LAUDA

Operating instructions

Variocool
VC 1200 (W), VC 2000 (W), VC 3000 (W), VC 5000 (W), VC 7000 (W), VC 10000 (W)
Circulation chiller

CE

Read the instructions prior to performing any task!

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Translation of the original operating instructions

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1 Safety

1.1 General safety instructions

- The devices must only be operated for the intended purpose under the conditions stated in this operating manual. Any other operating mode is considered to be non-intended use and can impair the protection provided by the device.
- The devices are not designed for use under medical conditions in accordance with DIN EN 60601-1 or IEC 601-1!
- The operating manual is a constituent part of the device. The information in this operating manual must therefore be available in the immediate vicinity of the device. Also take care to keep this copy of the operating manual.

If you lose this operating manual, contact the LAUDA Constant Temperature Equipment service department. The contact details can be found in Chapter 13.4 ‘LAUDA contact’ on page 102*.*

Use of the device results in hazards from high and low temperatures and from the use of electrical energy. The hazards arising from the device have been eliminated as far as possible by the design in accordance with the applicable standards. Residual hazards are reduced using any of the following measures:

- If relevant, there are safety fittings for the device. These devices are essential for the safety of the device. Their functionality must be ensured by carrying out the appropriate maintenance activities.

  The safety fittings of the device are described in this "Safety" chapter.
- If relevant, there are warning symbols on the device. These symbols must always be observed.

  The warning symbols on the device are described in this “Safety” chapter.
- There are safety instructions in this operating manual. These instructions must always be observed.
- There are additional specific requirements for the staff and for the personal protective equipment.

  These requirements are described in this "Safety" chapter.

An overview of the authorised personnel and the protective equipment can be found in Chapter 1.12 ‘Personnel qualification’ on page 10 *and* Chapter 1.13 ‘Personal protective equipment’ on page 11*.*

Further information about the general structure of safety instructions can be found in Chapter 1.15 ‘Structure of warnings’ on page 11*.*

1.2 Take note of additional operating instructions

Interface modules

The device can be equipped with additional interface modules. Installation and use of interface modules requires that the respective operating instructions of the interface module are read and adhered to.

1.3 Intended Use

Intended use

The present device is exclusively permitted to be used for tempering and delivering non-flammable heat transfer liquids in a closed circuit.

Non-intended use

The following applications are considered to be non-intended:

- in potentially explosive areas
- for tempering foodstuffs
- with a glass reactor without overpressure protection

1.4 Foreseeable misuse

Misuse of the device must always be prevented.

Among other things, the following uses are considered to be foreseeable misuse:

- Operation of the device without heat transfer liquid
- Incorrect connection of hoses
- Setting the device up on a tabletop surface
- Setting an incorrect pump pressure

1.5 EMC requirements

Tab. 1: Classification in accordance with EMC requirements

Device	Interference immunity	Emission class	Customer power supply
Variocool	Type 2 in accordance with DIN EN 61326-1	Emission class B in accordance with CISPR 11	only for EU Domestic connection value ≥ 100 A
Variocool	Type 2 in accordance with DIN EN 61326-1	Emission class B in accordance with CISPR 11	for rest of the world (outside EU) Unrestricted

1.6 Software versions

These operating instructions are valid for devices using the following software versions onwards.

Software	valid from version
Command operating system	3.45
Control system	1.35
Analogue IO module	3.24
RS 232/485 module	3.22
Digital IO module	3.14
External temperature module	1.35
Ethernet module	1.23
EtherCAT module	1.06

1.7 No modifications may be made to the device

Any modification of the device by the user is prohibited. The consequences of any such modifications are not covered by the product warranty or customer service. Service work is only permitted to be carried out by the LAUDA Constant Temperature Equipment service department or one of the service partners authorised by LAUDA.

1.8 Requirements for the heat transfer liquid

- Heat transfer liquids are used for temperature control. Only LAUDA heat transfer liquids are approved for use in the device. LAUDA heat transfer liquids are tested and approved by LAUDA DR. R. WOBSER GMBH & CO. KG
- In each case, the heat transfer liquids cover a specific temperature range. This temperature range must match the temperature range of your application.
- The use of heat transfer liquids can cause hazards arising from high and low temperatures, and fire, if certain temperature thresholds are exceeded or if the temperature falls below the threshold value, or if the container breaks and there is a reaction with the heat transfer liquid.
- The safety data sheet specifies the hazards and appropriate safety measures for handling the heat transfer liquid. The safety data sheet of the heat transfer liquid must therefore be consulted for the intended use of the device.

1.9 Materials

All parts coming into contact with the heat transfer liquid are made of high quality materials suitable for the operating temperature. High-quality stainless steel, copper, brass and temperature-resistant plastics are used.

1.10 Requirements regarding the hoses

Only LAUDA hoses must be used for the external hydraulic circuit. LAUDA hoses are hoses approved by LAUDA DR. R. WOBSER GMBH & CO. KG. Particular attention must be paid to the permissible temperature range and the maximum permissible pressure when selecting suitable hoses for the application.

1.11 Application area

The device is exclusively permitted to be used in the following areas:

- Commercial area
- Indoor use
  Outdoor installation is also possible with appropriate equipment.
- Ambient temperature range from 5 to 40 °C
  Ambient temperature range with outdoor installation from -20 to 40 °C
- Maximum relative air humidity 80% for temperatures up to 31 °C, decreasing linearly to 50% relative air humidity at 40 °C
- Altitude up to a maximum of 2,000 m above sea level
- Mains voltage fluctuations up to ± 10% of the rated voltage
- Overvoltage category II
- Contamination level 2
- Storage temperature range from 5 to 40 °C
- Transport temperature range from -20 to 43 °C

1.12 Personnel qualification

Operating personnel
Operating personnel are personnel who have been instructed by specialist personnel about the intended use of the device according to the operating manual.

Specialist
Specific activities on the device must be carried out by technical staff. Technical staff is personnel that can evaluate functions and risks of the device and the application based on their training, skills and experience.

1.13 Personal protective equipment

Protective clothing
Protective clothing is required for certain activities. This protective clothing must comply with the legal requirements for personal protective equipment. Protective clothing should have long sleeves. Safety footwear is additionally required.

Protective gloves
CE protective gloves are required for certain activities. These protective gloves must comply with the legal requirements for personal protective equipment of the European Union.

Protective goggles
Protective goggles are required for certain activities. These protective goggles must comply with the legal requirements for personal protective equipment of the European Union.

1.14 Product safety label

Hot

The graphic symbol “Hot surface” is applied to the device. This symbol warns about hot surfaces on the device. These surfaces must not be touched during operation. To be able to touch these surfaces during other life cycles such as e.g. during maintenance, they must be cooled down to room temperature.

1.15 Structure of warnings

Danger

- A warning of the type "Danger" indicates an **imminently hazardous** situation.
- This will result in **death** or **severe, irreversible injuries** if the warning is disregarded.

DANGER! **Type and source**	
	Consequences in the event of non-compliance
	• Measure 1 • Measure…

Warning

- A warning of the type "Warning" indicates a **potentially hazardous** situation.
- This can result in **death** or **severe, irreversible injuries** if the warning is disregarded.

WARNING!
Type and source

Consequences in the event of non-compliance

- Measure 1
- Measure…

Caution

- A warning of the type "Caution" indicates a **potentially hazardous** situation.
- This can result in **minor, reversible injuries** if the warning is disregarded.

CAUTION!
Type and source

Consequences in the event of non-compliance

- Measure 1
- Measure…

Notice

A "notice" warns about possible property or environmental damage.

NOTICE!
Type and source

Consequences in the event of non-compliance

- Measure 1
- Measure…

2 Unpacking

DANGER!
Transport damage

Electric shock

- Inspect the device for transport damage before commissioning.
- Never put the device into operation if you have discovered any transport damage.

Personnel: ■ Operating personnel

1. Unpack the device.

Keep the original packaging of your device for later transport.

2. Inspect the device and the accessories immediately after delivery for completeness and transport damage.

If there is unexpected damage to the device or accessories, inform the carrier immediately so that a damage report is produced and a check of the transport damage can be made. Also inform LAUDA Service Constant Temperature Equipment immediately. Contact details can be found in ↳ Chapter 13.4 ‘LAUDA contact’ on page 102.

Tab. 2: Accessories included as standard

Device type	Designation	Quantity	Catalogue number
VC 1200 (W) to VC 5000 (W)	Pump connection: ¾" hose nozzle with ¾" screw cap	2	EOA 004
VC 7000 (W) and VC 10000 (W)	Pump connection: 1" hose nozzle with 1¼" screw cap	2	EOA 003
Devices with water cooling	½" hose nozzle with ¾" screw cap	2	EOA 001
All devices	Operating manual	1	--

3 Device description

3.1 Device types

The type designation of the devices is composed of the following components.

Element	Description
VC	Variocool
<Number>, e.g. 5000	Specification of the cooling capacity in watts [W] at 20 °C
W	Device with water cooling This specification in the device type is optional. It identifies water-cooled devices.

- All device types can be equipped with a heater ex factory to heat the heat transfer liquid.
- All device types are also available without a heater, in which case they can only be used for cooling.
- All devices are equipped with a bypass to regulate the pump pressure.
- All devices are intended as floor-standing equipment. The devices have castors with locking brakes.

3.2 Design of the device

Fig. 1: Front

1 Filler nozzle with cover
2 Control panel
3 Manometer
4 Mains switch
5 Alarm output (interface 12N) and module slots
6 Front panel (ventilation openings only on air-cooled devices)
7 Ventilation openings (on both sides)
8 Four castors (front castors with locking brakes)

Fig. 2: Rear VC 5000 W

1 Pump connection, outlet
2 Bypass adjustment wheel
3 Pump connection, inlet
4 Drain tap
5 Connection nozzle for water cooling return (only present on water-cooled devices)
6 Connection nozzle for water cooling inlet (only present on water-cooled devices)
7 Ventilation grid
8 Type plate
9 Mains cable
10 Fuses (up to and including VC 3000 (W))

Control panel

Fig. 3: Control panel

1 Light sensor
2 Manometer
3 Mains switch
4 ENTER button and arrow buttons
5 Softkeys (left and right)
6 USB interface Type B (on the side of the control panel)
7 TFT display

3.3 Operating elements

3.3.1 Mains switch

VC 3000 (W) and lower

The mains power switch can be toggled between the following positions:

- In position [I], the device is switched on.
- In position [O], the device is switched off.

VC 5000 (W) and higher

The mains power switch can be turned to the following positions:

- In position [I], the device is switched on.
- In position [O], the device is switched off.

3.3.2 Screen buttons

Fig. 4: Screen buttons

1 Arrow buttons
2 ENTER button
3 Soft keys

Functions on the screen of the device can be controlled using the screen buttons.

- The UP, DOWN, RIGHT and LEFT arrow buttons can be used to navigate in the screen.
- A selection in the screen can be confirmed with the ENTER button.
- You can control can buttons functions shown in the display with the soft keys.

3.4 Functional elements

3.4.1 Hydraulic circuit

Fig. 5: Manometer

The hydraulic circuit designates the circuit through which the heat transfer liquid flows.

The circuit basically consists of the following components:

- Internal balancing bath with heat transfer liquid
- Immersion pump to convey the heat transfer liquid to the external consumer via the pump connections
- Adjustable bypass with manometer to adjust the pump pressure to the requirements of the external consumer.
- Heater in the bath boiler to heat the heat transfer liquid (the same devices are available without a heater)
- Cooling coil in the bath boiler to cool the heat transfer liquid

Detailed information about the technical data of the pump can be found in ↳ Chapter 11.4 ‘Filling volume and characteristics of the pumps’ on page 96.

3.4.2 Refrigeration unit

The refrigeration unit includes the following components:

- Compressor
  A reciprocating compressor is used in the refrigeration unit. The compressor is equipped with a motor circuit breaker which trips on the compressor temperature and compressor current consumption.
- Condenser
  Depending on the device type, an air-cooled or water-cooled condenser is used in the refrigeration unit. For air-cooled condensers, the heated air is discharged to the environment. The fresh air is sucked in through the front of the device using a fan, heated and discharged on the rear of the device. In water-cooled condensers, the heat is dissipated via the cooling water circuit.
- Evaporator
  In the internal bath, heat is discharged with a pipe coil evaporator.

Technical information for the refrigeration unit can be found in ↳ Chapter 11.2 ‘Cooling capacity’ on page 95.

3.4.3 Interfaces

A general overview of the standard interfaces and the optional interface modules of the device can be found in the following sections.

The equipment connected to the low-voltage inputs and low-voltage outputs must have safe separation from dangerous to touch voltages according to DIN EN 61140 such as by the use of double or reinforced insulation according to DIN EN 60730-1 or DIN 60950-1.

The installation of these additional interface modules is described in these operating instructions. Further information regarding wiring and the use of these interface modules is provided in the separate operating instructions for the interface modules. The respective operating instructions must be consulted regarding appropriate use.

USB interface

The devices are equipped with a USB interface (type B) as standard. This interface enables connection to a PC. Software updates are installed on the device via this interface (only for updaters, no process interface).

Alarm output

The devices are equipped with an alarm output as standard equipment. This changeover contact is switched if the device changes to the standby state or if an alarm is triggered. Reverse flow protection can be activated in this way or faults can be registered on a system.

Additional interface modules

Devices can be supplemented with additional interface modules.

- The **analogue module** (catalogue number LRZ 912) has 2 inputs and 2 outputs on a 6-pin DIN socket. The inputs and outputs can be adjusted independently as 0 – 20 mA, 4 – 20 mA or 0 – 10 V interfaces. For power supply of an external sensor with evaluation electronics, the socket is supplied with 20 V.
- The **RS 232/485 interface module** (catalogue no. LRZ 913) is designed as a 9-pin SUB-D socket. Galvanically separated by an optocoupler. The RS 232 interface can be connected directly with the PC using a straight-through cable. The LAUDA command set makes the interface module compatible with the product lines ECO, Variocool, Proline, Proline Kryomat, PRO, Integral XT and Integral T.

- The **contact module** (catalogue number LRZ 914) is designed as a connector according to NAMUR NE28. This contact module is designed to be identical to the LRZ 915, but with only 1 output and 1 input each on 2 sockets. The coupling socket (catalogue number EQD 047) and the coupling plug (catalogue number EQS 048) are 3-pin connectors.
- The **contact** (catalogue number LRZ 915) is designed as a 15-pin SUB-D socket. With 3 relay contact outputs (changeover contact, maximum 30 V / 0.2 A) and 3 binary inputs for control via external potential-free contacts.
- **Profibus module** (order number LRZ 917). The Profibus is a bus system with a high signal data transfer rate for the connection of to up to 256 devices and is mainly used in the chemical industry.
- **Pt100- / LiBus module** (catalogue number LRZ 918). An external temperature probe can be connected to the Pt100 interface of the module. The Command remote control can be used with the constant temperature equipment via the LiBus interface. A solenoid valve for cooling water control, reverse flow protection or a flow through cooler can, for example be connected in this way.
- **LiBus module** (catalogue number LRZ 920). The Command remote control can be used with the constant temperature equipment via the LiBus connection. It is also possible to connect additional modules (such as the LRZ 918, but without Pt100 interface). A solenoid valve for cooling water control, reverse flow protection or a flow through cooler can, for example be connected in this way.
- **Ethernet USB module** (catalogue number LRZ 921). The module provides the customer with the opportunity to monitor and control thermostatic regulation processes that are performed with a LAUDA constant temperature equipment via Ethernet using the LAUDA interface command set.

  An additional function of the module is remote maintenance of the LAUDA constant temperature equipment via Ethernet.

  Currently, the USB interfaces of the module are not functional.
- **EtherCAT module** (catalogue number LRZ 922) with connection via M8 sockets. **EtherCAT module** (catalogue number LRZ 923) with connection via RJ45 sockets. EtherCAT is an Ethernet-based field bus with master-slave functionality.

Detailed information for the connection and use of these interfaces can be found in the operating manual of the respective LAUDA interface module.

3.5 Equipment

Heater

A heater can be installed in all devices if required. The maximum working temperature is increased to 80 °C. The installation of the heater is only available ex factory.

More powerful pump

A more powerful pump can be installed in all devices if required. Depending on the increase in pump power, this option reduces the cooling capacity by more than 200 W. It also results in greater device installation height for the VC 1200 (W) and VC 2000 (W) devices. The installation of a more powerful pump is only available ex factory.

Outdoor installation

Outdoor installation is possible for the air-cooled VC 5000, VC 7000 and VC 10000 devices. Equipment for outdoor installation is only possible ex factory. The device may only be installed in outdoors if it is protected from weather influences (provide shelter or enclosure).

Operation outdoors for outdoor temperature below 5 °C:

- Outdoor installation is configured, the following warning is shown: **349 Preheat device for XX min**.
  The display shows this warning after the device is switched on. It indicates the remaining pre-heating time required before the compressor can be started. The compressor is preheated using its own heater. The other components (pump and heater) are started immediately when the device is switched from standby to operation.
- Outdoor installation is **not** configured, the following warning is shown: **349 Preheat device!**
  The display shows this warning for 10 seconds after switching on the device. It is possible to start the device afterwards.

Increased wear or damage to the compressor may result if the compressor is not preheated!

Sound insulation

Sound insulation is possible for the VC 5000 (W), VC 7000 (W) and VC 10000 (W) devices. Sound insulation is only available ex factory.

Insulation of the cooling water hydraulic system

Insulation of the cooling water hydraulic system is possible for all water-cooled devices. This insulation is available ex factory and can also later be installed on site by the LAUDA Constant Temperature Equipment service department.

3.6 Type plate

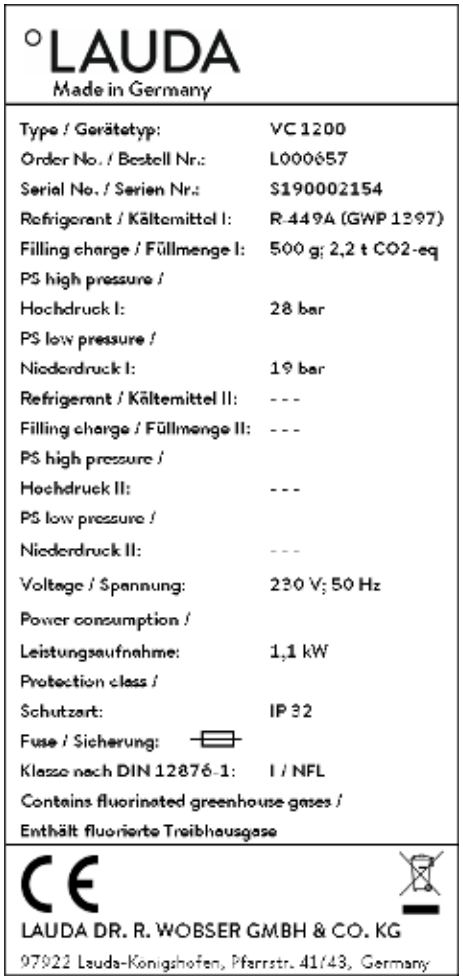


Fig. 6: Type plate (example)

The type plate information is explained in detail in the following table. Certain information is dependent on installed equipment.

Specification	Description
Type	Device type
Catalogue No.	Catalogue number of the device
Serial No.	Serial number of the device
Refrigerant I	Refrigerant that is used in the cooling unit of the device
Fill quantity I	Fill quantity of the refrigerant
PS high pressure I	maximum permitted operating pressure on the refrigerant high pressure side (compression, liquefaction)
PS low pressure I	maximum permitted operating pressure on the refrigerant low pressure side (expansion, evaporation)
Power consumption	Power consumption of the device
Power consumption with heater	Power consumption of the device; only applicable for devices with heater
Type of protection	IP type of protection of the device
Fuse	Fuse used in the device
Heater fuse	fuse used in the device; only applicable for devices with heater
Class according to DIN 12876-1	Device class according to DIN 12876-1

4 Before starting up

4.1 Placement

Very specific placement conditions are applicable to the devices. These placement conditions are mainly specified in the technical data for the device.

Further information about the technical data can be found at Chapter 11.1 ‘General data’ on page 93.

Additional placement conditions are described below.

- Irritant vapours can be produced, depending on the heat transfer liquid used and the operating mode. Ensure adequate extraction of these vapours.
- Observe the requirements of the device for electromagnetic compatibility (EMC).
- Do not cover the ventilation openings.

Further information about EMC requirements can be found at Chapter 1.5 ‘EMC requirements’ on page 8.

Operation outdoors at outdoor temperatures below 5 °C

A warning is displayed on the screen indicating the duration of the preheating time for the compressor and whether the compressor needs preheating. Increased wear or damage to the compressor may result if the compressor is not preheated! Further information can be found at ‘Outdoor installation’ on page 21.

Personnel: ■ Operating personnel

WARNING!
Rolling or toppling of the device from incorrect handling

Impact, crushing

- Do not tilt the machine.
- Place the device on a level, skid-free surface with sufficient load bearing capacity.
- Engage the reel brake when setting up the device.
- Do not place any heavy parts on the machine.

1. Place the devices on a suitable base.

The devices can be moved. Release the locking brakes of the castors for this by pushing the lever upwards.

2. Lock the castors on the device. Push the lever downwards to lock them.
3. Attach the "Hot surface" warning sticker in a clearly visible position for applications above 70 °C.

4.2 Connecting the consumer

CAUTION!
Bursting of the external consumer

Scalding, frostbite

- A bypass regulator is available to set the pump pressure.

4.2.1 Thermostatic hoses and hose clips

CAUTION!
Discharge of heat transfer liquid during operation caused by use of unsuitable tubes

Scalding, frostbite

- Use tubes with temperature resistance that is appropriate for the operating temperature range of the device.
- Use hoses with a temperature resistance of at least 100 °C for devices with a heater.

CAUTION!
Contact with hot or cold tubes

Burns, frostbite

- Use insulated tubes for temperatures below 0 °C or above 70 °C.

The hoses specified below can be used for all heat transfer liquids that are approved for the devices.

Tab. 3: Hoses

Type	Device Pump connection	Accessories required (nipple and screw cap are provided on the device as standard)	Maximum operating pressure	Clear width x outer diameter in mm	Temperature range in °C	Catalogue number
EPDM hose with fabric reinforcement	VC 1200 to VC 5000 (W) G ¾ (15), nipple ¾"	Hose nozzle with screw cap EOA 004	10 bar	19 x 27	-40 – 100	RKJ 032
EPDM hose with fabric reinforcement	VC 7000 to VC 10000 (W) G 1¼ (20), nipple 1"	Hose nozzle with screw cap EOA 003	10 bar	25 x 34	-40 – 100	RKJ 033

Tab. 4: Hose clips

Suitable for hose	Clear width Ø in mm	Catalogue number
RKJ 112, RKJ 031	12 — 22	EZS 013
RKJ 032, RKJ 033	25 — 40	EZS 016

4.2.2 Connecting external consumer

CAUTION!
Discharge of heat transfer liquid during operation caused by open consumer

Electric shock, scalding, frostbite

- Only use hydraulically closed consumers.

CAUTION!
Bursting of the external hydraulic circuit due to overpressure

Impact, cutting, scalding, frostbite

- Lay tubes so that they do not kink.

Note the following:

- To prevent damage to the consumer, fully open the bypass adjustment wheel on the rear of the device. To do so, turn the adjustment wheel anticlockwise.
- Temperature control hoses: Always use the largest possible diameters and shortest possible tube lengths in the external liquid circuit.
  If the temperature control tube diameter is too small, a temperature drop between device and external consumer occurs due to flow rate too low. In this case, increase or lower the temperature accordingly.
- Secure the temperature control tubes with hose clamps.
- If the external consumer is at a higher level than the device, emptying of the external volume can occur if the pump is stopped and there is ingress of air in the external liquid circuit even for closed circuits. In this case, there is the risk of the device overflowing.
- In the event of tube rupture, hot liquid can escape and become a danger for persons and material.

4.3 Cooling water

4.3.1 Requirements for the cooling water

This section is relevant for the following:

- For water-cooled devices

NOTICE!
Schema cooling circuit starts leaking due to corrosion

Device damage

- Do not use corrosive cooling water.

Requirements

There are specific requirements concerning the purity of the cooling water. A suitable process for treating and maintaining the water must be applied to handle the specific impurities in the cooling water. The condenser and the entire cooling water circuit can get blocked, damaged and can leak due to unsuitable cooling water. Extensive consequential damage to the entire cooling circuit and cooling water circuit may occur. The cooling water quality is dependent on the local conditions.

- Free chlorine, e.g. from disinfectants and water containing chloride results in pitting corrosion in the cooling water circuit.
- Distilled, deionised or demineralised water is not suitable due to its high reactivity and results in corrosion in the cooling water circuit.

- Seawater is not suitable due to its corrosive properties and will result in corrosion in the cooling water circuit.
- Water containing iron and iron particles in the water lead to corrosion in the cooling water circuit.
- Hard water is not suitable for cooling due to the high lime content resulting in calcification in the cooling water circuit.
- Cooling water with suspended matter is not suitable.
- Untreated, non-purified water, for example river or cooling tower water, is not suitable due to its microbiological content (bacteria) that may settle in the cooling water circuit.

Suitable cooling water quality

Data	Value	Unit
pH value	7.5 – 9.0	---
Hydrogen carbonate [HCO_3^-]	70 – 300	mg/l
Chlorides	< 50	mg/l
Sulphates [SO_4^{2-}]	< 70	mg/l
Ratio of hydrogen carbonate [HCO_3^-] / sulphates [SO_4^{2-}]	> 1	---
Total water hardness	4.0 – 8.5	°dH
Electrical conductivity	30 – 500	µS/cm
Sulphite (SO_3^{2-})	< 1	mg/l
Free chlorine gas (Cl_2)	< 0.5	mg/l
Nitrates (NO_3^-)	< 100	mg/l
Ammonia (NH_3)	not permitted	---
Iron (Fe), in solution	< 0.2	mg/l
Manganese (Mn), in solution	< 0.05	mg/l
Aluminium (Al), in solution	< 0.2	mg/l
Free, aggressive carbonic acid (CO_2)	not permitted	---
Hydrogen sulphide (H_2S)	not permitted	---
Algae growth	not permitted	---
Suspended matter	not permitted	---

4.3.2 Connecting cooling water

Description	Value
Maximum cooling water pressure	10 bar
Differential pressure cooling water △p	1 – 6 bar VC 1200 W and VC 2000 W 3 – 6 bar VC 3000 W and greater
Cooling water temperature	approx. 15°C recommended, 10 – 30°C permitted (in upper range with performance restrictions)

Note the following:

- Fix the cooling water hoses in place on the device using hose clips.
- Fix the return hose of the water cooling in the drain area to prevent uncontrolled slipping off of the hoses even in the event of pressure surges.

  Fix the return hose of the water cooling in the drain area so that spraying out of hot cooling water is not possible.
- Prevent kinking or crushing of the hoses.
- We recommend using a leak detector with water shut-off to prevent damage due to cooling water system leaks.
- Ensure that the cooling water meets the required criteria.
- In the case of leaks in the condenser, there is the danger that refrigerating machine oil and refrigerant from the refrigerant circuit of the device can get into the cooling water. Comply with the applicable legal provisions and the requirements of the water supply companies at the operating site.

4.4 Interfaces

4.4.1 Alarm output 12N

Available functions

Function	Description
Alarm output	--
Alarm and standby	for on-site return flow protection

- maximum 30 V DC; 0.2 A

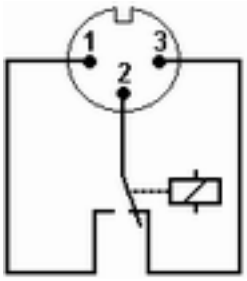


Fig. 7: Flange connector (front) in idle state

1 Normally open contact
2 Centre
3 Normally closed contact

Front view of the flange connector or of the coupling socket on the solder side

Idle state

- The alarm output is in resting state:
  - When the device is switched off,
  - after switching on if a fault is already evident at that time (e.g. level too low)
  - and during normal operations when a fault occurs.
- Pins 1 and 2 are open.
- Pins 3 and 2 are closed.

GO state

- The alarm output is in a sound state when no faults occur.
- Pins 1 and 2 are closed.
- Pins 3 and 2 are open.

Information on the settings for the alarm output can be found in ↳ Chapter 6.12.7 ‘Configuring alarm output’ on page 66.

Note the following:

- The equipment connected to the low voltage inputs and low voltage outputs must have be safely separated from dangerous voltages according to DIN EN 61140. For example, using double or reinforced insulation according to DIN EN 60730-1 or DIN 60950-1.
- Only use shielded connection cables. Connect shield to connector case. Cover unused plug connections with protective caps.

4.4.2 Installing the driver for the standard USB interface

A special USB driver must be installed on your PC to be able the USB interface of the constant temperature equipment to respond. The LAUDA company makes the USB Virtual COM Port driver available for download at http://www.lauda.de. Supported operating systems are Windows XP SP3, Windows Vista, Windows 7, Windows 8 and Windows 10 (each with 32 bit and 64 bit).

Personnel: ■ Specialist

1. Execute the driver set-up (exe file) for the USB interface on your PC.
   ▶ An installation wizard is displayed on your PC.
2. Follow the instructions of the wizard on your PC.
   ▶ The USB driver is installed on your PC.

4.4.3 Connecting device to a PC

Before connecting the device to a PC, the appropriate USB driver must be installed on the PC. ↳ Chapter 4.4.2 ‘Installing the driver for the standard USB interface’ on page 29

If the device is connected to the PC via the USB interface, a free COM port is automatically assigned to the device. The PC uniquely identifies the device using the internal serial number and always assigns the same COM port to this device. If additional devices are connected to the PC via USB interfaces, other free COM ports are assigned to these devices.

Establishing the connection

1. The device and the PC are switched on.
2. Connect the device and the PC using a USB cable.

   The USB cable is not included in the scope of delivery.

   ▶ Windows XP: The hardware search help function opens on your PC.
3. Follow the instructions of the wizard on your PC.
   ▶ The software for the new device is installed.

   Windows Vista, Windows 7, Windows 8: The software for the new device is installed in the background.

COM port

The device can be addressed as a COM port using conventional communication programs (e.g. Hyperterminal or Putty). Other settings such as baud rate are not necessary.

The COM port assignment for connected devices can be checked in Windows *Device Manager* under *Ports (COM & LPT)*.

4.4.4 Installing modules

Devices can be optionally supplemented with additional interface modules. These can be installed in two different size module slots on the front of the device.

- Right module slot (approx. 51 mm x 27 mm) for RS232 / RS485 module / analogue module / contact modules / Profibus module
- Left module slot (approx. 51 mm x 17 mm) for Pt100 / LiBus module

This section is relevant for the following sample cases:

- You would like to use an external temperature sensor.
- You would like to transmit a signal such as the actual temperature from an external consumer to the circulation chiller.
- You would like to transmit a signal such as the setpoint temperature to an external device.
- You would like to use the Command remote control unit.

DANGER!
Contact with live parts

Electric shock

- Disconnect the device from the mains power supply before installing modules.

1. Touch the grounded, bare metal stainless steel rear side of the circulation chiller to discharge any electrostatic charge.
2. Remove the module from the packaging.
3. Switch off the circulation chiller and unplug the mains plug.
4. The module slots are protected with a cover. Release the screws on the cover for the appropriate module slot and carefully remove the cover.
5. Carefully detach the bus connection cable from the cover.
6. Attach the bus connection cable - red plug to red socket.

   The plug and the socket have a reverse-polarity-proof design.

7. Insert the module into the appropriate slot and fasten it using the two Philips screws.

4.4.5 Read commands for serial interfaces

A read command is a request for current data from the control centre to the constant temperature equipment.

The following information refers to the Ethernet- as well as the RS 232/485-interfaces.

Command	Meaning
IN_PV_00	Query of the bath temperature (outlet temperature)
IN_PV_01	Query of controlled temperature (internal/external, Pt/external, analogue/ external serial)
IN_PV_03	Query of external temperature T_E (Pt100).
IN_PV_04	Query of external temperature T_E (analogue input).
IN_PV_05	Query of the level
IN_SP_00	Query of the temperature setpoint
IN_SP_02	Query of cooling state (0 = OFF/1 = ON/2 = AUTOMATIC).
IN_SP_03	Query of overtemperature switch-off point (devices with heater)
IN_SP_04	Query of the outlet temperature limit TiH
IN_SP_05	Query of the outlet temperature limit TiL
IN_PAR_00	Query of control parameter Xp
IN_PAR_01	Query of control parameter Tn (181 = OFF)
IN_PAR_02	Query of control parameter Tv
IN_PAR_03	Query of control parameter Td
IN_PAR_04	Query of control parameter KpE
IN_PAR_05	Query of control parameter TnE (response: XXXX; 9001 = OFF)
IN_PAR_06	Query of control parameter TvE (response: XXXX; 5 = OFF)
IN_PAR_07	Query of control parameter TdE (response: XXXX.X)
IN_PAR_09	Query of maximum correction value limit
IN_PAR_10	Query of control parameter XpF
IN_PAR_14	Query of setpoint offset
IN_PAR_15	Query of control parameter PropE
IN_DI_01	Status of contact input 1: 0 = open / 1 = closed
IN_DI_02	Status of contact input 2: 0 = open / 1 = closed
IN_DI_03	Status of contact input 3: 0 = open / 1 = closed
IN_DO_01	Status of contact input 1: 0 = normally open switch open / 1 = normally open switch closed

Command	Meaning
IN_DO_02	Status of contact input 2: 0 = normally open switch open / 1 = normally open switch closed
IN_DO_03	Status of contact input 3: 0 = normally open switch open / 1 = normally open switch closed
IN_MODE_00	Keyboard: 0 = free / 1 = blocked
IN_MODE_01	Control: 0 = internal / 1 = external Pt100 / 2 = external analogue / 3 = external serial
IN_MODE_02	Stand-by: 0 = device ON / 1 = device OFF
IN_MODE_03	Keyboard remote control unit Command: 0 = free / 1 = blocked
IN_MODE_04	Setpoint offset source: 0 = normal / 1 = external Pt / 2 = external analogue / 3 = external serial
TYPE	Query of device type (response = "VC")
VERSION_R	Query of software version number from the control system
VERSION_B	Query of software version number of remote control unit Command
VERSION_A	Query of software version number of analogue interface
VERSION_V	Query of software version number of RS 232-/485-module
VERSION_Y	Query of software version number of Ethernet module
VERSION_Z	Query of software version number of EtherCAT interface
VERSION_D	Query of software version number of digital interface
VERSION_M_0	Query of software version number of solenoid valve (cooling water)
VERSION_M_3	Query of software version number of solenoid valve (shut-off valve 1)
VERSION_M_4	Query of software version number of solenoid valve (shut-off valve 2)
VERSION_E	Query of software version number of external Pt100 module
STATUS	Query of the device status, 0 = OK, -1 = fault
STAT	Query for the fault diagnosis, response: XXXXXXX; X = 0 no fault, X = 1 fault 1st character = error 2nd character = alarm 3rd character = warning 4th character = low level warning 5th character = low level alarm 6th character = condenser dirty 7th character = external control value not present
RMP_IN_00_XXX	Query of a program segment XXX (response: e. g. 030.00_00010_005.00 => set temperature = 30.00 °C, time = 10 min, tolerance = 5.00 °C)

Command	Meaning
RMP_IN_01	Query of the current segment number
RMP_IN_02	Query of the set program loops
RMP_IN_03	Query of the current program loop
RMP_IN_04	Query of which program additional commands refer to
RMP_IN_05	Query of which program is currently running (0 = none)
LOG_IN_00_XXXX	Query of a measuring point XXXX from data logger (response: e. g. 020.00_021.23_030.50 => set temperature = 20.00 °C, bath temperature = 21.23 °C, external temperature = 30.5 °C)
LOG_IN_01	Query of all measuring points from data logger. Unlike with command "LOG_IN_00", a tab is used as a delimiter here instead of "_". The measuring points are separated with CR and LF. The end is indicated with CR LF CR LF.
LOG_IN_02	Query of starting time from data logger (response: e. g. 20_14_12_20 => day 20, 14:12:20)
LOG_IN_03	Query of recording interval from data logger (response in seconds)

Please note:

- For “_” “.” (space character) is also permitted.
- Unless otherwise specified for the command, the reply is always in fixed decimal format "XXX.XX" or "-XXX.XX" for negative values or "ERR_X". (RS 485 interface e.g. "A015_XXX.XX" or "A015_ERR_X").
- The command from the control centre must be terminated with CR, CRLF or LFCR.
- The response from the constant temperature equipment is always terminated with CRLF.
- After every command sent to the constant temperature equipment, it is necessary to wait for a response before the next command can be sent. This way, the allocation of queries and responses is clear.
  CR = Carriage Return (hex: 0D); LF = Line Feed (hex: 0A)

4.4.6 Write commands of serial interfaces

A write command is a command from the control centre to the constant temperature equipment.

The following information refers to the Ethernet- as well as the RS 232/485-interfaces.

Command	Meaning
OUT_PV_05_XXX.XX	Specifying external temperature via interface
OUT_SP_00_XXX.XX	Setpoint transfer with max. 3 digits before the decimal point and max. 2 digits afterwards
OUT_SP_02_XXX	State cooling (0 = OFF / 1 = ON / 2 = AUTOMATIC)
OUT_SP_04_XXX	Upper limit of TiH outlet temperature
OUT_SP_05_XXX	Lower limit of TiL outlet temperature
OUT_PAR_00_XX.X	Setting control parameter Xp
OUT_PAR_01_XXX	Setting control parameter Tn (5–180 s; 181 = Off)
OUT_PAR_02_XXX	Setting control parameter Tv
OUT_PAR_03_XX.X	Setting control parameter Td
OUT_PAR_04_XX.XX	Setting control parameter KpE
OUT_PAR_05_XXXX	Setting control parameter TnE (0–9000 s; 9001 = Off)
OUT_PAR_06_XXXX	Setting control parameter TvE (5 = OFF)
OUT_PAR_07_XXXX.X	Setting control parameter TdE
OUT_PAR_09_XXX.X	Setting the correction value limit
OUT_PAR_10_XX.X	Setting control parameter XpF
OUT_PAR_14_XXX.X	Setting the setpoint offset
OUT_PAR_15_XXX	Setting control parameter PropE
OUT_MODE_00_X	Keyboard: 0 = free / 1 = blocked (corresponds to: "KEY")
OUT_MODE_01_X	Control: 0 = internal / 1 = external Pt100 / 2 = external analogue / 3 = external serial
OUT_MODE_03_X	Keyboard remote control unit Command: 0 = free / 1 = blocked
OUT_MODE_04_X	Setpoint offset source: 0 = normal / 1 = external Pt / 2 = external analogue / 3 = external serial
START	Switches on device (from standby)
STOP	Switches machine to standby (pump, heater, cooling unit off)
RMP_SELECT_X	Selection of program (1–5) that other commands are to refer to. After switching on the device, program 5 is selected.

Command	Meaning
RMP_START	Starts programmer
RMP_PAUSE	Stops programmer
RMP_CONT	Starts programmer again after hold
RMP_STOP	Stops the program
RMP_RESET	Deletes program (all segments)
RMP_OUT_00_XXX.XX_XXX XX_XXX.XX_X	Sets the programmer segment (temperature, time, tolerance and pump level). A segment is added and allocated the appropriate values.
RMP_OUT_02_XXX	Number of program cycles: 0 = infinite / 1–250

Please note:

- For "_" "." (space character) is also permitted.
- Response from the thermostat "OK" or "ERR_X" in the case of an error. RS-485-interface e.g. "A015_OK" or with error "A015_ERR_X".
- The command from the control centre must be terminated with CR, CRLF or LFCR.
- The response from the constant temperature equipment is always terminated with CRLF.
- After every command sent to the constant temperature equipment, it is necessary to wait for a response before the next command can be sent. This way, the allocation of queries and responses is clear.
  CR = Carriage Return (hex: 0D); LF = Line Feed (hex: 0A)

Permitted data formats

-XXXX.XX	-XXXX.X	-XXXX.	-XXXX	XXXX.XX	XXXX.X	XXXX.	XXXX
-XXX.XX	-XXX.X	-XXX.	-XXX	XXX.XX	XXX.X	XXX.	XXX
-XX.XX	-XX.X	-XX.	-XX	XX.XX	XX.X	XX.	XX
-X.XX	-X.X	-X.	-X	X.XX	X.X	X.	X
-.XX	-.X	.XX	.X				

4.4.7 Error messages from the constant temperature equipment to the control centre

This list describes the error messages.

The following information refers to the Ethernet- as well as the RS 232/485-interfaces.

Error	Description
ERR_2	Incorrect input (e.g. buffer overflow)
ERR_3	Incorrect command
ERR_5	Syntax error in the value
ERR_6	Impermissible value
ERR_8	Module or value not available
ERR_30	All segments of the programmer are occupied
ERR_31	Setpoint input not possible, analogue setpoint input is set to ON.
ERR_33	External temperature probe not present
ERR_34	Analogue value not available
ERR_35	Automatic selected
ERR_36	Setpoint input not possible, the programmer is running or on hold.
ERR_37	Starting the programmer not possible, analogue setpoint input selected.

4.4.8 Cable and test of interface RS 232

Computer					Thermostat		
Signal	9-pin Sub-D female connector		25-pin Sub-D female connector		9-pin Sub-D female connector		Signal
	with hardware handshake	without hardware handshake	with hardware handshake	without hardware handshake	with hardware handshake	without hardware handshake	
RxD	2	2	3	3	2	2	TxD
TxD	3	3	2	2	3	3	RxD
DTR	4		20		4		DSR
Signal Ground	5	5	7	7	5	5	Signal Ground
DSR	6		6		6		DTR
RTS	7		4		7		CTS
CTS	8		5		8		RTS

With hardware handshake: Use a straight-through cable and not a null modem cable when connecting a thermostat to the PC. The RS 232 interface can be connected directly with the PC using a straight-through cable.

Without hardware handshake: Set the corresponding operating mode on the PC.

Please note:

- Use shielded connection cables.
- Connect shield to connector case.
- The cables must be galvanically isolated from the rest of the electronics.
- Do not connect unassigned pins.

The RS 232 interface can be easily checked on a connected PC with the Microsoft Windows operating system.

- For Windows® 3.11 using the "Terminal" program.
- For Windows® 95/98/NT/XP using the "HyperTerminal" program.

"HyperTerminal" is no longer part of the operating system for the Windows Vista, Windows 7 and Windows 8 operating systems.

- Freeware terminal programs are available for free download on the Internet. These programs provide similar functions to those of "HyperTerminal" (for example, PuTTY or RealTerm). Search request "serial port terminal program".

4.4.9 Protocol RS 232

Please note:

- Connection to SUB-D 9-pin socket
- The interface operates with 1 stop bit, no parity bit and 8 data bits.
- Selectable transmission speed: 2400, 4800, 9600 (factory setting) or 19200 baud.
- The RS 232 interface can be operated with OR without hardware handshake (RTS/CTS). To do so, pin 4 (DSR) and pin 6 (DTR) as well as pin 7 (CTS) and pin 8 (RTS) must be connected by a bridge.
- The command from the computer must be terminated with CR, CRLF or LFCR.
- The response from the thermostat is always terminated with CRLF.
- After every command sent to the thermostat, it is necessary to wait for a response before the next command can be sent. This way, the allocation of queries and responses is clear.
  CR = Carriage Return (hex: 0D); LF = Line Feed (hex: 0A)

Tab. 5: Example for setpoint transfer of 30.5 °C to the thermostat.

Computer	Thermostat
"OUT_SP_00_30.5"CRLF	⇨
⇦	"OK"CRLF

4.4.10 Connecting cable RS 485

Connection RS 485

Thermostat with 9-pin Sub-D socket	
Contact	**Data**
1	Data A (-)
5	SG (Signal Ground) optional
6	Data B (+)

Please note:

- Use shielded connection cables.
- Connect shield to connector case.
- The cables must be galvanically isolated from the rest of the electronics.
- Do not connect unassigned pins.

Termination

An RS 485 bus **absolutely** requires bus termination in the form of a termination network that ensures a defined idle state during the high-ohm phases of bus operation. The bus termination looks like the following:

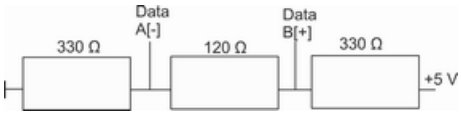


Fig. 8: RS 485 termination

This termination network is generally integrated on the PC plug-in card (RS 485) and can be activated using jumpers.

4.4.11 Protocol RS 485

Please note:

- The interface operates with 1 stop bit, no parity bit and 8 data bits.
- Selectable transmission speed: 2400, 4800, 9600 (factory setting) or 19200 baud.
- The device address always precedes the RS 485 commands. Up to 127 addresses are possible. The address must always have three digits (A000_... to A127_...).
- The command from the computer must be terminated with CR.
- The response from the constant temperature equipment is always terminated with CR.

CR = Carriage Return (hex: 0D)

Example for setpoint transfer of 30.5°C to the constant temperature equipment. Address 15 is used in this example.

Computer	Constant temperature equipment
“A015_OUT_SP_00_30.5“CR	➔
➔	“A015_OK“CR

5 Commissioning

5.1 Heat transfer liquids

Note:

- The heat transfer liquids each cover a recommended temperature range and must be suitable for the temperature range of your application.
- At the lower limit of the temperature range, the heat transfer liquid becomes more viscous and influences temperature stability, pump power and cooling capacity. The formation of vapours and odours increases in the upper range. Therefore, only use all of the temperature range if required. Particularly with Aqua 90 (water), ice forms which can result in destruction of the device.
- Never use contaminated or degenerated heat transfer liquid.
- Observe the safety data sheet of the heat transfer liquid. You can request the safety data sheets of the heat transfer liquid at any time if required.

Tab. 6: Approved heat transfer liquids

LAUDA designation	Chemical designation	Temperature range in °C	Viscosity (kin) in mm²/s (at 20 °C)	Viscosity (kin) in mm²/s for temperature	Container size Catalogue number		
					5 l	10 l	20 l
Kryo 30	Monoethylene glycol and water mixture	-30–90	4	50 at -25 °C	LZB 109	LZB 209	LZB 309
Aqua 90	decalcified water	5 – 90	1	---	LZB 120	LZB 220	LZB 320

Note the following for Kryo 30:

- The water content is reduced during long operating at higher temperatures and the mixture becomes flammable (flash point 119°C). Check the mixture ratio using a hydrometer.

Heat transfer liquid water

- The alkaline earth ions content (hardness) of the water must be between 0.71 mmol/l and 1.42 mmol/l (equivalent to 4.0 and 8.0°dH). Harder water results in lime deposits in the device.
- The pH value of the water must be between 6.0 and 8.5.
- Distilled, deionised, demineralised (DM) water or seawater must not be used due to their corrosive properties. Ultra-pure water and distillates are suitable as a medium after addition of 0.1 g soda (Na_2CO_3, sodium carbonate) per litre of water.
- Any chlorine content in the water must be strictly avoided. Do not add any chlorine to the water. Chlorine is contained, for example, in cleaning agents and disinfectants.

- The water must be free of impurities. Water containing iron is unsuitable due to rust formation and untreated river water is unsuitable due to algae formation.
- The addition of ammonia is not permitted.

5.2 Establishing power supply

Personnel: ■ Operating personnel

NOTICE!
Use of unauthorised mains voltage or mains frequency

Machine damage

- Compare the rating plate with available mains voltage and mains frequency.

Note the following:

- Only connect the device to an earthed (PE) power socket.

Note for on-site electrical installation:

- Single-phase devices
  - Single-phase devices must be fused with a circuit breaker of max. 16 amperes.
  - Exception: Devices with 13 ampere UK plugs.
- Three-phase devices
  - Three-phase devices must be fused according to the power consumption. The value can be found on the type plate. Always select the fuse that is immediately higher. The use of an excessively high fuse is not permitted.

Pump with three-phase motor

Personnel: ■ Specialist

The pump of the device types VC 5000 (W), VC 7000 (W) and VC 10000 (W) is driven by a three-phase motor. The direction of rotation of the power supply must be considered. The direction of rotation of the three-phase connection must be reversed by swapping 2 phases if the pressure gauge shows no pressure build-up!

This should only be performed by an electrician!

5.3 Switching on device for the first time and filling with water

5.3.1 Fill mode

If the filling mode is active, the words "filling mode" appear on a yellow background in the basic window. The device does not heat or does not cool.

The device has a program for convenient filling with heat transfer liquid.

If the fill level of the device is too low, i.e. at level stage 0, the *Fill mode* is started immediately after switching on the device. The fill mode supports the correct filling of the device. The current level stage is displayed under *Start filling* (in the menu *Setup → Fill mode*).

An audible signal with long intervals is output from approx. the fourth level stage to warn about any overfilling of the device. If filling continues, the interval of the signal is shortened in the following level stage. You must end the filling at the latest now.

If a continuous tone sounds, the device is overfilled and cannot be started. You must drain some heat transfer liquid from the device to be able to start it again.

To fill an external consumer, press the *Standby* softkey when there is sufficient fill level to start the pump. The heat transfer liquid now pumped into the external consumer can be refilled immediately. If the fill level drops too far, the device automatically goes into the standby state and the pump is switched off. This process is performed until the device and the connected consumer are filled.

The fill mode is completed with *End filling* and the audible notifications are deactivated. The fault messages for low level and high level take effect again.

After ending the filling mode, the device starts the temperature control thermostating, provided the starting state is not set to off. Changing the starting mode can be found in ↳ Chapter 6.12.4 ‘Specifying starting mode (Autostart)’ on page 64.

5.3.2 Switching on and filling device

Personnel:
- Operating personnel

Protective equipment:
- Protective goggles
- Protective clothing
- Protective gloves

WARNING!
Overflow of heat transfer liquid

Electric shock

- Do not overfill the machine. Note the level indicator and the thermal volume expansion of the heat transfer liquid.

WARNING!
Spraying of heat transfer liquid

Electric shock

- Do not spray any heat transfer liquid. Use a funnel for filling.

1. Close the drain tap. Turn the lever to the left for this.
2. Switch on the device using the mains power switch.

For devices VC 3000 (W) and lower, turn the mains switch to Position [1].

For devices VC 5000 (W) and higher, turn the mains switch to Position [1].

▶ A signal tone sounds.

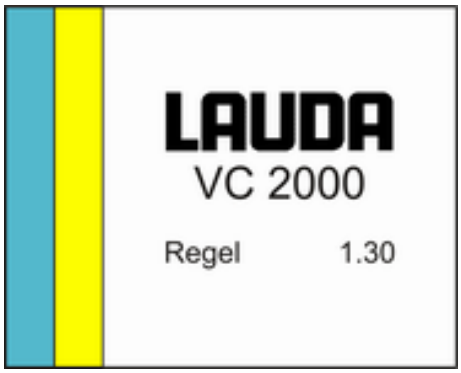


Fig. 9: Start screen

3. The type designation and version numbers of the software installed on the device are shown on the display for approx. 5 seconds.

You can retrieve the version numbers of the software available in the device at any time using the menu.

Fig. 10: Menu language

4. The window for selection of the menu language is displayed on the screen. Select the required menu language using the UP and DOWN arrow buttons. Confirm your selection with the OK button.

> *For example, select* [Deutsch] *to see display entries in the German language.*
>
> *The selection option for the menu language is only shown when the programme is first started.*

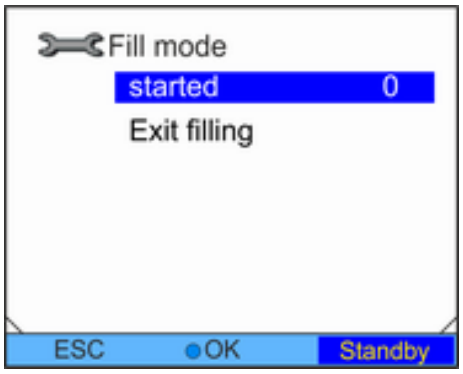


Fig. 11: Fill mode

5. The device detects when the heat transfer liquid level is low or zero.
   - ▶ The device automatically starts the filling mode.
6. Pull up the cover of the filler nozzle.
7. Fill the device with heat transfer liquid. In doing so, monitor the display on the screen and the audible signal of the device.

> *If necessary, use a funnel for filling.*
>
> *The filling mode can be invoked again at any time using the menu.*

8. Close the filler nozzle with the cover.
9. End the filling mode by selecting and confirming [End filling].

> *After ending the filling mode, the device starts the temperature control thermostating, provided the starting state is not set to* [off].
>
> *Changing the starting mode can be found in* ↳ Chapter 6.12.4 ‘Specifying starting mode (Autostart)’ on page 64.

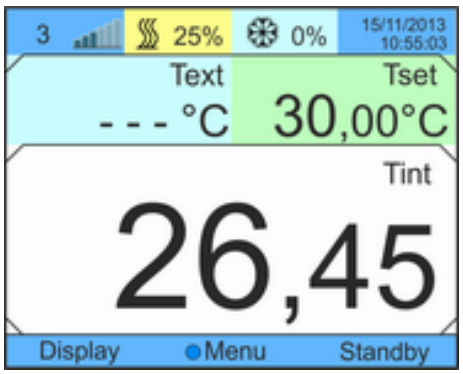


Fig. 12: Basic window

10. The basic window is displayed.

> *If the filling mode is active, the words "filling mode" appear on a yellow background in the basic window. The device does not heat or does not cool.*
>
> *The device can only be put into operation once filling mode has been ended.*

Operation outdoors at outdoor temperatures below 5 °C

A warning is displayed on the screen indicating the duration of the preheating time for the compressor and whether the compressor needs preheating. Increased wear or damage to the compressor may result if the compressor is not preheated! Further information can be found at ‘Outdoor installation’ on page 21.

5.4 Setting pump pressure

The pump pressure of the units is adjusted via an adjustment valve on the rear of the device. Individual setting of the pump pressure is possible with this when using pressure-sensitive external consumers.

Before switching on the device, fully open the bypass adjustment wheel on the back of the device. To do so, turn the adjustment wheel anticlockwise.

Personnel: ■ Operating personnel

CAUTION!
Bursting of the external consumer due to overpressure

Scalding, frostbite, cutting

- Use a pressure relief device on pressure-sensitive consumers (e.g. glass reactors).

CAUTION!
Bursting of the external consumer due to overpressure

Scalding, frostbite, cutting

- For consumers with a maximum permissible operating pressure below the maximum pressure of the pump, use a pressure relief device for protection. This pressure relief device must be installed in the inlet of the consumer.

1. To increase the pressure in the consumer, turn the bypass adjustment wheel clockwise until the maximum permitted pressure for the external consumer is reached.

   When doing so, observe the pressure indication on the front of the device.

6 Operation

6.1 General safety instructions

CAUTION!
Bursting of the external consumer

Scalding, frostbite

- A bypass regulator is available to set the pump pressure.

CAUTION!
Overheating beyond maximum operating temperature in the event of a fault

Burns, scalding

- In the event of a fault, devices with a heater may reach temperatures of up to 100 °C.

6.2 Operating modes

Two operating modes are supported for the devices.

- During operation, the components of the device are operated.
- In the standby operating mode, all components of the device are switched off. Only the screen of the device is supplied with power. For example, this operating mode is suitable for making extensive settings.

6.3 Menu structure overview

Menu structure for Setpoint Value, Setup and Programmer

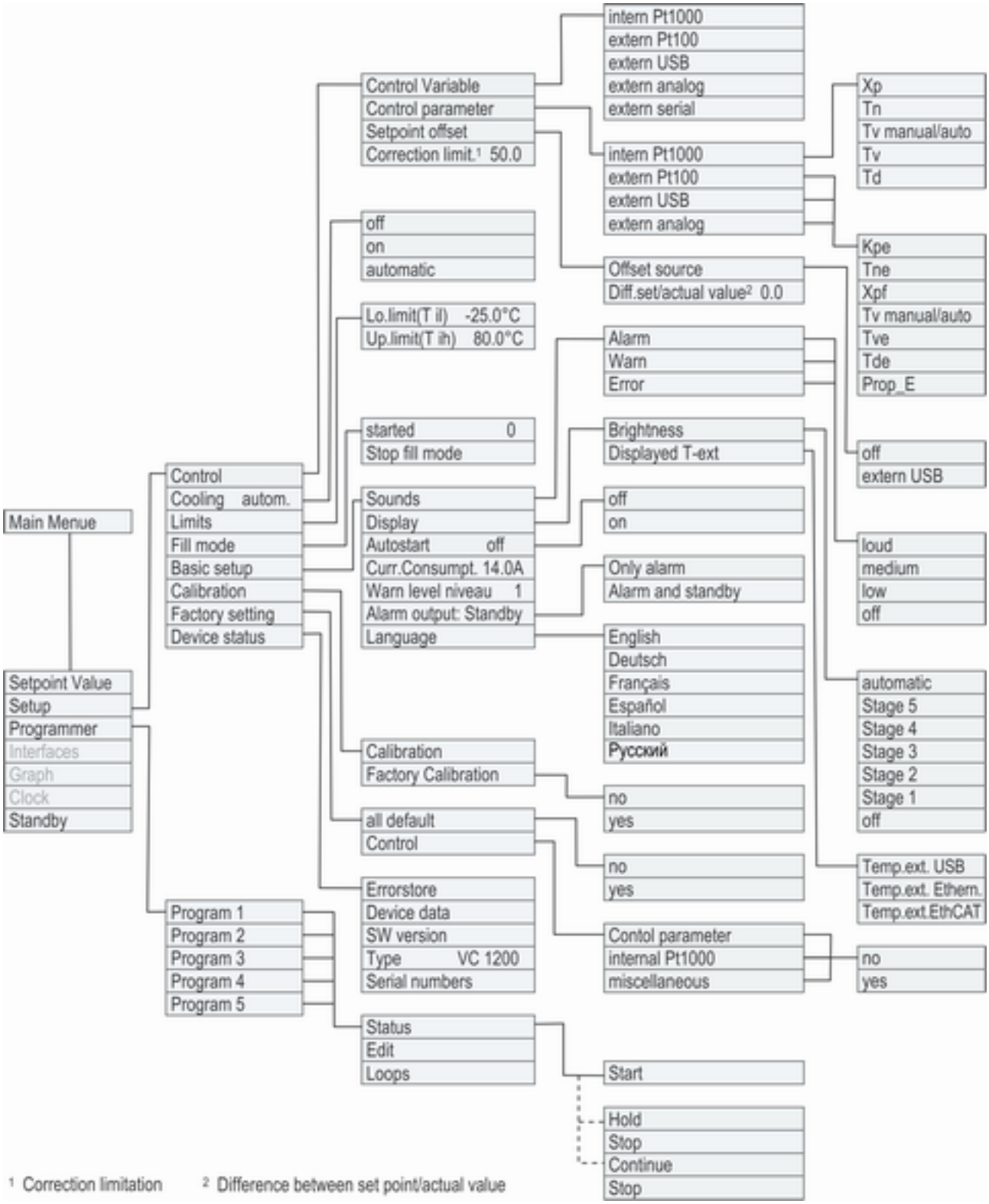


Fig. 13: Menu structure part 1

Menu structure for Graph, Clock and Standby

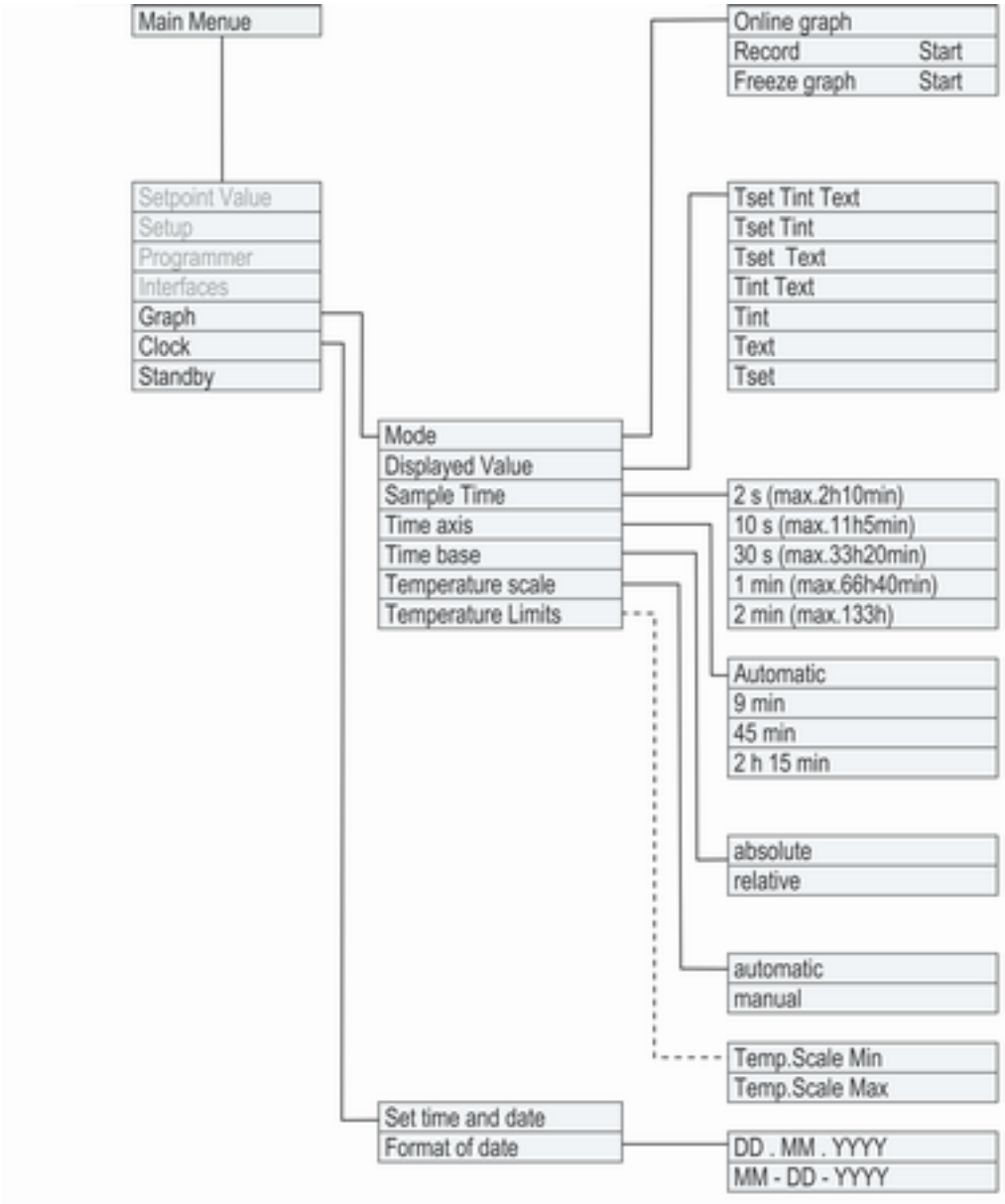


Fig. 14: Menu structure part 2

6.4 Switching on the device

Personnel: ■ Operating personnel

1. Switch on the device using the mains power switch.
   ▶ A signal tone sounds.
2. The basic window is displayed.

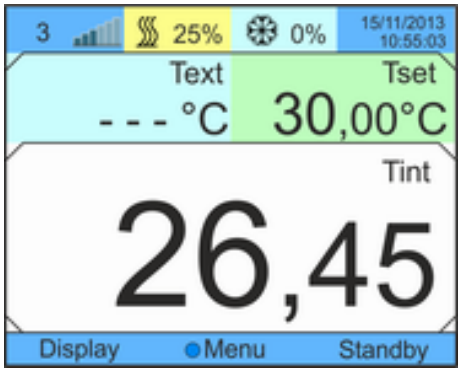


Fig. 15: Basic window

After switching on, the device defaults to the standby operating mode if the start operating mode is not set to on. Changing the start operating mode can be found in ↳ Chapter 6.12.4 ‘Specifying starting mode (Autostart)’ on page 64.

6.5 The display

6.5.1 Basic window

The basic window is displayed after switching on the device. The basic window contains different components depending on the state.

During normal operation

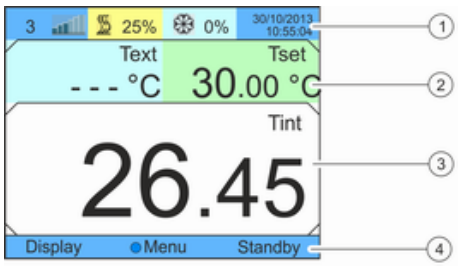


Fig. 16: Basic window structure

1 Expanded status display
2 Status display
3 Internal actual temperature Tint (depending on set control variable, the external actual temperature Text is also displayed here)
4 Softkey bar

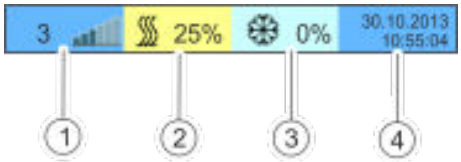
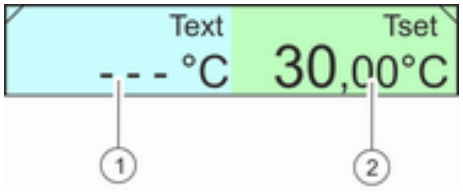


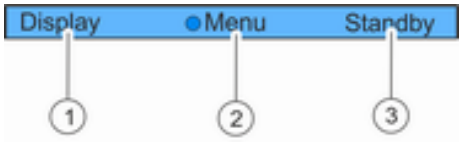
Fig. 17: Expanded status display

1 Level indicator
2 Heater is active and heats with the displayed percentage of total power. This display is only available if the device is equipped with a heater.
3 Cooling is active and cools with displayed percentage of total cooling capacity.
4 Display of date and time



1 External actual temperature Text (depending on set control variable, the internal actual temperature Tint is also displayed here)
2 Setpoint temperature Tset

Fig. 18: Status display

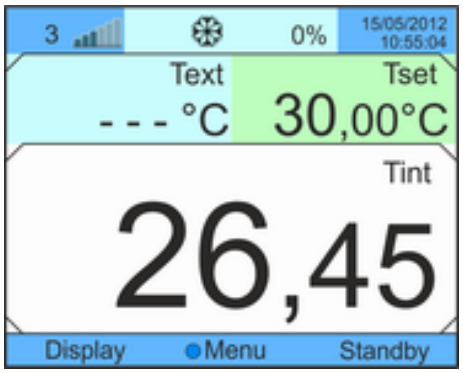


1 Softkey button, left
2 Enter button
3 Softkey button, right

The functions of the softkeys and the function of the Enter button are shown in this bar.

Fig. 19: Softkey bar

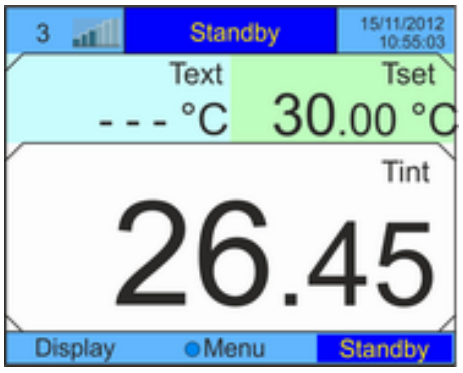
During normal operation – device without heater



Unlike devices with a heater, there is no field with heat output information available in the expanded status display.

Fig. 20: Basic window without heater

In the Standbystate



During standby operation, the expanded status bar shows *Standby* instead of the status of the components. The *Standby* area also has a dark blue background in the softkey bar.

Fig. 21: Basic window in Standby

6.5.2 Menu window

Navigating to the main menu

1. You can perform the following steps to reach the main menu:
   - Press the ENTER button in the basic window.
   - If you are in a submenu, you can return to the main menu with the left arrow button.

Main menu structure

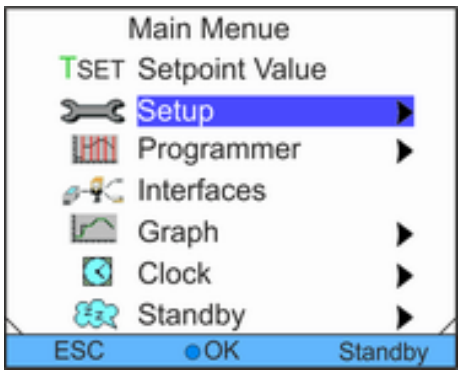


Fig. 22: Main menu

The main menu and also the submenus consist of menu items which are marked as follows.

Symbol	Description
▶	Indicates that other menu levels (submenus) are available.
🔒	The padlock symbolises a blocked function. These functions cannot be adjusted.

The currently selected entry is highlighted with colour.

Structure of submenus

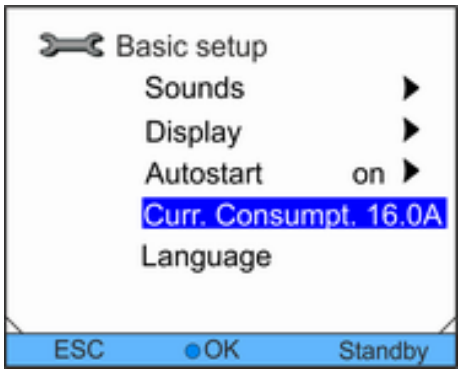


Fig. 23: Submenu

The structure of submenus basically corresponds to that of the main menu.

Softkey bar functionality

The softkey bar is shown in the lower display area. For example, the following functions can be selected using the softkeys:

The [ESC] softkey takes you back to the basic window.

The [Standby] softkey puts the device in the standby state.

Functions of the Enter key

The [OK] enter button leads to a submenu or to an input window.

Navigation in the menus

1. You have the following options:
   - Use the UP and DOWN arrow buttons to navigate between the menu items.
   - Press the RIGHT arrow button to select a submenu.
   - Press the LEFT arrow button to return to a previous menu.
   - The selected menu entry is highlighted in colour.

6.5.3 Input window

The input window is used for configuration of settings on the screen. Two versions of input windows are provided.

Input window for selecting options

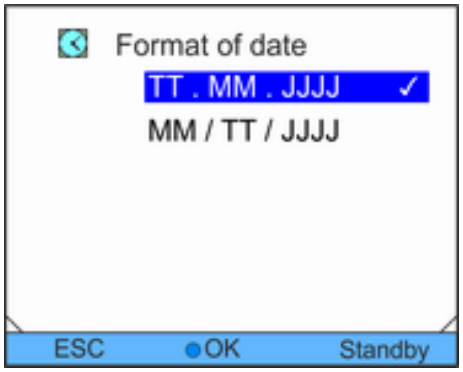


Fig. 24: Selecting option

- The tick mark indicates the active function.
- Navigation in the options is performed using the arrow buttons.
- In doing so, the selected setting is highlighted in colour.
- Using the softkey button [ESC], you return to the previous display without making any changes.
- The selected setting is accepted by pressing the [OK] enter button.

Input window for manual input

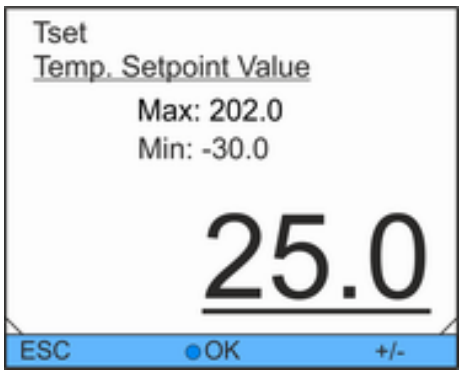


Fig. 25: Inputting values

- The value to be entered is shown in large characters. The cursor under the value flashes.
- Individual digits can also be selected and changed by pressing the RIGHT and LEFT arrow buttons.
- The value can be changed using the UP and DOWN arrow buttons. The change is accelerated if one of the two arrow buttons is pressed for a longer period.
- The [+/-] softkeys can be used to change the sign when your device is appropriately equipped.
- *Min:* and *Max:* can be used to enter the limits for the value specification.
- The value chosen is accepted by pressing the [OK] enter button.
- The [ESC] softkey brings you back to the previous screen without making any changes.

6.5.4 Lock and release operating buttons

The operating buttons can be locked in order to protect the device when using a process control system or against unauthorized access.

Lock the operating button

Personnel: ■ Operating personnel

1. Change to the main menu.
2. Press and hold down the [ENTER] button.
3. Press and hold down the [Down] arrow button within 4 seconds.
4. Hold down both buttons for 4 seconds.
   ▶ In the display the descriptions of the buttons are replaced by [---].

   The entry function is now locked.

The display can be switched between basic window and graphic display.

Release operating buttons

Personnel: ■ Operating personnel

1. Press and hold down the [ENTER] button.
2. Press and hold down the [Up] arrow button within 4 seconds.
3. Hold down both buttons for 4 seconds.
   ▶ In the display the descriptions of the buttons show up again.

   The device can be operated again.

6.6 Specifying temperature limit values

The temperature limits define the temperature range of your application, i.e. in which range temperature control can take place.

Personnel: ■ Operating personnel

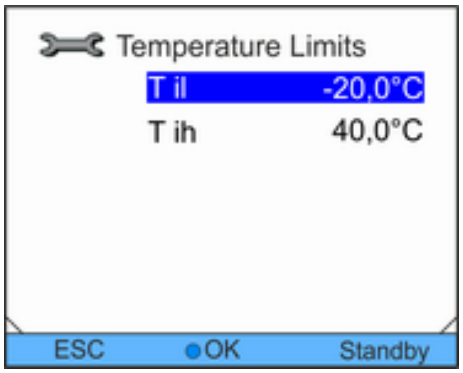


Fig. 26: Selecting temperature limit value

1. Change to the main menu.
2. Select the menu item *Setup* → *Temp. limits*.
3. Select one of the following options:
   - ■ Select the first entry *Til* to set the lower limit value.
   - ■ Select the second entry *Tih* to set the upper limit value.

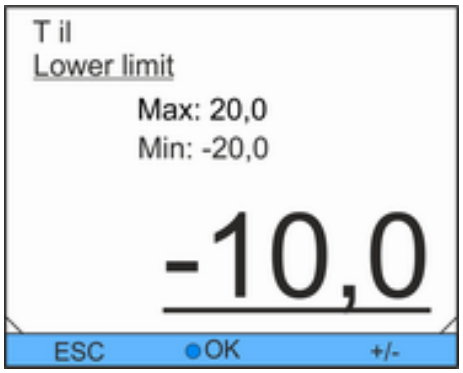


Fig. 27: Defining temperature limit value

4. Adjust the value in the following input window.

6.7 Specifying the set point

Personnel: ■ Operating personnel

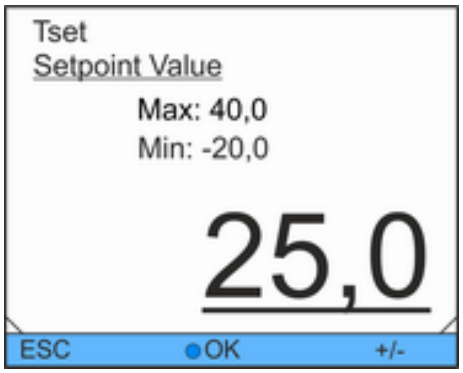


Fig. 28: Specifying the set temperature

1. Change to the main menu.
2. Select the *Set temperature* item in the main menu.
   - ► An input window is displayed. The cursor under the value flashes. The set temperature can be adjusted within the displayed limit values.
3. Adjust the set temperature accordingly.
4. Confirm with the OK button.

6.8 Activating and deactivating standby

During standby operation, the components of the device such as the pump are switched off. The display remains active.

Personnel: ■ Operating personnel

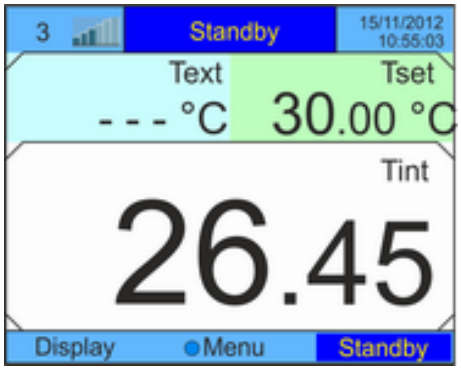


Fig. 29: Basic window in Standby

1. Press the [Standby] softkey button.
   - ▶ The device is in the standby operating mode. The *Standby* entry in the softkey bar is highlighted. This operating mode is also shown in the expanded status display.
2. Press the *Standby* softkey button to activate the Operation operating mode.

6.9 SmartCool (cooling)

The cooling unit of the constant temperature equipment is [automatically] operated, using the standard settings. During this process, the cooling unit is automatically switched on or off, depending on temperature and operating status. The cooling unit can also be permanently switched on or off by using the manual functions.

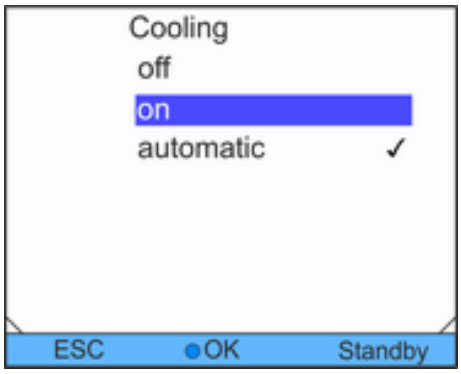


Fig. 30: Configuring cooling

1. Change to the main menu.
2. Select the menu item *Settings* → *Cooling*.
3. Select one of the following options:
   - The cooling unit is automatically controlled when [Automatic] mode is selected. The cooling unit switches on when cooling capacity is required.
   - The cooling unit always remains switched off when [Off] is ticked.
   - The cooling unit always remains on when [On] is ticked, also when no cooling capacity is required.
4. Confirm with the Enter button.

> *The cooling unit on devices without heating might show prolonged standstill periods (several minutes) in* [Automatic] *mode.*

Cooling in a device without a heater and in the [autom.] setting

If the consumer load is extremely low, the cooling unit automatically switches off as soon as the temperature is 2 K below the set point. On the other hand, heat input from the pump and consuming unit means that the cooling unit does not switch on until the set point is exceeded by 2 K.

The outflow temperature always moves ±2 K around the set point in this so-called two-position control. A tighter control range causes the cooling unit to switch on and switch off more frequently. This has negative impacts on the service life of the refrigeration compressor.

A low consumer load can therefore result in the temperature stability of ±0.05 K or ±0.1 K not being achieved. The specified temperature stability is always achieved if a heater is used.

Cooling in a device with a heater and in the [autom.] setting

On devices with a heater and the [autom.] setting, the cooling unit only switches off if no cooling capacity is required.

6.10 External control

6.10.1 Activating external control

Personnel: ■ Operating personnel

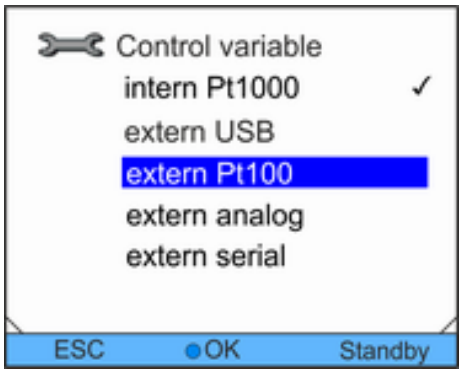


Fig. 31: Activating external control

1. Select the menu item *Control Variable* → *extern Pt100* in the Control menu.

   This option is only available if a Pt100 module for an external temperature sensor has been connected. A Pt100 temperature sensor must be connected to the module.

2. Confirm with the OK button.

6.10.2 Defining setpoint offset

It is possible to apply a value to the temperature that is predefined by the external temperature sensor and then process it as a setpoint. For example, the bath temperature can be 15 °C below the temperature of a reactor that the external temperature sensor measures.

Navigating to the settings

Personnel: ■ Operating personnel

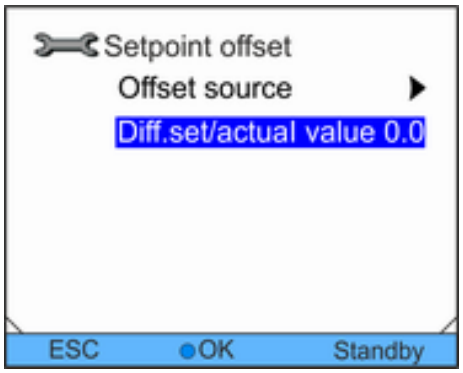


Fig. 32: Setpoint offset menu

1. Change to the main menu.
2. Select the menu item *Setup* → *Control* → *Setpoint offset*.
3. Select one of the following options:
   - With *Offset source*, you can specify which source to use to measure the offset.
   - With *Diff. set/actual value*, you can specify the offset.

Specifying offset source

Personnel: ■ Operating personnel

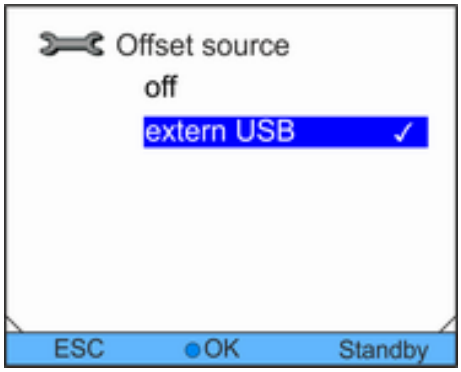


Fig. 33: Adjusting setpoint offset

1. Select the menu item *Offset source* in the Setpoint offset menu.
2. Select one of the following options:
   - You deactivate the setpoint offset using *off*.
   - You can select the appropriate source with the other menu items. For example, with *extern Pt100*, you can define the setpoint offset via an external temperature sensor.

   The LEFT arrow button takes you to the previous display without changes.
3. Confirm with the OK button.

Specifying offset

Personnel: ■ Operating personnel

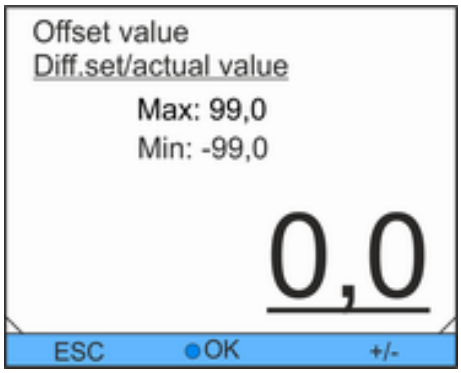


Fig. 34: Specifying offset

1. Select the menu item *Diff. set/actual value* in the Setpoint offset menu.
   - ▶ An input window is displayed.
2. Adjust the offset value within the displayed limit values.
3. Confirm with the OK button.

6.11 Control

The internal and external control parameters are preset at the factory for operation as circulation chiller (with water as heat transfer liquid). Depending on the application, adjustments of the control parameters can be necessary from case to case. The thermal capacity and the viscosity of the heat transfer liquid also influence the control behaviour and may require adjustment of the control parameters.

6.11.1 Basics

Explanation of terms

Control value	- Output value of the controller to compensate for the difference of actual value to setpoint (control deviation).
PID controller	- The PID controller operates very precisely and consists of P, I and D parts.
Proportional range Xp	- The proportional range Xp specifies the temperature range in which the proportional part (P part) of the controller is 0 – 100% of the maximum control value. For example, if the control deviation is 2 K for Xp set to 10 K, the P part is 20% of the control control deviation. In the case of a control deviation of 10 K and more, the P part is 100 % of the control value.
Reset time Tn	- The reset time is decisive for the integral part (I part) of the control value. It specifies the interval in which an existing control deviation is integrated. The larger Tn is, the slower the control deviation is integrated. Thus, the control is slower. A smaller Tn makes the control more dynamic and finally results in oscillations.
Lead time Tv	- The differential part (D part) of the control value is formed from the lead time Tv. It influences the approach speed of the actual value to the setpoint and counteracts the P and I parts. The larger the lead time Tv is set, the stronger the output signal is damped. As rule of thumb. the following applies: Tv = Tn x 0.75.

Optimising hydraulics

An important prerequisite for acceptable control quality is well-designed hydraulics. Therefore, an as good as possible connection between the application to be temperature-controlled and the constant temperature equipment must be established. This means:

- Only use approved heat transfer liquids: water or water-glycol mixture.
- Use short tubes with large cross section. This reduces the flow resistance. A lot of heat transfer liquid can circulate in a short time, thus the circulation time is short.
- Use bypass of the device to increase the flow rate of the heat transfer liquid.

Other precautions

The viscosity of the heat transfer liquid changes very quickly with the temperature. The liquids have higher viscosity at low temperatures. Therefore, the control quality is generally worse at low temperatures. For this reason, the controller should be set at the lower end of the temperature range to be covered. If the control is stable at low temperatures, then it is generally also stable at high temperatures. On the other hand, if a system is just still stable at high temperatures, it is highly probable it will be unstable at low temperatures, i.e. it oscillates.

If, for example, the operating temperature range of a system is -20 – 80 °C, then the controller setting should take place at -10 – 20 °C.

Indications of incorrect settings

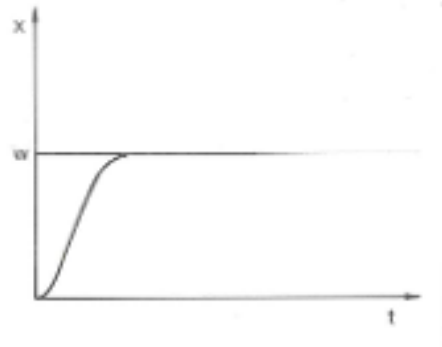


Fig. 35: Optimum setting

The picture on the left shows optimum setting of the control parameters.

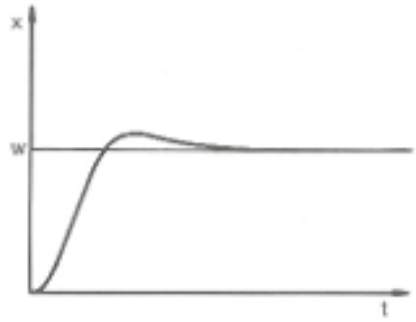


Fig. 36: Control parameter Xp too large

If the Xp parameter is selected too large, the actual value reaches the proportional range early and the P part becomes smaller than 100% of the control value. The approach to the setpoint slows down. Thus, the simultaneously integrating I part has more time to build up its control value portion. If the setpoint is reached, the I part summed too much results in overshooting beyond the setpoint. If the proportional range Xp is reduced, the P part remains at 100% for longer. Therefore the actual value approaches the setpoint more quickly and the I part has less time to integrate the control difference. The overshooting is reduced.

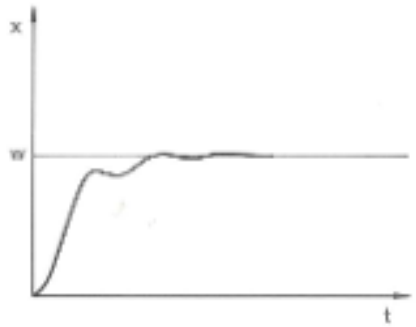


Fig. 37: Control parameter Xp too small

If the proportional range selected is too small, the P part on the control value is at 100% for a very long time. This value then reduces more quickly within the proportional range, i.e. the control value reduces rapidly and the approach of the actual value to the setpoint almost comes to a standstill. Due to the I part not becoming effective until now, the actual value approaches the setpoint slowly.

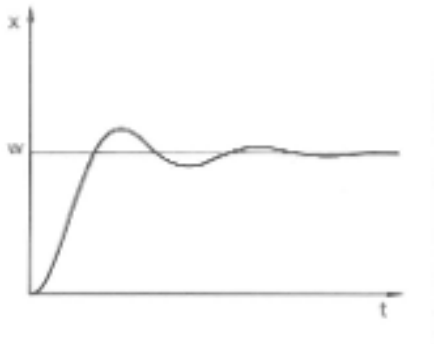


Fig. 38: Control parameters Tn and Tv too small

In this case shown, the I part is set too large (parameter Tn too small). The I part integrates the control deviation until this becomes 0. If this integration runs too quickly, the control value, i.e. the output signal of the controller, is too large. This results in (diminishing) oscillations of the actual value around the setpoint. Parameter Tv should be adjusted again using the formula: Tv = Tn x 0.75.

Fig. 39: Control parameters Tn and Tv too large

The actual value increases relatively steeply after specification of the setpoint. The proportional range appears to be well-adjusted. The approach to the setpoint becomes significantly slower for diminishing control deviation. The strong reduction of the proportional part (P part) must be compensated for by the integration part (I part). In this case, the I part integrates too slowly. The parameter Tn which specifies the integration interval must be reduced. The lead time (parameter Tv) should also be adjusted using the following formula: Tv = Tn x 0.75.

6.11.2 Calling the control menu

Personnel: ■ Operating personnel

1. Change to the main menu.

2. Select the menu item *Setup* → *Control*.

6.11.3 Overview of internal control parameters

The internal control compares the setpoint temperature with the outflow temperature and calculates the actuating signal, i.e. the amount to be heated or cooled.

Tab. 7: The following control parameters can be adjusted for internal control:

Parameter	Description	Unit
Xp	Proportional range	K
Tn	Reset time	s
Tv	Lead time	s
Td	Damping time	s

If Tv manual/auto is set to Auto, Tv and Td cannot be changed. In this case, they are derived with fixed factors from Tn.

The temperature limits Tih and Til also influence the control.

6.11.4 Adjusting internal control parameters

Personnel: ■ Operating personnel

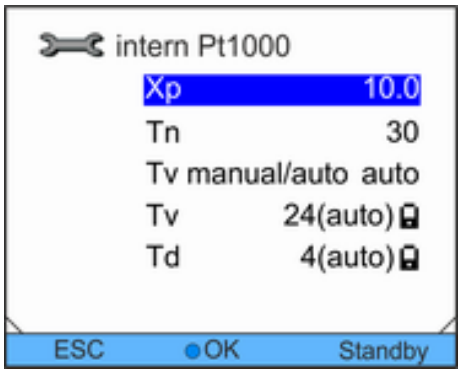


Fig. 40: Internal control parameter menu

1. Select the menu item *Control parameter → intern Pt1000* in the Control menu.
2. Select one of the following options:
   - You can select any of the listed control parameters.
   - With *Tv manual/auto*, you can define whether the control parameters *Tv* and *Td* are set manually or automatically. If the automatic setting is active, both control parameters are displayed with a padlock and cannot be selected. In this case, they are derived with fixed factors from *Tn*.

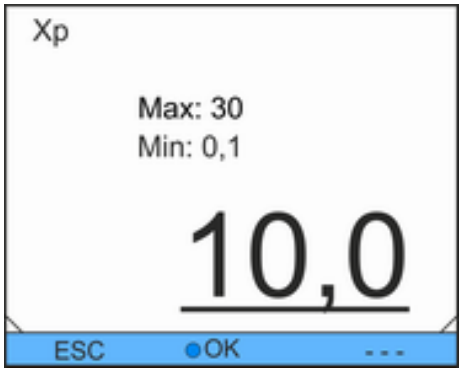


Fig. 41: Specifying internal control parameters

3. Confirm with the OK button.
   - ▶ Selection of the menu item *Tv manual/auto* activates manual or automatic adjustment of the parameters depending on the previous setting. An input window is displayed when the other menu items are selected. The respective value can be adjusted within the displayed limits.
4. Adjust the value accordingly.
5. Confirm with the OK button.

6.11.5 Overview of external control parameters

- The external control consists of a master controller (external controller) and a slave controller (internal controller). The temperature of the consumer to be temperature-controlled is also required. In general, this is determined with an external "Pt100 sensor".
- The master controller compares the setpoint temperature with the external temperature (consumer temperature) and uses this information to calculate the set temperature (set-point_internal) for the slave controller (internal controller).
- The slave controller compares the set temperature (set-point_internal) with the outflow temperature and calculates the actuating signal, i.e. the demand for heating or cooling.

Tab. 8: The following control parameters can be adjusted for the master controller (external controller):

Parameter	Description	Unit
Kpe	Gain	-
Tne	Reset time	s
Tve	Lead time	s
Tde	Damping time	s
Prop_E	Proportional range	K

Tab. 9: The following control parameters can be adjusted for the slave controller (internal controller):

Parameter	Description	Unit
Xpf	Proportional range	K

If Tv manual/auto is set to auto, Tve and Tde cannot be changed. In this case, they are derived with fixed factors from Tne.

The temperature limits Tih and Til also influence the control.

6.11.6 Adjusting external control parameters

Personnel: ■ Operating personnel

1. Select the menu item *Control Parameter → extern Pt100* in the Control menu.
2. Select one of the following options:
   - ■ You can select any of the listed control parameters.
   - ■ With *Tv manual/auto*, you can define whether the control parameters *Tve*, *Tde* and *Prop_E* are set manually or automatically. If the automatic setting is active, both control parameters are displayed with a padlock and cannot be selected. *In this case, Tve* and *Tde* are derived with fixed factors from *Tne*.
3. Confirm with the ENTER button.
   - ▶ Selection of the menu item *Tv manual/auto* activates manual or automatic control depending on the previous setting. An input window is displayed when the other menu items are selected.
4. Adjust the value accordingly.
5. Confirm with the ENTER button.

6.12 Basic settings

6.12.1 Invoking basic settings

1. Change to the main menu.
2. Select the menu item *Setup → Basic setup*.

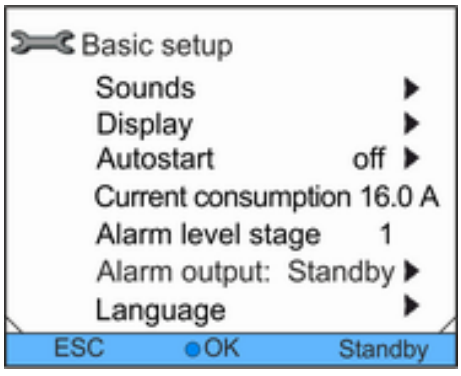


Fig. 42: Basic setup menu

The basic settings are described in the following chapters.

6.12.2 Setting volume of the sounds

The devices signal alarms and faults as two-tone sounds. Warnings are signalled as a continuous tone.

Personnel: ■ Operating personnel

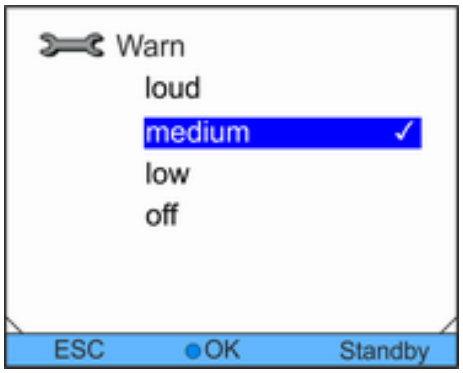


Fig. 43: Setting volume

1. Change to the main menu.
2. Select the menu item *Setup* → *Basic setup* → *Sounds*.
3. Select one of the options depending on which sound you want to adjust.
4. Select a volume level.
5. Confirm with the OK button.

6.12.3 Setting display brightness

The devices have a sensor which automatically adjusts the display brightness according to the ambient light level.

Adjustments to this setting are usually not necessary.

Personnel: ■ Operating personnel

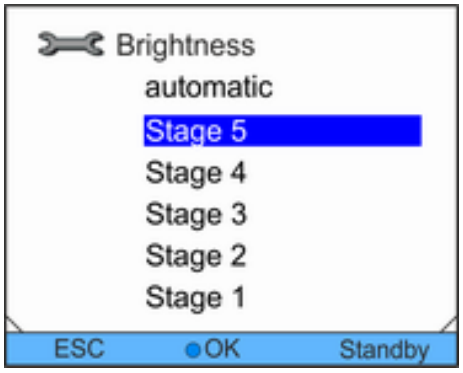


Fig. 44: Setting brightness

1. Change to the main menu.
2. Select the menu item *Setup* → *Basic setup* → *Display* → *Brightness*.
3. The following options are available in the input window:
   - ■ The brightness is adjusted automatically with the *automatic* default setting.
   - ■ The brightness can be set manually using the *Stage* entries.
     The brightness is increased from *Stage 1*. The corresponding brightness becomes visible on the display.
   - ■ The backlighting for the display can be completely switched off using *off*.
4. Confirm with the OK button.

6.12.4 Specifying starting mode (Autostart)

It is generally required that the device starts operating again after a mains power failure. A manual activation step can be inserted, e.g. for safety reasons.

Personnel: ■ Operating personnel

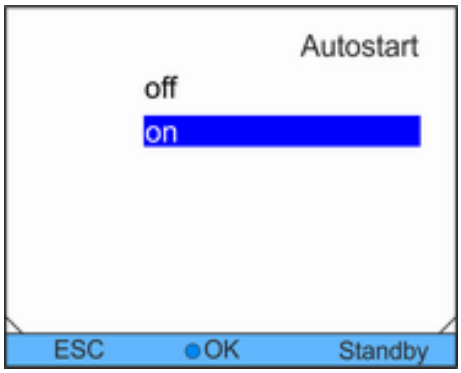


Fig. 45: Specifying Autostart

1. Change to the main menu.
2. Select the menu item *Setup* → *Basic setup* → *Autostart*.
3. Select one of the following options:
   - With *off*, the device is in the standby operating mode after a mains power failure.
   - Normal operation is continued directly after a power failure using *on*.
4. Confirm with the OK button.

6.12.5 Limiting current consumption

If your line fuse is below 16 A, the current consumption can be gradually reduced from 16 A to 8 A. For devices with a heater, the output of the heater is reduced accordingly. Take account here whether other consumers are still connected to the same fused circuit or whether your device is the only consumer.

Personnel: ■ Operating personnel

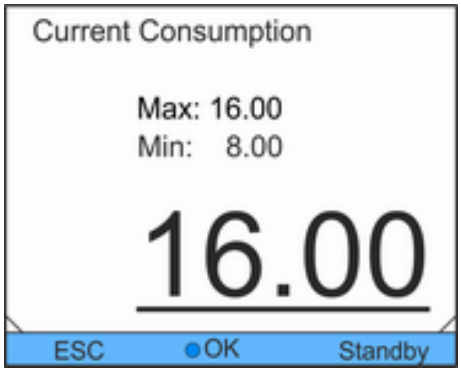


Fig. 46: Specifying current consumption

1. Change to the main menu.
2. Select the menu item *Settings* → *Basic settings* → *Curr. Consumpt.*
3. Adjust the current consumption accordingly.
4. Confirm with the Enter button.

6.12.6 Configuring alarm level for fill level

A warning about low level of the device is usually output on the device starting from the second level stage. However, the alarm level before low level can be configured within a specific range.

Personnel: ■ Operating personnel

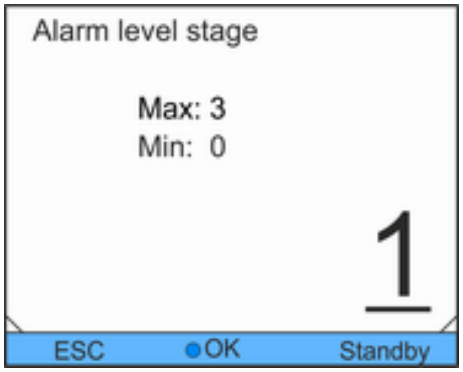


Fig. 47: Specifying level alarm level

1. Change to the main menu.
2. Select the menu item *Setup* → *Basic setup* → *Warn level niveau*.
3. You can select from four stages 0 to 3 for the warning before "low level". With *3*, a warning about too low fill level is output as early as from the third level stage. With *0*, no warning at all is output. In this case, the device is switched off and an alarm is displayed if low level is reached.
4. Confirm with the OK button.

6.12.7 Configuring alarm output

Appropriate configuration must be performed if standby of the device as well as alarms should be output at the alarm output. Return flow protection for the device can be activated with this.

Personnel: ■ Operating personnel

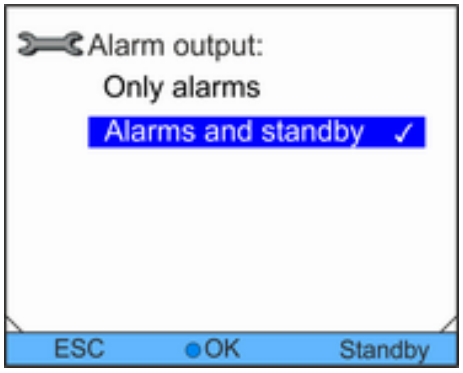


Fig. 48: Configuring alarm output

1. Change to the main menu.
2. Select the menu item *Setup* → *Basic setup* → *Alarm output*.
3. You have the following options:
   - With *Only alarms*, a signal is only output at the alarm output in the event of alarms of the device.
   - With *Alarms and standby*, a signal is also output during standby.
4. Confirm with the OK button.

6.12.8 Selecting menu language

The menu languages of German, English, French, Spanish, Italian and Russian are available in the devices.

Personnel: ■ Operating personnel

Fig. 49: Selecting menu language

1. Change to the main menu.
2. Select the menu item *Setup* → *Basic setup* → *Language*.
3. Select any of the available languages.
4. Confirm with the OK button.

6.13 Entering the offset of the internal actual temperature (calibration)

The factory calibration is overwritten during the adjustment. This requires a reference thermometer with the required level of accuracy. The factory calibration should otherwise not be changed.

A temperature deviation can be corrected if inspection of the thermostatic circulator with a calibrated reference thermometer shows such a deviation.

The probe of the reference thermometer must be installed in the outflow of the device in accordance with the specifications in the calibration certificate.

Personnel: ■ Operating personnel

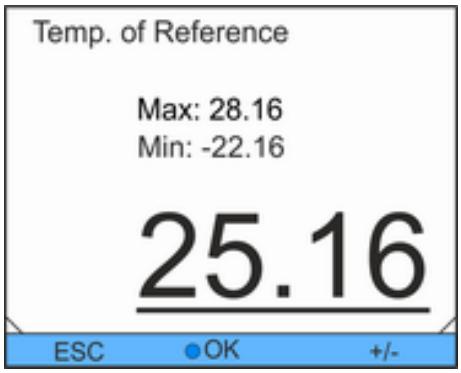


Fig. 50: Specifying offset

1. Change to the main menu.
2. Select the menu item *Setup* → *Calibration* → *Calibration*.
3. Adjust the value accordingly. The value displayed on the reference thermometer must be entered.
4. Confirm with the OK button.

6.14 Restoring factory calibration (internal temperature sensor)

Any offset specified for the internal temperature measurement can be restored to the factory setting.

Personnel: ■ Operating personnel

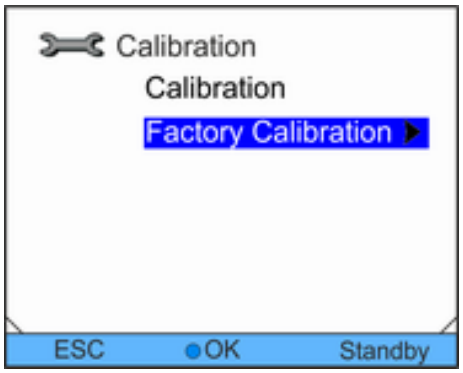


Fig. 51: Factory calibration setting

1. Change to the main menu.

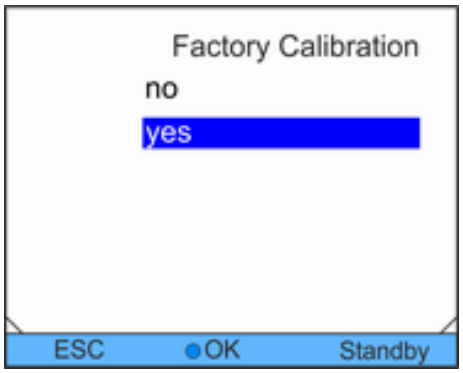


Fig. 52: Restoring factory calibration

2. Select the menu item *Setup* → *Calibration* → *Factory Calibration*.
3. Select one of the following options:
   - ■ Selecting *no* returns to the previous display without making any changes.
   - ■ Selecting *yes* restores the factory calibration.

6.15 Restoring factory settings

Navigating to the factory settings

Personnel: ■ Operating personnel

1. Change to the main menu.
2. Select the menu item *Setup* → *Factory settings*.

Restoring individual settings

Personnel: ■ Operating personnel

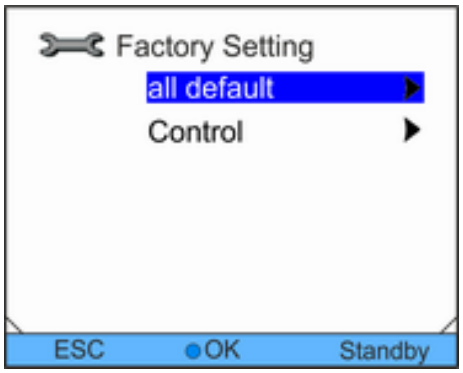


Fig. 53: Selecting mode

1. Select the menu item *Control*.
   - ▶ This takes you to a list using which you can reset the parameters individually.

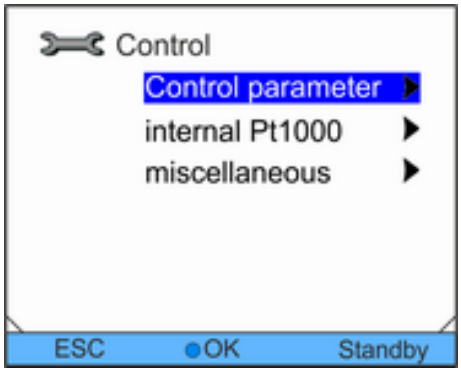


Fig. 54: Resetting control parameters

2. Select the appropriate menu item in the parameter list.
   - The internal and the external control parameters can be reset using *Control parameter*.
   - The settings for the internal sensor can be reset with *internal Pt1000*.
   - Setpoint and maximum current consumption can be reset with *miscellaneous*. The control is also set to internal control.
3. Select one of the following options in the input window:
   - Selecting *no* returns to the previous display without making any changes.
   - Selecting *yes* resets the selected parameter if you confirm this with the OK button.

Restoring all settings

Personnel: ■ Operating personnel

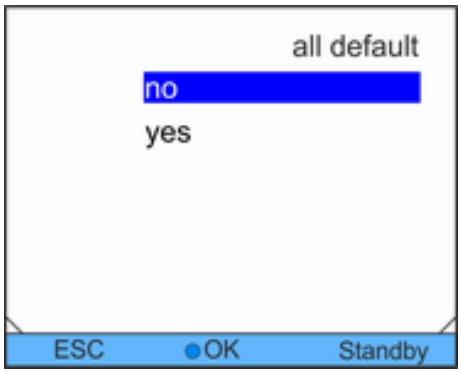


Fig. 55: Reset confirmation

1. Select the menu item *Reset all*.
2. Select one of the following options:
   - Selecting *no* returns to the previous display without making any changes.
   - Selecting *yes* restores the factory settings if you confirm this with the OK button.

6.16 Device status

6.16.1 Retrieving device status

Personnel: ■ Operating personnel

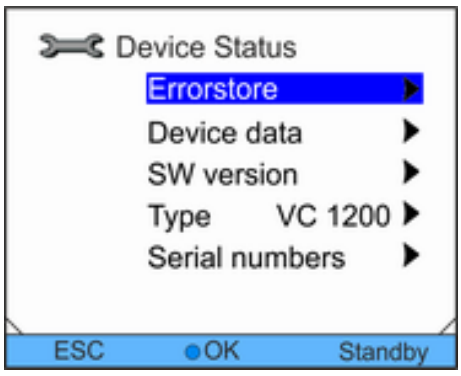


Fig. 56: Device status

1. Change to the main menu.
2. Select the menu item *Setup* → *Device status*.
   - ▶ The Device Status menu is displayed.
3. You have the following options:
   - Read Errorstore
   - Retrieving device data
   - Request software version
   - Request device type
   - Request serial numbers

6.16.2 Read Errorstore

The devices have an Errorstore for error analysis. Up to 140 warning, error and alarm messages can be stored in the Errorstore.

1. Select the menu item *Errorstore* in the Device Status menu.

> *The latest message is in the first position. The message text is displayed in the footer.*

Fig. 57: Errorstore

2. You can navigate through the list using the UP and DOWN arrow buttons.

The following information is displayed for each message:

- The relevant module which causes the message is displayed under *Source*.
- *Code* is the coded alarm, warning or error description.
- *Type* specifies alarm, warning or error.
- The exact time of the message is displayed with *Date* and *Time*

> *A list of the possible alarms, warnings and errors can be found in* ‘Procedure in the event of alarms’ on page 84.

6.16.3 Retrieving device data

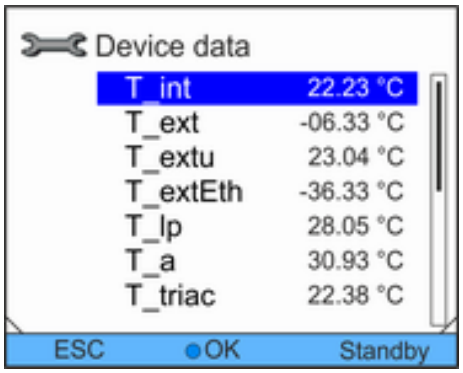


Fig. 58: Device data

1. Select the menu item *Device data* in the Device Status menu.

▶ Various parameters are displayed.

6.16.4 Retrieving software version

Among other things, the relevant software versions are needed for service cases.

Personnel: ■ Operating personnel

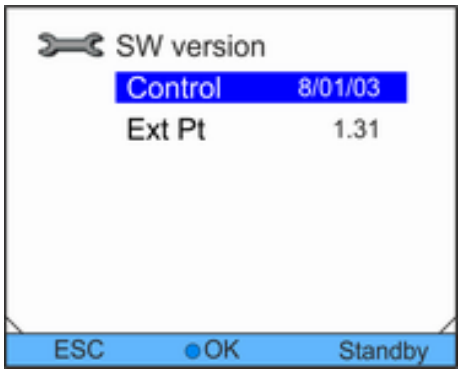


Fig. 59: Software version

1. Select the menu item *SW version* in the Device Status menu.
   ▶ The corresponding software versions are displayed depending on device type and connected modules.

6.16.5 Displaying device type

The device type is shown directly at the menu item *Type* in the Device Status menu.

6.16.6 Displaying serial numbers

Personnel: ■ Operating personnel

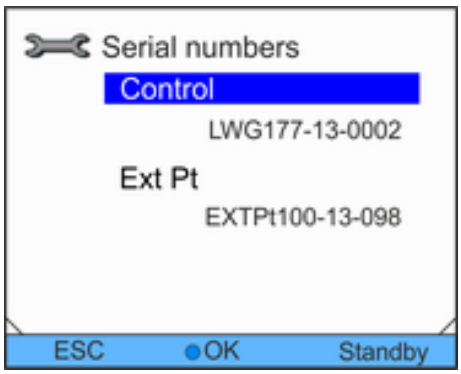


Fig. 60: Serial numbers

1. Select the menu item *Serial numbers* in the Device Status menu.
   ▶ The serial number of the device is displayed. The serial numbers of connected modules are also displayed if they are available.

6.17 Programmer

6.17.1 Programme example

The programmer function allows storage of temperature/time programmes. The program consists of several temperature/time segments and details about their repetition. Ramps, temperature jumps (time is zero) or temperature-holding phases with identical start and end temperature in the segment are possible. During the start, the current setpoint is stored as the starting value of the first segment.

The total number of freely programmable segments per programme is 150.

Up to 5 temperature/time programmes can be stored.

Possible settings

Setting	Description
No.	Segment number of the program
Tend	End temperature to be reached
hh	Time in hours (hh) in which the specified temperature should be reached.
mm	Time in minutes (mm) in which the specified temperature should be reached
Tolerance	The tolerance defines the level of accuracy with which the end temperature should be reached before the next segment will be processed.
S1, S2, S3	Switching contacts of the contact module (if available) can be programmed here. Contact modules are available as accessories.

The graphic shows an example of reprogramming a setpoint temperature profile.

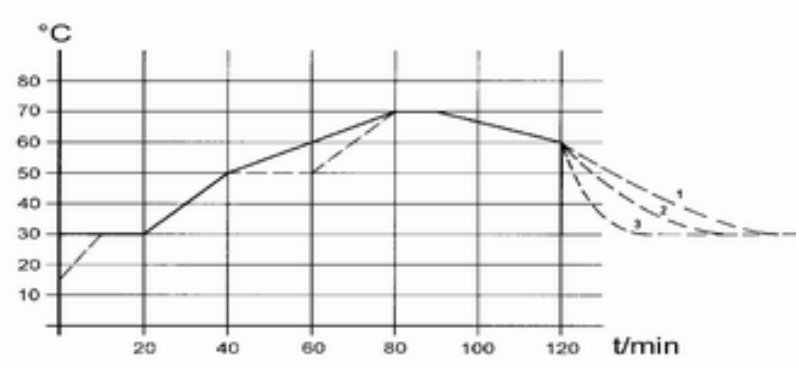


Fig. 61: Program example

The cool-down time in the graph varies according to the device type, consumer etc. The sample segment No. 2 is aimed at reaching 50 °C within 20 minutes.

The original values in the "Before" table provided below are shown by a solid line, while the edited profile of the "After" table is shown by a dotted line.

Tab. 10: "Before" table

(—)								
No.	Tend	hh	mm	Tol	Pump	S1	S2	S3
Start	30.00	--	--	0.1	---	off	off	off
2	50.00	0	20	0.0	---	off	off	off
3	70.00	0	40	0.0	---	off	off	off

(—)								
4	70.00	0	10	0.1	---	off	off	off
5	60.00	0	30	0.0	---	off	off	off
6	30.00	0	0	0.0	---	off	off	off

A new segment with the number 3 was entered in the edited table. The time for the segment with number 4 was also changed. The tolerance for the segment with number 5 was adjusted.

Tab. 11: "After" table

(- - - -, edited)								
No.	Tend	hh	mm	Tol	Pump	S1	S2	S3
Start	30.00	--	--	0.1	---	off	off	off
2	50.00	0	20	0.0	---	off	off	off
3	50.00	0	20	0.1	---	off	off	off
4	70.00	**0**	**20**	0.0	---	off	off	off
5	70.00	0	10	**0.8**	---	off	off	off
6	60.00	0	30	0.0	---	off	off	off
7	30.00	0	0	0.0	---	off	off	off

The entered tolerance can have a great influence with external bath control. The graph on the side of the edited profile clarifies the possible overrun of the actual temperature in the bath vessel (solid line) for the setpoint value of the programmer (grey background).

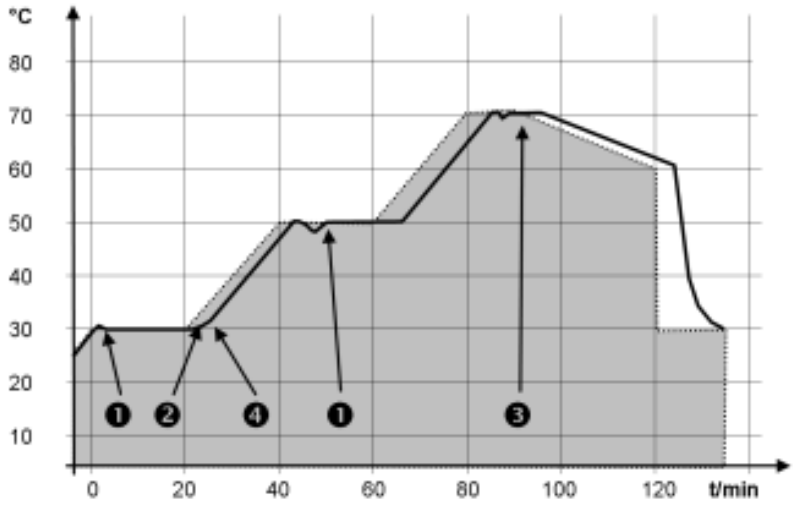


Fig. 62: Program tolerance

Note:

- The tolerance field enables precise adherence to the delay time at a specific temperature. Only once the actual temperature of the tolerance range has been reached (1), will the following segment be processed so that e.g. the ramp of the second segment will not be started until after a delay of 2.
- A tolerance range that has been selected too narrow can also cause undesired delays. The tolerance range should not be too narrow, particularly when external control is used. A larger tolerance was entered in segment 5, so that the desired time of 10 minutes can be adhered to even with transient processes (3).
- Only flat (slow) ramps should be programmed with a tolerance range as needed. Steep ramps that are close to the maximum possible heating or cooling rates of the device may be severely delayed (4) if the tolerance range (here in segment 2) is too narrow.

No time specification is possible in the starting segment (No. 1). The temperature of the first segment is reached as quickly as possible to change to segment 2 after reaching the set tolerance.

6.17.2 Selecting a program

Personnel: ■ Operating personnel

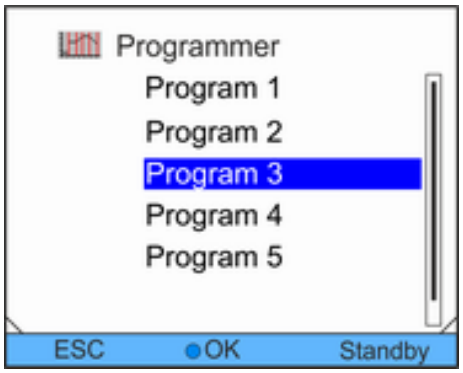


Fig. 63: Selecting a program

1. Change to the main menu.
2. Select the menu item *Programmer*.
3. Select one of the available programs.

6.17.3 Creating and editing programs

Starting editing

Note the following:

- If a segment time of >999 h: 59 min is intended, this time must be distributed among several successive segments.

Personnel: ■ Operating personnel

1. Select the menu item *Edit* for the selected program.
2. You can now edit the segments.

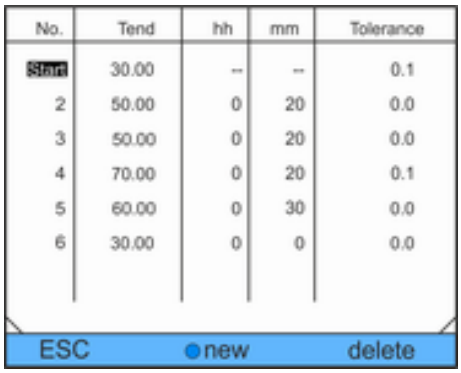


Fig. 64: Editing program

Editing segments

Personnel: ■ Operating personnel

Note the following:

- No time specification is possible in the starting segment. The temperature of the first segment is reached as quickly as possible to change to segment 2 after reaching the set tolerance.
- If the value "0" is entered in the fields *hh* and *mm*, the setpoint is applied immediately and the bath temperature reached as quickly as possible.
- If a tolerance range that is too small has been selected in the *Tolerance* field, the program may not be continued as the required tolerance is never reached.
- The default setting for contact modules is *off*. The entry "- -" for contact modules stands for no changes to the previous segment, i.e. if "- -" is in all fields, the contact position of the starting setting or the setting before the program start is maintained.

1. You have the following options:
   - You can display additional columns of the program using the RIGHT and LEFT arrow buttons.
   - You can navigate in the segments of a program using the UP and DOWN arrow buttons.
   - You can edit a selected segment by pressing ENTER. You can adjust the value using the UP and DOWN arrow buttons. Individual digits can be selected with the RIGHT and LEFT arrow buttons. Confirm your changes with the ENTER button.

Inserting a new segment

Personnel: ■ Operating personnel

1. Navigate to the segment below which the new segment should be inserted.
2. Navigate to the No. column in this segment.
3. Press ENTER.
   ▶ A new segment is created.

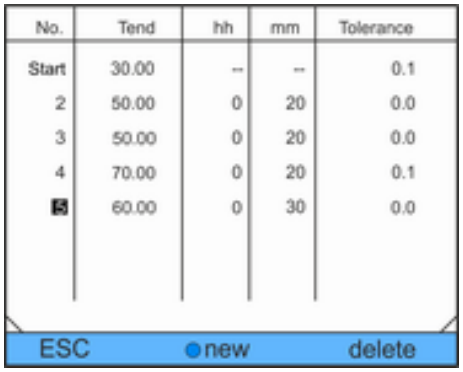


Fig. 65: Selecting program segments

Deleting a segment

Personnel: ■ Operating personnel

1. Navigate to the segment you want to delete.
2. Navigate to the No. column in this segment.
3. Press the *Delete* softkey button.
   ▶ The segment is deleted.

Editing a currently running program

Note the following:

- No segments can be added or deleted in a running program.
- Modifications of the existing temperature values and segment times are possible in a running program. The segment is continued as if the change had been valid since the segment was started.
- If the new segment time is shorter than the already elapsed segment time, the program jumps to the next segment.

Personnel: ■ Operating personnel

1. In the basic window, press the *Prog.x/y* softkey in the softkey bar.

   x represents the currently running program;
   y represents the current program loop.

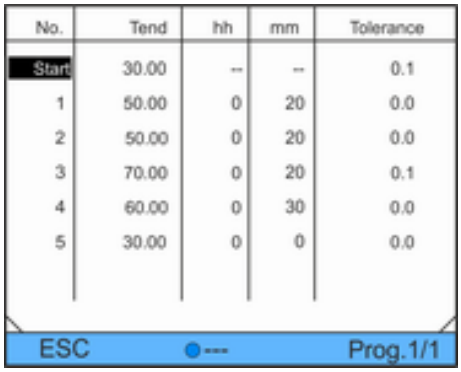


Fig. 66: running program

2. The currently running program opens.
3. You can now edit the segments of the currently running program.

Completing editing

Personnel: ■ Operating personnel

1. When you have completed the program, you can return to the program overview with the LEFT arrow button.

6.17.4 Defining program loops

Personnel: ■ Operating personnel

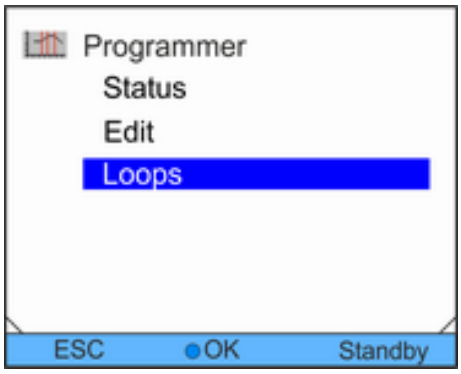


Fig. 67: Setting program loops

1. Select the *Loops* menu item for the selected program.
   ▶ An input window is displayed. The loops can be defined within the displayed limits.

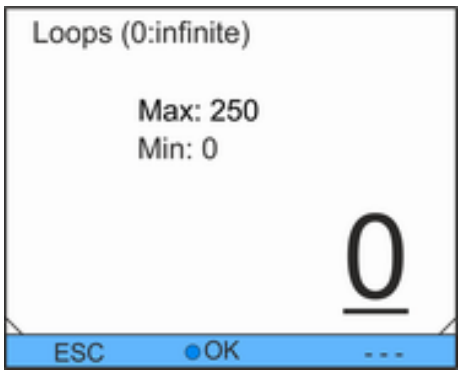


Fig. 68: Defining program loops

2. Adjust the number of loops accordingly.

Press the LEFT arrow button to enter two or three digit numbers. Another digit is displayed and can be adjusted.

If "0" is entered, the program is repeated continuously.

3. Confirm with the OK button.

6.17.5 Starting, interrupting and ending a program

Personnel: ■ Operating personnel

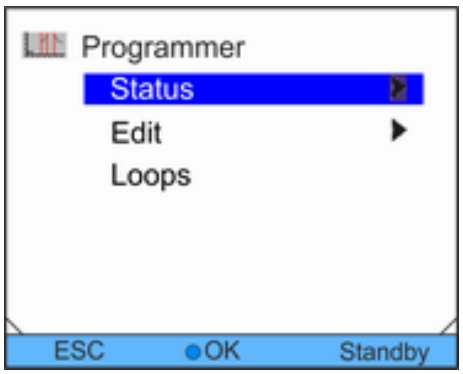


Fig. 69: Setting program status

1. Select the *Status* menu item for the selected program.

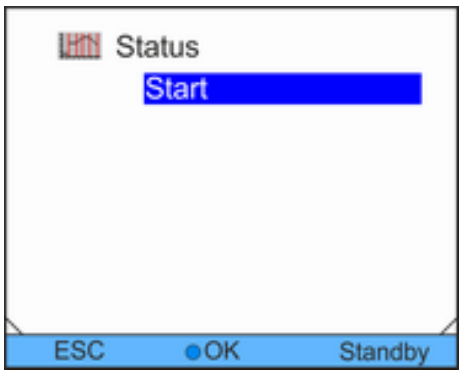


Fig. 70: Specifying program status

2. You have the following options:

- Select the *Start* option to start the program.
- If the program is started, it can be interrupted using *Pause*. An interrupted program can be continued using *Continue*.
- Select the *Stop* option to end the program.

7 Maintenance

7.1 General safety instructions

DANGER!
Contact with live or moving parts

Electric shock, impact, cutting, crushing

- The device must be disconnected from the mains power supply before any maintenance work.
- Repairs must only be carried out by specialists.

DANGER!
Heat transfer liquid drips onto the electronics

Short circuit

- The device must be disconnected from the mains power supply before any maintenance work.

CAUTION!
Contact with hot / cold device parts, accessories and heat transfer liquid.

Burns, scalding, frostbite

- Ensure device parts, accessories and heat transfer liquid are at room temperature before touching them.

NOTICE!
Contact with rotating part

Severed parts of the body

- Repairs must only be performed by specialist personnel.

Also note the following:

- Before all maintenance work, you should ensure that decontamination of the device has been performed if it came into contact with hazardous materials.

7.2 Maintenance intervals

The maintenance intervals described in the following table must be complied with. The following maintenance work is mandatory before every longer unsupervised operation.

Interval	Maintenance work
monthly	Inspection the drain tap for leaks by visual inspection from the outside
	Inspection of the external hoses for material fatigue and leaks
	Inspection of the hose clips for correct and secure fit
	Inspection of the low level safety function (only for devices with heater)
	Cleaning of the condenser (only for air-cooled devices)
	Cleaning of the water filter (only for water-cooled devices)
quarterly	Decalcifying of the cooling water circuit (only for water-cooled devices) A shorter interval must be selected, depending on water hardness and operating time
half-yearly	Inspection of the heat transfer liquid

7.3 Cleaning device

Personnel: ■ Operating personnel

WARNING!
Ingress of cleaning agents in the device

Electric shock

- Use a moist cloth for cleaning.

Also note the following:

- Only clean the control panel with water and detergent. Do not use acetone or solvents. The consequence would be permanent damage of the plastic surfaces.

7.4 Check low level protection

If the liquid level in the device drops so far that the heater is no longer completely covered with liquid, an alarm sounds. The display shows *low level*. The components of the device, the cooling unit, the heater and the pump are switched off by the electronics.

There must be an alarm signal as soon as low level is reached.

The liquid level in the device is shown on the display.

1. Switch on the device. Set the target temperature to room temperature.
2. Reduce the liquid level in the device. To do so, drain the heat transfer liquid via the drain tap.
   - ▶ The display will show the heat transfer liquid level dropping.

     If the liquid level is too low, the device will switch off. The message *low level* will appear on the display.
3. Close the drain tap and top up the heat transfer liquid.
   - ▶ The liquid level rises on the display.
4. Unlock the display with the Enter button.
   - ▶ The device restarts.

7.5 Cleaning air-cooled condenser

Personnel: ■ Operating personnel

Fig. 71: Remove the front panel

1. Switch off the device.
2. Remove the front panel carefully. Pull the panel to the front by gripping the recess and lift the panel out of the guide for this.

   The front panel is held in place by a magnetic catch.
3. Brush off or vacuum the condenser.
4. Replace the front cover carefully.

7.6 Cleaning water filter

This section is relevant for the following:

- ■ For water-cooled devices

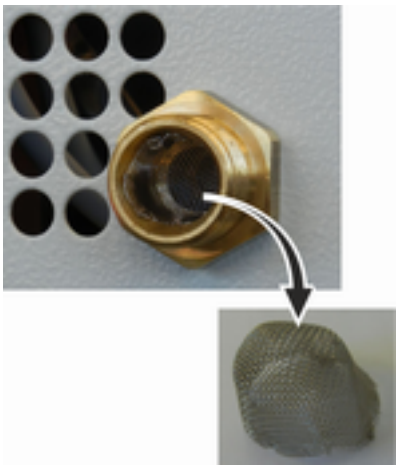


Fig. 72: Removing water filter

Personnel: ■ Operating personnel

1. Switch off the device using the mains power switch.
2. Unscrew the cooling water hose at the inlet of the water cooling unit from the threaded connection neck.
3. Carefully remove the water filter from the inlet connection spigot.

> *Use tweezers if necessary to remove / insert the water filter.*

4. Clean the water filter and then put it back into the inlet connection spigot.
5. Screw the cooling water hose at the inlet of the water cooling unit back again.

7.7 Decalcifying cooling water circuit

This section is relevant for the following:

- For water-cooled devices

The decalcifying agent is fed to the device through the water cooling inlet hose using a pump or a funnel. The decalcifying agent flows back through the return flow hose of the water cooling unit and should be directed into a container with sufficient storage capacity (at least 10 litres).

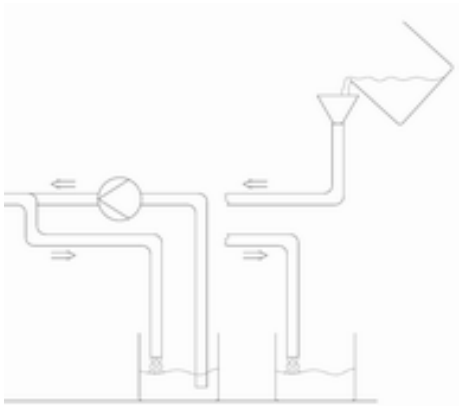


Fig. 73: Decalcification

Personnel: ■ Operating personnel

1. Switch off the device using the mains power switch.
2. Dissolve the decalcifying agent in a bucket of water.

> *Decalcification requires LAUDA decalcifying agent (catalogue number LZB 126, 5 kg packaging). Read the safety instructions and the instructions for use on the packaging for handling the chemical.*

3. Unscrew the cooling water hose at the inlet of the water cooling unit from the threaded connection neck.
4. Remove and clean the water filter of the device. The water filter is located in the inlet spigot of the water cooling unit.

> *Further information for cleaning the water filter can be found in* ↳ Chapter 7.6 ‘Cleaning water filter’ on page 81.

5. Leave the hose for the cooling water return flow screwed to the device. Insert the other end of the hose into a large container.

6. Switch on the device and adjust the setpoint to 10 °C. After starting the cooling unit, fill the device through the inlet hose of the water cooling unit with LAUDA decalcifying agent. Use a funnel or a pump.
7. Continuously fill in decalcifying agent or pump it around. Continue this process until the foaming reaction goes down. This is usually the case after approx. 20 to 30 minutes.
8. Drain the condenser afterwards.

   Further information about draining the condenser can be found in ↳ Chapter 9.2 ‘Draining condenser’ on page 90.

9. Thoroughly flush the cooling water circuit with clean water.

   Allow at least 10 litres of water to flow through the device.

10. Reconnect the device to the cooling water supply.

7.8 Checking heat transfer liquid

Contaminated or diluted heat transfer liquid must be replaced. Further use of the heat transfer liquid is only permitted with appropriate test results.

The heat transfer liquid must be checked according to DIN 51529.

8 Faults

8.1 Alarms, errors and warnings

Any alarms, error signals and warnings triggered on the device are shown as plain text on the screen.

Procedure in the event of alarms

Alarms are relevant for safety. The components of the device such as the pump switch off. A two-tone signal is output by the device. Alarms can be cancelled with the ENTER button after rectification of the cause of the fault.

You can find a list of alarms in ↳ Chapter 8.2 ‘Alarm codes’ on page 84.

Procedure in the event of warnings

Warnings are not relevant for safety. The device continues running. A continuous tone is output for a short time by the device. Warnings are output periodically. Warnings can be cancelled with the ENTER button after rectification of the cause of the fault.

A list of warnings can be found in ↳ Chapter 8.5 ‘Warnings - control system’ on page 86 and ↳ Chapter 8.6 ‘Warnings – safety system’ on page 87.

Procedure in the event of errors

A two-tone signal is output if any error occurs.

In the case of an error, switch off the device at the mains power switch. If the error occurs again after restarting the device, note the error code and the associated description and contact LAUDA Constant Temperature Equipment service. Contact details can be found in ↳ Chapter 13.4 ‘LAUDA contact’ on page 102.

Errors are displayed with the appropriate description and an error code in the form of a sequential number.

8.2 Alarm codes

Code	English output	Description
02	Low level	Low level detected by float switch
03	Overtemperature	Bath / outlet temperature higher than Tmax
09	T ext Pt100	External Pt100 actual value is not present
10	T ext analogue	External analogue actual value is not present
11	T ext serial	External serial actual value is not present
12	Input Analogue 1	Analogue module: Current input 1, interruption.
13	Input Analogue 2	Analogue module: Current input 2, interruption.
14	T ext serial	No signal for actual value via the USB interface

Code	English output	Description
15	Digital Input	Fault at the digital input / switch contact
20	T ext Ethernet	No signal for actual value via the Ethernet module

8.3 Low Level alarm

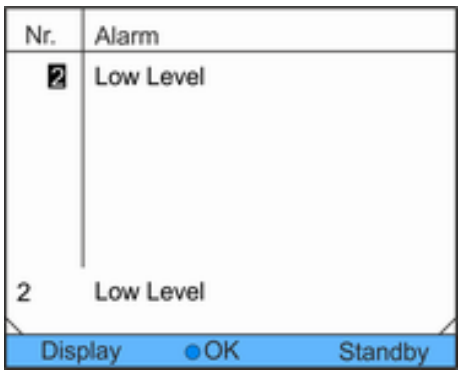


Fig. 74: Alarm Low Level

- If the liquid level falls below the minimum level, an alarm sounds.
- *Low Level* is shown on the screen. The device components such as the pump are switched off by the electronics.

Rectifying fault

Personnel: ■ Operating personnel

1. Refill lacking heat transfer liquid.
2. Unlock the display with the OK button.
   ▶ The device restarts.

8.4 Overtemperature alarm

This alarm can only occur for devices with heater.

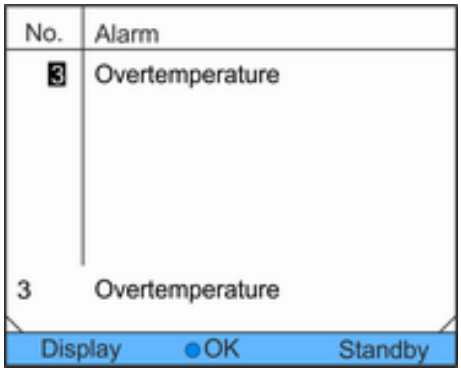


Fig. 75: Overtemperature alarm

- The message *3 Overtemperature* is shown on the screen if the temperature monitor trips.
- The electronics switch off the components of the device.
- The device outputs a two-tone signal.

Restarting device

1. Eliminate the cause of the error.
2. After cooling down, lock the display using the *OK* button.
   ▶ The device restarts.

8.5 Warnings - control system

All warnings of the control system start with the prefix 0. The prefix is followed by two additional digits. These digits are listed in the following table.

Code	English output	Description
001	CAN receive overflow	Overflow during CAN reception
002	Watchdog reset	Watchdog reset
003	T_il limit active	til-limit active
004	T_ih limit active	tih-limit active
005	Corrupt parameter	Inadmissible internal parameter
006	Corrupt programme	Inadmissible programmer data
007	Invalid parameter	Inadmissible parameter in memory
008	CAN system	Problem during internal data exchange
009	Unknown module	Unknown module connected
010	SW Control too old	Software version of control system too old
011	SW Safety too old	Software version of safety system too old
012	SW Command too old	Software version of remote control unit Command too old
013	SW Cool too old	Software version of cooling module too old
014	SW Analogue too old	Software version of analogue module too old
015	SW Serial too old	Software version of serial interface (RS232) too old
016	SW Contact old	Software version of contact module too old
017	SW Valve 0 old	Software version of solenoid valve 0 too old
018	SW Valve 1 old	Software version of solenoid valve 1 too old
019	SW Valve 2 old	Software version of solenoid valve 2 too old
020	SW Valve 3 old	Software version of solenoid valve 3 too old
021	SW Valve 4 old	Software version of solenoid valve 4 too old
022	SW Pump 0 old	Software version of pump 0 too old
023	SW Pump 1 old	Software version of pump 1 too old

Code	English output	Description
024	SW Pump 2 old	Software version of pump 2 too old
025	SW Pump 3 old	Software version of pump 3 too old
026	SW HTC old	Software version of high temperature cooler too old
027	SW Ext. Pt100 old	Software version of external Pt100 too old
028	SW Ethernet old	Software version of Ethernet too old
029	SW EtherCAT old	Software version of EtherCAT too old
033	Clock wrong time	Internal clock defective; battery power supply was/is interrupted (insert new battery)
034	Tset: Prog. is running	Setpoint was changed while the programmer is running.
041	Wrong mains voltage	Incorrect mains voltage setting
042	No VC type	Device type not configured
043	No VC voltage	Mains voltage not configured
050	Level very low	Level too low, top-up heat transfer liquid
051	Level high	Level too high (fill level of the heat transfer liquid too high, risk of bath overflow)
055	CAN buff. overflow	Buffer overflow for CAN reception

8.6 Warnings – safety system

All warnings of the safety system start with the prefix 1. The prefix is followed by two other digits. These digits are listed in the following table.

Code	English output	Description
101	CAN receive overflow	Overflow during CAN reception
102	Watchdog Reset	Watchdog reset
103	Heating not correct	Heaters have different outputs
104	Heat 1 failed	Heater 1 defective
105	Heat 2 failed	Heater 2 defective
106	Heat 3 failed	Heater 3 defective
107	Invalid Parameter	Inadmissible parameter in memory
108	CAN system	Problem during internal data exchange
109	Unknown Modul	Unknown module connected
110	SW Control too old	Software version of control system too old

Code	English output	Description
111	SW Safety too old	Software version of safety system too old
112	SW Command too old	Software version of command remote control unit too old
113	SW Cool too old	Software version of cooling module too old
114	SW Analog too old	Software version of analogue module too old
115	SW Serial too old	Software version of serial interface (RS232) too old
116	SW Contact too old	Software version of contact module too old
117	SW Valve 0 old	Software version of solenoid valve 0 too old
118	SW Valve 1 old	Software version of solenoid valve 1 too old
119	SW Valve 2 old	Software version of solenoid valve 2 too old
120	SW Valve 3 old	Software version of solenoid valve 3 too old
121	SW Valve 4 old	Software version of solenoid valve 4 too old
122	SW Pump 0 old	Software version of pump 0 too old
123	SW Pump 1 old	Software version of pump 1 too old
124	SW Pump 2 old	Software version of pump 2 too old
125	SW Pump 3 old	Software version of pump 3 too old
126	SW HTC old	Software version of high temperature cooler too old
127	SW Ext. Pt100 old	Software version of external Pt100 too old
128	SW Ethernet old	Software version of Ethernet too old
129	SW EtherCAT old	Software version of EtherCAT too old
155	CAN buff. overflow	Buffer overflow for CAN reception

8.7 Warnings – SmartCool

All warnings of the SmartCool system start with the prefix 3. The prefix is followed by two additional digits. These digits are listed in the following table.

Code	English output	Description
301	CAN receive overflow	Overflow during CAN reception
302	Watchdog reset	Watchdog reset
303	Missing SM adaptation	Adaptation run not performed
304	Pressure switch activated	Pressure switch in schema cooling circuit was triggered
305	Clean condenser	Clean the condenser

Code	English output	Description
306	TO1 out of range (Klixon)	Injection temperature outside value range
307	Invalid parameter	Inadmissible parameter in memory
308	CAN system	Problem during internal data exchange
309	Unknown module	Unknown module connected
310	SW Control too old	Software version of control system too old
311	SW Safety too old	Software version of safety system too old
312	SW Command too old	Software version of command remote control unit too old
313	SW Cool too old	Software version of cooling module too old
314	SW Analogue too old	Software version of analogue module too old
315	SW Serial too old	Software version of serial interface (RS232) too old
316	SW Contact old	Software version of contact module too old
317	SW Valve 0 old	Software version of solenoid valve 0 too old
318	SW Valve 1 old	Software version of solenoid valve 1 too old
319	SW Valve 2 old	Software version of solenoid valve 2 too old
320	SW Valve 3 old	Software version of solenoid valve 3 too old
321	SW Valve 4 old	Software version of solenoid valve 4 too old
322	SW Pump 0 old	Software version of pump 0 too old
323	SW Pump 1 old	Software version of pump 1 too old
324	SW Pump 2 old	Software version of pump 2 too old
325	SW Pump 3 old	Software version of pump 3 too old
326	SW HTC old	Software version of high temperature cooler too old
327	SW Ext. Pt100 old	Software version of external Pt100 too old
328	SW Ethernet old	Software version of Ethernet module too old
329	SW EtherCAT old	Software version of EtherCAT too old
341	sm0 min too small	Starting value of injection valve too low
344	chiller missing	Refrigerant unit does not run
345	Valve not closed	Valve of the cooling circuit does not close
347	Configure EEV0	Contact LAUDA Service
348	Configure EEV1	Contact LAUDA Service
349	Preheat unit	A warning concerning possible damage to the cooling system is sent when the device is operated below 5 °C. The cooling system must be preheated to prevent damage. This is automatically performed when outside installation is activated.
355	CAN buff. overflow	Buffer overflow for CAN reception

9 Decommissioning

9.1 Draining device

Personnel: ■ Operating personnel

WARNING!
Contact with hot or cold heat transfer liquid

Scalding, frostbite

- Bring the heat transfer liquid to room temperature before draining.

Also note the following:

- Observe the regulations for disposal of the used heat transfer liquid.

1. Switch off the device.
2. Let the device and the heat transfer liquid cool down or heat up to room temperature.
3. Position a container with appropriate capacity directly under the drain tap.

   Several draining processes are required for devices with high fill capacity.

4. Open the drain tap. Turn the lever to the right for this.

9.2 Draining condenser

This section is relevant for the following:

- For water-cooled devices

Fig. 76: Cooling water connection

Personnel: ■ Operating personnel

1. Temper the device to approx. 20°C. Switch off the device.
2. Close the cooling water inlet.
3. Unscrew the cooling water hose at the inlet of the water cooling unit from the threaded connection neck.
4. A water filter is located in the inlet connecting spigot of the water cooling unit. Carefully remove the water filter from the inlet connection spigot.

   Further information for removing the water filter can be found in ↳ Chapter 7.6 ‘Cleaning water filter’ on page 81.

5. Clean the water filter of the device. Then reinsert it into the inlet connection spigot.
6. Leave the cooling water hose for the return flow screwed to the device. Insert the other end of the hose into a drain or a large container.
7. Switch on the device and set the setpoint on the device to 10 °C.
8. After starting the compressor, immediately blow compressed air into the water inlet. Continue to blow compressed air through the device until all the cooling water has flowed out of the device.
9. Switch off the device.

10 Disposal

10.1 Disposing of refrigerant

The refrigerant must be disposed of in accordance with Directive 2015/2067/EU in combination with 517/2014/EU.

CAUTION!
Uncontrolled escape of refrigerant

Impact, cutting

- Disposal must be performed by specialist personnel.

NOTICE!
Uncontrolled escape of refrigerant

Environment

- Do not dispose of any pressurised cooling circuit.
- Disposal must be performed by specialist personnel.

Type and fill quantity of the refrigerant can be seen on the rating plate.

Repair and disposal may only be performed by a refrigeration technology specialist.

10.2 Device disposal

The following applies in member states of the EU: The device must be disposed of in accordance with Directive 2012/19/EU (WEEE Waste of Electrical and Electronic Equipment).

10.3 Disposing of packaging

The following applies in member states of the EU: The packaging must be disposed of according to EC Directive 94/62/EC.

11 Technical Data

11.1 General data

The device sound pressure level is below 70 dB. According to EC Directive 2006/42/EC. the sound pressure level of the devices is therefore not specified further.

Specification	Value	Unit
IP type of protection	IP 32	---
Classification of laboratory equipment in accordance with DIN 12 876-1		
- Class designation	I	---
- Labelling	NFL (suitable for non-flammable liquids)	---
Protection class for electrical operating equipment DIN EN 61 140 (VDE 0140-1)	1	---
Display	TFT display, 3.5", 320 x 240 pixels	---
Display resolution	±0.01	°C
Adjustment resolution	±0.01	°C

Type-specific data

Device	Working temperature range without heater	Working temperature range with heater	Temperature stability[1]	Dimensions (W x D x H)	Weight
Unit	°C	°C	K	mm	kg
VC 1200	-20 – 40	-20 – 80	±0.05	450 x 550 x 650	54
VC 1200 W	-20 – 40	-20 – 80	±0.05	450 x 550 x 650	51
VC 2000	-20 – 40	-20 – 80	±0.05	450 x 550 x 650	57
VC 2000 W	-20 – 40	-20 – 80	±0.05	450 x 550 x 650	54
VC 3000	-20 – 40	-20 – 80	±0.05	550 x 650 x 970	93
VC 3000 W	-20 – 40	-20 – 80	±0.05	550 x 650 x 970	89
VC 5000	-20 – 40	-20 – 80	±0.05	550 x 650 x 970	98
VC 5000 W	-20 – 40	-20 – 80	±0.05	550 x 650 x 970	94
VC 7000	-20 – 40	-20 – 80	±0.1	650 x 670 x 1250	138
VC 7000 W	-20 – 40	-20 – 80	±0.1	650 x 670 x 1250	131
VC 10000	-20 – 40	-20 – 80	±0.1	650 x 670 x 1250	147
VC 10000 W	-20 – 40	-20 – 80	±0.1	650 x 670 x 1250	140

[1]the temperature stability is load-dependent in devices without a heater ↳ “Cooling in a device without a heater and in the [autom.] setting” on page 55

The case height is 140 mm higher for the VC 1200 (W) and VC 2000 (W) devices with the more powerful pump.

Device	Clearance around the device	Exhaust air (air-cooled devices)
	cm (front/back/right/left)	m³/h
VC 1200	20/20/20/20	650
VC 1200 W	20/20/0/0	---
VC 2000	20/20/20/20	650
VC 2000 W	20/20/0/0	---
VC 3000	50/50/20/20	1300
VC 3000 W	20/20/0/0	---
VC 5000	50/50/20/20	2500
VC 5000 W	20/20/0/0	---
VC 7000	50/50/20/20	4500
VC 7000 W	20/20/0/0	---
VC 10000	50/50/20/20	4500
VC 10000 W	20/20/0/0	---

Tab. 12: Power consumption VC 1200 (W) to VC 3000 (W)

Alternating current	VC 1200 (W)	VC 2000 (W)	VC 3000 (W)	Unit
230 V; 50 Hz	1.1	1.6	1.8	kW
200 V; 50/60 Hz	1.3	2.0	2.2	kW
208–220 V; 60 Hz	1.4	2.2	2.3	kW

Tab. 13: Power consumption VC 5000 (W) to VC 10000 (W)

Three-phase current	VC 5000 (W)	VC 7000 (W)	VC 10000 (W)	Unit
400 V; 3/N/PE~50 Hz	3.3	4.3	5.4	kW
208-220 V; 3/PE~60 Hz	3.6	4.6	5.9	kW
200 V; 3/PE~50/60 Hz	3.5	4.5	5.7	kW

11.2 Cooling capacity

Tab. 14

Device	Cooling capacity (20°C)	Cooling capacity (10 °C)	Cooling capacity (0 °C)	Cooling capacity (-10 °C)	Cooling capacity (-20 °C)
	kW	kW	kW	kW	kW
VC 1200 (W)	1.20	1.00	0.70	0.40	0.14
VC 2000 (W)	2.00	1.50	1.06	0.68	0.38
VC 3000 (W)	3.00	2.40	1.68	0.95	0.45
VC 5000 (W)	5.00	3.90	2.75	1.70	0.90
VC 7000 (W)	7.00	5.30	3.70	2.40	1.30
VC 10000 (W)	10.00	7.60	5.30	3.50	2.00

The cooling capacity is measured for a specified temperature of the heat transfer liquid. These temperature values are shown in brackets. The ambient temperature for the measurement is 20 °C; ethanol was used as heat transfer liquid. The cooling water temperature is 15 °C and the cooling water differential pressure is 3 bar for the measurement of water-cooled devices.

Cooling water connection

All water-cooled Variocool circulation chillers have the following cooling water connection:

- ¾" external connection thread

11.3 Refrigerant and filling quantity

The device contains fluorinated greenhouse gases.

Tab. 15

	Unit	VC 1200	VC 2000	VC 1200 W	VC 2000 W
Refrigerant	---	R-449A	R-449A	R-449A	R-449A
Maximum filling weight	kg	0.50	0.58	0.50	0.58

	Unit	VC 1200	VC 2000	VC 1200 W	VC 2000 W
$GWP_{(100a)}$*	---	1397	1397	1397	1397
CO_2 equivalent	t	0.70	0.81	0.70	0.81

Tab. 16

	Unit	VC 3000	VC 5000	VC 3000 W	VC 5000 W
Refrigerant	---	R-449A	R-449A	R-449A	R-449A
Maximum filling weight	kg	0.95	1.10	0.95	1.10
$GWP_{(100a)}$*	---	1397	1397	1397	1397
CO_2 equivalent	t	1.33	1.54	1.33	1.54

Tab. 17

	Unit	VC 7000	VC 10000	VC 7000 W	VC 10000 W
Refrigerant	---	R-452A	R-452A	R-452A	R-452A
Maximum filling weight	kg	2.0	2.0	2.0	2.0
$GWP_{(100a)}$*	---	2140	2140	2140	2140
CO_2 equivalent	t	4.28	4.28	4.28	4.28

Global Warming Potential (GWP), comparisons CO_2 = 1.0

** Time horizon 100 years, in accordance with IPCC IV*

11.4 Filling volume and characteristics of the pumps

Tab. 18

Device	Maximum/minimum filling volume	Pump connection	Drain tap
	l	---	---
VC 1200 (W)	15/8	G ¾ (15), ¾" hose nozzle	G ½"
VC 2000 (W)	15/8	G ¾ (15), ¾" hose nozzle	G ½"
VC 3000 (W)	33/20	G ¾ (15), ¾" hose nozzle	G ½"
VC 5000 (W)	33/20	G ¾ (15), ¾" hose nozzle	G ½"
VC 7000 (W)	64/48	G 1¼ (20), 1" hose nozzle	G ¾"
VC 10000 (W)	64/48	G 1¼ (20), 1" hose nozzle	G ¾"

Characteristics of the pump with different mains supplies

The pumps characteristics were determined using water as heat transfer liquid.

Tab. 19: Maximum flow pressure and maximum flow rate

Alternating current	VC 1200 (W)	VC 2000 (W)	VC 3000 (W)
230 V; 50 Hz	0.9 bar; 28 L/min 3.2 bar; 37 L/min 4.8 bar; 37 L/min	0.9 bar; 28 L/min 3.2 bar; 37 L/min 4.8 bar; 37 L/min	3.2 bar; 37 L/min 4.8 bar; 37 L/min
200 V; 50/60 Hz	0.9 bar; 28 L/min[1] 3.2 bar; 37 L/min 4.8 bar; 37 L/min	0.9 bar; 28 L/min[1] 3.2 bar; 37 L/min 4.8 bar; 37 L/min	3.2 bar; 37 L/min 4.8 bar; 37 L/min
208–220 V; 60 Hz	0.9 bar; 28 L/min 3.2 bar; 37 L/min 4.8 bar; 37 L/min	0.9 bar; 28 L/min 3.2 bar; 37 L/min 4.8 bar; 37 L/min	3.2 bar; 37 L/min 4.8 bar; 37 L/min

[1] Characteristics at 200 V; 60 Hz: 1.2 bar; 28 L/min

Three-phase current	VC 5000 (W)	VC 7000 (W)	VC 10000 (W)
400 V; 3/N/PE~50 Hz	3.2 bar; 37 L/min 4.8 bar; 37 L/min 5.0 bar; 60 L/min	3.2 bar; 37 L/min 4.8 bar; 37 L/min 5.0 bar; 60 L/min	3.2 bar; 37 L/min 4.8 bar; 37 L/min 5.0 bar; 60 L/min
208-220 V; 3/PE~60 Hz	3.2 bar; 37 L/min 4.8 bar; 37 L/min 5.0 bar; 60 L/min	3.2 bar; 37 L/min 4.8 bar; 37 L/min 5.0 bar; 60 L/min	3.2 bar; 37 L/min 4.8 bar; 37 L/min 5.0 bar; 60 L/min
200 V; 3/PE~50/60 Hz	3.2 bar; 37 L/min 4.8 bar; 37 L/min 5.0 bar; 60 L/min[2]	3.2 bar; 37 L/min 4.8 bar; 37 L/min 5.0 bar; 60 L/min[2]	3.2 bar; 37 L/min 4.8 bar; 37 L/min 5.0 bar; 60 L/min[2]

[2] Characteristics at 200 V; 3/PE~50 Hz: 4.3 bar; 60 L/min

Characteristic curves of the pumps

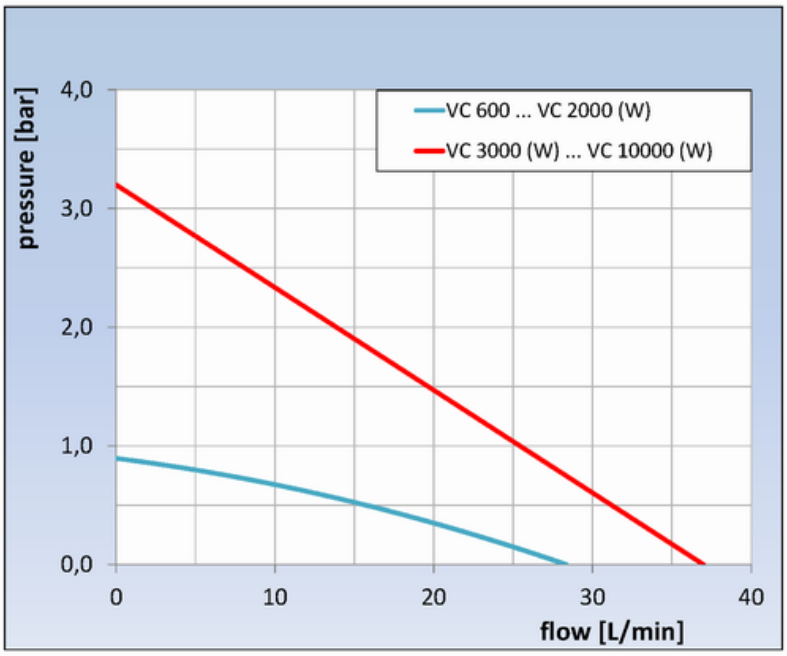


Fig. 77: Characteristic curves of the pumps

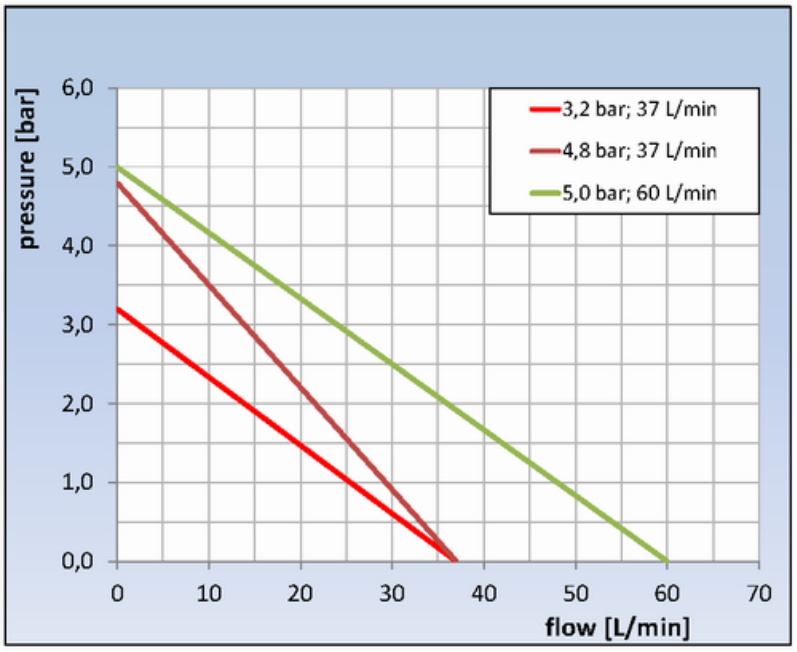


Fig. 78: Characteristic curves of the pumps

11.5 Heater

Tab. 20: Heat output and power consumption

Alternating current	VC 1200 (W)	VC 2000 (W)	VC 3000 (W)	Unit
230 V; 50 Hz				
Heat output	1.5	1.5	1.5	kW
Power consumption with heater	2.6	2.6	2.6	kW
200 V; 50/60 Hz				
Heat output	1.1	1.1	1.1	kW
Power consumption with heater	2.3	2.3	2.6	kW
208–220 V; 60 Hz				
Heat output	1.2 – 1.35	1.2 – 1.35	1.2 – 1.35	kW
Power consumption with heater	2.4	2.5	2.8	kW

Tab. 21: Heat output and power consumption

Three-phase current	VC 5000 (W)	VC 7000 (W)	VC 10000 (W)	Unit
400 V; 3/N/PE~50 Hz				
Heat output	4.5	4.5	7.5	kW
Power consumption with heater	7.8	8.8	11.1	kW
208-220 V; 3/PE~60 Hz				
Heat output	3.65 – 4.1	3.65 – 4.1	6.1–6.9	kW
Power consumption with heater	4.5	5.7	7.7	kW
200 V; 3/PE~50/60 Hz				
Heat output	3.4	3.4	5.7	kW
Power consumption with heater	4.3	5.4	7.6	kW

Tab. 22: Stronger heating

Alternating current	VC 1200 (W)	VC 2000 (W)	Unit
230 V; 50 Hz			
Heat output	2.25	2.25	kW
200 V; 50/60 Hz			
Heat output	1.7	1.7	kW
208–220 V; 60 Hz			
Heat output	1.8 – 2.1	1.8 – 2.1	kW

11.6 Equipment, voltage-independent

Devices	Sound insulation	Outdoor installation	Insulation of the cooling water hydraulic system
VC 5000	X	X	---
VC 7000	X	X	---
VC 10000	X	X	---
VC 1200 W	---	---	X
VC 2000 W	---	---	X
VC 3000 W	---	---	X
VC 5000 W	X	---	X
VC 7000 W	X	---	X
VC 10000 W	X	---	X

11.7 Line fuse

Alternating current	VC 1200 (W)	VC 2000 (W)	VC 3000 (W)
230 V; 50 Hz	T10 A	T16 A	T16 A
with heater	T16 A	T16 A	T16 A
200 V; 50/60 Hz	T16 A	T16 A	T16 A
with heater	T16 A	T16 A	T16 A
208–220 V; 60 Hz	T16 A	T16 A	T16 A
with heater	T16 A	T16 A	T16 A

Three-phase current	VC 5000 (W)	VC 7000 (W)	VC 10000 (W)
400 V; 3/N/PE~50 Hz	T16 A	T16 A	T16 A
with heater	T16 A	T16 A	T16 A
208-220 V; 3/PE~60 Hz	T16 A	T20 A	T25 A
with heater	T16 A	T20 A	T25 A
200 V; 3/PE~50/60 Hz	T16 A	T20 A	T25 A
with heater	T16 A	T20 A	T25 A

12 Accessories

The following accessories are available for all Variocool devices.

Tab. 23: Large module slot (51 mm x 27 mm)

Accessories	Catalogue number
Analogue module	LRZ 912
RS 232/485 interface module	LRZ 913
Contact module with 1 input and 1 output	LRZ 914
Contact module with 3 inputs and 3 outputs	LRZ 915
Profibus module	LRZ 917

Tab. 24: Small module slot (51 mm x 17 mm)

Accessories	Catalogue number
External Pt100/LiBus module	LRZ 918
Command remote control unit (only functional in combination with LRZ 918)	LRT 914

Tab. 25: Connector

Accessories	Catalogue number
External temperature sensor with connector and shielded connection cable	ETP 059
Coupling connector, 6-pin for analogue inputs/outputs	EQS 057
Connector SUB-D 9-pin	EQM 042
RS 232 cable (2 m) for PC	EKS 037
RS 232 cable (5 m) for PC	EKS 057
Coupling connector, 3-pin for contact input	EQS 048
Coupling socket, 3-pin for contact output	EQD 047

Tab. 26: Flow rate monitor

Accessories	for device	Catalogue number
Flow rate monitor G 3/4"	VC 1200 (W) – 5000 (W)	LWZ 118
Flow rate monitor G 1 1/4"	VC 7000 (W) – 10000 (W)	LWZ 119

13 General

13.1 Copyright

This manual is protected by copyright and is exclusively intended for the purchaser for internal use.

The transfer of this manual to third parties, reproductions of any type and form, whether in whole or in part, and the dissemination and/or communication of the contents are not authorised without the written permission of the manufacturer.

Infringements will result in legal action for damages. We reserve the right to assert further claims.

13.2 Technical changes

Manufacturer reserves right to make technical modifications.

13.3 Warranty conditions

LAUDA provides a warranty of one year on equipment as standard.

13.4 LAUDA contact

Contact LAUDA Service Constant Temperature Equipment in the following cases:

- In the event of faults on the device
- For technical questions about the device
- For spare part orders

Contact our Sales Department for application-specific questions.

Contact details

LAUDA Service constant temperature equipment

Telephone: +49 (0)9343 503 350

Fax: +49 (0)9343 503 283

Email: service@lauda.de

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EC DECLARATION OF CONFORMITY

Manufacturer: LAUDA DR. R. WOBSER GMBH & CO. KG
Pfarrstrasse 41/43 97922 Lauda-Königshofen Germany

We hereby declare under our sole responsibility that the machines described below

Product Line: Variocool **Serial number:** from S190000001

Types: VC 1200, VC 1200 W, VC 2000, VC 2000 W, VC 3000, VC 3000 W,
VC 5000, VC 5000 W, VC 7000, VC 7000 W, VC 10000, VC 10000 W

comply with all relevant provisions of the EC Directives listed below due to their design and type of construction in the version brought on the market by us:

Machinery Directive	2006/42/EC
EMC Directive	2014/30/EU
RoHS Directive	2011/65/EU

The equipment is not covered by the Pressure Equipment Directive 2014/68/EU, as the maximum classification of the equipment is Category 1 and it is covered by the Machinery Directive.

The protective objectives of the Machinery Directive with regard to electrical safety are complied with in accordance with Annex I Paragraph 1.5.1 in conformity with the Low Voltage Directive 2014/35/EU.

Applied harmonized standards:

- EN 12100:2011 (ISO 12100:2010)
- EN 61326-1:2013 (IEC 61326-1:2012)
- EN 378-2:2018
- EN 61010-1:2011 (IEC 61010-1:2010 + Cor. :2011)
- EN 61010-2-010:2015-05

Authorized representative for the composition of the technical documentation:

Dr. Jürgen Dirscherl, Director Research & Development

Lauda-Königshofen, 04.05.2020

A. Dinger

Dr. Alexander Dinger, Head of Quality Management

Product Returns and Clearance Declaration

Product Returns

Would you like to return a LAUDA product you have purchased to LAUDA? For the return of goods, e.g. for repair or due to a complaint, you will need the approval of LAUDA in the form of a *Return Material Authorization (RMA)* or *processing number*. You can obtain the RMA number from our customer service department at *+49 (0) 9343 503 350* or by email service@lauda.de.

Return address

LAUDA DR. R. WOBSER GMBH & CO. KG

Pfarrstrasse 41/43

97922 Lauda-Königshofen

Deutschland/Germany

Clearly label your shipment with the RMA number. Please also enclose this fully completed declaration.

RMA number	Product serial number
Customer/operator	Contact name
Contact email	Contact telephone
Zip code	Place
Street & house number	
Additional explanations	

Clearance Declaration

The customer/operator hereby confirms that the product returned under the above-mentioned RMA number has been carefully emptied and cleaned, that any connections have been sealed to the farthest possible extent, and that there are no explosive, flammable, environmentally hazardous, biohazardous, toxic, radioactive or other hazardous substances in or on the product.

Place, date	Name in block letters	Signature

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