

Operating Manual

Refrigerated and Heating Circulators

- with integrated programmer

FS18-

F25-

F26-

F32-

F33-

F34-

HP/SP

- with integrated programmer
- with proportional cooling capacity control

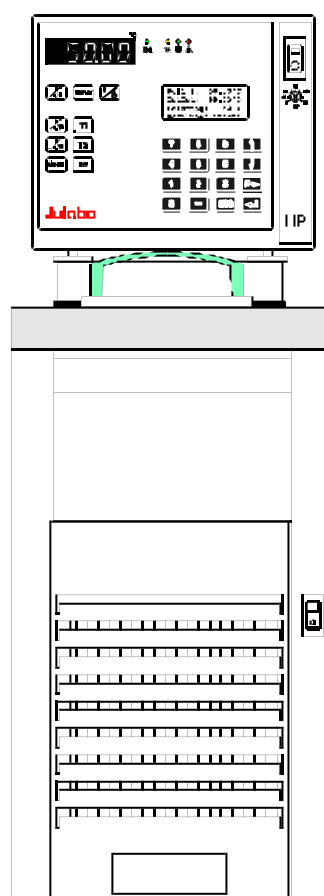
FP40-

FP45-

FP50-

FPW50

HP/SP



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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 principles of operating and possibilities of our circulators. For optimum utilization of all functions, we recommend that you thoroughly study this manual prior to beginning operation.

Safety Warnings

Take care your unit is operated only by qualified persons.

Make sure you read and understand all instructions and safety precautions listed in this manual before installing or operating your unit. If you have any questions concerning the operation of your unit or the information in this manual, contact JULABO.

Performance of installation, operation, or maintenance procedures other than those described in this manual may result in a hazardous situation and may void the manufacturer's warranty.

Transport the unit with care. Sudden jolts or drops may cause damages in the interior of the unit.

Observe all warning labels.

Never remove warning labels.

Never operate damaged or leaking equipment.

Never operate the unit without bath fluid in the bath.

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 empty the bath before moving the unit.

Never operate equipment with damaged mains power cables.

Refer service and repairs to a qualified technician.




In addition to the safety warnings listed above, warnings are posted throughout the manual. These warnings are designated by an exclamation mark inside an equilateral triangle. Read and follow these important instructions. Failure to observe these instructions can result in permanent damage to the unit, significant property damage, personal injury or death.

TABLE OF CONTENTS

1.	OPERATING CONTROLS AND FUNCTIONAL ELEMENTS	4
2.	QUALITY MANAGEMENT SYSTEM.....	6
3.	UNPACKING AND CHECKING.....	6
4.	DESCRIPTION.....	6
5.	PREPARATIONS	7
5.1.	Installation.....	7
5.2.	Bath liquids and tubing	7
5.3.	Filling / draining	9
5.4.	Temperature application to external systems.....	10
6.	OPERATING PROCEDURES	12
6.1.	Power connection.....	12
6.2.	Switching on - Start/Stop	12
7.	MANUAL OPERATION.....	13
7.1.	Start - Stop	13
7.2.	Setting the temperatures.....	14
7.3.	Warning functions	15
7.4.	Setting the safety temperature (with shutdown function).....	16
7.5.	Internal / external control.....	17
8.	MENU FUNCTIONS	18
8.1.	Configuration.....	19
8.2.	Control parameters.....	23
8.3.	Start of a profile.....	24
8.3.1.	Interrupting a profile	26
8.4.	Integrated programmer	27
8.5.	Analog inputs/outputs	30
8.6.	Limits.....	33
8.7.	Interface	33
8.8.	Sensors.....	34
9.	TROUBLESHOOTING GUIDE / ERROR MESSAGES	35
10.	SAFETY RECOMMENDATIONS	38
11.	ELECTRICAL CONNECTIONS	39
12.	REMOTE CONTROL	42
12.1.	Setup for remote control.....	42
12.2.	Communication with a PC or a superordinated data system	42
12.3.	List of commands	44
12.4.	Status messages / error messages	47
13.	MAINTAINING THE COOLING PERFORMANCE	49
14.	CLEANING THE UNIT.....	50
15.	MAINTENANCE.....	50
16.	TECHNICAL SPECIFICATIONS	51
17.	EC DECLARATION OF CONFORMITY	55
18.	WARRANTY CONDITIONS	56


1. Operating controls and functional elements


1a/1b Mains power switch, illuminated
Circulator/Cooling machine

2  Start / stop key


3  Working temperature T1


4  Working temperature T2

5  High temperature warning limit

6  Low temperature warning limit

7  Safety temperature

8  Adjustable excess temperature protection
(safety temperature)

9  Control type: internal/external control

10  MULTI-DISPLAY (LED) temperature indication

11  Display of internal/external actual value





Indicator lights:

 Temperature indication - external actual value

 /  /  Alarm / Cooling / Heating

12 DIALOG-DISPLAY (LCD) for indication of:

Setp.1: 37.00°C
ExtAct: 37.00°C
Power: 100 %
Control: intern

Line 1: Setpoint  or  or  or 

Line 2: Internal or external actual value 

Line 3: Heating power in %

Line 4: Control type: internal /  external control


13  MENU key - for selecting the menu functions

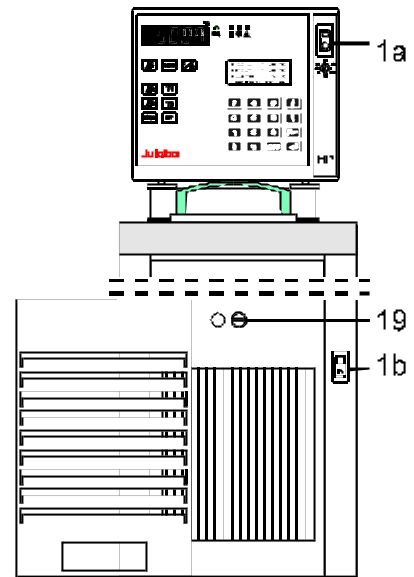
14   Cursor keys - Select menu items

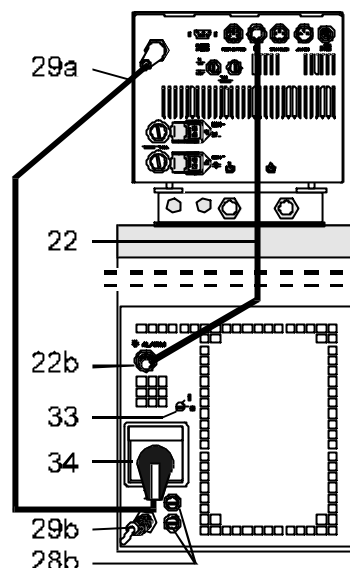
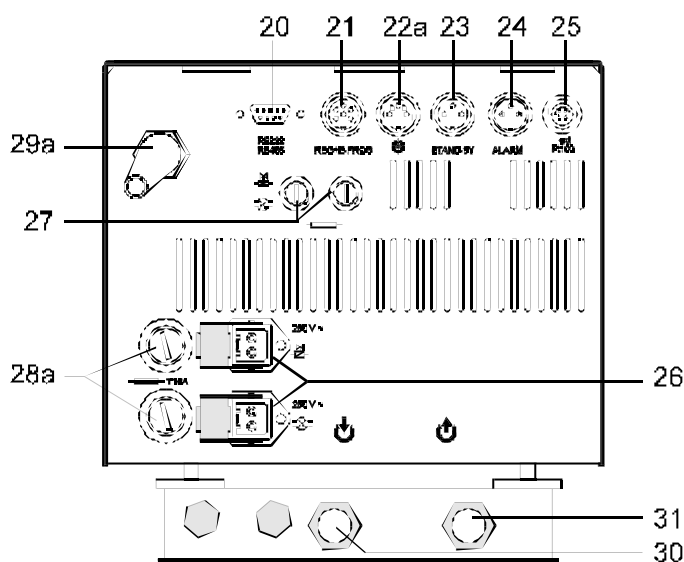
15  P-key Selecting parameters

16    Numeral keypad: numerals 0 to 9; minus / decimal point

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

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





Rear

20		RS232 RS485	Interface RS232/RS485
21		REG+E-PROG	Programmer input and temperature recorder output
22a/22b			Connector: control cable of JULABO refrigerated circulator
23		STAND-BY	Stand-by input (for external emergency switch-off)
24		ALARM	Alarm output (for external alarm signal)
25			Connector for external measurement and control sensor
26			Connectors for solenoid valve and/or supplementary pump 230 V / 115 V
27			Fuses (for connectors 26)
28a/28b			Mains fuses: Circulator Cooling machine
29a/29b			Mains power cable with plug: Circulator/Cooling machine
30 + 31			Pump connectors suction pump pressure pump
33			Selector dial for cooling machine (only on F25, F26, F34) Position „1“ for operation with circulator
34			Built-in mains outlet for connection of circulator
			Only for water cooled models: Cooling water OUTLET and INLET

2. Quality Management System



The JULABO Quality Management System:

Development, production and distribution of temperature application instruments for research and industries conform to the requirements according to DIN EN ISO 9001:1994-08.

Certificate Registration No. QA 051004008.

3. Unpacking and checking

Unpack the circulator and accessories and check for damages incurred during transit. These should be reported to the responsible carrier, railway, or postal authority, and a request for a damage report should be made. These instructions must be followed fully for us to guarantee our full support of your claim for protecting against loss from concealed damage. The form required for filing such a claim will be provided by the carrier.

4. Description

The JULABO refrigerated circulators employ a circulator head and a cooling machine with bath tank, and have been designed for heating and cooling of liquids in a bath tank.

Besides the cooling aggregate, the main functional elements are the heater, circulation pump, and control electronics. An electronic proportional temperature control (PID characteristic) adapts the heat supplied to the thermal requirements of the bath.

Setting is rapid and simple using the keypad with its easy to learn symbols. Keypad is splash-proof, easily cleaned and ergonomically designed.

The microprocessor technology allows four temperature values to be stored and indicated on the MULTI-DISPLAY (LED): working temperatures T1 and T2, high and low temperature warning limits.

The safety value for excess temperature protection, a safety installation independent from the control circuit, is adjustable on the front with simultaneous indication on the MULTI-DISPLAY (LED).

The RS232/RS485 port permits modern process engineering without additional interface, directly on-line, from the circulator to your application equipment.

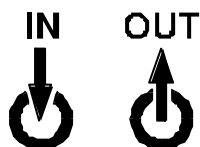
Besides the digital interface, additionally analog connectors are provided, such as for Pt100 external sensor, analog programmer input, temperature recorder output and others.

The circulator conforms to the safety requirements specified by DIN 12 876 (safety class III), as well as DIN 58 966, and the guideline for first voltage range EN 61010.

5. Preparations

5.1. Installation

- Place the unit in an upright position.
- Keep at least 20 cm of open space on the front and rear venting grids.
- Do not set up the unit in the immediate vicinity of heat sources and do not expose to sun light.
- Before operating the unit after transport, wait about one hour after setting it up. This will allow any oil that has accumulated laterally during transport to flow back down thus ensuring maximum cooling performance of the compressor.



- Only for water cooled models:
Ensure circulation of cooling water by connecting the tubing to cooling water inlet and outlet on the rear of the refrigerated circulator.

Cooling water connectors: 1/2"

Cooling water see page 53

5.2. Bath liquids and tubing



Carefully read the safety data sheet of the bath liquid used, particularly with regard to the fire point!

If Ethanol is used, only supervised operation is possible.

- **Recommended bath liquids:**

Bath liquids	Temperature range	Flash point	fire point
Thermal M	+50 °C ... 170 °C	>275 °C	>320 °C
Thermal H	+50 °C ... 250 °C	>280 °C	>350 °C
Thermal HY	-60 °C ... 50 °C	>62 °C	>110 °C
Ethanol (C ₂ H ₅ OH)	-100°C bis 0 °C	12 °C	
deionized water	5 °C bis 80 °C		



No liability for use of other bath liquids!

ATTENTION: The maximum permissible viscosity is $30 \text{ mm}^2 \times \text{s}^{-1}$.

Order No.	Bath liquid	
8 940 100	Thermal M	10 liters container
8 940 101	Thermal M	5 liters container
8 940 102	Thermal H	10 liters container
8 940 103	Thermal H	5 liters container
8 940 104	Thermal HY	10 liters container
8 940 105	Thermal HY	5 liters container



Please contact JULABO before using other than recommended bath liquids.

JULABO takes no responsibility for damages caused by the selection of an unsuitable bath liquid.

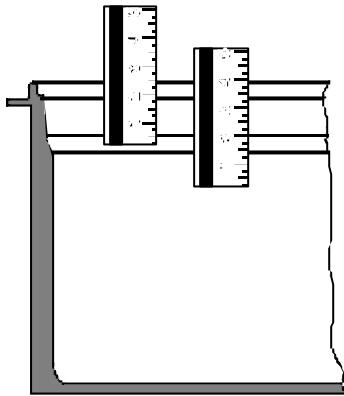
Unsuitable bath liquids are liquids which e.g.

- **are very highly viscous**
(much higher than $30 \text{ mm}^2 \times \text{s}^{-1}$ at the respective working temperature)
- **have corrosive characteristics or**
- **tend to cracking.**

• **Recommended tubing:**

	Temperature range
CR tubing	-20 °C to +120 °C
Viton tubing	-50 °C to +200 °C
Metal tubing	-100 °C to +350 °C

5.3. Filling / draining

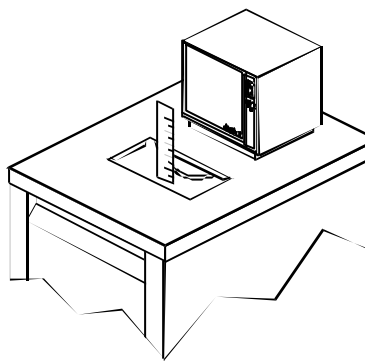


Filling

Take care that no liquid enters the interior of the circulator.

- Recommended maximum filling level with water as bath liquid: 25 mm below the tank rim
- Recommended maximum filling level with bath oils: 40 mm below the tank rim

After filling, immerse the samples in the bath or place the lid on the bath, in case the opening is not to be used.



FS18

Recommended maximum filling level is 5 mm.

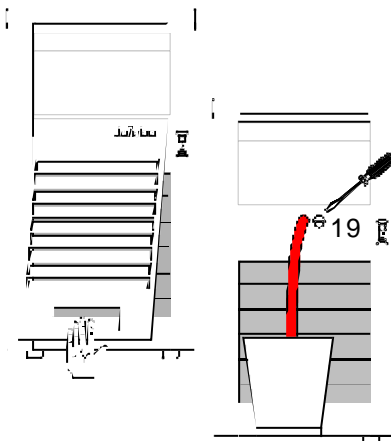
Note:

When switching the circulator on, the bath liquid may lie below the required minimum level due to liquid pumped into the external system.



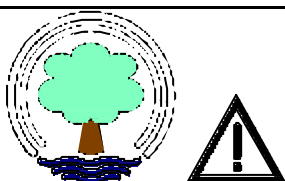
ATTENTION: The volume of bath oils will increase due to thermal expansion when the bath temperature rises.

Exercise CAUTION when emptying hot bath liquids!



Draining

- Turn off the circulator and cooling machine.
- Hold the venting grid, pull out and remove.
- Slide a short piece of tube onto the drain port and hold it into a pail.
- Unscrew the drain tap (19) and empty the unit completely.
- Tighten the drain tap.

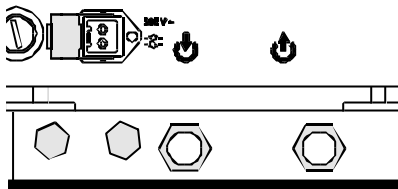




Store and dispose the used bath liquid according to the laws for environmental protection.

5.4. Temperature application to external systems

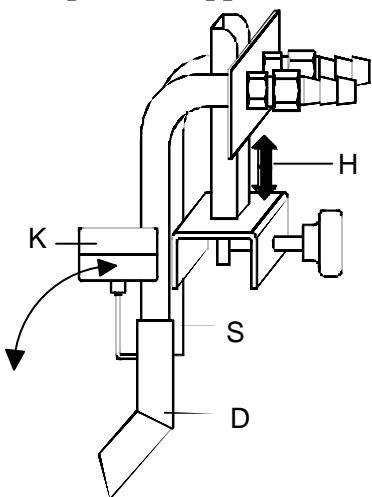
Temperature application to external, closed systems

The circulator is used for temperature application to external, closed systems (loop circuit) with simultaneous temperature application in the circulator bath.



- Unscrew the M 16 x 1 collar nuts on the pump connectors (pressure pump , suction pump ) with a 19 mm (3/4") wrench and remove the sealing disks. Using the collar nuts, screw on the tubing connection fittings (for tubing 8 mm or 12 mm in diameter) delivered with the unit and tighten firmly.
- Push on the tubings, and secure with tube clamps.
- Attach the tubings to the connectors of the external closed system, e.g., an instrument with a pressure-resistant temperature jacket or a temperature coil, and fasten with tube clamps to prevent slipping.

Temperature application to external, open systems



These circulators are equipped with both a pressure and suction pump for external temperature application in open systems.

Differing flow rates of the pressure and suction pumps should be compensated. To maintain a constant liquid level, the JULABO "D+S" Level Adapter is recommended for the external bath tank. The flow rate of the pressure pump will be then regulated by a built-in float device. The liquid level may be changed by a height adjustment on the "D+S" Level Adapter.

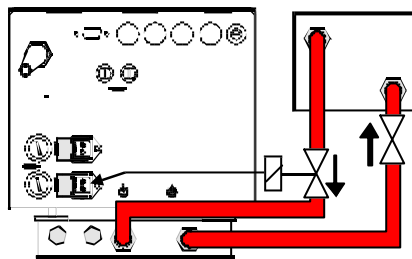
Order No. 8 970 410 "D+S" Level Adapter

S = Suction pump connection
D = Pressure pump connection
K = Float
H = Height adjustment



When working at temperatures below 0 °C and using the "D+S" Level Adapter do not use oil as the bath liquid. Condensing air will result in the formation of ice and thus affects the function of the float.

Return flow safety device



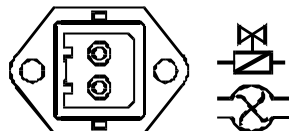
If the liquid levels in the circulator bath and the external system are at different heights, overflowing must be prevented after the power has been turned off.



Flood hazard!

For this reason, solenoid valves for loop circuit or shut-off valves can be integrated in the loop circuit.

Connect the valve (230 V / 115 V) to the connector (26).

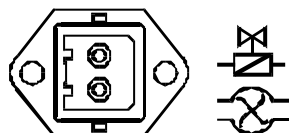


Order No.	Description
8 980 701	Solenoid valve for loop circuit up to +100 °C
8 970 456	Shut-off valve (suitable up to +90 °C)
8 970 457	Shut-off valve (suitable up to +250 °C)



Fasten tubing to prevent slipping.

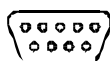
Supplementary pump



Both connectors (26) may be used for operating supplementary pumps.



Control (switching on/off) is effected by pressing the start/stop key or via the digital interface with the start/stop command.



Check to make sure that the line voltage matches the supply voltage specified on the identification plate (230 V or 115 V).

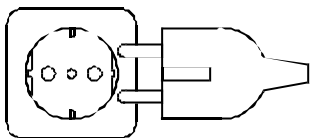
6. Operating procedures

6.1. Power connection



Connect the unit only to a grounded mains power socket!

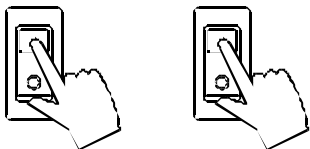
We disclaim all liability for damage caused by incorrect line voltages!



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

- Connect the circulator with mains power cable (29a) to the mains outlet (34).
- Connect the control cable (22) between the connectors ✱ (22a, 22b).
- Connect the refrigerated circulator with mains power cable (29b) to the mains socket.

6.2. Switching on - Start/Stop



Switching on:

Circulator and cooling machine may be turned on and off with separate mains switches. The integrated control light will illuminate to indicate that power has been applied.

The unit performs a self-test.

All segments of the 5-digit MULTI-DISPLAY (LED), all indicator lights and the DIALOG-DISPLAY (LCD) will illuminate.

Then the software version (example: n 1.01) appears. The display "**OFF**" indicates the unit is ready to operate (standby mode).

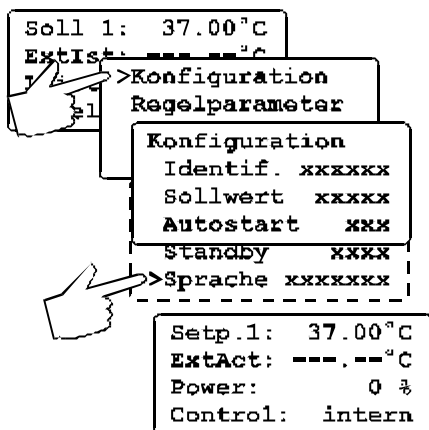
The circulator enters the operating mode activated before switching the circulator off:

keypad control mode (manual operation) or

remote control mode (operation via personal computer).

JULABO
HighTech
Thermostat
Version 1.01







- OFF -



Selecting the language:

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

Press the respective keys in the following order:

1. MENUE key  1 x
2. Enter key  1 x
3. Cursor key  4 x
4. P key  1 x
5. Enter key  1 x
6. Escape key  2 x


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

7. Manual operation

7.1. Start - Stop



Start:

- Press the start/stop key .
The MULTI-DISPLAY (LED) indicates the actual bath temperature. (example: 21.03 °C)



Stop:

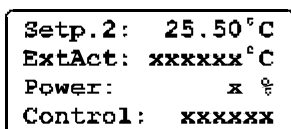
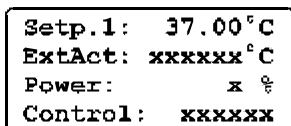
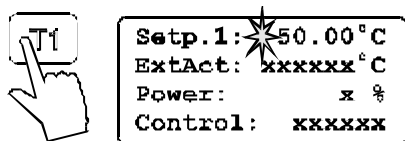
- Press the start/stop key .
The MULTI-DISPLAY (LED) indicates the message "OFF".



The unit also enters the safe operating state "OFF" or "r OFF" after a mains power interruption. In case of manual operation, the start/stop key has to be pressed to restart operation. The temperature values which were entered via the keypad of the circulator remain in memory.

If the circulator is operated in remote control mode, the order to start and all values which have to be adjusted, must be resent via interface by the personal computer.

7.2. Setting the temperatures



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

Setting the working temperature "T1":

- ① Press the setpoint key .

The value previously set appears on the DIALOG-DISPLAY (LCD) (example: 50.00°C).

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

- ② Use the keypad to enter the new value (example: -15.00 °C).

- ③ Press enter to store the selected value.

Setting the working temperature "T2":

- ① Press the setpoint key .

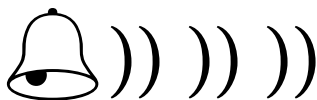
- ② Follow the instructions

- ③ for "T1" (example: 25.50 °C).

Selecting the working temperature:

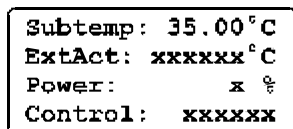
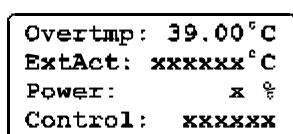
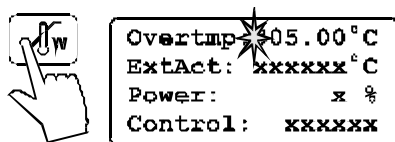
- Press the setpoint key and then enter .
- Press the setpoint key and then enter .

7.3. Warning functions



More protection for your samples in the bath!

An audible signal sounds in intervals when the actual temperature value exceeds one of the set limits (patented).



Setting the high temperature limit:

- ① Press the key .

The value previously set appears on the DIALOG-DISPLAY (LCD) (example: 305.00°C). A flashing segment indicates that a value needs to be entered.

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

- ③ Press enter to store the value.

Setting the low temperature limit:

- ① Press the key .

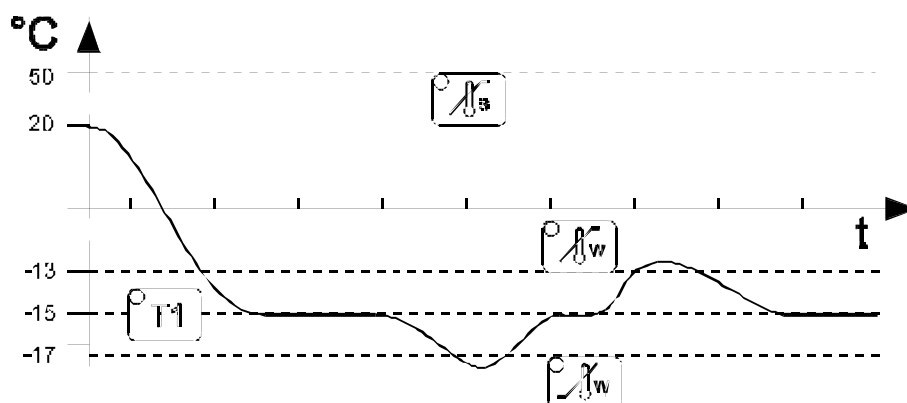
- ② Follow the instructions

- ③ for (example: -17.00 °C).

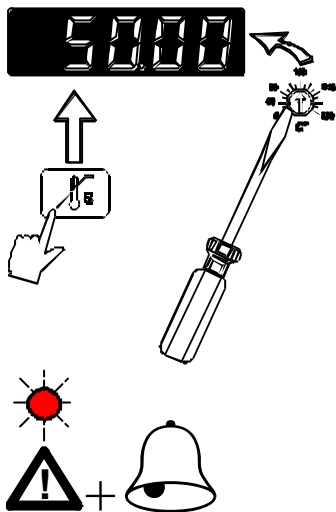


Note:

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



7.4. Setting the safety temperature (with shutdown function)



(excess temperature protection)

- Press the key to indicate the safety temperature value on the MULTI-DISPLAY and using a screwdriver simultaneously turn the setting screw to the desired value (example: 50 °C).

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

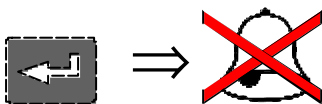
This safety installation is independent of the control circuit. When the temperature of the bath liquid has reached the safety temperature, a complete shutdown of the heater and pump is effected.

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



A L A R M !
ExtAct: xxx.xx °C
Temp/level alarm

On the MULTI-DISPLAY (LED) and DIALOG-DISPLAY (LCD) appears the error message "E 14".



Cancel the alarm state (see page 36).

Recommendation:

Set the safety temperature at 5 to 10 °C above the working temperature setpoint.



The excess temperature protection should be set at least 20 °C below the fire point of the bath liquid used.

In the event of wrong setting there is a fire hazard!

We disclaim all liability for damage caused by wrong settings!

7.5. Internal / external control

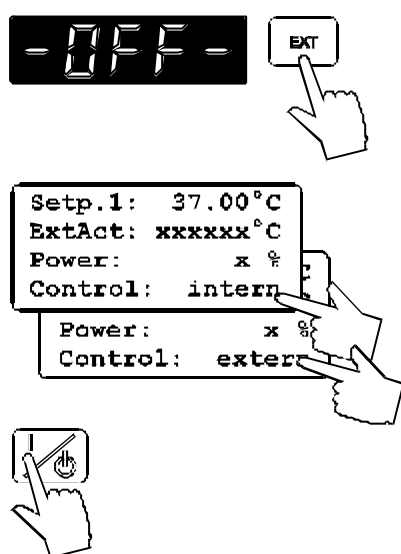
The circulator is suitable for temperature control in the internal bath as well as in the external system (loop circuit).





Setup for external control:

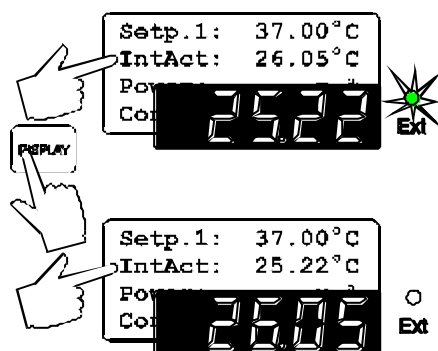
Connect a Pt100 sensor to the socket on the rear of the circulator, if necessary perform a calibration using the „ATC Ext:“ function (see page 34) and then securely fix the sensor in the external system.


Switching from internal to external control:



- Press the key  in operating state “OFF” to select the control type.
- The DIALOG-DISPLAY (LCD) indicates the effective control type.
- Press the start/stop key .

Temperature indication:



- Both actual temperatures are indicated at the same time:
 - 1) on the MULTI-DISPLAY (LED)
 - 2) on the DIALOG-DISPLAY (LCD).
- Press the key  to swap the values on the displays. The indicator light „Ext“ refers to the indication on the MULTI-DISPLAY (LED).






Important:

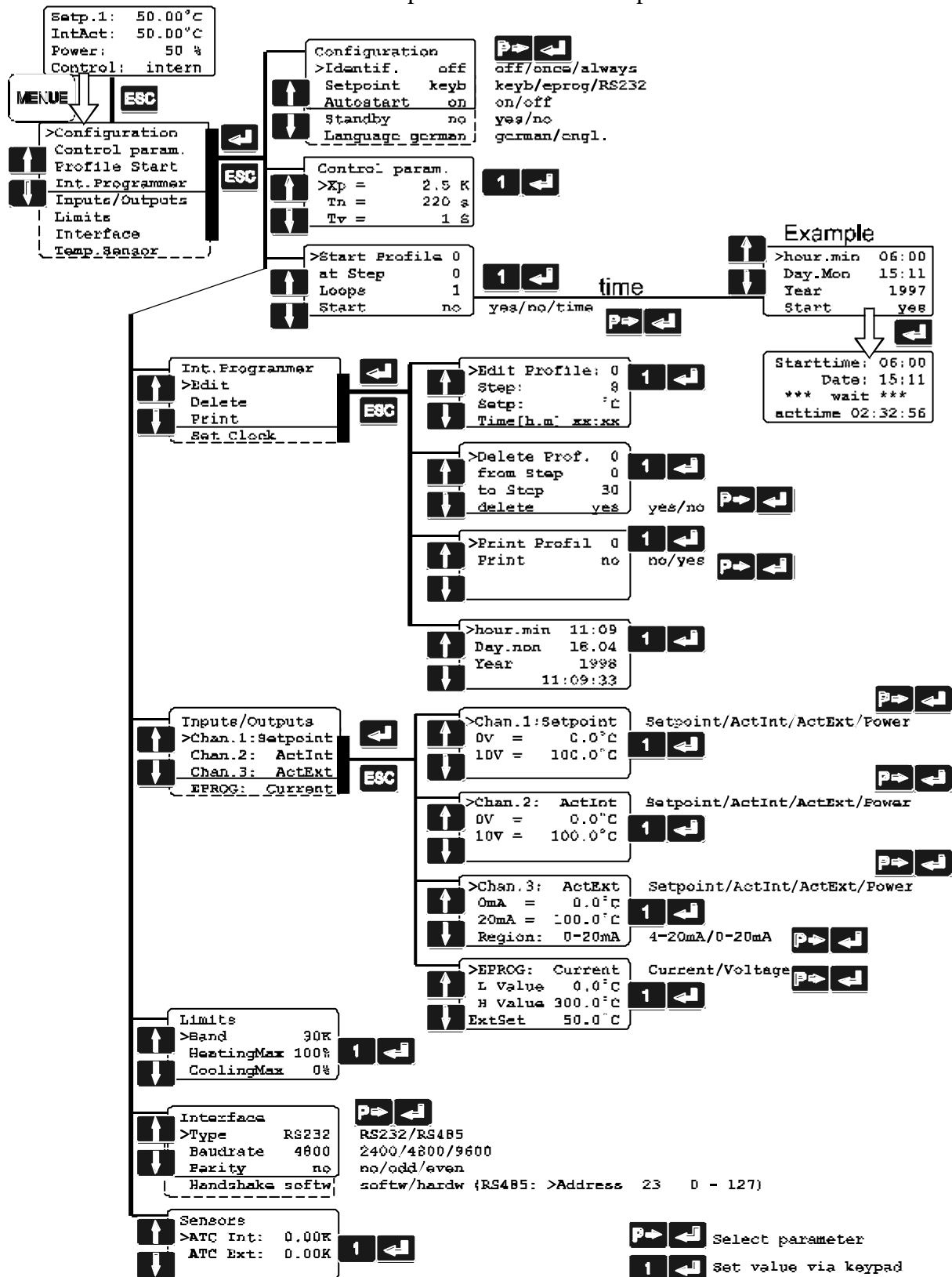
If the circulator is operated through the **integrated programmer** (see page 23) only the MULTI-DISPLAY (LED) swaps between the two actual values (internal and external), whereas the DIALOG-DISPLAY (LCD) indicates the actual value relating to the valid control type (internal or external).



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

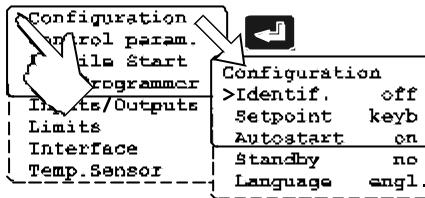
8. Menu functions







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



8.1. Configuration

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



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

Identification


When performing an identification for the controlled system (temperature application system), the control parameters X_p , T_n and T_v will be automatically determined and stored.

Possible parameters:

off - no identification.

The control parameters ascertained during the last identification are used for control purposes.

once - single identification

After switching-on at the mains switch and after the start, the unit always once carries out an identification of the autoleveller, either by the Start/Stop key  or the Start- command via the interface.


always - continual identification

The circulator performs an identification of the controlled system whenever a new setpoint is to be reached.

NOTE: Use this setting only when the temperature application system changes permanently.



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

This phase is indicated by a flashing indicator light .

Identification with simultaneous cooling is **only** possible on FP units!

Note:

Requirement for an identification of the controlled system:

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

Recommended setting for internal control:

$$X_p = 1.0 \text{ }^{\circ}\text{C}$$

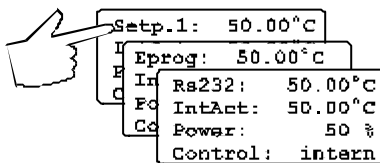
$$T_n = 80 \text{ s}$$

$$T_v = 8 \text{ s}$$

Setpoint

The circulator provides three possibilities for the setpoint selection.

The selected mode is indicated on the DIALOG-DISPLAY (LCD).



Possible parameters:

keyb- via keypad (working temperature T1 or T2) or via the integrated programmer.

eprog - via the analog interface REG+E-PROG (21) through an external programmer.

RS232 - via the serial RS232/RS485 interface (20) through a PC or superordinated data system.



REG+E-PROG



RS232

RS485

Autostart

Note:

The circulator has been configured and supplied by JULABO according to N.A.M.U.R. recommendations. This means for the start mode, that the unit must enter a safe operating state after a power failure (non-automatic start mode). This safe operating state is indicated by „OFF“ or „rOFF“, resp. on the MULTI-DISPLAY (LED). A complete shutdown of the main functional elements such as heater and circulation pump is effected simultaneously.

Only with setpoint adjustment the AUTOSTART-function can be executed via >Taste< and >EPROG< (see above).

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

Possible parameters:

on - AUTOSTART on

off - AUTOSTART off



Warning:

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

The circulator does no longer conform to N.A.M.U.R. recommendations. Take care you fully observe the safety and warning functions of the circulator.

If the setpoint is given via the serial interface, no AUTOSTART is possible.

Stand-by input

External stand-by for emergency switch-off
(connector - see page 40)

Possible parameters:

no - stand-by input is ignored

yes - stand-by input is active



STAND-BY

Language

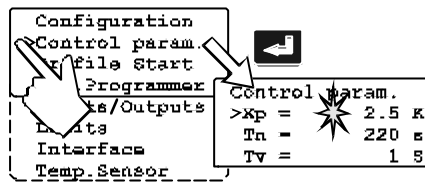
There are two options for the language of the DIALOG-DISPLAY (LCD): German or English.

Possible parameters:

German (deutsch)

English (engl).

8.2. Control parameters



Xp = **2** **=** **5** **↵**

When performing an identification for the controlled system (temperature applications system) (see page 19), the control parameters Xp, Tn, and Tv will be automatically determined and stored.

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

- Press enter **↵** to select the submenu „control parameters“.
- Use the up/down cursor keys **↑** **↓** to select the desired option. A flashing segment indicates that a new value needs to be entered.
- Use the numeral keypad to set the value and then set with enter **↵** (example: Xp = 2.5 °C).
- Press escape **ESC** to return to the previous menu level.

Optimization instructions for the PID control parameters:

The heat-up curve reveals inappropriate control settings.
(example: working temperature T1)

optimum setting

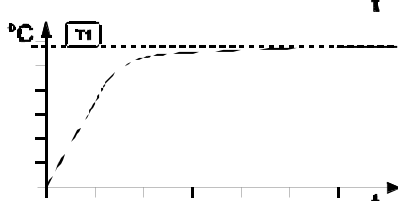
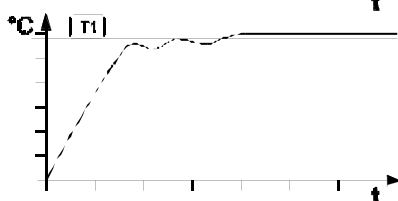
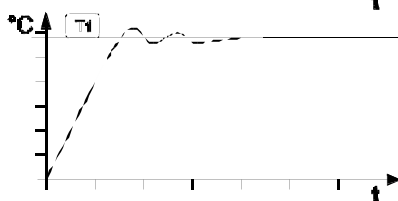
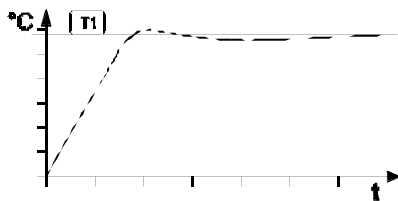
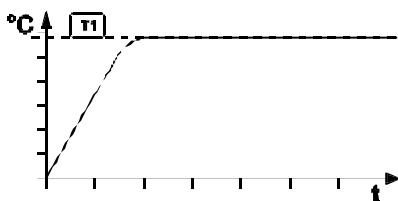
Inappropriate settings may produce the following heat-up curves:

Xp too low

Tv/Tn too low

Xp too high
or
Tv too high


Tv/Tn too high
or
Xp too high

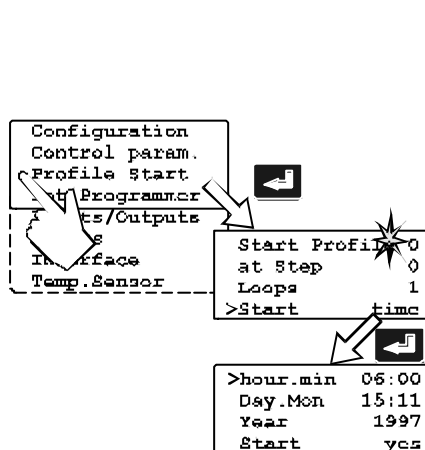





8.3. Start of a profile

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

There are two possibilities for manually starting a program:


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



- Press enter  to select the submenu „Profile Start“.
- Use the up/down cursor keys   to select the desired option.



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

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

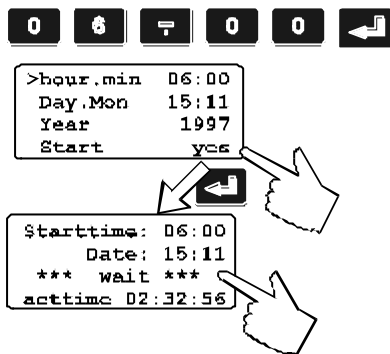
Enter the desired number and set each entry with enter .

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

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

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

Example: hour.min 6:00 h



- When selecting the parameter **time**, a new menu level is called up for entry of the start time.

A flashing segment indicates that a start time needs to be entered.

hour.min Start time
Day.Mon day and month
Year year

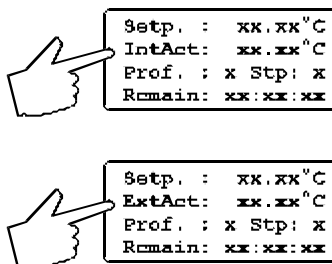
Set each entry with enter

Start no / yes

A flashing line indicates that the parameter „yes“ needs to be entered.

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

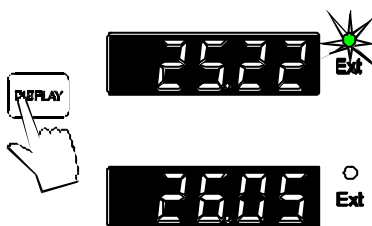
- The circulator switches to waiting mode and a flashing line „wait“ appears on the DIALOG-DISPLAY (LCD). The start time and actual time are permanently indicated on the display.



Indication after starting the profile:

DIALOG-DISPLAY (LCD)

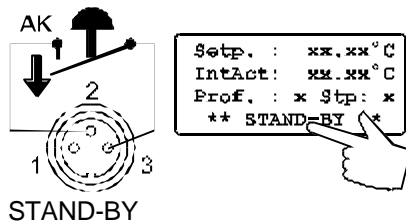
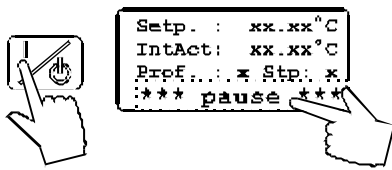
- 1st line: Setpoint of the programmer
- 2nd line: Actual temperature value
 at **internal control** = IntAct: xxx.xx
 at **external control** = ExtAct: xxx.xx
- 3rd line: Selected profile and the actual section
- 4th line: Remaining time of the actual section




MULTI-DISPLAY (LED)

If the circulator is operated through the **integrated programmer** the MULTI-DISPLAY (LED) swaps between the two actual values (internal and external) (see page 17).

8.3.1. Interrupting a profile



Interrupting a profile:

Press the start/stop key  to interrupt or continue a profile. The setpoint and time period set for the corresponding section are thus stopped at the values presently achieved.

The circulator is put on hold and the message „pause“ flashes on the DIALOG DISPLAY (LCD).

- A profile can be interrupted or restarted by an external emergency shut-off.(see page 40).



CAUTION:

This is not an actual emergency switch-off.

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

Important:

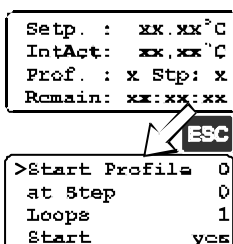
To achieve this, the stand-by condition must first be activated and the AUTOSTART function turned on
(See page 21).




Warning:




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

See Warning page 21



Termination of a profile:

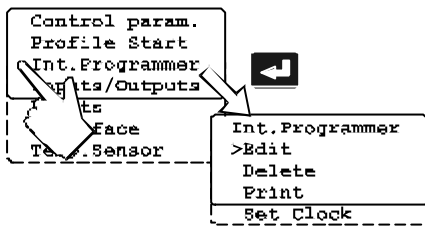
A profile can be terminated by pressing the escape key . The programmer switches back to the Start menu.





- Press the Escape-key  again to leave the menu
or
use the cursor keys   to remain in the Start menu.

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

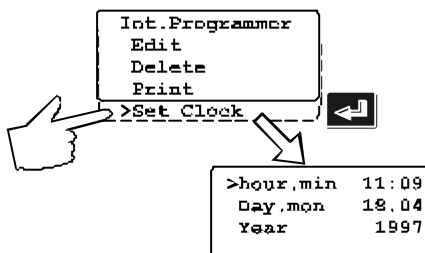
8.4. Integrated programmer

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



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

Edit	Compile profiles Display sections
Delete	Delete sections
Print	Print a programmed profile
Set clock	Set the real time on the circulator



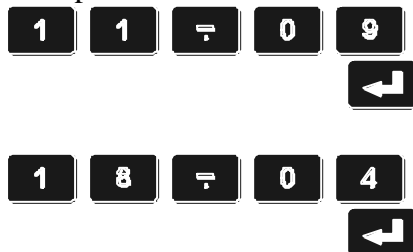
Setting clock



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

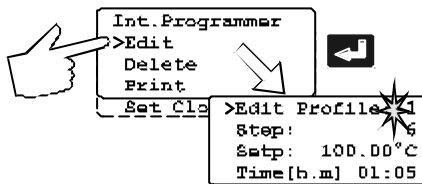
- Lines 1 to 3:
Check for correctness of the preset date and time and correct if necessary.

The time is displayed permanently in line 4.

Examples:











- Use the numerals to set time, date and year and set each entry with enter .
- Press escape  to return to the previous menu level.

**Edit**Compile profiles:

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

Examples:

Profile No. 1  Step  Setpoint    Time      


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

When the program is running, only sections having complete information for target temperature and time period are considered.

It makes sense, to leave out section numbers in the profile, in order to use them later for corrections in the profile.

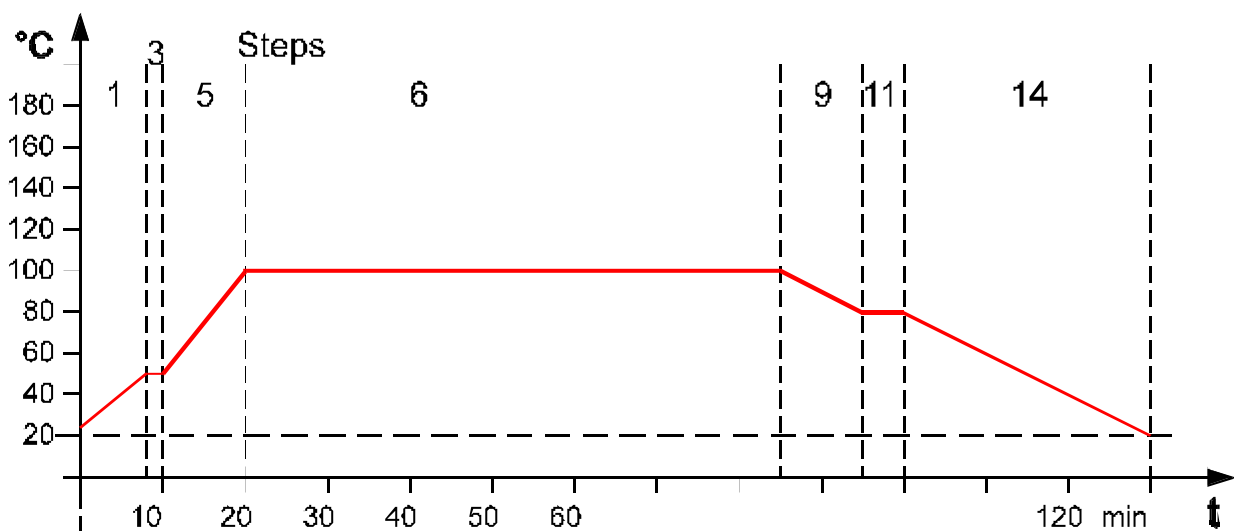
Important:

If a time of 00:00 is set for a profile, the profile is continued with the next section only after the setpoint temperature ($\pm 0.2^\circ\text{C}$) is reached.

- Press escape  to return to the previous menu level.

Example:

Step	(No.)	1	3	5	6	9	11	14
Setpoint	($^\circ\text{C}$)	50	50	100	100	80	80	20
Time	(h:m)	00:08	00:02	00:10	01:05	00:10	00:05	00:30



Step




 

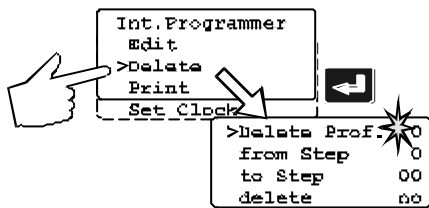
```

Edit Profile: 1
>Step:      3
Setp:      50:00 °C
Time [h.m] 00:02


```

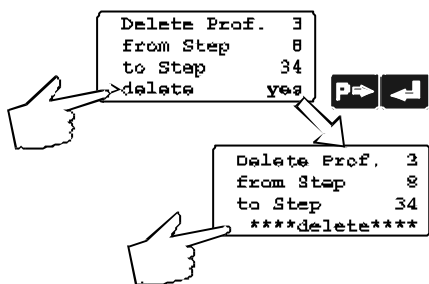
Display sections:

- Use the cursor keys   to select the submenu „Step“, enter the desired number and press enter .
- The values previously set are displayed.





Delete

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




- **delete** **no / yes**

Press the P-key  to select the parameter „yes“ and press enter .

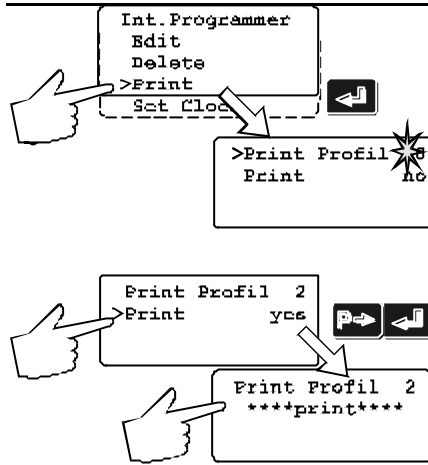
Line 4 indicates the deletion.

Example:

Delete section 8 to section 34 in profile 3.

- Press escape  to return to the previous menu level.

Menu functions





Print

Each profile may be printed via the serial interface for control or documentation.

- A flashing segment indicates that the number of the profile to be printed needs to be entered.

- **Print** **no / yes**

Press the P-key  to select the parameter „yes“ and press enter .

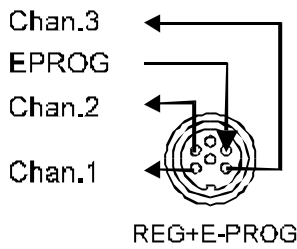
Printing is indicated in line 2.

Profile 1

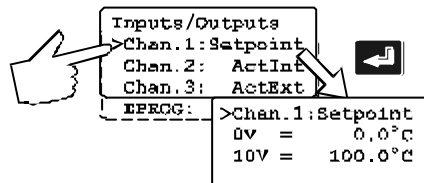
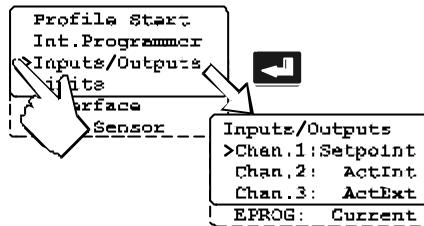
Step 0	not defined!	
Step 1	50	00:08
Step 2	not defined!	
Step 3	50	00:02
Step 4	not defined!	
Step 5	100	00:10
Step 6	100	01:05
Step 7	not defined!	
Step 8	not defined!	
Step 9	80	00:10
Step 10	not defined!	
Step 11	80	00:05
Step 12	not defined!	
Step 13	not defined!	
Step 14	20	00:30
Step 15	not defined!	
	etc.	

This printing example shows the profile given as example on page 27.

8.5. Analog inputs/outputs



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



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

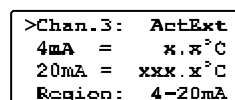
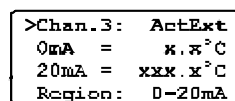
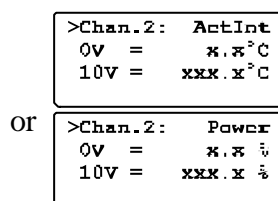
Chan.1 voltage output for recorder (V)
Chan.2 voltage output for recorder (V)
Chan.3 current output for recorder (mA)
EPROG external programmer input

- First define the desired output value for channels 1 to 3:

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

Setpoint active setpoint temperature
(T1, T2, integr. programmer/ext. programmer)
ActInt internal actual temperature value
(bath temperature)
ActExt external actual temperature value
(external sensor)
Power periodic or intermittent heating or cooling

- Then select the display size for channels 1 to 3:



Channel 1 and 2 voltage outputs

Assign the voltage values of 0 V to the lowest and 10 V to the highest necessary temperature or power rating required as an output value (°C / %).

Current output channel 3

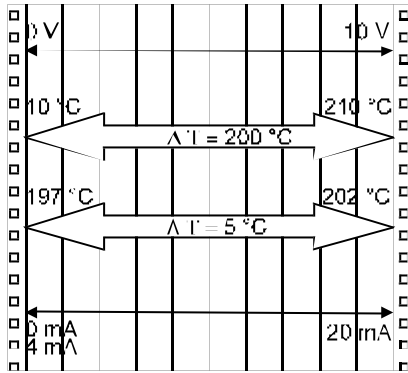
Assign the current values 0 mA or 4 mA to the lowest and 20 mA to the highest temperature or power rating required as an output value (°C / %).

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

Select the desired range by pressing the P-key

and set with enter .

The LCD display changes automatically.



Examples:

lowest temperature value: 10 $^{\circ}\text{C}$
 highest temperature value: 210 $^{\circ}\text{C}$
 Fig. shows 200 $^{\circ}\text{C}$ scaled to paper width
 rise: 50 mV/ $^{\circ}\text{C}$

lowest temperature value: 197 $^{\circ}\text{C}$
 highest temperature value: 202 $^{\circ}\text{C}$
 Fig. shows 5 $^{\circ}\text{C}$ scaled to paper width
 rise: 2000 mV/ $^{\circ}\text{C}$

```
>EPROG: Current
L Value 0.0 °C
H Value 300.0 °C
ExtSet 50.0 °C
```



EPROG - Input




This input is necessary when the nominal value is to be determined and set by an external programmer.

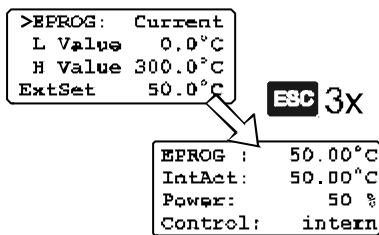
Connect the external programmer to socket (21)
 REG+E-PROG of the circulator.

- The programmer input of the circulator can be matched to the output signal of the external programmer.

Voltage voltage input
Current current input

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

- „L Value“ - Setting the LOW value:**
 Adjust and set the lowest desired working temperature on the programmer (e.g. 0 $^{\circ}\text{C}$).
 Enter this same temperature on the circulator by pressing the appropriate buttons on the keypad and press enter  to set.
- „H Value“ - Setting the HIGH value:**
 Adjust and set the highest desired working temperature on the programmer (e.g. 300 $^{\circ}\text{C}$).
 Enter this same temperature on the circulator by pressing the appropriate buttons on the keypad and press enter  to set.
- Return to the standard display by pressing escape .



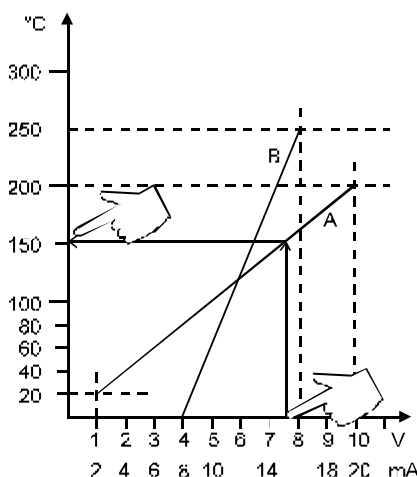
Example:

- Setting a temperature of 50 °C on the external programmer!

The value adjusted and set on the external programmer is displayed in line 4 of the DIALOG-DISPLAY (LCD) for control purposes (Example: ExtSet: 50.0 °C).

After returning the LCD display to standard display by pressing escape **ESC** („Setpoint“ - see page 20) this value is displayed in line 1 (Example: EPROG 50.00 °C).

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



- „L Value“ - Setting the LOW value:

- 1) Adjust and set the lowest desired value on the voltage or current source resp. (Example A: 1 V).
- 2) Assign a lower temperature threshold value to this adjusted voltage/current value by pressing the appropriate buttons on the keypad of the circulator (Example A: 20 °C) and set by pressing enter

- „H Value“ - Setting the HIGH value:

- 1) Adjust and set the highest desired value on the voltage or current source resp. (Example A: 10 V).
- 2) Assign an upper temperature threshold value to this adjusted voltage/current value by pressing the appropriate buttons on the keypad of the circulator

(Example A: 200 °C) and set by pressing enter .

- Return to the standard display by pressing escape **ESC**.

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

Example out of diagram A:

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

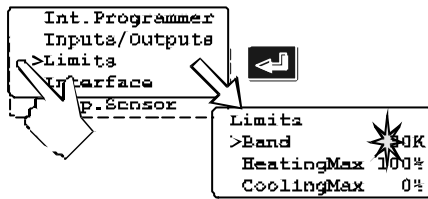
Line 4 of the DIALOG-DISPLAY (LCD) shows the externally set setpoint value. The circulator calculates this value from the rise angle of the two predecided end points (in example A: 7.6 V correspond to an external setpoint temperature of 152.0 °C).

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



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

8.6. Limits



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

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

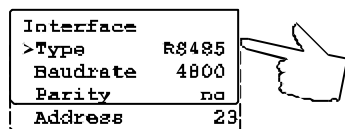
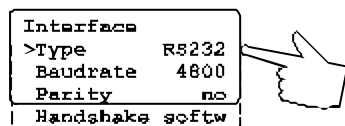
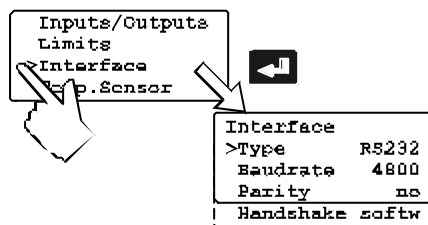
- Select the submenu „Limits“ with enter
- Select the desired option with the up/down cursor keys

A flashing digit indicates that a value needs to be entered.

Band	0 to 200 °C
HeatingMax	0 to 100 % in steps of 1 %
CoolingMax	0 to 100 % in steps of 1 %

- To set the newly entered value press enter
- To return to the previous menu level press escape **ESC**

8.7. Interface



The interface parameters are set by selecting the submenu „Interface“ on the circulator. Normally, this is a one-time-only adjustment.

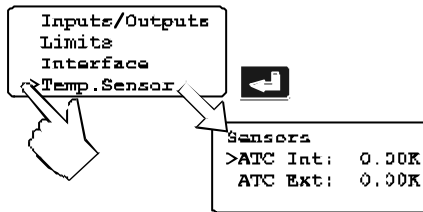
- Press enter to select the submenu „Interface“.
- Select the desired option with the up/down cursor keys . Enter the desired value for the flashing digit.

Type	RS232 / RS485
Baudrate	2400/4800/9600
Parity	none/even/odd
Handshake	software handshake/hardware handshake




Address 0 to 127

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

8.8. Sensors




ATC - Absolute Temperature Calibration

- Select the submenu „Temp.Sensor“ with enter .
- Select the desired option with the up/down cursor keys  . A flashing digit indicates that a value needs to be entered i.e. set.

ATC Int: internal sensor

ATC Ext: external sensor

- Enter the desired compensating value and set this value by pressing ENTER .

ATC Int:

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.

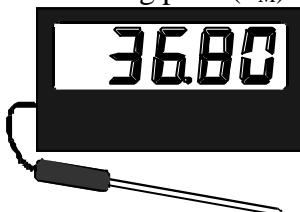
Note:

The ATC Int. adjustment is recommended for temperature tasks in the circulator bath.

Circulator (T_T)




Measuring point (T_M)



Measuring point (T_M)



- The difference temperature ($\Delta T = T_M - T_T$) is determined and stored as compensating value (example $\Delta T = -0.2\text{ }^{\circ}\text{C}$).
- Use the keypad to enter the desired compensating value (e.g. -0.20) and set with enter .

- The temperature on the measuring point rises to a temperature of $37.0\text{ }^{\circ}\text{C}$ and is indicated on the MULTI-DISPLAY (LED).

Note:

The compensating factor always affects the actual working temperature, even when set via the interface connection.

Recommendation:

In case a calibrated temperature measuring device is used, the ATC function allows use of the circulator as test instrument in accordance with ISO 9000.



ext. Pt100

Circulator (T_T)




Setp.1: 50.00 °C
ExtAct: 51.22 °C
Power: 100 %
Control: intern

External sensor (T_{Pt100})

ATC Ext:

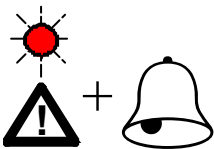
serves calibration of an external Pt100 sensor.


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



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

9. Troubleshooting guide / Error messages



Whenever the microprocessor electronics registers a failure, a complete shutdown of the heater and circulation pump is performed. The alarm light " " illuminates and a continuous signal tone sounds.



- The circulator is operated without bath liquid, or the liquid level is insufficient. Replenish the bath tank with the bath liquid.
- Tube breakage has occurred (insufficient filling level due to excessive bath liquid pumped out). Replace the tubing and replenish the bath tank with the bath liquid.
- The float is defect (e. g., because damaged in transit). Repair by authorized JULABO service personnel.



- During the self-test after switch-on a short-circuit is registered between pin 2 and pin 4 of the control cable or the control cable is interrupted during operation.
Reconnect the cable or eliminate the short-circuit.



- Cable of the working temperature sensor interrupted or short-circuited.



- Defect of the working or safety temperature sensor.
Working temperature and safety sensors report a temperature difference of more than 25 °C.

E 07

E 12

E 14



E 15

E 16

E 17

E 18

- Other errors
- Error in A/D converter.
- Safety sensor defect.
The safety temperature value lies below the working temperature setpoint.
Set the safety temperature to a higher value.
- External control selected, but external Pt100 sensor not connected.
- Heating circuit interrupted.
- Heating circuit short-circuited.
- Defective alarm relay.

E 20

E 21

E 22

Warnings without a complete shutdown of the unit: E 21 to E 24

- Cooling of the condenser is affected. Clean air-cooled condenser. Check the flow rate and cooling water temperature on water-cooled condenser.
- Compressor stage 1 does not work.
- Compressor stage 2 does not work.

Cooling compressor overload protection

The motor of the cooling compressor is equipped with an overload protector, which will be activated by excessive temperature in the capsule or by excessive current consumption.

Causes for motor disconnection:

- poor air circulation
- small distance to walls
- dirt accumulated on condenser
- high ambient temperature
- switch-off and on for short intervals

E 23

E 24

- Excess temperature on compressor stage 1.
- Excess temperature on compressor stage 2.

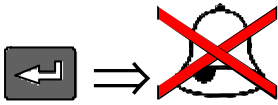
This message appears every 10 seconds as long as the compressor is not switched on although requested by the circulator.


After a short cooling interval, the motor will be automatically reconnected and the message "E xx" no longer appears.



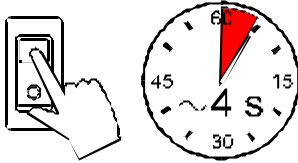


- Control cable of the refrigerated circulator short-circuited during self-test.




Press enter  to quit the audible signal.

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



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

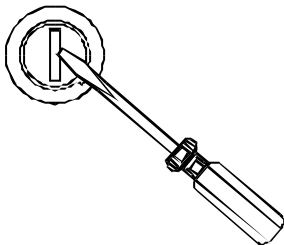


- Special message "Configuration **Error**"
The configuration of the circulator does not conform to its present use.
- Press enter  to automatically perform a single modification of the configuration.
Then contact an authorized JULABO service station.

Disturbances that are not indicated.

Pump motor overload protection

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



Fuses

The mains fuses on the rear of the unit may easily be exchanged as shown on the left.

Circulator: Fine fuses 230 V, T16 A or M 1.25 A, dia. 5 x 20 mm

115 V, T12.5 A or M2.5 A, dia. 5 x 20 mm

Cooling machine: Fine fuses T10A, dia. 5 x 20 mm



Only use fine fuses with a nominal value as specified.

10. Safety recommendations

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



- Connect the unit only to a grounded mains power socket!
- Observe the fire point of the bath medium used.
The excess temperature protection should be set at least 20 °C below the fire point.
- Carefully read the safety data sheet of the bath liquid used, particularly with regard to the flash point!
- Pay attention to the thermal expansion of bath oil during heating to avoid overflowing of the liquid.
- Prevent water from penetrating into the hot bath oil.
- Some parts of the bath cover and the pump connections may become extremely warm during continuous operation. Therefore, exercise particular caution when touching these parts.
- Exercise caution when emptying hot bath liquids!
- Observe the limited working temperature range when using plastic bath tanks.
- Employ suitable connecting tubing.
- Make sure that the tubes are 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).
- Before cleaning the unit, disconnect the power plug from the mains socket.



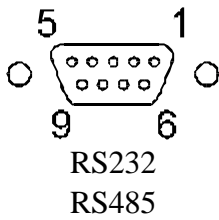
Recommendation:

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



Thus fractional over-heating of the bath liquid is prevented.

11. Electrical connections



RS232/RS485 serial interface (20)

This port can be used to connect a computer with an RS232 or RS485 cable for remote control of the circulator.

Pin assignments: RS232

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

Pin assignments: RS485

Pin 3	A	
Pin 5	0 VD	Signal GND
Pin 8	B	
Pins 1, 2, 4, 6, 7, 9		Reserved - do not use!

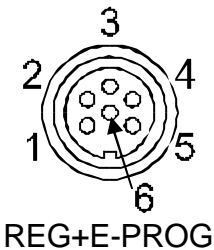
Interface correspondence:

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

RS232 interface cable 9-pin / 9-pin, 2,5 m Order No.: 8 980 073



Use shielded cables only.



Programmer input / temperature recorder output (21)

Analog inputs / outputs see page 29

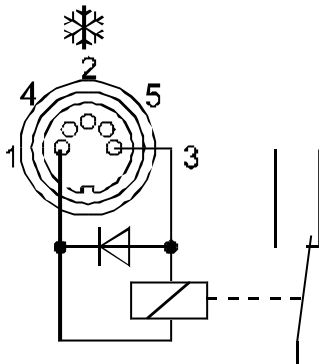
Pin		Signal
1	Voltage output Channel 1	0 ... 10 V
2	Voltage output Channel 2	0 ... 10 V
3	GND for outputs	0 V
4	Programmer input EPROG	0 to 10 V / 0 to 20 mA
5	Current output Channel 3	0 to 20 mA / 4 to 20 mA
6	GND for Programmer	0 V



Use shielded cables only.

❄ Control output (22)

The ❄ connector may be used for control of JULABO refrigerated circulators or as output for alarm messages.



Pin assignment:

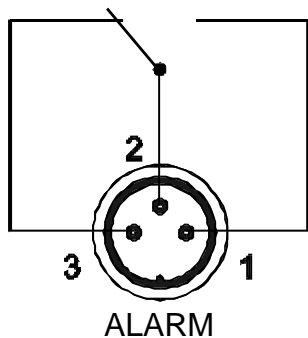
Pin	Signal
1	+24 V (I max. current 25 mA)
2	0 V
3	Alarm relay
4	Reserved - do not use!
5	Cooling pulse

Circuit: Operation = relay powered
 Alarm = relay not powered

Alarm output (24)

(for external alarm signal)

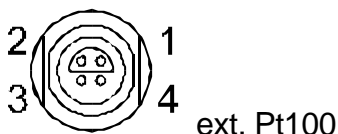
This potential-free change-over contact is activated in case of an alarm when pins 2 and 3 are connected.



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



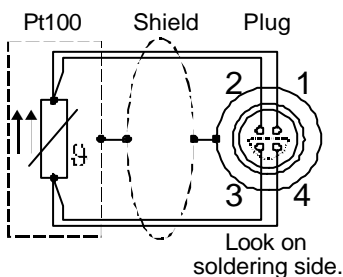
Use shielded cables only.



Connector for external Pt100 sensor (25)

Pin assignment:

Pin	Signal
1	Current+
2	Voltage+
3	Voltage-
4	Current-



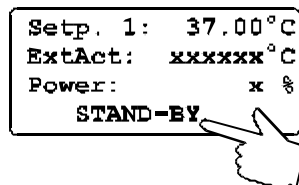
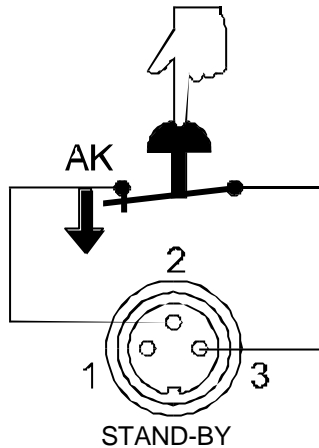
The shield of the connecting cable is electrically connected to the plug housing and the sensor tube.



Use shielded cables only.

STAND-BY input (23)

(for external emergency switch-off)



Pin assignment:	<u>Pin</u>	<u>Signal</u>
	1	not connected
	2	5 V / DC
	3	0 V

Use shielded cables only.

Activate the stand-by input:

- Under menu item Stand-by, set the parameter to „yes“ (see page 21).
- Connect an external contact 'AK' (e.g. for emergency switch-off) or an alarm contact of the superordinated system.

In case the connection between Pin 2 and Pin 3 is interrupted by opening the contact 'AK', a complete shutdown of the circulating pump and heater is effected, and the unit enters the condition "OFF".

As long as the contact remains open, line 4 of the DIALOG-DISPLAY (LCD) flashes and displays the message „STAND-BY“.

If the contact is reclosed, the circulator returns to the stand-by status and „OFF“ is displayed.

Additional tips for using the STAND-BY input:

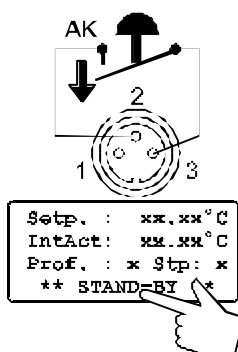
The Stand-by function can be used in conjunction with the AUTOSTART feature (see page 21)

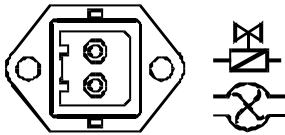
1. If the Autostart function is NOT turned ON, the Stand-by input should be used as described above.
2. If the Autostart function is enabled, the instrument will revert back to the original method of entering the setpoint (i.e. keypad, RS232, Analog input, etc.).

- Entering the setpoint with the keypad, for example T_1 . As described above, an bipolar shut-down is accompanied by the “STAND-BY” display and the OFF status. The programmable controller starts again when the contact is reclosed. The temperature of the bath liquid changed during the STAND-BY status.
- Entering the setpoint with the programmer (see pages 23 und 25). The display „STAND-BY“ appears. The setpoint value and the time are both held at the current value. The temperatur of the bath fluid will be held constant at this temperature. The programmer continues once the contact is reclosed.



Warning: this is not an actual shutoff feature





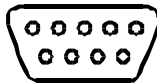
Control connector (26)

To be used as return flow safety device with solenoid valves (see page 11) and/or for supplementary pumps.

Line voltage: 230 V~ / max. 1.25 A
115 V~ / max. 2.5 A

12. Remote control

12.1. Setup for remote control



RS232
RS485

Select the „Configuration“ submenu and select the option „Setpoint“ to define the interface (see page 20).

The interface parameters are set by selecting the submenu „Interface“ on the circulator. Normally, this is a one-time-only adjustment. (Selecting and setting menu items, see page 32.)

Factory settings:

RS232

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



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

12.2. Communication with a PC or a superordinated data system

Suitable terminal programs for communicating with a PC are:

- MS-Windows - TERMINAL.EXE (included with MS-Windows).
- MS-DOS - Procomm Plus, Datastrom Technologies.
- MS-DOS - Norton Utilities.



If the circulator is put into remote control mode via the configuration level, the 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.

After a power interruption in case of remote control the order to start and all values which have to be adjusted, must be resent via the interface from the personal computer.

AUTOSTART is not possible.

A transfer sequence consists of:

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

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

in commands: asking for parameters to be displayed

out commands: setting parameters



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

When the RS485 interface is used, the three-digit instrument address stands in front of each command.

(example: address Ad32 = **A032**)

Examples:

Command to set the working temperature T1 to 55.5 °C

out_sp_00 \Leftrightarrow 55.5 \Leftarrow

A032_out_sp_00 \Leftrightarrow 55.5 \Leftarrow

Command to ask for the working temperature T1:

in_sp_00 \Leftarrow

A032_in_sp_00 \Leftarrow

Response from the circulator:



55.5 \Leftarrow

A032_55.5 \Leftarrow

12.3. List of commands



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

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

Command	Parameter	Response of circulator
version	none	Number of software version (V X.xx)
status	none	Status message, error message (see page 46)
in_pv_00	none	Actual bath temperature.
in_pv_01	none	Heating power being used (%).
in_pv_02	none	Temperature value registered by the external Pt100 sensor.
in_pv_03	none	Temperature value registered by the safety sensor.
in_sp_00	none	Working temperature "T1"
in_sp_01	none	Working temperature "T2"
in_sp_03	none	High temperature warning limit "  ".
in_sp_04	none	Low temperature warning limit "  ".
in_sp_05	none	Setpoint temperature of the external programmer (socket 21 - REG+E-PROG) .
in_hil_00	none	Max. cooling power (%).
in_hil_01	none	Max. heating power (%).

Command	Parameter	Response of circulator
in_mode_01	none	Selected working temperature: 0 = "T1". 1 = "T2".
in_mode_02	none	Identification type: 0 = no identification 1 = single identification 2 = continual identification
in_mode_03	none	Type of the programmer input: 0 = Voltage 0 V to 10 V 1 = Current 0 mA to 20 mA
in_mode_04	none	Internal/external temperature control: 0 = Temperature control in the circulator bath. 1 = Temperature control with external Pt100 sensor.
in_mode_05	none	Circulator in Stop/Start condition: 0 = Stop 1 = Start
in_par_01	none	Time constant of the external bath.
in_par_02	none	Internal slope.
in_par_03	none	Time constant of the internal bath.
in_par_04	none	Band limiting (max. difference between the temperatures in the internal bath and external system).
in_par_05	none	Ratio for max. cooling power versus max. heating power.
in_par_06	none	Xp control parameter of the internal controller.
in_par_07	none	Tn control parameter of the internal controller.
in_par_08	none	Tv control parameter of the internal controller.
in_par_09	none	Xp control parameter of the cascade controller.
in_par_10	none	Proportional portion of the cascade controller.
in_par_11	none	Tn control parameter of the cascade controller.
in_par_12	none	Tv control parameter of the cascade controller.

out commands: Setting parameters or temperature values.

Command	Parameter	Response of circulator
out_mode_01	0	Use working temperature "T1" *
out_mode_01	1	Use working temperature "T2" *
out_mode_02	0	No identification. Temperature control by using the stored parameters.
out_mode_02	1	Single identification of controlled system after the next start.
out_mode_02	2	Continual identification of controlled system whenever a new setpoint is to be reached.
out_mode_04	0	Temperature control of internal bath.
out_mode_04	1	External control with Pt100 sensor.
out_mode_05	0	Stop the circulator = r OFF.
out_mode_05	1	Start the circulator.
out_sp_00	xxx.x	Set working temperature "T1".
out_sp_01	xxx.x	Set working temperature "T2".
out_sp_03	xxx.x	Set high temperature warning limit  .
out_sp_04	xxx.x	Set low temperature warning limit  .
out_hil_00	xxx	Set the desired maximum cooling power (0 % to 100 %). This adjustment is required only for proportionally controlled refrigerated circulators.
out_hil_01	xxx	Set the desired maximum heating power (10 % to 100 %).




(*see "Note" page 33)


Command	Parameter	Response of circulator
out_par_04	xxx	Band limiting during external control. Setting the maximum difference between the temperatures in the internal bath and external system.
out_par_05	xxx	Ratio for max. cooling power versus max. heating power (0...0.99).
out_par_06	xxx	Xp control parameter of the internal controller.
out_par_07	xxx	Tn control parameter of the internal controller.
out_par_08	xxx	Tv control parameter of the internal controller.
out_par_09	xxx	Xp control parameter of the cascade controller.
out_par_10	xxx	Proportional portion of the cascade controller.
out_par_11	xxx	Tn control parameter of the cascade controller.
out_par_12	xxx	Tv control parameter of the cascade controller.

12.4. Status messages / error messages

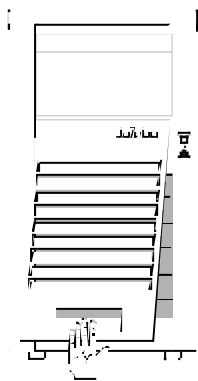
The circulator sends data (including error messages) only when the computer sends a query.

Status messages	Description
00 MANUAL STOP	Circulator in "OFF" state.
01 MANUAL START	Circulator in keypad control mode.
02 REMOTE STOP	Circulator in "r OFF" state.
03 REMOTE START	Circulator in remote control mode.

Error messages	Description
-01 LOW LEVEL ALARM	Low liquid level alarm
-02 REFRIGERATOR ALARM	Control cable of the refrigerated circulator or MVS solenoid valve controller short-circuited or interrupted.
-03 EXCESS TEMPERATURE WARNING	High temperature warning "  ".
-04 LOW TEMPERATURE WARNING	Low temperature warning "  ".
-05 WORKING SENSOR ALARM	Working temperature sensor short-circuited or interrupted.
-06 SENSOR DIFFERENCE ALARM	Sensor difference alarm. Working temperature and safety sensors report a temperature difference of more than 25 °C.
-07 I²C-BUS ERROR	Internal error when reading or writing the I ² C bus.
-08 INVALID COMMAND	Invalid command.
-09 COMMAND NOT ALLOWED IN CURRENT OPERATING MODE	Invalid command in current operating mode.
-10 VALUE TOO SMALL	Entered value too small.
-11 VALUE TOO LARGE	Entered value too large.
-12 TEMPERATURE MEASUREMENT ALARM	Error in A/D converter.
-13 WARNING : VALUE EXCEEDS TEMPERATURE LIMITS	Value lies outside the adjusted range for the high and low temperature warning limits. But value is stored.
-14 TEMPERATURE/LEVEL ALARM	Safety temperature alarm 
-15 EXTERNAL SENSOR ALARM	External control selected, but external Pt100 sensor not connected.
-16 TRIAC/RELAY CONNECTION OPEN	Heating circuit interrupted.
-17 TRIAC SHORTED	Heating circuit short-circuited.
-18 RELAY SHORTED	Defective alarm relay.

Error messages	Description
-20 WARNING: CLEAN CONDENSOR OR CHECK COOLING WATER CIRCUIT OF REFRIGERATOR	Cooling of the condenser is affected. Clean air-cooled condenser. Check the flow rate and cooling water temperature on water-cooled condenser.
-21 WARNING: COMPRESSOR STAGE 1 DOES NOT WORK	Compressor stage 1 does not work.
-22 WARNING: COMPRESSOR STAGE 2 DOES NOT WORK	Compressor stage 2 does not work.
-23 WARNING: HIGH TEMPERATURE ON COMPRESSOR STAGE 1	Excess temperature on compressor stage 1.
-24 WARNING: HIGH TEMPERATURE ON COMPRESSOR STAGE 2	Excess temperature on compressor stage 2.
-25 REFRIGERATOR WARNING	Error in the cooling machine.
-26 WARNING: STAND-BY PLUG IS MISSING	External stand-by contact is open. Stand-by input - see pages 21 and 40.
-30 CONFIGURATION ERROR: CONFIRM BY PRESSING <ENTER> ON CIRCULATOR	The configuration of the circulator does not conform to its present use. Press enter  to automatically perform a single modification of the configuration. (Then contact an authorized service station).

13. Maintaining the cooling performance



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

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

14. Cleaning the unit



Before cleaning the unit, disconnect the power plug from the mains socket!

Prevent humidity from entering into the circulator.

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

15. Maintenance

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

The tank should be filled only with a bath liquid recommended by JULABO. To avoid contamination, it is essential to change the bath liquid from time to time.

Repairs

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

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.

16. Technical specifications

		HP	SP
Temperature stability	°C	±0,01	
Temperature selection		digital	
via keypad		indication on DIALOG-DISPLAY (LCD)	
remote control via personal computer		indication on monitor	
Temperature indication		MULTI-DISPLAY (LED)	
		DIALOG-DISPLAY (LCD)	
Resolution	°C	0.01	
Absolute Temperature Calibration			
ATC1	°C	±3	
ATC2	°C	±9.99	
Temperature control		PID	
Working temperature sensor		Pt100	
Safety temperature sensor		Pt100	
Heater wattage	Watts	2000 (at 230 V)	2000 (at 230 V)
	Watts	1000 (at 115V)	1000 (at 115V)
<u>Pressure pump:</u>			
pressure, max.	at 0 liter	340 mbar	560 mbar
discharge, max.	at 0 bar	20 l/min.	24 l/min
<u>Suction pump:</u>			
suction, max.	at 0 liter	220 mbar	400 mbar
discharge, max.	at 0 bar	14 l/min	16 l/min
<u>Electrical connections:</u>			
Computer interface RS232/RS485			
Programmer input		0 - 10 V / 0 - 20 mA	
Temperature recorder output	Chanel 1 / 2	0 - 10 V /	
	Chanel 3	0 - 20 mA / 4 - 20 mA	
Stand-by input			
Alarm output 24 to 0 V DC / max. 25 mA			
External measurement and control sensor - Pt100			
Control connectors for solenoid valves or supplementary pump -		230 V / max. 1.25 A	
or		115 V / max. 2.5 A	
Mains power connection	V/ Hz	230 / 50	230 / 50
(±10 %)	V/ Hz	or 115 / 60	or 115 / 60
Total power consumption	Watts	2400 (at 230 V)	2400 (at 230 V)
	Watts	1400 (at 115 V)	1400 (at 115 V)

All measurements have been carried out at:

rated voltage and frequency ambient temperature: 20 °C

Technical changes without prior notification reserved.

		FP40-HP/-SP	FP45-HP/-SP
Working temperature range	°C	-38 ... 200	-42 ... 200
Temperature stability	°C	±0.01	±0.01
Cooling capacity	°C	<u>+20 0 -20 -30</u>	<u>+20 0 -20 -40</u>
(bath liquid: ethanol)	Watts	680 500 320 180	850 700 420 80
Refrigerant		R404a	R404a
Ambient temperature	°C	5... 40	5... 40
Mains power connection (±10 %)V/ Hz		230 / 50	230 / 50
Total power consumption	Watts	2920/2970 (at 230 V)	3100/3150 (at 230 V)
Bath opening (WxD)	cm	23x14	23x26
Bath depth	cm	20	20
Filling volume	Liter	9 ... 16	18 ... 26
Overall dimensions (WxDxH)	cm	37x46x70	38x58x68
Weight	kg	44/47	53/56

		FP50(W)-HP/SP
Working temperature range	°C	-50 ... 200
Temperature stability	°C	±0.01
Cooling capacity	°C	<u>+20 0 -20 -40 -50</u>
(bath liquid: ethanol)	Watts	900 800 500 160 50
Refrigerant		R404a
Ambient temperature	°C	5... 40
Mains power connection (±10 %)V/ Hz		230 / 50
Total power consumption	Watts	3100 (at 230 V)
Bath opening (WxD)	cm	18x12
Bath depth	cm	15
Filling volume	Liter	5,5 ... 8
Overall dimensions (WxDxH)	cm	42x50x71
Weight	kg	58

Technical specifications

		FS18-HP	F25-HP	F26-HP
Working temperature range	°C	-30 ... +150	-25 ... 200	-25 ... 200
Temperature stability	°C	±0.01	±0.01	±0.01
Cooling capacity	°C	<u>+20 0 -20</u>	<u>+20 0 -20</u>	<u>+20 0 -20</u>
(bath liquid: ethanol)	Watts	460 340 150	260 200 60	260 200 60
Refrigerant		R134a	R134a	R134a
Ambient temperature	°C	5... 40	5... 40	5... 40
Mains power connection	V/ Hz	230 / 50	230 / 50	230 / 50
(±10 %)	V/ Hz	or 115 / 60	or 115 / 60	or 115 / 60
Total power consumption	Watts	2770 (at 230 V)	2600 (at 230 V)	2600 (at 230 V)
	Watts	1770 (at 115 V)	1600 (at 115 V)	1600 (at 115 V)
Bath opening (WxD)	cm		12x14	12x14
Bath depth	cm		15	15
Filling volume	Liter	1.7 ... 3	3 ... 4,5	3 ... 4,5
Overall dimensions (WxDxH)	cm	31x43x65	23x43x63	43x42x44
Weight	kg	39	33	32
		F32-HP	F33-SP	F34-HP
Working temperature range	°C	-32 ... 200	-30 ... 200	-30 ... 150
Temperature stability	°C	±0.01	±0.01	±0.01
Cooling capacity	°C	<u>+20 0 -20</u>	<u>+20 0 -20</u>	<u>+20 0 -20 -30</u>
(bath liquid: ethanol)	Watts	380 340 150	500 320 120	450 320 140 30
Refrigerant		R134a	R134a	R134a
Ambient temperature	°C	5... 40	5... 40	5... 40
Mains power connection	V/ Hz	230 / 50	230 / 50	230 / 50
(±10 %)	V/ Hz	or 115 / 60	or 115 / 60	or 115 / 60
Total power consumption	Watts	2770 (at 230 V)	2800 (at 230 V)	2680 (at 230 V)
	Watts	1770 (at 115 V)	1800 (at 115 V)	1680 (at 115 V)
Bath opening (WxD)	cm	18x12	23x14	24x30
Bath depth	cm	15	20	15
Filling volume	Liter	5.5 ... 8	12 ... 16	14 ... 20
Overall dimensions (WxDxH)	cm	31x43x65	37x46x70	38x58x63
Weight	kg	38	45	49

<u>Safety Installations (DIN 12876)</u>		
Excess temperature protection		adjustable from 0 to 320 °C
Low liquid level protection		float switch
Safety class		III
<u>Supplementary safety installations:</u>		
High temperature warning function		optical + audible (in intervals)
Low temperature warning function		optical + audible (in intervals)
Supervision of the working sensor		plausibility control
Reciprocal sensor monitoring between working and safety sensors		difference >25 °C
Alarm indication		optical + audible (continuous tone)

<u>Standards:</u>		
EMC regulations		EN 61326
Guideline for first voltage range		EN 61010-1, EN 61010-2-010
Pressure equipment directive		EN 378

<u>Only for water-cooled models:</u>		
Cooling water pressure (IN / OUT)	max.	6 bar
Difference pressure (IN - OUT)		3.5 to 6 bar
Cooling water temperature		<20 °C
<u>Quality of cooling water:</u>		
pH at 25 °C		7 to 8.5
Suspended matter		<30 mg/l
Size of suspended matter	max.	0.1 mm
Growth of algae		not permissible

17. EC Declaration of Conformity



The following unit complies with the essential safety requirements outlined by the EC Directives concerning the guidelines for electromagnetic compatibility (89/336/EEC), low voltage regulations (73/23/EEC) and the pressure equipment directive (97/23/EEC).

Refrigerated Circulator:

Circulator:	HP, SP
Refrigerated bath:	FP40, FP45, FP50, FPW50
	FS18, F25, F26, F32, F33, F34

This unit is manufactured in compliance with the following guidelines

electrical equipment for control technology and laboratory application –
EMC requirements outlined by
EN 61326

safety regulation for electrical devices for measuring, control and
laboratory application specified by
EN 61010

refrigerated and heating circulators – safety and environmental – conscious requirements outlined by
EN 378



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A handwritten signature in black ink, appearing to read 'G. Juchheim'.

G. Juchheim, Managing Director

18. Warranty conditions

JULABO Labortechnik GmbH warrants its products against defects in material or in workmanship, when used under appropriate conditions and in accordance with appropriate operating instructions for a period of no less than

ONE YEAR

Extension of the warranty period – free of charge



With the '1PLUS warranty' the user receives a free of charge extension to the warranty of up to 24 months or 10.000 working hours; whichever is achieved first.

To apply for this extended warranty the user must register the unit on the Julabo web site www.julabo.de, indicating the serial no. The extended warranty will apply from the date of Julabo Labortechnik GmbH's original invoice.

Julabo Labortechnik GmbH reserves the right to decide the validity of any warranty claim. In case of faults arising either due to faulty materials or workmanship, parts will be repaired or replaced free of charge, or a new replacement unit will be supplied.

Any other compensation claims are excluded from this guarantee.