

BlueShadow

► Pump 40P User Manual

V7610



HPLC

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

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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.

HPLC High performance liquid chromatography (HPLC) is a method for separating substance mixtures, determining substances and measuring their concentration.

The device or system is suitable for high-pressure liquid chromatography. It is suitable for laboratory use, for analyzing substance mixtures that can be dissolved in a solvent or solvent mixture.

*Room ventilation,
AC system,
sunlight*

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

Due to the new drive used in the pump, pump heads of older series cannot be used any more.

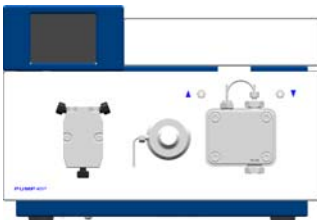
Scope of application

- Biochemistry analyses
- Chiral analyses
- Food analyses
- Pharmaceutical analyses
- Environmental analyses

Pumps – Device Types

- Pump with mixing chamber (optional)
- Pump with LPG module
- Pump with mixing chamber and LPG module

Pump with Mixing Chamber (optional)



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

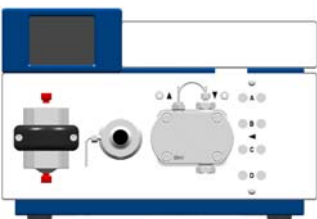
Automatic piston backflushing increases the support life of the seals and pistons, and removes salt and other substances from the area behind the seals.

Pump with LPG Module



The low pressure gradient module (LPG module) supplements the pump to a quaternary low pressure gradient system. The LPG Module is controlled by the touchscreen of the pump or with chromatography software.

Pump with Mixing Chamber and LPG Module



The pump for applications in the high pressure area is equipped with a mixing chamber, a pressure sensor and an LPG Module.

Eluents

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

Note: The solvent list contains the solvents KNAUER recommends for use. If there is any doubt, contact the Technical Support of the manufacturer.

Suitable solvents

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

Less suitable solvents

- Fluorinated hydrocarbons
- Dimethyl sulfoxide (DMSO)
- Methylene chloride
- Slightly volatile solvents
- Tetrahydrofuran (THF)

Not suitable solvents

- Mineral and organic acids (except in buffer solutions)
- Bases (except in buffer solutions)
- Liquids containing particles

Local Area Network and Automatic Configuration

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

Remote control Normally the pump is controlled by means of the chromatography software, via a local network (LAN).

Automatic pump head recognition The pump automatically recognizes the pump head by means of an RFID chip.

Automatic configuration A pump connected to a local area network (LAN) is automatically recognized by the chromatography software.

Device status When used in a local area network (LAN), the system status of the pump can be verified by means of chromatography software.

LAN setting Ex works, the pump is set to DHCP (Dynamic Host Configuration Protocol). This means that the pump is automatically assigned an IP address within the local network. In the Setup menu, this setting can be modified manually.

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.
- Decommissioning the Device Securely* 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.

Power Supply and Mains Connection

The device is intended for use with AC power networks of 100 – 240 V. The supplied power cable is to be used to connect the device to the mains supply.





Note: To disconnect the pump from the mains power, disconnect the power plug on the rear of the device.

PEEK Connections

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

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
	Electrostatic discharge hazard, damages to system, device, or components may occur.
	A device or system marked with CE fulfills the product specific requirements of European directives. This is confirmed in a Declaration of Conformity.
	Testing seals in Canada and the USA at nationally recognized testing centers (NRTL). The certified device or system has successfully passed the quality and security tests.

Installation

This chapter describes all preparatory steps prior to the start-up. If you encounter difficulties during installation, contact the Technical Support.

Contact Data

Phone	+49 30 809727-111
Fax	+49 30 8015010
E-mail	support@knauer.net

Transport

Carefully prepare the device for transport or storage. If you want to return your device to KNAUER for repairs, enclose the Service Request Form which can be downloaded from our website.

Device Data For a secure transport, note the weight and dimensions of the device (see Technical Data).



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 on the side of the housing only.

Lifting Clasp the device at its side panels and lift it out of the packaging. Do not hold onto front cover or leak tray.

Scope of Delivery

Pumps – device types

- Pump with installed pump head and mixing chamber (optional)
- Pump with installed pump head and LPG module
- Pump with installed pump head, mixing chamber and LPG module

Accessories

- Manual
- Cables
 - Power supply cable for Germany
 - Power supply cable for United Kingdom (optional)
 - Power supply cable for USA (optional)
 - Network cable
 - RS-232 port cable
 - 2 x flat ribbon cable, 10-pos.
- Set of connector strips, 12-pos.
- Kit for bleeding the pump
- Tools
- Silicon tubing
- Single-use syringe 10 ml
- 1 x Screw fitting 1/8"
- 2 x Seal ring 1/8"
- PTFE eluent filter
- Snap ferrite
- additional box
- Mounting bracket

Use original parts and original accessories

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

Checking the Scope of Delivery

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

Hotline of the technical support department of the manufacturer:

European hotline

Languages: German and English
 Available by telephone: 8 am to 5 pm (CET)
 Phone:+49-(0)30-809727-0
 Fax:+49-(0)30-8015010

E-mail: email: info@knauer.net (manufacturer)

Operating Environment

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 in the vicinity of other machines that cause floor vibrations.

Set-Up

Prerequisite

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

Tools: Utility knife

⚠ CAUTION**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 on the side of the housing only.

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.

Electrical Connections

- Use the *Events* and *Remote* terminal strip to connect the pump with external devices.
- Use the LAN connection to connect the pump with external devices within a network.
- Alternatively, connect the pump to a computer by means of the RS-232 port.
- Use the special connection cable to connect the pump and Manager 40M.

NOTICE

Electronic defect

Electrostatic discharge can destroy the electronics.

→ Wear a protective bracelet against electrostatic discharge and ground.

Attaching the Snap Ferrite

Flat ribbon cables that are connected to the *Events* and *Remote* terminal strips can sometimes cause electromagnetic interference. This can be suppressed by means of a snap ferrite.

Open the snap ferrite, place it around the flat ribbon cable and close it.

Legend

- ① Flat ribbon cable
- ② Snap ferrite

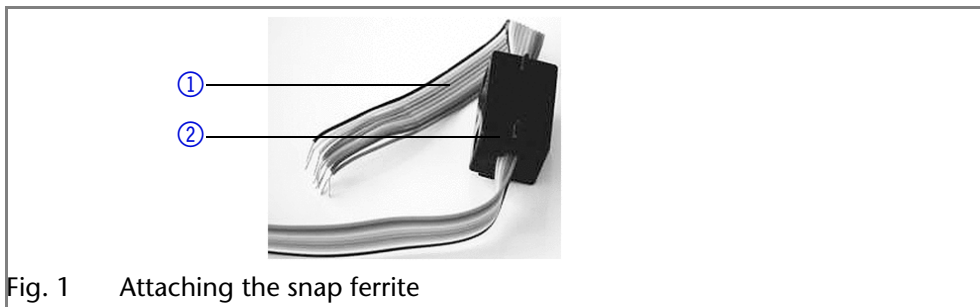


Fig. 1 Attaching the snap ferrite

Pin Header for Remote Control

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 (everything comes 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

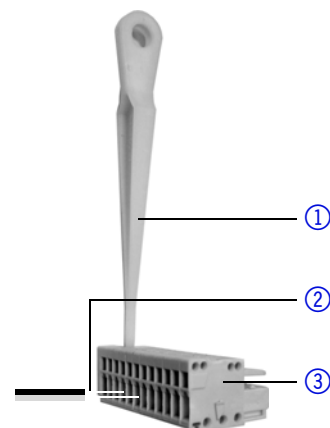
Electronic defect

Electrostatic discharge can destroy the electronics.

→ Wear a protective bracelet against electrostatic discharge and ground.

Process

1. Place the terminal strip ③ on a suitable surface.
2. Push the depressor tool ① into the opening on the upper side.
3. Continue pushing the depressor tool down and lead the cable ② into the front end of the terminal strip.
4. Remove the depressor tool.
5. Check whether the cables are tightly attached.
6. Plug the terminal strip onto the multi-pin connector.



Next steps

Finish the installation and perform the initial startup.

Terminal Strip: Remote

- For receiving start, control and error signals from external devices
- For sending start, control and error signals to external devices

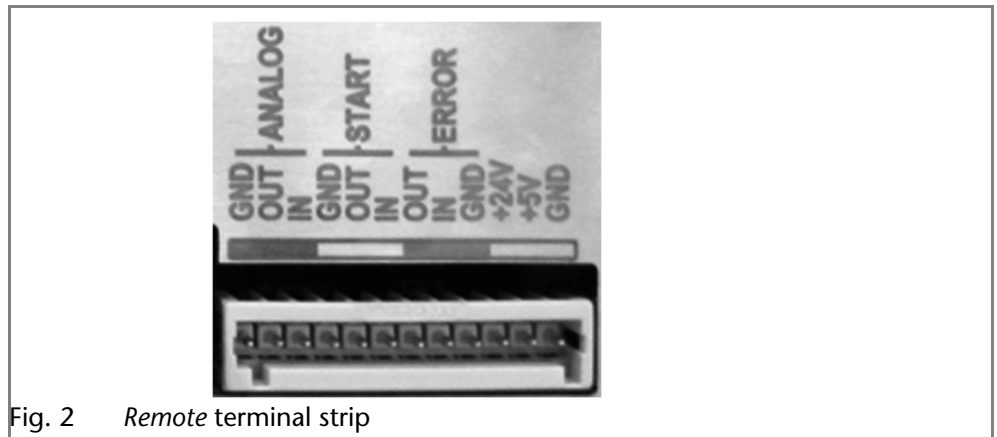


Fig. 2 Remote terminal strip

Signal	Explanations
ANALOG: OUT	<ul style="list-style-type: none"> ▪ Analog output signal reflecting either the measured system pressure or a control voltage for <i>Pump B</i>. ▪ The output range can be set to values of max. 1, 2, 5 and 10 V.
ANALOG: IN	Analog input signal for controlling the flow rate, e.g.: <ul style="list-style-type: none"> ▪ 1 V for 1 ml/min in the case of the 10 ml pump head ▪ 1 V for 5 ml/min in the case of the 50 ml pump head.
START: OUT	Output is active for 500 ms when the pump starts.
START: IN	Program is activated by a voltage of 0 V against GND.
ERROR: OUT	Output is active until the <i>Error</i> condition has been eliminated.
ERROR: IN	A voltage of 0 V against GND stops the pump.

Terminal Strip: Events

- Sending control signals (*Events*) to external devices
- Opening and closing contacts
- Activating 500 ms pulses

Legend

- ① Status display *Events*
- ② Terminal strip: *Events*

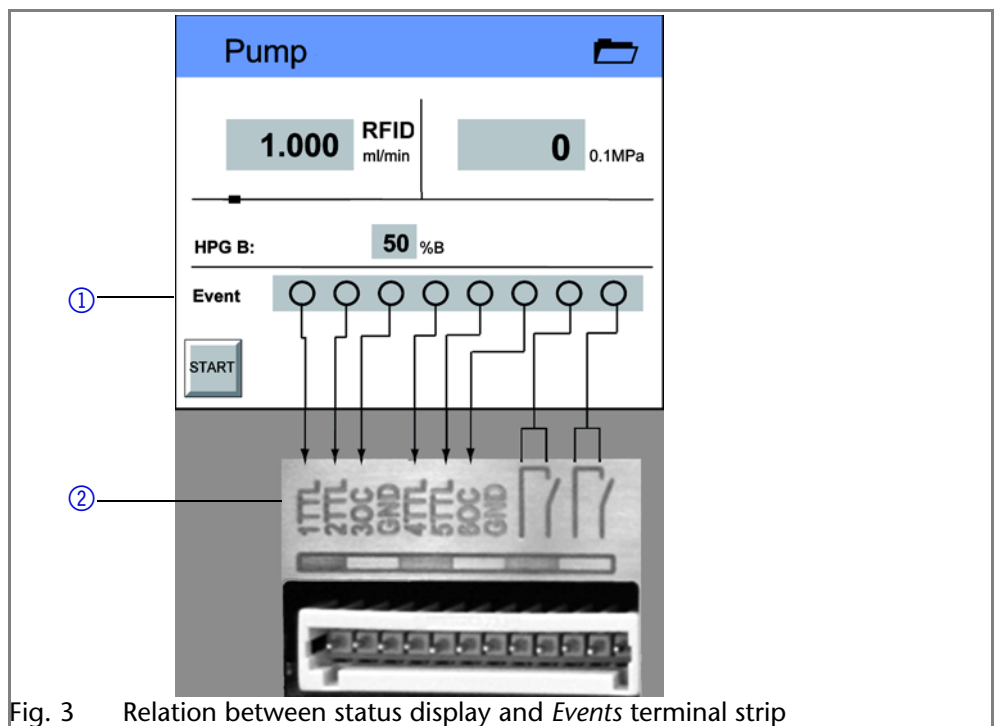


Fig. 3 Relation between status display and *Events* terminal strip

Controlling the Pump with Chromatography Software

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

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.

Note: 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

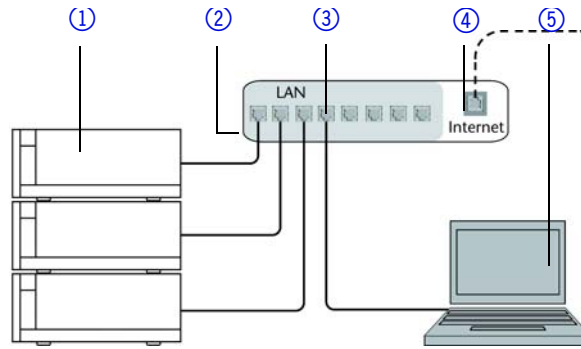
The LAN uses only one server (which is normally the router) from that the devices automatically receive their IP address.

- 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.
 - Only for Windows 7: For the network adapter, the option "Allow the computer to turn off this device to save power" in the Device Manager must be deactivated.

- Process*
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 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. You will find a label at the bottom side of the router, on which IP address, user name, and password are printed. These information help to open the 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.

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.

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.

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.

Features

- Dual-piston technology combined with optimized electronic pulsation dampening and compressibility compensation
- Liquid transport with low pulsation, stable flow rate and high flow accuracy
- Pump head made of stainless steel or with titanium inlays
- Automatic piston backflushing
- Internal controlling for programming binary to quaternary high-pressure gradients
- HPG system: Up to four pumps can be combined
- LPG system: Up to four eluents can be combined
- Ultra-precise gradient mixtures throughout entire flow range
- High physical and chemical stability
- Direct pump control via analog and digital signals
- Control with chromatography software
- Mixing chamber

Startup

What Should the User Pay Particular Attention to?

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

- | | |
|---|---|
| <i>Avoiding additional dead volumes</i> | <ol style="list-style-type: none"> 1. Once they have been used, never re-use capillaries in other areas of the HPLC system. 2. Only use a given PEEK fitting for one specific port and never re-use it for other ports. Always install new PEEK fittings on each separate port. |
| <i>Using special columns</i> | <ul style="list-style-type: none"> ▶ Use special columns and follow the manufacturer's instructions on caring for the columns! |
| <i>Checking for clogged capillaries</i> | <ul style="list-style-type: none"> ▶ Regularly check for clogged capillaries – test back pressure without column! |
| <i>Using filtered solvents</i> | <ol style="list-style-type: none"> 1. Use ultra-pure, filtered solvents – <i>Gradient grade</i> – for the HPLC. 2. Filtration of substances to be analyzed. 3. Use of inline filters. |

Operating Modes

Isocratic

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

Quaternary

The gradient is formed on the low-pressure side of the pump (low-pressure gradient)

Legend

- ① Gradient module
- ② Pump head
- ③ Pressure sensor
- ④ Mixing chamber

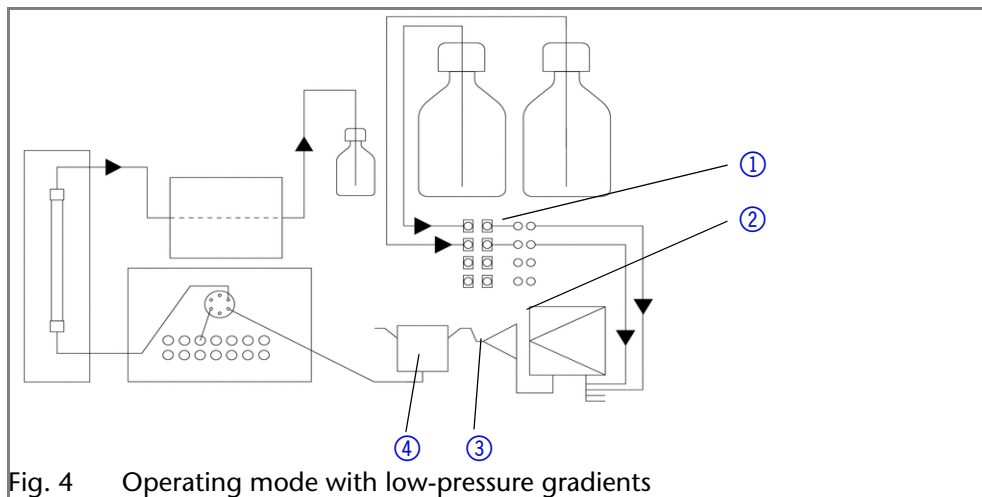


Fig. 4 Operating mode with low-pressure gradients

Binary

The gradient is formed on the high-pressure side of the pump (high-pressure gradient)

Legend

- ① Pump with degasser module and pressure sensor
- ② Pump with pressure sensor and mixing chamber

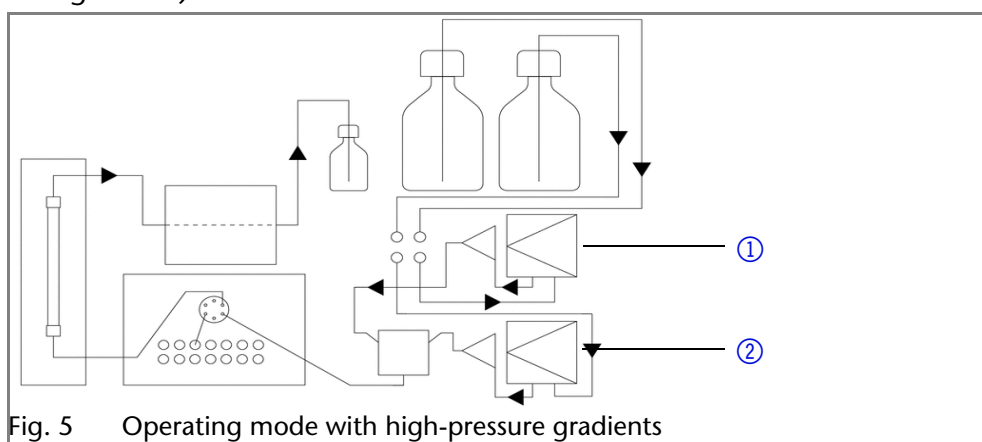


Fig. 5 Operating mode with high-pressure gradients

Series

The pump program consists of devices for analytical applications in the high-pressure range:

- High-pressure pump with pressure sensor and mixing chamber (optional)
- High-pressure pump with pressure sensor and LPG module

The pump program consists of devices for semi-preparative applications in the high-pressure range:

- High-pressure pump with pressure sensor and mixing chamber (optional)

Pump Heads

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

Pump with Mixing Chamber (optional)

Front View of the Device

Legend

- ① Touchscreen
- ② Mixing chamber
- ③ Pressure sensor
- ④ Ventilation screw
- ⑤ Tube connections for the piston backflushing
- ⑥ Pump head

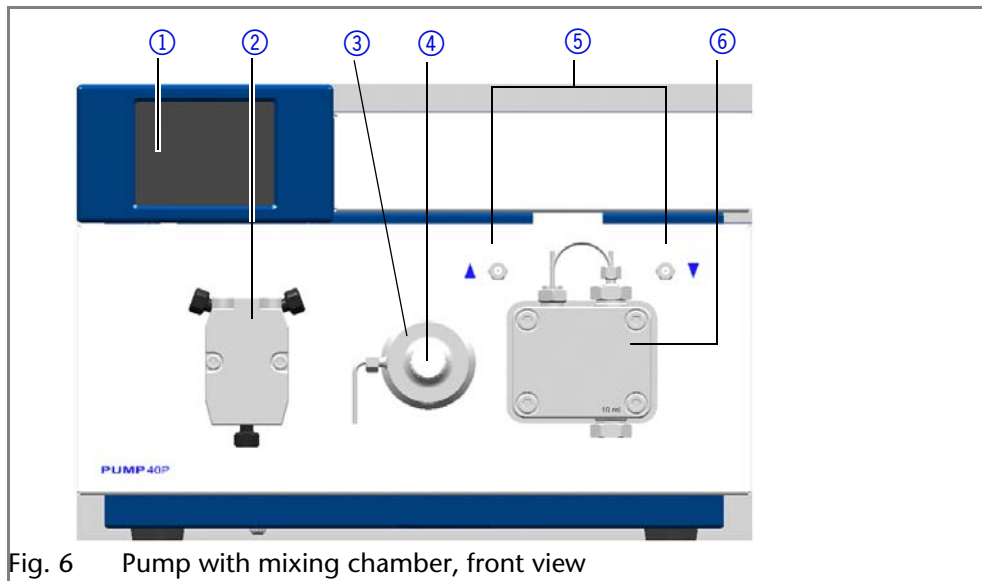


Fig. 6 Pump with mixing chamber, front view

Rear View of the Device

Legend

- ① Serial number
- ② Manager connection
- ③ Terminal strip: Events
- ④ Testing seal
- ⑤ LAN connection
- ⑥ Warning 1
- ⑦ RS-232 port
- ⑧ Fan opening
- ⑨ Terminal strip: Remote
- ⑩ Warning 2
- ⑪ Power switch
- ⑫ Mains power connection
- ⑬ CE mark

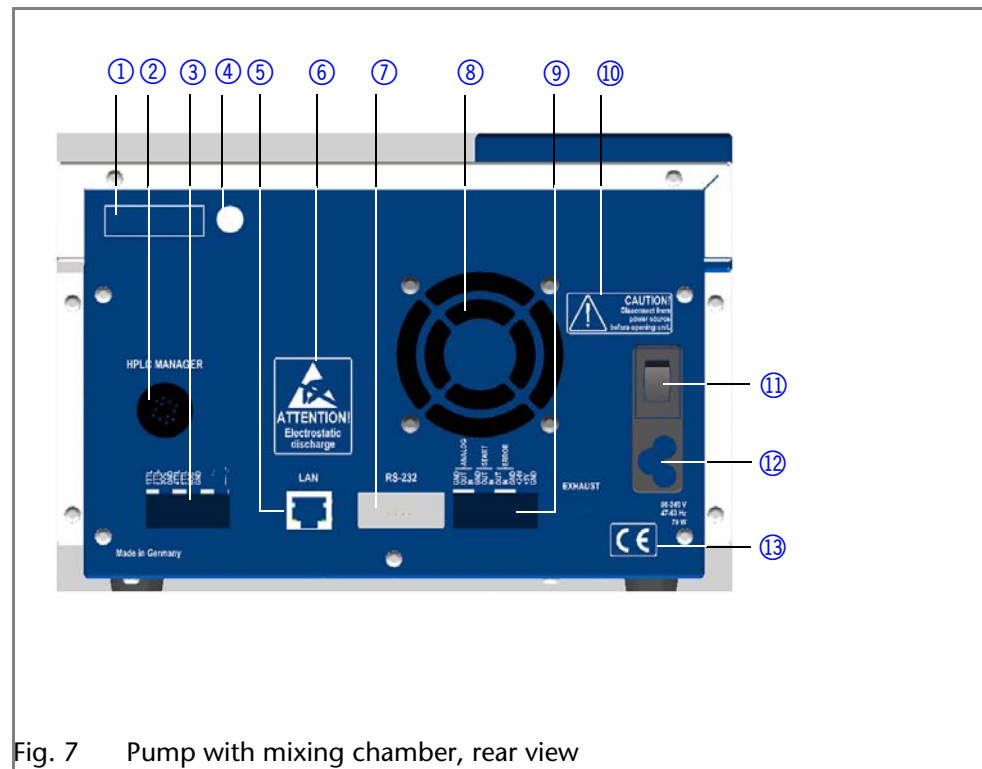


Fig. 7 Pump with mixing chamber, rear view

Pump with LPG Module

Front View of the Device

Legend

- ① Touchscreen
- ② Pressure sensor
- ③ Ventilation screw
- ④ Pump head
- ⑤ Degasser

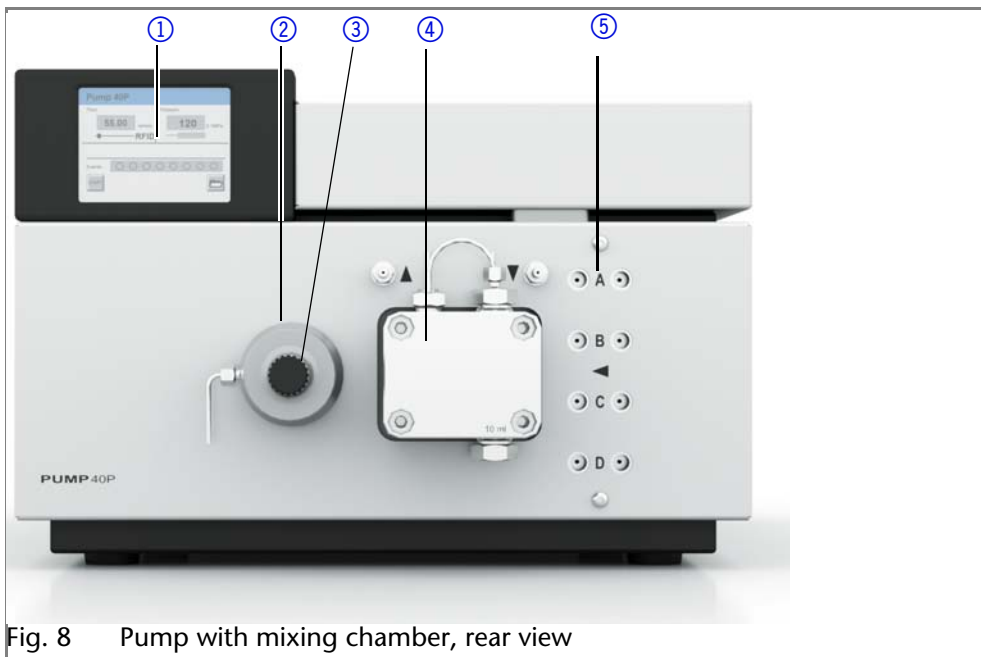


Fig. 8 Pump with mixing chamber, rear view

Rear View of the Device

Legend

- ① Serial number
- ② Terminal strip: Events
- ③ Testing seal
- ④ LAN connection
- ⑤ Warning 1
- ⑥ RS-232 port
- ⑦ Fan opening
- ⑧ Terminal strip: Remote
- ⑨ Warning 2
- ⑩ Power switch
- ⑪ Mains power connection
- ⑫ CE mark

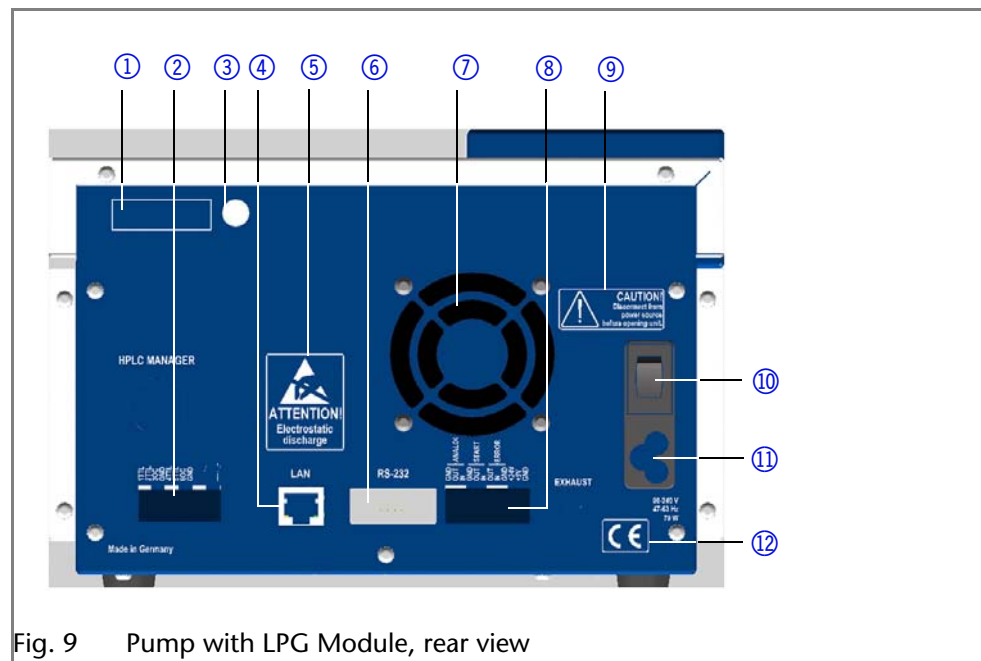


Fig. 9 Pump with LPG Module, rear view

Pump with Mixing Chamber and LPG Module

Front View of the Device

Legend

- ① Mixing chamber
- ② Touchscreen
- ③ Pressure sensor
- ④ Ventilation screw
- ⑤ Pump head
- ⑥ Tube connections for the piston backflushing
- ⑦ LPG Module

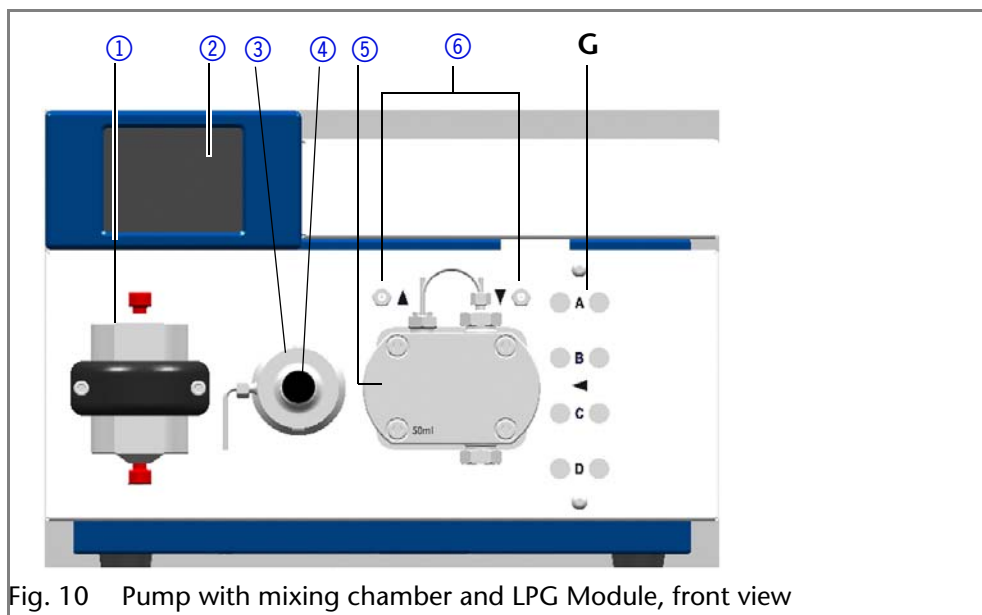


Fig. 10 Pump with mixing chamber and LPG Module, front view

Rear View of the Device

Legend

- ① Serial number
- ② Terminal strip: *Events*
- ③ Testing seal
- ④ LAN connection
- ⑤ Warning 1
- ⑥ RS-232 port
- ⑦ Fan opening
- ⑧ Terminal strip: *Remote*
- ⑨ Warning 2
- ⑩ Power switch
- ⑪ Mains power connection
- ⑫ CE mark

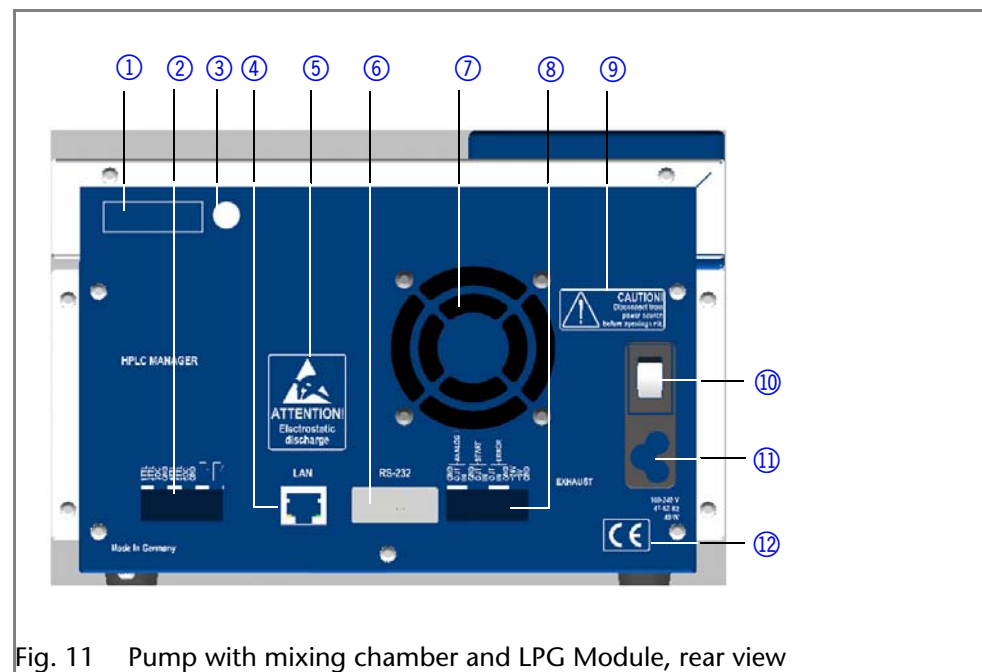


Fig. 11 Pump with mixing chamber and LPG Module, rear view

Additional Box

If desired, the pump with mixing chamber and LPG module can be supplied with an additional box so that wider devices can be placed on top of the pump.

The additional box needs to be installed by the manufacturer's technical support personnel.

Note: The device may not be opened by the user. Installation of the additional box requires removal of the pump's side panel.

Legend

- ① Pump with mixing chamber and LPG Module
- ② additional boxes

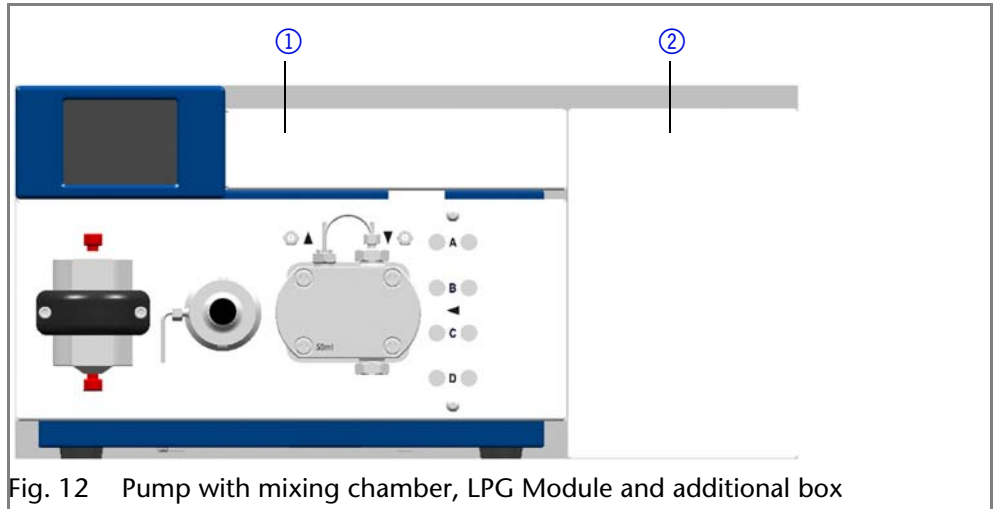


Fig. 12 Pump with mixing chamber, LPG Module and additional box

Labeling on the Pump Heads

The front of the pump head is labeled with the max. pumping capacity (10 ml or 50 ml). Pump heads with inlays carry additional material labels (SST for stainless steel, C for ceramic).

Legend

- ① Capacity
- ② Material

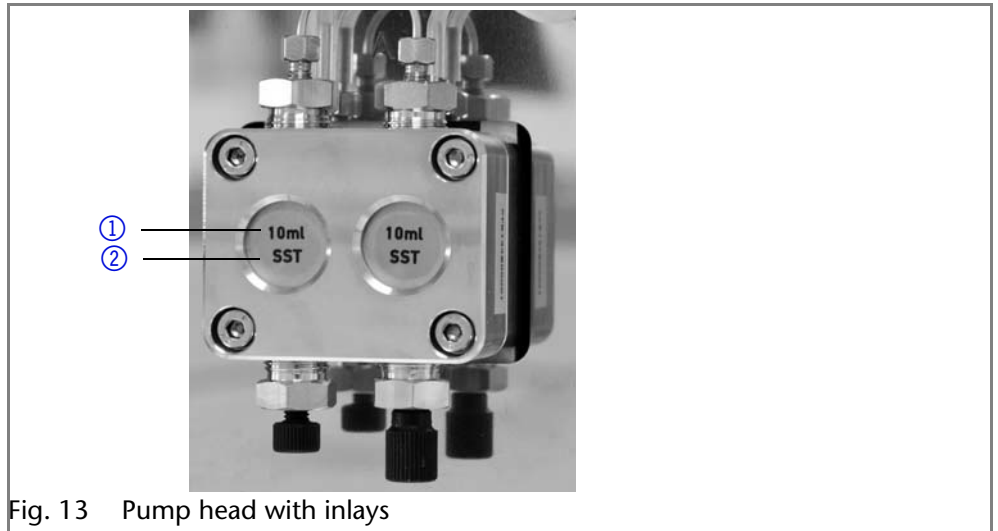


Fig. 13 Pump head with inlays

Connecting the Pump with other Devices

RFID Recognition

The pump head is equipped with an RFID chip. It is used to monitor and save all important parameters and settings of the pump and pump head.

Legend

- ① RFID designation

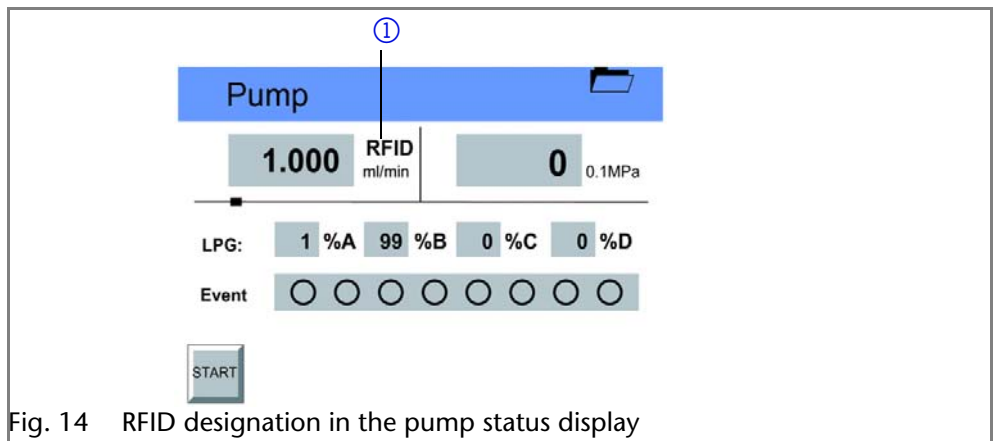


Fig. 14 RFID designation in the pump status display

The RFID technology offers the following advantages:

- Automatic detection of all important pump head parameters by means of radio signals (radio frequency identification), by the pump software or the chromatography software:
 - Pump head type
 - Serial number and year of manufacture
 - Number of cycles and operating times
 - Limit values of the pump head parameters
- All measuring data archived in accordance with GLP (good laboratory practice)
- Transfer of all data to the software and pump display

Solvent Line

- Make sure that all connections are tight
- Isocratic system: Connect the solvent reservoir to the pump, either directly or via an external degasser
- LPG system: Connect the solvent reservoir to the pump via the degasser module
- HPG system: Connect the respective solvent reservoir with the 2-channel degasser module of the pump or with an external degasser.

Note: The manufacturer recommends always using a degasser module to ensure reliable transport of the solvent as eluent.

Connecting the Solvent Line to the Pump Head in an Isocratic or Binary System

Prerequisites

- The device has been switched off.
- The power plug has been pulled.
- The front cover has been removed.

Material

Flangeless fitting

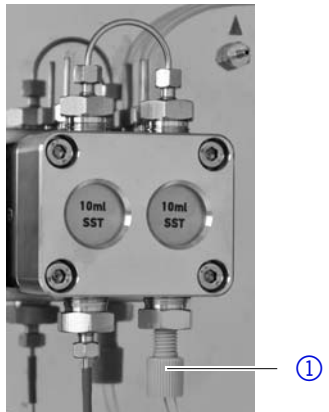
NOTICE

Device defect

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

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

Procedure

Process	Figure
<ol style="list-style-type: none"> 1. Slide the flangeless fitting onto the tubing. 2. Insert the tubing into the free inlet ① on the bottom of the pump head. 3. Tighten the fitting by hand. 	 <p>Fig. 15 Solvent line on the pump head</p>

Next steps

Integrate the pump into the HPLC flow system.

Intake Manifold

1. Connect up to four outputs of the pump's LPG module or the Manager to the intake manifold inlets at the pump head.
2. Close unused inlets by means of filler caps to prevent air from being sucked into the system.

Legend

- ① Knurled-head screw
- ② Filler cap
- ③ Mixing unit

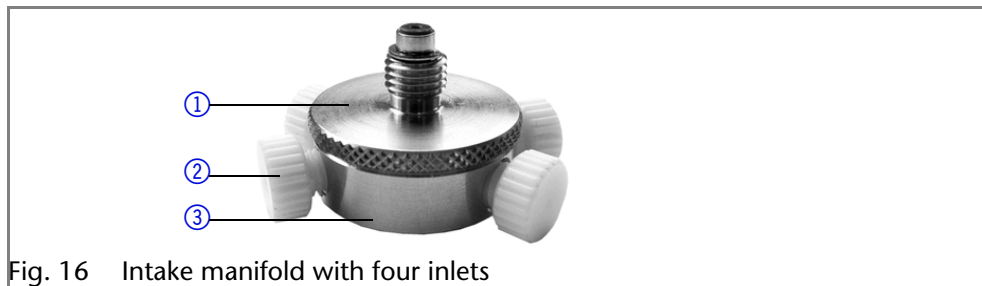


Fig. 16 Intake manifold with four inlets

Connecting the Solvent Line to the Pump Head in the LPG System

Procedure

Steps	Figure
<ol style="list-style-type: none"> 1. With the knurled-head screw ②, screw the intake manifold into the lower inlet fitting ① of the pump head. 2. Rotate the mixing unit until the inlets of the intake manifold ③ are at the side. 3. Tighten knurled-head screw. 	<p>Fig. 17 Connecting the intake manifold to the pump head</p>
<ol style="list-style-type: none"> 4. Screw the fastening screws ④ of the eluent line into the inlets of the intake manifold. 5. Use filler caps to close unused inlets. 	<p>Fig. 18 Screwing the eluent line into the intake manifold</p>

Mixing Chamber

With all gradient systems, the manufacturer recommends using a mixing chamber for mixing the eluents.

Connecting a Mixing Chamber (Binary System)

With two screws, attach the mixing chamber at the front panel of the device.

Legend

- ① Mixing chamber
- ② Capillary from pump A's pressure sensor
- ③ Pressure sensor for pump B
- ④ Pump head
- ⑤ Capillary from pump A's 2-channel degasser module
- ⑥ Capillary to injection valve

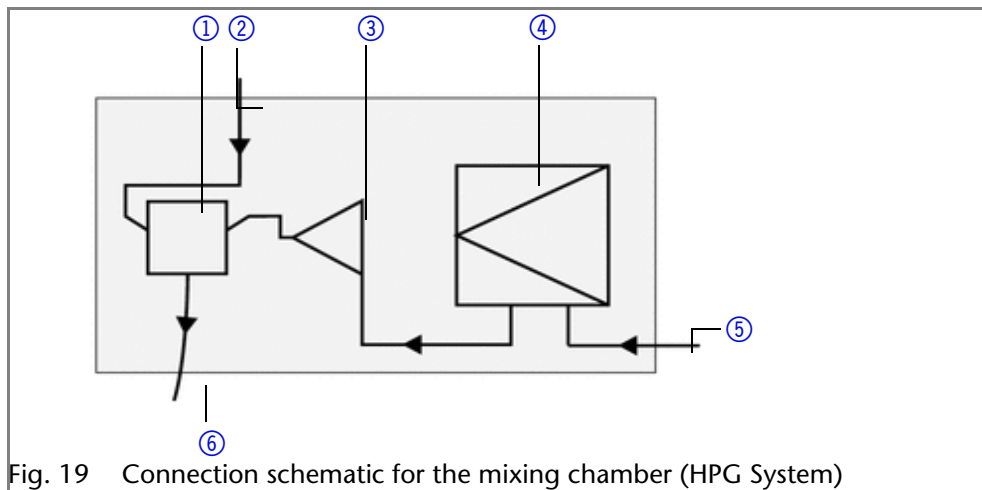


Fig. 19 Connection schematic for the mixing chamber (HPG System)

Connecting a Mixing Chamber (Quaternary System)**Legend**

- ① Mixing chamber
- ② Pressure sensor
- ③ Pump head
- ④ Intake manifold
- ⑤ Capillaries from LPG Module
- ⑥ Capillary to injection valve

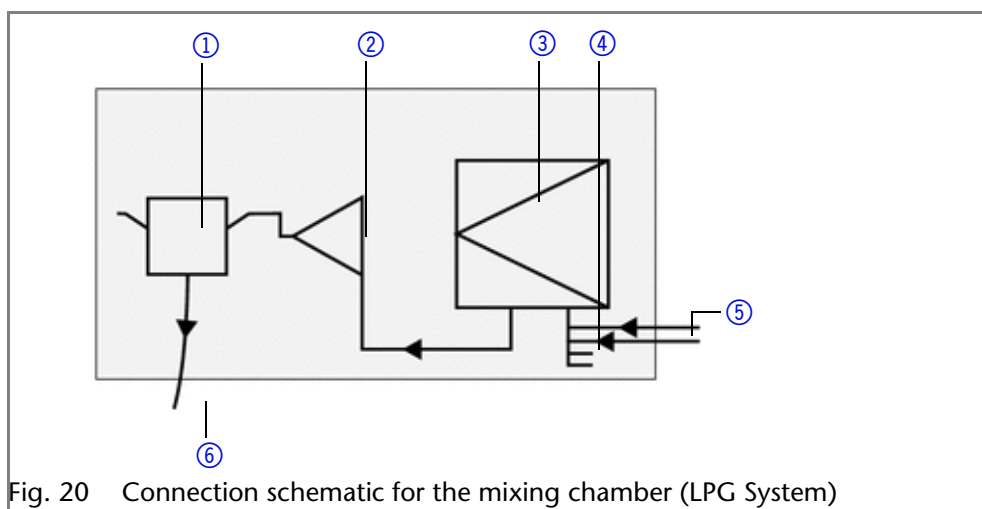


Fig. 20 Connection schematic for the mixing chamber (LPG System)

Connecting the LPG Module

The LPG module is integrated into the pump.

The required solvent tubes to connect the LPG module with the pump head are included as accessories.

1. Attach PTFE screw fittings and seal rings to the ends of the solvent tubing
2. Attach the solvent tubes to the inlets ① of the LPG module and tighten the screw fittings
3. Connect the outputs ② of the LPG module and the inlets of the intake manifold ③ at the pump head
4. Close unused inlets and outputs of the LPG module by means of filler caps
5. Make sure that the screw fittings for solvents and the filler caps are properly tightened.

Legend

- ① Input
- ② Output
- ③ Intake manifold

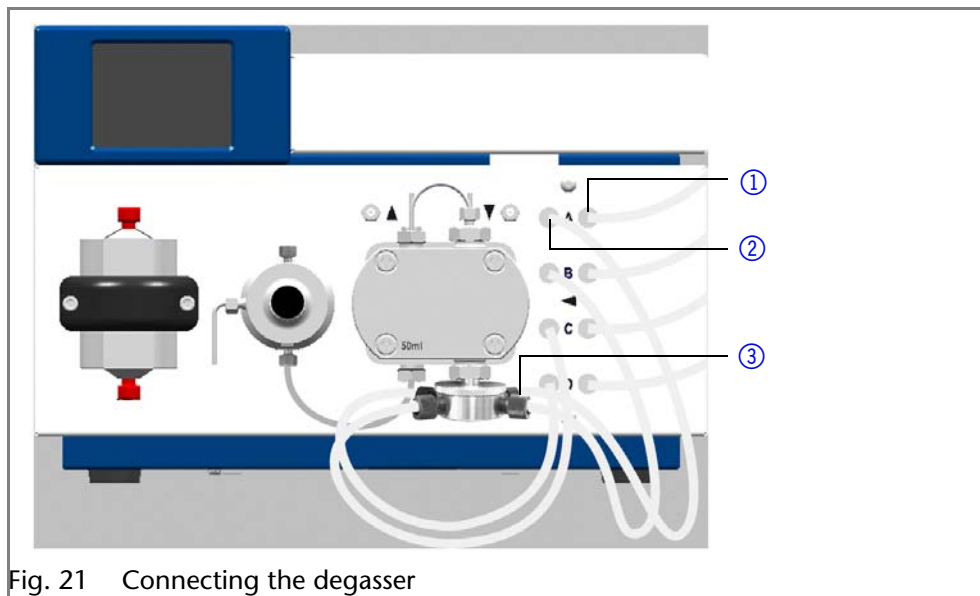


Fig. 21 Connecting the degasser

Control

Operator errors and clogged capillaries can cause high pressure spikes.

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

Touchscreen

Working without chromatography software

The touchscreen of the pump is suitable for the following tasks:

- Monitoring the device functions
- Using special programs for laboratory work:
 - Flushing program
 - *Standby and Wake Up (WU) program*
 - Program links (Link menu)
 - Programs for configuring the device (Setup menu)
 - Checking the system status as part of quality assurance measures in accordance with good laboratory practices (GLP menu)

Using the Touchscreen

The touchscreen is subdivided into different areas.

Legend

- ① Status line
- ② To main menu
- ③ Parameters or value
- ④ Animated information diagram
- ⑤ Button for starting or stopping the function

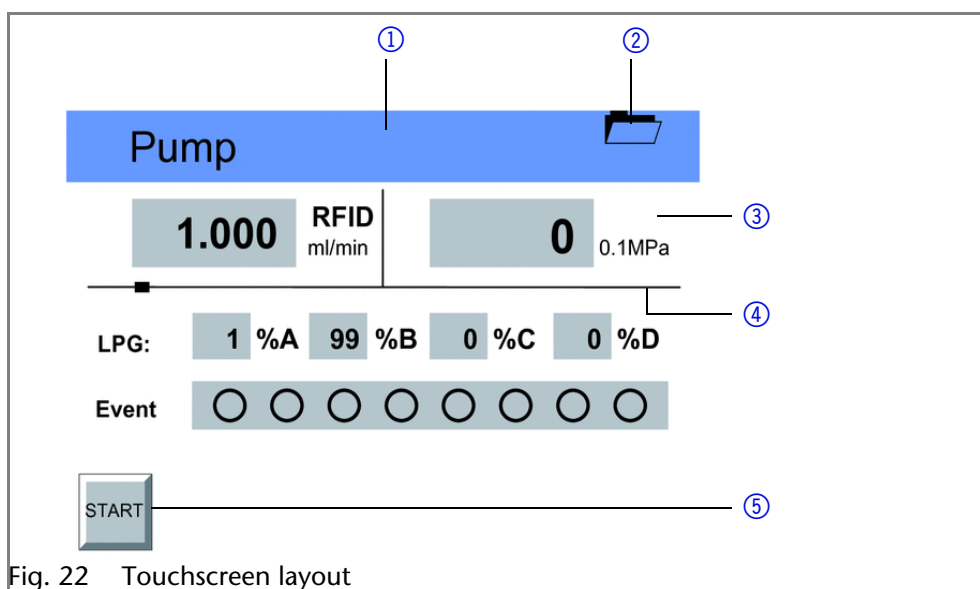


Fig. 22 Touchscreen layout










Operating the touchscreen

All fields with a gray background are touch sensitive and can be edited. The buttons for setting or modifying functions are always labeled, e.g., *START*. The pump starts to work, for example, when you tap the button and the label on the button changes to *STOP*.



The pumps can be switched off at any time using the [*STOP*] button on the touchscreen. This function can also be used in remote mode in the chromatography software.

Overview of the Touchscreen Buttons

Button	Function	Explanation
	Scroll	Scroll through all functions
	One level up	Tap to move up one level
	Go to device status display	Press and hold for two seconds
	To Main menu	Tap to go to the Main menu
	Start device	Starts the device, e.g. a pump begins pumping.
	Emergency stop symbol touchscreen of the pump	This function can also be used in remote mode in the chromatography software.
	Saves the entry	-
	Running a program	Starts previously configured program in <i>Program menu</i>
	Interrupt the program	-
	Stop program	-
Restart	Repeat program	-
Finish	Exit loaded program	-
Day	Confirm day	-
Month	Confirm month	-
Year	Confirm year	-

Button	Function	Explanation
New	Create a new program line with time indication	-
Load	Load program	-
Edit	Edit program	-
Del/Delete	Delete a program	-
Tab	Table	Program line display

Switch-On and Self-Test

1. Switch on the pump.
2. After turning on the device, the touchscreen displays *Initialization* – the device is running a self-test.
3. Wait until the pump has completed the self-test.
4. After the test has been successfully completed, the most recently active program will be displayed – the pump is now ready for operation.

Menu Structure of the Pump GUI

The pumps feature the following uniform structure for their software interface (graphical user interface, GUI):

- Creating programs (program menu)
- Creating program links (link menu)
- Data entry for selected solvent compressibility (solvent menu)
- Pump settings (setup menu)
- Device status displayed according to good laboratory practice (GLP menu)
- Function for switching device into *standby-mode*

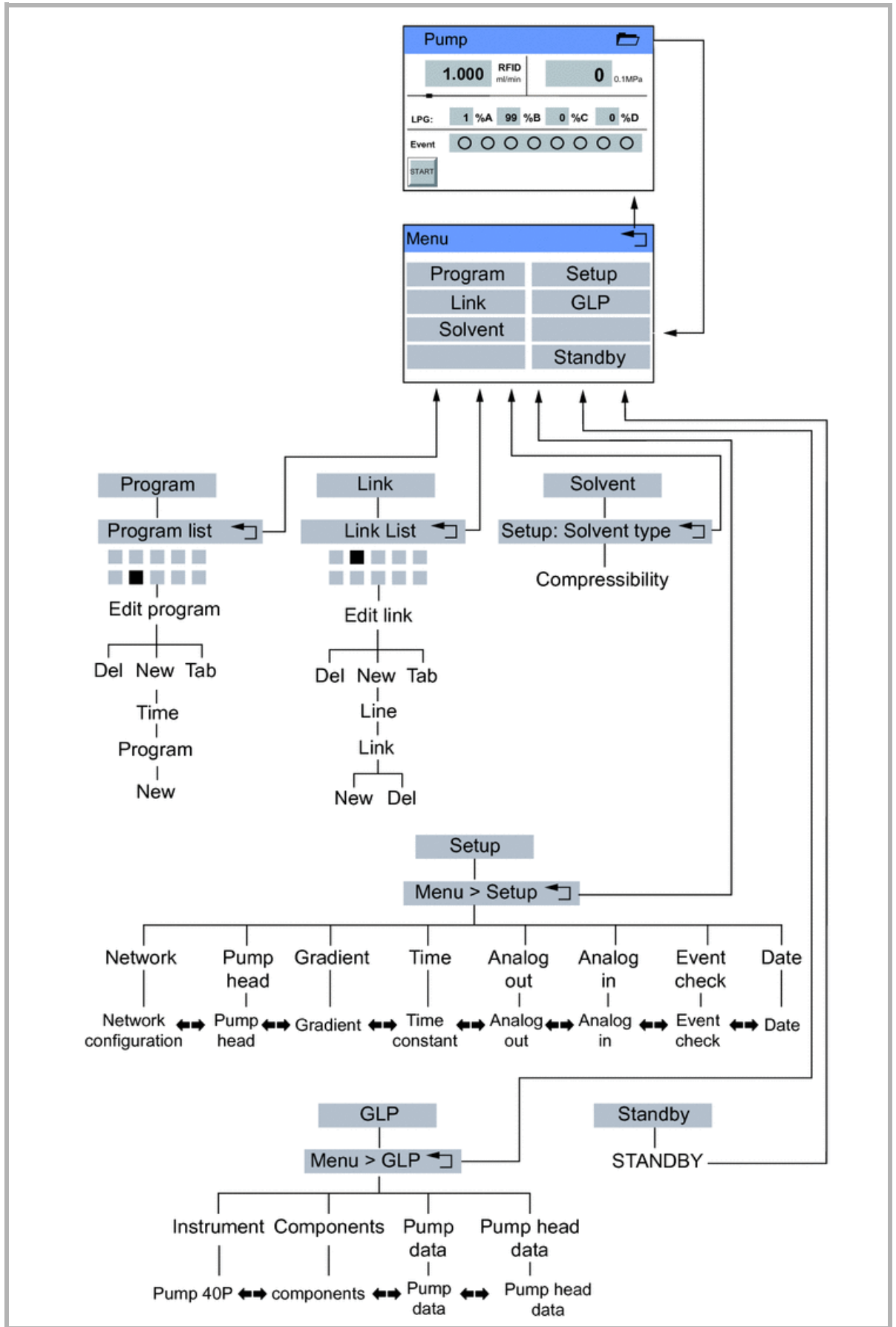





Fig. 23 Menu structure pump GUI

Setting Minimum and Maximum Pump Pressure


The pump stops automatically if the pump pressure drops below the min. value or exceeds the max. value.



Min. pump pressure serves to prevent dry running of the pump and enables the pump to stop if there is a leak. If the minimum is set to 0, the minimum pump pressure is not monitored.

1. In the status display, tap on the field with a gray background next to the pressure display to view the current settings in the *Pressure Min/Max* menu.
2. Use the numeric fields to enter the correct value for min. pressure.
3. Tap  to save the settings.
4. Use the numeric fields to enter the correct value for max. pressure.
5. Tap  to save the settings.
6. Tap  to move level up.

Configuring Control Signals

For test purposes or in some other cases, it can make sense to manually enter these signals.


Symbol	Explanation
○	Off
●	On
	Pulse

1. In the status display, tap on the field with a gray background next to *Event* to view the current settings in the *Select: Events* menu.
2. Tap on the corresponding symbols to configure the control signals.
3. Tap  to save the settings.
4. Tap  to move level up.

Main Menu

The main menu displays the Program, Link, Solvent, Setup, and GLP menu as well as the *Standby Mode* function.

Navigating the Main menu

1. Tap  to go to the Main menu.
2. Tap on desired menu.

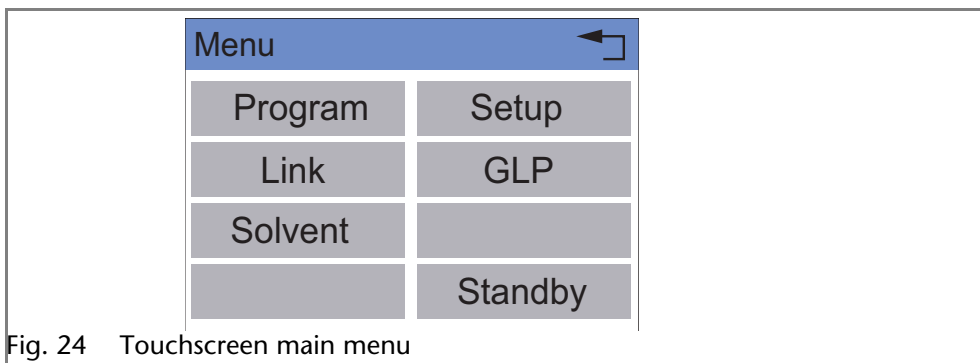


Fig. 24 Touchscreen main menu

Setup Menu

In the Setup menu, fundamental parameters for controlling the pump are specified.

Navigating the Setup menu

1. Tap the Setup menu to display options.
2. Tap options to display the current pump parameters.

3. Tap the gray highlighted values to display all available parameters.
4. Tap the desired parameters.
5. Tap ◀ ▶ to scroll through the other options in the Setup menu.
6. Tap ↶ to go to a higher level, or hold for two seconds to go to the operating menu.

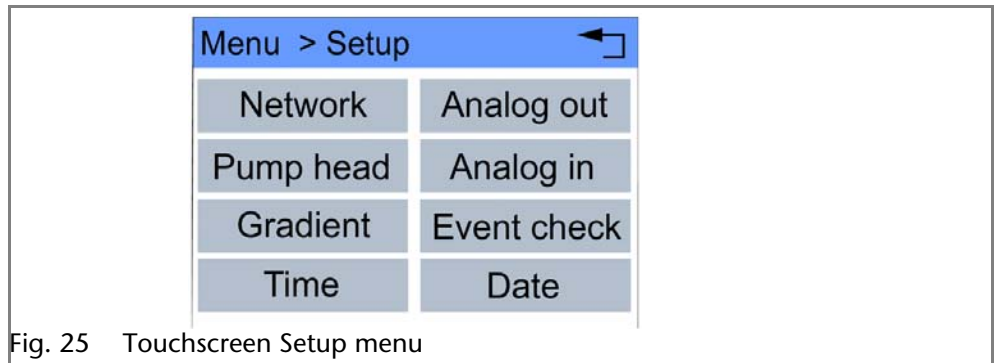


Fig. 25 Touchscreen Setup menu



Setup Menu Parameters

Value	Meaning
Analog in	<p>Calibration of the analog input of the <i>Remote</i> terminal strip, for remote flow rate control.</p> <p>With <i>Procedure: Set to Zero</i>, an input voltage that is presented can be defined as zero point (i.e. defined as a flow of 0.000 ml/min). If a deviating, positive control voltage is applied, a resulting flow rate is displayed at <i>actual interpreted flow</i>, based on the basic setting: 1 ml corresponds to 1 V for the 10 ml pump head, and 5 ml corresponds 1 V for the 50 ml pump head.</p> <p>That means that the flow rate can be regulated via the input voltage.</p> <p>This flow rate can be altered. Thus a second calibration point is generated, which modifies the scaling.</p>
Analog out	<p>Used to output analog pump signals to external devices, by means of the Remote:</p> <p>Setup: Analog out:</p> <ul style="list-style-type: none"> ▪ Data entry <i>Offset</i> for the analog output ▪ Voltage range options <i>Full scale</i>: 1 V, 2 V, 5 V ▪ Signal source: <ul style="list-style-type: none"> - <i>Pressure</i> preset for outputting the currently measured pressure for the purpose of external recordings or control. - <i>Slave B</i> for outputting a signal for controlling a second pump. - <i>HPG/LPG-A</i> to <i>HPG/LPG-D</i> - disabled
Date	Setting for the date and time.
Event check	<p>Testing the terminal strip <i>Events</i>:</p> <ul style="list-style-type: none"> ▪ <i>Start-IN</i> and <i>Error-IN</i>: statuses at the digital inputs ▪ <i>Active only</i>: connections <i>Event 1</i> to <i>Event 8</i> and <i>24 V</i>
Gradient	<p>Here the modes of the high-pressure gradient (HPG), low-pressure gradient (LPG) and isocratic system can be set:</p> <ul style="list-style-type: none"> ▪ <i>LPG</i>: activation of up to four channels ▪ <i>HPG</i>: selection between pump name <i>HPG-A</i> to <i>HPG-D</i> ▪ Isocratic system: <i>none</i>
Network	<p>Setting for external communication connection options of pump:</p> <ul style="list-style-type: none"> ▪ RS232 ▪ <i>LAN-DHCP</i>: Automatic network configuration ▪ <i>LAN manual</i>: Manual network-configuration (<i>Port</i>, <i>IP address</i>, <i>IP mask</i>, <i>Gateway</i>) ▪ Analog

Value	Meaning
Pump head	<p>Pump head selection:</p> <ul style="list-style-type: none"> ▪ automatic detection ▪ 10 ml ▪ 50 ml <p>Note: Only possible if automatic recognition of the pump head does not function. The selection is used as a basis for calculating the flow rate and determines the max. system pressure. This value applies for all operating modes and cannot be exceeded.</p>
Time	<p>Setting the time constant for analog input/output, to be used for signal smoothing. The larger the value of the selected time constant, the stronger the applied signal smoothing. Both an external signal present at the analog input (in) and a signal generated at the analog output (out) can be smoothed.</p> <ul style="list-style-type: none"> ▪ Time constant IN ▪ Time constant OUT

Configure LPG Module

In the Setup menu, up to four channels can be activated for the solvents used.


1. Tap  to go to the Main menu.
2. Tap the Setup menu to display options.
3. Tap *Gradient* to adjust the current pump parameters.
4. Tap *Type* to select Gradient mode *LPG*.
5. Activating channels for solvents used.
6. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.

Solvent Menu

In the Solvent menu data for the compressibility of the solvents are entered.

Value	Meaning
Solvent	<p>Data entry for the compressibility of the selected solvent:</p> <ul style="list-style-type: none"> ▪ Water: 0.46 ▪ Benzene: 0.95 ▪ Chloroform: 0.97 ▪ Ethanol: 1.10 ▪ Acetone: 1.23 ▪ Methanol: 1.21 ▪ n-heptane: 1.40 ▪ n-hexane: 1.50 ▪ Diethyl ether: 1.84 ▪ Acetonitrile: 0.99 ▪ Tetrahydrofuran: 0.93 ▪ Water/methanol (10/90): 1.17 ▪ Water/methanol (20/80): 0.86 ▪ Water/methanol (40/60): 0.56 ▪ Water/methanol (50/50): 0.52 ▪ Water/methanol (60/40): 0.46 ▪ Water/methanol (80/20): 0.40 ▪ Water/methanol (90/10): 0.34




*Navigating
the Solvent menu*

1. Tap Solvent menu to display current settings.
2. Tap on value in field with gray background to adjust the value to compressibility.
3. Use the numeric fields to enter the correct value.
4. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.

GLP Menu

In the GLP menu, statistical data on important parameters of the pump are displayed.

Navigating the GLP menu

1. Tap the GLP menu to display operating parameters.
2. Tap the gray highlighted values to display all available options.
3. Tap   to scroll through the other options in the GLP menu.
4. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.

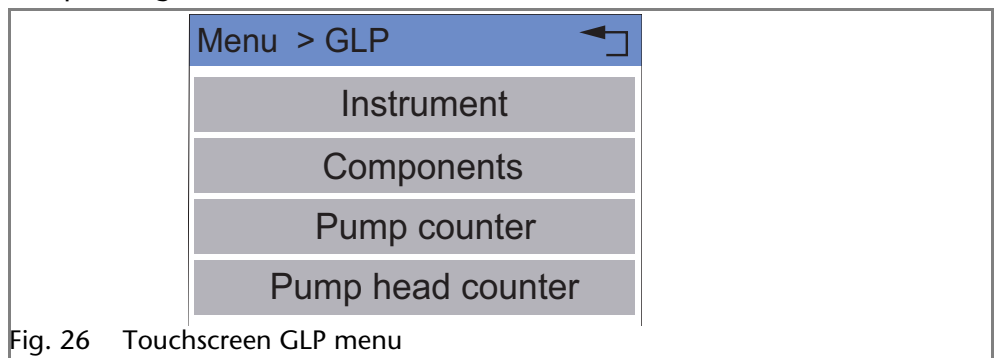


Fig. 26 Touchscreen GLP menu


Program Menu

The Program menu is used to list and create programs. The pump can save up to 20 programs and up to 100 program lines. Max. 10 program links between defined programs can be created and saved.

Programs have the following functions:

- Controlling the flow rate
- Controlling the solvent composition
- Sending control signals (*Events*)

*Navigating
the Program menu*

1. Tap the Program menu in order to display the program list.
2. Tap the desired program number to edit, open or delete the program.
3. Tap *Load* to run a program.
4. Tap *Edit* to enter the edit mode.
5. Tap *Delete* to delete a program.
6. Tap *Tab* to display a program line in a table.
7. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.

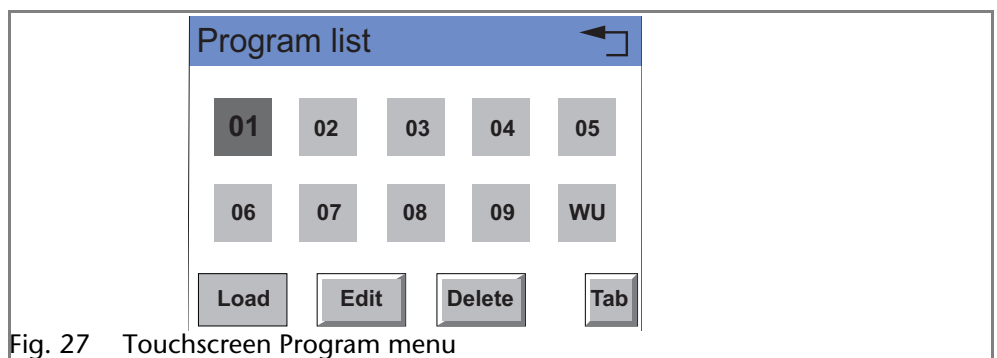
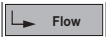







Fig. 27 Touchscreen Program menu

Creating a Program

The use of the device is demonstrated using the example of a program to be created: Program 01 is to be used to create a solvent gradient (channels A and B) with constant flow rate of 1 ml/min. The percentage of solvent A is to be continuously decreased from 100 % to 0 % within 0.5 minutes.

1. Tap the Program menu in order to display the program list.
2. Tap the desired program number and *edit* to edit the program (diagram A).
3. Enter the value for the flow rate: 1.
4. Tap  to save the settings.
5. Enter the value for channel A: 100.
6. Tap  to save the settings.
7. Tap  to move level up.
8. Tap *New* to specify the time (diagram B).
9. Enter the time value: 0.5 (diagram C).
10. Tap  to save the settings (diagrams C and D).
11. Enter the value for channel A: 0 (diagram E).
12. Tap  to save the settings.
13. Tap  to go to a higher level (diagram F), or hold for two seconds to go to the operating menu.

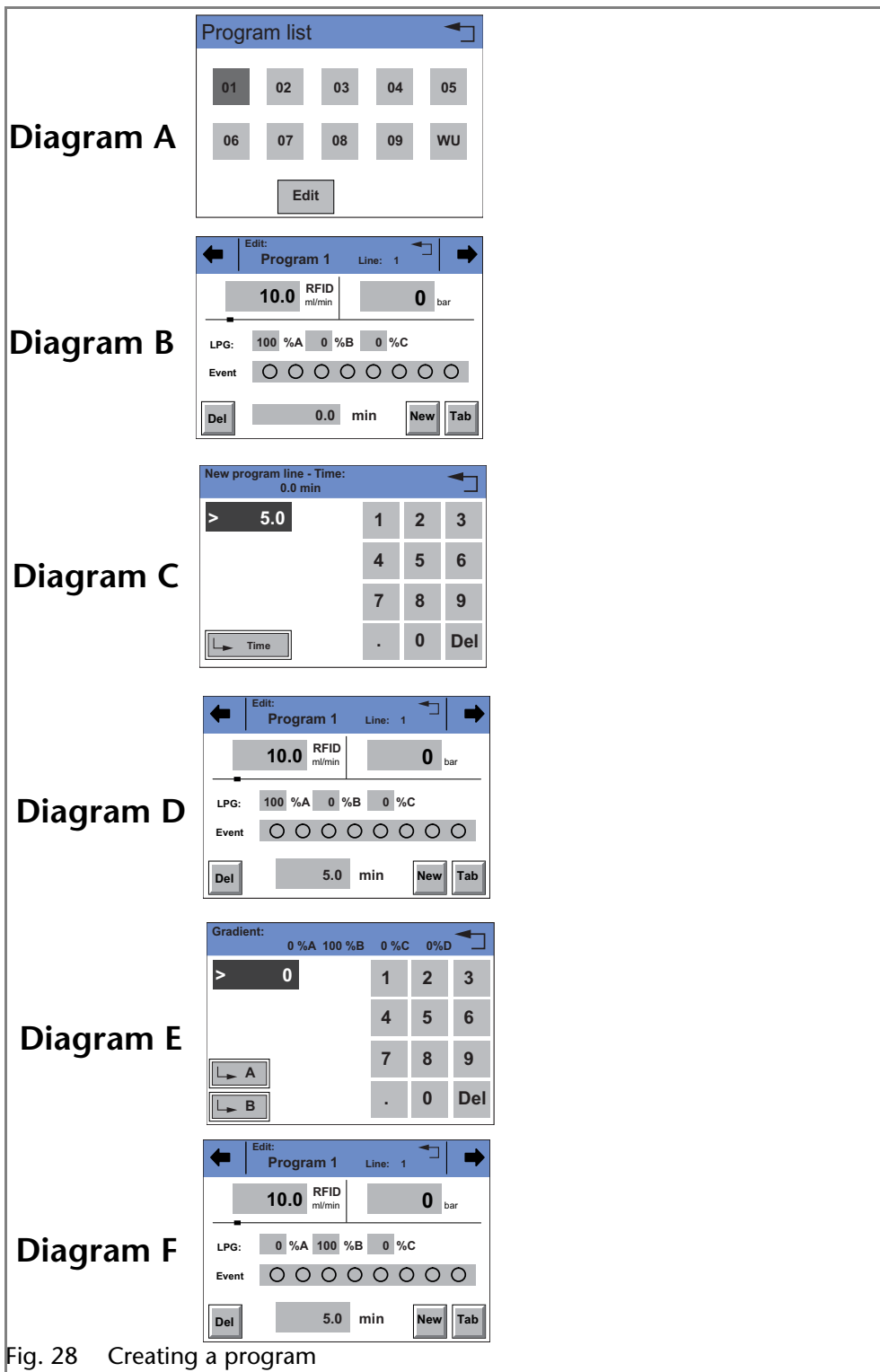


Fig. 28 Creating a program

Creating Program Lines

New program lines can be created while creating a program.

1. Tap *Tab* in the program's editing window to display the program lines.
2. Tap *New* to create a new program line.
3. Enter the time value.
4. Save setting.
5. Enter value of desired channel.
6. Save setting.

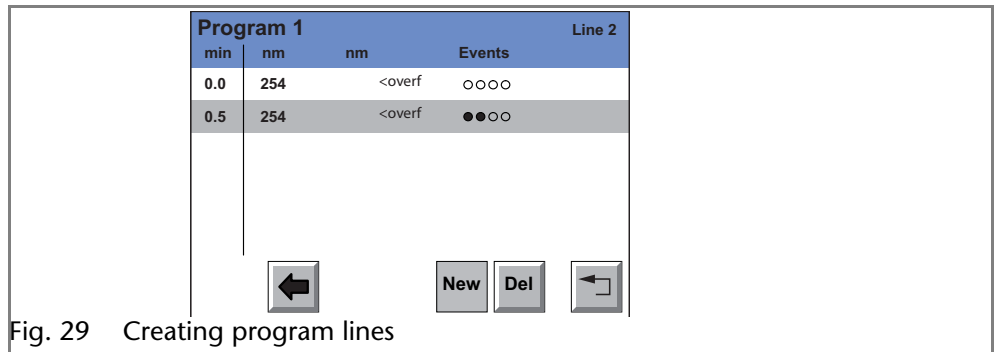


Fig. 29 Creating program lines

Deleting Program Lines

Program lines can be deleted while creating a program.

1. Tap *Tab* in the program's editing window to display the program lines.
2. Tap ← → to mark the desired program line.
3. Tap *Del* to delete the desired program line.
4. Confirm the query.
5. Tap ↶ to go to a higher level, or hold for two seconds to go to the operating menu.

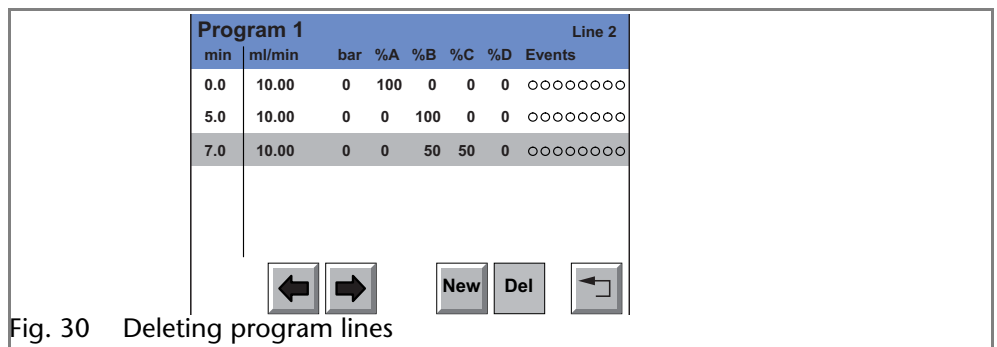


Fig. 30 Deleting program lines

Running a Program

During the program sequence, the changes in the solvent composition are displayed in the % A – % D fields.

1. Tap the Program menu in order to display the program list.
2. Tap the desired program number and *Load* to load the program.
3. Tap ▶ to start the program (diagram A).
4. Tap || to interrupt the program.
5. Tap ■ to stop the program.
6. Tap STOP to stop the pump.
7. Tap Restart to repeat the program (diagram B).
8. Tap Finish to exit the loaded program.



Fig. 31 Run program

Changing a Program

1. Tap the Program menu in order to display the program list.
2. Tap the desired program number and *Edit* to edit the program.
3. Change the desired values.
4. Save setting.
5. Tap to go to a higher level, or hold for two seconds to go to the operating menu.

Displaying the Program Lines

1. Tap the Program menu in order to display the program list.
2. Tap the desired program number and *Tab* to reach the program line display.
3. Tap to go to a higher level, or hold for two seconds to go to the operating menu.

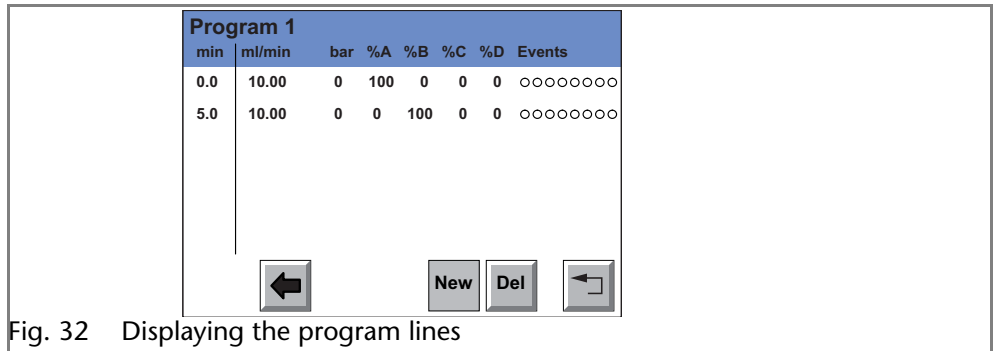


Fig. 32 Displaying the program lines

Deleting a Program

1. Tap the Program menu in order to display the program list.
2. Tap the desired program number and *Delete* to delete the program.
3. Confirm the query.
4. Tap to go to a higher level, or hold for two seconds to go to the operating menu.

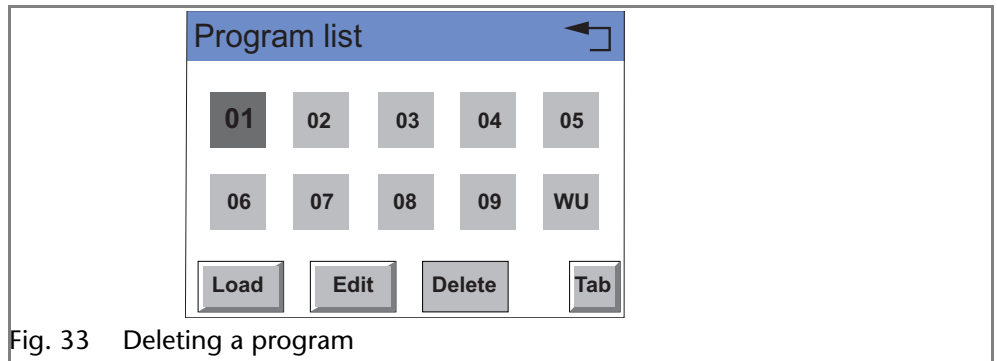






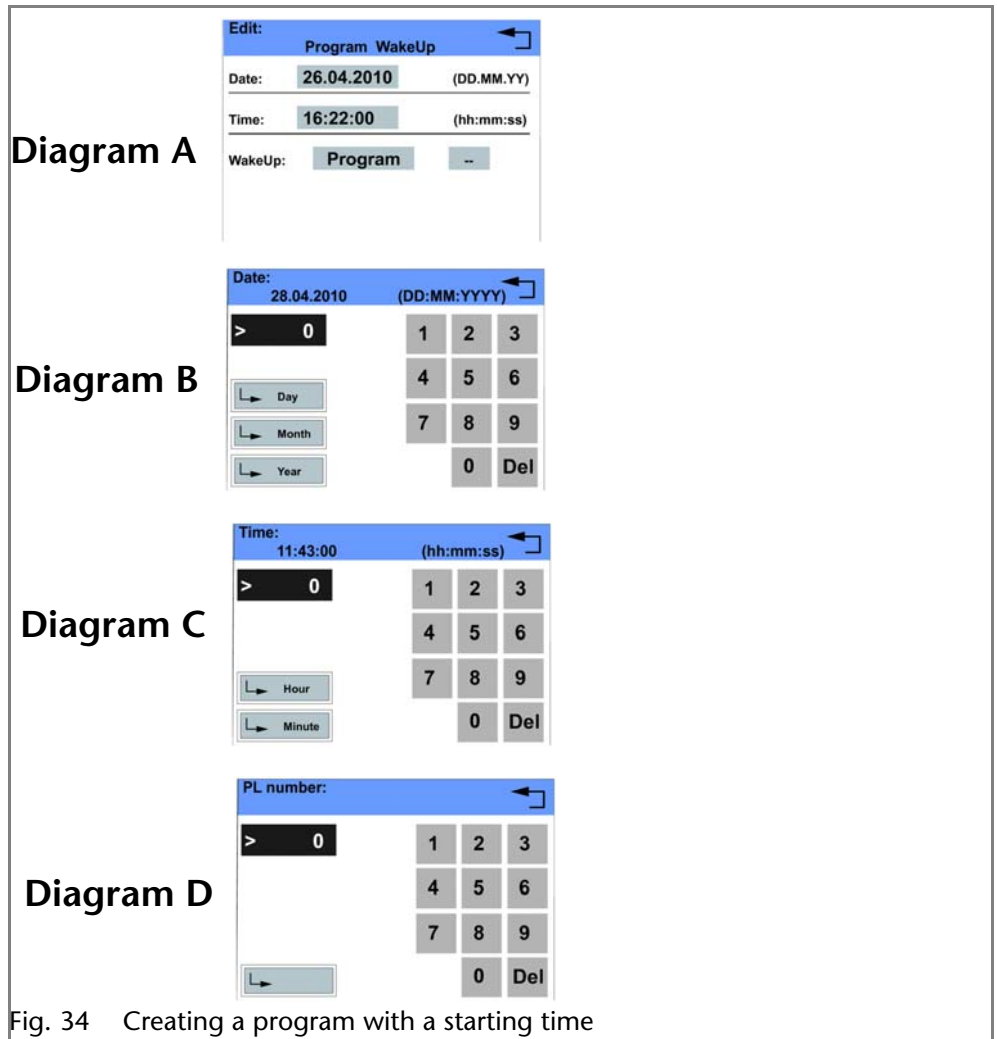
Fig. 33 Deleting a program

Creating a Program with a Starting Time

The pump can start a program or a program link at a preset time. This program is labeled *WU* (*Program Wake Up*) and is located in the program list.

Note: Make sure that the date and time configured in the Setup menu are correct.

1. Tap the Program menu in order to display the program list.
2. Tap *WU* and *Edit* to edit the program.
3. Enter the program start-date (diagrams A and B).
4. Tap  to save the settings.
5. Enter the time for the program start (diagram C).
6. Tap  to save the settings.
7. Choose program or Link (diagram A).
8. Enter program number or Link number (diagram D).
9. Tap  to save the settings.
10. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.



Link Menu

The Link menu displays the status of active links. Max. 10 program links between defined programs can be created and saved.

Navigating the Link menu

- Tap the Link menu to display the link list
- Tap the desired link number to edit, open or delete the link
- Tap *Load* to run a link
- Tap *Edit* to enter the edit mode
- Tap *Delete* to delete a link
- Tap *Tab* to display the program line
- Tap \leftarrow to go to a higher level, or hold for two seconds to go to the operating menu

Creating a Link

Note: In the setting *Wait: for external signal*, the pump waits for an external start signal before this program line is run. In the setting *Wait: no wait*, the link will run without interruption.

1. Tap the Link menu to display the Link list (diagram A).
2. Tap the desired link number to edit the link.
3. Enter program number (diagram B).
4. Tap \leftarrow to save the settings.
5. Enter the number of repetitions (*repeat*) for the previously specified program.
6. Tap \leftarrow to save the settings.
7. Select the desired option for *wait*: (diagram C).








8. Tap  to go to a higher level, or hold for two seconds to go to the operating menu.



Fig. 35 Creating a link

Executing a Link

While the link sequence runs, the changes in the solvent composition are displayed in the fields % A – % D.

1. Tap the Link menu to display the link list.
2. Tap the desired link number and *Load* to load the link.
3. Tap  to start the link (diagram A).
4. Tap  to interrupt the link.
5. Tap  to stop the link.
6. Tap  to stop the pump.
7. Tap  to re-run the link (diagram B).
8. Tap  to exit the loaded link.

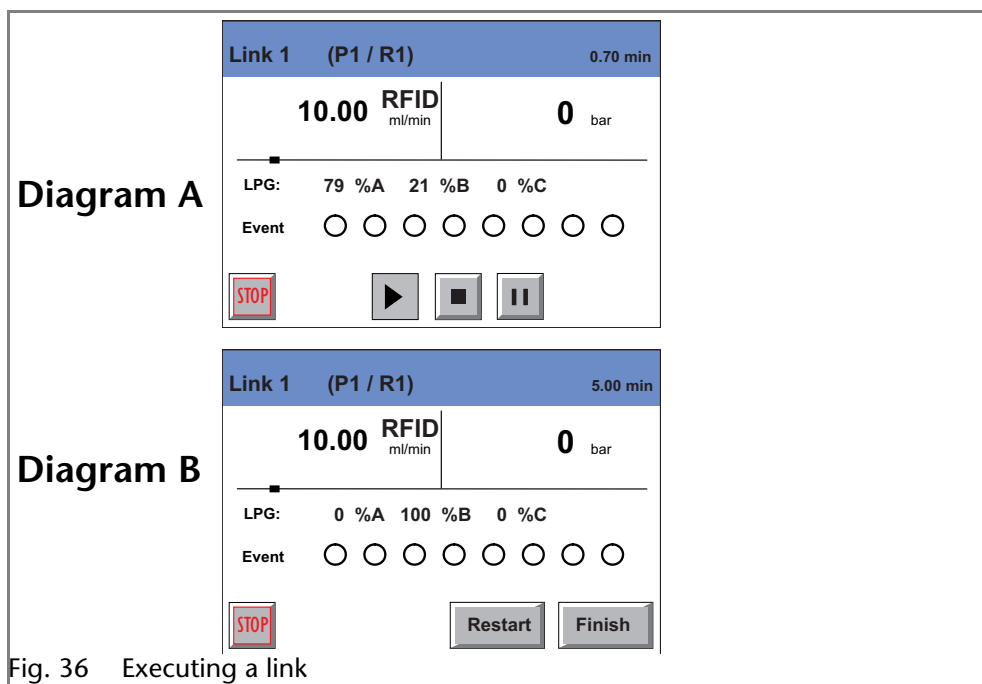


Fig. 36 Executing a link

Deleting a Link

1. Tap the Link menu to display the Link list.
2. Tap the desired link number and *Delete* to delete the link.
3. Confirm the query.
4. Tap \leftarrow to go to a higher level, or hold for two seconds to go to the operating menu.

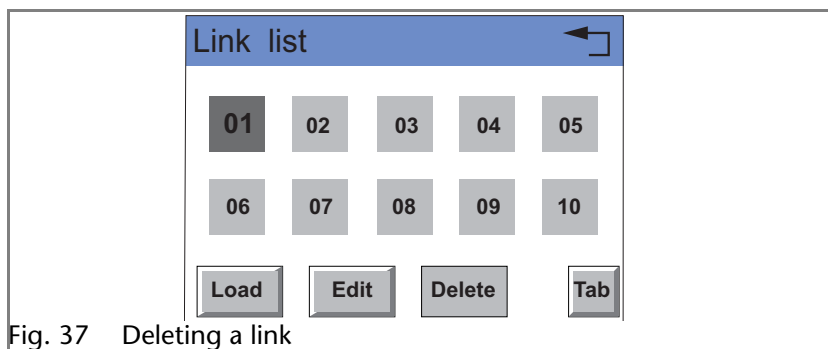


Fig. 37 Deleting a link

Purging the Pump

Purging in Quaternary Mode

The purging process of the pump is limited to a max. pressure of 5 MPa. If this value is exceeded during the purging process, the pump switches off automatically.

Settings in the Setup Menu

1. *Type*: Choose *LPG* in the gradient directory of the Setup menu (diagrams A and B).
2. Activate desired channels A – D (*ON* – *OFF*, diagram A).
3. In purging mode, choose either gradients *ABCD* or *A*, *B*, *C* and *D* individually.

Note: Before the purging process, open the ventilation screw to prevent a pressure surge and damage to the column.

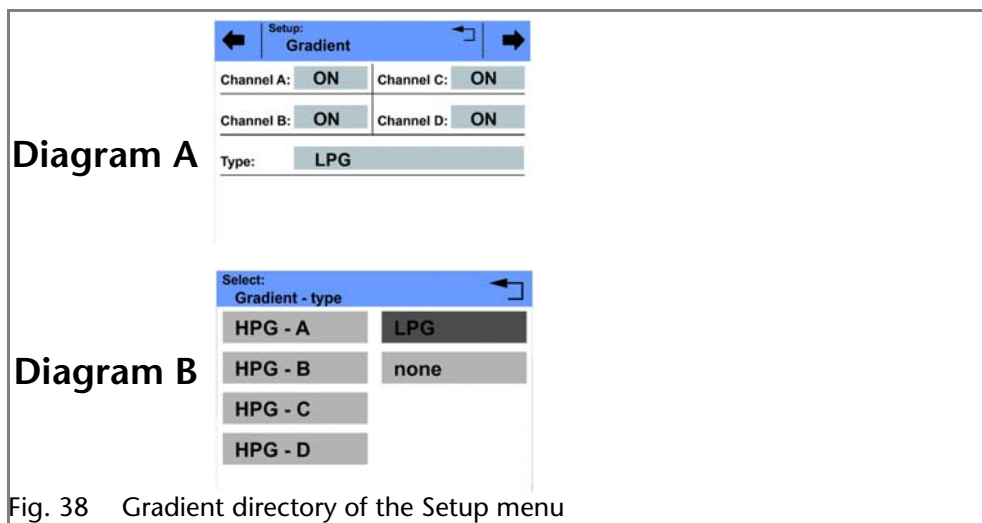


Fig. 38 Gradient directory of the Setup menu

Purging the Pump

1. Open the bleed screw of the pressure sensor.
2. In the status display of the pump, tap on the flow rate field highlighted in gray.
3. Enter the value for the flow rate (diagram A).
4. Tap \leftarrow Flow to save the settings.
5. Tap Purge to choose the channel.

6. Suck liquid in via a Luerlock syringe.
7. Choose either *ABCD* or *A*, *B*, *C* and *D* individually to start the purging process (diagram B).
8. Tap **Purge Stop** to stop the purging process.

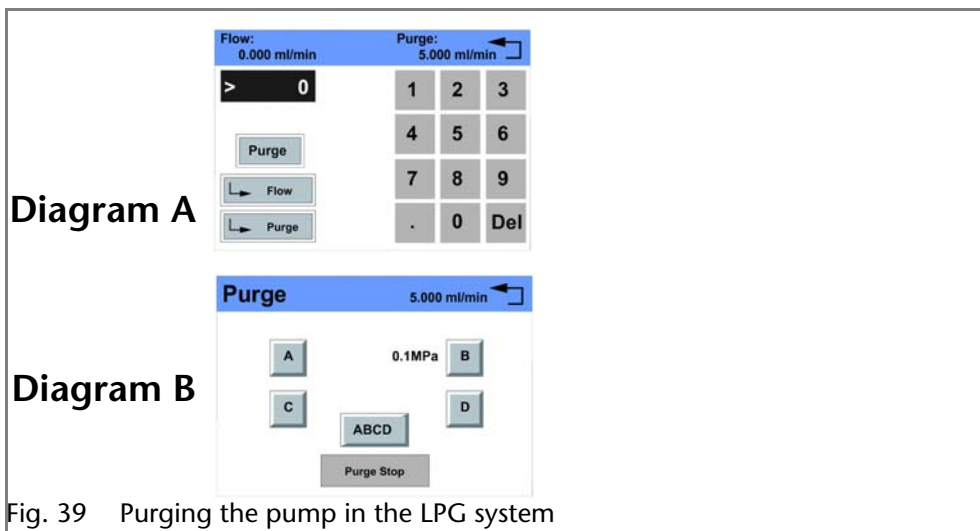


Fig. 39 Purging the pump in the LPG system

Purging in Isocratic or Binary Mode

Settings in the Setup Menu

1. In the Gradient directory of the Setup menu, choose *Type: HPG A, HPG B, HPG C or HPG D or none* (diagram A).
2. Activate desired channels A – D (*ON – OFF*)

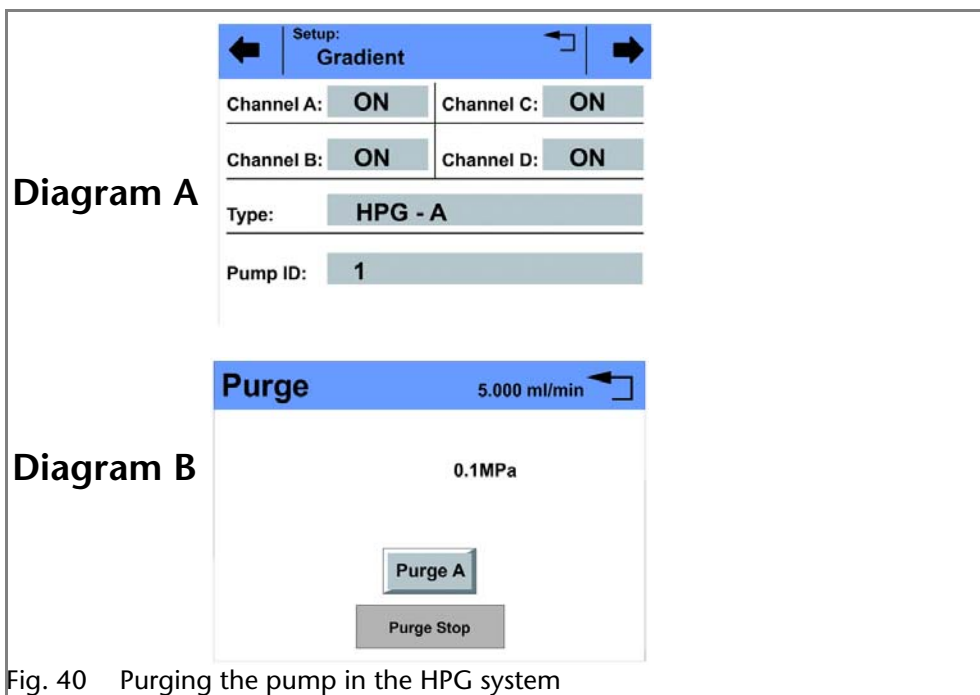



Fig. 40 Purging the pump in the HPG system

Purging the Pump

1. Open the bleed screw of the pressure sensor.
2. In the status display of the pump, tap on the flow rate field highlighted in gray.
3. Enter the value for the flow rate.
4. Tap **Flow** to save the settings.
5. Tap **Purge**.
6. Suck liquid in via a Luerlock syringe.

7. Choose *Purge A*, *Purge B*, *Purge C*, *Purge D* or *Purge* to start the purging process (diagram B).
8. Tap  to stop the purging process.

Piston Backflushing

The pump is equipped with automatic piston backflushing. It increases the service life of the seals and pistons, and removes contaminants from the area behind the seals.

Functional principle

The piston backflushing function automatically flushes the rear piston area of the pump head upon switch-on and in continuous mode.

- Upon switch-on: The rear piston area of the pump head is automatically flushed for 8 seconds
- In continuous mode: The rear piston area of the pump head is flushed automatically every two hours, for 15 seconds

Recommended flushing solution

The rear piston area is flushed with water, with an 80:20 mixture of water and methanol, or with isopropanol, depending on the application.

Legend

- ① Inlet from the solvent bottle to the flush pump
- ② outlet from the pump head to solvent bottle
- ③ Pump head inlet
- ④ Outlet from the flush pump to the pump head

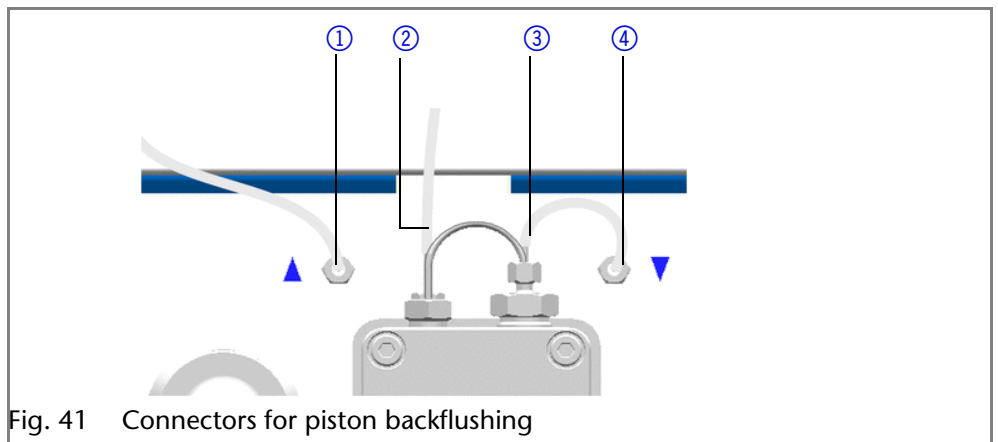


Fig. 41 Connectors for piston backflushing

Purging the LPG Module

Purge and fill the LPG module and the corresponding connecting tubes using the correct solvent.

Note: When the pump is turned off, the valves of the LPG module remain closed.

1. Switch on the pump.
2. Set flow rate to 0 ml/min.
3. Set solvent mixture ratio for the corresponding valve to 100%.
4. Open the bleed screw of the pressure sensor.
5. Connect syringe to the ventilation capillary of the pressure sensor.
6. Pull the plunger until no more air bubbles appear in the solution.
7. Repeat the process for all valves to be used.

Functionality Tests IQ and OQ

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 and must be purchased from the manufacturer. Contact the KNAUER Sales Department to request an offer. The Operation Qualification is a standardized KNAUER document and 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 using the Operation Qualification at following intervals:

- Every 3 months: average useful life of more than 5 days/week or 24 hours/day; when operating with buffer solutions or other salt solutions:
- Every 6 months: average useful life of 1 to 5 days/week

Execution

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

Maintenance and Care

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

Technical Support

Contact data for Technical
Support
European hotline

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

Languages: German and English
Available by telephone: 8 am to 5 pm (CET)
Phone:+49-(0)30-809727-111
Fax:+49-(0)30-8015010

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

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

Storage

Note that prior to storing all tubes and capillary should be emptied or filled with an appropriate flushing solution (e.g. isopropanol). To prevent algae formation, do not use pure water. Seal all inlets and outlets with cap fittings.

Storage conditions

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

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

What Maintenance Tasks Can Users Perform on the Device?

Users may perform the following maintenance tasks themselves:

- Changing the mixing chamber
- Replacing the pump head
- Exchanging the check valves

Note:

Note: The pump has to be switched off for all maintenance tasks.

What to do when the degasser shows a leak?

Should there be a leak in the degasser, solvent can reach the motor and from there reach the exhaust and spill out. In this case, the automatic pump control will switch the device off.

Inform the technical support department of the manufacturer.

Screw Fittings

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

Tightening the Screw Fittings

Note: To pump head AHB40CA (pump C56353HT.0) apply special torque values. Tighten the fastening screws with a maximum torque of 3 Nm. Exceeding the torque can damage the back plate.

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

Loosening the Screw Fittings

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

Legend

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

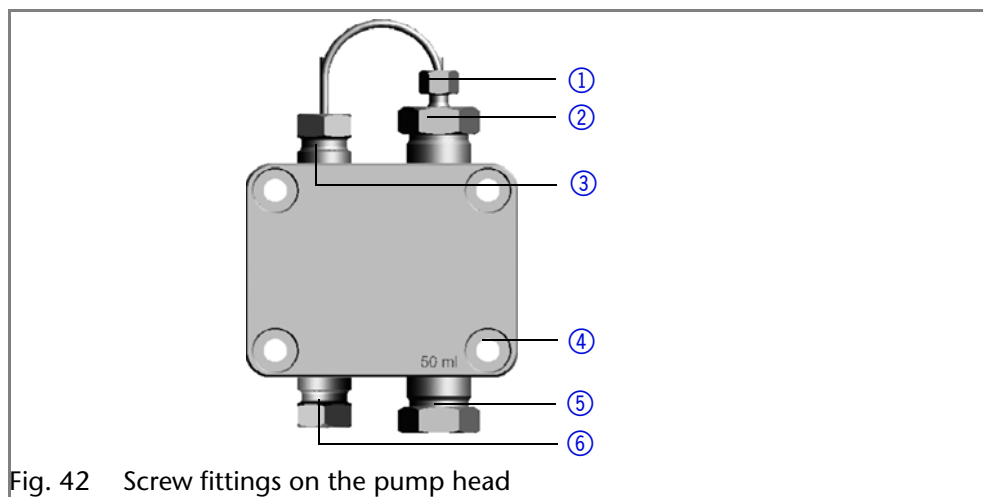


Fig. 42 Screw fittings on the pump head

Pump Head

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

Removing the Pump Head

Prerequisite

- The pump head has been purged.
- The tubes at the inlet and outlet have been removed.
- The pump head's inlet and outlet have been sealed with cap fittings.

Tools

- Allen wrench
- Open-end wrench, size 1/4 "
- Open-end wrench, size 13

⚠ WARNING

Chemical burns

Aggressive or toxic solvent residue can irritate the skin.

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

NOTICE

Device defect

Residuals chemicals can damage the pump head if they are not being removed before storage.

- For reuse, flush the pump head and fill it with isopropanol.
- Before storage, seal the inlets and outlets with cap fittings.

NOTICE

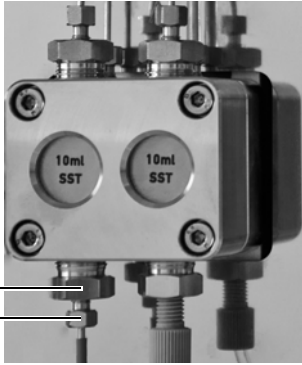
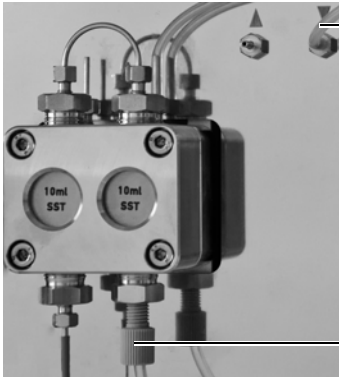
Component defect

Damage to the pistons if they tilt.


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

Note: The back plate of pump head AHB40CA (pump C56353HT.0) is made of ceramics and is sensitive to shocks. The back plate is no spare part and excluded from guarantee!

Procedure

Process	Figure
<ol style="list-style-type: none"> 1. Loosen the capillary connectors ① at the outlet. Remove the capillary. 1. Fixate the outlet fitting ① with an open-end wrench (size 13). 2. Loosen the fitting ② with an open-end wrench (size 1/4"). 	 <p>Fig. 43 Fitting at the outlet of the pump head</p>
<ol style="list-style-type: none"> 3. Remove the solvent line ② from the solvent inlet. 4. Disconnect the tubes of the piston backflushing ① from the flush pump and the pump head. 	 <p>Fig. 44 Tubing of the piston backflushing</p>

Procedure

Process	Figure
<ol style="list-style-type: none"> 5. Using the Allen wrench, unscrew the 4 screws ① subsequently by one turn. 6. Fixate the pump head with your hand and remove the screws. 7. Lift off the pump head. 	 <p>Fig. 45 Screws of the pump head</p>

Next steps Maintain the check valves or install a new pump head.

Installing the Pump Head

Note: To pump head AHB40CA (pump C56353HT.0) apply special torque values. Tighten the fastening screws with a maximum torque of 3 Nm. Exceeding the torque can damage the back plate.

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

Check Valves

Clogged check valves do not open and close properly. They cause pressure fluctuations and irregular flow. If it is impossible to clean the check valves, replace the whole unit.



Removing the Check Valve

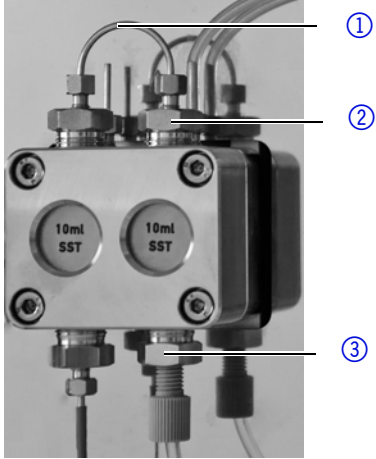
The pump head is equipped with two check valves.

Prerequisite

- The pump head has been purged.
- The capillary and tubing have been removed.
- The pump head has been removed.

Tools

- Open-end wrench, size 13

Procedure	Process	Figure
	<ol style="list-style-type: none"> 1. Unscrew and remove the capillary connector ①. 1. Loosen the outlet fitting ② with the open-end wrench. 2. Remove the first check valve. 3. Loosen the inlet fitting ③ with the open-end wrench. 4. Remove the second check valve. 	 <p>Fig. 47 Check valve in pump head</p>

Next steps Clean the check valves.

Cleaning the Check Valves

In order to be cleaned, the check valves are not disassembled but are cleaned as a whole.

Prerequisite Both check valves have been removed.

Procedure	Process
	<ol style="list-style-type: none"> 1. Place each check valve into a beaker with solvent, e.g. isopropanol. 2. Put the beaker with the check valve in an ultrasonic bath for at least 10 minutes. 3. Let the check valves dry afterwards.

Next steps Insert both cleaned check valves.

Installing the Check Valve

Insert the check valves in the direction of the flow. The notch of the check valve points downward.

Normal phase Insert the check valves in the direction of the flow. The arrow on the check valve points upward.

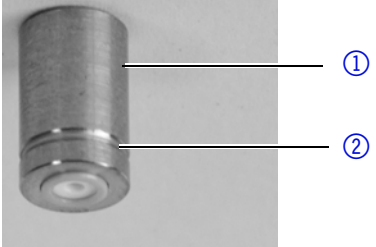
Prerequisite The check valves have dried.

NOTICE

Component defect

Damaging the threads of components caused by overtightened fittings.

→ Pay attention to the torque values.

Procedure	Process	Figure
	<ol style="list-style-type: none"> 1. Insert the check valves ① in such a way that the notch of the check valve ② points downward. 2. Screw in inlet and outlet fittings and tighten them with a torque wrench and the respective torque. 	 <p>Fig. 48 Check valve</p>

Next steps Re-install the pump head.

Cleaning and Caring for the Device

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.

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

Touchscreen The touchscreen of the device can be cleaned with isopropanol and wiped dry with a soft, lint-free cloth.

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 manufacturer's technical support department

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. 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 and secondly turn on 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?
 8. Make sure that the IP port of the device matches the port in the chromatography software.

Error List and Solutions

Problem	Solution
<i>Pump will not turn on</i>	The power cable must be connected to the power supply. ▶ Inspect the power cable to ensure that it is plugged into the power supply.
<i>When purging, the pump switches off</i>	The bleed screw on the pressure sensor must be opened. ▶ Check if the bleed screw on the pressure sensor is opened.
<i>Pump does not transport solvent</i>	Check the following options: <ul style="list-style-type: none"> ▪ Purge the pump head so as to remove the air bubbles ▪ Inspect the eluent filter of the HPLC column and change when blocked ▪ Exchange 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 department of the manufacturer
<i>Pressure or flow rate fluctuations</i>	Check the following options: <ul style="list-style-type: none"> ▪ Clean the check valves ▪ Exchange the check valves ▪ Purge the pump head so as to remove the air bubbles ▪ Tighten the capillary screw fittings on to the inlet and outlet screw fittings of the pump head with a torque wrench at a tightening torque of 28 Nm
<i>Pump head leaks</i>	Check the following options: <ul style="list-style-type: none"> ▪ Inspect and tighten the inlet and outlet screw fittings of the pump head ▪ Exchange the pump head ▪ If the pump head seals are defective, solvent enters the piston backflushing; inform the technical support department of the manufacturer
<i>Flow rate is not correct</i>	Check the following options: <ul style="list-style-type: none"> ▪ Check the data for the solvent compressibility ▪ Clean the check valves ▪ Exchange the check valves

System Messages

Explanation of the touchscreen's error messages. They are sorted alphabetically.

System message	Solution
<i>Auto pump head type: head data uninitialized!</i>	<ul style="list-style-type: none"> ▪ Switch the device off and on ▪ Check whether a pump head with RFID recognition has been installed ▪ Repeat the automatic configuration step in the chromatography software ▪ Remove pump head, clean it and install it again
<i>Auto pump head type: no head detected!</i>	<ul style="list-style-type: none"> ▪ Switch the device off and on ▪ Repeat automatic configuration in the chromatography software ▪ Remove pump head, clean it and install it again ▪ Check whether a pump head with RFID recognition has been installed
<i>Cannot delete active program/link</i>	Pause active program as well as Link and the delete the link.
<i>Cannot edit program from the running link</i>	First pause the link, then edit the data on the device display or in the chromatography software.
<i>Cannot initialize LAN</i>	Check the cables and connections in the local area network.
<i>Cannot operate with an empty link</i>	The link is empty. First create a <i>link</i> .
<i>Cannot read data from FRAM</i>	Switch the device off and on. If the system message appears again, notify the manufacturer for technical support.
<i>Cannot read RTC</i>	Switch the device off and on. If the system message appears again, notify the manufacturer for technical support.
<i>Cannot start time table</i>	Edit the data on the device display or in the chromatography software.
<i>Cannot use non-existing component!</i>	Change the setup settings or change the gradient in the program or in setup.
<i>Cannot write data on FRAM</i>	Switch the device off and on. If the system message appears again, notify the manufacturer for technical support.
<i>Error input activated</i>	Device error, change device settings.
<i>GUI communication failed (internal)!</i>	Switch the device off and on. If the system message appears again, notify the manufacturer for technical support.
<i>Insufficient access</i>	Change the entry.
<i>Invalid command</i>	<ul style="list-style-type: none"> ▪ Change the entry ▪ Check the cable connections
<i>Invalid parameter(s)</i>	Check the validity of the parameter(s).
<i>Invalid time in time table</i>	Correct the time entry.
<i>Invalid time table index</i>	Change the entry in the program line.
<i>Link is loaded</i>	First unload the link then change the link or delete it.

System message	Solution
<i>Link is running</i>	Wait until the link has been completed, then change the link or delete it.
<i>Maximum pressure! System stopped</i>	<ul style="list-style-type: none"> ▪ Reduce the pressure or adjust the upper pressure limit ▪ Restart the system
<i>Minimum pressure! System stopped</i>	<ul style="list-style-type: none"> ▪ Increase the pressure or adjust the lower pressure limit ▪ Restart the system
<i>No components are available in isocratic mode</i>	Since the pump can only be operated using a specific valve, the entered data has to be adapted to isocratic mode.
<i>No link available</i>	Create a link and edit it.
<i>No link available Pls edit link first</i>	Create a link and edit it.
<i>No time table to start</i>	Edit the data by means of the chromatography software.
<i>Non-existing component is set to non-0 value</i>	Switch on the channel or edit the data using the chromatography software.
<i>Not enough space to store link</i>	<ul style="list-style-type: none"> ▪ Check the pump ▪ Check the number of program lines – a maximum of 100 program lines are possible
<i>Not enough space to store program</i>	<ul style="list-style-type: none"> ▪ Check the pump ▪ Check the number of program lines – a maximum of 100 program lines are possible
<i>Not supported</i>	Change the entry.
<i>Prg not compatible with pump head!</i>	Modify the program or replace the pump head.
<i>Program does not exist</i>	Create and edit a program.
<i>Program is running.</i>	Quit program or wait until program has been completed.
<i>The gradient component is used!</i>	First unload the program. The setup data can only be edited when no program has been loaded or started.
<i>this link is used in WakeUp</i>	First quit or delete wakeup program (<i>WakeUp</i>), then edit or delete link.
<i>This program is used in a link</i>	First pause or delete link, then edit or delete data by means of the chromatography software.
<i>this program is used in WakeUp</i>	First quit or delete wakeup program (<i>WakeUp</i>), then edit or delete data by means of the chromatography software.
<i>Time already exists</i>	Correct the time entry.
<i>Time table line is empty</i>	Edit the program line.
<i>Too many lines in program</i>	Check the number of program lines – a maximum of 100 program lines are possible.
<i>Unknown pump head type!</i>	<ul style="list-style-type: none"> ▪ Check the pump head ▪ Check whether a pump head with RFID recognition has been installed

System message	Solution
<i>used!*/, CRC failed</i>	Switch the device off and on. If the system message appears again, notify the manufacturer for technical support.
<i>Wrong Line number</i>	Change the line index in the link.
<i>Wrong link</i>	<ul style="list-style-type: none"> ▪ Check Link no. – values from 1–10 are possible. ▪ Correct the entry

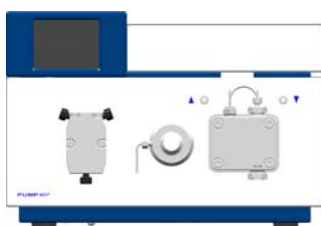
Technical Data

Ambient Conditions

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

Pump with Mixing Chamber (optional)

Conveying system	Dual-piston pump with main and auxiliary piston
Flow rate range	<ul style="list-style-type: none"> ▪ 10 ml pump head: 0.001–10.000 ml/min ▪ 50 ml pump head: 0.01–50.00 ml/min
Maximum pressure	<ul style="list-style-type: none"> ▪ 10 ml pump head: <ul style="list-style-type: none"> - 65 MPa up to 5 ml/min - 40 MPa up to 10 ml/min ▪ 50 ml pump head: <ul style="list-style-type: none"> - 3 MPa up to 10 ml/min - 20 MPa up to 50 ml/min
Flow rate accuracy	<ul style="list-style-type: none"> ▪ 10 ml pump head: <ul style="list-style-type: none"> - ± 1 %, measured at 5–80 % of flow range using ethanol ▪ 50 ml pump head: <ul style="list-style-type: none"> - ± 1 %, measured at 5–80% of flow range using ethanol
Flow rate precision	RSD (relative standard deviation) <ul style="list-style-type: none"> ▪ 10 ml pump head: <ul style="list-style-type: none"> - < 0.1 % RSD based on retention time at constant room temperature ▪ 50 ml pump head: <ul style="list-style-type: none"> - < 0.1 % RSD based on retention time at constant room temperature
Residual pulsation	< 2 % amplitude (typically < 1.3 %) or < 0.3 MPa (3 bar), whatever is greater, at 1 mL/min ethanol, at all pressures > 1 MPa (10 bar, 147 psi).
Automatic piston back-flushing	Standard



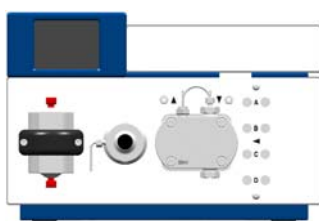
Gradients	<ul style="list-style-type: none"> ▪ Isocratic HPLC pump ▪ Pump with 4-channel gradients and manager (low-pressure gradient system, LPG) ▪ Up to 4 pumps combined (high-pressure gradient system, HPG) ▪ Semi-preparative (binary high pressure gradient system, HPG)
System protection	P_{min} and P_{max} adjustable
Control	<ul style="list-style-type: none"> ▪ LAN ▪ RS-232 ▪ remote control connections (Stop, Flow, Pressure, Error) ▪ RFID for automatic pump head detection ▪ Touchscreen
Programming	20 programs, 9 program links, <i>WAKE UP</i> program
Supply voltage range	100–240 V
Supply frequency	50–60 Hz
Power consumption	Maximum 40 W
IP protection class	IP-20
Weight	5.3 kg (without mixing chamber: 5.1 kg)
Dimensions (length x width x height)	399 x 242 x 165 mm



Pump with LPG Module

Eluent number	Up to 4
Gradient ranges	0–100%
Progression	1% increments
Precision	$\pm 0,5\%$
gradients – precision	< 1% RSD
Conveying system	Dual-piston pump with main and auxiliary piston
Flow rate range	<ul style="list-style-type: none"> ▪ 10 ml pump head: 0.001–10.000 ml/min ▪ 50 ml pump head: 0.01–50.00 ml/min
Maximum pressure	<ul style="list-style-type: none"> ▪ 10 ml pump head: <ul style="list-style-type: none"> - 65 MPa up to 5 ml/min - 40 MPa up to 10 ml/min ▪ 50 ml pump head: <ul style="list-style-type: none"> - 20 MPa up to 25 ml/min - 15 MPa up to 50 ml/min

Flow rate accuracy	<ul style="list-style-type: none"> ▪ 10 ml pump head: <ul style="list-style-type: none"> ▪ < 0.5% (1 ml/min) ▪ < 1% (0.1–8 ml/min) ▪ 50 ml pump head: < 1% (0.5–40 ml/min)
Flow rate precision	RSD (relative standard deviation) <ul style="list-style-type: none"> ▪ 10 ml pump head: < 0.1% (1 ml/min) ▪ 50 ml pump head: < 0.4% (5 ml/min)
Residual pulsation	< 1% at 1 ml/min
Automatic piston back-flushing	Standard
Gradients	<ul style="list-style-type: none"> ▪ Isocratic HPLC pump ▪ Pump with 4-channel gradients and manager (low-pressure gradient system, LPG) ▪ Up to 4 pumps combined (high-pressure gradient system, HPG) ▪ Semi-preparative (binary high pressure gradient system, HPG)
System protection	P_{\min} and P_{\max} adjustable
Control	<ul style="list-style-type: none"> ▪ LAN ▪ RS-232 ▪ remote control connections (Stop, Flow, Pressure, Error) ▪ RFID for automatic pump head detection ▪ Touchscreen
Programming	20 programs, 9 program links, <i>WAKE UP</i> program
Supply voltage range	100–240 V
Supply frequency	50–60 Hz
Power consumption	Maximum 40 W
IP protection class	IP-20
Weight	5.4 kg
Dimensions (length x width x height)	399 x 242 x 165 mm



Pump with Mixing Chamber and LPG Module

Conveying system	Dual-piston pump with main and auxiliary piston
Flow rate range	<ul style="list-style-type: none"> ▪ 10 ml pump head: 0.001–10.000 ml/min ▪ 50 ml pump head: 0.01–50.00 ml/min

Maximum pressure	<ul style="list-style-type: none"> ▪ 10 ml pump head: <ul style="list-style-type: none"> - 65 MPa up to 5 ml/min - 40 MPa up to 10 ml/min ▪ 50 ml pump head: <ul style="list-style-type: none"> - 20 MPa up to 25 ml/min - 15 MPa up to 50 ml/min
Flow rate accuracy	<ul style="list-style-type: none"> ▪ 10 ml pump head: <ul style="list-style-type: none"> - < 0.5 % (1 ml/min) - < 1 % (0.1–8 ml/min) ▪ 50 ml pump head: <ul style="list-style-type: none"> - < 1 % (0.5–40 ml/min)
Flow rate precision	RSD (relative standard deviation) <ul style="list-style-type: none"> ▪ 10 ml pump head: <ul style="list-style-type: none"> - < 0.1 % (1 ml/min) ▪ 50 ml pump head: <ul style="list-style-type: none"> - < 0.4 % (5 ml/min)
Residual pulsation	< 1 % at 1 ml/min
Automatic piston back-flushing	Standard
Gradients	<ul style="list-style-type: none"> ▪ Pump with 4-channel gradients and manager (low-pressure gradient system, LPG)
System protection	P_{\min} and P_{\max} adjustable
Control	<ul style="list-style-type: none"> ▪ LAN ▪ RS-232 ▪ remote control connections (Stop, Flow, Pressure, Error) ▪ RFID for automatic pump head detection ▪ Touchscreen
Programming	20 programs, 9 program links, <i>WAKE UP</i> program
Supply voltage range	100–240 V
Supply frequency	50–60 Hz
Power consumption	Maximum 40 W
IP protection class	IP-20
Weight	5.6 kg
Dimensions (length x width x height)	399 x 242 x 165 mm
Eluent number	Up to 4
Gradient ranges	0–100%
Progression	1 % increments
Precision	± 0.5 %
gradients – precision	< 1% RSD

Maximum flow rate	50 ml/min
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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 any damage, 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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 14163 Berlin, Germany
 Phone:+49 30 809727-111
 Telefax:+49 30 8015010
 e-mail:info@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.

Abbreviations and Terminology

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

Terminology	Explanations
GLP	Good Laboratory Practice – quality assurance for laboratories.
Gradient	Time-dependent composition of solvent (mobile phase) on low-pressure or high-pressure side of system.
HPG	High Pressure Gradient (HPG) Operating mode of an HPLC system. The solvent is mixed on the high-pressure side of the pump.
HPLC	High Pressure Liquid Chromatography (HPLC).
IP address	Unique address of transmitter or receiver in local network or Internet (Internet Protocol).
Link	Combination of multiple chromatography programs in a single HPLC system.
LPG	Low Pressure Gradient (LPG). Operating mode of an HPLC system. The solvent is mixed on the low-pressure side of the pump.
LPG Module	Low pressure gradient module supplements the pump to a quaternary low pressure gradient system.
Remote	The chromatography software controls the pump.
Solvent	Mobile phase (eluent) or carrier for liquid chromatography.

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