

Key features:

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

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



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PRODUCTS
➤ 9. - THERMODYNAMICS
& THERMOTECHNICS

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)

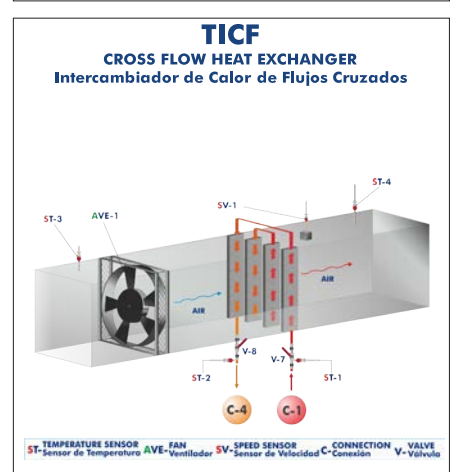
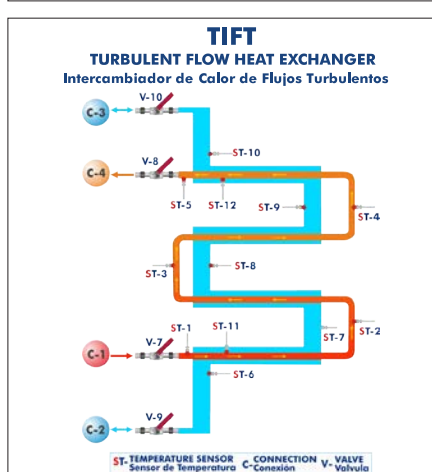
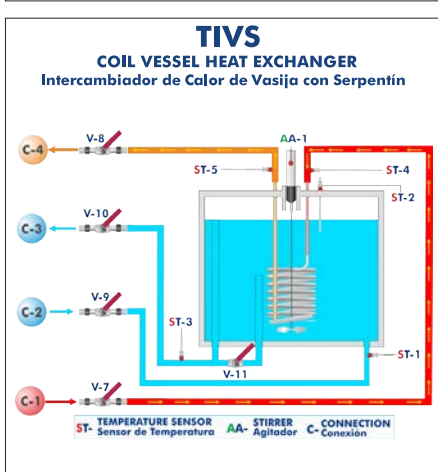
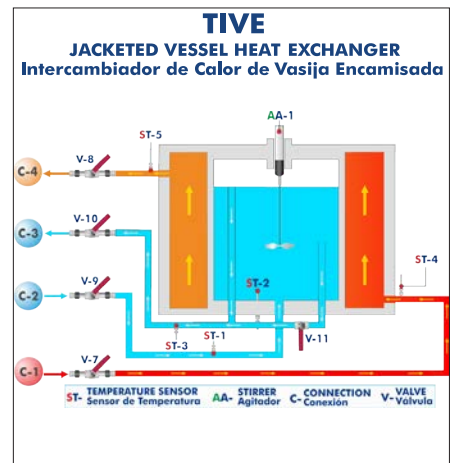
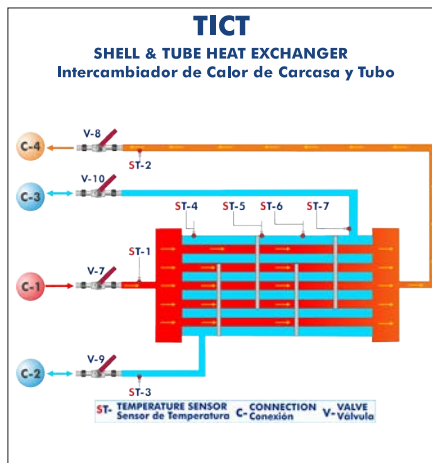
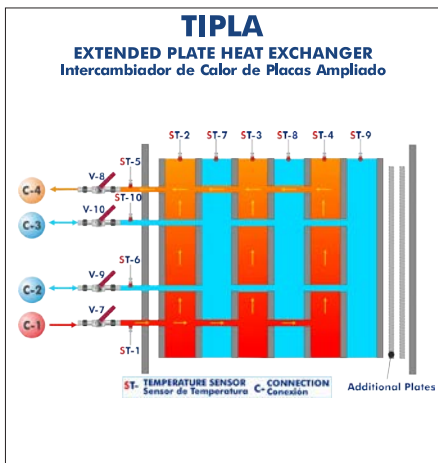
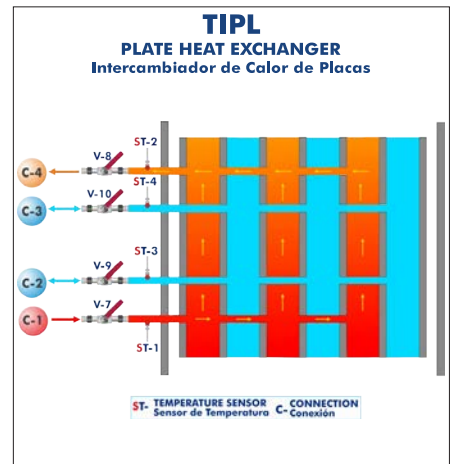
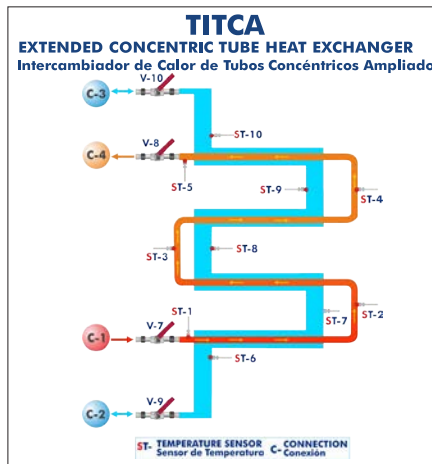
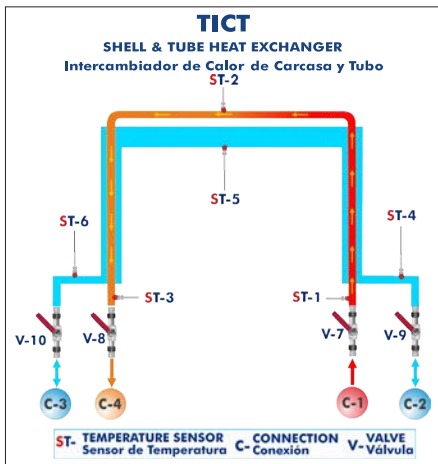
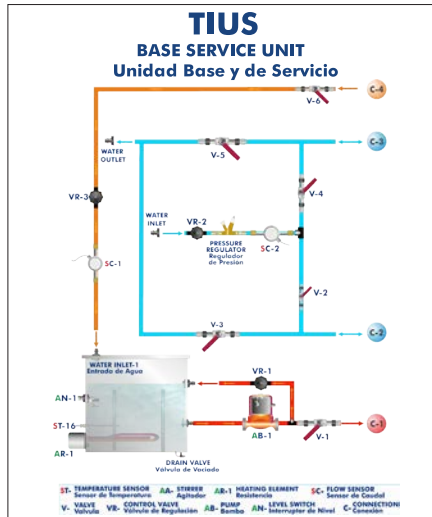


"Worlddidac Quality Charter" and Platinum Member of Worlddidac

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION

5 actuators and 16 sensors controlled from any computer, and working simultaneously

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL



With this unit there are several options and possibilities:

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

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

Heat Exchangers type "TI"

① TIUS. Base Service Unit:

This unit is common for Heat Exchangers type "TI" and can work with one or several exchangers. This unit performs the following tasks:

- Heating the water.
- Pumping of hot water.
- Change in the direction of cold water flows.
- Cold and hot water measures.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

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

Stainless steel tank (30 l), equipped with:

- Electric heating element (3000 W) with thermostat (70 °C), to heat the water, computer controlled. PID temperature control.
- Temperature sensor ("J" type) to measure the water temperature.
- Level switch to control the water level in the tank.
- Stainless steel cover to avoid the contact with hot water. In this cover there is a hole that allows us to visualize the water level and also to stuff the tank.
- Draining water valve.

Centrifugal pump with speed control from computer, range: 0 – 3 l/min.

Two flow sensors, one for hot water and the other for cold water, range: 0.25 – 6.5 l/min.

Control valves for the cold and hot water.

Four ball valves that, depending on how we manipulate them, give us co-current or counter-current flux in the exchanger.

Two ball valves to control and drain the hot water of the base unit.

Pressure regulator to avoid the introduction of too much pressure in the exchangers, tared at 0.6 Bar.

Four flexible tubes to connect with the different exchangers.



TIUS

② TICC/CIB. Control Interface Box:

This control interface is common for Heat Exchangers type "TI" and can work with one or several exchangers.

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

Real time PID and on/off control for pumps, compressors, heating elements, control valves, etc.

Real time PID control for parameters involved in the process simultaneously.

Proportional control, integral control and derivative control, based on the real PID mathematical formula, by changing the values, at any time, of the three control constants (proportional, integral and derivative constants).

Open control allowing modifications, at any moment and in real time, of parameters involved in the process simultaneously.

Possibility of automatization of the actuators involved in the process.

Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.



TICC/CIB

③ DAB. Data Acquisition Board:

Common for the modules type "TXC".

PCI Express Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI Express.

Analog input:

Number of channels= 16 single-ended or 8 differential. Resolution= 16 bits, 1 in 65536.

Sampling rate up to: 250 KS/s (kilo samples per second).

Input range (V)= ±10 V. Data transfers=DMA, interrupts, programmed I/O. DMA channels=6.

Analog output:

Number of channels=2. Resolution= 16 bits, 1 in 65536.

Maximum output rate up to: 900 KS/s.

Output range (V)= ±10 V. Data transfers=DMA, interrupts, programmed I/O.

Digital Input/Output:

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

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



DAB

④ **Heat Exchangers available to be used with the Base Service Unit:**

④① **TITC. Concentric Tube Heat Exchanger:**

This Concentric Tube Heat Exchanger allows the study of heat transfer between hot water flowing through an internal tube and cold water flowing in the ring area lying between the internal and the external tubes.

This exchanger allows measuring hot and cold water temperatures at different points of the exchanger.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

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

The exchanger is formed by two concentric copper tubes with hot water circulating through the interior tube and cold water circulating in the ring space.

This exchanger has two equal sections of 500 mm each one, where heat transfer takes place.

Exchange length: $L = 2 \times 0.5 = 1 \text{ m}$.

Internal tube:

Internal diameter: $D_{int} = 16 \cdot 10^{-3} \text{ m}$.

External diameter: $D_{ext} = 18 \cdot 10^{-3} \text{ m}$.

Thickness = 10 m^{-3} .

Heat transfer internal area: $A_h = 0.0503 \text{ m}^2$.

Heat transfer external area: $A_c = 0.0565 \text{ m}^2$.

External tube:

Internal diameter: $D_{int} = 26 \cdot 10^{-3} \text{ m}$.

External diameter: $D_{ext} = 28 \cdot 10^{-3} \text{ m}$.

Thickness = 10^{-3} m .

Six temperature sensors ("J" type):

Three temperature sensors for measuring cold water temperature:

Cold water inlet.

Cold water mid-position.

Cold water outlet.

Three temperature sensors for measuring hot water temperature:

Hot water inlet.

Hot water mid-position.

Hot water outlet.

Easy connection to the Base Service Unit.

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

Computer Control Software:

PID Computer Control + Data Acquisition + Data Management Software for Concentric Tube Heat Exchanger (TITC).

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.

Analog and digital PID control.

PID menu and set point selection required in the whole work range.

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.

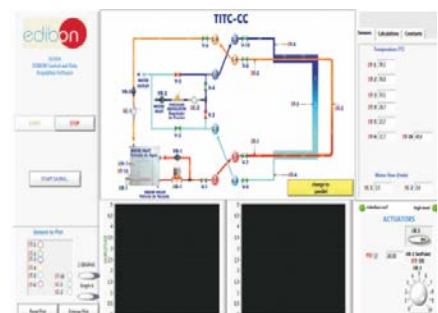
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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.



TITC



④ Heat Exchangers available to be used with the Base Service Unit:

④ **TITCA. Extended Concentric Tube Heat Exchanger:**

This Extended Concentric Tube Heat Exchanger allows the study of heat transfer between hot water flowing through an internal tube and cold water flowing in the ring area lying between the internal and the external tubes.

This exchanger allows measuring hot and cold water temperatures at different points of the exchanger.

“TITCA” is a more sophisticated unit than “TITC”, with four longer tube sections, giving four times the overall heat transfer area and three interim temperature measurement points (temperature sensors) in each fluid stream.

This exchanger has sufficient heat transfer area for demonstrating the typical counter-current flow conditions where the outlet of the heated stream is hotter than the outlet of the cooled stream.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

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

The exchanger is formed by two concentric copper tubes with hot water circulating through the interior tube and cold water circulating in the ring space.

This exchanger has four equal sections of 1000 mm each one, where heat transfer takes place.

Exchange length: $L=4 \times 1 = 4$ m.

Internal tube:

Internal diameter: $D_{int} = 16 \cdot 10^{-3}$ m.

External diameter: $D_{ext} = 18 \cdot 10^{-3}$ m.

Thickness = 10^{-3} m.

Heat transfer internal area: $A_h = 0.0503$ m².

Heat transfer external area: $A_c = 0.0565$ m².

External tube:

Internal diameter: $D_{int} = 26 \cdot 10^{-3}$ m.

External diameter: $D_{ext} = 28 \cdot 10^{-3}$ m.

Thickness = 10^{-3} m.

Ten temperature sensors (“J” type):

Five temperature sensors for measuring cold water temperature:

Cold water inlet.

Cold water at different interim positions (3).

Cold water outlet.

Five temperature sensors for measuring hot water temperature:

Hot water inlet.

Hot water at different interim positions (3).

Hot water outlet.

Easy connection to the Base Service Unit.

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

Computer Control Software:

PID Computer Control + Data Acquisition + Data Management Software for Extended Concentric Tube Heat Exchanger (TITCA).

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.

Analog and digital PID control.

PID menu and set point selection required in the whole work range.

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.

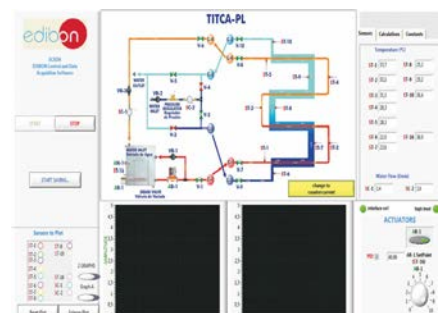
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Open software, allowing the teacher to modify texts, instructions. Teacher’s and student’s passwords to facilitate the teacher’s control on the student, and allowing the access to different work levels.

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TITCA



④ **Heat Exchangers available to be used with the Base Service Unit:**

④ **TIPL. Plate Heat Exchanger:**

This Plate Heat Exchanger allows the study of heat transfer between hot and cold water through alternate channels formed between parallel plates.

The exchanger allows measuring cold and hot temperatures at the inlet and outlet of the exchanger.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

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

Formed by corrugated stainless steel plates. It can be dismantled to observe its structure.

Four ports or connections of hot and cold water input and output.

Maximum flow: 12m³/h.

Maximum work pressure: 10 bar.

Maximum work temperature: 100 °C.

Minimum work temperature: 0 °C.

Maximum number of plates: 20.

Internal circuit capacity: 0.176 l.

External circuit capacity: 0.22 l.

Area: 0.32 m².

Four temperature sensors ("J" type):

Two temperature sensors for measuring cold water temperature (inlet and outlet).

Two temperature sensors for measuring hot water temperature (inlet and outlet).

Easy connection to the Base Service Unit.

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

Computer Control Software:

PID Computer Control+Data Acquisition+Data Management Software for Plate Heat Exchanger (TIPL).

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.

Analog and digital PID control.

PID menu and set point selection required in the whole work range.

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.

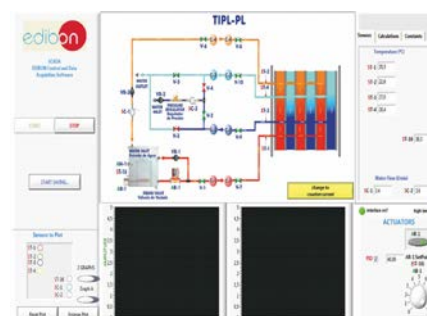
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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.

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TIPL



④ **Heat Exchangers** available to be used with the Base Service Unit:

④ **TIPLA. Extended Plate Heat Exchanger:**

This Extended Plate Heat Exchanger allows the study of heat transfer between hot and cold water through alternate channels formed between parallel plates.

The exchanger allows measuring cold and hot temperatures at different points of the exchanger.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

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

Formed by corrugated stainless steel plates. It can be dismantled to observe its structure.

Four ports or connections of hot and cold water input and output.

Maximum flow: 12 m³/h.

Maximum work pressure: 10 bar.

Maximum work temperature: 100 °C.

Minimum work temperature: 0 °C.

Maximum number of plates: 20.

Internal circuit capacity: 0.176 l.

External circuit capacity: 0.22 l.

Area: 0.32 m².

Ten temperature sensors ("J" type):

Five temperature sensors for measuring cold water temperature (inlet, outlet and interim positions).

Five temperature sensors for measuring hot water temperature (inlet, outlet and interim positions).

Easy connection to the Base Service Unit.

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

Computer Control Software:

PID Computer Control+Data Acquisition+Data Management Software for Extended Plate Heat Exchanger (TIPLA).

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.

Analog and digital PID control.

PID menu and set point selection required in the whole work range.

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.

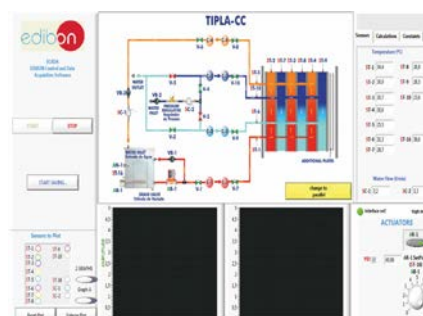
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TIPLA



④ **Heat Exchangers available to be used with the Base Service Unit:**

④③ **TICT. Shell & Tube Heat Exchanger:**

It consists on a group of tubes inside the heat exchanger. The hot water flows through the internal tubes and the cooling water circulates through the space between the internal tubes and the shell.

There are traverse baffles placed in the shell to guide the cold water to maximize the heat transfer.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

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

Formed by tubes of stainless steel with hot water circulating in the interior.

Four segmented baffles located transversaly in the shell.

Exchange length of the shell and each tube: $L = 0.5 \text{ m}$.

Internal tube (21 tubes):

Internal diameter: $D_{int} = 8 \cdot 10^{-3} \text{ m}$.

External diameter: $D_{ext} = 10 \cdot 10^{-3} \text{ m}$.

Thickness = 10^{-3} m .

Internal heat transfer area: $A_h = 0.0126 \text{ m}^2$.

External heat transfer area : $A_c = 0.0157 \text{ m}^2$.

Shell:

Internal diameter: $D_{int,c} = 0.148 \text{ m}$.

External diameter: $D_{ext,c} = 0.160 \text{ m}$.

Thickness = $6 \cdot 10^{-3} \text{ m}$.

Seven temperature sensors ("J" type), for measuring cold and hot water temperatures at different points of the exchanger.

Easy connection to the Base Service Unit.

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

Computer Control Software:

PID Computer Control+Data Acquisition+Data Management Software for Shell & Tube Heat Exchanger (TICT).

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.

Analog and digital PID control.

PID menu and set point selection required in the whole work range.

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Sampling velocity up to 250 KS/s (kilo samples per second).

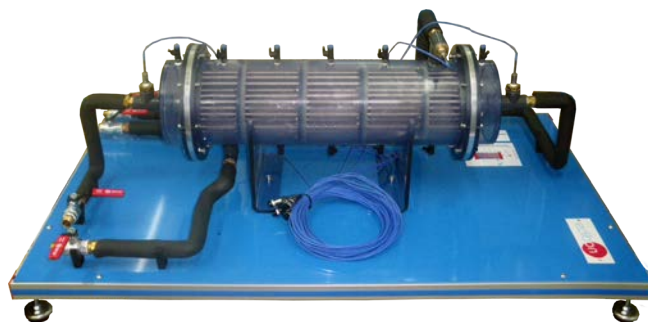
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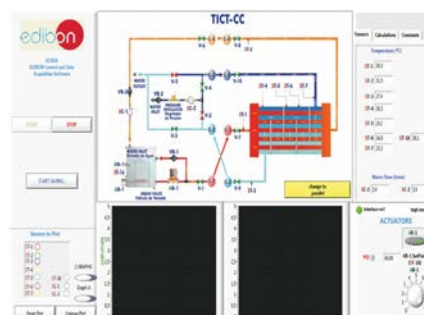
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TICT



④ **Heat Exchangers available to be used with the Base Service Unit:**

④ **TIVE. Jacketed Vessel Heat Exchanger:**

This Jacketed Vessel Heat Exchanger allows the study of heat transfer between hot water flowing through a jacket and the cold water contained in a vessel.

It can work in continuous supply or in a batch process (heating of a constant mass of water contained in a vessel).

The exchanger allows measuring temperatures at the inlet and outlet of the exchanger in cold as well as in hot water.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

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

Constituted of a vessel.

Vessel total volume: 14 l.

Interior vessel volume: 7 l approx.

Jacket volume: 7 l approx.

Overflow or a pipe allows the exit of the water in the vessel through its upper part to maintain a constant flow during the process with a continuous supply.

Jacket surrounds the vessel through where hot water flows.

Electric stirrer.

Five temperature sensors ("J" type):

Three temperature sensors for measuring cold water temperature.

Two temperature sensors for measuring hot water temperature.

Easy connection to the Base Service Unit.

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

Computer Control Software:

PID Computer Control+Data Acquisition+Data Management Software for Jacketed Vessel Heat Exchanger (TIVE).

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.

Analog and digital PID control.

PID menu and set point selection required in the whole work range.

Management, processing, comparison and storage of data.

Sampling velocity up to 250 KS/s (kilo samples per second).

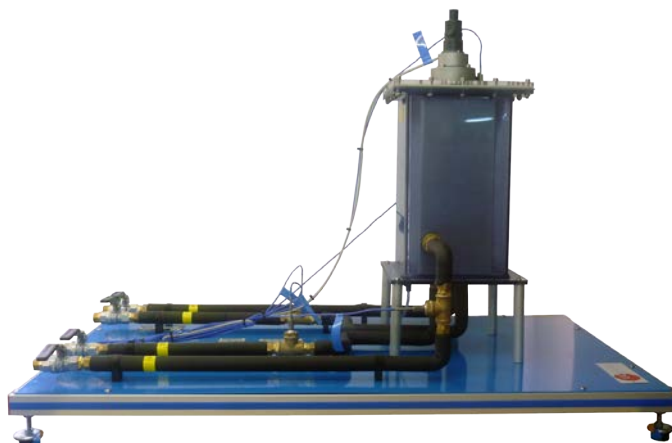
Calibration system for the sensors involved in the process.

It allows the registration of the alarms state and the graphic representation in real time.

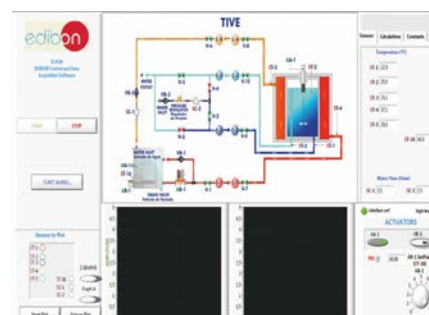
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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TIVE



④ **Heat Exchangers** available to be used with the Base Service Unit:

④ **TIVS. Coil Vessel Heat Exchanger:**

This heat exchanger allows the study of heat transfer between hot water flowing through a coil and cold water contained in the vessel.

It can work in continuous supply or in a batch process.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

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

Formed by a pvc-glass vessel, volume: 14 l.

Overflow or pvc-glass tube lets the output of water from the vessel in the upper part in order to maintain the flow constant for continue supply process.

Copper coil where the water circulates:

$$D_{int} = 4.35 \text{ mm.}$$

$$D_{ext} = 6.35 \text{ mm.}$$

Total length of the tube that forms the coil: 1.5 m.

Electric stirrer.

Five temperature sensors ("J" type):

Three temperature sensors for measuring cold water temperature.

Two temperature sensors for measuring hot water temperature.

Easy connection to the Base Service Unit.

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

Computer Control Software:

PID Computer Control+Data Acquisition+Data Management Software for Coil Vessel Heat Exchanger (TIVS).

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.

Analog and digital PID control.

PID menu and set point selection required in the whole work range.

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.

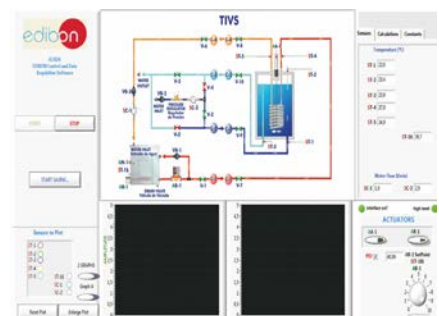
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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.



TIVS



④ **Heat Exchangers available to be used with the Base Service Unit:**

④ **TIFT. Turbulent Flow Heat Exchanger:**

This Turbulent Flow Heat Exchanger let us study the heat transfer between hot water that circulates through an internal tube and cold water that flows through the annular tube between the internal and the external tube. This exchanger let us measure cold water and hot water temperatures at different points of the exchanger.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

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

Formed by two copper concentric tubes with hot water circulating through the internal tube and cold water circulating through the annular space.

The exchanger has 4 equal sections of 500 mm each one, where the heat transfer takes place.

Exchange length: $L = 4 \times 0.5 = 2$ m.

Internal tube:

Internal diameter: $D_{int} = 8 \cdot 10^{-3}$ m.

External diameter: $D_{ext} = 10 \cdot 10^{-3}$ m.

Thickness = 10^{-3} m.

Internal heat transfer area: $A_h = 0.0377$ m².

External heat transfer area: $A_c = 0.0471$ m².

External tube:

Internal diameter: $D_{int,c} = 13 \cdot 10^{-3}$ m.

External diameter: $D_{ext,c} = 15 \cdot 10^{-3}$ m.

Thickness = 10^{-3} m.

Twelve temperature sensors: ("J" type):

Cold water temperature sensor at the exchanger inlet or outlet.

Hot water sensor at the exchanger inlet.

Cold water sensor between the first and second stretch of the exchanger.

Hot water sensor between the first and second stretch of the exchanger.

Cold water sensor between the second and third stretch of the exchanger.

Hot water sensor between the second and third stretch of the exchanger.

Cold water sensor between the third and fourth stretch of the exchanger.

Hot water sensor between the third and fourth stretch of the exchanger.

Cold water temperature sensor at the exchanger inlet or outlet.

Hot water sensor at the exchanger outlet.

Temperature sensor of the exterior surface of the interior tube at the exchanger inlet.

Temperature sensor of the exterior surface of the interior tube at the exchanger outlet.

Easy connection to the Base Service Unit.

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

Computer Control Software:

PID Computer Control+Data Acquisition+Data Management Software for Turbulent Flow Heat Exchanger (TIFT).

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.

Analog and digital PID control.

PID menu and set point selection required in the whole work range.

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.

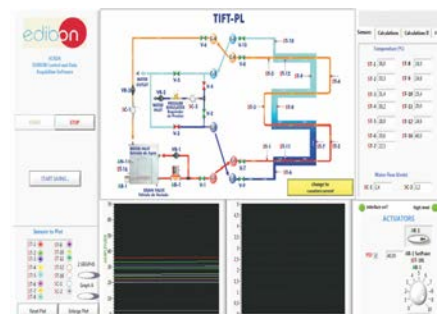
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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.



TIFT



④ **Heat Exchangers** available to be used with the Base Service Unit:

④ **TICF. Cross Flow Heat Exchanger:**

The cross flow heat exchanger is designed to study heat transfer between two fluids in cross flow configuration.

Hot water flow coming from the base unit enters and leaves a radiator perpendicular to an air current, which is generated by a fan.

The heat exchanger allows to measure water and air temperatures at the inlet and outlet of the exchanger.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

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

Poly methyl methacrylate (PMMA) rectangular duct of 800 x 200 x 200 mm.

Radiator located across the air duct.

The fins of the radiator are made of aluminum and have a heat transfer area of 35000 mm².

Axial fan with speed control from computer (PC). It provides a maximum air velocity of 3 m/s.

Four "J" type temperature sensors to measure input and output water and air temperatures.

Velocity sensor to measure air velocity, range: 0 – 4 m/s.

Two ball valves.

Easy connection to the Base Unit.

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

Computer Control Software:

PID Computer Control+Data Acquisition+Data Management Software for Cross Flow Heat Exchanger (TICF).

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.

Analog and digital PID control.

PID menu and set point selection required in the whole work range.

Management, processing, comparison and storage of data.

Sampling velocity up to 250 KS/s (kilo samples per second).

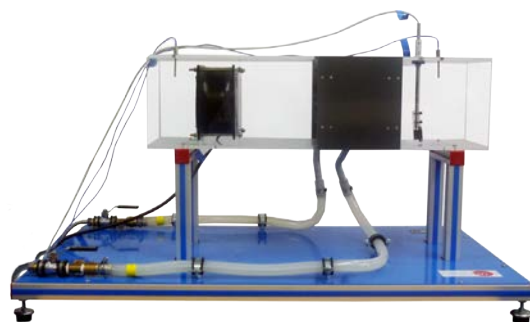
Calibration system for the sensors involved in the process.

It allows the registration of the alarms state and the graphic representation in real time.

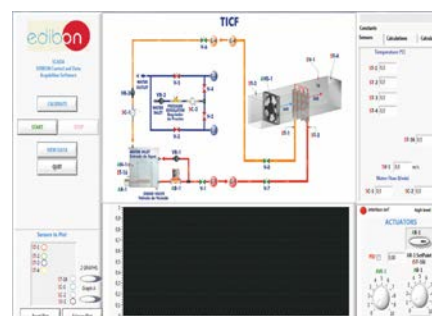
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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.



TICF



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.

Practices to be done with the Concentric Tube Heat Exchanger (TITC):

- 1.- Global energy balance in the heat exchanger and the study of losses.
- 2.- Exchanger effectiveness determination. NTU Method.
- 3.- Study of the heat transfer under counter-current and co-current flow conditions.
- 4.- Flow influence on the heat transfer. Reynolds number calculation.

Additional practical possibilities:

- 5.- Control system: Temperature sensors calibration.
- 6.- Control system: Flow sensors calibration.
- 7.- Study of the hysteresis of the flow sensor.

Practices to be done with the Extended Concentric Tube Heat Exchanger (TITCA):

- 8.- Global energy balance in the heat exchanger and the study of losses.
- 9.- Exchanger effectiveness determination. NTU Method.
- 10.- Study of the heat transfer under counter-current and co-current flow conditions.
- 11.- Flow influence on the heat transfer. Reynolds number calculation.

Additional practical possibilities:

- 12.- Control system: Temperature sensors calibration.
- 13.- Control system: Flow sensors calibration.
- 14.- Study of the hysteresis of the flow sensor.

Practices to be done with the Plate Heat Exchanger (TIPL):

- 15.- Global energy balance in the heat exchanger and the study of losses.
- 16.- Exchanger effectiveness determination. NTU Method.
- 17.- Study of the heat transfer under counter-current and co-current flow conditions.
- 18.- Flow influence on the heat transfer. Reynolds number calculation.

Additional practical possibilities:

- 19.- Control system: Temperature sensors calibration.
- 20.- Control system: Flow sensors calibration.
- 21.- Study of the hysteresis of the flow sensor.

Practices to be done with the Extended Plate Heat Exchanger (TIPLA):

- 22.- Global energy balance in the heat exchanger and the study of losses.
- 23.- Exchanger effectiveness determination. NTU Method.
- 24.- Study of the heat transfer under counter-current and co-current flow conditions.
- 25.- Flow influence on the heat transfer. Reynolds number calculation.

Additional practical possibilities:

- 26.- Control system: Temperature sensors calibration.
- 27.- Control system: Flow sensors calibration.
- 28.- Study of the hysteresis of the flow sensor.

Practices to be done with the Shell & Tube Heat Exchanger (TICT):

- 29.- Global energy balance in the heat exchanger and the study of losses.
- 30.- Exchanger effectiveness determination. NTU Method.
- 31.- Study of the heat transfer under counter-current and co-current flow conditions.
- 32.- Flow influence on the heat transfer. Reynolds number calculation.

Additional practical possibilities:

- 33.- Control system: Temperature sensors calibration.
- 34.- Control system: Flow sensors calibration.
- 35.- Study of the hysteresis of the flow sensor.

Practices to be done with the Jacketed Vessel Heat Exchanger (TIVE):

- 36.- Global balance of energy in the heat exchanger and losses study.
- 37.- Determination of the exchanger effectiveness. NTU Method.
- 38.- Influence of the flow on the heat transfer. Calculation of the number of Reynolds.

- 39.- Influence of the vessel stirring on the heat transfer when operating in batches.
- 40.- Influence of the vessel's water volume on the heat transfer when operating in batches.

Additional practical possibilities:

- 41.- Control system: Temperature sensors calibration.
- 42.- Control system: Flow sensors calibration.
- 43.- Study of the hysteresis of the flow sensor.

Practices to be done with the Coil Vessel Heat Exchanger (TIVS):

- 44.- Global balance of energy in the heat exchanger and the study of losses.
- 45.- Determination of the exchanger effectiveness. NTU Method.
- 46.- Influence of the flow on the heating transfer. Calculation of Reynolds number.
- 47.- Influence of the stirring vessel on the heat transfer with operation in batches.
- 48.- Influence of the water volume in the vessel on the heat transfer with operation in batches.

Additional practical possibilities:

- 49.- Control System: Temperature sensors calibration.
- 50.- Control System: Flow sensors calibration.
- 51.- Study of the hysteresis of the flow sensor.

Practices to be done with the Turbulent Flow Heat Exchanger (TIFT):

- 52.- Global energy balance in the heat exchanger and loss study.
- 53.- Determination of the exchanger effectiveness. NTU Method.
- 54.- Study of the heat transfer in counter-current and co-current flow conditions.
- 55.- Flow influence on heat transfer. Reynolds number calculation.
- 56.- Obtaining of the correlation that relates Nusselt number with Reynolds number and Prandtl number.
- 57.- Obtaining of the heat transfer coefficients by convection.

Additional practical possibilities:

- 58.- Control system: Temperature sensors calibration.
- 59.- Control system: Flow sensors calibration.
- 60.- Study of the hysteresis in the flow sensors.

Practices to be done with the Cross Flow Heat Exchanger (TICF):

- 61.- Introduction to the concept of psychometric properties.
- 62.- Effect of temperature differential on the heat transfer coefficient.
- 63.- Familiarization with cross flow heat exchanger.
- 64.- Overall energy balance in the heat exchanger and study of losses.
- 65.- Determination of the exchanger effectiveness (NTU method).
- 66.- Influence of air and water flow on the heat transfer. Reynolds number calculation.

Additional practical possibilities:

- 67.- Control system: Temperature sensors calibration.
- 68.- Control system: Flow sensors calibration.
- 69.- Study of the hysteresis in the flow sensors.

Other possibilities to be done with this System:

- 70.- Many students view results simultaneously.
To view all results in real time in the classroom by means of a projector or an electronic whiteboard.
 - 71.- 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.
 - 72.- The Computer Control System with SCADA and PID Control allow a real industrial simulation.
 - 73.- This unit is totally safe as uses mechanical, electrical and electronic, and software safety devices.
 - 74.- This unit can be used for doing applied research.
 - 75.- This unit can be used for giving training courses to Industries even to other Technical Education Institutions.
 - 76.- Control of the unit process through the control interface box without the computer.
 - 77.- Visualization of all the sensors values used in the 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, 220 V/50 Hz or 110 V/60 Hz.
- Water supply (0 to 6 l/min approx) and drain.
- Computer.

DIMENSIONS AND WEIGHTS

TICC:

TIUS. Base Service Unit:

- Dimensions: 1100 x 630 x 500 mm approx.
(43.30 x 24.80 x 19.68 inches approx.)
- Weight: 50 Kg approx.
(110.2 pounds approx.)

TITC. Unit:

- Dimensions: 1100 x 630 x 320 mm approx.
(43.30 x 24.80 x 12.60 inches approx.)
- Weight: 20 Kg approx.
(44.09 pounds approx.)

TITCA. Unit:

- Dimensions: 1500 x 700 x 320 mm approx.
(59.05 x 27.55 x 12.60 inches approx.)
- Weight: 30 Kg approx.
(66.13 pounds approx.)

TIPL. Unit:

- Dimensions: 1100 x 630 x 320 mm approx.
(43.30 x 24.80 x 12.60 inches approx.)
- Weight: 20 Kg approx.
(44.09 pounds approx.)

TIPLA. Unit:

- Dimensions: 1200 x 700 x 320 mm approx.
(47.24 x 27.55 x 12.60 inches approx.)
- Weight: 25 Kg approx.
(55.11 pounds approx.)

TICT. Unit:

- Dimensions: 1100 x 630 x 400 mm approx.
(43.30 x 24.80 x 15.74 inches approx.)
- Weight: 30 Kg approx.
(66.13 pounds approx.)

TIVE. Unit:

- Dimensions: 1100 x 630 x 700 mm approx.
(43.30 x 24.80 x 27.55 inches approx.)
- Weight: 35 Kg approx.
(77.16 pounds approx.)

TIVS. Unit:

- Dimensions: 1100 x 630 x 700 mm approx.
(43.30 x 24.80 x 27.55 inches approx.)
- Weight: 30 Kg approx.
(66.13 pounds approx.)

TIFT. Unit:

- Dimensions: 1100 x 630 x 350 mm approx.
(43.30 x 24.80 x 13.78 inches approx.)
- Weight: 20 Kg approx.
(44.09 pounds approx.)

TICF. Unit:

- Dimensions: 1100 x 630 x 600 mm approx.
(43.30 x 24.80 x 22.62 inches approx.)
- Weight: 20 Kg approx.
(44.09 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.)

AVAILABLE VERSIONS


- TICC. Computer Controlled Heat Exchangers Training System.
Offered in this catalogue:
- TICB. Heat Exchangers Training System.
Offered in other catalogue:

SOFTWARE MAIN SCREENS

SCADA and PID Control Main screens

Concentric Tube Heat Exchanger (TTC) Main Screens

Working options: Counter-current (CC) and Co-current (PL).
Sensors:



SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

Sensors to Plot

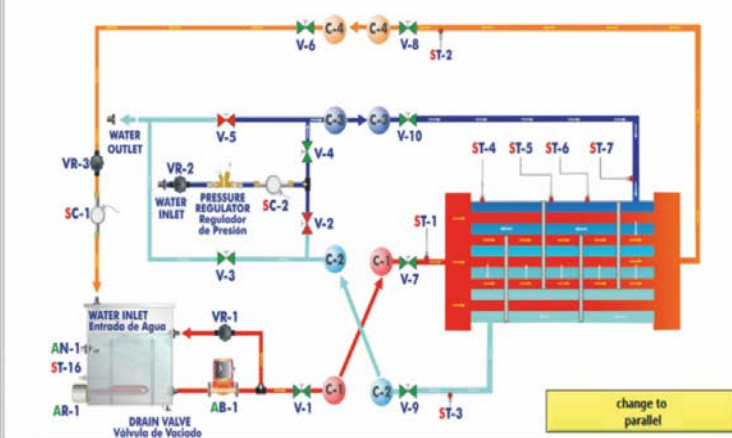
- ST-1
- ST-2
- ST-3
- ST-4
- ST-5
- ST-6
- ST-7
- ST-16
- SC-1
- SC-2

2 GRAPHS

Graph A

Reset Plot Enlarge Plot

TITC-CC



Sensors Calculations Constants

Temperature (°C)

ST-1	36,3
ST-2	31,5
ST-3	27,4
ST-4	26,5
ST-5	25,1
ST-6	24,9
ST-7	23,2
ST-16	39,1

Water Flow (l/min)

SC-1	3,4
SC-2	3,6

interface on? ● high level

ACTUATORS

PID 40,00


AR-1 SetPoint (ST-16)

AB-1

0 1 2 3 4 5 6 7 8 9 10

Note:
Sensors: ST=Temperature sensor. SC=Flow sensor.
Actuators: AB=Pump. AR=Heating element. AN= Level switch.

Calculations:



SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

Sensors to Plot

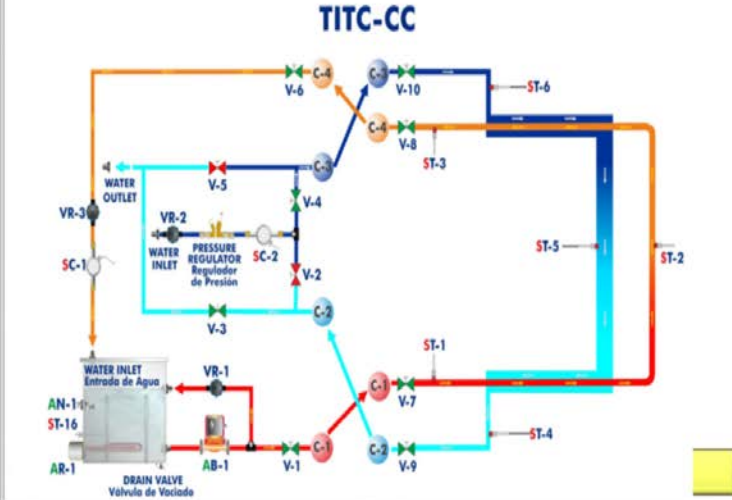
- ST-1
- ST-2
- ST-3
- ST-4
- ST-5
- ST-6
- ST-16
- SC-1
- SC-2

2 GRAPHS

Graph A

Reset Plot Enlarge Plot

TITC-CC



Sensors Calculations Constants

Heat transferred (Watts)

Qh	722
Qc	-494
Ql	227

Tlm 10,93 K Cr 1,04

U 1,25E+6 W/m² NTU 2,67E-1

Effectiveness (%)

Eff	14,84
Eff ntu	20,96

Reynolds Number

Redh	5886
Redc	5223

theoretical out (°C)

THot	36,1
TCOT	25,9

interface on? ● high level

ACTUATORS

PID 40,00


AR-1 SetPoint (ST-16)

AB-1

0 1 2 3 4 5 6 7 8 9 10

Concentric Tube Heat Exchanger (TITC) Main Screens (continuation)

Constants:



SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

Sensors to Plot

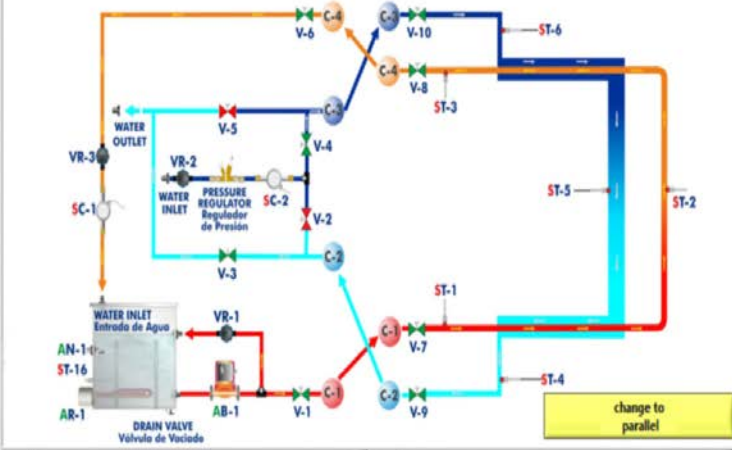
- ST-1
- ST-2
- ST-3
- ST-4
- ST-5
- ST-6
- ST-16
- SC-1
- SC-2

2 GRAPHS

Graph A

Reset Plot Enlarge Plot

TITC-CC



change to parallel

Sensors Calculations Constants

dimensions D(m); SectA(m²)

Dh	Dc	
0,016	0,0187	
Sect h	Sect c	Aexc
0,000201	0,000276	5,3E-5

fluid properties

Hot water		cold water	
Sp heat	J/KgK	Sp heat	J/KgK
4178		4178	
density	Kg/m3	density	Kg/m3
987,1		987,1	
viscosity	Kg/ms	viscosity	Kg/ms
7,69E-4		7,69E-4	
Khot	Khot	Kcold	Kcold
0,64		0,62	

interface on? high level

ACTUATORS

AR-1

PID 40,00 AR-1 SetPoint (ST-16)

AB-1

0 1 2 3 4 5 6 7 8 9 10

Extended Concentric Tube Heat Exchanger (TITCA) Main Screens

Working options: Counter-current (CC) and Co-current (PL).
Sensors:

Temperature (°C)

ST-1	33,7	ST-8	25,2
ST-2	32,1	ST-9	25,2
ST-3	31,1	ST-10	26,4
ST-4	29,3		
ST-5	28,3		
ST-6	22,0	ST-16	38,9
ST-7	23,6		

Water flow (l/min)

SC-1	3,4	SC-2	3,6
------	-----	------	-----

Note:
Sensors: ST=Temperature sensor. SC=Flow sensor.
Actuators: AB=Pump. AR=Heating element. AN= Level switch.

Calculations:

Heat transferred (Watts)

Qh	1232	Qc	-1083
Qi	149		

Tim 6,97 K Cr 1,04
U 8,19E+5 W/m² NTU 7,16E-1

Effectiveness (%)

Eff	37,25	Eff ntu	37,61
-----	-------	---------	-------

Reynolds Number


Redh	5857	Redc	5206
------	------	------	------

theoretical out (°C)

THot	33,7	TCot	27,4
------	------	------	------

Extended Concentric Tube Heat Exchanger (TITCA) Main Screens (continuation)

Constants:



SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

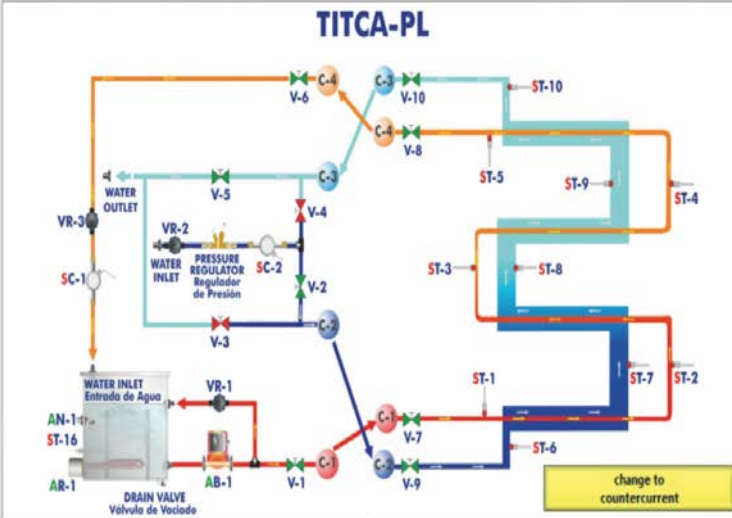
Sensors to Plot

ST-1	ST-9
ST-2	ST-10
ST-3	
ST-4	
ST-5	ST-16
ST-6	SC-1
ST-7	SC-2
ST-8	

2 GRAPHS
Graph A

Reset Plot Enlarge Plot

TITCA-PL



change to countercurrent

Sensors Calculations Constants

dimensions D(m); SectA(m²)

Dh	Dc	
0,016	0,0187	
Sect h	Sect c	Aexc
0,000201	0,000276	0,000216

fluid properties

Hot water		cold water	
Sp heat	Sp heat	Sp heat	Sp heat
4178	J/KgK	4178	J/KgK
density	density	density	density
987,1	Kg/m3	987,1	Kg/m3
viscosity	viscosity	viscosity	viscosity
7,69E-4	Kg/ms	7,69E-4	Kg/ms
Khot	Kcold	Khot	Kcold
0,64	Khot	0,62	Kcold


interface on? high level

ACTUATORS

AR-1

PID 40,00 AR-1 SetPoint (ST-16)

AB-1



Software Main Screens

Plate Heat Exchanger (TIPL) Main Screens Working options:
Counter-current (CC) and Co-current (PL)
Sensors:


Note:

Sensors: ST=Temperature sensor. SC=Flow sensor.
Actuators: AB=Pump. AR=Heating element. AN= Level switch.

Calculations:

Plate Heat Exchanger (TIPL) Main Screens (continuation)

Constants:



SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

Sensors to Plot

- ST-1
- ST-2
- ST-3
- ST-4
- ST-16
- SC-1
- SC-2

2 GRAPHS
Graph A

Reset Plot Enlarge Plot

TIPL-PL

change to
countercurrent

Sensors Calculations Constants

dimensions D(m); Sect.(Alm²)

Dh	Dc	
0,196	0,196	
Sect h	Sect c	Aexc
0,0302	0,0302	0,00192

fluid properties

Hot water		cold water	
Sp heat	Sp heat		
4178 J/KgK	4178 J/KgK		
density	density		
987,1 Kg/m3	987,1 Kg/m3		
viscosity	viscosity		
7,69E-4 Kg/ms	7,69E-4 Kg/ms		
Khot	Kcold		
0,64 Khot	0,62 Kcold		

interface on? high level

ACTUATORS

PID 40,00 AR-1 SetPoint (ST-16)

AB-1

Extended Plate Heat Exchanger (TIPLA) Main Screens

Working options: Counter-current (CC) and Co-current (PL).
Sensors:

Temperature (°C)

ST-1	34,4	ST-8	26,8
ST-2	30,9	ST-9	26,5
ST-3	30,7	ST-10	23,6
ST-4	26,6		
ST-5	25,5		
ST-6	31,3	ST-16	39,6
ST-7	28,7		

Water Flow (l/min)

SC-1	3,2	SC-2	3,3
------	-----	------	-----

Note:
Sensors: ST=Temperature sensor. SC=Flow sensor.
Actuators: AB=Pump. AR=Heating element. AN= Level switch

Calculations:

Heat transferred (Watts)

Qh	1936	Qc	-1742
Qi	194		

Effectiveness (%)

Eff	72,06	Eff ntU	77,26
-----	-------	---------	-------

Reynolds Number


Redh	442	Redc	456
------	-----	------	-----

theoretical out (°C)

THOt	34,3	TCOt	32,8
------	------	------	------

Extended Plate Heat Exchanger (TIPLA) Main Screens (continuation)

Constants:

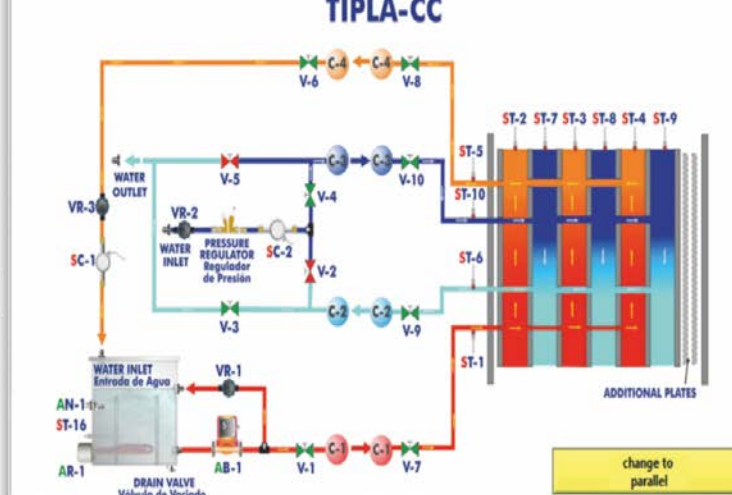


SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

TIPLA-CC



Sensors Calculations Constants

dimensions D(m); Sect.A(m²)

Dh	Dc	
0,196	0,196	
Sect h	Sect c	Aexc
0,0302	0,0302	0,00192

fluid properties

Hot water		cold water	
Sp heat	J/KgK	Sp heat	J/Kg
4178		4178	
density	Kg/m ³	density	Kg/m
987,1		987,1	
viscosity	Kg/ms	viscosity	Kg/m
7,69E-4		7,69E-4	
Khot	Khot	Kcold	Kcol
0,64		0,62	

Sensors to Plot

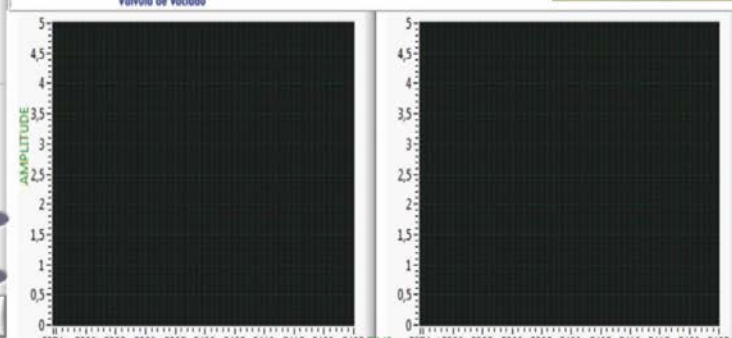
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ST-2	ST-10	<input type="checkbox"/>	<input type="checkbox"/>
ST-3		<input type="checkbox"/>	
ST-4		<input type="checkbox"/>	
ST-5	ST-16	<input type="checkbox"/>	<input type="checkbox"/>
ST-6	SC-1	<input type="checkbox"/>	<input type="checkbox"/>
ST-7	SC-2	<input type="checkbox"/>	<input type="checkbox"/>
ST-8		<input type="checkbox"/>	

2 GRAPHS

Graph A

Reset Plot Enlarge Plot

AMPLITUDE




interface on? high level

ACTUATORS

AR-1

PID 40,00 AR-1 SetPoint (ST-16)

AB-1



Software Main Screens

Shell & Tube Heat Exchanger (TICT) Main Screens
 Working options: Counter-current (CC) and Co-current (PL).
 Sensors:

Temperature (°C)

ST-1	36,3
ST-2	31,5
ST-3	27,4
ST-4	26,5
ST-5	25,1
ST-6	24,9
ST-7	23,2
ST-16	39,1

Water Flow (l/min)

SC-1	3,4
SC-2	3,6

ACTUATORS

interface on? high level

PID 40,00 AR-1 SetPoint (ST-16)

AB-1

10

Note:
 Sensors: ST=Temperature sensor. SC=Flow sensor.
 Actuators: AB=Pump. AR=Heating element. AN= Level switch.

Calculations:

Heat transferred (Watts)

Qh	1121
Qc	-1082
Ql	38

Tlm 8,55 K Cr 1,05

U 3,98E+2 W/m² NTU 5,26E-1

Effectiveness (%)

Eff	33,23
Eff ntu	34,21

Reynolds Number


Redh	562
Redc	NaN

theoretical out (°C)

THot	36,2
TCot	28,1

Shell & Tube Heat Exchanger (TICT) Main Screens (continuation)

Constants:



SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

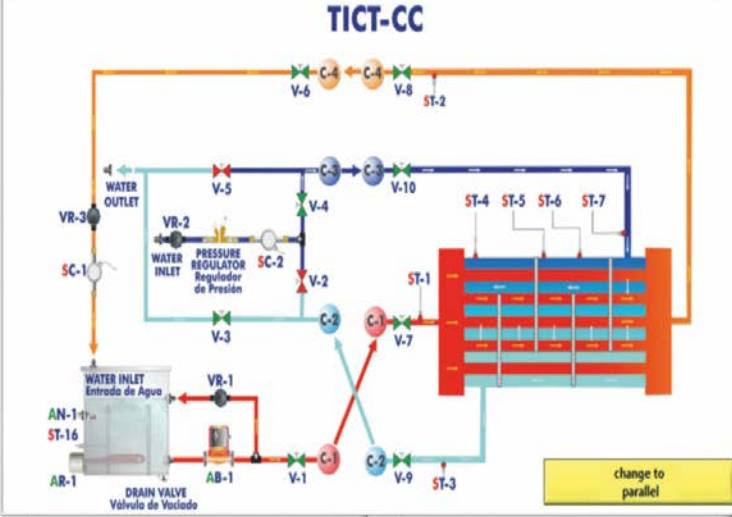
Sensors to Plot

- ST-1
- ST-2
- ST-3
- ST-4
- ST-5
- ST-6
- ST-7
- ST-16
- SC-1
- SC-2

2 GRAPHS
Graph A

Reset Plot Enlarge Plot

TICT-CC



change to parallel

Sensors Calculations Constants

dimensions D(m); Sect,Al(m²)

Dh	Dc	
0,008	NaN	
Sect h	Sect c	Aexc
5,027E-5	NaN	0,329867

fluid properties

Hot water		cold water	
Sp heat		Sp heat	
4178	J/KgK	4178	J/KgK
density		density	
987,1	Kg/m3	987,1	Kg/m3
viscosity		viscosity	
7,69E-4	Kg/ms	7,69E-4	Kg/ms
Khot		Kcold	
0,64	Khot	0,62	Kcold

interface on? high level

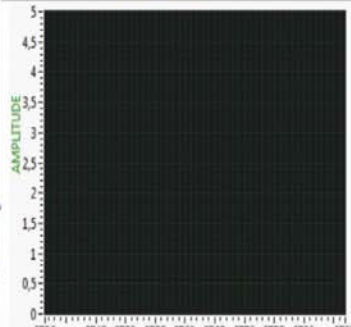
ACTUATORS

PID 40,00 AR-1 SetPoint (ST-16)

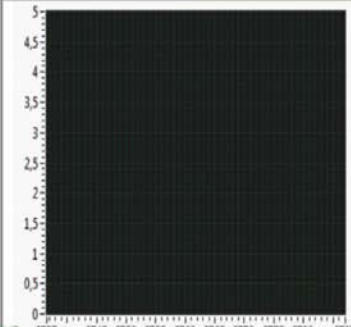
AB-1

0 1 2 3 4 5 6 7 8 9 10

AMPLITUDE



AMPLITUDE



Jacketed Vessel Heat Exchanger (TIVE) Main Screens

Sensors:

The interface displays the TIVE system schematic and sensor data. The schematic includes components like Water Inlet, Pressure Regulator, Water Outlet, and Jacketed Vessel with various sensors (ST-1 to ST-16) and actuators (AR-1, AB-1, AA-1). The left sidebar contains 'edibon' logo, 'SCADA EDIBON Control and Data Acquisition Software', and control buttons (START, STOP, START SAVING...). Below are 'Sensors to Plot' options for ST-1 through ST-16 and SC-1 through SC-2. The main area shows two empty graphs for amplitude. The right sidebar shows 'Sensors' data for Temperature (°C) and Water Flow (l/min).

Sensor	Temperature (°C)	Water Flow (l/min)
ST-1	22,9	SC-1 3,5
ST-2	25,0	SC-2 3,5
ST-3	25,1	
ST-4	37,1	
ST-5	35,0	
ST-16	40,0	

Note:

Sensors: ST=Temperature sensor. SC=Flow sensor.
 Actuators: AB=Pump. AR=Heating element. AA=Stirrer. AN= Level switch


Calculations:

The interface displays the TIVE system schematic and calculation data. The schematic is identical to the Sensors screen but includes a 'change to countercurrent' button. The left sidebar is the same. The main area shows two empty graphs. The right sidebar shows 'Calculations' data for Heat transferred (Watts), Tlm, U, Effectiveness (%), Reynolds Number, and theoretical out (°C).

Calculation	Value
Heat transferred (Watts)	Qh 518, Qc -518, Ql -1
Tlm	12,13 K, Cr 1,02
U	2,32E+2 W/m ² , NTU 1,76E-1
Effectiveness (%)	Eff 14,99, Eff ntu 14,84
Reynolds Number	Redh NaN, Redc NaN
theoretical out (°C)	THot 37,3, TCot 25,2

Jacketed Vessel Heat Exchanger (TIVE) Main Screens (continuation)

Constants:



SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

Sensors to Plot

- ST-1
- ST-2
- ST-3
- ST-4
- ST-5
- ST-16
- SC-1
- SC-2

2 GRAPHS

Graph A

Reset Plot Enlarge Plot

TIVE

Sensors Calculations Constants

dimensions D(m); Sect.A(m²)

Dh	Dc
NaN	NaN
Sect h	Sect c
NaN	NaN
Aexc	
0,1836	

fluid properties

Hot water		cold water	
Sp heat	J/KgK	Sp heat	J/KgK
4178		4178	
density	Kg/m3	density	Kg/m3
987,1		987,1	
viscosity	Kg/ms	viscosity	Kg/ms
7,69E-4		7,69E-4	
Khot	Khot	Kcold	Kcold
0,64		0,62	

interface on? high level

ACTUATORS

AA-1 AR-1

PID 40,00 AR-1 SetPoint (ST-16)

AB-1

3 4 5 6 7
2 1 -8
0 10

AMPLITUDE

AMPLITUDE

Coil Vessel Heat Exchanger (TIVS) Main Screens

Sensors:

Note:


Sensors: ST=Temperature sensor. SC=Flow sensor.

Actuators: AB=Pump. AR=Heating element. AA=Stirrer. AN= Level switch.

Calculations:

Coil Vessel Heat Exchanger (TIVS) Main Screens (continuation)

Constants:



SCADA
EDIBON Control and Data
Acquisition Software

START **STOP**

START SAVING...

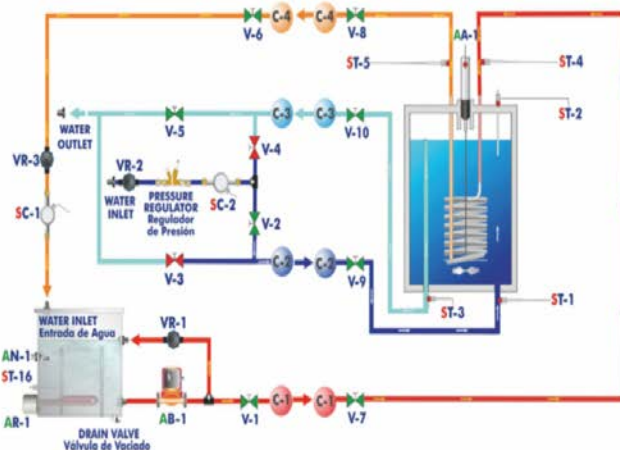
Sensors to Plot

- ST-1
- ST-2
- ST-3
- ST-4
- ST-5
- ST-16
- SC-1
- SC-2

2 GRAPHS
Graph A

Reset Plot Enlarge Plot

TIVS



Sensors Calculations Constants

dimensions D(m); Sect.A(m²)

Dh	Dc	
0,008	NaN	
Sect h	Sect c	Aexc
5,026E-5	NaN	0,0518

fluid properties

Hot water		cold water	
Sp heat	Sp heat		
4178 J/Kg	4178 J/Kg		
density	density		
987,1 Kg/m ³	987,1 Kg/m ³		
viscosity	viscosity		
7,69E-4 Kg/ms	7,69E-4 Kg/ms		
Khot	Kcold		
0,64 Khot	0,62 Kcold		

interface on? high level

ACTUATORS

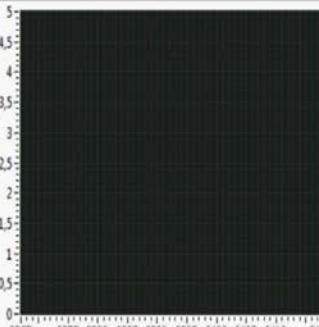
AA-1 AR-1

PID 40,00 AR-1 SetPoint (ST-16)

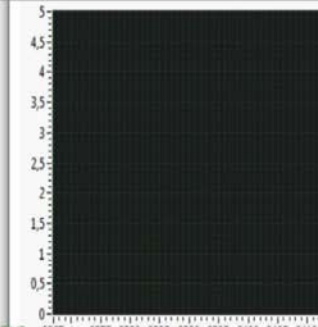
AB-1

3 4 5 6 7
2 1 -8
0 10

AMPLITUDE



AMPLITUDE



Turbulent Flow Heat Exchanger (TIFT) Main Screens
 Working options: Counter-current (CC) and Co-current (PL).
 Sensors:

Temperature (°C)

ST-1	36,0	ST-8	24,0
ST-2	33,3	ST-9	24,6
ST-3	31,4	ST-10	25,4
ST-4	30,2	ST-11	20,0
ST-5	28,9	ST-12	24,6
ST-6	20,6	ST-16	40,0
ST-7	22,5		

Water Flow (l/min)

SC-1	2,4	SC-2	2,2
------	-----	------	-----

Note:
 Sensors: ST=Temperature sensor. SC=Flow sensor.
 Actuators: AB=Pump. AR=Heating element. AN= Level switch.

Calculations:

Heat transferred (Watts)

Qh	1151	Qc	-732
Qi	419		

Effectiveness (%)


Eff	31,77	Eff ntu	41,31
-----	-------	---------	-------

theoretical out (°C)

THot	31,4	TCot	26,9
------	------	------	------

Turbulent Flow Heat Exchanger (TIFT) Main Screens (continuation)

Calculations:



SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

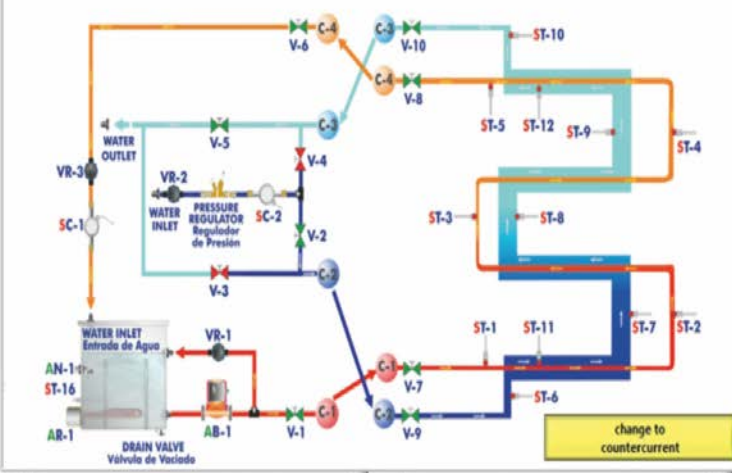
Sensors to Plot

- ST-1 ST-9
- ST-2 ST-10
- ST-3 ST-11
- ST-4 ST-12
- ST-5 ST-16
- ST-6 SC-1
- ST-7 SC-2
- ST-8

2 GRAPHS
Graph A

Reset Plot Enlarge Plot

TIFT-PL



Sensors Calculations Calculations II

logarithmic temperature (K)

T _{lmh}	T _{lmc}
4,43442	NaN

Prandtl Number

Prh	Prc
5,02013	5,18207

Nusselt Number

N _{uh}	N _{uc}
95,8012	NaN

interface on? high level

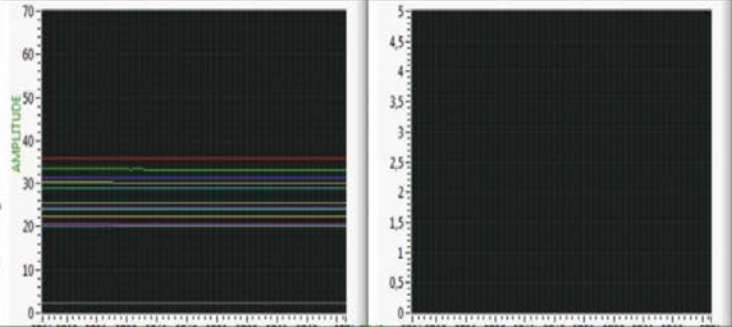
ACTUATORS

AR-1


PID 40,00 AR-1 SetPoint (ST-16)

AB-1

0 1 2 3 4 5 6 7 8 9 10



Constants:



SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

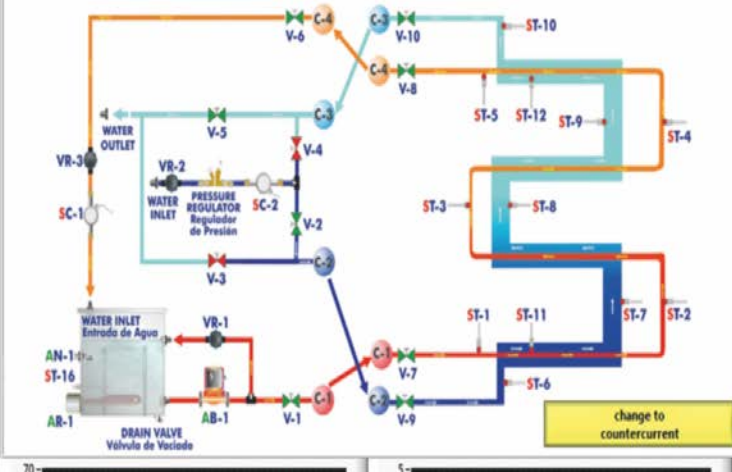
Sensors to Plot

- ST-1 ST-9
- ST-2 ST-10
- ST-3 ST-11
- ST-4 ST-12
- ST-5 ST-16
- ST-6 SC-1
- ST-7 SC-2
- ST-8

2 GRAPHS
Graph A

Reset Plot Enlarge Plot

TIFT-PL



Sensors Calculations Calculations II

Heat transferred (Watts)

Q _h	Q _c
1151	-732
Q _i 419	

T_{lm} 9,37 K Cr 0,92

U 2,89E+3 W/m² NTU 8,20E-1

Effectiveness (%)

Eff	Eff ntu
31,77	41,31

Reynolds Number

Re _{dh}	Re _{dc}
8079	7164

theoretical out (°C)

THOT	TCOT
31,4	26,9

interface on? high level

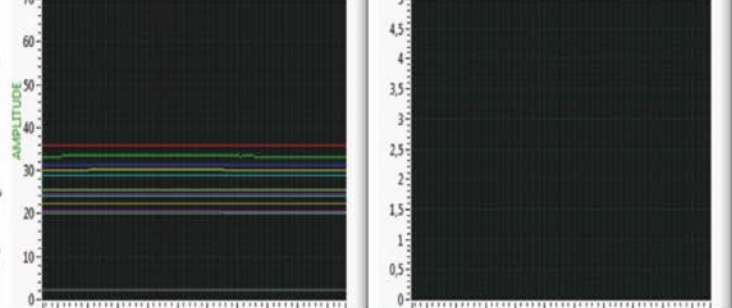
ACTUATORS

AR-1

PID 40,00 AR-1 SetPoint (ST-16)

AB-1

0 1 2 3 4 5 6 7 8 9 10



Cross Flow Heat Exchanger (TICF) Main Screens

Sensors:

The screenshot displays the SCADA interface for the TICF system. On the left, the Edibon logo and software name 'SCADA EDIBON Control and Data Acquisition Software' are visible, along with control buttons: CALIBRATE, START, STOP, VIEW DATA, and QUIT. Below these are 'Sensors to Plot' options for ST-1, ST-2, ST-3, ST-4, ST-16, SC-1, SC-2, and SV-1, with a '2 GRAPHS' indicator and 'Reset Plot' and 'Enlarge Plot' buttons.

The central part of the screen features a detailed process diagram of the TICF system. It shows a water loop with components like WATER INLET, WATER OUTLET, PRESSURE REGULATOR, and various valves (V-1 to V-6) and sensors (SC-1, SC-2, VR-1, VR-2, VR-3). A fan (AVE-1) is connected to the air side of the heat exchanger, with air flow indicated. Temperature sensors (ST-1 to ST-4) and a velocity sensor (SV-1) are also shown.

On the right side, there are 'Constants' and 'Calculations' tabs. Under 'Calculations', a table shows 'Temperature (°C)' for sensors ST-1, ST-2, ST-3, and ST-4, all with values of 0,0. Below this, 'Water Flow (l/min)' for SC-1 and SC-2 is also shown as 0,0. A 'high level' indicator is present.

At the bottom right, the 'ACTUATORS' section shows controls for AR-1 (Heating element) and AB-1 (Pump), including a PID control knob and a 'SetPoint (ST-16)' display.

Note:

Sensors: ST=Temperature sensor. SC=Flow sensor. SV=Velocity sensor.
 Actuators: AB=Pump. AR=Heating element. AVE=Fan. AN= Level switch.


Calculations:

This screenshot is similar to the one above but highlights the 'Calculations' section. The 'Calculations' tab is active, showing a table for 'Heat transferred (Watts)'. The table has columns for Power (P), Resistance (R), and Flow (F). The values shown are P: 0, R: 0, and F: 0,975.

The rest of the interface, including the process diagram, graph, and actuator controls, remains the same as in the previous screenshot.

Cross Flow Heat Exchanger (TICF) Main Screens (continuation)

Constants:



SCADA
EDIBON Control and Data
Acquisition Software

CALIBRATE

START STOP

VIEW DATA

QUIT

Sensors to Plot

- ST-1
- ST-2
- ST-3
- ST-4

2 GRAPHS

- ST-16 Graph A
- SC-1
- SC-2
- SV-1

Reset Plot Enlarge Plot

TICF

Sensors			Calculations			Calculation		
Constants								
dimensions D(m); SectA(m ²)								
Dh	Dc							
0,019	NaN							
Sect h	Sect c	Aexc						
0,0113715	NaN	0,035						
fluid properties								
Hot water			cold air					
Sp heat		Sp heat						
4178	J/KgK	1012		J/KgK				
density		density						
987,1	Kg/m3	1,2		Kg/m3				
viscosity		viscosity						
7,69E-4	Kg/ms	1,8E-5		Kg/ms				
Khot		Kcold						
0,64	Khot	0,02		Kcold				

interface on? ● high level ●

ACTUATORS

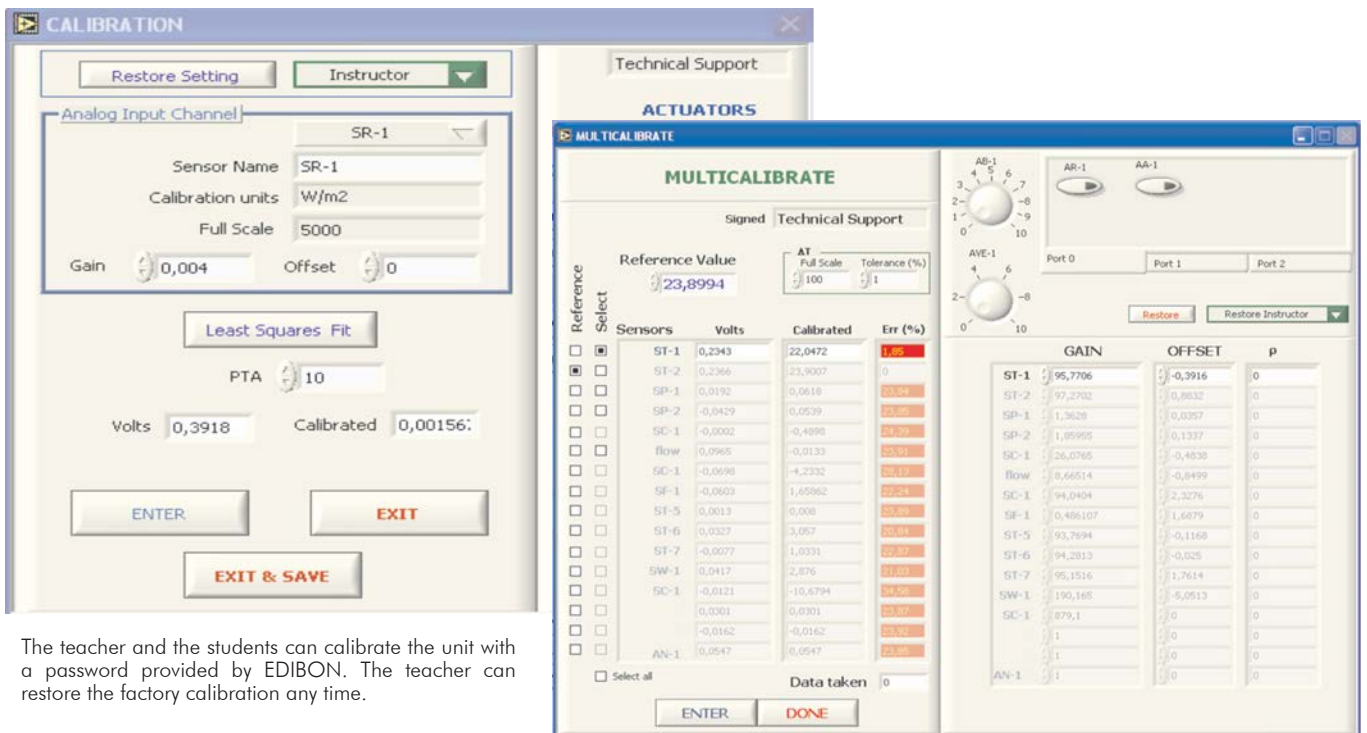
AR-1

PID 0,00 AR-1 SetPoint (ST-16)

AVE-1 AB-1

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.

COMPLETE TECHNICAL SPECIFICATIONS (for optional items)

Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 11.

All these items try to give more possibilities for:

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

a) Industrial configuration

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

-PLC-PI. PLC Module:

This unit is common for the modules type "TI" and can work with one or several modules.

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 μ 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.

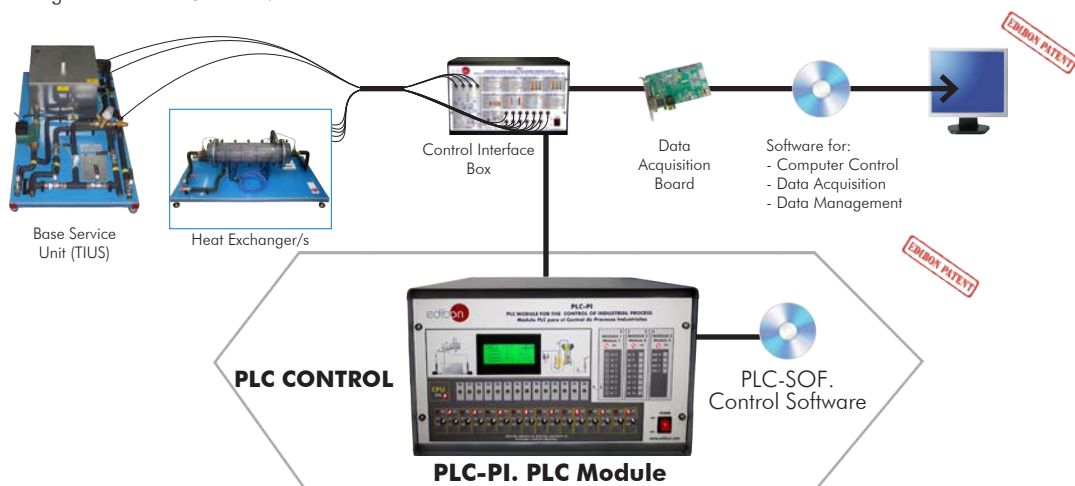
Communication RS232 wire to computer (PC).

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.).

-TICC/PLC-SOF. PLC Control Software:

Always included with PLC supply.

Each Heat Exchanger has its own Software.



Practices to be done with PLC-PI:

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

b) Technical and Vocational Education configuration

③ TICC/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

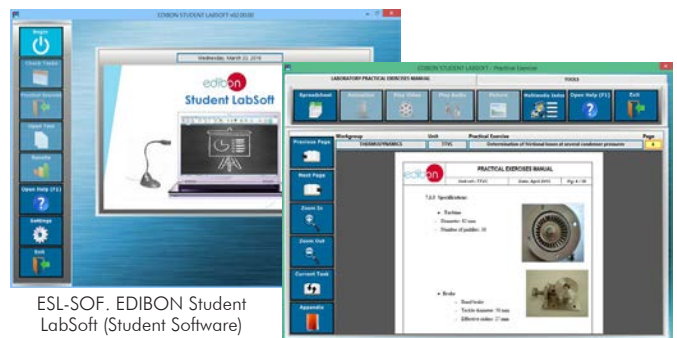
ECAL. EDIBON Calculations Program Package - Formula Editor Screen



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

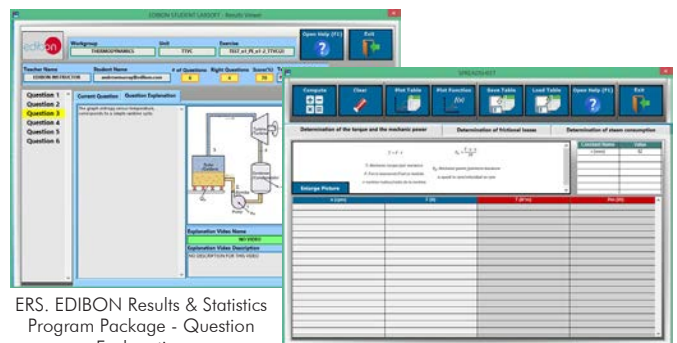
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

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

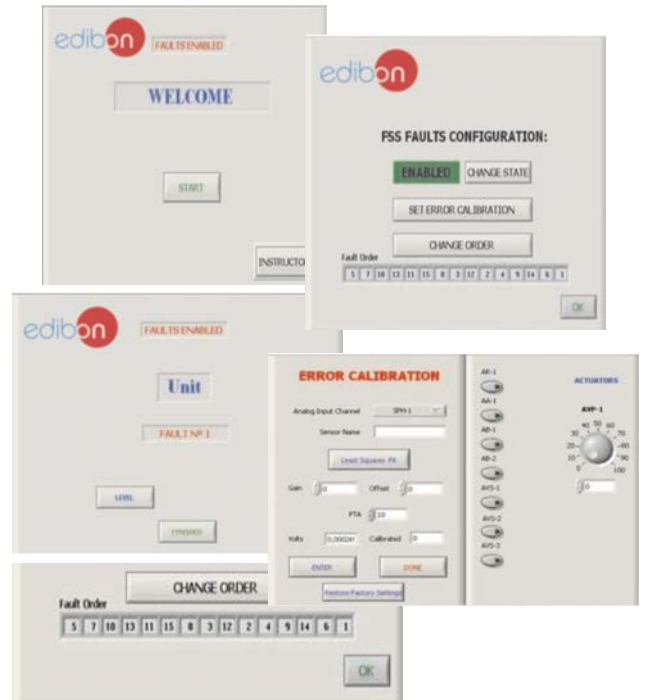
⑨ **TICC/FSS. Faults Simulation System.**

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 and PID Control 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 and PID Control, 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:

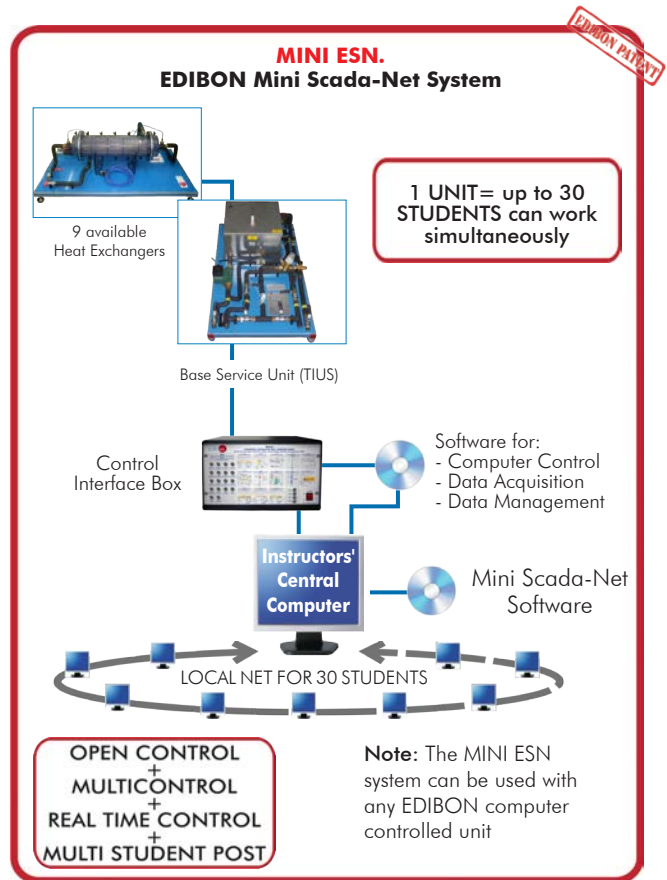
www.edibon.com/en/files/expansion/MINI-ESN/catalog

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



ORDER INFORMATION

Main items (always included in the supply)

Common items for Heat Exchangers type "TI":

- ① **TIUS. Base Service Unit** (Common for Heat Exchangers type "TI" and can work with one or several exchangers)
- ② **TICC/CIB. Control Interface Box.** (Common for Heat Exchangers type "TI" and can work with one or several exchangers).
- ③ **DAB. Data Acquisition Board.** ((Common for Heat Exchangers type "TI").
- ④ Heat Exchangers available to be used with the Base service unit:
 - ④.1 **TITC. Concentric Tube Heat Exchanger,** and/or
 - ④.2 **TITCA. Extended Concentric Tube Heat Exchanger,** and/or
 - ④.3 **TIPL. Plate Heat Exchanger,** and/or
 - ④.4 **TIPLA. Extended Plate Heat Exchanger,** and/or
 - ④.5 **TICT. Shell & Tube Heat Exchanger,** and/or
 - ④.6 **TIVE. Jacketed Vessel Heat Exchanger,** and/or
 - ④.7 **TIVS. Coil Vessel Heat Exchanger,** and/or
 - ④.8 **TIFT. Turbulent Flow Heat Exchanger,** and/or
 - ④.9 **TICF. Metal to Metal Heat Transfer Module.**
- ⑤ **Cables and Accessories,** for normal operation.
- ⑥ **Manuals.**

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.
 - TSTCC/PLC-SOF. PLC Control Software.

b) Technical and Vocational Education configuration

- ⑧ **TSTCC/ICAL. Interactive Computer Aided Instruction Software System.**
- ⑨ **TSTCC/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.**

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



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