edibon

Technical Teaching Equipment

Computer Controlled **Heat Transfer Series**

TSTCC

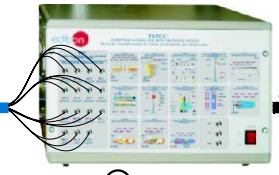
Always included in the supply:

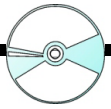
EDIBON PATENT

Teaching Technique used

www.edibon.com
Products
Products range
Units
9.-Thermodynamics & Thermotechnics

SCADA. EDIBON Computer Control System





(2) Control Interface Box

(3) Data Acquisition Board

(4) Computer Control Software for each Module

Computer (not included in the supply)

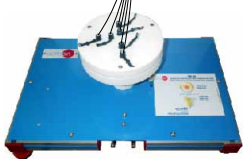
(5) Cables and Accessories

(6) Manuals

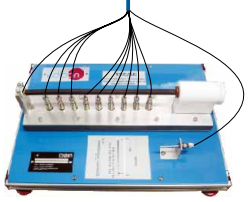
(1) Available Computer Controlled Modules

(1.1) TXC/CL. Linear Heat Conduction Module (4)

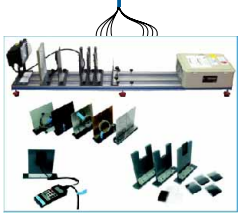
(1.4) TXC/CC. Combined Free and Forced Convection and Radiation Module (4)



(1.2) TXC/CR. Radial Heat Conduction Module (4)



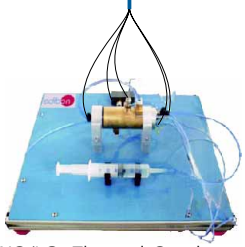
(1.5) TXC/SE. Extended Surface Heat Transfer Module (4)



(1.3) TXC/RC. Radiation Heat Conduction Module (4)

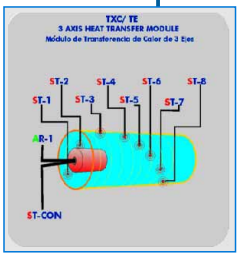
(1.6) TXC/ER. Radiation Errors in Temperature Measurement Module (4)

(1.7) TXC/EI. Unsteady State Heat Transfer Module (4)

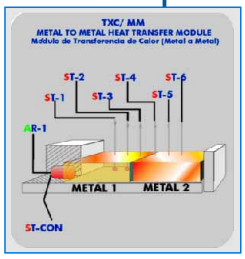


(1.8) TXC/LG. Thermal Conductivity of Liquids and Gases Module (4)

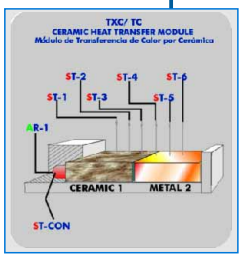
(1.9) TXC/FF. Free and Forced Convection Heat Transfer Module (4)



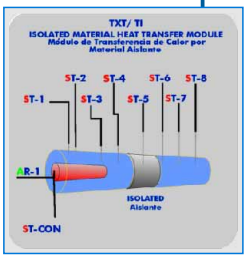
(1.10) TXC/TE. 3 Axis Heat Transfer Module (4)



(1.11) TXC/MM. Metal to Metal Heat Transfer Module (4)



(1.12) TXC/TC. Ceramic Heat Transfer Module (4)



(1.13) TXC/TI. Isolated Material Heat Transfer Module (4)

ISO 9001:2000 Certificate of Approval

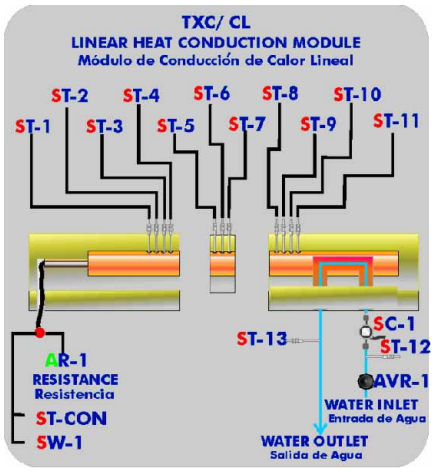
European Union Certificate

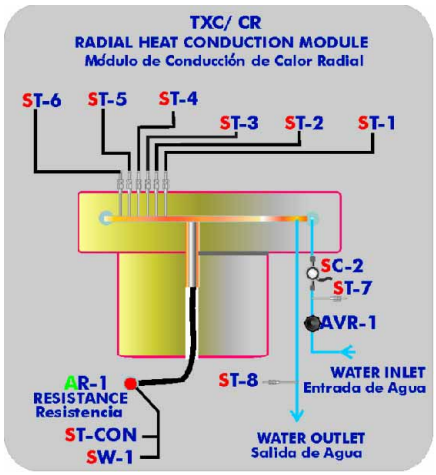
Certificates ISO 14001: 2004 and ECO-Management and Audit Scheme (environmental management)

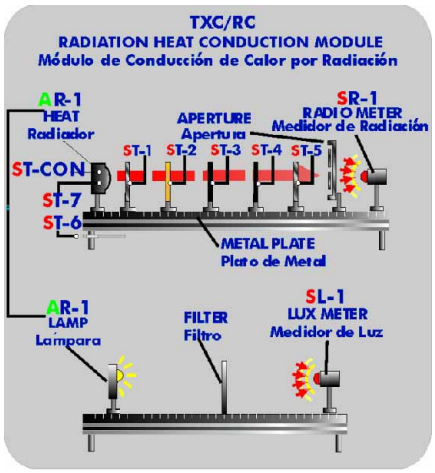
Worlddidac Quality Charter Certificate Worlddidac Member

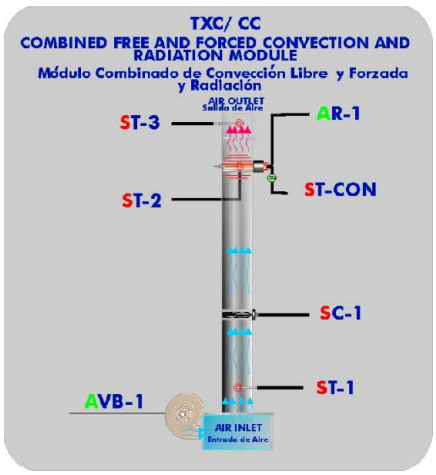
4 actuators and 15 sensors controlled from any computer, and working simultaneously

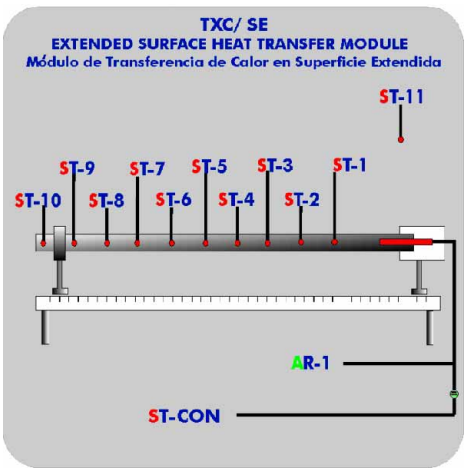
OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL

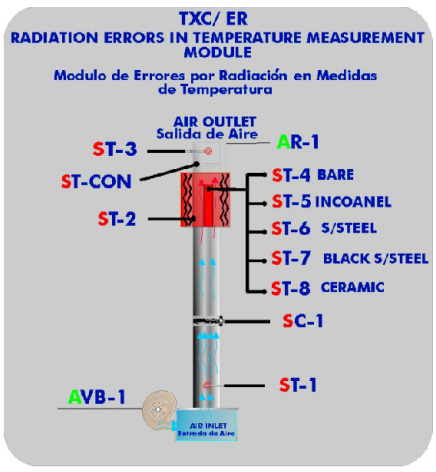


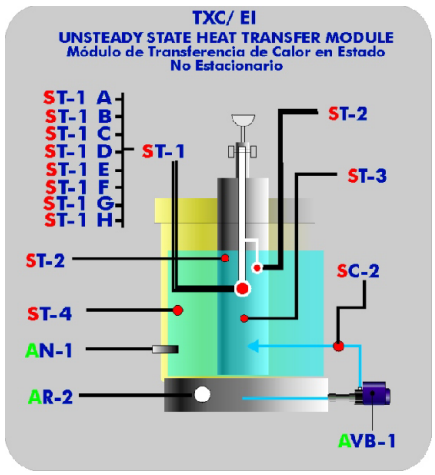


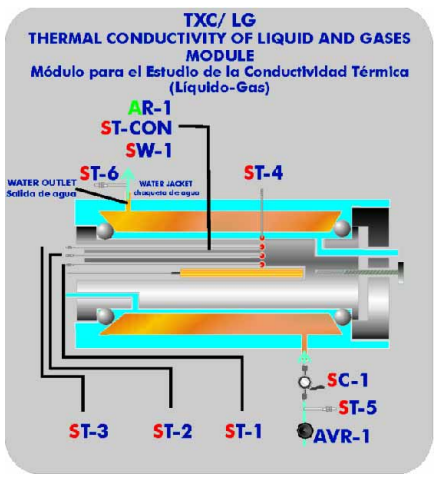


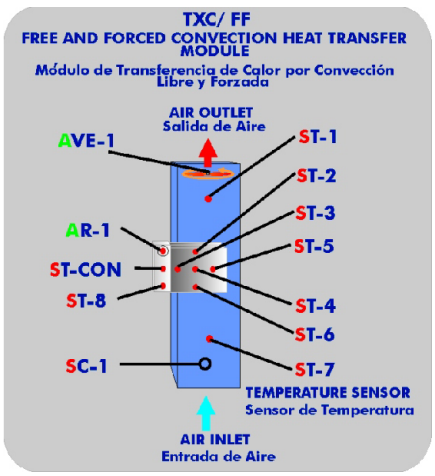


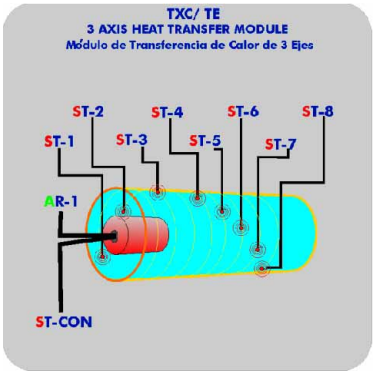


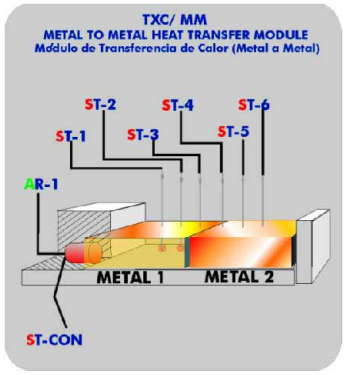


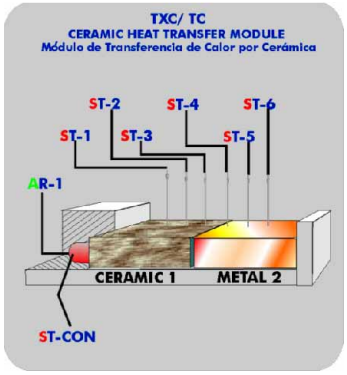


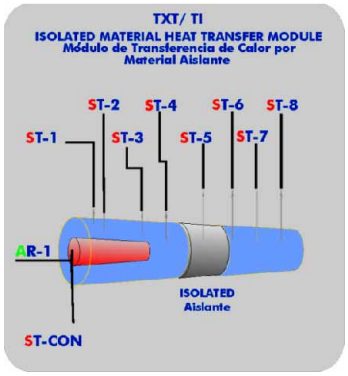












Note: ST= Temperature sensor. SC= Flow sensor. AR= Heating resistance. AVB= Fan. AB=Pump.

① Available Computer Controlled Modules

①.① TXC/CL. Linear Heat Conduction Module:

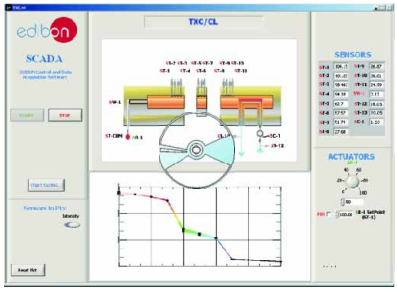
Bench-top unit to study the principles of linear heat conduction and to allow the conductivity of various solid conductors and insulators to be measured.
It is given with interchangeable samples of different materials, different diameters and different insulating materials that allow to demonstrate the area effects, the conductivity and the combinations in series in the heat transmission process.
Anodized aluminium structure and panel in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Input heat section.
Electric heater (heating resistance) with power regulation (150W, temperature max.: 150°C), computer controlled.
Refrigeration section with a surface cooled by water.
Central sections:
- With brass of 25 mm of diameter.
- With brass of 10 mm of diameter.
- With stainless steel of 25 mm of diameter.

Water flow sensor.
Water flow regulation valve.
Thermal paste is supplied to demonstrate the difference between poor and good thermal contact between the sections.
13 Temperature sensors, "J" type:
- 11 Temperature sensors distributed in the heating section, refrigeration section and central sections.
- 1 Temperature sensor at the water inlet of the unit.
- 1 Temperature sensor at the water outlet of the unit.

Power measurement from the computer (PC).
Cables and Accessories, for normal operation.
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 Linear Heat Conduction Module (TXC/CL).
  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 multi control 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 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.

-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

TXC/CL



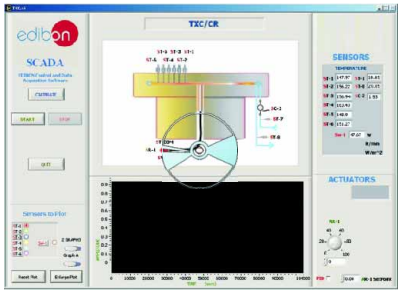
①.② TXC/CR. Radial Heat Conduction Module:

Bench-top unit to study the principles of radial heat conduction, and to allow the conductivity of solid brass disk to be measured.
Anodized aluminium structure and panel in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Brass disk of 110 mm of diameter and 3 mm of thickness.
Incorporated electric heater (heating resistance of 150W, temperature max.: 150°C), computer controlled.
Peripherical cooling tube.
Water flow sensor.
Water flow regulation valve.
8 Temperature sensors, "J" type:
- 6 Temperature sensors distributed in the unit.
- 1 Temperature sensor at the water inlet of the unit.
- 1 Temperature sensor at the water outlet of the unit.

Power measurement from the computer (PC).
Cables and Accessories, for normal operation.
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 Radial Heat Conduction Module (TXC/CR).
  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 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.
  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.

-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

TXC/CR



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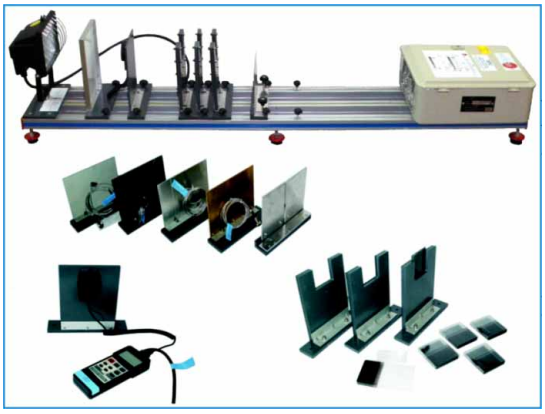
① Available Computer Controlled Modules (continuation)

⑬TXC/RC. Radiation Heat Conduction Module:

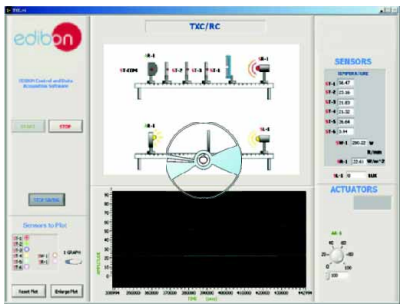
Bench-top unit designed to demonstrate the laws of radiant heat transfer and radiant heat exchange.
It basically consists in two independent parts. One of the parts is for the light radiation experiments and another part is for the thermal radiation experiments.
The elements provided with the unit allow making the measuring of the temperature, radiation, intensity light and the power in the resistance or bulb.
Anodized aluminium structure and panels in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
This unit consists on a metal plate with a resistance at one side and a lamp in the another side. Lengthwise of the metal plate you can place the elements supplied with the unit.
Heating resistance (ceramic resistance: 500 W), computer controlled.
Lamp 150 W, with diffuser.
The unit is provided with accessories for light experiments and radiation experiments.
Light accessories:
Luxmeter that allows to measure the intensity of the light:

Scale:	Resolution:	Accuracy:
0 to 1999 lux	1 lux	
2000 to 19990	10 lux	
20000 to 50000	100 lux	8%
Selection of light	Day, Tungsten, fluorescence or mercury	
Sensor	Photodiode with filter of adjustment of filter	
Sample frequency:	0.4 s	
Work temperature:	0 to 50°C	

Filters:
They allow to filtrate the light in the experiments.
There are:
3 Grey Neutral Density A153 filters.
1 Grey Neutral Density A152 filter.
1Grey Neutral Density A154 filter.
3 Filter portholes.
Radiation accessories:
Radiometer (50 x 50 mm, 5 μv (w/m²)). It allows to measure the intensity of the radiation.
Planes surfaces. They are elements for studying the radiation and each one contains one temperature sensor:
Polished aluminium.
Anodized aluminium.
Brass.
2 Black bodys.
Variable slit or aperture. It allows to regulate the area of the radiation.
7 Temperature sensors.
Power measurement from the computer (PC).
Radiation measurement from the computer (PC).
Cables and Accessories, for normal operation.
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 Radiation Heat Conduction Module (TXC/RC).
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 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.
-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).



TXC/RC



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① Available Computer Controlled Modules (continuation)

1.4 TXC/CC. Combined Free and Forced Convection and Radiation Module:

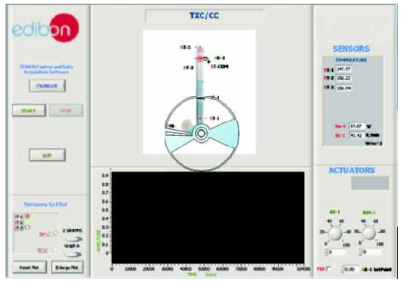
TXC/CC

Bench-top unit to study the principles of combined free and forced convection with radiation from a horizontal heater cylinder.
It studies the variation experimented by the local heat transfer coefficient around of a horizontal cylinder. It is subject to a forced and a free convection.
Anodized aluminium structure and panel in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Centrifugal fan (computer controlled) of 2650 rpm, which provides a maximum flow of 1200l/min. and allows to the air to reach a maximum velocity around 5 m/s.
Stainless steel conduct with interior cover, including:
- Temperature sensor, "J" type, in order to measure the temperature of inlet air.
- Flow sensor.
- Temperature sensor, "J" type, in order to measure the temperature of outlet air.

Heater:
- Copper cylinder with exterior cover: Interior resistance of 150W., temperature sensor "J" type for measuring the temperature of the cylinder.

Temperature sensor, "J" type.
Power measurement from the computer (PC).
Cables and Accessories, for normal operation.
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 Combined Free and Forced Convection and Radiation Module (TXC/CC).**
  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 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.

-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

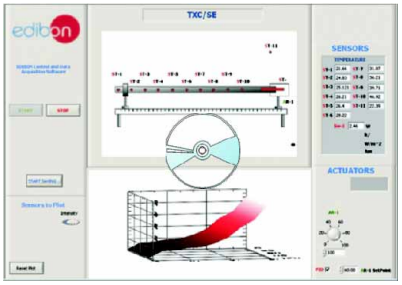


1.5 TXC/SE. Extended Surface Heat Transfer Module:

TXC/SE

Bench-top unit designed to demonstrate the temperature profiles and heat transfer characteristics for an extended surface. It studies the effect of adding fins to a body in order to extend its surface for a change in the cooling rate. Fins of different materials and cross section shapes are used to analyse the effect of cooling.
Anodized aluminium structure and panel in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
150 W Resistance, embedded in a copper capsule to permit a good contact with the interchangeable fins. The copper capsule is isolated by a coat of Teflon.
The fins are interchangeble, providing two different materials: brass and stainless steel and three different cross section shapes: square, circular and hexagonal.
The power to the resistance is controlled from the computer with the SCADA software by a 0-10 Volts signal.
11 Temperature sensors, "J" type.
Power measurement from the computer (PC).
Cables and Accessories, for normal operation.
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 Surface Heat Transfer Module (TXC/SE).**
  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 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.

-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).



Continue...

① Available Computer Controlled Modules (continuation)

1.6 TXC/ER. Radiation Errors in Temperature Measurement Module:

Bench-top unit to demonstrate how temperature measurements can be influenced by sources of thermal radiation.

The objective of this module is to measure the error in a black thermocouple due the radiation with respect with another normal thermocouple where there are not radiative shielding in comparison when there are radiative shielding, error in function of material of the thermocouple's capsule, size of the thermocouple, etc.

Anodized aluminium structure and panel in painted steel.

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

Centrifugal fan (computer controlled):

- 2650 rpm.
- Maximum flow of 1200l/min.
- It allows to the air to reach a maximum velocity around 5 m/s.

Stainless steel conduct with interior cover, including:

- Temperature sensor "J" type, in order to measure the temperature of inlet air.
- Flow sensor.
- Temperature sensor "J" type, in order to measure the temperature of outlet air.

Copper cylinder with exterior cover:

- Interior resistance of 150W.
- Temperature sensor, "J" type, for measuring the temperature of the cylinder.

5 Temperature sensors with different styles and sizes of bead installed in the duct to demonstrate the differences in readings obtained:

- Temperature sensor, without capsule.
- Temperature sensor, small size.
- Temperature sensor.
- Temperature sensor, with black painting.
- Temperature sensor, with ceramic capsule.

Power measurement from the computer (PC).

Cables and Accessories, for normal operation.

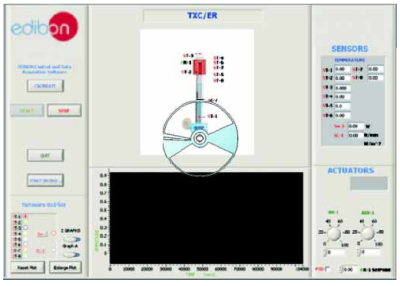
This unit is **supplied with 8 manuals:** Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

Computer Control Software:

- **Computer Control+Data Acquisition+Data Management Software for Radiation Errors in Temperature Measurement Module (TXC/ER).**
- 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 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.**

-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

TXC/ER



① Available Computer Controlled Modules (continuation)

①.7 TXC/EI . Unsteady State Heat Transfer Module:

Bench-top unit designed to allow practices and exercises to be performed in unsteady state heat transfer.

It studies the transient conduction with convection. Using different shapes (rectangular slabs, spheres and cylinders) of different materials, the temperature of other shapes and materials can be predicted.

Anodized aluminium structure and panel in painted steel.

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

Dual concentric open top tanks filled with water, total tank capacity: 40 litres, 300 x 350 x 400 mm. concentric tank: 1.2 l., diameter: 70 mm.

Different shapes of different size and material are studied:

- Brass sphere (diameter: 40 mm).
- Brass sphere (diameter: 25 mm).
- Stainless steel sphere (diameter: 40 mm).
- Stainless steel sphere (diameter: 25 mm).
- Brass cylinder (diameter: 15 mm, length: 150 mm).
- Stainless steel cylinder (diameter: 15 mm, length: 150 mm).
- Aluminium rectangular slab (40 x 10 x 150 mm).
- Stainless steel rectangular slab (40 x 10 x 150 mm).

Each shape is fitted with a temperature sensor at the center of the object.

The shapes are installed in special holder at the center of the top cover of the large tank. The holder also has a temperature sensor that enters in the water bath at the same time as the shape.

Heating element (immersion heater) with a power of 3000 W, the resistance is protected by a 16 A fuse. The high power allows reaching the steady state faster. It is computer controlled.

Water pump with variable speed. It allows to reach a maximum flow of 4 l./min.

3 Temperature sensors, "J" type, allow controlling the stability of the temperature of the water bath.

Flow sensor.

2 Temperature sensors, "J" type:

- The first one permits to record the evolution of the temperature of the shape at its center.
- The second one, works as a stopwatch, it will indicate the precise moment in which the shape is submerged.

Level switch.

Power measurement from the computer (PC).

Cables and Accessories, for normal operation.

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 Unsteady State Heat Transfer Module (TXC/EI).

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 the process and modification of the conditions during the process.

Open software, allowing to the teacher to modify texts, instructions.

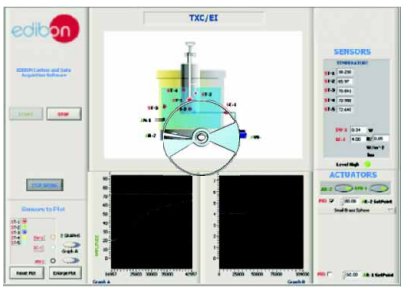
Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access at different work levels.

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.

-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

TXC/EI

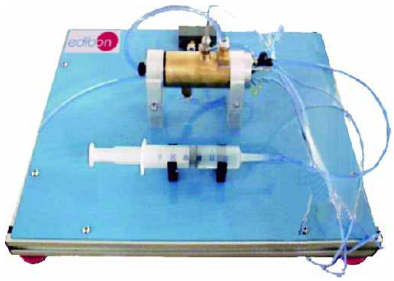

Detail of the different shapes



Continue...

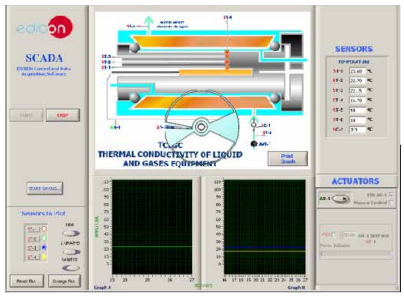
① Available Computer Controlled Modules (continuation)

1.8 TXC/LG. Thermal Conductivity of Liquids and Gases Module:



TXC/LG

This unit has been designed to enable students to easily determine the thermal conductivity of liquids and gases.
By the realization of the practices the student can determine the thermal conductivity of any suitable gas or compatible liquid with materials on construction.
Anodized aluminium structure and panel in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Aluminium body (cylinder) with brass jacket that contains the test fluid and the refrigeration water.
Variable heating resistance (in the cylinder), computer controlled, (150 W, temperature max.: 150°C).
Resistance power controlled from computer (0-100%). The power is measured by a sensor.
6 Temperature sensors, "J" type.
Water flow sensor. Water flow regulation valve.
Valves. Syringe.
Power measurement from the computer (PC).
Cables and Accessories, for normal operation.
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:



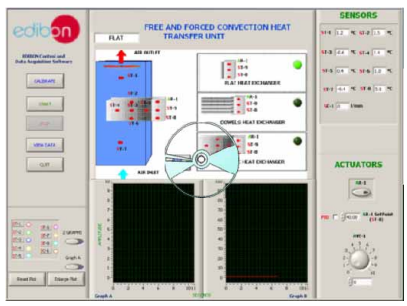
Computer Control+Data Acquisition+Data Management Software for Thermal Conductivity of Liquids and Gases Module (TXC/LG).
Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. **Compatible with the industry standards.**
Registration and visualization 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 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.
-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

1.9 TXC/FF. Free and Forced Convection Heat Transfer Module:

Sight of the different heat exchangers used

TXC/FF

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.
Anodized aluminium structure and panels in painted 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:
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.
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. Range: 0-1200 l/min.
Cables and Accessories, for normal operation.
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 Free and Forced Convection Heat Transfer Module (TXC/FF).
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 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.
-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).

Continue...

① Available Computer Controlled Modules (continuation)

1.10 TXC/TE. 3 Axis Heat Transfer Module:

Bench-top unit.

Anodized aluminium structure and panel in painted steel.

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

3 Axis conduction module.

Electric heater (heating resistance), computer controlled.

8 Temperature sensors.

Cables and Accessories, for normal operation.

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 3 Axis Heat Transfer Module (TXC/TE).

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.

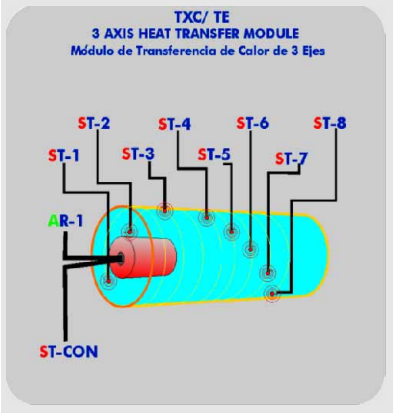
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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.

-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).



TXC/TE

1.11 TXC/MM. Metal to Metal Heat Transfer Module:

Bench-top unit.

Anodized aluminium structure and panel in painted steel.

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

Electric heater (heating resistance), computer controlled.

6 Temperature sensors.

Materials to test: Copper, brass, stainless steel, aluminium (to choose).

Cables and Accessories, for normal operation.

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 Metal to Metal Heat Transfer Module (TXC/MM).

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.

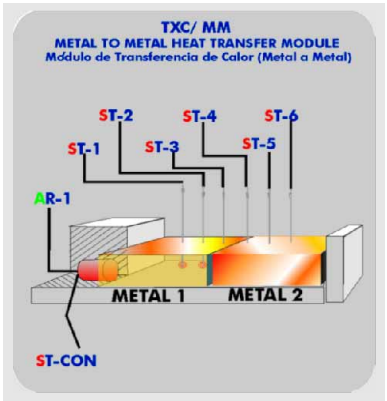
Comparative analysis of the obtained data, after the process and modification of the conditions during the process.

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.

-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).



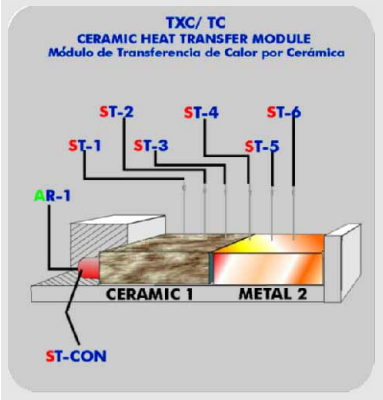
TXC/MM

Continue...

① Available Computer Controlled Modules (continuation)

1.12 TXC/TC. Ceramic Heat Transfer Module:

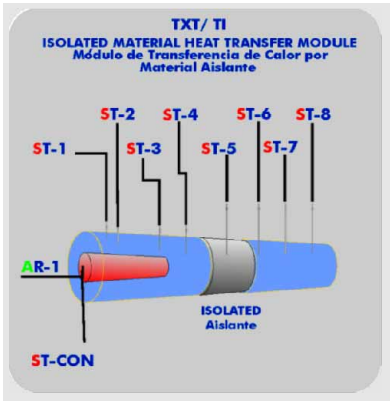
Bench-top unit.
Anodized aluminium structure and panel in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Electric heater (heating resistance), computer controlled.
6 Temperature sensors.
Suitable for ceramic materials.
Cables and Accessories, for normal operation.
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 Ceramic Heat Transfer Module (TXC/TC).
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 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.
-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).



TXC/TC

1.13 TXC/TI. Isolated Material Heat Transfer Module:

Bench-top unit.
Anodized aluminium structure and panel in painted steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Electric heater (heating resistance), computer controlled.
8 Temperature sensors.
Suitable for fibrous, granular and sheet materials. Suitable for homogeneous and non-homogeneous materials.
Suitable for soft, semi-rigid and rigid materials.
Cables and Accessories, for normal operation.
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 Isolated Material Heat Transfer Module (TXC/TI).
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 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.
-This module requires Control Interface Box (TSTCC/CIB) and Data Acquisition Board (DAB).



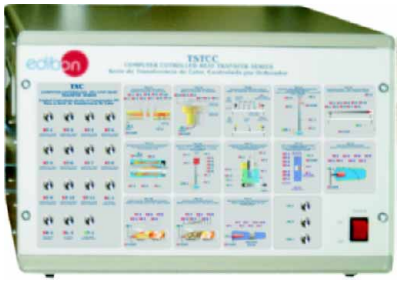
TXC/TI

Continue...

Items Common for the Modules type "TXC"

② TSTCC/CIB. Control Interface Box:

This control interface is common for the modules type "TXC" and can work with one or several modules.



TSTCC/CIB

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.

Open control allowing modifications, at any time and in a real time , of 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).

Possibility of automatization of the actuators involved in the process.

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

③ DAB. Data Acquisition Board:

Common for the modules type "TXC".

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

Analog input:

Number of **channels= 16** single-ended or 8 differential.

Resolution=16 bits, 1 in 65536.

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

Input range (V)=±10V.

Data transfers=DMA, interrupts, programmed I/0. Number of DMA channels=6.

DAB

Analog output:

Number of **channels=2**.

Resolution=16 bits, 1 in 65536.

Maximum output rate up to: 833 KS/s.

Output range(V)=±10V.

Data transfers=DMA, interrupts, programmed I/0.

Digital Input/Output:

Number of **channels=24 inputs/outputs**.

D0 or DI Sample Clock frequency: 0 to 1 MHz.

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

④ Cables and Accessories, for normal operation.

⑤ Manuals:

This system is **supplied with 8 manuals for each module:** Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenaince, Calibration & Practices Manuals.

Continue...

Complementary items

PLC. Industrial Control using PLC (6 and 7):

⑥PLC-PI. PLC Module:

This unit common for modules type "TXC" and can work with one or several modules.

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 μsec. 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 V DC).
Relay output: 14 (250 V A 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).

⑦TSTCC/PLC-SOF. PLC Control Software:

Always included with PLC supply.
Each module has its Own Software.

PLC-PI

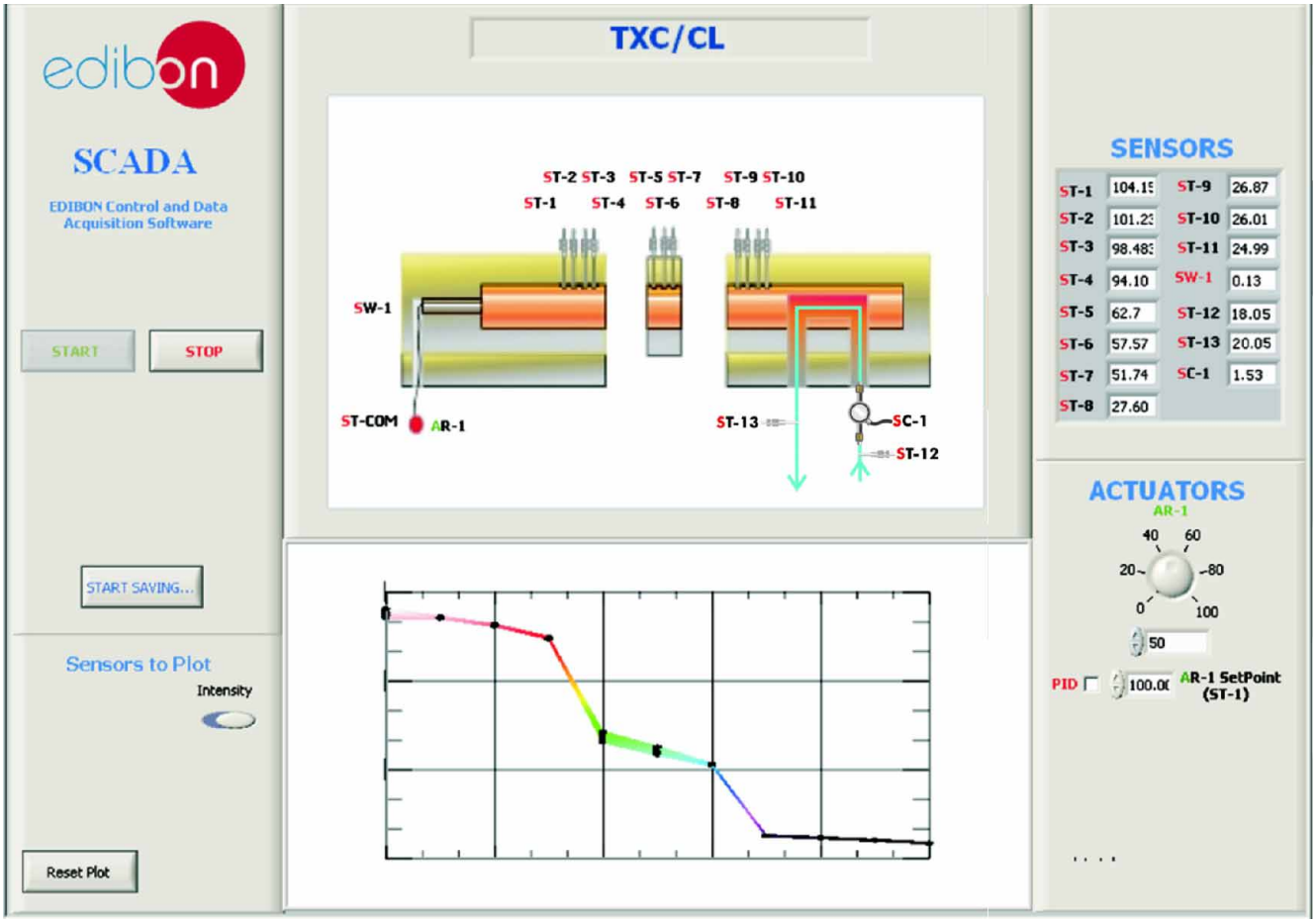
Items available on request

⑧TSTCC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

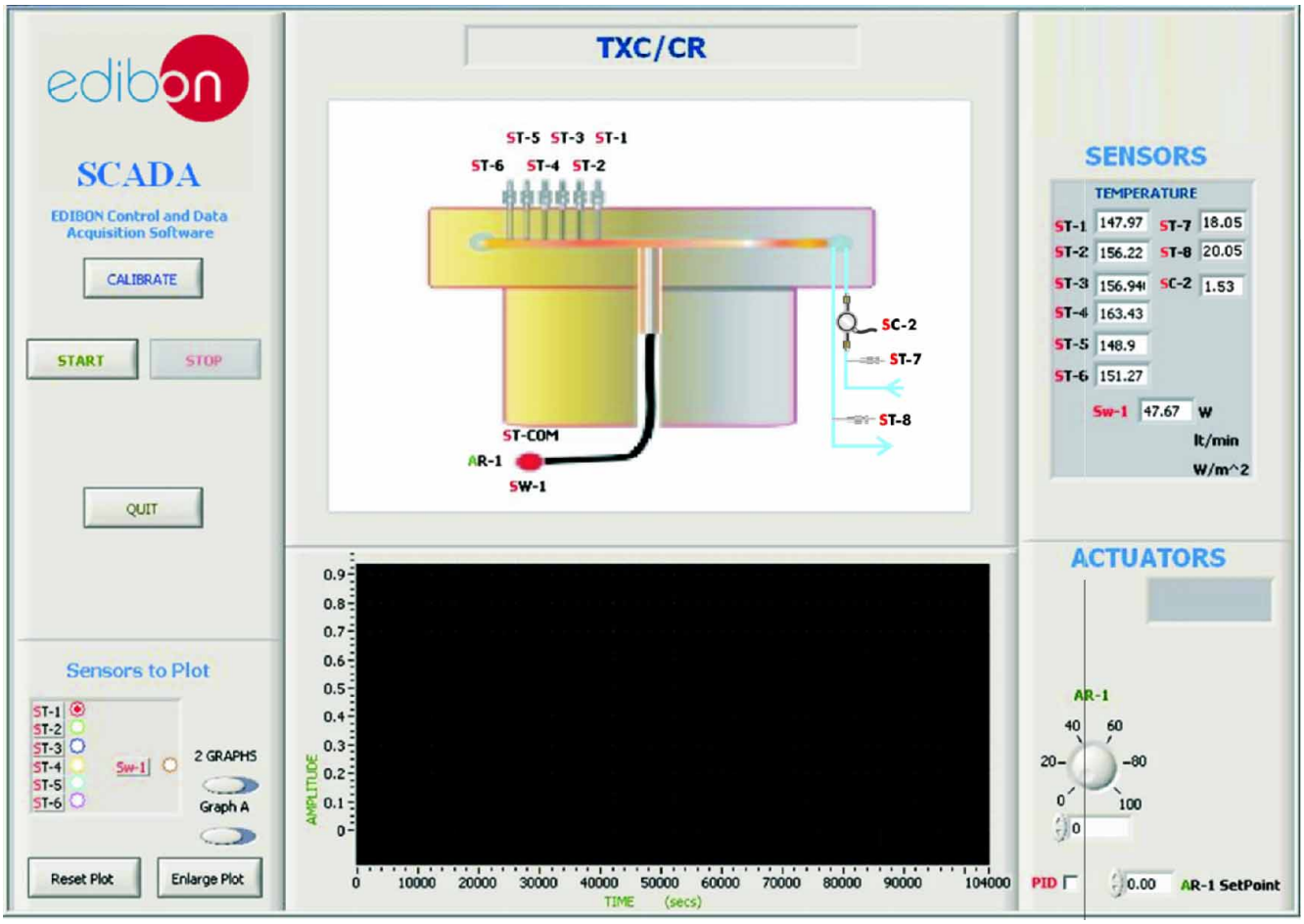
⑨TSTCC/FSS. Faults Simulation System.

Software Main Screens

Linear Heat Conduction Module (TXC/CL) Main Screen



Radial Heat Conduction Module (TXC/CR) Main Screen

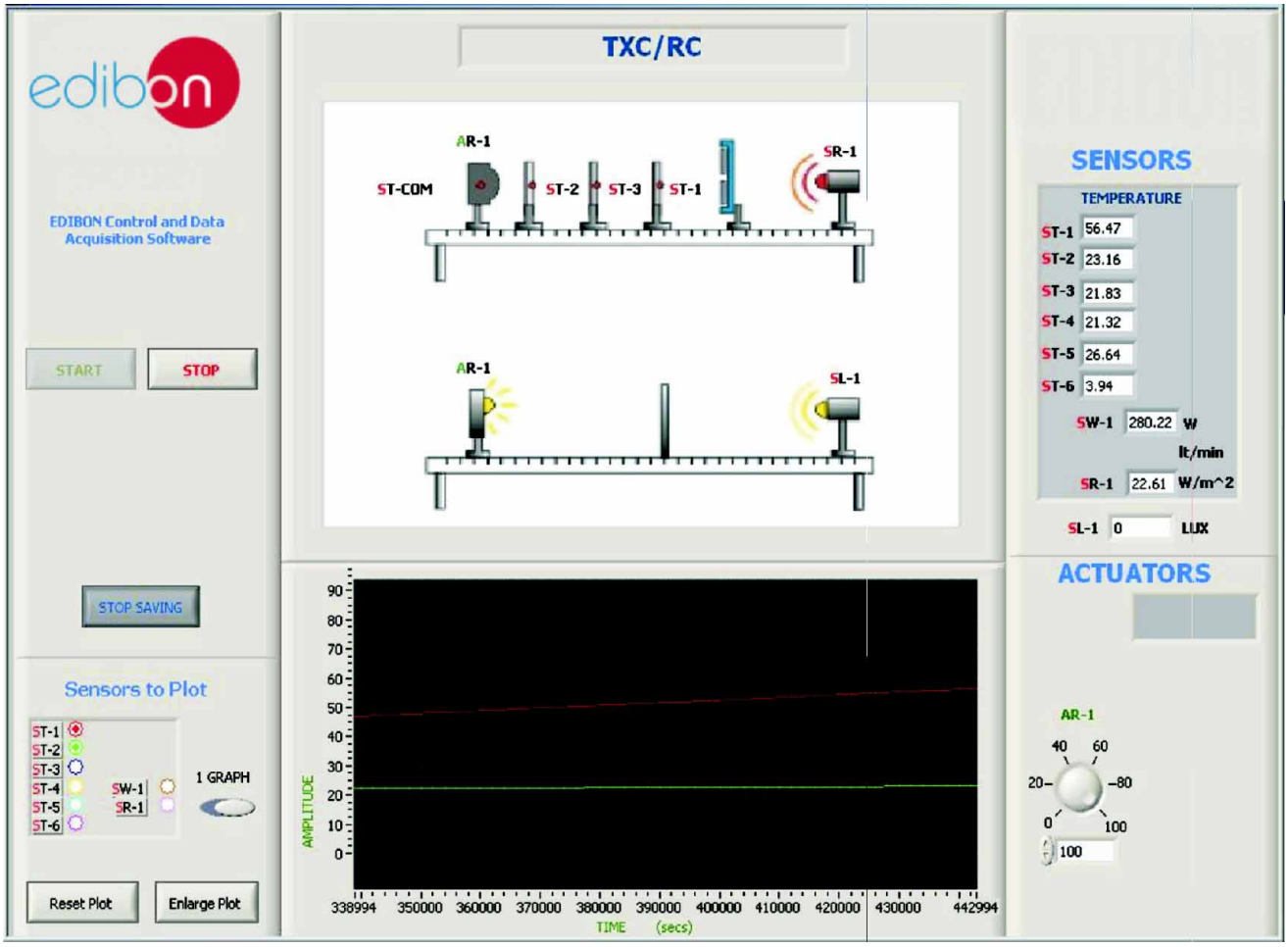


Note: ST= Temperature sensor. SC= Flow sensor. AR= Heating resistance. SW= Power sensor

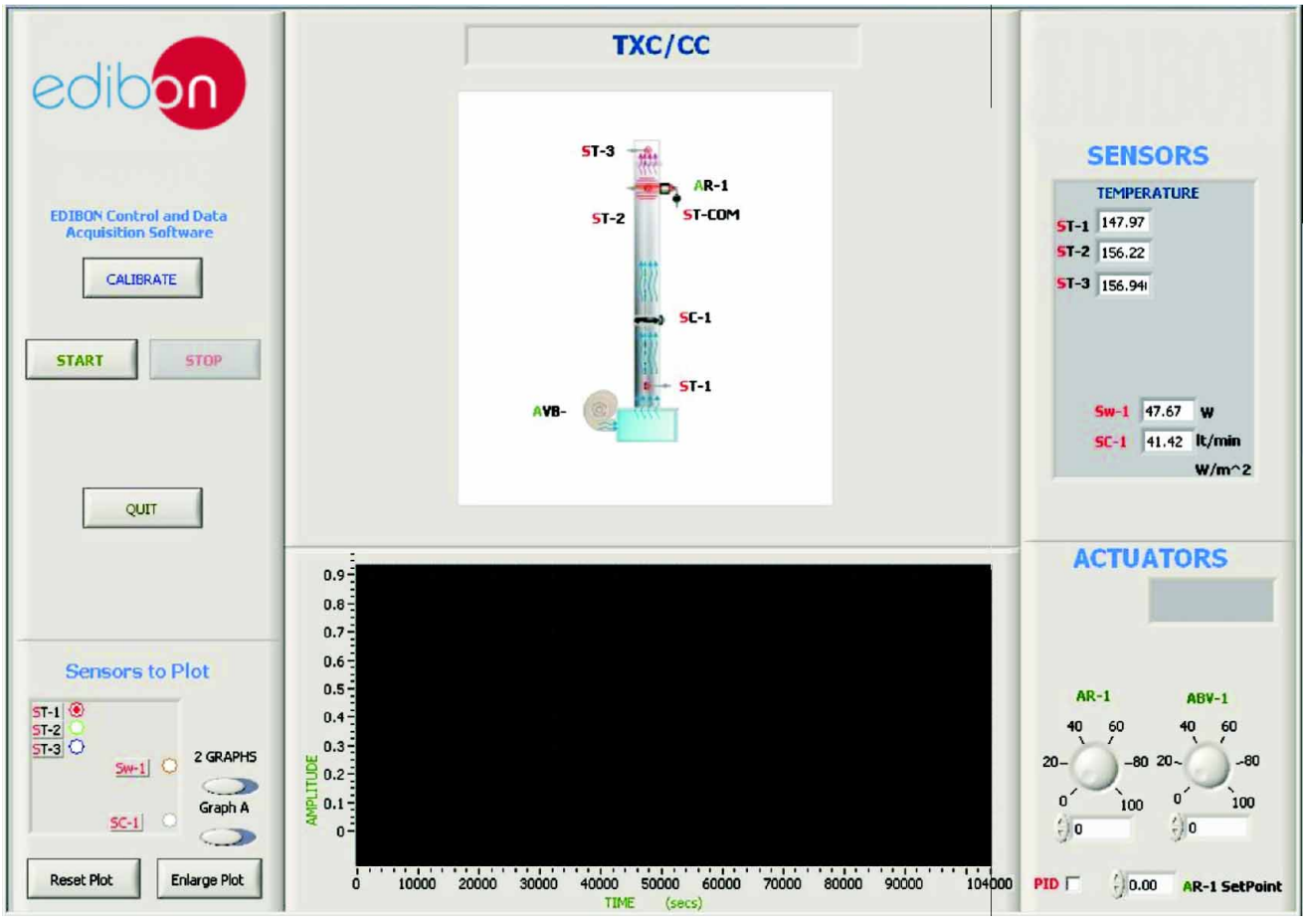
Continue...

Software Main Screens (continuation)

Radiation Heat Conduction Module (TXC/RC) Main Screen



Combined Free and Forced Convection and Radiation Module (TXC/CC) Main Screen

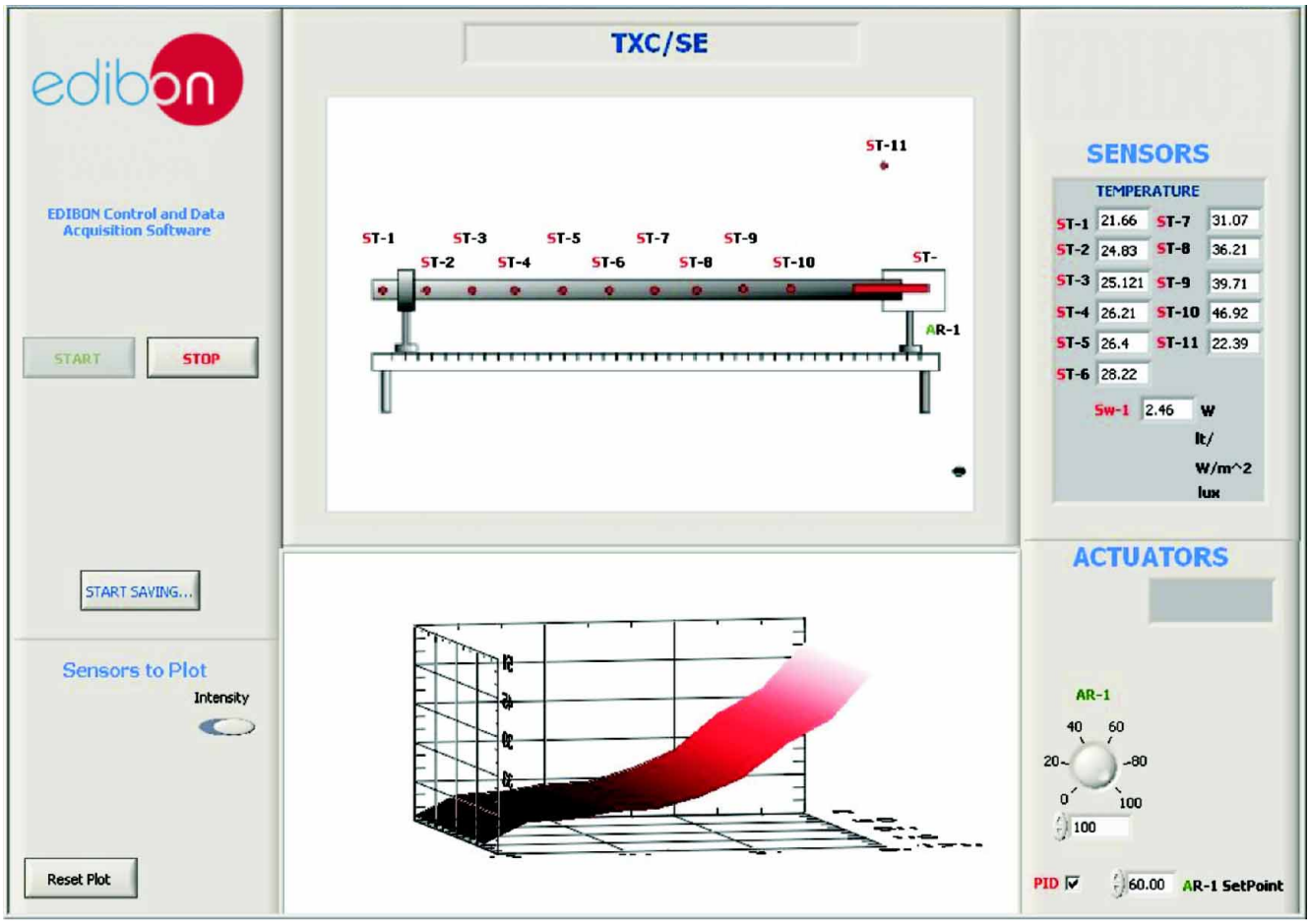


Note: ST= Temperature sensor. SC= Flow sensor. AR= Heating resistance. SW= Power sensor. SR= Radio meter. SL= Lux meter. AVB= Fan

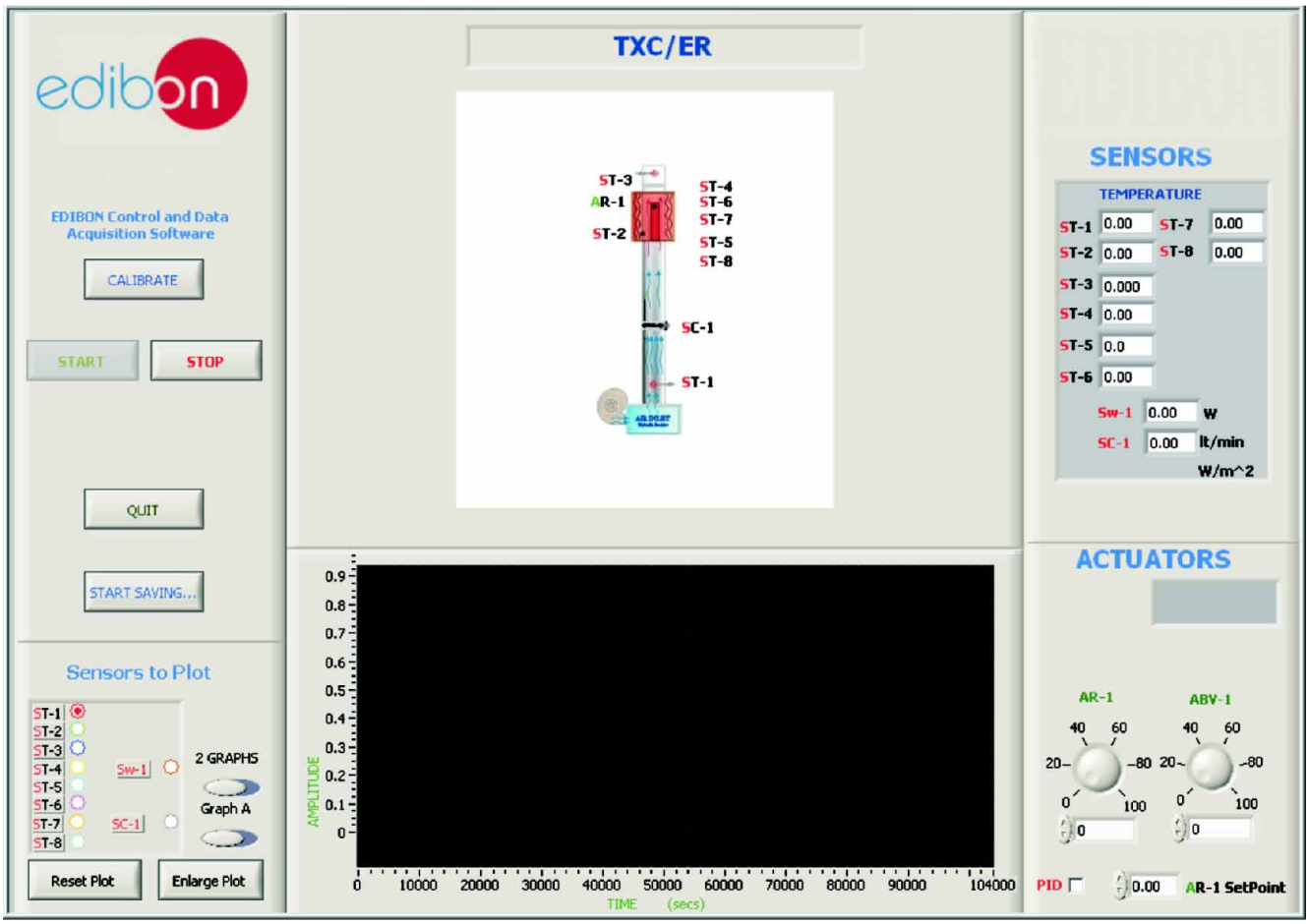
Continue...

Software Main Screens (continuation)

Extended Surface Heat Transfer Module (TXC/SE) Main Screen



Radiation Errors in Temperature Measurement Module (TXC/ER) Main Screen

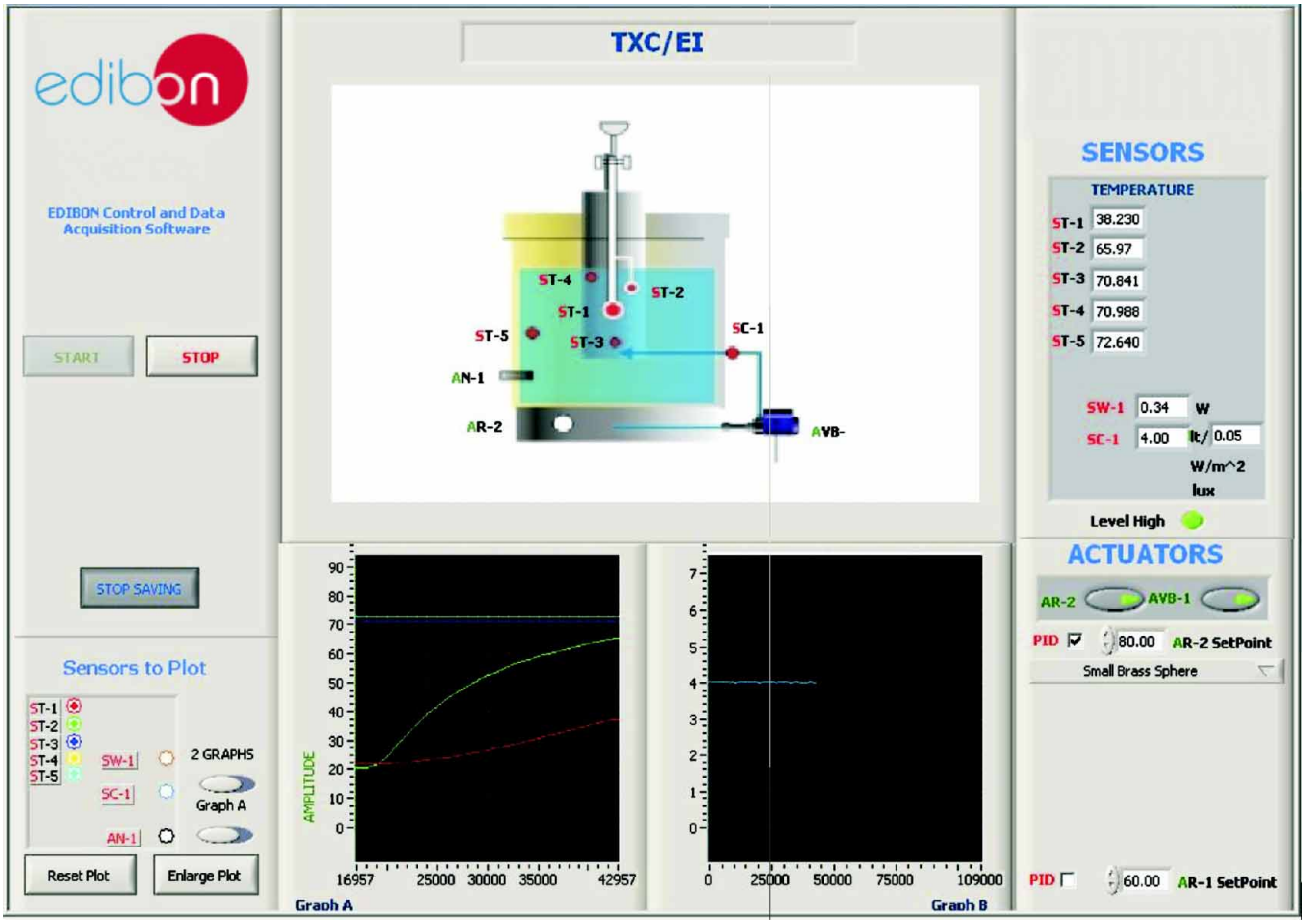


Note: ST= Temperature sensor. SC= Flow sensor. AR= Heating resistance. SW= Power sensor. ABV= Fan.

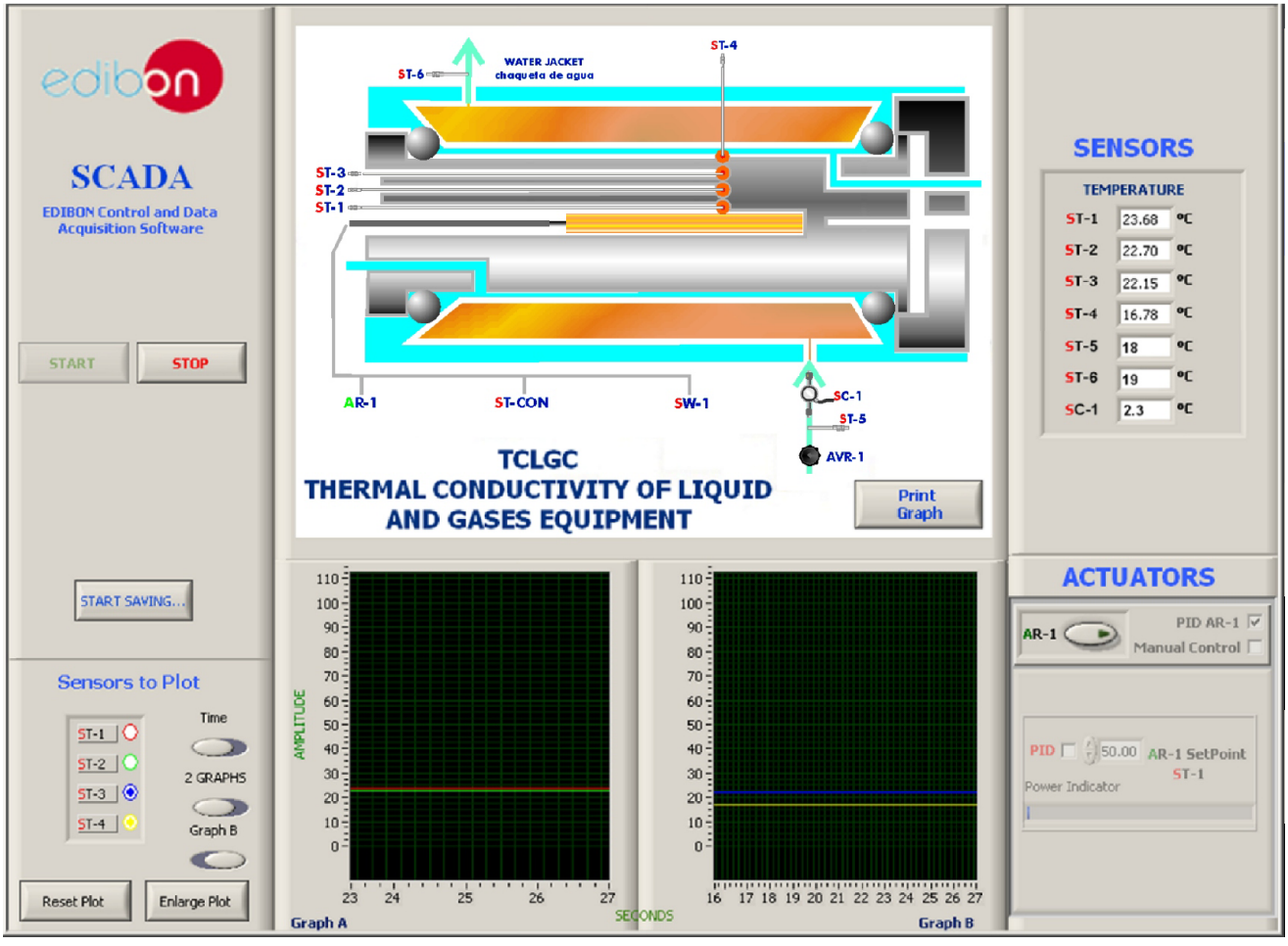
Continue...

Software Main Screens (continuation)

Unsteady State Heat Transfer Module (TXC/EI) Main Screen



Thermal Conductivity of Liquids and Gases Module (TXC/LG) Main Screen

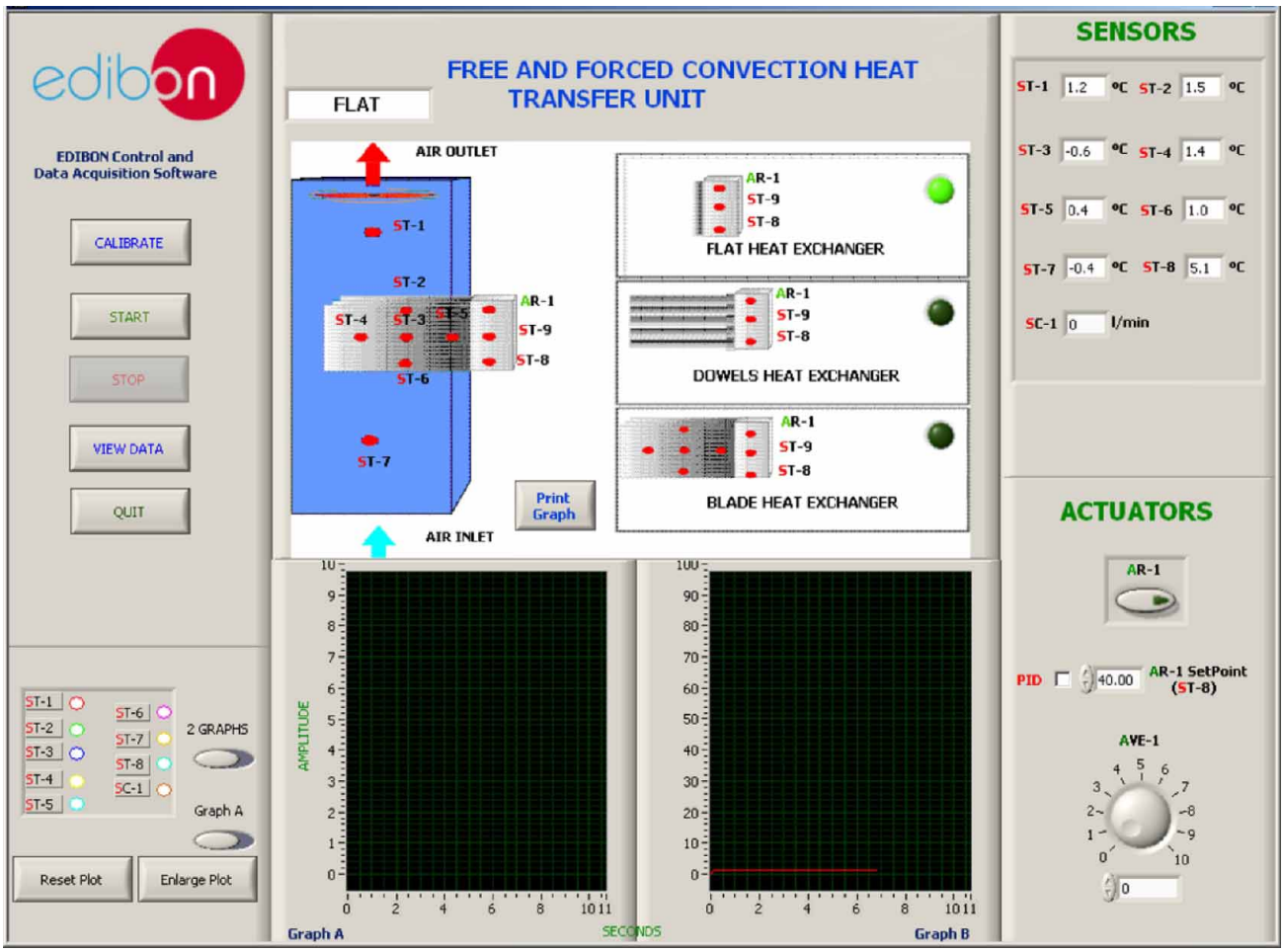


Note: ST= Temperature sensor. SC= Flow sensor. AR= Heating resistance. SW= Power sensor. AVB= Pump.

Continue...

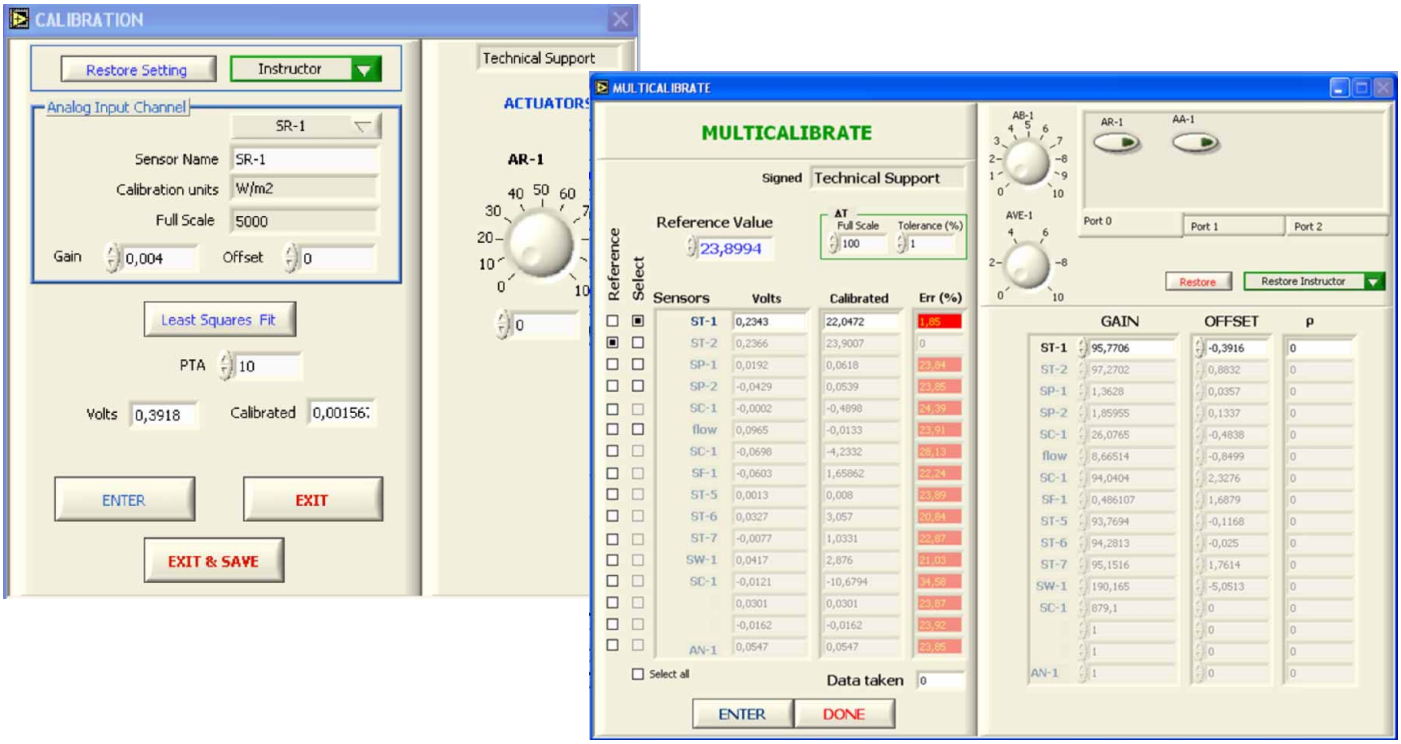
Software Main Screens (continuation)

Free and Forced Convection Heat Transfer Module (TXC/FF) Main Screen



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

Examples of Sensors Calibration Screens



Some Practical Possibilities of the System:

Practices to be done with the Linear Heat Conduction Module (TXC/CL):

1.- Conduction through a simple bar.
2.- Conduction through a compound bar.
3.- Determination of the thermal conductivity "k" of different materials (conductors and insulators).
4.- The thermal conductivity properties of insulators may be found by inserting paper or other elements between the heating and cooling sections.
5.- Insulation effect.
6.- Determination of the thermal contact resistance R_{tc}.
7.- Effect of the crossing sectional area.
8.- Understanding the use of the Fourier equation in determining rate of heat flow through solid materials.
9.- Observing unsteady-state conduction.
10.- Calibration of the temperature sensors.

Practices to be done by PLC Module (PLC-PI)+PLC Control Software:

11.- Control of the TXC/CL unit process through the control interface box without the computer.
12.- Visualization of all the sensors values used in the TXC/CL unit process.
13.- Calibration of all sensors included in the TXC/CL unit process.
14.- Hand on of all the actuators involved in the TXC/CL unit process.
15.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
16.- 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).
17.- PLC hardware general use and manipulation.
18.- PLC process application for TXC/CL unit.
19.- PLC structure.
20.- PLC inputs and outputs configuration.
21.- PLC configuration possibilities.
22.- PLC program languages.
23.- PLC different programming standard languages (literal structured, graphic, etc.).
24.- New configuration and development of new process.
25.- Hand on an established process.
26.- To visualize and see the results and to make comparisons with the TXC/CL unit process.
27.- Possibility of creating new process in relation with the TXC/CL unit.
28.- PLC Programming Exercises.
29.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with the Radial Heat Conduction Module (TXC/CR):

30.- Radial conduction.
31.- Determination of the thermal conductivity "k".
32.- Determination of the thermal contact resistance R_{tc}.
33.- Effect of the crossing sectional area.
34.- Insulation effect.
35.- Understanding the use of the Fourier equation in determining rate of heat flow through solid materials.
36.- Calibration of the temperature sensors.

Practices to be done by PLC Module (PLC-PI)+PLC Control Software:

37.- Control of the TXC/CR unit process through the control interface box without the computer.
38.- Visualization of all the sensors values used in the TXC/CR unit process.
39.- Calibration of all sensors included in the TXC/CR unit process.
40.- Hand on of all the actuators involved in the TXC/CR unit process.
41.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
42.- 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).
43.- PLC hardware general use and manipulation.
44.- PLC process application for TXC/CR unit.
45.- PLC structure.
46.- PLC inputs and outputs configuration.
47.- PLC configuration possibilities.
48.- PLC program languages.
49.- PLC different programming standard languages (literal structured, graphic, etc.).
50.- New configuration and development of new process.
51.- Hand on an established process.
52.- To visualize and see the results and to make comparisons with the TXC/CR unit process.
53.- Possibility of creating new process in relation with the TXC/CR unit.
54.- PLC Programming Exercises.
55.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with the Radiation Heat Conduction Module (TXC/RC):

56.- Inverse of the distant square law for the radiation.
57.- Stefan Boltzmann Law.
58.- Emission power I.
59.- Emission power II.
60.- Kirchorff Law.
61.- Area factors.
62.- Inverse of the distant square law for the light.
63.- Lambert´s Cosine Law.
64.- Lambert Law of Absorption.
65.- Sensors calibration.

Practices to be done by PLC Module (PLC-PI)+PLC Control Software:

66.- Control of the TXC/RC unit process through the control interface box without the computer.
67.- Visualization of all the sensors values used in the TXC/RC unit process.
68.- Calibration of all sensors included in the TXC/RC unit process.
69.- Hand on of all the actuators involved in the TXC/RC unit process.
70.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
71.- 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).
72.- PLC hardware general use and manipulation.
73.- PLC process application for TXC/RC unit.
74.- PLC structure.
75.- PLC inputs and outputs configuration.
76.- PLC configuration possibilities.
77.- PLC program languages.
78.- PLC different programming standard languages (literal structured, graphic, etc.).
79.- New configuration and development of new process.
80.- Hand on an established process.
81.- To visualize and see the results and to make comparisons with the TXC/RC unit process.
82.- Possibility of creating new process in relation with the TXC/RC unit.
83.- PLC Programming Exercises.
84.- Own PLC applications in accordance with teacher and student requirements.

Continue...

Some Practical Possibilities of the System: (continuation)

Practices to be done with the Combined Free and Forced Convection and Radiation Module (TXC/CC):

85.- Demonstration of the combined transmission effect of the radiation and convection on the surface of the cylinder. Determination of the combined transmission effect of heating by forced convection and radiation.

86.- Demonstration of the influence of air flow in the heating transfer. Determination of the combined transmission effect of heating by forced convection and radiation.

87.- Demonstration of the influence of input power in the heating transfer. Determination of the combined transmission effect of heating by forced convection and radiation.

88.- Demonstration of the combined transmission effect of the radiation and convection on the surface of the cylinder. Determination of the combined transmission effect of heating by free convection and radiation.

89.- Determination of the airflow.

90.- Control System: Temperature sensors calibration.

91.- Control System: Air flow sensor calibration.

Practices to be done by PLC Module (PLC-PI)+PLC Control Software:

92.- Control of the TXC/CC unit process through the control interface box without the computer.

93.- Visualization of all the sensors values used in the TXC/CC unit process.

94.- Calibration of all sensors included in the TXC/CC unit process.

95.- Hand on of all the actuators involved in the TXC/CC unit process.

96.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

97.- 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).

98.- PLC hardware general use and manipulation.

99.- PLC process application for TXC/CC unit.

100.- PLC structure.

101.- PLC inputs and outputs configuration.

102.- PLC configuration possibilities.

103.- PLC program languages.

104.- PLC different programming standard languages (literal structured, graphic, etc.).

105.- New configuration and development of new process.

106.- Hand on an established process.

107.- To visualize and see the results and to make comparisons with the TXC/CC unit process.

108.- Possibility of creating new process in relation with the TXC/CC unit.

109.- PLC Programming Exercises.

110.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with the Extended Surface Heat Transfer Module (TXC/SE):

111.- Heat transfer from a Fin.

112.- Effect of cross section shape in heat transfer from a Fin.

113.- Heat transfer from Fins of two different materials.

114.- Measuring the temperature distribution along an extended surface.

115.- Sensor calibration.

Practices to be done by PLC Module (PLC-PI)+PLC Control Software:

116.- Control of the TXC/SE unit process through the control interface box without the computer.

117.- Visualization of all the sensors values used in the TXC/SE unit process.

118.- Calibration of all sensors included in the TXC/SE unit process.

119.- Hand on of all the actuators involved in the TXC/SE unit process.

120.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

121.- 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).

122.- PLC hardware general use and manipulation.

123.- PLC process application for TXC/SE unit.

124.- PLC structure.

125.- PLC inputs and outputs configuration.

126.- PLC configuration possibilities.

127.- PLC program languages.

128.- PLC different programming standard languages (literal structured, graphic, etc.).

129.- New configuration and development of new process.

130.- Hand on an established process.

131.- To visualize and see the results and to make comparisons with the TXC/SE unit process.

132.- Possibility of creating new process in relation with the TXC/SE unit.

133.- PLC Programming Exercises.

134.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with the Radiation Errors in Temperature Measurement Module (TXC/ER):

135.- Radiation errors in temperature measurement.

136.- Measurement the errors in thermocouples in function of its painting, material of its capsules, size.

137.- Effect of air velocity on measurement error.

138.- Control System: Temperature sensors calibration.

139.- Control System: Air flow sensors calibration.

Practices to be done by PLC Module (PLC-PI)+PLC Control Software:

140.- Control of the TXC/ER unit process through the control interface box without the computer.

141.- Visualization of all the sensors values used in the TXC/ER unit process.

142.- Calibration of all sensors included in the TXC/ER unit process.

143.- Hand on of all the actuators involved in the TXC/ER unit process.

144.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

145.- 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).

146.- PLC hardware general use and manipulation.

147.- PLC process application for TXC/ER unit.

148.- PLC structure.

149.- PLC inputs and outputs configuration.

150.- PLC configuration possibilities.

151.- PLC program languages.

152.- PLC different programming standard languages (literal structured, graphic, etc.).

153.- New configuration and development of new process.

154.- Hand on an established process.

155.- To visualize and see the results and to make comparisons with the TXC/ER unit process.

156.- Possibility of creating new process in relation with the TXC/ER unit.

157.- PLC Programming Exercises.

158.- Own PLC applications in accordance with teacher and student requirements.

Continue...

Some Practical Possibilities of the System: (continuation)

Practices to be done with the Unsteady State Heat Transfer Module (TXC/EI):

159.- Predicting temperature at the center of a cylinder using transient conduction with convection.

160.- Predicting the conductivity of a similar shape constructed from a different material.

161.- Conductivity and temperature dependence on volume.

162.- Conductivity and temperature dependence on surrounding temperature T_{∞}.

163.- Sensors calibration.

Practices to be done by PLC Module (PLC-PI) + PLC Control Software:

164.- Control of the TXC/EI unit process through the control interface box without the computer.

165.- Visualization of all the sensors values used in the TXC/EI unit process.

166.- Calibration of all sensors included in the TXC/EI unit process.

167.- Hand on of all the actuators involved in the TXC/EI unit process.

168.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

169.- 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).

170.- PLC hardware general use and manipulation.

171.- PLC process application for TXC/EI unit.

172.- PLC structure.

173.- PLC inputs and outputs configuration.

174.- PLC configuration possibilities.

175.- PLC program languages.

176.- PLC different programming standard languages (literal structured, graphic, etc.).

177.- New configuration and development of new process.

178.- Hand on an established process.

179.- To visualize and see the results and to make comparisons with the TXC/EI unit process.

180.- Possibility of creating new process in relation with the TXC/EI unit.

181.- PLC Programming Exercises.

182.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with the Thermal Conductivity of Liquids and Gases Module (TXC/LG):

183.- Obtaining of the curve of thermal conductivity of the air.

184.- Thermal conductivity in vacuum.

185.- Water thermal conductivity determination.

186.- Thermal conductivity determination of a mineral oil.

187.- Calibration of the Unit.

188.- Control System: Calibration of the sensors.

189.- Dry air thermal conductivity under atmospheric pressure.

Practices to be done by PLC Module (PLC-PI) + PLC Control Software:

190.- Control of the TXC/LG unit process through the control interface box without the computer.

191.- Visualization of all the sensors values used in the TXC/LG unit process.

192.- Calibration of all sensors included in the TXC/LG unit process.

193.- Hand on of all the actuators involved in the TXC/LG unit process.

194.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

195.- 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).

196.- PLC hardware general use and manipulation.

197.- PLC process application for TXC/LG unit.

198.- PLC structure.

199.- PLC inputs and outputs configuration.

200.- PLC configuration possibilities.

201.- PLC program languages.

202.- PLC different programming standard languages (literal structured, graphic, etc.).

203.- New configuration and development of new process.

204.- Hand on an established process.

205.- To visualize and see the results and to make comparisons with the TXC/LG unit process.

206.- Possibility of creating new process in relation with the TXC/LG unit.

207.- PLC Programming Exercises.

208.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with the Free and Forced Convection Heat Transfer Module (TXC/FF):

209.- Demonstration of the basic principles of free and forced convection.

210.- Comparison between free and forced convection.

211.- Free convection in flat surfaces.

212.- Forced convection in flat surfaces.

213.- Dependence of the heat transmission with the temperature.

214.- Dependence of the heat transmission with the speed of the fluid.

215.- Dependence of the heat transmission with the exchanger geometry.

216.- Temperature distribution in the additional surfaces.

217.- Study of the advantage of using spiked and bladed surfaces in heat transmission in free convection.

218.- Study of the advantage of using spiked and bladed surfaces in heat transmission in forced convection.

219.- Comparative study between the free convection of a horizontal surface and vertical surface.

220.- Sensors calibration.

Practices to be done by PLC Module (PLC-PI) + PLC Control Software:

221.- Control of the TXC/FF unit process through the control interface box without the computer.

222.- Visualization of all the sensors values used in the TXC/FF unit process.

223.- Calibration of all sensors included in the TXC/FF unit process.

224.- Hand on of all the actuators involved in the TXC/FF unit process.

225.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).

226.- 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).

227.- PLC hardware general use and manipulation.

228.- PLC process application for TXC/FF unit.

229.- PLC structure.

230.- PLC inputs and outputs configuration.

231.- PLC configuration possibilities.

232.- PLC program languages.

233.- PLC different programming standard languages (literal structured, graphic, etc.).

234.- New configuration and development of new process.

235.- Hand on an established process.

236.- To visualize and see the results and to make comparisons with the TXC/FF unit process.

237.- Possibility of creating new process in relation with the TXC/FF unit.

238.- PLC Programming Exercises.

239.- Own PLC applications in accordance with teacher and student requirements.

Continue...

Some Practical Possibilities of the System: (continuation)

Practices to be done with the 3 Axis Heat Transfer Module (TXC/TE):

240.- Calibration processes.
241.- Temperature sensors calibration.
242.- Determination of the thermal conductivity "k", through 3 axis.

Practices to be done by PLC Module (PLC-PI) + PLC Control Software:

243.- Control of the TXC/TE unit process through the control interface box without the computer.
244.- Visualization of all the sensors values used in the TXC/TE unit process.
245.- Calibration of all sensors included in the TXC/TE unit process.
246.- Hand on of all the actuators involved in the TXC/TE unit process.
247.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
248.- 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).
249.- PLC hardware general use and manipulation.
250.- PLC process application for TXC/TE unit.
251.- PLC structure.
252.- PLC inputs and outputs configuration.
253.- PLC configuration possibilities.
254.- PLC program languages.
255.- PLC different programming standard languages (literal structured, graphic, etc.).
256.- New configuration and development of new process.
257.- Hand on an established process.
258.- To visualize and see the results and to make comparisons with the TXC/TE unit process.
259.- Possibility of creating new process in relation with the TXC/TE unit.
260.- PLC Programming Exercises.
261.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with the Metal to Metal Heat Transfer Module (TXC/MM):

262.- Calibration processes.
263.- Temperature sensors calibration.
264.- Determination of the thermal conductivity "k".
265.- Insulation effect.
266.- Determination of the thermal contact resistance.

Practices to be done by PLC Module (PLC-PI) + PLC Control Software:

267.- Control of the TXC/MM unit process through the control interface box without the computer.
268.- Visualization of all the sensors values used in the TXC/MM unit process.
269.- Calibration of all sensors included in the TXC/MM unit process.
270.- Hand on of all the actuators involved in the TXC/MM unit process.
271.- Realization of different experiments, in automatic way, without having in front the unit.(This experiment can be decided previously).
272.- 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).
273.- PLC hardware general use and manipulation.
274.- PLC process application for TXC/MM unit.
275.- PLC structure.
276.- PLC inputs and outputs configuration.
277.- PLC configuration possibilities.
278.- PLC program languages.
279.- PLC different programming standard languages (literal structured, graphic, etc.).
280.- New configuration and development of new process.
281.- Hand on an established process.
282.- To visualize and see the results and to make comparisons with the TXC/MM unit process.
283.- Possibility of creating new process in relation with the TXC/MM unit.
284.- PLC Programming Exercises.
285.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with the Ceramic Heat Transfer Module (TXC/TC):

286.- Calibration processes.
287.- Temperature sensors calibration.
288.- Determination of the thermal conductivity "k".
289.- Calculation of the heat transfer properties of specimens.

Practices to be done by PLC Module (PLC-PI) + PLC Control Software:

290.- Control of the TXC/TC unit process through the control interface box without the computer.
291.- Visualization of all the sensors values used in the TXC/TC unit process.
292.- Calibration of all sensors included in the TXC/TC unit process.
293.- Hand on of all the actuators involved in the TXC/TC unit process.
294.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
295.- 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).
296.- PLC hardware general use and manipulation.
297.- PLC process application for TXC/TC unit.
298.- PLC structure.
299.- PLC inputs and outputs configuration.
300.- PLC configuration possibilities.
301.- PLC program languages.
302.- PLC different programming standard languages (literal structured, graphic, etc.).
303.- New configuration and development of new process.
304.- Hand on an established process.
305.- To visualize and see the results and to make comparisons with the TXC/TC unit process.
306.- Possibility of creating new process in relation with the TXC/TC unit.
307.- PLC Programming Exercises.
308.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with the Isolated Material Heat Transfer Module (TXC/TI):

309.- Calibration processes.
310.- Temperature sensors calibration.
311.- Determination of the thermal conductivity "k".
312.- Calculation of the heat transfer properties of specimens.

Practices to be done by PLC Module (PLC-PI) + PLC Control Software:

313.- Control of the TXC/TI unit process through the control interface box without the computer.
314.- Visualization of all the sensors values used in the TXC/TI unit process.
315.- Calibration of all sensors included in the TXC/TI unit process.
316.- Hand on of all the actuators involved in the TXC/TI unit process.
317.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
318.- 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).
319.- PLC hardware general use and manipulation.
320.- PLC process application for TXC/TI unit.
321.- PLC structure.
322.- PLC inputs and outputs configuration.
323.- PLC configuration possibilities.
324.- PLC program languages.
325.- PLC different programming standard languages (literal structured, graphic, etc.).
326.- New configuration and development of new process.
327.- Hand on an established process.
328.- To visualize and see the results and to make comparisons with the TXC/TI unit process.
329.- Possibility of creating new process in relation with the TXC/TI unit.
330.- PLC Programming Exercises.
331.- Own PLC applications in accordance with teacher and student requirements.

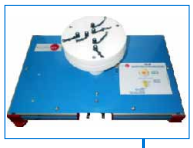
POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS

Expansion 1:

EDIBON PATENT

Teaching Technique used

⑩ Mini ESN. Multipost EDIBON Mini Scada-Net System



1 UNIT = 30 STUDENTS can work simultaneously

Heat Transfer Series: 13 available modules

Control Interface Box

Computer Control Software: Computer Control Data Acquisition+ Data Management

Teacher's Central Computer

Mini Scada-Net Software

30 Student Post

LOCAL NET

OPEN CONTROL + MULTICONTROL + MULTI STUDENT POST

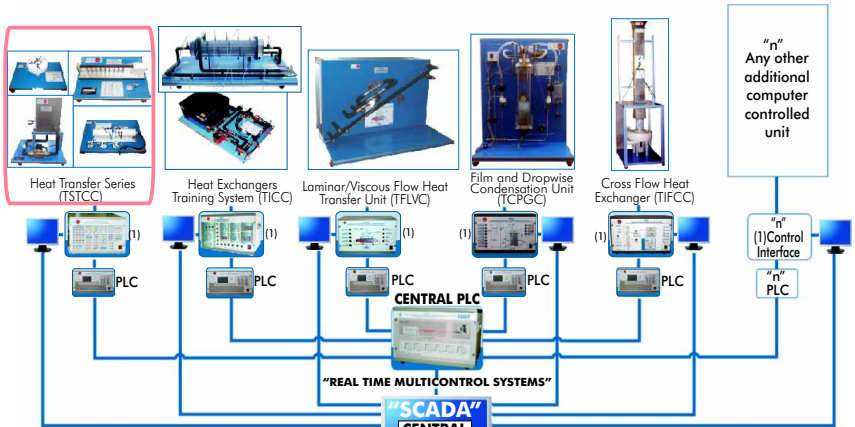
Note: The Mini ESN system can be used with any EDIBON computer controlled unit.

Expansion 2:

EDIBON PATENT

Teaching Technique used

⑪ ESN. Multipost EDIBON Scada-Net System



OPEN CONTROL + MULTICONTROL + MULTI STUDENT POST

Note: The ESN system can use any EDIBON computer controlled unit.

ORDER INFORMATION

Items always supplied as minimum configuration

① **Available Modules:**

- ①.1 TXC/CL. **Linear Heat Conduction Module**, and/or
- ①.2 TXC/CR. **Radial Heat Conduction Module**, and/or
- ①.3 TXC/RC. **Radiation Heat Conduction Module**, and/or
- ①.4 TXC/CC. **Combined Free and Forced Convection and Radiation Module,** and/or
- ①.5 TXC/SE. **Extended Surface Heat Transfer Module**, and/or
- ①.6 TXC/ER. **Radiation Errors in Temperature Measurement Module**, and/or
- ①.7 TXC/EI. **Unsteady State Heat Transfer Module,** and/or
- ①.8 TXC/LG. **Thermal Conductivity of Liquids and Gases Module,** and/or
- ①.9 TXC/FF. **Free and Forced Convection Heat Transfer Module**, and/or
- ①.10 TXC/TE. **3 Axis Heat Transfer Module**, and/or
- ①.11 TXC/MM. **Metal to Metal Heat Transfer Module**, and/or
- ①.12 TXC/TC. **Ceramic Heat Transfer Module**, and/or
- ①.13 TXC/TI. **Isolated Material Heat Transfer Module.**

② TSTCC/CIB. **Control Interface Box.** (Common for Modules type "TXC" and can work with one or several modules).

③ DAB. **Data Acquisition Board**. (Common for Modules type "TXC").

④ **Cables and Accessories**, for normal operation.

⑤ **Manuals.**

Complementary items

PLC. Industrial Control using PLC (6 and 7):

⑥ PCL-PI. PLC Module.(Common for Modules type "TXC" and can work with one or several modules).

⑦ TSTCC/PLC-SOF. PLC Control Software. (Each module has its own Software).

⑧ TSTCC/CAL. Computer Aided Learning Software. (Results Calculation and Analysis). (Available on request).

⑨ TSTCC/FSS. Faults Simulation System. (Available on request).

Expansions

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

⑪ ESN. Multipost EDIBON Scada-Net System.

REQUIRED SERVICES

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

Water supply and drainage.

Computer (PC).

DIMENSIONS & WEIGHTS

TXC/CL Module:	-Dimensions: 400 x 300 x 300 mm. approx. -Weight: 20 Kg. approx.
TXC/CR Module:	-Dimensions: 400 x 300 x 300 mm. approx. -Weight: 20 Kg. approx.
TXC/RC Module:	-Dimensions: 1400 x 500 x 500 mm. approx. -Weight: 40 Kg. approx.
TXC/CC Module:	-Dimensions: 430 x 350 x 1300 mm. approx. -Weight: 50 Kg. approx.
TXC/SE Module:	-Dimensions: 600 x 300 x 175 mm. approx. -Weight: 20 Kg. approx.
TXC/ER Module:	-Dimensions: 430 x 350 x 1300 mm. approx. -Weight: 50 Kg. approx.
TXC/EI Module:	-Dimensions: 600 x 600 x 750 mm. approx. -Weight: 60 Kg. approx.
TXC/LG Module:	-Dimensions: 500 x 400 x 300 mm. approx. -Weight: 40 Kg. approx.
TXC/FF Module:	-Dimensions: 370 x 610 x 920 mm. approx. -Weight: 25 Kg. approx.
TXC/TE Module:	-Dimensions: 300 x 300 x 300 mm. approx. -Weight: 20 Kg. approx.
TXC/MM Module:	-Dimensions: 300 x 300 x 300 mm. approx. -Weight: 20 Kg. approx.
TXC/TC Module:	-Dimensions: 300 x 300 x 300 mm. approx. -Weight: 25 Kg. approx.
TXC/TI Module:	-Dimensions: 300 x 300 x 300 mm. approx. -Weight: 20 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.

AVAILABLE VERSIONS

Offered in this catalogue:

-TSTCC. Computer Controlled **Heat Transfer Series.**

Offered in other catalogue:

-TSTCB. **Heat Transfer Series.**

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

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