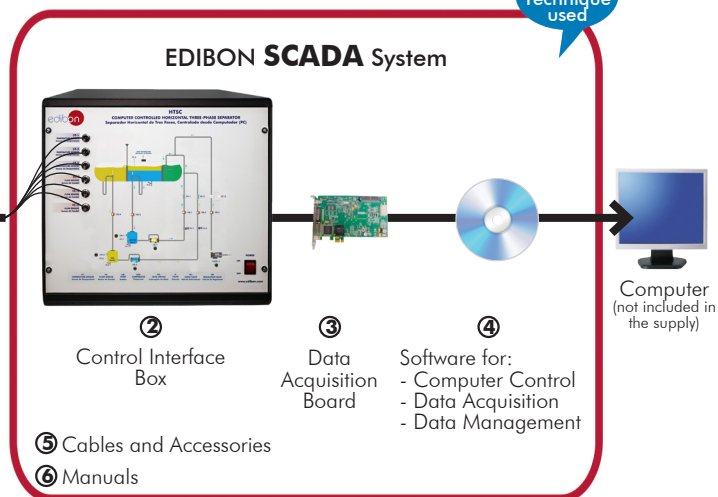
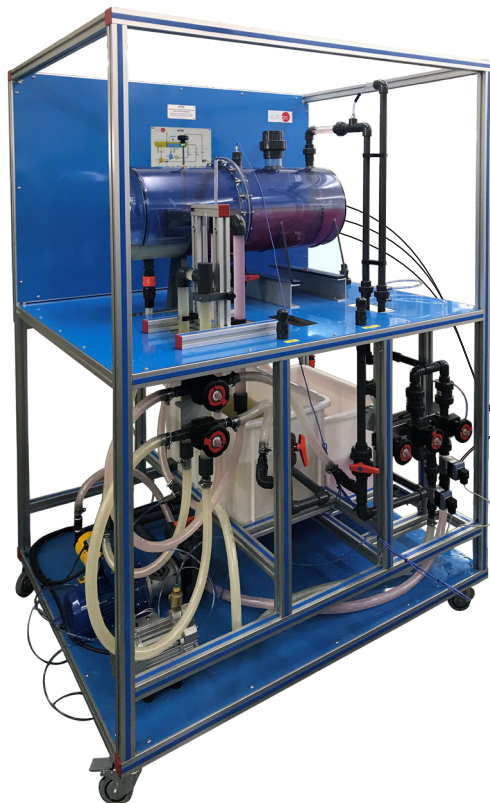


# Computer Controlled Horizontal Three-phase Separator, with SCADA

**HTSC**

**EDIBON PATENT**



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

① Unit: HTSC. Computer Controlled Horizontal Three-phase Separator

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**

POWERED BY  
NATIONAL INSTRUMENTS  
**LabVIEW™**

**www.edibon.com**

PRODUCTS  
11.-CHEMICAL  
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

Oil is a fluid that is extracted by drilling the well on a reservoir. This fluid is usually multiphase in nature, since it contains substances with gaseous thermodynamic properties, such as natural gas, liquids such as water and oil, and solids such as sand and other particles. This multiphase fluid does not separate by itself, it is necessary to use equipment for that purpose. The first equipment that is used in the oil industry is the three-phase separator, which separates the multiphase liquid that leaves the gas field and the two phases of the immiscible liquids.

In the Computer Controlled Horizontal Three-phase Separator, "HTSC", crude oil, gas and water will separate naturally due to the effects of gravity and the difference in density between the components of the incoming flow. The heavier particles of the flow go to the bottom, while the lighter particles remain on the surface. The gas rises and the liquid will tend to remain at the bottom of the separator. The separation is basically a natural process, which is generated by the retention of the fluids for a sufficient time and at a very low speed while the separation process occurs.

## GENERAL DESCRIPTION

The Computer Controlled Horizontal Three-phase Separator, "HTSC", designed by EDIBON, is a device that allows the study of the main characteristics of gravity separation and the effect of viscosity, flow and density difference in this separation.

Two computer controlled pumps drive water and oil to a point of mixing that also reaches a current of air produced by a computer controlled blower.

There are two level switches, one in each feed tank, to ensure the correct level for proper functioning of the fluid circulation pumps.

The mixture of water, oil and air enters the horizontal separator going towards its spherical part to force the first separation.

Next, the first coalescent element is encountered and the secondary separation section is started.

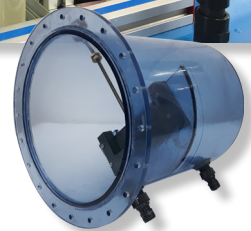
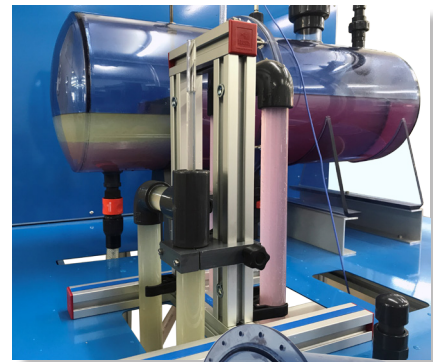
In this section you can place two interchangeable configurations of separators, one type dump and another type dump-deposit, whose heights in the tank can be easily adjusted manually. Here the speed of the fluids slows and they separate by gravity. The water begins to be the heaviest phase and remains in the bottom while the oil floats on it and the air occupies the available space in the tank.

For the separation of the air there is a fog extractor in its upper part.

By means of two overflow type outlets both water and oil separate phases are extracted, to return each one to its deposit. Both the flow rates and the levels in the tank can be controlled.

By means of three temperature sensors, it is possible to know both the water and oil inlet temperatures and the temperature in the separator.

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.

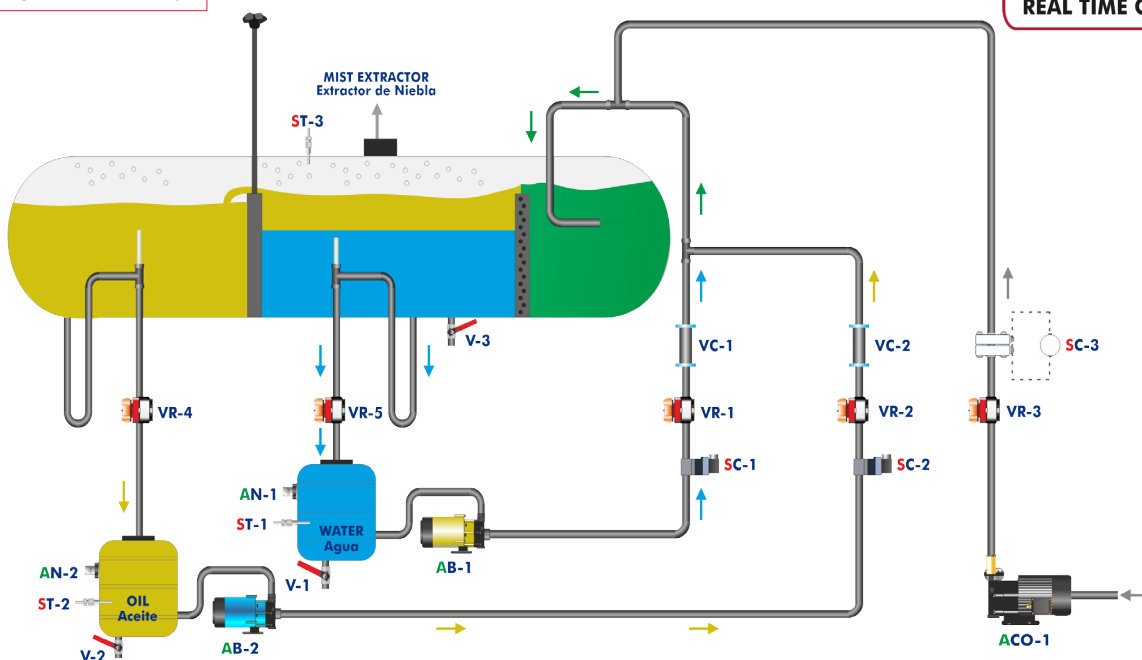


HTSC details

## PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION

3 actuators and 6 sensors controlled from any computer, and working simultaneously

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



<b>ST-</b>	<b>SC-</b>	<b>AB-</b>	<b>ACO-</b>	<b>AN-</b>	<b>V-</b>	<b>VC-</b>	<b>VR-</b>
TEMPERATURE SENSOR	FLOW SENSOR	PUMP	COMPRESSOR	LEVEL SWITCH	VALVE	CHECK VALVE	REGULATION VALVE
Sensor de Temperatura	Sensor de Caudal	Bomba	Compresor	Interruptor de Nivel	Válvula	Válvula Antirretorno	Válvula de Regulación

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):

① **HTSC Unit:**

Anodized aluminum frame and panels made of painted steel.

The unit includes wheels to facilitate its mobility.

Main metallic elements made of stainless steel.

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

Transparent horizontal separator for the visualization of the process:

Dimensions: 300 x 900 mm.

Two separating sections:

Weir adjustable in height.

Bucket and weir adjustable in height.

Mist extractor.

Water feed tank. Capacity: 50 l.

Oil feed tank. Capacity: 50 l.

Two overflows to control the level of the water - oil interface and the oil level in the separator.

Computer controlled oil pump, range: 0 –10 l/min

Computer controlled centrifugal water pump, range: 0 –10 l/min

Computer controlled air blower (compressor).

Water flow sensor, range: 0.5 – 10 l/min.

Oil flow sensor, range: 0 – 40 l/min

Air flow sensor including an orifice plate, range: 0 – 100 l/min.

“J” type temperature sensor for measuring the temperature of the inlet water.

“J” type temperature sensor for measuring the temperature of the inlet oil.

Temperature sensor type “J” in the horizontal separator.

Two level switches, one in each feed plug.

Two check valves for water and oil currents.

Five regulating valves.

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: HTSC

**② HTSC/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.**

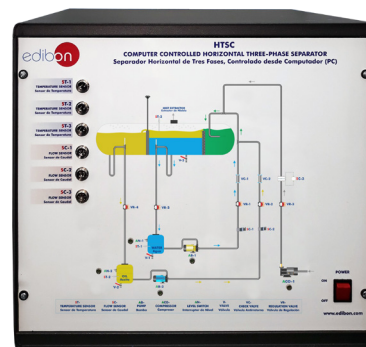
**Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.**

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.**



HTSC/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)= ±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**. 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 HTSC/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).**

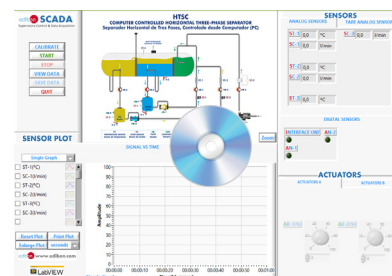
**Calibration system for the sensors involved in the process.**

**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.**



HTSC/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: HTSC + HTSC/CIB + DAB + HTSC/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.- Analysis of the design principles and control parameters of a three-phase separator.
  - 2.- Study of the separation of two immiscible liquids.
  - 3.- Study of the influence of the viscosity of the oil in the separation.
  - 4.- Study of the influence of the flow rates in the separation.
  - 5.- Study of the influence of the density difference in the separation.
  - 6.- Study of the Influence in the separation of a variation in the water cut.
  - 7.- Study of different separating landfills.
  - 8.- Study of the influence on the residence time of a variation in the water cut.
  - 9.- Study of the influence of the water/oil ratio on residence time for separation.
  - 10.-Study of the influence of gravity separation in small increments of specific gravity.
  - 11.-Study of the influence of the medium in continuous phase in the distribution and size of the drops.
  - 12.-Study of the influence of the flow in the formation of emulsions.
  - 13.-Study of different stable and unstable emulsions.
- Additional practical possibilities:
- 14.-Sensors calibration.

Other possibilities to be done with this Unit:

- 15.-Many students view results simultaneously.  
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
- 16.-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.
- 17.-The Computer Control System with SCADA allows a real industrial simulation.
- 18.-This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.
- 19.-This unit can be used for doing applied research.
- 20.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
- 21.-Control of the HTSC unit process through the control interface box without the computer.
- 22.-Visualization of all the sensors values used in the HTSC unit process.
  - By using PLC-PI additional 19 more exercises can be done.
  - Several other exercises can be done and designed by the user.

### REQUIRED SERVICES

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

### DIMENSIONS AND WEIGHTS

HTSC:

Unit:

- Dimensions: 1300 x 1000 x 1700 mm approx.  
(51.18 x 39.36 x 66.92 inches approx.)
- Weight: 80 kg approx.  
(176 pounds approx.)

Control Interface Box:

- Dimensions: 490 x 450 x 470 mm approx.  
(19.29 x 17.71 x 18.50 inches approx.)
- Weight: 20 kg approx.  
(44 pounds approx.)

### REQUIRED CONSUMABLES (Not included)

- Refined oil.



# SOFTWARE MAIN SCREENS

## SCADA Main screen

The SCADA Main screen displays a central process diagram of a 'COMPUTER CONTROLLED HORIZONTAL THREE-PHASE SEPARATOR'. The diagram includes various components like pumps (AB-1, AB-2), compressors (ACO-1), and valves (VC-1, VC-2, VC-3). Surrounding the diagram are several control panels:

- Top Left:** A menu with buttons for CALIBRATE, START, STOP, VIEW DATA, SAVE DATA, and QUIT.
- Top Right:** A 'SENSORS' panel showing real-time values for Analog Sensors (ST-1, SC-1, ST-2, SC-2, ST-3) and Digital Sensors (AN-1, AN-2).
- Bottom Left:** A 'SENSOR PLOT' panel with a 'Signal vs Time' graph showing Amplitude vs Time (hh:mm:ss). It includes a legend for selecting sensors and a 'Least Square Fit' button.
- Bottom Right:** An 'ACTUATORS' panel with two sub-sections, ACTUATORS A and ACTUATORS B, each containing a control knob for AB-1(%) and AB-2(%) and a digital display for ACO-1(%).

- ❶ Main software operation possibilities.
- ❷ Sensors displays, real time values, and extra output parameters. Sensors: ST=Temperature sensor. SC=Flow sensor.
- ❸ Actuators controls. Actuators: AB=Pump. ACO=Compressor. AN=Level switch.
- ❹ Channel selection and other plot parameters.
- ❺ Real time graphics displays.

## Software for Sensors Calibration

Example of screen

The calibration software consists of two main windows: 'Simple Calibrate' and 'Muticalibrate'.

**Simple Calibrate Window:** This window allows for the calibration of a single sensor. It includes fields for Sensor Name (ST-1), Calibration Units (°C), Full Scale (150), and Current Gain (107,98589). It also features a 'Read Value' section showing the current sensor output (0,456719) and a 'Measurements Unit' section. Below these are 'Gain & Offset Setting' and 'Scaling Parameters' sections, including a 'Least Square Fit' button.

**Muticalibrate Window:** This window is used for calibrating multiple sensors. It features a table with columns for Reference Value, Full Scale, Sensor Averages, and a grid for sensor data. The table lists the following sensors and their parameters:

Sensors	Units	Volts	Calibrated	Err(%)	Current Gain	Current Offset
ST-1	°C	0,456488	48,331	48,3353	107,996	-0,96316
SC-1	l/min	0,503603	0,396365	0,396388	0,682417	0,052697
ST-2	°C	0,471415	45,6964	45,7003	103,17	-2,93968
SC-2	l/min	0,513707	4,12859	4,12892	8,105	-0,035
ST-3	°C	0,446336	44,2464	44,2494	104,523	-2,4062
-	-	0	0	0	0	0
-	-	0	0	0	0	0

The window also includes buttons for 'Restore Factory Gains & Factory Offsets', 'Set New Gains & New Offsets', and 'Take Measurement'.

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

Representation in real time of the measured magnitudes.

CALIBRATE  
START  
STOP  
VIEW DATA  
SAVE DATA  
QUIT

### HTSC

COMPUTER CONTROLLED HORIZONTAL THREE-PHASE SEPARATOR  
Separador Horizontal de Tres Fases, Controlado desde Computador (PC)

Legend: ST-1: TEMPERATURE SENSOR, SC-1: FLOW SENSOR, AB-1: PUMP, ACO-1: COMPRESSOR, AN-1: LEVEL SWITCH, V-1: VALVE, VC-1: CHECK VALVE, VR-1: REGULATION VALVE

### SENSORS

ANALOG SENSORS		TARE ANALOG SENSORS	
ST-1	15,0 °C	SC-3	0,0 l/min
SC-1	5,3 l/min		
ST-2	13,1 °C		
SC-2	8,1 l/min		
ST-3	16,2 °C		

DIGITAL SENSORS

INTERFACE ON? AN-2  
AN-1

### SENSOR PLOT

Single Graph

- ST-1(°C)
- SC-1(l/min)
- ST-2(°C)
- SC-2(l/min)
- ST-3(°C)
- SC-3(l/min)

Reset Plot Print Plot  
Enlarge Plot seconds

Simple Graph

### ACTUATORS

ACTUATORS A ACTUATORS B

AB-1(%) 40 60 20 80 0 100 75

AB-2(%) 40 60 20 80 0 100 85

Representation in real time of the measured magnitudes.

CALIBRATE  
START  
STOP  
VIEW DATA  
SAVE DATA  
QUIT

### HTSC

COMPUTER CONTROLLED HORIZONTAL THREE-PHASE SEPARATOR  
Separador Horizontal de Tres Fases, Controlado desde Computador (PC)

Legend: ST-1: TEMPERATURE SENSOR, SC-1: FLOW SENSOR, AB-1: PUMP, ACO-1: COMPRESSOR, AN-1: LEVEL SWITCH, V-1: VALVE, VC-1: CHECK VALVE, VR-1: REGULATION VALVE

### SENSORS

ANALOG SENSORS		TARE ANALOG SENSORS	
ST-1	15,0 °C	SC-3	30 l/min
SC-1	5,4 l/min		
ST-2	14,5 °C		
SC-2	1,8 l/min		
ST-3	16,3 °C		

DIGITAL SENSORS

INTERFACE ON? AN-2  
AN-1

### SENSOR PLOT

Single Graph

- ST-1(°C)
- SC-1(l/min)
- ST-2(°C)
- SC-2(l/min)
- ST-3(°C)
- SC-3(l/min)

Reset Plot Print Plot  
Enlarge Plot seconds

Simple Graph

### ACTUATORS

ACTUATORS A ACTUATORS B

ACO-1(%) 40 60 20 80 0 100 20

Representation in real time of the measured magnitudes.

**edibon SCADA**  
Supervisory Control & Data Acquisition

CALIBRATE  
START  
STOP  
VIEW DATA  
SAVE DATA  
QUIT

**HTSC**  
**COMPUTER CONTROLLED HORIZONTAL THREE-PHASE SEPARATOR**  
Separador Horizontal de Tres Fases, Controlado desde Computador (PC)

Zoom

**SENSORS**

ANALOG SENSORS | TARE ANALOG SENSORS

TARE SC-3

DIGITAL SENSORS

INTERFACE ON? AN-2  
AN-1

**SENSOR PLOT**

Single Graph

- ST-1(°C)
- SC-1(l/min)
- ST-2(°C)
- SC-2(l/min)
- ST-3(°C)
- SC-3(l/min)

Reset Plot | Print Plot  
Enlarge Plot | seconds

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LabVIEW

SIGNAL VS TIME

Time (hh:mm:ss)	Amplitude
00:00:45	20
00:01:00	20
00:01:10	20
00:01:20	20
00:01:30	20
00:01:40	20
00:01:45	20

Simple Graph

**ACTUATORS**

ACTUATORS A | ACTUATORS B

AB-1(%) | 40 60 -80 0 100 | 50

AB-2(%) | 40 60 -80 0 100 | 80



## 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 11.

All these items try to give more possibilities for:

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

### a) Industrial configuration

#### ⑦ **PLC. Industrial Control using PLC** (it includes PLC-PI Module plus PLC-SOF Control Software):

##### **-PLC-PI. PLC Module:**

**Metallic box.**

**Circuit diagram in the module front panel.**

Front panel:

##### **Digital inputs (X) and Digital outputs (Y) block:**

**16 Digital inputs**, activated by switches and 16 LEDs for confirmation (red).

**14 Digital outputs** (through SCSI connector) with 14 LEDs for message (green).

##### **Analog inputs block:**

**16 Analog inputs** (-10 V. to + 10 V.) (through SCSI connector).

##### **Analog outputs block:**

**4 Analog outputs** (-10 V. to + 10 V.) (through SCSI connector).

##### **Touch screen:**

High visibility and multiple functions. Display of a highly visible status. Recipe function. Bar graph function. Flow display function. Alarm list. Multi language function. True type fonts.

Back panel:

Power supply connector. Fuse 2A. RS-232 connector to PC. USB 2.0 connector to PC.

Inside:

Power supply outputs: 24 Vdc, 12 Vdc, -12 Vdc, 12 Vdc variable.

##### **Panasonic PLC:**

**High-speed scan of 0.32  $\mu$ sec.** for a basic instruction.

**Program capacity of 32 Ksteps**, with a sufficient comment area.

Power supply input (100 to 240 V AC).

DC input: 16 (24 V DC).

Relay output: 14.

**High-speed counter.**

Multi-point PID control.

##### **Digital inputs/outputs and analog inputs/outputs Panasonic modules.**

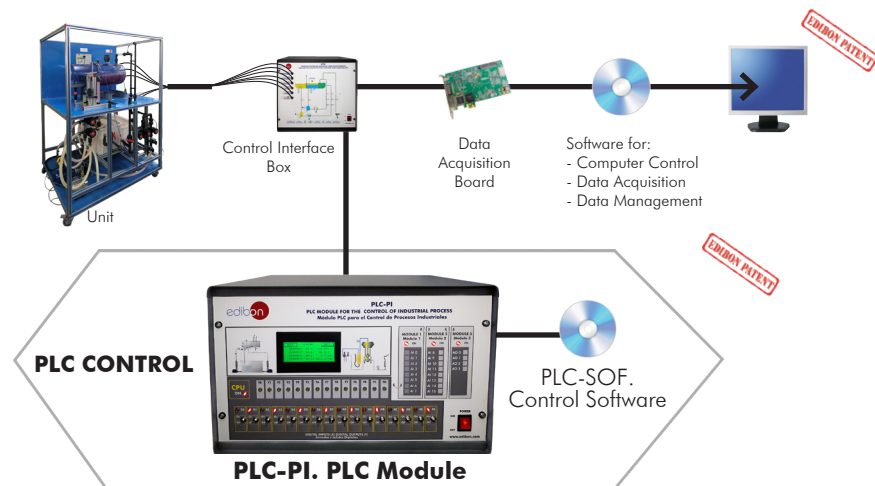
Communication RS232 wire to computer (PC).

Dimensions: 490 x 330 x 310 mm. approx. (19.29 x 12.99 x 12.20 inches approx.). Weight: 30 Kg. approx. (66 pounds approx.).

##### **-HTSC/PLC-SOF. PLC Control Software:**

**For this particular unit, always included with PLC supply.**

The software has been designed using Labview and it follows the unit operation procedure and linked with the Control Interface Box used in the Computer Controlled Horizontal Three-phase Separator (HTSC).



#### Practices to be done with PLC-PI:

- 1.- Control of the particular unit process through the control interface box without the computer.
- 2.- Visualization of all the sensors values used in the particular unit process.
- 3.- Calibration of all sensors included in the particular unit process.
- 4.- Hand on of all the actuators involved in the particular unit process.
- 5.- Realization of different experiments, in automatic way, without having in front the particular unit. (These experiments can be decided previously).
- 6.- Simulation of outside actions, in the cases do not exist hardware elements. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
- 7.- PLC hardware general use.
- 8.- PLC process application for the particular unit.
- 9.- PLC structure.
- 10.- PLC inputs and outputs configuration.
- 11.- PLC configuration possibilities.
- 12.- PLC program languages.
- 13.- PLC different programming standard languages (ladder diagram (LD), structured text (ST), instructions list (IL), sequential function chart (SFC), function block diagram (FBD)).
- 14.- New configuration and development of new process.
- 15.- Hand on an established process.
- 16.- To visualize and see the results and to make comparisons with the particular unit process.
- 17.- Possibility of creating new process in relation with the particular unit.
- 18.- PLC Programming Exercises.
- 19.- Own PLC applications in accordance with teacher and student requirements.

b) Technical and Vocational Education configuration

⑧ HTSC/ICAI. Interactive Computer Aided Instruction Software System.

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.

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

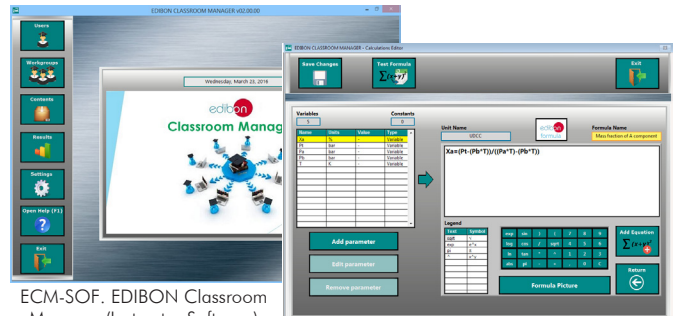
ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are 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.

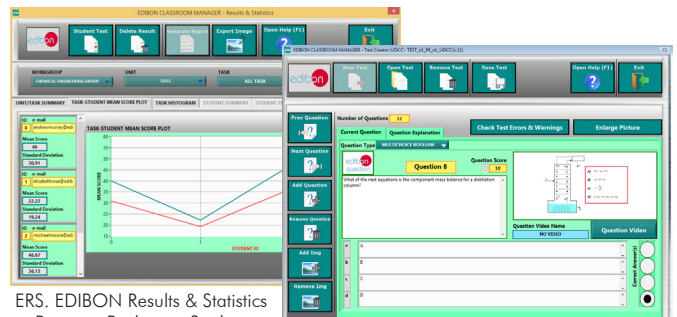
For more information see ICAI catalogue. Click on the following link:  
[www.edibon.com/en/files/expansion/ICAI/catalog](http://www.edibon.com/en/files/expansion/ICAI/catalog)

Instructor Software



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

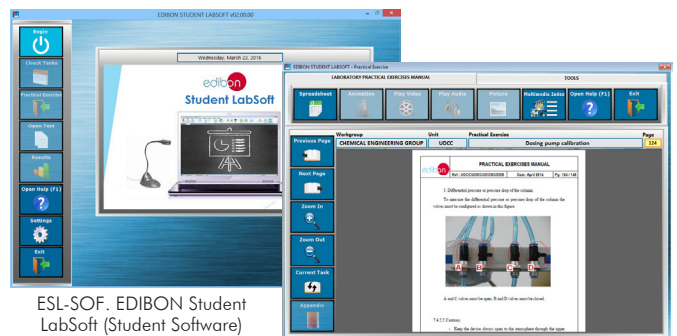
ECAL. EDIBON Calculations Program Package - Formula Editor Screen



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

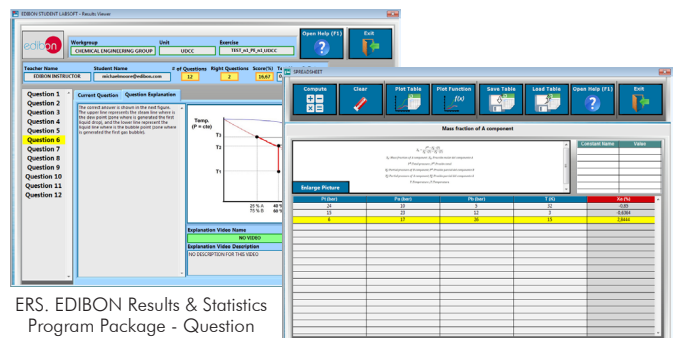
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

Student Software



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

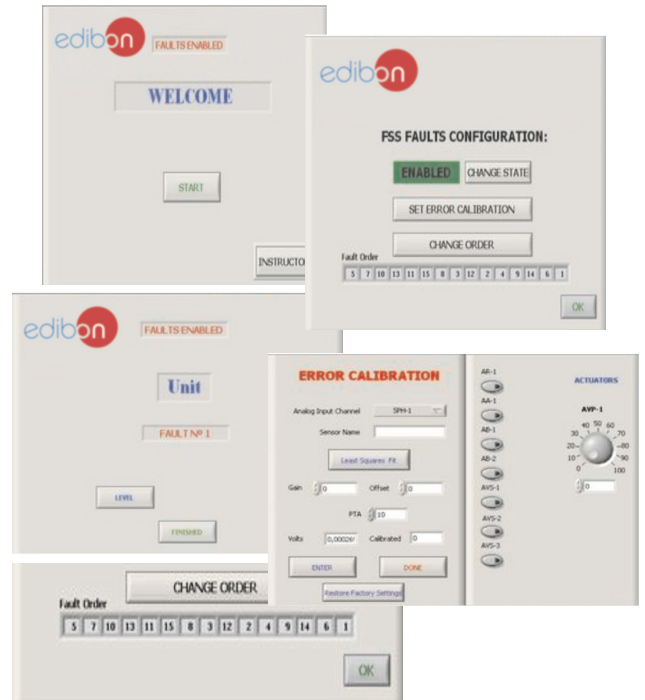
**⑨ HTSC/FSS. Faults Simulation System.**

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/files/expansion/FSS/catalog](http://www.edibon.com/en/files/expansion/FSS/catalog)

c) Multipost Expansions options

**⑩ 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:

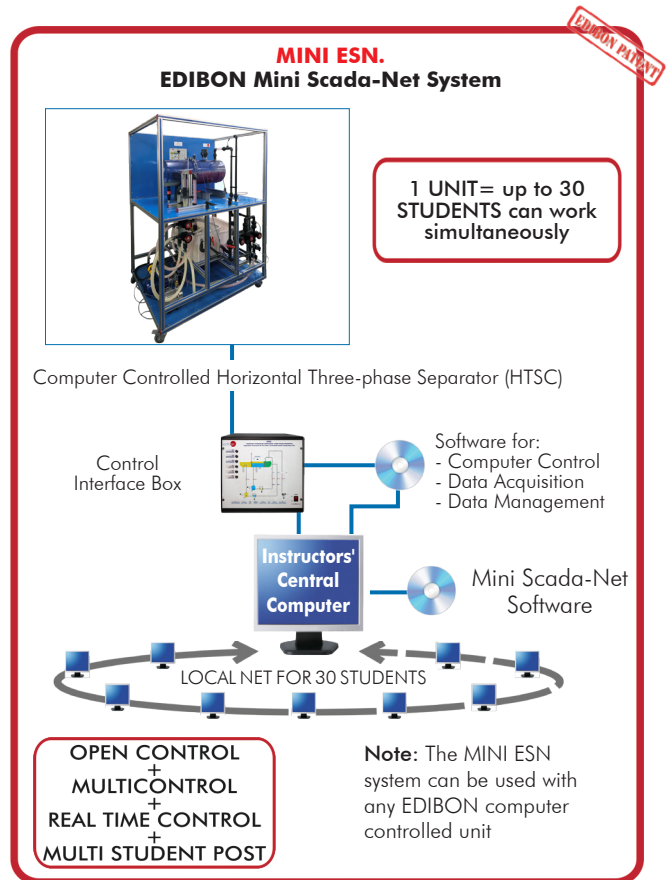
[www.edibon.com/en/files/expansion/MINI-ESN/catalog](http://www.edibon.com/en/files/expansion/MINI-ESN/catalog)

**⑪ 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/files/expansion/ESN/catalog](http://www.edibon.com/en/files/expansion/ESN/catalog)



## ORDER INFORMATION

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

Minimum supply always includes:

- ① **Unit: HTSC. Computer Controlled Horizontal Three-phase Separator.**
- ② **HTSC/CIB. Control Interface Box.**
- ③ **DAB. Data Acquisition Board.**
- ④ **HTSC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
- ⑤ **Cables and Accessories**, for normal operation.
- ⑥ **Manuals.**

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

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

#### a) Industrial configuration

- ⑦ PLC. Industrial Control using PLC (it includes PLC-PI Module plus PLC-SOF Control Software):
  - PCL-PI. PLC Module.
  - HTSC/PLC-SOF. PLC Control Software.

#### b) Technical and Vocational Education configuration

- ⑧ HTSC/ICAI. Interactive Computer Aided Instruction Software System.
- ⑨ HTSC/FSS. Faults Simulation System.

#### c) Multipost Expansions options

- ⑩ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.
- ⑪ ESN. EDIBON Scada-Net Systems.

**① HTSC Unit:**

Anodized aluminum frame and panels made of painted steel.  
 The unit includes wheels to facilitate its mobility.  
 Main metallic elements made of stainless steel.  
 Diagram in the front panel with distribution of the elements similar to the real one.  
 Transparent horizontal separator for the visualization of the process:  
     Dimensions: 300 x 900 mm.  
     Two separating sections:  
         Weir adjustable in height.  
         Bucket and weir adjustable in height.  
 Mist extractor.  
 Water feed tank. Capacity: 50 l.  
 Oil feed tank. Capacity: 50 l.  
 Two overflows to control the level of the water - oil interface and the oil level in the separator.  
 Computer controlled oil pump, range: 0 –10 l/min  
 Computer controlled centrifugal water pump, range: 0 –10 l/min  
 Computer controlled air blower (compressor).  
 Water flow sensor, range: 0.5 – 10 l/min.  
 Oil flow sensor, range: 0 – 40 l/min  
 Air flow sensor including an orifice plate, range: 0 – 100 l/min.  
 "J" type temperature sensor for measuring the temperature of the inlet water.  
 "J" type temperature sensor for measuring the temperature of the inlet oil.  
 Temperature sensor type "J" in the horizontal separator.  
 Two level switches, one in each feed plug.  
 Two check valves for water and oil currents.  
 Five regulating valves.  
 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.

**② HTSC/CIB. Control Interface Box:**

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 HTSC/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.- Analysis of the design principles and control parameters of a three-phase separator.
- 2.- Study of the separation of two immiscible liquids.
- 3.- Study of the influence of the viscosity of the oil in the separation.
- 4.- Study of the influence of the flow rates in the separation.
- 5.- Study of the influence of the density difference in the separation.
- 6.- Study of the Influence in the separation of a variation in the water cut.
- 7.- Study of different separating landfills.
- 8.- Study of the influence on the residence time of a variation in the water cut.
- 9.- Study of the influence of the water/oil ratio on residence time for separation.
- 10.-Study of the influence of gravity separation in small increments of specific gravity.
- 11.-Study of the influence of the medium in continuous phase in the distribution and size of the drops.
- 12.-Study of the influence of the flow in the formation of emulsions.
- 13.-Study of different stable and unstable emulsions.

Additional practical possibilities:

- 14.-Sensors calibration.

Other possibilities to be done with this Unit:

- 15.-Many students view results simultaneously.

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

- 16.-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.

- 17.-The Computer Control System with SCADA allows a real industrial simulation.

- 18.-This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.

- 19.-This unit can be used for doing applied research.

- 20.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions.

- 21.-Control of the HTSC unit process through the control interface box without the computer.

- 22.-Visualization of all the sensors values used in the HTSC unit process.

- By using PLC-PI additional 19 more exercises can be done.

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

## TENDER SPECIFICATIONS (for optional items)

### a) Industrial configuration

#### ⑦ **PLC. Industrial Control using PLC** (it includes PLC-PI Module plus PLC-SOF Control Software):

##### **-PLC-PI. PLC Module:**

Metallic box.

Circuit diagram in the module front panel.

Digital inputs (X) and Digital outputs (Y) block: 16 Digital inputs. 14 Digital outputs.

Analog inputs block: 16 Analog inputs.

Analog outputs block: 4 Analog outputs.

Touch screen.

Panasonic PLC:

High-speed scan of 0.32  $\mu$ sec. Program capacity of 32 Ksteps. High-speed counter. Multi-point PID control.

Digital inputs/outputs and analog inputs/outputs Panasonic modules.

##### **-HTSC/PLC-SOF. PLC Control Software:**

For this particular unit, always included with PLC supply.

##### **Practices to be done with PLC-PI:**

- 1.- Control of the particular unit process through the control interface box without the computer.
- 2.- Visualization of all the sensors values used in the particular unit process.
- 3.- Calibration of all sensors included in the particular unit process.
- 4.- Hand on of all the actuators involved in the particular unit process.
- 5.- Realization of different experiments, in automatic way, without having in front the particular unit. (These experiments can be decided previously).
- 6.- Simulation of outside actions, in the cases do not exist hardware elements. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
- 7.- PLC hardware general use.
- 8.- PLC process application for the particular unit.
- 9.- PLC structure.
- 10.- PLC inputs and outputs configuration.
- 11.- PLC configuration possibilities.
- 12.- PLC program languages.
- 13.- PLC different programming standard languages (ladder diagram (LD), structured text (ST), instructions list (IL), sequential function chart (SFC), function block diagram (FBD)).
- 14.- New configuration and development of new process.
- 15.- Hand on an established process.
- 16.- To visualize and see the results and to make comparisons with the particular unit process.
- 17.- Possibility of creating new process in relation with the particular unit.
- 18.- PLC Programming Exercises.
- 19.- Own PLC applications in accordance with teacher and student requirements.

### b) Technical and Vocational Education configuration

#### ⑧ **HTSC/ICAL. Interactive Computer Aided Instruction Software System.**

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.
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- Response reduction of an actuator.

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On/off faults:

- Several on/off faults can be included.

c) Multipost Expansions options

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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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