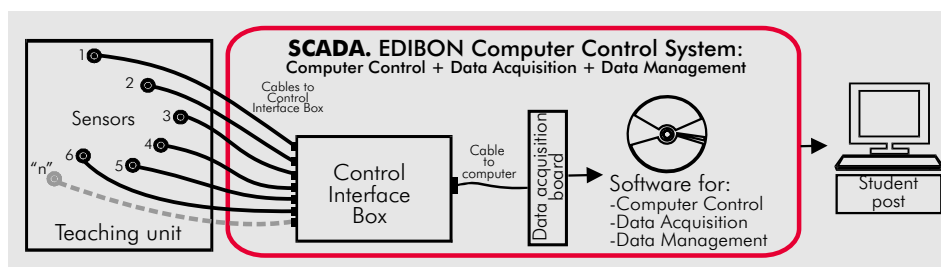


① Unit: TCLFC. Free and Forced Convection Heat Transfer Unit



www.edibon.com

Products
Products range
Units
9. Thermodynamics & Thermotechnics

DESCRIPTION

This Unit allows to study the efficiency of different exchangers, analyzing the heat transmission coefficients of each of the exchangers exposed to different airflows.

A fan placed in the upper part of the tunnel allows controlling the airflow that goes through the tunnel.

A control interface connectable to a computer (PC) contains the control circuits to measure temperatures, electrical control, electrical supply and speed control of the fan.

The interface provides an output to a computer (PC) where the values and graphics of all the variables involved in the practices are shown.

The airflow is measured with a flow sensor set on the inferior part of the tunnel.

This unit allows making a study of the heat transmission in three different types of exchangers:

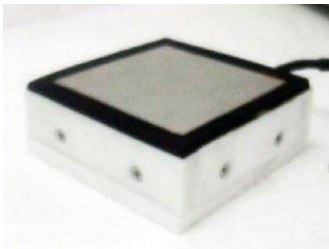
Flat exchanger.

Dowels exchanger.

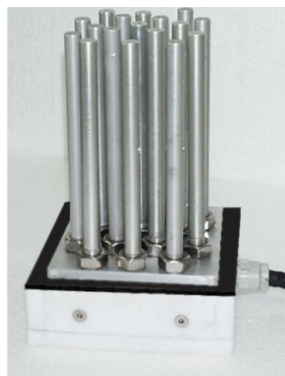
Blade exchanger.

With this computer controlled unit, the EDIBON Computer Control System (SCADA) is supplied, including: Control Interface Box + Data Acquisition Board + Computer Control and Data Acquisition Software, for controlling the process and the parameters involved.

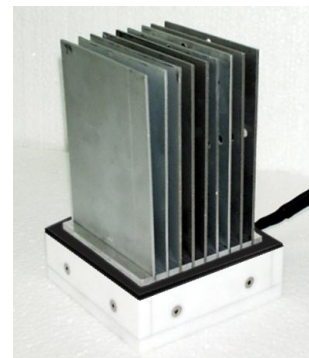
Heat Exchangers included:



Flat exchanger



Dowels exchanger

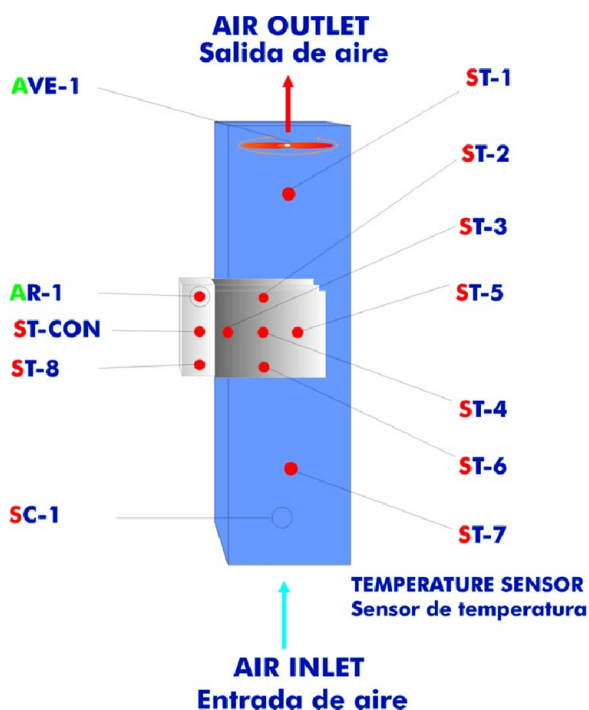


Blade exchanger

PROCESS DIAGRAM AND ELEMENTS ALLOCATION

2 actuators and 10 sensors
controlled from any computer,
and working simultaneously

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



Note:

ST= Temperature sensor.

SC= Flow sensor.

AR= Heating resistance.

AV= Fan.

Items supplied as standard

① TCLFC. Unit:

Bench-top Unit.

Anodized aluminium structure and panels in painted steel.

Main metallic elements in stainless steel.

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

Stainless steel tunnel of rectangular section, 700 mm long, painted and resistant to corrosion.

In the tunnel three type of different heat exchangers can be set.

Methacrylate viewer that allows a good visualization of the exchanger that is in use.

Stabilizers to guarantee an uniform air flux.

9 Temperature sensors, ("J" type, range: -40 to 750° C):

2 temperature sensors measure the air temperature at the inlet and outlet of the area of heat exchange.

Temperature measurements, at different distances of the base of the dowels and blade exchangers, are made by other five temperature sensors that are introduced by one side of the tunnel.

1 temperature sensor for the heating resistance.

1 temperature sensor in the exchangers.

Maximum working temperature: 150°C.approx.

Flow sensor, for measuring the air flow generated. Range: 0-5 l./min.

3 Aluminium exchangers:

Flat heat exchanger (100 x 100 mm).

Dowels heat exchanger. 17 dowels, each one of 10 mm diameter and 125 mm longitude.

Blade heat exchanger. 9 blades, each one of 100x125 mm.

Heating resistance of 150W for each exchanger, computer controlled.

Variable speed fan, computer controlled, which generates air flux through the tunnel.

Fan range: 0-1200 l/min.

② TCLFC/CIB. Control Interface Box:

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. Simultaneously 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 placed in only one computer screen.

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 time and in a 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, other electronic in control interface and the third one in the control software.

③ DAB. Data Acquisition Board:

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

Analog input: Channels= 16 single-ended or 8 differential. Resolution= 16 bits, 1 in 65536.

Sampling rate up to: 250 KS/s (Kilo samples per second). Input range (V) $\pm 10V$.

Data transfers=DMA, interrupts, programmed I/O. DMA channels=6.

Analog output: Channels=2. Resolution= 16 bits, 1 in 65536. Maximum output rate up to: 833 KS/s.

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

Digital Input/Output: Channels=24 inputs/outputs. D0 or DI Sample Clock frequency: 0 to 1 MHz.

Timing: Counter/timers=2. Resolution: Counter/timers: 32 bits.

④ TCLFC/CCSOF. Computer Control+ Data Acquisition+ Data Management Software:

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 simultaneously way. Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters. Analog and digital PID control. Menu for PID and set point selection required in the whole work range. Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. 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 to the process and modification of the conditions during the process.

Open software, allowing to 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 at different work levels.

This unit allows that the 30 students of the classroom can visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.

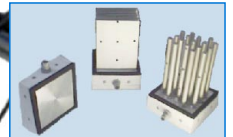
⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

***References 1 to 6: TCLFC + TCLFC/CIB + DAB + TCLFC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.**



Sight of the different exchangers used



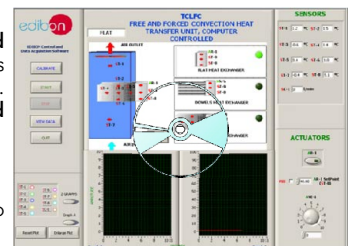
TCLFC. Unit



TCLFC/CIB



DAB



TCLFC/CCSOF

Complementary items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

⑦ PLC-PI. PLC Module:

Circuit diagram in the 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 (-10V. to + 10V.)(through SCSI connector).

Analog outputs block:

4 Analog outputs (-10V. to + 10V) (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.

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.

Free input AC voltage (100 to 240 V AC).

DC input: 16 (24 VDC).

Relay output: 14 (250 VA AC/2 A).

High-speed counter.

Multi-point PID control.

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

Communication RS232 wire, to computer (PC).

⑧ TCLFC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.



PLC-PI

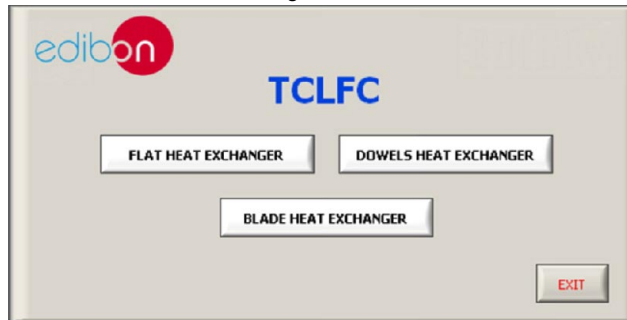
Items available on request

⑨ TCLFC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

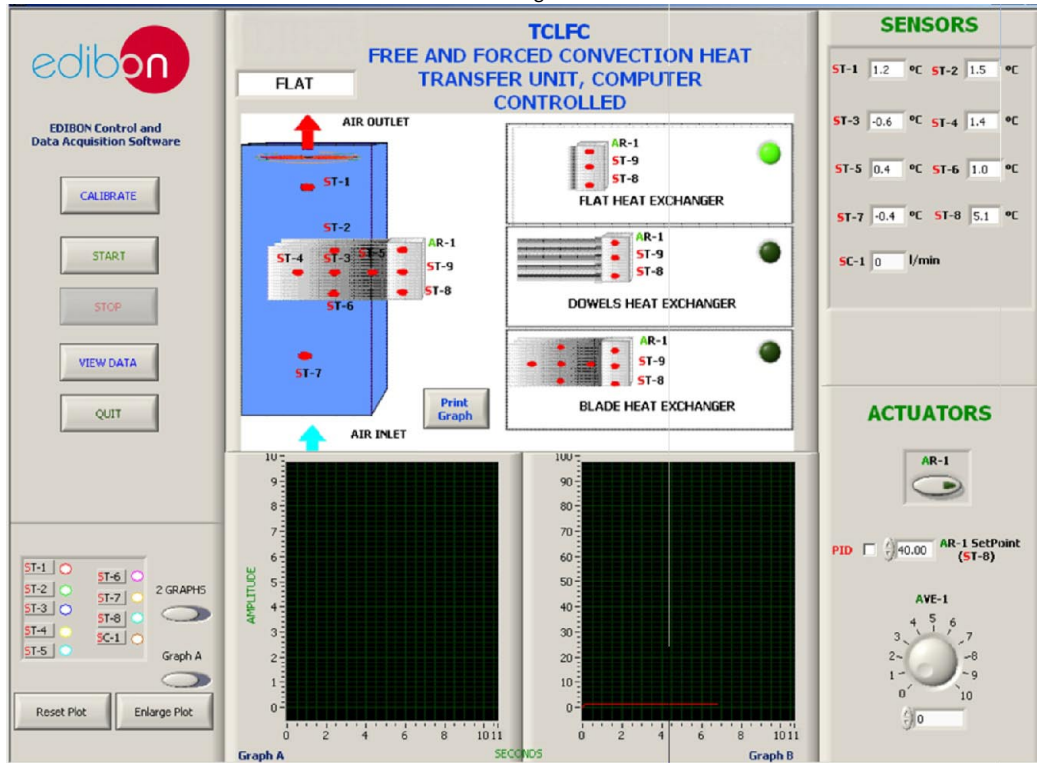
⑩ TCLFC/FSS. Faults Simulation System.

Software Main Screens

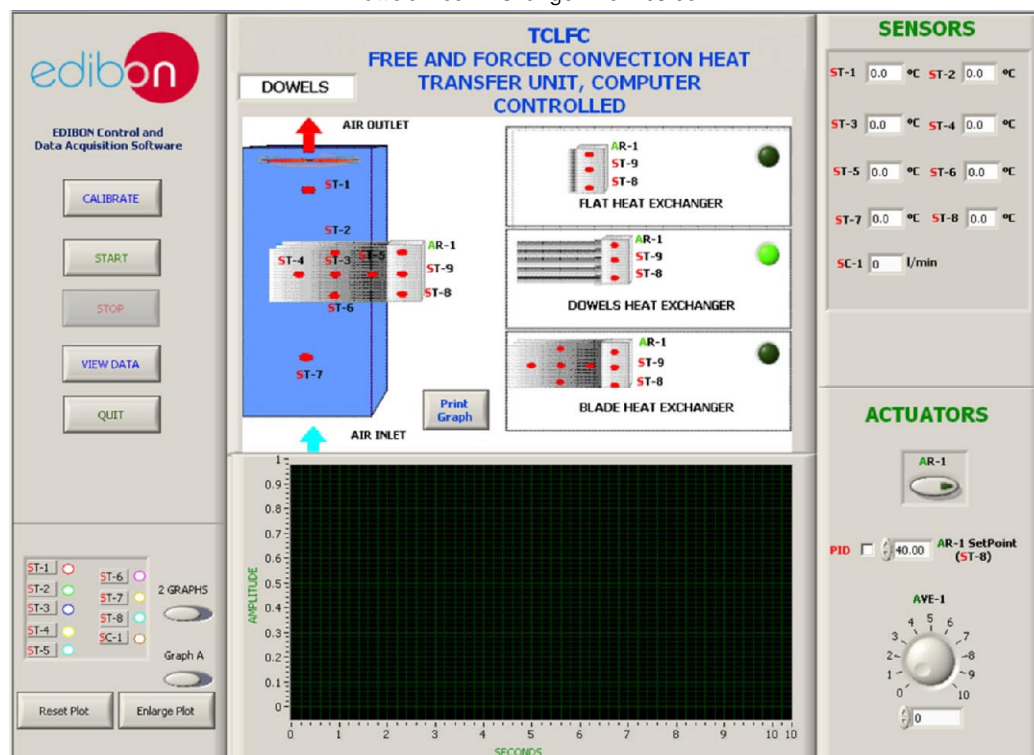
Heat Exchangers selection screen



Flat Heat Exchanger main screen



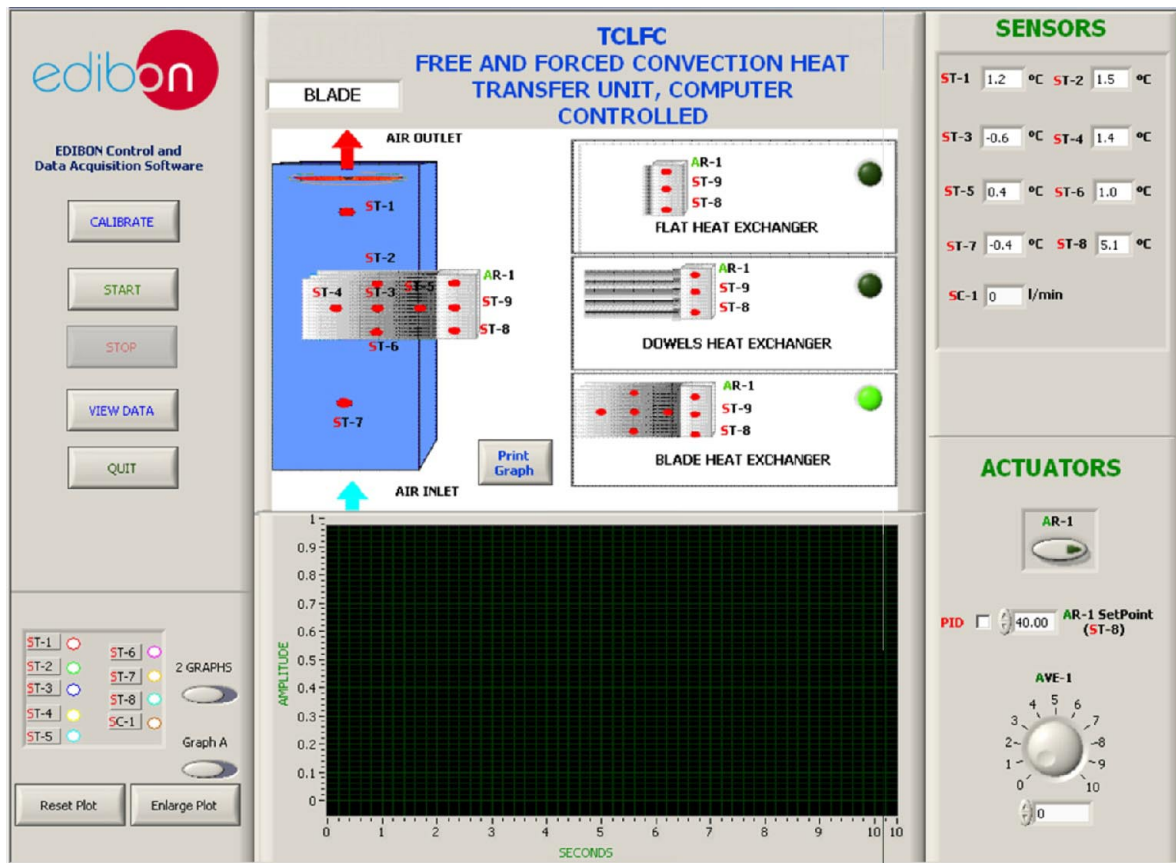
Dowels Heat Exchanger main screen



Note: ST=Temperature sensor. SC=Flow sensor. AR=Heating resistance. AVE=Fan

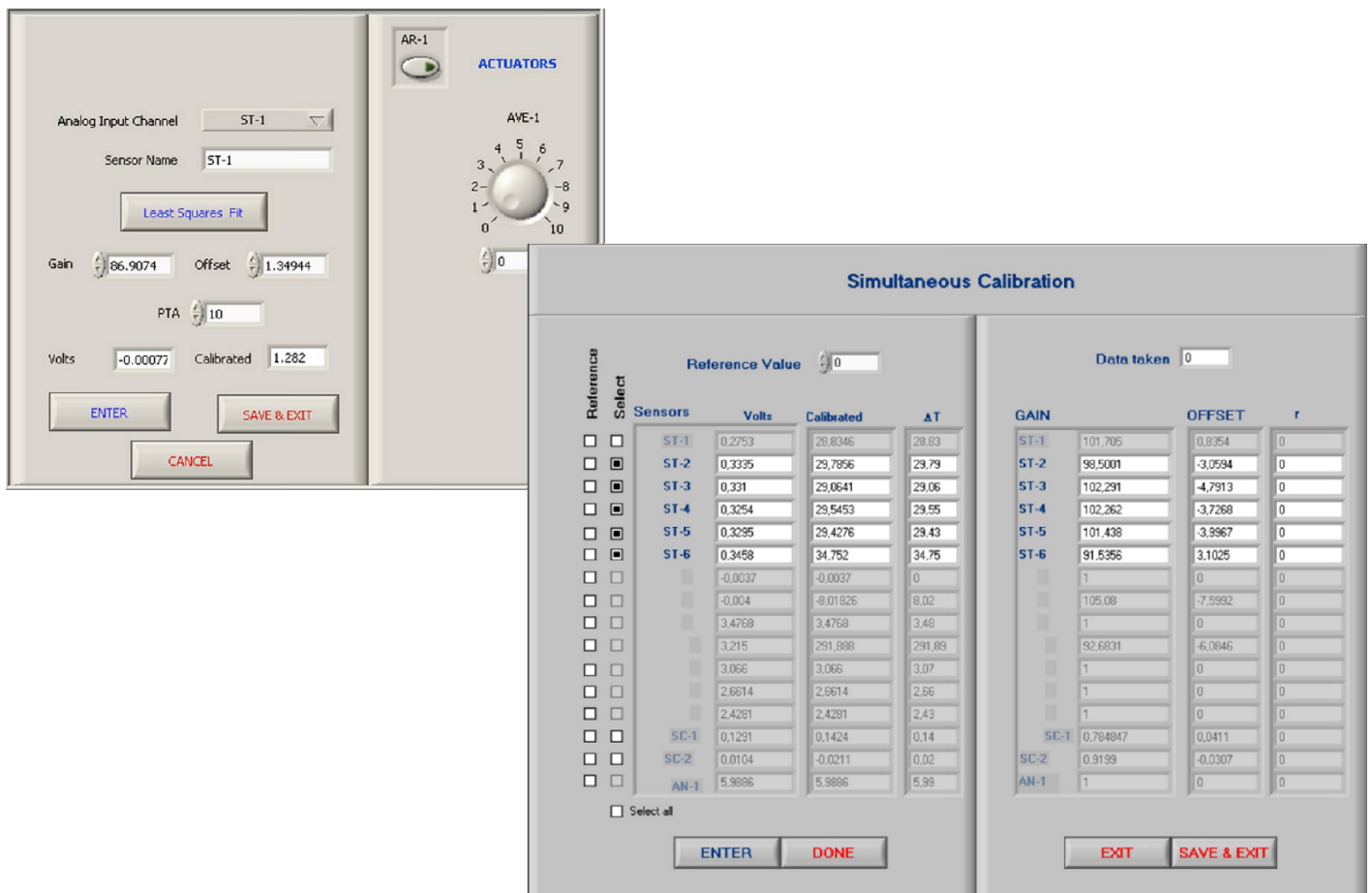
Software Main Screens (continuation)

Blade Heat Exchanger main screen



Note: ST=Temperature sensor. SC=Flow sensor. AR=Heating resistance. AVE=Fan

Examples of Sensors Calibration screens

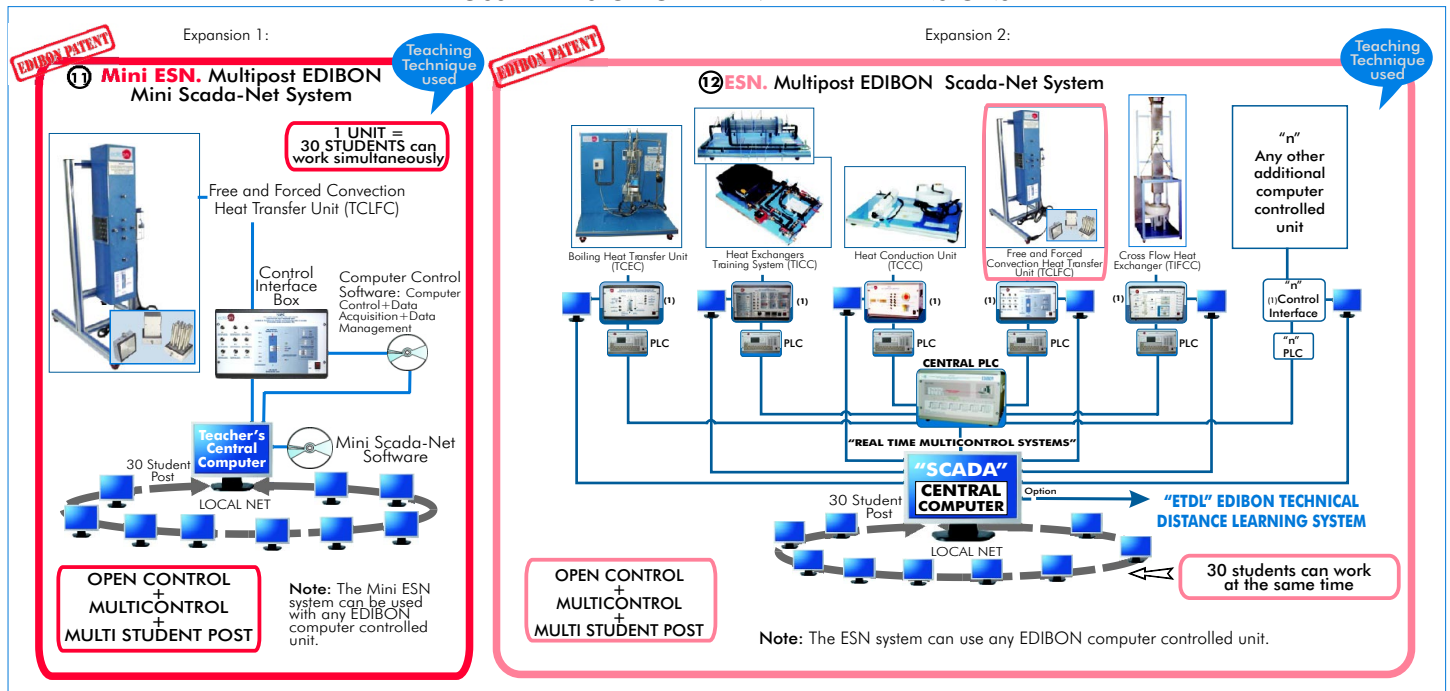


EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

- 1.- Demonstration of the basic principles of free and forced convection.
 - 2.- Comparison between free and forced convection.
 - 3.- Free convection in flat surfaces.
 - 4.- Forced convection in flat surfaces.
 - 5.- Dependence of the heat transmission with the temperature.
 - 6.- Dependence of the heat transmission with the speed of the fluid.
 - 7.- Dependence of the heat transmission with the exchanger geometry.
 - 8.- Temperature distribution in the additional surfaces.
 - 9.- Study of the advantage of using spiked and bladed surfaces in heat transmission in free convection.
 - 10.- Study of the advantage of using spiked and bladed surfaces in heat transmission in forced convection.
 - 11.- Comparative study between the free convection of a horizontal surface and vertical surface.
- Other possible practices:
- 12.- Sensors calibration.
- Practices to be done by PLC Module (PLC-PI)+ PLC Control Software:
- 13.- Control of the TCLFC unit process through the control interface box without the computer.
 - 14.- Visualization of all the sensors values used in the TCLFC unit process.
 - 15.- Calibration of all sensors included in the TCLFC unit process.
 - 16.- Hand on of all the actuators involved in the TCLFC unit process.
- 17.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
 - 18.- 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).
 - 19.- PLC hardware general use and manipulation.
 - 20.- PLC process application for TCLFC unit.
 - 21.- PLC structure.
 - 22.- PLC inputs and outputs configuration.
 - 23.- PLC configuration possibilities.
 - 24.- PLC program languages.
 - 25.- PLC different programming standard languages (literal structured, graphic, etc.).
 - 26.- New configuration and development of new process.
 - 27.- Hand on an established process.
 - 28.- To visualize and see the results and to make comparisons with the TCLFC unit process.
 - 29.- Possibility of creating new process in relation with the TCLFC unit.
 - 30.- PLC Programming Exercises.
 - 31.- Own PLC applications in accordance with teacher and student requirements.

POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS



ORDER INFORMATION

Items supplied as standard

Minimum configuration for normal operation includes:

- ① Unit: TCLFC. Free and Forced Convection Heat Transfer Unit.
- ② TCLFC/CIB. Control Interface Box.
- ③ DAB. Data Acquisition Board.
- ④ TCLFC/CCSOF. Computer Control + Data Acquisition + Data Management Software.
- ⑤ Cables and Accessories, for normal operation.
- ⑥ Manuals.

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

Complementary items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

- ⑦ PCL-PI. PLC Module.
- ⑧ TCLFC/PLC-SOF. PLC Control Software.
- ⑨ TCLFC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
- ⑩ TCLFC/FSS. Faults Simulation System. (Available on request).

Expansions

- ⑪ Mini-ESN. Multipost EDIBON Mini Scada-Net System.
⑫ ESN. Multipost EDIBON Scada-Net System.

REQUIRED SERVICES

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

DIMENSIONS & WEIGHTS

- | | |
|------------------------|--|
| TCLFC Unit: | -Dimensions: 370 x 610 x 920 mm. approx. |
| | -Weight: 25 Kg. approx. |
| Control Interface Box: | -Dimensions: 490 x 330 x 310 mm. approx. |
| | -Weight: 10 Kg. approx. |
| PLC Module (PLC-PI): | -Dimensions: 490 x 330 x 310 mm. approx. |
| | -Weight: 30 Kg. approx. |

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



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REPRESENTATIVE:

A large, empty rectangular box with a light blue border, intended for a representative's signature or stamp.