



Ingenieurbüro CAT
M. Zipperer GmbH

Instruction Manual

Microdosingpump HPLH PF 20 / HPLH PF 200



High precision liquid handling system

- **fully microprocessor controlled system**
- **multistep programs possible**
- **Interface for computer control**
- **RS 232**

Applications:

- precise dispensing of set volume
- Almost pulse-free liquid stream
- manual dispensing
- time controlled dispensing
- titrate
- pipetting
- diluting
- sampling with and without air cushion

The system consists of a microprocessor controlled pump unit and a programming unit, which can be easily removed from the pump unit.

All parts which come into direct contact with the medium to be dispensed consist of 99.7% AL₂O₃, PVDF and FEP.

The pump unit is driven by two robust stepper motors which are monitored optoelectronically. The innovative operating and user interface enables quick adjustment of all relevant system parameters. Data input is via an incremental encoder wheel, used together with the control and hotkeys.

To adapt to different unitary systems the units of volume resp. the units of flowrate can be set to the preferred values.

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1. User Instructions

1.1. Important Instructions for your safety



The HPLH pump has been constructed according to state-of-the-art technology and recognized safety instructions. However, risks may still arise during installation, operation and maintenance. To maintain the proper safety and operational functions of the instrument, the user has to follow the instructions and safety guidelines in this manual.







- Every user must read and understand this manual completely before use. Only instructed users may operate the instrument. Failure to do so can result in serious injury or death.
- Follow general instructions for hazard prevention and general safety instructions, e.g. wear protection clothing, eye protection and gloves.
- Every user must read and understand this manual completely before use. Failure to do so can result in serious injury or death.
- Comply with all safety and accident-prevention regulations applicable to laboratory work.
- Follow general instructions for hazard prevention and general safety instructions, e.g. wear protection clothing, eye protection and gloves.
- This operating manual is part of the product. Thus, it must always be easily accessible.
- This instruction sheet does not purport to address all of the safety problems which might result from the use of this device, chemicals, reagents, apparatus or equipment employed in any specific test or protocols. It is the responsibility of the user to consult their authorized safety advisors and establish appropriate health and safety practices and then determine the application of regulatory limitations prior to use.
- Enclose this operating manual when transferring the device to another place.
- If this manual is lost, please request another one. Please contact your dealer or

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1.2. info@cat-ing.de Danger symbols and levels in this operating manual

The safety instructions in this manual appear with the following danger symbols and danger levels:



Danger symbols:







	Hazard point		Electrical shock
	Risk of fire		Explosion
	Bio hazard		Chemical hazard

Danger levels:


⚠ DANGER	Will lead to severe injuries or death
⚠ WARNING	May lead to severe injuries or death
⚠ CAUTION	May lead to light to moderate injuries
NOTICE	May lead to material damage

2. General safety warnings and instructions

	<p>⚠ DANGER Risk of explosion</p> <ul style="list-style-type: none"> • Do not operate the device in the vicinity of highly flammable or explosive substances. The instrument is not explosion-proof. • Do not use this device for processing any substances which could generate an explosive atmosphere. • Do not use this device to process any explosive or highly reactive substances.
	<p>⚠ DANGER Electric shock as a result of penetration of liquid.</p> <ul style="list-style-type: none"> • Do not allow any liquids to penetrate the inside of the power supply • Switch off the device and disconnect the power plug before starting cleaning or disinfection work. The On/Off Switch on the device does not disconnect the device from the power source. • Only plug the device back in if it is completely dry, both inside and outside.

	<p>⚠️WARNING Electric shock due to damage to device or mains cable</p> <ul style="list-style-type: none"> • Only connect the power supply to the mains supply if the device and the mains cable are undamaged • Only use devices that have been properly installed or repaired. • In case of danger, disconnect the device from the mains supply by pulling the power plug from the mains socket or by using the isolating device intended for this purpose (e.g. emergency stop switch)
	<p>⚠️WARNING Damages to health due to infectious liquids and pathogenic germs.</p> <ul style="list-style-type: none"> • When handling infectious liquids and pathogenic germs, observe the national regulations, the biological security level of your laboratory, the material safety data sheets and the manufacturer`s application notes. • Wear personal protective equipment • For comprehensive regulations about handling germs or biological material of the risk group II or higher, please refer to the “Laboratory Biosafety Manual” in its respectively current valid version from the World Health Organisation
	<p>⚠️WARNING Damages to health due to corrosive and noxious substances</p> <ul style="list-style-type: none"> • Always check the pump for leaks and air bubbles. Special attention should be directed to determine that all push-ons, threaded connections and suction tubes are firmly in place before beginning operation. • Leaking solutions may endanger persons and materials • Observe the nationally prescribed safety environment when working with hazardous, toxic and pathogenic samples. Pay particular attention to personal protective equipment (gloves, clothing, goggles, etc.), extraction, and the safety class of the lab. • Decontaminate the device and the accessories before storage and shipping. • Only employ the instrument for the purpose intended by the manufacturer, and particularly within the resistance limits of the instrument. If in doubt, contact your supplier, or the manufacturer's factory representative at the phone number shown at the front page of this operating instruction.
	<p>⚠️WARNING Risk of fire</p> <ul style="list-style-type: none"> • Do not use this device to process any highly flammable liquids
	<p>⚠️CAUTION Poor safety due to inadequate fixing of the unit</p> <ul style="list-style-type: none"> • Ensure that the unit is firmly attached to a solid stand.
	<p>⚠️CAUTION Poor safety due to incorrect accessories and spare parts.</p> <p>The use of accessories and spare parts other than recommended by Ingenieurbüro CAT, M. Zipperer GmbH may impair the safety, function and precision of the device. Ingenieurbüro CAT, M. Zipperer GmbH cannot be held liable or accept any liability for damage resulting from the use of incorrect or non-recommended accessories and spare parts, or from the improper use of such equipment.</p> <ul style="list-style-type: none"> • Only use accessories and spare parts recommended by Ingenieurbüro CAT, M. Zipperer GmbH

2.1. Warning signs on the device

	<p>▲WARNING This symbol indicates to read the instruction manual carefully prior to operation of the instrument. Please mark points which require special attention in your field of application so they are not overlooked. Disregarding of warnings may result in impairment of serviceability as well as impairment of the user.</p>
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2.2. Scope of Delivery




Inspect the content of the package for damage or missing parts:

Included with the purchase of this instrument are the following items:

1 Pump-unit	PN 70980-0000 (HPLH PF 20)
1 Remote Controller with connection cord	PN 70985-0000 (HPLH PF 200)
1 Instruction manual	PN 60712-0000

A selection of additional discharge tubes and accessories may be found in the pricelist.

3. Intended Use

	<p>▲DANGER Do not use flammable or explosive substances near the instrument.</p>
	<p>▲WARNING It is the responsibility of the user to consult and establish appropriate safety and health practices, and then determine the applicability of regulatory limitations prior to use. Should there be any additional questions, after reading these instructions, concerning the set-up, operation or warranty, please contact either your distributor, or the manufacturer.</p>
	<p>▲WARNING Use the instrument only in compliance of the intended use and in way that neither user nor any other persons are endangered. Please comply with all safety and accident-prevention regulations applicable to laboratory work.</p>

This instrument is designed for pumping liquids up to a concentration of max. 2 Mol/l, observing the following physical limits:




- 15 to 40 °C of instrument and reagent
- When the instrument is correctly used, the dispensed liquid comes into contact with only the following chemically resistant materials:
 - Al₂O₃,
 - PVDF

3.1. Operating Exclusions

Any use which deviates from the device's intended use is considered to be improper. Ingenieurbüro CAT, M. Zipperer GmbH does not accept liability for any damages resulting from not permitted use. The risk is carried by the operator alone.

Never use this instrument for:

- liquids attacking Al₂O₃, PVDF
- suspensions (e.g., of charcoal) as solid particles may clog or damage the instrument
- strongly crystallizing solutions, concentrated acids and bases as well as non-polar solvents which effect swelling of PVDF
- **carbon disulphide, as this media inflames easily**
- The pumpheads must not be autoclaved!

	▲ DANGER Do not use flammable or explosive substances near the instrument.
	▲ WARNING Compatibility of the instrument for the application must be checked by the user or contact the manufacturer
	▲ WARNING It is the responsibility of the user to consult and establish appropriate safety and health practices, and then determine the applicability of regulatory limitations prior to use. Should there be any additional questions, after reading these instructions, concerning the set-up, operation or warranty, please contact either your distributor, or the manufacturer.

4. Unpacking

Unpack the instrument carefully and check to see that it is not damaged. It is important that any damage incurred in transport be recognized at the time of unpacking. Notify your carrier or forwarding agent immediately in case of such damage.

▲ WARNING

- Read this instruction manual carefully before operating the instrument. Should there be any additional questions, after reading these instructions, concerning the set-up, operation or warranty, please contact either your distributor, or the manufacturer.
- After reading and understanding the instruction manual you may now start operating the unit.
- Store the instruction manual in a place easily accessible to every user.
- When operating the instruments in countries with different AC plug systems, use an approved power supply cord suitable for the country of operation.

5. Set-up

▲ DANGER



- The unit is not to be used in rooms with danger of explosion.
- The unit is not to be used without supervision.

Please put the unit on to a fire-proof respectively non-combustible even surface.

	▲ DANGER Do not use flammable or explosive substances near the instrument.
	▲ WARNING It is the responsibility of the user to consult and establish appropriate safety and health practices, and then determine the applicability of regulatory limitations prior to use. Should there be any additional questions, after reading these instructions, concerning the set-up, operation or warranty, please contact either your distributor, or the manufacturer.

5.1. Description of the -pump

The piston and the cylinder of the microdosing pump consists of 99.7% Al_2O_3 . All other material, which come into contact to the media is PVDF and FEP.

These materials guarantee a high resistance against aggressive media in the laboratory. The pump unit is driven by a robust stepper motor and is monitored optoelectronically.

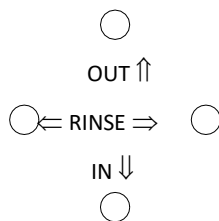
Do not attempt electronic or other complex repairs. There are no parts inside the pump or the pumphead that should be serviced by the user. Repairs by the user result in incorrect measurements may also result in loss of warranty.

5.2. Set-up

Ensure that the instrument is standing on a solid surface.

Please observe the specified ambient conditions (temperature and humidity) and mains voltage listed under „Technical Data“ as well as the safety instructions.

5.2.1. Discharge tube assembly



Connections of the pump: UNF ¼"-28

Install the discharge tube at the upper outlet ("OUT"). Therefore fed the discharge tube through the screw and turn the screw with the discharge tube into the outlet (upper connector).

	▲ WARNING Always check the pump for leaks and air bubbles. Special attention should be directed to determine that all push-ons, threaded connections and suction tubes are firmly in place before beginning operation. Leaking solutions may endanger persons and materials
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5.2.2. Suction tube assembly

NOTICE

Always use tube diameters as large as possible for the suction tube, to achieve a good flow of the liquid and accuracy.

NOTICE

Loose connections such as incomplete push-ons, loose threaded fittings or a poorly fitting suction tube lead to ventilation in the system. Inaccurate measurements will result !.

Install the suction tube at the lower connector (“IN”). Therefore feed the suction tube through the screw and turn both into the inlet of the inlet (lower connector).

5.2.3. The rinse ports

Rinsing protects the dosing pump against destruction by the used media.

H₂O or other corresponding cleaning solutions (e.g. alcohol) can be used for these rinse ports (“RINSE”). Do not use aggressive media (e.g. Aceton) for the rinse ports.

Operating with less aggressive media, just connect both rinse ports with a water or alcohol filled tube and change the water every day.

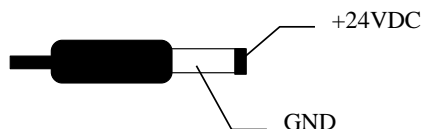
If you are operating with aggressive media, be sure that the pump is always cleaned with fresh cleaning solution. To achieve this, put the storage container of the cleaning solution higher than the pumphead, to let the cleaning solution flow through the pumphead by gravity. You also can use a separate pump to pump the rinsing solution through the rinse ports

5.2.4. Connection of the remote controller to the pump unit

To connect the remote controller to the pump unit use the connecting cable which comes with the system. The connection is made by plugging in the western-cable into the corresponding socket at the remote controller as well as plugging in the cable into the western socket (socket C, see page 10) at the pump unit.

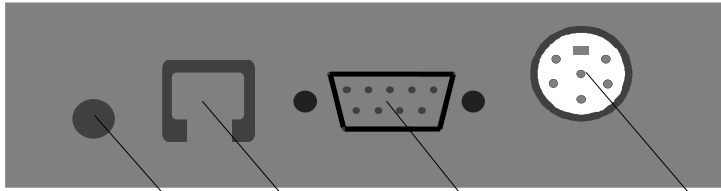
5.2.5. Connecting the power supply to the pump unit

To connect the pump² with the delivered power supply, use the power supply’s plug (3,5mm) and the socket on the rear side of the pump unit (socket D, see page 10).



pinout of the power supply's plug

6. Description of the sockets at the pump unit



- A: expansion port
- B: serial interface -> PC
- C: operating unit (remote controller)
- D: power supply

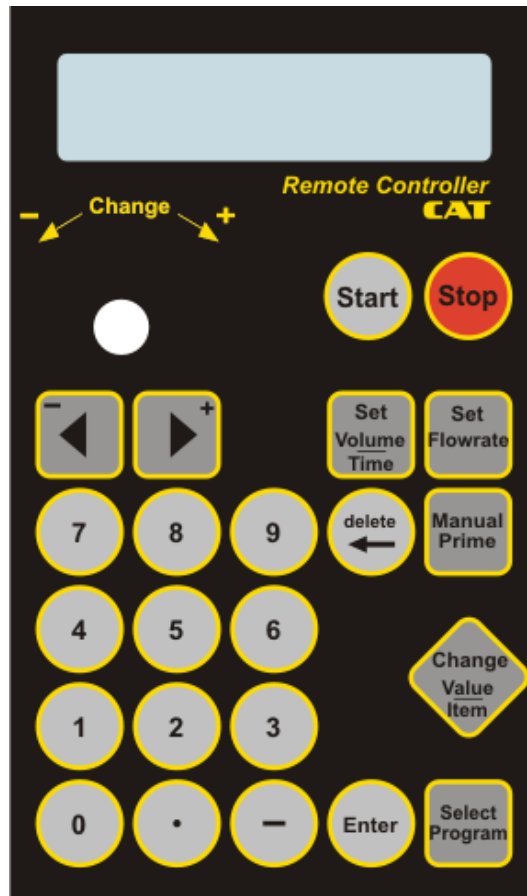
(rearview of the pump unit)

The sockets at the rear side of the pump unit are used to connect the system to the power supply and to connect external equipment to the pump unit.

expansion port	A	<i>The socket on the right side can be used to connect a footswitch or other externals to the pump unit.</i>
serial interface	B	<i>This socket can be used to connect the pump unit to a PC.</i>
remote controller	C	<i>This western socket is used to connect the pump unit to a remote controller.</i>
power supply	D	<i>The socket on the left side must be connected to a DC power supply (24 VDC 30W)</i>

7. Operating components

The pump unit can be operated via interface (see chapter 7) or by the operating components on the front of the housing. The new alphanumeric keypad simplifies data input. Changing of settings (volume, flowrate etc.) can be done with the handwheel the numeric keys or the +/- keys.







7.1. Description of the operating elements on the remote controller

LCD - Display	<i>The LCD - display shows all relevant systemdata</i>
Select Program	<i>This functionkey is used to select a program.</i>
Handwheel	<i>The handwheel, in connection with functionkeys or hotkeys is used to change system parameters or simply to scroll the data in the display.</i>
Change Value/Item	<i>By pressing this key, parameters (e.g. flowrate) which are shown in the display can be changed by turning the handwheel.</i>
Start	<i>With this key, you can start a program, resp. you can execute a programstep.</i>

Stop	<i>This key interrupts an already started program or a dispensing cycle.</i>
Manual / Prime	<p><i>Pressing this key a manual dispensing cycle will be executed. The flowrate is set by turning the handwheel.</i></p> <p><i>Turning the handwheel to the right increases the flowrate, turning the handwheel to the left decreases the flowrate down to zero. This means, the pump unit works like a valve in this mode .</i></p> <p><i>Turning the handwheel more to the left changes the flowdirection. (Liquid will be pumped back).</i></p> <p><i>Press and hold the "Manual-key" as long as you want to dispense manually. Releasing the "Manual-key" interrupts the dispensing and leaves the manual mode.</i></p>
Set Flowrate (Hotkey)	<p><i>This key can be used for a quick flowrate setting. Even, if the pump is running, the flowrate can be set using this key.</i></p> <p><i>Press this Hotkey and adjust the flowrate by turning the handwheel.</i></p>
Set Volume (Hotkey)	<p><i>This key can be used for a quick volume setting.</i></p> <p><i>Press this Hotkey and adjust the volume by turning the handwheel.</i></p>
numeric keypad	<i>The numeric keypad allows an optional fast and precise numeric input of system parameters (volume, flowrate etc.)</i>
delete	<i>numeric values can be corrected using delete</i>
+/- keys	<i>As the handwheel the +/- keys can modify a value (volume/flowrate) in connection to the Change Value/Item key</i>

Notice : To call up the submenu of a program press the key „select program“ for 3 seconds.
To leave the submenu press the key „select program“ again.

8. Operating of the Pump

	⚠ DANGER Do not use the device in potentially explosive areas. Mortal danger! Do not use flammable or explosive substances near the instrument.
	⚠ WARNING It is the responsibility of the user to consult and establish appropriate safety and health practices, and then determine the applicability of regulatory limitations prior to use. Should there be any additional questions, after reading these instructions, concerning the set-up, operation or warranty, please contact either your distributor, or the manufacturer.
	⚠ WARNING Please comply with all safety and accident-prevention regulations applicable to laboratory work.
	⚠ WARNING Make sure that the unit is only operated under the specified ambient conditions listed under „Technical Data“. Please study the instruction manual before operating the instrument. Please observe all instructions listed in the instruction manual.
	NOTICE If there is a sign of a potential malfunction (e.g., piston difficult to move) never use force. Immediately stop dispensing and follow cleaning instructions or contact the manufacturer.
	NOTICE Before connecting the power cord tot he mains make sure that Voltage and frequency of the instrument’s rating plate correspond to the local voltage and frequency.

8.1. Switching the instrument on/off

The instrument is switched on and off with the rocker switch on the rear of the housing.

8.2. Self test and Initialisation of the HPLH PF

At each power up of the HPLH PF, the microcontroller performs a self test of the system. All functions of the microdosing pump HPLH PF are checked during this test. After this test, the controller drives the piston of the microdosing pump to a reference position. By this the pumphead is synchronised to the control electronic.

Notice:

The Initialisation after switching on the HPLH PF can take up to 6 seconds. During this time the HPLH PF cannot receive or respond to any RS232 commands.

8.3. Synchronisation check of the microdosing pump

The HPLH PF has a built in synchronisation error check. This sync check is standard activated. This function allows to detect possible failures of the connected microdosing pump.

A synchronisation error could occur in case of:

- the pump gets stuck
- the counter pressure is too high
- the phase current for the stepper motor is too low -> motor has low torque

Notice:

After a synchronisation error has occurred the pump can be synchronised on the following ways:

- power down/up of the power supply
- using the serial interface (sending the command: *adr,SRF,1*)
- pressing a button on the hand held remote controller

The serial interface allows to modify the behaviour of the HPLH PF on a synchronisation error (RS232 commands RSY and WSY)

8.4. Connection of the pump unit with external equipment (socket A)

The following signals are lead out on the expansion port (socket A, see page 10):

- an analogous current input (0-24mA I-IN) to control the flowrate
- an analogous voltage input (0-10 V U-IN) to control the flowrate

N.B.: The selection of the input is made in the setup menu.
The load line of the analogue input is also set in the setup menu

Example:

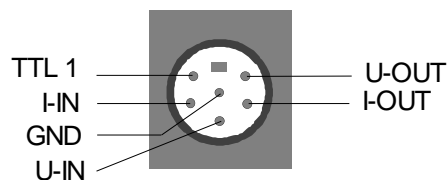
Settings: Analogue input: "current", Analogue inp. F=0 : "4 mA", Analogue Inp. F=1 : "20 mA", preset flowrate: 10 ml/min.

Input current	Factor	Real Flowrate
4 mA (and lower)	0	0
12 mA	0.5	preset flowrate * 0.5 = 5 ml/min
20 mA	1.0	preset flowrate * 1.0 = 10 ml/min.

- an analogous voltage output (0-10V U-OUT) to connect the pump to a datarecorder (flowrate). The voltage is proportional to the flowrate of the media.
0V - flowrate is zero
10V - maximum flowrate
- an analogous current output (0-24mA I-OUT) to connect the pump to a datarecorder (flowrate) the output current is proportional to the flowrate of the media.
0 mA - flowrate is zero
24 mA - maximum flowrate
- a digital TTL - Input (TTL 1) to execute a dispense step (e. g. a footswitch)

N.B.:

Startconditions of TTL 1 must be defined by the Command WSC (RS232) or in the setup menu "stop input mode"



pinout of the expansion port

8.5. Program Selection

After turning the unit on, the version number will be displayed, then you can choose one out of the following programs by using the + or keys.

- *PIPETTE - simulation of a pipette*
- *STANDARD DISPENSE - dispensing a volume*
- *DILUTOR - diluting a solution*
- *DELAYED DISPENSE - time controlled dispensing*
- *SETUP - changing basic setup data*

Press "*Select Program*" to select one of these programs.

example (for Pipette):

- a. press the "+" key, until "Pipette" is displayed
- b. press "*Select Program*" to select and switch to the "Pipette" program

8.6. Changing of program settings

Changes to the program parameters (e.g. volume, flowrate...) are made by using the functionkey "*Change Value*" and the + or keys or the numeric keypad

Sequence to change program settings:

a. Press the + or - key until the desired parameter is shown on the display

b. change settings

The functionkey "*Change Value*" enables to modify the displayed value. After pressing this functionkey an 'edit-arrow' appears in front of the value to be changed.

A parameter can be changed with I, as long as the 'edit-arrow' appears on the display.

You can leave the edit mode on one of the following ways:

- a. **press** "*Change Value*"-key
- b. **press** another functionkey

Changing the flowrate in the program pipette:

- a. **choose** program "pipette" (see above)
- b. **Press the + or - key** until "Flowrate" is displayed
- c. **press** the functionkey "*Change Value*" to switch into the edit mode
- d. **Press the + or - key or use the numeric keys** to adjust the flowrate in program "pipette"
- e. **exit** the edit mode by pressing the "*Change Value*" – key

8.7. Changing the settings by hotkeys

Hotkeys helps to switch very quickly to a desired menu position and to change the parameter by using the numeric keys or the +/- keys

- Set Volume (hotkey for volume)
- Set Flowrate (hotkey for flowrate)

Sequence:

- a. **choose** a program (e.g. pipette)
- b. **press** hotkey "*Set Flowrate*"
- c. **Press the + or - key or use the numeric keys** to adjust the flowrate
- d. **exit** the edit mode by pressing the hotkey "*Set Flowrate*" again.

Examples:

Using the hotkey "*Set Flowrate*"

- a. **choose** program "e.g. Standard Dispense"
- b. **press** hotkey "*Set Flowrate*"
- c. **Press the + or - key or use the numeric keys** to adjust the flowrate
- d. **exit** the edit mode by pressing the hotkey "*Set Flowrate*" again.

Using the hotkey "*Set Volume*"

- a. **choose** program "e.g. Standard Dispense"
- b. **press** hotkey "*Set Volume*"
- c. **Press the + or - key or use the numeric keys** to adjust the set volume
- d. **exit** the edit mode by pressing the hotkey "*Set Volume*" again.

8.8. Changing settings in submenus

Every program of the HPLH PF has special settings seldom changed by the user. These basic parameters can be individually set for every program. This enables the user to assign user units for volume and flowrate to every single program.

A programs submenu can be called up by pressing and holding the functionkey "*Select program*" for 3 seconds. The items of the submenu can be changed, using the + or - keys in connection with the functionkey "*Change Value*".

To leave the submenu, press the functionkey "*Select program*" again.

Sequence to modify settings in a submenu

- a. **select** a program
- b. **press** „*Select program*“ for 3 seconds
- c. **Press the + or - key** until the desired item is displayed
- d. **change** the value of the item

The functionkey "*Change Value*" enables you to modify the value displayed in the second line of the LCD-display. After pressing the functionkey "*Change Value*" an edit arrow appears in front of the value to be changed. As long as the edit arrow appears in the display the value can be changed by using the numeric keys or the +/- keys

The edit mode is left on one of the following ways:

- a. **press** the functionkey "*Change Value*" again
- b. **press** another functionkey
- c. **do not Press the + or - key** for more than 3 seconds

example:

Change the user units for volume in the program "Pipette"

- a. Select program "Pipette"
- b. **press** the functionkey "„Select program“ for 3 seconds"
- c. **Press the + or - key** until the item "Units of Volume" appears in the first display line
- d. **press** the functionkey "Change Value" to switch into the edit mode
- e. **Press the + or - key** until the desired units appear on the display
- f. **leave** the edit mode by pressing the functionkey "Change Value" again.
- h. **press** the functionkey "Select program" to leave the submenu

9. Description of the programs

After turning on the unit, the version number will be displayed, then the user can choose a program by using the +/- keys. Pressing the "Select Program"-key to switch to the desired program.

If the program is already in execution mode (pump is dispensing), **press STOP** to terminate the actual action, then **press** the "Select Program"-key to return to the main menu and to select a different program.

You can start the desired program (e.g. Pipette) on the following way:

- **return** to main menu (STOP/Select Program)
- **Press the + or - key**, until the desired program is displayed (e.g. Pipette)
- **press** "Select Program" switch to the displayed program
- **modify** the settings of the program (volume/flowrate/flowdirection) using the + or - keys in connection with the "Change Value" - key
- **press** START to start the program

A program can consist of max. five programsteps.

example:

1. programstep: aspirate air
2. programstep: aspirate sample
3. programstep: dispense sample
4. programstep: wait for 2 seconds, then continue with programstep no. 2

Single programsteps are also executed automatically or via the START-key. The STOP-key interrupts an already started program and stops the pump. Continuing at the interruption point is not possible, but the user can start the program again by pressing the START-key.

Beside the START-key a footswitch or any other switches can be used to execute a step of a program. The expansion port (socket A) can be used to connect these components to the pump unit.

9.1. Standard dispense - dispensing a defined volume

The program "Standard dispense" operates the *pump*^{[2][2]} like a dispenser. This program is suitable for dispensing liquids fast and precise. This electronic dispenser allows to define the volume to be dispensed, the flowrate and the flowdirection. The SUM Volume of all dispensing steps can be displayed and set to zero at any time.

program settings:

- Set Volume = dispensing volume
- SUM Volume = Sum Volume
- Flow Dir. = Flow Direction
normal/reverse
- Flowrate = Flowrate

Notice: If Set Volume is 0, the pump will run continuously until the STOP - key is pressed

This program consists of only one programstep, which is executed repetitively (e.g. START-key):

programstep: dispensing/aspirating

In this programstep the system dispenses the volume defined in "SET Volume", if flowdirection is set to "normal", otherwise the system aspirates the volume into the discharge tube.

press the STOP-key to redefine the program items (Set Volume, flowrate or flowdirection)

application example (titration):

The program "Standard Dispense" is very useful for titrations. A titration cycle could pass as described below:

1. SET SUM Counter to zero

- a. **Press the + or - key** until 'SUM' is displayed
- b. **press 'Change Value'** -key to set SUM to zero

2. Set the volume to be dispense

press the hotkey '*Set Volume*', then Press the + or - key or use the numeric keys to adjust the volume to dispense

3. Dispense predose volume

- a. **press 'START'** to execute the program
- b. **press 'START'** again for to dispense the programmed volume

4. dispense rest volume (titration point)

- a. **press** and hold 'Manual' at the remote controller
- b. **adjust** the flowrate by using the + or- key (hold Manual)
- c. **release** the 'Manual'-key at the titration endpoint

5. Read the total volume on the display

- a. **Press the + or - key**, until SUM Volume is shown on the display
- b. **read** the value

9.1.1. Settings in the submenu of "Standard Dispense"

- press **"Select program"** for 3 seconds to call up the submenu of the program Standard Dispense.
- Press the **+ or - key** until the desired item is displayed.
- press **"Change Value"** to edit the desired item. Press the + or - key or use the numeric keys to modify the value of the item.
- press **"Select program"** to return from the submenu.

Units of Volume	volume units µl - microliter ml - milliliter l - liter ga - gallons mg - milligram g - gram kg - kilogram oz - ounces
Units of Flowrate	Flowrate units µl/s microliter per second µl/min microliter per second ml/s milliliter per second ml/h milliliter per hour l/h liter per hour ga/h gallons per hour

9.2. Dilutor

The program "Dilutor" is suitable for making sample dilutions. Out of the Dilution Ratio, the Target Volume and the Dispense Rate the system calculates all system relevant parameters for the dilution steps.

program settings:

- Disp. Rate = dispense Flowrate
- Target Vol = target Volume (sample + dilution)
- Dil. Ratio % = dilution ratio in %
- Air Volume = volume of the air cushion (to separate sample from dilution)

After starting the program (**press** START) the following steps are executed repetitively:

- aspirate air to separate sample from dilution
- aspirate the sample into the discharge tube
- dispense sample and dilution into the target vessel

These dispensing steps can be executed by pressing the START-key at the remote controller.

1. programstep: aspirate air

The system aspirates an air cushion to separate sample and dilution. This programstep is only executed, if the value of 'Air Volume' is not equal to zero.

This programstep is executed automatically, if 'Auto air-aspir.' in the submenu is set to <enabled>.

2. programstep: aspirate sample

The system aspirates in this step the calculated "Sample Volume" into the discharge tube. The 'Sample Volume' is automatically calculated as follows:

$$\text{SampleVol} = \frac{\text{Ratio} * \text{TargetVolume}}{100}$$

3. programstep: dispense sample + dilution

The system dispenses the already aspirated Sample Volume, the aspirated air cushion and the calculated amount of dilution into the target vessel.

At the end of the last programstep the system jumps back to the first programstep, and is ready for another dilution cycle.

Notice:

Press the STOP-key if you want to modify the programmed parameters (target volume, dilution ratio or flowrates).

9.2.1. Settings in the submenu of the program "Dilutor"

- **press and hold „Select program“ for 3 seconds** to call up the submenu of the program Dilutor.
- **Press the + or - key** until the desired item is displayed.
- **press "Change Value"** to edit the desired item. Press the + or - key or use the numeric keys to modify the value of the item.
- **press "Select program"** to return from the submenu.

Units of Volume	volume units μ l - microliter ml - milliliter l - liter ga - gallons mg - milligram g - gram kg - kilogram oz - ounces
Units of Flowrate	Flowrate units μ l/s microliter per second μ l/min microliter per second ml/s milliliter per second ml/h milliliter per hour l/h liter per hour ga/h gallons per hour
auto air-aspir	automatic air aspiration ENABLED / DISABLE

9.3. Pipette - simulation of a pipette

The program "Pipette" lets the *pump*² work similar to normal pipette. This electronic pipette enables you to set the volume, the aspirate and the dispense flowrate in the program settings of "Pipette".

program settings:

- Pip. Volume (Pipette Volume) = pipette
- Disp. Rate (Dispense Flowrate) = dispense flowrate
- Aspir. Rate (Aspirate Flowrate) = aspirate flowrate
- Airvolume = air volume

After starting the program "Pipette" (e.g. START-key) the following dispensing steps (programsteps) are executed cyclically:

- aspirate air (to blow out the tube in the last programstep)
- aspirate sample into the tube
- dispense sample and air into the target vessel

1. programstep: aspirate air

In this programstep the system aspirates air into the discharge tube, to blow out the liquid completely in the third programstep. This programstep is executed automatically, if the setting '*auto air-aspir.*' in the submenu is set to <enabled>.

2. programstep: fill pipette

In this programstep the system aspirates the volume defined in the parameter '*Pip. Volume*' into the discharge tube.

3. programstep: dispense pipette

In this programstep the system dispenses the volumes aspirated in step 2 (sample) and step 1 (air). After this programstep the system returns to programstep no. 1 and is ready for a new pipette cycle.

Press the STOP-key to redefine the program settings (pipette volume, flowrates or your flowdirection)

9.3.1. Settings in the submenu of pipette:

- press **"Select program" for 3 seconds** to call up the submenu of the program pipette.
- Press the + or - key until the desired item is displayed.
- press **"Change Value"-key** to change the displayed item. Press the + or - key or use the numeric keys to modify the value of the item.
- press **"Select program"** to return from the submenu.

Units of Volume	volume units µl - microliter ml - milliliter l - liter ga - gallons mg - milligram g - gram kg - kilogram oz - ounces
Units of Flowrate	Flowrate units µl/s microliter per second µl/min microliter per second ml/s milliliter per second ml/h milliliter per hour l/h liter per hour ga/h gallons per hour
auto air-aspir (automatic air aspiration)	automatic air aspiration ENABLED / DISABLED

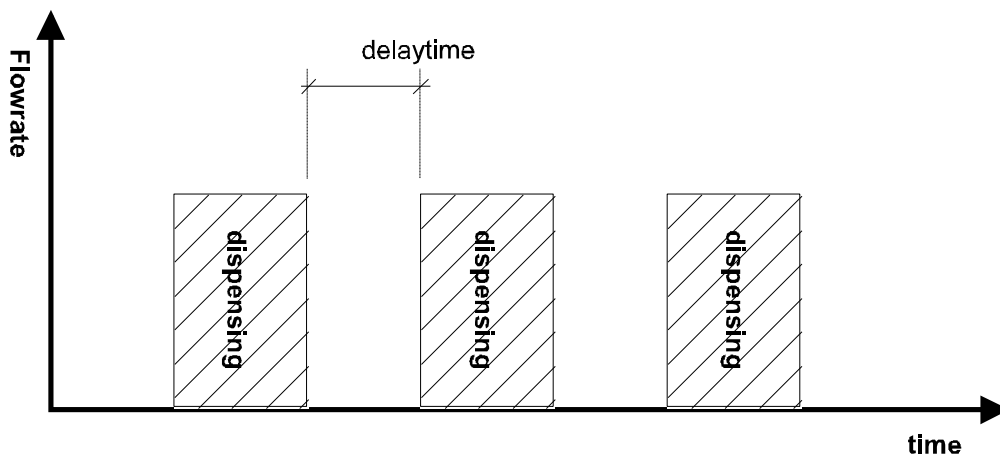
9.4. Delayed Dispense - time controlled dispense

This program is very useful to dispense liquids time controlled. This means that a specified volume is dispensed repetitively after a programmable delay time.

As the delay time can be adjusted in a very wide range, the resulting average flowrate of the system can be programmed very low.

program settings:

- Flowrate = Dispense Flowrate
- Step Volume = Volume to be dispensed per step
- cycles = number of steps
- delay time = time between steps



After starting the program (press the START-key) the following steps are executed cyclically:

- waiting, until the delay time is expired (max. 100 h)
- dispensing the step volume (min. 10 μ l) with the programmed flowrate

1. programstep: delay time

The system waits, until the delay time has expired.

2. programstep: dispense

The system dispenses in this step the programmed step volume with the programmed flowrate. After this step the system jumps automatically back to the first programstep, waiting until the delay time has expired again.

Notice:

Press the STOP-key if you want to modify the programmed parameters (step volume, delay time or flowrate).

If you choose the value zero for 'cycles', then the program is executed until the **STOP**-key is pressed. This means, the system runs endless, until the user stops the program.

9.4.1. Settings in the submenu of the program "Delayed Dispense"

- **press and hold „Select program“ for 3 seconds** to call up the submenu of the program Delayed Dispense.
- **Press the + or - key** until the desired item is displayed.
- **press "Change Value"-key** to edit the desired item. Press the + or - key or use the numeric keys to modify the value of the item.
- **press "Select program"** to return from the submenu.

Units of Volume	volume units μl - microliter ml - milliliter l - liter ga - gallons mg - milligram g - gram kg - kilogram oz - ounces
Units of Flowrate	Flowrate units μl/s microliter per second μl/min microliter per second ml/s milliliter per second ml/h milliliter per hour l/h liter per hour ga/h gallons per hour

9.5. Manual

This mode is very useful for manual dispensing, manual titration, but also to fill and empty the system. The + or - keys operates in this mode as a water tap.

In contrast to all other programs, this mode is not an independent program. To call up the "Manual"-Mode, press the *Manual-key* on the remote controller. This mode can be called from all programs, on condition that the pump is not running.

Releasing the "*Manual-key*", the user returns automatically to the program where the *Manual*"-Mode has been called up.

- **press and hold** the *Manual-key* on the remote controller
- **Press the + or - key** to the right to increase the flowrate
- **Press the + or - key** to the left to decrease the flowrate
- **release** the *Manual-key*, if you want to stop the manual dispensing

The starting flowrate can be defined in the setup menu (see changing basic settings in the setup menu)

The SUM Volume can be set to zero with the "*Change Value*"-key at the remote controller.

9.6. Changing basic settings in the setup menu

All basic data are stored in the setup-menu. These global settings match for all programs. These basic settings can be modified with the + or - keys, in connection with the "Change Value"-key.

the following settings can be adjusted in the setup menu:

- **specific weight**
specific weight of the pumped liquid in kg/liter
This value is only evaluated, if mass units like mg, gr.. are selected for the volume.
factory setting: 1.000 kg/liter
- **Slave Address of the HPLH**
The address (Pump number) definition of the HPLH (1-255)
- **Manual Startflow**
This setting defines the starting flowrate in the Manual-Mode. The value for Manual Startflow can be negative and also positive. A positive flowrate means, that the unit dispenses liquid, on the other side a negative flowrate means, that the unit tries to aspirate liquid back into the reservoir.

To call up the Manual-Mode without dispensing, nor aspirating any liquid the value for Manual Startflow must be set to zero. The unit starts then dispensing or aspirating liquid when using the + or - keys
factory setting: 0
- **Volume Round Factor and Flow Round factor**

These factors define the rate of changing the flowrate and volume when you use the +/- buttons. The rates increase when using a larger factor.

10. Checking the volume

10.1. Procedure of checking

1. Fill the pump with distilled water, using the buttons “manual” and “+”, dispense the water into a separate vessel until there are any bubbles are in the dispensing tube left.
2. Dispense 5 ml into a vessel.
3. Weigh the dispensed quantity with a precision balance.
4. Calculate the volume, taking the temperature into account.
5. Repeat step 2-5 at least 10 times.
6. Calculate the accuracy A% and coefficient of variation CV% by means of the formulas of the statistical computation.

Calculations:

Mean value $\bar{m} = \frac{\sum m_i}{n}$ m_i : results of weighing, n : number of weighing

Mean volume $\bar{V} = \bar{m} \cdot Z$ Z : Correction factor

Accuracy $A \% = \frac{\bar{V} - V_0}{V_0}$ V_0 : Nominal volume

Coefficient of variation $CV \% = \frac{100 s}{\bar{V}}$ s : Standard deviation of the results of weighing m_i

A detailed description of this test procedure you find e.g. in DIN EN ISO 8655-6.

Table 1: Correction factors Z ($\mu\text{l}/\text{mg}$ at 1013 hPa, abstract of EN ISO 8655-6)

Temperature °C	Correction factor Z		Temperature °C	Correction factor Z
15,0	1,00090		23,0	1,00247
15,5	1,00098		23,5	1,00259
16,0	1,00106		24,0	1,00272
16,5	1,00114		24,5	1,00284
17,0	1,00123		25,0	1,00297
17,5	1,00132		25,5	1,00310
18,0	1,00141		26,0	1,00323
18,5	1,00150		26,5	1,00336
19,0	1,00160		27,0	1,00350
19,5	1,00170		27,5	1,00364
20,0	1,00180		28,0	1,00378
20,5	1,00190		28,5	1,00393
21,0	1,00201		29,0	1,00408
21,5	1,00212		29,5	1,00422
22,0	1,00223		30,0	1,00437
22,5	1,00236			

11. The RS232 interface of the HPLH PF

The RS232 interface enables remote control of all functions as well as readout and change of all system parameters (e.g. programs, flow-rates, volumes, user-units, setup-parameters etc.). In this configuration a computer can access each connected unit via a sub address (daisy chaining). This address is programmable for every unit (→Setup menu, slave address).

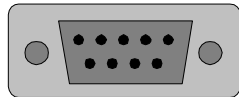
~~For daisy chaining, the transmit line (TxD) of the PC is connected to the receive line (RxD) of the first unit. The transmit line of this unit is then connected to the receive line of the next unit in the chain. The transmit line of the last unit in the chain is returned to the receive line of the PC, which closes the link (ring).~~

For addressing a specific unit in a daisy-chain, each controller carries a so called 'slave address' which can be any number from 1 to 255. The default slave address is 1.

The slave address of the pump can be set/changed in the Setup-menu.

The slave address 0 ~~is defined as the general call address on which all controllers will respond~~ is defined as the general call address on which all controllers will respond

A **Windows**[®] driver for easy control of every connected unit is optional available.



socket of the serial interface (view on socket - 9 pin Sub-D socket)

parameters of the serial interface (1200-4800,8,N,1):

Baudrate:	1200, 2400 - 4800 baud
Databits:	8 Bit
Parity:	none
Stopbits:	1

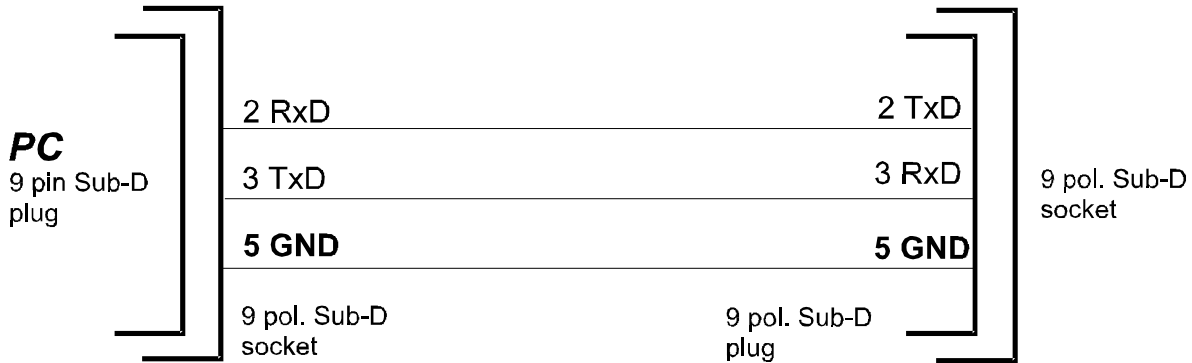
Pinout of the RS232 connector:

Description	pin number
TxD (transmit data)	2
RxD (receive data)	3
GND (GROUND)	5

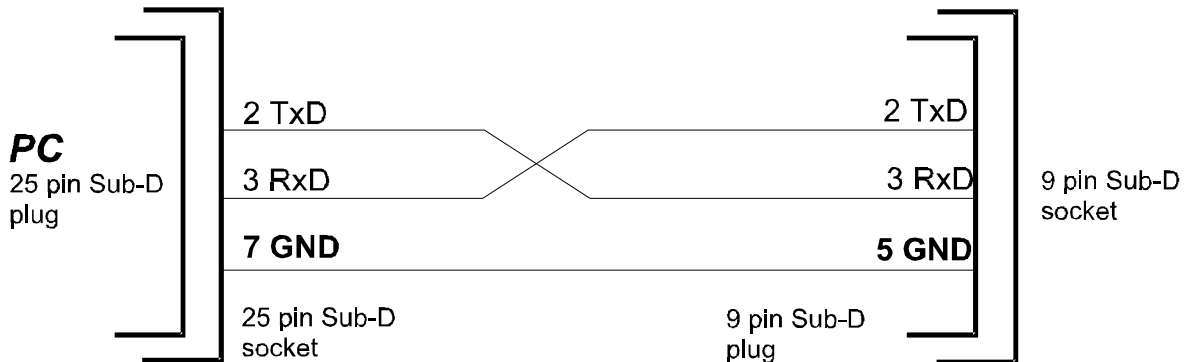
(female 9 pin SUB-D socket)

11.1. RS232 Connection configuration between PC and the HPLH PF

a) PC with 9-pin RS232-plug



b) PC with a 25-pin RS232-plug



11.2. Format of a RS232-Command

Each command which is sent to the device must have the format:

ADR , CMDCODE , PARAMETERLIST <CR>

Description:

ADR: Slave Address of the unit to execute the command

CMDCODE: Command-code

PARAMETERLIST: 1 to 6 parameters separated by commas

CR: The command string must be terminated by Carriage/Return (ASCII 13)

11.3. RS232 - COMMANDS

CMD. CODE	Explanation	Parameter list	Range	not allowed modes
	<i>Program-handling</i>			
CI	Generate continue- / start- impulse	1. Dummy parameter to initiate transfer	1	1/2
EP	Start program	1. Program number	1...7	2/4/5
PA	Abort execution of actual program step	1. Dummy parameter to initiate transfer	1	1/5
PAX	Abort program completely and return to mode 1	1. Dummy parameter to initiate transfer	1	1/5
RAP	Read actual (real) parameters: - Flow rate - Set volume - dispensed volume - Total volume - Elapsed time	1. Dummy parameter to initiate transfer → Controller sends in handshake: 1. Flow rate in user units 2. Set volume in user units 3. Dispensed volume in user units 4. Total volume in user units 5. Elapsed time in seconds	1 x x x x x	---
RSS	Read system status - System status code - Actual program number - Actual step number - Synchronisation error flag	1. Dummy parameter to initiate transfer → Controller sends in handshake: 1. Actual system status code (1 → in command mode 2 → in program execution mode (pump is running) 3 → in 'stop-mode' (pump is halted) 4 → in 'wait-mode', (controller waits for a start impulse to execute the program step) 5 → sync error stop mode, 6 → reserved) 2. Actual program number 3. Actual program step number 4. Sync error flag (0 - no sync error / 1 - sync error occurred)	1 1...6 0 / 1..7 1..5 0 / 1	---
RUL	Read limits for user entries: - Flow rate - Volume	1. Program number → Controller sends in handshake: 1. Min. allowed value for flow rate 2. Max. allowed value for flow rate 3. Flow rate round 4. Min. allowed value for volume 5. Max. allowed value for volume 6. Volume round	1...7 x x x x x x	---
WS0	Set 'Total Sum' counter to zero	1. Dummy parameter to initiate transfer	1	---
	<i>Program definitions</i>			
RAM	Read Analog Input setting	1. Dummy parameter to initiate transfer → Controller sends in handshake: 1. Analog input select (0 → disabled, 1 → current, 2 → voltage) 2. Analog input low 3. Analog input high 4. Hand manipulator mode(0 → disabled / 1→ enabled) 5. Manual start flow rate	1 0...2 0..30 0..30 0 / 1 x	---
RFR	Read step data: flow setting - Flow rate - Flow direction	1. Program number 2. Step number → Controller sends in handshake: 1. Flow rate at the beginning (in user units) 2. Flow rate at the end (in user units) 3. Flow direction (0 → normal, 1 → reverse)	1...7 1...5 x x 0 / 1	---

RPA	<p>Read step data: analog input, digital output setting</p> <p>- Analog input mode</p> <p>- Continuous operation</p> <p>- Output value on dig. port</p>	<p>1. Program number</p> <p>2. Step number</p> <p>→ Controller sends in handshake:</p> <p>1. Analog input mode (0 → disabled, 1 → enabled)</p> <p>2. Continuous-Operation (0→ No, 1→Yes)</p> <p>3. 2 bit output value at digital port before trigger</p> <p>4. 2 bit output value at digital port after trigger</p>	<p>1...7</p> <p>1...5</p> <p>0 / 1</p> <p>0 / 1</p> <p>0..3</p> <p>0..3</p>	---
RPI	<p>Read auxiliary program configuration</p> <p>- Number of loops</p> <p>- Repeat number</p> <p>- Number of steps</p> <p>- Program name</p>	<p>1. Program number</p> <p>→ Controller sends in handshake:</p> <p>1. Number of execution cycles (loops)</p> <p>2. Step number after the first cycle</p> <p>3. Last step number of program</p> <p>4. Describing text for the program</p>	<p>1...7</p> <p>0..100000</p> <p>1...5</p> <p>1...5</p> <p>Text</p>	---
RPU	<p>Read specific user units for:</p> <p>- Volume</p> <p>- Flow rate</p> <p>- Specific weight</p>	<p>1. Program number</p> <p>→ Controller sends in handshake:</p> <p>1. Unit code for 'volume' (0→ µl, 1→ ml, 2→ l, 3→ ga, 4→ mg, 5→ g, 6→ kg, 7→ oz)</p> <p>2. Unit code for 'flow rate' (0→ µl/s, 1→ µl/m, 2→ml/s, 3→ml/min, 4→ml/h, 5→ l/h, 6→ ga/h)</p> <p>3. Specific weight (kg/l)</p>	<p>1...7</p> <p>0...7</p> <p>0...6</p> <p>0...100</p>	---
RSC	<p>Read step data: start condition</p> <p>- 'Start' key</p> <p>- TTL1</p>	<p>1. Program number</p> <p>2. Step number</p> <p>→ Controller sends in handshake:</p> <p>1. Wait for 'Start' key</p> <p>0 - not defined</p> <p>1 - high</p> <p>2 - low</p> <p>3 - high → low</p> <p>4 - low → high</p> <p>2. Wait for TTL1</p> <p>0 - not defined</p> <p>1 - high</p> <p>2 - low</p> <p>3 - high → low</p> <p>4 - low → high</p>	<p>1...7</p> <p>1...5</p> <p>0...4</p> <p>0...4</p>	---
RVT	<p>Read step data: volume or time parameter</p> <p>- Operation mode (Time/Volume)</p> <p>- Time or volume</p> <p>- Text for step</p>	<p>1. Program number</p> <p>2. Step number</p> <p>→ Controller sends in handshake:</p> <p>1. Operation mode: (0 → Volume controlled, 1 → Time controlled)</p> <p>2. The volume or the execution time</p> <p>3. Describing text for the step</p>	<p>1...7</p> <p>1...5</p> <p>0 / 1</p> <p>x</p> <p>Text</p>	---
WAM	<p>Write analog input setting</p>	<p>1. Analog input select (0 → disabled, 1 → current, 2 → voltage)</p> <p>2. Analog input low</p> <p>3. Analog input high</p> <p>4. Hand manipulator mode (0 → disabled / 1→ enabled)</p> <p>5. Manual start flow rate (in user units)</p>	<p>0..2</p> <p>0..30</p> <p>0..30</p> <p>0 / 1</p> <p>x</p>	---
WFR	<p>Write step data: Flow settings</p> <p>- Flow rate</p> <p>- Flow-direction</p>	<p>1. Program number</p> <p>2. Step number</p> <p>3. Flow rate at the start</p> <p>4. Flow rate at the end</p> <p>5. Flow direction (0 → forward, 1→ reverse)</p>	<p>1...7</p> <p>1...5</p> <p>Min Flow..</p> <p>..Max Flow</p> <p>0 / 1</p>	---

WPA	Write step data Input/Output Setting - Analog input mode - Continuous operation - Output value on dig. port	1. Program number 2. Step number 3. Analog input mode (0 → disabled, 1 → enabled) 4. Continuous operation (0 → no, 1 → yes) 5. 2 bit output value at digital port before trigger 6. 2 bit output value at digital port after trigger	1...7 1...5 0 / 1 0 / 1 0...3 0...3	---
WPI	Write auxiliary program configuration - Number of loops - Repeat number. - Number of steps - Program name	1. Program number 2. Number of execution cycles (loops) 3. Step number after one cycle 4. Last step number of program 5. Describing text for the program (max. 12 Characters)	1...7 0...100000 1...5 1...5 Text	---
WPU	Write specific user units for: - Volume - Flow rate - Specific weight	1. Program number 2. Unit code for 'volume' 0 → µl, 1 → ml, 2 → l, 3 → ga, 4 → mg, 5 → g, 6 → kg, 7 → oz 3. Unit code for 'flow rate' 0 → µl/s, 1 → µl/m, 2 → ml/s, 3 → ml/m, 4 → ml/h, 5 → l/h, 6 → ga/h 4. Specific weight (kg/l)	1...7 0...6 0...7 0...30	---
WSC	Write step data 'Start signal'	1. Program number 2. Step number 3. Wait for 'Start' button from the Remote Controller 0 - not defined 1 - high (not pressed) 2 - low (pressed) 3 - high → low 4 - low → high 4. Wait for TTL1 0 - not defined 1 - high 2 - low 3 - high → low 4 - low → high	1...7 1...5 0...4 0...4	---
WVT	Write step data	1. Program number 2. Step number 3. Operation mode (0 → Volume controlled, 1 → Time controlled) 4. Volume (in user units) or execution time 5. Describing text for the step (max 13 Characters)	1...7 1...5 0 / 1 x Text	---
<i>additional commands</i>				
RAN	Read analog inputs	1. Dummy parameter to initiate transfer → Controller sends in handshake: 1. Analog input voltage (10 bit input code) 2. Analog input current (10 bit input code)	1 0...1023 0...1023	---
RAS	Readout autostart setting	1. Dummy parameter to initiate transfer → Controller sends in handshake: 1. Program select 2. Autostart (0 → disabled / 1 → enabled)	1 1...7 0 / 1	---
RDC	Read digital output port control	1. Dummy parameter to initiate transfer → Controller sends in handshake: 1. TTL1 output 2. TTL2 output 3. TTL3 output 4. TTL4 output	1 0 / 1 0 / 1 0 / 1 0 / 1	

RDD	Read digital state on dose	1. Dummy parameter to initiate transfer → Controller sends in handshake: 1. TTL1 output 2. TTL2 output 3. TTL3 output 4. TTL4 output 5. Read TTL output on dose (0 → no, 1 → auto)	1 0 / 1 0 / 1 0 / 1 0 / 1 0 / 1	
RDI	Read digital input port	1. Dummy parameter to initiate transfer → Controller sends in handshake: 1. TTL1 input status 2. TTL2 input status 3. TTL3 input status 4. TTL4 input status	1 0 / 1 0 / 1 0 / 1 0 / 1	---
RSY	Read behaviour on synchronisation error	1. Dummy parameter to initiate transfer → Controller sends in handshake: 0 - disabled 1 - display message 2 - stop pump 3 - check at stop	1 0..3	---
RTY	Read Information	1. Dummy parameter to initiate transfer → Controller sends in handshake: 1. name of connected device 2. firmware version number	1 PCONC 1.3	---
SRF	Initialises pump heads (→ set reference)	1. Security parameter to initiate transfer: 1	1	2/4/5
WAF	Set actual flow rate	1. Flow rate in actual user units	0..MaxFlow	1/5
WAS	Write autostart setting	1. Auto start program number 2. Autostart (0 → disabled / 1 → enabled)	1...7 0 / 1	---
WBD	Set baud rate	1. Baud rate 0 – 1200 1 – 2400 2 – 4800	0..2	
WDC	Set digital output port control	1. TTL1 output 2. TTL2 output 3. TTL3 output 4. TTL4 output	0 / 1 0 / 1 0 / 1 0 / 1	
WDD	Set digital state on dose	1. TTL1 output 2. TTL2 output 3. TTL3 output 4. TTL4 output 5. Set TTL output on dose (0 → no, 1 → auto) Remark: This is useful for switching a valve on dose	0 / 1 0 / 1 0 / 1 0 / 1 0 / 1	
WDO	Set digital output port	1. TTL1 output 2. TTL2 output 3. TTL3 output 4. TTL4 output	0 / 1 0 / 1 0 / 1 0 / 1	---
WEE	Save changes	1. Saving mode 21 – Program 6,7 30 – only Settings 2010 – all	21 / 30 / 2010	
WSA	Set RS232 slave address	1. New beginning slave address of controller	1...255	---
WSY	Write behaviour on synchronisation error	1. Behaviour on sync error 0 – no behaviour 1 - display message 2 - stop pump 3 - check at stop	0..3	2 / 4 / 5
	<i>special commands</i>			

WA1	Write step data - Flow rate - Flow direction - TTL - Sets 'Start signal' to not defined	1. Program number 2. Step number 3. Flow rate 4. Flow direction (0 → forward, 1→ reverse) 5. 3 bit output value at digital port before and after trigger	1...7 1...5 Min Flow.. ..Max Flow 0 / 1 0...7	---
-----	---	--	--	-----

Operation modes:

- 1 Command mode (default mode)
- 2 Program execution mode (pump is running)
- 3 Stop mode (pump is stopping)
- 4 Wait mode (pump waits for a start impulse to execute a program step)
- 5 Sync Error Stop mode (Safety feature)

11.4. Format of the Controller Handshake

After receiving an RS232-command the HPLH PF will :

- 1. Send the received command back to the PC (echo for the enhanced feature daisy chaining)
- 2. Answer with a handshake string, which is defined as follows:

ADR , "HS" , RETCODE , PARAMETERLIST CR

Explanation:

- ADR:** Slave address of the controller sending the handshake
- RETCODE:** Error code (see table 2 below)
- PARAMETERLIST:** 1 to 6 parameters (see table 1), each parameter is separated by a comma ","
- CR** the handshake as any command, is terminated by ASCII-code 13 (CR)

TABLE 2:

Return Code	Explanation	Parameter list
OK	command executed, no error	see table 1
UC	unknown command	none
PA	wrong parameter number (too few or too many parameters specified)	none
NA	command is not allowed in actual operation mode	actual operation mode
PR	at least one parameter is out of range	none
PL	at least one parameter is too long	none
DF	unknown data format	none

11.5. Writing parameters to the Controller

If, for example the flowrate in program no. 5, step no. 3 should be 500, the following command string has to be sent to the controller with slave address 2:

2,WFR,5,3,500,500,0

The Controller then sends the following two strings to the next Controller (or to the PC):

2,WFR,5,3,500,500,0
2,HS,OK

The first string is the Echo of the received command.

The second string indicates that the command was accepted and will be executed.

11.6. Reading parameters from the Controller

To read the program information of program no. 3 send the following command to the Controller with Slave Address 1.

1,RPI,3

The Controller then sends the following two strings to the next Controller (or to the PC):

1,RPI,3
1,HS,OK,10,2,4,Rep. Dispense

The first string is the Echo of the received command.

The second string indicates that the command was accepted and will be executed it also contains the following information (see table 2):

- the program makes 10 loops
- the program will repeat with step no. 2 after one cycle
- the program consists of 4 steps
- the name of the program is "Rep. Dispense" (Repeat Dispense)

11.7. Codes to dispense a defined volume

This example program lets the Controller with Slave Address 1 dispense a defined volume. The program is loaded in program location no. 5.

volume to dispense: 100 µl
flowrate: 10 µl/second
flowdirection: normal (forward)

The following commands have to be sent the Controller:

1,WPU,5,0,0,1.0	;setting user units µl // µl/sec
1,WPI,5,1,1,1,Disp10ul	;writing program information
1,WVT,5,1,0,10,dispense	;volume and step name
1,WFR,5,1,10,10,0	;flowdirection and flowrate
1,WSC,5,1,0,0	;starting conditions

after definition of the program, by sending these commands to the HPLH PF, this program can be started by sending:

1,EP,5

12. Cleaning and Maintenance


Surface and operating elements may be cleaned with a mild dishwashing detergent (water and a standard dishwashing detergent) and a soft, non-fuzzing moist cloth. Do not use a wet cloth. Use only a small amount of dishwashing detergent. Do not use chlorine bleach or other chlorine-based cleaning products with metallic components under any circumstances. These will damage the surface of the instrument. If you use any other cleaning method please make sure that the intended method does not cause any damage to the instrument.

The pumpheads must be cleaned as follows to assure proper functioning and continued accuracy.

- **immediately**, if the motor becomes sticky or jammed.
- **daily, after use of these liquids**
 - Solutions prone to crystallisation
 - Alkaline solutions, aromatics, chlorinated hydrocarbons scintillation liquids
 - inorganic solutions such as buret reagents
- **periodically**, to increase the lifetime of the instrument
- **always** after long term storage

Attention: the ceramic parts are subject to binding or freezing if stored after improper cleaning.

12.1. Cleaning the pumphead

	▲WARNING Be careful to avoid any personal injury from used chemicals. While and even after dispensing liquids, the instrument, the filling and the discharge tubes contain the used reagent. Make sure, that during cleaning and maintenance you avoid splashing chemicals. Wear face screens, protective gloves and protective clothes.
---	---

- 1 Hold the discharge tube over any designated dispensing receptacle and dispense the remaining reagent (press at the same time "Manual" and "+").
- 2 Put the suction tube into cleaning solution designated for that purpose
- 3 Clean the instrument by pumping. We recommend to pump a minimum volume of 50 times the amount of the strokevolume through the pump for a good cleaning.
- 4 Insert the suction tube into distilled water (or other liquids for sterilisation) for rinsing.


type	strokevolume	min. cleaning volume
HPLH 20	40 µl	2 ml
HPLH 200	400 µl	20 ml

Important:

The HPLH-PF is a measuring instrument and designed to provide high accuracy. To maintain this accuracy we recommend that this instrument be tested at regular intervals, especially after any mishandling (such as hitting or dropping) of the instrument. Testing of the instrument is provided by the manufacturer for a small fee. Under §4 of the Weights and Measuring Standards of 12.08.88 Germany, it is required that regular testing and inspections be performed when the *HPLH* is used as a medical instrument.

13. Dismantling and Disposal

13.1. Dismantling

	▲WARNING Pumpheads and tubing may contain reagents, which endanger persons and material. Make sure of cleaning pumphead and tubing according Chapter 7 before removing tubing.
---	--

1. Switch the instrument off.
2. Disconnect the instrument from the mains.
3. Disconnect the tubing
4. Now the instrument may be removed from the working area.


13.2. Disposal



Please dispose used instruments and defective components at your local recycling collection point. Prior to disposal, sort according to materials: metal, glass, plastic, etc. Also be sure to dispose of the packing material in an environmental-friendly manner.

14. Transport and Storage

14.1. Transport/Storage

	▲WARNING Pumpheads and tubing may contain reagents, which endanger persons and material. Make sure of cleaning pumphead and tubing according Chapter 7 before removing tubing.
---	--

Prior to transport:

Switch the instrument off and unplug the power supply.

Remove tubing and cables

Do not subject the instrument to mechanical shocks or vibration during transporting.

Place the instrument and its parts in its original packaging or another suitable container to protect it during transport. Close the packaging with adhesive tape.

In case you do not use the original packaging please mark the box with the following notes:


- Glass symbol (handle with care, fragile)
- Umbrella (keep dry)
- Content (list of content)

Store the instrument in a dry environment. Please observe the specified conditions of the ambient:

Ambient temperature: 5-40°C

Max. relative air humidity: 80%

14.2. Return for repair or calibration

	▲WARNING	For a maximum of protection from health hazards caused by contaminated instruments clean and decontaminate the instrument carefully before returning.
---	-----------------	---

We intend to give our staff a maximum of protection from health hazards caused by contaminated instruments. We therefore ask for your understanding that we cannot carry out any calibration / repair unless the

Declaration on the Absence of Health Hazards

is submitted completed and signed.

Please copy the declaration in the appendix and attach it completed and signed to the instrument when returned to your distributor or to the manufacturer.

Please provide us with the following supplementary information:

- Detected defect
- Media which the instrument has been used with

15. Warranty and Liability



The manufacturer agrees to correct for the original user of this product, either by repair, or at the manufacturer's discretion, by replacement, any defects in material or workmanship which develop within 24 months after delivery of this product to the original user. In the event of replacement, the replacement unit will be warranted for the remainder of the original twelve (24) months period of ninety (90) days, whichever is longer.

If this product should require service, contact your distributor or manufacturer for necessary instructions.

This warranty shall not apply if the defect or malfunction was caused by accident, neglect, unreasonable use, improper service, or other causes not arising out of defects in material or workmanship.

There are no warranties, expressed or implied, including, but not limited to, those of merchantability or fitness for a particular purpose, which extended beyond the description and period set forth herein.

The manufacturer's sole obligation under this warranty is limited to the repair or replacement of a defective product and the manufacturer shall not, in any event, be liable for any incidental or consequential damages of any kind resulting from improper use or misuse or possession of the product.

	▲WARNING	In case of malfunction do not try to carry out any repair works. The instrument does not consist of any part which may be serviced or maintained by the user. Any attempt by the user to repair the unit will cancel the warranty.
	▲WARNING	Do not open the instrument. Any work on the electronics of the unit should only be done by knowledgeable and trained personnel.

16. Technical Data



▲WARNING

The user has to determine, if the instrument is suitable for his specific application. If there are any further questions, contact your local dealer or the manufacturer.

min step volume:	HPLH20PF : 2µl HPLH200PF: 20µl
max step volume:	100 l
min. delaytime in delaymode:	0,2 s
max. delaytime in delaymode:	100 hours
min. cont. flowrate:	HPLH PF 20 : 30 µl/min HPLH PF 200 : 0.3 ml/min
min. flowrate in delaymode:	HPLH PF 20: 4µl/100h HPLH PF 200 : 40µl/100h
max. flowrate:	HPLH PF 20: 10 ml/min HPLH PF 200 : 100 ml/min
accuracy (testvolume 200µl):	EV <= 1 %
precision (testvolume 200µl):	CV <= 0.5%
counter-pressure:	up to 2 bar, depends on viscosity and max. flowrate
time programming:	0,2 s to 100 hours
inputs:	one digital TTL-input one analogous current input (0-24mA) one analogous voltage input (0-10V)
outputs:	one analogous voltage output (0-10V) one analogous current output (0-24mA)
serial interface:	RS232 (1200-4800,8,N,1) baudrate: 1200-4800 Baud databits: 8 Bit parity: none Stopbits: 1 Stopbit
power supply:	24 VDC 30W - stabilised

Chemical resistance:

The materials, which come into contact with the delivered medium are either aluminiumoxyd Al₂O₃, FEP or PVDF. These materials guarantee a high resistance against almost all aggressive media.

Attention:

The user has to determine, if the instrument is suitable for his specific application. If there are any further questions, contact your local dealer or the manufacturer.

17. Declaration on the Absence of Health Hazards

Please copy this declaration and attach it completed and signed to the instrument

Device designation:.....

Serial No.:

The Undersigned hereby declares:

- ◆ That the instruments have been carefully cleaned and decontaminated before shipment.
- ◆ That the instruments pose no danger through bacteriological, chemical, radiological or viral contamination.
- ◆ To be authorised to make declarations on behalf of the Institution represented.
- ◆ That he / she is aware that shipment of contaminated instruments is a violation of law, and that he / she personally and the Institution represented may be held liable for any damages caused by contaminated instruments.
- ◆ For calibrating service only: minor repairs of a value up to € 30,--+ VAT will be carried out and invoiced without further queries (cross out if not applicable).

Sender: Firm / Laboratory:

.....

Address:

.....

Tel. for enquiry:

.....

Name

.....

Date, Signature

.....

- ◆ In case of Return for Repair, please provide us with the following supplementary information:
Detected defect:

.....

Media which the instrument has been used with:

.....



**Ingenieurbüro CAT
M. Zipperer GmbH**

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**EG - Konformitätserklärung nach Maschinenrichtlinie 2006/42/EG Anhang II 1A
EC - Declaration of conformity in accordance with the EEC machine directive
2006/42/EG appendix II 1A
Déclaration de conformité CE selon Directive Européenne 2006/42/EG relative aux
machines appendice II 1A**

Wir erklären in alleiniger Verantwortung, dass dieses Produkt (siehe Tabelle) den Bestimmungen der Richtlinien entspricht und mit den folgenden Normen oder normativen Dokumenten übereinstimmt:
We declare under our sole responsibility that this product (see table) corresponds to the regulations and conforms with the standards or standardized documents:
Nous déclarons sous notre propre responsabilité que ce produit est en conformité avec les normes ou documents normalisés suivant:

Folgende weitere EU-Richtlinien wurden angewandt:
The following other EU directives have been applied:
Les autres directives européennes suivantes ont été appliquées:

EMV – Richtlinie 2004/108/EG

Folgende harmonisierte Normen wurden angewandt:
The following harmonized standards have been applied:
Les normes harmonisées suivantes ont été utilisées

DIN EN 12100 :2010
DIN EN 61000-6-2 :2005/AC2005
DIN EN 61000-6-4 :2007 +A1 :2011
EN 61010-1:2010
DIN EN 809:2012-10

Bei einer nicht mit uns abgestimmten Änderung des Gerätes verliert diese Erklärung ihre Gültigkeit und die Gewährleistung erlischt.
In the case of a modification of the unit which has not been agreed on with us, this declaration becomes null and void and the warranty expires.
Dans le cas d'une modification de l'appareil qui n'a pas été convenue avec nous, cette déclaration perd sa validité et la garantie expire.

**Ingenieurbüro CAT
M. Zipperer GmbH**


Markus Zipperer
Geschäftsführer

79219 Staufen, den 14.01.2015

Type
Mikrodosierpumpen Typ HPLH