

USER MANUAL

FNet – Fermentation Control Software

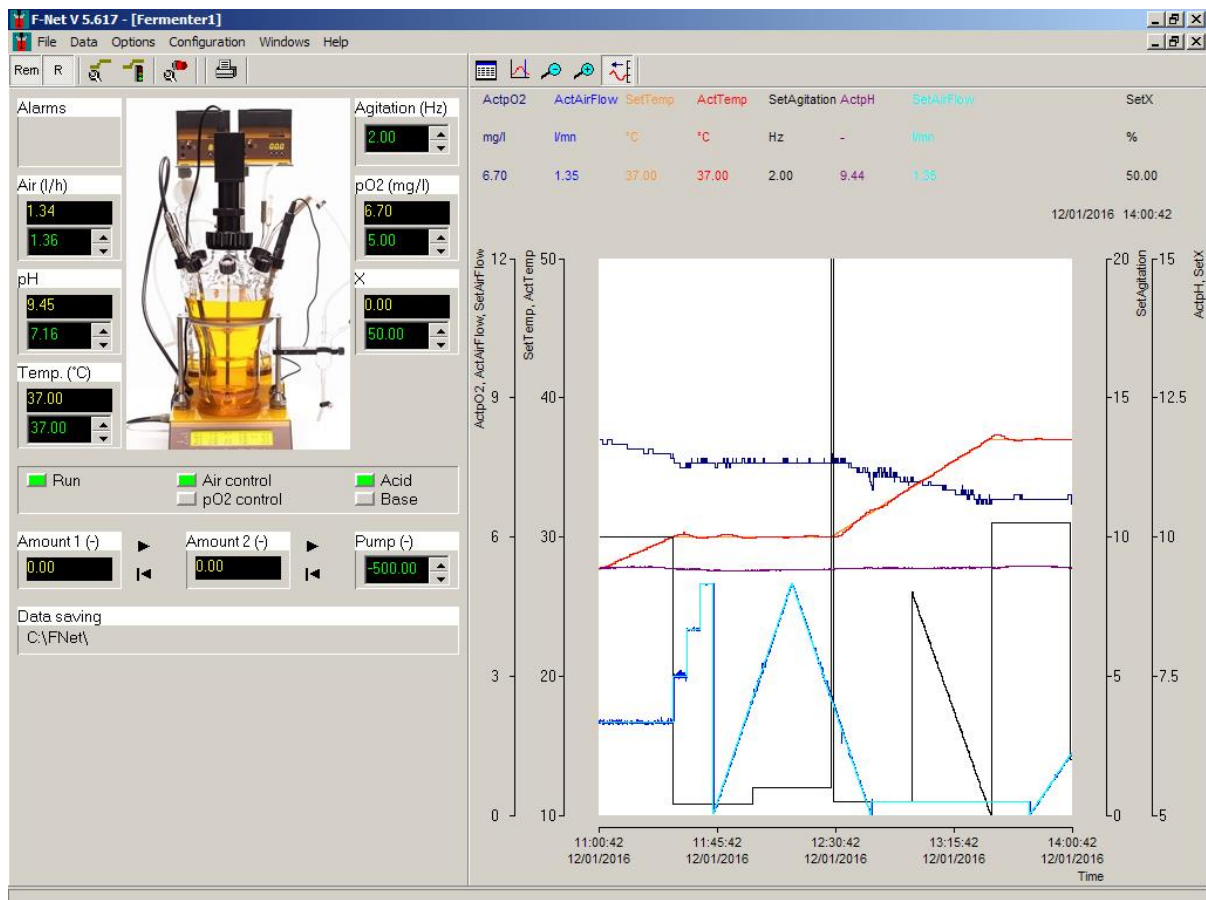


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PREFACE

Introduction

FNet is the PC remote control software to monitor and control the fermentation and cell culture processes of the LAMBDA MINIFOR Fermentor and Bioreactor system along with the peristaltic pumps and integrators.

The instruments are connected to the computer through a RS-232 or RS-485 interface. Then, the COM port to which the instrument is connected and its address are selected.

The software recognizes the connected fermenters and bioreactors at the start-up. Up to 6 LAMBDA MINIFOR Fermentor-Bioreactor, 6 Peristaltic Pumps and 12 INTEGRATORS can be connected and managed simultaneously.

If other functions are needed, you could contact us (support@lambda-instruments.com). If possible, we will integrate the desired functions in your software system, in such a way that it conforms optimally to your specifications.

Hints

An automation system should make the work easier. Before initiating the process, think of a question: what will happen in the event of a system failure (e.g. an interface, measuring apparatus or PC breaking down)? Experimental set up should be made to have a minimal effect due to breakdown and the system should be safe.

For example:

- Appropriate valves are opened or closed automatically during power cut.
- Pumps should not be overloaded.
- Before leaving the program, switch all apparatus to the "Zero" position.
- Your equipment must be capable of withstanding the most extreme possible conditions placed on it. (Example: For pressure regulation, your apparatus should be able to tolerate the maximum pressure allowed by the safety valve).
- To avoid overheating of electronic circuits, nothing should ever be placed on the D/A converter box.

Text convention

Italic: words which appear in the program, like menu, text on buttons (example: *OK*)

INSTALLATION

Any extension cards that may be required (RS232, RS485, etc.) can be installed. To do this, it is necessary to exit FNet, shut down Windows and switch OFF the computer.

If a RS232/RS485 converter is used, this can also be connected at this time.

To install FNet (version 5.6) insert the CD-ROM into the CD-ROM drive and start the set-up program 'Setup.exe'.

Finally, switch the various devices ON, boot the computer and start FNet (version 5.6).

PC CONNECTION

Setting up the PC connection kit

The PC connection kit includes RS 232-485 converter, power supply for the RS 232-485 converter, RS cable for MINIFOR, USB connection and CD with software program.

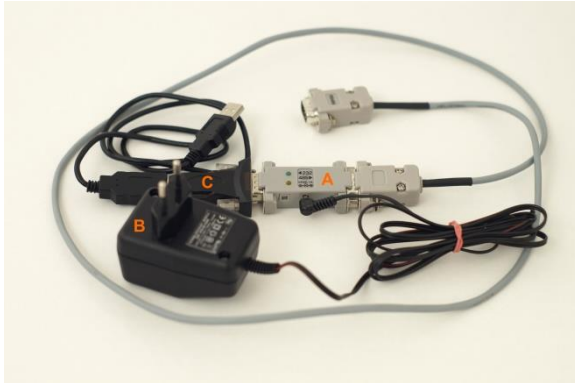


Figure 1 LAMBDA RS-485 CONNECTION KIT:
(A) RS-232/485 converter
(B) Power supply for RS-232/485 converter (5 V / 1 W)
(C) PC connection cable



Figure 2 Connect the PC connection cable to the DB 9 connector at the rear of the MINIFOR control unit.

- One end of the RS-485 cable has to be connected to the RS-232/485 converter **(A)**, and the other end connected to the **DB 9 connector of MINIFOR control unit** (refer *Figure 2*).
- The RS-232/485 converter **(A)** has to be connected to the PC using the serial or USB port with the help of the provided USB connector **(C)**.
- Install the corresponding USB Serial Port driver on the PC.

Please refer, section **6.4 PC Connection** in the MINIFOR fermentor-bioreactor operation manual at <http://lambda-instruments.com/pdf/LAMBDA-MINIFOR-Laboratory-Fermentor-Bioreactor-operational-manual.pdf>



Please make sure, the power supply of the RS-232/485 converter is connected to the mains.

Setting up the COM port

It is not necessary to set the COM port on the computer as the FNet automatically searches the devices connected to the COM 1 and COM 2. The COM ports 1 and 2 must be available for the connected MINIFOR fermenter-bioreactor.

If the FNet software does not recognize the connected instruments, please refer video manual at www.lambda-instruments.com/?pages=video-software to set the COM port number of the connected instruments. It is advisable to select **COM port 1 or COM port 2**.

Setting up the address of the instruments

The slave address of MINIFOR fermentor-bioreactor, peristaltic pumps and INTEGRATOR:

MINIFOR Fermenter 1 = address 1

Pump-flow Integrator 1 = address 7

Pump-flow Integrator 2 = address 8

Peristaltic pump = address 9

MINIFOR Fermenter 2 = address 2

Pump-flow Integrator 1 = address 10

Pump-flow Integrator 2 = address 11

Peristaltic pump = address 12

MINIFOR Fermenter 3 = address 3

Pump-flow Integrator 1 = address 13

Pump-flow Integrator 2 = address 14

Peristaltic pump = address 15

MINIFOR Fermenter 4 = address 4

Pump-flow Integrator 1 = address 16

Pump-flow Integrator 2 = address 17

Peristaltic pump = address 18

MINIFOR Fermenter 5 = address 5

Pump-flow Integrator 1 = address 19

Pump-flow Integrator 2 = address 20

Peristaltic pump = address 21

MINIFOR Fermenter 6 = address 6

Pump-flow Integrator 1 = address 22

Pump-flow Integrator 2 = address 23

Peristaltic pump = address 24

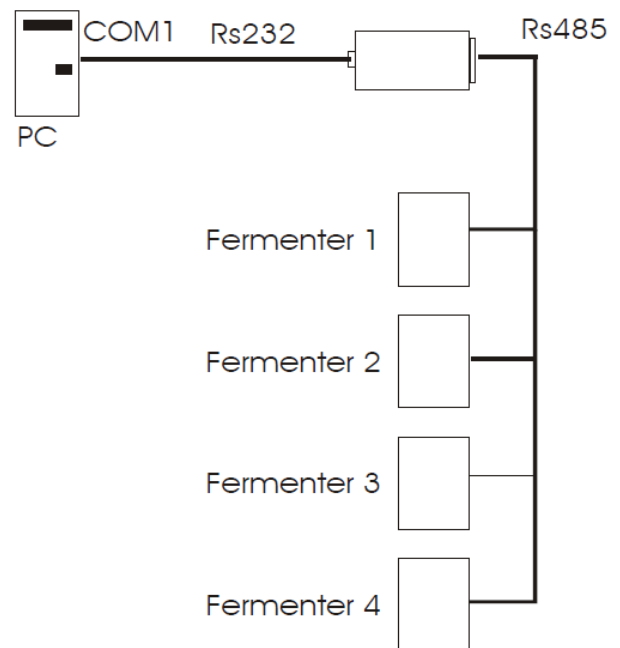


Figure 3 PC connection with MINIFOR fermenter-bioreactor

To look-up or modify the address of the MINIFOR fermentor-bioreactor:



Figure 4 Press button “C” on the MINIFOR control panel to enter the **Calibration mode** to set or control the address of the MINIFOR for PC control



Figure 5 ADR on the Air l/min parameter is the address of the MINIFOR fermentor-bioreactor unit



It is necessary to **leave the “C” calibration mode after checking / modifying the address** of the MINIFOR fermentor-bioreactor, by pressing the button “R”. Please refer, section **4 Display and control panel** in the MINIFOR fermentor-bioreactor operation manual for more information.

To look-up or modify the address of peristaltic pumps and pump-flow INTEGRATOR:



Figure 6 Disconnect the 8-pole remote control cable from the peristaltic pump. While keeping the direction button ◀▶ pressed connect the 8-pole cable to pump again



Figure 7 The message “A” and two numbers will appear on the display which correspond to the current address of the pump. Press the buttons ▲▲▲ under the display to modify the address. Press the **ON/OFF** button to save the set address.

The address of the PUMP-FLOW INTEGRATOR is same that of the peristaltic pump as it is electronically implemented inside the LAMBDA peristaltic and tubing pumps.

OPERATING INSTRUCTIONS

Ready to use software

After installing the FNet software to the PC, setting up the desired address on the instruments, PC connection and the COM port number, open the FNet software by clicking on the FNet icon shortcut on the desktop of the PC or laptop.

The software recognizes the connected fermenters, peristaltic pumps and the pump-flow INTEGRATORS at the start-up.

Fermenter window

The FNet software window opens at the start-up is the fermenter window. The software opens separate fermenter windows for each connected MINIFOR fermenter-bioreactor e.g.: two separate windows to control the parameters for the two MINIFOR fermenters-bioreactors in parallel cultivation.

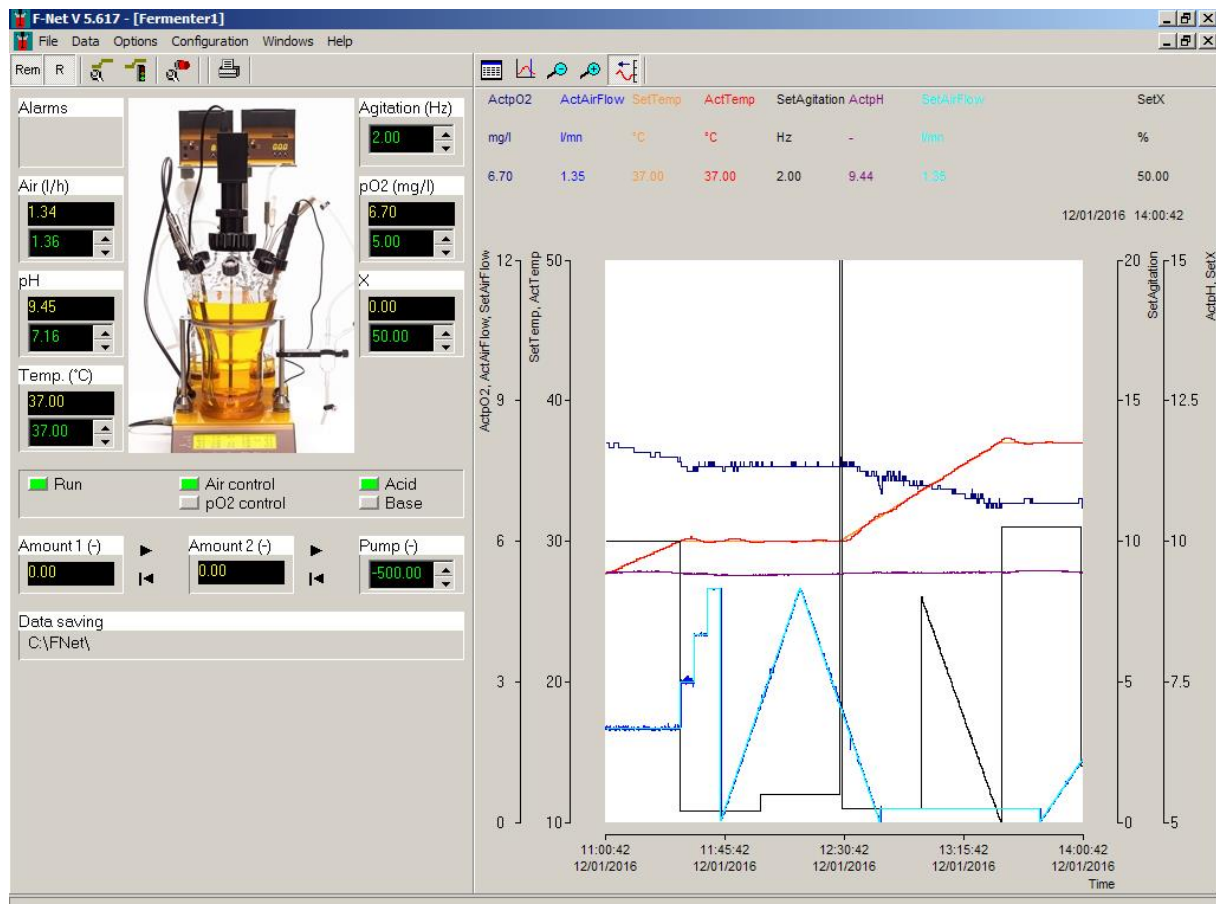
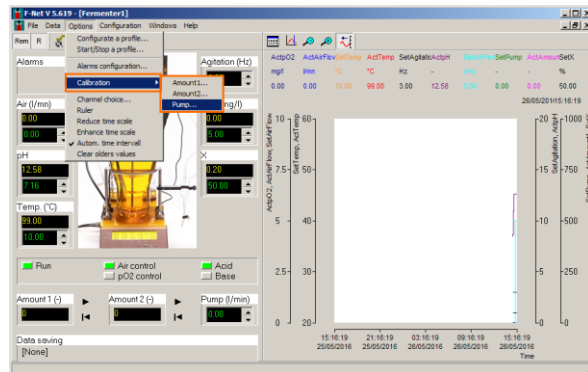
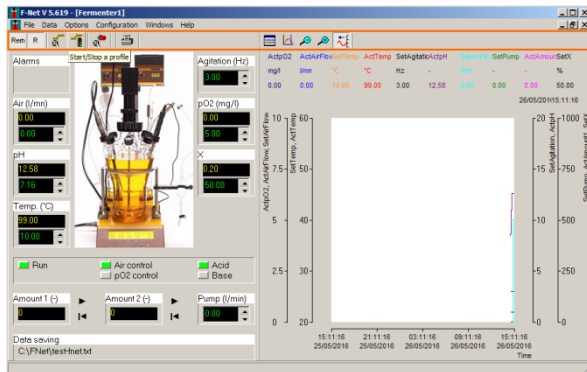


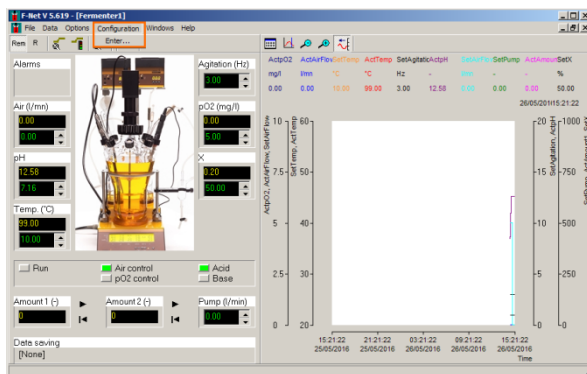
Figure 8 FNet fermenter window

3 level management to access the functions:

1. All the functions which are accessed often (e.g.: like set points, start / stop profile, ...) have direct access on the fermenter window
2. Function which are used occasionally (e.g.: like calibration of pump-flow INTEGRATOR) can be accessed from the menu bar

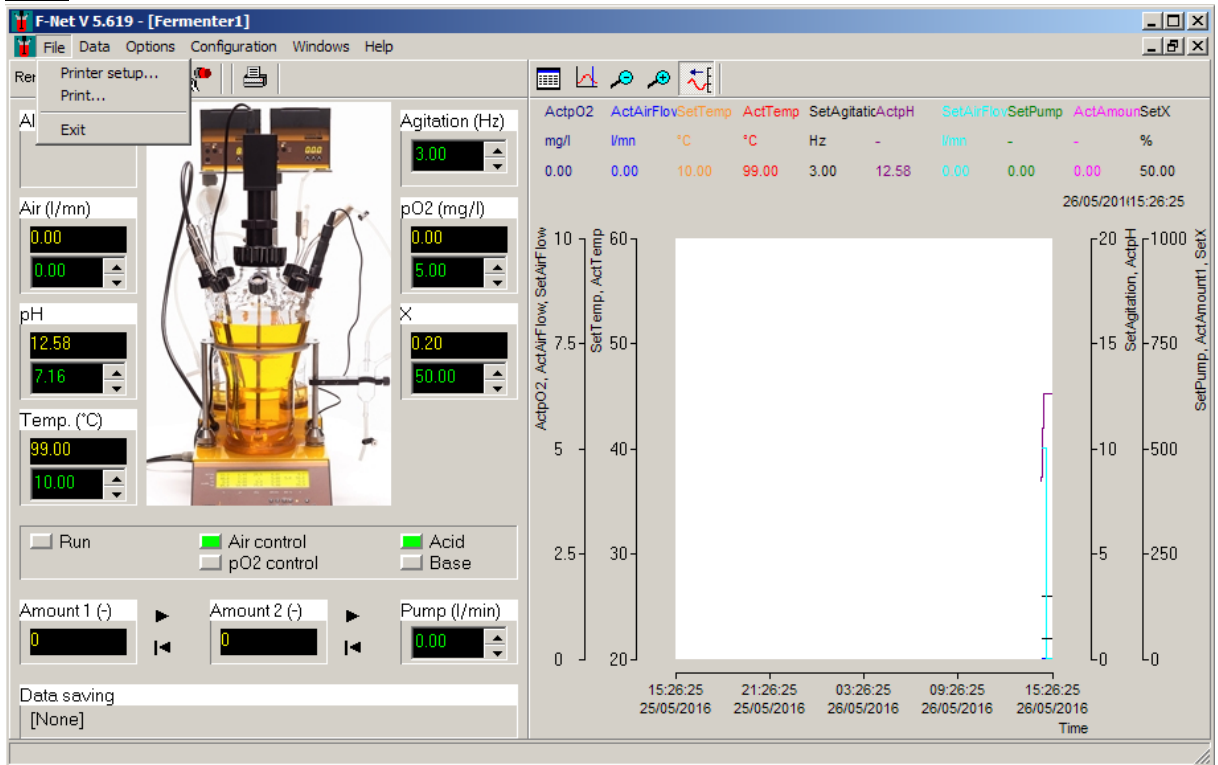


3. Configuration of installation (e.g.: pump-flow INTEGRATOR address) can be accessed only with a password



Menu

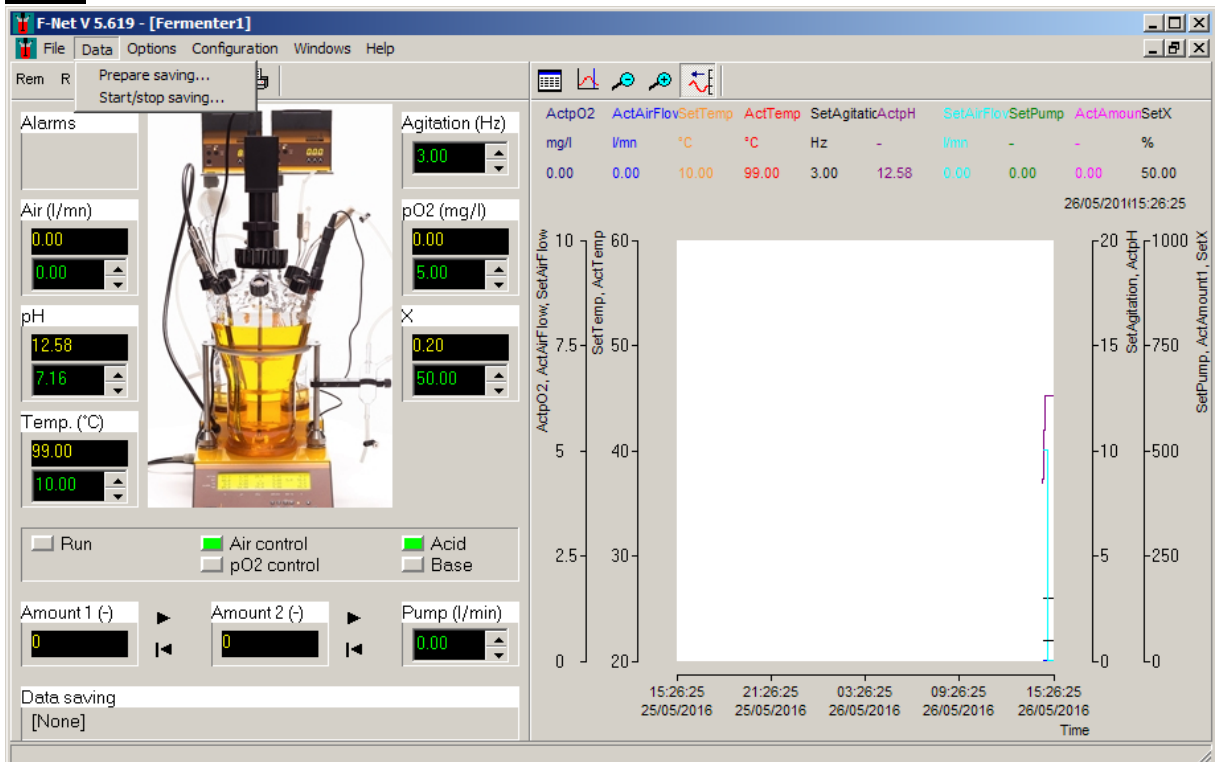
1. FILE menu



Printer configuration: Printer and its parameter selection

Print: Print outs the whole window (also accessible by clicking the **PRINT ICON** on the fermenter window without opening the MENU)

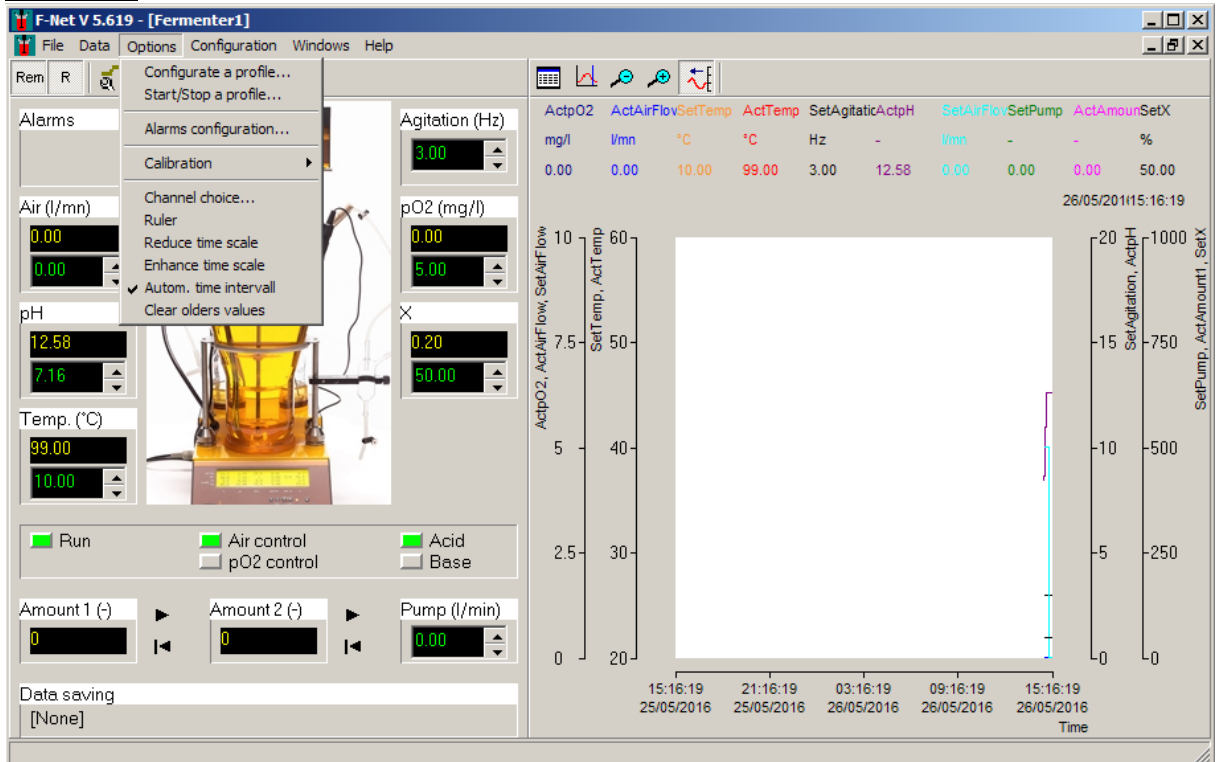
2. DATA menu



Prepare saving: Choice of channels (parameters values) to save to a data file


Start/Stop saving: Start or stop the saving of channel (parameter) values in a file


3. **OPTIONS** menu




Configure a profile: Enter set-points or create a profile of each parameter; Save the profile; Open the profile; (also accessible by clicking the *CONFIGURE A PROFILE*


ICON  on the fermenter window without opening the MENU)

Start/Stop a profile: Start or stop each profile (also accessible by clicking the *START / STOP A PROFILE* ICON  on the fermenter window without opening the MENU)


Alarm configuration: Configure the low and high alarm for the measured parameters (also accessible by clicking the *ALARM CONFIGURATION* ICON  on the fermenter window without opening the MENU)


Calibration: Calibration of peristaltic pump flow and pump-flow INTEGRATOR

Channel choice: Selection of channels to display in the graph (also accessible by clicking the *CHANNEL CHOICE* ICON  above the graph without opening the MENU)

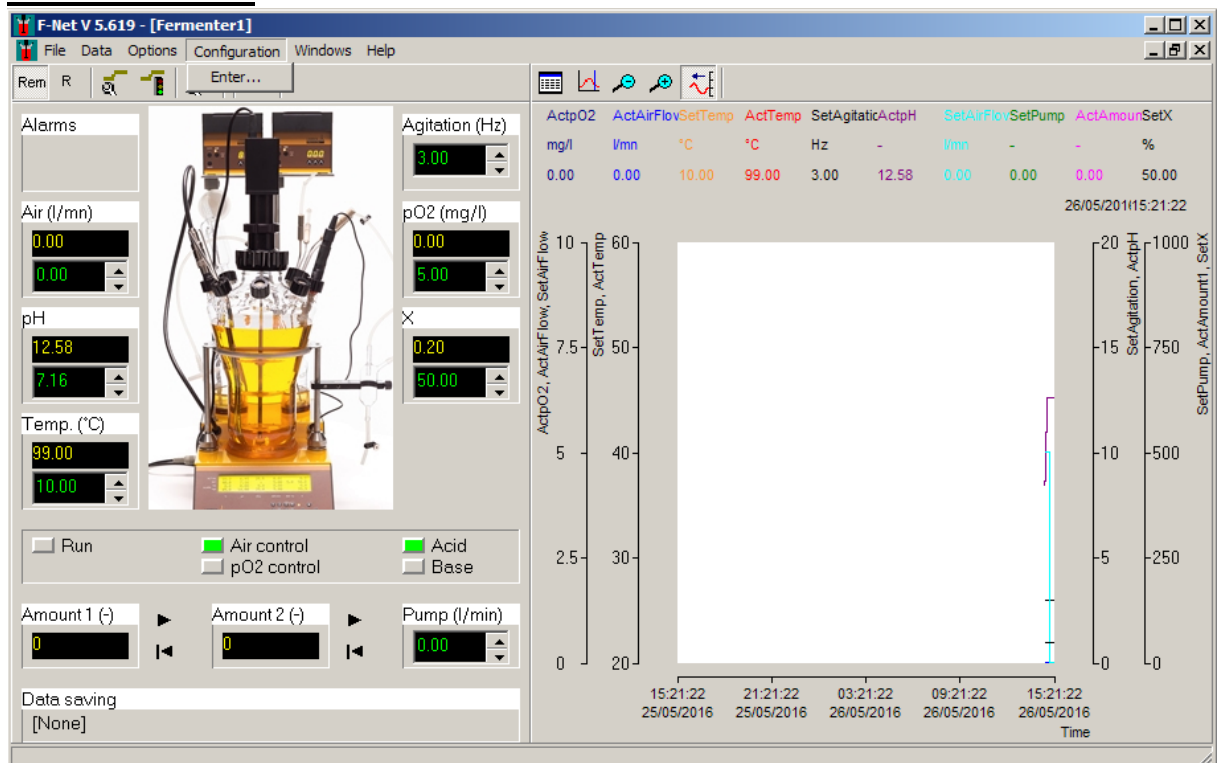
Ruler: Activate or deactivate the cursor on the graph (also accessible by clicking the *RULER* ICON  above the graph without opening the MENU)

Reduce time scale: To view the overview on the graph (also accessible by clicking the REDUCE TIME SCALE ICON  above the graph without opening the MENU)

Increase time scale: To view the details on the graph (also accessible by clicking the INCREASE TIME SCALE ICON  above the graph without opening the MENU)

Auto time interval: The new values are automatically added to the curves and start shift to left (also accessible by clicking the INCREASE TIME SCALE ICON  above the graph without opening the MENU)

4. CONFIGURATION menu



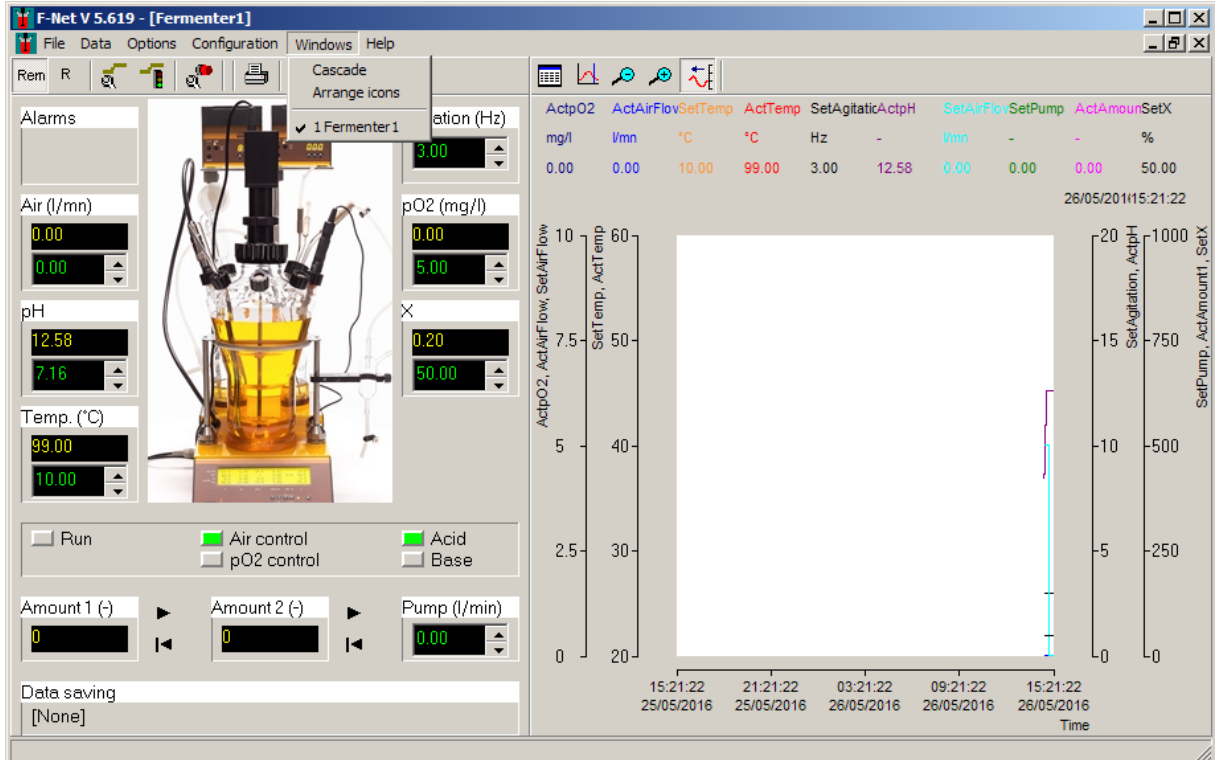
Enter: Personalize the software with password **fnet**

Device terminal: Device terminal window displays the communication between PC software and the MINIFOR fermenter-bioreactor

Fermenter name: Rename the fermenter window

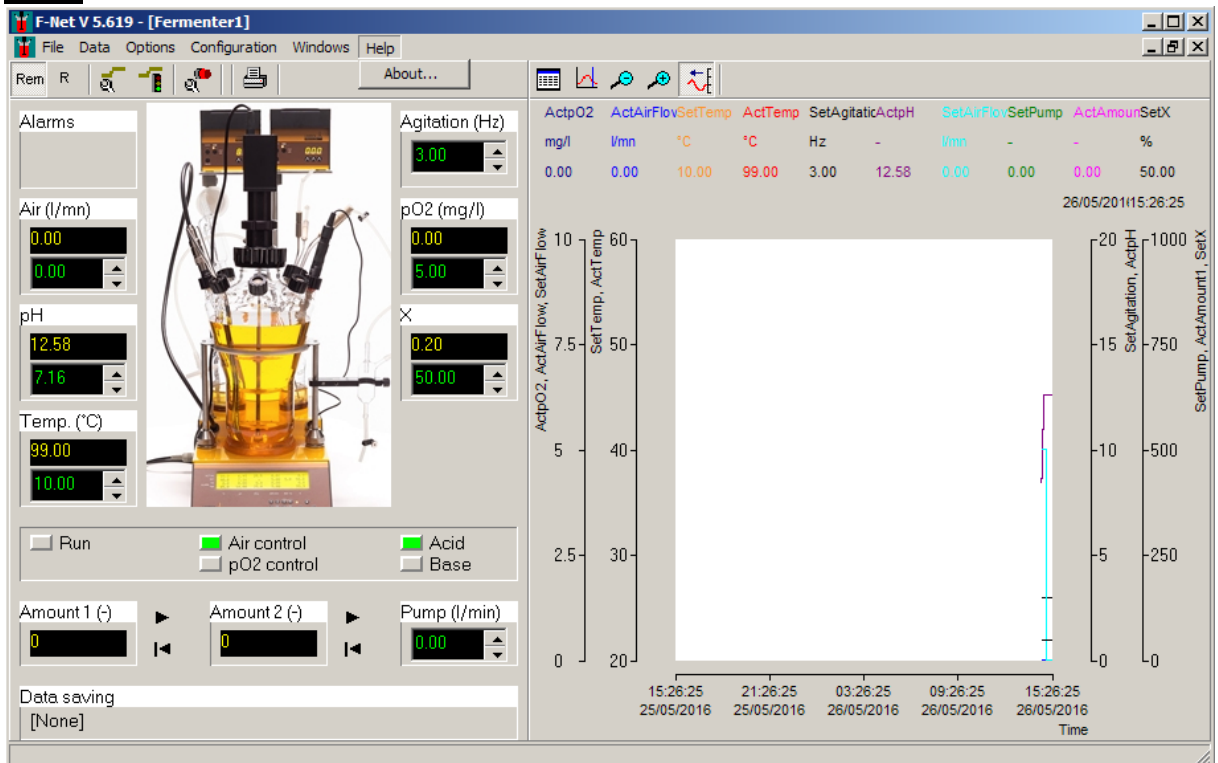
Capture: Set the address of the pump-flow INTEGRATOR (Amount 1 and amount 2)

5. **WINDOWS** menu



Shows the number of fermenter windows linked to the FNet software

6. **HELP** menu



About: To know more information about the FNet fermentation software and assistance

How to change the set-point?



Figure 9 Change parameter set-point value

Double click on the set-point field of the parameters and enter the new value in the drop down field. Save and close the entered new value with the enter key.

If the entered value is out of the channel range, the value entered will not be accepted. The set point can also be modified with the scroll key.

LOCAL, REMOTE AND RUN MODE

LOCAL mode

When the MINIFOR fermenter-bioreactor is switched ON and connected to the FNet fermentation software, it is possible to change the parameters on the control panel of the MINIFOR control unit.


In the local model, the modified set-points / parameter values cannot be sent to the MINIFOR fermenter-bioreactor from the FNet software.

REMOTE mode

To activate the remote mode, click on the *Rem* icon  on the fermenter window.

In the remote mode, it is not possible to change the parameter values on the control panel of the MINIFOR control unit. The set points, profiles and everything can be modified from the PC.

RUN mode

Run mode or the operation mode can be activated by clicking the *R* icon  on the fermenter window

In the RUN mode, MINIFOR fermenter-bioreactor would start working based on the set parameters.



During operation, make sure to *activate* both the *REM* and *RUN* icon.

STATUS INDICATION

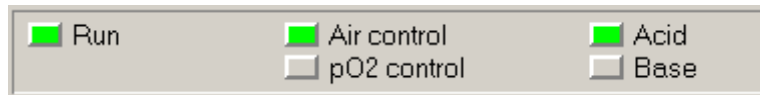

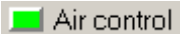
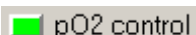

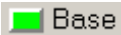


Figure 10 Status indication of MINIFOR during operation by green LED

The MINIFOR fermenter-bioreactor status during operation is indicated by the GREEN LED besides each parameter in the software fermenter window.

 Run	Main control of the fermenter is activated and the green LED indicates that the regulation / run mode is <i>ON</i> (with <i>RUN</i> icon)
 Air control	Air flow rate of the MINIFOR fermenter-bioreactor controlled independently of the pO ₂ set-point
 pO ₂ control	Dissolved oxygen (DO) concentration controlled by air flow rate
 Acid	Addition of acid by the peristaltic pump to maintain the pH
 Base	Addition of base by the peristaltic pump to maintain the pH

PARAMETER PROFILE CONFIGURATION

Configure profile

The profile of the parameters: air flow rate, pH, temperature, agitation, pO₂, 'X' and pump can be configured. It is possible to save the configured profile of each parameter and use them again.



The configured profile values will be sent to the MINIFOR fermenter-bioreactor only in the next step (please refer the section *Start/Stop the profile*)

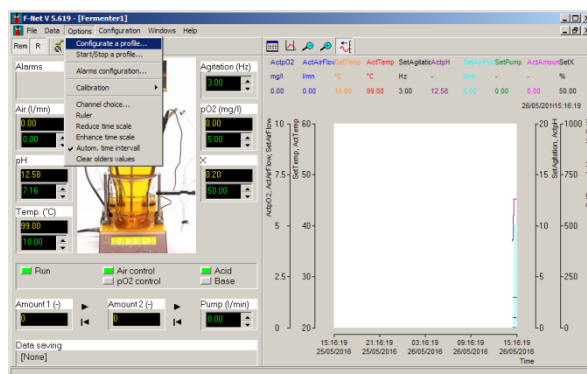



Figure 11 Configure the profile by clicking the  icon on the fermenter window or select the sub-menu *CONFIGURATE A PROFILE* under the menu *OPTIONS* (Options > Configure a profile)

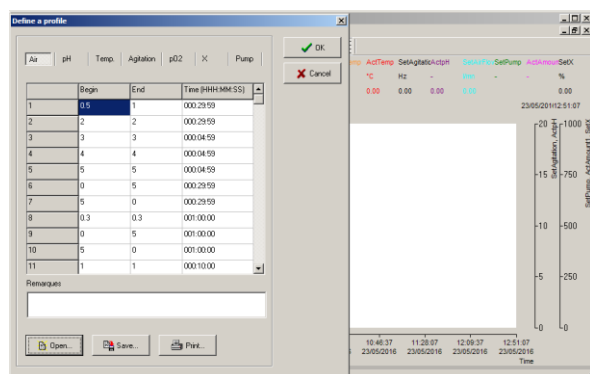


Figure 12 Profile definition window will appear where the profile of air flow rate, pH, temperature, agitation, pO₂, parameter X and pump can be configured. Click *OK* to close the window after profile configuration.

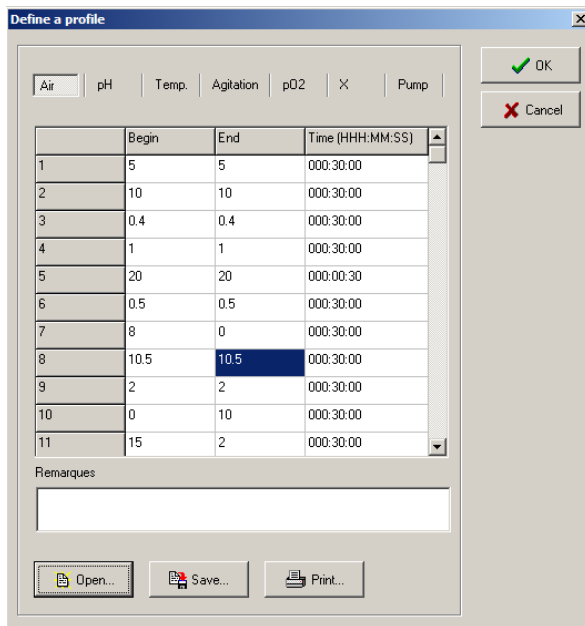


Figure 13 Parameters profile definition window

Choose a channel / parameter on the profile definition window (**Figure 12**) to configure the associated profile in the table. The first value is the start parameter value and the second value is the end value. The time (HH:MM:SS) represents the time elapsed to achieve the end value in the table from the start value. The program calculates the values between the two points and sends them as set-points to the fermenter.

Click *OK* button after configuring the profile. The program checks the entered values and stores them in its internal memory.


To save the configured profile of a parameter, click *SAVE* button on the window, enter the file name and close the window by clicking *OK* button.

It is also possible to program pauses in the pump profile, by entering the start and end value as '0' for the desired time.

Start/stop a profile

The configured parameter profiles will be activated only by clicking Start/Stop button of each respective profile.



Please make sure, the remote mode  is activated. The software can send the configured profile set-points to the MINIFOR only in *REM* mode.

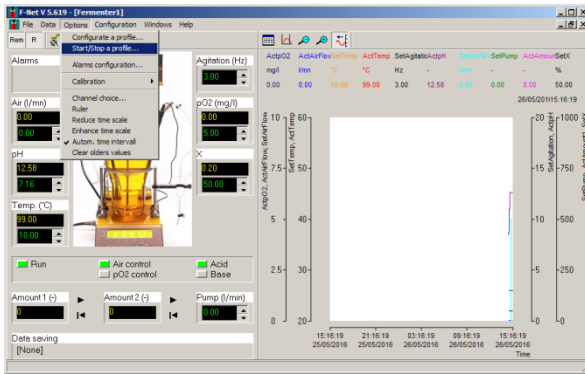



Figure 14 To start a configured parameter profiles, click the  icon on the fermenter window or select the sub-menu *START / STOP A PROFILE* under the main menu *OPTIONS* (Options > Start/stop a profile)

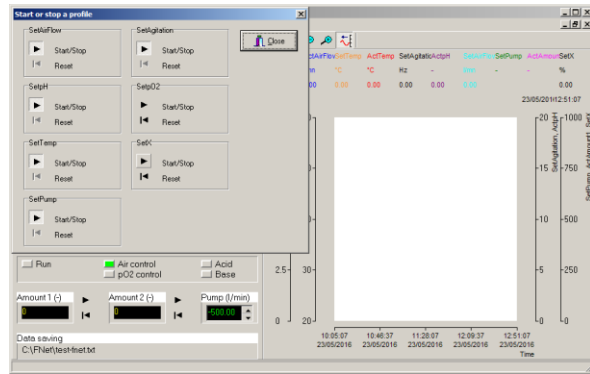



Figure 15 Start or stop a profile window will appear where the configured profile of air flow rate, pH, temperature, agitation, pO₂, parameter X and pump can be activated by clicking the  icon.

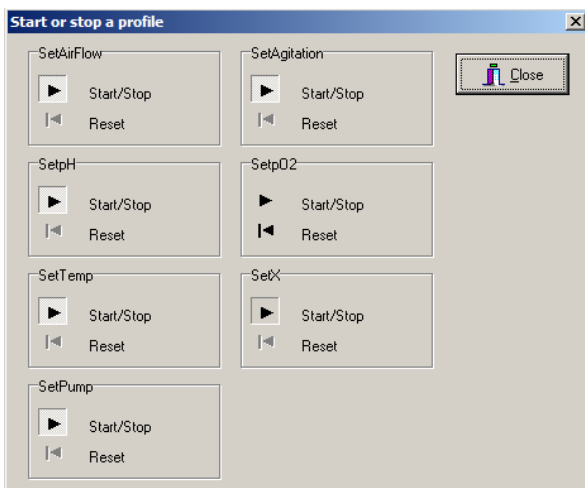




Figure 16 Start or stop a profile window





Click the start/stop icon  beside each parameter to start or stop the configured profile associated with that parameter. While restarting a stopped profile, it resumes from the value where it stopped. To start the profile from the beginning, click the reset icon .

TRENDS


Up to 10 channels can be displayed as curves.

In the curve, the legend displays the channel name, unit and the value of each parameter at the time indicated on the right side of the trend.

To change the scale, double click on the axis. A second field is displayed into which the minimum and maximum values can be entered.

The  and  icons reduce and enlarge the time interval and  icon displays a ruler. The channel values are displayed in the legend and the corresponding time is displayed on the right side of the trend. The ruler icon inactivates the automatic curve renewal mode. It is possible to return to this mode clicking the icon .

Channel choice

To select a channel, click on the  icon. This opens a window in which the channel to be displayed can be selected together with one of four axes and the curve colour of the curve.

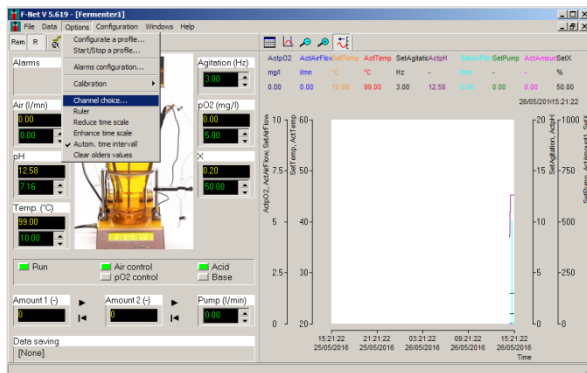



Figure 17 The channels to display on the trend can be selected by clicking the icon  or select the sub-menu *CHANNEL CHOICE* under the main menu *OPTIONS* (Options > Channel choice)

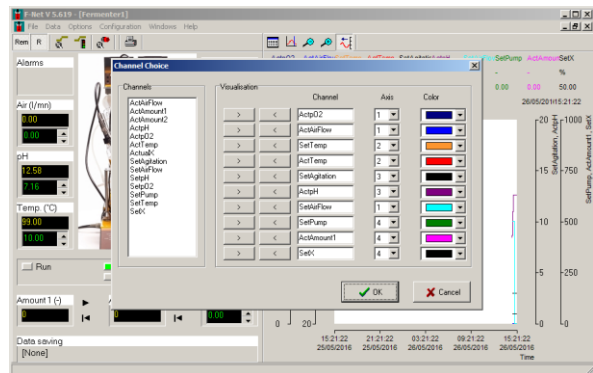


Figure 18 Channel choice window to configure the display of curves on the fermenter window

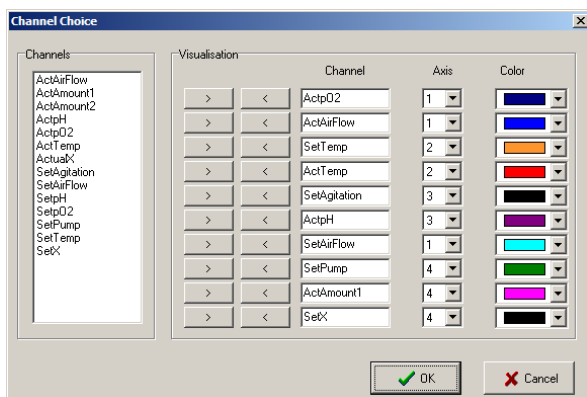
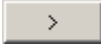
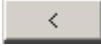



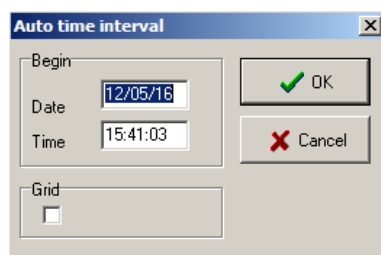
Figure 19 Channel choice window

Select a channel from the list, copy it to the field in the channel visualisation column with the  icon and choose the axis of the channel (Y1 & Y2 on the left, Y3 & Y4 on the right) and colour of the curve. Remove the channel from the visualisation column by clicking the  icon beside that particular channel and close the window with *OK*.



Automatic time interval

In this mode, the new values are automatically added to the curves. The icon  is activated. The time on the top right is the time of the last added data point. The speed of the curve displacement depends on the time interval.

To change the automatic time interval, double click on the time axis; a new window appears. It contains a time and a date, which correspond to the time at the left of the trend.





The date (DD/MM/YY format) and time (HH:MM:SS) must have 2 characters (e.g. 01:58:09 08/01/14 = correct; 1:58:9 8/1/24 = wrong). Clicking on the grid check box displays a grid.

It is also possible to change the time scale with the buttons  and .

The time interval is limited to 3 days in this mode.


Fixed time interval

In this mode, the curves are fixed. It is then possible to choose the time at the left and the right of the trend. The rules for formatting the values are the same as for automatic time interval.

It is also possible to change the time scale with the buttons  and .



The time interval can be up to 60 days.

The ruler

The ruler icon  helps to see the parameter value in the curve at the desired fixed time. If the trend is in automatic time interval mode, it will change to fixed time interval mode so that the curves become fixed.

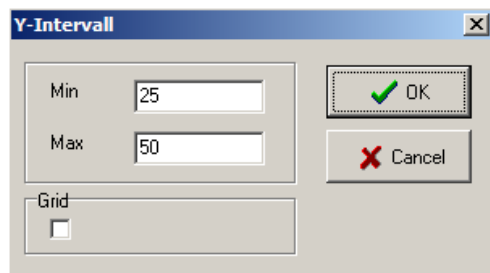
A black cursor appears at the left of the trend. Clicking with the mouse displaces the cursor.

The legend shows the value of the channels and the corresponding time.

After checking the parameter values with the ruler icon, it can be reset by clicking again on the  icon or automatic time interval mode by clicking on the  icon.

Y axis

To change the scale of the Y axis, double click on it. A new window appears which allows the maximum and minimum values for the Y axis to be entered.



The minimum value must be smaller than the maximal value. Clicking on the grid check box displays grid on the trends.

CALIBRATION OF PUMP AND INTEGRATOR

Peristaltic pump

One additional peristaltic pump can be connected to the FNet fermentation software (for example: the feed pump). The address of the additional peristaltic pump can be found at the section [Setting up the address of the instruments](#).

The pump profile can be configured, e.g.: feed profile.

Calibration of peristaltic pump

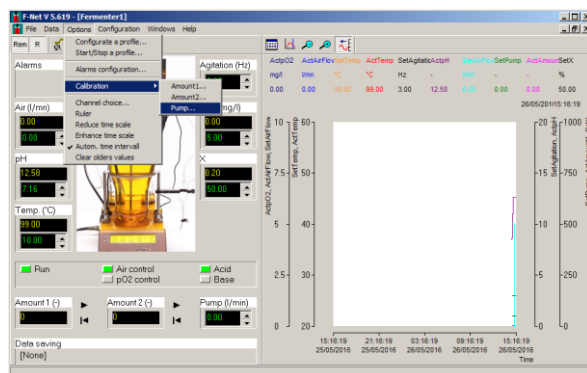


Figure 20 Select *PUMP* in the *CALIBRATION* sub-menu found under the *OPTIONS* main menu (Options > Calibration > Pump)

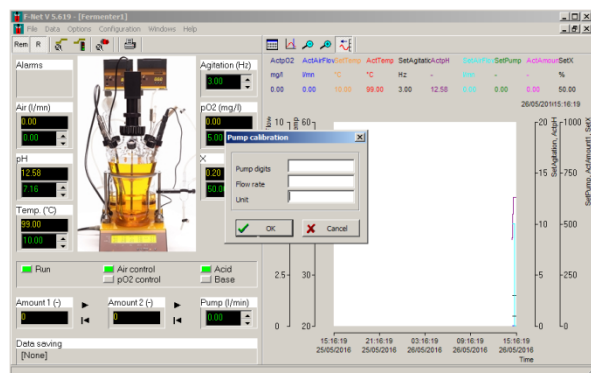


Figure 21 Pump calibration window to enter the speed of the pump and the corresponding flow rate with unit

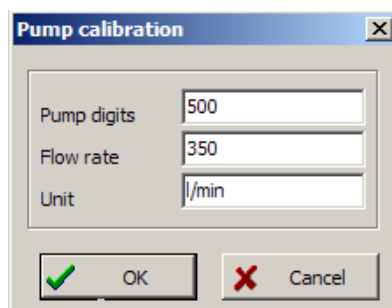


Figure 22 Example pump flow rate calibration: measured flow rate 350 l/min at pump speed 500

Pump-flow INTEGRATOR

The pump-flow integrator allows a simple and precise integration of the amount of liquid delivered by the pump as a function of time. 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.

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.

Address of the INTEGRATOR

To communicate with the INTEGRATOR, the program must know the address of the pump-flow integrator.

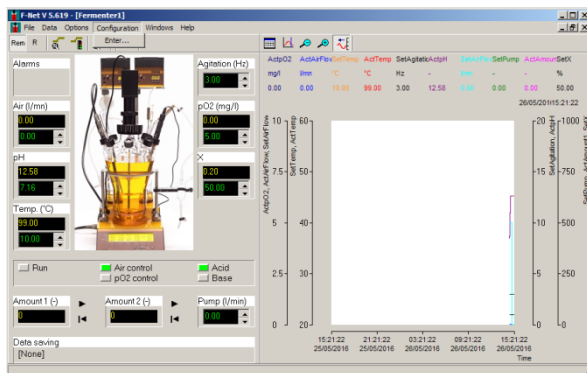


Figure 23 Select the sub-menu *ENTER* under the main menu *CONFIGURATION* and type the password in the new window *fnet* (Configuration > Enter)

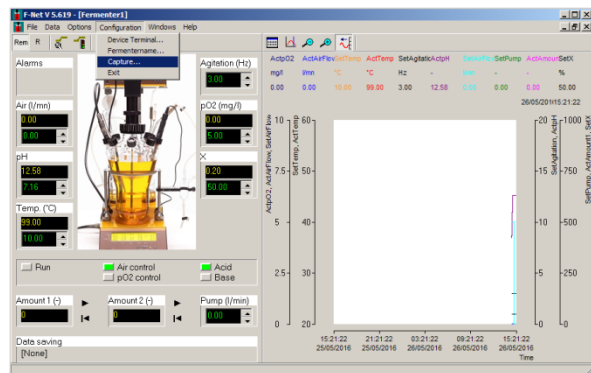


Figure 24 Select the sub-menu *CAPTURE* under the main menu *CONFIGURATION* after entering the password (Configuration > Capture)

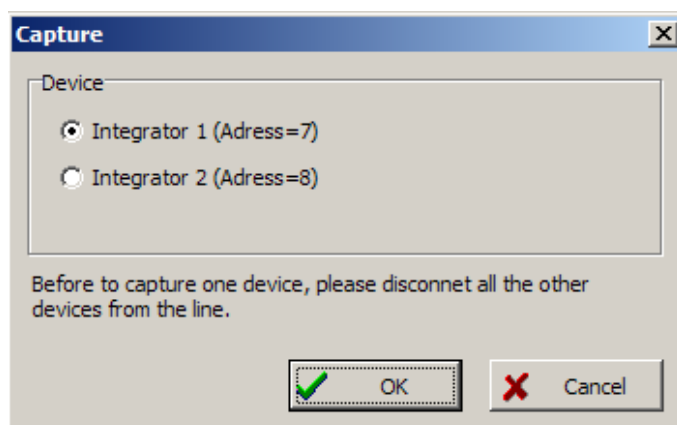


Figure 25 Capture the address of the integrator

Please also refer the section [Setting up the address of the instruments.](#)

Calibration of the INTEGRATOR

Calibration of the pump-flow integrator helps to obtain the real integration (amount) value which corresponds to the signal and the pump tubing used.

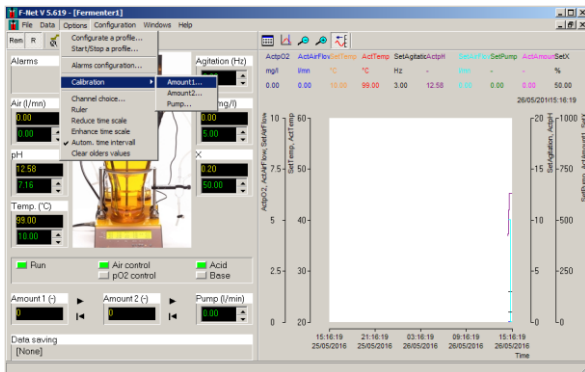


Figure 26 Select *AMOUNT 1* or *AMOUNT 2* in the *CALIBRATION* sub-menu found under the *OPTIONS* main menu (Options > Calibration > Amount 1)

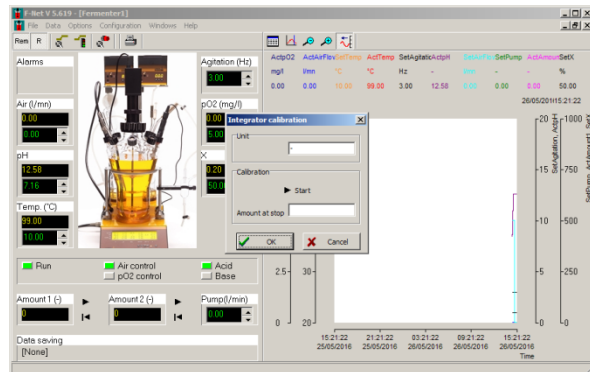


Figure 27 Integrator calibration window to start the pump flow integration and enter the measured amount with unit

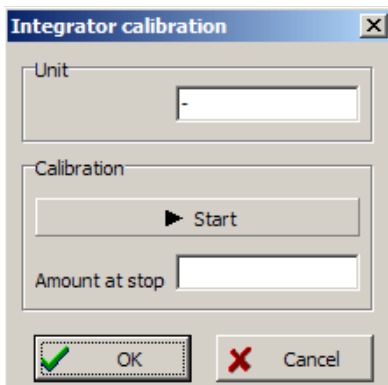




Figure 28 Pump-flow integrator calibration window

Press the start calibration button  on the Integrator calibration window. Switch ON the peristaltic pump and start collecting the pumped liquid. After collecting the desired amount of liquid, press the  button again to stop the calibration. Measure the pumped liquid (volume or weight) and enter the value in the field *Amount at stop* and the unit. Press *OK* to save and close the window.

Start / stop the pump-flow integration

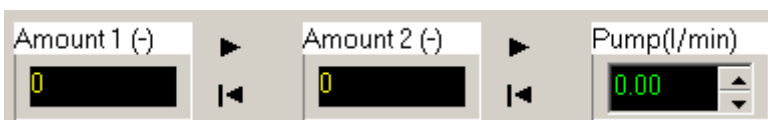




Figure 29 Start / stop pump-flow integration

To start the pump-flow integration, click  icon. Click  icon, to reset the measured pump-flow integrator value.

ALARM

The low and high alarm values of each parameter can be configured in the FNet software.

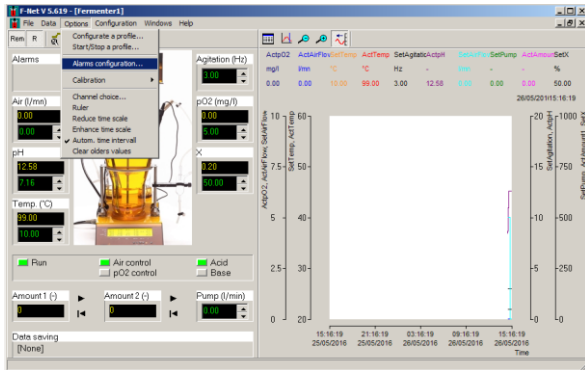



Figure 30 Select the sub-menu *ALARM CONFIGURATION* under the *OPTIONS* main menu (Options > Alarm configuration) or click the

icon  on the fermenter window

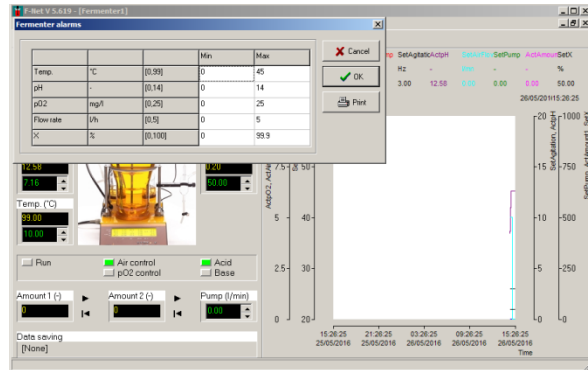


Figure 31 Enter the low and high alarm values of the desired parameter in the Fermenter alarms window.

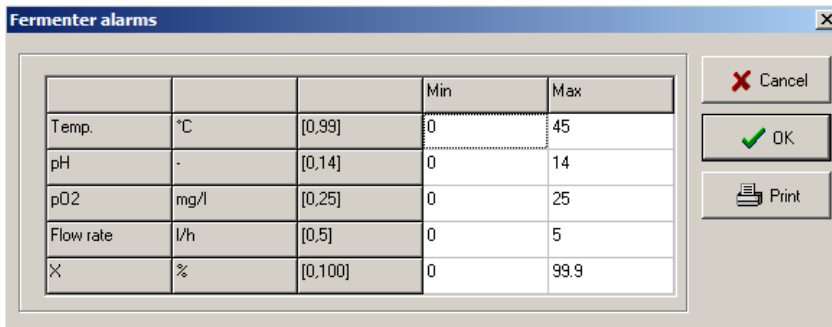


Figure 32 Fermenter alarms window
When the alarm goes off, red field will appear on the fermenter window.

DATA SAVING

This option allows the channel values to be saved as a text file. Text files can be imported into most office programs e.g. word processors, spreadsheets, databases etc.

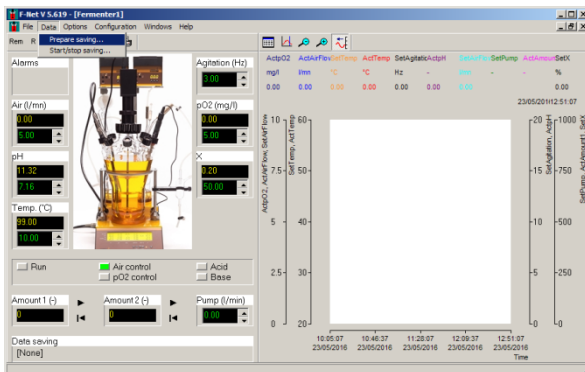


Figure 33 To choose the channels to save to a text file, select the sub-menu *PREPARE SAVING* under the main menu *DATA* (Data > Prepare saving)

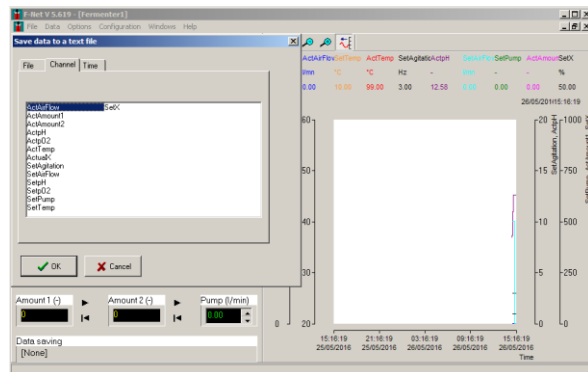


Figure 34 On the *Save data to a text file* window to save the desired channels

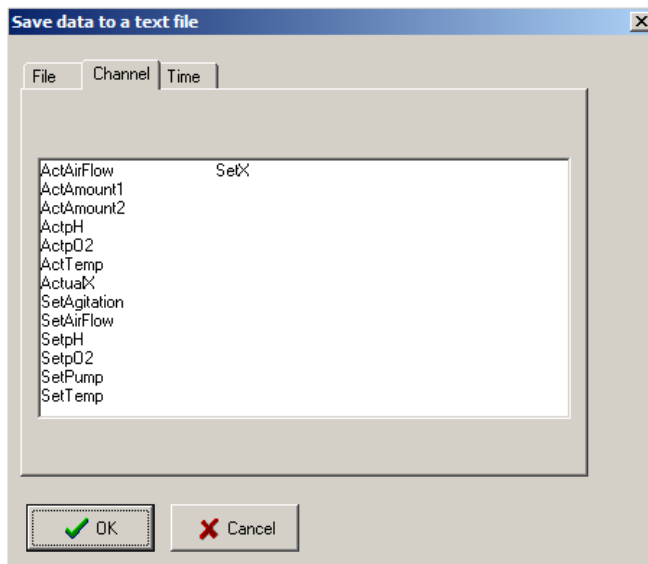


Figure 35 Save data to a text file window

Select the *File* tab and enter the *file name* and select the destination to save the file.

Select the *Channel* tab and choose the channel for which the values need to be saved.

Select the *Time* tab, if it is necessary to record the time interval between two entries and the time format

For example: a period of 10 seconds will write a new line, every 10 seconds in the file. The decimal separator for the saved values can also be chosen. This depends on the computer configuration which will read the file. If point is selected and the PC uses comma as a separator, the program (like Microsoft EXCEL,...) will probably interpret the values as a character chain and not as numbers. So, the separator has to be chosen according to the needs. Absolute time means that the recorded time contains the date and the time of the data. Relative time means that the time starts at 0.

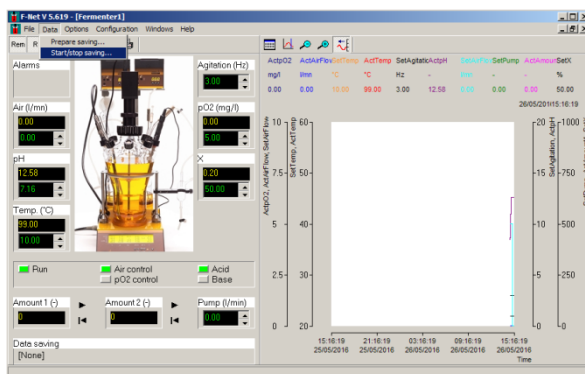


Figure 36 To start or stop saving the data, select the *START/STOP SAVING* sub-menu under the *DATA* main menu.

APPENDIX

Troubleshooting

No communication between fermenter and program

Check address of the instruments, COM port and the cable connections (please refer section [PC connection](#))

Empty trends window with some channel values

Please close the program and delete all the files with extension .DB (like MiniFor(1)_ActualAirFlow.DB, MiniFor(1)_ActualpH.DB, MiniFor(1)_ActualpO2.DB, MiniFor(1)_ActualTemp.DB) in the installation director. If the problem remains the same, then also delete the file Fnet.ini.

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