Operating manual

Temperaturr dry well calibrators

CCD91

Micro calibration baths

CCB91

BE 540 a

ONE NAME. ALL SOLUTIONS.

tecsis

Content Page

1 Device Description and Intended Use

The calibrator / micro calibration bath is a portable unit for service, industry and laboratory tasks. The tecsis temperature calibrators / micro calibration baths are intended to calibrate thermometers, temperature switches/thermostats, resistance thermometers and thermal elements. The operational safety of the supplied instruments is only guaranteed if they are operated according to their intended use (inspection of temperature sensors). Specified limit values (see “Technical Data”) should never be exceeded.

It is your responsibility to select the instrument which is suitable for your specific application, to connect it correctly, to carry out tests and to maintain all the components.

Various instrument versions are manufactured. The respective type label on the calibrator/micro calibration bath displays the version of each device.

These operating instructions apply to the following calibrator/micro calibration bath types:

Temperature calibrators

CCD91X999001 – up to 165 Grad	(cooling and heating)
CCD91X999002 – up to 450 Grad	(heating)
CCD91X999003 – up to 650 Grad	(heating)

Micro calibration baths

CCB91X999001 – up to 165 Grad	(cooling and heating)
CCB91X999002 – up to 225 Grad	(heating)

The calibrator / micro calibration bath consists of a rugged grey and blue steel housing with carrying handle.

The **rear part of the housing** contains a metal block/liquid bath with a hole, accessible from the top, for the test specimen fixture.

The heating or cooling elements and the temperature sensor for determining the reference temperature are integrated in the metal block / liquid bath.

The metal block / liquid bath is heat insulated.

Fig. 1: Temperature calibrator CCD91

Fig. 2: Micro calibration bath CCB91

The **front part of the housing** contains the complete electronic unit for controlling the reference temperature.
Solid state relays (SSR) are used to control the heating and cooling elements.
A controller equipped with a 7-segment LED (2 lines, 4 digits) for the reference and set temperature is located on the front plate.
The micro calibration bath also has a thumb wheel for controlling the stirring speed.

Front and top
At the top you will find the dry well access opening for the inserts for models:

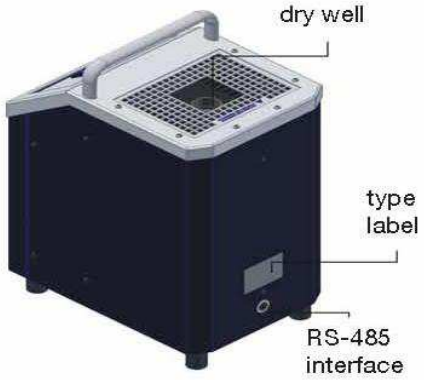
The controller with display and the four button control pad are positioned at the front.

Rear
At the rear you will find the type label with important information about the individual model:

The suitable line voltage and frequency is printed:

- 115 VAC 50...60 Hz or 230 VAC 50...60Hz
- 100 VAC ... 240VAC / 50 ... 60 Hz

Further you will find the individual serial number, e.g. S/N 550 33 44, the instrument's power consumption and the fuse rating.



Bottom
Mains connector, power switch and fuse holder are positioned at the bottom of the instrument close to the front.

Furthermore the fans air inlet(s) can be found there - one or two - depending on the model.

Do not obstruct air inlets.

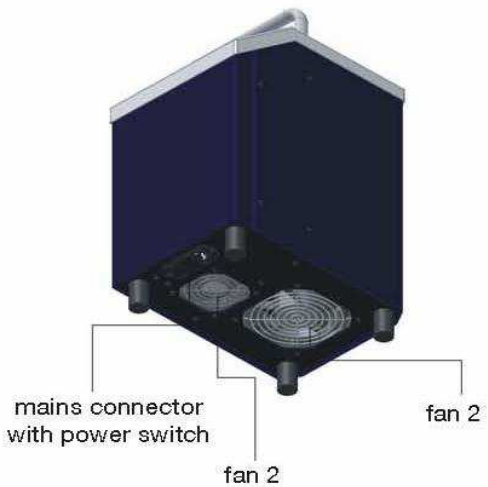


Fig. 4: Components overview

2 Safety Instructions

Always read the operating instructions carefully prior to using the new product. Always adhere to the instructions contained herein, especially the safety instructions; otherwise, there is a potential risk of operator injury and damage to the calibrator and the sensors being tested.

Even though tecsis provides assistance for the use of the product through personal consultation or the respective literature, it is the responsibility of the customer to determine the suitability of the product for the specific application.

The temperature calibrator / micro calibration bath is a state-of-the-art device. This relates to the accuracy, functioning and the safe operation of the calibrator / micro calibration bath. However, professional and safety conscious conduct of the operator is required to ensure safe operation.

2.1 Qualified personnel

- The personnel entrusted with start-up, operation and maintenance of the calibrator / micro calibration bath have to be suitably qualified; the required knowledge can be gained via training courses or appropriate on-the-job instruction. The personnel have to be familiar with the contents of these instructions, which have to be available to them at all times.
- The electrical connection should only be carried out by a fully qualified electrician.
- All work has to be carried out in accordance with existing national regulations on accident prevention and safety at work and with any internal regulations of the operator, even if they are not specified in these instructions.
- Always observe the safety information contained in these operating instructions.

2.2 Basic safety regulations

- Only operate the calibrator / micro calibration bath when it is in correct, fully functional condition.
- The calibrator / micro calibration bath is energized with hazardous voltages via a mains cable. Improper use can result in personal injuries.
- Correct and safe operation of the calibrator / micro calibration bath demands correct transport, storage, installation and assembly, as well as proper use and careful operation and maintenance.
- The calibrator / micro calibration bath should only be used for its intended purpose. Furthermore, hazardous media should not be used and all technical specifications have to be observed.
- If faults cannot be cleared, immediately shut down the calibrator / micro calibration bath and ensure that it cannot be started up accidentally.
- Repairs should only be carried out by the manufacturer. Tampering with or modifying the calibrator / micro calibration bath is strictly prohibited.
- Prior to replacing the safety fuse, always de-energize the calibrator / micro calibration bath completely by disconnecting the mains cable from the mains outlet.
- Ensure that the complete operating instructions are always available in excellent condition at the calibrator / micro calibration bath installation site.
- Ensure that calibrator / micro calibration bath operators receive regular instruction in the various aspects of occupational health and safety and environmental protection and have full knowledge of these operating instructions and the safety information contained herein.
- **Thermal fuse**

  For protection purposes, the calibrator / micro calibration bath is equipped with an autonomous thermal fuse, which interrupts the power supply to the heater if the temperature exceeds a certain value inside the housing. Once the metal bock / liquid bath has cooled down, the calibrator / micro calibration bath has to be returned to tecsis for inspection.
- The calibrator / micro calibration bath has been designed as a measurement and control instrument. If the calibrator / micro calibration bath is used for purposes not expressly specified in these operating instructions, additional safety measures have to be taken.

- The calibrator / micro calibration bath should **NOT** be used in **explosive atmospheres** without appropriate protection (flammable or explosive atmospheres).
- If malfunctioning of the calibrator / micro calibration bath can result in personal injuries or damage to property, the system has to be protected with additional electromechanical protective equipment.

2.3 Safety instructions for the application of calibration liquids

Calibration liquid water:

- Only use distilled water, otherwise excessive lime scale and soiling will build up in the calibrator tank.

Calibration liquid silicone oil:

- Only use the silicone oil recommended in these operating instructions.
- Always read the safety data sheet supplied with the silicone oil before using it.
- Always ensure adequate ventilation when working with silicone oil, since hazardous substances can be released.
- Prevent silicone oil from coming into contact with your eyes.
- Since silicone oil is hygroscopic, always use the transport lid to close the calibration bath after use.
- The transport lid is equipped with a safety valve. If the micro calibration bath is closed when warm, impermissible pressure can build up. In order to prevent excess pressure which can destroy the liquid bath, the safety valve is activated once the pressure reaches approx. 2.5 bar. This can result in hot steam being released.

Risk of severe burns!

Prior to transport or contact with the metal block / liquid bath ensure that it has cooled down sufficiently, otherwise there is a risk of severe burns caused by the metal block / liquid bath and the test specimen.

If problems or questions arise, please contact your supplier or the manufacturer directly:

tecsis GmbH

Carl-Legien-Straße 40
D-63073 Offenbach am Main
Phone:+49 69 5806-0
Fax:+49 69 5806-177
E-Mail: info@tecsis.de
Internet: www.tecsis.de

3 Unpacking and Inspecting the Delivery

⇒ Unpack your calibrator / micro calibration bath.

The calibrator / micro calibration bath is delivered in special protective packaging. Keep this protective packaging for sending the instrument for recalibration or repairs to the manufacturer.

⇒ Inspect the delivery first.

Standard delivery temperature calibrator:
- Calibrator
- Sleeve remover
- Mains connection cable
- Test certificate
- Operating instructions

Standard delivery micro calibration bath:
- Calibration bath
- Transport lid
- Sensor cage
- Magnetic stirrer
- Mains connection cable
- Bilge pump
- Test certificate
- Operating instructions

4 Description of the Controls

4.1 Front of the controller (controller type TLK 32)

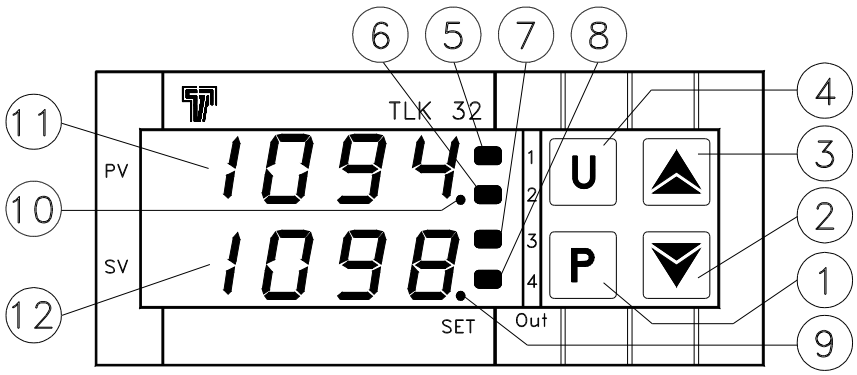


Fig. 5: Overview of the controls on the front of the controller

1 – P key
- Accessing the default set temperature
- Accessing menu items and parameters
- Confirming inputs

2 - ▼ key
- Reducing the setting values
- Selecting individual menu items
- Returning to the previous menu level

3 - ▲ key
- Increasing the setting values
- Selecting individual menu items
- Returning to the previous menu level

4 – U key
- Retrieving the saved set temperatures (only for the S version)

5 - LED OUT 1
- Signals the status of the output for the temperature control
  If the LED OUT 1 lights up, the calibrator / micro calibration bath is heating
  If the LED OUT 1 does not light up, the calibrator / micro calibration bath is not heating

6 - LED OUT 2
a) Heating instrument
- Signals the status of the output for the fan control
  If the LED OUT 2 lights up, the fan is running at high speed
  If the LED OUT 2 does not light up, the fan is running at low speed

b) Heating and cooling instrument
- Signals the status of the output for the temperature control
  If the LED OUT 1 lights up, the calibrator / micro calibration bath is cooling
  If the LED OUT 1 does not light up, the calibrator / micro calibration bath is not cooling

7 - LED OUT 3
- This LED has no function here

8 - LED OUT 4
- This LED has no function here

9 - LED SET
- When flashing, it signals access to the individual menu items and parameters

10 - LED AT/ST
- This LED has no function here

11 – PV indicator
- Displays the current reference temperature
- Displays the individual modes, menu items and parameters

12 – SV indicator
- Displays the set temperature
- Displays certain parameters in the individual modes and menu items

4.2 Data interface

The S version is equipped with a serial communication interface RS485. It is possible to connect a PC, a level converter or a network via this interface.

The utilized software protocol is a MODBUS-RTU protocol, which is used in numerous market-available monitoring programs.

The transfer rate (baud rate) is factory set to 9600 baud. Other transfer rates are available on request.

The 5-pole socket is provided with two connections, A and B, which have to be connected to the respective sockets of the PC, the level converter or the network.

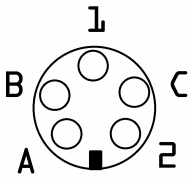


Fig. 6: Top view of the 5-pole socket

To enable connection to a PC, the RS 485 signals have to be externally converted into RS 232 or USB signals. Appropriate converters including drivers are optionally available. The PC records all the operating data and enables the programming of all the calibrator's configuration parameters.

The minimum requirements for operation with a USB converter are:

- IBM compatible PC,
- An installed Windows operating system 98SE, ME, 2000 or Windows XP (Home or Professional),
- A free USB port (USB 1.1 or USB 2.0).

A network configuration allows the connection of up to 32 calibrators / micro calibration baths to the same network.

Certain factory settings have to be carried out to enable configuration of a network. In this case, please contact your supplier or tecsis directly.

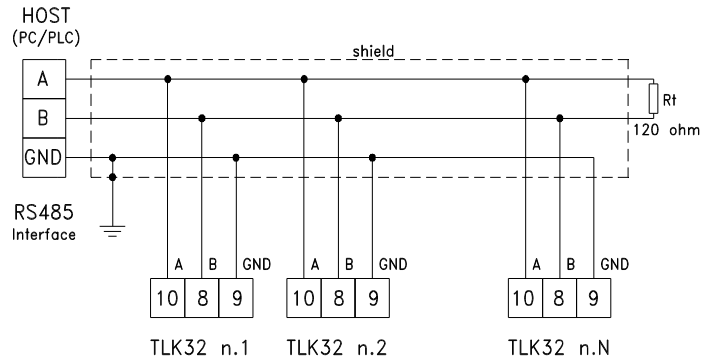


Fig. 7: Network configuration

Note:

If you access the programming via the keypad while communication via a serial interface is running, the message **"buSy"** appears on the display.

4.3 Transmission protocol

The transmission protocol is supplied as an additional document upon request.

5 Start-up of the Calibrator / Micro Calibration Bath

5.1 Operating position

The calibrator / micro calibration bath has to be placed in a vertical standing position for operation, this position guarantees optimum temperature distribution in the metal block / liquid bath.

5.2 Sleeves for the metal block

In order to achieve the best possible accuracy, the utilization of exactly fitting sleeves is necessary. The diameter of the test specimen has to be determined precisely. The bore in the sleeve results from the addition of +0.5 mm.

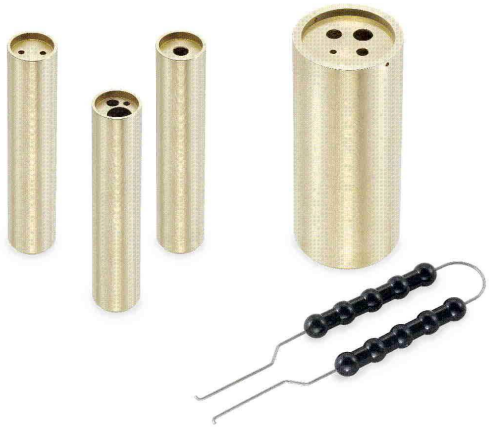


Fig. 8: Sleeves

⇒ Remove the sleeves after use with the aid of the sleeve remover, and remember to clean the sleeve and the block. This prevents the sleeves becoming jammed in the heating block.

5.3 Preparing the micro calibration bath

In order to achieve the best possible accuracy of a micro calibration bath, it has to be filled with a suitable calibration liquid.

5.3.1 Characteristics of the calibration liquids

Different calibration liquids supply varying calibration results due to their specific characteristics. Adjustment to the respective calibration liquid has to be carried out by the manufacturer.

We recommend the following calibration liquids for the various temperature ranges:

	Calibration Range		Flash point
Distilled water	0°C	95°C	-
Dow Corning 200 fluid with 5 CS	-40°C	123°C	133°C
Dow Corning 200 fluid with 10 CS	-35°C	155°C	165°C
Dow Corning 200 fluid with 20 CS	7°C	220°C	230°C
Dow Corning 200 fluid with 50 CS	25°C	270°C	280°C

When using water as the calibration liquid:

⇒ Only use distilled or demineralised water, otherwise excessive lime scale and soiling will build up in the calibrator tank.

When using silicone oil as the calibration liquid:

⇒ Only use the silicone oil recommended in these operating instructions.

⇒ Always read the safety data sheet supplied with the silicone oil before using it.

⇒ Always ensure adequate ventilation when working with silicone oil, since hazardous substances can be released.

⇒ Prevent silicone oil from coming into contact with your eyes.

⇒ Since silicone oil is hygroscopic, always use the transport lid to close the calibration bath after use.

5.3.2 Filling the micro calibration bath

⇒ Remove the transport lid.

⇒ Insert the test specimen into the sensor cage.

⇒ Fill the tank with calibration liquid. The max. filling level in the tank is displayed by the upper edge of the aluminium lining (see Fig. 9). The max. filling level is 0.5 litres.

Note:
The transport lid is equipped with a safety valve. If the micro calibration bath is closed when warm, impermissible pressure can build up. In order to prevent excess pressure which can destroy the liquid bath, the safety valve is activated once the pressure reaches approx. 2.5 bar. This can result in hot steam being released.

5.3.3 Operating the magnetic stirrer

The best possible homogeneity is achieved by stirring the calibration liquid with the magnetic stirrer.

⇒ Set the stirring speed to the respective max. speed. Turn the thumb wheel (Fig. 11) upwards to increase and downwards to decrease the stirring speed.

Fig. 10: Liquid bath

Fig. 11: Front of the controller with stirring speed wheel

Caution!
The magnetic stirrer is a wearing part.

5.4 Testing temperature sensors

A separate temperature measuring instrument connected to the test specimen is required to test the temperature sensors. By comparing the temperature displayed at the external measuring instrument with the reference temperature it is possible to assess the status of the test specimen. Remember that the test specimen requires a short period of time until it absorbs the temperature of the metal block or liquid bath.

Caution!
It is not possible to calibrate earthed thermal elements, because the heating block is earthed and any measurement would produce incorrect results.

5.5 Start-up procedure

If the calibrator is not used for a longer period, it is possible for moisture to enter the heating elements due to the material used (magnesium oxide).
After calibrator transport or storage in a damp environment, the heating elements have to be gently brought up to operating temperature. During the drying out procedure it has to be assumed that the calibrator has not yet achieved the required insulation voltage for protection class I. The start-up set value is T_{start}=120°C for a stop period of T_n=15 min.

5.6 Switching on the calibrator / micro calibration bath

⇒ Connect the supplied mains plug to a mains outlet.

⇒ Actuate the mains switch.

The controller is initialized
tESt appears on the upper **PV** display.
The version number, e.g. rL 2.2, appears on the lower **SV** display.

Initialization is completed after approx. 5 sec., the **calibration mode** is then automatically displayed.

The installed heating and cooling elements automatically adjust the metal block from the room temperature to the set temperature set at the controller.

5.7 Reference and set temperature display

Upper PV display:
The red, 4-digit, 7-segment display shows the current temperature of the metal block / liquid bath.

Lower SV display:
The green, 4-digit, 7-segment display shows the current set temperature of the metal block / liquid bath.

Once the set temperature has been achieved, the radiated heat energy from the metal block / liquid bath is supplied by short firing pulses, thus ensuring that the temperature inside is kept constant.

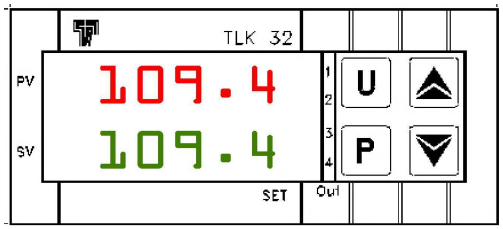


Fig. 12: Reference and set temperature display

5.8 Stabilizing the reference temperature

The switch on time of the heater is displayed by the red LED OUT 1.

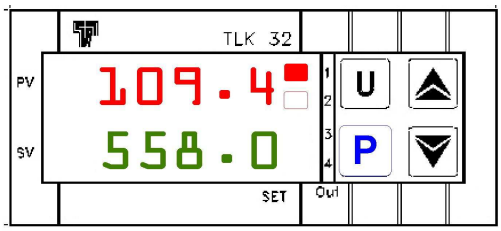


Fig. 13: LED OUT 1 displays

During the heating up phase a constantly lit LED displays the supply of heat energy, a flashing LED indicates that the reference temperature has almost reached the set temperature and the heat energy is now being supplied at short intervals.

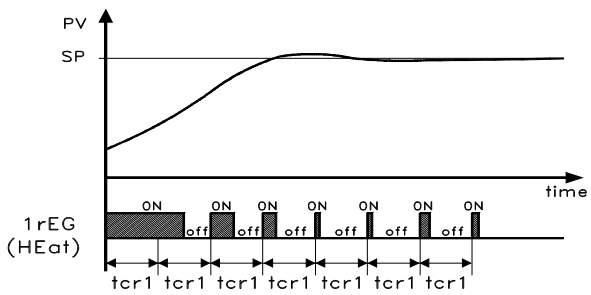


Fig. 14: Control occurs via PID algorithm

In order to guarantee excellent temperature stability, the cycle time of the controller is set to low and the control output is addressed on a regular basis.

6 Operating the Calibrator / Micro Calibration Bath

Three operating modes are available:

- **Calibration mode**
  This is the normal operating mode in which the calibration of test specimens is carried out.
- **Set value mode**
  The set temperatures can be entered in this mode.
- **Main menu**
  All the settings can be carried out in this mode, e.g. presetting the set temperatures or setting the control parameters.

6.1 Calibrating (calibration mode)

The calibrator / micro calibration bath is automatically in **calibration mode** as soon as it has been switched on and after initialization.
The current reference temperature is displayed by the upper **PV** display.
The set temperature is displayed by the lower **SV** display.

The LED **OUT 1** indicates the status of the output for the heater control:

- If LED OUT 1 lights up, the temperature is being increased.
- If LED OUT 1 does not light up, the heater is switched off.

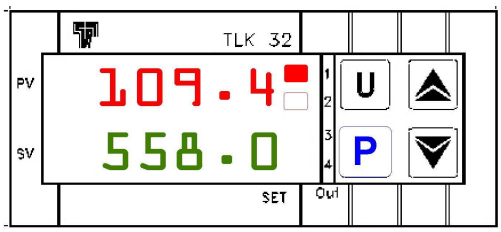


Fig. 15: Calibration mode HEATING displays

The LED **OUT 2** indicates the status of the output for the fan / cooling control:

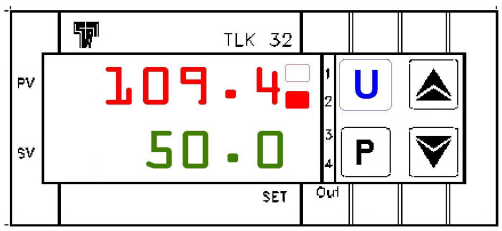


Fig. 16: Calibration mode FAN or COOLING displays

a) Heating instrument
The LED **OUT 2** indicates the status of the output for the fan control:

- If the LED OUT 2 lights up, the fan is running at high speed.
- If the LED OUT 2 does not light up, the fan is running at low speed.

b) Heating and cooling instrument
The LED **OUT 2** indicates the status of the output for the cooling control:

- If LED OUT 2 lights up, the temperature is being decreased.
- If LED OUT 2 does not light up, cooling is switched off.

There are two ways to set the set temperature: Either you set a temporary set temperature (see section 6.2) or you save fixed set temperatures in the main menu (see section 6.3).

6.2 Setting a temporary set temperature (set value mode)

In this operating mode it is possible to temporarily modify a saved set temperature.

⇒ Press the **P** key.
The currently active set value memory, e.g. SP 2 (set point 2), is displayed by the upper **PV** display. The respective set temperature is displayed by the lower **SV** display.

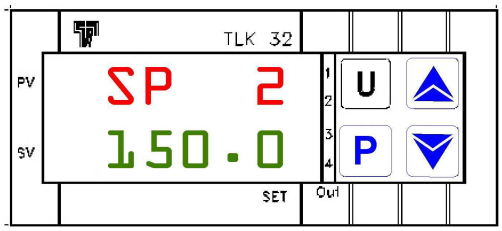


Fig. 17: Temporary set temperature setting

⇒ Press the ▲ key to increase the set temperature.
Press the ▼ key to decrease the set temperature.

⇒ Press the **P** key again to confirm the new set value.

Note:

- Press the ▲ and ▼ key to raise and lower the value by 0.1 respectively. If the keys are held pressed for at least one second, the value increases or decreases quickly and after two seconds even more quickly; this means the desired value can be reached rapidly.
- If no key is pressed in the **set value mode** for approx. 15 seconds, the device automatically returns to the **calibration mode**.

6.3 Programming (main menu)

All the settings can be carried out in this menu structure.

⇒ Press the **P** key for approx. 5 seconds. The main menu opens.

⇒ Use the ▼ and ▲ keys to select the desired main menu (see overview).

⇒ Press the **P** key to confirm the selected menu item.

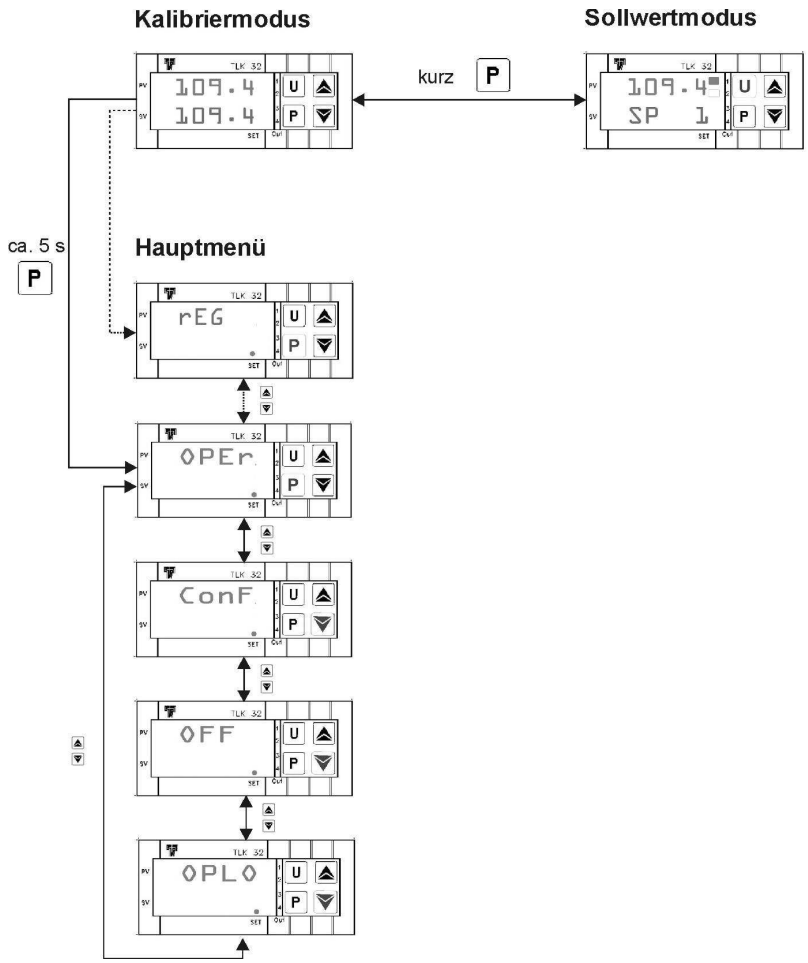


Fig. 18: Menu structure (main menu)

Note:
The S version provides certain additional functions, e.g. storage of four different set temperatures or setting of the control parameters.

As displayed by the menu structure, it is possible to reach the **group** and **parameter levels** to carry out settings via **OPEr**.

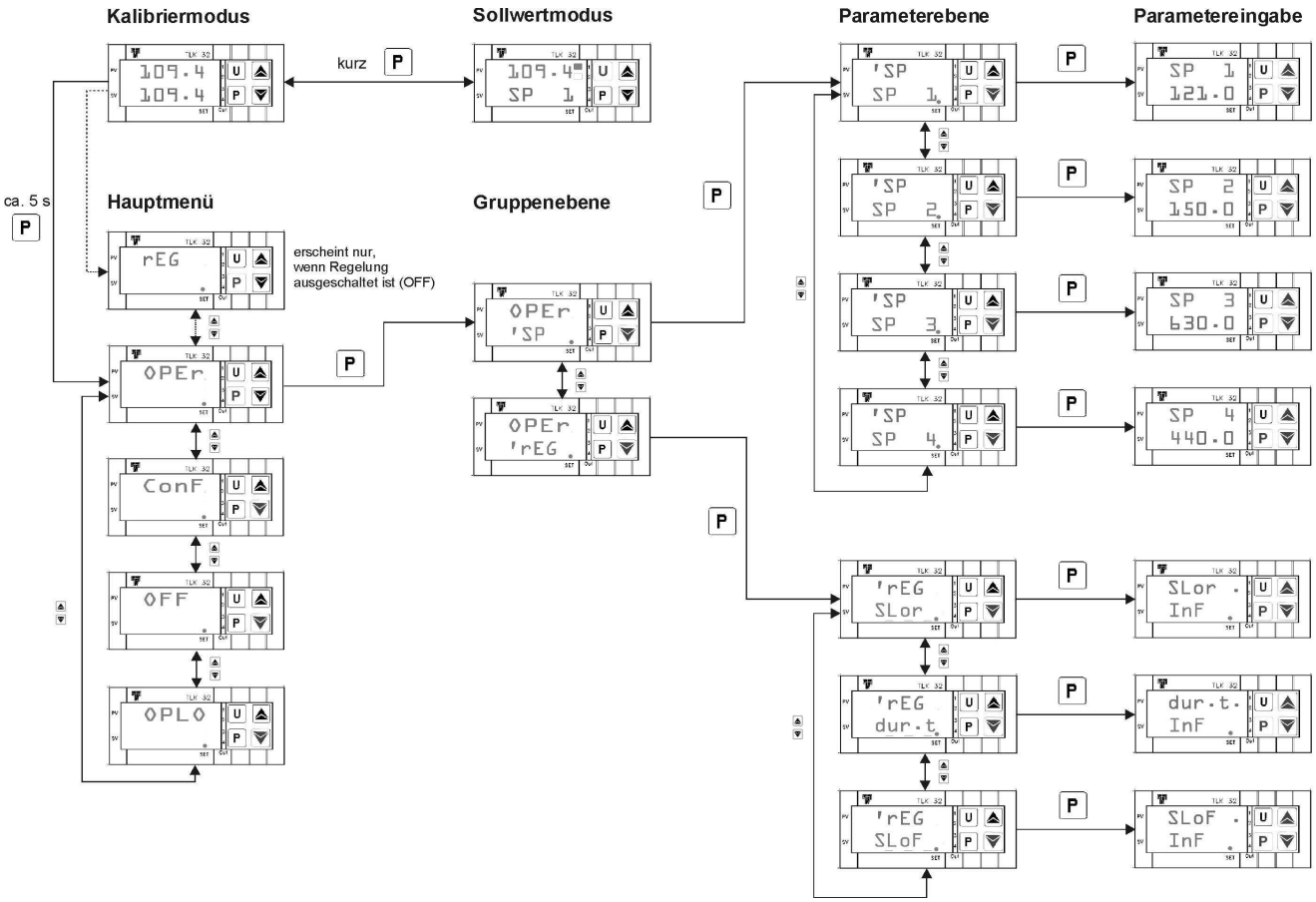


Fig. 19: Menu structure

Note: Many of the described settings can only be carried out in the S version, but this is displayed in the chapter heading.

Returning to another level

If no key is pressed in the **main menu** at the **group** or **parameter level** for approx. 15 seconds, the device automatically returns to the previous level up to the **calibration mode**.

You can also return to a previous level by pressing and holding the ▼ or ▲ key

6.3.1 Switching off the automatic control

For certain tasks it can be advantageous to switch off the control, e.g. to carry out settings at the calibrator / micro calibration bath.

⇒ Press the **P** key when in calibration mode for approx 5 sec., the main menu opens.
OPEr appears on the upper **PV** display
LED SET flashes on the lower **SV** display.

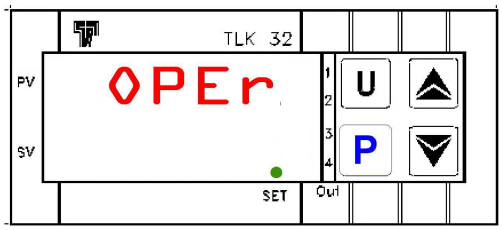


Fig. 20: Main menu display

⇒ Press the ▲ or ▼ key until **OFF** appears.

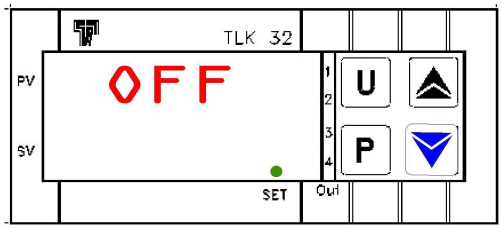


Fig. 21: Menu control OFF

⇒ Press the **P** key to confirm**.**
An alternating display of the current reference temperature and **OFF** appears on the upper **PV** display
The current set temperature appears on the lower **SV** display.

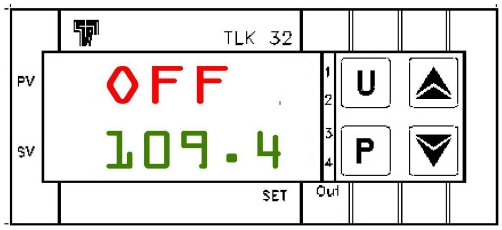


Fig. 22: Control OFF setting display

Caution! The control has now been switched off and the reference temperature will constantly drop without being regulated.

6.3.2 Switching on the automatic control

The control is switched off if the following display appears:
An alternating display of the current reference temperature and **OFF** appears on the upper **PV** display. The current set temperature appears on the lower **SV** display.

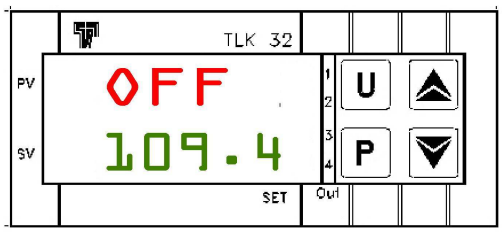


Fig. 23: Control OFF setting display

Switch the control back on by:

⇒ Pressing the **P** key for approx. 5 sec., the main menu opens.
rEG appears on the upper PV display
LED SET flashes on the lower **SV** display.

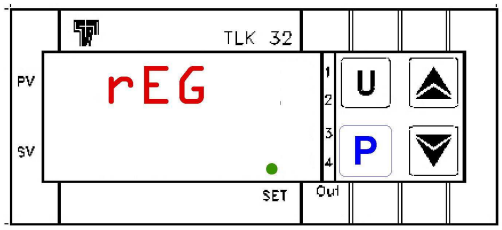


Fig. 24: rEG display

⇒ Press the **P** key to confirm switching on the control.

Caution! The control has been reactivated. The calibrator / micro calibration bath is in calibration mode and the set temperature is targeted.

6.3.3 Switching on the manual control

It is possible to switch off the automatic control of the calibrator / micro calibration bath and to achieve the desired temperature via manual control.

⇒ Press the **P** key for approx 5 sec., the main menu opens.
OPEr appears on the upper **PV** display.
LED SET flashes on the lower **SV** display.

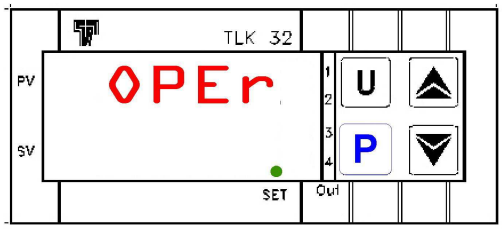


Fig. 25: Main menu display

⇒ Press the ▲ or ▼ key until **OPLO** appears
OPLO appears on the upper **PV** display.
LED SET flashes on the lower **SV** display.

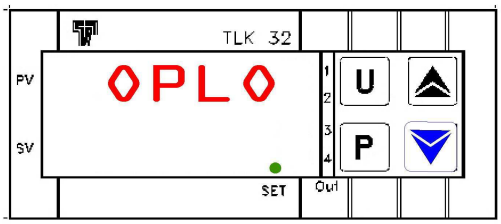


Fig. 26: Menu manual control OPLO

⇒ Press the **P** key to confirm**.**
The current reference temperature appears on the upper **PV** display.
The letter H and the currently set output capacity in % appear on the lower **SV** display.

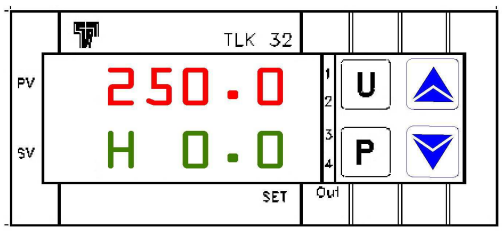


Fig. 27: Manual control OPLO setting display

⇒ Press the ▲ key**,** to **increase** the output capacity.

⇒ Press the ▼ key**,** to **decrease** the output capacity**.**

Caution! Press the ▲ and ▼ key to raise and lower the value by 0.1 respectively. If the keys are held pressed for at least one second, the value increases or decreases quickly and after two seconds even more quickly; this means the desired value can be reached rapidly.

6.3.4 Switching off the manual control

The manual control is switched on if the following display appears:
The current reference temperature appears on the upper **PV** display.
The letter H and the currently set output capacity in % appear on the lower **SV** display.

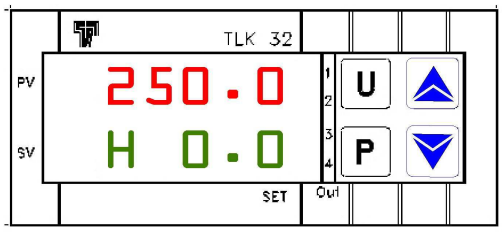


Fig. 28: Manual control OPLO setting display

Switch the manual control off again by

⇒ Pressing the **P** key for approx. 5 sec., the main menu opens.
rEG appears on the upper **PV** display.
LED SET flashes on the lower **SV** display.

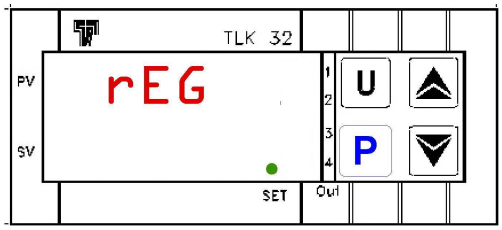


Fig. 29: Main menu display

⇒ Press the **P** key to confirm switching on the automatic control.

6.3.5 Setting and saving fixed set temperatures

In order to save set temperatures in the calibrator / micro calibration bath, the respective set value memory has to be opened.

⇒ Press the **P** key for approx 5 sec. when in **calibration mode,** the main menu opens.
OPEr appears on the upper **PV** display.
LED SET flashes on the lower **SV** display.

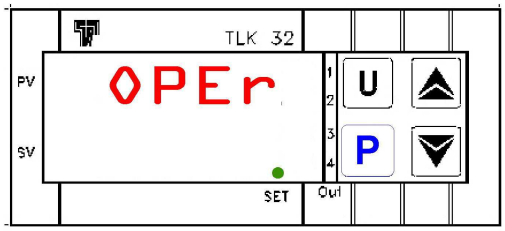


Fig. 30: Operator menu OPEr

⇒ Press the **P** key again, the **group level** opens.
OPEr appears on the upper **PV** display.
SP appears on the lower **SV** display and LED SET flashes.

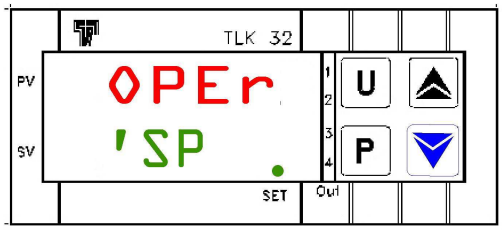


Fig. 31: Group SP

⇒ Press the **P** key again, the **parameter level** opens.
SP appears on the upper **PV** display.
The set value memory SP 1 and LED SET flash on the lower **SV** display.

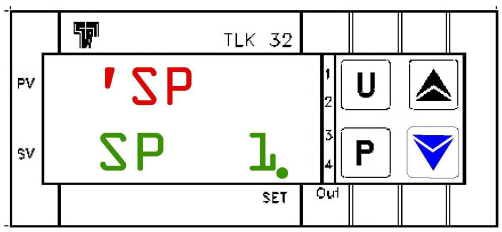


Fig. 32: Parameter for the set memory SP1

⇒ Use the ▲ or ▼ key to select one of the four set value memories SP1, SP2, SP3 and SP4.

⇒ Press the **P** key to open the respective set value memory.
The selected set value memory, e.g. **SP 3** flashes on the upper **PV** display.
The corresponding current set temperature appears on the lower **SV** display.

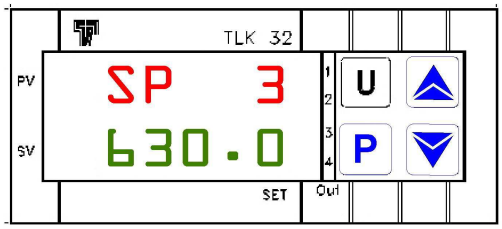


Fig. 33: Set value memory SP3 entry

⇒ Press the ▲ key to **increase** the set temperature.

⇒ Press the ▼ key to **decrease** the set temperature.

Note:
Press the ▲ and ▼ key to raise and lower the value by 0.1 respectively. If the keys are held pressed for at least one second, the value increases or decreases quickly and after two seconds even more quickly; this means the desired value can be reached rapidly.

⇒ Press the **P** key to confirm the set temperature.
The set value memory closes and the display returns to the **parameter level**.

⇒ Press and hold the ▼ or ▲ key to return to the **calibration mode**.

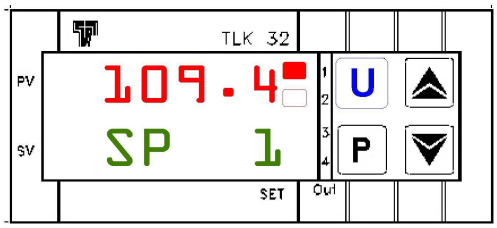
If no key is pressed for approx. 15 seconds, the device automatically returns to a previous level up to the **calibration mode**.

6.3.6 Retrieving the saved set temperatures

The saved set temperatures can be retrieved in calibration mode.

⇒ Press the **U** key for approx 2 sec., the current set value memory opens.
The current reference temperature appears on the upper **PV** display.
The set value memory SP1, SP2, SP3 or SP4 appears on the lower **SV** display for 2 sec. followed by the current set temperature.

Firstly, the set value memory SP1, SP2, SP3 or SP4



Secondly, the saved set temperature

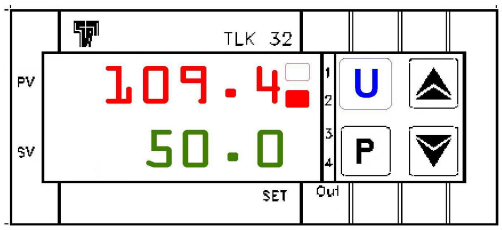


Fig. 34: Retrieving the set temperatures display

⇒ To receive another saved set value, press the **U** key again.

The selected temperature value is immediately adopted and targeted.

6.3.7 Setting a gradient control and a temperature profile

It is possible to carry out a gradient control yourself and thus determine the time in which the set temperature is reached. The time can be shorter or longer than the time usually required by the calibrator / micro calibration bath.

When modifying the set temperature or switching on the calibrator / micro calibration bath it is automatically determined which of the gradients (heating gradient “SLor” or cooling gradient “SLoF”) is to be used.

Additionally, you can ensure that the calibrator / micro calibration bath switches to the set temperature in set value memory SP2 as soon as the set temperature in set value memory SP1 has been achieved and after a programmed duration time “dur.t”; this creates a simple temperature profile.

After switching on the calibrator / micro calibration bath the temperature profile is automatically carried out.

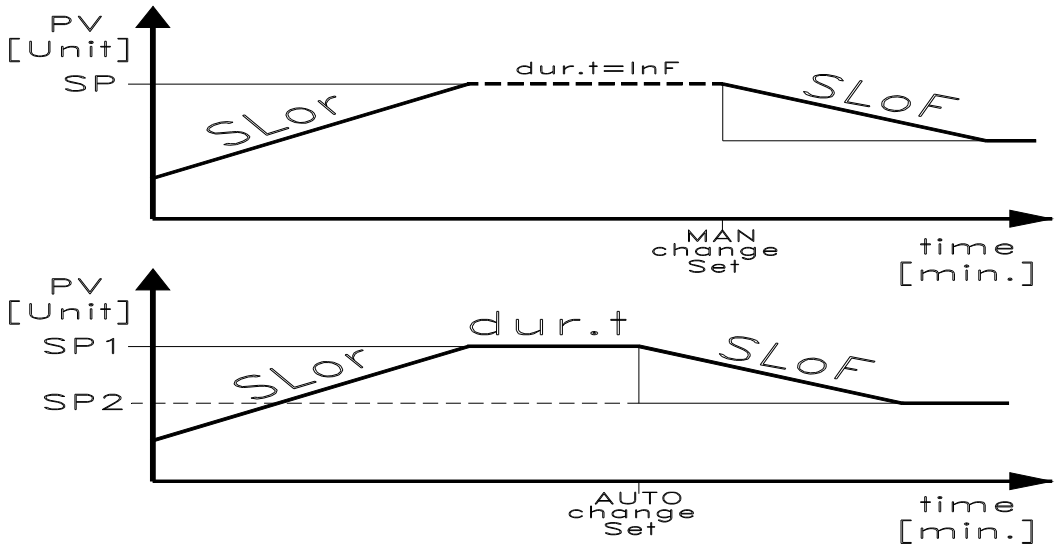


Fig. 35: Gradient control and temperature profile

Heating gradient “SLor”

The heating gradient "SLor" is active if the reference temperature is lower than the set temperature.

Each calibrator type has a max. heating capacity, meaning that only settings < than this heating capacity are reasonable and extend the time until the set temperature is achieved.

Calibrator type (heating/cooling)	Setting for “SLor”	Calibrator type (heating)	Setting for “SLor”
CCD91X999001 (up to165°C)	< 7 °C/min	-	< 35 °C/min
CCD91X999001 (up to 165°C) with silicone oil 20CS	< 3 °C/min	CB 91.999.002 (up to 225°C) with silicone oil 20CS	< 22 °C/min
CCD91X999001 (up to 165°C) with distilled water	< 5 °C/min	CCB91X999002 (up to 225°C) with distilled water	< 12 °C/min

Cooling gradient "SLoF"

The cooling gradient "SLor" is active if the reference temperature is higher than the set temperature.
Only settings below the cooling capacity of the calibrator have an effect on the cooling gradients.

Calibrator type (heating/cooling)	**Setting for "SLoF"**	**Calibrator type (heating)**	**Setting for "SLoF"**
CCD91X999001 (up to 165°C)	< 5 °C/min	-	< 10 °C/min < 5 °C/min
CCD91X999001 (up to 165°C) with silicone oil 20CS	< 6 °C/min	CCB91X999002 (up to 225°C) with silicone oil 20CS 200 °C up to 50 °C 50 °C up to 30 °C	< 4 °C/min < 0,5 °C/min
CCD91X999001 (up to 165°C) with distilled water	< 4 °C/min	CCB91X999002 (up to 225°C) with distilled water 90 °C up to 50 °C 50 °C up to 30 °C	< 2 °C/min < 0,5 °C/min

The **duration time "dur.t"** is active if the set temperature SP1 has been achieved. Subsequently, the calibrator / micro calibration bath automatically switches to set temperature SP2.

Warning:
If you have carried out settings for these three settings, the calibrator / micro calibration bath uses the new values only when modifying the set temperature or switching the calibrator off and on again. A further procedure is to switch off the automatic control prior to modifying parameters (see section 6.3.1), and to switch it on again afterwards (see section 6.3.2).

The heating and cooling gradients and the duration time can be set in the parameter level]rEG.
This is achieved by
Pressing the **P** key for approx. 5 sec., the main menu opens.
OPEr appears on the upper **PV** display.
LED SET flashes on the lower **SV** display.

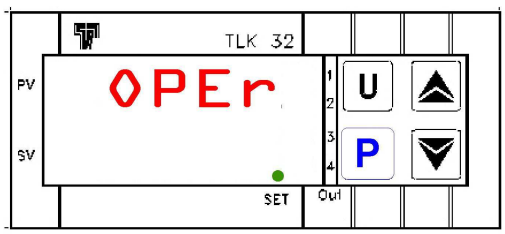


Fig. 36: Operator menu OPEr

⇒ Press the **P** key again, the **group level** opens.
OPEr appears on the upper **PV** display.
]**SP** appears on the lower **SV** display and LED SET flashes.

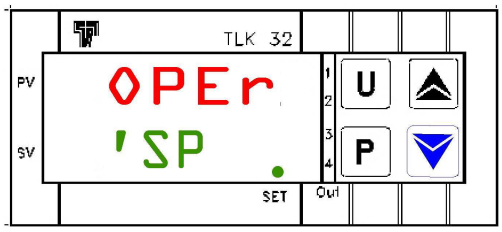


Fig. 37: Group]SP

⇒ Use the ▼ key to select the group]**rEG**.
OPEr appears on the upper **PV** display.
]**rEG** appears on the lower **SV** display and LED SET flashes.

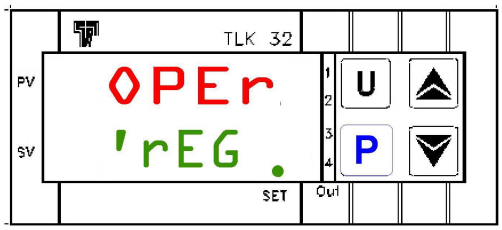


Fig. 38: Group]rEG

⇒ Press the **P** key again, the **parameter level** opens.
]**rEG** appears on the upper **PV** display.
SLor flashes on the lower **SV** display.

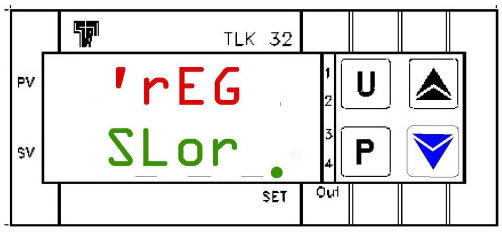


Fig. 39: Parameters for heating gradient SLor

6.3.7.1 Setting the heating gradient

The heating gradient **"SLor"** is active if the reference temperature is lower than the set temperature.
The setting range extends from 99.99 °C/min up to 0.00 °C/min.

Caution! The function is deactivated if SLor = InF (In no Function) has been set.

You are in the **parameter level** (as described in section 5.3.7).
rEG appears on the upper **PV** display.
SLor flashes on the lower **SV** display.

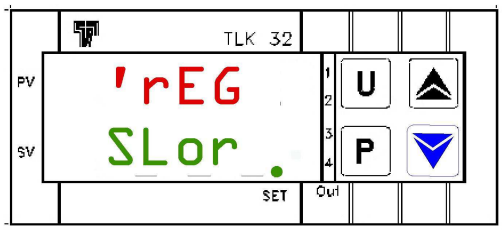


Fig. 40: Parameters for heating gradient SLor

⇒ Press the **P** key.
SLor flashes on the upper **PV** display.
The respective **currently set heating gradient** appears on the lower **SV** display.

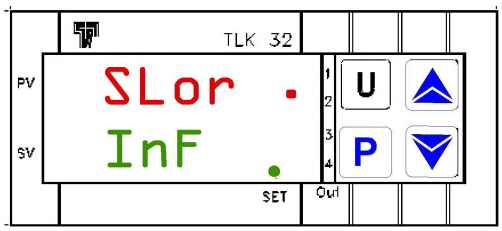


Fig. 41: Heating gradient entry

⇒ Press the ▲ key to **increase** the heating gradient **SLor.**
Press the ▼ key to **decrease** the heating gradient **SLor.**

Note:
Press the ▲ and ▼ key to raise and lower the value by 0.1 respectively. If the keys are held pressed for at least one second, the value increases or decreases quickly and after two seconds even more quickly; this means the desired value can be reached rapidly.

⇒ Press the **P** key to confirm the set heating gradient **SLor**.
The display returns to the parameter level and you can set the other parameters.

Caution! If no key is pressed for approx. 15 seconds, the device automatically returns to a previous level up to the **calibration mode**.

Important:

⇒ After carrying out the settings, the calibrator uses the new values only when modifying the set temperature or switching the calibrator/micro calibration bath off and on again.

6.3.7.1 Setting the cooling gradient

The cooling gradient "**SLoF**" is active if the reference temperature is higher than the set temperature.
The setting range extends from 99.99 °C/min up to 0.00 °C/min.

Caution! The function is deactivated if SLoF = InF (In no Function) has been set.

You are in the **parameter level** (as described in section 5.3.7).
]**rEG** appears on the upper **PV** display.
SLor flashes on the lower **SV** display.

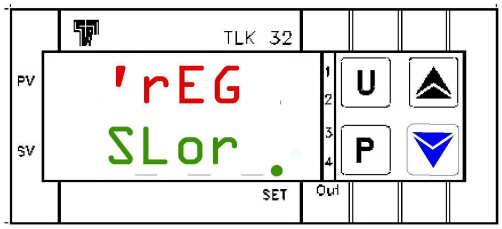


Fig. 42: Parameters for heating gradient SLor

⇒ Use the ▼ or ▼ key to select the parameter **SLoF**.
]**rEG** appears on the upper **PV** display.
SLoF flashes on the lower **SV** display.

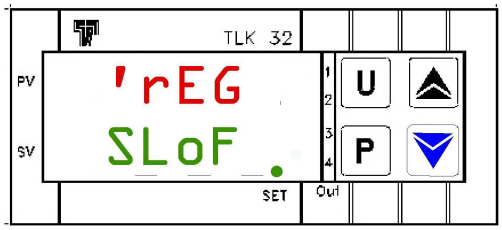


Fig. 43: Cooling gradient entry

⇒ Press the **P** key.
SLoF flashes on the upper **PV** display.
The respective **currently set cooling gradient** appears on the lower **SV** display.

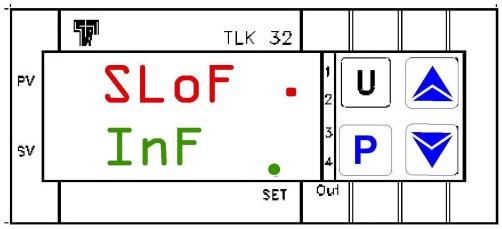


Fig. 44: Display of the cooling gradient input

⇒ Press the ▲ key to **increase** the cooling gradient **SLoF.**

⇒ Press the ▼ key to **decrease** the cooling gradient **SLoF.**

Note:
Press the ▲ and ▼ key to raise and lower the value by 0.1 respectively. If the keys are held pressed for at least one second, the value increases or decreases quickly and after two seconds even more quickly; this means the desired value can be reached rapidly.

Press the **P** key to confirm the set cooling gradient **SLoF**.
The display returns to the parameter level and other parameters can be set.

Caution! If no key is pressed for approx. 15 seconds, the device automatically returns to a previous level up to the **calibration mode**.

Important:

⇒ After carrying out the settings, the calibrator / micro calibration bath uses the new values only when modifying the set temperature or switching the calibrator / micro calibration bath off and on again.

6.3.7.1 Setting the duration time

The duration time **"dur.t"** is active if the set temperature SP1 has been achieved. Subsequently, the calibrator / micro calibration bath automatically switches to set temperature SP2.
The setting range extends from 99:59 [hh:min] to 00:00 [hh:min].

Caution! The function is deactivated if dur.t = InF (In no Function) has been set.

You are in the **parameter level** (as described in section 5.3.7).
]**rEG** appears on the upper **PV** display.
SLor flashes on the lower **SV** display.

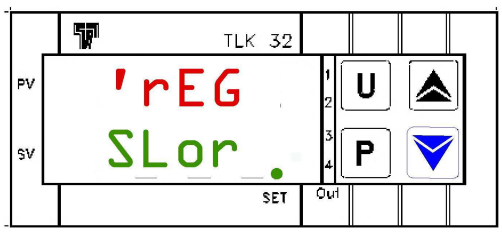


Fig. 45: Parameters for heating gradient SLor

⇒ Use the ▼ or ▼ key to select the parameter **dur.t**.
]**rEG** appears on the upper **PV** display.
dur.t flashes on the lower **SV** display.

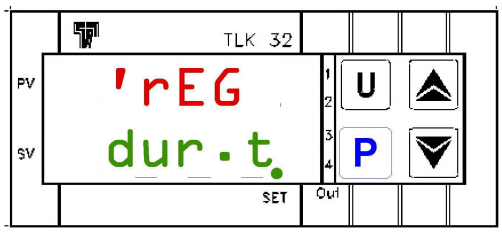


Fig. 46: Parameters for the duration time dur.t

⇒ Press the **P** key.
dur.t flashes on the upper **PV** display.
The respective **currently set duration time** appears on the lower **SV** display.

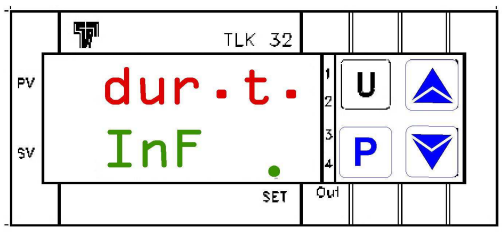


Fig. 47: Duration time entry

⇒ Press the ▲ key to **increase** the duration time **dur.t.**

⇒ Press the ▼ key to **decrease** the duration time **dur.t.**

Note:
Press the ▲ and ▼ key to raise and lower the value by 0.1 respectively. If the keys are held pressed for at least one second, the value increases or decreases quickly and after two seconds even more quickly; this means the desired value can be reached rapidly.

⇒ Press the **P** key to confirm the set duration time dur.t.
The display returns to the parameter level.

Caution! If no key is pressed for approx. 15 seconds, the device automatically returns to a previous level up to the **calibration mode**.

Important:

⇒ After carrying out the settings, the calibrator / micro calibration bath uses the new values only when modifying the set temperature or switching the calibrator / micro calibration bath off and on again.

7 Error Messages

Error	Possible cause	Remedy
- - - -	Interruption of the internal reference sensor or the internal reference sensor is defective.	The controller switches off the power supply to the heating cartridge (servicing required).
uuuu	Measured temperature under the limit value of the internal reference sensor (under range –200 °C)	
oooo	Measured temperature above the limit value of the internal reference sensor (over range +850 °C)	
ErEP	Possible fault in the EEPROM memory of the controller	Press the P key
Fan not running	The fan is defective or blocked	The temperature switch is possibly triggered, switching off the power supply to the heating cartridge (servicing required)
End temperature is not achieved	Solid state relay is defective or the heating / cooling element has short circuited or aged	Servicing required
No display	Controller defective	Servicing required
No function	Network connection not established correctly or fuse defective	Check the network connection and fuse

⇒ If servicing is required, shut down the calibrator / micro calibration bath (see chapter 12) and return it to the manufacturer.

8 Cooling Down of the Metal Block / Liquid Bath

Caution! Risk of burns:

Prior to transport or contact with the metal block / liquid bath ensure that it has cooled down sufficiently; otherwise there is a risk of severe burns at the metal block / liquid bath and the test specimen.

⇒ In order to cool down the metal block / liquid bath quickly, set the set temperature to a low temperature, e.g. room temperature.

The installed fan gently and automatically switches to a higher speed for heating instruments, thus providing more cooling air. The LED **OUT 2** indicates the status of the output for the fan control. If the LED OUT 2 lights up, the fan is running at high speed. If the LED OUT 2 does not light up, the fan is running at low speed.

The controller switches the active cooling on for heating / cooling instruments. The LED **OUT 2** indicates the status of the output for the active cooling. If the LED OUT 2 lights up, the active cooling is running. If the LED OUT 2 does not light up, the cooling is not active.

Caution! After switching off or after removing the mains connection, the installed fan can no longer provide cooling air. Nevertheless, sufficient thermal isolation between the metal block / liquid bath and the housing is still guaranteed.

9 Cleaning and Maintenance

⇒ Allow the calibrator / micro calibration bath to cool down as described in chapter 8.

⇒ Switch the calibrator / micro calibration bath off and disconnect the mains plug.

⇒ **Cleaning calibrators with sleeves:**

A small amount of brass dust is created when operating calibrators with sleeves, this can cause the metal block and sleeve to jam. To prevent this, remove the sleeves from the heating block at regular intervals and if the calibrator is not going to be operated for a longer period, flush the heating block bore with compressed air and clean the bore and sleeve with a dry cloth.

⇒ **Cleaning the fan grille**

Each calibrator is fitted with a small meshed air grille via which cooling air enters the calibrator. Clean the grille at regular intervals (vacuuming or brushing) depending on the level of air pollution.

⇒ **Cleaning the micro calibration bath:**

Drain as much of the silicone oil as possible. Subsequently remove the sensor cage from the tank and clean the cage, magnetic stirrer and the tank with water and plenty of washing-up liquid. Allow everything to dry completely. If you are using distilled water, remove the calibration liquid and allow the sensor cage, magnetic stirrer and tank to dry completely.

⇒ **External cleaning:**

Clean the outside of the calibrator / micro calibration bath with a damp cloth and some water or with a solvent-free mild cleaning agent.

10 Warranty and Repairs

The calibrator/micro calibration bath is under guarantee for 12 months as from the date of delivery for construction errors or material defects. The guarantee is limited to repairs or replacing the calibrator / micro calibration bath.

Warranty shall not apply if the calibrator / micro calibration bath is opened and unauthorized repair work is carried out or if the calibrator / micro calibration bath is not used for its intended purpose or installed incorrectly.

If the calibrator / micro calibration bath malfunctions during or after the warranty period, always contact the tecsis Test & Calibration Department before sending the calibrator / micro calibration bath for repairs.

The defective calibrator / micro calibration bath incl. details of the occurred fault can be sent freight paid to TECSIS, unless other agreements have been made.

11 Recalibrating

The calibrator / micro calibration bath is adjusted and tested with measuring equipment in accordance with recognized national standards prior to delivery.

The calibrator / micro calibration bath should, depending on the application situation, be inspected at appropriate intervals on the basis of DIN ISO 10 012. We recommend you to return the calibrator / micro calibration bath to tecsis at intervals of max. 12 months or approx. 500 operating hours for recalibration and readjustment.

Recalibration is based on the directive DKD R5-4 of the German Calibration Service. The measures described here are applied and considered during recalibration.

12 Decommissioning and Disposal

tecsis ensures correct disposal of used metal block calibrators / micro calibration baths.

⇒ Allow the instrument to cool down as described in chapter 8.

⇒ Switch off the calibrator / micro calibration bath and disconnect the mains plug.

⇒ If necessary, remove any existing calibration liquid from the micro calibration bath (see chapter 9).

Important!
Dispose of the silicone oil in accordance with the specifications on the safety data sheet.

⇒ Send the calibrator / micro calibration bath freight paid to tecsis.

13 Technical Data

13.1 Technical data CCB91

Display range/Setting range	
CCB91X999001 (up to 165°C)	-50,0 °C up to +165,0 °C in 0,1 °C resolution
CCB91X999002 (up to 225°C)	0,0 °C up to +225,0 °C in 0,1 °C resolution
Reference temperature setting range	
CCB91X999001 (up to 165°C) with water	between 0 °C and 100 °C
CCB91X999001 (up to 165°C) with silicone oil	between -30 °C and 165 °C
CCB91X999002 (up to 225°C) with water	between room temperature and 100 °C
CCB91X999002 (up to 225°C) with silicone oil	between room temperature and 225 °C
Block temperature control	via PID controller
Setting the reference temperature	via the P key and the ▲ or ▼ key to 0.1 °C fine adjustment occurs automatically
Accuracy	
CCB91X999001 (up to 165°C)	+/- 0,2 K
CCB91X999002 (up to 225°C)	+/- 0,3 K
Control stability	
CCB91X999001 (up to 165°C)/ CCB91X999002 (up to 225°C)	+/-0,05 °C
Block temperature display	4-digit, 7-segment LED, 7mm high red = PV, green = SV
Display resolution	+/- 0.1 °C
Influence of the operating temperature	
(0...50 °C) to the accuracy	+/- 0.02 °C/°C
Excess temperature behaviour	temperature fuses interrupt the power supply if there is excess temperature inside the housing
Sensor break behaviour	the control is switched off
Display unit	°C or °F (optional)
Display for sensor break	- - - -
Detection speed	130 ms
Controller outputs	1 x voltage output for control of the solid state relay (8 mA/ 8 VDC), heater control 1 x voltage output for control of the solid state relay (8 mA/ 8 VDC), cooling control 1 x relay SPDT (8 A-AC1, 3 A-AC3 / 250 VAC) 100,000 switching cycle, fan control

Power supply		
CCB91X999001 (up to 165°C)	90…240 VAC +/- 10 %, 50/60 Hz	
CCB91X999002 (up to 225°C)	230 VAC –15 % / +10 %, 50/60 Hz	
	optional 115 VAC –20 % / +10 %, 50/60 Hz	
Power consumption		
CCB91X999001 (up to 165°C)	approx. 400 VA	
CCB91X999002 (up to 225°C)	approx. 1000 VA	
Fuse		
CCB91X999001 (up to 165°C)	6.3 A slow	(for 90…240 VAC)
CCB91X999002 (up to 225°C)	6.3 A slow	(for 230 VAC)
	10.0 A slow	(for 115 VAC)
Operating temperature	0...50 °C	
Moisture in the operating area	30...95 %rH not condensing	
Transport and storage temperature	-10...60 °C	
Degree of protection	IP 20	
Serial interface type	RS 485 optoisolated	
Communication protocol	MODBUS RTU (JBUS)	
Serial transfer speed	9600 baud	
Test specimen holder		
CCB91X999001 (up to 165°C)/	Bore	∅ 60 mm
CCB91X999002 (up to 225°C)	Depth	150 mm
Housing dimensions		
CCB91X999001 (up to 165°C)	Width	approx. 210 mm
	Height	approx. 425 mm
	Depth	approx. 300 mm
CCB91X999002 (up to 225°C)	Width	approx. 150 mm
	Height	approx. 400 mm
	Depth	approx. 270 mm
Weight		
CCB91X999001 (up to 165°C)	approx. 12 kg	
CCB91X999002 (up to 225°C)	approx. 7,9 kg	
Sensor cage	Magnetic stirrer protection	
	Working depth 150 mm	

13.3 Technical data CCD91

Display range/Setting range	
CCD91X999001 (up to 165°C)	-50,0 °C up to +165,0 °C in 0,1 °C resolution
CCD91X999002 (up to 450°C)	0,0 °C up to +450,0 °C in 0,1 °C resolution
CCD91X999003 (up to 650°C)	0,0 °C up to +650,0 °C in 0,1 °C resolution
Reference temperature setting range	
CCD91X999001 (up to 165°C)	between -30 °C and 165 °C
CCD91X999002 (up to 450°C)	between room temperature and 450 °C
CCD91X999003 (up to 650°C)	between room temperature and 650 °C
Block temperature control	via PID controller
Setting the reference temperature	via the P key and the ▲ or ▼ key to 0.1 °C fine adjustment occurs automatically
Accuracy	
CCD91X999001 (up to 165°C)	+/- 0,15 … 0,25 K
CCD91X999002 (up to 450°C)	+/- 0,30 … 0,50 K
CCD91X999003 (up to 650°C)	+/- 0,30 … 0,80 K
Control stability	+/-0.05 °C
Block temperature display	4-digit, 7-segment LED, 7mm high red = PV, green = SV
Display resolution	+/- 0.1 °C
Influence of the operating temperature	
(0...50 °C) to the accuracy	+/- 0.02 °C/°C
Excess temperature behaviour	temperature fuses interrupt the power supply if there is excess temperature inside the housing
Sensor break behaviour	the control is switched off
Display unit	°C or °F (optional)
Display for sensor break	- - - -
Detection speed	130 ms
Controller outputs	1 x voltage output for control of the solid state relais (8 mA/ 8 VDC), heater control 1 x voltage output for control of the solid state relais (8 mA/ 8 VDC), cooling control 1 x relais SPDT (8 A-AC1, 3 A-AC3 / 250 VAC) 100,000 switching cycle, fan control

Power supply

CCD91X999001 (up to 165°C)	90…240 VAC +/- 10 %, 50/60 Hz
CCD91X999002 (up to 450°C)	230 VAC –15 % / +10 %, 50/60 Hz
CCD91X999003 (up to 650°C)	230 VAC –15 % / +10 %, 50/60 Hz
	optional 115 VAC –20 % / +10 %, 50/60 Hz

Power consumption

CCD91X999001 (up to 165°C)	approx. 400 VA
CCD91X999002 (up to 450°C)	approx. 2000 VA
CCD91X999003 (up to 650°C)	approx. 1000 VA

Fuse

CCD91X999001 (up to 165°C)	6.3 A slow	(for 90…240 VAC)
CCD91X999002 (up to 450°C)	10.0 A slow	(for 230 VAC)
CCD91X999003 (up to 650°C)	6.3 A slow	(for 230 VAC)
	10.0 A slow	(for 115 VAC)

Operating temperature	0...50 °C
Moisture in the operating area	30...95 % rH not condensing
Transport and storage temperature	-10...60 °C
Degree of protection	IP 20
Serial interface type	RS 485 optoisolated
Communication protocol	MODBUS RTU (JBUS)
Serial transfer speed	9600 Baud

Test specimen holder

TP 165 S	bore	∅ 28 mm
	depth	150 mm
TP 450 S	bore	∅ 60 mm
	depth	150 mm
TP 650 S	bore	∅ 28 mm
	depth	150 mm

Housing dimensions

CCD91X999001 (up to 165°C)	width	approx. 210 mm
	height	approx. 425 mm
	depth	approx. 300 mm
CCD91X999003 (up to 650°C)	width	approx. 150 mm
	height	approx. 400 mm
	depth	approx. 270 mm

Weight

CCD91X999001 (up to 165°C)	approx. 11 kg
CCD91X999002 (up to 450°C)	approx. 7,5 kg
CCD91X999003 (up to 650°C)	approx. 8 kg

Sleeves for smaller

1x	blanc, unbored
1x 1,5 mm	for thermometers to 1,2 mm diameter
1x 2,0 mm	for thermometers to 1,6 mm diameter
1x 3,0 mm	for thermometers to 2,7 mm diameter
1x 3,5 mm	for thermometers to 3,2 mm diameter
1x 5,0 mm	for thermometers to 4,7 mm diameter
1x 6,5 mm	for thermometers to 6,3 mm diameter
1x 7,5 mm	for thermometers to 7,2 mm diameter
1x 8,5 mm	for thermometers to 8,2 mm diameter
1x 10 mm	for thermometers to 9,5 mm diameter
1 x 3.2 mm und 1 x 6,3 mm	dual bore inserts, e.g. for probe and reference
2 x 3.2 mm, 1 x 4.2 mm, 1 x 6.3 mm, 1 x 8.4 mm und 1 x 9,5 mm	multiple bore insert
others upon request	

13.4 Heating and cooling periods

13.4.1 CCB91X999001

Measuring conditions:

- All heating and cooling periods are related to a reference Pt100 probe, Ø 6 mm, stainless steel sheath
- The reference sensor is located 5 mm above the protective basket in the middle of the tank
- All heating and cooling periods do not include stabilisation time
- The measurements were carried out at a room temperature of approx. 23 °C with bath without cover

With distilled water

Heating up:	Period
2 °C to 25 °C	5:31 min
25 °C to 50 °C	6:49 min
50 °C to 75 °C	8:07 min
75 °C to 90 °C	6:19 min

Cooling down:	Period
90 °C to 75 °C	3:09 min
75 °C to 50 °C	7:06 min
50 °C to 25 °C	10:18 min
25 °C to 2 °C	14:52 min

With silicone oil 5 CS

Heating up:	Period
-30 °C to -25 °C	0:56 min
-25 °C to -15 °C	1:06 min
-15 °C to 0 °C	1:18 min
0 °C to 25 °C	2:46 min
25 °C to 50 °C	2:37 min
50 °C to 75 °C	3:10 min
75 °C to 100 °C	4:23 min
100 °C to 120 °C	5:05 min

Cooling down:	Period
120 °C to 100 °C	2:24 min
100 °C to 75 °C	3:40 min
75 °C to 50 °C	4:48 min
50 °C to 25 °C	6:41 min
25 °C to 0 °C	8:50 min
0 °C to -15 °C	10:36 min
-15 °C to -25 °C	15:01 min
-25 °C to -30 °C	23:19 min

With silicone oil 10 CS

Heating up:	Period
-30 °C to -25 °C	1:17 min
-25 °C to -15 °C	1:17 min
-15 °C to 0 °C	1:20 min
0 °C to 25 °C	1:56 min
25 °C to 50 °C	2:30 min
50 °C to 75 °C	3:13 min
75 °C to 100 °C	4:24 min
100 °C to 125 °C	6:47 min
125 °C to 150 °C	12:51 min
150 °C to 165 °C	18:21 min

Cooling down:	Period
165 °C to 150 °C	1:54 min
150 °C to 125 °C	2:37 min
125 °C to 100 °C	3:11 min
100 °C to 75 °C	3:59 min
75 °C to 50 °C	5:02 min
50 °C to 25 °C	6:57 min
25 °C to 0 °C	8:26 min
0 °C to -15 °C	9:58 min
-15 °C to -25 °C	15:33 min
-25 °C to -30 °C	29:45 min

With silicone oil 20 CS

Heating up:	Period
-30 °C to -25 °C	1:14 min
-25 °C to -15 °C	1:11 min
-15 °C to 0 °C	1:31 min
0 °C to 25 °C	2:39 min
25 °C to 50 °C	2:59 min
50 °C to 75 °C	4:17 min
75 °C to 100 °C	5:18 min
100 °C to 125 °C	7:09 min
125 °C to 150 °C	12:06 min
150 °C to 165 °C	21:04 min

Cooling down:	Period
165 °C to 150 °C	1:37 min
150 °C to 125 °C	2:38 min
125 °C to 100 °C	3:16 min
100 °C to 75 °C	3:47 min
75 °C to 50 °C	4:33 min
50 °C to 25 °C	5:57 min
25 °C to 0 °C	7:49 min
0 °C to -15 °C	10:17 min
-15 °C to -25 °C	15:19 min
-25 °C to -30 °C	20:52 min

With silicone oil 50 CS

Heating up:	Period
-30 °C to -25 °C	1:53 min
-25 °C to -15 °C	1:22 min
-15 °C to 0 °C	1:38 min
0 °C to 25 °C	2:46 min
25 °C to 50 °C	3:15 min
50 °C to 75 °C	3:52 min
75 °C to 100 °C	5:08 min
100 °C to 125 °C	6:56 min
125 °C to 150 °C	11:38 min
150 °C to 165 °C	17:04 min

Cooling down:	Period
165 °C to 150 °C	1:59 min
150 °C to 125 °C	2:31 min
125 °C to 100 °C	2:58 min
100 °C to 75 °C	3:17 min
75 °C to 50 °C	4:13 min
50 °C to 25 °C	6:40 min
25 °C to 0 °C	9:17 min
0 °C to -15 °C	11:46 min
-15 °C to -25 °C	16:55 min
-25 °C to -30 °C	23:38 min

13.4.2 CCB91X999002

Measuring conditions:

- All heating and cooling periods are related to a reference Pt100 probe, Ø 6 mm, stainless steel sheath
- The reference sensor is located 5 mm above the protective basket in the middle of the tank
- All heating and cooling periods do not include stabilisation time
- The measurements were carried out at a room temperature of approx. 23 °C with bath without cover

With distilled water

Heating up:	Period
25 °C to 40 °C	0:55 min
40 °C to 50 °C	0:37 min
50 °C to 75 °C	1:27 min
75 °C to 90 °C	1:30 min

Cooling down:	Period
90 °C to 75 °C	5:53 min
75 °C to 50 °C	15:17 min
50 °C to 40 °C	10:50 min
40 °C to 25 °C	45:26 min

With silicone oil 5 CS

Heating up:	Period
25 °C to 40 °C	0:51 min
40 °C to 50 °C	0:16 min
50 °C to 75 °C	0:54 min
75 °C to 100 °C	1:13 min
100 °C to 120 °C	1:35 min

Cooling down:	Period
120 °C to 100 °C	3:27 min
100 °C to 75 °C	5:55 min
75 °C to 50 °C	10:00 min
50 °C to 40 °C	7:02 min
40 °C to 25 °C	34:28 min

With silicone oil 10 CS

Heating up:	Period
25 °C to 40 °C	0:52 min
40 °C to 50 °C	0:22 min
50 °C to 75 °C	0:52 min
75 °C to 100 °C	0:53 min
100 °C to 125 °C	0:59 min
125 °C to 150 °C	1:12 min
150 °C to 165 °C	1:03 min

Cooling down:	Period
165 °C to 150 °C	1:40 min
150 °C to 125 °C	3:17 min
125 °C to 100 °C	4:14 min
100 °C to 75 °C	5:59 min
75 °C to 50 °C	9:59 min
50 °C to 40 °C	7:00 min
40 °C to 25 °C	31:40 min

With silicone oil 20 CS

Heating up:	Period
25 °C to 40 °C	1:20 min
40 °C to 50 °C	0:22 min
50 °C to 75 °C	0:50 min
75 °C to 100 °C	0:48 min
100 °C to 125 °C	0:52 min
125 °C to 150 °C	0:58 min
150 °C to 165 °C	0:37 min
165 °C to 200 °C	1:39 min
200 °C to 225 °C	2:50 min

Cooling down:	Period
225 °C to 200 °C	2:08 min
200 °C to 165 °C	3:21 min
165 °C to 150 °C	1:46 min
150 °C to 125 °C	3:23 min
125 °C to 100 °C	4:30 min
100 °C to 75 °C	6:19 min
75 °C to 50 °C	10:30 min
50 °C to 40 °C	7:35 min
40 °C to 25 °C	40:02 min

With silicone oil 50 CS

Heating up:	Period
25 °C to 40 °C	1:18 min
40 °C to 50 °C	0:21 min
50 °C to 75 °C	0:48 min
75 °C to 100 °C	0:46 min
100 °C to 125 °C	0:47 min
125 °C to 150 °C	0:57 min
150 °C to 165 °C	0:40 min
165 °C to 200 °C	1:57 min
200 °C to 225 °C	4:11 min

Cooling down:	Period
225 °C to 200 °C	2:37 min
200 °C to 165 °C	3:25 min
165 °C to 150 °C	1:47 min
150 °C to 125 °C	3:31 min
125 °C to 100 °C	4:21 min
100 °C to 75 °C	6:04 min
75 °C to 50 °C	10:17 min
50 °C to 40 °C	7:09 min
40 °C to 25 °C	35:40 min

13.4.3 CCD91X999001

Measuring conditions:

- All heating and cooling periods are related to a reference Pt100 probe, Ø 6 mm, stainless steel sheath
- All heating and cooling periods do not include stabilisation time
- At full depth the reference sensor is located in the middle of the sleeve
- The measurements were carried out at a room temperature of approx. 23 °C

Heating up:	Period
-30 °C to -25 °C	0:32 min
-25 °C to -15 °C	0:56 min
-15 °C to 0 °C	1:19 min
0 °C to 25 °C	2:15 min
25 °C to 50 °C	2:42 min
50 °C to 75 °C	3:09 min
75 °C to 100 °C	4:17 min
100 °C to 125 °C	4:30 min
125 °C to 150 °C	5:46 min
150 °C to 165 °C	5:31 min

Cooling down:	Period
165 °C to 150 °C	1:13 min
150 °C to 125 °C	1:54 min
125 °C to 100 °C	2:11 min
100 °C to 75 °C	2:38 min
75 °C to 50 °C	3:13 min
50 °C to 25 °C	4:16 min
25 °C to 0 °C	6:26 min
0 °C to -15 °C	6:08 min
-15 °C to -25 °C	7:03 min
-25 °C to -30 °C	6:21 min

13.4.4 CCD91X999002

Measuring conditions

- All heating and cooling periods are related to a reference Pt100 probe, Ø 6 mm, stainless steel sheath.
- All heating and cooling periods do not include stabilisation time
- At full depth the reference sensor is located in the middle of the sleeve
- The measurements were carried out at a room temperature of approx. 23 °C

Heating up:	Period
25 °C to 40 °C	1:00 min
40 °C to 50 °C	0:31 min
50 °C to 100 °C	1:38 min
100 °C to 150 °C	1:23 min
150 °C to 200 °C	1:16 min
200 °C to 250 °C	1:18 min
250 °C to 300 °C	1:23 min
300 °C to 350 °C	1:33 min
350 °C to 400 °C	1:53 min
400 °C to 450 °C	2:33 min

Cooling down:	Period
450 °C to 400 °C	5:36 min
400 °C to 350 °C	5:10 min
350 °C to 300 °C	6:06 min
300 °C to 250 °C	7:28 min
250 °C to 200 °C	9:14 min
200 °C to 150 °C	12:07 min
150 °C to 100 °C	18:00 min
100 °C to 50 °C	37:01 min
50 °C to 40 °C	15:45 min
40 °C to 25 °C	50:53 min

13.4.5 CCD91X999003

Measuring conditions

- All heating and cooling periods are related to a reference Pt100 probe, Ø 6 mm, stainless steel sheath.
- All heating and cooling periods do not include stabilisation time
- At full depth the reference sensor is located in the middle of the sleeve
- The measurements were carried out at a room temperature of approx. 23 °C

Heating up:	Period
25 °C to 40 °C	0:54 min
40 °C to 50 °C	0:22 min
50 °C to 100 °C	1:18 min
100 °C to 150 °C	1:06 min
150 °C to 200 °C	1:03 min
200 °C to 250 °C	1:05 min
250 °C to 300 °C	1:06 min
300 °C to 350 °C	1:09 min
350 °C to 400 °C	1:21 min
400 °C to 450 °C	1:30 min
450 °C to 500 °C	1:32 min
500 °C to 550 °C	1:38 min
550 °C to 600 °C	1:55 min
600 °C to 650 °C	2:33 min

Cooling down:	Period
650 °C to 600 °C	2:25 min
600 °C to 550 °C	2:33 min
550 °C to 500 °C	2:55 min
500 °C to 450 °C	3:27 min
450 °C to 400 °C	4:01 min
400 °C to 350 °C	4:39 min
350 °C to 300 °C	5:36 min
300 °C to 250 °C	6:46 min
250 °C to 200 °C	8:32 min
200 °C to 150 °C	11:22 min
150 °C to 100 °C	17:01 min
100 °C to 50 °C	52:37 min
50 °C to 40 °C	15:23 min
40 °C to 25 °C	1:01:58 min

tecsis GmbH

Carl-Legien-Straße 40
D-63073 Offenbach am Main
Telefon: +49 69 5806-0
Telefax: +49 69 5806-177
E-Mail: info@tecsis.de
Internet: www.tecsis.de