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.

The JULABO Quality Management System
Temperature control devices for research and industry are developed, produced, and distributed according to the requirements of ISO 9001 and ISO 14001. Certificate Registration No. 01 100044846

Unpacking and inspecting
Unpack the circulator 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 to the full extent for us to guarantee our full support of your claim for protection against loss from concealed damage. The form required for filing such a claim will be provided by the carrier.

Important: keep operating manual for future use
TABLE OF CONTENTS

Operating manual ......................................................................................................................... 5
1. Intended use .......................................................................................................................... 5
   1.1. Description .................................................................................................................... 5
2. Operator responsibility – Safety recommendations ............................................................... 6
   2.1. Disposal ........................................................................................................................ 8
   2.2. Technical specifications ............................................................................................... 9
Operating instructions ..................................................................................................................11
3. Safety notes for the user ......................................................................................................11
   3.1. Explanation of safety notes ........................................................................................ 11
   3.2. Explanation of other notes ....................................................................................... 11
   3.3. Safety recommendations .......................................................................................... 11
4. Operating controls and functional elements ........................................................................14
   4.1. Circulator .................................................................................................................... 14
5. Preparations ..........................................................................................................................16
   5.1. Installation ................................................................................................................... 16
   5.2. Bath fluids .................................................................................................................... 16
   5.3. Temperature application to external systems ............................................................... 17
      5.3.1. Pump set ............................................................................................................. 17
      5.3.2. Tubing ................................................................................................................. 18
   5.2. Countercooling ........................................................................................................... 19
6. Operating procedures ..........................................................................................................20
   6.1. Power connection ....................................................................................................... 20
   6.2. Switching on / Start - Stop ....................................................................................... 20
      6.2.1. Switching on the circulator ............................................................................... 20
7. Setting of temperatures ........................................................................................................21
   7.1. Using the pre-settings in the menu ........................................................................... 21
   7.2. Direct setting of temperatures ................................................................................. 22
8. Safety installations, warning functions ..............................................................................23
   8.1. Excess temperature protection .................................................................................. 23
      8.1.1. Early warning system, low level protection ......................................................... 24
   8.2. Switch-over from warning to shutdown function ....................................................... 25
   8.3. Over and Sub temperature warning function ............................................................. 26
9. Menu functions ....................................................................................................................27
Operating manual

1. Intended use

JULABO circulators have been designed to control the temperature of specific fluids in a bath tank.

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

- The circulators are operated via the splash-proof keypad. The microprocessor technology allows different values to be set, stored, and displayed on the VFD COMFORT-DISPLAY. Three menu keys facilitate the adjustment of setpoints, warning and safety functions, and menu functions.
- Temperature- and time-dependent processes can be stored and executed using the integrated programmer.
- The adjustable PID cascade temperature control automatically adjusts the heat supply to the thermal requirements of the bath.
- Absolute Temperature Calibration (ATC3) provides high temperature stability at all points in the bath. With the 3-point calibration, an offset is adjusted at three temperatures to ensure an accurate temperature pattern at the selected spot in the bath over the entire temperature range.
- Electrical connections:
  - RS232 interface for modern process technology without an additional interface.
  - Connection for external Pt100 sensor for external temperature measurement and control.
  - Alarm output for external alarm message or control of JULABO refrigerating baths or solenoid valve (cooling water).
- The excess temperature protection according to IEC 61010-2-010 is a safety device independent from the control circuit. Its safety value can be displayed and adjusted on the VFD COMFORT-DISPLAY.
- The early warning system for low level signals that bath fluid needs to be refilled before the low level protection according to IEC 61010-2-010 triggers a safety shutdown of the main functional elements.
- Intelligent pump system: the pump capacity (electronically adjustable via the motor speed) can be adapted to different conditions for internal and external temperature-control applications.
2. Operator responsibility – Safety recommendations

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.

- 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 circulator. 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!

Contact
JULABO USA, Inc.
884 Marcon Boulevard
Allentown, PA 18109
Phone: +1(610) 231-0250
Fax: +1(610) 231-0260
info.us@julabo.com
www.julabo.com

Safety instructions for the operator:

- You have received a product designed for industrial use. Nevertheless, 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 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 perform configuration, installation, maintenance and repairs of the circulator. Routine operation can also be carried out by untrained personnel who should however be instructed by trained personnel.
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). Only use non-acid and non corroding materials.

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 | Mandatory label M018: Colors: blue, white |
| or | Carefully read the user information prior to beginning operation. |
| 2 | Semi S1-0701 Table A1-2 #9 |
|   | Carefully read the user information prior to beginning operation. |
|   | Scope: USA, NAFTA |

3 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.

| 1 | 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 respective safety recommendations. Also observe the pin assignment of plugs and technical specifications of the products.
2.1. Disposal

The circulator contains a back-up battery that supplies voltage to memory chips when the unit is switched off. Do not dispose of the battery with household waste!

Depending on battery regulations in your country, you might be obliged to give back used or defect batteries to gathering places.

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

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

<table>
<thead>
<tr>
<th>Heating Immersion Circulator</th>
<th>ME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working temperature range</td>
<td>°C 20 ... 200</td>
</tr>
<tr>
<td>Temperature stability</td>
<td>°C ±0,01</td>
</tr>
<tr>
<td>Overall dimensions (WxDxH)</td>
<td>cm 13x15x33</td>
</tr>
<tr>
<td>Usable bath depth</td>
<td>cm 8 ... 16,5</td>
</tr>
<tr>
<td>Weight</td>
<td>kg 4,0</td>
</tr>
</tbody>
</table>

All measurements have been carried out at:
- rated voltage and frequency: ambient temperature: 20 °C
- bath fluid: water    operating temperature: 70 °C

Technical changes without prior notification reserved.

<table>
<thead>
<tr>
<th>Mains power connection</th>
<th>V/ Hz</th>
<th>ME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current draw</td>
<td>(at 208 V / 230 V)</td>
<td>A 8 / 9</td>
</tr>
<tr>
<td>Mains power connection</td>
<td>V/ Hz</td>
<td>208 ... 230 / 50/60</td>
</tr>
<tr>
<td>Current draw</td>
<td>(at 100 V / 115 V)</td>
<td>A 8 / 9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature selection</td>
</tr>
<tr>
<td>via keypad</td>
</tr>
<tr>
<td>remote control via personal computer</td>
</tr>
<tr>
<td>Temperature indication</td>
</tr>
<tr>
<td>Resolution</td>
</tr>
<tr>
<td><strong>Absolute Temperature Calibration INT/EXT</strong></td>
</tr>
<tr>
<td>Temperature control</td>
</tr>
<tr>
<td>Heater wattage (at 230 V)</td>
</tr>
<tr>
<td>Heater wattage (at 115 V)</td>
</tr>
<tr>
<td>Electronically adj. pump capacity</td>
</tr>
<tr>
<td>Flow rate</td>
</tr>
<tr>
<td>Pressure max.</td>
</tr>
</tbody>
</table>

Electrical connections:
- External alarm device     | Vdc/mA 24-0 / max. 25 |
- Computer interface        | RS232 |
- External temperature sensor | Pt100 |

Ambient temperature     | °C 5 ... 40 |
Operator responsibility – Safety recommendations

Safety installations according to IEC 61010-2-010:
- Excess temperature protection adjustable from 0 °C ... 230 °C
- Low liquid level protection float switch
- Classification according to DIN 12876-1 class III

Supplementary safety installations
- Early warning system for low level float switch
- High temperature warning function optical + audible (in intervals)
- Low temperature warning function optical + audible (in intervals)
- Supervision of working sensor plausibility control
- Reciprocal sensor monitoring between working and safety sensors difference >35 K
- Alarm message optical + audible (permanent)
- Warning message optical + audible (in intervals)

Environmental conditions according to IEC 61 010-1:
- Use only indoor.
- Altitude up to 2000 m - normal zero.
- Ambient temperature: +5 ... +40 °C
- 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.

Protection class according to IEC 60 529 IP21
The unit corresponds to Class I
Overvoltage category II
Pollution degree 2

Caution:
The unit is not for use in explosive environment

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).
Operating instructions

3. Safety notes for the user

3.1. Explanation of safety notes

In addition to the safety warnings listed, warnings are posted throughout the operating 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 for averting dangers.

**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.

This icon is used in the operating instructions to indicate flashing values or parameters which have to be set or confirmed.

3.3. Safety recommendations

Follow the safety instructions to avoid personal injury and property damage. Also, the valid safety instructions for workplaces must be followed.

- Only connect the unit to a power socket with an earthing contact (PE – protective earth)!
- The power supply plug serves as a safe disconnecting device from the line and must always be easily accessible.
- Place the unit on an even surface on a base made of nonflammable 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 excess temperature safety installation at least 25 °C below the fire point of the bath fluid.
Safety notes for the user

- Observe the limited working temperature range when using plastic bath tanks.
- 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 entering the hot bath oil.
- Do not drain the bath fluid while it is hot! Check the temperature of the bath fluid prior to draining (e.g., by switching the unit on for a short moment).
- Use 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 units.
- 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 damage in the interior of the unit.
- Observe all warning labels.
- Never remove warning labels.
- Never operate units with damaged mains power cables.
- Repairs are to be carried out only by qualified service personnel.

Caution:
The temperature controlling i.e. of fluids in a reactor constitutes normal circulator 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.
Notice: Check the safety installations at least twice a year!

- Excess temperature protection according to IEC 61010-2-010. With a screwdriver turn back the adjustable excess temperature protection until the shut-down point (actual temperature).
- Low level protection according to IEC 61010-2-010. To check the function of the float, it can be manually lowered with a screwdriver for example.

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

4.1. Circulator

1. Mains power switch, illuminated

**Navigation keys**

2. **OK**
   1. Key: >OK< Start / Stop (pump / heater)
   2. >OK< in the menu Menu item / select submenu for setting
      - Save set value
      - Save selected parameter
      - A beep signals the end of setting

   After the actions Start, Stop and change from VFD Display to standard display the key **OK** is locked for a short time.
   The above graph “front side” shows an example for standard display.

3. **Return**
   1. Key: >Return< Stop (pump / heater)
   2. >Return< in the menu one menu level down
      - Correction function for parameters or values (prior to OK)

   - immediately back to standard display

   - icon for „keep key pressed down“.

4. **Up / Down**
   1. Key: >Up / Down< temperature – increase/decrease setpoint
      - Push key quickly for single steps,
      - Keep key pressed for fast change.
   2. >Up/Down< in the menu selection of menu items / parameters
Menu keys

5  Key: start the menu > warning and safety values<

6  Key: start the menu >temperature setpoints<

7  Key: display of MENU structure

10 **VFD COMFORT-DISPLAY**

Header: Control indicators see sections 11 and 12

Line 1: Actual value internal or external

The display is depending on the selected control mode in the menu > Control < (internal or external).

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

Line 3: Actual value (E = external or I = internal)

Alternating with the display in line 1

11 Control indicators in the header:

Heating / Cooling / Alarm /

Remote control

12 Control indicators in the header:

Temperature indication Internal or External actual value

Temperature indication in °C (°F not possible on this unit)

13 Display of set pump pressure stage

Four stages, can be set via the key MENU, under >MENU - PUMP<.

14 Adjustable excess temperature protection according to IEC 61010-2-010

15 Socket: control cable of JULABO refrigerated circulator

or output for alarm messages

16 Interface RS232: remote control via personal computer

17 Socket for external measurement and control sensor

or external setpoint programming

18 Mains circuit breakers (resettable) 15 A

19 Mains power cable with plug
5. Preparations

5.1. Installation

Caution:
Securely fix the immersion circulator. The heater may not be in contact with the wall of the bath tank. Keep a distance of at least 15 mm. Units not adequately fixed may drop into the bath tank. **Danger of electric shock!**

First pull out the power plug to disconnect the unit from the power supply net. Then take the immersion circulator out of the bath tank. Make a service technician check the instrument before it is used again.

- Place the unit on an even surface on a pad made of non-flammable material.

- The heating immersion circulator is mounted using a bath attachment clamp (21) designed for bath wall thicknesses up to 26 mm.

- Use the two sleeves (22) supplied with the unit to reduce the immersion depth from 165 mm to 145 mm (see drawing).

- For use with glass vessels an upright stand rod, available as optional accessory (order no. 8 970 022) may be attached.

5.2. Bath fluids

Caution:
Carefully read the safety data sheet of the bath fluid 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.

**Water:** The quality of water depends on local conditions.
- Due to the high concentration of lime, hard water is not suitable for temperature control because it leads to calcification in the bath.
- Ferrous water can cause corrosion - even on stainless steel.
- Chloric water can cause pitting corrosion.
- Distilled and deionized water is unsuitable. Their special properties cause corrosion in the bath, even in stainless steel.
Recommended bath fluids:

<table>
<thead>
<tr>
<th>Bath fluid</th>
<th>Temperature range</th>
</tr>
</thead>
<tbody>
<tr>
<td>soft/decalcified water</td>
<td>5 °C to 80 °C</td>
</tr>
</tbody>
</table>

See website for list of recommended bath fluids.

**ATTENTION:** The maximum permissible viscosity is 50 mm² /s.

**Caution:**

Fire or other dangers when using bath fluids that are not recommended:

Please contact JULABO before using other than recommended bath fluids. Use only nonacidic and noncorrosive bath fluids. JULABO assumes no liability for damage caused by the selection of an unsuitable bath liquid. Unsuitable bath fluids are fluids which, e.g.,
- are highly viscous (much higher than recommended 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!**

### 5.3. Temperature application to external systems

**Caution:** Securely attach all tubing to prevent slipping.

If the circulator is operated without external system, close the pump connector (24a) with the cap nut.

The circulator is used for temperature application to external, closed systems (loop circuit).

#### 5.3.1. Pump set

**Mounting the pump set:**
- Remove the bath attachment clamp (21).
- Screw the pump set to the circulator, and then fix the bath attachment clamp to the pump set.
- Slide the short piece of tubing supplied with the pump set onto the short pump nozzle and the pump connector (23).
- Thus the total immersion depth is reduced to 145 mm.
- Adjusting the pump for external bath circulation see example D - MENU PUMP.

**Connecting an external system:**
- Unscrew the collar nuts from the pump connector (24a).
- Slide the tubing onto the pump connector for feed (24a) and return flow (24b) and secure with hose clamps

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order No.</td>
<td>Description</td>
</tr>
<tr>
<td>8 970 140</td>
<td>Pump set</td>
</tr>
</tbody>
</table>
### 5.3.2. Tubing

#### Recommended tubing:

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Length</th>
<th>Tubing Type</th>
<th>Inner Dia.</th>
<th>Temperature Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 930 008</td>
<td>1 m</td>
<td>CR® tubing</td>
<td>8 mm</td>
<td>-20 °C to 120 °C</td>
</tr>
<tr>
<td>8 930 010</td>
<td>1 m</td>
<td>CR® tubing</td>
<td>10 mm</td>
<td>-20 °C to 120 °C</td>
</tr>
<tr>
<td>8 930 108</td>
<td>1 m</td>
<td>Viton tubing</td>
<td>8 mm</td>
<td>-50 °C to 200 °C</td>
</tr>
<tr>
<td>8 930 110</td>
<td>1 m</td>
<td>Viton tubing</td>
<td>10 mm</td>
<td>-50 °C to 200 °C</td>
</tr>
<tr>
<td>8 930 410</td>
<td>1 m</td>
<td>Insulation for tubing</td>
<td>8 mm or 10 mm</td>
<td>-50 °C to 100 °C</td>
</tr>
<tr>
<td>8 970 480</td>
<td></td>
<td>2 tubing clamps. size 1, tubing 8 mm inner dia.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 970 481</td>
<td></td>
<td>2 tubing clamps. size 2, tubing 10 or 12 mm inner dia.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 930 209</td>
<td>0.5 m</td>
<td>Metal tubing, triple insulated, M16x1 *</td>
<td></td>
<td>-100 °C to +350 °C</td>
</tr>
<tr>
<td>8 930 210</td>
<td>1.0 m</td>
<td>Metal tubing, insulated, M16x1 *</td>
<td></td>
<td>-50 °C to +200 °C</td>
</tr>
<tr>
<td>8 930 211</td>
<td>1.5 m</td>
<td>Metal tubing, insulated, M16x1 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 930 214</td>
<td>3.0 m</td>
<td>Metal tubing, insulated, M16x1 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 930 220</td>
<td>0.5 m</td>
<td>Metal tubing, insulated, M16x1 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 930 221</td>
<td>1.0 m</td>
<td>Metal tubing, insulated, M16x1 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 930 222</td>
<td>1.5 m</td>
<td>Metal tubing, insulated, M16x1 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 930 223</td>
<td>3.0 m</td>
<td>Metal tubing, insulated, M16x1 *</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*) Adapter for metal tubing M10x1 on M16x1

**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 fluid to be pumped out within a short time. This may result in:
- 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).
- Preventive maintenance: Replace the tubing from time to time.
5.2. Countercooling

Notice:
Observe the laws and regulations of the water distribution company valid in the location where the unit is operated.

For applications near the ambient temperature, the cooling coil (order no. 8 970 105) must be connected to the water mains.

Mounting the cooling coil:
- Remove the bath attachment clamp (21).
- Screw the cooling coil to the circulator, and then fix the bath attachment clamp to the cooling coil.
- Thus the total immersion depth is reduced to 145 mm.

- Using tubing, connect the cooling coil (25a) to the tap water supply, and lead the tap water in a sink through the return connector (25b).

A specific water flow rate of 100 ml/minute is sufficient to compensate for the characteristic temperature.

For applications near ambient temperature (20 °C), the cooling water temperature should at least be 5 °C below the working temperature.

By installing the MVS controller (26) and a solenoid valve (27), sudden temperature increases can be rapidly reversed by tap water flowing through the built-in cooling coil.

For applications requiring constant near-ambient temperature, tap water is thus only used in small amounts. The circulator provides the necessary control pulse via the connector (15).

Cooling coil connectors (25a, 25b)

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 790 000</td>
<td>MVS controller</td>
</tr>
<tr>
<td>8 980 700</td>
<td>Solenoid valve</td>
</tr>
</tbody>
</table>

FD200 Flow-through cooler  Order No. 9 655 825
The FD200 is suitable as cooling device for liquids in closed circuits (loops).
This unit is integrated in the return flow circuit from the external system connected to a circulator, and continuously withdraws heat from the liquid.

NOTE: Immersion coolers are used for countercooling instead of tap water in applications below room temperature.

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 650 820</td>
<td>FT200</td>
</tr>
<tr>
<td>9 650 840</td>
<td>FT400</td>
</tr>
<tr>
<td>8 970 400</td>
<td>Clamp for cooler probe for stainless steel or plexiglass bath tanks</td>
</tr>
</tbody>
</table>
Operating procedures

6. Operating procedures

6.1. Power connection

Caution:

- 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 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.

6.2. Switching on / Start - Stop

6.2.1. Switching on the circulator

Switching on:
- Turn on the mains power switch (1).

The unit performs a self-test. Then the software version (example: V 1.xx) appears. The display „OFF“ or „R OFF“ indicates the unit is ready to operate.

The circulator enters the operating mode activated before switching the circulator off:
- keypad control mode (manual operation)
- or remote control mode (operation via personal computer).

Start:
- Press key.
  The actual bath temperature is displayed on the VFD COMFORT-DISPLAY. The circulating pump starts with a slight delay.

Stop:
- Press key.
  or Keep key pressed.
  The VFD COMFORT-DISPLAY indicates the message "OFF".
7. **Setting of temperatures**

7.1. **Using the pre-settings in the **\(\text{T}\)** menu**

Press the \(\text{T}\) key to call up the menu for temperature selection.

3 different working temperatures can be adjusted. Their values are freely selectable within the operating temperature range.

- The temperatures can be set in start or stop mode.
- Press \(\text{OK}\) key if a value is to be retained.

**Setting of working temperature in the **\(\text{T}\)** menu**

1. Press the key \(\text{T}\). The value flashes.

2. Select SETPOINT 1 or 2 or 3 using the key or .

3. Confirm by pressing the \(\text{OK}\) key.

The circulator uses the new working temperature value for temperature control.

**Example: Adjustment/modification of the pre-setting of "SETPOINT 3"**

1. Press the \(\text{T}\) key.

2. Select SETPOINT 3 by pressing the key. Example: SETPNT 3 / 70.00 °C

3. Keep the \(\text{OK}\) key pressed until the integer digits flash. (example: <70>)

4. Adjust value by pressing the key and the key to 85.00 °C and confirm by pressing the \(\text{OK}\) key.

The decimal digits flash and can be adjusted if desired.

Confirm once more by pressing the \(\text{OK}\) key.

Example on the left: SETPNT 3 / 85.00.

- If the active setpoint (SETPNT) is changed, the new value is immediately used for the control of the working temperature. The heater control indicator flashes.
- If the other two setpoints (not activated for control) are changed the \(\text{T}\) MENU has to be left by pressing the \(\text{OK}\) key after the decimal digits have been confirmed.

Notice: Refer to SETPOINT MAX / MIN in chapter 9.8. **MENU LIMITS**
7.2. **Direct setting of temperatures**

The circulator uses the setpoint of SETPNT 1 or 2 or 3 for temperature control.

The indicated setpoint temperature can be changed directly any time. Example: change 25.00 °C to 50.00 °C

1. By pressing the key \textbf{\textarrow{up}} the circulator switches to the active SETPOINT< example on the left: \textgreater SETPNT / 1 \textarrow{25.00°C}. The integer digits flash \textarrow{\textasteriskcentered} (example: \textarrow{<25>).

2. By pressing the keys \textarrow{\textdownarrow} and \textarrow{\textuparrow} the value is changed to 50.00 °C and is confirmed by pressing the \textarrow{OK} key.

The decimal digits flash and can be adjusted if desired. Confirm once more by pressing the \textarrow{OK} key.

- The circulator uses the new working temperature value for temperature control.
- The temperatures can be set in start or stop mode.
8. Safety installations, warning functions

Check the safety installations at least twice a year! Refer to page 13.

SECVAL
(Security Values)
- SAFETMP
- AL-TYPE
- OVERTMP
- SUBTEMP

Settings for the excess temperature protection > SAFETMP< and for the warning functions for high > OVERTMP< and low > SUBTEMP< temperature are made in a menu which is called up by pressing the key.

Menu item > AL-TYPE< allows choosing between a warning and an alarm cut-off for the menu items > OVERTMP< and > SUBTEMP<.

8.1. Excess temperature protection

**Warning:**
The excess temperature protection must be set at least 25 °C below the fire point of the bath fluid used!
In case of wrong setting there is a fire hazard!
We disclaim all liability for damage caused by wrong settings!

This excess temperature protection is independent of the control circuit. When activated heater and circulating pump are completely shut down. The alarm is indicated by optical and audible signals (continuous tone) and the error message "ALARM-CODE 14" appears on the VFD COMFORT-DISPLAY together with the ticker:

> EXCESS TEMPERATURE PROTECTOR ALARM-CHECK ADJUSTMENT <

Setting range:  20 °C ... 230 °C

① Rough setting can be effected by using the temperature scale.

**Exact setting:**

1. Press the key to display menu >SAFETMP<.

2. Press the key and the set shutdown value is indicated.

3. Set the new shutdown value within 30 seconds using a screwdriver. The value is indicated on the VFD COMFORT-DISPLAY

Example: SAFETMP / 100 °C

Recommendation:
Set the excess temperature protection at 5 °C to 10 °C above the working temperature setpoint.
8.1.1. Early warning system, low level protection

This low level protection is independent of the control circuit and is divided into two sections:

1. Switch in stage 1 recognizes a defined fluid level 😊. An audible warning sounds (interval tone) and together with the ticker: > LOW LEVEL WARNING-FILL MEDIUM < a message appears on the VFD COMFORT-DISPLAY:

   ![Warning](image)
   Refill the bath fluid!

2. Switch in stage 2 recognizes a low fluid level 😞. If stage 2 of the low level protection according to IEC 61010-2-010 is triggered, a complete, all-pole shutdown of heater and circulating pump is effected. A continuous alarm sounds and together with the ticker: > LOW LEVEL ALARM-FILL MEDIUM < a message appears on the VFD COMFORT-DISPLAY:

   ![Alarm](image)
   Turn off the unit with the mains switch, refill bath fluid and turn the unit on again!

3. Float
4. Circulating pump
5. Heater

**Warning:**
When adding bath fluid, always use the type of fluid which is identical with the fluid in the bath. Bath oils must not contain any water and should be pre-heated approximately to the current bath temperature! Explosion hazard at high temperatures!
8.2. Switch-over from warning to shutdown function

If a shutdown of functional elements (e.g. heater, circulating pump) is required when the limit values are exceeded or undercut the circulator can be changed over from warning function >WARNING< to shutdown function >ALARM<.

Factory setting: >WARNING<

1. Press the key.
2. Select the menu >SECVAL -AL-TYPE< by pressing the key.
3. Press the OK key and the set parameter will flash (Example: WARNING)
4. Change the parameter by pressing the key and confirm by pressing the OK key.
   or press the key if the parameter is to retained.

1 Setting >WARNING<
A mere warning function with optical and audible warning signal (interval tone) A message appears on the VFD COMFORT-DISPLAY:

- OFF -
ALARM CODE 03 or CODE 04
OVERTMP or SUBTEMP

• Setting >ALARM<
Temperature limit with shutdown of heater and circulating pump. An audible alarm sounds (continuous tone) and a message appears on the VFD COMFORT-DISPLAY:

- OFF -
ALARM CODE 03 or CODE 04
OVERTMP or SUBTEMP
8.3. **Over and Sub temperature warning function**

If the observance of a working temperature value >SETP< has to be supervised for a sensitive temperature application, then set over and sub temperature warning values. In the example below the SETPOINT 85 °C is surrounded by the values OVERTMP 87 °C and SUBTEMP 83 °C. The electronics immediately register if the actual temperature breaches one of the set limit values. The resulting reaction is defined in a further menu item. (See chapter 8.2.)

1. Press the key.
2. By pressing the or key select the menu >OVERTMP< or >SUBTEMP<.
3. Press the key. The integer digits flash.
4. Change the values to 87. °C and/or 83. °C by pressing the and key and confirm with the key.
   The decimal digits flash and can be adjusted if desired.
   Confirm once more by pressing the key.
   See above examples.

⚠️ The warning functions are only activated if the actual bath temperature remains within the set limit values for 3 seconds after switch-on.

**Recommendation:**

Set the over temperature warning value >OVERTMP< 5 °C to 10 °C above the working temperature setpoint.

Set the sub temperature warning value >SUBTMP< 5 °C to 10 °C below the working temperature setpoint.
9. **Menu** Menu functions

The term „Menu functions“ refers to settings such as

**Menu level 1**

**Start program**

**Administration and creation of programs**

**Electronically adjustable pump capacity**

**Configuration of the unit**

- REMOTE – on / off (remote control via RS232)
- AUTOST – AUTOSTART on / off
- OFF-MODE – pump on / off
- TIME / DATE – setting time and date
- RESET – factory settings

**Control characteristics and parameters**

- C-TYPE – Internal or external control
  - DYNAMICS - internal
  - Control parameter - XP-, TN-, TV- INTERNAL
  - Control parameter - XP-, TN-, TV- XPU-, EXTERNAL

**Adjustable interface parameters**

- BAUD RATE, PARITY, HANDSHAKE

**ATC - Absolute Temperature Calibration**,

- Sensor calibration INTERNAL SENSOR,
- Sensor calibration EXTERNAL SENSOR
- 3-point calibration

**Limitations of temperature and capacity**

- SETPOINT MAX / MIN - Maximum and minimum setpoint
- HEAT MAX – Set maximum heating
- COOLING MAX – Set maximum cooling
- INTERN MAX / MIN – Limitation of the temperature range
- BAND HIGH / LOW – Band limit

1. Open the menu by pressing the **MENU** key.
2. Use the ** keys to scroll in menu level 1.
3. Press the ** key to change to menu level 2.
   Press the ** key if settings are to be retained.
9.1. MENU PROGRAM – START

This menu will start a previously set program.

Requirements:
1. Create a program. (refer to next chapter)
2. Return to the Start-MENU and confirm the desired setting of each MENU item with the key \textbf{OK}
3. Set a start time (>TIME< >DATE< >YEAR<) if the program is to be started by the internal timer.

Menu level 1

- \textbf{> STEP<} Program start at section 1 … 10
- \textbf{> RUNS <} Number of repetitions 1 … 99
- \textbf{> END<} Status at end of program (STDBY/SETPNT)
  Standby or last setpoint
- \textbf{> GO <} Time of start (NOW/TIMER)

Level 2 Parameter level

- \textbf{PRESS the} \textbf{key if a parameter is to be retained.}
  Correction function for parameters or values (prior to \textbf{OK})

- \textbf{Set program step with} \textbf{ and } \textbf{example: STEP 1}

- \textbf{Set number of runs with} \textbf{ and } \textbf{example: 1 run}

- \textbf{Set desired parameters with} \textbf{ and } \textbf{.}

  \textbf{(STDBY / SETPNT)}
  Parameter STanDBY: the circulator switches to – OFF-.
  Parameter SETPoiNT: the circulator constantly keeps the temperature at the value of the last step.

- \textbf{Confirm >NOW< with the} \textbf{ key and the program will start immediately}

  \textbf{or}
  start at the set time under parameter (TIMER ).
  Set time in the example below:
09. August 2009, 11:15 hrs
### Submenu TIMER

#### Parameter level

<table>
<thead>
<tr>
<th>Submenu TIMER</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIMER</td>
<td>TIME</td>
<td>&gt;TIME&lt; hours/minutes (hh:mm), set both values one after the other and confirm.</td>
</tr>
<tr>
<td>DATE</td>
<td>DATE</td>
<td>&gt;DATE&lt; day/months (TT/MM), set both values one after the other and confirm.</td>
</tr>
<tr>
<td>YEAR</td>
<td>YEAR</td>
<td>&gt;YEAR&lt; year</td>
</tr>
<tr>
<td>START</td>
<td>START</td>
<td>The program starts at the set time.</td>
</tr>
</tbody>
</table>

#### Notes:

- **Display of time until start:**
  - In line 3 the notice >TIMER< and the set values for „TIME“ and „DATE/YEAR“ are alternately indicated.
  - Check the correct setting of the internal real time clock if required (see MENU CONFIG).

The started program

After the start the program will indicate the currently calculated setpoint in line 2.

S XX.XX. The value increases within the time period >TSLICE< until the target temperature >SETPNT< of the section is reached.

If the time period in a section is set to „0“, the next section will not begin until the target temperature has been reached.

Use the edit keys [↑][↓] to scroll to line 3. The display changes approximately every 4 seconds between the current section (STEP XX) and the remaining time of the section (A), remaining time of the program (B), and current bath temperature (C1).

I xxx.xx - internal actual value or .
Menu functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E xxx.xx</td>
<td>external actual value</td>
</tr>
<tr>
<td>D RUN</td>
<td>program has started or</td>
</tr>
<tr>
<td></td>
<td>progress of the program has been interrupted by pressing</td>
</tr>
<tr>
<td></td>
<td>the key. While the time is stopped the temperature will constantly</td>
</tr>
<tr>
<td></td>
<td>remain at the last calculated setpoint</td>
</tr>
<tr>
<td>D PAUSE</td>
<td>program has started or</td>
</tr>
<tr>
<td></td>
<td>progress of the program has been interrupted by pressing</td>
</tr>
<tr>
<td></td>
<td>the key. While the time is stopped the temperature will constantly</td>
</tr>
<tr>
<td></td>
<td>remain at the last calculated setpoint</td>
</tr>
<tr>
<td>D2</td>
<td>program has started or</td>
</tr>
<tr>
<td></td>
<td>progress of the program has been interrupted by pressing</td>
</tr>
<tr>
<td></td>
<td>the key. While the time is stopped the temperature will constantly</td>
</tr>
<tr>
<td></td>
<td>remain at the last calculated setpoint</td>
</tr>
<tr>
<td>C2</td>
<td>program has started or</td>
</tr>
<tr>
<td></td>
<td>progress of the program has been interrupted by pressing</td>
</tr>
<tr>
<td></td>
<td>the key. While the time is stopped the temperature will constantly</td>
</tr>
<tr>
<td></td>
<td>remain at the last calculated setpoint</td>
</tr>
</tbody>
</table>

Termination / Interruption of a program

1. The program can be terminated any time by pressing the key.
2. In case of power failure the program is interrupted.
   The circulator switches to –OFF-.
3. If the AUTOSTART-function is activated the programmer starts again at the point in time approx. 5 minutes prior to the interruption. However, an uncontrolled change of the bath temperature has occurred.

9.2. MENU PROGRAM – creation, administration

The integrated programmer permits fast and easy programming of setpoint temperature sequences. This temperature sequence is called program. A program is composed of individual sections (STEP). The sections are defined by duration (TSLICE) and target temperature. The target temperature is the setpoint (SETPNT), which is achieved at the end of a section. The programmer calculates the temperature ramp from the difference in time and temperature.

<table>
<thead>
<tr>
<th>STEP (Nr.)</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>SETPNT (°C)</td>
<td>100</td>
<td>180</td>
<td>180</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>TIME (hh.mm)</td>
<td>00:20</td>
<td>00:10</td>
<td>00:20</td>
<td>00:50</td>
<td>00:20</td>
</tr>
</tbody>
</table>

Sections without set value and time are skipped. They can be defined retroactively and the integrated into the program.
Menu level 1

>EDIT< Create, administer program
>STEP< Program step (1 ... 10)
>SETPNT< Temperature setpoint of step ...
>TSLICE< Duration of step ...
>DELETE< delete program step (01 ... 10, ALL)

Press key, if a parameter is to be retained.
Correction function for parameters or values (prior to OK)

<table>
<thead>
<tr>
<th>Level 2</th>
<th>Level 3</th>
<th>Parameter level</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROGRAM</td>
<td>EDIT</td>
<td>STEP</td>
</tr>
<tr>
<td></td>
<td>OK</td>
<td>(STEP 1 ... 10)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Set program step with ▲ ▼ and OK</td>
</tr>
<tr>
<td>EDIT</td>
<td>STEP</td>
<td>(Example: EDIT STEP 01)</td>
</tr>
<tr>
<td>01</td>
<td></td>
<td>For STEP 01 the values for SETPOINT 01 and TSLICE 01 are set one after the other</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- (time slice)</td>
</tr>
<tr>
<td>EDIT</td>
<td>TSLICE</td>
<td>(Example: TSLICE 00.10)</td>
</tr>
<tr>
<td>01</td>
<td></td>
<td>- Set duration by pressing ▲ ▼ and OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Delete program</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Program steps can be deleted individually or entirely. (STEP 01, 02,... 10, ALL).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Set parameters by pressing ▲ ▼ and OK</td>
</tr>
<tr>
<td>PROGRAM</td>
<td>DELETE</td>
<td>(Example: DELETE STEP 01)</td>
</tr>
<tr>
<td></td>
<td>OK</td>
<td>- (values within working temp. range)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Integer digits flash, set by pressing ▲ ▼ + OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Decimal digits flash, set by pressing ▲ ▼ + OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Press key, if a parameter is to be retained.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Correction function for parameters or values (prior to OK)</td>
</tr>
</tbody>
</table>
9.3. **MENU PUMP – Setting of pump pressure**

The capacity of the circulating pump is set by adjusting the motor speed.

**Settings:** stage / LEVEL 1 ... 4

**Display:** with illuminated indicator

**Flow rate:** 11 ... 16 l/m

**Pump pressure:** 0.22 ... 0.45 bar

**Factory setting:** stage 1

1. Press the **MENU** key.
2. Select the menu >PUMP< pressing the **key** and confirm by pressing the **OK** key.
   The set parameter flashes (example: >LEVEL 2<)
3. Change the parameter by pressing **key** and confirm by pressing the **OK** key.
   or
   Press the **key** if the parameter is to be retained.

The pump flow is pre-adjusted in the factory and can be modified to suit user requirements.

- Using a screwdriver turn the screw (1) anti-clockwise by 360 °.
- Using flat pliers turn the marking of the slide (2) to the desired position.
- Tighten the screw.

**Examples:**

**Internal applications in the bath**

- A 100 % internal bath circulation
  (for large bath tanks)
- B Reduced internal bath circulation
  (for smooth surface of bath fluid)

**External/internal applications**

- C 40 % external discharge,
  60 % internal circulation
  (for large bath tanks)
- D 80 % external discharge,
  20 % internal circulation
  (for small bath tanks)
### 9.4. MENU CONFIG – Configuration of unit

#### Menu level 1

- **OK**

- **REV**

#### Level 2

##### Parameter level

- **OK**

- **REV**

- **OK**

- **REV**

- **OK**

#### Level 3

##### Parameter level

- **OK**

- **REV**

- **OK**

- **REV**

- **OK**

- **REV**

- **OK**

### A RESET can be effected only in the >OFF< mode.

Switch off circulator by pressing the **OK** key and call up the menu CONFIGURATION.

- Press the key **REV** if a parameter is to be retained. Correction function for parameters and values (prior to OK).

- Switch on and off remote control by pressing **REV** and **OK**.

- Control display in the topline **REV** for Remote

- For remote control refer to page 53

- Connect RS232 with PC.

- Switch on and off autostart by pressing **REV** and **OK**.

- AUTOSTART on = on

- AUTOSTART off = off

- See WARNING page 34

- Switch on and off OFFMODE by pressing **REV** and **OK**.

- PUMP ON continuous operation of circulating pump

- PUMP OFF circulating pump is linked to Start/Stop

- Hours flash, set by pressing **REV** + **OK**

- Minutes flash, set by pressing **REV** + **OK**

- Day flashes, set by pressing **REV** + **OK**

- Month flashes, set by pressing **REV** + **OK**
9.4.1. REMOTE

Factory setting: OFF

The control electronics offer two ways of adjusting a setpoint.

1. Adjustment of setpoint using the keypad or the integrated programmer.
2. Adjustment of setpoint via the serial interface RS232 using a PC or a superordinated process control system.

The topline of the VFD-DISPLAY shows a bright "R" for remote control; - remote control discontinued.

**IMPORTANT:** additional measures for remote control

1. Connect the circulator to the PC using an interface cable.
2. Check the interface parameters of both interfaces (circulator and PC) and make sure they match.
   (refer to 12.1. Setup for remote control page 53)

9.4.2. AUTOSTART

**Warning:**

For supervised or unsupervised operation with the "AUTOSTART" function avoid any hazardous situation to persons or property

Take care to fully observe the safety and warning functions of the circulator.

Factory settings: OFF

**Notice:**

The circulator has been configured and delivered by JULABO in accordance with the NAMUR recommendations. This means for the start mode that the unit must enter a safe operating status after a power failure. This safe operating status is indicated by the message "OFF" or "R OFF" on the VFD COMFORT-DISPLAY.

A complete, all-pole shutdown of the main functional elements such as heater and pump motor is effected.

The values set on the circulator remain saved and the unit is restarted by pressing the start/stop key in manual control.

In remote control mode the values need to be resent by the PC via the table:

<table>
<thead>
<tr>
<th>Menu functions</th>
<th>Level 3</th>
<th>Parameter level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TIME/DT</td>
<td>YEAR</td>
</tr>
<tr>
<td></td>
<td>OK</td>
<td>09</td>
</tr>
<tr>
<td></td>
<td>• Year flashes, set by pressing ▲ ▼ + OK</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RETURNS</td>
</tr>
<tr>
<td></td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Return to factory settings by pressing OK</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>RESET returns all set values to the factory setting except for date and time.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>① A RESET can be effected only in the –OFF- mode.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>② During the message –RUN- all parameters are reset to factory settings.</td>
</tr>
</tbody>
</table>

RS232
interface. If such a safety standard is not required, the NAMUR recommendations can be bypassed with the AUTOSTART function thus allowing a direct start of the circulator by pressing the mains switch or using a timer.

9.4.3. OFF-MODE

Factory setting: PMP OFF

Usually the circulating pump is controlled with the key OK or the start/stop command. If the circulating pump is to work in the OFF-mode, the adjustment can be set in a sub-menu.

ℹ️ The pump motor will be shutdown in case of alarm anyhow.

9.4.4. Setting of clock and date

The internal real time clock allows starting a program any time. The clock is set to the local mean time (MEZ) at the factory.

ℹ️ If the unit is operated in a different time zone, the clock can be adjusted in this menu.

ℹ️ Change summer/winter time in this menu

9.4.5. RESET – Factory settings

A Reset will return all values to factory setting except for date and time.

ℹ️ A RESET can be effected in the OFF< mode only.

Switch off the circulator by pressing the key OK and call up the menu CONFIGURATION.
### 9.5. MENU CONTROL – Control characteristics and parameters

**Menu level 1**

- **The circulator is qualified for internal and external temperature control.**
- The switchover is carried out in the menu >C-TYPE< (INT or EXT).
  - For external temperature control and measurement connect a Pt100 external sensor to the socket at the rear of the circulator.
  - Press the key if a parameter is to be retained. Correction function for parameters or values (prior to OK).

**Level 2 Parameter level**

<table>
<thead>
<tr>
<th>Control</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C-TYPE INTERNAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTROL</td>
<td>C-TYPE</td>
<td><strong>INT</strong></td>
</tr>
<tr>
<td>or</td>
<td>C-TYPE</td>
<td><strong>EXT</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTROL</td>
<td>DYNAMIC</td>
<td><strong>APER</strong></td>
</tr>
<tr>
<td>or</td>
<td>DYNAMIC</td>
<td><strong>NORM</strong></td>
</tr>
<tr>
<td>CONTROL</td>
<td>XP INT</td>
<td><strong>1.5</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1 ... 99.9</td>
</tr>
<tr>
<td>CONTROL</td>
<td>TN INT</td>
<td><strong>100</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 ... 9999</td>
</tr>
<tr>
<td>CONTROL</td>
<td>TV INT</td>
<td><strong>5</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 ... 999</td>
</tr>
<tr>
<td><strong>C-TYPE EXTERNAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTROL</td>
<td>XP EXT</td>
<td><strong>0.7</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.1 ... 99.9</td>
</tr>
<tr>
<td>CONTROL</td>
<td>TN EXT</td>
<td><strong>720</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 ... 9999</td>
</tr>
</tbody>
</table>
Level 2 Parameter level

- The parameter flashes, set by pressing

LEVEL 2

Parameter level

- The parameter flashes, set by pressing

9.5.1. CONTROL – Control INTERNAL / EXTERNAL

Switchover can only be effected if a Pt100 external sensor is connected.

Factory setting: INT

IMPORTANT: Additional measures for external temperature control

Suggested settings for external temperature control:
BAND HIGH / LOW and INTERN MAX / MIN
see chapter >LIMITS< page 47.

Sensor calibration of the Pt100 external sensor is carried out in the menu >ADJUST<, submenu >ATC SENOR - EXT<; set ATC STATUS< to >OFF<
(See page 41).

Attention:
Place the external sensor into the temperature-controlled medium and securely fix the sensor.

Accessory: Pt100 external sensor

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Description</th>
<th>Material</th>
<th>Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>8981003</td>
<td>200x6 mm Ø.</td>
<td>stainless steel</td>
<td>1.5 m</td>
</tr>
<tr>
<td>8981005</td>
<td>200x6 mm Ø.</td>
<td>glass</td>
<td>1.5 m</td>
</tr>
<tr>
<td>8981006</td>
<td>20x2 mm Ø.</td>
<td>stainless steel</td>
<td>1.5 m</td>
</tr>
<tr>
<td>8981010</td>
<td>300x6 mm Ø.</td>
<td>stainless steel</td>
<td>1.5 m</td>
</tr>
<tr>
<td>8981015</td>
<td>300x6 mm Ø.</td>
<td>stainless steel / PTFE coated</td>
<td>3 m</td>
</tr>
<tr>
<td>8981013</td>
<td>600x6 mm Ø.</td>
<td>stainless steel / PTFE coated</td>
<td>3 m</td>
</tr>
<tr>
<td>8981016</td>
<td>900x6 mm Ø.</td>
<td>stainless steel / PTFE coated</td>
<td>3 m</td>
</tr>
<tr>
<td>8981014</td>
<td>1200x6 mm Ø.</td>
<td>stainless steel / PTFE coated</td>
<td>3 m</td>
</tr>
<tr>
<td>8981103</td>
<td>Extension cable for Pt100 sensor</td>
<td>3.5 m</td>
<td></td>
</tr>
<tr>
<td>8981020</td>
<td>M+R in-line Pt100 sensor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The M+R in-line Pt100 sensor is a flow sensor and can be installed loop circuit.
9.5.2. Dynamic internal

This parameter affects the temperature sequence only in case of internal control.

Factory setting: APER (aperiodic)

Possible parameters:

**NORM** Allows for reaching the setpoint faster – with setpoint change or ramp function – but overshooting of up to 5% is possible.

**APER** Ramp function: the increase of temperature occurs temporally offset and achieves the target temperature without overshooting.

Setpoint change: The temperature increases at the same rate, the target temperature is achieved without overshooting.

With both settings constant temperature is achieved after approximately the same time.

9.5.3. Control parameters – XPU-, XP-, TN-, TV- EXTERNAL

In most cases the control parameters preset in the factors are adequate for achieving an optimum temperature sequence.

The control parameters allow adjustment to special control processes.

**Proportional range >Xpu<**

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

**XP EXT**

0.7

Setting range: 0.1 ... 99.9

**TN EXT**

720

Setting range: 3 ... 9999

**TV EXT**

55

Setting range: 0 ... 999

**XPU**

30

Setting range: 0.1 ... 99.9
9.5.4. Control parameters– XP-, TN-, TV- INTERNAL

In most cases the control parameters preset in the factory are adequate for achieving an optimum temperature sequence. The control parameters allow adjustment to special control processes.

**Proportional range >Xp<**

The proportional range is the range below the setpoint in which the control circuit reduces the heating capacity from 100% to 0%

Setting range: 0.1 ... 99.9

**Reset time >Tn< (Integral component)**

Compensation of the remaining control deviation due to proportional regulation. An insufficient reset time may cause instabilities. Excessive reset times will result in unnecessary prolongation of compensation of the control difference.

Setting range: 3 ... 9999

**Lead time >Tv< (Differential component)**

The differential component reduces the transient time. An insufficient lead time will prolong the time required for compensation of disturbance effects and cause high overshooting during run-up. An excessive lead time could cause instabilities (oscillations)

**Optimization instructions for the PID control parameters**

Optimum setting: Control parameters XP-, TN-, TV- INTERNAL as well as -EXTERNAL

The heat-up curve reveals possible faulty settings of the control parameter.

Inappropriate settings may produce the following heat-up curves:

- Xp too low
- Xp too high or Tv too high
- Tv/Tn too low
- Tv/Tn too high or Xp too high
### 9.6. MENU SERIAL - BAUDRATE, HANDSHAKE, PARITY

For communication between circulator and a PC or a superordinated process control system the interface parameters of both units must be identical.

1. For remote control refer to page 53

Factory settings:
- 4800 Baud
- even
- hardware handshake

<table>
<thead>
<tr>
<th>Level 2</th>
<th>Parameter level</th>
<th>Press the key if a parameter is to be retained.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Serial" /></td>
<td><strong>Baudrate</strong></td>
<td><img src="image" alt="Baudrate" /></td>
</tr>
</tbody>
</table>
| ![Serial](image) | **Parity** | ![Parity](image) | even: Data bits = 7; Stop bits = 1  
odd: Data bits = 7; Stop bits = 1  
no: Data bits = 8; Stop bits = 1 |
| ![Serial](image) | **Handshake** | ![Handshake](image) | Xon/Xoff-protocol (Software handshake)  
Protocol RTS/CTS (Hardware handshake) |
9.7. MENU ATC - Absolut Temperature Calibration

ATC serves to compensate a temperature difference that might occur between circulator and a defined measuring point in the bath tank because of physical properties.

Example:
1-point calibration

```
°C
T_1
```

3-point calibration

```
°C
TT_1
```

**Principle:**
For ATC calibration, in steady state the bath temperature at the location of the temperature sensor (CT) is determined at the respective adjusted working temperature. This value is then set on the circulator in the menu >ATCalibration< under menu item >CTEMP X<. This can be a 1-point, 2-point or 3-point calibration.

```
M
B (INT)
T
CT
TT
```

```
M
B (EXT)
CT
TT
```

M = Temperature measuring instrument with temperature sensor
B = Bath tank (INTernal or EXTernal)
T = circulator
CT = Temperature on measuring point
TT = Temperature on circulator
## Menu functions

### Menu level 1

<table>
<thead>
<tr>
<th>Menu</th>
<th>ATC</th>
</tr>
</thead>
<tbody>
<tr>
<td>OK</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level 2</th>
<th>Parameter level</th>
<th>① Press the key if parameter is to be retained. Correction function for parameters or values (prior to OK).</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATC</td>
<td>SENSOR INTERNAL</td>
<td>① The parameter flashes, switch by pressing and OK</td>
</tr>
<tr>
<td></td>
<td>INTERNAL</td>
<td>① On level 2 a (I) is indicated for internal or an (E) for external. Example: ATC (I): ATC (E)</td>
</tr>
<tr>
<td>STATUS</td>
<td>YES</td>
<td>① &gt;NO&lt; Carry out an ATC calibration ① &gt;YES&lt; return to standard operation after calibration.</td>
</tr>
<tr>
<td>TYPE</td>
<td>I-POINT</td>
<td>① A &gt;1-point&lt;, &gt;2-point&lt; or &gt;3-point&lt; calibration can be carried out. The selected calibration is indicated on level 2 by 1 or 2 or 3.</td>
</tr>
<tr>
<td>TMPVALI</td>
<td>8000</td>
<td>The value &gt;TMPVAL&lt; is only indicated ① In addition the measured temperature value &gt;CALVAL X&lt; is saved during the next step.</td>
</tr>
<tr>
<td>CALVALI</td>
<td>79.70</td>
<td>• Integer digits flash, set by pressing + OK ① Decimal digits flash, set by pressing + OK</td>
</tr>
</tbody>
</table>

① If only a 1-point calibration is carried out, the following menu items are not indicated anymore
9.7.1. ATC SENSOR - INTERNAL / EXTERNAL

In the first submenu the ATC function is set for the >INTERN< internal or the >EXTERN< external temperature sensor.

Calibration can be carried out for the internal temperature sensor and for the external temperature sensor connected to the socket „ext. Pt100“. The circulator is able to save both parameter sets. However only the one which has been set under menu item >ATC SENSOR< is displayed.

9.7.2. ATC STATUS - YES / NO

In the second submenu the ATC function for the temperature sensor selected above is activated >YES< or deactivated >NO<.

>YES< (factory setting) The controller of the circulator uses the original curve of the temperature sensor or the new curve measured during the ATC calibration.

**Important:** Set to >NO< during the calibration process

>NO< An ATC calibration is to be carried out.

**Important:** Set to >YES< after calibration.

① In the > ATC STATUS < >YES< the ATC calibration always affects the current working temperature; also the one set via interface.
9.7.3. CALIBRATION TYPE: 1 -/ 2 -/ 3 POINT

A >1-point<, >2-point< or >3-point< calibration can be carried out.

First geometrically define the location for calibration (measuring point CT), then determine the temperature values of the calibration points. The type of calibrations also determines the number of the following pairs of values indicated on the LCD DIALOG-DISPLAY.

Pairs of values:

**TMPVAL X:** Circulator temperature 1 or 2 or 3 (actual value TT )

The actual temperature of the bath is simultaneously saved with the “calibration value” >CALVAL< and can be indicated for control purposes (value does not flash).

**CALVAL X:** Calibration temperature 1 or 2 or 3 (actual value CT )

The „calibration value“ is determined with a temperature measuring device and saved under menu item >CALVAL<.

(value flashes )
9.7.4. Example: 3-point calibration for internal control

In the temperature range from 80 °C to 160 °C the calibration curve of the temperature sensor (TT) is to be adjusted to the actual temperatures at measuring point (CT).

1. Set circulator to internal control:
   **MENU CONTROL page 36**
   The type of control can be set only in the –OFF- mode.

   ![Menu level 1](image)

   **Menu level 1**
   
   OK

   OK

   OK

   ![Menu level 1](image)

   ![Menu level 1](image)

2. Set working temperature setpoint – SETPNT:
   Refer to „Direct temperature setting “ page 22
   • By pressing the key the circulator switches to the active >SETPOINT< see example on the left: >SETPNT / 1 25.00°C<. The integer digits flash (Example: <25>).
   • Change the value to 80.00 °C by pressing the keys and and confirm by pressing the key . The decimal digits flash.
     Confirm once more by pressing the key .
   • The bath is heated up.
     Wait for approx. 5 minutes until the temperature is constant.

3. Reading of temperature measuring device
   Read the value of measuring point CT on the device and enter under menu item >CALVAL X< by using the keypad.
   >CALVAL 1< (79.70 °C)
   >CALVAL 2< (119.50 °C)
   >CALVAL 3< (159.30 °C)

4. Calibration

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)

   ![Menu level 1](image)
Menu functions

- The parameter flashes, switch by pressing ▲ ▼ and OK.
  A >3-point< calibration is carried out.

The parameter >TMVVAL< is only indicated
In addition the measured value >CALVAL X< is saved during the following step

- Integer digits flash, set by pressing ▲ ▼ (79) + OK.
- Decimal digits flash, set by pressing ▲ ▼ (79) + OK.
  The first of 3 points is calibrated.

The value only is indicated

- Integer digits flash, set by pressing ▲ ▼ (119) + OK.
- Decimal digits flash, set by pressing ▲ ▼ (50) + OK.
  The second of 3 points is calibrated.

The value only is indicated.

- Integer digits flash, set by pressing ▲ ▼ (159) + OK.
- Decimal digits flash, set by pressing ▲ ▼ (30) + OK.
  The 3-point calibration is completed.

5. Return to standard operation

- Set >YES< after calibration. (Standard operation)
## 9.8. MENU LIMITS

### Menu level 1

#### Level 2

<table>
<thead>
<tr>
<th>Parameter level</th>
<th>Press the key if parameter is to be retained. Correction function for parameters or values (prior to OK).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LIMITS</strong></td>
<td><strong>SETMAX</strong> 20000</td>
</tr>
<tr>
<td></td>
<td>- Integer digits flash, set by pressing <strong>-</strong> + <strong>OK</strong></td>
</tr>
<tr>
<td></td>
<td>- Decimal digits flash, set by pressing <strong>-</strong> + <strong>OK</strong></td>
</tr>
<tr>
<td><strong>LIMITS</strong></td>
<td><strong>SETMIN</strong> -94.99</td>
</tr>
<tr>
<td></td>
<td>- Integer digits flash, set by pressing <strong>-</strong> + <strong>OK</strong></td>
</tr>
<tr>
<td></td>
<td>- Decimal digits flash, set by pressing <strong>-</strong> + <strong>OK</strong></td>
</tr>
<tr>
<td><strong>LIMITS</strong></td>
<td><strong>HEATMAX</strong> 100 0 ... 100 %</td>
</tr>
<tr>
<td></td>
<td>- The value flashes, set by pressing <strong>-</strong> + <strong>OK</strong></td>
</tr>
<tr>
<td><strong>LIMITS</strong></td>
<td><strong>COOLMAX</strong> 0 0 ... 100 %</td>
</tr>
<tr>
<td></td>
<td>- The value flashes, set by pressing mit <strong>-</strong> + <strong>OK</strong></td>
</tr>
</tbody>
</table>

In case of external control these menu items are additionally indicated.

| **LIMITS**      | **INTMAX** 20000  |
|                 | - Integer digits flash, set by pressing **-** + **OK**  |
|                 | - Decimal digits flash, set by pressing **-** + **OK**  |
| **LIMITS**      | **INTMIN** -94.99  |
|                 | - Integer digits flash, set by pressing **-** + **OK**  |
|                 | - Decimal digits flash, set by pressing **-** + **OK**  |
| **LIMITS**      | **BAND-H** 200  |
|                 | - The value flashes, set by pressing **-** + **OK**  |
| **LIMITS**      | **BAND-L** 200  |
|                 | - The value flashes, set by pressing **-** + **OK**  |
9.8.1.  Limits for internal control

**SETPOINT MAX / MIN** – Maximum and minimum setpoint
Restriction of the adjustable temperature range.

The limitation of the operating temperature range effects the temperature setting in the menu with the key \[ T \].

Only setting of working temperatures which lie within the determined limits is possible
Existing settings for SETPNT 1, -2, -3, as well as those for >OVERTMP< and >SUBTMP< (refer to page 26), are automatically deferred into the limit range.

**Setting range:** -94,90 °C ... +200,0 °C

1. SET MAX > SET MIN
   Interchange of values is not possible.

**Set maximum heating / cooling**

The heating and cooling capacity of the unit are adjustable. 100 % corresponds to the technical specification of the equipment.

**Setting range:**

- **HEAT MAX** – 0 to 100 % in 1 % steps
- **COOLING MAX** – 0 to 100 % in 1 % steps

9.8.2.  Limits for external control

**INTERN MAX / MIN**
Restriction for the temperature range of the internal bath.

**Setting range:** -94,9 °C ... +200,0 °C

The limits INT MAX and INT MIN are only active in external control. INT MAX and INT MIN determine fixed limits for the temperature within the internal bath. The temperature controller cannot exceed these limits even if it would be necessary for achieving the temperature in an external system. Therefore it is possible that the external setpoint cannot be achieved.

**Sense of limit setting:**

- Protects the bath fluid from overheating.
- Prevents an undesired alarm shutdown by the excess temperature protection - >ALARM CODE 14<.
  Set the value of > INT MAX at least 5 °C below the value of >SAFETMP<.
- Protects the pump motor from high viscosity of the bath fluid at low temperatures.
- For refrigerated circulators. Freezing protection when using water as bath fluid.
**BAND HIGH / LOW – Band limitation**

The band limitation is active during external control. Varied, practice-oriented setting are feasible for heat-up and cool-down phases.

**Setting range:** 0 °C ... 200 °C

**BAND HIGH** and **BAND LOW** allow for the limitation of the difference between the temperatures in the internal bath and the external system to any maximum value for the heat-up and cool-down phase. During the heat-up phase this difference value is always added to the actual external temperature. During the cool-down phase the difference value is subtracted.

---

Sense of a band limitation:

- ✔ Protection of objects and samples by gentle temperature control
- ✔ Protection of e.g. glass reactors from thermal shock.
10. Troubleshooting guide / error messages

Alarm with complete shutdown:
If one of the following failures occur a complete, all-pole shutdown of the heater and circulating pump is effected.

⚠️ lights up and a continuous signal sounds.
The code for the cause of alarm is indicated on the VFD COMFORT-DISPLAY.

Alarm without shutdown:
The code for the cause of alarm is indicated on the VFD COMFORT-DISPLAY. The warning signal sounds in regular intervals. The messages appear every 10 seconds.

Press the key OK to stop the signal

Error message with ticker: >LOW LEVEL ALARM-FILL MEDIUM<
Low level alarm
The circulator is operated without or insufficient bath fluid.
Switch the unit off with the mains switch, refill bath fluid and switch on!
Tube breakage has occurred (insufficient filling level of bath fluid caused by pumping-out)
Replace the tubing and refill bath liquid.
The float is defect (e.g. transport damage).
Repair by authorized JULABO service personnel.

Error message with ticker: >REFRIGERATOR ALARM-CHECK CONNECTION<
During the self-test after switch-on a short –circuit is detected between pin 2 and pin 4 of the control line or the control line was disconnected during operation.
Reconnect the control line or repair short-circuit.

Error message with ticker: >EXCESS TEMPERATURE WARNING-CHECK LIMITS<
Excess temperature warning or Excess temperature alarm
Type of warning: set to >warning< or >alarm< (refer to page 25)

Error message with ticker: >LOW TEMPERATURE WARNING-CHECK LIMITS<
Low temperature warning or Low temperature alarm.
Type of warning: set to >warning< or >alarm< (refer to page 25)

Error message with ticker: >WORKING SENSOR ALARM-CALL SERVICE<
Cable of working temperature sensor is disconnected or short-circuited.
Error message with ticker:
>SENSOR DIFFERENCE ALARM-CHECK VISCOSITY AND PUMP STAGE<
Defect of working or excess temperature protector.
Working temperature sensor and excess temperature protector report a
temperature difference of more than 35 K.

Error message with ticker:
> INTERNAL HARDWARE ERROR-CALL SERVICE <
Other errors

Error in A/D converter

Error message with ticker:
> EXCESS TEMPERATURE PROTECTOR ALARM-CHECK ADJUSTMENT <
Excess temperature protector defect.
The protection temperature is below the set working temperature setpoint.
Set the protection temperature to a higher value.

Error message with ticker:
> EXTERNAL SENSOR ALARM-CHECK EXTERNAL SENSOR <
External control was set but the Pt100 external sensor was not connected or is
defect.

Error message with ticker:
> SAFETY SENSOR ALARM-CALL SERVICE <
The cable of the excess temperature protector has been disconnected or
short-circuited

Error message with ticker:
> LOW LEVEL WARNING-FILL MEDIUM <
The early warning system for low level reports a critical fluid level. Refill bath
fluid.

By quickly switching off and restarting the unit the alarm is cancelled.
If the error occurs once more after the restart, a remote diagnosis is required.

Error message with ticker:
> CONFIGURATION ERROR-PRESS OK<
The configuration of the circulator does not correspond with its current
application.
Press the [OK] key for a non-recurring, automatic change of the
configuration.
In this case please call the JULABO Technical Service or an authorized dealer.

**Disturbances that are not indicated.**
The electronic pump motor is overload-protected by an electronic current
limiter. If viscosity of the bath fluid is or becomes too high, the motor stops
running.

Mains circuit breakers (resettable) 15 A
11. Electrical connections

**Notice:**
Use shielded cables only. The shield of the connecting cable is electrically connected to the plug housing. The unit ensures safe operation if connecting cables with a maximum length of 3 m are used. The use of longer cables does not affect proper performance of the unit, however external interferences may have a negative impact on safe operation (e.g. cellular phones).

### Socket for external Pt100 sensor

**Pin assignment:**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I+</td>
</tr>
<tr>
<td>2</td>
<td>U+</td>
</tr>
<tr>
<td>3</td>
<td>U-</td>
</tr>
<tr>
<td>4</td>
<td>I-</td>
</tr>
</tbody>
</table>

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

### RS232 serial interface

This port can be used to connect a computer with an RS232 cable for remote control of the circulator.

**Pin assignments RS232:**

- Pin 2: RxD Receive Data
- Pin 3: TxD Transmit Data
- Pin 5: 0 V Signal GND
- Pin 7: RTS Request to send
- Pin 8: CTS Clear to send

Pin 1; 4; 6, 9 Reserved - do not use!

**RS232 interface cable**

<table>
<thead>
<tr>
<th>Circulator (9-pol)</th>
<th>PC (9-pol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 2 RxD</td>
<td>Pin 3 TxD</td>
</tr>
<tr>
<td>Pin 3 TxD</td>
<td>Pin 2 RxD</td>
</tr>
<tr>
<td>Pin 5 GND</td>
<td>Pin 5 GND</td>
</tr>
<tr>
<td>Pin 7 RTS</td>
<td>Pin 8 CTS</td>
</tr>
<tr>
<td>Pin 8 CTS</td>
<td>Pin 7 RTS</td>
</tr>
</tbody>
</table>

### Accessories:

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 980 073</td>
<td>RS232 interface cable 9-pol./9-pol. , 2,5 m</td>
</tr>
<tr>
<td>8 900 110</td>
<td>USB interface adapter cable</td>
</tr>
</tbody>
</table>
12. Remote control

12.1. Setup for remote control

1. Check the interface parameters for both interfaces (on circulator and PC) and make sure they match.
   (Serial interface refer to page 40)

2. In the menu > MENU CONFIG < set the menu item > REMOTE < to > ON < .

3. Connect both units with an interface cable.

Like all parameters which can be entered through the keypad, interface parameters are stored in memory even after the circulator is turned off.
12.2. Communication with a PC or a superordinated data system

If the circulator is put into remote control mode via the configuration level, the VFD COMFORT-DISPLAY will read “R -OFF-” = REMOTE STOP. The circulator is now operated via the computer.

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

In remote control mode, the start command and all values to be set must be resent by the PC via the interface in case of a power interruption. AUTOSTART is not possible.

A transfer sequence consists of:
- command
- space (\(\leftrightarrow\); Hex: 20)
- parameter (decimal separation with a period)
- end of file (\(\downarrow\); Hex: 0D)

The commands are divided into in and out commands.
- in commands: retrieve parameters
- out commands: set parameters

Important times for a command transmission:

To ensure a safe data transfer, the time gap between two commands should be at least 250 ms.

The circulator automatically responds to an in command with a data string followed by a LF (Line Feed). The next command should only be sent after 10 ms.

The out commands are valid only in remote control mode.

Command to set the working temperature > SETPNT 1< to 55.5 °C
\[
\text{out_sp_00} \leftrightarrow 55.5,\downarrow
\]

Command to retrieve the working temperature > SETPNT 1< \(\text{in_sp_00}.,\downarrow\)

Response from the circulator:
55.5\(\downarrow\)
## 12.3. List of commands

### out commands: Setting temperature values or parameters.

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameter</th>
<th>Response of circulator</th>
</tr>
</thead>
<tbody>
<tr>
<td>out_mode_01</td>
<td>0</td>
<td>Use working temperature &gt; SETPNT 1&lt;</td>
</tr>
<tr>
<td>out_mode_01</td>
<td>1</td>
<td>Use working temperature &gt; SETPNT 2&lt;</td>
</tr>
<tr>
<td>out_mode_01</td>
<td>2</td>
<td>Use working temperature &gt; SETPNT 3&lt;</td>
</tr>
<tr>
<td>out_mode_04</td>
<td>0</td>
<td>Temperature control of internal bath.</td>
</tr>
<tr>
<td>out_mode_04</td>
<td>1</td>
<td>External control with Pt100 sensor.</td>
</tr>
<tr>
<td>out_mode_05</td>
<td>0</td>
<td>Stop the unit = R –OFF-.</td>
</tr>
<tr>
<td>out_mode_05</td>
<td>1</td>
<td>Start the unit.</td>
</tr>
<tr>
<td>out_mode_08</td>
<td>0</td>
<td>Set the control dynamics - aperiodic</td>
</tr>
<tr>
<td>out_mode_08</td>
<td>1</td>
<td>Set the control dynamics - standard</td>
</tr>
<tr>
<td>out_sp_00</td>
<td>xxx.xx</td>
<td>Set working temperature. „SETPNT 1“</td>
</tr>
<tr>
<td>out_sp_01</td>
<td>xxx.xx</td>
<td>Set working temperature. „SETPNT 2“</td>
</tr>
<tr>
<td>out_sp_02</td>
<td>xxx.xx</td>
<td>Set working temperature. „SETPNT 3“</td>
</tr>
<tr>
<td>out_sp_03</td>
<td>xxx.xx</td>
<td>Set high temperature warning limit „OVERTMP“</td>
</tr>
<tr>
<td>out_sp_04</td>
<td>xxx.xx</td>
<td>Set low temperature warning limit „SUBTMP“</td>
</tr>
<tr>
<td>out_sp_07</td>
<td>x</td>
<td>Set the pump pressure stage. (1 ... 4)</td>
</tr>
<tr>
<td>out_par_04</td>
<td>x.x</td>
<td>CoSpeed 0 ... 5.0 Band limit during external control. Setting the maximum difference between the temperatures in the internal bath and external system.</td>
</tr>
<tr>
<td>out_par_06</td>
<td>xxx</td>
<td>Xp control parameter of the internal controller. 0.1 ... 99.9</td>
</tr>
<tr>
<td>out_par_07</td>
<td>xxx</td>
<td>Tn control parameter of the internal controller. 3 ... 9999</td>
</tr>
<tr>
<td>out_par_08</td>
<td>xxx</td>
<td>Tv control parameter of the internal controller. 0 ... 999</td>
</tr>
<tr>
<td>out_par_09</td>
<td>xxx</td>
<td>Xp control parameter of the cascade controller. 0.1 ... 99.9</td>
</tr>
<tr>
<td>out_par_10</td>
<td>xxx</td>
<td>Proportional portion of the cascade controller. 1 ... 99.9</td>
</tr>
<tr>
<td>out_par_11</td>
<td>xxx</td>
<td>Tn control parameter of the cascade controller. 3 ... 9999</td>
</tr>
<tr>
<td>out_par_12</td>
<td>xxx</td>
<td>Tv control parameter of the cascade controller. 0 ... 999</td>
</tr>
<tr>
<td>out_par_13</td>
<td>xxx</td>
<td>Maximum internal temperature of the cascade controller.</td>
</tr>
<tr>
<td>out_par_14</td>
<td>xxx</td>
<td>Minimum internal temperature of the cascade controller.</td>
</tr>
<tr>
<td>out_par_15</td>
<td>xxx</td>
<td>Band limit (upper) 0 ... 200 °C</td>
</tr>
<tr>
<td>out_par_16</td>
<td>xxx</td>
<td>Band limit (lower) 0 ... 200 °C</td>
</tr>
</tbody>
</table>
**in commands:** Asking for parameters or temperature values to be displayed.

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameter</th>
<th>Response of circulator</th>
</tr>
</thead>
<tbody>
<tr>
<td>version</td>
<td>none</td>
<td>Number of software version (V X.xx)</td>
</tr>
<tr>
<td>status</td>
<td>none</td>
<td>Status message, error message (see page 57)</td>
</tr>
<tr>
<td>in_pv_00</td>
<td>none</td>
<td>Actual bath temperature.</td>
</tr>
<tr>
<td>in_pv_01</td>
<td>none</td>
<td>Heating power being used (%)</td>
</tr>
<tr>
<td>in_pv_02</td>
<td>none</td>
<td>Temperature value registered by the external Pt100 sensor.</td>
</tr>
<tr>
<td>in_pv_03</td>
<td>none</td>
<td>Temperature value registered by the safety sensor.</td>
</tr>
<tr>
<td>in_pv_04</td>
<td>none</td>
<td>Setpoint temperature of the excess temperature protection</td>
</tr>
<tr>
<td>in_sp_00</td>
<td>none</td>
<td>Working temperature „SETPNT 1“</td>
</tr>
<tr>
<td>in_sp_01</td>
<td>none</td>
<td>Working temperature „SETPNT 2“</td>
</tr>
<tr>
<td>in_sp_02</td>
<td>none</td>
<td>Working temperature „SETPNT 3“</td>
</tr>
<tr>
<td>in_sp_03</td>
<td>none</td>
<td>High temperature warning limit „OVERTEMP“</td>
</tr>
<tr>
<td>in_sp_04</td>
<td>none</td>
<td>Low temperature warning limit „SUBTEMP“</td>
</tr>
<tr>
<td>in_sp_07</td>
<td>none</td>
<td>Pump pressure stage</td>
</tr>
<tr>
<td>in_par_01</td>
<td>none</td>
<td>Te - Time constant of the external bath.</td>
</tr>
<tr>
<td>in_par_02</td>
<td>none</td>
<td>Si - Internal slope</td>
</tr>
<tr>
<td>in_par_03</td>
<td>none</td>
<td>Ti - Time constant of the internal bath.</td>
</tr>
<tr>
<td>in_par_04</td>
<td>none</td>
<td>CoSpeed - Band limit (max. difference between the temperatures in the internal bath and external system).</td>
</tr>
<tr>
<td>in_par_05</td>
<td>none</td>
<td>Factor pk/ph0: Ratio of max. cooling capacity versus max. heating capacity</td>
</tr>
<tr>
<td>in_par_06</td>
<td>none</td>
<td>Xp control parameter of the internal controller.</td>
</tr>
<tr>
<td>in_par_07</td>
<td>none</td>
<td>Tn control parameter of the internal controller.</td>
</tr>
<tr>
<td>in_par_08</td>
<td>none</td>
<td>Tv control parameter of the internal controller.</td>
</tr>
<tr>
<td>in_par_09</td>
<td>none</td>
<td>Xp control parameter of the cascade controller.</td>
</tr>
<tr>
<td>in_par_10</td>
<td>none</td>
<td>Proportional portion of the cascade controller.</td>
</tr>
<tr>
<td>in_par_11</td>
<td>none</td>
<td>Tn control parameter of the cascade controller.</td>
</tr>
<tr>
<td>in_par_12</td>
<td>none</td>
<td>Tv control parameter of the cascade controller.</td>
</tr>
<tr>
<td>in_par_13</td>
<td>none</td>
<td>Adjusted maximum internal temperature of the cascade controller.</td>
</tr>
<tr>
<td>in_par_14</td>
<td>none</td>
<td>Adjusted minimum internal temperature of the cascade controller.</td>
</tr>
<tr>
<td>in_par_15</td>
<td>none</td>
<td>Band limit (upper)</td>
</tr>
<tr>
<td>in_par_16</td>
<td>none</td>
<td>Band limit (lower)</td>
</tr>
</tbody>
</table>
### Command Parameter Response of circulator

<table>
<thead>
<tr>
<th>Command</th>
<th>Parameter</th>
<th>Response of circulator</th>
</tr>
</thead>
<tbody>
<tr>
<td>in_mode_01</td>
<td>none</td>
<td>Selected setpoint:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = SETPNT 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = SETPNT 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 = SETPNT 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 = Last setpoint setting was carried out through an external programmer</td>
</tr>
<tr>
<td>in_mode_04</td>
<td>none</td>
<td>Internal/external temperature control:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Temperature control with internal sensor.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Temperature control with external Pt100 sensor.</td>
</tr>
<tr>
<td>in_mode_05</td>
<td>none</td>
<td>Circulator in Stop/Start condition:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Stop</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = Start</td>
</tr>
<tr>
<td>in_mode_08</td>
<td>none</td>
<td>Adjusted control dynamics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = aperiodic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = standard</td>
</tr>
</tbody>
</table>

### 12.4. Status messages

<table>
<thead>
<tr>
<th>Status messages</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 MANUAL STOP</td>
<td>Circulator in „OFF“ state.</td>
</tr>
<tr>
<td>01 MANUAL START</td>
<td>Circulator in keypad control mode.</td>
</tr>
<tr>
<td>02 REMOTE STOP</td>
<td>Circulator in „r OFF“ state.</td>
</tr>
<tr>
<td>03 REMOTE START</td>
<td>Circulator in remote control mode.</td>
</tr>
</tbody>
</table>

### 12.5. Error messages

<table>
<thead>
<tr>
<th>Error messages</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-01 LOW LEVEL ALARM</td>
<td>Low liquid level alarm.</td>
</tr>
<tr>
<td>-02 REFRIGERATOR ALARM</td>
<td>Control cable of the refrigerated circulator or MVS solenoid valve controller short-circuited or interrupted.</td>
</tr>
<tr>
<td>-03 EXCESS TEMPERATURE WARNING</td>
<td>High temperature warning.</td>
</tr>
<tr>
<td>-04 LOW TEMPERATURE WARNING</td>
<td>Low temperature warning.</td>
</tr>
<tr>
<td>-05 WORKING SENSOR ALARM</td>
<td>Working temperature sensor short-circuited or interrupted.</td>
</tr>
<tr>
<td>Error messages</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>-06 SENSOR DIFFERENCE ALARM</td>
<td>Sensor difference alarm. Working temperature and safety sensors report a temperature difference of more than 35 K.</td>
</tr>
<tr>
<td>-07 I2C-BUS ERROR</td>
<td>Internal error when reading or writing the I2C bus.</td>
</tr>
<tr>
<td>-08 INVALID COMMAND</td>
<td>Invalid command.</td>
</tr>
<tr>
<td>-09 COMMAND NOT ALLOWED IN CURRENT OPERATING MODE</td>
<td>Invalid command in current operating mode.</td>
</tr>
<tr>
<td>-10 VALUE TOO SMALL</td>
<td>Entered value too small.</td>
</tr>
<tr>
<td>-11 VALUE TOO LARGE</td>
<td>Entered value too large.</td>
</tr>
<tr>
<td>-12 TEMPERATURE MEASUREMENT ALARM</td>
<td>Error in A/D converter.</td>
</tr>
<tr>
<td>-13 WARNING : VALUE EXCEEDS TEMPERATURE LIMITS</td>
<td>Value lies outside the adjusted range for the high and low temperature warning limits. But value is stored.</td>
</tr>
<tr>
<td>-14 EXCESS TEMPERATURE PROTECTOR ALARM</td>
<td>Excess temperature protector alarm</td>
</tr>
<tr>
<td>-15 EXTERNAL SENSOR ALARM</td>
<td>External control selected, but external Pt100 sensor not connected.</td>
</tr>
<tr>
<td>-20 WARNING: CLEAN CONDENSER OR CHECK COOLING WATER CIRCUIT OF REFRIGERATOR</td>
<td>Cooling of the condenser is affected. Clean air-cooled condenser. Check the flow rate and cooling water temperature on water-cooled condenser.</td>
</tr>
<tr>
<td>-21 WARNING: COMPRESSOR STAGE 1 DOES NOT WORK</td>
<td>Compressor stage 1 does not work.</td>
</tr>
<tr>
<td>-22 WARNING: COMPRESSOR STAGE 2 DOES NOT WORK</td>
<td>Compressor stage 2 does not work.</td>
</tr>
<tr>
<td>-23 WARNING: HIGH TEMPERATURE ON COMPRESSOR STAGE 1</td>
<td>Excess temperature on compressor stage 1.</td>
</tr>
<tr>
<td>-24 WARNING: HIGH TEMPERATURE ON COMPRESSOR STAGE 2</td>
<td>Excess temperature on compressor stage 2.</td>
</tr>
<tr>
<td>-25 REFRIGERATOR WARNING</td>
<td>Error in the cooling machine.</td>
</tr>
<tr>
<td>-30 CONFIGURATION ERROR: CONFIRM BY PRESSING &lt;OK&gt; ON CIRCULATOR</td>
<td>The configuration of the circulator does not conform to its present use. Press OK to automatically perform a single modification of the configuration.</td>
</tr>
<tr>
<td>-33 SAFETY SENSOR ALARM</td>
<td>Excess temperature sensor short-circuited or interrupted.</td>
</tr>
<tr>
<td>-40 NIVEAU LEVEL WARNUNG</td>
<td>Low liquid level warning in the internal reservoir.</td>
</tr>
</tbody>
</table>
13. JULABO Service – Online remote diagnosis

JULABO circulators of the HighTech series are equipped with a black box. This box is implemented in the controller and records all significant data for the last 30 minutes. In case of a failure, this data can be read out from the unit by using special software. This software is available as a free download from www.julabo.com \ EasyBlackBox.

- Installation is easy and is performed step by step. Please observe the instructions.

- Data read-out is possible in the conditions “OFF”, “R OFF” or “ALARM”.
- Connect the circulator to the computer using an interface cable.
- Start the EasyBlackBox program.

The program asks for the port used (COM1, ......) and the baud rate of the unit.
You do not have this information on hand? Simply try it out! The program continues to send the request until the correct settings are made.

- Data is read out and shown on the monitor divided in the sections >Einstellungen/Settings<, >Alarmspeicher/Alarms stored<, >Blackbox<

ĕ see example

- After pressing >Speichern/Save< a text file is compiled. The program proposes a filename - >C:\model description and barcode no.<. Modifications are possible.
- E-mail this file to ServiceUSA@Julabo.com, JULABO’s service department. JULABO is thus able to provide rapid support.
14. Cleaning / 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.

**Cleaning:**
For cleaning the bath tank and the immersed parts of the circulator, use low surface tension water (e.g., soap suds).
Clean the outside of the unit using a wet cloth and low surface tension water.

The circulator is designed for continuous operation under normal conditions. Periodic maintenance is not required.
The tank should be filled only with a bath fluid recommended by JULABO. To avoid contamination, it is essential to change the bath fluid from time to time.

**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:
- Clean the unit in order to avoid any harm to the service personnel.
- Attach a short fault description.
- 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.
15. 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 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,
WARRANTY PROVISIONS

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.