

BlueShadow

► Pump 10P/20P User Manual

V7630A



HPLC

Table of Contents

Note: For your own safety, **be sure to read** the manual and **always** observe the warnings and safety information on the device and in the manual!

Intended Use	6
Pump Type	6
Device Types	6
Laboratory Use	7
Where is it prohibited to use the device or system?	7
Features	8
Safety	9
Laboratory Regulations	9
Solvents	9
PEEK Connections	10
Protective Measures	10
Power Supply and Mains Connection	11
Ground Connection	11
Target Group	11
Operating the Device or System	11
To what should the user pay particular attention?	11
What expertise should users have to safely operate a HPLC device or device system?	12
Symbols and Signs	13
Installation	14
Protective Film on the Display	14
Scope of Delivery	14
Pumps – Device Types	14
Accessories	14
Checking the Scope of Delivery	15
Space Requirements	15
Installation Site	15
Initial Startup	16
Operating Modes	16
Isocratic	16
HPG	16
Device Types	16
Pump Heads	16
Labeling on the Pump Heads	17
Pump without Pressure Sensor	17
Front View of the Device	17
Rear View of the Device	18

Pump with Pressure Sensor	18
Front View of the Device	18
Rear View of the Device	19
Connecting the Pump with other Devices	20
Controlling the Pump with Chromatography Software	20
Local Area Network and automatic Configuration	20
Electrical Connections	20
External Control	20
Terminal Strip: Remote	22
ANALOG IN	23
START IN	23
STARTMODE	24
Connecting the flat Ribbon Cable with the Connector Strip	25
Connecting the Eluent Line to the Pump Head	25
Operating the Pump	26
Switch-on and Self-test	26
Display of the Pump	26
Overview of the Function Buttons	27
Communication Interface	27
Setting the Communication Interface on the Device	27
Setting the Flow Rate	27
Setting the Flow Rate manually on the Device	28
Setting the Pressure Absorption	28
Setting the maximum and minimum Pressure	28
Setting the Power Consumption	29
Standard Value for the maximum Power Consumption	29
Setting the maximum and minimum for the Power Consumption	29
Starting and stopping the Pump	30
Purging the Pump	31
Purging the Pump without Pressure Sensor	31
Purge the Pump with Pressure Sensor	31
Piston Backflushing	31
Recommended cleaning Solvents	32
Variant 1	32
Variant 2	33

Maintenance and Care	34
Contact with the Technical Support Hotline	34
Maintenance Contract	34
What maintenance tasks may users perform on the device?	34
Tightening the Screw Fittings	34
Loosening the Screw Fittings	35
Leaks in the Capillary Screw Fittings	35
Replacing the Pump Head	35
Removing the Pump Head	36
Installing the Pump Head	36
Exchanging the Ball Valves	37
Removing the Ball Valves	37
Cleaning the Ball Valves	37
Installing the Ball Valves	38
Cleaning and caring for the Device	38
Disposal	39
Decontamination	40
Storage	41
Ambient storage conditions for the device	41
Troubleshooting	42
Error List and Solutions	42
Technical Data	44
Ambient Conditions	44
Pumps	44
Legal Information	46
Warranty Conditions	46
Manufacturer	46
Transportation Damages	46
Declaration of Conformity	47
Abbreviations and Terminology	48
Table of Figures	49
Index	50

Intended Use

HPLC High performance liquid chromatography (HPLC) is a method for separating substance mixtures and their qualitative and quantitative determination.

The device or device system is designed for high-performance liquid chromatography. It is designed for laboratory use for analyzing as well as separating mixtures of fluid substances that can be dissolved in a solvent or solvent mixture.

The pump is a conveying system for analytical and semi-preparative applications. If bio-compatibility is required, titanium pump head inlays can be used. The pump heads can be exchanged by the user.

Pump Type

Non self-priming pump For an initial startup of the pump liquid has to be sucked in via a syringe.

Device Types

- Pump without pressure sensor, external power unit
- Pump with pressure sensor, external power unit

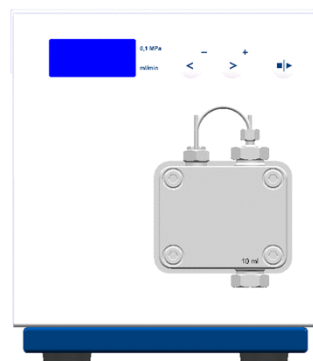


Fig. 1 Pump without pressure sensor, external power unit



Fig. 2 Pump with pressure sensor, external power unit

**Room ventilation,
AC system,
sunlight**

Always use the device in rooms that are well-ventilated, and are preferably equipped with an air-conditioning system. When setting up the system at the installation location, make sure that it is protected against direct sunlight.

Checking intended use

Only use the device for applications that fall within the range of the intended use. Alternatively, the protective and safety equipment of the device could fail.

Laboratory Use

- Biochemical analyses
- Chiral analyses
- Food analyses
- Pharmaceutical analyses
- Environmental analyses
- Chemical analyses

Where is it prohibited to use the device or system?



Risk of explosion! Never use the device in potentially explosive atmospheres without appropriate protective equipment and approval by a notified body!

Inform the technical support department of the manufacturer.

Features

- Dual-piston technology
- Liquid transport with stable flow rate and high flow accuracy
- Long service life
- Pump head made of stainless steel or with titanium inlays
- Piston backflushing
- The pump with a pressure sensor can be integrated into an HPG system
- High physical and chemical stability
- Direct pump control via analog and digital signals
- Control with chromatography software

Safety

Laboratory Regulations

Adherence to laboratory regulations

- Observe national and international regulations pertaining to laboratory work!
 - Good Laboratory Practice (GLP) of the American Food & Drug Administration
 - For development of methods and validation of devices: Protocol for the Adoption of Analytical Methods in the Clinical Chemistry Laboratory, American Journal of Medical Technology, 44, 1, pages 30–37 (1978)
 - Accident prevention regulations published by the accident insurance companies for laboratory work

Solvents

Flammability

Organic solvents are highly flammable. Since capillaries can detach from their screw fittings and allow solvent to escape, it is prohibited to have any open flames near the analytical system!

Leaks and clogged capillaries

Regularly check for leaks and clogged capillaries – test back pressure without column!

Suitable Solvents

Solvents suitable for use in HPLC:

- Acetone
- Acetonitrile
- Acetic acid (10–50%), at 25 °C (77 °F)
- Benzene
- Chloroform
- Ethyl acetate
- Ethanol
- Hexane/heptane
- Isopropanol
- Methanol
- Phosphoric acid
- Toluol
- Water

Note

Even small quantities of other substances, such as additives, modifiers, or salts can influence the durability of the materials. The list of selected solvents was compiled based on research in the pertinent literature and is only a recommendation by the manufacturer. If there is any doubt, contact the technical support of the manufacturer.

Unsuitable Solvents	The following solvents can attack the components of the pump and are therefore not suitable: <ul style="list-style-type: none">▪ Mineral and organic acids (except in buffer solutions)▪ Bases (except in buffer solutions)▪ Liquids containing particles
Only suitable to a limited extent	The following solvents are suitable to only a limited extent for use in the pump: <ul style="list-style-type: none">▪ Methylene chloride▪ Tetrahydrofuran (THF)▪ Dimethyl sulfoxide (DMSO)▪ Slightly volatile solvents▪ Fluorinated hydrocarbons
Solvent bottles	To avoid damage from leaks, do not place solvent bottles on the device.
Self-ignition point	Only use solvents that have a self-ignition point higher than 150 °C under normal ambient conditions!
Toxicity	Organic solvents are toxic above a certain concentration. Ensure that work areas are always well-ventilated! Wear protective gloves and safety glasses when working on the device!

PEEK Connections

Disposable PEEK fittings

- One-piece disposable polyetheretherketone fittings (PEEK) for easier installation of flexible, thin capillaries (outer diameter 0.5 mm)
- Tightening torque of the PEEK screw:
Tightened by hand (approx. 0.5 Nm)

Protective Measures

1. Only perform maintenance tasks described in this manual.
2. All other maintenance tasks are to be performed exclusively by the manufacturer or a company authorized by the manufacturer.

Without exception, the following applies to all maintenance tasks that can be performed by the user:

1. Pull the power plug!
2. Never open a device! High voltage poses a life-threatening risk!

Power Supply and Mains Connection

The device is intended for use with AC power networks of 100–240 V.

The supplied power cable is to be used in connection with the external power unit to connect the device to the mains supply.

Attention! If the power supply is switched on, then the firmware may be damaged by switching the mains on and off.

Switch off the power supply beforehand!

Ground Connection

The ground connection for the pump has a designated hole with a thread M3 on the back of the device.

- If the supplied power unit is used, than the ground connection remains unused.
- Please contact the technical support department of the manufacturer, if the pump along with other devices should be connected to the power supply with a 6-prong power unit; a pump needs to be grounded exclusively.

Attention! Contact the technical support of the manufacturer if the pump should be connected with a multiple power unit of another manufacturer to the power supply. There is a risk of damaging the electronics.

Target Group

Operating the Device or System

The device can be operated with chromatography software at the workstation or with the function buttons on the device.

To what should the user pay particular attention?

To make your HPLC separations as efficient as possible, pay close attention to the following:

Avoiding additional dead volumes

1. Once they have been used, never re-use capillaries in other areas of the HPLC system.
2. Only use a given PEEK fitting for one specific port and never re-use it for other ports. Always install new PEEK fittings on each separate port.

Using special columns

When using special columns, follow the manufacturer's instructions on caring for the columns!

Checking for clogged capillaries

Regularly check for clogged capillaries – test back pressure without column!

- Using filtered solvents**
1. Use ultra-pure, filtered solvents for HPLC – gradient grade.
 2. Filtration of substances under analysis
 3. Use of inline filters.





Note Only allow the technical support department of the manufacturer or a company authorized by the manufacturer to open the devices for maintenance and repair work.

What expertise should users have to safely operate a HPLC device or device system?

- Completed degree as chemical laboratory technician or comparable vocational training
- Fundamental knowledge of liquid chromatography
- Participation in an installation of the system performed by the manufacturer or a company authorized by the manufacturer, or suitable training on the system and english chromatography software
- Basic knowledge of Microsoft Windows®
- Knowledge regarding substances that are suitable only to a limited extent for use in liquid chromatography

Symbols and Signs

Explanations of symbols and labels on the device or system

Symbol	Explanation
	<p>Hazard symbol indicating microelectronic devices that can be damaged by electrostatic discharge when touched.</p>
	<p>CE (Conformité Européenne) mark for equipment that complies with the pertinent EU directives and comes with a declaration of conformity from the manufacturer.</p>
	<p>Marking for devices that comply with the canadian requirements for laboratory equipment: CAN/CSA-C22.2 No. 61010-1, second edition, including Amendment 1, or a later version</p>
	<p>For your own safety, carefully read the manual and always observe the warnings and safety information on the device and in the manual!</p>

Installation

Protective Film on the Display

During transport, a protective film prevents scratches on the display of the device.

Removing the protective film

Remove the protective film from the display.

Scope of Delivery

Pumps – Device Types

- Non self-priming pump with installed pump head and external power unit
- Non self-priming pump with installed pump head, pressure sensor and external power unit

Accessories

- Manual
- Cables
 - Power supply cable for Germany
 - Power supply cable for United Kingdom (optional)
 - Power supply cable for USA (optional)
 - Network cable
 - RS-232 port cable
 - Flat ribbon cables, 10-pin
- Connector strip with stylus, 5-pin
- Kit for bleeding the pump
- Tools
- Silicon tubing
- Syringe 10 ml
- 1 x Screw fittings 1/8" capillaries
- 2 x Seal ring 1/8"
- 1 x Screw fittings for 1/16" capillaries of the pump 10P
- PTFE eluent filter
- Snap ferrite

Use original parts and original accessories

- Only use original parts and accessories made by the manufacturer or a company authorized by the manufacturer.

Checking the Scope of Delivery

1. Check whether the device and accessories are complete.
2. If a part is missing, inform the technical support department of the manufacturer.

Technical support hotline of the manufacturer:

European hotline

Languages: German and English
Available by telephone: 8 a.m. to 5 p.m. (CET)
Phone: +49-(0)30-809727-0
Fax: +49-(0)30-8015010

email: email: info@knauer.net

Space Requirements

- Side clearance to other devices:
 - If there is a device on one side, min. clearance of 5 cm.
 - If there are devices on both sides, min. clearance of 10 cm.
- At least 30 cm gap to the fan on the rear of the device.

Note

Make sure that the power plug on the rear of the device is always accessible, so that the device can be disconnected from the power supply.

Installation Site

Ambient conditions of the installation site

- Air humidity: Below 90% (non-condensing)
- Temperature range: 4–40 °C; 39.2–104 °F
- Sunlight: When setting up the device at the installation location, make sure that it is protected against direct sunlight.

Initial Startup

Operating Modes

Isocratic

- Analysis without gradients
- The solvent composition is constant during the analysis.
- The solvent can be recycled.

HPG

- The gradient is formed on the high-pressure side of the pump (high-pressure gradient).
- The pump is controlled by chromatography software.

Device Types

The pump program consists of devices for analytical and semi-preparative applications:

- Pump without pressure sensor, external power unit
- Pump with pressure sensor, external power unit

Pump Heads

- Pump head 10 ml, for use in analytical applications, standard version made of stainless steel. Pump heads with titanium inlays for biocompatible applications.
- Pump head 50 ml, for use in semi-preparative applications, standard version made of stainless steel. Pump heads with titanium inlays for biocompatible applications.

Labeling on the Pump Heads

The front of the pump head is labeled with the specifications for the maximum pumping capacity. (10 ml or 50 ml). Pump heads with inlays carry additional material labels (*Ti* for titanium).

Legend

- ① Labeling on pump head (stainless steel) without inlays
- ② Labeling on pump head with inlays (titanium)

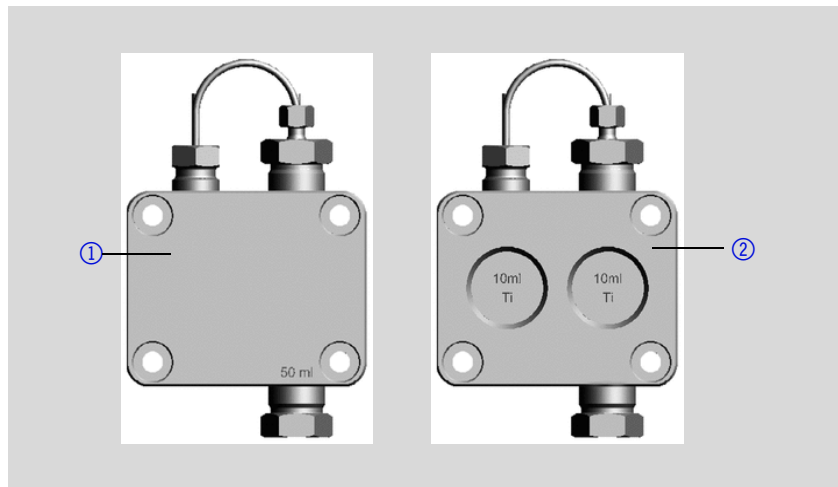


Fig. 3 Labeling on the pump heads

Pump without Pressure Sensor

To disconnect the pump from the mains power, disconnect the power supply and then disconnect the power plug.

Front View of the Device

Legend

- ① Display
- ② Function button 1
- ③ Function button 2
- ④ Start/Stop key
- ⑤ Pump head

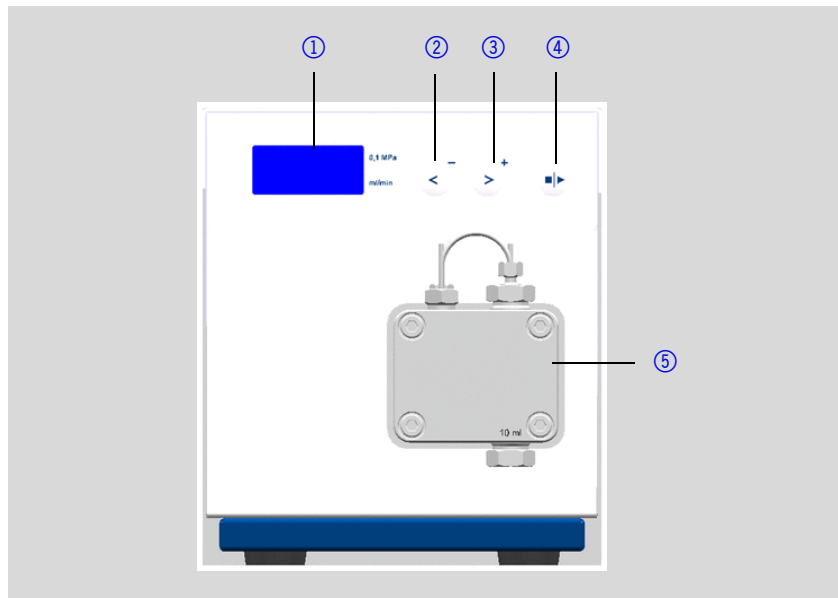


Fig. 4 Front view of the pump without pressure sensor

Rear View of the Device

Legend

- ① CE mark
- ② Opening of the fan
- ③ Serial number
- ④ RS-232 port
- ⑤ LAN connection
- ⑥ Terminal strip:
Remote
- ⑦ Power connection –
bushing
- ⑧ Hole for the ground
connection

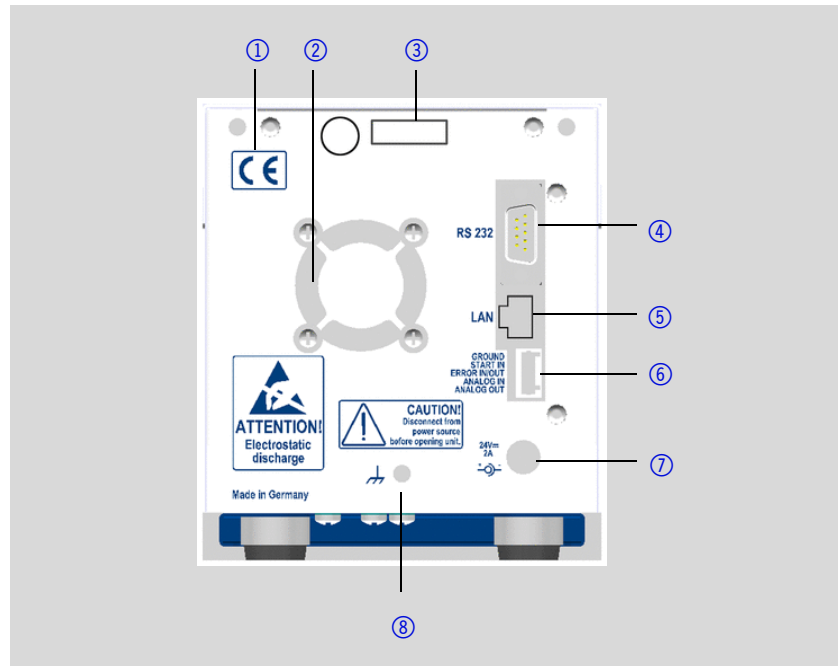


Fig. 5 Rear view of the pump without pressure sensor

Pump with Pressure Sensor

To disconnect the pump from the mains power, disconnect the power supply and then disconnect the power plug.

Front View of the Device

Legend

- ① Display
- ② Function button 1
- ③ Function button 2
- ④ Start/Stop key
- ⑤ Pump head
- ⑥ Ventilation screw
- ⑦ Pressure sensor

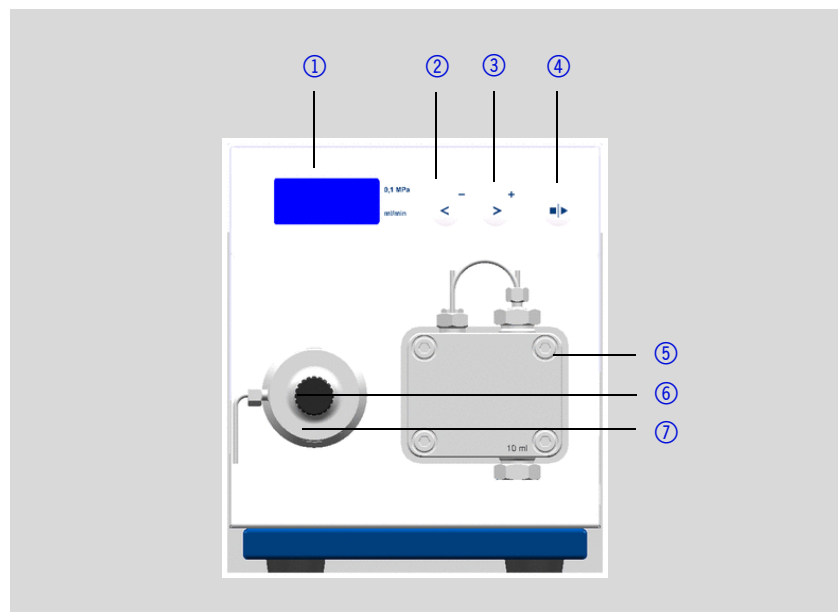


Fig. 6 Front view of pump with pressure sensor

Rear View of the Device

Legend

- ① CE mark
- ② Opening of the fan
- ③ Serial number
- ④ RS-232 port
- ⑤ LAN connection
- ⑥ Terminal strip:
Remote
- ⑦ Power connection –
bushing
- ⑧ Hole for the ground
connection

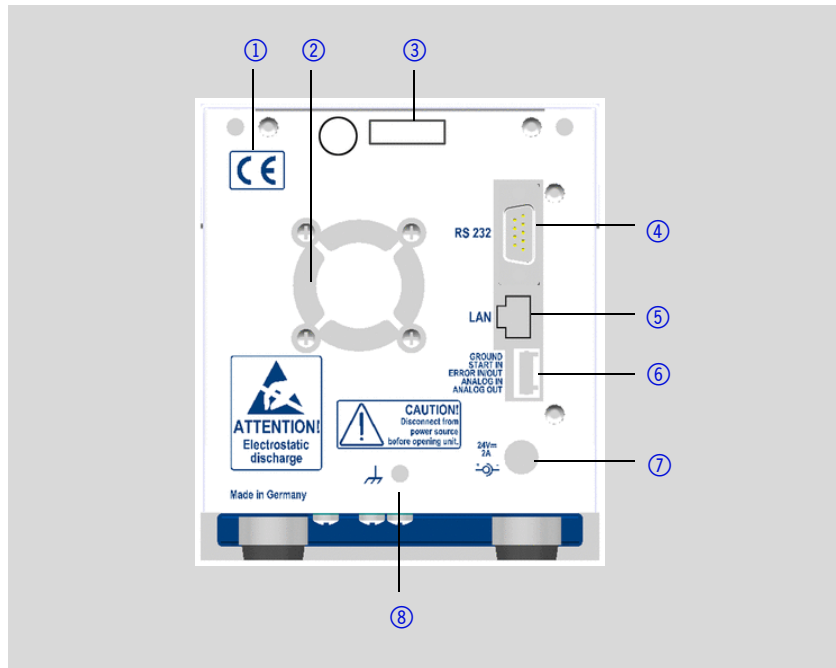


Fig. 7 Rear view of pump with pressure sensor

Connecting the Pump with other Devices

Controlling the Pump with Chromatography Software

The pump can be controlled individually or as part of a high-pressure gradient system by means of a computer and chromatography software.

Local Area Network and automatic Configuration

The pump is controlled either by means of the function keys on the front of the device, or by means of the chromatography software.

Remote control	Normally the pump is controlled by means of the chromatography software, via a local network (LAN).
Automatic configuration	A pump connected to a local area network (LAN) is automatically recognized by the chromatography software.
Device status	When used in a local area network (LAN), the system status of the pump can be verified by means of chromatography software.
LAN setting	Ex works, the pump is set to DHCP (Dynamic Host Configuration Protocol). This means that the pump is automatically assigned an IP address within the local network.

Electrical Connections

- Use the *Remote* terminal strip to connect the pump with external devices.
- Use the LAN connection to connect the pump with external devices within a network.
- Alternatively, connect the pump to a computer by means of the communication interface RS-232 port.

Attention! Electrostatic discharge can damage the electronics of the pump!
Never touch the electric contacts of the *Events* and *Remote* terminal strips.

External Control

Control commands	The control commands listed below are considered for the communication with RS-232 and LAN. When entering a parameter, you must place a colon or space between command and parameter value, e. g. PMIN10:100.
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Note Consider the following specifications for data transfer with RS-232 interface:

- 9600 baud
- 8 bit
- 1 stop-bit
- no parity check

Control command	Range and specification	Description
ADJ10(?)	RD/WR 100 – 2000	Adjust parameter for 10 ml pump head
ADJ50(?)	RD/WR 100 – 2000	Adjust parameter for 50 ml pump head
CORR10(?)	RD/WR 0 – 300	Correction parameter for 10 ml pump head
CORR50(?)	RD/WR 0 – 300	Correction parameter for 50 ml pump head
FLOW(?)	RD/WR 0 – 50000	Writing/reading the flow in $\mu\text{l}/\text{min}$
PRESSURE?	RD 0 – 400	Pressure readout in 0.1 MPa
PMIN10(?)	RD/WR 1 – 400	Minimum pressure for 10 ml pump head (in 0.1 MPa)
PMIN50(?)	RD/WR 150	Minimum pressure for 50 ml pump head (in 0.1 MPa)
PMAX10(?)	RD/WR 0 – 400	Maximum pressure for 10 ml pump head (in 0.1 MPa)
PMAX50(?)	RD/WR 0 – 150	Maximum pressure for 50 ml pump head (in 0.1 MPa)
IMIN10(?)	RD/WR 0 – 100	Minimum motor current for 10 ml pump head
IMIN50(?)	RD/WR 0 – 100	Minimum motor current for 50 ml pump head
IMAX10(?)	RD/WR 0 – 100	Maximum motor current for 10 ml pump head
IMAX50(?)	RD/WR 0 – 100	Maximum motor current for 50 ml pump head
HEADTYPE(?)	RD/WR 10, 50	Writing/reading the pump-head type
STARTLEVEL(?)	RD/WR 0,1	Sets logical level of the START-IN input to start the flow delivery
ERRIO(?)	RD/WR 0,1	Writing/reading the ERROR input/output, OUT (0) or IN (1)

Control command	Range and specification	Description
STARTMODE(?)	RD/WR 0,1	0 = Pump pauses after switch on 1 = Pump starts with last used flow rate at switch on
EXTCONTR	WR 0,1	0 = Prevents external flow control 1 = Allows flow control through analog input (1 V = 1(5) ml/min)
EXTFLOW?	RD	
IMOTOR?	RD 0 – 100	Motor current in relative units
LOCAL	WR	Put the instrument in local mode
REMOTE	WR	Put the instrument in remote mode
ERRORS?	RD	Returns 5 last saved errors
ON	WR	Start flow
OFF	WR	Stop flow

Terminal Strip: *Remote*

Sending and receiving start/control/error signals to and from external devices.

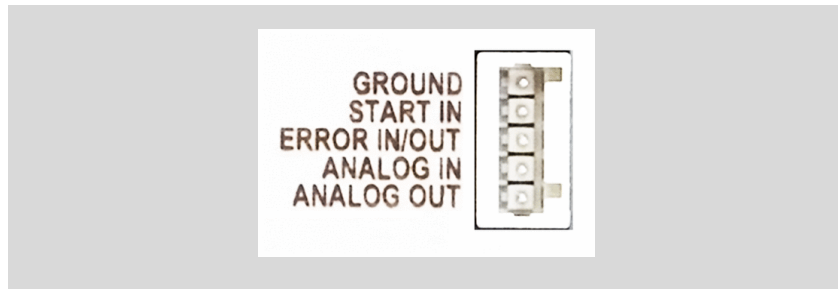


Fig. 8 Terminal strip: *Remote*


Signal	Explanation
GROUND	Ground reference for start and error signals
START IN	Connection for the short circuit (or <i>TTL-low</i>) to start and stop the operation of the pump.
ERROR IN/OUT	Connection for an input or output of an error signal (<i>open collector</i>). Example for the output: <ul style="list-style-type: none"> ▪ Counter pressure to high ▪ Pump stops due to a defect

Signal	Explanation
ANALOG IN	External control voltage (0–10 V) for controlling the flow rate, for example: <ul style="list-style-type: none"> 1 V for 1 ml/min in the case of the 10 ml pump head 1 V for 5 ml/min in the case of the 50 ml pump head
ANALOG OUT	Analog output signal for reproducing the measured system pressure.

ANALOG IN

The *control of the flow rate by an external control voltage* has to be prepared with a terminal program, for example with the Windows operating system program *HyperTerminal*:

Prerequisite The pump is connected to the power supply.

1. *Windows Start* ⇒ *All Programs* ⇒ *Accessories* ⇒ *Communication* ⇒ *HyperTerminal*.
2. Connect the pump using a LAN or RS-232.
3. Enter *EXTCONTR:1* to control the flow rate externally using ANALOG IN.
4. Apply control voltage.
5. Press the Start/Stop button, to start the pump. The star sign  on the display of the pump indicates that the pump is working with an externally controlled flow rate.

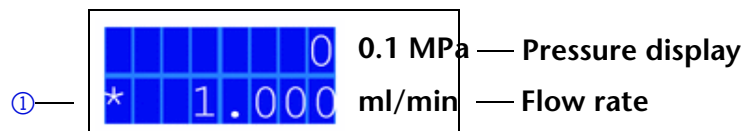


Fig. 9 Display of the Pump, ANALOG IN

Note The entry *EXTCONTR:0* (standard setting) in the terminal program disables the external control of the flow rate using ANALOG IN.

START IN

This is the connection for the short circuit (or TTL-low) to start and stop the operation of the pump. The operation of the pump is dependent on the *STARTLEVEL* setting:

- STARTLEVEL**
- *STARTLEVEL 1* (default setting): The pump does not operate during the short circuit period
 - *STARTLEVEL 0*: The pump operates during the short circuit period

Note: During the interruption, the horizontal arrow ① remains in the display, because the pump is still in operation status.

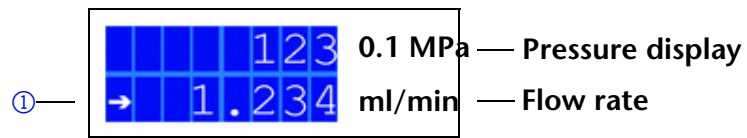


Fig. 10 Display of the pump, *START IN*

Enter in the terminal program `STARTLEVEL:0`, so that the pump operates during the short circuit period:

Prerequisite The pump is connected to the power supply.

1. Windows Start ⇒ All Programs ⇒ Accessories ⇒ Communication ⇒ HyperTerminal.
2. Connect the pump using a LAN or RS-232.
3. Enter `STARTLEVEL:0`.

STARTMODE

By default the pump is stopped and started using the Start/Stop button. The `STARTMODE` setting makes it possible that the pump is in operation directly after being connected to the power supply.

- `STARTMODE 0` (default setting): The pump does not operate directly after being connected to the power supply
- `STARTMODE 1`: The pump operates directly after being connected to the power supply

Enter in the terminal program `STARTMODE:1`, so that the pump operates directly after being connected to the power supply:

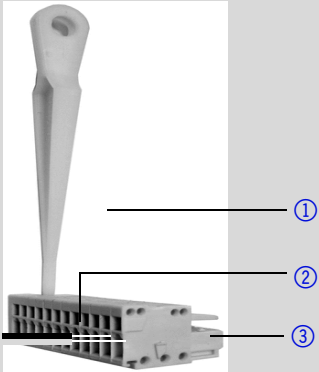
Prerequisite The pump is connected to the power supply.

1. Windows Start ⇒ All Programs ⇒ Accessories ⇒ Communication ⇒ HyperTerminal.
2. Connect the pump using a LAN or RS-232.
3. Enter `STARTMODE:1`.

Connecting the flat Ribbon Cable with the Connector Strip

To enable signal transmission from external devices to the pump, the flat ribbon cable is connected with a connector strip and connected to the *Remote* terminal strip on the rear of the pump.

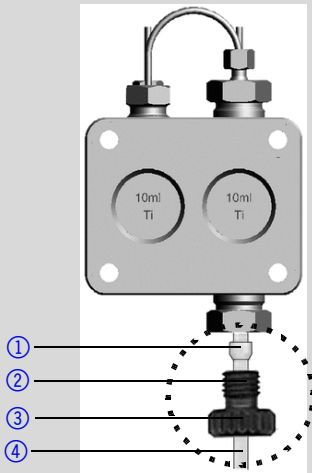
Connect the connector strip

Steps	Figure
<ol style="list-style-type: none"> 1. Place the connector strip ③ on a suitable surface. 2. Put the stylus ① in the opening on the top of the connector strip and press downward. 3. Keep the stylus pressed down and insert the cable ends ② into the front of the connector strip. 4. Remove the stylus. 5. Check whether the cables are tightly attached. 	 <p>Fig. 11 Connecting the flat ribbon cable with the connector strip</p>

Connecting the Eluent Line to the Pump Head

Note Make sure that the tapered side of the cutting ring points towards the fastening screw of the Teflon tube.

Connection eluent line at the pump head

Steps	Figure
<ol style="list-style-type: none"> 1. Push the Teflon tube ④ through the fastening screw ③ and the cutting ring ②. 2. Insert the tube end as far as possible into the inlet fitting ① of the pump head. 3. Tighten the fastening screw by hand. 	 <p>Fig. 12 Connect the eluent line to the pump head</p>

Operating the Pump

Note Operator errors and clogged capillaries can cause high pressure spikes.

To avoid damage to the pump head, never allow the pump to run without liquid in the pump head and piston backflushing components.

Switch-on and Self-test

After the device is switched on, *pump* and the firmware version appear on the display. The device performs a self-test. After all tests have been successfully completed, the status of the pump with its current flow rate is displayed. The pump is ready for operation.

- Switch-on and self-test**
1. Connect the external power unit to the power supply.
 2. Connect the pump with the plug of the external power unit.
 3. Wait until the pump has completed the self-test.

Display of the Pump

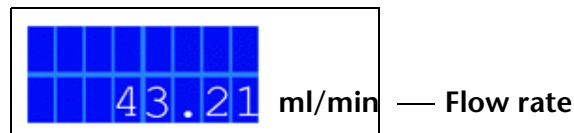


Fig. 13 Display of the pump (50 ml) without pressure sensor

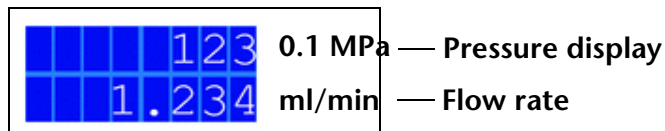
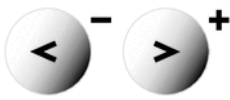



Fig. 14 Display of the pump (10 ml) with pressure sensor

Overview of the Function Buttons

Button	Function	Explanation
	<ul style="list-style-type: none"> ▪ Function button <ul style="list-style-type: none"> - Setting the values - Choosing the function 	<ul style="list-style-type: none"> ▪ Setting the flow rate ▪ Setting the maximum and minimum pressure ▪ Selecting the communication interface
	Start/Stop key	<ul style="list-style-type: none"> ▪ Switching the pump on and off ▪ Purging the pump

Communication Interface

- Terminal strip: *Remote*
- RS-232
- LAN

Setting the Communication Interface on the Device

1. Press both function buttons simultaneously to continue to the next display.
2. Repeat step 1 until the display of the first interface for communication.
3. Press one of the two function buttons to choose the appropriate interface for communication.
4. Press both function buttons simultaneously to continue on to the status display.



Fig. 15 *Display, select communication interface*

Setting the Flow Rate

The flow rate can be altered while the pump is in operation. In this case, the change takes effect immediately.

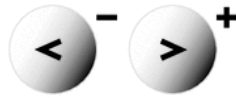
- Set the external flow rate with the chromatography software.
- Set the flow rate manually on the device.

Note In case of the pump without pressure sensor the actual produced flowrate is dependent on the resulting counter pressure.

The absolute deviation is dependent on the compressibility of the used solvent and on the pump. It must therefore be determined individually for each pump.

Setting the Flow Rate manually on the Device

Press one of the two function buttons to adjust the value of the current flow rate.



Practical tip! Hold down the function button to expedite changing the values.

Setting the Pressure Absorption

Due to the performance of the pump, intense pressures can build up in the bottom of the flow range.

Exceeding or undercutting the values for the maximum or minimum pressure leads to the pump being automatically shut-down.

1. Set maximum pressure to avoid damaging the pump or pump head.
2. Set minimum pressure to avoid running the pump dry.

Attention! Observe the permissible values for the maximum pressure depending on utilized pump head.

Setting the maximum and minimum Pressure

Note If the minimum is set to 0, the minimum pump pressure is not monitored.

In the display, the permissible maximum and minimum pressure of the pump is indicated by two vertical arrows ①.

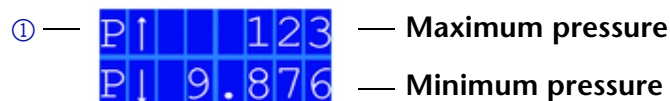


Fig. 16 Display, set pressure limits

Setting maximum and minimum pressure

1. Press both function buttons simultaneously to continue to the next display.
2. Repeat step 1 until the pressure absorption is displayed.
3. Press one of the two function buttons to enter the desired value for the maximum pressure.
4. Press both function buttons simultaneously to reach the display of the minimum pressure.
5. Press one of the two function buttons to enter the desired value for the minimum pressure.

6. Repeatedly press both function buttons simultaneously to return to the status display.

Note Using a pump without a pressure sensor makes setting the pressure limits not possible.

Setting the Power Consumption

The power consumption is dependent on the flow rate and the counter pressure. At high flow rates and strong counter pressure, the power consumption increases.

Exceeding or undercutting the values for the maximum or minimum power consumption leads to the pump being automatically shutdown.

- Set the maximum power consumption to avoid damages to the pump as well as pump head during a blockage or uncontrolled acceleration of the motors.
- Set the maximum power consumption for the pump without pressure sensor to limit the pump pressure.
- Set the minimum power consumption to avoid a dry run of the pump at highly reduced maximum power consumption (e. g. if leaking).

Note The values for minimum and maximum power consumption are proportional values to the current strength.


Standard Value for the maximum Power Consumption

The pump is preset to a standard value for the maximum power consumption. Therefore the optimal value can only be empirically determined from a sufficiently low value. The manufacturer recommends that with smaller flow rates the standard value for the maximum power consumption should be decreased.

Attention! Increase the standard value for the maximum power consumption only in small steps, if necessary.

Setting the maximum and minimum for the Power Consumption

Note If the minimum is set to 0, the minimum power consumption of the pump is not monitored.

In the display, the maximum and minimum power consumption of the pump is indicated by 2 vertical arrows .




 — Maximum power consumption
 — Minimum power consumption

Fig. 17 Display, power consumption

Setting the maximum and minimum power consumption

1. Press both function buttons simultaneously to continue to the next display.
2. Repeat step 1 until the power consumption is displayed.
3. Press one of the two function buttons to enter the desired value for the maximum power consumption.
4. Press both function buttons simultaneously to continue to the minimum power consumption.
5. Press one of the two function buttons to enter the desired value for the minimum power consumption.
6. Repeatedly press both function buttons simultaneously to return to the status display.

Starting and stopping the Pump

The Start/Stop button starts and stops the pump. The operation of the pump is displayed by a horizontal arrow  in the display.

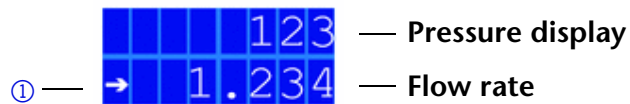


Fig. 18 *Display, starting the pump*

Attention! To avoid damages to the pump head, never operate the pump without fluids in the pump head and piston backflushing.

Starting and stopping the pump

1. Press the Start/Stop button to start the pump.
2. Press the Start/Stop button to stop the pump.

Purging the Pump

The purging process is displayed by 1 or 2 vertical arrows ① in the *display*.

The flow rate can be changed while being purged. The change takes effect immediately.

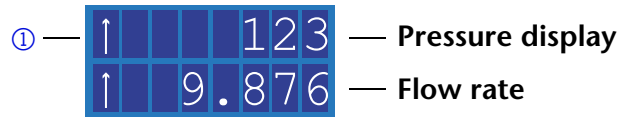


Fig. 19 *Display, purging the pump with pressure sensor*

Note Always unscrew the ventilation screw on the pressure sensor before purging the pump. Purging the pump without opening the ventilation screw leads to the device being automatically shutdown.

Purging the Pump without Pressure Sensor

1. Unscrew the outlet of the pump head to reduce counter pressure when purging.
2. Suck liquid in via a Luerlock syringe.
3. Hold the Start/Stop button for at least 1 second to start the purge function.

Purge the Pump with Pressure Sensor

1. Open the ventilation screw on the pressure sensor about a half turn.
2. Hold the Start/Stop button for at least 1 second to start the purge function.

Piston Backflushing

The piston backflushing increases the service life of the seals and pistons and removes contaminants from the area behind the seals.

Regularly clean the piston to avoid damages to the piston seals.

Recommended cleaning Solvents

- Water
- Mixture of 80% water and 20% methanol
- Isopropanol

Legend

- ① From the syringe to the inlet of the pump head
- ② From the outlet of the pump head to the waste bottle

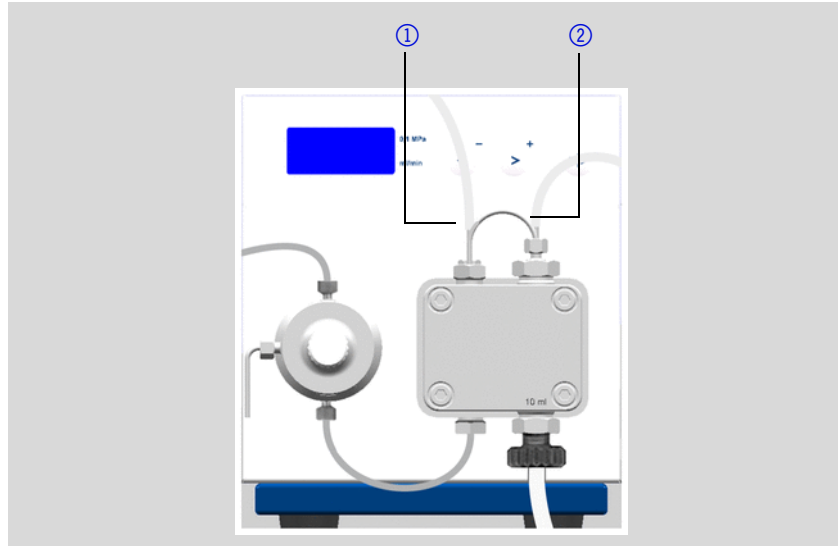


Fig. 20 Connectors piston backflushing

Variant 1

Piston backflushing, variant 1

1. Push two PTFE tubes onto the inlet and outlet of the pump head.
2. Insert the tube end in a waste bottle.
3. Fill the syringe with water or another suitable flushing fluid.
4. Connect the syringe with the second tube end.
5. Squeeze flushing fluid with the syringe through the pump head until the fluid runs into the waste bottle without air bubbles.
6. After purging, remove both tubes from the inlet and outlet of the pump head.
7. Connect the inlet and outlet of the pump head with a piece of tube to avoid the solvent from evaporating and the piston chamber from drying out.

Variant 2

Piston backflushing, variant 2

1. Push a PTFE tube onto the outlet of the pump head.
2. Insert the tube end in a waste bottle.
3. Insert the second PTFE tube into a container with flushing fluid.
4. Suck in flushing fluid to the syringe and push the tube end onto the inlet of the pump head.
5. Place the container so that the entire flushing fluid flows through the pump head due to gravity.
6. After purging, remove the tube from the inlet and outlet of the pump head.
7. Connect the inlet and outlet of the pump head with a piece of tube to avoid the solvent from evaporating and the piston chamber from drying out.

Maintenance and Care

Proper maintenance of your HPLC device will ensure successful analyses and reproducible results.

Contact with the Technical Support Hotline

Contact data for Technical support

If you have any technical questions regarding the hardware or software of the manufacturer, please use one of the contact options below:

Technical support hotline of the manufacturer:

European hotline

Languages: German and English
Available by telephone: 8 a.m. to 5 p.m. (CET)
Phone: +49-(0)30-809727-0
Fax: +49-(0)30-8015010

email: email: info@knauer.net

Maintenance Contract

The following maintenance work on the device may only be performed by the manufacturer or a company authorized by the manufacturer and is covered by a separate maintenance contract:

Opening the device or removing housing parts.

What maintenance tasks may users perform on the device?

Users may perform the following maintenance tasks themselves:

- Replacing the pump head
- Exchanging the ball valves

Tightening the Screw Fittings

1. Always tighten the inlet screw 1 ⑤ and the outlet screw 1 ② with a torque wrench and 15 Nm
2. Always hold the inlet fitting 1 ⑤ with a wrench when the capillary fitting ① is being tightened with a wrench.
3. Using an Allen wrench, screw in the opposite pairs of fastening screws ④ evenly and alternately to prevent the pump pistons on the inside from jamming.

Loosening the Screw Fittings

Using an Allen wrench, loosen the opposite pairs of fastening screws ④ evenly and alternately to prevent the pump pistons on the inside from jamming.

Legend

- ① Capillary screw fitting
- ② Outlet fitting 1
- ③ Inlet fitting 2
- ④ Fastening screw
- ⑤ Inlet fitting 1
- ⑥ Outlet fitting 2

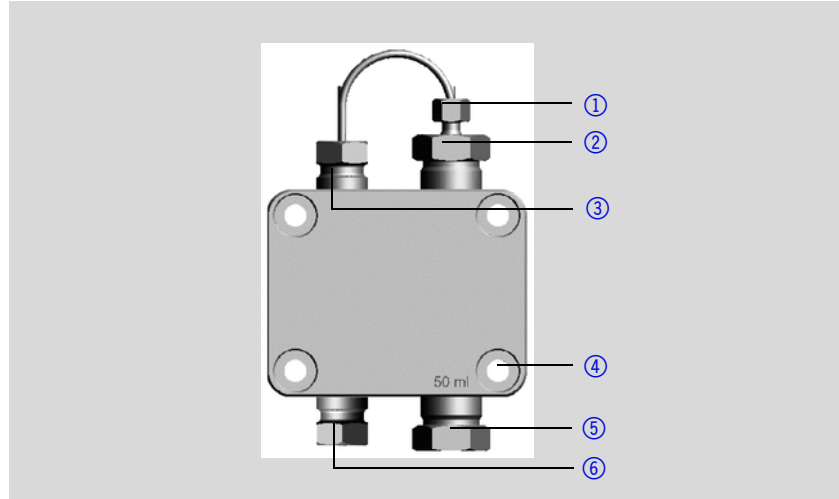


Fig. 21 Screw fittings on the pump head

Leaks in the Capillary Screw Fittings

Attention! If leaks occur on the capillary screw fittings after maintenance and proper assembly, do not tighten them further; instead replace them with new connection capillaries.

Replacing the Pump Head

Depending on the requirements of the user, different pump heads are used.

Prerequisite

The pump head has been purged.



**Aggressive or toxic solvent residue can irritate the skin!
Wear protective gloves!**

Removing the Pump Head

1. Remove the tubes from the inlet and outlet of the piston backflushing ①.
2. Unscrew the eluent line ④.
3. Unscrew the outlet fitting 2 ⑤ and the inlet fitting of the pressure sensor ⑥ to remove the capillary.
4. Loosen the opposite pairs of fastening screws ② on the pump head evenly and alternately.
5. Hold the pump head by hand, and consecutively pull out all fastening screws.
6. Remove the pump head.

Legend

- ① Inlet and outlet of the piston backflushing
- ② Fastening screw
- ③ Inlet fitting 1
- ④ Eluent line
- ⑤ Outlet fitting 2
- ⑥ Inlet fitting of the pressure sensor

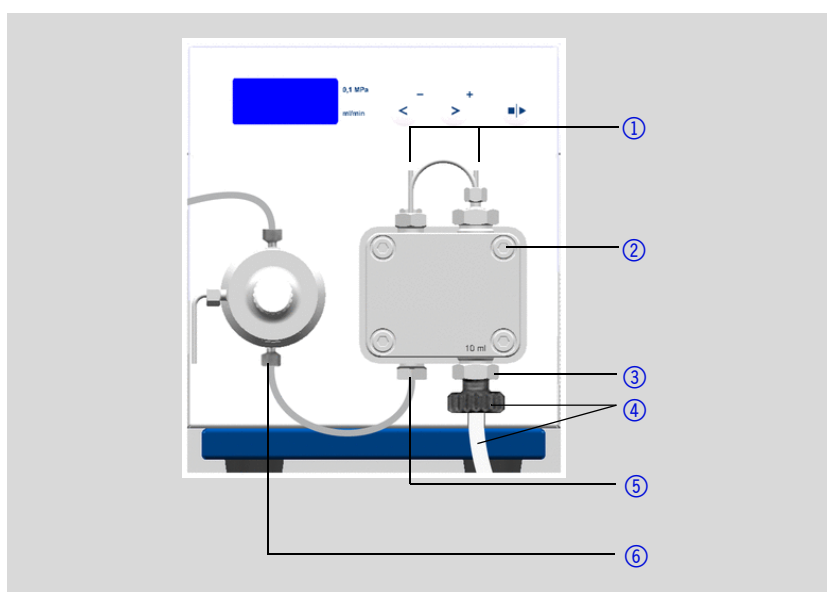


Fig. 22 Exchange the pump head

Installing the Pump Head

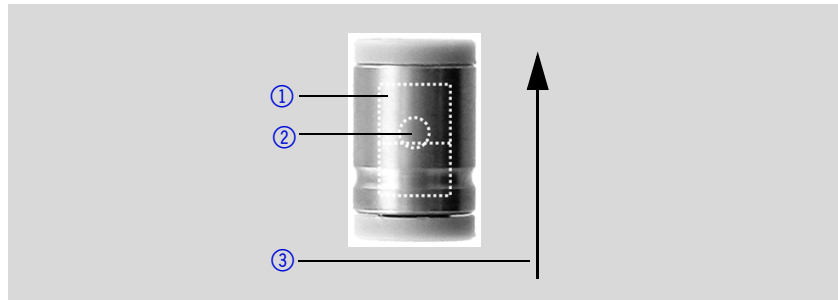
1. Screw in the opposite pairs of fastening screws ② evenly and alternately.
2. Tighten all fastening screws evenly with an Allen key.
3. Screw in the capillary with outlet fitting 2 ⑤ and inlet fitting pressure sensor ⑥ and tighten with a wrench.
4. Connecting the eluent line to the pump head.

Exchanging the Ball Valves

Note The ball and position of the valves have been harmonized to each other. Insert the valves in the direction of flow!

Legend

- ① Ball valve
- ② Ball (dotted line)
- ③ Flow direction (arrow)



Functional principle of the ball valve

Dirty ball valves do not open and close correctly. They cause pressure fluctuations and irregular flow.

Purge the pump head before changing the ball valve.

Removing the Ball Valves

Note Loosen the screw fittings of the capillary connections alternately, to prevent the capillaries from bending.

1. Unscrew the inlet fitting 2 ① and capillary fitting ② .
2. Unscrew outlet fitting 1 ③ .
3. Remove the ball valve.
4. Unscrew Inlet fitting 1 ⑤ .
5. Remove the ball valve.

Legend

- ① Inlet fitting 2
- ② Capillary screw fitting
- ③ Outlet fitting 1
- ④ Ball valve
- ⑤ Inlet fitting 1

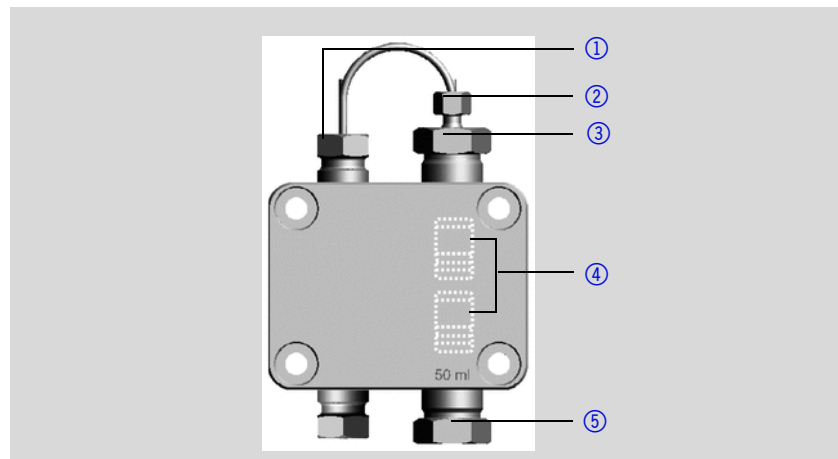


Fig. 23 Exchanging the ball valves

Cleaning the Ball Valves

1. Put the valve in a beaker with rinsing solvent, for example methanol or isopropanol.
2. Put the beaker in an ultrasonic bath for at least 10 minutes.

Installing the Ball Valves

1. Insert both ball valves.
2. Screw in the outlet fitting 1 ③ and tighten to 15 Nm with a torque wrench.
3. Screw in the inlet fitting 1 ⑤ and tighten to 15 Nm with a torque wrench.
4. Screw in the inlet fitting 2 ① and capillary fitting ② and tighten with a wrench.

Cleaning and caring for the Device



Risk of electrical shock or short circuit if cleaning solution enters the device's interior! Moisten the cleaning cloth only slightly.

All smooth surfaces of the device can be cleaned with a mild, commercially available cleaning solution, or with isopropanol.

Clean display

The display of the devices can be cleaned with isopropanol and wiped dry with a soft, lint-free cloth.

Disposal

Drop-off old devices at the certified waste facilities, where they will be disposed of properly.

AVV marking According to the German "Abfallverzeichnisverordnung" (AVV) (January, 2001), old devices manufactured by KNAUER are marked as waste electrical and electronic equipment: 160214

WEEE registration KNAUER as a company is registered by the WEEE number DE 34642789 in the German "ElektroAltgeräteRegister" (EAR). It belongs to category 8, under which fall all medical devices and laboratory equipment.

Within the meaning of the WEEE directive, all distributors and importers are responsible for the disposal of old devices. End-users can send their old devices, which must have been manufactured by KNAUER, back to the distributor, the importer, or the company free of charge, but would be charged for their disposal.

Decontamination

Contamination of devices with toxic, infectious or radio-active substances poses a hazard for all persons during operation, repair, sale and disposal of a device.



Danger caused by toxic, infectious, or radio-active substances! A contaminated device must never be submitted for repairs, sold, or disposed of!

Contract a specialist company to decontaminate the device or perform the decontamination yourself if you have the required expertise!

All contaminated devices must be properly decontaminated by a specialist company or the operating company before they can be recommissioned, repaired, sold, or disposed of.

All materials or fluids used for decontamination must be collected separately and disposed of properly.

Storage

Ambient storage conditions for the device

Temperature range: 4–40 °C; 39.2–104 °F

Air humidity: Below 90% humidity (non-condensing)

Troubleshooting

First measures for troubleshooting:

- Check all screw fittings
- Check whether air has gotten into the supply lines
- Check device for leaks

Further measures:

- Check errors against error list
- Contact the technical support hotline of the manufacturer

Error List and Solutions

Problem	Solution
Pump will not turn on	<p>The power cable must be connected to the power supply.</p> <ul style="list-style-type: none"> • Inspect the power cable to ensure that it is plugged into the power supply.
When purging, the pump switches off	<p>The ventilation screw on the pressure sensor must be turned up.</p> <ul style="list-style-type: none"> • Check if the ventilation screw on the pressure sensor is turned up.
Pump does not transport solvent	<p>Check the following options:</p> <ul style="list-style-type: none"> ▪ Purge the pump head to remove the air bubbles ▪ Inspect the eluent filter of the HPLC column and change when blocked ▪ Exchange the pump head ▪ Clean the ball valves ▪ Exchange the ball valves ▪ If the pump head seals are defective, solvent enters the piston backflushing; inform the technical support of the manufacturer.
Pressure or flow rate fluctuations	<p>Check the following options:</p> <ul style="list-style-type: none"> ▪ Purge the pump head to remove the air bubbles ▪ Always tighten the inlet screw 1 and outlet screw 1 on the pump head with a torque wrench and 15 Nm. ▪ Clean the ball valves ▪ Exchange the ball valves

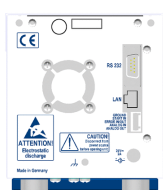
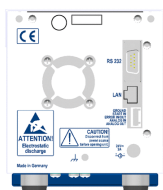
Problem	Solution
Pump head leaks	Check the following options: <ul style="list-style-type: none">▪ Inspect the inlet and outlet screw fittings of the pump head▪ Exchange the pump head▪ If the pump head seals are defective, solvent enters the piston backflushing; inform the technical support of the manufacturer
Flow rate is not correct	Check the following options: <ul style="list-style-type: none">▪ Inspect the inlet and outlet screw fittings of the pump head▪ Clean the ball valves▪ Exchange the ball valves▪ Exchange the pump head▪ Pump without pressure sensor: take the pressure into account (no compensation)▪ Inform the technical support of the manufacturer

Technical Data

Ambient Conditions

Temperature range	4–40 °C; 39.2–104 °F
Air humidity	below 90% humidity (non-condensing)

Pumps



Conveying system	Dual-piston pump with main and auxiliary piston
Flow rate range	<ul style="list-style-type: none"> ▪ 10 ml pump head: 0.001–10.000 ml/min ▪ 50 ml pump head: 0.01–50.00 ml/min
Maximum pressure	<ul style="list-style-type: none"> ▪ 10 ml pump head: 40 MPa up to 10 ml/min $I_{max} = 70$ ▪ 50 ml pump head: 15 MPa up to 50 ml/min $I_{max} = 80$
Flow rate accuracy	<ul style="list-style-type: none"> ▪ $\pm 1\%$ (1 ml/min) ▪ For pumps dependent on pressure with out a pressure sensor
Flow rate precision	Relative standard deviation RSD: < 0.5% (1 ml/min)
Gradients	<ul style="list-style-type: none"> ▪ Isocratic HPLC pump ▪ Expandable for the high pressure gradient system (HPG) with up to 4 eluents (controlled by software)
System protection	<ul style="list-style-type: none"> ▪ Pump with pressure sensor: <ul style="list-style-type: none"> - P_{min} and P_{max} adjustable - I_{min} and I_{max} adjustable ▪ Pump with pressure sensor: I_{min} and I_{max} adjustable
Control	<ul style="list-style-type: none"> ▪ LAN ▪ RS-232 ▪ Terminal strip: <i>Remote</i> ▪ Buttons on the device

Pump with integrated power unit: Supply voltage range	100–240 V
Pump with integrated power unit: Supply frequency	50–60 Hz
Pump with external power unit and power cable: Mains connection	24 V, 50 VA
Active power consumption	Maximum 40 W
IP protection class	IP 20
Weight	<ul style="list-style-type: none"> ▪ Pump without pressure sensor: 2.3 kg ▪ Pump with pressure sensor: 2.4 kg
Dimensions including components (length x width x height)	<ul style="list-style-type: none"> ▪ Pump without pressure sensor: 220 x 121 x 138.1 mm ▪ Pump with pressure sensor: 227.8 x 121 x 138.1 mm

Legal Information

Warranty Conditions

The factory warranty for the device is valid for 12 months after the date of dispatch. All warranty claims shall expire in the event that any unauthorized changes are made to the device.

During the warranty period, any components with material or design-related defects will be replaced or repaired by the manufacturer free of charge.

This warranty excludes the following:

1. Accidental or willful damage
2. Damage or errors caused by third parties that are not contractually related to the manufacturer at the time the damage occurs
3. Wear parts, fuses, glass parts, columns, light sources, cuvettes and other optical components
4. Damage caused by negligence or improper operation of the device and damage caused by clogged capillaries
5. Packaging and transport damage

In the event of device malfunctions, directly contact the manufacturer.

Manufacturer

Wissenschaftliche Gerätebau
Dr. Ing. Herbert KNAUER GmbH
Hegauer Weg 38
14163 Berlin, Germany
Phone: +49 30 809727-0
Fax: +49 30 8015010
E-Mail: info@knauer.net
Internet: www.knauer.net

Transportation Damages

The packaging of our devices provides the best possible protection against transportation damage. Check the devices for signs of transportation damages. In case you notice any damage, contact the technical support and the forwarder company within three workdays.

Declaration of Conformity

**Manufacturer name
and address** Wissenschaftliche Gerätebau
Dr. Ing. Herbert KNAUER GmbH
Hegauer Weg 38
14163 Berlin, Germany

Pump 10P/20P Product number:

- 10P: C56103.0, C56101.0, C56113.0, C56111.0
- 20P: C56203.0, C56201.0, C56213.0, C56211.0

The device complies with the following requirements and product specifications:

- DIRECTIVE 2006/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast)
- IEC 60799 (1998) Electrical accessories – Cord sets and inter-connection cords
- IEC 61010-1 (2010 + Corrigendum: 2011) Safety requirements for electrical equipment for measurement, control and laboratory use
 - Low voltage directive (2006/95/EC)
- EN 61000-3-2 (2005 + A1:2008 + A2:2009) Electromagnetic compatibility (EMC) Part 3-2
 - EMC standard (2004/108/EC)
- IEC 61326-1 (2006) Electrical equipment for measurement, control and laboratory use – EMC requirements
 - EN 61326-1 Corrigendum 2 (2011)
- Directives for an environmentally sound use of electrical and electronic equipment
 - RoHS directives 2002/95/EC (2003) and 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment
 - WEEE directive 2002/96/EC (2003) on waste electrical and electronic equipment

The product was tested with a typical configuration.

Berlin, 10/17/2012



Dr. Alexander Bünz (Managing Director)

The mark of conformity has been applied to the rear panel of the device.



Abbreviations and Terminology

Here you can find information on the abbreviations and terminology used in this manual.

Terminology	Explanations
GLP	Good Laboratory Practice – quality assurance for laboratories.
HPG	High Pressure Gradient (HPG) Operating mode of an HPLC system. The solvent is mixed on the high pressure side of the pump.
HPLC	High Performance Liquid Chromatography (HPLC).
Remote	The chromatography software controls the pump.
Solvent	Mobile phase (eluent) or carrier for liquid chromatography

Table of Figures

Fig. 1:	Pump without pressure sensor, external power unit	6
Fig. 2:	Pump with pressure sensor, external power unit	6
Fig. 3:	Labeling on the pump heads	17
Fig. 4:	Front view of the pump without pressure sensor	17
Fig. 5:	Rear view of the pump without pressure sensor	18
Fig. 6:	Front view of pump with pressure sensor	18
Fig. 7:	Rear view of pump with pressure sensor	19
Fig. 8:	Terminal strip: <i>Remote</i>	22
Fig. 9:	Display of the Pump, <i>ANALOG IN</i>	23
Fig. 10:	Display of the pump, <i>START IN</i>	24
Fig. 11:	Connecting the flat ribbon cable with the connector strip	25
Fig. 12:	Connect the eluent line to the pump head	25
Fig. 13:	Display of the pump (50 ml) without pressure sensor	26
Fig. 14:	Display of the pump (10 ml) with pressure sensor	26
Fig. 15:	Display, select communication interface	27
Fig. 16:	Display, set pressure limits	28
Fig. 17:	Display, power consumption	30
Fig. 18:	Display, starting the pump	30
Fig. 19:	Display, purging the pump with pressure sensor	31
Fig. 20:	Connectors piston backflushing	32
Fig. 21:	Screw fittings on the pump head	35
Fig. 22:	Exchange the pump head	36
Fig. 23:	Exchanging the ball valves	37

Index

A

Abbreviations **48**
AC system **7**
Accessories **14**
Ambient conditions **15**
ambient conditions **41**
AVV marking **39**

B

Ball valves
 cleaning **37**
 exchanging **36**
 installing **37**
 removing **37**

C

Care **34, 37**
CE-Zeichen, siehe Konformitätserklärung **47**
Chromatography software **20**
Cleaning **37**
Communication
 interfaces **27**
Contact **34**
Controlling the pump **20, 26**

D

Dead volume **11**
Decontamination **40**
Delivery program **46**
Disconnecting from power supply **15**
Disposal **39**

E

Electrical connections **22**
 remote terminal strip **20**
Eluent line
 connecting the pump head **25**
Environmental protection **39**
Explosion hazard **7**

F

Features **8**
Filter **11**
Fittings
 tightening **34**
Flammability **9**
Flashpoint, see self-ignition point **10**
Function buttons **27**

G

Gradient grade, filtered solvent **11**

H

Hotline **34**
HPG
 mode **16**
HPLC System
 operation **11**

I

Installation **14**
Installation site **15**
Isocratic
 mode **16**

K

Konformitätserklärung **47**

L

Labeling, pump head **17**
Laboratory regulations **9**
Laboratory use **7**
LAN **20**

Leaks **9**
 on capillary screw fittings **35**

M

Mains connection **10**
 ground connection **11**
Maintenance **34**
 by user **34**
 maintenance contract **34**

Manufacturer **46**

Markings **13**

Mode
 HPG **16**
 isocratic **16**

Module safety **9**

O

Operating mode **16**
Operation
 device **11**
Order numbers **48**
Original accessories **14**

P

PEEK connection **10**
Piston backflushing **31**
Power plug **15**
Power supply **10, 11**
Protective film **14**
Protective measures **10**
Pump
 device types **6**
 pump with pressure sensor, version A **18**
 pump without pressure sensor, external power supply **17**
Pump control **26**
Pump head **16**
 exchanging **35**
 installing **36**
 labeling **17**
 removing **35**
Purging the pump **31**
 with pressure sensor **31**
 without pressure sensor **31**

R

Remote terminal strip **22**
Room ventilation **7**

S

Safety **9**
Scope of delivery **14**
Screw fittings
 loosening **35**
Self-ignition point **10**
Self-test **26**
Setting the flow rate **27**
Setting the power consumption **29**
 maximum **29**
 minimum **30**
Setting the pressure sensor **28**
 maximum **28**
 minimum **28**
Solvent
 suitable **9**
 suitable to a limited extent **10**
 toxicity **10**
 unsuitable **9**
Solvent bottles **10**
Solvents **9**
Solvents, suitable **9**
Space requirements **15**
Startup **16**
storage **41**

Sunlight **7**
Switch-on **26**
Symbols **13**

T

Target group **11**
Technical data **44**
Technical support **34**
Toxicity **10**
 solvent **10**
Transportation damages **46**
Troubleshooting **42**

U

Use, intended **6**
User **11**

W

Warnings **9**
Warranty **46**

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