KNAUER

AZURA

Pump P 2.1S/P 4.1S
User Manual

V6870A

HPLC

Table of Contents

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

Intended Use

Note 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.

Legend

① Display

② Keypad

③ Pump head

④ Pressure sensor

P 2.1S HPLC pump	P 4.1S HPLC pump
	
Fig. 1 Pump 2.1S with 10 ml pump head	**Fig. 2 Pump 4.1S with 10 ml pump head**

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

- Biochemistry analyses
- Food analyses
- Pharmaceutical analyses
- Environmental analyses
- Chemical analyses
- Dosing applications

Features

- Analytical pump head with a flow rate range from 0.001 – 9.999 ml/min and a pressure of up to 400 bar
- Dual-piston technology for constant flow rates
- Setting a limit for minimum and maximum pressure to protect the columns and to avoid a dry run of the pump
- 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.

Features

- Liquid transport with stable flow rate and high flow accuracy
- Long service life
- Pump heads completely made of stainless steel or with titanium 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 to set up a binary high pressure gradient system.

Eluents

Even small quantities of other substances, such as additives, modifiers, or salts can influence the durability of the materials.

Note The list of selected solvents was compiled based on research in the pertinent literature and is only a recommendation. If there is any doubt, contact the technical support of the manufacturer.

Suitable eluents	Less suitable eluents	Not suitable eluents
▪ Acetone ▪ Acetonitrile ▪ Benzene ▪ Chloroform ▪ Ethyl acetate ▪ Ethanol ▪ Hexane/heptane ▪ Isopropanol ▪ Carbon dioxide (liquid 99.999% CO_2) ▪ Methanol ▪ Phosphate buffer solutions (0.5 M) ▪ Toluol ▪ Dilute ammonia solution ▪ Dilute acetic acid (10-50%), at 25° C ▪ Dilute sodium hydroxide (1M) ▪ Water	▪ Dimethyl sulfoxide (DMSO) ▪ Slightly volatile eluents ▪ Methylene chloride ▪ Tetrahydrofuran (THF) ▪ Dilute phosphoric acid	▪ Halogenated hydrocarbons, e.g. Freon® ▪ Concentrated mineral and organic acids ▪ Concentrated bases ▪ Eluents containing particles ▪ Perfluorinated eluents, e.g. Fluorinert® FC-75, FC-40 ▪ Perfluorinated polyether, e.g. Fomblin®

Scope of Delivery

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

Delivery	Pump P 2.1S/P 4.1S	☐
	User manual English and German	☐
	Power adapter 24 V	☐
	Installation Qualification Document	☐
Accessories kit	Pump	☐
	AZURA	☐

Safety

Professional group

The user manual is addressed to persons that have qualification as chemical-laboratory technician or 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

If you do not belong to this or a comparable professional group, under no circumstances may you perform the work described in this user manual.

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 eluents made or recommended by KNAUER
- Good Laboratory Practice (GLP)
- 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

More safety-relevant information is listed in alphabetical order in the following table:

Topic	Explanations
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. All contaminated devices must be properly decontaminated. All materials or fluids used for decontamination must be collected separately and disposed of properly.
Flammability	Organic eluents are highly flammable. Since capillaries can detach from their screw fittings and allow eluent to escape, it is prohibited to have any open flames near the analytical system.
Leak sensor	Pay attention to messages from the device or the chromatography software.
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.

Topic	Explanations
Eluent lines	Install capillaries and hoses so as to liquids can not get into the interior in case of a leak.
Power strip	If several devices are connected to one power strip, always consider the maximum power consumption of each device.
Power cable	Defective power cables are not to be used to connect the device and the mains power.
Self-ignition point	Only use eluents that have a self-ignition point higher than 150 °C under normal ambient conditions.
Power supply	Only connect devices to voltage sources, whose voltage equals the device's voltage.
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!

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.

Opening the device

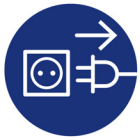
The device may only be opened by the Technical Support of KNAUER.

Definition of Personal and Material Damages

Possible dangers related to the device are distinguished in personal and material damages in this user manual.

Type of damage	Category	Explanations
Personal and material damages	DANGER!	Lethal or very serious injuries can occur.
	WARNING!	Serious injuries can occur.
	CAUTION!	Moderate injuries can occur. Device defect can occur.

Symbols and Signs

	Symbol	Meaning
CE mark		Device fulfills the requirements of the *Conformité Européenne*, which is confirmed by the Declaration of Conformity.
Warning signs		High-voltage hazard
		Electrostatic-discharge hazard
Mandatory signs		Wear protective bracelet against electrostatic discharge and ground.
		Pull the power plug.
		Observe torque of 5 nm maximum.
		Wear protective gloves.

Unpacking and Setup

Contacting the Technical Support

You have various options to contact the technical support:

Phone +49 30 809727-111

Fax +49 30 8015010

E-mail support@knauer.net

Location Requirements

Power supply The device is only suitable for 24 V direct current. The supplied power supply-unit is to be used to connect the device to the power unit.

Requirements The location for the device must meet the following requirements:

- Weight: 1.5 kg
- Dimensions: 105 × 100 × 185 mm (Width × Height × Depth)
- Power supply: 24 V DC
- Air humidity: < 90 %
- Temperature: 4 – 40 °C, 39.2 – 104 °F
- Space requirements:
  - Side clearance to other devices:
    - If there is a device on one side, minimum clearance of 5 cm.
    - If there are devices on both sides, minimum clearance of 10 cm
  - At least 30 cm gap to the fan on the rear of the device.

CAUTION! Defect of the device due to overheating!
Set up the device so that it is protected against exposure to direct sunlight.
Make sure the room is well-ventilated.
Allow 30-cm space at the rear of the device for air circulation.

Unpacking

Note

1. Setup the delivery so you are able to read the label. Using the utility knife, cut the adhesive tape. Open the delivery.
2. Remove the foam insert. Take out the accessories kit and the manual.
3. Open the accessories kit and take out all accessories. In case any parts are missing, contact the technical support. Grip the device at its side panels and lift it out of the packaging.
4. Remove the foam inserts from the device. Pull off the anti-static bag, if necessary.
5. Check for damages caused during transportation. In case you notice any damage, contact the technical support.
6. Set-up the device in its location.
7. Check the scope of delivery
8. Remove the protective foil.

Result The device is complete and ready for use.

Next steps Connect the device to power supply to prepare the initial startup.

Initial Startup

Ports on the Rear Side

All connectors are located on the rear side of the detector.

Legend

① CE mark

② Opening of the fan

③ Serial number

④ RS-232 port

⑤ LAN port

⑥ Pin header for remote control

⑦ Power connection - bushing

⑧ Warning 1

⑨ Hole for the ground connection

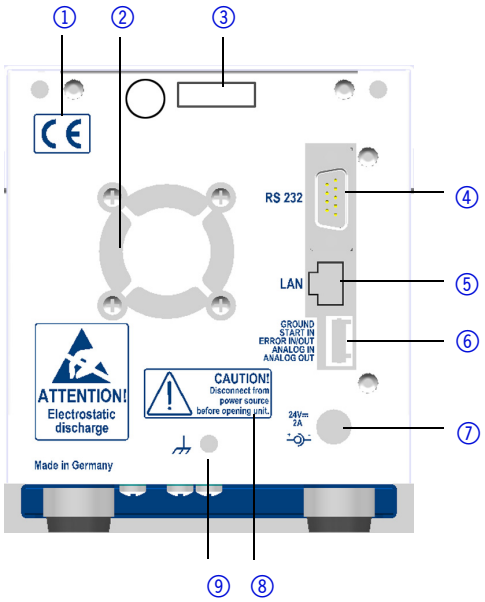


Fig. 3 Pump, rear view

External devices like computers, fraction collectors, etc. can be connected in 3 different ways:

- Connected to LAN within a network
- Connected to RS232, alternately to LAN connection
- Control with pin header

Controlling with a Computer in a Local Area Network (LAN)

This chapter describes how to set up 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.

Note To set up a LAN, we recommend to use a router. The following steps are necessary:

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 deactived.
- In case you use an USB-to-COM box, the option "Allow the computer to turn off ths device to save power" in the device-manager must be deactivated for all USB hosts.
- Only for Windows 7: For the network adapter, the option "Allow the computer to turn off ths device to save power" in the devicemanager must be deactivated.

Procedure

1. In Windows 7 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 an IP address automatically*
   b) *Obtain DNS server address automatically*
7. Click on the button *OK*.

Connecting the Cables

A router has several LAN ports and one WAN port that can be used to integrate the LAN into a wide area network (WAN), e. g. a company network or the Internet. On the other hand, the LAN ports serve to set up a network from devices and a computer. To avoid interference, we recommend to operate the HPLC system separate from the company network.

Note 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.

Legend

① Modules
② Router
③ LAN port
④ WAN port
⑤ Workstation

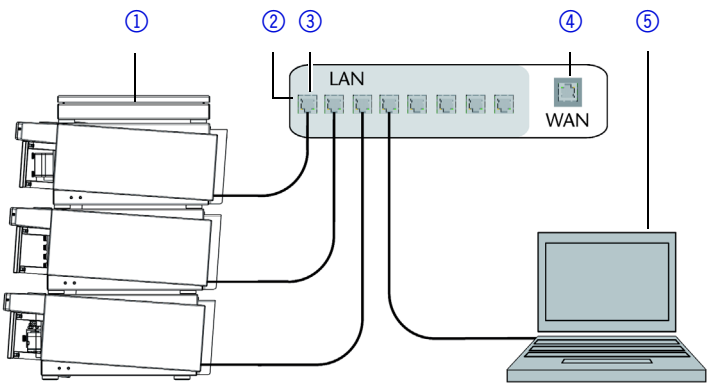


Fig. 4 Cabling system LAN

Prerequisite
- Computer is on.
- There is a patch cable for each device and the computer.

Procedure
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. You can find a label at the bottom side of the router, on which IP address, user name, and passwort are printed. These information help to open the router configuration.

Procedure
1. To open the router configuration, start your Internet browser and enter the IP address (not for all routers).
2. Enter user name and passwort.
3. Configure the router as DHCP server.
4. In the router configuration, check the IP-address range and make changes if necessary.

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.

Procedure
1. Check that the IP-address range of the router and of the company network do not overlap.
2. In case of an overlapping, 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 device, 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.

Note 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.

Procedure
1. Change the port number of the device.
2. Enter the port number in the chromatography software.

Result The connection is established.

Troubleshooting for Connection Problems

In case no connection between the computer and the devices can be established, go through the following points. Check after each point, if the problem is solved. If you did not manage to locate the problem, call the Technical Support.

1. Check the status of the LAN connection in the Windows taskbar: -  Connected -  Connection not established If no connection was established, test the following: ▪ Is the router on? ▪ Is the patch cable connected correctly to the router and the computer?	☐
2. Check the router settings: ▪ Is the router set to DCHP 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. In case you own a Control Unit, check the settings in the menu *Setup* > *Network*. ▪ Is *LAN-DHCP* set for controlling? ▪ Did the device receive an IP address?	☐
6. Turn off all devices, router, and computer. Firstly turn on the router, secondly the devices and the computer. ▪ Has this been successful?	☐
7. Replace the patch cable to the device with that no connection could be established. ▪ Has this been successful?	☐

Pin Header for Remote Control

CAUTION! Electrostatic discharge can destroy the electronics!
Wear protective bracelet against electrostatic discharge and ground.

Plug Connector Assignments

Contact data	Explanation
GROUND	Reference point of the voltage at the signal inputs.
START IN	**TTL-compatible input** ▪ min. 10 mA ▪ Low active After receiving a signal from an external device, the device starts. If controlled with software, an electronic trigger is send through the LAN.
ERROR IN/OUT	**TTL-compatible input** ▪ min. 10 mA ▪ Low active After receiving a signal (e. g. short-circuit to ground) from an external device, an error message appears and the device stops.
ANALOG IN	Flow rate is controlled through external control voltage (0 – 10 V).
ANALOG OUT	Analog output signal for reproducing the measured system pressure.

Ground

CAUTION! Electronic hazard when using an identically constructed power adapter from another manufacturer.
Before establishing a power connection, call the Technical Support.

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 support of KNAUER, 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.

Power Supply and Mains Connection

CAUTION! Electronic hazard if the power adapter is turned on while connecting or interrupting the power connection.
Switch off the power adapter beforehand.

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

Pump: The supplied power cable is to be used in connection with the external power adapter to connect the device to the power supply.

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)

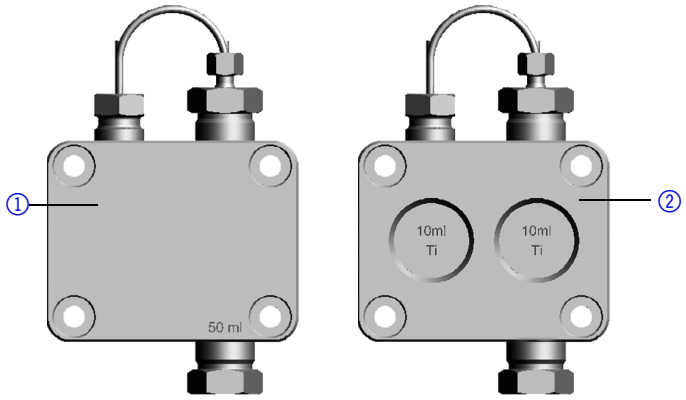


Fig. 5 Labeling on the pump heads

Connecting the Eluent Line to the Pump Head

Note Make sure that the tapered side of the cutting ring is pointed towards the fitting.

Procedure

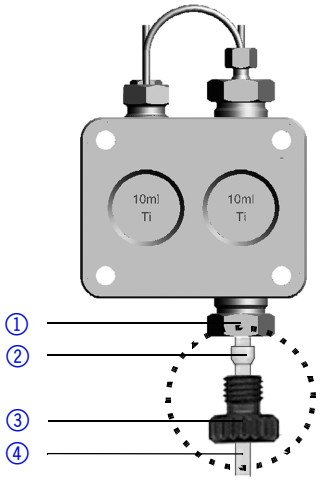
Process	Figure
1. Push the Teflon hose ④ through fitting ③ and cutting ring ②. 2. Insert the hose end as far as possible into the inlet ① of the pump head. 3. Tighten the fitting by hand.	

Fig. 6 Connect the eluent line to the pump head

Switching on the Pump

CAUTION! Defect of the device caused by condensed water!
Allow device to acclimate for 3 h, before it is taken into operation.

CAUTION! Damage to the pump head in case it runs dry.
Ensure that liquids runs through pump head and piston backflushing.

CAUTION! Procedure

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.

Operation

The pump can be operated in two ways:

- Using the buttons at the device
- Using the software ClarityChrom® or ChromGate®

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

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

Legend

① Pressure in 0,1 MPa

② Flow rate in ml/min

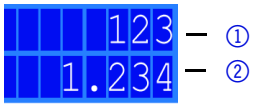
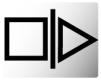


Fig. 7 Status display

Operating with the Keypad

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

Figure	Function
 **Fig. 8 Arrow keys**	Press both keys simultaneously to scroll.
	Press any of the arrow keys to set values and to change settings.
 **Fig. 9 Start/stop key**	▪ Starting and stopping the pump. ▪ 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.

Procedure

Process	Figure
1. Use the arrow keys to set a value for the flow rate. 2. Check if the right value appears on the display.	 **Fig. 10 Display control**
Result	The setting is completed and the pump runs at the set flow rate.

Setting the Pressure Switch Off

Legend

① Maximum value

② Minimum value

Figure


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

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

Procedure

Process	Figure
1. Press both arrow keys simultaneously until the correct display appears. 2. Let go of the arrow keys.	
3. When the cursor flashes, use the arrow keys again to set the value for the maximum pressure. 4. Hold down left arrow key. Press right arrow key once.	 **Fig. 11 Maximum pressure**

5. When the cursor flashes, use the arrow keys again to set the value for the minimum pressure. 6. Hold down left arrow key. Press right arrow key once to return to the start display.	 **Fig. 12 Minimum pressure**

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. The display shows an error message in both cases.

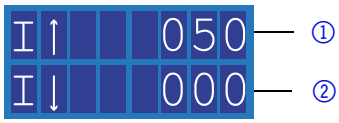
Setting the Power Consumption

Legend

① Maximum value

② Minimum value

Figure



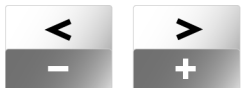
The power consumption is dependent on the flow rate and the counter pressure. It increases with higher flow rates and stronger counter pressure.

- 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 without pressure sensor 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. KNAUER recommends that with smaller flow rates the standard value for the maximum power consumption should be insignificantly decreased.

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

Procedure

Process	Figure
1. Press both arrow keys simultaneously until the correct display appears. 2. Let go of the arrow keys.	

3. When the cursor flashes, use the arrow keys again to set the value for the maximum power consumption. 4. Hold down left arrow key. Press right arrow key once.	 **Fig. 13 Minimum power consumption**
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. 14 Maximum power consumption**
Result	The setting is completed. If the value for maximum power consumption is exceeded, the pump switches off.

Flushing the Pump

The display shows vertical arrows while the pump is flushing.

Legend

① Flushing symbol

② Pressure

③ Flow rate

Figure


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

Prerequisite

- Pump with pressure sensor:
  - Venting screw of the pressure sensor is open.
  - Syringe is connected to venting capillary.
- Pump without pressure sensor:
  - Blind fitting in the outlet to the pressure sensor is removed.
  - Syringe is connected to the capillary on the pump-head outlet.

Procedure

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

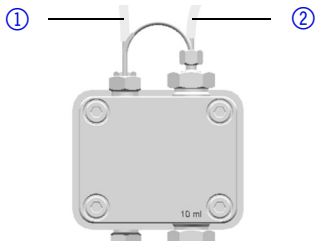
Flushing the Pistons

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.

Flushing solution: The following solvents are recommended for flushing the columns:

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

Procedure

Process	Figure
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.	 **Fig. 15 Flushing rear piston area**

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.

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 µl/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

Control command	Range and specification	Description
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)
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

Controlling the Flow Rate

The control of the flow rate by external control voltage is prepared with a terminal program, e. g. with the Windows operating system program *HyperTerminal*. The description is considered for Windows XP.

Prerequisite The pump is connected to the power supply.

1. *Windows Start* ⇒ *All Programs* ⇒ *Accessories* ⇒ *Communications* ⇒ *HyperTerminal*.
2. Connect the pump using a LAN or RS-232.
3. Enter *EXTCONTR:1* so as to control the flow rateexternally in ANALOG IN.
4. Apply control voltage.
5. 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.
6. To stop the pump, press the start/stop key again.

Legend

① Pressure in 0,1 MPa

② Flow rate in ml/min

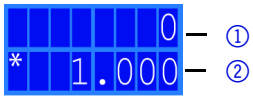


Fig. 16 Status display

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

Starting with a Short-Circut

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

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

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

Legend

① Pressure in 0,1 MPa

② Flow rate in ml/min

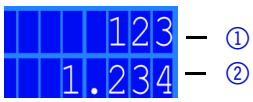


Fig. 17 Status display

Enter *STARTLEVEL:0* in the terminal program, to make the pump operate during short-circuit. The description is considered for Windows XP.

Prerequisite The pump is connected to the power supply.

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

Starting Directly after Connecting 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): The pump does not start operating right after being connected to power supply.
- STARTMODE 1: The pump starts operating right after being connected to power supply.

Enter in the terminal program using RS-232 *STARTMODE:1*, so that the pump is in operation directly after being connected to the power supply. The description is considered for Windows XP.

Prerequisite The pump is connected to the power supply.

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

Control with Chromatography 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.

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.

Procedure

Process	Figure
1. Press both arrow keys simultaneously until the correct display appears. 2. Let go of the arrow keys. 3. Using the arrow keys, scroll until LAN.	 **Fig. 18 Display control**
Result	When setting is finished, the status display appears.

RS-232 Port

Prerequisite

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

Procedure

Process	Figure
1. Press both arrow keys simultaneously until the correct display appears. 2. Let go of the arrow keys. 3. Using the arrow keys, scroll until RS-232 is displayed.	 **Fig. 19 Display control**
Result	When setting is finished, the status display appears.

Installation Qualification (IQ)

Installation report

Certification on the functionality of the device. During installation of the device, an installation report (IQ document) is created upon request in coordination with the technical support of the manufacturer.
This installation report needs to be completed in full and signed by both parties. It serves as proof of the properly executed installation and the functionality of the device.

Operation Qualification (OQ)

Extensive functionality test

Extensive test of the detector's functionality. A successfully executed *OQ* ensures that the detector functions properly.

Test Intervals

Run the device test at the following time intervals:

Average useful life	Device test
1 to 5 days/week:	Every 6 months
More than 5 days/week or 24 hours/day:	Every 3 months
Operation with buffer solutions or other salt solutions:	Every 3 months

Execution

The execution is done either by the manufacturer's technical service or by a technical service authorized by the manufacturer.

The *OQ* documentation required for executing the *OQ* is with costs (once) and can be ordered separately from the manufacturer.

Maintenance and Care

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

Switching Off the Pump

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

Contacting the Technical Support

Contact data 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:

European hotline

Languages: German and English
Available by telephone: 8 am to 5 pm (CET)
Phone: +49 30 809727 111
Fax: +49 30 8015010

E-mail contact: support@knauer.net (manufacturer)

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

CAUTION! Intruding liquids can cause damage to the device!
Place solvent bottles next to the device or on a solvent tray.
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.

Maintenance Contract

The following maintenance work on the device may only be performed by KNAUER or a company authorized by KNAUER 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 check valves

Replacing the Pump Head

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

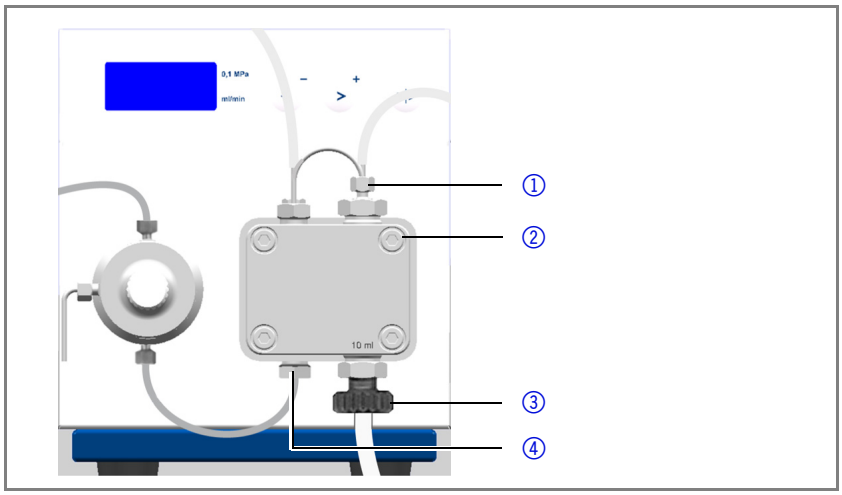
Legend

① Capillary fitting piston backflushing

② Fastening screw

③ Inlet fitting eluent

④ Outlet fitting pressure sensor

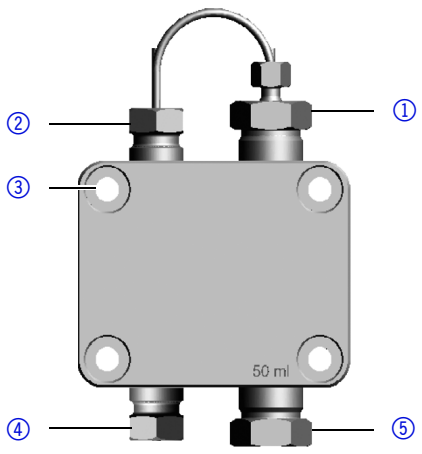


Removing the Pump Head

Requirements The pump head has been flushed with suitable solvent.

CAUTION! **Piston rods can break.**
Before disassembling the pump head, remove the two piston rods and deposit in the correct orientation. When assembling the pump head, the piston rods must be inserted on the same side they have been removed from.

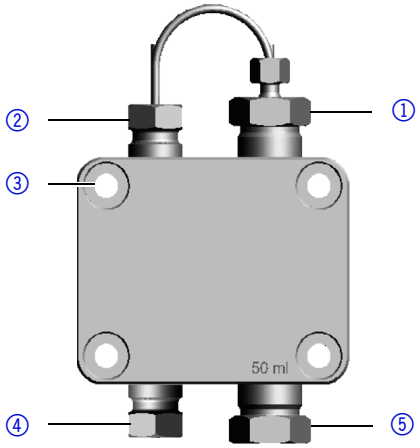
Procedure

Process	Figure
1. Unscrew inlet fitting ② and outlet fitting ① . 2. Unscrew the inlet fitting ⑤ to the eluent. 3. Unscrew the outlet fitting ④ to the pressure sensor. 4. Alternately unscrew the 4 fastening screws ③ . 5. Hold the pump head and consecutively pull out all fastening screws.	

Installing the Pump Head

CAUTION! Damage to the pump head caused by strongly tightened capillary fittings!
Check the torque of screw fittings:
- 5 Nm for stainless steel fittings
- 0,5 Nm for PEEK fittings

Procedure

Process	Figure
1. Insert the fastening screws ③ and tighten alternately. 2. Tighten the outlet fitting ④ to the pressure sensor. 3. Tigthen the inlet fitting ⑤ to the eluent. 4. Tighten the inlet fitting ② and the outlet fitting ① of the piston.	

Exchanging the Check Valves

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

Note: Insert the valves in the direction of flow!

Legend

① Ball

② Flow direction

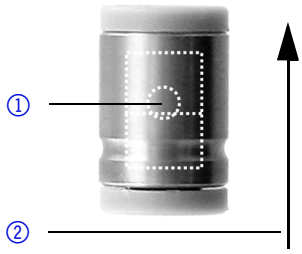


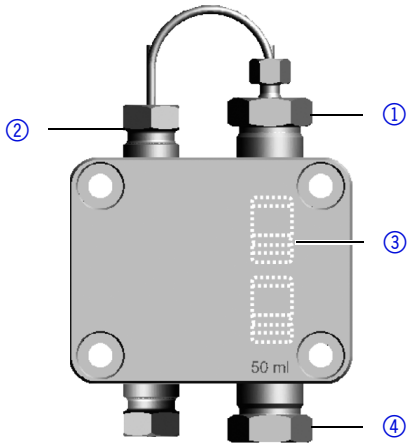
Abb. 20 Check valve

Removing the Check Valves

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

Prerequisite Pump head has been flushed.

Procedure

Process	Figure
1. Unscrew the inlet fitting ① and the outlet fitting ②. Remove the check valve ③. 2. Unscrew the inlet fitting ④ to the eluent and remove the check valve.	 **Abb. 21 Position check valve**

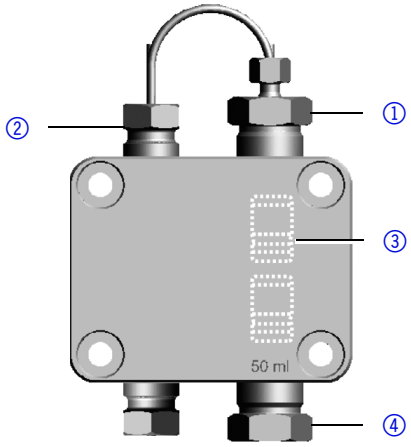
Cleaning the Check Valves

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

Tools Torque wrench

Procedure

Process	Figure
1. Insert the check valve ③ and tighten the inlet fitting ④ to the eluent. 2. Insert the check valve. Tighten the inlet fitting ① and the outlet fitting ②. 3. Using the torque wrench, tighten the outlet fitting ② and the inlet fitting ④ with 7.5 Nm.	 **Abb. 22 Position check valve**

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 of KNAUER

Error List 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. • 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. • Check if the venting screw on the pressure sensor is turned open.
Pump does not transport solvent	Check the following options: ▪ 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 ▪ Clean the check valves ▪ Exchange the check valves ▪ If the pump head seals are defective, solvent enters the piston backflushing; inform the technical support of KNAUER.
Pressure or flow rate fluctuations	Check the following options: ▪ Purge the pump head so as to remove the air bubbles ▪ Always tighten the inlet screw and outlet screw on the pump head with a torque wrench and 7.5 Nm. Clean the check valves ▪ Exchange the check valves

Pump head leaks	Check the following options: ▪ 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 KNAUER.
Flow rate is not correct	Check the following options: ▪ Inspect the inlet and outlet screw fittings of the pump head ▪ Clean the check valves ▪ Exchange 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 KNAUER.

Technical Data

Conveying system	Dual-piston pump with main and auxiliary piston
Flow rate range	▪ 10 ml pump head: 0.001 - 10 ml/min ▪ 50 ml pump head: 0.01 - 50 ml/min
Maximum pressure	▪ 10 ml pump head: 40 MPa to 10 ml/min Imax = 70 ▪ 50 ml pump head: 15 MPa to 50 ml/min Imax = 80
Flow rate accuracy	▪ ± 1%, measured at 5 - 50% of flow range using ethanol/water 10:90 ▪ For pumps without a pressure sensor dependent on pressure
Flow rate precision	Relative standard deviation RSD: < 0.5 % (1 ml/min)
Gradients	▪ Isocratic HPLC pump ▪ Expandable to a binary high pressure gradient system (controlled by software)
System protection	▪ Pump with pressure sensor: - P_{min} and P_{max} adjustable - I_{min} and I_{max} adjustable ▪ Pump with pressure sensor: I_{min} and I_{max} adjustable
Operation	▪ LAN ▪ RS-232 ▪ *Remote* terminal strip ▪ 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 adapter and power cable: Power supply	24 V, 50 VA
Active power consumption	maximum 40 W
IP protection class	IP-20
Weight	▪ Pump without pressure sensor: 2.3 kg ▪ Pump with pressure sensor: 2.4 kg
Dimensions including components (length x width x height)	▪ Pump without pressure sensor: 220 × 121 × 138.1 mm ▪ Pump with pressure sensor: 227.8 × 121 × 138.1 mm

Abbreviations and Terminology

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

Accessories and Spare Parts

Device and Accessories

Name	Order number
Pump	APG20
Accessories kit AZURA	FZA01
Accessories kit P 2.1S/P 4.1S	FPG
User manual German	V6870
User manual English	V6870A

Device Variations

Bezeichnung	Bestellnummer
Pump P 4.1S with 10 ml pump head (stainless steel)	APG20AA
Pump P 4.1S with 10 ml pump head (ceramic)	APG20BB
Pump P 4.1S with 10 ml pump head (titanium)	APG20AC
Pump P 4.1S with 50 ml pump head (stainless steel)	APG20DA
Pump P 4.1S with 50 ml pump head (titanium)	APG20DC
Pump P 2.1S with 10 ml pump head (stainless steel)	APG90AA
Pump P 2.1S with 10 ml pump head (titanium)	APG90AC
Pump P 2.1S with 10 ml pump head (ceramic)	APG90BB
Pump P 2.1S with 50 ml pump head (stainless steel)	APG90DA
Pumpe P 2.1S mit 50 ml Pumpenkopf (Titan)	APG90DC

Available Pump Heads

Name	Order number
10 ml pump head with titanium inlay	A54121-1
10 ml pump head with stainless-steel inlay	A54123-1
10 ml pump head with ceramic inlay	A54102
50 ml pump head with titanium inlay	A54131
50 ml pump head with stainless-steel inlay	A54133

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.

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 manufactred 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.

Declaration of Conformity

Manufacturer name and address

Wissenschaftliche Gerätebau
Dr. Ing. Herbert KNAUER GmbH
Hegauer Weg 38
14163 Berlin, Germany

AZURA Pump P 2.1S

Product numbers: DPG90AA; DPG90AC; DPG90DA; DPG90DC; DGP90BB

AZURA Pump P 4.1S

Product numbers: DPG20AA; DPG20AC; DPG20DA; DPG20DC; DPG20BB

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 interconnection 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, 2013/04/15

Dr. Alexander Bünz (Managing Director)

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

CE

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Wissenschaftliche Gerätebau
Dr. Ing. Herbert Knauer GmbH
Hegauer Weg 38
14163 Berlin, Germany

Phone: +49 30 809727-0
Telefax: +49 30 8015010
E-Mail: info@knauer.net
Internet: www.knauer.net

KNAUER