Operation manual

Integral process thermostats

IN 130 T, IN 230 T, IN 230 TW, IN 530 T, IN 530 TW, IN 1030 T, IN 1330 TW, IN 150 XT, IN 250 XTW, IN 280 XT, IN 280 XTW, IN 550 XT, IN 550 XTW, IN 590 XTW, IN 750 XT, IN 950 XTW, IN 1590 XTW, IN 1850 XTW

V2REV18

Read this manual prior to performing any task!

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1 Safety

1.1 Safety instructions

IMPORTANT

- Before using the device, please read the operating manual carefully.
- The information in this operating manual must therefore be kept at hand in the immediate vicinity of the device.
- Save the operating manual for later reference.
- This operating manual is part of the device. If the device is passed on, the operating manual must be kept with it.
- The operating manual is available on our homepage (www.lauda.de).

An overview of authorized personnel and the protective equipment can be found in Chapter 1.12 “Personnel qualification” on page 12 *and* Chapter 1.13 “Personal protective equipment” on page 13.

Refer to Chapter 1.15 “Structure of warnings” on page 14 *for more information on the general structure of warnings.*

- The devices can only be operated as intended under the conditions specified in this operating manual. Any other mode of operation is considered to be unintended use and could compromise the protection provided by the device.
- You, the user, must check the functionality of the safety fittings of the device. Maintain the maintenance intervals.
- Transport the device carefully. The device must never be tilted or turned upside down.
- The device and the inside of the device could be damaged:
  - due to fall,
  - due to shock.
- The device may only be operated by trained personnel.
- Never put the device into operation, if:
  - it is damaged,
  - it is leaky (for example, heat transfer liquid is escaping),
  - the mains cable and/or other cables are damaged.
- Do not install the device in areas with aggressive media.
- The installation surface must be tightly sealed, level, non-slip and non-combustible.
- Keep the specified distance from other devices, objects or walls.
- Protect the device from dripping or condensing water.
- Do not store any liquids or combustible objects above the device.
- Do not handle flammable liquids in the immediate vicinity of the device.
- Do not place heavy parts on the device.
- The devices are intended for operation on grounded networks. Operation on IT networks, for example, is not permitted.

- Turn off the device and pull out the mains plug
  - for service and repair work,
  - when moving the device,
  - when installing or removing interface modules or accessories.
- Do not operate the device without heat transfer liquid.
- Only skilled personnel are permitted to perform service and repair work.
- Completely drain the device before it is moved.
- Do not make any technical changes to the device.
- The devices are not designed for use in medical applications in accordance with DIN EN 60601-1 and IEC 601-1.
- Only connect hydraulically closed applications to the device.
- In pressure-sensitive applications (e.g. glass apparatus) with a maximum permissible working pressure below the maximum pressure of the device pump, a pressure relief device must be installed to protect against gage pressure.
- Parts of the device (e.g. pump, drain connectors) can assume surface temperatures of over 70°C at higher operating temperatures (possible risk of burns).
- After a power failure or when the device is switched off, parts of the device may become hotter for a short time.
- Use suitable hoses.
- Use hose clips to secure the hoses against slipping off the hose nozzle.
- Check the hoses from time to time for possible material fatigue. If a hose breaks hot liquids may leak out, thus endangering people and materials.
- Hoses with heat transfer liquid and other hot parts may not come into contact with the mains cable.
- Do not operate the device if leaks have been detected. Immediately ventilate the installation room.
- The following actions may unintentionally restart the thermostat from standby,
  - previously activated timer operation,
  - 'Start' command over active interfaces on the device.
- Observe the permissible storage and operating temperatures of the device.
- The device may not be exposed to fire, otherwise there is danger of explosion.
- The device may only be operated with the casing mounted.
- If a hose and a collecting vessel are connected to the overflow pipe, the hose and container must be suitable for the heat transfer liquid and the maximum working temperature.
- The overflow may not be closed.
- Bring the heat transfer liquid to room temperature before draining.
- When changing to another heat transfer liquid, clean the device intensively and drain it completely. It is recommended to flush the device with the new heat transfer liquid.
- It is essential to avoid the penetration of secondary liquids into the device (e.g. via a defective heat exchanger provided by the customer).
- Observe all product safety labels/safety marks on the device.

Additional safety advice for water-cooled devices

- Use suitable cooling water to prevent corrosion in the cooling water circuit.
- The return hose of the water cooling system must be securely fixed in the sink area to prevent uncontrolled slipping of the hose, even in the event of pressure surges.
- The return hose of the water cooling system must be fixed in the outlet area in such a way that hot cooling water cannot splash out.
- Avoid bending or squeezing the return hose of the water cooling system. Gage pressure can cause the cooling water hoses to rupture and hot cooling water to escape.
- In order to avoid damage caused by leakage of the cooling water system, it is recommended to install a leakage water detector with water shut-off.

Additional safety instructions for high-temperature thermostats with water cooling

- High-temperature thermostats with cooling water connection (type W) always require a cooling water supply, even if the devices are only used for heating.

1.2 Testing in accordance with the Industrial Safety and Health Ordinance

According to §15 of the Industrial Safety Ordinance (BetrSichV)[1] the device is a system requiring monitoring (classification according to Pressure Equipment Directive 2014/68/EU: Category I). The system must be subjected to an installation/order and function test by a competent person before it is started up. A certificate shall be issued for this test, documenting the scope and result of the tests.

[1] The national regulations of the respective country in which the system is installed must be observed.

1.3 EMC requirements

Table 1: Classification in accordance with EMC requirements

Device	Immunity	Emissions class	Customer power supply
Integral T process thermostat Integral XT process thermostat	Type 2 in accordance with DIN EN 61326-1	Emissions Class B in accordance with CISPR 11	Only for EU Domestic connection value ≥ 100 A
Integral T process thermostat Integral XT process thermostat	Type 2 in accordance with DIN EN 61326-1	Emissions Class B in accordance with CISPR 11	Rest of the world (outside EU) No limitation
Integral T high-temperature thermostat Integral XT high-temperature thermostat	Type 2 in accordance with DIN EN 61326-1	Emissions Class B in accordance with CISPR 11	No limitation

Instructions for Class A digital device, USA

"This equipment has been tested and found to comply with the limits for Class A digital device, pursuant to Part 15 of the FCC (Federal Communication Commission) Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense."

Instructions for Class A digital device, Canada

"This Class A digital apparatus complies with Canadian ICES-003" (ICES = Interference Causing Equipment Standards).

« Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada ».

1.4 Software versions

These operating instructions are valid for devices with the following software versions or higher.

Software	Valid from version
Control system	1.09
Protection system	1.12
Cooling system	1.11
Heating	1.12
Pump	2.47
External temperature	1.39
Analog IO module	3.27
RS 232/485 module	3.29

1.5 Observing additional operating instructions

Interface modules

Additional interface modules can be fitted to the device. Before installing and using interface modules, always read and observe the operating manual accompanying the relevant interface module.

1.6 Limits of the device

1.6.1 Usage limits

Intended use

- The process thermostat and the high-temperature thermostat may only be used for the temperature control and circulation of flammable and non-flammable heat transfer liquids in a closed circuit. The heat transfer liquid is pumped through a hose to the external closed consumer and flows through a hose back into the thermostat. The heat transfer liquids and hoses to be used are listed in these operating instructions.

Reasonably foreseeable improper use

- Operation without heat transfer liquid
- Operation with heat transfer liquid, hoses or refrigerants other than those specified in the operating instructions
- Operation with a glass reactor without gage pressure protection
- Operation in a non-closed hydraulic circuit
- Outdoor operation
- Connecting hoses incorrectly
- Setting an incorrect pump pressure
- Use for controlling the temperature of foodstuffs
- Use in a potentially explosive atmosphere
- Use as a medical device

Type of energy supply

- Electrical energy (each device)
- Cooling water (required for water-cooled process thermostat and high-temperature thermostat)

Performance limits, operating values

- See the Technical Data chapter

1.6.2 Environmental and operating conditions

The device may only be used in the following areas:

- Commercial sector
- Only used inside buildings
- Use up to a height of 2,000 m above sea level
- Ambient temperature from 5°C to 40°C
- Maximum relative humidity 80% at temperatures up to 31°C, linearly decreasing until 50% relative humidity at 40°C
- Surge category II
- Pollution degree 2

1.6.3 Time limits

Service life	- The service life of the device is 10 years.
Maintenance intervals	- See ↳ Chapter 7.2 “Maintenance intervals” on page 114
Maximum operating period without interruption	- The device is designed for supervised continuous operation.

1.7 Prohibition of modifications to the device

Any modification of the device by the user is prohibited. Anything resulting from unauthorized modification is not covered by customer service or the product warranty. Service work may only be performed by LAUDA Service Temperature control devices or a service partner authorized by LAUDA.

1.8 Materials

All parts that come into contact with heat transfer liquid are manufactured from high-quality materials adapted to withstand the operating temperature. High-quality stainless steels, copper, brass and premium-quality heat-resistant plastics are used.

1.9 Fluorinated refrigerant

The cooling thermostats are operated with non-odorized refrigerant (fluorinated greenhouse gas), depending on the device model. There are no special installation requirements due to the low refrigerant charge and hermetically sealed design. The designation and refrigerant charge are specified on the rating label.

1.10 Requirements for the heat transfer liquid

- Heat transfer liquids are used to control the temperature. Only LAUDA heat transfer liquids are approved for use in the device. LAUDA heat transfer liquids are liquids that have been tested and approved by LAUDA DR. R. WOBSER GMBH & CO. KG.
- The heat transfer liquids are suitable for a specific temperature range. This temperature range must correspond with the temperature range of your application.
- The use of heat transfer liquids poses a risk of injury from high and low temperatures and fire if certain upper or lower temperature thresholds are exceeded or the container is broken, causing a reaction with the heat transfer liquid.
- The risks and corresponding safety measures for handling the heat transfer liquid are specified in the safety data sheet. The safety data sheet of the heat transfer liquid must therefore be observed in order to use the device as intended.

1.11 Hose requirements

The hoses for the external hydraulic circuit must be resistant to:

- the heat transfer liquid used
- the pressure in the hydraulic circuit
- the high and low working temperatures

1.12 Personnel qualification

Operating personnel

Operating personnel are personnel who have been instructed on how to use the device as intended in line with the information in the operating manual.

Specialized personnel

Certain activities on the device must be performed by specialized personnel. Specialized personnel are personnel whose education, knowledge, and experience qualify them to assess the function and risks associated with the device and its use.

1.13 Personal protective equipment

Protective gloves

Protective gloves must be worn for certain tasks. The protective gloves must comply with the standard DIN EN 374 -1. The protective gloves must be chemically resistant.

Protective work clothing

Protective work clothing must be worn for certain tasks. The protective clothing must meet the legal requirements for personal protective equipment. The protective clothing must have long arms. Additionally safety shoes are required.

Safety glasses

Safety glasses must be worn for certain tasks. The safety glasses must comply with the standard DIN EN 166. The glasses must be tightly closed and equipped with side plates.

1.14 Safety fittings on the device

1.14.1 Overtemperature protection

The overtemperature protection is a safety unit that prevents combustible heat transfer liquid from igniting due to high temperatures. All safety components on the device are shut down to prevent fire from posing a danger. An alarm signal also indicates that the overtemperature protection has been activated. The temperature at which the safety fitting is activated must be set in line with the heat transfer liquid used.

Repeat the checks of the overtemperature protection at regular intervals.

Further information Chapter 7.2 “Maintenance intervals” on page 114 *and* Chapter 7.7 “Checking the overtemperature protection” on page 118.

1.14.2 Low-level protection

The low-level protection is a safety unit that prevents damage to the device and prevents the hot heater from igniting combustible heat transfer liquid. If the fill level of heat transfer liquid level in the device falls below a specified level, a warning is issued initially. If the fill level continues to fall, an alarm is triggered. All safety components on the device are switched off as a result.

Repeat the checks of the low-level protection at regular intervals.

Further information Chapter 7.2 “Maintenance intervals” on page 114 *and* Chapter 7.8 “Checking the low-level protection” on page 119.

1.14.3 Product safety label

Hot

A "Hot surface" graphical symbol is affixed to the device. This symbol warns against hot surfaces on the device. These surfaces must not be touched during operation. These surfaces must be allowed to cool to room temperature before they can be touched during other operation phases such as servicing.

1.15 Structure of warnings

Dangerous

- A warning of "dangerous" indicates an **immediately dangerous** situation.
- If this warning is not observed, then **death** or **severe, irreversible injury** could occur.

DANGER!
Type and source

Consequences of not following instructions

- Measure 1
- Measure...

Warning

- A warning of "warning" indicates a **possibly dangerous** situation.
- If this warning is not observed, then **death** or **severe, irreversible injury** could occur.

WARNING!
Type and source

Consequences of not following instructions

- Measure 1
- Measure...

Caution

- A warning of "caution" indicates a **possibly dangerous** situation.
- If this warning is not observed, then **minor, reversible injury** could occur.

CAUTION!
Type and source

Consequences of not following instructions

- Measure 1
- Measure...

Notice

A "notice" warns that dangers to property or the environment may exist.

!	NOTICE! Type and source
	Consequences of not following instructions
	• Measure 1 • Measure...

2 Unpacking

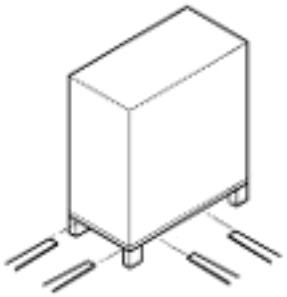


Fig. 1: Transport with forklift truck

Fig. 2: Ring bolt (example)

DANGER!
Transport damage

Electric shock

- Closely inspect the device for transport damage prior to commissioning!
- Never operate a device that has sustained transport damage!

Personnel: ■ Operating personnel

1. Check the device and accessories for completeness and transport damage immediately after delivery.

If the device or accessories are damaged contrary to expectations, immediately inform the shipping company so that a damage report can be compiled and the transport damage inspected. Also notify LAUDA Constant Temperature Equipment Service department immediately. You will find the contact information here Chapter 12.4 “Contact LAUDA” on page 131.

2. Unpack the device.

Keep the original packaging of your constant temperature equipment for subsequent transportation. If necessary, request the packing instructions for the device from LAUDA for repacking.

3. Screw the two ring bolts into the thread connection (M10) on the top of the casing.
4. Use one permissible round sling or steel cable (or similar) per ring bolt.
5. Align the hangers parallel to each other and at right angles to the top of the device.
6. Use a crane to lift the device off the transport pallet.

Fig. 3: Lift device

Table 2: Standard accessories Integral T

Device type	Designation	Quantity	Cat. No.
All devices	Operating manual	1	Q4DA-E_13-006
All devices	Power cable	1	---
IN 130 T, IN 230 T(W)	Ring bolt M10 x 17	2	DSS 044
IN 530 T(W), IN 1030 T, IN 1330 TW	Ring bolt M10 x 17	2	DSS 085
IN 130 T to IN 530 TW	Hose fitting for pump connector	2	EOA 004
IN 1030 T up to IN 1330 TW	Screw cap for pump connector	2	EOV 197
IN 1030 T up to IN 1330 TW	Hose nozzle for pump connector	2	HKA 168
Water-cooled devices	Hose fitting for cooling water nozzle	2	EOA 001

Table 3: Standard accessories Integral XT

Device type	Designation	Quantity	Cat. No.
All devices	Operating manual	1	Q4DA-E_13-006
All devices	Power cable	1	---
IN 150 XT, IN 250 XTW	Ring bolt M10 x 17	2	DSS 044
IN 280 XT(W), IN 550 XT(W), IN 590 XTW, IN 750 XT, IN 950 XTW, IN 1590 XTW, IN 1850 XTW	Ring bolt M10 x 17	2	DSS 085
Water-cooled devices	Hose fitting for cooling water nozzle	2	EOA 001

3 Device description

3.1 Overall view of Integral (small casing version)

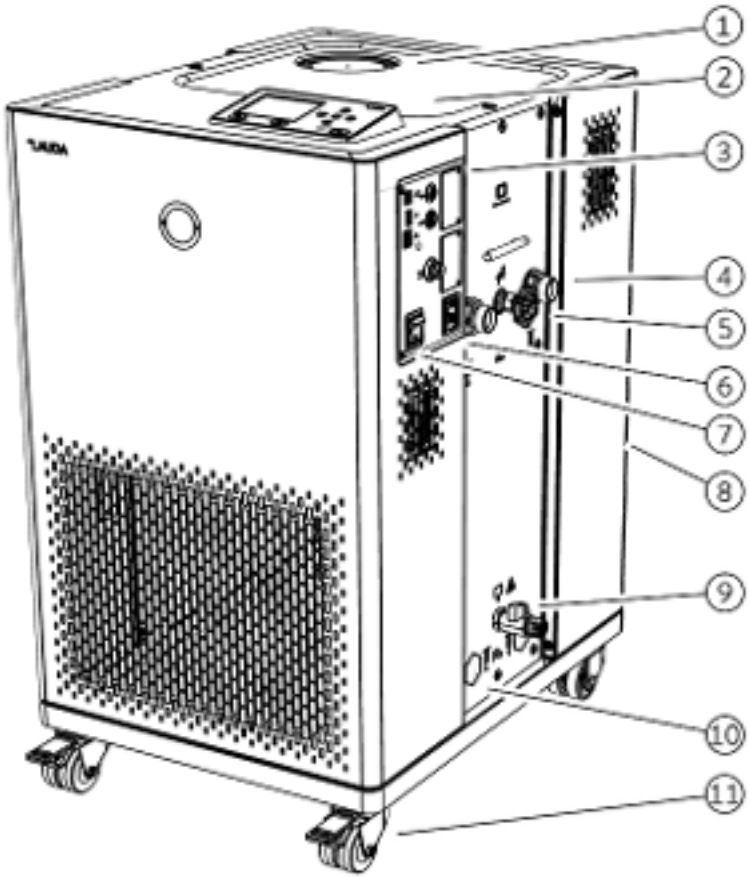


Fig. 4: View of Integral 230 T

1 Filler nozzle with cover
2 Operating unit
3 Interfaces and two slots for interface module
4 Pump connector
5 Adjusting wheel for bypass valve
6 Cold appliances built-in connector
7 Mains switch
8 Overflow pipe on the rear of the device (covered)
9 Drain tap for the hydraulic circuit
10 Additionally for water-cooled devices: connecting sleeves for cooling water
11 Four castors (front castors with parking brake)

3.2 Overall view of Integral (large casing version)

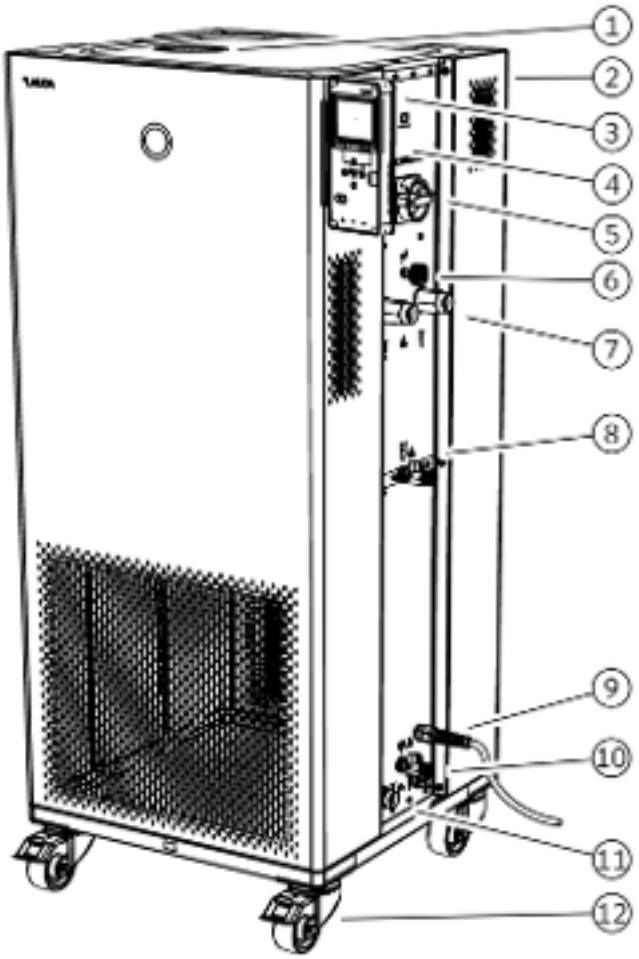


Fig. 5: View of Integral 950 XTW

1 Filler nozzle with cover
2 Overflow pipe on the rear of the device (covered)
3 Operating unit
4 Interfaces and two slots for interface module (covered)
5 Mains switch
6 Adjusting wheel for bypass valve
7 Pump connector
8 Drain tap for expansion vessel (from Integral 550 XT)
9 Power cable
10 Drain tap for the hydraulic circuit
11 Connecting sleeve for cooling water (only water-cooled devices)
12 Four castors (front castors with parking brake)

3.3 Mains switch

The devices have a mains switch on the right side of the device. This is designed either as a toggle switch or as a rotary switch. Position [0] switches the device off, position [I] switches it on.

Mains switch for single-phase devices

The toggle switch is also designed as a safety switch. If the current is too high, the toggle switch trips and disconnects the device from the mains supply. The device can be used again by switching the toggle switch to position [I]. If the safety switch trips again, contact the LAUDA Constant Temperature Equipment Service department.

Mains switch for three-phase devices

Switch on the automatic fuse only by a qualified electrician!

The rotary switch is not designed as a safety switch. The three-phase devices have a separate automatic fuse built in. If the automatic fuse trips, contact the LAUDA Constant Temperature Equipment Service department.

3.4 Hydraulic circuit

Hydraulic circuit in Integral T

The Integral T process thermostat is a powerful device for the temperature control and circulation of heat transfer liquid with a very small active bath volume. A thermally largely inactive part of the bath boiler serves as an additional expansion volume.

Heating capacity and cooling capacity are matched to each other in order to achieve rapid temperature changes in both heating and cooling operation.

The powerful pressure pump in the device ensures the necessary flow. The pump always delivers the heat transfer liquid at maximum capacity. The components of the external hydraulic circuit must be designed for this maximum performance. In pressure-sensitive applications, the resulting pressure may have to be limited via the bypass.

In the event of a fault, large quantities of heat transfer liquid can flow back into the device from the external circuit. In order not to flood the appliance, the bath boiler has an overflow pipe.

In the heating-up area the pump works up to a kinematic viscosity of 200 mm^2/s. 50 mm^2/s should not be exceeded during regular operation. Optimum temperature control is under 30 mm^2/s.

With the IN 1030 T, IN 1330 TW and IN 1830 TW devices, an additional pump is used to circulate the internal bath volume.

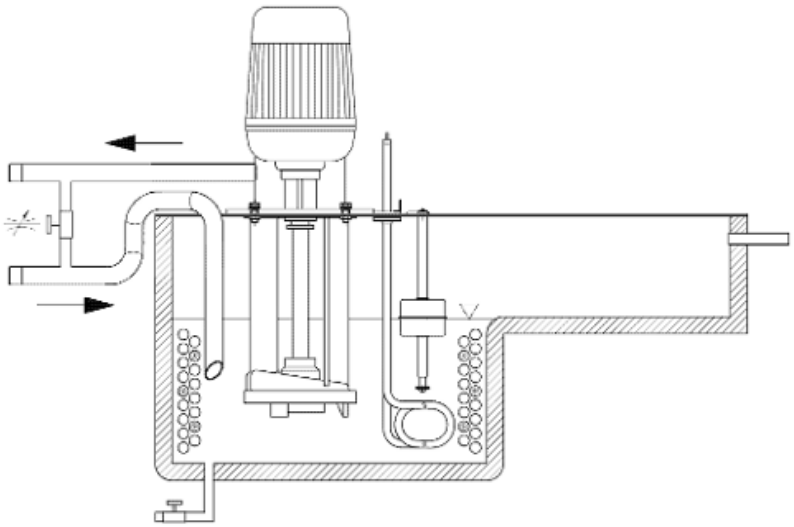


Fig. 6: Schematic of hydraulic circuit

The hydraulic circuit in the device consists of the following components:

- Bath boiler with expansion volume
- Level sensor
- Pump
- Bypass
- Heating
- Evaporator

Hydraulic circuit in Integral XT

The hydraulic circuit in the Integral XT consists of a piping system through which the heat transfer liquid flows under pressure.

All devices are equipped with an 8-stage, hermetically sealed (magnetically coupled) pump. The pump performance can thus be optimally adapted to the respective task: High pump pressure, if, for example, long hoses lead to the external consumer.

As an alternative to the 8 power stages, operation with pressure control is provided. The pressure control enables a very effective supply of pressure-sensitive glass reactors with maximum permissible pressurization.

In the event of a fault, large quantities of heat transfer liquid can flow back into the device from the external circuit. In order not to flood the appliance, the expansion vessel has an overflow pipe.

In the heating-up area the pump works up to a kinematic viscosity of 200 mm^2/s. 50 mm^2/s should not be exceeded during regular operation. Optimum temperature control is under 30 mm^2/s.

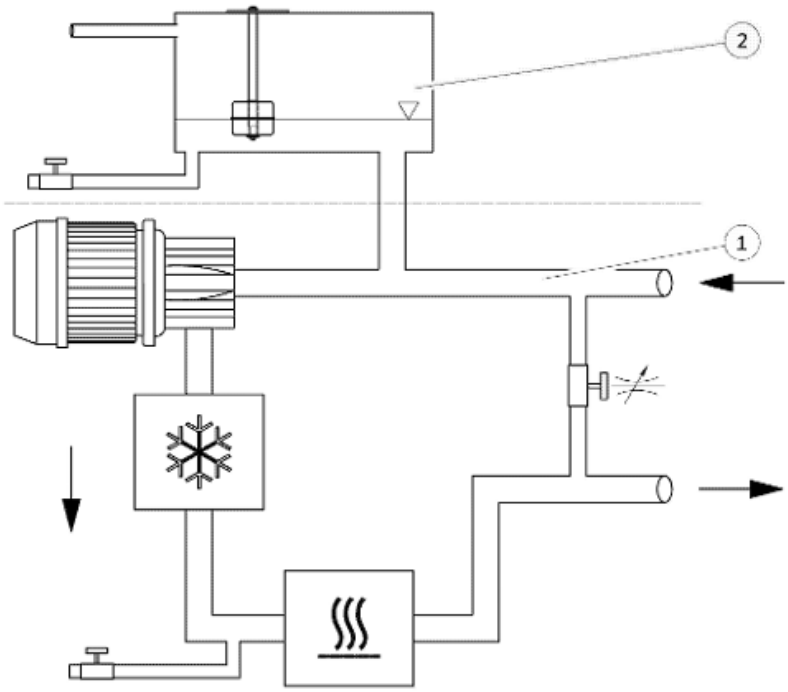


Fig. 7: Schematic of hydraulic circuit

1 Temperature-controlled
2 Not temperature-controlled

The hydraulic circuit in the device consists of the following components:

- Piping system
- Expansion vessel (not flowed through)
- Level sensor
- Pump
- Bypass
- Heating
- Evaporator

External hydraulic circuit

The external application is connected with hoses to the pump connectors of the device.

Only external applications with closed thermostatic circuits can be used on the Integral devices. Direct temperature control of open baths is not possible.

If the external temperature control volume exceeds the expansion volume in the Integral, a return flow of heat transfer liquid from higher-level consumers in the event of a fault or unintentional ventilation must be prevented with a reverse flow protection device.

The external hydraulic circuit consists of the following components:

- Hoses
- external application
- shut-off valves, if necessary

3.5 Rating label

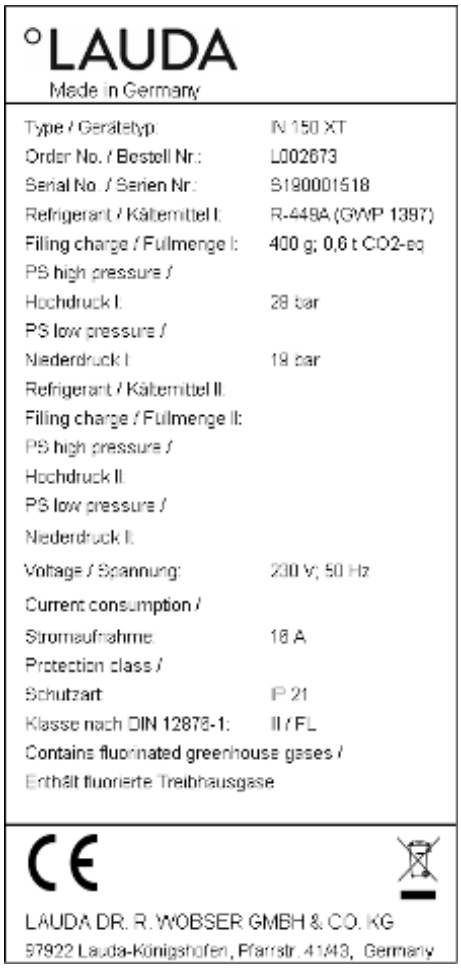


Fig. 8: Rating label

The serial number of a LAUDA device is made up as follows:

- the letter S,
- the year of manufacture (is shown with two digits).
- and a 7-digit number.

The specifications on the rating label are described in more detail in the following table. Certain specifications depend on the installed equipment.

Specification	Description
Type / Gerätetyp:	Type of the device
Order No. / Bestell Nr.:	Catalog number of the device
Serial No. / Serien Nr.:	Serial number of the device
Refrigerant / Kältemittel I:	Refrigerant used in refrigeration circuit 1 of the appliance for cooling. The global warming potential (GWP) of the refrigerant is given in brackets.
Filling charge / Füllmenge I:	Filling weight of the refrigerant and corresponding size of the CO_2 equivalent in tonnes.
PS high pressure / Hochdruck I:	Maximum permissible working pressure on the high-pressure side of the refrigeration circuit (compression, condensation)
PS low pressure / Niederdruck I:	Maximum permissible working pressure on the low-pressure side of the refrigeration circuit (expansion, evaporation)
Refrigerant / Kältemittel II:	Refrigerant used in refrigeration circuit 2 of the appliance for cooling. The global warming potential (GWP) of the refrigerant is given in brackets.

Specification	Description
Filling charge / Füllmenge II:	Filling weight of the refrigerant and corresponding size of the CO_2 equivalent in the second stage.
PS high pressure / Hochdruck II:	Maximum permissible working pressure on the high-pressure side of the refrigeration circuit (compression, condensation)
PS low pressure / Niederdruck II:	Maximum permissible working pressure on the low-pressure side of the refrigeration circuit (expansion, evaporation)
Voltage / Spannung:	Permissible power supply
Current consumption / Stromaufnahme:	Current consumption of the device
Protection class / Schutzart:	IP protection level of the device
Fuse / Sicherung:	Fuse used in device
Class according to DIN 12876-1:	According to DIN 12876-1, the device has the classification

3.6 Interfaces

Standard interfaces

Fig. 9: Interfaces

- **USB interface device** (type B). Software updates (updater) are installed on the device via this interface (no process interface).
- The **USB interface host** (type A) allows the connection of a USB drive. This interface can be used, for example, for data import, data export and software updates (no process interface).
- The **Ethernet interface** enables the connection to a control station or a PC. This interface offers the customer the opportunity to control and monitor their temperature control processes via a LAUDA interface command set (process interface).
- The Command Touch remote control unit or the module box are connected to the **LiBus interface** (marked with the label `LiBus`).
- The external Pt100 temperature probe is connected to the **Pt100 interface** (marked with the label `Pt100`).
- **Potential-free contact** (marked with label `OUT`), with built-in connector (after NAMUR NE 028) for program segment controlled signal transmission for freely selectable peripheral functions to be activated (e.g. alarm).

Accessories interface module

Different interface modules can be installed in the devices.

- The **analog module** (order no. LRZ 912) has a 6-pin socket with two inputs and two outputs. The inputs and outputs can be configured as a 0 – 20 mA, 4 – 20 mA or 0 – 10 V interfaces independently of one another. A voltage of 20 V applied to the socket supplies power to an external sensor with electronic evaluation unit.
- The **RS 232/485 interface module** (order no. LRZ 913) is available in a 9-pin SUB-D socket design and is galvanically isolated by an optocoupler. When combined with the LAUDA command set, the module is compatible with the ECO, Variocool, Proline, Proline Kryomat, PRO, Integral XT and Integral T product lines. The RS 232 interface can be connected directly to the control stand / PC using a 1:1 contacted cable.

- The **contact module** (order no. LRZ 914) is available in a plug connector design according to NAMUR NE28. This contact module is identical to LRZ 915, but only has two sockets, each with one output and one input. The coupling socket (order no. EQD 047) and the coupling connector (order no. EQS 048) have a 3-pin design.
- The **contact module** (order no. LRZ 915) is available in a 15-pin SUB-D socket design. The module has 3 relay contact outputs (changeover contacts, maximum 30 V/ 0.2 A) and 3 binary inputs for control via external potential-free contacts.
- **Profibus module** (order no. LRZ 917). Profibus is a bus system used primarily in the chemical industry, which can connect a maximum of 256 devices at a high signal transmission rate.
- **EtherCAT module** (order no. LRZ 922) with M8 connection sockets. **EtherCAT module** (order no. LRZ 923) with connection via RJ45 sockets. EtherCAT is an Ethernet-based field bus with master/slave functionality.
- **Pt100 LiBus module** (order no. LRZ 925) with a Lemo socket (label: Pt100) for an external Pt100 temperature probe. The LiBus socket (label: LiBus) serves to connect components via the LAUDA device bus.
- External **LiBus module box** (order no. LCZ 9727) with two additional module bays. The number of LiBus interfaces can be increased using the LiBus module box (LCZ 9727). Additional modules such as a solenoid valve for regulating the cooling water or a return protection can subsequently be connected.

Refer to the operating manual accompanying the relevant LAUDA interface module for further information on connecting and using these interfaces.

4 Before starting up

4.1 Install device

WARNING!
Rolling away or overturning of the device due to incorrect handling

Impact, crushing

- Do not tilt the device.
- Position the device on an even, non-slip surface with a sufficient load carrying capacity.
- Actuate the castor brake when setting up the device.
- Do not place heavy parts on the device.

WARNING!
Degradation of overflow or drain

Electric shock

- Overflow hose and drainage hose must each slope downward separately all the way into a collecting vessel.

WARNING!
Danger of overpressure from high ambient temperature

Injury, escape of refrigerant

- Note the permitted ambient temperature.

CAUTION!
Risk of heat transfer liquid escaping

Scalding, cold burns

- The temperature and media resistance of the hoses used for the device overflow must be suitable for the application.

Installation conditions:

- Irritant vapors may develop, depending on the heat transfer liquid and operating temperature used. Always ensure that the vapors are adequately extracted.
- Note the electromagnetic compatibility (EMC) requirements of the device ↳ Chapter 1.3 “EMC requirements” on page 9.
- Do not cover the ventilation openings of the device.
- Further conditions for installation apply to the devices. These are specified in the technical data ↳ Chapter 13.1 “General data” on page 132.

Personnel: ■ Operating personnel

1. Place the device on a suitable level surface.

The devices can be moved. To do this, release the parking brakes on the castors by pushing the lever upwards.

2. Lock the castors of the device. To lock, press down the lever on the castor.

4.2 Hoses

CAUTION!
Risk of external hydraulic circuit bursting

Scalding, cold burns

- Use hoses with a greater compressive strength than the maximum possible pump pressure.

CAUTION!
Risk of heat transfer liquid escaping due to the use of unsuitable hoses

Scalding, cold burns

- The temperature and media resistance of the hoses must be suitable for the application.

CAUTION!
Contact with hot or cold hoses

Hot and cold burns

- Use insulated hoses for temperatures below 0 °C and above 70 °C.

Please note:

- The thread connections of the pump connectors or the thread connections of the screw cap and the seat of the nut must be moistened with lubricant.
- When laying the water cooling and heat transfer liquid hoses, make sure that the hoses cannot be kinked or crushed.

Approved metal hoses for Integral T

Metal hose made from stainless steel with screw caps

- Working pressure: maximum 10 bar
- Temperature range: -50 – 150 °C
- Application area: for heating and cooling applications with special insulation, for all LAUDA heat transfer liquids

Fig. 10: Corrugated metal hose with cold insulation

Hose type	Length in cm	Cat. No.	Clear width in mm, connection thread	Maximum tightening torque in Nm
MTK 100	100	LZM 075	DN 20, G¾"	70
MTK 200	200	LZM 076	DN 20, G¾"	70

Approved metal hoses for Integral XT

Metal hose made from stainless steel with screw caps

- Working pressure: maximum 10 bar
- Temperature range: -100 – 350 °C
- Application area: for heating and cooling applications with special insulation, for all LAUDA heat transfer liquids

Fig. 11: Corrugated metal hose with cold insulation

Hose type	Length in cm	Cat. No.	Clear width in mm, connection thread	Maximum tightening torque in Nm
M30X 100S	100	LZM 091	DN20, M30 x 1.5	70
M30X 150S	150	LZM 097	DN20, M30 x 1.5	70
M30X 200S	200	LZM 092	DN20, M30 x 1.5	70
M30X 300S	300	LZM 093	DN20, M30 x 1.5	70
M38X 100S	100	LZM 094	DN25, M38 x 1.5	130
M38X 200S	200	LZM 095	DN25, M38 x 1.5	130
M38X 300S	300	LZM 096	DN25, M38 x 1.5	130

Approved elastomer hoses (for water cooled devices)

Hose made from EPDM with textile insert

- the EPDM hose is suitable for the cooling water supply
- Temperature range: -40 – 120 °C
- Application area: for all LAUDA heat transfer liquids, except Ultra 350, Kryo 65 and mineral oils

Hose type	Cat. No.	Clear width, Ø in mm x wall thickness	Maximum working pressure in bar
EPDM hose with textile insert, uninsulated	RKJ 103	½", Ø12 x 3.5	9
EPDM hose with textile insert, uninsulated	RKJ 104	¾", Ø19 x 3.5	9
EPDM hose with textile insert, uninsulated	RKJ 105	1", Ø25 x 3.5	6

4.3 Connecting an external application

DANGER!
Risk of hot heat transfer liquid overflowing

Fire

- A connecting hose with a collecting vessel must be attached to the overflow.
- The collecting vessel and connecting hose must be designed to withstand the maximum temperature of the heat transfer liquid.
- Avoid ignition sources in the vicinity of the collecting vessel.

CAUTION!
Risk of external hydraulic circuit bursting from overpressure

Scalding, cold burns

- When laying the hoses, make sure they cannot kink.
- Use safety valves in the hydraulic circuit.

CAUTION!
Risk of heat transfer liquid escaping during operation due to open consuming unit

Scalding, cold burns

- Always use hydraulically sealed consuming units.

The following information is only relevant for the Integral T device:

CAUTION!
Risk of external consumer bursting

Scalding, cold burns

- Adjust the pump pressure with the bypass.

CAUTION!
Risk of heat transfer liquid escaping from consuming unit in an elevated location

Electric shock

- If the external consuming unit is positioned above the device, heat transfer liquid may escape from the device when the pump stops. Therefore use the return protection available as an accessory in the external hydraulic circuit.

The following information is only relevant for the Integral XT device:

CAUTION!
Risk of external consuming unit bursting

Scalding, cold burns

- If the external consuming unit is located in a lower position and is sensitive to pressure, also take into account the additional pressure resulting from the difference in height between the consuming unit and the device.

Please note:

- Only connect hydraulically closed applications to the device!
- Use the shortest possible hoses with the largest possible diameter in the external circuit.
  If the diameter of the hose is too small, there will be a temperature gradient between the device and the external application due to the low flow rate. In this case, increase the outflow temperature or pump level accordingly.
- Secure the hoses to the hose nozzles using hose clips.
- If using a pressure-sensitive application (such as a glass reactor), use a pressure relief device.
- Open any shut-off valves in the external application. Only switch on the device when flow is possible through the external application.
- Depending on the type of application, a vent valve can significantly simplify the aeration process. The vent valve must be located at the highest point of the circuit (Fig. 12).
- Reactors for steam heating are not suitable as external applications, as they usually have a non-flow-through area in which gas cushions can form.
- If external control is used, a Pt100 sensor must be installed in the external application or the external temperature signal is transmitted via an interface module.

- If the external application is in a higher position, the application may run empty if the pump is switched off and air enters the thermostatic circuit (e.g. due to an incompletely closed or defective vent valve). This can cause the heat transfer liquid in the process thermostat to overflow.
- Install a dirt trap if the circuit in the application is not free of dirt.

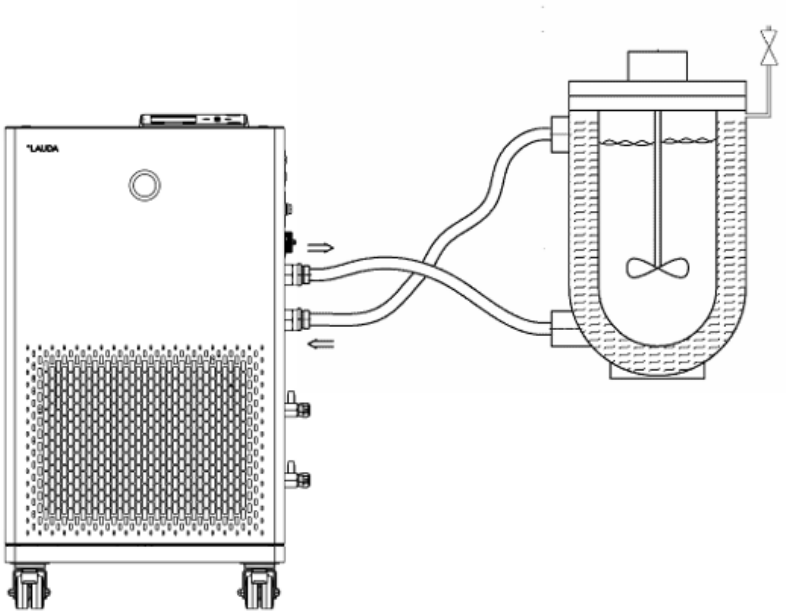


Fig. 12: Connection diagram with vent valve

The external application must be connected according to the sketch (Fig. 12) so that gas/vapor bubbles can be removed from the system and undisturbed operation is possible. The outflow of the pump must be connected to the lower connection of the application. The return line to the pump connector must be connected to the top connection of the application. The application is thus flowed through from bottom to top.

Mounting instructions for connecting an application

Hose nozzle:

- Push the hose onto the hose nozzle. Secure the hoses against slipping using hose clips or similar.

Ball bush and hose nozzle:

- The sealing surfaces of the cone and ball bush/hose nozzle may not be damaged (falling onto hard ground or similar).
- Carefully remove dirt from the sealing surfaces (cone and ball bush / hose nozzle) before assembly.
- Place the ball bush/hose nozzle vertically on the cone (support the hose when tightening).
- The ball bush / hose nozzle may not rotate when tightening the screw cap (if necessary apply some grease or oil between the ball bush / hose nozzle and screw cap).
- Tighten the screw cap only moderately with the open-end wrench and hold it against the connecting sleeve with a second open-end wrench.

4.4 LAUDA heat transfer liquids

DANGER!
Use of unsuitable heat transfer liquid

Fire

- Select a heat transfer liquid with a temperature range suitable for the application.

Please note:

- If the heat transfer liquid reaches the lower limit of the temperature range, the temperature control properties can be expected to deteriorate as a result of the increase in viscosity. Therefore, only fully utilize this temperature range when absolutely necessary.
- Never use contaminated heat transfer liquid. Contamination in the pump housing can cause the pump to seize and the device to shut down.
- Observe the safety datasheet for the heat transfer liquid. You can request a copy of the safety datasheets at any time, if necessary.

Please note:

- When using Kryo 30:
  The water content decreases during longer periods of operation at higher temperatures and the mixture becomes combustible (flash point 119°C). Check the mixing ratio using a hydrometer.
- When using Aqua 90:
  Evaporation losses occur at higher temperatures.
- When using Ultra 350 and Kryo 65:
  EPDM hoses are not suitable for Ultra 350 and Kryo 65.
- When using mineral oils:
  EPDM hoses are not suitable for mineral oils.
- When using silicone oils:
  Silicone hoses are not suitable for silicone oils.

Heat transfer liquid, water

- The proportion of alkaline earth ions in the water must be between 0.71 mmol/L and 1.42 mmol/L (equivalent of 4.0 and 8.0 °dH). Harder water leaves limescale deposits in the device.
- The pH value of the water must be between 6.0 and 8.5.
- Distilled, deionized and fully desalinated (FD) water is unsuitable due to its reactivity. High-purity water and distillates are suitable as a heat transfer liquid after 0.1 g of soda (Na_2CO_3, sodium carbonate) is added for every liter of water.
- Sea water is unsuitable due to its corrosive properties.
- Avoid chlorine content in the water at all costs. Do not add chlorine to the water. Cleaning agents and disinfectants, for example, contain chlorine.
- The water must be free of impurities. Water with iron content is unsuitable due to rust formation and untreated river water is unsuitable due to algae growth.
- The addition of ammonia is not permitted.

Table 4: Permissible heat transfer liquids for Integral T

Designation	Chemical characterization	Working temperature range in °C	Viscosity (kin) in mm²/s at 20 °C	Viscosity (kin) in mm²/s at temperature	Flash point in °C
Kryo 51	Silicone oil	-50 – 120	5	34 at -50 °C	120
Kryo 30	Monoethylene glycol/ water mixture	-30 – 90	4	50 at -25 °C	---
Kryo 20	Silicone oil	-20 – 170	11	28 at -20 °C	170
Aqua 90[1]	Decalcified water	5 – 90	1	---	---
Ultra 350	Aromatic hydrocarbon	30 – 200	48	16 at 40 °C	212

Please note:

[1] Aqua 90 or water may only be used in the Integral 130 T and 230 T(W) devices.

Table 5: Permissible heat transfer liquids for Integral XT (closed system)

Designation	Chemical characterization	Working temperature range in °C	Viscosity (kin) in mm²/s at 20 °C	Viscosity (kin) in mm²/s at temperature	Flash point in °C
Kryo 95	Silicone oil	-95 – 160	1.6	20 at -80 °C	64
Kryo 70	Silicone oil	-70 – 220	5	42 at -60 °C	121
Kryo 65	Hydrocarbon	-65 – 140	1.7	10 at -40 °C	62
Kryo 30[1]	Monoethylene glycol/ water mixture	-30 – 90	4	50 at -25 °C	119
Ultra 350[2]	Aromatic hydrocarbon	30 – 350	48	16 at 40 °C	212

Please note:

- [1] Do not use Kryo 30 in devices with cascade cooling.
- [2] Use Ultra 350 for the Integral high-temperature thermostats.

Please note:

Water may not be used with any Integral XTs over the entire working temperature range.

Table 6: Order numbers of the heat transfer liquids

Designation	Container size Cat. No.		
	5 L	10 L	20 L
Kryo 95	LZB 130	LZB 230	LZB 330
Kryo 70	LZB 127	LZB 227	LZB 327

Designation	Container size Cat. No.		
Kryo 65	LZB 118	LZB 218	LZB 318
Kryo 51	LZB 121	LZB 221	LZB 321
Kryo 30	LZB 109	LZB 209	LZB 309
Kryo 20	LZB 116	LZB 216	LZB 316
Aqua 90	LZB 120	LZB 220	LZB 320
Ultra 350	LZB 107	LZB 207	LZB 307

4.5 Cooling water requirements

This section is relevant for:

- Water-cooled devices

NOTICE!
Risk of cooling circuit leaking due to corrosion

Device damage

- Do not use corrosive cooling water.

Requirements

Cooling water is subject to specific purity requirements. A suitable procedure must be employed to purify the cooling water in line with the contamination in the water and maintain the water quality. Unsuitable cooling water may cause the condenser and the entire cooling water circuit to become blocked or damaged, or start to leak. The entire cooling circuit and cooling water circuit may sustain extensive consequential damage as a result.

- Free chlorine consisting of disinfectant, for example, and water containing chloride will cause pitting corrosion in the cooling water circuit.
- Distilled, deionized and demineralized water are unsuitable due to their reactivity and will cause corrosion in the cooling water circuit.
- Sea water is unsuitable due to its corrosive properties and will cause corrosion in the cooling water circuit.
- Iron particles and water containing iron will cause corrosion in the cooling water circuit.
- Hard water is unsuitable for cooling due to the high lime content and will lead to calcification of the cooling water circuit.
- Cooling water containing suspended matter is unsuitable.
- Untreated, unpurified water such as river water or cooling tower water is unsuitable due to its microbiological content (bacteria), which can settle inside the cooling water circuit.

Suitable cooling water quality

Data	Value	Unit
pH value	7.5 – 9.0	---
Hydrocarbonate [HCO_3^-]	70 – 300	mg/L
Chloride	< 50	mg/L
Sulfate [SO_4^{2-}]	< 70	mg/L
Ratio hydrogen carbonate [HCO_3^-] / sulfate [SO_4^{2-}]	> 1	---
Total water hardness	4.0 – 8.5	°dH
Electrical conductivity	30 – 500	µS/cm
Sulfite (SO_3^{2-})	< 1	mg/L
Free chlorine gas (Cl_2)	< 0.5	mg/L
Nitrate (NO_3^-)	< 100	mg/L
Ammonia (NH_3)	Not permitted	---
Iron (Fe), dissolved	< 0.2	mg/L
Manganese (Mn), dissolved	< 0.05	mg/L
Aluminum (Al), dissolved	< 0.2	mg/L
Free aggressive carbon dioxide (CO_2)	Not permitted	---
Hydrogen sulfide (H_2S)	Not permitted	---
Algae growth	Not permitted	---
Suspended matter	Not permitted	---

4.6 Connecting the cooling water

This section is relevant for:

- Water-cooled devices

Table 7: Cooling water data

Specification	Value
Maximum cooling water pressure	10 bar
Cooling water temperature	15 °C recommended, 10 to 30 °C permitted (in upper temperature range with reduced cooling output)

Please note:

- Connect the cooling water inlet and outlet according to the labeling on the device. The inlet and outlet of the cooling water supply may not be interchanged.
- The hoses used for the cooling water circuit must be suitable for the temperature range specified. Also observe the permitted hose diameter.
- Secure the hose nozzles or the coupling connectors to the hoses using hose clips.
- Secure the water cooling return hose in the outlet area to prevent the hose from jerking suddenly, even when pressure surges occur.
  Secure the water cooling return hose in the outlet area in such a way that hot cooling water cannot spray out.
- Avoid kinking or crushing the hoses.
- We recommend using a leakage water detector with water shut-off function to prevent leakages from causing damage in the cooling water system.
- Only use cooling water that meets the quality requirements.
- If the condenser leaks, there is a danger that refrigerating machine oil or combustible/non-combustible refrigerant from the device's refrigerant circuit will mix with the cooling water. Observe the legal requirements and provisions of the water supply company applicable at the operation site.

4.7 Configuring interfaces

WARNING!
Touching pieces charged with voltage when installing the modules

Electric shock

- Disconnect the device before installing modules.

Personnel: ■ Specialized personnel

Equipment connected to the low-voltage inputs and outputs must be safely insulated against dangerous contact voltages as per DIN EN 61140, for example, using double or reinforced insulation as per DIN EN 60730-1 or DIN 60950-1.

Refer to the separate operating manual accompanying the interface modules for further information on installing and operating these interface modules. Each respective operating manual must be observed in order to use the module as intended.

4.7.1 Configure potential-free contact (alarm output)

In the *Alarm output* menu, an option is always selected. The selected option is marked with a check mark. You can combine the other options.

A fault in the device can be an alarm or an error.

Table 8: Possible options

Options	Description
Fault	Signal transmission (e.g. for reverse flow protection, pilot lamp)
Safe Mode	Activation of Safe Mode (Safe Mode must be switched on beforehand in the device menu)
Standby	Switch device into standby

Personnel: ■ Operating personnel

1. Switch to the main menu.
2. Select the *Settings* → *Basic setting* → *Alarm output* menu item.
3. The following options are available:
   - *Fault*
   - *Safe Mode*
   - *Standby*
4. Press the Enter key to confirm your selection.

4.7.2 Interface potential-free contact

- The contacts may be loaded with a maximum voltage of 30 V direct current (DC) and a maximum current of 0.2 A.

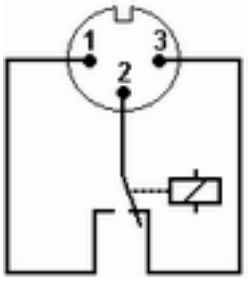


Fig. 13: Flange plug (front) in fault condition

View of the flange plug (front) or into the coupling socket on the soldering side.

Good condition

- Pin 1 and 2 are closed.
- During trouble-free operation, the alarm output is in good state.

Fault condition

- Pin 2 and 3 are closed.
- The alarm output is in fault condition:
  - If the device is switched off,
  - after switching on, if a fault (e.g. low level) is already present,
  - during operation, if a fault occurs, and
  - for each event configured in the *Alarm Output* menu.

Please note the following:

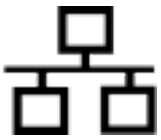
- The equipment connected to the extra-low voltage inputs and outputs must be reliably isolated from voltages dangerous to the touch in accordance with DIN EN 61140. For example, by double or reinforced insulation according to DIN EN 60730-1 or DIN 60950-1.
- Only use protected connection lines. Connect the protective screen with the connector shell. Cover unused connectors with protective caps.

4.7.3 Configuring the Ethernet interface

Technical data of the Ethernet interface

Data	Value	Unit
Ethernet - standard	10/100	MBit

A glossary (word list) with all the relevant explanations appears at the end of the document.



PC control

- The *PC control* menu item enables the device to be accessed by a PC or control station. You activate this function if you want to control or monitor the constant temperature equipment from an external control station.

Before the constant temperature equipment and control station can be operated together in a local network (LAN), the Ethernet interface must be configured.

The Ethernet interface can be configured in two different ways:

Automatically obtain LAN configuration	- In order for this to work, a DHCP server must be present in the local network (LAN). If communication is direct, the control station must support the auto IP standard.
Manually configure LAN configuration	- Manual configuration must be performed if a DHCP server is not available, auto IP standard is not supported or you wish to use the Ethernet interface with fixed IP addresses.

Obtain LAN configuration automatically (DHCP client on)

1. Switch on the constant temperature equipment.
2. Press the [Enter key] to open the menu.
3. Select the menu items from *Setup* ➞ *Basic setup* ➞ *Ethernet* ➞ *LAN configuration* ➞ *DHCP client* using the cursor keys.
   ▶ The options [Off] and [On] appear on the display.

4. Select the option [On] and press [OK] to confirm.
   - ▶ A check mark is set. The DHCP client is active. The Ethernet interface is configured automatically.
5. In the [PC control] menu, select the [on] entry.
   - ▶ A check mark is set. The control for the control station is activated.
6. If required, enter the port number in the [PC control] menu.

Specify LAN configuration manually (DHCP client off)

1. Switch on the constant temperature equipment.
2. Press the [Enter key] to open the menu.
3. Select the menu items → *Setup* → *Basic setup* → *Ethernet* → *LAN configuration* → *DHCP client*.
   - ▶ The options [Off] and [On] appear on the display.
4. Select the [Off] option and press the Enter key to confirm.
   - ▶ A check mark is set. The entry has been accepted.
5. Use the left arrow key to go back one menu level.
6. Scroll to the numerical values of the [Local IP address] menu item and press the Enter key.
   - ▶ The *Local IP address* menu opens.
7. Byte 1 is marked. Press the right arrow key.
   - ▶ The entry window opens. The area in which the numerical values can be entered is displayed.
8. Enter the numerical value for byte 1. Confirm the value with the Enter key [OK].

   The numerical values are entered byte by byte. From top to bottom, from byte 1 to byte 4, for example 120.0.0.13 (Byte1.Byte2.Byte3.Byte4).

   Press [ESC] to cancel the entry.
9. Enter the numerical values for byte 2, byte 3 and byte 4.
10. Once you have entered the numerical values, press the left arrow key.
    - ▶ You return to the *LAN configuration* menu.
11. Scroll to the numerical values of the [Local mask] menu item and press the Enter key.
    - ▶ The *Local mask* menu opens.
12. Enter the numerical values, as described in points 7 to 9.
13. Once you have entered the numerical values, press the left arrow key.
    - ▶ You return to the *LAN configuration* menu.
14. If required, also enter the numerical values for the [Gateway] and [DNS server].

15. Once you have entered the numerical values, press the left arrow key.
    - ▶ The entered numerical values of [Local IP address], [Local mask], [Gateway] and [DNS server] are displayed.
16. Press the [ANW.] softkey to accept the entered numerical values.
17. Press the left cursor key to the move up one menu level and select the *PC control* menu item and press Enter.
18. Confirm the [PC control] entry once more.
19. Select the option [On] and confirm the entry.
    - ▶ The control for the control station is activated.

No settings are accepted if you leave the LAN configuration menu without first pressing the [ANW.] *key.*

Set the [DHCP client] *from* [off] *to* [on], *all numerical values are reset to 0. 0. 0. 0.*

If you have set up an Ethernet communication between the control station and the constant temperature equipment, it may take 1 or 2 minutes to establish the connection.

Checking the LAN network

1. Start the Windows command processor by entering `cmd.exe↵` on the PC with Microsoft Windows operating system.
    - ▶ The entry window will open.
2. There are two ways of checking:
    - ■ Enter the ping command together with the IP address.
      `ping XXX.XXX.XXX.XXX↵`
      For "XXX.XXX.XXX.XXX", put the IP address that was entered when the Ethernet interface was configured.
      Or
    - ■ Enter the ping command together with the serial number of the thermostatic circulator (possible with software control system 1.36 or later).
      `ping serial number↵`
    - ▶ If the Ethernet interface is configured and connected correctly, the interface will return four responses within a very short time. See Fig. 14.

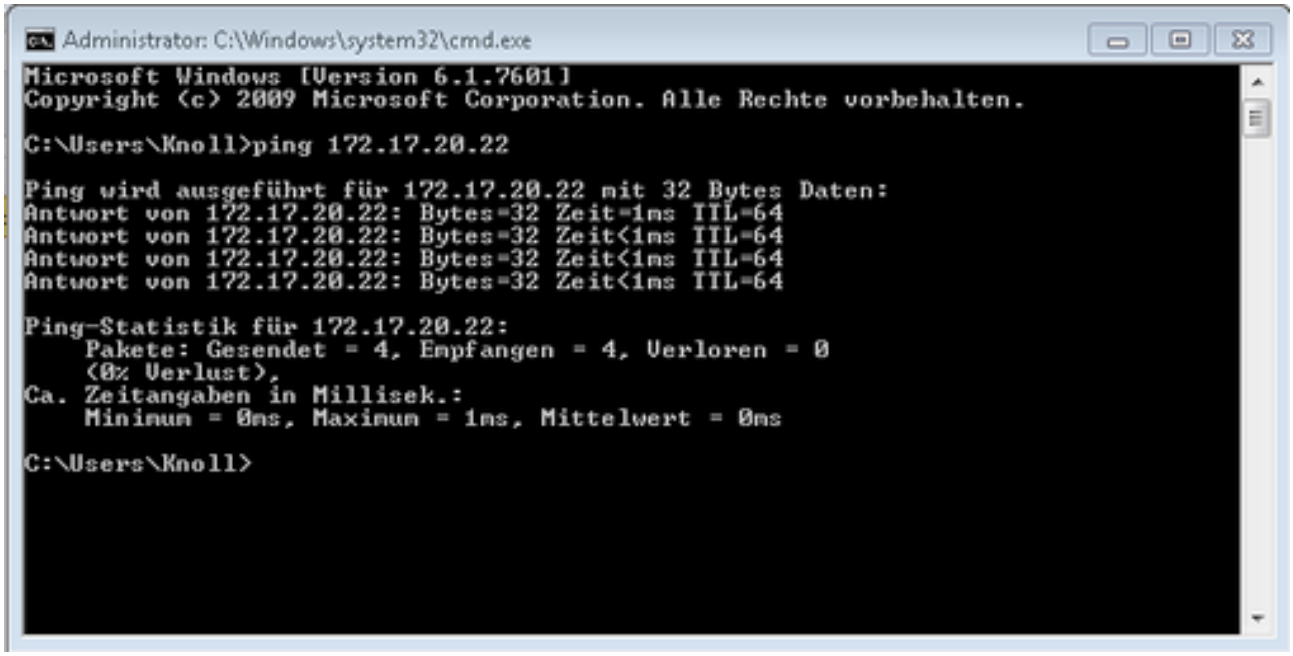


Fig. 14: Example for entering the ping command

Check the LAN network and the process interface

It is easy to check the connection to the interface with a PC and Microsoft Windows operating system.

- For Windows 3.11 with the program "Terminal".
- For Windows 95/98/NT/XP the program "HyperTerminal".
- For operating systems Windows Vista, Windows 7, Windows 8 and Windows 10 "HyperTerminal"* is not part of the operating system.

** Terminal programs are available on the Internet as freeware. These programs offer features similar to "HyperTerminal" (for example PuTTY or RealTerm). Search query "serial port terminal program".*

Checking with RealTerm

1. Open the program "HyperTerminal" or the "terminal program" on a PC with Microsoft Windows operating system.
   ▶ The entry window will open.

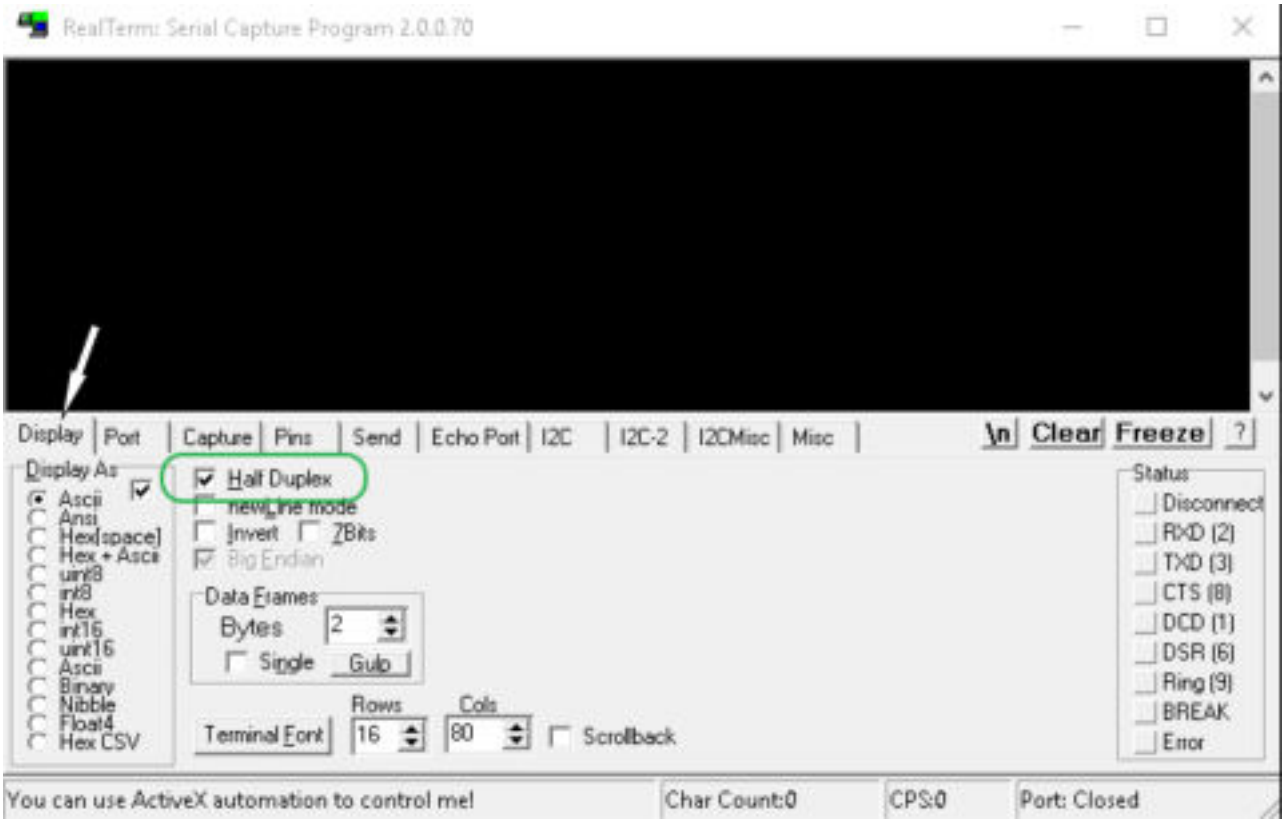


Fig. 15: "RealTerm" program

2. Place a checkmark under *Half Duplex* in the *Display* tab.

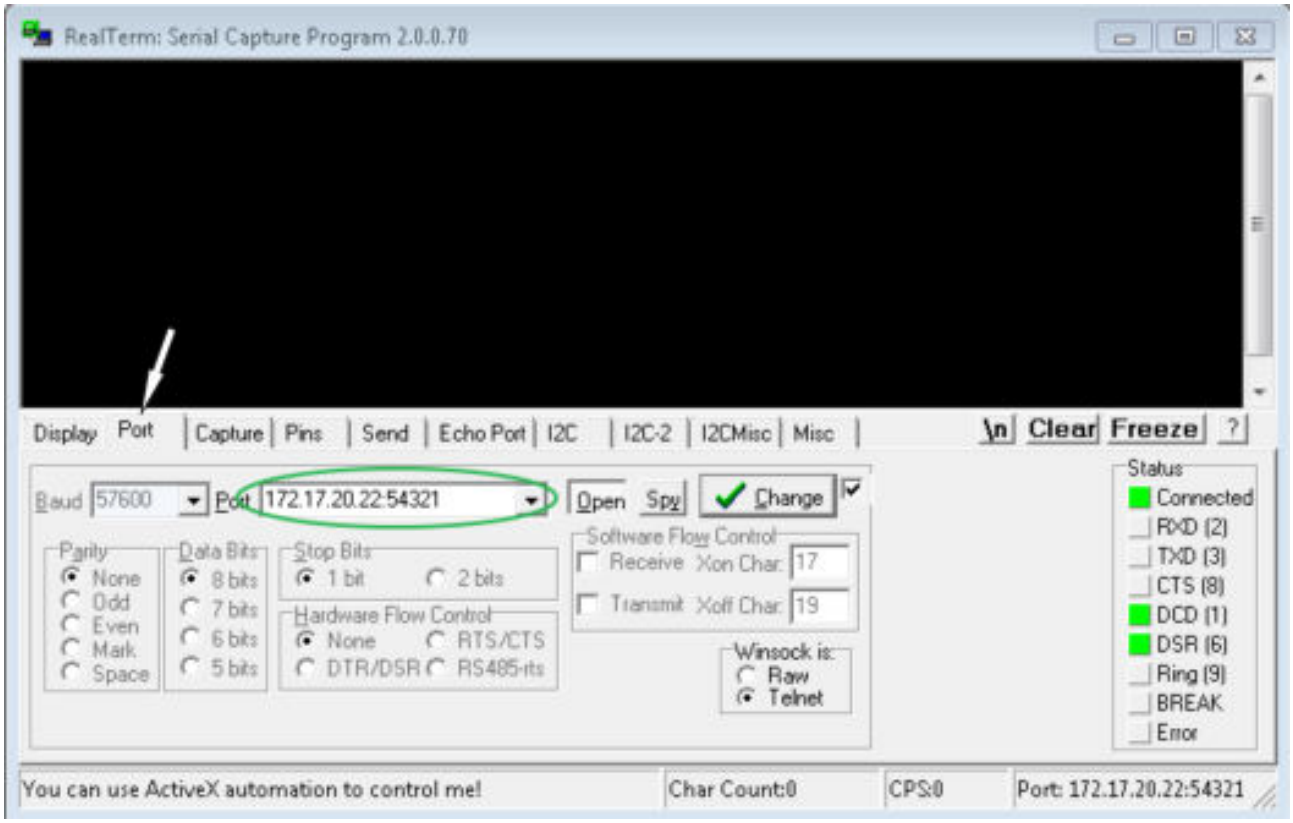


Fig. 16: Entry in the Port field

3. Enter the configured IP address and port number of the Ethernet interface on the constant temperature equipment in the *Port* tab. When you are doing this, be sure that the IP address and port number are separated by a colon.

   You can enter the serial number of the constant temperature equipment instead of the IP address.

4. Then press the [Open] button.
5. Open the *Send* tab.

   ▶ Now that the program has been configured, the actual test can begin.

6. Place a checkmark under *+CR* and *+LF*.

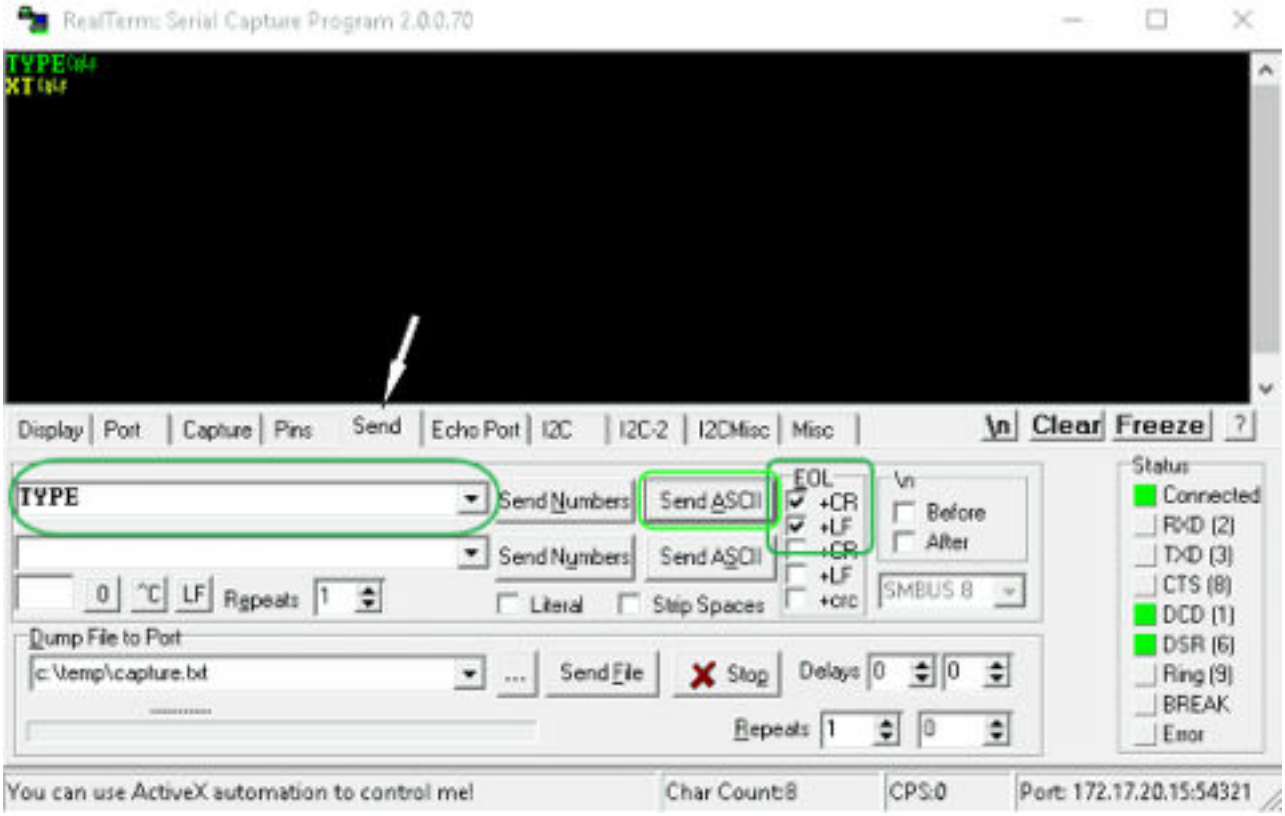


Fig. 17: Entries for the test

7. A command must be sent to the constant temperature equipment to test communication. For example, `TYPE`. Type the command and press [Send ASCII].

   ▶ If the connection is operational, the constant temperature equipment acknowledges the command.

4.7.4 Data transfer rate

The data transfer rate cannot be precisely defined. It depends on a variety of different factors:

- Are the constant temperature equipment (with the Ethernet interface) and the control station/PC on the same network?
- Are the control station/PC and constant temperature equipment connected wirelessly (WiFi) or through a cable?
- What is the load on the network?

Generally commands can be sent to the constant temperature equipment every 500 ms. For WiFi connections the period could exceed 1 s. A new command can only be sent if the previous command has been acknowledged by the constant temperature equipment.

4.7.5 Protocol of the interface

Note the following instructions:

- The command from the computer must be made with a CR, CRLF, or LFCR.
- The response from the thermostatic circulator is always made with a CRLF.
- After each command sent to the thermostat, it is necessary to wait for the reply before sending another command. This ensures that the sequencing of inquiries and answers is clear.
  CR = Carriage Return (Hex: 0D); LF = Line Feed (Hex: 0A)

Table 9: Example with set point transfer of 30.5 °C to the thermostatic circulator

Computer	Temperature control device
"OUT_SP_00_30.5"CRLF	→
←	"OK"CRLF

4.7.6 Read commands of the Ethernet interface

A read command is a data query from the control station to the constant temperature equipment.

Table 10: Read commands for Integral devices

Command	Meaning
IN_PV_00	Query outflow temperature
IN_PV_01	Query of the controlled temperature (internal/external, Pt/external, analog/external serial).
IN_PV_02	Query of outflow pump pressure in bar (only for Integral XT).
IN_PV_03	Query external temperature T_E (Pt100).
IN_PV_04	Query external temperature T_E (analog input).
IN_PV_05	Query of the level of heat transfer liquid.
IN_PV_07	Query of flow rate of the pump in[L/min] only for Integral XT).
IN_PV_10	Query of the outflow temperature in 0.001 °C.
IN_PV_13	Query of the external temperature T_E (Pt100) in 0.001 °C.
IN_SP_00	Query temperature target value
IN_SP_01	Query of the pump level (only for Integral XT)
IN_SP_02	Query of cooling mode (0 = OFF / 1 = ON / 2 = AUTOMATIC).
IN_SP_03	Query of overtemperature switch-off point.
IN_SP_04	Query of outflow temperature limit TiH.
IN_SP_05	Query of outflow temperature limit TiL.

Command	Meaning
IN_SP_06	Query of the set pressure (for pressure control).
IN_SP_07	Query of Tsafety (safety setpoint in case of communication interruption).
IN_SP_08	Query of communication interruption timeout in [s].
IN_SP_09	Query of setpoint of the through-flow control
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 (980 = OFF).
IN_PAR_06	Query of control parameter TvE (0 = OFF).
IN_PAR_07	Query of control parameter TdE.
IN_PAR_09	Query of the max. correction limitation.
IN_PAR_10	Query of control parameter XpF.
IN_PAR_14	Query of the setpoint offset.
IN_PAR_15	Query of control parameter PropE.
IN_DI_01	Status of contact entry 1: 0 = open / 1 = closed.
IN_DI_02	Status of contact entry 2: 0 = open / 1 = closed.
IN_DI_03	Status of contact entry 3: 0 = open / 1 = closed.
IN_DO_01	Status of contact exit 1: 0 = contact open / 1 = contact closed.
IN_DO_02	Status of contact exit 2: 0 = contact open / 1 = contact closed.
IN_DO_03	Status of contact exit 3: 0 = contact open / 1 = contact closed.
IN_MODE_00	Keyboard master: 0 = free / 1 = blocked.
IN_MODE_01	Control: 0 = internal / 1 = external Pt100 / 2 = external analog / 3 = external serial.
IN_MODE_02	Standby: 0 = device ON / 1 = device OFF.
IN_MODE_03	Keyboard remote control unit command: 0 = free / 1 = blocked.
IN_MODE_04	Target value offset source: 0 = normal / 1 = external Pt / 2 = external analog / 3 = external serial.
IN_MODE_05	Safe Mode Status

Command	Meaning
TYPE	Query of the device type (answer = "INT")
VERSION_R	Query of software version number control system
VERSION_S	Query of software version number protection system
VERSION_B	Query of software version number remote control unit command
VERSION_T	Query of software version number cooling system
VERSION_A	Query of software version number analog module
VERSION_A_1	Query of software version number flow module
VERSION_V	Query of software version number RS 232/485 module
VERSION_Z	Query of software version number EtherCAT module
VERSION_D	Query of software version number digital module
VERSION_M_0	Query of software version number solenoid valve (cooling water)
VERSION_P_0	Query of software version number pump 0
VERSION_P_1	Query of software version number pump 1
VERSION_H	Query of software version number heating module 0
VERSION_H_1	Query of software version number heating module 1
VERSION_E	Query of software version number Pt100 module 0
VERSION_E1	Query of software version number extern Pt100 module 1
STATUS	Query of device status 0 = no fault, 1 = fault
STAT	Query of fault diagnosis ■ Answer: XXXXXXX ● X = 0 no fault ● X = 1 fault 1. Character = error 2. Character = alarm 3. Character = warning 4th Character = overtemperature 5. Character = sublevel 6th Character = higher level (alarm setting) 7. Character = external control value missing

Please also note the following:

- " " (blank space) can also be used for "_".
- If not otherwise specified in the command, the response will always be given in fixed point format "XXX.XX" or for negative values "-XXX.XX" or "ERR_X" (RS 485 interface for example "A015_XXX.XX" or "A015_ERR_X").

4.7.7 Write commands of the Ethernet interface

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

Table 11: Write commands for Integral devices

Command	Meaning
OUT_PV_05_XXX.XX	Specify external temperature through the interface
OUT_SP_00_XXX.XX	Setpoint transfer with maximum 3 places in front of the decimal point and a maximum of 2 places after.
OUT_SP_01_XXX	Pump power level 1 to 8 (only for Integral XT)
OUT_SP_02_XXX	Mode of operation cooling (0 = OFF / 1 = ON / 2 = AUTOMATIC)
OUT_SP_04_XXX.X	TiH outflow temperature limit upper value
OUT_SP_05_XXX.X	TiL outflow temperature limit lower value
OUT_SP_06_X.XX	Set pressure (for pressure control settings)
OUT_SP_07_XXX.XX	Temperature setpoint T_{set} in Safe Mode
OUT_SP_08_XX	Timeout communication interface [s]; 0 = OFF)
OUT_SP_09_X.XX	Setpoint of the through-flow control [L/min]
OUT_PAR_00_XX.X	Configuration of control parameter Xp.
OUT_PAR_01_XXX	Setting the control parameter Tn (5 – 180 s; 181 = OFF).
OUT_PAR_02_XXX	Configuration of control parameter Tv.
OUT_PAR_03_XX.X	Configuration of control parameter Td.
OUT_PAR_04_XX.XX	Configuration of control parameter KpE.
OUT_PAR_05_XXX	Setting the control parameter TnE (0 – 979s; 980 = OFF).
OUT_PAR_06_XXX	Configuration of control parameter TvE (0 = OFF).
OUT_PAR_07_XXXX.X	Configuration of control parameter TdE.
OUT_PAR_09_XXX.X	Configuration of the correction limitation.
OUT_PAR_10_XX.X	Configuration of control parameter XpF.
OUT_PAR_14_XXX.X	Configuration of the setpoint offset.
OUT_PAR_15_XXX	Configuration of control parameter PropE.
OUT_MODE_00_X	Keyboard master: 0 = free / 1 = blocked (corresponds to: "KEY").
OUT_MODE_01_X	Control on: 0 = internal / 1 = external Pt100 / 2 = external analog / 3 = external serial Note: With some constant temperature equipment, this command can only be carried out if the command OUT_PV_05_XXX.XX has been sent by the interface. Also notice that the command OUT_PV_05_XXX.XX must be cyclically transmitted by the selected interface.

Command	Meaning
OUT_MODE_03_X	Keyboard remote control unit command: 0 = free / 1 = blocked.
OUT_MODE_04_X	Target value offset source: 0 = normal / 1 = external Pt / 2 = external analog / 3 = external serial Note: With some constant temperature equipment, this command can only be carried out if the command OUT_PV_05_XXX.XX has been sent by the interface. Also notice that the command OUT_PV_05_XXX.XX must be cyclically transmitted by the selected interface.
OUT_MODE_05_X	Setting the through-flow control: 1 = ON / 0 = OFF
START	Switches the device on (from standby)
STOP	Switches the device to standby mode (pump, heating, cooling unit off).

Please also note the following:

- " " (blank space) can also be used for "_".
- Response from thermostat will be "OK" or, if there is an error, "ERR_X". RS 485 interface for example "A015_OK" or for error "A015_ERR_X".

Table 12: Acceptable 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				

4.7.8 Error messages for interface

The following is a description of the error messages of the interface modules.

The following information relates to the analog module RS 232/485 module and contact module, as well as the Ethernet interface.

Error	Description
ERR_2	Wrong entry (for example, buffer overflow)
ERR_3	Wrong command
ERR_5	Syntax error in value
ERR_6	Impermissible value
ERR_8	Module or value not available
ERR_30	Programmer, all segments occupied

Error	Description
ERR_31	Not possible to specify target value, analog target value input ON
ERR_32	TiH ≤ TiL
ERR_33	External sensor missing
ERR_34	Analog value not present
ERR_35	Automatically configured
ERR_36	Not possible to specify target value, programmer is running or has been paused
ERR_37	Impossible to start the programmer, analog target value input is turned on

5 Commissioning

5.1 Establishing a mains connection

Personnel: ■ Operating personnel

WARNING!
Contact with voltage conductors due to faulty mains cable

Electric shock

- The mains cable may not come into contact with hot heat transfer liquid and other hot parts, neither during operation nor after the device is switched off.

NOTICE!
Use of impermissible mains voltage or mains frequency

Device damage

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

Please note:

- Only connect the device to sockets with a protective earth conductor (PE).
- Only use the supplied power cable for the power supply.
- The mains switch disconnects the device from the power unit. The mains switch must be easy to identify and access.

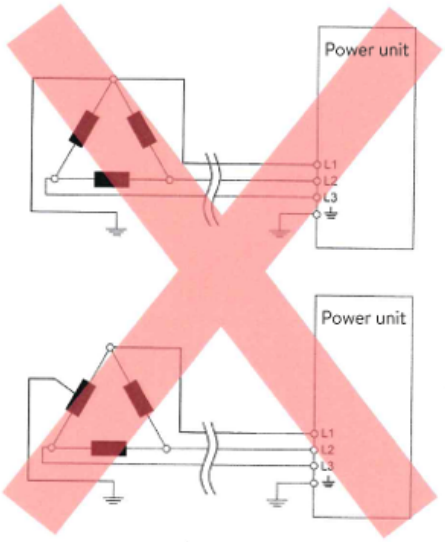


Fig. 18: Asymmetrically grounded delta network (without isolating transformer)

Notes for electric installation on site

- The fuse on the installation side must at least correspond to the maximum current consumption of the device (see rating label) and may not exceed the value permitted for the mains plug.
- Three-phase devices
  - Three-phase devices may only be operated on networks grounded at the neutral point, e.g. TN-C, TN-C-S or TN-S. For ungrounded networks (e.g. IT systems) or asymmetrically grounded networks, an isolating transformer must be connected upstream and the neutral point grounded. When selecting the isolating transformer, consider the maximum connected loads of the device.
  - Ensure correct rotating field! If the rotating field is incorrect, an error message is displayed and the device cannot be put into operation.

5.2 Switching on the device for the first time

You will find the entry sequence prescribed for safety reasons in the graphic. The entries must be input each time the heat transfer liquid is changed and after the device has been switched on for the first time.

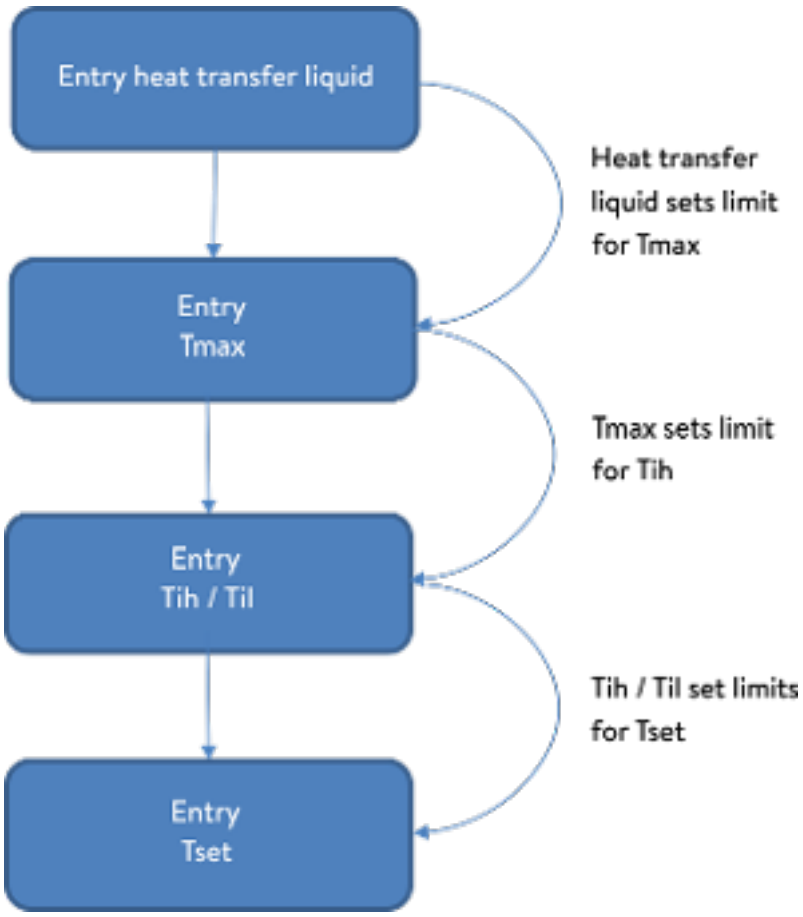


Fig. 19: Entry sequence

Switch on the device

Fig. 20: Start screen

1. Switch on the device at the mains switch. A sound is heard.
   ▶ Then the menu to choose the language appears.

Fig. 21: Menu language

2. Use the down and up arrow keys to select the desired [menu language].

   Press [CONTINUE] softkey to confirm your selection.

   You can change the menu language at any time via the menu.

   ▶ The menu for selecting the time zone then appears.

3. Use the down and up arrow keys to select the [Time zone] that you are in.

   Press [CONTINUE] softkey to confirm your selection.

   ▶ Then the menu to choose the heat transfer liquid appears.

4. Use the down and up arrow keys to select the [heat transfer liquid].

   Press [CONTINUE] softkey to confirm your selection.

   ▶

   Then the fill mode menu appears.

5. Fill the device with heat transfer liquid.

   ▶ Then the degas mode menu appears.

6. Let the device perform the degassing.

7. Set $T_{max/Tank}$ ↳ Chapter 6.4 “Setting Tmax” on page 80.

When the device is in operation, a red light spot is projected onto the floor under the front of the device.

If there is a fault, this light point flashes. If the device is in standby or switched off, the light point is not present.

5.3 Operating the device with the operating unit

5.3.1 Home window, navigation and softkeys

Home window

After switching on the device and configuring the settings, the "simple" home window (without status bar) is displayed. If no entry is made for about 10 seconds, the softkey bar is hidden. Press any key to display the softkey bar again.

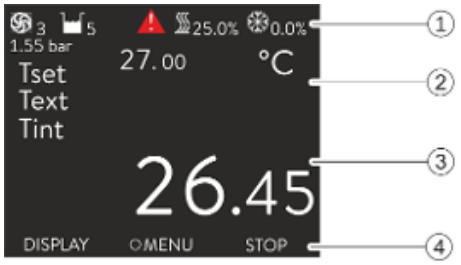


Fig. 22: Home window with status bar and softkey bar

1 Status bar
2 Display of the external temperature T_{ext} or the internal temperature T_{int} and the set temperature T_{set}.
3 Large display of the temperature according to which the device is regulated.
4 The softkey assignments are displayed in the softkey bar.

The softkeys are special keys that can be pressed at any time, but can assume different functions depending on the context. The respective function is shown in the display at the assigned position.

Status bar

Fig. 23: Status bar from the extended home window

1 When the pump is running, the pump symbol rotates. Only for Integral XT will the pump level be additionally displayed as a figure.
2 Display of the filling level of the heat transfer liquid in the device
3 A yellow or red warning triangle indicates error, alarm or warning messages.
4 The heater heats with the displayed percentage power.
5 The cooling unit cools with the displayed percentage power.

Keys, displays and softkeys

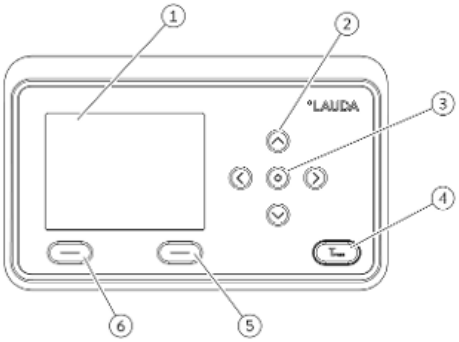


Fig. 24: Operating unit (transverse format design)

1 Display
2 4 arrow keys
3 Enter key
4 Key to display the overtemperature switch-off point
5 Right softkey
6 Left softkey

- To go from the home window to the main menu, press Enter.
- Navigate with the four arrow keys
  - You can scroll up and down in the menu using the arrow keys.
  - If you are in the main menu, pressing the right arrow key [>] (several times) or the Enter key [MENU] takes you deeper into the menu.
  - If you are in a submenu, you can return to the home window by pressing the left arrow key [<] several times.

Symbols in the menu

Symbol	Description
▶	The triangle indicates that there is a submenu.
🔒	The padlock indicates that this menu cannot be changed.

Functions of the softkeys

The softkey bar is located at the bottom of the display. Depending on the context, the softkeys are assigned several different functions.

You can select the following functions with the softkeys:

- With [DISPLAY] you switch through the different windows.
  - "simple" home window (without status bar)
  - "extended" home window (with status bar)
  - Graph window
  - List with `errors` and code number
  - List with `warnings` and code number
  - List with `alarms` and code number
- With [ESC] you exit the menu and jump back into the home window or exit an entry window.
- With [MENU]
  - you access the main menu and
  - confirm the selected menu command which takes you deeper into the submenu or to an entry window.

- With [OK]
  - you confirm an option in a selection window and
  - confirm a numerical value in an entry window.
- With [CHANGE] a device parameter (for example set temperature) is changed.
- With [SELECT] an element is selected in a selection list.
- With [START] or [STOP] you can switch between the two operating modes *Standby* and *Operation*.
- With [+/-] you can enter negative values in an entry window.
- Depending on the context, further functions are assigned to the soft-keys (e.g. NEW/DELETE in the programmer-editor).

5.3.2 Enter entry window and set temperature

Settings in the display are configured via the entry window. Two varieties of entry windows are available.

Entry window for selecting options

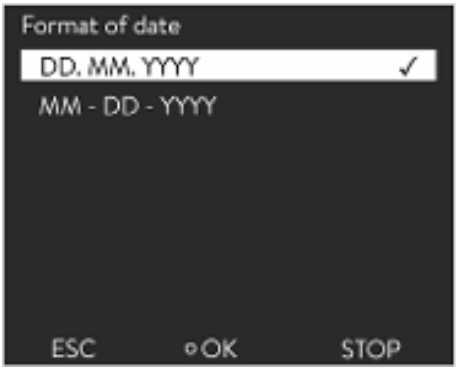


Fig. 25: Selecting options

- The check mark indicates the active option.
- You can navigate in the options using the arrow keys [up] and [down].
- The selected option is highlighted.
- Press the [ESC] softkey to exit the entry window, with or without changes.
- Press the Enter key [OK] to accept the selected option.

Entry window for a numerical value

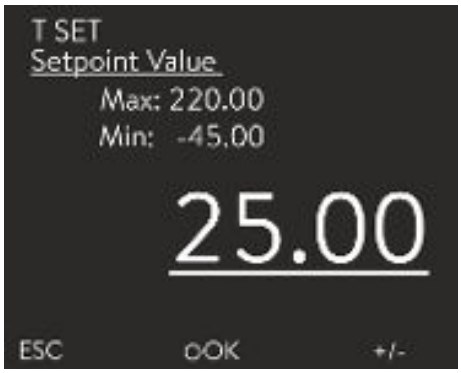


Fig. 26: Entering a value

- The value to be entered is displayed in enlarged font. The cursor flashes under the value.
- With the [up] and [down] arrow keys you can change the value. If you keep one of the two arrow keys pressed down longer, the change will be accelerated.
- By pressing the [left] or [right] arrow key, you can select individual digits and change them with the [up] and [down] arrow keys.
- With the [+/-] softkey you can change the sign of the value.
- The displayed values *Max:* and *Min:* specify the limits for the value entry.
- With the [ESC] softkey, you return to the previous display without making any changes.
- By pressing the Enter key [OK], the set value is accepted.

Entering set temperature

1. Press the Enter key to open the menu.
2. Select the → *Set temperature* menu item.

3. Press the Enter key.
   ▶ The entry window appears. The cursor flashes under the temperature value. The upper and lower temperature range is displayed.
4. Change the value with the arrow keys.

   By pressing the [ESC] *key, you return to the previous menu without making any changes.*

5. Press the [OK] to confirm the new value.
   ▶ The new value is active.

5.3.3 Graph window

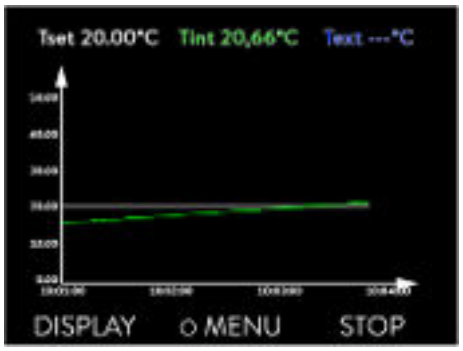


Fig. 27: Graph window

The display offers you the possibility to display temperature curves graphically.

The graphics window can be accessed via the [Display] softkey in the home window of the display.

- T_{set} indicates the set temperature (gray).
- T_{int} indicates the internal temperature (green) of the heat transfer liquid in the device.
- T_{ext} indicates the external temperature (dark blue) of the heat transfer liquid in the consumer.
- Use the arrow keys to scroll the graphic in any direction.

Edit the graphic window

1. Press the Enter key to open the menu.
2. Select the → *Graphic* menu item.
   ▶ The Graphic submenu opens.

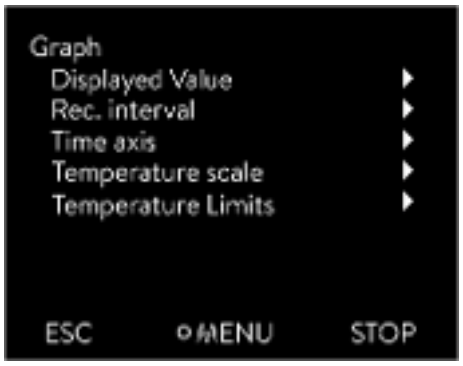


Fig. 28: Graphic menu

In this submenu, you can adapt the graphics window to your requirements.

- [Display measurement values]: T_{set}, T_{int}, T_{ext} and T_{ext2}.
  Here you can define which temperatures are displayed in the graph.
- [Sample time]: 2 s (maximum 50 min), 10 s (maximum 4 h), 30 s (maximum 12 h), 1 min (maximum 24 h) or 2 min (maximum 48 h).
  Here you can define the time interval at which new temperature values are measured.
- [Time Axis]: auto, 9 min, 45 min, 2 h15 min, 4 h30 min , 9 h, 24 h or 48 h.
  Here you can define the time range displayed in the visible graph window (corresponds to scaling of x axis).

- [Temperature scale]: automatic or manual.
  Here you can define which temperature range is displayed in the visible graph window.
  - [Autom.]: The size of the visible graphic area automatically adapts to the changing temperature curves.
  - If the setting is selected automatically, the following menu item (Temperature limits) is not visible.
- [Temperatutre limits]: T.scale Min and T.scale Max.
  Here you can manually define which time range is displayed in the visible graph window.

5.3.4 Operate the device using the Command Touch unit

The device can also be operated with the Command Touch remote control unit (accessory).

WARNING!
Device start carried out from remote control unit

Scalding, cold burns

- Switch the local operating unit into standby

5.4 Setting heat transfer liquid

WARNING!
Overheating of heat transfer liquid due to incorrect entry of overtemperature switch-off point T_{max} for the hydraulic circuit

Fire

- Set the overtemperature switch-off point for the hydraulic circuit to 5 K above the upper limit of the temperature range for your application. But not above the upper limit of the working temperature range of the heat transfer liquid.

The following information is only relevant for the Integral T device:

WARNING!
Overheating of heat transfer liquid due to incorrect entry of overtemperature switch-off point T_{max} for the hydraulic circuit

Fire

- In the menu of the device, set the heat transfer liquid used in the device. Set the overtemperature switch-off point below the flash point of the heat transfer liquid.

The following information is only relevant for the Integral XT device:

WARNING!
Overheating of heat transfer liquid due to incorrect entry of overtemperature switch-off point $T_{maxTank}$ for the expansion vessel

Fire

- In the menu of the device, set the heat transfer liquid used in the device. Set the overtemperature switch-off point $T_{maxTank}$ below the flash point of the heat transfer liquid.

In the menu of the device, set the heat transfer liquid used in the device. This process loads the values entered in the software into the controller of the device.

The entered values of the heat transfer liquid are:

- the flash point
- the viscosity
- the density
- the specific heat capacity
- the limits of the working temperature range in the hydraulic circuit
- the limits of the temperature range in the expansion vessel (only for Integral XT)

If you select the heat transfer liquid setting [Undefined], you can enter the properties of a new heat transfer liquid in the [Define heat transfer liquid] menu item.

Personnel: ■ Operating personnel

1. Press the Enter key to open the menu.
2. Select the menu items → *Settings* → *Fluid* → *Fluid*.
   ▶ A list of the approved heat transfer liquids for the device is displayed.
3. Scroll to mark a heat transfer liquid.

   By pressing the [ESC] *key, you return to the home menu without making any changes.*

4. Press [OK] to confirm the selection.
   ▶ The selection is marked with a checkmark.
5. In the menu item → *Display fluid properties*, you can display the properties of the heat transfer liquid.

   Set Tmax immediately
   After you have selected the heat transfer liquid, immediately set the overtemperature switch-off points Tmax/tank. $T_{max/Tank}$
   ↳ Chapter 6.4 “Setting Tmax” on page 80.

5.5 Fill the device with heat transfer liquid

LAUDA is not liable for damages resulting from the use of unsuitable heat transfer liquids.

Do not mix different heat transfer liquids together!

Use a funnel if required to fill the device with heat transfer liquid.

DANGER!
Use of unsuitable heat transfer liquid

Fire

- Select a heat transfer liquid with a temperature range suitable for the application.

WARNING!
Overheating of the heat transfer liquid

Fire

- The heat transfer liquid used in the device must be set in the menu of the device.

WARNING!
Risk of heat transfer liquid overheating due to incorrect entry of overtemperature switch-off point Tmax

Fire

- Set the overtemperature switch-off point to 5 K above the upper limit of the temperature range for your application. The overtemperature switch-off point must be below the flash point of the heat transfer liquid.

WARNING!
Splashing heat transfer liquid

Eye damage

- Always wear suitable safety glasses when working on the device.

WARNING!
Overflow of heat transfer liquid

Electric shock

- Do not overfill the device. Observe the level display and the thermal volume expansion of the heat transfer liquid.

WARNING!
Spraying of heat transfer liquid

Electric shock

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

WARNING!
Overflow of heat transfer liquid due to increase in volume caused by heating

Scalding, electric shock

- Take into account the increase in volume caused by heating of the heat transfer liquid.

CAUTION!
Risk of heat transfer liquid escaping

Slipping hazard

- Draining tap must be closed.

CAUTION!
Heat transfer liquid escaping from the overflow pipe

Slipping hazard

- Use a collecting vessel on the overflow.

Heat transfer liquids expand when heated (approx. 10 % for every 100 °C). If an external consumer is connected, the total expansion occurs in the tank of the thermostat.

- Avoid ignition sources in the vicinity of the cover and overflow hose.
- There must be no gas cushions in the consumer system.

Information on filling the device

- Refilling during operation is possible.
- Only operate the thermostat if a flow in the consumer system is possible. Open any shut-off valves in the consumer.

- During filling, the device may overflow if the consumer is positioned higher than the device and filling is interrupted (e.g. due to a power failure). There may be even larger amounts of air in the consumer, which allows the filled liquid to flow back. In case of doubt, a shut-off valve should be attached to the lower connection of the application.
- A vent valve Fig. 29 can significantly simplify the aeration process. For this purpose, periodically open the valve carefully and allow gas/air to escape until liquid escapes from the valve, and then close the vent valve again. Collect the liquid in a suitable container. Operate the valve again at regular intervals until no more air escapes.

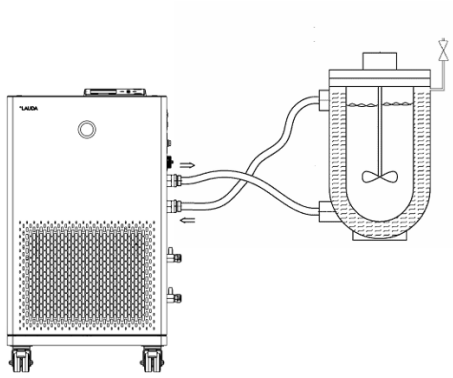


Fig. 29: Application with vent valve

Notes on fill mode in Integral XT

- The fill mode (only in Integral XT) supports you in filling the device. Messages in the display guide you through the filling process. Follow the instructions and switch on the display with the [>>] softkey.
- Furthermore, the fill mode removes gas bubbles and air bubbles from the thermostatic circuit. The pump starts automatically at pump level 2 and switches off briefly every 45 seconds for better aeration. Heating and cooling unit are switched off. Observe the pressure indication and level indication until the level no longer drops, the pressure indication no longer rises and the degassing symbol is no longer displayed for at least two minutes. Venting takes at least a few minutes and can take more than an hour in unfavorable conditions with large-volume consumers and high viscosity.
- For high-temperature thermostats up to 320 °C (H-devices), the switchover between the individual hydraulic paths takes place alternately every 20 seconds. This produces a buzzing sound of about 5 seconds. The displayed pressure changes periodically.

Fill an empty device

Protective equipment:
- Safety glasses
- Protective gloves
- Protective work clothing

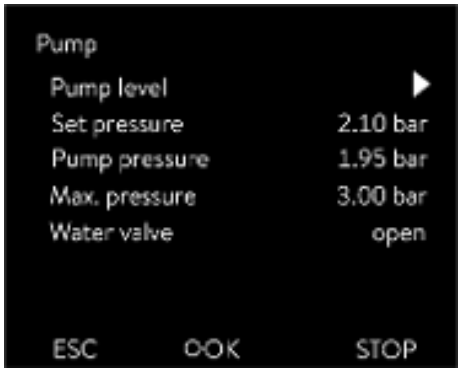


Fig. 30: Pump menu in Integral XT

1. Close the drain taps. By turning them clockwise.
2. Attach a suitable hose (heat transfer liquid/temperature) to the overflow connection on the device.
3. Place the end of this hose into a suitable canister to collect the overflowing heat transfer liquid.
4. Switch on the device.

   You can also switch the Integral T into standby.

   ▶ Only for Integral XT: If the tank is empty (level 0), immediately after switching on the device the *fill mode* is started.
5. Remove the tank lid. Use a funnel for filling, if required.
6. Carefully fill the heat transfer liquid. Check the level indicator and do not overfill the device!

   Recommendation: Fill the device up to level 6.
7. Integral T: Switch on the pump and fill the application. The level in the device drops.

8. Carefully top up the heat transfer liquid. Check the level indicator and do not overfill the device!

   From level 10 for Integral T or level 11 for Integral XT the device additionally supports you with a sound. At the beginning, the sound is emitted at larger time intervals. From level 12, the sound is repeated at shorter intervals. Once the **Fill maximum is reached**, a continuous tone is output.

For Integral XT: Refill the heat transfer liquid.

Heat transfer liquid should be pumped into the application.

1. If the device is only partly filled, *fill mode* can be manually started. → *Main menu* → *Pump* → *Fill mode* → *Start filling*.
2. Select the menu items → *Pump* → *Fill mode* → *Start filling* → *Start pump*.

   In the [Fill mode] menu you may have to [clear the alarm].

   ▶ Heat transfer liquid is pumped through the external consumer.
3. Fill up with heat transfer liquid until the desired fluid level is reached. Allow the pump to continue running during this time.

   The cooling unit is switched off. The outflow temperature can rise above the set temperature due to the heat input of the pump.
4. With [End filling], the fill mode is ended and the pump stopped.

   With [Stop pump], the pump is stopped.

When refilling during operation, it is not necessary to start the fill mode. If necessary, switch the device into standby. To do this press the [STOP] *softkey.*

Only for Integral XT

If [Fill mode] *is active, the device does not heat or cool. You can only start the device after you end* [Fill mode].

5.6 Degas heat transfer liquid (low boiling point expulsion)

This section is relevant for:

- Integral XT devices

The following information is only relevant for the Integral XT device:

- There must be no gas cushions in the consumer system. Check this by reducing the pump power by one or two stages. The level indication of the device may not rise.
- To extend the temperature range of the heat transfer liquid used, nitrogen overlay in the expansion vessel is recommended.
- Aerate the installation site. Vapors which are hazardous to health may be produced.

DANGER!
Hot heat transfer liquid in the expansion vessel

Fire

- Degas with the degas mode.

Degas mode description

Protective equipment:
- Safety glasses
- Protective gloves
- Protective work clothing

Principle: During degassing, the heat transfer liquid is boiling. The gas can be produced at various points in the circuit. For example, at the heater, at a throttle point.

The Integral XT device is equipped with a gravity separator upstream of the pump through which the gas is led into the expansion vessel.

To degas the heat transfer liquid, start the degas mode.

The following parameters are set automatically in degas mode:

- Pump level is set to Stage 2. Only change the pump level when it is necessary.
  Caution when selecting the pump level in connection with pressure-sensitive consumers (e.g. glass apparatus)!
- Do not use pressure control. Note the maximum pressure!
- The heating output is reduced to about 50% of the total heating output of the process thermostat.
- The cooling unit is switched off. The outflow temperature can rise above the set temperature due to the heat input of the pump.
- The pump switches briefly off and on again approximately every 45 seconds.
- For devices with a maximum temperature of up to 300°C, the cooling unit is switched over to the high-temperature cooler under certain operating conditions after the pump has been briefly switched off. This ensures that both the cooling unit and the high-temperature cooler are degassed. In addition, flushing is performed every 20 K.

Degassing

1. After filling and venting, heat the heat transfer liquid up to 20 K above the later maximum working temperature.

   Enter the new set temperature and confirm it.

- *Note the maximum working temperature range of the heat transfer liquid.*
- *Note the maximum working temperature range of the connected consumer.*

2. Start degas mode.

   In the → *Degas mode menu, select* → *Start degassing*.

   ▶ Degassing starts.

   In order to facilitate the removal of the low boilers during degassing, it may be useful to open the tank cover so that the steam escapes more easily (if necessary, use air extraction). In this operating status, constantly check the device; make sure to keep ignition sources away from the filling opening and protect the operating personnel from splashes (e.g. place the cover diagonally on the filling opening). Appropriate protective equipment or protective clothing must be worn. After the end of degassing, close the filling opening again with the tank cover.

3. The end of degassing is reached when the outflow temperature has approached the set temperature (< 10 K) and does not continue to rise.

   The end of degassing is also reached when the outflow temperature has exceeded the set temperature due to self-heating.

4. End the degas mode with → *Degas mode* → *End degassing*.

   ▶ The device is in standby. All parameters described above are retained with their current settings.

Automatic degassing

If necessary, the device carries out the degassing automatically. If the device detects gas in the hydraulic system, the heating and cooling capacity is first reduced or temporarily switched off completely. If the pump pressure drops sharply (a clear sign of degassing), the pump speed is limited and the pump may be switched off briefly. When the automatic degassing is finished, the device resumes its operation automatically.

For devices with a maximum temperature of up to 300°C, the cooling unit is switched over to the high-temperature cooler under certain operating conditions after the pump has been briefly switched off. This ensures that both the cooling unit and the high-temperature cooler are degassed.

5.7 Setting the flow rate of the heat transfer liquid

CAUTION!
Bursting of external consumer due to gage pressure

Scalding, frostbite, cuts

- For consumers with a maximum permissible working pressure below the maximum pressure of the pump, use a pressure relief device for protection. This pressure relief device shall be installed in the outflow to the consumer.

Setting flow rate for Integral T

This section is relevant for:

- Integral T devices

Before switching on, turn the bypass control knob counterclockwise to the fully open position.

Personnel: ■ Operating personnel

In the Integral T devices, the flow rate is set via the bypass on the right-hand side of the device. The bypass enables operation with a pressure-sensitive application.

1. To increase the flow rate and thus the pressure in the consumer, turn the bypass adjusting wheel clockwise until the desired (< permissible) pressure for the external consumer is reached.

   Observe the changing display of [pump pressure] *in the display.*

   To display the pump pressure, select the menu items → *Pump* → *Pump pressure*.

Entries in Pump submenu

- Pump pressure
  - Displays the current pressure of the pump in the outflow. No settings can be made here.
- Fill mode
- Water valve (only functions with water-cooled device)
  - The standard setting is `autom.` (automatic). If you want to drain the water-cooled condenser, select the `off`position in the water valve menu.

Setting pump level for Integral XT

This section is relevant for:

- Integral XT devices

The pump of the device can be adjusted by means of several pump levels. This optimizes the flow rate and discharge pressure, noise generation and mechanical heat input.

If you have connected a pressure-sensitive application, you must use the [Set pressure] *and* [Maximum pressure] *settings in the Pump menu.*

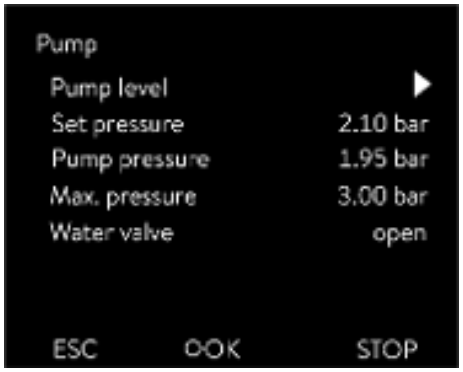


Fig. 31: Pump menu Integral XT

Entries in Pump submenu

- Pump level
- Set pressure
  - As an alternative to the 8 pump power stages, operation with pressure control is provided. The device then regulates to the set pressure and enables a careful supply of pressure-sensitive consumers.
  - You enter a value in this entry window when you have connected a pressure-sensitive consumer. This value in the bar unit depends on the sensitivity of your consumer. If you enter a setpoint of 0 bar, the pressure control is switched off.
- Pump pressure
  - Displays the current pressure of the pump in the outflow. No settings can be made here.
- Maximum pressure
  - Enter the maximum pressure of the connected application. This must be greater than the set pressure. If the maximum pressure you entered is exceeded, the device switches off. Pump, heater and cooling unit are switched off.
- Fill mode
- Degas mode
- Water valve (only functions with water-cooled device)
  - The standard setting is `autom.` (automatic). If you want to drain the water-cooled condenser, select the `off`position in the water valve menu.

Personnel: ■ Operating personnel

1. Press the Enter key to open the menu.
2. Select the menu items → *Pump* → *Pump level*.
   ▶ The pump levels 1 to 8 are displayed. The currently active pump level is displayed inverted.
3. Select one of the pump levels displayed.

   The selected pump level is activated automatically. It does not have to be activated separately.

4. With the [ESC] softkey, you return to the home window, or, with the left arrow key [<], you return to the Pump menu.

5.8 Control parameters

The thermal mass and the thermal connection of the application to the thermostat may make it necessary to adjust the control parameters.

Only modify the control parameters if you possess adequate knowledge of control system engineering.

5.8.1 Control basics

Definition

A brief explanation of terms

Actuating signal	- Initial value of the controller to compensate for the difference between the actual value and target value (control deviation).
PID controller	- The PID controller operates with extreme speed and precision and consists of a P, I and D-component.
Proportional range Xp	- The proportional range Xp indicates the temperature range within which the proportional component (P-component) of the controller represents 0 - 100 % of the maximum actuating signal. If the preset Xp is 10 K and the control deviation is 2 K, for example, the P-component is 20 % of the actuating signal. If the control deviation is 10 K or more, the P-component is 100 % of the actuating signal.
Adjustment time Tn	- The adjustment time is crucial for the I-component of the actuating signal. It specifies the interval at which an existing control deviation is integrated. The higher the Tn, the slower the control deviation is integrated and the more sluggish the control becomes. A small Tn makes the control more dynamic and eventually results in vibrations.
Hold-back time Tv	- The D-component of the actuating signal is formed from the hold-back time Tv. It influences the speed with which the actual value approaches the target value and counteracts the P-component and I-component. The greater the preset hold-back time Tv, the more intensively the output signal is attenuated. Rule of thumb: Tv = Tn x 0.75.
Attenuation time Td	- Attenuation time of the D-component. Rule of thumb: Td = Tv x 0.15.
Correction limitation	- Represents the maximum permitted deviation between the temperature at the external consumer and the temperature at the outflow.

Optimizing the hydraulic system

An important prerequisite for good control is a good connection between the application to be temperature-controlled and the constant temperature equipment.

- Use short hoses with a large cross section to reduce the flow resistance.
- Select a heat transfer liquid that is as thin as possible (viscosity below 30 mm^2/s) and with the highest possible heat capacity. Precedence list: Water, water-glycol mixture, oils, Fluorinert®.
- Set pump or bypass so that the volume flow of the heat transfer liquid is as high as possible.

Effects of viscosity on the heat transfer liquid

A control that is stable at low temperatures will usually be stable at high temperatures. Conversely, if a system is just about stable at high temperatures, it will most probably be unstable at lower temperatures, i.e. vibrate.

The viscosity of the heat transfer liquid changes drastically with the temperature. At low temperatures, liquids are more viscous. The control quality is therefore generally poorer at low temperatures. For this reason, the control setting should be towards the lower end of the temperature range.

If the temperature range of an application is -20 το 80 °C, for example, a control setting of -10 το 20 °C is most suitable.

Influence of control parameters on the control action

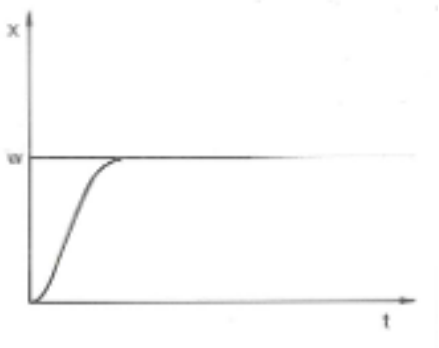
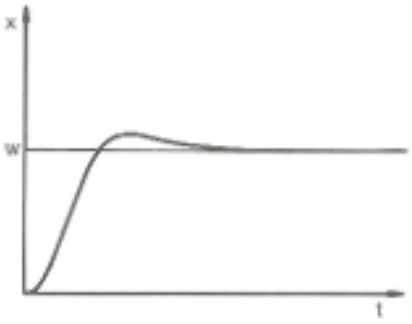
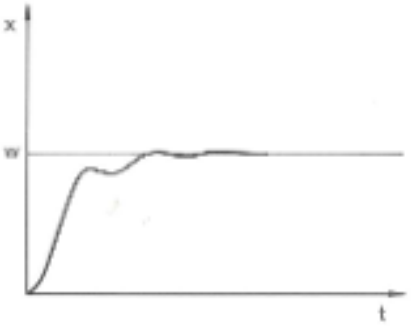


Fig. 32: Ideal setting



If the Xp parameter selected is too large, the actual value will reach the proportional range early and the P-component will be less than 100 % of the actuating signal. It takes longer to reach the target value and as a result, the simultaneously integrated I-component has more time to establish its actuating signal component. Once the target value is reached, the excessive addition of the I-component causes the value to overshoot the target value. If proportional range Xp is reduced, the P-component remains at 100 % for longer. Consequently, the actual value approaches the target value more quickly and the I-component has less time to integrate the system deviation. The overshoot is reduced.

Fig. 33: Control parameter Xp too large



If the proportional range selected is too small, the P-component of the actuating signal remains at 100 % for a long time. This value decreases even faster within the proportional range, i.e. the actuating signal decreases rapidly and the progress of the actual value towards the target value comes almost to a complete stop. The I-component, which only becomes effective now, causes the actual value to move slowly towards the target value.

Fig. 34: Control parameter Xp too small

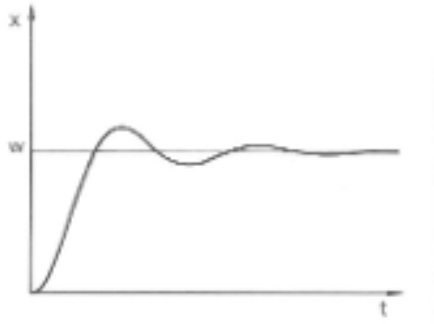


Fig. 35: Control parameters Tn and Tv too small

In the case shown here, the preset I component is too large (parameter Tn too small, Tn must be increased). The I-component integrates the control deviation until it becomes 0. If integration proceeds too rapidly, the actuating signal, i.e. the output signal of the controller, is too large. As a result, the actual value fluctuates (fading) around the target value. The hold-back time (parameter Tv) should be adapted using the formula:
Tv = Tn x 0.75 adapted.

Fig. 36: Control parameters Tn and Tv too large

The actual value increases relatively sharply towards the specified target value. The proportional area settings seem to be correct. If the control deviation becomes smaller, the actual value approaches the target value much more slowly. The integration component (I-component) must compensate for the drastic reduction of the proportional component (P-component). In this case, the I component is integrated too slowly. The parameter Tn, which specifies the integration interval, must therefore be reduced. The hold-back time (parameter Tv) should be adapted using the formula: Tv = Tn x 0.75.

5.8.2 Overview of internal control parameters

The internal control compares the set temperature with the outflow temperature and calculates the actuating signal, i.e. the measurement used for heating or cooling.

Table 13: The following control parameters can be adapted for internal control:

Characteristics	Designation	Unit
Xp	Proportional range	K
Tn	Adjustment time	s
Tv	Hold-back time	s
Td	Attenuation time	s

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

The temperature limits Tih and Til also have an effect on the control.

5.8.3 Overview of external control parameters

- 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 set temperature with the external temperature (consumer temperature) and, from these temperatures, calculates the set temperature (set_internal) for the slave controller (internal controller).
- The slave controller compares the set temperature (set_internal) with the outflow temperature and calculates the actuating signal, i.e. the measurement used for heating or cooling.

Table 14: The following control parameters can be adapted on the master controller (external controller):

Characteristics	Designation	Unit
Kpe	Amplification factor	-
Tne	Adjustment time	s
Tve	Hold-back time	s
Tde	Attenuation time	s
Prop_E	Proportional range	K

Table 15: The following control parameters can be adapted on the slave controller (internal controller):

Characteristics	Designation	Unit
Xpf	Proportional range	K

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

The temperature limits Tih and Til also have an effect on the control.

Correction limitation

If a temperature jump is specified via set temperature T_{set}, the control may set an outflow temperature which is considerably higher (e.g. 50 K, problem with enamel reactor) than the temperature T_{ext} required in the external application. Therefore, there is a correction limitation that specifies the maximum permitted deviation between the temperature at the outflow T_{int} and the temperature in the external consumer T_{ext}.

1. Press the [Enter key] to open the menu.
2. Select the menu items → *Setup* → *Control* → *Correction limit.*.
   ▶ An entry window opens for the numerical value.
3. Enter the value.

4. Confirm the new value with the [Enter key].
   ▶ The new value has been accepted.

5.8.4 Activate contr. variable

If the device is to be controlled to the internal control variable or an external control variable, you must set it accordingly. When setting, the old control variable with its set values is automatically deactivated. Only one control variable can be actively selected.

List of the possible control variables

- [Intern Pt1000]
- [Extern Pt100]
- [Extern analog]
- [Extern serial]
- [Extern USB]
- [Extern Ethernet]
- [Extern EtherCAT]
- [Extern Pt100-2]

Personnel: ■ Operating personnel

1. Press the Enter key to open the menu.
2. Select the menu items → *Settings* → *Control* → *Contr. Variable*.
   ▶ The active control variable is marked with a checkmark.
3. Scroll to another control variable and select it with the Enter key.
   ▶ The new control variable is valid with immediate effect.

5.8.5 Adapting control parameters

Personnel: ■ Operating personnel

Fig. 37: Change control parameters

1. Press the Enter key to open the menu.
2. Select the menu items → *Settings* → *Control* → *Control parameters*.
   ▶ If the control variable **extern** is active, the external control parameter is displayed on the display.

   If the contol. variable **Internal** is active, the internal control parameter is displayed on the display.
3. Scroll to another control parameter and select it with the Enter key.
   ▶ An entry window opens. You can now change the numerical value. The displayed values *Max:* and *Min:* specify the limits for the value entry.
4. Press the [OK] to confirm the new value.
   ▶ The new value is active.

Control parameter Tv

- With *Tv manual/auto* you can define whether the control parameter *Tv* and *Td* or *Tve*, *Tde* and *Prop_E* are set manually or automatically. If the automatic setting is enabled, these control parameters are displayed with a lock and cannot be selected.

  To be able to set these control parameters manually, change the control parameter *Tv manual/auto* to manual setting.

6 Operation

6.1 General warning

DANGER!
Hot heat transfer liquid in the expansion vessel

Fire

- Keep the cover of the expansion vessel closed during operation.

DANGER!
Risk of hot heat transfer liquid overflowing

Fire

- A connecting hose with a collecting vessel must be attached to the overflow.
- The collecting vessel and connecting hose must be designed to withstand the maximum temperature of the heat transfer liquid.
- Avoid ignition sources in the vicinity of the collecting vessel.

WARNING!
Splashing heat transfer liquid

Eye damage

- Always wear suitable safety glasses when working on the device.

WARNING!
Boiling heat transfer liquid escaping from the filling nozzle

Chemical and heat burns

- Never replenish hot heat transfer liquid with other fluids.

WARNING!
Overheating of the heat transfer liquid

Fire

- The heat transfer liquid used in the device must be set in the menu of the device.

WARNING!
Malfunctions on the overtemperature protection or low-level protection are not detected

Burns, scalding, fire

- Check the Tmax function and low-level protection on a regular basis.

WARNING!
Risk of refrigerant circuit bursting from excessive ambient temperatures while device is inoperative

Impacts, cutting, device damage

- Observe the permitted storage and operating temperatures.

CAUTION!
Touching hot/cold equipment parts and accessories

Hot and cold burns

- Never touch parts that are labeled with the warning symbol “Hot”.

CAUTION!
Automatic device start with the timer

Scalding, cold burns, injury

- Before using the timer, ensure that all preparatory measures for intended use have been implemented!

NOTICE!
Risk of refrigerant escaping from cooling water circuit

Device damage

- Before decommissioning the device or if there is a risk of freezing, drain the cooling water circuit of the cooling unit using compressed air or an industrial vacuum cleaner (watertight). Blow compressed air through the circuit.

The following information is only relevant for the Integral T device:

CAUTION!
Risk of external consumer bursting

Scalding, cold burns

- Adjust the pump pressure with the bypass.

The following information is only relevant for the Integral XT device:

- You can increase or reduce the pump pressure via the pump levels.
- You can limit the pump pressure via the pressure control.
- For pressure-sensitive consumers (e.g. glass apparatus) with a maximum permissible working pressure below the maximum pressure of the pump (with Integral T pressure 3.5 bar, with Integral XT pressure 7.0 bar), the hoses of the consumer must be laid in such a way that kinking or squeezing is not possible. In addition, a separate safety valve must be installed to protect against operating errors.

Please note:

- The device may only be moved after it has been drained. The device must be taken out of operation to do this.

6.2 Operating modes

The device supports two operating modes.

- In *Operation* mode, the components of the device are operational.
- In *Standby* mode, all device component are switched off. Power is only supplied to the display on the device. This operating mode is suitable for adjusting multiple settings, for example.
  A program that has been started is paused in *Standby* mode. After activating *Operation* mode, the program must be resumed again manually.

6.3 Menu structure

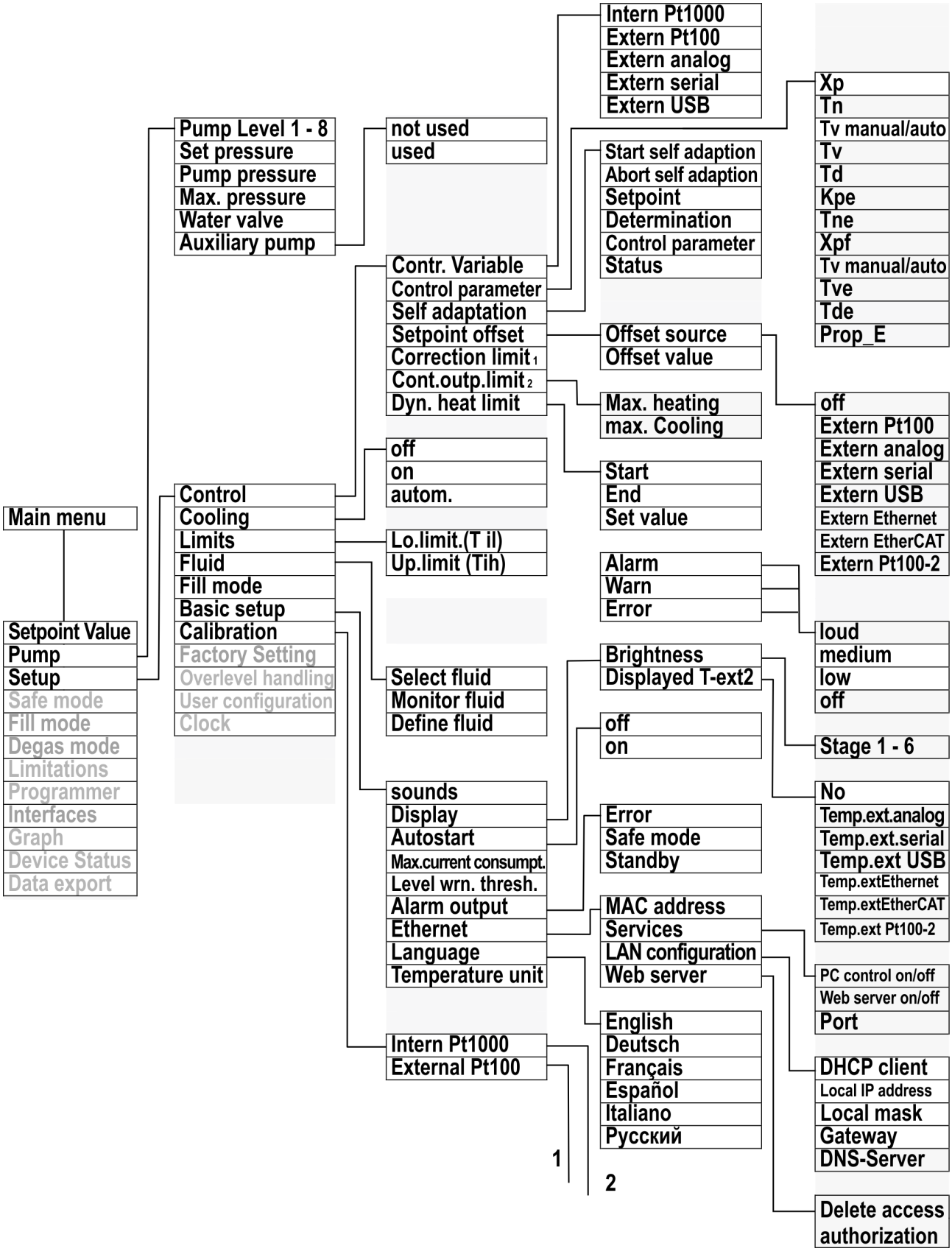


Fig. 38: Menu, Part 1

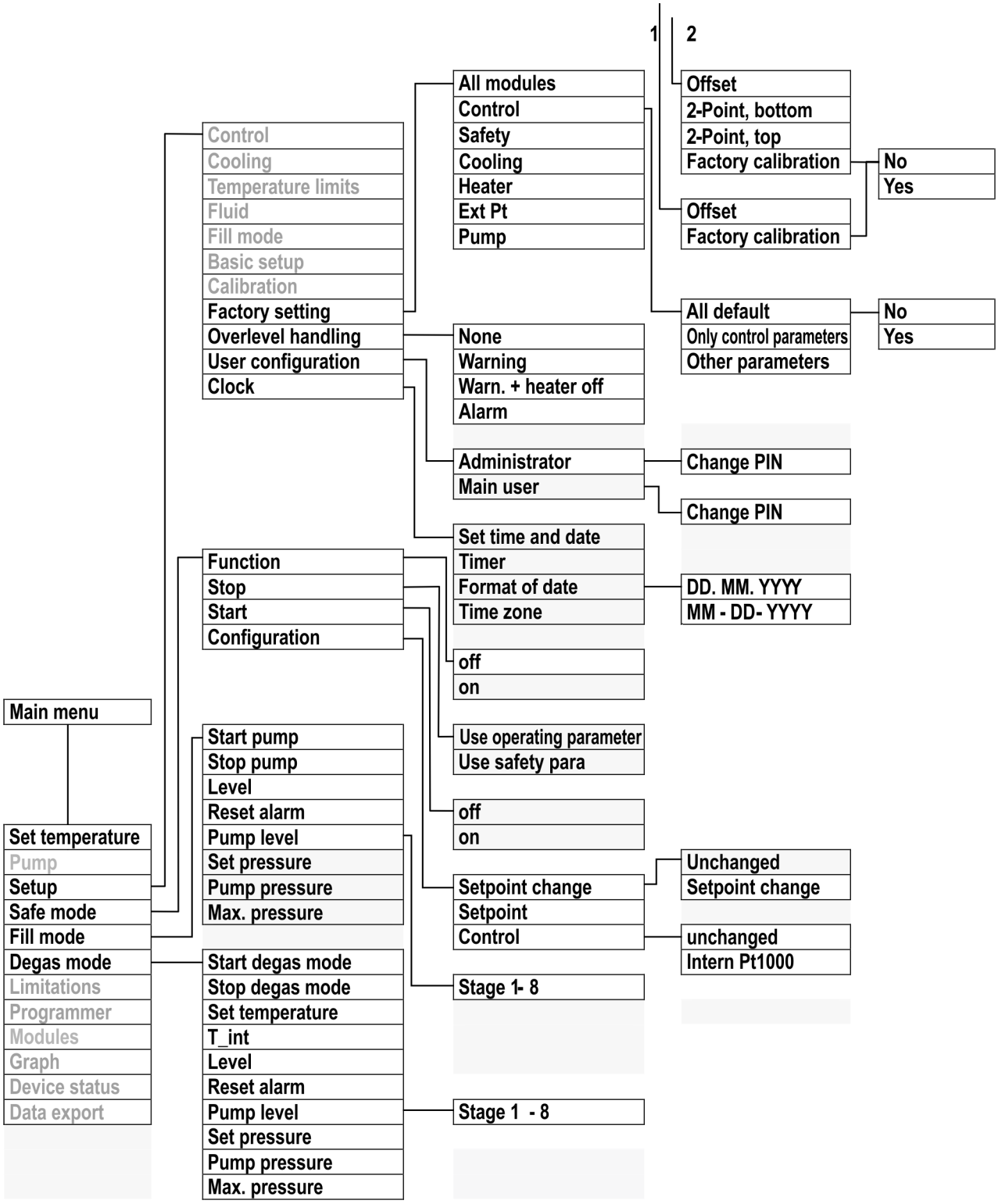


Fig. 39: Menu, Part 2 continuation from previous page

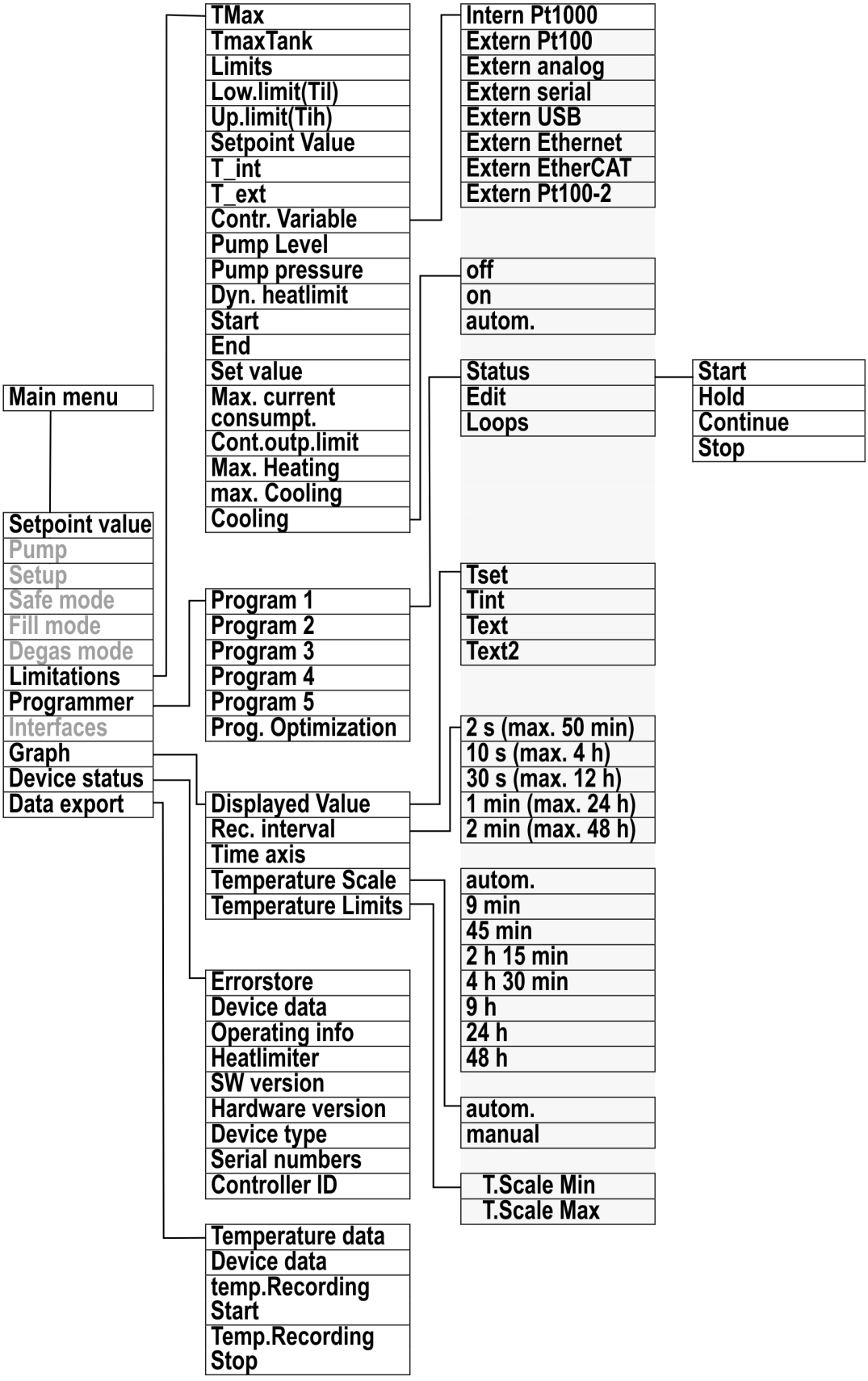


Fig. 40: Menu part 3, continuation from previous page

6.4 Setting Tmax

WARNING!
Overheating of heat transfer liquid due to incorrect entry of overtemperature switch-off point T_{max} for the hydraulic circuit

Fire

- Set the overtemperature switch-off point for the hydraulic circuit to 5 K above the upper limit of the temperature range for your application. But not above the upper limit of the working temperature range of the heat transfer liquid.

The following information is only relevant for the Integral T device:

WARNING!
Overheating of heat transfer liquid due to incorrect entry of overtemperature switch-off point T_{max} for the hydraulic circuit

Fire

- In the menu of the device, set the heat transfer liquid used in the device. Set the overtemperature switch-off point below the flash point of the heat transfer liquid.

The following information is only relevant for the Integral XT device:

WARNING!
Overheating of heat transfer liquid due to incorrect entry of overtemperature switch-off point $T_{maxTank}$ for the expansion vessel

Fire

- In the menu of the device, set the heat transfer liquid used in the device. Set the overtemperature switch-off point $T_{maxTank}$ below the flash point of the heat transfer liquid.

Personnel: ■ Specialized personnel

The limits for the T_{max}values (Integral T and XT) and $T_{maxTank}$values (only Integral XT) are set automatically,as soon as the heat transfer liquid is selected in the device menu.

Therefore the value ranges of T_{max} and $T_{maxTank}$ to be set are limited by the heat transfer liquid. You can reduce these values of T_{max} and $T_{maxTank}$, but not set them higher than the specified limits.

Fig. 41: Display Tmax

1. Press and hold down the T_{max} key.
   - ▶ The values T_{max} and $T_{maxTank}$ appear on the display.
2. With the arrow keys select one of the two T_{max} values, while keeping the T_{max} key pressed down.
3. Press the Enter key.
   - ▶ The entry window appears. The cursor flashes under the T_{max} value.

Fig. 42: Enter new Tmax/Tank

You must edit this field in the display (Fig. 42) and confirm with the Enter key.

4. Change the value with the arrow keys.

   If you release the T_{max} key, the process is aborted and $T_{max/Tank}$ was not changed.

5. Press the [OK] to confirm the new value.
6. Press [ANW] softkey to confirm the new value.
   - ▶ The new value is active.

6.5 Self adaptation

With the self adaptation function, the optimum control parameters for the respective application can be found automatically. Self adaptation can only be executed on a device with active cooling.

The self-adaptation function performs a test run of the thermostatic circulator to determine the parameters. The device and application must be ready for operation.

For Integral XT, self adaptation is carried out with the currently set pump level. The best results can be expected at the highest pump levels. The pressure control of the pump can be used, but will worsen the result. If the current consumption of the device is significantly limited, the result deteriorates and the duration of the self adaptation increases.

The test run must be performed on a passive application. In other words, changes cannot be made to the application and exothermic or endothermic reactions may not occur during the test run.

The test run takes between 30 minutes and a maximum of 3 hours, depending on the application. During the run, the temperature of the heat transfer liquid deviates a maximum of ±15 Kelvin from the defined setpoint. After completion of the test run, the newly determined values of the control parameters are accepted and stored in the [Control parameter] menu. The old control parameters are overwritten.

Start self adaptation

1. Press the [Enter key] to open the menu.
2. Select the menu items → *Settings* → *Control* → *Self adaptation*.
   ▶ A submenu opens.
3. Start self adaptation here:
   - [Start self adaptation]
     - The self adaption run begins.
     - You can stop the self adaptation process prematurely by pressing [Cancel self adaption].
   - Setpoint
     - Specify the temperature setpoint T_{set} here.
       Take the maximum temperature fluctuations of up to maximum ±15 Kelvin into consideration in the process.
     - Set [Tih] and [Til] accordingly.
   - Determination
     - With the *Only internal* command ,you determine the internal control parameters.
     - With the *Internal and external* command, you determine both internal and external control parameters.
   - Control parameters
     - Here you can view the control parameters.
   - Status
     - Shows the current phase of the program for determining the parameters.

   WAIT - Self adaption running

   END - Self adaption ended

   SEND - Parameters are transmitted

   STOPPED - Self adaption stopped

6.6 Set the setpoint offset

It is possible to apply an offset value to the temperature measured by an external temperature probe and then process this temperature as a target value. The setpoint of the heat transfer liquid in the device can therefore be set, for example, to 15 K below the temperature in the consumer, measured by the external temperature probe.

Navigating to the settings

1. Press the [Enter key] to open the menu.
2. Select the menu items → *Settings* → *Control* → *Setpoint offset*.

3. Select one of the following options:
   - [Offset source] allows you to select the source used to measure the offset.
   - [Diff. set/actual value] allows you to enter the value for the set-point offset.

Entering the offset value

1. Select the [Diff. set/actual] button in the setpoint offset menu.
   ▶ The entry window appears. An offset value can be entered within the limits displayed.
2. Enter the setpoint offset.
3. Press the [Enter key] to confirm.
4. The software returns to the previous Setpoint offset menu.

Activating an offset source

You can activate or deactivate the value entered for the setpoint offset of a corresponding source using the options in the [Offset source] menu. [External Pt100], for example, allows you to activate the setpoint offset for the external temperature probe.

1. Select the [Offset source] button in the Setpoint offset menu.
2. Select one of the following options:
   - Select [Off] to deactivate the offset source.
     Activate an offset source from the remaining options:
   - [Extern Pt100]
   - [Extern analog]
   - [Extern serial]
   - [Extern USB]
   - [Extern Ethernet]
   - [Extern EtherCAT]
   - [Extern Pt100-2]
3. Press the [Enter key] to confirm.
4. Press the [ESC] softkey to switch to the home window.

6.7 Limiting heating and cooling

The maximum heating power or max. cooling capacity can be limited using the controller output limit. The limit is set as a percentage of the maximum value.

The controller output limit for the heating output is designed to prevent excessive temperatures on the surface of the heater. Excessive heater temperatures may degrade the heat transfer liquid.

1. Press the [Enter key] to open the menu.
2. Select the menu items → *Settings* → *Control* → *Cont.outp.limit*.
3. Select [Max. heating] and press [OK] to confirm.
   ▶ An entry window appears. The controller output limit can be set to a value within the limits displayed.
4. Change the value accordingly.

5. Press the [OK] button to return to the previous screen with the new setting configured.
   ▶ The new setting is active.

Automatic heat limit for smaller pump power

In the Integral XT the heat output is increasingly reduced if the pump power falls below 150 W (pump level < 4). This measure protects the heat transfer liquid from overheating on the heater surface and thus prevents premature aging of the heat transfer liquid.

6.8 Dynamic heatlimiter

This section is relevant for:

- Integral XT devices

With the dynamic heat limiter, you limit the heating output of the device. At low flow rates at the heaters, there is a risk that the heat transfer liquid will overheat locally. This can lead to premature aging, oil cracking with silicone oils (depolymerization) or boiling.

Example

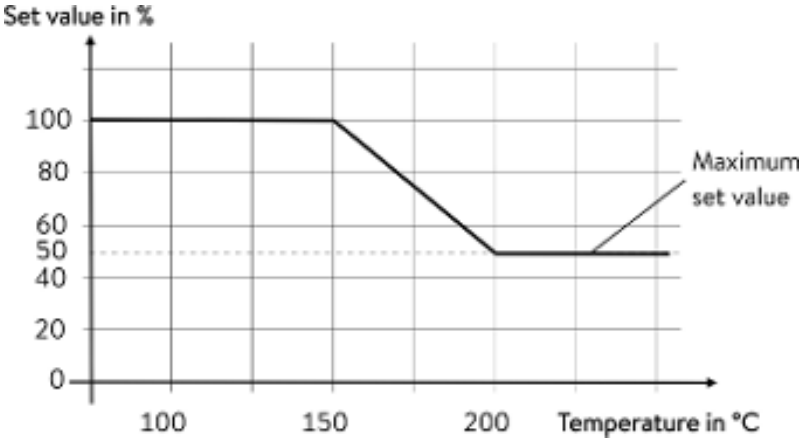


Fig. 43: Actuating signal

Start	-	150 °C
End	-	200 °C
Actuating signal	-	50 %

Personnel: ■ Operating personnel

1. Press the Enter key to open the menu.
2. Select the menu items → *Setup* → *Control* → *Dynamic heat limit*.
   ▶ The submenu opens.

3. Enter your values and press the Enter key to confirm.

Menu items	Description
Start	You use the values for Start and End to specify a temperature range, in which the power of the heater is linearly limited to the entered value of the actuating signal. The heater works at reduced power above the entered end temperature ([End]). The heater works at full power below the entered start temperature ([Start]).
End	
Actuating signal	You enter the value for limitation of the heating output in percent here.

▶ The dynamic heatlimiter is active.

6.9 Cooling

The cooling unit of the devices is operated in the standard setting [autom.]. Depending on the temperature and operating status, the cooling unit is automatically switched on or off. You can switch the cooling unit on or off permanently via the menu. In the case of sensitive control processes, control fluctuations can be prevented by automatically switching the cooling unit on or off.

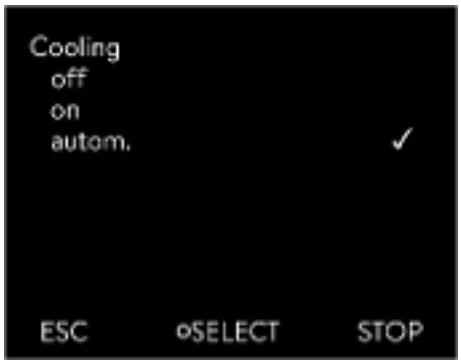


Fig. 44: Configuring cooling

1. Press the Enter key to open the menu.
2. Select the menu items ➞ *Setup* ➞ *Cooling*.
3. Select one of the following options:
   - With the [autom.] setting, the cooling unit is switched automatically. When cooling capacity is required, the cooling unit switches on.
   - With [off], the cooling unit remains switched off.
   - With [on] ,the cooling unit cools permanently.
4. Press [OK] to confirm the selection.

6.10 Setting temperature limits Tih and Til

This function is used to set temperature limits Tih and Til. The temperature limits limit the set temperature. A warning is issued if the internal actual temperature is outside the temperature limits. These temperature limits should reflect the limits of your application. A tolerance of 2 K should also be added to the upper and lower temperature limits to compensate for overshooting by the control, in particular external controls. The working temperature range of the heat transfer liquid must also be taken into consideration when defining temperature limits.

Setting Tih and Til

1. Press the Enter key to open the menu.
2. Select the menu items ➞ *Settings* ➞ *Temperature limits* ➞ *Lo.limit (Til)* or ➞ *Up.limit (Tih)*.
   ▶ The entry window appears. The cursor flashes under the value. The upper and lower temperature range is displayed.

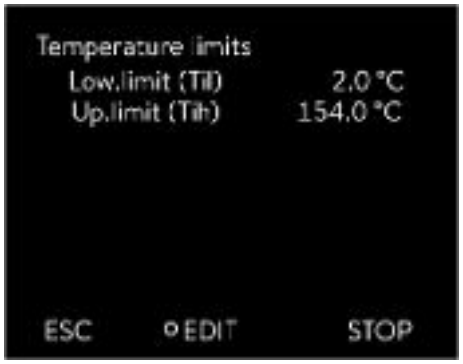


Fig. 45: Define temperature limits

3. Change the value with the arrow keys.

> *By pressing the* [ESC] *key, you return to the higher-level menu without making any changes.*

4. Press the Enter [OK] key.
   - ▶ The value is accepted.

6.11 Basic settings

Personnel: ■ Operating personnel

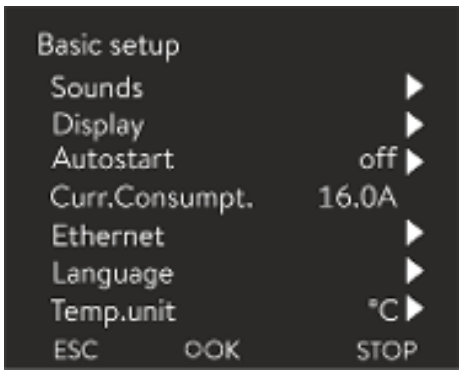


Fig. 46: Basic settings menu

1. Press the Enter key to open the menu.
2. Select the menu items → *Settings* → *Basic settings*.

The basic settings are described on the following pages.

Adjusting the volume of the sounds

The device indicates alarms, warnings and errors both visually and acoustically.

In the menu, you can adjust the volume of the sounds for:

- Alarm
- Warning
- Error

The volume settings are:

- loud
- medium

- low
- off

Fig. 47: Adjusting volume

1. In the Basic setting menu select the menu item → *Sounds*.
   - ▶ A list containing the sounds opens.
2. Select the sound that you wish to change using the arrow keys.
3. Press the Enter key to confirm your selection.
   - ▶ A list containing the volume settings opens.
4. Select a volume setting using the arrow keys.
5. Press the Enter key to confirm your selection.
   - ▶ The new setting is active.

Set the brightness of the display

Fig. 48: Adjusting brightness

The display brightness can be set manually.

1. In the Basic settings menu select the menu item *Display* → *Brightness*.
   - ▶ A list containing the settings opens.
2. The following options are available in the window:
   - You can select the brightness manually with entries [Level 1 - 6]. The brightness intensifies from [Level 1].
   - ▶ The new setting is valid with immediate effect.

Displayed temperatures in the display

In the [Displayed T-ext2] menu you can select via which interface a **second** external temperature value is read into your device. The newly selected temperature value is displayed in the home window and in the graphic window.

1. In the Basic settings menu select the menu item → *Display* → *Displayed T-ext2*.
   - ▶ A list containing the settings opens.
2. Select the external temperature with the arrow keys, which you would also like to be displayed.
   - ▶ The measuring channels are displayed which are installed in the device.
3. Press the Enter key to confirm your selection.
   - ▶ The new setting is active.

Automatic start after power failure

After a power failure and restoration of the power supply, the device **does not** resume operation (default setting). However, you can set the device to automatically resume operation after the power is restored.

1. In the [Basic settings] menu, select the menu item → *Autostart*.
   - ▶ A list containing the settings opens.

2. Select one of the following options:
   - With [Off], the device is set to standby operating mode after a power failure and when the power supply is restored.
   - With [On], the device is set automatically continue after a power failure and when the power supply is restored.

   Automatic running of the device may result in unattended operation.

3. Press the Enter key to confirm your selection.
   ▶ The new setting is active.

Limiting the current consumption

The fuse on the installation side must at least correspond to the maximum current consumption of the device (see rating label). If the mains fuse is lower, you must reduce the maximum current consumption of the device. The heating output will be reduced accordingly. When setting the current consumption, consider whether other loads may be connected to a fuse together with your device.

Personnel: ■ Specialized personnel

1. In the [Basic settings] menu select the menu item → *Curr. Limit*.
   ▶ An entry window opens for a numerical value. The cursor flashes under the numerical value. The upper and lower entry range is displayed.
2. Change the value with the arrow keys.

   By pressing the [ESC] *key, you return to the* [Basic settings] *menu without making any changes.*

3. Press the [OK] to confirm the new value.
   ▶ The new value is active.

The reduction of the maximum current consumption of the device reduces the heating power and thus influences the control characteristics, where applicable.

Selecting the menu language

The menu languages English, German, French, Spanish, and Italian are available for the device display.

Fig. 49: Select language

1. In the [Basic settings] menu select the menu item → *Language*.
   - ▶ A list containing the languages opens.
2. Select your language using the arrow keys.
3. Press the Enter key to confirm your selection.
   - ▶ The new setting is valid with immediate effect.

Select temperature unit

In the [Temp. unit] menu you can select in which unit the temperature value is displayed. In general, this setting is valid for all windows in the display.

1. In the [Basic settings] menu select the menu item → *Temp. unit*.
   - ▶ A list of the options opens.
2. Select one of the following options:
   - With [°C] all temperatures are displayed in *°Celsius*.
   - With [°F] all temperatures are displayed in *°Fahrenheit*.
3. Press the Enter key to confirm your selection.
   - ▶ The new setting is valid with immediate effect.

6.12 Calibrating the temperature probe

A calibrated reference thermometer with the desired level of accuracy is necessary. Otherwise you should not change the calibration of your constant temperature equipment.

If, when checking the temperature in a steady state, you discover a constant temperature deviation of T_{int} or T_{ext} from the reference thermometer, this can be equaled out via the *Calibration* menu point.

With the menu point *Offset* (1-point comparison), the characteristic of the temperature switch is adjusted in parallel by the input value.

With the menu point *2-point calibration* (2-point comparison), the characteristic of the temperature switch is adjusted and the slope of the characteristic is changed.

It is possible to change the temperature values T_{int} and T_{ext} within a range of ±3 K respectively.

Offset

- For calibration, the reference thermometer must be installed in the inlet of the device according to the specifications on the calibration certificate.
- To measure the temperature, wait until the system is in a steady state.

1. Press the [Enter key] to open the menu.
2. Select the menu items → *Settings* → *Calibration* → *intern Pt1000* or → *extern Pt100* → *Offset*.
   - ▶ The entry window opens.
3. Enter the temperature value read from the reference thermometer into the entry window.
4. Press the [OK] to confirm the new value.
   - ▶ The new value has been accepted.

2-point calibration

- For calibration, the reference thermometer must be installed in the inlet of the device according to the specifications on the calibration certificate.
- The upper and lower temperature measurement points must be at least 40 K apart.
- To measure the temperature, wait until the system is in a steady state.

1. Set a low T_{set} setpoint on the device.
2. Wait until the setpoint and the temperature of the heat transfer liquid have equaled out.
3. Press the [Enter key] to open the menu.
4. Select the menu items → *Settings* → *Calibration* → *intern Pt1000* or → *extern Pt100* → *2-point lower* .
   - ▶ The entry window opens.
5. Enter the temperature value read from the reference thermometer into the entry window.
6. Press the [OK] to confirm the new value.
   - ▶ The lower value has been accepted.
7. Set a high T_{set} setpoint on the device.
8. Wait until the setpoint and the temperature of the heat transfer liquid have equaled out.
9. Select the menu item [2-point upper] in the *Calibration* menu.
   - ▶ The entry window opens.
10. Enter the temperature value read from the reference thermometer into the entry window.
11. Press the [OK] to confirm the new value.
    - ▶ The upper value has been accepted. 2-point calibration has been completed.

Restore factory calibration

Use this menu item to restore the calibration configured in the factory.

1. Press the [Enter key] to open the menu.
2. Select the menu items ➞ *Settings* ➞ *Calibration* ➞ *intern Pt1000* or ➞ *extern Pt100* ➞ *Factory calibration*.
3. Select the option [yes].
4. Press [OK] to confirm the selection.
   - ▶ This deletes the customer's calibration and restores the calibration as it was configured in the factory.

6.13 Restore the factory setting

Navigate to the factory setting menu

1. Press the Enter key to open the menu.
2. Select the menu items ➞ *Settings* ➞ *Factory setting*.

Reset all modules

With the menu [All modules], the software settings of all modules of the device are reset to factory settings.

Further down in the Factory Setting menu you can select and reset individual modules.

Reset control system

In the [Control system] menu, you can reset your specific settings to factory settings.

- Reset all
- Only control parameters
- Other parameters

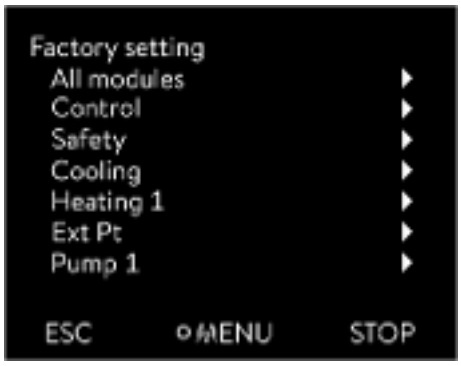


Fig. 50: Factory Setting menu

Reset in the [Reset all] menu:

- Control
  - Control variable
  - Control parameters
- Temperature limits
- Basic settings
  - Sounds
  - Display
  - Autostart: On
  - Current consumption
  - Language
- Calibration
- Graphic display
- Home window
- Operating mode (operation)

Personnel: ■ Operating personnel

1. Select the [Reset all] menu item.
2. Select one of the following options:
   - ■ By pressing the [no] key, you return to the higher-level menu without making any changes.
   - ■ By pressing the [yes] key, the device is reset to factory settings when you confirm this action with the Enter key.
   - ▶ The complete device is reset to factory settings.

Select and reset individual control parameters

With the menu [Only control parameters] or [Other parameters], only the selected parameters are reset to factory settings.

Personnel: ■ Operating personnel

1. Select the [Other parameters] menu item.
2. Select one of the following options:
   - ■ By pressing the [no] key, you return to the higher-level menu without making any changes.
   - ■ By pressing the [yes] key, the device is reset to factory settings when you confirm this action with the Enter key.
   - ▶ The parameters are reset to factory settings.

6.14 Viewing the device status

In the Device status menu and its submenus, you can display lots of information and data about the device. No settings are possible in the whole Device status menu.

1. Press the Enter key to open the menu.
2. Select the menu items → *Settings* → *Device status*.
   - ▶ A submenu opens.
3. These menu items are available:
   - ■ Errorstore
   - ■ Device data,
   - ■ Operating information,
   - ■ Heatlimiter
   - ■ Software version,
   - ■ Hardware version,
   - ■ Device type and
   - ■ Serial numbers are displayed.

Display errorstore

The device has an error store for storing up to 140 warning, error and alarm messages that can be used to analyze errors.

1. Select the → *Errorstore* menu item in the Device status menu.
2. You can navigate through the list using the up and down arrow keys. The most recent message is in the top line.

   The following information is displayed for each message:

   - *No.* refers to consecutive numbers listed chronologically after the error occurs.
   - The relevant module that triggered the message is displayed under *Source* .
   - *Code* is the encoded description of the alarm, warning or error.
   - *Type* specifies whether it is an alarm, warning or error.
   - *Date* and *Time* display the time of the message.

The message marked above is explained in more detail at the bottom of the display.

Display device data

LAUDA Service uses this list for diagnostic purposes.

The device data is required for on-site service visits and telephone support.

1. Select the → *Device data* menu item in the Device status menu.
   ▶ Various current values of the device are displayed (e.g. temperatures).

Display operating information

The menu item Operating information shows how long or how often components of the device have been in use.

The service life of the components listed below is displayed in hours unless otherwise stated.

- Heat transfer liquid (fluid)
- Heating
- Pump (only appears for Integral XT)
- Pump 2 (only appears for Integral 1850 XTW)
- Compressor
- Compressor 2 (only appears for devices with cooling cascade)
- Compressor duty cycle
  - The number of switching cycles (ON - OFF) is indicated.
- Compressor 2 duty cycle (only appears for devices with cooling cascade)
  - The number of switching cycles (ON - OFF) is indicated.
- EEV 0 steps
  - EEV are the electronic injection valves with the numbers 0 to 6, the opening of the valve is indicated in number of steps.

Heatlimiter

The submenu displays all current limits of the device. These limits have been set by the user in other menus or have been activated by the device software based on the device configuration.

- Pump
- Current consumption
- Dynamic heat limit

- Up.limit (Tih)
- Degas mode
- Fill mode
- Cont.outp.limit
- T_triac

Display software and hardware versions

The relevant versions of the installed software and hardware are required for on-site service visits and telephone support.

1. In the Device status menu select the menu item → *SW version* or → *Hardware version*.
   - ▶ The software versions installed on the device are displayed. If available, the software versions of any connected interface modules are also displayed. The hardware version is not displayed for all modules. In the case of older modules, no hardware version can be recorded by software and displayed. In such cases "---" is displayed.

Display device type

The device type is displayed in the Device type menu item.

Display serial numbers

The serial numbers are required for on-site service visits and telephone support.

1. Select the → *Serial numbers* menu item in the Device status menu.
   - ▶ The serial numbers of the device components are displayed.

6.15 Flow monitoring of the internal heater

This section is relevant for:

- Integral XT devices

The bypass valve is used to ensure that there is sufficient flow through the heater in the device to prevent damage to the heat transfer liquid.

1. If the flow rate in the device is too low, a sound is heard for three seconds.
   - ▶ The heating switches off on all poles, the pump and the cooling unit are switched off.
2. In the display the message appears that the flow is too low.
3. Eliminate the cause.

   If the reason for the low flow rate is the high flow resistance caused by the application, turn the adjusting wheel of the bypass valve counterclockwise. Turn the adjusting wheel so far until the required flow is reached.
4. Press the Enter key.

   Press the Enter key even if the device was switched off in the fault state. Warnings disappear automatically when the cause is eliminated.

6.16 Programmer

6.16.1 Basic information

The programmer allows you to perform and save a temperature-time program. A program consists of several temperature-time segments A segment contains information on the final temperature of the segment, the duration, the temperature tolerance, the pump level and the switch position (off/on) of the contact module. Ramps, temperature jumps and temperature maintenance phases are possible.

Fig. 51: Programmer

- Ramp
  A ramp is defined by the specified duration between the start and the end of the segment, and by the destination temperature, i.e. the temperature at the end of the segment.
- Temperature jump
  If a time is not specified (time is equal to 0), the end temperature is reached as quickly as possible.
- Temperature maintenance phase
  No temperature change (i.e. the temperatures at the start and the end of a segment remain identical).
- Pump level off or 0
  - Integral T: Pump level [off] can be selected within a segment. As a result, the program ends when this segment is reached, even though other segments follow in the program. The status of the thermostat is set to “Standby”. When the program is started, it is indicated that the program ends at this segment.
  - Integral XT: Pump level [---] (means pump is off) can be selected within a segment. As a result, the program ends when this segment is reached, even though other segments follow in the program. The status of the thermostat is set to “Standby”. When the program is started, a message appears indicating that the program will end at this segment with pump level 0.
- Program optimization
  Activating program optimization yields a very good control action in practice. With programs including both ramps and other types of segments, the actual temperature profile matches the target temperature profile more closely than programs without optimization. It reduces overshoots. There can only be large undershoots at the ramp ends if the control parameters are very unfavorable. Deactivate optimization in this case.
  Too tight *tolerances* impair the control result. Work without tolerances where possible.
- Standby
  If the device switches to standby while a program is running, the active program is automatically paused.

1. Press the Enter key to open the menu.
2. Select the menu item → *Programmer* → *Program X*.
   ▶ The submenu opens in the selected program.

Fig. 52: Program 1

3. The following options are available:
   - [Status]
     - Select the option [Start] to start the program.
     - Once the program has started, you can press [Hold] to pause it.
     - A paused program can be continued by pressing [Continue].
     - Select the option [Stop] to end the program.
   - [Edit]
   - [Cycles]
     - Here you enter the number of repetitions of the selected program.
4. Select the → *Edit* menu item.
   ▶ The program appears on the display and you can now edit it.

You can stop the programmer by pressing the [STOP] softkey. After pressing the [START]softkey, the programmer continues to run in the previously selected mode (pause or active mode).

100 temperature-time programs can be saved. A maximum of 250 freely programmable segments can be used per program.

The programmer encoder can be controlled or modified using the timer.

Available settings

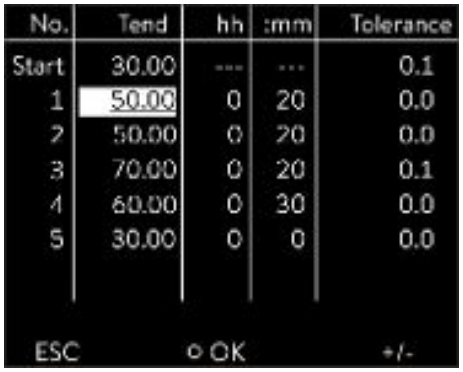


Fig. 53: In program editor

Setting	Description
No.	Program segment number
Tend	End temperature that should be reached
hh	Time in hours (hh) by which the specified temperature should be reached
:mm	Time in minutes (: mm) in which the specified temperature should be reached
Tolerance	Tolerance defines how close the temperature should be to the set temperature before the next segment is processed. 0.0 means that there is no tolerance. This means that the program starts the next temperature after the preset time, even if the output temperature has not yet been reached.

Setting	Description
Pump	In Integral T the pump is switched on or off. No pump levels can be set. In the Integral XT the pump level can be entered with which the segment is to be processed.
S1, S2, S3	The switching state (off or on) of a contact module (if installed) can be entered here. Contact modules are available as an accessory.

Examples of the functions of a contact module

- Functions of the inputs
  - Set fault
  - Set standby
  - Control programmer
  - Control change mode (2 different set temperatures)
  - Regulate internal or external control
- Functions of the outputs
  - Signal various error states
  - Signal standby
  - Specify position with respect to a temperature window (inside or outside)
  - Specify programmer status
  - Signal refilling

Editing program examples

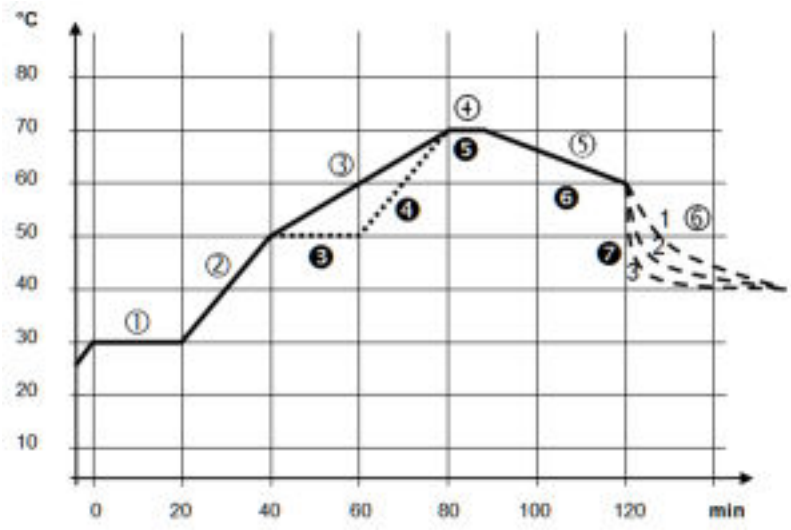


Fig. 54: Program example

The graph shows an example of a reprogrammed set temperature profile.

The cooling time in the graph varies depending on the device type, consumer and so on. In example segment number 2, 50 °C should be reached within 20 minutes.

The original values in the first table below (before) are represented by a solid line, while the values in the edited profile in the second table (after) are represented by a dashed line.

Start segment

Each program starts with the segment *Start* , which determines the temperature at which segment *1* continues the program. The temperature of the *Start* segment is reached as quickly as possible. It is not possible to specify a time limit for the *Start* segment. Without the *Start* segment, segment *1* would be different depending on the heat transfer liquid temperature at program start.

Table 16: Program example, before (——)

No.	Tend	hh	:mm	Tolerance	Pump	S1	S2	S3
Start	30.00	---	---	0.0	---	off	off	off
1	30.00	0	20	0.1	2	off	off	off
2	50.00	0	20	0.0	3	off	off	off
3	70.00	0	40	0.0	4	off	off	off
4	70.00	0	10	0.1	2	off	off	off
5	60.00	0	30	0.0	2	off	off	off
6	40.00	0	0	0.0	2	off	off	off

In the edited table, a new segment with the number 3 has been entered. The time and the pump level for segment 4 have also been modified. The tolerance and pump level for segment number 5 have been adapted.

Table 17: Program example, after (- - - - dashed line, edited)

No.	Tend	hh	:mm	Tolerance	Pump	S1	S2	S3
Start	30.00	---	---	0.0	---	off	off	off
1	30.00	0	20	0.1	2	off	off	off
2	50.00	0	20	0.0	2	off	off	off
3	50.00	0	20	0.1	3	off	off	off
4	70.00	**0**	**20**	0.0	**4**	off	off	off
5	70.00	0	10	**0.8**	**2**	off	off	off
6	60.00	0	30	0.0	2	off	off	off
7	30.00	0	0	0.0	2	off	off	off

In the Integral T in the **Pump***column* [off] *or* [on] *can be entered.*

Tolerance

Note the following and see Fig. 55:

- The Tolerance field ensures strict compliance with the residence time at a specific temperature, for example.
- The subsequent segment is only processed when the outflow temperature reaches the tolerance range (1) so the ramp in the second segment is delayed and only starts at 2, for example.

- Selecting a tolerance range that is too small can cause undesired delays. In extreme cases, it may not be possible to continue the program. The selected tolerance range should not be too small, **especially if the control is external**. A greater tolerance has been entered for segment 5 to guarantee adherence to the required time of 10 minutes, even with transient responses (3).
- A tolerance range should only be programmed for flat (slow) ramps, if appropriate. Steep ramps that come close to the maximum possible heating-up or cooling rates of the device may be severely delayed (4) if the tolerance range is too small (in segment 2 here).

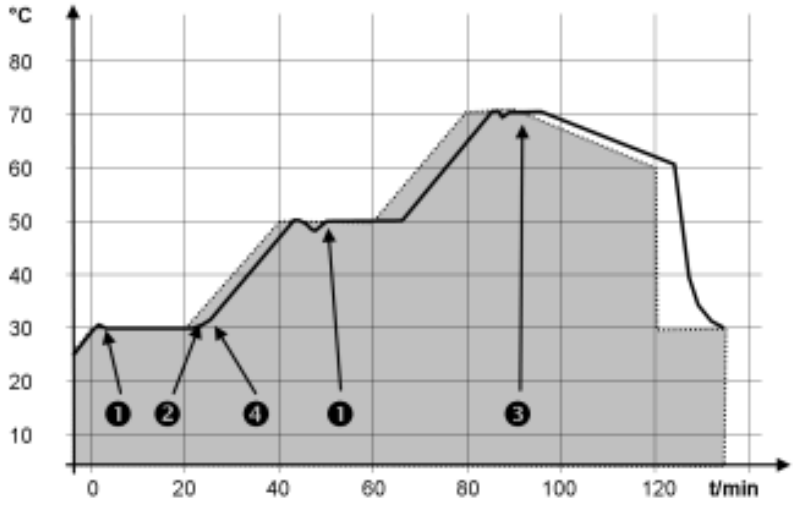


Fig. 55: Target/actual program process

The above graph of the edited process illustrates the possible delay of the actual temperature (solid line) in relation to the set temperature of the programmer (highlighted gray).

6.16.2 Set and process program

Please note:

- If a segment time > 999:59 h is included, this time must be distributed over several successive segments.

Start processing

No.	Tend	hh	:mm	Tolerance
Start	30.00	---	---	0.1
1	50.00	0	20	0.0
2	50.00	0	20	0.0
3	70.00	0	20	0.1
4	60.00	0	30	0.0
5	30.00	0	0	0.0

ESC ○ OK +/-

Fig. 56: Editing a program

1. Select the *Edit* menu item for the selected program.
   ▶ You can edit the program.

Editing a program

Please note:

- If in the *hh* and *:mm* field the value "0" is entered, the temperature T_{end} will be started as quickly as possible.
- Changes to the pump level are entered in the respective segment (= program line).
- The default value of the contact module is *off*.

You have the following options in the selected program:

- By pressing the right arrow key 5 times you can display the columns Pump, S1, S2 and S3 of the program.
- Use the left arrow key to display the columns Tend, hh, :mm and Tolerance again.
- With the [up] and [down] arrow keys, you can navigate to the segments (lines) of a program.
- With the [OK] you select a value for editing.
- Use the [right] and [left] arrow keys to select individual digits of the value.
- With the [up] and [down] arrow keys, you can increase or reduce the selected digit.
- With the [ESC] softkey, you can deselect a selected value again.
- With the [OK] key, you confirm your change.
- You exit the program with the [ESC] softkey. The entered values are saved.

Add new segment

1. Navigate to the segment under which the new segment should be added.
2. In this segment, navigate to the column with the *No.*
3. Press the [NEW] key.
   - ▶ A new segment is created.

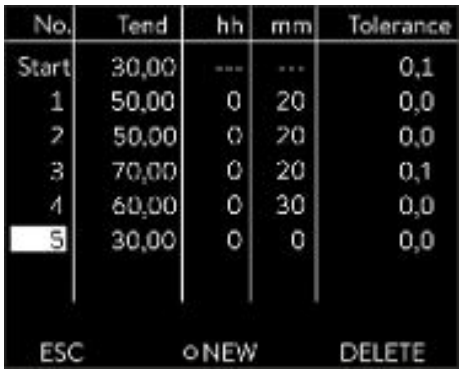


Fig. 57: Select program segment

Delete segment

1. Navigate to the segment that you want to delete.
2. In this segment, navigate to the column with the *No.*
3. Press the *DELETE* softkey.
   - ▶ The segment is deleted.

Editing a program currently running

Please note:

- No segments can be added or deleted in a currently running program.
- In the running program, changes of the existing temperature values and segment durations are possible. The segment is continued as if the change had been effective since the beginning of the segment.
- If the new segment time is shorter than the elapsed segment time, the program jumps to the next segment.

1. Select the *Edit* menu item for the running program.
   - ▶ You can edit the segments.

6.17 Set time, date, format and time zone

Set time format

The set time zone is used to convert between UTC (Universal Time Coordinated) and local time. The internal real-time clock runs in the Integral device according to UTC. The conversion then leads to the automatic changeover from standard time to daylight saving time and vice versa, since this is country-dependent. The leap years are independent of this setting as they are already included in the UTC. These entries with fixed dates for the coming decades are also included for countries that base their time zone offset on religious specifications.

UTC is also needed to obtain the time from the network because the time and date of NTP time servers are always supplied in UTC only. However, for this to work at all, the LAUDA device must be assigned an NTP time server via DHCP.

If DHCP is switched off and the IP address is permanently configured, automatic time tracking is not possible. (→ *Basic setting* → *Ethernet* → *LAN settings* → *DHCP client*)

Only change the time/date if you have previously set the time zone. Otherwise, the local time may change due to the changed time zone offset when the time zone is changed.

Set time format

Personnel: ■ Operating personnel

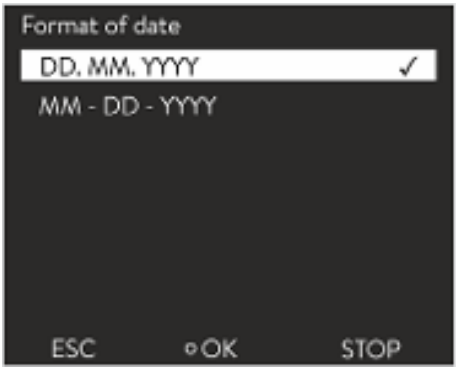


Fig. 58: Selecting options

You can display the date in two formats.

- Setting [DD.MM.YYYY] means days, month and year are displayed in this order (European).
- Setting [MM - DD - YYY] means month, day and year are displayed in this order (US English).

1. Press the Enter key to open the menu.
2. Select the menu items → *Clock* → *Date format*.
   - ▶ A list containing the settings opens.
3. The following options are available in the window:
   - Format [DD.MM.YYY]
   - Format [MM - DD - YYYY]
   - ▶ The new setting is valid with immediate effect.

Set time and date

Personnel: ■ Operating personnel

You can set the time and date.

1. Press the Enter key to open the menu.
2. Select the menu items → *Clock* → *Set time/date*.
   ▶ The entry window opens.
3. Set the correct time and date.
   Navigate with the four arrow keys.
   - ■ You scroll to the corresponding point with the right and left arrow keys.
   - ■ You change the numerical value with the up and down arrow keys.
4. Press the Enter key to confirm your selection.
   ▶ The new setting is valid with immediate effect.

Set time zone

Personnel: ■ Operating personnel

With the set time zone, the automatic changeover from daylight saving to standard time, correction of the date in a leap year, and so on takes place.

1. Press the Enter key to open the menu.
2. Select the menu items → *Clock* → *Time zone*.
   ▶ The entry window opens.
3. Select your corresponding time zone.
4. Press the Enter key to confirm your selection.
   ▶ The new setting is valid with immediate effect.

The device obtains the time and date from the network if it is operated in the network (Ethernet) with a time server. This means that the user only needs to set the time zone.

6.18 Operator and Viewer

Definition

Master - Operating unit on the LAUDA device

Command - Command Touch operating unit (optional accessory)

Operator - has read privileges and write privileges

Viewer - has read privileges only

The following operating units and interfaces are viewed:

- ■ Master
- ■ Command (optional accessory)
- ■ Web server

- Control station/PC
  - connected to the constant temperature equipment via Ethernet interface, RS 232/485 interface (optional accessory), Profibus interface (optional accessory) or EtherCAT interface (optional accessory)
- Analog interface (optional accessory)
- Contact interface (optional accessory)

Allowing access to the device via the network

If you wish to access the device from the outside, this must be set in the device software beforehand.

Allowing access to the device

1. Press the [Enter key] to open the menu.
2. Select the menu items → *Setup* → *Basic setup* → *Ethernet* → *PC control* or → *Web server*.
   - ▶ The options [Off] and [On] appear on the display.
3. Select the [On] option and press the Enter key to confirm.
   - ▶ A check mark is set. The entry has been accepted.

Range of functions of the operating units

- The full range of functions is available via the Master without restriction.
- Operation via the Command is reduced by the following functions:
  - Entry of TMax
  - Selection of the heat transfer liquid
- Operation via the Web server is reduced by the following functions:
  - Entry of TMax
  - Selection of the heat transfer liquid
  - Safety functions which require user presence at the device (e.g. menus for filling and draining)
- The control station is limited by the functionality of the interface and its protocol (command set).
- The analog interface and contact interface are restricted by their functionality and protocol.

Operator and Viewer

Applies equally to Master, Command, Web server and Control station via Ethernet.

- Operator, maximum one time
  - The operator has all setting options available, both reading and writing, if included in the range of functions of the operating unit.
- Viewer, multiple times possible, only read privileges
  - All menus are accessible to the viewer, but no settings which change the function of the device can be made. Exceptions are entries which are necessary to log in as Operator.

The Master has Operator privileges in the set delivery condition.

If a user logs in via Web server or connects the Command operating unit, the Web server or Command has Viewer privileges.

An Operator is logged in and another operating unit requests Operator privileges (↳ “Requesting Operator privileges” on page 105). The first Operator becomes a Viewer after this Operator requests Operator privileges.

If an Operator is downgraded to Viewer, a pop-up window appears with a corresponding message.

The Master automatically becomes an Operator if a separable control element with Operator privileges is removed. Exception: A Command Touch with restricted user privileges. In this case, an error is first generated by the constant temperature equipment. The Master becomes the Operator again after it has been restarted (without Command).

Control station via Ethernet

The control station must be activated by means of the command [OUT_SP_08_XX]. The control station is monitored by the device. If connection to the control station is interrupted, the constant temperature equipment reacts according to the configuration ↳ Chapter 6.20 “Safe Mode safety state” on page 107. Neither the Master, the Command nor the Web server can obtain operator privileges. The Master can obtain Operator privileges in the event of a timeout.

If the control station is not activated by the user, only read access via the interfaces is possible.

Cold start

The Master returns to the previous login level after the device has been switched off and on again. The same applies to the Command control element and the Web server.

An exception to this is the situation where the operating unit which last requested the Operator level is not connected. In this case, the Operator privileges automatically return to the Master when the device is switched on.

Status display

If an operating unit has Viewer privileges, a lock symbol is displayed instead of the right-hand softkey or the Start/Stop button:

- The right-hand softkey with the Start/Stop assignment is replaced by the assignment with the lock symbol in the Master.
- The Start/Stop button is replaced by the lock symbol in the Command.
- The Start/Stop button is replaced by the lock symbol in the Web server.
- When operation is carried out using a control station, it is the responsibility of the user (customer) to display the status.

Requesting Operator privileges

Fig. 59: Operation on the device is locked

Operator privileges are requested by selecting the lock symbol:

- Press the right-hand soft key in the Master. A pop-up window appears with the query Yes/No.
- Press and hold down the button longer (> 0.5 s) in the Command and in the Web Server on a smartphone or tablet. A pop-up window appears with the query Yes/No.
- Click the button in the Web server for desktop. A pop-up window appears with the query Yes/No.

Restricted user privileges in the Command Touch

If user privileges have been assigned/restricted via the Command operating unit (user configuration), the Master or the Web server becomes the Viewer. Neither Master, Web server nor Control station can obtain Operator privileges. A pop-up window with a negative message appears if an attempt to obtain operator privileges is made.

If a Command with restricted user privileges is disconnected from the constant temperature equipment, an error message is generated and the constant temperature equipment stops. The user must switch the device off and on again. The Master automatically becomes the Operator.

6.19 Web server

The embedded Web server

The LAUDA device is equipped with an integrated Web server. The Web server is used to visualize device-internal and process-relevant data such as temperature, pressure and flow rate. The scope of the information displayed depends on the device, device type and installed accessories.

You can use the following methods to access the Web server:

LAUDA App - Available in the App Stores for mobile devices based on iOS and Android and in the Windows Store for Windows-based PC systems.

Web browser - Connection to the LAUDA device via a browser.

Requirements

- The LAUDA device and the PC/control station must be connected to the same network. The network settings can either be set automatically (*DHCP on*) or manually (*DHCP off*) on the device ↳ Chapter 4.7.3 “Configuring the Ethernet interface” on page 38.

Connection to the device via the LAUDA App

LAUDA recommends using the LAUDA App. If you use this App, state-of-the-art security mechanisms which offer a very high level of security against digital threats are automatically put in place. In addition to this, the App has an integrated search service for LAUDA devices in the local network, so that manual entry of a host name or IP address is no longer necessary.

Security with the web browser

The device can be accessed with a web browser if users cannot use the LAUDA App for technical reasons or IT guidelines prohibit this.

The following must be ensured, in order to achieve a high level of security even when using a web browser:

1. Download the LAUDA CA certificates (Root CA, Device CA) from the website http://www.laudatv.de/Software/LAUDA_CA_Certificates.zip before connecting for the first time.
2. Install the certificates on all end devices which will be used later to access the LAUDA device.
3. Answer the question about whether you trust the LAUDA certificates with [Yes].
4. Compare the Common Name of the device certificate with the Controller ID of your LAUDA device during the initial connection setup.

   The number can be displayed in the device menu → *Device Status* → *Controller ID*.

   ▶ The 24-character identification number is displayed. This can consist of the numbers 0-9 and the letters A-F.
5. Confirm the connection.

Fig. 60: Controller ID

Operating the device with the Web server

You are using the LAUDA App. This automatically searches for existing devices in the network. The devices found are displayed in a list. Select the required device. Connection to the device is established. If a connection to a device was established before closing the App, connection to this device is established when the App is started again.

Fig. 61: Web server in the browser window

You need the IP address or the serial number of the device when you use the web browser. Enter the IP address or the serial number in the address line of the browser. Connection to the device is established.

Viewing the IP address

Select the menu items → *Setup* → *Basic setup* → *Ethernet* → *LAN configuration* → *Local IP address*.

Viewing the serial number

Select the menu items → *Device Status* → *Serial numbers*.

Cookies

Cookies must be activated if you use a web browser. The device creates a cookie with a connection-specific token which is generated during the initial mutual authentication. This information is lost if the cookie is rejected or deleted. Authentication must then be repeated the next time a connection is established.

Contact your network administrator if you require further assistance in implementing secure access.

Two-Factor Authentication (2FA) for increased security

Two-Factor Authentication is an authentication using a combination of two different and independent paths. The user is checked by the remote station and the remote station is checked by the user.

In the case of LAUDA, a user with automatically generated access data is created in the constant temperature equipment during the 2FA. The access data is stored in the App in the form of a token and as a cookie in the web browser. The token is valid for 6 months. In addition to this, all registered users (tokens) can be deleted via the Master on the constant temperature equipment. The user must repeat the 2FA in these cases.

The 2FA must be performed:

- At the first connection.
- When the token is no longer valid.
- When the cookie is no longer valid.
- If the cookie has been deleted in the browser or has not been saved.

The user is automatically prompted by the App or the web browser if a 2FA is necessary. A 6-digit one-time password is shown on the display of the constant temperature equipment when performing the 2FA. This is valid for 5 minutes. Type the code displayed in the Web client and confirm your entry. The connection is continued if authentication is successful. If an error occurs, check whether your entry was correct.

Operating the device with the Web server

Operation of the devices via the Web server is identical to the operation via the Master (operating unit on the device), see the relevant descriptions in this operating manual.

6.20 Safe Mode safety state

Aim of the Safe Mode

The Safe Mode enables the user to determine a safe state for the device and application in advance. In the event of faults in the process (e.g. communication with a control station), this safe state can be changed quickly and easily.

What happens with **activated** Safe Mode?

- The set temperature T_{set} and control variable are set automatically.
- The cooling unit is *automatically* set to the settings.
- In the display a yellow flashing font is displayed with *Safe Mode*.
- Warning *103 Safe Mode active* is displayed.
- The device continues to run and can be operated without limitations.

Which events lead to the **activation** of Safe Mode?

- communication with the control station being interrupted
- manually by the user
- via a command over an interface module ↳ Table 20 “Interface module and interface commands” on page 111
- by alarms ↳ Table 21 “Alarms which activate Safe Mode” on page 111

What affects a Safe Mode alarm?

- Not all alarms trigger Safe Mode.
- Some alarms ignore the settings of the control variable in Safe Mode menu.

What indicates that Safe Mode is **activated**?

- In the display a yellow flashing font is displayed with *Safe Mode*.

What happens when Safe Mode **is activated** by an alarm?

- In the display, the *Alarm* window is displayed. Only when the alarm on the device has been unlocked is the *Safe Mode* window displayed and ended in the *Safe Mode* menu.

Safe Mode can only be activated if the function of the Safe Mode was previously ***switched on*** *in the menu.*

Activating Safe Mode by disconnecting from the control station

Monitoring of the control station by the constant temperature equipment is switched on in [Ethernet] device menu. The control station must send a command to the constant temperature equipment periodically. The user must define the time the system waits before reporting a communication fault. If the control station fails to send a command within the specified time, the interface (Ethernet or RS 232) sends a corresponding command to the constant temperature equipment. In this way, Safe Mode is activated and a warning generated.

If Safe Mode is switched off, in the event of an alarm the device stops. The interruption to the control station only triggers a warning.

Switching off the activated Safe Mode

If Safe Mode is activated, the operator can switch off Safe Mode in the associated menu.

If an alarm has triggered Safe Mode, the alarm on the constant temperature equipment must be reset first. Only then can Safe Mode be switched off and then back on.

Switching off Safe Mode via an interface command is not possible.

Safe Mode menu

1. Press the [Enter key] to open the menu.
2. Select the → *Safe Mode* menu item and confirm the entry.
   ▶ The Safe Mode submenu opens.

Table 18: Settings in the *Safe Mode* menu

Menu items in the Safe Mode menu	Description
Switch on of Safe Mode Function ■ off ■ on	Here you can switch the function Safe Mode on or off (default value). Select one of the following options: ■ *off* : Safe Mode is switched off. ■ *on* : Safe Mode is switched on. ■ Only when the Safe Mode function is **switched on** do the following menu items appear: ● Start ● Configuration
Activation of Safe Mode Start ■ off ■ on	Manual activation of the Safe Mode function: ■ Option *off* : Safe Mode is not activated. ■ Option *on* : Safe Mode is activated.

Menu items in the Safe Mode menu	Description
Switching off of Safe Mode Stop ■ With operating parameter ■ With safety parameter	■ Stop only appears when Safe Mode has been activated with *Start On*. ■ Switch off of Safe Mode is only possible when there are no pending alarms. Select one of the following options: ■ *With operating parameter* ● Safe Mode is switched off. The device continues working with the parameters (Tset, Contr. Variable, Cooling Unit) before Safe Mode was switched on. ■ Option *With safety parameter* ● Safe Mode is switched off. The device continues working with the parameters (Tset, Contr. Variable, cooling unit), which were entered in the Configuration menu of Safe Mode.
Configuration	In this submenu you set the parameters with which the device will continue to work when the Safe Mode is activated ↳ Table 19 “Settings in the *Configuration* menu” on page 110.

Table 19: Settings in the *Configuration* menu

Menu items in the Configuration menu	Description of the options, actions with Safe Mode activated
Change setpoint	Select one of the following options: ■ *Change setpoint*: When the safe Mode is activated, the device adjusts to the new setpoint previously set in the *Setpoint* menu. This value is stored in the Safe Mode parameters. ■ *unchanged*: If the Safe Mode is activated, the device retains the setpoint with which it previously worked.
Setpoint	Here you enter the setpoint T_{set} with which the device continues to work after activated Safe Mode. This value is stored in the Safe Mode parameters.
Control	Select one of the following options: ■ Option *Unchanged*: If the Safe Mode is activated, the device retains the contr. variable with which it previously worked. ■ Option *Internal Pt1000*: With Safe Mode activated, the device switches to the internal Pt1000 control variable.

Table 20: Interface module and interface commands

Interface	Interface command	Description
Ethernet module	OUT_MODE_05_1	Interface command activates Safe Mode
RS 232/485 interface module	OUT_MODE_05_1	Interface command activates Safe Mode

Table 21: Alarms which activate Safe Mode

Alarm	Description	Description of action
Alarm 9 External actual value Pt is not available	Temperature value is not transmitted from external Pt probe.	The settings of the temperature setpoint are accepted from Safe Mode *Configuration* menu. Control variable is switched automatically to internal.
Alarm 10 External actual value Analog is not available	Temperature value is not transmitted from analog module.	
Alarm 11 External actual value Serial is not available	Temperature value is not transmitted from RS 232/485 interface module.	
Alarm 12 Current interface 1, interruption	Interruption to the analog module	The settings of the temperature setpoint and control variable are accepted from Safe Mode *Configuration* menu.
Alarm 13 Current interface 2, interruption	Interruption to the analog module	
Alarm 15 Fault at the digital input	Fault on the digital input/switching contact	
Alarm 16 Refilling has failed	Heat transfer liquid level is too low.	
Alarm 20 External actual value from Ethernet is not available	Temperature value is not transmitted from Ethernet module.	The settings of the temperature setpoint are accepted from Safe Mode *Configuration* menu. Control variable is switched automatically to internal.

6.21 Exporting data

Data can be exported from the LAUDA device to a USB stick.

The software creates the directory *LAUDA* on the USB stick with a subdirectory. The subdirectory is named after the serial number of the device, for example "S200000.014". All the exported files are stored in the subdirectory.

If new data is exported to the USB stick from the same device, new files are created with ascending numbering.

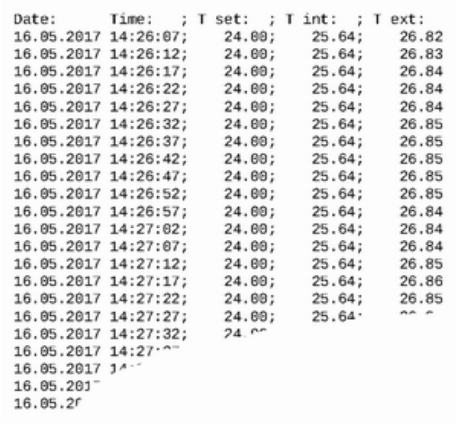
A different LAUDA device creates a subdirectory with its own serial number on the same USB stick in the directory *LAUDA*.

The LAUDA device only supports USB sticks which are formatted with the FAT32 file system. exFAT is not supported.

You can export the following files to the USB stick independently of each other:

- [Temperature data]
  The data record is located in the subdirectory *LOGS* and contains the file `LOG0.CSV` or several `.CSV files` with ascending numbering in the case of multiple exports.
  - All temperature-time values from the graphics memory of the device are exported.
- [Device data]
  This data record is located in the subdirectory *DEV_DATA* and contains the file `DEV0.CSV` or several `.CSV files` with ascending numbering in the case of multiple exports.
  For example, the following are stored in this file:
  - Device data
  - Serial numbers
  - Software version
  - Hardware version
  - Running time
  - Various temperature values
  - Control parameters
  - Network settings
  - Errorstore
- [Start temp. rec.]
  The record is stored in the subdirectory *LOGS*.
  - The temperature-time values given between pressing the [Start temp. recording] and [Stop Temp. recording] buttons are exported.
    You start the recording of the current temperature-time values in real time with this command. Recording will run until you stop it. If the memory space on the USB stick is full, recording continues and will overwrite the oldest stored values.

Personnel: ■ Operating personnel



```
Date:      Time:    ; T set:  ; T int:  ; T ext:
16.05.2017 14:26:07;    24.00;    25.64;    26.82
16.05.2017 14:26:12;    24.00;    25.64;    26.83
16.05.2017 14:26:17;    24.00;    25.64;    26.84
16.05.2017 14:26:22;    24.00;    25.64;    26.84
16.05.2017 14:26:27;    24.00;    25.64;    26.84
16.05.2017 14:26:32;    24.00;    25.64;    26.85
16.05.2017 14:26:37;    24.00;    25.64;    26.85
16.05.2017 14:26:42;    24.00;    25.64;    26.85
16.05.2017 14:26:47;    24.00;    25.64;    26.85
16.05.2017 14:26:52;    24.00;    25.64;    26.85
16.05.2017 14:26:57;    24.00;    25.64;    26.84
16.05.2017 14:27:02;    24.00;    25.64;    26.84
16.05.2017 14:27:07;    24.00;    25.64;    26.84
16.05.2017 14:27:12;    24.00;    25.64;    26.85
16.05.2017 14:27:17;    24.00;    25.64;    26.86
16.05.2017 14:27:22;    24.00;    25.64;    26.85
16.05.2017 14:27:27;    24.00;    25.64
16.05.2017 14:27:32;    24.00
16.05.2017 14:27
16.05.2017
16.05.201
16.05.2
```

Fig. 62: Example of a LOG file

1. Insert the USB stick in the USB host on the operating unit of the machine.
2. Press the Enter key to open the menu.
3. Select the menu item → *Data export* in the main menu.
   ▶ The submenu opens.
4. Select one of the following options:
   - [Temperature data]
   - [Device data]
   - [Start temp. rec.]
   - [Stop temp.rec.]
     You stop the temperature recording with the last command. This command only appears after the recording has been started.

5. Start the export by pressing the Enter key [OK].

   Messages appear on the display during the export:

   - Data export to USB stick started.
   - Data export to USB stick has been successfully completed. Confirm the message by pressing the Enter key [OK] once the data export has been completed.

If the data export was not successful, the message "Data export to USB stick failed" appears on the display. Press [OK] to confirm.

Check that the USB stick was inserted correctly and that there is enough free memory space (at least 1 MB).

Start the data export again.

7 Maintenance

7.1 Warning notes for maintenance

DANGER!
Contact with live or moving parts

Electric shock, impacts, cutting, crushing

- The device must be disconnected from the mains power supply before any kind of maintenance is performed.
- Only skilled personnel are permitted to perform repairs.

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

Scalding, hot or cold burns

- Allow device parts, accessories and heat transfer liquid to reach room temperature before touching.

Protective equipment:
- Safety glasses
- Protective gloves
- Protective work clothing

7.2 Maintenance intervals

The maintenance intervals described in the following table must be observed. The following compulsory maintenance tasks must be performed before operating the device for prolonged periods.

Interval	Maintenance work
Weekly	Check that the drain taps are closed and sealed. The sealing caps must be present on the drain taps and tightened.
Monthly	Inspect the external condition of the device.
	Check the external hoses for material fatigue.
	Clean the air-cooled condenser.
	Clean the filter strainer.
	Check the function of the overtemperature protection.
	Check the function of the low-level protection.
Quarterly	Descale the cooling water circuit. (a shorter interval must be selected, depending on the water hardness and operating period)
Six monthly	Check the heat transfer liquid for usability.

7.3 Cleaning the device

WARNING!
Risk of cleaning agent entering the device

Electric shock

- Only use a slightly damp cloth to clean the device.

Please also note the following:

- Only use water and detergent to clean the operating unit. Do not use acetone or solvent as these substances will permanently damage the plastic surfaces.
- Ensure that the device is decontaminated after coming into contact with hazardous materials.
- It is forbidden to use decontaminants or cleaning agents that may react with parts of the device or materials contained in those parts and potentially pose a **hazard**.
- We recommend using ethanol as a decontaminant. If you are unsure whether decontaminants or cleaning agents are compatible with parts of the device or the materials contained in those parts, please contact LAUDA Service Temperature control devices.

7.4 Draining heat transfer liquid

Drain device

Do not drain the heat transfer liquid in a hot state above 90°C or in a cold state below 0°C!

Protective equipment:
- Safety glasses
- Protective gloves
- Protective work clothing

The drain taps and drain nozzles are located on the right hand side of all devices.

1. Allow the device and heat transfer liquid to cool or warm up to room temperature.
2. Switch off the device and pull out the mains plug,
3. Screw a hose onto the drain nozzle (3/8" a). On the Integral XT there are two drain nozzles.
4. Place the hose in a suitable container to collect the heat transfer liquid.

It may be necessary to drain the device several times if the filling volume is high.

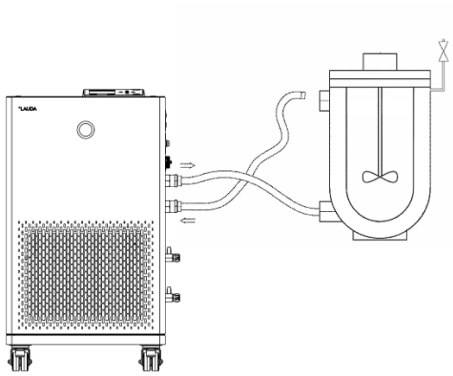


Fig. 63

5. Open the drain tap or taps. To do this, turn the tap counterclockwise.
6. Allow the device to run empty.
7. After the device has run empty, remove the hoses from the external consumers. Drain the heat transfer liquid in the hoses into a suitable container.

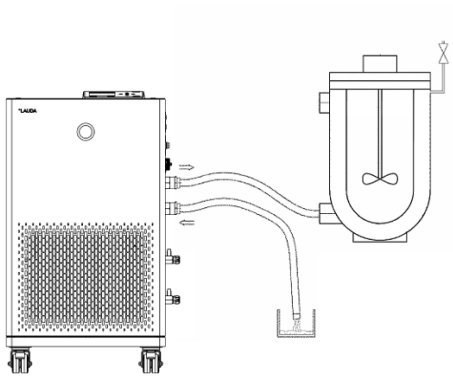


Fig. 64

8. After draining close the drain tap or taps.

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

7.5 Cleaning the air-cooled condenser

This section is relevant for:

- Air-cooled devices

WARNING!
Risk of mechanical damage to refrigerant circuit

Explosion, fire

- Do not use pointed objects to clean the condenser.

Protective equipment:
- Safety glasses
- Protective gloves
- Protective work clothing

With increasing operating time, the condenser becomes clogged with dust from the environment. This leads to a performance loss of cooling output.

1. Switch off the device.
2. Pull out the mains plug.
3. Remove the screws with which the front panel is screwed to the columns on both sides of the device.

4. Remove the front panel by holding it with both hands, right and left, and pulling the front panel towards you. Remove the front panel slowly and carefully to avoid damage.
5. Pull the earthing cable from the grounding terminal.
6. Sweep the condenser with a hand brush or use a vacuum cleaner with brush attachment to clean the fins.
7. Take the front panel and push the ground cable onto the grounding terminal.
8. Replace the front panel again with care.
9. Fasten the front panel to both columns. Screw the screws on the right and left columns back in.
10. You can switch the device back on.

Alternatively you can vacuum the dust with a vacuum cleaner through the ventilation openings on the front side.

7.6 Cleaning cooling water circuit

This section is relevant for:

- Water-cooled devices

Cleaning filter strainer

The cooling water circuit and filter strainer must be cleaned regularly to maintain full cooling output.

Protective equipment:
- Safety glasses
- Protective gloves
- Protective work clothing

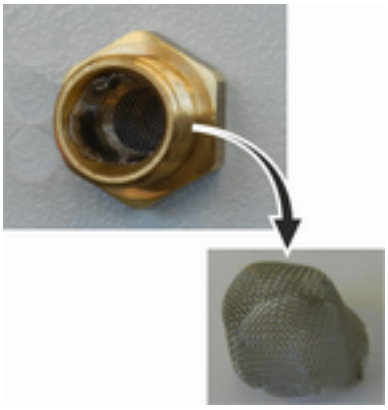


Fig. 65: Remove filter strainer

1. Switch machine off.
2. Shut down cooling water supply.
3. Unscrew the hose for the cooling water inlet from the device.
4. Remove the filter strainer from the water inlet. If necessary, use pointed pliers or large tweezers.
5. Clean the filter strainer.
6. Replace cleaned filter strainer and reconnect the hose.

Descale cooling water circuit

Required equipment for descaling with a pump (drum pump):

- a container with approx 20 liter volume
- a pump

- Hoses between container and pump and between pump and cooling water circuit
- Hose between cooling water circuit and container

Required equipment for descaling with a funnel:

- Two containers with 10 to 20 liter volume
- A funnel
- Hose between funnel and cooling water circuit Place the funnel as high as possible, so that the device fills with descaler quickly.
- Hose between cooling water circuit and container

Protective equipment:
- Safety glasses
- Protective gloves
- Protective work clothing

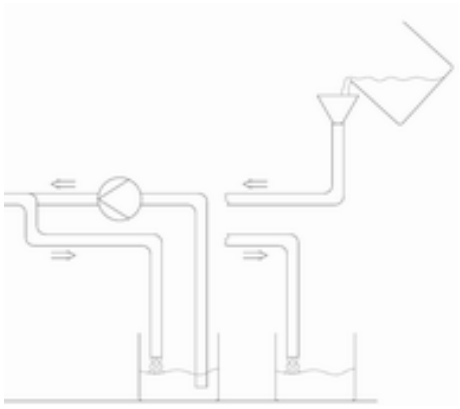


Fig. 66: Descaling

1. Switch the device into standby.
2. Press the Enter key to open the menu.
3. On the operating unit select the menu items → *Pump* → *water valve* → *open*.
   - ▶ The water valve opens.
4. Fill the device with descaler-water mixture via the hose on the cooling water inlet.
5. Recirculate the descaler/water mixture or refill continuously.
6. Leave the descaler-water mixture to work (see table below).
7. Flush the device thoroughly with clean water (see table below).
8. Drain cooling water circuit Blow compressed air through the cooling water circuit.
9. On the operating unit select the menu items → *Pump* → *water valve* → *auto*. That is also the default setting.

Reaction time:	Continue pumping or refilling until the foaming reaction (usually at the beginning) has subsided. This usually takes 15 to 30 minutes.
Descaler:	Only permitted: LAUDA descaler article number LZB 126 (pack of 5 kg). To handle the chemical, the safety instructions and the instructions for use on the package must be observed!
Flushing:	Let at least 30 liters of clean water run through the device.

7.7 Checking the overtemperature protection

The device must switch off if the temperature of the heat transfer liquid exceeds the overtemperature switch-off points T_{max} and/or $T_{maxTank}$. The electronics system switches off the device components.

Fig. 67: Display Tmax

Fig. 68: Enter Tmax

1. Press and hold down the T_{max} key Chapter 6.4 “Setting Tmax” on page 80.
   - ▶ The values T_{max} and $T_{maxTank}$ appear on the display.
2. With the arrow keys select the T_{max} value, while keeping the T_{max} key pressed down.
3. Press the Enter key.
   - ▶ The entry window appears. The cursor flashes under the T_{max} value.
4. Use the arrow keys to set a value that is a few °C above the set temperature Tset.

   If you release the T_{max} key the process is aborted.
5. Press the [OK] to confirm the new value.
6. Press [ANW] softkey to confirm the new value.
   - ▶ The new value is active.
7. Now set the set temperature T_{set} higher than the overtemperature switch-off point T_{max}. Press [OK] to confirm the set temperature.
   - ▶ The devices heats up. The device switches off when the overtemperature switch-off point is exceeded. A fault is displayed.
8. Using the T_{max} key, set the correct T_{max} value again.
   - ▶ In the display the set T_{max} value is displayed.
9. Delete the fault in the device menu.

7.8 Checking the low-level protection

An alarm signal sounds before the liquid level decreases so much that the heater is no longer covered completely with liquid. *Low level* appears on the display. The electronics system switches off the device components.

WARNING!
Contact with hot or cold heat transfer liquid

Scalding, cold burns

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

An alarm must sound as soon as the minimum level is reached.

Protective equipment:
- Safety glasses
- Protective gloves
- Protective work clothing

1. Switch on the device and the pump. Set the set temperature to room temperature.
2. Watch the level indication on the display.
3. Lower the liquid level in the device. For this purpose, allow the heat transfer liquid to flow out into a suitable container via the open drain nozzle.
   ▶ The display shows that the heat transfer liquid is sinking.

   If the fill level falls to level 2, a warning is issued on the display.

   If the liquid falls to level 0, the device switches off and the *Alarm* message appears on the display.
4. Close the drain tap.
5. Top up the heat transfer liquid.
   ▶ The liquid level in the display rises.
6. Delete the fault in the device menu.

7.9 Check the heat transfer liquid

Protective equipment:
- Safety glasses
- Protective gloves
- Protective work clothing

CAUTION!
Contact with hot/cold heat transfer liquid

Scalding, cold burns

- Bring the heat transfer liquid to room temperature for analysis.

Heat transfer liquid is subject to wear, such as cracking or aging (oxidation).

If necessary, the heat transfer liquid (e.g. if the operating mode is changed), but at least every six months, must be checked for usability. Continued use of the heat transfer liquid is only permitted following successful testing.

The heat transfer liquid must be tested as outlined in DIN 51529: Testing and assessment of used heat carrier media.

Source: VDI 3033; DIN 51529

8 Faults

8.1 Alarms, errors and warnings

All alarms, error messages and warnings triggered on the device appear in text form on the display.

Procedure in event of alarm

Alarms affect safety. The components of the device, such as the pump, switch off. The device emits an sound. Once the cause of the fault has been eliminated, the alarm can be canceled with the Enter key.

Refer to Chapter 8.2 “Alarms” on page 121 for a list of alarms.

Procedure in event of warning

Warnings do not have a significant effect on safety. The device continues to operate. The device will make a continuous noise for a short period of time. Warnings are issued periodically. Once the cause of the fault has been eliminated, the warning can be canceled with the Enter key.

Procedure in event of error

If an error occurs, the device emits a sound.

If this happens, switch off the device at the mains switch. If the error occurs again after switching on the device, make a note of the error code and the corresponding description and contact the LAUDA Constant Temperature Equipment Service department. You will find the contact information here Chapter 12.4 “Contact LAUDA” on page 131.

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

8.2 Alarms

Alarms are shown on all displays in use.

Table 22: Integral Alarms

Code	Message	Description	User action
1	Low-level pump	Pump detects low level	Refill the heat transfer liquid
2	Low level	Float detects low level	Refill the heat transfer liquid
3	Overtemperature	Overtemperature (T > Tmax)	Allow the device to cool down to T < TMax; adjust TMax if necessary
4	Pump blocked	Standstill of the pump	Switch off the device, check the viscosity
5	Verb. Command	The Command Touch remote control was withdrawn during operation.	Plug in the cable of the Command Touch remote control unit.
6	---	---	----

Code	Message	Description	User action
7	No water	No cooling water connected	Provide a supply of cooling water
8	---	---	---
9	T ext Pt100	No actual value from the Pt100 module	Check the temperature probe
10	T ext analog	No actual value from the analog interface	Check the temperature probe
11	T ext serial	No actual value from the serial interface	Check the serial connection
12	Analog input 1	Analog module: Current interface 1, interruption.	Check the connection
13	Analog input 2	Analog module: Current interface 2, interruption.	Check the connection
14	High level	Float detects high level	Drain the heat transfer liquid from the device; Caution: Risk of burns
15	Digital input	Interference signal at the input of the contact module	(customer application)
16	Refilling	Heat transfer liquid level is too low	Refill the heat transfer liquid
19	Gage pressure	Gage pressure in the outflow	Reduce/eliminate the hydraulic resistance in the hoses or/and in the consumer
20	T ext Ethernet	No actual value from the Ethernet interface	Check the serial connection
21	T ext USB	No actual value from the USB interface	Check the serial connection
22	Communication interrupted	Connection to the control station interrupted	Check the cable connection
23	T ext EtherCAT	No actual value from the EtherCAT interface	Check the serial connection
24	Overtemperature	Overtemperature in expansion vessel (T > TmaxTank)	Allow the device to cool down

Table 23: Flow Controller Alarms

Code	Message	Description	User action
55	Flow meter timeout	Error in the LiBus cable connection	■ Switch off the constant temperature equipment ■ Check the LiBus cable connection and restore if necessary ■ Switch on the constant temperature equipment

8.3 Troubleshooting

Before informing the LAUDA constant temperature equipment service department ↳ Chapter 12.4 “Contact LAUDA” on page 131, please check whether you can solve the problem with the following instructions

Table 24: Process thermostat

Fault	Cause ⇨ possible remedies
Device does not cool or is very slow.	■ Cooling unit (Smart Cool) is switched off ⇨ switch on the cooling unit. ■ Cont.outp.limit is active ⇨ switch off cont.outp.limit. ■ Condenser if contaminated ⇨ clean the condenser ↳ Chapter 7.5 “Cleaning the air-cooled condenser” on page 116. ■ Temperature limit Til is too high ⇨ reduce temperature limit Til.
Device does not heat or only heats very slightly.	■ Cont.outp.limit is active ⇨ switch off cont.outp.limit. ■ Temperature limit Tih is too low ⇨ increase the temperature limit. ■ Dynamic heating capacity limitation is active ⇨ switch off dynamic heating capacity limitation. ■ The maximum heat output is automatically reduced in the lower pump levels ⇨ raise the pump level
Pump level cannot be set.	■ Pump pressure control is active ⇨ switch off pump pressure control.
Degassing functions poorly.	■ Pump pressure control is active ⇨ switch off pump pressure control. ■ Pump level is too high ⇨ select a lower pump level ■ Heating output is too high ⇨ reduce the heating output. ■ Cooling unit is active ⇨ switch off cooling unit. ■ Heat transfer liquid is heavily contaminated ⇨ change the heat transfer liquid, drain the device completely, you may work with the cleaning procedure, if necessary. ■ The filling opening cover is closed ⇨ open the cover and put it loosely on the opening.
Cooling unit starts several times in quick succession	■ Normal function (special start), no remedy necessary
The cooling unit is in operation for a few minutes, although no cooling is necessary.	■ Normal function (protection function), no remedy necessary
Display: Low flow (cooling unit). (Flow in the evaporator area too low).	■ Check whether the hydraulic circuit is blocked (closed valves, jammed hose, dirt,...). ⇨ remedy the cause ■ Pump level is too low ⇨ select a higher pump level ■ Hose cross-section too small ⇨ increase the cross-section or install a bypass ■ Cooling output is too high for the available volume flow ⇨ reduce the cooling output

Fault	Cause ⇨ possible remedies
Display: Low flow (heater). (Flow in the heater area too low).	■ Check whether the hydraulic circuit is blocked (closed valves, jammed hose, dirt,...). ⇨ remedy the cause ■ Pump level is too low ⇨ select a higher pump level ■ The device is not sufficiently aerated or degassed ⇨ degas the device again. ■ Hose cross-section too small ⇨ increase the cross-section or install a bypass. ■ Heating output is too high for the available volume flow ⇨ reduce the heating output.
Display: Overtemperature protection.	■ Wait until the outflow temperature has cooled below the overtemperature turn-off point or set the switch-off point higher than the outflow temperature.
Display: Level very low (Impending low level in expansion vessel) Display: Low level. (Low level in expansion vessel)	■ Check hoses, connections and consumers for leaky points (leaks) ⇨ if necessary, eliminate the leakage and top up the missing heat transfer liquid. ■ Check the constant temperature equipment as to whether there is a leaky point (leak) ⇨ if necessary inform the LAUDA constant temperature equipment service department ↳ Chapter 12.4 “Contact LAUDA” on page 131 ■ The heat transfer liquid can drop due to cooling or degassing ⇨ if necessary refill the missing heat transfer liquid.
Display: Level too high (Impending high level in expansion vessel). Display: Level too high (High level in expansion vessel).	■ the heating increases the volume ■ the heat transfer liquid has absorbed moisture from the ambient air
Display: Pump blocked (Pump motor monitoring: overload, blockage).	■ The viscosity of the heat transfer liquid is too high ⇨ change to another heat transfer liquid or increase the set temperature ■ The pump is blocked ⇨ inform the LAUDA constant temperature equipment service department ↳ Chapter 12.4 “Contact LAUDA” on page 131
Display: Low level (pump) (Pump motor monitoring: idling).	■ No liquid in system. If this is the case, the level monitoring has failed. ⇨ Check whether the float in the expansion vessel is blocked by a foreign object. If not, inform LAUDA constant temperature equipment service department ↳ Chapter 12.4 “Contact LAUDA” on page 131.
Display: Gage pressure (Outflow pressure too high).	■ Pump level is too high ⇨ select a lower pump level ■ when pressure control is active, the set pressure is too high ⇨ reduce the set pressure. ■ The maximum pressure is too low ⇨ increase the maximum pressure.

9 Decommissioning

9.1 Information on decommissioning

WARNING!
Contact with hot or cold heat transfer liquid

Scalding, cold burns

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

NOTICE!
Risk of refrigerant escaping from cooling water circuit

Device damage

- Before decommissioning the device or if there is a risk of freezing, drain the cooling water circuit of the cooling unit using compressed air or an industrial vacuum cleaner (watertight). Blow compressed air through the circuit.

Protective equipment:
- Safety glasses
- Protective gloves
- Protective work clothing

To avoid damage during storage, all liquids must be drained completely from the device.

- Drain the cooling water from the device.
- Drain the heat transfer liquid from the device.
- Store the device, maintain the storage temperatures ↳ Chapter 13.1 “General data” on page 132.

9.2 Drain and clean the device

Drain device

Do not drain the heat transfer liquid in a hot state above 90°C or in a cold state below 0°C!

Protective equipment:
- Safety glasses
- Protective gloves
- Protective work clothing

The drain taps and drain nozzles are located on the right hand side of all devices.

1. Allow the device and heat transfer liquid to cool or warm up to room temperature.
2. Switch off the device and pull out the mains plug,

3. Screw a hose onto the drain nozzle (3/8" a). On the Integral XT there are two drain nozzles.
4. Place the hose in a suitable container to collect the heat transfer liquid.

> *It may be necessary to drain the device several times if the filling volume is high.*

5. Open the drain tap or taps. To do this, turn the tap counterclockwise.
6. Allow the device to run empty.
7. After the device has run empty, remove the hoses from the external consumers. Drain the heat transfer liquid in the hoses into a suitable container.

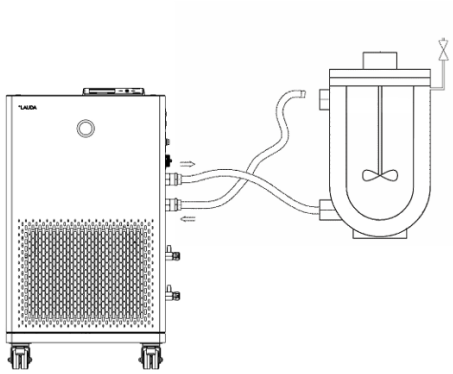


Fig. 69

8. After draining close the drain tap or taps.

> *Observe the regulations for the disposal of used heat transfer liquid.*

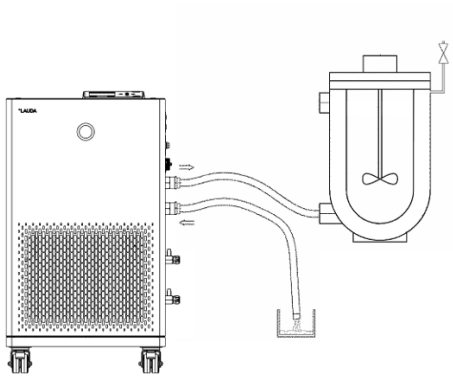


Fig. 70

Internal cleaning

After the heat transfer liquid has been drained, residues remain in the device. These residues should be removed to avoid deposits in the device during storage.

If new heat transfer liquid is added and the device is operated above the thermal load limit for the old heat transfer liquid, deposits can form, especially on the heaters. These coatings reduce the performance of the device and/or reduce the service life of the device.

If necessary, clean or flush out the device (with new heat transfer liquid, for example).

If water with a cleaning agent (grease solvent) is used as cleaning liquid, make sure that the device is only operated in fill mode (cooling unit is therefore switched off). Otherwise, there is a risk that the device may freeze internally and become damaged as a result.

1. Connect a hose to the pump connectors (short circuit between the outflow connector and the return connector).
2. Fill the device with a suitable cleaning fluid. During this time, operate the device in fill mode.
3. Drain the device via the drain connector.
4. Check the cleaning fluid for dirt or old heat transfer liquid.
   - ▶ If you detect dirt in the cleaning fluid, repeat points 2 to 3. Otherwise continue with point 5.
5. Remove hose from the pump connector.
6. Dry the hydraulic circuit in the device with compressed air.

   To do this, carefully allow the compressed air to flow into the device alternately via the outflow and return connectors.

If the device has been cleaned with a highly oil-soluble liquid (e.g. acetone), do not leave it dry for longer periods (1 day) or transport it, as the pump requires minimum lubrication.

Suitable cleaning fluid	For heat transfer liquid
Acetone (solvent) *It is essential to observe the relevant safety measures for handling acetone!*	Kryo 20 Kryo 51 Kryo 65 Kryo 70 Kryo 95 Ultra 350
Water	Kryo 30

9.3 Drain the cooling water circuit

This section is relevant for:

- Water-cooled devices

To avoid damage during storage, the cooling water circuit must be drained completely.

Protective equipment:
- Safety glasses
- Protective gloves
- Protective work clothing

The device is in standby mode.

1. Shut down cooling water supply.
2. Unscrew the hose for the cooling water inlet from the device.
3. Remove the filter strainer from the water inlet. If necessary, use pointed pliers or large tweezers.
4. Clean the filter strainer.
5. Insert cleaned filter strainer.
6. Press the Enter key to open the menu.
7. Select the menu items → *Pump* → *Water valve* → *open*.
   - ▶ The water valve opens.
8. Drain the cooling water circuit completely. Blow compressed air through the cooling water circuit.
9. Set the water valve to `auto` in the control menu. The standard setting is `autom.` (automatic).

10 Disposal

10.1 Disposing of packaging

The following applies for EU member states: Disposal of the packaging must proceed according to regulation 94/62/EC.

10.2 Disposing of refrigerant

Disposal of refrigerant must proceed according to regulation 2015/2067/EU in combination with regulation 517/2014/EU.

CAUTION!
Uncontrolled escape of refrigerant

Impacts, cutting

- Only specialized personnel are permitted to perform disposal work.

NOTICE!
Uncontrolled escape of refrigerant

Environment

- Never dispose of a cooling circuit that is still pressurized.
- Only specialized personnel are permitted to perform disposal work.

The type and refrigerant charge are printed on the rating label.

Have repair and disposal carried out only by a refrigeration technician.

10.3 Device disposal

The following applies for EU member states: The device must be disposed of according to Directive 2012/19/EU (WEEE Waste of Electrical and Electronic Equipment).

11 Accessories

The following optional accessories are available for the Integral devices.

Table 25: Module bay 51 mm x 27 mm

Accessories	Cat. No.
Analog interface module	LRZ 912
RS 232/485-interface module	LRZ 913
Contact interface module with 1 input and 1 output	LRZ 914
Contact interface module with 3 inputs and 3 outputs	LRZ 915
Profibus interface module	LRZ 917
EtherCAT interface module, M8 socket connection	LRZ 922
EtherCAT interface module, RJ45 socket connection	LRZ 923
Pt100 LiBus interface module	LRZ 925

Table 26: Connecting plug

Accessories	Cat. No.
External temperature probe with socket and shielded connection cable	ETP 059
Coupling connector, 6-pin for analog inputs/outputs	EQS 057
Connecting plug SUB-D, 9-pin	EQM 042
RS 232 cable (length: 2 m) for PC	EKS 037
RS 232 cable (length: 5 m) for PC	EKS 057
3-pin coupling connector for contact input	EQS 048
3-pin coupling socket for contact output	EQD 047

Accessories	Suitable for	Cat. No.
Command Touch remote control unit	All devices	LRT 923
Flow controller	Integral XT	L002882

Please also refer to our accessories brochure for further accessories.

12 General

12.1 Copyright

This manual is protected by copyright and only meant for internal use by purchasers.

The relinquishment of this manual to third parties, copying in any way whatsoever – even in the form of excerpts – and the utilization and/or conveyance of its content are not allowed, except for internal purposes, without written approval from the manufacturer.

Violation of this may obligate the violator to the payment of damages. Other claims reserved.

We point out that the designations and brand names of the respective companies used in the manual are generally subject to trademark, brand and patent protection.

12.2 Technical changes

The manufacturer reserves the right to make technical modifications to the device.

12.3 Warranty conditions

LAUDA offers a standard 12 month manufacturer's warranty on Integral process thermostats from the date of purchase.

12.4 Contact LAUDA

Contact LAUDA Service Constant temperature equipment in the following cases:

- For device errors
- For technical questions concerning the device
- To order replacement parts

Contact our Sales Department for application-specific questions.

Contact information

LAUDA Service Constant temperature equipment

Phone: +49 (0)9343 503 350

Fax: +49 (0)9343 503 283

Email: service@lauda.de

13 Technical data

13.1 General data

Specification	Value	Unit
Display type	TFT, white font on black background	---
Display size	3.5	Inches
Display resolution	320 x 240	Pixels
Resolution of setting	0.01	°C
Display resolution	0.01	°C
Entry	via eight keys	---
Installation and use	Indoors	---
Maximum height of installation above sea level	Up to 2,000	m
Relative air humidity	Maximum relative air humidity 80 % at ambient temperature of 31 °C and up to 40 °C, 50 % with linear decrease	---
Ambient temperature range	5 – 40	°C
IP protection level	IP 21	---
Mains voltage fluctuations	Permissible up to ±10 % of the nominal voltage	---
Protection class for electrical equipment DIN EN 61 140 (VDE 0140-1)	1	---
Class division according to DIN 12 876-1		
- Class designation	III	---
- Identification code	FL (suitable for combustible and non-combustible liquids)	---
Storage temperature range	5 – 43 °C; For water-cooled devices, the condenser must be completely empty	°C
Transportation temperature range	-20 – 43	°C

The noise level of the various devices was measured according to the guidelines included in DIN EN ISO 11200 and the basic standards cited therein. The measured values correspond to the operating conditions that occur during typical device operation.

Table 27: Integral T

Table 1	Unit	IN 130 T	IN 230 T	IN 230 TW
ACC area ①	°C	-30 – 120	-30 – 120	-30 – 120
Temperature stability ②	K	±0.05	±0.05	±0.05
Device dimensions width x depth x height	mm	430 x 550 x 760	430 x 550 x 760	430 x 550 x 760
Filling volume				
- minimum	L	3.6	3.6	3.6
- maximum	L	8.7	8.7	8.7
Pump data 50 Hz				
- maximum discharge pressure	bar	3.5	3.5	3.5
- maximum flow rate	L/min	40	40	40
Pump data 60 Hz				
- maximum discharge pressure	bar	4.0	4.0	4.0
- maximum flow rate	L/min	45	45	45
Connecting thread (external) inlet/ outlet	---	G¾"	G¾"	G¾"
Noise level 50 Hz ③	dB(A)	61	63	58
Noise level 60 Hz ③	dB(A)	61	63	60
Weight	kg	76	80	82
Distance between device and environment				
- Front	mm	500	500	200
- Back	mm	500	500	200
- Right	mm	500	500	200
- Left	mm	500	500	200

Table 2	Unit	IN 530 T	IN 530 TW	IN 1030 T	IN 1330 TW
ACC area ①	°C	-30 – 120	-30 – 120	-30 – 150	-30 – 150
Temperature stability ②	K	±0.05	±0.05	±0.1	±0.1
Device dimensions width x depth x height	mm	560 x 550 x 1325	560 x 550 x 1325	760 x 650 x 1605	760 x 650 x 1605
Filling volume					
- minimum	L	7.2	7.2	9.7	9.7
- maximum	L	20.5	20.5	25.5	25.5
Pump data 50 Hz					
- maximum discharge pressure	bar	3.5	3.5	5.5	5.5
- maximum flow rate	L/min	40.0	40.0	60.0	60.0
Pump data 60 Hz					

Table 2	Unit	IN 530 T	IN 530 TW	IN 1030 T	IN 1330 TW
- maximum discharge pressure	bar	4.6	4.6	7.0	7.0
- maximum flow rate	L/min	45	45	70.0	70.0
Connecting thread (external) inlet/outlet	---	G¾"	G¾"	M38 x 1.5	M38 x 1.5
Noise level 50 Hz ③	dB(A)	62	62	69	59
Noise level 60 Hz ③	dB(A)	66	62	70	62
Weight	kg	146	148	212	214
Distance between device and environment					
- Front	mm	500	200	500	200
- Back	mm	500	200	500	200
- Right	mm	500	200	500	200
- Left	mm	500	200	500	200

① - ACC area (Active Cooling Control) according to DIN 12876 is the working temperature range during operation with an active cooling unit.

② - Temperature stability determined according to standard DIN 12876-2

③ - Noise level determined according to Standard EN 11201 for operating position in front of the device at 1 meter distance

Table 28: Integral XT

Table 3	Unit	IN 150 XT	IN 250 XTW	IN 280 XT	IN 280 XTW
ACC area ①	°C	-45 – 220	-45 – 220	-80 – 220	-80 – 220
Temperature stability ②	K	±0.05	±0.05	±0.05	±0.05
Device dimensions width x depth x height	mm	430 x 550 x 760	430 x 550 x 760	560 x 550 x 1325	560 x 550 x 1325
Filling volume					
- minimum	L	2.5	2.5	4.8	4.8
- Maximum	L	8.7	8.7	17.2	17.2
Pump data 50/60 Hz					
- maximum discharge pressure	bar	3.1	3.1	3.1	3.1
- maximum flow rate	L/min	65.0	65.0	65.0	65.0
Connecting thread (external) inlet/outlet	---	M30 x 1.5	M30 x 1.5	M30 x 1.5	M30 x 1.5
Noise level 50 Hz ③	dB(A)	60	57	62	60
Noise level 60 Hz ③	dB(A)	60	57	63	62
Weight	kg	103	105	183	187

Table 3	Unit	IN 150 XT	IN 250 XTW	IN 280 XT	IN 280 XTW
Distance between device and environment					
- Front	mm	500	200	500	200
- Back	mm	500	200	500	200
- Right	mm	500	200	500	200
- Left	mm	500	200	500	200

Table 4	Unit	IN 550 XT	IN 550 XTW	IN 590 XTW	IN 750 XT
ACC area ①	°C	-50 – 220	-50 – 220	-90 – 220	-45 – 220
Temperature stability ②	K	±0.05	±0.05	±0.05	±0.05
Device dimensions width x depth x height	mm	560 x 550 x 1325	560 x 550 x 1325	760 x 650 x 1605	560 x 550 x 1325
Filling volume					
- minimum	L	4.8	4.8	8.0	4.8
- Maximum	L	17.2	17.2	28.6	17.2
Pump data 50/60 Hz					
- maximum discharge pressure	bar	3.1	3.1	3.1	3.1
- maximum flow rate	L/min	65.0	65.0	65.0	65.0
Connecting thread (external) inlet/outlet	---	M30 x 1.5	M30 x 1.5	M30 x 1.5	M30 x 1.5
Noise level 50 Hz ③	dB(A)	65	62	61	66
Noise level 60 Hz ③	dB(A)	65	64	64	68
Weight	kg	171	176	274	169
Distance between device and environment					
- Front	mm	500	200	200	500
- Back	mm	500	200	200	500
- Right	mm	500	200	200	500
- Left	mm	500	200	200	500

Table 5	Unit	IN 950 XTW	IN 1590 XTW	IN 1850 XTW
ACC area ①	°C	-50 – 220	-90 – 220	-50 – 220
Temperature stability ②	K	±0.05	±0.05	±0.05
Device dimensions width x depth x height	mm	560 x 550 x 1325	760 x 650 x 1605	760 x 650 x 1605
Filling volume				
- minimum	L	4.8	10.0	8.0
- Maximum	L	17.2	30.6	28.6

Table 5	Unit	IN 950 XTW	IN 1590 XTW	IN 1850 XTW
Pump data 50/60 Hz				
- maximum discharge pressure	bar	3.1	3.1	6.0
- maximum flow rate	L/min	65.0	65.0	120.0
Connecting thread (external) inlet/ outlet	---	M30 x 1.5	M38 x 1.5	M38 x 1.5
Noise level 50 Hz ③	dB(A)	67	63	62
Noise level 60 Hz ③	dB(A)	69	65	62
Weight	kg	173	345	272
Distance between device and environment				
- Front	mm	200	200	200
- Back	mm	200	200	200
- Right	mm	200	200	200
- Left	mm	200	200	200

① - ACC area (Active Cooling Control) according to DIN 12876 is the working temperature range during operation with an active cooling unit.

② - Temperature stability determined according to standard DIN 12876-2

③ - Noise level determined according to Standard EN 11201 for operating position in front of the device at 1 meter distance

13.2 Heating output and power supply

If the maximum current consumption is limited ↳ “Limiting the current consumption” on page 88 the heating output can be reduced.

Depending on the country-specific version, the maximum current consumption may already be limited ex works. Limited current consumption values are shown in brackets.

Table 29: Integral T

	Unit	IN 130 T	IN 230 T	IN 230 TW
Heating output				
230 V; 50 Hz	kW	2.7	2.7	2.7
200 V; 50/60 Hz	kW	2.2	2.2	2.2
208-220 V; 60 Hz	kW	2.4 – 2.6	2.4 – 2.6	2.4 – 2.6
Current consumption	A	16.0 (13.0)	16.0 (13.0)	16.0 (13.0)

	Unit	IN 530 T	IN 530 TW	IN 1030 T	IN 1330 TW
Heating output 400 V; 3/PE; 50 Hz & 460 V; 3/PE; 60 Hz	kW	8.0	8.0	8.0	16.0
Current consumption	A	16.0	16.0	25.0	25.0

Table 30: Integral XT

	Unit	IN 150 XT	IN 250 XTW	IN 280 XT	IN 280 XTW
Heating output 230 V; 50 Hz	kW	3.5 (2.8)	3.5 (2.8)	---	---
200 V; 50/60 Hz	kW	3.0	3.1	---	---
208-220 V; 60 Hz	kW	3.1 – 3.3	3.2 – 3.4	---	---
400 V; 3/PE; 50 Hz & 460 V; 3/PE; 60 Hz	kW	---	---	4.0	4.0
Current consumption	A	16.0 (13.0)	16.0 (13.0)	13.0	13.0

	Unit	IN 550 XT	IN 550 XTW	IN 590 XTW	IN 750 XT
Heating output 400 V; 3/PE; 50 Hz & 460 V; 3/PE; 60 Hz	kW	8.0	8.0	8.0	8.0
Current consumption	A	16.0	16.0	16.0	16.0

	Unit	IN 950 XTW	IN 1590 XTW	IN 1850 XTW
Heating output 400 V; 3/PE; 50 Hz & 460 V; 3/PE; 60 Hz	kW	8.0	12.0	16.0
Current consumption	A	16.0	30.0	25.0

13.3 Cooling output

Measuring the performance data according to DIN 12876

The cooling capacity is measured at fixed temperatures of the heat transfer liquid. Ethanol is used as the standard heat transfer liquid, thermal oil is used for temperatures above 20 °C. The ambient temperature for the measurement of air-cooled devices is 20 °C. For the measurement of water-cooled devices the cooling water temperature is 15 °C as well as the cooling water differential pressure 3 bar.

All water-cooled devices are equipped with the following cooling water connection:

- Exterior thread (male) ¾ inch

Table 31: Integral T with air-cooled cooling unit

	Unit	IN 130 T	IN 230 T	IN 530 T	IN 1030 T
Cooling output at 100 °C	kW	1.40	2.20	5.00	11.00
20 °C	kW	1.40	2.20	5.00	11.00
10 °C	kW	1.35	1.90	4.50	9.50
0 °C	kW	1.20	1.50	3.80	7.10
-10 °C	kW	0.80	1.00	2.60	4.90
-20 °C	kW	0.40	0.60	1.50	3.00
-30 °C	kW	0.10	0.15	0.60	1.60

Table 32: Integral T with water-cooled cooling unit

	Unit	IN 230 TW	IN 530 TW	IN 1330 TW
Cooling output at 100 °C	kW	2.30	6.00	13.00
20 °C	kW	2.30	6.00	13.00
10 °C	kW	2.30	5.50	10.00
0 °C	kW	1.90	4.50	7.60
-10 °C	kW	1.30	3.00	5.40
-20 °C	kW	0.75	1.60	3.40
-30 °C	kW	0.35	0.70	1.70
Minimum differential pressure of cooling water	bar	1	3	3

	Unit	IN 230 TW	IN 530 TW	IN 1330 TW
Maximum differential pressure of cooling water	bar	5	10	10
Cooling water consumption at 3 bar and a cooling water temperature of 15 °C	L/min	3.0	14.5	15.5

Table 33: Integral XT with single-stage air-cooled cooling unit

	Unit	IN 150 XT	IN 550 XT	IN 750 XT	Pump level
Cooling output at					
200 °C	kW	1.50	5.00	7.00	8
100 °C	kW	1.50	5.00	7.00	8
20 °C	kW	1.50	5.00	7.00	8
10 °C	kW	1.50	4.80	7.00	8
0 °C	kW	1.30	4.60	5.40	8
-10 °C	kW	1.00	3.30	3.60	8
-20 °C	kW	0.70	2.30	2.60	4
-30 °C	kW	0.30	1.20	1.60	4
-40 °C	kW	0.06	0.50	0.80	4
-45 °C	kW	0.02	0.22	0.50	2
-50 °C	kW	---	0.10	---	2

Table 34: Integral XT with single-stage water-cooled cooling unit

	Unit	IN 250 XTW	IN 550 XTW	IN 950 XTW	IN 1850 XTW	Pump level
Cooling output at						
200 °C	kW	2.20	5.80	9.50	20.00	8
100 °C	kW	2.20	5.80	9.50	20.00	8
20 °C	kW	2.10	5.80	9.50	20.00	8
10 °C	kW	2.00	5.80	8.50	15.00	8
0 °C	kW	1.80	5.40	6.20	11.50	8
-10 °C	kW	1.40	4.00	4.30	8.50	8
-20 °C	kW	1.00	2.60	3.00	6.10	4
-30 °C	kW	0.55	1.45	1.70	3.60	4
-40 °C	kW	0.20	0.55	0.90	1.90	4
-45 °C	kW	0.05	0.30	0.60	1.30	2
-50 °C	kW	---	0.12	0.35	1.10	2

	Unit	IN 250 XTW	IN 550 XTW	IN 950 XTW	IN 1850 XTW	Pump level
Minimum differential pressure of cooling water	bar	1	3	3	3	---
Maximum differential pressure of cooling water	bar	5	10	10	10	---
Maximum cooling water consumption at 3 bar and 15 °C	L/min	4.2	8.0	20.0	26.0	---

Table 35: Integral XT with two-stage cooling unit

	Unit	IN 280 XT	IN 280 XTW	IN 590 XTW	IN 1590 XTW	Pump level
Cooling output at 200 °C	kW	1.60	1.70	4.50	18.50	8
100 °C	kW	1.60	1.70	4.50	18.50	8
20 °C	kW	1.60	1.70	4.50	18.50	8
10 °C	kW	1.55	1.65	4.45	15.00	8
0 °C	kW	1.50	1.60	4.40	11.50	8
-10 °C	kW	1.50	1.60	4.40	8.70	8
-20 °C	kW	1.70	1.80	4.60	8.50	4
-30 °C	kW	1.70	1.80	4.60	8.50	4
-40 °C	kW	1.65	1.80	4.50	7.50	4
-50 °C	kW	1.40	1.50	4.20	6.00	4
-60 °C	kW	0.85	0.90	2.70	4.00	4
-70 °C	kW	0.35	0.45	1.40	2.20	4
-80 °C	kW	0.15	0.18	0.60	0.90	4
-90 °C	kW	---	---	0.20	0.35	2
Heat discharge of the refrigerating machine	---	Air	Water	Water	Water	---
Minimum differential pressure of cooling water	bar	---	1	3	3	---
Maximum differential pressure of cooling water	bar	---	5	10	10	---
Maximum cooling water consumption at 3 bar and 15 °C	L/min	---	2.7	15.8	26.0	---

13.4 Refrigerant and filling weight

The device contains fluorinated greenhouse gases.

Table 36: Integral T

	Unit	IN 130 T	IN 230 T	IN 230 TW
Refrigerant	---	R-449A	R-449A	R-449A
Maximum filling weight	kg	0.40	0.45	0.45
$GWP_{(100a)}$*	---	1397	1397	1397
CO_2 equivalent	t	0.6	0.6	0.6

	Unit	IN 530 T	IN 530 TW	IN 1030 T	IN 1330 TW
Refrigerant	---	R-449A	R-449A	R-449A	R-449A
Maximum filling weight	kg	1.20	1.20	2.00	2.20
$GWP_{(100a)}$*	---	1397	1397	1397	1397
CO_2 equivalent	t	1.7	1.7	2.8	3.1

Table 37: Integral XT with single-stage cooling unit

	Unit	IN 150 XT	IN 250 XTW	IN 550 XT	IN 550 XTW
Refrigerant	---	R-449A	R-449A	R-452A	R-452A
Maximum filling weight	kg	0.40	0.45	1.40	1.40
$GWP_{(100a)}$*	---	1397	1397	2140	2140
CO_2 equivalent	t	0.6	0.6	3.0	3.0

	Unit	IN 750 XT	IN 950 XTW	IN 1850 XTW
Refrigerant	---	R-449A	R-449A	R-449A
Maximum filling weight	kg	1.80	1.80	2.30
$GWP_{(100a)}$*	---	1397	1397	1397
CO_2 equivalent	t	2.5	2.5	3.2

Table 38: Integral XT with two-stage cooling unit

	Unit	IN 280 XT	IN 280 XTW	IN 590 XTW	IN 1590 XTW
Refrigerant first stage	---	R-449A	R-449A	R-449A	R-449A
Maximum filling weight first stage	kg	0.80	0.80	1.50	3.40
$GWP_{(100a)}$*	---	1397	1397	1397	1397
CO_2 equivalent	t	1.1	1.1	2.1	4.7
Refrigerant second stage	---	R-23	R-23	R-508B	R-508B
Maximum filling weight second stage	kg	0.40	0.38	1.20	1.80

	Unit	IN 280 XT	IN 280 XTW	IN 590 XTW	IN 1590 XTW
$GWP_{(100a)}$*	---	14800	14800	13400	13400
CO_2 equivalent	t	5.9	5.6	16.1	24.1

Global Warming Potential (GWP), CO_2 comparison = 1.0

** Time frame 100 years - according to IPCC IV*

14 Glossary

Auto IP	Auto IP is a standardized procedure where two or more participants agree on the same network configuration.
DHCP Client (Dynamic Host Configuration Protocol Client)	A DHCP client facilitates the automatic integration of an Ethernet interface in an existing network. As a result, the interface does not have to be manually integrated in the existing network.
DNS server (Domain Name Service Server)	The Domain Name Service is a database where mainly information on names and IP addresses of the computer are stored. A DNS can, for example, disperse a web address or URL (Uniform Resource Locator) to an IP address. The Ethernet interface specifies the IP address of the DNS server present in the connected network.
Gateway	Various networks are connected with one another via a gateway. Here, an IP address is given that can be used to reach a gateway in a local network.
IP address (Internet Protocol Address)	Each device within a data network requires an address, so that it can be clearly identified. This is the only way to ensure that e.g. the data flow is received by the correct device. When an Internet page is opened, the browser always transfers the IP address of your device. This is the only way that the web server can know where to send the required data packet. The Internet Protocol (IP) is a widely adopted network standard that stipulates how information can be exchanged.
IP version	Provides information about the Internet standard: IPv4 or IPv6. A well-known example of an IP address is 192.168.0.1. This address is structured according to the IPv4 standard: Four numbers between 0 and 255, whereby a period separates the numbers from one another. However, this system only allows a limited number of combinations, which is why there are IP addresses structured according to the standard in version 6 (IPv6). They consist of eight blocks of characters that can contain both numbers and letters as shown in this example: fe80:0010:0000:0000:0000:0000:0000:0001. Because this can seem rather confusing, a long string of zeros can be replaced by a colon. The IPv6 address from the example would therefore appear in a shortened form as follows: fe80:0010::1.
Local IP address	The local IP address is an address for the Ethernet interface in the local network. The Ethernet interface in the local network can be reached using this address. If the DHCP client is deactivated, the local IP address and the local mask must be manually configured. For manual configuration start by contacting your IT department.
Local mask	Local (subnet) masks are used to flexibly adapt the rigid class division of IP addresses in networks and computers to actual conditions.
MAC (Media Access Control)	Media Access Control is an almost unique global hardware address which can be used to clearly identify the device in an Ethernet network.
NTP (Network Time Protocol)	Network time protocol is a standard for synchronizing the time and date in networks.
Port	Port is a number that is used to establish a connection between two network participants. The port is a part of the network address. The port for the Ethernet interface can be taken from the approved "dynamic ports" range. This lies between 49152 and 65535.

Process Interface	A process interface on the LAUDA constant temperature equipment is the interface that makes it possible to control or monitor the constant temperature equipment via Ethernet using LAUDA interface command sets.
TCP (Transmission Control Protocol)	This network protocol define how data is exchanged between network components.

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Appendix

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

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: Integral **Serial number:** from S190000001

Types: IN 130 T, IN 230 T, IN 230 TW, IN 530 T, IN 530 TW, IN 1030 T, IN 1330 TW, IN 150 XT, IN 250 XTW, IN 280 XT, IN 280 XTW, IN 550 XT, IN 550 XTW, IN 590 XTW, IN 750 XT, IN 950 XTW, IN 1590 XTW, IN 1850 XTW

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 61326-3-1:2018 (IEC 61326-3-1:2017)
- EN 378-2:2018
- EN 61010-1:2011 (IEC 61010-1:2010 + Cor.:2011)
- EN 61010-2-010:2015 (IEC 61010-2-010:2014)

Authorized representative for the composition of the technical documentation:

Dr. Jürgen Dirscherl, Head of Research & Development

Lauda-Königshofen, 25.09.2019

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Dr. Alexander Dinger, Head of Quality Management

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