



LAMBDA MAXIFLOW

Peristaltic Pump - Tubing Pump

OPERATION MANUAL



LAMBDA Laboratory Instruments

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LAMBDA MAXIFLOW peristaltic pump – tubing pump

The LAMBDA peristaltic pumps have been developed for continuous cultures as the result of over twenty years of laboratory experience and involved the systematic elimination of the imperfections found in other pumps on the market.

The successful design and well-proved mechanics of the LAMBDA PRECIFLOW pump has been extended by flow rate programming. Up to 99 steps of time and flow rate can be easily programmed, thus allowing the creation of any desired flow rate profile. The maximum flow rate has been increased to up to 10'000 ml/hour. Until now, it was not possible to produce peristaltic pumps with such a high flow rate in such a small instrument casing.

- Flow rates from 0.2 to 10'000 ml/hour
- Large digital speed setting range from 0 to 999
- Greatly extended tubing life and decreased pulsation
- Flow rate programming (up to 99 steps) and automatic switch-on and -off without using any timer
- Extensive remote controls
- Very economic in use
- Tubing economy pays the pump after the use of mere 80 m tubing!
- Access to reaction kinetics by using the pump-flow INTEGRATOR
- Low voltage plug-in power supply for maximum safety
- RS-485 interface (optional)
- Control software PNet (optional)

LAMBDA Laboratory Instruments

is developer and producer of special laboratory instruments mainly for biotechnology, microbiology, food and agricultural, chemical and pharmaceutical research and development as well as for general laboratory and research applications.

LAMBDA MINIFOR - innovative and compact laboratory fermenter / bioreactor

LAMBDA OMNICOLL - fraction collector with new concept for unlimited number of fractions

LAMBDA PRECIFLOW, MULTIFLOW, HIFLOW and MAXIFLOW peristaltic pumps - practical, precise and extremely compact

LAMBDA SAFETY POWDER DOSER - allows automatic addition of powder without spoon. Safe operation with hazardous material (GLP)

LAMBDA VIT-FIT polyvalent syringe pump with extremely robust mechanics - programmable infusion and filling from micro syringes to large volume syringes of 150 ml without adapter

LAMBDA MASSFLOW is precise gas flow measurement and control with recording option

LAMBDA PUMP-FLOW INTEGRATOR - with LAMBDA pumps and doser allows the visualization and recording of the pumped volume

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OPERATING INSTRUCTIONS

1. SETTING UP THE PERISTALTIC PUMP

1.1 Insertion of the tubing

- Plug the connector of the power supply into the corresponding socket at the back side of the peristaltic pump and secure it in place by rotation of the ring.
- Plug the power supply into the AC mains (230V/50-60 Hz). After a short beep signal the display will be illuminated. The last used settings will be displayed.
- Remove the clear PVC cover by rotating it to the left or to the right (figure 1). A short video of the installation is on: <http://www.lambda-instruments.com/?pages=video>
- Press the **ON/OFF** button and select the sense of rotation of the pump by pressing the button **◀|▶**, so that the rotor will turn in a clockwise direction.
- Set the pump speed to about 30 (sense of rotation **▶**) by pressing the corresponding buttons **▲▲▲** under the LED display.
- Press the tubing into the back slot on the top of the peristaltic pump. Thin tubing should be pushed completely to the bottom of the slot. Guide the tubing around the outside of the slowly turning plastic bearing towards the front slot (figure 2). Then press the tubing into the front slot to secure it (figure 3).
- Replace the transparent cover by placing it again on the top of the pump and turn it so that the steel ball embedded in the left-front corner fits into the corresponding notch in the PVC cover. When the cover is gently pressed, the bearings will automatically adjust themselves.

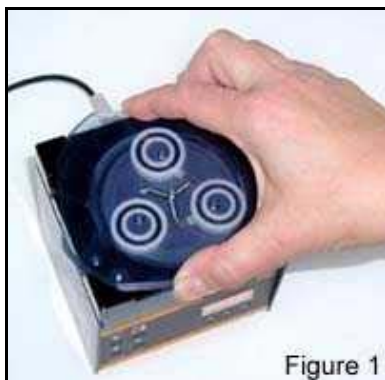


Fig. 1: Removing the cover



Fig. 2: Insertion of the tubing



Fig. 3: Tubing in the pump head

1.2 ON/OFF button

By pressing the **ON/OFF** button the pump is switched on or off. The internal memory will show the last used speed and flow direction setting.

1.3 Setting of the flow rate

The flow rates delivered by peristaltic pumps depend on the internal diameter of the tubing and the pump rotation speed. The speed of rotation can be selected by the control buttons **▲▲▲** under the LED display.

The MAXIFLOW tubing pump has been constructed for tubing with an internal diameter ranging from 0.5 to 4 mm with a tubing wall thickness of approximately 1 mm. The best results have been obtained with silicon tubing, but tubing made from other materials with similar elasticity can also be used.

The volume of liquid pumped per hour for tubing of different diameter and different speed settings is shown in the flow rate diagram in section 8. The flow rates of the LAMBDA MAXIFLOW peristaltic pump can be varied over a large range from 0.2 to 10000 ml/hour.

With the control buttons **▲▲▲** below the LED display the motor speed is selected. The speed setting from 0 to 999 corresponds to the velocity of the movement of the motor. The best way to correlate the flow rate obtained with the respective tubing is to make a preliminary calibration, in which the pump is allowed to pump the liquid over a certain time with a selected speed setting (e.g. for 1 minute with speed setting 500). Then, the weight or volume of the pumped sample is measured. Using this information the speed setting corresponding to the desired flow rate can be calculated easily (rule of three).

1.4 Setting of the flow direction

The direction of pump rotation can be selected by the **◀|▶** button. The corresponding direction LED diode will be on.

1.5 Fast filling or emptying of the line

If the direction **◀|▶** button is pressed continuously for about 2 seconds, the pump will rotate at maximum speed in the sense of rotation indicated by the LED. After releasing this button the pump is stopped. This is useful for filling tubing before the start of operation or for emptying tubing at the end of operation. This "HOLD=MAX" function can be used even though the **ON/OFF** button has not been pressed.

2. PROGRAMMING OF THE PERISTALTIC PUMP

Up to 99 pairs of time and speed settings (flow rates) may be programmed in a simple way. The programming mode is accessed by simultaneously pressing the buttons **REMOTE** and **RUN** until and the indication "**PGM**" appears on display and **both** directions LEDs (◀▶) are illuminated:

Remark: If you repeat this simultaneous pressing of the REMOTE and RUN buttons, the memory will be cleared and the indication "cLE" will appear on the display. To enter the programming mode again, press the REMOTE and RUN buttons again until "PGM" appears.

- Press the **ON/OFF** button. The indication "**F01**" will appear for a short time on the display indicating that you can select the first flow rate (speed setting) value.
- Select the direction of the pump rotation using the direction button ◀▶.
- Set the desired flow rate value for the first program step by pressing the buttons ▲▲▲ below the display (from 0 to 999, corresponding to 0 to 100% of the motor rotation speed).
- Press the **ON/OFF** button. The indication "**t01**" will appear for a few seconds on the display indicating that you can program the time period of the first step in minutes. Select the desired time period for the first program step by pressing the buttons ▲▲▲ below the display (from 0 to 999 minutes).
- Press the **ON/OFF** button. The indication "**F02**" will briefly appear on the display. You can now enter the desired flow rate for the second program step. After this press the **ON/OFF** button again. The symbol "**t02**" will briefly appear on the display. You can now set the time of the second program step.
- In a similar way up to 99 program steps can be entered.
- After having entered the time of the last step, press the **ON/OFF** button. The flow rate (000) of the next step **which will not be programmed** appears on the display. Press both **REMOTE** and **RUN** buttons simultaneously until the indication "**End**" appears on the display. Both direction LEDs will be switched off.

Remark: It is not possible to end the program after programming the time data. The direction LEDs indicate if you are programming speed or time:

*One direction LED is on: Programming of the flow rate (in the direction indicated by the LED)
Both directions LED are off: Programming of the time*

- Press the **ON/OFF** button again. You will see the indication "**c01**" on the display. This indicates that the program will be executed only once and the syringe pump will stop afterwards. If you wish to repeat the same program 3 times, increase the cycle number to "**c03**" by pressing the buttons ▲▲▲ below the display (from 0 to 99 cycles). The program can be repeated up to 99 times, indicated by "**c99**". If 0 is entered for the cycle number "**c00**", the program will run continuously (infinite loop).
- Press the **ON/OFF** button again to confirm the number of desired cycles.

To **start** the program, press the **RUN** button. The RUN and ON/OFF LEDs are on.

To **stop** the running program definitively, press the **RUN** button. The RUN and ON/OFF LEDs are off.

It is possible to stop the pump by pressing the **ON/OFF** button, to change the direction and the rotation speed during any running program step. This facilitates urgent replacement of tubing or allows reaction in other emergency situations.

*Remark: Do not forget to restore the right direction of the rotation and to switch the pump on again (by pressing the **ON/OFF** button) after you have finished your intervention.*

The **time basis** in the microprocessor is **not stopped** during this intervention, so that the total time of the running steps and of the whole program will not be affected. When the program step time has elapsed, the pump will automatically go on with the next program step. Thus, the program is not modified by this emergency intervention.

It is possible to review the program by proceeding in the same way as during programming but without modifying it.

3. REMOTE CONTROLS

3.1 ON/OFF remote control

By interlinking the contacts no. 4 and 5 of the socket at the rear of the pump (see figure 4), the pump will be blocked and both direction indicating LEDs will be switched off.

The same effect will be obtained by applying a voltage of 3 to 12 V DC to the contact no. 5 (0 line must be connected to contact no. 3).

Remark: In some cases a reversed logic for the remote control might be desired. Please contact us in this case.



Fig. 4: Backside of the pump

3.2 Remote control of the pump speed

The LAMBDA peristaltic pumps can be controlled over the whole range by an external signal (0 - 10 V, option 0-20 or 4-20 mA). The plus pole of the signal is connected to the contact no.1, 0 line to the contact no.3.

Press the button **REMOTE** on the front panel. The corresponding LED diode will go on and the display will indicate the approximate voltage of the external signal. This indication may become unstable when no external connection is made and indicates the high sensitivity of the electronics.



For safety reasons the voltage of the external signal must **not exceed** 48 V to earth!

3.3 PC control

When the instrument has been equipped with the optional RS-232 or RS-485 interface, it can be controlled digitally, e.g. from a PC.

Disconnect the pump from the mains. While keeping the direction button **◀|▶** pressed connect the pump to the mains again. The message **“A”** and two numbers will appear on the display. This number from 00 to 99 is the current address of the pump. To change the address press the buttons **▲ ▲ ▲** under the display until the desired number is obtained. To confirm the address and save it, press the **ON/OFF** button.

4. RECOMMENDATIONS

- It is advisable to use tubing with a small diameter and high-speed control setting for small flow rates rather than the opposite. This allows a finer selection of flow rates.
- If possible use the clockwise rotation of the tubing pump. This results in lower friction and the pressure of the liquid is also lower (approx. 0.1 MPa). If a higher pressure is required (up to 0.15 MPa) use the counter-clockwise rotation.
- Periodically smear a small amount of petroleum jelly or similar grease on the inner side of the transparent PVC cover of the peristaltic pump. This will increase the reliability and the lifetime of your peristaltic pump. **Do not grease the tubing holding slots.**
- If, as a consequence of tubing breakage or some other accident, liquid spills into the top of the tubing pump, disconnect the pump from the mains and clean it by removing the liquid and rinsing it with water. The rotor can be completely removed by unscrewing the nut (size M4) on the axis of the rotor and pulling the rotor out by hand or with pliers. After cleaning, grease the axis and replace the rotor by pressing and rotating until the rotor engages on the motor axis.
- Clean the peristaltic pump with a damp cloth. Mild solvents like ethanol, isopropanol, alkanes are tolerated, if the exposure is short.
- If you have any difficulties or questions concerning your MAXIFLOW peristaltic pump, please contact our service office.

5. FOR YOUR SAFETY

Thanks to the use of a plug-in power supply giving only a low voltage of 12 V DC the danger of electrical shock during the use of the MAXIFLOW peristaltic pump has been virtually eliminated, even when an electro conductive solution penetrates the tubing pump.

The peristaltic pump is usually used in a vertical position. The peristaltic pumps can also be stacked, thus allowing optimal use of your expensive laboratory areas.

If the tubing pump is not used for an extended period of time, disconnect it from the mains. A modern miniaturized switching power supply is used, which has only a negligible consumption of electric current when the peristaltic pump is not in use.

6. CONSTRUCTION ADVANTAGES OF THE MAXIFLOW PUMP

- Instead of small rollers, which are used by most pump producers, LAMBDA peristaltic pumps use ball bearings of a larger diameter with glass beads. This reduces pulsation, friction and mechanical strain on the tubing leading to better pump performance.
- The bearings glide over the tubing so gently, that unlike in other tubing pumps, it is not necessary to prevent the movement of the tubing by any special fixation (stoppers, clamps etc.). As a consequence, the lifetime of the tubing is considerably increased.
- The pressure on the tubing is transmitted gradually through an off-centre lever and spring made of stainless steel. This assures that only minimal pressure is applied to the tubing, which guarantees reliable functioning of the pump without unnecessary deformation of the tubing.

- The spring also reduces the liquid pressure to approx. 1.5 bar. This is useful when for any reason the line is blocked.
- The asymmetric pump head reduces pulsation and is made from hard, chemically stable material.
- A high quality, Swiss made, stepping motor, together with integrated microprocessor electronics assure highest precision of flow rates with no inertia while turning the peristaltic pump on and off.
- The tubing pump dimensions have been minimized. Therefore, the MAXIFLOW peristaltic pump is considerably smaller than other products of similar performance. The pump is easy to use and saves expensive laboratory bench space.
- The different remote control options and the possibility of flow integration increase the scope of use of the LAMBDA peristaltic pumps in automatically controlled systems (e.g. in fermentations and cell cultures, chemical synthesis, fraction collection, etc.)
- The microprocessor allows up to 99 program steps. This opens the possibility to realize almost any flow rate profile. Additionally, the MAXIFLOW peristaltic pump can be equipped with a RS-232 or RS-485 interface (optional) allowing for digital control, e.g. from a PC. This is particularly useful for adding medium to a fermentor or bioreactor to feed the culture which is also growing exponentially. Thus, the growth rate and resulting culture activity are considerably increased.

7. ACCESSORIES AND SPARE PARTS

7.1 Pump-Flow Integrator (Art. no. 4803)

The LAMBDA MAXIFLOW peristaltic pump and the other LAMBDA pumps are the only pumps on the market, which allow **a simple and precise integration of the amount of liquid that has been delivered by the pump.**



The electrical impulses, which move the pump motor, are registered and transformed into a direct voltage. This voltage can be measured or recorded by common recorders or voltmeters. The RS 485 interface allows the control from a PC.

In processes where the pump is controlled e.g. by a pH-stat during a fermentation or cell culture to keep the pH of the medium constant, it is often important to know when and how much acid or base were added. **This data yields important information about the process, its kinetics and time of completion, etc.**

Another use of the INTEGRATOR is for the **measurement of enzyme activities** (e.g. amidases, esterases, lactamases, lipases, proteases and other enzymes).

The pump-flow INTEGRATOR can be conveniently placed under the MAXIFLOW peristaltic pump, to which it is connected by a cable to the 8-pole socket at the rear of the pump (figure 4).

The INTEGRATOR connected to LAMBDA peristaltic pumps **allows new and unusual pump applications** (e.g. gradient making, counter flow elution, liquid chromatography, electronic burette, etc.) also shown in section 9.

7.2 List of accessories and spare parts

Art No	Accessories
4803	PUMP-FLOW INTEGRATOR (for LAMBDA pumps, DOSER and MASSFLOW)
4810	Pump remote control (analog and digital) cable (8 poles)
4802	Pump ON/OFF remote control cable (2 poles)
	Interface and Control software
4822	RS-232 interface (for connection of the instruments to the serial port)
4816	RS-485 interface (for connection of the instruments to the serial port)
4817	RS-232/485 converter
4818	Power supply for RS232/485 converter (5V/1W)
4819	RS-line connection cable
6600	PNet control software for peristaltic and syringe pumps, DOSER or MASSFLOW
800202	Quadruple plug box (Power and RS-connection for up to 4 LAMBDA laboratory instruments)
	Spare parts
4821	Plug-in power supply (12V/24W) for HIFLOW, MAXIFLOW, VIT-FIT, MASSFLOW
4804	Adaptor for 230V output controllers
4805	Roller
4806	Stainless steel spring
4807	Eccentric lever
4808	Rotor
4809	Cover
4811	Pump head
4813-bm	BLDC motor (MAXIFLOW)
4814-bm	Gearbox (MAXIFLOW)
4815	Silicone tubing 3/5mm x 10m
800113	Stainless steel tubing clamp

8. FLOW RATE DIAGRAM

The following figure shows the flow rate diagram of the MAXIFLOW peristaltic pump as a function of pump speed setting and internal tubing diameter. The flow rates are indicative and can differ depending on the pumped substance, pressure, tubing etc.

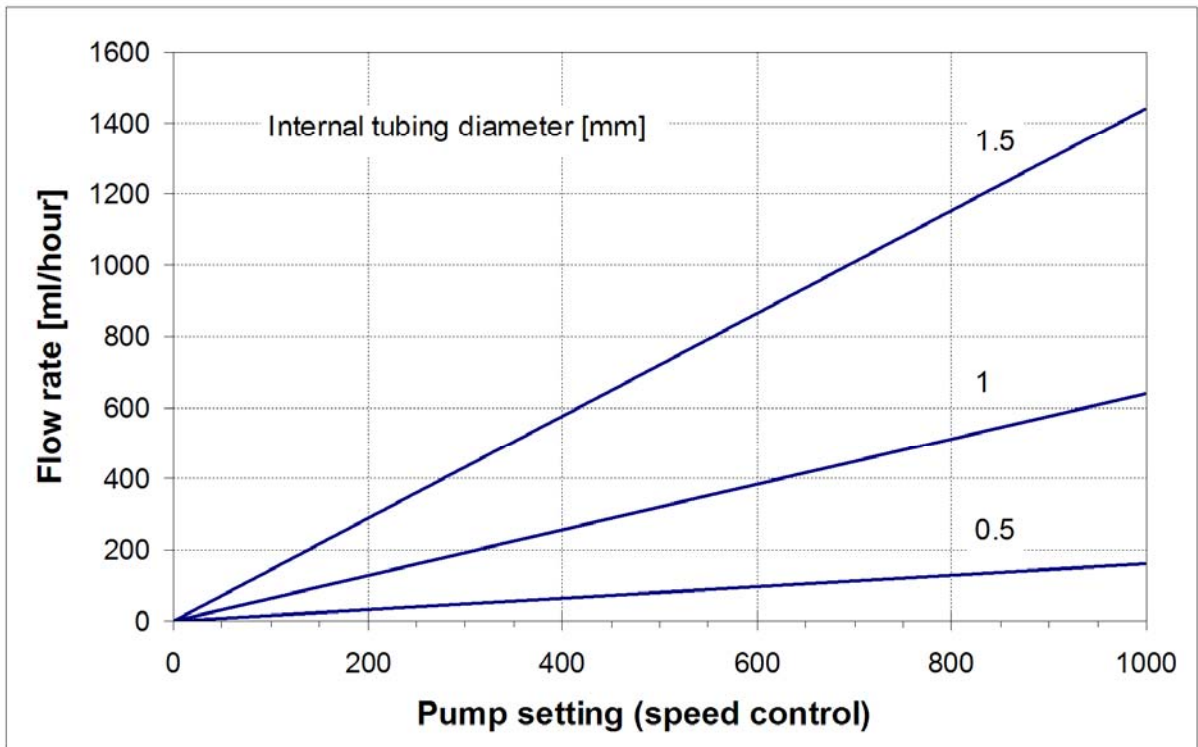
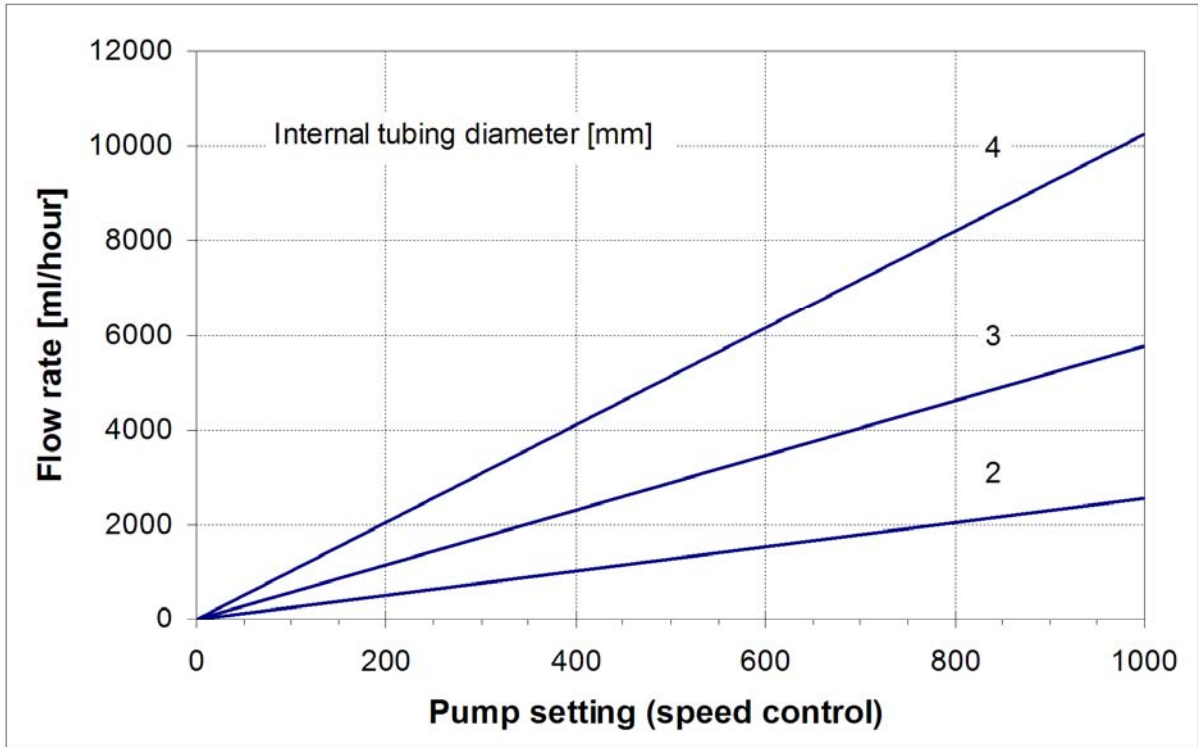
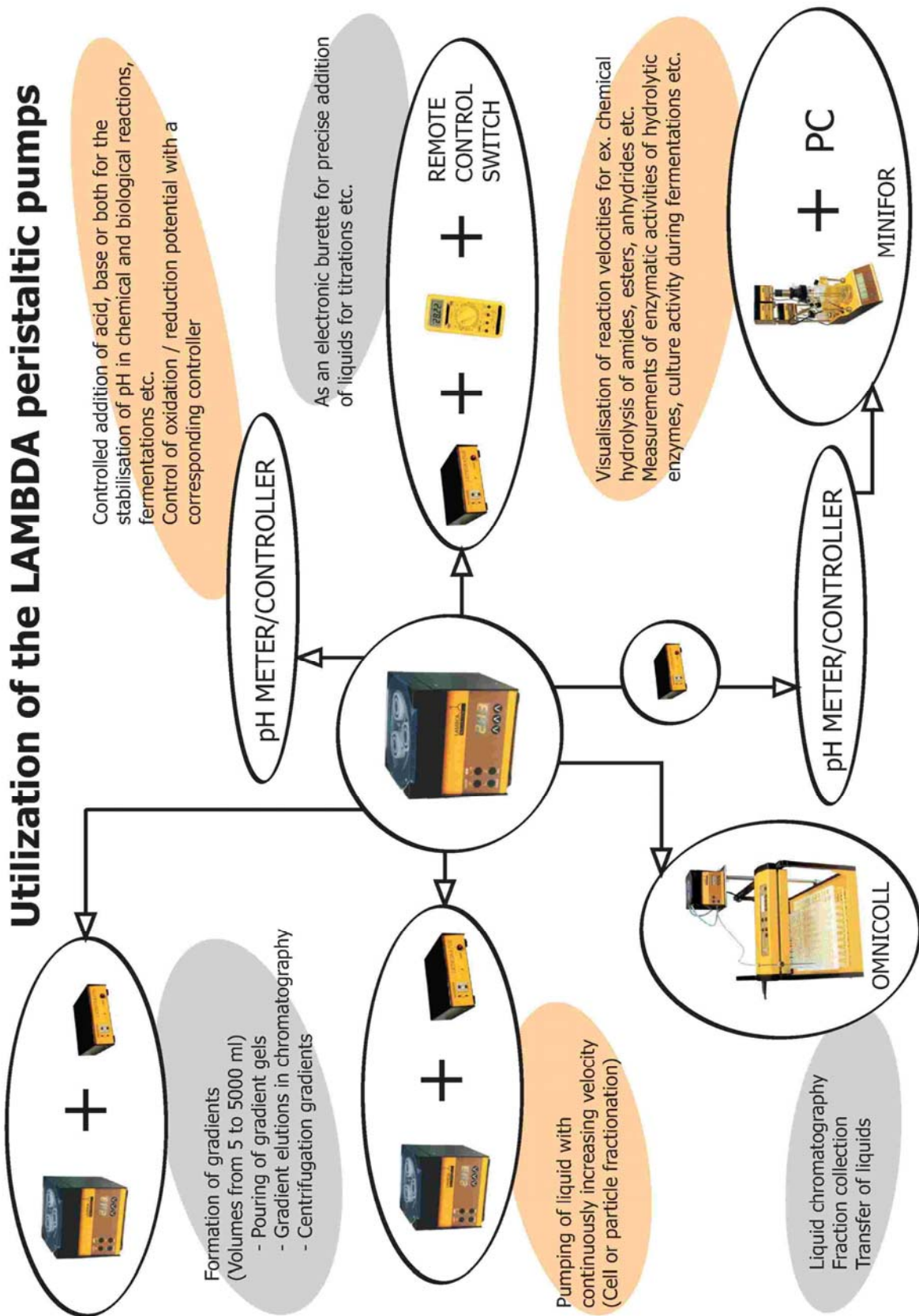


Fig. 5: Flow rate diagram of the LAMBDA MAXIFLOW peristaltic pump

9. UTILIZATION OF THE LAMBDA PERISTALTIC PUMPS



10. TECHNICAL SPECIFICATIONS

10.1 General specifications

Type:	LAMBDA MAXIFLOW – microprocessor-controlled programmable peristaltic pump
Programming:	up to 99 steps of speed and time
Time resolution:	0 to 999 minutes in 1 minute steps
Accuracy:	± 1%
Reproducibility:	± 0.2 % (electronics)
Tubing:	Silicone tubing or other materials having similar elasticity; inner tubing diameter from 0.5 to 4 mm and tubing wall thickness of approx. 1 mm
Flow rate range:	
Minimum:	0.2 ml/hour with 0.5 mm inner tubing diameter
Maximum:	10000 ml/hour with 4 mm inner tubing diameter
Non-volatile memory:	storage of all settings
Maximum pressure:	approx. 0.1 MPa in clockwise rotation; approx. 0.15 MPa in counter-clockwise rotation
Motor:	microprocessor controlled brushless long life BLDC motor with neodymium magnets
Speed control range:	0 to 999
Interface:	RS-485 (optional)
Power supply:	95–240 V/60–50 Hz AC plug-in power supply with DC 12V/24W output; possible field operation on 12 V accumulator
Dimensions:	10.5 (W) x 9.5 (H) x 10.5 (D) cm
Weight:	1.6 kg
Safety:	CE, meets IEC 1010/1 norm for laboratory instruments
Operation temperature:	0-40 °C
Operation humidity:	0-90% RH, not condensing
Remote control:	0-10 V; (option 0-20 or 4-20 mA)

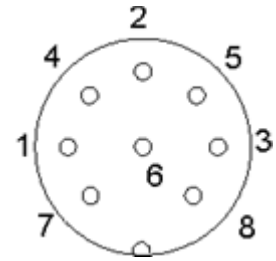


For safety reasons the voltage of the external signal must **not exceed** 48 V to earth!

10.2 Remote control (Inputs/Outputs)

No.	Color	Description
1	yellow	(+) input remote speed control 0-10V *)
2	grey	step signal from stepping motor (0 and 12V)
3	green	earth, 0 V
4	brown	+ 12 V
5	white	(+) input remote ON/OFF; 0V = ON, 3-12 V = OFF (this logic can be inversed on demand)
6	pink	earth, ground (GND)
7	red	RS 485 B (-)
8	blue	RS 485 A (+)

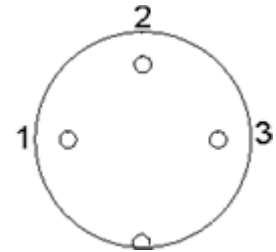
*) (zero line connected to the contact no. 3)



8-pole connector

10.3 Input (12 V DC)

Contact No.	Description
1	+ 12 V DC
2	0 V
3	not connected



3-pole connector

11. GUARANTEE

LAMBDA provides a two-year guarantee on material and manufacturing defects, if the instrument was used according to the operation manual.

Conditions of guarantee:

- The instrument must be returned with a complete description of the defect or problem. In order to send back the equipment for repair, you will need a returns authorization number from LAMBDA.
- The customer will send the instrument to our service office.
- Damage or loss of items during transport will not be compensated for by LAMBDA.
- Failure to fulfill these requirements will disqualify the customer from compensation.

Serial Number:.....

Guarantee from:.....

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