

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.**

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

For more information about Key Features, click here:



www.edibon.com

- Products
- Products range
- Units
- 5.-Energy



INTRODUCTION

At the same time when the consumption of electricity continues to increase, and there is a awareness of the adverse environmental impact of fossil fuels begins to arise, it is necessary to invest in clean and sustainable energy sources.

Generally, the renewable energy sources with greater capacity are hydro, wind and photovoltaic. Besides those mentioned, there is one with great exploration potential, the wave energy. Knowing that 70% of the planet's surface is covered in water, the oceans are a huge energy resource that may be of great help in the growing energy needs on a global level.

Wave energy is the transport of energy by ocean surface waves, and the capture of that energy to obtain useful work (i.e. water desalination, electricity generation, or the pumping of water).

GENERAL DESCRIPTION

The Computer Controlled Waves Energy Unit "EOMC" is an unit in scale, designed to study the wave energy and the influence of several variables. The unit consists of a Base Service Unit and Waves Generator "EOMC-UB" and several Modules to be used with the "EOMC-UB", which allow to study the conversion from the waves energy into mechanical energy.

The Base Service Unit and Waves Generator "EOMC-UB" is common for the Energy Generation Modules, "EOMC" type, and can work with one or several modules. This unit mainly consists of a flow channel and a waves generator:

The flow channel consists of a rectangular section with transparent walls through which water is made to circulate. Water is taken from the storage tank by means of a hydraulic pump (computer controlled) and it is driven to the inlet tank through the pipe, where the flow is quietened. Afterwards it circulates through the channel that discharges in the reception tank, returning finally to the storage tank. Thus, the closed circuit is complete. A waves sensor situated on the flow channel allows to measure the height and the frequency of the waves.

To regulate the water flow through the channel, there is a regulation valve at the output of the pump. A flow sensor is situated in the pump outlet to measure the water flow. A differential pressure sensor is used to measure the pressure drop in the orifice plate or in the Venturi tube situated in the water outlet of the pump.

The waves generator produces different types of waves. It is based on a blade that pulls the water, producing the waves. The waves frequency is modified by changing the blade rotating speed. The blade rotating speed can be regulated (computer controlled). The waves size changes according to the displaced amount of water. The amount of water displaced is modified by changing the water level in the tank or adjusting the blade in order to introduce it deeper into the channel. A speed sensor measures the blade rotating speed.

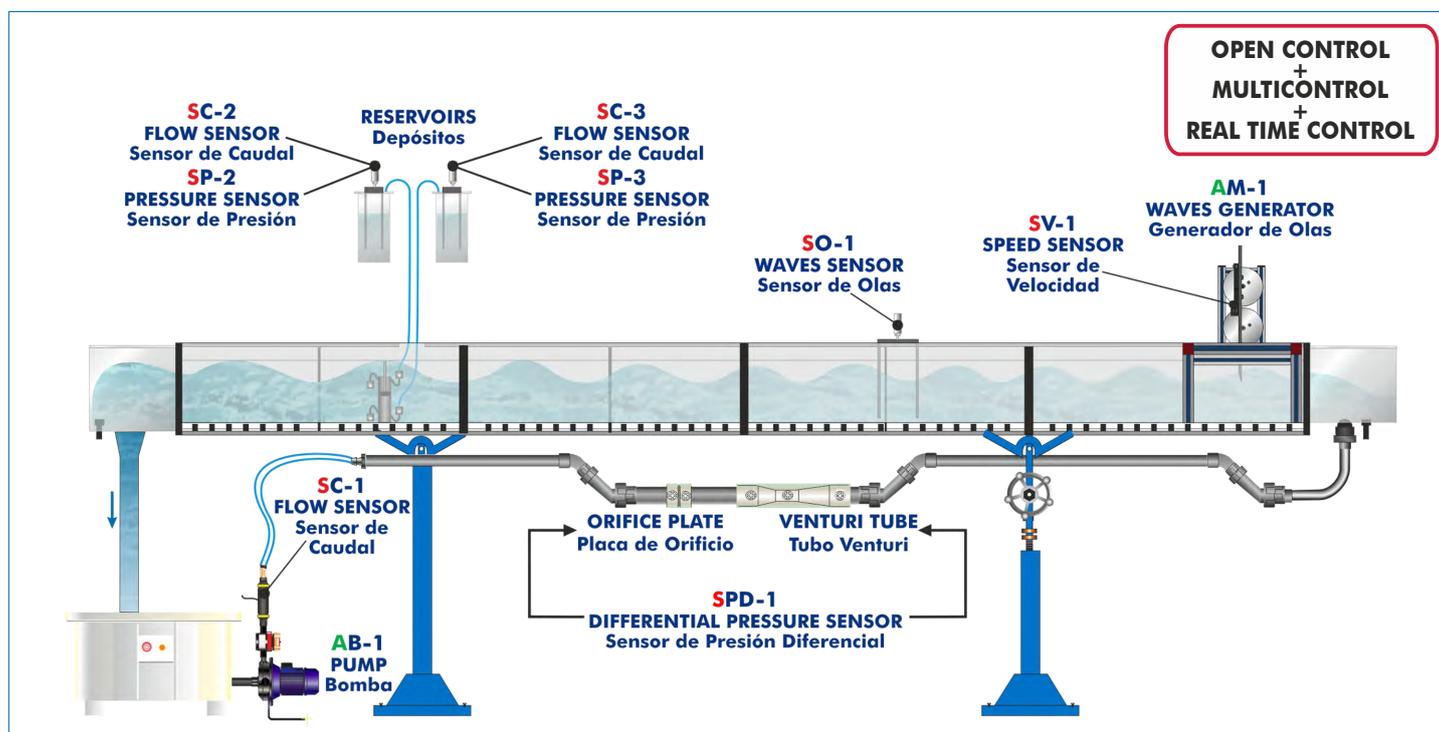
There are several Energy Generation Modules to be used with the "EOMC-UB":

- EOMC-1. Floating Buoy Module.
- EOMC-2. Oscillating Water Column Module.
- EOMC-3. Pelamis Module.
- EOMC-4. Tapered Channel Module.
- EOMC-5. Salter's Duck Module.

The EOMC-1, EOMC-2, EOMC-3 and EOMC-5 modules include a double acting water pump, able to extract a variable amount of water due to the up thrust of the wave and the down force of gravity. The outlet pipes are routed to two reservoirs mounted on a support. The amount of water collected over a number of wave cycles can be measured. They include two pressure sensors to measure the water height in the reservoirs and two flow sensors to measure the impelled water flow by the Modules.

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.

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION



With this unit there are several options and possibilities:

- Main items: 1, 2, 3, 4, 5, 6 and 7.
- Optional items: 8, 9, 10, 11, 12 and 13.

Let us describe first the main items (1 to 7):

① EOMC-UB. Base Service Unit and Waves Generator:

Metallic structure and panels made of painted steel.

Main metallic elements made of stainless steel.

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

Flow channel:

Channel of rectangular section with transparent walls. It is assembled on supports, with a system to control the inclination of the channel. Channel slope: adjustable.

Section: 80 x 300 mm.

Length: 5 m.

Inlet tank (capacity: 38 l.), with flow stilling and drain valve.

Reception tank (capacity: 38 l.), with drain valve.

Elevation angle: each cm in the scale corresponds to 0.18°, the maximum elevation angle is 3°.

Flow control valve.

Pipes.

Storage tank:

Capacity: 140 l., approx.

Impulsion pump, computer controlled:

Power: 0.37 kW. Max. flow: 80 l./min. Max. pressure: 20.1 m.

ON/OFF safety switch.

Manometric panel:

Formed by two PMMA pipes of 1000 mm of length mounted on an aluminium frame.

Orifice plate:

Material: PVC. Inner diameter: 80 mm.

Venturi tube:

Material: PMMA. Length: 180 mm.

Larger section: 32 mm. Smaller section: 20 mm.

A waves generator, computer controlled, to produce different types of waves. The waves frequency is modified by changing the blade rotating speed.

Two reservoirs to collect and measure the impelled water flow by the Modules (EOMC-1, EOMC-2, EOMC-3 and EOMC-5).

Flow sensors:

One sensor for the "Base Service Unit and Waves Generator" to measure the flow at the pump outlet, range: 2-150 l./min.

Two sensors for the "Energy Generation Modules" to measure the impelled water flow by the Modules. These sensors calculate the flow from the water height in the reservoirs. These water heights are measure by two pressure sensors, range: 0-300 mm. w.c.

A differential pressure sensor for the "Base Service Unit and Waves Generator" to measure the pressure drop in the orifice plate and the Venturi tube, range: 0-1 psi.

A waves sensor for the "Base Service Unit and Waves Generator". This sensor allows to measure the frequency and the amplitude of the waves generated by the waves generator.

A speed sensor to measure the blade rotating speed of the waves generator.

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.

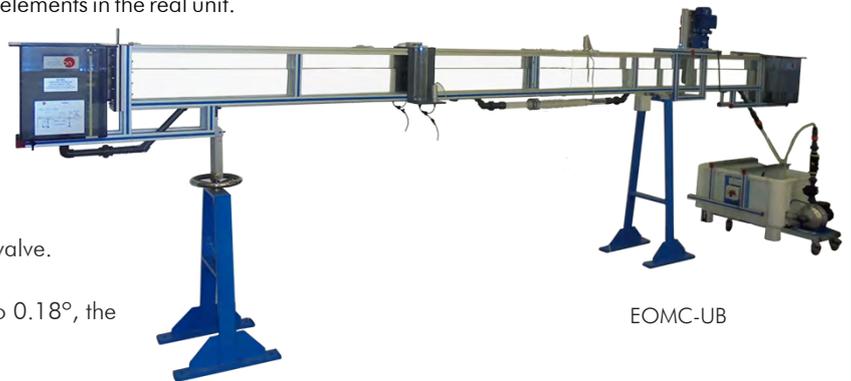
Remote operation and control by the user and remote control for EDIBON technical support, are always included.

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.



② **EOMC/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.

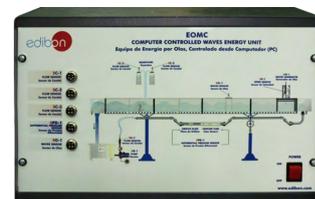
Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.

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.



EOMC/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)= 10V. 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: 900KS/s.

Output range(V)= 10V. 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.

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



DAB

④ **EOMC/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).

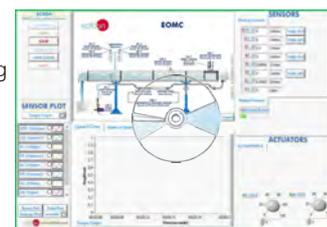
Calibration system for the sensors involved in the process.

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.



EOMC/CCSOF

⑤ **Energy Generation Modules** to be used with the Base Service Unit and Waves Generator:

5.1 **EOMC-1. Floating Buoy Module:**

A Floating Buoy system consists of a floating structure anchored to the seabed, which is used as the support of a cylinder which freely floats with an upwards and downwards vertical movement, following the waves. This cylinder slides by a central shaft joint to the immobile structure. The relative movement of the cylinder sliding through the shaft and the fixed structured serves to activate an energy converter which can be hydraulic or electromagnetic.

The EOMC-1 module is designed to operate with a double acting water pump that provides a variable load and measurable output.

There are several interchangeable floats: round, triangular and rectangular bottom floats, and another rectangular float of larger size. The floats are supplied with a support to which weights can be added.

This module includes:

A double acting water pump. This pump is fixed to a stainless steel frame. Pump material: PVC.

Four interchangeable floats: a round bottom float, a triangular float, a rectangular float and other rectangular float but larger size. Floats are made of medium density foam, and each float is provided with support to which weights can be added.

Set of weights: three 100 g. weight and a 50 g. weight.

The double acting water pump extracts a variable amount of water due to the up thrust of the wave and the down force of gravity. The outlet pipes are routed to two reservoirs mounted on a support. The amount of water collected over a number of wave cycles can be measured. They include two flow sensors to measure the impelled water flow by the Module.

The module is prepared to be installed in the Base Service Unit and Waves Generator (EOMC-UB).



EOMC-1

5.2 **EOMC-2. Oscillating Water Column Module:**

An Oscillating Water Column system is a structure with an opening for the wave.

When the water enters in the enclosure, it displaces the existing air into the enclosure and forces the air to exit by a duct where a turbine is installed. The air makes the turbine coupled to a generator to rotate. When the wave retires, the air enters in the enclosure through the same duct, at this moment in the reverse direction.

The EOMC-2 module allows experiments to be carried out using such a wave absorber. This module uses the oscillating air to drive a pneumatic piston connected to a special pump that provides an easily variable load and measurable output.

This module consists of three sections: a chamber to create the moving column of air, a pneumatic piston and a water pump. The chamber is mounted with its open-end submerged below the water level, in the path of the waves and creates a column of moving air. The upper edge of the chamber is attached to a pipe ducting the air to a cylinder, in which a lightweight piston is able to move. The energy in the wave is transferred to the air, which is in turn transferred to the piston. The piston is connected via a straight connecting rod to the double acting water pump.

This module includes:

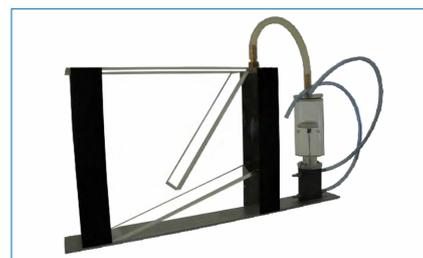
A double acting water pump. This pump is fixed to a stainless steel frame. Pump material: PVC.

An air chamber.

A pneumatic piston, diameter: 54.4 mm.

The double acting water pump extracts a variable amount of water due to the up thrust of the wave and the down force of gravity. The outlet pipes are routed to two reservoirs mounted on a support. The amount of water collected over a number of wave cycles can be measured. They include two flow sensors to measure the impelled water flow by the Module.

The module is prepared to be installed in the Base Service Unit and Waves Generator (EOMC-UB).



EOMC-2

5.3 **EOMC-3. Pelamis Module:**

The "Pelamis" is an attenuating type device. It consists of a longitudinal chain of cylinders linked each one with the others and anchored to the seabed, so that they are correspondingly aligned to the waves direction. A cylinders nodding is produced because of the wave height and this movement is used by the pistons connected between each cylinder to impulse the fluid in an hydraulic circuit to produce electric energy.

The EOMC-3 module consists of a longitudinal chain of two cylinders linked each other. A double acting water pump is connected between each cylinder.

This module includes:

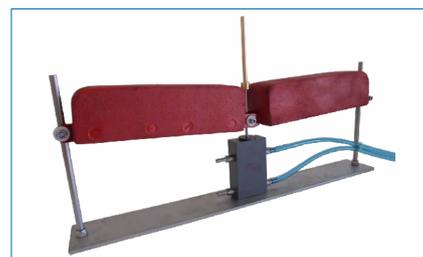
A double acting water pump. This pump is fixed to a stainless steel frame. Pump material: PVC.

A longitudinal chain of two cylinders linked each other. This device allows to simulate a "Pelamis" device.

Set of weights: three 100 g. weight and a 50 g. weight.

The double acting water pump extracts a variable amount of water due to the up thrust of the wave and the down force of gravity. The outlet pipes are routed to two reservoirs mounted on a support. The amount of water collected over a number of wave cycles can be measured. They include two flow sensors to measure the impelled water flow by the Module.

The module is prepared to be installed in the Base Service Unit and Waves Generator (EOMC-UB).



EOMC-3

Continue...

⑤ **Energy Generation Modules** to be used with the Base Service Unit and Waves Generator: (continuation)

⑤.4 **EOMC-4. Tapered Channel Module:**

The Tapered Channel is a channel built on the coast in the direction of the incident wave. The channel progressively narrows to the inside of the coast. When the wave enters the channel, it goes to a every time less section, which makes to rise its height to enter in a tank placed at the end of the channel.

Thus, there is water at a higher height that can be used in a turbine. Summarizing, it concentrates the waves and guides them up a ramp into a tank, from which a turbine extracts energy.

The EOMC-4 module allows experiments to be carried out on a variety of channel configurations. This module studies the energy in breaking waves, and allows to alter the way the waves break.

The module includes three ramps with different slop and a reservoir to contain and measure the water.

The ramps have two walls, which can be adjusted to provide a contraction on the wave as it moves up the ramp.

This module include:

- Three ramps with different slop and adjustable walls.

- A reservoir to contain and measure the water.

The module is prepared to be installed in the Base Service Unit and Waves Generator (EOMC-UB).



EOMC-4

⑤.5 **EOMC-5. Salter's Duck Module:**

Salter's Duck is a small buoy anchored to the seabed in a particular way which seems a duck moves in a swinging way when receiving the waves. This rotation is used to move, by means of mechanisms, a system connected to a generator.

The EOMC-5 module is designed to provide experiments to test the performance of basic flexible devices. A flexible device forms a structure from which a float can pivot.

The module captures the wave's energy by using a floating device. The device is extended beyond the pivot point by a lever used to drive the double acting water pump.

The float is supplied with a support to which weights can be added.

This module include:

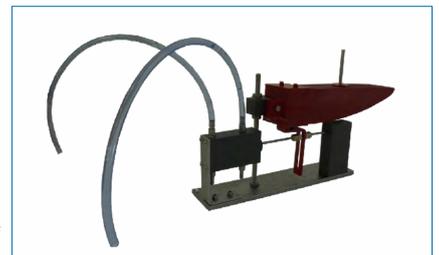
- A double acting water pump. This pump is fixed to a stainless steel frame. Pump material: PVC.

- A flexible float.

- Set of weights: three 100 g. weight and a 50 g. weight.

The double acting water pump extracts a variable amount of water due to the up thrust of the wave and the down force of gravity. The outlet pipes are routed to two reservoirs mounted on a support. The amount of water collected over a number of wave cycles can be measured. They include two flow sensors to measure the impelled water flow by the Module.

The module is prepared to be installed in the Base Service Unit and Waves Generator (EOMC-UB).



EOMC-5

⑥ **Cables and Accessories**, for normal operation.

⑦ **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

Practices to be done with the Base Service Unit and Waves Generator (EOMC-UB):

- 1.- Study of the characteristic parameters of waves.
- 2.- Measurement of flow using Venturi tube.
- 3.- Measurement of flow using orifice plate.

Practices to be done with the Floating Buoy Module (EOMC-1):

- 4.- Determination of the extracted energy with a floating buoy module.
- 5.- Study of the influence of the float shape in the extracted energy with a floating buoy module.

Practices to be done with the Oscillating Water Column Module (EOMC-2):

- 6.- Determination of the extracted energy with an oscillating water column module.

Practices to be done with the Pelamis Module (EOMC-3):

- 7.- Determination of the extracted energy with a Pelamis module.

Practices to be done with the Tapered Channel Module (EOMC-4):

- 8.- Determination of the extracted energy with a Tapered Channel module.
- 9.- Study of the effect of slope on the extracted energy with a Tapered Channel module.
- 10.- Study of the effect of width contraction on the extracted energy with a Tapered Channel module.

Practices to be done with the Salter's Duck Module (EOMC-5):

- 11.- Determination of the extracted energy with a Salter's Duck module.

Additional practical possibilities:

- 12.- Study of the different wave's energy generation systems.
- 13.- Study of the operation and performance of the different wave's energy generation systems.
- 14.- Study of the energy available from a wave.

- 15.- Study of the Archimedes and buoyancy principles.
- 16.- Study of the relationship between wave form and buoyancy.
- 17.- Determination of the potential energy in a fluid.
- 18.- Study of the float shape in determining energy extraction.
- 19.- Study of the compression of air.
- 20.- Study of the pneumatic/hydraulic pistons.
- 21.- Study of the effect of wave shape on its breaking characteristics.

Other possibilities to be done with this Unit:

- 22.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
- 23.- 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.
- 24.- The Computer Control System with SCADA allows a real industrial simulation.
- 25.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
- 26.- This unit can be used for doing applied research.
- 27.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
- 28.- Control of the EOMC unit process through the control interface box without the computer.
- 29.- Visualization of all the sensors values used in the EOMC unit process.
- By using PLC-PI additional 19 more exercises can be done.
- Several other exercises can be done and designed by the user.

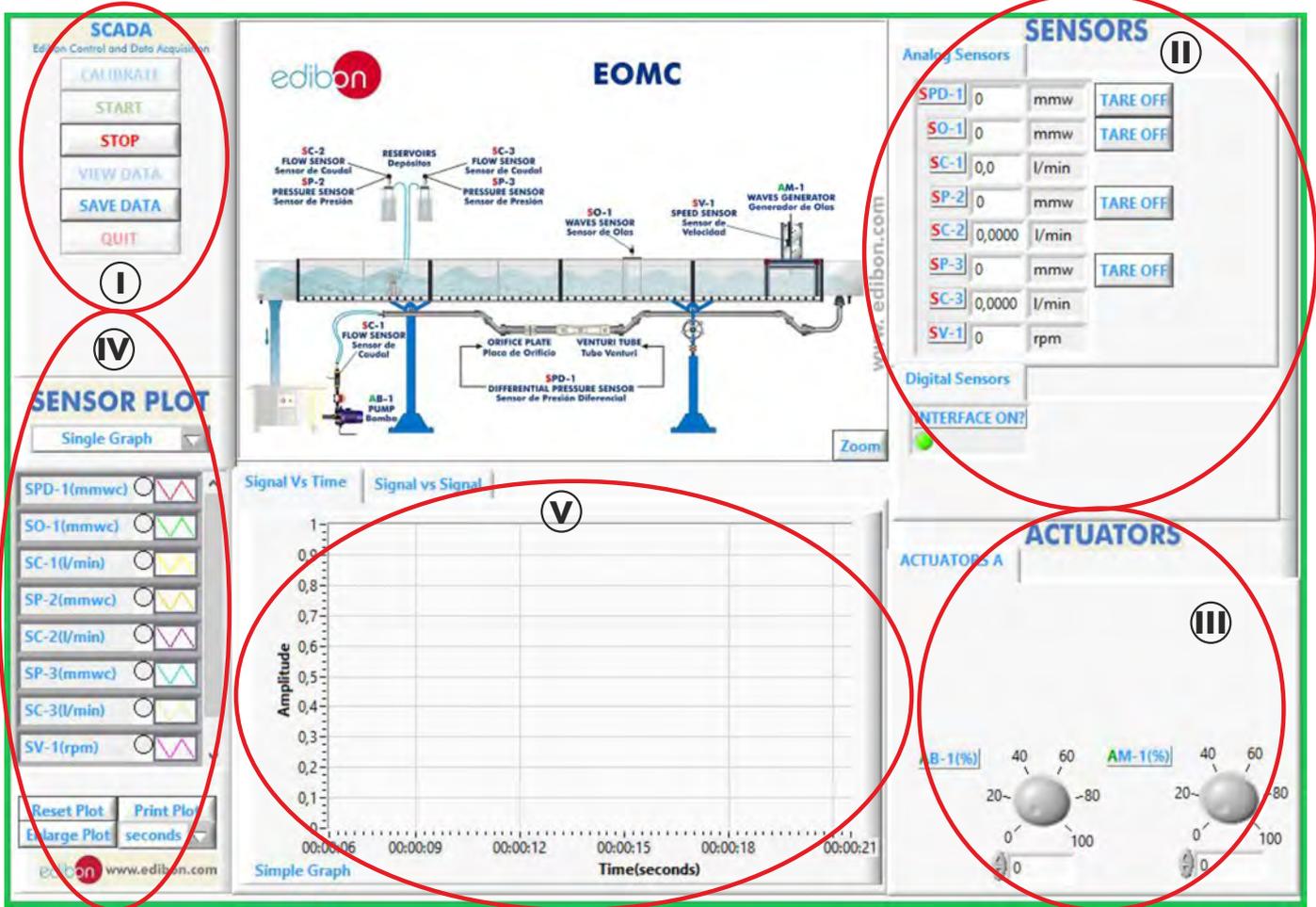
REQUIRED SERVICES

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

DIMENSIONS & WEIGHTS

EOMC-UB. Unit:	-Dimensions: 6050 x 1000 x 1700mm. approx. (238.18 x 39.37 x 66.92 inches approx.)
	-Weight: 350 Kg. approx. (771 pounds approx.)
EOMC-1. Module:	-Dimensions: 300 x 70 x 200mm. approx. (11.81 x 2.75 x 7.87 inches approx.)
	-Weight: 2 Kg. approx. (4.4 pounds approx.)
EOMC-2. Module:	-Dimensions: 610 x 70 x 400mm. approx. (24.01 x 2.75 x 15.74 inches approx.)
	-Weight: 4 Kg. approx. (8.8 pounds approx.)
EOMC-3. Module:	-Dimensions: 500 x 70 x 200mm. approx. (19.68 x 2.75 x 7.87 inches approx.)
	-Weight: 2 Kg. approx. (4.4 pounds approx.)
EOMC-4. Module:	-Dimensions: 500 x 70 x 200mm. approx. (19.68 x 2.75 x 7.87 inches approx.)
	-Weight: 2 Kg. approx. (4.4 pounds approx.)
EOMC-5. Module:	-Dimensions: 300 x 70 x 200mm. approx. (11.81 x 2.75 x 7.87 inches approx.)
	-Weight: 2 Kg. approx. (4.4 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.)

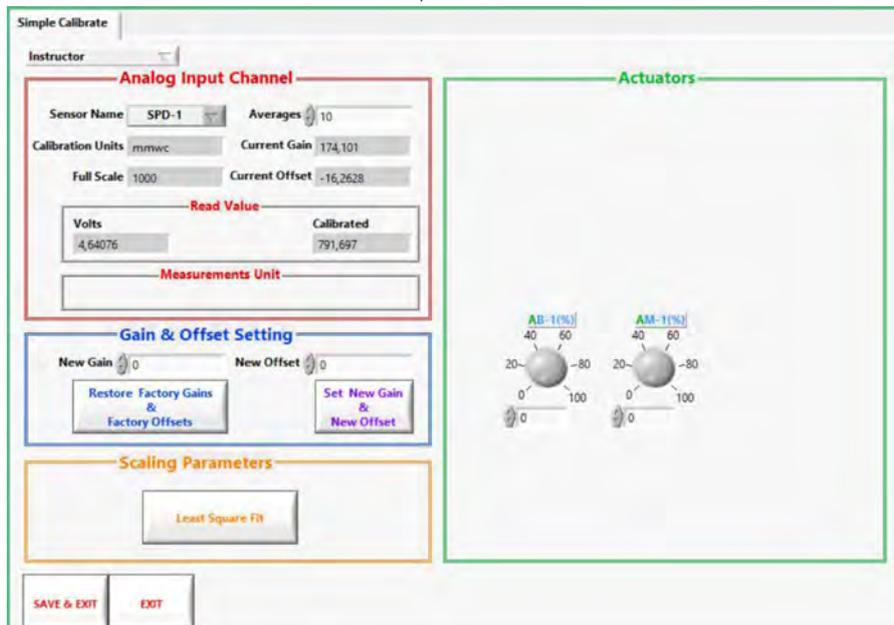
SCADA
Main screen



- Ⓘ Main software operation possibilities.
- Ⓚ Sensors displays, real time values, and extra output parameters. Sensors: SPD=Differential pressure sensor. SO=Waves sensor. SC=Flow sensor. SP=Pressure sensor. SV=Speed sensor.
- Ⓛ Actuators controls. Actuators: AB= Pump. AM= Waves generator.
- Ⓜ Channel selection and other plot parameters.
- Ⓝ Real time graphics displays.

Software for Sensors Calibration

Example of screen



By using a free of charge code, the teacher and the students can calibrate the unit.
The teacher can recover his/her own calibration by using the EDIBON code that we give free of charge.

COMPLETE TECHNICAL SPECIFICATIONS (for optional items)

Additionally to the main items (1 to 7) described, we can offer, as optional, other items from 8 to 13.

All these items try to give more possibilities for:

- a) Industrial configuration. (PLC)
- b) Technical and Vocational Education configuration. (CAI and FSS)
- c) Higher Education and/or Technical and Vocational Education configuration. (CAI)
- d) Multipost Expansions options. (Mini ESN and ESN)

a) Industrial configuration

⑥ **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 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.

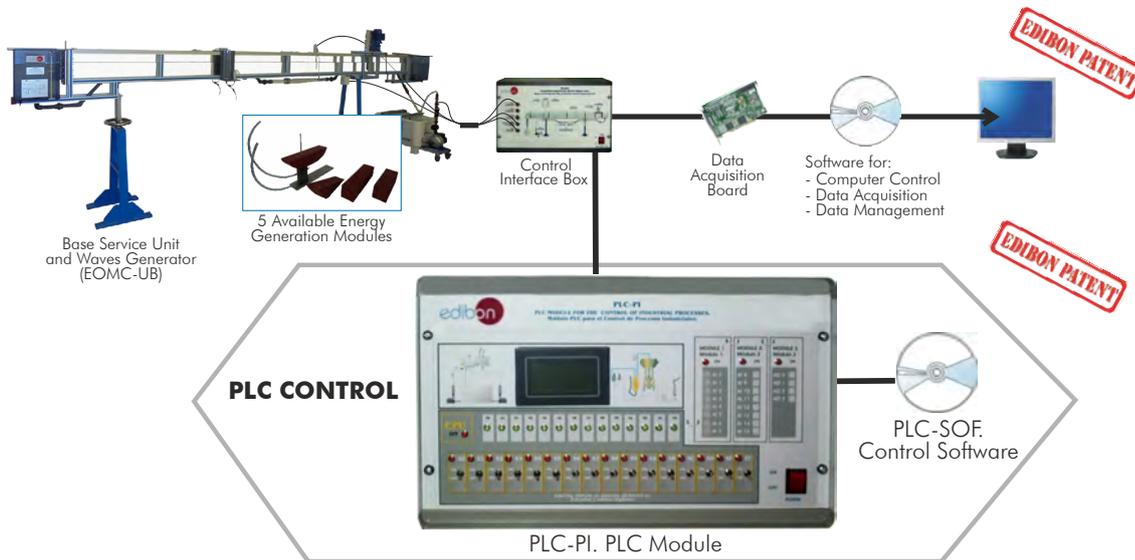
Communication RS232 wire to computer (PC).

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.).

-EOMC/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 Waves Energy Unit (EOMC).



Practices to be done with PLC-PI:

- 1.- Control of the EOMC unit process through the control interface box without the computer.
- 2.- Visualization of all the sensors values used in the EOMC unit process.
- 3.- Calibration of all sensors included in the EOMC unit process.
- 4.- Hand on of all the actuators involved in the EOMC unit process.
- 5.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
- 6.- Simulation of outside actions, in the cases hardware elements do not exist. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
- 7.- PLC hardware general use and manipulation.
- 8.- PLC process application for EOMC unit.
- 9.- PLC structure.
- 10.- PLC inputs and outputs configuration.
- 11.- PLC configuration possibilities.
- 12.- PLC programming languages.
- 13.- PLC different programming standard languages.
- 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 EOMC unit process.
- 17.- Possibility of creating new process in relation with the EOMC unit.
- 18.- PLC Programming exercises.
- 19.- Own PLC applications in accordance with teacher and student requirements.

b) Technical and Vocational Education configuration

⑨ **EOMC/CAI. Computer Aided Instruction Software System.**

This complete software package includes two Softwares: the INS/SOF. Classroom Management Software (Instructor Software) and the EOMC/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 (EOMC/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.

Instructor Software



- **EOMC/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.
- Exam.
- View Instructional Video.
- Save Results.

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

www.edibon.com/products/catalogues/en/CAI.pdf

Student Software



⑩ **EOMC/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.

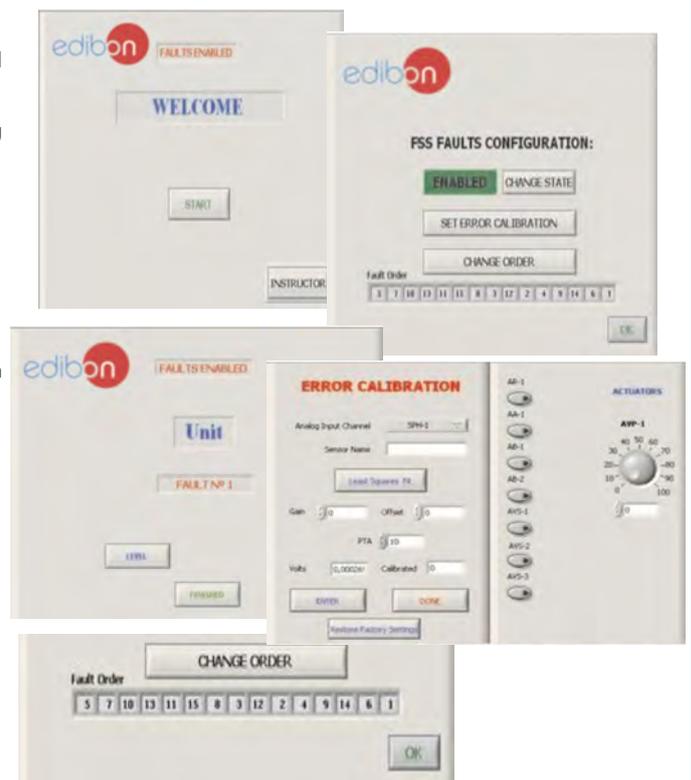
On/off faults:

- Several on/off faults can be included.

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

www.edibon.com/products/catalogues/en/FSS.pdf

Example of some screens



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

11) **EOMC/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, specifically developed by EDIBON. It is very useful for Higher Education level.

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

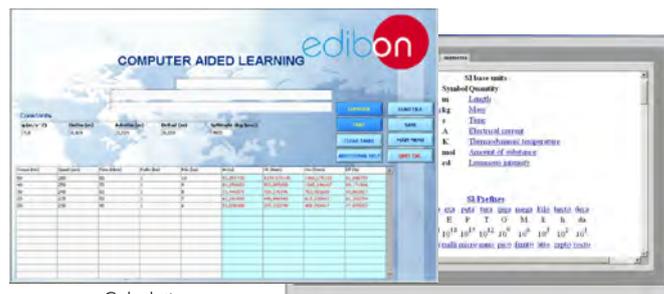
CAL computes the value of all the variables involved and performs the calculations.

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

Different plotting displays.

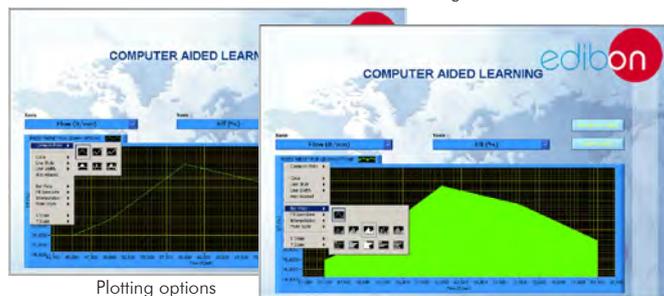
It has a wide range of information, such as constant values, unit conversion factors and integral and derivative tables.

For more information see CAL catalogue. Click on the following link:
www.edibon.com/products/catalogues/en/CAL.pdf



Calculations

Information of constant values, unit conversion factors and integral and derivative tables



Plotting options

d) Multipost Expansions options

12) **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).

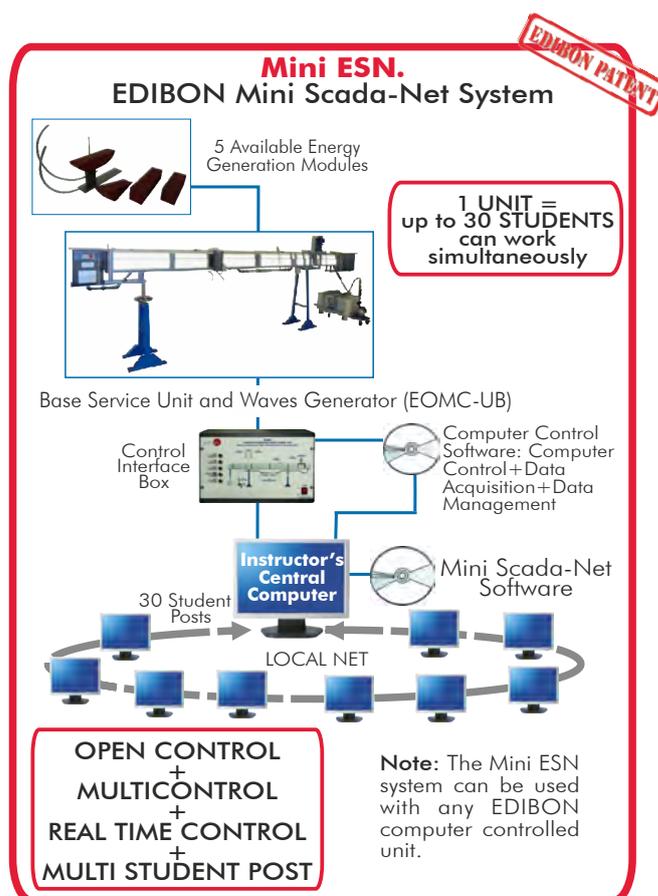
Main characteristics:

- 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



13) **ESN. EDIBON Scada-Net System.**

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/products/catalogues/en/units/energy/esn-alternativeenergies/ESN-ALTERNATIVE_ENERGIES.pdf

ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

- ① **Unit: EOMC-UB. Base Service Unit and Waves Generator.**
- ② **EOMC/CIB. Control Interface Box.**
- ③ **DAB. Data Acquisition Board.**
- ④ **EOMC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
- ⑤ **Energy Generation Modules:**
 - ⑤.1 **EOMC-1. Floating Buoy Module.**
 - ⑤.2 **EOMC-2. Oscillating Water Column Module.**
 - ⑤.3 **EOMC-3. Pelamis Module.**
 - ⑤.4 **EOMC-4. Tapered Channel Module.**
 - ⑤.5 **EOMC-5. Salter's Duck Module.**
- ⑥ **Cables and Accessories**, for normal operation.
- ⑦ **Manuals.**

* **IMPORTANT:** Under **EOMC** we always supply all the elements for immediate running as 1, 2, 3, 4, 5, 6 and 7.

Optional items (supplied under specific order)

a) Industrial configuration

- ⑧ **PLC. Industrial Control using PLC** (it includes PLC-PI Module plus PLC-SOF Control Software):
 - PCL-PI. PLC Module.
 - EOMC/PLC-SOF. PLC Control Software.

b) Technical and Vocational configuration

- ⑨ **EOMC/CAI. Computer Aided Instruction Software System.**
- ⑩ **EOMC/FSS. Faults Simulation System.**

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

- ⑪ **EOMC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).**

d) Multipost Expansions options

- ⑫ **Mini ESN. EDIBON Mini Scada-Net System.**
- ⑬ **ESN. EDIBON Scada-Net System.**

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



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