

**STEPDOS® PROCESSOR-CONTROLLED  
DIAPHRAGM METERING PUMP  
STEPDOS® 03 / STEPDOS® 08**

**Operating instructions  
ID 150 333**

You have selected a STEPDOS® diaphragm metering pump. The following tips will help you operate it safely and reliably over a long period. It is essential that you read these operating instructions before putting the pump into service. Follow them for all applications, they help prevent dangerous situations and damage.

These instructions apply to the series production pump models listed above. If there is a single letter before the "FEM", this serves only to distinguish models for particular countries, it is not a technical identification. For customer-specific projects (their model codes begin with "PL" or "PML") there may be detail deviations from these operating instructions. In the case of project pumps therefore, please observe the agreed technical specifications in addition to these operating instructions.

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# 1. Type overview

## 1.1 Pump variations

Pump type STEPDOS®	
FEM 03 .18 S	FEM 03 .18 RC
FEM 08 .18 S	FEM 08 .18 RC

The STEPDOS® diaphragm metering pumps are available in the following versions:

1	Base model		
	Flow rate at atmos. pressure (ml/min)	Max. suction height (mWg)	Max. pressure head (mWg)
FEM 03	0.03 ... 30	4	60
FEM 08	0.08 ... 80	3	20

Flow rate measured with water at 20°C and zero pressure head 0mWg.

2	Materials of head components	
FEM ...KT ...	Head Valves * Sealing rings Diaphragm	PP PP/FFPM FFPM PTFE-coated
FEM ...TT ...	Head Valves * Sealing rings Diaphragm	PVDF PVDF/FFPM FFPM PTFE-coated
FEM ...FT ...	Head Valves * Diaphragm	PTFE FFPM PTFE-coated
FEM ...ST ...	Head Valves * Diaphragm	Stainless steel FFPM PTFE-coated

The term „valve“ includes valve cartridges, valve plates and tongue valves. ST-/FT variations include only a valve plate and the tongue valve.

3	Housing
.18	Portable version

4	Choice of control system
S	For manual operation
RC	Can be changed from manual to remote control as desired

## 2. Description

### 2.1 General notes

- It is essential that you read these Operating Instructions before putting the pump into service. Follow them for all applications as they help prevent dangerous situations and damage.
- The STEPDOS® diaphragm metering pumps have been developed by KNF especially for laboratory and industrial applications that demand high chemical resistance, reliability and simple operation.

### 2.2 Areas of application

Dosing neutral and aggressive liquids in laboratories, industrial areas and systems.

### 2.3 Features of the STEPDOS® diaphragm metering pumps

- Even at the lowest speeds, STEPDOS® diaphragm metering pumps provide a quasi-continuous steady flow.
- They are self-priming, can operate dry and are quiet.
- They allow variable volume metering.
- Excellent accuracy, precision and repeatability.
- The pumps have an integrated over-pressure protection system to prevent damage and dangerous situations from occurring, refer to section 7 «Start-up/Shut-down».
- By using chemically resistant materials such as PTFE, PVDF, FFPM etc. for parts that come into contact with the

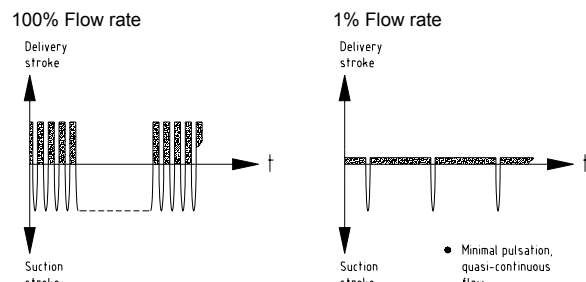
liquid, almost all neutral and aggressive liquids can be handled, refer to section 7 «Start-up/Shut-down».

- Manual control possible on all models.
- The “RC” models allow for analog input, digital interface operation (RS 232/RS 485), external control signals and relay output signals.
- Calibration possible
- Numerous metering options.
- Choice of language.
- Compact space-saving design.
- They can be used with different voltages and frequencies (100 to 230V and 50 to 60Hz).
- All models have protection class IP65.
- Overload protection for drive system – two fuses in live and neutral lines.
- Diaphragm and valves are easy to change.

## 2.4 Working principles

The STEPDOS® diaphragm metering pump is an oscillating positive displacement pump. An eccentric converts the rotary motion of the drive shaft into an oscillating movement of a connecting rod, which in turn transmits its motion to the diaphragm. In combination with inlet and exhaust valves, this diaphragm motion produces the pumping or metering action. The metering unit is controlled by a micro processor.

STEPDOS® pumps are driven by a patented stepper motor. The suction stroke is carried out at maximum speed, and slows down to the pre-set speed for the delivery stroke, so that the output is smooth and continuous over a complete cycle (sine wave compensation is used, see [Fig. 1]). This produces a smooth quasi-continuous delivery. This is the decisive difference between the STEPDOS® range and diaphragm metering pumps with linear magnetic drives or eccentric-driven metering pumps with conventional motors.



[Fig. 1] Working principle of the pump

Thanks to a newly developed system it is now possible to dispense just part of a stroke thus allowing small quantities of liquid to be delivered with a high accuracy (DISPENSE mode).

## 2.5 Accuracy/Repeatability

### 2.5.1 Accuracy in RUN mode

In RUN mode the dosing pump will dose a certain flow rate, e.g. 13ml/min, see section 8.2 «RUN mode».

- With the large flow range of the STEPDOS® the accuracy can be defined as the maximum absolute deviation A plus the maximum relative deviation B:

$$\text{Max. deviation} \leq A + B$$

For the STEPDOS®

Absolute deviation A  $\leq \pm 1\%$  nominal value

Absolute deviation B  $\leq \pm 1.9\%$  set value

$$\text{Deviation} \leq (\pm 1\% \text{ nominal value}) + (\pm 1.9\% \text{ set value})$$

- Example for STEPDOS® 03:  
With a set flow rate of 20ml/min the accuracy is within the following tolerances:

$$\begin{aligned} \text{Error} &\leq (\pm 1\% \times 30\text{ml/min}) + (\pm 1.9\% \times 20\text{ml/min}) \\ &\leq (\pm 0.03\text{ml/min}) + (\pm 0.38\text{ml/min}) \\ &\leq (\pm 0.41\text{ml/min}) \approx (\pm 2\% \text{ of set value}) \end{aligned}$$

- If all the parameters around the pump remain the same then the STEPDOS® has a repeatability of better than ±1%.
- ➔ Larger deviations can occur when the liquid has either a viscosity of >150cSt or a low boiling point. If this occurs then the dosing pump must be adjusted suitably in order to correct the problem. This can be carried out as project.

### 2.5.2 Accuracy in DISPENSE mode

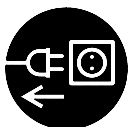
- Without calibrating the dosing pumps there can be differences in the larger dispense volumes of up to +/-5% and by the smallest volumes (<0.15ml) up to +/-15%.
- If the dosing pump is calibrated in DISPENSE mode an accuracy of +/- (3% from dispense volume +0.005ml) can be achieved. This is carried out by using the PC software and must be done with every pump at best in the application.
- If all the parameters around the pump remain the same then the STEPDOS® will have a repeatability of better than ±1%.
- ➔ The dosing pump is not equipped with a real-time clock which can mean that when pumping small quantities over a long time in DISPENSE mode the dosing time can differ from the real time by max. 1%. The dosing amount is not influenced by this. If this is not exact enough then the pump can be used in RUN mode and controlled with a timer externally over the logic in/outputs.

## 2.6 Operating conditions

- Permissible temperature of the medium being handled: +5°C to +80°C.
- Permissible ambient temperature: +5°C to +40°C.
- The unit must not be used in an environment which poses a danger of explosion.
- The presence of solids (>25µm) in the medium being handled may lead to faulty operation of the dosing pump. In this case we recommend that a filter is used in front of the pump.
- The dosing pump has been developed for liquids with viscosities of up to 150cSt. Depending on the type of liquid the pump can be modified to handle liquids with much higher viscosities.
- The pressure against which the unit operates must not exceed that shown on the type plate, see section 16 «Technical data».
- Protect the equipment from damp and excessive concentrations of dust.
- To avoid the overpressure protection system coming into operation, the dosing pump must not operate against a closed system.

## 3. General safety instructions

- Ensure that the pump is only used for its intended purpose, refer to section 16 «Technical data».
- The unit may not be used in areas in which there is a danger of explosion.
- Only connect the pump into fused sockets.
- Observe all relevant safety and accident prevention regulations.



### Safety Notice

„Before working on the pump, disconnect it from the mains supply!“

- The parts of the equipment that contain live parts may only be opened by qualified persons.
- The Operating Instructions should always be kept readily available and near to the equipment.
- When cleaning the unit, make sure that no liquid enters the housing.
- Use only genuine spare parts from KNF.

- ➔ If you return your KNF pump for repair, please state for what medium it has been used for, especially if this is very aggressive/dangerous.
- ➔ If the pump has been used for dangerous or highly aggressive media, please clean it before dispatch.
- ➔ Observe the specific safety instructions in section 7 «Start-up/Shut-down».

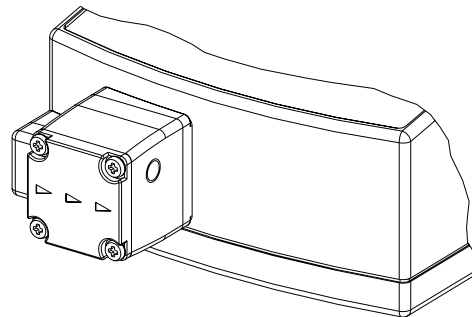
## 4. Transport and storage

- When packing the pump, make sure that it is properly secured inside the package.
- The package must be strong enough to withstand any rough treatment it may receive during transport.
- The package may not be immersed in any sort of liquid.
- Neither may it be stored in an extremely dusty, or a very hot or very cold environment.

## 5. Summary of pump and control functions

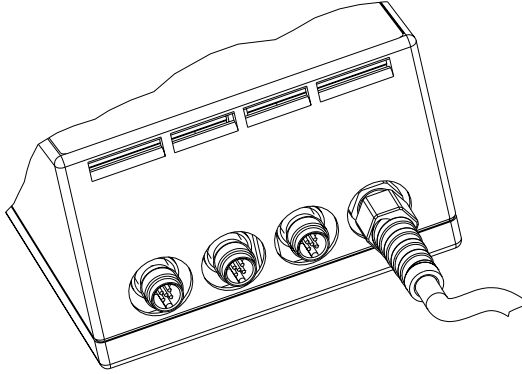
### 5.1 Dosing pump

- The connections for inlet and outlet hoses are in the pump head [Fig. 2].  
Connections STEPDOS® 03  
 Inside thread UNF ¼"-28; Inside diameter hose: from 1/16" (recommended) to 1/32" (for very small amounts of liquid or when pumping very slowly).  
Connections STEPDOS® 08  
 Compression fittings for hose with inside diameter from 4mm (recommended) to 3mm (for very small amounts of liquid or when pumping very slowly).
- The direction of flow is indicated by arrows on the pump head.



[Fig. 2] Pump head STEPDOS® 03

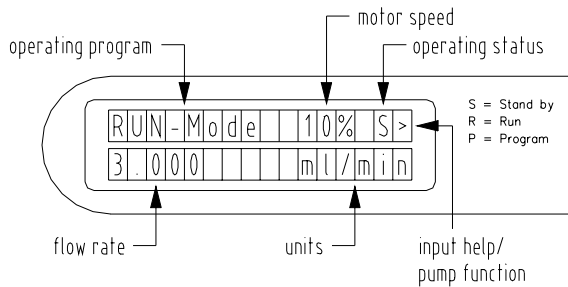
- For RC-versions  
On the back of the pump [Fig. 3] there is the power cable and the connection plugs for the interfaces (input, output and controlling). For more detailed information about the plugs refer to section 19 «Appendix» (Connection PC-control cable).
- The electrical fuse is situated on the bottom of the pump. The fuse type can be found in section 16 «Technical data».



[Fig. 3] Backside of the RC version

## 5.2 Display

The display shows the program being used and the current values. The following illustration shows the display when the pump is connected to the power supply.



[Fig. 4] Display (STEPDOS® 03)

### a) Operating programs

- RUN mode
- DISPENSE mode
- SETTINGS

- For a more detailed description of the separate programs refer to section 6 «Program overview».

### b) Operation status

Code	Operation status	Function
S	Stand-by	Indicates the readiness of the pump to run an operating program. Allows the choice of an operating program (using UP/DOWN buttons).
R	Run	Pump is running in a programmed process.
P	Program	Allows values/parameters to be entered in an operating program or menu item (using UP/DOWN buttons).
E	External Controlling	Readiness of the pump to receive an external command via RS232/485 (interface operation).

### c) Input support and pump function

Symbol	Meaning	Relevant for operation status
>	Directs to a lower menu	S (Stand-by) P (Program)
<	Directs to a higher level	P (Program)
^	Value change (using UP/DOWN buttons)	P (Program)
Revolving star	Pump is running	R (Run)

In Stand-by mode the display will automatically turn off after 10min if the pump has not been used.

## 5.3 LED-lights

### ■ FAULT:

- The LED lights up red if there is a problem simultaneously a message will appear in the display. In order to find out more about the problem refer to section 15 «Trouble shooting».
- The LED can also be connected with the logic inputs whereby the LED lights up when there is a fault with the pump and blinks when there is an external alarm signal, refer to section 19 «Appendix» (Overview settings).

### ■ I/O 1- and I/O 2-LED:

- Both of these LED show the status of the hardware input whereby the LED will light up for logic 1 (5V) and blinks for logic 0 (0V). If the I/O is not activated then is the LED turned off. If the inputs are inverted over the software this can not be seen from the LED's.

## 5.4 Button functions



- Starts a process
- Restarts an interrupted process
- Confirms an entry
- Acts as a reset for a failure (FAULT-LED)



- Stops and ends a process
- Pauses a process
- Discontinues a process
- Changes to a upper menu level
- Goes to the highest menu level if pressed and held for >2s



- As long as the button is pressed the pump will run at maximum speed thus filling or emptying a system.
- Brings the pump into the start position if „mot. not just.“ is shown (see section 15 «Trouble shooting»)



- Changes to a lower menu level.
- Enters values and parameters (lowest menu point)
- If pressed and held for >2s then the language swaps between English and German.
- Returns to the main menu

General: Changes between the menu points of a level.



- Special: Switches in the highest menu level between operating modes, RUN-mode, DISPENSE mode and SETTINGS.
- Scrolls upward through menu lists (e.g. l > ml > µl > % ...)
- Increases values
- By keeping the UP button pressed the values will be changed at high speed.



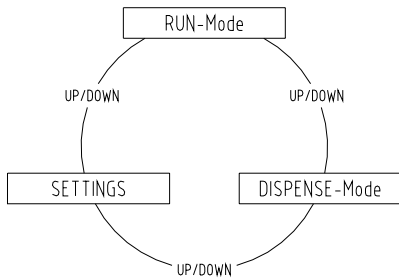
- General: Changes between the menu points of a level.
- Special: Allows switching between the operating modes RUN mode, DISPENSE mode and SETTINGS.
- Scrolls downwards through menu lists (e.g. l > ml > µl > % ...)
- Decreases values
- By keeping the DOWN button pressed the values will be changed at high speed.

## 6. Program overview

The STEPDOS® diaphragm metering pump has the following programs:

- RUN mode (Operating program used to dose a continual flow)
- DISPENSE mode (Operating program used to dose a series of charges)
- SETTINGS (Menu for user settings)

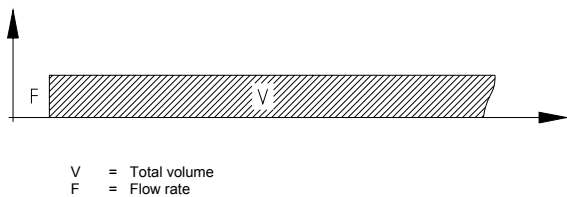
➔ The dosing pump can be adjusted/programmed by using either the Keypad or the PC software.



[Fig. 5] Operating programs

### 6.1 RUN mode

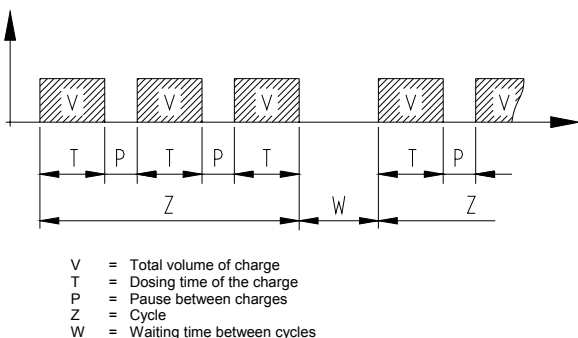
- The RUN mode allows a quasi-continual dosing of a definite quantity of liquid (volume / time see [Fig. 6]).
- For more information on using the RUN mode refer to section 8.2 «RUN mode».



[Fig. 6] Principle of the RUN mode

### 6.2 DISPENSE mode

- The DISPENSE mode allows a series of charges to be dosed:  
A total volume/charge (V) is delivered in time (T) with a pause (P) between the charges makes up a cycle (Z). A series of cycles can then be strung together with a waiting time (W) between them.
- This is illustrated in. [Fig. 7]
- For further information to the DISPENSE mode refer to section 8.3 «DISPENSE mode».



[Fig. 7] Principles of DISPENSE mode

### 6.3 SETTINGS

- In the SETTINGS section it is possible for the user to set their own values and parameters.

- For an overview of these options refer to section 19 «Appendix» (Overview settings).

## 7. Start-up/Shut-down

Before starting the unit check the following points:

- All conditions mentioned in section 2.6 «Operating conditions» must be met.
- All special safety instructions for the medium being handled must be observed.
- Check that the power supply agrees with the data given on the type plate.
- The medium-contact parts of the pump, the hose connections, and hoses must all have adequate chemical resistance to the liquid being handled (refer to section 1.1 «Pump variations»). For questions concerning the compatibility of parts with your medium, please contact your sales representatives.
- Check hoses, fittings etc. and their joints for correct, secure connections.
- The over-pressure protection system (electronic monitor) prevents the system pressure from rising above the maximum allowed value (60mWg for STEPDOS® 03, 20mWg for STEPDOS® 08). If the limit is exceeded, the unit switches off and pumping ceases, the red fault warning LED comes on, and the display shows a problem message.

### 7.1 Dosing pump start up

- Choose a safe place for the pump and place it on the four rubber feet on its base.
- The pump must be positioned so that it is able to draw in air through the cooling vent in the back of the pump in order to prevent overheating.
- The pump is delivered ready for use.

#### Hose sizes

- **FEM 03 (UNF ¼-28 connections)**  
Tighten the UNF connectors. Hoses with inside diameters from: 1/16" (recommended) to 1/32" (for very low flow rates or small volumes).
- **FEM 08 (compression fittings)**  
The hoses on the inlet and outlet must be pushed firmly over the hose barbs and the clamp nut firmly tightened. Hoses with inside diameters from: 4mm (recommended) to 3mm (for very low flow rates or small volumes).
- **UFEM 08**  
See section 19 «Appendix» (Instruction connection hosing FEM 08).

#### Electrical connections

- For the RC-Version  
To connect the interface see section 19 «Appendix» (Overview settings).
- Plug the pump into the mains supply.

### 7.2 Pump calibration

The STEPDOS® diaphragm metering pump is calibrated to the nominal flow rate during production. 100% motor speed corresponds to a flow rate of 30ml/min for the STEPDOS® 03 and 80ml/min for the STEPDOS® 08 this is valid for water at 20°C. For certain applications it is possible that the actual flow rate can differ from these values depending on many different factors e.g. liquid type, density, viscosity, temperature, pressure and the installation (e.g. thin hoses). In order to achieve an accurate dosing we recommend that the pump is calibrated in situ, refer to section 12 «Calibrating the pump».

### 7.3 Shut-down

- ➊ After using the pump rinse the pump and installation with a neutral liquid.
- ➋ Stop the pump operation by pressing the STOP button.
- ➌ Unplug the pump.

## 8. Program sequence and operating functions

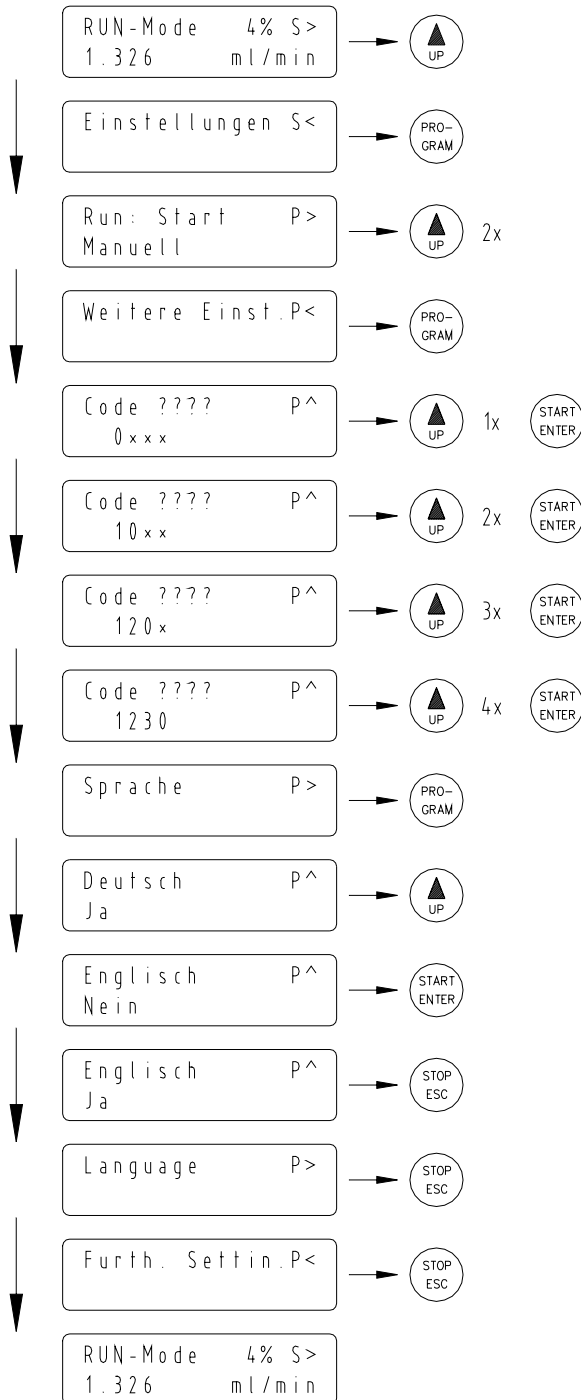
### 8.1 Standard settings

The code needed to access „further settings“ is 1234.

- Pump language (German or English)
 

There are two different ways of changing the pump language:

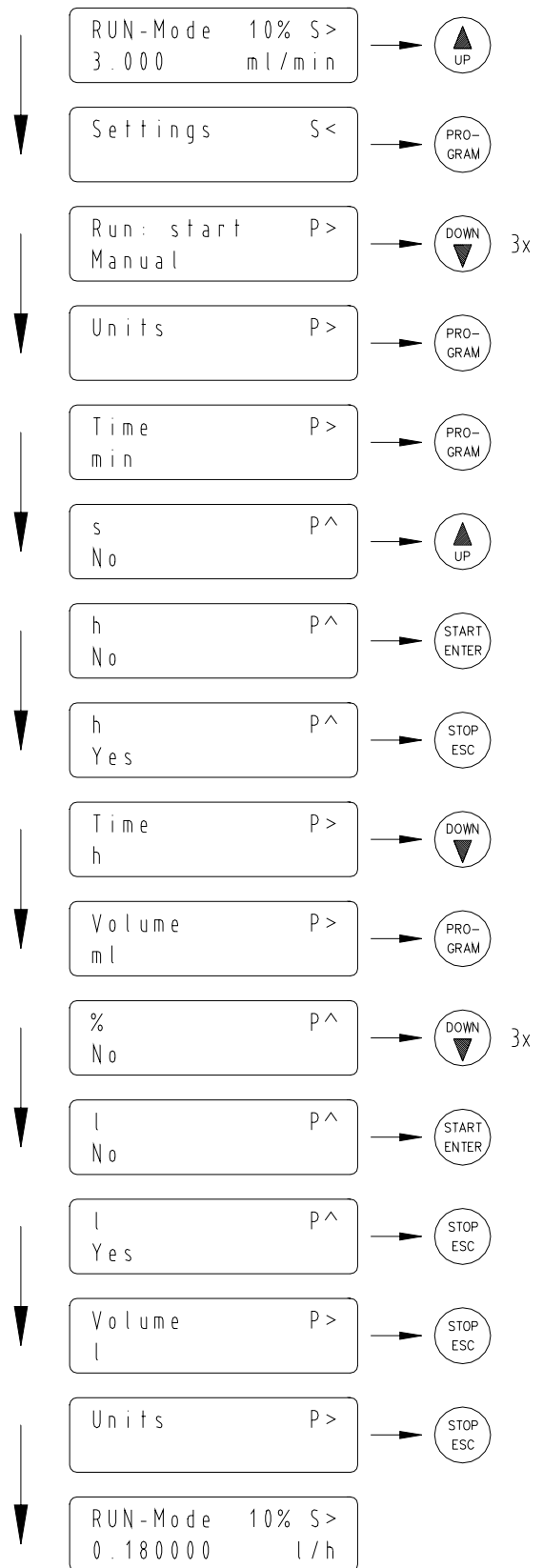
  - Press and hold the PROGRAM button for 3s and then press the DOWN button. The language swaps from one to the other each time the button is pressed
  - Adjust the language over the function “further settings” as demonstrated in [Fig. 8].



[Fig. 8] Example STEPDOS® 03: Changing the language from German to English.

- Changing the units for volume and .time:
 

The units are set as standard in „ml“ for the volume and “min” for the time.

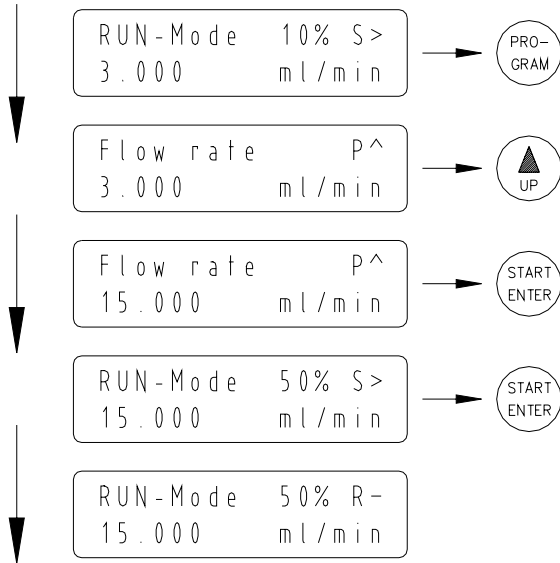


[Fig. 9] Example: Adjusting the units for the volume and time from ml/min to l/h (STEPDOS® 03).

## 8.2 RUN mode

➔ The RUN mode delivers a pre-defined quasi-continual flow (volume/time).

- ❶ Input the flow rate see [Fig. 10]
- ❷ Start the process by pressing the START button.
- ❸ Stop the process by pressing the STOP button.
- ❹ To change the flow rate whilst the pump is running press the PROGRAM button, UP/DOWN alters the flow rate, START/ENTER confirms and STOP/ESC back to original setting.
- ❺ The pump is calibrated for water at 20°C. In order to calibrate the pump for liquids with different viscosity, density or temperature, refer to section 12 «Calibrating the pump».
- ❻ In order to change the units for volume and time refer to section 8.1 «Standard settings».

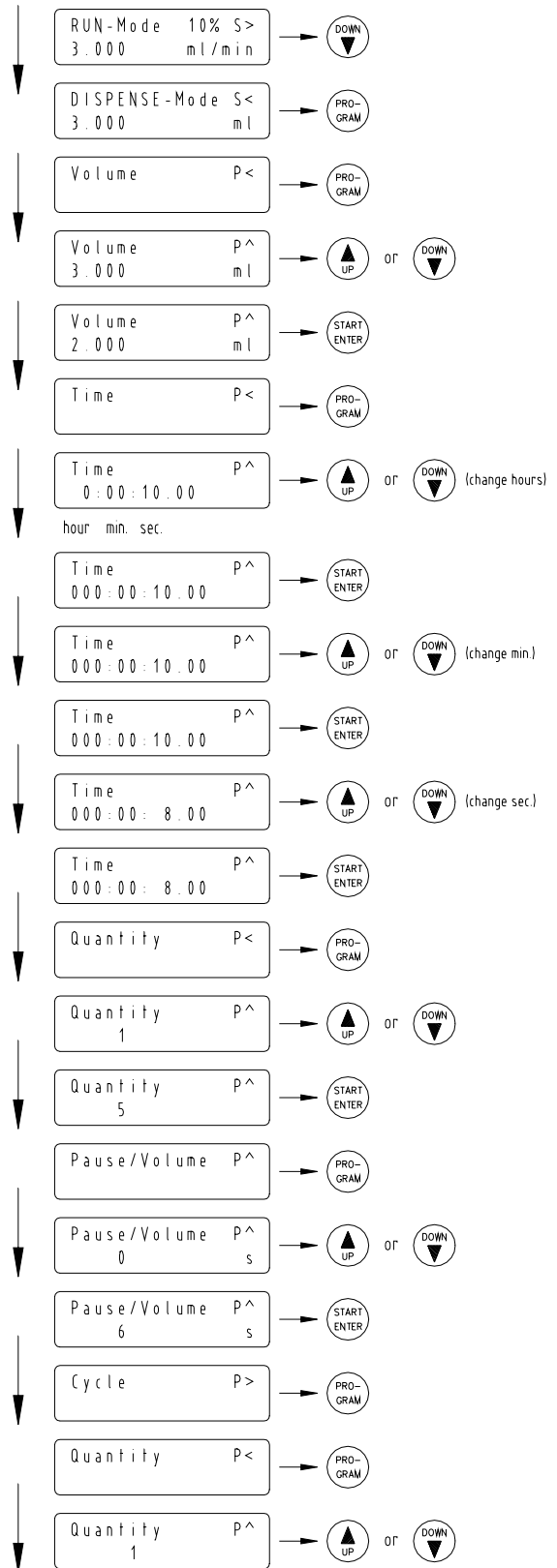


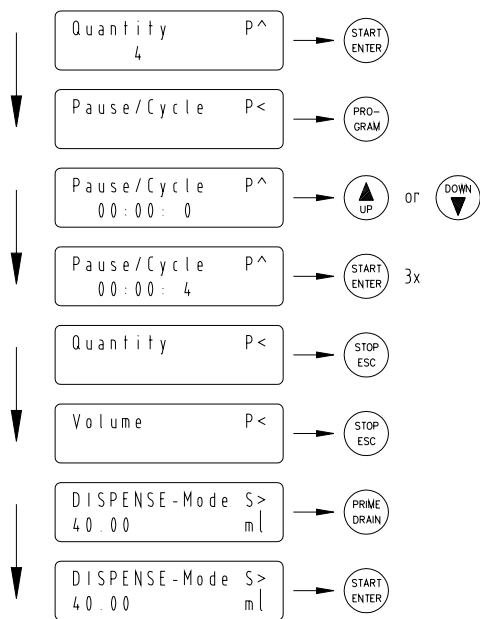
[Fig. 10] Example STEPDOS® 03:  
Change the flow rate from 3 ml/min to 15 ml/min

## 8.3 DISPENSE mode

➔ The DISPENSE mode allows a series of charges to be dosed:

- Total volume dosed (50µl to 43.2 l or 80µl to 115.2 l); Time to dose a charge (0,34s to 24h); Pause between the charges (0,34s to 24h); Number of charges (1 to 65'000); Repeating the cycle (1 to 65'000); Waiting time between the cycles (0s to 24h).
- The principle of the DISPENSE mode is shown in [Fig. 7]
- The following parameters must be programmed:
  - Total volume (V) per charge,
  - Dosing time of the charge (T),
  - The pause time (P) between two charges,
  - The number of charges per cycle,
  - The waiting time (W) between two cycles,
  - The number of cycles.
- For the programming sequence see [Fig. 11]
- To start the process:
  - ❶ Press the PRIME/DRAIN button to adjust the pump.
  - ❷ Press the START button.
- The program stops automatically when it is finished or can be paused by pressing the STOP button. In order to start the program again press the START button.
- The pump is calibrated for water at 20°C. In order to calibrate the pump for liquids with different viscosity, density or temperature, refer to section 12 «Calibrating the pump».
- In order to change the units for volume and time refer to section 8.1 «Standard settings».





[Fig. 11] Example STEPDOS® 03:  
Programming the parameters for the DISPENSE mode  
(Volume 2ml; Dosing time 8s; number of charges 5; Pause/Volume 6s;  
Number of cycles 4; Pause/cycle 4s).

### 8.4 Rapid suction/emptying

The STEPDOS® is equipped with a function which can be used to quickly fill and empty the hoses/system. This function can be activated from either:

- Keypad (PRIME/DRAIN button)
- PC software

Example using the keypad.

#### Rapid suction

- Place the suction hose in the liquid.
- Press the PRIME/DRAIN button.

#### Rapid emptying

- Remove the suction hose from the liquid.
- Press the PRIME/DRAIN button.

## 9. Settings

Please refer to section 19 «Appendix» (Overview settings).

## 10. External controlling of the pump

An external controller allows the dosing pump to be adjusted and run using the software which is delivered with the pump. It is also possible to integrate the pump into your own software solution; to do this you require a copy of the communication protocol (disc 2) which describes the orders.

The external controlling of the pump is only possible with the RC version of the STEPDOS®.

### 10.1 Installing the software

The Windows® compatible software is made up of ten data files.

- Double click the file *SETUP.EXE* on your installation disc.
- Follow the instructions of the Install Manager.
- Create a shortcut on your desktop.

### 10.2 Connection layout

Refer to section 19 «Appendix» (Electrical connection data).

### 10.3 Controlling using the RS 232-Interface

Almost every computer is equipped with an integrated serial interface RS 232 this allows a direct connection to be made

with the pump. The only changes which may have to be made in the software are the pre-selection of the interface and the correct pump address.

Normally these adjustment are preset as standard (PC and Pump on RS 232, Pump address 00).

For more information about this refer to section 19 «Appendix» (Connection PC-control cable).

## 10.4 Controlling using the RS 485-Interface

If you want to control more than one pump using a computer so that you do not have to keep on changing the cables then this is possible using a RS 485-bus-system.

For more information about this refer to section 19 «Appendix» (Connection PC-control cable).

## 11. Controlling using electrical in/outputs

The configuration of the signal from the Inputs/outputs can be made in following ways:

- with the Keypad
- with the PC software

For more information on how to connect the signal cable see section 19 «Appendix» (Connection PC-control cable).

For more information on the technical boundaries of the impulses see section 19 «Appendix» (Electrical connection data).

### 11.1 Analog controlling in RUN mode

Instead of controlling the flow manually it can be adjusted by using an analog signal. Different analog signals can be used e.g. 0...5V, 0...10V, 0...20mA and 4...20mA. There is also the possibility to allocate a part of the signal range to just a part of the dosing range [Fig. 10].

#### 11.1.1 User defined analog and flow ranges

Definition of analog range:

Range in % of the adjusted analog input signal (part of the signal range e.g. 0...10V, 0...20mA).

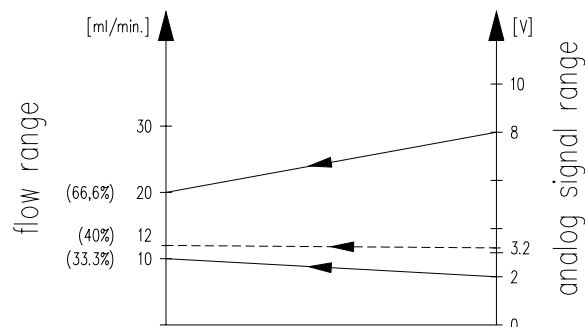
Definition of the flow range:

The range in % of the volume to be controlled by the analog signal. The adjustable range is also active without the analog signal, this means that even with a keypad only values within the input range can be used.

The analog signal range and the flow range can be adjusted independently from one another.

Example:

A part of the full analog signal range (e.g. 2...8V) can be used to control a part of the nominal flow range (e.g. 33%...66%). If for example a 3.2V signal is given then the dosing pump will deliver at a flow rate of 12ml/min (40%).



[Fig. 12] Projecting the analog range on to the flow range

### 11.1.2 Inverting the analog signal

By inverting the analog signal it is possible to turn the signal around so that with a low signal a high flow rate is delivered. Example: instead of 0V  $\leftrightarrow$  0ml/min and 10V  $\leftrightarrow$  30ml/min the following values are 0V  $\leftrightarrow$  30ml/min und 10V  $\leftrightarrow$  0ml/min.

## 11.2 Impulse control in DISPENSE mode

Instead of starting the DISPENSE mode manually it can be done by using impulses, this also allows a restart of an interrupted process. The number of impulses required can be set.

## 11.3 Controlling using logic signals

### 11.3.1 Description

the pump is equipped with two logic input/output plugs which act as higher level switches for the pump. The logic plugs are called I/O's (inputs and outputs). I/O 1 and I/O 2 can work independently and still be connected to logic functions.

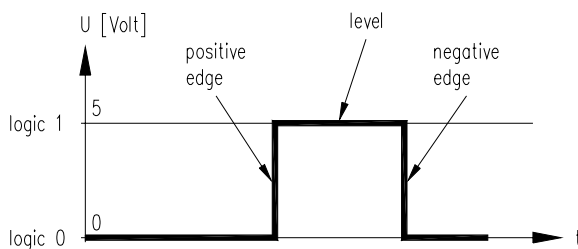
The logic inputs can be used to control the pump via external processes such as a foot switch, level switch etc.

### 11.3.2 Types of signal

The logic inputs differentiate between two types of signal; signal edge and signal level, see [Fig. 13].

For interpreting the signal level, 0V is logic 0 and 5V is logic 1.

For interpreting the signal edge is the switch from 0V to 5V, also a switch from logic 0 to logic 1 or vice versa logic 1 to logic 0.



[Fig. 13] Signal edge and signal level

### 11.3.3 Functions which react to a signal level

#### START/STOP

The pump runs when it receives I/O logic 1 (5V) and stops when it receives logic 0 (0V). The functions of START/STOP can be connected if both inputs are identically configured.

#### FAULT/STOP

The pump stops at logic 1 and the LED FAULT lights up. A restart of the pump is only possible manually. The I/O signal must be on logic 0.

#### Alarm LED

The FAULT LED blinks at a level logic 1 to indicate a problem in the system. The pump carries on running as normal.

#### Fault LED

The LED FAULT lights up at level logic 1. The pump carries on running as normal.

### 11.3.4 Functions which react to a signal edge

#### START/STOP

The pump changes from on/off after every impulse (positive Signal edge). By the first impulse it starts and after the next stops and so on.

#### Level START / Level STOP

This function is for use with a float switch. the switch must be installed so that logic1 (5V) is signalled when there is enough liquid in the container. When the container is empty then the level switches signal logic 0.

Level START: The pump runs, if a negative logic signal or logic 0 is received.

Level STOP: The pump stops running if a positive signal edge or logic 1 is received.

#### PRIME/DRAIN

For every positive signal edge received the pump carries out a PRIME.

#### Flow rate jumps/Motor speed jump

It is possible to change the motor speed externally by using impulses; both of the I/O's are required to do this. The signal level of the I/O 1 determines if the motor speed increases (logic 1) or decreases (logic 0). The I/O 2 counts the number of signal edges or impulses and changes the flow accordingly. The flow is increased by a predetermined amount per impulse the largest jump per impulse is 10% and the smallest 1% (relative to the calibrated flow rate).

#### Reset alarm/failure

If the pump shows a alarm/failure it can be reset using the logic input I/O 2. In order to do this a positive signal edge (closed contact) must be set up on the I/O 2.

#### Example

- Alarm No. 1: PE error (e.g. the back pressure is too high)
- Alarm No. 4: control signal is lower then 4mA when using the 4-20mA control option.

If in the menu „Furth. settin.“  Fault = Stop  Yes is selected (standard setting) then the dosing pump will only start again after an alarm/fault if the pump is reset.

If  Fault = Stop  No is selected then the dosing pump will start again as soon as the problem is removed.

#### Monitoring the dosing function

The pump can monitor the function of the system. It checks if an external sensor is delivering impulses. If impulses are being delivered then the pump will wait for 30s at the start before it shows a fault. Impulses must be received every 10s in order to prevent an error message from being shown and the process from being stopped.

### 11.3.5 Logic connection of input signals

If both inputs are occupied with the same function then they can be connected. The connections NONE, logic AND, logic OR und EXOR are possible.

The logic connection are only possible for functions which react to signal levels; refer to section 11.3.3 «Functions which react to a signal level».

### 11.3.6 Signal preparation

If by chance the signal is connected the wrong way around then it is still possible to work with them. The voltage 0V will be taken as logic 1 and 5V as logic 0.

## 12. Calibrating the pump

The STEPDOS 03 pump is calibrated in the factory to 30 ml/min at ambient conditions and the STEPDOS 08 to 80ml/min.

There are many different factors which can lead to differing values e.g.

- suction and pressure height
- soft hoses
- liquids with low vaporisation point producing gases
- high viscosity liquids
- unsuitable mounting position

In order to compensate for these factors it is possible to recalibrate the pump within a certain range. The calibration works by either superimposing the theoretical amount onto the real amount being dosed or by increasing / lowering the motor speed thus compensating for the special conditions.

In the RUN mode the pump is calibrated by altering the speed of the motors so that the actual flow corresponds with the set flow rate shown in the display. After making a comparison measurement between actual and set values a correction factor can be calculated in order to increase the accuracy over the entire range.

In DISPENSE mode the calibration is more complicated. The volume per cycle varies depending on the set time and the total volume which means that a single cycle must be calibrated with the set conditions. Because the pumping action is not linear the calibration takes place in segments. Every 10% of a theoretical cycle (18° angle of rotation) a correction factor is calculated by making a set/actual value comparison. This calibration is only possible using the Windows® compatible software.

### 12.1 Calibrating using weighing scales

This function is still being worked on. Only possible with the PC software.

### 12.2 Calibrating using measurements

➔ **The best accuracy is achieved if the dosing pump is calibrated with the actual operating conditions.**

A certain amount is pumped over a definite time span, e.g. 10s. The display shows the theoretical amount which has been pumped, the real amount can be determined by either weighing the sample (attention: observe the liquid density) or measuring in a measuring glass.

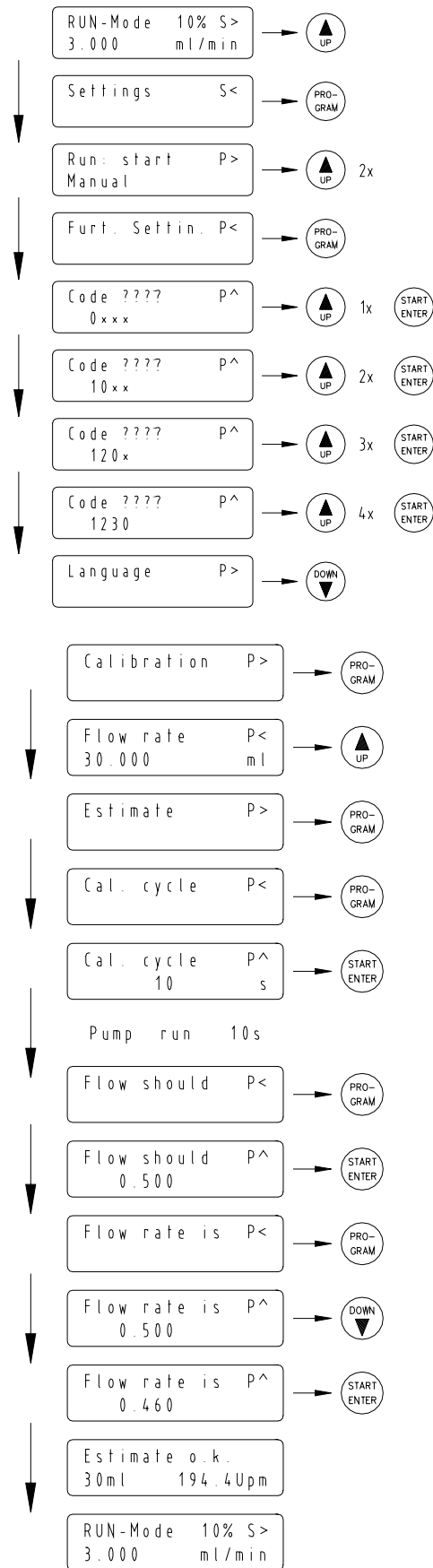
In the calibration menu these figures can be entered into the dosing pump so that it can carry out a compensation.

The calibration function only accepts differences of ±10% of the nominal flow rate, if the difference is larger than this there is generally a problem with the application (e.g. gas formation).

#### Calibration time

The time used for the dosing sample can be entered in the calibration menu (10-60s).

The real values must then be entered so that the pump can calculate the new values [Fig.14].



[Fig. 14] Example STEPPOS® 03: Entering the values for a calibration.

## 13. Settings

Please refer to section 19 «Appendix» (Overview settings).

## 14. Maintenance

In order to guarantee the leak tightness of the pump after changing the diaphragm or valves we recommend that the diaphragm, valve cartridge and tongue valve are all changed at the same time.



### Safety warning

Before working on the pump system the power supply must be turned off and checked that it is voltage-free.

Tools and parts required:

- Parts according to the spare parts list (19 «Appendix» (Spare parts kit/spare parts list))
- Philips screwdriver No. 1

How the pump is constructed can be seen in section 19 «Appendix» (Spare parts kit/spare parts list).

### 14.1 Preparation steps

- ❶ When the dosing pump is taken out of service, the complete installation including the pump must be rinsed with a neutral liquid, and then pumped empty.
- ❷ Take the unit out of operation, including separating it from the electrical supply (switch off the power supply, ensure that the unit is carrying no voltage and verify that this is the case).
- ❸ Disconnect the inlet and outlet tubes from the pump head.

### 14.2 Removing the pump head

- ❶ Undo the 4 screws (Pos. 090) and remove the complete head.

### 14.3 Changing the diaphragm

- ❶ Grip the diaphragm (Pos. 010) firmly and turn it anti-clockwise to unscrew it.
- ➔ **This is easier if a soft piece of paper or material is used to get a better grip.**
- ❷ Remove the old sealing ring (Pos. 130).
- ❸ Remove the spacers (Pos. 060) and the support (Pos. 070) from the old diaphragm, and fit them on to the new one (Pos.010).
- ❹ Screw in the new diaphragm, and tighten it firmly.
- ❺ Push the edge of the diaphragm down firmly into place.
- ❻ Place the new sealing ring (Pos. 130) in the intermediate plate.

### 14.4 Changing the valves KT-, TT-version

- ❶ Lift the connection plate (Pos. 110) from the intermediate plate (Pos. 100).
- ❷ Remove the old valve cartridge (Pos. 040) and sealing rings (Pos. 050) from the intermediate plate (Pos. 110) and discard them.
- ❸ Clean the intermediate plate (Pos. 100).
- ❹ Place the sealing ring (Pos. 030) dust free in the intermediate plate (Pos. 100).
- ❺ Clean the connection plate (Pos. 110).
- ❻ Place the sealing ring (Pos. 050) dust free into the connection plate.
- ❼ Place the new valve cartridge (Pos. 040) into the connection plate.

### 14.5 Changing the valves ST-, FT-version

- ❶ Lift the connection plate (Pos. 110) from the intermediate plate (Pos. 100).
- ❷ Remove the old valve plate (Pos. 030) from the connection plate (Pos. 110) and discard it.
- ❸ Clean the intermediate plate (Pos. 100).
- ❹ Clean the connection plate (Pos. 110).
- ❺ Place the valve plate (Pos. 030) into the connection plate.

## 14.6 Changing the tongue valve (solenoid valve)

- ❶ Lift the connection plate (Pos. 110) from the intermediate plate (Pos. 100).
- ❷ Remove the old tongue valve (Pos. 020) and the solenoid connecting rod (Pos. 080) from the intermediate plate.
- ❸ Disconnect the tongue valve (Pos. 020) from the solenoid connecting rod (Pos. 080).
- ❹ Clean the connection plate (Pos. 110).
- ❺ Clean the intermediate plate (Pos. 100).
- ❻ Insert the new tongue valve (Pos. 020) into the solenoid connecting rod (Pos. 080). For the correct positioning see section 19 «Appendix» (Spare parts kit/spare parts list).
- ❼ Place the tongue valve (Pos. 020) with the solenoid connecting rod (Pos. 080) into the intermediate plate (Pos. 100).

## 14.7 Re-assembling the pump head

- ❶ Check that the sealing rings are positioned correctly.
- ❷ Place the connection plate (Pos. 110) carefully into the intermediate plate (Pos. 100).
- ❸ Insert the screws (Pos. 090) in the holes in the pump head.
- ❹ Place the complete head on the pump, and tighten the 4 screws (Pos. 090). Always tighten the screws in a diagonal pattern.

## 15. Trouble shooting



### Safety warning

Before working on the pump system the power supply must be turned off and checked that it is voltage-free.

### 15.1 Possible problem messages in the display

In every case the first thing which has to be done is to press the **❶** ENTER button in order to reset the error message.

Error Message	Cause	Removal
Error No. 1: PE error	- Back pressure is too high	❶ Reduce the back pressure
Error No. 2: Dosing monitoring	- Dosing monitoring is activated but there is no flow meter connected	❶ Connect the flow meter correctly (see section «External controlling of the pump»)
	- No flow	❶ Refill the liquid container
	- System not in operation	❶ Turn the system on
Error No. 3: Impulse-fault	- Gas bubbles in the system	❶ Remove all of the air bubbles from the system (see section «Rapid filling and emptying»)
	- The next impulse came too early before the process was finished.	❶ Check the program data
Error No. 4: Signal under 4mA	- Run-Start is on analog 4-20mA. Analog signal is <4mA (error level is approx. 3.5mA)	❶ Check analog signal
Error No. 6: Temperature exceeded	- Ambient temperature is too high.	❶ Lower the ambient temperature
Error No. 8: PE - no signal	- Motor is blocked. Back pressure is too high	❶ Reduce the back pressure.
	- Hall-effect sensor (Positioning PE) not connected.	❶ PRIME/DRAIN button ❶ Check the cable to the hall-effect position sensor.
mot. not just.	- Motor is not in the zero position.	❶ Press the PRIME/DRAIN button, see section «Motor adjustments»
Display error	- EEPROM faulty	❶ New initialisation (see section «Initialising the pump system»)

## 15.2 General problems

### ➔ Motor does not run.

- Pump is not connected to the power supply.
- Power supply is turned off.
- One of the two fuses is burnt through (changing the fuses T1A from the underside of the pump).
- The system pressure is too high, observe the error message on the display.

### ➔ Pump does not prime.

- Pump is not connected on the inlet side or there is not enough liquid in the system.
- Hose connections are not tight.
- A system valve is closed or a filter is blocked.
- Diaphragm or valves are worn out or are covered in dirt.
- The pump head is empty so that the gas pressure on the outlet side can't be overcome.

### ➔ Flow rate, suction height, or pressure height is insufficient.

- The periphery installation contains components (hoses, valves, filters etc) which create too much resistance.
- Hose connectors are not tight.
- Diaphragm or valves are worn out or are covered in dirt.
- With liquids of high viscosity the dosing time may have to be increased.

## 15.3 Motor adjustments

### 15.3.1 DISPENSE mode

In the DISPENSE mode the dosing pump must start from a pre-defined point (zero) so that it can count the number of strokes which have been carried out.

If the dosing pump was running beforehand in the RUN mode or a new dispense volume has been programmed then the motor must be brought into the zero position. This can be done by pressing the PRIME/DRAIN button.

If this is not done then the error message "mot. not just." will appear. This can be reset by pressing ENTER/START button before pressing the PRIME/DRAIN button.

### 15.3.2 RUN mode

It is also better in the RUN mode to press the PRIME/DRAIN button before starting the process as this prevents any inaccuracies.



**In the PRIME/DRAIN function liquid will be pumped.**

The pump can be brought into the start position either manually on the keypad (described above) or by using the software.

### 15.3.3 Finding the Zero start point using a PC

#### ➔ Working in DISPENSE mode

- ① Choose the DISPENSE mode from the menu „Pump“
- ② Click on „P/D“ (= PRIME/DRAIN)

#### ➔ Working in RUN mode

- ① Choose the RUN mode from the menu „Pump“
- ② Click on „P/D“ (= PRIME/DRAIN)

## 15.4 Initialising the pump system

In case a failure occurs which can not be corrected (see [section 15.1 and 15.2](#)) then the pump can be initialised anew using the Starter Kit (=reset). All the values and program of the electronic will be reset to the factory settings.



**All of the parameters / values changed by the user will be lost.**

### ➔ Carry out initialising procedure

Before the pump system is connected to the power supply:

- ① Press and hold the PRIME/DRAIN button
- ② Reconnect the power supply
- ③ Wait until "init pump" is shown in the display
- ④ Release the PRIME/DRAIN button

## 16. Technical data

### 16.1 Pump system

Parameter	STEPDOS® 03
Power Supply	100-230 V / 50-60Hz AC
Power consumption	25 W
Max. current draw	0.25 ... 0.11 A
Noise level	< 40 dB
Protection class	IP 65
Nominal pump speed	180 rpm.
Dosing range	1 : 1'000
Life time	> 10'000 h (10 <sup>8</sup> cycles)
Accuracy	+/- 2%
Repeatability	+/- 1%
Flow rate <sup>1)</sup>	min. 30 µl/min - max. 30 ml/min
	50 µl ... 43.2 l
	0.34 s ... 24 h
Suction height	4 mWg
Pressure height	60 mWg
Ambient temp. range	+5 ... +40 °C
Liquid temp. range	+5 ... +80 °C
Max. viscosity	150 cSt
Connections	UNF ¼"-28
Hoses (OD)	1/8" - 1/32" (1.6 - 3.2 mm)
Weight <sup>2)</sup>	1.4 Kg

Parameter	STEPDOS® 08
Power Supply	100-230V / 50-60Hz AC
Power consumption	30 W
Max. current draw	0.3 ... 0.13 A
Noise level	< 40 dB
Protection class	IP 65
Nominal pump speed	180 rpm.
Dosing range	1 : 1'000
Life time	> 10'000 h (10 <sup>8</sup> cycles)
Accuracy	+/- 2%
Repeatability	+/- 1%
Flow rate <sup>1)</sup>	min. 80 µl/min - max. 80 ml/min
	80 µl ... 115.2 l
	0.34 s ... 24 h
Suction height	3 mWg
Pressure height	20 mWg
Ambient temp. range	+5 ... +40 °C
Liquid temp. range	+5 ... +80 °C
Max. viscosity	150 cSt
Connections	Compression fittings 4/6
Hoses (OD)	ID 4 mm, OD 6mm
Weight <sup>2)</sup>	1.4 Kg

<sup>1)</sup> Measured with water at 20°C and atmospheric conditions.

<sup>2)</sup> The weight can vary depending on the version

## 16.2 CE Certification

### 16.2.1 EEC Low voltage regulations 73/23 EWG

The diaphragm dosing pump type STEPDOS® confirm with the following standards of the safety regulations from the EEC low voltage regulations 73/23 EWG:

EN 60529  
EN 61010-1

### 16.2.2 EEC Guidelines of the electromagnetic compatibility 89/336 EWG

The diaphragm dosing pump type STEPDOS® confirm with the following standards of the EEC guidelines about electromagnetic compatibility 89/336 EWG:

EN 50082-2  
EN 55011  
EN 61000-3-2  
EN 61000-3-3

## 17. Pump construction

The pump construction is shown in section [19 «Appendix» \(Spare parts kit/spare parts list\)](#).

## 18. Accessories and spare parts

### 18.1 Accessories

The accessories are listed in section [19 «Appendix» \(Spare parts kit/spare parts list\)](#).

### 18.2 Spare parts

The spare parts are shown in section [19 «Appendix» \(Spare parts kit/spare parts list\)](#).

All of the parts in the spare parts kits are also available on their own.

## 19. Appendix (ID 152 267)

Please see attached documents.

Our strength is providing individual solutions,  
please contact us with your problems.

KNF reserves the right to make technical  
changes. Last modification: 22.01.2004 / X05

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