



sartorius stedim  
biotech

## BIOSTAT<sup>®</sup> B-DCU

The Industry Standard Bioreactor for Advanced  
Process Optimization and Characterization



turning science into solutions

## BIOSTAT® B-DCU at a Glance

The BIOSTAT® B-DCU is a fermenter | bioreactor specifically designed to accommodate the broad requirements of process optimization and characterization in the biotech and biopharmaceutical industry. It provides enhanced functionality and an unrivalled level of options for cell culture and microbial processes, making it the ideal scale-down model for your large scale process.



### **Advanced sensor and software integration**

Reveal more information about your process and increase manufacturing efficiency and productivity. Facilitate development of advanced, automated process control strategies to improve titer and quality, and to reduce human error.

### **Broad range of process control strategies**

Mimic your large scale process control approach and generate representative data. Benefit from our fully flexible aeration and feeding options.

### **Connectivity to supervisory systems**

Easily connect your BIOSTAT® B-DCU to our BioPAT® MFCS or third party supervisory software like DeltaV™. Straightforward integration into existing automation infrastructure provides you with data consistency across scales and throughout the entire development process.

### **Industry standard technologies**

Reliable technologies ensure hassle-free process optimization and characterization. Benefit from decades of experience in the biopharmaceutical industry.



*Parallel operation of up to six vessels*

Save valuable bench space by equipping your BIOSTAT® B-DCU with up to six bioreactor stations that are controlled independently from each other. Benefit from interchangeability of our UniVessel® Glass and UniVessel® SU.



## Scalability and Data Integrity

- Geometrical similarity of vessel design
- Consistent mixing and gassing strategies
- Similar user interface and controllers



Clone Screening | Media and Feed Optimization

Process Development | Process Parameter Optimization

Clinical Trial

### BioPAT® MFCS – Turnkey SCADA Solution for Reliable

**Accelerated process development and process transfer require seamless scalability and integration of process data & controls.**

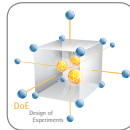
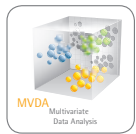
BioPAT® MFCS provides modules to meet your particular requirements. Designed as a "plug-and-play" tool, it is ideally suited for capturing, storing and visualizing process data of your BIOSTAT® B-DCU and other process equipment including 3<sup>rd</sup> party units.

This software enhances your ability to build your own SCADA network using our preconfigured and bioprocess optimized solution.

The advanced 21 CFR Part 11 compliant BioPAT® MFCS suite is a GAMP category 4 software package capable of supporting the most demanding research or production environment.

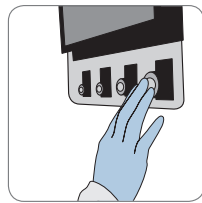
Besides the core functionality of a full-fledged SCADA system, BioPAT® MFCS in combination with the BioPAT® DCU is the most cost-effective and flexible platform specifically tailored for bioprocessing applications.



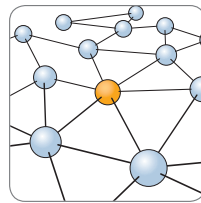


**Manufacturing**      **Process Characterization | Robustness Testing**      **Commercial Manufacturing**

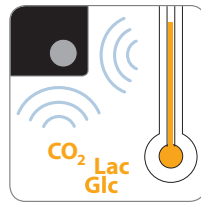
**Supervisory Control and Data Acquisition**



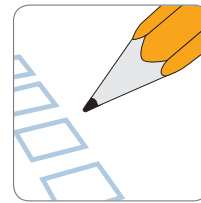
S88 recipe



Network



Connectivity



21 CFR Part 11

## Freely Configurable

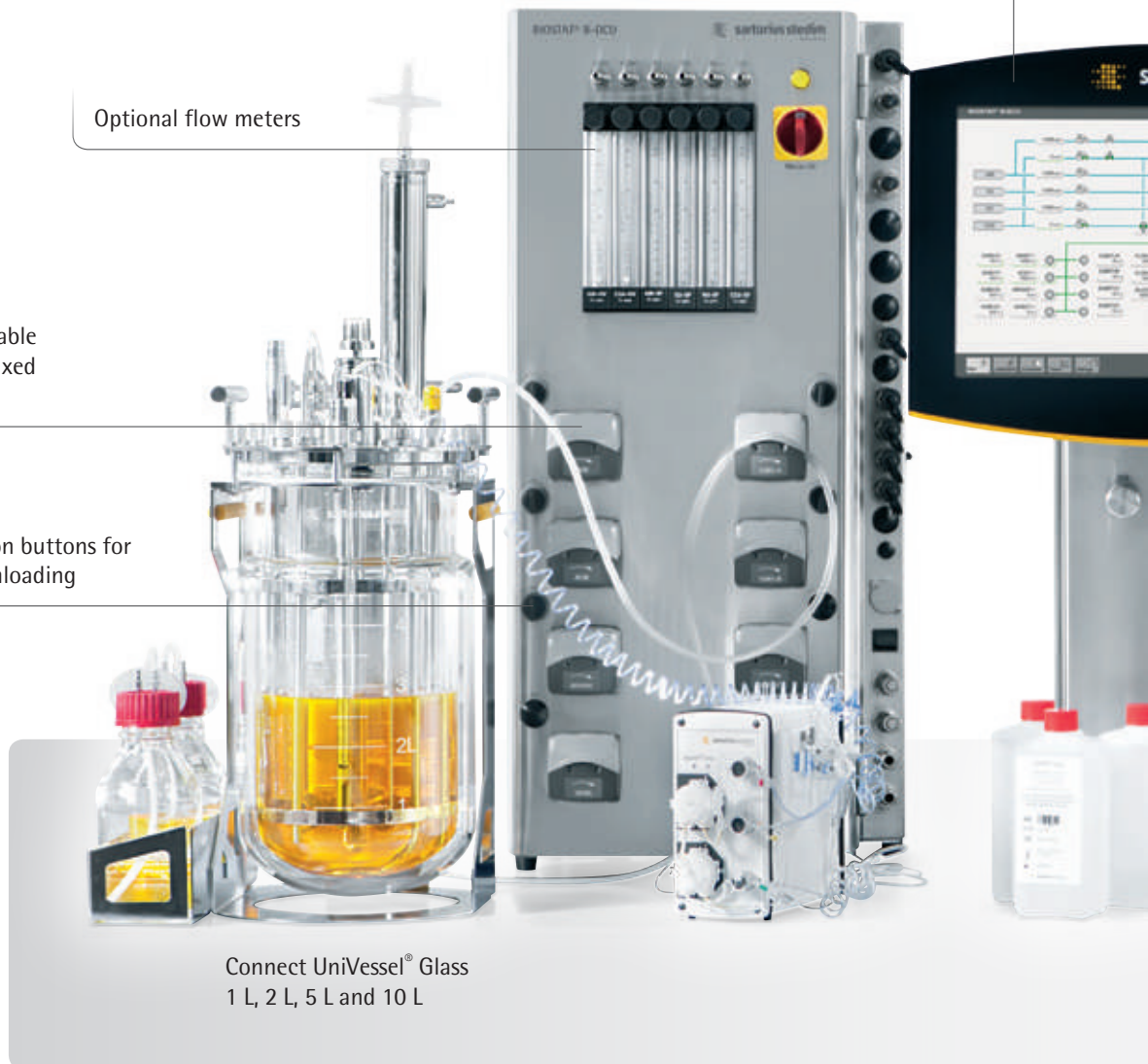
Numerous configurations are available to enable different kinds of process control strategies, which make the BIOSTAT® B-DCU the ideal scale-down and scale-up bioreactor system for all kind of microbial and cell culture processes.

Comfortable operation with a 19" display that can also be operated with gloves

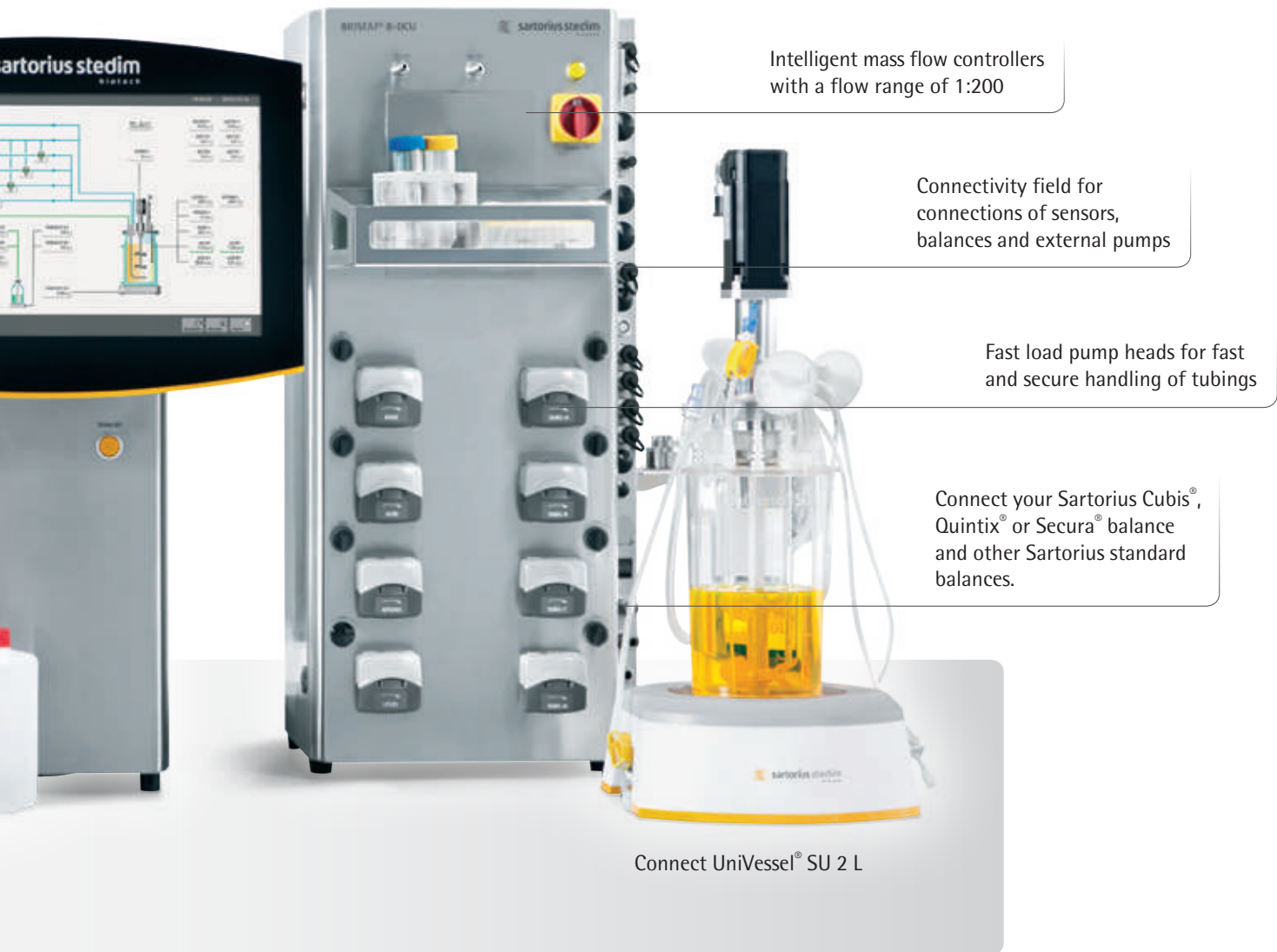
Optional flow meters

Choose up to four variable speed and up to four fixed speed pumps

Manual operation buttons for tube loading | unloading



Connect UniVessel® Glass  
1 L, 2 L, 5 L and 10 L

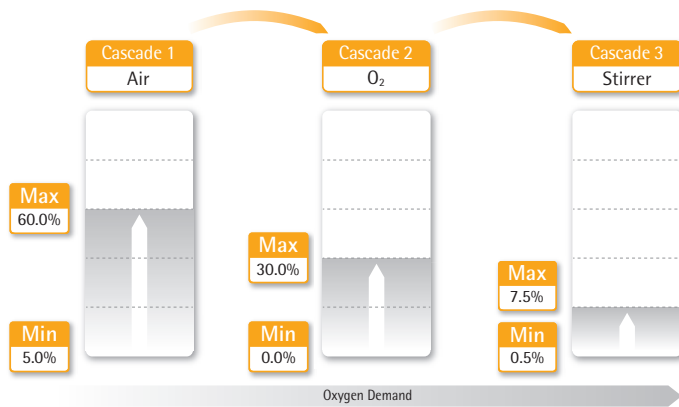


# Freely Configurable Gassing Lines

Intelligent mass flow controllers with a 1:200 flow range give you more flexibility in finding the optimal aeration strategy and enable a higher precision for more reliable and scalable processes. Moreover, not securely closing mass flow controllers are now a thing of the past, making additional

solenoid valves redundant. With mass flow controllers becoming a standard, the importance of flow meters for gas flow monitoring and control is decreasing. You can freely choose, if you want your BIOSTAT® B-DCU gassing lines being equipped with or without flow meters.

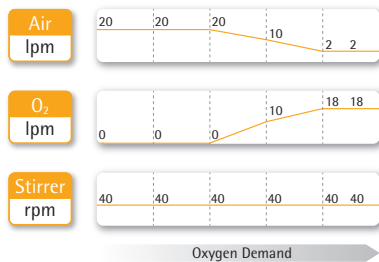
## Cascade Gassing Control



Automatic DO control is one of the most important functionalities of a bioreactor. It is designed to alter the volumetric oxygen transfer rate in order to meet process oxygen demands. As the measured DO moves off the set point, the system will change a parameter (over a defined range) such as the stirrer speed, air flow or oxygen percentage in order to re-establish the DO set point. Each parameter is placed in a cascade order. Once the parameter's limit has been reached the BIOSTAT® B-DCU will shift to the next cascade until reaching the set point.

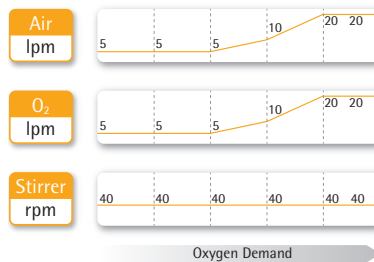
## Advanced DO Control

### Constant Gas Flow



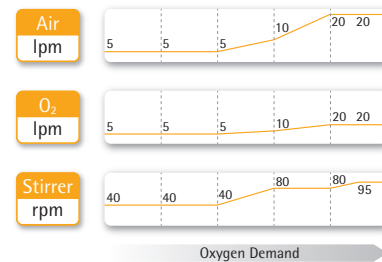
Constant gas flow decreases the flow of air and simultaneously increases oxygen flow keeping the total gas flow constant.

### Constant Gas Ratio



Constant gas ratio, increases both air and oxygen flows at the same rate keeping the ratio constant

### Bubble Size Optimization



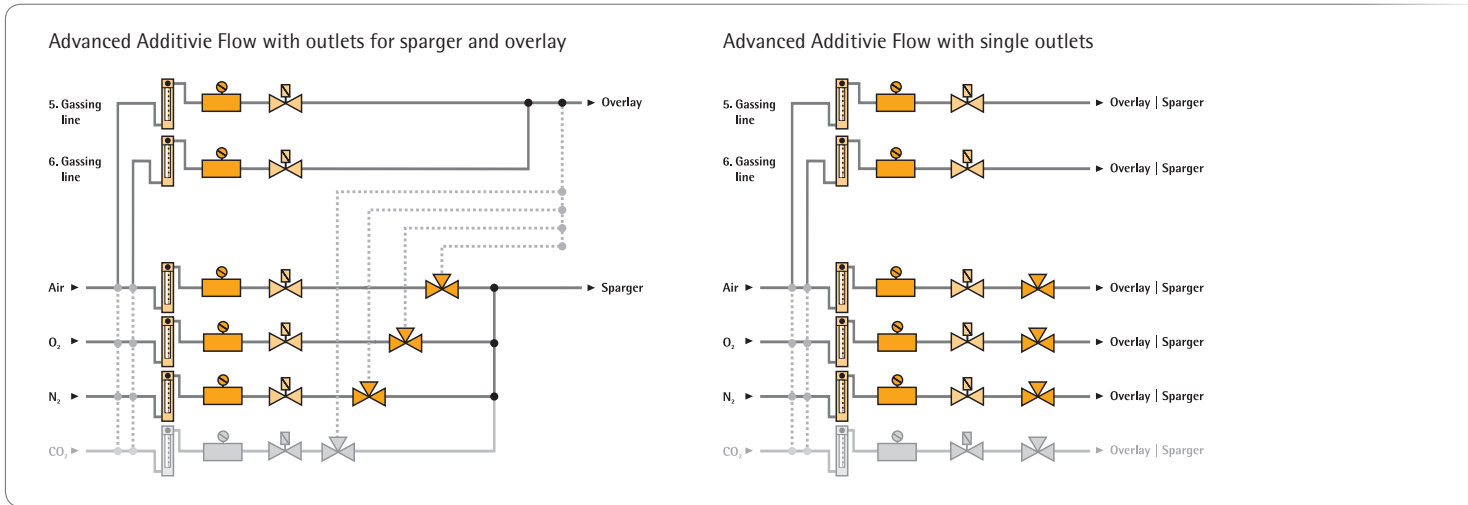
Bubble size optimization enables fine tuning of the oxygen percentage and gas-liquid interface area

Compared to the classic DO control cascade, the advanced DO control allows parallel modification of all physical parameters such as stirrer speed, aeration rate for air | oxygen or other parameters.

This allows simultaneous activation or change of multiple parameters. Therefore, allowing you to perform all gassing strategies and to be resource efficient.



## Aeration Modules for Cell Culture



Our Advanced Additive Flow module is available with two gas outlets for sparger and overlay or with a single outlet per gassing line.

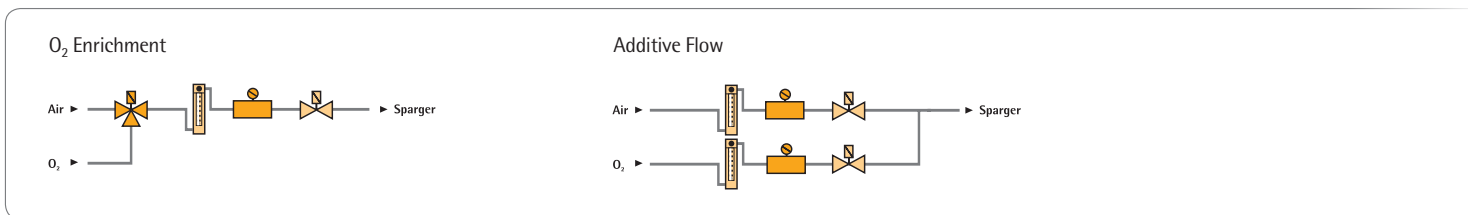
This gassing strategy allows to direct air, O<sub>2</sub>, N<sub>2</sub> and CO<sub>2</sub> to the sparger and to the overlay. Intelligent mass flow controllers can be installed for each flow path, and gas switching between overlay and sparger is available. Two additional gas flow paths

can be freely configured. This enables a maximum in operation flexibility: low flow and high flow aeration applications are possible with the same aeration system.

In combination with the new mass flow controller flow range of 1:200, you can run 1 L cell cultivations and 10 L microbial fermentations in the same BIOSTAT® B-DCU system.

The detailed design of the Advanced Additive Flow gassing approach depends on the configuration you select. Please contact your local Sartorius representative for further details.

## Aeration Modules for Microbial Fermentation



The Additive Flow strategy for microbial applications allows individual flow rate control for air and O<sub>2</sub> to a sparger outlet.

Our O<sub>2</sub> Enrichment module uses a 3 | 2-way solenoid valve to select either an air or O<sub>2</sub> flow to the sparger. O<sub>2</sub> is pulsed via a solenoid valve, when required to maintain the dissolved oxygen setpoint. Air is not provided at this time.

An intelligent mass flow controller can be integrated to measure and control the total gas flow rate via manual adjustment or automatically in conjunction with the controller, based on the signal from the DO probe and the selected setpoint.

## Risk is Inverse to Process Understanding

Unlock the superior potential of your BIOSTAT® B-DCU by incorporating our advanced BioPAT® sensor technologies. They enable you to use Process Analytical

Technology (PAT) approaches for a maximum in process understanding and for effective automation of your cell cultivation or fermentation process.



### BioPAT® ViaMass

Determine the viable biomass volume inline and continuously. BioPAT® ViaMass is based on the proven principle of capacitance measurement.

- Reduce operator-to-operator variability
- Reduce manual sampling and lower risk of contamination



### BioPAT® Trace

The BioPAT® Trace is ideal for simultaneous online monitoring of glucose, lactate and alcohol during cultures of micro-organisms or animal cells.

- Fully disposable sensor and fluidics set for easy setup and immediate use
- Fast concentration determination without any loss of volume



### BioPAT® Xgas

Precisely track O<sub>2</sub> | CO<sub>2</sub> concentration changes in respiratory gas emission from a cultivation vessel with the compact BioPAT® Xgas.

- Highest accuracy by automatic moisture and pressure compensation
- Compact design and parallel measurement in a single analyzer saves space in your lab





### BioPAT® Fundalux

The BioPAT® Fundalux turbidity systems are based on an integrated absorption-based probe using near infrared light for total biomass determination.

- Range of optical path lengths (1, 5 and 10 mm) yields optimal total biomass coverage for your specific process
- Robust LED light source with up to 10-year lamp lifetime



### Hamilton Arc (pH | DO)

The Arc  $\mu$ -transmitter located in the sensor head stores all relevant sensor data, including calibration and diagnostic information.

- Digital pH and DO sensors provide more reliable signals than traditional analog sensors, e.g. eliminate signal noises
- Maintenance-free pressurized pH sensor
- Optical VisiFerm outperforms traditional polarographic sensors in terms of measurement performance and maintenance
- Optional automatic GMP reporting, wireless monitoring with ArcAir mobile



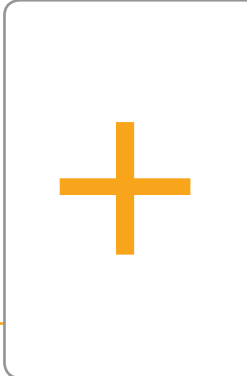
# Cell Cultivation



## Control of Glucose Concentration



## Control of Perfusion Processes





- Control the glucose level with the local control software of the BIOSTAT® B-DCU
- Automated glucose set point control
- Establish profiles for your glucose concentration set point
- Monitor lactate concentration directly on the local control screen of your DCU
- Select up to four variable speed pumps for substrate addition



### BioPAT® MFCS



- Create advanced control loops based on glucose and lactate concentration
- Develop your specific process strategy for event-based glucose feeds

- Operate the BioPAT® Viamass probe without any external software
- Monitor the viable cell volume directly on the local control screen of your DCU
- Make information about the viable cell volume available to supervisory control software

- Implement advanced perfusion control strategies, e.g. via automatic control of feeds and bleeds
- Robust and reliable determination of time of harvest or transfer of inoculum

### Parameter optimization and robustness testing with BioPAT® MODDE and MFCS

- Increase efficiency of bioprocess development, reduce project timelines and support Quality by Design (QbD) programs.
- Transfer your designed parameter setpoints automatically to your BioPAT® MFCS
- Our DoE module for BioPAT® MFCS ensures reliable and seamless integration of DoE procedures into control strategies.



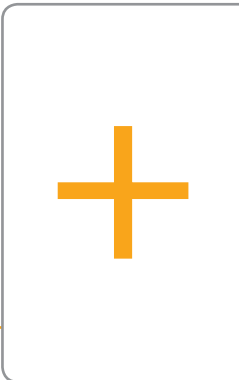
# Microbial Fermentations



Metabolic Respiration Control



Control of Glucose, Ethanol and Methanol Concentration



- High precision of gas flow control by intelligent mass flow controllers
- Realtime monitoring of exhaust gas is directly available in your BIOSTAT® B-DCU
- Facilitate insights into critical metabolic changes during your fermentation process
- Ensure optimal growth conditions, ultimately increasing the productivity of your process



### BioPAT® MFCS



- Obtain an automatic calculation of oxygen uptake rate, carbon dioxide evolution rate and respiratory quotient
- Apply reliable, advanced gassing or feeding strategies to improve production rates and reduce cultivation time
- Receive a complete batch record of O<sub>2</sub> | CO<sub>2</sub> in the off-gas to reveal more information about your process

- Monitor glucose, ethanol or methanol levels with the local control software of the BIOSTAT® B-DCU
- Automated glucose set point control
- Establish profiles for the glucose concentration set point
- Select up to four variable speed pumps for substrate addition

- Create advanced control loops based on glucose, ethanol, or methanol concentration
- Develop your specific event-based control strategies

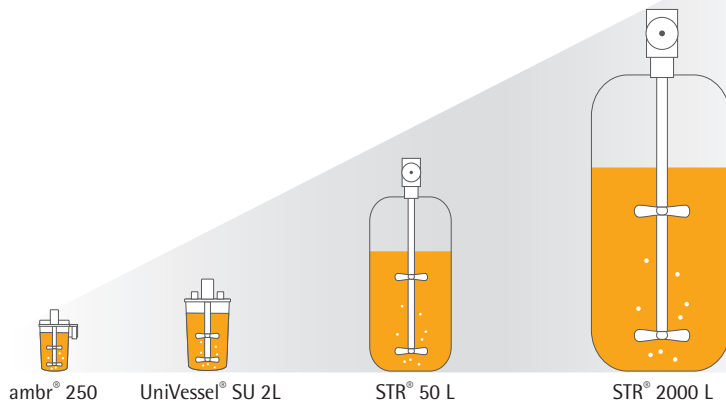
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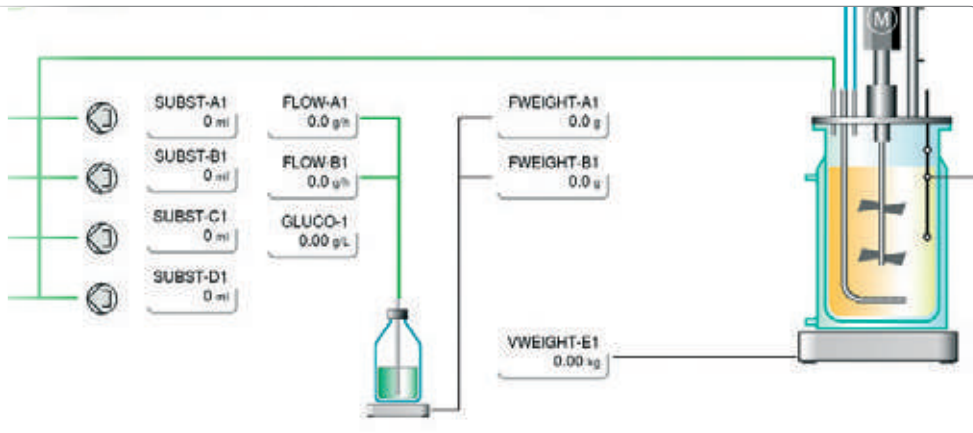
# The Optimal Scale Down Model

Seamless scalability from early process development to commercial production



Classic, stirred-tank design and geometric similarity of our range of bioreactors from bench scale to production scale.

Emulate control strategies of your production scale bioreactor in benchtop scale with our BIOSTAT B-DCU



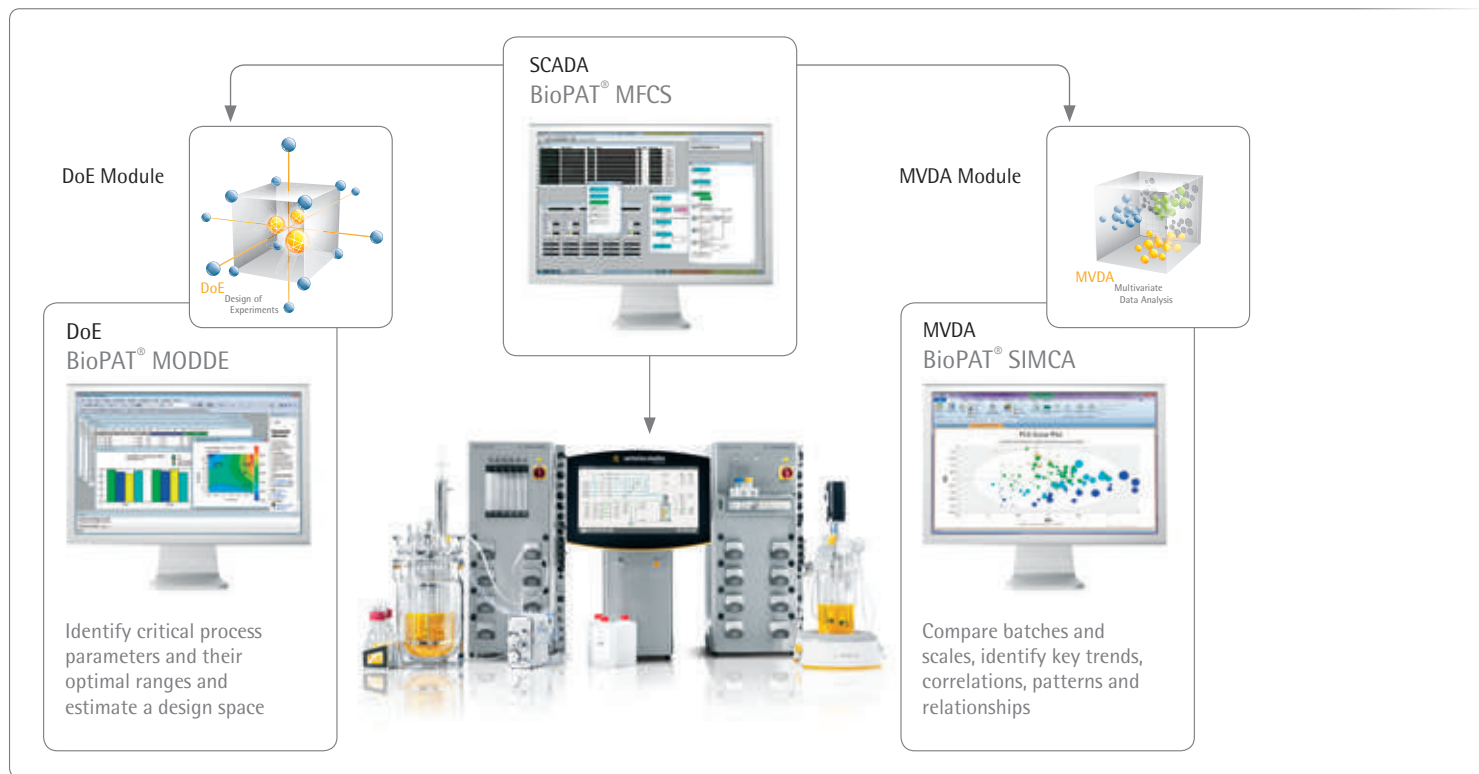
- Similar sensor technologies in benchtop scale and in manufacturing scale
- High flexibility in gas mixing strategies in combination with smart mass flow controllers. Learn more about our aeration strategies on pages 8 ff.
- Select up to four substrate addition lines with integrated, wide range variable speed pumps to mimic production scale feeding strategies

"Small-scale models can be developed and used to support process development studies. The development of a model should account for scale effects and be representative of the proposed commercial process."

ICH Q11 Step 4



Process characterization made easy with BIOSTAT® B-DCU and our BioPAT® Chemometrics Toolbox



Take advantage of the BioPAT® Chemometrics Toolbox and integrate advanced multivariate methods into your process control software BioPAT® MFCS | win.

- Unlock process understanding to ultimately improve the quality, safety and efficiency of your drug product.

Transfer data from your BIOSTAT® B-DCU to BioPAT® MODDE and SIMCA in order to reduce effort associated with data management and comparison of current and historical batches.

“It is important to understand the degree to which models represent the commercial process, including any differences that might exist, as this may have an impact on the relevance of information derived from the models.”

FDA Process Validation Guidance



## Integration and Connectivity at Its Best

If you need data acquisition or want full control of your BIOSTAT® B-DCU by your supervisory control and data acquisition system (SCADA) or distributed control system (DCS), the BIOSTAT® B-DCU provides the right interfaces and tools to connect to.



### BioPAT® MFCS – Turnkey SCADA Solution

Specialized for bioprocesses, BioPAT® MFCS is designed as a “plug-and-play” tool for advanced SCADA functionalities.

It is ideally suited for capturing, storing and visualizing process data of all BIOSTAT® and ambr® bioreactors and other process equipment.

One source bundle with full Sartorius responsibility and lifecycle concept

Specifically tailored for biopharmaceutical industry

Cost-effective & flexible automation platform



Process Values | Alarms

DCU Modbus fieldbus | DCU OPC interface

Setpoints | Actuator Access

Siemens Simatic PCS 7

Rockwell Automation

Emerson Process Management DeltaV™

For the straightforward integration of your BIOSTAT® B-DCU into a DeltaV™ network, we provide a Modbus mapping of your system in digital format. Once imported into your DeltaV™ configuration

it enables you to access process values, set controller parameters or even access actuators in a direct manner – e.g. pumps or valves.

ID	User	Name	Enabled	Password
1	Default	Frank Dultmann	YES	Frank
2	Frank	Sara Frensch	YES	Frank
3	Wes	Luigi Di	YES	Wes
4	Wes	Thomas Meyer	YES	Wes
5	Wes	John Smith	YES	Wes
6	Takashi	Hansu Koehne	YES	Wes
7	Wes	Alexandra Varona	YES	Wes
8	ADMIN	Administrator	YES	admin
9	Guest	Guest	YES	Guest

Domain: DCUWORLD

Realm: DCUWORLD.COM

User: Administrator

Password: [ ]



### Centralized User | Password Management Utilizing Windows® Domain Login

Central management of user rights for your bioprocess equipment has never been easier – the BIOSTAT® B-DCU can connect directly to your user management data implemented on your Microsoft® Server and your user can work with their well-known user names and passwords.

### Import and Export Process Relevant Settings of Instruments

Easily store your individual process settings and user authentication data and transfer them between BIOSTAT® B-DCU instruments.

The BIOSTAT® B-DCU has the tools to smoothly integrate into your individual control & IT infrastructure.



Microsoft® and Windows® are registered trademarks of Microsoft Corporation, USA.

# Maximized Process Security

To keep your biopharmaceutical process robust and reliable, we provide a comprehensive range of services to ensure the highest reliability and uptime of your BIostat® B-DCU, regulatory compliance and best quality of results. From installation and qualification to regular preventative maintenance: Our service team will be happy to assist you on site and will be with you quickly thanks to our worldwide service network.



### Installation and Commissioning

Safe and proper operation of your equipment – right from the start



### Qualification (SAT)

Compliance with GMP requirements, easy integration into your quality management system



### Operator Training

Quality through greater expertise: Sartorius trains the personnel operating our equipment

## Installation Phase

## Utilization Phase

### Repairs and Spare Parts

In the event of service requests, we are quickly at your side with the necessary spare parts – worldwide



### Maintenance and Contracts

Optimal equipment operation and protection against potential downtimes



### Calibration

Accurate results in the long term and compliance with regulatory requirements





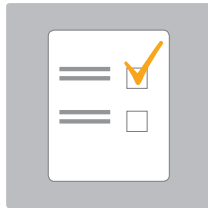
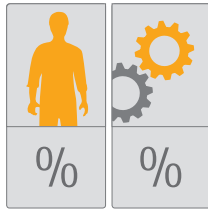
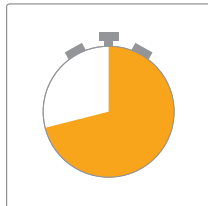
## Service Contracts for the Entire System Lifecycle

With our Bioprocess Service Program, Sartorius offers service contracts to protect your equipment through its entire lifetime. Based on your specific risk assessment and requirements, you can choose between three Service Level Agreements: Essential, Advanced and Comprehensive. Protect your BIOSTAT® B-DCU by choosing the appropriate service contract. For maximum productivity and minimum downtimes.

### Essential

You benefit from:

- A plannable annual maintenance
- A fast support at the technical helpdesk within one business day and priority on-site-response
- In case of repair: A discount on all time and material based cost elements

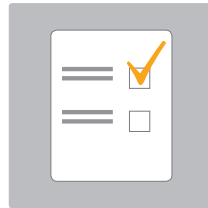
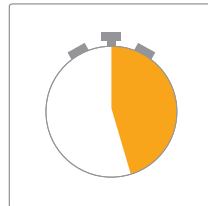


Essential

### Advanced

You benefit from:

- A plannable annual maintenance
- Technical helpdesk reaction time within 8 hours and 72 hours on-site response
- In case of repair: labor and travel costs are covered, a discount of 10% on spare parts

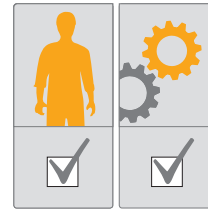
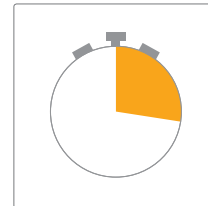


Advanced

### Comprehensive

You benefit from:

- A plannable annual maintenance
- Technical helpdesk reaction time within 4 hours and 48 hours on-site response
- In case of repair: all costs are covered



Comprehensive



## Your Benefits

- Process stability and minimized downtime
- Maximized system uptime, higher profitability
- Optimized total cost of ownership



For further details and the dedicated datasheets, please have a look at our website: [www.sartorius.com/service](http://www.sartorius.com/service)

# Technical Specifications

## Control Tower

### General

Weight	ca. 30 kg (ca. 66 lbs)
Dimensions (W×H×D)	490 mm × 730 mm × 535 mm (19.3" × 28.7" × 21.1")
Power supply	<ul style="list-style-type: none"> <li>- 100 – 240 V, 50 – 60 Hz, max. power consumption 4 A</li> <li>- Potential equalisation</li> </ul>
Housing	<ul style="list-style-type: none"> <li>- Stainless steel, AISI 304   EN 10020 1.4301</li> <li>- International protection rating: IP 30</li> </ul>
Display	<ul style="list-style-type: none"> <li>- Touch screen, 19", glass, capacitive</li> <li>- Resolution: 85 dpi</li> </ul>
SCADA communication	<ul style="list-style-type: none"> <li>- Industrial Ethernet (standard)</li> <li>- Modbus TCP (optional)</li> </ul>
Interfaces	<ul style="list-style-type: none"> <li>- USB</li> <li>- Ethernet</li> <li>- Potential-free alarm contact</li> <li>- 6× interfaces to supply towers</li> </ul>
Regulatory compliance	CE, NRTL recognized by the U.S. OSHA (Occupational Safety and Health Administration)



## Supply Tower

### General

Weight	ca. 45 kg (99 lbs); depends on configuration
Dimensions (W×H×D)	360 mm × 768 mm × 432 mm (14.2" × 30.2" × 17.0")
Power supply	<ul style="list-style-type: none"><li>- 230 V (± 10%), 50 Hz, max. power consumption 10 A</li><li>- 120 V (± 10%), 60 Hz, max. power consumption 12 A</li><li>- Average power consumption during cell cultivation (incl. control tower): ~ 190 kWh</li><li>- Potential equalisation</li></ul>
Housing	<ul style="list-style-type: none"><li>- Stainless steel, AISI 304</li><li>- International protection rating: IP 30</li></ul>
Gases	<ul style="list-style-type: none"><li>- Gas supply pressure 1.5 barg (22 psi)</li><li>- Gasses must be dry, oil and dust-free</li><li>- Hose barbs for tubings with Ø internal = 3.2 mm (0.13"); hose barbs removable for direct push-in connection of gas hoses with Ø external = 6 mm (0.24")</li></ul>
Water	<ul style="list-style-type: none"><li>- Water supply pressure: 2 – 4 barg</li><li>- Flow rate up to 20 lpm</li><li>- Temperature min. = 4°C</li><li>- Discharge pressure-less</li><li>- Hose barb for tubings with Ø internal = 8 mm (0.31")</li><li>- Degree of hardness: 12° dH max.</li><li>- Integrated water pressure reduction down to: 1.5 barg (22 psi)</li></ul>
Interfaces	<ul style="list-style-type: none"><li>- 3 × external signal inputs 0 – 10 V</li><li>- 3 × external signal inputs 4 – 20 mA</li><li>- Interface to control tower</li><li>- Fieldbus for serial or ethernet devices</li><li>- Digital output 24 V for on   off control of external devices</li><li>- Up to 4 analoge outputs for external pumps</li><li>- Connection for control of external drive motor (0 – 10 V)</li><li>- Further interfaces depend on configuration</li></ul>
Regulatory compliance	CE, NRTL recognized by the U.S. OSHA (Occupational Safety and Health Administration)

## Motor drive

Maintenance-free, quiet direct drive	Power: 200 W (400 W optional)
Maintenance-free top drive with magnetic motor coupling	Power: 200 W (400 W optional)
Rotation speed motor, direct coupling	1L Glass: 20 – 2,000 rpm 2L Glass: 20 – 2,000 rpm 5L Glass: 20 – 1,500 rpm 10L Glass: 20 – 800 rpm 2L Single-use: 20 – 400 rpm
Rotation speed motor, magnetic coupling	1L Glass: 20 – 2,000 rpm 2L Glass: 20 – 2,000 rpm 5L Glass: 20 – 1,500 rpm 10L Glass: 20 – 800 rpm

## Process Control | Sensors

	Sensor   Measurement Range   Display Resolution	UniVessel® Glass	UniVessel® SU
Temperature	Pt100   0 – 150°C (temperature control 0 – 80°C)   0.1°C	•	•
Dissolved oxygen, reusable	Polarographic or optical   0 – 100%   0.1%	•	•
Dissolved oxygen, single-use	DO sensor patch   0 – 100%   0.1%		•
pH, reusable	Combined measuring electrode   2 – 12 pH   0.01 pH	•	•
pH, single-use	pH sensor patch   6.5 – 8.5 pH   0.1 pH		•
Foam control	Electrical conductive sensor, stainless steel, ceramic insulated	•	
Level	Electrical conductive sensor, stainless steel, ceramic insulated	•	
Turbidity	1-channel NIR absorption sensor   0 – 6 AU   0.01 AU	•	
Redox	Combined measur. with pH sensor   –1,000 – 1,000 mV   1 mV	•	•
Balance substrate	7 kg (15.4 lbs) max.   1 g (0.035 oz) 60 kg (132.3 lbs) max.   10 g (0.35 oz)	•	•
Balance culture vessel	60 kg (132.3 lbs) max.   10 g (0.35 oz)	•	•
Gravimetric flow controller	Accuracy for 7 kg balance: 5 g/h Accuracy for 60 kg balance: 50 g/h	•	•
Pressure measurement	Pressure   0 – 1000 mbarg (control range: 0 – 500 mbarg)   1 mbar	•	
Glucose	Enzymatic sensor   0 – 40 g/L   0.01 g/L	•	•
Lactate	Enzymatic sensor   0 – 10 g/L   0.01 g/L	•	•
Viable biomass	Capacitance sensor   0 – 400 pF/cm or 0 – 400 E <sup>6</sup> cells/mL   0.1 pF/cm or 0.01 E <sup>6</sup> cells/mL	•	
O <sub>2</sub> offgas	Zirconium dioxide   0 – 50 vol%   0.1 vol%	•	•
CO <sub>2</sub> offgas	Infrared   0 – 10 vol%   0.1 vol%	•	•

## Aeration Module

Dimension outlets to culture vessel	Hose barbs for tubings with $\varnothing$ internal = 3.2 mm (0.13"); removable for direct push-in connection of gas hoses with $\varnothing$ external = 6 mm (0.24")
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**UniVessel® Glass MO (Microbial) Two-gas mixing with sparger outlet**

O<sub>2</sub> Enrichment or Additive Flow 2-Gas (Gas Flow Ratio) aeration modules;  
for further information, please see pages 8 ff. on "Aeration Strategies"

Gas outlets	1
Max. total flow	Up to 20 lpm per gassing line
Mass flow controllers	Up to 2
Range of mass flow controllers	1 : 200
Accuracy of mass flow controllers	± 0.3 % full scale + ± 0.5 % current value
Flow meters	Up to 2
Range of flow meters	1 : 10
Accuracy of flow rate controllers	± 5 % full scale
Solenoid valves	Up to 2

**UniVessel® Glass CC (Cell Culture) | UniVessel® SU Four-gas mixing with sparger and headspace outlet**

Additive flow 4-gas (Air, O<sub>2</sub>, N<sub>2</sub>, CO<sub>2</sub>) aeration module plus optional 5th and 6th aeration line;  
for further information, please see pages 8 ff. on "Aeration Strategies"

Gas outlets	2 (sparger   overlay) or single gas outlets per gassing line
Max. total flow	Up to 20 lpm per gassing line
Gas switching valves sparger to overlay (only for aeration module with 2 gas outlets)	Up to 4
Mass flow controllers	Up to 6
Range of mass flow controllers	1 : 200
Accuracy of mass flow controllers	± 0.3 % full scale + ± 0.5 % current value
Flow meters	Up to 6
Range of flow meters	1 : 10
Accuracy of flow rate controllers	± 5 % full scale
Solenoid valves	Up to 6



## Pump Module

### Pump heads

Watson Marlow 114, fast load pump head

### Built-in pumps

#### Flow rate (tubing wall thickness 1.6 mm)

Fixed speed (on | off controlled)  
Speed 5 rpm

Int. dia.: 0.5 mm (0.2"): 0–0.1 mL/min  
Int. dia.: 0.8 mm (0.31"): 0–0.2 mL/min  
Int. dia.: 1.6 mm (0.63"): 0.01–0.7 mL/min  
Int. dia.: 2.4 mm (0.94"): 0.03–1.5 mL/min  
Int. dia.: 3.2 mm (1.26"): 0.05–2.4 mL/min  
Int. dia.: 4.8 mm (1.89"): 0.09–4.3 mL/min

Fixed speed (on | off controlled)  
Speed 44 rpm

Int. dia.: 0.5 mm (0.2"): 0.02–0.9 mL/min  
Int. dia.: 0.8 mm (0.31"): 0.04–1.8 mL/min  
Int. dia.: 1.6 mm (0.63"): 0.12–6.2 mL/min  
Int. dia.: 2.4 mm (0.94"): 0.26–12.8 mL/min  
Int. dia.: 3.2 mm (1.26"): 0.41–20.7 mL/min  
Int. dia.: 4.8 mm (1.89"): 0.75–37.4 mL/min

Speed-controlled in low speed mode  
Speed 0.15–5 rpm

Int. dia.: 0.5 mm (0.2"): 0–0.1 mL/min  
Int. dia.: 0.8 mm (0.31"): 0.01–0.2 mL/min  
Int. dia.: 1.6 mm (0.63"): 0.02–0.7 mL/min  
Int. dia.: 2.4 mm (0.94"): 0.04–1.5 mL/min  
Int. dia.: 3.2 mm (1.26"): 0.07–2.4 mL/min  
Int. dia.: 4.8 mm (1.89"): 0.13–4.3 mL/min

Speed-controlled in high speed mode  
Speed 5–150 rpm

Int. dia.: 0.5 mm (0.2"): 0.1–3 mL/min  
Int. dia.: 0.8 mm (0.31"): 0.2–6 mL/min  
Int. dia.: 1.6 mm (0.63"): 0.7–21 mL/min  
Int. dia.: 2.4 mm (0.94"): 1.45–43.5 mL/min  
Int. dia.: 3.2 mm (1.26"): 2.35–70.5 mL/min  
Int. dia.: 4.8 mm (1.89"): 4.25–127.5 mL/min

### External pumps

Speed-controlled

Watson Marlow WM120  
Fast load pump head  
Up to 200 rpm, speed range selectable  
Speed range controllable by DCU = 1 : 100

## Temperature Control Module

### For UniVessel® Glass Single-wall Culture Vessels

- Electrical heating system and automatic cooling water valve; connection to heating blanket and cooling finger
- Temperature control of 8°C above cooling-water inlet temperature up to 60°C
- Heating blanket capacities  
1 L | 2 L | 5 L | 10 L:  
100 | 170 | 400 | 780 W

### For UniVessel® Glass Double-wall (Jacketed) Culture Vessels

- Open thermostat system with recirculation pump and automatic cooling water valve
- Temperature control of 8°C above cooling-water inlet temperature up to 80°C
- Heating capacity: 1000 W

### For UniVessel® SU Single-use Culture Vessels With Heating Blanket

- Electrical heating blanket
- Temperature control up to 50°C
- Heating capacity 2 L : 200 W

### For UniVessel® SU Single-use Culture Vessels With Heating | Cooling Water Jacket

- Open thermostat system with recirculation pump and automatic cooling water valve; connection to heating | cooling jacket
- Temperature control up to 50°C
- Heating capacity: 1000 W



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