Computer Controlled Biomedical Spirometry and Breath Teaching Unit, with SCADA

**Key features:**

- **Advanced Real-Time SCADA.**
- **Open Control + Multicontrol + Real-Time Control.**
- **Specialized EDIBON Control Software based on Labview.**
- **National Instruments Data Acquisition board (250 KS/s, kilo samples per second).**
- **Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.**
- **Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.**
- **Capable of doing applied research, real industrial simulation, training courses, etc.**
- **Remote operation and control by the user and remote control for EDIBON technical support, are always included.**
- **Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).**
- **Designed and manufactured under several quality standards.**
- **Optional CAL software helps the user perform calculations and comprehend the results.**
- **This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.**

**Unit:** BISBC. Biomedical Spirometry and Breath Teaching Unit

**www.edibon.com**

**Products range**

**Units**

14.- Biomedical Engineering

- **ISO 9000: Quality Management** (for Design, Manufacturing, Commercialization and After-sales service)
- **European Union Certificate** (total safety)
- **Certificates ISO 14000 and ECO-Management and Audit Scheme** (environmental management)
- **Worlddidac Quality Charter Certificate** and **Worlddidac Member**

*Minimum supply always includes: 1 + 2 + 3 + 4 + 5 + 6*
*(Computer not included in the supply)*
Respiratory diseases are a significant and common cause of death all around the world. It is of great importance to understand the principles of its diagnostic techniques to be able to apply a successful treatment.

One of those diagnostic techniques is spirometry, a pulmonary function test which measures the lung function by means of the volume and flow of air that can be inhaled and exhaled. It is an important tool to assess conditions such as asthma, and pulmonary and cystic fibrosis, among other respiratory diseases.

The Computer Controlled Biomedical Spirometry and Breath Teaching Unit (BISBC) performs a spirometry test and displays its results with a diagnostic aim. It also includes a breath simulator so that the respiratory function parameters are easily understood and related to the spirometry test.

The Computer Controlled Biomedical Spirometry and Breath Teaching Unit (BISBC) unit is provided with a set of practical exercises, through which the user will understand the basic principles about the respiratory function and apply them to interpret the results of a spirometry test.

The Computer Controlled Biomedical Spirometry and Breath Teaching Unit (BISBC) allows the students to relate the respiratory function parameters to the results shown in the pneumotachograph of a spirometry test, in order to diagnose possible respiratory diseases.

The Computer Controlled Biomedical Spirometry and Breath Teaching Unit (BISBC) includes:
- Spirometer, a real device used to perform the spirometry test and analyze its results.
- Breath simulator, which imitates the respiratory function, by means of a bellows system.

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + a Control Interface Box + a Data Acquisition Board + Computer Control, Data Acquisition and Data Management Software Packages, for controlling the process and all parameters involved in the process.

**UNIT ELEMENTS ALLOCATION**

- **Valve**
- **Security Valve**
- **Spirometer**
- **Compressor**
- **Spirometry Printer**
- **Bellows**

**OPEN CONTROL**

**MULTICONTROL**

**REAL TIME CONTROL**
With this unit there are several options and possibilities:
- Main items: 1, 2, 3, 4, 5 and 6.
- Optional items: 7, 8, 9, 10 and 11.
Let us describe first the main items (1 to 6):

**BISBC. Unit:**

Bench-top unit with an anodized aluminum profile structure and painted steel panels.

This unit is composed of:

- **Spirometer:**
  - Early diagnosis of respiratory diseases:
  - Temperature sensor: semiconductor (0-45°C).
  - Flow range: 0 - 16 l./s. ± 5%.
  - Volume range: 10 l. ± 3%.
  - Spirometric parameters:
    - Static lung volume: VC, IVC, IC, ERV, VT...
    - Dynamic lung volume: FVC, FEV1, FEF25%, FEF50%, FEF75%, FET, FIVC, FIV1, FIVC/VC%, PIF, FEV1/VC%...
  - LCD display for visualization of the spirometric curves.
  - Spirometry printer.
  - Set of buttons to control the printing, starting of the spirometry and display options.
  - Flowmeter to measure the spirometric parameters.

- **Breath simulator:**
  - It is a controlled bellows system which simulates the respiratory function, with three different peak expiratory flows (PEF), corresponding to different spirometric patterns: normal, obstructive and restrictive.
  - It consists of an air compressor connected to a tank with bellows for easy visualization of the breathing process. It has a manual valve to empty the tank.

The complete unit includes as well:

- **Advanced Real-Time SCADA.**
- **Open Control + Multicontrol + Real-Time Control.**
- **Specialized EDIBON Control Software based on Labview.**
- **National Instruments Data Acquisition board (250 KS/s, kilo samples per second).**
- **Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.**
- **Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.**
- **The unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.**

**BISBC/CIB. Control Interface Box:**

The Control Interface Box is part of the SCADA system.

- **Control interface box with process diagram in the front panel** and with the same distribution that the different elements located in the unit, for an easy understanding by the student.
- All sensors, with their respective signals, are properly manipulated from -10V to +10V computer output.
- Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors.
- Single cable between the control interface box and computer.
- **The unit control elements are permanently computer controlled,** without necessity of changes or connections during the whole process test procedure.
- **Simultaneous visualization in the computer of all parameters involved in the process.**
- **Calibration of all sensors involved in the process.**
- **Real-time curves representation about system responses.**
- **All the actuators’ values can be changed at any time from the keyboard** allowing the analysis about curves and responses of the whole process.
- **Shield and filtered signals to avoid external interferences.**
- **Real-time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.**
- **Real time computer control for pumps, compressors, heating elements, control valves, etc.**
- **Real time computer control for parameters involved in the process simultaneously.**
- **Open control** allowing modifications, at any moment and in real time, of parameters involved in the process simultaneously.
- **Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.**
DAB. Data Acquisition Board:
The Data Acquisition board is part of the SCADA system.
PCI Express Data acquisition board (National Instruments) to be placed in a computer slot.
Bus PCI Express.

Analog input:
- Number of channels = 16 single-ended or 8 differential. Resolution = 16 bits, 1 in 65536.
- Sampling rate up to: 250 KS/s (kilo samples per second).
- Input range (V) = ±10 V. Data transfers = DMA, interrupts, programmed I/O. DMA channels = 6.

Analog output:
- Number of channels = 2. Resolution = 16 bits, 1 in 65536. Maximum output rate up to: 900 KS/s.
- Output range (V) = ±10 V. Data transfers = DMA, interrupts, programmed I/O.

Digital Input/Output:
- Number of channels = 24 inputs/outputs. D0 or DI Sample Clock frequency: 0 to 100 MHz.

BISBC/CCSOF. Computer Control + Data Acquisition + Data Management Software:
The three softwares are part of the SCADA system.
Compatible with actual Windows operating systems.
Graphic and intuitive simulation of the process in screen.
Compatible with the industry standards.
Registration and visualization of all process variables in an automatic and simultaneous way.
Flexible, open and multicontrol software, developed with actual Windows graphic systems, acting simultaneously on all process parameters.
Management, processing, comparison and storage of data.
Sampling velocity up to 250 KS/s (kilo samples per second).
Calibration system for the sensors involved in the process.
It allows the registration of the alarms state and the graphic representation in real time.
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.
Open software, allowing the teacher to modify texts, instructions. Teacher’s and student’s passwords to facilitate the teacher’s control on the student, and allowing the access to different work levels.
This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

Cables and Accessories, for normal operation.
Manuals: This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

References 1 to 6 are the main items: BISBC + BISBC/CIB + DAB + BISBC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.
1.- Study of the respiratory function.
2.- Analysis of changes in the respiratory function.
3.- Study of the main respiratory parameters.
4.- Basic principles of spirometry.
5.- Understanding of the normal static lung volume.
6.- Interpretation of changes in the static lung volume.
7.- Understanding of the normal dynamic lung flow.
8.- Interpretation of obstructive changes in the dynamic lung flow.
9.- Interpretation of restrictive changes in the dynamic lung flow.
10.- Study of respiratory diseases which can be diagnosed with a spirometry test.

Other possibilities to be done with this Unit:

11.- Many students view results simultaneously.
    - To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
12.- Open Control, Multicontrol and Real Time Control.
    - This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivate parameters; etc., in real time.

- The Computer Control System with SCADA allows a real industrial simulation.
14.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
15.- This unit can be used for doing applied research.
16.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
17.- Control of the BISBC unit process through the control interface box without the computer.
18.- Visualization of all the sensors values used in the BISBC unit process.
    - Several other exercises can be done and designed by the user.

REQUIRED SERVICES

- Electrical supply: single-phase, 220V./50Hz or 110V./60Hz.
- Computer (PC).

DIMENSIONS & WEIGHTS

BISBC:
- Dimensions: 705 x 570 x 1125 mm. approx. 
  (27.75 x 22.44 x 44.29 inches approx.)
- Weight: 50 Kg. approx. 
  (110 pounds approx.)
Control-Interface Box:
- Dimensions: 490 x 330 x 310 mm. approx. 
  (19.29 x 12.99 x 12.20 inches approx.)
- Weight: 10 Kg. approx. 
  (22 pounds approx.)
 Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 11.

All these items try to give more possibilities for:

a) Technical and Vocational Education configuration (CAI and FSS)

b) Higher Education and/or Technical and Vocational Education configuration (CAL)

c) Multipost Expansions options (Mini ESN and ESN)

a) Technical and Vocational Education configuration

1 BISBC/CAI. Computer Aided Instruction Software System.

This complete software package includes two Softwares: the INS/SOF Classroom Management Software (Instructor Software) and the BISBC/SOF Computer Aided Instruction Software (Student Software).

This software is optional and can be used additionally to items (1 to 6).

This complete software package consists of an Instructor Software (INS/SOF) totally integrated with the Student Software (BISBC/SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- INS/SOF Classroom Management Software (Instructor Software):
  
  The Instructor can:
  
  - Organize Students by Classes and Groups.
  - Create easily new entries or delete them.
  - Create data bases with student information.
  - Analyze results and make statistical comparisons.
  - Generate and print reports.
  - Detect student's progress and difficulties.
  - ...and many other facilities.

- BISBC/SOF. Computer Aided Instruction Software (Student Software):

  It explains how to use the unit, run the experiments and what to do at any moment.

  This Software contains:
  
  - Theory.
  - Exercises.
  - Guided Practices.
  - Exams.

  For more information see CAI catalogue. Click on the following link:

2 BISBC/FSS. Faults Simulation System.

Faults Simulation System (FSS) is a Software package that simulates several faults in any EDIBON Computer Controlled Unit. It is useful for Technical and Vocational level.

The "FAULTS" mode consists on causing several faults in the unit normal operation. The student must find them and solve them.

There are several kinds of faults that can be grouped in the following sections:

- Faults affecting the sensors measurement:
  - An incorrect calibration is applied to them.
  - Non-linearity.

- Faults affecting the actuators:
  - Actuators channels interchange at any time during the program execution.
  - Response reduction of an actuator.

- Faults in the controls execution:
  - Inversion of the performance in ON/OFF controls.
  - Reduction or increase of the calculated total response.
  - The action of some controls is annulled.

- On/off faults:
  - Several on/off faults can be included.

For more information see FSS catalogue. Click on the following link:
**Mini ESN. EDIBON Mini Scada-Net System.**

Mini ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously. It is useful for both, Higher Education and/or Technical and Vocational Education.

The Mini ESN system consists on the adaptation of any EDIBON computer controlled unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit. Then, the number of possible users who can work with the same unit is higher than in an usual way of working (usually only one).

**Main characteristics:**
- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.
- Open Control + Multicontrol + Real Time Control + Multi Student Post.
- Instructor controls and explains to all students at the same time.
- Any user/student can work doing “real time” control/multicontrol and visualisation.
- Instructor can see in the computer what any user/student is doing in the unit.
- Continuous communication between the instructor and all the users/students connected.

**Main advantages:**
- It allows an easier and quicker understanding.
- This system allows you can save time and cost.
- Future expansions with more EDIBON Units.

For more information see Mini ESN catalogue. Click on the following link: [www.edibon.com/products/catalogues/en/Mini-ESN.pdf](http://www.edibon.com/products/catalogues/en/Mini-ESN.pdf)

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**Mini ESN. EDIBON Mini Scada-Net System.**

This unit can be integrated, in the future, into a Complete Laboratory with many Units and many Students.
Minimum supply always includes:

1. **Unit**: BISBC. Biomedical Spirometry and Breath Teaching Unit.
2. **BISBC/CIB**: Control Interface Box.
3. **DAB**: Data Acquisition Board.
4. **BISBC/CCSOF**: Computer Control + Data Acquisition + Data Management Software.
5. **Cables and Accessories**: for normal operation.
6. **Manuals**.

*IMPORTANT*: Under BISBC we always supply all the elements for immediate running as 1, 2, 3, 4, 5 and 6.

**Optional items** (supplied under specific order)

- **Technical and Vocational configuration**
  - BISBC/FSS: Faults Simulation System.

- **Higher Education and/or Technical and Vocational Education configuration**
  - BISBC/CAL: Computer Aided Learning Software (Results Calculation and Analysis).

- **Multipost Expansions options**
  - Mini ESN. EDIBON Mini Scada-Net System.
  - ESN. EDIBON Scada-Net System.
BISBC. Unit:
Bench top-unit with an anodized aluminum profile structure and painted steel panels. This unit is composed of:

- Spirometer:
  - Early diagnosis of respiratory diseases:
  - Temperature sensor: semiconductor (0-45°C).
  - Flow range: 0 - 16 l./s. ± 5%.
  - Volume range: 10 l. ± 3%.
  - Spirometric parameters:
    - Static lung volume: VC, IVC, IC, ERV, VT...
    - Dynamic lung volume: FVC, FEV₁, FEV₂/FVC%, PEF, FEF₂₀, FEF₂₅, FEF₅₀, FET, FIVC, FIV, FIV/FIVC%, PIF, FEV₁/VC%...
  - LCD display for visualization of the spirometric curves.
  - Spirometry printer.
  - Set of buttons to control the printing, starting of the spirometry and display options.
  - Flowmeter to measure the spirometric parameters.

- Breath simulator:
  - It is a controlled bellows system which simulates the respiratory function, with three different peak expiratory flows (PEF), corresponding to different spirometric patterns: normal, obstructive and restrictive.
  - It consists of an air compressor connected to a tank with a bellows for easy visualization of the breathing process. It has a manual valve to empty the tank.

The complete unit includes as well:
- Advanced Real-Time SCADA.
- Open Control + Multicontrol + Real-Time Control.
- Specialized EDIBON Control Software based on Labview.
- National Instruments Data Acquisition board (250 KS/s, kilo samples per second).
- Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.
- Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.
- Capable of doing applied research, real industrial simulation, training courses, etc.
- Remote operation and control by the user and remote control for EDIBON technical support, are always included.
- Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).
- Designed and manufactured under several quality standards.
- Optional CAL software helps the user perform calculations and comprehend the results.

This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.

BISBC/CIB. Control Interface Box:
The Control Interface Box is part of the SCADA system. The control interface box with process diagram in the front panel.
The unit control elements are permanently computer controlled.
- Simultaneous visualization in the computer of all parameters involved in the process.
- Calibration of all sensors involved in the process.
- Real time curves representation about system responses.
- All the actuators’ values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.
- Shield and filtered signals to avoid external interferences.
- Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.
- Real time computer control for parameters involved in the process simultaneously.
- Open control allowing modifications, at any moment and in real time, of parameters involved in the process simultaneously.
- Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.

DAB. Data Acquisition Board:
The Data Acquisition board is part of the SCADA system.
- PCI Express Data acquisition board (National Instruments) to be placed in a computer slot.
  - Analog input: Channels= 16 single-ended or 8 differential. Resolution=16 bits, 1 in 65536. Sampling rate up to: 250 KS/s (kilo samples per second).
  - Analog output: Channels=2. Resolution=16 bits, 1 in 65536.
  - Digital Input/Output: Channels=24 inputs/outputs.

BISBC/CCSOF. Computer Control + Data Acquisition + Data Management Software:
The three softwares are part of the SCADA system.
- Compatible with the industry standards.
- Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
- Management, processing, comparison and storage of data.
- Sampling velocity up to 250 KS/s (kilo samples per second).
- Calibration system for the sensors involved in the process.
- It allows the registration of the alarms state and the graphic representation in real time.
- Open software, allowing the teacher to modify texts, instructions. Teacher’s and student’s passwords to facilitate the teacher’s control on the student, and allowing the access to different work levels.
- This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

- Cables and Accessories, for normal operation.
- Manuals: This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.
Exercises and Practical Possibilities to be done with Main Items

1. Study of the respiratory function.
2. Analysis of changes in the respiratory function.
3. Study of the main respiratory parameters.
4. Basic principles of spirometry.
5. Understanding of the normal static lung volume.
6. Interpretation of changes in the static lung volume.
7. Understanding of the normal dynamic lung flow.
8. Interpretation of obstructive changes in the dynamic lung flow.
9. Interpretation of restrictive changes in the dynamic lung flow.
10. Study of respiratory diseases which can be diagnosed with a spirometry test.

Other possibilities to be done with this Unit:

11. Many students view results simultaneously.
    To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
12. Open Control, Multicontrol and Real Time Control.
    This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivate parameters; etc., in real time.
13. The Computer Control System with SCADA allows a real industrial simulation.
14. This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
15. This unit can be used for doing applied research.
16. This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
17. Control of the BISBC unit process through the control interface box without the computer.
18. Visualization of all the sensors values used in the BISBC unit process.

Several other exercises can be done and designed by the user.
TENDER SPECIFICATIONS (for optional items)

a) Technical and Vocational Education configuration

1 BISBC/CAI. Computer Aided Instruction Software System.

This complete software package consists of an Instructor Software (INS/SOF) totally integrated with the Student Software (BISBC/SOF).

- INS/SOF. Classroom Management Software (Instructor Software):
  The Instructor can:
  - Organize Students by Classes and Groups.
  - Create easily new entries or delete them.
  - Create data bases with student information.
  - Analyze results and make statistical comparisons.
  - Generate and print reports.
  - Detect student's progress and difficulties.

- BISBC/SOF. Computer Aided Instruction Software (Student Software):
  It explains how to use the unit, run the experiments and what to do at any moment.
  This Software contains:
  - Theory.
  - Exercises.
  - Guided Practices.
  - Exams.

2 BISBC/FSS. Faults Simulation System.

Faults Simulation System (FSS) is a Software package that simulates several faults in any EDIBON Computer Controlled Unit.

The 'FAULTS' mode consists on causing several faults in the unit normal operation. The student must find them and solve them.

There are several kinds of faults that can be grouped in the following sections:
  - Faults affecting the sensors measurement:
    - An incorrect calibration is applied to them.
    - Non-linearity.
  - Faults affecting the actuators:
    - Actuators channels interchange at any time during the program execution.
    - Response reduction of an actuator.
  - Faults in the controls execution:
    - Inversion of the performance in ON/OFF controls.
    - Reduction or increase of the calculated total response.
    - The action of some controls is annulled.
  - On/off faults:
    - Several on/off faults can be included.

b) Higher Education and/or Technical and Vocational Education configuration

3 BISBC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

This Computer Aided Learning Software (CAL) is a Windows based software, simple and very easy to use.

CAL is a class assistant that helps in doing the necessary calculations to extract the right conclusions from data obtained during the experimental practices.

CAL computes the value of all the variables involved and performs the calculations.

It allows to plot and print the results. Within the plotting options, any variable can be represented against any other.

Different plotting displays.

It has a wide range of information, such as constant values, unit conversion factors and integral and derivative tables.
**Mini ESN. EDIBON Mini Scada-Net System.**

EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously.

The Mini ESN system consists on the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit.

Main characteristics:
- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.
- Open Control + Multicontrol + Real Time Control + Multi Student Post.
- Instructor controls and explains to all students at the same time.
- Any user/student can work doing "real time" control/multicontrol and visualisation.
- Instructor can see in the computer what any user/student is doing in the unit.
- Continuous communication between the instructor and all the users/students connected.

Main advantages:
- It allows an easier and quicker understanding.
- This system allows you can save time and cost.
- Future expansions with more EDIBON Units.

The system basically will consist of:
- This system is used with a Computer Controlled Unit.
  - Instructor’s computer.
  - Students’ computers.
  - Local Network.
  - Unit-Control Interface adaptation.
  - Unit Software adaptation.
  - Webcam.
- Mini ESN Software to control the whole system.
- Cables and accessories required for a normal operation.