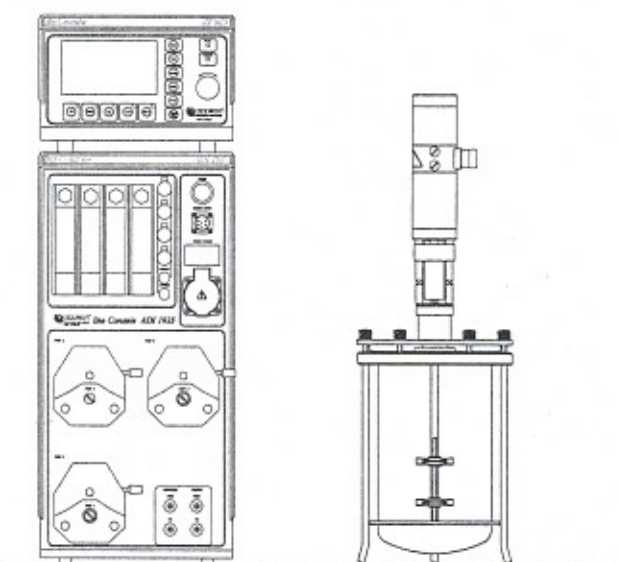




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# Bio Bundles 1 - 15 Liter (US Version)

## for Microbial Applications



HARDWARE & INSTALLATION MANUAL

April 2004

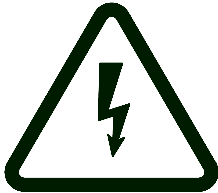
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## SYMBOLS

The following symbols are used on the equipment and in this manual:



Warning; refer to this manual.



Caution; electrical shock hazard.



Important note; read the instructions carefully.

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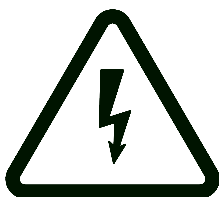
## SAFETY CLASS I EQUIPMENT



This set of equipment has been designed in accordance with IEC1010-1 "Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use", and has been supplied in a safe condition. The Hardware & Installation manual contains information and warnings which have to be followed by the user to ensure safe operation and to retain the equipment in safe condition.

Before switching the equipment on, make sure that it is set to the line voltage.

This equipment is designed for bio-process control; it must not be used for other purposes!



**Caution:**

Any interruption of the protective conductor inside or outside the apparatus or disconnection of the protective conductor terminal will make the apparatus dangerous. Intentional interruption is prohibited.

Capacitors inside the apparatus may still be charged, even if the apparatus has been disconnected from all voltage sources.

Any adjustment, maintenance and repair of the opened apparatus under voltage shall be avoided as far as possible and, if inevitable, must only be carried out by qualified personnel.

Make sure that only fuses with the required rated current and of the specified type (IEC 127) are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders are prohibited.

## EU DECLARATION OF CONFORMITY



The company Applikon Dependable Instruments B.V., Schiedam, The Netherlands, hereby certifies that the following set of instruments:

**ADI 1010 BIO CONTROLLER,  
ADI 1025 BIO CONSOLE and  
ADI 1032 STIRRER CONTROLLER**

meets the requirements of the EU Directives 89/336/EEC (Electromagnetic Compatibility) and 73/23/EEC (Low Voltage).

### SOURCE OF THE SPECIFICATIONS:

89/336/EEC:	EN 50081-1 (1992) EMC Generic emission standard. Residential, commercial and light industry. EN 61000-3-2 (1995) EMC Limits for harmonic current emissions (equipment input current $\leq$ 16A per phase). EN 61000-3-3 (1995) EMC Limits concerning voltage fluctuations and flicker for equipment having an input current up to and including 16 A per phase. EN 50082-1 (1992) EMC Generic immunity standard. Residential, commercial and light industry. EN 50082-2 (1995) EMC Generic immunity standard. Industrial environment (including table A.4).
73/23/EEC	EN 61010 Safety requirements for electrical equipment for measurement, control and laboratory use.

ing J. van Burg, President.

September 25<sup>th</sup> 2000

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# CHAPTER 1

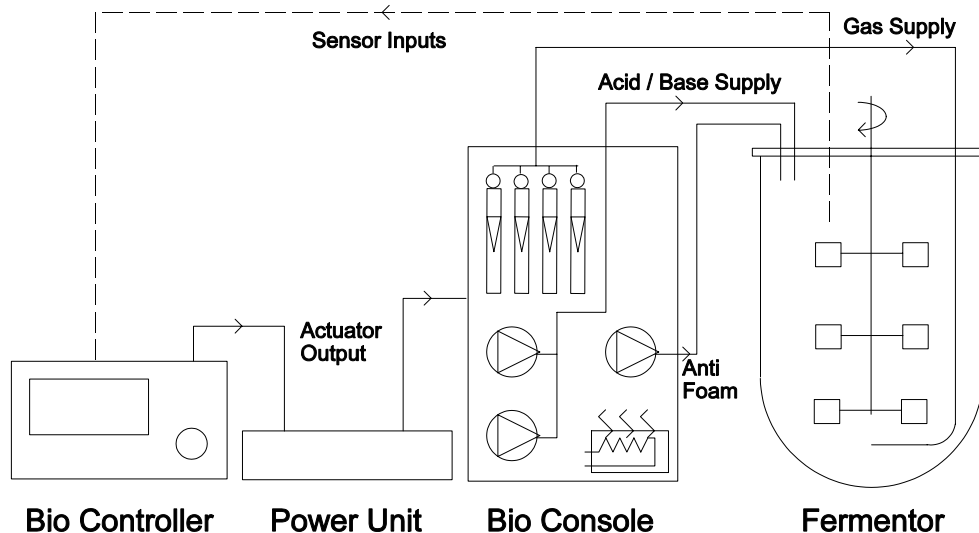
## GENERAL

### 1 GENERAL INTRODUCTION:

The ADI Bio Bundles (1 - 15 liter; US Version) basically consist of the following parts:

- an autoclavable bioreactor with the appropriate auxiliaries like a stirrer assembly, baffles, an aeration assembly, etc.
- an ADI 1010 Bio Controller together with an ADI 1010 Power Unit.  
The Bio Controller measures process variables (pH, Temperature, dO<sub>2</sub>, level and stirrer speed) and calculates corresponding controller outputs in order to keep process conditions on set point.  
The Power Unit amplifies the control signals of the Bio Controller to Power Outputs (on/off output signals for pumps and valves, analog output signals for mass flow controllers and stirrer speed).
- an ADI 1025 Bio Console that combines and supports actuators like pumps and valves in order to optimize the use of limited bench-space.

Schematic overview of a Bio Bundle lay-out:

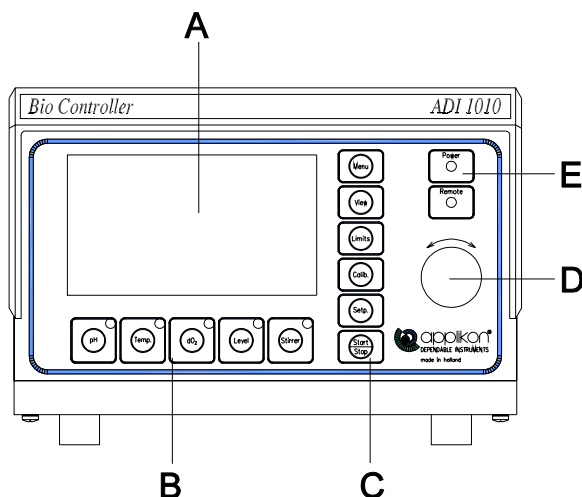


Note:

The ADI 1010 Power Unit is mounted inside the ADI 1025 Bio Console (at the rear).

## 1.1 BIO CONTROLLER FRONT & REAR VIEW:

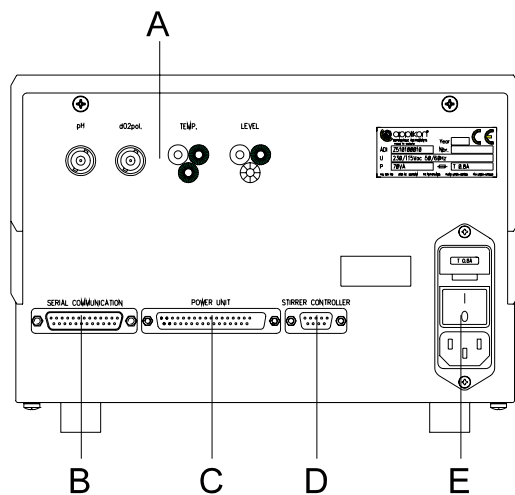
The front view of the Bio Controller shows the graphical display, parameter & function keys, a digital potentiometer (dial) and indicators:



Where:

- A = graphical display,
- B = parameter selection keys,
- C = function keys (for operation),
- D = digital potentiometer (dial),
- E = indicators (power-on and remote operation).

At the rear of the Bio Controller connections can be found for sensors, serial communication, I/O and mains:



Where:

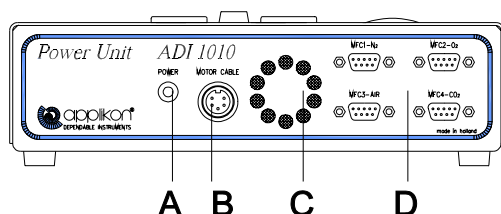
- A = sensor connections,
- B = cable connection for serial communication (SCADA system),
- C = I/O cable connection, to Power Unit,
- D = I/O cable connection, to external Stirrer Controller ADI 1032\*,
- E = mains entry with power switch and fuse holder.

\* Only the 15 Liter Bio Bundle (Microbial Application) is equipped with an External Stirrer Speed Controller; the other versions of the Bio Bundles come with an Internal Stirrer Controller in the ADI 1010 Power Unit (mounted inside the ADI 1025 Actuator Console).



## 1.2 POWER UNIT FRONT, REAR & TOP VIEW:

At the front of the ADI 1010 Power Unit connections for the stirrer motor and mass flow controllers are located:

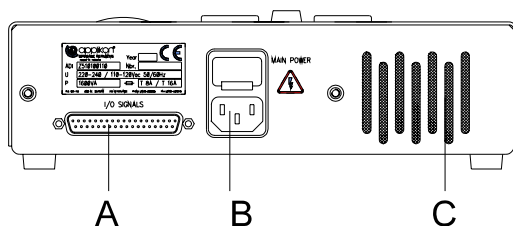


Where:

A = indicator for power-on,  
 B = connector for cable to stirrer motor P100 / P140\*,  
 C = holes for vent purposes,  
 D = cable connections for mass flow controllers.

\* In case stirrer speed control is performed by an external Stirrer Controller ADI 1032, this connector is not in use.

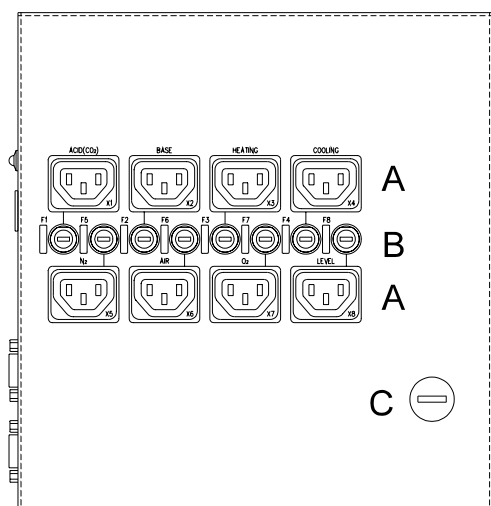
At the rear of the ADI 1010 Power Unit the I/O and mains connector can be found:



Where:

A = I/O cable connection with the ADI 1010 Bio Controller,  
 B = mains entry and fuse holder,  
 C = slots for vent purposes.

At the top of the ADI 1010 Power Unit the digital (on/off) actuator output connections and related fuse holders can be found:

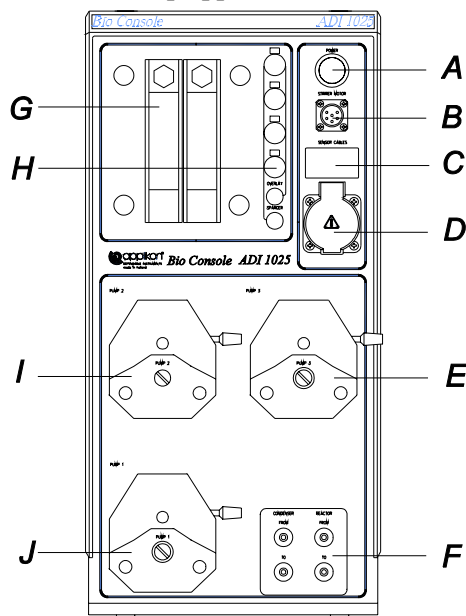


Where:

A = Euro Outlets for actuators (pumps, rotameter valves and switches for heating and cooling),  
 B = fuse holders (per actuator outlet),  
 C = covered hole for optional actuator connection at TTL level.

### 1.3 BIO CONSOLE FRONT & REAR VIEW:

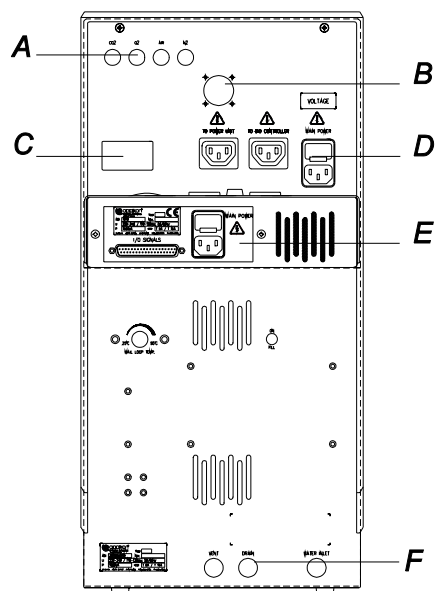
The ADI 1025 Bio Console is used to support actuator hardware for control in bioprocesses (bench-top applications). Its front view is presented below:



Where:

- A = main power switch
- B = motor cable connector
- C = sensor cable tunnel
- D = supply for heating blanket
- E = tubing pump (anti-foam)
- F = Cold Water Valve connections (to / from reactor / condenser)
- G = rotameters
- H = gas selection block (sparging/overlay)
- I = tubing pump (base)
- J = tubing pump (acid)

The rear view of the ADI 1025 Bio Console is presented below:



Where:

- A = gas inlets (to rotameters),
- B = blinded hole for applications with In Situ sterilizable reactors,
- C = sensor cable tunnel,
- D = mains section (euro inlet + fuse holder for Bio Console, two euro outlets for resp. Bio Controller and Power Unit),
- E = Power Unit, mounted inside the Bio Console,
- F = hydraulic bulkhead connectors (water inlet, and drain) for the Cold Water Valve.

## 1.4 INTERNAL OR EXTERNAL STIRRER CONTROL:

Depending on the reactor volume (required power of the stirrer motor), an internal or external stirrer controller is applied.

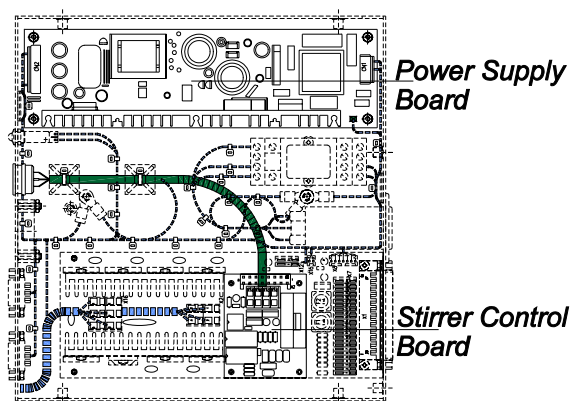
The table below shows the standard combinations of reactor volume and stirrer configuration:

Reactor volume (L)	Stirrer motor type	Type of stirrer control	Stirrer Speed Range (rpm)
1, 3	P100	Internal	0 - 1250
7	P140	Internal	0 - 1400
15	P1000	External	0 -1000

### INTERNAL STIRRER CONTROLLER:

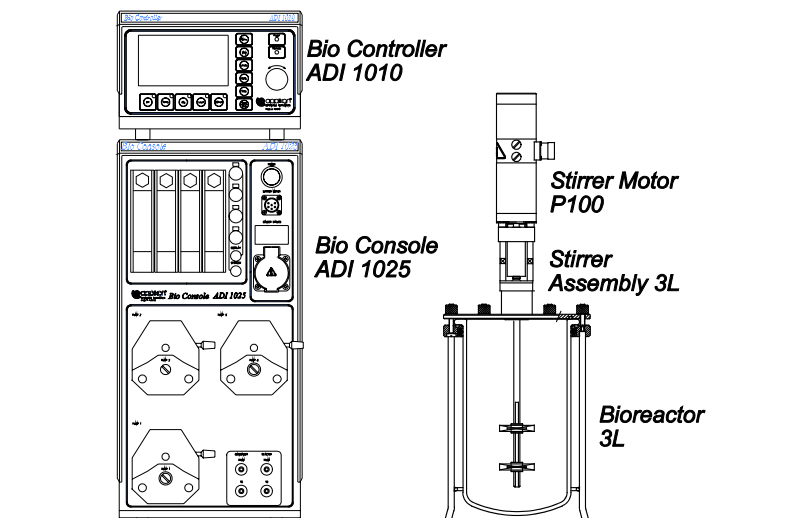
The Internal Stirrer Controller is located inside the ADI 1010 Power Unit.

Maximum Power Output of the Internal Stirrer Controller = 50 W.

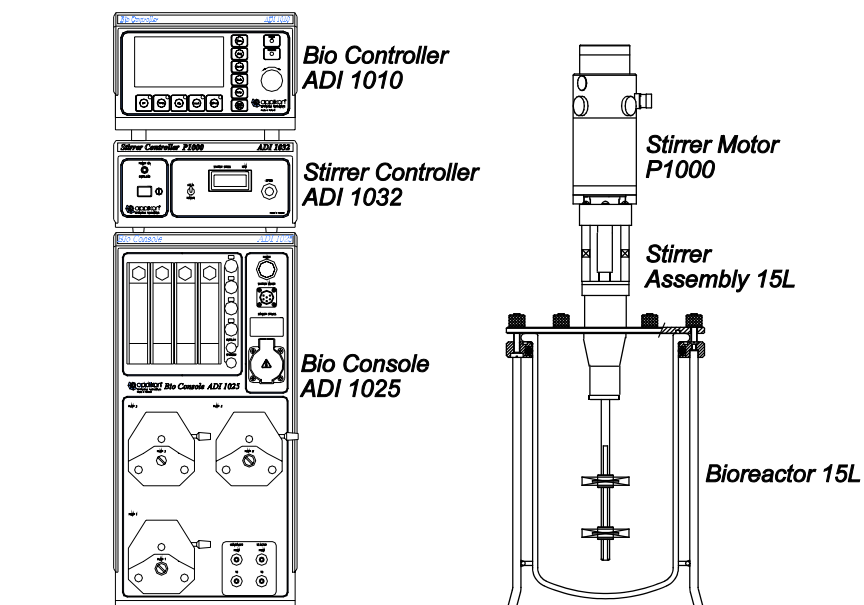


Top View of Power Unit (without cover).

## BIO REACTOR SYSTEM WITH INTERNAL STIRRER CONTROLLER:



## BIO REACTOR SYSTEM WITH EXTERNAL STIRRER CONTROLLER:

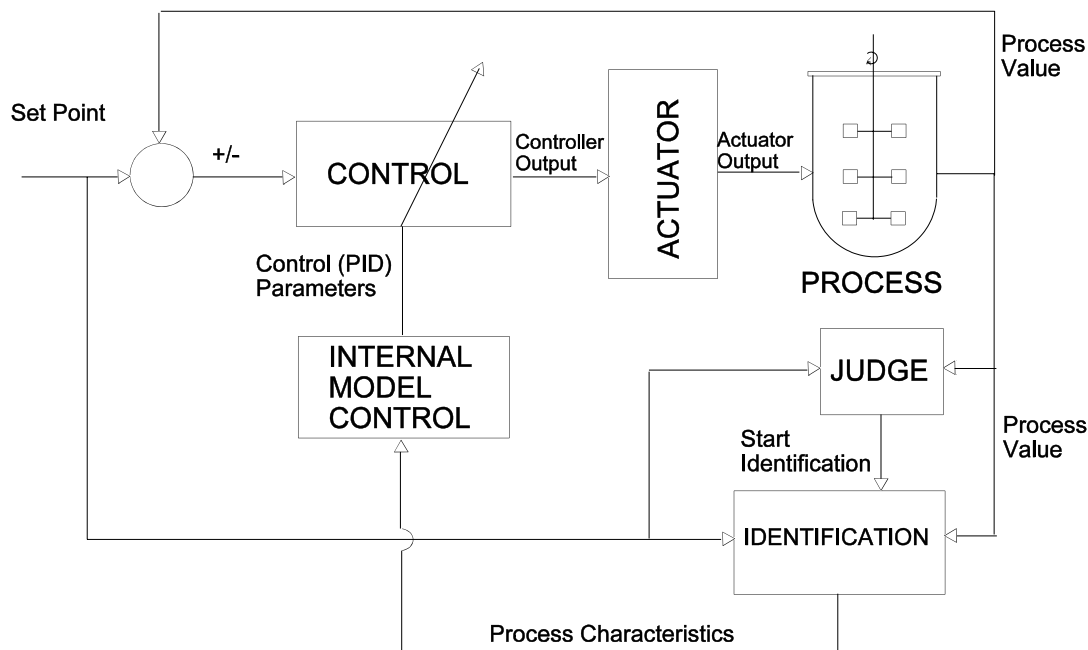


```

graph LR
    SP[Set Point] --> Sum(( ))
    PV[Process Value] --> Sum
    Sum -- "+/-" --> C[CONTROL  
(Fixed PID)]
    C -- "Controller Output" --> A[ACTUATOR]
    A -- "Actuator Output" --> P[PROCESS]
    P --> PV
  
```

The Bio Controller ADI 1010 is also capable of **ADAPTIVE PID CONTROL**, which means that the PID control parameters are adapted for changes in process characteristic.

Schematic presentation of an adaptive PID controller:



In case the controller is started without historical data, it starts with “moderate” control data. The **JUDGE** evaluates the response of the Process-Output and decides whether a new identification of the Process Characteristics is required.

**IDENTIFICATION** is executed based on small variations in set point value (to both sides); the character of the process is identified through the way the process control reacts to these minor disturbances in set point value.

Finally **INTERNAL MODEL CONTROL** converts the identified process character into new PID control parameters.

Identification is based on a measuring and verification process. During this interval, process control is carried out based on current control parameters.

Note:

The identification process for pH and dO takes approx. 15 - 20 minutes. Temperature control is characterized with a much slower response; therefore the identification process for temperature control takes approx. 90 minutes.

In case the Bio Controller has collected process data from previous runs, it can continue control based on this history or can restart based on the default parameters.

## 2.1 SENSOR INPUT SPECIFICATIONS:

The installed input amplifiers have the following specifications:

pH amplifier:	Range:	0 - 14 pH
	Accuracy:	$\pm 0.01$ pH
	$R_{in}$ :	$> 10^{15} \Omega$
Temp. amplifier:	Type:	Pt-100
	Range:	0 - 150EC
	Accuracy:	$\pm 0.1$ EC
dO <sub>2</sub> amplifier:	Type:	Polarographic
	Range:	0 - 500 % (air)
	Accuracy:	$\pm 0.1$ %
Level amplifier:	Type:	On/Off signal
	Sensitivity (firmware selectable)	
	High: $> 26 \mu S \Omega$ 100 %	
	Low: $> 200 \mu S \Omega$ 100 %	

## 2.2 STATUS OF LED INDICATORS:

At the front of the ADI 1010 Bio Controller 7 LED-indicators are located.

The LED-indicators “Power” (green) and “Remote” (orange) indicate whether the power and remote control (SCADA-system) are on.

The keys of the five control loops have a dual-color LED (green / red); the table below describes the different possibilities:

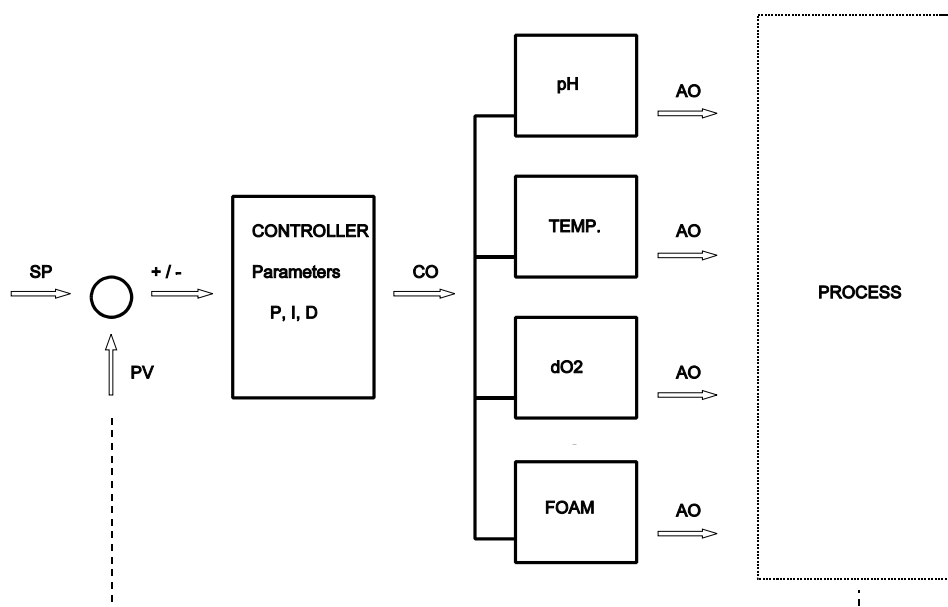
Status LED	Status Controller	Status Alarm (out of range)
Off	Off	No alarm (within range)
Green	On	No alarm (within range)
Red	Off	Alarm (out of range)
Green / Red (alternating)	On	Alarm (out of range)

## 2.3 DEDICATED ACTUATOR CONFIGURATION:

The ADI 1010 Bio Controller comes with a dedicated actuator configuration per control loop (based at the applied actuator hardware).

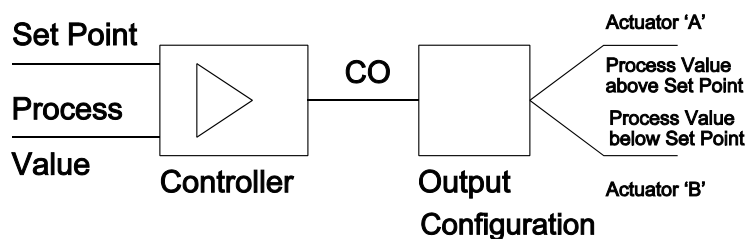
Basically the Control Loops in the ADI 1010 Bio Controller can be represented by the figure below, where the following abbreviations are used (alphabetical order):

- AO - **A**ctuator **O**utput
- CO - **C**ontroller **O**utput
- D - **D**erivative time
- I - **I**ntegral time
- P - **P**roportional gain
- PV - **P**rocess **V**alue
- SP - **S**et **P**oint



Schematic overall control loop lay-out

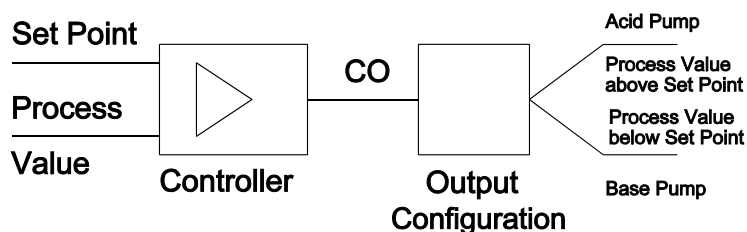
General presentation of an individual control loop:



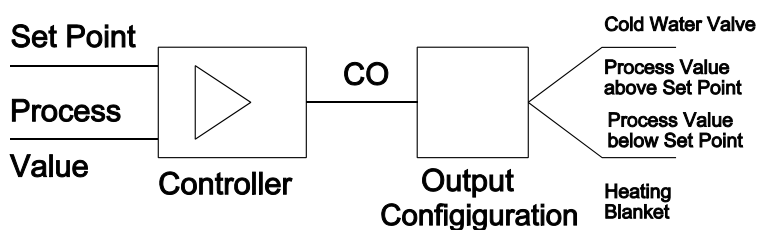


The different Control Loop Configurations are described below:

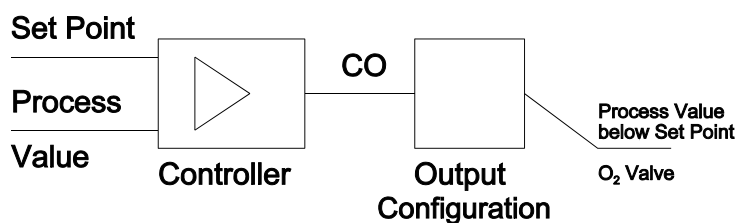
### pH CONTROL:



### TEMPERATURE CONTROL:

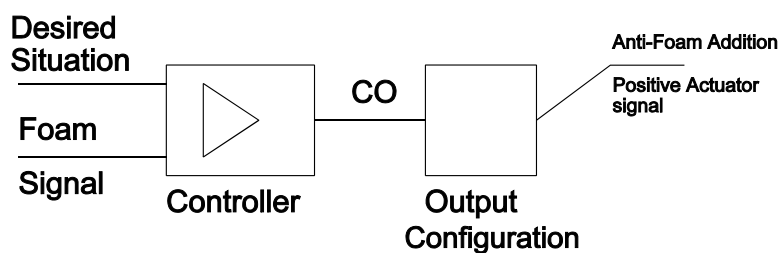


### DISSOLVED OXYGEN (dO<sub>2</sub>) CONTROL:



### LEVEL CONTROL:

Level Control generates a positive Actuator Output signal when the level sensor detects an undesired situation ("contact" or "no contact").



**ON/OFF ACTUATORS versus CONTINUOUS ACTUATORS:**

On/Off actuators like valves and pumps are steered in a “Pulse Width Modulated” manner; during a certain duty cycle (e.g. 10 sec.) the output is switched on during the “on-% interval”.

*Example:*

*On/Off Output:*

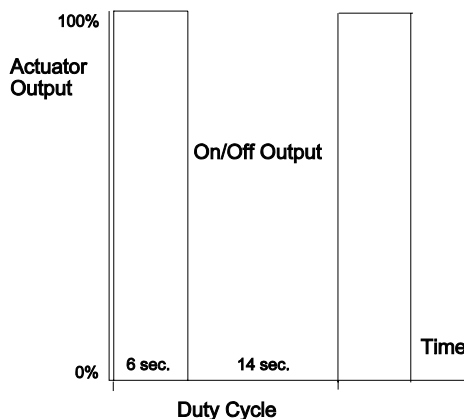
*Duty cycle = 20 sec.*

*Controller output = 30 %*

*Results in a sequence of:*

*output = on during 6 sec.*

*output = off during 14 sec.*



Continuous actuators like mass flow controllers and stirrers do not have a duty cycle.

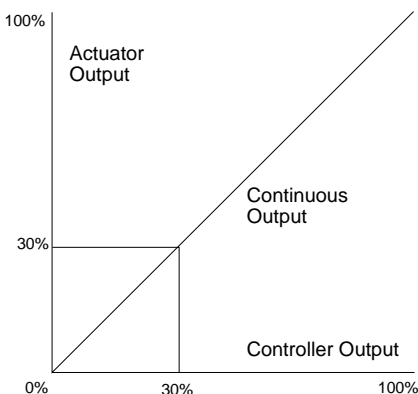
Deviation from set point results in a controller output that relates to the actuator output in a linear way.

*Example:*

*Continuous Output*

*Controller output = 30 %*

*Results in an Actuator output of 30 %*

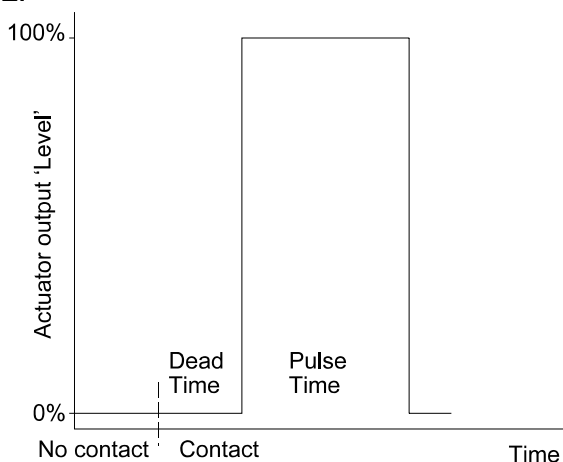
**ACTUATOR FOR LEVEL CONTROL:**

The actuator for level / anti-foam control is either off (AO = 0%) or on (AO = 100%). In most cases the desired situation = “No Contact”.

In case the status “No Contact” changes in “Contact”, first a “Dead Time” elapses after which the actuator is switched on during the “Pulse Time” interval.

*Note:*

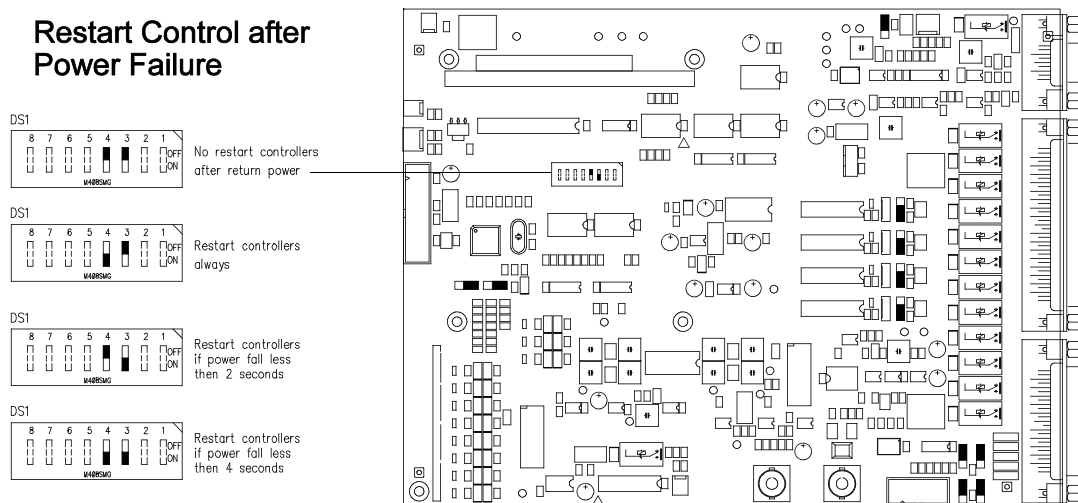
- Values for Dead Time and Pulse Time can be edited by using the Menu Option “Level Control Timing”.
- The sensitivity of the level sensor (discrimination between “no contact” and “contact”) can be selected by “calibrating” the level sensor.



## 2.4 HARDWARE SETTINGS AT THE ADI 1010 BIO CONTROLLER:

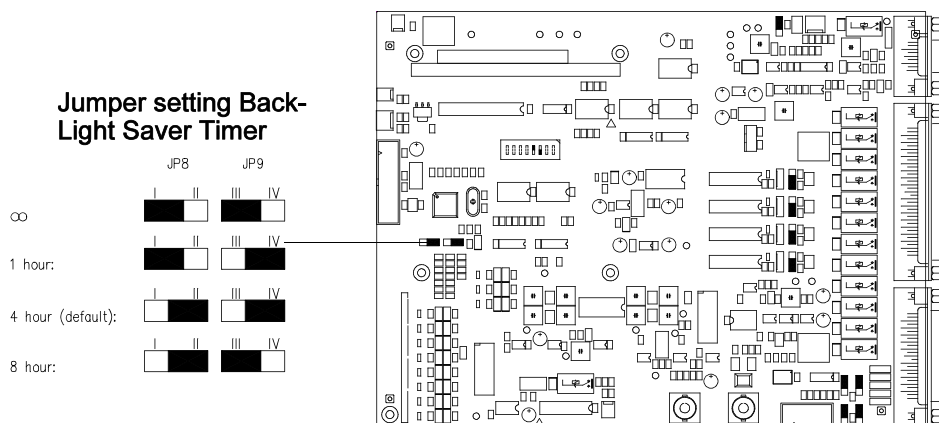
The Interface board of the ADI 1010 offers a number of hardware selection options in relation to:

- restart options after power failure
- serial communication mode and protocol
- display back-light saver timer
- required output setting MFC's (mA or V)
- Pt-100 measurement mode (2 or 3 wire scheme)



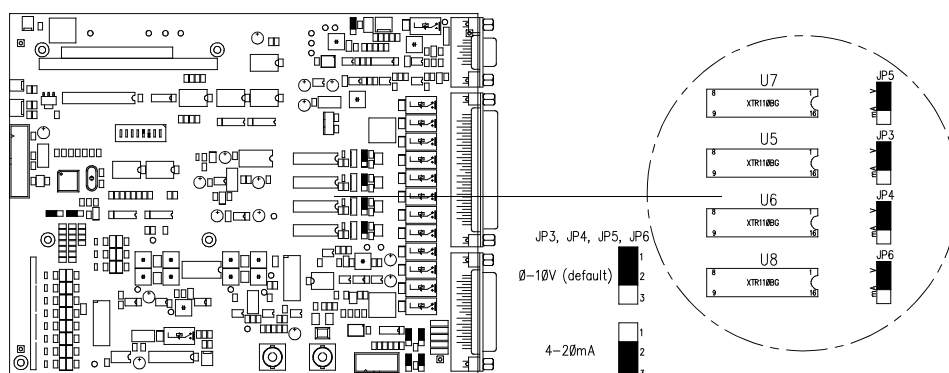
The Dip Switches 3 and 4 at DS1 can be set in four different modes:

- Never restart controllers after power failure
- Always restart controllers after power failure
- Restart controllers after power failure less than 2 seconds
- Restart controllers after power failure less than 4 seconds (default setting)



Set jumpers 8 and 9 to the required setting of the Back-light Saver Timer (4 hours is default).

Jumpers for Mass Flow Controller Power Supply:



The default jumper setting for MFC power supply = 0 - 10 V.

The analog output converter (0 - 10 V to 4 - 20 mA) is available as Z510100050.

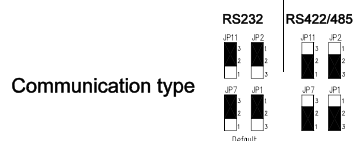
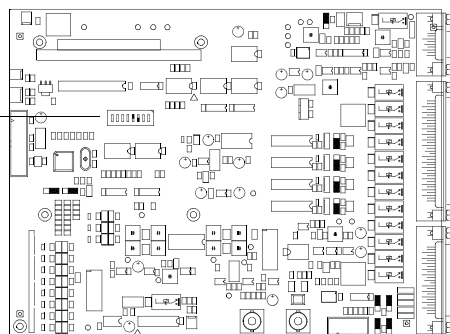
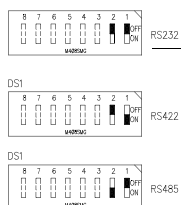
Signal	Position	Jumper	Analog Output number ADI 1010	Serial Comm. Function Code
MFC-O <sub>2</sub>	U7	JP5	3	F5.1.4
MFC-CO <sub>2</sub>	U5	JP3	4	F5.1.1
MFC-N <sub>2</sub>	U6	JP4	1	F5.1.2
MFC-air	U8	JP6	2	F5.1.3

## Serial Communication settings

Set jumpers JP1, JP2, JP7 and JP11 to the required communication type (RS-232 is default).

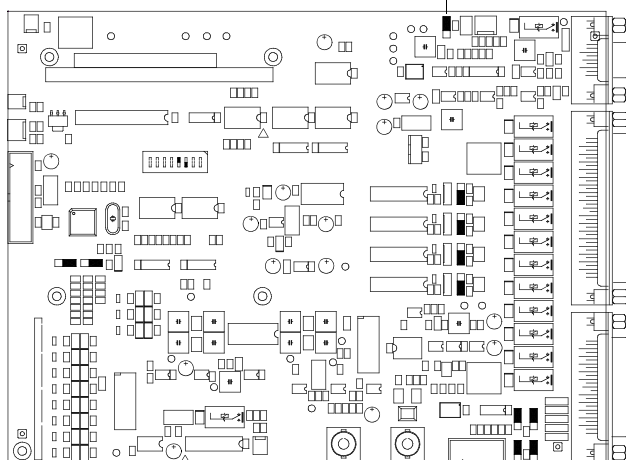
Set switches 1 and 2 at Dip Switch DS1 to the required communication protocol (RS-232 is default).

### Communication Protocol



## Temperature measurement:

### Temperature Measurement mode



The required mode of the Temperature Measurement depends on the type of the applied sensor. The ADI Pt-100 sensors are of the 3-wire type.

### Note:

In the 3-wire mode, the measured temperature value is not affected by the cable length of the sensor.

### 2.5 SERIAL COMMUNICATION SETTINGS:

The communication settings of the ADI 1010 Bio Controller are by default set to:

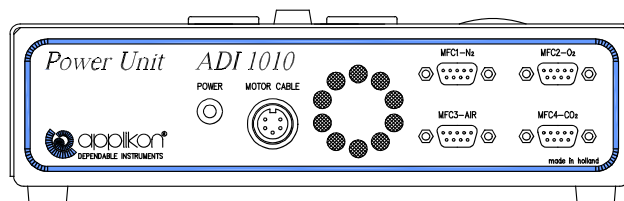
Number of data bits:	7
Number of stop bits:	1
Parity:	none
Baud rate:	19200
Checksum mode:	ON
Device number:	1

These settings can be edited by using the list of menu options (refer to the firmware reference manual).

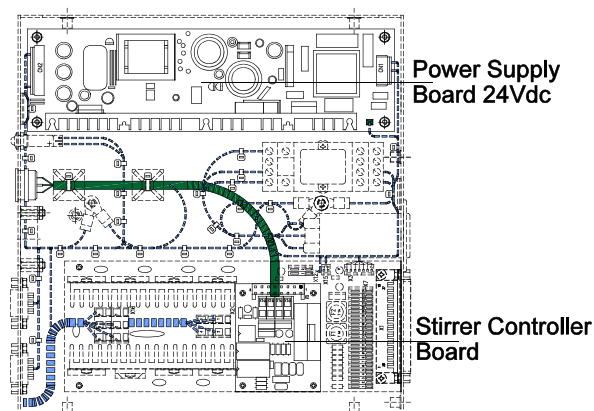
## 2.6 ADI 1010 POWER UNIT:

The ADI 1010 Bio Controller requires the Power Unit in order to convert the control signals into “power signals” for pumps, valves and mass flow controllers.

The Power Unit is designed to fit inside the ADI 1025 Bio Console but it can also be used as a stand-alone unit.

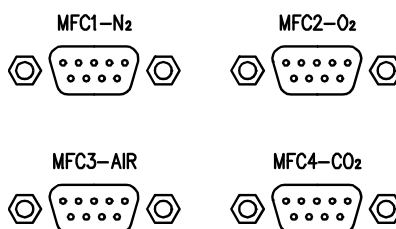


As explained in chapter 1.4, the ADI 1010 Power Unit may accommodate an Internal Stirrer Controller with a maximum power output of 50W (applications with stirrer motors P100 and P140).



The Power Unit supports:

- analog outputs for:  
 MFC N<sub>2</sub>,  
 MFC Air,  
 MFC O<sub>2</sub>,  
 MFC CO<sub>2</sub>.



Note:

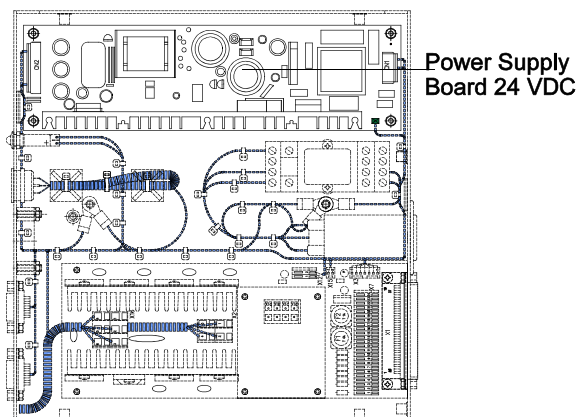
In case an analog output is not in use for a Mass Flow Controllers, it may be used for additional purposes (like a variable speed pump drive (Stand Alone drive)).

Note:

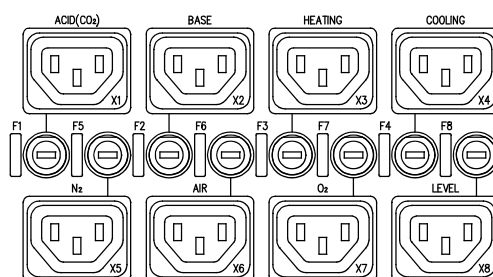
The mass flow controller outputs require a 24 VDC power supply. In case no Internal Stirrer Controller is applied, a separate 24 VDC Power Supply must be installed inside the ADI 1010 Power Unit.

The mass flow controller output signal is either 0 - 10 V or 4 - 20 mA (jumper selectable); refer to chapter 2.3.

Only two Mass Flow Controllers can be mounted inside the ADI 1025 Bio Console; housing for a third or fourth MFC is available on request!



- digital outputs for:  
Acid pump or CO<sub>2</sub> rotameter valve,  
Base pump,  
Heating element,  
Cooling valve,  
N<sub>2</sub> rotameter valve,  
Air rotameter valve,  
O<sub>2</sub> rotameter valve,  
Level (anti-foam) pump.



In case the Power Unit is applied as a stand-alone unit, a set with Euro connectors is available for connection of stand-alone actuators!

### FUSE RATING FOR THE POWER UNIT AND DIGITAL OUTPUTS:

Fuse	230 VAC	115 VAC	Fuse	230 VAC	115 VAC
Main Fuse	T 5A	T 10A			
Acid Pump (CO <sub>2</sub> Valve)	T 1A	T 1A	N <sub>2</sub> Valve	T 1A	T 1A
Base Pump	T 1A	T 1A	Air Valve	T 1A	T 1A
Heating	T 4A	T 8A	O <sub>2</sub> Valve	T 1A	T 1A
Cooling	T 1A	T 1A	Level Pump	T 1A	T 1A

Note: Applied fuses must comply with IEC 127!

### 2.7 ADI 1010 ORDERING INFORMATION:

Z510100010 ADI 1010 Bio Controller  
Z510100110 ADI 1010 Power Unit  
Z510100120 ADI 1010 Internal Stirrer Unit

Communication cables for Supervisory Control & Data Acquisition:

Z510203160 Data cable RS232 L = 5m  
Z510302910 Data cable set PC - ADI 1010 RS422  
Z510302930 Data cable extension RS422 (for more ADI 1010's in a network)  
Z510302940 Data cable set PC - ADI 1010 RS485  
Z510302950 Data cable extension RS485 (for more ADI 1010's in a network)

Note:

Chapter 6 of this manual (Installation) explains how to connect the communication cable set.



## CHAPTER 3

# ADI 1025 BIO CONSOLE

## FOR ACTUATOR SUPPORT

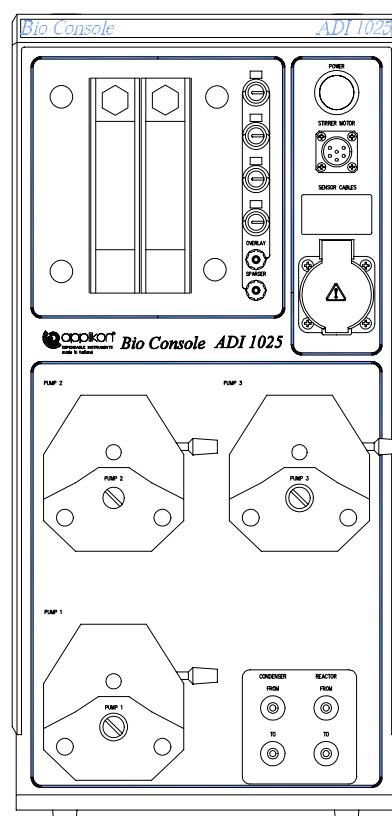
The ADI 1025 Bio Console is an actuator console that is used in combination with the ADI 1010 Bio Controller.

It supports gas flow regulation (with rotameters or mass flow controllers), temperature control (with hot and cold water or a heating blanket) and liquid addition with pumps. It also supports tuning the flow of cooling water to the condenser.

Because of its compact design, the ADI 1025 allows you to run a bio process on a minimum amount of bench space.

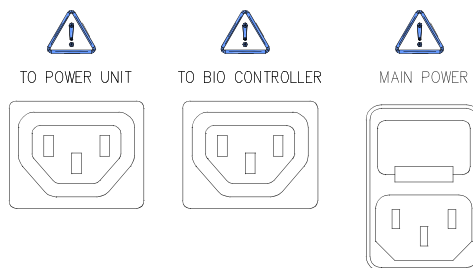
Z310250010: Bio Console Basic ADI 1025

In this chapter, the applied actuator hardware is described.

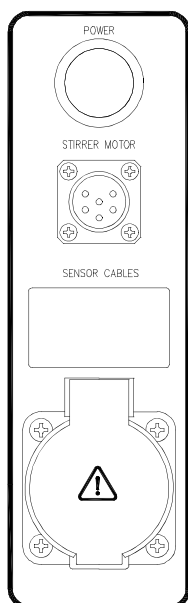


### 3.1 POWER SECTION:

At the rear side of the ADI 1025 Bio Console a central mains entry for the bio reactor system can be found. The mains entry socket also contains a fuse holder for two fuses. Rating: 115 VAC: T 16A  
Applied fuses must comply with IEC 127!



The two power outlet sockets must be used for supply of the ADI 1010 Bio Controller and Power Unit (Refer to Chapter 6: Installation).



The power section of the ADI 1025 Bio Console contains a central Power On/Off switch with a green pilot light as Power-On indicator.

In case an ADI 1010 internal stirrer controller is applied, the stirrer motor cable is connected at this power section. In case of an external (ADI 1032) stirrer controller, this stirrer motor connector is not in use.

The sensor cables can be lead through the cable tunnel.

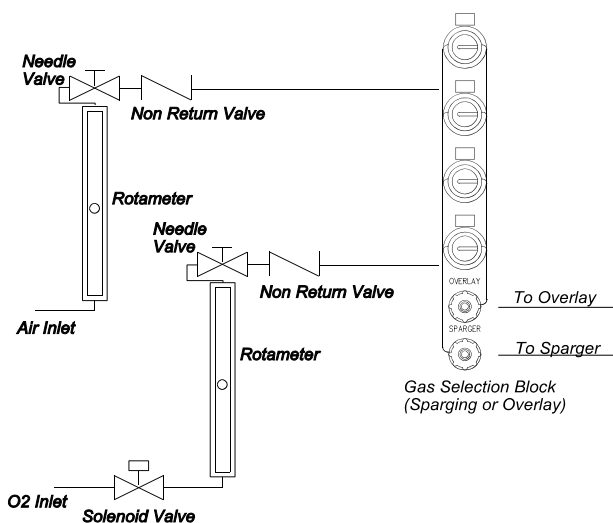
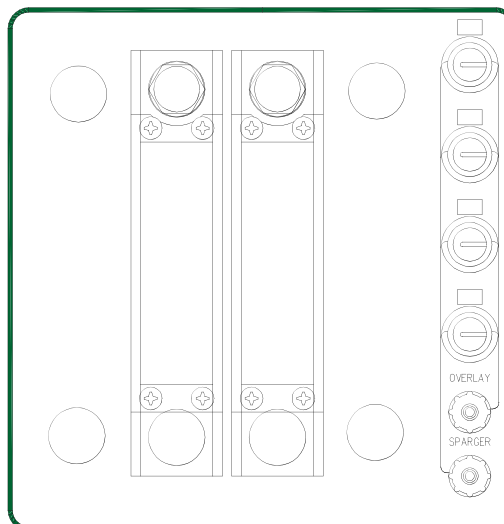
The wall socket is used for power connection of a heating blanket; in case the ADI 1018 thermo circulator is used for heating and cooling, this wall socket connector is not in use (and carries no mains).

### 3.2 GAS SUPPLY SECTION:

The gas supply section supports up to four rotameters; in this application (Bio Bundles for Microbial Cultures) two rotameters (air & oxygen) are applied.

The gas selection block module offers easy switching (per gas) between overlay and sparging.

Z311302020 Gas Selection Block



The air flow is manually adjusted by the needle valve on top of the rotameter. In case the concentration of dissolved oxygen drops below Set Point, the oxygen valve is activated by the ADI 1010 Bio Controller.

## Rotameters for the 1-Liter BioBundle:

Z3RM002010 Rotameter 100 ml/min for O<sub>2</sub>

Z3RM002020 Rotameter 1 l/min for air

## Rotameters for the 3-Liter BioBundle:

Z3RM002015 Rotameter 500 ml/min for O<sub>2</sub>

Z3RM002025 Rotameter 5 l/min for air

## Rotameters for the 7-Liter BioBundle:

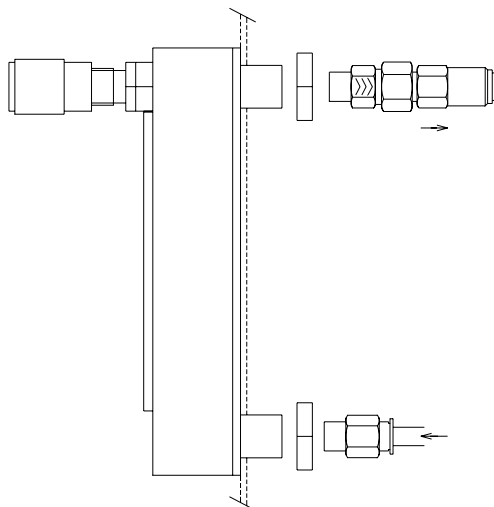
Z3RM002015 Rotameter 500 ml/min for O<sub>2</sub>

Z3RM002030 Rotameter 10 l/min for air

## Rotameters for the 15-Liter BioBundle:

Z3RM002025 Rotameter 5 l/min for O<sub>2</sub>

Z3RM002035 Rotameter 50 l/min for air

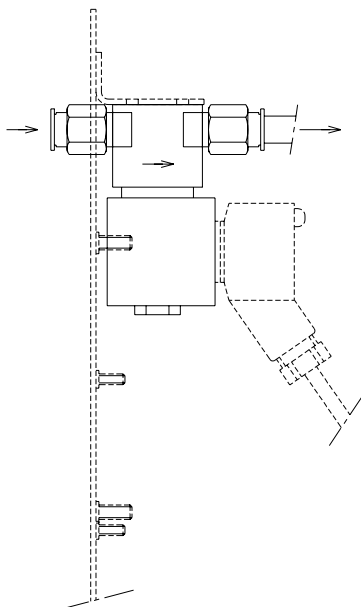


Each rotameter contains a non-return valve at the gas-outlet. As a result, pressure differences cannot cause back-flow through the rotameter.

## Valves in the gas supply lines:

At the inner rear side of the ADI 1025 cabinet, a solenoid valve is mounted in the oxygen supply line (before the rotameter).

Z311302085 Solenoid Valve Gas/Liquid 115 VAC



## Specifications for the gas inlet lines:

Gas inlet connections: bulkhead union 6 mm

Gas outlet connections: bulkhead union 6 mm

Required inlet pressure: 2 barg

### 3.3 ACTUATORS FOR TEMPERATURE CONTROL:

For temperature control the following actuator configurations is used:

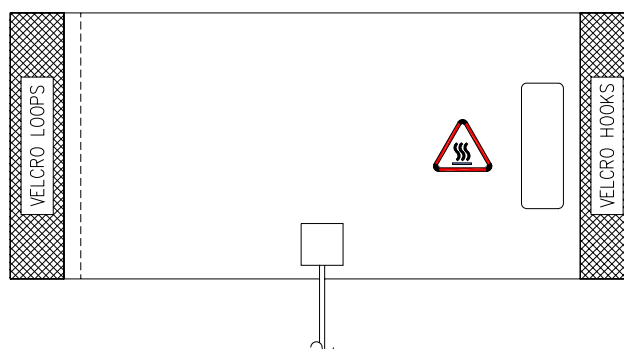
Actuator for Heating:	Actuator for Cooling:
Heating Blanket	Cold Water Valve

A heating blanket is wrapped around the glass bio reactor (no jacket).

Voltage

Power consumption:

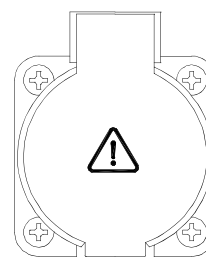
- 1L: 110 W
- 3L: 110 W
- 7L: 200 W
- 15L: 383 W



The heating blanket is connected to the wall socket in the power section of the ADI 1025 Bio Console.



**DANGER!**  
 ELECTRICAL SHOCK HAZARD. WHEN  
 THE ACTUATOR IS SWITCHED ON,  
 MAIN VOLTAGE IS DIRECTLY  
 CONNECTED TO THE WALL SOCKET!



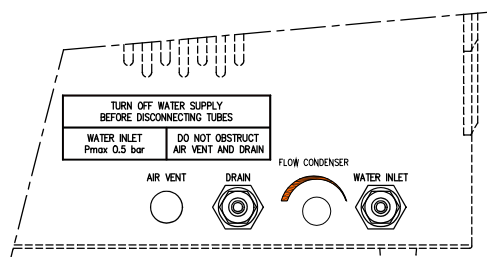
Available Heating Blankets:

- ZC8130HB01 Heating blanket 110 VAC for 1 liter dish bio reactor
- ZC8130HB03 Heating blanket 110 VAC for 3 liter dish bio reactor
- ZC8130HB07 Heating blanket 110 VAC for 7 liter dish bio reactor
- ZC8130HB10 Heating blanket 110 VAC for 15 liter dish bio reactor

Hydraulic connections must be made at the rear and front of the ADI 1025 Bio Console.

At the rear (lower right hand corner) of the Bio Console Cabinet connections can be found for Water Inlet and Drain.

Hose barb connections: OD = 6 mm  
Max. inlet pressure: 0.5 barg.

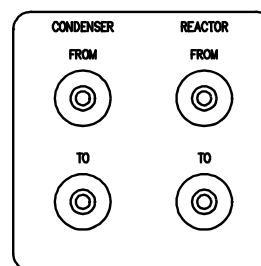


At the front (lower, right hand corner of the pump section) the mounting position for Quick Connectors can be found for direction of water to and from the reactor (heat exchanger) and condenser.

Note:

Both Quick Connectors to reactor and condenser contain a valve that closes the connector when removing the hose part.

Hose barb connections: OD = 6 mm



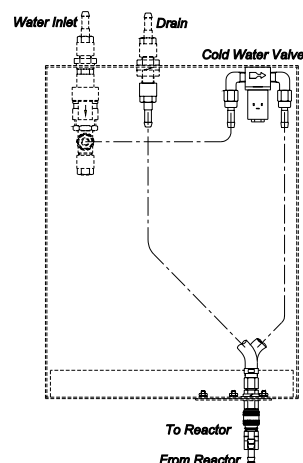
Internally in the ADI 1025 Bio Console flexible tubing is used to connect the following parts:

- water inlet with the cold water valve inlet
- cold water valve outlet with QC-To-Reactor
- QC-From-Reactor with water outlet

Note: QC = Quick Connector

Max. Cooling Flow to reactor: 1.1 l/min

Z311303020 Cold Water Valve Module 115 VAC ADI 1025



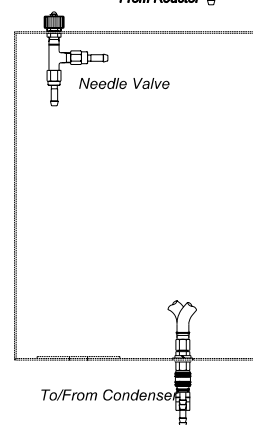
In addition to the Cold Water Valve, a Condenser Connection Set is applied.

It consists of a needle valve (mounted at the rear of the ADI 1025 Bio Console) and two Quick Connectors to and from the condenser.

The inlet of the needle valve is directly connected to the water inlet. The outlet of the needle valve is directly connected to the Quick Connectors to and from the condenser.

In this way the flow of cooling water to the condenser can be adjusted independently from any flow to the cold water valve!

Z310180100 Condenser Connection Set ADI 1025

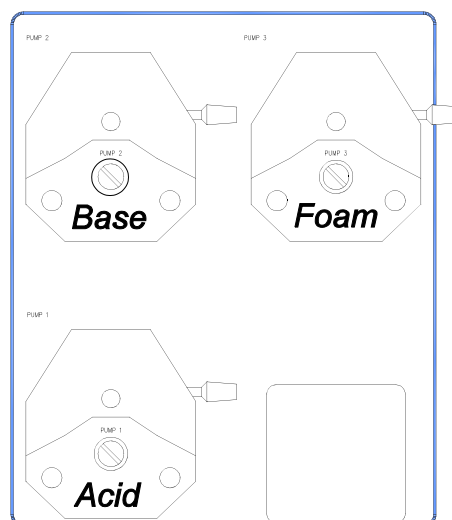


### 3.4 PUMPS:

At the Pump Section upto three tubing pump drives with “Easy Load” pump heads may be installed.

Pump configuration:

Pump 1:            Acid pump  
Pump 2:            Base pump  
Pump 3:            Anti-foam agent pump



**Caution:**

According to the European Community legislation on machinery, a pump drive is a machine with potential hazard. Only apply these drives with the pump heads and tubing that are described in this chapter!

Do not use the tubing pump drives for other purposes than displacement of fluids (or gas).

Switch off the pump drive before replacing any tubes or pump heads (use the Manual Control option of the ADI 1010 Bio Controller)! Application of damaged tubes may result in fluid leaking into the pump drive! Verify the tube quality inside the pump head before every fermentation run.

Z311500021	Fixed speed drive 20 rpm, 115 VAC, ADI 1025,
Z375180000	Easy-load pump head for tubing size 14 & 16,
ZC39641014	Silicone tubing size 14 (25 feet per pack) for 1 and 3 liter Bundle
ZC39641016	Silicone tubing size 16 (25 feet per pack) for 7 and 15 liter Bundle

Tube size specification:

Size:	14	ID = 1.6 mm	flow = 0.2 ml/rev
Size:	16	ID = 3.1 mm	flow = 0.8 ml/rev

---

## CHAPTER 4

# AGITATION

### 4.1 APPLICABLE STIRRER MOTORS:

This chapter describes different DC permanent magnet motors for ADI bioreactors.

A direct current tachometer generator, present in the motor, is used for feedback to the motor controller.

The stirrer motor comes with four motor studs to fit in the stirrer assembly and a covered (flexible) coupling fork to avoid noise and vibrations during operation.

No tools are required to mount the stirrer motor on top of the stirrer assembly.

Warning:



- The stirrer motor is a machine with potential hazard (moving parts).  
In order to avoid dangerous situations, make sure that the stirrer motor is only operated when it is properly seated in the stirrer assembly of the ADI autoclavable bioreactor.
- The stirrer motor must only be used as part of a Bio Process (bioreactor with control systems); it therefore comes with supplier's declaration of conformity of type IIb regarding the European Community legislation on machinery! The stirrer motor must not be put into service until the machinery into which it is to be incorporated has been declared to conform to machinery directive 98/37/EC.



#### 4.1.1 STIRRER MOTORS FOR THE INTERNAL STIRRER CONTROLLER:

The stirrer motors that are listed in this paragraph can be controlled by the Internal Stirrer Controller of the ADI 1010.

##### Z5100002M0: Stirrer Motor Assembly P100

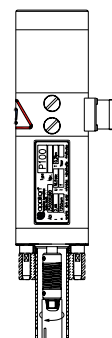
Motor P100 including motor studs and flexible coupling; standard motor for the Bio Bundles 1 and 3 liter.

Standard Stirrer Speed range: 0 - 1250 rpm

Maximum torque: 0.20 Nm.

Weight: 1.6 kg.

The motor studs fit in the Top Stirrer Assemblies of the 1 and 3 liter reactors.



##### Z5100002M1: Stirrer Motor Assembly P140

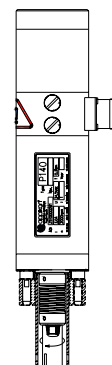
Motor P140 including motor studs and flexible coupling; heavy duty motor for the Bio Bundle 7 liter.

Standard Stirrer Speed range: 0 - 1400 rpm

Maximum torque: 0.30 Nm.

Weight: 1.9 kg.

The motor studs fit in the Top Stirrer Assemblies of the 7 liter reactor.



#### 4.1.2 STIRRER MOTORS FOR THE EXTERNAL STIRRER CONTROLLER:

The stirrer motors that are listed in this paragraph must be controlled by the External Stirrer Controller ADI 1032-2.

##### Z5100P1000: Stirrer Motor Assembly P1000

Motor P1000, including motor studs and coupling; standard motor for the Bio Bundle 15 liter.

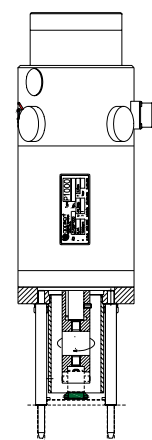
Standard Stirrer Speed range: 0 - 1000 rpm.

The motor can also be used in the in-situ sterilizable bioreactors as a top-drive stirrer.

Maximum torque: 3.0 Nm.

Weight = 8.1 kg.

The motor studs fit in the Top Stirrer Assemblies of the 15 and 20 liter reactors.



If specified on the purchase order, other speed ranges can be calibrated. Use order number Z510120000: specific calibration range for motor and motor controller (specify the required range when ordering).



The combination of a stirrer motor and a motor controller is calibrated; for accurate reproducibility of the stirrer speed, this combination should be kept together.

The stirrer motor is virtually maintenance-free. The only parts that require regular maintenance are the carbon brushes and the ball bearings. The life span of the carbon brushes depends on the operating conditions (normally approx. 6000 operating hours).  
Minimum length of the carbon brush:

- Carbon brush for motor: 9 mm,
- Carbon brush for tachometer: 9 mm.

Operating the stirrer motor with worn-out carbon brushes will cause irreversible damage!

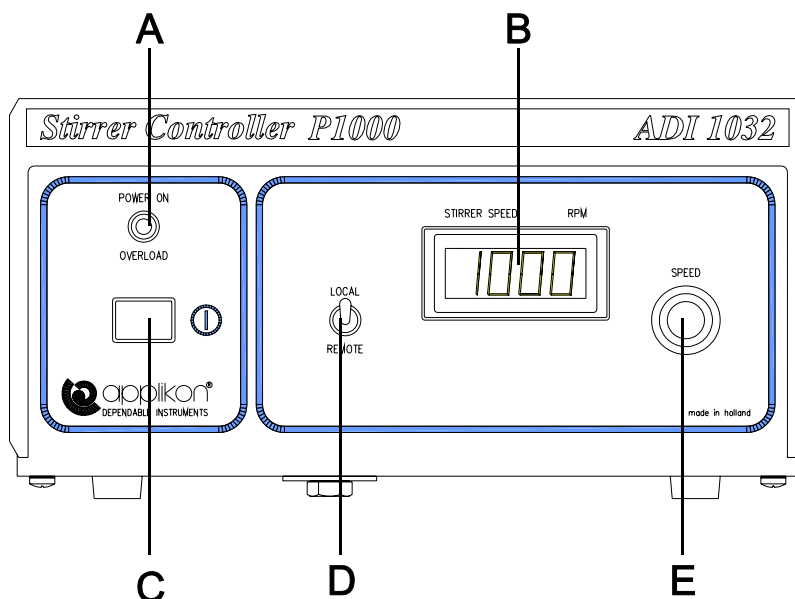
The stirrer motor should be serviced every 12,000 - 15,000 operating hours; revision instructions and spare parts are listed in the corresponding maintenance data sheet.

#### 4.4 STIRRER SPEED CONTROLLER ADI 1032:

Use of the stirrer motor P1000 (Bio Bundle 15 liter) requires an external Stirrer Speed Controller:

Z510320020: Stand alone Stirrer Speed Controller for motor P1000.

Z510120900: Control cable, L = 600 mm

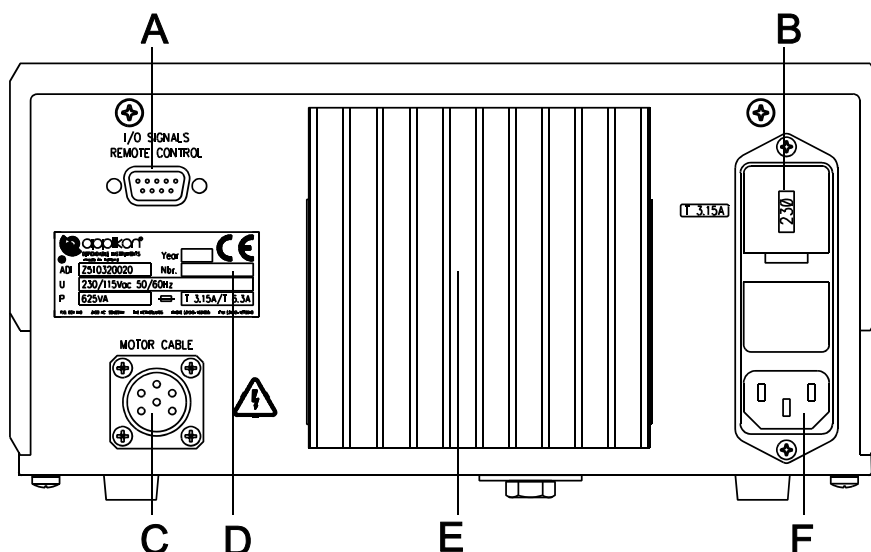


Front view of the Stirrer Speed Controller

- A = Power-on / overload indicator,
- B = Stirrer speed display,
- C = Power "On/Off" switch, switches the power on/off,
- D = "Local/Remote" switch, switches between local and remote control,
- E = 10 turn potentiometer for local stirrer speed control.

Note:

- The "Local/Remote" switch is used to select manual stirrer speed control by using the potentiometer on the front panel ("local") or by a 0/4 - 20 mA (or 0 - 10 V) input signal from the ADI 1010 Bio Controller ("remote").
- In overload situations (green LED turns red), the maximum torque is supplied; as a result, the stirrer speed will be reduced.
- After changing the stirrer speed set point (local or remote), the stirrer speed will ramp up/down until the new set point is reached (ramping speed = approx. 60 rpm/sec.).



Rear view of the Stirrer Controller

- A = 9 Pins female "sub-D" connector for remote I/O control,  
 B = Fuse holder and voltage selection,  
 C = Cable connector for stirrer motor,  
 D = General identification sticker,  
 E = Heat sink for motor controller,  
 F = Main supply entry.



The stirrer cable (C) must not be disconnected while the power is switched on; the voltage at the connector may exceed 60VDC, so precaution must be taken to avoid risk of electric shock!  
 The heat sink (E) must not be covered in any way!

### FUSES, VOLTAGE SELECTION AND SUPPLY:

When the fuse holder (B) is removed (use a little screwdriver), a voltage selector (115 / 230 V) becomes visible. Make sure that the selector is correctly inserted (sticker with the correct line voltage must be in view); if not, take out the voltage selector, rotate it 180° and re-insert it. The fuse holder contains two fuses for both the live and neutral side; fuse rating:

- 115 VAC: T 6.3A.

Applied fuses must comply with IEC 127!

Use the main supply cable to connect the ADI 1032 to the mains (Euro connector in the ADI 1032, mains connector in the wall socket).

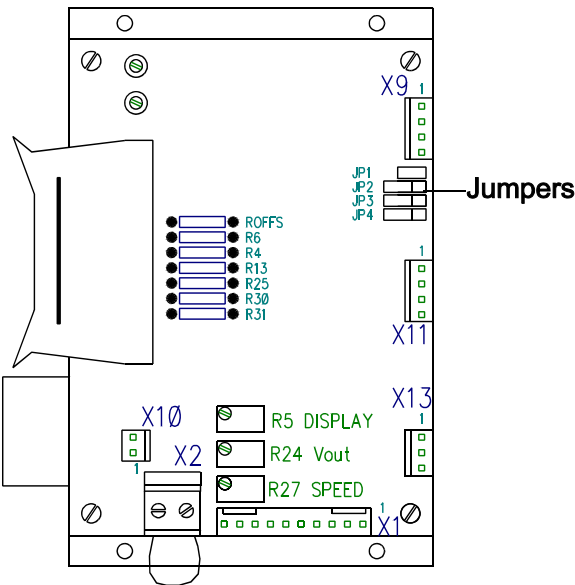
4.5 REMOTE CONTROL SIGNAL:

The set point of the ADI 1032 Stirrer Speed Controller can be controlled with an external analog 0 - 10 VDC or 0/4 - 20 mA signal.

The remote control signal of the ADI 1010 Bio Controller has a range of 0 - 10 VDC.

On the controller board of the ADI 1032 Stirrer Speed Controller four jumpers concerning the remote control signal can be found.

Refer to the table below for technical reference:



	JP1	JP2	JP3	JP4
0 - 10 V	close	open	open	open
0 - 20 mA	close	close	open	open
4 - 20 mA	open	close	close	close

The jumper settings can be reviewed by removing the cover of the ADI 1032 Stirrer Speed Controller cabinet. Make sure that the power is switched off before removing the cover!

## CHAPTER 5

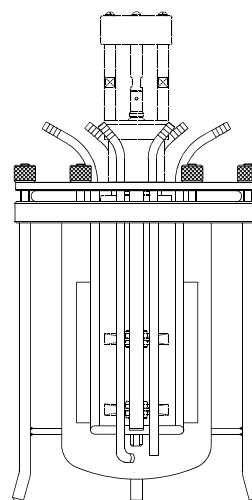
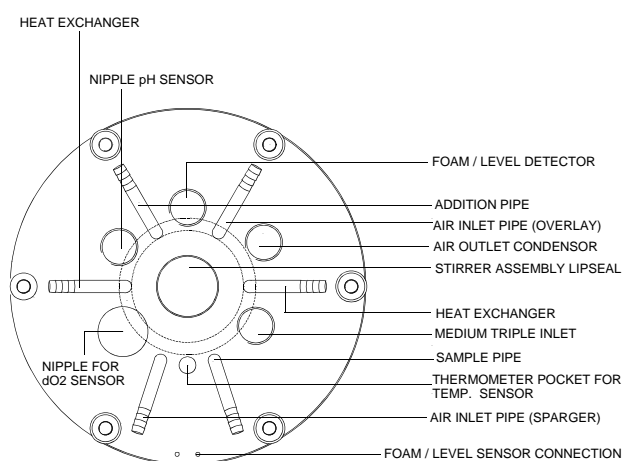
# REACTORS & AUXILIARIES

In this chapter the range of Bio Bundle reactors are described (reactor and head plate specifications) with the available head plate auxiliaries.

### 5.1 THE REACTORS:

Materials in contact with the medium (all reactors):  
borosilicate glass      stainless steel  
silicone rubber      viton & EPDM

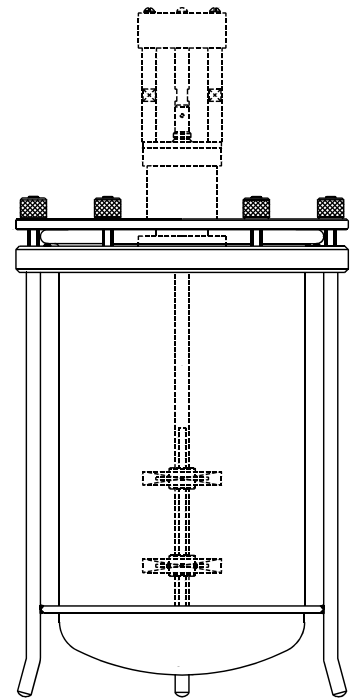
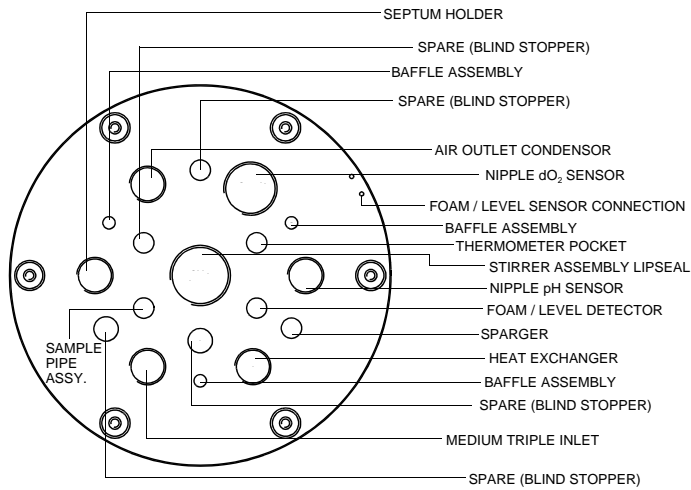
#### THE 1 LITER REACTOR:



Z61101C004: 1 Liter Dished-bottom reactor

Reactor type	1 liter dished		
Inner Diameter	95 mm	Autocl. Space (HxD)	350 x 175 mm
Inner Height (max.)	200 mm	Overall height reactor	275 mm
Liquid Height (working vol.)	150 mm	Total Volume	1.25 liter
Welded Connections in Head Plate	Water in/outlet (heat exchanger)		
	Sample Pipe	Working Volume	0.9 liter
	Air Inlet Pipe (Sparger)	Min. Working Volume	0.3 liter
	Addition Pipe	H/D Total	2.0
	Air Inlet Pipe (Overlay)	H/D Work Vol.	1.5
	Thermometer Pocket		
Ports in Head Plate	1 x M30 x 1		
	1 x G3/4"		
	4 x M18 x 1.5		

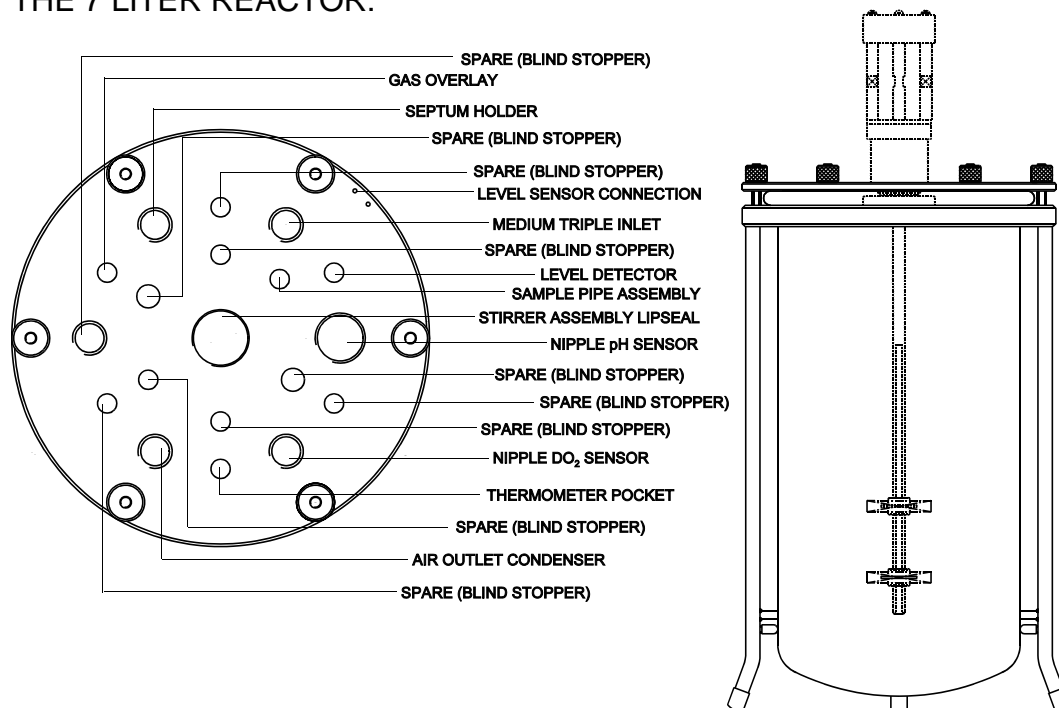
## THE 3 LITER REACTOR:



Z61101C006 3 Liter dished-bottom reactor

Reactor type	3 liter dished		
Inner Diameter	130 mm	Autocl. Space (HxD)	400 x 200 mm
Inner Height (max.)	250 mm	Overall height reactor	290 mm
Liquid Height (working vol.)	200 mm	Total Volume	3.1 liter
Ports Head Plate	1 x M30 x 1	Working Volume	2.7 liter
	1 x G3/4"	Min. Working Volume	0.6 liter
	5 x M18 x 1.5	H/D Total	19
	3 x 6 mm	H/D Work Vol.	15
	6 x 10 mm		
	2 x 12 mm		

THE 7 LITER REACTOR:



Z611000007 7 Liter dished-bottom reactor

Reactor type	7 liter dished		
Inner Diameter	160 mm	Autocl. Space (HxD)	510 x 260 mm
Inner Height (max.)	350 mm	Overall height reactor	390 mm
Liquid Height (working vol.)	270 mm	Total Volume	6.8 liter
Ports Head Plate	1 x M30 x 1	Working Volume	5.4 liter
	1 x G3/4"	Min. Working Volume	1.5 liter
	5 x M18 x 1.5	H/D Total	2.2
	10 x 10 mm	H/D Work Vol.	1.8
	2 x 12 mm		



SPARE (BLIND STOPPER)

AIR OUTLET CONDENSOR

SPARE (BLIND STOPPER)

SPARE (BLIND STOPPER)

SPARE (BLIND STOPPER)

NIPPLE pH SENSOR

SPARE (BLIND STOPPER)

AIR OUTLET PIPE

NIPPLE  $\text{dO}_2$  SENSOR

STIRRER ASSEMBLY LIPSEAL

GAS OVERLAY

SPARE (BLIND STOPPER)

MEDIUM TRIPLE INLET

THERMOMETER POCKET

SPARE (BLIND STOPPER)

SEPTUM ASSEMBLY

SPARE (BLIND STOPPER)

SAMPLE PIPE ASSEMBLY

LEVEL SENSOR CONNECTION

SPARE (BLIND STOPPER)

Reactor type	15 liter dished		
Inner Diameter	220 mm	Autocl. Space (HxD)	800 x 400 mm
Inner Height (max.)	440 mm	Overall height reactor	510 mm
Liquid Height (working vol.)	274 mm	Total Volume	16.5 liter
Ports Head Plate	1 x 69 mm	Working Volume	12 liter
	6 x 27 mm	Min. Working Volume	3.0 liter
	2 x 12 mm	H/D Total	1.7
	10 x 10 mm	H/D Work Vol.	1.5

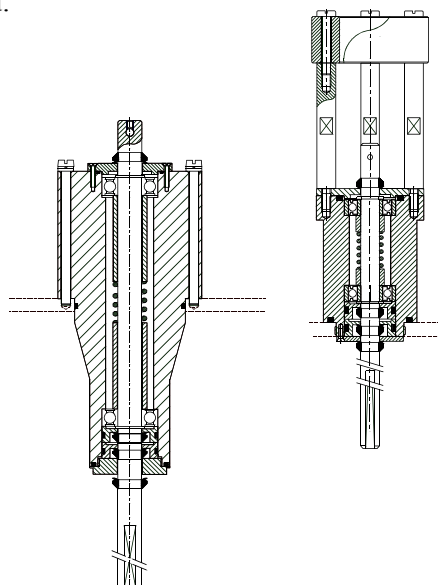
## 5.2 AGITATION:

For agitation, the following stirrer assemblies are used:

Z81315R002	Lipseal stirrer assembly 1 liter
Z81315R003	Lipseal stirrer assembly 3 liter
Z81315R007	Lipseal stirrer assembly 7 liter

Z81315R010 Lipseal stirrer assembly 15 liter

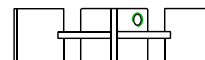
The stirrer assembly is mounted at the central stirrer port in the head plate.



## IMPELLERS:

The Bio Bundles for microbial applications come with two turbine impellers per bundle.

Z81313R602	- Rushton impeller, 6 bladed, 1 and 3 liter reactor (for 8 mm shaft)
Z81313R607	- Rushton impeller, 6 bladed, 7 liter reactor (for 8 mm shaft)
Z81313R610	- Rushton impeller, 6 bladed, 15 liter reactor (for 15 mm shaft)



## BAFFLE ASSEMBLIES:

Note:

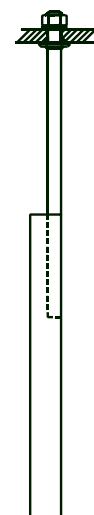
The 1 liter reactor comes with 2 baffles that are fixed to the heat exchanger!

Baffles are used to increase the mixing efficiency (without baffles, the medium flow can become laminar, causing poor mixing efficiency and mass transfer). The baffles are mounted in the head plate, near the reactor wall for optimum mixing performance.

The baffle assembly consists of one baffle and mounting material.

Z81326KS03	3 liter reactor, 6 mm port
Z81326KS07	7 liter reactor, 10 mm port
Z81326KS10	15 liter reactor, 10 mm port

Applied number of baffles for the 3, 7 and 15 liter bundle: 3.



## REQUIRED POWER FOR STIRRING:

The power (Watt) of the stirrer motor that is required depends on the number, type and diameter of the impellers, density of the medium and the stirrer speed. The required power per impeller of a stirrer motor in **non-aerated** media is given by the equation:

$$P = \rho \times (N/60)^3 \times D^5 \times N_p$$

where:

P	= the required power of the stirrer motor (W)
$\rho$	= the density of the medium (kg/m <sup>3</sup> )
N	= the stirrer speed (rpm)
D	= the impeller diameter (m)
$N_p$	= the power number of the impeller type:
Rushton turbine impellers:	$N_p = 6$

Note:

When mounted according to the given configuration, a second or third impeller on a shaft requires only 90% of the power of the first impeller. This means that the equation above is multiplied with the factor 1.9 for two impellers and with a factor 2.8 for three impellers.

## REQUIRED TORQUE:

The required torque of the stirrer motor is related to its power according to the following equation:

$$M = P \times 60 / (2 \pi N)$$

where:

M	= the required torque of the stirrer motor (Nm)
P	= the required power of the stirrer motor (W)
N	= the stirrer speed (rpm)

## IMPELLER TIP SPEED:

The Tip Speed (m/s) of an impeller at a certain stirrer speed is given by the equation:

$$\text{Tip speed} = (N / 60) \times \pi \times D$$

where:

N	= the stirrer speed (rpm)
D	= the impeller diameter (m)

On next page, examples are given how to calculate the required power and torque of the stirrer motor and the corresponding tip speed of the impeller.

The maximum torque value that can be supplied by the applicable stirrer motors is described in chapter 4.1.

Below some examples are given of required stirrer power, torque and corresponding tip speed for non-aerated media with a density of 1100 kg/m<sup>3</sup>:

1 or 3 liter reactor with 2 6-bladed turbine impellers of 45 mm:

required power at 1250 rpm:  $P = 1100 \times (1250/60)^3 \times (0.045)^5 \times 6 \times 1.9 = \text{approx. } 21 \text{ W}$

required torque:  $M = 21 \times 60 / (2 \pi 1250) = \text{approx. } 0.16 \text{ Nm}$

tip speed: approx. 2.9 m/s

7 liter reactor with 2 turbine impellers of 60 mm:

required power at 800 rpm:  $P = 1100 \times (800/60)^3 \times (0.060)^5 \times 6 \times 1.9 = \text{approx. } 23 \text{ W}$

required torque:  $M = 23 \times 60 / (2 \pi 800) = \text{approx. } 0.28 \text{ Nm}$

tip speed: approx. 2.5 m/s

15 liter reactor with 2 turbine impellers of 75 mm:

required power at 800 rpm:  $P = 1100 \times (800/60)^3 \times (0.075)^5 \times 6 \times 1.9 = \text{approx. } 70 \text{ W}$

required torque:  $M = 70 \times 60 / (2 \pi 800) = \text{approx. } 0.85 \text{ Nm}$

tip speed: approx. 3.1 m/s

Note:

- In bacterial cultures, when aeration is approx. 2 VVM (2 gas volumes per reactor (working) volume per minute) the required motor power and torque will show a substantial decrease in relation to the calculated value.
- Friction in the (ball) bearings may cause power losses of 10 - 20 %.

### 5.3 AERATION:

To meet the oxygen demand of the culture, a sterile gas stream is sparged through the medium, using an air-inlet pipe.

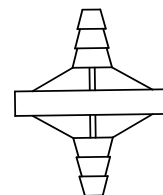
In Microbial applications, the bioreactor is normally aerated with a flow of 1 - 2 VVM (gas volume per reactor volume per minute).

#### GAS IN-/OUTLET FILTER:

The bacterial air filter is an economical filter for sterile gas delivery and venting applications. The hydrophobic PTFE filter membrane excludes the risk of contamination. Housing material: polypropylene. The filter is autoclavable.

Specifications:

Effective filtration area:	25 cm <sup>2</sup>
Pore size:	0.2 µm
Typical flow rate:	40 Lpm at 0.4 barg (6 psig)
Hose barb connection:	Stepped hose barbs: 7 / 9.5 mm
Maximum temp.	132 °C



Z811302030 Disposable air filter

Note: for venting applications, a condenser is applied in order to prevent the filter from becoming clogged with water.

#### SPARGER PIPE:

Spargers or gas inlet pipes are tubes that are immersed in the medium. Consequently the supplied gas is sparged through the medium. The sparger pipe causes only a low pressure drop in the aeration line. As a result, high gas flow rates (up to 2 VVM) can be achieved.

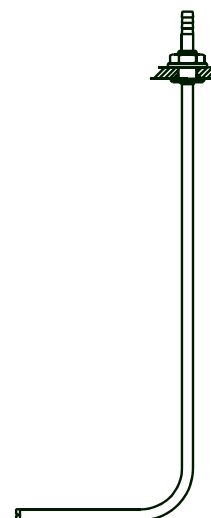
#### L-TYPE SPARGER:

The 1 liter reactor comes with an L- sparger that is fixed in the head plate.

The other Bio Bundles come with a sparger that is mounted in a 10 mm port of the head plate.

The aeration holes in the sparger pipe are located at the bottom; in this way medium will be driven out of the sparger by the gas stream.

Z81318L003	3 liter reactor, 10 mm port
Z81318L007	7 liter reactor, 10 mm port
Z81318L010	15 liter reactor, 10 mm port



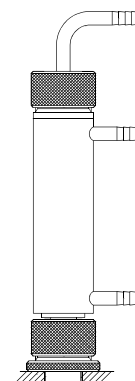
## AIR OUTLET CONDENSER:

Working at process temperature (37 °C), aeration of the medium will cause evaporation during fermentation (causing increase of nutrient concentration and decrease in volume); this effect is decreased by using an air-outlet condenser.

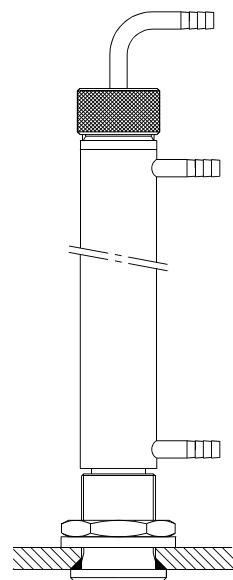
The stainless steel condenser fits into an M18 x 1.5 port

Z81308L002 SS condenser for 1 and 3 liter reactor, M18 x 1.5 port

Z81308L007 SS condenser for 7 liter reactor, M18 x 1.5 port



Z81308L010 SS condenser for 15 liter reactor, 27 mm port



## 5.4 ADDITION:

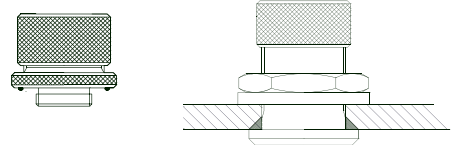
During preparation and while running a process, fluids need to be added to the reactor (medium addition, inoculation, pH and level control, perfusion, etc.).

Septum holder assembly:

The septum holder is equipped with a silicone rubber septum and can be used as a universal addition port by piercing it with one or more needles.

Z81302PD02 1, 3 and 7 liter reactor, M18 x 1.5 port

Z81302PD10 15 liter reactor, 27 mm port

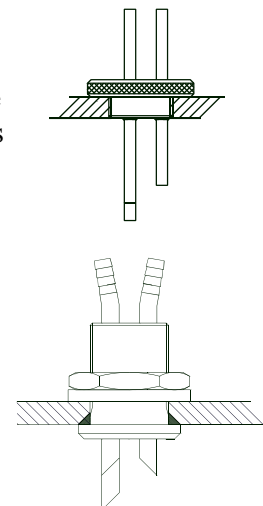


Medium inlet triple:

The medium inlet triple allows you to equip one head plate port with three additions (e.g. for acid, alkali and anti-foam addition). This device can be used to expand the number of entries beyond the number of ports in the head plate.

Z81324MT03 1, 3 and 7 liter reactor, M18 x 1.5 port

Z81324MT10 15 liter reactor, 27 mm port



### Liquid Addition Bottle:

Each Bio Bundle contains 2 pieces of the following liquid addition bottles:

Bundle 1, 3 and 7 liter: Z811302009: bottle 0.5 liter

Bundle 15 liter: Z811302010: bottle 1.0 liter

The liquid addition bottles come with an air-inlet filter.



### 5.5 SAMPLING & DRAIN:

The 1 liter Bio Bundle comes with a sample pipe that is fixed in the head plate of the reactor!

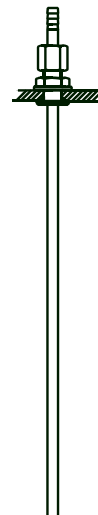
The other Bio Bundles come with a fixed length Sample pipe that is mounted in a 10 mm port of the head plate:

Tube diameter (O.D.): 6 mm

Z81319MB03 3 liter reactor, fits in a 10 mm port

Z81319MB07 7 liter reactor, fits in a 10 mm port

Z81319MB10 15 liter reactor, fits in a 10 mm port





## 5.6 HEAT EXCHANGERS:

In Microbial applications the heat exchanger is used for cooling purposes (in combination with the cold water valve in the ADI 1025 Bio Console).

The 1 liter Bio Bundle comes with an heat exchanger that is fixed in the head plate of the reactor!

The 3 liter Bio Bundle is equipped with a heat exchanger that fits in a M18 x 1.5 port in the head plate:

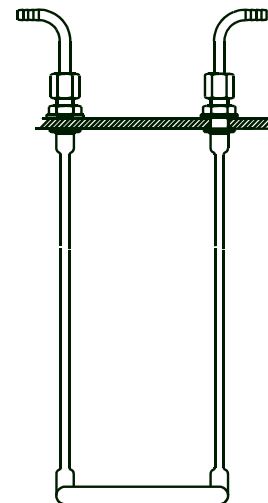
Z81317KV03 Heat exchanger for 3 liter reactor



The 7 and 15 liter Bio Bundle are equipped with a heat exchanger that fits in two 10 mm ports of the head plate:

Z81317HE07 Heat exchanger for 7 liter reactor

Z81317HE10 Heat exchanger for 15 liter reactor



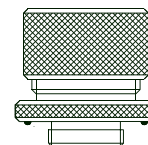
## 5.7 MISCELLANEOUS:

Sensor holders:

Nipple ID = 12 mm for M18 x 1.5 port:

This nipple fits into a M18 x 1.5 port and can accommodate electrodes (pH, dO<sub>2</sub>, etc.) and other 12 mm (O.D.) tubes.

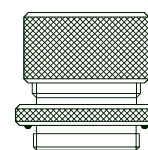
All items that are hold by this nipple are height-adjustable.



Z81300N002 1, 3 and 7 liter reactor, M18 x 1.5 port

Nipple ID = 12 mm for G3/4" port:

This nipple can be used to fit a pH or mV electrode or any other device with an OD of 12 mm (height-adjustable) to the G3/4" port.

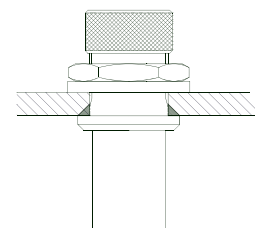


Z81300N005 1, 3 and 7 liter reactor, G3/4" port

Nipple ID = 12 mm for 27 mm port:

This nipple fits into a 27 mm port and can accommodate electrodes (pH, dO<sub>2</sub>, etc.) and other 12 mm (O.D.) tubes.

All items that are hold by this nipple are height-adjustable.



Z81300N011 15 liter reactor, 27 mm port

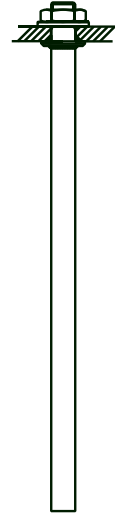
### Thermometer pocket:

Temperature measurement is achieved by inserting a Pt-100 temperature sensor in the temperature pocket. This pocket is normally filled with water (or silicone oil) in order to improve thermal contact between the medium and the sensor.

The 1 liter Bio Bundle comes with a thermometer pocket that is fixed in the head plate!

The 3, 7 and 15 liter Bio Bundle are equipped with a fixed length thermometer pocket that fits in a 10 mm port of the head plate of the reactor.

Z81323TP03	Thermometer pocket 3 liter reactor
Z81323TP07	Thermometer pocket 7 liter reactor
Z81323TP10	Thermometer pocket 15 liter reactor



Applied sensors (diameter of the pH and dO<sub>2</sub> electrodes = 12 mm):

Z71201AG12 Sensor pH+ (annular junction), L = 235 mm for 1 and 3 liter reactor  
Z71201AG22 Sensor pH+ (annular junction), L = 325 mm for 7 liter reactor  
Z001042551 Sensor pH+ (annular junction), L = 425 mm for 15 liter reactor  
Z71501AP10 Cable pH / dO<sub>2</sub>, L = 2 m

Z71202AP11 Sensor dO<sub>2</sub> (low drift), L = 235 mm for 1 and 3 liter reactor  
Z71202AP21 Sensor dO<sub>2</sub> (low drift), L = 385 mm for 7 liter reactor  
Z71202AP31 Sensor dO<sub>2</sub> (low drift), L = 590 mm for 150 liter reactor  
Z71501AP10 Cable pH / dO<sub>2</sub>, L = 2 m

Z71204T002 Sensor temperature (Pt-100), L = 200 mm

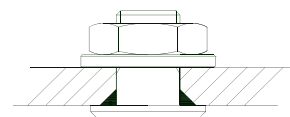
Z711202001 Level Detector M18 x 1.5 port for 1 liter reactor  
Z711203001 Level Detector 10 mm port for 3 and 7 liter reactor  
Z711210001 Level Detector 10 mm port for 15 liter reactor

Blind stoppers:

Blind stoppers 10, 12, and 27 mm ports:

These blind stoppers can be used to blind unused ports in the head plate; the assemblies are fitted into the head plate from the inside of the reactor, leaving only a flat surface in the reactor.

Z81322BP03 10 mm port, 3, 7 and 15 liter reactor (2 pcs. in the 3 and 7 liter Bundle, 1 pc. in the 15 liter Bundle)  
Z81322BP08 12 mm port, 2 - 20 liter reactor (2 pcs. per 3, 7 and 15 liter Bundle)  
Z81322BP10 27 mm port, 15 liter reactor (1 pc. In the 15 liter Bundle)



Blind stopper threaded ports:

The following blind stoppers are available for the threaded ports:

Z81301BD02 M18 x 1.5 port, 7 liter reactor (1 pc per Bundle)



## 5.8 START-UP KIT:

The BioBundle comes with a "Start-Up Kit" to assist in system set-up. It contains various hoses, clamps, O-rings and other necessary components for the BioBundle.

### START-UP KIT 1 AND 3 LITER BIO BUNDLE:

Article Number	Quantity	Description	Material / Type
V1S4135X40	2	O-Ring	Silicone / 135.00 x 4.00
V1S4ARP023	2	O-Ring	Silicone / 26.70 x 1.78
V1S4020X20	10	O-Ring	Silicone / 20.00 x 2.00
V1S4085X25	12	O-Ring	Silicone / 8.50 x 2.50
V1S4ARP111	4	O-Ring	Silicone / 10.77 x 2.62
V1SA057X19	6	O-Ring	Silicone / 5.70 x 1.90
V1S4ARP124	2	O-Ring	Silicone / 31.42 x 2.62
V1S400PDR2	8	Rubber Septum	Silicone
V3MA000031	2	Clamping Ring	Viton
V1S1302007	4	Lipseal Ring	FPM
V1S1302001	2	Lipseal Ring	FPM
V0R9900101	1	Allen Wrench	1.5 mm
V0M5219025	150 cm	Tubing	Silicone
V0M5217215	500 cm	Tubing	Neoprene
V0M5217000	500 cm	Tubing	Neoprene
V0W0530004	1	Reducer	male-male 1/8" - 3/16"
V0W0430001	1	T-Connector	3/16" - 3/16" - 3/16"
V0W0430002	2	T-Connector	1/8" - 1/8" - 1/8"
V0W0530005	3	Reducer	male-male 1/16" - 3/16"
V0W0700001	6	Tubing Clamp	
V0R1451010	25	Cable Ties	92 x 2.4 mm
V0R9900007	1	Component Storage Box	19 compartments

Z81100AK10 Start-Up Kit for Autoclavable 1- 3 liter systems

**START-UP KIT 7 LITER BIO BUNDLE:**

Article Number	Quantity	Description	Material / Type
V1S4ARP260	2	O-Ring	Silicone / 164.70 x 3.53
V1S4ARP023	2	O-Ring	Silicone / 26.70 x 1.78
V1S4020X20	10	O-Ring	Silicone / 20.00 x 2.00
V1S4ARP111	4	O-Ring	Silicone / 10.77 x 2.62
V1S4085X25	12	O-ring	Silicone / 8.50 x 2.50
V1S4ARP124	2	O-Ring	Silicone / 31.42 x 2.62
V1S400PDR2	8	Rubber Septum	Silicone
V3MA000031	2	Clamping Ring	Viton
V1S1302007	4	Lipseal Ring	FPM
V1S1302001	2	Lipseal Ring	FPM
V0R9900101	1	Allen Wrench	1.5 mm
V0M5219025	150 cm	Tubing	Silicone
V0M5217215	500 cm	Tubing	Neoprene
V0M5217000	500 cm	Tubing	Neoprene
V0W0530004	1	Reducer	male-male 1/8" - 3/16"
V0W0430001	1	T-Connector	3/16" - 3/16" - 3/16"
V0W0430002	2	T-Connector	1/8" - 1/8" - 1/8"
V0W0530005	3	Reducer	male-male 1/16" - 3/16"
V0W0700001	6	Tubing Clamp	
V0R1451010	25	Cable Ties	92 x 2.4 mm
V0R9900007	1	Component Storage Box	19 compartments

Z81100AK20 Start-Up Kit for Autoclavable 7 liter systems

**START-UP KIT 15 LITER BIO BUNDLE:**

Article Number	Quantity	Description	Material / Type
V1S4ARP373	2	O-Ring	Silicone / 227.97 x 5.33
V1S4ARP121	12	O-Ring	Silicone / 26.65 x 2.62
V1S4ARP145	2	O-Ring	Silicone / 64.77 x 2.62
V1S4ARP111	4	O-Ring	Silicone / 10.77 x 2.62
V1S4085X25	16	O-ring	Silicone / 8.50 x 2.50
V1S400PDR7	8	Rubber Septum	Silicone
V1S1310014	4	Lipseal Ring	FPM
V1S1310020	2	Lipseal Ring	FPM
V0R9900102	1	Allen Wrench	2.0 mm
V0M5219025	150 cm	Tubing	Silicone
V0M5217215	500 cm	Tubing	Neoprene
V0M5217000	500 cm	Tubing	Neoprene
V0W0530004	1	Reducer	male-male 1/8" - 3/16"
V0W0430001	1	T-Connector	3/16" - 3/16" - 3/16"
V0W0430002	2	T-Connector	1/8" - 1/8" - 1/8"
V0W0530005	3	Reducer	male-male 1/16" - 3/16"
V0W0700001	6	Tubing Clamp	
V0R1451010	25	Cable Ties	92 x 2.4 mm
V0R9900007	1	Component Storage Box	19 compartments

Z81100AK30 Start-Up Kit for Autoclavable 15 liter systems

## CHAPTER 6

# OPTIONAL ITEMS & PACKAGES

The contents of the Bio Bundles for Microbial Applications can be extended by the following items and packages:

### 6.1 ADDITION: NEEDLE FOR SEPTUM:

#### Z81309IN02

The needle is used to pierce the septum and to add a fluid or gas to the culture.

Z81309IN02 Needle for septum



### 6.2 TEMPERATURE CONTROL: THERMO-CIRCULATOR PACKAGE:

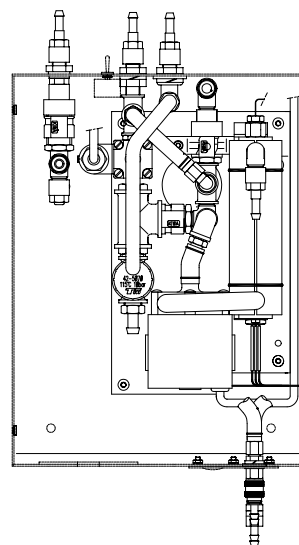
#### \*\* Z4JACKET010 The Thermo-Circulator package for Microbial Bundle 3 Liter

includes:

Z310180080	ADI 1018 thermo-circulator module
Z310180050	Water pressure reducer
Z61103CT04	Bioreactor 3L Jacketed
Z81301BD02	Blind Stopper M18 x 1.5

replaces:

Z61101C006	Bioreactor 3L
Z311020030	Silicone heating blanket 3l
Z311303010	Cold water valve
Z81317KV03	Heat exchanger for bioreactor 3L





**\*\* Z4JACKET011      The Thermo-Circulator package  
for Microbial Bundle 7 Liter**

includes:

Z310180080    ADI 1018 thermo-circulator module  
Z310180050    Water pressure reducer  
Z61103CT07    Bioreactor 7L Jacketed  
Z81301BD02    2 Blind Stoppers M18 x 1.5

replaces:

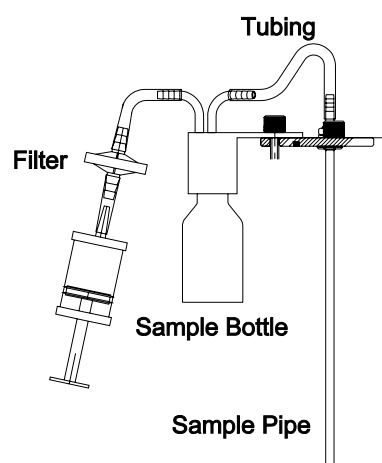
Z611000006    Bioreactor 7L  
Z311020072    Silicone heating blanket 7L  
Z311303010    Cold water valve  
Z81317HE07    Heat exchanger for bioreactor 7L

**6.3 SAMPLING PACKAGE:**

**Z4SAMP0010 Sampling package**

includes:

Z81207SS02    Sample system for Autoclavable  
Bioreactors  
Z81207BT30    (5x) sample bottles, 30 ml



### 6.4 MAGNETICALLY COUPLED STIRRER ASSEMBLY:

#### Z4MAGC0010 Magnetically Coupled Stirrer Assembly 3L Reactor

Includes:

Z81315MG03 Stirrer Assembly Magnetically Coupled 3 Liter  
Reactor

Replaces:

Z81315R003 Stirrer Assembly Lip Seal 3 Liter Reactor

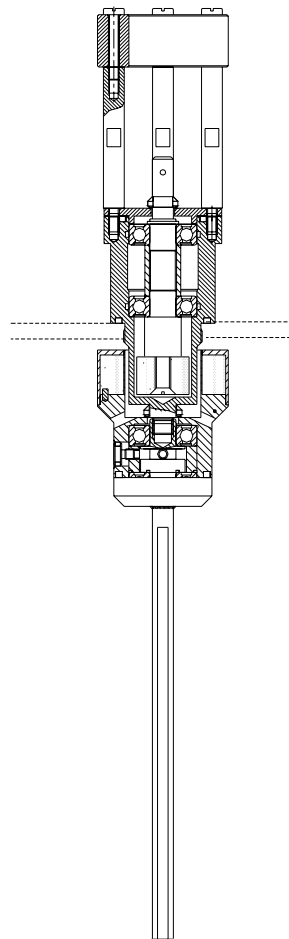
#### Z4MAGC0020 Magnetically Coupled Stirrer Assembly 7L Reactor

Includes:

Z81315MG07 Stirrer Assembly Magnetically Coupled 7 Liter  
Reactor

Replaces:

Z81315R007 Stirrer Assembly Lip Seal 7 Liter Reactor



## 6.5 BIO BUNDLE SOFTWARE PACKAGE:

### Z4BIOX0020 BioBundle Software package 2 (for Windows NT, 2000 or XP)

includes:

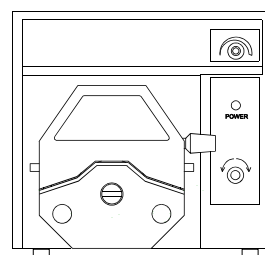
Z590007120 Applikon BioXpert v.2 (Supervisory Control & Data Acquisition)  
Z510203160 RS 232 cable to PC

## 6.6 VARIABLE SPEED PUMP PACKAGE (STAND ALONE):

### \*\* Z4VARSP010 Variable-speed pump package

includes:

Z510100050 Analog output 4-20 mA  
Z510100240 Cable external analog outputs ADI 1025  
Z377521570 Variable-speed pump 1 - 100 rpm  
Z375180000 Easy-load pump head  
V1LE085051 Internal Cable ADI 1025 for variable-speed pump



Note:

The variable-speed pump is connected to one of the four analog outputs in the AD 1010 Power Unit.

## 6.7 ADDITION TO THE STANDARD IQ/OQ DOCUMENTATION:

In order to obtain adequate IQ/OQ documentation, the option packages marked with \*\* must be ordered with the item: Z4IQOQ0020 IQ/OQ documents.

## CHAPTER 7

# INSTALLATION

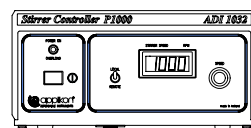
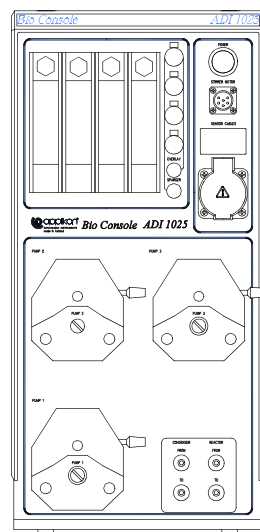
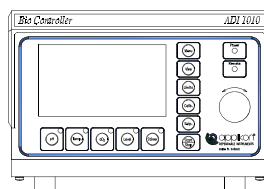
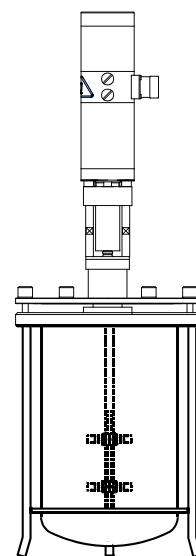
An ADI Autoclavable Bio Bundle consists of the following components:

- a Bio Reactor with Head Plate Auxiliaries (like a stirrer assembly, air-inlet filter with sparger tube, condenser with air-outlet filter, triple inlet for addition, sample tube, sensors, etc.) and stirrer motor.
- an ADI 1010 Bio Controller with a Power Unit to amplify the Controller Output signals.
- an ADI 1025 Bio Console to support actuators like rotameters, mass flow controllers, heating blankets, pumps for acid, base and anti-foam addition and a thermo circulator for heating and cooling.

Note:

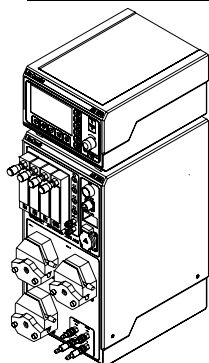
The ADI 1010 Power Unit is mounted inside the ADI 1025 Bio Console (at the rear).

- (only in case of the 15 liter Bio Bundle) an ADI 1032 external Stirrer Speed Controller.



Installation of the described equipment is listed in the next paragraphs.

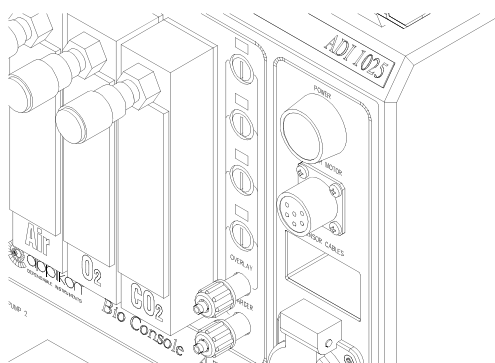
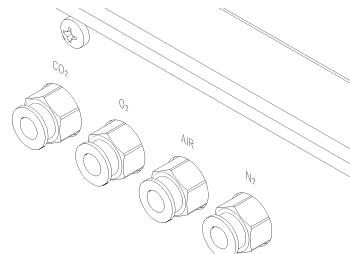
## 7.1 BIO REACTOR SYSTEM WITH INTERNAL STIRRER CONTROLLER:



Connection of the gasses (air, O<sub>2</sub>, N<sub>2</sub>, CO<sub>2</sub>):

Connect the gas supply lines to the rear side of the ADI 1025 Bio Console using OD 6 mm air tube.

Required inlet pressure per gas: 2 barg (29 psi).



At the front of the ADI 1025 Bio Console a gas selection block can be found that is used to direct each individual gas to either overlay or sparger.

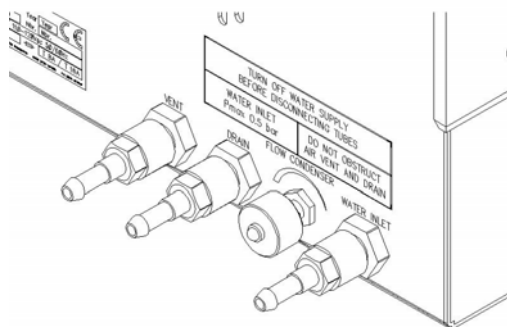
Connect the gas outlet(s) at the front of the ADI 1025 to the sparger / overlay of the reactor using flexible tubing.

Open the different gas supply lines to the ADI 1025 Bio Console.

Connection of tap water supply (application of Cold Water Valve):

Connect the tap water supply to the rear of the ADI 1025 Bio Console. Hose barb size: 6 mm. Apply a hose clamp to secure the tubing on the Water Inlet bulkhead connector.

Connect the Drain bulkhead connector to a sink using flexible tubing.

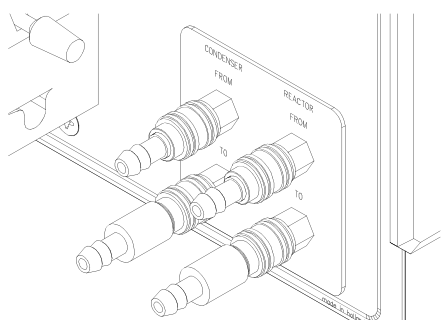


In case the Thermo

Circulator is applied as an option in combination with a jacketed reactor, the water inlet pressure must be reduced to 0.5 barg (7 psi)!

A water inlet pressure reducer is part of the Thermo Circulator option.

For more information concerning the ADI 1018 Thermo Circulator, refer to the ADI 1018 User Manual!



## Water to and from reactor / condenser:

Use flexible tubing to connect the water outlets (quick connectors) to and from the reactor (heat exchanger) and condenser; apply hose clamps to secure the tubing.

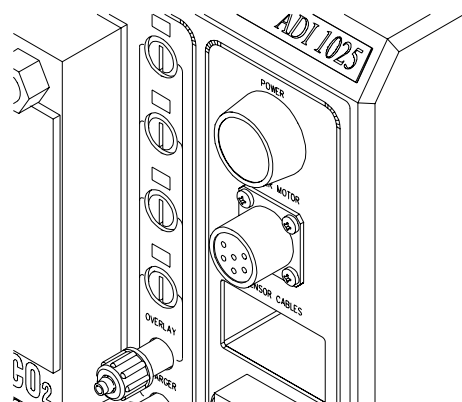
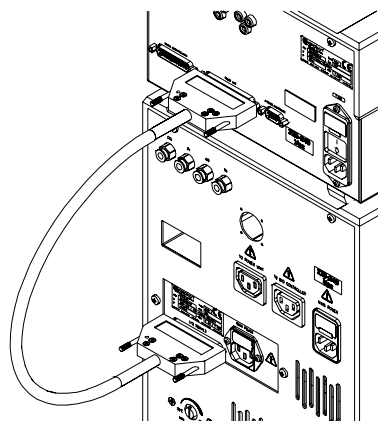
### Note:

The quick connectors to reactor and condenser contain a valve in the removable hose barb in order to prevent draining of the jacket or condenser.

Open the tap water supply.

## I/O cable between ADI 1010 Bio Controller and ADI 1010 Power Unit:

Connect the I/O cable between the rear of the ADI 1010 Bio Controller and the rear of the ADI 1010 Power Unit (mounted inside the ADI 1025 Bio Console).

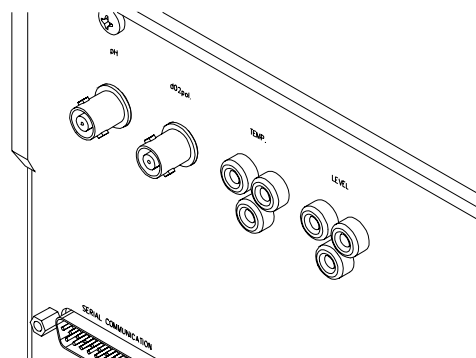


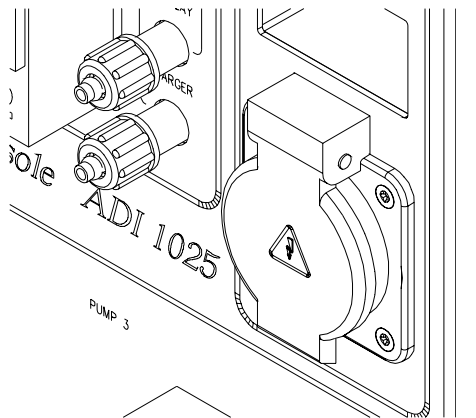
## Stirrer motor cable:

Connect the Stirrer Motor cable to its connector at the front of the ADI 1025 Bio Controller (just below the power switch).

## Sensor cables:

Connect the sensor cables (pH, temperature, dO<sub>2</sub> and level) through the cable tunnel at the rear side of the ADI 1010 Bio Controller.





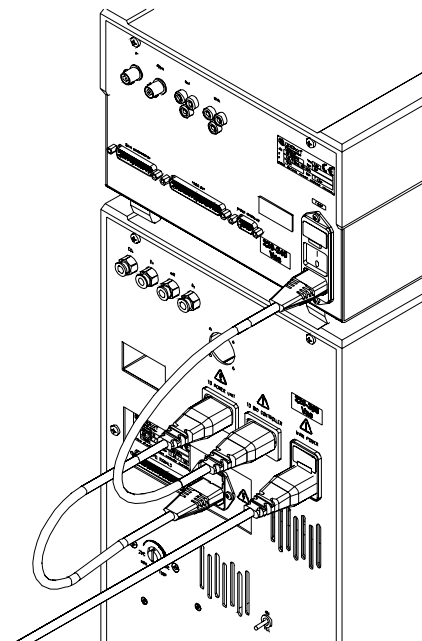
**Heating blanket:**  
Connect the heating blanket to the controlled supply socket at front of the ADI 1025 Bio Console.

**Main power supply:**

Connect a power cord in order to connect the (euro) main power inlet of the ADI 1025 Bio Console to a wall socket. Do not yet switch on the main switch of the ADI 1025.

Use a power cord to connect the main power outlet of the ADI 1025 with the power inlet of the ADI 1010 Bio Controller.

Use a power cord to connect the main power outlet of the ADI 1025 with the power inlet of the ADI 1010 Power Unit.

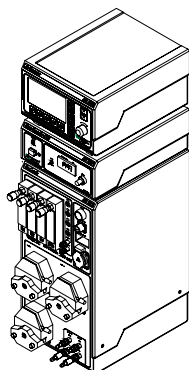


The ADI 1010 Bio Controller with ADI 1025 Bio Console are now ready for operation.

**Note:**

Pump tubes are normally inserted after autoclaving!

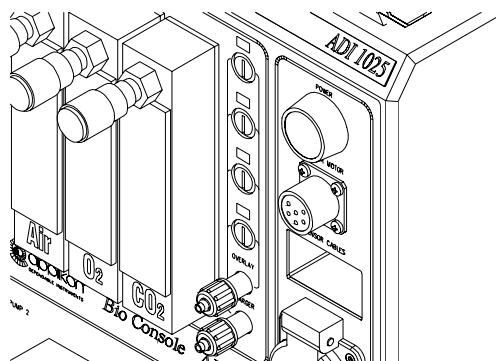
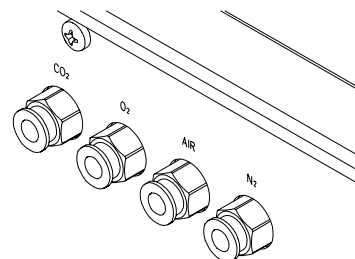
## 7.2 BIO REACTOR SYSTEM WITH EXTERNAL STIRRER CONTROLLER:



Connection of the gasses (air, O<sub>2</sub>, N<sub>2</sub>, CO<sub>2</sub>):

Connect the gas supply lines to the rear side of the ADI 1025 Bio Console using OD 6 mm air tube.

Required inlet pressure per gas: 2 barg.



At the front of the ADI 1025 Bio Console a gas selection block can be found that is used to direct each individual gas to either overlay or sparger.

Connect the gas outlet(s) at the front of the ADI 1025 to the sparger / overlay of the reactor using flexible tubing.

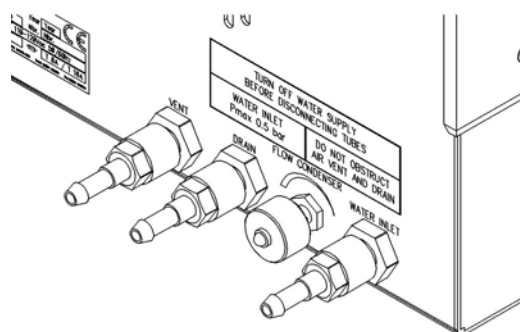
Open the different gas supply lines to the ADI 1025 Bio Console.

Connection of tap water supply (application of Cold Water Valve):

Connect the tap water supply to the rear of the ADI 1025 Bio Console. Hose barb size: 6 mm.

Apply a hose clamp to secure the tubing on the Water Inlet bulkhead connector.

Connect the Drain bulkhead connector to a sink using flexible tubing.

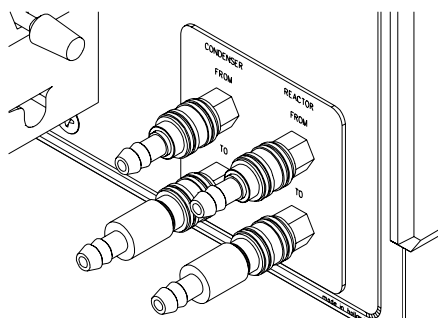


In case the Thermo Circulator is applied as an option in combination with a jacketed reactor, the water inlet pressure must be reduced to 0.5 barg (7 psi)!

A water inlet pressure reducer is part of the Thermo Circulator option.

For more information concerning the ADI 1018 Thermo Circulator, refer to the ADI 1018 User Manual!





Water to and from reactor and condenser:

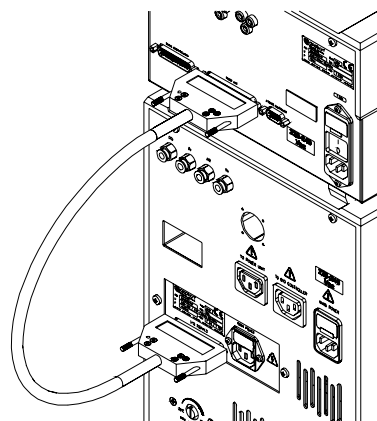
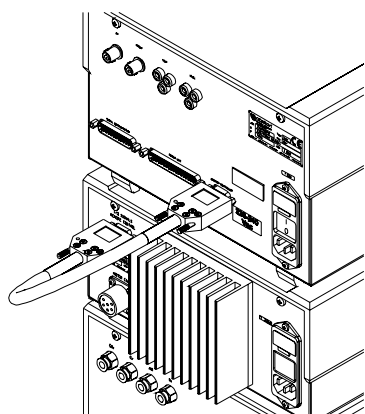
Use flexible tubing to connect the water outlets (quick connectors) to and from the reactor (jacket or heat exchanger) and condenser; apply hose clamps to secure the tubing.

Note:

The quick connectors to reactor and condenser contain a valve in the removable hose barb in order to prevent draining of the jacket or condenser. Open the tap water supply.

I/O cables:

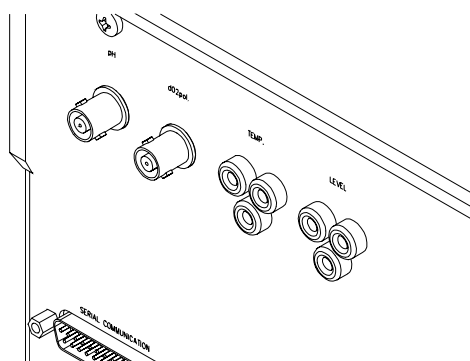
Connect the I/O cable between the rear of the ADI 1010 Bio Controller and the rear of the ADI 1010 Power Unit (mounted inside the ADI 1025 Bio Console).

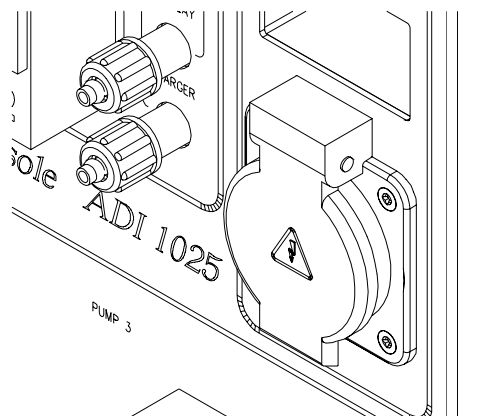


Connect the stirrer control cable (2 x 9 pins sub-D) between the ADI 1010 stirrer control output and the ADI 1032 Stirrer Controller (rear side).

Sensor cables:

Connect the sensor cables (pH, temperature, dO<sub>2</sub> and level) through the cable tunnel at the rear side of the ADI 1010 Bio Controller.





**Heating blanket:**  
Connect the heating blanket to the controlled supply socket at front of the ADI 1025 Bio Console.

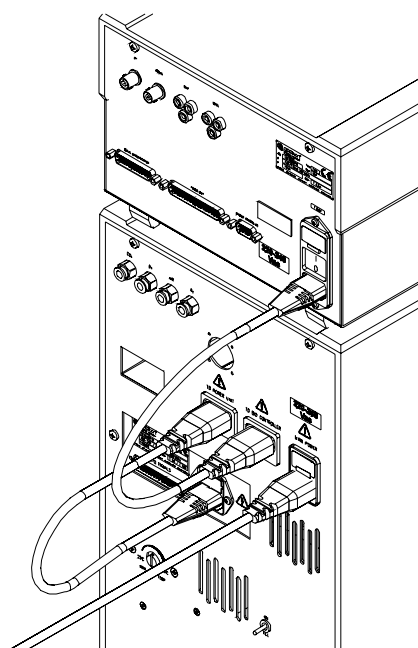
## Main power supply:

Connect a power cord in order to connect the (euro) main power inlet of the ADI 1025 Bio Console to a wall socket. Do not yet switch on the main switch of the ADI 1025.

Use a power cord to connect the main power outlet of the ADI 1025 with the power inlet of the ADI 1010 Bio Controller.

Use a power cord to connect the main power outlet of the ADI 1025 with the power inlet of the ADI 1010 Power Unit.

Connect the power cord of the ADI 1032 Stirrer Speed Controller to a wall socket.



The ADI 1010 Bio Controller with ADI 1025 Bio Console and ADI 1032 Stirrer Controller are now ready for operation.

## Note:

Pump tubes are normally inserted after autoclaving!

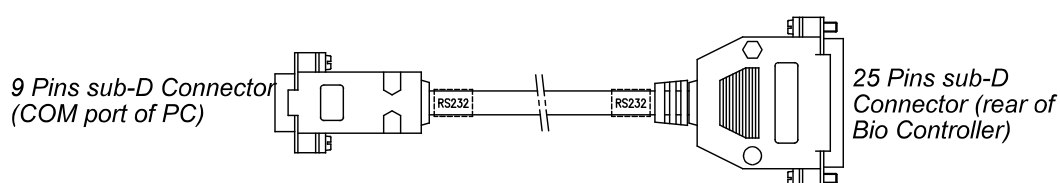
### 7.3 SERIAL COMMUNICATION BETWEEN ADI 1010 AND HOST COMPUTER:

The ADI 1010 Bio Controller can communicate with a Host Computer through serial communication; communication types:

- RS 232 (one-to-one connection of the Bio Controller to the Host)
- RS 422 (up to 10 Bio Controllers connected to a Host using the multi-drop principle)
- RS 485 (up to 32 Bio Controllers connected to a Host through a network)

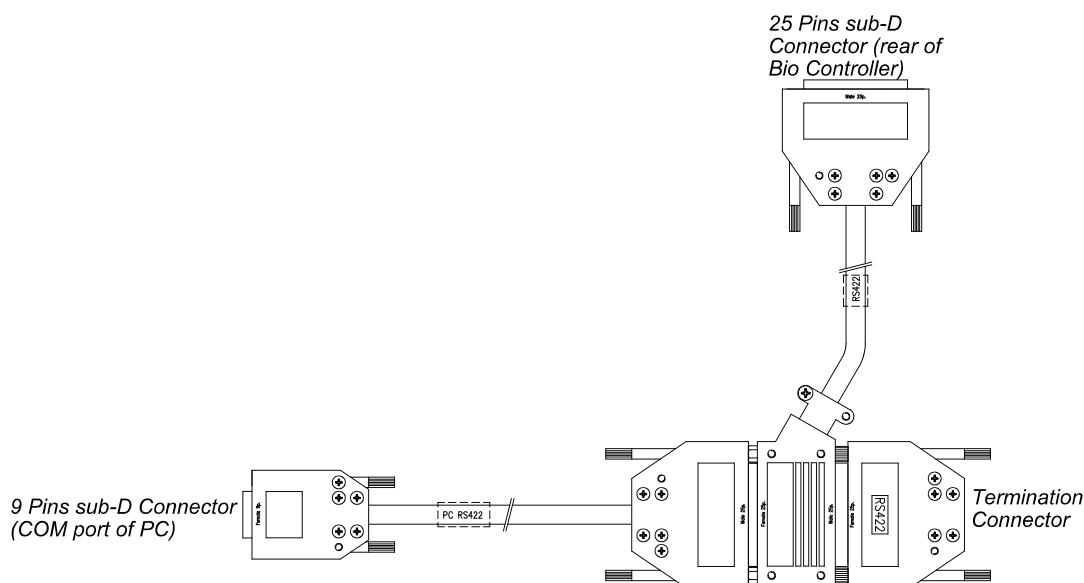
Below the cable configuration for the different types of serial communication is described:

#### RS232 Communication:



Z510203160: Data Cable RS232 25 - 9 Pins

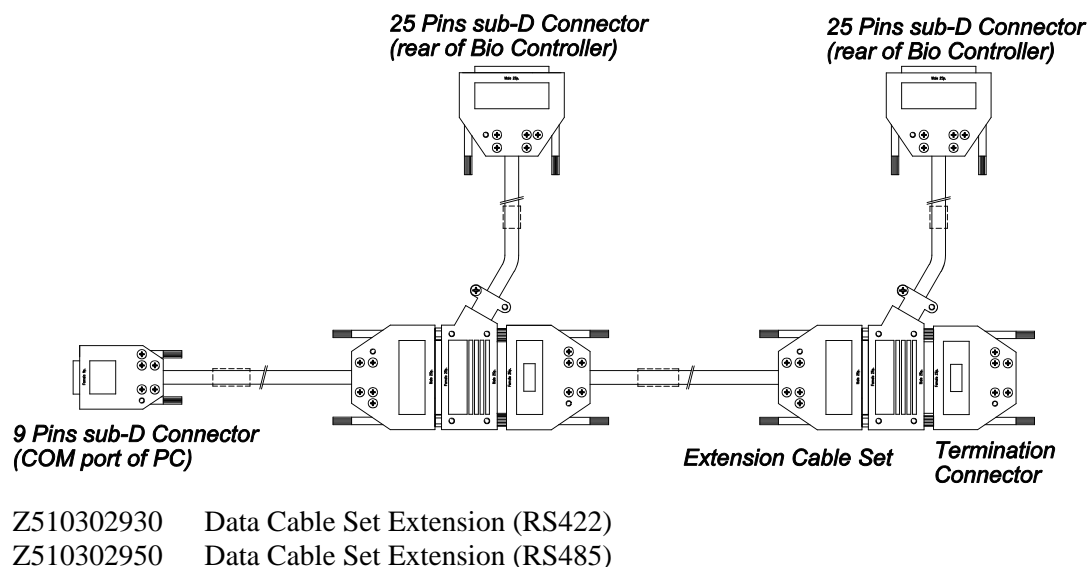
#### RS422/485 Communication (one to one connection):



Z510302910 Data Cable Set P.C. - ADI 1010 (RS422)

Z510302940 Data Cable Set P.C. - ADI 1010 (RS485)

## RS422/485 Communication (network connection):



### Note:

- By adding one Extension Cable Set, the network can be extended with one extra Bio Controller.
- In case more than one Bio Controller is applied in a network, each Bio Controller must have a specific Node Number; this Node Number value can be set between 1 and 99 using the Menu option of the ADI 1010 Bio Controller. For more information concerning the Node Number setting, refer to chapter 2 of the Firmware Reference Manual (Menu Options)

### Note:

- The type of serial communication mode & protocol (RS232/422/485) must be selected with jumpers on the Interface Board of the ADI 1010 Bio Controller (refer to chapter 2.4 of this manual).

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## 7.4 ENVIRONMENTAL CONDITIONS:

The ADI autoclavable Bio Reactor Systems may be used at locations with the following environmental conditions:

- Indoor use,
- Altitude: up to 2000 m,
- Temperature: 4°C to 45°C,
- Maximum relative humidity 80% for temperatures up to 31°C, decreasing linearly to 50% relative humidity at 45°C,
- Mains supply voltage: 115/230 VAC (+15%/-20%), 50/60Hz,
- Transient over voltages according to INSTALLATION CATEGORIES II,
- POLLUTION DEGREE 2 in accordance with IEC 664,
- P-max = 2875 VA.

## 7.5 CLEANING INSTRUCTIONS:

The ADI autoclavable Bio Reactor Systems (controller(s) and console) may be cleaned with a moist tissue in combination with a non-abrasive cleaner.