must be installed in the temperature control system.
If you have any questions, please contact SINGLE Temperiertechnik customer service. The entire range of functions confirmed in your customer order and in the technical specifications is included in the temperature control system.

2 User interface and operation

Switching on the temperature control system using the main switch also starts the Smart Controller. The start-up process takes a few seconds; a start screen is displayed during this time.
After completion of the start-up process, the controller displays the *Process Data view* ("Cockpit").



The Smart Controller is equipped with a 7" touch screen. This screen is used for all operator activities. The screen is divided into the navigation bar at the top (grey background) and the control panel.

2.1 Navigation bar

The navigation bar is displayed in all menus and in all operating states. It displays important information and is used for quick navigation.
The navigation bar provides the following functions:

Symbol	Meaning
	Jumps from the individual menus back to the Process Data view (see 2 User interface and operation). The current actual temperature (control temperature) is always displayed.
	Calls up menu *Service and Information* (see 2.3.1 Service and Information menu).
	Calls up menu *Functions* (see 2.3.2 Functions menu).
	Calls up menu *Expert parameters* (see 5 Expert parameters).
	If the lock is activated, a padlock icon appears. If the padlock is closed, operation of the device is limited. (This functionality is explained below.)
	Displays the alarm list (see 0 Alarm list). If the field flashes red, an alarm is currently active; the colour yellow signals a warning. If the field is grey, there is no currently active alarm.
	Switches the temperature control system on and off. Green means that the device is switched on. Red means off, meaning that among others, pump, heating and cooling are switched off. If the field flashes red, the system is in cooling-down mode for tool changing or tool draining.

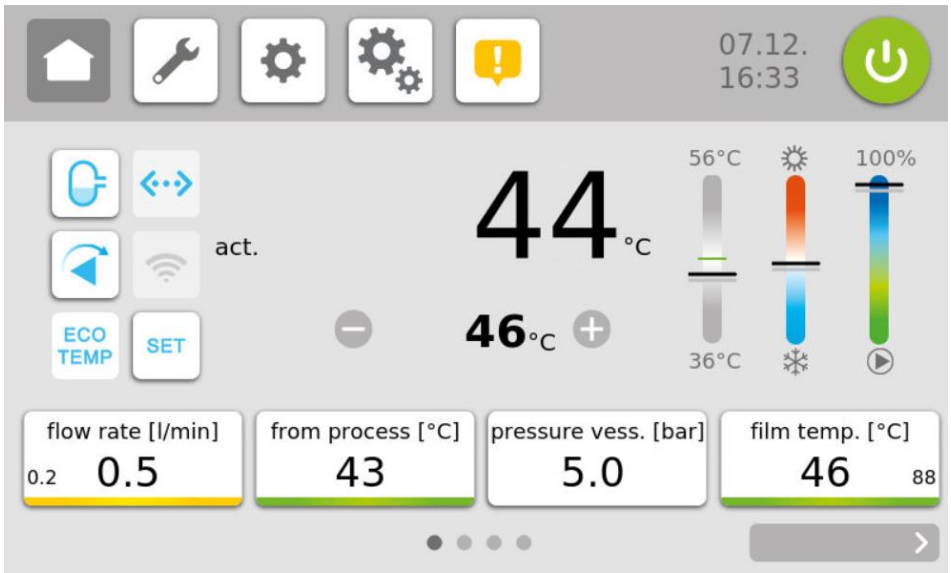
Operation lock
It is possible to lock the device to prevent unwanted operation. To do so,enter a lock code under *Expert Parameters / Basic Settings* (see 0

Basic settings).
Activating the lock:
If the operation lock is not OFF (see chapter 5.1), the navigation bar displays an open padlock icon.
Tap this icon to activate the lock. In the confirmation dialog box, confirm the prompt.
The lock becomes active, and a closed padlock is displayed.
Deactivating the lock:
Tap the padlock in the navigation bar. Enter the release code.
If the code has been entered correctly, the lock is deactivated.

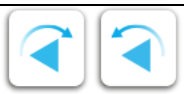
2.2 Control panel

The control panel shows the actual and setpoint temperatures in the centre.

The actual temperature is the temperature on which the closed-loop control is based. At delivery, this is the temperature that is detected by the closed-loop control sensor (last measuring point before the medium leaves the device). Parameter “control source” under *Expert parameters / Unit control* can be set in such a way that an external sensor or the return sensor is used for closed-loop control.
Tap the central area of the control panel to open the setpoint adjustment screen. The permitted value range appears below the input window. Tap “Save” to confirm any changes.

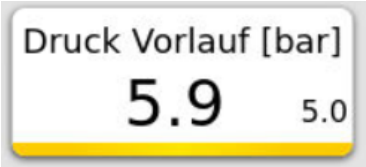


Pictograms on the left and right of the temperature display indicate the state of the system.

Symbol	Meaning
	The system closure is open or closed (only for pressurised water units). If the button is enabled, this means it can be used to configure the system closure water temperature.
	The pump is running in the indicated direction of rotation (arrow pointing right: normal operation; arrow pointing left: inverse operation. e.g. for leak stop function). For temperature control devices with speed control, the button is enabled and can be used to set the parameters for speed control.
	Interface symbol: Grey: The interface is not enabled or no protocol has been selected in the communication parameters. Blue (flashing): The interface is active and the device is transmitting or receiving data via the interface. Blue (steady): The protocol is selected, interface operation is deactivated. Red (flashing): Interface operation is activated but communication cannot be established.
	Blue: Communication is happening via the network. Red: Communication is not happening via the network.
	Grey: ECOTEMP not enabled Green: ECOTEMP in stand-by mode Blue: ECOTEMP active
	Use to enter the temperature setpoint.

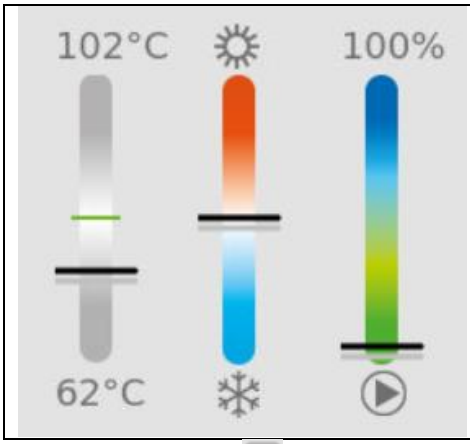
The four buttons along the bottom show important process variables. The values may be underline in colour.

- Green means that the value is in the desired range or that no value has been entered.
- Yellow means that a process value is not in the desired range.
- Red means alarm, i.e. the safe operation of the device is in danger.



Depending on the device design, the buttons alternate between showing two values, e.g. *Pressure vess.* and *Pressure to proc.* Tap the value on the button to adjust the limit values.
Each button has a value shown in large characters in the centre. This is the current process value. If there are warnings or alarms set for the respective process variable, these are shown on the left (lower limit) or right (upper limit) of the respective button.

The right-hand section of the control panel contains a graphic showing temperature, regulation ratio and pump speed.

	The left part of the graphic shows the actual temperature (black bar) relative to the setpoint temperature (green bar). The middle part of the graphic shows the regulation ratio. If the black bar is at the top, the device is heating at full load. If the black bar is at the bottom, the device is cooling at full load; positions in-between correspond to partial loads. If the position is in the middle, the device does not heat or cool. The right part of the graphic shows the pump speed. If the black bar is at the top, the speed is 100 %. Positions below correspond to partial loads.

Tap the arrow button at the bottom right of the control panel to go to expert mode.

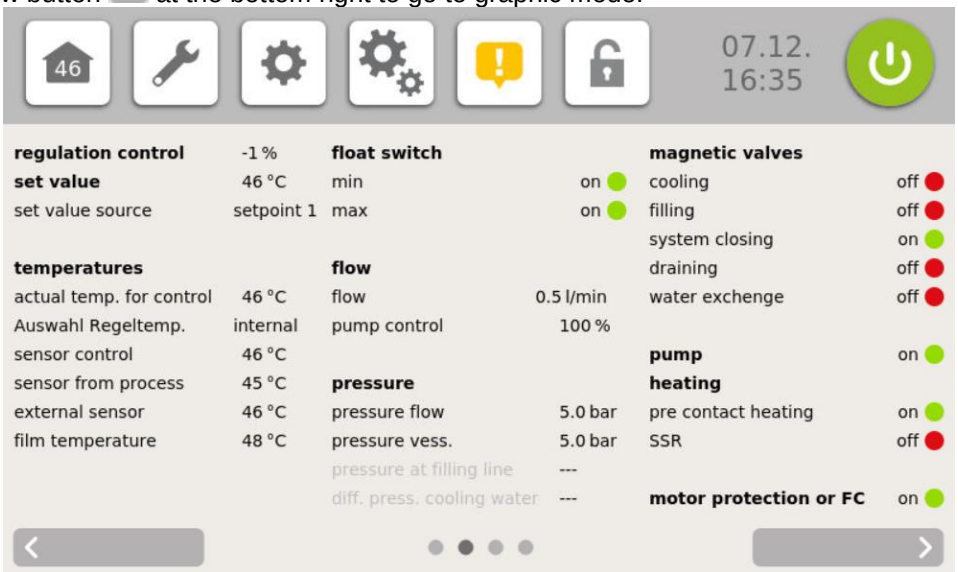
Expert mode
In expert mode, additional information is displayed. It is designed for special applications, or for servicing the device.
The data displayed here includes the following:

- Signals from all connected sensors
- State of the float switch
- Regulation ratio “heating” or “cooling”
- Flow rate and pressure (if the device has the corresponding equipment)
- Outputs of all valves
- Outputs “Pump” and “Pre contact heating”
- State of motor circuit breaker

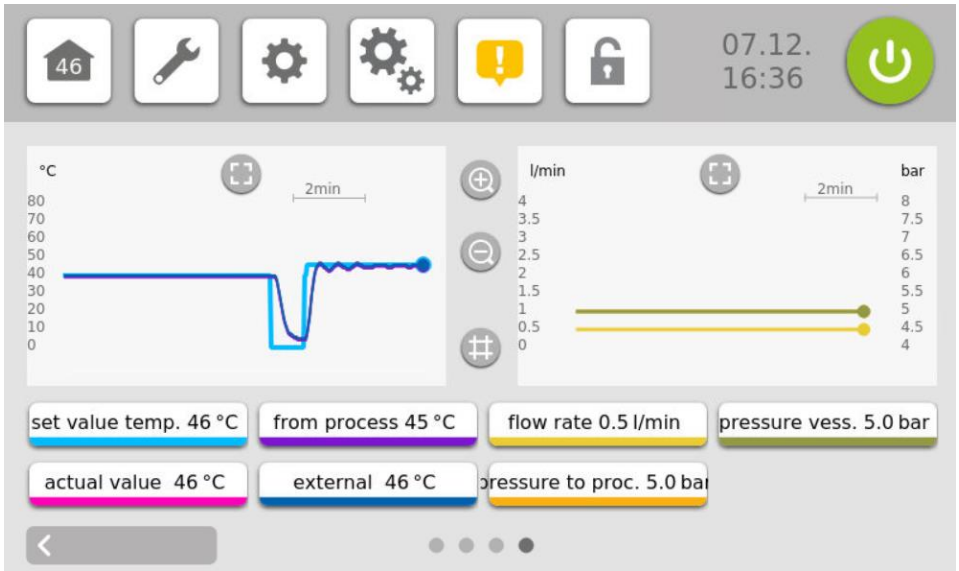
The following illustration shows an example.

Parts of the display are connected to optional sensors (e.g. pressure gauge) or actuators (e.g. system closing valve). If these optional components are not installed, the associated values are not displayed.

Tap the arrow button at the bottom right to go to graphic mode.



Graphic mode



The left-hand side shows temperatures, the right-hand side flow rate and pressure. To show or hide individual values, tap the corresponding buttons.
Other controls:

	Zoom in
	Zoom out
	Full screen
	Show/hide grid

After switching from *Cockpit*, *Expert mode* or *Graphic mode* to a different view and then back, tapping the Home button jumps back to the original view.

2.3 Overview of the operating concept

The navigation bar can be used to navigate to other screens.

- Service and Information
- Functions
- Expert parameters
- Alarm list

The following illustration shows the relationships.

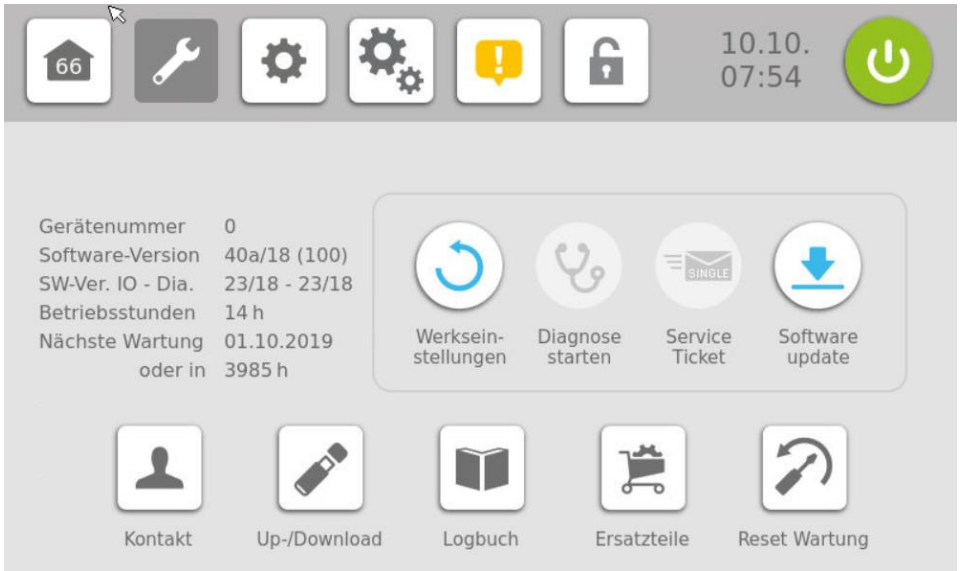
Tap the Home button to return to the process screen. The menus are described in the following sections.

2.3.1 Service and Information menu

The following information is displayed on the screen when switching to the *Service and Information* menu:

- Unit number
- Hours of operation
- Software version
- Information on maintenance

The unit number is important if the device needs to be serviced; SINGLE stores the device data for each unit number.



The following buttons are available:

	Reset to factory settings Tapping the *Reset* button rests the device to the condition 'as delivered'. Before the operation is executed, a confirmation prompt appears that the user needs to confirm. **Notice:** Customised parameters are lost during the reset!
	Start diagnostic run If the icon is greyed out, the diagnostic run is not enabled.
	Send service request to SINGLE If the icon is greyed out, this function is not support or there is no active network connection.
	Perform update In order to use this function, a USB stick must be plugged in that contains the program data in a sub-directory named *Software*.
	Contact The telephone number and e-mail address of the service partner are stored here.
	USB function The prerequisite for using the USB function is that a commercially available USB stick formatted as FAT16 or FAT32 is plugged into the back of the Smart Controller. Note: Due to the technical diversity, it cannot be guaranteed that every USB stick works. The following functions can be performed using the *USB Function* button:

	Parameter export, parameter modification, process data, device documentation, spare parts list, messages (alarms etc.), programs and tools from Smart Controller to USB stick, parameter import.
	Log book Can be used to store text entries. Maintenance operations and updates are stored automatically.
	Maintenance The temperature control system must be serviced after a defined number of operating hours. An operating hours counter counts down for this purpose. As soon as the counter has finished, a message about the required maintenance is triggered. Alternatively, the time is counted down on a calendar. In addition to device maintenance, the temperature control system tracks the usage of other components. If the typical service life has elapsed, a message is generated. After the component has been replaced, the counter can be reset.

2.3.2 Functions menu

The most important and most frequently used device functions can be configured in the *Functions* menu. There are further settings for many functions that can be defined in the *Expert Parameters* submenu (see 5 Expert parameters).
Some functions can be activated or deactivated. A green frame around the button indicates that a function has been enabled.
The following buttons are available:

	Temperature warning The limit value for triggering a temperature alarm can be set or the function can be activated or deactivated using the *Temperature Alarm* button. Additional parameters can be configured using *Expert Parameters / Alarms* (see 0 Alarms).
	Leak stop mode (optional) If this function is activated, it causes the reversal of the pump rotation direction. This causes the pump to run in suction mode to stop water escaping from a leak. This feature is only available for open systems or below the system closing temperature. If the leak stop mode is activated, the pump delivers less medium; this can adversely affect the temperature balance of the tools. Flow sensors only measure in one direction. Therefore the flow rate display is suppressed and there are no alarms in relation to the flow rate.
	Interface mode (optional) The prerequisite for the *interface mode* is an appropriate master system (e.g. injection moulding machine) with appropriate cabling between the master system and the temperature control system. If this function is activated, the device receives commands via a digital interface (e.g. setpoints, switching on of the device) and returns process values and alarms.
	Tool draining (optional) Prerequisite for any *tool draining* is the completed cooling down of the system, otherwise the device is still pressurised. If this function is activated, the temperature control system and the connected consumer are drained immediately after switching off the device. Additional parameters can be configured using *Expert Parameters / Unit control* (see 0 Unit control).

	Pump overrun If this function is activated, the temperature control system and the connected consumer are cooled down immediately after switching off the device (only for temperature control systems with heat exchanger). Additional parameters can be configured using *Expert Parameters / Unit control* (see 0 Unit control). Further information about pump overrun can be found in chapter 3.1 Switching on / off, pump overrun.
	Pump control (optional equipment required) If this function is activated, the pump runs either at full power or with reduced speed. There are further options for the reduced speed which can be set using *Expert Parameters / Pump Control* (see 5.6 Pump control (only with optional frequency converter)).
	Self-optimisation Self-optimisation is used to determine suitable parameters for the P, I and D components of the PID temperature controller. The objective is to reach the setpoint temperature as quickly as possible with minimum overshooting. The procedure will be explained under capter 5.3.
	Water change From time to time, the temperature control system can pump water into the cooling water outlet and take in fresh water, for example in order to dispense additional water conditioning agents. Additional parameters can be configured using *Expert Parameters / Unit control* (see 0 Unit control).
ECO TEMP	ECOTEMP For cyclic processes, it may make sense to interrupt the heating/cooling of the consumer. This is done by the ECOTEMP function. Additional parameters can be configured using *Expert Parameters / ECOTEMP* (see 5.7 ECOTEMP).

2.3.3 Alarm list

Alarms are displayed in this screen.

An alarm indicates a device malfunction, such as insufficient fill levels or a tripped motor circuit breaker. If an alarm has occurred, this is indicated by a yellow or red exclamation mark in the navigation bar.
A **yellow** exclamation mark means "warning"; this indicates a minor fault; the device continues running.
A **red** exclamation mark indicates an alarm. Depending on the severity of the fault, the entire device or only the heater is switched off. In refrigeration units, the compressor may shut down.
In addition, the Cockpit displays a red bar with a short description of the alarm.
The most recent alarm is shown at the top in the alarm list. The following information is shown:

- Date and time when the alarm was created
- Error code
- Error text / short description

Tap in order to acknowledge an alarm; the alarm remains on the screen but the field colour changes to grey. Tapping deletes the alarm from the screen, but it remains stored in the background. Alarms whose causes have not yet been resolved are regenerated and displayed again.

Tap above the scroll bar to clear the entire alarm list. If a USB stick is plugged in, tap to write the alarms to the stick.

3 Operation of the temperature control system

3.1 Switching on / off, pump overrun

When the supply voltage is connected and the temperature control system is switched on at the main switch, the Smart Controller also starts up. The start-up process takes a few seconds.

Restarting after interruption of the supply voltage
If the supply voltage was disrupted or the system was switched off at the main switch, the controller enters the "ready for operation" state after the supply voltage has been restored or the system has been switched back on. In environments with frequent supply voltage interruptions, it can be desirable that the temperature control system should start automatically immediately after the supply voltage is restored.
This can be achieved by setting the *Restart lockout* parameter to "off" (under *Expert Parameters / Unit control*, see 0

Unit control). The system starts automatically after the supply voltage is switched on.

Filling
Set the *Filling* parameter to “Automatic” (under *Expert Parameters / Unit control*, see 0

Unit control) so that the temperature control system starts filling automatically after being switched on, if it is empty. This is only possible if the device is connected to a suitable supply, either by using the cooling water intake for filling, or by using a separate filling intake (see device configuration). Temperature control systems that use oil as heat transfer medium are typically filled manually.
After reaching a sufficient fill level, the pump starts up and the system applies the specified setpoint temperature.

Switching on/off via signal contact
As an option, the system can be switched on and off using a signal contact, To do so, the device must have previously been switched on manually. This contact can be used by the customer (see 7 Pin assignment). The system can be switched on manually or using a switch-on command in interface operation.

Alarm list
If the system cannot be switched on, check the alarm list for any faults (e.g. power supply fault, motor circuit breaker tripped, etc.). Note that it can take up to 10 seconds before an alarm is displayed.

Switching off and pump overrun
Depending on the setting (under *Functions / Pump Overrun*, see 2.3.2 Functions menu), the device does not switch off immediately but passes through cooling down (pump overrun) and/or draining.
If no (optional) heat exchanger is installed in the temperature control system, the cooling down of the pump overrun function works through heat loss only. As the pump brings additional energy into the circuit, the temperature can level out at values above the shutdown temperature. Then the system no longer switches off automatically.

Draining
After the system has cooled down, it shuts down or drains the consumer if *Tool draining* has been selected (see 2.3.2 Functions menu). This is possible only if the device is equipped with a built-in tool draining unit. To protect the device and the cooling water pipes, the system cannot be drained before cooling down. If the *Pump overrun* parameter is set to "off", the device cools down to the preset value of 60 °C before draining.

3.2 Switching on/off via external contact / restart lockout

The temperature control system can also be switched on and off remotely using one of the following two methods:

Switching on/off via external contact
The terminal board of the controller has an input for switching the device on and off via an external floating contact. The factory setting for this contact is “High” (24 V DC). To operate the device, the "On/Off" input must be set to logical "1", and the device must be switched on manually. The device shuts down if the "On/Off" input is set to logical "0" (0 V). Setting the input back to logical "1" switches the device back on. Switching the device on and off remotely will work until it is switched off manually, It is always possible to switch off the device manually on the display.

Switching on/off via interface
Prerequisite: The operation via an interface must be enabled.
Various interfaces support the switching. Further information about interface operation can be found under *Expert Parameters / Communication* (see 0

Communication).

Parameters *Pump overrun* (On/Off) and *Shutdown temperature* (On) affect both options. If the device is switched off remotely and the *Pump overrun* parameter is enabled, it cools down until the shutdown temperature is reached.

3.3 Filling the system

A magnetic float switch monitors and controls the filling process. The switching contacts of the float switch are usually designed as normally open contacts for rising level.
Water systems: During automatic filling, the filling valve in the temperature control system opens until the contact signals “full”. This does not happen until the device is switched on.
Oil systems: Oil systems are usually intended for manual filling. They may only be filled until reaching the minimum contact. If the level reaches “full”, the system triggers an "overfill" alarm and the heating switches off.
An alarm is always triggered if the level falls below “empty”. The pump is switched off for self-protection. Depending on the operating state, the switching off may involve a brief delay.
No alarm is generated if the system is switched on when it is empty. The temperature control system must be filled, or it fills automatically if the *Filling* parameter is set to "Automatic". An alarm is not generated until the system has been filled sufficiently once and then the level has dropped below the "empty" contact.
If the system has been filling without interruption for longer than the specified *Fill monitoring* parameter, it will be assumed that there is a major leak. The system stops the filling and triggers an alarm.
The system is equipped with an “Aquatimer” for the monitoring of minor leaks. To do so, the system counts the filling cycles during operation. An alarm is also triggered if the number of filling cycles is exceeded. For the initial filling process, the Aquatimer is disabled for the duration of the *Aquatimer start time*. The Aquatimer start time and the number of filling cycles are set in the *Expert parameters* under *Unit control* (see 0

Unit control).

3.4 System closure (only pressurised water units)

To ensure that water-based temperature control systems can be operated at temperatures above 90 °C, the system must be pressurised. For this purpose, the system contains a valve that closes the water circuit off from atmospheric contact. This makes it possible for a pressure to build up that prevents the evaporation of the water.
The closure happens at the *system closing temperature* which is configured using parameter *System closing temperature* under *Expert parameters / Alarms and limits* (see 0

Alarms and limits).
This valve stays closed when the controller starts up. The valve also remains closed in the switched-off state; except immediately and briefly after draining for ventilation.
The system closure temperature is also an important parameter for the leak stop function as this is not available in the pressurised area for physical reasons

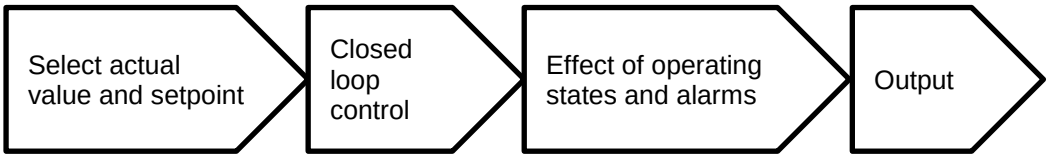
3.5 Flow measurement

If the temperature control system is equipped with a flow rate sensor, the controller shows the water flow rate. Values that are below approx. 10 % of the maximum flow rate cannot be displayed for physical reasons. The temperature control system should not be operated in the range below this value because a minimum flow rate is needed for meaningful energy transfer and temperature control. The minimum flow rate can be adjusted using parameters (see 0

Alarms). An alarm is triggered if the value drops below this threshold.
As the flow rate measurement only works in one direction for physical reasons, the display of values and the triggering of alarms are suppressed if the device is being operated in leak stop mode in the opposite direction.

4 Temperature control

The closed-loop and open-loop control unit can assume different operating states. The system maintains the temperature at a desired setpoint value during normal operation only; in other operating states such as draining, the control outputs are set to "zero". The actual control behaviour can be influenced in many different ways using a range of control parameters. These parameters are described in the *Expert parameters* chapter in the section on control parameters (see 5.3)
The description of the control behaviour is divided into the following segments:



In a first step, there is a choice between various different inputs, such as temperature sensors. A number of setpoints also exists – fixed, variable (ramps) or externally defined (analogue or via interface) setpoints.
The controller uses the input signals and parameters to determine a control variable.
The effects of operating states and alarms correct the control variable as need, e.g. the regulation ratio “heating” is set to “zero” if there is a film temperature alarm.
The output describes the activation of the various outputs for controlling actuators such as valves.

4.1 Control Sensor

By default, the control sensor provides the temperature value used for closed-loop control.
If the *External Sensor* parameter (under Expert Parameters / Unit control, see 0

Unit control) is set to "external", the temperature signal of the external sensor is used for closed-loop control. If no sensor signal is present (e.g. sensor not connected or defective), the closed-loop control reverts to the control sensor and outputs an alarm.
Alternatively, the temperature control system may also use the temperature value from the return sensor or an actual temperature transmitted via Profibus as basis for closed-loop control.

4.2 Setpoint for temperature control

By default, the *Setpoint* parameter is used for closed-loop control. Setpoints can only be entered within the limits specified by parameters *Lower/upper setpoint limit* (see 0

Alarms and limits).
However, other settings can override the setpoint. The following prioritisation applies:

Priority 1 (interface mode):
If interface mode is enabled, the transmitted setpoint is used for closed-loop control and overrides any other specified setpoints.
If interface mode is not activated, the following applies:

Priority 2 analogue external setpoint (only for Smart Controller plus):

If the *Setpoint selection* **parameter is set to "external setpoint", the input signal from the external setpoint input is used for closed-loop control.**

Priority 3:

If the *Setpoint selection* **parameter is set to"Setpoint 2" or** *input 2 Setpoint active* **is set to "1", the second setpoint is used for closed-loop control.**

Priority 4 program:
If a program is active, the setpoint is generated dynamically by the program.
Otherwise, the value of the *Setpoint* parameter is adopted for closed-loop control. If the transmitted setpoint is outside the *Lower/upper setpoint limits* parameters, the lower or upper setpoint limit is used for closed-loop control and an alarm is output.

4.3 Temperature control

The temperature controller is either a PID controller or, in combination with a refrigeration unit, a two-position controller. The parameters for the adjustment can be found under *Expert Parameters* in the section for temperature control.
In order to prevent heavy overshooting if the temperature control uses an external sensor that has long dead times due to poor placement, cascade control has been implemented. The dead time is the time that elapses after a control variable has changed (e.g. a cooling valve opens) and until this change has an effect on the sensor.
If the temperature deviates by more than the value set in the *Cascade control dT* parameter, heating or cooling is limited. This gives the controlled system time to allow the temperature change to arrive before the regulation ratio increases. The entire system thus tends less to overshoot.

4.3.1 PID control behaviour

The controller uses standard control engineering variables.
All control parameters can be set separately for heating and cooling.
Separate actuating signals are generated for heating and cooling; simultaneous heating and cooling cannot occur. The heating is always realised as PID controller, the cooling either as PID controller or as two-position controller, mainly for devices with active compressor cooling.

4.3.2 Control behaviour of two-position controller

This is a classic two-position controller with hysteresis. The hysteresis can be adjusted above and below the setpoint separately. The two-position controller only affects the cooling output. The heating output stays in the PID characteristics.

5 Expert parameters

The expert parameters are grouped into the following subjects:

After selecting one of the menu items, a screen appears that lists the individual parameters.

On the left, the individual parameters are listed; in the white fields below, the current setting at the centre. If there are upper and/or lower limits, these appear in the white field in grey characters on the left or right. Select a field to change the parameter. The right side of the screen then shows a numeric field or a selection, depending on the type of parameter. After making any changes, tap “Save”; otherwise, the new setting is not applied. If an illegal value has been entered, e.g. the value is too high, this value will not be applied.
After selecting a parameter, a brief description of the parameter appears at the bottom right.

5.1 Basic settings

Use the button to **make basic settings.**
The following settings can be made:

Language
Select the desired language.

Pressure unit (only for optional pressure sensor)
Select between bar and psi for the pressure unit.

If no pressure sensor has been installed at the factory, this selection/button is not available. In this case, the corresponding displays are suppressed and no alarms are created.

Unit for the flow rate volume (only for optional flow rate sensor)
Select between l/min, m^3/h and gal/min for the flow rate volume.
If no flow rate sensor has been installed at the factory, this selection/button is not available. In this case, the corresponding displays are suppressed and no alarms are created.

Units of measure
Select between degrees Celsius (°C) and degrees Fahrenheit (°F) for the unit of the temperature. For °C, it can be selected for the temperature display whether the value should be displayed as an integer or with a decimal place.

Operation lock
Enter a four-digit code under Logoff code. You can also select whether all inputs are locked or whether the setpoint can still be adjusted. Switching on and off is always possible for safety reasons.
If the *Logoff* parameter is not set to “OFF”, the navigation bar at the top displays an open padlock icon (see 2.1 Navigation bar).
The lock must be activated so that it becomes effective.
Activating the lock:
Tap the displayed symbol (open padlock) to activate the lock. In the confirmation dialog box, confirm the prompt.
The lock becomes active, and a closed padlock is displayed.
Deactivating the lock:
Tap the closed padlock in the navigation bar. Enter the release code. If the code has been entered correctly, the lock is deactivated.
Note: If the code has been lost while the lock is activated, contact SINGLE Service to obtain a release code. This requires the 6-digit unit number.

5.2 Unit control

Use the *Unit control* button to can make settings for controlling the device logic.
The following settings can be made:

Drain time

This parameter is used to define the duration of the draining process if *Tool draining* **has been selected (see 2.3.2 Functions menu).**

Filling by hand/automatically
This parameter defines whether the device is filled manually or automatically (see 3.1 Switching on / off, pump overrun).
Manual or automatic filling requires the corresponding preparation of the hydraulic system. For details, refer to the technical specifications or the order confirmation.

Switch over control
If the device has been set up accordingly, closed-loop control can also be performed by an external controller. It can directly control the heating and cooling within the temperature-control system without any involvement of the Smart Controller. Device monitoring is not affected.

Indirect/direct cooling
If the relevant option is installed in the hydraulic system, cooling can be switched over to direct cooling. This increases the cooling capacity for lower temperatures.
Indirect cooling of temperature control devices means that cooling water is passed through a heat exchanger. The cooling water circuit supply contains a solenoid valve that is controlled by the temperature controller.
In the case of direct cooling, the cooling water is fed directly into the heating circuit. The "cool" control output directly affects the "fill" output, thereby actuating the filling valve. The Aquatimer must be deactivated for direct cooling.
As this changeover to direct cooling can also be used for pressurised temperature control devices (temperatures of up to 200 °C), the following framework condition must be met:
The system closing valve must have opened for direct cooling so that the hot water can flow through the system closing valve into the cooling water outlet, i.e. the direct cooling only works up to the system closing temperature.

Shutdown temperature for pump overrun
This parameter defines the temperature that needs to be achieved by the pump overrun cooling phase. Independent of this parameter, the cooling phase must always achieve the system closing temperature to ensure that the system is unpressurised.

Set value source
This parameter defines which setpoint will be used. By default, the system applies the specified setpoint; it is possible to use an alternative value for closed-loop control (setpoint 2).
The Smart Controller plus also supports the provision of an analogue setpoint (0 - 10 V, 4 mA – 20 mA).

Control source
This parameter is used to define which actual temperature will be used for closed-loop control. The selection includes: control sensor, external or return sensor, or a signal via the Profibus interface.

Type external sensor
This parameter tells the controller what type of sensor is connected. The selection includes: PT 100, thermocouple element type J, L, K, 0 – 10 V or 4 mA – 20 mA.

Actual value output (Smart Controller plus only)

This parameter is used to define which actual temperature value will be assigned to the analogue output. The selection includes: control sensor, external or return sensor, or a signal via the Profibus interface.

Aquatimer start time and cycles

This parameter is used for leak monitoring (see 0 Prerequisite: The operation via an interface must be enabled.
Various interfaces support the switching. Further information about interface operation can be found under *Expert Parameters / Communication* (see 0

Communication).

Parameters *Pump overrun* (On/Off) and *Shutdown temperature* (On) affect both options. If the device is switched off remotely and the *Pump overrun* parameter is enabled, it cools down until the shutdown temperature is reached.

Filling the system). After the "start time" has elapsed, the Aquatimer starts counting the filling cycles within one hour. If the count exceeds the value set under *Cycles***, the system triggers an alarm.**

Fill Monitoring
This parameter defines the duration of the filling. If the time specified here is exceeded, the system shuts down because a major leak must be assumed or there is a problem with the supply. The system triggers an alarm.
Notice: No alarm is generated for devices where direct cooling is activated.

Restart lockout
This parameter defines whether the device should start automatically after operating voltage is applied (the restart lockout must be set to "off" for this).

Graph resolution
This parameter defines the time resolution in graphic mode.

Water exchange configuration (only for water devices)
The purpose of the water change is to pump water out of the system, for example in order to re-supply conditioned water immediately afterwards. If the device includes the *Water exchange* option, this can be done manually after switching of, or as a timed process.
The pumping-off duration is controlled by the water change time; for a timed configuration, parameter *Water exchange interval* defines the frequency for pumping off the water. The device is configured for automatic filling. If using the water change function for pressurised water devices, it must be ensured that the device can be filled, either by an adequate cooling water pressure or by a booster pump integrated into the temperature control system.

5.3 Temperature control

The *Temperature control* button is used to configure parameters that affect the temperature control behaviour.
The following settings can be made.

Setpoint

This parameter is the setpoint that is typically used. It can be adjusted directly in the Cockpit.

Setpoint 2
This parameter can be used to define an alternative setpoint. Parameter *Set value source* (see 0

Unit control) can be used to switch to this second value; alternatively, the setpoint terminal contact (see Smart Controller plus terminal diagram) can be used to switch between the regular and the second setpoint.

Regulation ratio heating / cooling
These parameters are used to set the regulation ratio and limit effective output to a value between 0 and 100%, slowing down the heating or cooling process. Specifying such a limit can be useful if the consumer cannot tolerate too rapid heating or cooling.

Control parameters XP, TV and TN
The parameters XP, TV and TN are used to determine the specific control behaviour. Because a temperature control system may have different power ratings for cooling and heating, these parameters can be configured individually.
XP is the amplification factor. Increase this parameter if the system tends to overload or overshoot. Reduce the parameter if the system heats up too slowly at a regulation ratio below 100%.
TN is the integral component which is required to ensure that the system achieves the setpoint value (which cannot be achieved with the XP component alone). Increase this parameter if the system tends to overshoot. You can try reducing this parameter if a deviation remains in place for a relatively long period of time, even though the system has not yet reached a regulation ratio of 100 %.
TV is the differential component. TV comes into play when interference causes the actual temperature to move away from the setpoint temperature. In this case, the TV component counteracts the change in corresponding proportion. You can try increasing the TV value, if interference causes the temperature to move away too much and the system has not yet reached a regulation ratio of 100%.

Do not heat dead range

This parameter defines a dead range around the setpoint. Operating a system at a very low regulation ratio can result in alternating cooling and heating. To avoid this, you can define a range in which no cooling or heating takes place.

Switching cycle time heating / cooling
The percentage-based regulation ratio is converted into a binary on/off behaviour for heating and cooling valves. A regulation ratio of 70% means that an actuator is 70% on and 30% off. The "on/off" cycle is always the same length which is specified with the “Switching cycle time” parameter. To protect the components, the time period should be as long as possible, however without the switching behaviour affecting the temperature.

Setpoint ramp increasing / decreasing

If the consumer is sensitive to rapid temperature changes, parameter *Setpoint ramp increasing / decreasing* can be used to reduce the rise/fall speed. The value is entered in K/min.

Cascade control dT (only in connection with an optional external temperature sensor connection)
The cascade control is needed in connection with external sensors to prevent any oscillations of the temperature. Positioning a sensor too far away from the temperature control medium can cause a time delay between the time the device responds and the time the sensor detects this change (dead time). This might result in the controller over-regulating, sending the entire system into temperature oscillation.
To avoid this, the controller switches off the heating when the control temperature exceeds a value greater than the setpoint plus dT of the cascade control.
Example: Setpoint temperature 150 °C, dT 10 K.
The system switches off the heating when 160 °C is reached at the control sensor even if the external sensor indicates lower values.
This principle is used in a similar manner for cooling, i.e. the cooling is switched off if the control temperature falls below a value smaller than setpoint minus dT of the cascade control.

This gives the external sensor time to detect the changes. The system is no longer over-regulating but instead heats/cools in sync with the change at the external sensor.

Switching hysteresis for cooling on/off
For devices with compressor cooling, the cooling is switched on when the temperature reaches the “hysteresis on” temperature, and switched off when the temperature reaches the “hysteresis off” temperature. The values must be entered as difference from the setpoint.
Example: Setpoint 25 °C; switch on at 26 °C and switch off at 23 °C.
The parameters must be set as follows:
- Hysteresis cooling on: 1 K
- Hysteresis cooling off: 2 K

For cooling devices with two compressors, the on/off points for the second compressor can be set separately under *Cooling 2*.

Limit/tolerance for film temperature
Particularly in heat transfer systems that use oil as medium, in order to protect the oil from heating up excessively at the heating, the regulation ratio can be limited before an excessive temperature is reached. If the film temperature reaches the level defined in parameter *Limitation film temperature*, the regulation ratio is reduced to zero.
However, there is a smooth transition to reach this value: The reduction rate is defined by the *Tolerance film temperature* value.
Example: If the *Tolerance film temperature* is 270 °C and the *tolerance* is 10 K, no limitation is applied up to 260 °C; at 265 °C the limitation of the heating regulation ratio is 50%; starting at 270 °C, no regulation ratio is permitted.

Automatic Self-optimization
Self-optimization determines suitable parameters for the P, I and D parameter of the PID temperature controller. The aim is to achieve the target temperature as quickly as possible with minimal overshoot. Self-optimization is started in the menu Functions (see chapter 2.3.2)
If self-optimization is started, a program routine will be started. The system is cooling down to a temperature of approx. 13 ° C below the setpoint. If the device is still 13 ° C or more away from the setpoint when the self-optimization is switched on, no initial cooling takes place. The controller then controls the device in the direction of the setpoint temperature; after exceeding a maximum value near the setpoint value, the device cools down for a certain time. This means that the temperature during the self-optimization is not at the setpoint, it can come to bad parts during this time.
Since the device and the controlled system (consumers) are temperature-dependent systems and the optimal control settings are therefore also temperature-dependent, it makes sense to carry out the optimization at the setpoint temperature, which is later also used in the process. During the self-

optimization, the external circumstances must not be changed and the disturbances must be kept low.
Since the device can cool down by approx. 13 ° C below the setpoint within the scope of self-optimization, the setpoint must be at least approx. 20K higher than the minimum achievable temperature. The minimum achievable temperature for temperature control systems is the cooling water temperature, for refrigeration systems the minimum temperature of the refrigeration system. It should be noted that cooling to temperatures close to zero can cause frost damage if the circulating water is not accompanied by sufficient antifreeze.
If the device does not reach the desired temperatures during self-optimization, the system aborts the optimization and proceeds with the old parameters.

The self-optimisation aborts as soon as any alarm occurs or if the limit value of the internal control temperature is exceeded during active cascade control is active and the heating is switched off as a result (see chapter "5.3 Cascade Control dT"). Therefore, deactivation of the cascade control is required before the start of the self-optimisation.

After the activation, a dialog box appears with the text "Self-optimisation". Tap "Start" to confirm or "Cancel" to abort the process.
Selecting “Start” starts the self-optimisation process. While it is running, another window with status information and the option to abort the process at any time is displayed. While the process is running, no further user intervention is possible.
If "Cancel" is selected, the Smart Controller returns to the Process Data view.
Self-optimisation results in conservative values without overshoots. If faster temperature regulation is desired, the Xp value can be gradually reduced until the required result is obtained.

Manual self-optimization
To do this, the controller parameters Xp for heating and cooling must be set to zero by hand. This causes the system to start oscillating, the temperature is not stable at the set point, but fluctuates. This means that the temperature during the self-optimization is not at the setpoint, it can come to bad parts during this time.
For the determination, the duration of a full oscillation is measured, this is called Ts in the following. Furthermore, the difference temperature dX is measured between the lowest and highest temperature values of the **oscillation** amplitude.
The parameters are then calculated to:

Xp, heat = dX / 220 * 100%
Xp, cool = dX / 110 * 100%
Tv = 1/10 * Ts (heating and cooling)
Tn = 1/2 * Ts (heating and cooling)

These **calculated** parameters must be entered manually. If the system still tends to overshoot or fluctuate too much, gradually increase the Xp values by approximately 25%**.**

5.4 Alarms and limits

The *Alarms and limits* button can be used to set alarms.
Most alarms are not activated immediately after a fault occurs, but with a 10 second delay. This serves to prevent false alarms that could potentially shut down the system.

Temperature alarm configuration
This function relates to the temperature alarm. Temperature alarms can be triggered in various ways: The associated temperature parameter is set under "Device configuration" (see 2.3.2 menu fuctions).
The following values can be defined:

- **Signal value**
  The value entered here is added to the setpoint. An alarm is triggered if the actual temperature reaches this total value.
- Limit value
  The value entered here is an absolute value. An alarm is triggered if this value is exceeded.
- Comparator
  The value entered here defines an operating range around the setpoint, both downward and upward. An alarm is triggered if this range is exceeded in either direction.
- Comparator with standby
  This mode is similar to the comparator mode, however the triggering of an alarm is initially disabled. The deactivation is not revoked until the actual temperature has reached the operating range of the comparator once, i.e. alarms are not output until afterwards if the actual temperature is outside the operating range.

If the setpoint is modified, the warning is deactivated again until the temperature in the new operating range has reached the value of the comparator again. The associated signal values, limit values and comparator values are located in parameter *Value temp. warning*.

Upper/lower setpoint limit
This parameter is used to define an upper and a lower setpoint limit.
Setpoints can only be entered in the range between the lower and upper setpoint limits. If setpoints outside these limits are entered or specified by an external source (analogue setpoint specification or interfaces), the input is limited to the minimum or maximum entered here.

Warning “To process”

In addition to the actual control sensor in the supply line, in many systems a second supply sensor is installed which monitors the supply. A warning can be activated for the temperature value measured by this sensor.

Alarm "Film temperature"

A film temperature sensor that monitors the heating temperature separately is installed in the device. When the alarm is activated and the alarm value is exceeded, the heating is switched off in addition to the alarm signalling.

Warning “From process temperature”

If the unit is fitted with a return sensor, a warning can be generated for the temperature value measured by this sensor if it exceeds the value configured here.

Warning “dT”
A warning is triggered if the difference between supply and return exceeds this value.

System closing temperature
Pressurised devices are open below this value to guarantee ventilation of the entire hydraulic circuit. If the system closing temperature is reached, the system seals against the atmosphere and can

build up pressure. Above the system closing temperature, the entire system including connected hoses/piping and consumers can be pressurised.

Alarm “Flow”
The system triggers an alarm if the flow rate drops below this value. The system requires a minimum flow rate to lubricate the pump and to remove the heat produced by the heater. A minimum flow rate is also essential to ensure proper temperature control. The user should not change the specified alarm value.
Unlike the “flow rate below limit”, the purpose of this setting is to protect the functionality of the device.
In the (optional) leak stop mode, the medium flows through the flow rate sensor in the opposite direction, and no measurement can be taken. Accordingly, no alarms will be triggered.

Warning “Flow rate below limit”
An alarm is triggered if the value drops below this threshold. Unlike the minimum flow rate, the purpose of this parameter is to safeguard the flow volume that the process needs.

Warning “Flow rate over limit”

A warning is triggered if the value exceeds this threshold.

Alarm “Pressure over limit”
An alarm is triggered if the measured pressure on the supply side is above the *High pressure* parameter.

Alarm “Pressure under limit”

An alarm is triggered if the measured pressure on the supply side is below the *Pressure too low* **parameter.**

Unit stops in case of alarm
If this function is activated, the device switches off whenever any alarm occurs.

5.5 Communication

The *Communication* button can be used to configure communication details, e.g. which protocol is used. The settings must match those of the master system.
If the system is equipped with an interface and a protocol is selected, the Smart Controller transmits process data (temperatures, alarm states, etc.).
In interface operation, the interface icon flashes blue.
If your temperature control system is not equipped with an interface, it can be retrofitted with various interfaces and protocols which need to be activated at a separate charge. Contact SINGLE Service if interested.
There are SINGLE-specific protocols in addition to finally specified interfaces. The protocol specification can be requested from SINGLE.

The Smart Controller can communicate with the Single Smarthub via a local network. To allow communication with the Smarthub, it must be enabled once on the temperature control device. This is done using parameter *Smarthub-connection allow*. After activation, the device can connect for 30 minutes. If a DHCP server will assign the IP address, this setting must be activated under DHCP. The IP address is displayed in the field below. If the IP address will be assigned manually, this can also be done using this parameter. However, the IP address can be entered manually only if the DHCP parameter is “off”.

5.6 Pump control (only with optional frequency converter)

This function is only available if an optional frequency converter is installed in the temperature control system. The pump controller controls the pump speed, e.g. to achieve energy-optimised operation. Tap the Pump control button to go to the screen for setting the parameters.
The “Pump control” analogue output controls a frequency converter that affects the pump speed. It is necessary to have a minimum flow rate for all the functions described here, e.g. to be able to regulate the temperature cleanly. Therefore the minimum flow rate is restricted to 30% of the maximum flow rate; a higher lower limit can be necessary in some cases for a functioning process.

Pump control selection
This parameter defines which procedure should be used to control the pump speed.
The following options are possible:
Speed fix set in %:
The pump runs with a fixed output level.
Flow rate fix set in l/min:
The pump is regulated so that it maintains a defined flow rate value.
Auto (Difference dT):
The pump speed is regulated automatically according to the needs of the temperature control process so that the production process runs with lowest possible energy consumption of the pump.
Pressure rate fix set in bar:
The pump is regulated so that it maintains a defined pressure (to process) value.

Fix value
This parameter is used to set a fixed speed relative to the maximum speed. 100% is full load. The minimum accepted speed is 30% in order to satisfy minimum requirements for temperature control. As the power input is approximately the square root of the speed, the energy consumption of the pump at 30% speed is less than 10% of the rated motor power.

Fix Flow rate (only in combination with flow rate measurement)
This parameter is used to configure a flow volume. The system controller maintains this value.
If the set value is above the maximum value that the device can produce, the pump will run at full load. To achieve correct temperature control results, the specified flow rate must not be below 30% of the maximum flow rate.
The closed-loop control is performed using a PID controller. If the control behavior does not achieve the required results for the application, it can be adjusted using the XP flow rate, TV flow rate and TN flow rate parameters (see below).

Deviation dT (only with optional return sensor)

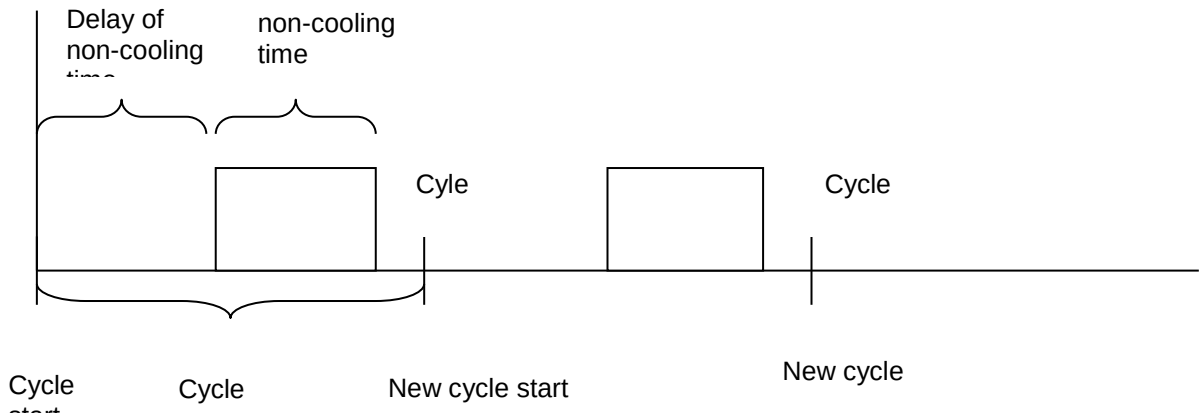
This parameter sets the temperature difference between flow and return.
The pump speed is reduced slowly. In doing so, the temperature difference between flow and return is monitored. The speed reduction is stopped when the dT temperature difference set here is reached.
In this process, the speed is reduced only if the difference between setpoint and actual temperature is less than 1 K. A minimum flow rate is also needed for temperature control. Therefore, the system maintains a control variable of at least 30%.

Fix Pressure rate (only in combination with pressure difference transmitter to process)
This parameter is used to configure a to process pressure. The system controller maintains this value.
If the set value is above the maximum value that the device can produce, the pump will run at full load.
The closed-loop control is performed using a PID controller. If the control behavior does not achieve the required results for the application, it can be adjusted using the XP flow rate, TV flow rate and TN flow rate parameters (see below).

XP flow rate, TV flow rate, TN flow rate
These parameters influence the control behavior of the pump for the *fix flow rate* and *fix pressure rate* function (see above).

5.7 ECOTEMP

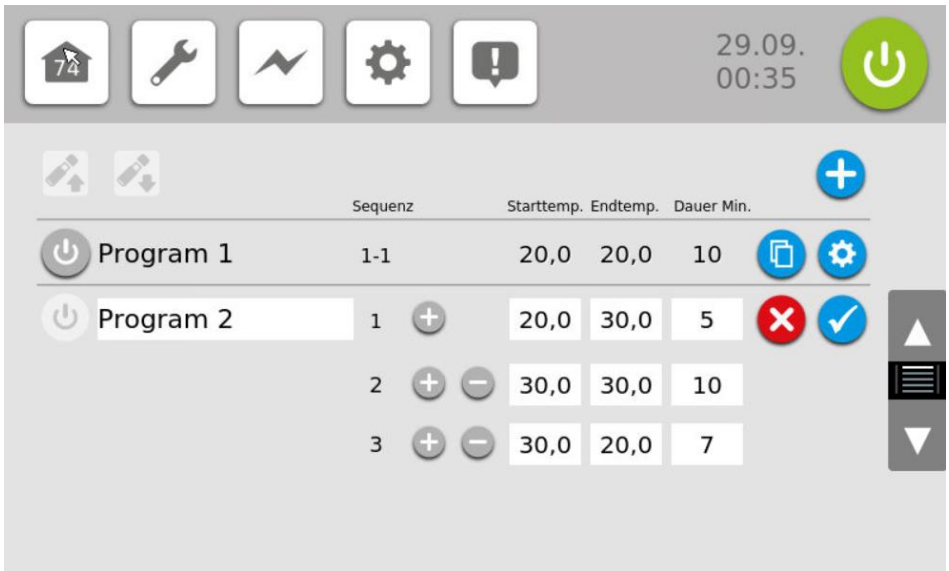
ECOTEMP is an optional feature that interrupts the temperature control process – typically cooling in an injection moulding process – by redirecting the water flow to an internal bypass.
The *ECOTEMP* button can be used to switch the function on and off. If the function is active, the ECOTEMP icon in the Cockpit flashes green or blue.
ECOTEMP can only be activated when the device is switched on and not in leak stop mode.
The ECOTEMP module generates an intermittent flow through the mould. It controls the cooling and non-cooling periods of the temperature control system. Controlling the temperature of the injection mould at systematic graduations during the cycle offers a number of benefits in terms of processes, surface and strength of the moulded part, and cost-effectiveness.
In addition, this feature offers a watchdog functionality which puts the temperature control system into standby mode after a specified period (P: timer standby mode). In standby mode, the temperature control device operates based on the second setpoint.
At the ECOTEMP input, the controller expects a 24 V signal. The response follows a status change from 0 V to 24 V. In the as-delivered state of the temperature control system, one contact of the ECOTEMP connection is supplied with 24 V so that closing a floating contact between 24 V and the ECOTEMP input provides the required signal at the controller. For details, refer to the circuit diagram included with the device.
After the ECOTEMP input has switched from “Low” to “High” (from 0 V to 24 V), the non-cooling delay time starts. At this point, the mould performs the temperature control (cooling).
After this period has elapsed, the actual non-cooling time starts. During this time, the device is in bypass mode and the mould is not being cooled. If the system includes an optional frequency converter, the temperature control system lowers the pump speed to the “Fix value” (set on the Pump control screen) for the duration of the non-cooling period.



if no new signal is received after the end of the standby period, the system regulates the temperature to a standby temperature, this is setpoint 2.
Output (ECOTEMP Out) and input signal (ECOTEMP In) are displayed in expert mode. The input and output signals can be monitored here.

5.8 Program

The *Program* button can be used to view a temperature curve, as opposed to a constant temperature in normal mode. The curve consists of straight lines. A curve can contain up to 20 straight line sections.
Each section (program step) has a temperature value at the start and end as well as a duration (entry in minutes).
After starting the program, the first program step is executed. The initial value is applied as setpoint for temperature control. For the duration of the first program step, the temperature setpoint changes constantly so that after the time has elapsed, the final temperature value has been reached.
Example: The initial value is 50 °C, the final value is 65 °C, the duration is 3 minutes.
The program starts at 50 °C and increases the temperature constantly. After one minute, the temperature reaches 55 °C, after two minutes 60 °C, and so on.
If the program contains multiple steps, these are executed in immediate succession. In principle, it is possible for the final value of one step to differ from the initial value of the following step. In this case, the temperature setpoint jumps. The controller tries to follow this specified curve. Due to the thermal inertia of the overall system, however, jumps are not possible. Depending on the overall system, a certain time is needed.



Tap the button to create a new program. Enter a program name and tap the “Enter” button to confirm. The program is created. Initially, it consists of only one program step. Tap the icon to edit the program. Specify start temperature, end temperature and duration for this step.

Tap the small button in the program line to append further program steps.
If the start value does not match the final value of the preceding step, a jump occurs in the setpoint curve.

Tap to delete program steps. Select a name field to edit the name.

Tap to finish editing a program. Programs can be modified later. This is not possible while the program is running.

Tap on to duplicate a program.
Up to 10 programs can be programmed, each with 10 individual steps.

Tap the icon next to the program name to start the program. The icon turns green and a symbol with an arrow appears. Tapping the icon again switches the program to repeat mode. This is indicated by a symbol with two arrows . Tapping the icon again turns off the program immediately.

The prerequisite for starting the programs is that the device is switched on and that it is not in interface mode. Because there are different setpoint sources, pay attention to the further parameter configuration (see also 4.2 Setpoint for temperature control).

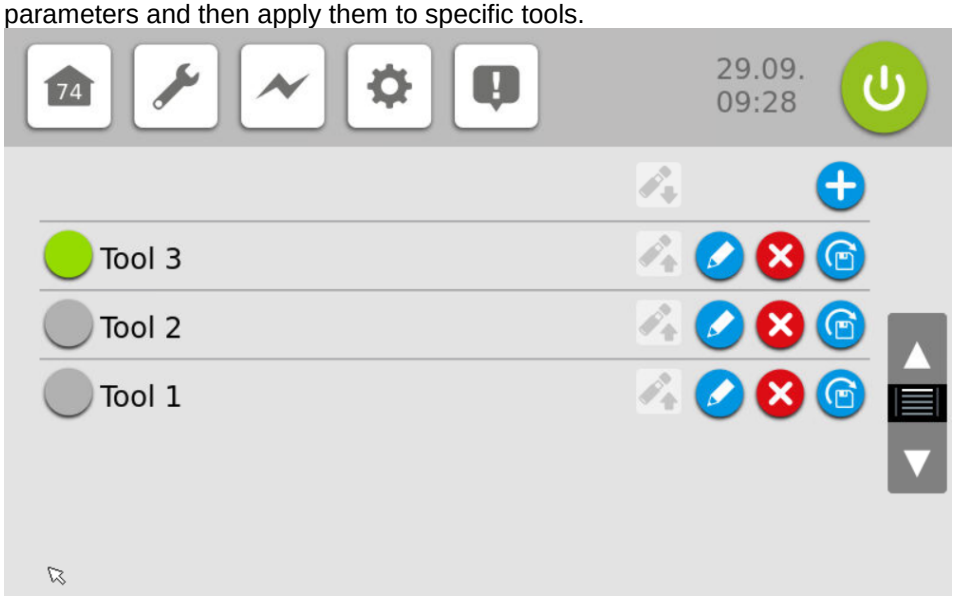
Tap to copy all programs to a USB stick. The programs are stored as individual files using the program names.

Tap to load programs from the USB stick onto the temperature control system. This copies all programs that are stored in the designated “program” directory. Programs with identical names are not copied.

In order to delete a program, tap to select it and then tap to delete it.

5.9 Tool

Temperature control systems can be used for different end products, which may require different parameter configurations.of the temperature control device. The *Tool* button can be used to store parameters and then apply them to specific tools.



Tap to create a new tool and store the current parameters for this tool. After tapping the icon, the system will first prompt for a tool name.
Up to 20 tools can be saved.
After tapping a grey dot to switch on a tool, the indicator turns green. If a parameter is modified at this point, the current parameter configuration no longer matches the tool parameters. The changes are not saved automatically in the tool. For this reason, the colour of the dot changes back to grey.
Tap the floppy disc icon to update a version. The tool data are overwritten with the current parameters. Alternatively, after changing the parameters, tap the icon. A new tool data record is created.

It is also possible to download and upload tools by tapping the USB stick icon on the line, provided a suitable USB stick is plugged in. Tap in order to copy tools from a USB stick to the device. This works provided that on the stick, one or multiple data records are saved in the “werkzeug” ("tool") directory.
Tap to delete tools.

5.10 Timer

The controller includes a battery-backed clock. The *Timer* button can be used to switch the device on and off on any day of the week. The times for switching on and off must be specified for each day. Note that if using the timer, the main switch on the device must not be switched off.

5.11 Offset values

As a result of ageing, the sensors may lose some of their accuracy. An offset value can be stored for each measured value that compensates for measuring errors due to ageing. The individual values are listed in the parameter lists in chapter 8.
The Smart Controller plus includes an analogue setpoint input / actual value output. This menu under “Analogue value 4..20mA/0..10V” as well as “Temperature at 0V / 4mA” and “Temperature at 10V / 20mA” can be used to calibrate this function.

- A selection can be made between 0 - 10 V or 4 mA - 20 mA.
- The temperatures can be defined where the analogue transmission range starts and ends.

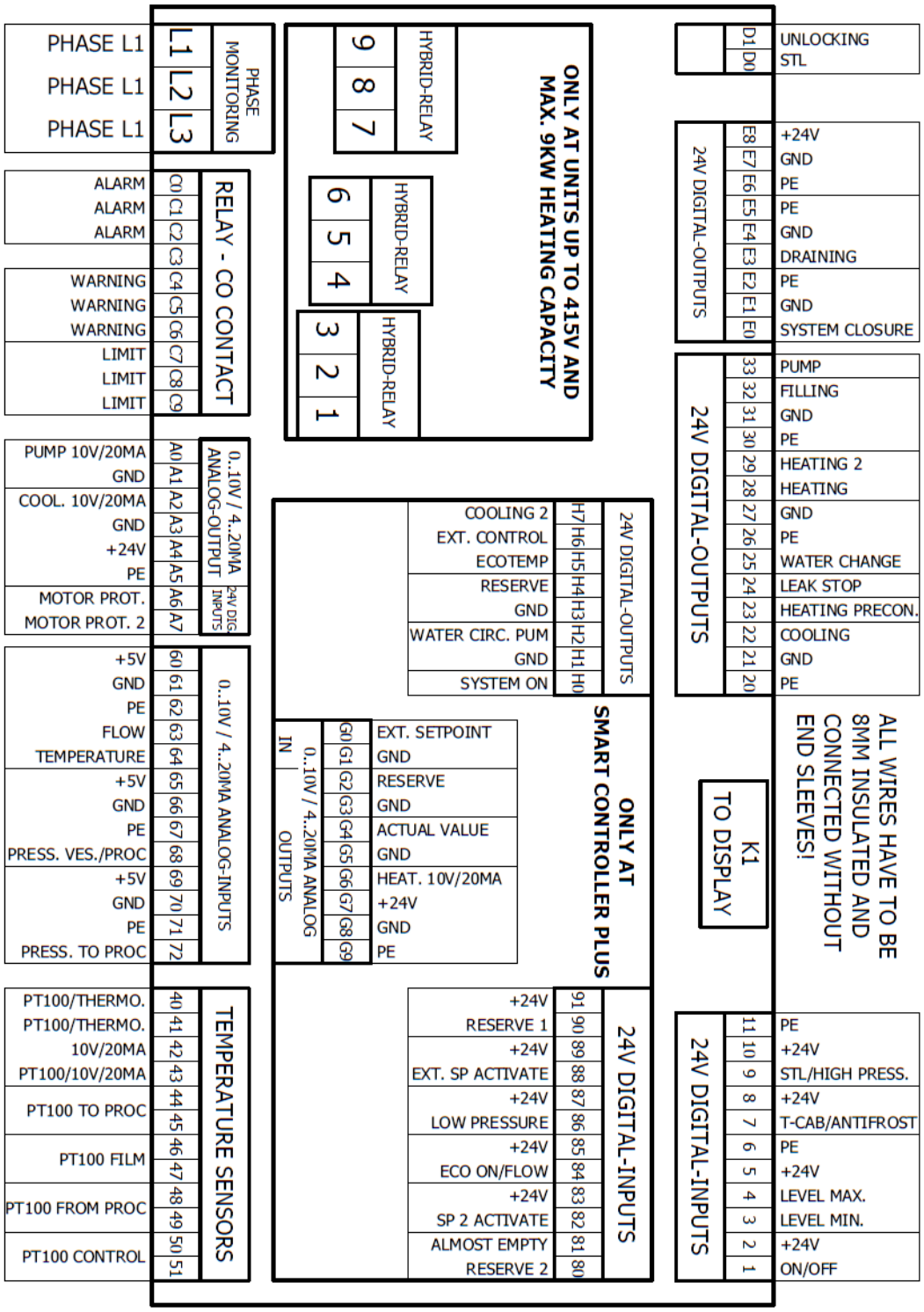
If for example the temperature range between 50 °C and 150 °C is relevant, parameter *Temperature at 0V / 4mA* is set to 50 °C; parameter *Temperature at 10V / 20mA* is set to 150 °C. If the setpoint is now specified as 5 V or 12 mA, the controller interprets this as setpoint temperature 100 °C.

6 Software update

It is possible to update the software via the USB port. In order to use this function, a USB stick must be plugged in that contains the program files in a sub-directory named *Software*.
Tap the *Maintenance* icon in the navigation bar and call up the *Service and Information* menu.

Tap  and start the software update.
The process takes several seconds. The supply voltage must remain switched on during the process, i.e. the device is connected and the main switch is in the "On" position.
If the update process could not be completed, the voltage must be switched off for 10 seconds using the main switch of the device. The controller then starts with the old program.
After the update is complete, the supply voltage must be switched off for 10 seconds before restarting.

7 Pin assignment



8 Parameter lists

Remarks: The settings range refers to metric units. Some parameters will be hidden if the associated functionality of the device is not enabled.

8.1 Functions

Name	Value range	To	Function	Only SCC plus
Temp. warning			Value for temperature warning	
Leak stop	ON, OFF		Further parameter configuration under Unit control	
Communication	ON, OFF		Interface operation; further parameter configuration under Communication	
Tool draining	ON, OFF		Tool draining before switch-off; further parameter configuration under Unit control	
Cooling down before off	ON, OFF		Cooling down before switch-off; further parameter configuration under Unit control	
Pump speed	ON, OFF		Rotational speed 100 % or limited; further parameter configuration under Pump control	
Self-optimisation			Start self-optimisation	
Enable water exchange	ON, OFF		Activate the water change function	
ECOTEMP	ON, OFF		Activate the water function ECOTEMP	

8.2 Basic settings

Name	Value range From	To	Function	Only SCC plus
Language	Various		Language used on device display screen	
Units temperature	C; 0,1C; F		Indication of temperature	
Units pressure	Off, bar, PSI		Unit of measure for pressure	
Units flow	Off, l/min; m3/h; gal/min		Unit of measure for flow rate	
Date				
Time				
Summertime	ON, OFF			
Operator lock	Off; On/Off; On/Off and setpoint		Lock that prevents operation by user	
Logoff code	****		Lock code for locking and unlocking, specified by user	
Service access			Only for Single service team	
Test interval safety valve	0	20,000	After this time has elapsed, a warning message is generated	

8.3 Unit control

Name	Value range from	To	Function	Only SCC plus
Drain time	Off, 10 sec	900 sec	Blow-out or extraction time for devices with tool draining, in seconds	
Filling	By hand / automatic		**By hand** means the filling of the devices is performed manually. **Automatic** means the filling of the devices is performed automatically.	
External regulation	ON, OFF		If external control is set to ON, heating and cooling is activated by an external controller.	
Cooling	Indirect / direct		Cooling using heat exchange, or direct Direct cooling is only possible for water-operated devices	
Shutdown temperature	10°C	100°C	After switching off, the pump runs until this temperature has been reached	
Setpoint selection	Setpoint or setpoint 2 or ext. setpoint (option)		Switch-over between setpoints	X (ext. setpoint)
Control source	Internal, external, from process, or via Profibus		Select which temperature will be used as basis for closed-loop control	
Type external sensor			PT100, thermocouple element type J, K, L, 0-10V, 0-20mA or 4-20mA	
Aquatimer start time	5 min	120 min	Time from start-up without monitoring of filling cycles	
Aquatimer cycles	Off ;1	40	Setting corresponds to max. permissible filling cycles after 1 hour of operation	
Max. filling duration	Off ; 1	99	Setting in minutes; if the filling takes longer, the filling process is aborted and the device shuts down (only for auto. filling)	
Restart lockout	ON, OFF		Restart lock after network reset • off = restart lock not activated • on = restart lock activated	
Graph resolution	1 min	24 h	Scaling of recorder	
Control external sensor	Internal, external		Temperature control based on external sensor (only if enabled in factory parameters)	
Water exchange configuration	Off, by hand, after switching on, by timer		Water change functionality	
Water exchange duration	1 sec	30 sec	Duration of water change cycle	
Water exchange interval	1 min	300 min		

8.4 Temperature control

Name	Value range	To	Function	Only SCC plus
Setpoint	Min. set value	Max. set value	Minimum set value Maximum set value	
Setpoint 2	Min. set value	Max. set value	Minimum set value Maximum set value	
Regulation ratio heating	0	100	in %	
Regulation ratio cooling	0	100	in %	
XP heating	OFF, 0,1	99.9	In %, proportional range of the controlled system	
TV heating	OFF, 1	200	In seconds, rate time of the controlled system	
TN heating	OFF, 1	1000	In seconds, reset time of the controlled system	
XP cooling	OFF, 0,1	99.9	In %, proportional range of the controlled system	
TV cooling	OFF, 1	200	In seconds, rate time of the controlled system	
TN cooling	OFF, 1	1000	In seconds, reset time of the controlled system	
Dead area no heating	OFF, 0,1	10		
Switch cycle time heating	1s	240s	For hybrid output starting at 10 sec	
Switch cycle time cooling	1s	240s		
Setpoint ramp increasing	OFF, 0,1	99.9	In K/min	
Setpoint ramp decreasing	OFF, 0,1	99.9	In K/min	
Hysteresis cooling on	0.5 K	10 K	Only for cooling devices	
Hysteresis cooling off	0.5 K	10 K	Only for cooling devices	
Hysteresis cooling 2 on	0.5 K	10 K	Only for cooling devices with two power levels	
Hysteresis cooling 2 off	0.5 K	10 K	Only for cooling devices with two power levels	
Limitation of unit-internal to process temperature	OFF; 1	100 K	Limitation of supply flow temperature for external sensor	
Limitation film temperature	OFF; 100	400°C	Reduction of regulation ratio when this value is reached	
Tolerance film temperature	1	20 K	Degree of regulation ratio reduction for limitation of film temperature	

8.5 Alarms

Name	Value range	To	Function	Only SCC plus
Configuration temp. warning	1	4	Configuration of warning output • ❶ = Signal contact • ❷ = Limit contact • ❸ = Limit comparator • ❹= Limit comp. with stand-by behaviour	
Value temp. warning	OFF; 0.1	400		
Maximum set value	Minimum set value		Maximum setpoint limits corresponds to maximum temperature of device	
Minimum set value		Maximum set value	In °C; can be used to pre-select the starting value of the setpoint settings range	
Warning To process	OFF; 0	400	Temperature warning for supply flow (not for cold)	
Film temp. over limit	OFF; 0	400	Temperature alarm on heating	
Warning From process temperature	OFF; 0	400	Temperature in return flow	
Warning dT	OFF; -100	100	Monitoring of temperature difference between supply flow and return flow	
System closing temperature	OFF; 35	95	In pressurised water devices, the hydraulic system is sealed off from the atmosphere. **Water**: Temperature pre-selection for system closure in °C **Oil**: extraction only possible below the configured value	
Alarm flow	OFF; 0	2000	Protects the device, minimum that ensures proper functioning of the device; only for normal pump function	
Warning Flow rate below limit	OFF; 0	2000	Safeguards the production process; only for normal pump function	
Warning Flow rate over limit	OFF; 0	2000		
Alarm Pressure over limit	OFF, 0,1	40.0		
Alarm Pressure under limit	OFF, 0,1	40.0		
Unit stops in case of alarm	On; OFF		Safety shut-down	

8.6 Communication

Name	Value range	To	Function	Only SCC plus
Address	1	255	Enter the device address. If several devices run on the same interface, different addresses must be configured.	
Protocol	OFF		• Arburg • KraussMaffei • Dr. Boy • Engel • Profibus DP • Modbus • Single Standard • SPI • CAN Euromap 66 • OPC-UA Euromap 82 Selection according to which interfaces are enabled	
Baud rate	OFF, 0,3	19.2	Used to program the transmission speed – baud rate – of the interface. Possible settings: OFF = no baud rate configured • 1.2 = 1.2 kBaud • 2.4 = 2.4 kBaud • 4.8 = 4.8 kBaud • 9.6 = 9.6 kBaud • 19.2=19.2 kBaud • 38.4=38.4 kBaud	
Data format			Used to program the data format of the interface. The data format is composed of: Data bits, parity bit, stop bit. Possible settings: 7E1, 7o1, 7E2, 7o2, 7n2, 8E1, 8o1, 8n1, 8n2	
Status	---	Data Exchange	Interface status	
Switchover	RS232/485	20mA TTY		
Smarthub	ON; OFF		Allow connection to Smarthub	
DHCP			Allow DHCP (automatic assignment of IP address by DHCP server)	
IP address			Network address of the device	

8.7 Pump control

Name	Value range	To	Function	Only SCC plus
Mode	Pump control mode: 1.) Speed fix set in % 2.) Flow rate fix set in l/min (only with flow measurement) 3.) Auto dT: Process window if dT is less than 50% of the setpoint and |Set-act. temperature|>1°C, the speed will be reduced by 1% per minute (only with sensor from process) 4.) Pressure rate fix set in bar (only with pressure transmitter to process)			
Fix value	30	100	In %	
Fix flow rate	0	100.0	In l/min;	
Deviation dT	0	10	Maximum permitted temperature difference between supply and return flow temperature	
Fix pressure rate	0	25	In bar	
XP pump	OFF, 0,1	999.9	In %, proportional range of the controlled system for speed control	
TV pump	OFF, 1	200	In sec., rate time of the controlled system for speed control	
TN pump	OFF, 1	1000	In sec., reset time of the controlled system for speed control	

8.8 Offset

Name	Value range	To	Function	Only SCC plus
Offset internal	Off, -199	199°C	Offset for internal control sensor	
Offset from process sensor	Off, -199	199°C	Offset for return sensor	
Offset external sensor	Off, -199	199°C	Offset for external sensor	
Offset to process pressure	Off, -199	199°C	Offset for supply flow sensor	
Offset film	Off, -199	199°C	Offset for film temperature sensor	
Offset regulation ratio cooling	0	100	%, regulation ratio	
Setpoint value, actual value output	0-10V; 4-20mA		Configuration of analogue input and output	X
Temperature at 0V / 4mA	MR start	MR end	Configuration of analogue input and output	X
Temperature at 10V / 20mA	MR start	MR end	Configuration of analogue input and output	X
Flow metering offset	-1.00	1.00	mA or V	
Threshold flow rate	0	500	mV; below this threshold, no flow rate is displayed	
Offset to process pressure	-1.00	1.00	mA or V	
Offset pressure vessel	-1.00	1.00	mA or V	

8.9 ECOTEMP

Name	Value range	To	Function	Only SCC plus
Start non-cooling period	0	100		X
Duration non-cooling period	0	1000		X
Duration to standby mode	0	2000		X

9 List of alarms

Code	Status	Text	Help text
H100	A	at least one phase of supply net is missing	Check the electrical connection and the fuses of the supply net
H1001	A	Sensor control has short circuit or measuring range undershot	defect at the sensor or at the electrical connection of the sensor. please check and replace sensor if necessary
H1002	A	sensor control interrupted or measuring range exceeded	defect at the sensor or at the electrical connection of the sensor. please check and replace sensor if necessary
H101	A	incorrect rotating field direction of electrical supply	turn two phases on the electrical connection
H1022	A	Sensor film temperature has short circuit or measuring range undershot	defect at the sensor or at the electrical connection of the sensor. please check and replace sensor if necessary
H1023	A	film temperature interrupted or measuring range exceeded	defect at the sensor or at the electrical connection of the sensor. please check and replace sensor if necessary
H1026	A	film temperature over limit	Too low heat transfer at the heater; check for sufficient flow (clean the strainer, check connection to the tool, check the tool for deposits or blockages). Check heating element for deposits. Increase the speed of the pump when a speed control is installed and in use. Alarm message is triggered when the maximum film temperature is exceeded. If Alarm Film Temperature (in setup under alarms and limits) is switched off, it is checked for upper set point limit (setup under alarms and limits).
H1027	A	flow temperature exceeded	Check for sufficient flow (clean the strainer, check connection to the tool, check the tool for deposits or blockages). Increase the speed of the pump when a speed control is installed and in use. If necessary, reduce the warning value in the setup under alarms and limits.
H1080	W	Electric current at sensor flow is less than 4mA	Check the electrical connection of the sensor and the sensor itself
H1083	W	Electric current at the sensor pressure expansion vessel is less than 4mA	Check the electrical connection of the sensor and the sensor itself
H1084	W	Electric current at the sensor to process is less than 4mA	Check the electrical connection of the sensor and the sensor itself
H1100	H	set parameter enabler defect.	

Code	Status	Text	Help text
H1101	H	set parameter unit control defect.	
H1103	H	set parameter Ecotemp defect.	
H1104	H	set parameter alarms defect.	
H1105	H	set parameter communication defect.	
H1106	H	set parameter pump speed control defect.	
H1107	H	set parameter water exchange defect.	
H1108	H	set parameter temp. control defect.	
H1109	H	set parameter factory setting defect.	
H1111	H	Logbook could not be read or written	
H1112	H	messages could not be read or written	
H1113	H	Password lost or could not be read or written	
H1114	H	Programmliste verloren oder Programme können nicht geschrieben oder gelesen werden.	
H1115	H	list of tools lost or could not be read or written	
H1116	H	timer settings lost or could not be read or written	
H1117	H	memory could not be read or written	
H1150	H	Invalid configuration of the flow sensor.	
H2010	W	external enabling is missing	The unit can be switched on by the customer via an external 24V signal or a contact on pin 1 of the connection board. This switch-on signal is missing, therefore the unit can not be switched on. Please provide signal, respectively, check electrical connection.
H2020	W	level almost empty undershot	Fill the system with the configuration "manual filling"; ensure sufficient water supply with "automatic filling" configuration
H2030	W	flow rate below limit	Check the dirt trap, the hydraulic connection to the consumer (tool) and check the consumer for deposits and closures. Increase the speed of the pump when a speed control is installed and in use.

Code	Status	Text	Help text
			If necessary, reduce the warning value (setup under alarms and limits).
H2031	W	upper flow rate exceeded	adjust the flow through the dosing tap or check warning value parameters (setup under alarms and limits)
H2040	W	maintenance interval has expired	carry out maintenance on the temperature control system and confirm the maintenance in the service menu
H2041	H	Test interval safety valve has expired	Carry out a check of the safety valve (acknowledgment of the check in the menu Service, then reset maintenance)
H2050	W	lower limit set value undershot	The external setpoint input from an interface or a program falls below or exceeds the permitted lower / upper setpoint limit. Please check the external setpoint specifications.
H2051	W	upper setpoint limitation exceeded	The external setpoint input from an interface or a program falls below or exceeds the permitted lower / upper setpoint limit. Please check the external setpoint specifications.
H2059	W	dT to from process over limit	Temperature difference to / from process over warning value. Check for sufficient flow (clean the strainer, check connection to the tool, check the tool for deposits or blockages). Increase the speed of the pump when a speed control is installed and in use. If necessary, increase the warning value in the setup under alarms and limits.
H2060	W	to process sensor short-circuit or measuring range undershot	Please check the connection of the sensor. If no error can be detected, change the sensor
H2061	W	flow sensor interrupted or measuring range exceeded	Defect on the sensor or on the electrical connection of the sensor. Please check and, if necessary, replace the sensor
H2070	W	Sensor from process temperature has short circuit or measuring range undershot	Please check the connection of the sensor. If no error can be detected, change the sensor
H2071	W	return flow control interrupted or measuring range exceeded	Defect on the sensor or on the electrical connection of the sensor. Please check and, if necessary, replace the sensor
H2075	W	external sensor short-circuit or measuring range undershot	Please check the connection of the sensor. If no error can be detected, change the sensor
H2076	W	external sensor interrupted, not connected or measuring range exceeded	Defect on the sensor or on the electrical connection of the sensor. Please check and, if necessary, replace the sensor
H2078	W	cooling water inlet sensor short-circuit or measuring range undershot	Please check the connection of the sensor. If no error can be detected, change the sensor
H2079	W	Sensor cooling water supply interrupted or measuring range exceeded	Please check the connection of the sensor. If no error can be detected, change the sensor

Code	Status	Text	Help text
H2081	W	sensor cooling water outlet short-circuit or measuring range undershot	Please check the connection of the sensor. If no error can be detected, change the sensor
H2082	W	sensor cooling water outlet interrupted or measuring range exceeded	Defect on the sensor or on the electrical connection of the sensor. Please check and, if necessary, replace the sensor
H2084	W	motor temperature sensor short-circuit or measuring range undershot	Please check the connection of the sensor. If no error can be detected, change the sensor
H2085	W	motor temperature sensor interrupted or measuring range exceeded	Defect on the sensor or on the electrical connection of the sensor. Please check and, if necessary, replace the sensor
H2086	W	vessel sensor short-circuit or measuring range undershot	Please check the connection of the sensor. If no error can be detected, change the sensor
H2087	W	vessel sensor interrupted or measuring range exceeded	Defect on the sensor or on the electrical connection of the sensor. Please check and, if necessary, replace the sensor
H2101	W	temperature is lower than limit	If necessary, reduce the warning value in the setup under alarms and limits. Eliminate causes of insufficient temperature control, e.g. controller parameters (with fluctuating temperature), insufficient heating power (unit does not reach target temperature)
H2102	W	temperature is higher than limit	If necessary, increase the warning value in the setup under alarms and Limits. Eliminate causes of insufficient temperature control, e.g. controller parameters (fluctuating temperature), insufficient cooling capacity or too warm cooling water (unit does not reach target temperature)
H2112	W	from process temp. over limit	Check for sufficient flow (clean the strainer, check connection to the tool, check the tool for deposits or blockages). Increase the speed of the pump when a speed control is installed and in use. If necessary, reduce the warning value in the setup under alarms and Limits.
H2130	H	sensor control as replacement for external sensor	The external sensor has an error or is not connected correctly. Therefore, the system now regulates on the control sensor.
H2130	H	sensor control as replacement for external sensor	The external sensor has an error or is not connected correctly. Therefore, the system now regulates on the control sensor.
H2132	H	flow sensor as replacement for sensor regulation	control sensor has an error. therefore, in emergency mode, the system now controls to sensor/sensor in the flow.
H2133	A	no temperature signal, unit had to be switched off	No temperature signal could be determined for the control
H2134	W	no release for heating	please contact Single service

Code	Status	Text	Help text
H2135	W	Sensor return as a replacement for sensor control	control sensor has an error. therefore, in emergency mode, the system now controls to sensor/sensor in the return flow. check the control sensor
H2140	H	unable to use USB stick	try another USB stick
H2141	H	export/import error	
H2160	W	minimum pressure undershot	Check causes of pressure loss: Hydraulic connection with short circuits or too many parallel loads, decreasing pump performance, defective sensor. If necessary, reduce the warning value in the setup under alarms and limits.
H2161	W	pressure over limit	Check causes of high pressure: Excessive external volume (only if overpressure arises during heating), consumer or strainer clogged (partially), defective sensor. If necessary, increase the warning value in the setup under alarms and limits.
H2180	H	defect of process log file	
H2185	H	Could not open spare part list	
H2200	W	abortion of self optimization	self-optimization was aborted because the temperature fluctuates too much. avoid external interference, allow the unit to run for a few minutes and restart self-optimization.
H2210	H	EAROM failure	Please contact Single Service
H2211	H	Profibus failure	
H2212	H	calibration failure	Please contact Single Service
H2213	A	flow monitor shows insufficient flow	clean dirt trap, ensure sufficient flow in the consumer (tool)
H2301	W	The actual temperature transmitted by Profibus is outside the measuring range	Please check sensor
H4001	W	temperature in control cabinet too high	Clean the air filter in the control box, ensure sufficiently low ambient temperatures. If necessary, check fan for function.
H4002	W	Leakage detected at the leakage sensor	Check device for leaks
H4003	W	motor temperature too high	check the installation situation and ambient temperature
H4004	W	diff. pressure cooling water too low	check cooling water supply, cooling water connection and dirt trap cooling water

Code	Status	Text	Help text
H4005	W	dirt trap congested	clean dirt trap
H5001	H	Serviceticket started	
H5002	H	Article number of the requested part: Spare part request	
H600	A	motor protection/FC has released	Check or unlock motor protection switch or frequency converter. If there is a recurring error, check electrical current of pump, replace pump if necessary
H601	W	motor protective switch of second pump has triggered	Check or unlock motor protection switch or frequency converter of pump two. If there is a recurring error, check electrical current of pump, replace pump if necessary
H700	H	Set language could not be loaded.	
H710	A	pressostat high pressure has triggered	please carry out a reset on the high pressure monitor, then switch off the unit and switch it on. in case of repeated occurrence: remedial measures according to operating instructions
H720	A	Frost protection guard has triggered.	to restart: correct the error, then switch off and on the unit. please contact the Single service department
H721	A	sensor in internal chiller circuit defective	Check sensor at controller input "supply". This monitors the internal circulation
H722	W	set temperature in internal chiller circuit not yet reached	Wait until the temperature has been reached or increase the switch-on circulation pump parameter at the alarm parameters
H725	A	Low pressure pressostat has triggered	
H730	A	safety temp. limiter has triggered	Reset the safety temperature limiter by acknowledging the error message.
H800	A	defective float switch	Float switch must be changed
H810	A	maximum filling time exceeded	Check the entire system including the tool for leaks. Check that the filling pressure is sufficient; for pressurized water units without a filling pump, the supply pressure must be higher than the system pressure. Check the water supply cooling water connection or, if available, the separate filling connection, check the float switch for clearance. If necessary, check filling valve. If necessary, increase the permitted filling time in the setup under unit control.
H811	A	the unit is overfilled	The maximum value of the float switch has been reached: the cause may be that too much oil has been filled or external volume is too high. For heat transfer systems, the oil may only be filled up to the minimum value of the float switch. When the temperature increases, the oil expands. For safety reasons, the heating was

Code	Status	Text	Help text
			switched off. Reduce the amount of oil in the tank; check whether the external volume is greater than the value that has been removed (specified in the technical specification of the unit documentation).
H812	A	unit is empty	For water units and manual filling configuration: add or top up with water For water units and configuration for automatic filling: Connect the cooling water inlet correctly and wait for filling, ensure sufficient filling pressure. If the unit does not fill up, check that the filling pressure is sufficient. For pressurized water units without a filling pump, the supply pressure must be higher than the system pressure. If necessary, check filling valve. For oil units and manual filling configuration: add or top up with oil
H820		leakage in unit or consumer	Aquatimer reports too many unit fillings. Find and correct the leakage in the consumer (tool), tubing, piping and equipment.
H830	A	flow rate below limit	Check the dirt trap, the hydraulic connection to the consumer (tool) and check the consumer for deposits and closures. Increase the speed of the pump when a speed control is installed and in use. If necessary, reduce the warning value (setup under alarms and limits).
H831	A	flow control defective	please check, clean flow sensor if necessary change
H840	H	Tool data structure defect	
H990	H	I/O board is missing	please contact Single service
H993	A	IO-Board reports connection error	The IO-Board has detected an interruption of the connection to the controller. If this warning occurs together with the alarm "I/O board missing", check the connection cable for loose contact.
H994	A	unit was started	Smart Controller restarted after switching off via main switch or mains interruption