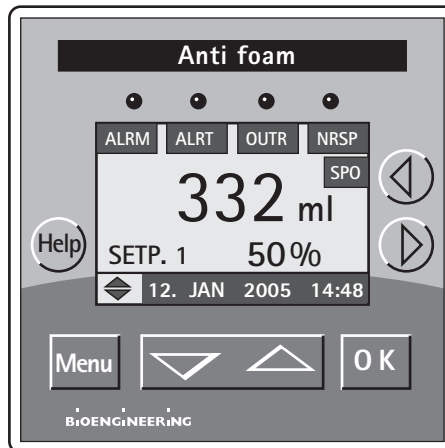


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The Intelligent Front Module is a controller which can be used for measuring and controlling a variety of physical quantities. It consists of two parts, the display module and the IFM module. The desired function is configured in the menu. The controller can be used for proportional as well as limiting value controls.

All settings are entered with the pushbuttons and shown on the display. Calibration and parameter adjustments are performed in the corresponding menus.

It is mandatory to get familiar with the safety section on page 3 and to read carefully all warning instructions in order to avoid damages and malfunctions.

The IFM controller is to be operated only by trained personnel well acquainted with this operation manual.

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1 Safety instructions

The instructions listed below contribute to the safety of the user.

To secure safe operation, follow the safety instructions and read this manual carefully.

Non-observance of these warning instructions can lead to malfunctions and defects of the device.

Caution! These notes help you to operate the universal controller properly and to fully use its possibilities.

Note! The electrical wiring must be connected by a licensed electrician.

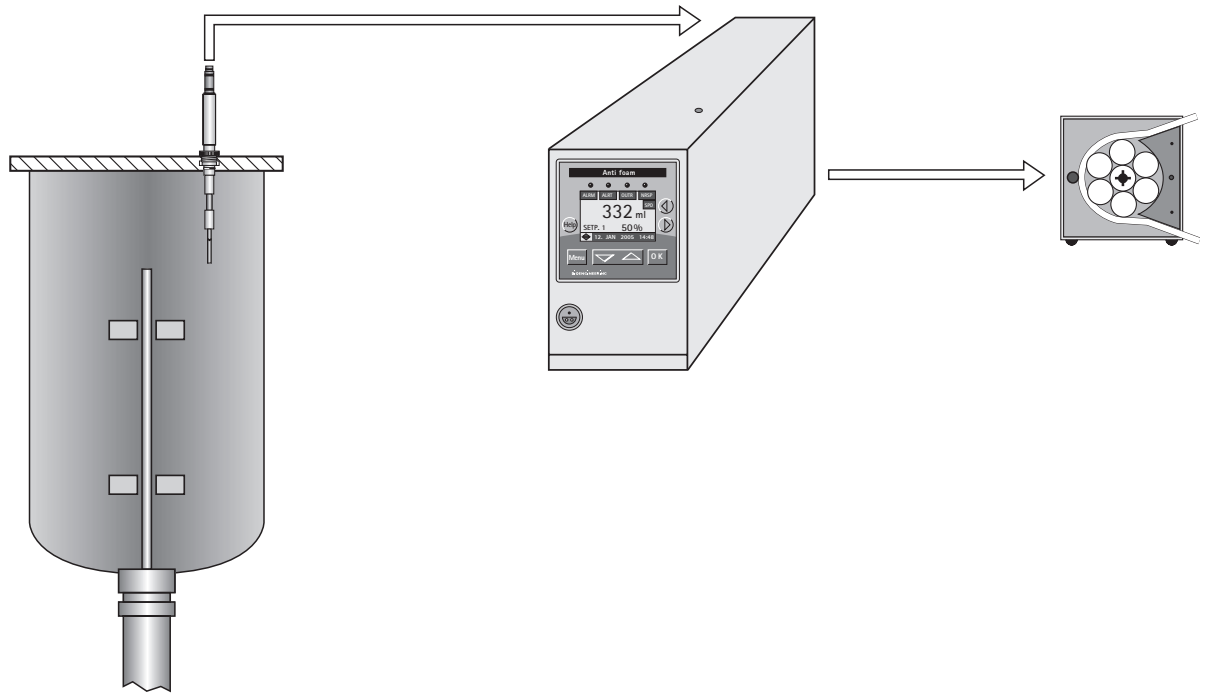
The power supply voltage must correspond to the voltage displayed on the rating plate.

The IFM may be operated only by trained personnel familiar with the operation manual and the safety instructions. If the control cabinet is opened or the IFM is removed, parts which may carry dangerous high voltage are exposed. Exercise caution not to contact exposed metal parts during installation, interconnection or maintenance. Maintenance and other operations may only be performed by trained and qualified personnel familiar with the operation manual and the safety instructions.

1.1 Safe and correct use

The IFM controller may be used only for products listed in this manual and in the component file, or in connection with devices and components, which are checked resp. approved by Bioengineering AG for their compatibility. It may only be installed as stated the operation manual or according to the recommendation of Bioengineering AG.

2 General



The antifoam control is achieved by a specially configured IFM universal controller. Besides standard setpoint control the IFM controller features a variety of functions in this standard configuration:

- control modes such as setpoint, profile, cascade control
- manual activation of control elements including limitation of max/min output during control mode
- trend graph and monitoring of consumption
- alarm features
- password protection of settings

Measurement of the foam level is performed by an antifoam probe connected to the antifoam controller.

To control the foam chemical antifoam agents are necessary. Therefore the antifoam controller has one ON/OFF output to control a peristaltic pump to dose the chemical antifoam agent. Alternatively a foam kill motor can be used to control the foam (NLF, LP, Pilot).

The complete parameter description is included in the manual of the universal controller. The most important functions for the operation of the antifoam controller are described in detail in this manual.

Note! The antifoam-controller does not require all possible functions of the universal controller. Chapter 8 describes which functions are not valid and therefore show no effect when being altered, and which functions were set by Bioengineering and should not be altered for proper use.

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Note! The setpoint is defined in % output value. The on/off pump is active during the programmed setpoint % of the cycle time.

As example:

A 20% set point value with 10sec cycle time gives in 2sec pump time and a 8sec pause. The cycle time and slew rate are defined in the function menu OUTPUT1.

The measuring value is initially displayed in minutes of pump run-time and can be changed to a display of the volume of the antifoam agent consumed in the function menu CONSUMPTION 1.

Note! The IFM antifoam-controller is not a PID controller. This type of control is indicated by the SPO (= SetPoint equals Output) sign in the upper right corner of the information window.

3 Scope of delivery

- Autoclavable or sterilizable antifoam probe
- Electronic measuring and control unit
- Connecting cables

4 Electronic measurement and control unit and probes

The electronic measurement and control unit is incorporated in a standard 19" component module and is suitable for separate mounting or integration in a standard 19" cabinet.

The Bioengineering foam sensor is adjustable in height and connected to the control unit.

Special design features ensure that the sensor operates trouble-free, even under the conditions of extreme humidity prevailing in the fermenter.

Perfectly satisfactory results are obtained with this standard system in most processes. We recommend the use of the admittance system for cultures which are inclined to pronounced surface and wall growth.

If chemical antifoam agents should be avoided, optionally a mechanical foam-kill system is available additionally to or instead of the chemical system.

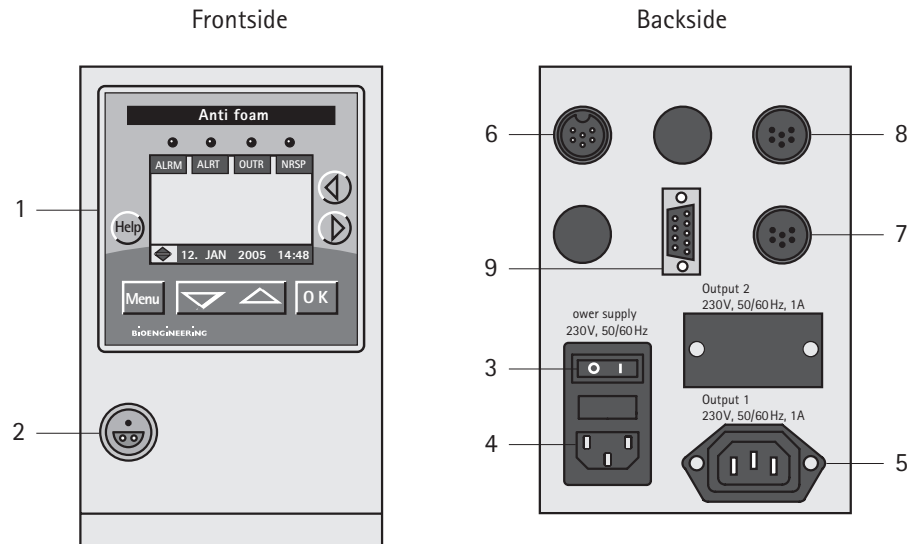
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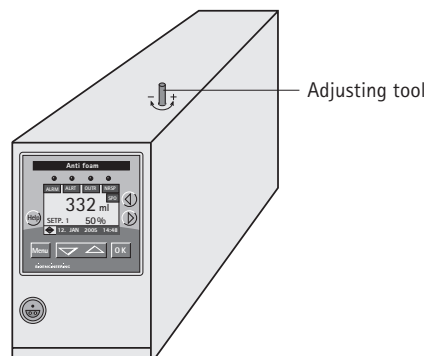
4.1 Electronic measurement and control unit



- 1 IFM display modul
- 2 Connector for antifoam probe
- 3 I/O switch
- 4 Main power supply 100-240V, 50/60 Hz, fuses 1,6 A
- 5 Dose pump or power supply, max. 1 A, 230V (110V)
- 6 DIN-input/output socket for the current signals measured value and external set point for communication with computer-controlled measuring data acquisition and process control system.
- 7 Controller output 4-20 mA for pumps
- 8 Controller output 4-20 mA for valves or pumps
- 9 Connector for Profibus (option)

4.2 Adjusting the probe's response sensitivity

Pull the Anti Foam control unit out of the cabinet. On the top of the unit there is a hole for the adjusting tool. By turning this key counterclockwise the response sensitivity is increased, turning it clockwise will reduce the sensitivity (see the picture below).



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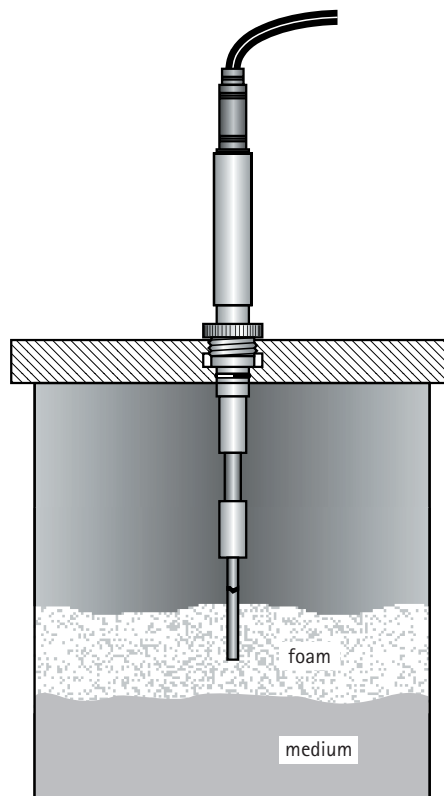
4.3 Probes

Antifoam probes can be in-situ sterilizable or autoclavable, depending on the fermenter set-up. Antifoam probes operate on the principle of conductive boundary status detection. The bottom of the fermenter and the probe form two electrodes, between which a small A.C. voltage exists. As soon as the conductive foam touches the tip of the probe, a small current flows and causes a relay to respond via an amplifier circuit.

This system produces ideal results even with cultures which have a pronounced tendency towards surface and wall growth. Special design and measuring techniques were used to produce a foam detection device which operates faultlessly even with a sensor which is overgrown by a conductive coating.

Note! The probe does not work properly in deionized water.

Note! The function of the probe can only be tested when it is installed in the fermenter.



4.4 Technical data

Antifoam-transmitter

Sensitivity

≤ 0.1 pF

Response time

approx. 0.2 sec.

Probes

See data sheet





5 Start-up, operation and antifoam agents

5.1 Start-up

- Check for transport or storage damages
- Mount probe onto the fermenter lid.
- Connect probe cable to the controller and probe
- Switch on controller with I/O switch on the backside.
- Check if the pump for the antifoam agent is connected on the backside of the controller.
- Sterilization: Sterilizable probes are sterilized in situ with the filled fermenter.
- Autoclaving: Autoclavable probes are sterilized with the filled fermenter in an autoclave.
 Therefore the cable is removed from the probe.

Note! Always make sure that the probe is clean before starting the sterilization. Overgrowth of the probe can simulate constant foam contact. This would lead to continuous dosage of antifoam agent.

5.2 Operation:

- Connect sterile antifoam agent to the fermenter.
- Ensure that the antifoam agent is installed correctly to be dosed to the fermentation broth and check pump direction or pressurization of feed vessels.
- Check if the settings of the controller are correct.
- Select desired operation mode (Information window   Information line control mode
 Set control mode with  .

5.3 Antifoam agents

Often used antifoam agents are:

- Polyethylene glycol PEG 200-2000 (especially PEG-1000)
- Antifoam B (based on silicon oil): dilute 1:2
- Antifoam emulsion SI-B (based on silicon oil)
- Propylene glycol 2020
- Pluronic F-68: suitable for mammalian or insect cell cultures

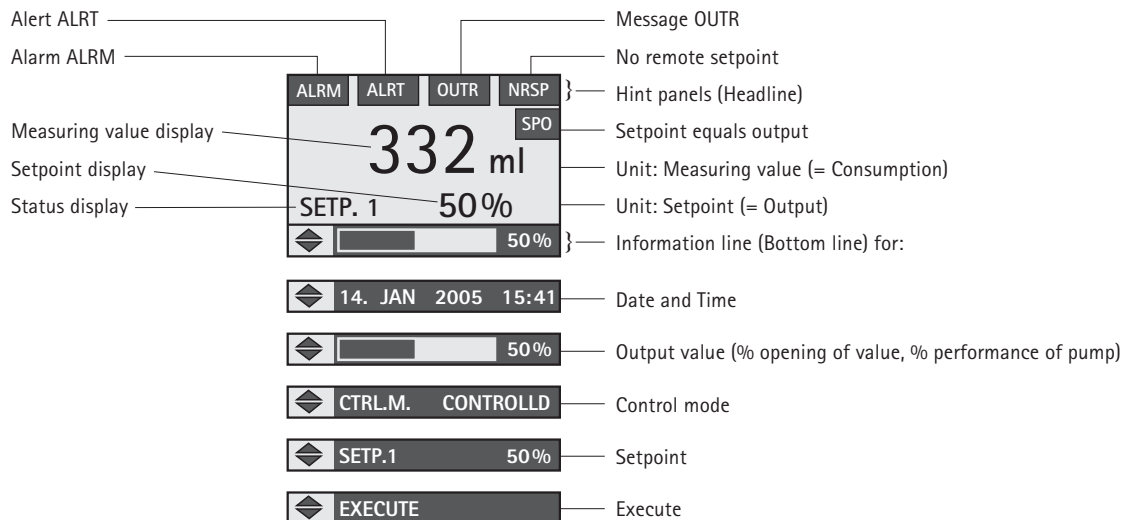
It is recommended to add a little antifoam agent (e.g. 1 ml/l) to the fermentation broth before sterilization to avoid foaming during heating.

All antifoam agents can be autoclaved in concentrated form. During autoclaving the antifoam emulsion could break. Therefore it is recommended to insert a magnetic stirrer before autoclaving to dissolve precipitates by vigorous stirring if necessary. Sterilized antifoam agent can be stored at room temperature.

Note! Antifoam agents may have a negative effect in down-stream processes.

6 Important control functions


Information window:




Note! The control functions important for antifoam-control are explained in detail in this chapter. Functions set by Bioengineering, which should not be altered and functions not valid for antifoam control are indicated in chapter 8. All functions of the controller are listed in the manual of the universal controller.

6.1 Selection of control mode

The control mode is changed in the information window:

Select the information line Control mode in the information window with .

Select the desired control mode with .

Control modes are:

OFF: The control is de-activated. In the OFF mode the NRSP lamp is illuminated. The Remote setpoint is not valid.

MANUAL: The % output of the controller is entered on the display. The output 0-100% means the pump/valve setting from minimum to the maximum (100%). When the control mode MANUAL is selected the output of the controller can be adjusted in the information line Output.

CONTR.: Setpoint control is selected. The display shows Setp. 1 if internal setpoint is selected, Setp. 2 if an external setpoint is selected (via PLC), or REMOTE if a remote setpoint is selected (via software).

PROFILE: A predefined profile is activated. For the programming of the profile see chapter 6.4.

STERILIZE: Controller switches to control mode STERILIZE. This mode opens the pump/valve outputs. It is used only for specially defined applications.

Note! If the operation modes CONTROLLED or PROFILE are selected, they will only be active when the probe is in contact with the foam. When the probe is not in contact with the foam, in the status display EXT.OFF is displayed.

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6.2 Setpoint adjustment and measuring value

The setpoint is displayed in the information window as % output of the controller. This means, with the setpoint the output and therefore the pumping capacity is selected between 0 and 100%: an on/off pump is delivered as standard 0 and 100% output signals correspond to the calculation of cycle times.

To alter a setpoint the information line Setpoint is selected with   in the information window. With   the desired output is chosen and it is confirmed with . The measuring value is initially displayed in minutes of pump or valve activation. To obtain a volume display of antifoam agent dosed, the volume must be calibrated in the function menu consumption 1 (see chapter 6.6).






6.3 Manual mode: Filling of the transfer lines

The MANUAL control mode is selected as described in chapter 6.1. To fill the antifoam transfer lines select positive % output value. Put the output of the controller to 0 when the line is full, but before the antifoam agent is inserted into the vessel.

6.4 Profile mode

The profile function is especially useful for the antifoam control, because the dosage of the antifoam agent can be delayed and/or adjusted with the profile function.

To save chemicals the dosage can be delayed for e.g. 1 min after the first contact of foam before dosage of the antifoam agent starts. If there is still foaming after 1 min, more and more antifoam agent is dosed dependent on the time the foaming lasts. This ensures that the dosage is adjusted to the intensity of the foaming and no chemicals are wasted during short-time foaming which subsides without addition of chemicals. At the beginning of each contact of the probe with foam the profile is started new.

To program a profile enter the group menu PARA by pressing  and then select PARA with   and confirm with . Then select PROFILE by pressing . With the duration the period of time is defined within which the setpoint (End val.) is reached. If the setpoint should be maintained, another step with the same setpoint and a later duration must be defined.

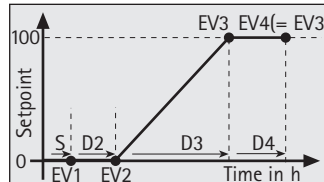
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The given example is programmed by setting SLOPE, END VAL 1 and END VAL 2 to 0 and DURATION 2 to 0.017 h. END VAL3 is set to the desired setpoint (e.g. 100%). The time within the END VAL 3 is reached (e. g. 1 h), is defined by setting the DURATION 3 (see also figure).



The functions are as follows:

SLOPE: Slope (S) is the calculated slope with which the first setpoint (end value 1) is reached (in hours).

If the value is set to zero, end value is reached as fast as possible. The slope can be rising or falling.

END VAL. 1: Setpoint (EV 1) for the first step

DURATION 2: Duration (D2) of the second step (in hours)

END VAL. 2: Setpoint (EV 2) for the second step

Ten steps can be entered. If a step has the duration 0, the program stops and the last setpoint is kept.

DURAT. 10: Duration of the tenth step (in hours).

END VAL. 10: Setpoint for the tenth step.

6.5 Control Behavior

In the group menu **PARA** choose function menu CONTR PAR and select BEHAVIOR.

BEHAVIOR: (Protected with password 1): This function defines the behavior of the controller when it is switched from manual to controlled mode.

CLOSE OUT: The output starts at 0% before the PID calculations are initiated.

Thus the acid and the base pump are deactivated during the switch over before starting the control.

KEEP OUT: The acid and base pumps change continuously (shock-free) from the present value into the new entity.

6.6 Consumption

The antifoam-controller enables the monitoring of antifoam agent consumption.

In the function menu CONSUMPT.1 the consumption of antifoam agent is displayed and can be calibrated.

To enter the function menu enter the group menu STAT by pressing **Menu** and then select STAT with **◀ ▶** and confirm with **OK**. Then select CONSUMPT. 1 by pressing **OK**.

For the viewing of the consumption of antifoam agent CONS. TOT is selected in the function menu CONSUMPT. 1. The total consumption is displayed in ml or l (as chosen in UNITS), only if the parameter CONS./M. was set correctly.

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In the function RESET the consumption is set to zero with **OK** when the RES. MODE is set to MANUAL.

The reset mode is selected in RES. MODE (Protected with password 1): LOCKED: the consumption cannot be reset; MANUAL: the consumption is set to zero with reset; or AUTO: The consumption is set to zero every time the controller is switched on.

Initially the consumption values are set to minutes of dosing times of the pump. To obtain actual volumes of antifoam agent two steps are necessary:

– External calibration of the pump:

The volume of liquid delivered by the pump per minute at 100% output (e.g. set in the manual mode) is determined with a measuring cylinder and a watch or other suitable equipment.

– Setting of the following parameters (protected by password 1) in the function menu CONSUMPT. 1:

FORMAT: The format of the consumption is defined as places before and after the comma (e.g. XXX.X).

UNITS: The unit for the consumption is selected.

CONS./M: Since the calculation of the consumption is based on the measurement of time, the exact consumption in the respective output (which has been calibrated as described above) per minute at 100% pump capacity must be inserted.

MIN. VALUE: A minimum volume (or whatever was selected in UNITS) of antifoam agent in the feed bottle or tank is defined (usually 0).

MAX. VALUE: A maximum volume (or whatever was selected in UNITS) of antifoam agent in the feed bottle or tank is defined. (usually filling level of antifoam agent).

Note! With the last two functions also the alarm values are defined.

6.7 Trend graph

The IFM-controller enables the monitoring of the parameter values over a defined period of time (trend).

The trend graph is displayed when **OK** is pressed in the information window. To return to the information window **OK** is pressed.

To select the duration of the trend graph enter the group menu STAT by pressing **Menu** and then select STAT with **◀ ▶** and confirm with **OK**. Then select TREND CONF by pressing **OK**. The length of the trend graph can now be altered.

6.8 Setting of alarms

High and low alarms can be set. Their display and possible causes are described in chapter 8.

Note! Alarms are only active in the control modes CONTROLLED and PROFILE.

Note! For the alarms the consumption of the antifoam agent is selected.

Therefore the settings in the function menu consumpt 1 must also be considered when setting the alarms.

LOW ALARM: Defines the lower alarm limit (normally not used for antifoam control).

L. A. OOTP (Low alarm output):

OFF: The low alarm is switched off.

NO OUTPUT: No external signal is generated

ALARM 1*: External signal option 1 is selected (e.g. lamp)

ALARM 2*: External signal option 2 is selected (e.g. acoustic sound)

ALARM 1 + 2*: Both external signal options are selected.

* The lamp ALRM at the display module is always illuminated when an alarm is active, regardless of the settings of external alarm signals. External signal options are not included in the supply as standard.

HIGH ALARM: Defines the upper alarm limit in the units set in CONSUMPT 1

(e.g. is set to give alarm before the feed-bottle/tank is empty).

H. A. OOTP (High alarm output): Same as L. A. OOTP.

DEV. ALARM: Defines the deviation alarm limit (normally not used for antifoam control).

D. A. OOTP (Deviation alarm output) used to switch alarm on and off: As L. A. OOTP.

ALARM 1: Direct/Reverse

ALARM 2: Direct/Reverse

6.9 Password Setting

Some function menus such as CALIB MEAS and some functions such as behavior are password protected.

To activate or change the password, enter group menu **OPTI** and select the function menu **PASSWORD**.

Menu **PASSWORD**





ACTIVATE: If the password is entered, it stays active for further operations (with temporal limitation).

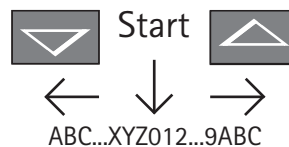
DEACTIVATE: The entered password is deactivated and must be entered again for operations requiring the password.

CHANGE PW: To change password 1 the following steps have to be performed:

1. CHANGE PW: **OK**.

2. ENTER THE PASSWORD:





Enter the old password (six-digit figure; always 000000 before first change) with   and   (numbers and letters can be entered) and confirm with **OK**.



THE PASSWORD HAS BEEN ACCEPTED: Confirm with **.** If the wrong password has been entered the following message appears: THE PASSWORD IS NOT ACCEPTED PRESS MENU TO ABORT.

The function is aborted with **Menu**.

3. ENTER THE NEW PASSWORD: Enter the new password with   and   and confirm with **OK**.

4. ENTER THE NEW PASSWORD AGAIN: Enter the new password again with   and   and confirm with **OK**.

THE NEW PASSWORD HAS BEEN STORED: The new password is now active.

5. Confirm with **OK**. If an error has occurred during the confirmation of the password the following message appears: THE PASSWORD IS NOT ACCEPTED PRESS MENU TO ABORT.

The function is aborted with **Menu**.

Caution! In the group menus protected with password 2 parameters essential for the basic functions of the controller are defined. These parameters should not be changed on any account. Therefore password 2 can only be ordered by contacting Bioengineering AG.

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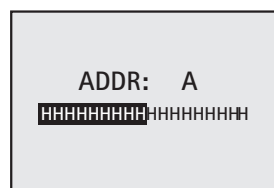
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6.10 Date and Time Setting (password 1 protected)


Enter group menu OPTI and select function menu DATE+TIME.

SUMMERTIME: To select (+ 1 HOUR) or deactivate (OFF) summertime.**DATE FORM:** Defines date display (DD.MMM or MMM.DD).**SECONDS, MINUTES, DAY, MONTH, YEAR:** Time and date are set.**ADJ. CLOCK:** Running errors of the clock since initialization are compensated.**INIT CLOCK:** Initializes the clock at first adjustment.**SOFTW. DATE:** Software version**6.11 Start-up and Power-Failure****PWRON-MODE:** (Protected by password 1): Defines settings of the control mode after start-up or power-failure:**OFF:** The controller is switched off.**MANUAL:** Manual mode is started.**CONTROLLED:** Controlled mode is started.**PROFILE:** The profile program is started.**CASCADE:** This control mode is inactive for antifoam control and should therefore not be selected.**LATEST:** The control mode selected before the start-up or power-failure are started.

Note! If external control via software is used, all remote setpoints are active after failure of the computer. If the start-up of the computer fails and local control is required, it is recommended to switch off the interface or deactivate the external control by setting AUTO RSP in the function menu CONTROL PAR to OFF.

6.12 Control service hoursThe running time of the controller is displayed in group menu **STAT**, function menu VARIOUS.**6.13 Contrast Setting on the Display**To set the contrast on the display **Menu** is pressed while the controller is switched off and on with the I/O switch on the backside. The following display appears:The contrast is altered with   until everything on the display is clearly visible.To get back to the information window press **OK**.

Caution! Please make sure that at the end of this procedure the address is set to ADDR: A.

Otherwise the menu of the controller will not be loaded. If necessary the address is set back to A with  .

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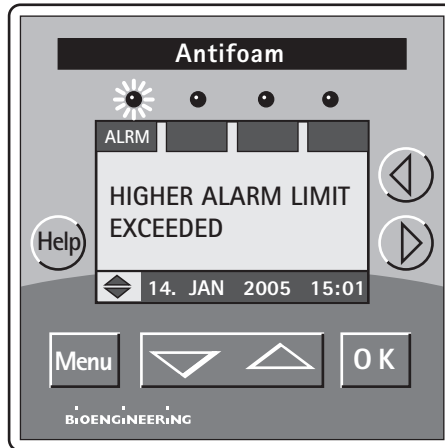
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7 Alarms and trouble shooting

7.1 Alarms



ALARM Description	Possible Cause	Action
HIGHER ALARM LIMIT EXCEEDED The high alarm limit predefined in the function menu ALARMS has been exceeded. When all settings are correct, the storage bottle is nearly empty.	Alarm setting and consumption setting do not correspond	Check settings
	Storage bottle/feed vessel of anti-foam agent is (nearly) empty	Refill bottle
	Probe sends constant signal to controller	Check if probe is overgrown or check level of probe.
	More foam is formed than can be destroyed	Change antifoam agent or if a profile is used change the settings of the profile, decrease the level of the medium or enhance pump capacity by: <ul style="list-style-type: none"> a) increasing the setpoint, b) using tubes with bigger diameters, c) using a pump with a higher capacity

Alarms are displayed by the corresponding line on the display and by a flashing LED lamp.

The alarms are confirmed with **OK**.

If the problem is eliminated simultaneously the LED lamp is extinguished. If the alarm is only acknowledged but the corresponding problem is not eliminated the LED lamp stops blinking and glows continuously.

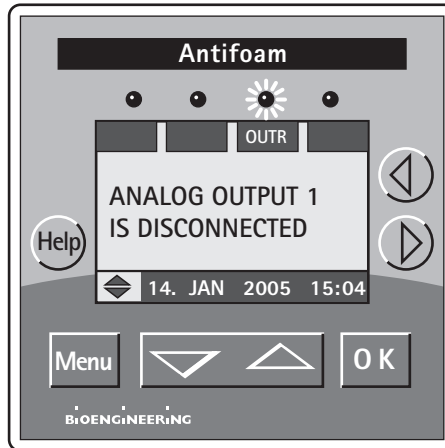
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7.2 Messages



Message	Possible Cause	Action
ANALOG OUTPUT 1 IS DISCONNECTED	Pump/valve is not connected	Check connection of pump
PULSE OUTPUT 1 HAS SHORT CIRCUIT	Pulse output 1 has a short circuit	Check wiring
ALARM OUTPUT HAS SHORT CIRCUIT	Alarm output has a short circuit	Check wiring

Messages are displayed by the corresponding line on the display and by a flashing LED lamp.

The alarms are confirmed with **OK**.

If the problem is eliminated simultaneously the LED lamp is extinguished. If the alarm is only acknowledged but the corresponding problem is not eliminated the LED lamp stops blinking and glows continuously.

8 Non-valid and pre-set functions

Note! This chapter describes which functions are not valid and therefore show no effect when being altered (marked with: "Not valid for antifoam control") and which functions were set by Bioengineering (marked with: "Set by Bioengineering").

Group menu **PARA**

Function menu CONTRL PAR

TEMP. COMP.: Not valid for antifoam-control.

MAN. T. COMP: Not valid for antifoam -control

AUTO RSP: Set by Bioengineering

Function menu STERIL PAR

Set by Bioengineering

Function menu CASC. INP

Not valid for antifoam-control.

Function menu PID PARAMS

Not valid for antifoam-control.

Function menu CONTR. SET

Set by Bioengineering

Function menu INPUT PAR

Set by Bioengineering

Function menu OUTPUT PAR

Set by Bioengineering.

Function menu OUTPUT 1

Set by Bioengineering.

Function menu KOBIO 1

Not valid for antifoam-control.

Function menu OUTPUT 2

Not valid for antifoam-control.

Function menu KOBIO 2

Not valid for antifoam-control

Group menu **STAT**

Function menu CONSUMPT. 2

Not valid for antifoam-control.

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Group menu **CALI**

Function menu CALIB. MEAS.

Set by Bioengineering

Function menu CALIB. RSP

Set by Bioengineering

Function menu CALIB. CASC

Set by Bioengineering

Function menu PREV. CALIB

Displays the offset and the slope of the three calibrations (has only display function and cannot be adjusted).

Group menu **OPTI**

Function menu CONFIGUR.

Set by Bioengineering

Function menu SETTINGS

Set by Bioengineering