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Parallel autoclavable mini fermenters/bioreactors

Scope of supply

This technical proposal describes a Solaris IO 200.

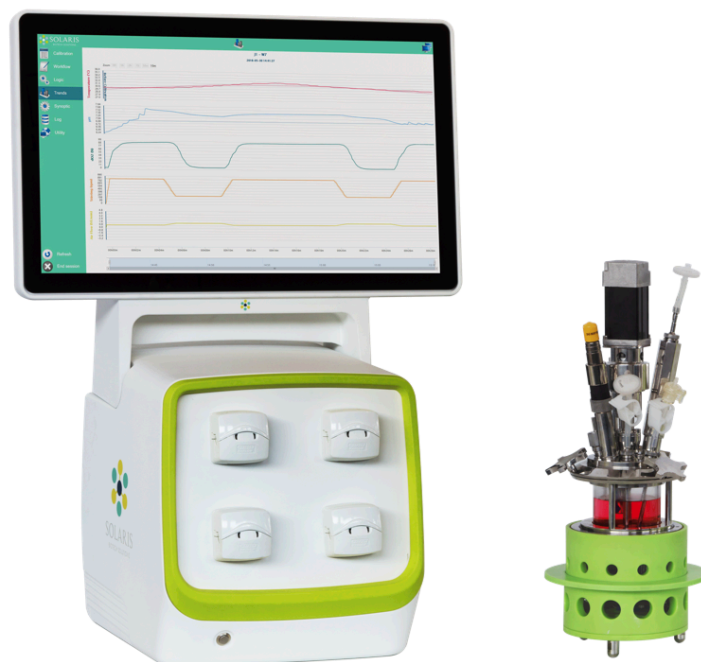
For supervisory control and data acquisition Leonardo 3.0 is included.

The system consists of 200 ml fermenter/bioreactor (total volume), bench-top, pre-assembled unit, supplied with all necessary tubes, valves and instruments, automation, control panel (HMI).

The system is designed for aerobic and anaerobic cultivations/ fermentations, closed aseptic operations.

IO is completely electrical. The thermoregulation (both heating and cooling) is performed through a Peltier Cell, placed on the bottom of the fermenter/bioreactor. This avoids water circulation (no water source is needed in the lab).

The control is based on a SCADA control system.



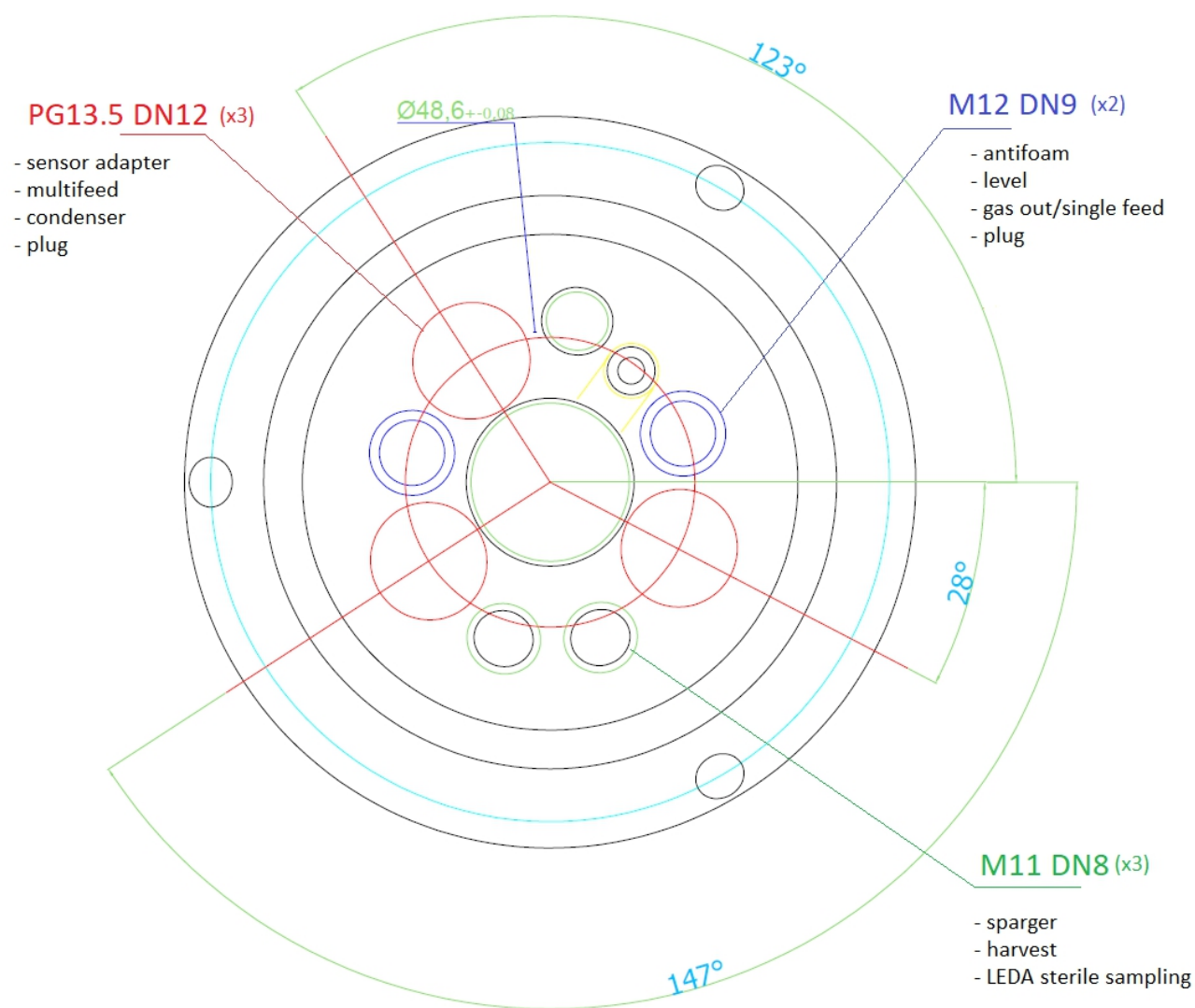
• INCLUDED

° OPTION

IO 200 Data Sheet

VESSEL

Total Volume	200 ml
Working Volume (min-max)	50-150 ml
Ratio D/H	1:1,5
Max temperature	70°C
Operating pressure (not controllable)	< 0,8 bar(g)
Headplate Ports (8)	n.3 ports PG13.5 (sensors, gas out condenser, multi feed) - n.2 ports DN8 (gas in sparger, harvest/sampling) - n.3 DN9 (gas out, antifoam probe, level probe, single feed)



Design	Borosilicate Glass Single Wall Vessel
Materials	Vessel: Borosilicate Glass Others: AISI 316 L

DIMENSIONS		
Height	430 mm	
Depth	200 mm	
Length	200 mm	
DIMENSIONS FOR AUTOCLAVE		
Height	320 mm	
Diameter	170 mm	
AGITATION		
Drive	• Brushless Motor Direct Assembly	
RPM	1-2000 RPM, Accuracy 1RPM	
Impeller type	Rushton, Marine or Pitched blade	
THERMOREGULATION		
Type	Peltier Cell for both heating and cooling	
Control	PID Control for Heating and Cooling, Accuracy: 0.1°	
AERATION		
Gas control	• n.1 TMFC	Max. up to 5 TMFC
Gas mixing (AIR, N ₂ , CO ₂ , O ₂)	° numbers of TMFCs or n.4 solenoid valves	
Gas overlay	° TMFC	
Sparger	• Fluted Type	
Input/Output 0.22 µm filters	•	
INTEGRATED PERISTALTIC PUMPS		
Quantity and type	• n.2 WM 400 F/A • n.2 WM 114FD/DV	
Controller	Fixed Speed (regulated on/off) Application assignable from software	
Speed	Watson Marlow 400F/A 35 rpm Watson Marlow 114FD/DV 60 rpm	
Flow rates	Watson Marlow 400F/A - ID 0.25 mm: 0.09 ml/min - ID 0.51 mm: 0.34 ml/min - ID 0.76 mm: 0.7 ml/min - ID 1.02 mm: 1.2 ml/min - ID 1.22 mm: 1.6 ml/min - ID 1.52 mm: 2.4 ml/min - ID 2.06 mm: 3.6 ml/min	Watson Marlow 114FD/DV - ID 0.5 mm: 1.4 ml/min - ID 0.8 mm: 2.6 ml/min - ID 1.6 mm: 8.4 ml/min - ID 2.4 mm: 17.5 ml/min - ID 3.2 mm: 28.5 ml/min - ID 4.0 mm: 40.5 ml/min - ID 4.8 mm: 51 ml/min
PCS and SOFTWARE		
PCS (W x D x H)	• (35 cm x 37cm x 36 cm)	

HMI	•Touch screen PC , 24" Color Monitor
Software	• SCADA Solaris Software Control Leonardo 3.0
Solaris Logic Parser Software	•
Solaris Fermentation Manager (offline data analysis)	•
Data Extraction	• Through USB port or Ethernet/Wi-Fi
Graphs Trends, displaying in real time and in remote	•
On line Parameters Calibration	•
Alarms Management	•
Events Recording	•
Multipasswords Levels	•
OTHER ACCESSORIES	
LEDA Sterile Sampling System (up to 180 sterile samplings per batch)	°
Harvest/Sampling Tube (dip tube)	•
Sterile Additive Needle free connectors	• n. 1-4
COMMUNICATION	
n.4 Analog Input 0-10V and 0-20 mA/4-20mA <i>Choice between:</i> <ul style="list-style-type: none"> - n.2 channels 0-10V + n.2 channels 0-20 mA/4-20mA - n.4 channels 0-10V - n. 4 channels 0-20 mA/4-20mA 	° (ex. sensors powered by Solaris electrical cabinet)
n.4 Analog Output 0-10V and 0-20 mA/4-20mA <i>Choice between:</i> <ul style="list-style-type: none"> - n.2 channels 0-10V + n.2 channels 0-20 mA/4-20mA - n.4 channels 0-10V - n. 4 channels 0-20 mA/4-20mA 	° (ex. pumps or valves with power supply independent from Solaris electrical cabinet)

IO 200 Controls (integrated in the PCS)

TEMPERATURE	
Sensor	Integrated in pH probe
Control range	12 - 70°C
Probe accuracy	± 0.1 °C
pH	
Sensor	Digital sensor,

	Combination electrode
Length	120 mm
Control range	0 - 14 pH
Probe accuracy	0.01 pH
Probe sensitivity	57 to 59 mV/ pH at 25 °C
Autoclavable	Yes, max. temperature 130 °C
Pressure range	0 - 6 bar
Actuator	Actuation of peristaltic pumps for the addition of acid/base solutions, or TMFC (CO ₂) for pH control
dO₂	
Sensor	Digital Optical sensor
Length	120 mm
Control range	0 - 300% air saturation
Probe accuracy	1 ± 0.05 %-vol, 21 ± 0.2 %-vol; 50 ± 0.5 %-vol
Autoclavable	Yes, max. temperature 130 °C
Pressure range	0 - 12 bar
Actuator	Cascade to RPM, Gas Control, feedings, etc.
ANTIFOAM CONTROL	
Sensor	Solaris sensor (Fixed length)
Actuator	Peristaltic pump for the addition of antifoam solution
LEVEL CONTROL	
Sensor	Solaris sensor (Fixed length)
Actuator	Peristaltic pump for feeding/harvesting
REDOX (ORP)	
Sensor	Digital sensor, Combination electrode
Length	120 mm
Measuring range	±1500 mV
Autoclavable	Yes, max. temperature 130 °C
Pressure range	0 - 6 bar
CONDUCTIVITY	
Sensor	Digital sensor
Length	120 mm
Measuring range	1 µS/cm to 300 mS/cm

Autoclavable	Yes, max. temperature 130 °C
Probe accuracy	± 3 % at 1 µS/cm to 100 mS/cm, ± 5 % at 100 to 300 mS/cm
Pressure range	0 - 20 bar

Modular additional parameters integrated in the supply including dCO₂, Cell Density, weight and peristaltic pumps.



IO 200 Controls (modular external box)

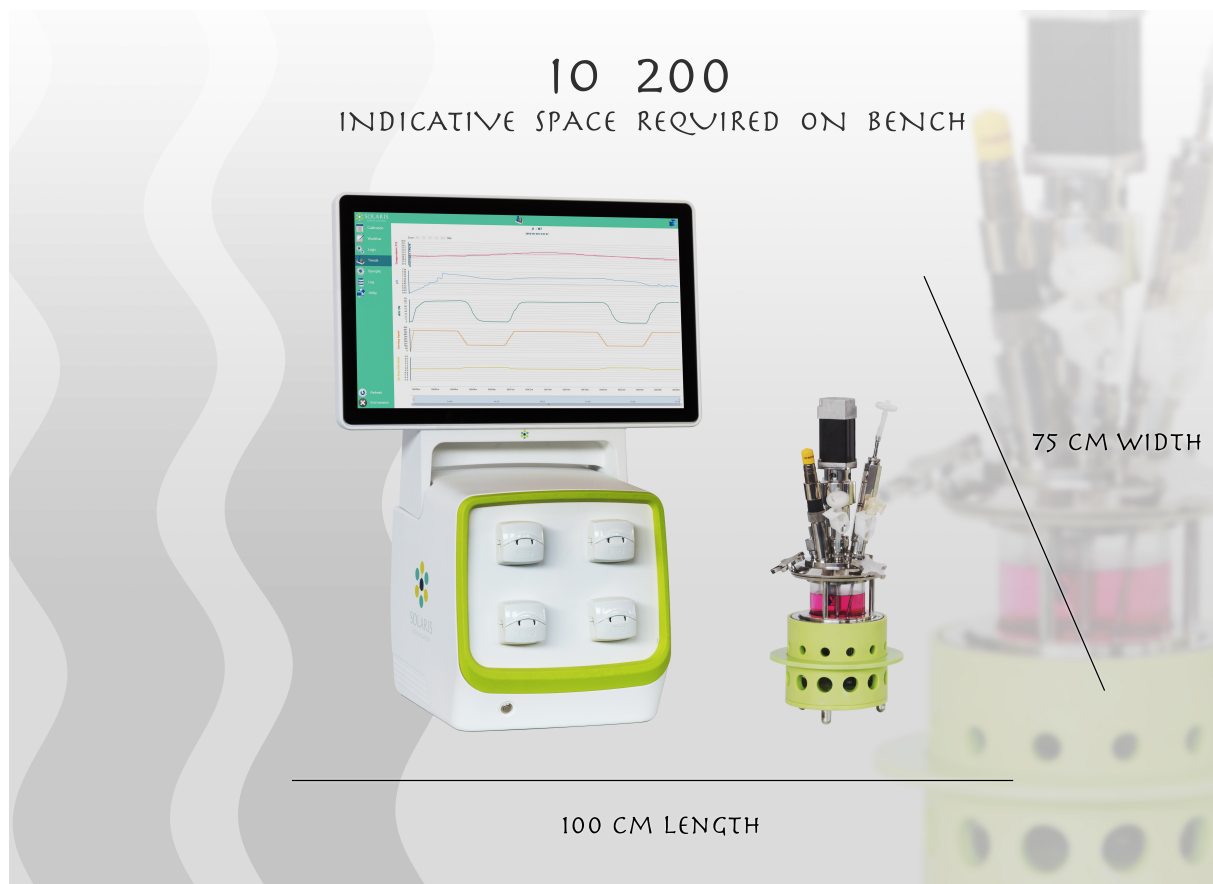
dCO₂

Sensor	Analog sensor
Length	120 mm
Control range	0-200% saturation
Autoclavable	Yes, max temperature 130 °C.
Probe accuracy	± (10 % of the reading + 10 mbar)
Pressure range	0 – 4 bar

CELL DENSITY

Sensor	Digital sensor
Length	120 mm
Control system	Measuring resident in Leonardo 3.0 software
<u>Option 1</u>	Total cell density based on turbidity Two ranges: 10 ⁵ to 7•10 ⁸ mammalian cells/ml 0.5 to 100 g/L dry weight
Pressure range	0 – 10 bar
Operation temperature	0 – 80°C
Autoclavable	Yes, max. temperature 135 °C
<u>Option 2</u>	Viable cell density based on capacitance Two ranges: 5•10 ⁵ to 8•10 ⁸ mammalian cells/ml 5 to 200 g/L dry weight)
Pressure range	0 – 3 bar
Operation temperature	0 – 60°C

Autoclavable	Yes, max. temperature 135 °C
Probe accuracy	Mammalian cells in suspension $\pm 5 \cdot 10^4$ cells/ml - Fermentation ± 0.05 g/l dry weight
WEIGHT	
Digital Balance (accuracy ± 0.1 g)	
ADDITIONAL EXTERNAL PERISTALTIC PUMPS	
<i>WM 120 U Brushless</i>	
Quantity and type	n. of WM 120 U Brushless
Controller	Variable speed Manual and automatic with application assignable from software
Speed	1-200rpm
Flow rates (Marprene tubing, 1.6mm wall)	Watson Marlow 120U/DV - ID 0.5 mm: 0.02 - 4.0 ml/min - ID 0.8 mm: 0.04 - 8.0 ml/min - ID 1.6 mm: 0.14 - 28.0 ml/min - ID 2.4 mm: 0.29 - 58.0 ml/min - ID 3.2 mm: 0.47 - 94.0 ml/min - ID 4.0 mm: 0.67 - 130.0 ml/min - ID 4.8 mm: 0.85 - 170 ml/min
<i>WM 313 FDM/D</i>	
Quantity and type	n. of WM 313 FDM/D
Controller	Fixed Speed (regulated on/off) Application assignable from software
Speed	175 rpm
Flow rates (Marprene tubing, 1.6mm wall)	Watson Marlow 313 FDM/D - ID 0.5 mm: 6 ml/min - ID 0.8 mm: 13 ml/min - ID 1.6 mm: 48 ml/min - ID 3.2 mm: 175 ml/min - ID 4.8 mm: 385 ml/min - ID 6.4 mm: 630 ml/min - ID 8.0 mm: 875 ml/min
<i>WM 313 OEM VBM-D</i>	
Quantity and type	n. of 313OEM VBM-D
Controller	Variable speed Application assignable from software
Speed	1-360 rpm
Flow rates (Marprene tubing, 1.6mm wall)	Watson Marlow 313OEM VBM-D - ID 0.5 mm: 12 ml/min - ID 0.8 mm: 26 ml/min - ID 1.6 mm: 100 ml/min - ID 3.2 mm: 360 ml/min - ID 4.8 mm: 790 ml/min - ID 6.4 mm: 1296 ml/min



Utilities and Service Connections

Utilities	Connection	Requirement
Electrical	Universal Power Supply 110 - 230 Vac 50-60Hz (1P + N + GND) 1 KW Cable & Plug	
Process Gas	Quick Connection For tube 4 x 6 mm	2,5-3,0 bar(g) 36,5-43,5 PSI(g)
Exhaust	Open	

NB: the air supply MUST be oil free in order to avoid damages to the TMFCs



PCS - Process Control System



Solaris' modular product design strategy decreases the number of unique parts which reduces time of production. The result is a lean, smart and flexible PCS. In case of parallel fermentations/cultivations, the PCS can be stacked with a dedicated support, optimizing lab space.



General characteristics

IO is fitted with a Process Control System working with web-based (Linux) software Leonardo 3.0 and Siemens S7 1200 PLC.

The HMI is a PC 24" touch screen.

LEONARDO 3.0: USER-FRIENDLY SOFTWARE

Solaris controlling software offers a simply laid out, yet powerful platform for experimental design planning and process control. The graphical user interface enables the intuitive selection and adjustment of control functions.

Extracted data is compatible with Window Excel, but in addition, Solaris offers a platform



where fermentation data can be easily exported in real time and thus managed. This software is included in the supply and can be installed on an unlimited number of the client's PC or laptops.

Features:

- Home with Multi-level password protection
- Workflow settings (warm up, calibration, cultivation, cleaning, additional custom phases, etc.)
- Synoptic page with manual operation of all the actuators (pumps, valves etc.), parallel synoptic comparison between units
- Continuous trend graphs representation to track, print and export data on up to 6 processes and set point variables. Different dynamic zooms and configurations in a time frame that can be set interactively
- Cascade and profile programs
- Parallel set point settings
- Parallel Parameters Calibration (off and on line)
- Parallel trend comparison between parallel units
- Pumps configuration and calibration
- On line parameters calibration
- PID setting
- USB connection for free data extracting
- Remote control for after sale assistance; 100% assistance from our office
- Remote control for the user
- Possibility of saving up to recipes for repeat usage
- Print-out of hard copy of each screen
- Cascade and profile programs
- Parallel trend comparison between units
- Pumps Configurator

Solaris Logic Parser

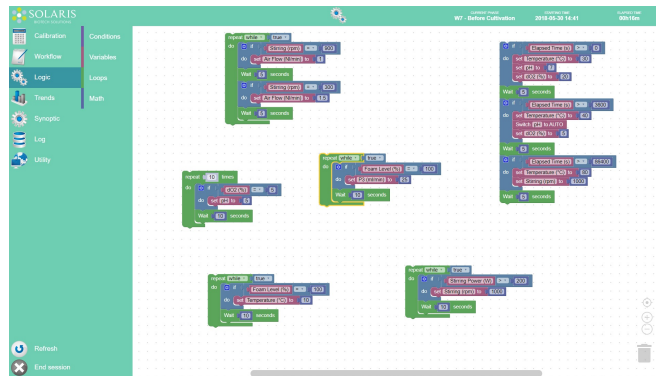
Solaris Logic Parser, integrated in Leonardo 3.0, gives to the user additional possibilities of controls putting in relation all the variables involved in the fermentation process with common logic functions.

The communication between the software Leonardo 3.0 and the software Logic Parser is via exchange database.

The Logic Parser software lets the user write every kind of program, from simple business logic (like an actuator that turns on when a specific condition is met) to a complex program with nested loops.

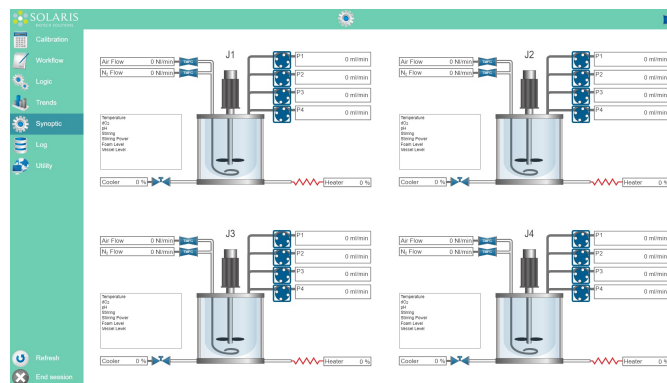
It is possible to run multiple program blocks in parallel, each one having its separate thread and timing of execution.

Each logic diagram is automatically saved with the current recipe, but of course it is possible to store the program to a separate file and keep it for later use.



Do it parallel: smarter...faster

Leonardo allows intuitive and time-saving parallel operation. Up to 24 independent fermentations/cultivations can be carried out simultaneously.



Example parallel synoptic

Do it wireless!

Increase mobility: users have the option to access the platform remotely, via PC, tablet, and/or smartphone. Remote access is multi-level password protected.