ValorNatural – Valorização de Recursos Naturais através da Extração de Ingredientes de Elevado Valor Acrescentado para Aplicações na Indústria Alimentar.

Entregável nº 6.2.3

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Responsável: Paralab – Equipamentos Industriais e de laboratório, S.A.

Nome do Documento: Sistema laboratorial de extração e refinação

Histórico de Revisão

Revisão	Data	Parceiros Envolvidos	Descrição
R.1	30/08/2021	INEGI, FEUP-LSRE	

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Resumo

A atividade 6.2 pretende o desenvolvimento de um sistema laboratorial de extração e refinação líquido-líquido e líquido/supercrítico utilizando a tecnologia NETmix. O entregável 6.2.3 - Sistema laboratorial de extração e refinação, consiste na entrega do protótipo da instalação laboratorial e o presente relatório descreve os testes preliminares efetuados.

Índice

1 Identificação

Deliverable	E 6.2.3. Montagem, implementação da programação e testes preliminares do sistema laboratorial de extração e refinação
Tipo de *deliverable*	Protótipo
Nível de disseminação	Confidencial
PPS	6. Inovação em processos de extração

2 Informação

No que diz respeito à tarefa 6.2.3, procedeu-se a montagem dos elementos *standard* e fabricados, assim como todos os acessórios e componentes de sensorização descritos no Entregável nº 6.2.2 – "Dossiê técnico do sistema laboratorial de extração e refinação." De seguida procedeu-se a otimização dos protocolos de automação que permitem um funcionamento da instalação. A Figura 1 apresenta o diagrama do sistema laboratorial de extração e refinação.
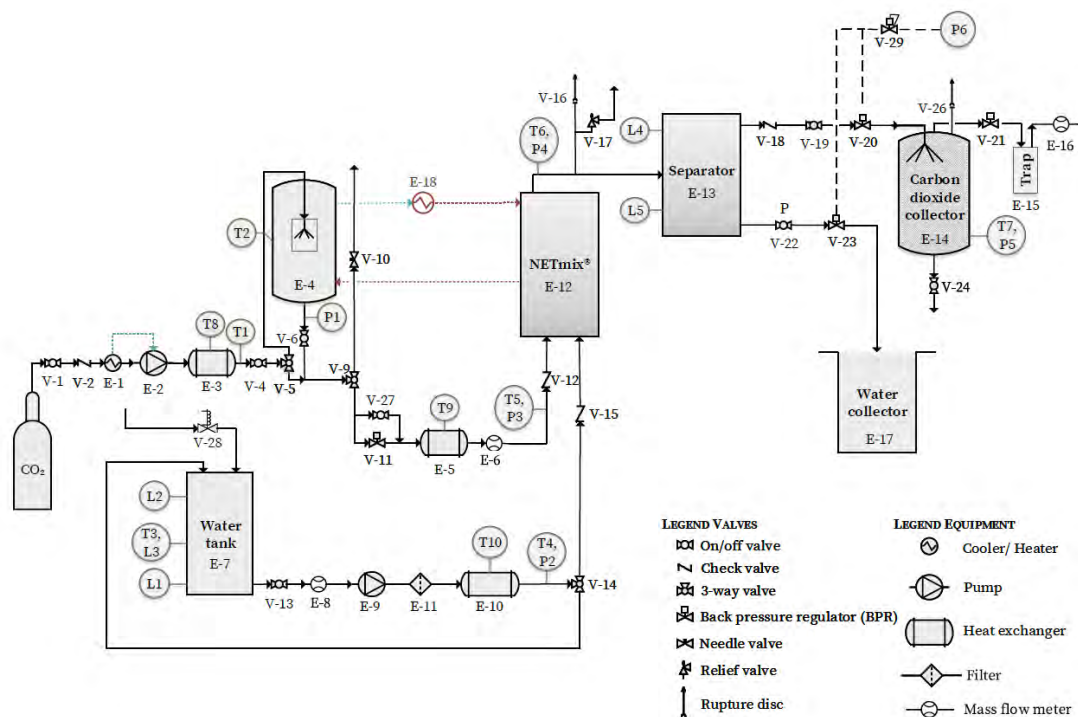

Figura 1 – Diagrama de processo da instalação de extração e refinação

No presente relatório descrevem-se os testes preliminares realizados ao protótipo para verificar: (i) o correto funcionamento dos diferentes equipamentos como: bombas CO_2 (E-2) e água (E-9), transdutores de pressão, medidores de caudal (E-6, E-8, E-16), termopares, sensores de nível (L1, L2, L4 e L5), válvulas automáticas (V-19 e V-22), válvulas reguladoras de pressão (V-23 e V-20), entre outros; (ii) a existência de fugas; (iii) a etapa de pressurização do sistema e operação em contínuo.

1. Funcionamento dos diferentes equipamentos

Foi verificado o correto funcionamento para todos os equipamentos. De realçar que foi desenvolvida uma interface com recurso ao painel HMI (da Delta Electronic, INC.) que permite que o controlo através do painel das bombas, válvulas automáticas, válvulas reguladoras de pressão (V-23 e V-20); a Figura 2 mostra uma das janelas do painel, onde é possível a monitorizar e definir as condições de operação como: temperatura, pressão e caudal. Todos os parâmetros de operação podem ser visualizados diretamente no painel ou exportados para uma pen-drive.
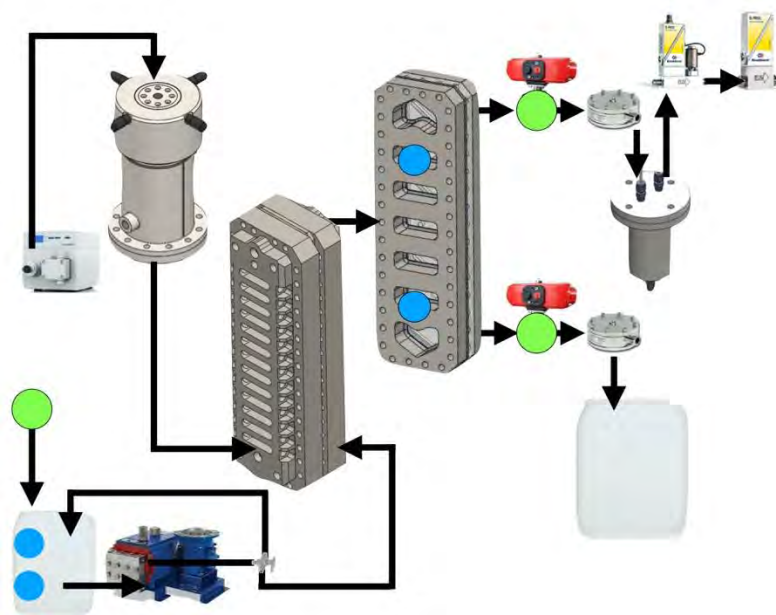

Figura 2 – Layout Painel HMI da instalação laboratorial de extração e refinação

Para evitar oscilações na temperatura dos fluidos como consequência de possíveis perdas de energia, todas as tubagens da instalação, assim como os permutadores de calor (E-3, E-5 e E-10), e o vaso de CO_2 (E-4) foram isolados, tal como se apresenta na Figura 3.

Figura 3 – Vista frontal da instalação laboratorial de extração e refinação após isolamento térmico das tubagens, permutadores de calor e vaso de CO2 (E-4).

2. Testes verificação de ausência de fugas.

Para este teste procedeu-se à pressurização da instalação por secções. Em todos os assessórios de ligação foi colocado um líquido detetor de fugas e, de seguida, pressurizou-se a respetiva secção. Caso houvesse uma fuga era possível observar a formação de bolhas, sendo que, nesse caso, se procedeu ao ajuste do acessório até não se formarem mais bolhas. Só foi possível avançar para a seguinte secção quando todos os problemas de fugas estivessem resolvidos. Para além da visualização da formação de bolhas, outro teste consistiu em verificar se, com o sistema fechado, a pressão se mantinha constante. Finalizados estes ensaios procederam-se os testes de pressurização até 90 bar.

3. Teste pressurização sistema

Antes de iniciar o primeiro teste de pressurização do sistema, foi definido um protocolo para a utilização da instalação laboratorial, descrito no Anexo A deste entregável.

A Figura 4 mostra o histórico de todas as variáveis num ensaio em que foi fixada a pressão de operação em 82 bar, a temperatura do sistema em 40 °C e o caudal total em 12 kg/h com 10 % de CO_2. É possível verificar que a temperatura à entrada e a saída do NETmix são constantes e correspondem ao valor definido, o que indica que o controlador das resistências dos permutadores de calor E-5 e E-10, para o CO_2 e a água à entrada do NETmix, estão a funcionar corretamente. O banho de aquecimento E-18 que alimenta ao NETmix também consegue manter a temperatura constante ao longo do equipamento. No que diz respeito às condições no separador, os dois gráficos inferiores da Figura 4, mostram as condições dos sensores de nível e a abertura das válvulas para saída do CO_2 e da água (V-19 e V-22). Neste ensaio verificou-se que a válvula de saída da água do separador (V-22) só foi fechada quando o nível de CO_2 no separador chega ao sensor inferior do separador (L-5).
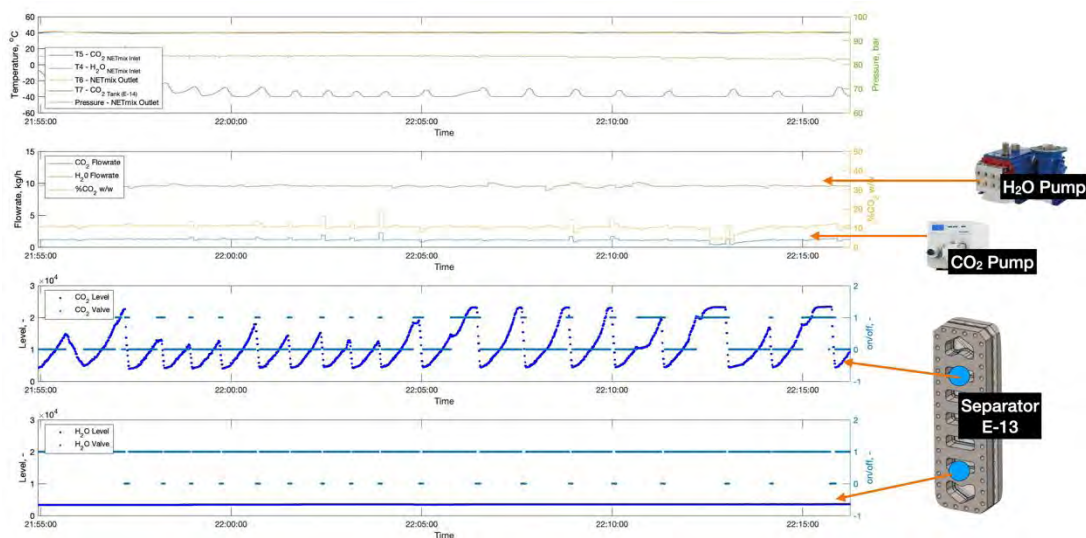

Figura 4 – História da temperatura, pressão, caudal e nível de CO_2 e H_2O no separador para uma operação em contínuo. Caudal total de 12 kg/h – 10 % wt. CO_2, 82 bar e 40 °C

Após diversos ensaios foi verificado o correto funcionamento do sistema. Contudo, verificou-se que no processo de despressurização existe um problema de incompatibilidade química entre o acrílico (PMMA) e o dióxido de carbono. A Figura 5 mostra o efeito do CO_2 no acrílico após os testes realizados; o acrílico fica totalmente opaco, inviabilizando a visualização da interface CO_2-água. Na secção superior do separador, o acrílico encontra-se mais exposto ao CO_2, apresentando maior degradação. Outro tópico levantado durante os ensaios preliminares concerne as temperaturas negativas atingidas no vaso E-14 como consequência da despressurização do CO_2 e que leva ao entupimento do mesmo. Atualmente está a ser

avaliada a colocação de uns cartuchos como forma de manter a temperatura constante no equipamento.

a) Separador (antes da utilização) b) Separador após despresurização
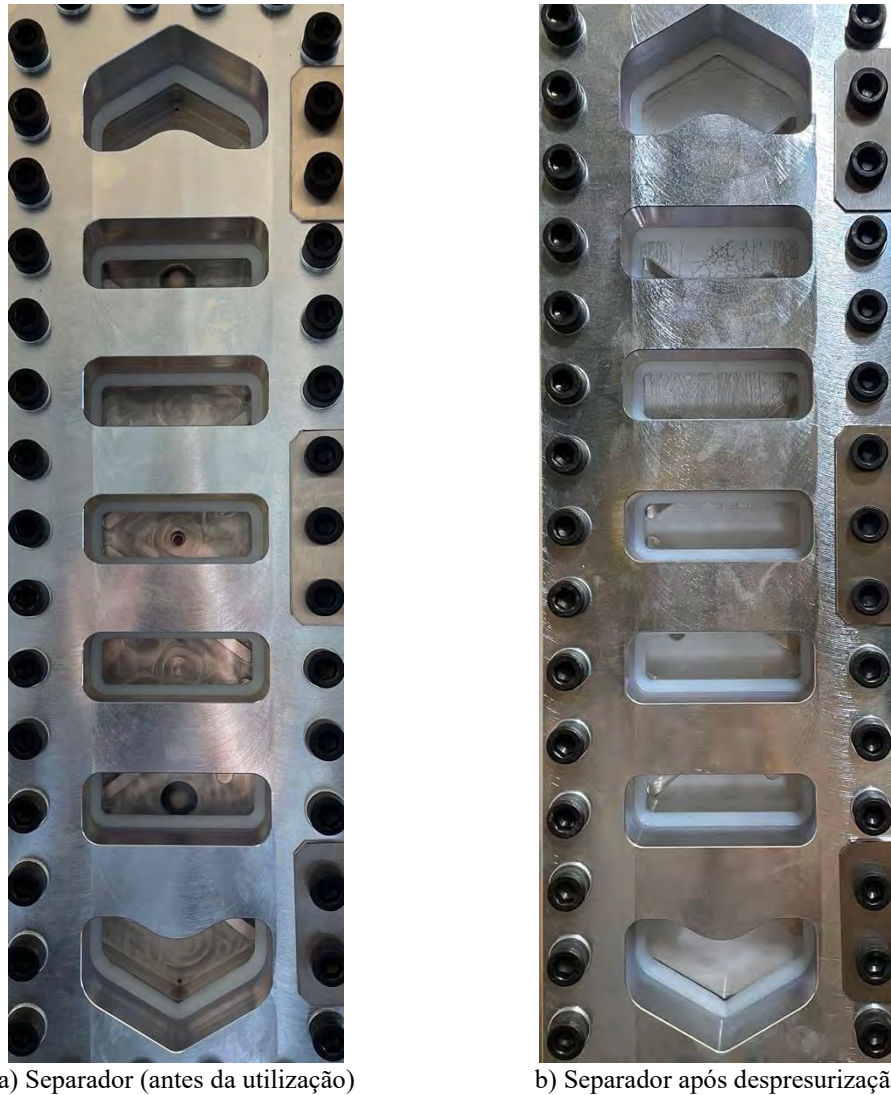
Figura 5 – Janela de Visualização do Separador.

Finalizados os testes preliminares é possível avançar a etapa relativa aos testes de aplicação do sistema laboratorial, já que os problemas relativos a incompatibilidade química do acrílico e do CO_2 não limita o funcionamento do equipamento e não devem colocar em causa a sua integridade estrutural a curto prazo.

No âmbito deste entregável também foi elaborado o Anexo B com todos os manuais dos equipamentos.

Anexo A

Manual de operação da instalação laboratorial de extração e refinação:

A.1. Ligar a instalação laboratorial de extração e refinação, os banhos de arrefecimento (E-1) e aquecimento (E-18) são automaticamente ligados no *set-point* previamente definido para a experiência. A temperatura do banho de arrefecimento deve garantir que o CO_2 entra na bomba de CO_2 (E-2) em estado líquido.

A.2. Verificar a alimentação da água à instalação.

A.3. Verificar a alimentação da linha de ar comprimido para a atuação das válvulas (V-19 e V-22).

A.4. Confirmar a posição de todas as válvulas manuais.

A.5. Após os banhos de arrefecimento (E-1) e aquecimento (E-18) atingirem o *set-point*, verificar que a temperatura dos termopares T2 e T6 estão próximas da temperatura definida.

A.6. Abrir a garrafa de N_2 (para atuação do V-29) e verificar que a pressão do redutor da garrafa é igual ao *set-point* da pressão que será definida na experiência.

A.7. Abrir a garrafa de CO_2 (com tubo de pesca), e esperar até a pressão da bomba de CO_2 (E-2) ficar em equilíbrio com a pressão da garrafa. De seguida abrir a válvula V-4 e subsequentemente a válvula V-5, aberta ao vaso de CO2 (E-4) e pressurizar até pressão de operação. Logo abrir a válvula V-5 para o NETmix e deixar estabilizar o sistema com a pressão da garrafa de CO_2. A seguir pressurizar até a pressão de operação.

A.8. Logo que se atingir a pressão de operação, verificar que a temperatura do vaso CO_2 (E-4) e do NETmix (E-12) estão de acordo com o definido para a experiência e verificar que o caudal total e o rácio CO_2-água correspondem ao pretendido.

A.9. Findo o tempo de extração encerra-se com a alimentação de CO_2 e água ao sistema e inicia-se o processo de despressurização.
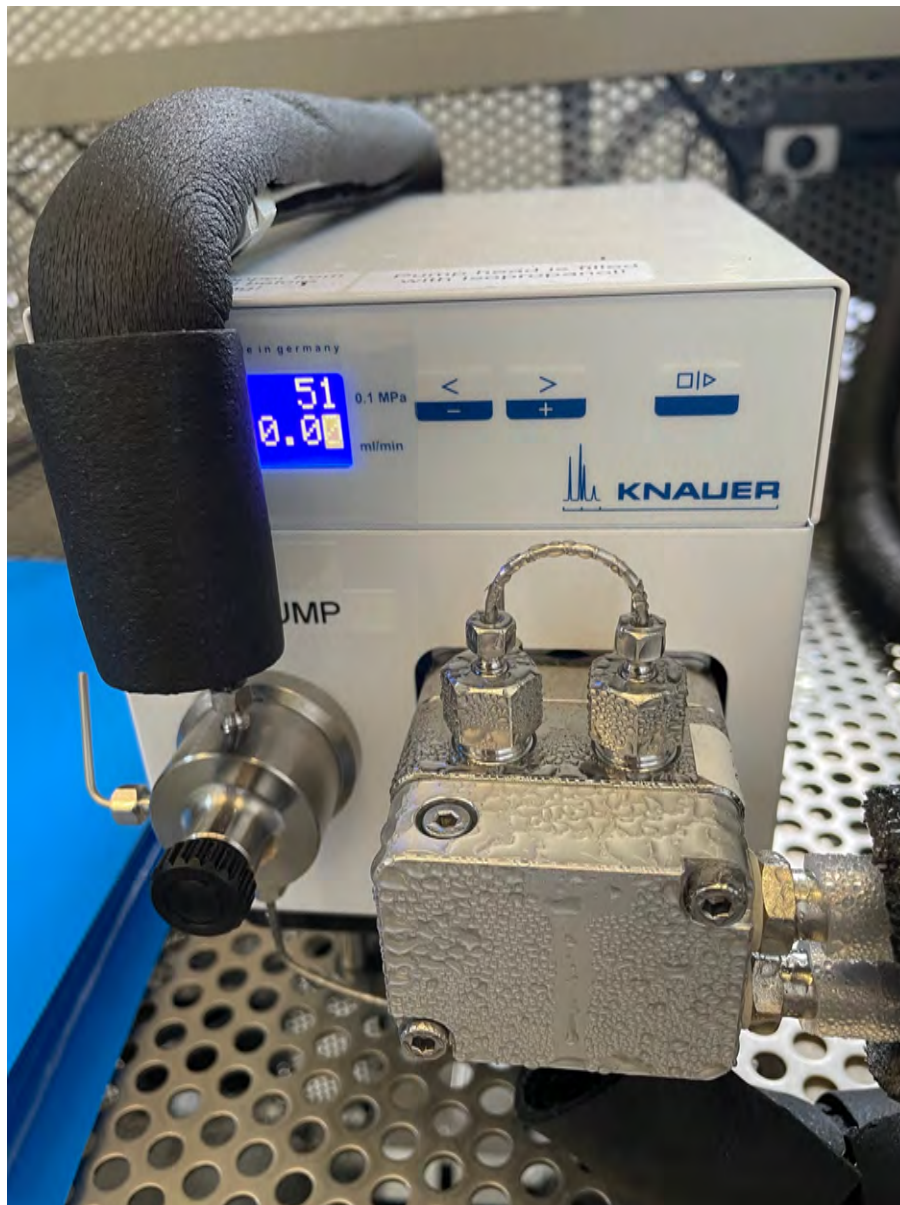
Anexo B

1. Bomba de CO_2 (E-2)
2. Bomba H_2O (E-9)
3. Transdutores de pressão
4. Válvula reguladora de pressão (V-29)
5. BPR (V-20, V-23 e V-21)
6. Sensor de Nível Separador (L-4 e L-5)
7. Banhos Termostáticos (E-1 e E-18)

Anexo B.1 – Bomba CO$_2$ (E-2)

Bomba CO2

Marca: Knauer,

Modelo: APG20FA

KNAUER

AZURA

Pump P 2.1S/P 4.1S
Instructions

Note: For your own safety, read the instructions and observe the warnings and safety information on the device and in the instructions. Keep the instructions for future reference.

Note: In case you require this instruction in another language, please submit your request including the corresponding document number via e-mail or fax to KNAUER.

Support: Do you have questions about the installation or the operation of your instrument or software?

International Support:

Contact your local KNAUER partner for support:

www.knauer.net/en/Support/Distributors-worldwide

Support in Germany

(Austria & Switzerland on case-to-case basis):

Phone: +49 30 809727-111 (workdays 9-17h CET)

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The information in this document is subject to change without prior notice. For the latest version of the instructions, visit our website: www.knauer.net/library

Sustainability: For the printed versions of our instructions, we use environmentally friendly paper from sustainable forests.

Table of contents

1. Product information

1.1 Device overview

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

1.2 Intended use

(i) **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.

Operating ranges The device can be used in the following areas:
- Biochemical analyses
- Food analysis
- Pharmaceutical analysis
- Environmental analysis
- Chemical analysis
- Dosing applications

1.3 Views

1.3.1 Front view

Legend
① Display
② Keypad
③ Pump Head
④ Pressure sensor
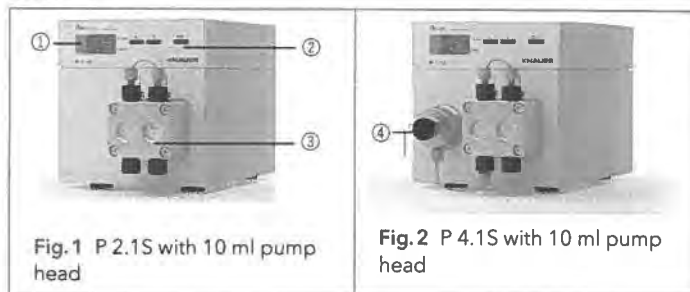
Fig.1 P 2.1S with 10 ml pump head

Fig.2 P 4.1S with 10 ml pump head
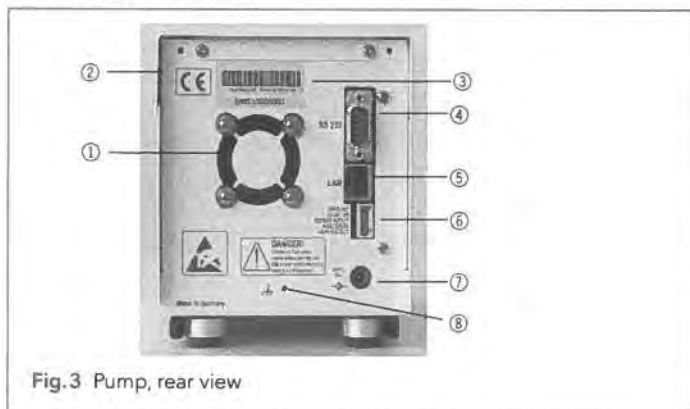
1.3.2 Rear view

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

Fig.3 Pump, rear view

1.4 Features

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

1.4.1 Performance overview

- Liquid transport with stable flow rate and high flow accuracy
- Long service life
- Pump head made of stainless steel or with Hastelloy-C or ceramic inlays
- Piston backflushing
- High physical and chemical stability
- Flexible control with LAN connection, RS-232 interface, and analog control signals
- Control with chromatography software

1.4.2 Options

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

1.5 Pump heads

Pump head for use in analytical applications:
- Stainless steel with stainless steel inlays for standard applications
- Stainless steel with stainless steel inlays and sapphire pistons for water applications
- Stainless steel with ceramic inlays for biocompatible applications
- Stainless steel with Hastelloy-C inlays for corrosive media
- Different pump head sizes: 10 ml or 50 ml

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

Legend
① Flow rate
② Material
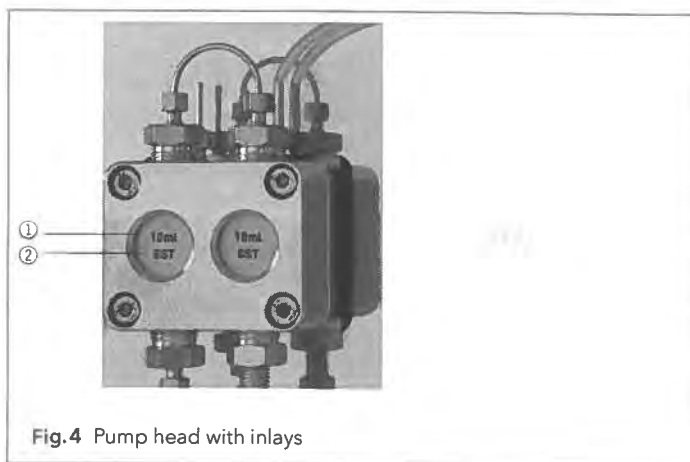
Fig.4 Pump head with inlays

2. Scope of delivery

> **Note:** Only use spare parts and accessories made by KNAUER or a company authorized by KNAUER.

- 24V power adapter with power cable
- Instructions (German/English)
- AZURA accessories kit
- P 2.1S/P 4.1S accessories kit
- Declaration of conformity

3. Basic safety instructions

3.1 Target group

The document is intended for people who have completed at least a training as a chemical laboratory assistant or a comparable training path..

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 must under no circumstances carry out the work described in this operating manual. In this case, please contact your superior.

3.2 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

3.3 What does the user have to consider?

- All safety instructions.
- The environmental, installation and connection specifications
- When working with solvents, make sure the room is well-ventilated.
- National and international regulations pertaining to laboratory work
- Original spare parts, tools, and eluents made or recommended by KNAUER
- Good Laboratory Practice (GLP)
- Accident prevention regulations of the accident health insurance companies for laboratory activities.
- Filtration of substances under analysis
- Use of inline filters
- No used capillaries elsewhere in the chromatographic insert 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

Other important topics for your security are listed alphabetically in the following list:

- Flammability: Organic eluents are highly flammable. Since capillaries can detach from their screw fittings and allow eluent to escape, it is prohibited to have any open flames near the analytical system.
- Solvent tray: Risk of electrical shock or short circuit if liquids get into the device's interior. Therefore always use a bottle tray.
- Eluent lines: Install capillaries and hoses 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.
- Auto-ignition: Only use eluents that have an auto-ignition temperature of more than 150 ° C under normal room condition.
- 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!
- Supply cable: Damaged supply cables must not be used to connect the devices to the power supply.

3.4 Where is use of the device prohibited?

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

3.5 Taking the device safely out of operation

The device can be taken out of operation completely at any time by turning off the power switch of the power supply or disconnecting the supply connection.

3.6 Opening the device

Only have the device opened by a KNAUER Technical Customer Service representative or a KNAUER authorized company.

3.7 Warnings

Possible dangers that can arise from a device are classified into personal injury or damage to property.

⚠ GEFAHR   DANGER (red) indicates a high degree of risk. If not followed, will result in death or serious injury.

⚠ WARNUNG   WARNING (orange) indicates the average degree of risk. Failure to do so may result in death or serious injury.

⚠ VORSICHT   CAUTION (yellow) indicates a low risk level of the hazard. Failure to do so may result in minor or moderate injury.

ACHTUNG   NOTICE (blue) indicates features that are not related to injury.

3.8 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

Life-threatening injuries

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

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

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

Decontamination report   Devices that reach KNAUER without a service request form (decontamination report) will not be repaired. If you return a device to KNAUER, you must enclose the completed service request form: www.knauer.net/Dokumente/service/VFM-SBS-EN.pdf.

4. Symbols and signs

The following table explains symbols and labels which are used on the device, in the software or in the instruction:

Symbol	Meaning
CE	Device fulfills therequirements of the Conformité Européenne, which is confirmed by the Declaration of Conformity.
⚠	High-voltage hazard
Electrostatic Discharge	Electrostatic-discharge hazard
TÜVRheinland	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.
i	Notes provide useful tips and valuable information.

5. Unpacking and setup

5.1 Preparations

5.1.1 Location requirements

i   **Note:** The intended use be ensured only if the requirements for ambient conditions of the operating environment are met. You will find the ambient conditions under Technical data "Technische Daten" on page 33.

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.

→ Leave room for air circulation: See paragraph „space requirements".

General requirements
- Position the device on a level surface.
- Protect the device against direct exposure to sunlight.
- Set up the device at a location not exposed to air drafts such as air conditioning systems.
- Protect the device from strong draft.
- Do not set up the device near to machines that cause floor vibrations.
- Keep the the devices away from high frequency sources. High-frequency sources may compromise measuring values.

Space requirements
- At least 5 cm, if there is another device on one side.
- At least 10 cm, if there are devices set up on both sides.
- At least 15 cm to the cooler fan on the rear.

5.2 Power supply

NOTICE

Electronic defect

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

→ Only use spare parts and accessories from KNAUER or a company authorized by KNAUER.

For power supply, use the supplied power cable and power adapter to meet the specifications which are described in the chapter Technical Data. But inspect the provided power cable beforehand to ensure that it is approved for your country. Replace defective power cables only with accessories from KNAUER. Detachable power cables are not allowed to be replaced with other cable types.

5.2.1 Conditions

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

5.2.2 Power plug

- The power adapter is intended for use with AC power networks of 100 – 240 V.
- Make sure that the power plug on the rear of the device is always accessible, so that the device can be disconnected from the supply.

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

5.3 Unpacking the device

Prerequisites ▪ Check the carton for damage caused during transportation.

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 only centrally on the side of the housing.

Process

1. Set-up the package in such a way that you can read the label.
2. Using the utility knife, cut the adhesive tape and open the packaging.

Legend
① Foam padding

Process

3. Lift the foam padding. Take out the accessories kit and the manual.
4. Open the accessories kit and check the scope of delivery. In case any parts are missing, contact the Technical Support.
5. Clasp the device from below, lift it out of the packaging and place it on its feet. Do not hold onto the front cover.
6. Check the device for signs of damage that occurred during transport. In case any parts are missing, contact the Technical Support.
7. Set up the device at the operation site. Lift the foam padding.

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

5.3.1 Removing transport protection

Foam parts are inserted between the ends of the pump capillaries and the housing ① as transport protection to prevent damages of the paintwork during transportation. After setting up the device, the foam parts can be removed. In case of a new transport or storage, the foam parts should be inserted between the capillaries and the device.
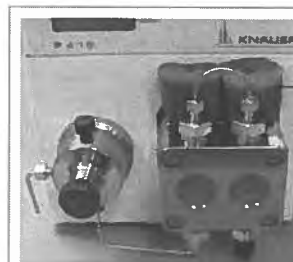
Fig. 5 Transport protection between the ends of the pump capillaries and the housing

5.4 Integrating the pump into the HPLC system

The pump can be integrated into an HPLC system by connecting the pressure sensor (P4.1S) or the pump head outlet (P2.1S) and the HPLC system with capillaries.

Note: To integrate the pump into a system, note the ambient conditions found in the sections Operating Environment and Technical Data as well as the ambient conditions of other devices to be integrated into that system.

NOTICE

Component defect

Possible damage to the pump head due to over-tightened capillary fitting.

→ Note the torque of the screw connection.

The figure shows the installation plan for capillary and tubing on both P2.1S and P4.1S versions of the pump.

Legend
— Connection solvent to pump
-- Passive piston backflushing
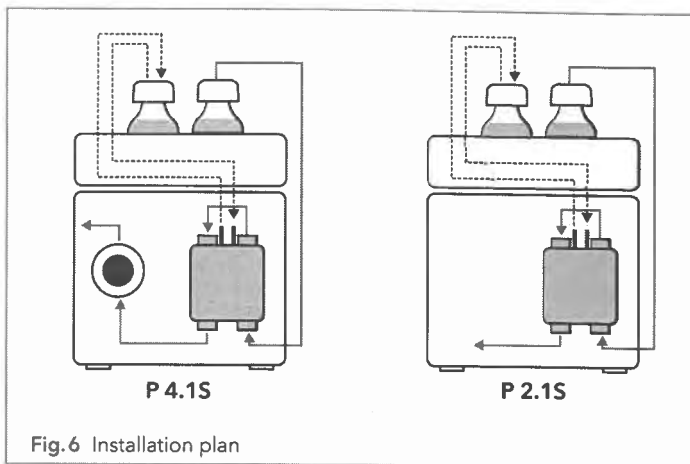
Fig. 6 Installation plan

Piston backflushing

To flush the backpiston space, aspirate flushing solution with the syringe included in the accessory kit. Ensure regular backpiston flushing for optimal seal lifetime.

Solvent flow path

The pump head takes the liquid in from the solvent bottle and conveys it to the pressure sensor (P4.1S) or directly into the hplc system (P2.1S).

5.5   Connecting the eluent line to the pump head

Prerequisites ▪ The device has been switched off.
▪ The power plug has been pulled.

Tools ▪ Flangeless fitting
▪ Flat seal

> **Note:** Fittings, hose and filter are supplied in the pump's accessory kit (article no. FPGA).

> **NOTICE**
>
> **Device defect**
>
> Damage to pump head, device or system when inlet and outlet of the pump head are blocked.
>
> → Remove the cap fittings from the inlet and outlet of the pump head prior to use.

Procedure

Process	Figure
1. Stick the tube ④ through the nut ③. 2. Stick the tube through the seal ring ②. The narrow end must point away from the nut. 3. Stick the cutting ring ① onto the tube.	 Fig. 7 Tube with nut, seal ring and cutting ring

4. Insert the tubing into the free inlet ⑤ on the bottom of the pump head.
5. Tighten the fitting by hand.

Fig. 8 Solvent line on pump head

Next steps Integrate the pump into the HPLC flow system. Use 5 Nm torque for stainless-steel fittings or 1 Nm for PEEK fittings.

5.6   Ports on the rear side

Legend
① Fan
② CE mark
③ Serial number
④ Interface RS-232
⑤ LAN connection
⑥ Pin header for remote control
⑦ Power connection - bushing
⑧ Hole for the ground connection
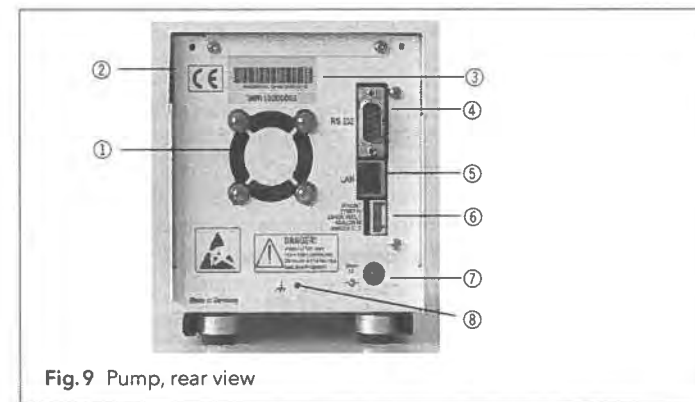
Fig. 9 Pump, rear view

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

▪ Via the pin header for remote control ⑥
▪ via LAN connector ⑤ within a network
▪ Connected to RS232 ④, alternately to LAN connection

5.6.1 Pin header connectors

Contact	Explanation
GROUND	Reference point of the voltage at the signal inputs.
START IN	TTL-compatible input ■ Min. 10 mA ■ Low-active At stand alone, RS-232 or LAN control stops the motor at a short circuit contact between START IN and GROUND. At analog control, the motor starts at a short circuit contact between START IN and GROUND. In addition, pump delivery is automatically started after switching on. This contact can not be used as a trigger to start the data acquisition of a chromatography software.
ERROR IN/OUT	TTL-compatible input ■ min. 10 mA ■ Low-active These contacts output an error signal and can receive one. The pump can thus be stopped by the error signal (ERROR-IN) or ensure that a second device is stopped by an error signal that is output at the ERROR-OUT.
ANALOG IN	Flow rate is controlled through external control voltage (0-10 V).
ANALOG OUT	Analog output signal for reproducing the measured system pressure (0-1 V).

5.6.2 Connecting cables to the pin header

To control one device through another, you use the pin header. To use remote control, you have to connect cables to the pin header. The single ports are used to exchange control signals.

Prerequisites
■ The device has been switched on.
■ 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.

Procedure
1. Insert the depressor tool ③ in an upper small opening at the front of the pin header ① .
2. Insert the cable into the opening ② underneath the inserted depressor tool.
3. Pull out the depressor tool.
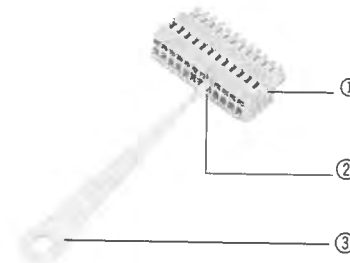
Next steps Check whether the cables are tightly attached. Press the pin header onto the plug. Finish the installation. Afterwards take the device into operation.

5.6.3 Ground

> **NOTICE**
>
> **Electronic defect**
> Electronic hazard when using an identically constructed power adapter from another manufacturer.
> → Only use spare parts and accessories from KNAUER or a company authorized by KNAUER.

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

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

5.7 Connecting the device to a computer

> **Note:** HPLC devices from KNAUER only work with IP addresses, which have been assigned by IPv4. IPv6 is not supported.

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

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

Process
1. On the computer, go to the control panel and check the LAN properties.
2. Hook up the router to the devices and the computer.
3. Set up the router for the computer network.

4. Install the chromatography software.

5. Switch on the device and run the chromatography software.

5.7.1 Configuring the LAN settings

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

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

Procedure
1. In Windows: Open Network and Sharing Center.
2. Double-click on **LAN Connection**.
3. Click on the button **Properties.**
4. Select **Internet Protocol version 4 (TCP/IPv4).**
5. Click on the button **Properties.**
6. Check the settings in the tab **General.** The correct settings for the DHCP client are:
   a) Obtain an IP address automatically)
   b) Obtain DNS server address automatically
7. Click on the button **OK**.

5.7.2 Connect devices to the LAN

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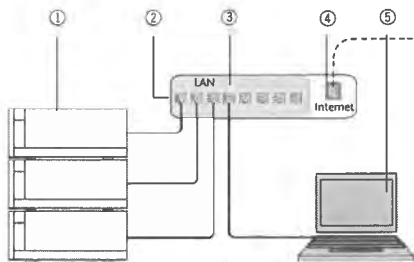
You will find patch cables for each device and the router in the accessories kit. To connect the router to a WAN, an additional patch cable is required, which is not supplied within the scope of delivery.

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

Procedure
1. Use the patch cable to connect the router and the computer. Repeat this step to connect all devices.

2. Use the power supply to connect the router to the mains power system.

5.7.3 Configuring the router

The router is preset at the factory. For IP address, user name, and password information, refer to the router instruction: http://bit.ly/KNAUER_PC-Hardware_EN.

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

ⓘ **Note:** If the IP address range has been changed, it is necessary to note this information down on the router.

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

5.7.4 Integrating the LAN into the company network

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

Prerequisites
- There is a patch cable for the connection.

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

5.7.5 Controlling several systems separately in the LAN

Devices connected to a LAN communicate through ports, which are part of the IP address. If more than one chromatography systems are 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.

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.

ⓘ **Note:** Assign a fixed IP address.

ⓘ **Note:** Check the IT security standards for your lab before you interfere with the LAN settings.

5.7.6 Firmware Wizard:

Changing LAN settings by entering the serial number requires that the device has been found by Firmware Wizard after browsing.

Changing LAN settings by MAC address does not require that the device has been found after browsing. The IP address can be part of another network.

5.7.6.1 Firmware Wizard: Assign static IP address

Prerequisites
- The device has been switched on.
- Mobile Control has been installed and started.
- The connection between Mobile Control and the device has been established.

Procedure
1. In the Firmware Wizard click on <Reset LAN Settings....>.
2. The <Device connection settings> window opens. In the text box <Target device serial number> ① enter the serial number of the device. The serial number and the MAC address are noted on the back of the device.
3. Choose the option <Use the following IP address> ② .
4. Enter the IP-Address in the text box <IP Address> ③ .
5. If necessary, customize the subnet mask and gateway ④ .
6. Press the button <Reset Conn. Settings> ⑤ to apply the change.
7. Restart the device.

Result   The device can now be rached via the static IP address.

5.7.6.2 Firmware Wizard: Assign dynamic IP address

Prerequisites
- The device has been switched on.
- Mobile Control has been installed and started.
- The connection between Mobile Control and the device has been established.

Procedure
1. In the Firmware Wizard click on <Reset LAN Settings....>.
2. The <Device connection settings> window opens. In the text box <Target device serial number> ① enter the serial number of the device. The serial number and the MAC address are noted on the back of the device.
3. Choose the option <Obtain an IP address automatically>.
4. Press the button <Reset Conn. Settings> ⑤ to apply the change.

---

5. Restart the device.

Result   The device can now be reached via the static IP address.

6. Initial startup

> **ⓘ**   **Note:** It is mandatory to perform a running-in procedure after a pump head maintenance, or if new pump heads are installed on a pump.
>
> If a pump was not in operation for a long time, e.g. after shipment, a running-in procedure might be necessary to obtain the best pump performance. The pump head underwent this procedure during the manufacturing process.
>
> If the pump is performing within specification, or during intensive operation, it is not necessary to perform this procedure.

NOTICE

Component defect

Damage to the pump head in case running-in procedure was not performed correctly.

→ Set the correct backpressure and flowrate for the running-in procedure of the pump head. Specific running-in parameters and the general procedure can be found in the supplement „Running-in procedure for pump heads (V6894)".

NOTICE

Device defect

If the pump is operated only with pure distilled water, significantly higher wear of the piston and the piston seals can be expected.

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

6.1 Switching on the pump

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

NOTICE

Component defect

Possible damage to the pump head due to dry running.

→ Make sure that solvent flows through the pump head and piston backflushing.

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

Result
- After the device has been switched on, the display shows pump and the firmware version. The device performs a self-test. After all tests have

been successfully completed, the status of the pump with its current flow rate is displayed. The pump is ready for operation.

6.2   Operation

The pump can be operated in three ways:

- Using the keyboard at the device
- Via chromatography software with integrated drivers for the pump
- Analog: Control with applied voltage

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

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

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

```
     123 — ①
   1.234 — ②
```

Fig. 10   Status display

6.2.1   Controlling via keyboard at the device

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

Figure	Function
< **>** **Fig. 11** Arrow buttons	■ To scroll through, press both buttons simultaneously. ■ To change the values in the menu, push the right button when the desired menu item is blinking.
  Fig. 12 Start/Stop key	■ Switching the pump on or off. ■ Flushing the Pump

6.2.2   Menu Structure

Start-up routine	PUMP V1.37
Status display	0 1,000
Pressure switch off	P↑400 P↓ 0
Current switch off	I↑100 I↓ 0
Control	PC: LAN PC: RS-323: PC: ANALOG
Pump head	HEAD: 10ml HEAD: 50ml
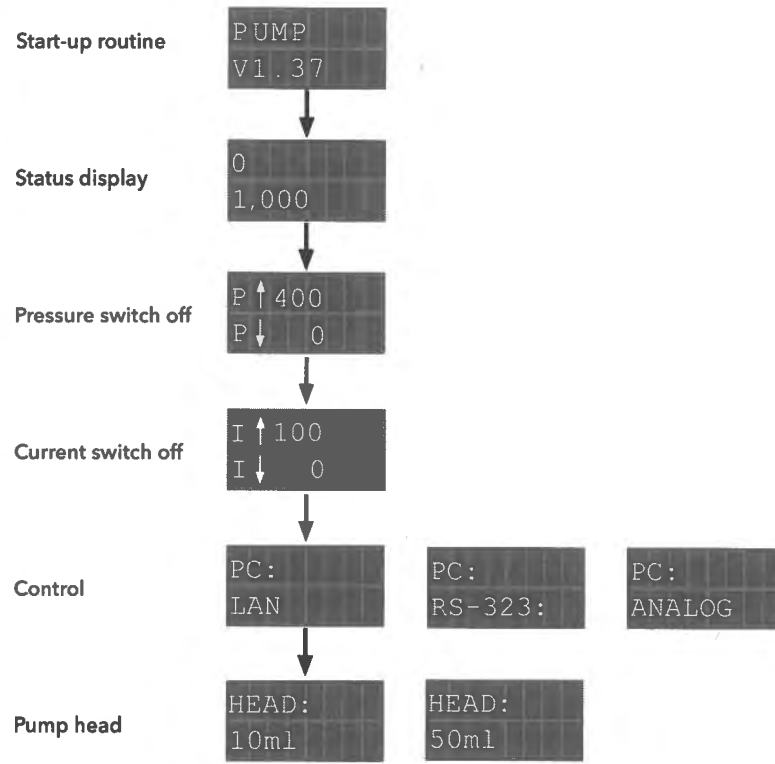
Fig. 13   Menu Structure

6.2.2.1   Setting the Flow Rate

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

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

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

NOTICE

Device defect

Danger of strong overpressure: If the button is pressed for a longer time, the flow rate changes much faster.

➔ Control the keystroke.

Procedure	Figure
1. Use the arrow keys to set a value for the flow rate. 2. Check if the right value appears on the display.	< > **Fig. 14** Display control

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

6.2.2.2 Adjusting pressure turn-off (only P 4.1S)

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

P| 123 —①
P| 9 —②

nd
aximum value
inimum value

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

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

Procedure	Figure
1. To scroll through, press both buttons simultaneously.	< >
2. When the cursor flashes, use the arrow keys again to set the value for the maximum pressure. 3. Hold down the left arrow key. Press right arrow key once.	P| 123 **Fig. 15** Maximum pressure
4. When the cursor flashes, use the arrow keys again to set the value for the minimum pressure. 5. Press start/stop key once to return to the start display.	P| 9 **Fig. 16** Minimum pressure

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

6.2.2.3 Setting the shutdown threshold

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

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

■ Set the maximum power switch off for the pump to limit the pump pressure.
■ Set the minimum power switch off so as to avoid a dry run of the pump at highly reduced maximum power consumption (e. g. if leaking).

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

Legend
① Maximum value
② Minimum value

I i   050 —①
I.!   000 —②

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

Procedure	Figure
1. To scroll through, press both buttons simultaneously.	< >
2. When the cursor flashes, use the arrow keys again to set the value for the maximum power consumption. 3. Hold down the left arrow key. Press right arrow key once.	I I 050 **Fig. 17** Maximum current admission
4. When the cursor flashes, use the arrow keys again to set the value for the minimum power consumption. 5. Press start/stop key once to return to the start display.	I| 000 **Fig. 18** Minimum power consumption

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

6.2.2.4 Flushing the pistons

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

The following solvents are recommended for flushing the columns:

■ water
■ mixture of 80 % water and 20 % ethanol
■ isopropanol

Procedure	Figure
1. Connect the outlet to the waste container with a hose ①. 2. Connect the inlet to the syringe with a hose ②. 3. Fill up flushing solution with the syringe through the pump head until there are no more air bubbles running through the waste bottle. 4. Afterwards, remove the hoses and connect inlet and outlet with a hose.	 **Fig. 19** Flushing rear piston area

6.2.3 Choosing pump head

Procedure	Figure
1. To scroll through, press both buttons simultaneously. 2. Scroll with the right arrow key until 10 ml / 50 ml is displayed.	 **Fig. 20** Choosing pump head

Result   When setting is finished, the status display appears.

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

6.2.4 Flushing the pump

The display shows vertical arrows while the pump is flushing.

Legend
① Symbol for flushing procedure
② Pressure in 0,1 MPa (only for P4.1S)
③ Flow rate
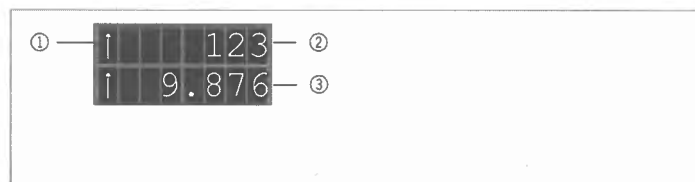
Prerequisites   **Pump with pressure sensor:**
- Venting screw of the pressure sensor is open.
- A jar or a hose to the waste container was set up.

Pump without pressure sensor:
- Cap fitting on the pump head outlet is removed.
- A jar or a hose to the waste container was set up.
- Fitting on the pump head outlet ist removed.
- Venting syringe with screw connection at the pump head outlet is screwed on.

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

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

6.2.5 Software

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

6.2.5.1 Via Local Area Network (LAN)

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

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

Procedure	Figure
1. To scroll through, press both buttons simultaneously. 2. Using the arrow buttons, scroll until it shows LAN.	 **Fig. 21** Display control

Result   When setting is finished, the status display appears.

6.2.5.2 Via RS-232 port

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

Procedure	Figure
1. To scroll through, press both buttons simultaneously. 2. Using the arrow buttons, scroll until it shows RS-232.	 **Fig. 22** Display control

Result   When setting is finished, the status display appears.

6.2.5.3 Control commands

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

Consider the following specifications for data transfer with RS-232 interface:

- 9600 baud
- 8 bit

- 1 stop bit
- no parity check

Control command	Range and specification	Description
ADJ10(?)	RD/WR 100-2000	Adjust parameter for 10 ml pump head
ADJ50(?)	RD/WR 100-2000	Adjust parameter for 50 ml pump head
CORR10(?)	RD/WR 0-300	Correction parameter for 10 ml pump head
CORR50(?)	RD/WR 0-300	Correction parameter for 50 ml pump head
FLOW(?)	RD/WR 0-50000	Writing/reading the flow in µl/min
PRESSURE?	RD 0-400	Pressure readout in 0.1 MPa
PMIN10(?)	RD/WR 0-400	Minimum pressure for 10 ml pump head (in 0.1 MPa)
PMIN50(?)	RD/WR 0-150	Minimum pressure for 50 ml pump head (in 0.1 MPa)
PMAX10(?)	RD/WR 0-400	Maximum pressure for 10 ml pump head (in 0.1 MPa)
PMAX50(?)	RD/WR 0-150	Maximum pressure for 50 ml pump head (in 0.1 MPa)
IMIN10(?)	RD/WR 0-100	Minimum motor current for 10 ml pump head
IMIN50(?)	RD/WR 0-100	Minimum motor current for 50 ml pump head
IMAX10(?)	RD/WR 0-100	Maximum motor current for 10 ml pump head
IMAX50(?)	RD/WR 0-100	Maximum motor current for 50 ml pump head
HEADTYPE(?)	RD/WR 10, 50	Writing/reading the pump-head type
STARTLEVEL(?)	RD/WR 0.1	Configures START IN. 0 = Pump starts the flow at short circuit contact only. (Start In <> Ground). 1 = Pump starts the flow without a short circuit contact. (Start In <> Ground).
ERRIO(?)	RD/WR 0.1	Writing/reading the ERROR input/output, OUT (0) or IN (1)
STARTMODE(?)	RD/WR 0.1	0 = Pump pauses after switch-on. 1 = Pump starts immediately after switch-on with the previous set flow rate.
EXTCONTR	WR 0,1	0 = prevents external flow control 1 = allows the flow rate control via analog input 0 - 10V (10ml: 1 V = 1 ml/min, 50ml: 1 V = 5 ml/min)
EXTFLOW?	RD	
IMOTOR?	RD 0-100	Motor current in relative units
LOCAL	WR	Command for releasing the pump to change the settings manually (control command to cancel the remote command)

Control command	Range and specification	Description
REMOTE	WR	Command to prevent a manual parameter input, with exception of stopping the flow via START/STOP button.
ERRORS?	RD	Display of the last 5 error codes.
ON	WR	Starts the flow
OFF	WR	Stops the flow

6.2.5.4 Activating the analog control (prior to firmware version 1.37)

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

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

Procedure	Figure
1. To scroll through, press both buttons simultaneously. 2. Using the arrow buttons, scroll until it shows RS-232.	**Fig. 23** Display control

3. In the Hyperterminal program, enter the EXTCONTR: 1 command (see "control-commands" Page 23).

Result The display shows a star symbol left to the flow rate.

You cannot adjust the flow rate any longer via the key pad.

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

6.2.5.5 Adjusting the analog control (prior to firmware version 1.37)

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

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

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

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

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

Procedure	Figure
1. To scroll through, press both buttons simultaneously. 2. Using the right arrow buttons, scroll until it shows ANALOG.	PC: ANALOG

Fig. 24   Display control

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

6.2.5.6 Controlling the flow rate analog

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

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

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

```
         0 — ①
* 1.000 — ②
```
Fig. 25   Status display

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

6.2.5.7 Starting with a short-circuit

Connection for the short circuit (or TTL-low) for interrupting and continuing the operation of the pump. The operation of the pump is dependent on the STARTLEVEL setting:
- STARTLEVEL 1 (default setting RS-232, LAN): The pump does not operate during the time of short-circuit.
- STARTLEVEL 0 (default setting analog): The pump operates during the time of short-circuit.

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

```
  123 — ①
1.234 — ②
```
Fig. 26   Status display

Enter STARTLEVEL:1 in the terminal program, so that the pump does not operate for the duration of the short circuit.

Prerequisites   The pump is connected to the power supply.

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

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

6.2.5.8 Starting directly after connection to power supply

By default the pump is stopped and started using the start/stop button. The STARTMODE setting allows you to start the device right after connecting it to power supply.
- STARTMODE 0 (default setting RS-232, LAN): The pump does not start operating right after being connected to power supply.
- STARTMODE 1 (default setting analog): The pump starts operating right after being connected to power supply.

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

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

Prerequisites   ▪ The pump is connected to the power supply.
Procedure   1. Connect the pump with an applicable terminal program.
2. Connect the pump using a LAN or RS-232.
3. Enter STARTMODE:1.

6.3   Switching off the pump

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

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

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

Result   The display turns off.

7. Functionality tests

ⓘ **Note:** Standard procedure for IQ and OQ can be handled differently in individual cases for devices.

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 Operation Qualification is a standardized KNAUER document 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 OQ is a detailed operating test based on the standardized KNAUER OQ documents. The Operation Qualification is a standardized KNAUER document and is free of charge. It is not included with the instrument. If necessary, contact technical customer service.

The OQ protocol 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: The test intervals are determined by the use of the device.

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

8. Troubleshooting

First measures
1. Check all cabling.
2. Check all screw fittings.
3. Check whether air has gotten into the supply lines.
4. Check device for leaks.
5. Pay attention to system messages.

Further measures Inform the Technical Support of KNAUER.

8.1 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 taskbar:

- 🖳 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 DCHP server?
- Is the IP address range sufficient for all the connected devices?

3. Check all connections:

- Are the patch cable connected to the LAN ports and not the WAN port?
- Are all cable connections between devices and router correct?
- Are the cables plugged in tightly?

4. If the router is integrated into a company network, pull out the patch cable from the WAN port.

- Can the devices communicate with the computer, even though the router is disconnected from the company network?

5. Turn off all devices, router, and computer. First switch on the router and wait until it has successfully completed its self-test. Then turn on the devices and the computer.

- Has this been successful?

6. Replace the patch cable to the device with that no connection could be established.

- Has this been successful?

7. Make sure that the IP port of the device matches the port in the chromatography software.

8.2 Possible problems and solutions

Problem	Solution
Pump does not turn on	Power cable needs to be connected to power supply and power adapter has to be turned on. ■ Inspect the power cable to ensure that it is plugged into the power supply.
When flushing (Purge) the pump turns off.	The venting screw on the pressure sensor must be turned up. ■ Check if the venting screw on the pressure sensor is turned open.
Pump does not transport solvent	Check the following options: ■ Purge the pump head so as to remove the air bubbles ■ Inspect the eluent inlet and filter of the HPLC column and change when blocked. ■ Replacing the pump head ■ Cleaning the check valves ■ Changing the check valves ■ If the pump head seals are defective, solvent enters the piston backflushing; inform the technical support of the manufacturer.
Pressure or flowrate fluctuations	Check the following options: ■ Purge the pump head so as to remove the air bubbles ■ Always tighten the inlet screw 1 and outlet screw 1 on the pump head with a torque wrench (7.5 Nm for stainless steel, 3 Nm for ceramic). ■ Cleaning the check valves ■ Changing the check valves

Problem	Solution
Pump head leaks	Check the following options: • Inspect the inlet and outlet screw fittings of the pump head • Replacing the pump head • If the pump head seals are defective, solvent enters the piston backflushing; inform the technical support of the manufacturer.
Flow rate is not correct	Check the following options: • Inspect the inlet and outlet screw fittings of the pump head • Cleaning the check valves • Changing the check valves • Replacing the pump head • Pump without pressure sensor: Pay attention to the influence of the pressure on the flow rate (will not be compensated). • Inform the technical support of the manufacturer.

Further measures Inform the Technical Support of KNAUER.

9. Maintenance and care

Proper maintenance of your HPLC device will ensure successful analyses and reproducible results. In this chapter, you find the information relevant for maintenance, care and storage. Additionally, you find instructions for maintenance tasks that may be performed by the customer. In case there are any maintenance tasks on that you do not find instructions here, contact your supplier or the Technical Support.

9.1 Maintenance contract

The following maintenance work on the device may only be performed by KNAUER or a company authorized by KNAUER and is covered by a separate maintenance contract:
• Opening the device.
• Removing the hood or the side panels.

9.2 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.

9.3 Which type of maintenance tasks may users perform on the device?

The following maintenance tasks are recommended by the manufacturer and may be performed by the user.
• Replacing the pump head
• Exchanging the ball valves

9.3.1 Pump head

9.3.1.1 Torque values

Pump head	Type (ml)	Screw fitting Fitting, outlet (Nm)	Screw fitting, inlet (Nm)	Capillary connection (Nm)
AHB40	10	7.5	3.5	5.0
AHB40BA				
AHB40CA				
AHB32	10	3.5	3.5	1.0 (finger tight)
AHB32DA				
AHB43	10	7.5	7.5	5.0
AHC22	50	3.5	3.5	1.0 (finger tight)
AHC23	50	7.5	7.5	5.0

Pump head	Type (ml)	Screw fitting Fitting, outlet (Nm)	Screw fitting, inlet (Nm)	Capillary connection (Nm)
AHC20	50	7.5	7.5	5.0
AHC20BA	10	7.5	3.5	5.0
AHC20CA	50	7.5	7.5	5.0

9.3.1.2 Removing the pump head

Prerequisites The pump head has been flushed with suitable solvent.

> **⚠ WARNING**
>
> **Chemical burns**
>
> Skin damage from aggressive or toxic eluents.
>
> → Wear protective gloves.
>
> → Flush the pump head before changing.

> **NOTICE**
>
> **Component defect**
>
> Possible damage to the pump piston by tilting the pump head.
>
> → Tighten diagonally opposite fastening screws evenly one turn at a time.
>
> → Also loosen the fastening screws evenly.

Procedure	Figure
1. Loosen inlet fitting ② and outlet fitting ① . 2. Loosen the piston seal wash tubings ④ . 3. Loosen 4 fixing screws ③ alternately and hold the pump head.	
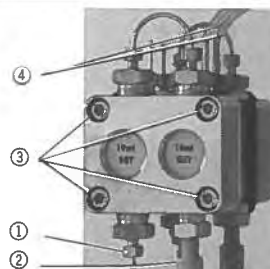
9.3.1.3 Installing the pump head

> **NOTICE**
>
> **Component defect**
>
> Possible damage to the pump head due to over-tightened capillary fitting.
>
> → Note the torque of the screw connection.

Procedure	Figure
1. Tighten 4 fixing screws ③ alternately and hold the pump head. 2. Mount the piston seal wash tubings ④ . 3. Tighten the inlet fitting ② and the outlet fitting ① .	
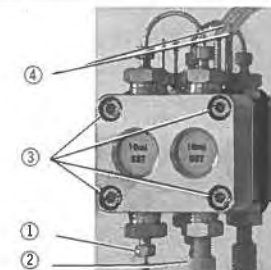
9.3.2 Check valves

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

ⓘ | **Note:** Insert the check valves in the direction of the flow.

9.3.1 Removing the check valves

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

Tools
- Open-end wrench, size 13

Procedure	Figure
1. Unscrew and remove the capillary connector ① . 2. Loosen the outlet fitting ② with the open-end wrench. 3. Remove the first check valve. 4. Loosen the eluent connection ⑥ . 5. Loosen the inlet fitting ③ with the open-end wrench. 6. Remove the second check valve.	
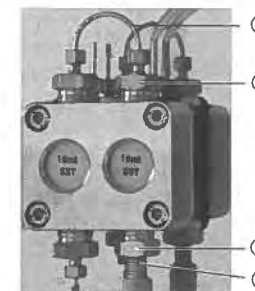
Next steps
- Clean the check valves.

9.3.2 Cleaning the check valves

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

Another way to clean clogged check valves is to blow them out with **compressed air**.

9.3.3 Installing the check valves

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

Prerequisites ▪ The check valves have dried.

> **NOTICE**
>
> **Component defect**
>
> Damage to components due to excessive tightening possible.
> Observe the torque of the screw connection
>
> → Use 5 Nm torque for stainless steel fittings.
> → Use 1 Nm torque for PEEK fittings.

Procedure	Figure
1. Insert the check valves ① so that the notch of the check valve ② points downwards: In case of NP valves alternatively check the direction of the arrow. 2. Manually screw in inlet and outlet fittings and tighten them with a torque wrench and the respective torque.	 Fig. 27 Check valve
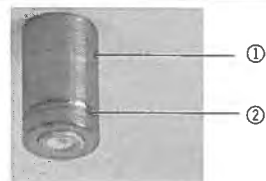
Next steps ▪ Re-install the pump head.

10.   Technical data

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

10.1   General

Pump type	Dual-piston pump with main and auxiliary piston
Flow rate range	▪ 10 ml pump head: 0.001-10 ml/min ▪ 50 ml pump head: 0.01-50 ml/min
Precision of the flow rate	▪ P 4.1S: ±2 % (1 ml/min) ▪ P 2.1S: ±5 % (1 ml/min) ▪ For pumps without a pressure sensor dependent on pressure
Reproducibility of the flow rate	Relative standard deviation RSD: < 0.5 % (1 ml/min)
Gradient support	▪ Isocratic HPLC pump ▪ Expandable to a binary high pressure gradient system (controlled by software)

System protection	▪ Pump with pressure sensor:
	    P_{min} and P_{max} adjustable
	    I_{min} and I_{max} adjustable
	
	▪ Pump with pressure sensor: I_{min} and I_{max} adjustable

Wetted materials	For ceramic: Graphite fiber reinforced PTFE, FKM, PEEK, sapphire, aluminum oxide (Al_2O_3), titanium (only P 4.1S)
	For stainless steel: Stainless steel, graphite fiber reinforced PTFE, FKM, PEEK, sapphire, aluminum oxide (Al_2O_3), titanium (only P 4.1S)
	For Hastelloy® C: Hastelloy® C, graphite fiber reinforced PTFE, FFKM, KEL-F, sapphire, aluminium oxide (Al_2O_3), zirconium oxide (Z_rO_2)

10.2   Communication

Control	▪ RS-232 ▪ LAN ▪ Analog ▪ Buttons on the device
Analog Inputs	0-10 V

10.3   Technical parameters

Supply frequency	See type plate of the power supply
Power consumption	Maximum 40 W at the 24V connection of the pump
Protection type	IP 20
Temperature range	4-40 °C/39,2-104 °F
Air humidity	Below 90 % non-condensing
Power supply	See type plate of the power supply
Dimensions (width × height × depth)	▪ Pump without pressure sensor: 121 × 129.1 × 220.2 mm ▪ Pump with pressure sensor: 121 × 129,1 × 228 mm

Weight	■ Pump without pressure sensor: 2.3 kg
	■ Pump with pressure sensor: 2.4 kg

10.4 Dimensions
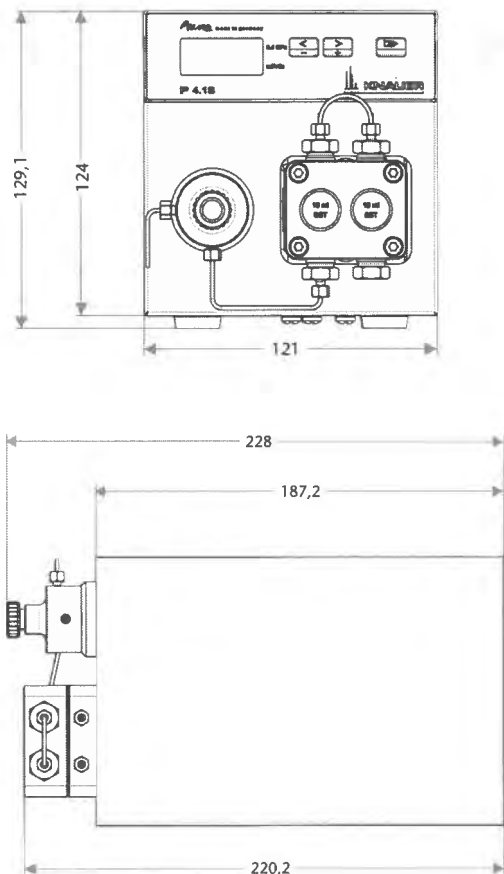
Fig. 28   Dimensions of the pump in mm

11. Chemical compatibility of wetted materials

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

11.1 General

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

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

All resistances mentioned here are for use at temperatures up to 40 ° C, unless stated otherwise.

Please note that higher temperatures can significantly affect the stability of different materials.

11.2 Plastics

11.2.1 Polyetheretherketone (PEEK):

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

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

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

11.2.2 Polyethylene terephthalate (PET, outdated PETP)

PET is a thermoplastic and semi-crystalline material with high wear resistance. It is resistant against diluted acids, aliphatic and aromatic hydrocarbons, oils, fats and alcohols, but not against halogenated hydrocarbons and ketones. Since PET belongs chemically to esters, it is not compatible with inorganic acids, hot water and alkalis. Maximum operating Temperature: up to 120 °C.

11.2.3 Polyimide (Vespel®):

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

11.2.4 Ethylene-tetrafluorethylene copolymer (ETFC, Tefzel®):

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

11.2.5 Perfluorethylenpropylen-Copolymer (FEP), Perfluoralkoxy-Polymer (PFA)

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

11.2.6 Polyoxymethylene (POM, POM-H-TF):

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

11.2.7 Polyphenylene sulfide (PPS)

PPS is a soft polymer which is known for its high break resistance and very high chemical compatibility. It can be used with most organic, pH neutral to pH high, and aqueous solvents at room temperaturewithout concerns. However, it is not recommended for using with chlorinated, oxidizing and reducing solvents, inorganic acids or at higher temperatures. Maximum operating temperature: 50 °C

11.2.8 Polytetrafluorethylene (PTFE, Teflon®):

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

11.2.9 Systec AF™:

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

11.2.10 Polychlortrifluorethylene (PCTFE, Kel-F®):

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

11.2.11 Fluorinated rubber (FKM):

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

11.2.12 Perfluorinated rubber (FFKM):

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

11.3 Non-metals

11.3.1 Diamond-like carbon (DLC)

diamond-like carbon, DLC **diamond-like carbon, DLC)** is characterized by a high hardness, a low coefficient of friction and thus low wear. In addition, it is highly biocompatible. DLC is inert against all acids, alkalis and solvents commonly used in HPLC.

11.3.2 Ceramic

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

11.3.3 Alumina (Al_2O_3)

Due to their high resistance to wear and corrosion, alumina ceramic is used as a coating for mechanically stressed surfaces.
It is a biocompatible material with low thermal conductivity and low thermal expansion.

11.3.4 Zirconium oxide (Z_rO_2)

Zirconia ceramics are characterized by their high mechanical resistance, which makes them particularly resistant to wear and corrosion.
It is also biocompatible, has low thermal conductivity and is resistant to high pressures.

11.3.5 Sapphire

Synthetic sapphire is virtually pure monocrystalline alumina.
It is biocompatible and very resistant to corrosion and wear.
The material is characterized by a high hardness and a high thermal conductivity.

11.3.6 Ruby

Synthetic ruby is monocrystalline alumina and gets its red color by the addition of some chromium oxide. It is biocompatible and very resistant to corrosion and wear. The material is characterized by a high hardness and a high thermal conductivity.

11.3.7 Mineral wool

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

11.3.8 Glass, glass fibre, quartz, quartz glass:

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

11.4 Metals

11.4.1 Stainless steel

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

They are inert against almost all solvents. Exceptions are biological applications which are metal ion sensible, and applications with extreme corrosive conditions. These steels, in comparison to commonly used steels, are increasingly resistant against hydrochloric acid, cyanides and other halogen acids, chlorides and chlorinated solvents.

The use in ion cromatography is not recommended. In case of electrochemical applications, a passivation must be executed first.

11.4.2 Hastelloy®-C:

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

11.4.3 Titanium, titanium alloy (TiA16V4):

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

11.5 Repeat orders

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

12. Accessories

Name	Order Number
AZURA® accessories kit	FZA01
AZURA® Pump P 2.1S/P 4.1S accessories kit	FPGA
Maintenance kit for 10 ml pump head	A96423
Maintenance kit for 10 ml pump head Hastelloy-C	A964231
Maintenance kit for 10 ml pump head for water application	A964232
Maintenance kit for 50 ml pump head	A96424
Maintenance kit for 50 ml pump head Hastelloy-C	A964233
Rebuild-kit for 10 ml pump head KEL-F valve cover, FFKM O-ring	A5821-1
Rebuild-kit for 50 ml pump head KEL-F valve cover, FFKM O-ring	A5821-2
Rebuild-kit for 10 ml pump head for water application sapphire piston, GFPseals, FKM O-rings	A5823
Inlet-bushing kit for 1/8" capillary for 10 ml pump head	A58202
Inlet-bushing kit for 1/16" capillary for 10 ml pump head	A58203
Inlet-bushing kit für 1/16" capillary for 50 ml pump head and 10 ml pump head, ceramic	A58205
Deaeration screw KEL-F	A1644
Instructions	V6870
Mobile Control license with 10" touchscreen	A9607
Mobile Control Chrom license with 10" touchscreen	A9608
Mobile Control license	A9610
Mobile Control Chrom license	A9612

12.2 Device variants

Name	Order Number
AZURA® Pump P 4.1S without pump head	APG20
AZURA® Pump P 4.1S with 10 ml stainless steel pump head	APG20EA
AZURA® Pump P 4.1S with 10 ml ceramic pump head	APG20EB
AZURA® Pump P 4.1S with 10 ml pump head Hastelloy-C	APG20EC
AZURA® Pump P 4.1S with 10 ml ceramic pump head, titanium fittings	APG20EF

Name	Order Number
AZURA® Pump P 4.1S with 10 ml pump head (stainless steel, for water application)	APG20EG
AZURA® Pump P 4.1S with 10 ml pump head (ceramic, for water application), titanium fittings	APG20EH
AZURA® Pump P 4.1S with 50 ml stainless steel pump head	APG20FA
AZURA® Pump P 4.1S with 50 ml ceramic pump head	APG20FB
AZURA® Pump P 4.1S with 50 ml Hastelloy C pump head	APG20FC
AZURA® Pump P 2.1S without pump head	APG90
AZURA® Pump P 2.1S with 10 ml stainless steel pump head	APG90EA
AZURA® Pump P 2.1S with 10 ml ceramic pump head	APG90EB
AZURA® Pump P 2.1S with 10 ml Hastelloy-C pump head	APG90EC
AZURA® Pump P 2.1S with 50 ml stainless steel pump head	APG90FA
AZURA® Pump P 2.1S with 50 ml ceramic pump head	APG90FB
AZURA® Pump P 2.1S with 50 ml Hastelloy-C pump head	APG90FC
AZURA® Pump P 2.1 S with 50 ml pump head (stainless steel, for water application)	APG90FG

12.3 Available pump heads

Name	Order Number
10 ml stainless steel pump head with stainless steel inlay	AHB40
10 ml pump head with ceramic inlay	AHB32
10 ml pump head with ceramic inlay and titanium fittings	AHB32DA
10 ml pump head with Hastelloy-C inlay	AHB43
10 ml pump head stainless steel for normal phase applications	AHB40BA
10 ml pump head stainless steel for water application	AHB40FA
50 ml pump head with ceramic inlay	AHC22
50 ml pump head with Hastelloy-C inlay, for corrosive media	AHC23

Name	Order Number
50 ml stainless steel pump head with stainless steel inlay	AHC20
50 ml stainless steel pump head for normal phase application	AHC20BA

13. Legal information

13.1 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.

13.2 Warranty conditions

The factory warranty for the device is contractually agreed. During the warranty period, any components with material or design-related defects will be replaced or repaired by the manufacturer free of charge. Please check the terms and conditions on our website.
All warranty claims shall expire in the event that any unauthorized changes are made to the device. Also excluded from the warranty:

- 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 capillaries
- Packaging and transport damage

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

KNAUER Wissenschaftliche Geräte GmbH
Hegauer Weg 38
14163 Berlin, Germany

Telephone: +49 30 809727-111
Telefax: +49 30 8015010
E-Mail: support@knauer.net
Internet: www.knauer.net

13.3 Declaration of conformity

The Declaration of Conformity accompanies the product as a separate document and is available online:
www.knauer.net/en/Support/Declarations-of-conformity

Disposal

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

13.3.1 AVV-Marking Germany

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

13.3.2 WEEE-Registration number

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.

13.3.3 Eluents and other operating materials

All eluents and other operating materials must be collected separately and disposed of properly. All wetter components of a device, e. g. flow cells of detectors or pump heads and pressure sensors for pumps, have to be flushed with isopropanol first and water afterwards before being maintained, disassembled or disposed.

Science Together

Latest KNAUER instructions online:
www.knauer.net/library

KNAUER

Anexo B.2 – Bomba H₂O (E-9)

Bomba H₂O

Marca: Hydra·Cell (AxFlow)

Modelo: MT08 NSN J N SS GE07S
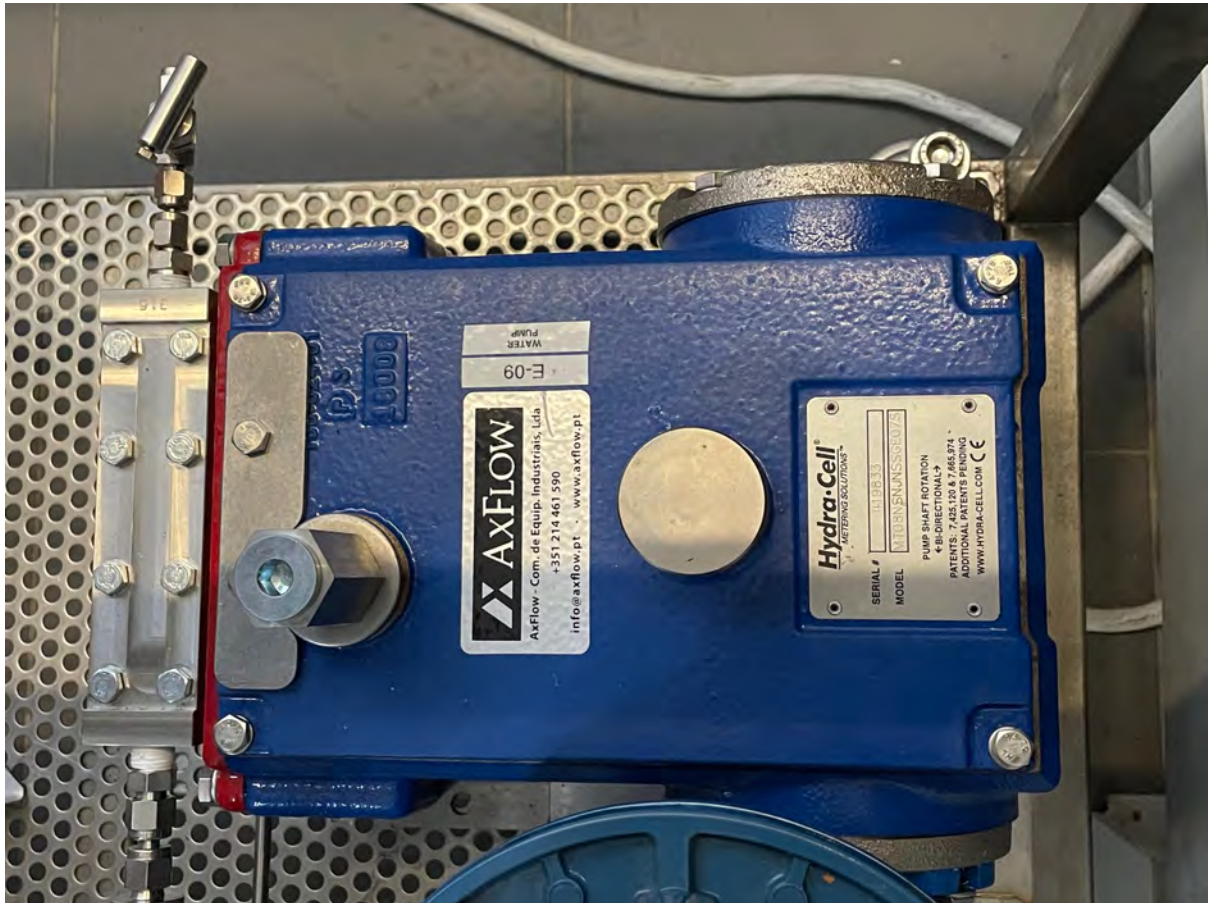
Anexo B.3 – Transdutores de Pressão

Trandutores de Pressão

Marca: Omega

OMEGA ENGINEERING INC.

PRESSURE TRANSDUCER
FINAL CALIBRATION

0.00 -   2000.00 PSIG
Excitation   28.000 Vdc

Job: WHS0046163   Serial: 092520D331
Model: PX319-2KGI   Tested By: JTP
Date: 1/21/2021   Temperature Range: -20 to +85 C
Calibrated: 0.00 -   2000.00 PSIG   Specfile: PX319-I+=100G

Pressure PSIG	Unit Data mA
0.00	3.983
1000.00	12.039
2000.00	20.028
1000.00	12.027
0.00	3.984

Balance   3.983   mA
Sensitivity   16.045   mA

ELECTRICAL LEAKAGE: PASS
PRESSURE CONNECTION/FITTING: 1/4-18 NPT Male
ELECTRICAL WIRING/CONNECTOR: Pin 1 = +EXC
                             Pin 2 = -EXC

This Calibration was performed using Instruments and Standards that are traceable to the United States National Institute of Standards Technology.

S/N	Description	Range	Reference	Cal Cert
12720	Ametek 15K	0 - 2000.00 PSIG	C-2506	C-2506
MY4400265	HP 34970A DMM	Unit Under Test	C-1280	N/A

Q.A. Representative : *Joshua Petro*   Date: 1/21/2021

This transducer is tested to & meets published specifications. This product is controlled in a bonded storage location until sold. The recalibration date of this product should not exceed either (A) one year from the date of shipment or (B) two years from the date on this certificate, whichever is less. Calibration cycles less than the provided guidelines should be managed per the customer's quality management system.

Omega Engineering Inc., 800 Connecticut Ave., Norwalk, CT 06854
http://www.omega.com   email: info@omega.com   phone (800) 826-6342

OMEGA ENGINEERING INC.

PRESSURE TRANSDUCER
FINAL CALIBRATION

0.00 -   2000.00 PSIG
Excitation   28.000 Vdc

Job: WHS0046145   Serial: 041520D449
Model: PX319-2KGI   Tested By: JTP
Date: 1/19/2021   Temperature Range: -20 to +85 C
Calibrated: 0.00 -   2000.00 PSIG   Specfile: PX319-I+=100G

Pressure PSIG	Unit Data mA
0.00	3.998
1000.00	12.005
2000.00	19.970
1000.00	11.984
0.00	3.999

Balance   3.998   mA
Sensitivity   15.972   mA

ELECTRICAL LEAKAGE: PASS
PRESSURE CONNECTION/FITTING: 1/4-18 NPT Male
ELECTRICAL WIRING/CONNECTOR: Pin 1 = +EXC
                             Pin 2 = -EXC

This Calibration was performed using Instruments and Standards that are traceable to the United States National Institute of Standards Technology.

S/N	Description	Range	Reference	Cal Cert
12720	Ametek 15K	0 - 2000.00 PSIG	C-2506	C-2506
MY4400265	HP 34970A DMM	Unit Under Test	C-1280	N/A

Q.A. Representative : *Joshua Petro*   Date: 1/19/2021

This transducer is tested to & meets published specifications. This product is controlled in a bonded storage location until sold. The recalibration date of this product should not exceed either (A) one year from the date of shipment or (B) two years from the date on this certificate, whichever is less. Calibration cycles less than the provided guidelines should be managed per the customer's quality management system.

Omega Engineering Inc., 800 Connecticut Ave., Norwalk, CT 06854
http://www.omega.com   email: info@omega.com   phone (800) 826-6342

OMEGA ENGINEERING INC.

PRESSURE TRANSDUCER
FINAL CALIBRATION

0.00 -   2000.00 PSIG
Excitation   28.000 Vdc

Job: WHS0046145		Serial:	041520D457
Model: PX319-2KGI		Tested By:	JTP
Date: 1/19/2021		Temperature Range:	-20 to +85 C
Calibrated: 0.00 - 2000.00 PSIG		Specfile:	PX319-I+=100G

Pressure PSIG	Unit Data mA
0.00	4.021
1000.00	12.039
2000.00	19.988
1000.00	12.021
0.00	4.023

Balance	4.021	mA
Sensitivity	15.967	mA

ELECTRICAL LEAKAGE: PASS
PRESSURE CONNECTION/FITTING: 1/4-18 NPT Male
ELECTRICAL WIRING/CONNECTOR: Pin 1 = +EXC
Pin 2 = -EXC

This Calibration was performed using Instruments and Standards that are traceable to the United States National Institute of Standards Technology.

S/N	Description	Range	Reference	Cal Cert
12720	Ametek 15K	0 - 2000.00 PSIG	C-2506	C-2506
MY4400265	HP 34970A DMM	Unit Under Test	C-1280	N/A

Q.A. Representative : *Joshua Petro*   Date: 1/19/2021

This transducer is tested to & meets published specifications. This product is controlled in a bonded storage location until sold. The recalibration date of this product should not exceed either (A) one year from the date of shipment or (B) two years from the date on this certificate, whichever is less. Calibration cycles less than the provided guidelines should be managed per the customer's quality management system.

O M E G A   E N G I N E E R I N G   I N C.

PRESSURE TRANSDUCER
FINAL CALIBRATION

0.00 -   2000.00 PSIG
Excitation   28.000 Vdc

Job: WHS0046163	Serial: 092520D335
Model: PX319-2KGI	Tested By: JTP
Date: 1/21/2021	Temperature Range: -20 to +85 C
Calibrated: 0.00 - 2000.00 PSIG	Specfile: PX319-I+=100G

Pressure PSIG	Unit Data mA
0.00	3.987
1000.00	12.016
2000.00	20.013
1000.00	11.994
0.00	3.989

Balance	3.987	mA
Sensitivity	16.026	mA

ELECTRICAL LEAKAGE: PASS
PRESSURE CONNECTION/FITTING: 1/4-18 NPT Male
ELECTRICAL WIRING/CONNECTOR: Pin 1 = +EXC
                             Pin 2 = -EXC

This Calibration was performed using Instruments and Standards that are traceable to the United States National Institute of Standards Technology.

S/N	Description	Range	Reference	Cal Cert
12720	Ametek 15K	0 - 2000.00 PSIG	C-2506	C-2506
MY4400265	HP 34970A DMM	Unit Under Test	C-1280	N/A

Q.A. Representative : *Joshua Petro*   Date: 1/21/2021

This transducer is tested to & meets published specifications. This product is controlled in a bonded storage location until sold. The recalibration date of this product should not exceed either (A) one year from the date of shipment or (B) two years from the date on this certificate, whichever is less. Calibration cycles less than the provided guidelines should be managed per the customer's quality management system.

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OMEGA ENGINEERING INC.

PRESSURE TRANSDUCER
FINAL CALIBRATION

0.00 -   2000.00 PSIG
Excitation   28.000 Vdc

Job: WHS0046145
Model: PX319-2KGI
Date: 1/19/2021
Calibrated: 0.00 -   2000.00 PSIG

Serial: 092520D336
Tested By: JTP
Temperature Range: -20 to +85 C
Specfile: PX319-I+=100G

Pressure PSIG	Unit Data mA
0.00	4.003
1000.00	12.060
2000.00	20.053
1000.00	12.035
0.00	4.004

Balance	4.003	mA
Sensitivity	16.050	mA

ELECTRICAL LEAKAGE: PASS
PRESSURE CONNECTION/FITTING: 1/4-18 NPT Male
ELECTRICAL WIRING/CONNECTOR: Pin 1 = +EXC
Pin 2 = -EXC

This Calibration was performed using Instruments and Standards that are traceable to the United States National Institute of Standards Technology.

S/N	Description	Range	Reference	Cal Cert
12720	Ametek 15K	0 - 2000.00 PSIG	C-2506	C-2506
MY4400265	HP 34970A DMM	Unit Under Test	C-1280	N/A

Q.A. Representative : *Joshua Petro*   Date: 1/19/2021

This transducer is tested to & meets published specifications. This product is controlled in a bonded storage location until sold. The recalibration date of this product should not exceed either (A) one year from the date of shipment or (B) two years from the date on this certificate, whichever is less. Calibration cycles less than the provided guidelines should be managed per the customer's quality management system.

OMEGA ENGINEERING INC.

PRESSURE TRANSDUCER
FINAL CALIBRATION

0.00 -   2000.00 PSIG
Excitation   28.000 Vdc

Job: WHS0046145	Serial: 041520D460
Model: PX319-2KGI	Tested By: JTP
Date: 1/19/2021	Temperature Range: -20 to +85 C
Calibrated: 0.00 - 2000.00 PSIG	Specfile: PX319-I+=100G

Pressure PSIG	Unit Data mA
0.00	3.978
1000.00	11.963
2000.00	19.898
1000.00	11.943
0.00	3.979

Balance	3.978	mA
Sensitivity	15.920	mA

ELECTRICAL LEAKAGE: PASS
PRESSURE CONNECTION/FITTING: 1/4-18 NPT Male
ELECTRICAL WIRING/CONNECTOR: Pin 1 = +EXC
                             Pin 2 = -EXC

This Calibration was performed using Instruments and Standards that are traceable to the United States National Institute of Standards Technology.

S/N	Description	Range	Reference	Cal Cert
12720	Ametek 15K	0 - 2000.00 PSIG	C-2506	C-2506
MY4400265	HP 34970A DMM	Unit Under Test	C-1280	N/A

Q.A. Representative : *Joshua Petro*   Date: 1/19/2021

This transducer is tested to & meets published specifications. This product is controlled in a bonded storage location until sold. The recalibration date of this product should not exceed either (A) one year from the date of shipment or (B) two years from the date on this certificate, whichever is less. Calibration cycles less than the provided guidelines should be managed per the customer's quality management system.

Omega Engineering Inc., 800 Connecticut Ave., Norwalk, CT 06854
http://www.omega.com   email: info@omega.com   phone (800) 826-6342

Anexo B.4 – Válvula reguladora de pressão (V-29)

Regulador Electronico de Pressão

Marca: Equilibar

P/N ERP-3000-Modbus485

Range: 0-3000 psi(g)

EQUILIBAR.
PRECISION PRESSURE CONTROL

Unit S/N	Unit P/N	Date	Inspector
238752	EPR-3000-Modbus485	7/16/20	

Calibration Range

Pressure Range	Monitor Range
0-3000 PSIG / serial, 0-5vac	serial, 0-5 vac

Pressure Recording Device	Monitor Device
ID: Druck Pace1000	ID: Fluke 789
S/N: 3923870	S/N: 42470046

This certifies that the Equilibar unit described above has been calibrated to the stated specifications before shipment from the factory using NIST traceable Druck model PACE 1000 Pressure Indicator and a Fluke 789 Process meter. Please review this information to be sure that it suits the needs of your system and the correct pneumatic and electrical connections have been supplied for your order.

Be sure to consult the enclosed Installation and Maintenance literature for this product to ensure proper and safe installation. Both compressed gases and electrical equipment can be dangerous. Be sure that installers, users and maintenance personnel have read and understand the enclosed Installation and Maintenance literature. Ensure that the literature remains accessible throughout the life of the product.

If you need a new copy of the Installation and Maintenance literature, please contact Equilibar at (828) 650-6590 or email at info@equilibar.com or find it online at www.equilibar.com/support/downloads.

Sam Sematis

Sam Sematis, Production Manager
Equilibar

EQUILIBAR.
PRECISION PRESSURE CONTROL

Fletcher, NC 28732 USA • Tel: +1 (828)650-6590 • www.equilibar.com • inquiry@equilibar.com

EQUILIBAR.
PRECISION PRESSURE CONTROL

READ THIS FIRST

WARNING:

Make sure that you have read and understand these directions before using, installing, or maintaining an EPR Series electronic pressure regulator. Take steps to ensure this instruction manual reaches the operator of this regulator and stays with the regulator throughout its lifetime. Use, installation, operation, and maintenance of all pressurized products including this regulator must be performed by personnel who are properly trained and qualified through experience or specific training.

Failure to properly observe the instructions contained in this document may result in but is not limited to:

- Serious personal injury or death
- Unconstrained release of the pressurized media
- Permanent damage to the pressure regulator and/or permanent damage to connected equipment

NOTICE:

The manufacturer reserves the right to make any changes and improvements to the products described in this manual at any time and without notice.

Although we provide assistance on our products both personally and through our literature, it is the complete responsibility of the user to determine the suitability of any product to their application.

The manufacturer does not warrant or assume responsibility for the use of its products in life support applications or systems.

WARRANTY:

This product is warranted to the original purchaser for a period of one year from the date of purchase to be free of defects in material or workmanship. Under this warranty the product will be repaired or replaced at manufacturer's option, without charge for parts or labor when the product is carried or shipped prepaid to the factory together with proof of purchase. This warranty does not apply to cosmetic items, nor to products that are damaged, defaced or otherwise misused or subjected to abnormal use. See "Application" under the Installation section. Where consistent with state law, the manufacturer shall not be liable for consequential economic, property, or personal injury damages.

CONFORMITY / SUPPLEMENTAL INFORMATION:

The product complies with the requirements of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC and carries the CE Marking accordingly. Contact the manufacturer for more information.

SYSTEM INSTALLATION AND HAZARD ANALYSIS ⚠️

Both normal operation as well as possible failure modes and foreseeable misuse must be accounted for in the design of the system which interacts with and connects to the EPR Series Regulator. It is the responsibility of the end user to account for these hazards.

- Inspect the EPR for any damage. If you find any damage, consult Equilibar before proceeding.
- Verify that the part number on the EPR product label matches what you had requested.
- Verify that the Command, Monitor and Range listed on the product label match what you ordered.
- Call, write, or e-mail Equilibar if you have any questions, concerns, or need a new copy of these instructions. Be sure to include the full part number and serial number of the EPR you are inquiring about. (Equilibar, 320 Rutledge Road, Fletcher, NC, 28791, USA, Phone 01-828-650-6590, www.equilibar.com, info@equilibar.com)
- Take precautions to prevent injury to personnel in the event of an internal or external leak. Sensitive fluid controls can experience internal or external leaks. See standard terms and conditions for important limitations of liability notes.
- Exceeding the maximum specified line pressure may cause permanent damage to the solid-state differential pressure transducer.
- The EPR is not orientation sensitive and may be mounted in any plane and maintain good pressure control.
- The EPR Series controllers are intended for use with clean, dry, non-corrosive gases only.
- EPR Series controllers have National Pipe Thread (NPT) female inlet and outlet port connections. Use anaerobic thread sealant such as Loctite 545 to prevent leakage around port threads.
- It is recommended that a 20 micron filter be installed upstream of EPR Series instruments.
- System media will be vented out the EPR exhaust port. Be sure that the media is vented to a safe environment, away from employees and in accordance with applicable laws in your jurisdiction. Take care that the outlet port cannot become blocked during operation.
- Even inert gases can cause suffocation through oxygen displacement. Take care to ensure that adequate ventilation and oxygen levels will be maintained.
- Provide adequate exhaust line or exhaust muffler capacity. Short or oversized exhaust lines are recommended. Inadequately sized mufflers can build to high pressures and explode.
- The Equilibar EPR is not a "Safety Accessory" as defined by the Pressure Equipment Directive 2014/68/EU. Be sure to install appropriate over pressure protection devices such as safety relief valves or rupture discs to protect the system and the EPR from exceeding the maximum allowable working pressures. These safety devices must meet applicable law, codes, regulations, and standards for your jurisdiction.
- Enriched oxygen media (>21%) should not be used in the EPR unless Equilibar has specifically worked with you to provide a product rated and labelled for enriched oxygen. Standard products are not oxygen cleaned. Particle impact, adiabatic compression, and solenoid motion can all cause ignition in an enriched oxygen media. This kindling chain can cause the entire EPR to oxidize extremely rapidly resulting in high temperatures, discharge of flames and molten metal, and unrestrained escape of process fluid.
- Never perform maintenance or inspections on a system when pressurized fluids are present. Depressurize the system before performing this work. After depressurizing, always de-energize all electrical power before attempting any service work.

TABLE OF CONTENTS

INTRODUCTION

The EPR is a high resolution electronic pressure regulator. The EPR provides a regulated output pressure that is proportional to an electrical command signal input.

The EPR is available in a wide range of calibrated pressure ranges covering vacuum through 3000 psig (200 Bar). The EPR is available with 4-20 mA or 0-5 VDC analog input signal types, and RS-232 or RS-485 (optionally) serial digital inputs.

The EPR is a complete closed loop control valve consisting of two solenoid valves, a manifold, an electronic control circuit board, and an internal pressure sensor. Pressure is controlled by the use of the two solenoid valves. One valve functions as inlet control and acts to allow supply media into the system to increase the controlled pressure. The other solenoid valve acts as the exhaust and will decrease the controlled pressure by venting the system to atmosphere. Both solenoid valves operate proportionally to the current supplied by the EPR's electronic control circuit.

This variable orifice effect allows precise control of pressure at low flow conditions and avoids the digital steps of traditional ON/OFF solenoids. The ability to vary the solenoid valve orifice opening in an analog fashion allows the EPR to control pressure with extremely high resolution.

The regulated pressure output is measured by a solid state pressure transducer internal to the EPR. This pressure transducer provides a feedback signal to the EPR's electronic control circuit. The control circuit compares the internal sensor feedback signal to the command signal input. Any difference between the two signals

causes the appropriate solenoid valve to open, allowing flow in or out of the system. Accurate pressure is maintained by controlling these two valves.

The EPR is a relatively low flow regulator. This makes the EPR a great choice any time low flow rates or small volumes require precise pressure control. The EPR is often used to provide the pilot pressure signal to the dome of either an Equilibar® back pressure regulator or an Equilibar® vacuum regulator. (See Fig. 1).

The EPR can then be used to electronically control back pressure or vacuum pressure in line sizes from 1/8 inch through 6 inch by pilot operating the appropriately sized regulator. An electronic monitor output signal from the internal pressure transducer is provided. All EPR valves come standard with an analog voltage monitor output in 4-20mA or 0-5Vdc matching the analog input.

Fig. 1 EPR pilot operating an Equilibar H3P back pressure regulator

PLUMBING

It is most common to have a .050 inch diameter orifice in the inlet valve, and a .050 inch diameter exhaust valve. The response time of the system will depend on the size of the volume being controlled and the feed pressure.

The controllers are intended for use with clean, non-corrosive gases only. These instruments are *extremely sensitive to dirt and debris*, so the gas line should have a filter to ensure no dirt enters the controller.

The EPR controllers are designed with an Inlet port, a Process (outlet) port, and an Exhaust port. This allows the controllers to raise and lower the pressure of a closed system within the operating range of the controller without wasting gas under constant pressure conditions.

Your instrument is shipped with plastic plugs fitted in the exhaust and process port openings. To reduce the chance of contaminating the flow stream, do not remove these plugs until you are ready to install the device. The inlet port has a factory-installed filter as a final filter (after the gas line filter) to further reduce the chance of dirt and debris contamination. *Do not remove this filter.*

Connect the EPR into your process via the 1/8" NPT port on the front of the unit (see Fig. 2) This is the "Process" port.

Note that the process volume must be at least one cubic inch (16cc) to prevent the EPR from oscillating and blowing out the exhaust.

Connect a supply pressure to the 1/8" NPT port on the left side device. This is the "Inlet" port.

Note that the supply pressure connected to the inlet port must exceed the maximum calibrated range of the EPR by 15% to allow the inlet solenoid valve adequate differential pressure to operate correctly. For example, an EPR-3000 should have 3400 to 3500psi applied to the supply port.

The 1/8" NPT "Exhaust" port, located on the right side of the device can vent to atmosphere if the application is suitable, or to a collection network if necessary.

Note that the pressure at the exhaust port should be at atmospheric pressure or below to allow the controller to be used over its full scale range.


Fig. 2 Typical EPR Plumbing Diagram

POWER AND SIGNAL CONNECTIONS

Power can be supplied to your controller through either the power jack (power jack not available on CSA/ATEX approved devices) or the 8 pin Mini-DIN connector.

An AC to DC adapter which converts line AC power to DC voltage and current as specified below is required to use the power jack.

A 2.1mm, positive center, 12-30 Vdc AC/DC adapter rated for at least 250 mA is required to use the adapter jack in a EPR Series controller.

NOTE: 4-20mA analog output requires at least 15 Vdc.
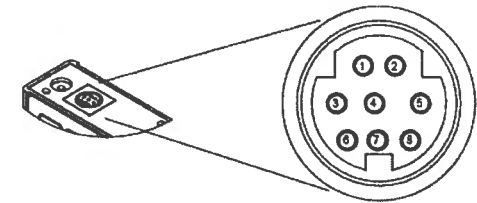
STANDARD 8 PIN MINI-DIN PIN-OUT

Pin	Function	Mini-DIN cable color
1	Primary 4-20mA Current Output Signal	Black
2	Static 5.12 Vdc Output	Brown
3	Serial RS-232 Input Signal (receive)	Red
4	Setpoint Input and Remote TARE (Ground to Tare)	Orange
5	RS-232 Serial Output Signal (transmit)	Yellow
6	Primary 0-5 Vdc Voltage Output Signal	Green
7	DC Power In	Blue
8	DC common for power, communications and analog signals	Purple
Note: The above pin-out is applicable to all the controllers with the Mini-DIN connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.		

⚠️ **CAUTION! Do not connect power to pins 1 through 6 as permanent damage can occur!**

It is common to mistake Pin 2 (labeled 5.12 Vdc Output) as the standard 0-5 Vdc analog output signal. In fact, Pin 2 is normally a constant 5.12 Vdc that reflects the system bus voltage and can be used as a source for the setpoint signal.

INPUT SIGNALS

ANALOG INPUT SIGNAL

Apply analog input to Pin 4 as shown on previous page.

4-20mA or 0-5Vdc input signal configuration is specified at the time of order. Depending on what was specified in the order:

- A 4-20 mA input signal can be applied to pin 4, with common ground on pin 8; or
- A 0-5 V dc input signal can be applied to pin 4, with common ground on pin 8.

Note: This is a current sinking device. The receiving circuit is essentially a 250 ohm resistor to ground.
Note: 4-20mA output requires at least 15 Vdc power input.

⚠ **CAUTION!** *Do not connect this device to "loop powered"" systems, as this will destroy portions of the circuitry and void the warranty. If you must interface with existing loop powered systems, always use a signal isolator and a separate power supply.*
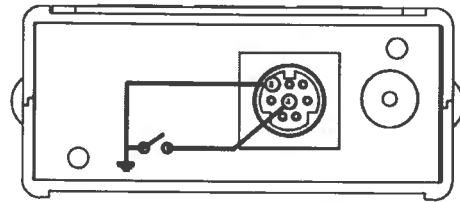
A remote tare can be achieved by momentarily grounding pin 4 to tare.
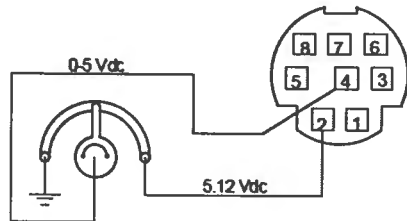
Controllers: A simple method for providing setpoint to controllers

RS-232 / RS-485 DIGITAL INPUT SIGNAL

To use the RS-232 or RS-485 input signal, connect the RS-232 / RS-485 Output Signal (Pin 5), the RS-232 / RS-485 Input Signal (Pin 3), and Ground (Pin 8) to your computer serial port as shown below. (See page 17 for more details on RS-232 / RS-485.)


Serial Cable End   PC Serial Port

8 Pin Mini-DIN Cable End   8 Pin Mini-DIN Connector
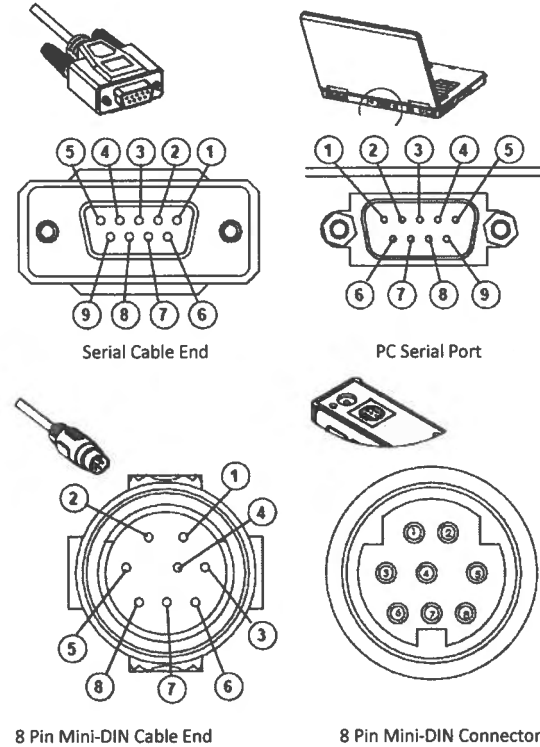
| 9 PIN SERIAL CONNECTION		8 PIN MINI-DIN CONNECTION	
Pin	Function	Function	Pin
5	DC Common (Ground)	DC Common (Ground)	8
3	Transmit	Receive	3
2	Receive	Transmit	5

DB9 to Mini-DIN Connection for RS-232 / RS-485 Signals

STANDARD DB9 INPUT SIGNAL

If your instrument was ordered with a **DB9 connection** (check the Calibration Record accompanying the device), then the following chart describes the pin connection arrangement.
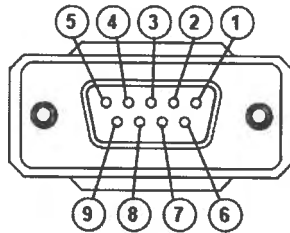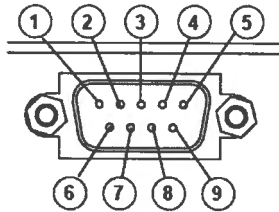
Male Connector: Front View   **Female Connector: Front View**

Pin	Function
1	Not Connected (4-20mA analog output signal optional)
2	5.12 Vdc or (secondary analog output (4-20mA, 5Vdc, 10Vdc or alarm optional)
3	Serial RS-232RX or RS-485(-)
4	Analog Input Signal [4-20mA, 5Vdc, or 10Vdc] (short to ground for remote tare function on non controllers)
5	Serial RS-232TX or RS-485(+)
6	0-5 Vdc Output Signal (or 0-10 Vdc optional)
7	Power In (+Vdc)
8	Ground (common for power, digital communications, analog signals and alarms)
9	Ground (common for power, digital communications, analog signals and alarms)

Note: The above pin-out is applicable to all controllers with the DB9 connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's Calibration Record.

⚠ *Do not connect RS-485 to RS-232 units or cables. Damage will occur! Check part number or contact factory to verify RS-485 functionality.* ⚠

Due to variance in cable manufacturing, please identify proper wiring/pins via continuity check & color when using blunt cut multi-strand cables.

OUTPUT SIGNALS

See the Calibration Data Sheet that shipped with your device to determine which output signals were ordered.

CURRENT (4-20 MA) OUTPUT SIGNAL

If your EPR controller was ordered with a 4-20 mA current output signal, it will be available on Pin 1 (see p.7 for details). The current signal is 4 mA at 0 pressure and 20 mA at the device's full scale pressure. The output current is linear over the entire range. DC common ground for this signal is on Pin 8. Current output units require 15-30Vdc power.

VOLTAGE (0-5 VDC) OUTPUT SIGNAL

EPR controllers equipped with with a 0-5 Vdc Output Signal will have this output signal available on Pin 6. This voltage is usually in the range of 0.010 Vdc for zero pressure and 5.0 Vdc for full-scale pressure. The output voltage is linear over the entire range. DC common ground for this signal is on Pin 8.

RS-232 / RS-485 DIGITAL OUTPUT SIGNAL

To use the RS-232 or RS-485 output signal, it is necessary to connect the RS-232 / RS-485 Output Signal (Pin 5), the RS-232 / RS-485 Input Signal (Pin 3), and Ground (Pin 8) to your computer serial port as shown on page 9. (See page 17 for details on accessing RS-232 / RS-485 output.)

Female Serial Cable Front
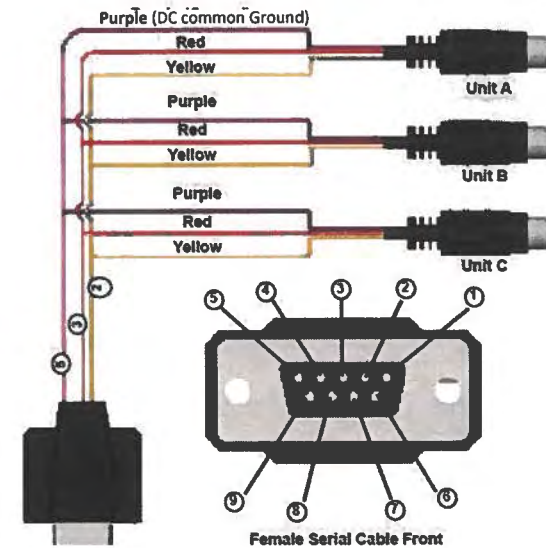
Optional Multiple Device (Addressable) Wiring Configuration for RS-485

NG STARTED - DISPLAY SCREEN & MENUS

ing pages describe the controller screens that can be set with user preferences. Upon
up, the MAIN screen will appear and navigation will begin there.

screen shows the setpoint and actual pressure at the process port.

ING EPR MENU OPTIONS AND FUNCTIONS

button under MENU on the MAIN screen to access the following functions.
button above or below the function name to access the sub menu(s) of that item.
CK> button to return to the previous screen. Press <MAIN> to return to main screen.

T RAMP
ELTA - Pressure change per unit of time
ME UNITS - msec, sec, min, hr, day
ME - Time per selected unit for ramp up or down
CONTROL
ETPT SOURCE – Selects Serial/Front Panel or Analog control of pressure setpoint
OP SETUP
  LOOP VAR - Guage pressure is only option
  LOOP TYPE - Select PD/PDF or PD2I control
  LOOP GAINS - Proportional, Integral and Derivative gain settings
ONTROL OPTS
  RAMP ENABLE - Enable or disable ramp up or ramp down function
  DEAD BAND - Range (+ or -) within which the controller will not attempt control
  SETPT LIMITS - Set minimum or maximum setpoint limits or remove limits
T - manually establish setpoint

CE INFO – Displays model, serial #, mfg date, calibration info, and firmware revision
CE STATE – Diagnostic information
INFO – No function. Manufacturer's information

PRESS – TARE function (establishes ZERO pressure point)
TARE – Select or de-select the power-on TARE function

OR SETUP
SPLAY AS ZERO – Percent of full scale to display as zero
G DIGITS - Select *"Maximize significant digits"* or *"Match older devices"*
ERAGING – Set averaging time constant in milliseconds
M SETUP
NIT ID – Set unit ID
UD – Serial baud rate
SETUP
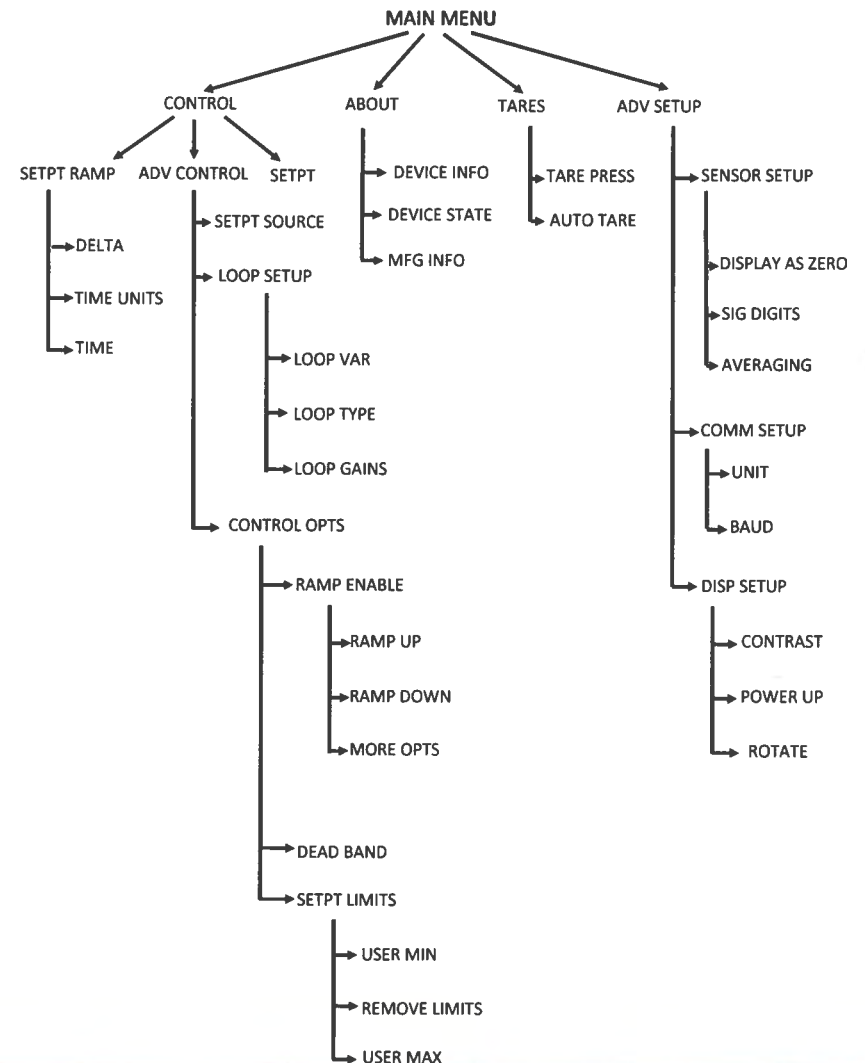ONTRAST – Set the contrast of the LCD display
WER UP - Select the power-up state of the display backlight
TATE - Rotate the display 0 to 180 degrees

> **Flashing Error Message:** An error message (POV = pressure overrange)
> flashes when pressure exceeds the range of the sensor. When any item
> flashes, the pressure measurement is not accurate. Reducing the pressure to
> within specified limits will return the unit to normal operation and accuracy.
> If the unit does not return to normal operation, contact Equilibar.

MENU STRUCTURE

The tree diagram below outlines the menu structure for the EPR Series controllers. To access a
specific menu, follow the appropriate tree, by pressing the button(s) listed until you reach the
desired menu screen. Detailed menu operations can be found on pages 14-15.

MAIN MENU
- CONTROL
  - SETPT RAMP
    - DELTA
    - TIME UNITS
    - TIME
  - ADV CONTROL
    - SETPT SOURCE
    - LOOP SETUP
      - LOOP VAR
      - LOOP TYPE
      - LOOP GAINS
    - CONTROL OPTS
      - RAMP ENABLE
        - RAMP UP
        - RAMP DOWN
        - MORE OPTS
      - DEAD BAND
      - SETPT LIMITS
        - USER MIN
        - REMOVE LIMITS
        - USER MAX
  - SETPT
- ABOUT
  - DEVICE INFO
  - DEVICE STATE
  - MFG INFO
- TARES
  - TARE PRESS
  - AUTO TARE
- ADV SETUP
  - SENSOR SETUP
    - DISPLAY AS ZERO
    - SIG DIGITS
    - AVERAGING
  - COMM SETUP
    - UNIT
    - BAUD
  - DISP SETUP
    - CONTRAST
    - POWER UP
    - ROTATE

MAIN MENU DETAILS

The MAIN screen displays the pressure setpoint and actual pressure in the units specified at the time of order. To change units, press the top left button then press **"Set Button Eng Units"** to change the displayed units. Or press **"Set Device Eng Units"** to change the displayed units *and* the units the device sends across the serial port to the computer. Pushing the TARE PRESS button tares the pressure gauge. See information under "TARES MENU" for more details. Pushing SETPT button allows you to set the pressure setpoint when "Front Panel" is selected as SETPT SOURCE.

CONTROL MENU AND SUBMENU DETAILS

ADVANCED CONTROL > SETPT SOURCE
Pressing the button above SETPT SOURCE will allow you to select how the setpoint will be conveyed to your controller.

The controller will ignore any setpoint except that of the selected setpoint source and it will remember which input is selected even if the power is disconnected. OPTIONS:

1. **Serial/Front Panel**
- Serial refers to a setpoint applied via a serial connection to a computer or PLC as described in the RS-232 / RS-485 Communications Setup pages of this manual.
- Front Panel refers to a setpoint applied directly at the controller. *Front Panel input must be selected prior to changing the setpoint at the device.
2. **Analog**
- Analog refers to a remote analog setpoint

applied to Pin 4 of the Mini-DIN connector as described in the installation section of this manual. To determine what type of analog setpoint your controller has, refer to the Calibration Data Sheet that was included with your controller.
- Caution: If nothing is connected to Pin 4, and the controller is set for analog control, the device will generate random setpoint values.

ADVANCED CONTROL > LOOP GAINS
PID Values determine the performance and operation of your EPR control valve. These terms dictate control speed, control stability, overshoot and oscillation. All units leave the factory with a generic tuning designed to handle most applications. If you encounter issues with valve stability, oscillation or speed, then fine tuning these parameters may resolve the problem. PID fine tuning steps are given on p. 16.

TARES MENU DETAILS

> ⚠️ **Do Not Attempt to Tare Absolute Pressure (psia) Instruments!**

Taring (or zeroing) is an important step in obtaining accurate measurements. Taring (or zeroing) an EPR pressure controller provides it with a reference point for zero pressure.

Before performing the TARE function, It is very important to ascertain that the process ports are open to atmosphere and that there is **No Flow!**

TARE PRESS
If your pressure controller was ordered with the optional "TARE PRESS", you may tare it by pressing the TARE PRESS button.

AUTO TARE ON/ OFF
The controller must be left in the default AUTO TARE OFF mode except when actually taring the controller as explained below.

To correctly tare a pressure controller:
1. Be sure the unit is in the AUTO TARE OFF default setting.
2. Disconnect all plumbing and make sure there is No Flow.
3. Push the button above AUTO TARE OFF once so that the display reads AUTO TARE ON.
4. Enter a Setpoint of ZERO. A zero setpoint results in the closing of the valve and a known "no flow" condition.
5. Wait at least 30 seconds.
6. Push the button above AUTO TARE ON once so that the display reads AUTO TARE OFF.
7. Reconnect the plumbing.
If the unit reads significantly different than zero when removed from the line and open, it is a good indication that it was given a false zero.

ABOUT MENU DETAILS

Press **DEVICE INFO** to view model #, serial #, manufacture date, calibration info, and firmware revision.

Press **DEVICE STATE** to view diagnostic information. **MFG INFO** menu button has no function.

ADV SETUP MENU AND SUBMENU DETAILS

SENSOR SETUP

AVERAGING > PRESS AVG
Pressure Averaging may be useful to make it easier to read and interpret rapidly fluctuating pressures. Pressure averaging can be adjusted between 0 msec (no averaging) and 999 msec (maximum averaging).

Pressure averaging can be effective at "smoothing" high frequency process oscillations such as those caused by diaphragm pumps. Use the SELECT DIGIT button and the UP and DOWN buttons to change the value. Press SET to save.

COMM SETUP

UNIT ID
This identifier allows you to assign a unique address to each EPR unit so that multiple units can be connected to a single RS-232 or RS-485 computer port. Valid unit identifiers are the letters A-Z and @.

Press UNIT ID, then use the UP and DOWN buttons to change the Unit ID. Press SET to record the ID.
Any Unit ID change will take effect upon exit of Communication Setup menu.

If the symbol @ is selected as the Unit ID, the device will enter streaming mode when Communication Select menu is exited.

See RS-232 Communications (page 17) for information about the streaming mode.

COMM SETUP (cont'd)

BAUD
Both the EPR and your computer must send/ receive data at the same baud rate. The default baud rate for is 19200 baud.

Baud rate choices are 115200, 57600, 38400, 19200, 9600, or 2400 baud. Use the UP and DOWN buttons to select the baud rate that matches your computer. Press SET to save.

Any baud rate change will not take effect until power to the unit is cycled.

DISP SETUP

LCD CONTRAST
The display contrast can be adjusted between 0 and 31, with zero being the lightest and 31 being the darkest. Use the UP and DOWN buttons to adjust the contrast. Press SET when you are satisfied.

POWER UP
Toggle between "LIT" display or "DARK" display upon powering up.

ROTATE DISP
The EPR is not orientation sensitive and may be mounted in any plane and still maintain good pressure control. In order to read the display more easily if it is not mounted in an upright position, the display may be rotated 180°. The display and buttons will rotate together.

> ⚠️ **CAUTION! Never leave a Controller with a non-zero setpoint if no pressure is available to make flow. The controller will apply full power to the valve in an attempt to reach the set-point. When there is no flow, this can make the valve very HOT!**

PID TUNING

EPR Series controllers allow you to adjust the Proportional, Integral and Differential terms of the PID control loop.

To change the PID loop parameters, push the button below PID.

Press LOOP TYPE. Then use the UP and DOWN buttons to select the appropriate PID control algorithm. Press SET.

Read below for descriptions of the PID Loop Types (PID Control Algorithms).

P refers to the Proportional term of the PID loop.
I refers to the Integral term of the PID loop.
D refers to the Differential term of the PID loop.

Press P, I or D. Then use SELECT to choose the decimal with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

Before changing the P, I or D parameter, please record the initial value so that it can be returned to the factory setting if necessary.

Valve tuning can be complex. If you would like assistance, please contact Equilibar for technical support. This video provides helpful instuctions: https://www.youtube.com/watch?v=Hm3d0Vh_tgY

The PD algorithm is the most common PID algorithm used on EPR Series controllers.

It is divided into two segments:
The first compares the process value to the setpoint to generate a proportional error. The proportional error is multiplied by the **'P' gain,** with the result added to the output drive register.

The second operates on the present process value minus the process value during the immediately previous evaluation cycle. This 'velocity' term is multiplied by the **'D' gain,** with the result subtracted from the output drive register.

The additions to and subtractions from the output drive register are carried over from process cycle to process cycle, thus performing the integration function automatically.

Increasing the **'P' gain** will promote the tendency of the system to overshoot, ring, or oscillate.

Increasing the **'D' gain** will reduce the tendency of the system to overshoot.

The PD2I algorithm is a PID algorithm used primarily for high performance pressure control applications.

It exhibits two basic differences from the PD algorithm that most controllers utilize.
1. Instead of applying a damping function based upon the rate of change of the process value, it applies a damping function based upon the square of the rate of change of the process value.
2. The damping function is applied directly to the proportional error term before that term is used in the proportional and integral functions of the algorithm. This provides a certain amount of 'look ahead' capability in the control loop.

Because of these differences, you will note the following:
1. Increasing 'P' gain can be used to damp out overshoot and slow oscillations in pressure controllers. You will know that 'P' gain is too high, when the controller breaks into fast oscillations on step changes in setpoint. A good starting value for 'P' gain is 200.
2. If the unit was originally shipped with the PD2I algorithm selected, the 'D' gain value should be left at or near the factory setting because it relates primarily to the system phase lags. If you are changing from the default algorithm to the PD2I algorithm, you should start with a 'D' gain value of 20.
3. The 'I' gain is used to control the rate at which the process converges to the setpoint, after the initial step change. Too low a value for 'I' gain shows up as a process value that jumps to near the setpoint and then takes a while to converge the rest of the way. Too high a value for 'I' gain results in oscillation. A good starting value for the 'I' gain is 200.

RS-232 / RS-485 COMMUNICATIONS SETUP

CONFIGURING HYPERTERMINAL®:
1. Open your HyperTerminal® RS-232 / RS-485 terminal program (installed under the "Accessories" menu on all Microsoft Windows® operating systems).
2. Select "Properties" from the file menu.
3. Click on the "Configure" button under the "Connect To" tab. Be sure the program is set for: 19,200 baud (or matches the baud rate selected in the RS-232 / RS-485 communications menu on the meter) and an 8-N-1-None (8 Data Bits, No Parity, 1 Stop Bit, and no Flow Control) protocol.
4. Under the "Settings" tab, make sure the Terminal Emulation is set to ANSI or Auto Detect.
5. Click on the "ASCII Setup" button and be sure the "Send Line Ends with Line Feeds" box is not checked and the "Echo Typed Characters Locally" box and the "Append Line Feeds to Incoming Lines" boxes are checked. Those settings not mentioned here are normally okay in the default position.
6. Save the settings, close HyperTerminal® and reopen it.

STREAMING MODE (RS-485 units do not have a streaming mode)
In the default Polling Mode, the screen should be blank except the blinking cursor. In order to get the data streaming to the screen, hit the "Enter" key several times to clear any extraneous information. Type "*@=@" followed by "Enter" (or using the RS-232 / RS-485 communication select menu, select @ as identifier and exit the screen). If data still does not appear, check all the connections and COM port assignments.

Streaming Mode – Advanced
The streaming data rate is controlled by register 91. The recommended default rate of data provision is once every 50 milliseconds and this is suitable for most purposes.

If a slower or faster streaming data rate is desired, register 91 can be changed to a value from 1 millisecond to 65535 milliseconds, or slightly over once every minute.

Below approximately 40 milliseconds, data provision will be dependent upon how many parameters are selected. Fewer data parameters can be streamed more quickly than more. It is left to the user to balance streaming speed with number of parameters streamed.

To read register 91, type "*r91" followed by "Enter".

To modify register 91, type "*w91=X", where X is a positive integer from 1 to 65535, followed by "Enter".

To return to the recommended factory default streaming speed, type "*w91= 50".

SENDING A SETPOINT VIA RS-232 / RS-485:

To send a setpoint via RS-232 / RS-485, **"Serial/Front Panel "** must be selected under SETPT SOURCE

Method 1: Setpoint may be set in floating point in serial communication using serial command (UnitID)SX.YZ
      Example: AS4.54 results in Unit ID A changing setpoint to 4.54.

Method 2: Type in a number between 0 and 65535 (2% over range), where 64000 denotes full-scale pressure rate, and hit "Enter".

The setpoint column and pressure rates should change accordingly. If they do not, try hitting "Enter" a couple of times and repeating your command. The formula for performing a linear interpolation is as follows: Value = (Desired Setpoint X 64000) / Full Scale Pressure Range

For example, if your device is a 50 psig full-scale unit and you wish to apply a setpoint of 12.5 psig you would enter the following value: 16000 = (12.5 psig X 64000) / Full Scale Pressure Range

If the controller is in polling mode as described in *Changing from Streaming Mode to Polling Mode*, the setpoint must be preceded by the address of the controller. For example, if your controller has been given an address of D, the setpoint would be sent by typing: D16000 followed by "Enter"

CHANGING FROM STREAMING TO POLLING MODE:

When the meter is in the Streaming Mode (RS-485 units do not have a streaming mode), the screen is updated approximately 10-60 times per second (depending on the amount of data on each line) so that the user sees the data essentially in real time. It is sometimes desirable, and necessary when using more than one unit on a single RS-232 line, to be able to poll the unit.

In Polling Mode the unit measures the pressure normally, but only sends a line of data when it is "polled". Each unit can be given its own unique identifier or address. Unless otherwise specified each unit is shipped with a default address of capital A. Other valid addresses are B thru Z.

Once you have established communication with the unit and have a stream of information filling your screen:

1. Type *@=A followed by "Enter" (or using the RS-232 / RS-485 communication select menu, select A as identifier and exit the screen) to stop the streaming mode of information. Note that the flow of information will not stop while you are typing and you will not be able to read what you have typed. Also, the unit does not accept a backspace or delete in the line so it must be typed correctly. If in doubt, simply hit enter and start again. If the unit does not get exactly what it is expecting, it will ignore it. If the line has been typed correctly, the data will stop.
2. You may now poll the unit by typing A followed by "Enter". This does an instantaneous poll of unit A and returns the values once. You may type A "Enter" as many times as you like. Alternately you could resume streaming mode by typing *@=@ followed by "Enter". Repeat step 1 to remove the unit from the streaming mode.
3. To assign the unit a new address, type *@=New Address, e.g. *@=B. Care should be taken not to assign an address to a unit if more than one unit is on the RS-232 / RS-485 line as all of the addresses will be reassigned. Instead, each should be individually attached to the RS-232 / RS-485 line, given an address, and taken off. After each unit has been given a unique address, they can all be put back on the same line and polled individually.

COLLECTING DATA

The RS-232 / RS-485 output updates to the screen many times per second. Very short-term events can be captured simply by disconnecting (there are two telephone symbol icons at the top of the HyperTerminal® screen for disconnecting and connecting) immediately after the event in question. The scroll bar can be driven up to the event and all of the data associated with the event can be selected, copied, and pasted into Microsoft® Excel® or other spreadsheet program as described below.

For longer term data, it is useful to capture the data in a text file. With the desired data streaming to the screen, select "Capture Text" from the Transfer Menu. Type in the path and file name you wish to use. Push the start button. When the data collection period is complete, simply select "Capture Text" from the Transfer Menu and select "Stop" from the sub-menu that appears.

Data that is selected and copied, either directly from HyperTerminal® or from a text file can be pasted directly into Excel®. When the data is pasted it will all be in the selected column. Select "Text to Columns..." under the Data menu in Excel® and a Text to Columns Wizard (dialog box) will appear. Make sure that "Fixed Width" is selected under Original Data Type in the first dialog box and click "Next". In the second dialog box, set the column widths as desired, but the default is usually acceptable. Click on "Next" again. In the third dialog box, make sure the column data format is set to "General", and click

"Finish". This separates the data into columns for manipulation and removes symbols such as the plus signs from the numbers. Once the data is in this format, it can be graphed or manipulated as desired.

For extended term data capture see: "Sending a Simple Script to HyperTerminal®" on the next page.

Data Format:

The data stream on the screen represents the pressure parameters of the main mode in the units shown on the display.

For EPR Series Controllers, there are 2 columns of data representing pressure and setpoint. The first column is pressure (normally in psig), the second column is the setpoint (in the units specified at time of order and shown on the display).

<div align="center">

+014.70 014.70
+014.70 014.70
+014.70 014.70
+014.70 014.70
+014.70 014.70
+014.70 014.70
EPR Series Pressure Controller Data Format

</div>

SENDING A SIMPLE SCRIPT FILE TO HYPERTERMINAL®

It is sometimes desirable to capture data for an extended period of time. Standard streaming mode information is useful for short term events, however, when capturing data for an extended period of time, the amount of data and thus the file size can become too large very quickly. Without any special programming skills, you can use HyperTerminal® and a text editing program such as Microsoft® Word® to capture text at defined intervals.

1. Open your text editing program, MS Word for example.
2. Set the cap lock on so that you are typing in capital letters.
3. Beginning at the top of the page, type A<Enter> repeatedly. If you're using MS Word, you can tell how many lines you have by the line count at the bottom of the screen. The number of lines will correspond to the total number of times the pressure device will be polled, and thus the total number of lines of data it will produce.

    For example: A
                     A
                     A
                     A
                     A
                     A

    will get a total of six lines of data from the pressure meter, but you can enter as many as you like.

    The time between each line will be set in HyperTerminal.
4. When you have as many lines as you wish, go to the File menu and select save. In the save dialog box, enter a path and file name as desired and in the "Save as Type" box, select the plain text (.txt) option. It is important that it be saved as a generic text file for HyperTerminal to work with it.
5. Click Save.
6. A file conversion box will appear. In the "End Lines With" drop down box, select CR Only. Everything else can be left as default.
7. Click O.K.
8. You have now created a "script" file to send to HyperTerminal. Close the file and exit the text

editing program.
9. Open HyperTerminal and establish communication with your pressure device as outlined in the manual.
10. Set the pressure device to Polling Mode as described in the manual. Each time you type A<Enter>, the meter should return one line of data to the screen.
11. Go to the File menu in HyperTerminal and select "Properties".
12. Select the "Settings" tab. 43
13. Click on the "ASCII Setup" button.
14. The "Line Delay" box is defaulted to 0 milliseconds. This is where you will tell the program how often to read a line from the script file you've created. 1000 milliseconds is one second, so if you want a line of data every 30 seconds, you would enter 30000 into the box. If you want a line every 5 minutes, you would enter 300000 into the box.
15. When you have entered the value you want, click on OK and OK in the Properties dialog box.
16. Go the Transfer menu and select "Send Text File..." (NOT Send File...).
17. Browse and select the text "script" file you created.
18. Click Open.
19. The program will begin "executing" your script file, reading one line at a time with the line delay you specified and the pressure device will respond by sending one line of data for each poll it receives, when it receives it.
    You can also capture the data to another file as described in the manual under "Collecting Data". You will be simultaneously sending it a script file and capturing the output to a separate file for analysis.
20. You can also capture the data to another file as described in the manual under "Collecting Data". You will be simultaneously sending it a script file and capturing the output to a separate file for analysis.

SUPPORTED UNITS OF MEASURE

This device supports many different units of measure. You may select the desired units as described . Note that only units appropriate to this device are available for selection.

PRESSURE UNITS

Absolute	Gauge	Differential	Notes
PaA	PaG	PaD	pascal
hPaA	hPaG	hPaD	hectopascal
kPaA	kPaG	kPaD	kilopascal
MPaA	MPaG	MPaD	megapascal
mbarA	mbarG	mbarD	millibar
barA	barG	barD	bar
g/cm2A	g/cm2G	g/cm2D	gram force per square centimeter
kg/cmA	kg/cmG	kg/cmD	kilogram force per square centimeter
PSIA	PSIG	PSID	pound force per square inch
PSFA	PSFG	PSFD	pound force per square foot
mTorrA	mTorrG	mTorrD	millitorr
torrA	torrG	torrD	torr
mmHgA	mmHgG	mmHgD	millimeter of mercury at 0 C
inHgA	inHgG	inHgD	inch of mercury at 0 C
mmH2OA	mmH2OG	mmH2OD	millimeter of water at 4 C (NIST conventional)
mmH2OA	mmH2OG	mmH2OD	millimeter of water at 60 C
cmH2OA	cmH2OG	cmH2OD	centimeter of water at 4 C (NIST conventional)
cmH2OA	cmH2OG	cmH2OD	centimeter of water at 60 C
inH2OA	inH2OG	inH2OD	inch of water at 4 C (NIST conventional)
inH2OA	inH2OG	inH2OD	inch of water at 60 C
atm			atmosphere
m asl			meter above sea level (only in /ALT builds)
ft asl			foot above sea level (only in /ALT builds)
V	volt; no conversions are performed to or from other units		
count	count	count	setpoint count, 0 – 64000
%	%	%	percent of full scale

VALVE DRIVE UNITS

Label	Notes
count	+/- 65536 at full drive
%	Percent of full scale drive

TROUBLESHOOTING

Display does not come on or is weak.
Check power and ground connections and supply voltage.

Pressure reading is fixed either near zero or near full scale regardless of actual line pressure.
Differential pressure sensor may be damaged. A common cause of this problem is instantaneous application of high-pressure gas as from a snap acting solenoid valve upstream of the EPR. If you suspect that your pressure sensor is damaged, please discontinue use of the controller and contact Equilibar.

Displayed pressure is flashing and message POV is displayed.
The EPR controllers display an error message (POV = pressure overrange) when a the pressure exceeds the range of the sensors in the device. When any item flashes on the display, the pressure measurement is not accurate. Reducing the pressure to within specified limits will return the unit to normal operation and accuracy. If the unit does not return to normal contact Equilibar.

My controller does not respond to the setpoint.
Check that your setpoint signal is present and supplied to the correct pin and that the correct setpoint source is selected under the SETPT SOURCE list in the control set up display (page 14). Also check that the unit is properly grounded.

After installation, there is no pressure.
EPR Series Controllers incorporate normally closed valves and require a setpoint to operate. Check that your setpoint signal is present and supplied to the correct pin and that the correct input is selected under the SETPT SOURCE list in the control set up display (page 14). Also check that the unit is properly grounded.

The pressure lags below the setpoint.
Be sure there is enough pressure available. If either the setpoint signal line and/ or the output signal line is relatively long, it may be necessary to provide heavier wires (especially ground wiring) to negate voltage drops due to line wire length. An inappropriate PID tuning can also cause this symptom if the D term is too large relative to the P term. See page 16 for more information on PID tuning.

Controller is slow to react to a setpoint change or imparts an oscillation to the flow.
An inappropriate PID tuning can cause these symptoms. Use at conditions considerably different than those at which the device was originally set up can necessitate a re-tuning of the PID loop. See page 16 for more information on PID tuning. Note: The larger the volume pressured, the longer it takes to change the pressure in that volume.

The output signal is lower than the reading at the display.
This can occur if the output signal is measured some distance from the EPR controller as voltage drops in the wires increase with distance. Using heavier gauge wires, especially in the ground wire, can reduce this effect.

My controller oscillates wildly and/or exhibits very different reactions to the setpoint than I expect.
Conditions considerably different than those at which the device was originally set up can necessitate a re-tuning of the PID loop. See page 16 for more information on PID tuning. Ensure the volume on the output is at least one cubic inch (16cc).

RS-232 / RS-485 Serial Communications is not responding.
Check that your EPR controller is powered and connected properly. Be sure that the port on the computer to which the EPR controller is connected is active. Confirm that the port settings are correct per the RS-232 / RS-485 instructions in this manual (Check the RS-232 / RS-485 communications select screen for current EPR readings). Close HyperTerminal® and reopen it. Reboot your PC. See pages 9, 10 and 17 for more information on RS-232 / RS-485 signals and communications.

Slower response than specified.
EPR Series Controllers feature an RS-232 / RS-485 programmable Geometric Running Average (GRA). Depending on the full scale range of the controller, it may have the GRA set to enhance the stability/readability of the display, which would result in slower perceived response time. Please see "Pressure Averaging" on page 15.

Jumps to zero at low pressure.
EPR Controllers feature an RS-232 / RS-485 programmable zero deadband. The factory setting is usually 0.5% of full scale. This can be adjusted between NONE and 3.2% of full scale. See page 15 for ZERO BAND setup.

MAINTENANCE AND RECALIBRATION

GENERAL
EPR Series Pressure Controllers require minimal maintenance. The single most important thing that affects the life and accuracy of these devices is the quality of the gas being controlled. The instruments are designed to control CLEAN, DRY, NON-CORROSIVE gases. If your application requires an aggressive or corrosive gas, please contact Equilibar for more information.

RECALIBRATION
The recommended period for recalibration is once every year. A label located on the back of the controller lists the most recent calibration date. The controller should be returned to the factory for recalibration within one year from the listed date. Before calling to schedule a recalibration, please note the serial number on the back of the meter. The Serial Number, Model Number, and Date of Manufacture are also available on the DEVICE INFO display menu (see pages 12-14 for more information).

CLEANING
EPR Series Pressure Controllers require no periodic cleaning. If necessary, the outside of the controller can be cleaned with a soft dry cloth. Avoid excess moisture or solvents.

For repair, recalibration or recycling of this product, please contact Equilibar

Tel: +1 (828) 650-6590
inquiry@equilibar.com

Anexo B.5 – BPR (V-20 e V23)

Regulador de Pressão

Marca: Equilibar

P/N: H3P2SNN8-NSBP200T100K30EEBB

Anexo B.6 – Sensor de Nível Separador (L-3 e L-4)
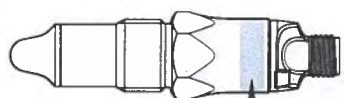
Sensor de nível no Separador (E-13)

Marca: Baumer

Modelo: PL20H/S

Baumer
Passion for Sensors

⊘ IO-Link

11221287 03

Baumer
Passion for Sensors

Type plate / Typenschild

Type	■ Type of sensor
Mat	■ Material number
S/N	■ Serial number
Date	■ Date of manufacture
🗑	■ Do not dispose of in household waste
CE	■ Conformity with EU directives
	■ Permissions, customer-specific

Version	■ Sensortyp	Version	■ Type de capteur
Mat	■ Materialnummer	Mat	■ Réf. mat.
S/N	■ Seriennummer	S/N	■ Numéro de série
Date	■ Herstellungsdatum	Date	■ Date de fabrication
🗑	■ Nicht im Hausmüll entsorgen	🗑	■ Ne pas jeter avec les ordures ménagères
CE	■ Konformität mit EU-Richtlinien	CE	■ Conformité avec les directives européennes
	■ Zulassungen, kundenspezifisch		■ Autorisations, selon le client

Table of contents

1. Safety

Intended use
The sensor must be used solely for the level detection of liquids and solids with a dielectric constant of at least 1.5.
The sensor must only be used for media against which the housing material and sensor tip are resistant.

Staff qualification
Only use staff who are trained for the activities described. This applies in particular to assembly, installation, configuration and troubleshooting. Make sure that the staff have read and understood these instructions.

Technical condition
Only use sensor in perfect technical condition.
Only use Baumer accessories.
Baumer will accept no liability for other manufacturers' accessories.

Risk of burns from hot media
During operation the sensor housing may warm up to over 50 °C. When working with hot media provide protection against burns.

2. Construction and function
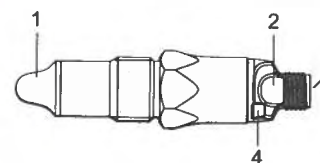
Fig. 1. Construction

1	Sensor tip
2	LED
3	Connection with M12 plug
4	qTeach detector
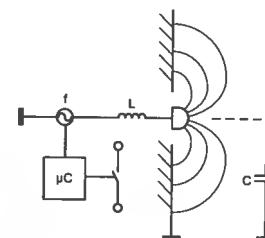
Fig. 2. Function

An electrode integrated into the sensor tip forms a virtual capacitor with the environment. The medium determines the capacity value depending on its dielectric constant (DC values). The virtual capacitor and a coil built into the sensor form a resonant circuit. Depending on the resonance frequency measured and the programmable trigger type, the switch signal is activated.

3. Symbols in warning signs

| Symbol	Warning term	Explanation
⚠	DANGER	In situations which cause death or serious injuries.
	WARNING	In situations which can cause death or serious injuries.
	CAUTION	In situations which can cause light or medium injuries.
	ATTENTION	For material damage

4. Transport and storage

⚠ **ATTENTION**
Unintended change of measurement characteristics
If the sensor is dropped, measurement characteristics might change. The error cannot be corrected.
► Handle the sensor with care.

► Check packaging and sensor for damage.
► In the event of damage: Do not use sensor.

► Store sensor where it will be secure against shock.
Storage temperature: –40 ... +85 °C
Relative humidity: < 98 %

5. Assembly
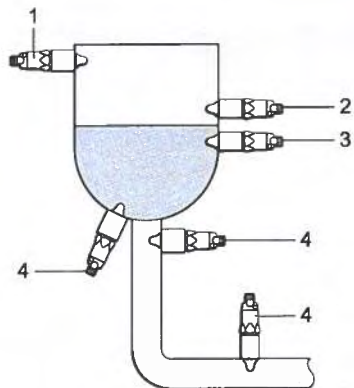
1 Overfill protection
2 Limit level, max.
3 Limit level, min.
4 Run-dry protection

The sensor can be mounted on any point in the vessel.

A sensor mounted at the top of the vessel (1) ensures against overfilling. Sensors attached further down detect a maximum (2) or minimum (3) limit level. A sensor attached at the bottom or on the outfeed pipe (4) can protect a connected pump against dry running.

If the sensor is mounted in a pipe, it is recommended to use window trigger as the trigger function. The adaptive trigger can have limited functionality if it is mounted in a pipe.

Fig. 3. Mounting options

5.1 PL20S mounting

⚠ **DANGER**
Risk of injury from hazardous medium
► Wear protective equipment for hazardous media (e.g. acids, alkaline solutions).
► Empty vessel and pipelines before mounting.
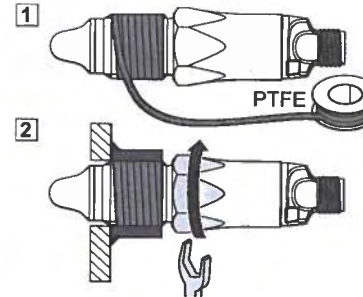
PL20S with the following process connections:
■ G 1/2 A ISO 228-1 (BCID G07)
■ 1/2-14 NPT (BCID N02)

✓ Vessel and pipelines are free of media.
► Seal thread on sensor with Teflon tape (PTFE).
► Screw in sensor.
G 1/2 A tightening torque: 30 Nm max.
NPT tightening torque: 20 Nm max.
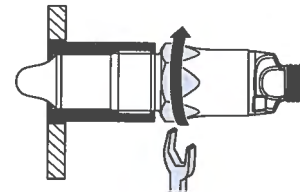
PL20S with the following process connections:
■ G 1/2 A ISO 228-1 (BCID G07) with industrial weld-in sleeve for universal use, Ø 30 x 26 (ZPW1-711, ZPW1-721)
■ G 1/2 A hygienic (BCID A03) with weld-in sleeve or adapter from Baumer
■ G 1/2 A DIN 3852-E (BCID G51)

For these process connections, do not seal with Teflon tape (PTFE) or elastomer.

✓ Vessel and pipelines are free of media.
✓ Adapter or weld-in sleeve are mounted free of dead space.
► Screw in sensor.
Tightening torque: 15 ... 20 Nm

5.2 PL20H mounting

⚠ **WARNING**
Danger to health from contaminated medium
▶ Only use weld-in sleeves or adapters from Baumer.
▶ Do not seal process connections with Teflon tape (PTFE) or elastomer.
▶ Welding work must only be carried out by welders trained in the area of hygiene.
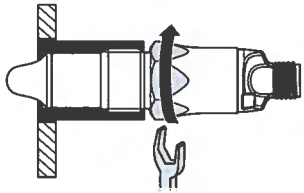
**PL20H with the following process connection:**
■ G 1/2 A hygienic, BCID A03

✓ Weld-in sleeve or adapter are hygienically mounted and are internally flush.
✓ Weld seams are smoothed out to Ra < 0.8 µm.
✓ Leakage hole points downwards.
▶ Screw in sensor.
Tightening torque: 15 ... 20 Nm

Example of mounting with weld-in sleeve ZPW3-321
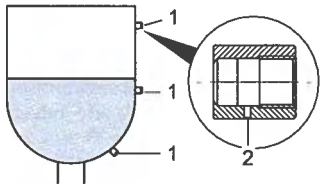
1   ZPW3-321
2   Leakage hole

Example of mounting with weld-in sleeve ZPW3-326 or ZPW3-327
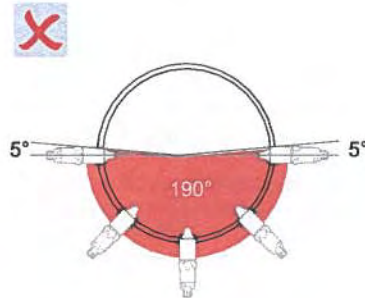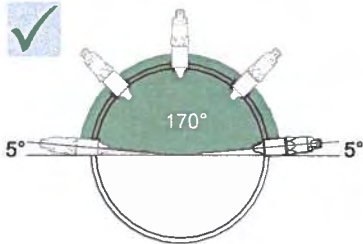
6. Approvals

CERTIFIED EHEDG — The EHEDG certificate is only valid in connection with the appropriate installation parts. These are marked with the "EHEDG Certified" logo.

Ⓐ3 — The 3-A Sanitary Standard requirements are only met with the appropriate installation parts. These are marked with the 3-A logo.

For more information about approvals and certification, please see the product page on www.baumer.com.

7. Electrical connection

Output type	Equivalent circuit	Electrical connection	Function	Pin assignment
Programmable output IO-Link PNP			+ Vs	1
			SW1 (IO-Link)	4
			SW2	2
			GND (0 V)	3
			+ Vs	1
			SW1 (IO-Link)	4
			SW2	2
			GND (0 V)	3
			Frame ground	Plug thread
Programmable output IO-Link NPN			+ Vs	1
			SW1 (IO-Link)	4
			SW2	2
			GND (0 V)	3
			+ Vs	1
			SW1 (IO-Link)	4
			SW2	2
			GND (0 V)	3
			Frame ground	Plug thread

Output type	Equivalent circuit	Electrical connection	Function	Pin assignment
Programmable output IO-Link Digital (push-pull)			+ Vs	1
			SW1 (IO-Link)	4
			SW2	2
			GND (0 V)	3
			+ Vs	1
			SW1 (IO-Link)	4
			SW2	2
			GND (0 V)	3
			Frame ground	Plug thread
Programmable output IO-Link PNP + Analog 4 ... 20 mA			+ Vs	1
			SW1 (IO-Link)	4
			Iout	2
			GND (0 V)	3
			+ Vs	1
			SW1 (IO-Link)	4
			Iout	2
			GND (0 V)	3
			Frame ground	Plug thread
Programmable output IO-Link NPN + Analog 4 ... 20 mA			+ Vs	1
			SW1 (IO-Link)	4
			Iout	2
			GND (0 V)	3
			+ Vs	1
			SW1 (IO-Link)	4
			Iout	2
			GND (0 V)	3
			Frame ground	Plug thread

Output type	Equivalent circuit	Electrical connection	Function	Pin assignment
Programmable output IO-Link + Analog 4 ... 20 mA Digital (push-pull)			+ Vs	1
			SW1 (IO-Link)	4
			Iout	2
			GND (0 V)	3
			+ Vs	1
			SW1 (IO-Link)	4
			Iout	2
			GND (0 V)	3
			Frame ground	Plug thread

8. Configuration

The sensor can be configured either via qTeach, remote teach, FlexProgrammer 9701 or IO-Link master. The following trigger modes are possible:
- Adaptive trigger
- Window trigger
- Analog output 4 ... 20 mA

For a detailed description of the different output modes and different parameter settings, refer to "14. Configuration overview and factory settings" on page 13.

Configuration via qTeach

Via qTeach, the different trigger types can be set for SW1 and SW2. The switch logic is normally open (NO) for both SW1 and SW2.
For a graphical overview of the configuration procedure, refer to "14.5 qTeach configuration procedure" on page 15.

Note: Configuration is only possible during the first 5 minutes after connecting the sensor to the power supply. After that, qTeach is locked.

Step 1: Selecting the switch
✓ Sensor is powered up.
▶ Hold a screwdriver or other metal object on the qTeach detector.
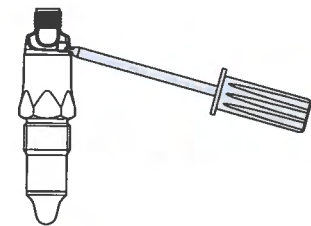
The LED rapidly blinks magenta. The LED alternates between yellow, cyan and orange in 3 second intervals.

▶ When the LED has the color assigned to the desired switch, remove the screwdriver from the qTeach area:
- Yellow: SW1
- Cyan: SW2
- Orange: Factory setting
The LED slowly blinks in the selected color.

Step 2: Selecting the trigger type
► For the switch selected in step 1, select the trigger type by holding the screwdriver on the qTeach area again. When the desired trigger type appears, remove the screwdriver:
  ▪ White: Window trigger
  ▪ Green: Adaptive trigger

If the LED flashes red, an error has occured and the changes are not saved.
► To restart the configuration, disconnect and reconnect the sensor to the power supply.

Configuration via remote teach
Sensors that are installed in inaccessible locations can be easily configured via remote teach. Via remote teach, the different trigger types can be set for SW1 and SW2. The switch logic is normally open (NO) for both SW1 and SW2.

Note: Remote teach has to be activated with FlexProgram. The configuration is only possible during the first 5 minutes after connecting the sensor to the power supply. Within the 5 minutes, the switch being configured does not work.

✓ The remote teach function is activated on either SW1 or SW2 with FlexProgrammer 9701 before the integration of the sensor.
► Short-circuit the switch output which has remote teach activated with GND (0 V).
  The LED rapidly blinks magenta.
► Continue as described in „Configuration via qTeach", step 1 and 2.
  ▪ Instead of a screwdriver, use the GND.

Configuration via FlexProgrammer 9701 and PC
Switch points, hysteresis, damping, output mode, etc. can be configured via FlexProgram and FlexProgrammer 9701. Furthermore, a visualization of the measured value can be displayed by using the online measurement in FlexProgram.

► Connect the FlexProgrammer 9701 to the sensor:
  ▪ M12 plug version: Connect with the black head M12 plug.
  ▪ Cable version: Connect with crocodile clips. Connect the red clip to Pin 1 (+Vs) and the black clip to Pin 3 (GND).
► Connect the FlexProgrammer 9701 to a PC with FlexProgram installed.
► Set parameters (refer to the HELP menu in FlexProgram for more information).
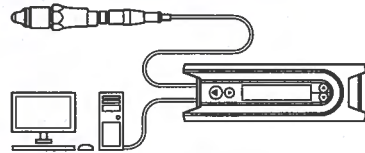
Configuration via IO-Link master
Switch points, hysteresis, damping, output mode, etc. can be configured through an IO-Link master.

► Connect IO-Link master to sensor.
► Connect IO-Link to PC and set parameters.

For a detailed description of the parameter and process data for the IODD, refer to the product page on www.baumer.com.

9. Troubleshooting

Fault	Cause	Action
LED does not light up	Sensor not correctly connected	► Check plug and power supply.
Red LED indicator light	Short circuit	► Remedy short circuit.
LED flashes orange	Unstable media characteristics, switch is untriggered	► Check signal quality with IO-Link master / FlexProgrammer 9701.
LED flashes red	Device error	► Dismount and return sensor.

10. Cleaning, maintenance and repair

Cleaning
► Clean, disinfect or sterilize sensor as needed (CIP/SIP).

Maintenance
Regular maintenance is not required.

Repair
Do not repair the sensor yourself.
► Send damaged sensor to Baumer.

11. Disposal

► Do not dispose of in household waste.
► Separate materials and dispose of in compliance with nationally applicable regulations.

12. Accessories

For adapter and other accessories, refer to www.baumer.com.

13. Technical data

Ambient conditions	
Operating temperature	▪ −40 ... 85 °C ▪ −40 ... 60 °C, with 4 ... 20 mA output signal
Storage temperature	▪ −40 ... 85 °C
Ambient humidity	▪ < 98 % RH, condensing
Protection class	▪ IP67 ▪ IP69K (with appropriate cable)
Vibration (EN 61373)	▪ Category 2 (bogie-mounted) Functional random: 5.4 m/s², 5...250 Hz, 10 min in XYZ Simulated long-life: 30.6 m/s², 5...250 Hz, 5 hours in XYZ
Shock (EN 61373)	▪ Category 2 (bogie-mounted) 300 m/s², 18 ms, 3 pos + 3 neg in XYZ

	Output signal	
■ 8 ... 35 V DC	Output type	■ PNP ■ NPN ■ Digital (push-pull) ■ 4 ... 20 mA
■ Yes	Current load	■ 100 mA max.
■ 25 mA typ., 53 mA max.	Short circuit protection	■ Yes
■ < 1.5 s	Voltage drop	■ PNP: (+Vs –1.4 V) ± 0.5 V, Rload = 10 kΩ ■ NPN: (–Vs +0.6 V) ± 0.3 V, Rload = 10 kΩ
■ ± 1 mm		
■ ± 1 mm		
■ < 150 ms	Leakage current	■ ± 100 µA max.
■ 0.1 ... 10.0 s (adjustable)	Switching logic	■ Normally open (NO), active low ■ Normally closed (NC), active high

		Continuous		Temporary (t < 1 h)	
connection	BCID	Process temperature at Tamb < 50 °C	Process pressure	Max. process tempera-ture at Tamb < 50 °C	Process pressure at max. process temperature
		[°C]	[bar]	[°C]	[bar]
SO 228-1 BSC	G07	–40 ... 115	–1 ... 100	135	–1 ... 100
ygienic	A03	–40 ... 115	–1 ... 10	135	–1 ... 5
DIN 3852-E	G51	–40 ... 115	–1 ... 100	135	–1 ... 100
PT	N02	–40 ... 115	–1 ... 100	135	–1 ... 100
ygienic, 2 mm	A03	–40 ... 115	–1 ... 100	135	–1 ... 100
ygienic, e connection	A03	–40 ... 150	–1 ... 5	N/A	N/A

---

14. Configuration overview and factory settings

The two switches in the CleverLevel PL20H/S can be configured independently. One of three trigger modes can be selected for each switch:
- Adaptive trigger
- Window trigger
- Analog output

For further information, refer to the following sections.

14.1 Adaptive trigger

The adaptive trigger is a plug-and-play solution. With the adaptive trigger, manual sensor configuration is not required, since the trigger will automatically configure the output signal to react to a new medium. The adaptive trigger is very useful for applications with sticky media or for applications where the medium is changed frequently.

Normally, it is not necessary to configure the adaptive trigger, but if the advanced setup is enabled, it is possible to define low and high set points for the adaptive trigger window and a damping. The steady detection function ensures that the input signal is steady for 1 second before the switch output reacts. If the steady detection function is inactive, the switch output will react immediately to each input change.

To ensure a fully functional adaptive trigger, the following conditions have to be fulfilled:
- The sensor has to be in air during startup.
- The input signal has to be steady.

- The difference between the value for untriggered and the value for triggered must be more than 3 %.
- If a new medium with a DC value lower than the previously configured DC value has to be detected, the sensor tip should be cleaned before the new medium is filled in the tank or pipe.

For more information, refer to the HELP menu in FlexProgram.

Adaptive trigger – Output setup	
SW1 (NO) / SW2 (NO)	**Factory setting**
Advanced setup	Disabled
Set point low	0 %
Set point high	100 %
Damping	0 ms
Steady detection	Active

14.2 Analog 4 ... 20 mA

The analog signal (4 ... 20 mA) represents the complete range of the sensor from 0 ... 100 %. The analog signal can be used to evaluate different media in the application.

It is possible to zoom on the sensor range, so that the resolution of the signal is higher within the zoomed area. Additionally, the analog signal can be reversed.

For more information, refer to the HELP menu in FlexProgram.

Output setup	Factory setting
Zoom from	0 %
Zoom to	100 %
Reverse	Normal

14.3 Window trigger

The window trigger is used to cause a sensor switch to react within a specific range, for example, in order to isolate a specific medium. The switching window can be configured within a range from 0 … 100 %. The window trigger is recommended for detecting and separating different layers, for example oil from water or foam from beer.

1 Good conductive medium
2 Adhesion from good conductive adhesive medium
3 Oily medium
4 Air
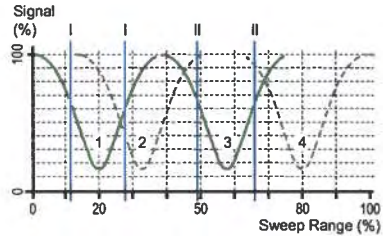
Configuration example for a vessel that can be filled with either a good conductive adhesive medium (e.g. fruit preparation) or with an oily medium (e.g. chocolate mix).
Switch windows I and II in this example are set to achieve the following goals:
■ to detect the fruit preparation (1)
■ to exclude adhesion from fruit preparation (2)
■ to identify the chocolate mixture (3)

For more information, refer to the HELP menu in FlexProgram.

Window trigger – Output setup

SW1 (NO) / SW2 (NO)	Factory setting
Switch window, min.	0 %
Switch window, max.	75.3 %
Switch window, hysteresis	2.4 %
Damping	0.1 s

14.4 LED factory settings

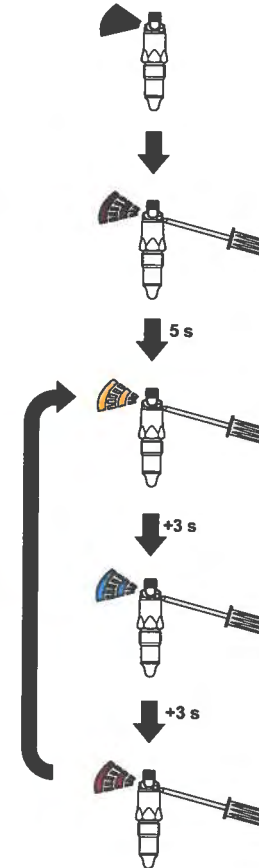| LED function*		
SW1	SW2	LED color
0	0	Green
1	0	Yellow
0	1	Cyan
1	1	Blue
Error	Error	Flashing red
Short circuit	Short circuit	Red

*1 = active, 0 = inactive

Color examples

YE   CY   BU   GN
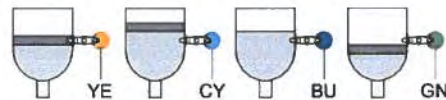
■ YE = SW1 active
■ CY = SW2 is active
■ BU = Both SW1 and SW2 are active
■ GN = Both SW1 and SW2 are inactive

14.5 qTeach configuration procedure
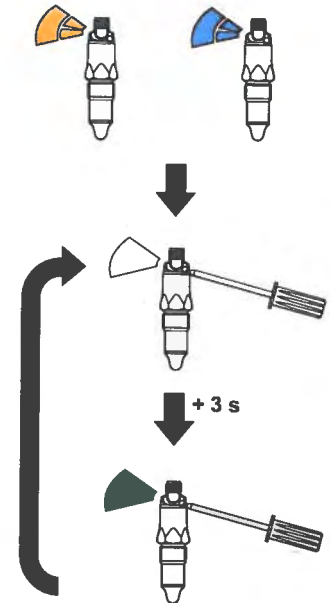
Step 1: Selecting the switch

Step 2: Selecting the trigger type

A switch is selected by holding the screwdriver on the qTeach area and removing it when the LED displays the color assigned to the switch:
■ Yellow: SW1
■ Cyan: SW2
■ Orange: Factory setting

The trigger type for the selected switch can be chosen by holding the screwdriver on the qTeach area and removing it when the desired trigger type is displayed:
■ White: Window trigger
■ Green: Adaptive trigger

Configuration via qTeach is enabled in the factory settings and can be disabled by the user in FlexProgram.

Inhaltsverzeichnis

1. Sicherheit

Bestimmungsgemässe Verwendung
Der Sensor darf ausschliesslich zur Füllstandserkennung von Flüssigkeiten und Feststoffen mit einer Dielektrizitätskonstante von mindestens 1,5 verwendet werden.
Der Sensor darf nur für Medien eingesetzt werden, gegen die das Gehäusematerial und die Sensorspitze resistent sind.

Personalqualifikation
Nur Personal einsetzen, das für die beschriebenen Tätigkeiten geschult ist. Dies gilt insbesondere für Montage, Installation, Konfiguration und Störungsbehebung.
Sicherstellen, dass das Personal diese Anleitung gelesen und verstanden hat.

Technischer Zustand
Sensor nur in einwandfreiem technischem Zustand verwenden.
Nur Zubehör von Baumer verwenden.
Für Zubehör anderer Hersteller übernimmt Baumer keine Haftung.

Verbrennungsgefahr bei heissen Medien
Das Gehäuse des Sensors kann sich im Betrieb auf über 50 °C erwärmen. Bei heissen Medien für Verbrennungsschutz sorgen.

2. Aufbau und Funktion
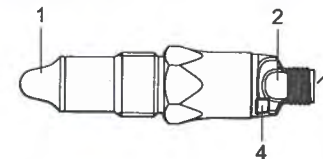
Abb. 1. Aufbau

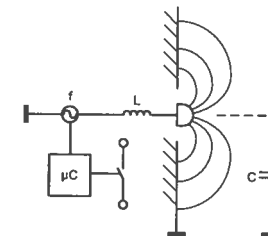|	
1	Sensorspitze
2	LED
3	Anschluss mit Stecker M12
4	qTeach-Detektor

Abb. 2. Funktion

Eine in die Sensorspitze integrierte Elektrode bildet zusammen mit der Umgebung einen virtuellen Kondensator. Das Medium bestimmt abhängig von seiner Dielektrizitätskonstanten (DK-Wert) den Kapazitätswert. Der virtuelle Kondensator und eine im Sensor verbaute Spule bilden einen Resonanzkreis. Abhängig von der gemessenen Resonanzfrequenz und dem programmierbaren Triggertyp wird das Schaltsignal angesteuert.

Anexo B.6 – Banhos Termotáticos (E-1 e E-18)

Banho Termostático

Marca: Julabo

Modelo: 200F

Julabo

CORIO CD-200F Banhos termostáticos

Criostatos de circulação da nova linha CORIO se destacam por uma excelente relação custo-benefício. Eles são adequados para tarefas padrão e trabalhos de rotina no laboratório e na indústria.

Características do produto

- Modelos aplicações internas e externas
- Mostradores luminosos brancos, bem visíveis à distância
- Especialmente silenciosos
- Conversão fácil da bomba entre agitação interna e externa
- Conexões de bomba externas
- Conexão USB
- Mais espaço útil no banho, devido a serpentina de evaporador compacta
- Tampa do banho e torneira de dreno incluídas
- Grelha de ventilação amovível
- Máquinas frigorificas sem aberturas laterais para ventilação
- Classe III (FL) conforme DIN 12876-1
- Muito silenciosos
- Cubas para banho de aço inoxidável de alta qualidade com tampa do banho e torneira de dreno

Valores de desempenho

230V/50Hz (Schuko Plug - CEE 7/4 Plug Type F)	
Potência de aquecimento kW	2
Viscosidade máx. cST	50
Vazão da bomba l/min	15
Pressão da bomba bar	0.35
Potência A	12

Refrigerant variants

Nº. de pedido		9012701.03		
Capacidade de refrigeração (Etanol)				
°C	20	0	-10	-20
kW	0.22	0.17	0.13	0.06
Fluido frigorífico nível 1				
Fluido frigorífico	R134a			
Volume de preenchimento g	70			
Potencial de Aquecimento Climático para R134a	1430			
Equivalente em gás carbônico t	0.1			

Dados técnicos

Versões de tensão disponíveis	Banho

Julabo

Nº. de pedido	9 012 701
Versões de tensão disponíveis:	
9012701.01	100V/50-60Hz (Nema N5-15 Plug) (R134a)
9012701.02	115V/60Hz (Nema N5-15 Plug) (R134a)
9012701.03.chn	230V/50Hz (CN Plug) (R134a)
9012701.03	230V/50Hz (Schuko Plug - CEE 7/4 Plug Type F) (R134a)
9012701.04	230V/50Hz (UK Plug Type BS1363A) (R134a)
9012701.05	230V/50Hz (CH Plug Type SEV 1011) (R134a)
9012701.13	230V/60Hz (Schuko Plug - CEE 7/4 Plug Type F) (R134a)

Cuba para banho	Aço Inoxidável
Cobertura de banho	integrado
Abertura útil do banho cm (L x P / LP)	13 x 15 / 15

Refrigeração

Resfriamento da máquina frigorífica	Ar em 1 estágio

Outros

Classificação	Classe III (FL)
Classificação IP	IP 21
Função da bomba	Bomba de pressão
Tipo de bomba	Bomba de imersão

Eletrônicos

Controle de temperatura	PID1
Calibração de temperatura absoluta	Calibração de 1 ponto
Indicação de temperatura	LED
Ajuste de temperatura	Externo

Dimensões e volumes

Peso kg	26
Diâmetro interno conector para mangueira	8/12 mm
Dimensões cm (L x P x A)	23 x 39 x 65
Dimensões l	3 ... 4
Rosca de conexão da bomba	M16x1 homem

Valores de temperatura

Ajuste da resolução da indicação de temperatura °C	0.1
Faixa de temperaturas de trabalho °C	-20 ... +150
Constância de temperatura °C	±0.03
Temperatura ambiente permitida °C	+5 ... +40
Resolução da indicação de temperatura °C	0.01 ... 0.1

Benefícios

Testado 100%.
Teste 100%. Qualidade 100%. Todo banho de aquecimento JULABO passa por um controle de qualidade antes de sair da fábrica.

Quality Assurance

ATC.
Calibração de temperatura absoluta, calibração de 1 ponto (CD).
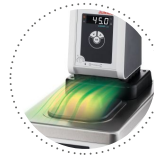
ATC

Tudo sob controle.
Facilita o seu dia a dia no trabalho. Implementação confortável, graças aos manípulos ergonômicos (na frente e atrás).

Mais banho.
Design para um maior conforto. O banho interno oferece mais espaço devido à serpentina de resfriamento retraída.

Julabo

Econômico em espaço. Espaço livre.
Posicione o seu banho de aquecimento JULABO diretamente ao lado de aplicações, aparelhos e paredes. Isso economiza espaço. Dispensar ranhuras de ventilação e conexões laterias tornou isso possível.
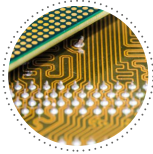
Tecnologia verde.
Durante desenvolvimento foram considerados materiais e tecnologias que protegem o meio ambiente.

Moderno. Confiável.
Componentes de alta qualidade em todos os CORIO. Sensores de platina, tecnologia de motores comprovada, comunicação por CAN-Bus e muito mais.
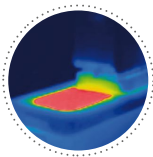
Satisfação.
11 Filiais e mais de 100 representantes em todo o mundo asseguram um suporte JULABO rápido e competente.

Solide.
Evita a perda de energia através do isolamento de alta qualidade.

Limpeza.
A torneira de dreno especial para o esvaziamento confortável e sem ferramentas dos líquidos de banho.

JULABO. Qualidade.
Altíssimos requisitos de qualidade no desenvolvimento e fabricação de aparelhos de alto valor e longa vida útil.

Temporizador. Integrado.
Os termostatos CORIO possuem uma função de temporizador interno. Após transcurso do tempo ajustado soa um sinal sonoro e o aparelho desligará. Faixa de ajuste: 0 ... 999 minutos.

Conexão. Facilidade.
Conexões de bomba inclinadas (M16 x1) facilitam a conexão de aplicações. 2 Conectores incluídos, respectivamente para mangueira diâm. int. 8 e 12 mm.

Precisão.
Pode confiar. O controle PID1 e "Active Cooling Control" tornam o novo CORIO preciso e perfeito.

Proteção contra condensação.
Solução com design de ponta. A ventilação integrada conduz ar sobre a tampa do banho, minimizando a condensação.

Interno. Externo.
A bomba é controlada diretamente na frente, abaixo do mostrador. Para uma conversão fácil entre agitação interna e externa.

Segurança.
CORIO CD correspondem à classe III (FL) conforme DIN 12876-1 e desligam automaticamente em caso de superaquecimento ou nível baixo.

Assistência 24/7.
A qualquer hora você encontra acessórios adequados, fichas de dados, instruções, estudos de casos e mais. www.julabo.com.

Estável.
Graças aos pés de borracha os CORIO são estáveis e protegem a sua instalação de laboratório.

É permitido tocar.
Máxima segurança. O manípulo plástico ergonômico protege os seus dedos contra superfícies quentes.

Quick-Start.
Consultoria individual JULABO e instruções detalhadas ajudam a colocação em funcionamento dos seus aparelhos no local.

Brillante.
Mostrador claro com luminosidade intensa, bem legível, mesmo a uma distância maior.

Tudo na frente.
Elementos de segurança e funções de segurança facilmente e confortavelmente acessíveis pela frente.

Não desencaixa.
O travamento adicional no conector cria uma conexão segura. Maior segurança de processo.

Ligar … e pronto.
Conceito de operação inteligente. Pronto para funcionamento com apenas poucas ações, de forma rápida e segura.

Controle remoto facilitado. Termostatos CORIO CD oferecem uma conexão USB.

Aviso antecipado para nível baixo
Máxima segurança na aplicação, um alarme visual e sonoro permite o reabastecimento em tempo do líquido para banho

Refer to www.julabo.com for more information regarding the entire JULABO product portfolio. Technical changes without prior notification. Images may deviate from the original. | Datasheet No.PT9.012.701/210727

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