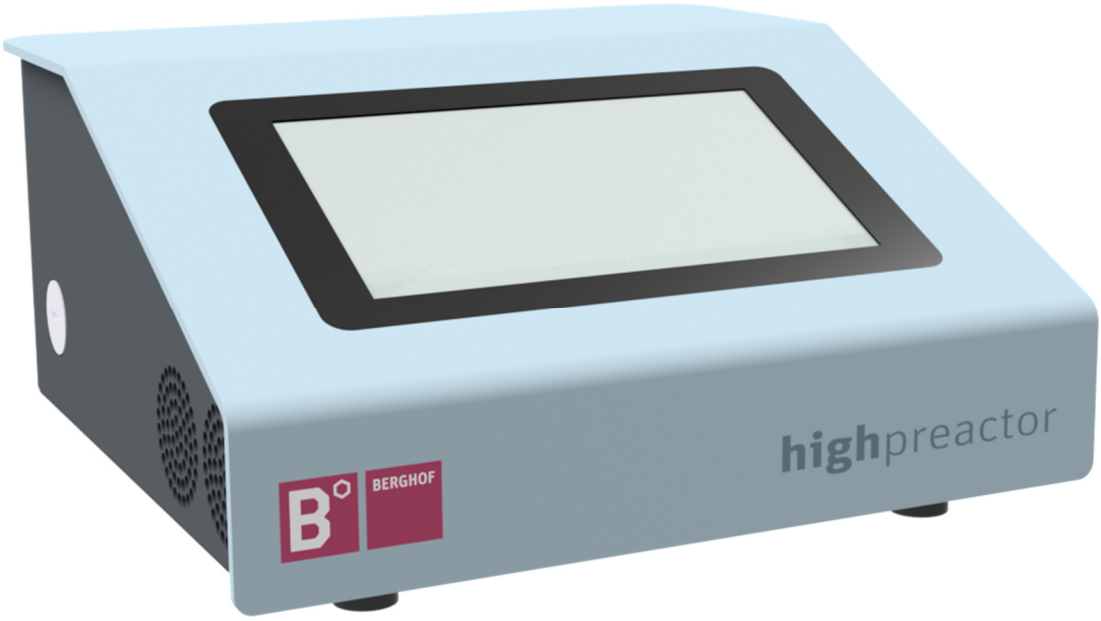
User manual
highpreactor® BRC



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Disclaimer
The content of this publication has been checked for conformity with the hardware and software described. Deviations can nevertheless not be excluded, therefore we cannot give any guarantee of complete conformity. The information in this publication is checked regularly and necessary corrections are included in subsequent editions. Improvement suggestions are always welcome. Subject to technical changes.

Trademarks
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General Information on this Manual
This user manual:

- ➔ Describes the process controller BRC from Berghof Products + Instruments GmbH. It contains product specific information.
- ➔ guides the user in the safe and proper use of the temperature controller. Familiarity with the relevant chapters of this handbook is required for safe and intended use of the equipment.
- ➔ must be read carefully prior to operating the equipment to avoid errors during operation and become familiar with the device.
- ➔ does not include repair instructions. Should repairs be required, please contact your representative or Berghof Products + Instruments GmbH.

After unpacking, the device must be checked for mechanical damage or loose parts. If any transport damage is found, the manufacturer is to be informed immediately and the device is not to be put into operation.

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1.0	21.07.2022	P. Wagner	Elaboration
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1.3	14.12.2023	M. Edele	New Dunker BG75x75SI 4:1 stirring motor with separate power supply “BRM-3 for BRC”

Table of contents

1. GENERAL INFORMATION 6

1.1. Information about the BRC 6

1.1.1. Type plate 6

1.2. Warranty / Limitation of Warranty 7

2. SAFETY 8

2.1. Qualified Users 8

2.2. Intended use 8

2.3. Safety instructions 9

2.3.1. Danger Categories and Signal Words 9

2.4. General safety instructions 10

2.5. Product Safety 11

2.5.1. Safety and emission 11

2.5.2. Safety instructions on the unit 11

2.5.3. Safety regulations in the EU 11

2.5.4. CE-mark 12

2.6. Disposal instruction 13

3. DEVICE DESCRIPTION 14

3.1. Basic instrument 14

3.1.1. Electrical connections 15

3.1.2. Technical data 16

3.2. Electric heating jacket (BHM) 17

3.2.1. Technical data 17

3.3. Data logger function 17

4. INSTALLATION AND COMMISSIONING 18

4.1. Scope of delivery 18

4.2. Installation and Commissioning 19

4.2.1. Ambient conditions 19

4.2.2. Unpacking / Inspection 20

4.2.3. Software 20

5. OPERATING 21

5.1. General 21

5.2. User Management 26

5.3. Reactor configuration 27

5.4. Temperature measurement 29

5.4.1. Connection 29

5.4.2. Configuration 29

5.4.3. Calibration 30

5.4.4. Usage 31

5.5. Pressure measurement 32
5.5.1. Connection 32
5.5.2. Configuration 32
5.5.3. Calibration 33
5.5.4. Usage 34
5.6. Autotuning / control parameters 35
5.7. Heating and cooling 38
5.7.1. Installation with BHM - heating jacket 38
5.7.2. Installation with BLH-650 Heating plate 41
5.7.3. Connection Cooling 45
5.8. Process configuration / control 46
5.8.1. General 46
5.8.1.1. Preheating 47
5.8.2. Manual mode (Manually) 48
5.8.3. Ramp mode 49
5.8.4. Sequence mode 51
5.9. Stirring 53
5.9.1. Drives 53
5.9.2. Connection 53
Connection to BRC 53
Wiring diagram BRC with stirring depending on the stirring motor 54
5.9.3. Configuration 55
5.9.4. Usage 56
5.10. Valve control 57
5.10.1. Connection 57
5.10.2. Configuration 57
5.10.3. Usage 58
5.11. BRVI Data logging 59
5.11.1. Installing BRVI 62
5.11.2. Starting BRVI 62
5.11.3. Connecting BRC 63
5.11.4. Configuration menu 63
5.11.5. Expert mode 64

6. MAINTENANCE, TROUBLESHOOTING AND SERVICE 66
6.1. Maintenance 66
6.2. Cleaning 66
6.3. Error notes 67
6.4. Repairs / customer service 68

7. APPENDIX 69
7.1. Declaration of conformity 69
7.2. Conversion of units 70
7.3. Abbreviations 70

1. General information

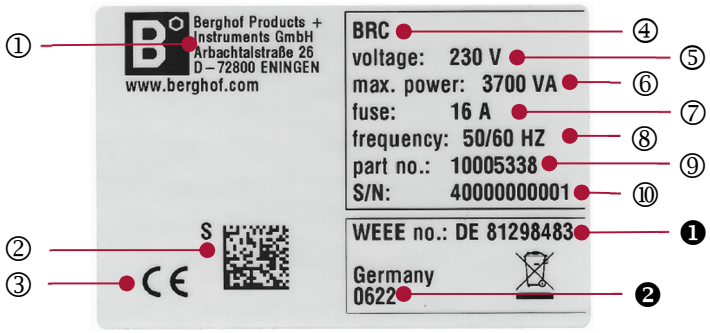
Please read these operating instructions carefully before operating your process controller. Failure to follow these operating instructions may result in damage to the equipment and injury to the operating personnel. Safety instructions and their classifications are described in the section Danger Categories and Signal Words. These instructions must be followed in any case!

1.1. Information about the BRC

No modifications may be made to the unit without the written consent of Berghof Products + Instruments GmbH. Unauthorized modifications may affect the safety of the unit.

1.1.1. Type plate

The type plate is located on the bottom of the device.



① Manufacturer with address	⑦ Fuse
② QR Code	⑧ Input voltage frequency
③ CE-marking	⑨ Part No.
④ Model	⑩ Serial number
⑤ Input voltage	❶ WEEE Registration
⑥ Maximum power consumption	❷ Country of origin

1.2. Warranty / Limitation of Warranty

Berghof Products + Instruments GmbH subjects each device to a functional and safety test before delivery. Provided that no modifications have been made to the equipment, Berghof Products + Instruments GmbH warrants that all its products will conform to Berghof Products + Instruments GmbH specifications and will be free from defects in material and workmanship when operated under normal conditions of use and service. Berghof Products + Instruments GmbH's obligation ends after one (1) year and is limited to repair, or at its option, replacement free of charge, of such equipment that is proven by its own judgment to be defective within the meaning of this warranty statement. No warranty is given on wear parts.

In the event of any claim, please attach a mark to the unit and a description of the defect found. Please state your name, department, address, and telephone number so that a quick settlement can be made.

The unit should be returned in its original packaging to ensure adequate security. We regret that any damage caused in transit by improper packaging is not covered by this warranty.

Except as expressly set forth in this agreement, there is no other warranty, contractual or statutory, given by Berghof Products + Instruments GmbH hereunder, including the statutory warranty of merchantability and fitness for a particular purpose. Berghof Products + Instruments GmbH shall not be liable to the customer for loss of profit, consequential damages of any kind resulting from a breach of the foregoing warranty.

2. Safety

The safety of users and personnel can only be guaranteed if the safety instructions and safety related warnings are observed and followed. Therefore, this manual must be available to all persons working with the BRC.

Use the device only:

→ As intended
→ In technically perfect condition
→ Without unauthorized changes
→ Under supervision
→ Through qualified operators

Comply with the requirements of the professional trade bodies, the technical monitoring association, the VDE regulations, or corresponding national provisions.

2.1. Qualified Users

Qualified users in the sense of the safety instructions in this documentation are appropriately trained and instructed specialists with basic chemical and technical knowledge. They should be familiar with the relevant legal regulations for handling pressure vessels and chemicals.
The device may only be used by laboratory personnel who, as a result of their education and training, have an overview of the hazards that can arise during operation of the device.

2.2. Intended use

⚠ WARNUNG

Follow the operating instructions!

Always observe the operating instructions for the heating systems that are controlled by the process controller and for the devices that are to be heated. Particular care must always be taken when handling pressure vessels.

→ Scope of application of the BRC

The BRC is used for process control of Berghofs own reactor systems and pressure digestion vessels. Heating systems with up to 3000W can be operated.
The main functions are:
→ Control and PID control of the heating process based on temperature and pressure.
→ Control and management of stirring.
→ Control of cooling devices and supplementary valves.
→ Data logging and monitoring.
The system may only be used within the scope of the data and applications specified in this documentation and the associated user manuals.

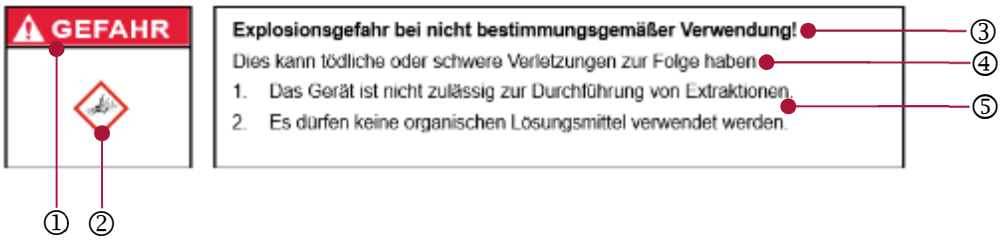
2.3. Safety instructions

2.3.1. Danger Categories and Signal Words

DANGER, WARNING, CAUTION and NOTICE are standardized signal words for classifying the risk and danger of suffering injury or damage to property. All signal words relating to personal injury are listed together with the general safety symbol.
For safety reasons, it is necessary that you read and understand the table of signal words and their definitions below.

Symbol	Signal word	Definition
	DANGER	DANGER means that failure to follow the safety instructions **is likely to cause** severe personal injury or death.
	WARNING	WARNING means that failure to follow the safety instructions **may cause** severe personal injury or death.
	CAUTION	CAUTION means that failure to follow the safety instructions **may cause** personal injury.
	NOTICE	NOTICE means that failure to follow the safety instructions may cause damage to the device.

Additional safety symbols can be indicated under the signal word.



① Signal word classifying the risk	④ Type and source of danger
② Safety symbol	⑤ Measures to avoid risk
③ Possible consequences in the case of failure to comply	

2.4. General safety instructions

In addition to the safety precautions listed below, the operation of the BRC process controller also includes those that must be observed for the operation of the equipment to be heated. These can be found in the corresponding operating instructions.
The following general safety instructions must be read carefully and observed before setting up and commissioning the system.
No liability can be accepted for damage caused by improper handling or non-observance of these instructions.

⚠ WARNING	**Comply with max. operating temperatures!** When operating the process controller, always observe the maximum permissible operating temperatures of the units to be heated!
⚠ WARNING	**Comply with max. current load!** Always observe the maximum permissible current load of 16 A when operating the process controller!
⚠ WARNING	**Continuous operation, overnight operation** Only operate heaters overnight if they have at least one additional overtemperature switch!
⚠ WARNING 	**Unit uses mains voltage AC 230V!** The device must always be connected to a protective earth conductor. The connection from the unit to the power source must always be made via a three-core cable with a protective earth conductor. Only use approved mains cables. The socket used must be freely accessible at all times. The device must not be put into operation if it is damaged. Repair and service work may only be carried out by appropriately trained and qualified personnel of Berghof Products + Instruments GmbH.

2.5. Product Safety

2.5.1. Safety and emission

In the following cases, the unit must be disconnected from the mains supply and protected against unintentional use:

- → if there is visible damage to the unit,
- → if the unit has loose parts,
- → if the unit does not work,
- → after prolonged storage in unfavorable conditions (e.g., outdoors or in a very humid environment)

2.5.2. Safety instructions on the unit

This safety notice is located on the bottom of the unit.

2.5.3. Safety regulations in the EU

This appliance has been designed and tested in accordance with the following standards:

Title	Standards
Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General requirements	IEC 61010-1:2010/AMD1:2016
Electrical equipment for measurement, control, and laboratory use – EMC- requirements Part 1: General requirements	EN 61326-1:2013 IEC 61326-1:2012 **Class A device** Professional equipment. The equipment is suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

2.5.4. CE-mark

The products from Berghof Products + Instruments GmbH comply with the VDE directives and European Standards. The conformity tests performed by Berghof Products + Instruments GmbH comply with the currently prescribed standards of safety for electrical measuring, control, regulation and laboratory equipment, as well as their EMC requirements (Class A).

Declaration of conformity
See Chapter 7.1: Declaration of conformity

2.6. Disposal instruction

The product is made of high-quality, recyclable, and reusable materials and components. Correct disposal is essential for environmental protection.

→ Disposal within the EU

European Union
Electrical and electronic devices must not be disposed via domestic waste. Berghof Products + Instruments GmbH takes back its electrical and electronic products from business customers for free disposal, raw material recovery and recycling. Contact your dealer or Berghof Products + Instruments GmbH directly, if you are intending to dispose of electrical and electronic devices.

The form "WEEE return of old devices" describes the return of old devices. Customers must fill this out and return it with the device. We will be happy to send you the form or you can download it from our website:

https://www.berghof-instruments.com/en/downloads/

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Important note!
Customers wishing to return instrumentation and/or associated materials to Berghof Products + Instruments GmbH or regional dealer are advised that all returned goods must be certified as clean and free from contamination. Therefore, clean and decontaminate your old device before returning it.

Countries outside the European Union
Outside the European Union, the relevant regional and local laws regarding proper disposal must be complied with.

→ Disposal outside the EU

⚠ CAUTION

Environmental hazard in case of incorrect disposal!

This can result in minor or moderate injuries.

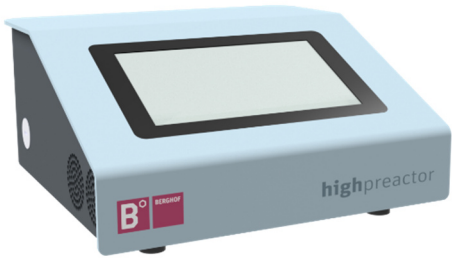
1. The device must be disposed of in accordance with the requirements of the European Union.
2. The relevant regional and local laws regarding proper disposal must be complied with.
3. To ensure proper disposal, you can contact Berghof Products + Instruments GmbH.

3. Device description

3.1. Basic instrument

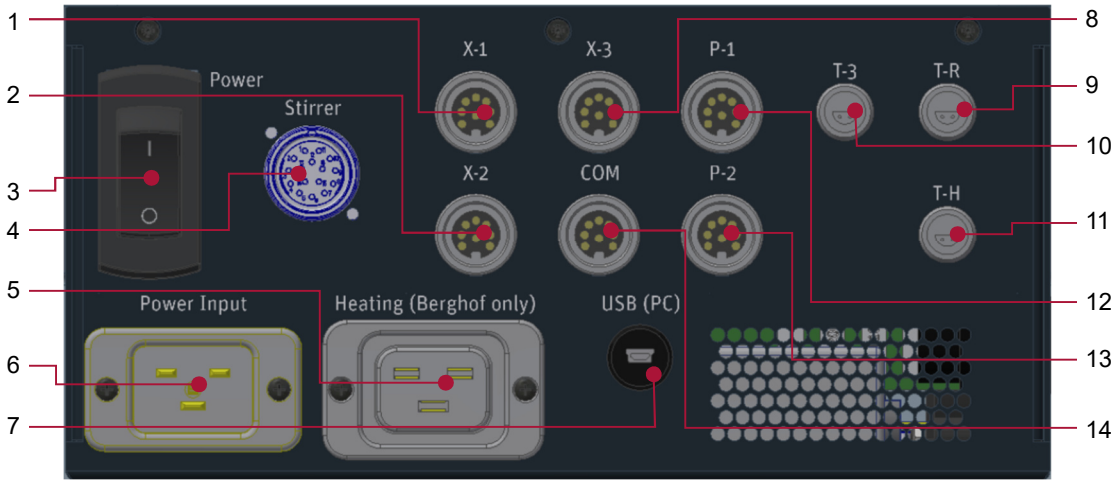
The BRC process controller can be used universally as a controller for loads up to a power consumption of 3000 W. The control parameters of the PID controller can be freely programmed for different temperature ranges. However, Berghof Products + Instruments GmbH recommends the BRC process controller specifically for controlling the heating process of the Berghof high-pressure laboratory reactors *highpreactor* and pressure digestion vessels *digestec*. Therefore, this manual describes the use of the BRC process controller specifically for these control tasks.
The heating systems are connected via special connectors on the back of the unit. Special adapter cables are available on request for connecting third-party devices.
The system may only be used within the scope of the data and applications specified in this documentation and the associated user manuals.

BRC



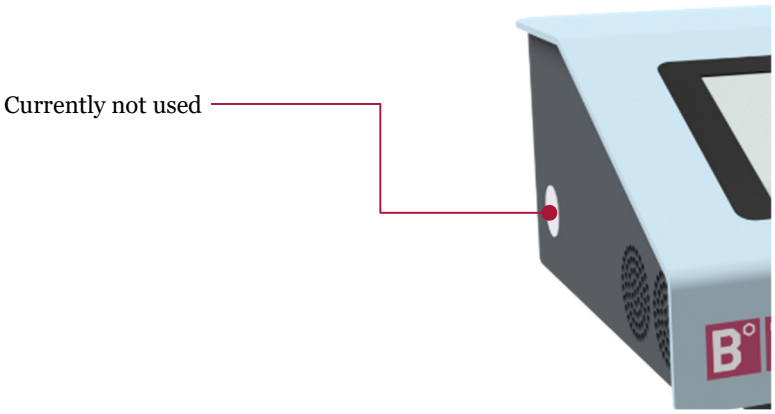
User interface

3.1.1. Electrical connections



No.	Function	No.	Function
1	*X-1:* Connection Valve1/ext. Heating	8	*X-3:* Connection cooling valve
2	*X-2:* Connection Valve2/BLH-650 Heating plate	9	*T-R:* Connection PT-100 reactor
3	*Power:* Mains switch	10	*T-3:* Connection PT-100 (e.g., additions)
4	*Stirrer:* Connection stirrer motor BRM-1/-2	11	*T-M:* *T-H:* Connection PT-100 heating jacket
5	*Heating (Berghof only):* Connection BHM heating jacket	12	*P-1:* Connection pressure sensor 1
6	*Power Input:* Mains connection	13	*P-2:* Connection pressure sensor 2
7	*USB (PC)*: Connection Mini-USB (to a computer)	14	*COM:* Connection RS422/RS232

The USB type-A connection on the side is not yet supported and is available for possible future expansion.



3.1.2. Technical data

BRC	
Power supply	230 V, 3700 VA, 50/60 Hz
Maximum power output for heaters	3000 W (via solid state relays)
Fuse protection	Automatic thermal fuse in the mains switch
Temperature sensor	PT-100 (2-/4-wire)
Measuring range	0…+400°C (32...752 °F)
Type of regulation	PID controller
Weight approx.	2,6 kg (5,7 lbs)
Dimensions approx.. (W x D x H)	260 x 260 x 140 mm (10,2 X 10,2 X 5,5 inch)

3.2. Electric heating jacket (BHM)

Electric heating jacket with a ring heating element and coated stainless steel protective cover as well as an integrated overtemperature protection, adjustable between 50 and 350°C. The heating jacket is therefore safe, even in the event of a malfunction of the BRC. The heating jacket is thermally insulated and covered on the outside.
The temperature is controlled by measuring the internal temperature of the high-pressure laboratory reactor in conjunction with a BRC process controller. For this purpose, there is a special connection cable for the voltage supply of the heating jacket by the BRC.

3.2.1. Technical data

BHM-300 to BHM-4000	
Heating power	See type plate
Operating temperature	0 - 350° C (32 – 662 °F)
Overtemperature protection	50 - 350°C
Heater connection	To a 230 V / 50 Hz controller using a 3-pin plug-in connector
Protection	IP 54

3.3. Data logger function

By connecting an external PC, the BRC process controller can also be used as a data logger for documenting the temperature and pressure curves or other standard signals. With the aid of the software supplied, the temperature, pressure, heating power, speed and motor current curves can be recorded via the BRC.
See "Data recording via PC software".

→ Documentation with PC software

The graphs include the set temperature, current temperature, current pressure and current heating power, motor speed and motor current.

4. Installation and commissioning

WARNING	The security of a system into which the BRC is integrated is the responsibility of the operator of the system.

4.1. Scope of delivery

See the scope of delivery list enclosed with the unit.

4.2. Installation and Commissioning

4.2.1. Ambient conditions

When selecting the installation site, the corresponding regulations and conditions of the equipment to be heated (e.g. high-pressure laboratory reactors) must also be observed.

The BRC is intended for indoor use and must not be placed in wet areas (no splash resistance).

BRC	
Ambient temperature	+5°C (41°F) bis +40°C (104°F) It should also be - 40°C (-40°F) to +70°C (158°F) during transport or storage.
Maximum relative humidity	Maximum relative humidity 80% at temperatures up to 31°C, decreasing linearly to 50% relative humidity at 40°C. Non-condensing.
Elevation	Up to 2000 m
Electrical connection	230 V, 3700 VA, 50/60 Hz Fluctuations of the mains supply voltage up to ±10% of the nominal voltage. Overvoltage category II.
Pollution degree	Pollution degree 2: Non-conductive pollution only, although occasional temporary conductivity caused by dew is expected.
Sound pressure level	<= 55 dB(A)
Space requirement (W x D x H)	ca. 27 cm x 35 cm x 15cm (ca. 10,6 x 13,8 x 5,9 inch)
Load capacity	at least 2,6 kg (5,7 lbs)
Open spaces	To ensure sufficient internal ventilation, the following areas must be kept clear: - Left side: min. 100 mm - backside: min. 100 mm

Positioning
First, position the unit in the space provided. The footprint must be statically sufficient for the weight of the process controller (approx. 2.6 kg; 5.7 lbs) and must be approx. 27cm x 35cm
(10.6 x 13.8 inch; L x W).

4.2.2. Unpacking / Inspection

Carefully open and remove the transport packaging. Please keep it so that you can return the unit in its original packaging to the manufacturer in case of service.

Also remove the other accessories and check the delivery for completeness.

Check the system for transport damage such as cracks, scratches, dents, etc.

WARNING	**Visible damage!** For safety reasons, do not operate the unit if any damage has been detected. Contact your local dealer or Berghof Products + Instruments GmbH directly to obtain the appropriate service. (For contact address see section '6.4 Repairs / customer service').
NOTICE	If any parts are missing or damaged, contact your local dealer or Berghof Products + Instruments GmbH directly. see section ‘6.4 Repairs / customer service’).

4.2.3. Software

The process values of the BRC can be visualized and logged in a file via the supplied PC application "BRVI" .

System requirements: Windows 7 SP1 or later

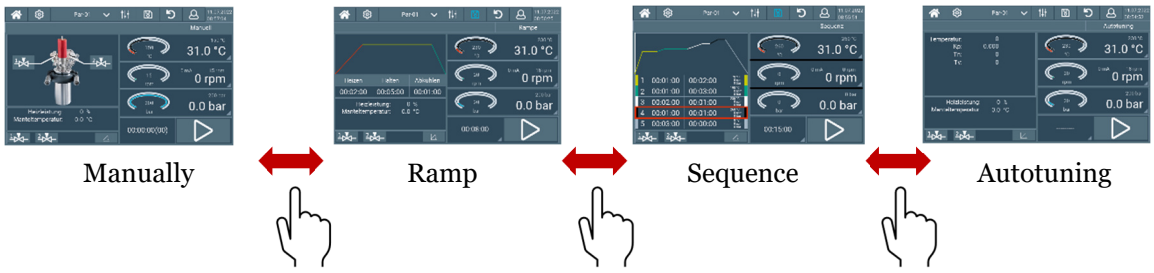
5. Operating

WARNING	**Observe maximum operating temperatures!** When operating the process controller, always observe the maximum permissible operating temperatures of the equipment to be heated!

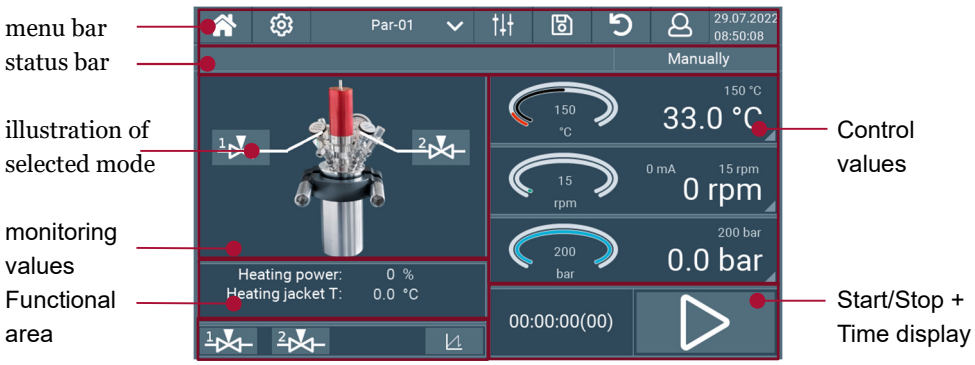
5.1. General

The range of functions differs in the three option packages "Basic", "Comfort" and "Professional". With the "Professional" package, all functions and all screens are activated.
All illustrations and descriptions below show the "Professional" package.

The 7" capacitive touch display can be used to navigate through the various screens of the user interface by swiping.



There are a total of four modes to choose from. Any of those can be set up as a start page via the **system parameters → General**. The user interfaces of these modes are all similarly structured. At the top is the menu bar with the status bar below it. On the right-hand side, the control values reactor temperature, stirrer speed and reactor internal pressure are displayed. Below this are the buttons for starting and stopping the process. Depending on the mode, various illustrations or monitoring values are displayed on the left-hand side.



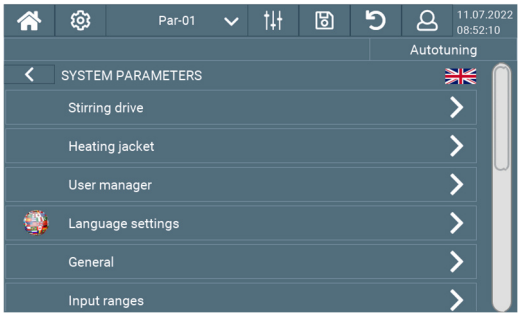
Button	Description	Function
	Home-Screen	You can switch to the start screen at any time by pressing the **home screen** button twice. The start screen can be set individually under **System parameters → General**. Single press calls up the previous main screen.
	System Parameters	This is used to call up the system parameter settings. Global settings can be made for the entire system.
	Selected parameter set	The drop-down menu allows you to choose between ten different parameter sets.
	Parameter settings	In the parameter settings, the currently selected parameter set can be edited. An individual name can be assigned, the controller sets can be managed, and other settings can be made. The settings made only apply to the active parameter set and not to the entire system.
	Save	Changes to the control values (times, temperatures, speeds, pressure limits) can be saved in the active parameter set using the save button. Only the changes of the currently selected mode 'Ramp' or 'Sequence' are saved. Changes must be saved separately in the parameter set for each of these two modes. The icon will turn blue if there are changes that have not yet been saved. Values in 'Manually' and 'Autotuning' modes cannot be saved.
	Undo	The undo button can be used to undo changes made to the control values and restore the initial state (only mode 'Ramp' or 'Sequence').
	User settings	User types with different rights can be selected in the user settings. Password protection for the user types can be activated via **System parameters → User manager** and corresponding passwords can also be assigned for the various roles.

The menu bar is permanently displayed in the upper area and contains buttons for standard functions. The last actions and messages as well as the currently selected mode are displayed in the status bar. By pressing on the current message, the last messages of the system are displayed.

When a process has started, icons show the current status:

Symbol	Description	Explanation
	Cooling active	The symbol indicates that the optional cooling is currently active, and the cooling valve is actuated.
	Heating active	The symbol indicates that the signal for heating is issued by the controller.
	Heating active but heating circuit interrupted	The symbol indicates that the heating is activated by the controller, but the heating circuit is interrupted. Either the safety switch in the heating is active (e.g. due to the manually adjustable capillary regulator on the BHM heating jacket) or the heating circuit is interrupted due to a defect.
	Power limit active	The symbol indicates that a set power limit is currently in effect and that the output heating power is being limited. The specified temperature may not be reached due to the limitation.
	Pressure limit active	The symbol indicates that a set pressure limit is currently in effect and that no heating power is currently being output. This typically leads to a drop in temperature, i.e., the specified temperature may no longer be reached.

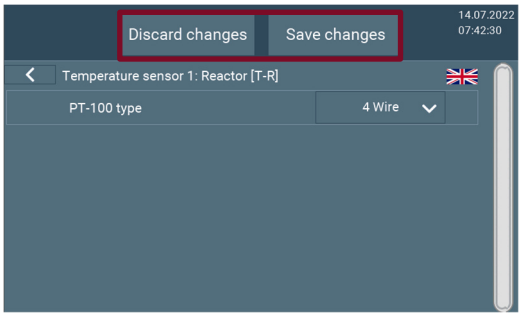
By pressing the symbol for English language  at the top right, the system language can be temporarily switched to English in this display area in order to make navigation easier in certain situations.



The light bulb symbol  in the respective submenus can be used to call up information on the setting options. This system runs through all menus and setting options.

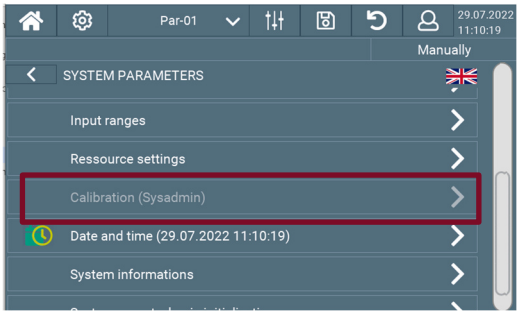
Sub menu	Function
Stirring drive	Configuration stirring drive (see Cap. 5.9) - Drive used - Acceleration - Deceleration - Auto-repeat
Heating jacket	Heating jacket configuration - T-Limit Heating jacket: Here you can configure the switching temperature of the temperature safety switch used so that it is not exceeded by the controller during normal operation. - Max. Delta-T above T-Set (see 5.7)
User manager	The user management can be activated here and the passwords for the rights levels *Sysadmin* and *Admin* can be managed.
Language settings	In the language settings submenu, you can choose between the different system languages.
General	General settings of the unit can be made here - Start screen after switching on the device - Active parameter set after switching on the device - Base temperature - Start temperature is the base temperature (see 5.8.3)
Ressource settings (Sysadmin)	In the ressource settings submenu, the connected sensors (temperature, pressure), valves, stirrer drives, and heating jackets can be configured. The *Sysadmin* rights level is required to call up this menu.
Calibration (Sysadmin)	The temperature and pressure sensors can be calibrated here (see Cap. 5.5.3).
Date and time (24.03.2023 09:43:44)	The date and time of the system can be set here. These settings are also used for the time stamp in the log file, which is created via the BRVI, and for the status messages on the device.
System informations	The serial number of the device and the software version used can be viewed in the system information.
System presets, basic initialization	The basic initialization and the selection of whether the system is operated with or without PTFE insert can be made here (see Cap. 5.3). In addition, subsequently purchased software packages can be activated here.

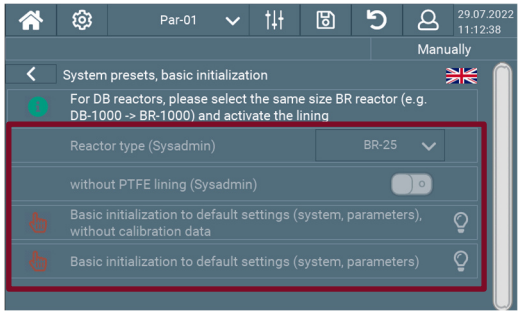
Changes in the settings are discarded or confirmed by pressing the **Discard changes** or **Save changes** button. Pressing the buttons completes the editing of the settings and returns to the main screen. Several settings can be adjusted before completing the edit by pressing the arrow  to exit the sub-menu and enter another.



The symbol  indicates that the corresponding data field can be switched. Here the running time of a ramp. You can choose between the remaining running time and the time that has already passed.

Options are inactive (grayed out) if the currently set rights level is not sufficient. Select the required level of rights  .

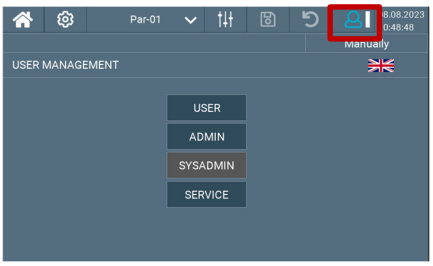




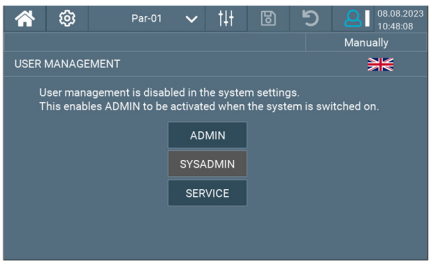
5.2. User Management

Only included in the Professional software package.
On the device, the user manager controls the access to setting options. There are four hierarchy levels:

1. User
(only when user management is activated)
2. ADMIN
3. SYSADMIN
4. SERVICE



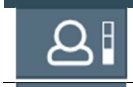
User manager is activated
(see system parameters)



User manager is deactivated
(see system parameters)

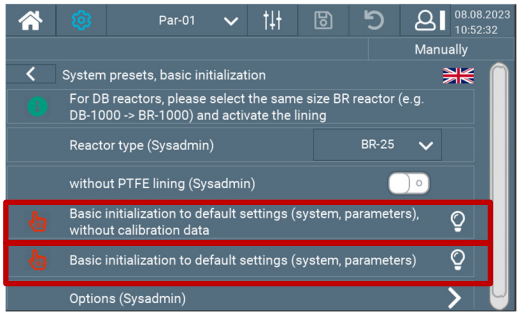
If the user management is deactivated, the system is started as "Admin" by default. Some global settings are blocked here and are displayed in grey. These settings are available as "Sysadmin".
If user management is activated, the system is started as "User".

To call up the user "Service", a password entry is necessary. Further setting options are available as "Service". These may only be changed by appropriately trained service personnel.

Rights level	Symbol
User	
Admin	
Sysadmin	
Service	

5.3. Reactor configuration

The instrument can be set to a specific reactor type (with/without PTFE insert) via the menu **System parameters -> System presets, Basic initialization**. This automatically presets the reactor configuration for each parameter set and the default values of the control sets.

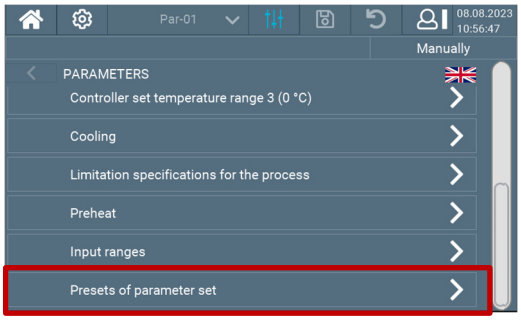


You can select whether the calibration values entered for the temperature and pressure measurement should also be reset during the basic initialization.

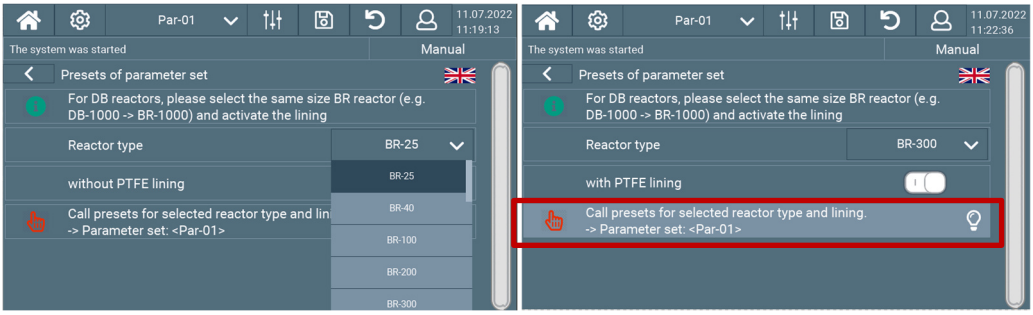
NOTICE	Calling up the basic initialization resets all parameter sets and sequence values to factory settings!

In addition, the software packages can be managed under the menu item "Options".

The **parameter settings menu**  can be used to make individual changes to the different parameter sets. Preset control parameters for different reactor types and configurations can be loaded or existing parameter sets can be edited. A total of ten different parameter sets can be stored in the memory. These can be selected via the menu bar at the top.



To load the standard parameter sets, the menu **Presets of parameter set** can be selected in the lower area of the parameter settings.
The reactor type can be selected, and it can be specified whether a PTFE insert is used.

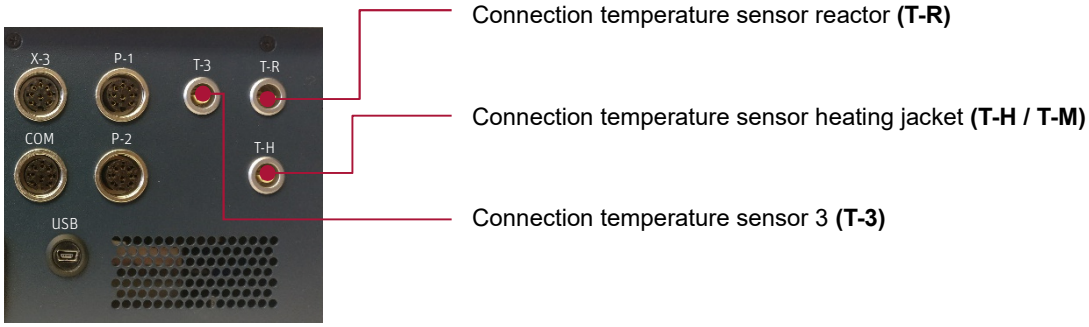


The default values for this reactor configuration can then be called up as **Presettings**. These default values can be used to obtain good temperature control even without an autotuning procedure. These are valid for standard applications with an watery medium and approx. 2/3 filled reactors.

5.4. Temperature measurement

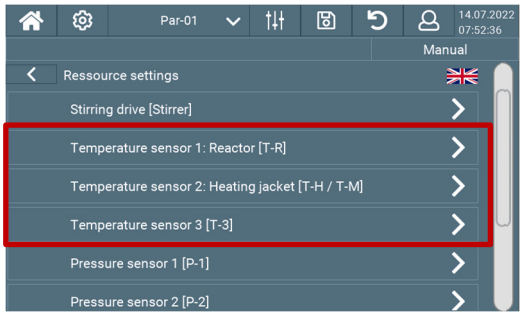
5.4.1. Connection

The BRC has a total of three separate connections for PT-100 temperature sensors (2-/4-wire). The sensor for the internal reactor temperature is connected to the **T-R** input. If a temperature sensor is used for measuring the heating jacket temperature, it can be connected to **T-H (formerly T-M)**. Input **T-3** can be used to measure an additional temperature, e.g., the temperature of added media. If no temperature sensor is connected, a temperature of -99°C is displayed.

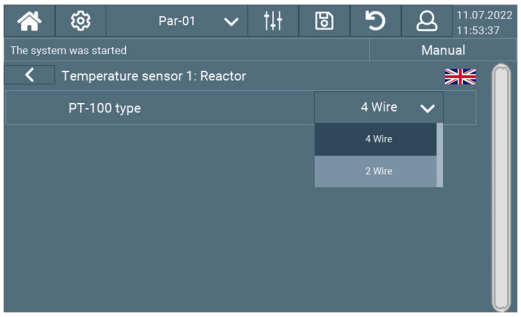


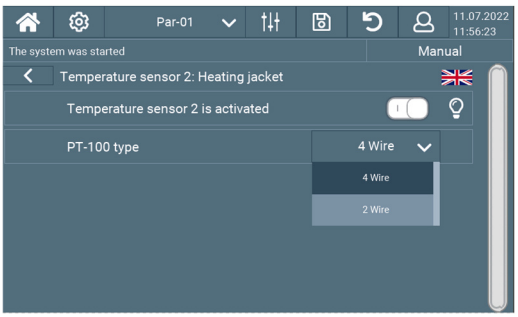
5.4.2. Configuration

The various inputs can be configured in the menu **System parameters → ressource settings**.



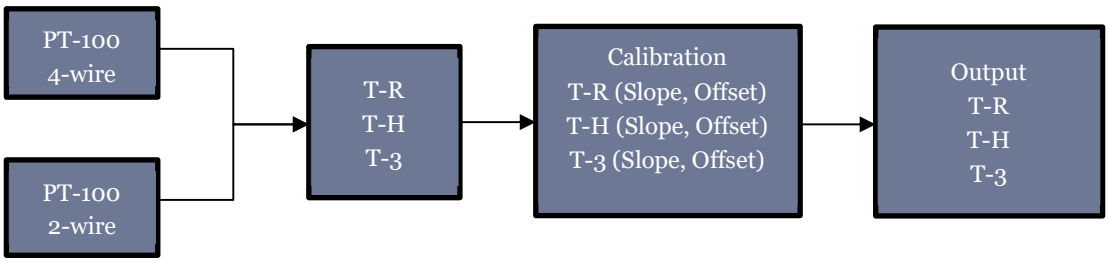
The type of PT-100 temperature sensor (2-/4-wire) can be selected for each input and, if necessary, unneeded inputs can be deactivated so that the measured value is hidden in the main screen. The temperature sensor for the reactor cannot be deactivated. A measured value must be available here in order to start a process.



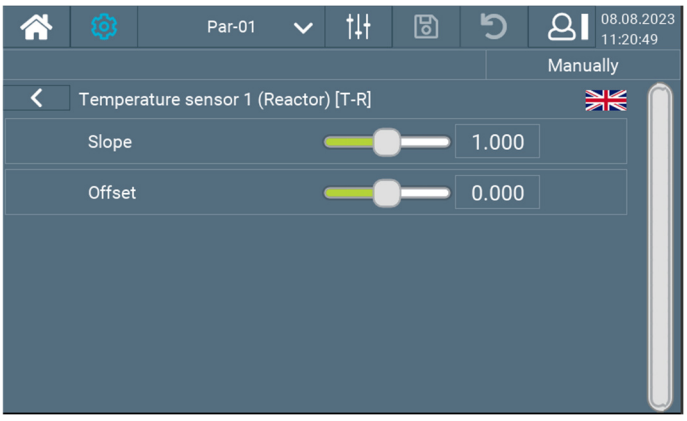


5.4.3. Calibration

Each temperature channel can be calibrated separately with the appropriate equipment. The schematic of the signal processing is shown below:



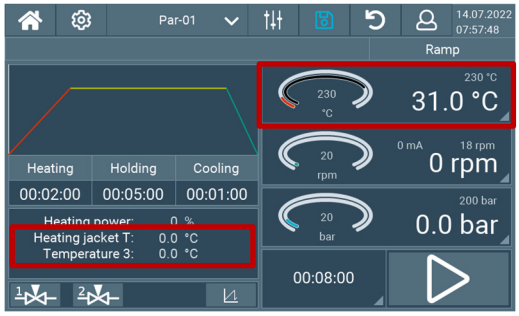
To set the calibration values, the user must be logged in as SYSADMIN. Under **System Parameters → Calibration**, the menu for calibration and the desired channel can be selected.



The measuring chain can be calibrated by changing the values for slope and offset. It is necessary to recalibrate the temperature input when changing the temperature sensor from 2-wire to 4-wire or vice versa.

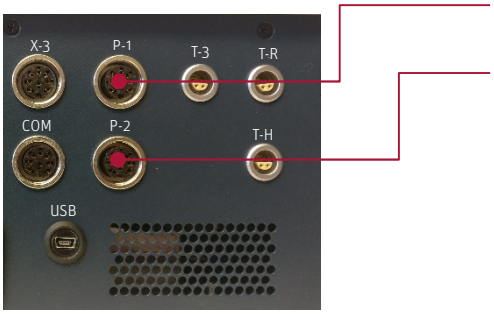
5.4.4. Usage

The measured values are displayed on the surface. The reactor temperature and the setpoint (upper, grayed value) are displayed on the right. The heating jacket temperature T-H and the temperature of the input T-3 bottom left as monitoring values.



5.5. Pressure measurement

5.5.1. Connection

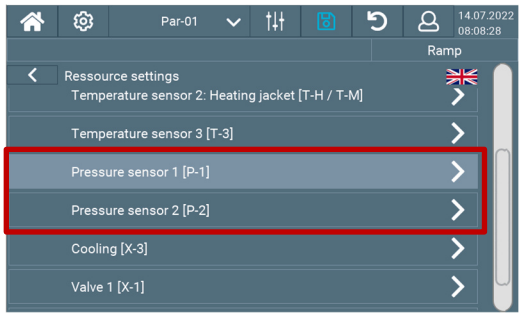


Connection pressure sensor 1 **(P-1)**

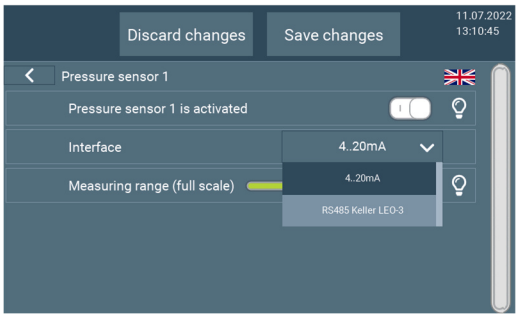
Connection pressure sensor 2 **(P-2)**

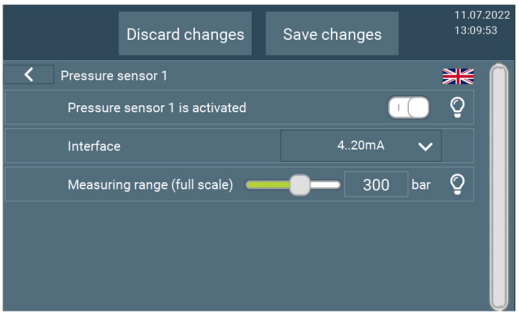
The BRC has two inputs for connecting pressure sensors. These can be connected either via the **P-1** or **P-2** connection. You can choose between a 4...20mA or an RS 485 interface (for special sensors from Keller). If no pressure sensor is connected, a pressure of -99 bar is displayed in the data logging.

5.5.2. Configuration



Each input channel can be configured separately via **system parameters → ressource settings**. You can choose between a 4...20 mA and an RS485 interface for the pressure sensor LEO-3 from Keller on both connections. For each sensor, the measuring range of the sensor used must be specified (see technical data sheet).

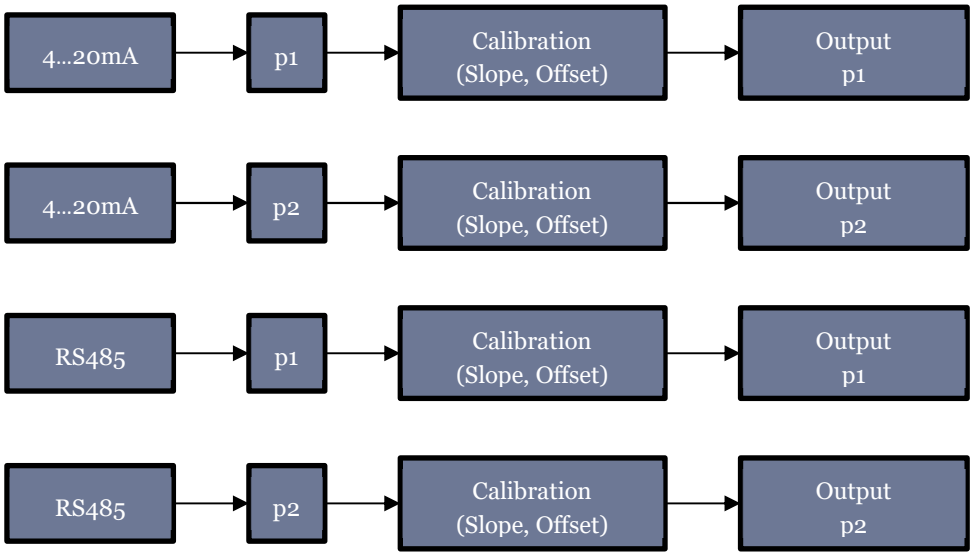




The following applies to the RS485 interface: If pressure sensor 1 is activated, it is addressed with bus address 250 (default). If pressure sensor 2 is also activated, pressure sensor 1 is addressed with bus address 1, pressure sensor 2 always with bus address 2. The pressure sensor must be configured to this bus address (1 or 2) before use. The bus address settings are made directly on the display of the LEO-3 pressure sensor.

5.5.3. Calibration

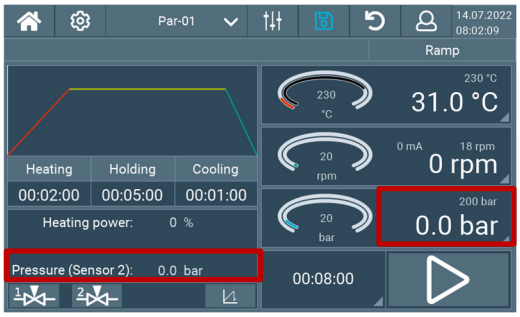
Each channel for pressure measurement (p1, p2) can be calibrated either for the 4...20mA or for the RS485 interface with the appropriate equipment. The schematic of the signal processing is shown below:



To set the calibration values, the user must be logged in as **SYSADMIN**. Under **System Parameter → Calibration** the menu for calibration and the desired channel can be selected. By changing the values for slope and offset, the measuring chain can be calibrated.

5.5.4. Usage

The measured values of sensor 1 and 2 are displayed on the user interface.



In the main screen on the right, the pressure limit for pressure sensor 1 can be set (upper, greyed value). This causes the controller to switch off the heating power when the pressure limit is reached and to activate cooling if necessary. Due to a delayed reaction of the temperature, temperature overshoots and undershoots can occur and thus possibly also the pressure limit can be exceeded. Overshoots can be reduced by using slow temperature curves, e.g., a temperature ramp as a default.
The input range for the adjustable pressure limit can be configured under **parameter → Input ranges**.

The value of the pressure sensor 2 is used only as a monitoring value, e.g. pressure of an added medium.

NOTICE

The "pressure limit" function is **not** an exact **pressure control**, but a **switch-off**. The pressure limit must be selected with a sufficient distance to the maximum permissible pressure (due to rupture discs, reactor specification, ...), as exceeding the set pressure limit cannot be ruled out.

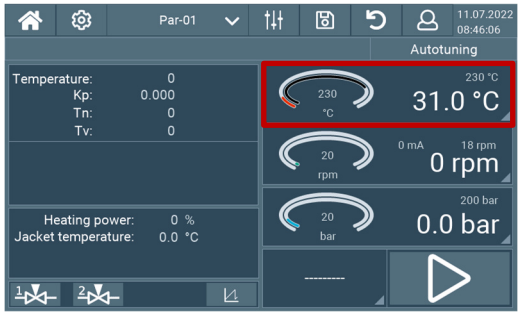
5.6. Autotuning / control parameters

Only included in the Comfort and Professional software package.

WARNING	**Respect max. operating temperatures** When operating the BRC, always observe the maximum permissible operating temperatures of the units to be heated!

NOTICE	**Heating of pressure vessels with PTFE lining** Pressure vessels with PTFE lining may only be heated to higher temperatures under a minimum pressure of approx. 5 bar. This pre-pressure can be generated with water or other liquids, for example.

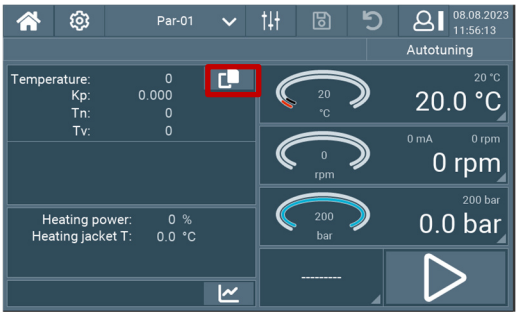
Autotuning is a procedure for determining the PID parameters of a given system at a specific temperature. This makes it possible to take into account the versatile configuration options of reactor, heating, stirring, medium, PTFE lining, lid assemblies, etc. An oscillation around the set temperature value is induced and the PID parameters are determined from the course of the oscillation. To do this, the desired setpoint temperature is set in auto-tuning mode and the process is started.

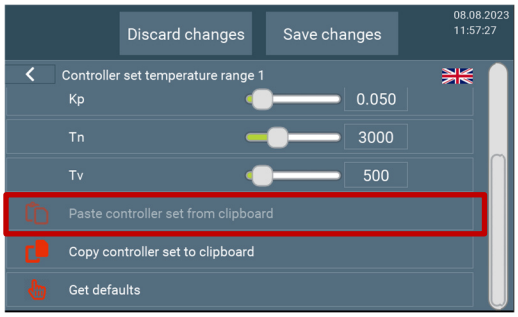


Depending on the dynamics of the system and the set temperature, autotuning can take between a few minutes and several hours. During autotuning, set pressure limits and heating jacket temperature limits are also taken into account and the heating is switched off if necessary. If the control has to intervene when limit values are exceeded, the PID control set can still be useful for the later applications.

DANGER	Due to the way in which the control parameters are determined in autotuning, possibly high overshoots can occur, depending on the dynamics of the system and the selected temperature range. The maximum permissible temperatures of the components used and the maximum permissible pressure of the reactor must be considered. Limits can be set for the heating jacket temperature (option) or the internal pressure. It is advisable to start with lower temperatures to detect the level of overshoots and then increase the temperature in small steps if the overshoots do not pose a problem.

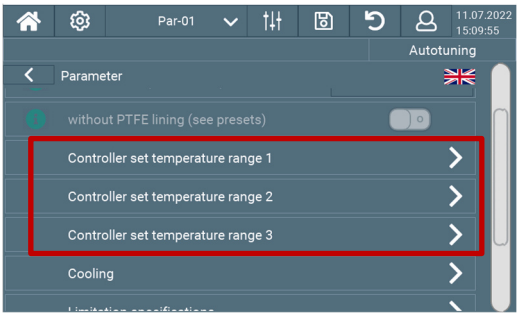
When the autotuning run is finished, the PID values determined can be copied to the clipboard via the button and inserted in the desired parameter set under **parameter settings** .



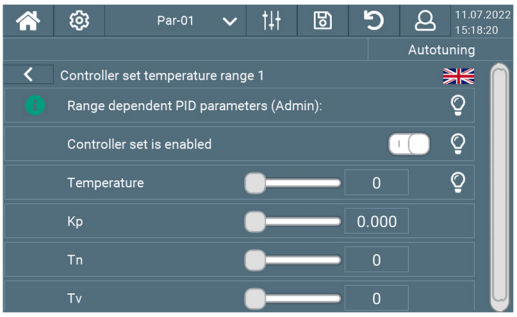


PID values can also be copied/pasted between parameter sets or the default values can be recalled at any time.

Via the button **Parameter settings** , the controller sets can be configured. A total of three different controller sets for different temperatures can be entered, saved, and activated or deactivated depending on the application. At least one controller set must be active.



Each parameter set consists of the temperature and the three PID values (Kp, Tn, Tv).



The parameter set closest to the current set temperature is always used for control. When following a ramp, the set temperature is the temperature after the ramp (holding temperature). This means that the active controller set changes during a sequence with different holding temperatures. If a sequence is run with several holding temperatures, it makes sense to carry out an auto-tuning for exactly these temperatures and to store the PID values as controller sets (up to 3).

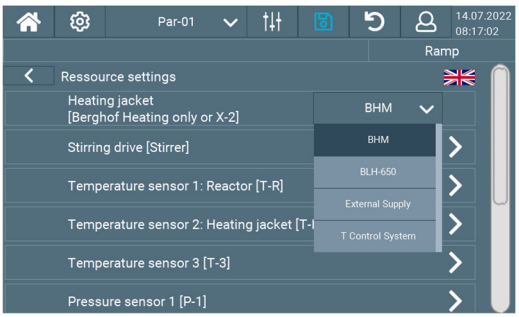
The PID parameters define the temperature control characteristics of the system. A distinction is made whether a reactor is operated with or without a PTFE lining, as this has a major influence on the controllability of the system.

For the various reactor sizes and types, default values are already stored, which can be used to achieve useful results even without autotuning procedures. These apply to standard applications with an aqueous medium and approx. 2/3 filled tanks.

NOTICE	The control of PTFE-lined autoclaves requires completely different control parameters due to the very slow reacting controlled system. Corresponding PID parameters can be called up for the individual reactor types in the process controller.

5.7. Heating and cooling

To control different heating systems (BHM heating jacket, BLH-650 heating plate or other heating systems), the corresponding heating system must be selected under **System parameters → ressource settings**.



Depending on the selected heating system, it is connected differently.

5.7.1. Installation with BHM - heating jacket

WARNING

Unit uses mains voltage AC 230V!

The unit must always be connected to a protective earth conductor. The connection from the unit to the power source must always be made via a three-core cable with a protective earth conductor.

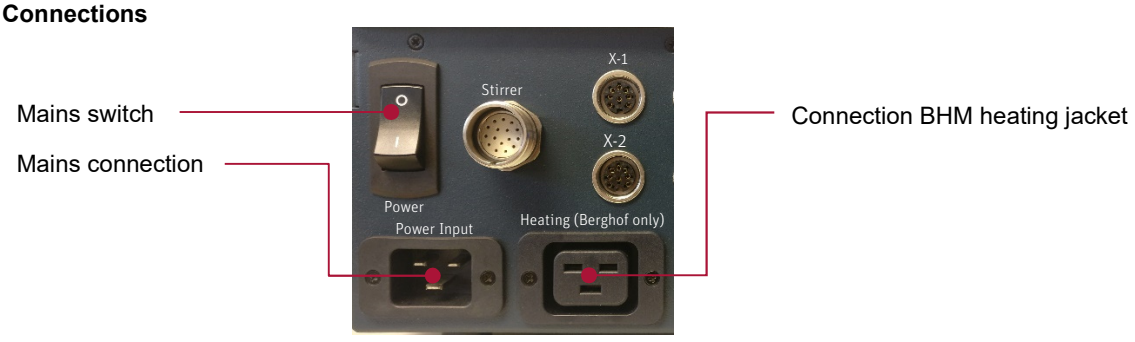
Only use approved mains cables.

The socket used must be freely accessible at all times.

The unit must not be put into operation if it is damaged.

Repair and service work may only be carried out by appropriately trained and qualified personnel of Berghof Products + Instruments GmbH.

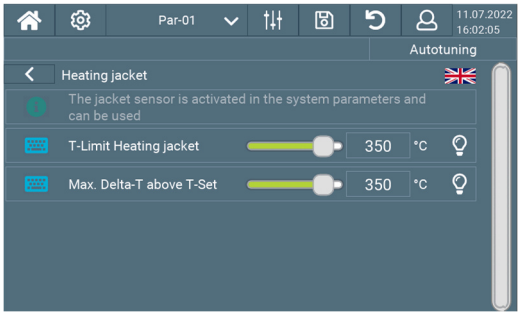
Connections



If a BHM heating jacket is used, it is operated via the connection **Berghof Heating only**. The heating current is output to the BHM heating jackets via this output. Only Berghof heating mantles may be controlled via this output.

BHM must be selected as the heating jacket via the **system parameter → ressource settings**.

Settings for the heating jacket used can be made via the **system parameters → Heating jacket**.

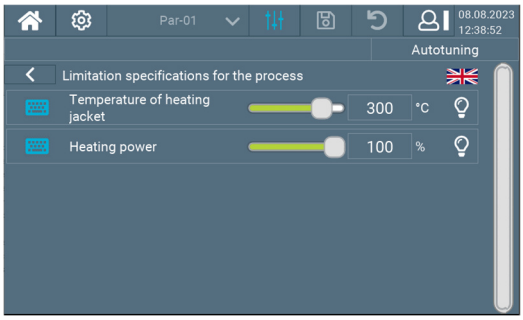


The temperature sensor in the heating jacket must be activated for this. The switching temperature of the capillary controller installed in the heating jacket (adjustable by means of a rotary knob, if necessary) or temperature switch can be set (see technical data sheet of the heating jacket). This safety temperature limiter ensures that the heating system is intrinsically safe and that no uncontrolled heating can happen. To detect whether the heating circuit is interrupted by the safety temperature limiter, the current flow in the BRC is detected. If the signal for heating is issued and the heating circuit is closed, the 

symbol is displayed in the status bar. If the BRC detects that no current is flowing although the heating is activated, the 

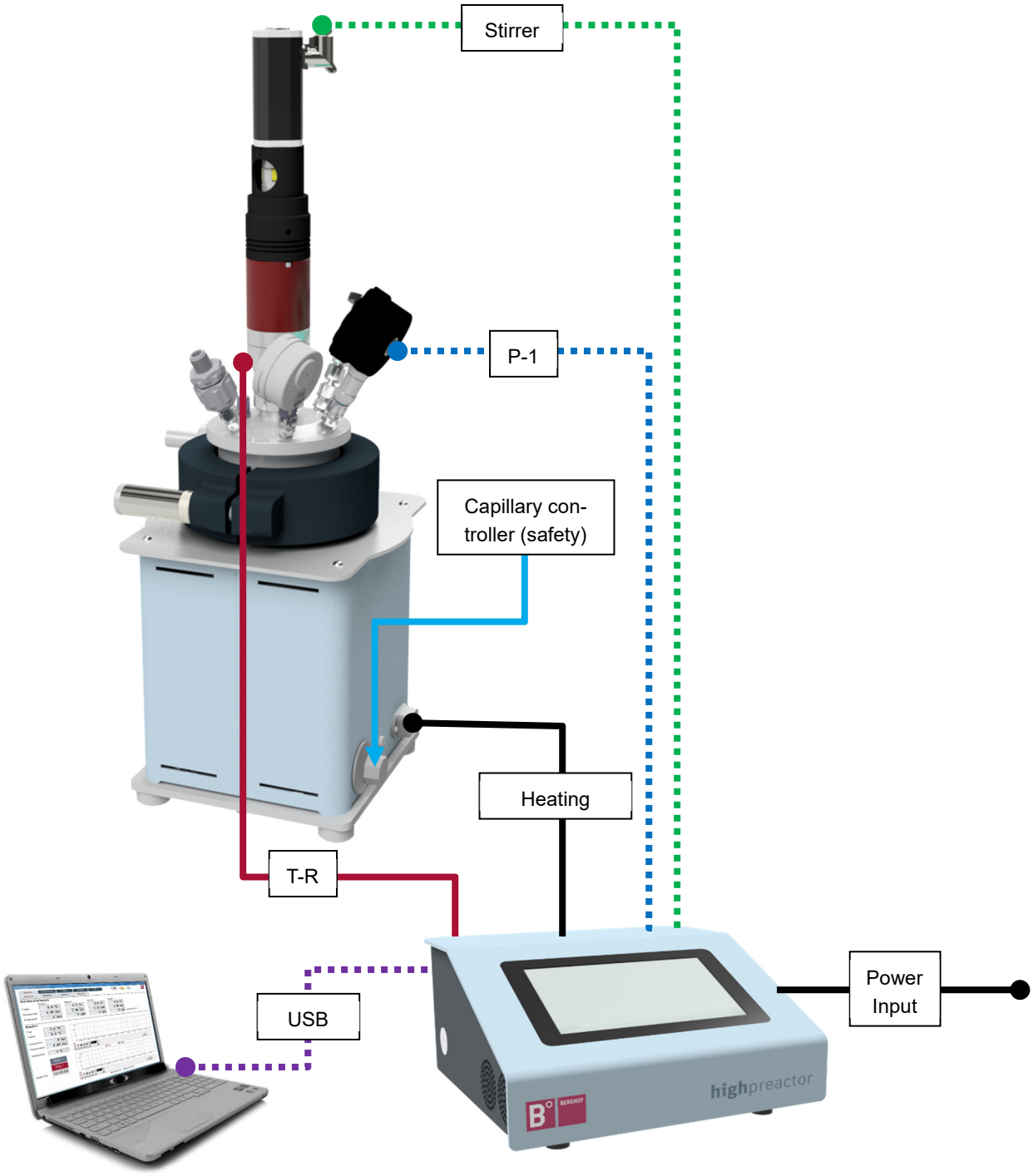
symbol appears.
In addition, it is possible to specify a maximum temperature difference between the reactor and the heating jacket. This ensures that the heating jacket temperature and the reactor temperature are not too far apart, especially in very slow systems, and make control more difficult.

Under **parameter settings**  **→ Limitation specification for the process** limit values can be set for the maximum permissible heating jacket temperature and the heating power.



In addition to the control parameters, these setting options can, for example, ensure that overshoots are avoided by limiting the heating power or heating jacket temperature.
Furthermore, it can be prevented that installed PTFE components are overheated and damaged (e.g. limitation to 230°C). The limit of the heating jacket temperature must be above the setpoint for the reactor temperature to be reached (approx. 50°C higher), otherwise the desired temperature in the reactor cannot be reached.

Wiring diagram BRC with BHM - heating jacket



Wiring BRC with BHM heating jacket and optional stirrer motor, pressure sensor and PC.

5.7.2. Installation with BLH-650 Heating plate

WARNING

Unit uses mains voltage AC 230V!

The unit must always be connected to a protective earth conductor. The connection from the unit to the power source must always be made via a three-core cable with a protective earth conductor.

Only use approved mains cables.

The socket used must be freely accessible at all times.

The unit must not be put into operation if it is damaged.

Repair and service work may only be carried out by appropriately trained and qualified personnel of Berghof Products + Instruments GmbH.

Setting the BLH-650 heating plate

Safety temperature limit

The max. achievable heating plate temperature is limited to 360 °C by an adjustable safety temperature limiter.
When this limit is reached, the appliance switches off the heating.

Do not turn the adjusting screw beyond the left or right stop, as this will destroy the potentiometer.

In order to reach the maximum possible temperature in the reactor, the "Safe Temp" safety temperature limiter should be set to 360°C with the screwdriver supplied (clockwise stop).

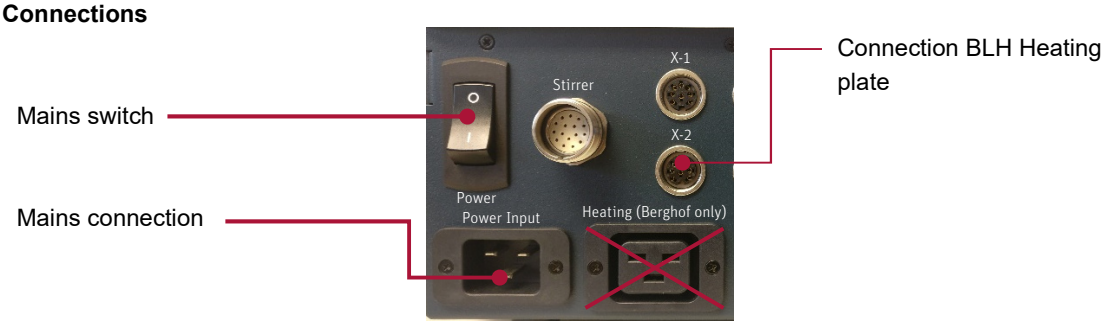
Adjusting screw „Safe Temp“

NOTICE

For further information see original documents

If a BLH heating plate is used, it is connected via interface X-2. The control signal is output to the heating plate via this port. The heating plate itself is supplied with a separate mains cable.

Connections



After the installation of the units used has been carried out in accordance with the respective installation and operating instructions, proceed as follows:

Process

Switch on the BLH-650 heating plate using the appliance switch on the right side of the appliance.

Appliance Switch

Display with connection cable (Start state)

Display without connection cable (Error message)

→ Set the temperature using the + and - buttons; this should be 50 °C above the desired temperature set with the Berghof control units.

The maximum temperature that can be set on the BLH-650 heating plate is 320°C. If the temperature is set too low, it overrides the control of the Berghof control units.

Temperature control

→ Press the Heating On/Off button

Heating on/off

→ Only now can the Berghof control programme be started.
→ When the heating function is switched on, the LED lights up and indicates the heating process.

NOTICE

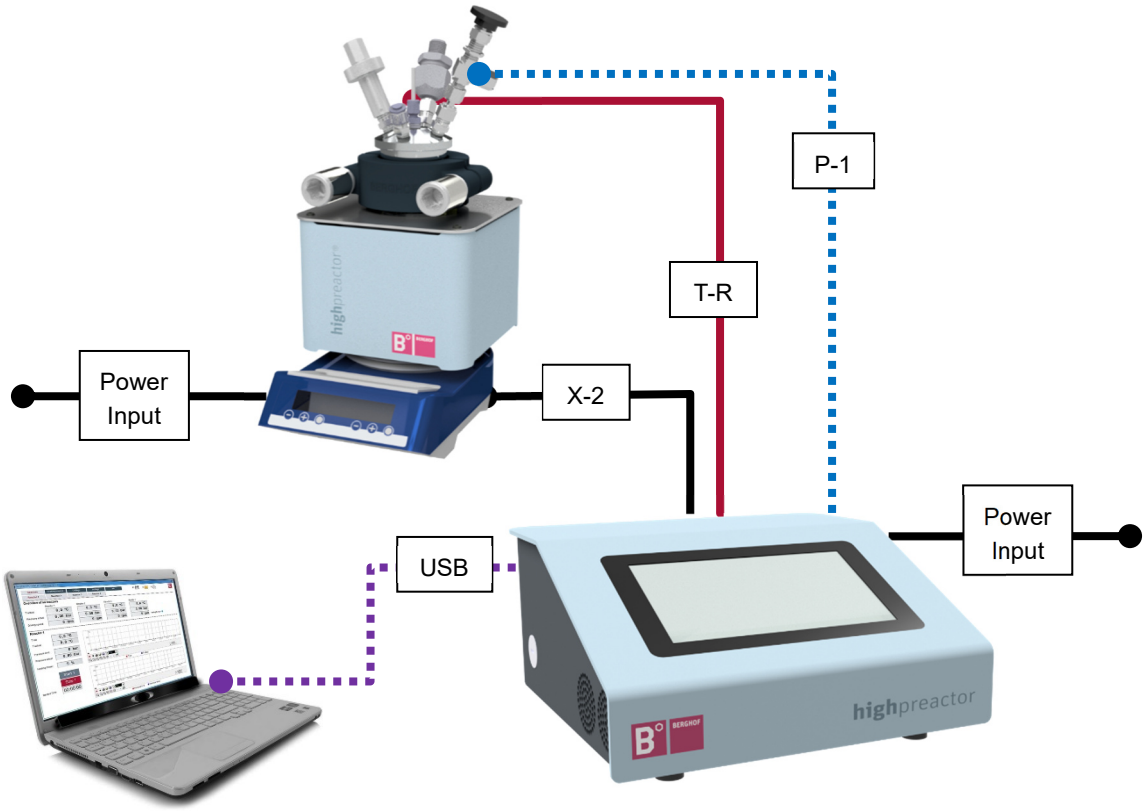
For further information see original documents

Safety menu

In order to be able to guarantee safety in the event of voltage dips or power failures, the heating is not re-started after an interruption with
"Heating Stop", the heating is not activated again after an interruption.

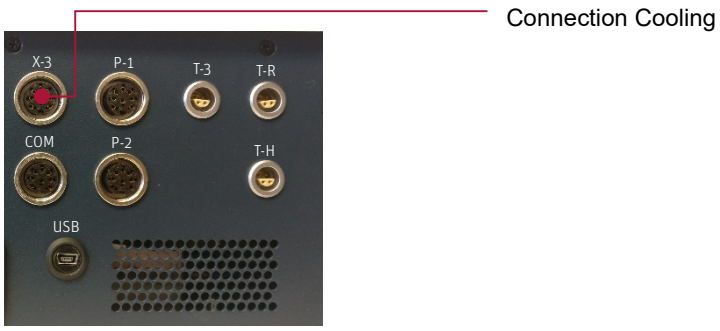
Correct data recording in the event of a power failure cannot be guaranteed.

Wiring diagram BRC with BLH-650 heating plate

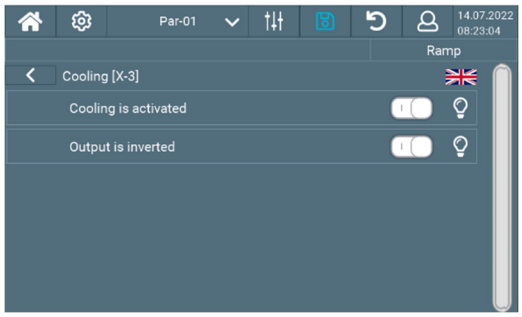


5.7.3. Connection Cooling

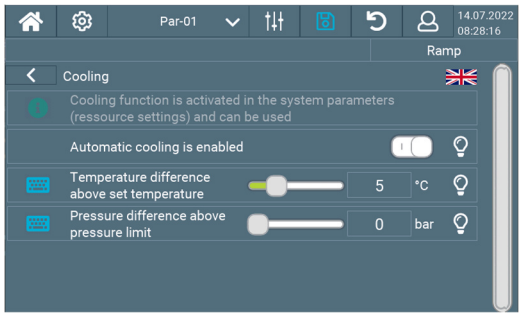
In addition to the heaters, an optional cooling system can also be connected. For this, a 24 V valve is connected to the interface **X-3** with the cable supplied. The cooling valve is used in a cooling circuit with a constantly applied pressure of the coolant. The reactor lid must be equipped with the corresponding cooling coil.



In the **ressource settings**, the control of the cooling valve can be configured under the menu item **Cooling**. Depending on the valve used, the output can be inverted (n.o. / n.c.).



If a cooling valve is activated in the ressource settings, the use of the cooling valve can be configured in **parameter settings → Cooling**. It can be selected whether the automatic cooling should be used in this parameter set. This switches on in the event of overshoots, cooling processes and exceeding of the pressure limit. The threshold value for switching on the cooling can be configured via the settings of the difference above the setpoint temperature or the difference above the pressure limit.



5.8. Process configuration / control

5.8.1. General

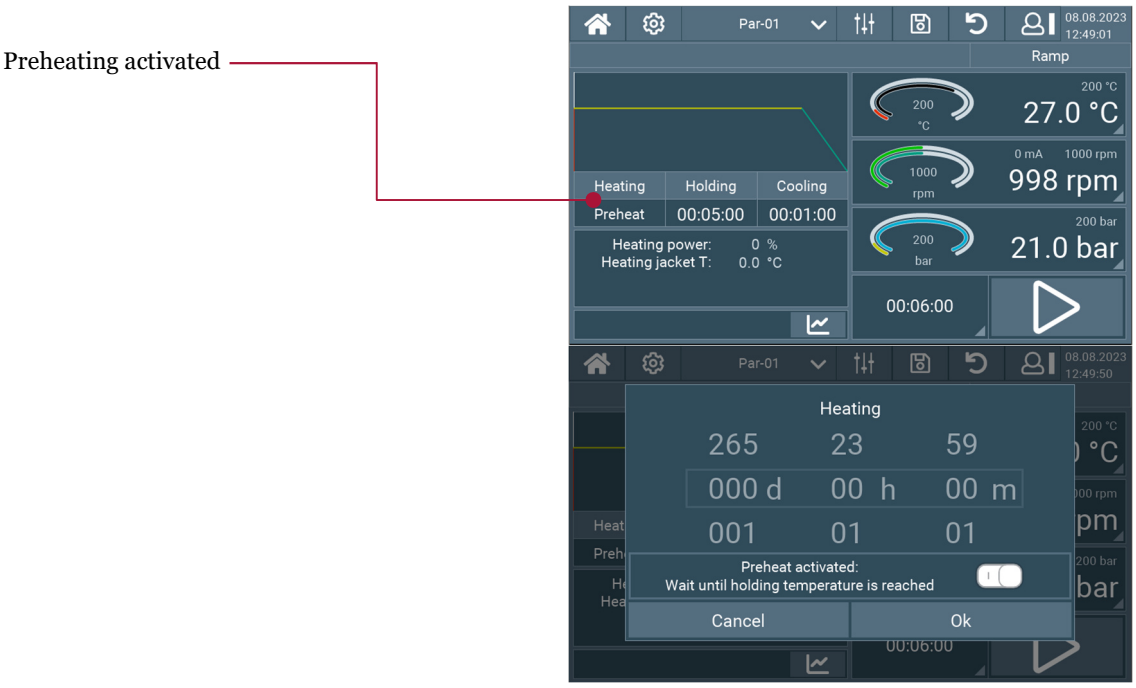
WARNING	**Respect the maximum operating temperatures** When operating the process controller, always observe the maximum permissible operating temperatures of the units to be heated!
WARNING	**Connection of third-party devices** If third-party devices are to be connected, this is only permitted via an adapter cable supplied by Berghof Products + Instruments GmbH. The use of cables not approved by us will invalidate the warranty and it is the responsibility of the operator to ensure electrical safety!
NOTICE	**Heating of pressure vessels with PTFE lining** Pressure vessels with PTFE lining may only be heated to higher temperatures under a minimum pressure of approx. 5 bar. This pre-pressure can be z. This pre-pressure can be generated with water or other liquids, for example.

To start a heating process, one of the three available modes (manual, ramp, sequence) can be selected. On the right-hand side, pressing the upper button calls up the slider for setting the target temperature. The temperature can be selected by moving the slider and fine-tuned by pressing the + or - button. Pressing and holding the buttons starts a fast run of the temperature. Pressing **Ok** terminates the entry and the value is accepted. Tap in the dark area next to the item to **cancel** the entry.
The black arc above the numerical value indicates where the temperature is in the selectable temperature range.

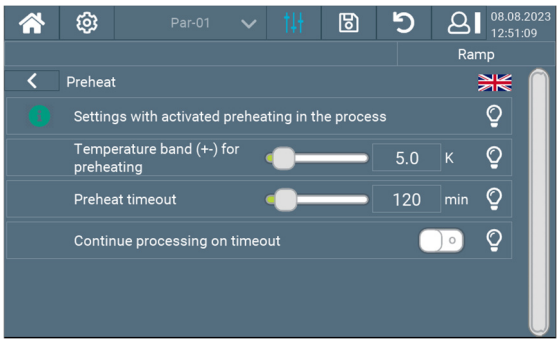
The controller will approach this temperature differently (ramp or direct) depending on the mode selected. As long as no sequence has been started, the current measured values of the sensors are already displayed.

5.8.1.1. Preheating

For the **ramp** and **sequence** modes, there is the option of activating the so-called **preheating**. Preheating is used instead of a fixed ramp time to approach a target temperature. In this case, the hold time of the program only starts when the reactor temperature is within a defined temperature band around the set temperature.

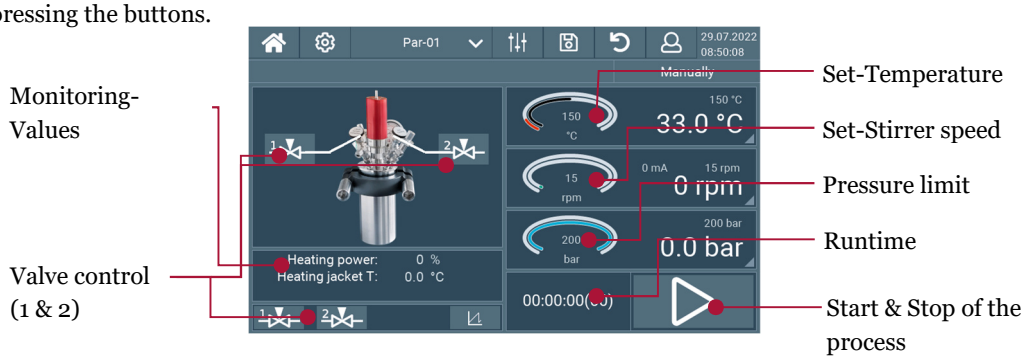


The advantage of this function is that the set temperature is reached as quickly as possible and is then maintained for the defined period (hold time). Under **parameter settings → Preheating**, the width of the temperature band from which the runtime starts can be set, as well as the termination conditions if the target temperature is not reached.



5.8.2. Manual mode (Manually)

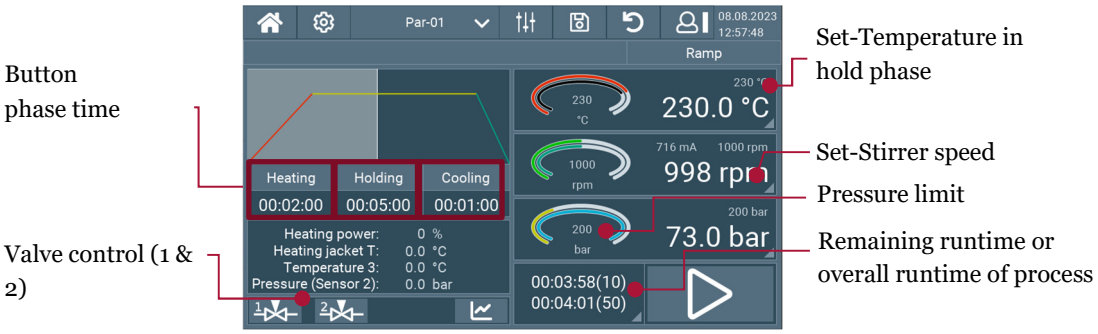
In the manual mode (Manually), simple processes can be carried out, which are started and stopped manually. For this purpose, the temperature, speed of the stirrer motor and a pressure limit can be selected and, if necessary, also changed during the process. If valves are activated, they can be operated manually by pressing the buttons.



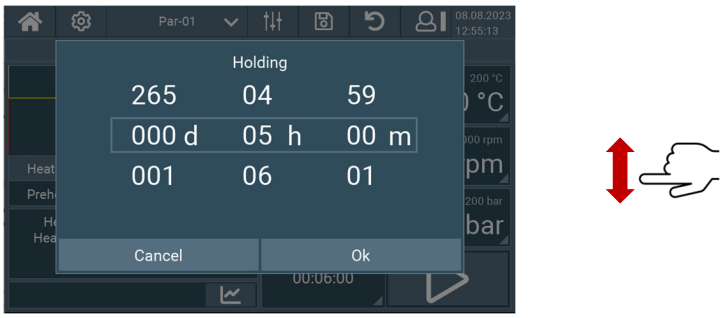
The runtime in this mode is unlimited and is started and stopped manually by the user. The set temperature is approached as quickly as possible according to the PID parameters for this temperature. Overshoots of the temperature can occur.

5.8.3. Ramp mode

In the ramp mode, three phases of the sequence can be programmed: A heating phase, a holding phase, and a cooling phase. By pressing the buttons below the ramp graphic, the times of the individual steps can be configured.



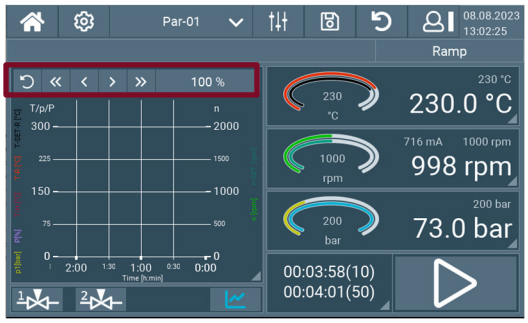
The time can be set in each case by scrolling.



The start temperature of the ramp can be set under **system parameters → General**. You can choose between a fixed base temperature and the current temperature of the reactor. This results in different starting points for the ramp and thus also different heating rates for the same ramp time. The gradient of the heating or cooling ramp results from the set target temperature and the time for the heating or cooling phase. The set temperature of the current time step is displayed above the currently measured temperature. A set stirring speed is approached directly according to the settings in the **system parameters → Stirring drive** and is not taken into account in the ramp calculation.
The remaining run time and the current run time of the sequence are displayed in the area at the bottom right. Pressing the runtime field toggles between the times. If all setpoints are set, the sequence can be started by pressing the start button. If valves are activated, they can be operated manually by pressing the buttons.
By programming a ramp to a desired setpoint temperature, overshoots can be reduced.

The current time in the sequence is represented by a time marker in the diagram area.
During the sequence, it is possible to change set values directly.

The graphical progression of various parameters can be viewed via the  button.

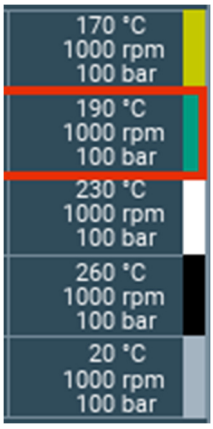


	Resetting the graphics settings to default
	Scroll forward and back (page by page or according to scale element)
	Zoom setting time axis

5.8.4. Sequence mode

Only included in the Comfort and Professional software package.
In **Sequence** mode, several sequence steps can be configured. There are a total of five sequence pairs, each consisting of a heating or cooling phase and a hold phase. By pressing and holding the time for the respective sequence step in the left-hand area, the time selection can be opened, and the days, hours and minutes of the step can be set by scrolling. If valves are activated, they can be operated manually by pressing the buttons during the sequence.

The time values in the left-hand area and the control values in the right-hand area are each represented by coloured markings. A target temperature, a stirring speed and a pressure limit can be entered for each sequence step. The control values are displayed together in the left-hand area for each step.



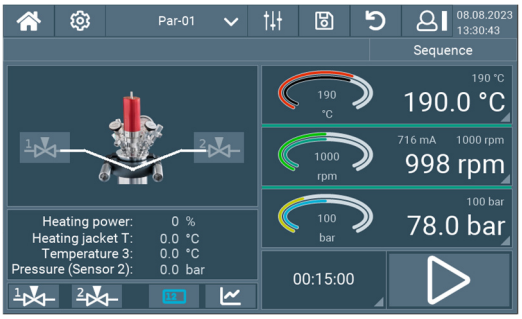
During the process, a time marker shows the current status of the program.

The button  can be used to view the graphical progression of various parameters.

Resetting the graphics settings to default
Scroll back and forth (2h resp. 30min)

Zoom setting time axis

The monitoring values can be displayed via the  button.



5.9. Stirring

5.9.1. Drives

The BRC supports the following drives:

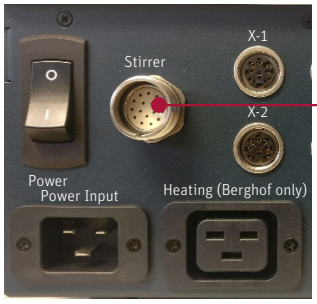
- Dunker BG45x30 1:1
- Dunker BG45x30 4,5:1
  Reduction using a gear with transmission ratio i = 4.5
- Dunker BG65x50SI 1:1
- Dunker BG65x25SI 4:1
  Reduction using a gear with transmission ratio i = 4
- Dunker BG75x75SI 4:1
  Reduction using a gear with transmission ratio i = 4

The drives are selected in the **Resource settings / Stirring drive** (see Chapter 5.9.3).
If a stirring motor with a gear is selected, the BRC takes the gear ratio into account. Input values such as speed always refer to the actual stirring (abrasion) in the reactor.

5.9.2. Connection

Connection to BRC

If the contents of the reactor are to be stirred, various stirring motors can be used, depending on the application. These are all connected to the **Stirrer** connection with the cable supplied.



Connection Stirrer

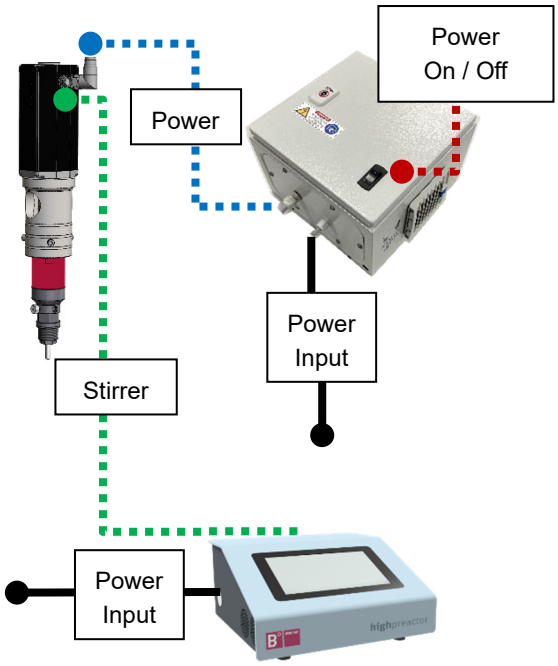
Wiring diagram BRC with stirring depending on the stirring motor

Dunker BG45x30 1:1
Dunker BG45x30 4,5:1
Dunker BG65x50SI 1:1
Dunker BG65x25SI 4:1

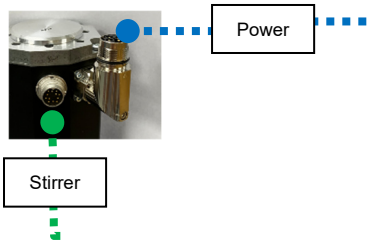
The stirrer motor is powered by the BRC

Dunker BG75x75SI 4:1.

With this stirrer motor, power is provided by a supply box ("BRM-3 for BRC"), not by the BRC.

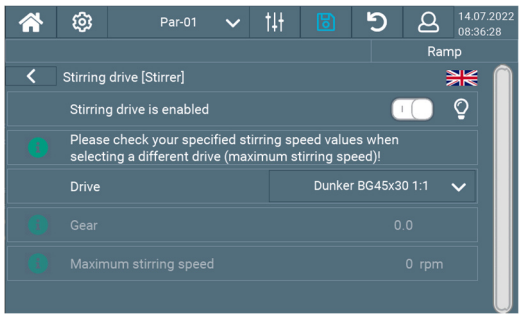


Detail:

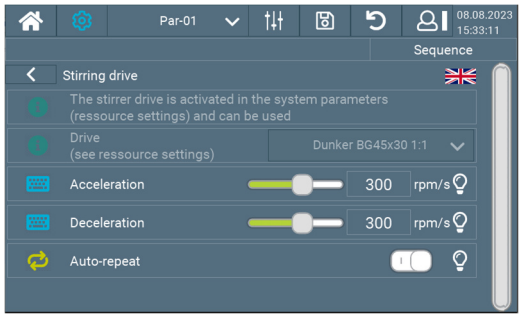


5.9.3. Configuration

The stirrer drive can be activated, and the type of motor used can be selected via the ressource settings menu. For information, the gear ratio and the maximum speed of the motor are displayed after saving the selection.



The stirrer drive can then be configured via **System parameters → stirrer drive**.



The acceleration and deceleration characteristics of the motor can be set, as well as an automatic repeat function. The automatic repeat function specifies what should happen after the stirrer motor has been switched off in the event of a malfunction or when exceeding the current limit. This can be caused, for example, by an increasing viscosity of the medium being stirred. In this case, the motor may be overloaded.
If the motor is switched off due to the overload, this option can be used to select whether or not the motor should restart after a short waiting time.

5.9.4. Usage

The set stirring speed is selected analogue to the setpoint temperature via the slider. When programming a ramp or a sequence, the speed is not ramped up or down according to the ramp time, but according to the configuration of the acceleration and deceleration ramp. For multi-step sequences, a different speed can be specified for each sequence step. The information on the stirring is displayed in the right-hand area. The set speed below the arc is displayed in rpm. The momentary motor current is displayed to the right. This can be observed as an indicator for changes in viscosity. The target speed for the current time step is displayed to the right above the currently measured actual speed.

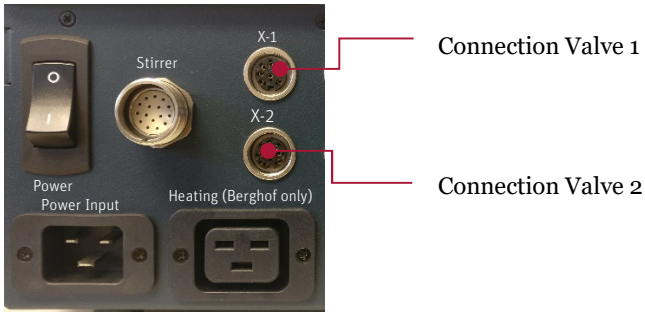
If the **Dunker BG75x75SI 4:1** stirring motor is selected in the configuration, the power supply to the supply box "BRM-3 for BRC" must be switched on using the **On/Off switch** before use by the operator. In this case, the motor current is not shown on the display because the power is not routed via the BRC.

5.10. Valve control

Only included in the Comfort and Professional software package.

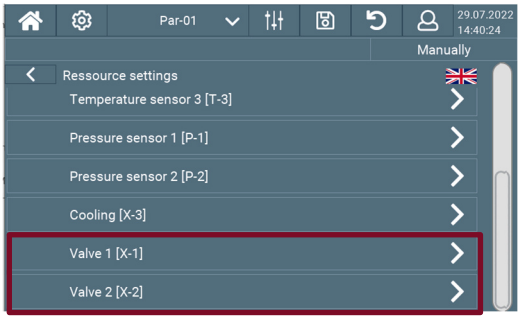
5.10.1. Connection

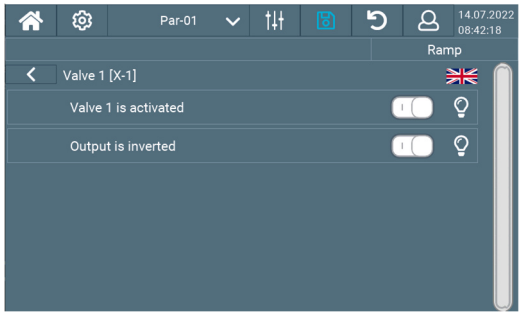
Valves can be connected to the BRC via connections **X-1** and **X-2**.



5.10.2. Configuration

The connected valves can be activated via **ressource settings → valve 1/valve 2.**





The output for controlling the valves can be inverted so that a valve in the non-confirmed state is n.o. (normally open) or n.c. (normally close).

5.10.3. Usage

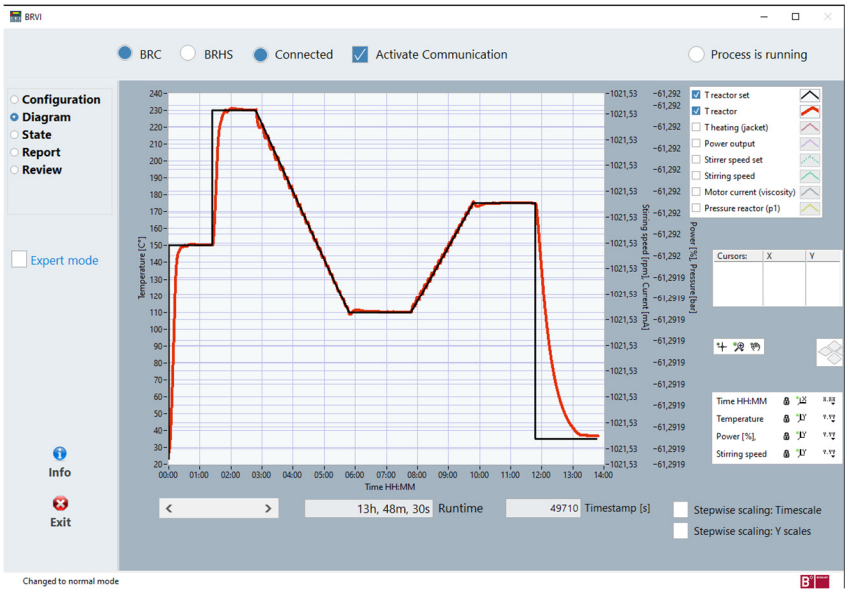
If valves are activated, they can be operated manually by pressing the buttons at the bottom left during **Manually, Ramp and Sequence modes**. In **Manual mode**, the valves can also be activated/deactivated using the buttons in the graphic area. A pulsating colour change indicates that the valves are active.

Valve control (1 & 2)

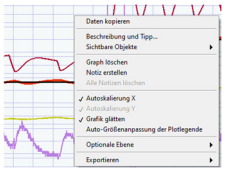
Valve control (1 & 2)

5.11. BRVI Data logging

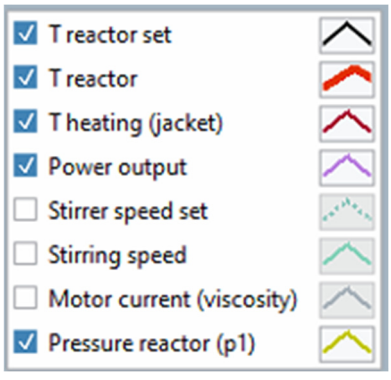
After starting the BRVI application, the following display appears on the screen.
Temperature, pressure and power curves can be viewed individually, enlarged or reduced on the screen using the magnifying glass functions and copied to the clipboard for transfer to other applications (e.g. text editors).



During a sequence, an improved display can be achieved by a gradual scaling adjustment.

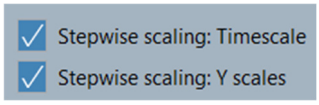


Right-clicking on the diagram gives access to display and export functions.

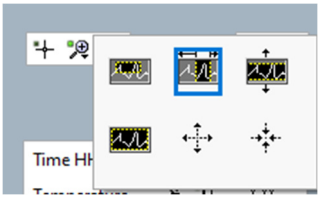


Select which curves are to be displayed in the diagram by activating the monitoring value  .
A basic setting (after the start of the application) can be made in the "Configuration" area.

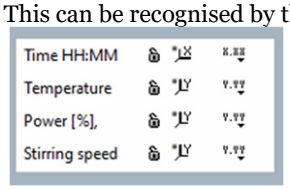
Click with the left mouse button on the diagram symbol  to display the respective data curve individually.



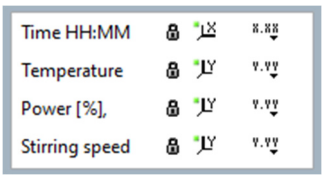
During a sequence, an improved complete representation can be achieved by a step-by-step scaling setting.
If a zoom operation is to be carried out in the diagram during the sequence, the respective element (Timescale, Y) should be deactivated beforehand.



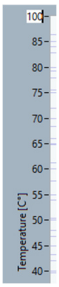
Zoom options are available via the palette shown.
By zooming in, the automatic scaling of the diagram is deactivated.
This can be recognised by the open lock symbol



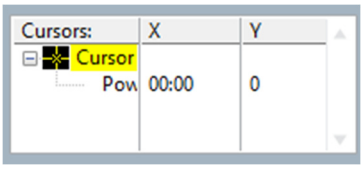
With  and holding the left mouse button in the diagram, the display area can be shifted during a zoom display.



Click on the lock symbol to automatically scale the corresponding axis again so that the symbol (locked lock) appears.



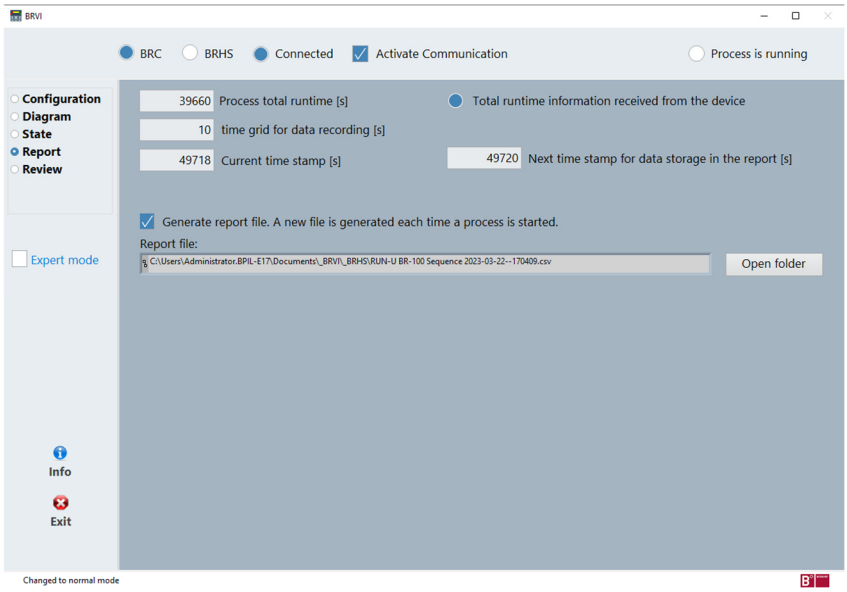
Change the scale range by entering values directly in the scale.



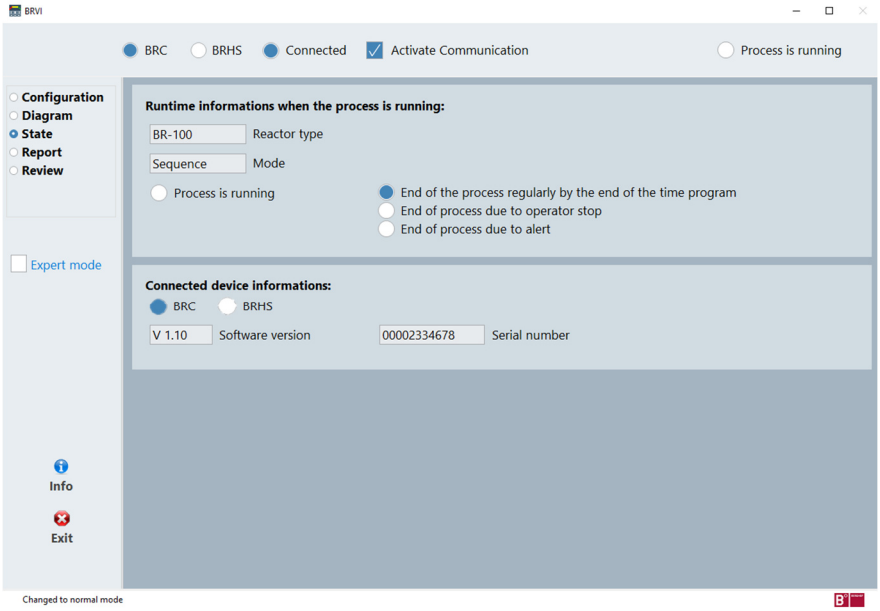
Create a cursor (right mouse button on the field) that can display single values of a selected axis.

The cursor position can be moved with the  elements.

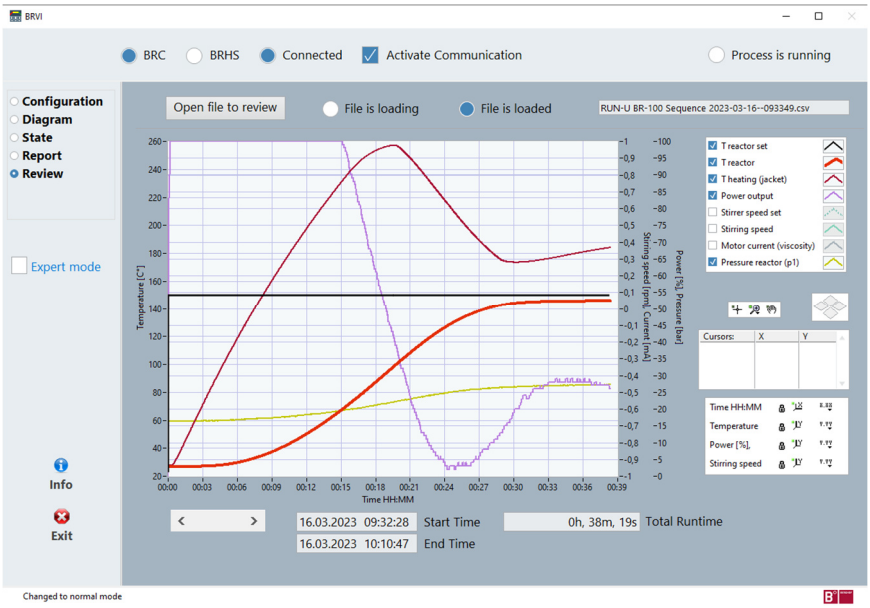
The recorded data is continuously stored in a .csv file in the specified storage location. Each start of the programme creates a new .csv file. The .csv file can also be read in and evaluated with MS-Excel© , for example.



With the selection "State", the current status information of the BRC is displayed.



By selecting "Review", report files that have already been saved can be read in again.
However, files saved in expert mode cannot be opened here (see following chapters).



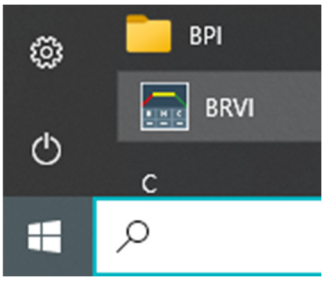
5.11.1. Installing BRVI

The PC application for Windows is supplied on a USB stick and can be installed by executing the file "setup.exe". The system requirements are Windows 7 SP1 or newer and a USB connection.
Follow the installation instructions. Administrator rights are required for the installation.

5.11.2. Starting BRVI

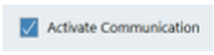
Start the application by clicking on  and the icon 

in the Windows start bar in the BPI directory



5.11.3. Connecting BRC

To establish a connection between the PC software BRVI and the BRC, it may be necessary to adjust the COM port of the software.
To do this, the BRC is connected to the computer via a mini-USB cable.
Under Windows, the number of the COM port can be found via Settings > Devices > Device Manager. By switching on the BRC, the COM port appears in the device manager and disappears again after switching off the BRC.
The COM port number can be set in the **Configuration** menu.

After setting the correct COM port, the connection must be activated once in the header 

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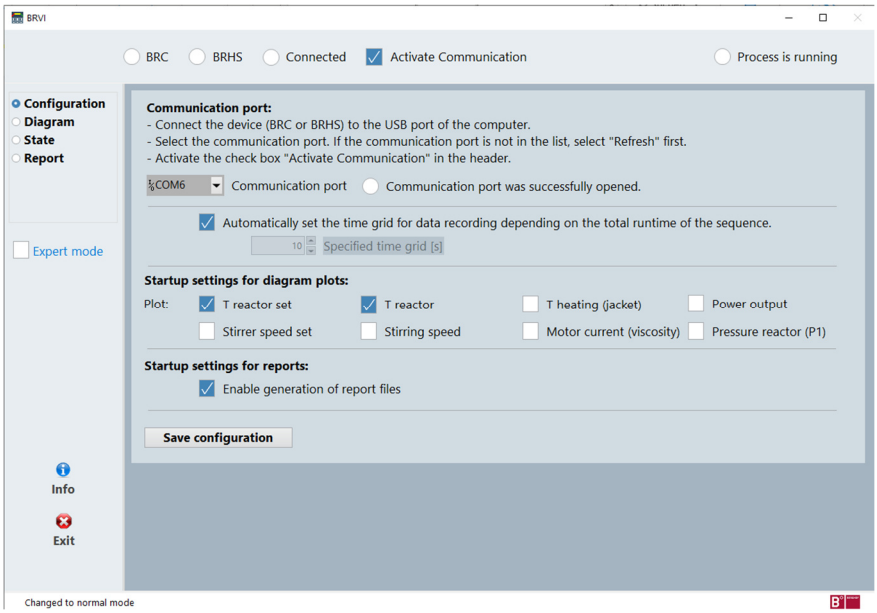
5.11.4. Configuration menu

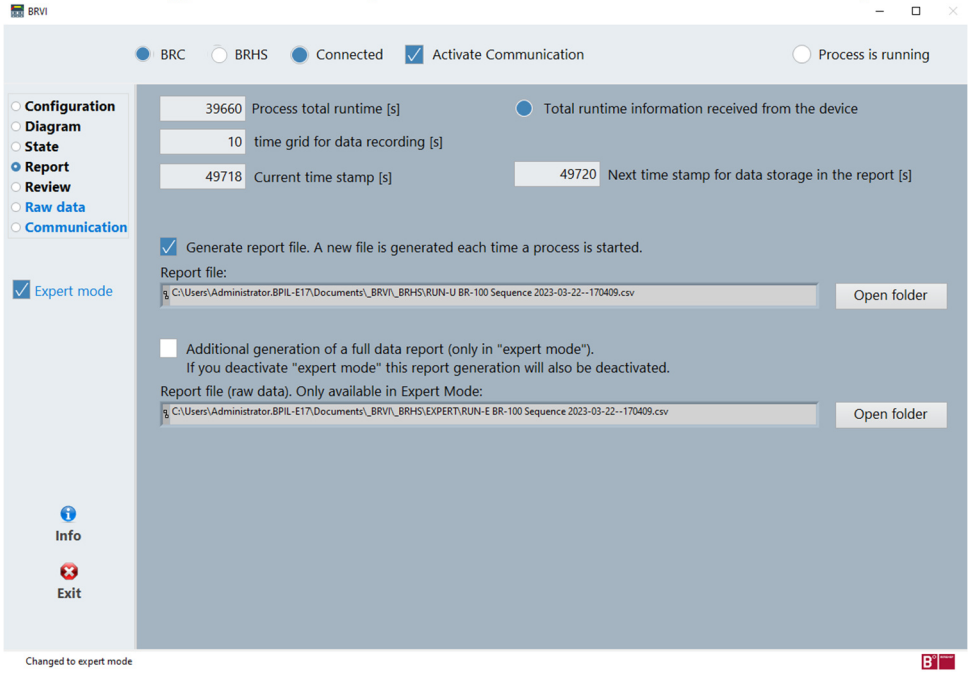
In the **Configuration** menu, program settings can be made and saved.



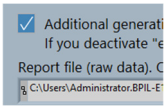
5.11.5. Expert mode

By activating the expert mode 

in the left sidebar, further selections are available. These are particularly useful for support from the Berghof Products + Instruments GmbH service department.

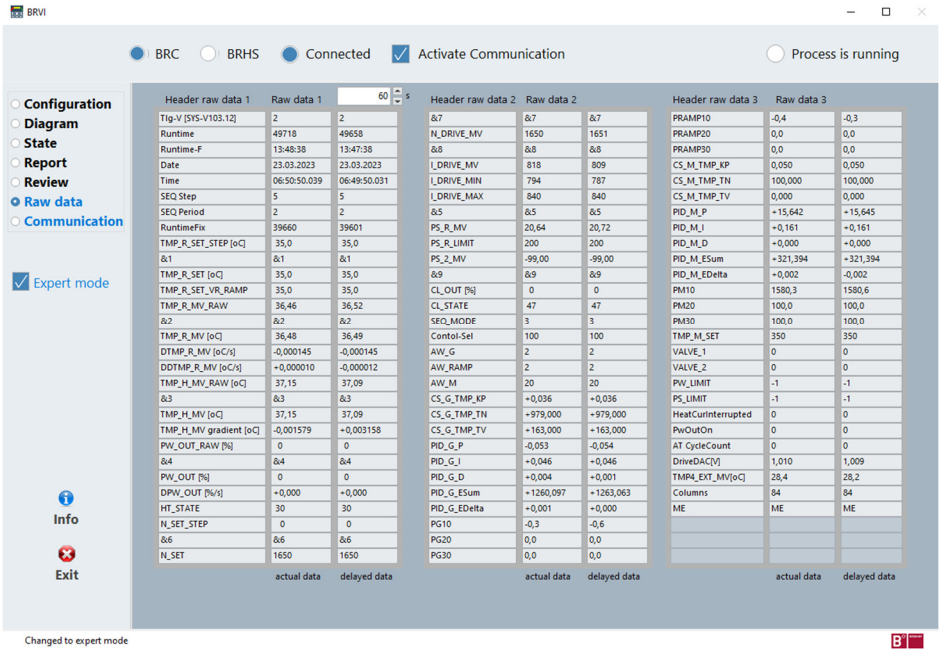


Under "Report" an extended report file can be stored as a .csv file. Since this file generates a lot of data, it must be selected after each programme start (BRVI).

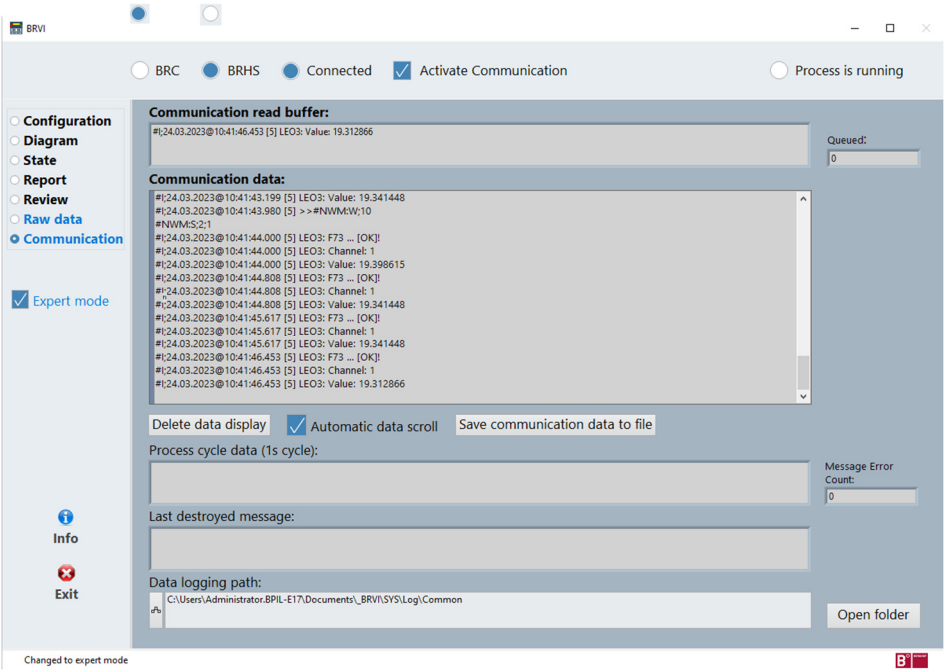


Please note that this file cannot be opened with „Review“. The evaluation and viewing can be done e.g. with MS-Excel© or other text editors. The files can be identified by the file name „RUN-E....“.

Raw data" shows the raw data received from the BRC.



Under "Communication", the communication between communication between BRC and BRVI is logged and displayed.



6. Maintenance, troubleshooting and service

6.1. Maintenance

The BRC requires no maintenance.

6.2. Cleaning

Do not use any aggressive cleaning agents to clean the unit, but only wipe it with a dry or damp cloth. The fan filters can be cleaned from the outside with a hoover.

6.3. Error notes

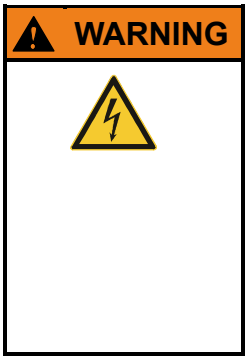
Error description	Cause	Remedy
Device does not heat	Overtemperature switch in the heating system has switched off.	Do not set the target temperature too high (<250°C for reactors with PTFE lining). Check the setting of the overtemperature switch (it may be too low).
	Heating system not connected to controller	Check connection cable and plug
Instrument fuse triggers	Short circuit in the heating system	Send heating system with controller to the factory for inspection.
Strong control deviations, strong overshoot	Unfavorable choice of parameters Temperature sensor defective	Optimize control parameters with autotuning Replace defective parts

Technical support is available from your regional Berghof dealer or directly from Berghof Products + Instruments GmbH at:

Berghof Products + Instruments GmbH
Arbachtalstraße 26
72800 Eningen
Germany
T +49.7121.894-170
F +49.7121.894-300
E-Mail: service.bpi@berghof.com
www.berghof-instruments.com

Please state the serial number of your unit in all repair enquiries or repair orders. You will find it on the type plate.

6.4. Repairs / customer service



Unit uses mains voltage AC 230V!

The unit must always be connected to a protective earth conductor. The connection from the unit to the power source must always be made via a three-wire cable with a protective earth conductor.

Only use approved mains cables.

The socket used must be always freely accessible.

The unit must not be put into operation if it is damaged.

Repair and service work may only be carried out by appropriately trained and qualified personnel of Berghof Products + Instruments GmbH.

Technical support and information on spare parts (order no. and prices) can be obtained from your regional Berghof dealer or directly from Berghof Products + Instruments GmbH at:

Berghof Products + Instruments GmbH
Arbachtalstraße 26
72800 Eningen
Germany
T +49.7121.894-170
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E-Mail: service.bpi@berghof.com

Please state the serial number of your unit in all repair enquiries or repair orders. You will find it on the type plate.

7. Appendix

7.1. Declaration of conformity

DECLARATION OF CE-CONFORMITY P. 1/1

BRC
Berghof Reactor Controller

Manufacturer	Berghof Products + Instruments GmbH Arbachtalstraße 26 D - 72800 Eningen
Product	**BRC** – Berghof Reactor Controller Part numbers: 10005338

This declaration of conformity is issued under the sole responsibility of the manufacturer.

The object of the declaration described above is in conformity with the relevant Union Harmonisation Legislation:

Low Voltage Directive (LVD) 2014/35/EU
EMC Directive 2014/30/EU
RoHS Directive 2011/65/EU

The following harmonized standards and technical specifications have been applied:

Safety requirements for electrical equipment for measurement, control and laboratory use Part 1: General requirements	IEC 61010-1:2010/AMD1:2016
EMC – Generally	Professional equipment. The equipment is suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes (Class A).
Electrical equipment for measurement, control and laboratory use – EMC- requirements Part 1: General requirements	EN 61326-1:2013 IEC 61326-1:2012

Eningen, July 08, 2022
Date

Dr. Dieter Gutwerk
CEO

BERGHOF

7.2. Conversion of units

Conversion of units		
Description	**Units**	**Conversion**
Temperature	°C = °F =	(°F – 32°) / 1.8 1.8 * °C +32°
Length	1 cm = 1 inch =	0.3937 inch 2.540 cm
Volume	1 ml = 1 $inch^3$ = 1 gallon =	0.06102 $inch^3$ = $2.642*10^{-4}$ gallon 16.387 ml = $43.29*10^{-4}$ gallon 3785 ml = 231 $inch^3$
Pressure	1 bar = 1 psi = 1 MPa =	14.504 psi = 0.1 MPa 0.06895 bar = 0.0068948 MPa 10 bar = 145.04 psi
Weight	1 kg = 1 lb. =	2.2046 lb. 0.4536 kg

7.3. Abbreviations

Plastics	
Abbreviation	**Full name**
PE	Polyethylene
PEEK	Polyether ether ketone
PFA	Perfluoralkoxy
PTFE	Polytetrafluoroethylene
TFM™-PTFE	modified Polytetrafluoroethylene
PP	Polypropylene