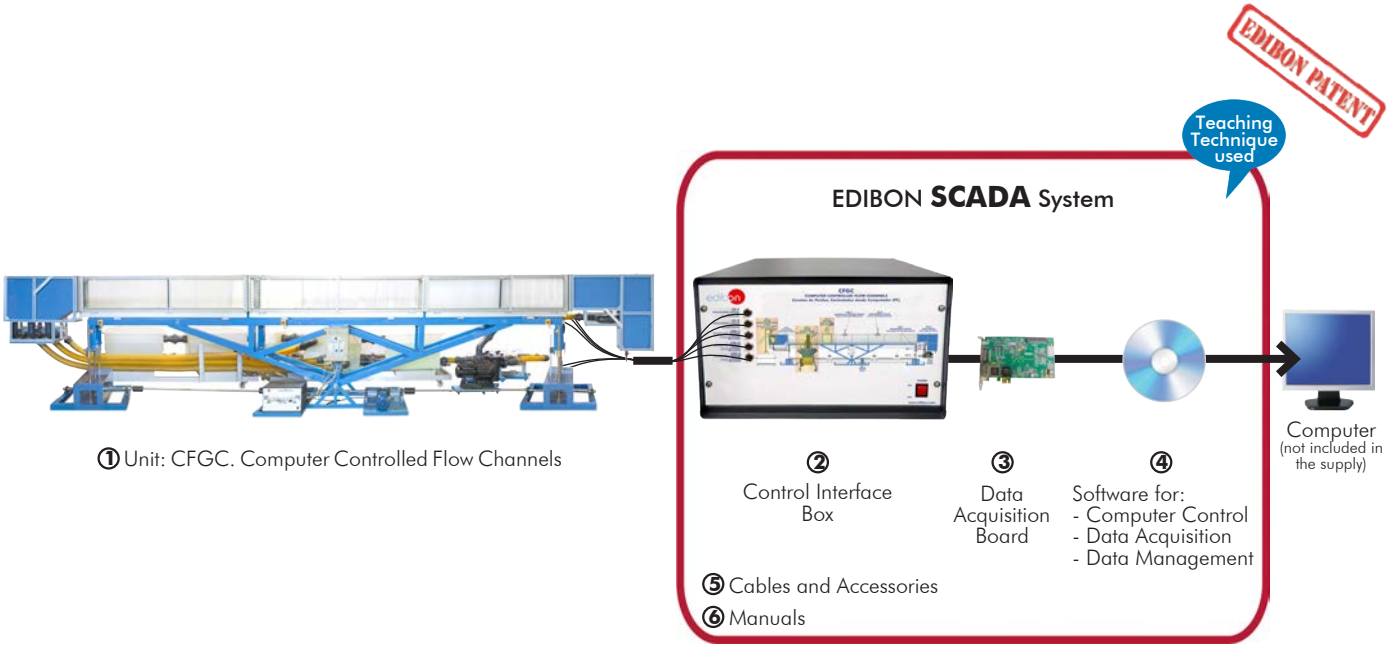
edibon

Engineering and Technical Teaching Equipment

Computer Controlled **Flow Channels,** with SCADA

CFGC



① Unit: CFGC. Computer Controlled Flow Channels

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

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
80.- FLUID MECHANICS

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

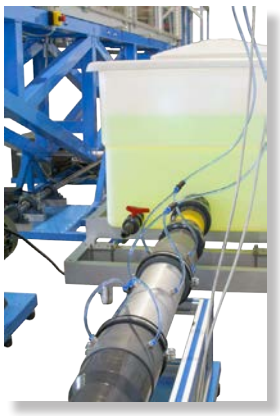
INTRODUCTION

Channels carry out an important role in engineering, covering in a broad sense many liquids flow situations. The Computer Controlled Flow Channels, "CFGC", are designed to study several situations.

GENERAL DESCRIPTION

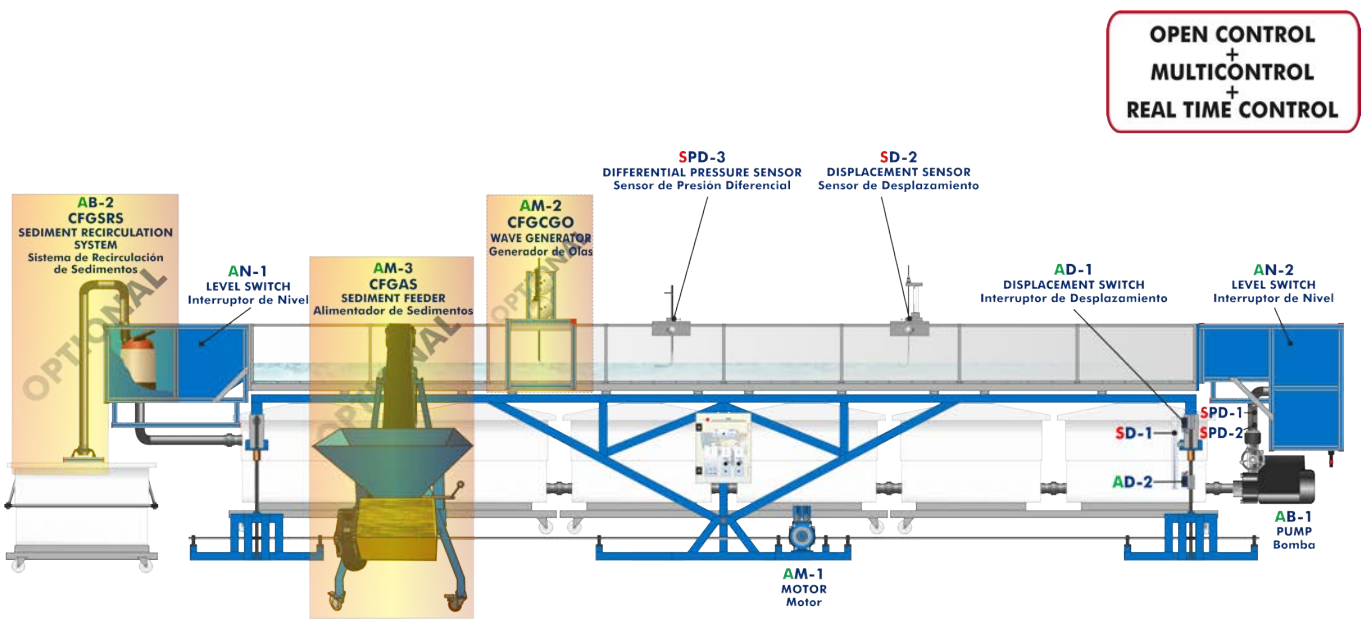
The Computer Controlled Flow Channels, "CFGC", are hydrodynamic channels to perform multiple hydraulic tests. They consist of a rectangular section channel with tempered glass transparent walls through which water flows. Water is impelled by a pump from the storage tank and driven to the inlet tank through the pipe. In the inlet tank there is a flow stilling device that allows for performing different experiments without hydraulic disturbances. Afterwards, water flows through the channel and is discharged into the reception tank, finally returning to the storage tanks and completing the closed circuit.

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.



CFGC 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, 10 and 11.

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

① CFGC. Unit:

Channel made up of group of modular parts of 2.5 m long. Each rectangular piece of different sections with transparent walls of 10 mm thick is made in such a way that guarantees a uniform section along the entire channel. All the sections are made of tempered glass, stainless steel and anodized aluminum, guaranteeing corrosion resistance. The alignment process and level testers guarantee a perfect alignment of the perfectly watertight assembled unit.

The assembly has inlet and outlet gates to carry out different experiments and safety level switches that prevent water from exceeding the maximum level.

Unit: CFGC

Metal beam structure, made of welded steel, to support the assembly of sections. It allows for adjusting the tilt from -0.5% to 2.5%. The tilt of the channel is controlled and monitored from the computer through a displacement sensor.

Fiberglass **inlet tank** with draining valve and safety water level switch.

Fiberglass **reception tank** with draining valve and safety water level switch.

Two storage tanks with cover and draining valve at the bottom to store the recirculation water. Capacity: 1200 l per tank.

Computer controlled variable speed **driving pump**. The power of the pump varies in function of the channel version up to 140 m^3/h, 4 kW. Water velocity inside the channel can be controlled from 0 m/s to the maximum flow rate supplied by the pump.

Instrumentation:

Displacement sensor to obtain the channel height position (tilt). The readout is displayed in the computer at all times.

Two differential pressure sensors for inlet flow measurement (included in CFGCTVC).

Displacement sensor (included in CFGCRM).

Differential pressure sensor (included in CFGCTP).

Available versions to choose:

- CFGC300/5. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 5 m.
- CFGC300/7. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 7.5 m.
- CFGC300/10. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 10 m.
- CFGC300/12. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 12.5 m

- CFGC310/5. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 5 m.
- CFGC310/7. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 7.5 m.
- CFGC310/10. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 10 m.
- CFGC310/12. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 12.5 m.

- CFGC400/5. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 5 m.
- CFGC400/7. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 7.5 m.
- CFGC400/10. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 10 m.
- CFGC400/12. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 12.5 m.

- CFGC600/5. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 5 m.
- CFGC600/7. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 7.5 m.
- CFGC600/10. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 10 m.
- CFGC600/12. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 12.5 m.

- CFGC1000/5. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 5 m.
- CFGC1000/7. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 7.5 m.
- CFGC1000/10. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 10 m.
- CFGC1000/12. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 12.5 m.

- CFGCCD. Computer Controlled Flow Channel (dimensions: “Custom Design”).

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.

Required elements:

- CFGCRM. Level Gauge for Water Height Measurement (Hook and Point Gauge) (to measure water level).
- CFGCTP. Pitot Tube (to measure velocity).
- CFGCTVC. Venturi Tube with Pressure Sensors for Inlet Flow Measurement (to measure the inlet flow to the channel).

Recommended elements:

- CFGPR. Adjustable Undershot Weir.
- CFGCVR. Vertical Flat Gate and Radial Gate.
- CFGVD. Sharp Crested Weir.
- CFGVG. Broad Crested Weir.
- CFGVC. Crump Weir.
- CFGPV. Weirs.
- CFGVOTP. Ogee Type Weir with Pressure Measurement.
- CFGPVTP. Weirs with Pressure Intakes.
- CFGPVP. Weirs and Piers.
- CFGSDL. Syphon Spillway.
- CFGSDS. Air Regulated Syphon.
- CFGMDE. Energy Dissipation Accessories.
- CFGRA. Rake.
- CFGMU. Model of Sill.
- CFGMA. Models of Culvert.
- CFGCA. Culvert Fitting.
- CFGPCG. Rotatory Short Piers.
- CFGP. Long Piers.
- CFGPLR. Artificial Roughened Bed.
- CFGFS. False Floor Sections.
- CFGVEN. Venturi Flume.
- CFGMP. Parshall Meter.
- CFGMT. Trapezoidal Meter.
- CFGCGO. Computer Controlled Wave Generator.
- CFGMPL. Model of Plain Beach.
- CFGPVI. Set of Vibrating Piles.
- CFGSRS. Sediment Recirculation System.
- CFGAS. Sediment Feeder.
- CFGTS. Sediment Trap.
- CFGRMD. Digital Water Level Indicator.
- CFGMV. Velocity Meter.
- CFGSMI. Movable Instruments Support.
- CFGTA. Water Tank.
- CFGPAS. Metallic Footbridge.
- CFG10SP-KIT. Kit for Pressure Measurement along the Channel.
- CFGC10SP. Ten Pressure Sensors Module.
- CFGBAE. Scale, drag and lift.
- CFGZG. "Zagni" Flow Monitoring Model.
- APIV. Accessory for Particle Image Velocimetry (PIV).

② CFGC/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.

CFGC/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/0. 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/0.

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 CFGC/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).

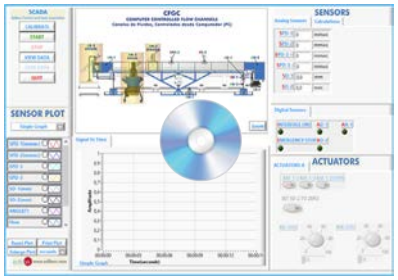
Calibration system for the sensors involved in the process.

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.



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

Required elements:

CFGCRM. Level Gauge for Water Height Measurement (Hook and Point Gauge)

In many cases it is decisive in hydraulics to know the discharge depth. The ruler to measure the height is used to measure the water level in the fluids channel.

The "CFGCRM" accessory is an instrument consisting of a probe tip in contact with water and the level is measured by a displacement sensor.

Its length is enough to enable the measurement of any water level in the channel and its main elements are made of stainless steel.

The accessory is mounted on a movable support, which can be displayed along the whole fluids channel.

CFGCTP. Pitot Tube

The Pitot tube is a device to measure the total pressure and the static pressure in a random point of the flow.

The pressure difference between the static pressure and the total pressure corresponds to the dynamic pressure from which the flow velocity and the flow rate in any point can be calculated.

The "CFGCTP" accessory is a Pitot tube mounted on a movable support that can be displaced along the whole channel, connected to a differential pressure sensor.

CFGCTVC. Venturi Tube with Pressure Sensors for Inlet Flow Measurement

This accessory is a Venturi tube located at the inlet of the channel with two pressure sensors.

A Venturi tube is a device designed to measure a fluid velocity or flow by using Venturi effect.

The Venturi effect is the pressure reduction of a fluid in motion inside a closed pipe when its velocity increases as it passes through a smaller section area.

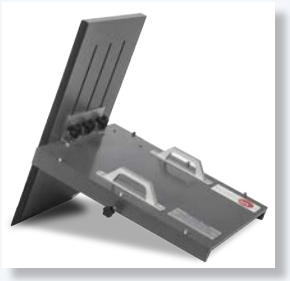
Recommended elements:

CFGPR. Adjustable Undershot Weir

One way to regulate the flow in a channel is by using control floodgates. When the floodgate is totally closed, the flow of water is blocked, and when it is open, water flows underneath and a flow starts to circulate through the channel.

The "CFGPR" accessory consists of a PVC floodgate mounted on a frame that can be displaced along the whole fluids channel. The floodgate can be fixed at the desired height, allowing for measuring that height.

It has flexible lateral reinforcements to assure water-tightness.



CFGCVR. Vertical Flat Gate and Radial Gate

One way to regulate the flow in a channel is by using control floodgates. When the floodgate is totally closed, the flow of water is blocked, and when it is open, water flows underneath and a flow circulating through the channel starts.

Radial floodgates are part of movable control structures and are normally used together with fixed control structures to adjust the flow according to the necessity.

The "CFGCVR" accessory consists of two floodgates, a flat vertical floodgate and a radial floodgate. The degree of inclination of the radial floodgate can be adjusted and it is mounted on a frame that can be displaced along the whole fluids channel.

They have flexible lateral reinforcements to assure water-tightness.

Recommended elements:

CFGVD. Sharp Crested Weirs

Sharp crested weirs are hydraulic weirs used, generally, to measure flow rates. They are called sharp-crested weirs because the discharge is done through a plate whose profile, regardless its shape, ends in a sharp edge.

The "CFGVD" accessory includes four PVC weirs (one triangular, two rectangular and one trapezoidal) lodged in slots designed for that purpose at the outlet of the channel, reinforced with flexible rubber, guaranteeing water-tightness.

CFGVG. Broad Crested Weir

Broad crested weirs have a lower discharge capacity for the same water load than sharp-crested weirs. They are most frequently used as level control structures, although they can also be calibrated and used as flow measurement structures.

The "CFGVG" accessory includes a broad-crested weir made of PVC thick enough to keep the verticality of the weir and its non-deformation and with flexible lateral reinforcements to assure water-tightness. It can be fixed to any part of the bottom of the channel. The weir can be located by one side (round edge) or the other side (straight edge).

CFGVC. Crump Weir

Crump weirs belong to control structures. It is a weir with triangular longitudinal profile, triangular transverse profile and smooth slopes. It is normally used as sill to reduce the flow rate and prevent erosion.

The "CFGVC" accessory includes a critical weir made of PVC; it can be fixed to any part of the bottom of the channel and has flexible lateral reinforcements to assure water-tightness. It has defined slopes upstream and downstream.

CFGPV. Weirs

Ogee-shaped weirs are fixed weirs and belong to control structures. They are normally used to divert flows and create pools in a river.

The "CFGPV" accessory includes three Ogee-shaped weirs with different discharge slopes.

They are made of PVC and can be fixed to any part of the bottom of the channel. They also have flexible lateral reinforcements to assure water-tightness.

CFGVOTP. Ogee Type Weir with Pressure Measurement

Ogee-shaped weirs are fixed weirs and belong to control structures. They are normally used to divert flows and create pools in a river.

The back of the weir is normally made to facilitate the flow, having thus the largest discharge possible.

The "CFGVOTP" accessory includes an Ogee-shaped weir with eight pressure tappings perpendicular to the surface. This way, pressure distribution along the back of the weir can be studied. It has tube manometers to measure pressure.

It can be fixed to any part of the bottom of the channel. It also has flexible lateral reinforcements to assure water-tightness.

Recommended elements:

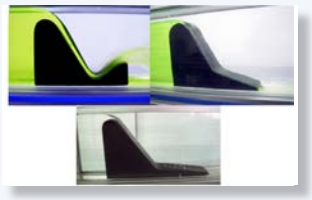
CFGPVTP. Weirs with Pressure Intakes

The "CFGPVTP" accessory includes three Ogee-shaped weirs (used to divert flows) with different discharge slopes.

They are made of PVC and can be fixed to any part of the bottom of the channel. They also have flexible lateral reinforcements to assure water-tightness.

The weirs with pressure intakes have eight pressure tappings along their surface. The bottom of the channel has openings with double seal in every section. They allow the connection of the pressure tappings to the corresponding measuring instruments.

The "CFGC10SP" accessory allows the connection of the elements with pressure intakes to a module consisting of ten pressure sensors that send the readout to the computer to visualize the pressure profiles in the elements.



CFGPVP. Weirs and Piers

The "CFGPVP" accessory includes three Ogee-shaped weirs (used to divert flows) with different discharge slopes.

They are made of PVC and can be fixed to any part of the bottom of the channel. They also have flexible lateral reinforcements to assure water-tightness.

Besides, it includes an element with two transparent long piers made of PMMA. It can be fixed to any part of the channel.

CFGSDL. Syphon Spillway

One way to regulate the water level in a channel is by using syphons.

Syphon weirs are part of fixed weirs. They are installed as spillways in reservoirs and have a high specific discharge capacity.

When the level exceeds a specific height water flows through the syphon, being the upstream level regulated.

The syphon spillway designed by EDIBON can be fixed to any part of the bottom of the channel and is made of PMMA to visualize flow lines. It has flexible lateral reinforcements to assure water-tightness.

CFGSDS. Air Regulated Syphon

One way to regulate the water level in a channel is by using syphons.

Syphon weirs are part of fixed weirs. They are installed as spillways in reservoirs and have a high specific discharge capacity.

When the level exceeds a specific height water flows through the syphon, being the upstream level regulated.

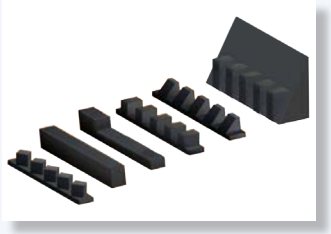
The self-regulating syphon designed by EDIBON can be fixed to any part of the bottom of the channel and is made of PMMA to visualize flow lines. It has flexible lateral reinforcements to assure water-tightness.

CFGMDE. Energy Dissipation Accessories

The flow acquires kinetic energy during its descent. One of the aspects that generally deserves special attention when designing hydraulic works is to dissipate that energy. This situation arises in surplus weirs, waterfall structures, culvert outlets, etc.

Kinetic energy dissipation is achieved by applying different measures: generation of hydraulic jump, impact or roughness increase. The energy dissipating structure is an important part of the surplus work, whose objective is to dissipate the kinetic energy acquired by water when falling from the duct to an appropriate place at the bottom of the bed, where it does not generate erosion or scour problems.

The "CFGMDE" accessory includes several energy dissipation elements, such as two jagged sills with five rectangular teeth, a jagged sill with five triangular teeth, two outlet sills with different heights and one block. They can be fixed to any part of the channel either in a combined or individual way.

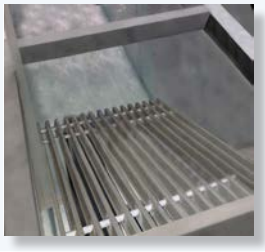


Recommended elements:

CFGRA. Rake

Rakes are used in the primary stages of treatment plants to stop thick dirt that might damage the system.

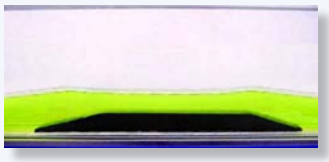
The "CFGRA" rake prevents dirt from being introduced in the system. It includes different bar profiles so the tilt angle can be adjusted.



CFGMU. Model of Sill

Sills are normally used to smooth the drops of a channel and prevent erosion. Sills cause a constriction of the flow cross-section.

The "CFGMU" accessory includes a sill made of PVC, which can be fixed to any part of the bottom of the channel and has flexible lateral reinforcements to assure water-tightness.



CFGMA. Models of Culvert

Culverts belong to crossing structures and enable the passage of water. They can be a sewer, syphon, aqueduct, bridge, etc.

The "CFGMA" accessory consists of a crossing structure formed by a circular section hollow channel and a rectangular cross-section channel, which allow for observing the hydraulic jumps in culverts.

They can be fixed to any part of the bottom of the channel and have flexible lateral reinforcements to assure water-tightness.

CFGCA. Culvert Fitting

Culverts belong to crossing structures and enable the passage of water. They can be a sewer, syphon, aqueduct, bridge, etc.

The "CFGCA" accessory is made of PVC and represents the connection of the channel to the culvert, allowing the regulation of its height.

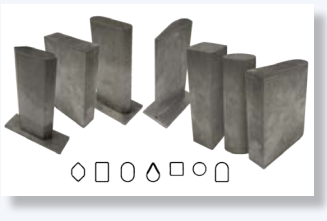
It can be fixed to any part of the channel and has flexible lateral reinforcements to assure water-tightness.

CFGPCG. Rotatory Short Piers

Piers in a channel are obstacles that reduce the flow cross-section. This way, a pool can be created in the water before the obstacles.

The "CFGPCG" accessory includes several bridge piers of different profile and a device to fix the pier to the test channel and rotate the pier, measuring the angle between the end of the pier and the flow, to study the influence of the angle of attack.

Different profiles are included: rectangular, square, circular, rounded on one end, rounded on both ends, tapered on one end and tapered on both ends.



Recommended elements:

CFGP. Long Piers

Accessory with two removable transparent long piers to study the effect of flow between piers with or without sediments.

They are made of PMMA and can be fixed to any part of the channel.

CFGPLR. Artificial Roughened Bed

The flow behavior in a river depends particularly on slopes and the roughness of the base of the channel.

The "CFGPLR" accessory consists of PVC plates with different elements (three different sizes) that allow for simulating in the fluids channel a riverbed of three different slopes. They can be fixed to any part of the bottom of the channel.

CFGFS. False Floor

The flow behavior in a river depends particularly on slopes and the roughness of the base of the channel.

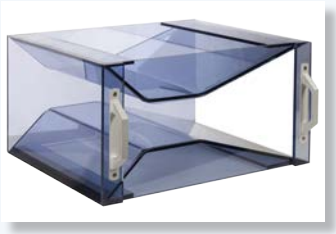
The "CFGFS" accessory consists of PVC plates with different material of different roughness that allow for simulating in the fluids channel a riverbed of three different roughness. They can be fixed to any part of the bottom of the channel.

CFGVEN. Venturi Meter

In the same way that the Venturi meter in tubes is used to measure the flow in closed flows, the Venturi flume is used to measure the flow in open channels.

It is made of a transparent material that enables to visualize the flow inside.

It can be fixed to any part of the bottom of the channel and has flexible lateral reinforcements to assure water-tightness.



CFGMP. Parshall Meter

One of the most common methods to know the discharge of a channel is the use of gauge flumes.

The Parshall meter is a device designed to measure flow rates in channels or rivers.

It has particular elevations so the current concentrates in three sides.

It can be fixed to any part of the bottom of the channel and has flexible lateral reinforcements to assure water-tightness.

CFGMT. Trapezoidal Meter

One of the most common methods to know the discharge of a channel is the use of gauge flumes.

The trapezoidal meter is a device designed to measure flow rates in channels or rivers.

It has particular elevations so the current concentrates in three sides.

The section of the channel is trapezoidal and has smooth walls.

It can be adjusted to natural channel sections and fixed to any part of the bottom of the channel. It also has flexible lateral reinforcements to assure water-tightness.

Recommended elements:

CFGCGO. Computer Controlled Wave Generator

The "CFGCGO" accessory enables to generate waves with a displacement plate that develops a rotating motion.

The plate is made of PVC and is driven by an electric motor with variable frequency drive. It enables the user to vary the frequency and amplitude of the waves through a computer.

It is located on a frame made of aluminum profiles that enables to place it in any part of the channel.

CFGMPL. Models of Beaches

The "CFGMPL" accessory represents different models of beaches that enable to study the breakers in different beaches. A wave generator is required to use this accessory.

It includes models of beaches, such as a smooth beach, a rough beach and a permeable beach.

It enables to regulate the slope of the beaches to study the breakers with different conditions. They are made of PVC and have flexible lateral reinforcements to assure water-tightness.

CFGPVI. Set of Vibrating Piles

Drilling platforms, such as oil platforms, normally stand on piles in the water.

Circulating water exerts forces on the part of the piles immersed in the water and causes vibrations.

Karman vortexes can be generated in the flow around a pile. The separation of those vortexes makes the flow direction to be modified.

The "CFGPVI" accessory allows to observe vibrating piles formed by rods of different diameter with weights added.

CFGSRS. Sediment Recirculation System

The sediment recirculation system consists of a pipe system with pump to impel water with sediments from the sediment trap to the sediment feeder.

The pump is located in the discharge tank of the channel inside a mesh basket that allows the flow of fluids but retains the sediments.

Recirculation is done through pipes with a flow regulation valve to vary the flow of sediments.

The sediment feeder "CFGAS" and the sediment trap "CFGTS" are required to use this accessory.

CFGAS. Sediment Feeder

The "CFGAS" accessory transports and measures out sediments of different grain size.

It consists of a vibrating hopper of 50 l and an arm that enables to distribute the sediments in the channel uniformly at a transport rate of 0.5 m^3/h. It is mounted on a rail to facilitate its motion along the whole channel.

This accessory requires the sediment trap "CFGTS" and the sediment recirculation system "CFGSRS".

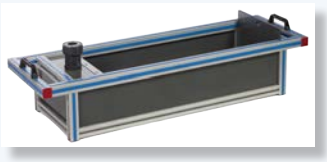
Recommended elements:

CFGTS. Sediment Trap

Flows in rivers, channels and coastal zones are normally accompanied by sediment transport. In this case, the transport of sediments dragged by the current plays an important role, since solid matter moves in the base of the waters.

The "CFGTS" accessory consists of a fine mesh located under the water outlet device, thus clean water flows to the tank. This way the sediments do not go to the pump or to the flowmeter, preventing them from blocking.

This accessory requires the sediment feeder "CFGAS" and the sediment recirculation system "CFGSRS".



CFGRMD. Digital Water Level Indicator

In many cases it is decisive in hydraulics to know the discharge depth. The ruler to measure the height is used to measure the water level in the fluids channel.

The "CFGRMD" accessory is an instrument formed by a probe tip in contact with water and the level is directly read in a display.

Its length is enough to enable the measurement of any water level in the channel and its main elements are made of stainless steel.

The accessory is mounted on a movable support, which can be displayed along the whole fluids channel.

CFGMV. Velocity Meter

The "CFGMV" accessory consists of a flow velocity meter. The device consists of a wheel with blades, which rotates proportionally to the flow velocity, read in a display.

The accessory can be displaced up and down the length and width of the fluids channel.

CFGSMI. Movable Instruments Support

Support for measurement accessories, such as the Pitot tube (CFGCTP) or the level gauge for water height (CFGCRM).

Thanks to some guides, this support allows for displacing the meter along the channel.

It includes graduated lines to determine the exact position of the meter.

CFGTA. Water Tank

Additional water tank of 1200 l capacity.

Recommended elements:

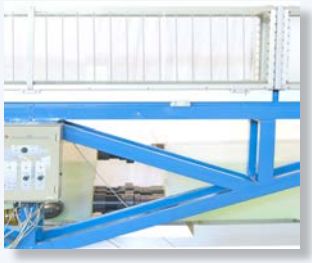
CFGPAS. Metallic Footbridge

This accessory is an elevated platform to facilitate the access to the channel in order to work with it.

CFG10SP-KIT. Kit for Pressure Measurement along the Channel

The kit for pressure measurement along the channel consists of ten measurement intakes with height indicating tube distributed along the channel.

It enables to represent the pressure height in function of flow.



CFGC10SP. Ten Pressure Sensors Module

Console with ten pressure sensors where different accessories of the channel are connected. It will send the measurements to the computer through the electronic interface. This allows for obtaining and analyzing different pressure distributions in the elements under study.

CFGBAE. Scale, drag and lift

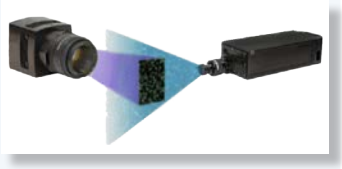
The objective of the "CFGBAE" model is to calculate the forces generated by water on various bodies, such as a cube, a cylinder or two discs of different diameter. Three force sensors are included.

CFGZG. "Zagni" Flow Monitoring Model

The "Zagni" Flow Monitoring Model consists of a manometer board and a Pitot tube for the study of pressure distribution and flow velocity.

APIV. Accessory for Particle Image Velocimetry (PIV)

The "APIV" model uses the particle image velocimetry technique to measure the flow velocity in many points. A laser light sheet projector, a camera system and processing software are included.



EXERCISES AND PRACTICAL POSSIBILITIES TO BE DONE WITH THE MAIN ITEMS

1.- Measurement of water level and speed along the channel.
2.- Flow rate measurement using sharp-crested weirs.
3.- Flow rate measurement through changes in the channel section.
4.- Flow rate measurement using Venturi flume.
5.- Flow rate control using gates.
6.- Level control using syphons.
7.- Flow over overflow weirs.
8.- Flow between the piers of a bridge.
9.- Connection of a channel to a culvert.
10.-Characterization of the hydraulic jump.
11.-Profiles of the water free surface.
12.-Manning coefficient calculation for channels with sedimentation.
13.-Comparison of the discharge coefficient in gates with or without sedimentation.
14.-Simulation of the effect of the piers of a bridge in a channel with sediments.
15.-Study of turbulences using ink.
16.-Visualization of the transitions of the sediments on the bed when abrupt discharges are generated.
17.-Dependence of the sediments shape on the flow rate variation.
18.-Study of the sediments transport and settling mechanisms.

Additional practical possibilities:

19.-Investigation of currents and torrential floods states.
20.-Water levels measurement.
21.-Discharge process in a submergible spillway.
22.-Pressure drop in open channels.
23.-Operation and study of a syphon.
24.-Flow and discharge coefficient of a syphon.
25.-Flow in pipes.
26.-Comparison between overflow and syphon.
27.-Study of the amplitude of the hydraulic jump.
28.-Generation of different flow states using an underwater dam.
29.-Study of the discharge processes under an adjustable weir:
    - Study of alternating changes during the discharge.
30.-Relationship between backwater level and discharge level.
31.-Study of discharge under a radial gate:
    - Study of alternating changes during the discharge.
32.-Hydrostatic pressure on a weir.
33.-Study of waves.
34.-Behaviour of structures under swell conditions (in rough sea).
35.-Application and understanding of Manning formula.
36.-Study of subcritical and supercritical flows.
37.-Learning how to apply the force, momentum and energy equations in typical situations.
38.-Study of the transition from flowing current to accelerated current.
39.-Calculation of the water flow.
40.-Use of the limnimeter.

Other possibilities to be done with this Unit:

41.-Many students view results simultaneously.

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

42.-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.

43.-The Computer Control System with SCADA allows a real industrial simulation.
44.-This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
45.-This unit can be used for doing applied research.
46.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
47.-Control of the CFGC unit process through the control interface box without the computer.
48.-Visualization of all the sensors values used in the CFGC 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/50Hz or 110V/60Hz.
- Water supply and drainage.
- Computer.

REQUIRED AND RECOMMENDED ELEMENTS

Required elements:

- CFGCRM. Level Gauge for Water Height Measurement (Hook and Point Gauge).
- CFGCTP. Pitot Tube.
- CFGCTVC. Venturi Tube with Pressure Sensors for Inlet Flow Measurement.

Recommended elements:

- CFGPR. Adjustable Undershot Weir.
- CFGCVR. Vertical Flat Gate and Radial Gate.
- CFGVD. Sharp Crested Weir.
- CFGVG. Broad Crested Weir.
- CFGVC. Crump Weir.
- CFGPV. Weirs.
- CFGVOTP. Ogee Type Weir with Pressure Measurement.
- CFGPVTP. Weirs with Pressure Intakes.
- CFGPVP. Weirs and Piers.
- CFGSDL. Syphon Spillway.
- CFGSDS. Air Regulated Syphon.
- CFGMDE. Energy Dissipation Accessories.
- CFGRA. Rake.
- CFGMU. Model of Sill.
- CFGMA. Models of Culvert.
- CFGCA. Culvert Fitting.
- CFGPCG. Rotatory Short Piers.
- CFGP. Long Piers.
- CFGPLR. Artificial Roughened Bed.
- CFGFS. False Floor Sections.
- CFGVEN. Venturi Flume.
- CFGMP. Parshall Meter.
- CFGMT. Trapezoidal Meter.
- CFGCGO. Computer Controlled Wave Generator.
- CFGMPL. Model of Plain Beach.
- CFGPVI. Set of Vibrating Piles.
- CFGSRS. Sediment Recirculation System.
- CFGAS. Sediment Feeder.
- CFGTS. Sediment Trap.
- CFGRMD. Digital Water Level Indicator.
- CFGMV. Velocity Meter.
- CFGSMI. Movable Instruments Support.
- CFGTA. Water Tank.
- CFGPAS. Metallic Footbridge.
- CFG10SP-KIT. Kit for Pressure Measurement along the Channel.
- CFGC10SP. Ten Pressure Sensors Module.
- CFGBAE. Scale, drag and lift.
- CFGZG. “Zagni” Flow Monitoring Model.
- APIV. Accessory for Particle Image Velocimetry (PIV).

AVAILABLE VERSIONS

Offered in this catalog:

- CFGC300/5. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 5 m.
- CFGC300/7. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 7.5 m.
- CFGC300/10. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 10 m.
- CFGC300/12. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 12.5 m.

- CFGC310/5. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 5 m.
- CFGC310/7. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 7.5 m.
- CFGC310/10. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 10 m.
- CFGC310/12. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 12.5 m.

- CFGC400/5. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 5 m.
- CFGC400/7. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 7.5 m.
- CFGC400/10. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 10 m.
- CFGC400/12. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 12.5 m.

- CFGC600/5. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 5 m.
- CFGC600/7. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 7.5 m.
- CFGC600/10. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 10 m.
- CFGC600/12. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 12.5 m.

- CFGC1000/5. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 5 m.
- CFGC1000/7. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 7.5 m.
- CFGC1000/10. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 10 m.
- CFGC1000/12. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 12.5 m.

- CFGCCD. Computer Controlled Flow Channel (dimensions: "Custom Design").

Offered in other catalogs:

- CFG300/5. Flow Channel (section: 300 x 450 mm), length: 5 m.
- CFG300/7. Flow Channel (section: 300 x 450 mm), length: 7.5 m.
- CFG300/10. Flow Channel (section: 300 x 450 mm), length: 10 m.
- CFG300/12. Flow Channel (section: 300 x 450 mm), length: 12.5 m.

- CFG310/5. Flow Channel (section: 310 x 450 mm), length: 5 m.
- CFG310/7. Flow Channel (section: 310 x 450 mm), length: 7.5 m.
- CFG310/10. Flow Channel (section: 310 x 450 mm), length: 10 m.
- CFG310/12. Flow Channel (section: 310 x 450 mm), length: 12.5 m.

- CFG400/5. Flow Channel (section: 400 x 450 mm), length: 5 m.
- CFG400/7. Flow Channel (section: 400 x 450 mm), length: 7.5 m.
- CFG400/10. Flow Channel (section: 400 x 450 mm), length: 10 m.
- CFG400/12. Flow Channel (section: 400 x 450 mm), length: 12.5 m.

- CFG600/5. Flow Channel (section: 600 x 450 mm), length: 5 m.
- CFG600/7. Flow Channel (section: 600 x 450 mm), length: 7.5 m.
- CFG600/10. Flow Channel (section: 600 x 450 mm), length: 10 m.
- CFG600/12. Flow Channel (section: 600 x 450 mm), length: 12.5 m.

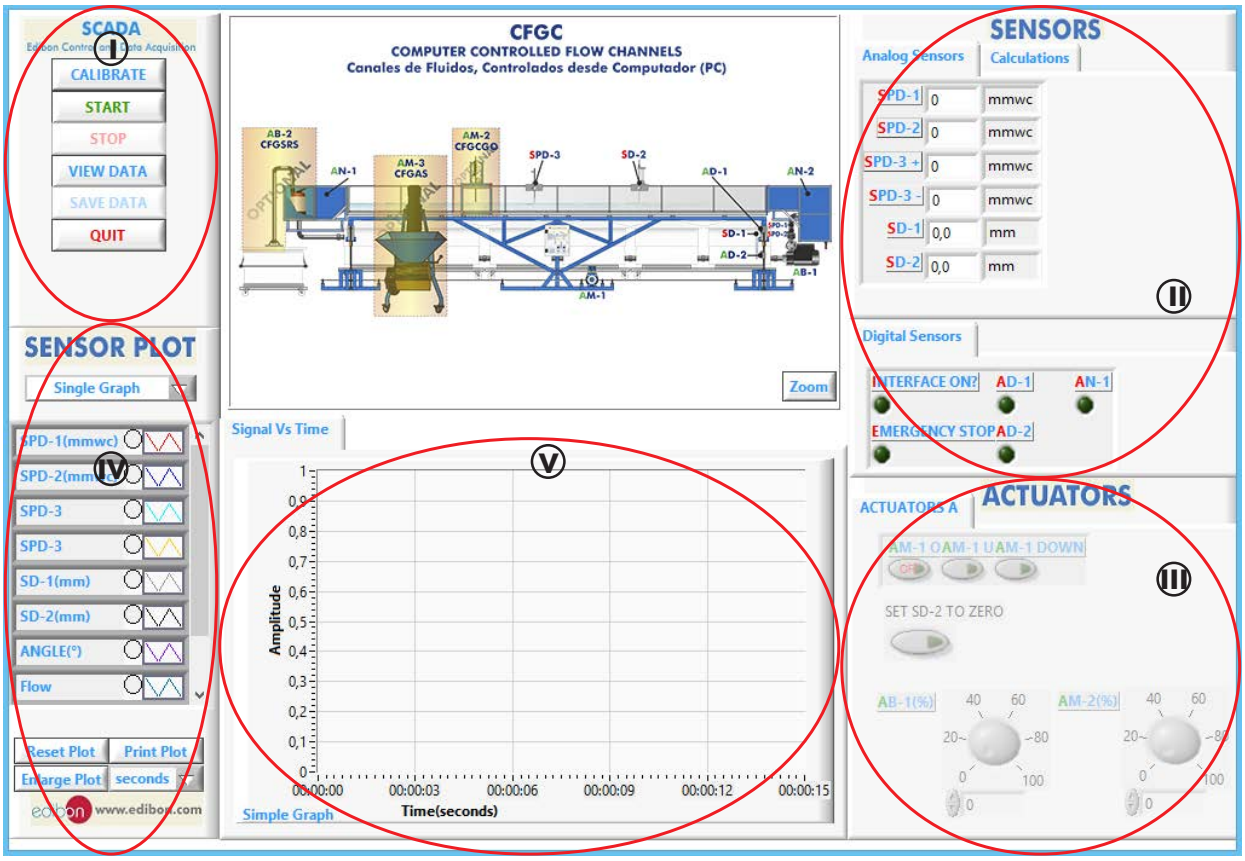
- CFG1000/5. Flow Channel (section: 1000 x 450 mm), length: 5 m.
- CFG1000/7. Flow Channel (section: 1000 x 450 mm), length: 7.5 m.
- CFG1000/10. Flow Channel (section: 1000 x 450 mm), length: 10 m.
- CFG1000/12. Flow Channel (section: 1000 x 450 mm), length: 12.5 m.

- CFGCD. Flow Channel (dimensions: "Custom Design").

- CFC80/2. Computer Controlled Flow Channel (section: 80 x 300 mm), lenght: 2.5 m.
- CFC80/5. Computer Controlled Flow Channel (section: 80 x 300 mm), lenght: 5 m.

- CF80/2. Flow Channel (section: 80 x 300 mm), lenght: 2.5 m.
- CF80/5. Flow Channel (section: 80 x 300 mm), lenght: 5 m.

SCADA
Main screen



Ⓘ Main software operation possibilities.

Ⓘⓘ **Sensors displays, real time values, and extra output parameters. Sensors:** SPD=Differential pressure sensor. SD=Displacement sensor.

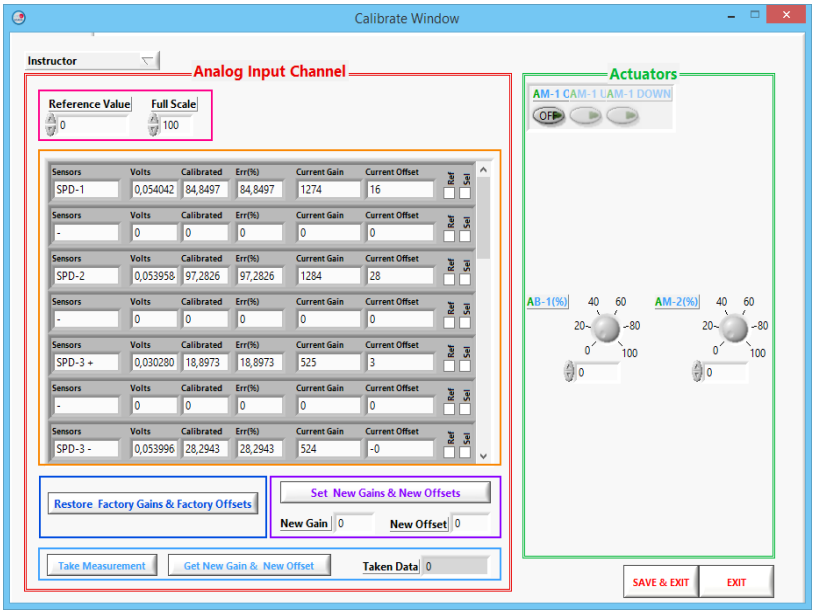
Ⓘⓘⓘ **Actuators controls. Actuators:** AB=Pump. AM=Motor. AN=Level switch.

Ⓘⓥ Channel selection and other plot parameters.

Ⓥ 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.

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 μsec. 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.

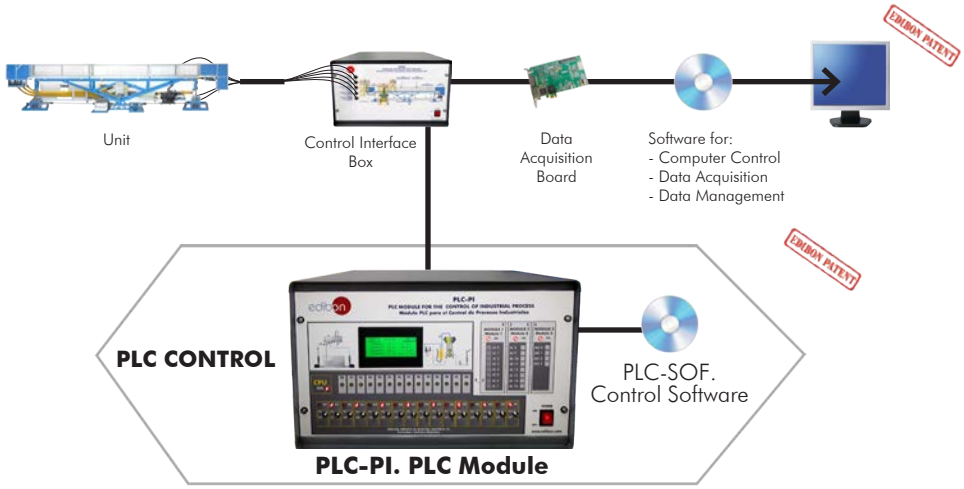
Communication RS232 wire to computer (PC).

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.).

-CFGC/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 Flow Channels (CFGC).



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 industrialenvironment 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 CFGC/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:

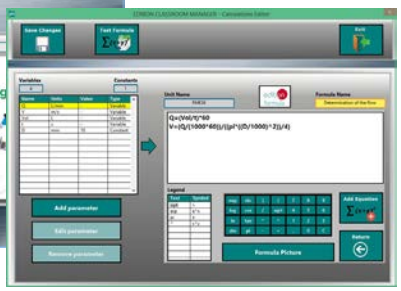
- **Student Log-In & Self-Registration.**
- **Existing Tasks checking & Monitoring.**
- **Default contents & scheduled tasks available to be used from the first session.**
- **Practical Exercises accomplishment by following the Manual provided by EDIBON.**
- **Evaluation Methods to prove your knowledge 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

Instructor Software

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



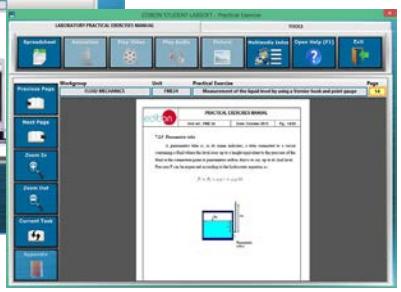
ECAL. EDIBON Calculations Program Package - Formula Editor Screen

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

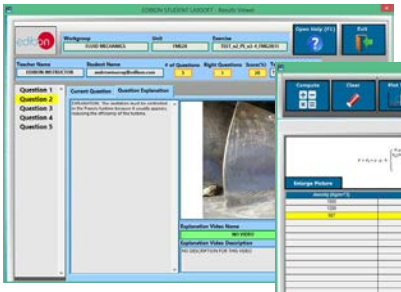
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

Student Software

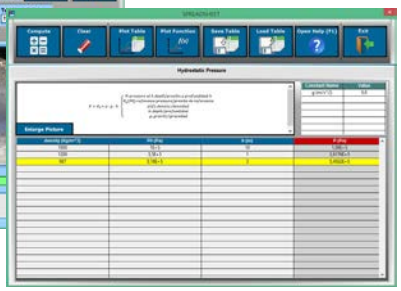
ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen



EPE. EDIBON Practical Exercise Program Package Main Screen



ERS. EDIBON Results & Statistics Program Package - Question Explanation



ECAL. EDIBON Calculations Program Package Main Screen

⑨ CFGC/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.

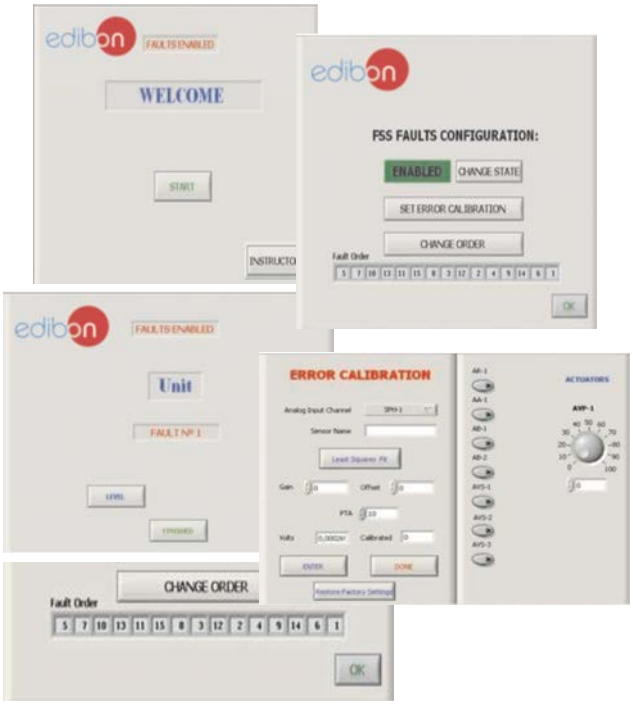
- Reduction or increase of the calculated total response.

- 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

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.

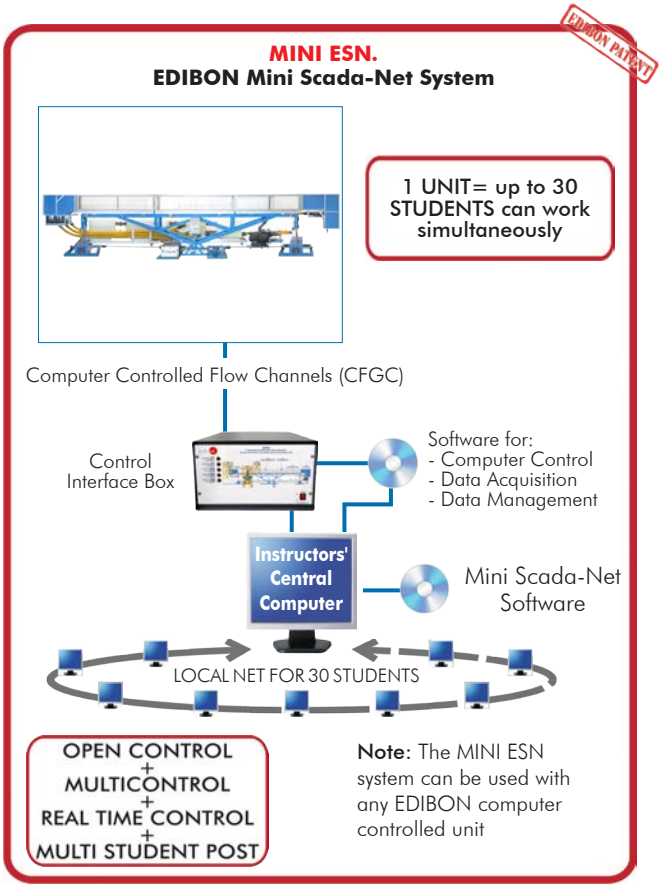
- Continuous communication between the instructor and all the users/students connected.

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

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

Main items (always included in the supply)

Minimum supply always includes:

① **Unit: CFGC. Computer Controlled Flow Channels.**

Available versions to choose:

- **CFGC300/5. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 5 m.**
- **CFGC300/7. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 7.5 m.**
- **CFGC300/10. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 10 m.**
- **CFGC300/12. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 12.5 m**

- **CFGC310/5. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 5 m.**
- **CFGC310/7. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 7.5 m.**
- **CFGC310/10. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 10 m.**
- **CFGC310/12. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 12.5 m.**

- **CFGC400/5. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 5 m.**
- **CFGC400/7. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 7.5 m.**
- **CFGC400/10. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 10 m.**
- **CFGC400/12. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 12.5 m.**

- **CFGC600/5. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 5 m.**
- **CFGC600/7. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 7.5 m.**
- **CFGC600/10. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 10 m.**
- **CFGC600/12. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 12.5 m.**

- **CFGC1000/5. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 5 m.**
- **CFGC1000/7. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 7.5 m.**
- **CFGC1000/10. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 10 m.**
- **CFGC1000/12. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 12.5 m.**

- **CFGCCD. Computer Controlled Flow Channel (dimensions: "Custom Design").**

② **CFGC/CIB. Control Interface Box.**

③ **DAB. Data Acquisition Board.**

④ **CFGC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**

⑤ **Cables and Accessories**, for normal operation.

⑥ **Manuals.**

*IMPORTANT: Under CFGC 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.
- CFGC/PLC-SOF. PLC Control Software.

b) Technical and Vocational Education configuration

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

⑨ CFGC/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 CFGC. Unit:

Channel made up of group of modular parts of 2.5 m long. Each rectangular piece of different sections with transparent walls of 10 mm thick is made in such a way that guarantees a uniform section along the entire channel. All the sections are made of tempered glass, stainless steel and anodized aluminum, guaranteeing corrosion resistance. The alignment process and level testers guarantee a perfect alignment of the perfectly watertight assembled unit.

The assembly has inlet and outlet gates to carry out different experiments and safety level switches that prevent water from exceeding the maximum level.

Metal beam structure, made of welded steel, to support the assembly of sections. It allows for adjusting the tilt from -0.5% to 2.5%. The tilt of the channel is controlled and monitored from the computer through a displacement sensor.

Fiberglass **inlet tank** with draining valve and safety water level switch.

Fiberglass **reception tank** with draining valve and safety water level switch.

Two storage tanks with cover and draining valve at the bottom to store the recirculation water. Capacity: 1200 l per tank.

Computer controlled variable speed **driving pump**. The power of the pump varies in function of the channel version up to 140 m^3/h, 4 kW. Water velocity inside the channel can be controlled from 0 m/s to the maximum flow rate supplied by the pump.

Instrumentation:

Displacement sensor to obtain the channel height position (tilt). The readout is displayed in the computer at all times.

Two differential pressure sensors for inlet flow measurement (included in CFGCTVC).

Displacement sensor (included in CFGCRM).

Differential pressure sensor (included in CFGCTP).

Available versions to choose:

- CFGC300/5. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 5 m.
- CFGC300/7. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 7.5 m.
- CFGC300/10. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 10 m.
- CFGC300/12. Computer Controlled Flow Channel (section: 300 x 450 mm), length: 12.5 m

- CFGC310/5. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 5 m.
- CFGC310/7. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 7.5 m.
- CFGC310/10. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 10 m.
- CFGC310/12. Computer Controlled Flow Channel (section: 310 x 450 mm), length: 12.5 m.

- CFGC400/5. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 5 m.
- CFGC400/7. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 7.5 m.
- CFGC400/10. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 10 m.
- CFGC400/12. Computer Controlled Flow Channel (section: 400 x 450 mm), length: 12.5 m.

- CFGC600/5. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 5 m.
- CFGC600/7. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 7.5 m.
- CFGC600/10. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 10 m.
- CFGC600/12. Computer Controlled Flow Channel (section: 600 x 450 mm), length: 12.5 m.

- CFGC1000/5. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 5 m.
- CFGC1000/7. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 7.5 m.
- CFGC1000/10. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 10 m.
- CFGC1000/12. Computer Controlled Flow Channel (section: 1000 x 450 mm), length: 12.5 m.

- CFGCCD. Computer Controlled Flow Channel (dimensions: “Custom Design”).

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.

Required elements:

- CFGCRM. Level Gauge for Water Height Measurement (Hook and Point Gauge) (to measure water level).
- CFGCTP. Pitot Tube (to measure velocity).
- CFGCTVC. Venturi Tube with Pressure Sensors for Inlet Flow Measurement (to measure the inlet flow to the channel).

Recommended elements:

- CFGPR. Adjustable Undershot Weir.
- CFGCVR. Vertical Flat Gate and Radial Gate.
- CFGVD. Sharp Crested Weir.
- CFGVG. Broad Crested Weir.
- CFGVC. Crump Weir.
- CFGPV. Weirs.
- CFGVOTP. Ogee Type Weir with Pressure Measurement.
- CFGPVTP. Weirs with Pressure Intakes.
- CFGPVP. Weirs and Piers.
- CFGSDL. Syphon Spillway.
- CFGSDS. Air Regulated Syphon.
- CFGMDE. Energy Dissipation Accessories.
- CFGRA. Rake.
- CFGMU. Model of Sill.
- CFGMA. Models of Culvert.
- CFGCA. Culvert Fitting.
- CFGPCG. Rotatory Short Piers.
- CFGP. Long Piers.
- CFGPLR. Artificial Roughened Bed.
- CFGFS. False Floor Sections.
- CFGVEN. Venturi Flume.
- CFGMP. Parshall Meter.
- CFGMT. Trapezoidal Meter.
- CFGCGO. Computer Controlled Wave Generator.
- CFGMPL. Model of Plain Beach.
- CFGPVI. Set of Vibrating Piles.
- CFGSRS. Sediment Recirculation System.
- CFGAS. Sediment Feeder.
- CFGTS. Sediment Trap.
- CFGRMD. Digital Water Level Indicator.
- CFGMV. Velocity Meter.
- CFGSMI. Movable Instruments Support.
- CFGTA. Water Tank.
- CFGPAS. Metallic Footbridge.
- CFG10SP-KIT. Kit for Pressure Measurement along the Channel.
- CFGC10SP. Ten Pressure Sensors Module.
- CFGBAE. Scale, drag and lift.
- CFGZG. "Zagni" Flow Monitoring Model.
- APIV. Accessory for Particle Image Velocimetry (PIV).

② **CFGC/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.

④ **CFGC/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.- Measurement of water level and speed along the channel.
2.- Flow rate measurement using sharp-crested weirs.
3.- Flow rate measurement through changes in the channel section.
4.- Flow rate measurement using Venturi flume.
5.- Flow rate control using gates.
6.- Level control using syphons.
7.- Flow over overflow weirs.
8.- Flow between the piers of a bridge.
9.- Connection of a channel to a culvert.
10.-Characterization of the hydraulic jump.
11.-Profiles of the water free surface.
12.-Manning coefficient calculation for channels with sedimentation.
13.-Comparison of the discharge coefficient in gates with or without sedimentation.
14.-Simulation of the effect of the piers of a bridge in a channel with sediments.
15.-Study of turbulences using ink.
16.-Visualization of the transitions of the sediments on the bed when abrupt discharges are generated.
17.-Dependence of the sediments shape on the flow rate variation.
18.-Study of the sediments transport and settling mechanisms.

Additional practical possibilities:

19.-Investigation of currents and torrential floods states.
20.-Water levels measurement.
21.-Discharge process in a submergible spillway.
22.-Pressure drop in open channels.
23.-Operation and study of a syphon.
24.-Flow and discharge coefficient of a syphon.
25.-Flow in pipes.
26.-Comparison between overflow and syphon.
27.-Study of the amplitude of the hydraulic jump.
28.-Generation of different flow states using an underwater dam.
29.-Study of the discharge processes under an adjustable weir:
    - Study of alternating changes during the discharge.
30.-Relationship between backwater level and discharge level.
31.-Study of discharge under a radial gate:
    - Study of alternating changes during the discharge.
32.-Hydrostatic pressure on a weir.
33.-Study of waves.
34.-Behaviour of structures under swell conditions (in rough sea).
35.-Application and understanding of Manning formula.
36.-Study of subcritical and supercritical flows.
37.-Learning how to apply the force, momentum and energy equations in typical situations.
38.-Study of the transition from flowing current to accelerated current.
39.-Calculation of the water flow.
40.-Use of the limnimeter.

Other possibilities to be done with this Unit:

41.-Many students view results simultaneously.
    To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
42.-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.
43.-The Computer Control System with SCADA allows a real industrial simulation.
44.-This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
45.-This unit can be used for doing applied research.
46.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
47.-Control of the CFGC unit process through the control interface box without the computer.
48.-Visualization of all the sensors values used in the CFGC unit process.

- By using PLC-PI additional 19 more exercises can be done.
- Several other exercises can be done and designed by the user.

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 μsec. Program capacity of 32 Ksteps. High-speed counter. Multi-point PID control.
Digital inputs/outputs and analog inputs/outputs Panasonic modules.

-CFGC/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 industrialenvironment 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 **CFGC/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.

- 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.

⑨ CFGC/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.

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.
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.

edibon INTERNATIONAL

C/ Del Agua, 14. Polígono Industrial San José de Valderas.
28918 LEGANÉS. (Madrid). ESPAÑA - SPAIN.
Tel.: 34-91-6199363 Fax: 34-91-6198647
E-mail: edibon@edibon.com Web: **www.edibon.com**

Edition: ED01/18
Date: March/2018

REPRESENTATIVE: