Operating Manual

SINGLE Basic Controller Touch (SBC-T)

SINGLE Basic Controller Touch Plus (SBC-T*plus*)

Imprint

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1 About this manual

This operating manual describes the function and operation of the *SINGLE Basic Controller Touch* (SBC-T) and *SINGLE Basic Controller Touch Plus* (SBC-Tplus).

In comparison with the SBC-T, the SBC-Tplus has additional inputs and outputs that enable flow rate measurement, exchange of analogue signals and pressure measurement. The software of the SBC-Tplus provides parameters for these additional inputs. Corresponding functions are indicated in the description.

This manual covers the full range of functions of the controller. Some of the range of functions in the temperature control devices are optional add-ons. Actual functionality is based on each SINGLE customer order confirmation and technical specifications.

The range of functions is defined in the factory settings that are only accessible for Single. These affect the operation of the controller and also what you see on the screen. Buttons and parameters for non-released functions are not displayed; this can result in discrepancies between the images shown in this manual and the output on your system.

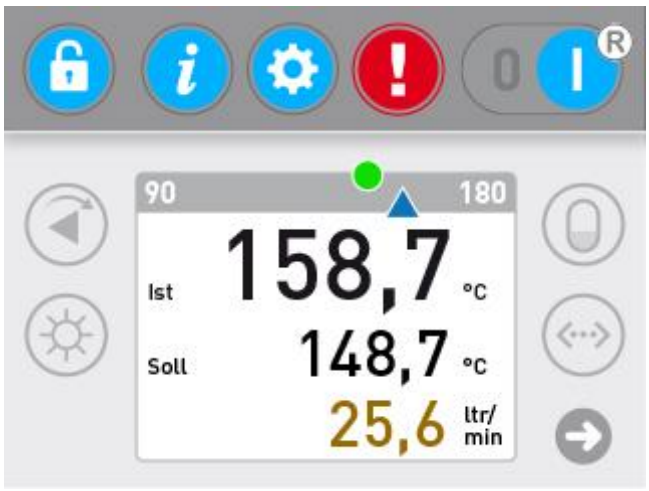
Subsequent activation of functions is usually not possible as appropriate components for the functionality must be installed in the temperature control system.

If you have any questions, please contact SINGLE Temperiertechnik customer service. All confirmed functions in the customer order and in the technical specifications are included and enabled in your temperature control system.

2 User interface and operation

The SBC-T is also started when the temperature control system is switched on using the main switch. The starting process takes a few seconds; a start screen is displayed during this time.

After completion of the starting process, the controller displays the *Process Data view* ("Cockpit").



The SBC-T is equipped with a 3.5" touch screen. Operation is exclusively screen-based.

The screen is divided into the navigation bar at the top edge (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 content 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. The current actual temperature is always displayed. If a lock code has been entered, a padlock is displayed (blue: lock deactivated; yellow: lock activated).
	Calls the *Service and Information* menu (see 2.3.1 Service and Information menu).
	Calls the *Function* menu (see 2.3.2 Functions menu) with the *Expert Parameters* submenu (see 5 Expert parameters).
	Displays the alarm list (see 2.3.3 Alarm list).
	Switches the temperature control system including the SBC-T on or off.

Operation Lock

It is possible to lock the device against unwanted operation. Input a lock code for this under *Expert Parameters / Basic Settings* (see 5.1 Basic settings).

Activating the lockout:
A blue padlock instead of the Home icon is displayed in the navigation bar when the parameter logoff is not on off (see 5.1)
Tap this to activate the lock. Confirm the request in the additional dialogue.
The lock becomes active and a yellow padlock is displayed.

Deactivating the lockout:
Tap the yellow padlock in the navigation bar. Input the release code.
The lock is deactivated if the code has been entered correctly.

2.2 Control panel

The control panel shows the actual and setpoint temperatures centrally. The flow rate value is also displayed for devices with flow rate measurement.

The actual temperature is the temperature that is included for the control. In the delivery condition, this is the temperature of the regular control sensor. You can configure the parameters to define that an external sensor is used for control instead.

The view for the setpoint adjustment is displayed by tapping on the central area in the control panel. The permitted range of values is displayed. Changes must be confirmed using "Save".

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

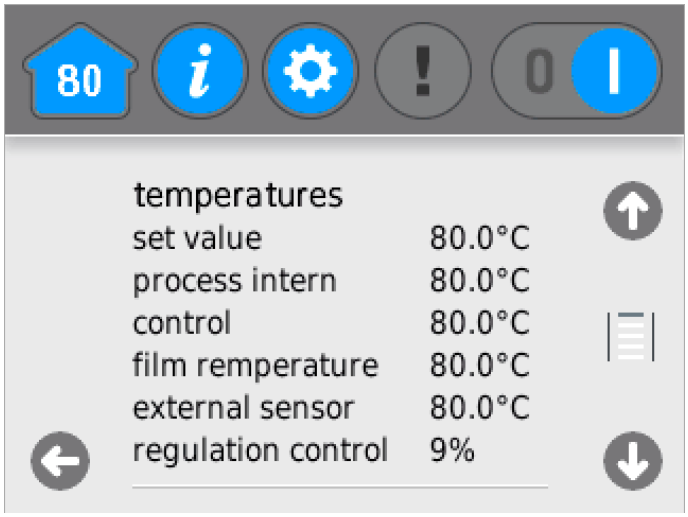
Symbol	Meaning
	The pump is running in the indicated direction of rotation (arrow pointing right: normal operation; arrow pointing left: inverse operation. e.g. for leak stop function).
	The temperature control system is cooling or heating.
	The system closure is open or closed (only for pressurised water units).
	Interface symbol: grey: interface enabled, but not active blue: interface operation activated blue, flashing: device is sending and receiving data via interface
	The SBC-T switches to expert mode.

Expert mode

Additional information is displayed in the expert mode. It has been designed for special applications or a service case.

Among other things, this mode displays signals of all connected sensors, the state of the float switch, "heating" and "cooling" regulation ratios, flow rate and pressure (if the device is equipped accordingly), the outputs of all valves, the "pump" and "pre-contact heating" outputs and the state of the motor protection switch.

The following screenshot shows an example.



Parts of the system 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.

2.3 Overview of the operating concept

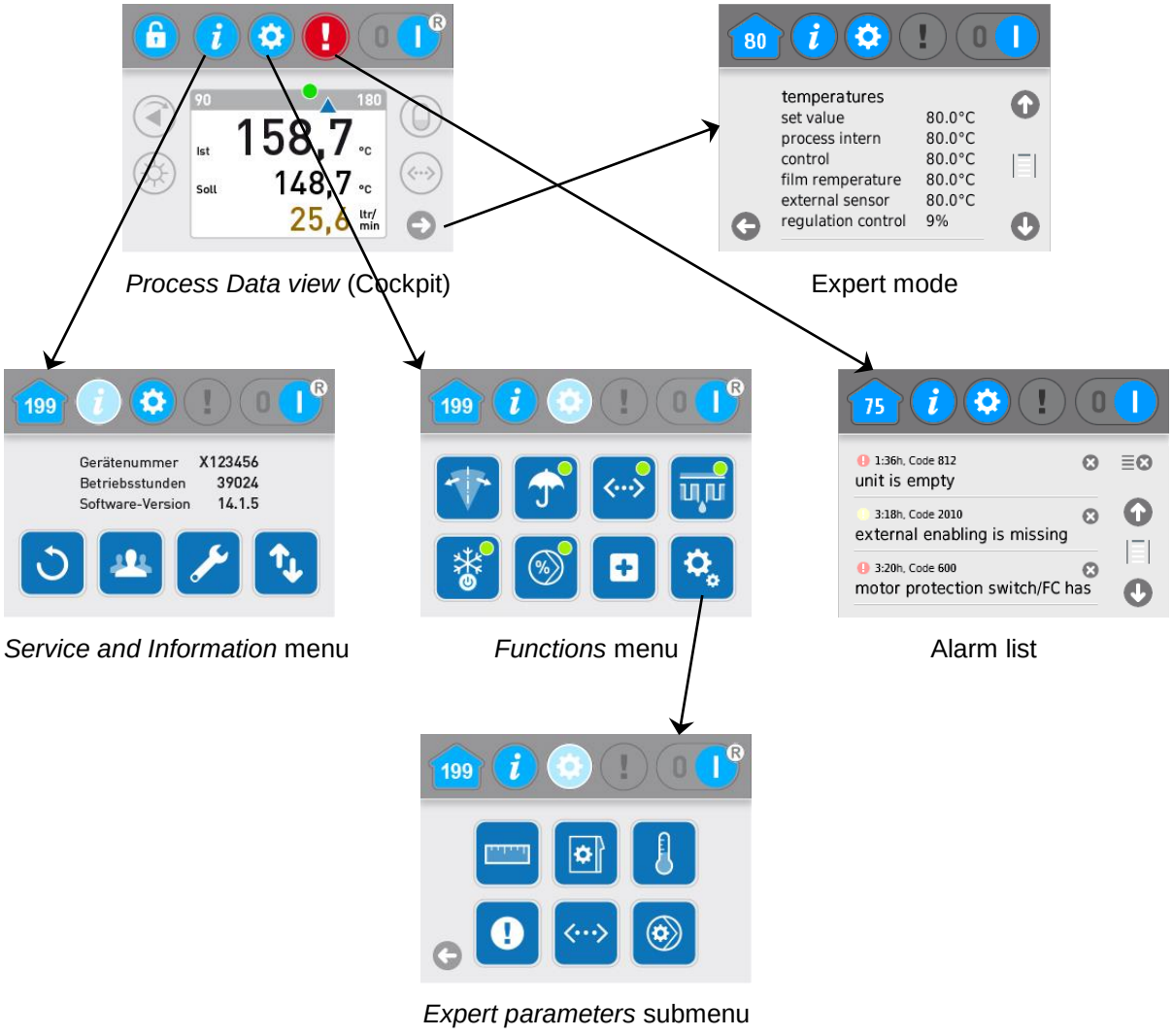
The navigation is performed using the *Process Data view*.

The following submenus are reached using the navigation bar:

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

Tapping the arrow button on the control panel launches expert mode.

The following illustration shows the relationships.



Process Data view (Cockpit)

Expert mode

Service and Information menu

Functions menu

Alarm list

Expert parameters submenu

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:

- Device number
- Operating hours
- Software version

The device number information is important for any service case; SINGLE stores device data under the device number.

The following buttons are available:

	**Reset to factory settings** The device is reset to the delivery condition using the *Reset* button. There is an additional query that must be confirmed by the operator before the reset is performed. **Attention:** parameters set by the customer are lost with the reset!
	**Contact** The telephone number and E-mail address of the Service Partner are stored here.
	**Servicing** The temperature control system must be serviced after a defined number of operating hours. An operating hours counter counts down for this. An alarm is triggered as soon as the counter reaches zero. The *Service* button acknowledges a performed service and the service counter is reset to the start value.
	**USB function** The prerequisite for use of the USB function is that a commercially available USB stick formatted as FAT16 or FAT32 has been plugged into the rear side of the SBC-T. 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: • Export of parameters from the SBC-T to the USB stick. • Import of parameters from the USB stick to the SBC-T. **Attention:** parameters set by the customer will be overwritten! • Saving of current process values and the alarm list. If the USB stick is left plugged in during operation, the saving of process data is performed at a defined time interval. The time interval is set using the *Sample time* parameter, the Sample time must not be switched off for saving process data.

Files are created in the root directory for the export to the USB stick. The file names contain the unit numbers of the Single temperature control system for unique identification.

LogAlarmXXXXXX	All alarms are written to this file when the USB stick is plugged in

LogBookXXXXXX	The messages are written to this file for the export of the current alarm list
LogPara.bin	Parameter set in machine-readable form The copying of parameters to the devices takes place using this file
LogPara	Parameter set in text form
LogZykXXXXXX	Recording of the process data

"XXXXXX" stands for the 6-digit device number.

A file exported from any device can be read for the import of the parametrisation. Storage location, name or contents of the file must not be changed, otherwise no import is possible.

2.3.2 Functions menu

The most important and most frequently used device functions can be set 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. An activated function is identified by a green dot on the button; a deactivated function is identified by a grey dot.

The following buttons are available:

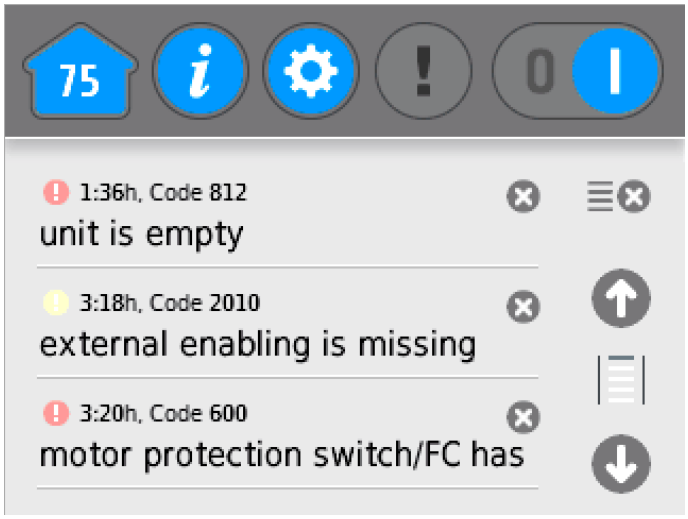
	**Temperature alarm** The limit value for tripping a temperature alarm can be set or the function can be activated or deactivated using the *Temperature alarm* button. Further parametrisation is performed using *Expert parameters / Alarms* (see 5.4 Alarms).
	**Leak stop mode**(optional) If this function 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 and/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 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-mouldingmachine) with appropriate cabling between the master and temperature control systems. 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 consumers are drained immediately after switching off the device. Further parametrisation can be performed using *Expert parameters / Device control* (see 0 Unit control).
	**Cool down mode** If this function is activated, the temperature control system and the connected consumers are cooled down immediately after switching off the device (only for temperature control systems with heat exchanger). Further parametrisation can be performed using *Expert Parameters / Device Control* Unit controlFurther information about cool down mode can be found in chapter 3.1
	**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 that can be set using *Expert parameters / Pump control*.
	**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. If the self-optimisation is started, a program routine runs that lets the temperature control system run temperature curves for a few minutes. This means that the temperature is not at the setpoint; production rejects can occur in this time. As device and controlled system (consumers) are temperature-dependent systems and the optimum control settings are also temperature-dependent, it makes sense to perform optimisation at the same temperature that will also be used later in the process. Therefore, the self-optimisation should be started at setpoint temperature. External circumstances must not be changed and interference must be kept to a minimum during self-optimisation. The self-optimisation aborts as soon as any alarm occurs. As it cannot be ruled out that there can be temperatureovershoots or undershoots during the self-optimisation routine, the self-optimisation is permitted to be started at maximum 10 K below maximum temperature and 20 K above minimum temperature of device and consumers. After the activation, a dialogue window opens with the text "Start self-optimisation". Confirm with "Run" or cancel the process with "Cancel". Selecting “Run” starts the self-optimisation. While this is running, another window with status information and the option to cancel the process at any time is displayed. No further operation is possible during the running time. If "Cancel" is selected, the SBC-T returns to the Process Data view. The self-optimisation results in conservative values without overshoots. If faster temperature control should be achieved, the Xp value can be gradually reduced until the required result is obtained.

	**Expert parameters** Tapping this button switches to the *Expert parameters* submenu where the additional parameters can be edited. These parameters are assigned sensible values at the factory and usually do not have to be changed. Details for the expertparameters can be found in chapter 5 Expert parameters.

2.3.3 Alarm list

Alarms are displayed in this screen.



An alarm indicates a device malfunction, such as insufficient filling levels or a tripped motor protection switch. If an alarm has occurred, this is identified in the navigation bar with a yellow or red exclamation mark.

A **yellow** exclamation mark means "warning"; this indicates a minor error; the device continues running.

A **red** exclamation mark indicates an alarm that requires an action. Depending on the severity of the fault, the entire unit or only the heater is switched off. Shutdown of the compressor can occur for refrigeration units. A red bar with a short description of the alarm is also displayed in the Cockpit.

The last 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 on  to acknowledge an alarm. Alarms whose cause has not yet been resolved are regenerated and displayed again.

Tap on  to scroll down in the alarm list if more alarms are pending than can be displayed on the screen.

Tap on  above the scroll bar to clear the entire alarm list. If a USB stick is plugged in continuously, the alarms are continuously recorded on this stick even if the alarm list on the controller is deleted.

3 Operation of the temperature control system

3.1 Switching on / off, pump cool down mode

The SBC-T is also started with the application of the supply voltage and switching on the temperature control system using the main switch. The starting process takes a few seconds.

Restarting after interruption of the supply voltage

In the case of interruption of the supply voltage or switching off using the main switch, the controller goes to the "ready for operation" state after switching on again or restore of the supply voltage. In environments with frequent supply voltage interruptions, it can be desirable that the temperature control system starts automatically after return of the supply voltage.

Set the *Restart lockout* parameter to "off" for this (under *Expert parameters / Device control*). The system starts automatically after switching on the supply voltage.

Filling

Set the *Filling* parameter to **Automatic** (under *Expert parameters / Device control*) so that the temperature control system starts the filling automatically if it is empty.

After reaching a sufficient fill level, the pump starts and the system regulates to the specified target temperature.

Switching on and off via signal contact

The system can optionally be switched on and off using a signal contact, The device must have previously been switched on manually for this. This contact can be used by the customer (see 7 connection diagram). 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 whether there is any fault in the alarm list (e.g. power supply fault, motor protection switch tripped, etc.). Note that it can take up to 10 seconds before an alarm is displayed.

Switching off and pump cool down mode

Depending on the setting (under *Functions /down mode*, see 2.3.2 Functions menu), the device does not switch off directly, but passes through cooling down (cool down mode) and/or draining.

If no (optional) heat exchanger is installed in the temperature control system, the cooling down of the cool down mode function only takes place through heat loss. 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

The system shuts down after it has cooled down or drains the consumer if *Tool draining* has been selected (see 2.3.2 Functions menu). To protect the device and the cooling water pipes, the system cannot be drained before cooling down. If the *cool down mode* 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 with one of the following two methods:

Switching on/off via external contact

Requirement: The controller must be parametrised in the factory settings to *external On/Off*; this is not possible if the input is assigned with changeover to second setpoint.

The controller has an input on the connection board for switching the device on and off via an external floating contact. The factory setting for the 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 once. The device shuts down if the "On/Off" input is set to logical "0" (0 V). Setting the input back to logical "1" switches on the device again. Switching the device on and off remotely will work until it is switched off manually, there is always the option on the display for switching off manually.

Switching on and off via interface

Requirement: The operation via an interface must be enabled.

Various interfaces allow the switching. Further information about interfaceoperation can be found under *Expert parameters / Communication* (see 5.5 Communication).

The *cool down mode* (On/Off) and *Shutdown temperature* (On) have effects on both options. If the device is switched off remotely and the *cool down mode* 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 remains open in the temperature control system until the contact signals “full”. This does not happen if the device is switched off.

Oil systems: oil systems are usually intended for manual filling. They must be filled only to the min level. If the level reaches “full”, the system triggers an "overfill" alarm, which stops the heaters.

An alarm is always triggered if the level falls below “empty”. The pump is switched off for self-protection.

No alarm is created if the system is switched on when it is empty. The temperature control system must be filled or fills automatically if the *Filling* parameter is set to "Automatic". An alarm is not created until the system has been filled sufficiently once and then the "empty" contact has been undercut.

If the system has been filling without interruption for longer than the specified *Filling duration* parameter, it will be assumed that there is a substantial leak. The system stops the filling and triggers an alarm.

The system is equipped with a so-called Aquatimer to monitor smaller leaks. Thereby, the system counts the filling processes during operation. An alarm is also triggered if the number of filling processes is exceeded. The Aquatimer is disabled for the duration of the "Aquatimer start time" for the initial filling process. The Aquatimer start time and the number of filling processes are set in the expert parameters under "Device 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. The system contains a purpose-specific valve which closes water circulation off from atmospheric. In this way, it is possible that pressure can build up that prevents any evaporation of the water.

This closing takes place at the so-called *system closing temperature* that is set using the *System closing temperature* parameter under *Expert parameters / Parameters for the temperature control and Offset for sensor*).

This valve stays closed when the controller starts up. The valve also remains closed in the switched-off state; also directly after and for a short time after any draining process 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 the SBC-Tplus controller variant and a flow rate sensor, the controller shows the water flow rate. Values cannot be displayed until from approx. 10% of the maximum flow rate for physical reasons. The temperaturecontrol system should not be operated in the range below this as a minimum flow rate is needed for energy transfer and proper temperature control.

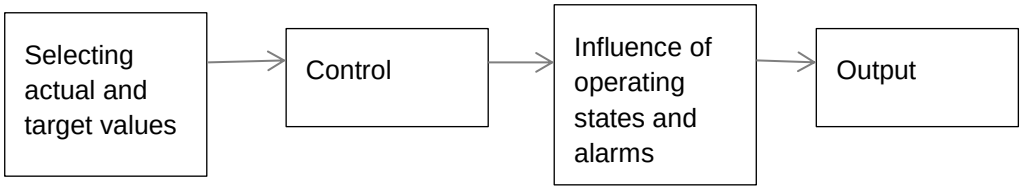
The minimum flow rate can adjusted using parameters (see 5.4 Alarms). An alarm is tripped in the event of undercutting this.

As the flow rate measurement only functions in one direction for physical reasons, any display as well as the alarm signalling are suppressed if the device is being operated in leak stop operation in the opposite direction.

4 Temperature control

The regulation and control unit can assume different operating states. The system only regulates the temperature to a desired setpoint value during normal operation; in other operating states such as draining, the control outputs are set to "zero". The actual control behaviour is influenced by a variety of factors. These parameters are described for the control parameters in the "Expert parameters" chapter.

The description of the control behaviour is divided into the following segments:



Firstly, you can choose between 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 determines a correcting variable from the input signals and parameters.

Operating states and alarms can influence the correcting variabl. For example, the "heating" regulation ratio will be set to "zero" in the case of a film temperature alarm.

The output specifies the control of the various outputs for the actuation of control elements such as valves.

4.1 Control sensor

By default, the control sensor provides the temperature value used for control.

If the *External sensor* parameter (under *Expert parameters / Device control*) is set to "external", the temperature signal of the external sensor is included for the regulation. If no sensor signal is present (e.g. sensor not connected or defective), the regulation reverts to the control centre and an alarm is output.

4.2 Setpoint for the temperature control

By default, the *Setpoint* parameter is included for the control. You can only enter setpoints within the limits specified by the *Lower/upper setpoint limit* parameters.

However, other settings can override the regular setpoint. The following prioritisation applies:

Priority 1 (interface mode):

If interface mode is enabled, the transmitted setpoint is used for control and overrides any other target values.

The following applies if interface mode is not activated:

Priority 2 (fixed values):

A parametrised setpoint is used. However, an alternative setpoint can be specified under the *Setpoint selection* parameter.

Priority 3a:

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

Priority 3b:

For SBC-Tplus: If the *Setpoint selection* parameter is set to "external setpoint", the input signal from the external setpoint input is used for the control.

Otherwise, the value of the *Setpoint* parameter is adopted for the control. If the transmitted setpoint is outside the *Lower/upper setpoint limits* parameters, the lower or upper setpoint limit is used for the control and an alarm is output.

4.3 Temperature control

The temperature controller is either a PID controller or a two-point controller in combination with a refrigeration unit. The parameters for the adjustment can be found under *Expert parameters* for the temperature control.

Cascade control is implemented to prevent strong overshooting for temperature control using an external sensor that has long dead times due to unfavourable placement. The dead time is that time that elapses from any change of the control variable (e.g. opening a cooling valve) until the effect of this change at the sensor.

The heating or cooling is limited if the temperature deviates by more than the value set in the *Cascade control dT* parameter. Thus the controlled system is given time so that the temperature change arrives before the degree of actuation accelerates further. The entire system thus tends less to overshoot.

4.3.1 PID control behaviour

The controller uses standard control engineering parameters.

All control parameters can be set separately for heating and cooling.

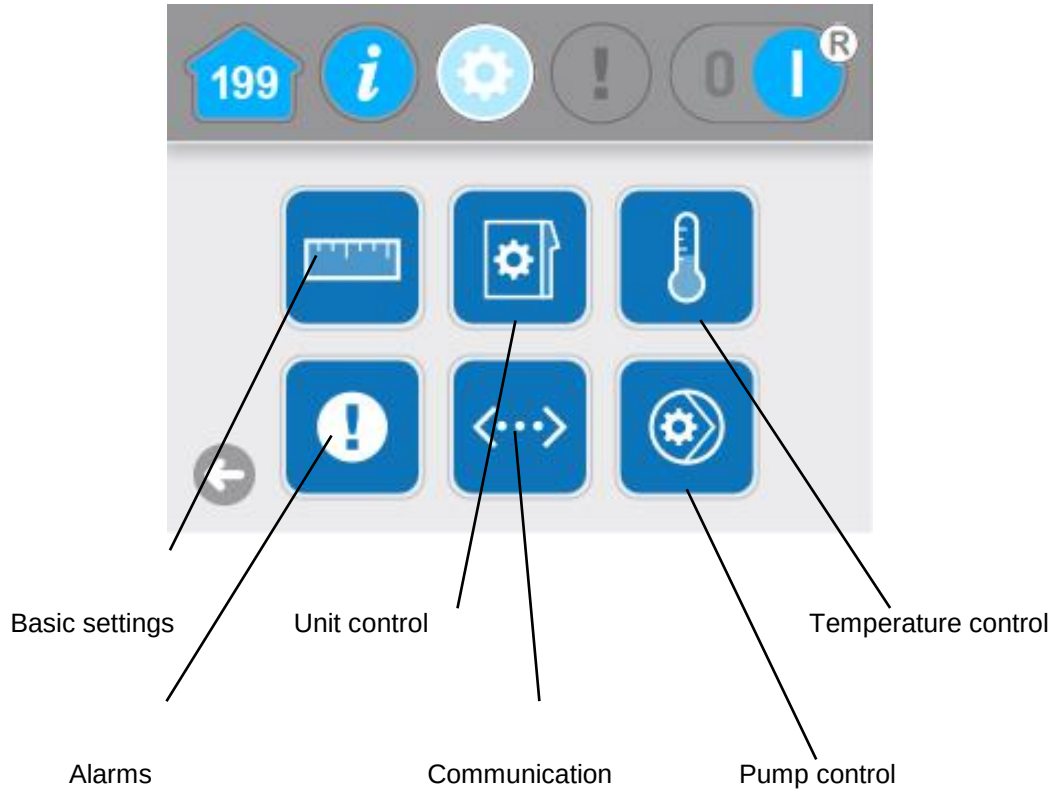
An actuating signal is generated in each case for heating and cooling; simultaneous heating and cooling is ruled out. The heating is always realised as PID controller, the cooling either as PID or as On/Off controller, mainly for equipment with active compressor cooling.

4.3.2 On/Off controller control behaviour

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

5 Expert parameters

The expert parameters are sorted into 6 subjects:



These are explained below.

5.1 Basic settings

Using the  button, you can make basic settings.

The following settings can be made:

Language

Select the desired language.

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 Lock Code. You can also select whether all inputs are locked out or whether the setpoint can still be adjusted. Switching on and off is always possible for safety reasons.

A blue padlock is displayed at the top left in the navigation bar (see 2.1 Navigation bar) if the parameter is not set to off.

The lockout must be activated so that it becomes effective.

Activating the lockout:
Tap the displayed symbol (blue padlock) to activate the lockout. Confirm the request in the additional dialogue.
The lockout becomes active and a yellow padlock is displayed.

Deactivating the lockout:
Tap the yellow padlock in the navigation bar. Input the release code. The lockout is deactivated if the code has been entered correctly.

Note: if the code has been lost when the lockout is activated, contact SINGLE Service to obtain a release number. The 6-digit device number is needed for this.

Factory access (only for SINGLE personnel)

Pressure unit (only for optional pressure sensor)

Select between bar and psi for the pressure unit.

If the evaluation of the pressure has been deactivated (optional), this selection option / 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.

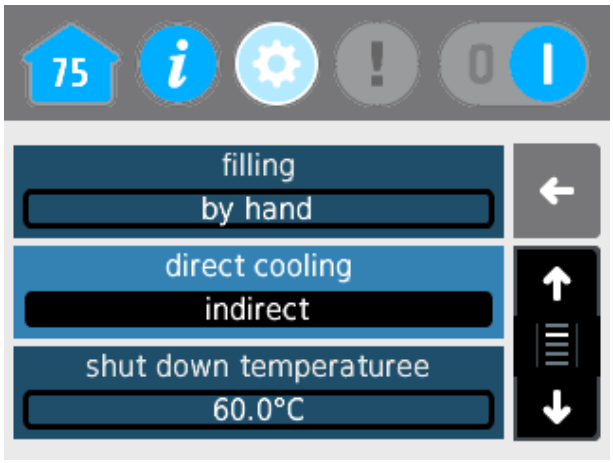
If the evaluation of the flow rate volume has been deactivated (optional), this selection option / button is not available. In this case, the corresponding displays are suppressed and no alarms are created.

Firmware update

Tap "Start update" and "save" to perform a software update. Details for this can be found in chapter 6 Software update.

5.2 Unit control

Using the  button, you can make settings for the control of the device logic.



The following settings can be made:

Manual / Automatic filling

This parameter defines whether the device is filled manually or automatically (see 3.1 Switching on / off, pump cool down mode).

The hydraulics must be prepared accordingly in each case for manual or automatic filling; refer to the technical specification or the order confirmation for details about this.

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 influences the "fill" output, thereby regulating the filling valve. The Aquatimer must be deactivated for the 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 boundary condition must be complied with.
The system closing valve must have been opened for direct cooling so that the hot water can flow through the system closing valve into the cooling water outlet. This means the direct cooling is only possible up to the system closing temperature.

Shutdown temperature for pump cool down mode

This parameter defines to which temperature cooling down will be performed for the pump cool down mode. Independently of this parameter, cooling down to the system closing temperature will always be performed so that the system is certainly depressurised.

Drain time

This parameter defines the duration of the draining if *Tool draining* has been selected (see 2.3.2 Functions menu).

Setpoint selection

This parameter defines which setpoint should be included. Control to the specified setpoint is performed by default; it is possible to control to an alternative value (Setpoint 2) An analogue setpoint (0 - 10 V, 4 mA – 20 mA) can also be specified in the SBC-Tplus version.

Aquatimer start time and cycles

This function is used for leak monitoring (see 3.3 Filling the system). The Aquatimer starts counting the filling cycles within one hour after expiry of the "start time". In doing so, the system initiates an alarm if the value set under *Cycles* is exceeded.

Fill monitoring

This parameter defines the duration of the filling. If the time specified here is exceeded, the system is shut down as a major leak is assumed or the supply is not guaranteed. The system initiates an alarm.

Attention: No alarm is generated for devices with activated direct cooling.

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).

Sample time

This parameter defines a time interval, after which the system saves a process data record. Among other things, the record includes operating state, key temperature values, flow rate and actual temperature.

The *Sample time* is set to 1 minute in the delivery condition, i.e. a value is recorded every minute.

The prerequisite for saving the process data is that a USB stick is plugged in and the Sample Time must not be set to “Off”.

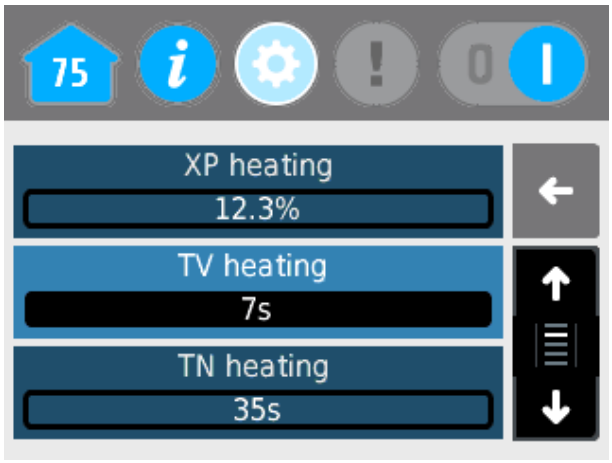
Note: Due to the technical diversity, it cannot be guaranteed that every USB stick works. Therefore check that the USB stick is recognised by the temperature control system.

External sensor

This parameter defines whether the temperature signal of the external sensor is included for the control. In this case, the parameter must be set to "external"; further information can be found in chapter 4 Temperature control.

5.3 Parameters for the temperature control and offset for sensor

Using the  button, parameters can be set that influence the temperature control behaviour.



Setpoint 2

An alternative setpoint can be defined with this parameter. Using the *Setpoint selection* parameter, the setpoint can be switched to the setpoint 2 temperature, alternatively between the normal and the second setpoint via the setpoint contact.

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. Parameters can be configured individually as a temperature control system for cooling and heating may be used for different services.

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 regulates to the desired value (which cannot be achieved with the XP value 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%.

Activate switching hysteresis / Deactivate cooling

For devices with compressor cooling, the cooling is activated for the compressor at the activate hysteresis temperature or deactivated for deactivate hysteresis cooling. The values must be entered as difference from the setpoint.

Example: Setpoint 25°; activate at 26° and deactivate at 23°. The following must be parametrised

Activate cooling hysteresis: 1K

Deactivate cooling hysteresis: 2K

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 a control element 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.

Lower / upper setpoint limit

An upper and a lower setpoint limit are defined with this parameter.

It is only possible to make a setpoint entry 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.

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 is pressurised.

Setpoint ramp rising / falling

If the consumer is sensitive to fast temperature changes, the rise / fall rate can be reduced using "Setpoint ramp rising / falling". The value is entered in K/min.

Offset temperature sensor (internal, film, return or external)

Measured value errors, e.g. due to aging processes or long connection lines to the external sensor can be compensated for with the offset. The device can also be calibrated using a reference sensor via this function.

Analogue value specification 4...20 mA or 0...10 V (only SBC-Tplus)

This parameter calibrates the actual value output and the setpoint specification. These values are transmitted either with 4..20 mA or with 0 to 10 V signal.

Temperature for 0 V, 4 mA and 10 V, 20 mA (only SBC-Tplus)

These parameters calibrate the analogue actual value output and the setpoint specification. The lower limit of the measuring range is output using the *Temperature for 0 V, 4 mA* parameter and the

upper limit with the *Temperature for 10 V, 20 mA* parameter.

Example: The measuring range should be 50 °C to 120 °C. Then "50°C" must be input for the *Temperature for 0V / 4mA* parameter and "120 C" for the *Temperature for 10V / 20mA* parameter.

Cascade control dT (only in connection with 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 point when the device responds and the point when the sensor measures the 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 below 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.

The system functions analogously in the cooling area, i.e. the cooling is switched off if the control temperature undercuts a value smaller than setpoint minus dT of the cascade control.

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

5.4 Alarms

Alarms can be set using the  button.

Most alarms are not activated immediately after a fault occurs, but with a 10 second delay. This is used to prevent false alarms that could possibly result in shutdown of 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 Functions menu).

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 tripping 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 adjusted, the warning is deactivated again until the temperature in the new operating range has reached the value of the comparator again.

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.

Alarm "Minimum flow" (only for SBC-Tplus with flow rate measurement)

The system triggers an alarm if this value is undercut. The system requires a minimum flow rate to lubricate the pump and to ensure a proper temperature regulation. The user should not change the specified alarm value.

In contrast to the minimum flow rate, this concerns protecting the device functionality.

In the optional leak stop mode for some devices, the medium flows through the flow rate sensor in the opposite direction; basically no measurement takes place here. Accordingly, no alarms will be triggered.

Alarm "Low flow" (only for SBC-Tplus with flow rate measurement)

An alarm is triggered if these limits are undercut. These values are also used to scale the cockpit displays. In contrast to the minimum flow rate, this parameter is intended to safeguard the flow rate value that the process needs.

Alarm "pressure high" (only for SBC-Tplus with flow rate measurement)

An alarm is triggered of the measured pressure is above the *pressure high* parameter.

Alarm "Delta T" (only with optional return sensor)

An alarm is triggered if the temperature difference between flow and return is greater than *Delta T*.

Alarm "From process temp." (only with optional from process sensor)

An alarm is triggered if this value is exceeded at the from process sensor.

5.5 Communication

Details of the communication, e.g. which protocol is used, can be set using the  button. The settings must match those of the master system.

If the system is equipped with an interface and a protocol is selected, the SBC-T transmits process data (temperatures, alarm states and others).

An "R" for remote operation is displayed at the On/Off switch during running interface operation.

If your temperature control system does not have any interface, the 20mA TTY interface with various protocols can be activated subsequently using a (paid) enable code. Contact SINGLE Service for this.

There are SINGLE-specific protocols in addition to finally specified interfaces. The protocol specification can be requested from SINGLE.

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 control controls the pump speed, e.g. to achieve energy-optimised operation.

You reach the area for setting the parameters via the  button.

The “Pump control” analogue output controls a frequency converter that regulates 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:

Fixed output level:
The pump runs with a fixed output level.

Required flow rate:
The pump is regulated to a defined flow rate

Difference dT (automatic operation):
The pump speed is regulated automatically according to the needs of the tempering process so that the production process runs with lowest possible energy consumption of the pump.

Fixed output level

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 is less than 50% of the motor rated power at 70% speed.

Required flow rate value (only for SBC-Tplus with flow rate measurement)

This parameter sets a flow rate; the system regulates to this value.

If you set a value 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 regulation is performed using a PID controller. If the control behaviour 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).

Difference dT (only with optional from process sensor)

This parameter sets the temperature difference between flow and from process.

The pump speed is reduced slowly. In doing so, the temperature difference between flow and from process is monitored. The speed reduction is stopped when the dT temperature difference set here is reached.

Thereby, the speed is only reduced if the difference between setpoint and actual temperature is less than 1 K. A minimum flow rate is also needed for the temperature control. Therefore, the system maintains a minimum turn of at least 30%.

Xp flow rate, TV flow rate, TN flow rate

These parameters influence the control behaviour of the pump for the *Required flow rate value* function (see above).

6 Software update

It is possible to update the software via the USB port.

Under *Expert parameters* select the *Basic settings* menu.

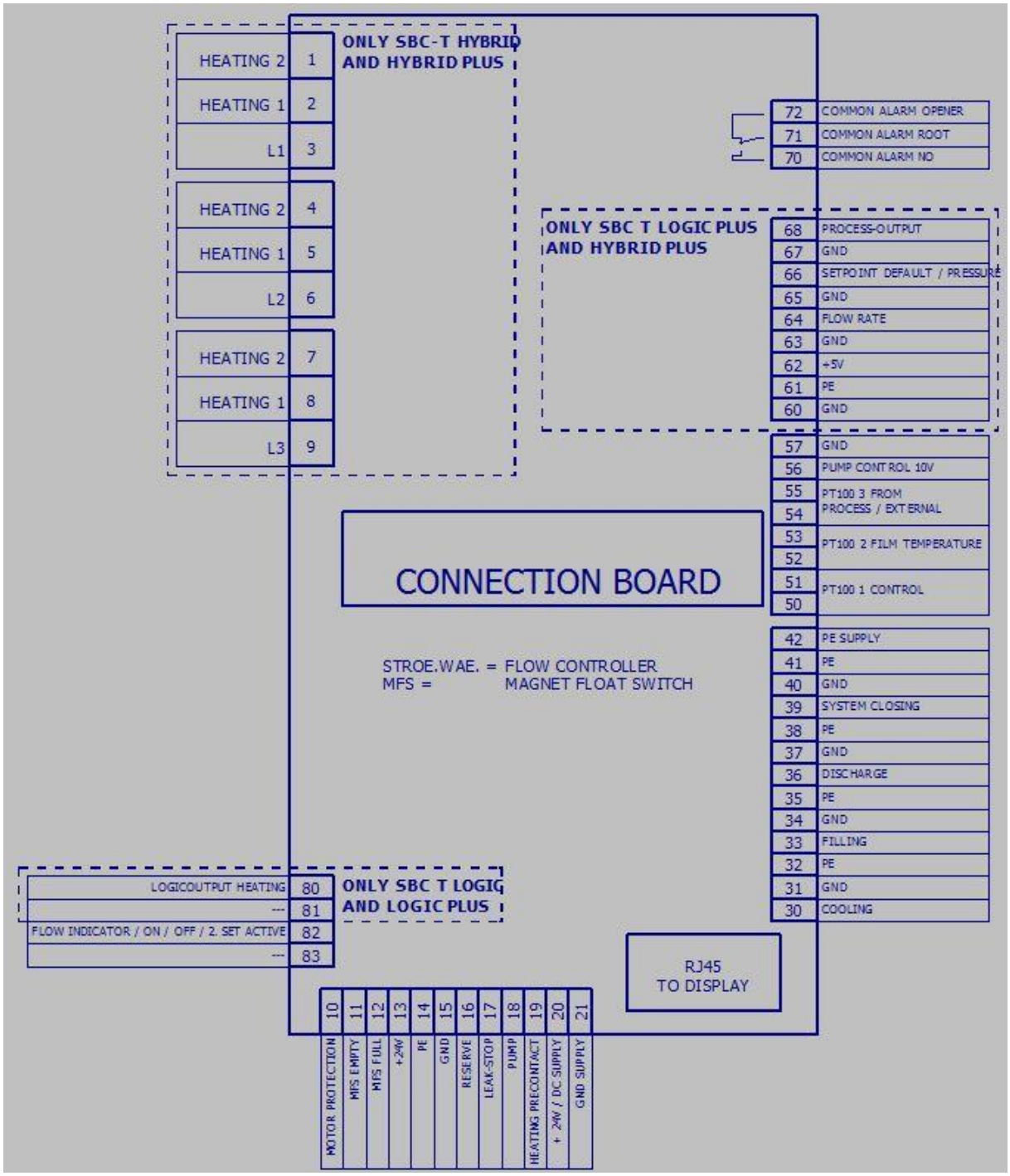
Select the *Firmware* function and perform the update by tapping "start update" and "save". Update is only possible, if the unit is switched off; the supply voltage must remain switched on during the process, i.e. the device is connected and the main switch is in the "On" position.

The process takes several seconds.

If the update process could not be performed completely, 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 has ended, the supply voltage must be switched off for 10 seconds before restarting.

7 Connection diagram



8 Parameter lists

Remark: Shown values in mectrical units

Functions

Term	from	to	function	only SBC-T plus
Temp. Alarm			Value of temperature alarm	
Leak stop	ON, OFF		Further parameterization under unit control	
Communication	ON, OFF		Interface mode; further parameterization under Communication	
Tool draining	ON, OFF		Tool draining before switching off; Further parameterization under unit control	
Cool down mode	ON, OFF		Cooling before switching off; Further parameterization under unit control	
Pump control	ON, OFF		Pump turns 100% or reduced; further parameterization under pump control	
self optimization			Start of self optimization	

Basic settings

Term	from	to	function	only SBC-T plus
Language	D, Eng., Fr., Sp			
Unit temp.	C; 0,1C; F		Temperature unit	
Logoff	Off; ON/OFF; ON/OFF and set point		Logout against unauthorized use	
Logoff code	****		Code for Logoff/Login	
Singel access			Only for Single-Service	
Unit pressure	Off, bar, PSI			X
Unit flow	Off, ltr/min; ltr/h; gal/min			X
Firmware update			Start of Updates	

Unit control

Term	from	to	function	only SBC-T plus
Filling	Hand / Auto		**Hand** is manual filling **Auto** is automatic Filling of unit	
Cooling	Indirect / Direct		Cooling via heat exchanger or direct. Directe Cooling only with water units possible	
Switching off temperature	10°C	100°C	For cool down mode before switching off	
Draining time	Off, 10 sec	900 sec	Duration of blowing or sucking for units with tool draining in sec	
Selection of set point	Set point or set point2 or ext. Set point (option)			
Aquatimer starting time	5 min	120 min	Period after switching on without monitoring of filling cycles	
Aquatimer cycles	Off ;1	40	Value is max. allowed filling cycles in one hour of operation	
Filling duration	Off ; 1	99	In Minutes	
Protection against automatic start (Restart lockout)	ON, OFF		• off = unit starts automatically after power failure • on = unit does not starts automatically after power failure	
Sample time	Off, 1 sec	10min	If USB-stick is plugged and parameter is not off, process data are stored; one set of record is saved in the period of sample time	
Temp. Control by external sensor	Internal, external		Temperature control by external sensor (only, if enabled in factory parameter)	

Temperature control

Term	from	to	cunction	only SBC-T plus
Set point 2	Min temp	Max temp		
Control regulation Heating	0	100	in %	
Control regulation Cooling	0	100	in %	
XP-Heating	OFF, 0,1	99,9	XP-Heating in %, the control system's proportional range	
TV-Heating	OFF, 1	200	TV-Heating in sec., derivative action time of the control system	
TN-Heating	OFF, 1	1000	TN-Heating in sec., integral action (reset) time of control system	
XP-Cooling	OFF, 0,1	99.9	XP-Cooling in %, the control system's proportional range	
TV-Cooling	OFF, 1	200	TV-Cooling in sec., derivative action time of the control system	
TN-Cooling	OFF, 1	1000	TN-Cooling in sec., integral action (reset) time of control system	
Schalthysterese Heating Cooling	OFF; 0,1 OFF; 0,01	10,0 10,00	Switching hysteresis between heating and cooling in relationship to set point (2-point controller)	
Dead area not Heating	OFF, 0,1	10		
Switching time Heating	1s	240s	For hybrid output min 10sec	
Switching time Cooling	1s	240s		
Upper set value limit	Lower set value limit	Max temp.		
Lower set value limit	Min. temp	Upper set value limit		
System closing-Temperature	OFF, 35	95	Closing to off water system to atmosphere. **Water:** temperature selection for system shut-off in °C **Oil:** evacuation by vacuum is only possible below this value	

Set point ramp rising	OFF, 0,1	99.9	Set point ramp rising in K/min	
Set point ramp decreasing	OFF, 0,1	99.9	Set point ramp decreasing in K/min	
Offest intern	Off, -199	199°C	Temperature correction of the internal temperature sensor in °C	
Offset Film	Off, -199	199°C	Temperature correction of the film sensor temperature in °C	
Offset External/From Process	Off, -199	199°C	Temperature correction of the ext/from process sensor temperature in °C	
Analoge value	0-10V; 4-20mA		Calibration of analog In-/Output	X
Temperature at 0V or 4mA	Min temp	Max temp	Calibration of analog In-/Output	X
Temperature at 10V or 20mA	Min temp	Max temp	Calibration of analog In-/Output	X

Alarms

Term	from	to	function	only SBC-T plus
Configuration temperature alarm	1	4	Configuration of Alarm output • ❶ = Signal contact • ❷ = Limiting value • ❸ = Limitcomparator • ❹= Limitcomp. with readiness	
Alarm Film	Min temp	Max temp	At this temp. A film alarm is released (heaters off)	
Alarm minmum flow	0	1000	For unit protection, minimum is required for proper funktion; only if pump turns in regular direction	X
Alarm low flow	0	1000	To protect productions process; only if pump turns in regular direction	X
Alarm pressure high	OFF, 0,1	25,0	At this pressure a alarm is released	X
Alarm dT	OFF, -100	100	Monitoring of temperature difference between to and from process	
Alarm from process temp.	Min temp	Max temp	At this temp. A from process temp. alarm is released	
Cascade control	OFF, 0	100	Temperature limitation with external sensor	
External Sensor Logik	Always active	Activee after oversh.t	Cascade control always or after an overshoot active	

Communication

Term	from	to	cunction	only SBC-T plus
Adress	1	255	Adress of Unite. If more than one Units at one interface, units must have different addresses	
Protocol	OFF		• Arburg-Protocol activ • KraussMaffei-Protocol active • Dr. Boy-Protocol active • Engel-Protocol active Pb = Profibus active only for controller with profibus interface	
Baudrate	OFF, 0,3	19,2	transmission speed – baud rate – of the interface:	

			OFF = interface is off • 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	
Date format			Data format of interface. The data-format is comprised of: Data-bits, parity bit, stop bit. Possible settings are: 7E1, 7o1, 7E2, 7o2, 7n2, 8E1, 8o1, 8n1, 8n2 7E1, 7o1, 7E2, 7o2, 7n2, 8E1, 8o1, 8n1, 8n2	
Status	---	Data Exchange	Status of interface	

Pumpencontrol

Term	**from**	**to**	**cunction**	**only SBC-T plus**
Mode	Mode of pump control: 1.) Fix value in % 2.) Fix flow rate (only Plus) 3.) Auto dT: If Temp. difference to/from process is lower than 50% of Auto dT and |Setpoint temp-Actual temp| lower 1°C, pump turn is reduced by 1% per minute (only in conjunction with from process sensor)			
Pump fix value	30	100	In %	
Pump flow rate	0	100,0	In ltr/min;	X
Auto dT	0	10	See above	
XP-Pumpe	OFF, 0,1	999.9	XP-pump in %, the control system's proportional range	
TV-Pumpe	OFF, 1	200	TV-pump in sec., derivative action time of the control system	
TN-Pumpe	OFF, 1	1000	TN-pump in sec., integral action (reset) time of control system	

9 List of alarms

Code	Text	Caused by	Remark	Other consequences	10 sec delay
H600	Motor protection/FC has released	Contact motor protection switch open, or no „o.k.“-signal by frequency converter (at least 1 sec after switching on)		Unit will be switched off	yes
H800	Defective float switch	Max-contact „on“, min-contact „off“		Unit will be switched off	yes
H810	Maximum filling time exceeded	If filling takes longer than parameter filling duration		Unit will be switched off	yes
H811	Unit is overfilled	Mag. Float switch max-contact is „on“"	Only for oil-units	Heating will be switched off; Reset by switching unit Off/On necessary	yes
H812	Unit is empty	Not enough water/oil in unit		Pump and temperature control stays off	yes
H820	Leakage (unit or consumer)	Aquatimer is activated; filling cycles more than parameter Aquatimes cycles	Leakage can be **anywhere** in unit, hoses to tool or tool	Unit will be switched off	yes
H830	Flow below specified limit	If flow rate is lower than parameters minimum flow	Only units with flow measurement	Heating will be switched off	yes
H990	I/O board is missing	If no communication between connection board and display		Unit will be switched off	yes
H1026	Film temperature alarm	If film temperature is higher than parameter alarm film	Only, if sensor is o.k.	Heating will be switched off (no delay)	
H2059	dT Alarm	Alarm is on and difference between control and from process sensor is higher than parameter Alarm dT	If from process sensor is activated and o.k	None	yes
H2060	Defective control sensor	Shortcut, break, under or overflow, no proper measurement values of sensor		Unit will be switched off	yes
H1022	Defective film temperature sensor	Shortcut, break, under or overflow, no proper measurement values of sensor		Heating will be switched off	no

Code	Text	Caused by	Remark	Other consequences	10 sec delay
H2075	Defective back run or ext. sensor	Shortcut, break, under or overflow, no proper measurement values of sensor	If sensor is activated	none	yes
H2010	External enabling is missing	If unit is switched on, contact external on/off is low	If input is parametrized as external on/off	Unit can not be switched on, if on unit will be switched off	yes
H2030	Flow below limit	If flow rate is lower than parameters low flow parameter and alarm is on	Only units with flow measurement	none	yes
H2040	Maintenance interval has expired	If maintenance counter is on zero		none	yes
H2101	Temperature is lower than limit	Control temp. violates the parametrized temperature limit		none	yes
H2102	Temperature is higher than limit	Control temp. violates the parametrized temperature limit		none	yes
H2112	Limit value from process	If from process temp. is higher than parameter from process temp.	If from process sensor is activated	none	yes
H2140	Unable to use USB stick	Selection of any USB-function but no detection of a working USB		none	yes
H2141	Export/import error	Problems during reading/writing data from/to USB-Stick		none	yes
H2200	Abortion of self optimization			Self optimization will be switched off	yes
H2210	EAROM failure	Hardware problem on controller		Unit will be switched off	nein
H2211	Profibus failure	Problem with Profibus communication		No Communication	nein
H2212	Calibration failure	Hardware problem on controller		Unit will be switched off	nein
H2213	No sufficient flow (flow monitor)	If flow monitor shows no flow		none	yes

rot	Alarm with activation of alarm relay
blau	Message , no activation of alarm relay