Computer Controlled **Contact Plate Freezer,**
with SCADA

TPCC

Teaching Technique used

EDIBON **SCADA** System

② Control Interface Box

③ Data Acquisition Board

④ Software for:
- Computer Control
- Data Acquisition
- Data Management

Computer
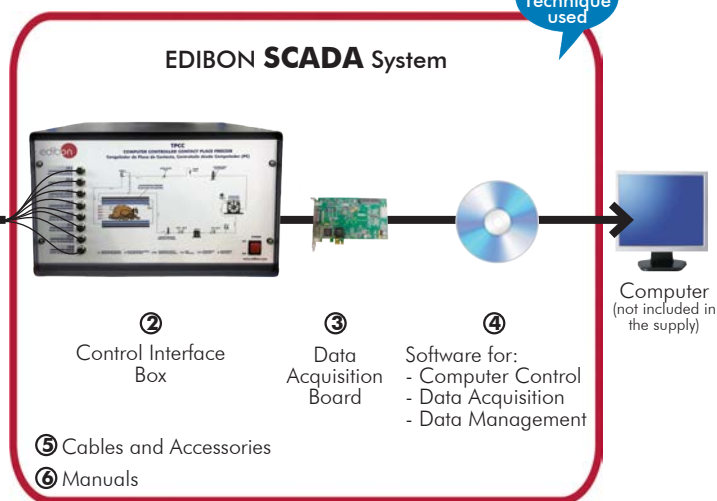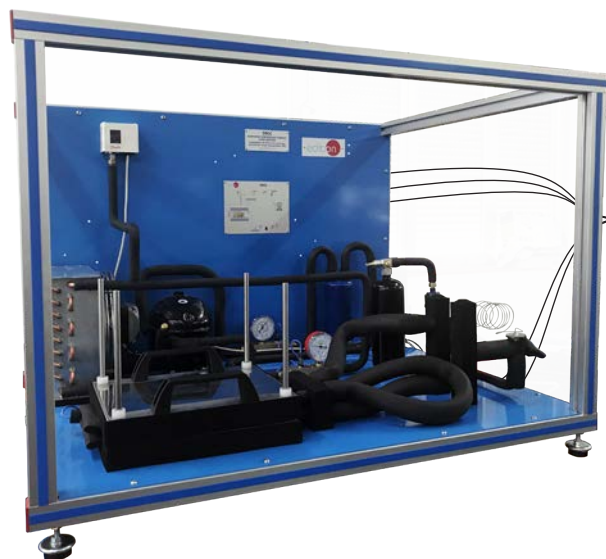(not included in the supply)

⑤ Cables and Accessories

⑥ Manuals

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

① Unit: TPCC. Computer Controlled Contact Plate Freezer

Key features:

➢ **Advanced Real-Time SCADA.**

➢ **Open Control + Multicontrol + Real-Time Control.**

➢ **Specialized EDIBON Control Software based on LabVIEW.**

➢ **National Instruments Data Acquisition board (250 KS/s, kilo samples per second).**

➢ **Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.**

➢ **Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.**

➢ **Capable of doing applied research, real industrial simulation, training courses, etc.**

➢ **Remote operation and control by the user and remote control for EDIBON technical support, are always included.**

➢ **Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).**

➢ **Designed and manufactured under several quality standards.**

➢ **Optional ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.**

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

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

POWERED BY
NATIONAL INSTRUMENTS
LabVIEW™

www.edibon.com
➢PRODUCTS
➢9.- THERMODYNAMICS
& THERMOTECHNICS
AND
12.-FOOD & WATER
TECHNOLOGIES

For more information about Key Features, click here

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INTRODUCTION

Keeping food at low temperatures is required to protect food against bacteriological or enzymatic activity that, at a higher temperature, can be quickly increased in such quantities that could cause diseases.

This low temperature maintenance is carried out by a compression refrigeration. It is based on mechanically forcing the circulation of a refrigerant through a closed circuit divided into two zones (high and low pressure), so that the fluid absorbs heat from the environment in a heat exchanger called evaporator (low pressure zone) and transfers heat in another heat exchanger called condenser (high pressure zone).

One of the industries where these refrigeration processes are most used is in the food industry. Within this industry, there are freezing processes applied to a wide variety of products, including meat, fish, seafood, vegetables, ready-cooked food or pastries.

There are three large groups of freezers in the industry: air blast freezers, direct contact freezer and indirect contact freezers.

One of the best known freezers is the contact plate freezer. It is a contact freezer formed by a series of horizontally or vertically arranged plates through which a refrigerant fluid circulates. The product to be frozen is placed between the plates. The refrigerant evaporates inside those plates.

The Computer Controlled Contact Plate Freezer, "TPCC", has been designed to introduce the student into the quick freezing processes, to study the advantages of these processes over other conventional freezing processes, as well as to study the thermodynamic process involved in those freezing technique.

GENERAL DESCRIPTION

The Computer Controlled Contact Plate Freezer, "TPCC", allow the student to freeze food products quickly by using an industrial freezing process.

The unit includes a compression refrigeration circuit. It is based on mechanically forcing the circulation of a refrigerant through a closed circuit divided into two zones (high and low pressure), so that the fluid absorbs heat from the environment in a heat exchanger called evaporator (low pressure zone) and transfers heat in another heat exchanger called condenser (high pressure zone).

The main elements of the unit are: a hermetic compressor, a condenser with computer controlled fan, an expansion valve and a contact plate freezer-evaporator.
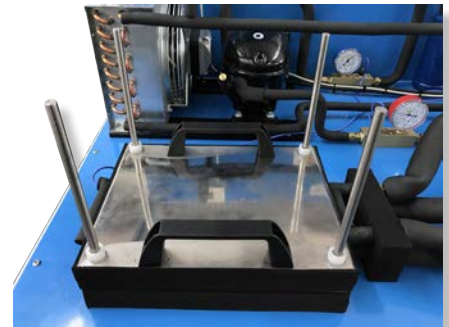
The contact plate freezer-evaporator consists of two freezing plates of 305 x178 mm. One is fixed and the other can be adjusted in height through two handles. The packaged food is placed on the fixed plate and can be frozen quickly.

Two temperature sensors and manometers are included to provide the conditions of the refrigerant at the inlet and outlet of the compressor. Besides, a temperature sensor located at the contact plate and five temperature sensors, which can be located in different points of the food product to be frozen, allow the student to monitor the product during the whole freezing process.

TPCC detail

In addition, the circuit includes a sight glass to observe the state of the refrigerant, a filter, a storage tank to ensure a proper flow of refrigerant in the circuit and a liquid separator to prevent liquid from entering the compressor.
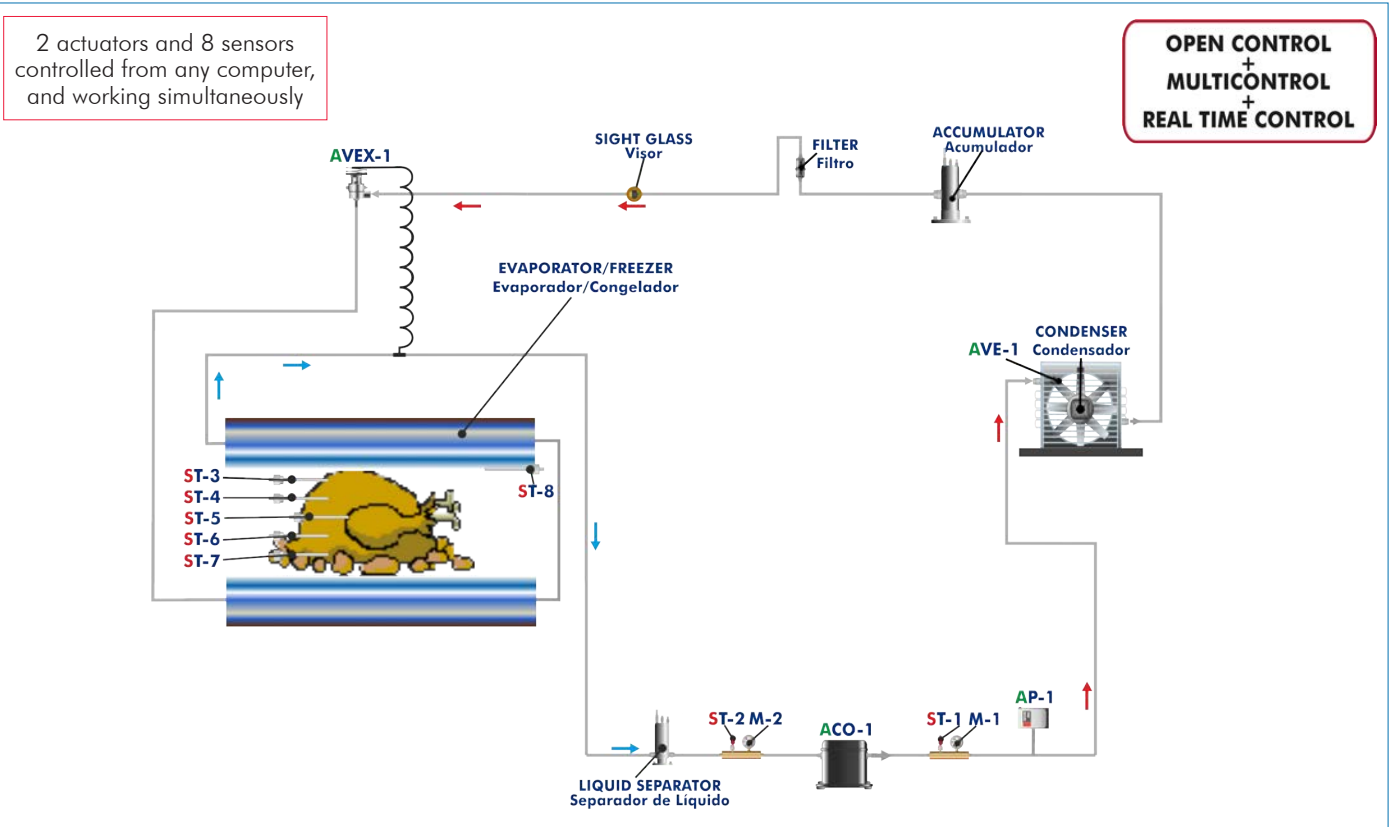
As a safety measure, the circuit includes a high pressure switch, which stops the cycle when the pressure is high.

This Computer Controlled Unit is supplied with the EDIBON Computer Control System (SCADA), and includes: The unit itself + a Control Interface Box + a Data Acquisition Board + Computer Control, Data Acquisition and Data Management Software Packages, for controlling the process and all parameters involved in the process.

PROCESS DIAGRAM AND UNIT ELEMENTS ALLOCATION

2 actuators and 8 sensors controlled from any computer, and working simultaneously

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

AVEX-1

SIGHT GLASS
Visor

FILTER
Filtro

ACCUMULATOR
Acumulador

EVAPORATOR/FREEZER
Evaporador/Congelador

CONDENSER
Condensador

AVE-1

ST-3
ST-4
ST-5
ST-6
ST-7

ST-8

AP-1

ST-2 M-2   ACO-1   ST-1 M-1

LIQUID SEPARATOR
Separador de Líquido

With this unit there are several options and possibilities:
- Main items: 1, 2, 3, 4, 5 and 6.
- Optional items: 7, 8, 9, 10 and 11.

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

① **TPCC. Unit:**

Bench-top unit.

Anodized aluminum frame and panels made of painted steel.

Main metallic elements made of stainless steel.

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

Compressor:

Type: hermetic.

Power: ½ CV.

Refrigerant: R-404a (environmentally friendly).

Condenser with computer controlled fan. Flow of air: 410 m³/h.

Storage tank. Capacity: 1.2 l.

Filter for refrigerant.

Sight glass for refrigerant.

Thermal expansion valve.

Contact plate freezer-evaporator:

Two cold contact plates. Dimensions: 305 x 178 mm. One is fixed and the other is adjustable in height (maximum height: 150 mm).

Two handles to adjust the upper plate.

High pressure switch, range: 8 – 32 bar.

Liquid separator to prevent liquid from entering the compressor, capacity: 0.73 l.

Two manometers:

High pressure manometer.

Low pressure manometer.

Five "J" type temperature sensors to monitor the temperature of the product during the whole freezing process.

"J" type temperature sensor to measure the temperature of the contact plate.

Two "J" type temperature sensors to measure the inlet and outlet temperature of the compressor.

Unit: TPCC

The complete unit includes as well:

Advanced Real-Time SCADA.

Open Control + Multicontrol + Real-Time Control.

Specialized EDIBON Control Software based on LabVIEW.

National Instruments Data Acquisition board (250 KS/s, kilo samples per second).

Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.

Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.

Capable of doing applied research, real industrial simulation, training courses, etc.

Remote operation and control by the user and remote control for EDIBON technical support, are always included.

Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).

Designed and manufactured under several quality standards.

Optional ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.

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

② TPCC/CIB. Control Interface Box:

The Control Interface Box is part of the SCADA system.

<u>Control interface box with process diagram in the front panel</u> and with the same distribution that the different elements located in the unit, for an easy understanding by the student.

All sensors, with their respective signals, are properly manipulated from -10V. to +10V. computer output.

Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors.

Single cable between the control interface box and computer.

The unit control elements are permanently computer controlled, without necessity of changes or connections during the whole process test procedure.

Simultaneous visualization in the computer of all parameters involved in the process.

Calibration of all sensors involved in the process.

Real time curves representation about system responses.

Storage of all the process data and results in a file.

Graphic representation, in real time, of all the process/system responses.

All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.

All the actuators and sensors values and their responses are displayed on only one screen in the computer.

Shield and filtered signals to avoid external interferences.

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

Real time computer control for pumps, compressors, heating elements, control valves, etc.

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

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

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

TPCC/CIB

③ DAB. Data Acquisition Board:

The Data Acquisition board is part of the SCADA system.

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

Analog input:

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

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

Input range (V)=±10 V. Data transfers=DMA, interrupts, programmed I/0. DMA channels=6.

Analog output:

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

Maximum output rate up to: 900 KS/s.

Output range (V)=±10 V. Data transfers=DMA, interrupts, programmed I/0.

Digital Input/Output:

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

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

DAB

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

The three softwares are part of the SCADA system.

Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. **Compatible with the industry standards.**

Registration and visualization of all process variables in an automatic and simultaneous way.

Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.

Management, processing, comparison and storage of data.

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

Calibration system for the sensors involved in the process.

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

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

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

This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.
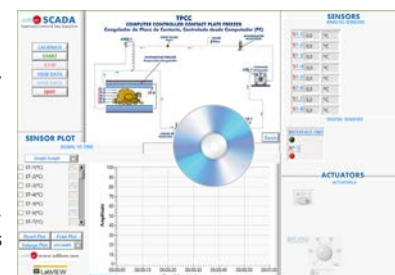
TPCC/CCSOF

⑤ Cables and Accessories, for normal operation.

⑥ Manuals:

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

✱References 1 to 6 are the main items: TPCC + TPCC/CIB + DAB + TPCC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply for enabling normal and full operation.

EXERCISES AND PRACTICAL POSSIBILITIES TO BE DONE WITH THE MAIN ITEMS

1.- Study of industrial freezing processes in terms of preservation and effects on food.

2.- Investigate the effect of the freezing process on the morphological characteristics of food: size, shape, etc.

3.- Differences between freezing at home and industrial freezing (deep-freezing).

4.- Assess the effect of freezing rates on food preservation.

5.- Thermodynamic description of the process through temperature sensors.

6.- Evaluation of taste and texture.

7.- Study of the structural, composition and sensory effects of deep-freezing and thawing process.

8.- Study of the fundamentals of a deep-freezing system.

9.- Study of the operation, structure and elements of a deep-freezing system.

10.-Analysis of the freezing curves.

11.-Analysis of the theoretical freezing times.

Additional practical possibilities:

12.-Connections with physics (refrigeration) and biology (structure of foods).

13.-Study the effect of the temperature on bacteria.

14.-Sensors calibration.

Other possibilities to be done with this Unit:

15.-Many students view results simultaneously.

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

16.-Open Control, Multicontrol and Real Time Control.

This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.

17.-The Computer Control System with SCADA allows a real industrial simulation.

18.-This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.

19.-This unit can be used for doing applied research.

20.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions.

21.-Control of the TPCC unit process through the control interface box without the computer.

22.-Visualization of all the sensors values used in the TPCC unit process.

- By using PLC-PI additional 19 more exercises can be done.

- Several other exercises can be done and designed by the user.

REQUIRED SERVICES

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

DIMENSIONS AND WEIGHTS

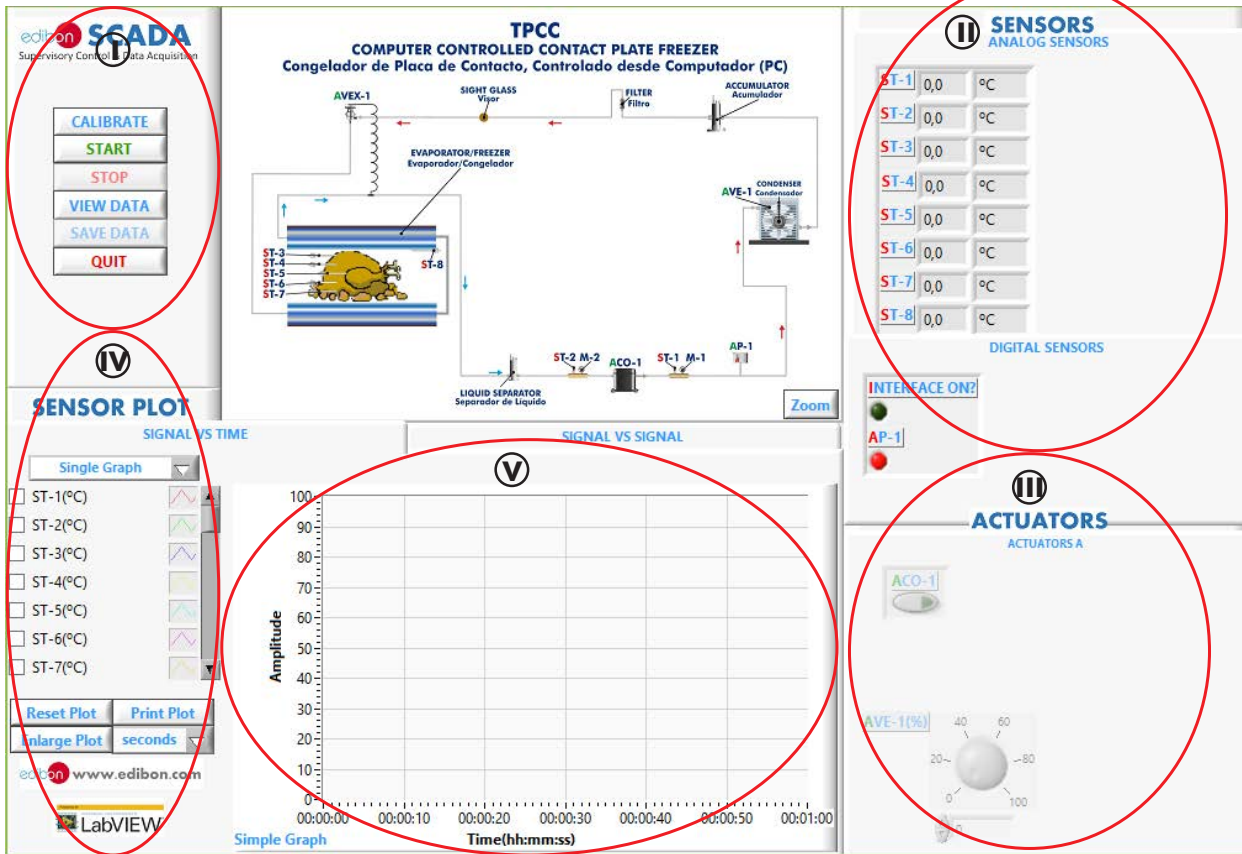TPCC:
  Unit:
      -Dimensions: 1000 x 750 x 650 mm approx.
            (39.36 x 29.52 x 25.59 inches approx.)
      -Weight: 50 kg approx.
            (110 pounds approx.)
  Control-Interface Box:
      -Dimensions: 490 x 330 x 310 mm approx.
            (19.29 x 12.99 x 12.20 inches approx.)
   -Weight: 10 kg approx.
            (22 pounds approx.)

SCADA
Main screen

Ⓘ Main software operation possibilities.

Ⓘ Ⓘ Sensors displays, real time values, and extra output parameters. **Sensors:** ST= Temperature sensor.

Ⓘ Ⓘ Ⓘ Actuators controls. **Actuators:** ACO-1= Compressor. AVE-1=Condenser. AP-1=High Pressure Control.

Ⓘ Ⓥ Channel selection and other plot parameters.

Ⓥ Real time graphics displays.

Software for Sensors Calibration
Example of screen
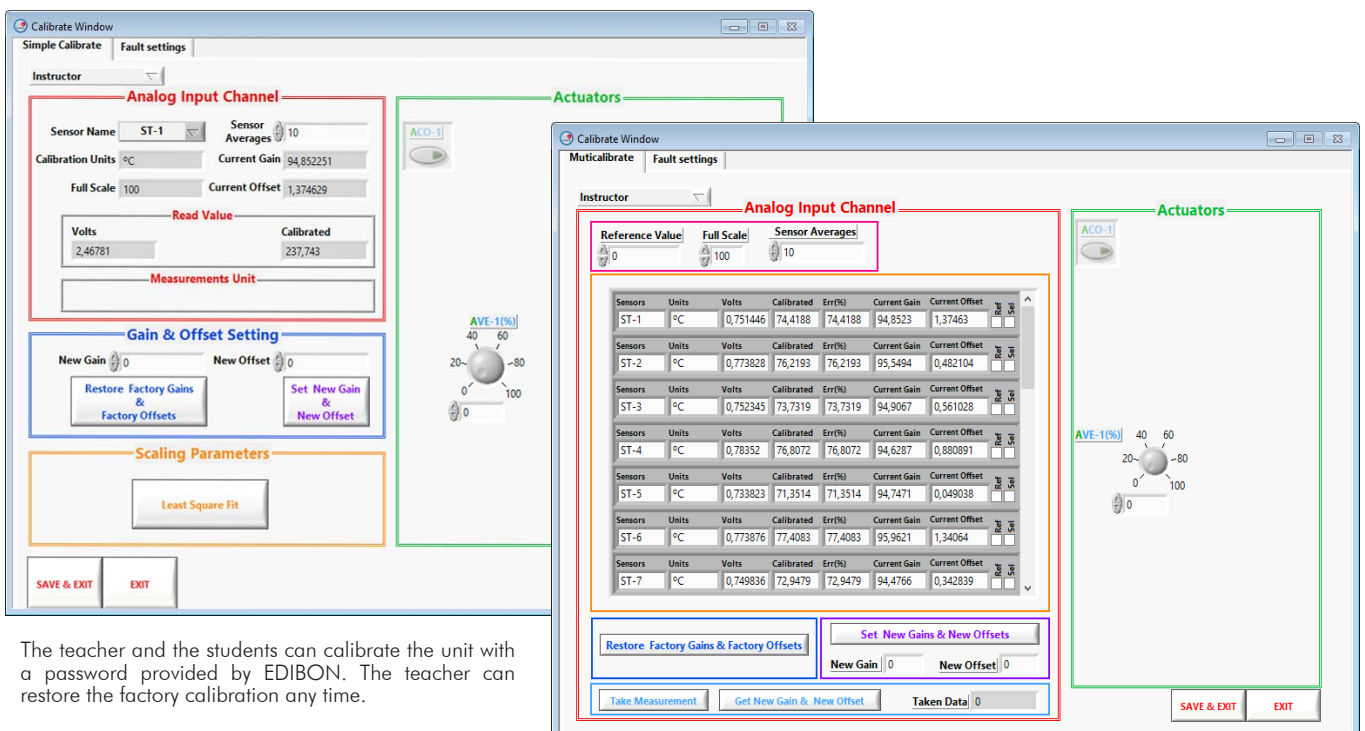
The teacher and the students can calibrate the unit with a password provided by EDIBON. The teacher can restore the factory calibration any time.

Representation in real time of the measured magnitudes. Representation of the inlet and outlet temperature of the compressor and the temperature in the center of the food product.
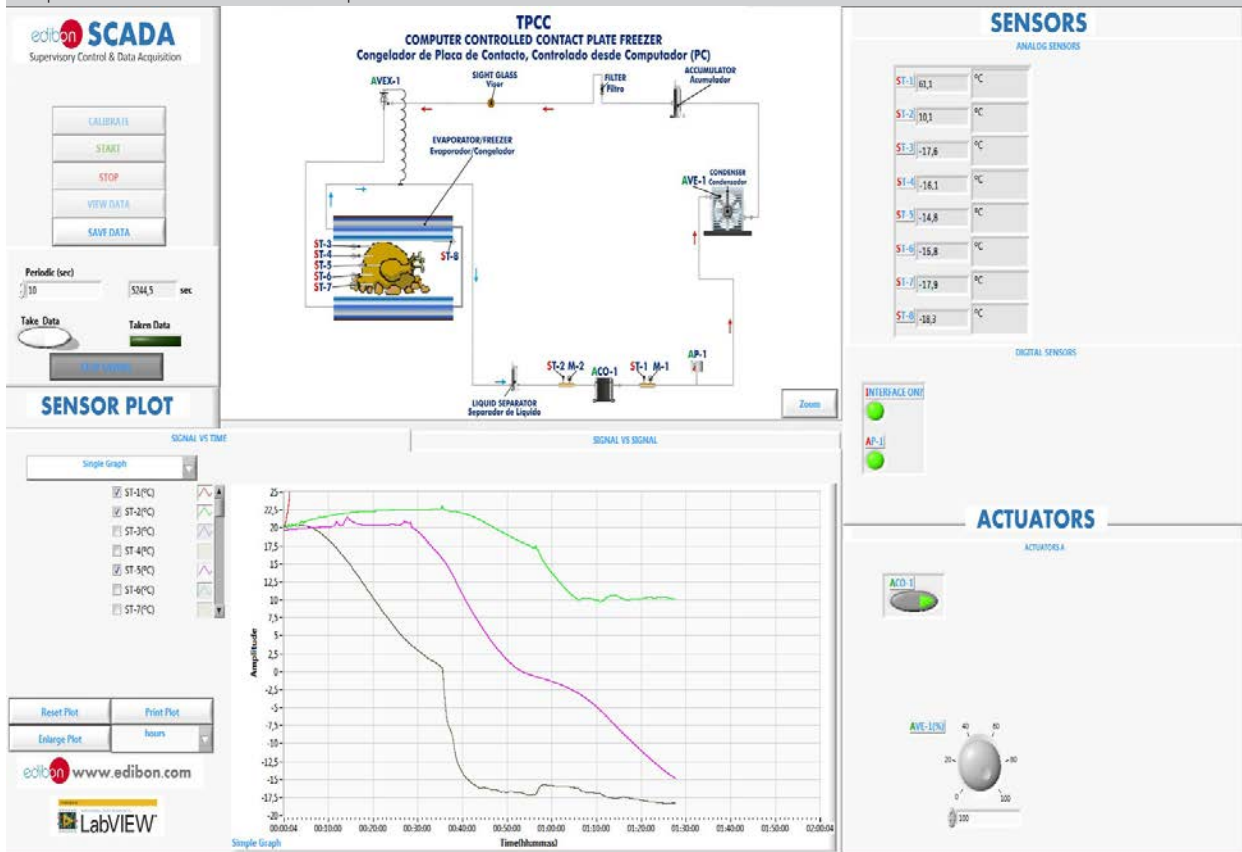
Representation in real time of the measured magnitudes. Freezing curve of a food product.
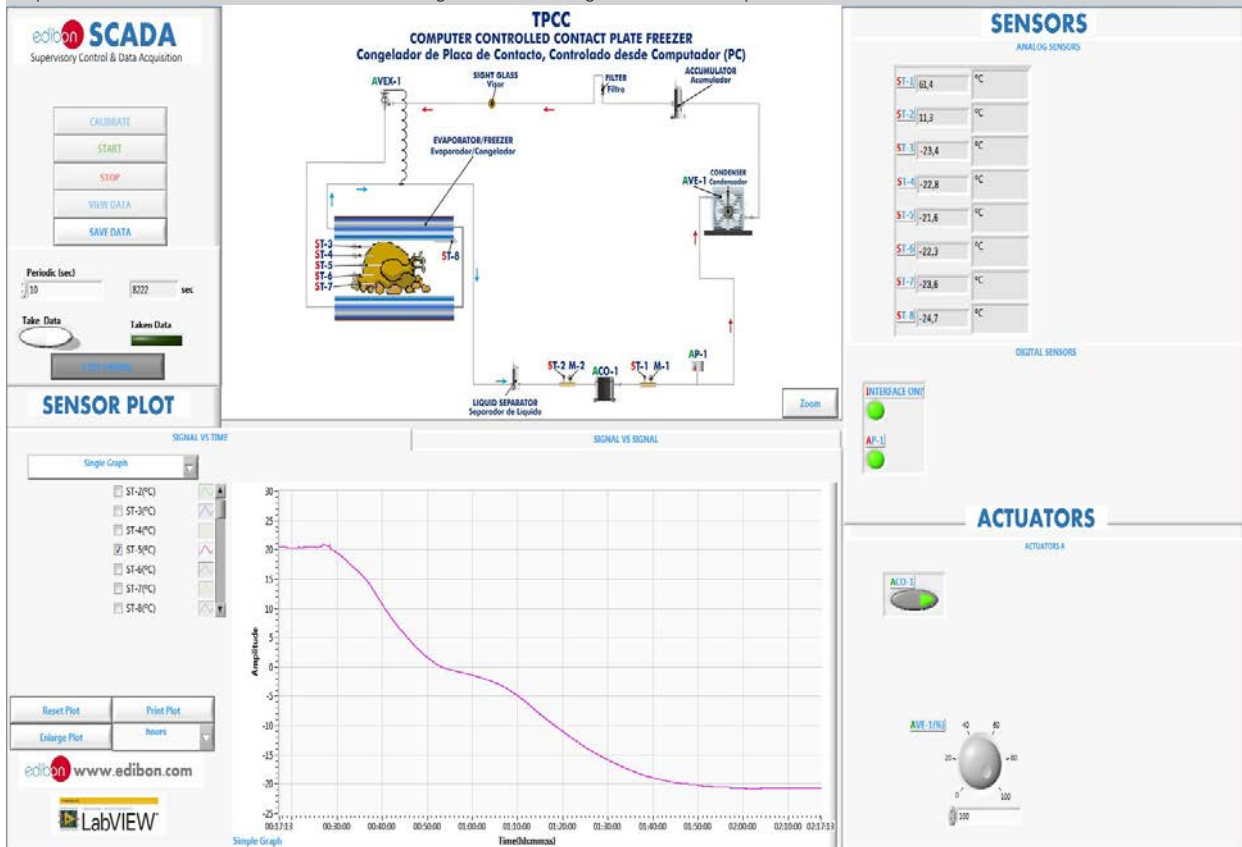
Some **real** results obtained from this Unit

Representation in real time of the measured magnitudes. Graphical comparison between the evolution of the contact plate temperature and the evolution of the temperature in the center of the food.
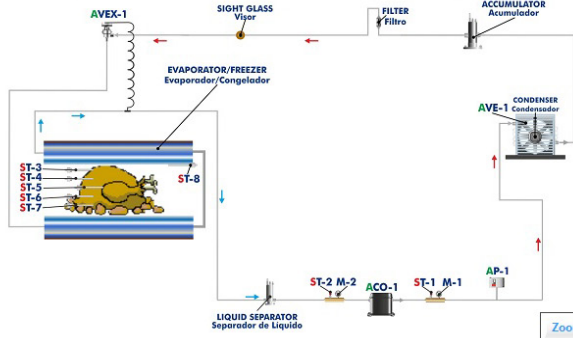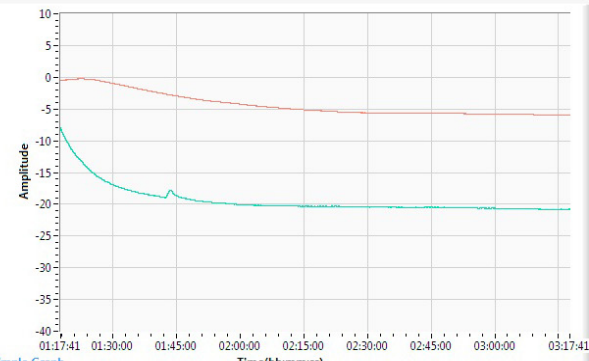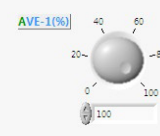

Visualization and representation of saved data.
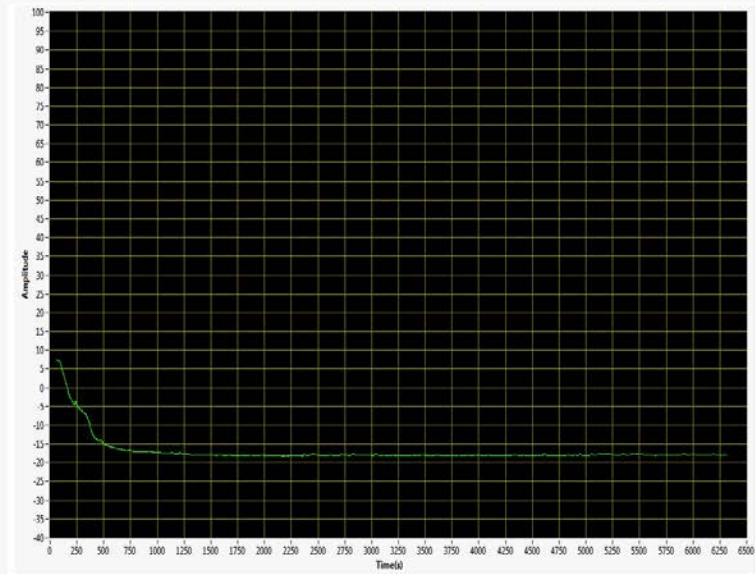
Additionally to the main items (1 to 6) described, we can offer, as optional, other items from 7 to 11.

All these items try to give more possibilities for:

   a) Industrial configuration. (PLC)

   b) Technical and Vocational Education configuration. (ICAI and FSS)

   c) Multipost Expansions options. (MINI ESN and ESN)

a) Industrial configuration

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

-PLC-PI. PLC Module:

Metallic box.

Circuit diagram in the module front panel.

Front panel:

   Digital inputs (X) and Digital outputs (Y) block:

      16 Digital inputs, activated by switches and 16 LEDs for confirmation (red).

      14 Digital outputs (through SCSI connector) with 14 LEDs for message (green).

   Analog inputs block:

      16 Analog inputs (-10 V. to + 10 V.) (through SCSI connector).

   Analog outputs block:

      4 Analog outputs (-10 V. to + 10 V.) (through SCSI connector).

   Touch screen:

      High visibility and multiple functions. Display of a highly visible status. Recipe function. Bar graph function. Flow display function. Alarm list. Multi language function. True type fonts.

Back panel:

   Power supply connector. Fuse 2A. RS-232 connector to PC. USB 2.0 connector to PC.

Inside:

   Power supply outputs: 24 Vdc, 12 Vdc, -12 Vdc, 12 Vdc variable.

   Panasonic PLC:

      High-speed scan of 0.32 μsec. for a basic instruction.

      Program capacity of 32 Ksteps, with a sufficient comment area.

      Power supply input (100 to 240 V AC).

      DC input: 16 (24 V DC).

      Relay output: 14.

      High-speed counter.

      Multi-point PID control.

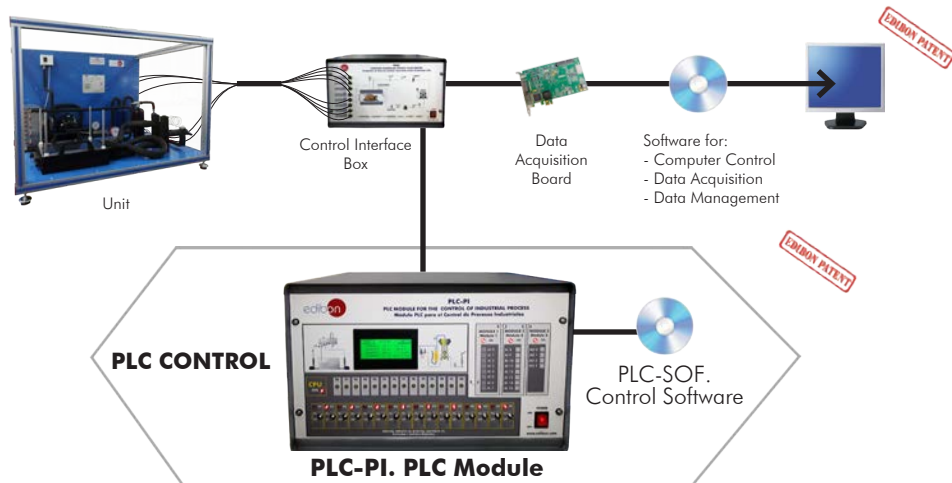   **Digital inputs/outputs and analog inputs/outputs Panasonic modules.**

Communication RS232 wire to computer (PC).

Dimensions: 490 x 330 x 310 mm. approx. (19.29 x 12.99 x 12.20 inches approx.). Weight: 30 Kg. approx. (66 pounds approx.).

-TPCC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

The software has been designed using Labview and it follows the unit operation procedure and linked with the Control Interface Box used in the Computer Controlled Contact Plate Freezer (TPCC).

Unit — Control Interface Box — Data Acquisition Board — Software for: - Computer Control - Data Acquisition - Data Management

PLC CONTROL — PLC-SOF. Control Software

PLC-PI. PLC Module

Practices to be done with PLC-PI:

1.- Control of the particular unit process through the control interface box without the computer.
2.- Visualization of all the sensors values used in the particular unit process.
3.- Calibration of all sensors included in the particular unit process.
4.- Hand on of all the actuators involved in the particular unit process.
5.- Realization of different experiments, in automatic way, without having in front the particular unit. (These experiments can be decided previously).
6.- Simulation of outside actions, in the cases do not exist hardware elements. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
7.- PLC hardware general use.
8.- PLC process application for the particular unit.
9.- PLC structure.
10.- PLC inputs and outputs configuration.
11.- PLC configuration possibilities.
12.- PLC program languages.

13.- PLC different programming standard languages (ladder diagram (LD), structured text (ST), instructions list (IL), sequential function chart (SFC), function block diagram (FBD)).
14.- New configuration and development of new process.
15.- Hand on an established process.
16.- To visualize and see the results and to make comparisons with the particular unit process.
17.- Possibility of creating new process in relation with the particular unit.
18.- PLC Programming Exercises.
19.- Own PLC applications in accordance with teacher and student requirements.

⑧ **TPCC/ICAI. Interactive Computer Aided Instruction Software System.**

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

This software is optional and can be used additionally to items (1 to 6).

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

• User Data Base Management.

• Administration and assignment of Workgroup, Task and Training sessions.

• Creation and Integration of Practical Exercises and Multimedia Resources.

• Custom Design of Evaluation Methods.

• Creation and assignment of Formulas & Equations.

• Equation System Solver Engine.

• Updatable Contents.

• Report generation, User Progression Monitoring and Statistics.

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

• Student Log-In & Self-Registration.

• Existing Tasks checking & Monitoring.

• Default contents & scheduled tasks available to be used from the first session.

• Practical Exercises accomplishment by following the Manual provided by EDIBON.

• Evaluation Methods to prove your knowledge and progression.

• Test self-correction.

• Calculations computing and plotting.

• Equation System Solver Engine.

• User Monitoring Learning & Printable Reports.

• Multimedia-Supported auxiliary resources.

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

www.edibon.com/en/files/expansion/ICAI/catalog

Instructor Software

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

ECAL. EDIBON Calculations Program Package - Formula Editor Screen

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

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

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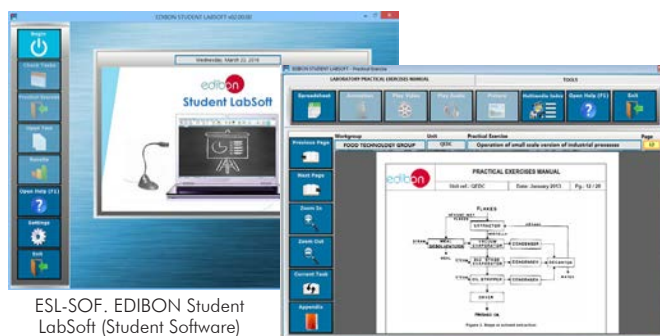
ESL-SOF. EDIBON Student LabSoft (Student Software) Application Main Screen

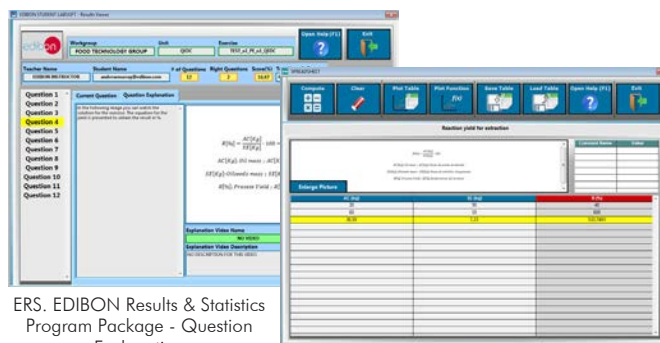EPE. EDIBON Practical Exercise Program Package Main Screen

ERS. EDIBON Results & Statistics Program Package - Question Explanation

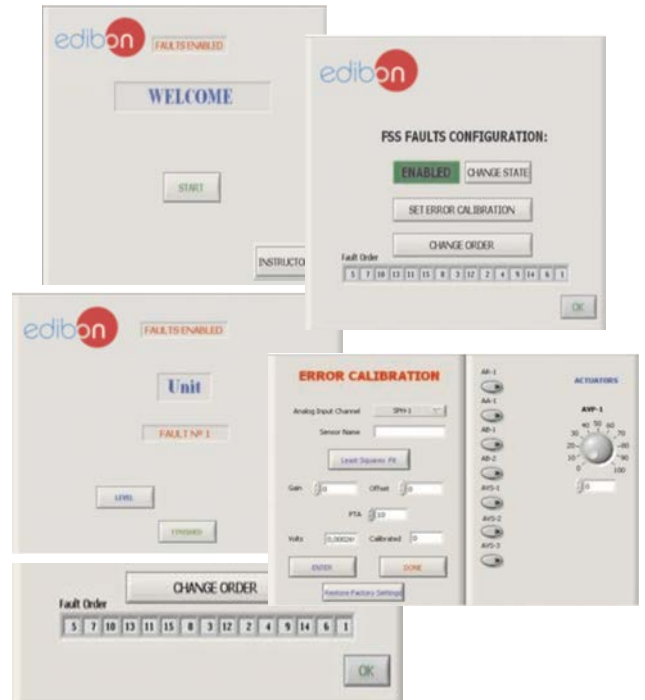ECAL. EDIBON Calculations Program Package Main Screen

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

Faults Simulation System (FSS) is a Software package that simulates **several faults** in any EDIBON Computer Controlled Unit. It is useful for Technical and Vocational level.

The "FAULTS" mode consists in causing several faults in the unit normal operation. The student must find them and solve them. There are several kinds of faults that can be grouped in the following sections:

Faults affecting the sensors measurement:

- An incorrect calibration is applied to them.

- Non-linearity.

Faults affecting the actuators:

- Actuators channels interchange at any time during the program execution.

- Response reduction of an actuator.

Faults in the controls execution:

- Inversion of the performance in ON/OFF controls.

- Reduction or increase of the calculated total response.

- The action of some controls is annulled.

On/off faults:

- Several on/off faults can be included.

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

www.edibon.com/en/files/expansion/FSS/catalog

Example of some screens

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c) Multipost Expansions options

⑩ **MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.**

MINI ESN. EDIBON Mini Scada-Net System allows up to 30 students to work with a Teaching Unit in any laboratory, simultaneously. It is useful for both, Higher Education and/or Technical and Vocational Education.

The MINI ESN system consists of the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit. Then, the number of possible users who can work with the same unit is higher than in an usual way of working (usually only one).

Main characteristics:

- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.

- Open Control + Multicontrol + Real Time Control + Multi Student Post.

- Instructor controls and explains to all students at the same time.

- Any user/student can work doing "real time" control/multicontrol and visualisation.

- Instructor can see in the computer what any user/student is doing in the unit.

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

Main advantages:

- It allows an easier and quicker understanding.

- This system allows you can save time and cost.

- Future expansions with more EDIBON Units.

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

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

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

1 UNIT= up to 30 STUDENTS can work simultaneously

Computer Controlled Contact Plate Freezer (TPCC)

Control Interface Box

Software for:
- Computer Control
- Data Acquisition
- Data Management

Instructors' Central Computer

Mini Scada-Net Software

LOCAL NET FOR 30 STUDENTS

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL
+
MULTI STUDENT POST

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

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⑪ **ESN. EDIBON Scada-Net Systems.**

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

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

www.edibon.com/en/files/expansion/ESN/catalog
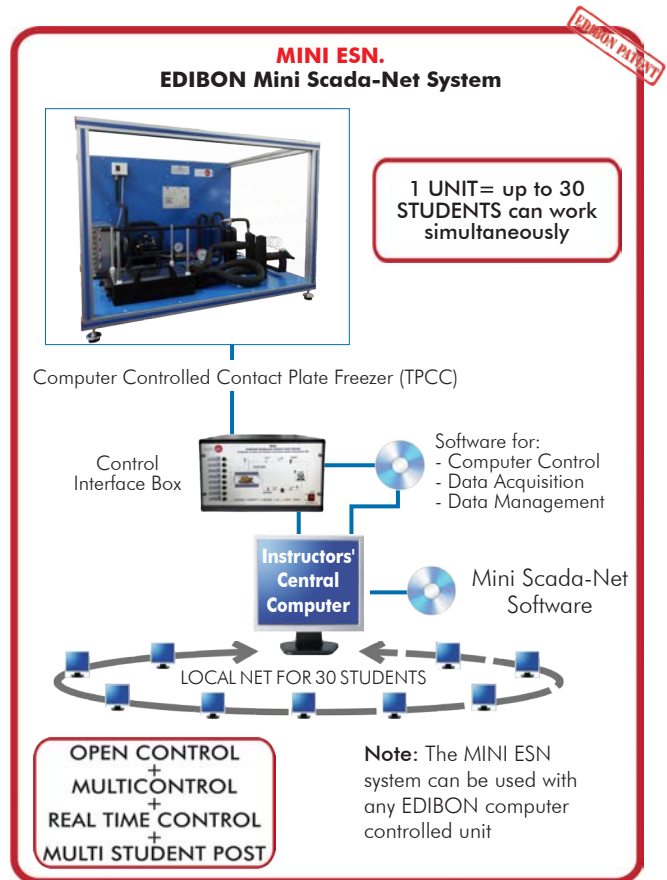
ORDER INFORMATION

Main items (always included in the supply)

Minimum supply always includes:

① **Unit: TPCC. Computer Controlled Contact Plate Freezer.**

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

③ **DAB. Data Acquisition Board.**

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

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

⑥ **Manuals.**

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

Optional items (supplied under specific order)

a) Industrial configuration

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

   - PCL-PI. PLC Module.

   - TPCC/PLC-SOF. PLC Control Software.

b) Technical and Vocational Education configuration

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

⑨ TPCC/FSS. Faults Simulation System.

c) Multipost Expansions options

⑩ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.

⑪ ESN. EDIBON Scada-Net Systems.

① TPCC. Unit:
Bench-top unit.
Anodized aluminum frame and panels made of painted steel.
Main metallic elements made of stainless steel.
Diagram in the front panel with distribution of the elements similar to the real one.
Compressor:
Type: hermetic.
Power: ½ CV.
Refrigerant: R-404a (environmentally friendly).
Condenser with computer controlled fan. Flow of air: 410 m³/h.
Storage tank. Capacity: 1.2 l.
Filter for refrigerant.
Sight glass for refrigerant.
Thermal expansion valve.
Contact plate freezer-evaporator:
Two cold contact plates. Dimensions: 305 x 178 mm. One is fixed and the other is adjustable in height (maximum height: 150 mm).
Two handles to adjust the upper plate.
High pressure switch, range: 8 – 32 bar.
Liquid separator to prevent liquid from entering the compressor, capacity: 0.73 l.
Two manometers:
High pressure manometer.
Low pressure manometer.
Five "J" type temperature sensors to monitor the temperature of the product during the whole freezing process.
"J" type temperature sensor to measure the temperature of the contact plate.
Two "J" type temperature sensors to measure the inlet and outlet temperature of the compressor.
The complete unit includes as well:
Advanced Real-Time SCADA.
Open Control + Multicontrol + Real-Time Control.
Specialized EDIBON Control Software based on LabVIEW.
National Instruments Data Acquisition board (250 KS/s, kilo samples per second).
Calibration exercises, which are included, teach the user how to calibrate a sensor and the importance of checking the accuracy of the sensors before taking measurements.
Projector and/or electronic whiteboard compatibility allows the unit to be explained and demonstrated to an entire class at one time.
Capable of doing applied research, real industrial simulation, training courses, etc.
Remote operation and control by the user and remote control for EDIBON technical support, are always included.
Totally safe, utilizing 4 safety systems (Mechanical, Electrical, Electronic & Software).
Designed and manufactured under several quality standards.
Optional ICAI software to create, edit and carry out practical exercises, tests, exams, calculations, etc. Apart from monitoring user's knowledge and progress reached.
This unit has been designed for future expansion and integration. A common expansion is the EDIBON Scada-Net (ESN) System which enables multiple students to simultaneously operate many units in a network.

② TPCC/CIB. Control Interface Box:
The Control Interface Box is part of the SCADA system.
Control interface box with process diagram in the front panel.
The unit control elements are permanently computer controlled.
Simultaneous visualization in the computer of all parameters involved in the process.
Calibration of all sensors involved in the process.
Real time curves representation about system responses.
All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process.
Shield and filtered signals to avoid external interferences.
Real time computer control with flexibility of modifications from the computer keyboard of the parameters, at any moment during the process.
Real time computer control for parameters involved in the process simultaneously.
Open control allowing modifications, at any moment and in real time, of parameters involved in the process simultaneously.
Three safety levels, one mechanical in the unit, another electronic in the control interface and the third one in the control software.

③ DAB. Data Acquisition Board:
The Data Acquisition board is part of the SCADA system.
PCI Express Data acquisition board (National Instruments) to be placed in a computer slot.
Analog input: Channels= 16 single-ended or 8 differential. Resolution=16 bits, 1 in 65536. Sampling rate up to: 250 KS/s (kilo samples per second).
Analog output: Channels=2. Resolution=16 bits, 1 in 65536.
Digital Input/Output: Channels=24 inputs/outputs.

④ TPCC/CCSOF. Computer Control +Data Acquisition+Data Management Software:
The three softwares are part of the SCADA system.
Compatible with the industry standards.
Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
Management, processing, comparison and storage of data.
Sampling velocity up to 250 KS/s (kilo samples per second).
Calibration system for the sensors involved in the process.
It allows the registration of the alarms state and the graphic representation in real time.
Open software, allowing the teacher to modify texts, instructions. Teacher's and student's passwords to facilitate the teacher's control on the student, and allowing the access to different work levels.
This unit allows the 30 students of the classroom to visualize simultaneously all the results and the manipulation of the unit, during the process, by using a projector or an electronic whiteboard.

⑤ Cables and Accessories, for normal operation.

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

Exercises and Practical Possibilities to be done with the Main Items

1.- Study of industrial freezing processes in terms of preservation and effects on food.

2.- Investigate the effect of the freezing process on the morphological characteristics of food: size, shape, etc.

3.- Differences between freezing at home and industrial freezing (deep-freezing).

4.- Assess the effect of freezing rates on food preservation.

5.- Thermodynamic description of the process through temperature sensors.

6.- Evaluation of taste and texture.

7.- Study of the structural, composition and sensory effects of deep-freezing and thawing process.

8.- Study of the fundamentals of a deep-freezing system.

9.- Study of the operation, structure and elements of a deep-freezing system.

10.-Analysis of the freezing curves.

11.-Analysis of the theoretical freezing times.

Additional practical possibilities:

12.-Connections with physics (refrigeration) and biology (structure of foods).

13.-Study the effect of the temperature on bacteria.

14.-Sensors calibration.

Other possibilities to be done with this Unit:

15.-Many students view results simultaneously.

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

16.-Open Control, Multicontrol and Real Time Control.

   This unit allows intrinsically and/or extrinsically to change the span, gains; proportional, integral, derivative parameters; etc, in real time.

17.-The Computer Control System with SCADA allows a real industrial simulation.

18.-This unit is totally safe as uses mechanical, electrical/electronic, and software safety devices.

19.-This unit can be used for doing applied research.

20.-This unit can be used for giving training courses to Industries even to other Technical Education Institutions.

21.-Control of the TPCC unit process through the control interface box without the computer.

22.-Visualization of all the sensors values used in the TPCC unit process.

- By using PLC-PI additional 19 more exercises can be done.

- Several other exercises can be done and designed by the user.

TENDER SPECIFICATIONS (for optional items)

<u>a) Industrial configuration</u>

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

-PLC-PI. PLC Module:
Metallic box.
Circuit diagram in the module front panel.
Digital inputs (X) and Digital outputs (Y) block: 16 Digital inputs. 14 Digital outputs.
Analog inputs block: 16 Analog inputs.
Analog outputs block: 4 Analog outputs.
Touch screen.
Panasonic PLC:
   High-speed scan of 0.32 μsec. Program capacity of 32 Ksteps. High-speed counter. Multi-point PID control.
Digital inputs/outputs and analog inputs/outputs Panasonic modules.

-TPCC/PLC-SOF. PLC Control Software:
For this particular unit, always included with PLC supply.

Practices to be done with PLC-PI:

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

<u>b) Technical and Vocational Education configuration</u>

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

This complete software package consists of an Instructor Software (EDIBON Classroom Manager - ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft - ESL-SOF). Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc...so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:
• User Data Base Management.
• Administration and assignment of Workgroup, Task and Training sessions.
• Creation and Integration of Practical Exercises and Multimedia Resources.
• Custom Design of Evaluation Methods.
• Creation and assignment of Formulas & Equations.
• Equation System Solver Engine.
• Updatable Contents.
• Report generation, User Progression Monitoring and Statistics.

- ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:
• Student Log-In & Self-Registration.
• Existing Tasks checking & Monitoring.
• Default contents & scheduled tasks available to be used from the first session.
• Practical Exercises accomplishment by following the Manual provided by EDIBON.
• Evaluation Methods to prove your knowledge and progression.
• Test self-correction.
• Calculations computing and plotting.
• Equation System Solver Engine.
• User Monitoring Learning & Printable Reports.
• Multimedia-Supported auxiliary resources.

⑨ TPCC/FSS. Faults Simulation System.

Faults Simulation System (FSS) is a Software package that simulates several faults in any EDIBON Computer Controlled Unit.

The "FAULTS" mode consists in causing several faults in the unit normal operation. The student must find them and solve them.

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

Faults affecting the sensors measurement:

- An incorrect calibration is applied to them.

- Non-linearity.

Faults affecting the actuators:

- Actuators channels interchange at any time during the program execution.

- Response reduction of an actuator.

Faults in the controls execution:

- Inversion of the performance in ON/OFF controls.

- Reduction or increase of the calculated total response.

- The action of some controls is annulled.

On/off faults:

- Several on/off faults can be included.

<u>c) Multipost Expansions options</u>

⑩ MINI ESN. EDIBON Mini Scada-Net System for being used with EDIBON Teaching Units.

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

The MINI ESN system consists of the adaptation of any EDIBON Computer Controlled Unit with SCADA integrated in a local network.

This system allows to view/control the unit remotely, from any computer integrated in the local net (in the classroom), through the main computer connected to the unit.

Main characteristics:

- It allows up to 30 students to work simultaneously with the EDIBON Computer Controlled Unit with SCADA, connected in a local net.

- Open Control + Multicontrol + Real Time Control + Multi Student Post.

- Instructor controls and explains to all students at the same time.

- Any user/student can work doing "real time" control/multicontrol and visualisation.

- Instructor can see in the computer what any user/student is doing in the unit.

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

Main advantages:

- It allows an easier and quicker understanding.

- This system allows you can save time and cost.

- Future expansions with more EDIBON Units.

The system basically will consist of:

This system is used with a Computer Controlled Unit.

- Instructor's computer.

- Students' computers.

- Local Network.

- Unit-Control Interface adaptation.

- Unit Software adaptation.

- Webcam.

- MINI ESN Software to control the whole system.

- Cables and accessories required for a normal operation.

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

REPRESENTATIVE: