OPERATION MANUAL

Peristaltic Pump – Tubing Pump

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 – highly innovative and compact fermenter and bioreactor system for laboratory scale fermentation and cell cultures

LAMBDA OMNICOLL – fraction collector-sampler for unlimited number of fractions

LAMBDA PRECIFLOW, MULTIFLOW, HIFLOW and MAXIFLOW peristaltic pumps – reliable, precise and extremely compact

LAMBDA SAFETY POWDER DOSER – allows automatic feeding of powders 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 – precise gas flow measurement and control with data acquisition option

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

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1 SETTING UP THE PERISTALTIC PUMP

1.1 Tubing Insertion

A short video of the peristaltic pump installation can be viewed online: http://www.lambda-instruments.com/?pages=video-peristaltic-pumps

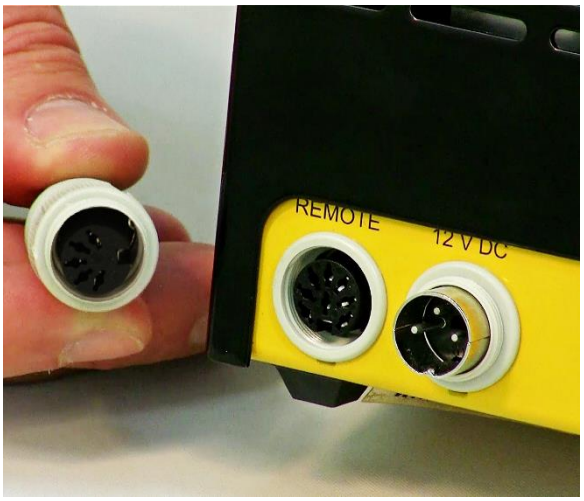


Figure 1-1 Plug the connector of the power supply into the corresponding socket (12 V DC) at the rear of the peristaltic pump and secure it.

Figure 1-2 Plug the power supply into the AC mains (90-264V/50-60 Hz). After a short beep signal, the display will be illuminated. The last used settings will be displayed.

Figure 1-3 Rotate the transparent PVC head cover either clockwise or anti-clockwise to remove it.

Figure 1-4 The speed of rotation has to be increased using the "**Λ Λ Λ**" arrows present below the LED display.
Set the pump speed to about 700. The speed range of about 300-700 for tubing insertion can be used.

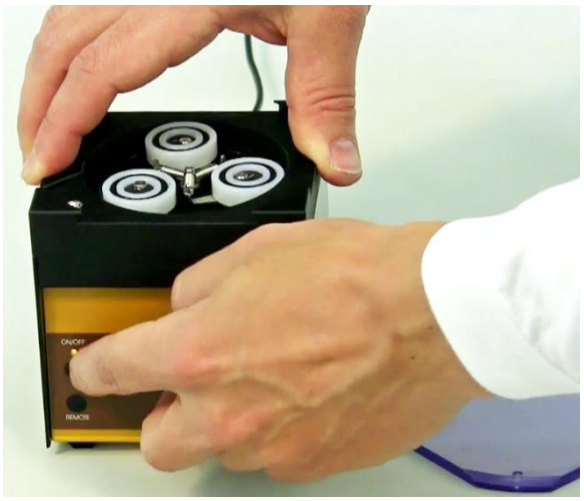


Figure 1-5 Press the ON/OFF button and select the sense of rotation of the peristaltic pump by pressing the button ◄I►

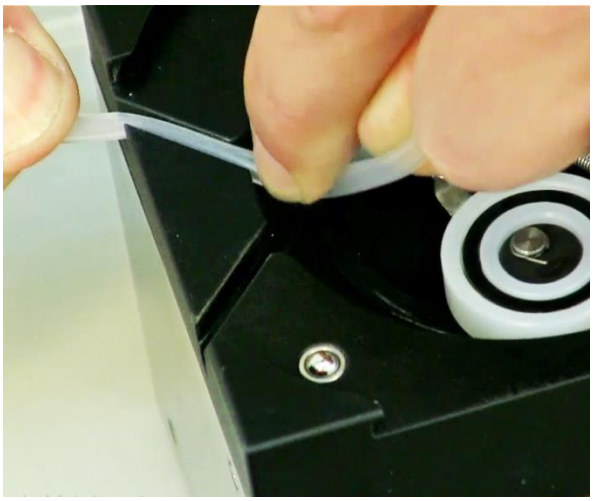


Figure 1-6 Press the tubing into the back slot on the top of the peristaltic pump. Thin tubing should be pushed completely to the bottom.

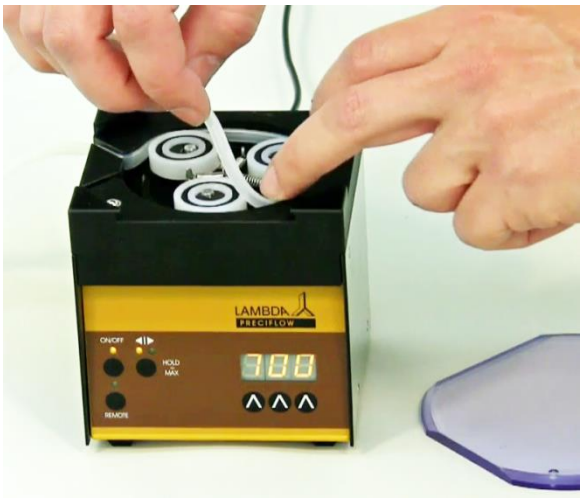


Figure 1-7 Guide the tubing around the slowly turning plastic bearings towards the front slot.

Figure 1-8 Press the tubing into the front slot to secure it.

Figure 1-9 Replace the transparent cover by placing it back on the top of the peristaltic pump.

Figure 1-10 Turn the cover so that the steel ball embedded in the left-front corner of the peristaltic pump fits into the notch in the cover.

1.2 ON/OFF button

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

1.3 Setting up 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 **Λ Λ Λ** 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 (*refer figure 8-1 and section 8*). The flow rates of the LAMBDA MAXIFLOW peristaltic pump can be varied over a large range from 0.2 to 10,000 ml/hour.

Figure 1-11 The **Λ Λ Λ** buttons can be used to set the desired flow rate.

Figure 1-12 Each **Λ Λ Λ** arrow can be used to change the corresponding digit on the flow rate.

With the control buttons **Λ Λ Λ** 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 volume (*refer section 3.1*) or weight (*refer section 3.2*) 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 Choosing flow direction

The direction of the pump rotation can be selected by the ◄I► button, clockwise or anti-clockwise. The corresponding direction LED diode will be on.

If possible use the clockwise rotation of the tubing pump. This results in lower friction and the pressure of the liquid (approx. 0.1 MPa). If a higher pressure is required (up to 0.15 MPa), use the counter-clockwise rotation.

Figure 1-13 LED illumination in the direction ◄| represents the clockwise rotation.

Figure 1-14 LED illumination in the direction I► represents the anticlockwise rotation.

1.5 Fast filling or emptying the line

If the direction ◄I► button is pressed continuously for about 2 seconds, the pump will rotate at a maximum speed in the direction of rotation indicated by the LED.

After releasing this direction button the pump will stop pumping. This factor can be used for filling tubing before starting or for emptying the tubing line at the end of the operation.

This “**HOLD=MAX**” function can be used even if the **ON/OFF** button has not been pressed.

2 PROGRAMMING THE PERISTALTIC PUMP

A short video about programming the Maxiflow Peristaltic Pump can be found at: http://lambda-instruments.com/?pages=video#peristaltic.

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 the indication **"PGM**" appears on the display and both directions LEDs (◄I►) are illuminated.

Figure 2-1 Press the **REMOTE** and **RUN** simultaneously until the indication **"PGM"** appears on the display.

Figure 2-2 Continuous pressing of **REMOTE** and **RUN** button even after the indication of **"PGM"** ends up with the **"cLE"** indication.

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.*

Figure 2-3 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.

Figure 2-4 Select the direction of the pump rotation using the direction button ◄I►.

Figure 2-5 Set the desired flow rate value for the first program step by pressing the buttons **ΛΛΛ** below the display (from 0 to 999, corresponding to 0 to 100% of the motor rotation speed).

Figure 2-6 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.

Figure 2-7 Select the desired time period for the first program step by pressing the buttons **ΛΛΛ** below the display (from 0 to 999 minutes or 00.0 to 99.9 minutes).

Figure 2-8 By pressing the ◄I► button, the time resolution can be set in minutes or 0.1 minutes. In the 0.1 minute time resolution a dot is displayed, e.g. "00.1". The time resolution can be set individually for each program step.

Figure 2-9 Press the ON/OFF button. The indication “F02” will briefly appear on the display.

Figure 2-10 Select the direction of the pump rotation using the direction button ◄I► for each flow rate program.

Figure 2-11 Enter the desired flow rate for the second program step.

Figure 2-12 Press the **ON/OFF** button again, the symbol **“t02”** will briefly appear on the display.

Figure 2-13 Set the time of the second program step.

Figure 2-14 Press ◄I► button, to set the time resolution.

In a similar way up to 99 program steps can be entered.

Figure 2-15 After having entered the time of the last step, press the **ON/OF**F button.

Figure 2-16 The flow rate (**000**) of the next step which will not be programmed appears on the display.

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*

Figure 2-17 Press the **Remote** and **Run** button simultaneously and you will see the indication **"c01"** on the display. This indicates that the program will be executed only once and the peristaltic pump will stop afterwards.

Figure 2-18 If you wish to repeat the same program 3 times, increase the cycle number to **"c03"** by pressing the buttons **Λ Λ Λ** 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).

Figure 2-19 Press the **ON/OFF** button until the indication **"End"** appears on the display to confirm and save the program.

Figure 2-20 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 PERISTALTIC PUMP FLOW CALIBRATION

If you need to know the amount of liquid added without a balance or if you want to measure the flow rate, then you will need the calibration of your LAMBDA pump speed / flow rate.

While calibrating the pump flow, make sure that the liquid completely fills the tubing and reaches its free end. Only then initiate the measuring process, for precise calibration.

The calibration of the pump flow rate with speed can be done to know the amount of the liquid pumped.

A short video of peristaltic pump flow calibration can be found at http://lambda-instruments.com/?pages=video#peristaltic

The Maxiflow Peristaltic Pumps can be programmed for the calibration, for example: flow rate 600 and time 1 minute.

3.1 Volumetric Calibration of the peristaltic pump flow

In the volumetric calibration, the amount of liquid pumped at a particular speed for a minute is calculated. Program the pump with flow rate say 600 and time of about 1 minute.

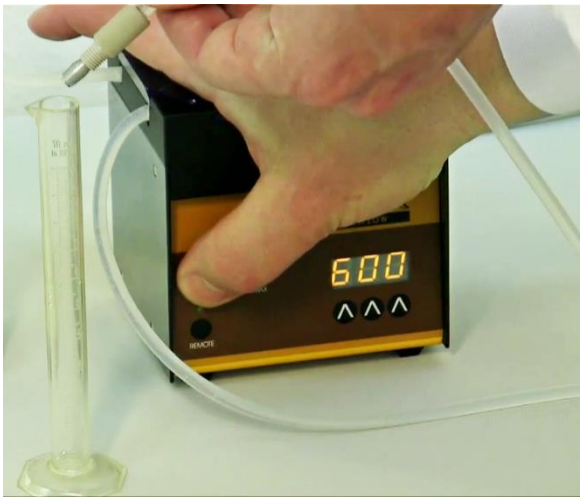


Figure 3-1 Turn on the pump and have the other end of the tubing ready near the measuring cylinder. Carefully collect the liquid being pumped in the measuring cylinder for about 60 seconds.

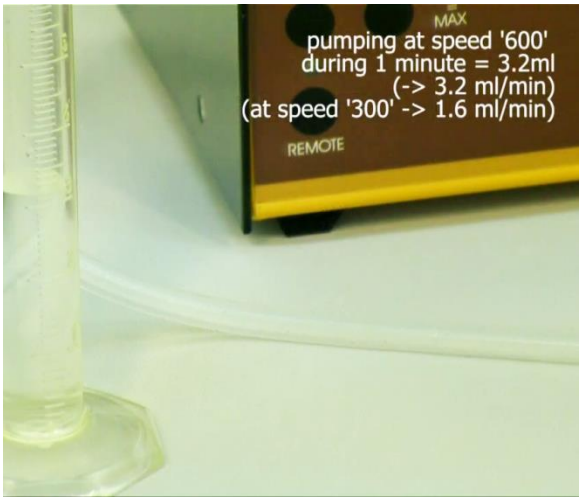


Figure 3-2 Measure the volume of liquid collected in a minute.

At the speed of 600, 3.2 ml/minute has been collected. Calculate the flow rate for other speed range using this value.

3.2 Peristaltic pump flow calibration by weight

In the calibration by weight, the weight of the liquid pump in a minute was calculated. Program the Maxiflow Peristaltic pump for the calibration by weight.

Figure 3-3 Measure the weight of the empty beaker using a sensitive weighing scale. For the exact measurement of the liquid collected, tare the weighing scale with the measuring beaker (Example: 0.000 g).

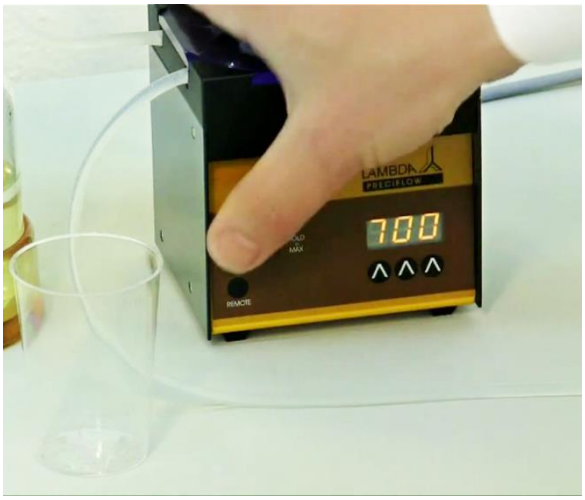


Figure 3-4 Connect the one end of the tubing to the liquid source and press ON/OFF or RUN button of the pump to start the program.

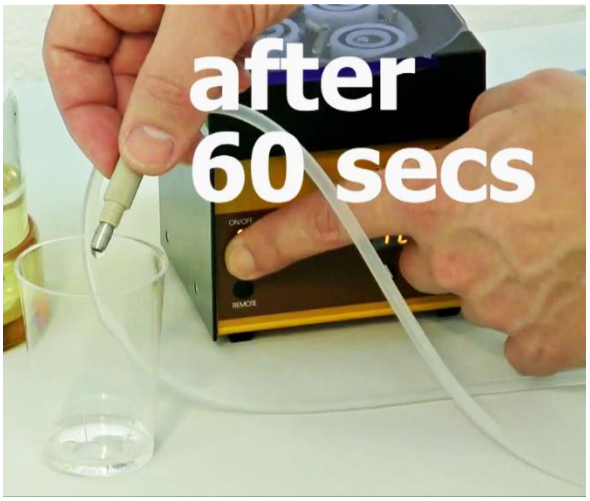


Figure 3-5 Carefully collect the liquid being pumped into the measuring beaker for about 60 seconds.
Pump gets switched off exactly after 60 seconds as programmed.

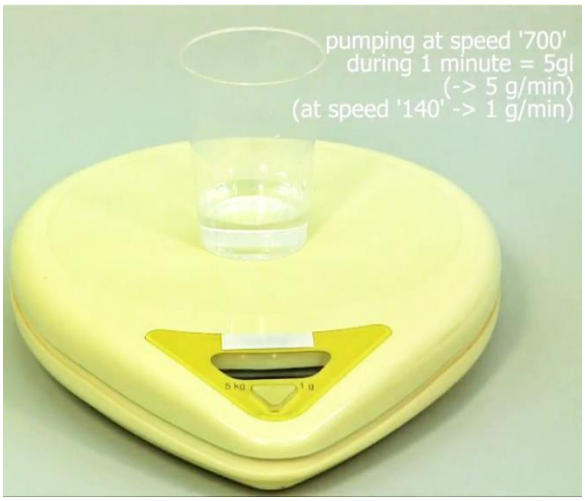


Figure 3-6 Weigh the measuring beaker with the liquid been collected in the past 60 seconds.

For example: At the pumping speed of 700, the weight of the liquid collected is 5 g/min. With this calculation, the weight of liquid collected at other pump speed can be found.

4 REMOTE CONTROLS

4.1 ON/OFF remote control

By interlinking the contacts no. 4 and 5 of the socket at the rear of the pump (see *figure 10–1 and section 10.2),* the pump will be blocked and the ON/OFF LED 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.*

4.2 Remote control of the pump speed

The LAMBDA Peristaltic pumps can be controlled over the whole speed range by an external signal (0 - 10 V DC, 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.

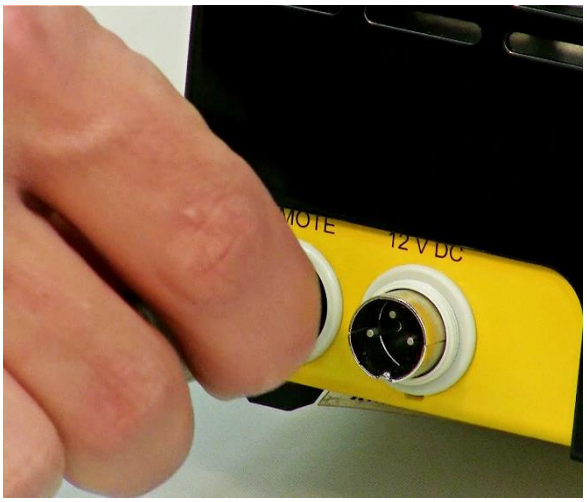


Figure 4-1 For remote control, connect the 8-poles Pump remote control cable into the 'Remote' socket at the rear of the Peristaltic Pump.

Figure 4-2 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.

The indication on the display 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!

4.3 PC control

If the instrument has been equipped with the optional RS-232 or RS-485 interface, it can be controlled digitally, e.g. from a PC by ***PNet peristaltic pump control software***.

This is particularly useful when adding medium to a fermentor or bioreactor to feed the culture which is also growing exponentially (feed pump and harvest pump). Thus, the growth rate and resulting culture activity are considerably increased.

Figure 4-3 Disconnect the pump from the mains. While keeping the direction button ◀I▶ pressed connect the pump to the mains again.

Figure 4-4 The message **"A"** and two numbers will appear on the display. This number from 00 to 99 is the current address of the pump.

Figure 4-5 To change the address press the buttons **Λ Λ Λ** under the display until the desired number is obtained.

Figure 4-6 To confirm the address and save it, press the **ON/OFF** button.

5 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 (support@lambda-instruments.com).

6 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.

7 CONSTRUCTION ADVANTAGES OF THE 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.

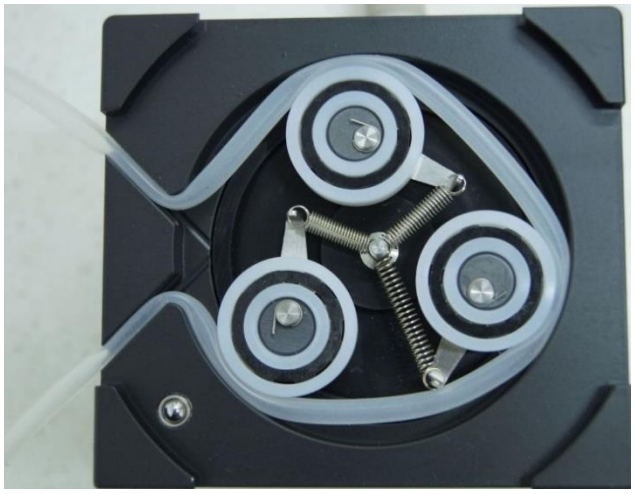


Figure 7-1 Peristaltic pump head of large diameter with large ball bearing rollers and asymmetric design to decrease pulsations and increase tubing life.

- 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.

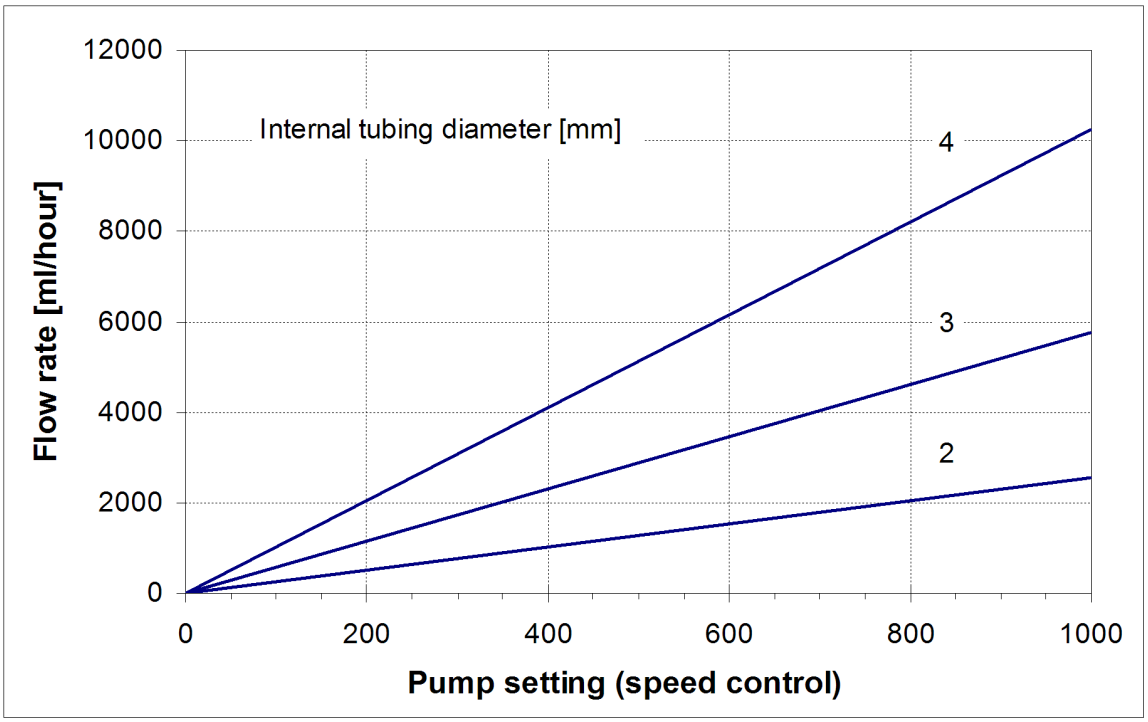
- A high quality, Swiss made, stepping motor, together with integrated microprocessor electronics assure highest precision of flow rates with no inertia while turning the peristaltic pump on and off.

- 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.)

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.



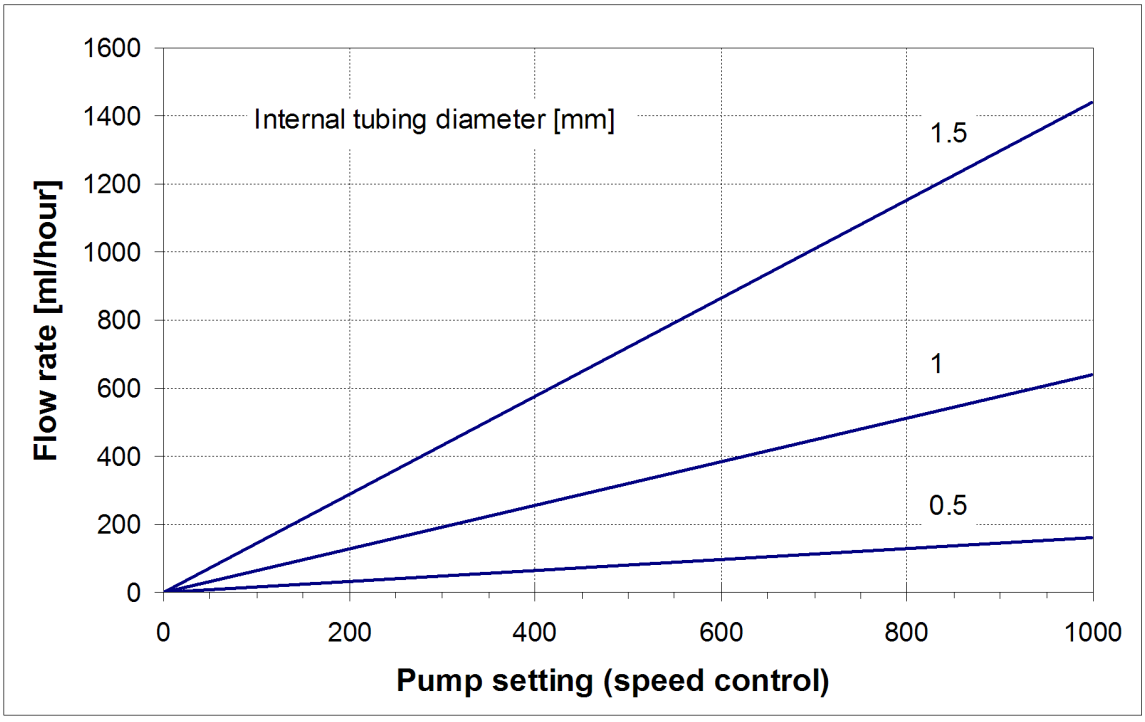


Figure 8-1 Flow rate diagram of the LAMBDA MAXIFLOW peristaltic pump

9 UTILIZATION OF LAMBDA PERISTALTIC PUMPS

LAMBDA peristaltic pumps/tubing pumps can be used in the following fields:

- ✓ *Chromatographic techniques:* Liquid chromatography, collecting fractions, sampling, taking samples, gradient elution, pouring gradient gels, gradient formation, etc.
- ✓ *Single use systems:* Since it is contamination sensitive process, LAMBDA pumps can be used for precise addition or removal of the desired liquid
- ✓ *Fermentation and cell culture techniques:* addition of nutrients, pH control (buffers, acid, base), antifoam control (antifoam agent), feed, harvest, sampling, continuous processes, chemostat.
- ✓ *Pharmaceutical research:* Process validation, drug trails
- ✓ *Chemical reactions*: Precise addition of liquids for titration, visualisation of reaction velocity – hydrolysis of amides, esters, anhydrides, etc.
- ✓ *Biochemical reactions:* Control of oxidation and reduction potential, measurement of enzyme activities, long term reactions

10 TECHNICAL SPECIFICATIONS

10.1 General specification

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 0 to 99.9 minutes in 0.1 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:	10,000 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:	1.2 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.	*Colour*	*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)*

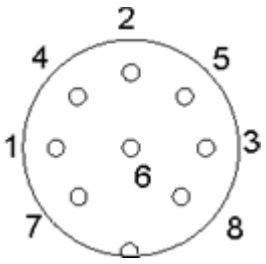


Figure 10-1 8-pole connector

10.3 Input (12 V DC)

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

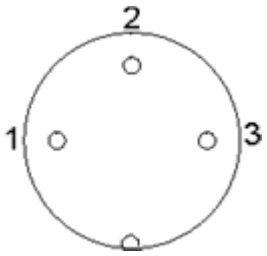


Figure 10-2: 3-pole connector

11 ACCESSORIES AND SPARE PARTS

11.1 Pump flow integrator (Art. No. 4803)

The MAXIFLOW peristaltic pumps and the other LAMBDA instruments like powder dosing instrument LAMBDA DOSER are the only pumps on the market, which allow **a simple and precise integration of the amount of liquid, solid or gas 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

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 now be electronically implemented inside the MULTIFLOW peristaltic and tubing pump and therefore, does not require any additional valuable laboratory bench space.

The activated INTEGRATOR within the LAMBDA pumps allows **new and unusual pump applications** (e.g. gradient making, counter flow elution, liquid chromatography, electronic burette, etc.).

11.2 PNet control software for peristaltic and syringe pumps, DOSER or MASSFLOW (Art. No. 6600)

PNet is a PC control software for the remote control of LAMBDA laboratory instruments (peristaltic pumps PRECIFLOW, MULTIFLOW, HIFLOW, MAXIFLOW, syringe pump VIT-FIT, powder dosing instrument DOSER and gas flow controller MASSFLOW).

The pumps are connected to the computer through a RS-232 or RS-485 interface. Up to 6 LAMBDA laboratory instruments and 12 INTEGRATORs can be connected and controlled simultaneously.

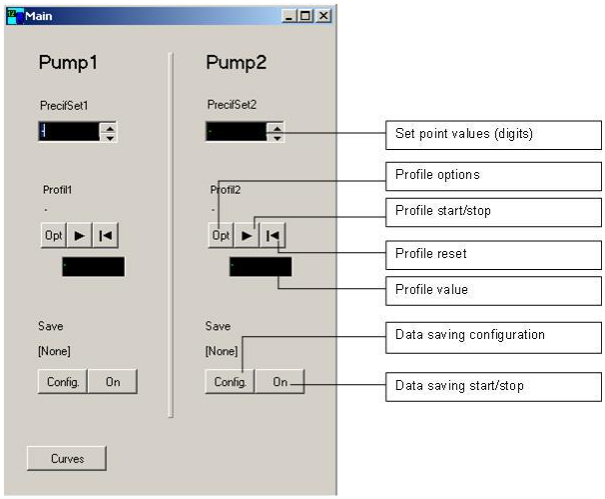


Figure 11-1 Remote control of the peristaltic pump with the PNet control software

11.3 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 (open ends)*
4802	*Pump ON/OFF remote control cable, 2 poles (open ends)*
4823	*Foot switch for ON/OFF control, 8 poles*
4824	*Cable for inverted analog ON/OFF control, 8 poles*
	Interface and Control software
4822	*RS232 interface (for connection of the instruments to the serial port)*
4816	*RS485 interface (for connection of the instruments to the serial port)*
4817	*RS232/485 converter*
4817-kit	*RS485 connection kit (for connection to a serial port or USB port)*
4818	*Power supply for RS232/485 converter (5V/1W)*
4819	*RS-line connection cable (serial)*
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*
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)*
4815-1	*Silicone tubing 0.5/2.5 mm X 10 m*
4815-2	*Silicone tubing 1/3 mm X 10 m*
4815-3	*Silicone tubing 2/4 mm X 10 m*
4815-4	*Silicone tubing 3/5 mm X 10 m*
4815-5	*Silicone tubing 4/6 mm X 10 m*
4815-3v	*Viton tubing 2/4 mm X 5 m*
4815-4v	*Viton tubing 3/5 mm X 5 m*
800113	*Stainless steel tubing clamp*

12 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 fulfil these requirements will disqualify the customer from compensation.

Serial Number: _____

Guarantee from: _____

13 APPENDIX

13.1 RS communication protocol for LAMBDA PERISTALIC and SYRINGE PUMPS, powder DOSER and MASSFLOW gas flow regulator

13.1.1 Format of data sent by the PC to the pump and back

Data sent by the PC: #ss mm a ddd qs c
Data sent back by the pump: <mm ss a ddd qs c
where,

is the first sign of a command sent by PC
< is the first sign of a message sent by pump
ss is the address of the pump
mm is the address of the PC
a is the command for the sense of rotation:
r for clockwise (cw) rotation (to the right)
l for counter-clockwise (ccw) rotation (to the left) (not for DOSER and MASSFLOW)
ddd is the speed of rotation (3 ASCII numbers from 0 to 9; sent from the highest order digit to the lowest order digit)
qs is the control sum in HEX format (2 ASCII signs of the type 0…9ABCDEF)
c is the end sign cr (carriage return) The pump will fulfill the task and block any manual command on the pump front panel.

13.1.2 Commands not containing data

ss mm **g** qs c activates the local command of the pump
ss mm **s** qs c the pump is stopped
ss mm **G** qs c to send pump data to the PC

13.1.3 Checksum control

The PC sends: #0201r123EEcr

The control sum (checksum) qs is made in the following way (only the **last byte** (2 ASCII characters of the type 0…9ABCDEF) is taken):

#	0	2	0	1	r	1	2	3	EE (last byte)	cr
23h	+30h	+32h	+30h	+31h	+72h	+31h	+32h	+33h	=1**EE**h	0Dh

13.1.4 Format of the data transmission

Speed: 2400 Bd (Baud)
8 data bits, odd parity, 1 stop bit

13.2 Examples

Address of the PC: 01
Address of the pump: 02

The PC sends: #0201r123EEcr
The pump will rotate cw at the speed of 123

The PC sends: #0201G2Dcr
The answer of the pump: <0102r12307cr

The PC sends: #0201l123E8cr
The pump will rotate ccw at the speed of 123. (not for DOSER and MASSFLOW)

The PC sends: #0201s59cr
The pump stops.

The PC sends: #0201g4Dcr
The pump will go to the local command (pump front panel is activated).

13.3 How to set the MAXIFLOW peristaltic pump address?

To look up/modify the instrument address, disconnect the MAXIFLOW peristaltic pump from mains. (Refer *figures 4-3, 4-4, 4-5, 4-6* under the *section 4.3 PC control*)

Press the ◄I► button continuously and at the same time connect the MAXIFLOW peristaltic 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 peristaltic pump.

To change the address press the buttons **Λ Λ Λ** under the display until the desired number is obtained.

To confirm and save the address, press the **ON/OFF** button.

13.4 RS-connection scheme

The 8-pole DIN connector "REMOTE" is used for the remote control and RS-485 connection. When the optional RS-485 interface is available the pins are used as follows:

No.	***Colour***	***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)*

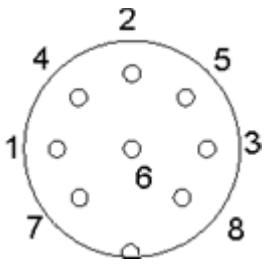


Figure 13-1: 8 pole connector

13.5 RS communication protocol for the on-board INTEGRATOR (optional)

13.5.1 Communication between the PC and the INTEGRATOR of the LAMBDA instrument

From the PC to the INTEGRATOR:

#ss mm z qs c

From the INTEGRATOR to the PC:

<mm ss = qs c	confirmation of the reception of a command
<mm ss dddd qs c	sending of the requested data

where,

#	is the first sign of a command sent by the MASTER (PC)
<	is the first sign of a message sent by the SLAVE (INTEGRATOR)
ss	is the address of the subordinate station (address of the instrument with integrated INTEGRATOR)
mm	is the address of the commanding station (PC)
z	is a command (see below): small letters indicate a command, capital letters request data transfer from the subordinate station
=	confirmation of reception
aa	new address of the subordinate station (ss) (two numbers and possibly other ASCII characters A B C D E F)
dddd	transferred data (values are two bytes in hexadecimal form. Single bytes are transformed into two ASCII characters 0,..,9,A,B,C,D,E,F)
qs	is the control sum (obtained by the addition modulo 256 of binary values of all preceding characters including the leading sign) in HEX format (2 ASCII signs of the type 0…9ABCDEF)
c	is the end sign cr (carriage return)

13.5.2 Commands for the INTEGRATOR

n	reset (sets the INTEGRATOR to zero)
i	start of integration
e	stop of integration
I	sends the integrated value
N	sends the integrated value and sets the integrator to zero
L	sends the integrated value ccw rotation (to the left) (not for DOSER)
R	sends the integrated value of cw rotation (to the right)

13.5.3 Examples

Address of the PC: 01
Address of the instrument with on-board INTEGRATOR: 02

The PC sends: #0201I2Fcr

The control sum (checksum) qs is made in the following way (only the **last byte** (2 ASCII characters of the type 0…9ABCDEF) is taken):

#	0	2	0	1	I	2F (last byte)	cr
23h	+30h	+32h	+30h	+31h	+49h	=**12F**h	0Dh

The PC sends: #0201i4Fcr
i.e. in hexadecimal form: 23h 30h 32h 30h 31h 69h 34h 46h 0Dh
This means: For a subordinate station (SLAVE) with address 02 from commanding station (MASTER) with address 01
Start of integration
The control sum is 14Fh (last byte: **4F**); end of message cr (carriage return)
The INTEGRATOR answers: <0102=3Ccr

The PC sends: #0201N34cr
The INTEGRATOR answers: <0102N03C225cr (integrated value is 03C2h)
and resets to zero

The PC sends: #0201e4Bcr
The integration will be stopped and the command will be confirmed.
The INTEGRATOR answers: <0102=3Ccr

LAMBDA Laboratory Instruments
Sihlbruggstrasse 105
CH-6340 Baar
SWITZERLAND – EUROPE
Tel.: +41 444 50 20 71
Fax: +41 444 50 20 72

E-mail: support@lambda-instruments.com
Web: www.lambda-instruments.com

LAMBDA CZ s.r.o.
Lozíbky 1
CZ-61400 Brno
CZECH REPUBLIC – EUROPE

Hotline: +420 603 274 677

www.peristaltic-pumps.eu