

# BlueShadow

► **Manager 40M**  
**User Manual**

V7645A



# 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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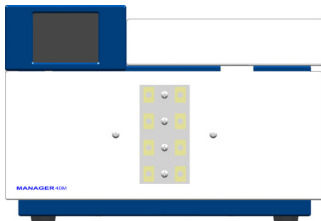
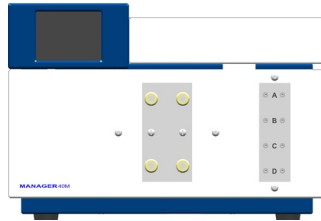
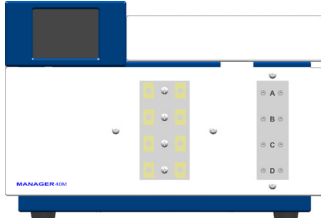
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# Intended Use

## HPLC

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

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



## Device Types

Device for analytical and semi-preparative applications in the high-pressure range and low-pressure range:

- Device with degasser, low-pressure gradient (LPG), and interface module
- Device with degasser and LPG module
- Device with degasser and interface module

Table 4 lists various models that take analytical and semi-preparative applications into account.

Degasser, analytical, flow rate up to 10 ml	Degasser, analytical, flow rate up to 50 ml
+ LPG module (VA) + interface box	+ LPG module (VA) + interface box
+ interface box	+ interface box

### Room ventilation, A/C 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.

### Checking intended use

- 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.

## Laboratory Use

- Biochemistry analyses
- Chemical analyses
- Food analyses
- Pharmaceutical analyses
- Environmental analyses

## Where is it prohibited to use the device or system?



**DANGER!** Explosion hazard, if the device is used in potentially explosive atmospheres without appropriate protective equipment! Let specialists carry out protective measures.

## Features

- Long service life
- High physical and chemical stability
- Control with chromatography software

# Safety

## Laboratory Regulations

### Adherence to laboratory regulations

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

## Solvents

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
<ul style="list-style-type: none"> <li>▪ Acetone at 4°-25° C (39.2°-77.0° F)<sup>a</sup></li> <li>▪ Acetonitrile</li> <li>▪ Benzene</li> <li>▪ Chloroform</li> <li>▪ Ethyl acetate</li> <li>▪ Ethanol</li> <li>▪ Hexane/heptane at 4°-25° C (39.2°-77.0° F)<sup>a</sup></li> <li>▪ Isopropanol</li> <li>▪ Carbon dioxide (liquid 99.999% CO<sub>2</sub>)</li> <li>▪ Methanol</li> <li>▪ Phosphate buffer solutions (0.5 M)</li> <li>▪ Toluol</li> <li>▪ Dilute ammonia solution</li> <li>▪ Dilute acetic acid (10-50%), at 25° C/77.0° F</li> <li>▪ Dilute sodium hydroxide (1M)</li> <li>▪ Water</li> </ul>	<ul style="list-style-type: none"> <li>▪ Dimethyl sulfoxide (DMSO)</li> <li>▪ Slightly volatile eluents</li> <li>▪ Methylene chloride</li> <li>▪ Tetrahydrofuran (THF)</li> <li>▪ Dilute phosphoric acid</li> </ul>	<ul style="list-style-type: none"> <li>▪ Halogenated hydrocarbons, e.g. Freon<sup>®</sup></li> <li>▪ Concentrated mineral and organic acids</li> <li>▪ Concentrated bases</li> <li>▪ Eluents containing particles</li> <li>▪ Perfluorinated eluents, e. g. Fluorinert<sup>®</sup> FC-75, FC-40</li> <li>▪ Perfluorinated polyether, e.g. Fomblin<sup>®</sup></li> </ul>

a. valid for the specified temperature range

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

**Leaks and clogged capillaries**

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

**Exhaust** Connect silicone tube (inner diameter: 3.0 mm) with the olive-type tube fitting of the exhaust and lead the gases or liquids into a suitable collecting container or to a fume hood.

**Solvent tray** To avoid damage from leaks, always place solvent bottles in a solvent tray on the device.

**Self-ignition point** Only use solvents that have a self-ignition point higher than 150°C under normal ambient conditions!



**Toxicity** Organic solvents are toxic above a certain concentration. Ensure that work areas are always well-ventilated! Wear protective gloves and safety glasses when working on the device!

## Protective Measures

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

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

Never open a device! High voltage poses a life-threatening risk.

## Power Supply

The device is intended for use with AC power networks of 100-240 V. The device does not have an own power adapter, but is supplied with power through a connection cable to the pump.

## Target Group

### Operating the Device or System

The device can be operated with chromatography software at the workstation.

### To what should the user pay particular attention?

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





- |                                      |  |
|--------------------------------------|--|
| <b>Avoid additional dead volume</b>  | <ol style="list-style-type: none"> <li>1. Once they have been used, never re-use capillaries in other areas of the system.</li> <li>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.</li> </ol> |
| <b>Using special columns</b>         | <ul style="list-style-type: none"> <li>• When using special columns, follow the manufacturer's instructions on caring for the columns!</li> </ul>  |
| <b>Check for clogged capillaries</b> | <ul style="list-style-type: none"> <li>• Regularly check for clogged capillaries – test back pressure without column.</li> </ul>   |
| <b>Using filtered solvents</b>       | <ol style="list-style-type: none"> <li>1. Use ultra-pure, filtered solvents for HPLC – gradient grade</li> <li>2. Filtration of substances under analysis</li> <li>3. Use of inline filters.</li> </ol>  |
| <b>Note</b>                          | <p>Only allow the technical support of KNAUER or a company authorized by KNAUER to open the devices for maintenance and repair work.</p>   |

### **What expertise should users have to safely operate an HPLC device or device system?**

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

# Symbols and Signs

Explanations of symbols and labels on the device or system

Symbol	Explanation
	<p>Hazard symbol indicating microelectronic devices that can be damaged by electrostatic discharge when touched.</p>
	<p>CE (Conformité Européenne) mark for equipment that complies with the pertinent EU directives and comes with a declaration of conformity from the manufacturer.</p>
	<p>Marking for devices that specifically meet the Canadian guidelines for laboratory devices: CAN/CSA-C22.2 no. 61010-1, 2nd issue with the extension 1 or newer</p>
	<p>For your own safety, <b>read</b> the manual and <b>always</b> observe the warnings and safety information on the device and in the manual!</p>

# Installation

## Packaging and Transport

At the factory, the device was carefully packed for safe transport.

### Checking for signs of damage during transport

Check the device for signs of damage that occurred during transport. If the shipment is incomplete or damaged, inform KNAUER within three workdays. Also inform the freight carrier about transport damage.

## Fastening Material and Shipping Boxes

The device is held in place and protected by foam inserts at the top and bottom. Please keep the transport box and the foam inserts.

### Remove packaging material

### Removing device from packaging

- Remove the foam insert on the top of the device.
- Grip the device at its sides near the front and lift it out of the packaging.

## Protective Film on the Screen

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

### Removing the protective film

- Remove the protective film from the display.

## Scope of Delivery

### Device types:

- Device with degasser, LPG, and interface module
- Device with degasser and LPG module
- Device with degasser and interface box

### Accessories

- User Manual
- Accessories kit depending on device type
- Only use original parts and original accessories made by the manufacturer or a company authorized by the manufacturer.

### Use original parts and accessories

## Checking the Scope of Delivery

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

Hotline of the manufacturer's technical support:

### European hotline

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

### E-mail contact:

E-mail: info@knauer.net

## Space Requirements

The device is arranged in the device system between the solvent tray and the pump.

- 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

## Installation Site

### Ambient conditions of the installation site

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

# Initial Startup

The device does not have an own power adapter, but is supplied with power through a connection cable to the pump.

## Front View of Devices

### Device with Degasser, LPG Module, and Interface Box, Analytical

#### Legend

- ① Display
- ② Degasser module
- ③ LPG module

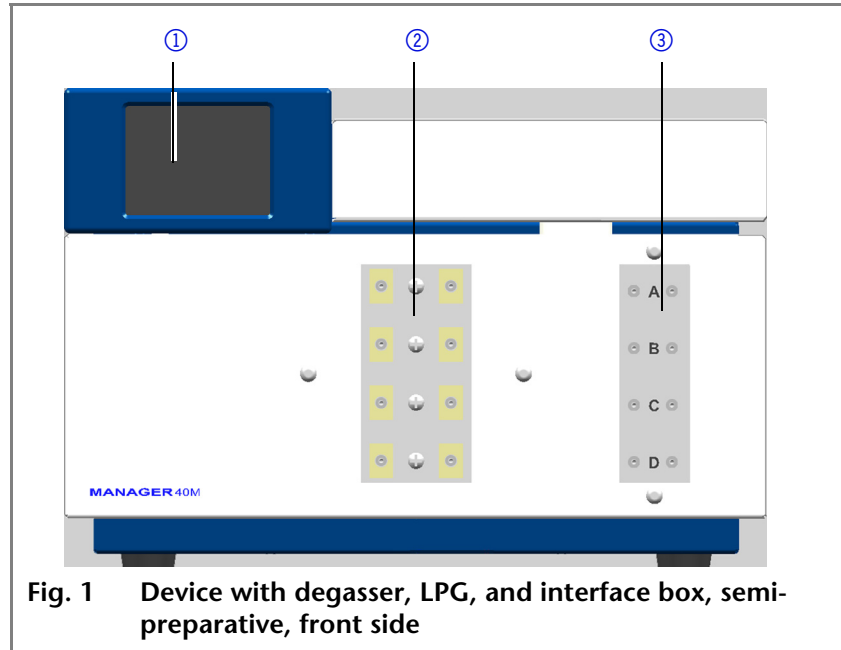


Fig. 1 Device with degasser, LPG, and interface box, semi-preparative, front side

## Device with Degasser, LPG Module, and Interface Box, Semi-Preparative

### Legend

- ① Display
- ② Degasser module
- ③ LPG module

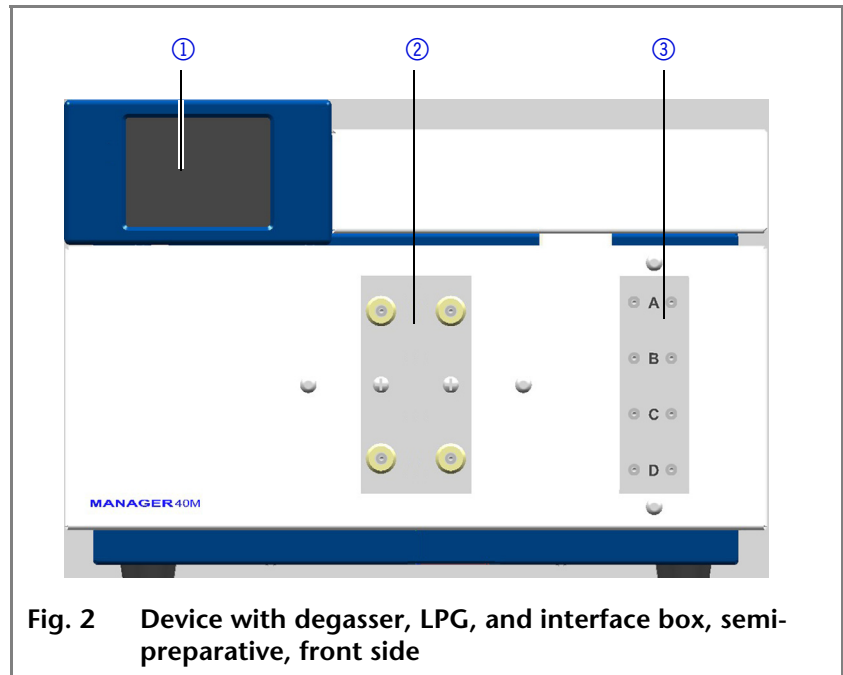


Fig. 2 Device with degasser, LPG, and interface box, semi-preparative, front side

## Rear Views of Device

### Device with Degasser, LPG module, and Interface Box, Analytical and Preparative

### Legend

- ① Interface box, channel 1-4
- ② Serial number
- ③ Warning 1
- ④ Interface RS-232
- ⑤ Warning 2
- ⑥ CE mark
- ⑦ Connection pump
- ⑧ Exhaust

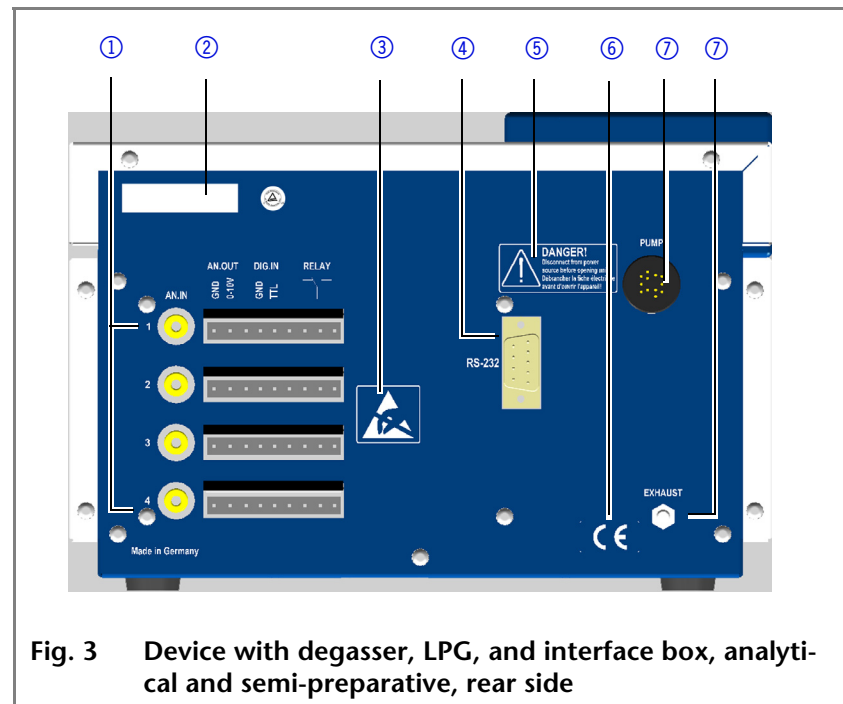


Fig. 3 Device with degasser, LPG, and interface box, analytical and semi-preparative, rear side

## Device with Degasser and LPG Module, Analytical, without Interface Box

### Legend

- ① Serial number
- ② Warning 1
- ③ Warning 2
- ④ CE mark
- ⑤ Connection pump
- ⑥ Exhaust

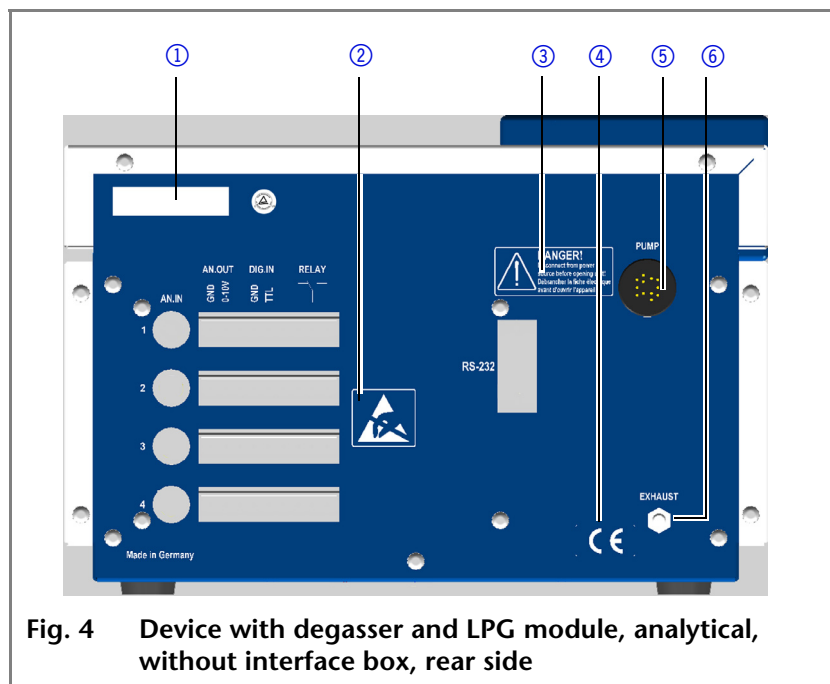


Fig. 4 Device with degasser and LPG module, analytical, without interface box, rear side

## Degasser

Gases that have dissolved into the solvent can cause bubbles in pumps and detectors. Good chromatographic separation therefore requires degassing the solvent.

- Analytical degasser module (A): four degassing chambers, degassing of up to four solvents simultaneously
- Semi-preparative degasser module (B): two degassing chambers, degassing of up to two solvents simultaneously

## Degassing Principle

While the solvent flows through the short Teflon AF<sup>®</sup> tubes, the dissolved gases are removed from the solvent by means of a vacuum on the other side of the membrane. An integrated vacuum pump maintains a constant vacuum.

The special pump design makes it possible to flush the pump head with a small blast of air, to remove solvent fumes, which could escape from the vacuum chamber.



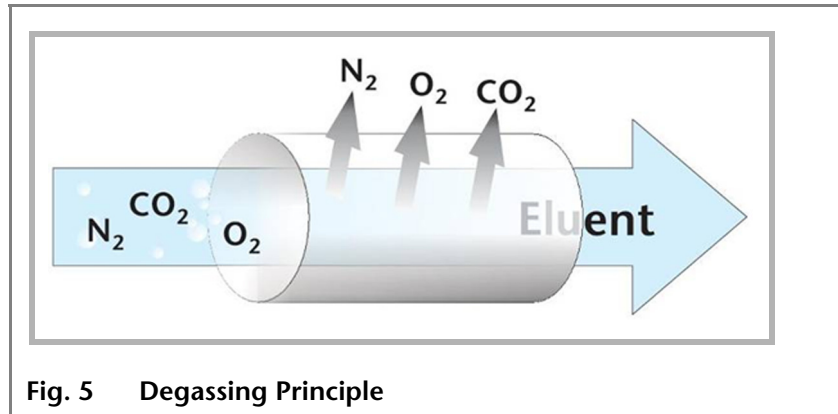


Fig. 5 Degassing Principle

## Degassing Principle of the Teflon AF<sup>®</sup> Membrane

- Structural properties of the AF<sup>®</sup> membrane accelerate the degassing process.
- Thanks to the molecular structure of the AF<sup>®</sup> membrane, only a very small surface is required for degassing the solvent. Thus the risk of carryover during a solvent change is reduced.
- The solvophobic and hydrophobic properties of Teflon AF<sup>®</sup> reduces the risk of contamination between the individual solvent channels.

## LPG Module

The LPG module supplements the pump to a quaternary low-pressure gradient system.

- LPG module with up to four channels
- Flow range in dependency of pump head up to 50 ml/min
- Control of the LPG module by the pump
- Alternative control by computer and chromatography software

## Interface Box

Data acquisition and control of up to four channels or four external devices, for example:

- Analog inputs (*ANALOG IN*): Data acquisition from a detector
- Analog outputs (*ANALOG OUT*): Controlling the flow rate of a pump
- Digital outputs (*RELAY*): Valve switching

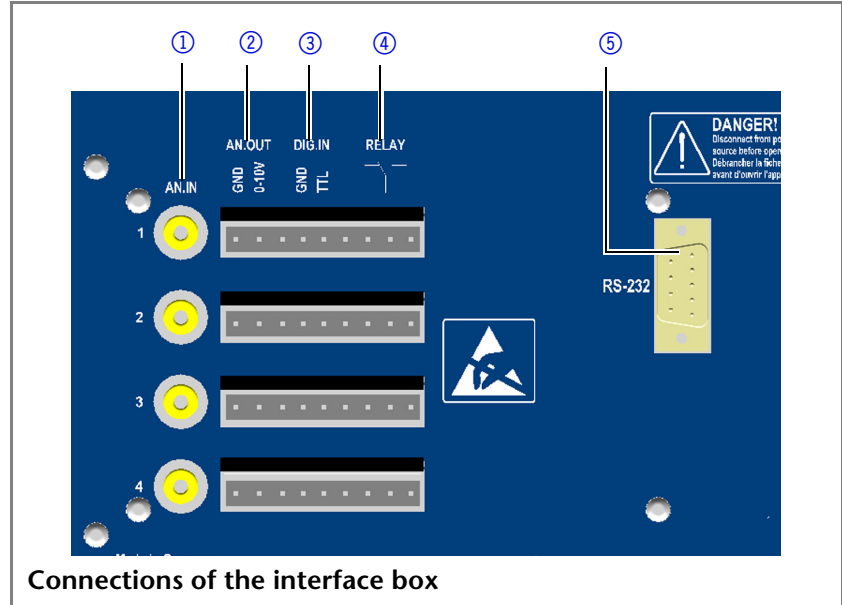
Hinweis: the analog out and input of a channel cannot be used at the same time.

The cables for the analog and digital in- and outputs as well as the cable for the RS-232 interface are included with the device's accessories.

## Connections of the Interface Box

### Legend

- ① ANALOG IN
- ② ANALOG OUT
- ③ DIGITAL IN
- ④ RELAY
- ⑤ Interface RS-232



**Note** The interface box has no *standalone* functionality. A chromatography software is mandatory (ChromGate® as of version 3.1 or ClarityChrom® for Windows). The configuration of the interface box is described in the manual of the corresponding software.

### Analog Inputs (ANALOG IN)

- Input of analog voltage signals
- Channels are independent of each other and can be used simultaneously by one system or various systems.

<i>Voltage range</i>	-2.56 V bis +2.56 V (bipolar mode)
<i>Absolute maximum ratings</i>	-10 V to +10 V
<i>Input impedance</i>	10 MΩ
<i>Maximum resolution</i>	24 bit
<i>Minimum noise level</i>	7 μV (1 Hz, time constant 0.1 s)
<i>Maximum data rate</i>	up to 10 Hz (each channel)
<i>Gain factor (for all channels)</i>	1, 2, 4, 8, 16

### Analog Outputs (*ANALOG OUT*)

- Output of analog voltage signals
- Channels are independent of each other and can be used simultaneously by one system or various systems.

<i>Voltage range</i>	0 V to +10 V
<i>Minimum voltage step (DAC resolution)</i>	2.5 mV (12 bit)
<i>Maximum load resistance</i>	2 kΩ

### Digital Inputs (*DIGITAL IN*)

- Input of start signals
- Contact end on ground
- TTL/CMOS or *Open Collector* compatible
- Separate start signal possible from each channel if the channels are used in separated systems

<i>Max. high level input voltage</i>	+15 V
<i>Min. high level input voltage</i>	+2.5 V
<i>Max. low level input voltage</i>	+1 V
<i>Min. low level input voltage</i>	-15 V
<i>Maximum input, current at V (in) = 0,5 V</i>	10 mA

### Digital outputs (*RELAY*)

- Output as electro mechanical relay with single-polar change-over switch (*Single Pole Double Throw, SPDT*)
- Configuration of pulse or steady-rate signals
  - Pulse signal approx. 1 s
  - Steady-rate signal as desired

<i>Output type</i>	<ul style="list-style-type: none"> <li>▪ NO (normally open)</li> <li>▪ NC (normally closed)</li> </ul>
<i>Max. switching voltage</i>	max. 175 V DC
<i>Max. switching current</i>	max. 0.25 A

### Interface RS-232

The interface is a 9-pin standard RS-232 interface, which is also named serial interface or COM port. It is used for PC connection to allow software control of the interface box.

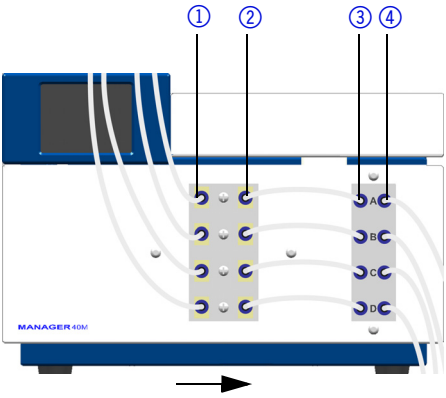
<b>Connector assignment</b>	Pin 2RxD
	Pin 3TxD
	Pin 5GND
<b>Configuration</b>	Transfer rate: 19200 baud fix,
	Data width: 8 bit
	Stop bit: : 1
	Parity: no

## Connecting the Degasser to the LPG Module

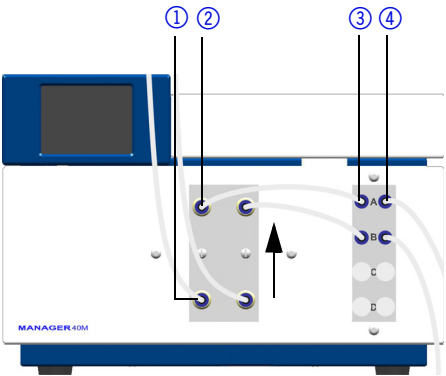
Each degassing chamber features an inlet and an outlet.

- Degasser module, analytical: Connection of the chambers horizontally from left to right
- Degasser module, semi preparative: Connection of the chambers vertically from bottom to top
- Remove the cap fittings from the degassing chamber inlets and outlets that are to be used, and keep the filler caps.
- Use cap fittings to close unused inlets and outlets.

### Connection of the Degasser (Analytical) to the LPG Module

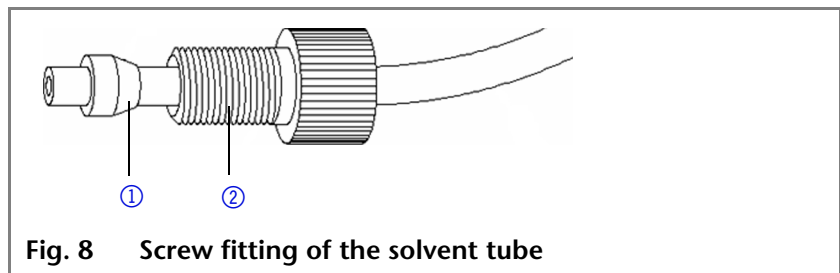
Procedure	Steps	Figure
	<ol style="list-style-type: none"> <li>1. Tube connection from the solvent bottle to the degasser chamber inlet ① .</li> <li>2. Tube connection from the degasser chamber outlet ② to the LPG module inlet ③ .</li> <li>3. Tube connection from the LPG module outlet ④ to the pump head.</li> </ol>	 <p><b>Fig. 6</b> Connection of the degasser module (analytical) to the LPG module</p>

## Connecting the Degasser (Semi-Preparative) to the LPG Module

Procedure	Steps	Figure
	<ol style="list-style-type: none"> <li>1. Tube connection from the solvent bottle to the degasser chamber inlet ①.</li> <li>2. Tube connection from the degasser chamber outlet ② to the LPG module inlet ③.</li> <li>3. Tube connection from the LPG module outlet ④ to the pump head.</li> </ol>	 <p><b>Fig. 7</b> Connection of the degasser (semi-preparative) to the LPG module</p>

### Screw Fitting of the Solvent Tube

- Make sure that the tapered side of the seal ring ① faces the screw ② of the solvent tube.



### Solvent Tube Connection

Suitable cut-to-length solvent tubes are included with the device's accessories. This makes short tube distances possible between the individual connections.

- Make sure that the tube has a straight ending.
- Only tighten screw fittings by hand.

**Note** All solvent tubings feature color markings (either blue, yellow, red or black). Per channel, the same marking color is to be used for all tube sections.

# Connecting the Device to Other Devices

## Electrical Connections

- For power supply and electrical control of the valves of the LPG module, connect the 12-pin connection cable to the device and the pump.

## Connecting the Pump to the Device

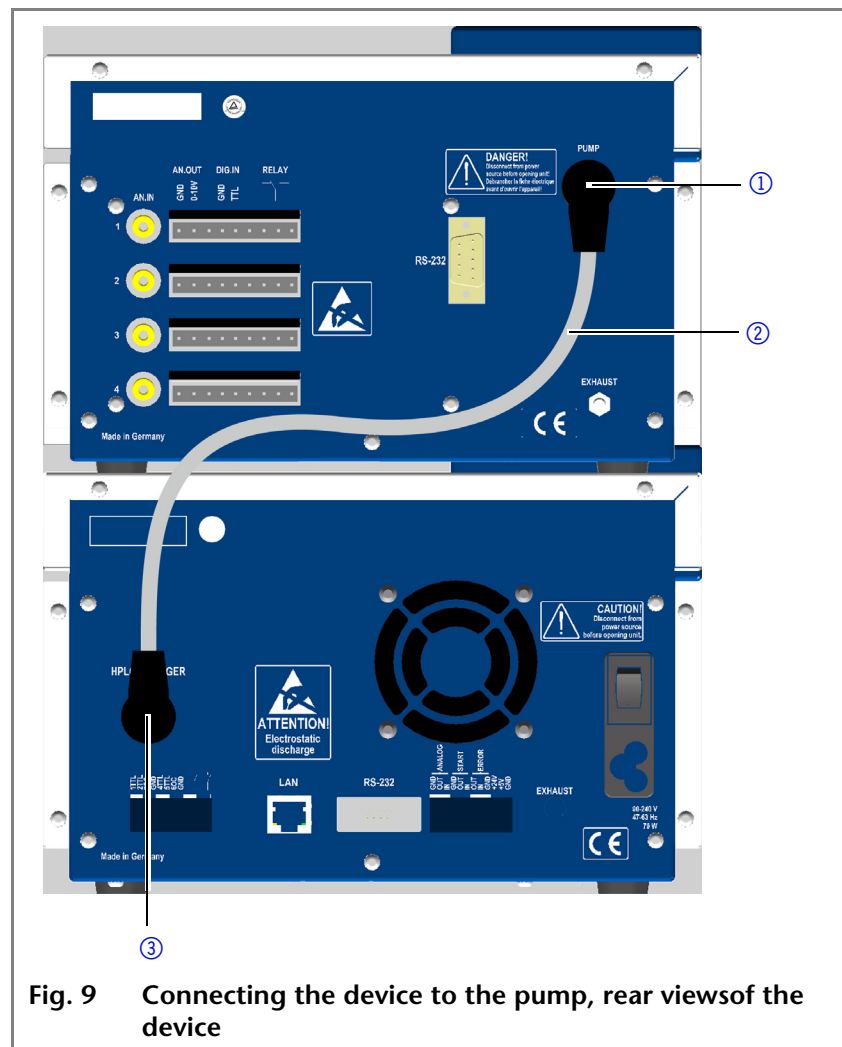
- Place device on the pump.
- Connect the one connection cable plug on the rear of the pump into the connection with the label *HPLC Manager*.
- Plug the other connection cable plug on the rear of the device into the connection with the label *Pump*.



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

### Legend

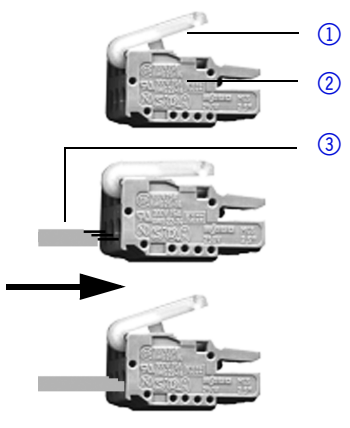
- ① Connection Pump
- ② Connection cable
- ③ Pump: Connection *HPLC Manager*



**Fig. 9** Connecting the device to the pump, rear views of the device

## Connecting the Flat Ribbon Cable with the Connector Strip

To enable signal transfers from external devices to the device, flat ribbon cables are connected with a connector strip and connected to the terminal strip of the interface box on the device's rear side.

Procedure	Steps	Figure
	<ol style="list-style-type: none"> <li>1. Place the connector strip ② on a suitable surface.</li> <li>2. Push the stylus ① into the opening on the connector strip and press it down.</li> <li>3. Keep the stylus pressed down and insert the cable ends ③ into the front of the connector strip.</li> <li>4. Pull out the stylus.</li> <li>5. Check whether the cables are tightly attached.</li> </ol>	 <p><b>Fig. 10</b> Connecting the flat ribbon cable with the connector strip</p>

## Connection of the Device in the LPG System

Sample configuration for an LPG system:

### Legend

- ① 40M
- ② Degasser
- ③ LPG module
- ④ Pump 40P
- ⑤ Mixing chamber
- ⑥ Pressure sensor
- ⑦ Pump head
- ⑧ Inlet valve
- ⑨ Detector 40D
- ⑩ Column
- ⑪ Flow cell

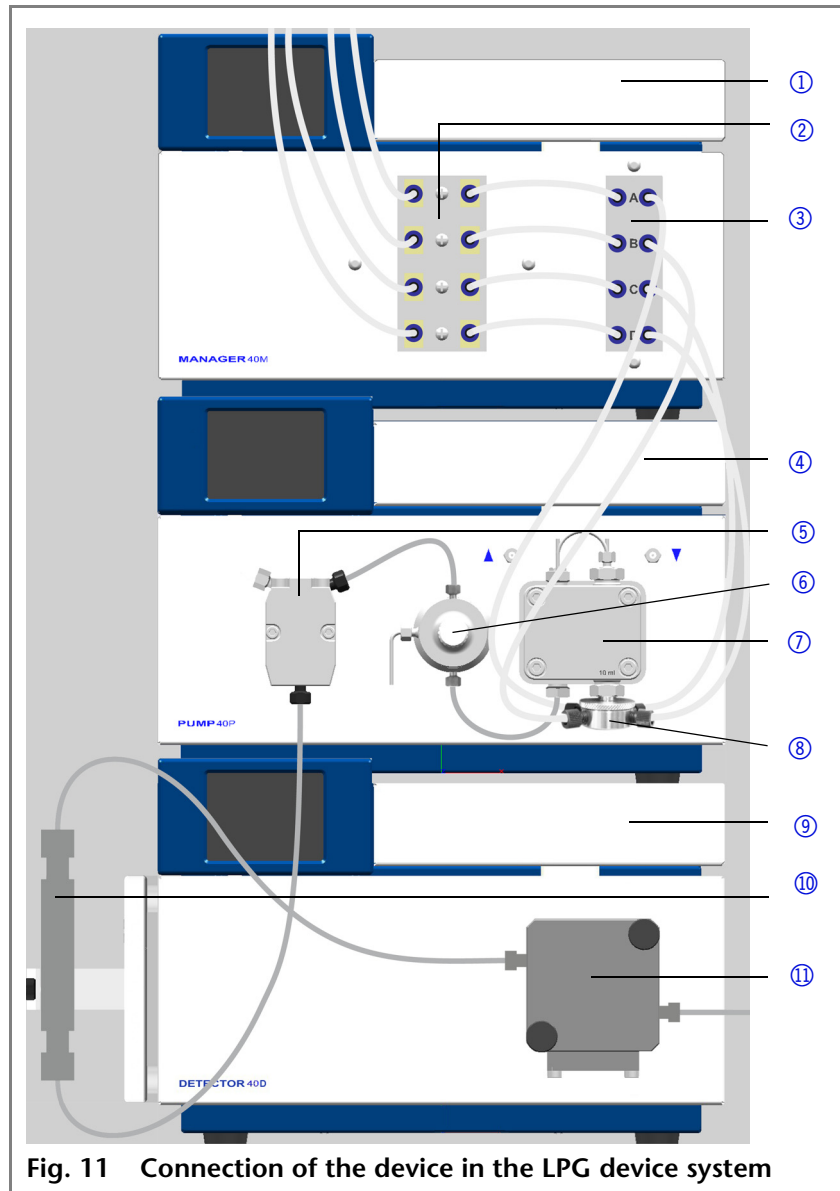


Fig. 11 Connection of the device in the LPG device system



# Controlling the Device

## Switching On

**Prerequisite** Pump and device are connected by a 12-pin connection cable.

- Switch on the pump.

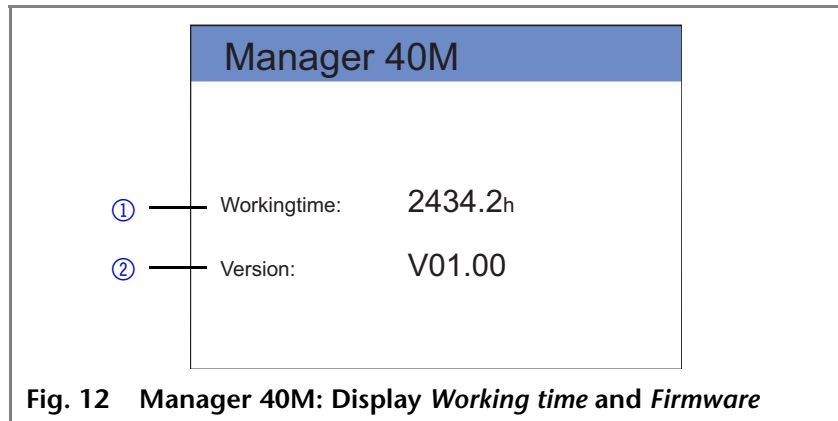
As soon as the device is switched on, a microprocessor checks the signal of the vacuum sensor.

## Working Time and Firmware

- Display *Working time*: Working time of the device
  - Display of the *firmware* version: Version of the device software
- After the display *Working time* and *Firmware*, the last active status of the device is displayed—the device is now ready for operation.

### Legend

- ① Display *Working time*
- ② Display *Firmware*

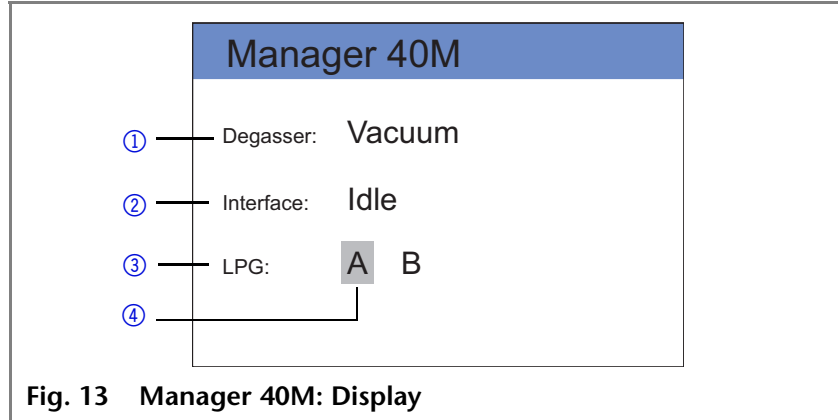


## Display

- Display *Degasser: Initialize*: Specified vacuum value is initialized
- Display *Degasser: Vacuum*: Specified vacuum value has been reached
- Display *Interface: Idle*: No communication via interface module
- Display *Interface: Busy*: Communication via interface module
- Display of the gradient module:
  - *LPG*: Activation of up to four channels

**Legend**

- ① Display *Degasser*
- ② Display *Interface*
- ③ Display for LPG module (when module is installed)
- ④ Display for currently active channels

**Fig. 13** Manager 40M: Display

**Note** If there is a loss of vacuum due to a leak, the vacuum pump switches off automatically.

## Select Gradient Mode

The gradient mode is set in the *Setup* menu of pump 40P.

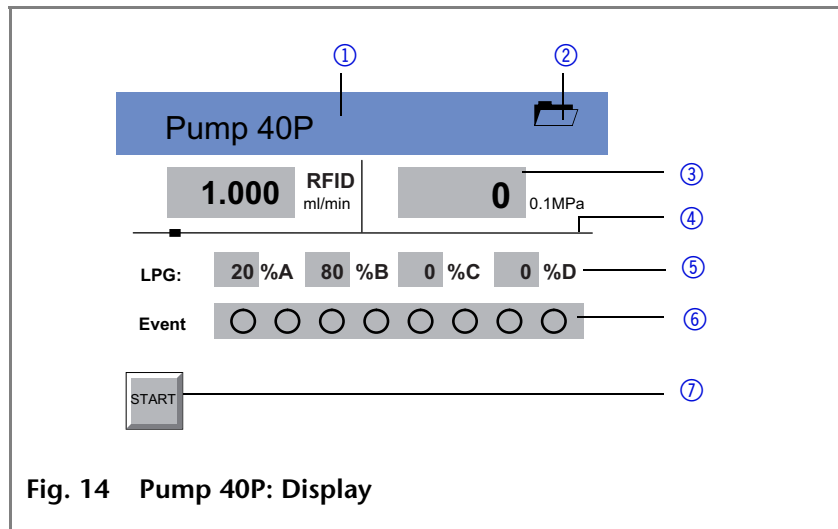
- *LPG*: Activation of up to four channels
- *HPG*: Selection of pump name *HPG-A* to *HPG-D*
- *None*: Isocratic mode

## Status Indicator of Pump 40P

The status indicator of the pump is a *touchscreen*. The *touchscreen* is divided into various areas.



**Legend**

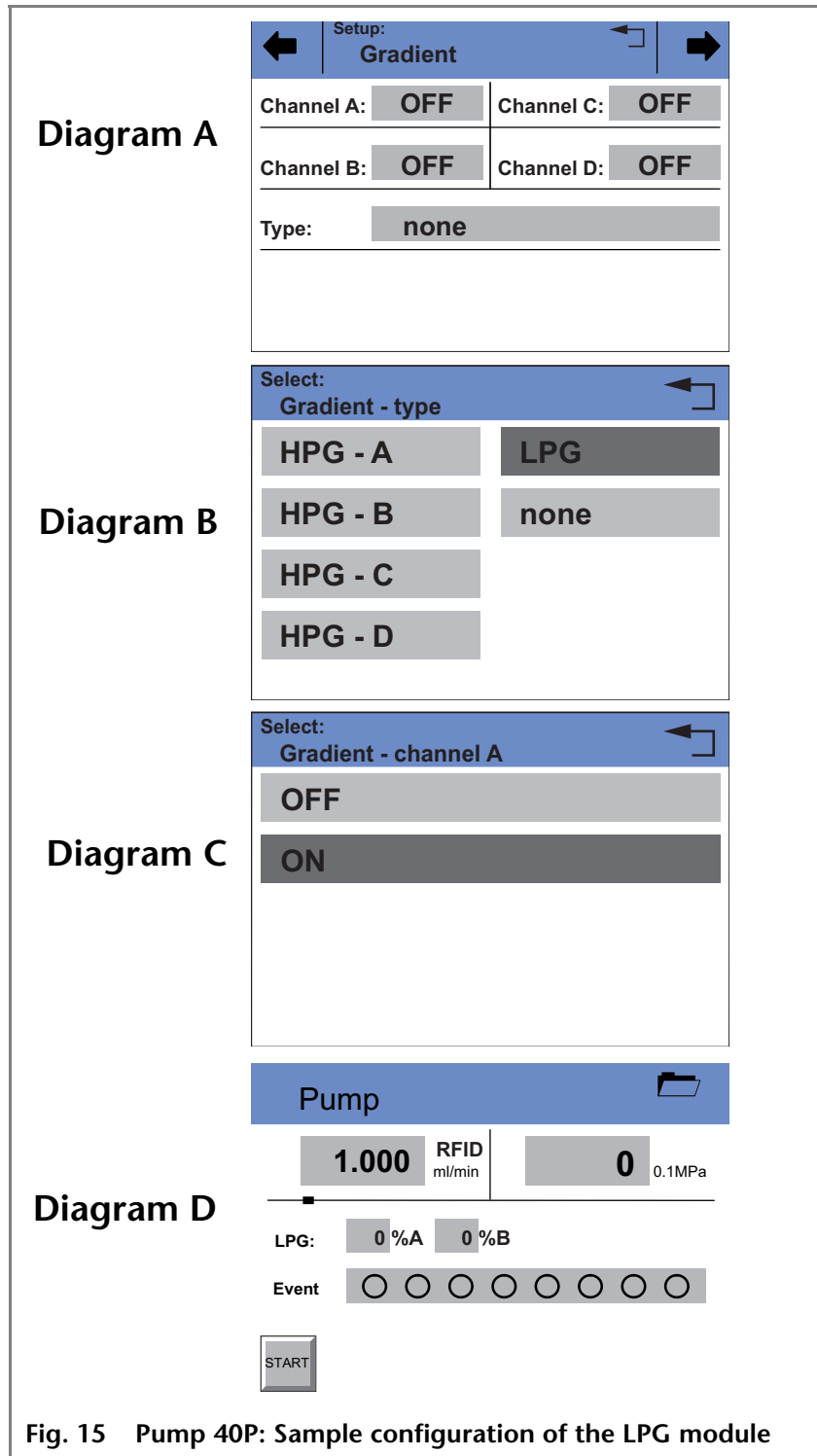
- ① Status bar
- ② To main menu
- ③ Parameters or value
- ④ Animated information diagram
- ⑤ Display of the gradients
- ⑥ Display *Event*
- ⑦ Button

**Fig. 14** Pump 40P: Display

## Configuring the LPG Module

In the *Setup* menu of pump 40P, 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 the Gradient mode *LPG* (diagram A and B).
5. Activating channels for solvents used (diagram C).
6.  Tap to go to a superordinate level, or hold for two seconds to go to the pump's operational display (diagram D).

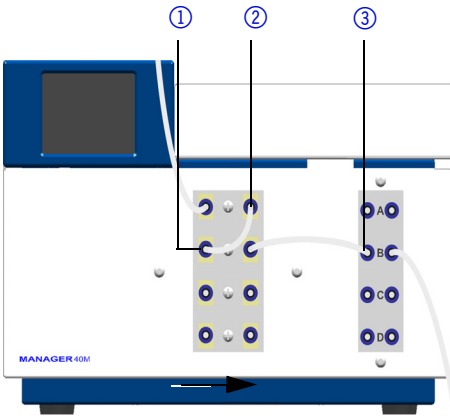


## Capacity Extension of the Degasser

Certain organic solvents, such as alcohols, acetonitrile and Tetrahydrofuran, gas out in mixtures with water in cases of insufficiently carried out degassing.

If methanol and water are mixed at a certain ratio, e.g. 75 : 25, further degassing effects can occur at higher flow rates despite employing the degassing module.

- To double the degassing output, feed solvent through a second degassing chamber.

Procedure	Steps	Figure
	<ol style="list-style-type: none"> <li>1. Connect the degassing chamber outlet ② to a further degassing chamber inlet ①.</li> <li>2. Connect second degassing chamber outlet to a the LPG module inlet ③ or to the pump head.</li> </ol>	 <p><b>Fig. 16</b> Expanding the capacity of the degasser module</p>

## Switching Off

The device is switched off automatically after the pump is switched off. The degassing chambers are vented thereby, reducing the risk of condensation of solvent gases in the solvent tubing.

### Switching Off for a Brief Duration

Observe the warnings for handling dangerous solvents and such solvents that can create health-hazardous decomposition and transfer products.

1. Purge column according to the specifications of the column manufacturer.
2. Purge buffer solutions with water out of the entire device system to prevent crystallisations by vaporization.
3. Remove critical solvents from the device with a suitable flushing solvent.
4. Avoid longer standing times with solvents that tend to decompose, e.g. chloroform (forms hydrochloric acid).

5. Connect capillaries at the pump's output to a waste container and flush the degassing and LPG module with isopropanol.
6. Use only solvents that do not stand open for more than 24 hours to avoid a device contamination.
7. Switch off the pump.
8. If operation is interrupted for several days, for instance over weekends, flush the device and device system with a mixture of methanol and water (60 %/40 %) and then switch it off.

**Note** Damages to the degasser module that result from using buffered solvents are not covered by the warranty.

### Switching Off for a Longer Duration

1. Carry out steps 1-4 for the short switch off.
2. Connect capillaries at the pump's output to a waste container and flush the degassing and LPG module with water and afterwards with isopropanol.
3. Switch off the pump.
4. Remove all connection tubes.
5. If necessary, blow out solvent from the degassing chambers with laboratory gas.
6. Close inlets and outputs of the degasser and LPG module by means of cap fittings.
7. Store the device in a clean and dry location.
8. Prior to reusing the device, flush the degasser and LPG module with a solvent (e.g. isopropanol).
9. When reusing the column, flush the degasser and LPG module with an appropriate solvent.

# Flushing the Device

## Flushing the LPG Module

- Purge and fill the LPG module and the connecting tubing using the appropriate solvent before use.

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

1. Switch on the pump.
2. Setting the flow rate: 0 ml/min.
3. Set solvent mixture ratio for the corresponding valve: 100 %.
4. Open the venting 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.

## Flushing the Degasser

- Flush the degasser module and the connecting tubes with the appropriate solvent prior to use.

**Note** Prior to changing the solvent in the degasser module, flush with a liquid in which both solvents are soluble.

## Flushing the Degasser with a Syringe

Usually, 2 ml solvent is adequate for a flushing. About 15 ml solvent is needed for the semi-preparative device type.

1. Connect the solvent tube to the outlet of the degassing chamber.
2. Connect the syringe to the solvent tube.
3. With the syringe, extract solvent through the degasser module until there are no air bubbles in the solution any more.
4. Repeat step 1-4 for all degassing chambers that are to be used.

## Flushing the Degasser with the Pump



**CAUTION!** Very high pressures damage the degasser membrane. The membrane can withstand a maximum pressure of 7 bar. Do not connect the degasser to the pump outlet.

1. Configure the pump: Flow rate 2 ml/min.
2. Start the pump and flush for 1 to 2 minutes.

**Note** When using a semi-preparative degasser module, the time increases depending on the flow rate used, for example, 5-10 minutes at a flow rate of 2 ml/min and 1-2 minutes at a flow rate of 10 ml/min.



# Functionality Tests

## 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 KNAUER.

This installation report needs to be completed in full and signed by both parties. It serves as proof of the properly executed installation and functionality of the device.

## Operation Qualification (OQ)

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

**Test Intervals** Run the extensive functionality test at the following time intervals:

Average use	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 test can be carried out either by KNAUER's Technical Support or by a technical service authorized by KNAUER.

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

# Maintenance and Care

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

## Contact with the Technical Support

**Contact 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: Available by telephone in German or English: 8 am to 5 pm (CET)  
Phone:+49-(0)30-809727-0  
Fax:+49-(0)30-8015010

**E-mail contact:** info@knauer.net

## Maintenance Contract

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

- Opening the device or removing housing parts.

## What to do when the degasser shows a leak?

Should there be a leak in the degasser module, 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 of the manufacturer.

## Tightening the Screw Fittings

1. If the screw fitting of the solvent tube is untight, carefully tighten the screw fitting.
2. If it still leaks, loosen and check the screw fitting.
3. If no damage or deformation is visible at the seal ring and at the screw fitting, repeat step 1.
4. If it still leaks, replace the screw fitting and cutting ring.

## Cleaning and Caring for the Device



**CAUTION!** 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.

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

# Disposal

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

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

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

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

# Decontamination

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



**DANGER! Danger if getting in contact with toxic, infectious or radio-active substances. Before disposing off or sending away contaminated devices, commission an expert with the decontamination.**

All contaminated devices must be properly decontaminated by a specialist company or the operating company before they can be recommissioned, repaired, sold, or disposed of. All materials or fluids used for decontamination must be collected separately and disposed of properly.

# Storage

**Ambient conditions for storing the device**

Humidity: below 90 % (non-condensing)

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

# 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 the manufacturer

## Error List and Solutions

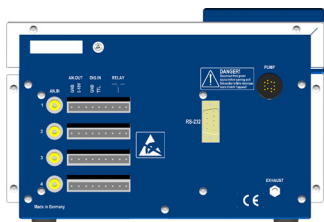
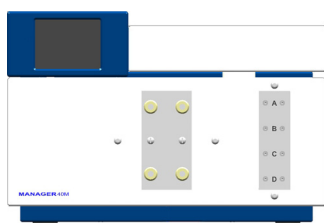
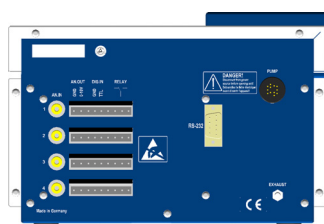
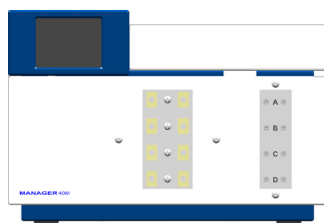
Problem	Solution
The display of the device is not lit	<ul style="list-style-type: none"> <li>▪ Check if the pump is switched on.</li> <li>▪ Check whether the connection cable is connected between the device and the pump.</li> <li>▪ Inform the Technical Support of the manufacturer.</li> </ul>
Vacuum pump does not function.	Inform the Technical Support of the manufacturer.
Pump cannot be heard.	<ul style="list-style-type: none"> <li>▪ At low rotational speeds, the pump can hardly be heard.</li> <li>▪ Compare the baseline of non-degassed methanol at 215 nm with the baseline of degassed methanol. If the device is working properly, the baseline of the non-degassed methanol should have significantly higher noise.</li> </ul>
Air bubble in the solvent tube to the outlet of the degassing chamber.	<ul style="list-style-type: none"> <li>▪ Check the screw fitting.</li> <li>▪ Exchange the screw fitting.</li> </ul>
No solvent flow	<ul style="list-style-type: none"> <li>▪ Check the pump head.</li> <li>▪ Flushing the pump head.</li> <li>▪ If a buffer solution is left in the device for an extended period, it can cause clogging in the degasser module.               <ul style="list-style-type: none"> <li>▪ Carefully let water flow into the clogged degassing chamber to dissolve the buffer.</li> <li>▪ Inform the Technical Support of the manufacturer.</li> </ul> </li> </ul>

# Technical Data

## Ambient Conditions

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

## Device with Degasser, LPG, and Interface Box

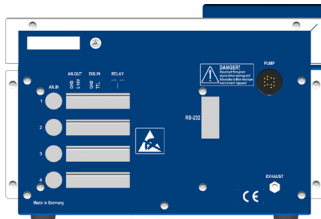
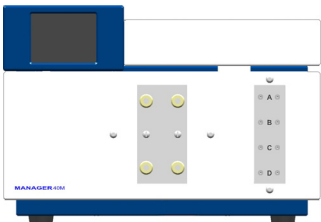
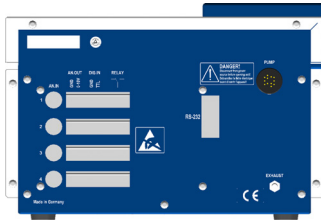
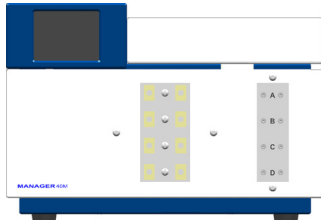


Flow rate range	<ul style="list-style-type: none"> <li>▪ 10 ml/min analytical</li> <li>▪ 50 ml/min semi-preparative</li> </ul>
LPG module: Number of eluents	Up to 4
LPG module: Maximum flow rate	50 ml/min
Gradient range	0-100 %
Gradient gradation	1 % steps
Degasser: Number of channels	<ul style="list-style-type: none"> <li>▪ analytical: 4</li> <li>▪ semi-preparative: 2</li> </ul>
Degasser: Maximum flow rate	<ul style="list-style-type: none"> <li>▪ analytical: 10 ml/min</li> <li>▪ semi-preparative: 50 ml</li> </ul>
Degassing method	Degassing by porous fluoropolymer membrane Teflon AF®
Degassing capacity	< 0.5 ppm dissolved O <sub>2</sub> at 1 ml/min
Degasser: Dead volume	<ul style="list-style-type: none"> <li>▪ analytical: 285 µl per channel</li> <li>▪ semi-preparative: 7.7 ml per channel</li> </ul>
Degasser: Solvent durability	Universal, with the exception of hydrochloric acid and halogenated hydrocarbons - in particular hexafluoroisopropanol (HFIP)
Degasser: Contact materials	PEEK, Tefzel®, Teflon® AF
Degassing chamber	Polypropylene and stainless steel



Vacuum pump	<p>Low hysteresis behavior</p> <ul style="list-style-type: none"> <li>▪ &gt; 6.2 kPa : 400 cycles/min</li> <li>▪ &lt; 6.2 kPa : 60 cycles/min</li> </ul>
Operation	<ul style="list-style-type: none"> <li>▪ Pump 40P</li> <li>▪ Chromatography software <ul style="list-style-type: none"> <li>▪ ChromGate®</li> <li>▪ ClarityChrom®</li> </ul> </li> </ul>
Interfaces	<ul style="list-style-type: none"> <li>▪ RS-232</li> <li>▪ Analog inputs</li> <li>▪ Analog outputs</li> <li>▪ Digital inputs</li> <li>▪ Digital outputs</li> </ul>
Supply voltage range	Pump 40P: 100-240 V
Supply frequency	Pump 40P: 50-60 Hz
Active power consumption	maximum 40 W
IP protection class	IP-20
Weight	5 kg
Dimensions (length x width x height)	352 x 242 x 155 (165) mm

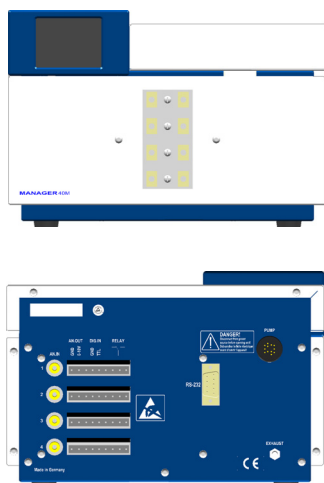
## Device with Degasser and LPG module



Flow rate range	<ul style="list-style-type: none"> <li>▪ 10 ml/min analytical</li> <li>▪ 50 ml/min semi-preparative</li> </ul>
LPG module: Number of eluents	Up to 4
LPG module: Maximum flow rate	50 ml/min
Gradient range	0-100 %
Gradient gradation	1 % steps
Degasser: Number of channels	<ul style="list-style-type: none"> <li>▪ analytical: 4</li> <li>▪ semi-preparative: 2</li> </ul>
Degasser: Maximum flow rate	<ul style="list-style-type: none"> <li>▪ analytical: 10 ml/min</li> <li>▪ semi-preparative: 50 ml</li> </ul>
Degassing method	Degassing by porous fluoropolymer membrane Teflon AF <sup>®</sup>
Degassing capacity	< 0.5 ppm dissolved O <sub>2</sub> at 1 ml/min
Degasser: Dead volume	<ul style="list-style-type: none"> <li>▪ analytical: 285 µl per channel</li> <li>▪ semi-preparative: 7.7 ml per channel</li> </ul>
Degasser: Solvent durability	Universal, with the exception of hydrochloric acid and halogenated hydrocarbons - in particular hexafluoroisopropanol (HFIP)
Degasser: Contact materials	PEEK, Tefzel <sup>®</sup> , Teflon <sup>®</sup> AF
Degassing chamber	Polypropylene and stainless steel
Vacuum pump	Low hysteresis behavior <ul style="list-style-type: none"> <li>▪ &gt; 6.2 kPa : 400 cycles/min</li> <li>▪ &lt; 6.2 kPa : 60 cycles/min</li> </ul>
Operation	<ul style="list-style-type: none"> <li>▪ Pump 40P</li> <li>▪ Chromatography software <ul style="list-style-type: none"> <li>▪ ChromGate<sup>®</sup></li> <li>▪ ClarityChrom<sup>®</sup></li> </ul> </li> </ul>
Supply voltage range	Pump 40P: 100-240 V

Supply frequency	Pump 40P: 50-60 Hz
Active power consumption	maximum 40 W
IP protection class	IP-20
Weight	5 kg
Dimensions (length x width x height)	352 x 242 x 155 (165) mm

## Device with Degasser and Interface Box



Flow rate range	<ul style="list-style-type: none"> <li>▪ 10 ml/min analytical</li> <li>▪ 50 ml/min semi-preparative</li> </ul>
Degasser: Number of channels	4
Degasser: Maximum flow rate	10 ml/min
Degassing method	Degassing by porous fluoropolymer membrane Teflon AF®
Degassing capacity	< 0.5 ppm dissolved O <sub>2</sub> at 1 ml/min
Degasser: Dead volume	<ul style="list-style-type: none"> <li>▪ analytical: 285 µl per channel</li> <li>▪ semi-preparative: 7.7 ml per channel</li> </ul>
Degasser module: Solvent durability	Universal, with the exception of hydrochloric acid and halogenated hydrocarbons - in particular hexafluoroisopropanol (HFIP)
Degasser: Contact materials	PEEK, Tefzel®, Teflon® AF
Degassing chamber	Polypropylene and stainless steel
Vacuum pump	Low hysteresis behavior <ul style="list-style-type: none"> <li>▪ &gt; 6.2 kPa : 400 cycles/min</li> <li>▪ &lt; 6.2 kPa : 60 cycles/min</li> </ul>
Operation	<ul style="list-style-type: none"> <li>▪ Pump 40P</li> <li>▪ Chromatography software <ul style="list-style-type: none"> <li>▪ KNAUER ChromGate®</li> <li>▪ KNAUER ClarityChrom®</li> </ul> </li> </ul>

Interfaces	<ul style="list-style-type: none"><li>▪ RS-232</li><li>▪ Analog inputs</li><li>▪ Analog outputs</li><li>▪ Digital inputs</li><li>▪ Digital outputs</li></ul>
Supply voltage range	Pump 40P: 100-240 V
Supply frequency	Pump 40P: 50-60 Hz
Active power consumption	maximum 40 W
IP protection class	IP-20
Weight	4.8 kg
Dimensions (length x width x height)	352 x 242 x 155 (165) mm

# Legal Information

## Warranty conditions

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

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

This warranty excludes the following:

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

In the event of device malfunctions, contact:

## Manufacturer

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

The packaging of our devices provides the best possible protection against transport damage. However, immediately inspect each delivery for signs of transport damage. If the shipment is incomplete or damaged, inform the manufacturer within three workdays. Also inform the freight carrier about transport damage.

# Declaration of Conformity

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

**Manager 40M** Order number C55331.0, C55338.0, C55333.0, C55332.0  
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)
- DIN EN 60799 (June 1999) Electrical accessories - Cord sets and interconnection cord sets
- 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) and 2012/19/EU on waste electrical and electronic equipment

Berlin, 8/30/2013



Dr. Alexander Bünz (Managing Director)

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



# Abbreviations and Terminology

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

Term	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. 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
LPG	Low Pressure Gradient. 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.

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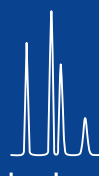
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