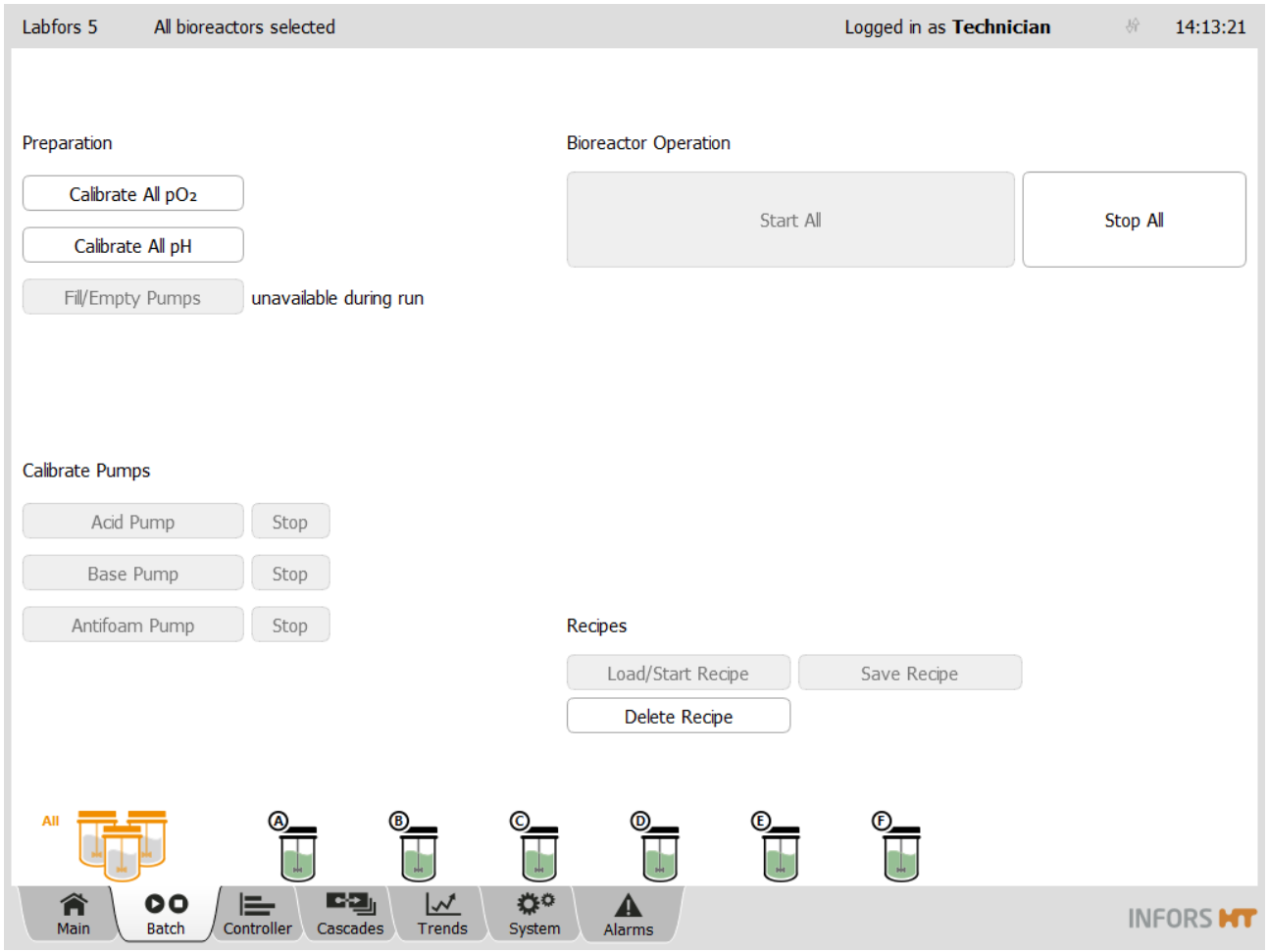
Operating Manual

Touch Screen Software V 3.5

for Bench-Top Bioreactors Labfors 5 and Multifors 2



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1 Screen, Menu Navigation and Control Elements

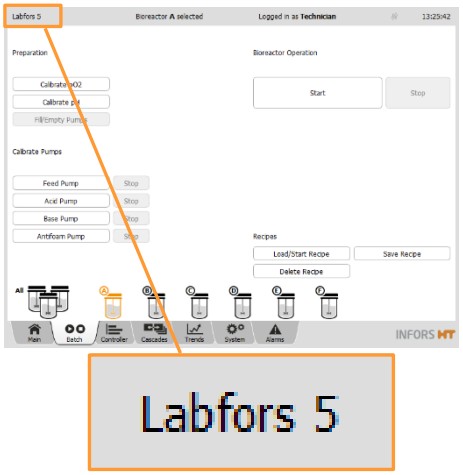
ATTENTION

Changing settings in the touch screen software by unqualified personnel or personnel with insufficient training may lead to loss of property.

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

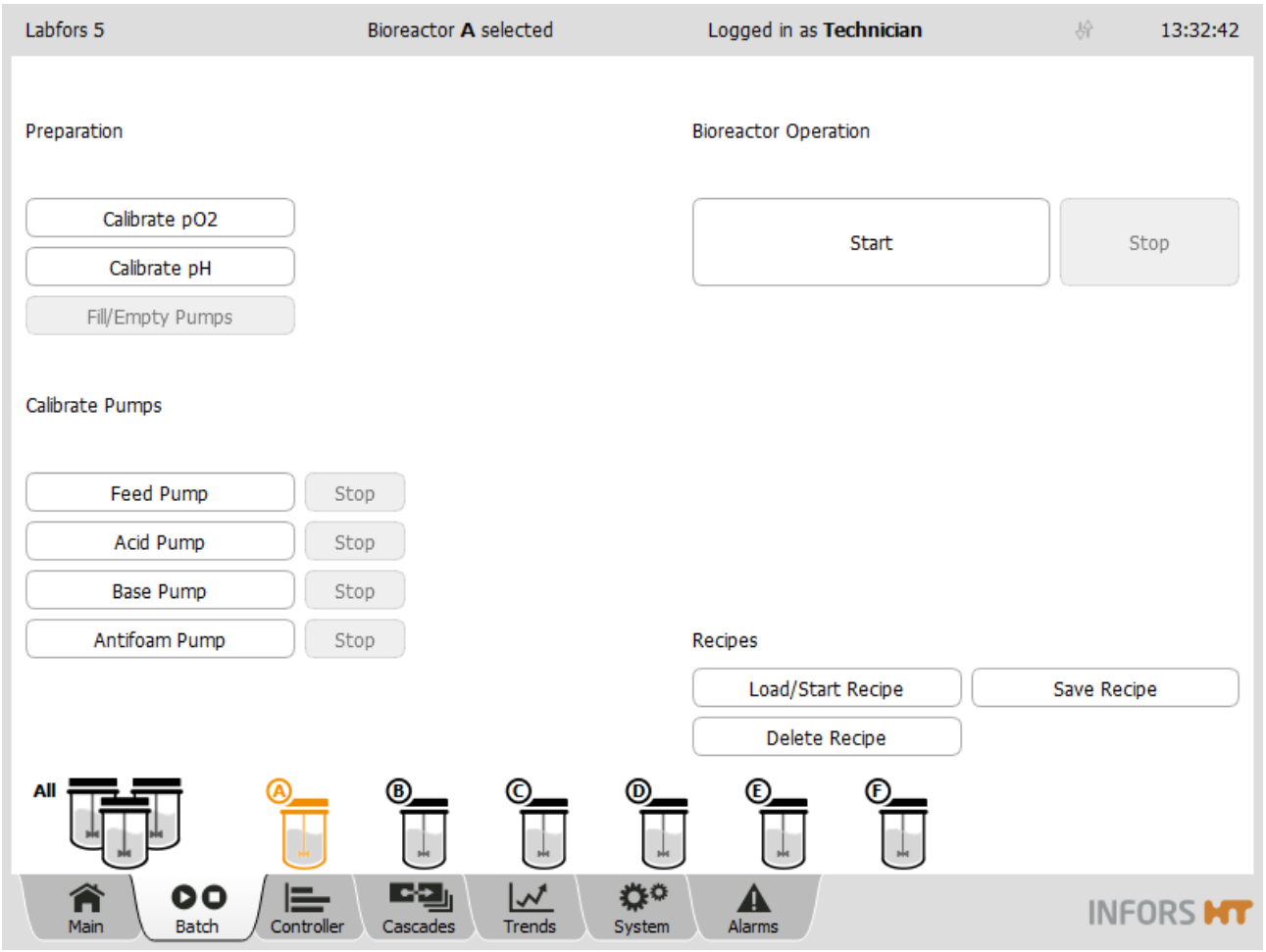
Most of the illustrations of the various menus, dialog boxes and tab pages of the touch screen software in this manual correspond to the view of a user of the Technicians user group and serve as examples. For further information on user groups and access rights, see chapter “Security – User Administration”.

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



Header

Shows (from left to right): name of the device, selected bioreactor e.g. *Bioreactor A selected*, login status and the time.

If an external software like eve® accesses the OPC XML DA server of the touch screen software, this is indicated by two vertically opposed arrows in the title bar. These flash while data is being transmitted.

Main area

shows main menus, e.g. Batch (figure), and submenus. 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 dialog boxes.

The lowest part of the main area shows a selection bar of the individually selectable bioreactors. The bioreactors are displayed symbolically as culture vessels.

Screen, Menu Navigation and Control Elements

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 color with grey content, non-available bioreactors are in light grey color without content.
A selected bioreactor is shown in orange color 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.

Main menus

Menu	Description
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 (cultivations) are started and stopped, and where sensors and pumps are calibrated. Depending on the access authorizations, it may also be possible to store, upload or delete recipes.
Controller	Shows parameters for the selected bioreactor and offers the option of changing values.
Cascade	Allows serial, parallel or parallel serial (mixed) cascaded control of one or more parameters.
Trends	Shows trend lines of the parameters, time spread between 15 min and 2 days.
System	Provides access tot he submensu *Valves*, *Security*, *Settings*, *Wipe Screen* and Shutdown.
Alarms	Shows parameter and system alarms.

1.2 Control Elements

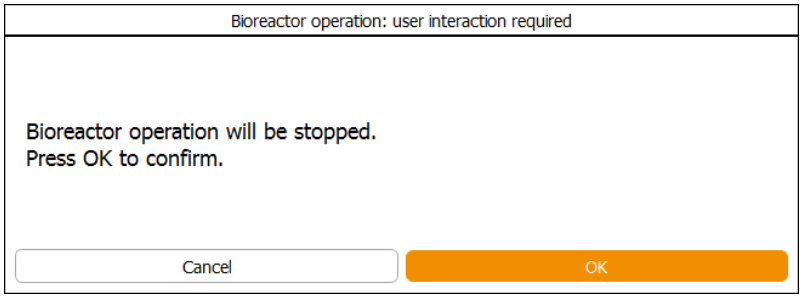
Buttons

Different buttons are displayed depending on the selected main menu or submenu and access rights. Pressing buttons opens submenus, dialog boxes or tab pages. Available buttons have a white background, buttons that are not available appear grey. Enabled buttons are white in color, disabled buttons are grey in color.

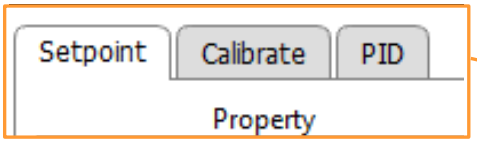
Buttons that are intended to be the next logical step are highlighted in orange color, see figure in next section.

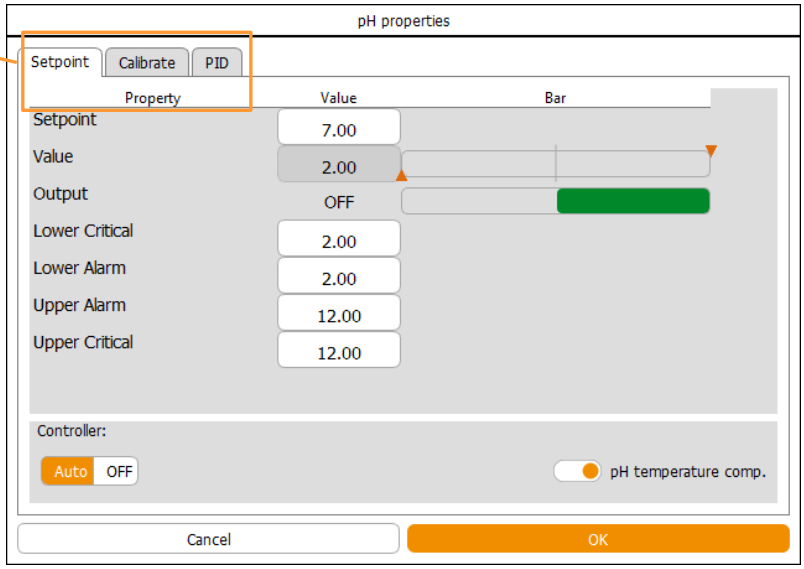
Dialog boxes and tab pages

A dialog box can contain instructions, notes, warnings and general information.



A dialog box can contain additional buttons, input fields or view boxes as well as tab pages. For example, dialog box *pH properties* dialog box with tabs which lead to the different parameter options.



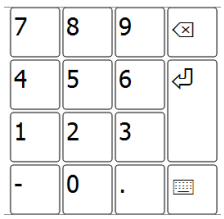


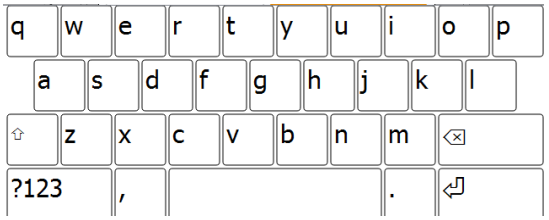
Input fields and view boxes

Input fields and view boxes are included in various menus, dialog boxes and tab pages. They require numeric or alphanumeric values to be entered or display these.

Numeric keypad and alphanumeric keyboard

Numeric values are entered using a numeric keypad and alphanumeric values are entered using an alphanumeric keyboard. After pressing an input field, the corresponding block for the input appears, depending on the type of field.





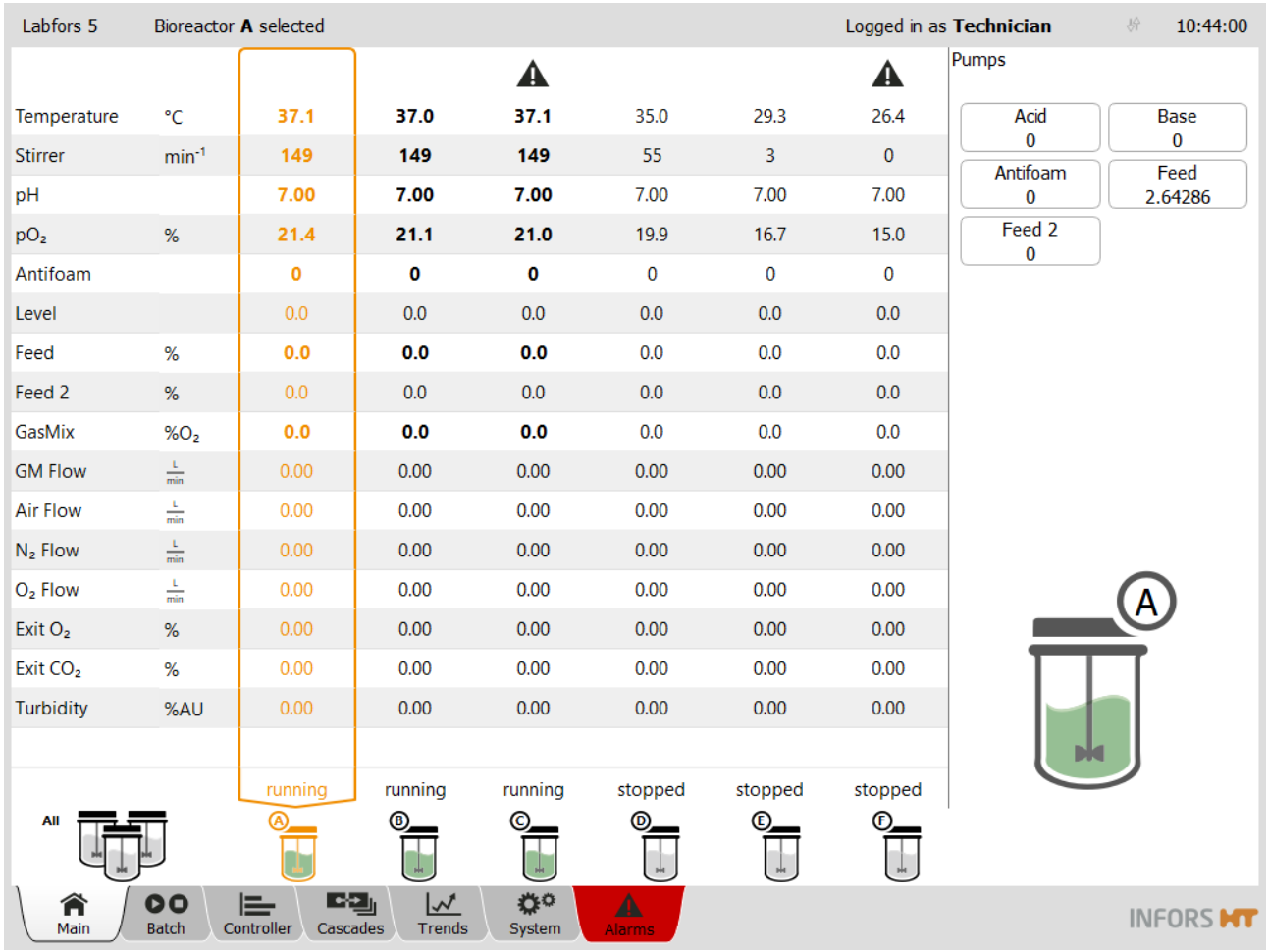
ON / OFF switch

The ON / OFF switch is used for activating or deactivating a function.

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

2 Main Menus

2.1 Main – Parameter Display All Bioreactors



The main menu *Main* opens automatically after system start. Here all parameters are listed with actual values of the available bioreactors. The operating states (*running* / *stopped*) of the bioreactors are also visible here, and parameter alarms are signalled.

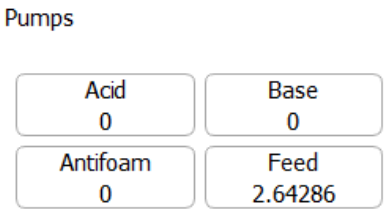
The quantity and type of parameters differ depending on the system configuration but remain the same for each individual available bioreactor.

Value display and alarms

Actual values and the symbol of a selected bioreactor are displayed in orange. Actual values of switched-on parameters of running bioreactors are in bold letters.

Main Menus

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.*



Pumps

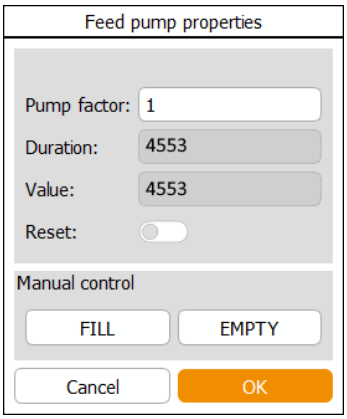
A large illustration of the bioreactor which has been selected via the selection bar is displayed on the right-hand section of the screen. All pumps of the selected bioreactor are displayed above it as buttons. By default, the following four pumps are available.

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

INFORMATION

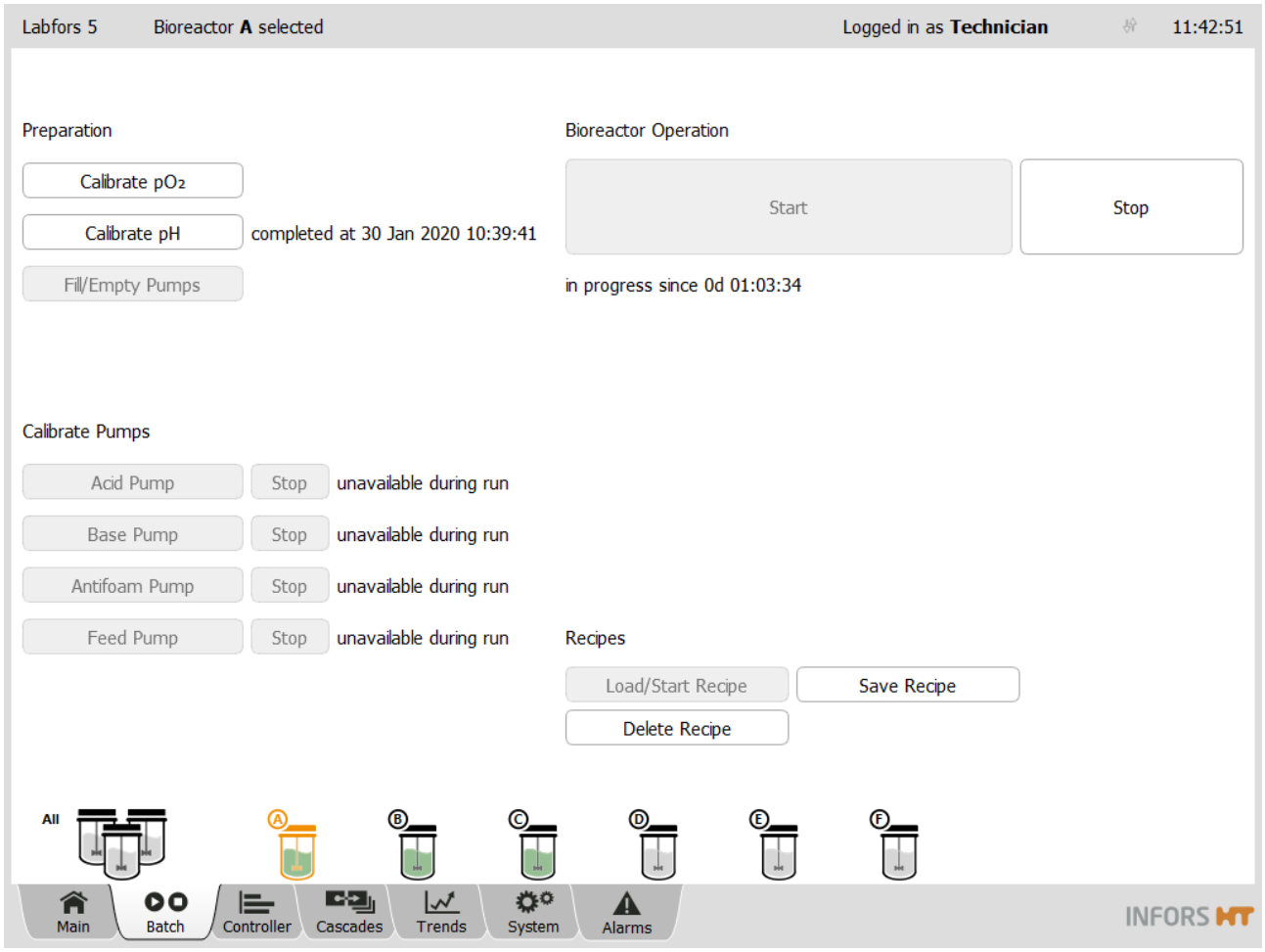
If all bioreactors (*ALL*) are selected, the message *Please select the bioreactor to view the pumps* appears instead.

The delivered volume (in mL) of a calibrated pump is continuously shown during a cultivation. This numerical value is displayed on the corresponding pump button.
If the pump is not calibrated, the number of revolutions is displayed.



After pressing one of the four buttons a dialog box, e.g. *Feed pump properties* appears 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. In addition, the two buttons **FILL** / **EMPTY** on the standard pumps allow the manual filling or emptying of the hoses.

2.2 Batch – Start Menu



In the *Batch* main menu, the following activities can be performed:

- Starting and stopping one bioreactor, several or all bioreactors
- Calibratiing pH- und pO_2 sensors and pumps
- Filling/emptying pump hoses
- Loading, saving and deleting recipes.

Depending on the device configuration, 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.

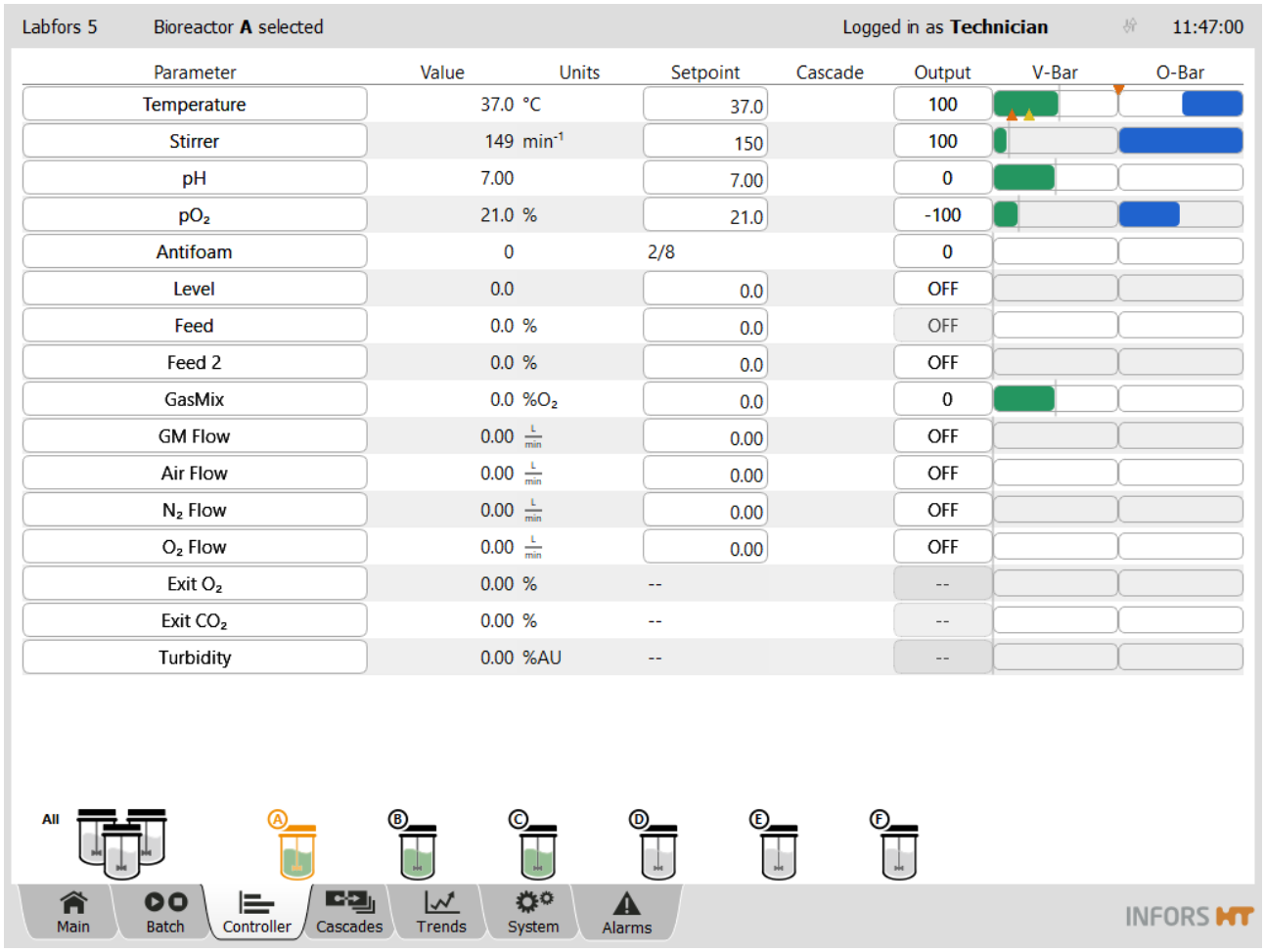
The following additional functions are available for certain device versions of the bioreactor Labfors 5:

- Version for microorganisms with option LabCIP: **Perform CIP/SIP** (starting/stopping the CIP/SIP).

  The CIP/SIP process and its configuration are described in detail in the separate operating manual of the device (LabCIP).
- Version for solid substrates and enzymatic bioprocesses: **Set Stirrer Max.** (rotation speed limit).

  This function is shortly described in the main chapter “Parameters” chapter “Stirrer”, section “Set Stirrer Max. - rotation speed limit”.

2.3 Controller – Value Display



The *Controller* main menu shows the actual values, setpoints and control outputs of the parameters of a selected bioreactor. This menu is not available when all bioreactors (*ALL*) are selected. Parameter settings of a bioreactor can be changed here.

Overview menu

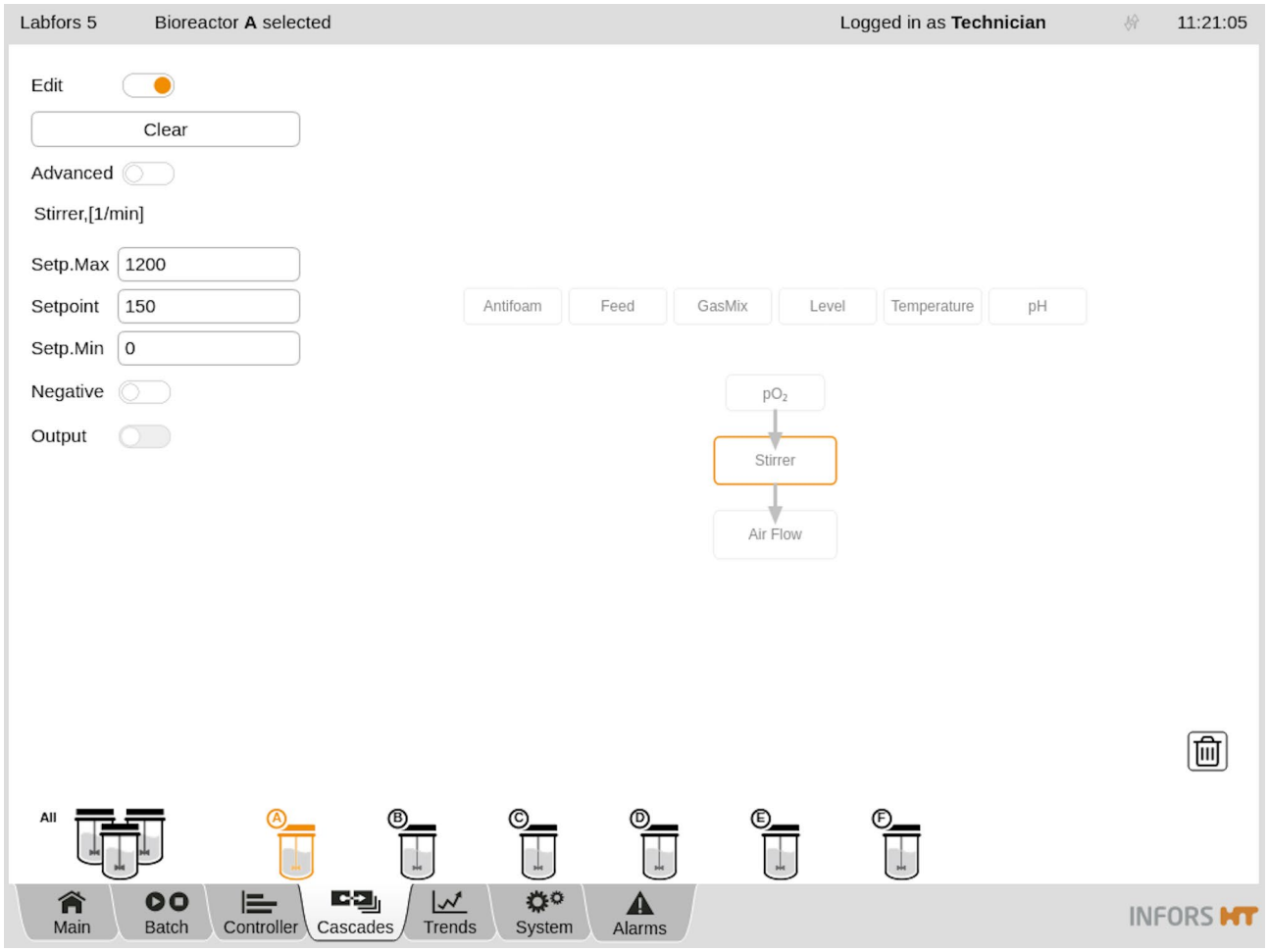
Designation	Description
Parameter	Lists the parameters. Pressing a parameter button calls up its setting menu, see chapter “Parameter Options”.
Value	Shows the actual value of the parameters.
Units	Shows the unit of the parameters.
Setpoint	Enter/change parameter setpoints, see chapter “Setting Setpoints, Activating and Deactivating Parameters”.

Designation	Description
Cascade	Shows whether and which cascade control is active and which process parameters are used. Settings for cascade control are made in the Cascade main menu. For details refer to chapter “Cascade Control”.
Output	Displays the controller output of a parameter in %. A deactivated parameter is indicated with the word **OFF**. If no process is running, all parameters are automatically deactivated. While a cultivation is running, parameters can be activated or deactivated by pressing the controller output button (**.. %**) or **OFF** provided automatic mode is set in the *Setpoint* parameter option. For details see chapter “Setting Setpoints, Activating and Deactivating Parameters”.
V-Bar (value bar)	Graphically displays the comparison between the actual value, set point and alarm limit: • Grey continuous marking: set setpoint • Yellow marking: set alarm limits (*lower alarm* / u*pper alarm*). • Red marking: set critical values (lower critical / upper critical) • Green bar: actual value is within alarm limits. • Yellow bar: actual value has exceeded the upper alarm limit or fallen below the lower alarm limit. • Red bar: actual value has exceeded the upper critical value or fallen below the lower critical value.
O-Bar (controller output bar)	Graphically displays the current controller output in %. Two-sided controlled parameters (e.g. pH and temperature) are displayed as two-part bars.

INFORMATION

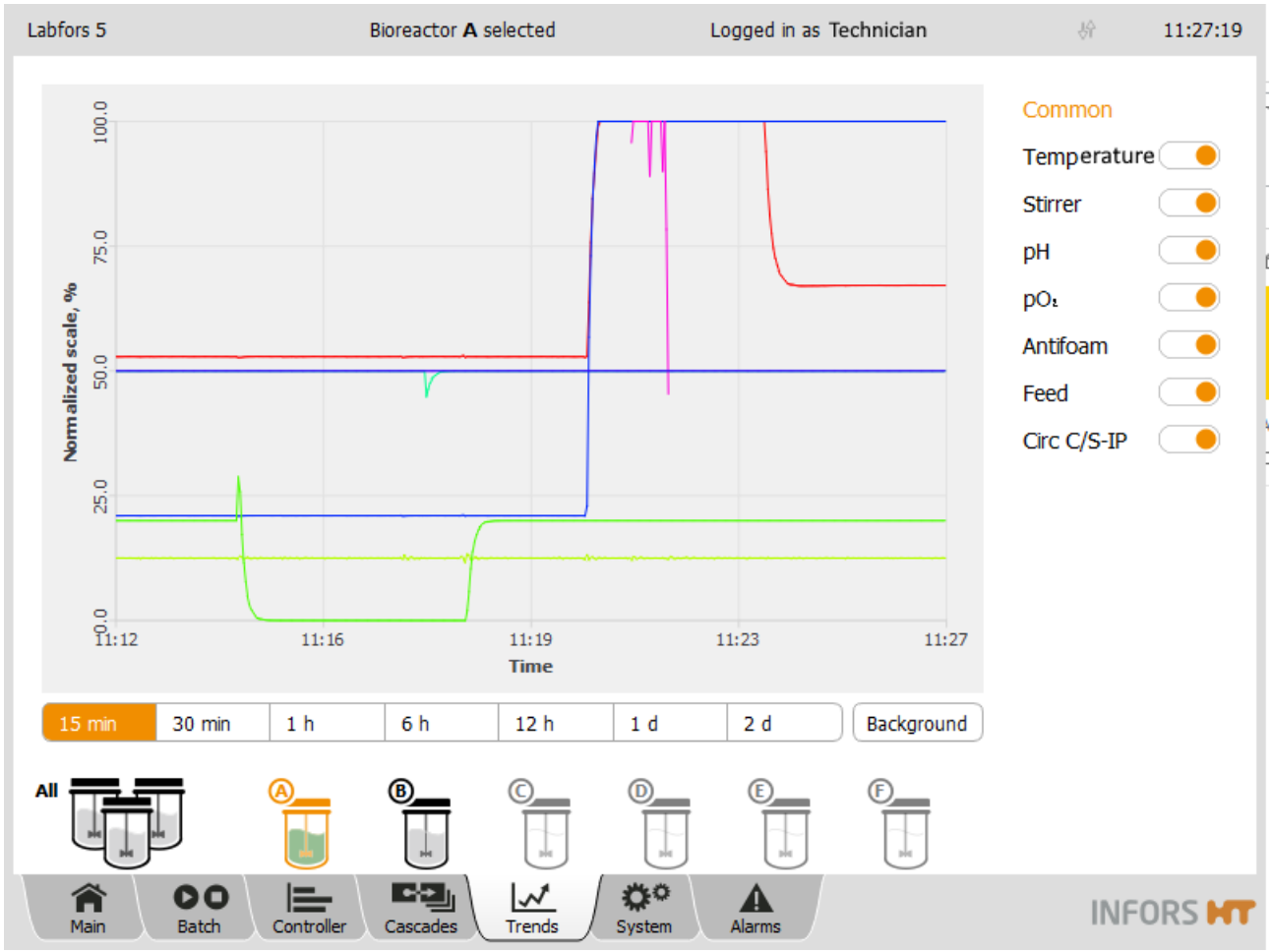
Changed settings in the *Controller* main menu only apply to the running cultivation. A bioreactor is always started with the settings in the configuration dialog.

2.4 Cascades



The *Cascades* main menu provides the option of setting up a serial, parallel or mixed cascade control of a parameter. This function is mainly used for pO_2 control. 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 & and dropping them. For details refer to chapter “Cascade Control”.

2.5 Trends – Trend Lines



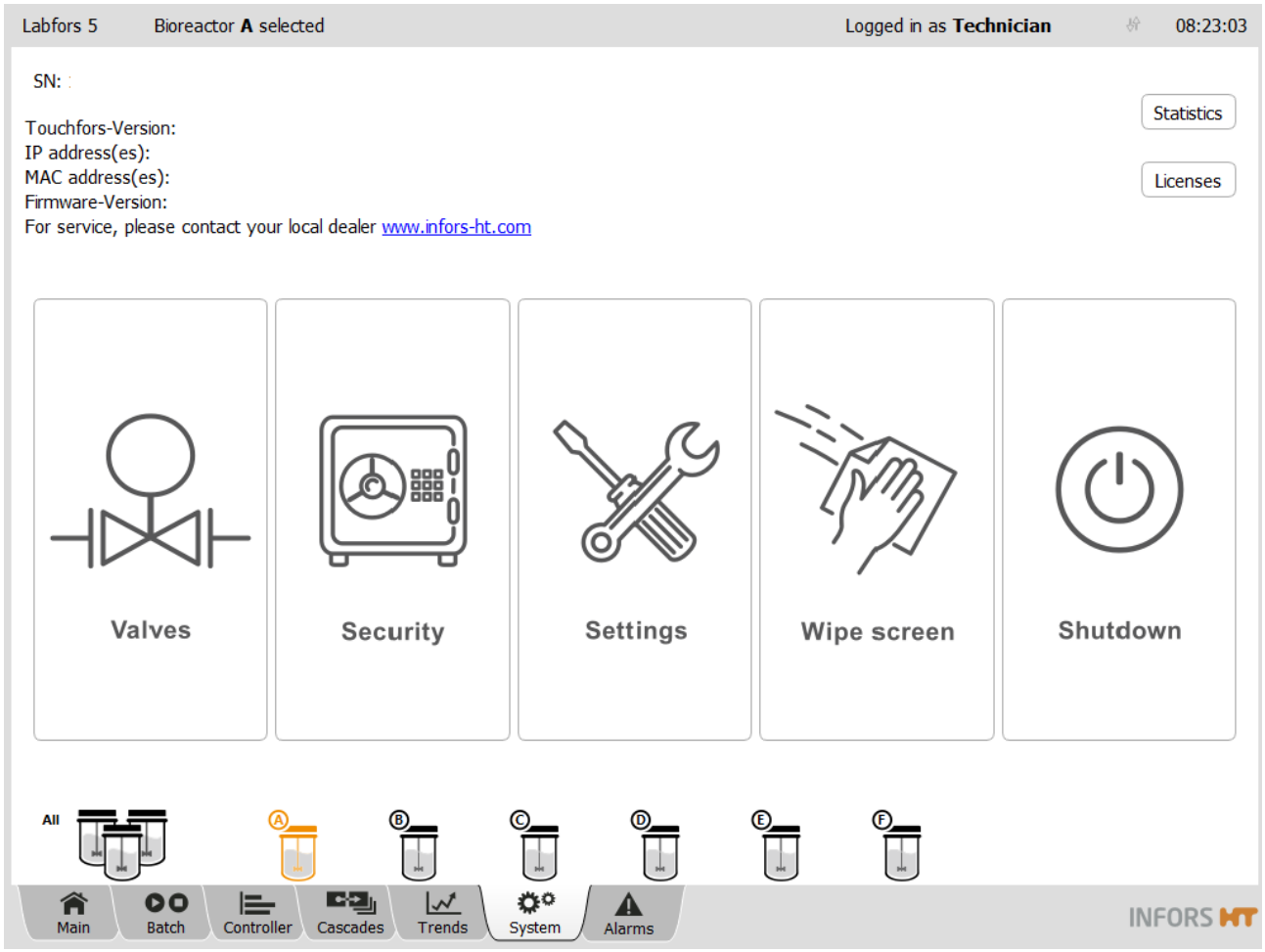
The touch screen operating panel keeps the actual values of the parameters in a buffer memory and displays them continuously as a diagram in the *Trends* main menu. This data cannot be archived, edited or exported. However, this data can be transferred to a computer connected via a network, for example, by using eve®, and then be archived there. The parameters are displayed on the right side of the screen. The trend lines can be shown or hidden by using the **ON**/**OFF** switches.

- Y-axis: if the *Common* view is selected (press *Common* above the parameter list), all trend lines of the parameters are displayed on a normalized scale. This means that minimum and maximum permissible values are displayed as 0 % and 100 %. If a parameter is selected in the list (press the parameter name), the Y-axis label changes to the value range in the parameter's unit.

- X-axis: the time spread of the diagram display can be set from 15 min to 2 days using the buttons below the diagram.
- **Background**: to set the background color in white, grey or black.

This menu is not available when all bioreactors (*ALL*) are selected.

2.6 System – System Settings



Device Information

The *System* main menu shows the following information on the device:

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

Buttons

The top right of the screen has two buttons:

Main Menus

- **Statistics**: enables viewing some statistics of the software communication with the control board, i.e. the hardware of the bioreactor(s). The function is only used for fault diagnosis for technical support from the manufacturer.
- **Licences**: opens a menu with the licenses of all software libraries used.

Submenus

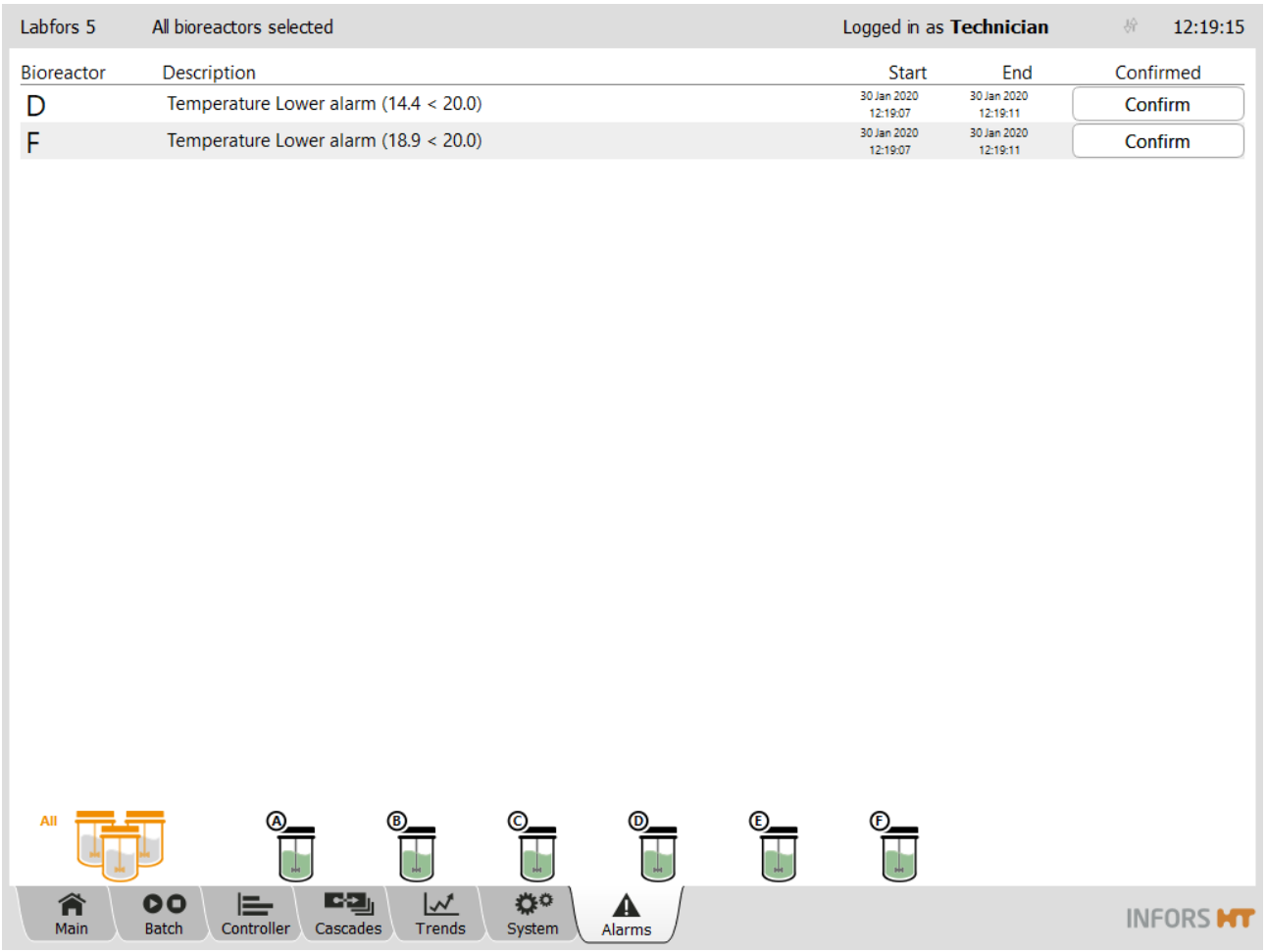
The menu has 5 buttons, which lead to different submenus:

- **Valves**: shows the status of the digital outputs.
- **Security**: for system log-in and log-off, passwords and user management.
- **Settings**: for system and basic settings of the bioreactor(s)
- **Wipe Screen**: to lock the screen for 20 seconds, e.g. for screen cleaning
- **Shutdown**: for shutting down the system.

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

2.7 Alarms – Alarm Display

2.7.1 Menu Overview



The *Alarms* main menu lists all process parameter alarms for all running bioreactors by time of occurrence. All system alarms are also displayed here.

Alarm display

An alarm is indicated by the alternately light red-dark red flashing *Alarms* tab.

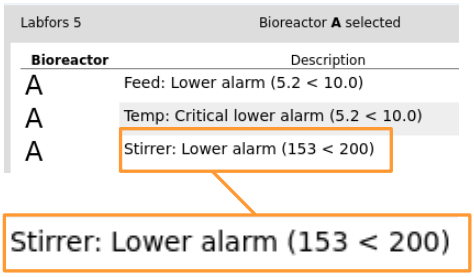
The screen contains the following columns:

- *Bioreactor*: displays the bioreactor (A to F) to which the parameter alarm refers.
- *Description*: describes the alarm.

- *Start* and *End*: shows the date and time when the alarm started/ended.
- *Confirmed*: indicates via **Confirm** confirmed alarms with date, time and user.

2.7.2 Parameter Alarms

A parameter alarm occurs as soon as the actual value of a parameter is outside the set alarm limits or critical values.



Example

The example in the figure on the left shows: *Stirrer: Lower alarm (153 < 200)*. I.e. for biorecter A, the actual value for parameter Stirrer (= 153 min^{-1}) is below the lower alarm limit (= 200 min^{-1})

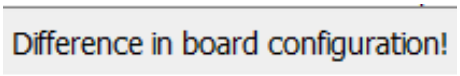
INFORMATION

The values in brackets always refer to the actual value compared to the set alarm value or critical value.

2.7.3 System Alarms

The following system alarms can occur:

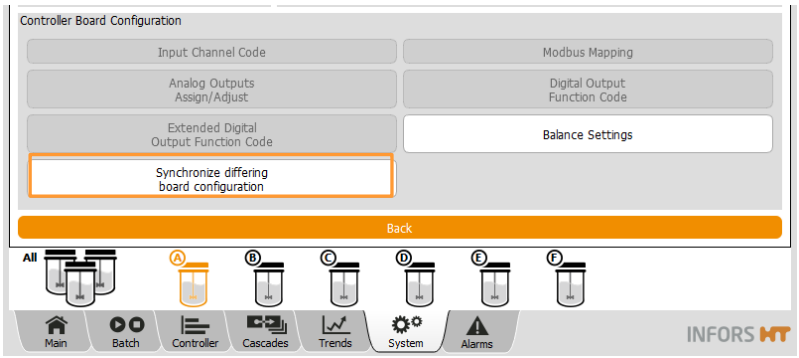
Alarm	Short Description	Additional Information
Password Expiry	The password expires. The alarm for password expiry appears during the 10-day period leading up to the expiry. The password validity period is set when a new user login is created.	Chapter “Security – User Management”, “Setting Password Rules”.
Difference in board configuration:	Different control board configuration(s) detected.	Section “System Alarm – Difference in board configuration”.
Invalid modbus map for *Parameter xy*	Invalid modbus setting for parameter xy.	This alarm can only appear if changes have been made in the modbus settings. Modbus settings can only be changed by the *Service* user group.
Requested specialized configuration not installed	An error occurred while restoring backed up data via **Restore** or installing software updates via **Update.**	Section “System Alarm – Difference in board configuration”.
No communication	No communication between the control board and the operating panel.	Chapter “Interferences Basic Operation and Operating Panel” in the separate operating manual of the device
System restarted after power failure	System restart after power failure.	Chapter “Behaviour in Case of Power Interruption” in the separate operating manual of the device.



System-Alarm “Difference in board configuration”

A backup of each control 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/control board or touch screen swap, the *Difference in board configuration* alarm might appear. This means that the backup does not match with the current configuration.

To be able to select the corresponding configuration, the *Settings* submenu, *Controller Board Configuration* area now shows the **Synchronize differing board configuration** button.



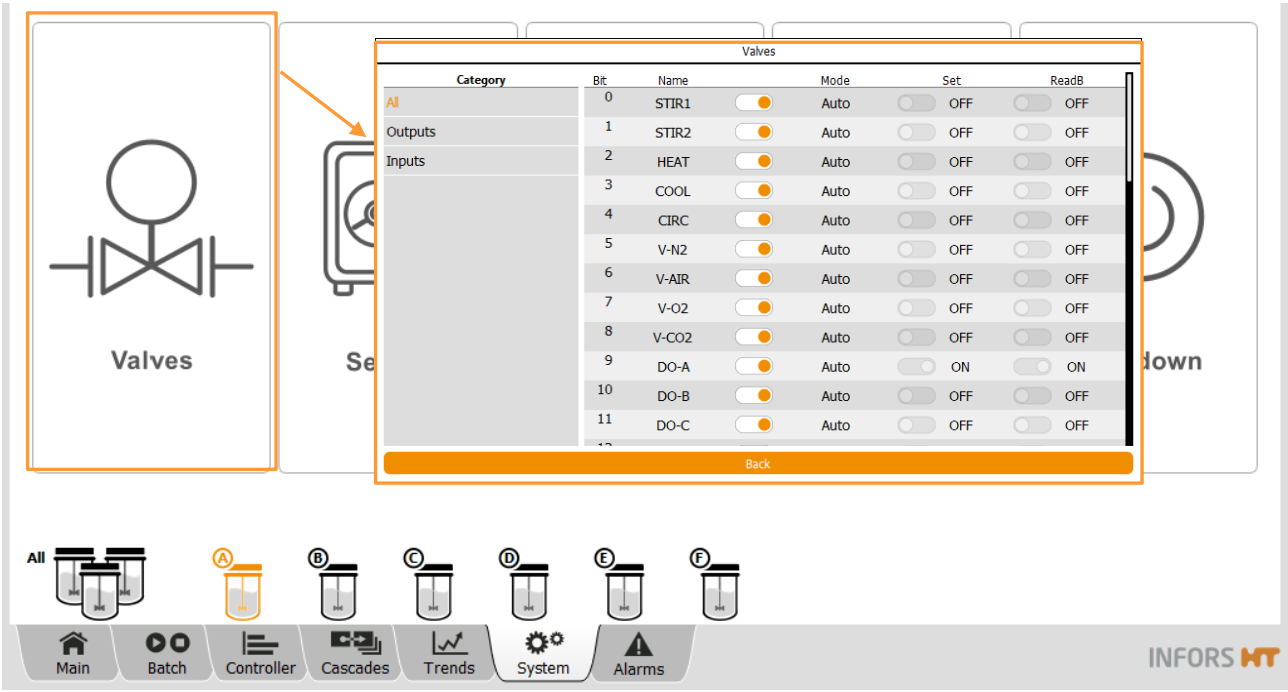
When this function is selected (by pressing the button), the menu appears with two options:

- **Use current board configuration**: replace the backup in the touch screen with the current configuration of the control board. This option is useful after changing the touch screen.
- **Use stored board configuration**: the configuration of the control board is overwritten with that from the backup. This option is useful after a firmware update or changing the control board.

The alarm disappears as soon as the selected function has been executed.

3 Submenus

3.1 Valves – Digital Outputs



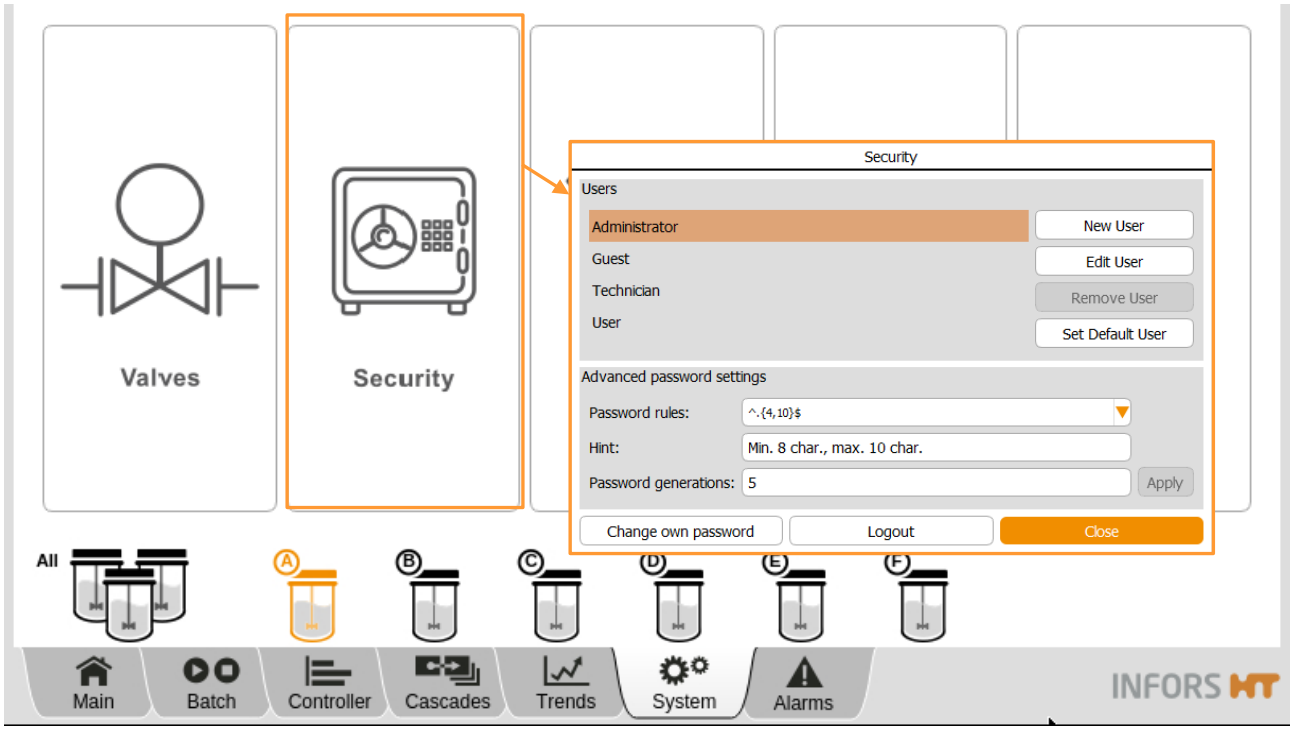
The submenu *Valves* displays the digital outputs and inputs of the control boards. The overview is predominantly used for fault diagnosis. All valves and digital outputs set to automatic mode (*Auto*) ex-factory. These settings must not be changed! In column *Category* the view of all (*All*) digital inputs and outputs can be selected.

The main column shows:

Main Column		
Bit / Name		Channel number and designation
Mode	*Auto*	Automatic switching
	Manual	Manual switching, outputs are forced, i.e. the automatic switching is thus disabled.
Set (Switching status of the digital output)	*OFF / ON*	Output is switched off / on
ReadB (electronic feedback channel, which confirms the change in status.	*OFF / ON*	Readback is switched off / on
If the electrical connection is faulty, it is displayed as FALSE.		

3.2 Security – User Administration

3.2.1 Menu Overview



The *Security* submenu is used for logging on and off to and from the system. Users can also be added or deleted here, passwords can be set, and access rights can be assigned. The number of functions available depends on the authorization of the user that is logged on:

- **Login/Logout**: log in to/out of the system.
- **Change own password**: change your own password.
- **New User**: add a new user.
- **Edit User**: edit user settings.
- **Remove User**: deleteuser.
- **Set Default User/Clear Default User**: set/delete automatic user login.
- *Advanced password settings*: define password rules for password security.

The different user groups, access rights and functions are described in the following chapters.

3.2.2 User Groups

There are five user groups (*Groups*) with different access rights. Ex-factory, a user has been created for each of the groups, except for the *Service* group.

User groups	User	Password
Guest [1)]	*Guest*	No password
Users	User	qwertyuiop
Technicians	*Technician*	qwertyuiop
Administrators	*Administrator*	qwertyuiop
Service [2)]	--	--

1) *Without access rights, is logged on automatically if no other user is logged on.*

2) *Can only be accessed by qualified INFORS HT service technicians and is blocked for all other users.*

INFORMATION

The passwords defined ex-factory should be changed and administrated by the authorized person (Administrator) during initial commissioning.

3.2.3 Access Rights

Legend

- V (= View) = visible, function cannot be executed. Depending on the function, visible means that only the button or the menu/dialog box is visible.
- E (= Execute) = visible and function can be executed.
- Blank field = neither visible nor can the function be executed.

CULTIVATION (*Bioreactor Operation*)	**User Groups**				
	Guests	Users	Techn.	Admin.	Service
Start / Stopp (individually and all) (**Start / Stop / Start All / Stop All**)	V	E	E	E	E

Submenus

RECIPES ***(Recipes)***	**User Groups**				
	Guests	Users	Techn.	Admin.	Service
Load / **Start**	V	E	E	E	E
Save	V	V	E	E	E
Delete	V	V	E	E	E

PUMPS	**User Groups**				
	Guests	Users	Techn.	Admin.	Service
Calibrating (*Calibrate Pumps*)	V	E	E	E	E
Resetting the counter (*Reset*)	V	E	E	E	E
Manually setting the pump factor manually (*Pump factor*)	V	E	E	E	E
Filling/emptying hoses (**Fill** / **Empty Pumps**)	V	E	E	E	E

PARAMETER Options	**User Groups**				
	Guests	Users	Techn.	Admin.	Service
Setpoint input (*Setpoint*)	V	E	E	E	E
Alarm values and critical values (*Upper/Lower Alarm, Upper/Lower Critical*)	V	E	E	E	E
Activating and deactivating parameters (*Output active ON / OFF*)	V	E	E	E	E
Calibrating the pH sensor / all pH sensors (**Calibrate pH** / **Calibrate All pH**)	V	E	E	E	E
pH analog: changing *Slope* and/or *Offset* (calibration mode **Manual**)		E	E	E	E
Calibrating the pO_2 sensor / all pO_2 sensors (**Calibrate pO2** / **Calibrate All pO2**)	V	E	E	E	E
pO_2 analog: **USE AS SETPOINT** function in calibration menu		E	E	E	E
USE AS SETPOINT function (if available) in calibration menus				E	E
Calibrate, all except the ones mentioned above			V	E	E
Calibration, manual (calibration mode **Manual**), all except the ones mentioned above				E	E
Option: Turbidity sensor (ASD-12N); calibrating the zero point (*Turbidity, Calibrate*)	V	E	E	E	E
PID			E	E	E

Options					E

CASCADES (*Cascades*)	**User Groups**				
	Guests	Users	Techn.	Admin.	Service
Setting a cascade	V	E	E	E	E
Setting an advanced cascade (*Advanced*)			E	E	E

TREND LINES (*Trends*)	**User Groups**				
	Guests	Users	Techn.	Admin.	Service
Changing the display settings	E	E	E	E	E

ALARMS (*Alarms*)	**User Groups**				
	Guests	Users	Techn.	Admin.	Service
Confirming an alarm (**Confirm**)	V	E	E	E	E

SYSTEM (*System*)	**User Groups**				
	Guests	Guests	Guests	Guests	Guests
Viewing the statistics of the communication software with the bioreactor hardware (**Statistics**)	E	E	E	E	E
Viewing licenses for software libraries (**Licenses**)	E	E	E	E	E

DIGITAL INPUTS/OUTPUTS (*System / Valves*)	**User Groups**				
	Guests	Users	Techn.	Admin.	Service
Switching inputs/outputs manually (*Inputs / Outputs*)	V	V	E	E	E

USER MANAGEMENT (*System / Security*)	**User Groups**				
	Guests	Users	Techn.	Admin.	Service
Logging in (**Login**)	E	E	E	E	E
Logging out (**Logout**)		E	E	E	E
Changing the password (**Change Password**)		E	E	E	E
Setting password rules (*Advanced password settings*)					
Adding a new user (**New User**)		V	V	E	E
Deleting a user (**Remove User**)		V	V	E	E

Submenus

Changing user settings (**Edit User**)		V	V	E	E
Setting a default user (**Set Default User**)		V	V	E	E
List of all users (*Users*)				V	V

SYSTEM SETTINGS (*System / Settings*)	**User Groups**				
	Guests	Users	Techn.	Admin.	Service
Settings					
Network settings (**IP Settings**)	V	V	V	E	E
Changing the date and time (**Change Time**)	V	V	V	E	E
Files					
Saving data (**Backup**)	V	V	V	E	E
Restoring data backups (**Restore**)	V	V	V	E	E
Service Menu					E
Exporting log files (**Export Logs**)		V	E	E	E
Controller Board Configuration					
Setting codes for input channels (**Input Channel Code**)			V	V	E
Assigning/changing analog outputs (**Analog Outputs Assign/Adjust**)			V	V	E
Setting extended function codes for digital outputs (**Extended Digital Output Function Code**)			V	V	E
Synchronizing different control board configurations (**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
Balance Settings	V	V	V	E	E

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

SYSTEM SHUTDOWN (*System / Shutdown*)	User Groups				
	Guests	Users	Techn.	Admin.	Service
Shutting down the system (**Shutdown**)	V	E	E	E	E

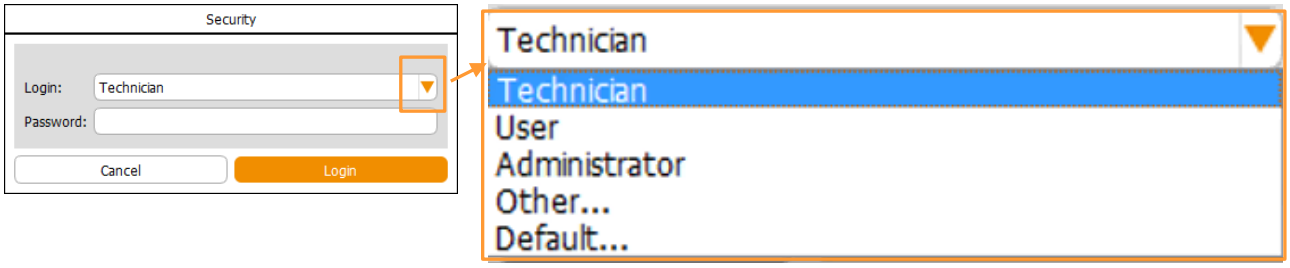
Labfors 5 Version for microorganisms Option LabCIP	User Groups				
	Guests	Users	Techn.	Admin.	Service
LabCIP Settings	V	V	E	E	E
Starting the LabCIP (Perform CIP/SIP)	V	E	E	E	E
Labfors 5 Version for solid substrates and enzymatic bioprocesses	**Benutzergruppen**				
	Guests	Users	Techn.	Admin.	Service
Activating/deactivating rotation speed limit (Set. Stirrer Max.)	V	E	E	E	E

3.2.4 Login / Logout – Logging in to/out of the System

To log in to the system, proceed as follows:

Procedure

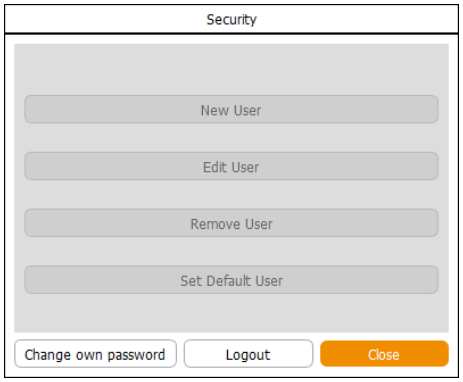
1. Call up the *System* main menu and press **Security**.
   The *Security* submenu appears.



The drop-down list in the *Login* field field contains all users that are pre-set ex-factory and can be selected:

- *User*
- *Technician*
- *Administrator*
- *Other*: only for INFORS HT staff
- *Default*: automatic user login without password input, if previously configured via **Set Default User**.

2. Select the desired user, e.g. *Technician.*



3. Enter the password and press **Login**.

   The user is logged in.

   The *Security* menu now lists the different functions as buttons. **Change own Password** (change your own password), **Logout** (log out of the system) and **Close** (leave menu) are available to all users (except for the *Guest* user).

INFORMATION

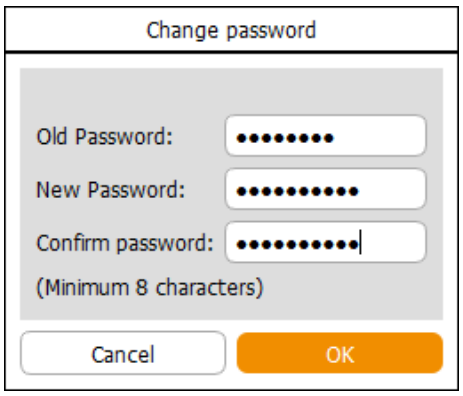
For the *Administrators* user group, all password rules can also be set here, see “Password Security – Defining Password Rules”.

3.2.5 Change Own Password – Changing the (Own) Password

Users of all user groups can change their own password. To be able to change their password, the user must be logged in to the system.

Proceed as follows:

Procedure



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

   The *Change password* dialog box appears.

2. Enter the old password.
3. Enter the new password and confirm it by entering it again.

   All inputs are displayed as dots.

INFORMATION

Depending on the password rules set, the password must meet various conditions. Password rules can be configured by *Administrator* users.

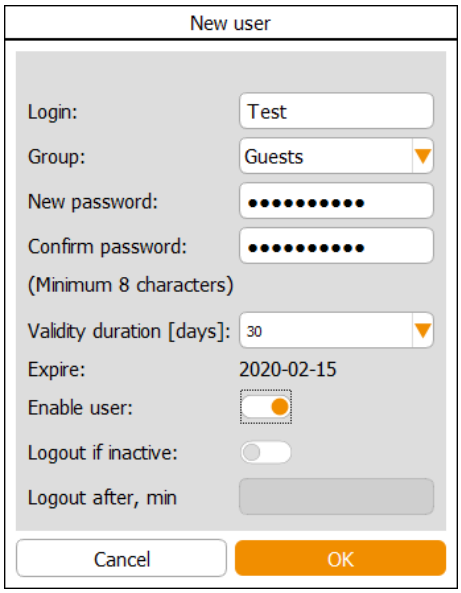
4. Press **OK**.

   The dialog box disappears; the new password is saved.

3.2.6 New User – Adding a New User

To add a new user, proceed as follows:

Procedure



1. As *Administrator* call up the *Security* submenu and press **New User**.

   The *New User* dialog box appears.
2. Enter the new user (*Login).*
3. Select the user group in the *Group* drop-down list.
4. Enter the password in *New password* and confirm it by entering it again in *Confirm password*.

INFORMATION

Depending on the password rules set, the password must meet various conditions. Password rules can be configured by *Administrator* users.

5. Select the validity period of the password in the *Validity duration [days]* drop-down list, by choosing between “unlimited”, 30, 100 and 365 days.

   The corresponding expiry date is then shown in *Expire.*
6. Activate or deactivate the new user’s access rights (*Enable user*); these are activated by default.

INFORMATION

If the function is deactivated, the user has no access rights, and a password cannot be assigned.

7. Activate or deactivate the automatic user logout (*Logout if inactive*) after expiry of a defined time period of screen inactivity, and set a time limit (*Logout after, min*), if necessary.

8. Press **OK**

   The dialog box disappears, the new user appears in the user list of the *Security* submenu.

3.2.7 Edit User – Changing User Settings

Edit User can be used to change the following settings of an existing user:

- Assign a new user group.
- Change the password.
- Set automatic user logout on screen inactivity after a predefined time in minutes. The lowest user group *Guests* is then set automatically.

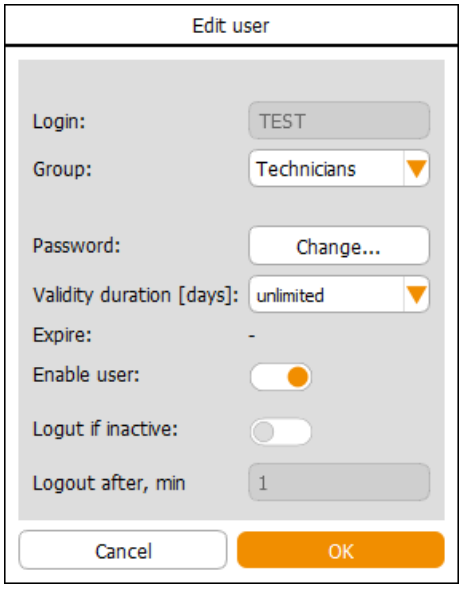
To make changes, proceed as follows:

Procedure

1. As *Administrator* call up the *Security* submenu.

2. Select the desired user (her: *TEST*) from the selection list and press **Edit User**.

   The *Edit User* dialog box appears with almost identical options to those for entering a new user.



3. Make the desired settings.
4. Press **OK**

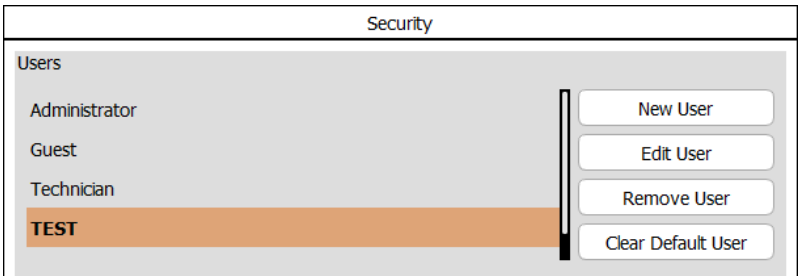
   The settings are applied; the dialog box disappears.

3.2.8 Remove User – Deleting a User

To delete a user, proceed as follows:

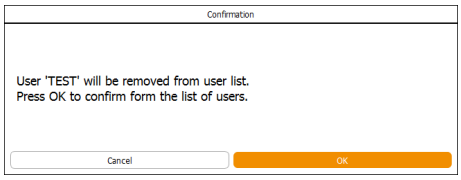
Procedure

1. As *Administrator* call up the *Security* submenu.



2. Select the desired user (here: *TEST*) from the selection list and press **Remove User**.

   The *Confirmation* dialog box appears with information and the prompt to confirm the deletion of the user.



3. Press **OK** to confirm the deletion**.**

   The dialog box disappears, the *TEST* user has been deleted.

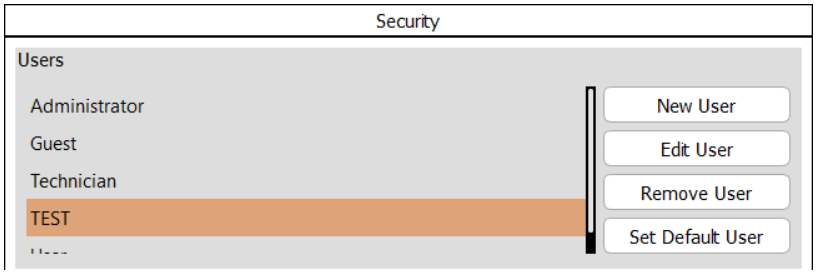
3.2.9 Set / Clear Default User – Setting Up Automatic User Login

Set Default User is used to set up an automatic user login. That is, a user can be defined, which will be logged in automatically by the system next time it is switched on. This setting can be deleted via **Clear Default User**.

Proceed as follows:

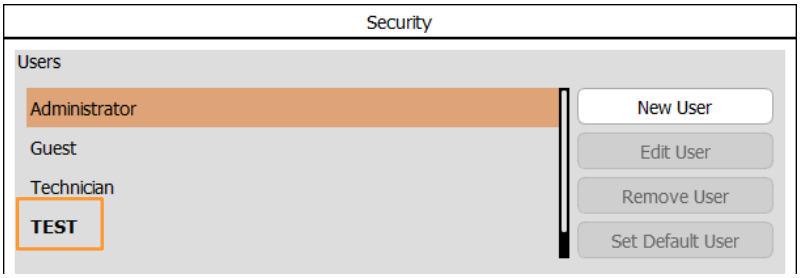
Procedure

1. As *Administrator* call up the *Security* submenu.



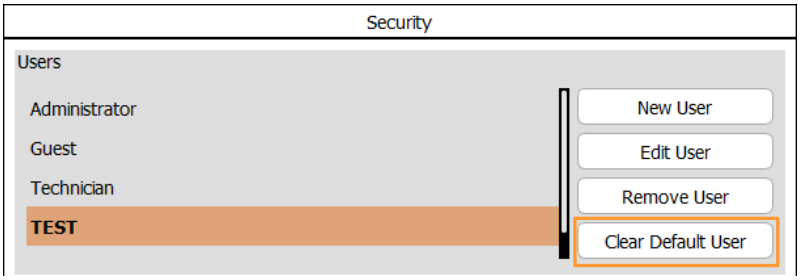
2. Select the desired user (here: *TEST*) from the selection list and press **Set Default User**.

   The defined user for automatic user login is now displayed with a bold font, the **Set Default User** button is still visible but no longer available.



By selecting any other user, all buttons become available for changes again.

By selecting the defined user with automatic user log in, the **Clear Default User** button becomes available instead of **Set Default User**.



3.2.10 Password Security – Setting Password Rules

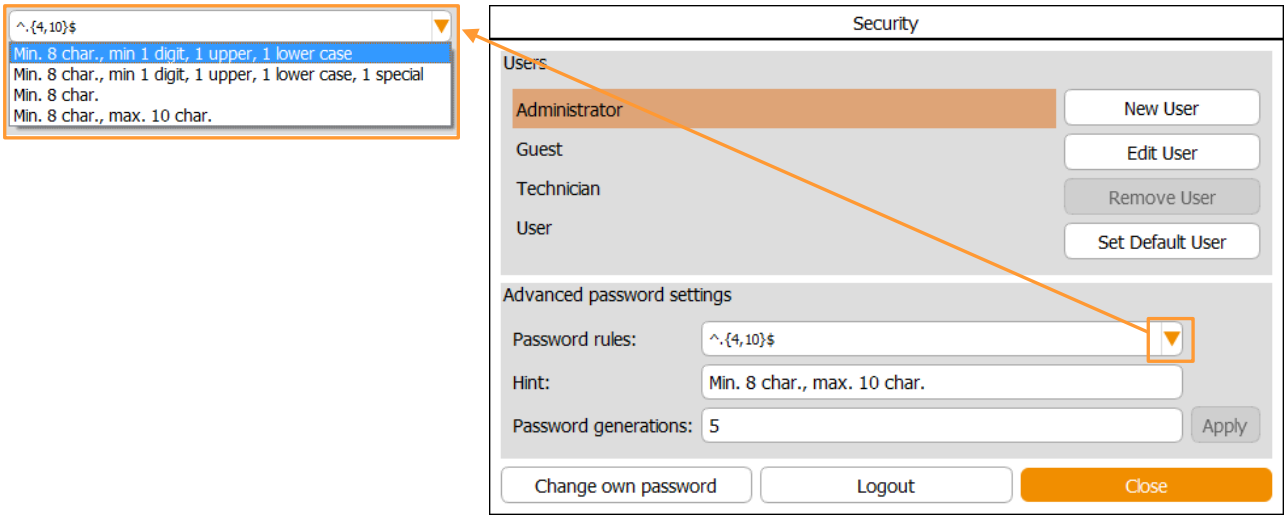
As *Administrator* user, the conditions for creating new user passwords can be configured in the *Security* sumbenu.

Proceed as follows:

Procedure

1. As *Administrator* call up the *Security* submenu.

The lower menu section *Advanced password settings* is now visible and available.



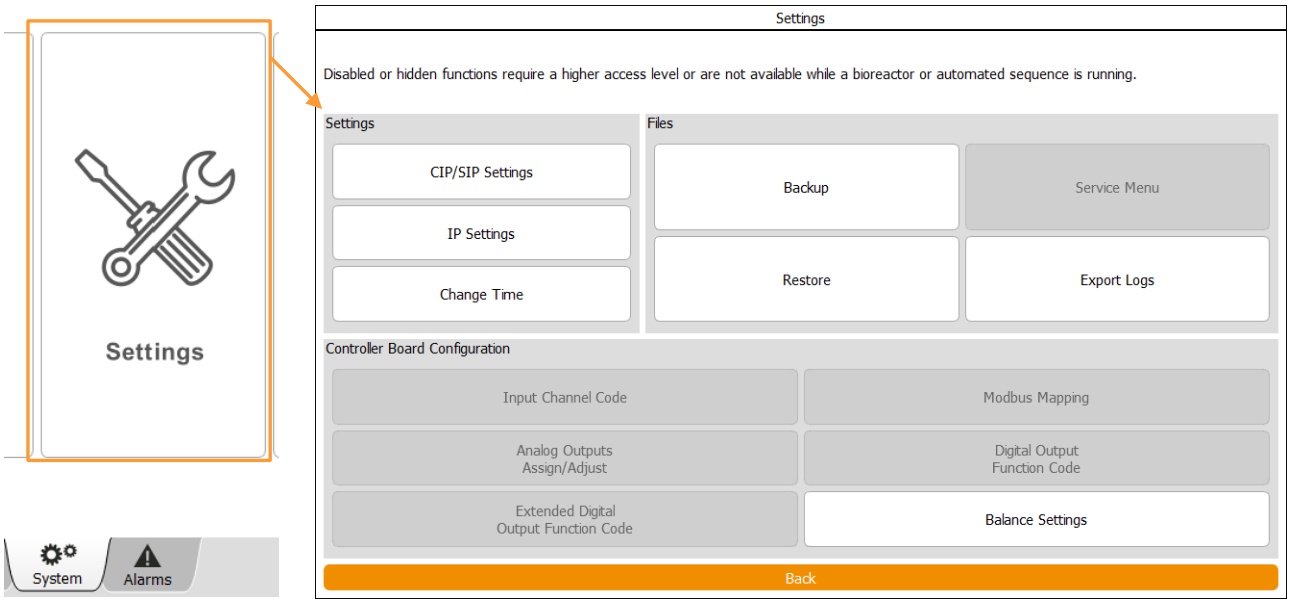
- *Password rules*: a drop-down list with four password rules is (see figure above). The password must contain at least:
  - 8 characters, which have to include at least 1 number, 1 upper case letter and 1 lower case letter.
  - 8 characters, which have to include at least 1 number, 1 upper case letter, 1 lower case letter and a special character.
  - 8 characters.
  - 8 to a maximum of 10 characters.
- *Hint*: when a password is being created, this shows the rules that have to be observed.
- *Password generations*: specifies the number of new passwords to be created before a password may be reused.
- **Apply:** apply the rule for new passwords to be created from now on.

2. Select the rule and enter the number of new passwords to be created.
3. Press **Apply**.

   The rule is saved and is displayed accordingly when the next password is to be created.
4. Close the *Security* submenu via **Close**.

3.3 Settings – Basic Settings of the Device

3.3.1 Menu Overview



The basic settings of the device are made in the *Settings* submenu. The number of buttons visible and available in this menu depends on the authorization of the user that is logged on. The figure above shows the menu for an *Administrator* user. The menu is divided into three sections with different functions.

Settings

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

Files

- **Backup**: save data.
- **Restore**: upload saved data to the system.
- **Service Menu**: access only for INFORS HT service technicians or licensed dealers.
- **Export Logs**: export log files.

Controller Board Configuration (Control Board Configuration)

- **Input Channel Code**: set codes for input channels.

- **Analog Outputs Assign/Adjust**: assign/change analog outputs.
- **Extended Digital Output Function Code**: set function codes for extended digital outputs.
- **Synchronize differing board configuration**: synchronize differing control board configurations.

INFORMATION

This button only appears if a corresponding alarm (*Difference in board configuration*) has been triggered after a firmware update/change of control board or touch screen replacement and is displayed in the *Alarms* main menu.

- **Modbus mapping**: make Modbus settings.
- **Digital Output Function Code**: set function codes for digital outputs.

INFORMATION

This manual does not provide any further details on all the functions concerning inputs and outputs, function codes and modbus mappings. Only INFORS HT service technicians or authorized dealers have access to these functions.

- **Balance Settings**: balance settings.

3.3.2 IP Settings – Network Settings

IP Settings can be used to configure a network connection. This can be done automatically or manually.

INFORMATION

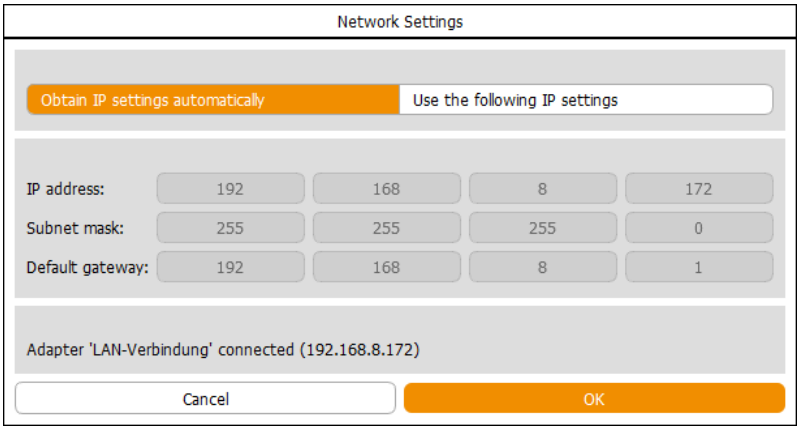
Settings can only be made if a network cable is connected. This manual does not cover how a network is set up or a network connection is established.

To call up this menu, proceed as follows:

Procedure

1. As *Administrator* call up the *Settings* submenu.
2. Press **IP-Settings**.

The *Network Settings* menu appears.



- **Obtain IP settings automatically**: automatically apply IP settings (default settings). Prerequisite: a DHCP [1)] server is available in the network.
- **Use the following IP settings**: use the following IP settings. An entry can only be made in the following fields after pressing this button.
- *IP address*: IP address or enter IP address manually.
- *Subnet mask*: shows the current subnet mask or lets you enter one manually.
- *Default gateway*: shows the default gateway or lets you enter one manually.

INFORMATION

A status message ending with …*connected* indicates that the network connection has been established correctly. If that is not the case (no signal), the message "*No active LAN connection*" appears.

1) *Dynamic Host Configuration Protocol*

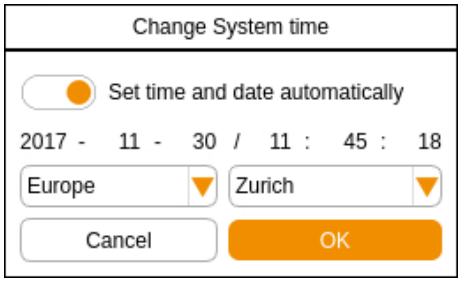
3.3.3 Change Time – Changing the Date and Time

Change Time is used to adjust the date and time to the system's location. Ex-factory, the system is set to automatic synchronization with the time server. That is, it is displayed according to the selected time zone. Alternatively, settings can also be made manually.

To make settings, proceed as follows:

Procedure

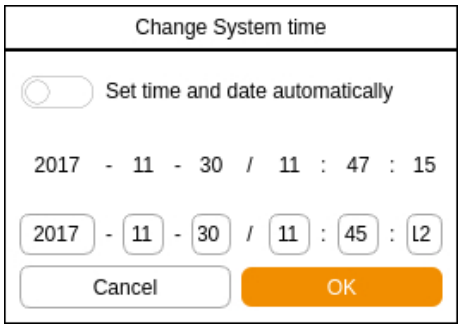
1. As *Administrator* call up the *Settings* submenu.
2. Press **Change Time**.



The *Change System time* dialog box appears with the configuration set ex-factory:

- *Set time and date automatically*: activate or deactivate automatic time and date setting. This function is activated by default. This makes it possible to select the time zone and the cities assigned accordingly.
- Drop-down lists for selecting time zones and cities: *Europe* and *Zurich* are set as the default.

To make manual settings proceed as follows:



3. Deactivate automatic time and date setting**.**

Instead of the drop-down lists, input fields for year/month/day and hours/minutes/seconds appear now.

4. Set the desired values and use **OK** to confirm.

The entries are saved, and the dialog box disappears.

3.3.4 Backup – Saving Data

The *Backup* function is used to save all settings of the touch screen software and the control board. This data can then be restored using the *Restore* function.

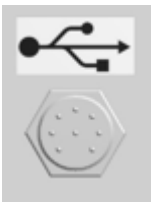
Note the following:

- Data can be backed up to internal storage or a USB stick..
- A data backup can only be executed when all processes have stopped.
- Skip step 1 in the following description if you are not backing up the data onto a USB stick.

Submenus

To backup up data, proceed as follows.

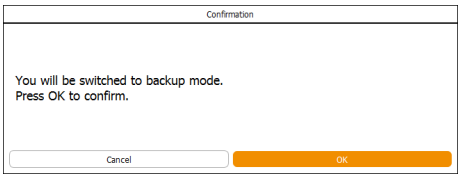
Procedure



1. Connect the special cable supplied by the device manufacturer to the connection socket on the back of the operating panel and connect the USB stick.

2. As *Administrator* call up the *Settings* submenu.
3. In the *Files* section, press **Backup**.

   The *Confirmation* dialog box appears a note and a prompt for switching to backup mode.



4. Press **OK**.

   The data backup menu appears with the following options:

   - *Select backup destination*: choose a storage location, either *local* or *external* (on the connected USB stick).
   - **Create configuration backup**: create a backup file of the current configuration.
   - **Create configuration report**: output configuration data in a CSV file.
   - **Delete backup(s)**: delete saved backup file(s).
   - **Export backup(s)**: export the backup file(s) from the local storage location to the USB stick.

5. Select a storage location and press **Create configuration backup** to create the data backup.

   The configuration backup is stored as a 7zip file at the selected storage location.

6. Press **OK** to leave the menu.
7. Remove the USB stick, as necessary.

3.3.5 Restore – Restoring Data Backups

The *Restore* function enables loading data to the system, which were saved using the *Backup* function. Also, factory settings can be restored.

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 an INFORS HT service technician or a licensed dealer.

Note the following:

- The data is loaded either from the internal storage or from a USB stick, see, see chapter “Backup – Saving Data”.
- The *Restore* function can only be executed when all bioreactors are stopped.
- Skip step 1 in the following description if you are not loading the data from a USB stick.

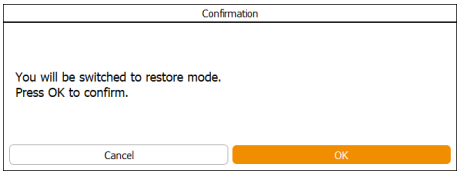
To load data backups to the system, proceed as follows:

Procedure

1. Connect the special cable supplied by the device manufacturer to the connection socket on the back of the operating panel and connect the USB stick with the saved data (*Backup* data).

2. As *Administrator*, call up the *Settings* submenu.
3. In the *Files* section, press **Restore**.

   The *Confirmation* dialog box appears with a note and prompt for switching to *Restore* mode.



4. Press **OK**.

   The data backup/restore menu appears:

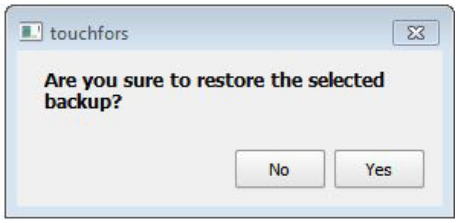
   - **Select Configuration for restore**: select configuration data backup for restoring.
   - **Select factory settings:** select the factory setting.

5. Press **Select configuration for restore**.

   The window for selecting the data source appears in the menu with the choice:

   - *local*: local, internal memory
   - xy (Drive): detected connected USB stick

6. Select a data source and press **OK**.



A dialog box with a confirmation prompt **No** or **Yes** for restoring the data appears.

7. Press **Yes**.

The menu view changes, and the configuration comparison listing appears (not shown here).

INFORMATION

The view of the differences within a file is primarily intended as information for the INFORS HT service technician. It represents the differences of the settings file to be restored compared to the version currently used in unified format (also unidiff).

8. Use **Cancel** to terminate the process or **OK** to execute the data restore.
9. Remove the USB stick, if applicable.

3.3.6 Export Logs – Exporting Log Files

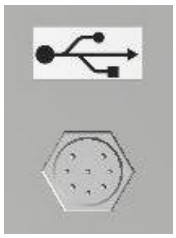
The *Export Log* function can be used to store all log files as well as alarms and error messages on a USB stick.

Note the following:

- A USB stick is required for the data export.
- A data export can only be executed when all processes have stopped.

To export the log files, proceed as follows:

Procedure



1. Connect the special cable supplied by the device manufacturer to the connection socket on the back of the operating panel and connect the USB stick.
2. As *Administrator* or *Technician*, call up the *Settings* submenu.
3. In the *Files* section, press **Export Logs**.

   The data export is started. As soon as this is done, an *Information* dialog box appears with the message that the log data has been successfully exported as a zip file (*Log files successfully exported to: xxxxx*).
4. Press **OK** to close the dialog box.

3.3.7 Balance Settings

The *Balance Settings* function is used to set up a maximum of 7 balances that can be connected (via the device manufacturer's Switchbox). Balances must be configured with the correct values. *Baud rate 9600, 8 bits, no parity, 2 stop bits*.

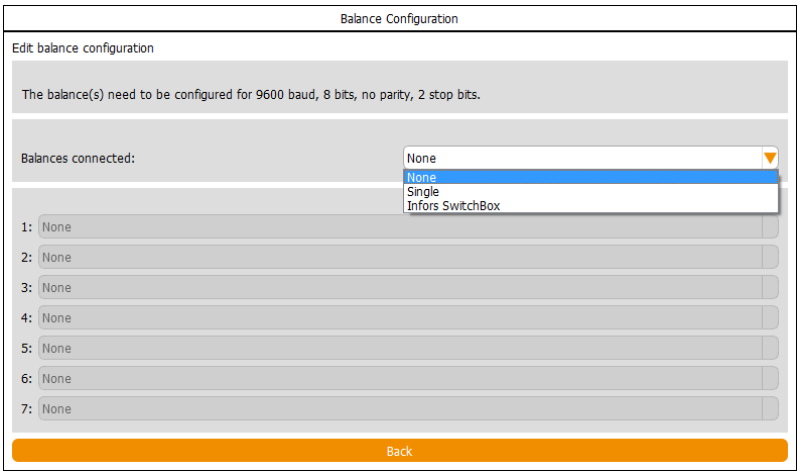
To make settings, proceed as follows:

Procedure

1. Connect the balance(s) or switchbox
2. As *Administrator* call up the *Setting*s submenu.
3. Press **Balance Settings.**

   The menu *Balance Configuration* appears the mentioned configuration values for scales and drop-down lists for selecting the number and type of connected scales.

Submenus

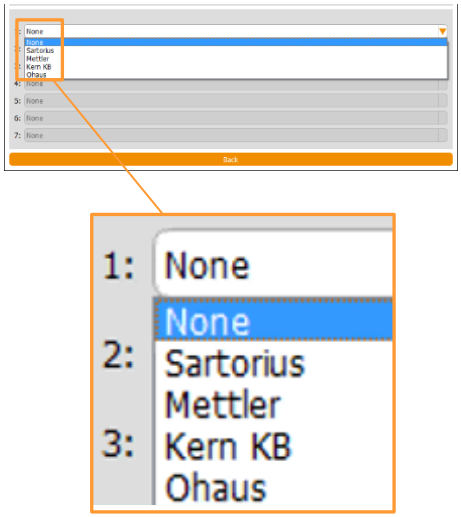


- *None*:
- *Single*: one balance (without Switchbox)
- *Infors SwitchBox*

- 7 drop-down lists, of which one or all are enabled, once one option has been selected.

4. Select the number of balance(s) in *Balances connected*:

- *None*: none
- *Single*: one balance; this means that the first drop-down list in the menu area becomes available.
- *Infors Switchbox*: switchbox, this makes all 7 drop-down lists in the lower menu section available.



5. Select the balance type(s) from the drop-down list(s).

6. Press **Back**.

The settings are applied, the configuration menu disappears.

3.4 Wipe Screen – (Temporarily) Locking the Screen

The Wipe Screen submenu has only one function: it locks all input on the screen for 20 seconds. This enables you to clean the screen within 20 seconds, if required.

To activate the temporary screen lock, proceed as follows:

Procedure

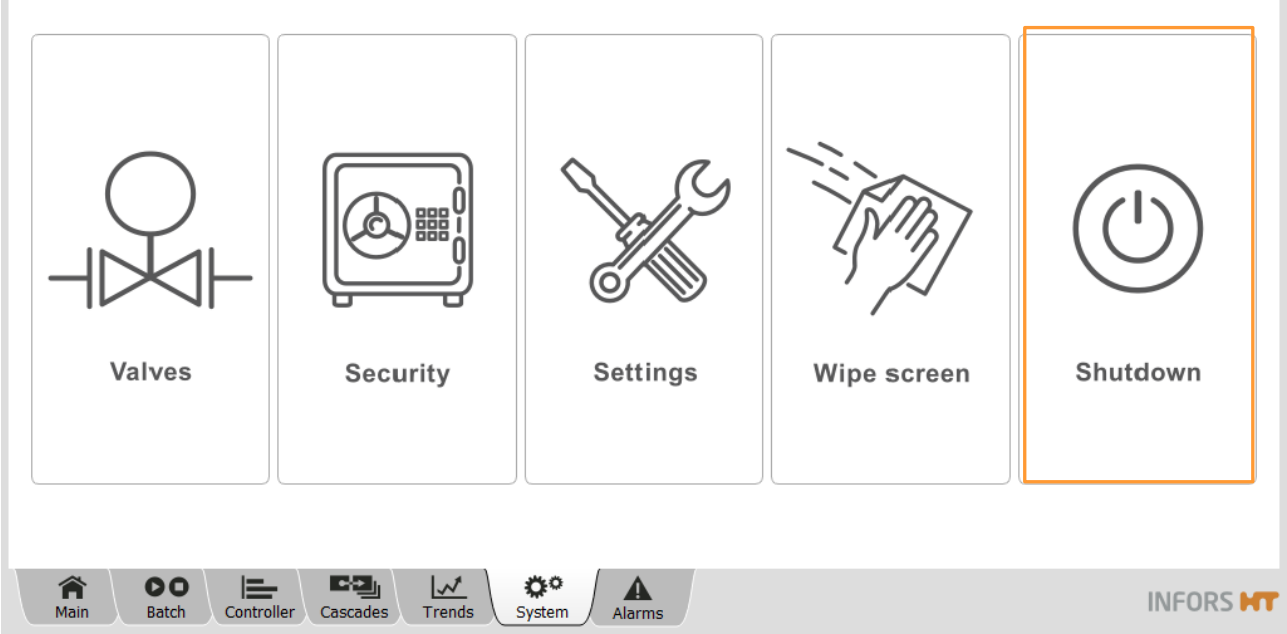
1. Press **Wipe Screen**.

   The screen turns blank, the remaining time (*Wipe time left*) is displayed.

   Wipe time left: 9 seconds...

   At the end of this time, the last screen display reappears automatically.

3.5 Shutdown – Shutting Down the System



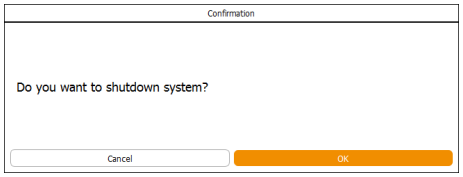
The *Shutdown* submenu has only one function: it shuts down the system. The system can only shut down, if all bioreactors and processes are stopped.

INFORMATION

ALWAYS shut down the system first, only then switch off the device at the power switch.

Proceed as follows:

Procedure



1. Call up the *System* main menu and press **Shutdown**.

   The *Confirmation* dialog box appears with the query/prompt to confirm shutdown.
2. Press **OK**.

   The system shuts down.

4 Recipes

4.1 General Information

The different buttons of the *Recipes* function in the *Batch* main menu can be used to load and start, store or delete what are referred to as recipes. That is, the parameter settings (including cascades) of a cultivation can be stored and reused when the same work processes occur again.

INFORMATION

All parameter settings, cascade settings and sensor calibration data are stored. Pump calibration data is not stored. Sensor calibration data is not loaded.

4.2 Save Recipe

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

Proceed as follows:

Procedure

1. Select the bioreactor.
2. In the main menu *Batch*, press **Save Recipe**.

   The *Save Recipe* dialog box appears for naming the recipe to be saved.

3. Enter a file name of your choice (example: *Rezept1*)
4. Press **OK**.

The recipe has been saved.

4.3 Load/Start Recipe

Recipes must be loaded individually for each bioreactor. One bioreactor recipe can also be used for all other bioreactors.

Before loading and starting a recipe, all preparations for cultivation should have been performed.

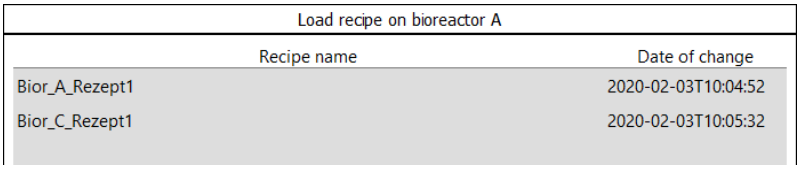
Loading recipe from bioreactor for same bioreactor

The following example shows how to load a saved recipe of bioreactor A to the same bioreactor. Proceed as follows:

Procedure

1. Select bioreactor A.
2. Call up the *Batch* main menu and press **Load/Start Recipe**.

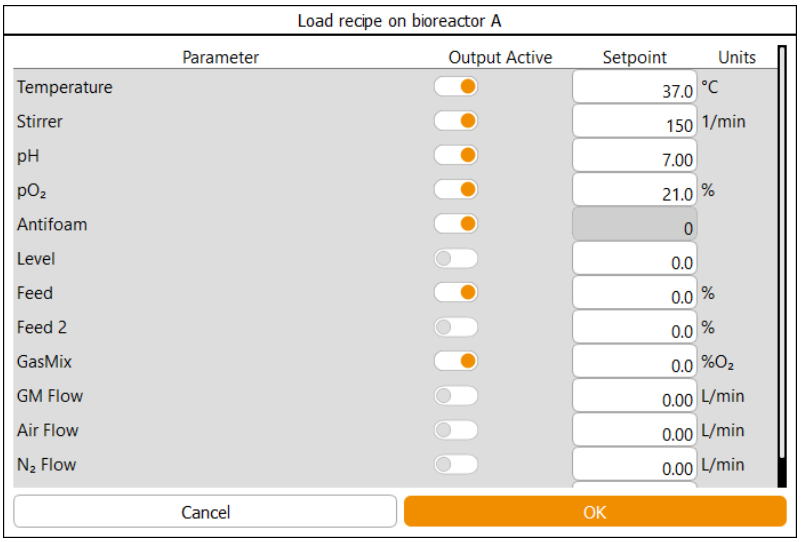
   The *Load recipe on bioreactor A* dialog box appears with a list of all saved recipes of all bioreactors with date and time.



3. Select the recipe.

   The selected recipe is displayed highlighted in orange.
4. Press **Next**.

   The dialog box changes views.

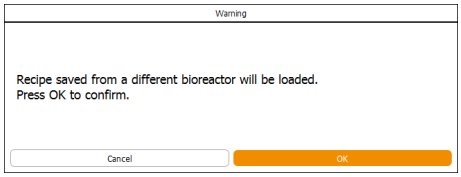


All parameters used in the recipe are listed here. Setpoints can be changed subsequently, and parameters can be activated or deactivated.

5. If applicable, change setpoints and/or activate/deactivate parameters.
6. Press **OK**.

   The dialog box disappears, bioreactor is A started.

Loading recipe from a bioreactor to another bioreactor



The recipe of one bioreactor can also be used for other bioreactors. To do this, proceed in the same way as for loading for the same bioreactor. Before saving after pressing **Next**, a corresponding notice appears.

4.4 Delete Recipe

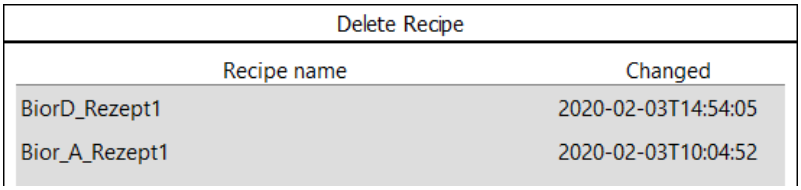
Recipes can only be deleted individually. A recipe can also be deleted during a running cultivation.

To delete a recipe, proceed as follows:

Procedure

1. Select one bioreactor or all bioreactors.
2. Call up the *Batch* main menu and press **Delete Recipe**.

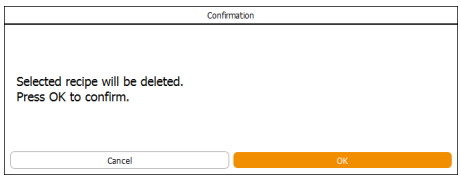
   The *Delete Recipe* dialog box appears listing all saved recipes with date and time.



3. Select the recipe.

   The selected recipe is displayed highlighted in orange.
4. Press **OK**.

   The *Confirmation* dialog box appears to confirm the deletion process.
5. Press **OK.**



The recipe has been 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 Temperature

Measures and controls the temperature in the culture vessel. The measured values are recorded by a platinum resistance thermometer (Pt100 sensor). The control range varies depending on the temperature control system and can be found in the technical specifications in the operating manual of the device.

5.2 Stirrer

Measures and controls the rotation speed of the stirrer shaft in min^{-1}. The rotation speed range depends on factors such as the vessel volume, drive system, culture viscosity and number and kind of impellers and can be found in the technical specifications of the device's operating manual.

Set Stirrer Max. – rotation speed limit

This function is only present and relevant for the benchtop bioreactor Labfors 5, version for solid substrates and enzymatic bioprocesses with servomotor. Depending on the cultivation phase and the impellers used, lower or higher speeds are used. The maximum adjustable stirrer speed is limited to 300 min^{-1} ex works. This speed limitation can be removed, if required.

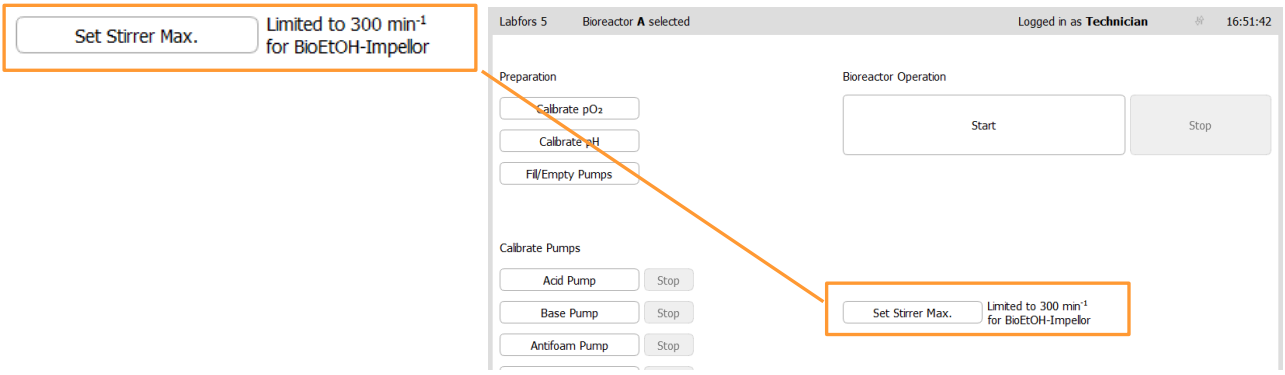
ATTENTION

The glass vessel and the impellers can be damaged if operated at too high a speed or if inappropriate impellers are used.

– Only use the helix impellers at speeds up to max. 300 min^{-1}.

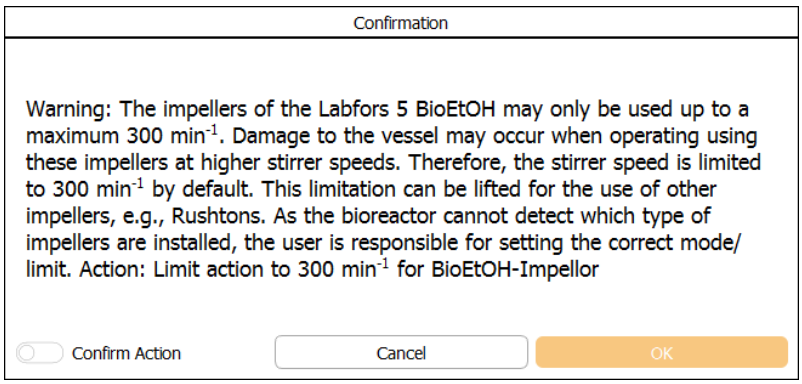
– Only when the medium is completely liquefied, work at speeds higher than 300 min^{-1}.

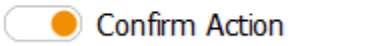
The limitation is activated or deactivated via the **Set Stirrer Max**. button in *Batch* main menu. Which setting is active is displayed next to **Set Stirrer Max**.



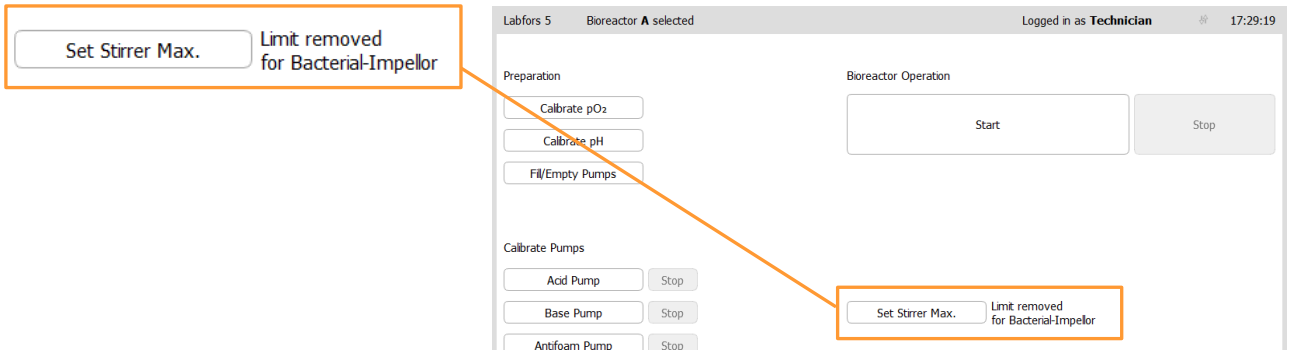
The display *Limited to 300 min^{-1} for BioEtoH Impellor* indicates an activated speed limitation.

After pressing **Set Stirrer Max**. a dialog box appears with the corresponding warning and the mentioned instructions for the possible removal of the rotation speed limit:





The **Confirm Action** switch allows switching between the modes.



The display *Limit removed for Bacterial-Impellor* indicates a deactivated speed limitation.

5.3 pH

Measures and controls the pH. The control range is from pH 2 to pH 2. Depending on the selected variant, the measurement system is analog or digital.

The pH is controlled by adding acid and base via the two 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 the analog pH sensor from the manufacturer METTLER. This function must be switched on during cultivation so that the temperature dependency of the measurement principle is corrected.

INFORMATION

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

5.4 pO_2

Measures and controls the saturation of dissolved oxygen. Depending on the selected variant, the measurement system is analog or digital.

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 absolute 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*.

5.5 Antifoam

Detects foam and controls the addition of antifoam agent. The antifoam pump is activated as soon as the antifoam sensor comes in contact with foam. The parameter output (*Output*) shows 100 % instead of 0 %. 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 vessel by means of the level sensor. As soon as liquid is detected, a signal is generated, and the parameter output (*Output*) shows 100 % instead of 0 %. This signal can be used as required for level control in the vessel. Configurations of this type are available on request.

5.7 Feed

Controls the corresponding analog peristaltic pump for adding nutrient solution. The pump speed is adjustable and can be set in steps of 0.1 % within a range of 0 % to 100 %.

5.8 Feed 2 and Feed 3

Regulate the analog peristaltic pumps *Feed 2* and *Feed 3*. The pump speed is adjustable and can be set in steps of 0.1 % within a range of 0 % to 100 %.

5.9 Flow

Measures and controls the volume flow of two or more process gases in the culture vessel via one 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^{-1} respectively in mL min^{-1}.

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

5.10 Air Flow, O_2 Flow, N_2 Flow

All these flow parameters measure and control the volume flow of the appropriate process gas in the vessel via an individual mass flow controller (thermal mass meter with integrated control valve) per gas. The measurement system is entirely electronic, and the measurement is displayed is displayed according to the present configuration in L min^{-1} or mL min^{-1}.

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.

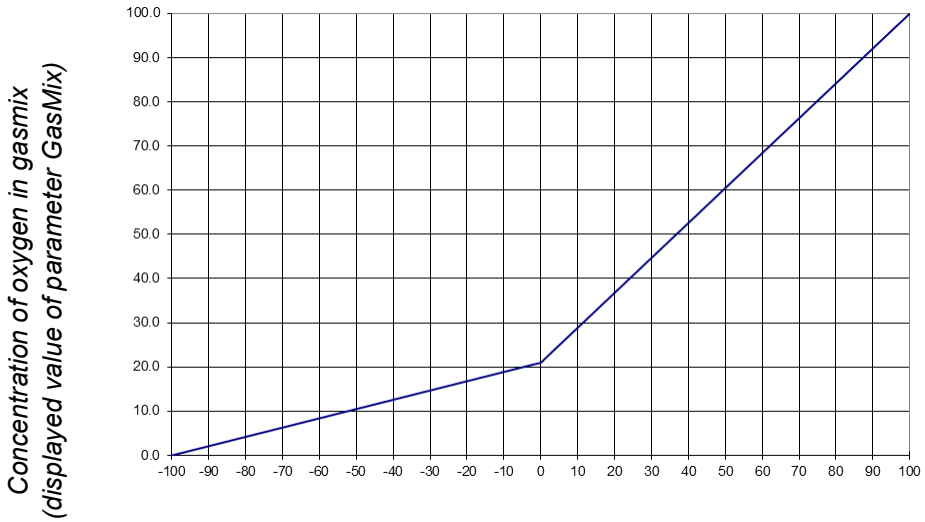
Depending on the existing configuration this means that the relevant solenoid valve is switched on or the individual gas flow parameters are controlled.

INFORMATION

If the parameter *GasMix* combined with the parameter *GM Flow* and the parameters *Air Flow*, *O_2 Flow* and/or *N_2 Flow* is installed and configured, the specified parameters are preconfigured by the device manufacturer in an advanced cascade for pO_2 control.

The following applies to the setpoint input and value display in the touch screen software:

Setpoint GasMix	Meaning	Value display
-100 %	Nitrogen only	0 % O_2
0 %	Air only	21 % O_2
100 %	Oxygen only	100 % O_2



Setpoint Parameter GasMix

Example

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

The solenoid valves are switched according to the pre-set cycle duration in parameter option *PID* of the *GasMix* parameter.

Settings

- cycle duration: 10 seconds (*Eval. Time (s)* in option *PID*)
- setpoint *GasMix*: 20

This means that:

- the solenoid valve for oxygen opens for 2 seconds
- the solenoid 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 solenoid valves, the oxygen portion of the gas mixture cannot fall below 20.95 %.

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 O_2 *Flow* and/or N_2 *Flow*.

From the gassing rate of the gas mixture (*GM Flow*) and the setpoints of the GasMix parameters the device calculates the volume flow rates of the individual gases (e.g. *Air Flow*, O_2 *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.

5.13 CO_2 Flow

Measures and regulates the volume 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 L min^{-1} or mL min^{-1}.

Labfors 5 version for phototrophic organisms

If the parameter pCO_2 is available, parameter CO_2 *Flow* is pre-configured for control of the pCO_2 parameter ex-factory.

5.14 Weight

Displays the measurement of a connected external scale.

5.15 Turbidity

Is used to determine the turbidity of the culture. Turbidity can be used to draw conclusions regarding the biomass concentration in the culture. The measurement system used, and its range of measurement can be found in the device specifications.

5.16 Exit CO_2 and Exit O_2

Measure the gas concentration of carbon dioxide (CO_2) and oxygen (O_2) in the exit gas of the bioreactor via a combined gas sensor and are used for exit gas analysis. Depending on the selected variant of the measurement system, the measurement ranges and application areas of the gas sensors are different.

5.17 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.

INFORMATION

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.

5.18 Conductivity

If the bioreactor is equipped with an ABER FUTURA biomass sensor, this can also be used to measure conductivity (see chapter “Capacitance”). In this case the measurement range is 0 mS cm^{-1} to 40 mS cm^{-1}.

5.19 Redox

Measures the reduction/oxidation potential (redox) in the medium in mV. Depending on the selected variant, the measurement system is analog or digital.

5.20 Ext. Pump

Regulates the external peristaltic pump of the type 120U/DV from the manufacturer Watson Marlow. The pump speed is adjustable and can be set in steps of 0.1 % within a range of 0 % to 100 %.

5.21 pCO_2

Measures the saturation of dissolved carbon dioxide (CO_2) in the culture by means of a digital CO_2 sensor with integrated temperature sensor. Measured values are displayed on the associated transmitter and in the touchscreen software. The measurement display of parameter *pCO_2* is set to a range from 0 to 1000 hPa, analogous to the measurement display of the transmitter.

If a CO_2 gas line is available with a mass flow controller (*CO_2 Flow* parameter), this can be used to control the pCO_2, e.g. by cascades.

5.22 Pressure

Labfors 5

Measures and controls the pressure in the culture vessel, if the option is present [1)]. The measurement is performed by a piezoresistive pressure sensor and control takes place by a solenoid valve. Control range: 0 to 400 mbar.

[1)] *does not apply to version for phototrophic organisms*

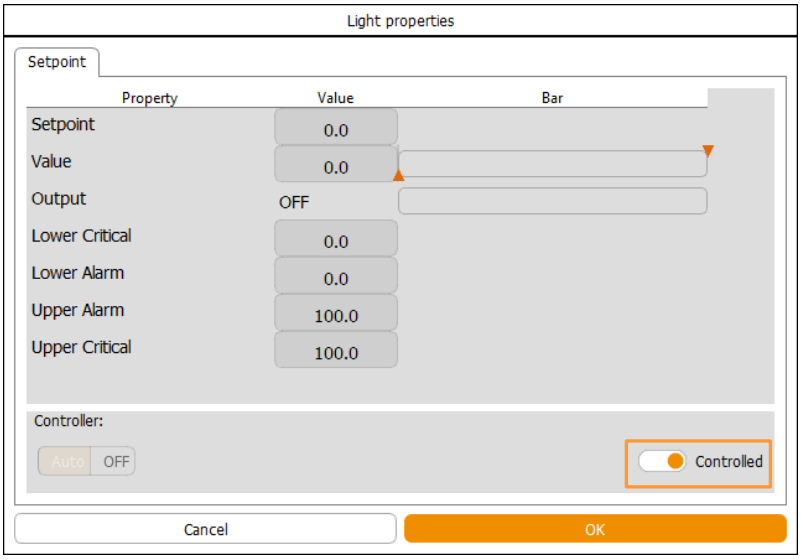
5.23 Light

Labfors 5 – version for phototrophic organisms

Regulates the light intensity of the LEDs on the irradiation unit. Setting range: 0 % – 100 %, settings can then be made in increments of 0.1 %.

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 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 HT service technician). 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.

5.24 JTemperature

Labfors 5 – version for solid substrates and enzymatic bioprocesses

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 vessel 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 *Temperature* (temperature), whereby the *JTemperature* is specified as a control parameter. Within the limits of the minimum and maximum setpoint, the vessel jacket temperature of the system varies to reach the required setpoint for the parameter *Temperature*.

5.25 Torque

Labfors 5 – version for solid substrates and enzymatic bioprocesses

INFORMATION

This parameter is not available for the above-mentioned device version with standard servomotor.

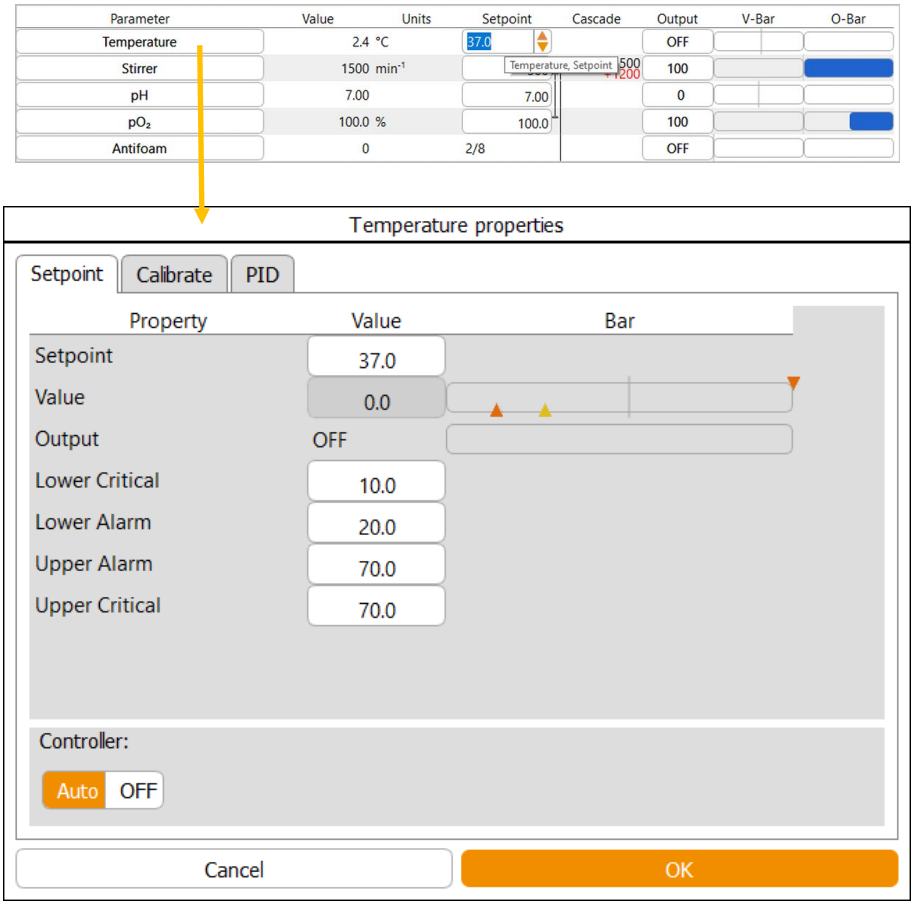
When using the optional servomotor (High Torque), it is possible to measure the power, which allows conclusions to be drawn about the actual torque. The measured torque is displayed in parameter *Torque*. This value can in turn be used to control the motor.

The current torque can serve as an indicator of the progress of the hydrolysis process. By cascading with the Stirrer parameter, it is also possible, for example, to automatically adjust the stirrer speed for operation at constant torque. In this way, an overload of the motor at the start of the process can be avoided and the mixing during the hydrolysis can be increased.

6 Parameter Options

6.1 Overview of Settings Menu

Parameter options are called up via the *Controller* main menu. The settings menus are displayed as tab pages in *Properties* dialog boxes of the selected parameter.



Each *Properties* dialog box has two buttons:

- **OK**: save the entries, close the dialog box.
- **Cancel**: close the dialog box without making any changes.

Depending on the access rights and type of the parameters, a greater or smaller number of options will be available:

- *Setpoint*: this is where setpoints, alarm values and critical values are set, and parameters are activated and deactivated.

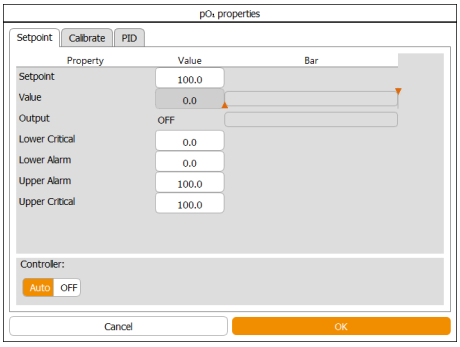
Parameter Options

- *Calibrate*: this is where the measurements of the sensors are calibrated and the functionality of the measurement sections is checked.
- *PID*: this is where controller settings are made.
- *Options*: only qualified INFORS HT personnel has access to this. This option is not available nor visible to any other user group.

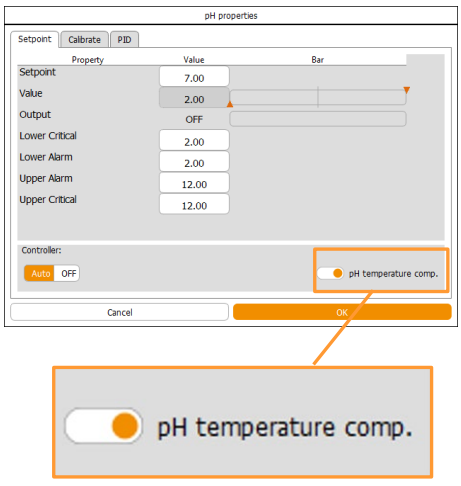
The following chapters explain the individual setting menus. This is then followed either by detailed instructions for making the appropriate settings or a reference to the corresponding chapter.

6.2 Setpoint

6.2.1 Menu Content



- *Setpoint*: set the setpoint.
- *Value*: shows the current measurement (actual value).
- *Output*: shows the controller output in *%* or *OFF*.
- *Lower Critical* and *Upper Critical*: set the lower and the upper critical value.
- *Lower Alarm* and *Upper Alarm*: set the lower and the upper alarm limit.
- *Controller* **AUTO:** activate the parameter, automatic mode. In this mode, the parameter can be activated or deactivated via the controller output (*Output*) in the *Controller* main menu at any time while a cultivation is running.
- *Controller* **OFF:** deactivate the parameter. This mode also deactivates the controller output in the *Controller* main menu.



Function for pH Temperature Compensation

In the pH measurement system with analog pH sensor, the *pH* parameter has the additional function *pH temperature comp* (pH temperature compensation). In the digital pH measurement system, this function is integrated into the pH sensor. The pH temperature compensation must be activated during a cultivation so that temperature compensated values can be generated. That is, this is used to correct the temperature dependence of the measurement principle.

INFORMATION

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

For calibration of the pH sensor with simultaneous temperature measurement of the pH buffer solution or manual entry of the temperature of the buffer solution, this function must also be activated.

6.2.2 Setting Setpoints, Activating and Deactivating Parameters

General Information

The setpoints of parameters are generally set in the configuration dialog of a bioreactor or all bioreactors. During a running cultivation, these can be changed via the *Controller* menu for each bioreactor individually.

The same applies for activating and deactivating parameters. For this, the controller output must be switched to automatic mode (*Setpoint* option, *Controller* = **Auto**).

When the cultivation (bioreactor) is stopped, all parameters are automatically deactivated.

INFORMATION

Each cultivation (bioreactor) is started with the settings in the configuration dialog. Changes to these settings are saved and transferred into the next configuration dialog. Changes of parameter settings during the running process are only applied to the current cultivation.

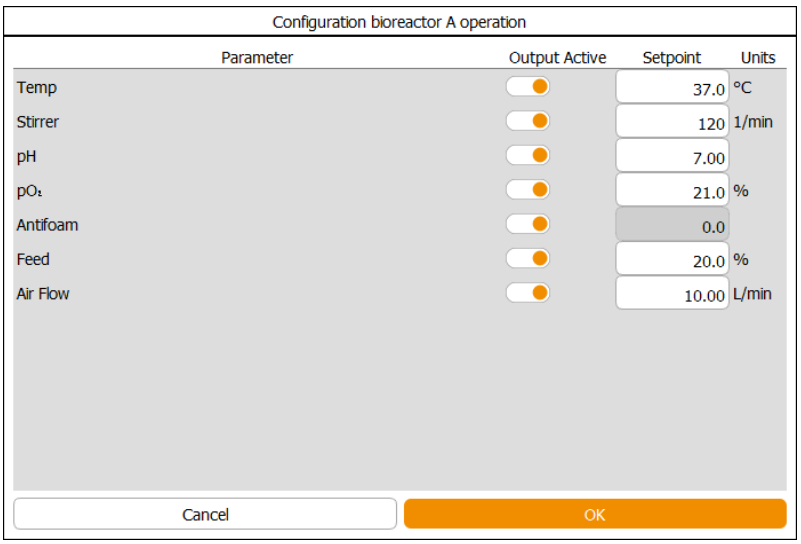
Settings in the Configuration Dialog

Proceed as follows:

Procedure

1. Select the desired bioreactor.
2. Call up the *Batch* main menu and press **Start**.

   The configuration dialog appears.



- All controlled parameters are listed on the left. The number of available parameters depends on the respective device configuration.
- On the right, there are switches for activating or deactivating the parameters and the start setpoints are listed in the corresponding input fields.

3. If necessary, change the setpoints and activate/deactivate parameters.
4. Press **OK**.

   The settings have been saved; the cultivation (bioreactor) is started. When all bioreactors are selected (*ALL*), they are all started with the same settings.

   Changed settings are transferred to the next configuration dialog.

Settings while the Cultivation is Running

There are two options for entering settings while the cultivation is running:

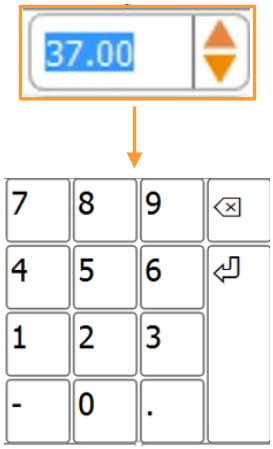
- Variant A: directly via the*Setpoint* input field/view box and controller output button in the *Output* column.
- Variant B: via the *Setpoint* option of the selected parameter in the parameter column.

INFORMATION

Changed settings are only applied to the cultivation that is currently running.

Parameter Options

Procedure



Variant A)

1. In the *Controller* main menu, press the *Setpoint* input field/view box of the desired parameter, e.g. *Temperature*.
2. Set the setpoint via the numeric keypad.
3. Activate the parameter via the controller output button.

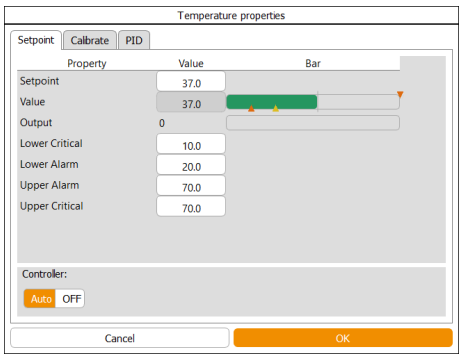
   The controller output switches from **OFF** to the corresponding numerical value in percent.

INFORMATION

The parameter can only be activated or deactivated here, if the controller output is switched to automatic mode (*Setpoint* option, *Controller* = **Auto**); refer also to variant B.

Variant B)

Procedure



1. In the *Controller* main menu, press the button of the desired parameter.

   The *Setpoint* tab page appears.
2. Set the setpoint and, if necessary, change alarm values and critical values.
3. Ensure that the controller output is in automatic mode, if not, activate it.
4. Press **OK**.

The settings have been saved.

6.2.3 Setting Alarm Limits and Critical Values

The alarm limits and critical values of a parameter can be set symmetrically or asymmetrically:

- Symmetric = the difference between the setpoint and the upper alarm limit or upper critical value = difference between setpoint and lower alarm limit or lower critical value.
- Asymmetric = the difference between the setpoint and the upper alarm limit or upper critical value ≠ difference between setpoint and lower alarm limit or lower critical value.

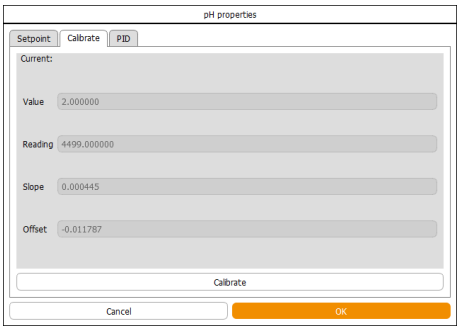
The upper alarm limits can be set as ≤ the upper critical values. The lower alarm limits can be set as ≥ the lower critical values.

A parameter alarm is triggered as soon as the value falls below the lower alarm limit or exceeds the upper alarm limit. For more information, see chapter “Parameter Alarms”.

Alarm limits and critical values must be set in the *Controller* main menu via the *Setpoint* option of each parameter for each bioreactor individually, irrespective of whether the cultivation is stopped or running. The procedure is the same as for setting the setpoints.

6.3 Calibrate – Calibration

6.3.1 Menu Content



- *Reading*: shows the current measurement in digital units.
- *Value*: shows the current measurement, depending on the last calibration.
- *Slope*: shows the digital value of the calculated linear slope.
- *Offset*: describes the intersection of the calibration line with the x-axis.

Reading, *Slope* und *Offset* are not relevant for measurement systems with digital pH and pO_2 sensors. These values are stored directly in the integrated electronic system of the respective sensor.

INFORMATION

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

6.3.2 General Information on Calibration

Sensors for measuring the pH, pO_2 and turbidity (only variant ASD12-N, manufacturer OPTEK) are usually calibrated before each cultivation.

- pH sensors: pH sensors must be calibrated before each sterilization. That is, this is done before mounting in the culture vessel.
- pO_2-sensors: as a rule, a 1-point calibration to 100 % is usually sufficient for exact measurement, and should be carried out before each cultivation. If necessary, 2-point calibration to 100 % and 0 % is also possible.

INFORMATION

The prerequisites for exact calibration results are available in separate documentation from the sensor's manufacturer. The calibration conditions and how these can be met are specified by the operator and are not part of this operating manual.

Calibrating All (pH / pO_2) Sensors

The **Calibrate ALL pH** and **Calibrate ALL pO_2** buttons in the *Batch* main menu are available, as soon as more than one bioreactor (= culture vessel) is controlled using the touch screen software. These functions enable a simultaneous calibration of several or all connected pH sensors or pO_2 sensors.

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 device = 1 bioreactor (= 1 culture vessel)
  max. 1 master device with 5 satellite devices is possible
- Multifors 2: 1 device = 2 bioreactors (= 2 culture vessels)
  max. 1 master device with 2 satellite devices is possible.

6.3.3 Calibrating a Digital pH Sensor

General Information

The pH buffers and their temperature dependence are saved in the digital pH sensors and are automatically detected during calibration. It is therefore not necessary to carry out a separate temperature measurement of the buffer solution.

INFORMATION

If a digital pH sensor has already been calibrated externally, the bioreactor will use this data and there is no need for calibration on the touch screen software.

Calibrating

Proceed as follows:

Procedure

1. Connect the sensor cable.
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

Wiping or rubbing the pH sensor after rinsing can generate an electrostatic charge. This can greatly increase the response time and generate incorrect measurements. At most, lightly dab the pH sensor after rinsing, NEVER wipe or rub.

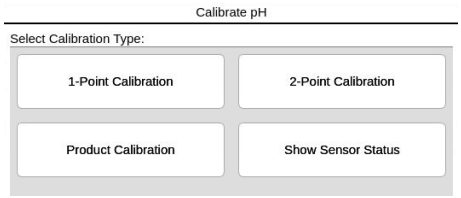
INFORMATION

Only sensor type Easyferm Plus ARC: an *ERROR Glass resistance too high* that might appear after initialization can be ignored. This can occur if the sensor is in contact with air or non-conductive liquid such as distilled water.

3. In the *Batch* main menu, press **Calibrate pH**.

Parameter Options

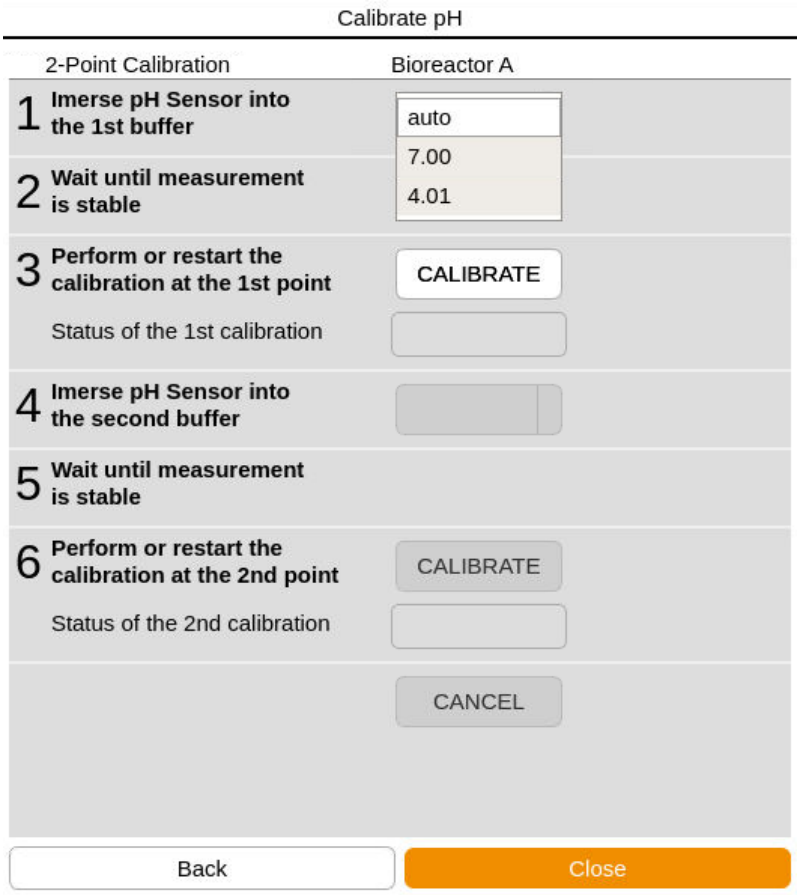
The calibration menu opens with four options:



- **1-Point Calibration** and **2-Point Calibration**: select 1-point or 2-point calibration.
- **Product Calibration**: select product calibration.
- **Show Sensor Status**: menu with dates and values that are output by the sensor manufacturer's firmware that is integrated in the sensor. For more details see section “Sensor Status”.

4. Select 2-point calibration.

The menu opens and guides you through the calibration step by step (1 to 6).



- Step 1 and 4: select the first or second reference value in drop-down lists. If the connected sensor allows the use of different calibration buffers or an automatic detection of the calibration buffer (“auto”), this can be selected. Otherwise, the calibration buffer to be used is displayed.

- Step 2 and 5: display of measurements, wait for stabilization.
- Step 3 and 6: use **CALIBRATE t**o start the calibration process.

  As soon as the bar of the status display is filled and *Ready* is displayed, the button switches to **CONFIRM** to save the calibration point. **CANCEL** is available for aborting the calibration process.

Status display *Ready*

- Variante METTLER ISM: measured value is stable; calibration point can be saved.
- Variant HAMILTON Easyferm Plus ARC: calibration point ready to save, regardless of whether the measured value is stable.

INFORMATION

The calibration process can be continued from the last saved point at any time, if the menu was closed using **Close**. However, this does not apply if another calibration process is started.

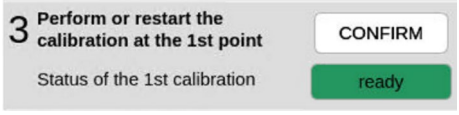
5. Hold the pH sensor in the appropriate buffer solution of the first calibration point and, if possible, select reference value or automatic buffer recognition in drop-down list (step 1).

INFORMATION

HAMILTON Easyferm Plus ARC: always start with the lower calibration buffer (4.01).

6. Wait until the measurement is stable (step 2).

7. Press **CALIBRATE** (step 3a).



The calibration process starts. The **CALIBRATE** button turns into **CONFIRM**. The status display turns green:

- Variant METTLER ISM: as soon as the status display is full, the calibration point can be confirmed.
- Variant HAMILTON Easyferm Plus ARC: the calibration point can be confirmed if the measured value in line 2 is defined as stable by the operator.

8. Press **CONFIRM** (step 3b).

The calibration point is saved.

INFORMATION

If the calibration process fails, an error message is displayed with a corresponding notice. In this case, restart the calibration.

If the calibration was successful, the drop-down list for selecting the second reference value and the **CALIBRATE** button become available for calibrating the second point.

The calibration process for the second point is the same as for the first point. After rinsing the pH sensor with distilled water, the same *ERROR* might occur. This can also be ignored.

After the 2nd calibration point has been saved successfully via **CONFIRM**, calibration is complete, and the menu can be closed using **CLOSE**.

Sensor Status

Show Sensor Status is used to show data and values produced by the firmware of the sensor manufacturer integrated in the sensor. In addition to information on the sensor type and information on calibration, the following two values are displayed for METTLER ISM sensors:

- **ACT** (Adaptive Calibration Timer in days): adaptive calibration timer in days, determines the time of the next calibration to ensure that optimal measurement performance is guaranteed. After successful calibration, it is reset to its start value.
- **DLI** (Dynamic Lifetime Indicator in days): dynamic display of the lifetime. Shows the number of days remaining and is preset by the sensor manufacturer.

6.3.4 Calibrating All Digital pH Sensors

The procedure for calibrating all digital pH sensors simultaneously remains the same as the calibration procedure for a single digital pH sensor. Therefore, the individual steps are not described in detail in this chapter.

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.

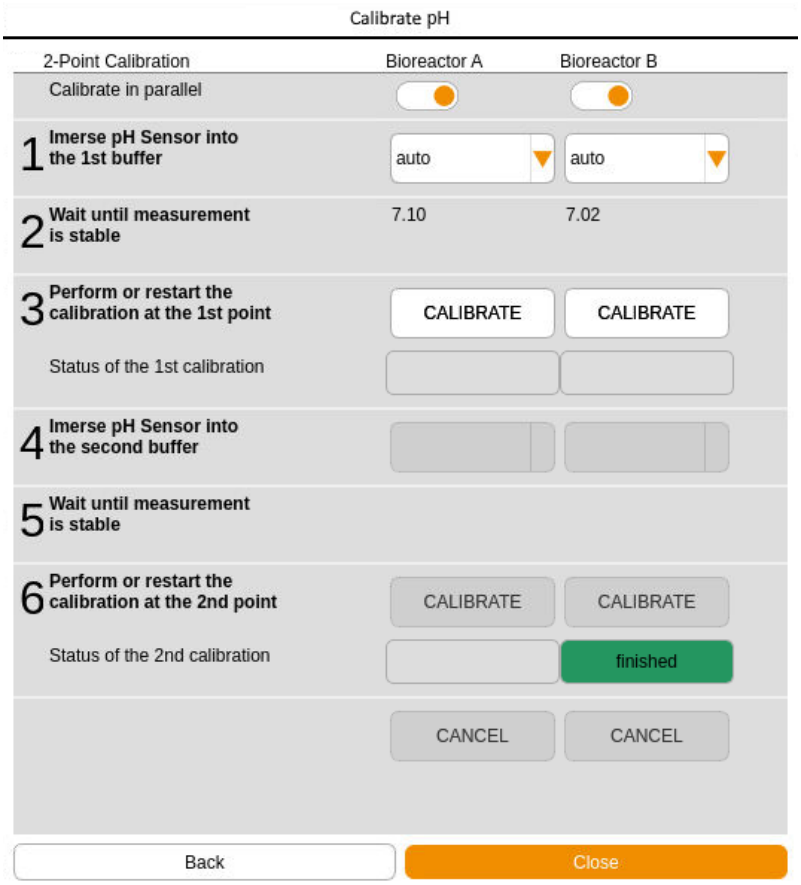
Proceed as follows for calibration:

Procedure

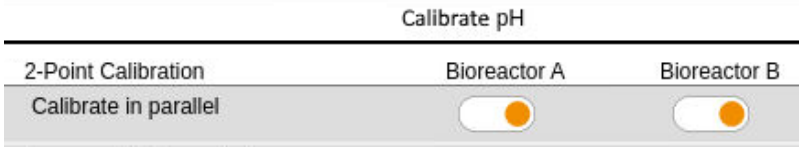
1. Depending on the desired method, prepare a container, e.g. measuring beaker, with both buffer solutions at a known temperature for each pH sensor individually or for all pH sensors.
2. Connect all sensor cables.
3. Select all (*All*) bioreactors via selection bar.
4. In the *Batch* main menu, press **Calibrate All pH**.

   The calibration menu opens with the different calibration options as for the single calibration.
5. Select 2-point calibration.

The menu opens with up to 6 (bioreactor A to F) bioreactors. The example below shows the 2-point calibration menu for bioreactor A and B.



The calibration menu leads through the calibration step by step (1 to 6) in the same way as for a single pH sensor.



Calibrate in parallel: this function is additionally available here. It defines whether the calibration steps of one, several or all pH sensors should be carried out simultaneously or individually one after the other

6. Switch the function on/off as required.
7. Rinse the pH sensors with distilled water, (do not rub!) and hold them into the appropriate buffer solution of the first reference point.

INFORMATION

Observe the notes on electrostatic charging and possible error message *ERROR Glass resistance too high in chapter* “Calibrating a Digital pH Sensor”.

8. Proceed with calibration as described from step 6 in the chapter “Calibrating a Digital pH Sensor”.

6.3.5 Product Calibration of a Digital pH Sensor

General Information

It is possible to adjust the calibration curve to the current process conditions using product calibration. This could be necessary if there is a possibility of drift of the displayed pH during a long-term cultivation, for example.

INFORMATION

Product calibration can only be carried out and is only effective if the externally measured and entered pH value does not deviate from the original pH value by more than 2 pH units.

Calibrating

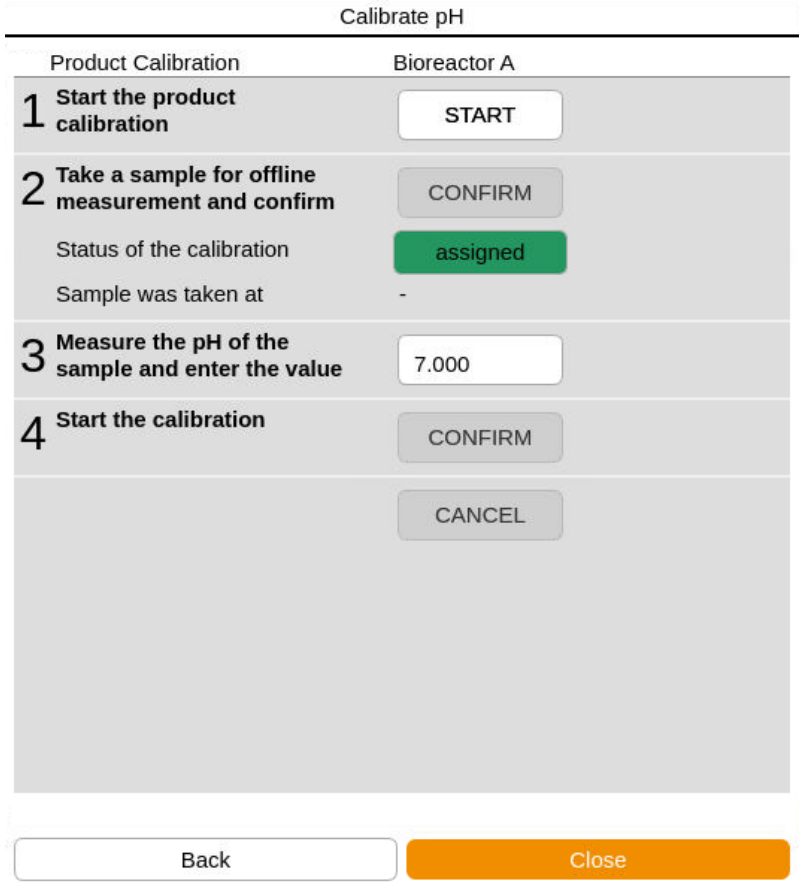
Proceed as follows:

Procedure

1. Call up the calibration menu of the pH sensor and press **Product Calibration**.

Parameter Options

The menu for product calibration opens and guides you through the product calibration step by step (1 to 4):



- Step 1 +2: start product calibration via **START** and confirm sampling via **CONFIRM** to generate a time stamp (*Sample was taken at*).

  Status display of the calibration with the following possible displays:
  - *ready*: time stamp for completed sampling can be generated via **CONFIRM**.
  - *measured*: time stamp has been generated.
  - *assigned*: last product calibration was successful and is active. A new product calibration can be performed.
  - *aborted:* last product calibration was aborted via **CANCEL** or was not successful; restart product calibration.
- Step 3 + 4: enter an external measurement and use **CONFIRM** to confirm in order to start the calibration.

INFORMATION

The calibration process can be continued from the last saved point at any time, if the menu was closed using **Close**. However, this does not apply if another calibration process is started.

2. Press **START**.
3. Take a sample from the process.

   There are two possible approaches:

   a) Confirm the sampling (generate a time stamp), carry out a laboratory measurement of the pH value for the sample, enter the measured value and carry out product calibration.

   OR:

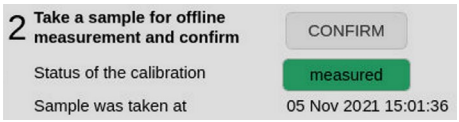
   b) Confirm the sampling (generate a time stamp), leave the calibration menu via **Close** and carry out the product calibration with an external measured value at a later time.
4. Choose **Close** to leave the menu.

INFORMATION

An new product calibration or 1-point calibration or 2-point calibration cancels the active product calibration.

Procedure

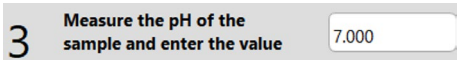
<u>Details for variant a)</u>



1. After sampling, press **CONFIRM**.

   The status display changes to *measured.* The date and time of sampling are now displayed.

2. Carry out a laboratory measurement of the pH value for the sample.



3. Enter the measured pH value of the sample, in the example to the left that is pH 7.0.
4. Press **CONFIRM** to start the calibration.
5. Wait until calibration is complete.

That is, the status display changes to *assigned*. This status allows you to perform another product calibration or leave the menu.

6. Choose **Close** to leave the menu.

Procedure

Details for variant b)

1. After sampling, press **CONFIRM**.

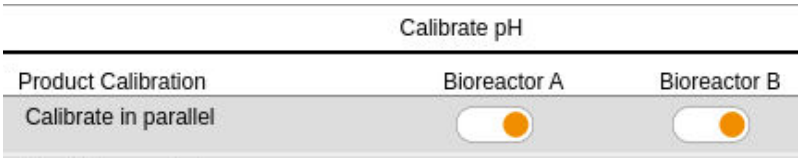
   As in variant a), the status display changes to *measured*, and the date and time of sampling are displayed underneath. This indicates that sampling was carried out, but product calibration is not yet active. If a sample is lost, step 1 can be repeated.

2. Leave the calibration menu using **Close** and carry out a laboratory measurement of the pH value for the sample at a later time.

3. To carry out product calibration, proceed as in Variant a) from step 2.

Product Calibration of All Digital pH Sensors

The procedure for simultaneous product calibration of all digital pH sensors remains the same as for a single pH sensor.



Calibrate in parallel: this function is additionally available here. It defines whether the calibration steps of one, several or all pH sensors should be carried out simultaneously or individually one after the other.

6.3.6 Calibrating an Anlaog pH Sensor

General Information

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 device during calibration. Another option is to measure the temperature externally and enter the value manually in the touch screen software. In both cases, the temperature compensation of the pH parameter must be activated. This is used to correct the temperature dependence of the measurement principle. If not measured or manually input, the buffer temperature is assumed to be 20 °C.

Calibrating

Proceed as follows:

Procedure

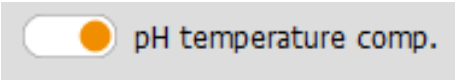
1. Connect the sensor cable.

   Ensure the sensor cable is not buckled or twisted.

ATTENTION

The screening on the sensor cable may become damaged if it is kinked or twisted. This may lead to faulty measurements.

If the externally measured temperature of the pH buffer solutions is to be entered or their temperature is to be measured using the temperature sensor:



2. In the *Setpoint* parameter option, activate temperature compensation (*pH temperature comp.*).

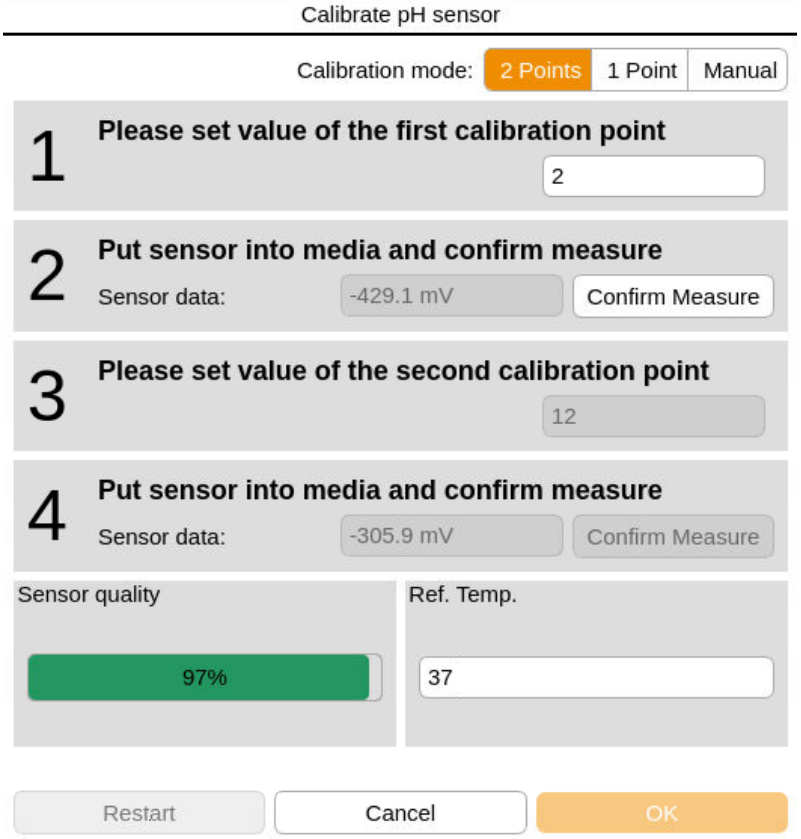
3. Carefully remove the cap with the storage solution from the pH sensor and rinse the sensor with distilled water, do not rub it!

ATTENTION

Wiping or rubbing the pH sensor after rinsing can generate an electrostatic charge. This can greatly increase the response time and generate incorrect measurements. At most, lightly dab the pH sensor after rinsing, NEVER wipe or rub.

4. In the *Batch* main menu, press **Calibrate pH**.

The calibration menu opens and guides you through the calibration step by step (1 to 4).



2-point calibration mode is selected automatically. The *Ref. Temp* display/input field for temperature compensation is displayed.

INFORMATION

Without activating pH temperature compensation first, this display/input field is not visible.

The *Sensor quality* bar graphically depicts the quality of the sensor on a scale from 0 % to 100 %.

5. Enter the value of the lower (or upper) reference button in the input field in line 1.

INFORMATION

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

If temperature compensation is active:

6. Enter the temperature of the buffer solution in the *Ref. Temp*. display/input field or hold the temperature sensor together with the pH sensor in the buffer solution at step 7.
7. Place the pH sensor in the relevant buffer solution.

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

   As soon as the measurement is stable:
8. Press **Confirm Measure** in line 2.

   The calibration value is 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 stable. Wait a few minutes before confirming with **OK** and check the measurement again, if in doubt.

9. Rinse the pH sensor with distilled water, do not rub!
10. For the second calibration point, repeat the same steps as for the first point.

    As soon as the second calibration value has been accepted:
11. Press **OK**.

    The dialog box disappears, the calibration values are stored.
12. Rinse the pH sensor with distilled water, do not rub!

6.3.7 Calibrating All Analog pH Sensors

If the exact temperature of the buffer solution is to be determined for the calibration of all pH sensors, this must be done externally; it cannot be measured here with the temperature sensor. If the temperature of the buffer solution is not entered, a buffer temperature of 20 °C is assumed.

Proceed as follows for calibration:

Procedure

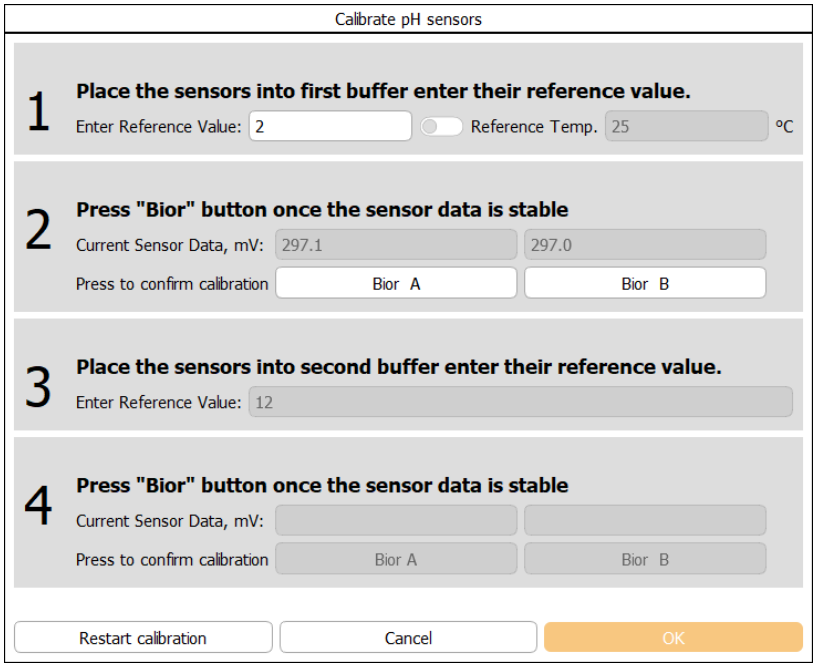
1. Depending on the desired method, prepare a container, e.g. measuring beaker, with both buffer solutions at a known temperature for each pH sensor individually or for all pH sensors.
2. Connect all sensor cables and ensure they are not kinked or twisted.

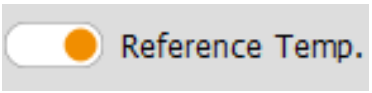
ATTENTION

The screening on the sensor cable may become damaged if it is kinked or twisted. This may lead to faulty measurements.

3. Select all (*All*) bioreactors via selection bar.
4. Call up the *Batch* main menu and press **Calibrate All pH**.

The menu opens with up to 6 (bioreactor A to F) bioreactors. The figure shows the 2-point calibration menu for bioreactor A and B. The menu leads through the calibration step by step (1 to 4).





5. Activate the *Rerence Temp*. function for manual input of the buffer solution temperature as required

INFORMATION

When using this function, it must be ensured that temperature compensation (*pH temp compens*) is activated for the individual bioreactors in the pH parameter option *Setpoint.*

6. If necessary, enter the measured temperature value of the buffer solution in the *Reference Temp*. input field
7. Rinse all pH sensors with distilled water, do not rub!

ATTENTION

Wiping or rubbing the pH sensor after rinsing can generate an electrostatic charge. This can greatly increase the response time and generate incorrect measurements. At most, lightly dab the pH sensor after rinsing, NEVER wipe or rub.

8. Enter value of lower (or upper) reference buffer in input field on line 1

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

9. Place the pH sensors into the relevant buffer solution.

   Measured values (in mV) of the pH sensors are displayed in *Current Sensor Data* in line 2 above the **Bior** buttons.

   As soon as all measured values are stable:

10. Press the **Bior** buttons one after the other.

    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 stable. Wait a few minutes before confirming with **OK** and check the measurement again, if in doubt.

11. Rinse all pH sensors with distilled water, do not rub!
12. Repeat the same steps for the second calibration point as for the first.

    As soon as the second calibration value of all pH sensors has been accepted:

13. Press **OK**.

    The menu disappears, the calibration values are stored.

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

6.3.8 Recalibrating an Analog pH Sensor

General Information

To compensate for a deviation (drift) of a measurement of an analog pH sensor during a long-term cultivation, a re-calibration is possible and sufficient. There are two different ways in which this can be done:

- 1-point calibration
- Manual correction of the “Offset”

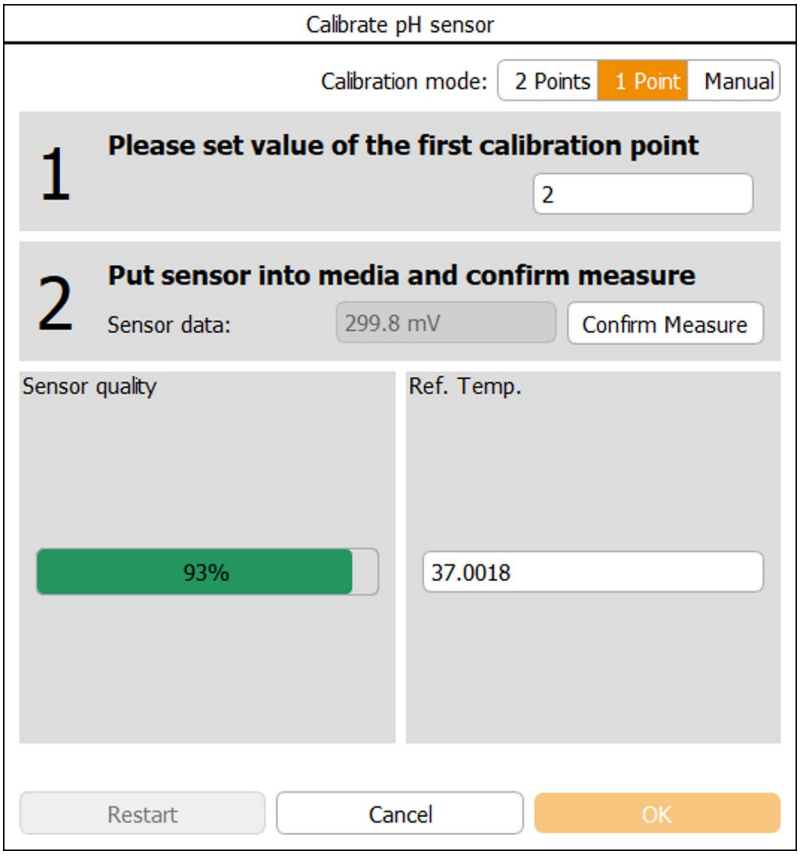
Calibrating

Proceed as follows:

Procedure

1. In the calibration menu, use **1 Point** to select 1-pont calibration mode.

   The menu view changes.



2. Enter the externally measured pH of a sample taken as a reference value in line 1.
3. Use **Confirm Measure** to confirm the value.

   The calibration value is accepted.
4. Press **OK**.

   The calibration disappears, the value is saved.

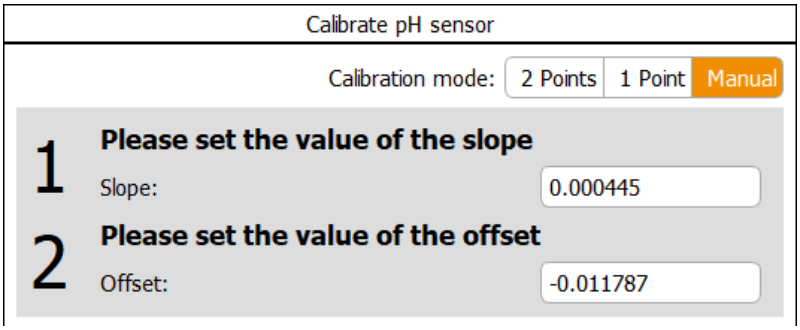
Manual Correction

Proceed as follows:

Procedure

1. Determine the difference between the pH measured via an external measuring device and the pH of the culture measured via the connected pH sensor.
2. In the calibration menu, use **Manual** to switch to manual calibration mode.

   The menu view changes.



3. Depending on the difference between the two pH measurements, either add the result to the displayed "Offset" or subtract it and enter it.
4. Press **OK**.

   The calibration menu disappears, the value is saved.

6.3.9 Calibrating a Digital pO_2 Sensor

General Information

2-point calibration can only be performed in the correct sequence:

1st calibration point = 100 %, 2nd calibration point = 0 %. The following example describes a 2-point calibration.

INFORMATION

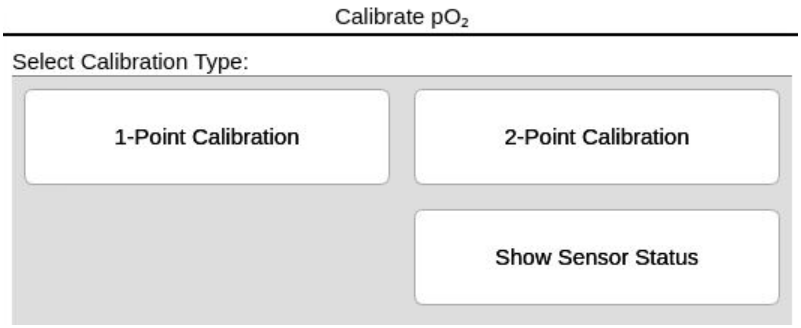
Digital pO_2 sensors are preconfigured by the device manufacturer to the measurement %-sat.

Calibrating

As soon as the desired calibration conditions for 100 % calibration are reached, proceed as follows:

Procedure

1. In the *Batch* main menu, press **Calibrate pO_2**.
   The calibration menu appears with three options:

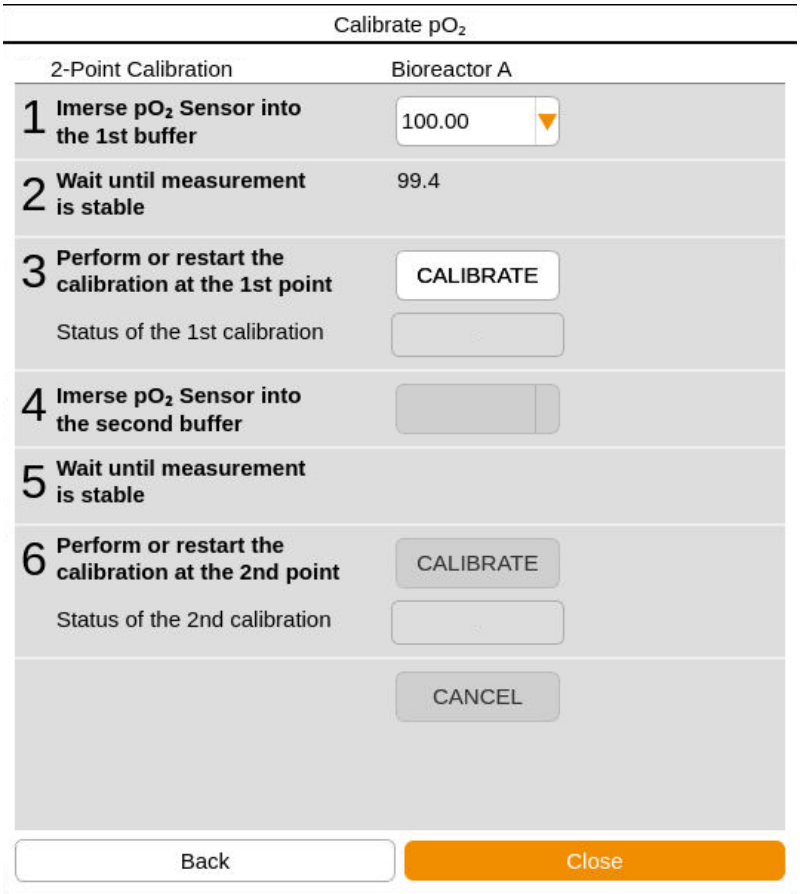


   - **1-Point Calibration** and **2-Point Calibration**: select 1-point or 2-point calibration.
   - **Show Sensor Status**: shows dates and values that are output by the firmware that is integrated into the sensor.

2. Select 2-point calibration.

Parameter Options

The menu opens and guides you through the 2-point calibration:



- Step 1 and 4: select the first or second reference value in drop-down list. If the connected sensor allows the use of different reference values or an automatic detection of the reference value (“auto”), this can be selected. Otherwise, the reference value to be used is displayed.
- Step 2 and 5: display of measurements, wait for stabilization.
- Step 3 and 6: use **CALIBRATE** to start the calibration process.

  As soon as the status display bar is filled and *Ready* is displayed, the button switches to **CONFIRM** to save the calibration point. **CANCEL** is available for aborting the calibration process.

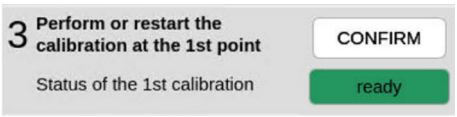
Status display *Ready*

- Variant METTLER ISM: measured value is stable; calibration point can be saved.
- Variant HAMILTON Visiferm DO ARC / RS485-ECS: calibration point ready to save, regardless of whether the measured value is stable.

INFORMATION

The calibration process can be continued from the last saved point at any time, if the menu was closed using **Close**. However, this does not apply if another calibration process is started.

3. If possible, select reference value *100* (= 100 %) in the drop-down list (step 1).
4. Wait until the measurement is stable (step 2).
5. Press **CALIBRATE** (step 3a).



The calibration process starts. The **CALIBRATE** button turns into **CONFIRM**. The status display turns green:

- Variant METTLER ISM: as soon as the status display is full, the calibration point can be confirmed.
- Variant HAMILTON Easyferm Plus ARC: the calibration point can be confirmed if the measured value in line 2 is defined as stable by the operator.

6. Press **CONFIRM** (step 3b).

   The calibration point is saved.

INFORMATION

If the calibration process fails, an error message is displayed with a corresponding note. In this case, restart the calibration.

If the calibration is successful, the drop-down list for selecting the second reference value and the **CALIBRATE** button become available to calibrate the second point.

7. Establish correct calibration conditions for the 0 % calibration.

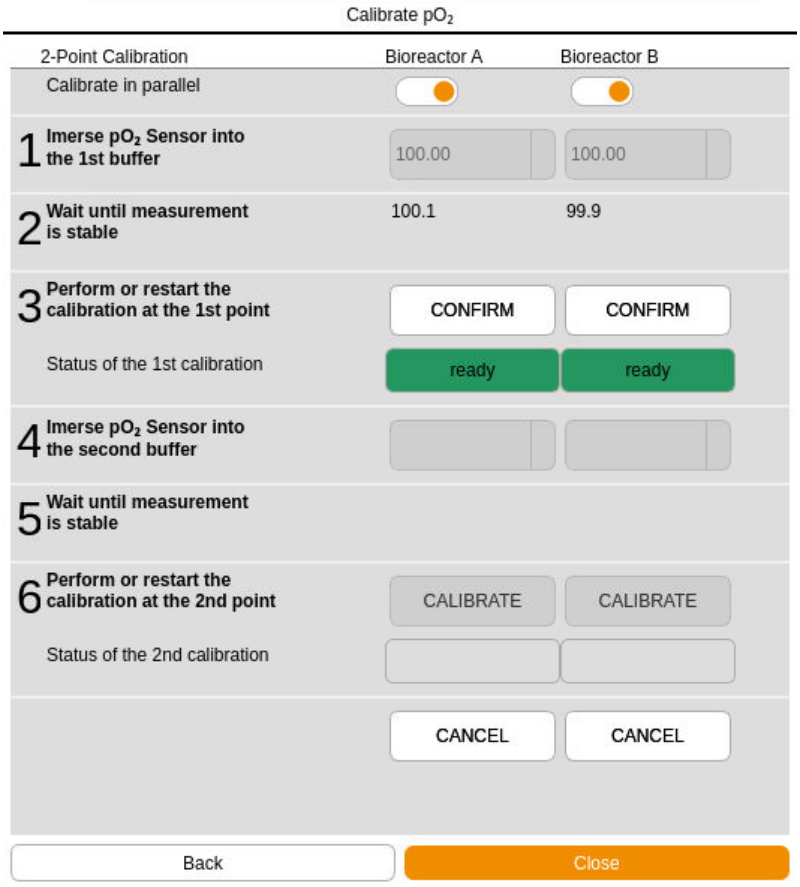
   Once these are met:

8. For the second calibration point for 0 %, proceed in the same way as described starting from step 4.

After the 2nd calibration point has been saved successfully via **CONFIRM**, calibration is complete, and the menu can be closed using **Close**.

6.3.10 Calibrating All Digital pO_2 Sensors

The procedure for calibrating all digital pO_2 sensors simultaneously remains the same as the calibration procedure for a single pO_2 sensor. The individual steps are therefore not repeated in this chapter. The figure shows the 2-point calibration menu for bioreactor A and B.



Calibrate in parallel: only this function is additionally available here. This defines whether the calibration steps of one, several or all pO_2 sensors should be carried out simultaneously or individually (one after the other).

6.3.11 Calibrating an Analog pO_2 Sensor

General Information

INFORMATION

Polarographic pO_2 sensors must be polarized at initial operation or after disconnection from the voltage source. Correct calibration is not possible otherwise. More details about polarization can be found in the separate documentation from the sensor manufacturer.

2-point calibration of an analog pO2 sensor can be performed in 2-point calibration mode or sequentially in 1-point calibration mode. The 2-point calibration must take place in the correct order. 1st calibration point = 0 %,2nd calibration point = 100 %. The following example describes a 2-point calibration.

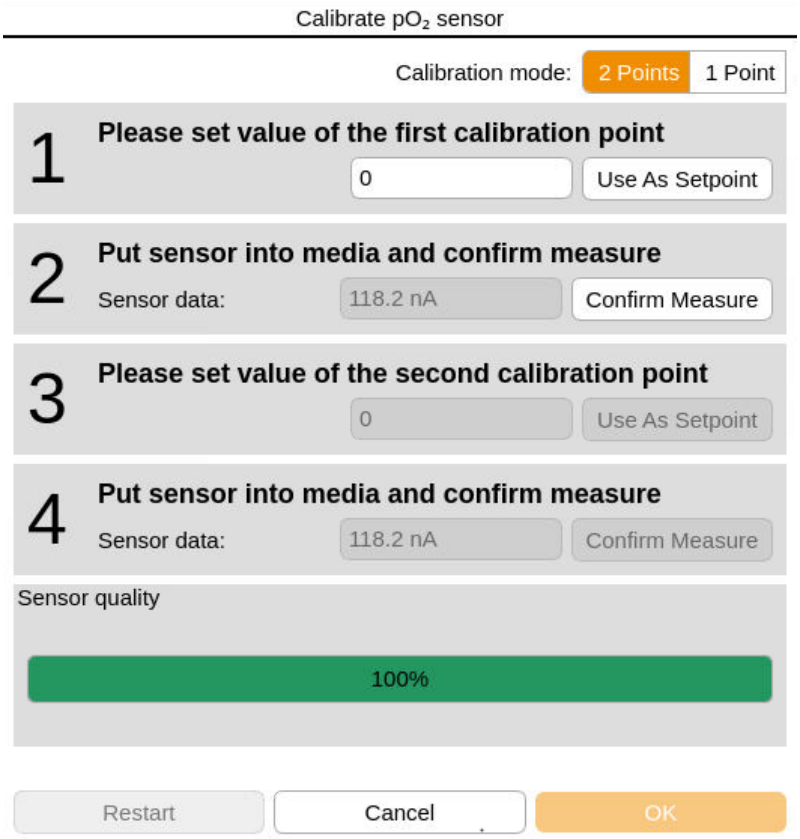
Calibrating

As soon as the desired calibration conditions for 0 % calibration are reached, proceed as follows:

Procedure

1. Call up the *Batch* main menu and press **Calibrate pO_2**.

The calibration menu appears.



2-point calibration mode is selected automatically. The menu guides you through the calibration step by step.

INFORMATION

The **Use As Setpoint** button is only relevant and can only be used under certain circumstances, see next section “Function Use As Setpoint Analog pO_2 Sensors”.

2. In line 1, enter the value 0 (zero = 0 %) for the first calibration point.
3. Wait until the measurement (*Sensor data*, line 2) is stable.
4. Press **Confirm Measure**.

   The value is accepted as 0 % oxygen.
5. Establish correct calibration conditions for the 100 % calibration.

Once these are met:

6. In line 3, enter the value 100 (= 100 %) for the second calibration point.
7. Wait until the measurement (*Sensor data,* line 4) is stable.
8. Press **Confirm Measure**.

   The value is accepted as 100 % oxygen saturation.
9. Press **OK**.

   The dialog box disappears, the calibration values are stored.

Use As Setpoint Function Analog pO_2 sensors

Operators can use the **Use As Setpoint** buttons in the calibration menu of the analog pO_2 sensors under the following conditions:

- Configuration with GasMix, air/O_2/N_2 is available.
- The *Gasmix* parameter is configured in a cascade for the pO_2 control.

INFORMATION

For all other parameters the **Use As Setpoint** button is only relevant for INFORS HT service technicians.

How it works

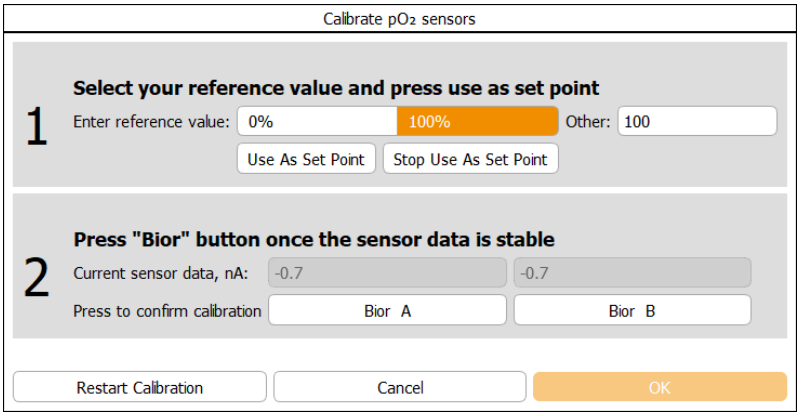
In the calibration menu of the *pO_2* parameter (METTLER sensors):

- 0 % calibration: The input ***0*** (%) in the input field of the first calibration point and pressing the **Use As Setpoint** button causes the *Gasmix* parameter to switch to nitrogen for this value.
- 100 % calibration: (2nd point), prior to entering the value ***100***: The input of ***21*** (%) in the input field of the second calibration point and pressing 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.

6.3.12 Calibrating All Analog pO_2 Sensors

The procedure for calibrating all analog pO_2 sensors simultaneously remains the same as the calibration procedure for a single pO_2 sensor. The individual steps are therefore not repeated in this chapter.

The calibration menu for all analog pO_2 sensors is slightly different from the calibration menu for a single pO_2 sensor



- There is no 2-point calibration mode available. A 2-point calibration is performed one after the other in the correct sequence (zero point before 100 %).
- The **Bior** buttons are available for confirming the measured values.

For details on the special function “Use As Setpoint”, see the section “Use As Setpoint Function Analog pO_2 Sensors” in chapter “pO_2 Sensor (Analog) Calibration”.

6.3.13 Calibrating the Turbidity Sensor

General Information

Turbidity sensors ASD12-N are pre-calibrated ex-factory. Inserts are available for reference measurement. Due to the different light absorption of different media, zero point calibration of the turbidity sensor should be performed before each cultivation process. This can be done either before or after autoclaving, depending on the application in question.

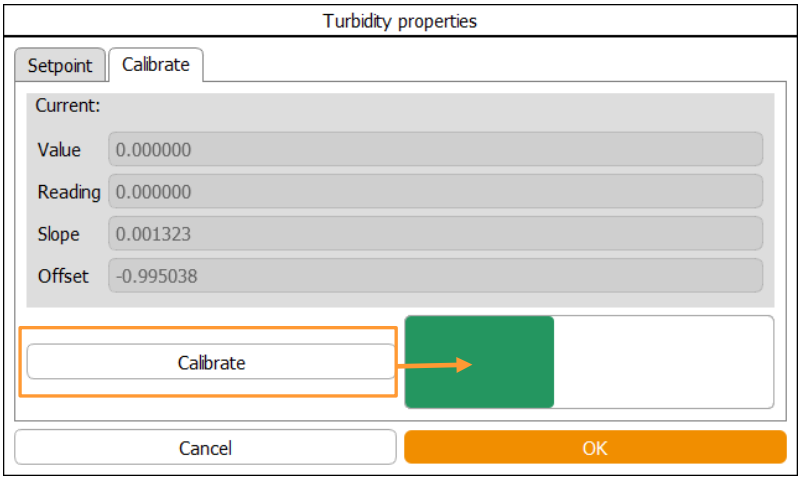
Conditions for zero point calibration of the sensor: the sapphire windows of the turbidity sensor must be clean and free of air or gas bubbles. The light absorption of the medium before activation of the gassing and before inoculation can be used as a reference value for the zero point.

Calibrating

Proceed as follows:

Procedure

1. Connect the sensor cable.
2. Call up the *Controller* main menu and wait until the measurement of the *Turbidity* parameter is stable.
3. Call up the *Calibrate* option of the parameter and press **Calibrate.**



A display bar now briefly appears to the right of the **Calibrate** button, which graphically depicts the calibration process. The progress is shown using a green color.

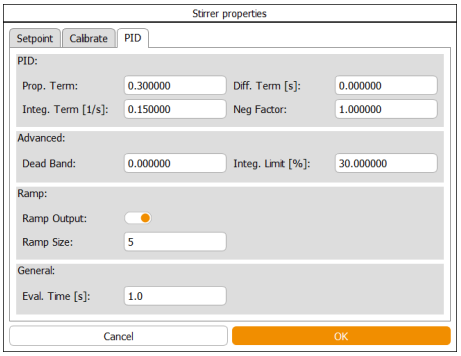
If the bar disappears after a few seconds, the calibration is complete.

4. Press **OK.**

The calibration is saved; the menu disappears.

6.4 PID Controller Settings

6.4.1 Menu Content



The PID menu contains input fields for setting up PID control (Proportional Integral Derivative control). The table in the following chapter explains the functions of the setting value in more detail.

Note the following points:

- If *Ramp Output* is deactivated, the value in *Ramp Size* is not relevant.
- For parameters that are not controlled but only measured, only the value in *Eval Time [s]* is relevant. This is always > 0 (zero).

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

Note the following:

- If the ramp output is switched off, the value in the Ramp Size-einput field is not relevant.
- 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.

6.4.2 Table with Setting Values for the PID Controller

Setting	Description
P (Prop. Term)	Proportional term: the greater the difference between setpoint and actual value, the greater the controller output.
I (Integ. Term [1/s])	The integral factor sums up all errors over the term. If the setpoint is not reached with the proportional factor, the integral factor successively adjusts the output until the setpoint is reached. If the integral factor is set too high, this leads to fluctuations of the control loop.
D (Diff Term [s])	The differential quotient calculates the change in the actual value over time and counteracts this change.
Neg. Factor	The negative factor can be used to weight a two-sided control (+100 to -100 percent) (e.g. strong acid, weak base). Here, 1 is the balance and 0.5 or 2 the corresponding halving or doubling of the controller output. Example: nitrogen affects the pO_2 value less than oxygen, so a negative factor of 2 can rebalance the controller's response.
Dead Band	If a deadband value is entered, no control takes place within this value around the setpoint (symmetrical, +/-). That is, the controller output is = 0. The deadband is used for pH control.
I Limit (Integ. Limit [%])	To ensure that the integral factor cannot increase indefinitely, the integral influence is used. This limits the error summation. The integral influence is set between 0 % and 100 % of the controller output.
Ramp output	To make changes slowly and incrementally, a ramp can be activated. This makes sense, in particular, for the stirrer speed or a mass flow valve.
Ramp Size	Time period over which the setpoint of the controller is gradually brought up to the newly entered setpoint.
Eval Time [s]	The evaluation time shows the intervals in seconds of the new calculation of the PID value. The controller speed is defined by this. 10 s is a good average value for the eval. time.

6.4.3 PID Control Explained

The PID function is based on a generic formula provided as the 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, also called slope, with which a setpoint is reached. The larger the value, the faster the control.
- *I* = Integral factor of the error in 1/second. A typical integral factor is < 0.05.
- D = Differential quotient of the deviation (*Error*). This is set in seconds (mostly to 0).

The following has to be kept in mind in relation to the individual factors:

Factor	Explanation
Proportional factor	Changing the proportional factor has a big impact on a running process. Increasing it too much leads to oscillation of the control loop around the setpoint. Using the pH parameter as an example To reach the setpoint, a little acid is alternately added, then some base, acid again, then base, and so on. If the proportional factor is reduced too much, the controller hardly reacts to deviations and never reaches the setpoint.

Parameter Options

Factor	Explanation
Integral Term	The integral factor should have a small value and only be changed a little in small steps with very large pauses. Ideally, switch off the device briefly after changing the integral factor in order to delete the pending error calculation. A typical integral factor is < 0.05. It should be the reciprocal of two to four times the period of the system. The bigger the value, the less time in seconds remains for the control. Typically, a value greater than 0.05 does not make sense as it exceeds the minimum time required for the control. This leads to oscillations of the control circuit.
Differential quotient	The differential quotient is rarely required. It is set to 0 (zero) at the start. A high value is only necessary, if greater changes are taking place rapidly. It leads to a more rapid speed of response of the controller output for a given error value.

Example for Calculating the Integral Factor

The period of oscillation of the system is detected with 50 seconds from amplitude to amplitude. The integral factor is calculated as follows then:

$1 / (50 \text{ s} \times 2) = 0.01 \text{ s}^{-1}$

$1 / (50 \text{ s} \times 4) = 0.005 \text{ s}^{-1}$

Integral factor	Seconds
0.1	10
0.05	20
0.001	100
0.005	200

6.4.4 Tips for Readjusting a PID Controller

To readjust the PID controller, proceed as follows:

Procedure

1. Write down the factory setting or ensure that these can be restored if need be.
2. Start by setting the proportional factor when readjusting a PID controller. Choose the proportional bandwidth as large as possible.
3. Set the integral factor and differential quotient to zero.
4. Increase the proportional factor until the controller causes oscillations of the actual value.
5. Measure the period of oscillation, e.g. with the bioprocess platform software eve® of the device manufacturer.
6. Halve the proportional factor and vary the integral factor between the reciprocal of twice and four times the period of oscillation.

7 Cascade Control

7.1 Cascade Control Explained

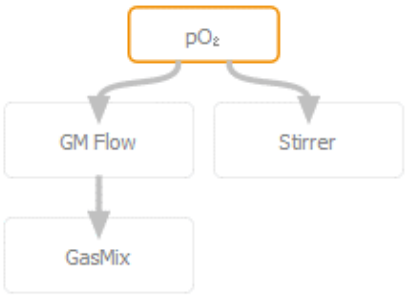
The *Cascade* main menu provides the option of setting up a cascade control of a process parameter, usually pO_2. This means that the controller output of the primary parameter (e.g. pO_2) is used as the reference variable for the secondary parameter(s) in the cascade.

Serial cascade

The parameter *Stirrer* is activated first in the cascade, to control the *pO_2* parameter. The parameter *AirFlow* is only activated when the setpoint of parameter *pO_2* has not been achieved by the *Stirrer* parameter.

Parallel cascade

The parameters *Stirrer* and *Air Flow* are activated at the same time to control the *pO_2* parameter.



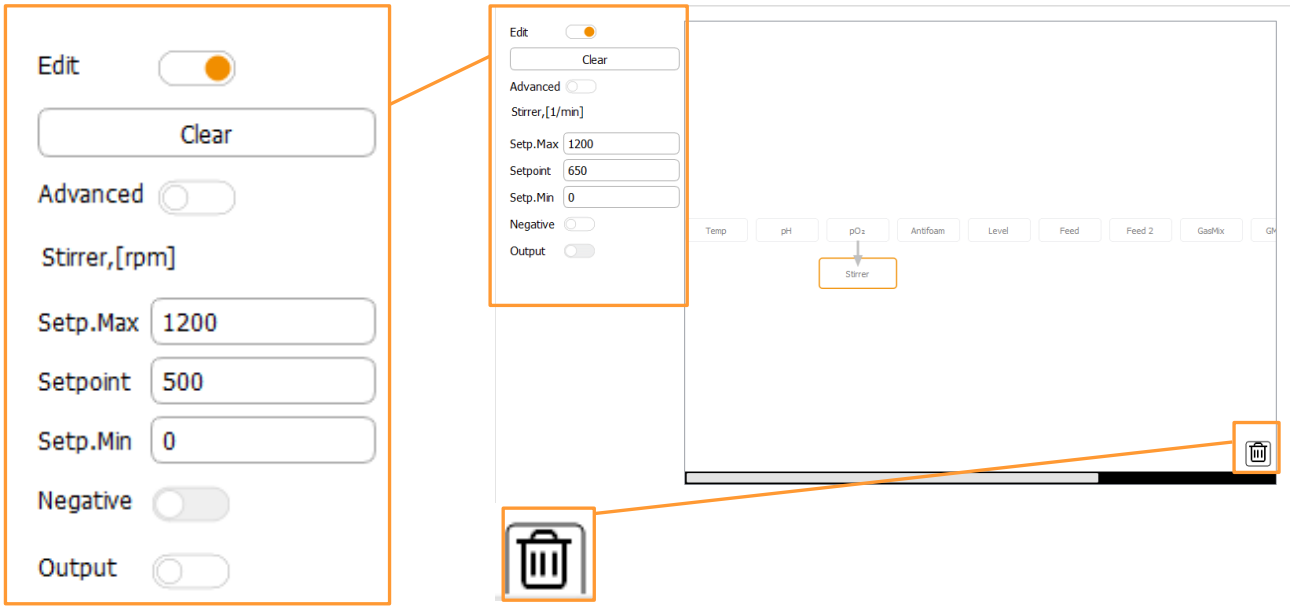
Parallel serial cascade

The parameters *Stirrer* and *Air Flow* are activated at the same time to control the pO_2 parameter. The parameter *GasMix* is only activated when the setpoint of parameter *pO_2* has not been achieved by the *Stirrer* and *AirFlow* parameters.

7.2 Setting a Cascade

7.2.1 Menu and Functions

Overview



The various cascade settings are made in the left menu area. To activate the view of the existing process parameters in the main area and to be able to make settings, the edit (*Edit*) function

In the main area, the process parameters can then be combined into a cascade using drag & drop or removed individually from the cascade (recycle bin).

Each parameter can generally only be used once in a cascade. A selected parameter is visually highlighted to distinguish it from the other parameters. At the same time, its settings menu becomes visible to its left.

Settings

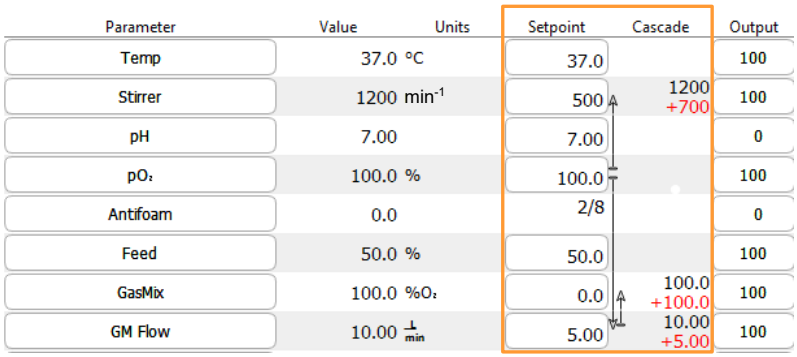
Input / Function	Description
Edit	Activate or deactivate the edit function.
Clear	Delete a (simple) cascade.
Advanced	Activate or deactivate the setting mode for an advanced cascade. Advanced cascades are used for customer-specific device configurations. They are set exclusively by the device manufacturer ex-factory. In this case, their settings and change options are created for the specific device and can be requested from the manufacturer.

Input / Function	Description
Setpoint Max. and *Setpoint Min.*	Control valves set ex-factory. These define the value range of the selected parameter, in which the cascade can change the setpoint of the cascaded parameter to control the setpoint of the primary parameter. These values can be changed within a predefined value range.
Setpoint	Setpoint of the parameter. ■ For the primary parameter: the setpoint to be controlled. ■ For the secondary parameter: the initial setpoint of the parameter from which the setpoint can be varied by the cascade within the value range of *Setp. Min.* to *Setp. Max*. We generally recommend setting the setpoint for seondary parameters to the lower end of the value range.
Negative	Activate or deactivate the Negative function of the cascade. The Negative function causes a change in sign of the controller output. This means that a negative controller output causes the addition of a positive value for the setpoint of the cascaded parameter and vice versa. The function can be used for secondary parameters if an increase in the setpoint of the secondary parameter results in a decrease in the actual value of the primary parameter.

7.2.2 Cascade Progress Display

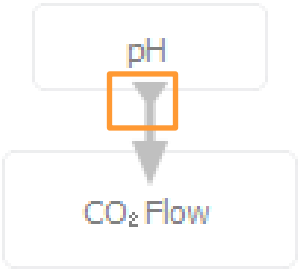
Overview

A cascade and its progress can be seen in the *Controller* main menu.



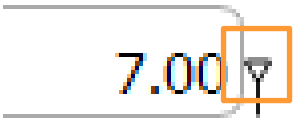
In addition to arrows showing the direction of the cascade control, the setpoint and the control output of the cascade that is added to or subtracted from the setpoint is displayed in the *Cascade* column. These values are specified in the relevant parameter unit.

Cascade Control

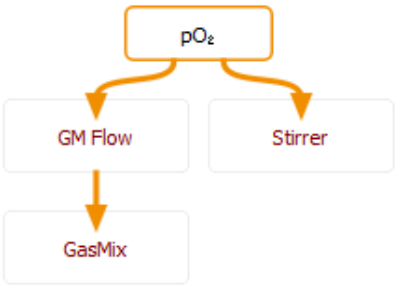


Negative Function Display

The fact that the Negative function is active is indicated by the triangle symbol on the arrow that indicates the direction of the cascade control.



This arrow shape can be seen in the *Controller* menu.



Color Scheme

The color of an added/subtracted setpoint in the Controller menu and the name of the parameter in the *Cascade* menu indicates the progress of the cascade. According to the following scheme, it shows how much leeway of the cascade remains in the value range of a secondary parameter in order to control the primary parameter:

Color	Utilisation of value range
Grey	Inactive
Green	0 – 90 %
Yellow	90 – 99 %
Red	100 %
Blue	0 %

Calculation of Example

Stirrer parameter is used as the example for secondary parameter from *setpoint* to *max. setpoint.*

- Setpoint max. 1200 min^{-1}
- Setpoint: 500 min^{-1}
- Difference (= value range): 700 min^{-1}

Conversion:

700 min^{-1} = 100 %

630 min^{-1} = 90 %

This means for the display according the color scheme mentioned:

- Green: up to 1130
- Yellow: up to 1193
- Red: at 1200

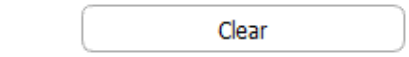
This results in a setpoint of 1130 min^{-1} (500 + 630), from which 90 % of the value range is reached. For this display according to the aforementioned color scheme, this means:

- Green: up to 1130 min^{-1}
- Yellow: up to 1193 min^{-1}
- Red: up to 1200 min^{-1}

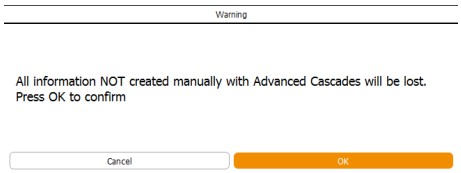
7.2.3 Deleting a Cascade

To delete all settings of a cascade (does not apply to extended cascades), proceed as follows:

Procedure



1. In the *Cascade* main menu, press **Clear**.



A dialog box appears with the warning that all settings that were NOT made in *Advanced* cascade mode will be deleted.

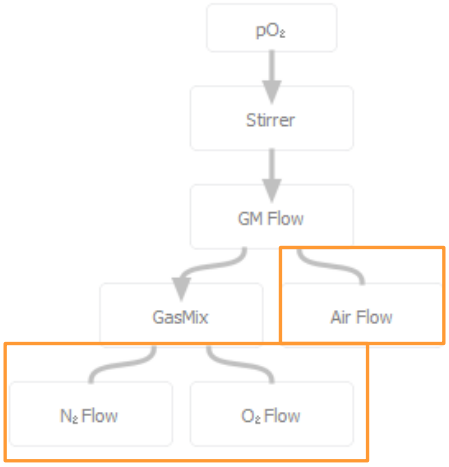
2. Press **OK**.

The cascade is deleted.

7.2.4 Special Configurations

For bioreactors with the "High-End" gassing strategy (configuration with several mass flow controllers and GasMix), the gases to be used, e.g. *Air Flow*, *N_2 Flow* and *O_2 Flow*, must be assigned to the two gasmix controlling parameters *GasMix* and *GM Flow* in the cascade configuration. To do so, set up the following cascades in addition to the desired cascade configuration, provided the corresponding parameters are available:

- Parameter *Air Flow* as secondary parameter to parameter *GM Flow*
- Parameter *O_2 Flow* as secondary parameter to parameter *GasMix*
- Parameter *N_2 Flow* as secondary parameter to parameter *GasMix*



If parameters *O_2 Flow* and *N_2 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

8.1 Control and Settings

The pumps are controlled in accordance with the respective parameters:

Pump	Parameter
Acid (digital)	*pH*
Base (digital)	*pH*
Antifoam (digital)	*Antifoam*
Feed (analog)	*Feed*
Feed 2 / *Feed 3* (analog, optional pumps)	*Feed 2* / *Feed 3*

Digital pumps and time-depending and always operate at the same speed in start/stop mode. Analog pumps run continuously at a speed that can be set. Both digital and analog pumps are controlled within a range of 0 % to 100 %.

Example

- Analog: 50 % of the maximum flow rate = pump runs at half speed.
- Digital: 50 % of the maximum flow rate = pump runs half the time.

Settings

The following settings can be made for the pumps:

- Feed pump(s): set the speed in 0.1 % increments in the range of 0 % to 100 %.
- Antifoam pump: set the dose/wait time in s.
- Calibrate the pumps.
- Manually reset the pump counter to zero.
- Fill and empty pump hoses (only standard pumps).

8.2 Calibrating a Pump

Calibration of the pumps enables display and recording of the actual pumped volume. The quantity conveyed is stated in mL.

Tools

Provide the following tools:

- Graduated measuring cylinder/cup or balance and empty vessel.
- Reagent bottle equipped with silicone hose and filled with the reagent to be pumped or equally viscous liquid.

INFORMATION

For very precise results, the reagent bottle should be placed on a balance that can also be connected to the bioreactor or a PC with the eve® bioprocess platform software installed.

Requirements

Note the following points:

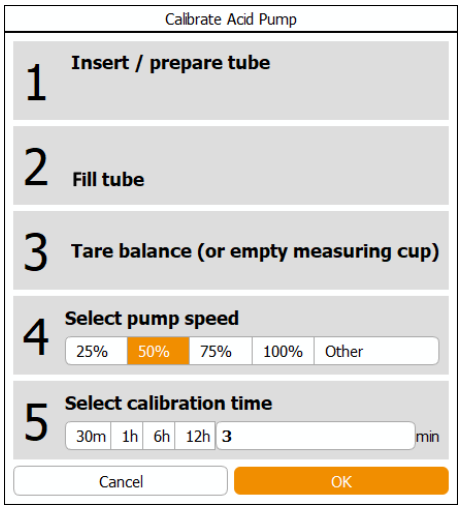
- Execute the calibration before sterilisation in the autoclave.
- Always use similar hoses with the same dimensions for calibrating and conveying the media.
- For calibration, use the same or equally viscous liquid as that used during the cultivation.

Calibrating

To calibrate a pump, e.g. the acid pump (*Acid*), proceed as follows:

Procedure

1. Connect the reagent bottle to the pump.
2. Hang the output side of the hose into the measuring cylinder/beaker or place the reagent bottle on the balance and tare to zero, hang the output side of the hose in the empty vessel.
3. Fill the hose completely.
4. Select bioreactor A from the selection bar.
5. Call up the *Batch* main menu and press **Acid Pump**.



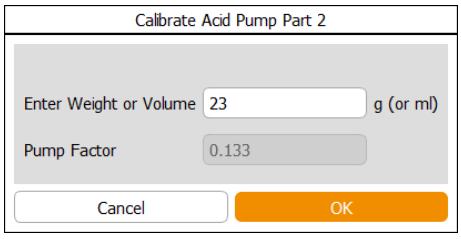
The *Calibrate Acid Pump* dialog box appears and guides you through the calibration step by step.

6. At step 4 (*select the pump speed*) select the pump speed in percent or manually enter a value via the **Other** option.

INFORMATION

or best results, the pump should be calibrated at the speed expected during operation.

7. At step 5 (*select calibration time*) select the calibration time or set it manually.
8. Press **OK**.



Calibration starts. The remaining time (*time left:*….) in h/min/s is displayed next to the **Stop** button that is now available.

As soon as this time has expired, the second dialog box appears (*Calibrate Acid Pump Part 2*).

9. Enter the pumped liquid in mL or g (*Enter Weight or Volume*).

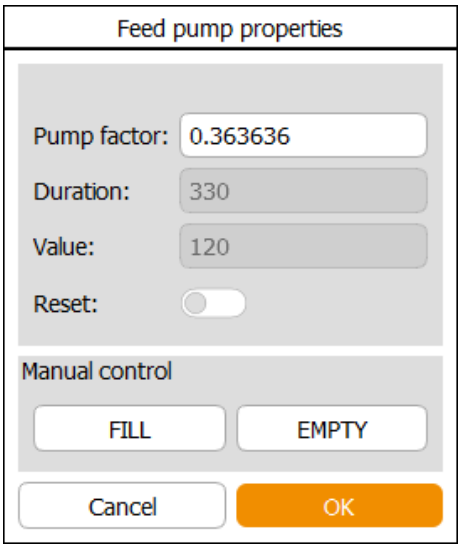
   After entering the pumped quantity, the automatically calculated pump factor is displayed. For a calibrated pump, the pump factor is always ≠ 1.
10. Press **OK**.

    The dialog box disappears; the calibration value is saved. *Completed at* with date and time next to **Stop** shows that the pump has been calibrated as well as when this happened.

8.3 Resetting the Pump Counter to Zero

The number of revolutions (pump not calibrated) or the quantity conveyed in mL (pump calibrated) of the peristaltic pumps are continuously displayed during cultivation. After the end of the process (bioreactor is stopped), this display continues until a new cultivation is started.

The counter can also be reset to zero manually, proceed as follows:



Pressing one of the pump buttons in the *Main* main menu of the selected bioreactor opens the pump dialog box, e.g. of the Feed pump, as shown to the left.
The displayed number of pump revolutions (*Duration*) and the delivered quantity in mL (*Value*) can be reset via *Reset*.

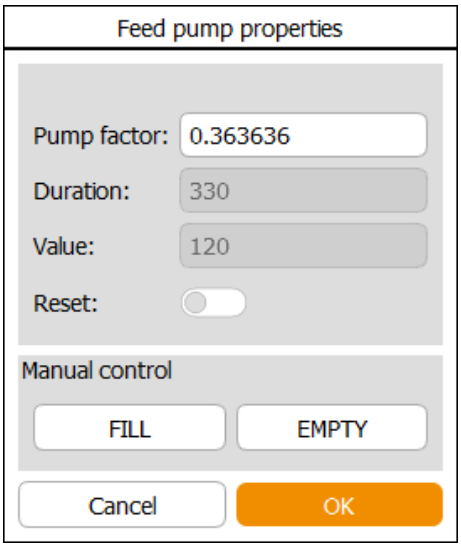
INFORMATION

By manually changing the pump factor (*Pump factor*) the previously performed calibration is discarded. For a calibrated pump, the pump factor is always ≠ 1.

8.4 Filling and Emptying the Pump Hoses

The pump hoses of the standard pumps can be filled and emptied manually individually or all at the same time, time controlled. Both functions are only available when all bioreactors are stopped.

Manual Filling and Emptying



Pressing one of the pump buttons in the *Main* main menu of the selected bioreactor opens the pump dialog box with the **FILL** and **EMPTY** buttons for filling and emptying. The pump runs as long as the corresponding button is pressed.

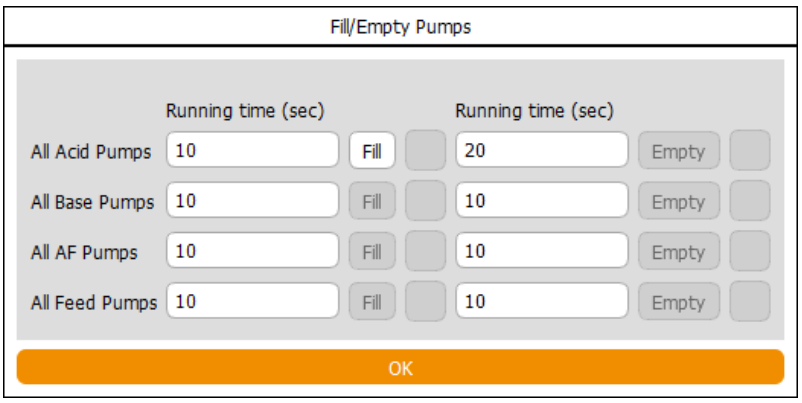
Time Controlled Filling and Emptying

If all (*All*) bioreactors are selected, **Fill/Empty Pumps** in the *Batch* main menu allows automatic, time-controlled filling or emptying of the pump hoses of all standard pumps.

INFORMATION

If only one bioreactor is available, the function is also possible by selecting the bioreactor in the selection bar.

The figure below shows the *Fill/Empty Pumps* dialog box.



The pumps are grouped by function, thus, for example, all acid pump hoses are filled or emptied simultaneously without affecting the base pumps etc. For each pump group, an individual filling/emptying duration in seconds can be defined. The filling or emptying procedure is started via **Fill** and **Empty**. Stop buttons are provided next to each of these buttons for immediately stopping the filling or emptying process.

INFORMATION

If a filling or emptying procedure is active, the remaining filling or emptying duration is displayed. The menu cannot be closed while at least one filling or emptying procedure is active.

Note the following:

- The pump duration of a pump should preferably be tested with the liquid which has the same or similar viscosity as the liquid to be pumped.
- Observe hose lengths and hose sizes of the pumps/pump groups and, if necessary, test the pumping time of each pump/pump group individually, taking into account the condition mentioned above.

9 Cultivation (Bioreactor) Starting and Stopping

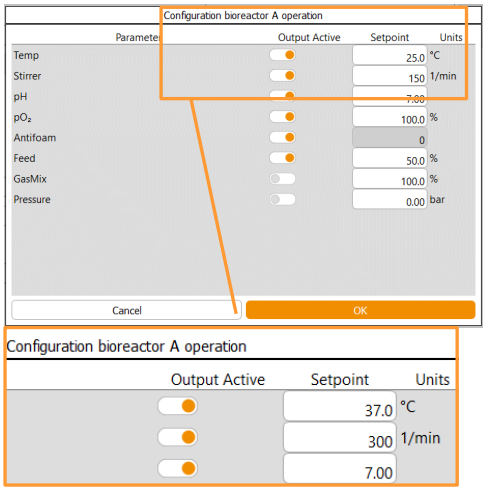
9.1 Starting

To start one bioreactor (= 1 culture vessel) or all available bioreactors, proceed as follows:

Procedure

1. Select the desired bioreactor, e.g. bioreactor *A* (icon to the left) left) or *All* bioreactors (icon to the right) from the selection bar.

2. In the *Batch* main menu, press **Start** or **Start All**.



The configuration dialog box of the selected bioreactor (figure to the left) or of all bioreactors appears containing more or less controlled parameters, depending on the device configuration.
Setpoint settings of the previous cultivation are visible here.

INFORMATION

The cultivation (bioreactor) is always started with the settings in the configuration dialog box. Changes to these settings are saved and transferred to the next configuration dialog. Changes of parameter settings during the running process are only applied to the current cultivation.

3. Make settings as necessary and press **OK**.

   The cultivation i.e. the bioreactor(s) is/are started. That and how long a process is running is indicated by *in progress since* with running time in h/min/s in the *Batch* main menu.

- The actual values and control outputs of the parameters are visible in the *Controller* main menu.
- A record of actual values and a display as a diagram are available in the *Trends* main menu.

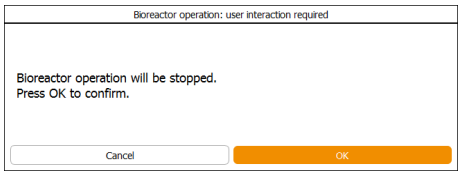
9.2 Stopping

To stop one running bioreactor (= 1 culture vessel) or all bioreactors, proceed as follows:

Procedure

1. Select the desired bioreactor, e.g. bioreactor *A* (icon to the left) left) or *All* bioreactors (icon to the right) from the selection bar.

2. In the *Batch* main menu, press **Stop** or **Stop All**.



The dialog box for confirming the cultivation stop of one bioreactor (figure to the left) or all bioreactors appears.

3. Press **OK**.

The bioreactor(s) is/are stopped. *Stopped after* with display of d/h/min/s below **Start** in main menu *Batch* of each stopped bioreactor indicates after how much running time the bioreactor was stopped.

4. If necessary, shut down the system via **Shutdown** in main menu *System* and switch off the device(s) at the power switch (see separate operating manual for the device).