

MASSFLOW

OPERATION MANUAL

1. SET UP

POWER SUPPLY

The MASSFLOW has a low consumption of electric current and is normally connected to the 12 V DC line of the MINIFOR using the supplied 8-pole cable with DIN connectors. One connector is plugged into the rear of the MASSFLOW (REMOTE), the other to any of the four pump sockets at the rear of the MINIFOR laboratory fermentor.



When used independently without a fermentor, a universal plug integrated power supply 100–240 V AC/50–60 Hz, 12 V, 6 W DC power supply can be supplied (cat. no. 4815). The power supply cable is connected to the three-pole socket (12 V) at the rear of the MASSFLOW.

When the MASSFLOW is connected to a power supply, all LEDs and the display are lit up for one second. This allows a function control of all signal elements.

GAS INPUT AND OUTPUT

Gas tubing (interior diameter about 5.5 to 6 mm) is connected to a nozzle (gas in) and secured in place with appropriate clamps. The maximum permissible gas pressure is 0.2 MPa (2 atm or 30 psig). Higher pressures will damage the instrument! A simple overpressure security valve is part of the inlet nozzle, which allows the gas to escape when the pressure exceeds about 0.22 MPa.

Fix the other tubing onto the gas output nozzle. Turn on the gas supply. The regulating valve is closed and no gas will come out of the output.



SETTING THE FLOW RATE

Press the SET button. The corresponding LED will light up and the display will show the preset value of the flow rate. Set a desired flow rate with the buttons underneath the display. Press the SET button again. The LED is switched off and the display shows the actual flow rate. It should indicate 0.0 l/min. Press the ON/OFF button. The corresponding LED is lit up. After about 10 seconds (about 30 seconds for low flow rates) the flow rate will progressively attain the preset value.

2. REMOTE CONTROL

ANALOGICAL CONTROL

ON/OFF

The gas flow rate can be switched off by applying a voltage (3–12 V) to contact no. 5 of the eight-pole socket (figure 1) at the rear of the MASSFLOW (0 V is connected to pole no. 3). The 12 V voltage can also be taken from contact no. 4 of the socket). The applied voltage will stop the gas flow. When this voltage disappears the gas flow will continue until it is switched off by using the ON/OFF button.

PROPORTIONAL FLOW RATE CONTROL

The gas flow rate can be regulated over the whole range of 0.0 to 5.0 l/min by an external DC voltage 0 to 10 V applied to contact no. 1 of the rear side socket (REMOTE). The 0V line must be connected to contact no. 3 of the same socket (figure 1). The remote control is activated by pressing the REMOTE button. The corresponding REMOTE LED is lit.

PC CONTROL

A PC can be used to regulate all functions of MASSFLOW over an RS-485 line. The commands used for all functions are indicated below. The line should be connected according to figure 1. (A resistor of 100 ohms should be connected between both RS-485 lines, if it is not already present. This resistor is not part of MASSFLOW or any other Lambda instrument.) When the digital control is activated the REMOTE LED is on and all manual commands (with exception of the SET button) are blocked.

ADDRESS SETTING FOR PC CONTROL

The digital control requires an attribution of an appropriate address to the MASSFLOW. This is done in the following way: Pull out the power supply cable from the rear of the MASSFLOW. Press and hold the SET button while plugging the cable into the socket again. The front panel illuminates and the display shows A00. Release the SET button. Select a desired address from 0 to 99 and press the ON/OFF button to store it in the memory.

3. PROGRAMMING OF FLOW RATES

Up to 50 pairs of flow rates and time periods can be programmed. This allows almost any flow rate profile to be obtained.

To enter the programming sequence press the REMOTE and RUN buttons simultaneously until the message PGM appears on the display. (The ON/OFF button is used to go from one step of the program to another and at the same time stores the previous step in the memory.)

Press the ON/OFF button. The message F01 will appear for one second on the display followed by the value of the flow rate for the first step, which has been stored in the memory. If the MASSFLOW is new or the previous program has been deleted the value 0.0 will be displayed.

Press the buttons under the display window to select the flow rate value for the first step (for example 1.0).

Press the ON/OFF button again. The message t01 will appear on the display indicating that the time period of the first step can be programmed. The display will then show the time period stored earlier for the first step.

Select the duration of the first flow rate (for example 02 = two minutes) and press the ON/OFF button to store the duration in the memory and go on to the next step. F02 will appear on the display and after one second the value of the flow rate in the memory will be displayed.

Select the value of the flow rate for the second step and press the ON/OFF button to store your setting and continue on to the setting of the duration for the second step. The message t02 will shortly appear on the display followed by the duration, which has been stored earlier.

Select the duration and store it by pressing the ON/OFF button. F03 will appear on the display and you can proceed as described in the first two steps. All other steps are also programmed in this way.

When the *duration* of the last step has been entered the programming is terminated by pressing the REMOTE and RUN buttons simultaneously until the message End appears on the display.

The program is started by pressing the RUN button and the corresponding LED will light up. The flow rate of the first step will appear on the display if the SET button is activated. Otherwise, the reading 0.0 seen at the beginning will increase progressively until the programmed flow rate is attained. This may take about 15 seconds depending upon the selected flow rate.

During the execution of the program it is possible to manually modify the flow rate or even stop the flow rate with the ON/OFF button. However, the program will continue when the next step is executed. This allows certain emergency manipulations to be performed without terminating the program.

The running program can be terminated definitively by pressing the RUN button. The corresponding LED will go out.

After the last step of the program the gas flow will be stopped.

If you wish to maintain a certain flow rate at the end of the program, set the duration of the last step to 00. Such time is not defined and the flow rate will be maintained until the MASSFLOW is switched off manually or the power supply is disconnected.

READING THE PROGRAM

Reading the program can be done in the same way as the programming described above. No modification is made by the buttons under the display. After the last step a simultaneous pressing of the REMOTE and RUN buttons will end the reading process. The message END will appear on the display. Pressing the RUN button will start the program.

DELETING THE PROGRAM

Press the REMOTE and RUN buttons simultaneously. The message PGM will appear on the display. Press both buttons again simultaneously. The message CLE will appear on the display. This indicates that the program has been deleted from the memory.

4. VOLUME TOTALIZER

The MASSFLOW generates an electric signal after a delivery of each 5 ml of gas. This signal can be integrated and transformed into a DC voltage using a PUMP-FLOW INTEGRATOR (cat.no. 4803). A full range volume of the integrator can be adjusted from 10 l to 5 000 l. After this an automatic reset will set the integrator to zero and the integration will continue. In connection with a PC any volume from 5 ml upwards can be recorded (FNet or SIAM).

5. USE OF MASSFLOW FOR PH CONTROL DURING CELL CULTURE

The pH of a cell culture media is kept constant by the controlled addition of gaseous carbon dioxide (CO₂). The MASSFLOW is ideal for this purpose.

Connect the CO₂ gas tubing to the MASSFLOW and to the bioreactor. Plug the remote control cable of the MASSFLOW into the pump socket (ACID) on the rear side of the MINIFOR.

Press the REMOTE button on the MASSFLOW and switch the flow on with the ON/OFF button. The pH of the medium will be controlled automatically.

Note: *If the actual pH of the medium is much higher than the preset value on the MINIFOR, the initial flow of carbon dioxide may be very high. To prevent this, it is advisable to start with manual control of CO₂ addition until both the actual and preset pH values are almost identical. Only then should the REMOTE button be pressed and the automatic control started.*

If the pH of the culture medium is lower than the preset pH. The excess of CO₂ has to be removed. In most cases this is achieved by air, if the air is used for control of dissolved oxygen. When this is not possible a second MASSFLOW connected to nitrogen and its remote control cable plugged into the pump socket (BASE) in the rear of the MINIFOR is required.

When the actual pH is lower than the preset pH, the flow of nitrogen controlled by the second MASSFLOW will blow the excessive amount of carbon dioxide out and the pH will increase.

As mentioned above, when there is a big difference between the actual and preset pH, it is advisable to initially control manually and only later activate the remote control by pressing the REMOTE button.

The best way to connect both gases to the MINIFOR is by using T, Y or X tubing between the regulated air output of the MINIFOR and a sterile gas filter on the gas line leading to the bioreactor vessel.

The use of one or two MASSFLOW gas flow rate controllers together with the MINIFOR bioreactor assures a good pH and pO₂ control during cell culture. It may completely replace expensive gas mix stations and assure much better parameters.

6. CONNECTIONS:

INPUTS/OUTPUTS:

Contact no.: socket and cable colour code

- | | |
|---|---|
| 1 | + input remote gas flow control 0–10 V (yellow)* |
| 2 | 5 ml signal from MASSFLOW (0 and 5 V) (grey) |
| 3 | ground, 0 V (green) |
| 4 | + 12 V (brown) |
| 5 | + input remote ON/OFF (white)*
0 V = ON, 3–12 V = OFF
*(zero line connected to contact no. 3) |
| 6 | GND RS-485 pink conductor |
| 7 | RS-485 B (–) red conductor |
| 8 | RS-485 A (+) blue conductor |

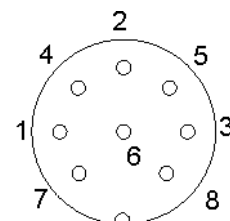


Figure 1

7. ACCESSORIES AND SPARE PARTS

Pump/gas-Flow Integrator (cat. no. 4803)

The FLOW INTEGRATOR allows the simple but precise integration of the amount of gas, which has passed through the MASSFLOW gas controller.

The electric pulses, which correspond to 5 ml of gas (air, nitrogen, oxygen) are registered and transformed into a direct voltage. The resulting voltage can be measured or recorded by common recorders or voltmeters. Using an RS-485 line, the gas volume can be recorded on a PC (for example using the fermentation software FNet).

In processes where the gas flow is controlled e.g. by a pH-stat during a cell culture to keep the pH of the medium constant, it is often important to know when and how much acid (such as carbon dioxide) or base (nitrogen in cell cultures) was added. This data yields important information about the process, its kinetics, time of completion etc.

Another use of the INTEGRATOR is the measurement of enzyme activities (esterases, amidases, lactamases and other enzymes).

The PUMP/GAS-FLOW INTEGRATOR is connected by a cable to the 8-pole socket at the rear of the pump (figure 1).

Remote control cable (cat. no. 4810)

Power supply 100–240 V AC/50–60 Hz, 12 V, 6W DC (cat. no. 4815)

8. GUARANTEE

Lambda offers a three-year parts and labour guarantee on all its products, when the instrument has been used in accordance with our operating instructions and the advice given above.

CONDITIONS OF GUARANTEE:

- The instrument must be returned with a complete description of the defect or problem.
- The customer should send the instrument to our service office.
- Lambda will not be responsible for any damage or loss, which may occur during transportation.
- Failure to fulfil these requirements will invalidate the guarantee.

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