

Azura

Pump P 2.1S/P 4.1S

User Manual



HPLC



For your own safety, read the manual and always observe the warnings and safety information on the device and in the manual

Manuel en français:

Si jamais vous préférez un manuel en français pour ce produit, veuillez vous contacter le support technique (Technical Support) par email ou par fax avec le no. de série. Merci beaucoup.

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Note for BlueShadow Products:

The contents of this user manual apply for the BlueShadow product. Please submit a request on any article numbers for BlueShadow.

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Product information



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

Device overview

The HPLC pumps P 4.1S/ P 2.1S with pump heads can be used as feed pumps or dosing pumps in analytical or preparative applications. Pumps transport solvents or dissolved samples through the HPLC system.

Connecting external devices

External devices like a computer can be connected with the pump in 3 different ways:

- via LAN connector within a network
- Connected to RS232, alternately to LAN connection
- Via the pin head

Operating ranges

In laboratories the device can be used in the following areas:

- biochemical analysis
- food analysis
- pharmaceutical analysis
- environmental analysis
- chemical analysis
- Dosing applications

Views

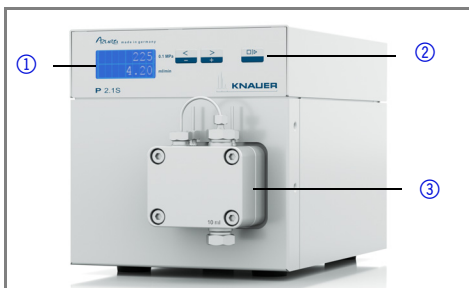


Fig. 1 Pump 2.1S with 10 ml pump head

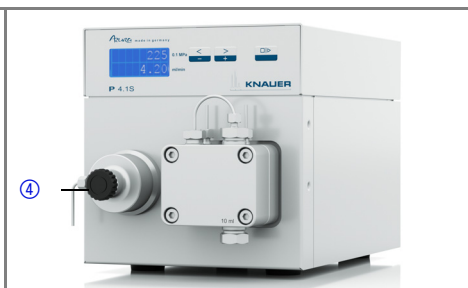


Fig. 2 Pump 4.1S with 10 ml pump head

Legend

- ① Display
- ② Keypad

- ③ Pump head
- ④ Pressure sensor

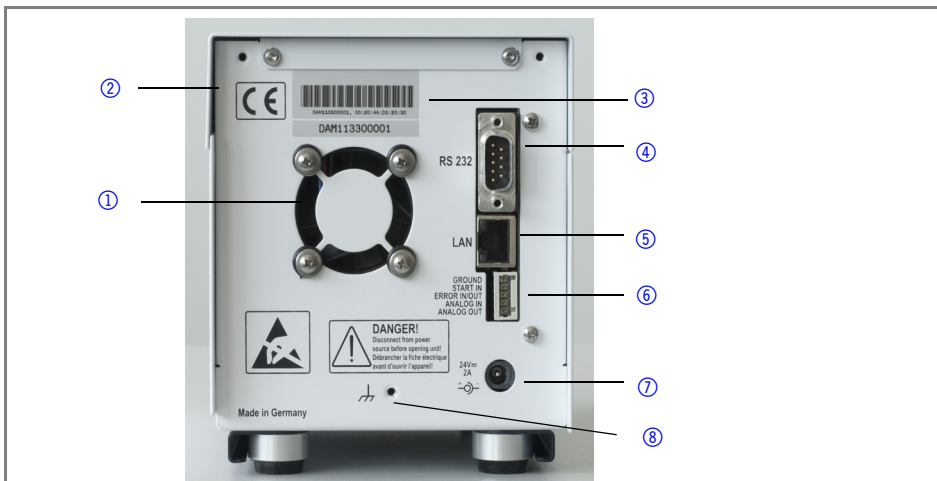


Fig. 3 Pump, rear view

Legend

- | | |
|-----------------|----------------------------------|
| ① Fan | ⑤ LAN connector |
| ② CE mark | ⑥ Pin header for remote control |
| ③ Serial number | ⑦ Power-connection bushing |
| ④ RS-232 port | ⑧ Hole for the ground connection |

Features

- Analytical pump head with a flow rate range from 0.001 - 9.999 ml/min and a pressure of up to 400 bar
- Analytical pump head with a flow rate range from 0.01 - 50 ml/min and a pressure of up to 150 bar
- Dual-piston technology for constant flow rates
- Setting a limit for minimum and maximum pressure to protect the HPLC columns and to avoid a dry run of the pump (only P 4.1S)
- Emergency stop, independent from control with chromatography software
- The pump can be controlled with the keypad in standalone mode or with the chromatography software.
- The pump heads can be easily removed and replaced via four front-accessible screws by the user.
- Unlike the pump P 2.1S, pump P 4.1S is equipped with a pressure sensor.

Performance range

- Liquid transport with stable flow rate and high flow accuracy
- Long service life
- Pump head made of stainless steel or with Hastelloy-C® or ceramic inlays

- Piston backflushing
- High physical and chemical stability
- Flexible control with LAN connection, RS-232 interface, and analog control signals
- Control with chromatography software

Options

A pump in combination with another pump can be used optionally to set up a binary high pressure gradient system.

Pump heads

Pump head for use in analytical applications:

- Stainless steel with stainless steel inlays for standard applications
- Stainless steel with ceramic inlays for biocompatible applications.
- Stainless steel with Hastelloy-C® inlays for corrosive media
- Different pump head sizes: 10 ml or 50 ml

The front of the pump head is labeled with the max. pumping capacity (10 ml or 50 ml). Pump heads with inlays are additionally labeled with the respective material (SST for stainless steel, Ti for titanium, C for ceramic, HC for Hastelloy-C®).

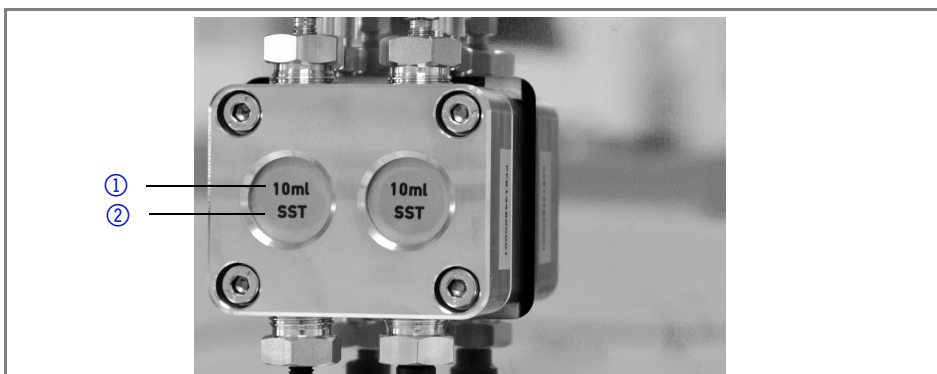


Fig. 4 Pump head with inlays

Legend

- ① Flow rate
- ② Material

Scope of delivery



Only use original parts and accessories made by KNAUER or a company authorized by KNAUER.

- Power cable
- User manual (German/English)
- Installation Qualification document ("IQ", English)
- AZURA accessories kit
- P 2.1S/P 4.1S accessories kit

Safety

Professional Group

The user manual addresses persons who are qualified as chemical laboratory technicians or have completed comparable vocational training.

The following knowledge is required:

- Fundamental knowledge of liquid chromatography
- Knowledge regarding substances that are suitable only to a limited extent for use in liquid chromatography
- Knowledge regarding the health risks of chemicals
- Participation during an installation of a device or a training by the company KNAUER or an authorized company.

If you do not belong to this or a comparable professional group, you may not perform the work described in this user manual under any circumstances. In this case, please contact your superior.

Safety Equipment

When working with the device, take measures according to lab regulations and wear protective clothing:

- Safety glasses with side protection
- Protective gloves
- Lab coat

What must be taken into account?

- All safety instructions in the user manual
- The environmental, installation, and connection specifications in the user manual
- National and international regulations pertaining to laboratory work
- Original spare parts, tools, and solvents made or recommended by KNAUER
- Good Laboratory Practice (GLP)

- Accident prevention regulations published by the accident insurance companies for laboratory work
- Filtration of substances under analysis
- Use of inline filters
- Once they have been used, never re-use capillaries in other areas of the HPLC system.
- 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.
- Follow KNAUER or manufacturer's instructions on caring for the columns.

More safety-relevant information is listed below:

- 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.
- solvent tray: Risk of electrical shock or short circuit if liquids get into the device's interior. For this reason, place all bottles in a solvent tray.
- solvent lines: Install capillaries and tubing in such a way that liquids cannot get into the interior in case of a leak.
- leaks: Regularly check if any system components are leaking.
- power cable: Defective power cables are not to be used to connect the device and the power supply system.
- self-ignition point: Only use eluents that have a self-ignition point higher than 150 °C under normal ambient conditions.
- power strip: If several devices are connected to one power strip, always consider the maximum power consumption of each device.
- power supply: Only connect devices to voltage sources, whose voltage equals the device's voltage.
- toxicity: Organic eluents 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!

Where is use of the device prohibited?

Never use the system in potentially explosive atmospheres without appropriate protective equipment. For further information, contact the Technical Support of KNAUER.

Secure decommissioning

At any time, take the device completely out of operation by either switching off the power switch or by pulling the power plug.

Opening the Device

The device may be opened by the KNAUER Technical Support or any company authorized by KNAUER only.

Signal words

Possible dangers related to the device are divided into personal and material damage in this user manual.



Lethal injuries will occur.



Serious or moderate injuries can occur.



Minor injuries can occur.



Device defects can occur.

Decontamination

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



Life-threatening injuries

Health danger if getting in contact with toxic, infectious or radio-active substances.

→ Before disposing of the device or sending it away for repair, you are required to decontaminate the device in a technically correct manner.


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.



Decontamination Report

Devices without a completed Decontamination Report will not be repaired. If you would like to return a device to KNAUER, make sure to enclose a completed Decontamination Report with the device: <http://www.knauer.net/en/knowledge/downloads/service.html>

Symbols and signs

The following symbols and signs can be found on the device, in the chromatography software or in the user manual:

Symbol	Meaning
	Electric shock hazard

Symbol	Meaning
	Electrostatic discharge hazard, damages to system, device, or components can occur.
	A device or system marked with CE fulfills the product specific requirements of European directives. This is confirmed in a Declaration of Conformity.

Unpacking and setup

Preparations

Work location

Only if the requirements for ambient conditions of the operating environment are met, can the intended use be ensured. Details on the operating conditions can be found in the Technical Data section.

NOTICE

Device defect

The device overheats at exposure to sunlight and insufficient air circulation. Device failures are very likely.

- Set up the device in such a way that it is protected against exposure to direct sunlight.
- Keep at least 15 cm clear at the rear and 5-10 cm at each side for air circulation.

Space requirements

- At least 5 cm if another device is set up on one side
- At least 10 cm if further devices are set up on both sides
- At least 15 cm on the rear panel for the fan.
- Leave the power plug on the rear of the device accessible to be able to disconnect the device from the mains.

General requirements

- Position the device on a level and even surface.
- Protect the device against direct exposure to sunlight.
- Set up the device at a location not exposed to air drafts (A/C systems).
- Do not set up the device near other machines that cause floor vibrations.

Power supply

Use only the enclosed power cable to connect the device to the mains to make sure that the specifications stated in Technical Data are met. But check beforehand to use power cables admitted for use in your country. Replace defective power cables only with accessories from KNAUER. Detachable power cables must not be replaced with different cable types.

NOTICE

Electronic defect

Electronic hazard when using an identically constructed power adapter from another manufacturer.

→ Only use original parts and accessories made by KNAUER or a company authorized by KNAUER.

Prerequisites

- The electrical power supply at the installation site must be connected directly to the nearest main power line.
- The power must be free from ripple, residual current, voltage peaks and electromagnetic interference.
- The connectors for the mains voltage are grounded accordingly.
- The device receives sufficient power with reserve capacity.

Power plug

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



The nominal capacity of the connected devices must be maximum 50 % of the power supply to account for larger inrush currents when switching on the modules.

Unpacking the device

Prerequisite

Check packaging for damage caused during transportation. If necessary, put forward any claim for damages to the carrier.

Tools

Utility knife



Bruising danger

Damage to the device by carrying or lifting it on protruding housing parts. The device may fall and thus cause injuries.

→ Lift the device only centrally on the side of the housing.

Process

1. Set up the package in such a way that you can read the label. Using the utility knife, cut the adhesive tape and open the packaging.
2. Remove the foam insert. Take out the accessory kit and the manual.
3. Open the accessory kit and check the scope of delivery. In case any parts are missing, contact the Technical Support.
4. Clasp the device from below, lift it out of the packaging and place it on its feet. Do not hold onto the front cover.
5. Check the device for signs of damage that occurred during transport. In case you notice any damage, contact the Technical Support.
6. Place the device in its site of operation and remove protective foil.

Next steps

Store packaging and keep the included packing list for repeat orders.

Removing transport protection

Foam parts are inserted between the ends of the pump capillaries and the housing ① as transport protection to prevent damages of the paintwork during transportation. After setting up the device, the foam parts can be removed. In case of a new transport or storage, the foam parts should be inserted between the capillaries and the device.

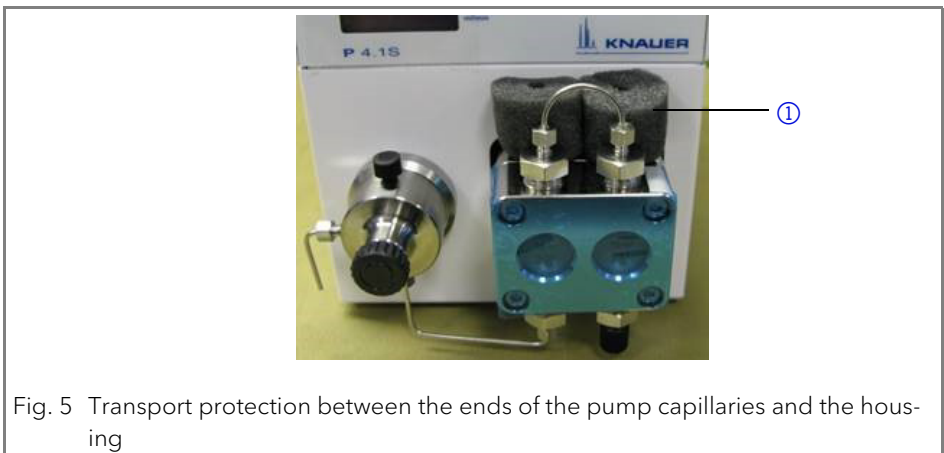


Fig. 5 Transport protection between the ends of the pump capillaries and the housing

Connecting the eluent line to the pump head

Prerequisites

- The device has been switched off.
- The power plug has been pulled.

Tools

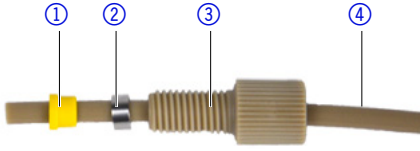

- Flangeless fitting
- Flat seal

NOTICE

Device defect

The pump can get damaged if the inlet and outlet are blocked.

→ Remove the cap fittings from the inlet and outlet of the pump head prior to use.

Process	Figure
<ol style="list-style-type: none"> 1. Stick the tube ④ through the nut ③. 2. Stick the tube through the seal ring ②. The narrow end must point away from the nut. 3. Stick the cutting ring ① onto the tube. 	 <p data-bbox="562 879 1028 948">Fig. 6 Tube with nut, seal ring and cutting ring</p>
<ol style="list-style-type: none"> 4. Insert the tubing into the free inlet ⑤ on the bottom of the pump head. 5. Tighten the fitting by hand. 	 <p data-bbox="562 1378 1028 1412">Fig. 7 Solvent line on pump head</p>

Next Steps

Integrate the pump into the HPLC flow system.

Connecting the device to the computer

Hinweis: HPLC devices made by KNAUER work only with IP addresses which are assigned via IPv4. IPv6 is not supported.

This section describes how to set up an HPLC system in a local area network (LAN) and how a network administrator can integrate this LAN into your company network. The description applies to the operating system Windows and all conventional routers.

To set up a LAN, we recommend to use a router. That means the following steps are required:

Process

1. On the computer, go to the control panel and check the LAN properties.
2. Hook up the router to the devices and the computer.
3. On the computer, configure the router to set up the network.
4. Install the chromatography software from the data storage device.
5. Switch on the device and run the chromatography software.

Configuring the LAN settings

The LAN uses only one server (which is normally the router) from that the devices automatically receive their IP address.

Prerequisite

- In Windows, power saving, hibernation, standby, and screen saver must be deactivated.
- In case you use an USB-to-COM box, the option "Allow the computer to turn off this device to save power" in the devicemanager must be deactivated for all USB hosts.
- For all LAN devices: For the network adapter, the following option in the Device Manager must be deactivated: "Allow the computer to turn off this device to save power".

Process

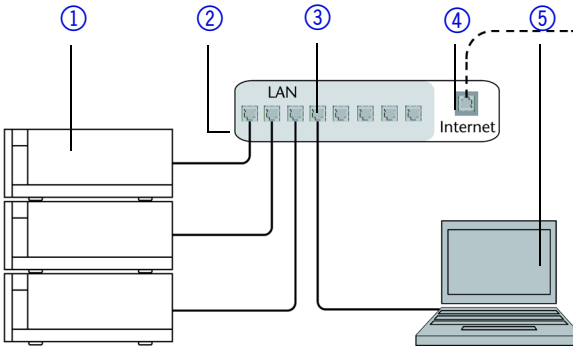
1. In Windows choose Start ⇒ Control Panel ⇒ Network and Sharing Center.
2. Double-click on LAN Connection.
3. Click on the button Properties.
4. Select Internet Protocol version 4 (TCP/IPv4).
5. Click on the button Properties.
6. Check the settings in the tab General. The correct settings for the DHCP client are:

- a) Obtain IP address automatically
- b) Obtain DNS server address automatically

7. Click on the button OK.

Connecting the cables

A router ③ has several LAN ports ② and one WAN port ④ that can be used to integrate the LAN into a wide area network (WAN), e.g. a company network or the Internet. In contrast, the LAN ports serve to set up a network from devices ① and a computer ⑤. To avoid interference, we recommend operating the HPLC system separately from the company network.



You will find patch cables for each device and the router in the accessories kit. To connect the router to a WAN, an additional patch cable is required, which is not supplied within the scope of delivery.

Prerequisite

- The computer has been switched off.
- There is a patch cable for each device and the computer.

Process

1. Use the patch cable to connect the router and the computer. Repeat this step to connect all devices.
2. Use the power supply to connect the router to the mains power system.

Configuring the router

The router is preset at the factory. The login information is mentioned on the router case (IP address, user name, and password), which is needed for router configuration.

Process

1. To open the router configuration, start your Internet browser and enter the IP address (not for all routers).
2. Enter user name and password.

3. Configure the router as DHCP server.
4. In the router configuration, check the IP address range and make changes if necessary.

Hinweis: If the IP address range has been changed, it is necessary to note it down.

Result

Once the router has assigned IP addresses to all devices, the chromatography software can be used to remotely control the system.

Integrating the LAN into a company network

A network administrator can integrate the LAN into your company network. In this case you use the WAN port of the router.

Prerequisite

There is a patch cable for the connection.

Process

1. Check that the IP address range of the router and of the company network do not overlap.
2. In case of an overlap, change the IP address range of the router.
3. Use the patch cable to connect the router WAN port to the company network.
4. Restart all devices, including the computer.

Controlling several systems separately in a LAN

Devices connected to a LAN communicate through ports, which are part of the IP address. If more than one HPLC system is connected to the same LAN and you plan on controlling them separately, you can use different ports to avoid interference. Therefore, the port number for each device must be changed and this same number must be entered into the device configuration of the chromatography software. We recommend to use the same port number for all devices in the same system.

Hinweis: The port is set to 10001 at the factory. You must use the same numbers in the device configuration of the chromatography software as in the device, otherwise the connection fails.

Process

1. Find out port number and change it on the device.
2. Enter the port number in the chromatography software.

Result

The connection is established.

Remote control

Pin header connectors

contact	Explanation
GROUND	Reference point of the voltage at the signal inputs.
START IN	<p>TTL-compatible input</p> <ul style="list-style-type: none"> ▪ min. 10 mA ▪ Low active <p>At stand alone, RS-232 or LAN control stops the motor at a short circuit contact between START IN and GROUND.</p> <p>At analog control, the motor starts at a short circuit contact between START IN and GROUND.</p>
ERROR IN/OUT	<p>TTL-compatible input</p> <ul style="list-style-type: none"> ▪ min. 10 mA ▪ Low active <p>After receiving a signal from an external device, the device starts. If controlled with software, an electronic trigger is send through the LAN.</p>
ANALOG IN	Flow rate is controlled through external control voltage (0-10 V).
ANALOG OUT	Analog output signal for reproducing the measured system pressure (0-1 V).

Connecting cables to the pin header

To control one device through another, you use the multi-pin connector. To use remote control, you have to connect cables to the terminal strip (both included with delivery). The single ports are used to exchange control signals.

Prerequisite

- The device has been turned off.
- The power plug has been pulled.

Tools

Depressor tool

NOTICE**Electronic defect**

Connecting cables to the multi-pin connector of a switched on device causes a short circuit.

- Turn off the device before connecting cables.
- Pull the power plug.

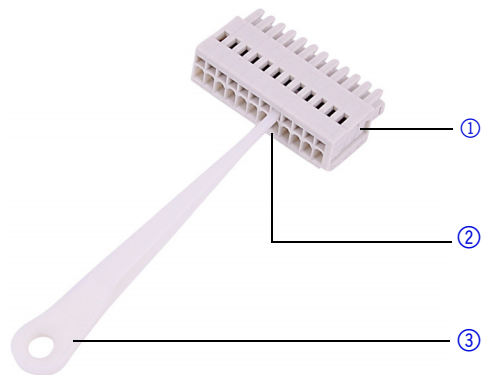
NOTICE**Electronic defect**

Electrostatic discharge can destroy the electronics.

- Wear a protective bracelet against electrostatic discharge and ground.

Process

1. Push the depressor tool ① into an upper small opening on the front of the terminal strip ③.
2. Lead the cable into the opening ② below the inserted depressor tool.
3. Remove the depressor tool.

**Next steps**

Check if the cables are firmly attached. Push the terminal strip onto the multi-pin connector. Finish the installation. Then put the device into operation.

Ground**NOTICE****Electronic defect**

Electronic hazard when using an identically constructed power adapter from another manufacturer.

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

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

- If the supplied power adapter is used, then the ground connection remains unused.

- Please contact the technical service department of the manufacturer, if the pump along with other devices should be connected to the power supply with a 6-prong power adapter; a pump needs to be grounded exclusively.

Operation

NOTICE

Device defect

If the pump is operated with pure distilled water, a significant higher wear of the piston and the piston sealing must be expected.

→ If possible, operate the pump only with water together with additive or modifier.

Switching on the pump

Prerequisites

At analog control, the contact between GROUND and START IN has to be closed to start the pump.

NOTICE

Component defect

Damage to the pump head in case it runs dry.

→ Ensure that liquid runs through pump head and piston backflushing.

Process

1. Connect the power adapter to the power supply.
2. Connect the pump with plug from the external power adapter.
3. Switch on the power adapter.
4. Wait until the pump has completed the self-test.

Result

After the device is switched on, the display shows pump and the firmware version. 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.

Control

The pump can be operated in three ways:

- Keypad
- Chromatography software with integrated drivers for the pump
- Analog



Operator errors and clogged capillaries can cause high pressure spikes.

The status display shows the flow rate and also the pressure for pumps with pressure sensor.

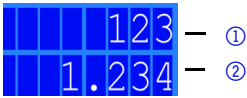


Fig. 8 status display

Legend

- ① Pressure in 0,1 MPa
- ② Flow rate in ml/min

Keypad

The keypad consists of 3 buttons, which allow monitoring the device or changing the settings.

Figure	Function
<p>Fig. 9 Arrow buttons</p>	<p>Press both arrow keys simultaneously to activate the keypad.</p> <p>Hold down the left arrow button and use the right arrow button to browse through the menu.</p> <p>To change the values in the menu, push the right button when the desired menu item is blinking.</p>
<p>Fig. 10 Start/stop key</p>	<ul style="list-style-type: none"> ▪ Switching the pump on or off. ▪ Flushing the Pump

Setting the flow rate

In case of the pump without pressure sensor the actual required flow rate is dependent on the resulting counter pressure. The absolute deviation is dependent on the compressibility and the viscosity of the used solvent and on the pump. Therefore, it must be determined individually for each pump.

The flow rate can be altered while the pump is in operation.


Practical tip: hold down both arrow keys to expedite changing the values.

NOTICE

Device defect

Danger of high overpressure: If the button is pressed over a longer time, the flow rate is changing rapidly.


→ Check the button pressure.

Process	Figure
<ol style="list-style-type: none"> 1. Use the arrow keys to set a value for the flow rate. 2. Check if the right value appears on the display. 	 <p data-bbox="568 248 801 272">Fig. 11 Display control</p>

Result: The setting is completed and the pump runs at the set flow rate.

Adjusting pressure turn-off (only P 4.1S)

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





<p>Legend</p> <p>① Maximum value</p> <p>② Minimum value</p>



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



Configuring the pump heads 10 ml or 50 ml, the maximum pressure for the respective pump head is applied.

Process	Figure
<ol style="list-style-type: none"> 1. Press both arrow buttons simultaneously to activate the keypad. 2. Hold down the left arrow button and use the right arrow button to browse through the menu. 	
<ol style="list-style-type: none"> 3. When the cursor flashes, use the arrow keys again to set the value for the maximum pressure. 4. Hold down the left arrow key. Press right arrow key once. 	 <p data-bbox="568 1198 860 1222">Fig. 12 Maximum pressure</p>
<ol style="list-style-type: none"> 5. When the cursor flashes, use the arrow keys again to set the value for the minimum pressure. 6. Hold down the left arrow key. Press right arrow key once to return to the start display. 	 <p data-bbox="568 1382 860 1406">Fig. 13 Minimum pressure</p>

Result

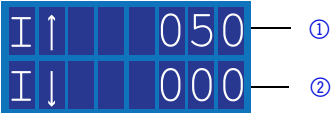
The setting is completed. If the maximum pressure is exceeded, the pump switches off. If the minimum pressure is undercut, the pump switches off after 30 s. In both cases, an error message is shown on the display, which must be confirmed at a control via keyboard or analog. In case of control via chromatography software, it may not be necessary

Setting the power consumption

The power consumption is dependent on the flow rate and the counter pressure. It increases with higher flow rates and stronger counter pressure.



- Exceeding or undercutting the values for the maximum or minimum power consumption leads to the pump being automatically shutdown.
- Set the maximum power consumption for the pump to limit the pump pressure.
- Set the minimum power consumption so as to avoid a dry run of the pump at highly reduced maximum power consumption (e. g. if leaking).

The pump is preset to a standard value for the maximum power consumption. The manufacturer recommends that with smaller flow rates the standard value for the maximum power consumption should be insignificantly decreased.


<p>Legend</p> <p>① Maximum value</p> <p>② Minimum value</p>



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

Process	Figure
<ol style="list-style-type: none"> 1. Press both arrow buttons simultaneously to activate the keypad. 2. Hold down the left arrow button and use the right arrow button to browse through the menu. 	
<ol style="list-style-type: none"> 3. When the cursor flashes, use the arrow keys again to set the value for the maximum power consumption. 4. Hold down the left arrow key. Press right arrow key once. 	 <p>Fig. 14 Minimum power consumption</p>

5. When the cursor flashes, use the arrow keys again to set the value for the minimum power consumption.
6. Press start/stop key once to return to the start display.



Fig. 15 Maximum power consumption

Result

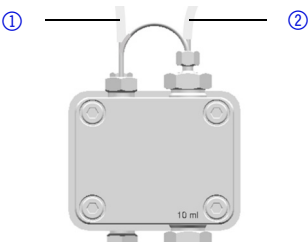
The setting is completed. If the maximum pressure is exceeded, the pump switches off.

Flushing the pistons


When you flush the pistons regularly, the service life of the seals and pistons increases. While flushing, contaminants are washed from the rear piston area.

The following solvents are recommended for flushing the columns:

- Water
- Mixture of 80 % water and 20 % ethanol
- isopropanol

Process	Figure
<ol style="list-style-type: none"> 1. Connect the outlet to the waste container with a hose ①. 2. Connect the inlet to the syringe with a hose ②. 3. Fill up flushing solution with the syringe through the pump head until there are no more air bubbles running through the waste bottle. 4. Afterwards, remove the hoses and connect inlet and outlet with a hose. 	 <p data-bbox="565 1005 924 1037">Fig. 16 Flushing rear piston area</p>

Choosing pump head

Process	Figure
<ol style="list-style-type: none"> 1. Press both arrow buttons simultaneously to activate the keypad. 2. Hold down the left arrow button and use the right arrow button to browse through the menu, until it shows 10 ml/50 ml. 	 <p data-bbox="565 1364 896 1396">Fig. 17 Choosing pump head</p>

Result

When setting is finished, the status display appears.



Configuring the pump heads 10 ml or 50 ml, the maximum pressure for the respective pump head is applied automatically. Check the allowed maximum pressure for the pump head.

Flushing the pump

The display shows vertical arrows while the pump is flushing.

①	↑					123	—	②
	↑		9	.	876		—	③

Legend

- ① Flushing symbol
- ② Pressure (only P 4.1S)
- ③ Flow rate

Prerequisites

- Pump with pressure sensor:
 - Venting screw of the pressure sensor is open.
 - Syringe is connected to bleed capillary.
- Pump without pressure sensor:
 - Cap fitting in the outlet to the pressure sensor is removed.
 - Syringe is connected to the capillary on the pump head outlet.
 - Fitting on the pump head outlet ist removed.
 - Venting syringe



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

Process	Figure
1. Prime liquid with the syringe. 2. Hold down start/stop key until flushing starts.	

Software


To be able to control the pump using chromatography software, the computer must be connected to the device either with a RS232 cable or a LAN cable.

Control the Devices with a Computer in a Local Area Network (LAN)

A device connected to a LAN is recognized by the software and automatically receives an IP address because it is set to Dynamic Host Configuration Protocol (DHCP) at the factory.

Prerequisite:

- Device has been connected to LAN.
- Status display is active.

Process	Figure
<ol style="list-style-type: none"> 1. Press both arrow buttons simultaneously to activate the keypad. 2. Hold down the left arrow button and use the right arrow button to browse through the menu. 3. Using the arrow buttons, scroll until it shows LAN. 	 <p>The image shows a blue LCD display with a grid. The top row contains 'PC:' followed by four empty boxes. The second row contains four empty boxes followed by 'LAN'.</p> <p>Fig. 18 Display control</p>


Result

When setting is finished, the status display appears.

Via RS-232 port

Prerequisite:

- Interface RS-232 is connected.
- Status display is active.

Process	Figure
<ol style="list-style-type: none"> 1. Press both arrow buttons simultaneously to activate the keypad. 2. Hold down the left arrow button and use the right arrow button to browse through the menu. 3. Using the arrow buttons, scroll until it shows RS-232. 	 <p>The image shows a blue LCD display with a grid. The top row contains 'PC:' followed by four empty boxes. The second row contains four empty boxes followed by 'RS-232'.</p> <p>Fig. 19 Display control</p>

Result

When setting is finished, the status display appears.

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.

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 0-400	Minimum pressure for 10 ml pump head (in 0.1 MPa)
PMIN50(?)	RD/WR 0-150	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	Configures START IN. 0 = Pump starts the flow at short circuit contact only. (START IN <> GROUND). 1 = Pump starts the flow without a short circuit contact. (START IN <> GROUND).


Control command	Range and specification	Description
ERRIO(?)	RD/WR 0.1	Writing/reading the ERROR input/output, OUT (0) or IN (1)
STARTMODE(?)	RD/WR 0.1	0 = Pump pauses after switch-on. 1 = Pump starts immediately after switch-on with the previous set flow rate.
EXTCONTR	WR 0,1	0 = Prevents external flow control 1 = allows the flow rate control via analog input 0 - 10V (10ml: 1 V = 1 ml/min, 50ml: 1 V = 5 ml/min)
EXTFLOW?	RD	
IMOTOR?	RD 0-100	Motor current in relative units
LOCAL	WR	Command for releasing the pump to change the settings manually (control command to cancel the remote command)
REMOTE	WR	Command to prevent a manual parameter input, with exception of stopping the flow via START/STOP button.
ERRORS?	RD	Display of the last 5 error codes.
ON	WR	Starts the flow
OFF	WR	Stops the flow

Activating the analog control (prior to firmware version 1.37)

The analog control is switched on and off via a serial port RS-232 with an applicable hyperterminal program.

Prerequisite:

- The serial port RS-232 is wired and set up successfully. The pump is connected with the control PC via an available COM port.
- An applicable hyperterminal program is available on the PC.
- Status display is active.

Process	Figure
<ol style="list-style-type: none"> 1. Press both arrow buttons simultaneously to activate the keypad. 2. Hold down the left arrow button and use the right arrow button to browse through the menu. 3. Using the arrow buttons, scroll until it shows RS-232. 	 <p data-bbox="566 288 815 316">Fig. 20 Display control</p>
<ol style="list-style-type: none"> 4. In hyperterminal program, enter command EXTCONTR:1 (see "Control commands" on p. 22). 	

Result: The display shows a star symbol left to the flow rate. You cannot adjust the flow rate any longer via the key pad.

To deactivate the analog control, enter "0" instead of "1" as parameter for EXTCONTR.

Adjusting the analog control (prior to firmware version 1.37)

If you adjust the pump via analog control, the start setting changes at switch-on. In analog operation, the pump starts with switched on flow only. The flow rate corresponds to the wired voltage. The contact between GROUND and START IN has to be closed to start the pump.

In addition, it is possible to send commands to the pump via RS-232 or LAN.




It is only possible to use the communication connection which has been chosen before the adjustment (RS-232 or LAN).

If you reset the pump to RS-232 or LAN, the device is set to standard settings. The pump does not start with switched on flow. The flow stops at active short circuit connection GROUND and START IN.

Prerequisite:

- Interfaces ANALOG IN, GROUND and START IN, GROUND of pin header is wired.
- Status display is active.

Process	Figure
<ol style="list-style-type: none"> 1. Press both arrow buttons simultaneously to activate the keypad. 2. Hold down the left arrow button and use the right arrow button to browse through the menu. 3. Using the right arrow buttons, scroll until it shows ANALOG. 	 <p data-bbox="566 1347 815 1374">Fig. 21 Display control</p>

Result

The display shows a star symbol left to the flow rate. You cannot adjust the flow rate any longer via the key pad. To deactivate the analog control, choose RS-232 or LAN in the menu. In this case, the starting parameter of the pump are reset (START IN, START mode) and you can use the pump as usual.

Controlling the flow rate analog

For the flow rate control, choose analog in the selection menu via an external control voltage. This is valid from firmware version 1.37, for older versions please contact the Technical Support.



The parameter can be changed via a terminal connection. Deactivating and activating the analog control, the parameter must be set again. Alternative: Installation of a permanent short circuit connection.



Fig. 22 Status display

Legend

- ① Pressure in 0,1 MPa
- ② Flow rate in ml/min

Prerequisite: The pump is connected to the power supply.

Procedure:

1. Apply control voltage.
2. Press the Start/Stop button, so as to start the pump. The star symbol on the display of the pump indicates that the pump is working with an externally controlled flow rate.
3. To stop the pump, press the start/stop button again.

Starting with a short circuit

Connection for the short circuit (or TTL-low) for interrupting and continuing the operation of the pump. The operation of the pump is dependent on the STARTLEVEL setting:

- STARTLEVEL 1 (default setting RS-232, LAN): The pump does not operate during the time of short-circuit.
- STARTLEVEL 0 (default setting analog): The pump operates during the time of short-circuit.



Fig. 23 Status display

Legend

- ① Pressure in 0,1 MPa
- ② Flow rate in ml/min

Enter STARTLEVEL:1 in the terminal program, to prevent the pump from operating during short-circuit.

Prerequisite: The pump is connected to the power supply.



During the interruption, the horizontal arrow (A) remains in the display, because the pump is still in operation status.

Procedure:

1. Connect the pump with an applicable terminal program.
2. Connect the pump using a LAN or RS-232.
3. Enter STARTLEVEL:1.

Starting directly after connection to power supply

By default the pump is stopped and started using the start/stop button. The STARTMODE setting allows you to start the device right after connecting it to power supply.

- STARTMODE 0 (default setting RS-232, LAN): The pump does not start operating right after being connected to power supply.
- STARTMODE 1 (default setting analog): The pump starts operating right after being connected to power supply.

If the start mode must be changed, it is possible to do this via command STARTMODE 0.

Deactivating and activating the analog control, the parameter must be set again.

Prerequisite: The pump is connected to the power supply.

Procedure:

1. Connect the pump with an applicable terminal program.
2. Connect the pump using a LAN or RS-232.
3. Enter STARTMODE:1.

Switching off the pump

If you want to switch off the pump for a longer term, flush the pump head with isopropanol.

Prerequisite:

- The pump has been rinsed. Use isopropanol before a long-term decommissioning or to prepare for storage.
- The pump is out of use.

Process

1. Stop the flow.
2. Switch off the power switch on the back of the device.

Result

The display turns off.

Functionality tests

Installation Qualification (IQ)

The customer may request the Installation Qualification, which is free of charge. In case of a request, the Technical Support of KNAUER or from a provider authorized by KNAUER performs this functionality test during the installation.

The Installation Qualification is a standardized document that comes as part of the delivery and includes the following:

- confirmation of flawless condition at delivery
- check if the delivery is complete
- certification on the functionality of the device

Operation Qualification (OQ)

The Operation Qualification includes an extensive functionality test according to KNAUER standard OQ documents. The Operation Qualification is a standardized document and free of charge. It is not part of the delivery, please contact the Technical Support in case of request.

The Operation Qualification includes the following:

- definition of customer requirements and acceptance terms
- documentation on device specifications
- device functionality check at installation site

Test Intervals

To make sure that the device operates within the specified range, you should test the device regularly. The test intervals are dependent on the usage of the device.

Execution

The test can be carried out either by the Technical Support of KNAUER or from a provider authorized by KNAUER (for a fee).

Troubleshooting

First measures for troubleshooting:

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



Further Measures

- Compare occurring errors with the list of possible problems (S. 30).
- Contact the Technical Support hotline of the manufacturer.

LAN

Go through the following steps, in case no connection between the computer and the devices can be established. Check after each step if the problem is solved. If the problem cannot be located, call the Technical Support.

1. Check the status of the LAN connection in the Windows task bar:

-  Connected
-  Connection not established

If no connection was established, test the following:

- Is the router switched on?
 - Is the patch cable connected correctly to the router and the computer?
2. Check the router settings:
- Is the router set to DHCP server?
 - Is the IP address range sufficient for all the connected devices?
3. Check all connections:
- Are the patch cable connected to the LAN ports and not the WAN port?
 - Are all cable connections between devices and router correct?
 - Are the cables plugged in tightly?
4. If the router is integrated into a company network, pull out the patch cable from the WAN port.
- Can the devices communicate with the computer, even though the router is disconnected from the company network?
5. Turn off all devices, router, and computer. Firstly, switch on the router and wait until its self-test is finished. Secondly, switch on the devices and the computer.
- Has this been successful?
6. Replace the patch cable to the device with that no connection could be established.
- Has this been successful?
7. Make sure that the IP port of the device matches the port in the chromatography software.

Possible problems and solutions

Problem	Solution
Pump will not turn on	Power cable needs to be connected to power supply and power adapter has to be turned on. <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	The venting screw on the pressure sensor must be turned up. <ul style="list-style-type: none"> • Check if the venting screw on the pressure sensor is turned open.
Pump does not transport solvent	Check the following options: <ul style="list-style-type: none"> • Purge the pump head so as to remove the air bubbles • Inspect the eluent inlet and filter of the HPLC column and change when blocked. • Replacing the pump head • Cleaning the check valves • Changing the check 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	Check the following options: <ul style="list-style-type: none"> • Purge the pump head so as to remove the air bubbles • Always tighten the inlet screw 1 and outlet screw 1 on the pump head with a torque wrench (7.5 Nm for stainless steel, 3 Nm for ceramic). • Cleaning the check valves • Changing the check valves
Pump head leaks	Check the following options: <ul style="list-style-type: none"> • Inspect the inlet and outlet screw fittings of the pump head • Replacing 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	<p>Check the following options:</p> <ul style="list-style-type: none">• Inspect the inlet and outlet screw fittings of the pump head• Cleaning the check valves• Changing the check valves• Replacing the pump head• Pump without pressure sensor: Pay attention to the influence of the pressure on the flow rate (will not be compensated).• Inform the Technical Support of the manufacturer
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Maintenance and care

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

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.

Cleaning and caring for the device

Users may perform the following maintenance tasks themselves:

- Replacing the pump head
- Exchanging the check valves

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

NOTICE

Device defect

Intruding liquids can cause damage to the device.

- Place solvent bottles next to the device or in a solvent tray.
- Moisten the cleaning cloth only slightly.

Pump head

Torque values

Pump head	Type (ml)	Fitting, outer (Nm)	Fitting, inner (Nm)	Capillary connection (Nm)
AHA60	5	10.0	7.5	5.0
AHB40	10	7.5	3.5	5.0
AHB40BA				
AHB40CA				
AHB32	10	3.5	3.5	1.0 (finger tight)
AHB32DA				
AHB43	10	7.5	7.5	5.0
AHC22	50	3.5	3.5	1.0 (finger tight)
AHC23	50	7.5	7.5	5.0
AHC20	50	7.5	7.5	5.0
AHC20BA	10	7.5	3.5	5.0
AHC20CA	50	7.5	7.5	5.0

Removing the pump head

Prerequisites

The pump head has been flushed with suitable solvent.



Chemical burns

Aggressive or toxic solvent residue can irritate the skin.

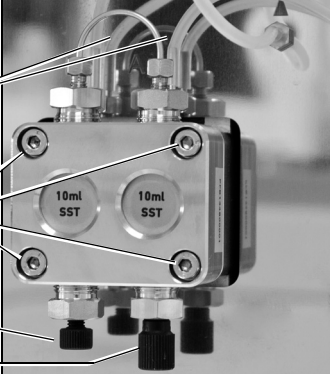
- Wear protective gloves.
- Flush the pump head before exchanging it.

NOTICE

Component defect

Damage to the pistons if they tilt.

- Undo or tighten diagonally opposite screws evenly by one turn each at a time.

Process	Figure
<ol style="list-style-type: none"> 1. Loosen inlet fitting ② and outlet fitting ①. 2. Loosen the piston seal wash tubings ④. 3. Loosen 4 fixing screws ③ alternately and hold the pump head. 	

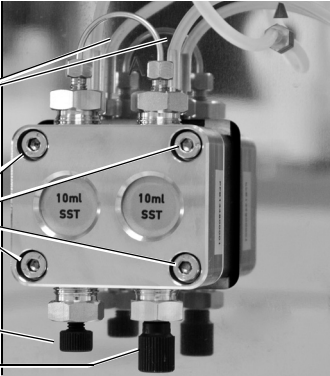
Installing the pump head

NOTICE

Device defect

Damage to the pump head caused by overtightened capillary fittings.

→ Note the torque of the fittings.

Process	Figure
<ol style="list-style-type: none"> 1. Tighten 4 fixing screws ③ alternately and hold the pump head. 2. Mount the piston seal wash tubings ④. 3. Tighten the inlet fitting ② and the outlet fitting ①. 	

Check valves

Clogged check valves do not open and close properly. They cause pressure fluctuations and irregular flow.



Insert the check valves in the direction of the flow.

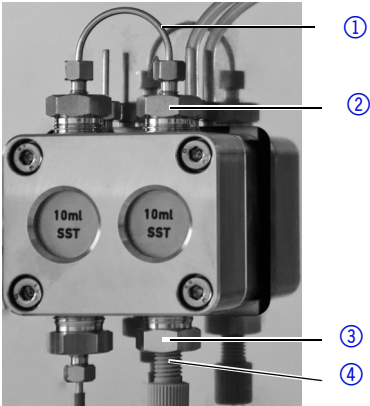
Removing the check valves

Prerequisites

- The pump head has been purged.
- The capillaries and tubings have been removed.
- The pump head has been removed.

Tools

- Open-end wrench, size 13

Process	Figure
<ol style="list-style-type: none"> 1. Unscrew and remove the capillary connector ①. 2. Loosen the outlet fitting ② with the open-end wrench. 3. Remove the first check valve. 4. Loosen the eluent connection ④. 5. Loosen the inlet fitting ③ with the open-end wrench. 6. Remove the second check valve. 	

Next steps

Clean the check valves.

Cleaning the check valves

1. Fill a beaker with solvent.
2. Place the valve in the beaker.
3. Put the beaker in an ultrasonic bath for at least 10 minutes.

Installing the check valves

Insert the check valves in the direction of the flow. The notch of the check valve points downward. Insert the NP check valves in the direction of the flow. The arrow on the NP check valve points upward.

Prerequisites

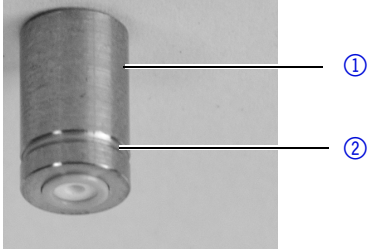
The check valves have dried.

NOTICE

Device defect

Damage to the pump head caused by overtightened capillary fittings.

→ Note the torque of the fittings.

Process	Figure
<ol style="list-style-type: none"> 1. Insert the check valves ① so that the notch of the check valve ② points downwards: In case of NP valves alternatively check the direction of the arrow. 2. Manually screw in inlet and outlet fittings and tighten them with a torque wrench and the respective torque. 	 <p data-bbox="564 427 784 454">Fig. 24 Check valve</p>

Next steps

Re-install the pump head.

Technical data



The pump was adjusted under specific conditions. If the pump is operated under different conditions (flow, pressure, eluent), a calibration of the pump may be necessary at the selected place of operation.

General

Pump type	Dual-piston pump with main and auxiliary piston
Flow rate range	<ul style="list-style-type: none"> ▪ 10 ml pump head: 0.001-10 ml/min ▪ 50 ml pump head: 0.01-50 ml/min
Maximum pressure	<ul style="list-style-type: none"> ▪ 10 ml pump head: 40 MPa to 10 ml/min $I_{max} = 70$ ▪ 50 ml pump head: 15 MPa to 50 ml/min $I_{max} = 80$
Flow rate accuracy	<ul style="list-style-type: none"> ▪ P 4.1S: $\pm 1 \%$ (1 ml/min) ▪ P 2.1S: $\pm 5 \%$ (1 ml/min) ▪ For pumps without a pressure sensor dependent on pressure
Flow rate precision	Relative standard deviation RSD: $< 0.5 \%$ (1 ml/min)
Gradient support	<ul style="list-style-type: none"> ▪ Isocratic HPLC pump ▪ Expandable to a binary high pressure gradient system (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

Wetted materials	Ceramic pump heads: Graphite fiber reinforced PTFE, FKM, PEEK, sapphire, aluminum oxide (Al ₂ O ₃), titanium (only P 4.1S)
	Stainless steel pump heads: Stainless steel, graphite fiber reinforced PTFE, FKM, PEEK, sapphire, aluminum oxide (Al ₂ O ₃), titanium (only P 4.1S)
	Hastelloy® C pump heads: Hastelloy® C, graphite fiber reinforced PTFE, FKM, KEL-F, zirconium oxide (ZrO ₂)

Communication

Control	<ul style="list-style-type: none"> ▪ RS-232 ▪ Analog ▪ Buttons on the device
Analog Inputs	0-10 V

Technical parameters

Supply frequency	50-60 Hz
power consumption	maximum 40 W
protection type	IP 20
temperature range	4-40 °C/39,2-104 °F
air humidity	below 90 % non-condensing
power supply	100-240 V; 50-60 Hz
dimensions (Width × Height × Depth)	<ul style="list-style-type: none"> ▪ Pump without pressure sensor: 121 × 129.1 × 220.2 mm ▪ Pump with pressure sensor: 121 × 129.1 × 228 mm
weight	<ul style="list-style-type: none"> ▪ Pump without pressure sensor: 2.3 kg ▪ Pump with pressure sensor: 2.4 kg

Dimensions

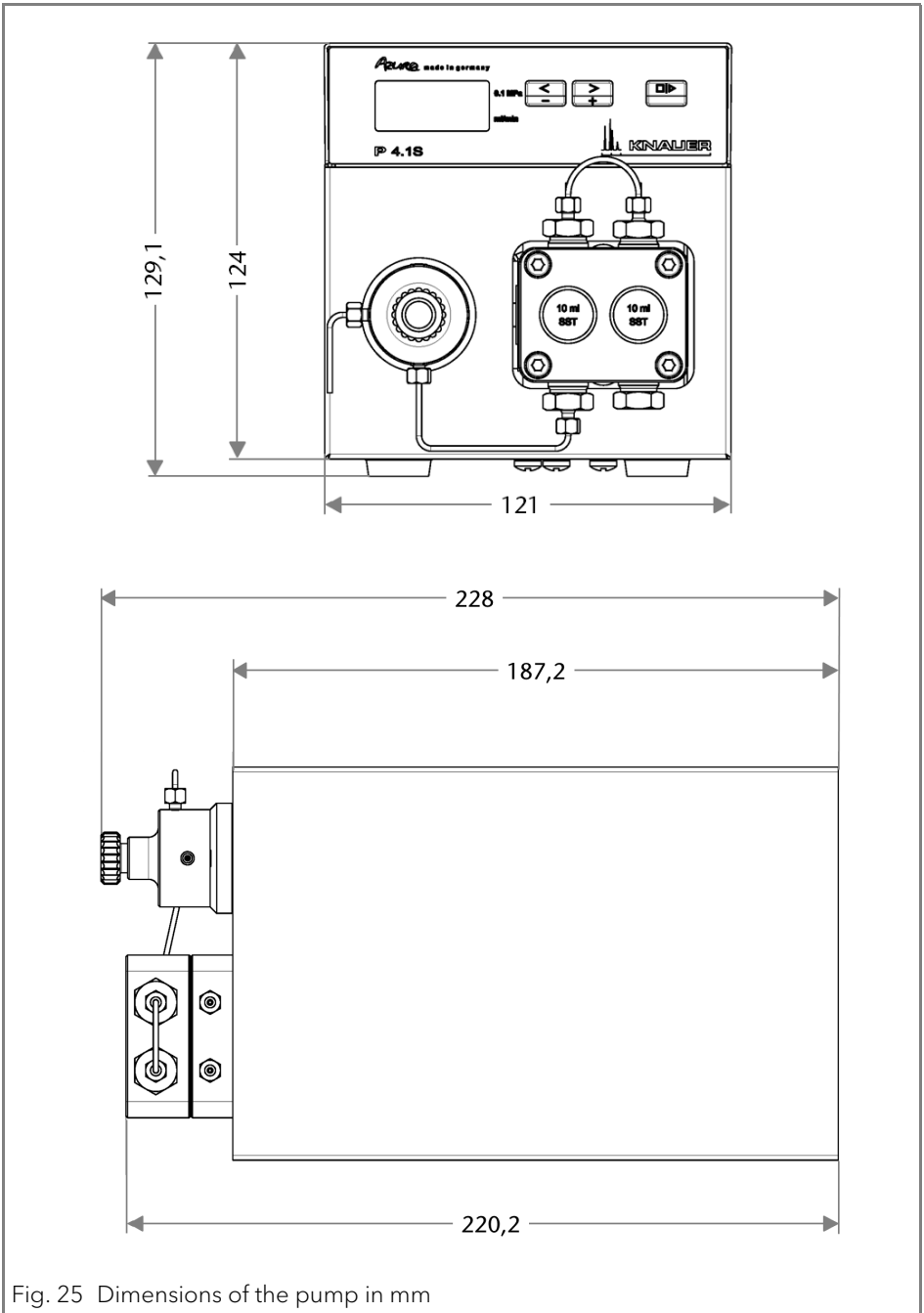


Fig. 25 Dimensions of the pump in mm

Chemical compatibility of wetted materials



The user is responsible for using the fluids and chemicals in an appropriate and safe way. In cases of doubt contact the Technical Support.

General

The device is very resistant against a variety of commonly used eluents. However, make sure that no eluents or water come in contact with the device or enter into the device. Some organic solvents (such as chlorinated hydrocarbons, ether) may cause coating damage or loosen glued components by improper handling. Even small quantities of other substances, such as additives, modifiers, or salts can influence the durability of the materials. Exposure time and concentration have a high impact on the resistance.

The following list contains information about the chemical compatibility of all wetted materials which are used in devices made by KNAUER. The data bases on a literature research on the manufacturer specifications of the materials.

All resistances listed here refer to an operation at temperatures up to 40 °C, unless stated otherwise. Note that higher temperatures may have a significant impact on the stability of several materials.

Note: The user takes the responsibility for using the fluids and chemicals in an appropriate and safe way. If there is any doubt, contact the Technical Support of the manufacturer.

Plastics

Polyetheretherketone (PEEK)

PEEK is a durable and resistant plastic and, apart from stainless steel, the standard material in HPLC. It can be used at temperatures up to 100 °C and is highly chemical resistant against almost all commonly used solvents in a pH range of 1-12,5. PEEK is potentially moderate resistant against oxidizing and reducing solvents.

Therefore, following solvents should not be used: Concentrated and oxidizing acids (such as nitric acid solution, sulfuric acid), halogenated acids (such as hydrofluoric acid, hydrobromic acid) and gaseous halogens. Hydrochloric acid is approved for most applications.

In addition, following solvents can have a swelling effect and may have an impact on the functionality of the built-in components: Methylene chloride, THF and DMSO in any concentration such as acetonitrile in higher concentrations.

Polyethylene terephthalate (PET, former PETP)

PET is a thermoplastic and semi-crystalline material with high wear resistance. It is resistant against diluted acids, aliphatic and aromatic hydrocarbons, oils,

fats and alcohols, but not against halogenated hydrocarbons and ketones. Since PET belongs chemically to esters, it is not compatible with inorganic acids, hot water and alkalis. Maximum operating Temperature: up to 120 °C.

Polyimide (Vespel®)

This material is wear-resistant and permanent resilient thermally (up to 200 °C) as well as mechanically. It is chemically broadly inert (pH range 1-10) and is especially resistant against acidic to neutral and organic solvents, but vulnerable to pH strong chemical or oxidizing environments: It is incompatible with concentrated mineral acids (such as sulfuric acid), glacial acetic acid, DMSO and THF. In addition, it will be disintegrated by nucleophilic substances like ammonia (such as ammonium salts under alkaline conditions) or acetate.

Ethylene-tetrafluoroethylene copolymer (ETFC, Tefzel®)

This fluorinated polymer is highly resistant against neutral and alkaline solvents. Some chlorinated chemicals in connection with this material should be handled with care. Maximum operating Temperature is 80 °C.

Perfluoroethylenpropylene copolymer (FEP), perfluoroalkoxy copolymer (PFA)

These fluorinated polymers hold similar features as PTFE, but with a lower operation temperature (up to 205 °C). PFA is suitable for ultrapure applications, FEP can be used universally. They are resistant against almost all organic and inorganic chemicals, except elemental fluorine under pressure or at high temperatures and fluorine-halogen compounds.

Polyoxymethylene (POM, POM-H-TF)

POM is a semi-crystalline, high-molecular thermoplastic material which stands out due to its high stiffness, low friction value and thermic stability. It can even substitute metal in many cases. POM-H-TF is a combination of PTFE fibres and acetal resin and is softer and has better slip properties as POM. The material is resistant against diluted acids (pH > 4) as well as diluted lyes, aliphatic, aromatic and halogenated hydrocarbons, oils and alcohols. It is not compatible with concentrated acids, hydrofluoric acid and oxidizing agent. Maximum operating temperature is 100 °C.

Polyphenylene sulfide (PPS)

PPS is a soft polymer which is known for its high break resistance and very high chemical compatibility. It can be used with most organic, pH neutral to pH high, and aqueous solvents at room temperature without concerns. However, it is not recommended for using with chlorinated, oxidizing and reducing solvents, inorganic acids or at higher temperatures. Maximum operating temperature: 50 °C.

Polytetrafluorethylene (PTFE, Teflon®)

PTFE is very soft and anti-adhesive. This material is resistant against almost all acids, lyes and solvents, except against fluid sodium and fluoride compounds. In addition, it is temperature-resistant from -200 °C to +260 °C.

System AF™

This amorphous perfluorinated copolymer is inert against all commonly used solvents. However, it is soluble in perfluorinated solvents like Fluorinert® FC-75 and FC-40, and Fomblin perfluor-polyether solvents from Ausimont. In addition, it is affected by Freon® solvents.

Polychlorotrifluorethylene (PCTFE, Kel-F®)

The semi-crystalline thermoplastic material is plasticizer-free and dimensionally stable, even in a wide temperature range (-240 °C to +205 °C). It is moderately resistant against ether, halogenated solvents and toluene. Halogenated solvents over +60 °C and chlorine gas should not be used.

Fluorinated rubber (FKM)

The elastomer consisting of fluorinated hydrocarbon stands out due to a high resistance against mineral oils, synthetic hydraulic fluids, fuels, aromatics, and many organic solvents and chemicals. However, it is not compatible with strong alkaline solvents (pH value >13) like ammonia, and acidic solvents (pH value <1), pyrrole and THF. Operating temperature: Between -40 °C and +200 °C.

Perfluorinated rubber (FFKM)

This perfluoro elastomer has a higher fluorine content as fluorinated rubber and is therefore chemically more resistant. It can be employed at higher temperatures (up to 275 °C). It is not compatible with Pyrrole.

Non-metals

Diamond-like carbon (DLC)

This material stands out due to its high hardness, low friction coefficient and thus minimum wear. In addition, it is highly biocompatible. DLC is inert against all acids, alkalis and solvents commonly used in HPLC.

Ceramic

Ceramic is resistant against corrosion and wear and is fully biocompatible. An incompatibility against acids, alkalis and solvents commonly used in HPLC is not known.

Mineral wool

This insulating material consists of glass or stone wool fibres and isolates in high oxidizing conditions and at high temperatures. Mineral wool is valid as commonly inert against organic solvents and acids.

Glass, glass fibre, quartz, quartz glass

These mineral materials are resistant against corrosion and wear and are mostly chemical inert. They are compatible with oils, fats and solvents and show a high resistance against acids and lyes up to pH values of 3-9. Concentrated acids (especially hydrofluoric acid) may embrittle and corrode the minerals. Lyes may ablate the surfaces slowly.

Metals

Stainless steel

Stainless steel is, apart from PEEK, the standard material in HPLC. Steels with WNr. 1.4404 (316L) are used, or with a mixture of higher compatibility.

They are inert against almost all solvents. Exceptions are biological applications which are metal ion sensitive, and applications with extreme corrosive conditions. These steels, in comparison to commonly used steels, are increasingly resistant against hydrochloric acid, cyanides and other halogen acids, chlorides and chlorinated solvents. The use in ion chromatography is not recommended. In case of electrochemical applications, a passivation must be executed first.

Hastelloy®-C

This nickel-chrome-molybdenum alloy is extremely resistant to corrosion, especially against oxidizing, reducing and mixed solvents, even at high temperatures. This alloy may be used in combination with chlor, formic acid, acetic acid and saline solutions.

Titanium, titanium alloy (TiA16V4)

Titanium has a low weight and a high hardness and stability. It stands out due to its very high chemical compatibility and biocompatibility. Titan is applied when neither stainless steel nor PEEK are usable.

Repeat orders

This list for repeat orders is valid for the time the document has been published. Deviations afterwards are possible.

For repeat orders of spare parts use the enclosed packing list. Contact the Technical Support in case there are any questions on spare parts or accessories.

Further Information

Further information on spare parts and accessories can be found online:

www.knauer.net

Accessories

Name	Order number
AZURA accessories kit	FZA01
P 2.1S/P 4.1S accessories kit	FPGA
user manual	V6870
Mobile Control license with 10" touchscreen	A9607
Mobile Control Chrom license with 10" touchscreen	A9608
Mobile Control license	A9610
Mobile Control Chrom license	A9612

Device variants

Name	Order number
Pump P 4.1S without pump head	APG20
Pump P 4.1S with 10 ml stainless steel pump head	APG20EA
Pump P 4.1S with 10 ml ceramic pump head	APG20EB
Pump P 4.1S with 10 ml ceramic pump head, titanium fittings	APG20EF
Pump P 4.1S with 50 ml stainless steel pump head	APG20FA
Pump P 4.1S with 50 ml ceramic pump head	APG20FB
Pump P 2.1S without pump head	APG90
Pump P 2.1S with 10 ml stainless steel pump head	APG90EA
Pump P 2.1S with 10 ml ceramic pump head	APG90EB
Pump P 2.1S with 10 ml Hastelloy-C pump head	APG90EC
Pump P 2.1S with 50 ml stainless steel pump head	APG90FA
Pump P 2.1S with 50 ml ceramic pump head	APG90FB
Pump P 2.1S with 50 ml Hastelloy-C pump head	APG90FC

Available pump heads

Name	Order number
10 ml stainless steel pump head with stainless steel inlay	AHB40
10 ml pump head with ceramic inlay	AHB32
10 ml pump head with ceramic inlay and titanium fittings	AHB32DA
10 ml pump head with Hastelloy-C inlay	AHB43
50 ml pump head with ceramic inlay	AHC22

Name	Order number
50 ml pump head with Hastelloy-C inlay, for corrosive media	AHC23
50 ml stainless steel pump head with stainless steel inlay	AHC20

Legal information

Transport damage

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

Warranty conditions

The factory warranty for the device is stipulated by contract. During the warranty period, any components with material or design-related defects will be replaced or repaired by the manufacturer free of charge. Please connect to our website for further information on terms and conditions.

All warranty claims shall expire in the event that any unauthorized changes are made to the device. This warranty also excludes the following:

- accidental or willful damage
- damage or errors caused by third parties that are not contractually related to the manufacturer at the time the damage occurs
- wear parts, fuses, glass parts, columns, light sources, cuvettes and other optical components
- damage caused by negligence or improper operation of the device and damage caused by clogged capillary
- packaging and transport damage

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

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Telefax: +49 30 8015010

e-mail: support@knauer.net

Internet: www.knauer.net

Declaration of conformity

The Declaration of Conformity is part of the delivery and accompanies the product as a separate document.

Disposal

Hand in old devices or disassembled old components at a certified waste facility, where they will be disposed of properly.

AVV Marking in Germany

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). The number belongs to category 8 and 9, which, among others, comprise laboratory equipment.

All distributors and importers are responsible for the disposal of old devices, as defined by the WEEE directive. End-users can send their old devices manufactured by KNAUER back to the distributor, the importer, or the company free of charge, but would be charged for the disposal.

Solvents and Other Operating Materials

All solvents and other operating materials must be collected separately and disposed of properly.

All wetted components of a device, e. g. flow cells of detectors or pump heads and pressure sensors for pumps, have to be flushed first with isopropanol and then with water before being maintained, disassembled or disposed.

Glossary

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

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

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