LAMBDA GAS FLOW REGULATOR

MANUAL

MASSFLOW 500
MASSFLOW 5000

TABLE OF CONTENT

1. TECHNICAL DESCRIPTION

1.1 TECHNICAL PARAMETERS OF LAMBDA PERISTALTIC PUMPS

	MASSFLOW 5000	**MASSFLOW 500**
Type	Microprocessor-controlled programmable laboratory gas flow regulator	
Accuracy	± 3%	
Flow rate	5.000 l/min	0.500 l/min
	with 0.1/0.01/0.001 step (configurable)	
Internal memory	Up to 10 programs (each 100 segments)	
Operating pressure	Min. 0.5 bar Max. 2 bar	
Interface	USB 1.1/2.0 & Remote (CAN BUS)	
Display	3.5" TFT IPS Display with 320 x 240 pixels resolution Viewing angles: ±70°	
Conformity	DIRECTIVE 2014/35/EU, DIRECTIVE 2014/30/EU	
Technical standards	EN 61010-1:2010/A1:2019/AC:2019-04, EN 61326-1:2013	
Weight	750 g	
Dimensions (W x H x D)	105 mm x 95 mm x 210 mm	
Operating temperature	0 – 40 ºC	
Operating humidity	0 – 90%, not condensing	
Power supply	Plug-in power adapter Input Voltage: 90–240 V AC 50/60 Hz, Barrel jack 5.5/2.1	
	12 / 1A	

1.2   DEVICE DESCRIPTION

MASSFLOW is a mass flow gas regulation system specially designed for the use together with LAMBDA MINIFOR laboratory fermenters and bioreactors. The MASSFLOW allows a precise metering or automatic control of pH in cell cultures without the need of any other gas station.

- Allows the metering and/or control of pH of cell cultures by controlled addition ofgaseous CO_2, N_2 or any other gas with a suitable controller
- Can be also used independently, since all functions can be accessed from the front panel
- High-quality laminar mass flow sensor
- Mass flow cell shows a minimal pressure drop
- Linearity error less than ± 3 % reading (which is much better than precision expressed as percent of full scale used by some producers)
- The repeatability is better than ± 0.5% reading
- The flow rate can be programmed (controller only) and the volume totalized
- The flow rate is regulated by a special proportional needle valve controlled by microprocessor (controller only)

INPUT
(Pure gas with filter)

OUTPUT (REGULATED)

LAMBDA REMOTE 1 CONNECTION
(Smart adapters, LAMBDA MINIFOR 2 BIO)

POWER SUPPLY
External 12 V DC adapter

PC CONNECTION
USB connection
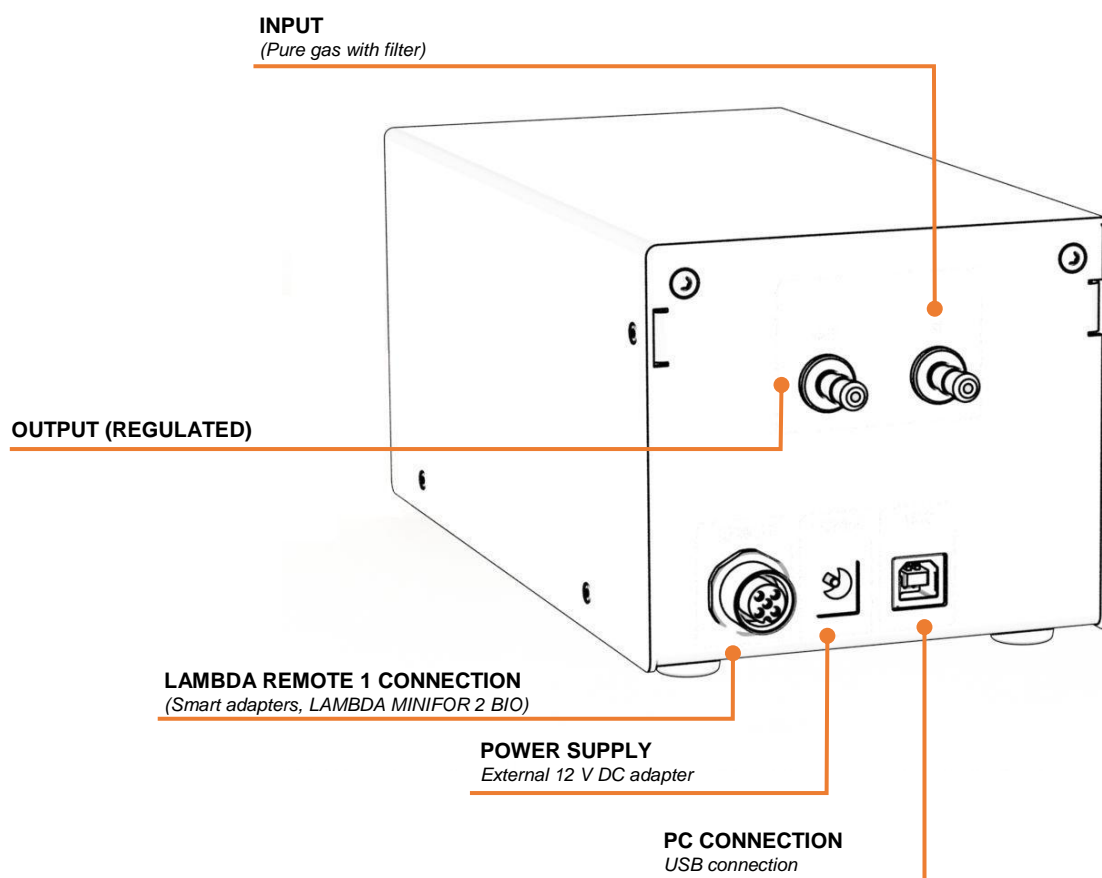
2 SAFETY FOR INSTALLATION, OPERATION, CLEANING, MAINTENANCE AND STORAGE

〉 The massflow must be installed and used only within the **designed operating conditions**.

〉 For safety reasons, the voltage of the external signal must **not exceed 12 V to earth!**

〉 **Do not open or remove the pump casing** without instructions from LAMBDA CZ s.r.o.!

For service and repairs, contact support@lambda-instruments.com for instructions. Repairs and services can only be carried out by an authorized person who is aware of the hazard involved. LAMBDA CZ s.r.o. assumes no liability for any service or repair performed by the user, an unauthorized person, or third-party companies.

3 GUARANTEE ON LAMBDA PERISTALTIC PUMP

LAMBDA offers a **2-year guarantee** on MASSFLOW gas flow regulator. These guarantees cover proven material and manufacturing defects, provided that the instrument was used following the operational manual and advice given by LAMBDA. Making a warranty claim will not affect the duration of the warranty. Further claims are excluded.

Conditions of guarantee:

• After consulting support@lambda-instrumens.com, the pump must be returned with a comprehensive description of the defect/problem and an authorization number assigned by LAMBDA.

• The customer should dispatch the equipment in its original packaging or packaging of equivalent quality to the LAMBDA service office. Shipping costs to the manufacturer are charged to the customer.

• LAMBDA will not compensate for damage or loss of items during transport.

- Failure to meet these conditions will render the customer ineligible for compensation.

Serial number: _____

Guarantee from: _____

The warranty becomes invalid in the event of improper installation, operation, cleaning, maintenance or storage (for example, outside the intended environmental and/or electrical specifications), in case of damage caused by contaminations or leaks due to torn or burst tubing or unauthorized modification carried out by the user or a third party.

4 POWER SUPPLY CONNECTION

4.1 POWER SUPPLY FOR REMOTE-CONTROLLED PUMP

Do not use any power supply for the *LAMBDA peristaltic pump* if the pump is connected to a bioreactor/fermenter LAMBDA MINIFOR 2 BIO!

1. Plug the connector of the remote-control cable from the LAMBDA MINIFOR 2 BIO into the corresponding socket (REMOTE) at the rear of the peristaltic pump.

2. The display will illuminate.

4.2 POWER SUPPLY FOR STAND-ALONE PUMP

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

2. Plug the power supply into the AC mains (90–240 V AC 50/60 Hz).
   The display will illuminate, showing the last used settings.

5 INPUT/OUTPUT GAS CONNECTION

Connect the gas tubing (inside diameter about 5.5 to 6 mm) to the gas IN nozzle and secured it in place with appropriate clamps.

Fix the other tubing onto the gas OUT nozzle. Open the gas supply. The regulating valve is closed and no gas comes out from the output.

!	The maximal gas pressure is 0.2 MPa (2 atm or 30 psig). Higher pressures will damage the instrument!

6 MENU (USER CONTROL LOGIC)

The menu is **only available in the STOP state** when **dosing is not in progress:**

On the main screen in stop mode,

〉 Press the icon "MENU".

〉 For horizontal navigation between menu items
use the "UP" and "DOWN" icons on the right
side of the screen.

〉 Confirm the selection by clicking on the item
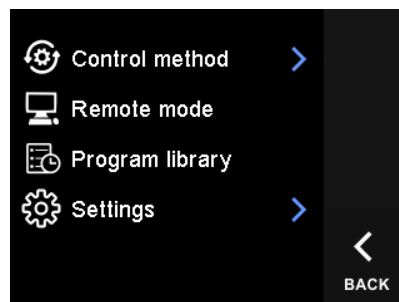
6.1 CONTROL METHOD

The pump is equipped with two dosing control modes:

FIXED VALUE

Fixed value method is used to **regulate on fixed flow
rate,** see chapter "7 Direct mode (fixed value)".

PRE-DEFINED PROGRAM

Program mode allows dosing control **at various flow
rates** and **durations**. See chapter

"8 Program mode (pre-defined program)".
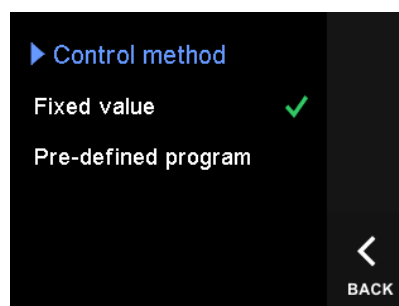
6.2 REMOTE MODE

This item is used for activate REMOTE mode, when
the pump is controlled by one REMOTE CAN bus
communication interfaces.

**For external control of the device it is always
necessary to bring it into this mode.**
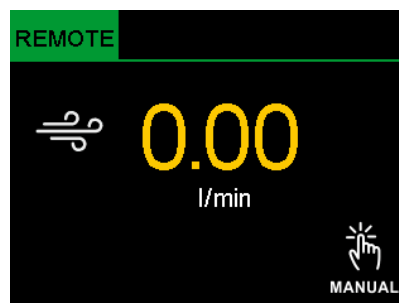
6.3 PROGRAM LIBRARY

The built-in program library allows the creation of 10 programs, where each program can contain up to 100 records.

Use the "**UP**" and "**DOWN**" icons to navigate horizontally and change the program. The highlighted program is considered selected for use.

See chapter

6.4 SETTINGS

Device settings file,

For horizontal navigation between menu items use the "**UP**" and "**DOWN**" icons on the right side of the screen.
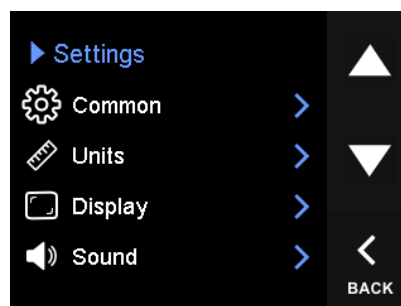
6.4.1 COMMON

〉 **Auto zero when start**

If the option is activated, the dosing statistics are automatically reset on restart (RUN).

6.4.2 PRECISION

Possibility to set the accuracy (decimal places) of the flow rate - 0.1, 0.01 and 0.001 l/min.

6.4.3 DISPLAY

〉 **Backlight intensity**

Display backlight intensity setting / range from **1** to **5**

〉 **Touch sensitivity**

Adjust the sensitivity of the touch panel display / range from **1** to **5**

6.4.4 SOUND

〉 **Sound volume**

Central adjustment of the acoustic alarm volume / range from **0** to **4**

(Level 0 disable acoustic alarm volume)

〉 **Tap sound**

Switching the acoustic response on/off when processing a touch on the display

〉 **Alarm sound**

Switching on/off the permanent acoustic signalling when an alarm is announced. If enabled, the alarm condition is accompanied by an acoustic signal until cancelled.

6.4.5 PROGRAMS

〉 **Auto-reset when start**

If the option is active, each new batch run in program mode automatically starts the program from the beginning.
If not active, the display shows the option "Continue or Restart".

〉 **Program end alarm**

If the option is active, an "Program finished!" alarm will be issued to complete the program

6.4.6 DEVICE INFORMATION

View information about the device. Information is available:

Serial number, Software version, Hardware version and Device type.

6.4.7 RESTORE DEFAULT

This option is used to reset the menu items to their default state.

7 DIRECT MODE (FIXED VALUE)

Direct mode is a mode in which the speed is controlled by a fixed value.

7.1 HOME SCREEN DESCRIPTION

The home screen is always displayed when the pump is idle. The parameter setting is done by clicking on the value. Changing the parameter type is done by clicking the right or left arrow icon.

Home screen in DIRECT mode (See also chapter "6.1 Control method").
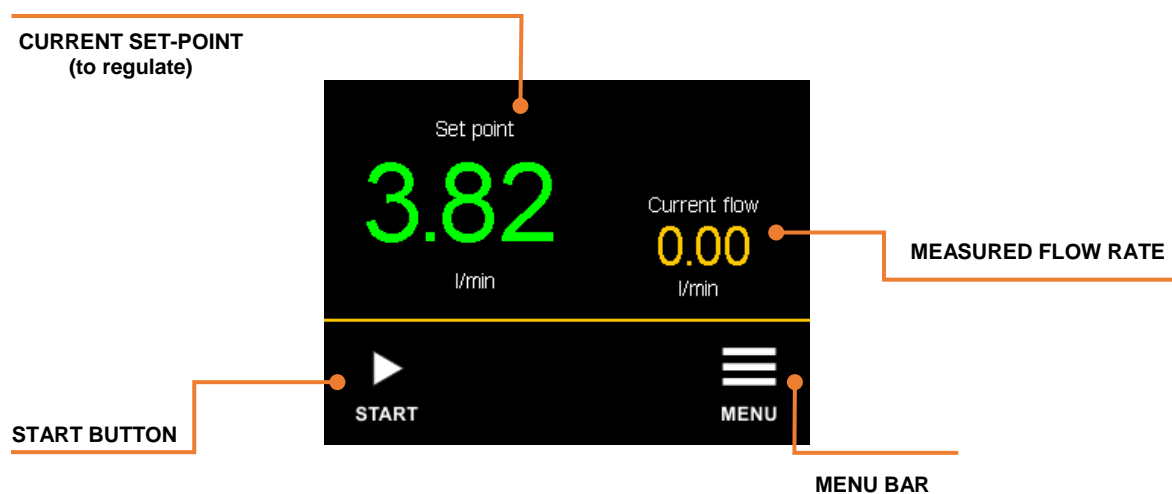
7.2 DOSING SCREEN DESCRIPTION

During dosing, the dosing screen is displayed with information about the flow rate and elapsed dosing time.
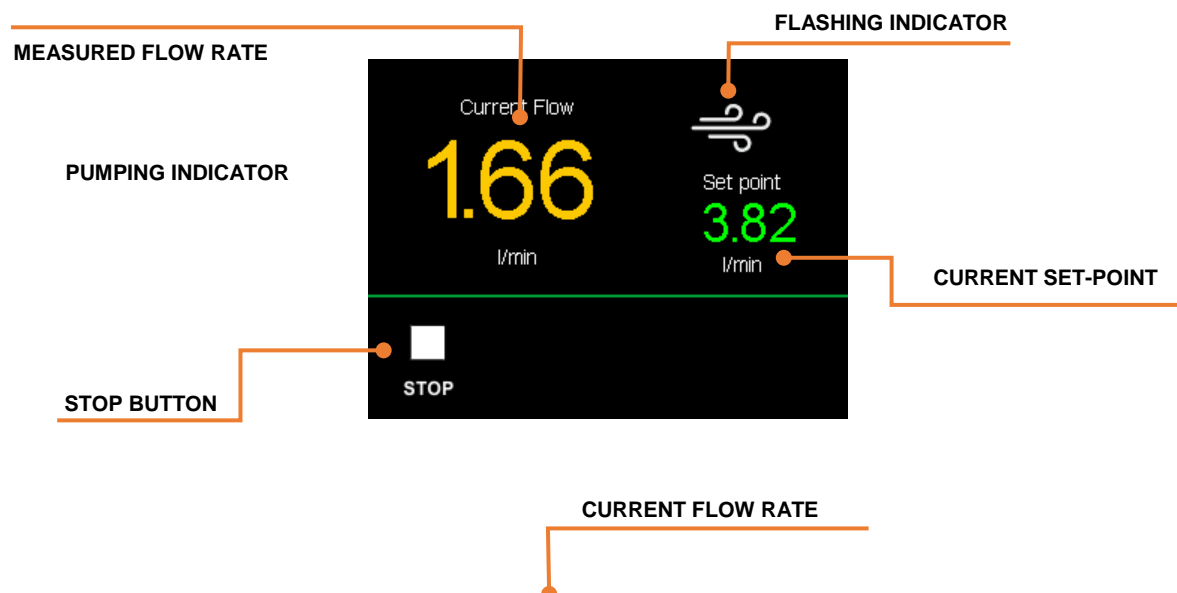
7.3   START FLOW

On the main screen,

- flow is started by clicking on the "**START**" icon.

After clicking, flow starts at the set rate and the dosing screen appears on the display.
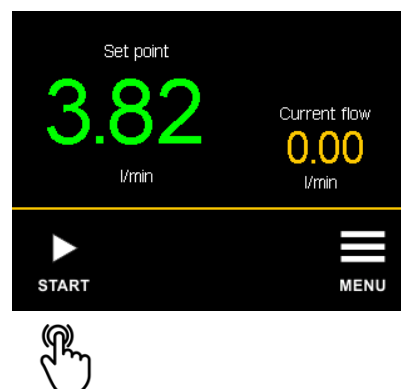
7.4   STOP FLOW

On the dosing screen,

- flow is stopped by clicking on the "**STOP**" icon.

After clicking, the flow is finished, and the main screen will appear on the screen.
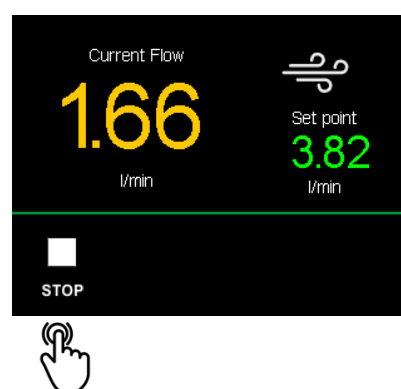
7.5   SET FLOW RATE

The digital speed can be changed during pumping with DIRECT flow control.
To set the digital speed click on the **flow rate parameter** on the **main screen**.

The individual flow rate digits will be displayed on the screen.

- Use the up or down arrows to set the desired value.
- Confirm the new value by clicking the "**SET**" button, or go back and ignore the change by clicking the "**BACK**" button.
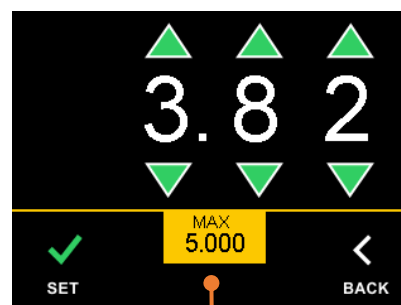
MAXIMAL FLOW RATE INDICATOR

8 PROGRAM MODE (PRE-DEFINED PROGRAM)

For use in program mode it is necessary to activate the **control method** in the menu on **pre-defined program**.

Program structure:

Name	Name of program
Segments	Segment (defined by flow rate, time length and type of transition)
Action on End	Selection of program end by stop (invoke alarm), continue with last speed/flow rate or repeat from start
Count	Number of program repetitions

ⓘ Completion of the program is indicated by the "Program finished!" alarm. Valid for action on end "stop" or "repeat" with defined repetition.

8.1 HOME SCREEN DESCRIPTION

Home screen in DIRECT mode (See also chapter "6.1 Control method").
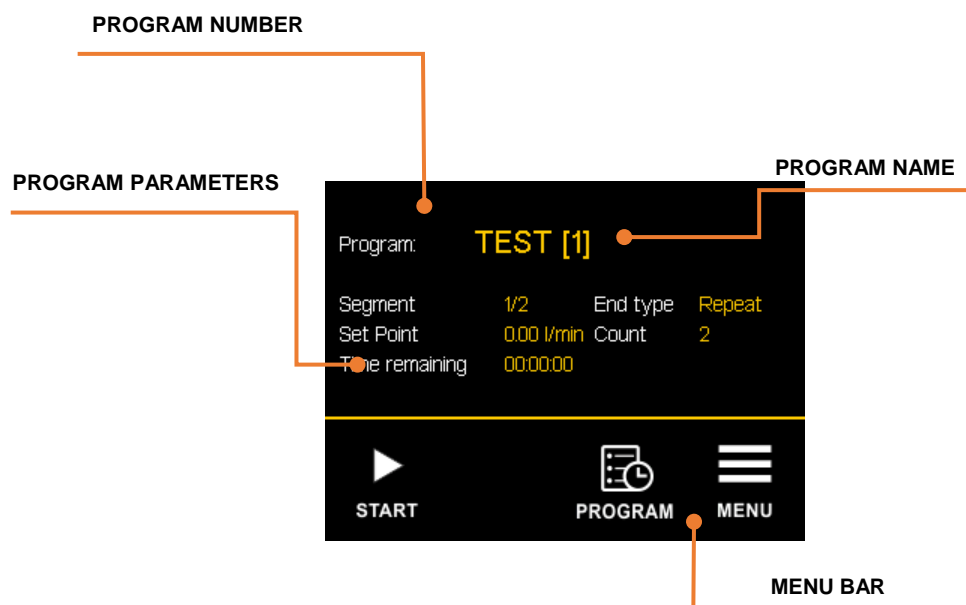
8.2   DOSING SCREEN DESCRIPTION

After starting the dosing, the dosing screen will appear on the display.

CURRENT SEGMENT SPEED/FLOW RATE

REMAINING TIME TO NEXT SEGMENT
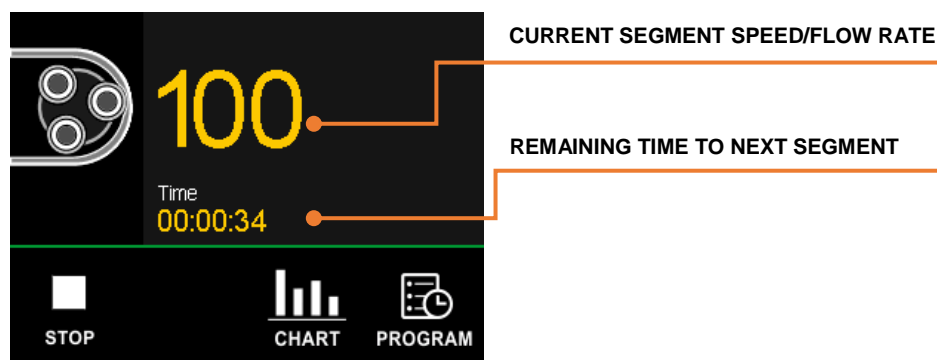
8.2.1   PROGRAM OVERVIEW

During the program processing, it is possible to display the program's current parameters. The display can be called up by clicking the "**PROGRAM**" icon on the dosing screen in program mode.
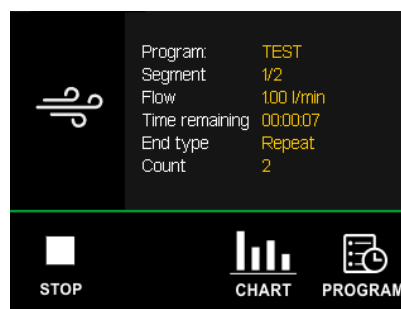
8.2.2   CHART VIEW

It is possible to display the progress of program processing in a graph.

The program processing is represented by a gradually filling area of the graph. The different fill color symbolizes the dosing direction (**DIRECTION**).
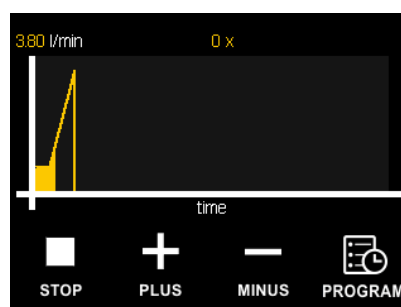
By clicking the **+ or - icon**, it is possible to change the timescale.

8.3   SELECT PROGRAM

Changing or selecting the program is only possible when the pump is stopped, idle.

Steps:

1. Go to the program library by clicking on the **Program** icon on the main screen or by clicking on **Program library** in the menu.

On the **PROGRAMS** screen, the currently selected program is the highlighted row of the table.

1. Click the up and down arrow icons to **change the program**.

2. Click the "**BACK**" icon to **return to the main screen**.
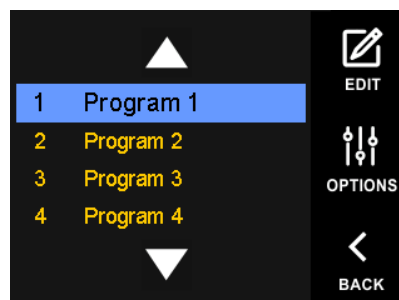
Changing the program is done automatically by selection. The newly selected program is automatically applied by closing the program library by clicking on "**BACK**".

8.4   EDIT PROGRAM

Steps:

2. Go to the program library by clicking on the **Program** icon on the main screen or by clicking on **Program library** in the menu.

On the **Program library** screen, the currently selected program is the highlighted row of the table.

3. Click the up and down arrow icons to **select the requested program** to edit.

4. Click the "**EDIT**" icon to go to the program edit screen.
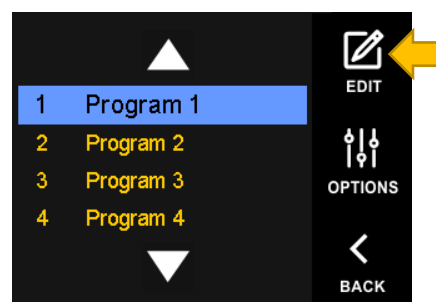
8.4.1 EDIT NAME

Click in the **program name area** to change it. The screen will show the current name with an alphanumeric keyboard. Confirm the change by clicking the "**OK**" button.
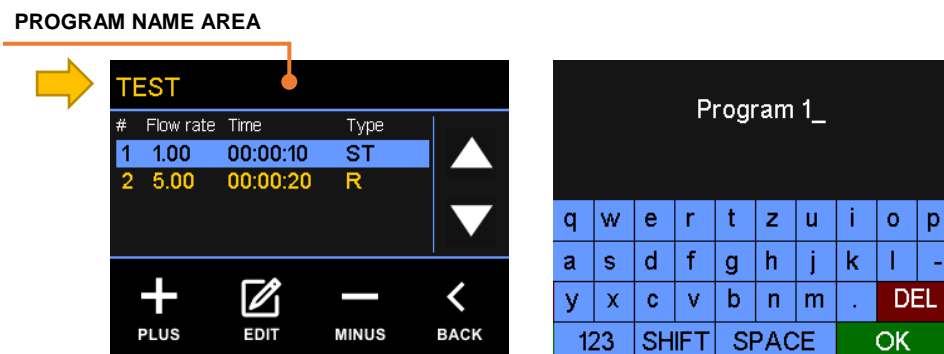
8.4.2 ADD NEW SEGMENT

1. Click on the "**PLUS**" icon to add a new program segment.
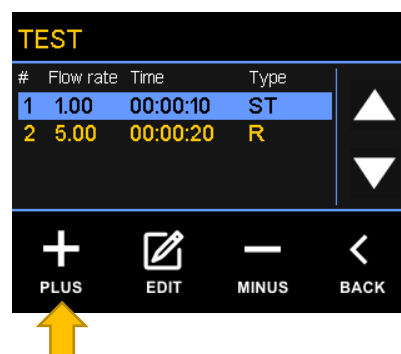
2. Enter the program segment parameters:
You can call up the settings of individual parameters by clicking on the parameter value.

> **SPEED/FLOW RATE:** requested speed/flow rate
>
> **TIME**: requested time length of set speed/flow rate
>
> **TYPE**: transition type (STEP or RAMP)
>
> **DIRECTION**: CW or CCW
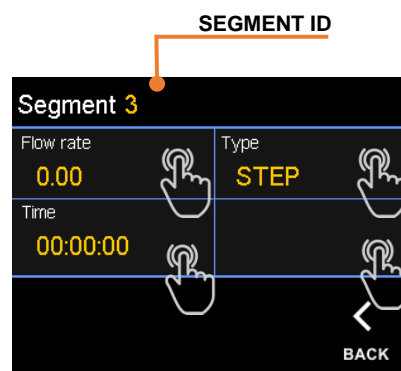
The speed/flow rate transition type has two setting options. **STEP** means that the value will be set immediately. **RAMP** means that the desired value is the target value and will be approximated for the set time length.

3. Click the "**BACK**" icon to return to the program edit screen.

8.4.3 REMOVE SEGMENT

1. Select the segment you want to remove (highlighted table row) by clicking the up and down arrow icons.

2. Click the "**MINUS**" icon to remove a currently highlighted program segment.
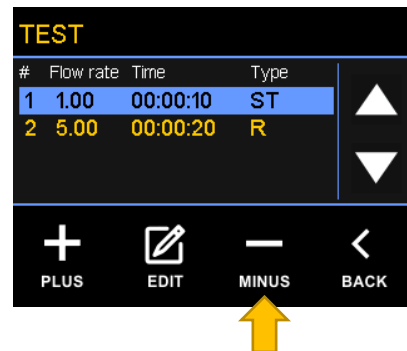
8.4.4 PROGRAM OPTIONS

Each program has its own specific global settings such as action on end, repeat count, program units and calibration constant.
The program includes setting options: *Action on End*, *Repeat Count*, and *Flow rate units*.

Click on the "**OPTIONS**" icon to view the program settings.
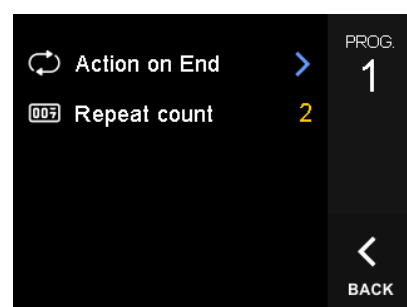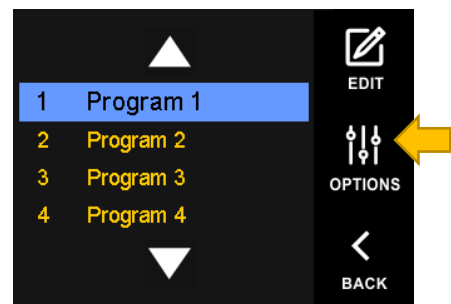
8.4.4.1 ACTION ON END

Choose what action shall take place to process all program segments:

REPEAT PROGRAM:

The program will be processed again from the first

segment. The number of repetitions can be set.

CONTINUE:

After completion of the last segment of the program,

dosing will continue with the last set speed/flow rate

value.

STOP PROGRAM:

Dosing will be terminated when the last segment of

the program is completed and invoke alarm

"**Program finished!**".
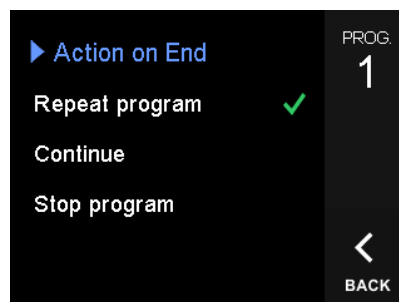
8.4.4.2 REPEAT COUNT

This parameter will only be used if action on end is set to repeat.

Choose the number of program repetitions.

A value of 0 means infinite repetition!
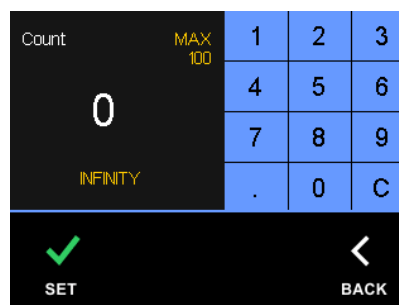
8.5 START, PAUSE/RESTART THE DOSING PROGRAM

To use programs, it is necessary to activate **FLOW CONTROL** in the device menu to **PROGRAM** mode.

8.5.1 PROGRAM START

For starting the dosing by the dosing program, click on "START", on the pump display.

The dosing program is running.
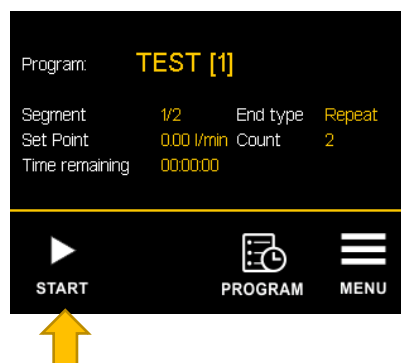
8.5.2 PROGRAM PAUSE

For interruption/pause of the dosing program, click on "STOP", on the pump display.
The dosing / dosing program is interrupted.

8.5.2.1 CONTINUE OR RESTART OF THE DOSING PROGRAM AFTER A PAUSE

To finish the pause, click on "START, on the pump display.

The pump display shows "Continue or Restart ?"

- Click "**CONTINUE**" to resume the program
  from where it stopped = continue the
  program.

  OR

- Click "**RESTART**" for running the program
  from the beginning (First step 1 of program, t
  = 0) = restart the program
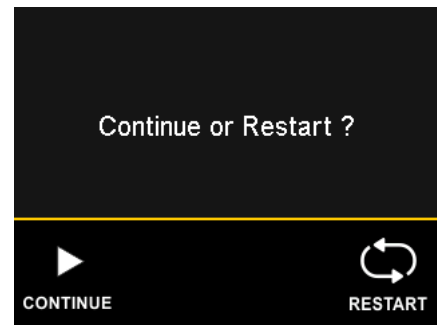
The automatic restart of the program can be set in the main menu, settings
item. See options in chapter "6.4.5 Programs".
If the automatic restart is not active, the user is prompted for a decision with
each new start of dosing.

9   SOFTWARE UPDATE

9.1   SOFTWARE UPDATE FILE

First, download the pump software update file to your PC from the manufacturer's website. The file is compressed, tagged and has a fixed format (pump-1-X.YY.zip).

Steps:

1. Download the archive "**pump-2-x.yy.zip**" file.
2. Decompress archive containing pump software file "**pump-2-x.yy.hex**"

9.2   PC SOFTWARE APPLICATION

The PC software application *LAMBDA Device Manager* (ldm) is available for pump software updates.

Steps:

3. Download "**ldm-x.y-x64-setup.exe**" file (X, Y subsites version number)
4. Run the downloaded installation file.
5. Finish the installation of the application.
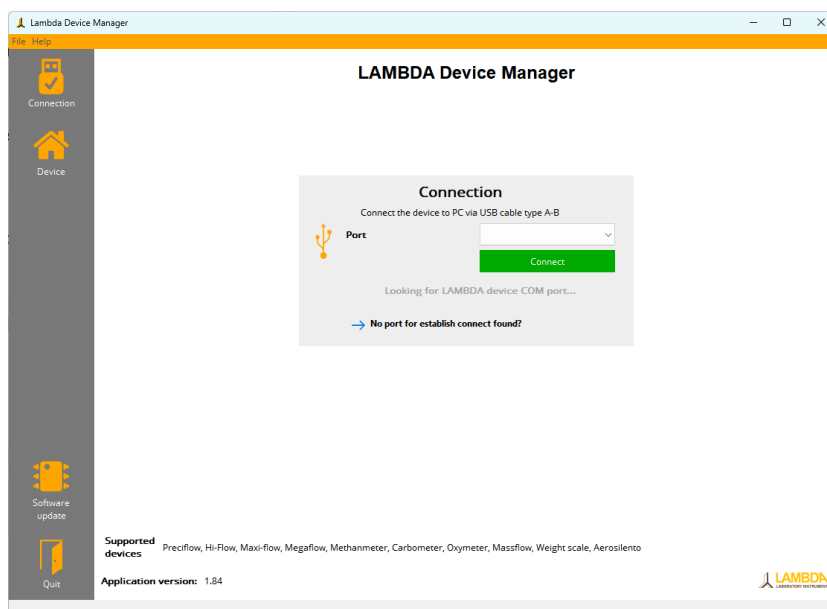
9.3   UPDATE PROCEDURE

Follow these steps to update:

1.   Connect the supplied 12V DC power adapter to the pump.

2.   Connect the pump to the PC using the A-B USB cable.

3.   Start the *Lambda Device Manager* application.

4.   Wait and check that the computer has detected the pump.
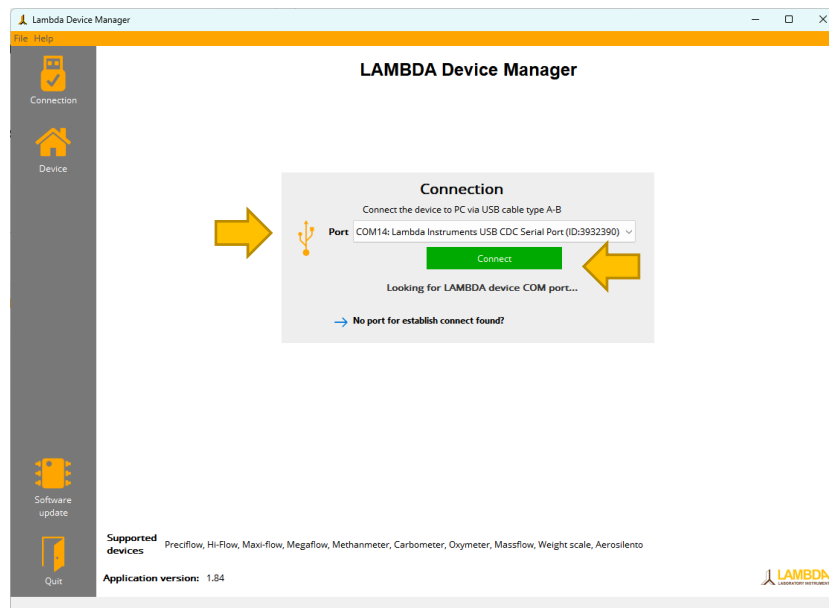
*Example: Detected **port** COM14, pump with identification number 3932333.*

5.   Click on the "Connect" button*.*
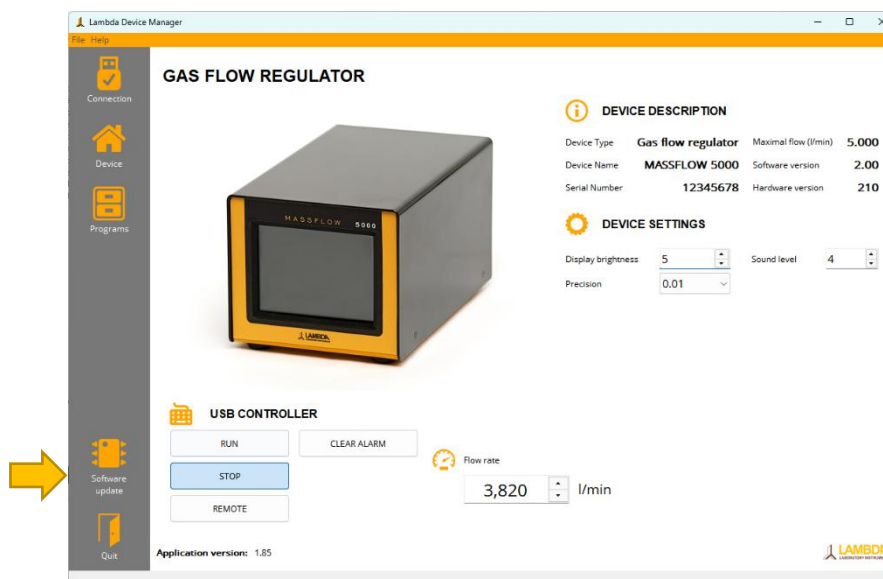
6.   Select the "**Software Update**" function on the left bottom side of the panel.
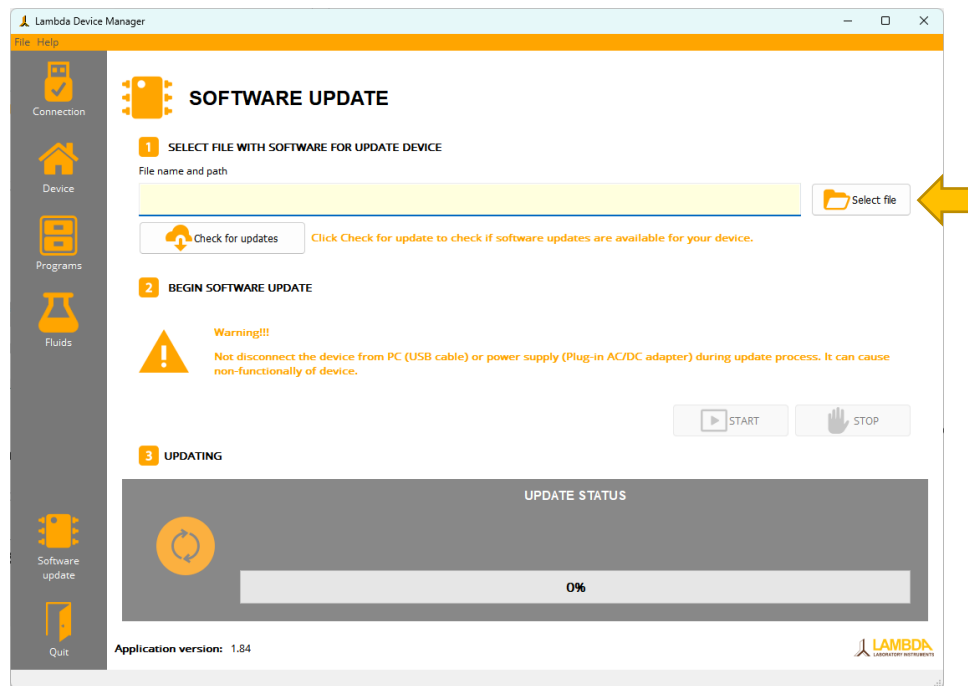
7. Click the "**Select file**" button and browse the path to the decompressed peristaltic pump software file (**pump-2-X.YY.hex**).

8. Click on the "**Start**" button to initiate the update process.

⚠ **Do not disconnect the power or USB communication cable during the update process!!!**
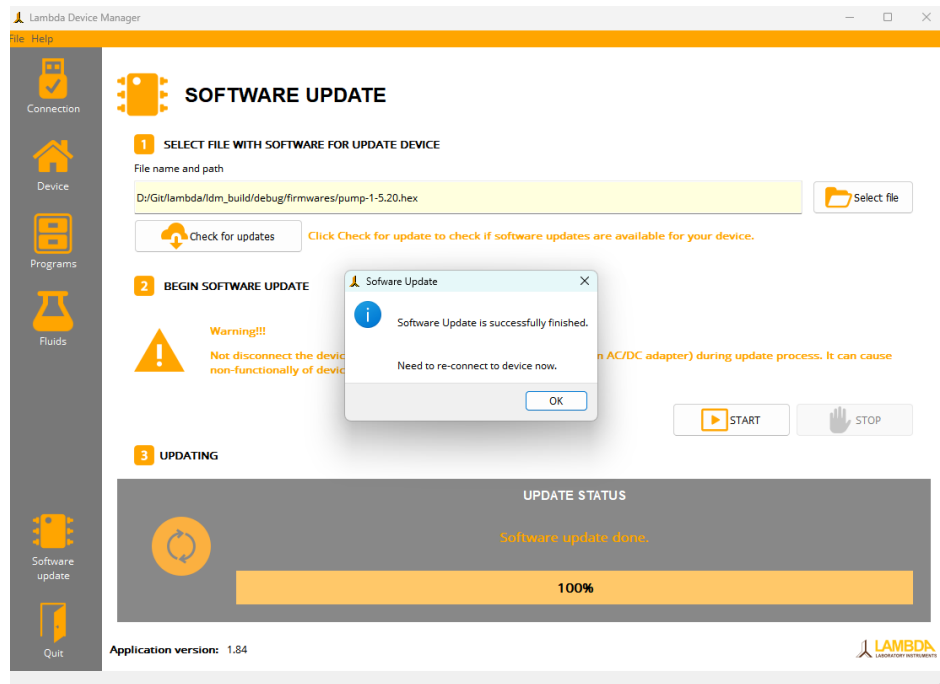
Software update done

9. The progress of the process is displayed in the lower part of the window labelled "**UPDATE STATUS**". Wait for the process to complete. When finished, a new text window will appear: "**Software update is successfully finished**."

10. Click on the "**OK**" button.

10 USB COMMUNICATION

The peristaltic pump can be set and controlled using a USB interface via a virtual COM port. The communication is text-based and uses the JSON data transfer format. After connecting to a PC, a virtual COM port (COMx) is created automatically. Most operating systems will not require the installation of additional drivers, as the peristaltic pump is identified as a CDC-class device using the USB Descriptor.

Supported data types: number, string, object

10.1 SYNTAX

{"Cmd":{"GetDeviceInfo":1}}   Each sending is initiated by send character LF (line feed)

Root object is "Cmd".

The internal JSON parser does not respect white spaces in strings. All JSON commands must be cleaned of white space.

Example send command GetDeviceInfo:
{"DeviceInfo":{"Name":"Preciflow","DeviceId":10,"SW":"2.00","SerialNumber":3932390,"Type":"Gas flow regulator",
"MaxSpeed":5.000,"SW":2.00,"HW":"210"}}

Command returns parameters with values of string/number type (above).

10.2 BASIC COMMANDS

Example: {"Cmd":{"GetDeviceInfo":1}}\n

KEY	VALUE	RESPONSE	NOTES
ProcPeriod	Integer	{"ACK":1}	Set the period of sending asynchronously process data (the value of the period is a multiple of 100 ms). Value 0 stop send process data.

KEY	VALUE	RESPONSE	NOTES
SetDefaults	1	{"ACK":1}	Reset configuration to factory defaults.
SetOpMode	0 or 1	{"ACK":1}	Set operating mode (RUN=1, STOP=0)
GetVer	1	Return object Version	
GetProcData	1	Return object ProcData	
GetDeviceInfo	1	Return object DeviceInfo	Information about device
GetConfigData	1	Return object ConfigData	Device setup
ClearError	1	{"ACK":1}	Clear error

10.3 COMMANDS WITH OBJECTS

Example: {"Cmd":{"SetConfigData":{"Flow":1.00}}}

SUB-OBJECT	KEYS	RESPONSE	DESCRIPTION
SetConfigData	Flow		Flow rate (double) if non-rpm unit is set.
	Display	{"ACK":1}	Set display brightness (value 0-5)
	Sound	{"ACK":2}	Set sound level (value 0-4)
	Precision		Set precision (0=0.1, 1=0.01, 2=0.001)

Receipt of the command is acknowledged by an ACK response with a value of 1. A parameter value that is not valid (e.g., out of range) is an ACK response value of 2.

10.4 RESPONSE OBJECT DESCRIPTION

Example:

{"ProcData":{"Flow":1.000,"OpMode":0,"DelivTime":0,"DelivVolume":0.0}}

OBJECT	KEYS	VALUES	VALUE DESCRIPTION
Version	HW	String	Hardware version
	SW	Number	Software version (major.minor)
	SN	Number	Serial number
ProcData	Flow	Number	Flow rate if non-rpm unit is set

OBJECT	KEYS	VALUES	VALUE DESCRIPTION
	DelivVolume	Number	Delivered volume in ml if calibration is set and units are non-rpm
DeviceInfo	Name	String	Device type (Preciflow)
	DeviceId	Number	ID of device
	SW	Number	Software version
	SerialNumber	Number	Device serial number
	Type	String	Device type (Peristaltic pump, …)
	MaxSpeed	Number	Maximal flow rate in float
	HW	String	Hardware version
ConfigData	Precision	Int	Set precision (0=0.1, 1=0.01, 2=0.001)
	Display	Int	Display brightness (1-5)
	Sound	Int	Sound level (0-4)

11 CAN BUS COMMUNICATION (REMOTE 1)

The peristaltic pump implements the CAN Specification 2.0B (Controller Area Network) interface. This asynchronous serial data communication protocol provides reliable communication in an electrically noisy environment. For internal purposes, the auxiliary bits in the extended identifier are used for the 1x master/n-slave communication model. See below for an explanation. The pump uses an extended data frame format with a 29-bit identifier. The nominal bit rate is fixed at 1 Mbit/s (cable length is limited to 20m).

11.1 DESCRIPTION OF COMMUNICATION

The CAN bus protocol uses asynchronous communication. Information is passed from the transmitters to receivers in data frames, composed of byte fields that define the contents of the data frame, as illustrated below.

Each frame begins with a Start of Frame (SOF) bit field and ends with an End of Frame (EOF) bit field. The SOF is followed by the Arbitration and Control fields, which specify the message's type, format, length, and priority. This information allows each node on the CAN bus to respond appropriately to the message. The Data field expresses the content of the message and has a variable length of 0 to 8 bytes. Error protection is provided by a Cyclic Redundancy Check (CRC) field and an acknowledgement (ACK) field.

CAN Bus Message Frame

SOF	ARBITRATION	CONTROL	DATA	CRC	ACK	EOF

11.1.1 EXTENDED DATA FRAME

The extended data frame begins with an SOF bit followed by a 31-bit arbitration field, as shown below. The arbitration field for the extended data frame contains 29 identifier bits in two fields, separated by a Substitute Remote Request (SRR) bit and an IDE bit. The SRR bit determines whether the message is a remote frame. SRR is 1 for extended data frames. The IDE bit indicates the data frame type. IDE is 1 for the extended data frame. The extended data frame Control field consists of seven bits.

The first bit is the RTR. For the extended data frame, RTR is 0. The next two bits, RB1 and RB0, are reserved bits in the dominant state (logic level '0'). The last four bits in the control field are the DLC, which indicates the number of data bytes in the message. The control field is followed by the data field. This field contains the message data – the actual payload of the data frame. This field is of variable length, ranging from 0-8 bytes. The number of bytes is user-selectable. The data field is followed by the CRC field, which is a 15-bit CRC sequence with a delimiter bit. The Acknowledgement (ACK) field is sent as a recessive bit (logic level '1') and is overwritten as a dominant bit by any receiver that has correctly received the data. The message is acknowledged by the receiver regardless of the result of the acceptance filter comparison. The last field is the EOF field, which consists of seven recessive bits that indicate the end of the message.

Format of the Extended Data Frame (29-Bit identifier)

S O F	IDENTIFIER 11-bit	S R R	I D E	IDENTIFIER 18-bit	R T R	R1	R0	DLC	DATA	CRC	ACK	EOF	IFS
						1	0	4 bits	8 bytes	16 bits	2 bits	7 bits	3 bits

An extended identifier is used to identify the peristaltic pump on the network. 29 bits are used to distinguish master/slave messages (frames) and to transmit a serial number that uniquely identifies the pump on the network (more in chapter 11.1.2).

After the pump is connected to the CAN network, the pump transmits the CAN_STATUS command (*chapter 11.3*) until the message is acknowledged by any receiver, regardless of the result of the acceptance filter comparison.

Once the CAN_STATUS message is acknowledged, the peristaltic pump automatically triggers the asynchronous transmission of the following commands outside CAN_STATUS:

- CAN_DEV_NAME
- CAN_FLOW

It sends these commands periodically, approximately every 50 milliseconds.

(For more information about commands, see Chapter 11.3)

11.1.2 EID BITWISE SIGNIFICANCE

The extended data frame is composed as follows. Serial number 3932390_{10} is used for the following examples.

EID assembled for broadcasting (the pump sends, master receives)

EID (29 bits)			
Slave identifier		None (no significance)	Pump Serial Number
Bit 28 1	Bit 27 1	Bit 26	Bit 25 – Bit 0
0x1800 0000			**0x3FF FFFF** e.g. (0x183C00E6 [bitwise AND] 0x3FF FFFF -> 0x3C00E6 = 3932390_{10})
0x1800 000 (bitwise OR) 0x3C00E6 ⇩ **0x183C00E6**			

EID assembled for receiving (master transmits)

EID (29 bits)			
Slave identifier		None (no significance)	Pump Serial Number
Bit 28 0	Bit 27 1	Bit 26	Bit 25 – Bit 0
0x0800 0000			3932390_{10} = 0x3C00E6
0x0800 0000 (bitwise OR) 0x3C00E6 ⇩ **0x083C00E6**			

EID decomposed into SID and EID for arbitration fields (master sends)

EID (29 bits) – 0x083C00E6	
SID (11 bits)	**EID (18 bits)**
010 0000 1111	00 0000 0000 1110 0110
0x20F	**0xE6**
0x083C00E6 >> 18	0x083C00E6 bitwise AND 0x3FFFF
(shift the requested EID 18 bits to the right)	Perform bitwise AND with EID and 0x3FFFF

11.2 MESSAGE FILTERING

The peristaltic pump continuously monitors messages on the CAN bus. As messages are received, the message identifier (EID) is compared to the filter/mask. If there is a match, the pump processes the message (frame). The first byte of the CAN message/frame is reserved to identify the command to be executed by the peristaltic pump or, when transmitting to a master device, to identify the data it is sending. The remaining bytes (up to 7) are reserved for the actual message data.

In order to accept the message, an EID (29-bits) must be created in the format described below.

> **EID = 0x800 0000** bitwise OR "**Serial Number**"
>
> Example (Pump serial number 3932390_{10} = 0x3C00E6)
>
> **0x0800 0000** bitwise OR **0x3C00E6**
>
> ⇩
>
> **0x083C00E6**
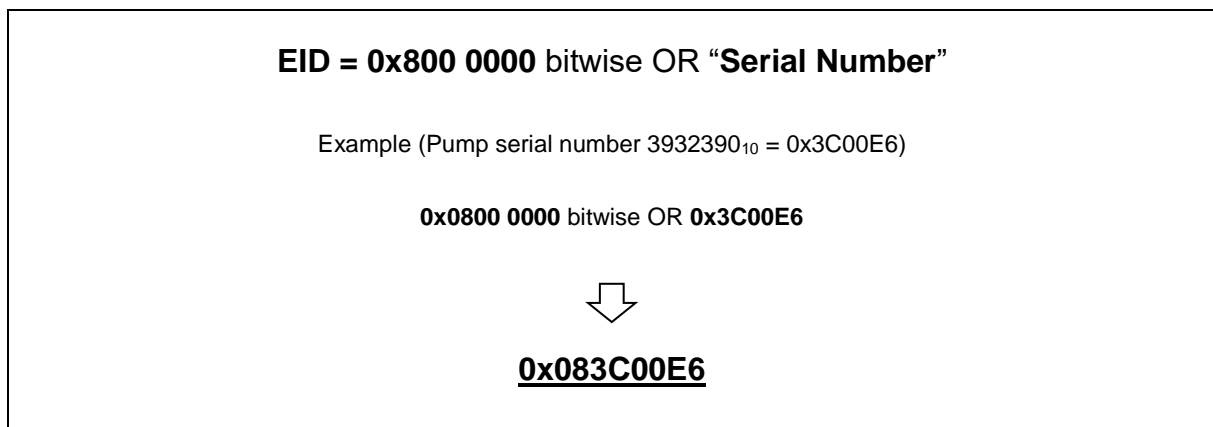
If you use, for example, a 32-bit integer to compose the EID, you need to clean it up using bitwise AND 0x1FFFFFFF.

11.3 COMMANDS (PSEUDO-IDENTIFIER)

The commands (pseudo-identifiers) are used to identify the type of message that the peristaltic pump is sending or that the pump is to process. Commands sent to the pump (EID bit 28 = 0 and 27 = 1) may or may not contain values. Some commands contain only the command code in the data portion of the message. A command that contains a value must be processed back to the correct state.

The EID must be constructed correctly to send a message to the pump (see chapter 11.1.2).

Commands are identified by the code (value) of the first data byte of the CAN message (frame). The following bytes represent the data value of the parameter. The following data bytes (max. 7) represent the data value of the command.

EXAMPLE (READ)

CAN_STATUS message sent by pump with serial number 3932390_{10}.

Message/Frame:

EID	DLC	DATA0 (command code)	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	CRC
0x183C00E6	0x7	**0x80**	0x03	0x00	0x00	0x04	0x1B	0x78	0x717A

Extracting the serial number from the EID identifier (hexadecimal):

0x183C00E6 bitwise AND 0x3FFFFFF = 0x3C00E6 (**3932390_{10}**)

Command Type

DATA0 = 0x80 -> CAN_STATUS

Command Data

DATA1 = 0x0A -> Massflow

DATA2 = 0x00 -> STOP operating mode

DATA3 = 0x00 -> No error

DATA4 = 0x04 -> Software version (**major**.minor) -> 0x04.xx (**4 decimal**)

DATA5 = 0x1B -> Software version (major.**minor**) -> x.0x1B (**27 decimal**)

DATA6 = 0x78 -> Hardware version 0x78 -> **120 decimal**)

EXAMPLE (WRITE)

CAN_FLOW command to set pump speed to 1000 rpm with serial number 3932390_{10}.

EID	DLC	DATA0 (command code)	DATA1	DATA2	DATA3	DATA4
0x083C00E6	0x8	**0x82**	0x00	0x00	0x7A	0x44

For more information on how to represent each data type, see 11.3.3.

11.3.1 READ COMMANDS

The table lists the commands the pump sends and describes the information they provide. Some commands are sent asynchronously, see section (11.1). Only the meaning of the data part of the CAN message (frame) is described in the table. The whole message is described above.

COMMAND NAME	CODE (1st data byte)	DATA LENGTH (bytes)	DESCRIPTION (DATA1-DATA7)	
CAN_STATUS	**0x80**	7	Byte order	Byte (value) significance
			0	Command identifier
			1	Device type 0x10 = MASSFLOW
			2	Operating mode 0x00 = STOP (LOCAL) 0x01 = RUN (LOCAL) 0x02 = ALARM (LOCAL) 0x03 = REMOTE
			3	Error code 0 = no error 0x06 = ERR_LID_OPEN 0x10 = ERR_PROG_END
			4	Software version (major, e.g. 4_{10})
			5	Software version (minor, e.g. 26_{10})
			6	Hardware version (e.g. 120_{10})
			e.g. 0x80 0x03 0x00 0x00 0x04 0x1B 0x78	
CAN_FLOW	**0x82**	5	Byte order	Byte (value) significance
			0	Command identifier
			1-4	Double data type Current set flow in rpm units
			e.g. 1000 rpm 0x82 0x00 0x00 0x7A 0x43	
CAN_ROTATION	**0x88**	5	Byte order	Byte (value) significance
			0	Command identifier
			1-4	Integer data type Current set direction of rotor rotation 0x00000001 = CW 0xFFFFFFFF = CCW
			e.g. 0x88 0x00 0x00 0x00 0x01	
CAN_DEV_NAME	**0x81**	0 – 8 (max 4x 8 bytes)	Byte order	Byte (value) significance
			0	Command identifier
			1-7	String data type Name of device (e.g. Megaflow)
			e.g. 0x81 0x50 0x72 0x65 0x63 0x69 0x66 0x6C 0x81 0x6f 0x77 0x00	

For information about the data format, see the chapter 11.3.3.

11.3.2 WRITE COMMANDS

The table contains commands that can be used to control the pump or change parameter values. Only the commands, i.e., the data part of the CAN message, are

described in the table. Creating a complete CAN message/frame is necessary for writing, as described in chapter 11.1.1.

COMMAND NAME	CODE (1st data byte)	DATA LENGTH (bytes)	DESCRIPTION	
CAN_FLOW	**0x82**	5	Byte order	Byte (value) significance
			0	Command identifier
			1-4	Double data type Current set flow in rpm units
			e.g. 1000 rpm 0x82 0x00 0x00 0x00 0x7A 0x44	
CAN_ROTATION	**0x88**	5	Byte order	Byte (value) significance
			0	Command identifier
			1-4	Integer data type Current set direction of rotor rotation 0x00000001 = CW 0xFFFFFFFF = CCW
			e.g. 0x88 0x00 0x00 0x00 0x01	
CAN_FLUID_NAME	**0x86**	0 – 8 (max 4x 8 bytes)	Byte order	Byte (value) significance
			0	Command identifier
			1-7	String data type Fluid name (e.g. BASE)
CAN_LOCATION	**0x89**	5	Byte order	Byte (value) significance
			0	Command identifier
			1-4	Integer data type 0x01 = calls up the location function (display flashes)
			e.g. 0x89 0x00 0x00 0x00 0x01	
CAN_PURPOSE	**0x8A**	5	Byte order	Byte (value) significance
			0	Command identifier
			1-4	Integer data type 0x00 = None 0x01 = ACID 0x02 = BASE 0x03 = FOAM 0x04 = FEED 0x05 = HARVEST 0x06 = PUMP-X 0x07 = PUMP-Y 0x08 = PUMP-Z
			e.g. 0x8A 0x00 0x00 0x00 0x01	
CAN_MASTER	**0x8C**	1	Byte order	Byte (value) significance
			0	Command identifier
			e.g. 0x8C	
CAN_CLEAR_ERROR	**0x8B**	1	Byte order	Byte (value) significance
			0	Command identifier
			e.g. 0x8B	

For information about the data format, see the chapter 11.3.3.

11.3.3 DATA FORMAT

- Integer - 32-bit signed integer, in little-endian format with the Least Significant byte (LSB) at lower data byte (DATA1).

EXAMPLE, READ

EID	DLC	DATA0 (command code)	DATA1	DATA2	DATA3	DATA4
0x183C00E6	0x05	**0x88**	0x00	0x00	0x00	0x01

Result: 0x00000001 = 1_{10}

EXAMPLE, WRITE

EID	DLC	DATA0 (command code)	DATA1	DATA2	DATA3	DATA4
0x083C00E6	0x05	**0x88**	0xFF	0xFF	0xFF	0xFF

Change rotation (-1)

- Double (IEEE 754 floating point format, single-precision, 32bit) – values are represented in little-endian format with the Least Significant byte (LSB) at lower data byte (DATA1).

EXAMPLE, READ (CAN_FLOW)

EID	DLC	DATA0 (command code)	DATA1	DATA2	DATA3	DATA4
0x183C00E6	0x5	**0x88**	0x00	0x00	0x20	0x41

Result: 0x41200000 = 10_{10} rpm

EXAMPLE, WRITE (CAN_FLOW)

EID	DLC	DATA0 (command code)	DATA1	DATA2	DATA3	DATA4
0x083C00E6	0x5	**0x88**	0x00	0x00	0x20	0x41

Result: 0x41200000 = 10_{10} rpm

- Strings (ASCII characters)

Strings are represented as byte arrays (hexadecimal values of ASCII characters). The maximum length of characters is limited to 32. The end of string is identified by byte **0x00**. The user application must ensure the creation of a chain based on the processing of up to 4 messages.

EXAMPLE, READ (CAN_DEV_NAME) – 1st message

EID	DLC	DATA0 (command code)	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x183C00E6	0x8	**0x81**	0x50	0x72	0x65	0x63	0x69	0x66	0x6C

Result: 0x50 = '**P**', 0x72 = '**r**', 0x65 = '**e**', 0x63 = '**c**'; 0x69 = '**i**', 0x66 = '**f**', 0x6C = '**l**'

EXAMPLE, READ (CAN_DEV_NAME) – 2nd message

EID	DLC	DATA0 (command code)	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6	DATA7
0x183C00E6	0x8	**0x81**	0x6f	0x77	0x00				

Result: 0x6f = '**o**', 0x77 = '**w**', 0x00 = end
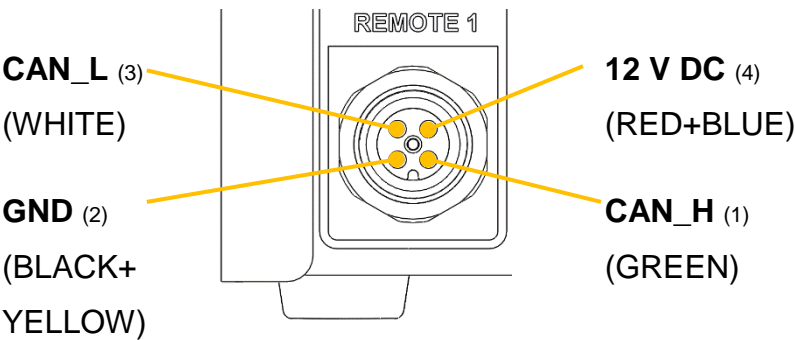
Final string = **Preciflow**

11.4 HEARTBEAT

Peristaltic pumps must accept the CAN_MASTER command to remain in REMOTE mode. If the peristaltic pump loses the connection, i.e., stops receiving this command, the motor automatically stops, and the pump switches from REMOTE mode to STOP mode (local control).

This method ensures that the peristaltic pump stops dosing the moment it loses contact with the element that controls it.

The limit for receiving the CAN_MASTER command is 15x the asynchronous transmission period (50 ms), i.e., approximately 750 milliseconds.

11.5 CONNECTOR WIRING

CAN_L (3)
(WHITE)

GND (2)
(BLACK+
YELLOW)

12 V DC (4)
(RED+BLUE)

CAN_H (1)
(GREEN)

Marking	Color	Purpose
CAN_L	White	CAN-
CAN_H	Green	CAN+
GND	Black+Yellow	Ground (Device power supply)
12V DC	Red+Blue	Device power supply It is used to power the entire device instead of using an external power adapter. (If a power adapter is connected to the device, the voltage will also be present on this pin).

! - The input voltage must not exceed 14V, the absolute maximum of 16V
- Take extra care not to reverse the polarity of 12V and GND

12 ALARMS

In the event that any error occurs or user intervention is required, the pump will go into ALARM. Each alarm has its own separate identification code. The alarm can be accompanied by an audible alarm if it is active, the audible alarm is active for the entire time the alarm screen is displayed.

(i) The acoustic alarm can be switched on/off in the menu (see chapter "6.4.4 Sound").

* To cancel the alarm, click on "**CLEAR**"
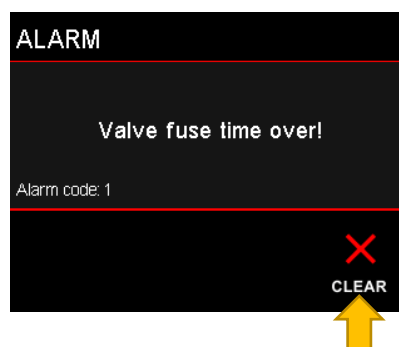
12.1 ALARM CODES

Code	Name	Description
1	Valve fuse time over!	There was no gas flow during the protection period. Check that the MASSFLOW has an IN connected.
2	Cannot reach set point!	Input gas pressure is too low and the regulator fails to achieve the required setpoint. Check the inlet gas pressure.
4	Flow sensor error!	The integrated sensor is not working.

		The integrated sensor is not working. Try turning MASSFLOW on and off. Make sure you are using the supplied 12V power adapter.
16	Program finished	The current program has been completed, all segments of the program have been processed.
17	Program has no data	You are trying to run a program in which no segments are set. Go to the program settings and set the batching segments. See chapter "8.4 Edit program".

Revision history

Rev	Description
1	Initial version