User Guide

ECP201L / ECP201LG

PREPARATIVE HPLC PUMP

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02	03.10.2023	Kateřina Kněžourková	Jakub Hodaň	The new declaration of conformity.
03	06.03.2023	Kateřina Kněžourková	Jakub Hodaň	Change of accessories – new diameter of inlet tubing, nuts, ferrule.
04	20.08.2024	Kateřina Kněžourková	Jakub Hodaň	Spare parts – black seals GTP55HT

Related documents	
Manual-Ethernet_devices	

CONTENT:

1. General Information

This unit is designed for use in laboratories in systems of liquid chromatography as preparative HPLC pump.

1.1. Product Function

Preparative pump with very high pressure of 15 MPa at flow rate up to 1000 ml/min. The pump is double-acting with two pumping blocks which are connected in parallel. Both pumping heads are equipped with inlet and outlet check valve. The smooth flow of the mobile phase is ensured by suitable shape of the driving cams, thanks to which a steady run of ceramic pistons pumping in a back pressure way, is achieved and at the same time by precise control of the motor rotation. The pump on its own works as an **isocratic unit**. Together with a **Preparative gradient box** (ACMG000X), works also as a **gradient pump**. If the box is disconnected, the unit informs about the disconnection when entering menu items designated for gradient mode (e. g. *Menu/Parameters/Concentration*).

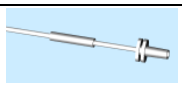
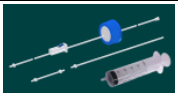
1.2. Produced Versions

ECP201L Preparative HPLC Pump	Cat. No.: ACM0000X
ECP201LG Gradient Preparative HPLC Pump	Cat. No.: ACMG000X

1.3. Accessories

Basic Accessories

P/N	Qty.	Picture	Description
EKAB-011	1		Mains supply cord 10A-250V 2 m EU (certified cable type is inserted according to order)
EKAB-031	1		Mains supply cord 10A-250V 2 m US/CAN (certified cable type is inserted according to order)
EKAB-060	1		Mains supply cord 10A-250V 2 m UK (certified cable type is inserted according to order)
24036000	1		Tube fuse T - 4A/250V, CSA (main unit fuse; for combined power socket with main switch and main fuse)
EKAB-040	1		LAN cable 1 m (for ETHERNET connector)
00051478	1		Terminal block 8 pins green (for connector IO INTERFACE)
18331000	1		Screwdriver Torx TX20 S2 FESTA (for mounting bypass valve, pumping block, cover)

P/N	Qty.	Picture	Description
990395	1		Open End Wrench 3/8" (for metal through bolts on capillaries)
99038900	1		Open End Wrench OK 11-12 (for mounting/dismounting of check valves)
SCK43001	1		FEP inlet tubing 3/8” 2000 mm (FEP tubing,OD=3/8”, ID=1/4”, volume=63.3 ml only tubing, 1x SS nut 3/8”, 1x PTFE ferrule 3/8", thread UNF 5/8”-18)
J0062600	1		SS Tubing OD 1/8" x ID 2.1 mm, l = 1 m (outlet tubing)
00000160	2		SS Nut 1/8", 5/16"-24 UNF threads (for outlet tubing)
JR-ZF2S6	2		SS Ferrule 1/8" (for outlet tubing)
PN000080	1		Waste tubing with adapter 3/32” Barb (PTFE tubing OD 2 mm x ID 0.3 mm, l=1 m)
ACE99700	1		Piston back washing set EC2300
YY007000	1		Syringe LUER 50 ml, plastic
DOC00004	1		Flash disk with User Manual
DOC00002	1	-	Production protocol

Spare parts see *13.*

OPTIONAL PARTS ON A SPECIAL ORDER

P/N	Qty.	Picture	Description
ECS91200	1		FEP tubing OD 1/8“ x ID 1/16“, l=1 m, with LUER LOCK fittings and PEEK nut 1/8”, 1/4” – 28 threads (output connection alternative)

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2. General Operating Instructions

Caution:	**If the unit is used in a manner not specified by the manufacturer, the protection provided by the manufacturer may be impaired.**
Caution:	**The unit must not be used, if it is leaking.**
Caution:	**Do not replace detachable main supply cords with inadequately rated cords.**
Caution:	**Do not place the unit or any other equipment in a way that disconnecting the power cord will be difficult.**
Caution:	**Do not dismount the unit cover. It is not necessary for the maintenance or service.**
Caution:	**After production or service, the pump is filled with isopropanol.**
Caution:	**When using buffers or other crystalizing agents in mobile phases, piston back washing must be performed.**
Caution:	**The pump and box must be calibrated together, see Production protocol.**

2.1. Safety Symbols on Unit

Electrical device! Disconnect power cord before servicing.

Electrical device! Disconnect power cord before servicing. Read the operational guide before replacing fuse!

3. DESCRIPTION

FRONT VIEW

No.	Description
1	Front switch.
2	Keyboard.
3	Status LED lights: PUMP (green) indicates status of pump motor (PUMP and PURGE). RMT (yellow) indicates status of unit remote control. It lights when the unit is communicating through interface ETHERNET or RS232. ERR (red) indicates error status of the unit. It lights, if an error is indicated and blinks, if a fatal error is indicated, when unit status has been changed.
4	Display.
5	Pumping block.
6	Connection for input tubing (pump inlet).
7	Connection for output capillary (pump outlet).
8	Pressure sensor.
9	Bypass valve.

KEYBOARD BUTTONS AND THEIR FUNCTION

Symbol	Description
MENU	Entering unit menu, fast menu leaving.
PUMP	Pump start/stop and other functions when working with gradient program (viz. *6.3.2*).
FLOW	Direct setting of pump flow rate.
PURGE	Entering purge mode.
ENTER	Confirms selected MENU item, confirms newly set parameter value, evokes *QUICK DIAGNOSTICS* screen.
ESC	One step back return without saving changes.
"◁ B", " ▷ D", "△ A", "▽ C"	Direction keys. Using arrows up/down increase/decrease the value of set parameter. A, B, C, D – direct choice of mobile phase valve. D – starts gradient program.

REAR VIEW

No.	Description
1	Combined power socket with main switch and main fuse.
2	Connector for connection of a Gradient Box.
3	Connector RS232.
4	Connector Ethernet/LAN.
5	Connector USB.
6	Connector for external start.
7	Connector IO Interface.

4. INSTALLATION AND FIRST START

Place the unit in a suitable location that meets the following conditions:

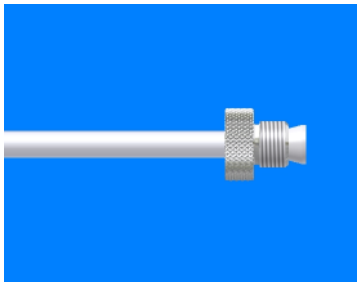
- Horizontal place.
- Keep at least 10 cm space behind the rear side of the unit.
- Keep away from equipment generating strong magnetic field.
- The unit is intended for use in regular laboratory environment only - see *Technical parameters – operating environment conditions*.

4.1. Inlet Tubing Connection

For connecting the pump in **isocratic** mode, use inlet tubing (`SKC43001`) with the SS Handtight nut (`00000360`) and PTFE ferrule (`00000230`) from supplied pump accessories.

At first dismount plug on the pump inlet.

Caution:	**After production or service, the pump is filled with isopropanol.**



Isocratic connection of a pump inlet:
Connect the inlet tubing and place the other end of the tubing to the storage bottle with mobile phase.

Make sure that the tubing in the mobile phase storage bottle is sufficiently fastened and secured.

Caution:	**Inlet tubing inserted in storage bottle with mobile phase must be fixed so that it does not loose during pumping.**
Caution:	**Inlet tubing end inserted in storage bottle with mobile phase must be above the bottom.**

4.2. Outlet Capillary Connection

To connect the pump to the injection valve or column outlet capillary with stainless steel nut and ferrule (J0062600; 00000160; JR-ZF2S6) is used.

Outlet capillary is connected and then the capillary nut is tightened with side wrench 3/8".

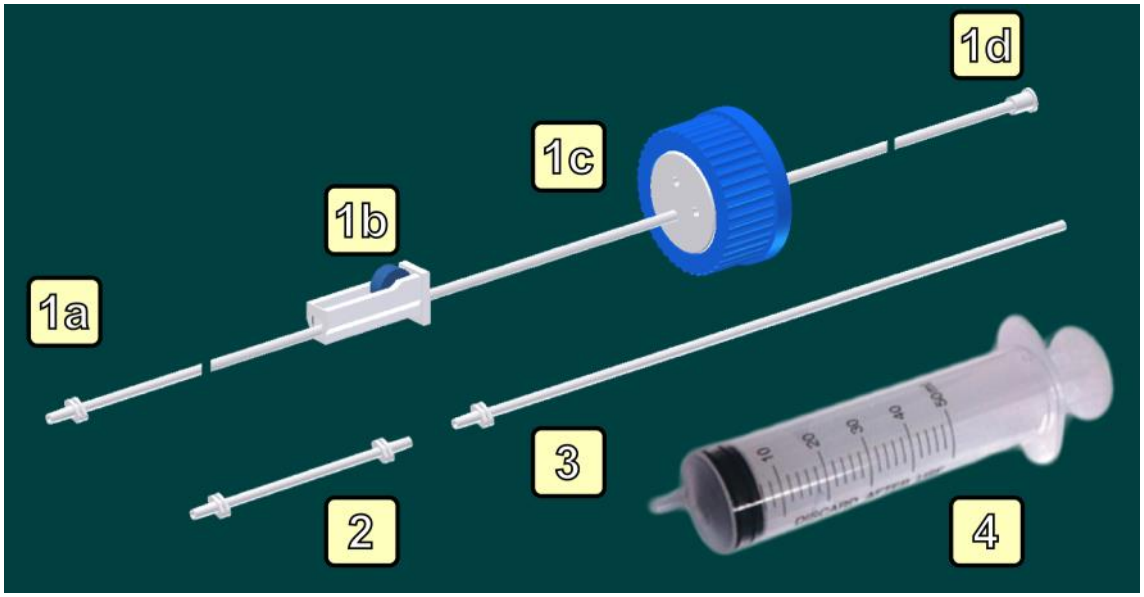
The other end of capillary is connected to the injector valve or to the column.

4.3. Piston Backwash

Caution:	**When using buffers or other crystalizing agents in mobile phases, piston back washing must be performed.**

Each pumping block (left and right) has two heads – pumping and washing. Pumping heads are farther from the unit. For connection of the piston back washing set, the washing heads have a slot with LUER cone in upper and lower part. Both heads are equipped with a seal (piston padding) and during work with buffer solutions may buffer crystals adhering to the piston damage the seal and the pump may start leaking.

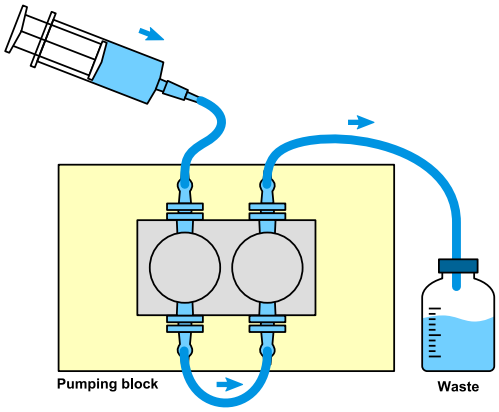
PISTON BACK WASHING SET



1. Inlet part; 1a. Luer cone for connecting to a backwashing head; 1b. Flow rate regulator; 1c. Lid GL45 with a plug; 1d. Luer cone for syringe connection; 2. Coupling of washing heads; 3. Outlet leading into the waste system; 4. Syringe 50ml

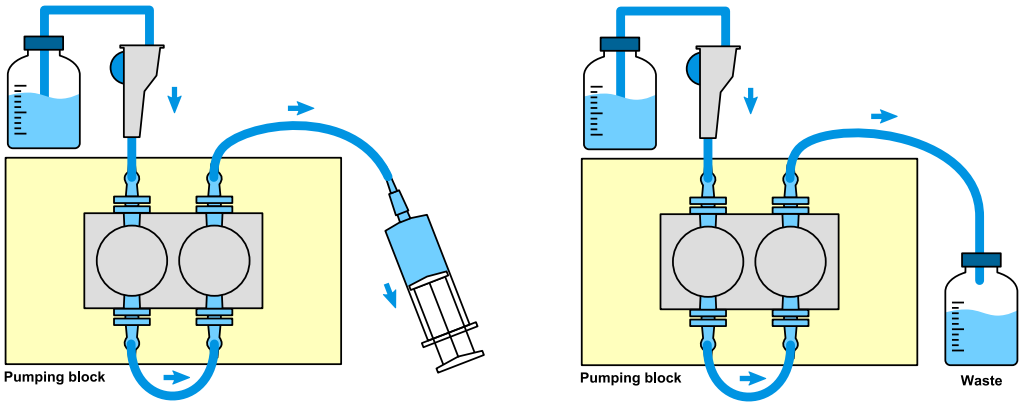
4.3.1. Simple Manual Use

Connect both **Washing heads** in series using tubing and LUER adapters. Fill the syringe with HPLC water (or mobile phase dissolving buffers) and rinse the heads. Washing heads are now filled with liquid, rinsing the pistons from the rear side. Now once in a while, during work with the pump, push through the pump some liquid to the washing system (approx. 1x per hour).



4.3.2. Automatic Backwash

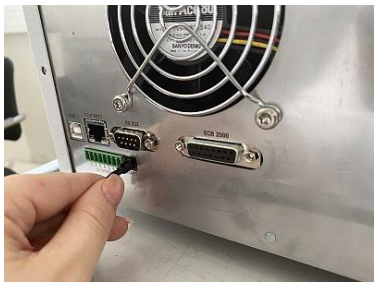
Connect both **Washing heads** in series using tubing and LUER adapters. Insert the tubing with flow rate regulator into the reservoir with HPLC water (or mobile phase dissolving buffers). Loosen the flow rate regulator and suck liquid into the system using plastic syringe connected to the other end of the system (left picture). Disconnect the syringe and place the tubing end into the waste reservoir. Now the liquid is flowing through the system by gravity (right picture). Set the flow rate regulator so that at the end of the tubing escapes approx. 5-7 drops per minute.



4.4. Connectors on Unit Rear Panel

Plug the power supply cord into the instrument socket on the rear panel. The cord is among unit accessories.

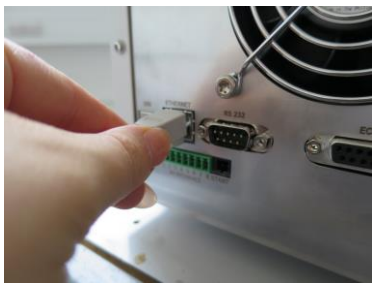
Plug interconnecting cable between pump and **box** into connector **ECB2000**. The cable is among accessories of **box**.
Connector can be fixed by two screws using cross tip screwdriver.



Plug **injection valve** cable into **START** connector. Plug it all the way until it snaps in.

In order to unplug the connector, press the safety pin and pull out.

Insert terminal block into connector **IO INTERFACE**. If there is no signal connected to the terminal block, it is not necessary to connect it.
Terminal block is among the unit accessories.



Plug LAN network cable into connector **ETHERNET**. Press the connector in until the safety pin snaps in. In order to unplug the connector, press the safety pin and pull out.
The other end of network cable shall be plugged into PC or Data switch.
Cable is among the unit accessories.

Plug serial line cable into connector **RS232** for interconnection with PC.

Cable is not among the unit accessories.

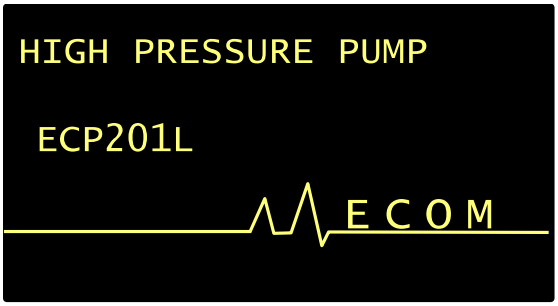
Connector **USB** serves for plugging USB cable for interconnection with PC.

Cable is not among the unit accessories.

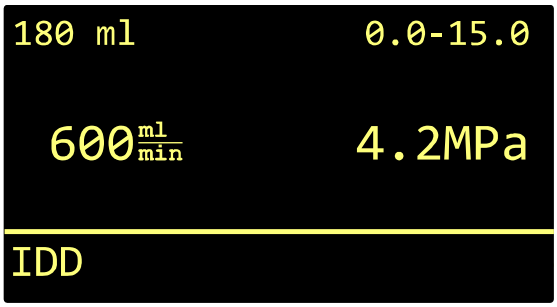
4.5. Start of the Unit

Use a switch on the rear panel of the unit for connecting to mains voltage, then switch on the unit using push button on the front panel. The push button glows red, if the power source is off and green, if power source is on. If the power supply is disconnected, the unit remembers the last status of this push button and after power supply reconnection it restores the last status. This can be used for an automatic start in the system with a common power source switch for a whole system of liquid chromatograph (for example using a multiple socket-outlet with a switch).

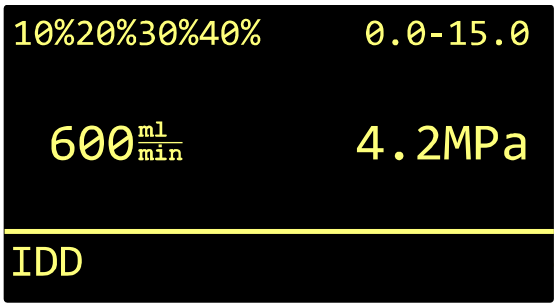
4.6. Basic Control by Keyboard



After switching the unit on (Mode *START*) initial screen displays the unit type.



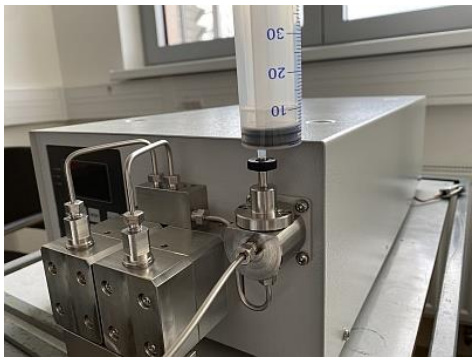
Then the unit turns to mode *IDD*, pump motor is in idle status.
Main screen – **isocratic** pump mode.



Main screen - **gradient** pump mode.
Gradient mode is automatically detected by the connecting cable to the **box** when switched on.

4.7. Pump Initiation

The unit is filled with isopropanol, it is necessary to **rinse it out** and fill the system with mobile phase and **degass** the entire system.



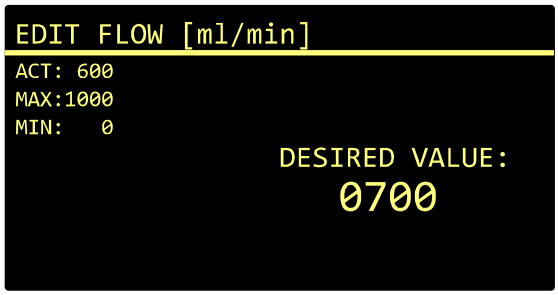
Loosen the purge/degassing valve by turning it by 90°.

Slip a plastic syringe into the purge/degassing valve, the syringe (50 ml) is a part of pump accessories.

In gradient mode, it is necessary to check, whether appropriate valve (A, B, C or D) with mobile phase is opened. By pressing the PURGE kye and then pressing the PUMP key, the pump rinsing is started. Suck in the mobile phase with the plastic syringe as long as bubbles come out from the pump. It is possible to switch the valves during rinsing by pressing the keys with arrows - this allows the liquid to draw into all required channels. Press the PUMP key again to stop the pump rinsing. Tighten the purge/degass valve and pull out the plastic syringe.

To repeatedly degass/purge the unit, it is possible to mount the waste tubing (PN000080) to the purge/degass valve.

In chapter *6.2.2* it is possible to set parameters for rinsing.



Now the flow rate can be set by pressing the FLOW key. Use left and right arrow to move with the cursor and up and down arrow to change the value. Press the ENTER key to confirm the value, press PUMP key to run the pump. Press the PUMP key again to stop the pump.

For fast setting of one of the valves to 100 %, it is possible to use arrow with the letter of the appropriate valve. This switching is functional in gradient mode during modes *IDD*, *PRG* and *PMP* (see *7*).

Note:	**We recommend to run and stabilize the unit before starting the analyzes or after a longer shutdown of the unit at 500 ml/min, pressure 1-5 MPa for approximately 30 min. Liquid can circulate.**
Note:	**Run the gradient pump with a 25 % concentration setting for each valve approximately 10 min.**

4.8. Description of Symbols on the Display

Value/Symbol	Meaning
10%20%30%40% 0.0 l	Actual gradient concentration for A, B, C, D. In isocratic mode is displayed remaining mobile phase volume.
0.0-15.0	Value of low – high pressure limit in actually set pressure units.
600 ml/min	Actual flow rate value.
4.2 MPa	Actual pressure value.
IDD	Abbreviation of an actual pump mode.

Value/Symbol	Meaning
	Actual piston position is displayed after first finished pump rotation. During flow rate higher than ~3 ml/min actual position cannot be displayed and this symbol is shown.
	Pulsation compensation status: OFF – turned off. FIXED – according to predefined values. LEARNING – learning in progress. LEARNED – according to learned values. LEARNED OFF – compensation is turned off. LEARNED 0 – according to learned values. LEARNED 0 – compensation is turned off or not learned. LEARNED 1 – according to learned values. LEARNED 1 – compensation is turned off or not learned.
	Gradient valve status (A, B, C, D). Only in gradient mode. During very fast valve switching (low percentage of component and higher flow rate) it may not manage to display valve switching. Mark X – all valves are closed.
	One of IO INTERFACE inputs is used for a pump control.
E(1)	An error has occurred „ERROR“ (number of errors). By using the ENTER key on main screen, it is possible to enter the *QUICK DIAGNOSTICS* screen and see a description of all errors and warnings.
W(1)	„WARNING“ (number of warnings). By pressing the ENTER key on the main screen, it is possible to enter the *QUICK DIAGNOSTICS* screen and see a description of all errors and warnings.

5. CONTROL FROM PC

When controlling the unit from a PC, communication precedes through serial line RS232 or via LAN. Communication protocol can be sent upon request.

Unit may be controlled with SW Clarity or ECOMAC.

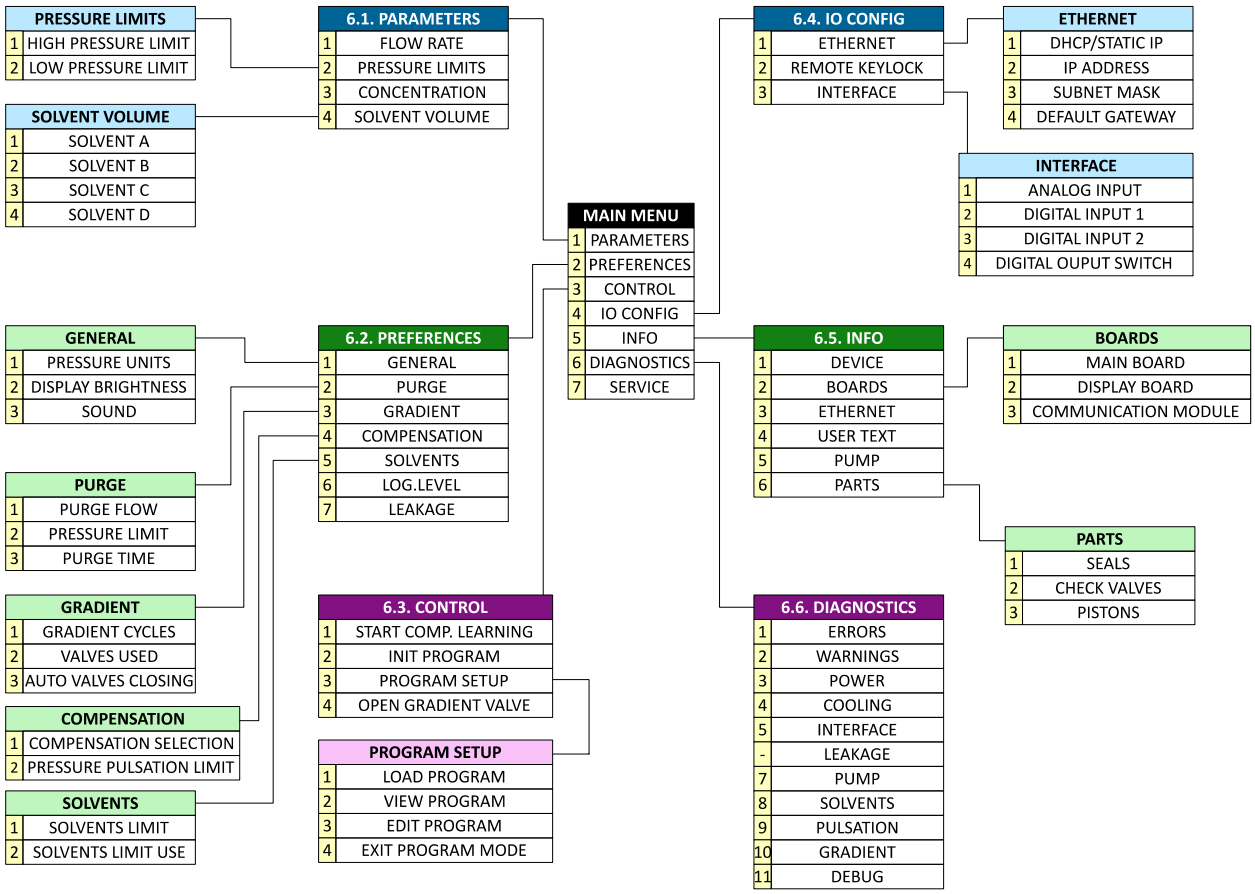
For controlling the pump with SW Clarity, use the last actualized program version containing drivers for this unit. Help regarding control of the unit can be found in Clarity installation directory in file: `(C:\Clarity; C:\Clarity\Bin)` in file `CswEcomECP2000.chm`. A double click will open the file for reading.

6. WORKING WITH MENU

Menu enables setting all parameters and functions of the unit, its diagnostics and service.

MAIN MENU can be entered by pushing MENU key. In the menu it is possible to move using arrows and the ENTER and ESC keys. Any part of the menu can be exited by pressing MENU key again. All gradient items are only available for the gradient version of the pump (preparative pump connected to a gradient box).

MENU FLOW DIAGRAM



6.1. Parameters

Here the basic parameters of the pump such as flow rate, pressure limits, concentration and volume of mobile phase can be set.

6.1.1. Flow Rate

This screen is identical to the screen displayed after pressing the FLOW key. Flow rate can be set in the range of **0 - 1000 ml/min**. Default value is 600 ml/min.

6.1.2. Pressure Limits

Pressure limits can be set in following submenus.

6.1.2.1. High Pressure Limit

High pressure limit can be set in the range of **1.0 – 15.0 MPa (150 – 2180 psi)**. Minimal value of high pressure limit is **1 MPa (150 psi)** higher than value of low pressure limit. Default value is 5.6 MPa (813 psi).

Example:	If the value of low pressure limit is for example **6.3 MPa (910 psi)**, the value of high pressure limit can be set only in the range of **7.3 – 15.0 MPa (1060–2180 psi)**.

This function is used for column protection. Limit should be set approximately 20% higher than normal pressure in the column.

6.1.2.2. Low Pressure Limit

Low pressure limit can be set in the ranges **0.0 – 14.0 MPa (0 – 2030 psi)**. Maximal value of the low pressure limit is **1 MPa (150 psi)** lower than the value of the high pressure limit. **Unit automatically sets maximal value of the low pressure limit according to maximal value of the high pressure limit.** Default value is 0 MPa (0 psi).

Example:	If the value of the high pressure limit is for example **5.6 MPa (813 psi)**, the value of the low pressure limit can be set only in the range of **0.0 – 4.6 MPa (0 – 670 psi)**.

This function is used for unattended pump run to avoid uncontrolled outflow of the mobile phase in case of capillaries disconnection.

6.1.3. Concentration

Concentration (gradient values) is set for each valve in percentages. Default setting is for four valves (**A**, **B, C** and **D**). The rest of the concentration value is calculated for the valve **A**. Using left and right arrow moves with cursor, up and down arrow changes the concentration value and pressing the ENTER key confirms set concentration value.

Setting number of used valves can be performed in *Menu/Preferences/Gradient/Valves used*. Minimal number of used valves is two.

If box is not connected to the pump, the message "*Pump is not in gradient mode*" is displayed on the screen.

6.1.4. Solvents Volume

Current remaining volume (mobile phase) for valves (**A**, **B, C** and **D**) can be set in range **0.0 – 100.0 l**. Warning and volume limit setting can be done in *Menu/Preferences/Solvents.* Default value is 0.0 l.

6.2. Preferences

For optimizing pump functions to satisfy any user needs.

6.2.1. General

In this submenu pressure units, display brightness and sound signalization can be set.

6.2.1.1. Pressure Units

Pressure units can be set in *MPa* (megapascal), *PSI* (pound-force per sq. inch) and *BAR* (bar). 1 MPa=10 bar=145 psi. Default pressure unit is MPa.

Note: The PSI unit pressure values are automatically rounded to tens (ie. 145 psi after rounding is 150 psi).

6.2.1.2. Display Brightness

Display brightness can be set in eight levels, where 8 is maximum brightness. Default value is 3.

6.2.1.3. Sound

Sound signalization of the unit can be set as follows:

SOUND SIGNALIZATION SETTING

Setting	Description
KEYBOARD	Each time the key is pressed, a short sound (beep) will be generated if the key has no meaning, a medium sound for value changes and menu movements and a longer sound for confirming value changes.
ERRORS	A sound signal will be generated, when an error occurs. vThree longer consecutive tones in case of an error and in the case of a fatal error with a repeat every 5 s. The repeat can be interrupted by pressing any key.
WARNINGS	A sound signal will be generated, when a warning occurs. Three short tones in a row.
OPERATIONS	When performing an operation, a longer beep will be generated and during long operations may be this beep generated at the beginning and at the end of the operation.

In default setting all sounds are turned on.

6.2.2. Purge

In each submenu the options for flushing the pump are set.

6.2.2.1. Purge Flow

Purge flow can be set in the range of **100 – 1200 ml/min**. Default value is 500 ml/min.

6.2.2.2. Pressure Limit

Purge pressure limit can be set in the range of **0.1 - 2.0 MPa (20-290 psi)**. Default value is 1 MPa (150 psi).

6.2.2.3. Purge Time

Purge duration time can be set in the range of **0-10 min**. Value 0 means, that purge is not time limited. Default value is 0 min.

6.2.3. Gradient

Gradient options are set in each submenu. **This item is only available for the gradient version of the pump**.

6.2.3.1. Gradient Cycles

Here, the number of cycles (cam cycles) of the pump, necessary for gradient mixing, can be set. Default setting is **AUTOMATIC**, in which the number of cycles is set depending on the set flow rate, one cycle for flow rates up to 200 ml/min, two cycles for flow rates from 200 ml/min up to 500.0 ml/min and 4 cycles for flow rates over 500.0 ml/min, or it is possible to choose in offer a specific number of cycles.

6.2.3.2. Valves Used

Here can be selected valves used for gradient. Minimal number of used valves is two. In default setting all valves are selected.

6.2.3.3. Auto Valves Closing

In this item the possibilities of automatic gradient valves closing after starting the unit and also during every time the pumping is stopped is set.

AUTO VALVES CLOSING SETTING

Setting	Description
ENABLED	Automatic closing of gradient valves is enabled. Default settings.
DISABLED	Automatic closing of gradient valves is disabled.

After starting the pumping is one of the valves automatically opened according to setting of used valves (see *6.2.3.2*) and their concentration setting (see *6.1.3*).

Unit enables to change this setting also manually (see *6.3.5*), but after starting the pumping and stopping the pumping again, valves automatically close/open according to setting in this menu item.

6.2.4. Compensation

In each submenu possibilities of pulsation compensation function can be set.

6.2.4.1. Compensation Selection

Here can be selected desired mode of pulsation compensation. On main screen is displayed a mark according to selected choice (see *4.8*).

PULSATION COMPENSATION TYPE

Setting	Description
OFF	Compensation is turned off. Motor runs steadily independently of the pressure. Warnings about exceeding pulsation limit are not active. Default value.

Setting	Description
LEARNED 0 TMP	Compensation works on learned pump run. Learned process is temporary. By turning the pump off and on the learned process will be canceled.TMP (Temporary). Warnings about exceeding pulsation limit are active. Learning process is trying to find optimal curve of pump rotagion speed, so that pulsation meets the condition set in *Menu/Preferences/Compensation/Pressure pulsation limit*. Pump learning must be started in *Menu/Control/Start comp. learning.*
LEARNED 1 MEM	Compensation works on learned pump run. Learned process is saved until new learning under different conditions is performed. MEM (Memory) Warnings about exceeding pulsation limit are active. Learning process is trying to find optimal curve of pump rotation speed, so that pulsation meeds the condition set in *Menu/Preferences/Compensation/Pressure pulsation limit*. Pump learning must be started in *Menu/Control/Start comp. learning.*

6.2.4.2. Pressure Pulsation Limit

Pressure pulsation limit can be set in the range of **0.1-5.0 MPa (20 -730 psi)**. Default value is 1 MPa (150 psi). If the range width of pressure pulsation exceeds this limit, a warning is emitted.

6.2.5. Solvents

In each submenu options for monitoring the volume of the remaining mobile phase can be set.

6.2.5.1. Solvents Limit

Solvent limit can be set in the range of **0.0-100.0 l**. Default value is 1.0 l.

6.2.5.2. Solvents Limit Use

In this menu item desired mode of notice to volume limit overflow can be marked.

SOLVENT INSUFFICIENCY NOTICE MODE

Setting	Description
OFF	None notice is displayed. Default value.
AS WARNING	A warning is displayed.
AS ERROR	An error is displayed; the pump stops running and goes to the idle status. For pump restart, it is necessary to change actual volume of residual mobile phase in *Menu/Parameters/Solvents volume* or temporarily switch the notice mode to another setting possibility.

6.2.6. Log. Level

Here can be selected normal (*NORMAL*) or detailed (*DETAILED*) mode of logging level of unit run. Records can be read only from PC. Default value is *NORMAL*.

6.2.7. Leakage

This item is not supported for this type of pump. The pump don´t have leakage sensor.

6.3. Control

In submenu possibilities of pulsation compensation learning function can be set.

6.3.1. Start Compensation Learning

By entering this menu item, a pulsation compensation learning process starts. Before initiation of pulsation compensation learning, the pump **connects to the column and starts pumping.** It is ideal to carry out the learning process under working conditions, including used tubing, column etc. Learning process is trying to find optimal curve of pump rotation speed, so that pulsation meets condition set in item *Menu/Preferences/Compensation/Pressure pulsation limit*, at least for three consecutive revolutions. Learning process runs under constant flow rate (minimal flow rate is 8 ml/min). Learning process is shown by an icon on main screen (see *4.8*) and also warning with the message, that learning is in process. If it is not possible to complete the process under 10 min., another warning is displayed, that learning process has not been completed in desired time limit. Learning process can be stopped by pressing the PUMP key, which stops pumping, or using first item in *Menu/Control*, that changes to *Stop comp. learning*. In this case pumping does not stop. After confirmation by pressing the ENTER key (for *Stop comp. learning)* a question, whether to save the best result, is displayed. If the learning process is interrupted, it returns to last learned compensation value. Under the standard conditions, the pump usually learns compensation within 5 min.

In menu item *Menu/Diagnostics/Pulsation* pulsation status and information about values of parameters, under which compensation learning took place (see *6.6.9*) is displayed. After setting a different flow rate, then flow rate used the during learning process, with difference higher than ±166.7 ml/min (1/6 from maximal flow rate), pulsation compensation turns off. The unit displays a warning and a symbol on main screen (see *4.8*) is changed.

Note: When changing a column or mobile phase, we recommend to proceed the pulsation compensation learning process again.

A LIST OF WARNINGS AND ERRORS DURING PROCESS AND AFTER LEARNING PROCESS

Warnings and Errors	Description	Reason / Solution
W13	*LEARNING IN PROGRESS! OPERATE PUMP STEADILY.*	Displays after the learning process start.
W14	*PRESSURE PULSATION OVER LIMIT!*	Pumping continues in learned mode of compensation. It indicates e.g. unit aeration or leakage in flow system. Check the unit according to instructions in chapter *11*.
W21	*LEARNING TIME EXCEEDED BASIC PERIOD! AUTOMATICALLY CONTINUES TO PROLONGED PERIOD.*	Learning process did not complete within 5 min. It has been prolonged to 10 min.
W24	*PULSATION COMPENSATION WAS SWITCHED OFF DUE TO ACTUAL FLOW IS OUTSIDE LEARNED BOUNDS.*	After setting flow rate in interval ± 50 ml/min of learned flow rate compensation starts again.
W25	*LEARNING PROCEDURE WAS RESTARTED DUE TO ACTUAL FLOW CHANGE.*	New flow rate value has been set during learning process.

Warnings and Errors	Description	Reason / Solution
W30	*PUMP IS NOT LEARNED. COMPENSATION IS SWITCHED OFF!*	Proceed compensation learning process.
E44	*LEARNING DID NOT MEET PULSATION LIMIT WITHIN THE TIME! DATA WERE ANNULLED.*	Operating error. Pumping stops. Check the unit according to instructions in chapter *11.*
E45	*LEARNING WAS INTERRUPTED BECAUSE OF WORSENING! DATA WERE ANNULLED*.	Operating error. Pumping stops. Check the unit according to instructions in chapter *11.*
E51	*LEARNING WAS INTERRUPTED BECAUSE NEW FLOW IS TOO LOW! DATA WERE ANNULLED.*	Operating error. Pumping stops. Raise the flow rate to 8 ml/min.

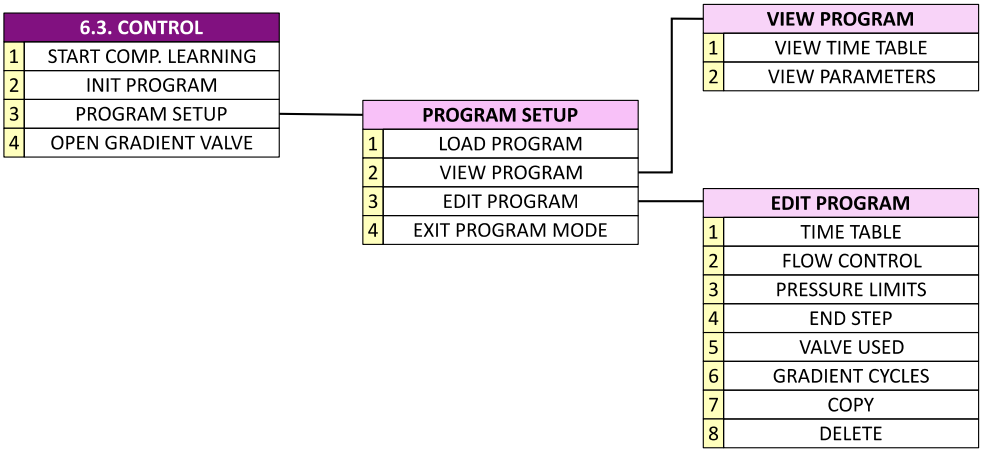
6.3.2. Gradient Program

Both pump types enable setting of 12 gradient programs directly in the unit. Programming offers a tool for gradient concentration course control and controlling mobile phase flow rate in time. It is also possible to set e.g. high and low pressure limit, different options of a program termination etc.

Mobile phase gradient concentration is changed linearly depending on time between steps. Contrary to a gradient concentration, flow rate change is proceeded immediately in time of given step. Program enables also step change of the concentration (see *6.3.4.3*). This item is only available for the gradient version of the pump.

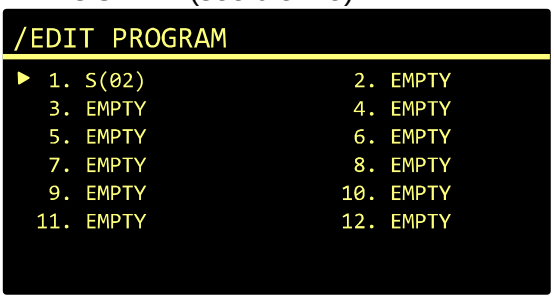
Attention: **We do not recomment to control the gradient from the pump keybord and PC at the same time.**

FLOW DIAGRAM FOR MENU ITEMS CONTROL A PROGRAM SETUP



Steps from Program Creating to Leaving Program Mode.

a) Creating program in *EDIT PROGRAM* (see *6.3.4.3*).



X. …program sequence number, S…Step, xx…total number of steps, EMPTY…empty.

b) Saving the program. Then the program is available in *VIEW PROGRAM* (see *6.3.4.2*) and *LOAD PROGRAM* (see *6.3.4.1*).

c) Uploading a program to the unit memory using *LOAD PROGRAM*. The unit enters the control state by a program called program mode. The screen switches to the *INIT PROGRAM* menu item.

d) Initialization of the *INIT PROGRAM* program (see *6.3.3*). The unit sets the default program parameters = initialization phase. Mobile phase, flow rate and pressure stabilize. At this stage, the sample is injected into the loop.

e) Starting the program – by turning the injecting valve from the LOAD position to the INJECT position (the sample passes to the column); by pressing the D key or by the external signal, which is set in menu item *Menu/IO Config/Interface/Digital input 1(2)/Program start*.

f) Program termination – automatically according to the setting in the menu item *END STEP* (final step) - *RUN* (program ends, pump is pumping), *STOP* (program ends, pumping stops), *REPEAT* (program ends, pump is pumping, program reinitiates for restart) – or during the running program by evoking menu item *Menu/Control/Reinit program* a následně *Menu/Control/Stop program.*

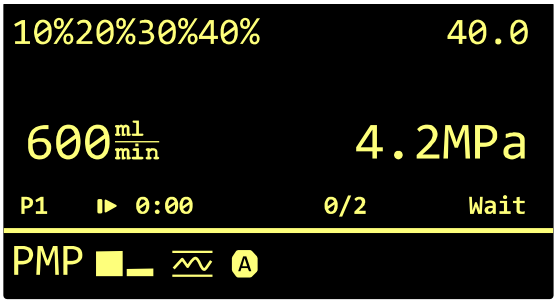
The program mode remains recorded after turning the unit off and on. When switched on, it is in the *STOP* state. If it is necessary to exit the program mode, it can be performed by *EXIT PROGRAM MODE* (see *6.3.4.4*).

When continuing to work with the **same program**, proceed in the same way from the **paragraph d)** in case of termination of *END STEP – RUN, STOP* or in case of termination during the running program (see paragraph f). Proceeding from the **paragraph e)** follows in case of *END STEP – REPEAT* or termination during the running program by evoking the menu item *Menu/Control/Reinit program*.

Accelerated selection of program initialization by long pressing the PUMP key after various options of program termination is described in more details below, including the state after turning the unit off and on.

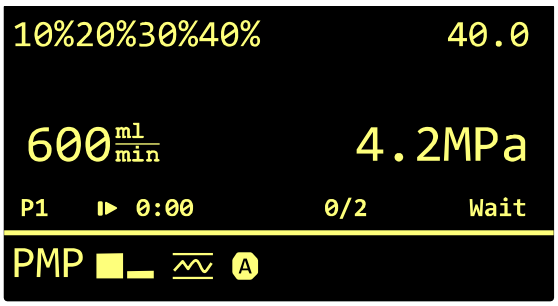
When continuing to work with a **new program,** proceed in the same way from the **paragraph c)** after each variant of the program termination or when it is necessary to first exit the program mode using *EXIT PROGRAM MODE*.

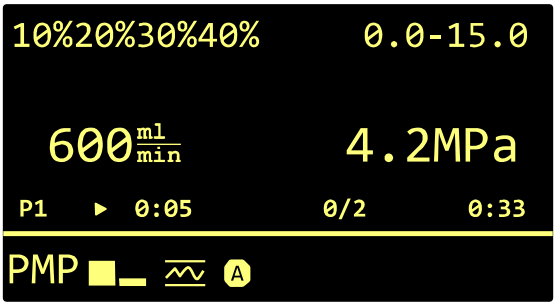
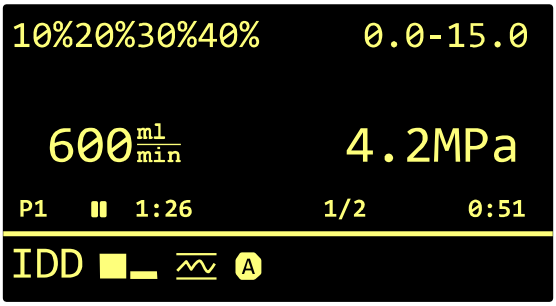
The program course can be monitored on main screen, which displays the parameters and symbols listed in chapter *4.8.* At the same time, new items related to the course of the gradient program are displayed, depending on the program phase or the performed action.

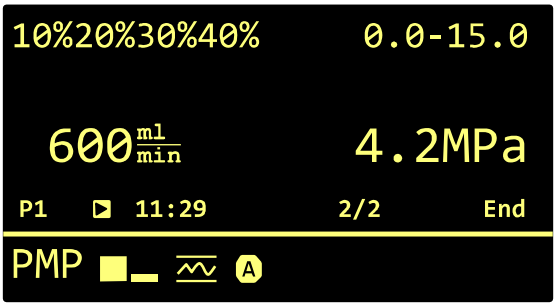
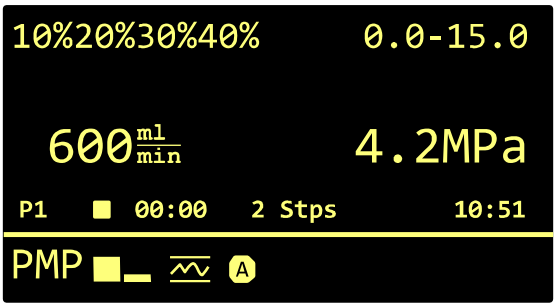
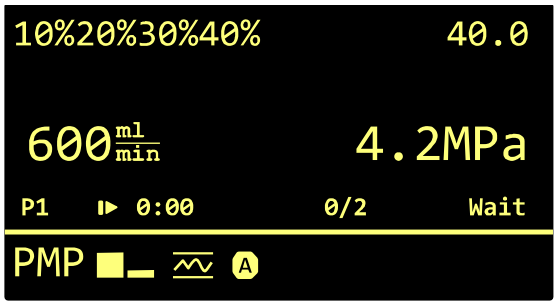


Value/Symbol	Meaning
P*zz*	Program sequence number *zz*.
►, II, I►, ■, ▶I	Program status and its influence on other unit functions is described below.
x/y	*X*th step from *y* steps. When setting the termination of the *STOP* program, *y Stps* (Stps…Steps) is displayed.
Total time	Time status (min:s) from the start of the program is placed in the upper right corner of the screen.
Step time	Time status (min:s) until the end of current step or *Wait* − waiting for start or *End* – program terminated. Displayed below x/y.
A%B%C%D%	The concentration is changed with visible countdown and countup of % in time for each valve or step changes or is constant.

CHANGES ON MAIN SCREEN FROM INITIALIZATION TO PROGRAM TERMINATION

Action	Description
Program loading	In item *Menu/Control/Program setup/Load program* is selected e.g. *10. S(06)*.
INIT PROGRAM	In item *Menu/Control/Init program*, press the ENTER key. Parameter setting of initialization step 0. I► is displayed on the screen, the total time does not count up and flashes, the pump is pumping. 

Action	Description
Program start	The change from I► to ► will be displayed on the screen, the total time and step time will start. The startup method is described above. 
Intercepting of running program	a) Pressing the **PUMP** key On display is shown change from ► to **II**, the total time stops and flashes, the step time stops, the pump stops. Mobile phase concentration change stops.  After pressing the PUMP key or D again, the program restarts. b) Pressing the **D** key On display is shown the change from ► to I►, the total time stops and flashes, the step time stops, the pump is running. Mobile phase concentration change stops. By pressing the PUMP key, the status changes to paused, I► changes to **II** and follows the manipulation as in previous paragraph. By pressing the D key, the status changes to running, I► changes to ►.
REINIT PROGRAM	During the program, the program can be reinitialized in the *Menu/Control/Reinit program* item. It is possible to pause the program by pressing the PUMP or D key before reinitializing.

Action	Description
Program termination	**RUN** – the program stops, the pump runs, ► changes to ◪, total time is counting up and step time changes to *End*. The pump retains the setting from the last program step.  **STOP** – the program terminates, the pump stops, ► changes to■, the total time is reset,the step time changes to the time of the entire program and the total number of steps with the abbreviation *Stps* is displayed. The pump retains the settings from the last program step.  **REPEAT** – the program ends and prepares for restart, ► changes to I►. Initialization phase performs. 

Accelerated Option of Program Initialization by Pressing the PUMP key

In case that the program has been terminated by *END STEP* (*RUN, STOP*), it is possible to use the accelerated option of program initialization by pressing the PUMP key for 3 s. For *RUN*, first press the PUMP key shortly in order to stop the pumping, (◪ changes to ■), then press the PUMP key longer, the program will initiate (■ changes to I►). For *STOP* press the PUMP key longer (■ changes to I►).

Status after Unit Turning Off and On

If **the unit is turned off during a running program** (e.g. due to a power failure), the program is set to the pause state of the running program when the device is turned on (see table above) (► changes to **II)**. Continue the same way as when a running program is paused.

If the unit is turned off after program termination *END STEP* (*RUN, STOP*), the program is set to the *STOP* ■ (*RUN* - ▶ changes to ■). Continue the same way as above. If *END STEP* (*REPEAT*), the program is set to the pause of the running program (**I►** changes to **II**). Continue the same way as above.

6.3.3. Init/stop/reinit Program

This menu item controls the initialization/stop/reinitialization of the program.

TEXT OPTIONS OF MENU ITEM

Setting	Description
INIT PROGRAM	Program initialization. Displays in the menu after loading the program from menu item *LOAD PROGRAM* (see *6.3.4.1*) and after the program termination.
STOP PROGRAM	Program stopping. Displays in the menu only during initialization phase of a program.
REINIT PROGRAM	Returning program to initialization phase and change to *STOP PROGRAM*. Displays in the menu during the entire running program.

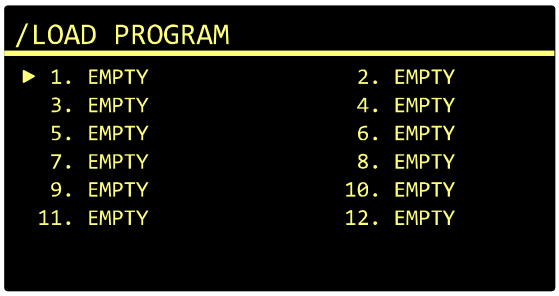
Press the ENTER key to perform the selected action.

6.3.4. Program Setup

In this item, gradient programs are loaded, viewed, created and eventually edited and the program mode is exited. The system allows the creation and storage of 12 programs. The default state is *EMPTY*.

6.3.4.1. Load Program

By loading the program into the unit memory, the unit is prepared for initialization using *INIT PROGRAM*. The system allows to upload only one program.



Use the arrow keys to select the desired program, press the ENTER key to load the program The item is automatically exited. The cursor appears on the screen next to the menu item *INIT PROGRAM*. Press the ENTER key again to set the initialization phase parameters.

6.3.4.2. View Program

The created program viewer allows to view the set parameters. The screen after entering the item is similar to the *LOAD PROGRAM* item. The *VIEW PROGRAM* is written in the header.

View Time Table

Sequence number of step, time (min:s) of the step start, flow rate (ml/min), mobile phase concentration A, B, C, D in % of volume. Use up and down arrow to move between the table pages.

An unadjusted valve is marked with - -.

View Parameters

Setting	Description
STEPS	Total number of program steps.
TIME	Total program time.
PLMIN	Low pressure limit.
PLMAX	High pressure limit.
VALVE	Used valves A, B, C, D.
CYCLE	Gradient cycles.
FLOWC	Flow control. ENBL = enabled or DISA = disabled.
ENDST	Options of program termination. RUN = pumping continues; STOP = pumping stops; RPT = pumping continues and reinitiates for restart.

6.3.4.3. Edit Program

In this menu item programs are created and edited. Submenu items are listed in flowchart above.

First Gradient Program Creating

Choose desired sequence number of program *X* and press the ENTER key.

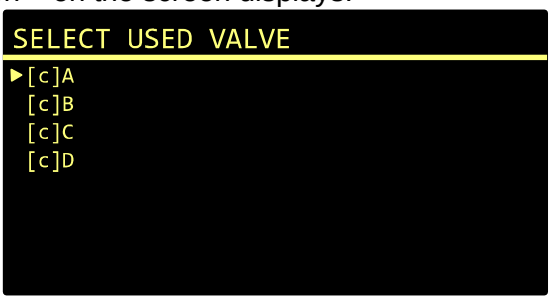
Note: It is recommended to set at first menu item *VALVE USED* and other functions before setting *TIME TABLE*.

Note: It is recommended to save the program after setting all steps. Saving of the program is proceeded after leaving the program by pressing the ESC key – a window menu with question save YES by pressing the ENTER key or NO by pressing the ESC key. After the saving of the program, the screen is changed - *X. EMPTY* changes to *X. S (xx)*. After pressing the ESC key, a confirming question is displayed, whether to leave without the saving or not.

Note: After creating a program, it is recommended to draft a graph of mobile phase gradient concentration, flow rate in steps depending on time, with marked beginning of each step.

SETTABLE PARAMETERS

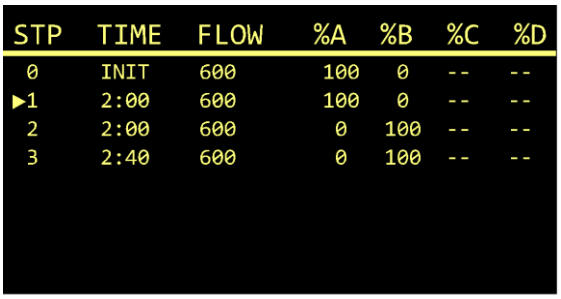
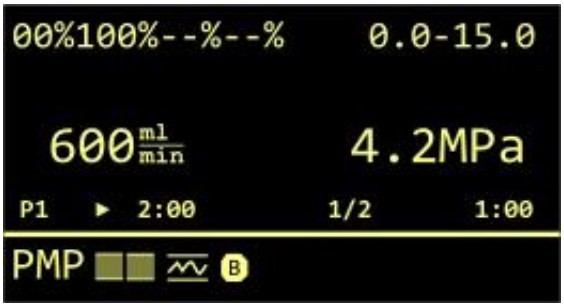
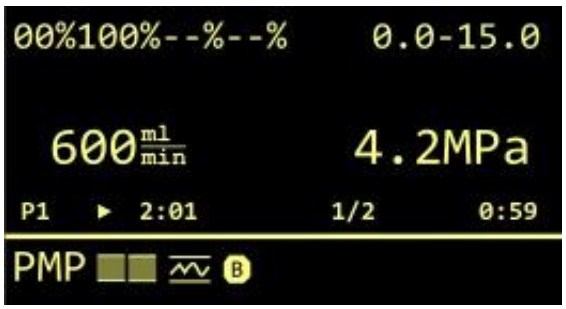
Setting	Description
TIME TABLE	Setting parameters for individual program steps. Use left/right arrows to select parameter, press the ENTER key to enter the editing screen: STP = step number 0-49. • 0…initialization phase. • Adding a step by using the down arrow from the last step. • Up to 8 steps are displayed on screen. • The options for working with the steps are described below the table. TIME = start time of each step on timeline. • INIT…initialization time, cannot be changed. • Range 00:01 – 99:59 (min:s). Entering the time 00:00 deletes the row. • Two steps of the same time can be entered (see below). FLOW = flow rate setting *0-1000* ml/min. The default is the current flow rate setting. %A, %B, %C, %D = mobile phase concentration setting (% of volume).
FLOW CONTROL	Choice of mobile phase flow control. The default state is *ENABLED*. **ENABLED** = program controls the flow rate. The flow rate is changed according to the setting in *TIME TABLE*. At the end of the END STEP – RUN, STOP, the flow rate from the last step of the program remains set and END STEP – REPEAT sets the flow rate of the initialization phase. **DISABLED** = program does **NOT** change flow rate. In the *FLOW* column in the *TIME TABLE* is displayed --. The running program works with the current flow rate of the unit, which can be changed by using the *FLOW* key.
PRESS LIM.	Setting of low and high pressure limit. The default is the current pressure limits settings. HIGH PRESSURE LIMIT (see *6.1.2.1*) LOW PRESSURE LIMIT (see *6.1.2.2*);
END STEP	Program termination and its impact on the mobile phase pumping. RUN = the pumping continues; STOP = the pumping stops; REPEAT = the pumping continues, the program initializates. The default value is RUN.
VALVE USED	Selection of used valves A, B, C, D (see *6.2.3.2*). The default is the current

Setting	Description
	valve settings. No valve selection – on the screen displays:  In *TIME TABLE*, *c* is displayed in all steps and in columns %A, %B, %C, %D. The running program works with the current valve settings and their concentrations (see *6.2.3.2, 6.1.3*). During the running program, **it is not possible to change** valves using the keys nor in the item *Menu/Preferences/Gradient/Valves used*. **It is possible to change** the concentration in the *Menu/Parameters/Concentration* item.
GRAD CYCLES	Setting of the gradient cycles (see *6.2.3.1*). The default is the current cycle settings.
COPY	Copying the program to other positions. Press the ENTER key to enter an item. The cursor sets the position number *Y. EMPTY*. Press the ENTER key again to start copying and this screen is automatically returned back to the currently edited program *X. S(xx)*. *Y. EMPTY* changes to *Y. S(xx).*
DELETE	Delete the content of the edited program. After pressing the ENTER key, a menu is displayed with a question, whether to delete YES by pressing the ENTER key or NO by pressing the ESC key. After confirming YES, we stay in currently edited program, then it is saved and *X. S(xx)* changes to *EMPTY.*

Note: Steps with same time are lined in order, as they were created.

WORKING WITH STEPS IN MENU ITEM *TIME TABLE*

Action	Description
Adding new step	Use an arrow down from the last step.
Adding new step between existing steps	1) Create a new step – initial step time, flow rate, concentration in % (see table above). 2) Exit *TIME TABLE* – ESC. 3) Controlling of the change made – enter the *TIME TABLE*. New step is enlisted on its position in timeline of the step beginnings.
Deleting step	1) Select step *X*. to delete. 2) Adjust the start time of the step – *mm:ss* to 00:00 – ENTER – the step remains on the same position in the list. 3) Exit *TIME TABLE* – ESC. 4) Controlling of the change made – enter the *TIME TABLE*. Step *X*. is deleted.
Moving step	1) Select step *X*. to move.

Action	Description
	2) Adjust the start time of step *X* to the desired start – ENTER – step remains on the same position in the list. 3) Exit *TIME TABLE* – ESC. 4) Controlling the change made – enter *TIME TABLE*. Step *X*. is moved to its position in timetable of the step beginnings.
Step change of concentration	1) Create a new step – the start time of the step is equal to the start time of the previous step. The flow rate value remains the same or is different from the previous step. Enter the required concentration. e.g.: A 100% changes to 0%, B 0% changes to 100%, C, D are closed.  2) Save.
	The change is displayed on the main screen as follows:   

Example:	The creation of a step change of the concentration in the already created *TIME TABLE*, when the new step should be listed before the start time of the already created step, is performed by creating a new step with a start time 1 s lower than the next step. Set the required concentration and flow rate. Then exit *TIME TABLE*. After re-entering the *TIME TABLE*, the new step is enlisted on its position in the timeline of step beginnings. Adjusting the start time of the newly inserted step to the same time as the step below creates step change in concentration.

Modifications of Existing Gradient Programs

Choose a number of the modified program *X. S(xx)*, press the ENTER key to enter and work like during the first setting. When leaving the modified program *X. S(xx)*, you will always be asked whether to save the changes or not.

Note:	If the modified program is also an uploaded program, it is not necessary to reload it after saving changes.

Viewing Running Program

Running program can be viewed in the menu item *Menu/Control/Program setup/View program* with no influence on the program course.

Modifications of Running Program

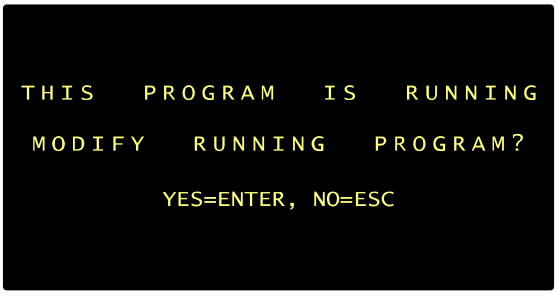
During the running program, it is possible to modify items in *TIME TABLE* (mobile phase gradient concentration, flow rate, step start time (*tn*), deleting steps, moving steps), termination of the program by *END STEP*, *FLOW CONTROL*, *PRESS LIM.* (high/low pressure limit) and *VALVE USED*. Some modifications of running step are described below including an example.

Only **flow rate** can be modified directly by pressing **the FLOW key** in initialization phase and other steps. When setting *FLOW CONTROL – ENABLE*, the adjustment is valid only for the given step and is not saved in the program. The next step runs according to the program setting.

All parameters are modified in the menu item *Menu/Control/Program setup/Edit program* directly during running program or it is possible to hold the program prior to the modifications.

Note:	We recommend to hold the running program by pressing the PUMP key.

It is possible to make modifications in the initialization phase, in the unstarted step, in running step and in the past step. When leaving the modified program by pressing the ESC key, you will be asked whether to save the changes or not. After saving the changes, you will see displayed:



Pressing the ENTER key	Pressing the ESC key
Saved changes are applied to the running	Saved changes are not applied to the running

program. Program concludes according to new setting. Program does not have to be reloaded.

program. Program concludes according to original setting. By reloading the program in menu item *LOAD PROGRAM,* the changes are applied.

Note: We do not recommend to combine saving changes with/without the running program modifications.

DETAILED DESCRIPTION OF SOME MODIFICATIONS OF RUNNING STEP

Modified setting	Description
TIME TABLE	**Moving start time of subsequent step** shortens/prolongs the time of the running step. This motion does not change the final value of a gradient concentration of running step. **Flow rate modification** does not influence the speed of the gradient concentration change. **Modification of gradient concentration** is done by concentration change of each valve in subsequent step.
FLOW CONTROL	After the change from *ENABLE* to *DISABLE*, the program keeps the flow rate value before this change and in *TIME TABLE* displays in column *Flow* - -.
VALVE USED	Removing and adding valves is possible. % of valve concentration should be always set to total sum of 100%. After leaving the menu item, check the *TIME TABLE*. When modifying this item incoordinatedly, it may happen that in *TIME TABLE* is set 100% for one valve and 0% for other valves in all steps.

Graphic Presentation of Modifications in Running Step.

In *TIME TABLE* is stated default program setting. There will be done two modifications during the running program. First modification is change of gradient concentration, proceeded during step 0 from %A = 70 to %A´ = 90. Second is modification of start time of step 3, done during step 2 from t3 = 5 min to t3´= 4 min.

TIME TABLE

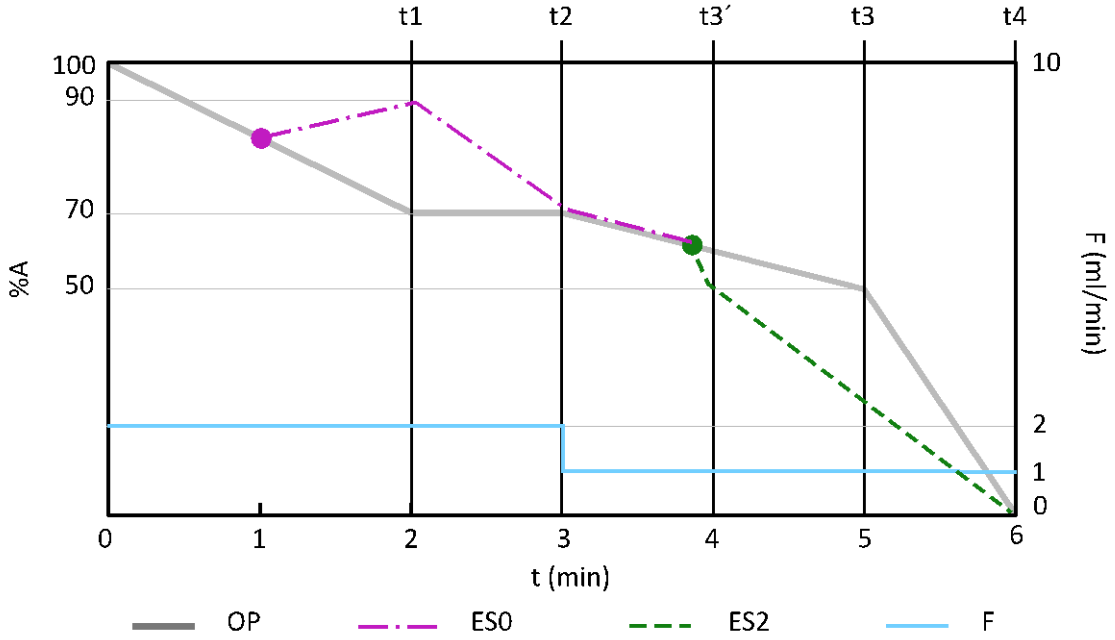
STP	TIME	FLOW	%A	%A´	%B	%C	%C´	%D
0	INIT	2	100	100	--	0	0	--
1	2:00	2	**70**	**90**	--	**30**	**10**	--
2	3:00	1	70	70	--	30	30	--
3´	**4:00**	1	50	50	--	50	50	--
3	**5:00**	1	50	50	--	50	50	--
4	6:00	1	0	0	--	100	100	--

The course of the original program in the graph below is representated by the *OP* curve. After the first modification during step 0, the course is represented by the *ES0* curve. After the second modification during step 2, the course is represented by the *ES2* curve. The course of the flow rate is displayed by the *F* curve. The initial times of the steps are shown by the line *tn*.

In time 1:00, the gradient concentration is changed, which is shown by a change of the curve direction from the point of change. By the end of step 0, the desired concentration is set.

In time 3:53, the start time of step 3 t3´ is shifted, which is shown by a change in the direction of the curve of the linear concentration gradient course starting from the point of change and with the concentration setting until the end of the step 2 according to the table.

GRAPHICAL RECORD OF PROGRAM AND ITS MODIFICATIONS



6.3.4.4. Exit Program Mode

Leaving program mode can be done by pressing the ENTER key. Pump gets to status, when it is not controlled by any program. Unit keeps setting from last used program.

6.3.5. Open/Close Gradient Valves

This item enables to open valves (A, B, C, D) manually when the pump is stopped, respectively it enables to close opened valves when the pump is not running. It is used during pump service, when it is necessary to disconnect the flow system, where mobile phase flows by gravity. Both actions are done in the same menu item, where text is different according to the valve status.

TEXT OPTIONS IN MENU ITEM

Setting	Description
OPEN GRADIENT VALVES	Displays when valves are closed and enables to open them.
CLOSE GRADIENT VALVES	Displays when valves are opened and enables to close them.

Press ENTER to proceed selected action.

Example: When *ENABLE* in the menu item *AUTO VALVES CLOSING* (see *6.2.3.3*) is set, the valves are closed after the unit start. When the pump stops running, the valves are automatically closed again. In this moment the unit enables to open the valves manually by pressing the ENTER key in the menu item *OPEN GRADIENT VALVES*. The corresponding valve opens and the name *OPEN GRADIENT VALVE* of the menu item changes to *CLOSE GRADIENT VALVES*. After starting and pausing the pumping, the valve closes again.

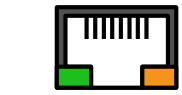
6.4. IO Config

6.4.1. Ethernet

In each submenu possibilities of Ethernet connection can be set.

Note: **Before connecting the unit into "corporate" network, always contact local network administrator and consult connecting parameters. This way you will prevent colisions in the network. For more information and troubleshooting with connecting ethernet devices, read document *Manual-Ethernet_devices*, available upon request.**

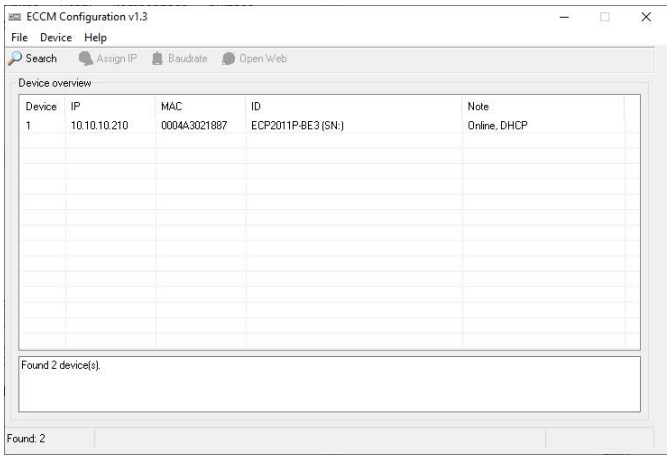
Ethernet interface supports communication speed 10/100 Mb/s. Common UTP cable (Cat 5e) can be used for connection. The RJ45 connector for Ethernet connection is on the rear panel of the unit and has two signaling diodes:

Location	Description
 	LED1 Meaning: Operating speed (OFF = 10 Mbit/s, green = 100 Mbit/s).
	LED2 Meaning: Link activity (OFF = inactive, orange = active). The LED blinks normally.

Communication with the unit can be easily tested from a computer using internet browser by entering address http://XXX.XXX.XXX.XXX, where XXX.XXX.XXX.XXX is actual IP address of the unit.

Current setting can be found in *Menu/Info/Ethernet*.

Special application **EccmConf** can be used to search and manage device IP setting. The application can be downloaded from ECOM website.



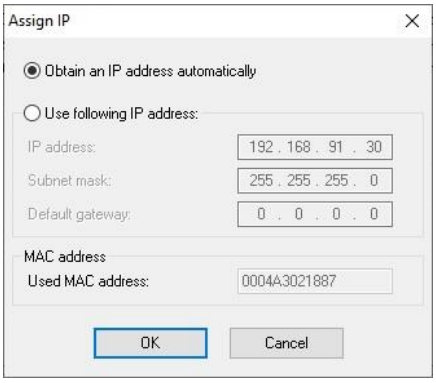
Search icon can be used to find all adequate units connected to the network. If no unit was found, check the unit power supply and ethernet connection (LEDs on connector should shine). The problem can be caused by firewall or network restrictions too (contact network administrator).

All found units will be shown in application list with following information (IP address, physical MAC address, unit identification and connection note). The note describes connection status together with assignment state (Static IP/DHCP):

CONNECTION STATUS

Note state	Description
Online	Connection is OK and the unit is ready for communication.
Used	Connection is OK, but communication cannot be opened. The unit is used already.
Unreachable!	Connection is invalid. The unit IP address doesn't correspond to a local network address and communication cannot work without setting valid IP setting.

Assign IP icon can be used to set new IP setting. Assignment should work regardless the unit is unreachable. IP parameters are following:



Application icon ***Open Web*** can be used to open unit website in an internet browser. Its function is at the moment only informative. Any browser can be used, when valid actual unit IP address (xxx.xxx.xxx.xxx) is entered to URL field.

Device web pages offer basic device overview and configuration of network and serial setting. Setup is available only after a valid login. Default login is following:

Default login	
User name	user
Password	1991

Note: Password can be reset to default by special command through USB or RS232 only.

6.4.1.1. DHCP/STATIC IP

The choice of *DHCP* enables automatic setting of connecting parameters (IP address, Subnet Mask, Defaul Gateway) in network, where this function is supported. Allocation of address can take several seconds. Actual connecting parameters can be found in *Menu/Info/Ethernet*.

The choice of *STATIC IP* enables manual setting of connecting parameters in next subchapters. This choice is suitable for direct connection with PC (using a cable/switch) without other connection to another network. It is necessary to set on the unit and also in the PC suitable connecting parameters (e.g. ECP2000: IP=192.168.091.030, MASK=255.255.255.000 and PC: IP=192.168.091.001, MASK=255.255.255.000).

Caution:	**When using static address on a corporate network, always contact network administrator in order to avoid colisions!**

Default setting is automatic parameter assignment via DHCP, which makes the initial connection easier. However, it is necessary to contact the network administrator if you are on a corporate network, in order to ensure that the connection parameters do not change over time.

6.4.1.2. IP Address

IP address, used in *STATIC IP* mode. Default value is 192.168.091.030.

6.4.1.3. Subnet Mask

Subnet mask, used in *STATIC IP* mode. Default value is 255.255.255.000.

6.4.1.4. Default Gateway

Default gateway, used in *STATIC IP* mode. Default value is 000.000.000.000.
It is usually not necessary to set this item.

6.4.2. Remote Keylock

If the unit is controlled or data are collected via serial line (RS232) or via Ethernet, the LED RMT is alight. The unit switches to mode of remote control immediately after receiving first query or demand through RS232 line or Ethernet, and leaves this mode, if it does not receive any query or demand for a period of 3s.

KEYLOCK SETTING

Setting	Description
LOCKED	Keypad is fully locked. Default value.
ALLOW PUMP, PURGE	Keypad is locked except the PUMP and PURGE keys.
ALLOW PUMP, PURGE, FLOW	Keypad is locked except the PUMP, PURGE and FLOW keys.
UNLOCKED	Keypad is fully functional.

6.4.3. Interface

The unit is equipped with auxiliary external interface (connector IO INTERFACE), which can be used according to setting described below. Number of interface pins are stated on unit rear panel.

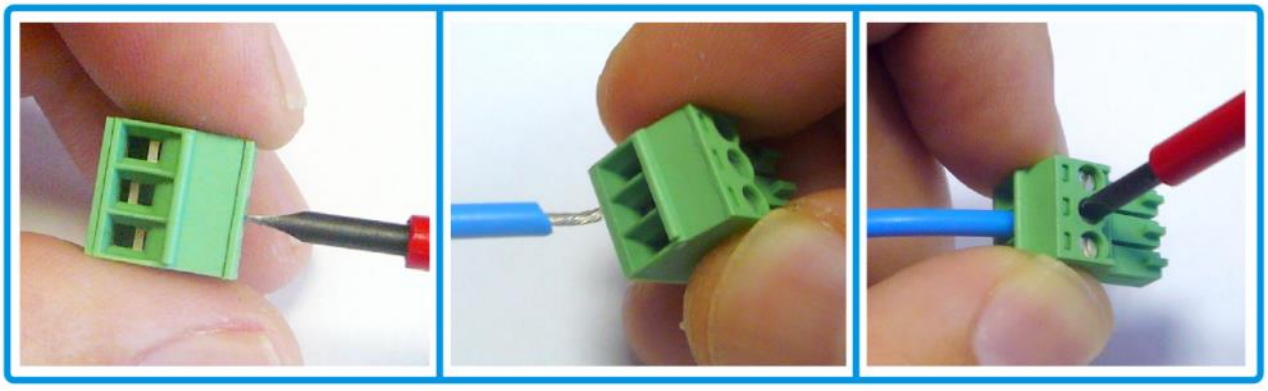
IO INTERFACE SPECIFICATION

Pin	Abb.	Name	Description
1	+5V	-	Auxiliary power supply +5 V DC max. 40 mA.
2	AIN−	ANALOG INPUT	Analog input ground. Internally connected with GND and chassis.
3	AIN+		Analog input signal. 0 - 10 V DC. Overvoltage protection up to 12 V. Sampling frequency min. 100 Hz, input impedance 100 kΩ, resolution 2.5 mV.
4	GND	-	Ground.
5	DIN2	DIGITAL INPUT 2	Digital input 2. Compatible with TTL, HC, HCT. Overvoltage protection up to 12 V. In opened status it is on level H.
6	DIN1	DIGITAL INPUT 1	Digital input 1. Compatible with TTL, HC, HCT. Overvoltage protection up to 12 V. In opened status it is on level H.
7	ACOB	DIGITAL OUTPUT SWITCH	Semiconductor switching device, contact A and B. Working voltage max. 60 Vdc, 42 Vac. Working current max. 240 mA. Switch impedance ON max. 2.5 ohm. Residual current max. 1 uA.
8	ACOA		

For external input/output interface IO INTERFACE are used connector blocks with screwing contact (included in accessories).

For connecting the cable to the connector block, loosen the nut using a small flat-tip screwdriver. Remove an isolation from the connected cable in the length of approximately 3 to 4 mm. Insert the skinned part of the cable into the place under the nut and tighten the nut. Carefully try, if the conductor holds in the block. If the conductor is too thin, it is better to remove the isolation from a longer part and bend the skinned part before inserting it into the block.

Note: Connector blocks are meant for cables with section up to 1.5 mm^2.



Diagnostics of actual IO INTERFACE status can be done in *Menu/Diagnostics/Interface*. For digital inputs, the *OPEN (H)* value means opened input, high level and *CLOSE (L)* value means closed input, low level. For digital output is displayed *OFF* (for open switch) and *ON* (for closed switch).

Analog input, digital input 1, 2 and digital output switch can always be read through remote control (RS232/ETHERNET/USB).

6.4.3.1. Analog Input

ANALOG INPUT can be used as follows:

SETTING MODES OF ANALOG INPUT

Setting	Description
OFF	Analog input does not have any assigned function. Default setting.
FLOW CONTROL	Analog input is used for setting flow rate. 0 V = 0 ml/min and 10 V = 1000 ml/min. Flow rate cannot be set using keyboard or through remote control (RS232/ETHERNET/USB). The PUMP key and pumping command through remote control (RS232/ETHERNET/USB) can control pumping.

6.4.3.2. Digital Input 1

DIGITAL INPUT can be used as follows:

SETTING ACTIONS ON DIGITAL INPUTS

Setting	Description
OFF	Digital input does not have any assigned action. Default setting.
SAFETY STOP	When switching input from level H to level L, pumping is stopped and operating error is evoked. This error must be cancelled using the PUMP key or with a pumping command through remote control (RS232/ETHERNET/USB) or using signal PUMP on any other digital input.
PUMP	When switching input from level H to level L, pumping is started (motor is excited even when flow rate is set on 0 ml/min). When switching input from level L to level H, pumping is stopped. The PUMP key, pumping command through remote control (RS232/ETHERNET/USB) or SAFETY STOP can control pumping.
PROGRAM START	External start of the program. When switching from level H to level L, program is started (e.g. VICI type injection valve from position LOAD to INJECT).

6.4.3.3. Digital Input 2

The same possibilities and setting as for Digital input 1.

6.4.3.4. Digital Output Switch

Digital output (DIGITAL OUTPUT SWITCH) can be used as follows:

SETTING ACTIONS ON DIGITAL OUTPUT

Setting	Description
OFF	The output is not controlled by any action. The output is disconnected.
REMOTE	Output remote control. Default setting
LEAKAGE	If the measuring sensor is immersed in liquid, output is connected. **This action is not available for this pump type.**
ERROR	If at least one error is evoked, output is connected.
PUMP	If the pump runs, output is connected.
COPY START	If the signal START is on level L, output is connected.
COPY DIN1	If the digital input 1 is on level L, output is connected. Even in case of setting

Setting	Description
	digital input on OFF.
COPY DIN2	If the digital input 2 is on level L, output is connected. Even in case of setting digital input on OFF.

6.5. Info

In each submenu information about the unit and its parts is displayed.

The unit contains information about internal components, their serial numbers, versions etc. All information can be read from computer and serves for clear identification of the unit and its components.

The unit contains global time counter about service time of the unit (*Menu/Info/Device*). Based on this time are also recorded events, that have occurred during unit use and for service needs it is possible to read them using a computer. In the same manner are also recorded replacements of most important unit components, which are saved in a special record.

6.5.1. Device

Displays unit's name, its serial number and total operating time.

6.5.2. Boards

Displays information about electronic boards in the unit. *BN* - board name, *HW* - board version, *FW* - firmware version, *UN* - board identification number.

6.5.2.1. Main Board

Unit main board.

6.5.2.2. Display Board

Display and keyboard board.

6.5.2.3. Communication Module

Ethernet communication module.

6.5.3. Ethernet

Displays information about actual setting of ethernet. *IP*-IP address of the unit, *MASK* – subnet mask, *GATE* – default gateway, *MAC* – unique hardware address.

6.5.4. User Text

User information about the unit. This information can be set only through PC. It serves for user description of the unit, its placement etc.

6.5.5. Pump

In this submenu is displayed supplementary information about the pump run from unit start-up. *REV. COUNT* - camshaft speed (number of piston cycles), *OPER. TIME* - operating time.

6.5.6. Parts

Displays information about replaced pump components. First item is operating time (pumping) from last replacement and second item is number of revolutions (piston cycles) from last replacement (speed is in thousands).

6.5.6.1. Seals

L. PUMPING - left working head seal, *R. PUMPING* - right auxiliary head seal, *L. WASHING* - left washing head seal, *R. WASHING*-right washing head seal.

6.5.6.2. Check Valves

L INLET – left inlet check valve, *R INLET* – right inlet check valve, *L OUTLET* – left outlet check valve, *R OUTLET* – right outlet check valve.

6.5.6.3. Pistons

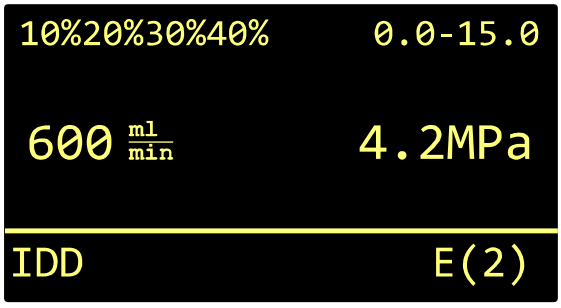
LEFT - left piston, *RIGHT* - right piston.

6.6. Diagnostics

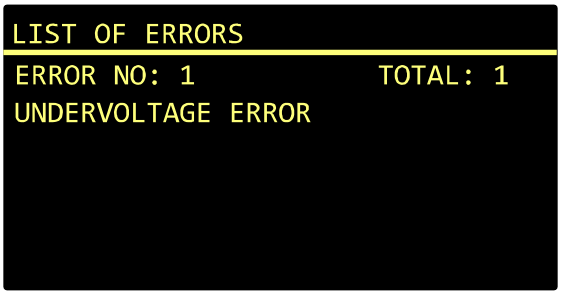
Diagnostic information about the unit.

6.6.1. Errors

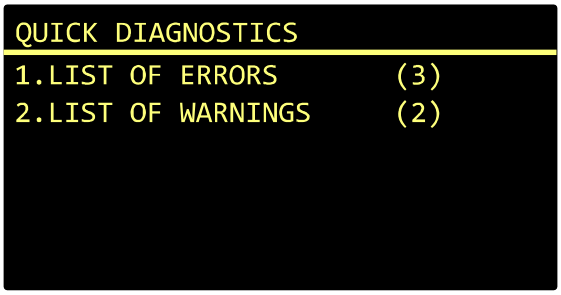
ERROR is displayed on the screen. The unit distinguishes three types of errors – simple error, operating error and fatal error. When reporting simple error, pumping does not stop, error is announced by three beeps and LED ERR still shines red. When reporting operating error, pumping stops and after pressing the PUMP key, it starts pumping again, if the fault source has been corrected. When reporting fatal error, pumping stops and its start is blocked. Reset can be done by turning the unit off and on, after elimination of the fatal error.



If a serious problem occurs, display shows symbol *E* with a number of errors in brackets.



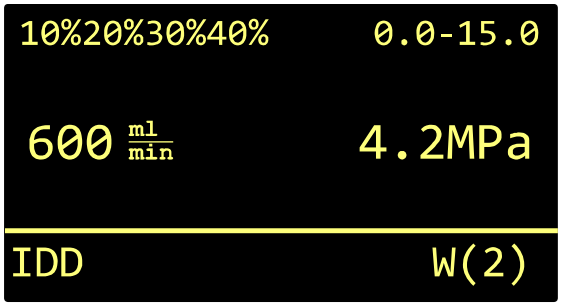
After entering a menu item *Menu/Diagnostics/Errors*, a number (*ERROR NO:*), description of actually displayed error, total number of occurred errors (*TOTAL:*) and eventually arrows indicating possibility to browse, in case more then one error has occurred, is displayed. When entering this detailed screen, it is possible to see an actual status, which is not updated. For an update, you have to leave this screen and re-enter it.



For an easier access to description of errors and warnings is designed the *QUICK DIAGNOSTICS* screen, which you can evoke from basic screen by pressing the ENTER key. When entering this screen, you can see an actual status, which is not updated. For and update, you have to leave this screen and re-enter it.

6.6.2. Warnings

WARN is displayed on the screen.



If a deviation from standard unit behavior occurs, symbol *W* with a number, is displayed on the basic sreen, meaning number of warnings. Access to description and further behavior similar to errors, see previous the chapter.

6.6.3. Power

In this menu item is displayed voltage value of main supply, mosfet drive circle, tensometer, analog.

STATUS OF POWER

Item	Description
MAIN	Voltage on main supply. It should be 28 ± 1 V.
MOSFET DRIVE	Voltage on mosfet drive circle. It should be 15 ± 1 V.
TENSOMETER	Voltage on pressure sensor. It should be 5 ± 0.5 V.
5 V ANALOG	Voltage on analog. It should be 5 ± 0.5 V.

.

6.6.4. Cooling

In this item rotation speed of fans *FAN1*, *FAN2*, *FAN 3 and FAN 4 (RPM)*, their common voltage *VFAN (V)* and information about the temperature inside the instrument *TEMP (°C)* is shown. *FAN 3* is not used.

6.6.5. Interface

This menu item gives information about inputs/outputs of *IO INTERFACE* and start signal input from injection valve (*START)*.

STATUS OF IO INTERFACE

Item	Description
AIN	Voltage on analog input.
DIN1 a DIN 2	Status of digital inputs.
DOUT	Status of digital output switch.
STRT	Status of input signal *START.*

6.6.6. Leakage State

This menu item shows status of a leakage sensor. **The menu item is not supported for this pump type.**

6.6.7. Pump

In this menu item status of pump mechanism is displayed. Units for pressure are stated in upper row.

STATUS OF PUMP MECHANISM

Item	Description
PACT	Actual pressure.
PAVG	Middle (integral) pressure during one cycle.
PULS	Pressure pulsation (bandwidth *PMAX – PMIN*) per one cycle.
DEAD	Status of optical switch detecting position of top dead centre of main (left) piston – CLOSE/OPEN.
MAGV	Motor load mean value (% of maximum allowed load).
MMAX	Motor load peak value (% of maximum allowed load).
CAMR	Camshaft speed (rotations per minute).
PPOS	Piston actual position.

6.6.8. Solvents

In this menu item an actual volume of residual mobile phase (solvents) in ml is displayed.

6.6.9. Pulsation

In this menu item the status of pump pulsation is displayed. Units for pressure are stated in upper row.

PUMP PULSATION STATUS

Item	Description
PU01	Pulsation during last rotation.
PUAN	Average pulsation in *n* rotations, *n* is determined by firmware based on actual flow rate.
PUBT	Best reached pulsation during learning process.
PULI	Pressure pulsation limit.
PAVG	Average pressure in one rotation.
LTIM	Learning time – time lapsed from learning start.
LFLO	Learning flow – flow rate during learning (constant).
PPOS	Actual piston position.

Note: After compensation learning start (see *6.3.1*) for items *PUAN, PUBT* displayed ---. Values of pulsation are displayed after *n* rotations. At this moment learning process starts.

6.6.10. Gradient State

In this menu item values for controlling gradient valve are displayed.

STATUS OF GRADIENT VALVE

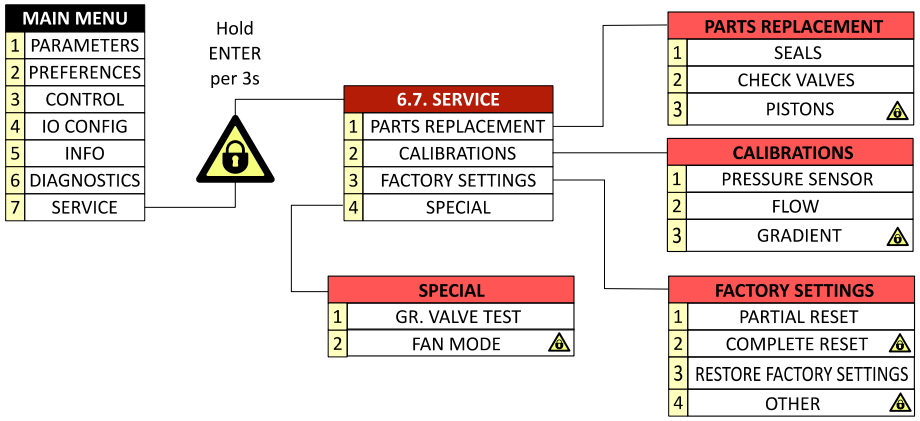
Item	Description
FUNCT	Connection with the box: ON =connected, OFF = disconnected.
VALVE	Used valve.
IDRES	Measured value of the identification resistor.
BOX	Box type number.
GVHV	Gradient valve switch voltage 26 – 30 V (H … high current).
GVLV	Gradient valve hold voltage 4 – 6 V (L … low current).
GVAC	Gradient Valve Actual Current.

6.7. Service

Service menu is **secured with a password**. **Before entering this part, please read following chapters first!**

Code for entering service menu = press and hold the ENTER key for the period of 3 s!

SERVICE MENU FLOW DIAGRAM



Caution: **Items marked with ⚠ are inaccessible for users. Only authorized person can enter this part of menu.**

Caution **The following operations can be performed only by qualified person. Before starting below described procedures, disconnect the unit from power source by disconnecting the main supply cable. The unit may be reconnected to power source only after all service operations are finished!**

6.7.1. Parts Replacement

In this part of menu can be noted seals exchange (in working head and washing head), checkvalves and pistons replacement. In the following chapters is described process of replacement of these parts and recording in *Menu/Servis/Replacement/Seals (Check valves,*

Pistons). The unit maintenance and terms for the replacement of individual unit components are stated in chapter *12.1*.

Other replaceable parts are needle and O-ring in degassing/purging valve. This exchange is not recorded by the device.

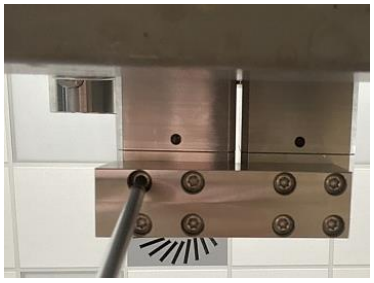
Caution:	**Before and after parts replacement, print and file Info sheet from ECOMAC or from Clarity.**
Caution:	**New parts should be rinsed in isopropanol or methanol before replacement. Eventually clean them in ultrasound.**
Caution:	**Regularly reset the counters (see *6.5.6*) after parts replacement. Information in the counter are very important for future unit service.**

6.7.1.1. Seals

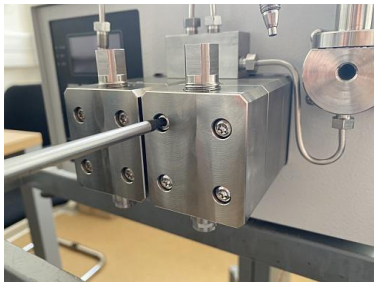
Caution:	**Pump piston is made of fragile material. When mishandled, its smooth surface may be irreversibly damaged or it may crack!**

Disconnect the unit from power source!!!

Disconnect the inlet tubing.



Use a TORX TX20 screwdriver to loosen the screws on the underside of the pump inlet block and remove the block.



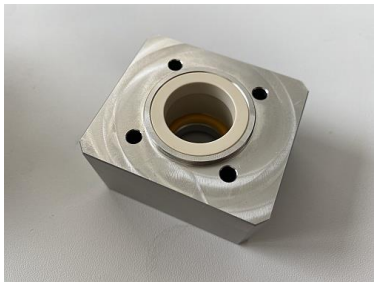
Loosen the capillary on the outlet valve holder using side wrench 3/8" and bend it slightly. It is possible to dismount the connecting capillary completely, if needed.

Loosen 4 screws in head using screwdriver TORX TX20. The screwdriver is a part of a unit accessories.

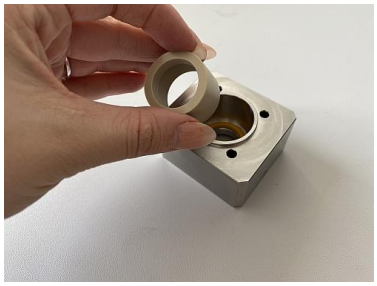
Pull the head straightly out of the piston.
Leaning the head to sides may cause a piston damage!

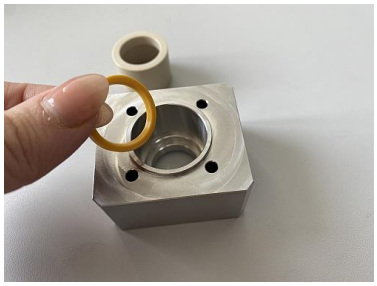
Detail of working head.

Remove the seal using a suitable tool. Wash and clean the piston and interior of the head with isopropanol.



Usually, it is not necessary to exchange the seal in washing heads, but in case it is needed, follow the same steps as with working heads.
Detail of a washing head.





Wet new seal in isopropanol and place it on the piston carefully. The spring is facing toward the head.

The steps for mounting are same as for dismounting, but in reverse order.

Pushing the head with new seal back on the piston must be straight. **Leaning the head to sides may damage the seal.**

Caution:	**Screw in the left and right screw alternately into the heads of each block. Each screw must be screwed with the same number of rotations.**

New seals should be run-in before the first use. Disconnect all equipment connected to the pump output. Connect a reduction valve (or other reliable hydrodynamic resistor) directly to the pump output. Put the inlet tubing and output capillary into the same reservoir with solvents isopropanol: water in a ratio of 1:1.

Note:	It is recommended to connect a 10 µm filter (frit) in front of the pressure reducing valve. Small parts of the seals may be released.

Set the flow rate to 1000 ml/min, start pumping and set pressure at 5 MPa using reduction valve. Let the pumping for at least 30 min (optimally 2 h). Keep the flow rate at 1000 ml/min and

set pressure at 10 MPa. Let the pumping for at least 30 min (optimally 2h). Keep the flow rate at 1000 ml/min and set pressure at 14 MPa. Let the pumping for at least 10 min (optimally 30 min.). Then set flow rate at 100 ml/min and pressure at 7.5 MPa. Let the pumping for at least 10 min (optimally 1 h).

Seals are now set and run-in. Pump is ready for standard operations. Do not forget to rinse the isopropanol from the pump using your mobile phase. (If the pressure decreases during this operation, it is necessary to run the pump in for a longer time (optimally). If you do not have a reduction valve, it is possible to use an old column, which meets the above stated parameters).

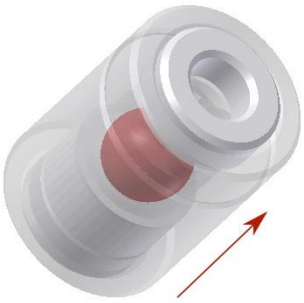
Caution:	**Watch washing heads and all connections during run-in for any leakage. Correct every untightness!**

In unit menu item *Menu/Service/Parts replacement/Seals* tick the seal that has been replaced.

LEFT PUMPING - left working head seal
LEFT WASHING - left washing head seal
RIGHT PUMPING - right auxiliary head seal
RIGHT PUMPING - right washing head seal

Continue by choosing the *CONTINUE* item. Press the ENTER key for confirming the replacement. After this step, the operation counters in *Menu/Info/Parts/Seals* are zeroized.

6.7.1.2. Check Valves



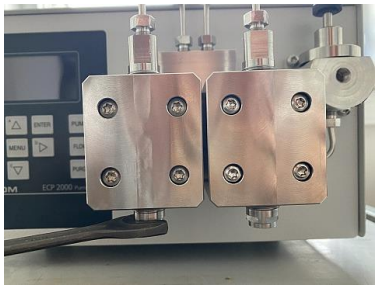
The basis of a check valve is a precise ruby **ball and seat** placed in a case made of PEEK with stainless steel reinforcement. Liquid flow pushes the ball into the seat and thus seals. Due to high pressures in the pump, any **slight impurity** adhering to the ball or seat surface may cause **pressure fluctuation** or the pump fails to start at all. If it is not possible to eliminate this problem by repeated purge, it is necessary to exchange or clean the check valves.

Flow direction through the valve is in the direction of the drawn arrow on the side of the valve.

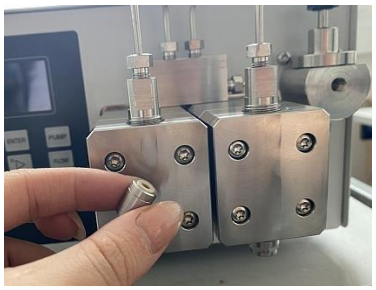
Disconnect the unit from power source!!!

Disconnect the inlet tubing.

Use a TORX TX20 screwdriver to loosen the screws on the underside of the pump inlet block. and remove the block.



To exchange the inlet valve, loosen its holder using side wrench 12 mm and remove the holder with the inlet valve.



Take the inlet valve from the holder and replace it with a new one.

Loosen the capillary on the outlet valve holder using side wrench 3/8" and bend it slightly. It is possible to dismount the connecting capillary completely, if needed.

To exchange the outlet valve, loosen its holder using side wrench 12 mm.

Remove the outlet valve holder.

Take out the outlet valve from the head and replace it with a new one.

Insert the new valve in the same way as the old one. Continue the same way as during dismounting, but in reverse order. Tight all screws strongly and after starting the pump, check all connections for any leakage.

In menu item *Menu/Service/Parts replacement/Check valves* tick the valve (valves) that has been replaced.

LEFT INLET – left inlet valve

LEFT OUTLET – left outlet valve

RIGHT INLET – right inlet valve

RIGHT OUTLET – outlet valve

Continue by pressing the CONTINUE key. Press the ENTER key to confirm the check valve(s) replacement. After this step operation counters are zeroized in *Menu/Info/Parts/Check valves*.

Caution:	**After replacing check valves, purge/degass the unit.**

6.7.1.3. Pistons

Replacement of a piston can be performed only by a qualified person.

6.7.1.4. Needle of Degassing/Purging Valve

Disconnect the unit from power source!!!

Unscrew the old needle and replace it with a new one.

6.7.1.5. O-ring in Degassing/Purging Valve

Disconnect the unit from power source!!!

Unscrew two screws using screwdriver TORX TX20 from unit accessories.

Take out the head of degassing/purging valve. White or transparent seal is under the head.

Unscrew the needle, take out a metal ring and O-ring and replace the O-ring with a new one.

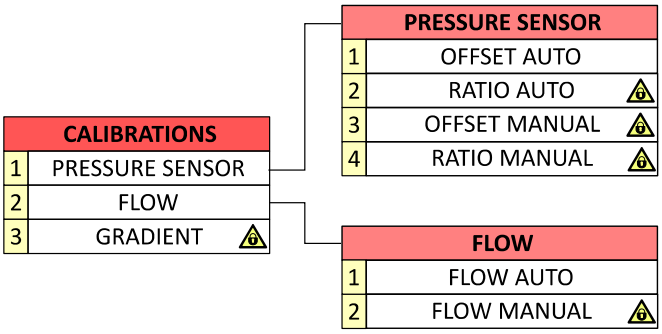
After replacement of the O-ring, steps for mounting are the same as for dismounting, only in reverse order.

Caution:	**Needle is screwed into head of degassing/purging valve in a way that it does not go out of the valve and then the head of the valve with needle is screwed onto pressure sensor.**

6.7.2. Calibrations

In these submenus pressure sensor, flow rate and gradient are calibrated. For user is available only automatical calibration of pressure sensor zero *OFFSET AUTO* and automatical flow rate calibration *FLOW AUTO*.

CALIBRATIONS FLOW CHART



6.7.2.1. Pressure Sensor

In this menu item the zero of pressure sensor is calibrated. For user is available only item *OFFSET AUTO*, where pressure sensor zero is set automatically. Calibration is proceeded on **stopped pump**. At first loosen purge/degassing valve and then press the ENTER key for proceeding automatical calibration.

Caution:	**When correcting offset often, contact service.**

6.7.2.2. Flow

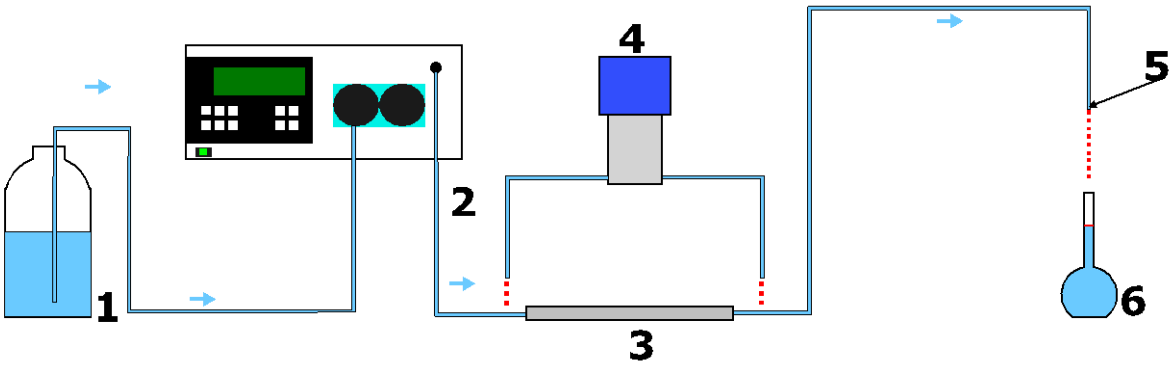
In this menu item a mobile phase flow rate is calibrated. For user is available only automatical flow rate calibration *FLOW AUTO*.

Caution:	**For correct calibration process it is necessary that the pumping system is rinsed properly. There must not be any bubbles and check valves must work correctly (if there are used check valves without springs, pressure should be at least 1 MPa (150 psi).**
Caution:	**For own calibration conditions (pressure, flow rate, mobile phase) are set as close as possible to the conditions used during common unit use.**

In menu item *FLOW AUTO* is flow rate calibration proceeded in six steps. The unit makes calculations by itself based on measured time and volume passed through during this time, which is recorded. For the calculations it is necessary to add value of reference (exact) volume. Based on the calculated deviation, the unit sets flow rate correction.

Prior to calibration is the unit connected according to flow chart below. Reference volume is the volume of accurately measured volumetric flask class A (according to ISO 1042), into which the mobile phase flowing through the unit drips. After filling the exact volume of the volumetric flask, the measuring is finished.

FLOW CHART OF SYSTEM FOR FLOW RATE CALIBRATION



1.Container with liquid; 2. Pump; 3. Column (CAUTION: some are not intended for pure water); 4. Pressure control valve (may be used instead of the column); 5. End of a capillary, 6. Volumetric flask.

Note:	We recommend to use freshly degassed mobile phase.

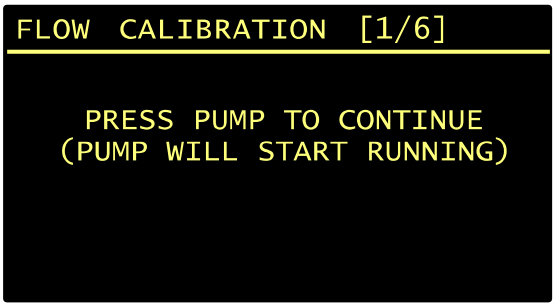
Selection of Volumetric Flask Volume

Volume of volumetric flask should be chosen based upon set flow rate, so that the measuring takes from 5 up to 15 min.

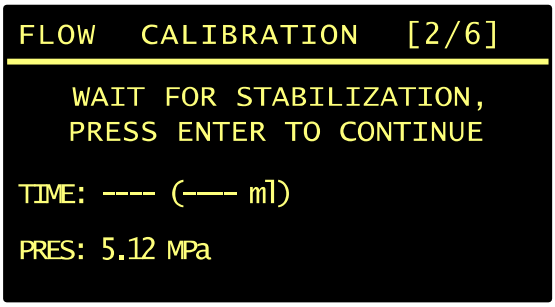
Example:	For flow rate 10 ml/min resp. 150 ml/min resp. 300 ml/min is selected volumetric flask with volume 100 ml resp. 1000 ml resp. 2000 ml.

Press the ENTER key to enter menu item *FLOW AUTO*. At the screen heading 1/6 with action instructions is displayed. After completing given action proceed to the following step.

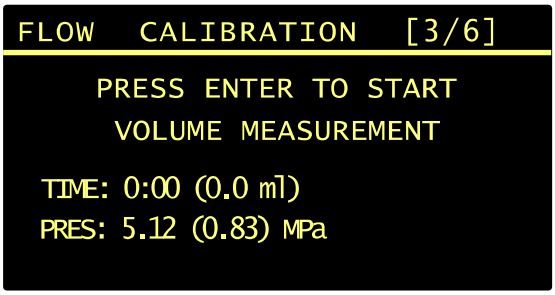
1/6) Start the pump by pressing the PUMP key. Process proceedes to the following step.



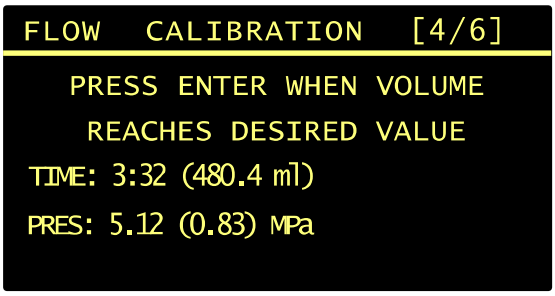
2/6) Parameters measured by the unit are displayed – time, volume, pressure. Let the unit to stabilize for approximately 1 minute. Press the ENTER key to continue.
TIME --- (--- ml); PRES xx (yy) MPa (xx…actual pressure, yy…pulsation)



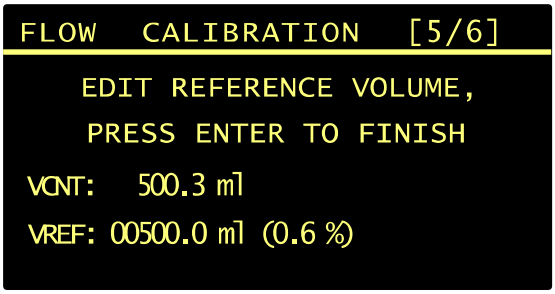
3/6) The unit is prepared for start by pressing the ENTER key. At the same time start capturing mobile phase in the volumetric flask.



4/6) Time and volume start to countdown. After filling volumetric flask, press the ENTER key.

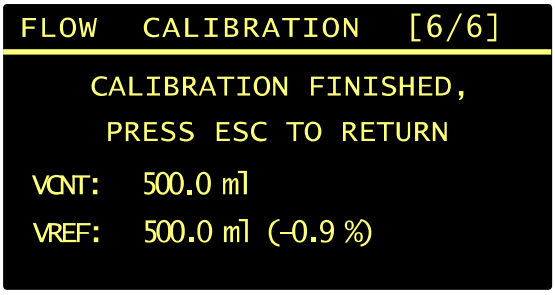


5/6) Pumping stops, time and volume countdown stop. Display shows *VCNT*…volume measured by the unit during measuring (ml); *VREF*…reference volume (ml), filled in according to used volumetric flask; *(xx %)* …deviation from previous calibration.



After pressing the ENTER key, the calibration of flow rate (*FLOW AUTO)* is finished. After pressing the ESC key, the calibration won't finish.

6/6) The unit calculates new deviation based on measured and submitted parameters and corrects *VCNT* compared to *VREF* and records new deviation.



Checking Flow rate

After check valve or seals replacement or after significant change of working conditions, check real flow rate first without using menu item *FLOW AUTO*. The mobile phase is collected into volumetric flask and time is measured with a stopwatch.

Calculation of real flow rate of the pump **when measuring time of filling volumetric flask**:

$$F = \frac{V}{t}$$

F(ml/min)	pump flow rate
V(ml)	volume of the volumetric flask
t(min)	time of the volume collection

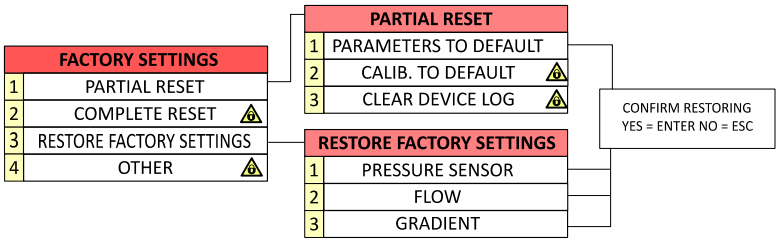
6.7.2.3. Gradient

Gradient calibration is accessible only to a qualified person.

6.7.3. Factory Settings

This menu item enables to partially or completely reset the system of the unit. Majority of the menu items is blocked for user and is available only to a qualified person.

FACTORY SETTINGS FLOW CHART



6.7.3.1. Partial Reset

User can access menu item *PARAMETERS TO DEFAULT*, enabling setting unit's default parameters.

6.7.3.2. Complete Reset

System complete reset is accessible only to a qualified person.

6.7.3.3. Restore Factory Settings

This menu item enables restoring factory configuration of pressure sensor calibration, flow rate and gradient. After entering menu items by pressing ENTER – *PRESSURE SENSOR*, *FLOW* (flow rate), *GRADIENT* – is displayed menu for confirming the restoration.

6.7.3.4. Other

This menu item is accessible only to a qualified person.

6.7.4. Special

6.7.4.1. Gr. Valve Test

During the gradient valve test, all gradient valves are switched one after the other and their electrical functionality is tested. **This item is available for the gradient version of the pump only.**

6.7.4.2. Fan Mode

This menu item is accessible only to a qualified person.

7. WORKING MODES

The unit may be in different working modes regarding to requested actions. The pump passes to some modes after command of staff or PC, others are evoked automatically in order to execute a sequence of operations.

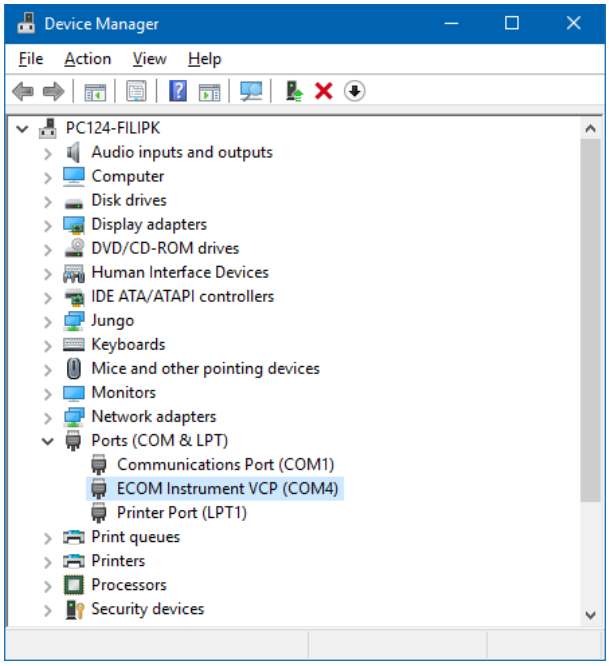
WORKING MODES

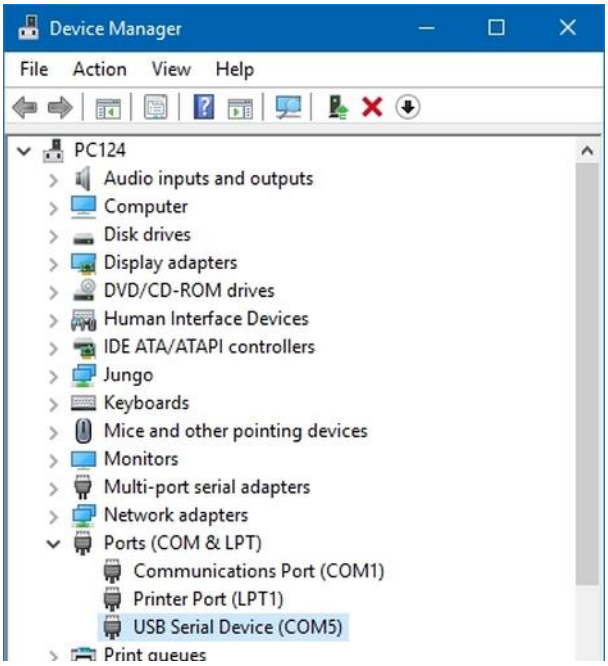
Mode **EN name** **Abbreviation**	**Description**
Initialization INITIALIZATION INI	Temporary mode after unit start. Basic unit initialization is executed.
Idle IDLE IDD	Mode after the pumping was stopped. It enables to reconfigure operating parameters. The unit is waiting for command to start pumping.
Pumping PUMPING PMP	Mode during pumping.
Other	Unit has several other modes, used only for special reasons.

8. USB

USB interface together with adequate driver emulates serial connection (Virtual Com port) and removes the need of any USB/RS232 converter. The connector USB type B is on the unit back panel and standard USB print cable (A to B) can be used for connection to PC. We recommend to use good quality cable with length up to 2 meters for connection.

The driver ECOM Instrument VCP needs to be installed on the PC. It creates virtual serial port, which should be available for the device (see Windows Device Manager). The driver is part of ECOMAC software or it can be downloaded from our website. It is available for Windows 7, Windows 8 and 8.1. Drivers are installed automatically for systems Windows 10.



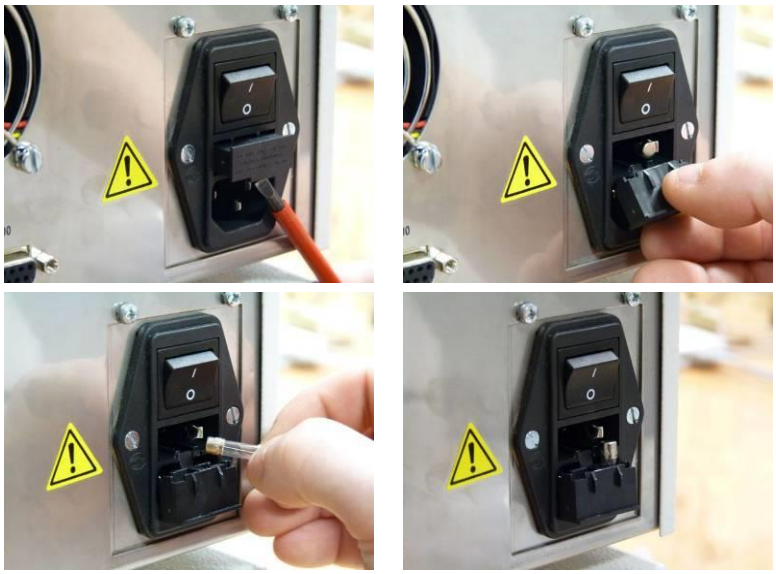


The unit communicates based on communication protocol which is available upon request.

9. RS232

The unit enables communication via line RS232. On the unit is connector Canon DB9 male and on the cable must be Cannon DB9 female connector. For connecting must be used crossed serial cable, containing Canon DB9 female connectors on both sides. Parameters for connection are 115 200 Baud, 8 data bit, 1 start bit, 1 stop bit, no parity. The unit communicates based on communication protocol which is available upon request.

10. REPLACEMENT OF LINE FUSE



Disconnect the unit from power source!!!

Using a flat-tip screwdriver release the fuse holder from its bottom.

Remove old line fuse.

Insert into the holder the new line fuse (which is a part of pump accessories), whose value is indicated on the device label.

Insert the fuse holder back.

Push the fuse holder all the way inside.

11. TROUBLESHOOTING

Situation	Caused by / Conditions	Solution
Liquid leaking from washing heads.	Damaged seal in a pumping head.	**Replace the seal immediately. The pump must not be used with damaged seal.**
Pressure pulsation. Pressure sometimes suddenly decreases.	Column, injection valve or other equipment connected after the pump.	Test if the problem persists without any equipment connected after the pump. Then try to connect any reliable source of hydrodynamic resistance (column, reduction valve).
	Bubbles.	Check all connections on capillaries and tubings connected before, in and after the pump. Try to purge the pump again and watch the tubing connected after mobile phase filter, for bubble formation. If any bubbles are formed there, exchange/rinse this filter. It is possible to use a degassing unit.
	Defective check valve.	Try to replace the check valve. See *6.7.1.2*.
	Impurity in a check valve.	Purge it with air flow or insert in ultrasound bath (see *12.3*)
	Damaged seal – esp. when using solvents as Acetonitrile. It may seem like bubbles are formed inside the pumping system; it is convenient to remove other source of bubbles using degasser.	Try to replace the seals. See *6.7.1.1.*
	Insufficient run-in of the pump after replacing the serals.	Try to exchange seals. See *6.7.1.1*.
	Electronic failure.	Contact service center.

Situation	Caused by / Conditions	Solution
Flow rate is lower than set value.	Pressure stability.	Problems with lower flow rate occur and usually relate to problems with pressure stability – see solution above.
	Solution agent.	Solution agents with very high or very low viscosity may cause these problems. As well as not degassed solvents.
	Calibration.	After excluding the above reasons, perform the automatic calibration *FLOW AUTO* (see *6.7.2.2*).
	Electronic failure.	Contact service center.
Motor works hardly/loudly, there wasn't indicated any pressure and flow rate is low or none.	Clogged frit of outlet valve (only if check valves with frit are used).	Check the frit, try to clean it or replace the check valve.
	Wrong orientation of outlet valve.	Check the orientation of the outlet valve.
	Electronic/mechanic failure.	Contact service center.
Errors and warnings reporting (Wxx, Exx)	E24 – *PRESSURE PEAK OVER SAFETY LIMIT!*	Operating error. Locate and eliminate reason for pressure escalation – stuck column, clogged frit connected after the unit or other, above mentioned.
	E41 – *PRESSURE OVER HIGH LIMIT*	
	E28 – *PRESSURE UNDER LOW LIMIT!*	Operating error. Locate and eliminate reason for pressure suppression – leakage from the system (leaking purge/degass valve and other, above mentioned).
	W5, E30 – *BOX LEAKAGE! REMOVE ALL LEAKS. DRY UP SENSOR AND WAIT FOR 60 s TO UPDATE.*	Reported according to setting in *6.2.7*. Operating error. Eliminate source of leaking and dry up surroundings of sensor (see *6.2.7)*
	W 17, 18, 19, 20; E 37, 38, 39, 40 – *SOLVENT A (B, C, D) UNDER LIMIT!*	In gradient mode. Reported according to setting in *6.2.5.2.* Operating error. Add mobile phase into reservoir and set new volume in menu item *Menu/Parameters/Solvents volume*.

Situation	Caused by / Conditions	Solution
	W 22; E 42 - *SOLVENT UNDER LIMIT!*	In isocratic mode. Reported according to setting in *6.2.5.2*. Operating error. Add mobile phase into reservoir and set new volume in menu item *Menu/Parameters/Solvents volume*.
	E6 – *GRADIENT VALVE MALFUNCTION! CHECK CONNECTION TO BOX.*	Simple error. Check and tighten holding screws on connector ECB 2000 or on the box.
	E7 – *BOX NOT RECOGNIZED! CHECK CONNECTION TO BOX.*	
	E8 – *GRADIENT PROGRAM WAS STARTED, BUT PUMP IS NOT IN A GRADIENT MODE*.	Simple error. Check and tighten holding screws on connector ECB 2000 or on the box.
	W13, 14, 21, 24, 25, 30; E44, 45, 51.	Pulsation compensation learning, see *6.3.1*.
	Other.	Contact service center. Save log and Infosheet from ECOMAC or Clarity.

12. MAINTENANCE

12.1. Periods

Minimal period for check valve and seal exchange is one year. This period may be shortened, if buffers, high pressure/flow rate and aggressive solvents are used, in everyday use or other aggravating working conditions. In case of such difficult environment, it is recommended to exchange the check valves and seals every 6 months.

Piston replacement is performed approximately once per 5 years under difficult working conditions or when pistons are damaged after inappropriate replacement of other parts. When the unit is used under common conditions, piston replacement is performed approximately once per 10 years.

Checking unit function (Operational qualification (OQ), unit validation) under heavy-duty operating conditions is recommended to be performed once per 6 months or once per 1 year, if the working conditions are optimal, max. once per 2 years. During unit validation a complete unit control is proceeded and according to observed unit condition the damaged parts can be replaced.

Periodic control of tightness of pumping block (working and washing) screws is recommended once per month.

It is recommended to check lubrication of moving parts of the pump mechanics once per a year.

Recommended period for replacing mobile phase filters on inlet tubings is 1 year.

Caution:	**When pumping above 10 MPa and flow above 500 ml/min, it is necessary to check belts, lubricate mechanical gears and leakage of liquid from washing head every 500,000 camshaft speed or the each 1/2 year (counter of camshaft speed is recorded in the *Menu/Info/Pump*). Replacement of seal the each 1,000,000 camshaft speed.**
Caution:	**When liquid leaks from washing head so the seals must be exchange in the both head (working and washing).**

12.2. Cleaning and Decontamination

Follow safety instructions of agents used in chromatography process.
Use dry or moistened cotton cloth for cleaning unit's surface.

12.3. Cleaning Check Valves

Remove the check valves (see *6.7.1.2)* and **clean them using ultrasound** in distilled water or other solution agent, which is dissolving used buffers. You may also try a combination of water bath with inorganic/organic or polar/nonpolar solvent.

12.4. Storage and Transport

If the pump is to be shut down for a longer period of time or transported, it is advisable to flush it with isopropanol and plug it afterwards. The unit must be packed in a way to avoid possible damage during transportation.

13. SPARE PARTS

P/N	Picture	Description
58606000		GL45 Media/Storage Bottle 1000mL (storage bottle for piston back washing set, for ECP201L and ECP201LG)
00519		Piston seal 20 mm UHMWPE (working head seal; polyethylen with high molecular weight; lower chemical resistance; high abrasion resistance, for ECP201L and ECP201LG)
00524		Piston seal 20 mm UHMWPE (washing head seal from UHMWPE, for ECP201L and ECP201LG)
00525		Piston seal 20 mm GFP55HT (working head seal; teflon filled with graphite; high chemical resistance; lower abrasion resistance, for ECP201L and ECP201LG)
00531		Piston seal 20 mm GFP55HT (washing head seal from GFP55HT, for ECP201L and ECP201LG)

P/N	Picture	Description
ACM40000		High-flow preparative check valve for 1000 ml/min (for ECP201L and ECP201LG)
ACM21200		Ceramic piston with a spring and positioning parts (piston diameter 20 mm, for ECP201L and ECP201LG)
12480		Stainless steel spring, 75/47/3 (for ECP201L and ECP201LG)
ACM00060		Outlet check valve holder (for ECP201L and ECP201LG)
ACM00050		Inlet check valve holder (for ECP201L and ECP201LG)
ART05477		O – ring ID 4,47 mm, cross section 1.78 mm, Kalrez® (for ECP201L and ECP201LG)
PG252000		Needle of degassing/purging valve, PEEK (for ECP201L and ECP201LG)
ACA20140		Leveling head seal KEL-F (seal for degassing/purging valve head, for ECP201L and ECP201LG)
33018000		Strain gauge pressure sensor (1/4-16 BSPP, 10 mV/V, 600 bar, for ECP201L and ECP201LG)
ACM23000M		Motor with a pinion (when ordering, note unit serial number and pump type, for ECP201L and ECP201LG)
990673		Timing belt HTD8 60 teeth, 20 mm wide (for ECP201L and ECP201LG)
990671		Timing belt HTD5 72 teeth, 15 mm wide (for ECP201L and ECP201LG)

P/N	Picture	Description
990695		Timing belt HTD5 105 teeth, 9 mm wide (for ECP201L and ECP201LG)
ACM70000		Dita + Ervin + Grace-P+ Paul Boards (when ordering, note unit serial number and pump type, for ECP201L and ECP201LG)
MV101P1A		Oliver24 Board (Display Board, for ECP201L and ECP201LG)
EKAB-024		Crossed serial cable 9pin RS 232 (2x DB9 female, length approx. 2 m, for ECP201L and ECP201LG)

14. Warranty and Post-Warranty Repairs

Warranty and post-warranty repairs are provided by the manufacturer or dealer organization authorized by company ECOM.

Repair of products in the warranty period carried out by a person other than manufacturer or authorized service organization, is a reason for warranty nullification.

The scope of the warranty and its duration is given in the certificate of warranty.

Manufacturer:
ECOM spol. s r.o.
Trebonicka 239
252 19 Chrastany u Prahy
Czech Republic

Tel.: + 420 221 511 310
E-mail: info@ecomsro.cz
www.ecomsro.com

15. TECHNICAL PARAMETERS

Parameter	ECP201L
Flow rate	2 – 1000 ml/min
Pumping system	two plungers dia. 20 mm connected in parallel
Maximum operating pressure	15 MPa (2180 psi*, 150 bar) up to 1000 ml/min
Flow rate setting	1 ml/min steps
Repeatability of flow rate adjusting	± 1 %
Accuracy of flow rate setting	± 2 %
Adjustable upper pressure limit	1.0 – 15.0 MPa
Adjustable lower pressure limit	0.0 – 14.0 MPa
Wetted materials	stainless steel, PEEK, Tefzel™, Kalrez®, ceramic, ruby, seals**
Control	RS232, Ethernet (LAN), USB, Remote I/O Interface
Display, keypad	OLED 2.4“ 128x64 pixels, 10 buttons
Power supply	100 – 240 VAC
Power input	500 VA
Dimensions (w x h x d)	276 x 153 x 620 mm (10.87 x 6.14 x 24.40 in)
Weight	26 kg (57.32 lb)
Input tubing outer diameter	3/8”
Output capillary outer diameter	1/8”
Operational environment conditions	Indoor use only. Altitude: up to 2000 m Temperature: 5-40°C Humidity: maximum relative humidity 80 % for temperatures up to 31°C decreasing linearly to 50 % rel. humidity at 40°C. Voltage fluctuations: up to ±10 % of nominal voltage. Overvoltage category II. Pollution degree 2.

*) ***SW of unit rounds the pressure in psi automatically to tens.***
***) Seals material: default is GFP (PTFE), optional is UHMW-PE, more information upon request.*

16. APPENDIX 1 - DECLARATION OF CONFORMITY

We,
ECOM spol. s r.o.
Trebonicka 239, CZ-252 19, Chrastany
Czech Republic
Company ID No.: 41 192 192

as the manufacturer declares, that the product meets all applicable provisions of the EU directive on electromagnetic compatibility Government Decree No.117/2016 Coll. (Directive 2014/30/EU) and all applicable provisions of the EU low voltage directive Government Decree No.118/2016 Coll. (Directive 2014/35/EU), as well as Restriction of the use of Certain Hazardous Substances (RoHS-2) 2011/65/EU

Product: **Preparative HPLC Pump**
Model: **ECP201L**

Contextual models: ECP201LG
Application of the product: The equipment is used in the lab for the injection of sample, switching mobile phase delivery from different pumps, sample collecting during chromatographic analysis
Manufacturer: ECOM spol. s r.o., Trebonicka 239, CZ-252 19, Co. ID No.: 41192192

The following technical standards were applied when evaluating conformity:

EN 61010-1 ed.2:2011 + A1:2019 (idt IEC 61010-1:2010+A1:2016+COR1:2019),
EN 61000-6-3 ed.3:2021 (idt IEC 61000-6-3:2020),
EN 61000-3-2 ed.5:2019 (idt IEC 61000-3-2:2018),
EN 61000-3-3 ed.3:2014 (idt IEC 61000-3-3:2013),
EN 61000-6-1 ed.3:2019 (idt IEC 61000-6-1:2016),
EN 61000-4-2 ed.2:2009 (idt IEC 61000-4-2:2008),
EN 61000-4-4 ed.3:2013 (idt IEC 6100-4-4:2012),
EN 61000-4-5 ed.3:2015 (idt IEC 6100-4-5:2014),
EN 61000-4-6 ed.4:2014 (idt IEC 6100-4-6:2013),
EN 61000-4-8 ed.2:2010 (idt IEC 61000-4-8:2010),
EN 61000-4-11 ed. 3:2020 (idt IEC 6100-4-11:2020).

Evaluation of conformity was performed by company TÜV SÜD Czech, s.r.o with the certified quality system according to ČSN EN ISO 17020 which issued the following reports:

26.05.2023 Inspection report for electromagnetic compatibility No. 15.345.828-1
26.05.2023 Inspection report for electrical equipment safety No. 15.345.828-2

Prague 03.10.2023

Ing. Jan Fara, PhD.
CEO

17. APPENDIX 2 – ECP201LG GRADIENT PREPARATIVE PUMP

Gradient preparative pump with a high pressure of 15 MPa at a flow rate up to 1000 ml/min.

17.1. Accessories

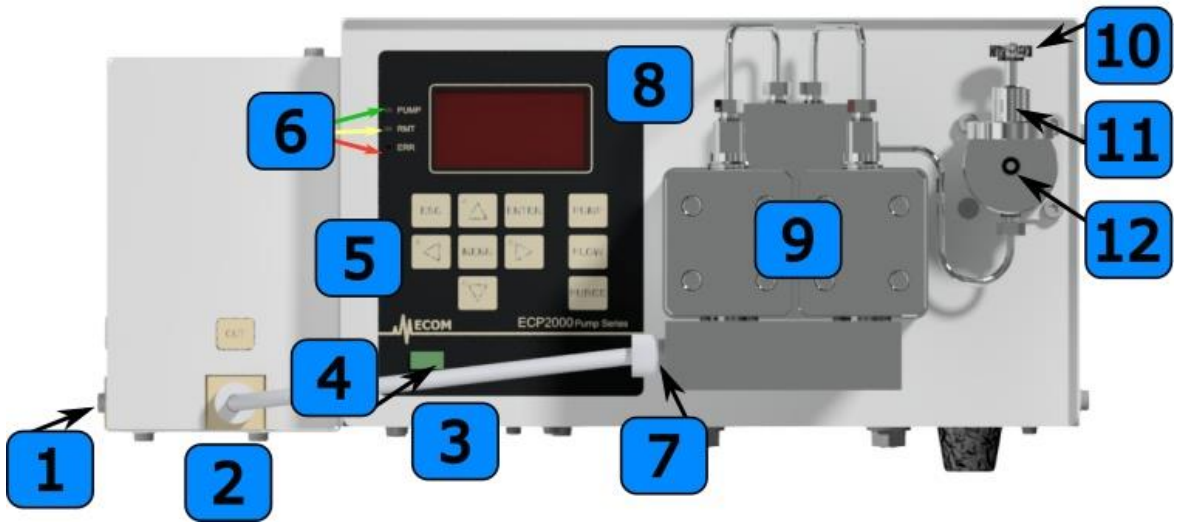
BASIC ACCESSORIES

P/N	Qty.	Picture	Description
SCK43001	4		FEP inlet tubing 3/8” 2000 mm (FEP tubing,OD=3/8”, ID=1/4”, volume=63.3 ml only tubing, 1x SS nut 3/8”, 1x PTFE ferrule 3/8", thread UNF 5/8”-18)
ACMG1000	1		FEP inlet tubing OD 3/8"x ID 1/4", l = 0.24 m (FEP tubing,OD=3/8”, ID=1/4”, volume=17.1 ml only tubing, 2x SS nut 3/8”, 2x PTFE ferrule 3/8", thread UNF 5/8”-18 Connecting of gradient box with pump, only for ECP201LG)

The ECP201LG pump is supplied with a different number of accessories Cat. No.: SCK43001.

17.2. Description

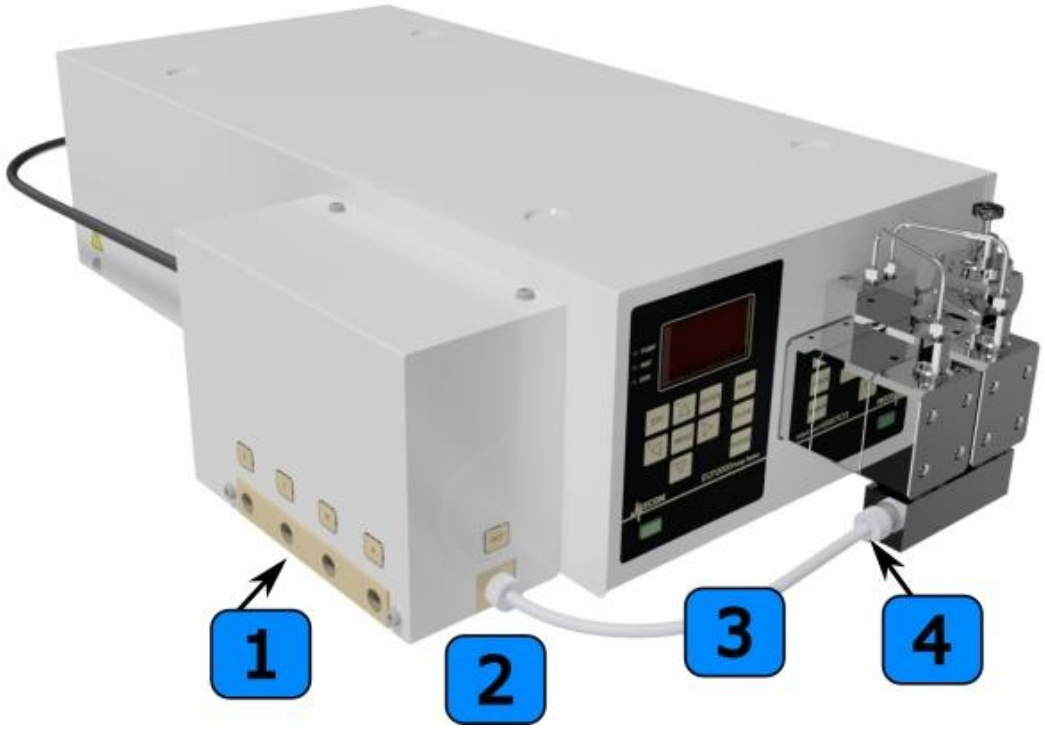
FRONT VIEW



No.	Description
1	Gradient box inlets A, B, C, D.
2	Gradient box output.
3	Connecting tubing OD 3/8" x ID 1/4", 0.24 m.
4	Front switch.
5	Keyboard.

No.	Description
6	Status LED lights: PUMP (green) indicates status of pump motor (PUMP and PURGE). RMT (yellow) indicates status of unit remote control. It lights when the unit is communicating through interface ETHERNET or RS232. ERR (red) indicates error status of the unit. It lights, if an error is indicated and blinks, if a fatal error is indicated, when unit status has been changed.
7	Connection for input tubing (pump inlet).
8	Display.
9	Pumping block.
10	Bypass valve.
11	Pressure sensor.
12	Connection for output capillary (pump outlet).

SIDE VIEW



No.	Description
1	Gradient box inlets A, B, C, D.
2	Gradient box output.
3	Connecting tubing OD 3/8" x ID 1/4", 0.24 m.
4	Pump inlet.

REAR VIEW

No.	Description
1	Combined power socket with main switch and main fuse.
2	Connector ECB2000 with cable (gradient box connection).
3	Connector RS232.
4	Connector Ethernet/LAN.
5	Connector USB.
6	Connector for external start.
7	Connector IO Interface.

17.3. Inlet Tubing Connection

At first dismount plug on the gradient box and pump inlet.

Caution: After production or service, the pump is filled with isopropanol.

At the gradient box inlet, connect the tubings (SKC43001) with ss Handtight nut (00000360) and PTFE Ferrule (00000230) to the gradient box channels and insert the other end into the containers with mobile phases. The tubings are part of the ECP201LG pump accessories.

Make sure that the tubing in the mobile phase storage bottle is sufficiently fastened and secured.

17.4. Technical Parameters

Parameter	ECP201LG
Preparative Pump	
Flow rate	2 – 1000 ml/min
Pumping system	two plungers dia. 20 mm connected in parallel
Maximum operating pressure	15 MPa (2180 psi*, 150 bar) up to 1000 ml/min
Flow rate setting	1 ml/min steps
Repeatability of flow rate adjusting	± 1 %
Accuracy of flow rate settign	± 2 %
Wetted materials	stainless steel, PEEK, Tefzel™, Kalrez®, ceramic, ruby, seals***
Adjustable upper pressure limit	1.0 – 15.0 MPa
Adjustable lower pressure limit	0.0 – 14.0 MPa
Input tubing outer diameter	3/8”
Output capillary outer diameter	1/8”
Gradient valves control module - OPTIONALLY	Up to four valves
Gradient box	
Number of valves**	4 (A, B, C, D)
Setting of component concentrations**	0.0 – 100.0 %
Maximum operating pressure	0.2 MPa (29 psi, 2 bar)
Input tubing outer diameter	3/8”
Length of the connecting tubing between the gradient box and the pump	250 mm
Orifice	5.0 mm (3/16”)
Fluid temperature	+5 - +90°C
Wetted materials	FFKM, PEEK
Connecting thread	5/8” – 18 UNF
Complete set	
Control	RS232, Ethernet (LAN), USB, Remote I/O Interface
Display, keypad	OLED 2.4“ 128x64 pixelů, 10 tlačítek
Dimensions (w x h x d)	340 x 170 x 640 mm (13.4 x 6.7 x 25.2 in)
Weight	30 kg (66.14 lb)
Power supply	100 – 240 VAC
Power input	500 VA

Parameter	ECP201LG
Operational environment conditions	Indoor use only. Altitude: up to 2000 m Temperature: 5-40°C Humidity: maximum relative humidity 80 % for temperatures up to 31°C decreasing linearly to 50 % rel. humidity at 40°C. Voltage fluctuations: up to ±10 % of nominal voltage. Overvoltage category II. Pollution degree 2.

*) ***SW of unit rounds the pressure in psi automatically to tens.***
***) The gradient functions are available only for the ECP201LG version.*
****) Seals material: default is GFP (PTFE), optional is UHMW-PE, more information upon request.*