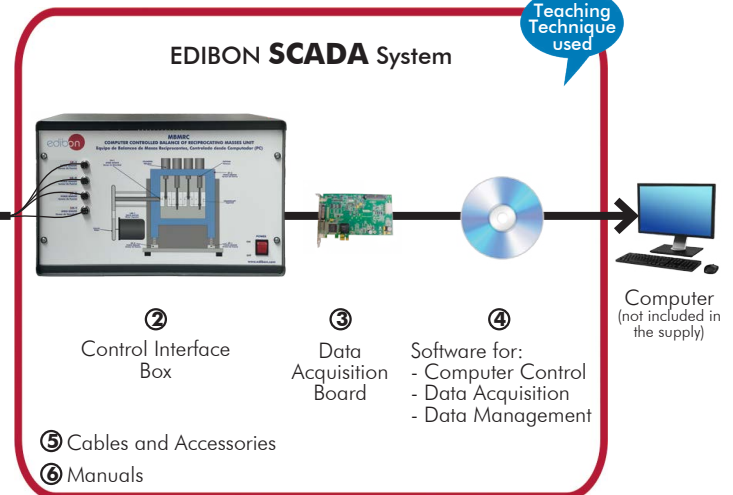


# Computer Controlled Balance of Reciprocating Masses Unit, with SCADA

**MBMRC**



Teaching  
Technique  
used



\* Minimum supply always includes: 1 + 2 + 3 + 4 + 5 + 6  
(Computer not included in the supply)

① Unit: MBMRC. Computer Controlled Balance of Reciprocating Masses Unit

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 ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.**
- **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.**

**OPEN CONTROL  
+  
MULTICONTROL  
+  
REAL TIME CONTROL**



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PRODUCTS  
↳ 7.- MECHANICS  
AND  
14.-BIOMEDICAL  
ENGINEERING

For more information about Key Features, click here



ISO 9001: Quality Management (for Design, Manufacturing, Commercialization and After-sales service)



European Union Certificate (total safety)



Certificates ISO 14001 and ECO-Management and Audit Scheme (environmental management)



"Worlddidac Quality Charter" and Platinum Member of Worlddidac

## INTRODUCTION

Reciprocating engines consist of a piston reciprocating in a cylinder and connected to a crank shaft by a connecting rod. Every reciprocating engine generates mass forces. The mass forces of the oscillating masses cannot be compensated completely while the mass forces of the rotating masses are fully compensated. By using several cylinders it is possible that the forces compensate each other.

The Computer Controlled Balance of Reciprocating Masses Unit, "MBMRC", is a model four-cylinder in-line engine that shows the primary and secondary forces and moments when balancing reciprocating masses.

## GENERAL DESCRIPTION

The Computer Controlled Balance of Reciprocating Masses Unit, "MBMRC", is a bench-top unit that allows to investigate and examine the free masses and moments of a reciprocating engine with a single cylinder, with two cylinders or with four cylinders.

A robust frame bears a support that holds a model four-cylinder in-line engine. The model engine has a crankshaft, connecting rods, bearings, pistons and a cylinder block.

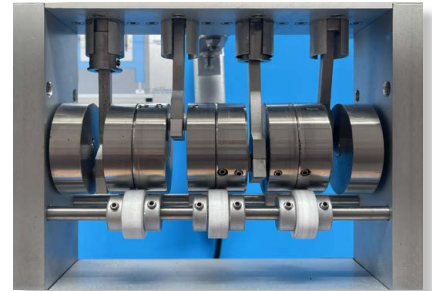
The crankshaft has adjustable sections and the students can rotate each section relative to the others to change the crank angles. For each cylinder, the angle between cranks can be adjusted continuously.

The oscillating masses can be varied by using additional weights at the piston. Each piston includes a tapped hole to allow students to add or remove weights. These weights are securely fixed during engine running.

The engine crankshaft is driven by a computer controlled motor. The speed is measured by a speed sensor. The forces and moments are measured by three force sensors placed at the supports of the unit.

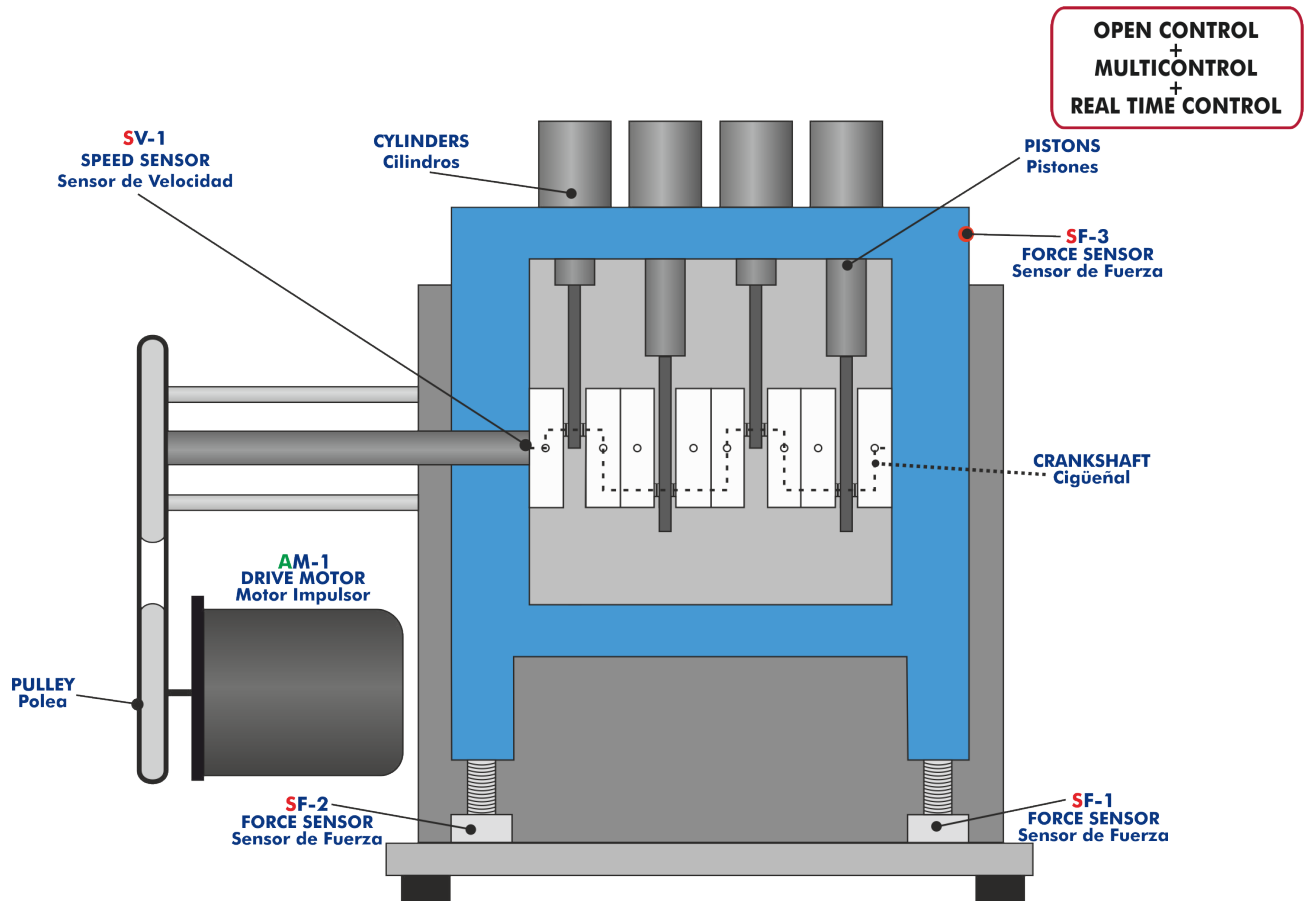
A transparent protective cover protects students from the moving crankshaft and allows the visibility of the practical exercises and components of the unit. This cover includes a switch, which allows automatically stops the drive motor if the cover is opened.

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.



MBMRC detail

## PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION



With this unit there are several options and possibilities:

- Main items: 1, 2, 3, 4, 5 and 6.
- Optional items: 7, 8, 9 and 10.

Let us describe first the main items (1 to 6):

### ① **MBMRC. Unit:**

Bench-top unit.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

Diagram in the front panel with distribution of the elements similar to the real one.

It includes rubber elements to have a vibration isolation.

Transparent protective cover protects students from the moving crankshaft and allows the visibility of the practical exercises and elements of the unit. This cover includes a switch, which allows automatically stops the drive motor if the cover is opened.

The unit includes:

Engine:

Number of cylinders: 4.

Crankshaft:

Distance between the centers of the cylinders: 43 mm.

Radius: 18 mm.

Length of connecting rod: 70 mm.

Computer controlled motor:

Speed: 100 – 3000 rpm.

Sensors:

Speed sensor to measure the motor speed, range: 100 – 3000 rpm.

Three force sensors to measure the forces and moments, ranges: one of 0 – 20 N and two of 0 – 150 N.

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 ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.**

**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: MBMRC

## ② MBMRC/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.**

Storage of all the process data and results in a file.

Graphic representation, in real time, of all the process/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.

All the actuators and sensors values and their responses are displayed on only one screen in the computer.

**Shield and filtered signals to avoid external interferences.**

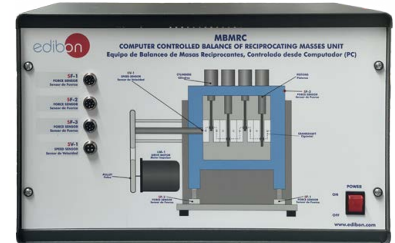
**Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.**

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.**



MBMRC/CIB

## ③ 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)=  $\pm 10$  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)=  $\pm 10$  V. Data transfers=DMA, interrupts, programmed I/O.

**Digital Input/Output:**

Number of **channels=24 inputs/outputs**. DO or DI Sample Clock frequency: 0 to 100 MHz.

Timing: Number of **Counter/timers=4**. Resolution: Counter/timers: 32 bits.

**The Data Acquisition board model may change at any moment, providing the same or better features than those required for the unit.**



DAB

## ④ MBMRC/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).**

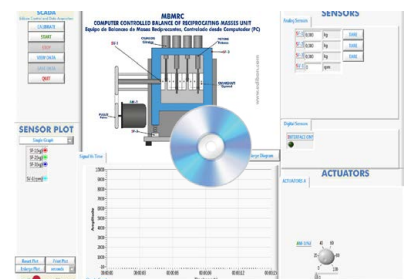
**Calibration system for the sensors involved in the process.**

**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.**



MBMRC/CCSOF

## ⑤ Cables and Accessories, for normal operation.

## ⑥ 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: MBMRC + MBMRC/CIB + DAB + MBMRC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.

## EXERCISES AND PRACTICAL POSSIBILITIES TO BE DONE WITH THE MAIN ITEMS

- 1.- Study of the polygons of forces and polygon of moment for a symmetrical engine.
- 2.- Study of first and second forces and moments for different crankshaft settings: single cylinder.
- 3.- Study of first and second forces and moments for different crankshaft setting: two-cylinder, 180° angle between cranks.
- 4.- Study of first and second forces and moments for different crankshaft settings: four-cylinder, non-symmetrical, 90° angle between cranks.
- 5.- Study of first and second forces and moments for different crankshaft settings: four-cylinder, symmetrical, 180° angle between cranks.
- 6.- Study of the effect of mass forces in dependence on the speed.
- 7.- Study of the effect of mass forces in dependence on the piston mass.
- 11.- The Computer Control System with SCADA allows a real industrial simulation.
- 12.- This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.
- 13.- This unit can be used for doing applied research.
- 14.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
- 15.- Control of the MBMRC unit process through the control interface box without the computer.
- 16.- Visualization of all the sensors values used in the MBMRC unit process.

- Several other exercises can be done and designed by the user.

Additional practical possibilities:

- 8.- Sensors calibration.

Other possibilities to be done with this unit:

- 9.- Many students view results simultaneously.

To view all results in real time in the classroom by means of a projector or an electronic whiteboard.

- 10.- Open Control, Multicontrol and Real Time Control.

This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.

### REQUIRED SERVICES

- Electrical supply: single-phase 200 VAC – 240 VAC/50 Hz or 110 VAC – 127 VAC/60 Hz.

- Computer.

Note: The bench where the unit will be located must be strong and robust.

### DIMENSIONS AND WEIGHTS

MBMRC:

Unit:

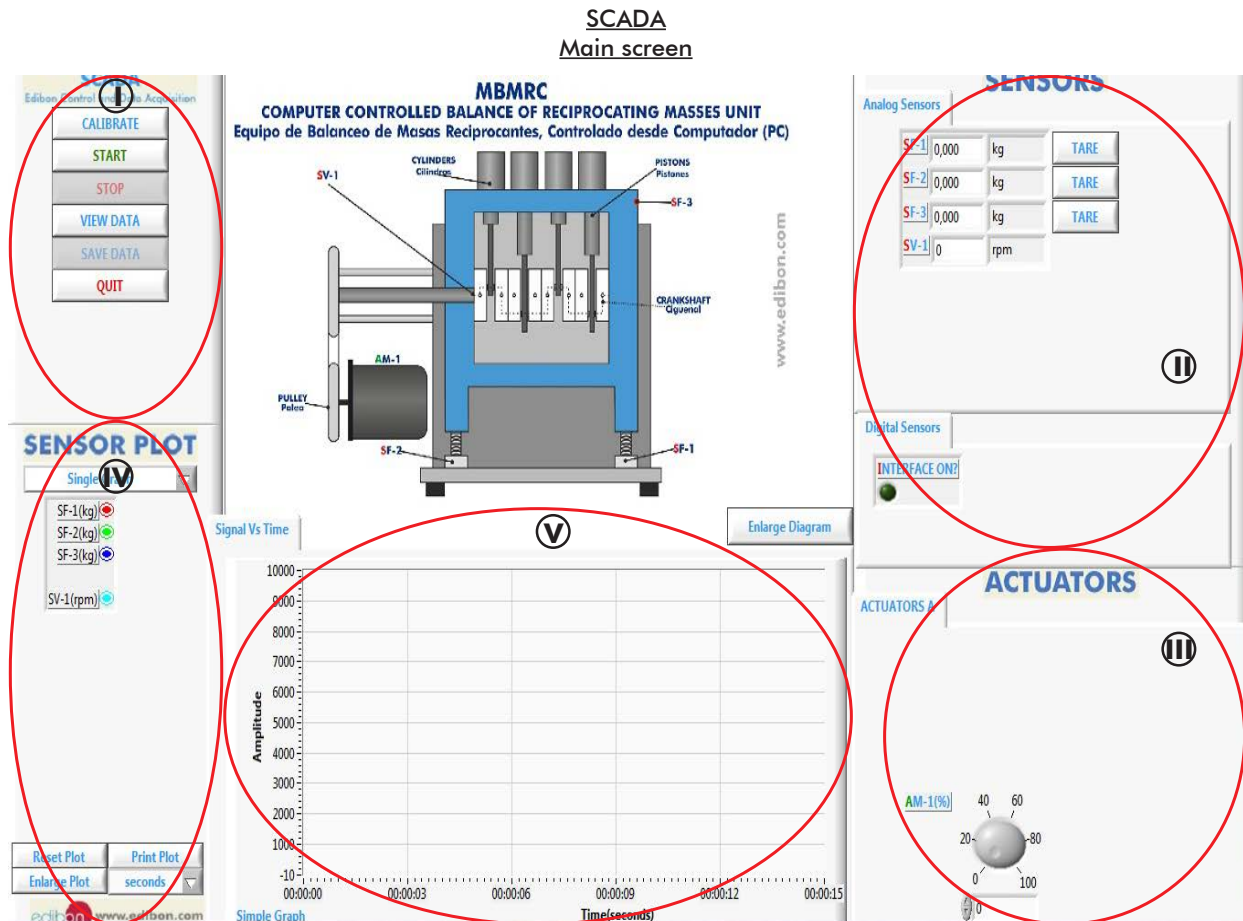
- Dimensions: 600 x 600 x 400 mm approx.  
(23.62 x 23.62 x 15.75 inches approx.)
- Weight: 45 Kg approx.  
(99.2 pounds approx.).

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.).



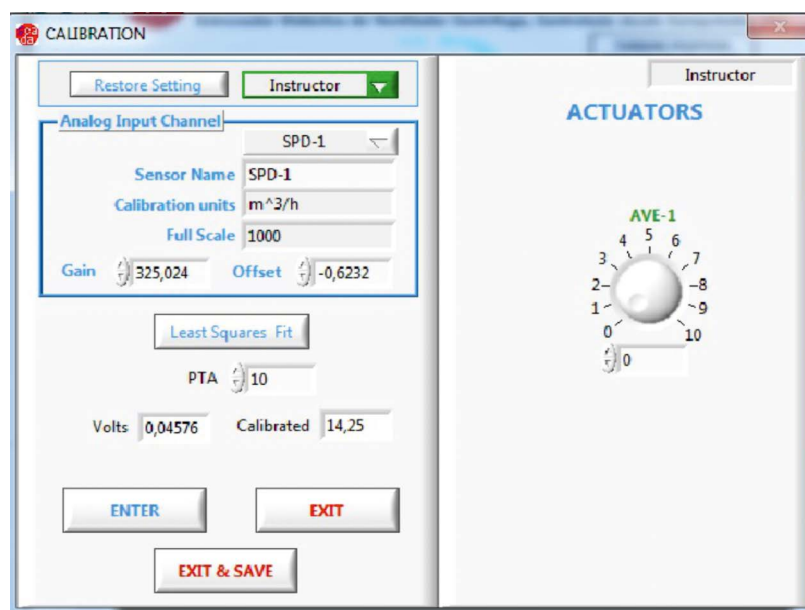
## SOFTWARE MAIN SCREENS



- I Main software operation possibilities.
- II Sensors displays, real time values, and extra output parameters. Sensors: SV=Speed sensor. SF=Force sensor.
- III Actuators controls. Actuators: AM=Drive motor.
- IV Channel selection and other plot parameters.
- V Real time graphics displays.

### Software for Sensors Calibration

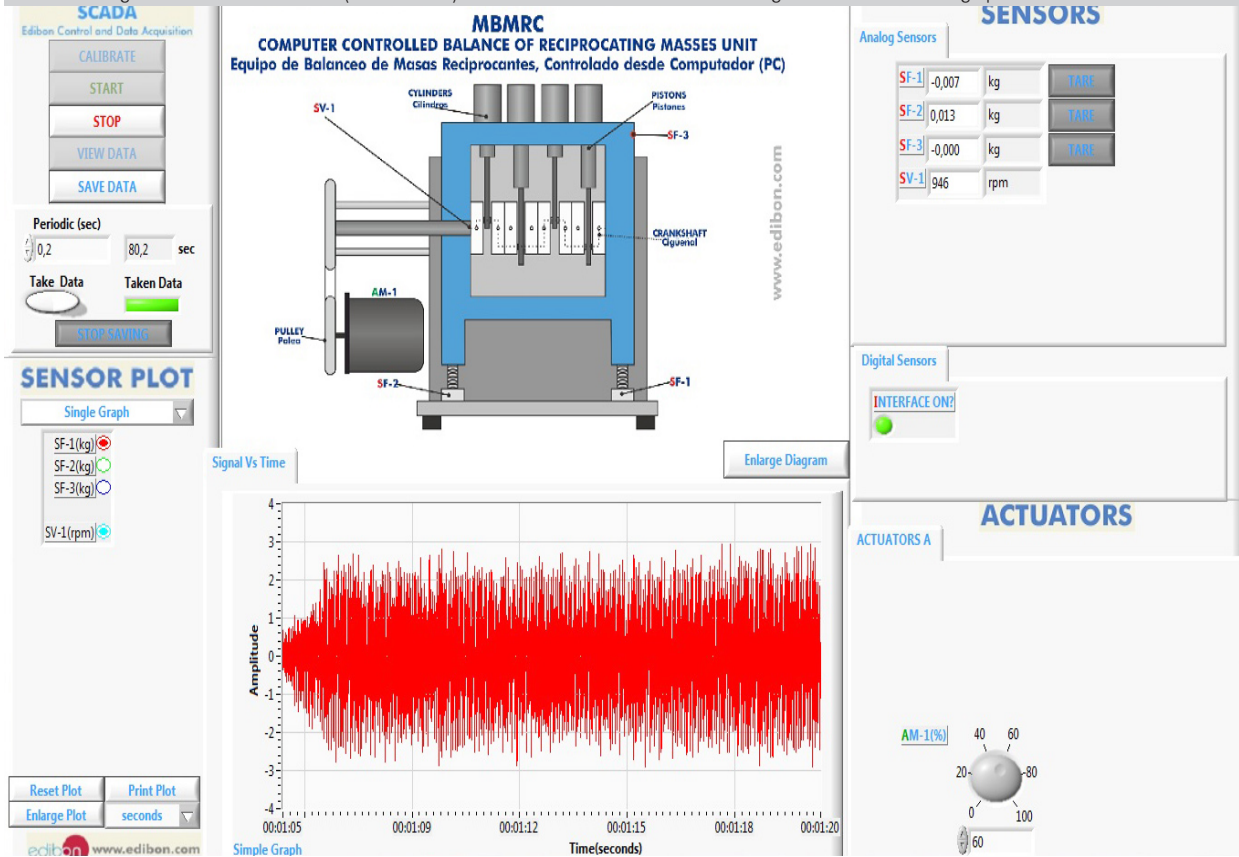
Example of screen



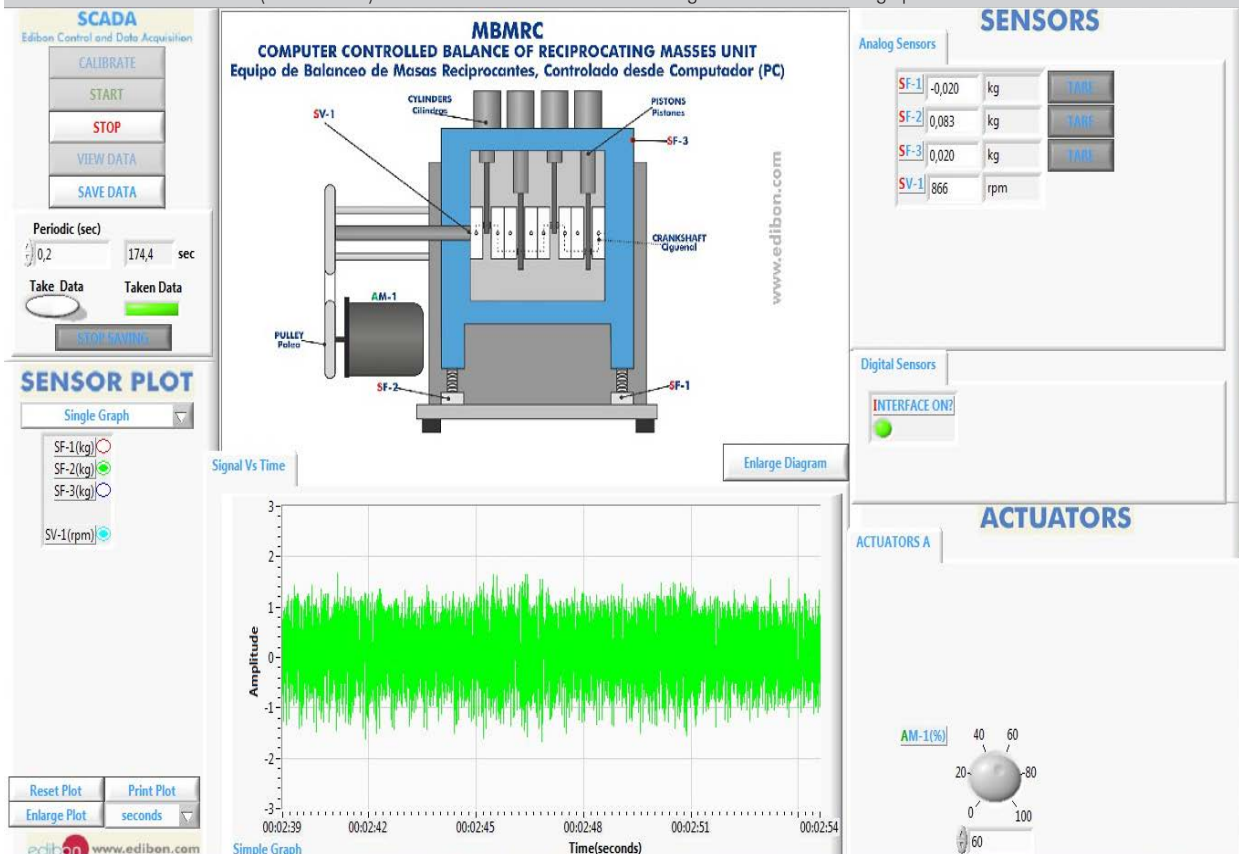
The teacher and the students can calibrate the unit with a password provided by EDIBON. The teacher can restore the factory calibration any time.

## SOME REAL RESULTS OBTAINED FROM THIS UNIT

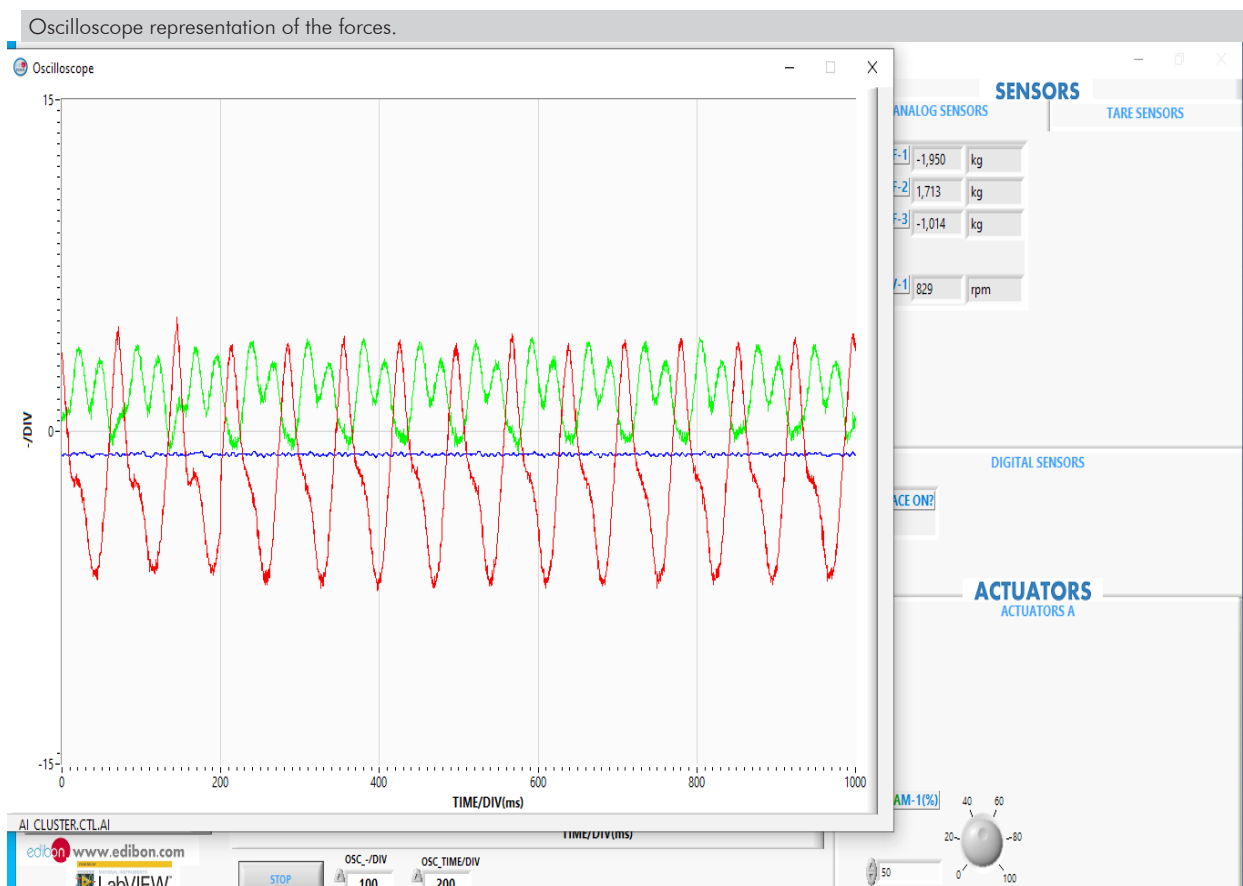
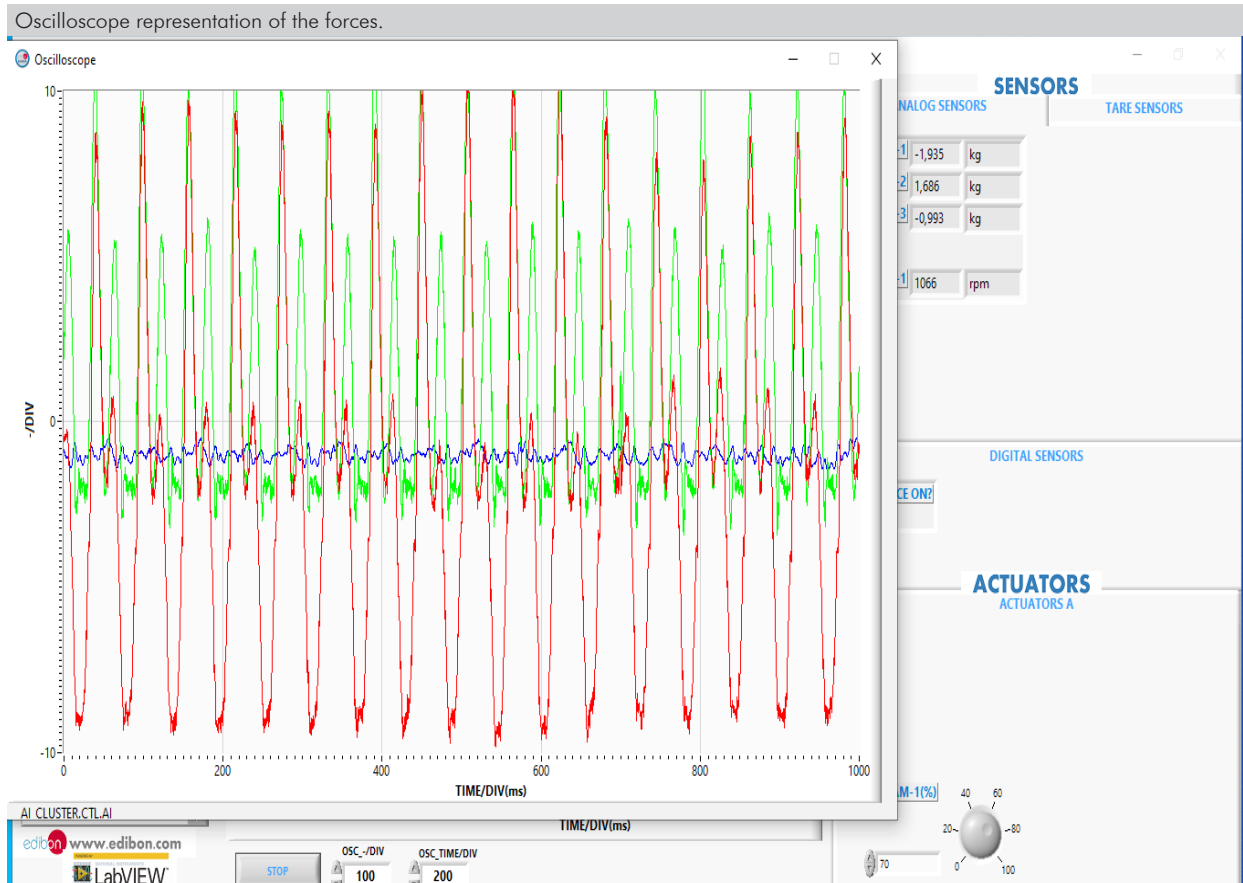
The following screen shows the force (sensor SF-1) versus time when the unit is working at a constant turning speed.



This screen shows the force (sensor SF-2) versus time when the unit is working at a constant turning speed.

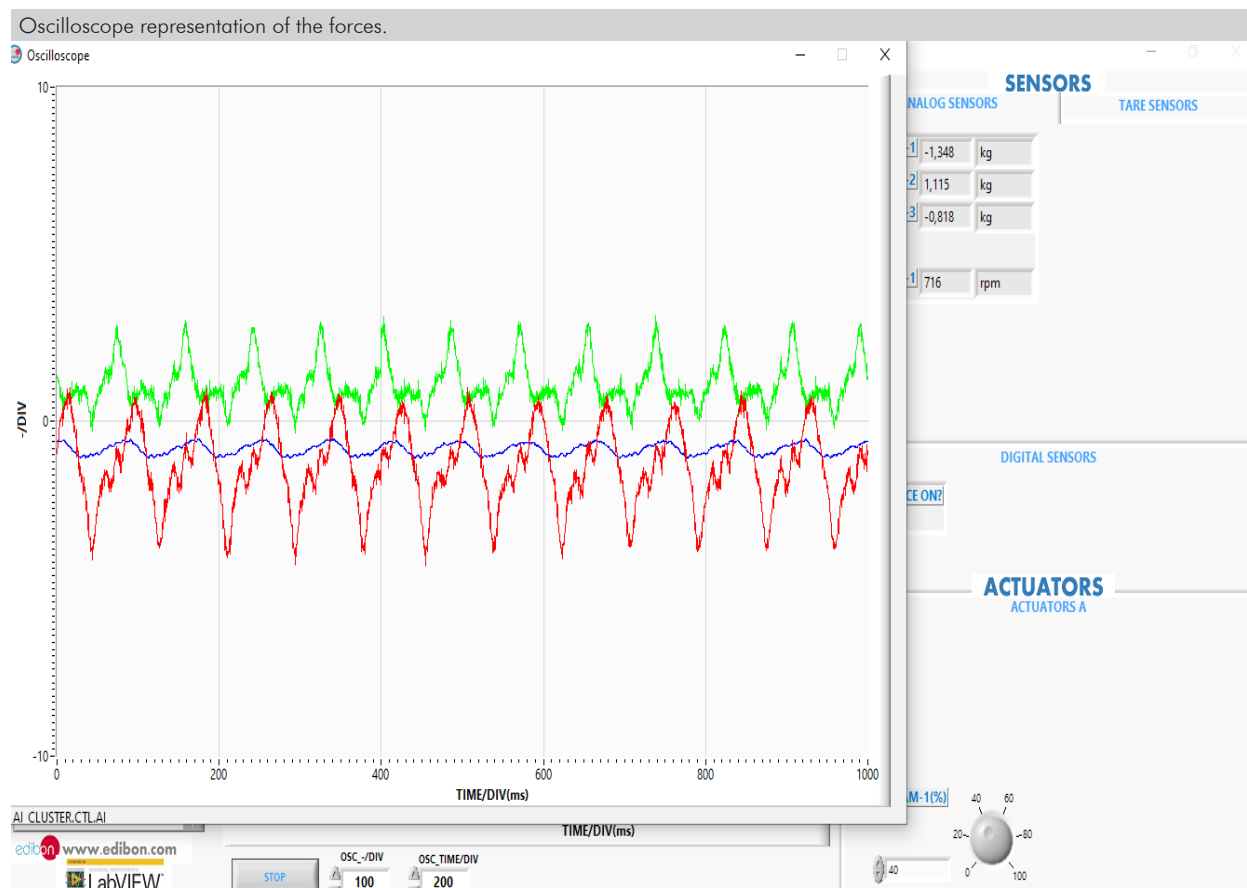


Some **real** results obtained from this Unit

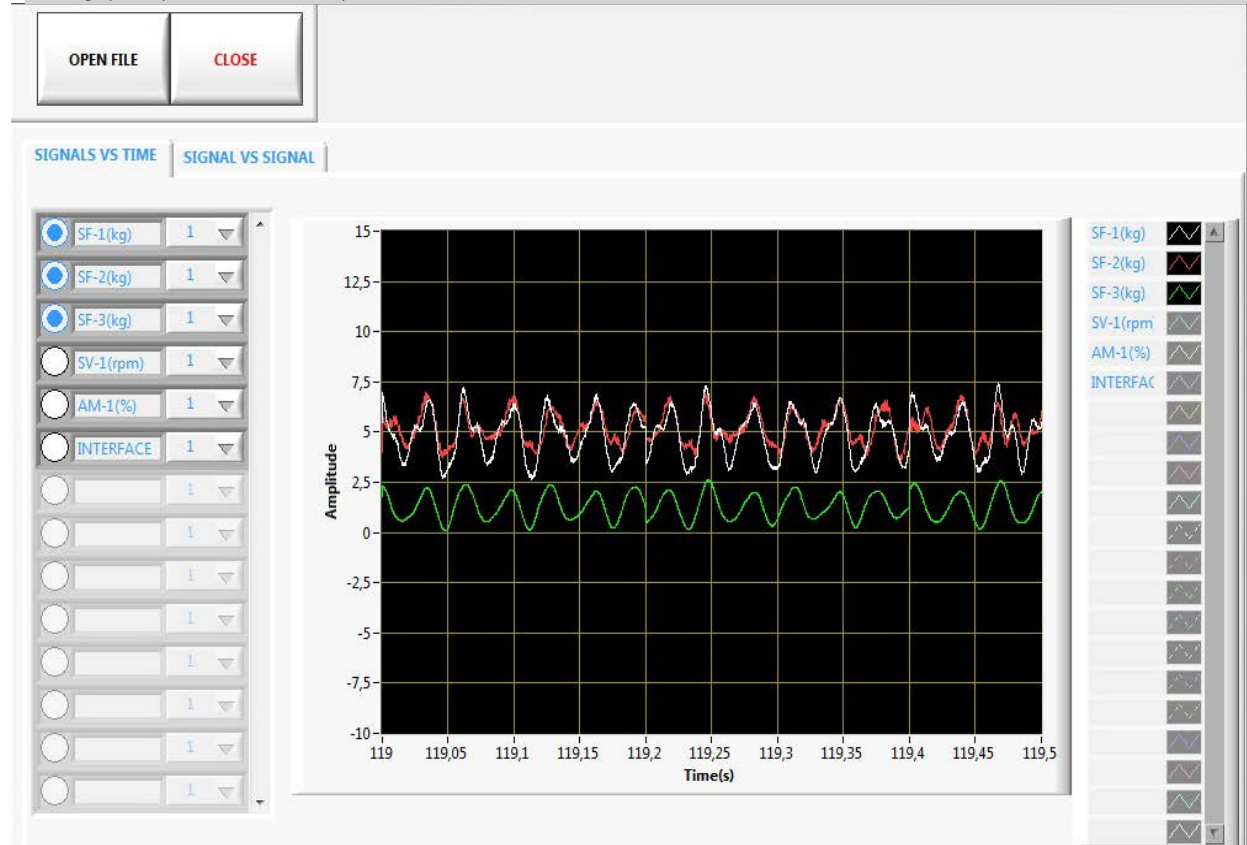




Some **real** results obtained from this Unit



This last screen shows the data collected by the force sensors (SF-1, SF-2 and SF-3) versus time when the unit is working at a constant turning speed (VIEW DATA window).



## COMPLETE TECHNICAL SPECIFICATIONS (for optional items)

Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 10.

All these items try to give more possibilities for:

- a) Technical and Vocational Education configuration. (ICAI and FSS)
- b) Multipost Expansions options. (MINI ESN and ESN)

### a) Technical and Vocational Education configuration

#### ⑦ MBMRC/ICAI. Interactive Computer Aided Instruction Software.

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

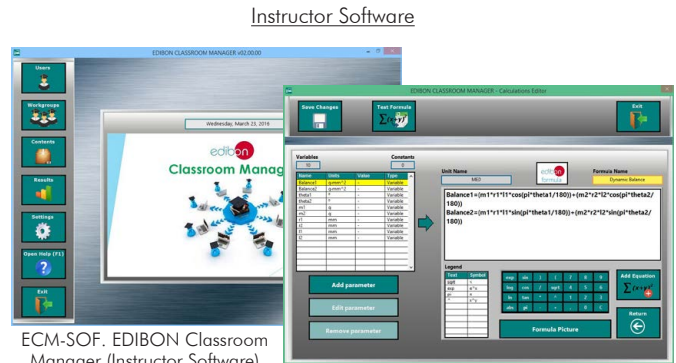
This software is optional and can be used additionally to items (1 to 6).

#### - ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

- User Data Base Management.
- Administration and assignment of Workgroup, Task and Training sessions.
- Creation and Integration of Practical Exercises and Multimedia Resources.
- Custom Design of Evaluation Methods.
- Creation and assignment of Formulas & Equations.
- Equation System Solver Engine.
- Updatable Contents.
- Report generation, User Progression Monitoring and Statistics.



ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen

ECAL. EDIBON Calculations Program Package - Formula Editor Screen



ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram

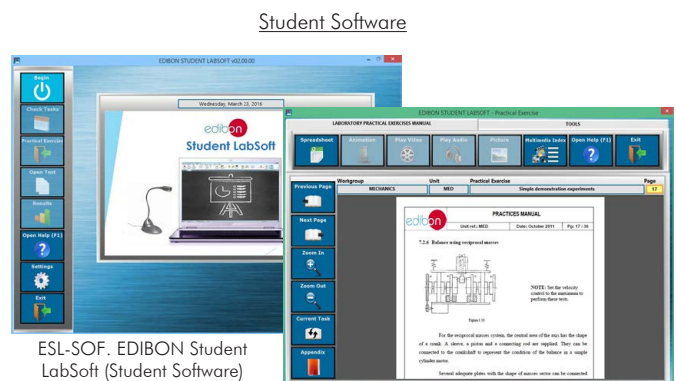
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

#### - ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

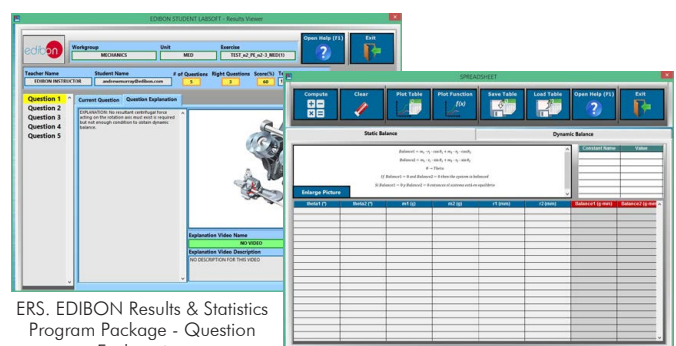
Innovative features:

- Student Log-In & Self-Registration.
- Existing Tasks checking & Monitoring.
- Default contents & scheduled tasks available to be used from the first session.
- Practical Exercises accomplishment by following the Manual provided by EDIBON.
- Evaluation Methods to prove your knowledge and progression.
- Test self-correction.
- Calculations computing and plotting.
- Equation System Solver Engine.
- User Monitoring Learning & Printable Reports.
- Multimedia-Supported auxiliary resources.



ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen

EPE. EDIBON Practical Exercise Program Package Main Screen



ERS. EDIBON Results & Statistics Program Package - Question Explanation

ECAL. EDIBON Calculations Program Package Main Screen

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

[www.edibon.com/en/interactive-computer-aided-instruction-software](http://www.edibon.com/en/interactive-computer-aided-instruction-software)

## ⑧ MBMRC/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 in 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.

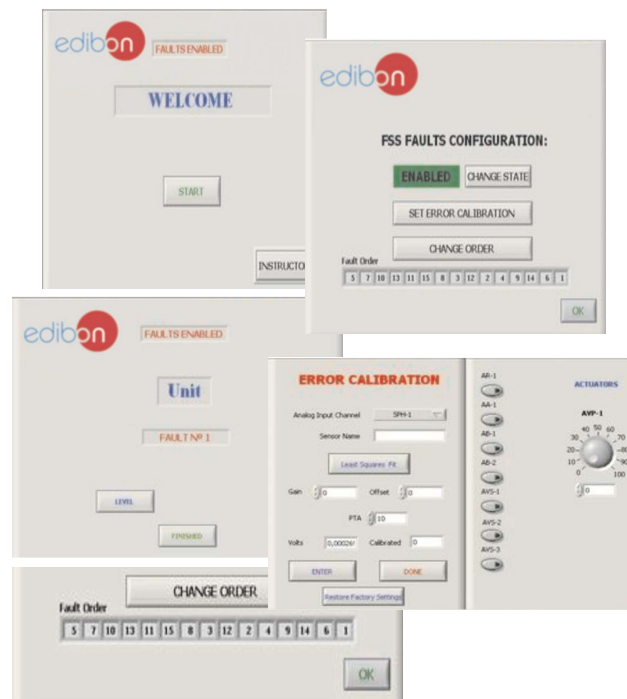
Faults in the controls execution:

- 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.

Example of some screens



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

[www.edibon.com/en/fault-simulation-system](http://www.edibon.com/en/fault-simulation-system)

### b) Multipost Expansions options

## ⑨ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.

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 of 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:

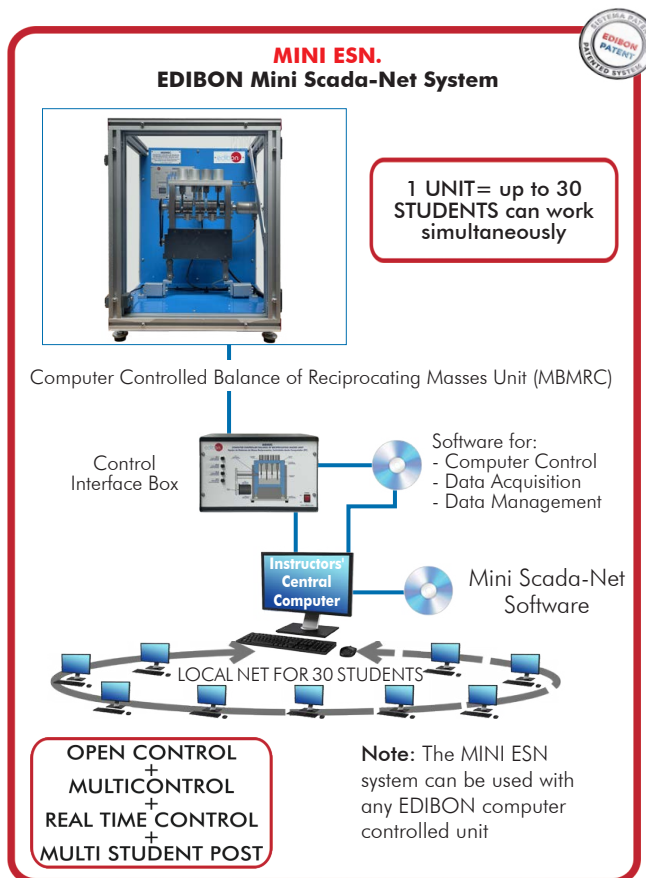
[www.edibon.com/en/edibon-scada-net](http://www.edibon.com/en/edibon-scada-net)

## ⑩ ESN. EDIBON Scada-Net Systems.

This unit can be integrated, in the future, into a Complete Laboratory with many Units and many Students.

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

[www.edibon.com/en/edibon-scada-net](http://www.edibon.com/en/edibon-scada-net)



## ORDER INFORMATION

### **Main items** (always included in the supply)

Minimum supply always includes:

- ① **Unit: MBMRC. Computer Controlled Balance of Reciprocating Masses Unit.**
- ② **MBMRC/CIB. Control Interface Box.**
- ③ **DAB. Data Acquisition Board.**
- ④ **MBMRC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
- ⑤ **Cables and Accessories**, for normal operation.
- ⑥ **Manuals.**

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

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

a) Technical and Vocational Education configuration

- ⑦ MBMRC/ICAL. Interactive Computer Aided Instruction Software.
- ⑧ MBMRC/FSS. Faults Simulation System.

b) Multipost Expansions options

- ⑨ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.
- ⑩ ESN. EDIBON Scada-Net Systems.

**① MBMRC. Unit:**

Bench-top unit.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

Diagram in the front panel with distribution of the elements similar to the real one.

It includes rubber elements to have a vibration isolation.

Transparent protective cover protects students from the moving crankshaft and allows the visibility of the practical exercises and elements of the unit. This cover includes a switch, which allows automatically stops the drive motor if the cover is opened.

The unit includes:

Engine:

Number of cylinders: 4.

Crankshaft:

Distance between the centers of the cylinders: 43 mm.

Radius: 18 mm.

Length of connecting rod: 70 mm.

Computer controlled motor:

Speed: 100 – 3000 rpm.

Sensors:

Speed sensor to measure the motor speed, range: 100 – 3000 rpm.

Three force sensors to measure the forces and moments, ranges: one of 0 – 20 N and two of 0 – 150 N.

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 ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.

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.

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The Control Interface Box is part of the SCADA system.

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.

**③ 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.

The Data Acquisition board model may change at any moment, providing the same or better features than those required for the unit.

**④ MBMRC/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.

**⑤ Cables and Accessories, for normal operation.****⑥ 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 the Main Items

- 1.- Study of the polygons of forces and polygon of moment for a symmetrical engine.
- 2.- Study of first and second forces and moments for different crankshaft settings: single cylinder.
- 3.- Study of first and second forces and moments for different crankshaft settings: two-cylinder, 180° angle between cranks.
- 4.- Study of first and second forces and moments for different crankshaft settings: four-cylinder, non-symmetrical, 90° angle between cranks.
- 5.- Study of first and second forces and moments for different crankshaft settings: four-cylinder, symmetrical, 180° angle between cranks.
- 6.- Study of the effect of mass forces in dependence on the speed.
- 7.- Study of the effect of mass forces in dependence on the piston mass.

Additional practical possibilities:

- 8.- Sensors calibration.

Other possibilities to be done with this Unit:

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

### a) Technical and Vocational Education configuration

#### ⑦ **MBMRC/ICAI. Interactive Computer Aided Instruction Software.**

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc...so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

- User Data Base Management.
- Administration and assignment of Workgroup, Task and Training sessions.
- Creation and Integration of Practical Exercises and Multimedia Resources.
- Custom Design of Evaluation Methods.
- Creation and assignment of Formulas & Equations.
- Equation System Solver Engine.
- Updatable Contents.
- Report generation, User Progression Monitoring and Statistics.

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

- Student Log-In & Self-Registration.
- Existing Tasks checking & Monitoring.
- Default contents & scheduled tasks available to be used from the first session.
- Practical Exercises accomplishment by following the Manual provided by EDIBON.
- Evaluation Methods to prove your knowledge and progression.
- Test self-correction.
- Calculations computing and plotting.
- Equation System Solver Engine.
- User Monitoring Learning & Printable Reports.
- Multimedia-Supported auxiliary resources.

#### ⑧ **MBMRC/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 in 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) Multipost Expansions options

⑨ **MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.**

MINI ESN. 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 of 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.

\* Specifications subject to change without previous notice, due to the convenience of improvement of the product.



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