

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.**
- **This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.**

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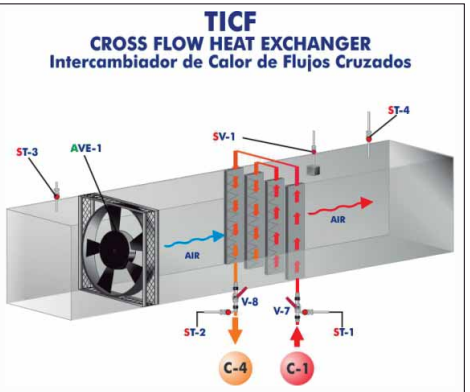
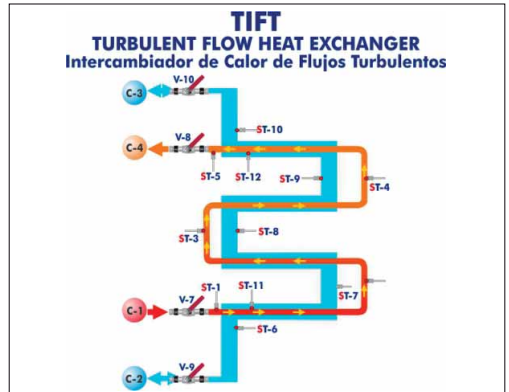
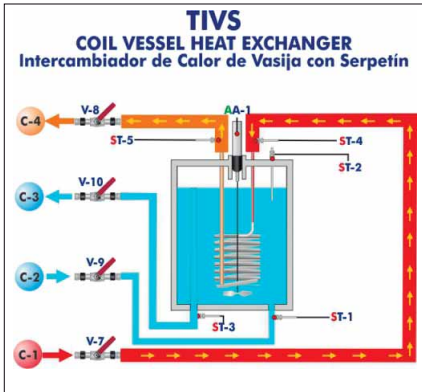
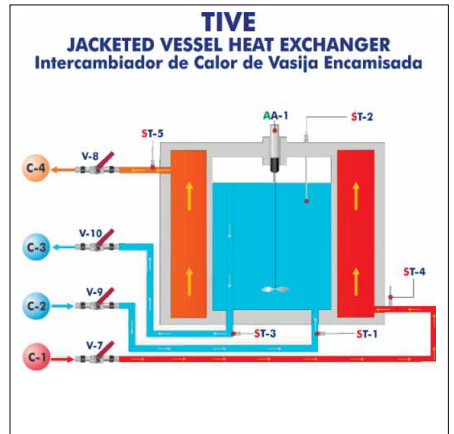
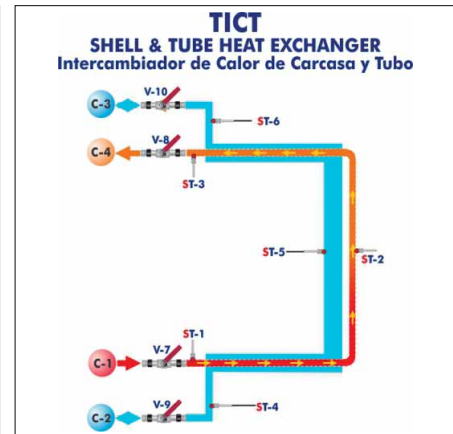
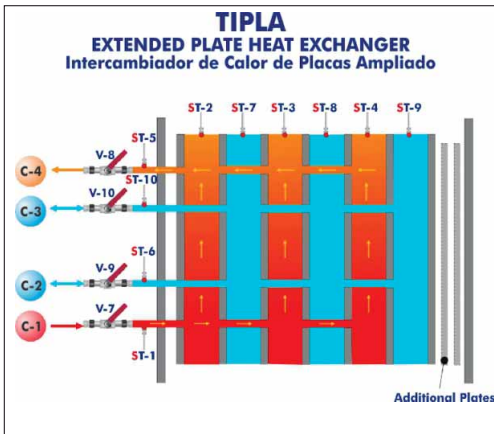
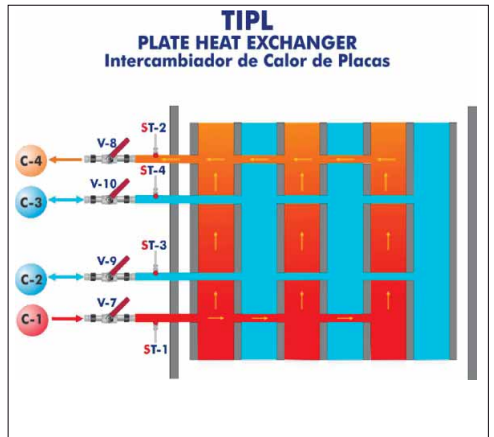
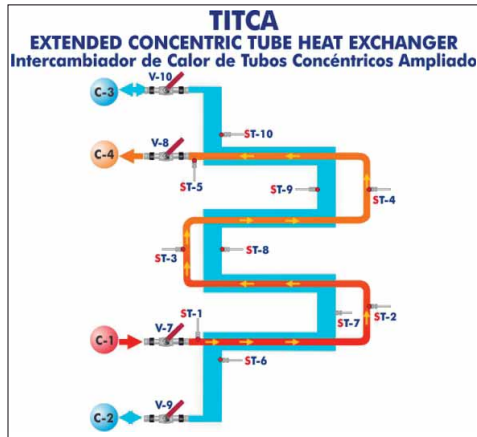
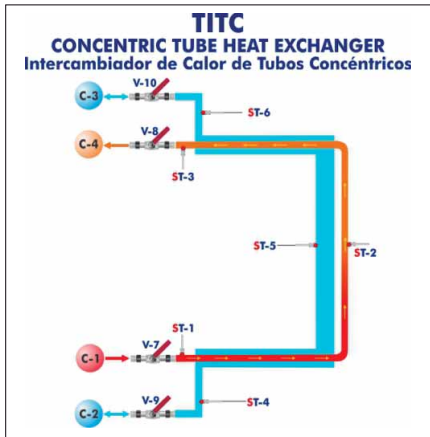
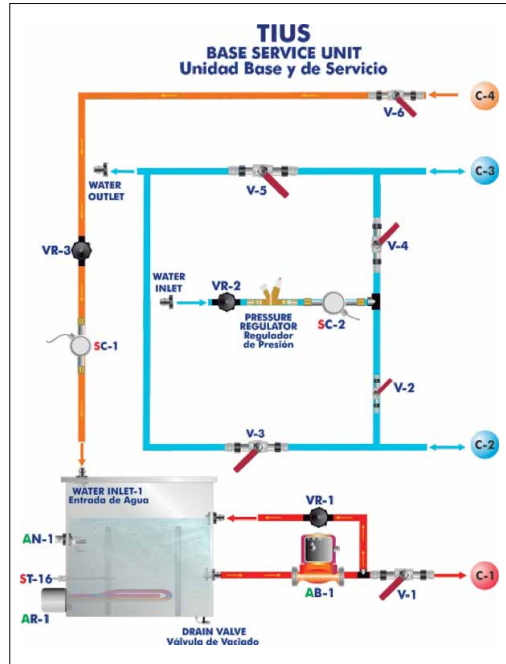
- Products
- Products range
- Units
- 9.-Thermodynamics & Thermotechnics

For more information about Key Features, click here:



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

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL



Note: ST=Temperature sensor. SC= Flow sensor. AR= Heating element. AB= Pump. AN=Level switch. V=Valve. VR=Regulation valve.
⊙= Connection between Base Service Unit and Exchanger. AA=Stirrer. SV=Speed sensor. AVE=Fan.

Common items for 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 structure and panel of painted steel.

Main metallic elements of stainless steel.

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

Stainless steel tank (30 l.), equipped with:

- Electric heating element (3000W) 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 (PC), range: 0 - 3 l./min.

2 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.

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

2 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.

4 Flexible tubes to connect with the different exchangers.

Cables and accessories, for normal operation.



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.

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 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, resistances, 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.

③ DAB. Data Acquisition Board:

This board is common for Heat Exchangers type "TI".

The Data Acquisition board is part of the SCADA system.

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

Analog input:

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

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

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

Analog output:

Number of channels=2. Resolution= 16 bits, 1 in 65536. Maximum output rate up to: 900 KS/s.

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

Digital Input/Output:

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

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



TICC/CIB



DAB

Continue...

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

④ 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 structure and panel of painted steel.

Main metallic elements of stainless steel.

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

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 2 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^{-3} m .

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 .

6 Temperature sensors ("J" type):

3 Temperature sensors for measuring cold water temperature:

Cold water inlet.

Cold water mid-position.

Cold water outlet.

3 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:

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.

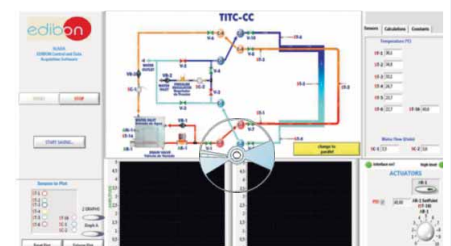
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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



Continue...

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

⊕ 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 structure and panel of painted steel.

Main metallic elements of stainless steel.

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

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 4 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: $A_{hi} = 0.0503$ m².

Heat transfer external area: $A_{hc} = 0.0565$ 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.

10 Temperature sensors ("J" type):

5 Temperature sensors for measuring cold water temperature:

Cold water inlet.

Cold water at different interim positions (3).

Cold water outlet.

5 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:

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.

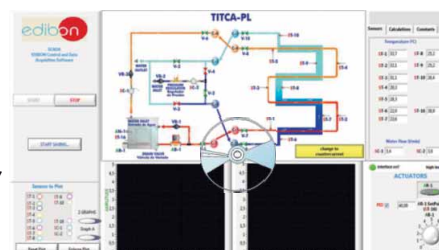
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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.



TITCA



Continue...

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 structure and panel of painted steel.

Main metallic elements of stainless steel.

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

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

4 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: 0.32m².

4 Temperature sensors ("J" type):

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

2 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:

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.

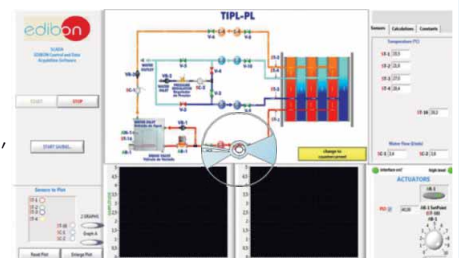
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Open software, allowing the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.

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TIPL



Continue...

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 structure and panel of painted steel.

Main metallic elements of stainless steel.

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

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

4 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: 0.32m².

10 Temperature sensors ("J" type):

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

5 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:

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.

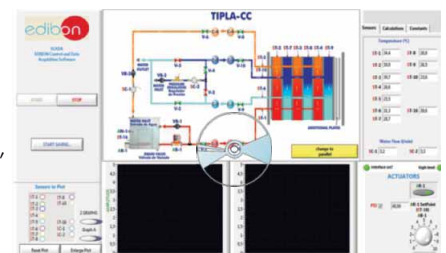
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TIPLA



Continue...

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

④.5 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 structure and panel of painted steel.

Main metallic elements of stainless steel.

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

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

4 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: $A_i = 0.0126\text{ m}^2$.

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

Shell:

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

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

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

7 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:

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.

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.

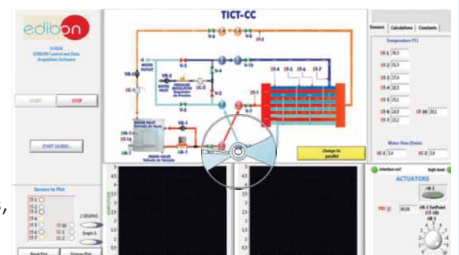
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TICT



Continue...

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 structure and panel of painted steel.

Main metallic elements of stainless steel.

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

Constituted of a vessel.

Vessel total volume: 14 l.

Interior vessel volume: 7 l. approx.

Jacket volume: 7 l. approx.

An 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.

A jacket surrounds the vessel through where hot water flows.

An electric stirrer.

5 Temperature sensors ("J" type):

3 Temperature sensors for measuring cold water temperature.

2 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:

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).

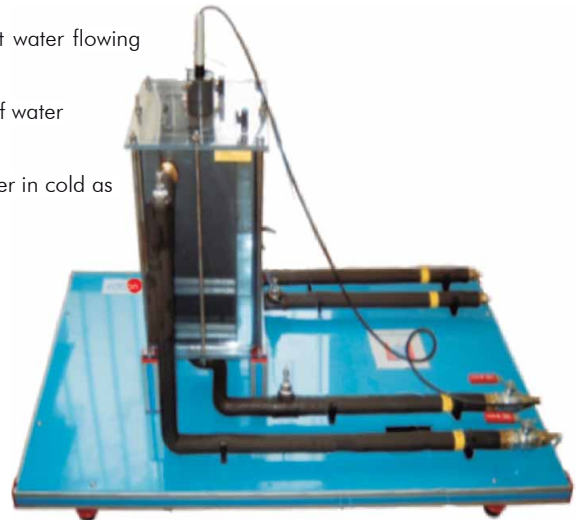
Calibration system for the sensors involved in the process.

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

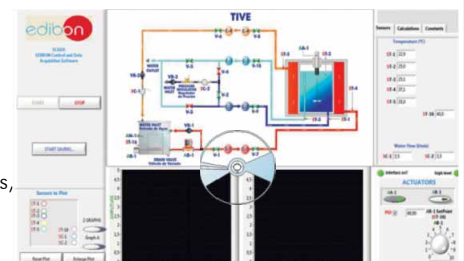
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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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TIVE



Continue...

④ **Heat Exchangers available to be used with the Base Service Unit:**④7 **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 structure and panel of painted steel.

Main metallic elements of stainless steel.

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

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

An 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.

A copper coil where the water circulates:

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

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

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

An electric stirrer.

5 Temperature sensors ("J" type):

3 Temperature sensors for measuring cold water temperature.

2 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:

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).

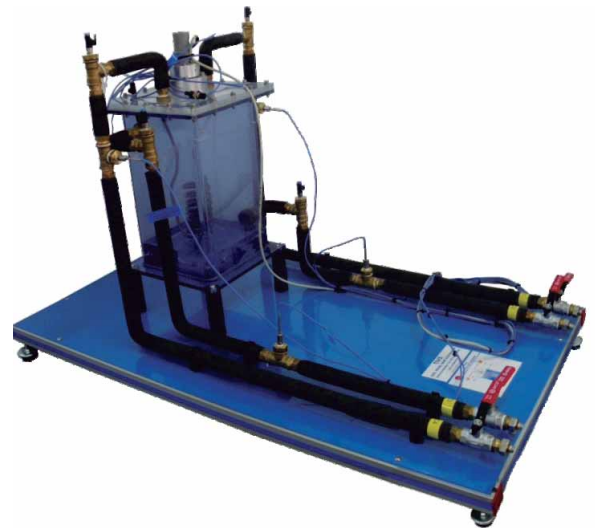
Calibration system for the sensors involved in the process.

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

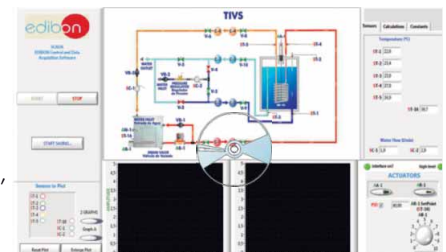
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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



Continue...

④ **Heat Exchangers available to be used with the Base Service Unit:****4.9 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 zone 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 structure and panel of painted steel.

Main metallic elements of stainless steel.

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

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: $L = 4 \times 0.5 = 2 \text{ m}$.

Internal tube:

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: $A_h = 0.0377 \text{ m}^2$.

External heat transfer area: $A_c = 0.0471 \text{ m}^2$.

External tube:

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

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

Thickness = 10^{-3} m .

12 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:

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.

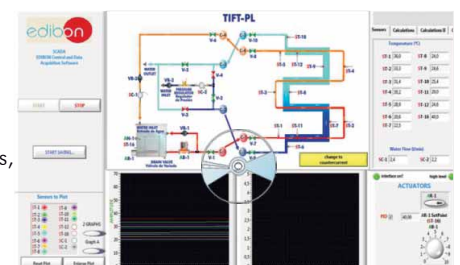
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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



Continue...

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

4.9 TICF. Cross Flow Heat Exchanger:

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

A 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 structure and panel of painted steel.

Main metallic elements made of stainless steel.

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

A 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.

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

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

2 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:

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).

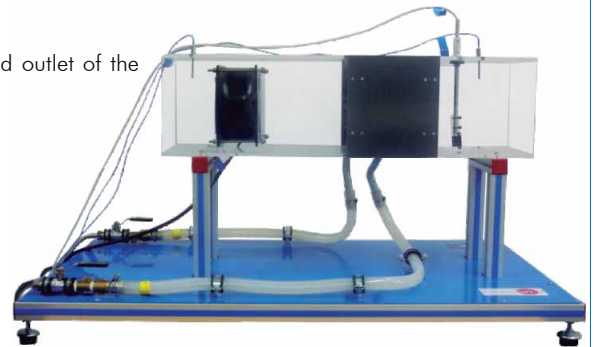
Calibration system for the sensors involved in the process.

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

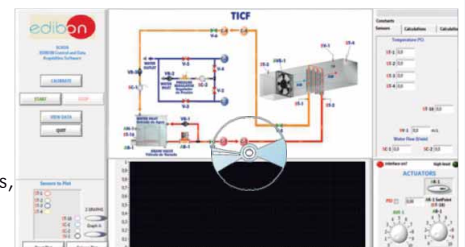
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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 system is supplied with 8 manuals for each Heat Exchanger: Required service, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

Some Practical Possibilities of the System:

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./50Hz or 110V./60 Hz.
- Water supply (0 to 6 l./min. approx).
- Drainage.
- Computer (PC).

DIMENSIONS & WEIGHTS

TIUS. Unit:	-Dimensions: 1100 x 630 x 500 mm. approx. (43.3 x 24.8 x 19.68 inches approx.). -Weight: 50 Kg. approx. (110.2 pounds approx.).
TITC. Unit:	-Dimensions: 1100 x 630 x 320 mm. approx. (43.3 x 24.8 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 12.6 inches approx.). -Weight: 30 Kg. approx. (66.13 pounds approx.).
TIPL. Unit:	-Dimensions: 1100 x 630 x 320 mm. approx. (43.3 x 24.8 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 12.6 inches approx.). -Weight: 25 Kg. approx. (55.11 pounds approx.).
TICT. Unit:	-Dimensions: 1100 x 630 x 400 mm. approx. (43.3 x 24.8 x 15.74 inches approx.). -Weight: 30 Kg. approx. (66.13 pounds approx.).
TIVE. Unit:	-Dimensions: 1100 x 630 x 700 mm. approx. (43.3 x 24.8 x 27.55 inches approx.). -Weight: 35 Kg. approx. (77.16 pounds approx.).
TIVS. Unit:	-Dimensions: 1100 x 630 x 700 mm. approx. (43.3 x 24.8 x 27.55 inches approx.). -Weight: 30 Kg. approx. (66.13 pounds approx.).
TIFT. Unit:	-Dimensions: 1100 x 630 x 350 mm. approx. (43.3 x 24.8 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 24.8 x 23.62 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

Offered in this catalogue:

-TICC. Computer Controlled Heat Exchangers Training System.

Offered in other catalogue:

-TICB. Heat Exchangers Training System.

SCADA and PID Control

Concentric Tube Heat Exchanger (TITC) Main Screens

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

Sensors:

The interface displays the TITC-CC process diagram with various components like valves (V-1 to V-10), pumps (AB-1), and heating elements (AR-1). The sensor data table is as follows:

Temperature (°C)	
ST-1	36,1
ST-2	34,8
ST-3	33,1
ST-4	24,7
ST-5	23,7
ST-6	22,7
ST-16	40,6

Water Flow (l/min)	
SC-1	3,5
SC-2	3,6

The interface also includes a 'Sensors to Plot' section with checkboxes for ST-1 through ST-6 and SC-1 through SC-2, and a 'change to parallel' button.

Note:

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

Calculations:

The interface shows the same process diagram as above. The 'Calculations' tab is active, displaying the following data:

Heat transferred (Watts)	
Qh	722
Qc	-494
Ql	227

Effectiveness (%)	
Eff	14,84
Eff ntu	20,96

Reynolds Number	
Redh	5886
Redc	5223


theoretical out (°C)	
THot	36,1
TCOt	25,9

The interface also includes the same 'Sensors to Plot' section and actuator controls as the previous screen.

Continue...

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

Constants:



SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

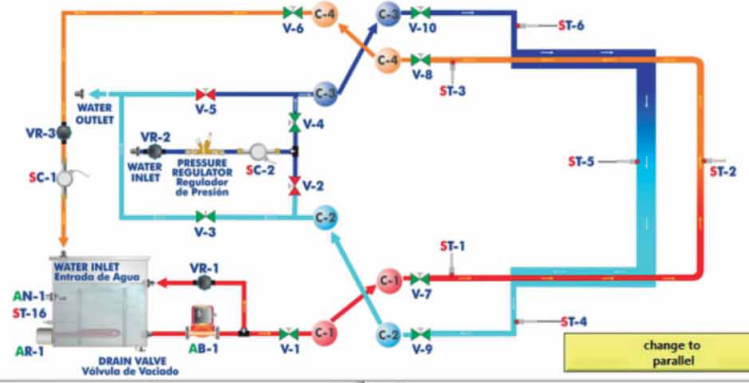
Sensors to Plot

- 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); Sect.A(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	Sp heat	Sp heat	Sp heat
4178	J/KgK	4178	J/KgK
density	density	density	density
987,1	Kg/m ³	987,1	Kg/m ³
viscosity	viscosity	viscosity	viscosity
7,69E-4	Kg/ms	7,69E-4	Kg/ms
Khot	Kcold	Khot	Kcold
0,64	0,62	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

Continue...

Extended Concentric Tube Heat Exchanger (TITCA) Main Screens

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

Sensors:

The screenshot displays the Edibon SCADA interface for the TITCA-PL system. On the left, there are control buttons for 'START', 'STOP', and 'START SAVING...'. The central part features a detailed schematic of the concentric tube heat exchanger with various components labeled: WATER INLET, WATER OUTLET, PRESSURE REGULATOR, DRAIN VALVE, and several sensors (ST-1 to ST-16) and actuators (AR-1, AB-1, SC-1, SC-2, V-1 to V-10, C-1 to C-4). Below the schematic are two empty graph plots with 'AMPLITUDE' on the y-axis (0 to 5) and time on the x-axis. On the right, the 'Sensors' panel is active, showing a table of temperature readings in degrees Celsius:

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

Below the temperature table, 'Water Flow (l/min)' is shown with values for SC-1 (3,4) and SC-2 (3,6). The 'ACTUATORS' panel shows 'AR-1 SetPoint (ST-16)' set to 40,00.

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

Calculations:

This screenshot shows the same Edibon SCADA interface as above, but with the 'Calculations' tab selected in the right-hand panel. The 'Calculations' panel displays various heat exchanger performance metrics:

Heat transferred (Watts)	
Qh	1232
Qc	-1083
Ql	149

Effectiveness (%)	
Eff	37,25
Eff ntu	37,61


Reynolds Number	
Redh	5857
Redc	5206

theoretical out (°C)	
THot	33,7
TCot	27,4

Other parameters shown include Tlm (6,97 K), U (8,19E+5 W/m²·K), Cr (1,04), and NTU (7,16E-1). The 'ACTUATORS' panel remains visible at the bottom right.

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

Constants:

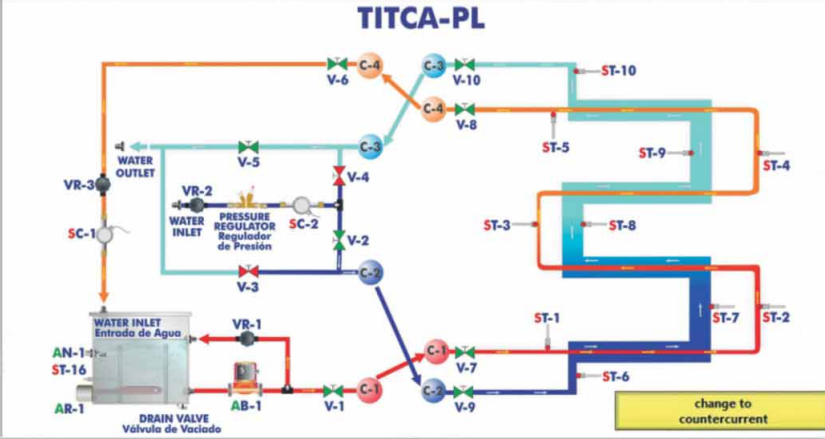


SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

TITCA-PL



change to
countercurrent

Sensors Calculations **Constants**

dimensions D(m); Sect,A(m²)

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

fluid properties

Hot water	cold water
Sp heat	Sp heat
4178 J/KgK	4178 J/KgK
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

AR-1

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

AB-1



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

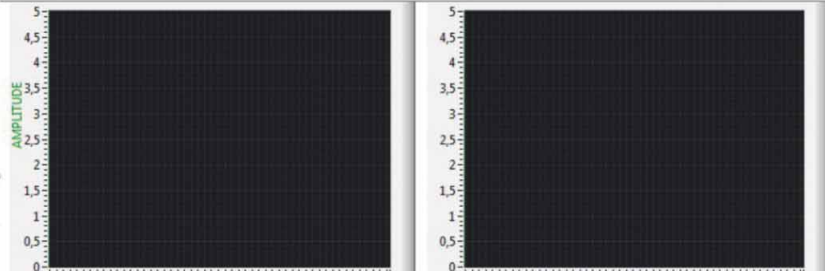


Plate Heat Exchanger (TIPL) Main Screens

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

Sensors:

ST-1	35,5
ST-2	21,6
ST-3	27,0
ST-4	28,4
ST-16	39,3

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:

Qh	1454
Qc	-1267
Ql	188

Eff	43,68
Eff ntu	42,26


Redh	446
Redc	458

THOT	34,5
TCOT	28,6

Continue...

Plate Heat Exchanger (TIPL) Main Screens (continuation)

Constants:

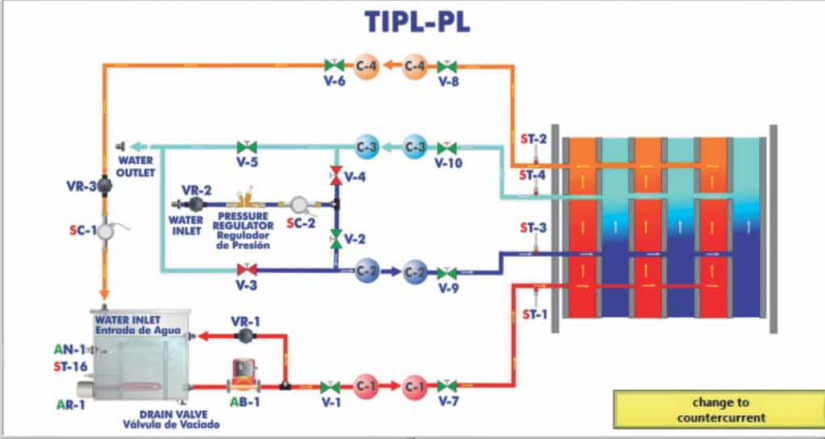


SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

TIPL-PL



change to
countercurrent

Sensors Calculations **Constants**

dimensions D(m); Sect.A(m²)

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

fluid properties

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


interface on? high level

ACTUATORS

AR-1

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

AB-1

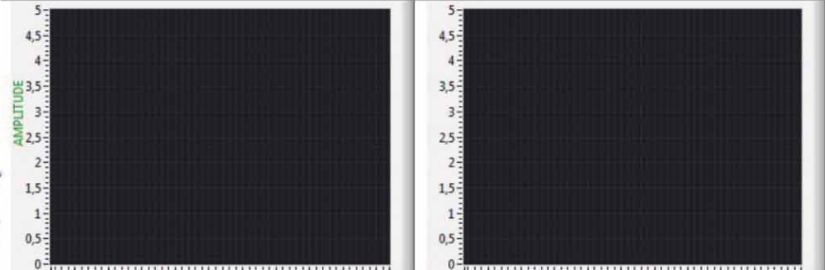


Sensors to Plot

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

2 GRAPHS Graph A

Reset Plot Enlarge Plot



AMPLITUDE

Continue...

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
Ql	194		

Tim 2,39 K Cr 1,03
 U 4,22E+5 W/Km² NTU 3,59E+0

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...

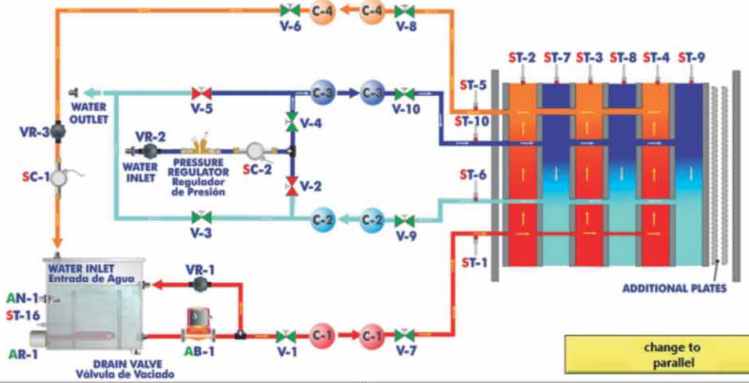
Sensors to Plot

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

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	Kcot
0,64		0,62	


interface on? high level


ACTUATORS

PID AR-1 SetPoint (ST-16) AB-1

40,00

0 1 2 3 4 5 6 7 8 9 10





Continue...

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

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
Qi	38

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...

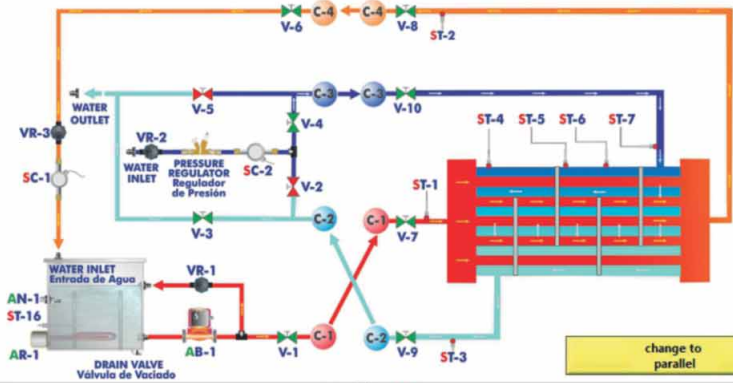
Sensors to Plot

- 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



Sensors Calculations **Constants**

dimensions D(m); Sect.A(m²)

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

fluid properties


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

interface on? high level

ACTUATORS

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

AB-1



Continue...

Jacketed Vessel Heat Exchanger (TIVE) Main Screens

Sensors:

Note:


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

Calculations:

Continue...

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

Constants:



SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

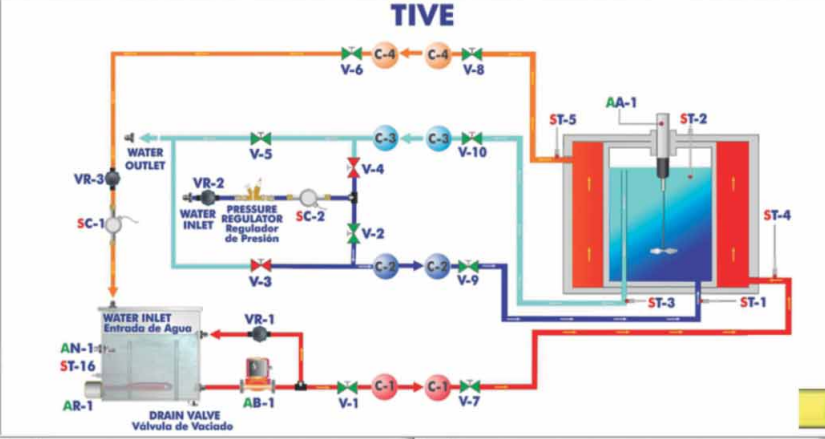
Sensors to Plot

- 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
Aecc 0,1836	

fluid properties

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


interface on? high level


ACTUATORS

AA-1 AR-1

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

0 1 2 3 4 5 6 7 8 9 10





Continue...

Coil Vessel Heat Exchanger (TIVS) Main Screens

Sensors:

The screenshot shows the 'Sensors' screen in the Edibon SCADA software. The central part of the screen displays a schematic diagram of the TIVS (Coil Vessel Heat Exchanger) system. The diagram includes components like Water Inlet, Water Outlet, Pressure Regulator, Drain Valve, and various sensors (ST-1 to ST-5, SC-1, SC-2, AN-1, AR-1, VR-1, VR-2, VR-3) and valves (V-1 to V-10). Below the diagram are two empty graph areas for plotting sensor data.

On the right side, there is a 'Sensors' panel with a 'Calculations' tab selected. It displays a table of Temperature (°C) for sensors ST-1 through ST-5, with values ranging from 22.6 to 39.9. Below this, it shows Water Flow (l/min) for SC-1 (1.9) and SC-2 (2.9). There are also indicators for 'interface on?' (high level) and 'ACTUATORS' (AA-1, AR-1) with a PID control interface for AR-1 SetPoint (ST-16) AB-1.

On the left side, there is a 'Sensors to Plot' section with a legend for ST-1 to ST-5 and SC-1, SC-2, and buttons for 'Reset Plot' and 'Enlarge Plot'.

Note:

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

Calculations:

The screenshot shows the 'Calculations' screen in the Edibon SCADA software. The central part of the screen displays the same schematic diagram of the TIVS system as in the Sensors screen.


On the right side, there is a 'Calculations' panel with a 'Calculations' tab selected. It displays a table of Heat transferred (Watts) with values for Qh (387), Qc (-274), and Qi (114). Below this, it shows various parameters: Tlm (13,08 K), Cr (1,59), U (5,72E+2 W/Km^2), NTU (1,45E-1), Effectiveness (%) with Eff (8,79) and Eff ntu (12,12), Reynolds Number (Redh 6340, Redc NaN), and theoretical out (°C) with THOt (37,8) and TCOt (27,4). There are also indicators for 'interface on?' (high level) and 'ACTUATORS' (AA-1, AR-1) with a PID control interface for AR-1 SetPoint (ST-16) AB-1.

On the left side, there is a 'Sensors to Plot' section with a legend for ST-1 to ST-5 and SC-1, SC-2, and buttons for 'Reset Plot' and 'Enlarge Plot'.

Continue...

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

Constants:



SCADA
EDIBON Control and Data
Acquisition Software

START STOP

START SAVING...

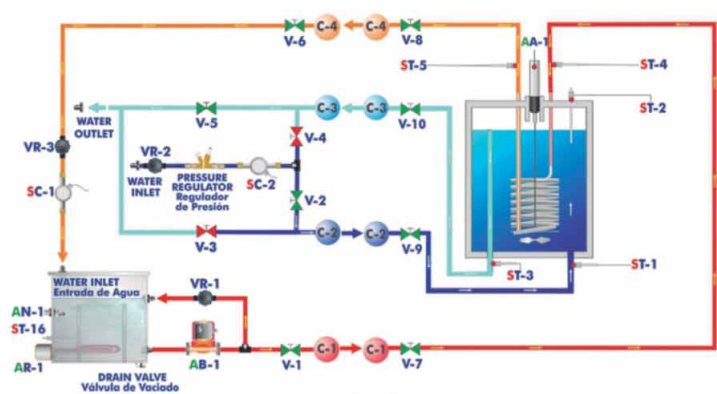
Sensors to Plot

- 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
5,026E-5	NaN
Aexc	0,0518

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 Kcolt	0,62 Kcolt

interface on? high level


ACTUATORS


AA-1 AR-1

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

AB-1

0 1 2 3 4 5 6 7 8 9 10





Continue...

Turbulent Flow Heat Exchanger (TIFT) Main Screens

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

Sensors:

Sensors Calculations Calculations II C

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

interface on? high level

ACTUATORS

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

Note:

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

Calculations:

Calculations Calculations II C

Heat transferred (Watts)

Qh 1151 Qc -732
Ql 419

Tlm 9,37 K Cr 0,92

U 2,89E+3 W/Km² NTU 8,20E-1

Effectiveness (%)

Eff 31,77 Eff ntu 41,31

Reynolds Number

Redh 8079 Redc 7164

theoretical out (°C)

THOT 31,4 TCOT 26,9

interface on? high level

ACTUATORS

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

Continue...

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

Calculations:

Calculations II

logarithmic temperature (K)	
Timh	Timc
4,43442	NaN
Prandtl Number	
Prh	Prc
5,02013	5,18207
Nusselt Number	
Nuh	Nuc
95,80117	NaN

interface on? high level

ACTUATORS

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

AB-1

Constants:

Calculations II

dimensions D(m); Sect.A(m ²)		
Dh	Dc	
0,008	0,0083	
Sect h	Sect c	Aexc
5,026E-5	5,4E-5	0,0424
fluid properties		
Hot water		cold water
Sp heat	Sp heat	
4178	4178	J/KgK
density	density	
987,1	987,1	Kg/m ³
viscosity	viscosity	
7,69E-4	7,69E-4	Kg/ms
Khot	Kcold	
0,64	0,62	KcalK

interface on? high level

ACTUATORS

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

AB-1

Continue...

Cross Flow Heat Exchanger (TICF) Main Screens

Sensors:

The screenshot displays the Edibon SCADA interface for the TICF system. On the left, there is a control panel with buttons for CALIBRATE, START, STOP, VIEW DATA, and QUIT. Below this is a 'Sensors to Plot' section with checkboxes for ST-1, ST-2, ST-3, ST-4, ST-16, SC-1, SC-2, and SV-1, and options for '2 GRAPHS' and 'Graph A'. The central area shows a schematic diagram of the TICF system with various components labeled: WATER INLET, WATER OUTLET, PRESSURE REGULATOR, DRAIN VALVE, and HEATING ELEMENT. The right panel shows sensor status for Temperature (°C) and Water Flow (l/min). The bottom right panel shows actuator controls for AR-1, AVE-1, and AB-1.

Note:

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

Calculations:

The screenshot displays the Edibon SCADA interface for the TICF system, showing the Calculations screen. The layout is similar to the Sensors screen, but the right panel shows calculation results for Heat transferred (Watts) with values for P, R, and F. The bottom right panel shows actuator controls for AR-1, AVE-1, and AB-1.

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

Constants:

SCADA
EDIBON Control and Data
Acquisition Software

CALIBRATE

START STOP

VIEW DATA

QUIT

TICF

Sensors Calculations Calculation

Constants

dimensions D(m); Sect.A(m²)

Dh	Dc
0,019	NaN
Sect h	Sect c
0,0113715	NaN
Aexc	0,035

fluid properties

Hot water		cold air	
Sp heat	J/KgK	Sp heat	J/Kg
4178		1012	
density	Kg/m ³	density	Kg/m ³
987,1		1,2	
viscosity	Kg/ms	viscosity	Kg/m ³
7,69E-4		1,8E-5	
Khot		Kcold	
0,64		0,02	

interface on? high level

ACTUATORS

AR-1

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

AVE-1

AB-1

Sensors to Plot

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

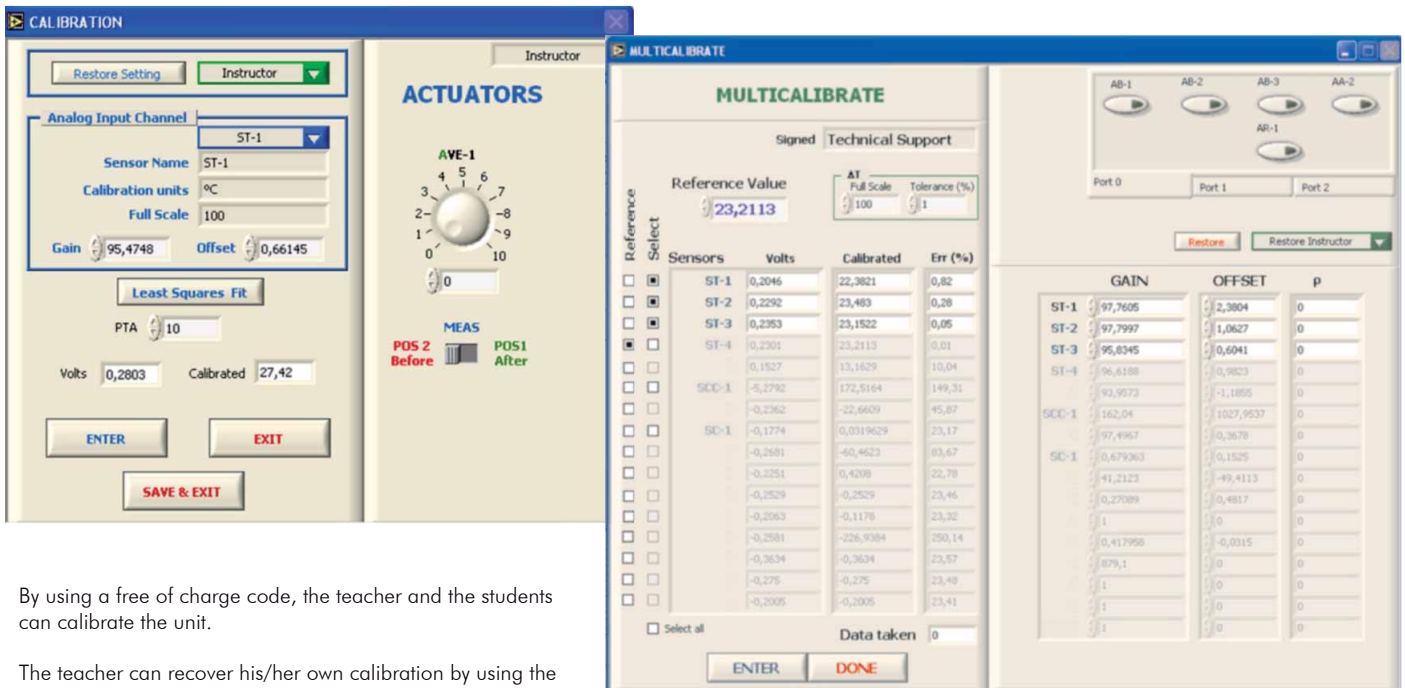
2 GRAPHS

Graph A

Reset Plot Enlarge Plot

Software for Sensors Calibration

Examples of screens



By using a free of charge code, the teacher and the students can calibrate the unit.

The teacher can recover his/her own calibration by using the EDIBON code that we give free of charge.

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 Heat Exchangers type "TI" and can work with one or several exchangers.

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 VDC).

Relay output: 14.

High-speed counter.

Multi-point PID control.

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

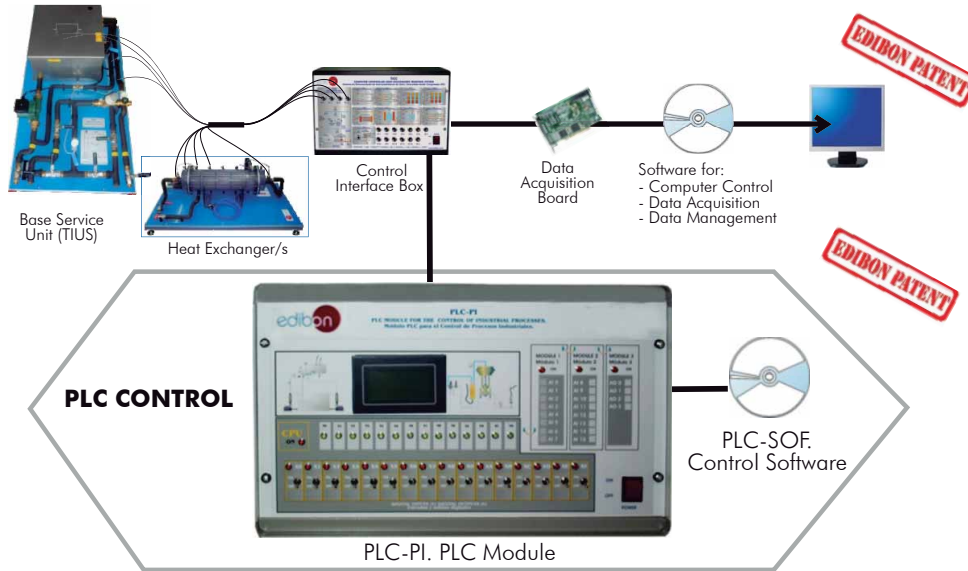
Communication RS232 wire to computer (PC).

Dimensions: 490 x 330 x 310 mm. approx. (19.3 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 unit process through the control interface box without the computer.
- 2.- Visualization of all the sensors values used in the unit process.
- 3.- Calibration of all sensors included in the unit process.
- 4.- Hand on of all the actuators involved in the unit process.
- 5.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
- 6.- Simulation of outside actions, in the cases hardware elements do not exist. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
- 7.- PLC hardware general use and manipulation.
- 8.- PLC process application for unit.
- 9.- PLC structure.
- 10.- PLC inputs and outputs configuration.
- 11.- PLC configuration possibilities.
- 12.- PLC programming languages.
- 13.- PLC different programming standard languages.
- 14.- New configuration and development of new process.
- 15.- Hand on an established process.
- 16.- To visualize and see the results and to make comparisons with the unit process.
- 17.- Possibility of creating new process in relation with the unit.
- 18.- PLC Programming exercises.
- 19.- Own PLC applications in accordance with teacher and student requirements.

⑧ **TICC/CAI. Computer Aided Instruction Software System.**

This complete software package includes two Softwares: the INS/SOF. Classroom Management Software (Instructor Software) and the TICC/SOF. Computer Aided Instruction Software (Student Software).

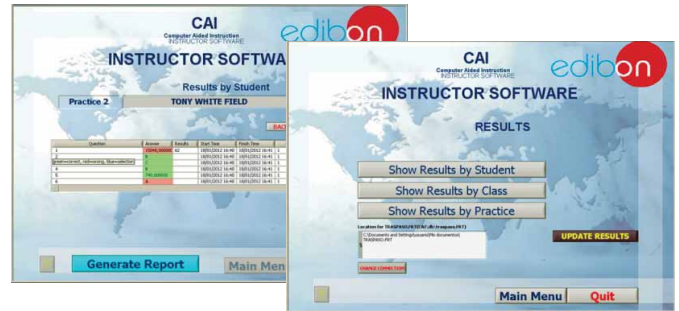
This complete software package consists of an Instructor Software (INS/ SOF) totally integrated with the Student Software (TICC/SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- INS/SOF. Classroom Management Software (Instructor Software):

The Instructor can:

- Organize Students by Classes and Groups.
- Create easily new entries or delete them.
- Create data bases with student information.
- Analyze results and make statistical comparisons.
- Generate and print reports.
- Detect student's progress and difficulties.
- ...and many other facilities.

Instructor Software



- TICC/SOF. Computer Aided Instruction Software (Student Software):

It explains how to use the unit, run the experiments and what to do at any moment.

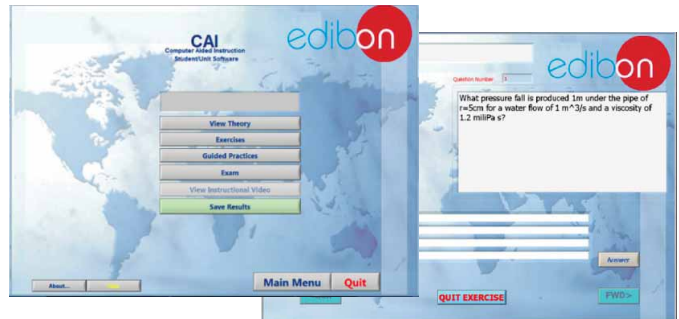
This Software contains:

- Theory.
- Exercises.
- Guided Practices.
- Exams.

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

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

Student Software



⑨ **TICC/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 on causing several faults in the unit normal operation. The student must find them and solve them.

There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:

- An incorrect calibration is applied to them.
- Non-linearity.

Faults affecting the actuators:

- Actuators channels interchange at any time during the program execution.
- Response reduction of an actuator.

Faults in the controls execution:

- Inversion of the performance in ON/OFF controls.
- Reduction or increase of the calculated total response.
- The action of some controls is annulled.

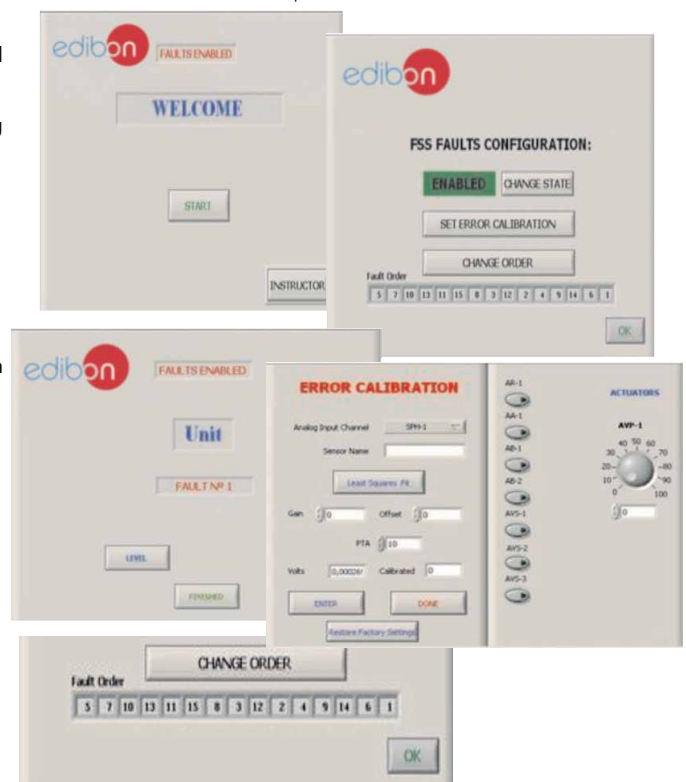
On/off faults:

- Several on/off faults can be included.

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

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

Example of some screens



⑩ **Mini ESN. EDIBON Mini Scada-Net System.**

Mini ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously.

The Mini ESN system consists on 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:

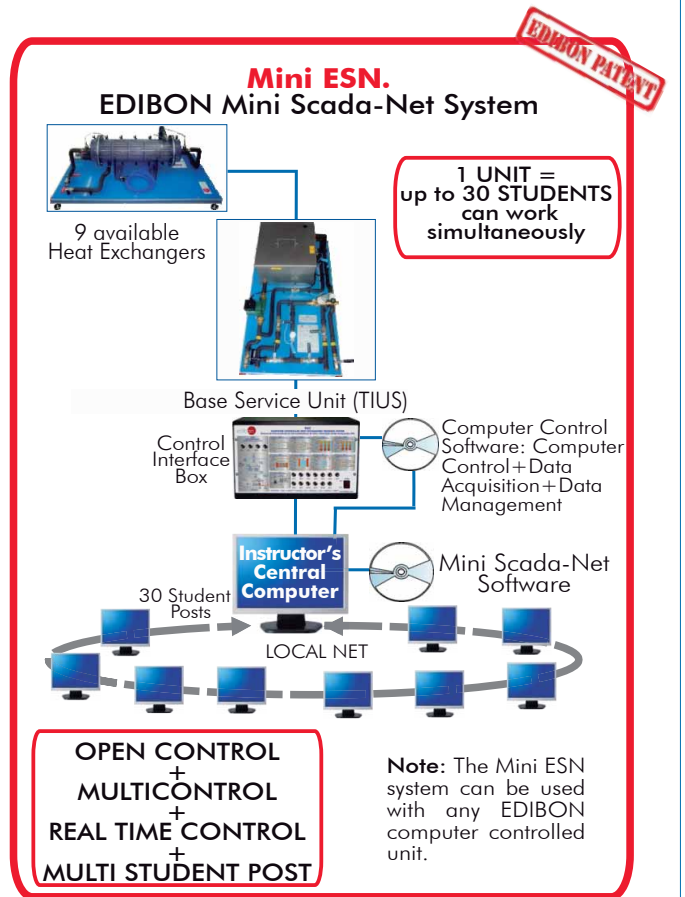
- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA and PID Control, connected in a local net.
- Open Control + Multicontrol + Real Time Control + Multi Student Post.
- Instructor controls and explains to all students at the same time.
- Any user/student 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/products/catalogues/en/Mini-ESN.pdf



⑪ **ESN. EDIBON Scada-Net System.**

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

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

www.edibon.com/products/catalogues/en/units/thermodynamicsthermotechnics/esn-thermodynamics/ESN-THERMODYNAMICS.pdf

Items always supplied as minimum configuration

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. Cross Flow Heat Exchanger.**
- ⑤ **Cables and Accessories,** for normal operation.
- ⑥ **Manuals.**

Additional and optional items

- ⑦ **PLC. Industrial Control using PLC** (it includes PLC-PI Module plus PLC-SOF Control Software):
 - PCL-PI. PLC Module.
 - TICC/PLC-SOF. PLC Control Software.
- ⑧ **TICC/CAI. Computer Aided Instruction Software System.**
- ⑨ **TICC/FSS. Faults Simulation System.**
- ⑩ **Mini ESN. EDIBON Mini Scada-Net System.**
- ⑪ **ESN. EDIBON Scada-Net System.**

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



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REPRESENTATIVE: