Operating Manual

Highly Dynamic Temperature Control Systems

- with integrated programmer

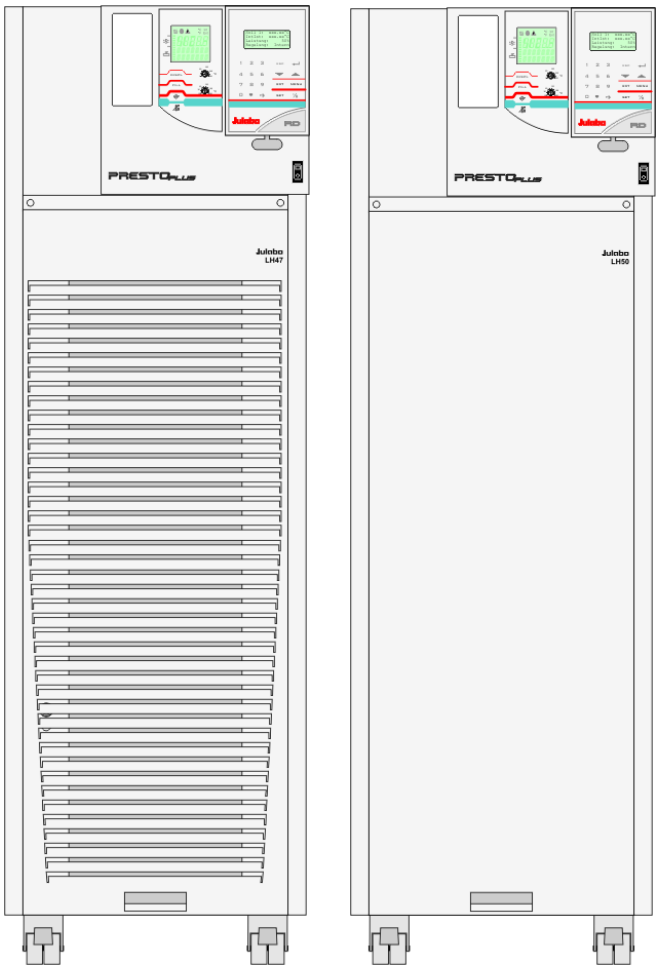
PRESTO PLUS

LH 47

air cooled

LH 50

water cooled



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Print date: 15.09.09

Congratulations!

You have made an excellent choice.
JULABO thanks you for the trust you have placed in us.
This operating manual has been designed to help you gain an understanding of the operation and possible applications of our circulators. For optimal utilization of all functions, we recommend that you thoroughly study this manual prior to beginning operation.

Quality Management System

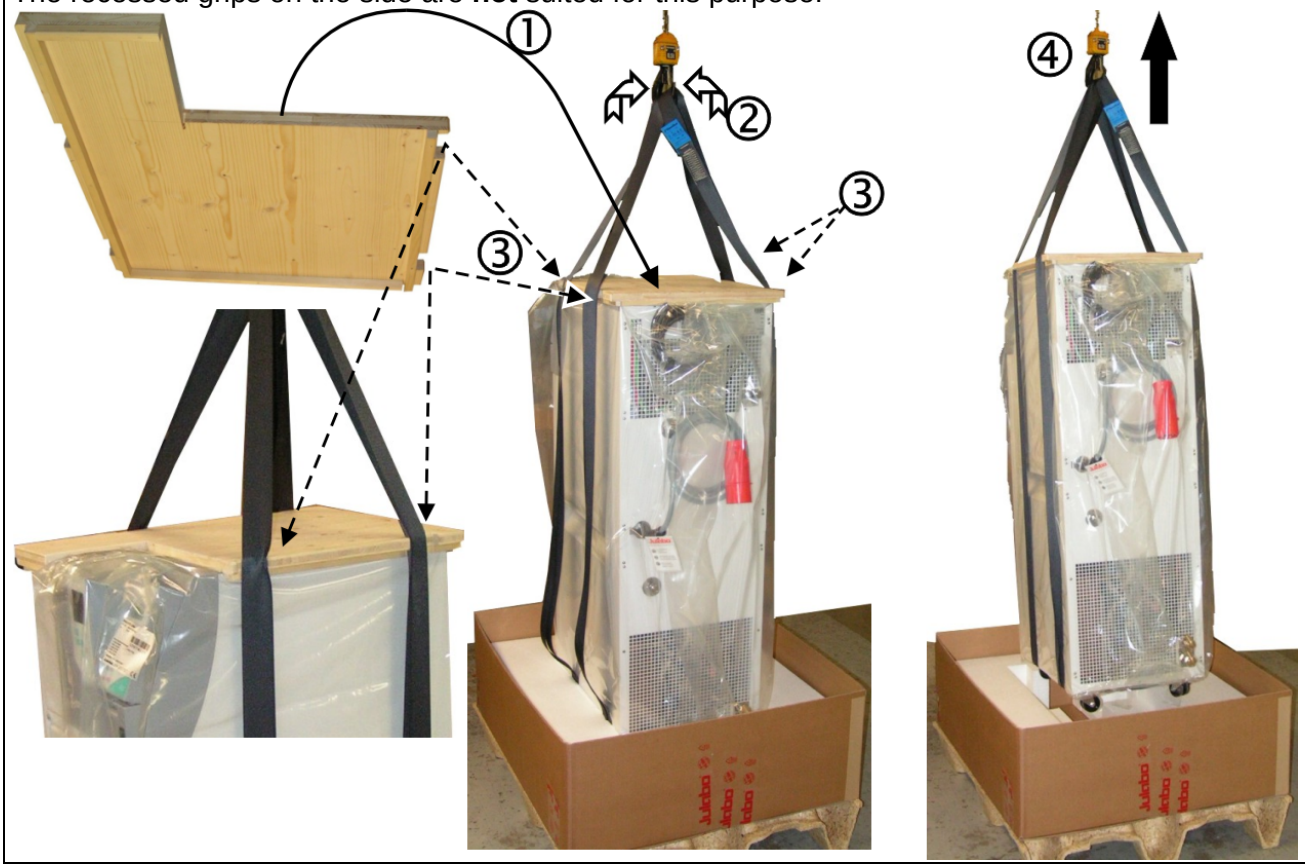
We are ISO 9001 2000 certified

The JULABO **Q**uality **M**anagement **S**ystem:
Temperature control devices for research and industry are developed, produced, and distributed according to the requirements of DIN EN ISO 9001:2000.
Certificate Registration No. 01 100044846

Unpacking and inspecting

Unpack the unit and accessories and inspect them for possible transport damage. Damage should be reported to the responsible carrier, railway, or postal authority, and a damage report should be requested. These instructions must be followed fully for us to guarantee our full support of your claim for protecting against loss from concealed damage. The form required for filing such a claim will be provided by the carrier.

Lift the unit only with a crane (see pictures) using the lifting strands and the wooden crate ①.
The recessed grips on the side are **not** suited for this purpose!



1.953.2790BE0 08/09 Printed in Germany Changes without prior notification reserved

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Operating manual

1. Intended use

JULABO Temperature Systems have been designed for temperature application to specific fluids in a external closed system (oop circuit). The units feature pump connections for temperature control of external systems (loop circuit).

JULABO circulators are not suitable for direct temperature control of foods, semi-luxury foods and tobacco, or pharmaceutical and medical products. Direct temperature control means unprotected contact of the object with the bath medium (bath fluid).

1.1. Description

- Besides the cooling unit, the main functional elements are the heater, circulation pump and control electronics. Via an external Pt100 control sensor, a self-optimizing, electronic proportional temperature control (PID characteristic) adapts the heat supplied to the thermal requirements of the external system.
- The high pump capacity can be reduced by regulating the motor speed in five grades. It may thus be adapted to sensitive vessels.
- LH47: The cooling unit may be cooled with air.
  LH50: The cooling unit may be cooled with water.
- Setting is rapid and simple using the splash-proof keypads. The operating elements consist of the local operating board with a bright VFD-Info-Display, as well as the removable control module RD connected with a cable.
  The microprocessor technology allows four temperature values to be stored and indicated on the DIALOG-DISPLAY (LCD) of the control module RD: working temperature, high and low temperature warning limits as well as pump pressure stage.
- The digital RS232 / RS485 port permits modern process engineering without additional interface.
- The excess temperature protection (safety temperature), a safety feature functioning independent of the regulator circuit, is adjusted and indicated via the VFD-Info-Display.
- The integrated programmer allows programming of setpoint and time values for six temperature profiles.
- The following analog sockets are available:
  - The REG+E-PROG socket for setpoint selection via an external, analog programmer.
    At the same time, this socket provides three analog outputs for temperature recorders.
  - The external Pt100 socket for external control.
  - The alarm output for an external signal.
  - The stand-by input for external emergency switch-off.

2. Operator responsibility – Safety instructions

The products of JULABO ensure safe operation when installed, operated, and maintained according to common safety regulations. This section explains the potential dangers that may arise when operating the circulator and also specifies the most important safety precautions to preclude these dangers as far as possible.

Operator responsibility – Safety instructions

The operator is responsible for the qualification of the personnel operating the units.

- The personnel operating the units should be regularly instructed about the dangers involved with their job activities as well as measures to avert these dangers.
- Make sure all persons tasked with operating, installing, and maintaining the unit have read and understand the safety information and operating instructions.
- When using hazardous materials or materials that could become hazardous, the circulator may be operated only by persons who are absolutely familiar with these materials and the unit. These persons must be fully aware of possible risks.

If you have any questions concerning the operation of your unit or the information in this manual, please contact us!

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Safety instructions for the operator:

- Avoid strikes to the housing, vibrations, damage to the operating-element panel (keypad, display), and contamination.
- Make sure the product is checked for proper condition regularly (depending on the conditions of use). Regularly check (at least every 2 years) the proper condition of the mandatory, warning, prohibition and safety labels.
- Make sure that the mains power supply has low impedance to avoid any negative effects on the instruments being operated on the same mains.
- This unit is designed for operation in a controlled electromagnetic environment. This means that transmitting devices (e.g., cellular phones) should not be used in the immediate vicinity.
- Magnetic radiation may affect other devices with components sensitive to magnetic fields (e.g., monitors). We recommend maintaining a minimum distance of 1 m.
- Permissible ambient temperature: max. 40 °C, min. 5 °C.
- Permissible relative humidity: 50% (40 °C).
- Do not store the unit in an aggressive atmosphere. Protect the unit from contamination.
- Do not expose the unit to sunlight.

Appropriate operation

Only qualified personnel is authorized to configure, install, maintain, or repair the unit.
Persons who operate the circulator must be trained in the particular tasks by qualified personnel. The summarized user guidance (short manual) and the specification table with information on individual parameters are sufficient for this.

Use

The bath can be filled with flammable materials. Fire hazard!
There might be chemical dangers depending on the bath medium used.

Observe all warnings for the used materials (bath fluids) and the respective instructions (safety data sheets).
Insufficient ventilation may result in the formation of explosive mixtures. Only use the unit in well ventilated areas.
Only use recommended materials (bath fluids). Do not use poisonous, vitriolic or corrosive bath fluids..

When using hazardous materials or materials that could become hazardous, **the operator must** affix the enclosed safety labels to the front of the unit so they are highly visible:

If this unit is intended for use within the United States of America, all 3 warning labels **must** be affixed to the housing of the unit prior to use. Directions for the positioning of the individual warning labels are enclosed with the warning labels included in the delivery. Warning labels must be easily visible to users.

1		Warning label W00: Colors: yellow, black Danger area. Attention! Observe instructions. (operating manual, safety data sheet)
2 **or**		Mandatory label M018: Colors: blue, white Carefully read the user information prior to beginning operation. **Scope: EU**
2		Semi S1-0701 Table A1-2 #9 Carefully read the user information prior to beginning operation. **Scope: USA, NAFTA**
3	**WARNING:** This product contains chemicals known to the state of California to cause cancer, birth defects or other reproductive harm.	Warning label Proposition 65

Particular care and attention is necessary because of the wide operating range.
There are thermal dangers: Burn, scald, hot steam, hot parts and surfaces that can be touched.

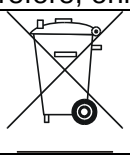
	Warning label W26: Colors: yellow, black Hot surface warning. (The label is put on by JULABO)

Observe the instructions in the manuals for instruments of a different make that you connect to the circulator, particularly the corresponding safety instructions. Also observe the pin assignment of plugs and technical specifications of the products.

2.1. Disposal

The product may be used with oil as bath fluid. These oils fully or partially consist of mineral oil or synthetic oil. For disposal, follow the instructions in the material safety data sheets.

This unit contains the refrigerants R-404A and R-23, which at this time are not considered harmful to the ozone layer. However, over the long operating period of the unit, disposal rules may change. Therefore, only qualified personnel should handle the disposal.

	Contact an authorized waste management company in your country. Disposal with household waste (unsorted waste) or similar collections of municipal waste is not permitted!

2.2. Technical specifications

PRESTO PLUS		LH 47	LH 50
Mains power connection 400 V/3P/50 Hz	**V / Hz**	**360-440V/3PNPE/50Hz**	**360-440V/3PNPE/50Hz**
Current input (at 230 V)	A	12	20
Working temperature range	°C	-47 ... 250	-50 ... 250
Temperature stability	K	±0.01 ... ±0.05	±0.01 ... ±0.05
Cooling capacity	°C	200 100// 20 0 -20 -40	200 // 20 0 -20 -40
pump pressure stage 1	kW	3,7 3,1 // 3,07 2,0 0,99 0,27	5.5 // 7.3 4.6 2.3 0.45
pump pressure stage 5	kW	3,5 3,0 // 2,9 1,9 0,90 0,07	5.5 // 7.2 5.1 2.3 0.19
(bath liquid: Thermal / Ethanol)			
Cooling compressor		1-stage air-cooled	1-stage water-cooled
Refrigerant		R404A	R404A
Cooling water : Flow rate at 20 °C inlet temperature	l/h	-----	390
Heater wattage	kW	1.8	6.0
Pressure pump, adjustable	grade	1 2 3 4 5	
pressure min ... max. at 0 liter	bar	0.5 0.7 1.1 1.3 1.7	
discharge, max. at 0 bar	l/min	16 19 23 26 30	
Pressure pump, adjustable	grade		1 2 3 4 5
pressure min ... max. at 0 liter	bar		0.7 0.9 1.4 1.8 2.3
discharge, max. at 0 bar	l/min		17 19 24 27 31
		Viskosität max. 50 mm²/s (50 cSt)	
Noise level, 1 m distance	dBA	72	-----
Ambient temperature	°C	5 ... 40	5 ... 40
Filling volume Heat exchanger	liters	2.5	10
Reservoir	liters	3.2 … 8.4	3.2 … 8.4
Overall dimensions (WxDxH)	cm	40x55x127	40x55x127
Weight	kg	150	182

All measurements have been carried out at: rated voltage and frequency
ambient temperature: 20 °C Technical changes without prior notification reserved.

Pump data in relation to fluids with a specific density of 1 kg/dm^3

PRESTO PLUS		LH 47	LH 50
Mains power connection 230 V/3P/60 Hz	**V / Hz**	**207-253V/3PPE/60Hz**	**207-253V/3PPE/60Hz**
Current input (at 230 V)	A	13	27
Working temperature range	°C	-47 ... 250	-50 ... 250
Temperature stability	K	±0.01 ... ±0.05	±0.01 ... ±0.05
Cooling capacity	°C	200 100// 20 0 -20 -40	200 // 20 0 -20 -40
pump pressure stage 1	kW	3,8 3,3 // 3,2 2,1 1,1 0,32	5.5 // 7.3 4.9 2.6 0.5
pump pressure stage 5	kW	3,7 3,2 // 3,1 2,0 1,0 0,12	5.5 // 7.2 4,6 2.1 0.4
(bath liquid: Thermal / Ethanol)			
Cooling compressor		1-stage air-cooled	1-stage water-cooled
Refrigerant		R404A	R404A
Cooling water : Flow rate at 20 °C inlet temperature	l/h	-----	330
Heater wattage	kW	1.8	6.0
Pressure pump, adjustable	grade	1 2 3 4 5	
pressure min ... max. at 0 liter	bar	0.5 0.7 1.1 1.3 1.7	
discharge, max. at 0 bar	l/min	16 19 23 26 30	
Pressure pump, adjustable	grade		1 2 3 4 5
pressure min ... max. at 0 liter	bar		0.7 0.9 1.4 1.8 2.3
discharge, max. at 0 bar	l/min		17 19 24 27 31
		Viskosität max. 50 mm²/s (50 cSt)	
Noise level, 1 m distance	dBA	72	-----
Ambient temperature	°C	5 ... 40	5 ... 40
Filling volume Heat exchanger	liters	2.5	10
Reservoir	liters	3.2 … 8.4	3.2 … 8.4
Overall dimensions (WxDxH)	cm	40x55x127	40x55x127
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All measurements have been carried out at: rated voltage and frequency
ambient temperature: 20 °C Technical changes without prior notification reserved.

Pump data in relation to fluids with a specific density of 1 kg/dm^3

PRESTO PLUS

Temperature selection		digital
via Removable control module RD		indication on DIALOG-Display (LCD)
remote control via personal computer		indication on monitor
Temperature indication		VFD-Info-Display
		DIALOG-DISPLAY (LCD)
Resolution	K	0.01 from -9.99 °C to +249.99 °C
Pump pressure display		on VFD-Info-Display in five grades
Liquid level display		on VFD-Info-Display in five grades
Absolute **T**emperature **C**alibration		
(ATC1)	K	±3
(ATC2)	K	±9
Temperature control		ICC - Intelligent Cascade Control, self-optimizing Cascade, parameter can be called-in and modified
Working temperature sensor		Pt 100
Safety temperature sensor		Pt 100

Electrical connections:

Computer interface	RS232 or RS485
Programmer input -100 °C to 400 °C =	0 to 10 V or 0 to 20 mA or 4 to 20 mA
Temperature recorder outputs	0 to 10 V (0 V = -100 °C, 10 V = 400 °C)
	0 to 20 mA (0 mA = -100 °C, 20 mA = 400 °C)
	4 to 20 mA (4 mA = -100 °C, 20 mA = 400 °C)
Stand-by input	
External alarm device	24-0 V DC / max. 25 mA
External measurement and control sensor	Pt100, 4-lead technique
Control connector (10) Output voltage:	230 V~ / max. 0.1 A

Safety installations according to IEC 61010-2-010:

Excess temperature protection >TANK<	adjustable from 0 °C ... 320 °C
Excess temperature protection >RES<	adjustable from 0 °C ... 220 °C
Low level protection	float switch
Liquid level display	optical, 5-graded
Classification according to DIN 12876-1	class III FL
Supplementary safety installations	
High temperature warning function	optical + audible (in intervals)
Low temperature warning function	optical + audible (in intervals)
Supervision of the working sensor	plausibility control
Reciprocal sensor monitoring between working and safety sensors	difference >25 °C
Alarm indication	optical + audible (permanent)

Environmental conditions according to IEC 61 010-1:

- Use only indoor.
- Altitude up to 2000 m - normal zero.
- Ambient temperature: see Technical specifications
- Air humidity:
  Max. rel. humidity 80 % for temperatures up to +31 °C,
  linear decrease down to 50 % relative humidity at a temperature of +40 °C
- Max. mains fluctuations of ±10 % are permissible.
- Overvoltage category II
- Pollution degree 2

Caution:
The unit is not suitable for use in explosive atmosphere

Protection class according to IEC 60 529: IP31
The unit corresponds to Class I

Standards for interference resistance according to EN 61326-1
This unit is an ISM device classified in Group 1 (using high frequency for internal purposes) Class A (industrial and commercial range).

2.3. Cooling water connection

Cooling water pressure (IN / OUT)	max.	6 bar
Difference pressure (IN - OUT)		3.5 to 6 bar
Cooling water temperature		<20 °C

Notice: **Cooling water circuit**

Risk of oil leaking from the refrigeration system (compressor) of the recirculating cooler into the cooling water in case of a fault in the cooling water circuit!
Observe the laws and regulations of the water distribution company valid in the location where the unit is operated.

Notice:

Danger of corrosion of heat exchanger due to unsuitable quality of cooling water.

- Due to its high content of lime, hard water is not suitable for cooling and causes scale in the heat exchanger.
- Ferrous water or water containing ferrous particles will cause formation of rust even in heat exchangers made of stainless steel.
- Chlorinated water will cause pitting corrosion in heat exchangers made of stainless steel.
- Due to their corrosive characteristics, distilled water and deionized water are unsuitable and will cause corrosion of the bath.
- Due to its corrosive characteristics, sea water is not suitable.
- Due to its microbiological (bacterial) components, which settle in the heat exchanger, untreated and unpurified river water and water from cooling towers is unsuitable.
- Avoid particulate matter in cooling water.
- Avoid putrid water.

Recommended quality of cooling water:

pH	*7.5 to 9.0*
Sulfate [SO4 2-]	*< 100 ppm*
Hydrocarbonate [HCO 3-]/sulfate [SO4 2-]	*> 1 ppm*
Hardness [Ca 2+, Mg 2+]/[HCO 3-]	*> 0.5 °dH*
Alkalinity	*60 ppm < [HCO 3-] < 300 ppm*
Conductivity	*< 500 µS/cm*
Chloride (Cl -)	*< 50 ppm*
Phosphate (PO4 3-)	*< 2 ppm*
Ammonia (NH3)	*< 0.5 ppm*
Free chlorine	*< 0.5 ppm*
Trivalent iron ions (Fe 3+)	*< 0.5 ppm*
Manganese ions (Mn 2+)	*< 0.05 ppm*
Carbon dioxide (CO2)	*< 10 ppm*
Hydrogen sulfide (H2S)	*< 50 ppm*
Content of oxygen	*< 0.1 ppm*
Algae growth	*impermissible*
Suspended solids	*impermissible*

Operating instructions

3. Safety notes for the user

3.1. Explanation of safety notes

	In addition to the safety warnings listed above, warnings are posted throughout the manual. These warnings are designated by an exclamation mark inside an equilateral triangle. “Warning of a dangerous situation (Attention! Please follow the documentation).” The danger is classified using a signal word. Read and follow these important instructions.
	**Warning**: Describes a possibly highly dangerous situation. If these instructions are not followed, serious injury and danger to life could result.
	**Caution:** Describes a possibly dangerous situation. If this is not avoided, slight or minor injuries could result. A warning of possible property damage may also be contained in the text.
	**Notice:** Describes a possibly harmful situation. If this is not avoided, the product or anything in its surroundings can be damaged.

3.2. Explanation of other notes

	**Note!** Draws attention to something special.
	**Important!** Indicates usage tips and other useful information.

3.3. Safety instructions

Follow the safety recommendations to prevent damage to persons or property.
Further, the valid safety instructions for working places must be followed.

- Only connect the unit to a power socket with earthing contact (PE – protective earth)!
- The power supply plug serves as safe disconnecting device from the line and must be always freely accessible.
- Place the instrument on an even surface on a pad made of non-inflammable material.
- Do not stay in the area below the unit.
- Make sure you read and understand all instructions and safety precautions listed in this manual before installing or operating your unit.
- Set the safety temperature.
- Never operate the unit without bath fluid in the bath.

- Pay attention to the thermal expansion of bath oil during heating to avoid overflowing of the fluid.
- Prevent water from penetrating into the hot bath oil.
- Do not drain the bath fluid while it is hot!
  Check the temperature of the bath fluid prior to draining (by switching the unit on for a short moment for example).
- Employ suitable connecting tubing.
- Avoid sharp bends in the tubing, and maintain a sufficient distance from surrounding walls.
- Make sure that the tubing is securely attached.
- Regularly check the tubing for material defects (e.g. for cracks).
- Never operate damaged or leaking equipment.
- Always turn off the unit and disconnect the mains cable from the power source before performing any service or maintenance procedures, or before moving the unit.
- Always turn off the unit and disconnect the mains cable from the power source before cleaning the unit.
- Always empty the bath before moving the unit.
- Transport the unit with care.
- Sudden jolts or drops may cause damages in the interior of the unit.
- Observe all warning labels.
- Never remove warning labels.
- Never operate equipment with damaged mains power cables.
- Repairs are to be carried out only by qualified service personnel.

Some parts of the bath cover and the pump connections may become extremely warm during continuous operation. Therefore, exercise particular caution when touching these parts.

Caution:

The temperature controlling i.e. of fluids in a reactor constitutes normal temperature system practice.

We do not know which substances are contained within these vessels.
Many substances are:

- inflammable, easily ignited or explosive
- hazardous to health
- environmentally unsafe

i.e.: **dangerous**

The user alone is responsible for the handling of these substances!

The following questions shall help to recognize possible dangers and to reduce the risks to a minimum.

- Are all tubes and electrical cables connected and installed?
  Note:
  sharp edges, hot surfaces in operation, moving machine parts, etc.
- Do dangerous steams or gases arise when heating?
  Is an exhaust needed when working?
- What to do when a dangerous substance was spilled on or in the unit?
  Before starting to work, obtain information concerning the substance and determine the method of decontamination.

Caution: **Escape of vapors / gas**

The necessity of degassing requires that a closed system is not entirely sealed. Especially at increased working temperatures vapor / gas may escape.
Ensure sufficient ventilation at the place of installation!

Notice:

When you have finished the application, it is recommended to keep on circulating the liquid in the bath or the external system for some time. Simultaneously set the working temperature to +20 °C to allow the temperature in the system to decrease slowly.
Thus fractional over-heating of the bath liquid is prevented.

Notice:

Please check the safety device from time to time.

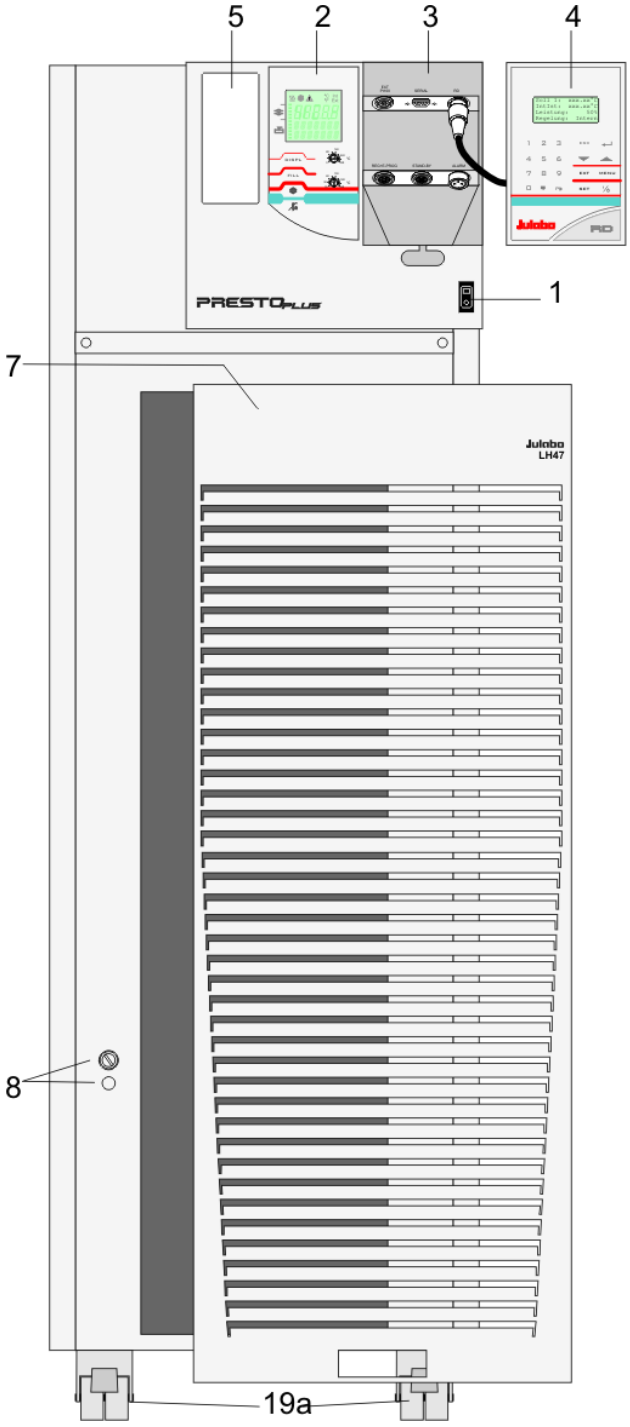
- Excess temperature protection according to IEC 61010-2-010
  With a screw driver turn back the adjustable excess temperature protection until the shut-down point (actual temperature).
- Low level protection
  To check the function of the float of this unit it cannot be operated manually.
  The 5-graded level display should therefore be observed whenever refilling.
  If the bath liquid thickens or cracks, the instrument should be cleaned and checked by qualified personnel.

WARNING

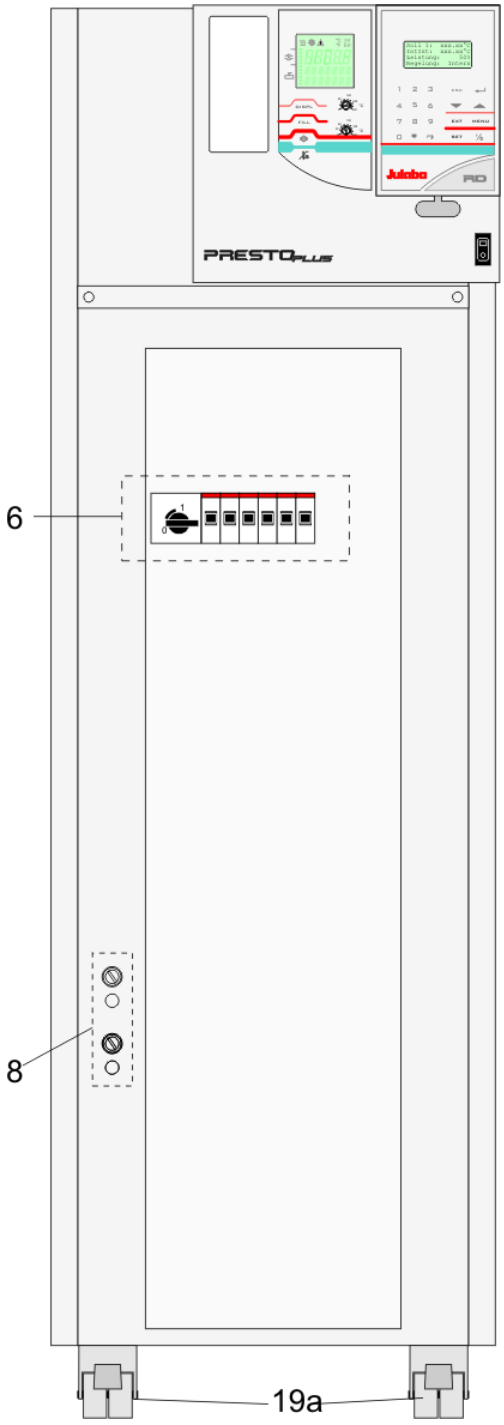
This product contains chemicals known to the state of California to cause cancer, birth defects or other reproductive harm.

4. Operating controls and functional elements

Front view LH47 LH50



air-cooled



water-cooled

1 Mains power switch, illuminated

2 Local operating board

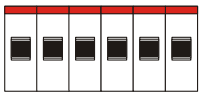
3 Socket board - description see page 18

4 Removable control module RD

5 Filling funnel (hinged)

6 

Motor protection circuit breaker for compressor motor



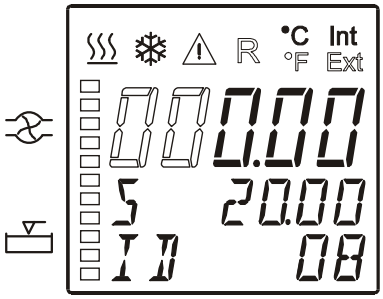
2 Mains circuit breakers (resettable) 10 A for the pump-motor
4 Mains circuit breakers (resettable) 16 A

7 Venting grid, removable

8 Drain with drain port

2 Local operating board

2.1



VFD-Info-Display

Header: Control indicators see section 2.2

Line 1: Actual value Int or Ext

To swap, press the key DISPL (see below)

Line 2: Working temp. setpoint, constantly S xxx.xx

or indication of the safety temperature (TANK)

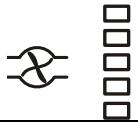
Line 3: Miscellaneous values

To swap, press the key (see below)

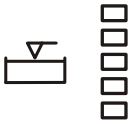
or indication of the safety temperature (RES)

2.2 ≋ ❄ ⚠ R
°C Int
°F Ext

Control indicators in the header:
Heating / Cooling / Alarm / Remote control
Temperature indication Internal or External actual value
Temperature indication in °C or °F



Display for the adjusted pump pressure stage (five grades), adjustable via the key SET.



Liquid level display (five grades)
for the reservoir.

2.3 

Key to swap line 3 on the VFD

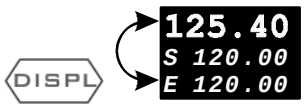
ID xx Identification no. of control module RD

L xx Capacity in %

E xxx.xx or I xxx.xx Actual value (external or internal)

P x.xx Pump pressure in bar

2.4 Int



Key to swap line 1 on the VFD

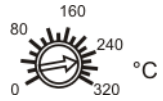
Actual value Int or Ext alternating with line 3

2.5 

Key to indicate the safety temperature on the VFD

Line 2: TANK - Safety temperature in internal bath

Line 3: RES - Safety temperature in internal reservoir

2.6 

Adjustable excess temperature protection (safety temperature)
Used for setting the safety temperature in the internal bath, called "TANK" on the display

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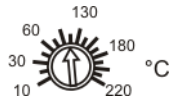
2.7 

Adjustable safety temperature.
Used for setting the safety temperature in the internal reservoir, called "RES" on the display

---

2.8 

Key for automatic filling and air purge of the unit as well as the connected external system.

---

3 Socket board

3.1 

REG+E-PROG

Programmer input and temperature recorder output

3.2 

STAND-BY

Stand-by input (for external emergency switch-off)

3.3 

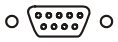
ALARM

Alarm output (for external alarm signal)

3.4 

EXT. Pt100

Connector for external measurement and control sensor

3.5  SERIAL

Interface RS232/RS485

3.6 

RD

Connector: control cable of control module RD

4 Control module RD

4.0

```
Setp:   120.00°C
IntAct   21.00°C
ExtAct:  20.00°C
Control:  Intern
```

DIALOG-DISPLAY (LCD) **Standard indication**

Line 1:	Setpoint	in °C
Line 2:	Internal actual value	in °C
Line 3:	External actual value	in °C
Line 4:	Control type: internal / external control Indicating messages (e. g. warnings)	

4.1 I/⏻

Start / stop key

To switch the circulation pump, heating element and cooling unit.

4.2 SET

SET Menu Key - Indicating and setting setpoint values

Set the following values:

```
>Setp.: 120.00°C
 Overt.:255.00°C
 Subtmp:-55.00°C
 St.Pump:   2
```

in	Line 1:	the working temperature	**Setp.:**
	Line 2:	the high temperature limit	**Overt.:**
	Line 3:	the low temperature limit	**Subtmp:**
	Line 4:	the pump pressure stage	**St.Pump:**

4.3 EXT

Control type: internal / external control

To swap, the unit has to be in the STOP MODE.

Indicated in line 4 on the DIALOG-DISPLAY (LCD)

4.4 MENU

MENU key - for selecting the menu functions

(Menu see page 40)

```
>Configuration
 Control param.
 Profile Start
 Int. Programmer
```

4.5 ▼ ▲

Cursor keys - Select menu items

4.6 P▸

P-key Selecting parameters

4.7 ESC

Escape key
1) Cancel entries
2) Return to a higher menu level

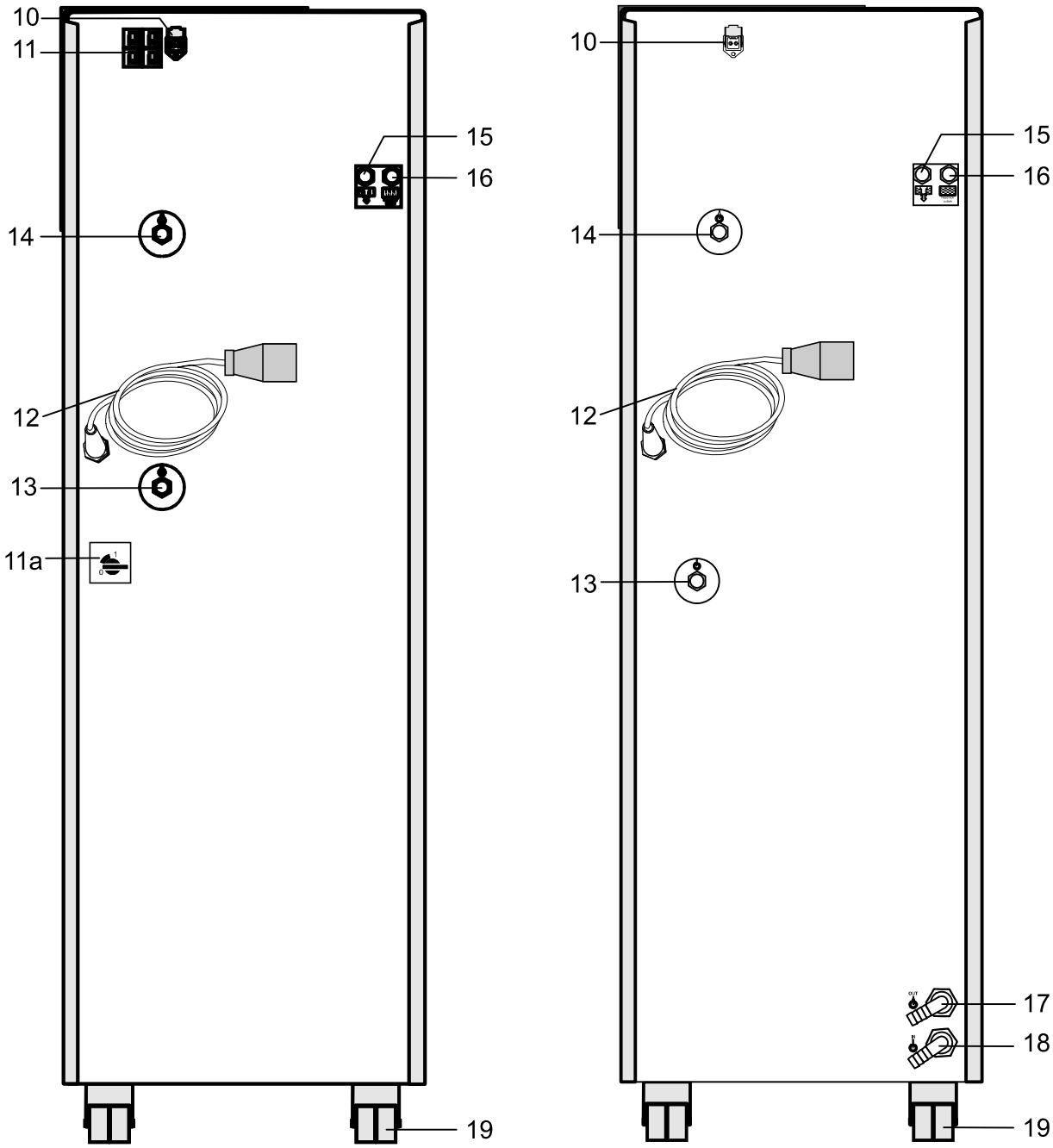
4.8 ↵

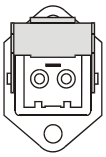
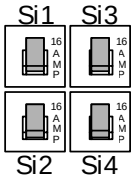
Enter key
1) Store value / parameter
2) Next lower menu level

4.9 0 .... 9 -

Numeric keypad: numerals 0 to 9; minus / decimal point

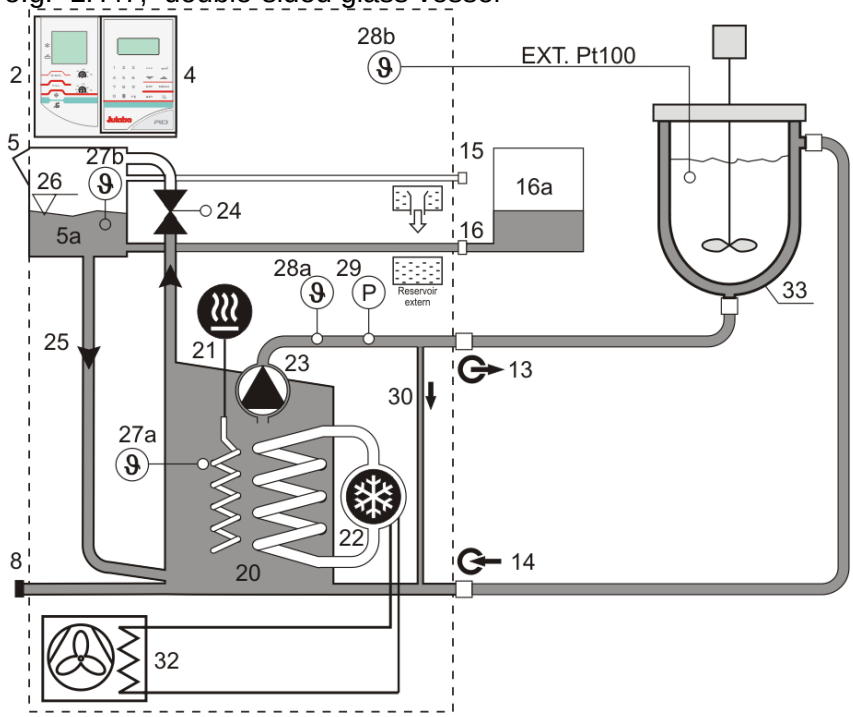
Rear



10		Control connector 230 V / max. 0.1 A
11		4 Mains circuit breakers (resettable) 16 A F1 and F3 → Compressor F2 and F4 →Heater, Pump
11a		Motor protection circuit breaker for compressor motor
12		Mains power cable with plug
13 + 14		Pump connectors Return Feed M16x1
15		Overflow connector M16x1
16		Connector for expansion vessel M16x1
17 + 18		Cooling water connectors LH41 G3/4" external thread IN - inlet OUT - outlet
19		Castor without brake (at the back)
19a		Castor with brake (at the front)

4.1. The Presto Plus principle with closed external system

e.g. LH47; double-sided glass vessel



Operating:
The operation of the temperature system and the indication is effected via the local control panel (2) and the removable operating device RD(4).

Filling :
First connect the external consumer. The menu option >Mode< is set on >Fill<. The unit is filled at the hinged filling funnel (5) via the internal reservoir (5a). The bath liquid spreads from here into the external reservoir (16a) and into the heat exchanger (20).

The filling pipe (25) represents narrows. Therefore the filling should be done slowly. The air from the heat exchanger (20) escapes via the venting valve. In a first step approximately 2,6 liters of bath liquid is filled in until the level indication indicates 3 or 4 batons (see –Filling volume- page 29). Then, by pressing the key FILL an automatic filling and venting mode with activation of the circulating pump (23) is started. In intervals the tempering liquid is pumped via connection (13) into the external system (33) and led back into the heat exchanger (20) via connection (14). At the end of the filling process the menu option >Mode< has to be set on >Sys close<.

Working:
In case of a closed external system the filling pipe (25) remains open and allows a change in volume of the bath liquid caused by temperature during operation. In case of emergency it has to be possible that the expanding bath liquid can drain off at the overflow (15) into a suitable vessel. If necessary the external reservoir (16a) can be mounted at connection (16).
The temperature system can be cooled with air (32 / LH47) or water (LH50). Connect the cooling water to the lead in for cooling water (18). Lead the outflow for cooling water (17) into the locally provided drain respectively backflow.

The temperature system is started with the key I/⏻. The heating (21), the cooling aggregate (22) and the circulating pump (23) start according to the desired adjustments at the operating device RD (4). In the line to the pump exit (14) the pump pressure (29) and the actual temperature of the internal control sensor (28a) is permanently measured. If the temperature control has to be effected externally a Pt100 external sensor (28b) has to be connected and switched over to external control at the operating device RD(4).

Safety:
In the internal reservoir (5a) there are the level sensor (26) as well as a safety sensor (27b).
The safety sensor (27a) as high temperature protection is located directly at the heater (21).
If the external circuit is interrupted (e.g. with a shut-off valve), an emergency circuit is maintained via an internal Bypass (30).

5. Preparations

5.1. Bath fluids

Caution:
Carefully read the safety data sheet of the bath liquid used, particularly with regard to the fire point!
If a bath fluid with a fire point of ≤65 °C is used, only supervised operation is possible.

Recommended bath liquids for external, c l o s e d s y s t e m s :

See website for list of recommended bath fluids.
Contact: see page 6

Caution:

Fire or other dangers when using bath fluids that are not recommended:
Please contact JULABO before using other than recommended bath liquids.
JULABO assumes no liability for damage caused by the selection of an unsuitable bath fluid.
Unsuitable bath fluids are fluids which, e.g.,

- are highly viscous
  (much higher than 50 mm^2 / S at the respective working temperature)
- have a low viscosity and have creep characteristics
- have corrosive characteristics or
- tend to crack.

No liability for use of other bath fluids!

ATTENTION: The maximum permissible viscosity is 50 mm^2 / S·

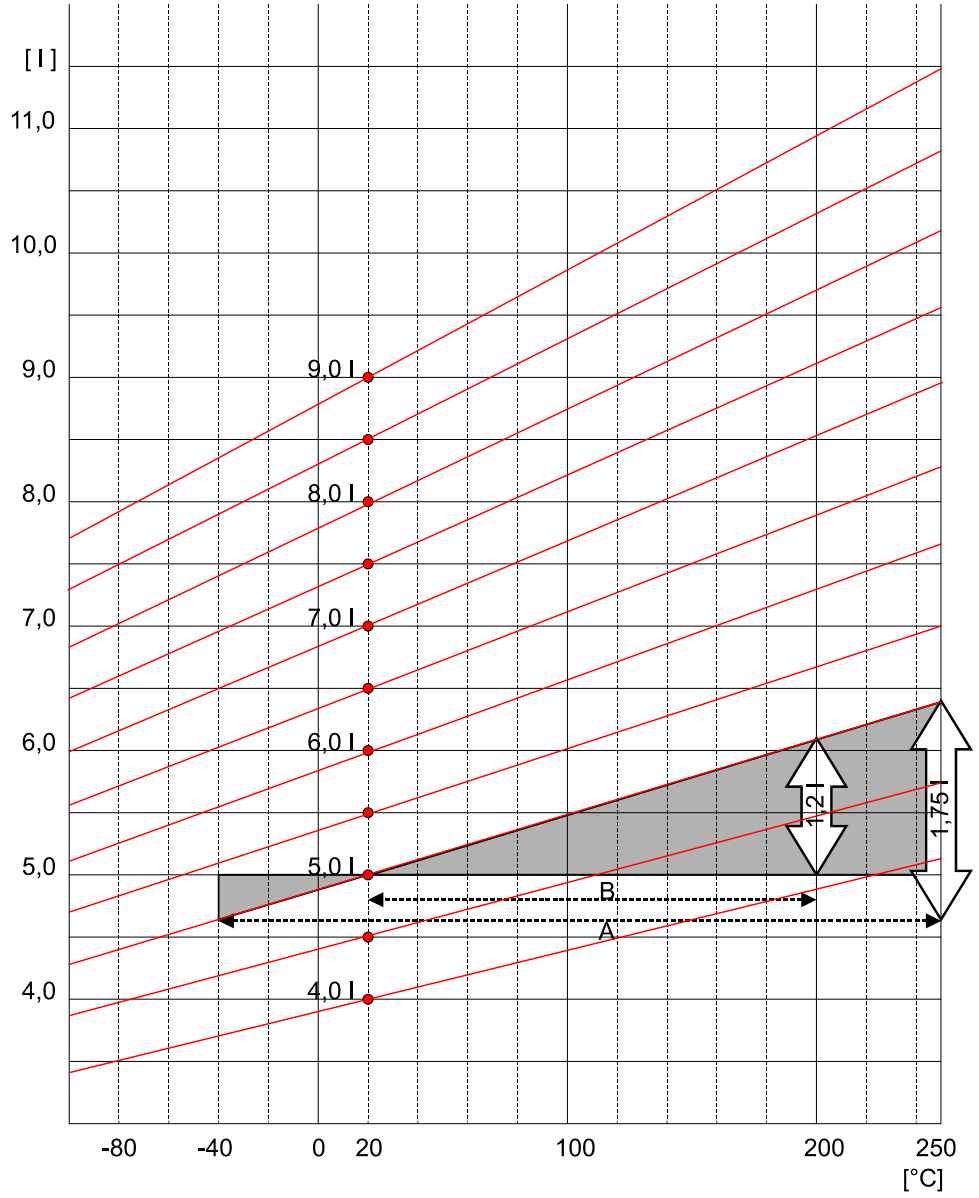
Caution:

The use of water in purified or unpurified form is not allowed.
Examples: Tap water, distilled water, water-glycol mixture, $CaCl_2$-brine

Important notice concerning the recommended bath liquids:

- Bath liquids with a range of application above the fire point ?
- This temperature system is mainly operated in a **closed external** system (loop circuit). The contact of the bath liquid with atmospheric oxygen only takes place in the internal reservoir, which is not located directly in the termperature circuit.
- A safety device supervises and controls the the temperature in the internal reservoir.
- The temperature of the bath liquid is maintained constant at approx. +20°C
- The safety device with an adjustable temperature value >RES< works independently from the control circuit. When actuating this safety device (too much hot fluid streams into the internal reservoir) the temperature system is switched off all-polo and permanently.
- **Adjust the safety temperature >RES< at at least 20 K below the fire point of the bath liquid.**

Diagram 1: JULABO Thermal oils
Change in volume in dependence on the temperature of bath liquid.



Example A: Filling quantity at ambient temperature 5 liters
Intended working temperature range -40 °C bis +250 °C
Change in volume caused by temperature 1,75 liters
Here an external expansion vessel is required (Order no.: 8 970 830)

Example B: Filling quantity at ambient temperature 5 liters
Intended working temperature range +20 °C bis +200 °C
Change in volume caused by temperature 1,2 liters
Here no external expansion vessel is required
(see table „Filling volume“ Page 29).

5.2. Tubing

Recommended tubing:
Metal tubing, triple insulated, M16x1, Temperature range -100 °C ... +350 °C

Order No.	Length
8 930 209	0.5 m
8 930 210	1.0 m
8 930 211	1.5 m
8 930 214	3.0 m

Metal tubing, insulated, M16x1, Temperature range -50 °C ... +200 °C

Order No.	Length
8 930 220	0.5 m
8 930 221	1.0 m
8 930 222	1.5 m
8 930 223	3.0 m

Pressure max.	6.0 bar	at	+20 °C
	4.6 bar	at	+200 °C
	3.8 bar	at	+350 °C

Warning:

Tubing:
At high working temperatures the tubing used for temperature application and cooling water supply represents a danger source.
A damaged tubing line may cause hot bath liquid to be pumped out within a short time.
This may result in:

- Fire hazard
- Explosion hazard
- Burning of skin
- Difficulties in breathing due to hot atmosphere

Safety recommendations

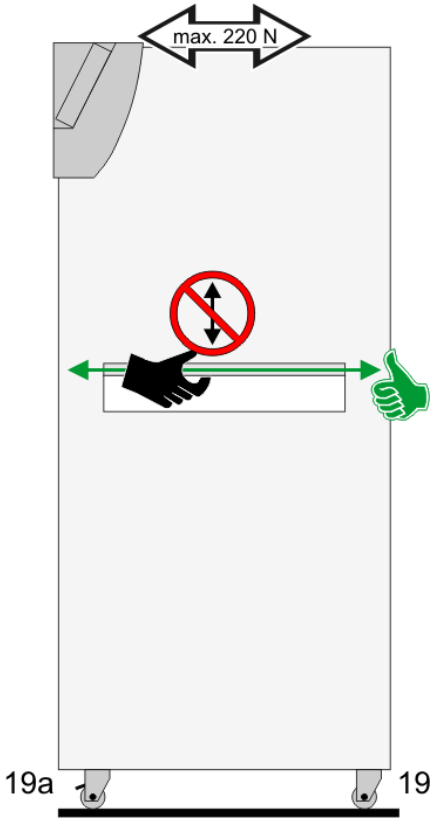
- Employ suitable connecting tubing.
- Make sure that the tubing is securely attached.
- Avoid sharp bends in the tubing, and maintain a sufficient distance from surrounding walls.
- Regularly check the tubing for material defects (e.g. for cracks).

5.3. Installation

Caution:

Danger of tipping

- Lift the unit only with a crane using the lifting strands and the wooden crate (see pictures on page 2)
- The recessed grips on the side are **not** suited for lifting the unit!
  Careful positioning of the unit on its rollers is permitted.
- Max. permissible application of force to the upper side 220 N.
  Danger of tipping if larger force is applied.
- The unit is not suitable for use in explosive environment



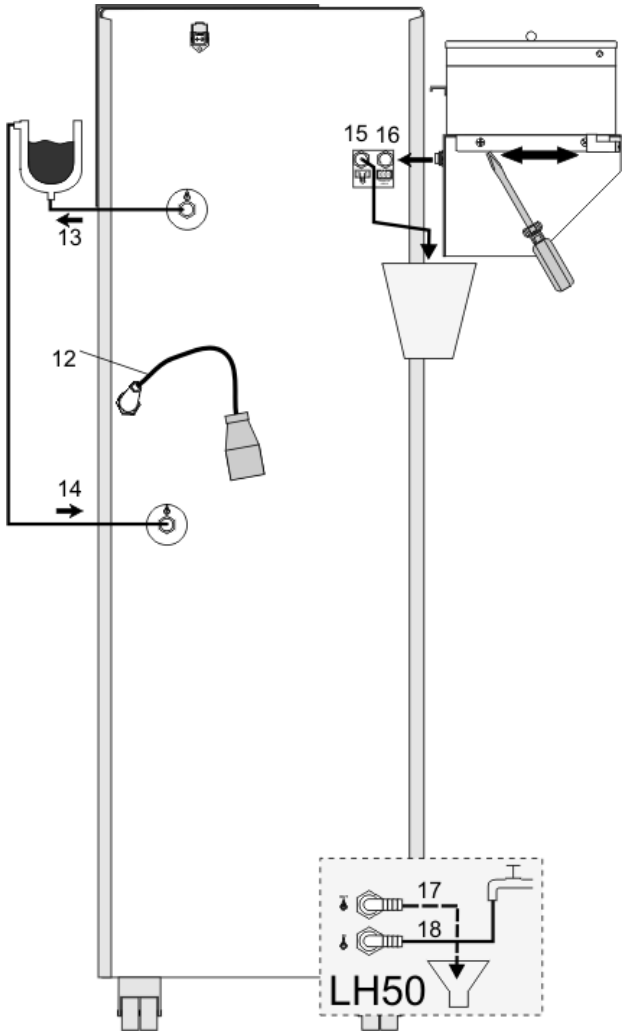
- Place the unit on an even surface on a base made of **nonflammable** material. Lift the handle (6) and using the castor (19) move the unit to the intended location.
- Keep at least 20 cm of open space on the front and rear venting grids.
- Do not install the unit in the immediate vicinity of heat sources and do not expose it to sunlight.
- Before operating the unit after transport, wait about one hour after setting it up. This will allow any oil that has accumulated laterally during transport to flow back down thus ensuring maximum cooling performance of the compressor.

- The place of installation should be large enough and provide sufficient air ventilation to ensure the room does not warm up excessively because of the heat the instrument rejects to the environment. (Max. permissible ambient temperature: 40 °C).
  For a fault (leakage) in the refrigeration system, the standard EN 378 prescribes a certain room space to be available for each kg of refrigerant.
  The refrigerant quantity is specified on the type plate.
  > For 0.48 kg of refrigerant R404A, 1 m^3 of space is required.

5.4. Connect the external system

The temperature systems are designed for temperature application to closed, external systems (loop circuits). To profit from the system's rapid performance, ensure the tubing line between the temperature system and the connected external system is as short as only possible.

Caution:
Securely attach all tubing to prevent slipping.



Connecting the external system:

- Remove the cap nuts from the pump connectors (13, 14) and using tubing connect the external system (M16x1 / wrench 19 mm).

  To prevent the formation of bubbles in the loop circuit, the pressure line (13) is to be connected to the lower nozzle of the external system.
  Also see the description on page 22

- Connect a piece of tubing to the overflow connector (15) and drain into a suitable vessel. (M16x1 / wrench 19 mm), which always has to be placed lower than the exit „Overflow“.

- If required, the connector (16) may be used for connecting an expansion vessel. (M16x1 / wrench 19 mm)

  The use of an expansion vessel is depending on the highest temperature and the volume of the bath liquid in the loop circuit.
  (see diagram 1 page 24).

- Close the expansion vessel with the cover Das

Order No. 8 970 831 Expansion vessel 5 liters

Note:
At the desired highest temperature, drain overflowing bath liquid into a suitable vessel via the connector (15). If at the desired lowest temperature, low liquid level alarm is not triggered, there is no need to use an external expansion vessel.

Important: Leakage on shaft sealing

The shaft sealings of the pump are never absolutely tight. But this does not have an impact on the proper functioning of the instrument. The slight leakage that appears ensures good sliding properties of the sealing. Any excess fluid is drained via the overflow connector (15).

Warning:
An external expansion vessel is heated up by the wam outgoing air, especially in small rooms or if there is not enough distance between the wall and the unit.
In this case only bath liquids with a fire point of ≥100 °C are allowed to be used.

Notice:

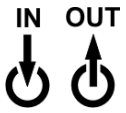
If an expansion vessel is not used, make sure the connector (16) is closed with a cap nut.
If an external expansion vessel is mounted later, a part of the bath liquid should be drained before (see chapter Emptying on page 33). It might be helpful to put the castors at the back on a base which is approximately 10-15 mm high. So the bath fluid can be collected in the front part of the internal reservoir.

5.5. Cooling water connection LH 50

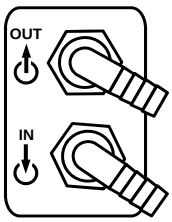
Notice: **Cooling water circuit**
Risk of oil leaking from the refrigeration system (compressor) of the recirculating cooler into the cooling water in case of a fault in the cooling water circuit!
Observe the laws and regulations of the water distribution company valid in the location where the unit is operated.

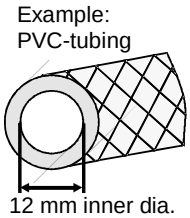
Even high quality heat exchangers as they are installed in our equipment can be damaged by unsuitable cooling water.
The quality of the cooling water depends on the local conditions.
The heat exchanger may become leaky due to corrosion or it may become clogged due to particulate matter

Caution:
Securely attach all tubing to prevent slipping.



- Supply cooling water via the inlet (18).
- Conduct the cooling water via the outlet (17) in the respective sink or return flow circuit.





Cooling water connectors G3/4" external thread
Tubing 12 mm inner dia. tubing

Cooling water see page 12

5.6. Power connection

Caution:

- Only connect the unit to a power socket with earthing contact (PE – protective earth)!
- The power supply plug serves as a safe disconnecting device from the line and must be always easily accessible.
- Never operate equipment with damaged mains power cables.
- Regularly check the mains power cables for material defects (e.g. for cracks).
- We disclaim all liability for damage caused by incorrect line voltages!

Check to make sure that the line voltage matches the supply voltage specified on the identification plate.
Deviations of ±10 % are permissible

- Connect the mains plug (12) to a power socket with earthing contact (PE – protective earth)!

5.7. Filling

Caution:

Take care of the bath liquid's changing volume varying with the working temperature of the Presto temperature system.

Guideline:
A volume change of 12 % per 100 °C temperature variation is to be considered..
The maximum change in volume in the internal reservoir for the different models is included in the table below.

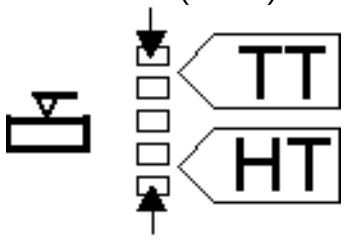
Filling is performed in two sections.
In section 2, the temperature system starts an automatic filling process enabling convenient filling.

Notice:
First connect the external system! (see page 26)

Take care no bath liquid enters the interior of the unit.

Filling volume (**without** external system connected)	LH47 approx. liters	LH50 approx. liters
- in the heat exchanger	2,5	10
- in the internal reservoir	2,5	10
	8.4	8,4

Indication max:
11 liters (LH 47)
18.5 liters (LH 50)



Indication min:
3.0 liters (LH 47)
10.5 liters (LH 50)

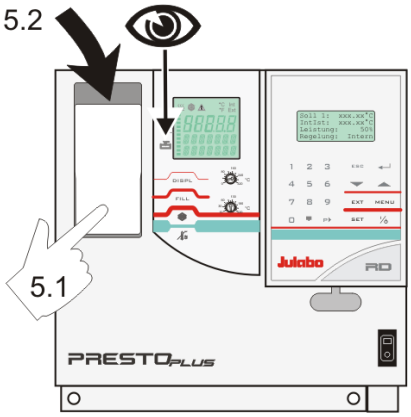
Recommendation:

For filling, use for example an approx. 2 liters measuring jug.

Select the bath liquid suitable for the temperature application task. (see also diagram 1 page 24).

For temperature applications to +250 °C fill up to marker "HT", for applications to for example –50 °C fill up to marker "TT".

5.7.1. Filling of external, closed systems



Section 1

- Connect the unit to a mains power socket (see page 29) and turn on the unit with the mains power switch (1).
  During the self-test all segments of the VFD-Info-Display, all control indicators and the DIALOG-DISPLAY light up.
  After the self-test, the VFD-Info-Display signals low liquid level alarm. >CODE 14< and a signal tone sounds.
- Press (5.1) to open the filling funnel (5). Slowly pour in bath liquid into the opening (5.2) and observe the liquid level display.
- Watch the level indication . During the filling procedure 3 or 4 steps of the level indication **can** light-up, in the end they **should** light-up.

Section 2

- Turn the unit off and on again with the mains power switch (1). Wait until the self-test is completed.
- Press the key FILL to start the automatic filling process.
  As soon as the pump pressure indication in the 3rd line of the VFD-Info-Display
  („P X.XX“) has scaled up to at least 0.1 bar, the tempering liquid is pumped into the external system. In intervals of 10 seconds bath liquid is pumped into the external system - air purge is carried out in the breaks.
  Notice: The filling mode has to stay activated for **at least** 5 minutes in order to fully de-air the system.
- The liquid level in the unit falls.
  In case of a WARNING >CODE 40< again slowly fill in tempering liquid into the opening (5.2).
  In case of a ALARM >CODE 14< return to the final condition of section 1 and restart section 2.
- If the liquid level display remains unchanged after some minutes, complete filling according to the application task.
  See page 29 - marker "HT" or "TT".
- Press FILL to finish the automatic filling process.
- The message >SELECT SYSTEM<is a demand to make now an adjustment in the menu >Pump<.
  In the sub >Pump< the unit has to be set on >Mode:< >sys close< .
  (see page 31 **Adjusting Mode:**)
- The unit is now ready for operation .

```
Pump
>Pump          OFF
 Mode:Sys close
```

Notice:
In the >Mode< > fill < or. >drain<>SELECT SYSTEM< is shown when starting.

The message >SELECT SYSTEM<is a demand to make an adjustment in the menu >Pump<.
The insertion is effected cyclicly until the adjustment has been made.

Adjusting Mode:

- Notice concerning the filling
  The temperature system was emptied last, therefore the menu option >Mode< now still stands on >drain<. In the configuration of this unit the >Mode< >fill< means the same as >drain< and therefore does not have to be adjusted.

Explanation of terms:
>Mode: sys close< stands for closed, external system (Presto principle page 22)

Press the respective keys in the following order:

1.	MENUE key	MENU	1x
2.	Cursor key	▼	up to Submenu "Pump"
3.	Enter key	↵	1x
4.	Cursor key	▼	1x up to "Pump"
5.	P- key	P▸	sys close / fill / drain
6.	Enter key	↵	1x
7.	Escape key	ESC	2x

The DIALOG-DISPLAY (LCD) helps to follow up the individual settings.

The VFD-Info Display shows the recently chosen operating status for approx. 3 seconds.

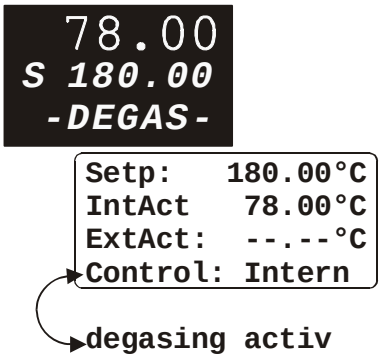
↵	Switch over to > sys close <	CLOSED SYSTEM
↵	Switch over to > fill <	FILL SYSTEM
↵	Switch over to >drain<	DRAIN SYSTEM

5.8. Degasifying

If the temperature system is operated an automatic degasifying is carried out after the start.
During the degasifying unwelcome components of the bath liquid are are drawn off .

Examples:
- Air bubbles which were enclosed in the bath liquid during the filling for the unit.
- Slightly volutile components which are eventually in the fluid.
- Eventually existing water components, which reached the bath liquid during the storage.

The automatic degasifying is a part of the program in the unit, which is always active in the background. Experience shows that the activity is only noticed after a first or new filling of the unit.
During the heating-up phase, e.g. to a working temperature of 180°C, the VFD-Info-Display shows >DEGAS<.
Parallely to this, in line 4 in the DIALOG-DISPLAY the message >Degasifying active< is inserted. In this phase the temperature rise is stopped, the pump motor and the ventilation valve are activated alternately (audible). During the heating-up phase this degasifying mode can be repeated with the most different temperatures.



ⓘ The automatic degasifying can be stopped by :

Operating the key ⏻
or
adjusting the set temperature on at least 50°C lower than the current set temperature.

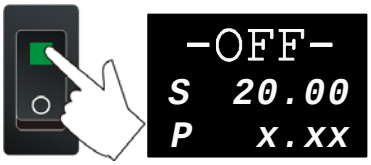
Caution: Escape of vapors / gas

- The necessity of degassing requires that a closed system is not entirely sealed. Especially at increased working temperatures vapor / gas may escape.
  Ensure sufficient ventilation at the place of installation!
- With different substances the change-over to the steam phase and therefore also an enormous change of volume is carried out very quickly. The fluid, for which there is no more room in the internal reservoir, now has to drain off controlled via the overflow.
  Important:
  Connect a piece of tubing to the overflow connector (15) and drain into a suitable vessel. (min. 2 liters) (M16x1 / wrench 19 mm), which always has to be placed lower than the exit „Overflow“

5.9. Draining

Notice

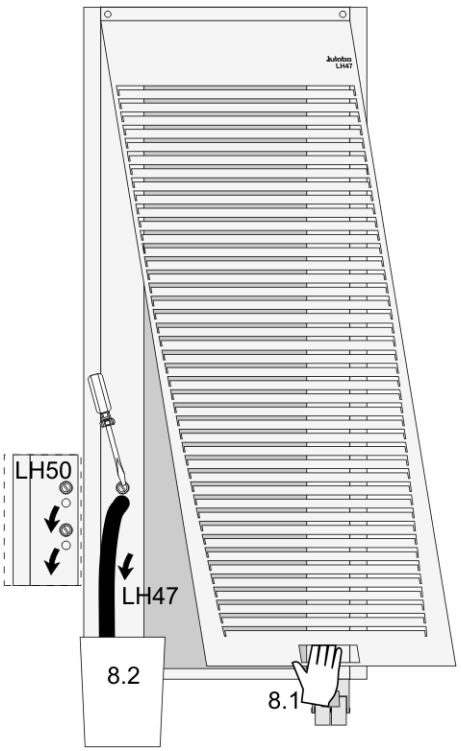
- Do not drain the bath fluid while it is hot or cold !
  Check the temperature of the bath fluid prior to draining (by switching the unit on for a short moment, for example).
- Store and dispose the used bath fluid according to the laws for environmental protection.



- Turn on the temperature system with the mains power switch or
  press the stop key ⏻ to make the unit enter the STOP-MODE.
- In the submenu >Pump<, set the menu items >Mode< to >drain<.
  (see page 31 **Adjusting Mode:**)

```
Pump
>Pump          OFF
 Mode:       drain
```

ⓘ The reset to another mode can only take place after the next filling.
Reason: During the >ALARM – CODE 14< there is no possibility for access to the menu functions !



- Pull the venting grid (8.1) to the front and remove.
- Place a suitable vessel (8.2) for accepting the used bath liquid underneath the drain.
- Slide a short piece of tubing onto the drain port and hold the end into the vessel.
- Unscrew the drain screw by some turns.
  The LH50 has two drain screws. Both have to be used.
- The liquid level in the unit falls.
  Now the VFD-Display of the unit should show low level, WARNING >CODE 40< and then ALARM >CODE 14<.
  Press enter ↵ to quit the audible signal.

ⓘ Drain the external system:
At the upper nozzle of the external system, disconnect the tubing to the pump connector "return" (14) until an air stream moves in.
(see sketch on page 26)

- **Tighten** the **drain screw** after draining the unit.

The internal reservoir should additionally be emptied via the connection for the expansion vessel (16) on the rear side of the temperature system.

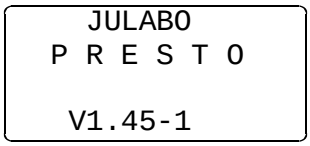
(Cleaning the unit see page 70)

6. Operating procedures

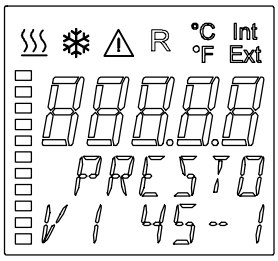
6.1. Switching on / Selecting the language

Switching on:

- The unit is operated by pressing the mains power switch (1). The integrated pilot lamp illuminates.



ⓘ During the self-test all segments of the VFD-Info-Display, all control indicators and the DIALOG-DISPLAY light up. Then the software version number (example: V1.45-1) appears for a short moment and the message "**OFF**" indicates the unit is ready to operate.

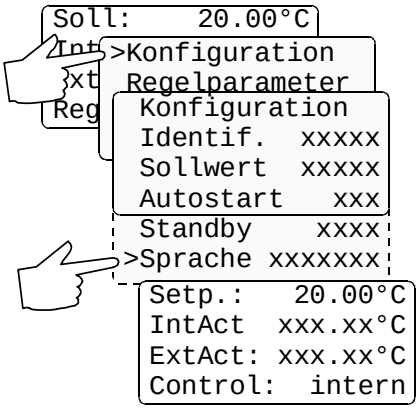


ⓘ Message >WAIT< when adjusting >Mode: sys close<:. During the message >WAIT< the ventilation valve is opened for 10 seconds. So, the air which has eventually been collected during the standstill, can escape.

ⓘ The unit returns to the previous operating mode that was active before it was turned off:
keypad control mode
(manual operation via the unit itself/RD)
or
remote control mode
(operation via PC).

Selecting the language:

There are two options for the language of the DIALOG-DISPLAY (LCD): German or English. Select the desired language in the MENU level under the submenu >Configuration.



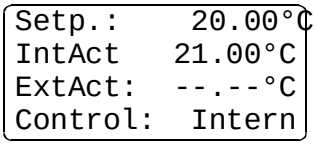
Press the respective keys in the following order:

1.	MENU key	MENU	1x
2.	Enter key	↵	1x
3.	Cursor key	▼	up to Submenu "Sprache/Language"
4.	P-key	P▸	1x
5.	Enter key	↵	1x
6.	Escape key	ESC	2x

The DIALOG-DISPLAY (LCD) helps to follow up the individual settings (example: swap the language from German to English).

7. Manual operation

7.1. Start - Stop



Start:

- Press the start/stop key ⏻.
  The actual bath temperature is displayed.

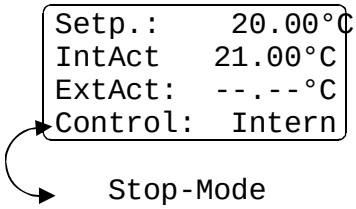
  For **approx. 3 seconds** the VFD-Info-Display shows the adjusted >Mode< .

  Adjustment > sys close < → CLOSED SYSTEM

  The temperature system runs.

Notice:
The message >SELECT SYSTEM<is a demand to make an adjustment in the menu >Pump< according to the connected system. The insertion is effected cyclicly until the adjustment has been made
(see page 31 **Adjusting Mode:**)
In the >Mode< > fill < or. >drain<>SELECT SYSTEM< is shown when starting.

Notic:
For physical reasons, refrigeration units provide full cooling performance only after some minutes. After the start up to 5 minutes can go by, until the cooling capacity is given.

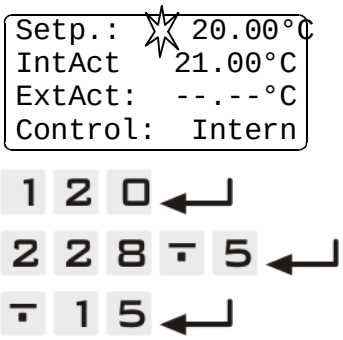


Stop:

- Press the start/stop key ⏻.
  The VFD indicates "OFF" and the message STOP-MODE flashes in line 4 on the LCD.

The unit also enters the safe operating state "OFF" after a mains power interruption. The temperature values entered via the keypad remain in memory. With the temperature system in keypad control mode, press the start/stop key to restart operation. With the instrument in remote control mode, the personal computer must first resend the parameters set via the interface before the temperature system may be restarted.

7.2. Direct setting of the working temperature



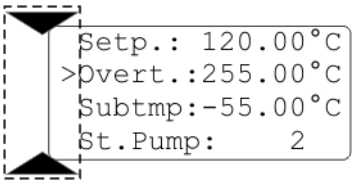
This setting may be carried out with the temperature system being in operating state Start or Stop!

- The value previously set appears on the DIALOG-DISPLAY (LCD) (example: 20.00 °C).
  A flashing segment indicates that a value needs to be entered.
- Use the keypad to enter the new value and press enter ↵ to store the selected value.

  (examples: 120.00 °C; 228.50 °C; -15.00 °C).

7.3. Settings in the SET menu

SET



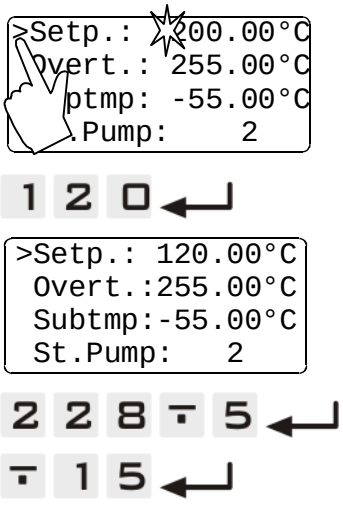
- Press the key SET to call up the SET menu. It is then indicated on the DIALOG-DISPLAY (LCD).

  Set the following values:

in	Line 1:	the working temperature in °C	**Setp.:**
	Line 2:	the high temperature limit in °C	**Overt.:**
	Line 3:	the low temperature limit in °C	**Subtmp:**
	Line 4:	the pump pressure stage	**St.Pump:**

- Enter the desired values via the keypad. Settings may be carried out with the temperature system being in operating state Start or Stop!
- Use the cursors ▲ ▼ to swap the lines.
- Press escape ESC to quit the SET menu.

7.3.1. Setting the working temperature



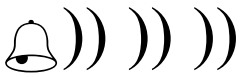
>Setp: **Setting the working temperature**

① Setting in line 1.
The value previously set appears on the DIALOG-DISPLAY (LCD) (example: 100.00 °C).
A flashing segment indicates that a value needs to be entered.

② Use the keypad to enter the new value
(examples: 120.00 °C; 228.50 °C; -15.00 °C).

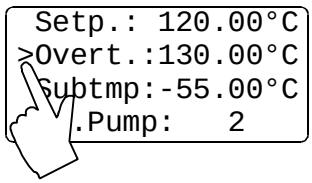
③ Press enter ↵ to store the selected value.

7.3.2. Warning functions



The high and low temperature warning functions accompany the working temperature value. An audible signal sounds in intervals when the actual temperature exceeds one of the set limits (patented).
The corresponding message appears in line 4 on the DIALOG-DISPLAY (LCD).

>Overt: Setting the high temperature limit

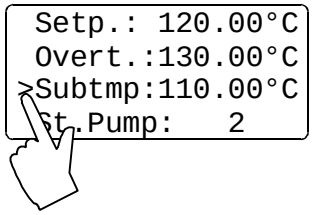


① Setting in line 2.
The value previously set appears on the DIALOG-DISPLAY (LCD).
A flashing segment indicates that a value needs to be entered.

② Use the keypad to enter the new value
(examples: 130.00 °C; -13.00 °C).

③ Press enter ↵ to store the selected value.

>Subtmp: Setting the low temperature limit



① Setting in line 3.
The value previously set appears on the DIALOG-DISPLAY (LCD).
A flashing segment indicates that a value needs to be entered.

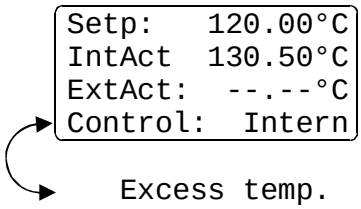
② Use the keypad to enter the new value
(examples: 110.00 °C; -17.00 °C).

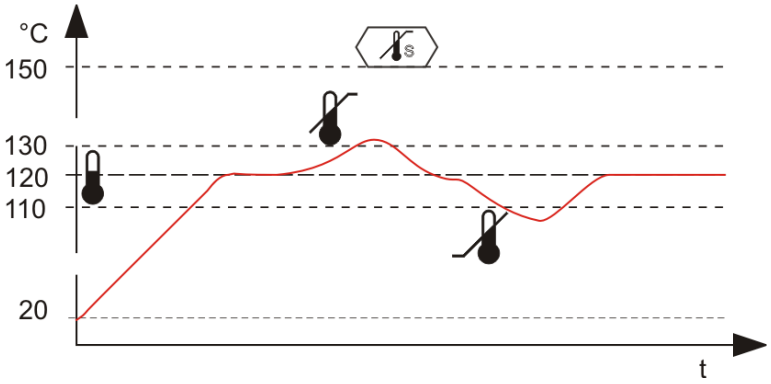
③ Press enter ↵ to store the selected value.

Note:

The warning functions will only be triggered when the actual bath temperature, after start from the "OFF" or "rOFF" mode, lies within the set limits for 3 seconds.

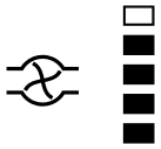
Example:





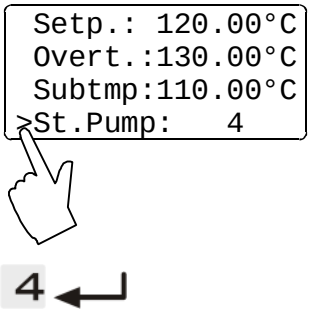
The corresponding message appears in line 4 on the DIALOG-DISPLAY (LCD).

7.3.3. Setting the pump pressure stage



The pressure of the circulation pump is adjustable in five grades. After setting, the VFD-Info-Display indicates the corresponding value.

>St.Pump: Setting the pump pressure stage



① Setting in line 4.
The value previously set appears on the DIALOG-DISPLAY (LCD).
A flashing segment indicates that a value needs to be entered.

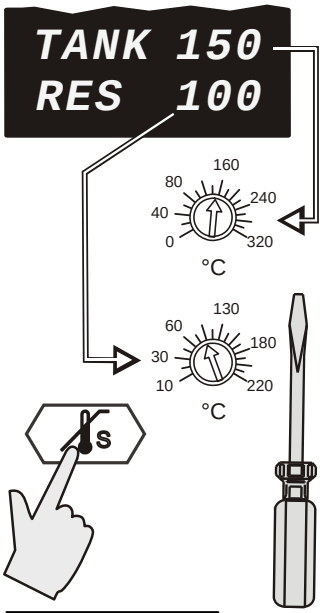
② Use the keypad to enter the new value (example: 4).

③ Press enter ↵ to store the selected value.

Note:
The mechanical rotation of the circulation pump produces heat that is radiated into the bath liquid. The lowest working temperature may thus only be reached if the pump pressure is set to grade 1.

7.4. Setting the safety temperature (with shutdown function)

ⓘ **Check the safety installations at least twice a year!** See page 15.



This safety feature functions independent of the regulator circuit. When the temperature of the bath liquid has reached the safety temperature, a complete shutdown of the heater and pump is effected.

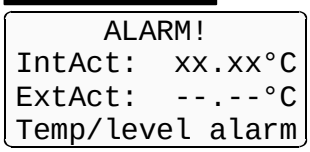
Safety temperature in the heat exchanger >TANK<

(excess temperature protection)

- Press the key S to indicate the safety temperature value in line 2 >TANK< on the VFD-Info-Display and using a screwdriver simultaneously turn the setting screw to the desired value (example: 150 °C).

Setting range: 0 °C to 320 °C
in 2 °C steps

The alarm is indicated by optical and audible signals (continuous tone).



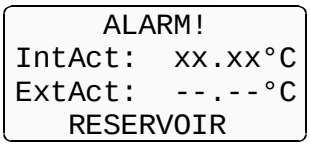
The error messages opposite appear on the DIALOG-DISPLAY (LCD) and VFD-Info-Display.

Safety temperature in the internal reservoir >RES<

This supplementary safety installation supervises and controls the temperature of the bath liquid in the internal reservoir.

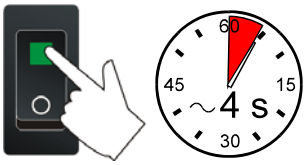
- Press the key  to indicate the safety temperature value in line 3 >RES< on the VFD-Info-Display and using a screwdriver simultaneously turn the setting screw to the desired value (example: 100 °C).

Setting range: 10 °C to 220 °C
in 2 °C steps



The alarm is indicated by optical and audible signals (continuous tone).
The error messages opposite appear on the DIALOG-DISPLAY (LCD) and VFD-Info-Display.

- Press enter ↵ to quit the audible signal.



- After eliminating the malfunction, press the mains power switch off and on again to cancel the alarm state.

Warning:

- Set the safety temperature >TANK< 15 °C above the working temperature setpoint.
- The safety temperature value >RES<should be set at least 25 °C below the fire point of the bath liquid used.

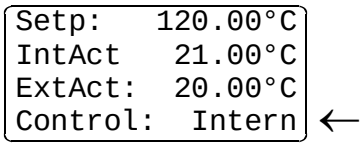
7.5. Internal / external control

ext. Pt100

The temperature system offers the possibility of internal temperature control in the internal bath or external control directly in an external system.

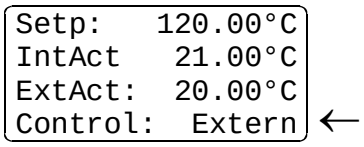
Setup for external control:

Connect a Pt100 sensor to the socket "EXT" of the Presto® temperature system, if necessary perform a calibration using the "ATC Ext:" function (see page 57) and then securely fix the sensor in the external system.



To swap internal to external control:

- Press the key EXT in operating state "OFF" to select the control type.
- The DIALOG-DISPLAY (LCD) indicates the effective control type in line 4
  >Control: intern< or > Control: extern<

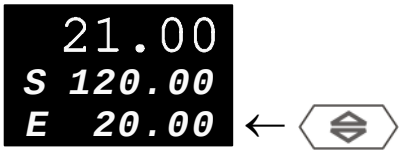


- Press the start/stop key.

Temperature indication:

- The DIALOG-DISPLAY (LCD) simultaneously indicates both actual temperatures.
- The VFD-Info-Display indicates the actual temperature in line 1. In the header the corresponding symbol >Int< or >Ext< is illuminated.
  Press the key DISPL to swap the display.
- It is useful, to set line 3 to show the actual temperature >E xx.xx°C< by pressing the key .

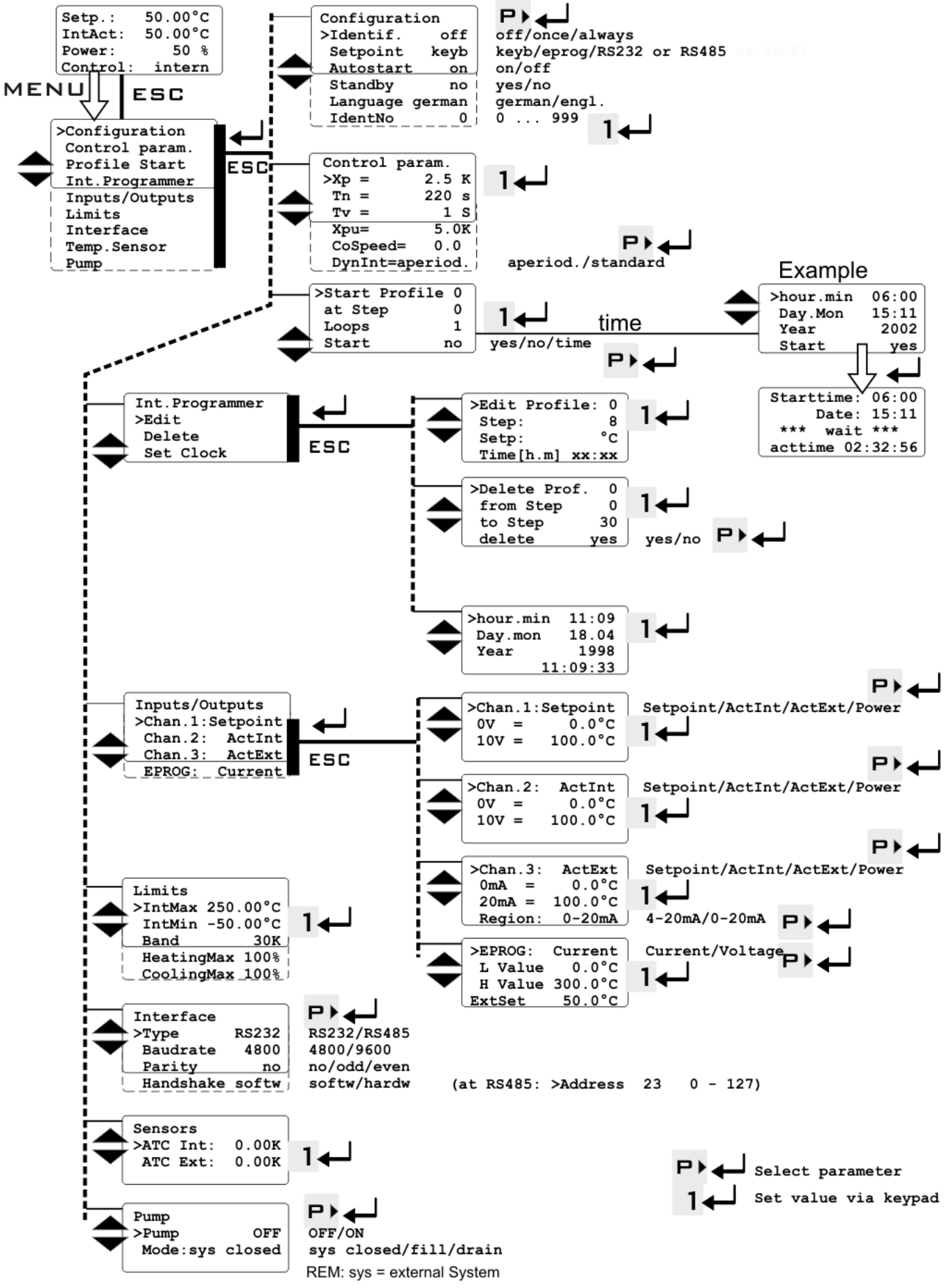
Int ← DISPL



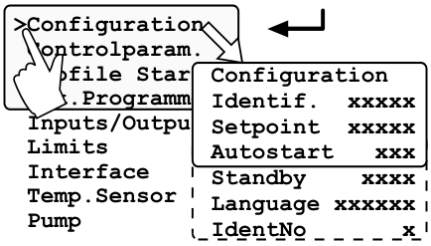
Caution:
Place the external sensor into the bath medium and securely fix the sensor.

8. Menu functions

- Press the MENU key MENU to enter the menu level.
- Use the up/down cursor keys to select the desired submenu and press enter.
- Press escape ESC to return to the previous menu level.


Setp.: 50.00°C
IntAct: 50.00°C
Power: 50 %
Control: intern
MENU
ESC
>Configuration
Control param.
Profile Start
Int.Programmer
Inputs/Outputs
Limits
Interface
Temp.Sensor
Pump
ESC
Configuration
>Identif. off
Setpoint keyb
Autostart on
Standby no
Language german
IdentNo 0
P
off/once/always
keyb/eprog/RS232 or RS485
on/off
yes/no
german/engl.
0 ... 999
1
Control param.
>Xp = 2.5 K
Tn = 220 s
Tv = 1 S
Xpu= 5.0K
CoSpeed= 0.0
DynInt=aperiod.
1
P
aperiod./standard
>Start Profile 0
at Step 0
Loops 1
Start no
1
yes/no/time
time
P
Example
>hour.min 06:00
Day.Mon 15:11
Year 2002
Start yes
Starttime: 06:00
Date: 15:11
*** wait ***
acttime 02:32:56
Int.Programmer
>Edit
Delete
Set Clock
ESC
>Edit Profile: 0
Step: 8
Setp: °C
Time[h.m] xx:xx
1
>Delete Prof. 0
from Step 0
to Step 30
delete yes
1
yes/no
P
>hour.min 11:09
Day.mon 18.04
Year 1998
11:09:33
1
Inputs/Outputs
>Chan.1:Setpoint
Chan.2: ActInt
Chan.3: ActExt
EPROG: Current
ESC
P
>Chan.1:Setpoint
0V = 0.0°C
10V = 100.0°C
1
Setpoint/ActInt/ActExt/Power
P
>Chan.2: ActInt
0V = 0.0°C
10V = 100.0°C
1
Setpoint/ActInt/ActExt/Power
P
>Chan.3: ActExt
0mA = 0.0°C
20mA = 100.0°C
Region: 0-20mA
1
Setpoint/ActInt/ActExt/Power
P
4-20mA/0-20mA
P
>EPROG: Current
L Value 0.0°C
H Value 300.0°C
ExtSet 50.0°C
1
Current/Voltage
P
Limits
>IntMax 250.00°C
IntMin -50.00°C
Band 30K
HeatingMax 100%
CoolingMax 100%
1
Interface
>Type RS232
Baudrate 4800
Parity no
Handshake softw
P
RS232/RS485
4800/9600
no/odd/even
softw/hardw
(at RS485: >Address 23 0 - 127)
Sensors
>ATC Int: 0.00K
ATC Ext: 0.00K
1
Pump
>Pump OFF
Mode:sys closed
P
OFF/ON
sys closed/fill/drain
REM: sys = external System
P
Select parameter
1
Set value via keypad

8.1. Configuration



By means of the configuration functions, operation of the instrument can be optimized for the current application.

- Press enter ↵ to select the configuration submenu.
- Use the up/down cursor keys ▲ ▼ to select the desired option. A flashing line indicates that a value needs to be entered.
- Press the P-key P▸ to select the parameter and press enter ↵.
- Press escape ESC to return the previous menu level.

> Identification

When performing an identification for the controlled system (temperature application system), the control parameters Xp, Tn and Tv will be automatically determined and stored.

Possible parameters:

off - no identification.
The control parameters ascertained during the last identification are used for control purposes.

once - single identification
The instrument performs a single identification of the controlled system after start.
After the identification process the parameter is automatically set to "off".

always - continual identification
The instrument performs an identification of the controlled system whenever a new setpoint is to be reached.
NOTE: Use this setting only when the temperature application system changes permanently.

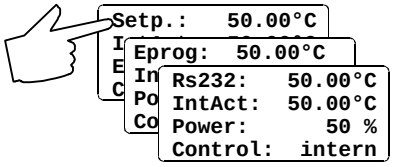
Important:
For physical reasons, refrigeration units provide full cooling performance only after some minutes. During identification this is given consideration by waiting for 5 minutes after switch-on.

Note:

Requirement for an identification of the controlled system:

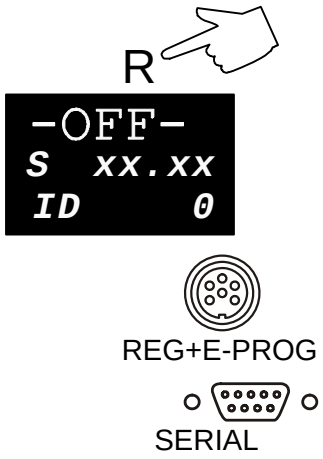
- The temperature system must heat to a setpoint temperature at least 10 °C above the previous setpoint using the adjusted heating power.
- When the adjusted control parameters Xp, Tn and Tv are too high, this requirement may not be given with respect to on how much the setpoint temperature has to change. In this case, prior to carrying out an identification in the "OFF" state, set the control parameters to lower values.

  Recommended setting for internal control:
  Xp = 1.0 °C
  Tn = 80 s
  Tv = 8 s



> Setpoint

The instrument provides three possibilities for setpoint selection. The active mode is indicated on the DIALOG-DISPLAY (LCD). The control indicator >**R**< (REMOTE) is illuminated in the header of the VFD-Info-Display if setpoint selection is effected via the EPROG or SERIAL input.



Possible parameters:

keyb- Setpoint setting via keypad (Setp.:) or via the integrated programmer.

eprog - Setpoint setting via the analog interface REG+E-PROG (3.1) connection with an external voltage or current source or a programmer. (see page 53)

RS232 - Setpoint setting via the serial RS232/RS485 interface (3.5) through a PC or superordinated data system.

>Autostart

Note:

The temperature system has been configured and supplied by JULABO according to N.A.M.U.R. recommendations. This means for the start mode, that the unit must enter a safe operating state after a power failure (non-automatic start mode). This safe operating state is indicated by "OFF", resp. on the VFD-Info-Display. A complete shutdown of the main functional elements such as heater and circulation pump is effected simultaneously.
Only with setpoint adjustment the AUTOSTART-function can be executed via >Taste< and >EPROG< (see above).

Should such a safety standard not be required, the AUTOSTART function (automatic start mode) may be activated, thus allowing the start of the instrument directly by pressing the mains power switch or using a timer.

Possible parameters:

on - AUTOSTART on

off - AUTOSTART off

Warning :
For supervised or unsupervised operation with the AUTOSTART function, avoid any hazardous situation to persons or property.
The instrument does no longer conform to N.A.M.U.R. recommendations.

Take care you fully observe the safety and warning functions of the instrument.
If the setpoint is given via the serial interface, no AUTOSTART is possible.

>Stand-by input

STAND-BY

External stand-by for emergency switch-off
(connector - see page 6)

Possible parameters:

no - stand-by input is ignored

yes - stand-by input is active

> Language

There are two options for the language of the DIALOG-DISPLAY (LCD): German or English.

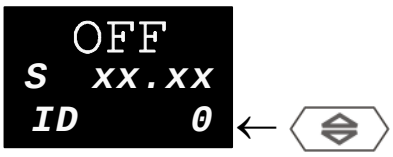
Possible parameters:

German (deutsch)

English (engl).

>IdentNo

The identification number identifies the removable control module RD.
Assign identification numbers if more than one **Presto**® temperature system is available.

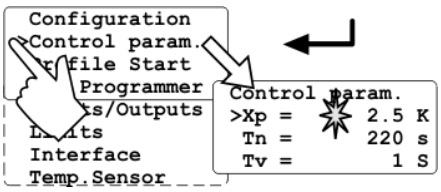


Adjustable parameters:

0 ... 999

Indicated also on the VFD-Info-Display.

8.2. Control parameters



Xp = 2 ⊤ 5 ↵

When performing an identification for the controlled system (temperature applications system) (see page 42), the control parameters Xp, Tn, Tv and Xpu will be automatically determined and stored.

Each parameter may be manually set via the keypad if necessary, to allow optimum control performance.

- Press enter ↵ to select the submenu "control parameters".
- Use the up/down cursor keys ▲ ▼ to select the desired option. A flashing segment indicates that a new value needs to be entered.
- Use the numerals to set the value and then set with enter ↵ (example: Xp = 2.5 °C).

- or at >DynInt<

  Press the P-key P▸ to select the parameter and press enter ↵.

- Press escape ESC to return to the previous menu level.

Proportional range >Xp<

The proportional range is the range below the selected temperature value in wich the the control circuit reduces the heating power from 100 % to 0 %.

Resetting time >Tn< (Integral component)

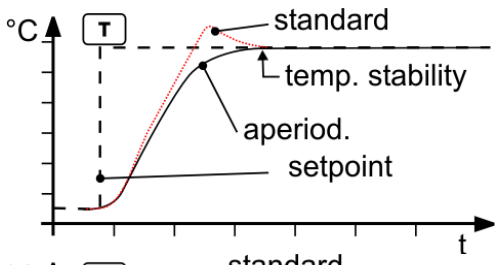
Compensation of the remaining control deviation due to proportional regulation. An insufficient resetting time may cause instabilities to occur. Excessive resetting time will unnecessarily prolong compensation of the control difference.

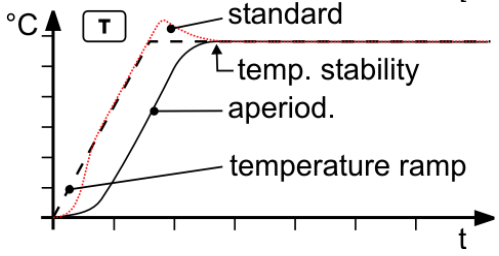
Lead time >Tv< (Differential component)

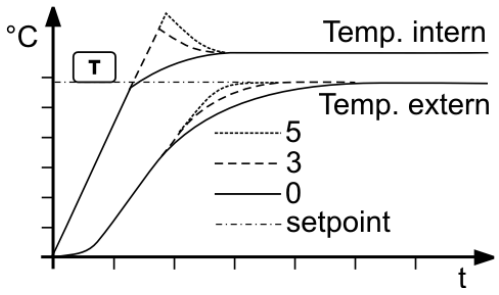
The differential component reduces the control settling time. An insufficient lead time will prolong the time required to compensate for disturbance effects and cause high overshooting during run-up. An excessive lead time could cause instabilities (oscillations) to occur.

Proportional range >Xpu<

The proportional range Xpu of the cascaded controller is only needed for external control.







>DynInt< - Dynamics

This parameter affects the march of temperature only in case of internal control (see page 40)

Adjustable parameter:

standard The temperature rises quicker, however can overshoot up to 5 %. If a ramp is defined, the march of temperature often follows this ramp.

aperiod. The temperature rises chronologically without overshoot.

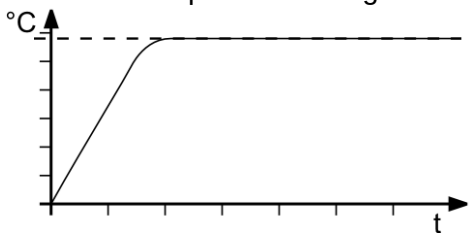
With both adjustments a sufficient temperature stability is reached after approximately the same time.

>CoSpeed< 0 up to 5

This parameter affects the march temperature only in case of external control (see page 40).
The adjustment affects the calculation of the control parameter when identifying and so the control course.

Optimization instructions for the PID control parameters:

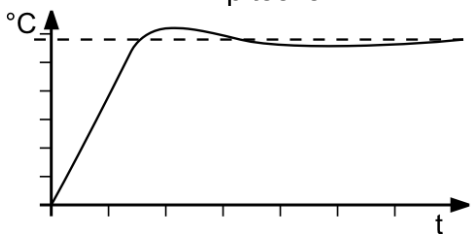
optimum setting



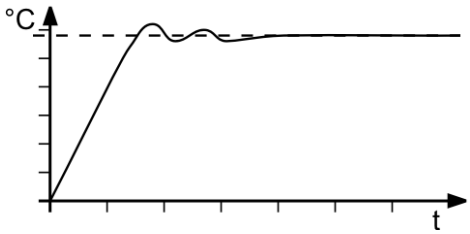
The heat-up curve reveals inappropriate control settings.

Inappropriate settings may produce the following heat-up curves:

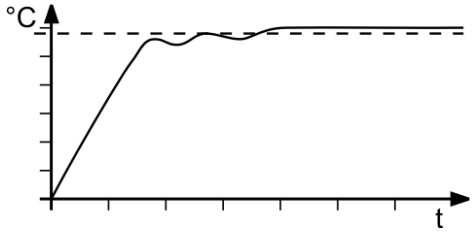
Xp too low



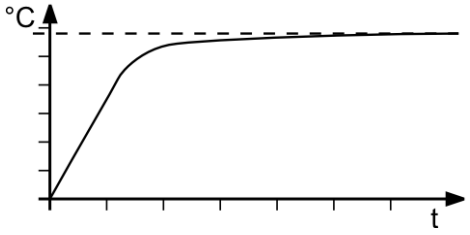
Tv/Tn too low



Xp too high or Tv too high



Tv/Tn too high or Xp too high



8.3. Start of a profile

The start menu of the integrated programmer allows calling up and defined starting of one of six previously stored temperature profiles. The profiles are started manually or via the integrated timer.

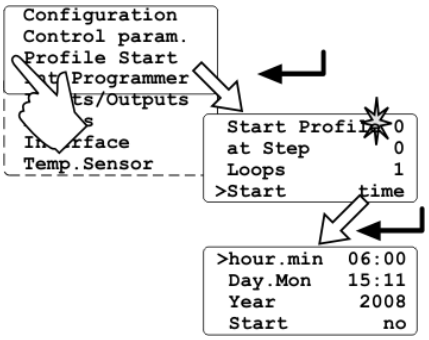
There are two possibilities for manually starting a program:

1. Starting a profile from the OFF state:
   The temperature system switches back to the OFF state at the end of the program.
2. Starting a profile from the operating state.
   The temperature system is started with the start key ⏻, and the bath is heated to the desired temperature, for example 100 °C. At the end of the program, the programmer switches to the operating state and holds the bath temperature stable at 100.00 °C.

1.

2. ⏻

- Press enter ↵ to select the submenu "Profile Start".
- Use the up/down cursor keys ▲ ▼ to select the desired option.



A flashing segment indicates that a number needs to be entered.

Start Profile	0 to 5
at Step	0 to 60
Loops	1 to 99

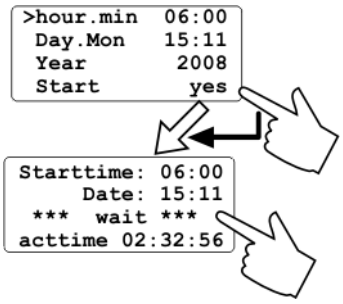
Enter the desired number and set each entry with enter ↵.

Start	**no / yes** ⇨ (manual start)
	or
	time ⇨ (via integrated timer)

A flashing line indicates that a parameter needs to be entered.

Press the P-key P to select the respective parameter and press enter ↵.

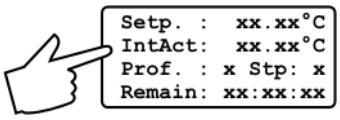
Example: hour.min 6:00 h

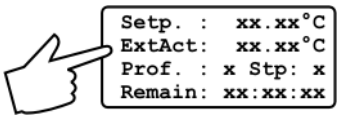


- When selecting the parameter **time**, a new menu level is called up for entry of the start time.
  A flashing segment indicates that a start time needs to be entered.
  hour.min Start time
  Day.Mon day and month
  Year year
  Set each entry with enter ↵.

  Start no / yes
  A flashing line indicates that the parameter "yes" needs to be entered.

  Press the P-key P▸ to select the parameter and press enter ↵.
- The temperature system switches to waiting mode and a flashing line "wait" appears on the DIALOG-DISPLAY (LCD). The start time and actual time are permanently indicated on the display.





Indication after starting the profile:

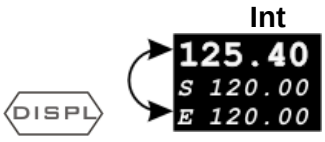
DIALOG-DISPLAY (LCD)

1st line: Setpoint of the programmer

2nd line: Actual temperature value
at **internal control** = IntAct: xxx.xx
at **external control** = ExtAct: xxx.xx

3rd line: Selected profile and the actual section

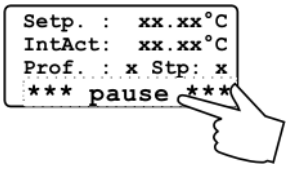
4th line: Remaining time of the actual section



VFD-Info-Display:

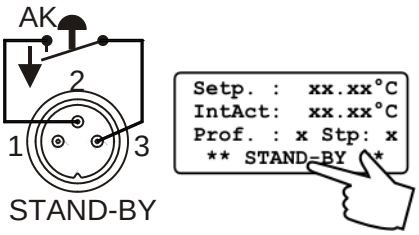
- Line 1 indicates the actual temperature value.
  In the header the corresponding symbol >Int< or >Ext< is illuminated.
- Press the key DISPL to swap the values in line 1 and line 3.

8.3.1. Interrupting a profile



Interrupting a profile:

- Press the start/stop key ⏻ to interrupt or continue a profile.
  The setpoint and time period set for the corresponding section are thus stopped at the values presently achieved.
  The instrument is put on hold and the message "pause" flashes on the DIALOG DISPLAY (LCD).



- A profile can be interrupted or restarted by an external emergency shut-off (see page 6).

  ⚠ **CAUTION:**
  This is not an actual emergency switch-off.

- The setpoint control and the timer are interrupted by breaking the contact "AK".
  The instrument is put on hold and the message "Stand-By" flashes on the DIALOG-DISPLAY (LCD).

  Important:
  To achieve this, the stand-by condition must first be activated and the AUTOSTART function turned on
  (See page 44).

Warning:
Following a power interruption, it would be possible in this condition for the instrument to restart automatically. The safety and warning functions of the instrument should always be used to their fullest capacity.

See Warning page 44

Termination of a profile:

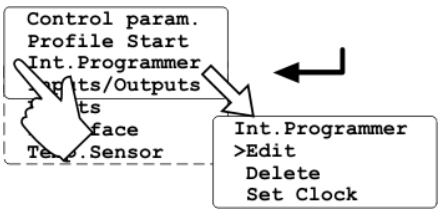
A profile can be terminated by pressing the escape key ESC.
The programmer switches back to the Start menu.

- Press the escape key ESC again to leave the menu
  or
  use the cursor keys ▲ ▼ to remain in the Start menu.

  The execution of another temperature profile can now be prepared if necessary.

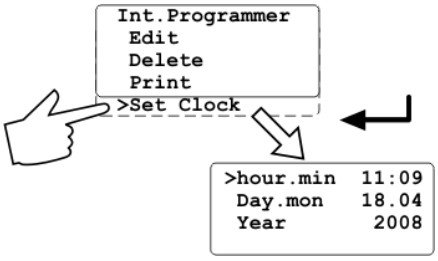
8.4. Integrated programmer

The integrated programmer allows any desired temperature program sequences to be realized. Such a temperature sequence is called profile. A profile consists of individual sections defined by duration (t:) and target temperature. Target temperature is the setpoint (T:), that is achieved at the end of a section. The programmer uses time and temperature difference values within a section to calculate a temperature ramp.



- Press enter ↵ to select the submenu "Int. Programmer".
- Use the up/down cursor keys ▲ ▼ to select the desired option. Then press enter ↵ to open.
  A flashing segment indicates that a number or value needs to be entered.

Edit	Compile profiles
	Display sections
Delete	Delete sections
Set clock	Set the real time on the instrument



<u>Setting clock</u>

The integrated clock allows starting a profile at any date and time. The clock is preset in the factory.

- Lines 1 to 3:
  Check for correctness of the preset date and time and correct if necessary.

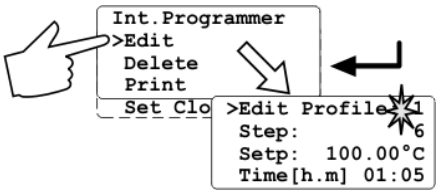
  The time is diplayed permanently in line 4.

Examples:

- Use the numerals to set time, date and year and set each entry with enter ↵.

- Press escape ESC to return to the previous menu level.

Edit



Compile profiles:

- A flashing segment indicates that a number needs to be entered.
  Under submenu "Edit Profile" enter a profile number.
  Six profiles may be stored (nos. 0 to 5).

Examples:

Profile No 1: 1 ↵

Step 6 ↵

Setpoint 1 0 0 ↵

Time

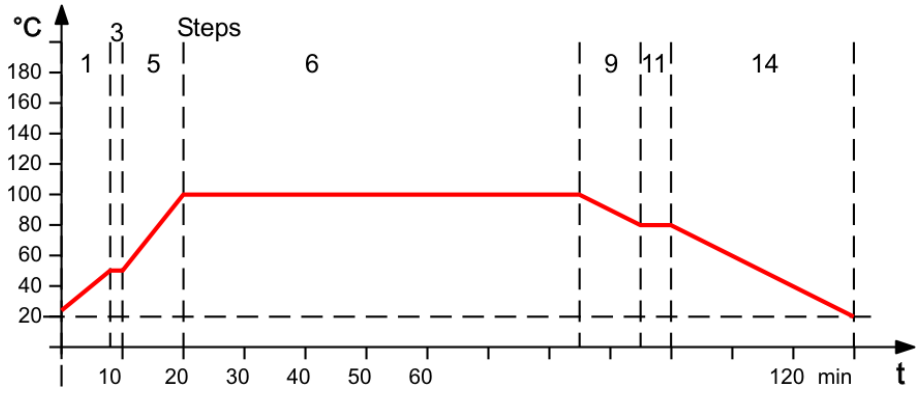
0 1 : 0 5 ↵

- Then programme the desired values for each section.
  Use the keypad to set section number, target temperature and time period. Set each entry with enter ↵.

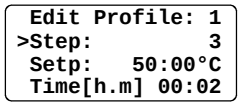
  When the program is running, only sections having complete information for target temperature and time period are considered.
  It makes sense, to leave out section numbers in the profile, in order to use them later for corrections in the profile.
  Important:
  If a time of 00:00 is set for a profile, the profile is continued with the next section only after the setpoint temperature (±0.2 °C) is reached.
- Press escape ESC to return to the previous menu level.

Example:

Step	(No.)	1	3	5	6	9	11	14
Setpoint	(°C)	50	50	100	100	80	80	20
Time	(h.m)	00:08	00.02	00:10	01:05	00:10	00:05	00:30



Step 3 ↵



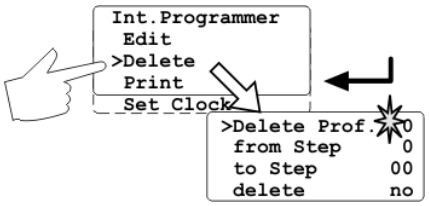
Display sections:

1. Use the cursor keys ▲ ▼ to select the submenu "Step", enter the desired number and press enter ↵.

or

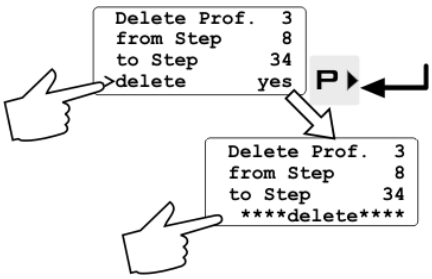
2. If the submenu „Set“ is selected, section by section can be shown in ascending order by the P-key P▸.

3. Each previously set value is displayed.



Delete

- A flashing segment indicates that the respective profile number needs to be entered in which one or more consecutive sections are to be deleted.
- In lines 2 and 3 of the DIALOG DISPLAY (LCD) enter the numbers of the sections to be deleted. Press enter ↵.

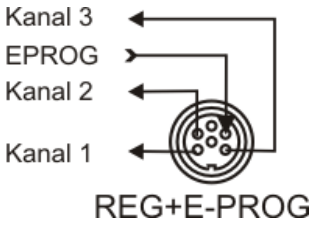


- **delete no / yes**

  Press the P-key P to select the parameter "yes" and press enter ↵.
  Line 4 indicates the deletion.

  Example:
  Delete section 8 to section 34 in profile 3.
- Press escape ESC to return to the previous menu level.

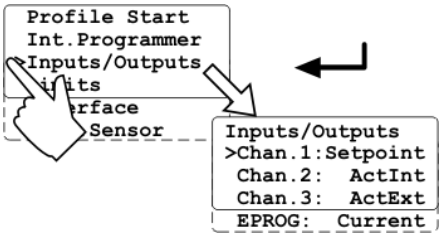
8.5. Analog inputs/outputs

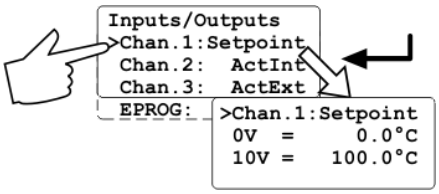


This submenu enables setting of the input and output values for the programmer input and the temperature recorder outputs of socket REG+E-PROG (21).

- Press enter ↵ to select the inputs/outputs submenu.
- Use the up/down cursor keys ▲ ▼ to select the desired option and press enter ↵ to open.

Chan.1	voltage output for recorder	(V)
Chan.2	voltage output for recorder	(V)
Chan.3	current output for recorder	(mA)
EPROG	external programmer input	

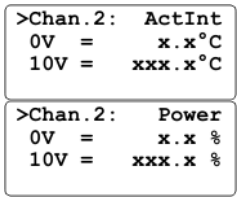




- <u>First define the desired output value for channels 1 to 3</u>:

  Press the P-key P▸ to select the desired output value and set with enter ↵.

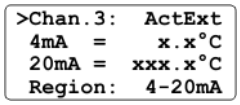
Setpoint	active setpoint temperature (Keypad, integr. programmer/ext. programmer)
ActInt	internal actual temperature value (bath temperature)
ActExt	external actual temperature value (external sensor)
Power	periodic or intermittent heating or cooling

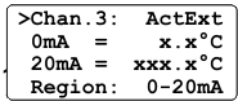


or

- <u>Then select the display size for channels 1 to 3:</u>

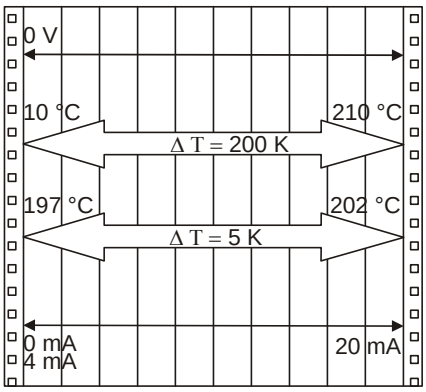
Channel 1 and 2 voltage outputs
Assign the voltage values of 0 V to the lowest and 10 V to the highest necessary temperature or power rating required as an output value (°C / %).
Current output channel 3
Assign the current values 0 mA or 4 mA to the lowest and 20 mA to the highest temperature or power rating required as an output value (°C / %).





The current output offers 2 ranges for selection:
0 to 20 mA and 4 to 20 mA

Select the desired range by pressing the P-key P▸ and set with enter ↵.
The LCD display changes automatically.



Examples:

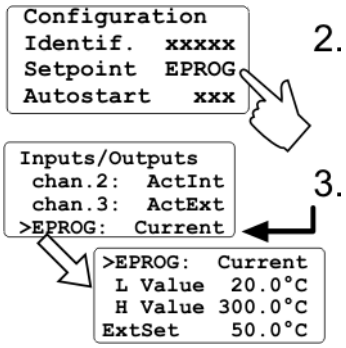
lowest temperature value: 10 °C
highest temperature value 210 °C
Fig. shows 200 °C scaled to paper width
rise: 50 mV/°C

lowest temperature value: 197 °C
highest temperature value: 202 °C
Fig. shows 5 °C scaled to paper width
rise: 2000 mV/°C

EPROG - Input

This input is necessary when the nominal value is to be determined and set by an external programmer (see page 43)

REG+E-PROG **1.**



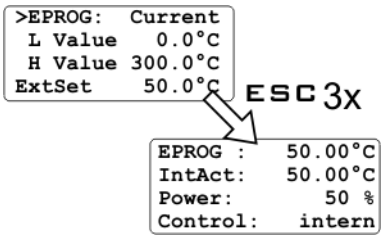
1. Connect the external voltage or current source or programmer to socket (3.1) REG+E-PROG of the instrument.
2. Adjust the menu option >Setpoint< on >EPROG< in the menu >Konfiguration< (see page 43)

3. The programmer (E-PROG) input of the instrument can be matched to the output signal of the external voltage or current source.

   Voltage voltage input
   Current current input

   Select the desired input value with the P-key P and set with enter ↵.

- **"L Value" - Setting the LOW value:**:
  First adjust and set the lowest voltage or current on the external voltage or current source (e.g. 0 V or 0 mA).
  Then after approx. 30 secs enter the corresponding temperature value (e.g. 20.00°C).on the instrument by pressing the appropriate buttons on the keypad and press enter ↵ to set.
- **"H Value"** - **Setting the HIGH value:**
  First adjust and set the highest voltage or current on the external voltage or current source (e.g. 10 V or 20 mA).
  Then after approx. 30 secs enter the corresponding temperature value (e.g. 300 °C).on the instrument by pressing the appropriate buttons on the keypad and press enter ↵ to set.
- Return to the standard display by pressing escape ESC.

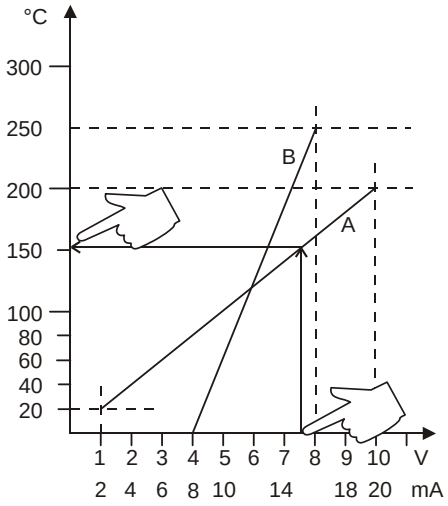


Example:

- Set the external voltage or current source output for the equivalent of 50 °C temperature setpoint.

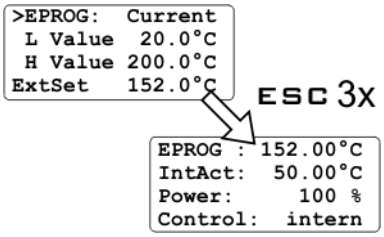
The value adjusted and set on the external programmer is displayed in line 4 of the DIALOG-DISPLAY (LCD) for control purposes (Example: ExtSet: 50.0 °C).
After returning the LCD display to standard display by pressing ESC the temperature value adjusted and set on the external voltage or current source is displayed in line 1
(Example: EPROG 50.00 °C).

This EPROG input enables the use of different voltage and current values as program parameters.



- **"L Value" - Setting the LOW value:**
  1) Adjust and set the lowest desired value on the voltage or current source resp. (Example A: 1 V).
  Wait appr. 30 seconds.
  2) Assign a lower temperature threshold value to this adjusted voltage/current value by pressing the appropriate buttons on the keypad of the instrument (Example A: 20 °C) and set by pressing enter ↵.
- **"H Value" - Setting the HIGH value:**
  1) Adjust and set the highest desired value on the voltage or current source resp. (Example A: 10 V).
  Wait appr. 30 seconds.
  2) Assign an upper temperature threshold value to this adjusted voltage/current value by pressing the appropriate buttons on the keypad of the instrument
  (Example A: 200 °C) and set by pressing enter ↵.
- Return to the standard display by pressing escape ESC.

Example B in the diagram serves to illustrate that the end point values are freely selectable.



Example out of diagram A:

- Adjusting the voltage source for an output of 7.6 V!

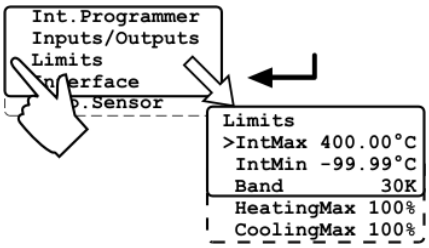
Line 4 of the DIALOG-DISPLAY (LCD) shows the externally set setpoint value. The instrument calculates this value from the rise angle of the two predecided end points (in example A: 7.6 V correspond to an external setpoint temperature of 152.0 °C).

After returning the LCD display to standard display by pressing escape ESC, this value is displayed in line 1
(Example: EPROG 152.00 °C).

Notice:

If this adjustment is not correctly performed at two different points, the setpoint setting will be incorrect.

8.6. Limits



The limits IntMax and IntMin are only valid under external control (see 7.5. Internal / external control). They restrict the temperature of the internal bath to the desired maximum/minimum, also if the controller would require a higher/lower temperature for the external system. As a result the external setpoint may thus not be reached.

When operating the temperature system under external control, band limiting is active. The preset value determines the maximum temperature difference between the internal bath and the external load. This adjustment possibility prevents sensitive equipment and temperature devices from damage.

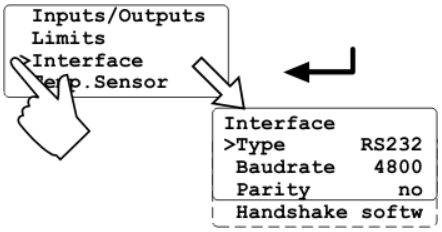
Heating and cooling power of the instrument are adjustable. 100 % corresponds to the values in the technical specifications of the equipment.

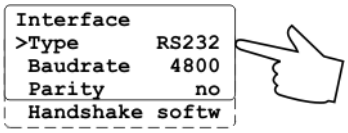
- Select the submenu "Limits" with enter ↵.
- Select the desired option with the up/down cursor keys ▲ ▼.
  A flashing digit indicates that a value needs to be entered.

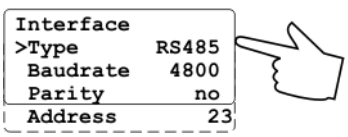
IntMax	see temperature range LHxx
IntMin	see temperature range LHxx
Band	0 to 200 °C
HeatingMax	0 to 100 % in steps of 1 %
CoolingMax	0 to 100 % in steps of 1 %

- Set the newly entered value by pressing enter ↵.
- Return to the previous menu level by pressing escape ESC.

8.7. Interface







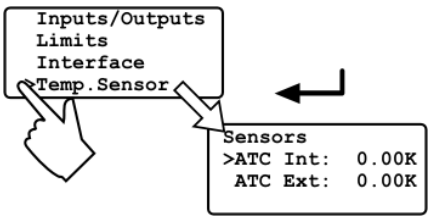
The interface parameters are set by selecting the submenu "Interface" on the temperature system. Normally, this is a one-time-only adjustment.

- Press enter ↵ to select the submenu "Interface".
- Select the desired option with the up/down cursor keys ▲ ▼ Enter the desired value for the flashing digit.

Type	RS232 / RS485
Baudrate	4800/9600
Parity	none/even/odd
Handshake	software handshake/hardware handshake
Address	0 to 127

- Press the P-key P▸ to select the desired parameter and set with enter ↵.
- Return to the previous menu level with escape ESC.

8.8. Sensors



ATC - Absolute Temperature Calibration

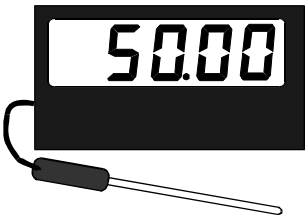
- Select the submenu "Temp.Sensor" with enter ↵.
- Select the desired option with the up/down cursor keys ▲ ▼. A flashing digit indicates that a value needs to be entered i.e. set.
  ATC Int: internal sensor
  ATC Ext: external sensor
- Enter the desired compensating value and set this value by pressing enter ↵.

Notice:
ATC Int: Do not alter the factory-setting!

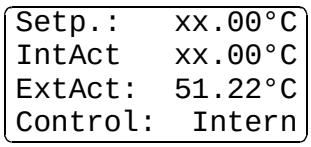

ext. Pt100

ATC Ext:
serves calibration of an external Pt100 sensor.

Calibrated thermometer (T_M)



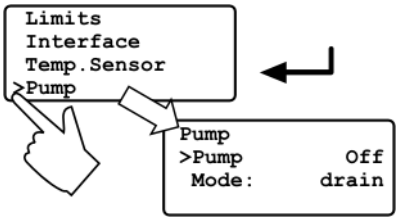
Presto: Pt100 sensor (T_{ExtIst})



- Immerse the external Pt100 sensor and a calibrated thermometer together in a calibration bath at 50°C, for example, and allow the reading to stabilize.
- Read the temperatures of the calibrated thermometer (T_M) and the external Pt100 sensor (T_{ExtIst}) in their respective displays.
- Calculate the temperature difference and enter and set this difference value as the ATC external compensating parameter. (Example: $\Delta T = T_{ExtIst} - T_M = 1.22$ K)
- Use the keypad to enter the desired compensating value (e.g. 1.22 °C) and set with enter ↵.

Important:
The ATC function remains active until reset to 00.00 °C.

8.9. Pump



In this submenu the circulation pump can be turned on separately, without heating element or cooling unit.

The menu option „Modus“ refers to the filling valve and the ventilation valve. Depending on the operating status (drain / fill / sys close) the valves are switched off automatically.

- Press enter ↵ to select the submenu "Pump".
- Select the desired option with the up/down cursor keys ▲ ▼. Enter the desired value for the flashing digit.
  Pump **OFF/**ON
  Mode: **drain / fill / sys close**

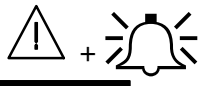
- Press the P-key P▸ to select the desired parameter and set with enter ↵.
- Return to the previous menu level with escape ESC

Explication of terms:

>Mode: System closed<stands for closed, external system. (**Presto** principle page 22)

>Mode: drain<. (Chapter „Draining“ see page 33)
In the configuration of this unit the >Mode: fill< means the same as >Mode: drain<.

9. Troubleshooting guide / Error messages



Whenever the microprocessor electronics registers a failure, a complete shutdown of the temperature system is performed.

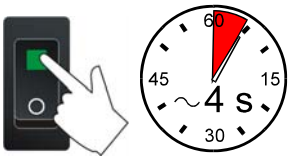
The VFD-Info-Display indicates the cause for the alarm in form of a code.

The alarm light "⚠" illuminates and a continuous signal tone sounds.

CODE 02	Defect temperature sensor in refrigeration circuit. Repair by authorized JULABO service personnel.
CODE 05	Cable of the working temperature sensor interrupted or short-circuited.
CODE 06	Defect of the working or safety temperature sensor. Working temperature and safety sensors report a temperature difference of more than 25 °C.
CODE 07	Other errors (I^2C-BUS errors)
CODE 12	Error in A/D converter.
CODE 13	Sensor in the internal reservoir >RES< is defect The safety temperature value lies below the working temperature setpoint. Set the safety temperature to a higher value.
CODE 14	Safety sensor defect >TANK< The safety temperature value lies below the working temperature setpoint. Set the safety temperature to a higher value. The temperature system is operated without bath liquid, or the liquid level is insufficient. Replenish the bath tank with the bath liquid. Tube breakage has occured (insufficient filling level due to excessive bath liquid pumped out). Replace the tubing and replenish the bath tank with the bath liquid. The float is defect (e. g., because damaged in transit). Repair by authorized JULABO service personnel.
CODE 15	External control selected, but external Pt100 sensor not connected.
CODE 16	Heating circuit interrupted.
CODE 17	Heating circuit short-circuited.
CODE 31	Communication between control module RD and instrument interrupted.

54.56 Warning CODE 40	**Warnings without a complete shutdown of the unit**
CODE 03	Excess temperature warning
CODE 04	Low temperature warning
CODE 20	Cooling of the condenser is affected. Clean air-cooled condenser. Check the flow rate and cooling water temperature on water-cooled condenser.
CODE 21	Compressor stage 1 does not work. Check mains circuit breakers F1 and F3, both might have triggered. Reset circuit breakers if necessary (see below).
CODE 40	Low liquid level warning in the internal reservoir
	These messages appear every 10 seconds as long as the compressor is not switched on although requested by the instrument. After a short cooling interval, the motor will be automatically reconnected and the message " CODE XX " no longer appears.

- Press enter ↵ to quit the audible signal.

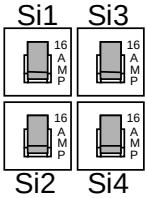


- After eliminating the malfunction, press the mains power switch off and on again to cancel the alarm state.

If the unit cannot be returned to operation, contact an authorized JULABO service station.

Disturbances that are not indicated.

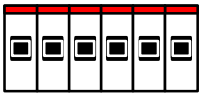
Pump motor overload protection
The pump motor is protected against overloading. After a short cooling interval, the motor will automatically start running.



LH47

Fuses:
The mains fuses are safety cutouts.

4 Mains circuit breakers (resettable) 16 A
F1 and F3 → Compressor
F2 and F4 →Heater, Pump



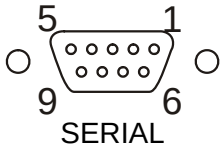
LH50

2 Mains circuit breakers (resettable) 10 A for the pump-motor
4 Mains circuit breakers (resettable) 16 A

Motor protection circuit breaker for compressor motor

10. Electrical connections

Important:
Use shielded cables only.
The shield of the connecting cable is electrically connected to the plug housing.



RS232/RS485 serial interface (3.5)
This port can be used to connect a computer with an RS232 or RS485 cable for remote control of the temperature system.

Pin assignments: RS232

Pin 2	RxD	Receive Data
Pin 3	TxD	Transmit Data
Pin 5	0 VD	Signal GND
Pin 6	DTR	Data terminal ready
Pin 7	RTS	Request to send
Pin 8	CTS	Clear to send

Pin assignments: RS485

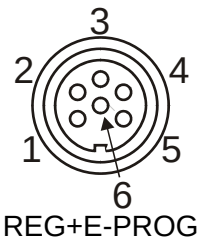
Pin 3	A	
Pin 5	0 VD	Signal GND
Pin 8	B	
Pin 1; 2; 6; 7; 9		Reserved - do not use!

Interface correspondence:

Instrument 9-pole		Computer 25-pole	Instrument 9-pole		Computer 9-pole
Pin 2 RxD	⇔	Pin 2 TxD	Pin 2 RxD	⇔	Pin 3 TxD
Pin 3 TxD	⇔	Pin 3 RxD	Pin 3 TxD	⇔	Pin 2 RxD
Pin 5 GND	⇔	Pin 7 GND	Pin 5 GND	⇔	Pin 5 GND
Pin 6 DTR	⇔	Pin 6 DSR			
Pin 7 RTS	⇔	Pin 5 CTS	Pin 7 RTS	⇔	Pin 8 CTS
Pin 8 CTS	⇔	Pin 4 RTS	Pin 8 CTS	⇔	Pin 7 RTS

Accessories:

Order No.	Description
8 980 073	RS232 interface cable 9-pol./9-pol. , 2,5 m
8 900 110	USB interface adapter cable

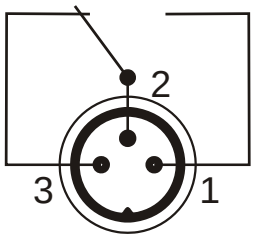


REG+E-PROG

Programmer input / temperature recorder output (3.1)

Analog inputs / outputs see page 53

Pin		Signal
1 Voltage output	Channel 1	0 ... 10 V
2 Voltage output	Channel 2	0 ... 10 V
3 GND for outputs		0 V
4 Programmer input	EPROG	0 to 10 V / 0 to 20 mA
5 Current output	Channel 3	0 to 20 mA / 4 to 20 mA
6 GND for Progammer		0 V



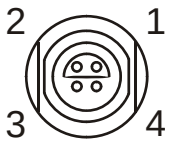
ALARM

Alarm output (3.3)

(for external alarm signal)

This potential-free change-over contact is activated in case of an alarm when pins 2 and 3 are connected.

Switching capacity	max.	30 W / 40 VA
Switching voltage	max.	125 V~/–
Switching current	max.	1 A

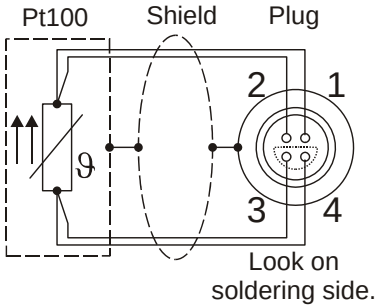


ext. Pt100

Socket for external Pt100 sensor (3.4)

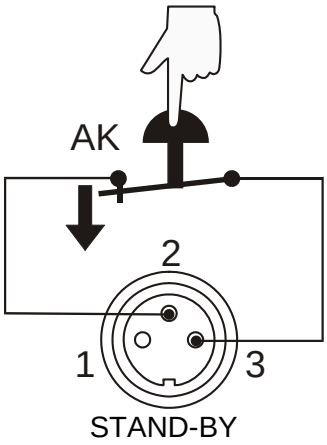
Pin assignment:

Pin	Signal
1	I+
2	U+
3	U-
4	I-



The shield of the connecting cable is electrically connected to the plug housing and the sensor tube.

Stand-by input (3.2)



(for external emergency switch-off)

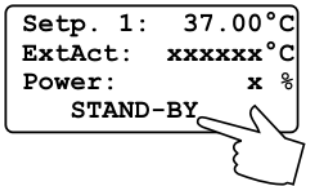
Pin assignment:

Pin	Signal
1	not connected
2	5 V / DC
3	0 V

Use shielded cables only.

Activate the stand-by input:

- Under menu item Stand-by, set the parameter to "yes" (see page 44).
- Connect an external contact 'AK' (e.g. for emergency switch-off) or an alarm contact of the superordinated system.



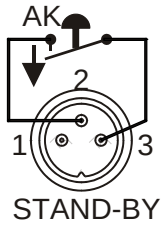
In case the connection between Pin 2 and Pin 3 is interrupted by opening the contact 'AK', a complete shutdown of the circulation pump and heater is effected, and the unit enters the condition "OFF".
As long as the contact remains open, line 4 of the DIALOG-DISPLAY (LCD) flashes and displays the message "STAND-BY".

If the contact is reclosed, the instrument returns to the stand-by state and "OFF" is displayed.

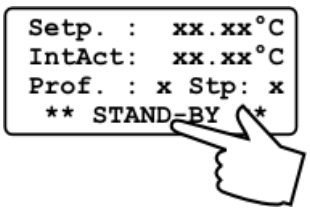
Additional tips for using the STAND-BY input:

The stand-by function can be used in conjunction with the AUTOSTART feature (see page 44)

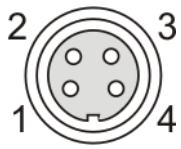
1. If the Autostart function is NOT turned ON, the stand-by input should be used as described above.
2. If the Autostart funcion is enabled, the instrument will revert back to the original method of entering the setpoint (i.e. keypad, RS232, Analog input, etc.).



- Entering the setpoint with the keypad.
  As described above, a bipolar shut-down is accompanied by the "STAND-BY" display and the OFF state. The programmable controller starts again when the contact is reclosed. The temperature of the bath liquid changed during the STAND-BY state.
- Entering the setpoint with the programmer (see pages 47 and 49).
  The display "STAND-BY" appears. The setpoint value and the time are both held at the current value. The temperature of the bath liquid will be held constant at this temperature. The programmer continues once the contact is reclosed.

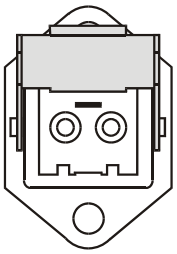


⚠ **Warning: this is not an actual shutoff feature.**



Connector for removable control module RD (3.6)

Extension cable for operating device RD:
Order No. 8 980 126 2 m long
Order No. 8 980 127 5 m long



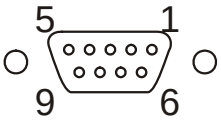
Control connector (10)

Output voltage is applied when the unit runs,
for example after pressing the start/stop key ⏻.

Output voltage: 230 V~ / max. 0.1 A

11. Remote control

11.1. Setup for remote control



RS232
RS485

Select the "Configuration" submenu and select the option "Setpoint" to define the interface (see page 43).

The interface parameters are set by selecting the submenu "Interface" on the instrument. Normally, this is a one-time-only adjustment. (Selecting and setting menu items, see page 56.)

Factory settings:

RS232

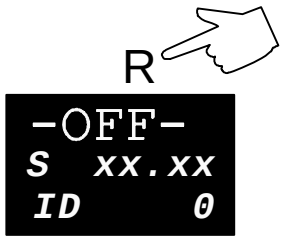
BAUDRATE	4800 bauds
PARITY	even parity
HANDSHAKE	Protocol RTS/CTS (hardware handshake)
Data bits	7
Stop bit	1

Like all parameters which can be entered through the keypad, interface parameters are stored in memory even after the instrument is turned off.

11.2. Communication with a PC or a superordinated data system

Suitable terminal programs for communicating with a PC are:

- MS-Windows - TERMINAL.EXE (included with MS-Windows).



If the temperature system is put into remote control mode via the configuration level, the display will read
"R -OFF-" = REMOTE STOP.

In general, the computer (master) sends commands to the instrument (slave). The instrument sends data (including error messages) only when the computer sends a query.

D A transfer sequence consists of:

- address (RS485 interface only)
- command
- space (⇔; Hex: 20)
- parameter (the character separating decimals in a group is the period)
- end of file (↵; Hex: 0D)

The commands are divided into **in** or **out** commands.

in commands: asking for parameters to be displayed

out commands: setting parameters

The **out** commands are valid only in remote control mode.

When the RS485 interface is used, the three-digit instrument address stands in front of each command.
(example: address Ad32 = A**032**)

Examples:

Command to set the working temperature to 55.5 °C

out_sp_00 ⇔ 55.5↵
A032_out_sp_00 ⇔ 55.5↵

Command to ask for the working temperature :

in_sp_00↵
A032_in_sp_00↵

Response from the instrument:

55.5↵
A032_55.5↵

11.3. List of commands

When the RS485 interface is used, the instrument address stands in front of each command (Axxx_).

in commands: Asking for parameters or temperature values to be displayed.

Command	Parameter	Response of instrument
version	none	Number of software version (V X.xx)
status	none	Status message, error message (see page 69)
in_pv_00	none	Actual bath temperature.
in_pv_01	none	Heating power being used (%).
in_pv_02	none	Temperature value registered by the external Pt100 sensor.
in_pv_03	none	Temperature value registered by the safety sensor. >TANK<
in_pv_05	none	Pump pressure in bar.
in_sp_00	none	Working temperature
in_sp_03	none	High temperature warning limit
in_sp_04	none	Low temperature warning limit .
in_sp_05	none	Setpoint temperature of the external programmer (socket 3.1 - REG+E-PROG) .
in_sp_07	none	Pump pressure stage
in_hil_00	none	Max. cooling power (%).
in_hil_01	none	Max. heating power (%).
in_mode_02	none	Identification type: 0 = no identification 1 = single identification 2 = continual identification
in_mode_03	none	Type of the programmer input: 0 = Voltage 0 V to 10 V 1 = Current 0 mA to 20 mA
in_mode_04	none	Internal/external temperature control: 0 = Temperature control with internal sensor. 1 = Temperature control with external Pt100 sensor.

Command	Parameter	Response of instrument
in_mode_05	none	Temperature system in Stop/Start condition: 0 = Stop 1 = Start
in_mode_08	none	Adjusted control dynamics 0 = aperiodic 1 = standard
in_par_01	none	Time constant of the external bath.
in_par_02	none	Internal slope.
in_par_03	none	Time constant of the internal bath.
in_par_04	none	Band limiting (max. difference between the temperatures in the internal bath and external system).
in_par_06	none	Xp control parameter of the internal controller.
in_par_07	none	Tn control parameter of the internal controller.
in_par_08	none	Tv control parameter of the internal controller.
in_par_09	none	Xp control parameter of the cascade controller.
in_par_10	none	Proportional portion of the cascade controller.
in_par_11	none	Tn control parameter of the cascade controller.
in_par_12	none	Tv control parameter of the cascade controller.
in_par_13	none	Adjusted maximum internal temperature of the cascade controller.
in_par_14	none	Adjusted minimum internal temperature of the cascade controller.

out commands: Setting parameters or temperature values.

Command	Parameter	Response of instrument
out_mode_01	0	Use working temperature
out_mode_02	0	No identification. Temperature control by using the stored parameters.
out_mode_02	1	Single identification of controlled system after the next start.

Command	Parameter	Response of instrument
out_mode_02	2	Continual identification of controlled system whenever a new setpoint is to be reached.
out_mode_04	0	Temperature control of internal bath.
out_mode_04	1	External control with Pt100 sensor.
out_mode_05	0	Stop the unit = R –OFF-.
out_mode_05	1	Start the unit.
out_mode_08	0	Set the control dynamics - aperiodic
out_mode_08	1	Set the control dynamics - standard
out_sp_00	xxx.x	Set working temperature.
out_sp_03	xxx.x	Set high temperature warning limit .
out_sp_04	xxx.x	Set low temperature warning limit .
out_sp_07	x	Set the pump pressure stage (1 ... 5).
out_hil_00	-xxx	Set the desired maximum cooling power (0 % to 100 %). **Note:** Enter the value with a preceding negative sign!
out_hil_01	xxx	Set the desired maximum heating power (10 % to 100 %).
out_par_04	xxx	Band limiting during external control. Setting the maximum difference between the temperatures in the internal bath and external system.
out_par_06	xxx	Xp control parameter of the internal controller.
out_par_07	xxx	Tn control parameter of the internal controller.
out_par_08	xxx	Tv control parameter of the internal controller.
out_par_09	xxx	Xp control parameter of the cascade controller.
out_par_10	xxx	Proportional portion of the cascade controller.
out_par_11	xxx	Tn control parameter of the cascade controller.
out_par_12	xxx	Tv control parameter of the cascade controller.
out _par_13	xxx	Maximum internal temperature of the cascade controller.
out _par_14	xxx	Minimum internal temperature of the cascade controller.

11.4. Status messages / error messages

The instrument sends data (including error messages) only when the computer sends a query.

Status messages	Description
00 MANUAL STOP	Presto in "OFF" state.
01 MANUAL START or 01 MANUAL START,DEGASING	Presto in keypad control mode or Presto in keypad control mode and degasifying active
02 REMOTE STOP	Presto in "r OFF" state.
03 REMOTE START or 03 REMOTE START,DEGASING	Presto® in remote control mode. or Presto in remote control mode and degasifying active

Error messages	Description
-02 REFRIGERATOR ALARM	Defect temperature sensor in refrigeration circuit.
-03 EXCESS TEMPERATURE WARNING	High temperature warning " ".
-04 LOW TEMPERATURE WARNING	Low temperature warning " ".
-05 WORKING SENSOR ALARM	Working temperature sensor short-circuited or interrupted.
-06 SENSOR DIFFERENCE ALARM	Sensor difference alarm. Working temperature and safety sensors report a temperature difference of more than 25 °C.
-07 I^2C-BUS ERROR	Internal error when reading or writing the I^2C bus.
-08 INVALID COMMAND	Invalid command.
-09 COMMAND NOT ALLOWED IN CURRENT OPERATING MODE	Invalid command in current operating mode.
-10 VALUE TOO SMALL	Entered value too small.
-11 VALUE TOO LARGE	Entered value too large.
-12 TEMPERATURE MEASUREMENT ALARM	Error in A/D converter.
-13 WARNING : VALUE EXCEEDS TEMPERATURE LIMITS	Value lies outside the adjusted range for the high and low temperature warning limits. But value is stored.
-14 TEMPERATURE/LEVEL ALARM	Safety temperature alarm Low level alarm.

Error messages	Description
-15 EXTERNAL SENSOR ALARM	External control selected, but external Pt100 sensor not connected.
-16 TRIAC/RELAY CONNECTION OPEN	Heating circuit interrupted.
-17 TRIAC SHORTED	Heating circuit short-circuited.
-20 WARNING: CLEAN CONDENSOR OR CHECK COOLING WATER CIRCUIT OF REFRIGERATOR	Cooling of the condenser is affected. Clean air-cooled condenser. Check the flow rate and cooling water temperature on water-cooled condenser.
-21 WARNING: COMPRESSOR STAGE 1 DOES NOT WORK	Compressor stage 1 does not work. Check mains circuit breakers F1 and F3, both might have triggered. Reset circuit breakers if necessary.
-26 WARNING: STAND-BY PLUG IS MISSING	External stand-by contact is open. Stand-by input - see pages 44 and 6.
-31 INTERNAL COMMUNICATION ERROR	Communication between remote module RD and instrument interrupted.
-40 NIVEAU LEVEL WARNING	Low liquid level warning in the internal reservoir.

12. Cleaning the unit

Caution:
Always turn off the unit and disconnect the mains cable from the power source before cleaning the unit.
Prevent humidity from entering into the circulator.
Electrical connections and any other work must be performed by qualified personnel only.

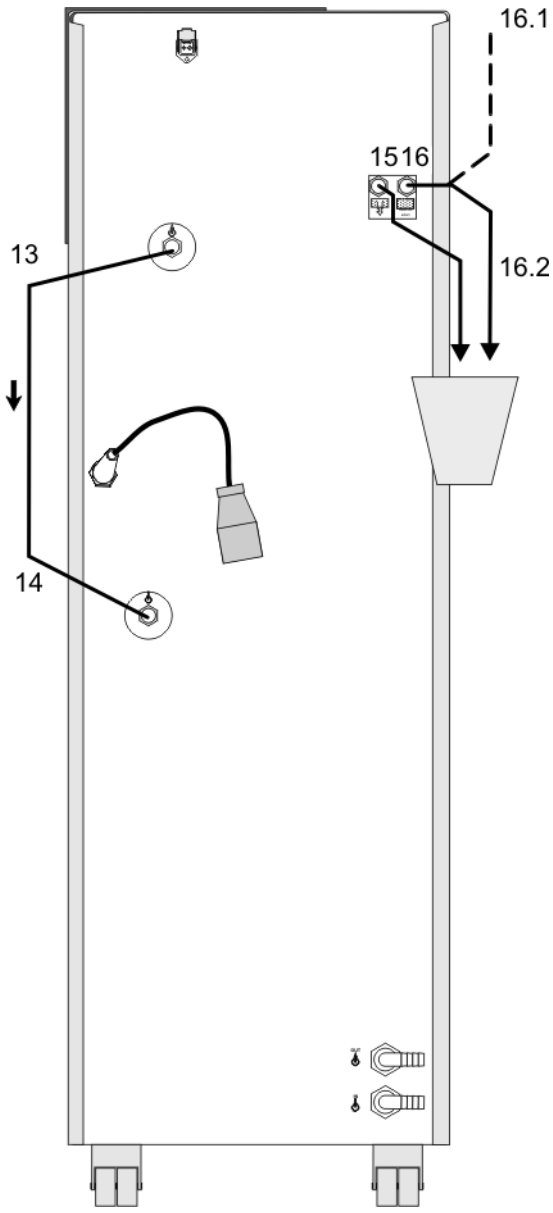
Cleaning the unit outside

- Clean the outside of the unit using a wet cloth and low surface tension water (e.g., soap suds).

Before applying a cleaning or decontamination method different from the one recommended by JULABO, the user has to make sure with the manufacturer, that the planned method does not damage the unit.

Caution:

- Choose the detergent according to the bath liquid which is used.
  E.g. Ethanol, Silicon remover can be used.
- Take care the room where cleaning takes place is well ventilated.
- Set the working temperature setpoint.
  Recommendation: 20 °C 2 0 ↵



Cleaning the inside:

If you change the bath liquid or want to use a different one, carefully clean the parts in contact with the bath liquid. The heat exchanger, internal reservoir, connecting tubing and external system should be rinsed several times using cleaning liquid.

Preparations:

1. Drain the temperature system.
   See chapter 5.9. Draining

2. If only the **Presto** temperature system is to be cleaned, connect the pump connectors (13, 14) using a tubing.

3. Connect a tubing to the connector (16) "Reservoir extern". First hold the end of the tubing towards position 16.1, to prevent the cleaning liquid from flowing down instantly.

4. Hold the tubing from the overflow connector (15) into a suitable vessel.

Cleaning is performed in two steps.
First rinse the internal reservoir, the tubing lines and the heat exchanger.
As second step, carefully remove the cleaning liquid.

1. Cleaning internal reservoir, tubing lines and heat exchanger:

- Fill the temperature system with cleaning liquid.
  See chapter 5.7. Filling

```
Pump
>Pump          OFF
 Mode: Sys close
```

- In the submenu >Pump< the unit has to be adjusted on the operating status >Sys close< .
- Set the working temperature setpoint. 
  Recommendation: 20 °C
- Press the start key  and allow the liquid to be pumped through the unit for about 15 minutes.
- Press the stop key .

```
Pump
>Pump          OFF
 Mode:       drain
```

  Drain the temperature system.
  In the submenu >Pump< adjust the menu option >Mode< on >drain< stellen.
  See chapter 5.9. Draining

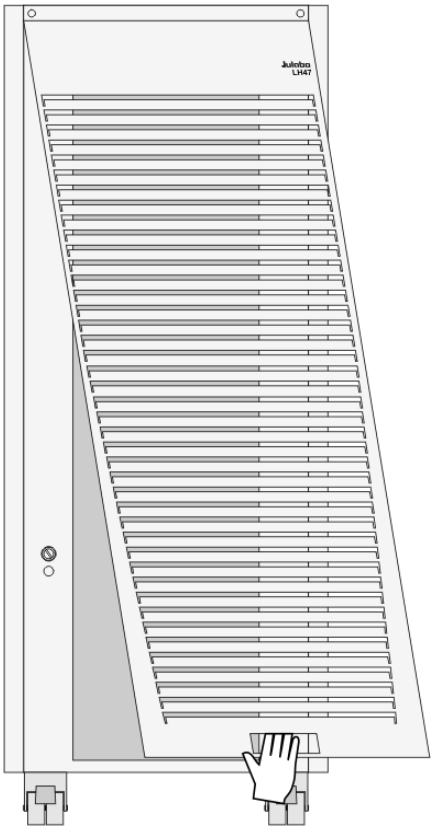
2. Removing the cleaning liquid:

- **Switch on** the unit with the mains switch!
  The venting valve remain open.
- Blow through the temperature system with dry, warm air.
  The air is fed in turns through the different connectors on the temperature system.
  Begin with the connectors (15, 16) leading to the internal reservoir.
  Then blow through the pump connectors (13, 14) leading to the heat exchanger and the drain port (8) on the front.
- Allow the system to dry (wait until the humidity evaporates). Then reconnect the temperature system or close the connectors according the intended use.
  Tighten the drain screw on the front.

13. Maintaining / repairing the unit

Caution:
Always turn off the unit and disconnect the mains cable from the power source before cleaning the unit.
Prevent humidity from entering into the circulator.

Electrical connections and any other work must be performed by qualified personnel only.

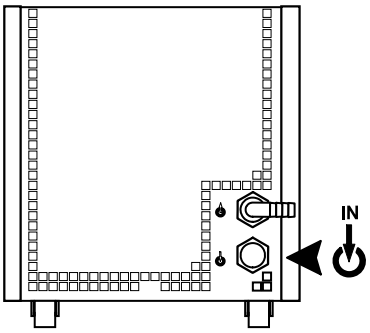


Maintaining the cooling performance

Air-cooling:

To maintain the full cooling performance, clean the condenser from time to time.

- Switch off the unit, disconnect mains power cable.
- Hold the venting grid, pull out and remove.
- Clean the ribbed condenser with a vacuum cleaner.
- Replace the venting grid.
- Switch on the unit.



Water-cooling:

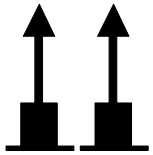
To maintain the full cooling performance, clean the filter in the cooling water entry from time to time.

- Switch off the unit, disconnect mains power cable.
- Interrupt the cooling water supply.
- Disconnect the tubing from the inlet "IN" (18) and remove the dirty filter.
- Clean the filter.
- Replace the filter and reconnect the tubing.
- Open the cooling water supply.
- Check the tubing connection for tightness.
- Unit is ready to operate.

The unit is designed for continuous operation under normal conditions. Periodic maintenance is not required.

Repairs

Before asking for a service technician or returning a JULABO instrument for repair, please contact an authorized JULABO service station.



When returning the unit:

- Empty completely, remove the expansion tank, close tightly the connections with nuts and closing caps.
- Careful and appropriate packing is important.
- During transport the unit has to stand upright. Mark the packing correspondingly.
- When returning a unit, take care of careful and adequate packing. JULABO is not responsible for damages that might occur from insufficient packing.

JULABO reserves the right to carry out technical modifications with repairs for providing improved performance of a unit.

14. WARRANTY PROVISIONS

The following Warranty Provisions shall apply to products sold in North America by Julabo ("Seller") to the entity shown as buyer ("Buyer") on Seller's invoice.

1. Initial Warranty. Upon Seller's receipt of payment in full for the products and subject to Buyer's compliance with the terms of sale and any other agreement with Seller relating to the products, Seller warrants to the Buyer that the products manufactured by the Seller are free from defects in material and workmanship for a period not to exceed two (2) years or ten thousand (10,000) hours of operation, whichever comes first, from the date the product is shipped by Seller to Buyer (the "Initial Warranty").

2. EXCLUSION OF ALL OTHER EXPRESS WARRANTIES; EXCLUSION OF ALL IMPLIED WARRANTIES. OTHER THAN THE INITIAL WARRANTY, NO OTHER EXPRESS WARRANTIES ARE MADE. ALL IMPLIED WARRANTIES OF EVERY TYPE AND KIND, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, ARE EXCLUDED IN ALL RESPECTS AND FOR ALL PURPOSES. SELLER DISCLAIMS AND MAKES NO IMPLIED WARRANTIES WHATSOEVER.

3. Exclusions. The Initial Warranty does not include damage to the product resulting from accident, misuse, improper installation or operation, unauthorized or improper repair, replacement or alteration (including but not limited to repairs, replacements, or alterations made or performed by persons other than Seller's employees or authorized representatives), failure to provide or use of improper maintenance, unreasonable use or abuse of the product, or failure to follow written installation or operating instructions. Buyer must return the product's record of purchase to the Seller or one of Seller's authorized representatives within thirty (30) days of the date the product is shipped by Seller to Buyer in order to make a claim under the Initial Warranty. Notwithstanding anything contained herein to the contrary, all glassware, including but not limited to reference thermometers, are expressly excluded from the Initial Warranty.

4. Buyer's sole remedies; Limitations on Seller's Liability. Buyer's sole and exclusive remedy under the Initial Warranty is strictly limited, in Seller's sole discretion, to either: (i) repairing defective parts; or (ii) replacing defective parts. In either case, the warranty period for the product receiving a repaired or replaced part pursuant to the terms of the Initial Warranty shall not be extended. All repairs or replacements performed by Seller pursuant to these Warranty Provisions shall be performed at Seller's facility in Allentown, Pennsylvania, U.S.A. or Vista, California, U.S.A or at the facility of an authorized representative of Seller, which location shall be determined by Seller in its sole discretion; provided, however, that Seller may, in its sole discretion perform such repairs or replacements at Buyer's facility in which case Buyer shall pay Seller's travel, living and related expenses incurred by Seller in performing the repairs or replacements at Buyer's facility. As a condition precedent to Seller's obligation to repair or replace a product part under the Initial Warranty, Buyer shall (i) promptly notify Seller in writing of any such defect; (ii) shall have returned the product's record of purchase to Seller or to one of Seller's authorized representatives within thirty (30) days of the date the product is delivered to Buyer; and (iii) assist Seller in all respects in its attempts to determine the legitimacy and basis of any claims made by or on behalf of Buyer including but not limited to providing Seller with access to the product to check operating conditions. If Buyer does not provide such written notice to Seller within the Initial Warranty period or fails to return the product's record of purchase as set forth above, Seller shall have no further liability or obligation to Buyer therefore. In no event shall Seller's liability under the Initial Warranty exceed the original purchase price of the product which is the subject of the alleged defect.

5. THE REMEDIES PROVIDED IN THE INITIAL WARRANTY ARE THE SOLE AND EXCLUSIVE REMEDIES AVAILABLE TO THE BUYER. NOTWITHSTANDING ANYTHING TO THE CONTRARY CONTAINED HEREIN, AND EVEN IF THE SOLE AND EXCLUSIVE REMEDIES FAIL OF THEIR ESSENTIAL PURPOSE FOR ANY REASON WHATSOEVER, IN NO EVENT SHALL SELLER BE LIABLE FOR BUYER'S MANUFACTURING COSTS, LOST PROFITS, GOODWILL, OR ANY OTHER SPECIAL, INDIRECT, PUNITIVE,

INCIDENTAL OR CONSEQUENTIAL DAMAGES TO BUYER OR ANY THIRD PARTY AND ALL SUCH DAMAGES ARE HEREBY DISCLAIMED.

6. Assignment. Buyer shall not assign any of its rights or obligations hereunder without the prior written approval of Seller; provided, however, that if Buyer is a distributor of Seller, the rights and obligations of Buyer under these Warranty Provisions shall inure to the benefit of and be binding upon Buyer's customers who provide the product's proof of purchase to Seller pursuant to the terms set forth herein. Seller may assign any or all of its rights or obligations hereunder without Buyer's prior consent.

7. Governing Law. The Warranty Provisions and all questions relating to their validity, interpretation, performance, and enforcement shall be construed in accordance with, and shall be governed by, the substantive laws of the Commonwealth of Pennsylvania without regard to its principles of conflicts of law.

8. Waiver. Any failure of the part of Seller to insist on strict compliance with the Warranty Provisions shall no way constitute a waiver of such right. No claim or rights arising out of a breach of the Warranty Provisions by Buyer may be discharged in whole or in part by a waiver of the claim or right, unless the waiver is in writing signed by an authorized representative of Seller. Seller's waiver or acceptance of any breach by Buyer of any provisions of the Warranty Provisions shall not constitute a waiver of or an excuse for nonperformance as to any other provision of the Warranty Provisions nor as to any prior or subsequent breach of the same provision.

9. Freight. Buyer will arrange and pay for shipping and handling charges for the unit to be returned to the Seller.Seller will arrange and pay for shipping and handling for the return of the unit to the Buyer.