WAVEPOD™ II Integrated Controller

WAVEPOD II Integrated Controller is part of GE Healthcare Life Sciences’ ReadyToProcess platform of ready-to-use products. WAVEPOD II Integrated Controller integrates instrumentation associated with the WAVE Bioreactor™ 20/50 system for the setup, control, and monitoring of cell culture parameters in Cellbag™ bioreactors. Multiple configurations of the WAVEPOD II controller are available to meet individual cell culture needs and a large color touchscreen provides easy access to all operations, data, and alarm conditions from the integrated control modules. ReadyToProcess brings flexibility and speed to upstream and downstream processing of biologicals. The product range comprises WAVE Bioreactor systems, WAVE Mixer™, tubing sealers and welders, hollow fiber and normal flow filters, prepacked chromatography columns, and ÄKTA™ ready chromatography system with a disposable flow path, as well as the assemblies and connections in between. The platform is scalable from the lab bench to manufacturing.

WAVEPOD II Integrated Controller delivers:

- Versatility: Multiple configurations of control modules to meet individual cell culture needs
- Reliability: Optimized PID parameters ensure accurate pH and dissolved oxygen (DO) control
- Flexibility: Large color touchscreen provides easy navigation of advanced setup and control capabilities
- Convenience: Alarm contacts for chart recorders and remote monitoring systems

System description

WAVEPOD II is available with a choice of control modules to meet your specific cell culture needs. By coordinating the functions of individual control modules, you can develop complex schemes for the precise measurement and control of culture conditions including pH, DO, CO₂, and O₂ gas mixing.

**pH controller**

The pH controller enables online measurement and control of pH using an optical pH sensor preinstalled in Cellbag bioreactors. The pH controller incorporates a set point controller to power PUMP20 units or to switch user-supplied base and acid pumps on and off to maintain and control pH. Alternatively, pH can be maintained by controlling CO₂ concentration.

![Fig 1. WAVEPOD II Integrated Controller coordinates the functions of optional control modules for use with the WAVE Bioreactor 20/50 system.](image)

![Fig 2. The pH controller produced reliable monitoring of pH in a 20 L culture bag over several days.](image)
**Dissolved oxygen controller**
The DO controller provides amplification, display, and data transmission of DO concentration allowing real-time measurement of DO concentration inside the Cellbag bioreactor. The DO controller is designed for use with the new optical DO sensor (DOOPT II) integrated into the cellbag. The DO controller can alter the concentration of the gas mix or change the rocking rate automatically to maintain online control of DO.

**O₂/air mix controller**
The O₂/air mix controller connects to a supply of oxygen (and low pressure N₂ supply if required) to provide O₂/air concentrations between 0% and 50% O₂. The instrument controls enriched oxygen levels for insect cell/baculovirus and high culture density applications and it is also useful for maintaining low-oxygen environments for near-anaerobic applications.

**CO₂/air mix controller**
The CO₂/air mix controller connects to a supply of 100% CO₂ to provide CO₂/air concentrations between 0% and 15% CO₂. The instrument is useful for pH control of bicarbonate-buffered cell culture media.

**Airflow controller**
The Airflow controller can be used as a standalone module for Cellbag bioreactor aeration or as a conditioned gas supply to a WAVE Bioreactor 20/50 system. The flow of ambient or processed air is measured by a thermal mass flow sensor and regulated by a flow control valve operated by an internal controller.

**Alarms**
WAVEPOD II controller can be configured to trigger an alarm when certain conditions are met. If such an alarm condition is triggered, a flashing alarm button would appear at the bottom of the screen and you have the option of enabling a simultaneous alarm sound (beep). Clicking on the Alarm button provides access to the Alarm Log screen where information such as the date, time, description, and status of individual alarms can be viewed. A series of Help screens provide hints on troubleshooting all alarm messages. WAVEPOD II controllers can also be connected to an external monitoring system to alert you when an alarm goes off. A DB15 female jack on the rear panel of the unit provides the alarm contacts.

**Requirements and options**
Depending on the options installed, the following equipment or supply sources might be required.

**Oxygen supply source**
The O₂ controller must be connected to oxygen from a cylinder, generator, or facility pipeline.

**Carbon dioxide supply source**
The CO₂ controller must be connected to CO₂ from a facility pipeline or cylinder.

**Acid/base pumps**
WAVEPOD II controller can be used to operate acid and base pumps for pH control. Two DB9 jacks located on the rear panel are designed to interface with PUMP20 modules or other compatible user-supplied pumps.

**Optical pH sensor**
The optical pH sensor can be used with the pH controller to monitor the pH of the culture in a stable and reliable manner. The optical pH sensor is supplied preinstalled in the sterilized Cellbag bioreactor. A specially designed fiber-optic cable is needed to connect to the Cellbag bioreactor.

**Optical DO sensor**
The optical DO sensor (DOOPT II) can be used with the DO controller to provide reliable online measurement of dissolved oxygen concentration inside the Cellbag bioreactor. The DOOPT II is supplied preinstalled in the sterilized Cellbag bioreactor. A specially designed fiber-optic cable is needed to connect to the Cellbag bioreactor.

**UNICORN™ DAQ**
UNICORN DAQ 1.0 software facilitates real time data acquisition for the management and evaluation of results from cell cultures performed using up to four different WAVE Bioreactor systems connected to a single PC. The WAVE Bioreactor system can be connected directly or networked to the software providing a common platform and user interface for monitoring and storing result data. A dynamic graphical user interface informs you about the real-time status of the run being monitored. During a run, data is automatically saved to a local hard drive or server in a secure and unalterable result file for added security.
Technical information and specifications

WAVEPOD II

Dimensions 395 × 280 × 405 mm
Weight 13.6 kg
Communications RJ12-6 for connecting WAVE bioreactor base
RJ12 Converter 100
RJ45 AUX jack
Two DB9 jacks for connecting acid/base pumps
DB15 alarm jack
Environmental Operating conditions: 5°C to 40°C
Operating humidity: 10% to 90% noncondensing
Storage conditions: -20°C to 60°C
Pollution degree rating: 1
Ingress protection (IP) rating: 32
Indoor use only
Utilities Voltage: 110 to 120/220 to 240 VAC, (auto switching)
Frequency: 50/60 Hz
Power: 200 VA

Air flow measurement and control
When running WAVEPOD II in "LOCAL" mode
Air flow measurement range 0 to 1.0 L/min
Air flow control range 0.05 to 1.00 L/min
Operating pressure, system air inlet Ambient air, no over pressure
Process gas 10 to 20 kPa (1 to 3 psi)
Bag pressure controlled by pressure relief valve at bag

CO₂ measurement and control
CO₂ mix, measurement range 0% to 20%
CO₂ mix, measurement accuracy ± 0.5% CO₂ for 0% to 5% CO₂
± 10% of reading for 5% to 12% CO₂ (0.5% to 1.2% CO₂)
Ambient temperature variation dependency: ± 0.05% CO₂/°C temp deviation
CO₂ mix, control range 0% to 15%
± 0.5% CO₂ for 0% to 5% CO₂
± 10% of reading for 5% to 12% CO₂ (0.5% to 1.2% CO₂)
Ambient temperature variation dependency: ± 0.05% CO₂/°C temp deviation
CO₂ inlet specifications 100% CO₂
Inlet pressure to system: 0.7 to 1.0 bar
Min flow rate: 0.2 L/min for full CO₂ specification

O₂ measurement and control
O₂ mix, measurement range 0% to 50%
Default 21% to 50%
Note: N₂ is required for delivery of O₂ < 20.9%
O₂ mix, displayed measurement resolution 0.1%
O₂ mix, measurement accuracy ± 1.0% O₂ for 21% to 50% O₂
O₂ mix, control range 0% to 50%
O₂ mix, control accuracy ± 1.0% O₂ for 21% to 50% O₂
Inlet pressure to system 0.7 to 1.0 bar
Min flow rate 0.2 L/min for full O₂ specification.

Temperature measurement and control
Liquid temperature control range Min: Ambient temperature 5°C
Max: 40°C
Accuracy at equilibrium conditions ≤ ± 0.1°C (exclusive of measurement accuracy)
Precision at equilibrium conditions ≤ ± 0.2°C (exclusive of measurement accuracy)
Readout of process value (PV) from BASE 20/50 unit

pH measurement and control
pH measurement range pH 4.5 to 8.5
pH control range pH 6 to 8
pH accuracy within control range ± 0.05 pH within 0.25 pH from offset calibration pH*, ± 0.10 pH within 0.25 to 0.5 pH from offset calibration pH*

DO measurement and control
DO measurement range 0% to 250% air sat
DO control range 0% to 100% air sat
DO accuracy within control range ± 3% air sat (offset calibration to be done at 0% and 100% air sat)

* Offset calibration to be done at the setpoint pH

Ordering information

Product Code number
WAVEPOD II CO₂ pHOPT 28-9847-41
WAVEPOD II O₂ DOOPT II 29-0016-34
WAVEPOD II CO₂ O₂ pHOPT DOOPT II 29-0016-32

Related literature
Disposable Cellbag bioreactors for the WAVE Bioreactor system, Data file 28-9511-36
ReadyToProcess connectivity, Data file 29-0138-84
UNICORN DAQ 1.0, Data file 28-9778-46
WAVE Bioreactor 2/10 and 20/50 systems, Data file 28-9520-58
WAVE Bioreactor 200 and 500/1000 systems, Data file 28-9606-53