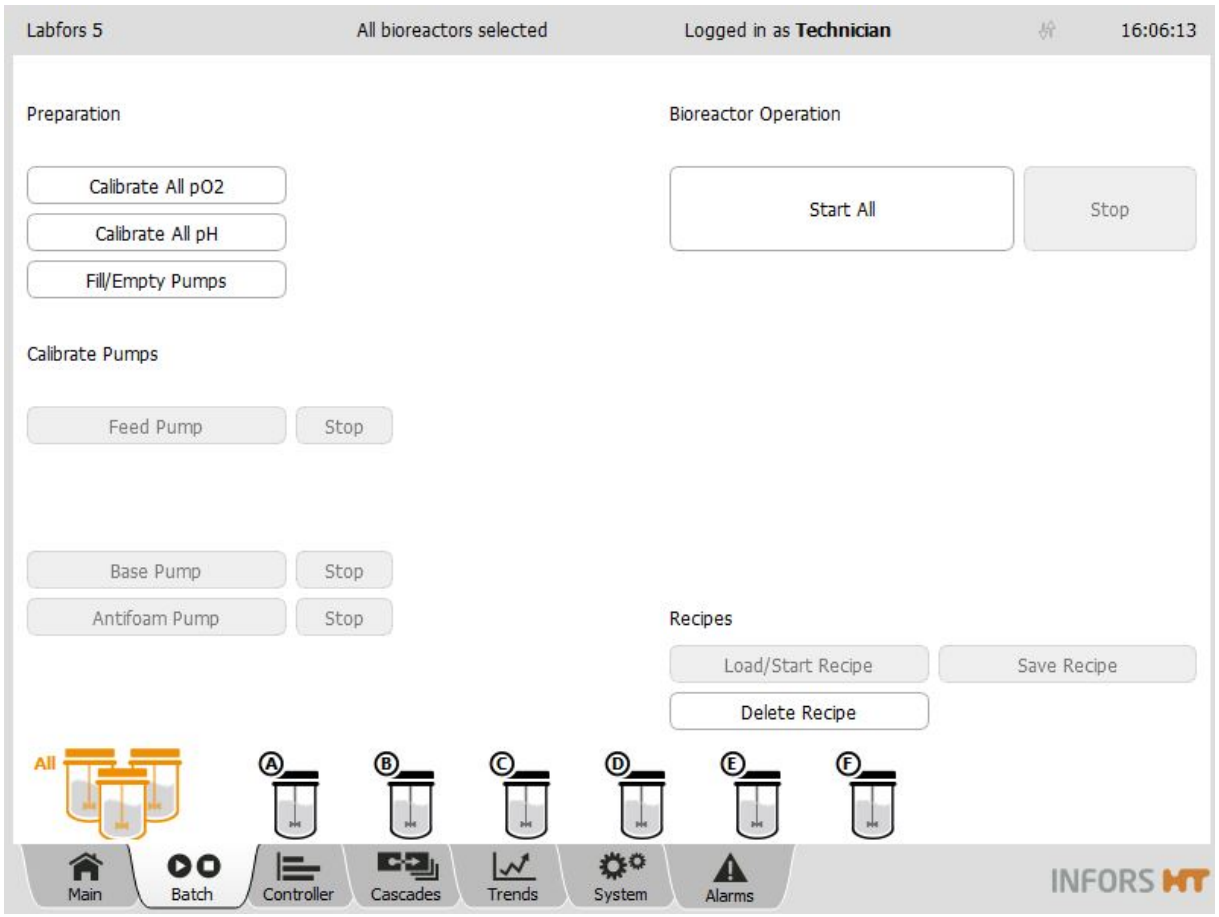
Operating Manual

Touch Screen Software V 3.0

for benchtop bioreactors Labfors 5 and Multifors 2



CE Dok-ID: 77085 - Original - V.01.01

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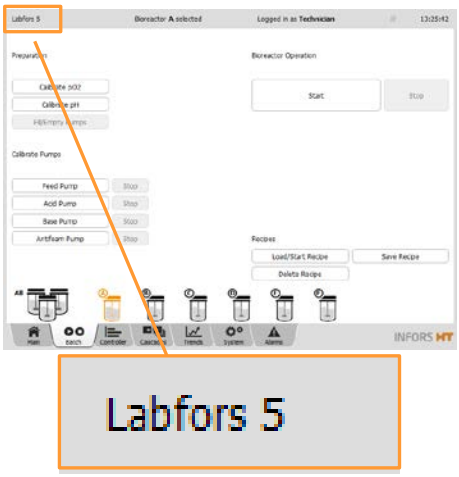
1 Screen, Menu Navigation and Control Elements

Most of the figures in this manual showing the various menus, dialogue boxes and tab pages of the touch screen software reflect the view of a user with the user authorisation level of *Technician*.

For further information about user levels and access authorisation see chapter “Security – User Management”, “User Levels”.

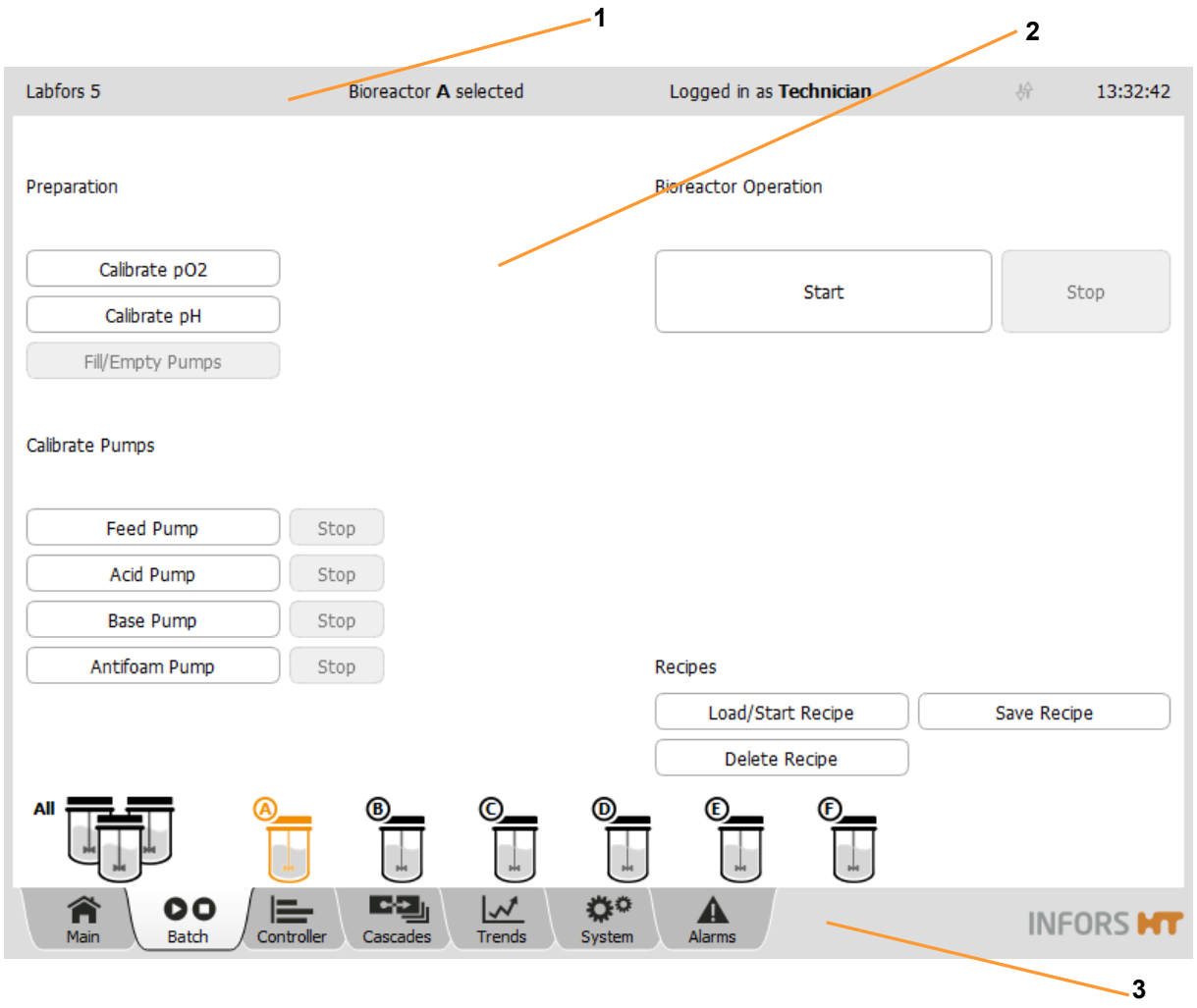
The figures in this manual showing main menus always show the maximum possible number of controllable bioreactors (= 6) and are from the touch screen software for Labfors 5.



The touch screen software for Labfors 5 and Multifors 2 is identical except for the different names of the equipment displayed in the upper left corner of the screen.

1.1 Screen Areas

The screen is divided into the three sections:



1 Header

2 Main are

3 Footer

Header

shows (from left to right): name of the equipment, selected bioreactor e.g. *Bioreactor A selected*, login-status, e.g. *Logged in as Technician* and the time.

Two opposing vertical arrows in the header signalise that an external software like e.g. eve® has access to the OPC XML DA server

of the touch screen software. They are flashing while data is transmitted

Main area

shows main menus and submenus, e.g. main menu *Batch*, see figure above.

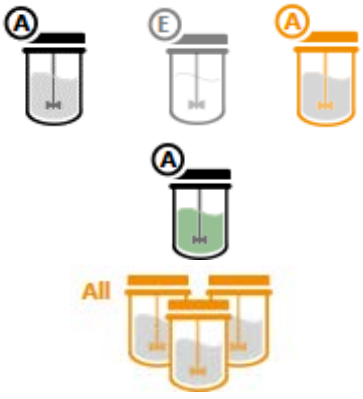
Inputs are made exclusively in the main area. I.e. you press buttons or input fields to select bioreactors or to call up menus and dialogue boxes.

The lower section of the main area shows a selection bar for individual bioreactors which are available for selection. The bioreactors are represented by a culture vessel symbol.

Depending on the configuration of the system, up to six bioreactors (= culture vessels) may be connected. This equates to six Labfors 5 basic units with one culture vessel or max. three Multifors 2 basic units with two culture vessels each.

One operating unit with touch screen software can be used to control up to six bioreactors. I.e. one basic unit serves as the master unit and can control up to five more basic units of the Labfors 5 bioreactor and up to two more basic units of the Multifors 2 bioreactor. These basic units are referred to as satellite units.

Bioreactors 1 to 6 correspond to the bioreactors **A** to **F** in the selection bar. They can be operated independently of each other.



Available bioreactors are shown in dark grey colour with grey content, non-available bioreactors are in light grey colour without content. A selected bioreactor is shown in orange colour (from left to right) with grey content.

A running bioreactor (operating status *running*) is shown with green content.

ALL can be used to select all available bioreactors simultaneously.

Footer

comprises 7 tabs which provide access to the 7 main menus.

The tabs are displayed with a grey background. A selected tab is shown light grey.

Screen, Menu Navigation and Control Elements

The following main menus are available (from left to right):

- *Main*: shows parameters and values for the available bioreactors. If a single bioreactor is selected, its available pumps are also visible here.
- *Batch*: this is where bioreactors (fermentation/cultivation processes) are started and stopped, and where sensors and pumps are calibrated. Depending on the access authorisations, it may also be possible to store, upload or delete recipes (fermentation logs).
- *Controller*: shows parameters for the selected bioreactor and offers the option of changing values.
- *Cascade*: allows to set up a serial, parallel or parallel serial (mixed) cascade control of one or several parameters.
- *Trends*: shows trends in the parameters, time span between 15 min. and 2 days.
- *System*: provides access to the submenus *VALVES*, *SECURITY, SETTINGS, WIPE SCREEN* and *SHUTDOWN*
- *Alarms*: shows parameter alarms, user alarms and system alarms

1.2 Control Elements

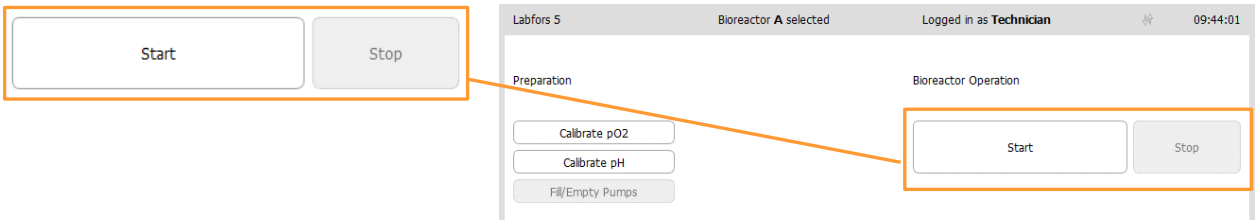
The following control elements are used in the touch screen software:

Buttons

Depending on the selected main menu or submenu and access authorisations, various buttons may be visible and available. Pressing a button either opens a sub menu, or a dialogue box or a tab page.

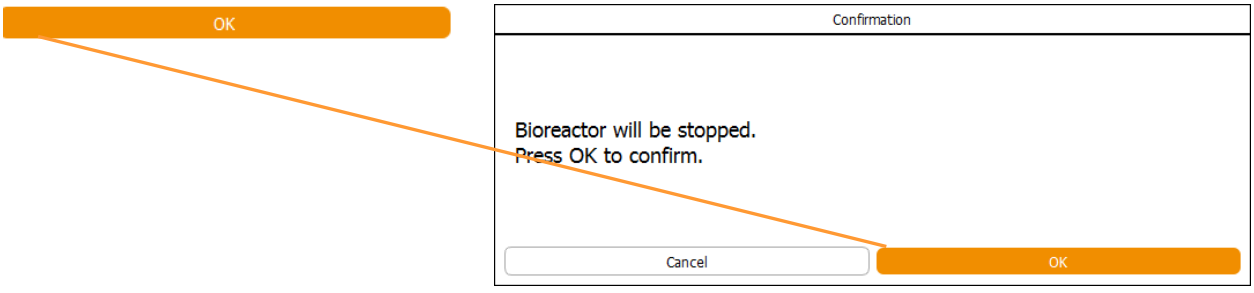
Enabled buttons are white in colour, disabled buttons are grey in colour.

Example: **Start**/**Stop** of the bioreactor (fermentation/cultivation process).



Buttons, which are intended as the next logical step in the procedure, are shown in orange colour.

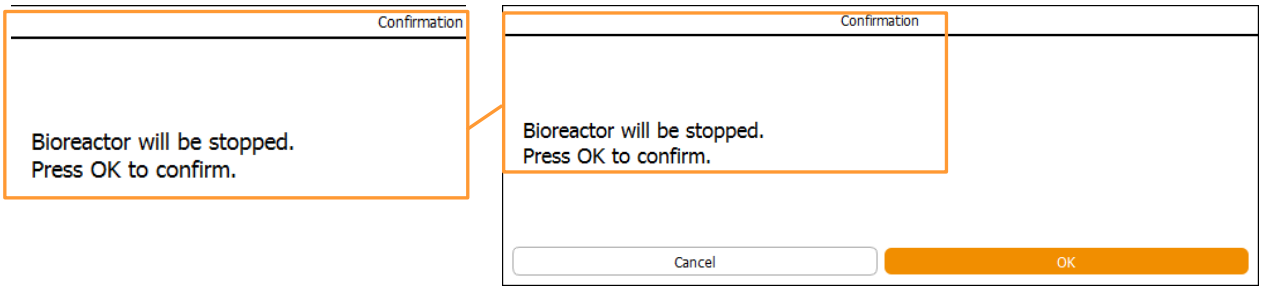
Example: Confirmation of an entry and/or starting/ending a process with **OK**.



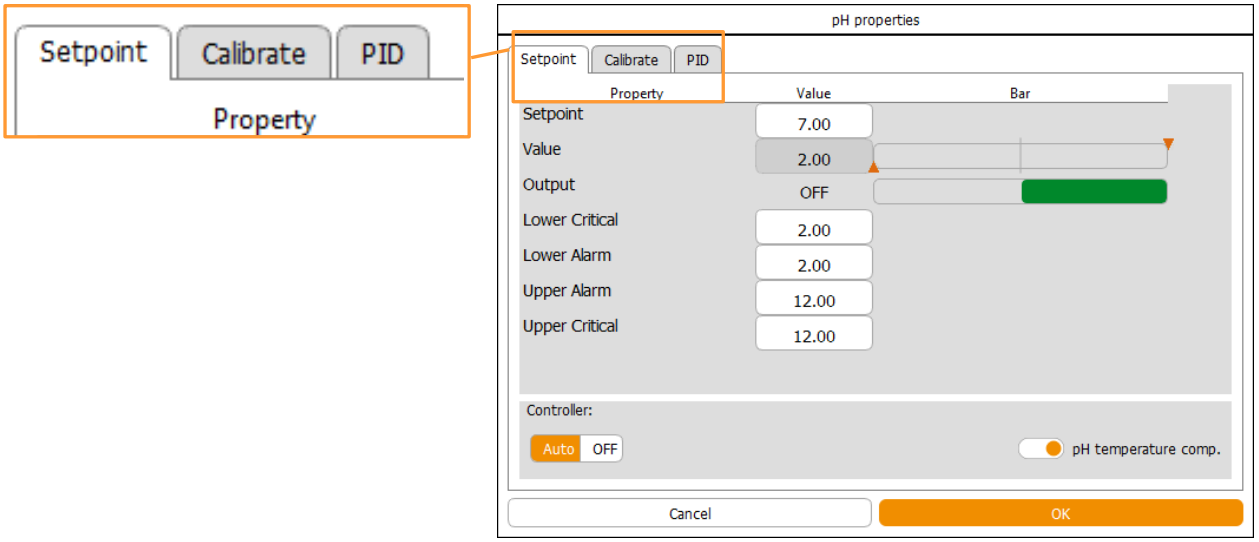
Dialogue boxes and tab pages

A dialogue box may contain further buttons, input fields or view boxes and tabs. A dialogue box may also contain instructions, notes, warnings or general information

Example: *Confirmation* dialogue box with confirmation prompt.



Example: *pH properties* dialogue box with tabs which lead to the different parameter options.



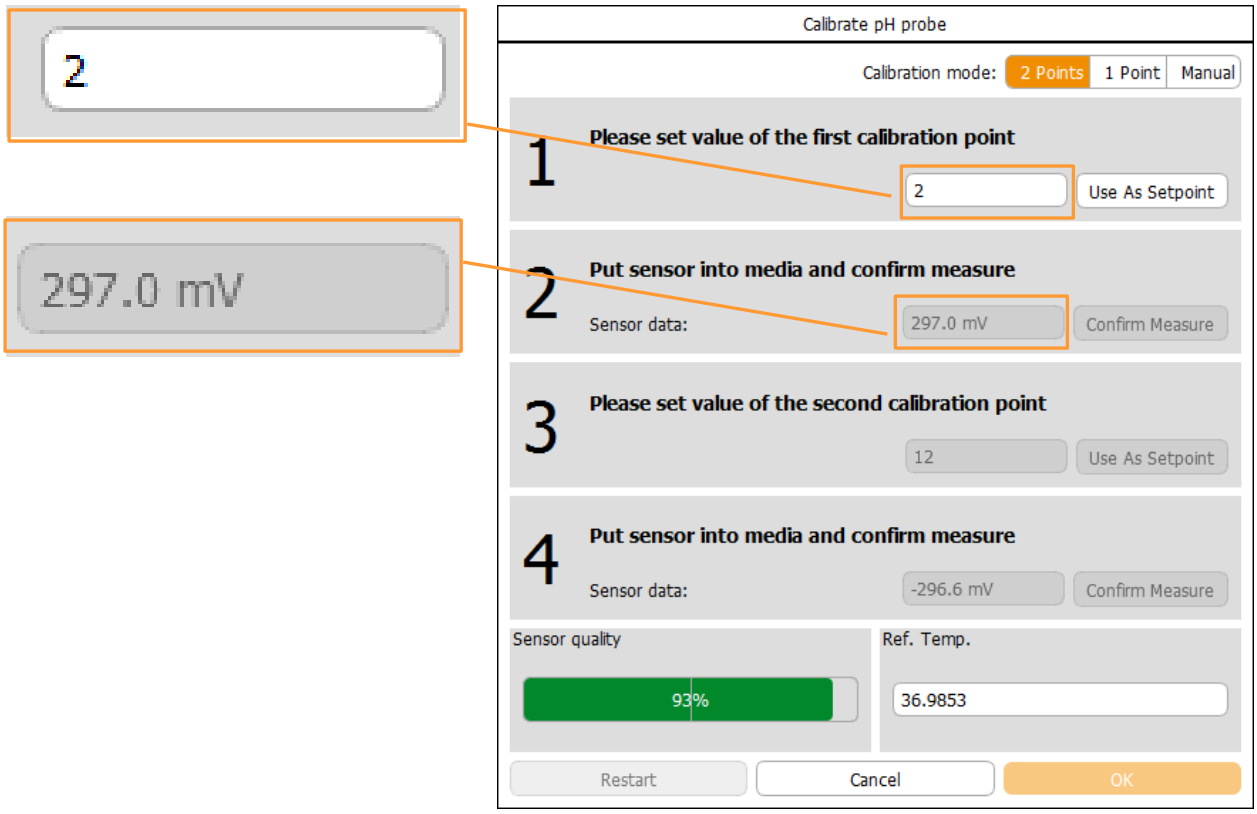
Pressing a tab leads to access of the respective option for the selected tab page. The tab for a selected tab page is displayed with a white background.
Depending on the parameter and the access authorisations there may be more or less available options for a parameter.

Input fields and view boxes

They are included in various menus, dialogue boxes and tab pages. They either require the inputting of a numerical or an alpha-numerical value or show these values.

Example: *Calibrate pH probe* dialogue box with input fields for calibration points and view boxes *Sensor data*.

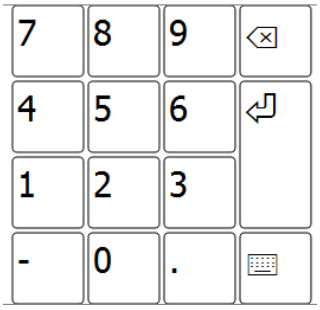
Screen, Menu Navigation and Control Elements

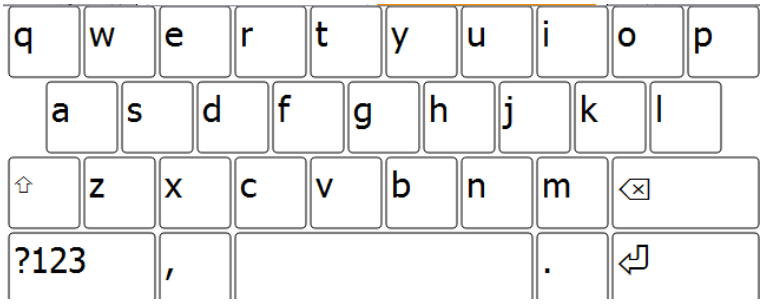


Numeric keypad and alphanumeric keyboard

Numerical values are entered using a numeric keypad (figure on the left). Alphanumerical values are entered using an alphanumeric keyboard (figure on the right).

After pressing an input field, the appropriate pad/board appears.





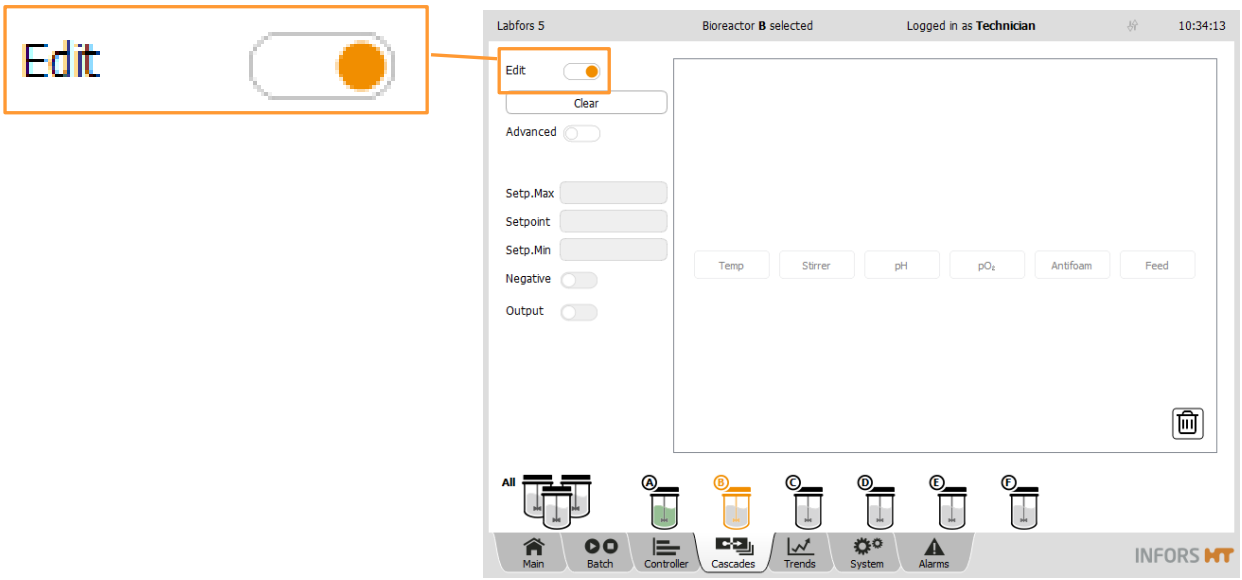
Screen, Menu Navigation and Control Elements

ON / OFF switch

The ON / OFF switch is used in order to switch a function on or off.

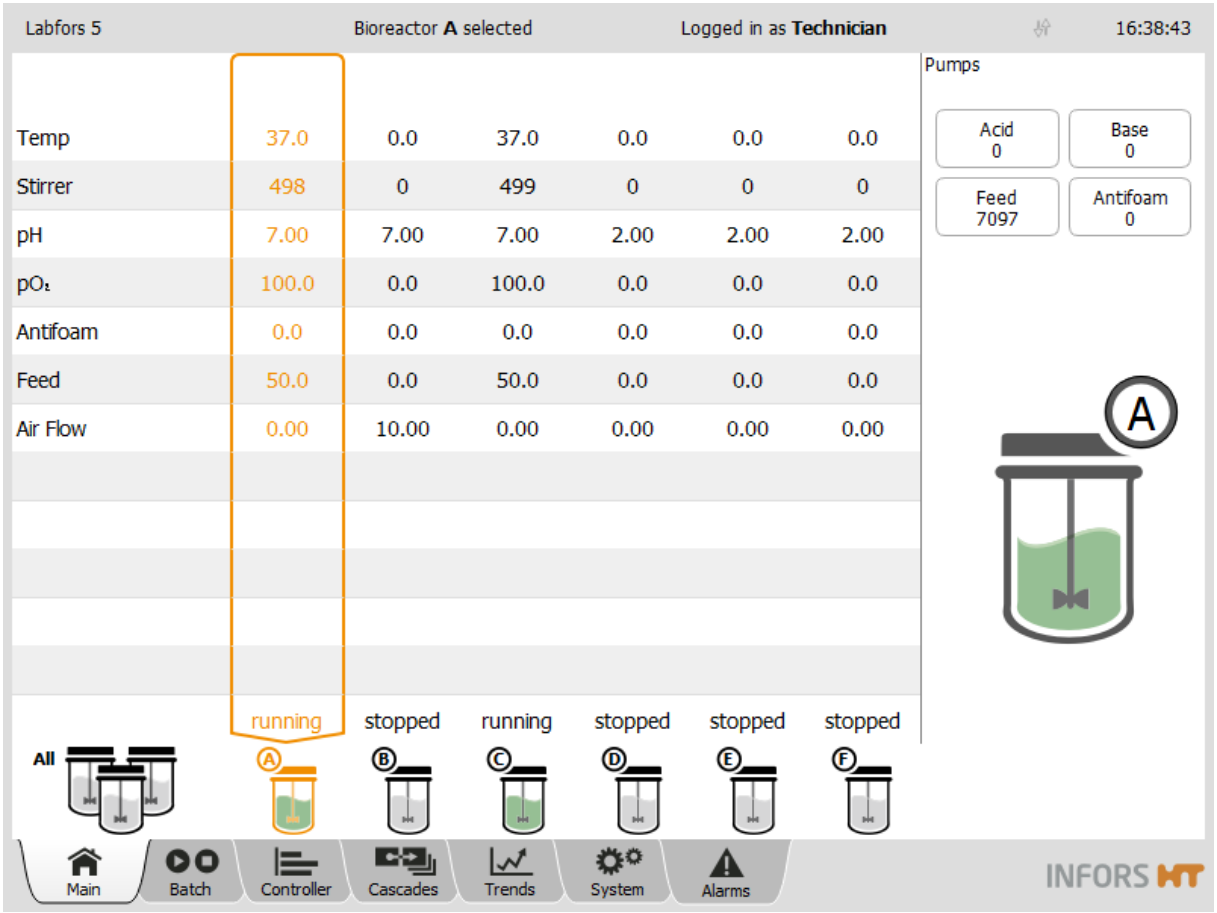
- **ON**: the switch is in orange colour
- **OFF**: the switch is in white colour

Example: **ON/OFF** switch to enable/disable *Edit* function in main menu *Cascades*



2 Main Menus

2.1 Main – Parameter Display All Bioreactors

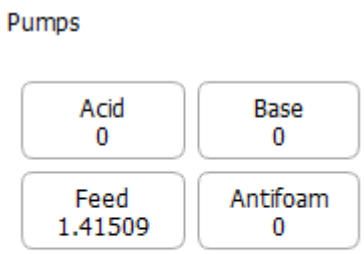


After a system start the main menu *Main* opens automatically. This is where the parameters for the available bioreactors are listed with their current values. Also the operating statuses of the bioreactors (*running* / *stopped*) are visible and the parameter alarms are signalled here.

The quantity and type of parameters differ depending on the system configuration but remain the same for each individual available bioreactor.

Parameter values and the symbol of a selected bioreactor are displayed in orange.

Main Menus



A large illustration of the bioreactor which has been selected via the selection bar is displayed on the right-hand section of the screen. All pumps of the selected bioreactor are displayed above it as buttons.

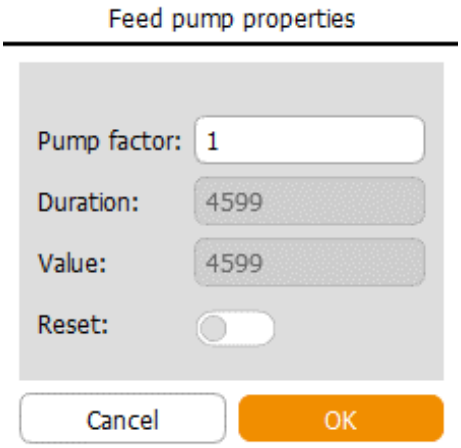
The following four pumps are available by default:

- *Acid*
- *Base*
- *Feed*
- *Antifoam*

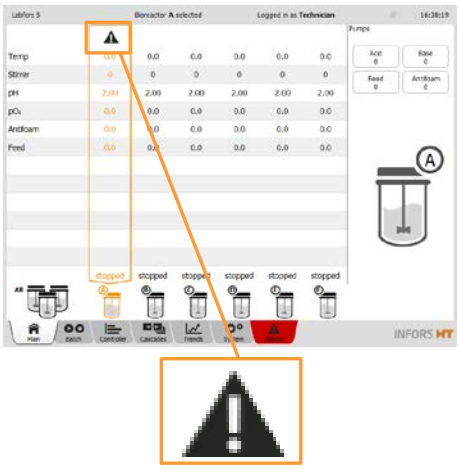
INFORMATION

If all bioreactors (*ALL*) are selected, the message *Please select the bioreactor to view the pumps* appears instead.

The delivered volume (in mL) of a calibrated pump is continuously shown while the bioreactor is running. This numerical value is displayed on the appropriate pump button, as the example for the Feed pump shows on the left.

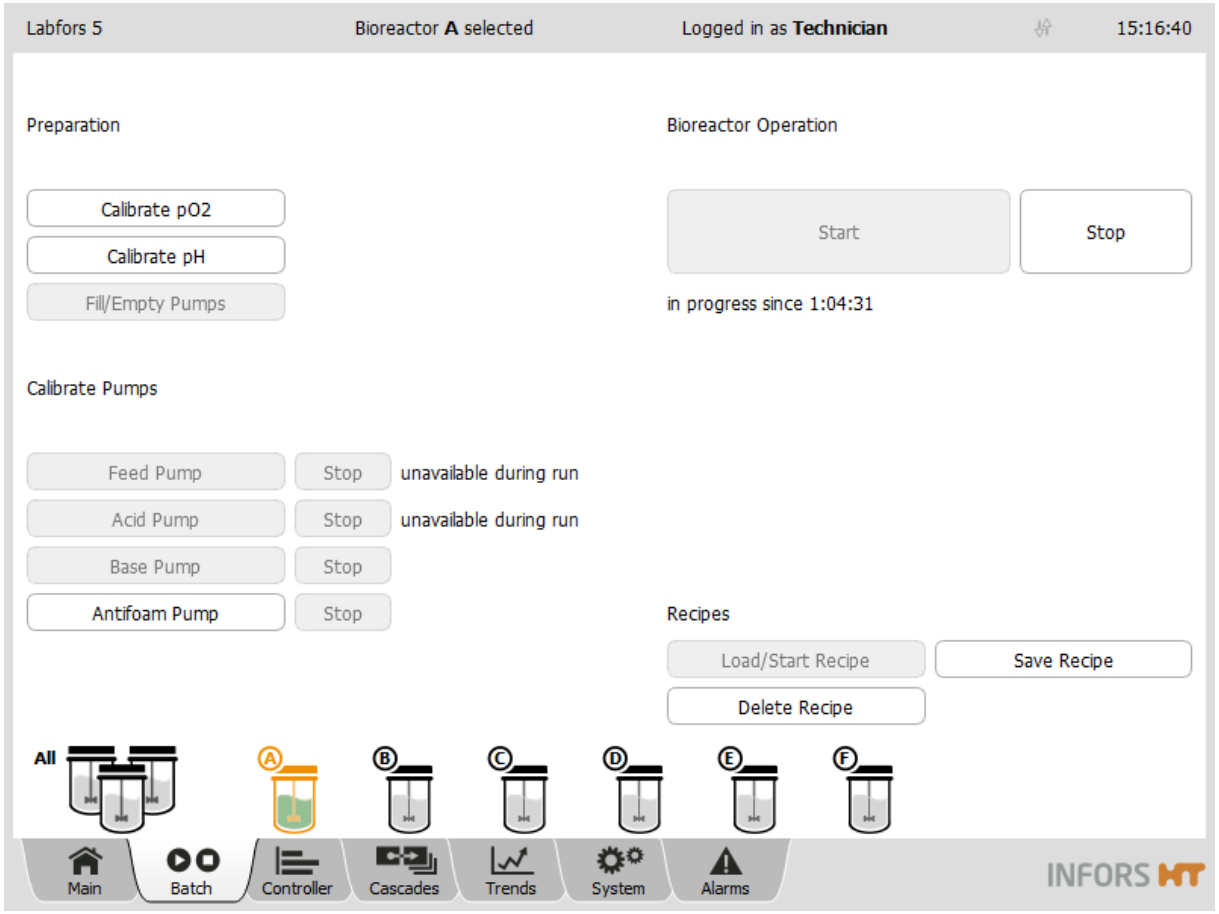


After pressing one of the four buttons a dialogue box, e.g. *Feed pump properties* appears.
This is where the number of rotations of the selected pump can be reset to zero.
The pump factor calculated during pump calibration is also visible and can be changed manually here.



Parameter alarms which have not been confirmed are signalled in the corresponding bioreactor column with a warning symbol above the actual values. A detailed list of parameter alarms can be found in the main menu *Alarms*.

2.2 Batch – Start Menu



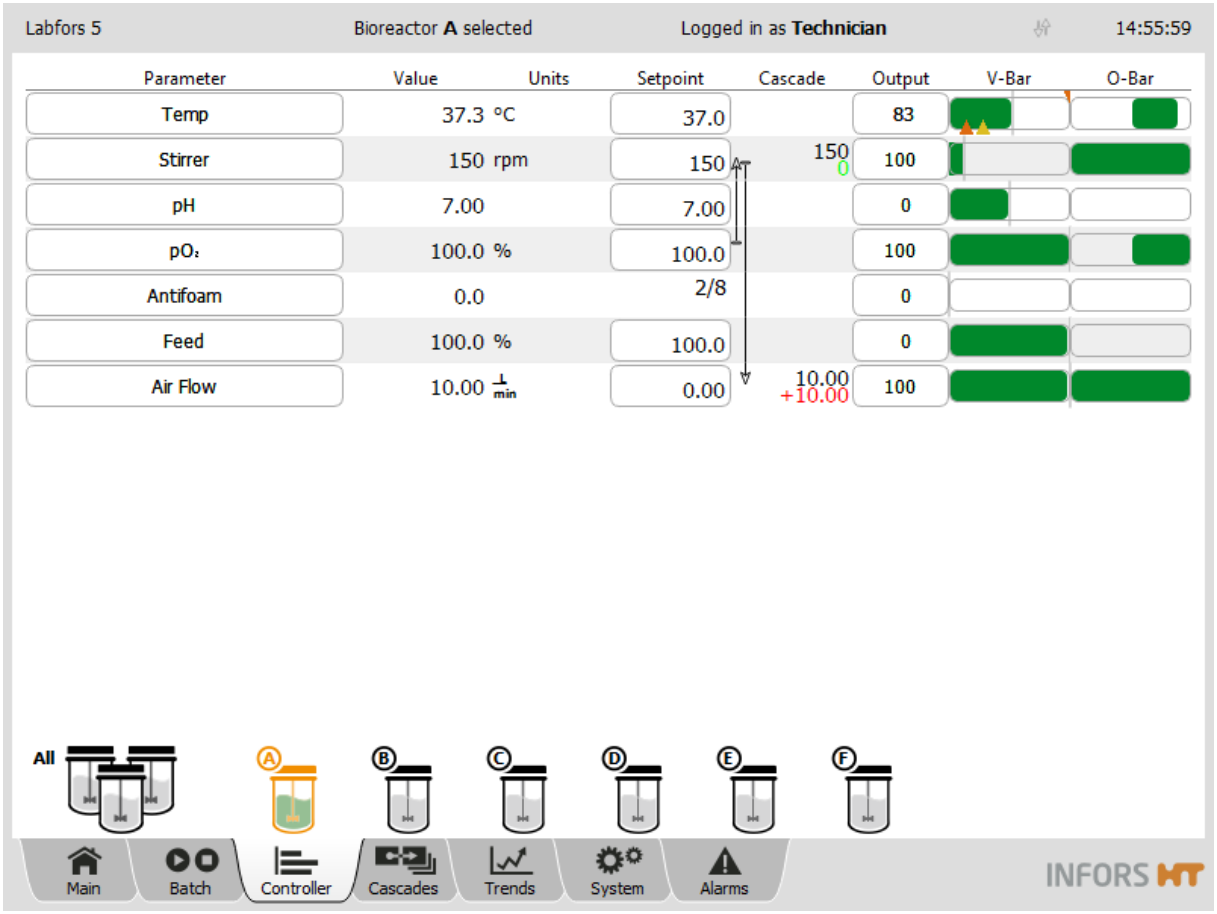
The main *Batch* menu is divided up into groups with various buttons which correspond to the function of the group:

- *Preparation*: to calibrate individual or all pH and pO2 sensors and automatic and to simultaneously fill or empty all pump hoses.
- *Calibrate Pumps*: to start and stop pump calibration. Pumps can only be calibrated individually for each bioreactor.
- *Bioreactor Operation*: to start and stop one bioreactor (fermentation/cultivation), several bioreactors or all bioreactors
- *Recipes*: to load, save and delete recipes.

Depending on access rights of the operator, selection of the bioreactor(s) and operating status of an individual or several bioreactors more or less functions are available.

Detailed descriptions of each function can be found in the appropriately named chapters in this manual.

2.3 Controller – Value Display



The main menu *Controller* shows current values, setpoint values and controller outputs for the parameters of a selected bioreactor. This menu is not available when all bioreactors (*ALL*) are selected.

Settings for parameters can be changed here.

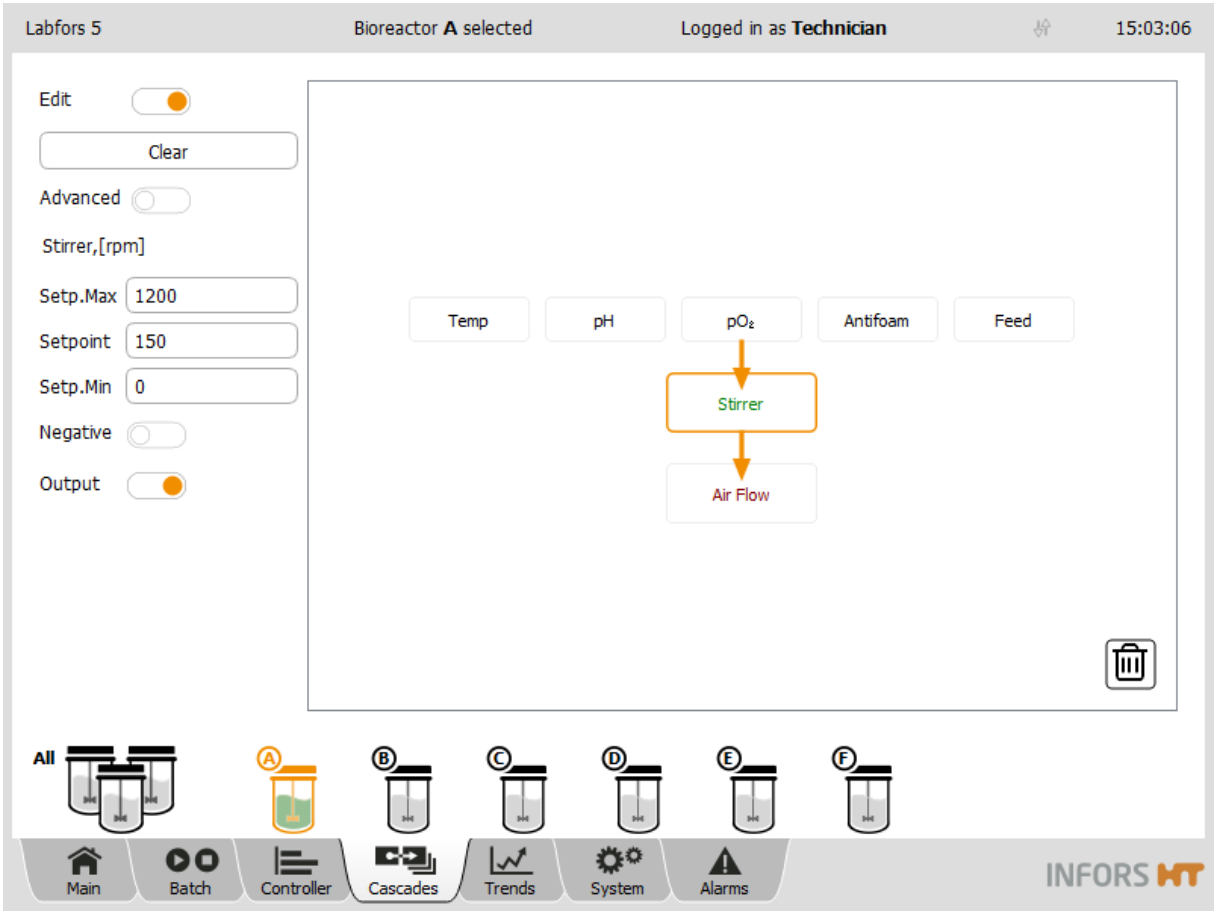
- *Parameter*: lists the available parameters. Touching the desired parameter button opens its setting menu, see chapter “Calling up Parameter Options”.
- *Value*: displays the actual parameter values
- *Units*: displays the units of the parameters
- *Setpoint*: to enter/change setpoint values of parameters

INFORMATION

When the bioreactor has been stopped, setpoint values in the Controller menu are overwritten with the setpoint values set in the start dialogue. See the chapters “Setpoint” and “Setting Setpoint Values, Switching Parameters ON / OFF” for details.

- *Cascade*: indicates, whether and how cascade control is active and which process parameters are used. Settings for a cascade are made in the main menu Cascade. A detailed description about cascade control can be found in the chapter “Cascade Control”.
- *Output*: displays the controller output for a parameter in % when a bioreactor is running. A switched off parameter is displayed as *OFF*. When the bioreactor has been stopped, all its parameters are automatically switched off. Parameters can be switched on or off here whilst a bioreactor is running by touching the controller output (displayed value *OFF* or %). This is only possible, if the automatic mode is set in the *Setpoint* option of the parameter concerned.
- *V-Bar* (vertical bar): shows a graph comparing the current value, set value and alarm limits:
  - Grey continuous marking: set setpoint value
  - Yellow marking: set alarm value (lower alarm / upper alarm).
  - Red marking: set critical values (lower critical / upper critical).
  - Green bar: current value is within the alarm limits.
  - Yellow bar: current value has exceeded the upper alarm value or dropped below the lower alarm value.
  - Red bar: current value has exceeded the upper critical value or dropped below the lower critical value.
- *O-Bar* (controller output bar): shows a graph of the current controller output (%). Parameters which are controlled on two sides (e.g. pH and temperature) are shown as a two-part bar.

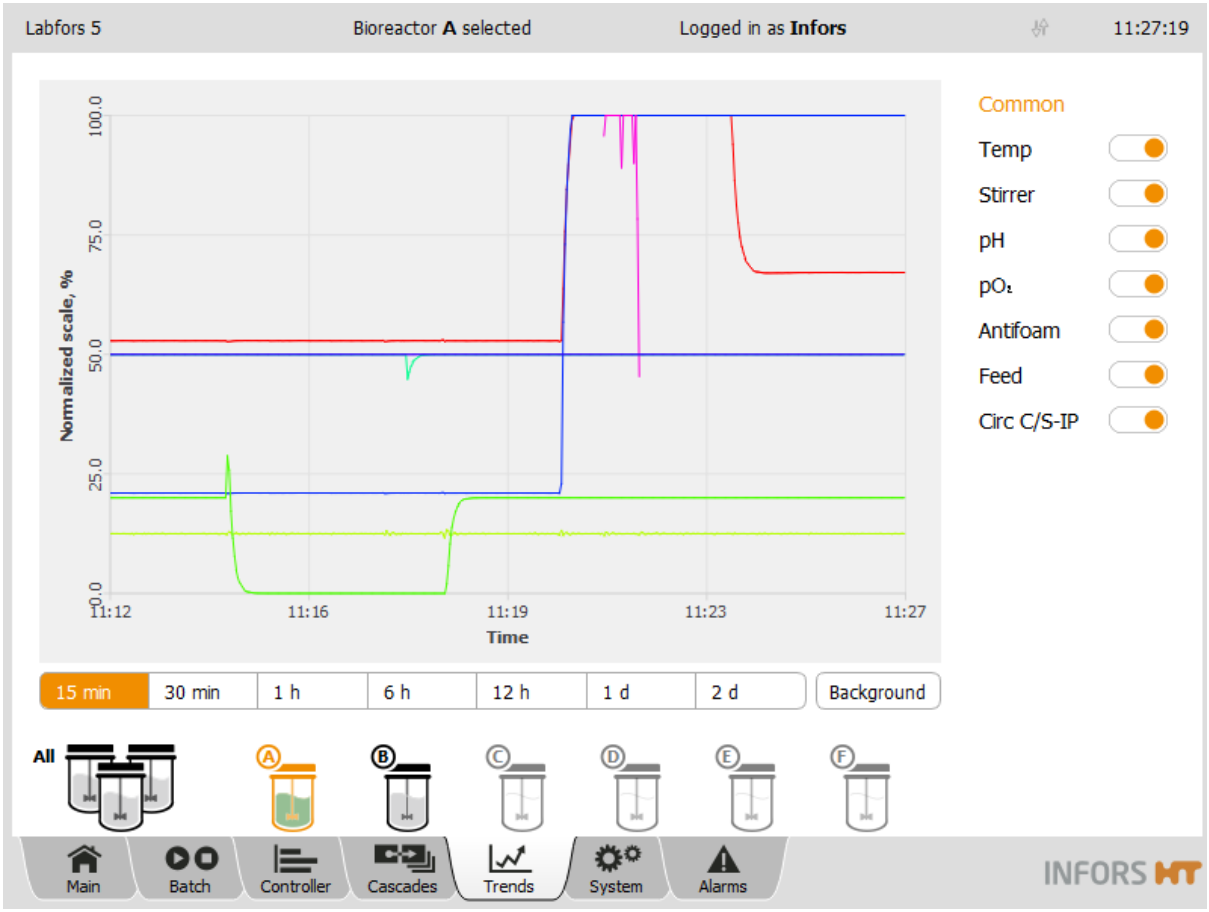
2.4 Cascade



The main menu *Cascade* provides the option of setting up a serial, parallel or mixed cascade control of a parameter. This function is mainly used for pO_2 regulation.

The cascade settings are made in the left-hand section of the screen and the main section presents these schematically. The individual process parameters can be added to a cascade by dragging & dropping them.

2.5 Trends – Trend Lines



The touch screen operating unit keeps the current parameter values in a buffer and continuously charts them in the main menu *Trends*. This data can neither be archived nor edited or exported. The main menu *Trends* serves to provide quick information on the progress of the cultivation only. This menu is not available when all bioreactors (*ALL*) are selected.

However, the data can be archived on computer connected via network using eve®.

The parameters for the selected bioreactors are listed on the right-hand side of the screen. The **ON/OFF** switch next to each parameter allows to activate/deactivate the display of its trend line in the main area of the screen.

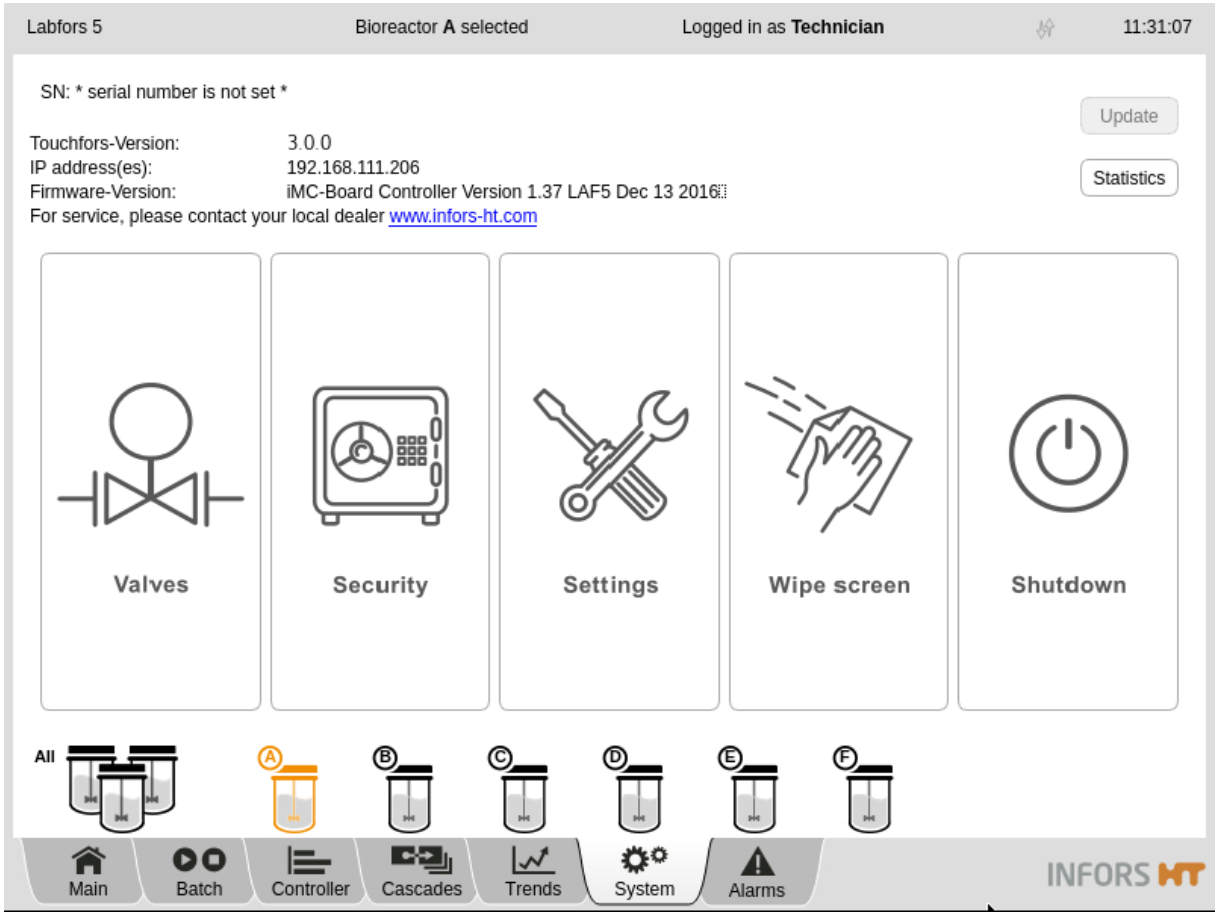
All trend lines are normalised to the value range of the respective parameter. The maximum value (= 100 % of the normalised scale) is located on the top of the diagram, the minimum value (= 0 % of the normalised scale) on the bottom. When a parameter is selected from the list, the labels on the Y axis will switch to the value range of the selected parameter. When *Common* is selected, the labels on the Y axis are reverted to the normalised scale.

The sideways spread of the diagram can be selected via the buttons below the diagram:

- **15 min** and **30 min**: 15 and 30 minutes
- **1 h**, **6 h** and **12 h**: 1, 6 and 12 hour(s)
- **1 d** and **2 d**: 1 and 2 day(s)

The **Background** button allows to change the background colour of the diagram display (white, grey and black).

2.6 System – System Settings



The main menu *System* shows the following:

- Serial number
- Software version
- IP address of the system(s)
- Firmware version
- Manufacturer's internet address (Domain)

Two buttons are situated in the upper right side of the screen:

- **Update**: for software updates. This button is only available on user level *Administrators* and above. For details about this function see chapter "Update – Intalling Software Updates"

- **Statistics**: enables viewing some statistics of the software communication with the controller, i.e. the hardware of the bioreactor(s). The function is only used for fault diagnosis for the technical support from the manufacturer and is available on user level Technicians and above.

The menu has 5 buttons which access the submenus with various functions:

- **VALVES**: displays the status of the digital outputs.

INFORMATION

In normal mode and with the default factory settings, all digital outputs are set to *Auto* mode (automatic mode) and should not be changed.

- **SECURITY**: for system log-in and log-off, passwords and user management.
- **SETTINGS**: for the system and basic settings of the bioreactor(s)
- **WIPE SCREEN**: to lock the screen for 20 seconds, e.g. for screen cleaning
- **SHUTDOWN**: to shut down and switch off the system.

A detailed description of the submenus can be found in the appropriately titled chapters.

2.6.1 Statistics – Software Communication with Bioreactor Hardware

The *Statistic* function (**Statistics** button) in main menu *System* enables viewing some statistics of the software communication with the controller, i.e. the hardware of the bioreactor(s). This function is only used for fault diagnosis for the technical support from the manufacturer.

2.6.2 Update – Installing a Software Update

The Update function in main menu *System* enables to install software updates from a USB stick onto the system.

INFORMATION

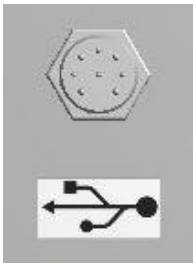
It is recommended to create a backup copy on an USB stick of the existing system configuration using the Backup function in submenu Settings before installing the software update.

ATTENTION

The existing configuration is preserved in the best possible way when performing a software update. In individual cases, e.g. for customized equipment, it may be necessary to make specific adjustments after the update. Therefore, always consult the Infors service or an authorised service partner before installing an update.

Proceed as follows:

Procedure



1. Use the special cable provided with the equipment and connect it to the appropriate connector (see figure on the left) on the rear side of the operating panel.

2. Connect the USB stick.
3. Log on to the system on user level *Administrator*.
4. Call up main menu *System*.

5. Press **Update**.

The *Confirmation* dialogue box appears with:

- Information: *The system will be updated*.
- Instruction: *Press OK to confirm*.
- **OK**: to execute the update
- **Cancel**: to cancel and close the dialogue box without changes.

6. Press **OK**.

   Progress is continuously displayed on the screen.

   Once the update is completed, the system is restarted with its standard settings and the message *Configuration files from previous version detected!* in main menu *Alarms* indicates that configuration data of a previous version were detected.

Restoring individual settings

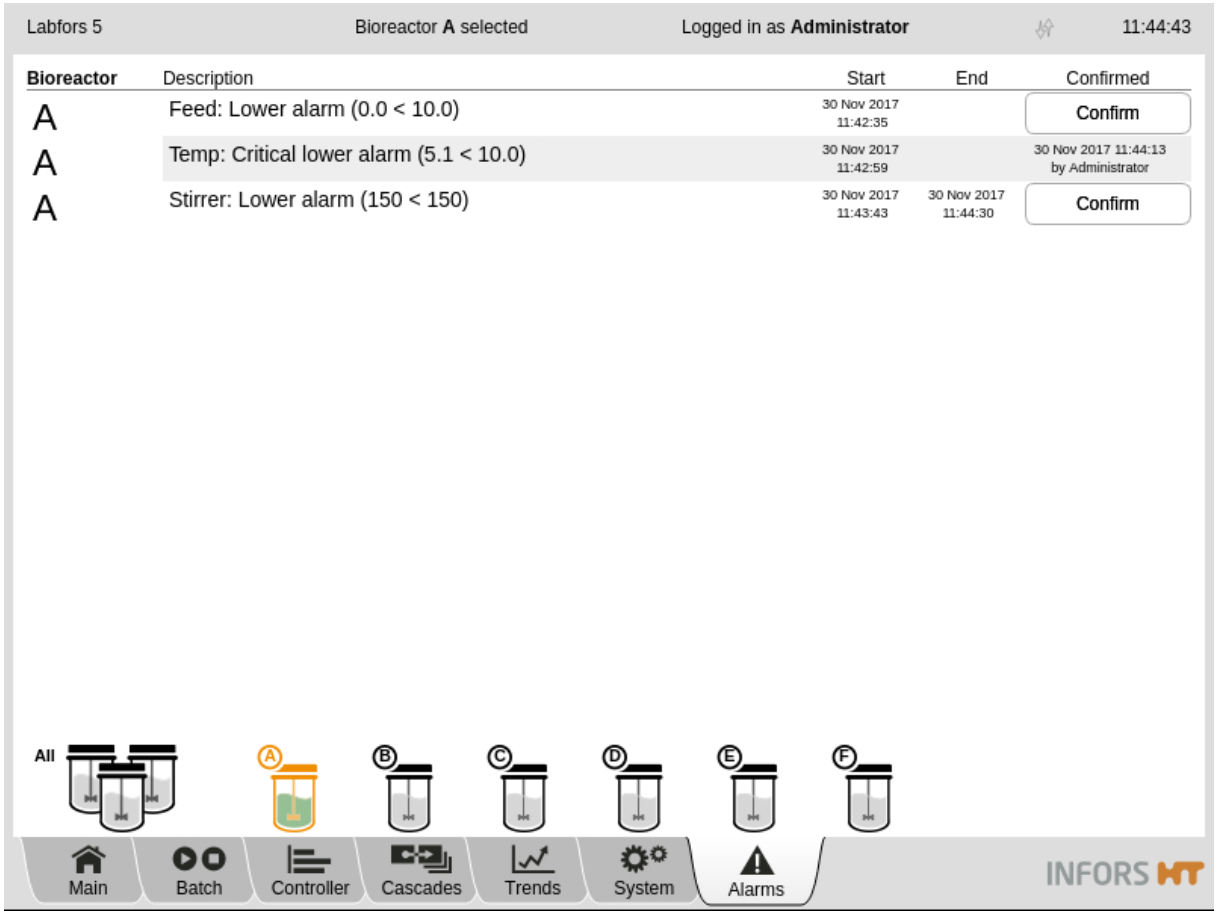
The Restore function is used now, to restore the previous individual bioreactor setttings.

Proceed as follows:

Procedure

1. If applicable, connect other USB stick with the previously saved data via Backup function..
2. In main menu System, call up submenu *Setting*s and press **Restore**.
3. Select the file "*ModifiedConfiguration_number_of_previous version".* Alternatively, select desired backup data from USB stick.
4. Continue as described in chapter "Restore – Restoring Saved Data or Factory Settings".

2.7 Alarms – Parameter Alarms, User Alarms, System Alarms



The main menu *Alarms* lists the parameter alarms for all running bioreactors by time of occurrence. The following user alarms and system alarms are shown here, too:

- *Password Expiry*
- *Difference in board configuration*:

INFORMATION

A backup of each controller board configuration of each satellite is stored in the touch screen. This alarm will occur after a firmware update / exchange of the controller board, if there are differences between the backup and the current configuration.

- *System restarted after power failure*
- *Invalid modbus map* for Parameter xy

INFORMATION

This alarm can only occur if modbus settings were modified. Modbus settings can only be modified on user level Service.

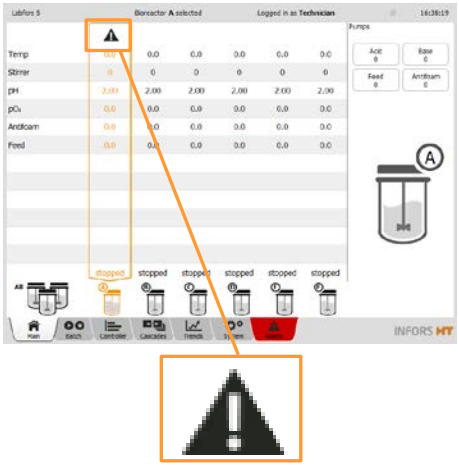
A parameter alarm is signalled by the *Alarm* tab flashing light red and dark alternately.

The screen contains the following columns:

- *Bioreactor*: displays the bioreactor (A to F) to which the parameter alarm refers.
- *Description*: describes the alarm
- *Start*: shows the date and time when the alarm started.
- *End*: shows the date and time when the parameter alarm ended.
- *Confirmed*: indicates confirmed and not confirmed alarms.

  Not confirmed alarms are confirmed by pressing **Confirm**.

  Confirmed alarms are displayed with the date, time and user.

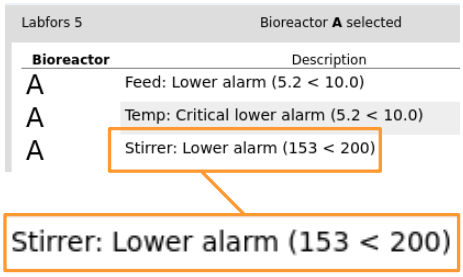


Not confirmed parameter alarms are also signalled in the main menu *Main* in the corresponding bioreactor column with a warning symbol.

2.7.1 Parameter Alarms

A parameter alarm occurs as soon as the current value of a parameter is outside the set alarm tolerances.

A parameter alarm is triggered as soon as a value drops below the lower alarm value or exceeds the upper alarm value.

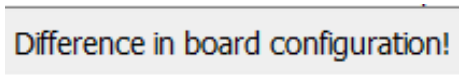


The example in the figure on the left shows: *Stirrer: Lower alarm (153 < 200)*. I.e. for biorecter A, the current value for parameter Stirrer (=153 rpm) is below the lower alarm value (= 200 rpm)

INFORMATION

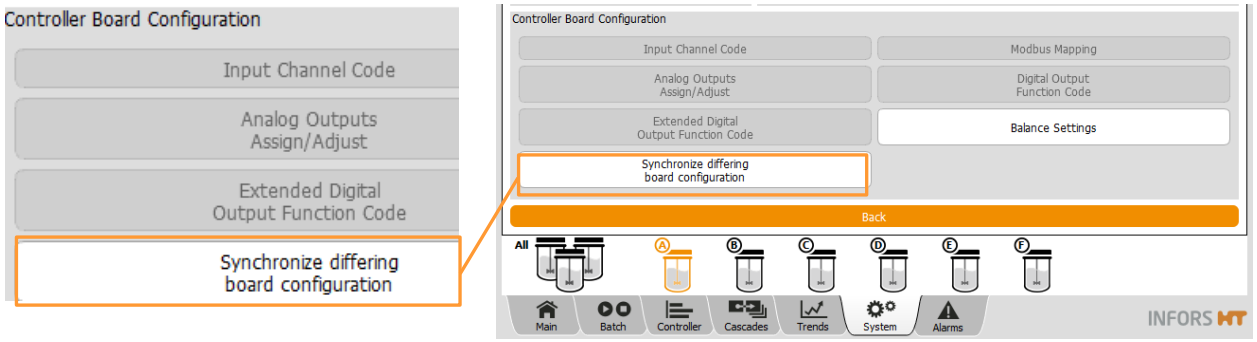
The values in brackets always refer to the setting of the alarm value or critical value compared with the current alarm value or critical value.

2.7.2 System-Alarm “Difference in board configuration”

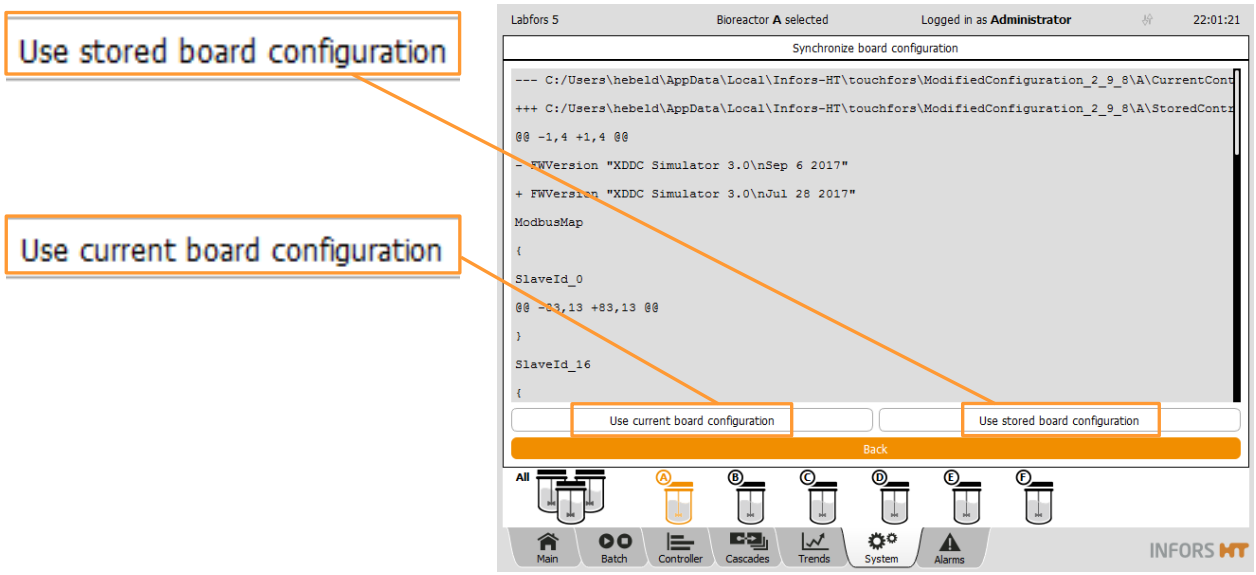


A backup of each controller board configuration of each satellite is stored in the touch screen. If there are differences between the backup and the current configuration after a firmware update / exchange of the controller board respectively the touch screen, the alarm will *Difference in board configuration* occur. This signifies that the configurations do not correspond with each other.

To enable to select the appropriate configuration, the **Synchronize differing board configuration** appears and is enabled in the *Controller Board Configuration* section of the main menu Settings.



After selection of this function (pressing the button), the menu appears with the two following options:



- **Use current board configuration**: to replace the bakcup in the touch screen with the current configuration of the controller board.

  This is appropriate after exchange of a touch screen.

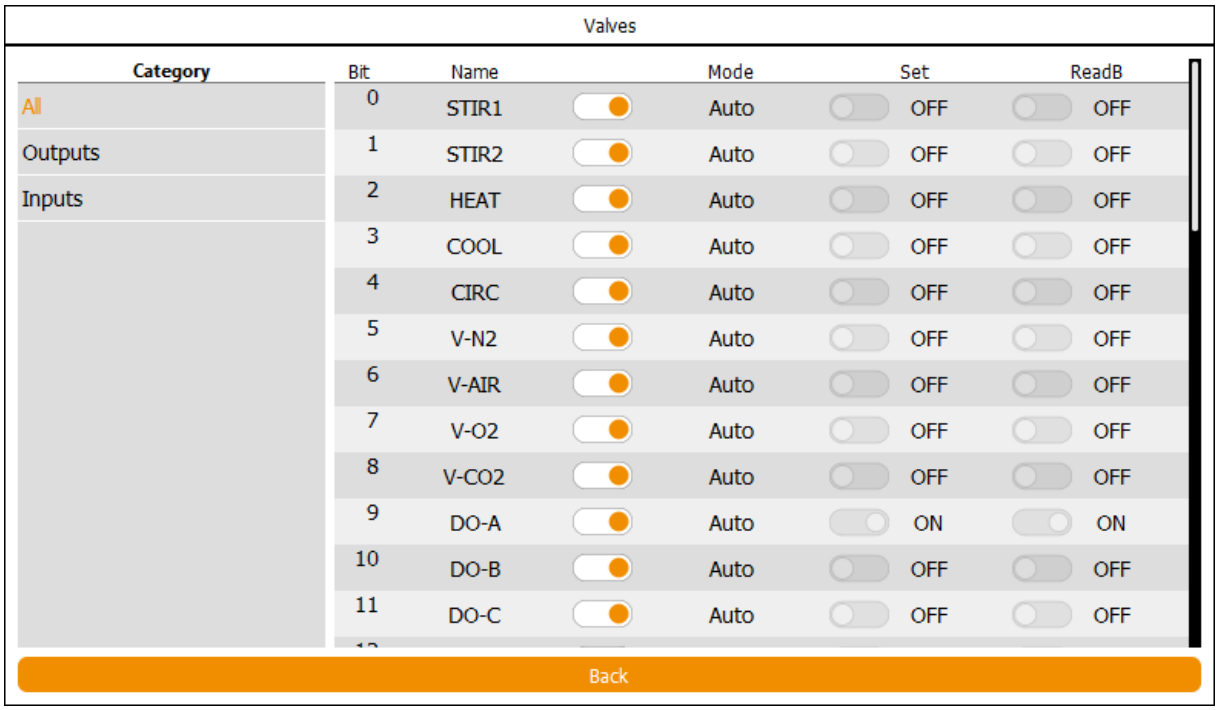
- **Use stored board configuration**: to overwrite the configuration of the controller board with the configuration from the backup.

  This is appropriate after a firmware update, respectively replacement of a controller board.

The alarm disappears as soon as the function is executed.

3 Submenus

3.1 Valves – Digital Controller Outputs



The submenu *VALVES* displays the digital outputs and inputs of the controller in the basic unit of the equipment. The overview is predominantly used for fault diagnosis.

In normal mode and with the default factory settings, all digital outputs are set to *Auto* mode (automatic mode) and should not be changed.

The menu has two parts and is divided into several columns:

Left Side: Category

- *All*: To select display of all digital outputs (an inputs)
- *Outputs*: To select display of all digital outputs
- *Inputs*: To select display of all digital inputs

Main area

- *Bit*: Channel number
- *Name*: Designation
- *Mode*: Mode: A distinction is made between two modes:

  - Auto: automatic mode = automatic switching
  - *Manual*: manual mode = outputs are forced. I.e. the automatic switching is thus disabled.
- *Set*: Switching status of the digital output. A distinction is made between two statuses:
  - *OFF*: output is switched off.
  - *ON*: output is switched on.
- *ReadB* (ReadBack): electronic feedback channel which confirms the change in status.
  - *OFF*: Readback is switched off
  - *ON*: Readback is switched on

INFORMATION

If the electrical connection is faulty, it is displayed as FALSE.

- **Back**: To get back to the main menu System.

The following table contains an overview and shows the general significance of the listed digital outputs.

Note the following points:

- The outputs Bit 0 – 8 and 13 are reserved
- The outputs Bit 0 – 4 and 13 are always present
- The outputs Bit 5 – 8 are only functional, if the appropriate options of the equipment are present with valves
- The outputs Bit 9 – 12 as well as 14 and 15 are spare outputs. They are only used for special applications or, if the appropriate option of the equipment is present.

INFORMATION

Depending on the equipment's configuration, not all outputs can be manually operated. I.e. although the output can be set to manual mode, switching between ON/OFF will have no effect.

Submenus

Bit	Name (designation)	Meaning
0	STIR1	Stirrer1 Labfors 5 Lux LED Flatpanel and Multifors 2 Cell: not relevant
1	STIR2	Stirrer[1] Labfors 5 Lux LED Flatpanel and Multifors 2 Cell: not relevant
2	HEAT	Heating
3	COOL	Cooling
4	CIRC	Circulation pump Multifors 2: not relevant
5	V-N2	N_2 output (N_2 input valve into vessel)
6	V-AIR	Air output (air input valve into vessel)
7	V-O2	O_2 output (O_2 input valve into vessel)
8	V-CO2	CO_2 output (CO_2 input valve into vessel)
9	DO-A	24 V output
10	DO-B	24 V output
11	DO-C	24 V output
12	DO-D	24 V output
13	GCOOL	Exit gas cooler valve
14	OC-A	Open collector output / reserve
15	OC-B	Open collector output / reserve

[1)] *Used only for special configurations*

The following outputs are only present and visible, if a Labfors 5 bioreactor is configured for operation and control of the CIP/SIP unit LabCIP.

Bit	Name (designation)	Meaning
24	V601	Solenoid valve (NC) / Water inlet
25	V602	Solenoid valve (NC) / CIP/SIP compressed air inlet
26	V603	Solenoid valve (NC) / Exit gas
27	V604	Solenoid valve (NC) / Compressed air to semi-automatic push valve 612 (exit gas cooler)
28	V605	Peristaltic valve (NC) / CIP/SIP circuit
29	V606	Peristaltic valve (NC) / CIP/SIP air inlet and venting
30	V607	Peristaltic valve (NC) / CIP/SIP emptying
31	V608	Peristaltic valve (NC) / CIP/SIP venting
32	V609	Peristaltic valve (NC) / CIP/SIP exit gas
33	V610	Peristaltic valve (NC) / CIP/SIP inlet air

34	V611	Peristaltic valve (NC) / CIP/SIP emptying
35	Free1	Spare output
36	Free2	Spare output
37	Free3	Spare output
38	Free4	Spare output
39	Free5	Spare output
80	LA600	Levels sensor vessel
81	LA601	Level sensor CIP/SIP circuit
82	Switch	Water leak detector (optional)
83	Free 1	Spare input
84	Free 2	Spare input
85	Free 3	Spare input
86	Free 4	Spare input
87	Free 5	Spare input

3.1.1 Switching Digital Outputs Manually

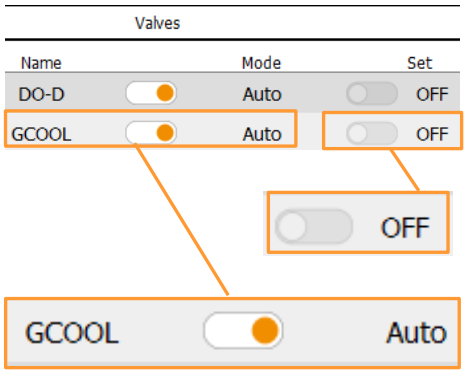
If the user has the appropriate access authorisation (user level *Technician* and above), the digital outputs can be switched to manual for fault diagnosis (forced).

ATTENTION

Inappropriate switching of the digital outputs from automatic to manual mode can cause the equipment to malfunction and result in the risk of loss of property!

The following explains the procedure using the example of the *GCOOL* output (exit gas cooler valve).

The initial position is: The output is switched off and in automatic mode.

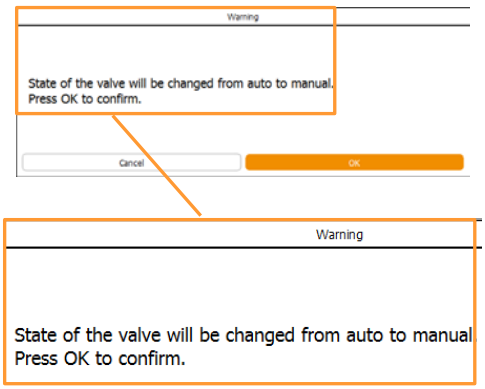


Initial position: The output is switched off and in automatic mode.

Proceed as follows:

Arbeitsschritte

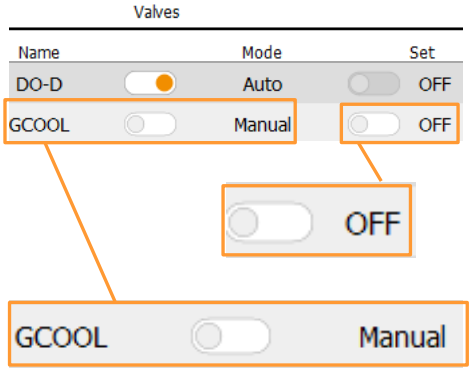
1. Move the **ON/OFF** switch of the cooler to the left.



The *Warning* dialogue box appears with:

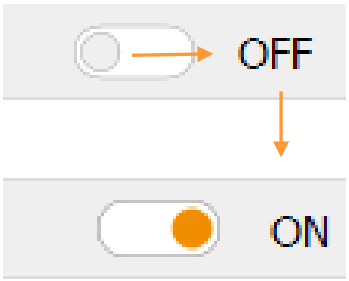
- *State of the valve will be changed from auto to manual*:.
- *Press OK to confirm*
- **OK**: to execute switching
- **Cancel**: to cancel the procedure

2. Press **OK**.



Ausgang *GCOOL* schaltet in den manuellen Modus und gleichzeitig wird der Ausgang forciert ausgeschaltet (Status in Spalte *Set* = OFF).
The *GCOOL* output switches to manual mode and is therefore forced switched off. (State in *Set* column = *OFF*).

The *GCOOL* output can now be manually switched on:



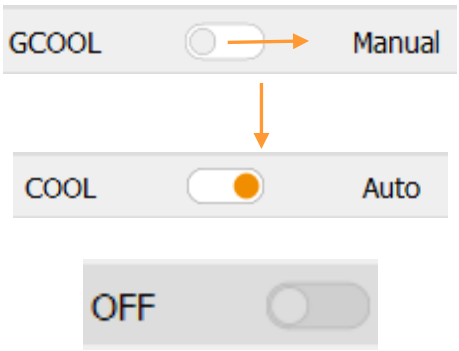
3. Move the **ON/OFF** switch of the cooler to the right in the *Set* column.

The *GCOOL* output remains in manual mode but is switched on.

3.1.2 Switching Back to Automatic Mode

To switch the *GCOOL* output back to automatic mode:

Procedure

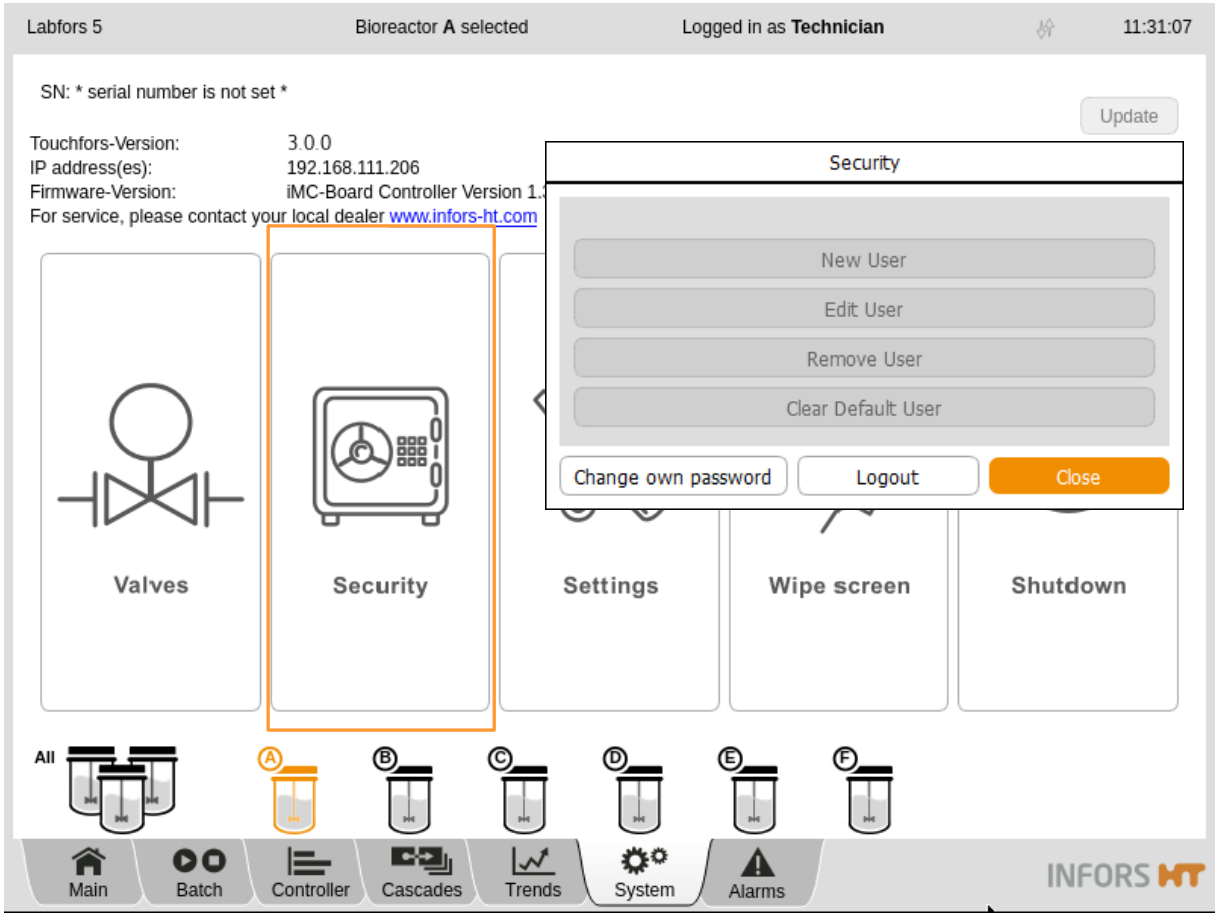


1. Move the **ON/OFF** switch of the cooler to the right.

The *GCOOL* output switches back to automatic mode.

The output is in its original switching status; i.e. it is set to *OFF* (*Set* column) in this example.

3.2 Security – User Management



The submenu *Security* is used for logging on and off the system. This is where users can also be added or deleted, passwords can be issued and access authorisations can be assigned.

More or less buttons may be enabled in this menu depending on the access authorisation of the registered user:

- **Login/Logout**: to log on to the system / to log off from the
- **Change own password**: to change the own password
- **New User**: to add a new user
- **Edit User**: to edit user settings
- **Remove User**: to delete a user.
- **Set Default User/Clear Default User**: to define/delete automatic user login.

The different user levels, access authorisations and functions are described in the following chapters.

3.2.1 User Levels

The system has five user levels with different access authorisations. The user levels are designated and defined as *Groups*.

Service: This user group has access to all system and bioreactor settings. This user level is accessible for the manufacturer's (INFORS HT) qualified service employees only and access for all other users is blocked.

Administrators: This user group has access to basic system and bioreactor settings. New users can only be added, altered and deleted by users allocated to the user groups *Service* or *Administrators*. The default setting for the login to the system is predefined as *Administrator*.

ATTENTION

The Administrators user level provides access to important settings for the bioreactor(s) and the system. Improper changes to the settings can have a negative influence of the function of the equipment and cause serious loss of property!

Technicians: This user group has limited access to system and bioreactor settings. The default setting for the login to the system is predefined as *Technician*.

User: This user group only has restricted access to the system. The default setting for the login to the system is predefined as *User*.

Guests: This user group has viewing authorisations only and no access authorisations. Exception: users with this user level can select trend lines in the main *Trends* menu to display or hide them, change the background colour for the diagram display and select the time range for the diagram display. This user level serves as protection against unauthorised access to the system or unintentional changes to settings.

This user level is set automatically as long as no user is logged on to the system. This is indicated by the words *Guest mode* in the header on the screen.

The default password setting for the user groups *Administrators*, *Technicians* and *User* is the same: qwertyuiop

INFORMATION

Passwords should be changed and managed by the authorised person (users with user level Administrators) after commissioning for the first time.

3.2.2 Access Authorisations of User Groups

The following tables group the various functions of the touch screen software with an indication of the access authorisations of the user groups.

Key:

- V (view) = visible, function cannot be executed
  Visible means that, depending on the function, the button or the menu/dialogue can only be viewed.
- E (execute) = Visible and function can be accessed for execution
  I.e. functions are executable
- Empty field = cannot be viewed and function cannot be executed

Function	**User Groups**				
START / STOP BIOREACTOR(S)	Guests	User	Technician	Admin.	Service
Start / Stop Bioreactor(s)	V	E	E	E	E

Function	**User Groups**				
RECIPES	Guests	User	Technician	Admin.	Service
Load/Start	V	V	E	E	E
Save	V	V	E	E	E
Delete	V	V	E	E	E

Function	**User Groups**				
LAB CIP (Option CIP/SIP Unit)	Guests	User	Technician	Admin.	Service
LabCIP Settings	V	V	E	E	E
Starting the LabCIP (Perform CIP/SIP)	V	E	E	E	E

Function	**User Groups**				
PUMPS	Guests	User	Technician	Admin.	Service
Calibrating pump(s)	V	E	E	E	E
Resetting counter (*Reset*)	V	E	E	E	E
Setting pump factor manually (*Pump factor*)	V	E	E	E	E
Filling/emptying hoses automatically (*Fill/Empty Pumps*)	V	E	E	E	E

Function	User Groups				
PARAMETERS	Guests	User	Technician	Admin.	Service
Setpoint	V	E	E	E	E
Setting alarm and critical values (*Upper/Lower Alarm, Upper/Lower Critical*)	V	E	E	E	E
Switching parameters on and off (*Output active ON/OFF*)	V	E	E	E	E
Calibrating pH sensor(s) (*Calibrate pH* / *Calibrate All pH*)	V	E	E	E	E
METTLER pH sensor : changing *Slope* and/or *Offset* (*Manual* calibration mode)		E	E	E	E
Calibrating pO2 sensor(s) (*Calibrate pO2* / *Calibrate All pO2*)	V	E	E	E	E
Special function *USE AS SETPOINT* in calibration menu pO_2		E	E	E	E
Special function *USE AS SETPOINT* in all calibration menus except pO_2				E	E
Calibrating the zero point of turbidity sensor OPTEK (*Calibrate OD*).	V	E	E	E	E
Calibrate, all except pH and pO_2			V	E	E
Calibrate, manually (manual calibration mode), all except pH and pO_2				E	E
PID			E	E	E
Options					E

Function	User Groups				
CASCADES	Guests	User	Technician	Admin.	Service
Setting a cascade	V	E	E	E	E
Setting an advances (*Advanced option*)			E[1]	E[1]	E

1) *For details refer to chapter "Setting a Cascade".*

Funktion	User Groups				
TREND LINES (Trends)	Guests	User	Technician	Admin.	Service
Change display settings	E	E	E	E	E

Function	User Groups				
ALARMS (Alarms)	Guests	User	Technician	Admin.	Service
Confirming alarms	V	E	E	E	E

Submenus

Function	User Groups				
SYSTEM	Guests	User	Technician	Admin.	Service
Loading software update (*Update*)	V	V	V	E	E
Viewing statistics of communication between software and bioreactor hardware (*Statistics*)	V	V	E	E	E

Function	User Groups				
DIGITAL INPUTS/OUTPUTS (System / Valves)	Guests	User	Technician	Admin.	Service
Manually switching digital inputs and outputs	V	V	E	E	E

Function	User Groups				
SECURITY user management (Security)	Guests	User	Technician	Admin.	Service
Logging on to the system (*Login*)	E	E	E	E	E
Logging out from the system (*Logout*)		E	E	E	E
Changing password (*Change Password*)		E	E	E	E
Adding a new user (*New User*)		V	V	E	E
Deleting a user (*Remove User*)		V	V	E	E
Changing user settings (*Edit User*)		V	V	E	E
Setting automatic user login (*Set Default User*)		V	V	E	E
List of all users				V	V

Function	User Groups				
SYSTEM SETTINGS (System / Settings)	Guests	User	Technician	Admin.	Service
Network settings (*Settings* / *IP Settings*)	V	V	V	E	E
Changing date and time (*Settings* / *Change Time*)	V	V	V	E	E
Saving data (*Files* / *Backup*)	V	V	V	E	E
Restoring data (*Files* / *Restore*)	V	V	V	E	E
Exporting log files (*Files* / *Export Logs*)		V	E	E	E
Settings in Service Menu (*Files / Service Menu*)					E

Function	User Groups				
SYSTEM SETTINGS / CONTROLLER BOARD (System / Settings / Controller Board Configuration)	Guests	User	Technician	Admin.	Service
Setting codes for input channels (*Input channel code*)			V	V	E
Assigning/changing analogue outputs (*Analog Outputs Assign/Adjust*)			V	V	E
Setting extended function codes for digital outputs (*Extended Digital Output Function Code*)			V	V	E
Synchronising different configurations of the controller board (*Synchronize differing board configuration*)			E	E	E
Modbus settings (*Modbus mapping*)			V	V	E
Setting function codes for digital outputs (*Digital Output Function Code*)			V	V	E
Settings for balances (*Balance Settings*)	V	V	V	E	E

Function	User Groups				
TEMPORARY SCREEN LOCK (System / Wipe Screen)	Guests	User	Technician	Admin.	Service
Activating the temporary screen lock	V	E	E	E	E

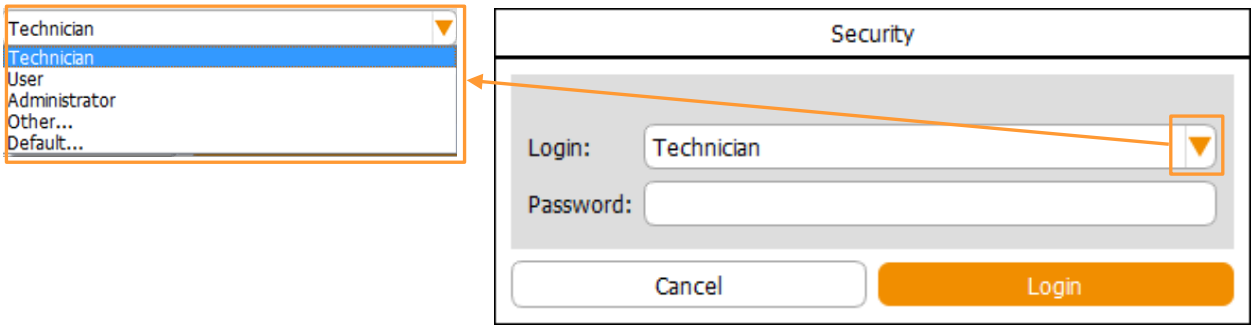
Function	User Groups				
SYSTEM SHUTDOWN	Guests	User	Technician	Admin.	Service
Shutting down and switching off the system	V	E	E	E	E

3.2.3 Login – Logging on to the System

To log on to the system, proceed as follows:

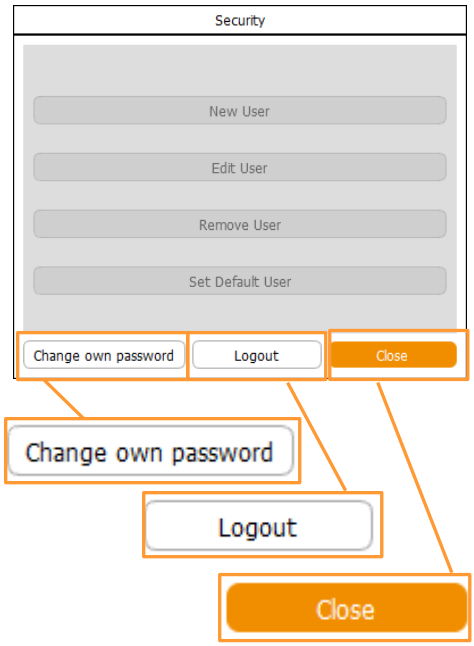
Procedure

1. Call up the main menu *System* and press **Security**.
   Submenu *Security* appears with:



- *Login*: Drop-down menu with users available by default with factory settings (see picture above to the left):
  - *User*
  - *Technician*
  - *Administrator*
  - *Other*: for use by INFORS HT service employees only
  - Default: Automatic user login without entering a password if previously set using **Set Default User**
- *Password*: To enter the password
- **Cancel**: To cancel and close the menu without changes
- **Login**: To log on to the system (after password entry)

2. Select the desired user, e.g. *Technician.*
3. Press the input field *Password*.
   The alphanumeric keyboard appears.
4. Enter the password and confirm with the **OK** key.
   The input is saved; the alphanumeric keyboard disappears.
5. Press **Login**.



The user is logged in as *Technician*. This is shown in the header on the screen and the different functions are listed as buttons in the *Security* menu. The buttons **Change Password, Logout**, and **Close** are enabled on all user levels (except for *Guest*).

6. Press **Close**.

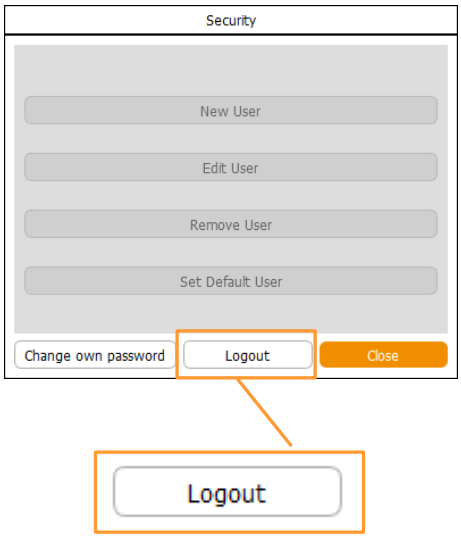
   Submenu *Security* disappears.

3.2.4 Logout – Logging off the System

To log off from the system, proceed as follows:

Procedure

1. Call up main menu *System* and press **Security**.



Submenu *Security* appears.

2. Press **Logout**.

The user is logged off, menu *Security* appears for login.

3. Press **Cancel**.

Menu disappears.

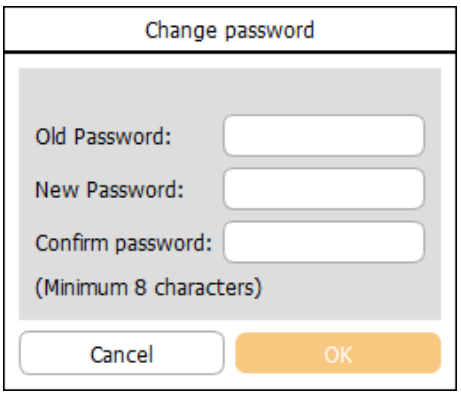
3.2.5 Change Password

Users of all user groups can change their own password. In order to be able to change a password, the user must be logged on to the system.

Proceed as follows:

Procedure

1. Call up submenu Security and press **Change Password**.



The *Change password* dialogue box appears with:

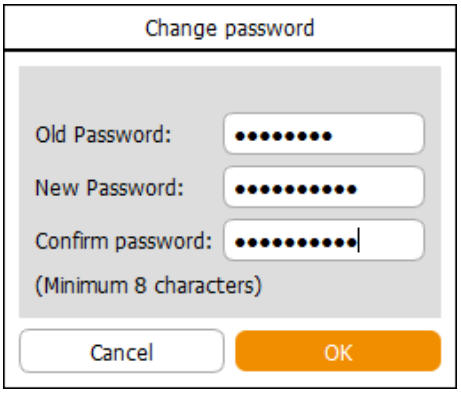
- *Old Password*: To enter the old password
- *New Password*: To enter the new password
- *Confirm Password (minimum 8 characters)*: To confirm then new password (min. 8 characters)
- **OK**: To confirm inputs, save changes.

  This button is not enabled until the inputs have been made.
- **Cancel**: To cancel without saving.

2. Press the input field *Old Password.*

   The alphanumerical keyboard appears.
3. Enter the old password and confirm with the **OK** key.

   Inputs appear as dots in the input field.
4. Proceed the same way with the new password in the input fields *New Password* and *Confirm Password*.



All inputs are displayed as dots in the input fields.

5. Press **OK**.

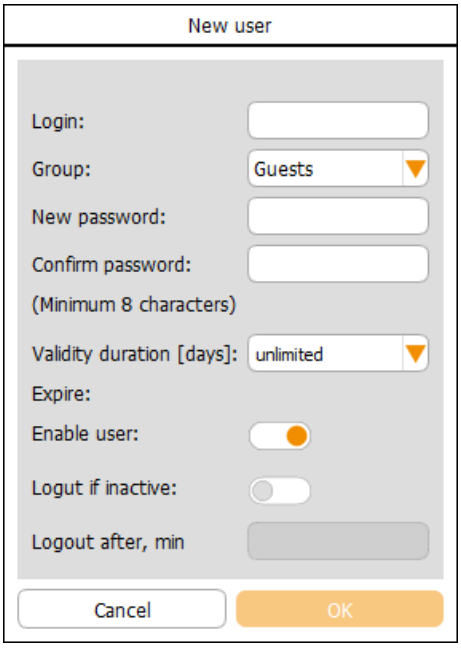
   The dialogue box disappears; the new password is saved.

3.2.6 New User – Adding a New User

To add a new user to the user list, proceed as follows:

Procedure

1. Log on to the system on user level Administrator.
2. Call up the submenu *Security* and press **New User**.



The *New User* dialogue box appears with:

- *Login*: to enter a new user (name)
- *Group*: to select the user group
- *New Password*: to enter the password (min. 8 characters).
- *Confirm Password (minimum 8 characters)*: to confirm the password with min. 8 characters.
- *Validity duration [days]*: to enter the validity duration of the password, choose “unlimited”, 30, 100 or 365 days.
- *Expire*: shows the selected validity duration of the password.
- *Enable user*: to activate/deactivate access authorisation of the new user.

  This function is switched on by default.

INFORMATION

The user has no access rights and no password can be defined, if this function is deactivated.

- *Logout if inactive:* to switch on/off the automatic logout when inactive after predefined duration.
- *Logout after, min*: to set the expiration time of the automatic logout in minutes.

  This input field is enabled only, when the function is switched on.
- **OK**: to confirm entries.

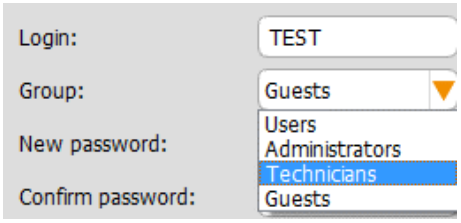
  This button is enabled only after input
- **Cancel**: to cancel without saving

3. Press ***Login***.

   The alphanumeric keyboard appears.

4. Enter desired new user name, e.g. TEST, and confirm with the **OK** key.

   Input appears in the Login-field



5. Select the desired user group, e.g. *Technicians*

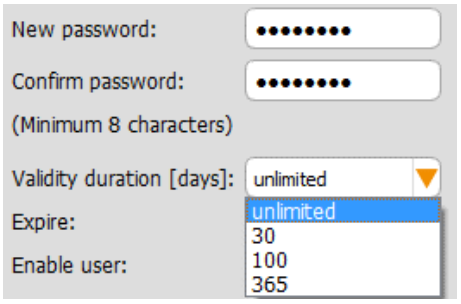
6. Press *Password*.

   The alphanumeric keyboard appears.

7. Enter the desired password and confirm with the **OK** key.

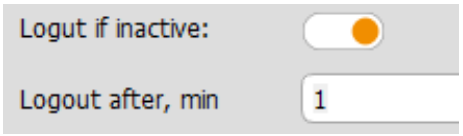
   The input appears as dots in input field.

8. Repeat the same procedure with the *Confirm password* input field.



9. Select the validity duration of the password, e.g. validity.

10. Switch on access rights, if necessary.



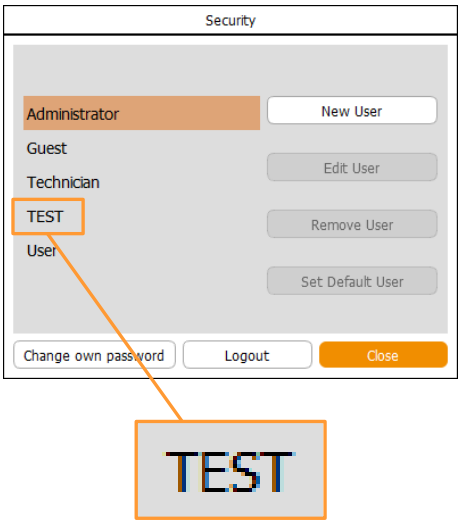
11. If applicable, set automatic logout, if inactive:

    Switch the function on and enter the desired time in minutes.

Once all settings are made:

12. Press **OK**.

Submenus



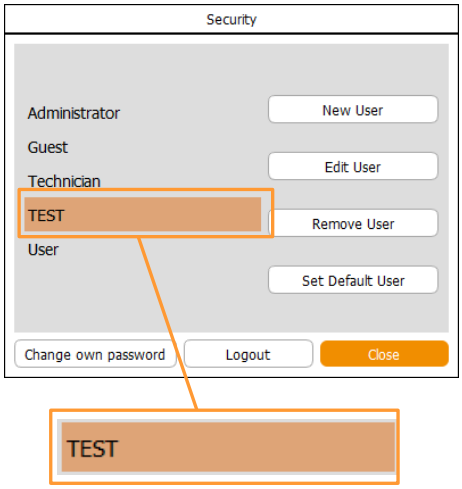
The dialogue box disappears, the new user is added and shown in the user selection list.

3.2.7 Remove User – Deleting a User

To remove a user from the, proceed as follows:

Procedure

1. Log on to the system on user level *Administrator*.
2. Call up submenu *Security*.



3. Select the user to be deleted in the user selection list. The fictitious user *TEST* is used in this example.

4. Press **Remove User**.

The *Confirmation* dialogue box appears with:

- Information *User "TEST" will be removed from user list*:
- Instruction *Press Yes to confirm operation*.
- **OK**: To delete the user
- **Cancel**: To cancel without changes.

5. Press **OK**.

   The dialogue box disappears, the user *TEST* is deleted from the user selection list.

3.2.8 Edit User – Editing User Settings

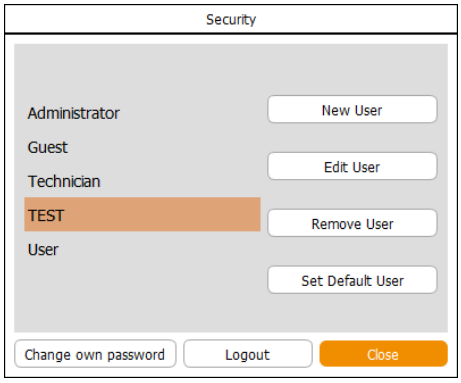
Edit User is used to change the following settings for an existing user:

1) Assign new user group
   See chapter “New User – Adding a New User” for details on the procedure.
2) Change password
   See chapter “Change Password” for details on the procedure.
3) Automatic user log-out when screen is inactive after a predefined time in minutes has elapsed. The first user level *Guests* is then set automatically.

To edit settings, proceed as follows:

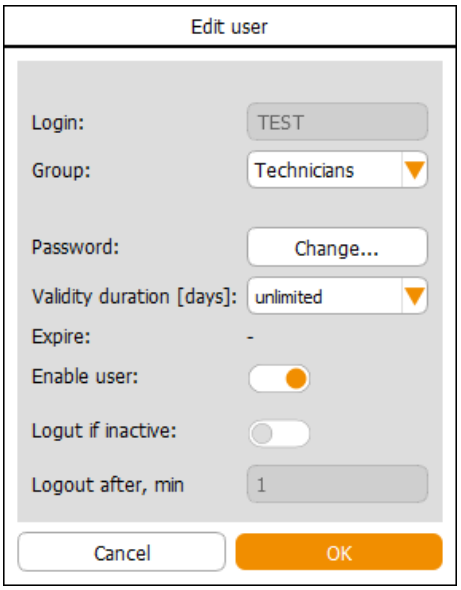
Procedure

1. Log on to the system on user level *Administrator*.
2. Call up submenu *Security*.



3. Select the desired user from the user selection list, the fictitious user *TEST* is used in this example.

4. Press **Edit User**.



The *Edit User* dialogue box appears with nearly identical input fields, view boxes, ON/OFF switches and buttons as in dialogue box *New User*.

Exceptions:

- *Login*: This function is not enabled here
- **Change …**: To change the password. The two input fields *New Password* and *Confirm Password* appear after pressing this button.

5. Make required settings.
6. Press **OK**.

   Settings are adopted; the dialogue box disappears.

3.2.9 Set / Delete Default User – Setting or Deleting an automatic User Login

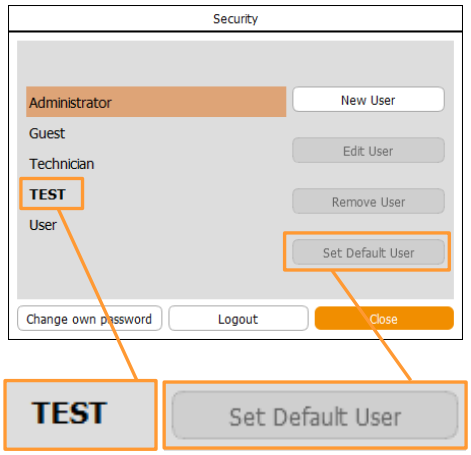
Set Default User is used to set an automatic user login. I.e. a user can be defined who is then automatically logged on to the system the next time it is switched on.

Clear Default User is used to delete the automatic login of a user.

Proceed as follows:

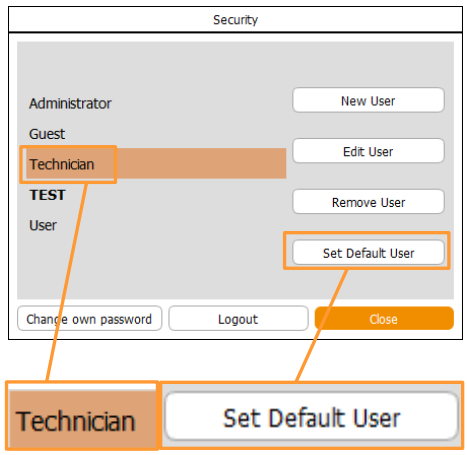
Procedure

1. Log on to the system on user level *Administrator*.
2. Call up submenu *Security.*
3. Touch the desired user in the user selection list. The fictitious user *TEST* is used in this example.
4. Press **Set Default User**.



The selected user *TEST* is displayed in bold letters, the **Set Default User** button is only visible, but not enabled anymore.

Changing the automatic user login

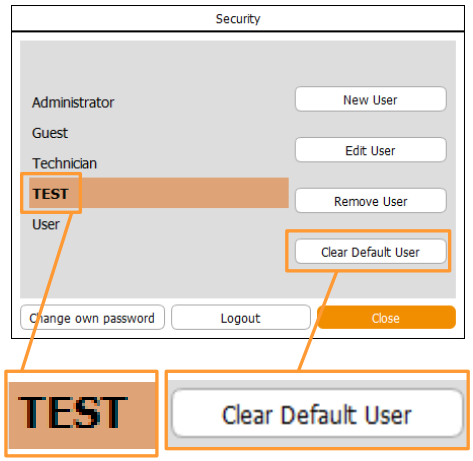


Another user can be defined here for automatic login.

When selecting the desired user in the list, the **Set Default User** button is enabled again.

The new user is adopted for automatic user login after pressing **Set Default User**.

Deleting automatic user login

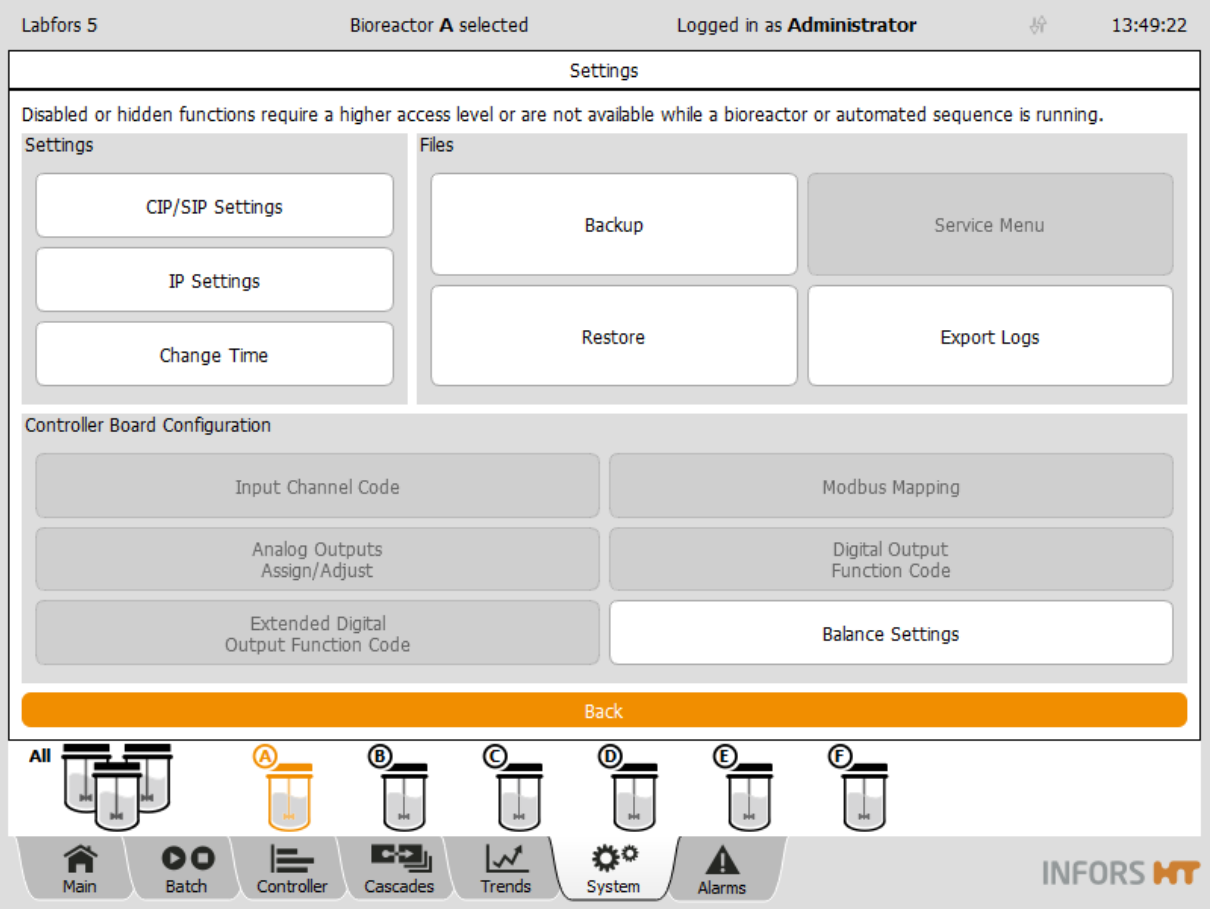


The automatic user login can be deleted here, too.

When selecting the defined user with the automatic user login setting in the list, the **Clear Default User** button is visible and enabled instead of the **Set Default User** button.

After pressing **Clear Default User**, the automatic user login is deleted.

3.3 Settings – Basic Unit Settings



In the submenu *Settings* basic settings for the equipment are made. Depending on the access authorisation, more or less buttons are visible and enabled (for details refer to the tables in chapter “Access Authorisations of User Groups”.

The figure above shows the menu on user level *Administrator.*

The menu is divided into three areas with the following functions:

Settings

- **CIP/SIP Settings**: only visible and enabled for Labfors 5 with LabCIP. For details refer to the separate operating manual.
- **IP Settings**: for network settings
- **Change Time**: to set the date and time

Files

- **Backup**: to save data.

- **Restore**: to restore and upload saved data.
- **Service Menu**: access only for qualified Infors service or licensed dealer.
- **Export Logs**: to export log files.

Controller Board Configuration

- **Input Channel Code**: to set codes for input channels
- **Analog Outputs Assign/Adjust**: to assign/change analogue outputs.
- **Extended Digital Output Function Code**: to set function codes for extended digital outputs.
- **Synchronize differing board configuration**: to synchronize differing board configurations.

INFORMATION

This button is only visible, if the appropriate alarm (*Difference in board configuration!*) has been triggered and is displayed in main menu Alarms after an update of the firmware / change of a control board. For details refer to chapter “System Alarm Difference in oard configuration”.

- **Modbus mapping**: for Modbus settings.
- **Digital Output Function Code**: to set function codes for digital outputs.
- **Balance Settings**: for balance settings.

Back directs back to the main menu *System*.

INFORMATION

None of the functions concerning inputs and outputs, function codes and modbus mappings are described in this manual. These functions are only accessible for Infors service or Infors licensed dealers.

3.3.1 IP Settings – Network Settings

IP Settings is used to establish a network connection. This can be performed either automatically or manually.

INFORMATION

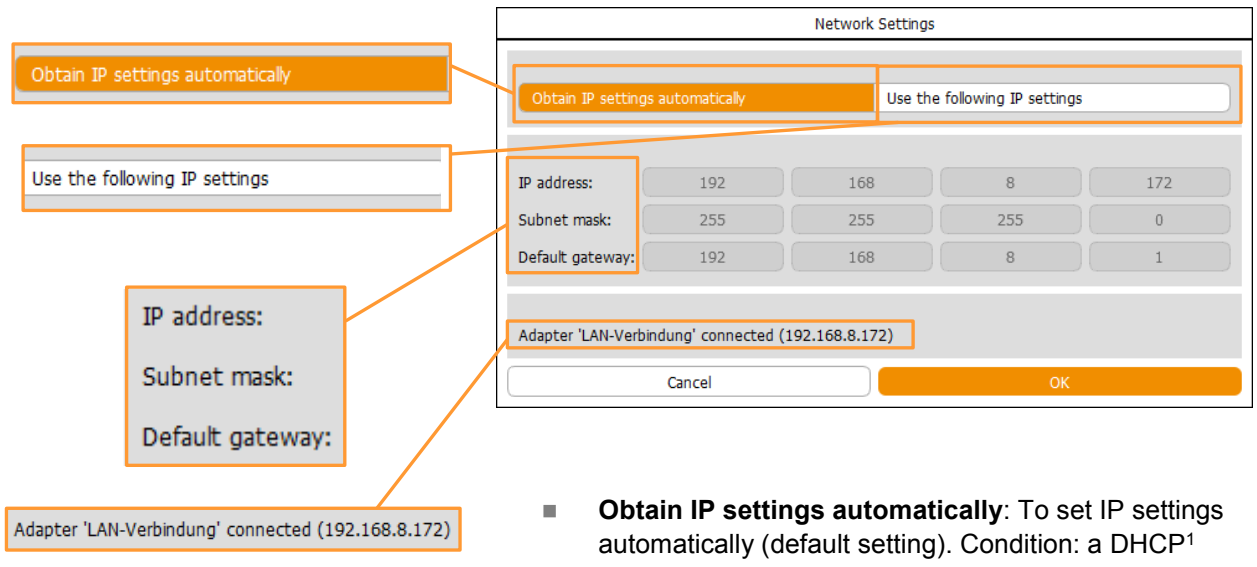
This is only possible, if a network calble is connected.

This manual does not describe how to setup a network connection.

To call up the menu to make settings, proceed as follows:

Procedure

1. Log on to the system on user level Administrator.
2. Call up submenu *Settings*.
3. Press **IP-Settings**.
   The *Network Settings* menu appears with:



- **Obtain IP settings automatically**: To set IP settings automatically (default setting). Condition: a DHCP[1] server is available in the network.
- **Use the following IP settings**: To use the following IP settings.

  Only after pressing this button, the following fields are enabled.
- *IP address*: Shows current IP address or to enter IP address manually

- *Subnet mask*: Displays default gateway or allows manual input
- *Default gateway*: Shows default gateway or allows manuel input
- *„….connected*“: Status message of the network connection.

INFORMATION

The status message …*connected* indicates that correct network connection is established. If this is not the case (no signal), the message „*No active LAN connection*“ appears.

- **OK**: To save inputs and close the dialogue box.
- **Cancel**: To close the dialogue box without changes.

[1] *Dynamic Host Configuration Protocol*

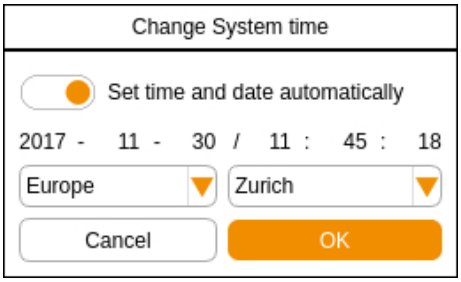
3.3.2 Change Time – Changing Date and Time

Change Time enables adjusting the system date and time to the local conditions. The system is set for automatic synchronisation with the time server ex-factory. I.e. the display is corresponding with the selected time zone. Alternatively, these settings can be manually adjusted.

To make settings, proceed as follows:

Procedure

1. Log on to the system on user level *Administrator* and call up the submenu *Settings*.
2. Press **Change Time**.



The *Change System time* dialogue box appears with:

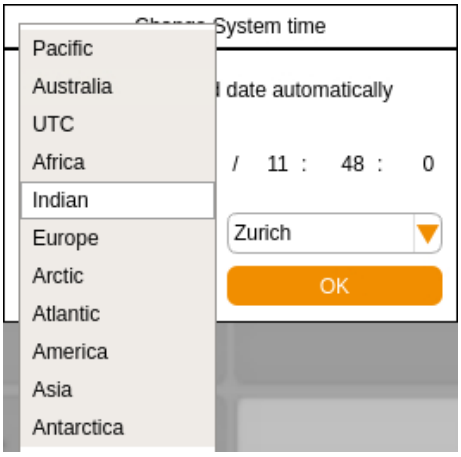
- **ON/OFF** switch *Set time and date automatically* is in position **ON**
- Display (from left to right) for year, month, day, hours, minutes and seconds.
- Dropdown menus for time zone and city: default = Europe / Zurich
- **Cancel**: To close the dialogue box without changes
- **OK**: To adopt inputs and close the dialogue box.

Changes with automatic adjustment

Proceed as follows:

Procedure

1. Select the time zone and city in the drop down menus.



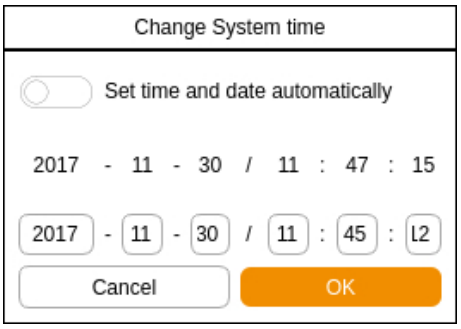
2. Press **OK**.

   Settings are saved, the dialogue box disappears.

Manual changes

Proceed as follows:

Procedure



1. Switch automatic time and date setting **off.**

   Input fields (from left to right) for year, month, day, hours, minutes and seconds appear.

2. Press the desired input field(s), enter the value(s) via appearing numeric keypad and confirm with the **OK** key.

   Inputs are adopted.

3. Press **OK**.

   Inputs are saved, the dialogue box disappears.

3.3.3 Backup – Saving Data

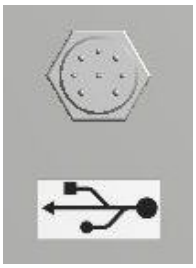
The Backup function is used to save the entire settings of the touch screen software and the control board of all connected bioreactors. These data can be restored using the Restore function.

Note the following:

- Data can be saved on the internal memory or on a USB stick.
- A data backup is only executable when all bioreactors are stopped, i.e. no fermentation/cultivation is running.

To execute a backup, proceed as follows.

Procedure



Only when using a USB stick, otherwise go to step 2:

1. Use the special cable provided with the equipment and connect it to the appropriate connector (see figure on the left) on the rear side of the operating panel and connect the USB stick.

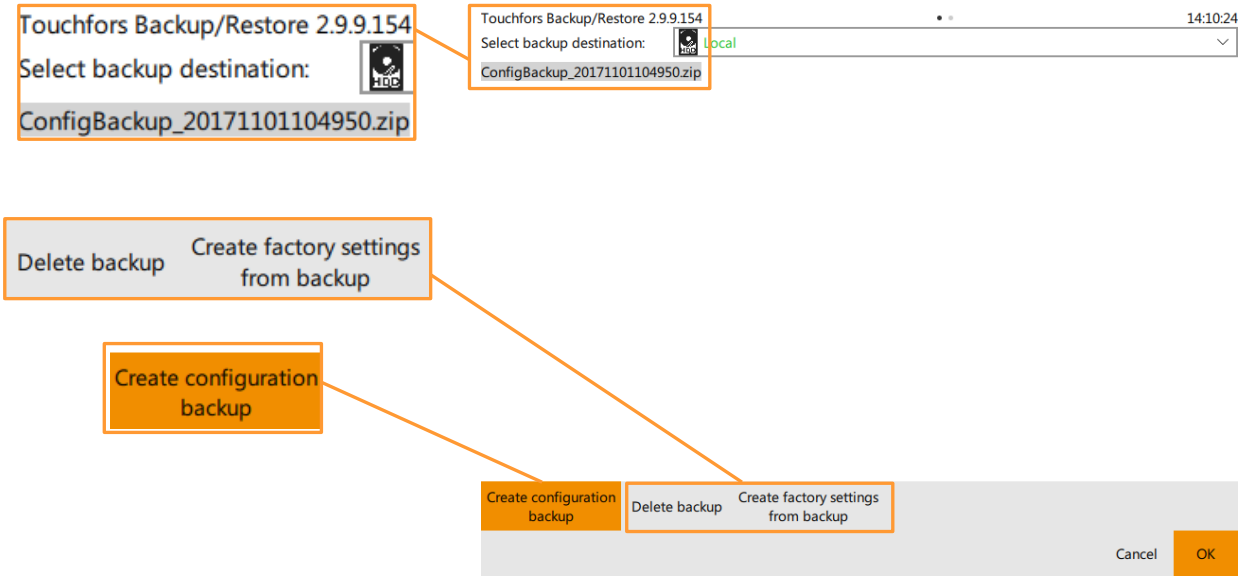
2. Log on to the system on user level *Administrator*, call up main menu *System* and select submenu *Settings*.
3. Press **Backup** in the *Files* area.

The *Confirmation* dialogue box appears with:

- Information: *You will be switched to backup mode*
- Instruction: *Press OK to confirm*
- **OK**: To confirm switching to data backup mode
- **Cancel**: To close the dialogue box without changes

4. Press **OK**.

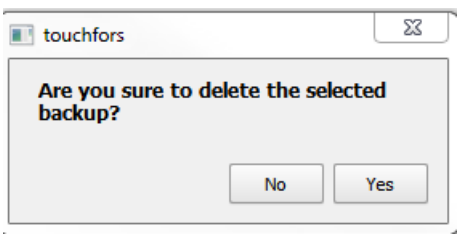
The menu for data backup opens with:



- *Select backup destination*:
  - *local*: To locally save the backup
  - *external*: To save the backup externally on a detected and connected USB stick.
- **Create configuration backup**: To create the backup
- **Delete backup**: To delete the backup
- **Create factory settings from backup**: To create factory settings from the backup.
- **Cancel**: To leave the menu without changes
- **OK**: To save the backup and leave the menu.

5. Select the backup destination and press **Create configuration backup** to create the backup.
6. Press **OK** to save the backup and leave the menu.

Deleting a backup



Pressing **Delete backup** opens a dialogue box with:

- Question: *Are you sure to delete the selected backup?*
- **No**: To cancel and close the dialogue box without changes
- **Yes**: To delete the backup and close the dialogue box

If backup on USB stick:

7. Remove the USB stick and the cable.

3.3.4 Restore – Restoring Saved Data or Restoring Factory Settings

The Restore function enables to restore data, which have previously been saved using the Backup function. Data will be uploaded to the system again. It is also possible to restore factory settings using this function.

INFORMATION

Factory settings usually represent the settings of the bioreactor/bioreactors in as-delivered condition. In case of retrofitting of one or several bioreactors, these settings can be updated, too. Both is exclusively carried out by Infors Service or a licensed dealer.

Note the following:

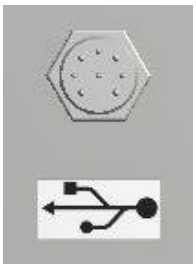
- Data are either restored from the internal memory or from a USB stick, see chapter “Backup – Saving Data”.
- The Restore function is only executable when all bioreactors are stopped, i.e. no fermentation/cultivation is running.

To execute the Restore function, proceed as follows:

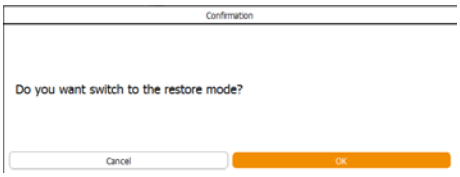
Procedure

Only when using a USB stick, otherwise go to step 2:

1. Use the special cable provided with the equipment and connect it to the appropriate connector on the rear side of the operating panel and connect the USB stick with the saved date (Backup data).



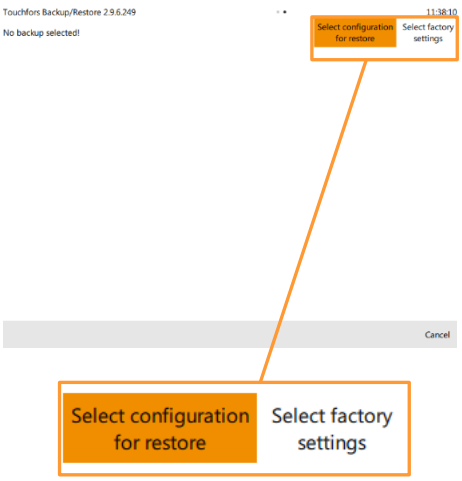
2. Log on to the system on user level *Administrator*, call up main menu *System* and select submenu *Settings*.
3. Press **Restore**.



The *Confirmation* dialogue box appears with:

- Information: *You will be switched to restore mode*
- Instruction: *Press OK to confirm*
- **OK**: To confirm switching to restore mode.
- **Cancel**: To close the dialogue box without changing the mode.

4. Press **OK**.



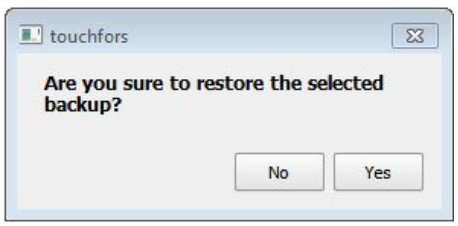
The menu for data restoring appears with:

- **Select Configuration for restore**: To select the backup data for restoring.
- **Select factory settings:** To select factory settings
- **Cancel**: To leave the menu without changes.
- **OK**: To load the selected backup and restore data.

Executing the backup for data restoring

Pressing **Select configuration for restore** changes the menu display and shows with *Select backup source* the choice of the possible data sources:

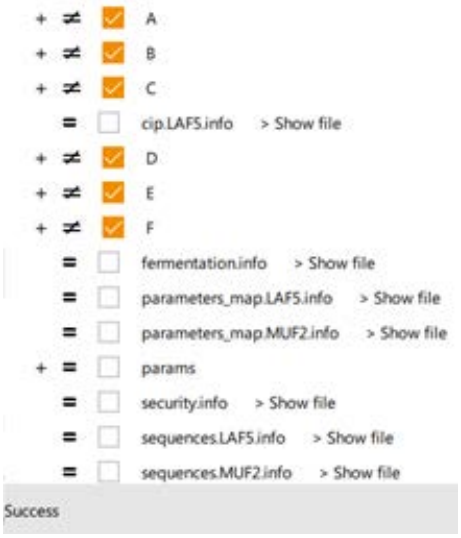
- local: internal memory
- xy (drive) / external: detected and recognised USB stick
- **OK**: To confirm selection



After selection of the data source, a dialogue box appears with:

- *Are you sure to restore the selected backup?*
- **No**: To cancel and close the dialogue box without changes.
- **Yes**: To confirm restoration and start listing data for configuration comparison.

Submenus



After confirmation via **Yes**, the screen changes and lists data for configuration comparison.

- **≠** signifies a difference between Backup and current configuration.
- **=** No difference between Backup and current configuration.
- **+/-** To open/close tree
- Show file / Show difference: To display file / difference

INFORMATION

This view for showing the difference within a file is for information purposes and mainly foreseen for Infors service or licensed Infors dealers. It shows the differences between the settings of the file to restore and the currently used version in unified format (also *unidiff*).

- **Cancel**: To cancel the backup process and leave the menu.
- **OK**: To execute the backup for restoring data.

3.3.5 Export Logs – Exporting Log Files

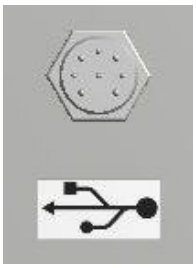
The Export Log functions enables to save all log files (protocol files) as well as alarms and error messages on a USB stick.

Note the following:

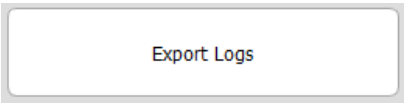
- A USB stick is needed for the export.
- Export is only executable when all bioreactors are stopped, i.e. no fermentation/cultivation is running.

Proceed as follows:

Procedure



1. Use the special cable provided with the equipment and connect it to the appropriate connector (see figure on the left) on the rear side of the operating panel.
2. Connect the USB stick.
3. Log on to the system on user level Technician or Administrator.
4. In main menu *System*, call up submenu *Settings*.



5. Press **Export Logs**.

   Data export is started.

   Once the export is finished, the *Information* dialogue box appears with:

   - Information *Log files successfully exported to: xxxxx*
   - **OK**: To confirm and close the dialogue box.

6. Press **OK**.

   The dialogue box disappears. The Zip file is stored on the USB stick now.

3.3.6 Balance Settings

This function is used to configure the connected balances. It is possible to connect up to maximum 7 balances using the equipment manufacturers switchbox.

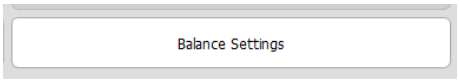
Note the following:

The balance(s) must be configured as follows:
Baud rate 9600, 8 bits, no parity, 2 stop bits.

Proceed as follows:

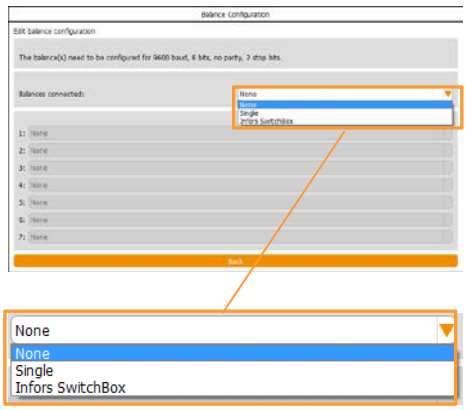
Procedure

1. Connect the balance(s) or switchbox
2. Log on to the system on user level *Administrator*.
3. In main menu *System*, call up submenu *Settings*.



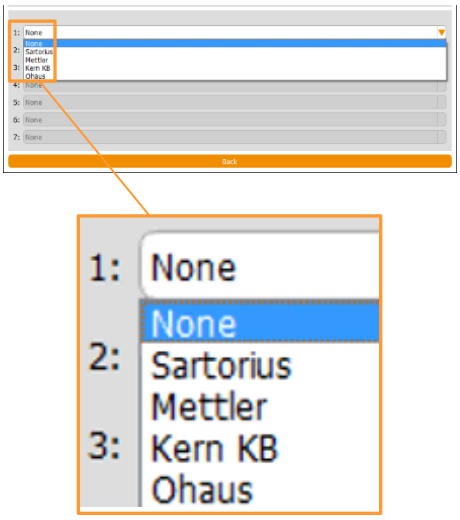
4. Press **Balance Settings**.

The menu *Balance Configuration* appears with:



- Information *The balance(s) need to be configured for 9600 baud, 8 bits, no parity, 2 stop bits*.
- Dropdown menu *balances connected*: to select number of connected balance(s)
  - *None*: no balance
  - *Single*: one balance (without Switchbox)
  - *Infors SwitchBox*
- 7 dropdown menus which are enabled, once one option has been selected.
- **Back**: to save settings and return to submenu *Settings*.

5. Select the desired balance(s).



Dropdown menu(s) for selection of the balance type(s) connected appear(s). The choice contains the following types: none (no balance), Sartorius, Mettler, Kern KB und Ohaus

6. Select the balance type(s).
7. Press **Back**.

   Settings are adopted, submenu Settings reappears.

3.4 Wipe Screen – (Temporarily) Locking the Screen

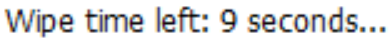
The submenu Wipe Screen has one function only: It locks the screen to prevent any inputs on the screen for 20 seconds. This allows e.g. cleaning the screen for 20 seconds if required.

To activate the temporary screen lock, proceed as follows:

Procedure

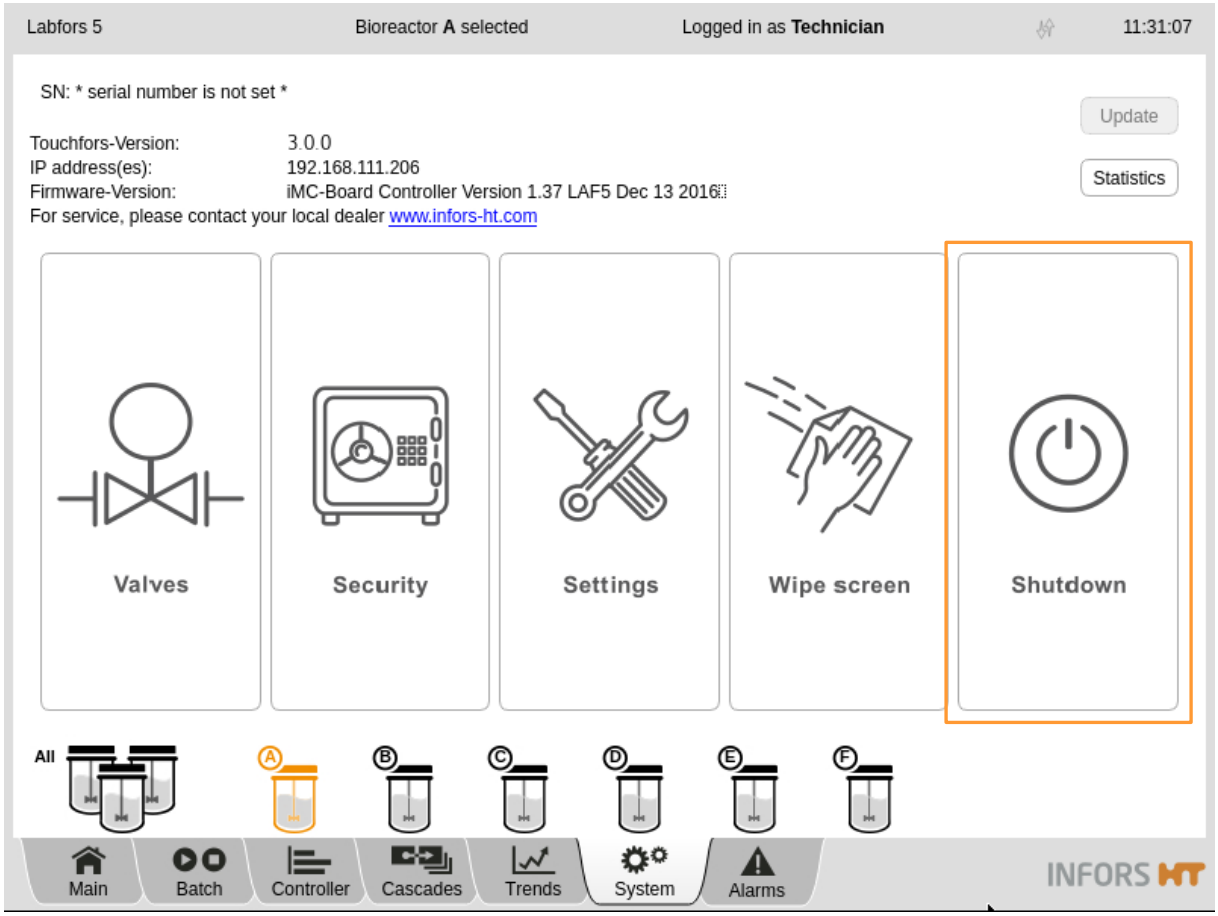
1. In main menu *System*, press **Wipe Screen**.

   The screen turns white, the remaining time is displayed in seconds (*Time left: xx seconds*).



   Once the time has elapsed, the last screen reappears automatically.

3.5 Shutdown – Shutting Down the System



The submenu *Shutdown* has one function only: it shuts down and switches off the system.

The system can only shut down and switch off if all bioreactors have been stopped.

Proceed as follows:

Procedure

1. Stop any running bioreactors by pressing **Stop** in the main menu *Batch*, if necessary.
2. Call up the main menu *System*.
3. Press **Shutdown**.

Submenus

The Confirmation dialogue box appears with:

- Question *Do you want to shutdown the system?*
- **OK**: To shut down the system
- **Cancel**: To close the dialogue box without changes

4. Press **OK**.

The system shuts down and switches off.

INFORMATION

ALWAYS shut down the system first, only then switch the equipment (Labfors 5 / Multifors 2) off at the main switch.

4 Recipes

The various buttons for the Recipes function in main menu *Batch* can be used to load and start, save or delete what are referred to as recipes. This means all parameter settings (including cascade settings) for a fermentation process can be saved and re-used for recurring operating processes later.

INFORMATION

All parameter settings, cascade settings and calibration data of sensors are saved. Pump calibration data are not saved. Calibration data of sensors are not uploaded.

4.1 Save Recipe – Saving a Recipe

Recipes can be saved when the bioreactor is running or stopped. Recipes can only be saved individually for each bioreactor.

To save a recipe, proceed as follows:

Procedure

1. Log on to the system on user level *Technician* or above.
2. Select the desired bioreactor from the selection bar.
3. Call up main menu *Batch* and press **Save Recipe**.

The *Save Recipe* dialogue box appears with:

- Input field for the file name of the recipe being saved.
- **OK**: To save the recipe

  This button is not enabled until a file name has been entered.
- **Cancel**: To cancel the process without saving

4. Touch the input field.

   The alphanumeric keyboard appears.
5. Enter the desired file name, e.g. *BiorA* and confirm with the **OK** key.

   The alphanumeric keyboard disappears

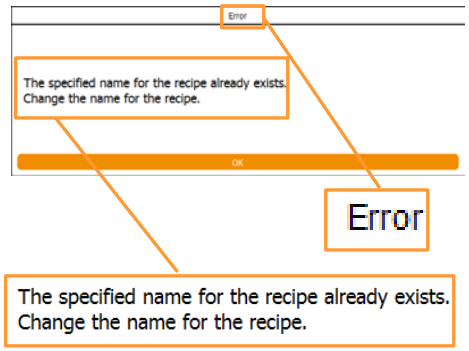
The file name is accepted, **OK** is enabled now.

6. Press **OK**.

   The dialogue box disappears, the recipe is saved.

Recipe file name used twice

If the file name for a recipe has been used twice, an *Error* dialogue box appears with:



- *The specified name for the recipe already exists*
- *Change the name for the recipe*.
- **OK**: To close the dialogue box and enter the new name.

4.2 Load/Start Recipe – Loading and a Recipe

A recipe has to be loaded for each individual bioreactor. One bioreactor recipe can also be used for all other bioreactors.

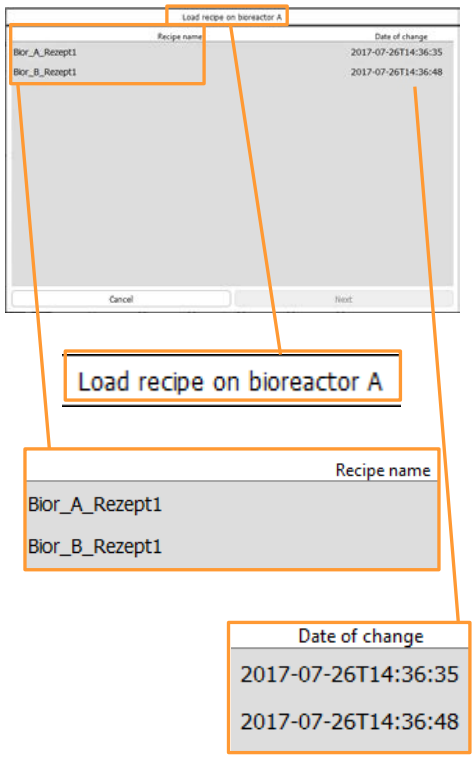
All preparations for a fermentation/cultivaion process should be made before loading and starting a recipe.

Loading recipe from bioreactor A for bioreactor A

The following example shows how a saved recipe of bioreactor A is loaded to bioreactor A. Proceed as follows:

Procedure

1. Log on to the system on user level *Technician* or above.
2. Select the desired bioreactor from the selection bar.
3. Call up main menu *Batch* and press **Load/Start Recipe**.

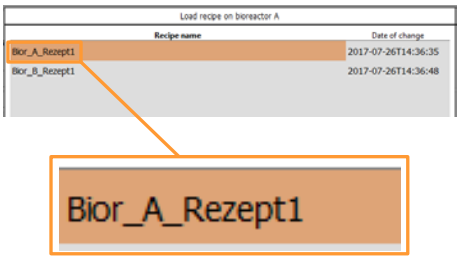


The *Load recipe on bioreactor A* dialogue box appears with:

- *Recipe name*: lists all file names of saved recipes.
- *Date of change*: shows date and hour of the saved recipe(s).
- **Next**: to continue

  This button is not enabled until a recipe has been selected.
- **Cancel**: to cancel the process without saving

4. Select the saved recipe of bioreactor A.



The selected recipe is displayed with an orange background.

5. Press **Next**.

The *Load recipe on bioreactor A* dialogue box changes views:

- *Parameter*: lists all the available parameters
- *Output Active*: to switch parameters on/off
- *Setpoint*: lists the saved parameter setpoint values of the recipe

INFORMATION

This is where setpoint values can be subsequently changed here.

- **OK**: to start the bioreactor
- **Cancel**: to cancel the process without saving

6. If applicable, change setpoints and/or switch parameters on/off.
7. Press **OK**.

   The dialogue box disappears, bioreactor A starts.

Loading recipe from bioreactor A to bioreactor B

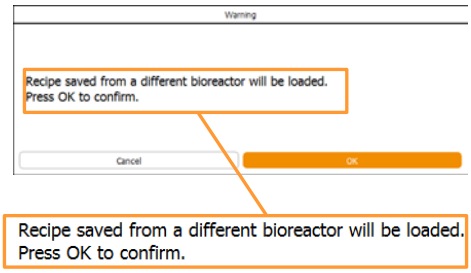
The recipe from one bioreactor (in this case bioreactor A) can also be used for all other bioreactors (in this case bioreactor B). Proceed as follows:

Procedure

1. Select bioreactor B from the selection bar.
2. Touch the **Load/Start Recipe** button in main menu *Batch*.

   The *Load recipe on bioreactor B* dialogue box appears with the same content as described for bioreactor A.
3. Select the saved recipe for bioreactor A.
4. Press **Next**.

Recipes



The *Warning* dialogue box appears with:

- Warning *Recipe saved from a different bioreactor will be loaded*.
- Instruction *Press OK to confirm.*
- **OK**: to confirm execution and load the recipe.
- **Cancel**: to go back to the recipes selection.

5. Press **OK**.

The *Load recipe on bioreactor B* dialogue box changes the view as described for bioreactor A.

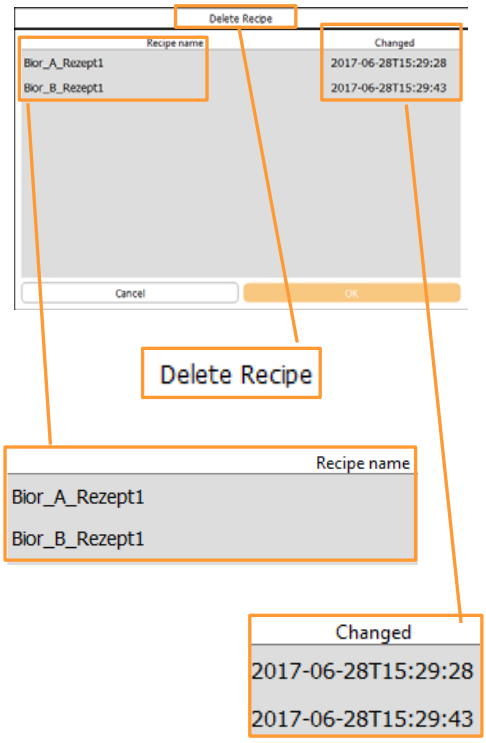
4.3 Delete Recipe – Deleting a Recipe

Recipes can only be deleted one by one. Recipes can also be deleted during a running fermentation process.

To delete a recipe, proceed as follows:

Procedure

1. Log on to the system on user level *Technician* or above.
2. Select any bioreactor or all bioreactors from the selection bar.
3. Call up main menu *Batch* and press **Delete Recipe**.

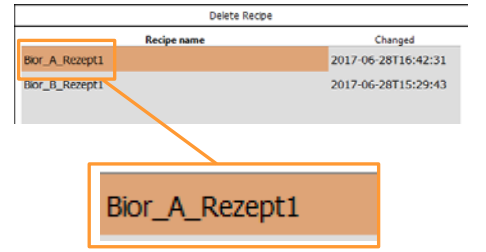


The *Delete Recipe* dialogue box appears with:

- *Recipe name* column: file name of all saved recipes.
- *Changed* column: date and time of the saved recipes.
- **OK**: to delete the selected recipe

  This button is not enabled until a recipe has been selected.
- **Cancel**: to cancel the process without saving.

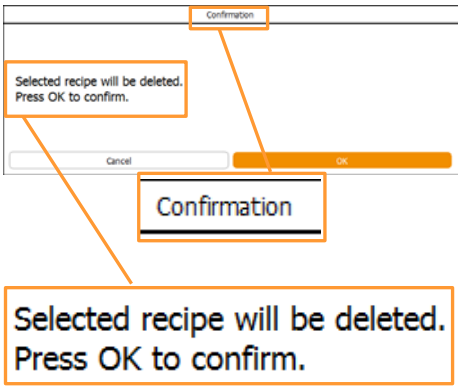
4. Select the desired recipe, e.g. ***Bior_A_Rezept1***.



The selected recipe is displayed highlighted in orange.

5. Press **OK**.

Recipes



The *Confirmation* dialogue box appears with:

- *Selected recipe will be deleted*
- *Press OK to confirm*
- **OK**: to delete the recipe and close the dialogue box.
- **Cancel**: to cancel the process without saving.

6. Press **OK**.

The dialogue box disappears; the recipe is deleted.

5 Parameters

The touch screen operating panel can display and control a maximum of 24 parameters. Depending on the equipment and its configuration, more or fewer parameters are visible and available in the system.

The following describes first the default integrated parameters and their function. It then describes the frequently used optional parameters and their intended function.

Further application-specific parameters, whose configuration and function differ from those described here, are available on request. As a result of the various combination options, not all possible configurations are described.

5.1 Temp

Measures and controls the temperature in the culture vessel. Measurements are recorded by a platinum resistance temperature sensor (Pt100).

Control range(s) vary depending on the equipment's temperature control system and can be found in the technical specifications of the equipment's operating manual.

5.2 Stirrer

Measures and controls the rotation speed of the stirrer shaft. This depends on factors such as the type of vessel volume, drive system, culture viscosity and number and kind of impellers and can be found in the technical specifications of the equipment's operating manual.

5.3 pH

Measures and controls the pH in the culture vessel. Control range: pH 2 to 12. There are two systems to choose from for measuring pH:

Analogue system

- Measuring range: pH 2 to 12
- Traditional pH sensor (potential measurement against reference)
- Manufacturer METTLER TOLEDO

Digital system

- Measuring range: pH 0 to 14
- Traditional pH sensor (potential measurement against reference) with integrated electronics, of the type Easyferm Plus ARC
- Manufacturer: HAMILTON

  These pH sensors are preconfigured before dispatch by the equipment manufacturer INFORS HT. Replacement sensors of this type must be reconfigured before use!

pH is controlled as standard by adding acid and base via the two digital peristaltic pumps *Acid* and *Base*. CO_2 can also be used instead of acid. In this case it is added via a magnetic valve or a mass flow controller in the gas line. This configuration requires a corresponding cascade control with a factory preset.

The activity of the pumps is time dependent. This means that they always operate in start/stop mode at the same speed. Control is made by a PID loop. A dead band can be used to prevent unwanted rapid dosing.

Temperature compensation is a special function of the pH parameter when using METTLER pH sensors. This function must be switched on during fermentation so that the temperature dependency of the measurement principle is corrected. For the digital HAMILTON pH sensors, this function is integrated in the sensor.

INFORMATION

pH of liquids is also temperature dependent which is why the pH also reacts on temperature changes when temperature compensation is switched on.

Details on technical data, use and maintenance of the pH sensors can be found in the separate documentation of the sensor manufacturers.

5.4 pO2

Measures and controls the saturation of dissolved oxygen in the (culture) medium. Control range: 0 – 100 %. There are two systems to choose from for measuring pO_2:

Analogue system

- Measuring range: 0 – 150 %
- Traditional amperometric/polarographic pO_2 sensor.
- Manufacturer: METTLER TOLEDO

Digital system

- Measuring range: 0.05 % - 300 % air saturation
- pO2 sensor with integrated optoelectronics, type Visiferm DO ARC
- Manufacturer: HAMILTON

  These pO_2 sensors are preconfigured before despatch by the equipment manufacturer INFORS HT. Replacement sensors of this type must be reconfigured before use!

In comparison, for example, with pH measurement which is calibrated to absolute measurements, calibrating the oxygen measurement is always performed to a relative reference point. To do this the calibration is to 100 % relative oxygen saturation, generally determined with air to a max. stirrer speed and maximum gassing rate. The actual concentration of dissolved oxygen in mmol/l can therefore differ for 100 % saturation depending on the process.

The PID controller output from pO_2 is generally cascaded to other parameters such as *Stirrer*, *Flow*, *Feed* or *GasMix*.

Details on technical data, use and maintenance of the pO_2 sensors can be found in the separate documentation of the sensor manufacturers.

5.5 Antifoam

Measures the fill level or the foam formation and controls the addition of antifoam reagent via the digital peristaltic pump *Antifoam* in the culture vessel. The antifoam pump is activated when the antifoam sensor comes in contact with foam.

The activity of the pump is time dependent. This means that it always operates in start/stop mode at the same speed.

- The *Dose time* must be set in seconds instead of the setpoint.
- The *Wait time* must be set in seconds instead of setting an alarm limit.

5.6 Level

Detects liquid in the culture vessel using a level sensor and regulates the fill level using an assigned pump, depending on the configuration.

5.7 Feed

The addition of the feed solution (feed) is regulated via the analogue peristaltic pump *Feed*. Pump speed is adjustable and can be set in steps of 0.1 % within a range of 0 % to 100 %.

5.8 Feed 2 + Feed 3

Regulates the addition of feed solution (feed) via the (optional) 5th and 6th *Feed 2* + *Feed 3* peristaltic pumps. Pump speed is adjustable and can be set in steps of 0.1 % within a range of 0 % to 100 %.

5.9 Weight

Displays the measurement of a connected external scale.

5.10 Flow

Measures and regulates the flow of two or more process gases in the culture vessel via a single mass flow controller (thermal mass meter with integrated control valve). The measurement system is entirely electronic and the measurement is displayed according to the present configuration in L/min or mL/min.

INFORMATION

The mass flow controllers are calibrated by the manufacturer at their factory under standard conditions, which means at 1.013 bar and 20 °C. For this reason for each gas flow rate, the standard volumetric flow is given in L/min or mL/min.

If the parameter *Flow* is available this means that the individual process gas lines are equipped with magnetic valves, which are switched using the *Gasmix* parameter.

5.11 GasMix

Controls the oxygen concentration in the inlet air. This is achieved by switching between air and oxygen or air and nitrogen for a 2-gas-mix system or air, oxygen and nitrogen for a 3-gas-mix system.

Depending on the existing configuration this means that the relevant magnetic valve is switched on or the individual gas flow parameters are controlled.

Example

2-gas-mix system with air and oxygen, supplied via a magnetic valve:

Settings

- cycle duration: 10 seconds
  (visible in the input field *Eval. Time (s)* in the option *PID* of the *GasMix* parameter)
- setpoint in the *GasMix* parameter: 20

This means that:

- the magnetic valve for oxygen opens for 2 seconds
- the magnetic valve for process air opens for 8 seconds

Setpoint 100 ≙ 10 seconds

Setpoint 20 ≙ 2 seconds

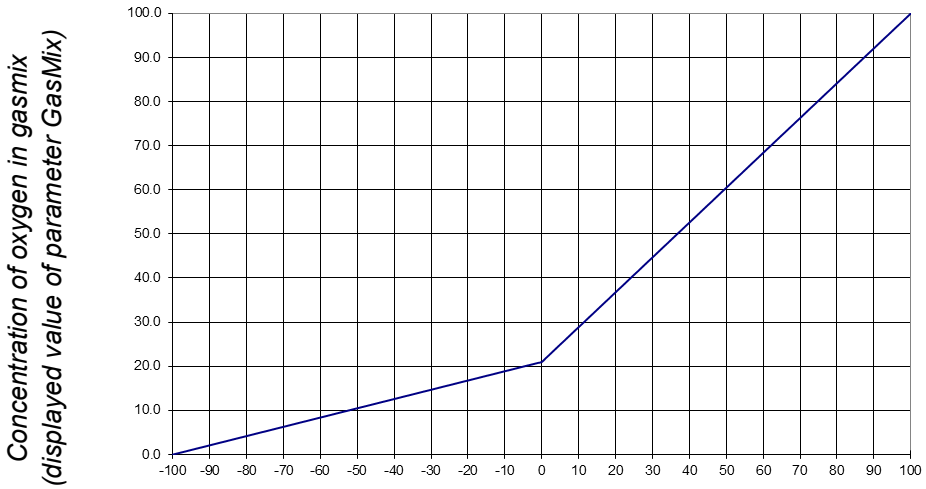
INFORMATION

For this described configuration of the 2-gas-mix system with air + oxygen with two magnetic valves, the oxygen portion of the gas mixture cannot fall below 20.95 %.

For a 3-gas-mix system the displayed value is the percentage of oxygen in the gas mixture.

However, for entering the setpoint the following applies:

- -100 = only nitrogen ≙ 0 % O_2 content
- 0 = only air ≙ 21 % O_2 content
- 100 = only oxygen ≙ 100 % O_2 content



Setpoint Parameter GasMix

If the parameter *GasMix* combined with the parameter *GM Flow* and the parameters *Air Flow*, *O2 Flow* and/or *N2 Flow* is installed

and configured, the specified parameters are preconfigured by the equipment manufacturer in an advanced cascade for pO_2 control.

ATTENTION

Changes to a cascade that has been preset by the equipment manufacturer may cause controller errors!

5.12 GM Flow

Sets the gassing rate of the gas mixture (GasMix parameter). This parameter can only be used and set in conjunction with the parameters *GasMix*, *Air Flow* and *O2 Flow* and/or *N2 Flow*.

From the gassing rate of the gas mixture (*GM Flow*) and the setpoints of the GasMix parameters the equipment calculates the flow rates of the individual gases (e.g. *Air Flow*, *O2 Flow* etc.)

Only a setpoint input for the *GM Flow* parameter is required, the values of the parameters specified above are automatically determined and controlled.

ATTENTION

Additionally entering setpoints for individual flow parameters when using the GM Flow parameter causes controller errors!

Should the flow parameters be individually controlled, the parameters *GM Flow* **and** *GasMix* **need to be switched off**.

5.13 Air Flow

Measures and regulates the flow of air in the culture vessel via a mass flow controller (thermal mass meter with integrated control valve). The measurement system is entirely electronic and the measurement is displayed according to the present configuration in L/min or mL/min.

INFORMATION

The mass flow controllers are calibrated by the manufacturer at their factory under standard conditions, which means at 1.013 bar and 20 °C. For this reason for each gas flow rate, the standard volumetric flow is given in L/min or mL/min.

To specify the gassing rate independent of the used vessel size, the specific gassing rate (also: vvm) is often used, at which the standard volumetric flow is given in relationship to the culture volume. Bioreactors for cultivating bacteria are generally designed for a maximum specific gassing rate of 2 min^{-1}. This means that the maximum gassing rate is twice the maximum working volume per minute. Cell culture bioreactors, in comparison, are usually designed for a maximum specific gassing rate of 0.1 min^{-1}.

5.14 O2 Flow

Measures and regulates the flow of oxygen in the culture vessel via a mass flow controller (thermal mass meter with integrated control valve). The measurement system is entirely electronic and the measurement is displayed according to the present configuration in L/min or mL/min.

INFORMATION

The mass flow controllers are calibrated by the manufacturer at their factory under standard conditions, which means at 1.013 bar and 20 °C. For this reason for each gas flow rate, the standard volumetric flow is given in L/min or mL/min.

5.15 N2 Flow

Measures and regulates the flow of nitrogen in the culture vessel via a mass flow controller (thermal mass meter with integrated control valve). The measurement system is entirely electronic and the measurement is displayed according to the present configuration in L/min or mL/min.

INFORMATION

The mass flow controllers are calibrated by the manufacturer at their factory under standard conditions, which means at 1.013 bar and 20 °C. For this reason for each gas flow rate, the standard volumetric flow is given in L/min or mL/min.

5.16 CO2 Flow

Measures and regulates the flow of carbon dioxide in the culture vessel via a mass flow controller (thermal mass meter with integrated control valve). The measurement system is entirely electronic and the measurement is displayed according to the present configuration in L/min or mL/min.

INFORMATION

The mass flow controllers are calibrated by the manufacturer at their factory under standard conditions, which means at 1.013 bar and 20 °C. For this reason for each gas flow rate, the standard volumetric flow is given in L/min or mL/min.

Labfors 5 Lux

If the parameter *pCO2* is available, *CO2 Flow* is pre-configured for control of the *pCO2* parameter ex-factory.

5.17 Exit CO2 and Exit O2

These parameters measure the gas concentration of carbon dioxide (CO2) and oxygen (O2) in the exit gas of the bioreactor and are used for exit gas analysis. Usually these two measurements are combined that is why both parameters are described here.

There are two systems to choose from for this (combined) measuring:

Gas analysis device of the equipment manufacturer

- Measuring range CO_2: 0 % - 10 Vol. % CO_2
- Measuring range O_2: 1 % - 25 Vol. % O_2

Gas sensor of the manufacturer BlueSens

a) Type BlueIn OneFerm

- Measuring range CO_2: 0 % - 10 Vol. % CO_2
  Or 0 % - 25 Vol. % CO_2
- Measuring range O_2: 1 % - 50 Vol. % O_2

b) Type BlueInOne Cell

- Measuring range CO_2: 0 % - 10 Vol. % CO_2
- Measuring range O_2: 0.1 % - 100 Vol. % O_2

Both types and all variants of these gas sensors of the manufacturer BlueSens are combined CO2 and O2 sensors.

ATTENTION

Risk of damaging the gas sensor by operating outside of specifications! The measurement cells of zirconium oxide-based gas sensors (Infors Gas Analyser and BlueInOne Ferm) are damaged when continuously operated with oxygen-free gas mixtures.

Therefore, only use gas sensors with galvanic measurement cells (type BlueInOne Cell) when permanently operating with oxygen-free gas mixtures.

Details on technical data, use and maintenance of the gas analysis device or the gas sensors can be found in separate documentation.

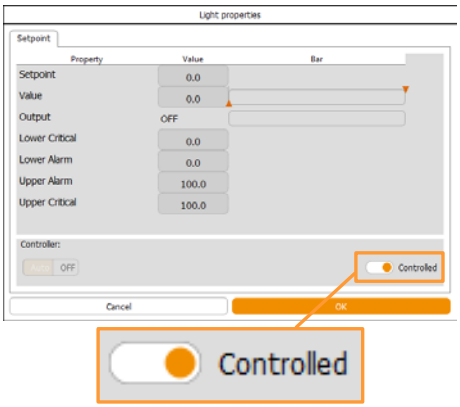
5.18 Light

Labfors 5 Lux LED flat panel

Controls the light intensity of the LEDs on the irradiation unit. Setting range: 0 %–100 %.

Settings can then be made in 0.1 % increments.

When using the optional light sensor, the Light parameter is calibrated based on the absolute light intensity range of the built-in irradiation unit. The value is indicated in µmol m^{-2} s^{-1}.



Also luminostat operation is possible, if the optional light sensor is used. In this case, the *Controlled* function (check box) in parameter option *Setpoint* must be activated to enable control.
The light intensity reaching the light sensor, is then used to define a setpoint.

The controller modifies the light intensity of the irradiation unit so that the same light intensity reaches the sensor allowing for varying culture density conditions. In other words: the biomass always “receives” the same quantity of light.

The bioreactor can also be converted for turbidostat operation on request (Infors-Service). Here, the light intensity is recorded by the separate parameter *Light Sensor.* A pump can also be cascaded to this parameter in order to dilute the culture, if the measured light intensity decreases. Over time, the biomass is adjusted so that the average light intensity per biomass is kept constant.

5.19 OD

Is used to determine the turbidity of the culture by means of a measuring system of the manufacturer Optek. The optical density measurement can be used to draw conclusions regarding the biomass concentration in the culture.

The measuring system comprises a sensor of the type ASD12-N with a transmitter that is integrated into the bioreactor basic unit.

Measuring range of absorption: 0 – 6 CU.

The OD parameter is set to this measuring range, too.

There are three different sensors with three different optical path lengths available:

- OPL01: for very high cell densities
- OPL05: for higher cell densities
- OPL10: for lower cell densities

The ASD12-N sensors supply a non-linearised turbidity measurement for the culture. This can be linearised manually using the soft

sensor in eve®, for example, in order to determine correlation with factors such as the biomass concentration or optical density.

Details on technical data, use and maintenance of the measuring system can be found in the separate documentation of the sensor manufacturer.

5.20 Capacitance

Measures the capacity that correlates to the live biomass. This is measured using an ABER FUTURA biomass sensor. The measurement range is 0 pF cm^{-1} to 400 pF cm^{-1}.

Sensors of the ABER Futura systems measure the permittivity (also: *capacitance*) and conductivity of the culture. This measured data can be used to determine a correlation with the live biomass concentration, for example, using the soft sensor in eve® or data evaluation.

The sensor with the corresponding transmitters must be purchased directly from the manufacturer ABER. INFORS HT offers a connection to the transmitter on the basic unit.

All information about the ABER Futura system is available in the separate documentation provided by the manufacturer.

5.21 Conductivity

If the bioreactor is equipped with an ABER FUTURA biomass sensor, this can also be used to measure conductivity.

In this case the measuring range is: 0 - 40 mS cm^{-1}

Sensors of the ABER Futura systems measure the permittivity (also: *capacitance*) and conductivity of the culture. This measured data can be used to determine a correlation with the live biomass concentration, for example, using the soft sensor in eve® or data evaluation.

The sensor with the corresponding transmitters must be purchased directly from the manufacturer ABER. INFORS HT offers a connection to the transmitter on the basic unit.

All information about the ABER Futura system is available in the separate documentation provided by the manufacturer.

5.22 Redox

Measures the reduction/oxidation potential (redox) in the medium. Two systems are available for redox measurement:

Analogue system

- Measuring range: –2000 mV bis +2000 mV.
- Classic combined sensor (oxidation reduction potential measurement against a reference)
- Manufacturer: METTLER TOLEDO

  To use the sensor, the basic unit must be equipped with a corresponding connection.

Digital system

- Measuring range: -1500 mV bis +1500 mV.
- Classic combined sensor (oxidation reduction potential measurement against a reference) with integrated electronics, type Easyferm Plus ORP ARC.
- Manufacturer: HAMILTON

If the basic unit is configured for Hamilton sensors, the redox sensor can be connected instead of the pO_2 sensor. If the sensor is configured in addition to the Hamilton pO_2 sensor or if the basic unit is configured for Mettler sensors, an additional connecting cable is required.

The redox sensor is usually not calibrated/adjusted. However, the calibration of the sensor can be checked using the appropriate redox buffer solution.

- METTLER system: 1-point calibration in the calibration menu of the redox parameter in the touch screen software from the administrator user level.
- HAMILTON system: Calibration using a Hamilton Arc Handheld or a Hamilton Arc USB cable, both of which are available separately from the sensor manufacturer.

Details on technical data, use and maintenance of the Redox sensors can be found in the separate documentation of the sensor manufacturers.

5.23 pCO2

Measures the saturation of dissolved carbon dioxide (CO_2) in the culture in hPa.

- Measuring range: 0 - 1000 hPa
- Digital CO_2 sensor with integrated temperature sensor, type InPro5000i ISM
- Manufacturer: METTLER TOLEDO (sensor and transmitter)

The measurement display of the pCO2 parameter in the touch screen software is set similarly to the measurement display of the transmitter.

If a CO_2 gas line is available with a mass flow controller (CO2 Flow parameter), this can be used to control the pCO2.

The sensor is calibrated directly at the transmitter according the manufacturer's specifications.

Details on technical data, use and maintenance of the pCO_2 sensor and the associated transmitter can be found in the separate documentation of the manufacturer METTLER TOLEDO.

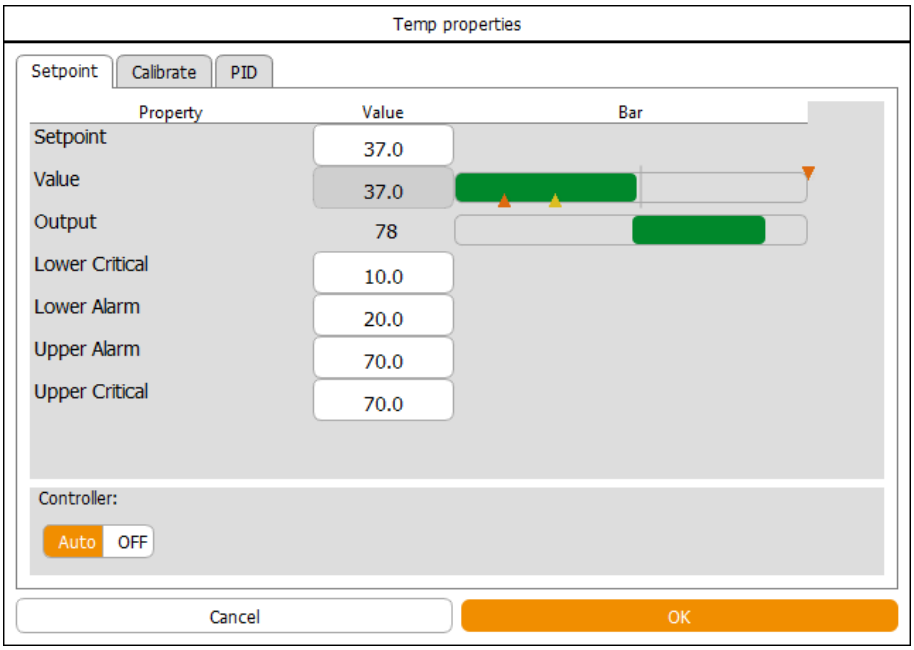
5.24 JTemp

Labfors 5 BioEthanol

As a result of the high solid content inside the vessel, the heat transfer from the vessel jacket to the culture vessel is not ideal, which means that there can be a high temperature drop from the jacket to the vessel content. In some circumstances this may lead to inactivating enzymes/bacteria close to the jacket. It can therefore be useful to limit the maximum temperature of the vessel jacket.

To do this you need to create a cascade for the parameter *Temp* (temperature), whereby the *JTemp* is specified as a control parameter. Within the limits of the minimum and maximum setpoint, the jacket temperature of the system varies to reach the required setpoint for the Temp parameter.

6 Parameter Options



Parameter options are setting menus for the parameters. They are shown as tab pages in the *Properties* dialogue box for the selected parameter. The figure above shows the example of the *Temp properties* dialogue box (temperature parameter).

The parameters and their options (setting menus) for each individual bioreactor are called up in main menu *Controller*.

Depending on the access authorisation and the type of the parameter, more or less options may be available.

For details on user levels and their access authorisations see the chapter “Access Authorisation of User Groups”.

Every *properties* dialogue box for each parameter has two buttons:

- **OK**: Saves inputs, closes dialogue box
- **Cancel**: Closes the dialogue box without changes

Most parameters have the following options:

- *Setpoint*: This is where setpoint values, alarm values and critical values can be set and where parameters can be switched on and off.
- *Calibrate*: This is where the sensors’ measured values are calibrated.

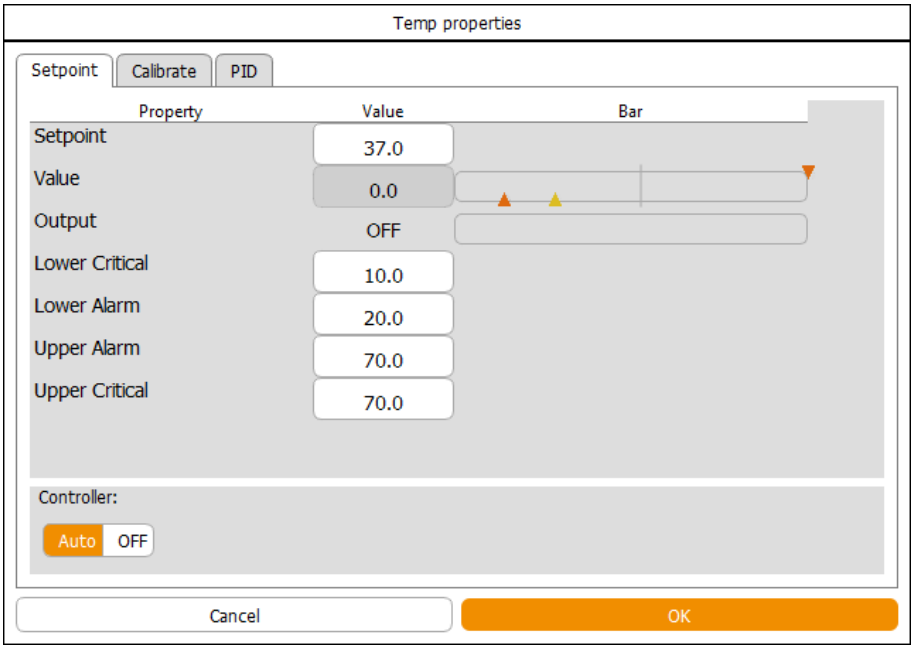
This option is only available for calibration of the measured values of the pH, pO2 and OD sensors (OPTEK system) on user levels User and Technician. All other calibration menus are only accessible on user level Administrator and above.

- *PID*: This is where controller settings are made.
- *Options*: This is where the basic parameter settings are made.

  This option is only accessible to the manufacturer's qualified personnel. This option is not visible or enabled at any other user level.

The following chapters describe the content and function of the individual tab pages, i.e. parameter menus. Each menu description is followed by either detailed setting instructions or a cross reference to the respective corresponding in these operating instructions.

6.1 Setpoint



The tab page for the *Setpoint* option is divided up into a three-column main area with input fields and view boxes and a *Controller* area.

Columns

- *Property*: designation of the input fields and view boxes
- *Value*: values of the input fields and view boxes
- *Bar*: graphic display of the values as in main menu Controller. For details refer to chapter “Main Menus”, “Controller – Value Display”.

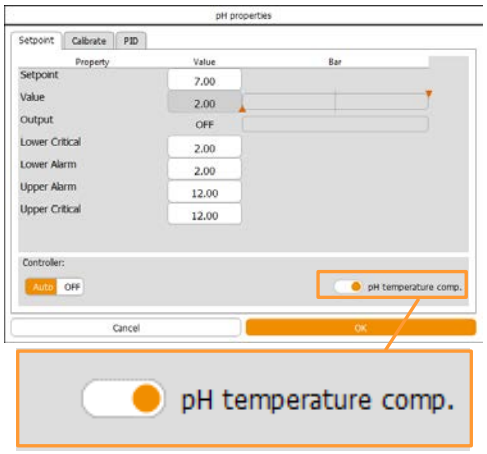
Input fields and view boxes

- *Setpoint*: to enter the setpoint
- *Value*: displays the current value
- *Output*: Shows the controller output as a percentage.
- *Lower Critical*: to enter the lower critical value
- *Lower Alarm*: to enter the lower alarm value
- *Upper Alarm*: to enter the upper alarm value
- *Upper Critical*: to enter the upper critical value

Parameter Options

Controller

- **Auto**: to switch on the parameter into automatic mode. In this mode, it is possible to switch the parameter on or off by touching the controller output (displayed value *OFF* or %) in main menu *Controller* during a running fermentation/cultivation.
- **OFF**: to switch off the parameter. This mode deactivates the controller output in main menu *Controller*, too.



The pH parameter has the additional function *pH temperature comp*. (pH temperature compensation). It has to be switched on during a fermentation/cultivation process so that temperature-compensated values can be generated. That means, the temperature dependency of the measuring principle will be corrected.

pH of liquids is temperature-dependent, too. Therefore pH will still be responsive to temperature variation, although temperature compensation is switched on.

This function also has to be switched on to calibrate the pH sensor whilst simultaneously measuring the temperature of the pH buffer solution or manually entering the temperature of the buffer solution.

INFORMATION

Temperature compensation is only relevant when the analogue measuring system is configured for the use of pH sensors from the manufacturer METTLER. The digital measuring system which uses pH sensors from the manufacturer HAMILTON this function is integrated into the sensor, and is therefore not used in the touch screen software.

6.1.1 Setting Setpoint Values, Switching Parameters ON / OFF

Parameter setpoint values are basically set in the start dialogue for one bioreactor or all bioreactors. Once the bioreactor(s) is/are running, setpoint values can be changed then via main menu *Controller* for each bioreactor individually.

Parameters can be switched on or off in the start dialogue or via main menu *Controller* once the bioreactor(s) is/are running, if their controller output is set to automatic mode in the *Setpoint* option of the parameter.

In stopped state of a bioreactor, all its parameters are automatically switched off and cannot be switched on.

INFORMATION

Bioreactor(s) is/are always started with the settings in the start dialogue. Changes to these settings are saved and transferred to the next start dialogue. If setpoint values are changed or parameters are switched on/off whilst a bioreactor is running, these settings are only adopted for the current fermentation process.

Note the following when setting setpoints:

When using a lightly foaming medium, set the setpoints in parameters *Stirrer* (stirrer speed) and the different *Flow* parameter(s) as low as possible if this does not have a negative effect on the oxygen supply to the culture.

If there is still heavy foaming, a chemical antifoaming agent will need to be used. In this case the *Dose time* and *Wait time* in the parameter *Antifoam* has to be set accordingly.

Settings in the start dialogue

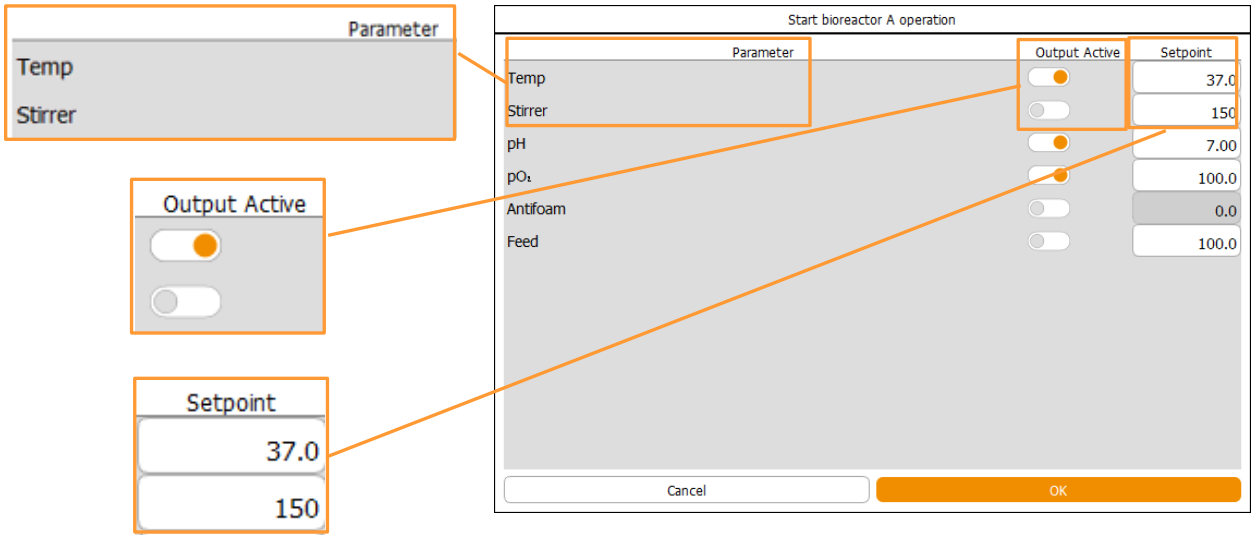
To make the setings in the start dialogue, proceed as follows:

Procedure

1. Select the desired bioreactor from the selection bar, e.g. bioreactor A.
2. Call up main menu *Batch* and press **Start**.

Parameter Options

The *Start bioreactor A operation* (start dialogue) dialogue box appears with:



- *Parameter*: lists all the available (depending on the equipment configuration) parameters
- *Output Active*: to switch each parameter individually on or off, if the *Controller* in the *Setpoint* option of the parameter is set to automatic (*Auto*) mode.
- *Setpoint*: lists all parameter setpoint values with which the bioreactor is started. Setpoint values can be changed here.
- **OK**: to save inputs and start the bioreactor (fermentation/cultivation)
- **Cancel**: to close the dialogue box without changes

3. Press ***Setpoint*** of the desired parameter, e.g. *Stirrer*.

   The numeric keypad appears.
4. Type in the desired setpoint value, e.g. **300**, and confirm with the **OK** key.

   The numeric keypad disappears; the value is accepted for the *Setpoint* view box/input field.
5. Repeat the same procedure for all desired parameters.
6. Switch on/off parameters as required.
7. Press **OK**.

   The dialogue box disappears, the settings are saved, the bioreactor (fermentation/cultivation) is started.

   When all bioreactors are selected (*ALL*), they are all started with the same settings.

   Changed settings are transferred to the next start dialogue.

Settings on a running bioreactor

To make the settings on a running bioreactor the following two options are available:

a) Directly via the *Setpoint* input field/view boxes and the controller output buttons in the *Output* column of the main menu *Controller*.

b) In the *Setpoint* menu of the selected parameter in the *Parameter* column of the main menu *Controller*.

INFORMATION

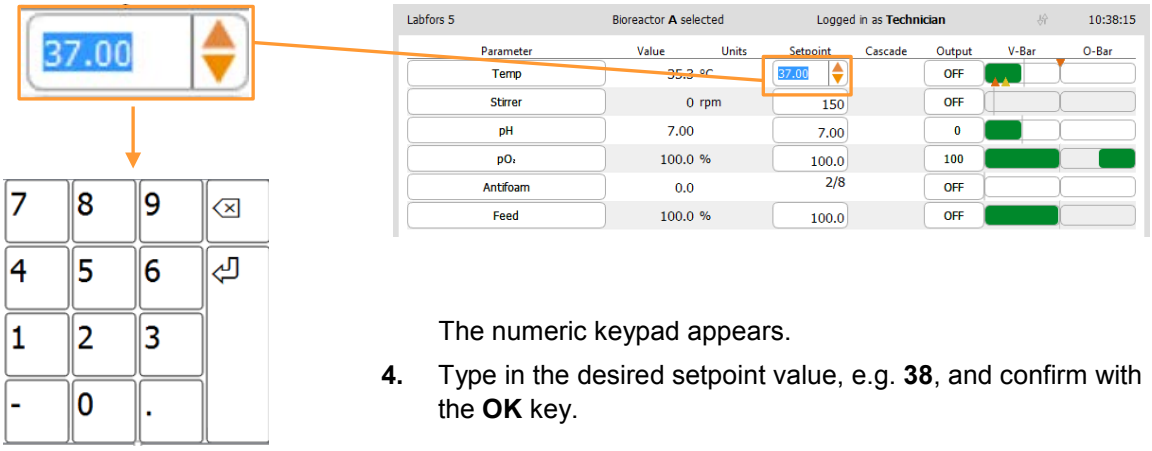
Changed settings are adopted for the fermentation/cultivation process in progress only.

Proceed as follows:

Variant a)

Procedure

1. Select the desired bioreactor from the selection bar, e.g. bioreactor A.
2. Call up main menu *Controller*.
3. Press the *Setpoint* input field/view box of the desired parameter, e.g. *Temp*.

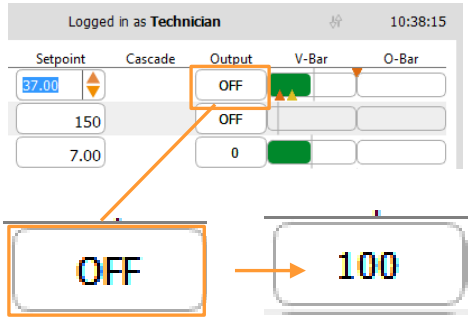


The numeric keypad appears.

4. Type in the desired setpoint value, e.g. **38**, and confirm with the **OK** key.

The numeric keypad disappears; the value is accepted for the *Setpoint* view box/input field.

Parameter Options



5. Press the controller output button of the parameter.

The parameter is switched on, the controller output changes from *OFF* to the display of the corresponding numeric value in %.

INFORMATION

To switch the parameter i.e. controller output on or off here, is only possible, if the controller of the parameter is set to automatic (Auto) mode in its *Setpoint* option. See also next procedure in variant b).

6. Repeat the same procedure for all desired parameters.

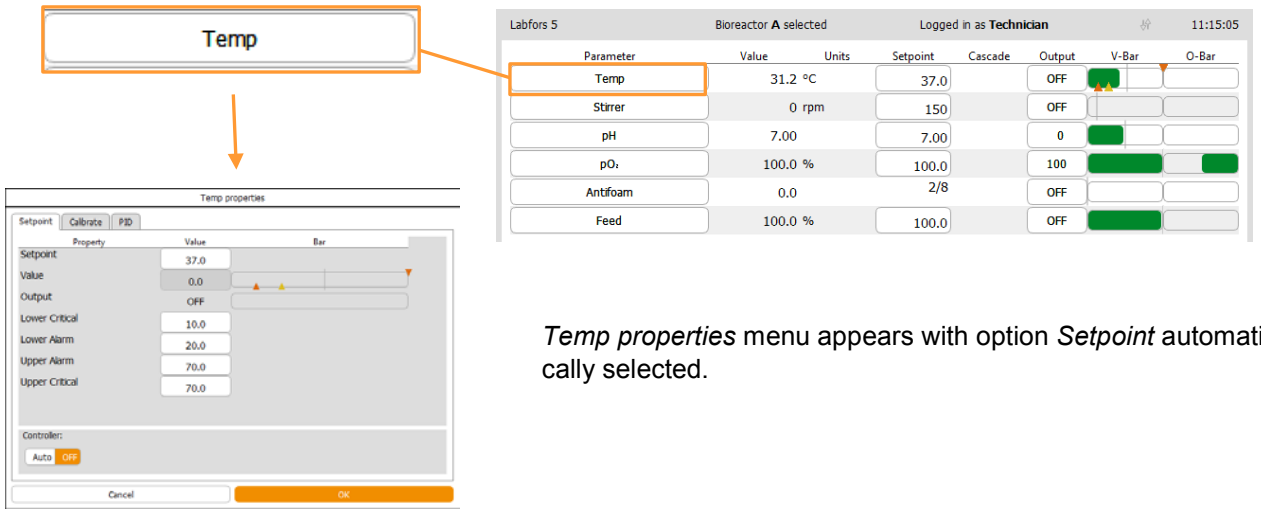
Variant b)

Procedure

1. Select the desired bioreactor from the selection bar, e.g. bioreactor A.

2. Call up main menu *Controller*.

3. Press the desired parameter button, e.g. **Temp**, in the *Parameter* column.



Temp properties menu appears with option *Setpoint* automatically selected.

4. Press ***Setpoint***.

The numeric keypad appears.

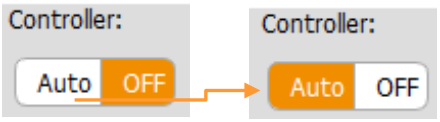
Type in the desired setpoint value, e.g.**38**, an confirm with the **OK** key.

The numeric keypad disappears; the value is accepted for the *Setpoint* input field**.**

5. Change alarm values and critical values as required.

INFORMATION

For details about alarm value and critical value settings refer to chapter „Setting Alarm Values and Critical Values”.



6. Ensure the controller output is switched to automatic mode (**Auto)**, change setting as necessary.

   The parameter is set switched on now.

7. Press **OK**.

   The dialogue box disappears, the settings are saved.

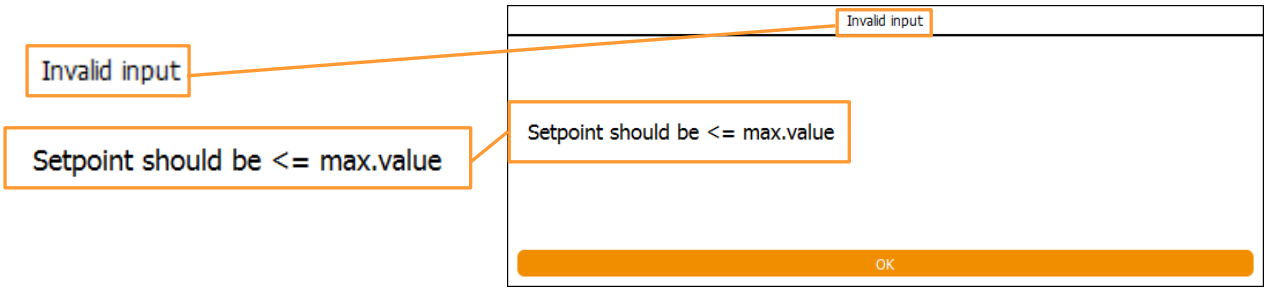
8. Repeat the same procedure for all desired parameters.

Invalid setpoint value or alarm limit input

When an invalid setpoint, alarm or critical alarm value is entered, a corresponding *Invalid input* dialogue box appears after confirming the entered value via OK key.

Example with input of setpoint > max. value

Invalid input dialogue box appears with:

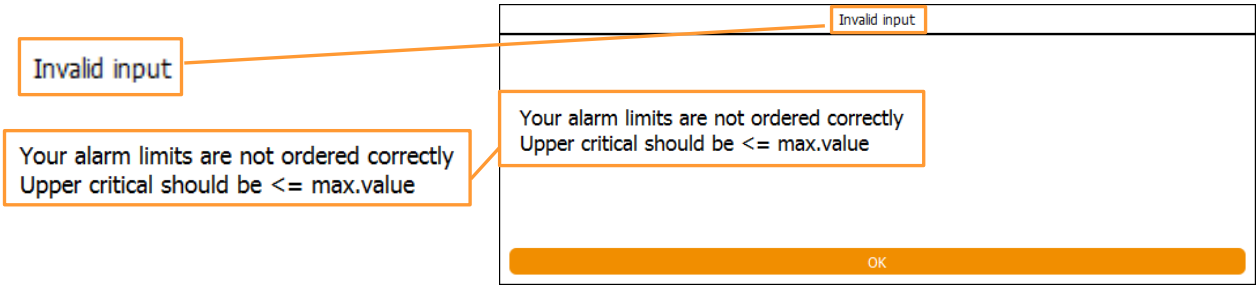


- *Setpoint should be <= max. value*
- **OK**: To close the dialogue box without changes and enter a new setpoint.

Parameter Options

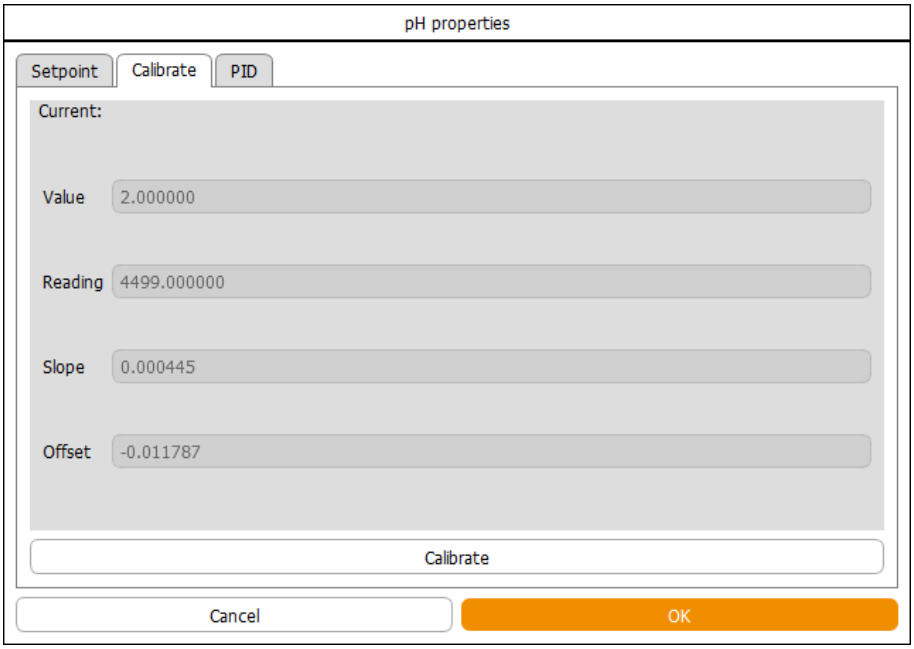
Example with input of upper critical value > max. value

Invalid input dialogue box appears with:



- *Your alarm limits are not ordered correctly. Upper critical should be <= max. value*.
- **OK**: To close the dialogue box without changes and enter a new value.

6.2 Calibrate



The tab page for the *Calibrate* option contains four view boxes and a button:

- *Reading*: shows the current measured value in digital units
- *Value*: shows the current measured value depending on the last calibration
- *Slope*: shows the digital value of the calculated slope of the calibration line
- *Offset*: describes the intersection point of the calibration line with the X axis
- **Calibrate**: To open the calibration menu

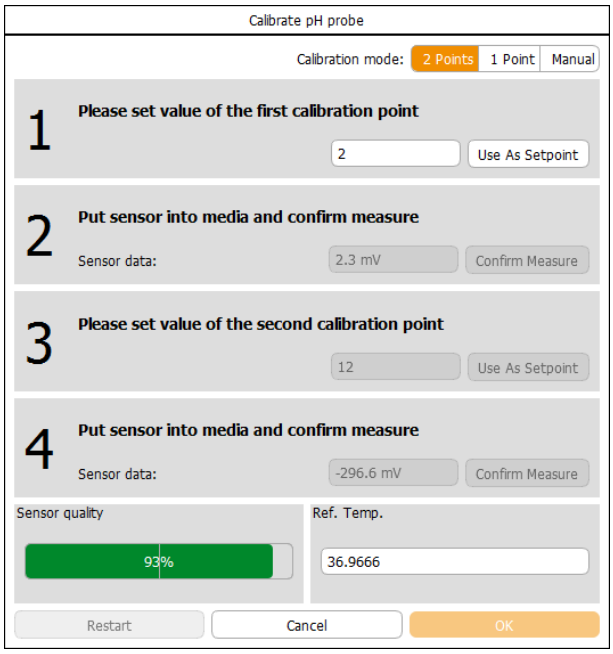
The *Reading*, *Slope* and *Offset* view boxes are not relevant for the digital measuring system with HAMILTON pH and pO_2 sensors. These values are memorised directly in the sensor's integrated electronics. Calibration menus for METTLER and HAMILTON pH and pO2 sensors differ from each other and are described in detail in the following chapters.

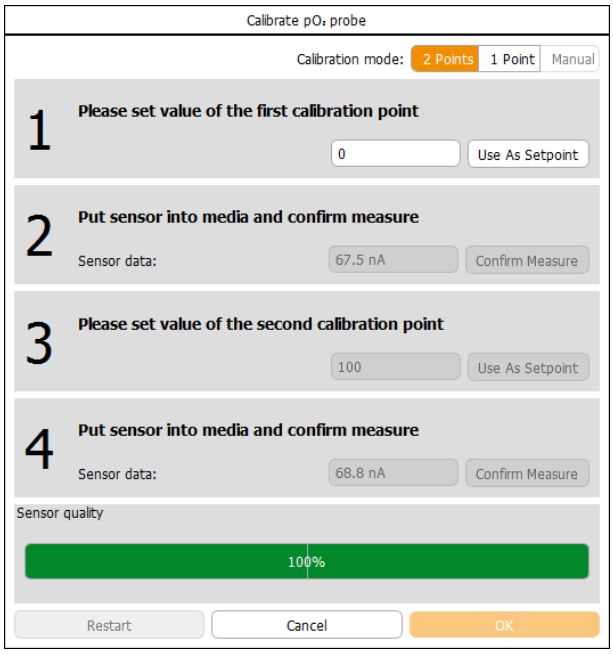
INFORMATION

The calibration menus for pH and pO_2 can also be called up directly via **Calibrate pH** and **Calibrate pO2** in the main menu *Batch*.

6.2.1 Calibration Menus METTLER Sensors

The below figures show the calibration menu for METTLER pH sensors on the left-hand side and on the right, the calibration menu for METTLER pO_2 sensors. Both menus look essentially the same, small differences are explained in the following menu description.





The calibration menu contains the following:

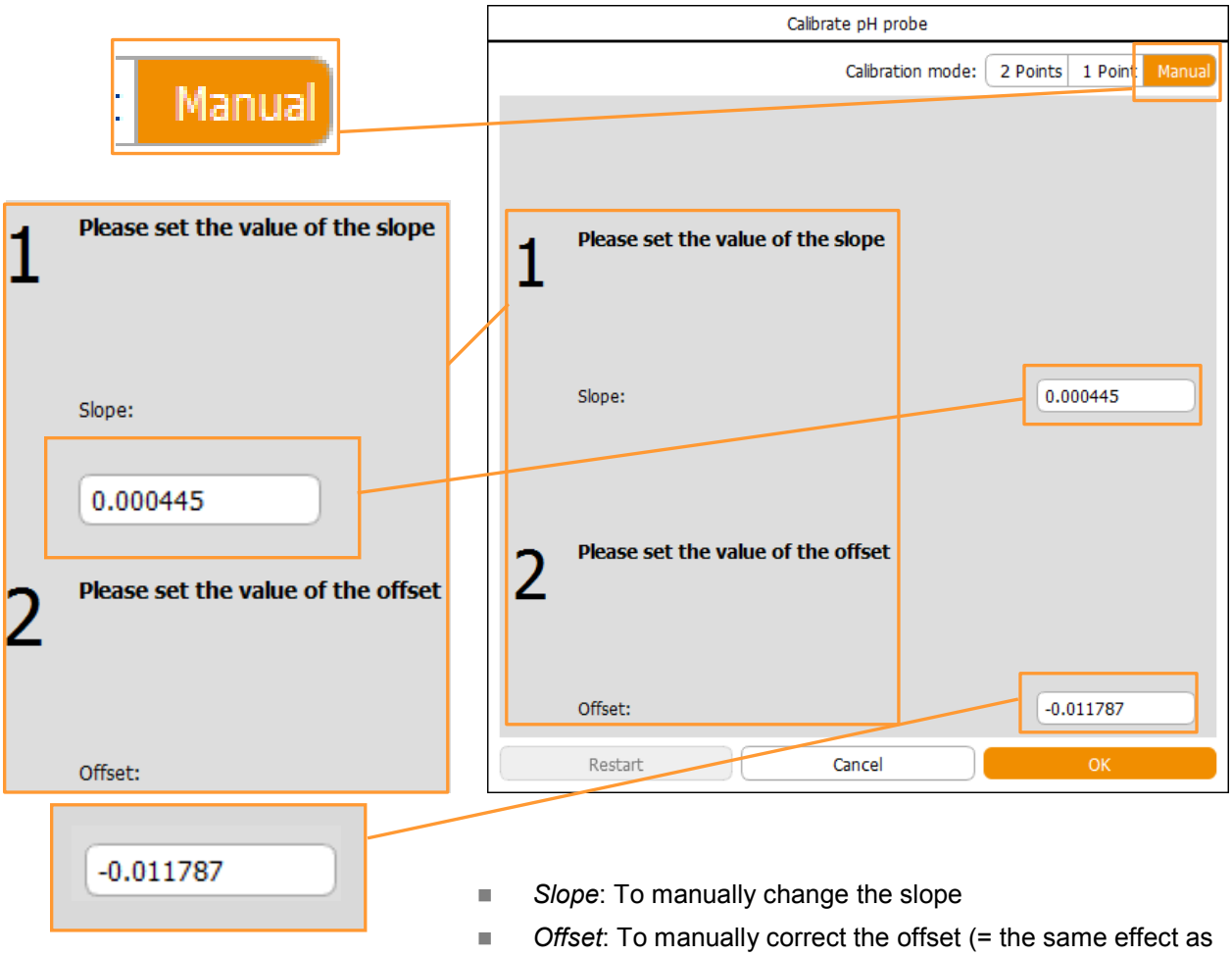
Header: Calibration mode

- **2 point**: To select 2-point calibration mode.

  This mode is automatically selected in the calibration menu for pH sensor calibration.
- **1 point**: To select 1-point calibration mode.

  If you need to recalibrate the pH sensor, this is carried out in 1-point calibration mode.
- **Manual:** To select manual calibration mode

  This mode is only relevant to the user for parameter pH. The menu contains:



- *Slope*: To manually change the slope
- *Offset*: To manually correct the offset (= the same effect as recalibration in 1-point mode).

  For details on recalibration see the chapter “Recalibrating a METTLER pH Sensor”.

INFORMATION

For all other parameters the manual button is only relevant to the manufacturer's service specialists. The necessary full menu can only be accessed at the service level.

Parameter Options

Main section: Line 1 and 3

- Instruction: *Please set value of the first / of the second calibration point*.
- **Use As Setpoint (pO2):** this function is only relevant and can only be used under certain circumstances at the *Technician* user level. For details see the chapter “Special function USE AS SETPOINT”.

INFORMATION

For all other parameters the USE AS SETPOINT button is only relevant to the manufacturer’s service specialists.

Main section: Line 2 and 4

- Instruction: *Put sensor into media and confirm measure.* For the pH sensor this is the buffer solution.
- *Sensor data*: Displays the measurement
- **Confirm Measure**: To confirm measurement

INFORMATION

The input fields and buttons in line 3 and 4 are only available once the first measurement has been confirmed. Line 3 and 4 are faded out in 1-point calibration mode.

Lower section

- *Sensor quality* display bar: Charts the quality of the sensor.

  If the green colour in the display bar is barely or not at all visible:

  - pH sensor: Replace the sensor.
  - pO_2 sensor: Replace the membrane body of the sensor in accordance with the sensor manufacturer's instructions in separate documentation.

  If the green colour fills less than half of the display bar:

  - pO_2 sensor, recommended: replace the sensor in accordance with the sensor manufacturer's instructions in separate documentation.

- *Ref. Temp*: Displays the measured temperature of the reference buffer solution, or is used as an input field to manually enter the temperature of the reference buffer solution.

INFORMATION

This field is only relevant for the pH sensor. It is only visible and available if the temperature compensation function in the setpoint menu has been switched on.

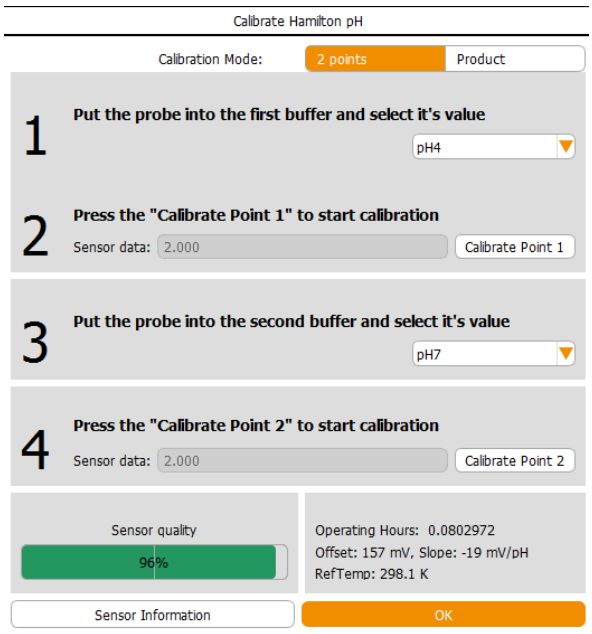
Footer

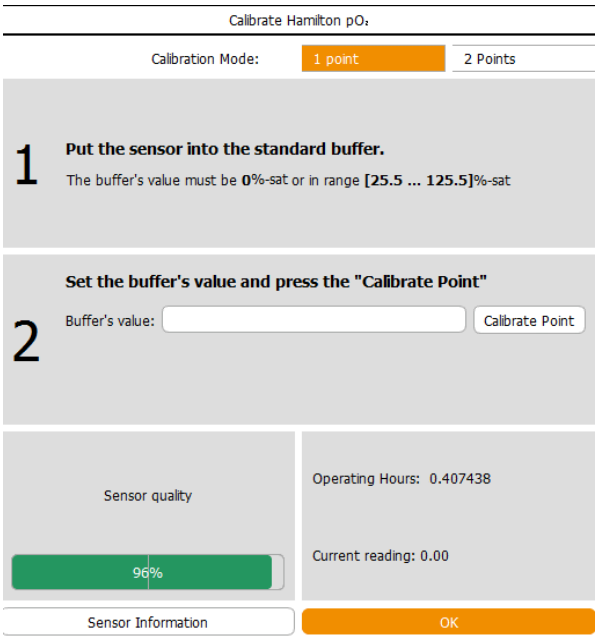
- **Restart calibration**: To restart the calibration.
- **Cancel calibration**: To abort calibration.
- **OK**: To confirm calibration, close calibration menu

OK and **Restart** are only available once at least one measurement has been confirmed.

6.2.2 Calibration Menu HAMILTON Sensors

The below figures show the calibration menu for HAMILTON pH sensors on the left-hand side and on the right, the calibration menu for HAMILTON pO_2 sensors. The two menus look similar, small differences are explained in the following menu description.





The calibration menu contains the following:

Header Calibration Mode/both calibration menus

- **1 point**: To select 1-point calibration mode.
  - pH: this button does not exist because it is generally a 2-point calibration being performed.
- **2 point**: To select 2-point calibration mode

INFORMATION

A 2-point calibration with HAMILTON pO_2 sensors is generally also possible in succession in 1-point calibration mode.

- **Product**: To select product calibration mode for pH sensor. This function is not relevant for the pO_2 sensor.

Main section, pH sensor calibration menu

Line 1 and 3

- Instruction: *Put the probe into the first / second buffer and select its value.*

  Hold the sensor into the first respectively the second buffer solution and select the value in the drop-down menu.

INFORMATION

The pH sensors are pre-calibrated at the factory using the two following standards: pH 4 (calibration point 1), and pH 7 (calibration point 2) at room temperature. The following buffers within Hamilton standards set are defined as factory default for calibration with automatic buffer recognition (*Auto* in drop-down menu): pH 4.01, pH 7.00 and pH 10.01.

Line 2 and 4

- Instruction: *Press the "Calibrate Point 1 / Point 2" button to start calibration.*
- *Sensor data*: Displays the measurement
- **Calibrate Point 1 / 2**: To calibrate the first or second point.

Main section, pO_2 sensor calibration menu

Line 1

- Instruction: *Put the sensor into the standard buffer. The buffer's value must be 0%-sat or in range (xx.xxx%-sat...yyy.yyy%).*

  Keep the sensor in the standard buffer solution (here the medium in the culture vessel). The medium either needs to show 0% air saturation or be within a range from xx.xxx %-sat...yyy.yyy %-sat (the value is read by the sensor).

INFORMATION

The measurement parameter is preconfigured to **%-sat** in the factory of the equipment. When performing a 2-point calibration, always first calibrate the zero point (0 %)!

Line 2 (and 4 if 2-point calibration mode is selected)

- Instruction: *Set the buffer's value and press the "Calibrate Point" button.*
- *Buffer's value*: set the calibration point value
- **Calibrate Point**: To start calibration.

Parameter Options

Lower section calibration menu

This section displays dates and values that are given by the sensor manufacturer's firmware that is integrated in the sensor.

pH sensor

- *Offset* and *Slope*: shows the calculated values for the *Offset* in mV and for *Slope* in mV/pH
- *Ref Temp K*: shows the reference temperature in Kelvin.

pO2 sensor

- Information *Current reading*: shows the current measured value.

Both sensors

- *Sensor quality* display bar: charts the quality of the sensor in a scale from 0 to 100 %
- **Sensor Information**: To call up sensor information of the sensor manufacturer.
- *Sensor type Hamilton*: shows the connected sensor type, Hamilton
- *Operating Hours:…*: shows how long the sensor has been operating.

Footer

- **OK**: To exit the calibration menu.

6.2.3 pH Sensor Calibration

The bioreactor is configured at the factory with a measurement system either for analogue classic pH sensors from the manufacturer METTLER or for digital pH sensors, type Easyferm Plus ARC, from the manufacturer HAMILTON.

For all pH sensors it generally applies that a reliable pH measurement always needs a 2-point calibration with a high and low reference buffer. It also applies that the calibration should be performed again before each fermentation/cultivation process. Calibration must be performed prior to sterilisation, in other words before mounting the pH sensor in the vessel.

The sequence that the two reference points are calibrated is irrelevant for both measurement systems.

Detailed information on the calibration of sensors and of the pH buffers supported by the sensors can be found in separate documentation provided by the sensor manufacturer.

6.2.3.1 Calibrating a METTLER pH Sensor

The correct temperature of the buffer solution must be measured to achieve extremely exact calibration results. This can be measured directly using the temperature sensor of the equipment during calibration. Another option is to measure the temperature externally and enter the value manually using the operating panel. If not measured or manually input, the buffer temperature is assumed to be 20 °C.

The following describes a 2-point calibration of a METTLER pH sensor with simultaneous temperature measurement of the buffer solution. This means that the calibration takes place with temperature compensation switched on. This corrects the temperature dependence of the measurement principle.

The pH of liquids is also temperature dependent, which is why the pH also reacts to temperature deviations when temperature compensation is switched on.

Information on technical data, use, maintenance and servicing can be found in the separate sensor documentation of the manufacturer.

For the calibration proceed as follows:

Procedure

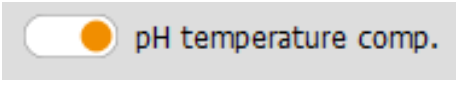
1. Connect the sensor cable.

   Ensure the cable is not buckled or twisted.

ATTENTION

The integrity of the sensor cable can be damaged by buckling or twisting. This may lead to faulty measurements.

2. Select the desired bioreactor from the selection bar in the touch screen software. This means the bioreactor to which the pH sensor is attached.
3. Call up main menu *Controller*, select parameter *pH* and call up Option *Setpoint*.



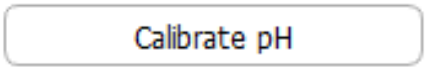
4. Switch pH temperature compensation on.
5. Press **OK**.

The dialogue box disappears, the setting is stored.

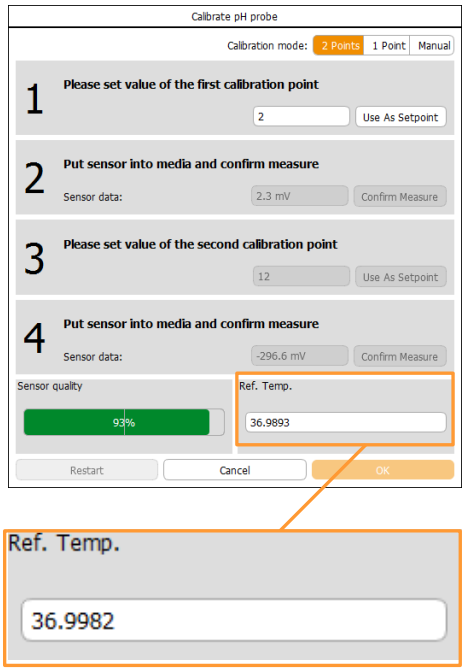
6. Carefully remove the watering cap from the pH sensor and rinse the pH sensor with distilled water, do not rub!

ATTENTION

Dry wiping or rubbing a pH sensor after rinsing can cause electrostatic charge. This can greatly increase the response time and generate incorrect measurements. At most, gently dab a pH sensor after rinsing, **NEVER** rub or wipe it!



7. Call up main menu *Batch* and press **Calibrate pH**.



The calibration menu *Calibrate pH probe* appears.

The 2-point calibration mode is automatically selected. The *Ref. Temp* input field/view box is displayed.

INFORMATION

Without switching pH temperature compensation on before, this field is not visible.

8. Press the input field in line 1.

   The numeric keypad appears.

9. Type in the value of the low (or high) reference buffer confirm with the **OK** key.

INFORMATION

The order in which the reference points are calibrated is irrelevant.

The numeric keypad disappears, the value is adopted.

10. Put the pH sensor with the temperature sensor (Pt100) into the relevant buffer solution.

    The measurement (in mV) is displayed in line 2 in *Sensor data*.

    As soon as the measurement is stable:

11. Press **Confirm Measure** in line 2.

    The calibration value is accepted. The input fields and buttons in line 3 and 4 are available now.

NOTICE!

The signal characteristics are asymmetric. In other words, the closer the signal comes to the real value, the slower the change. The calibration is inaccurate, if the measurement is confirmed with OK before the sensor signal has completely stabilised. Wait a few minutes before confirming with OK and check the reading again, if in doubt.

12. Rinse the pH sensor with distilled water, do not rub!
13. Press the input field in line 3.

    The numeric keypad appears.

14. Type in the value of the high (or low) reference buffer and confirm with the **OK** key.

INFORMATION

The order in which the reference points are calibrated is irrelevant.

    The numeric keypad disappears; the value is adopted.

15. Put the pH sensor with the temperature sensor (Pt100) into the relevant buffer solution.

    The measurement (in mV) is displayed in line 4 in *Sensor data*.

    As soon as the measurement is stable:

16. Press **Confirm Measure** in line 4.

    The calibration value is accepted.

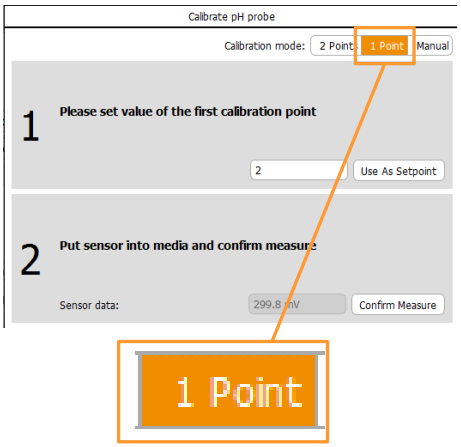
17. Press **OK**.

    The dialogue box disappears, the calibration values are stored.

18. Rinse the pH sensor with distilled water, do not rub!

19. Release the sensor cable from the pH sensor, if necessary, reattach the watering cap.
20. Continue with the preparatory work for sterilisation.

6.2.3.2 Recalibrating a METTLER pH Sensor



To compensate for a deviation (drift) in the measurement over a long-term fermentation, it is possible and sufficient to recalibrate with a 1-point calibration. This means that the pH of a sample measured using an external measurement device is accepted as the new reference value in 1-point calibration mode.

The same effect is achieved by manually correcting the offset (deviation). In other words, the difference between the externally determined measurement and the displayed measurement in the culture needs to be added to or subtracted from the last calculated offset value depending on the result. The correction is made in manual calibration mode. The menu is illustrated in chapter “Calibration Menus METTLER Sensors”.

6.2.3.3 Calibrating a HAMILTON pH Sensor

The pHs and the temperature dependency of pH buffers are stored in the HAMILTON pH sensors and are automatically detected on calibration. It is therefore not necessary to measure the temperature of the used buffer solution separately.

The following describes a 2-point calibration of a HAMILTON pH sensor. Which reference point in the 2-point calibration is calibrated first is irrelevant for this type of sensor.

Information on technical data, use, maintenance and servicing can be found in the separate sensor documentation of the manufacturer.

Proceed as follows:

Procedure

1. Connect the sensor cable.

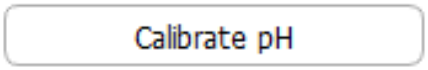
   Ensure the cable is not buckled or twisted.
2. Carefully remove the cap with the storage solution from the pH sensor and rinse the sensor with distilled water, do not rub it!

ATTENTION

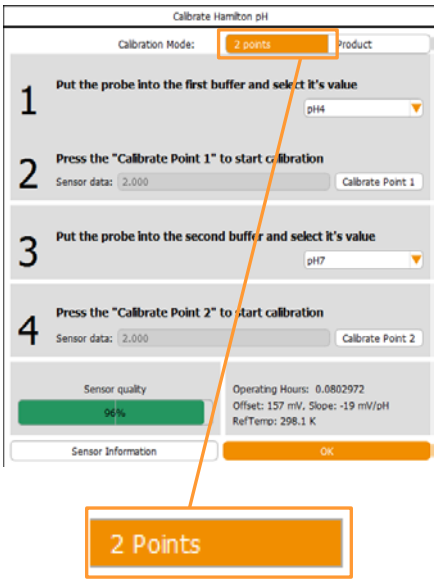
Dry wiping or rubbing a pH sensor after rinsing can cause electrostatic charge which can greatly increase response time and generate incorrect measurements. At most, gently dab a pH sensor after rinsing, **NEVER** rub or wipe it!

3. In the touch screen software, select the required bioreactor from the selection bar. In other words, the bioreactor to which the pH sensor is connected.
4. Call up the *Controller* main menu und check pH:

   Communication is established, if a pH value of ≠ -1.0 is displayed.

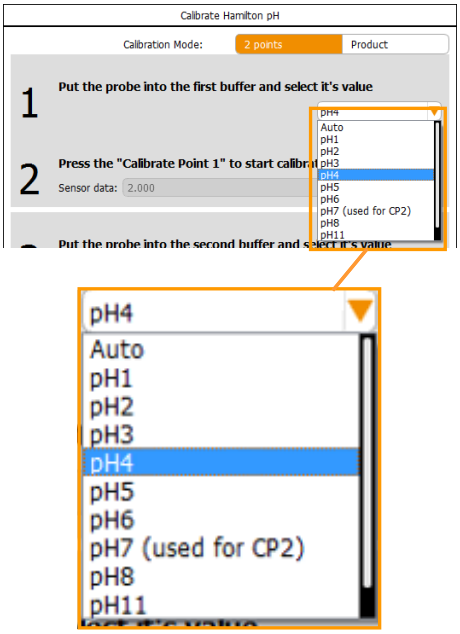


5. Call up main menu *Batch* and press **Calibrate pH**.



The calibration menu *Calibrate Hamilton pH* appears.
The 2 point calibration mode is automatically selected.

6. Place the pH sensor in the buffer solution of the first reference point, e.g. a solution of pH 4.01.



7. On line 1, in the drop-down menu, either leave the *Auto* entry of the possible pH reference values or select the appropriate value.

INFORMATION

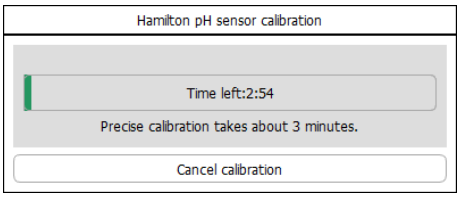
The pH sensors are pre-calibrated at the factory using the two following standards: pH 4 (calibration point 1), and pH 7 (calibration point 2) at room temperature. The following buffers within Hamilton standards set are defined as factory default for calibration with automatic buffer recognition (*Auto* in drop-down menu): pH 4.01, pH 7.00 and pH 10.01.

The measured value is displayed in line 2 in *Sensor Data*.

As soon as the measured value is stable:

8. Press **Calibrate Point 1**.

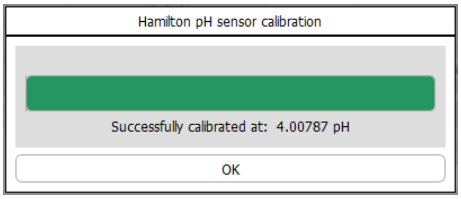
Parameter Options



The dialogue box *Hamilton pH sensor calibration* appears with:

- Display bar: charts the course of the calibration. The progress is shown by a green colour.
- *Precise calibration takes 3 minutes*
- *Time left: x:xx*: shows the lime left in minutes and seconds.
- **Cancel calibration**: to abort calibration.

9. Wait until calibration is complete.



As soon as calibration has successfully completed:

- Display bar: entirely filled
- *Successfully calibrated at …*: shows that the calibration is completed with the selected reference value
- **OK**: to close the dialogue box.

10. Press **OK**.

The calibration is confirmed, the dialogue box disappears.

11. Rinse the pH sensor with distilled water; do not rub!

12. Place the pH sensor in the buffer solution of the second reference point, e.g. a solution of pH 7.00.

13. On line 3, in the drop-down menu, either leave the *Auto* entry of the possible pH reference values or select the appropriate value

The measured value is displayed in line 4 in *Sensor Data*.

As soon as the measured value is stable:

14. Press **Calibrate Point 2**.

The dialogue box *Calibrate Hamilton sensor* appears again, charting the course of calibration.

15. Wait until calibration is complete

16. Press **OK**.

Calibration is confirmed; the dialogue box disappears.

17. In the calibration menu, press **OK** to close the menu.

18. Rinse the pH sensor with distilled water; do not rub!

19. Release the sensor cable from the pH sensor; if necessary, reattach the storage cap.

20. Continue with the preparatory work for sterilisation.

6.2.3.4 HAMILTON pH Sensor Product Calibration

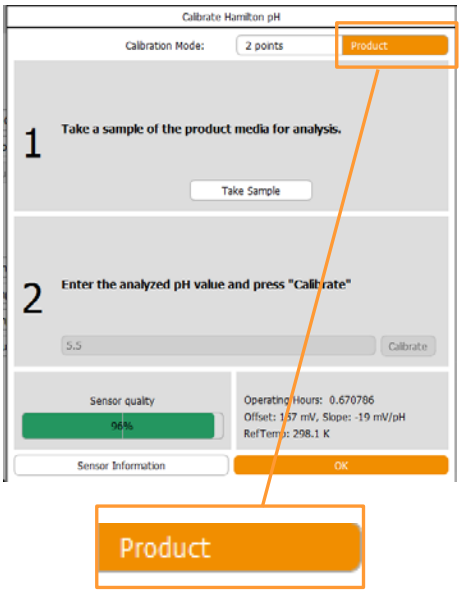
Adapting the calibration curve to the current process conditions is possible by performing a product calibration.

Further information on product calibration can be found in the separate documentation of the HAMILTON sensor manufacturer.

To perform a product calibration, proceed as follows:

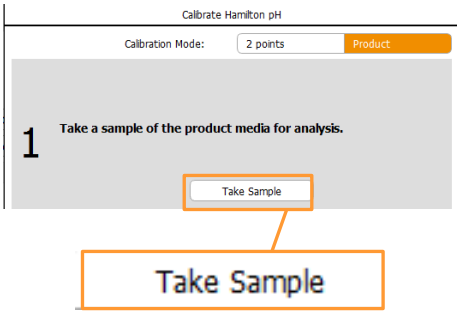
Procedure

1. Call up the calibration menu of the pH sensor.



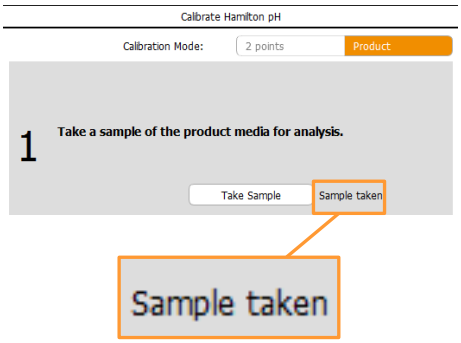
2. Press **Product** to initialise product calibration.

3. Take a sample from the process (in the culture vessel) and perform a laboratory measurement of the sample at the same temperature as the measurement was taken in the process.



4. Press **Take Sample** in line 1 (*Take a sample of the product media for analysis*).

Parameter Options



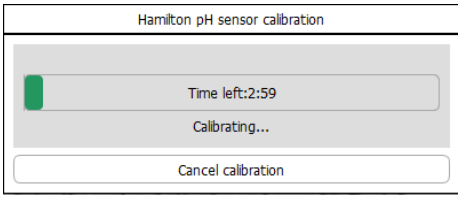
The message *Sample taken* appears on the left of the button.

5. Touch the input field in line 2.

   The numeric keypad appears.

6. Type in the externally measured pH (e.g. 7.2) confirm with the **OK** key.

7. Press **Calibrate** in line 2.



The dialogue box *Hamilton pH sensor calibration* appears, calibration begins. The progress is illustrated in green in the display bar.

INFORMATION

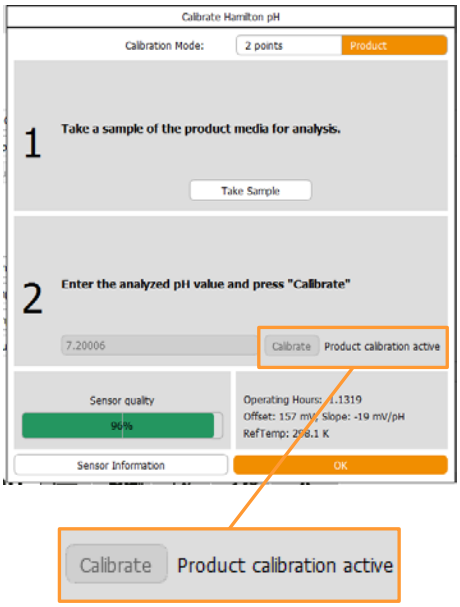
Product calibration can only be performed and be effective if the externally measured and input pH does not deviate by more than 2 pH units from the original pH.

As soon as calibration has successfully completed, the dialogue box contains:

- Display bar entirely filled
- Message: Display *Successfully calibrated at …*: Shows that the calibration is completed with the input pH value
- **OK**: To close the dialogue box

8. Press **OK**.

   Calibration is completed; dialogue box disappears.



In the calibration menu, the **Calibrate** button is no longer available. The message *Product calibration active* appears.

9. Press **OK** to close the menu.

INFORMATION

To restore the original calibration curve, the product calibration can be overruled at any time. This is easy to do by calling up the calibration menu again and touching the 2 points button. A new standard calibration (2-point calibration) overrules the product calibration.

6.2.4 Calibrating all pH Sensors

The *Calibrate ALL pH* function is available as soon as more than one bioreactor = culture vessel is controlled using the touch screen software. A maximum of 6 bioreactors can be controlled using an operating panel with the touch screen software.

For the bench-top bioreactors Labfors 5 and Multifors 2 this means:

Labfors 5

1 unit = 1 bioreactor = 1 culture vessel

(max. 1 master unit with 5 satellite units is possible)

Multifors 2

1 unit = 2 bioreactors = 2 culture vessels

(max. 1 master unit with 2 satellite units is possible)

The function enables you to perform a 2-point calibration for multiple or all connected METTLER pH sensors at the same time.

It is possible to handle the pH sensors and buffer solutions in various ways.

For example:

a) Place all pH sensors in a container with the buffer solution at the same time and calibrate the first and the second point one after the other.

b) Place each pH sensor in the buffer solution individually (or in pairs for Multifors 2) and calibrate the first point of each pH sensor one after the other. Repeat the same process for the second point.

c) Place all pH sensors in a container with the buffer solution individually and calibrate the first and the second point one after the other.

6.2.4.1 Calibrating all METTLER pH Sensors

For METTLER pH sensors, the temperature of the buffer solution must be determined externally, it cannot be measured using the temperature sensor in this case. If no temperature is manually input for the buffer solution, a buffer temperature of 20 °C is assumed.

The following example describes a 2-point calibration in which the exact temperature of the buffer solutions is entered and the maximum possible number of connected pH sensors (6 sensors) is used.

The method a) is applied as described in the general chapter “Calibrating all pH Sensors – General Information”.

Proceed as follows:

Procedure

1. Prepare two containers, e.g. graduated beakers, with the two buffer solutions with known temperatures.
2. Connect all pH sensors in turn to their sensor cable.

   Ensure the cables are not buckled or twisted.

ATTENTION

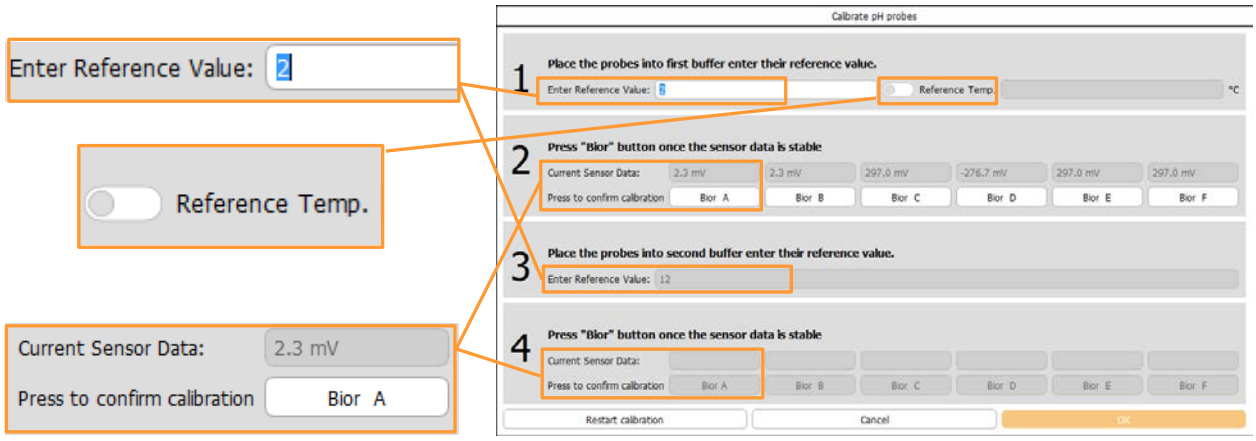
The integrity of the sensor cables can be damaged by buckling or twisting. This may lead to faulty measurements.

3. Select all (*All*) bioreactors from the selection bar.

4. Call up the *Batch* main menu and press **Calibrate All pH**.

   The calibration menu *Calibrate pH probes* appears with:

Parameter Options



Line 1 and 3:

- Instruction: *Place the probes into first/second buffer enter their reference value*.
- Instruction: *Enter Reference Value*

Additionally on line 1

- *Reference Temp °C*: To activate the function for manual entry of the temperature of the buffer solution in °C and to enter the value itself.

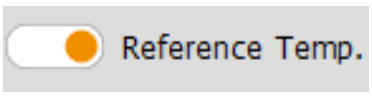
Line 2 and 4:

- Instruction: *Press Bior button once the sensor data is stable*
- *Current Sensor Data*: Displays current measurements in mV
- *Press to confirm calibration* and **Bior A** to **Bior F**: To confirm each pH sensor measurement by pressing the relevant button.

The input fields and buttons in line 3 and 4 are only available once the first measurements have been confirmed.

Footer

- **Restart calibration**: To restart calibration
- **Cancel**: To cancel calibration
- **OK**: To confirm calibration and close the calibration menu.



5. Activate the reference temperature function.

The input field is available now.

6. Press ***Reference Temp***.

   The numeric keypad appears.

7. Type in the temperature of the buffer solution, e.g. 23 (°C), and confirm with the **OK** key.

   The numeric keypad disappears.

   The value is adopted.

8. Remove the watering cap of each pH sensor in turn and rinse the pH sensor with distilled water, do not rub!

ATTENTION

Dry wiping or rubbing a pH sensor after rinsing can cause electrostatic charge. This can greatly increase the response time and generate incorrect measurements. Gently dab a pH sensor after rinsing, **NEVER** rub or wipe it!

9. Press ***Reference value*** in line 1.

   The numeric keypad appears.

10. Type in the value of the low (or high) reference buffer and confirm with the **OK** key.

    The order in which the reference points are calibrated is irrelevant.

    The numeric keypad disappears; the value is adopted.

11. Place all pH sensors in the relevant buffer solution.

    Measurements (in mV) of each pH sensor are displayed in line 2 in *Current Sensor Data* above the **BiorA** to **BiorF** buttons.

    Once all measurements are stable:

12. Press button **BiorA** to **BiorF** one after another.

    The calibration values are accepted. The input fields and buttons in line 3 and 4 are now available.

INFORMATION

The signal characteristics are asymmetric. In other words, the closer the signal comes to the real value, the slower the change. The calibration is not accurate, if the measurement is confirmed with OK before the sensor signal is completely steady. Wait a few minutes before confirming with OK and check the reading again, if in doubt.

13. Rinse all pH sensors with distilled water, do not rub!

14. Press ***Reference value*** in line 3.

    The numeric keypad appears.

15. Type in the value of the high (or low) reference buffer and confirm with the **OK** key.

    The order in which the reference points are calibrated is irrelevant.

    The numeric keypad disappears; the value is adopted.

16. Place all pH sensors in the relevant buffer solution.

    Measurements (in mV) of each pH sensor are displayed in line 4 in *Current Sensor Data* above the **BiorA** to **BiorF** buttons.

    Once all measurements are stable:

17. Press button **BiorA** to **BiorF** one after another.

    The calibration values are accepted.

18. Press **OK**.

    The menu disappears, the calibration values are stored.

19. Rinse all pH sensors with distilled water, do not rub!

INFORMATION

To be able to assign the sensors to the relevant bioreactor again after calibration, identify these accordingly if necessary, for example, using lab tape or something similar.

20. Release the sensor cables from the pH sensors, if necessary, reattach the watering caps.
21. Continue with the preparatory work for sterilisation.

6.2.4.2 Calibrating all HAMILTON pH Sensors

The pHs and the temperature dependency of pH buffers are stored in the HAMILTON pH sensors and are automatically detected on calibration. It is therefore not necessary to measure the temperature of the used buffer solution separately.

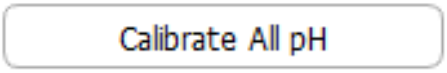
The following example describes a 2-point calibration of two pH sensors (Bior A and Bior C).

The method a) is applied as described in the general chapter “Calibrating all pH Sensors”, method example a).

Proceed as follows:

Procedure

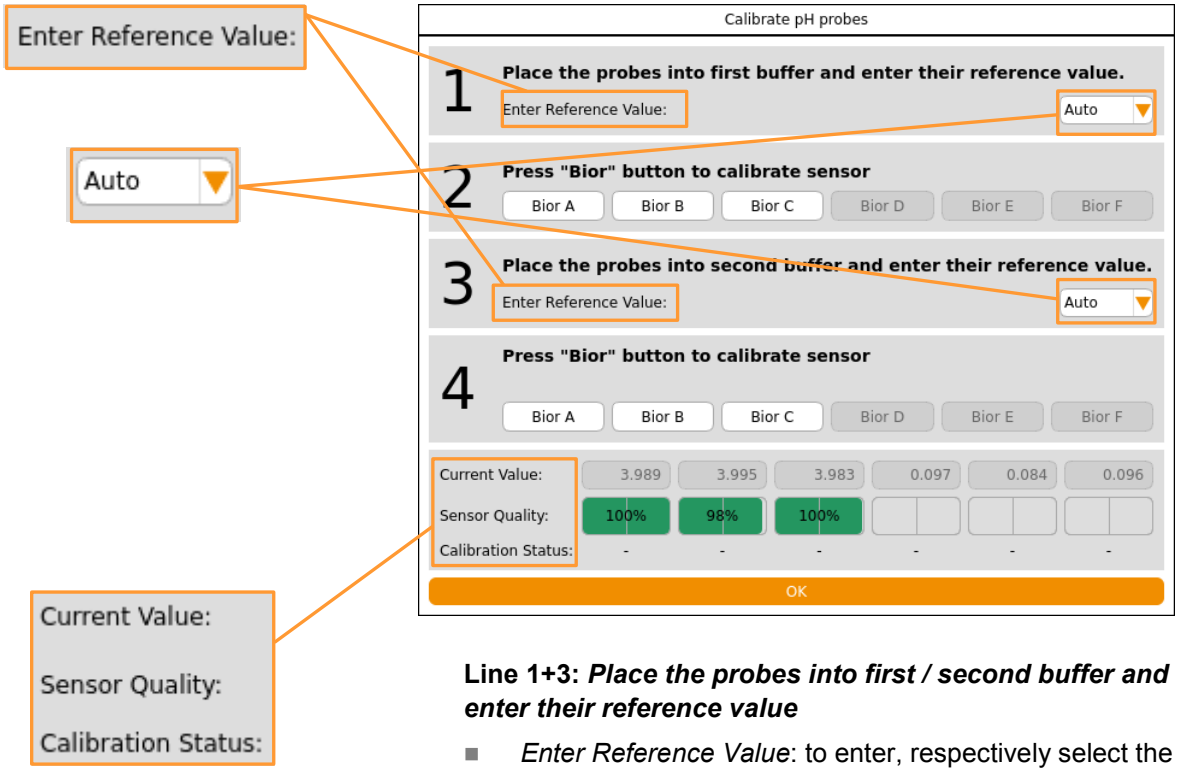
1. Prepare two containers, e.g. graduated beakers, with the two buffer solutions with known temperatures.
2. Connect the pH sensors in turn to their sensor cable. Ensure the cables are not buckled or twisted.
3. Select all (*All*) bioreactors from the selection bar.



4. Call up the main menu *Batch* and press **Calibrate All pH**.

Parameter Options

The calibration menu *Calibrate pH probes* appears with:



Line 1+3: *Place the probes into first / second buffer and enter their reference value*

- *Enter Reference Value*: to enter, respectively select the reference value.

Line 2+4: *Press Bior button to calibrate sensor*

- **Bior A** to **Bior F**: to start calibration of each pH sensor by pressing its appropriate bioreactor button.

Footer

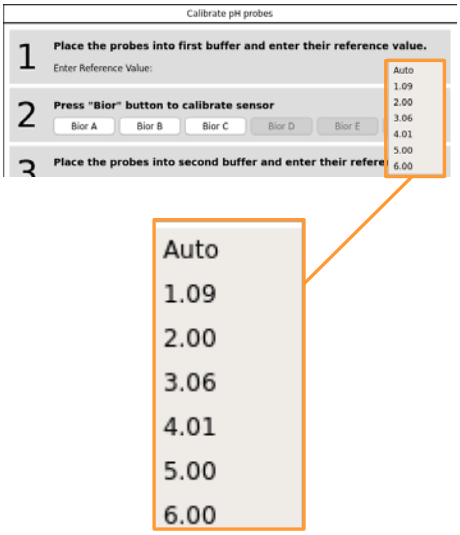
- *Current Value*: shows the current measured value
- *Sensor Quality*: charts the quality of the sensor in a scale from 0 to 100 % in form of a display bar.
- *Calibration Status*: displays the calibration status
- **OK**: to exit the calibration menu.

5. Remove the cap with the storage solution from each pH sensor in turn and rinse the pH sensor with distilled water!

ATTENTION

Dry wiping or rubbing a pH sensor after rinsing can cause electrostatic charge which can greatly increase response time and generate incorrect measurements. At most, gently dab a pH sensor after rinsing, **NEVER** rub or wipe it!

6. Place all pH sensors in the buffer solution of the first reference point, e.g. a solution of pH 4.01.



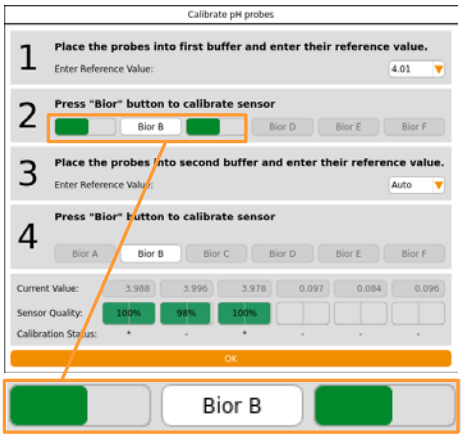
7. Either leave the *Auto* entry in the drop-down menu of the possible pH reference values or select the appropriate value in the menu.

INFORMATION

The pH sensors are pre-calibrated at the factory using the two following standards: pH 4 (calibration point 1), and pH 7 (calibration point 2) at room temperature. The following buffers within Hamilton standards set are defined as factory default for calibration with automatic buffer recognition (*Auto* in drop-down menu): pH 4.01, pH 7.00 and pH 10.01.

Measurement of each pH sensor is displayed.

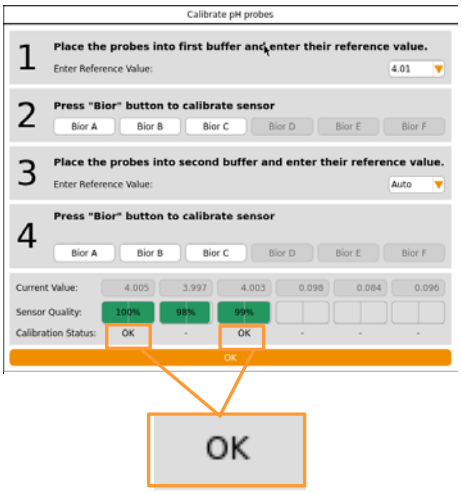
8. Press the bioreactor buttons one after another, in this case **BiorA** and **BiorC.**



Progress bars of the calibration procedure appear instead of the different buttons.

9. Wait until calibration is complete.

Parameter Options



Successful calibration is shown with **OK** in the *Calibration Status* line. In case of appearance of a number instead of OK: this indicates an error which is a direct output of the sensors's integrated software from the sensor manufacturer HAMILTON.

INFORMATION

A list with error codes and their description can be found in chapter "Error Codes HAMILTON pH Sensor Calibration".

10. Rinse each pH sensor with distilled water, do not rub!
11. Place all pH sensors in the buffer solution of the second reference point, e.g. a solution of pH 7.00.
12. Either leave the *Auto* entry in the drop-down menu of the possible pH reference values or select the appropriate value in the menu.

    Measurement of each pH sensor is displayed.
13. Press **BiorA** and **BiorC** one after another.

    The progress bars of the calibration procedure reappear again instead of the different buttons.
14. Wait until calibration is complete.

    After successful completion of the calibration (*Calibration Status* = OK):
15. In the calibration menu, press **OK** to close the menu.
16. Rinse each pH sensor with distilled water, do not rub!
17. Release the sensor cables from each pH sensor, if necessary, reattach the storage caps.

INFORMATION

To be able to assign the sensors to the relevant bioreactor again after calibration, identify these accordingly if necessary, for example, using lab tape or something similar.

18. Continue with the preparatory work for sterilisation.

6.2.4.3 Error Codes Calibrating all HAMILTON pH Sensors

Error Code	Description
01	Difference between CP1 (calibration point 1) and CP2 (calibration point 2) < pH 1.0
02	No matching calibration standard
04	Actual temperature reading is too high
08	Actual temperature reading is too low
10	Temperature reading during calibration is not stable
20	Offset at pH 7 is too low or slope is too low
40	Offset at pH 7 is too high or slope is too high
80	pH reading during calibration is not stable
03	01 + 02 = Difference between CP1 (calibration point 1) and CP2 (calibration point 2) < pH 1.0 + No matching calibration standard
05	01 + 04 = Difference between CP1 (calibration point 1) and CP2 (calibration point 2) < pH 1.0 + Actual temperature reading is too high
09	01 + 08 = Difference between CP1 (calibration point 1) and CP2 (calibration point 2) < pH 1.0 + Actual temperature reading is too low
21	01 + 20 = Difference between CP1 (calibration point 1) and CP2 (calibration point 2) < pH 1.0 + Offset at pH 7 is too low or slope is too low
41	01 + 40 = Difference between CP1 (calibration point 1) and CP2 (calibration point 2) < pH 1.0 + Offset at pH 7 is too high or slope is too high
90	10 + 80 = Temperature reading during calibration is not stable + pH reading during calibration is not stable

INFORMATION

For detailed information about error codes contact the sensor manufacturer HAMILTON.

6.2.5 pO_2 Sensor Calibration

The bioreactor is configured at the factory with a measurement system either for analogue polarographic pO_2 sensors from the manufacturer METTLER or for digital optical pO_2 sensors, type Visiferm DO ARC, from the manufacturer HAMILTON

METTLER pO_2 sensors are polarographic and therefore need to be polarised before calibration.

HAMILTON pO_2 sensors are preconfigured by the equipment manufacturer to the measurement parameter %-sat. Replacement sensors also need to be configured by the equipment manufacturer before use!

Detailed information on the calibration, use, maintenance and servicing can be found in the separate sensor documentation of the sensor manufacturers.

Generally it applies that: calibrating the pO_2 sensor should be performed after sterilisation because sterilisation can change the gradient of the pO_2 sensor.

A 1-point calibration to 100 % is generally sufficient for an exact measurement and should be carried out again before each fermentation/cultivation.

The zero point (0 % calibration) should be checked at regular intervals of about 6 months.

Respect the following point:

When performing a 2-point calibration, the 0 % calibration must always be performed before the 100 % calibration.

100 % calibration conditions

The 100 % calibration of the pO_2 sensor is performed under the following conditions:

- in the medium
- at the operating temperature
- at the maximum expected stirrer speed
- at the maximum expected gassing rate with air or the oxygen-containing gas(es) provided for fermentation/ cultivation

0 % calibration conditions

The operating conditions of the 0 % calibration are the same as the 100 % calibration. One exception is the gassing.

To displace oxygen out of the medium, the medium has to be gassed before and during the 0 % calibration with nitrogen instead of with air or the gas(es) used for fermentation/cultivation.

6.2.6 Polarising the pO_2 Sensor (METTLER)

Polarographic pO_2 sensors must be polarised at initial operation or after disconnection from the voltage source. Correct calibration is not possible otherwise. This means that the pO_2 sensor must be polarised before calibration.

For polarisation, the sensor cable must simply be connected to the pO_2 sensor and the equipment must be switched on at the main switch.

Duration of polarisation (= polarisation time) depends on how long the pO_2 sensor has been disconnected from the voltage source (= depolarisation time)

As a general rule: if depolarisation time > 30 minutes, the minimum polarisation time is 360 minutes.

More details about polarisation can be found in the separate documentation form the manufacturer METTLER TOLEDO.

6.2.6.1 Calibrating a METTLER pO_2 Sensor

The following example describes a 2-point calibration of a (polarographic analogue) METTLER pO_2 sensor. This needs to take place in the correct sequence. This means that the first calibration point is 0 % (zero point), the second calibration point is 100 %.

Proceed as follows:

Procedure

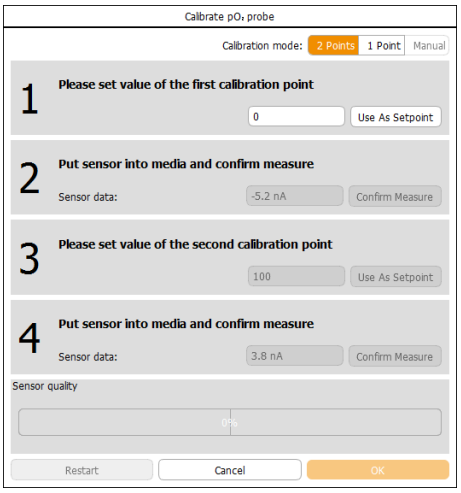
1. Connect the gassing line to nitrogen. In doing so, leave the gas supply turned off.

INFORMATION

Depending on the equipment configuration, there may already be a nitrogen gas line. In this case you only need to adjust the gas supply accordingly.

2. Select the desired bioreactor from the selection bar in the touch screen software. This means the bioreactor to which the pO2 sensor is attached.
3. In main menu *Batch*, call up the start menu (**Start** button).
4. Set the temperature setpoint and switch on the parameter.
5. Set the maximum expected stirrer speed during fermentation and switch on the parameter.
6. Start the bioreactor.
7. Slowly turn on the nitrogen supply and gas the medium.
8. Wait until the required stirrer speed and operating temperature are reached and the oxygen is displaced out of the medium.

9. Call up main menu *Batch* and press **Calibrate pO2**.



The calibration menu *Calibrate pO2 probe* appears.

The 2-point calibration mode is automatically selected.

INFORMATION

The Use As Setpoint button is not relevant for this calibration.

If the value in the first input field is not set to 0 (zero for zero point = 0 %):

10. Press the first input field (…*first calibration point*) in line 1.

    The numeric keypad appears.

11. Type in the value 0 confirm with the **OK** key.

    The numeric keypad disappears; the value is adopted.

    As soon as the measurement (line 2, *Sensor data*) is stable:

12. Press **Confirm Measure** in line 2.

    The value is accepted as 0 % oxygen.

13. Switch off the nitrogen gassing and switch on normal gassing.

14. Set the maximal expected gassing value during fermentation/cultivation.

    If the value in the second input field is not set to 100 (for 100 %):

15. Press the second input field (…*second calibration point)* in line 3.

    The numeric keypad appears.

16. Type in the value 100 and confirm with the **OK** key.

    The numeric keypad disappears; the value is adopted.

17. Wait until the medium is saturated with oxygen.

    As soon as the measurement (line 4, *Sensor data*) is stable:

18. Press **Confirm Measure** in line 4.

    The value is accepted as 100 % oxygen saturation.

19. Press **OK**.

    The dialogue box disappears, the calibration is stored.

Parameter Options

Special Function USE AS SETPOINT

The special function *USE AS SETPOINT* is for users of the *Technicians* user level and is only relevant in the calibration menu of the pO_2 parameter when using METTLER sensors.

It can only be used if a three-fold gas mixture (air/O_2/N_2) is installed and the parameter *Gasmix* is configured in a cascade for the pO_2 regulation.

INFORMATION

For all other parameters the USE AS SETPOINT button is only relevant to the manufacturer's service specialists.

How it works

In the calibration menu of the *pO2* parameter (METTLER sensors):

a) 0 % calibration

The input ***0*** (%) in the input field of the first calibration point and touching the **USE AS SETPOINT** button causes the *Gasmix* parameter to switch to nitrogen for this value.

b) 100 % calibration

(2nd point), before entering the ***100*** value:

The input ***21*** (%) in the input field of the second calibration point and touching the **USE AS SETPOINT** button causes the *Gasmix* parameter to switch to air for this value. The value can then be changed to ***100*** (%) in the input field and the calibration completed.

6.2.6.2 Calibrating a HAMILTON pO_2 Sensor

The following example describes a 2-point calibration of a HAMILTON pO_2 sensor, of the type Visferm DO ARC. This needs to take place in the correct sequence. Which means that the zero point (0 %) is calibrated before the 100 % oxygen saturation.

INFORMATION

A 2-point calibration can also be performed in turn in 1-point calibration mode.

Proceed as follows:

Procedure

1. Connect nitrogen to the gassing line.

   In doing so, leave the gas supply turned off.

INFORMATION

Depending on the unit configuration, there may already be a nitrogen gas line. In this case you only need to adjust the gas supply accordingly.

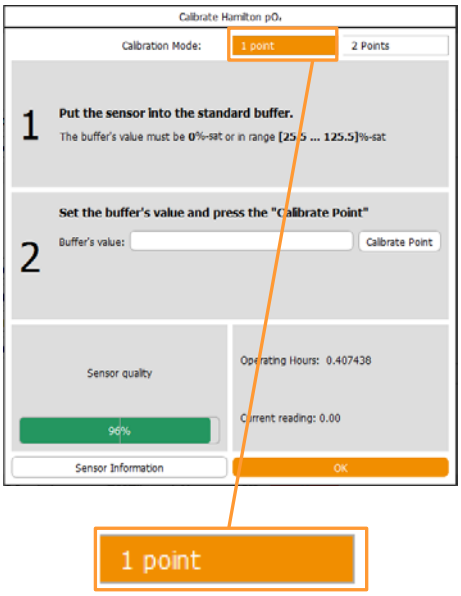
2. Select the desired bioreactor from the selection bar in the touch screen software. This means the bioreactor to which the pO2 sensor is attached.
3. In main menu *Batch*, call up the start menu (**Start** button).
4. Set the temperature setpoint and switch on the parameter.
5. Set the maximum expected stirrer speed during fermentation/cultivation and switch on the parameter.
6. Start the bioreactor.
7. Slowly turn on the nitrogen supply and gas the medium.
8. Wait until the required stirrer speed and operating temperature are reached and the oxygen is displaced out of the medium.

INFORMATION

The pO_2 sensor needs 10 to 15 minutes to warm up after switching on. In this phase, it can measure. However, for optimum calibration wait until after this period. A value of -1.0 indicates an error in communication.

Parameter Options

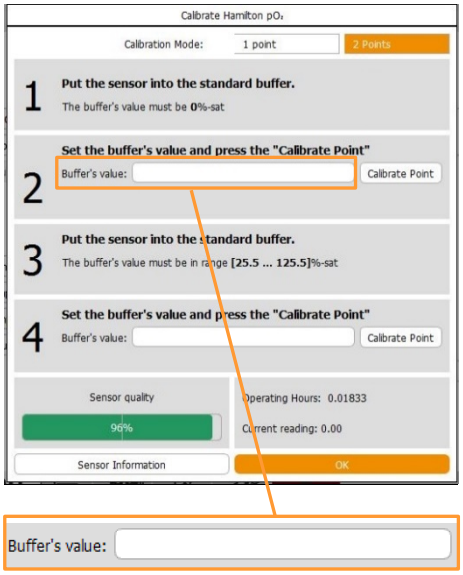
9. Call up the *Batch* main menu and touch the **Calibrate pO2** button.



The calibration menu *Calibrate pO2 probe* appears.
1-point calibration mode is automatically selected.

Once the pO_2 measurement is stable:

10. Press **2 Points**.
2-point calibration mode is activated.

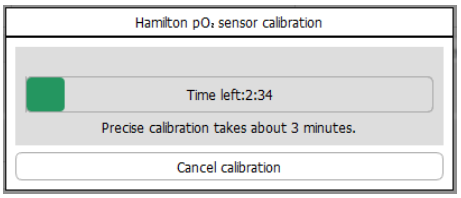


11. Press the input field ***Buffer's value*** in line 2.

The numeric keypad appears.

12. Type in the value ***0*** and confirm with the **OK** key.

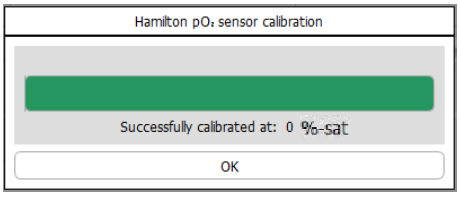
13. Press **Calibrate Point.**



The *Hamilton poO2 sensor calibration* dialogue box appears with:

- Display bar: charts the course of the calibration. The progress is shown by a green colour.
- Display: *Precise calibration takes 3 minutes*
- *Time left: x:xx*: displays the remaining time in minutes and seconds
- **Cancel calibration**: To abort calibration.

14. Wait until calibration is complete.



As soon as calibration has successfully completed, the dialogue box contains:

- Display bar entirely filled
- Display *Successfully calibrated at 0 %-sat*: shows that the calibration is completed with the selected reference value
- **OK**: To confirm calibration and close dialogue box

15. Press **OK**.

    The calibration is confirmed; the dialogue box disappears.
16. Switch off nitrogen gassing and switch on gassing with air.
17. Set the maximal expected gassing value during fermentation/cultivation.
18. Wait until the medium is saturated with oxygen.
19. Press the input field ***Buffer's value*** in line 4.

    The numeric keypad appears.
20. Type in the value ***100*** and confirm with the **OK** key.

    The numeric keypad disappears; the value appears in the input field.
21. Press **Calibrate Point**.

    The dialogue box *Calibrate Hamilton pO_2 sensor* appears again with the message that accurate calibration takes 3 minutes.
22. Wait until calibration is complete.

    As with 0 % calibration, successful completion is indicated by a full green bar and the message *Successfully calibrated at xx %- sat.*
23. Press **OK**.

    The dialogue box disappears.
24. Press the **OK** button in the calibration menu to close the menu.

6.2.1 Calibrating all pO2 Sensors

The *Calibrate ALL pO2* function is available as soon as more than one bioreactor = culture vessel is controlled using the touch screen software. A detailed explanation can be found in the chapter “Calibrating All pH Sensors”.

The function enables you to perform a calibration for multiple or all connected pO_2 sensors at the same time.

The conditions for calibrating all pO_2 sensors remain the same as for calibrating a single pO_2 sensor. These are described in detail in the corresponding chapters.

6.2.1.1 Calibrating all METTLER pO_2 Sensors

In the following example a 100% calibration of all (polarographic analogue) METTLER pO_2 sensors is performed. The 0 % calibration with nitrogen of all METTLER pO_2 sensors is not described in these instructions. The procedure remains the same as described in the chapter “Calibrating a METTLER pO_2 Sensor”.

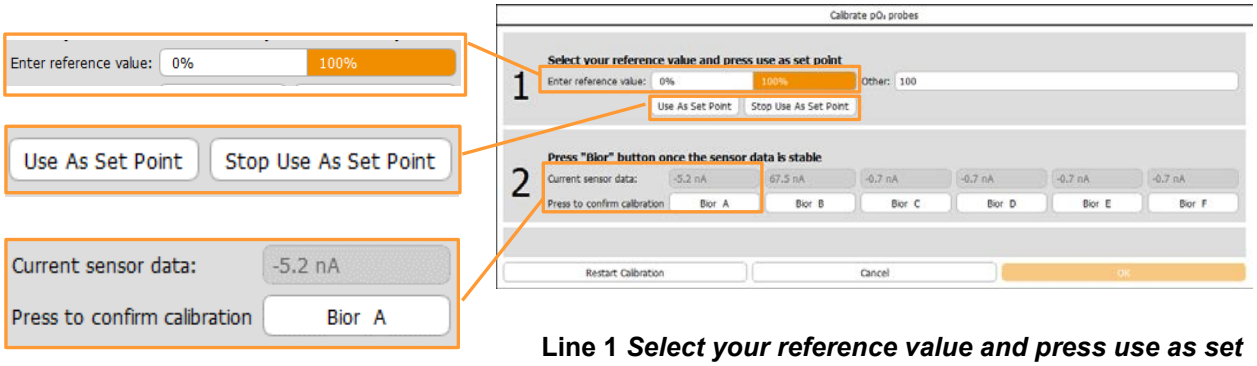
Proceed as follows:

Procedure

1. Ensure that all pO2 sensors are polarised, otherwise do this.
2. Select all *(All)* bioreactors from the selection bar.
3. In main menu *Batch* call up the start menu (**Start All**) of all bioreactors.
4. Set the temperature setpoint and switch on the parameter.
5. Set the maximum expected stirrer speed during fermentation and switch on the parameter.
6. Start the bioreactors.
7. Set the maximal expected gassing value during fermentation for all bioreactors.
8. Wait until the required stirrer speed and operating temperature have been achieved.
9. Wait until the medium in all bioreactors is saturated with oxygen.

10. In main menu *Batch*, press **Calibrate All pO2**.

The dialogue box *Calibrate pO2 probes* appears with:



Line 1 *Select your reference value and press use as set point*

- Instruction *Enter reference value*, buttons **0%**, **100%**, and display/input field *Other*: To select reference value *0 %* or *100 %* or to enter another value
- **Use As SetPoint**: To adopt reference value as setpoint
- **Stop Use As SetPoint**: To clear reference value as set-point

For an explanation on the Use As SetPoint function refer to chapter “Special Function USE AS SETPOINT”.

Line 2 *Press Bior once the sensor data is stable*

- *Current Sensor Data*: displays current measurements in nA
- Instruction *Press to confirm calibration* and **Bior A** to **Bior F**: To confirm each pO_2 sensor measurement using the relevant button.
- **Restart calibration**: To restart calibration.
- **OK**: To confirm calibration and close the dialogue box.

11. Press **100%**.

The value is accepted in the view box/input field.

As soon as all measurements (*Current Sensor data*) are stable:

12. Press **Bior A** to **Bior F** one after another.

The values are accepted as 100 % oxygen saturation.

13. Press **OK**.

The dialogue box disappears, the calibration values are stored.

6.2.1.2 Calibrating all HAMILTON pO_2 Sensors

In the following example a 100 % calibration of all (digital, optical) HAMILTON pO_2 sensors is performed. The 0 % calibration with nitrogen of all pO_2 sensors is not described in these instructions. The procedure remains the same as described in the chapter “Calibrating a HAMILTON pO_2 Sensor”.

INFORMATION

If a 2-point calibration shall be carried out, the zero point (0 %) must be calibrated first. The procedure remains the same as for a single sensor.

Proceed as follows:

Procedure

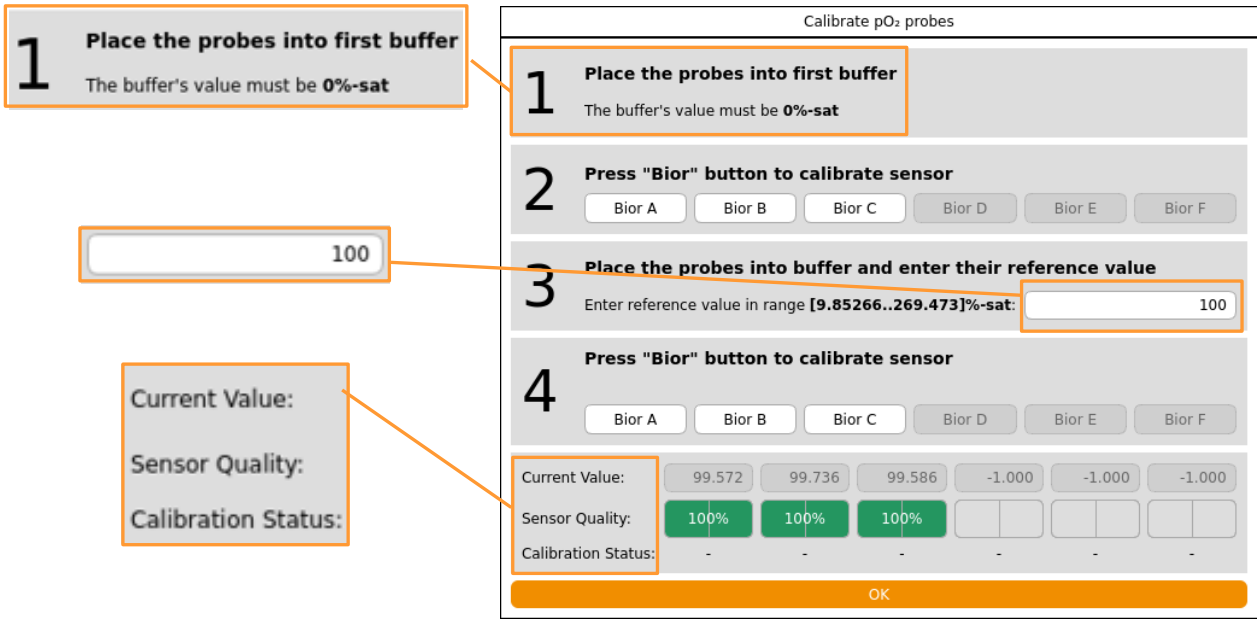
1. Select all *(All)* bioreactors from the selection bar.
2. Call up the start menu of all bioreactors by pressing **Start All**.
3. Set the temperature setpoints and switch on the parameters.
4. Set the maximum expected stirrer speed during fermentation and switch on the parameters.
5. Start the bioreactors.
6. Set the maximal expected gassing value during fermentation for all bioreactors.
7. Wait until the required stirrer speed and operating temperature have been achieved.

INFORMATION

pO_2 sensors need 10 to 15 minutes to warm up after switching on. In this phase they can measure. However, for optimum calibration wait until after this period. If pO_2 sensors are correctly connected, the current pO_2 value should be ≥1.0.

8. Call up main menu *Batch* and press **Calibrate All pO2**.

The calibration menu *Calibrate pO2 probe* appears with:



Line 1: *Place the probes into first buffer*

- Information: The buffer's value must be 0%-sat.

  The zero point is pre-set and cannot be changed. The zero point is always calibrated first when carrying out a 2-point calibration.

Lines 2 + 4: *Press "Bior" button to calibrate sensor*

- **Bior A** to **Bior F**: to start calibration of each pO2 sensor by pressing its appropriate bioreactor button

Line 3: *Place the probes into buffer and enter their reference value in range xx.xxx … ...yyy.yyy %-sat.* (Value displayed in %-sat, the value is read by the sensor itself)

- Instruction *Enter reference value*

  The value 100 (for 100 %) is pre-set in this input field and is editable.

Footer

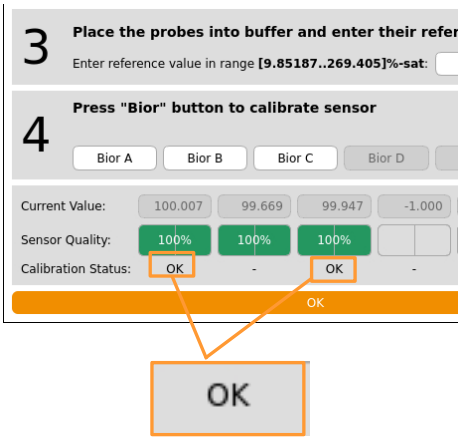
- *Current Value*: shows the current measured value
- *Sensor Quality*: charts the quality of the sensor in a scale from 0 to 100 % in form of a display bar.
- *Calibration Status*: displays the calibration status
- **OK**: to exit the calibration menu.

Parameter Options

9. Wait until the medium is saturated with oxygen.
10. Press the input field in row 3 (if the value is not set to 100).
    The numeric keypad appears.
11. Type in the value ***100*** and confirm with the **OK** key.
    The value appears in the input field.
12. Press **BiorA** to **BiorF** one after another.

Progress bars of the calibration procedure appear instead of the different buttons. The example to the left shows that the pO2 sensors of bioreactor A and C are calibrated at the same time i.e. progress of their calibration procedure is displayed.

13. Wait until calibration is complete.



Successful calibration is shown with **OK** in the *Calibration Status* line.
In case of appearance of a number instead of OK: this indicates an error which is a direct output of the sensors's integrated software from the sensor manufacturer HAMILTON.

INFORMATION

A list with error codes and their description can be found in chapter "Error codes HAMILTON pO2 sensor calibration".

14. In the calibration menu, press **OK** to close it.

6.2.1.3 Error Codes Calibrating all HAMILTON pO2 Sensors

Error Code	Description
01	Value to be calibrated at is too low
02	Value to be calibrated at is too high
04	Current temperature reading is too low
08	Current temperature reading is too high
10	Temperature reading is not stable
20	Phase is too low for the value to be calibrated at
40	Phase is too high for the value to be calibrated at
80	Phase reading during calibration is not stable
05	01 + 04 = Value to be calibrated at is too low + Current temperature reading is too low
09	01 + 08 = Value to be calibrated at is too low + Current temperature reading is too high
06	02 + 04 = Value to be calibrated at is too high + Current temperature reading is too low
0A	02 + 08 = Value to be calibrated at is too high + Current temperature reading is too high
11	01 + 10 = Value to be calibrated at is too low + Temperature reading is not stable
12	02 + 10 = Value to be calibrated at is too high + Temperature reading is not stable

INFORMATION

For detailed information about error codes contact the sensor manufacturer HAMILTON.

6.2.2 Calibrating the Zero Point of the Turbidity Sensor Optek-ASD

Due to the different light absorption characteristics of each medium, a zero calibration of the turbidity sensor OPTEK-ASD should be carried out before every fermentation/cultivation. Depending on the application, this can be carried out **before or after** autoclaving.

Conditions for zero calibration of the sensor

The sapphire windows of the sensor must be clean and no air/gas bubbles may adhere to them.

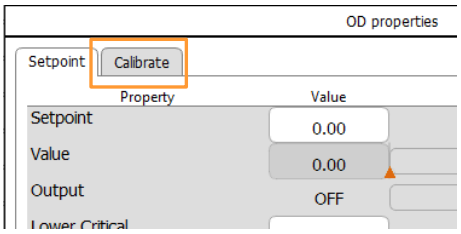
The light absorption of the medium prior to gassing and inoculation can be used as the reference value for the zero point.

For details about technical data, use and maintenance refer to the operating manual of the bioreactor.

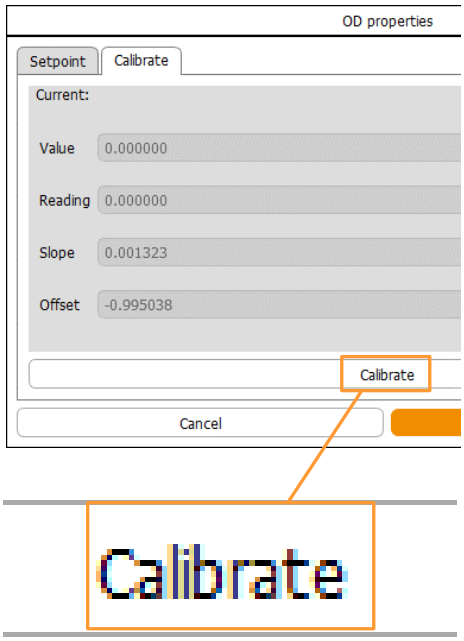
Proceed as follows:

Procedure

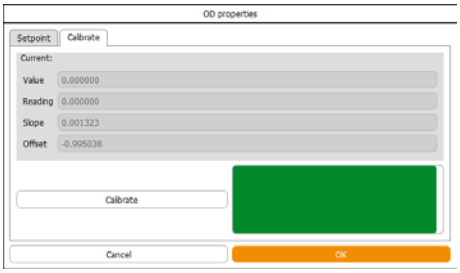
1. Connect the sensor cable.
2. Call up the main menu *Controller*.
3. Wait until the measured value (parameter *OD*) is stable.



4. Call up the *Calibrate* option of the parameter.



5. Press **Calibrate** in the calibration menu.



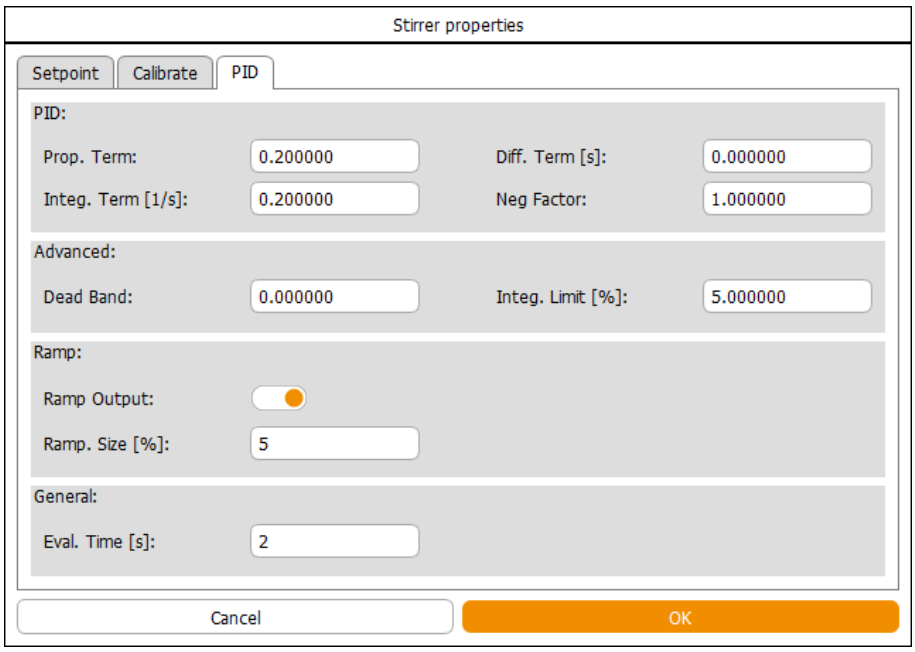
Calibration is started and a view bar appears to the right side of the **Calibrate** button which charts the course of the calibration .The progress is shown by a green colour.

If the view bar disappears after a few seconds, the calibration is completed.

6. Press **OK.**

Calibration is saved, menu disappears.

6.3 PID (Control)



The *PID* tab page is split into four horizontal areas and contains input fields for PID control settings. The following table explains the function of the individual setting values in more detail.

A detailed explanation of PID control with important notes for its settings can be found in the following chapters.

Note the following:

- In the case of parameters which are not controlled but only measured, only the value in the Eval Time (s) input field is relevant. This value is always > 0.
- If the ramp output is switched off, the value in the Ramp Size % input field is not relevant.

Parameter Options

Setting value	Description
Prop. Term	Proportional factor: The greater the discrepancy between the set-point value and the actual value the greater the controller output.
Integ. Term [1/s]	The integral factor aggregates all errors over the time. If the setpoint is not achieved using the proportional factor, the integral factor adjusts the output successively until the setpoint value is achieved. An integral factor set too high will lead to oscillation of the control loop.
Diff Term [s]	The differential quotient calculates the change in the actual value over the time and counteracts this change to limit any overshoot.
Neg. Factor	The negative factor can be used to add weighting to two-sided control (+100 to -100 %) (e.g. heavy acid, light alkali). In the process 1 is the balance and 0.5 or 2 equate to the half or double the controller output accordingly. Example: Nitrogen influences the pO_2 value less than oxygen, thus a negative factor of 2 can compensate for the reaction of the controller.
Dead Band	If a dead band is entered, no control is implemented within this value at either side of the setpoint value (symmetrically, + / -). I.e. the controller output is = 0. The dead band is used for pH control.
Integ. Limit [%]	The integral influence is used to ensure that the integral factor cannot increase over an indefinite period. This limits erroneous accumulation. The integral influence is set between 0 and 100 % of the controller output.
Ramp output	In order to perform changes slowly or step-by-step, a ramp can be introduced. This is useful above all for the stirrer speed or a mass flow valve.
Ramp Size [%]	The ramp size is a percentage value with which the controller output is increased step-by-step and evenly over a set time. For the set time see the value (in seconds) in the Eval Time input field.
Eval Time [s]	The evaluation time determines the intervals in seconds at which the PID value is recalculated. The controller speed is defined this way. A scanning time of 10 seconds is a good average value.

6.3.1 Explanations of PID Control

The PID function is based on a generic formula provided as example:

$$Error_n = \frac{Set - Act}{Max.Value - Min.Value}$$

$$Output_n = P.Term * \left\{ Error_n + I.Term \cdot \int_{i=0}^{n} Error_i + D.Term \cdot (Error_n - Error_{n-1}) \right\}$$

Explanation of the formula

- Error = deviation between setpoint value and actual value.
- P = proportional factor, proportional response to an error, used to reach a setpoint.
  The bigger the value, the sharper the control.
- I = integral factor, integration of the error in 1/second.
  A typical integral factor is < 0.05.
- D = differential quotient, derivative of the error, set in seconds (mostly to 0).

Be aware of the following relating to the individual factors:

Proportional factor

The change of the proportional factor has a considerable effect on a running process.

If the proportional factor is increased excessively, this causes oscillations in the control loop around the setpoint value.

Example, the pH parameter

To achieve the setpoint value, a little acid, then a little base, acid again, then base etc. is added.

If the proportional factor is reduced excessively, the controller hardly reacts to the deviations and never achieves the setpoint value.

Integral factor

The integral factor should have a low value and only be changed a little in small steps with long pauses.

The ideal approach is to switch off the equipment briefly after changing the integral factor in order to delete the pending error calculation.

A typical integral factor is < 0.05. It should equate to the reciprocal value of double to quadruple the system's cycle duration. The higher the entered value, the less the time (in seconds) remains for control.

A higher value than 0.05 is generally of no use as it exceeds the time minimum for which the control is required. This causes fluctuations in the control circuit.

Example of calculation of the integral factor

The cycle duration of system oscillations is measured at 50 seconds from amplitude to amplitude. The integral factor is thus calculated as follows:

1 / (50 sec x 2) = 0.01 1/sec

1 / (50 sec x 4) = 0.005 1/sec

Integral factor	Seconds
01	10
0.05	20
0.001	100
0.005	200

Differential quotient

The differential quotient is rarely required. It is set to 0 (zero) at the beginning.

A high value is only necessary if major changes are made in quick succession. In all circumstances it causes the controller output to react stronger.

6.3.2 Changing the PID Controller Settings

ATTENTION

Inappropriate changes to the PID controller settings may have a negative effect on the fermentation/cultivation process and cause loss of property.

Only change factory settings of the PID controller(s), if you are fully aware of the consequences or after consulting the manufacturer!

When making changes to the PID controller settings proceed as follows:

Procedure

1. Make a note of the factory settings, i.e. make sure they can be restored, if necessary.
2. For readjustment of a PID controller, start with the setting for the proportional factor. Select a proportional band width as large as possible.
3. Reset the integral factor and the differential quotient to zero.
4. Increase the proportional factor until the controller causes the actual value to oscillate.
5. Measure the oscillation duration. E.g. with the diagram of the parameter in the software from the equipment manufacturer.
6. Halve the proportional factor and vary the integral factor between the reciprocal value of the doubled and quadrupled oscillation duration.

7 Cascade Control

The main menu *Cascade* provides the option of setting up a cascade control of a process parameter – mostly pO2. This means that the controller output parameter (=Output) of the master controller (e.g. pO2) is used as a master parameter for the slave controller(s).

INFORMATION

The master controller and slave controllers are also called master and slave.

Serial cascade

A deviation of the setpoint of the parameter to be controlled (master controller) influences the setpoint of the first parameter (slave controller) in the cascade.

If the first parameter in the cascade reaches its maximum or minimum setpoint and the setpoint of the parameter being controlled is not yet achieved, the next parameter in the serial cascade is activated and so it continues.

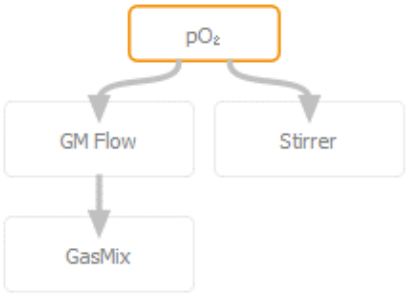
In the example of the left-hand figure:
The parameter *Stirrer,* the 1st slave controller, is activated first in the cascade, to control the pO_2 parameter, the master controller.
The parameter *AirFlow,* the 2nd slave controller, is only activated when the setpoint of parameter pO_2 has not been achieved by the *Stirrer* parameter.

Parallel cascade

A deviation of the setpoint of the parameter to be controlled (master controller) influences the setpoint of all parameters (slave controllers) that are in the cascade.

In the example of the left-hand figure:
The parameters *Stirrer* and *Air Flow*, both slave controllers, are activated at the same time to control the pO_2 parameter, the master controller.

Cascade Control



Parallel serial cascade

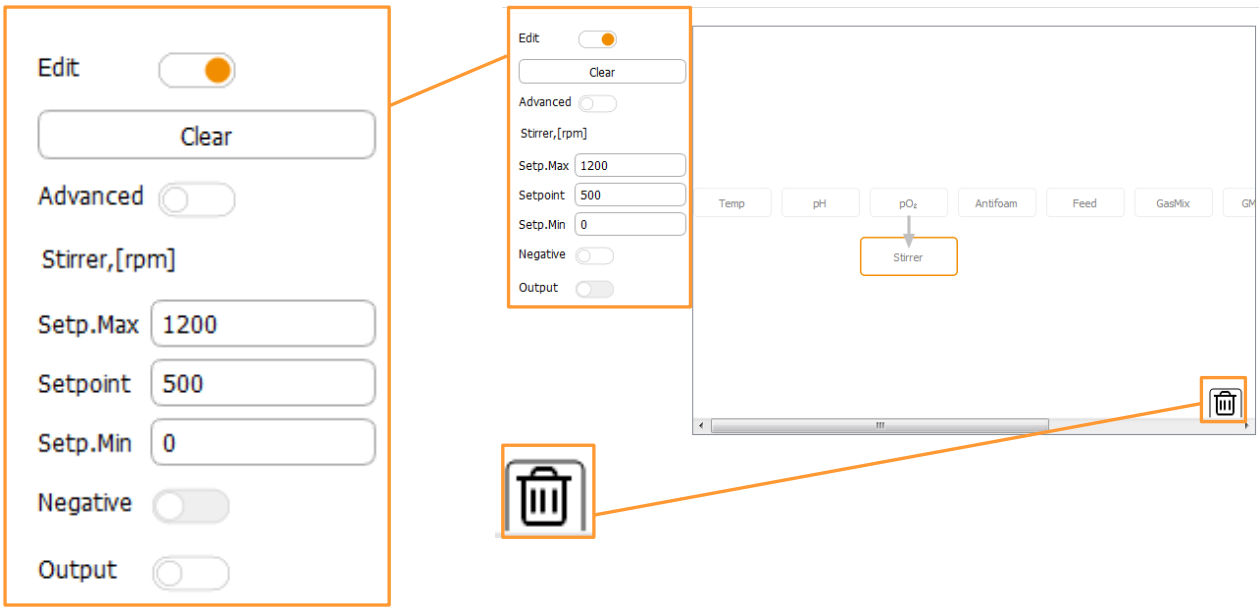
A deviation of the setpoint of the parameter to be controlled (master controller) influences the setpoint of all parameters (slave controllers) that are parallel and the first element in the cascade.

If the parameters that are connected in parallel reach their maximum or minimum setpoint and the setpoint of the parameter being controlled is not yet achieved, the next parameter(s) in the cascade is/are activated.

In the example of the left-hand figure:
The parameters *Stirrer* and *Air Flow* (master controller) are activated at the same time to control the pO_2 parameter.
The parameter *GasMix* (slave controller) is only activated when the setpoint of parameter *pO_2* has not been achieved by the *Stirrer* and *AirFlow* parameters.

7.1 Setting a Cascade

The different cascade settings are made in the left-hand side of the main menu *Cascade*. The process parameters can be merged to a cascade in the main area of the menu using drag & drop.



Cascade elements (parameters) can be removed and dropped off in the recycle bin using drag&drop.

- *Edit*: to switch on/off the edit function of the cascade.

  Switching off this function will also deactivate the display of the present process parameters in the main area of the menu.

  Once the edit function is switched on, all parameters can be merged to one or even several cascades using drag&drop.

  Each parameter can only be used once and in one cascade only.
- **Clear**: to call up warning dialogue and delete cascade after confirmation.
- *Advanced*: to switch on/off the setting mode for advanced cascade.

Cascade Control

INFORMATION

Advanced cascades are used for customised equipment configurations. They are only set from the equipment manufacturer at the factory. Their settings and possible adjustments are equipment-specific saved at the factory. If required, they may be obtained upon request from the manufacturer.

ATTENTION

Incorrect settings of an advanced cascade may have a negative effect on the fermentation/cultivation process and cause loss of property.

Only set or change an advanced cascade after consulting the manufacturer and if you are fully aware of the consequences!

- Parameter name, (e.g. *Stirrer*): selected parameter with unit.

  The selected parameter visually stands out from the other parameters in the main screen area. The input fields for min./ max. and setpoint values are visible and enabled at the same time to the left-hand side.
- *Setp. Max*. und *Setp. Min*.: factory settings for min. and max. setpoint values which define the adjustable value range of the selected parameter in which the cascade can change the setpoint of the cascaded parameter to control the setpoint of the master controller. These values are adjustable within this predefined value range.
- *Setpoint*: setpoint of the parameter.
  - Master controller: the setpoint to be controlled.
  - Slave controller: the starting setpoint of the parameter from which the setpoint of the parameter of the cascade can be varied within the value range of *Setp. Min. up to Setp. Max.*

INFORMATION

In most cases, it is recommended to set the setpoint for the slave controller to the lower end of the value range (Setp. Min.)

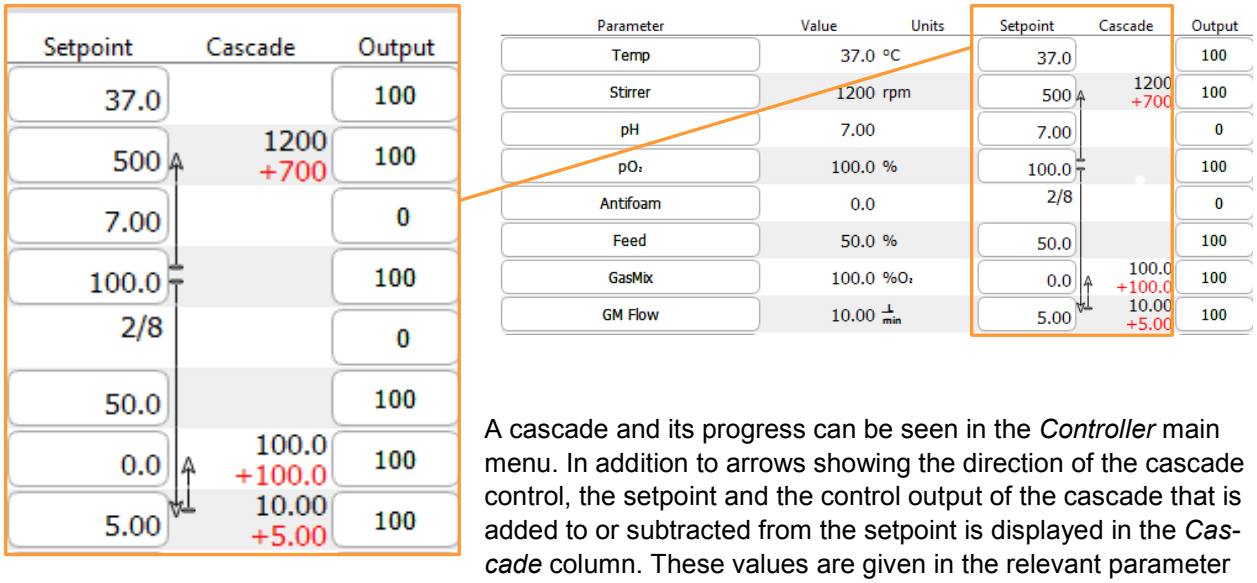
- *Negative*: to switch on/off the negative function of a cascade. Can be used for slave controller, if an increase of the setpoint of the slave controller leads to a decrease of the current value of the slave controller.
- *Output*: to switch on/off the cascade and all used parameters in the cascade hereby.

  Each parameter in the cascade must be switched on (*Output ON*) for the cascade to function.

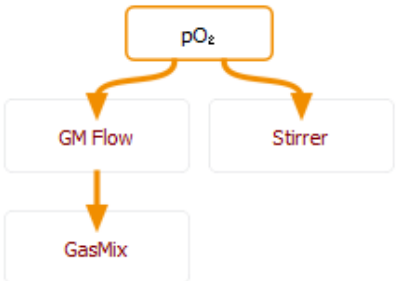
  The parameters can also be switched on and off in the *Controller* main menu.

  If a parameter is switched off (*Output OFF*), all of the following parameters are uncoupled from the cascade.

Cascade progress display



A cascade and its progress can be seen in the *Controller* main menu. In addition to arrows showing the direction of the cascade control, the setpoint and the control output of the cascade that is added to or subtracted from the setpoint is displayed in the *Cascade* column. These values are given in the relevant parameter unit.



The colour of the added/subtracted setpoint in the *Controller* menu and the name of the parameter in the *Cascade* menu indicates the progress of the cascade and the remaining scope of the cascade within the value range of a slave controller to control the master controller according to the following scheme:

Colour	Utilisation of value range
Grey	Inactive
Green	0 – 90 %
Yellow	90 – 99 %
Red	100 %
Blue	0 %

Cascade Control

Example of calculation

Stirrer, e.g. for slave controller from setpoint to max. setpoint.

- Setpoint: 500
- Setpoint max. 1200
- Value range: 1200 – 500 = 700

700 = 100 % / 630 = 90 %

500 + 630 = 1130 = setpoint, from which 90 % of the value range are reached.

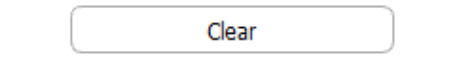
This means for the display according the colour scheme mentioned:

- Green: up to 1130
- Yellow: up to 1193
- Red: at 1200

7.2 Deleting a Cascade

To delete all settings of a cascade (does not apply to advanced cascade), proceed as follows:

Procedure



1. In main menu *Cascade*, press **Clear**.

A warning dialogue box appears with:

- Warning / Instruction: *All information NOT created manually with Advanced Cascades will be lost. Press OK to confirm*:
- **OK**: To confirm delete of the cascade and close the dialogue box.
- **Cancel**: To close dialogue box without changes

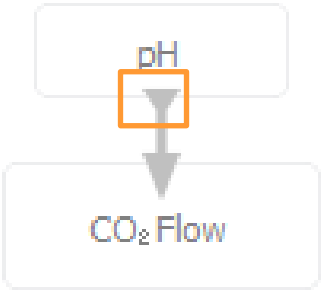
2. Press **OK**.

Cascade is deleted.

7.3 Negative Function of a Cascade

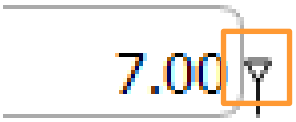
The *Negative* function causes a change in sign of the controller output.
This means, a negative controller output causes the addition of a positive value for the set point of the cascaded parameter and vice versa.

The pH regulation with base and CO_2 instead of acid is a classic example of this: to reduce the pH, the CO_2 flow rate (*CO2Flow* parameter) needs to increase.



The fact that the *Negative* function has been switched on is illustrated by the triangle symbol on the arrow that indicates the direction of the cascade control.

This arrow shape can be seen both in the *Cascade* menu as well as in the *Controller* menu.

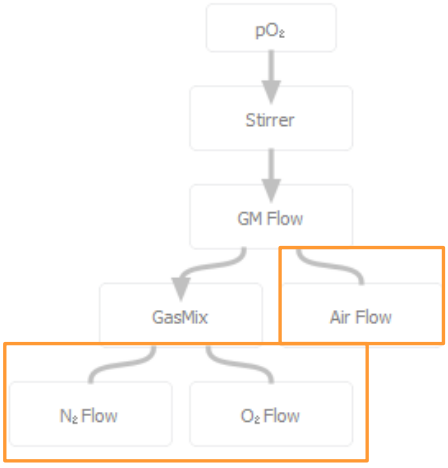


7.4 Special Configurations

For bioreactors with gassing strategy “High End” (configuration with several mass flow controllers for flow control and gas mix) the gases to be used e.g. *Air Flow*, *N2 Flow* and *O2 Flow*, must be assigned to both parameters that control the gas mixture, i.e. parameters *GasMix* and *GM Flow*, in the cascade configuration.

For this purpose, setup the following cascades additionally to the desired cascade configuration, if the appropriate parameters are present:

- Parameter *Air Flow* as slave controller to parameter *GM Flow*
- Parameter *O2 Flow* as slave controller to parameter *GasMix*
- Parameter *N2 Flow* as slave controller parameter *GasMix*



If parameters *O2 Flow* and *N2 Flow* are present, then they are setup as a parallel cascade below parameter *GasMix*.

To make a distinction between the allocation of these parameters and regular cascade elements, the connections are shown without arrow.

8 Pumps & Options

The pumps are controlled in accordance with the corresponding parameters:

- *Acid* (digital): in accordance with the *pH* parameter
- *Base* (digital): in accordance with the *pH* parameter
- *Antifoam* (digital): in accordance with the *Antifoam* parameter
- *Feed* (analogue): in accordance with the *Feed* parameter
- Optional extra analogue pump(s) which can be assigned to one or two separate parameter(s) e.g. *Feed 2 + 3*.

Digital pumps have a set speed and are time controlled. I.e., they always run at the same speed in start/stop mode. Analogue pumps have a variable speed. Both digital and analogue pumps are controlled within a range of 0 % to 100 %.

Example:

- Analogue: 50 % of the maximum feed rate = pump runs at half speed.
- Digital: 50 % of the maximum feed rate = pump runs during half the time

The following pump settings are possible:

- Setting the pump speed for feed pump(s) and dosing/waiting time for the antifoam pump
- Calibrating the pumps
- Resetting the delivery rate manually to zero
- Filling or emptying the pumps and reagent hoses automatically

For details on how to set the pump speed for the antifoam and feed pumps see the chapters “Parameters”, “Antifoam” and “Feed”.

Calibration, pump counter and automatic filling and emptying of all pump and reagent hoses is described in detail in the following chapters.

8.1 Calibrating a Pump

Calibrating a pump makes it possible to display and record the actual delivered volume. The delivery rate is indicated in millilitres.

INFORMATION

Always use hoses of the same kind with the same dimensions for calibration and pumping media.

Aids

- Graduated measuring cylinder/jug or scale/balance and an empty vessel
- Reagent bottle equipped with silicone hose, filled with the reagent to be delivered, the feed or a liquid which has the same viscosity

INFORMATION

To obtain precise results, the reagent bottle should be put on a scale which is linked to the bioreactor or to the bioprocess platform software eve® installed on a PC or laptop.

Calibration

To calibrate a pump, e.g. the feed pump on bioreactor A, proceed as follows:

Procedure

1. Connect the reagent bottle to the pump.
2. Place the output end of the hose in a measuring cylinder/jug. Or: Place the reagent bottle on a scale and tare to zero, place the output end of the hose in an empty vessel
3. Use the rocker switch of the pump to completely fill the hose.

Pumps & Options

Note the following:

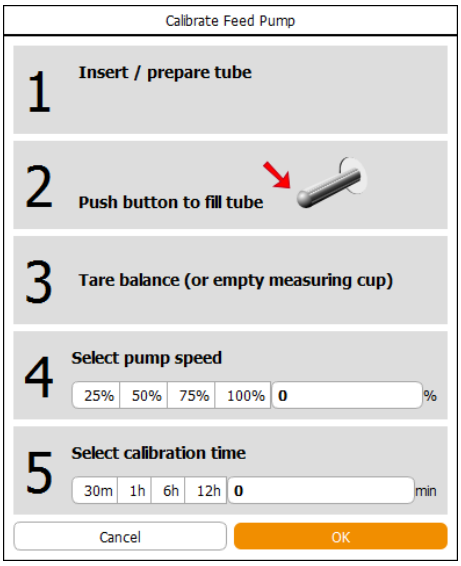
Press the rocker switch to the right

- Labfors 5 (figure to the left): the pump runs clockwise
- Multifors 2 (figure to the right): the pump runs counter clockwise

INFORMATION

The same applies to both: if the reagent bottle is connected correctly, the liquid is drawn from the reagent bottle and pumped towards the culture vessel.

4. Select the desired bioreactor (in this case A) from the selection bar I.e. the bioreactor whose pump you wish to calibrate.
5. Call up the main menu *Batch* (start menu) and press **Feed Pump**.



The *Calibrate Feed Pump* dialogue box appears with:

Lines 1 to 3 with the following instructions

- *Insert/prepare tube*: Prepare the hose
- *Push button to fill tube*: Press and hold the rocker switch to fill the hose.
- *Tare balance (or empty measuring cup)*: tare the balance or empty the measuring jug.

Line 4 *Select pump speed* and

- **25%**, **50%**, **75%**, **100%** and input field %: To select the pump speed in percent or enter another value in %.

After selecting one of the buttons, the **Other** button appears instead of the % input field. Selection can be cancelled using this button.

Line 5 *Select calibration time*

- **30m**, **1h**, **6h**, **12h** and input field *min*: To select the calibration duration or enter another calibration duration in minutes.

Footer

- **OK**: To confirm entries and start calibration
- **Cancel**: To cancel procedure and close the dialogue box without changes.

6. Select the desired pump speed in % via the appropriate button or enter it manually into the input field *Other* using the numeric keypad.

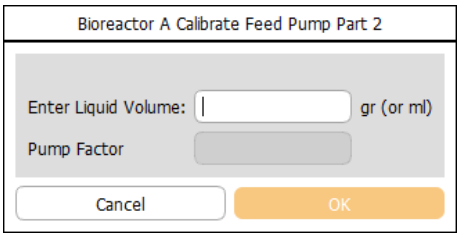
INFORMATION

To obtain most accurate results, the pump should be calibrated at the same speed as it is to be expected to run during fermentation/cultivation.

7. Select the desired calibration duration via the appropriate button or enter it manually into the input field *min*. using the numeric keypad.
8. Press **OK**.

Calibration starts. This and the remaining time in hours/minutes/seconds are displayed with *in progress* and *time left...* next to the available **Stop** button.
This button allows you to cancel the calibration process.

Once the time has elapsed:



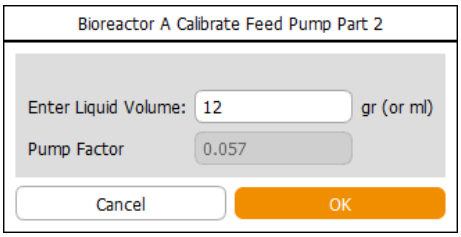
the *Bioreactor A, Calibrate Feed Pump Part 2* dialogue box appears with:

- *Enter Liquid Volume gr (or ml)* input field: Enter the delivered volume in mL or g.
- *Pump Factor*: Displays the calculated pump factor after entry of the delivered volume.

  The pump factor is always ≠ 1 with a calibrated pump.
- **OK**: To confirm entries.
- **CANCEL**: To cancel calibration and close the dialogue box without changes.

9. Press the *Enter Liquid Volume* input field.

   The numeric keypad appears.
10. Enter the delivered liquid in mL or g and confirm with the **OK** key.



The numeric keypad disappears; the value is adopted for the input field.
The pump factor is calculated automatically and displayed in the *Pump Factor* view box.

11. Press **OK**.

The dialogue box disappears; the calibration value is saved.

Done at with date and time next to the **Stop** button indicates that and when the pump was cablibrated.

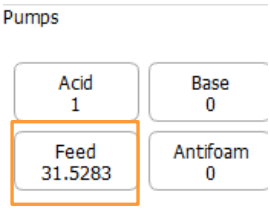
8.2 Resetting the Pump Counter to Zero

The number of pump revolutions and the delivered quantity (in mL) of calibrated pumps are displayed constantly during a running fermentation/cultivation process. The display remains in place after completion of the process (when the bioreactor is stopped) until a new fermentation / cultivation process is started again (when the bioreactor is started).

The counter can also be reset to zero manually, proceed as follows:

Procedure

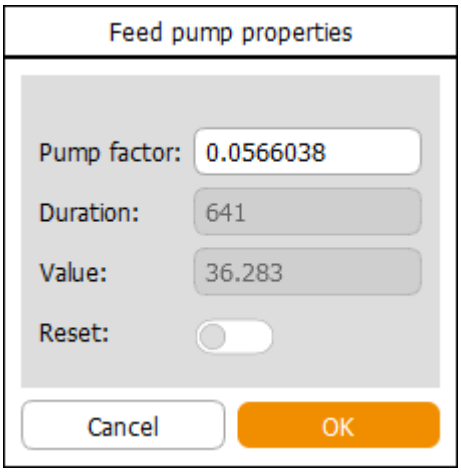
1. Select the desired bioreactor from the selection bar, e.g. bioreactor A.
2. Call up the main menu *Main*.



The delivered quantity (in mL) of the pumps is displayed on the right-hand side of the screen.

3. Press the desired pump button, e.g. **Feed**.

Pumps & Options



The *Feed pump properties* dialogue box appears with:

- *Pump factor*: Displays the pump factor or allows to be changed manually.
  The pump factor is always ≠ 1 with a calibrated pump.
- *Duration*: Displays number of pump revolutions
- *Value*: Displays delivered quantity in mL

INFORMATION

The values displayed here are fictitious and used only as an example!
Manual change of the pump factor leads to rejection of the previous calibration value.

- *Reset*: To switch on the reset of the pump counter
- **Cancel**: To close the dialogue box without changes
- **OK**: To confirm entry and close the dialogue box

4. Activate the counter reset via *Reset*.

   The function is switched on.
5. Press **OK**.

   The counter is reset to zero and the count starts from the beginning, as soon as the bioreactor is started i.e. fermentation / cultivation running.

8.3 Automatically Filling/Emptying Pump Hoses

The *Fill/Empty Pumps* function allows the automatic filling or emptying of all pump hoses. The function is available only if all bioreactors are in stopped state.

The pumps are grouped by function, thus, for example, all acid pumps are filled or emptied simultaneously without affecting the base pumps etc. For each pump group, an individual filling duration / emptying duration can be defined.

⚠ WARNING

If the reagent bottles are not connected correctly, reagents may emerge when filling the pump and reagent hoses!

⚠ WARNING

If acids and bases are directed into the same vessel when emptying the pump and reagent hoses, chemical reactions may be caused!

Note the following:

- The pump duration should preferably be tested with the liquid which has the highest viscosity and the longest hose connection.
- Reagent hoses with the same function should be of the same length and have the same filling volume. That means, for example, that the same hoses of the same length are used for all acid pumps etc.

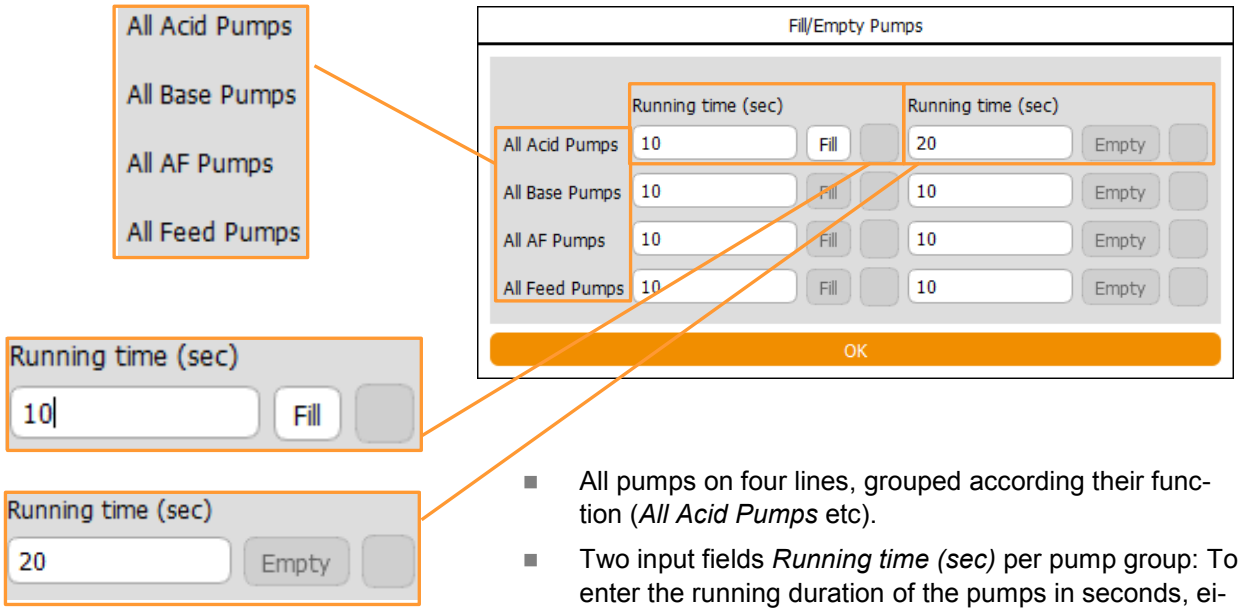
To call up the menu, proceed as follows:

Procedure

1. Select all bioreactors (***All***) from the selection bar.
2. Call up main menu *Batch* and press **Fill/Empty Pumps**.

Pumps & Options

The *Fill/Empty Pumps* dialogue box appears with:



- All pumps on four lines, grouped according their function (*All Acid Pumps* etc).
- Two input fields *Running time (sec)* per pump group: To enter the running duration of the pumps in seconds, either for filling or for emptying
- Two buttons per pump group:

  Fill: To start automatic filling
  Empty: To start automatic emptying

  Stop buttons are provided next to each of these buttons for immediately stopping the filling or emptying process. These buttons are not enabled until the respective process has been started.

- **OK**: To close the menu / dialogue box.

INFORMATION

If a filling or emptying procedure is active, the remaining filling or emptying duration is displayed. The menu / dialogue box cannot be closed while at least one filling or emptying procedure is active.

9 Starting & Stopping the Bioreactor(s)

A single bioreactor is started and stopped via **Start** and **Stop** in main menu *Batch* of the selected bioreactor.

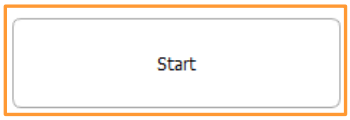
If more than one bioreactor is controlled via touch screen software, then all stopped or running bioreactors can be started or stopped at once via **Start All** / **Stop All** after selecting all (*All*) bioreactors in the selection bar

9.1 Starting a Bioreactor

To start a bioreactor (= 1 culture vessel) proceed as follows:

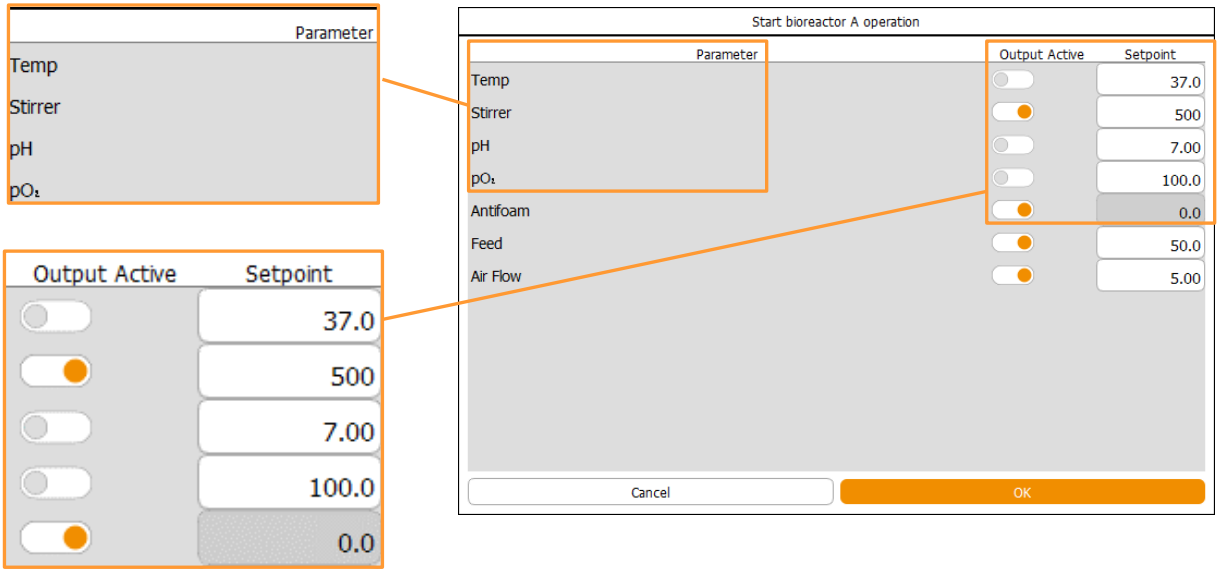
Procedure

1. Select the desired bioreactor from the selection bar, e.g. bioreactor A.



2. In main menu *Batch*, press **Start**.

The *Start bioreactor A operation* (start dialogue) appears with all present parameters. This is where the setpoint value settings for the parameters of the last fermentation/cultivation process are visible.



INFORMATION

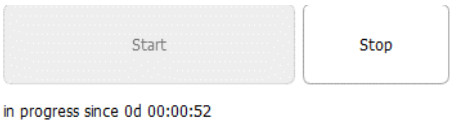
The bioreactor is started with the settings in the start dialogue. Changes to these settings are saved and transferred to the next start dialogue. If setpoint values are changed or parameters are switched on/off whilst a bioreactor is running, these settings are only adopted for the current fermentation process.

3. Set the desired setpoint values and switch on all required parameters.

   For details on the start dialogue and setpoint value settings / switching parameters on/off refer to chapter “Parameter Options”, Setting Setpoint Values, Switching Parameters ON /OFF”.

4. Press **OK**.

The bioreactor starts.



Start is no longer enabled, but **Stop** is available now. The display *in progress since* indicates, that and for how long the bioreactor has been running in hours/minutes/seconds.

Current values and controller outputs for the parameters are visible in the main menu *Controller*.

A recording of the current values and a diagram are visible in the main menu *Trends*.

9.2 Stopping a Bioreactor

To stop a running bioreactor (= 1 culture vessel) proceed as follows:

Procedure

1. Select the desired bioreactor from the selection bar, e.g. bioreactor A.

2. In main menu *Batch,* press **Stop**.

The *Confirmation* dialogue box appears with:

- Information: *Bioreactor will be stopped*.
- Instruction: *Press OK to confirm*
- **OK**: To stop the bioreactor and close the dialogue box.
- **Cancel**: To cancel and close the dialogue box without changes.

3. Press **OK**.

   The dialogue box disappears, the bioreactor stops.

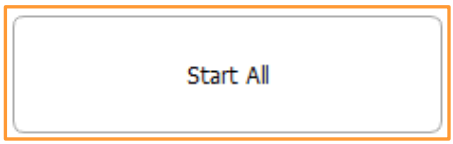
Stop is no longer enabled. The display *stopped after* indicates that and after how much time the bioreactor was stopped.

9.3 Starting all Bioreactors

To start all stopped bioreactors, proceed as follows:

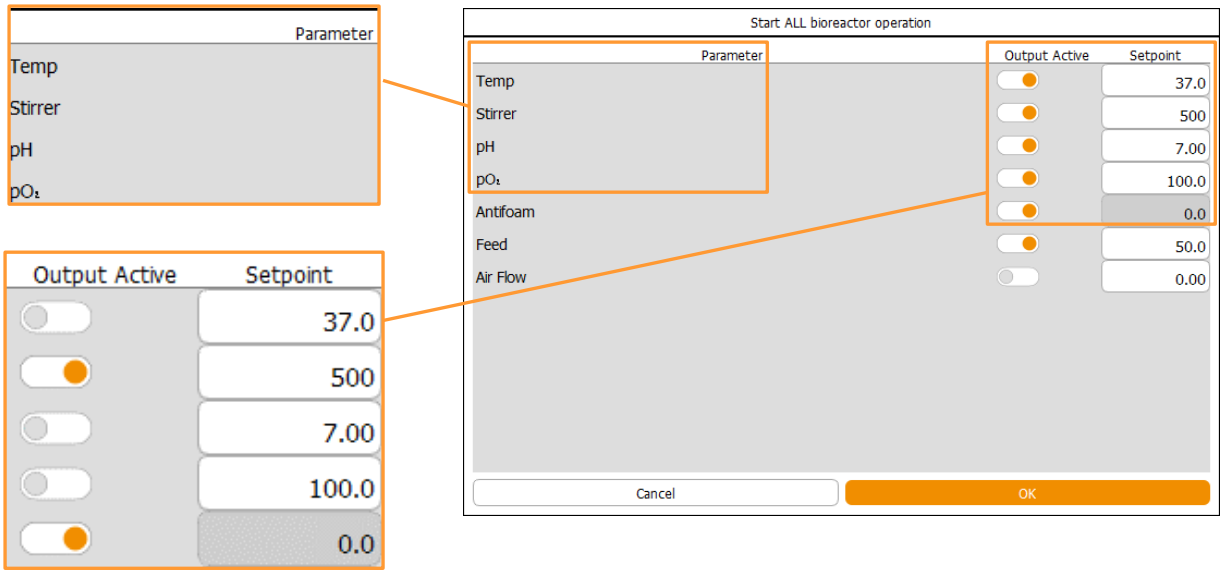
Procedure

1. Select all bioreactors from the selection bar.



2. In main menu *Batch,* press **Start All.**

The *Start ALL bioreactor operation* (start dialogue) dialogue box appears with all present parameters. This is where the setpoint value settings for the parameters of the last fermentation processes are visible.



INFORMATION

All bioreactors are started with the settings in the start dialogue. Changes to these settings are saved and transferred to the next start dialogue. If setpoint values are changed or parameters are switched on/off whilst bioreactors are running, these settings are only adopted for the current fermentation process.

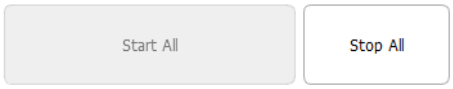
Starting & Stopping the Bioreactor(s)

3. Set the desired setpoint values for the parameters and switch on all required parameters.

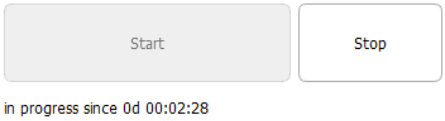
   For details on the start dialogue and setpoint value settings / switching parameters on/off refer to chapter “Parameter Options”, Setting Setpoint Values, Switching Parameters ON /OFF”.

4. Press **OK**.

All the bioreactors are started.



Start All is no longer enabled, but **Stop All** is available now.



For every single bioreactor, the display *in progress since* indicates, that and for how long the bioreactor has been running in hours/minutes/seconds.

Current values and controller outputs for the parameters are visible in the main menu *Controller* of each bioreactor. A recording of the current values and a diagram are visible in the main menu *Trends* of each bioreactor.

There exists no complete view of all bioreactors.

All running bioreactors can be individually stopped only one by one or all at once.

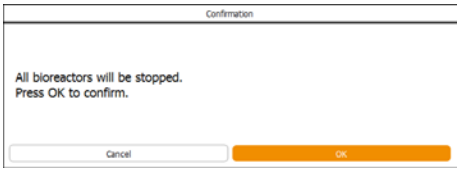
9.4 Stopping all Bioreactors

To stop all running bioreactors at once, proceed as follows:

Procedure

1. Select all bioreactors from the selection bar.

2. In main menu *Batch,* press **Stop All**.



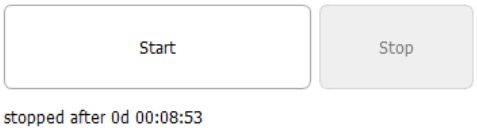
The *Confirmation* dialogue box appears with:

- Information: *All bioreactors will be stopped.*
- Instruction: *Press OK to confirm*.
- **OK**: To stop all bioreactors and close the dialogue box.
- **Cancel**: To cancel and close the dialogue box without changes.

3. Press **OK**.

The dialogue box disappears, all bioreactors are stopped.

Stop All is no longer enabled. **Start All** is enabled again.



The display *stopped after* indicates for every single bioreactor that and after how much time the bioreactor was stopped.