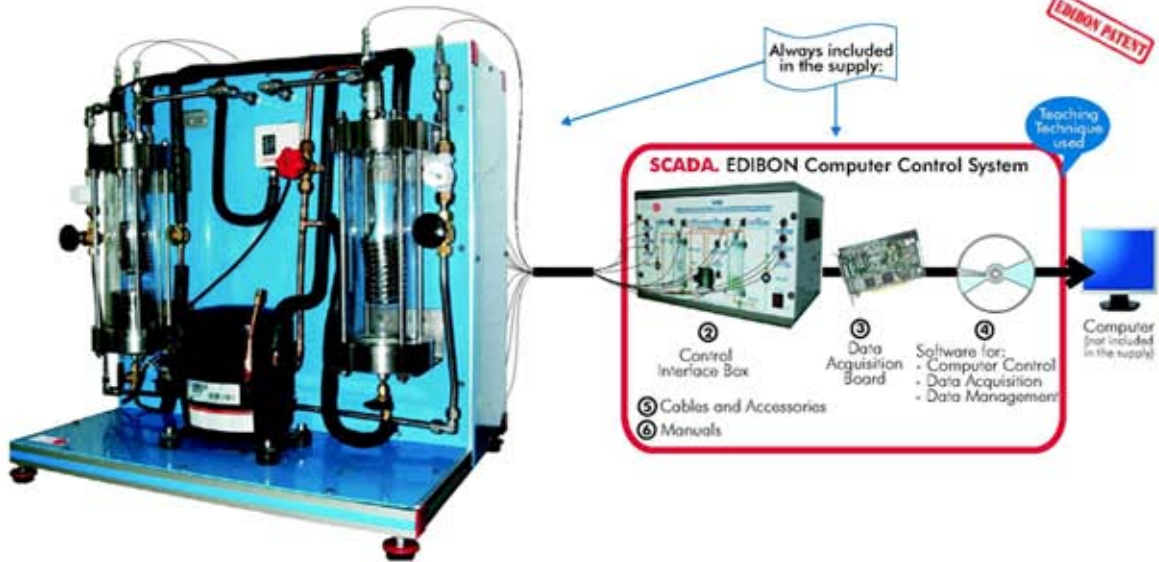
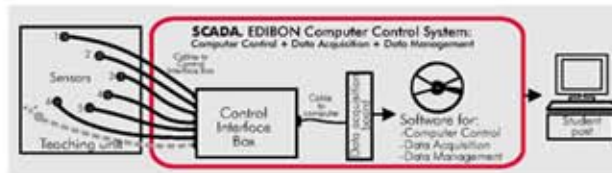




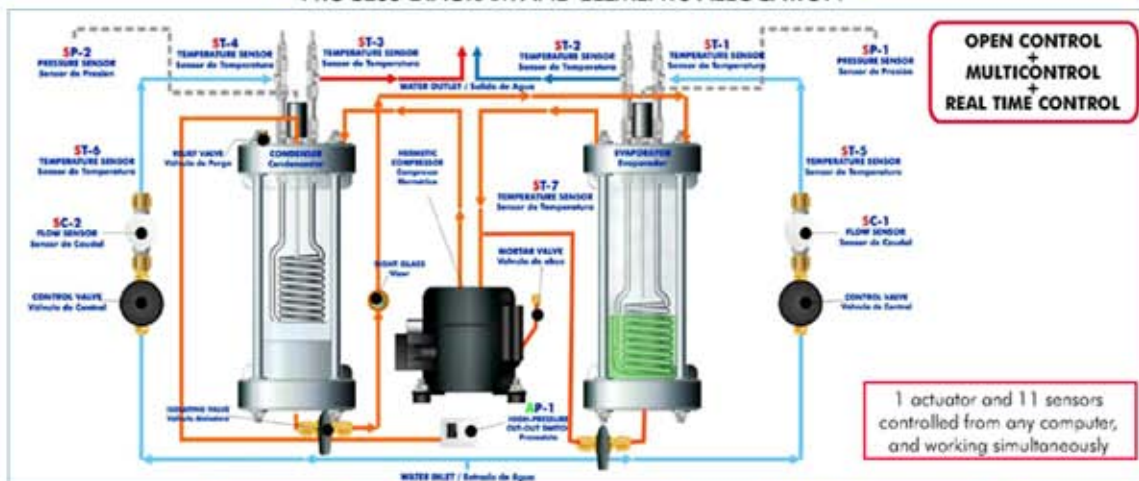
Computer Controlled Refrigeration Cycle Demonstration Unit
TCRC



① Unit: TCRC. Refrigeration Cycle Demonstration Unit



PROCESS DIAGRAM AND ELEMENTS ALLOCATION





DESCRIPTION

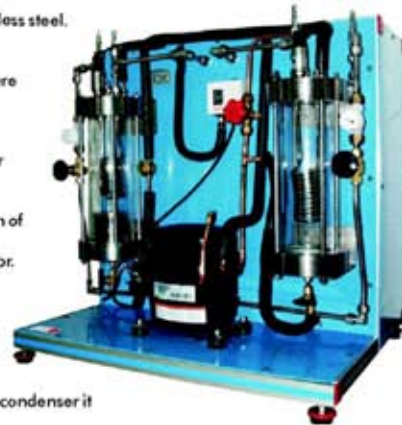
Computer Controlled Refrigeration Cycle Demonstration Unit with SES36 refrigerant and water cooled cylindrical glass evaporator and condenser. It allows the demonstration of steam compression refrigeration and heat pump cycle with visual observation of all important processes. This Computer Controlled Unit, is supplied with the EDIBON Computer Control System (SCADA), including: Control Interface Box + Data Acquisition Board + Computer Control and Data Acquisition Software, for controlling the process and the parameters involved.

SPECIFICATIONS

Items supplied as standard

① TCRC Unit:

Bench-top unit.
Anodized aluminium structure and panels in painted steel. Main metallic elements in stainless steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
Compressor: hermetic compressor of 3/8CV.
Condenser: vertical and transparent glass cylinder, through which the coil can be seen where in its inside cooling water circulates. The heat transmission surface is formed by 9 nickel-plated copper spires through which the water flows. The heat transmission area is approx. 0.032 m².
Evaporator: of similar structure to that of the condenser, and with a specially treated copper coil to promote the ebullition.
Expansion valve, float type.
Sight glass: placed between the evaporator and the expansion valve, to show the formation of steam bubbles after the expansion valve.
2 Pressure sensors indicate the cooling fluid pressure in the condenser and in the evaporator.
Pressure sensors range: 0 to 90 psi.
7 Temperature sensors ("J" type, range: -40 to 750°C) indicate the water output and input Temperatures, both in the condenser and in the evaporator, and the evaporation and condensation temperatures, and room temperature as well.
2 Flow sensors to measure the water flow (condenser and evaporator), range: 0.25 - 6.5 l/min.
There is a relief valve with a tare of 2.3 bar approximately, so in case of overpressure in the condenser it will open.
High pressure cut-out, that stops the compressor if the condensation pressure exceeds 2.3 bar.
This unit has been designed for the use with the SES36 refrigerant.
Power measurement from the computer (PC).



TCRC Unit

② TCRC/CIB. Control Interface Box :

Control interface box with process diagram in the front panel and with the same distribution that the different elements located in the unit, for an easy understanding by the student.
All sensors, with their respective signals, are properly manipulated from -10V to +10V computer output. Sensors connectors in the interface have different pins 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 the 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 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, resistances, control valves, etc. Open control allowing modifications, at any time and in a real time, of parameters involved in the process simultaneously.
Three safety levels, one mechanical in the unit, other electronic in control interface and the third one in the control software.



TCRC/CIB

③ DAB. Data Acquisition Board:

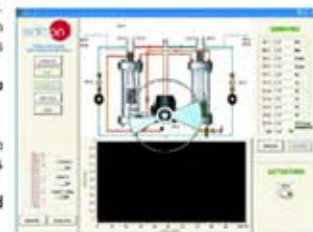
PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.
Analog input: Number of channels= 16 single-ended or 8 differential. Resolution= 16 bits, 1 in 65536.
Sampling rate up to: 250 KS/s (Kilo samples per second). Input range (V)= ±10V. Data transfers=DMA, interrupts, programmed I/O. Number of DMA channels=6.
Analog output: Number of channels=2. Resolution= 16 bits, 1 in 65536. Max. output rate up to: 833 KS/s. Output range(V)= ±10V. Data transfers=DMA, interrupts, programmed I/O.
Digital Input/Output: Channels=24 inputs/outputs. D0 or D1 Sample Clock frequency: 0 to 1 MHz.
Timing: Counter/timers=2. Resolution: Counter/timers: 32 bits.



DAB

④ TCRC/CSOF. Computer Control + Data Acquisition + Data Management Software:

Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen.
Compatible with the industry standards. Registration and visualization of all process variables in an automatic and simultaneously way. Flexible, open and multicontrol software, developed with actual windows graphic systems, acting simultaneously on all process parameters.
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 of 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.



TCRC/CSOF

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: TCRC + TCRC/CIB + DAB + TCRC/CSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.

Continue...



SPECIFICATIONS

Complementary items to the standard supply

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

⑦ PLC-PI. PLC Module:

Circuit diagram in the front panel.

Front panel:

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

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

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

Analog inputs block:

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

Analog outputs block:

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

Touch screen:

High visibility and multiple functions.

Display of a highly visible status.

Recipe function.

Bar graph function.

Flow display function.

Alarm list.

Multi language function.

True type fonts.

Back panel:

Power supply connector.

Fuse 2A.

RS-232 connector to PC.

Inside:

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

Panasonic PLC:

High-speed scan of 0.32 μ sec. for a basic instruction.

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

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

DC input: 16 (24 V DC).

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

High-speed counter.

Multi-point PID control.

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

Communication RS232 wire, to computer (PC).

⑧ TCRC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.



PLC-PI

Items available on request

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

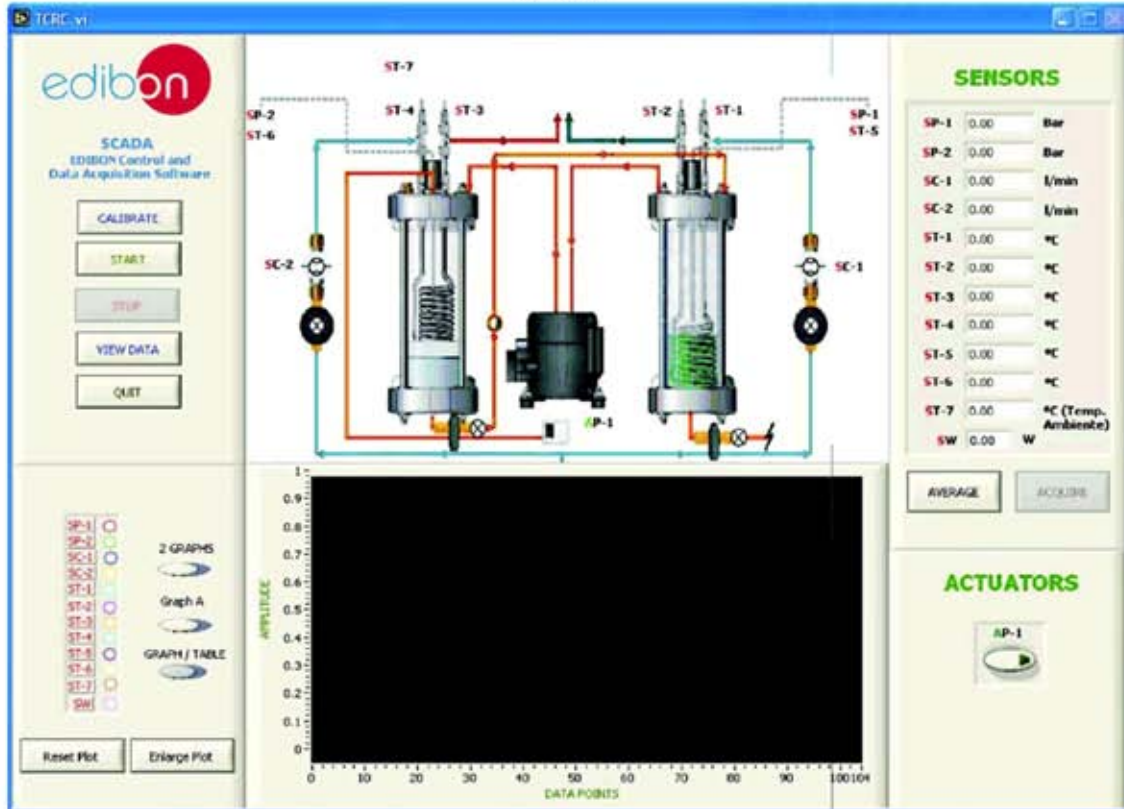
⑩ TCRC/FSS. Faults Simulation System.



EDIBON Computer Control System

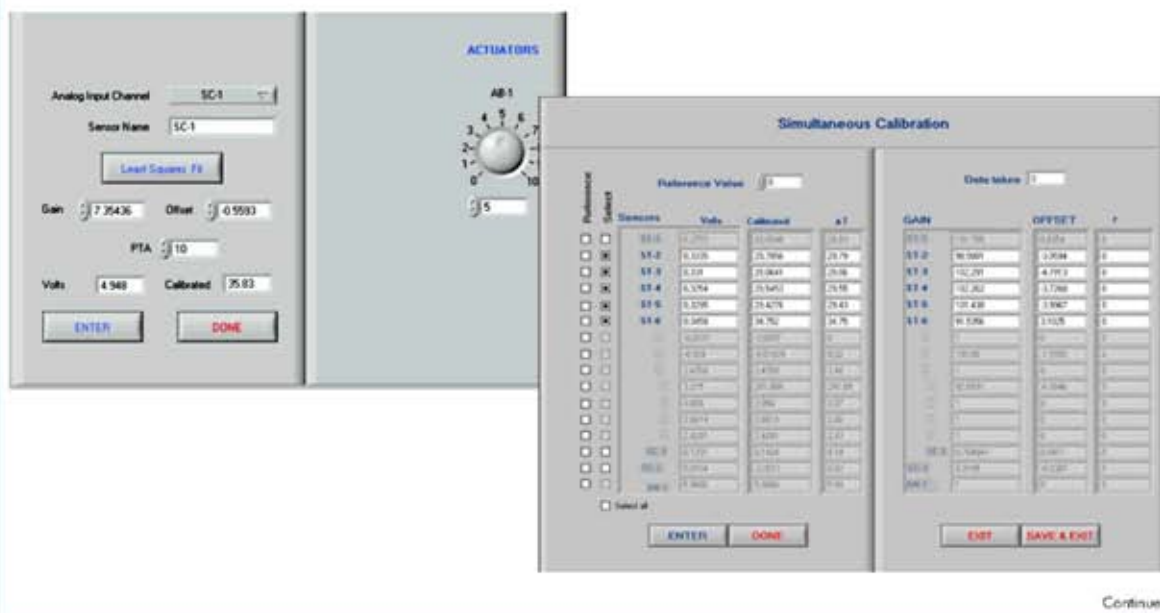
Software Main Screens

Main screen



Note: ST= Temperature sensor SP=Pressure sensor SC=Flow sensor SW=Power measurement AP= Compressor

Examples of Sensors Calibration screens



Continue...



EDIBON Computer Control System (continuation)

Some typical exercises results

SENSORS

SP-1	0,50	Bar
SP-2	0,34	Bar
SC-1	0,50	liters
SC-2	0,40	liters
ST-1	22,29	°C
ST-2	19,67	°C
ST-3	19,36	°C
ST-4	19,37	°C
ST-5	5,44	°C
ST-6	24,29	°C
ST-7	10,71	°C (Temp. Ambient)
SW	100	W

ACTUATORS

AC-1

SENSORS

SP-1	0,50	Bar
SP-2	0,37	Bar
SC-1	0,50	liters
SC-2	0,41	liters
ST-1	22,29	°C
ST-2	19,21	°C
ST-3	19,36	°C
ST-4	19,36	°C
ST-5	4,51	°C
ST-6	24,29	°C
ST-7	10,71	°C (Temp. Ambient)
SW	100	W

ACTUATORS

AC-1

SENSORS

SP-1	0,50	Bar
SP-2	0,34	Bar
SC-1	0,50	liters
SC-2	0,41	liters
ST-1	22,29	°C
ST-2	19,36	°C
ST-3	19,36	°C
ST-4	19,36	°C
ST-5	5,44	°C
ST-6	24,29	°C
ST-7	10,71	°C (Temp. Ambient)
SW	100	W

ACTUATORS

AC-1

In the graphic "A" the pressures of high and low condenser and evaporator are represented.
In the graphic "B" the condenser and evaporator temperatures are represented.

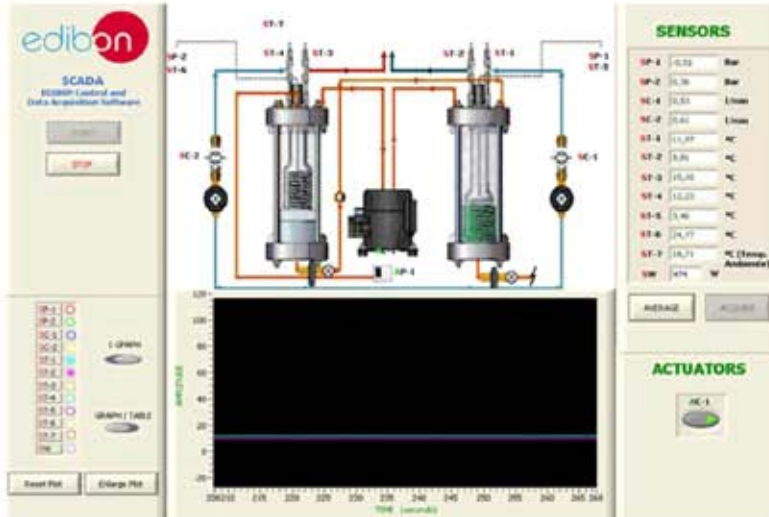
Pressures in high (evaporator) and in low (condenser) are represented (SP-1 and SP-2) in the graphic.
It can be seen that SP-1, evaporator pressure is -0,35 bar due to the expansion produced in the evaporator and to the compressor aspiration.
SP-2 pressure in high condenser pressure is 0,5 bar approx.

The temperature sensors ST-5 and ST-6 that characterize the evaporator and condenser temperatures are represented in the graphic.
In the condenser we have high pressure and therefore high temperature, which correspond to the ST-6, and for the pressure of the experiment, it has a temperature of 25°C.
In the evaporator there is an expansion making low pressure and low temperature, which correspond to the ST-5, that for the experiment conditions has a temperature of 5°C approx.



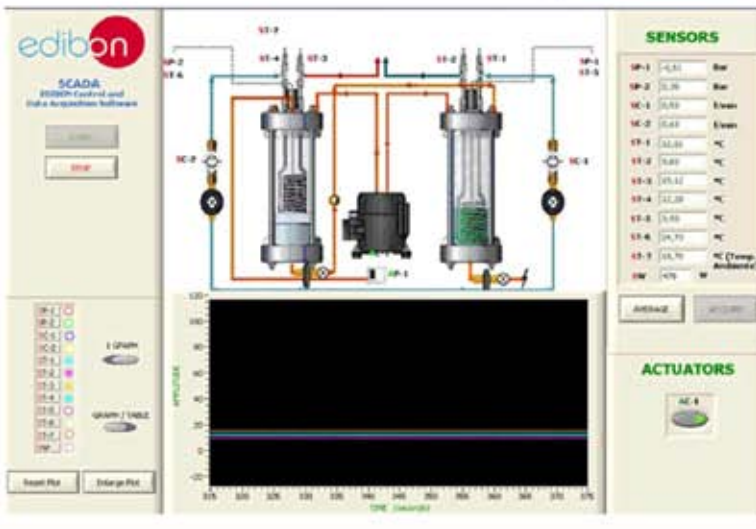
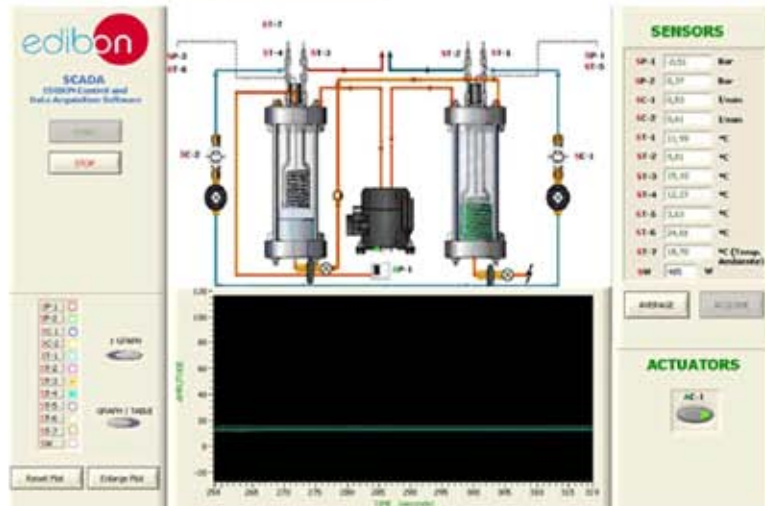
EDIBON Computer Control System (continuation)

Some typical exercises results



Screen representing the water temperatures of the evaporator (ST-1 and ST-2). The water gets in at 12°C and gets out at 9°C due to the fact that it becomes colder in the evaporator.

Screen representing the water temperatures of the condenser (ST-3 and ST-4). The water gets in at 12°C and gets out at 16°C due to the fact that it becomes warmer in the condenser.



It represents the inlet and outlet water temperatures in the condenser and in the evaporator as well.

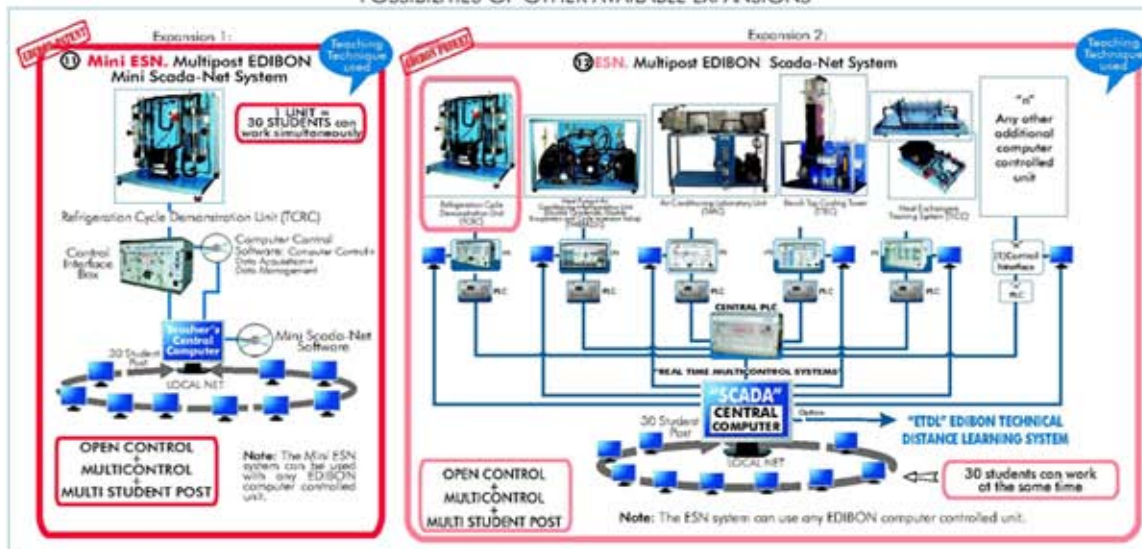


EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

- 1.- Demonstration of the steam compression refrigeration and heat pump cycle.
 - 2.- Relation between pressure and temperature.
 - 3.- Charging demonstration.
 - 4.- Demonstration of the air effect in a refrigeration system.
 - 5.- Evaporation and condensation temperatures effect in the refrigeration (cooling) rate and in the heat transfer in the condenser.
 - 6.- Analysis of the pressures relation effect in the system behaviour.
 - 7.- Determination of the system operation coefficients.
 - 8.- Estimation of the heat transmission global coefficient between the SES36 refrigerant and the water.
 - 9.- Measurement of the electrical power.
- Other possible practices:
- 10.- Sensors calibration.
- Practices to be done by PLC Module (PLC-P) + PLC Control Software:
- 11.- Control of the TCRC unit process through the control interface box without the computer.
 - 12.- Visualization of all the sensors values used in the TCRC unit process.
 - 13.- Calibration of all sensors included in the TCRC unit process.
 - 14.- Hand on of all the actuators involved in the TCRC 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 TCRC unit.
 - 19.- PLC structure.
 - 20.- PLC inputs and outputs configuration.
 - 21.- PLC configuration possibilities.
 - 22.- PLC program languages.
 - 23.- PLC different programming standard languages (ladder 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 TCRC unit process.
 - 27.- Possibility of creating new process in relation with the TCRC unit.
 - 28.- PLC Programming Exercises.
 - 29.- Own PLC applications in accordance with teacher and student requirements.

POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS



ORDER INFORMATION

Items supplied as standard

Minimum configuration for normal operation includes:

- ① Unit: TCRC. Refrigeration Cycle Demonstration Unit.
- ② TCRC/CIB. Control Interface Box.
- ③ DAB. Data Acquisition Board.
- ④ TCRC/CCSOF. Computer Control + Data Acquisition + Data Management Software.
- ⑤ Cables and Accessories, for normal operation.
- ⑥ Manuals.

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

Complementary items to the standard supply

- ⑦ PLC. Industrial Control using PLC (7 and 8):
- ⑧ PCL-Pi. PLC Module.
- ⑨ TCRC/PLC-SOF. PLC Control Software.
- ⑩ TCRC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
- ⑪ TCRC/FSS. Faults Simulation System. (Available on request).

Expansions

- ⑫ Mini ESN. Multipost EDIBON Mini Scada-Net System.
- ⑬ ESN. Multipost EDIBON Scada-Net System.

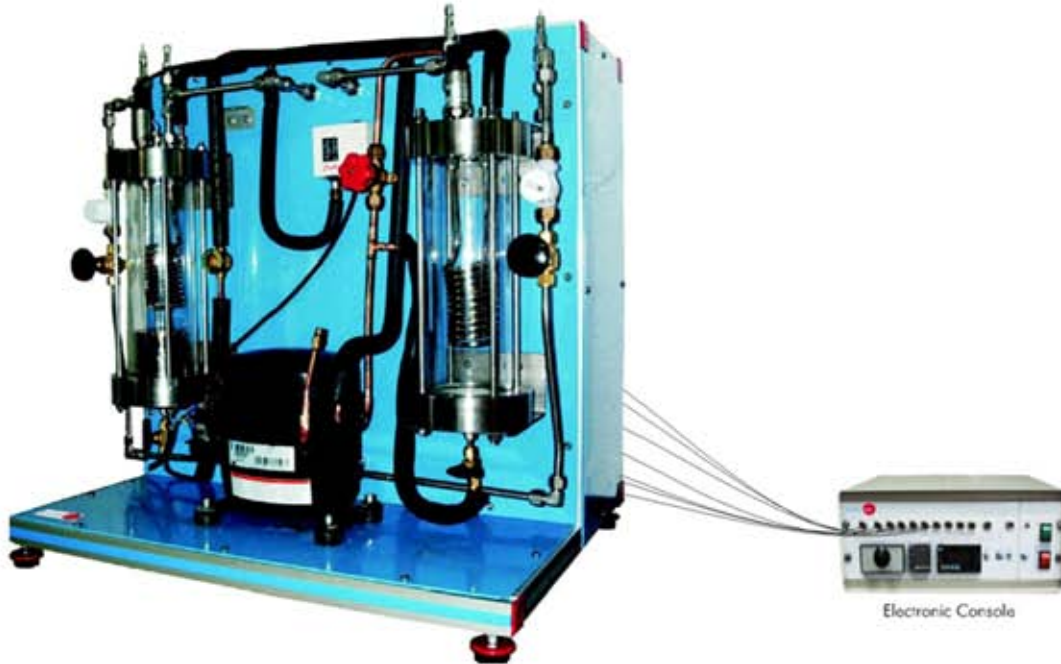
REQUIRED SERVICES

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

DIMENSIONS & WEIGHTS

- TCRC Unit: -Dimensions: 700 x 700 x 720 mm. approx. -Weight: 70 Kg. approx.
- Control Interface Box: -Dimensions: 490 x 330 x 310 mm. approx. -Weight: 10 Kg. approx.
- PLC Module (PLC-Pi): -Dimensions: 490 x 330 x 310 mm. approx. -Weight: 30 Kg. approx.

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



DESCRIPTION

Refrigeration Cycle Demonstration Unit with SES36 refrigerant and water cooled cylindrical glass evaporator and condenser. It allows the demonstration of steam compression refrigeration and heat pump cycle with visual observation of all important processes.

SPECIFICATIONS

Bench-top unit.

Anodized aluminium structure and panels in painted steel. Main metallic elements in stainless steel.

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

Compressor: hermetic compressor of 3/8CV.

Condenser: vertical and transparent glass cylinder, through which the coil can be seen where in its inside cooling water circulates. The heat transmission surface is formed by 9 nickel-plated copper spires through which the water flows. The heat transmission area is approx. 0.032 m².

Evaporator: of similar structure to that of the condenser, and with a specially treated copper coil to promote the ebullition.

Expansion valve, float type.

Sight glass: placed between the evaporator and the expansion valve, to show the formation of steam bubbles after the expansion valve.

7 Temperature sensors ("J" type, range: -40 to 750°C) indicate the water output and input temperatures, both in the condenser and in the evaporator, and the evaporation and condensation temperatures, and room temperature as well.

2 Flow meters to measure the water flow (condenser and evaporator).

2 Pressure meters indicate the cooling fluid pressure in the condenser and in the evaporator.

Power measurement.

There is a relief valve with a tare of 2.3 bar, approximately, so in case of overpressure in the condenser it will open.

High pressure cut-out, that stops the compressor if the condensation pressure exceeds 2.3 bar.

This unit has been designed for the use with the SES36 refrigerant.

Electronic Console:

Metallic box.

Temperature sensors connections.

Digital display for temperature sensors.

Selector for temperature sensors.

Compressor switch.

Wattmeter digital display.

High pressure control connection.

Cables and Accessories, for normal operation.

Manuals: This unit is supplied with following manuals: Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.



EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

- 1.- Demonstration of the steam compression refrigeration and heat pump cycle.
- 2.- Relation between pressure and temperature.
- 3.- Charging demonstration.
- 4.- Demonstration of the air effect in a refrigeration system.
- 5.- Evaporation and condensation temperatures effect in the refrigeration (cooling) rate and in the heat transfer in the condenser.
- 6.- Analysis of the pressures relation effect in the system behaviour.
- 7.- Determination of the system operation coefficients.
- 8.- Estimation of the heat transmission global coefficient between the SES36 refrigerant and the water.
- 9.- Measurement of the electrical power.

REQUIRED SERVICES

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

DIMENSIONS & WEIGHTS

- TCRB:
- Unit: -Dimensions: 700 x 700 x 720 mm. approx.
-Weight: 70 Kg. approx.
 - Electronic Console: -Dimensions: 490 x 330 x 310 mm. approx.
-Weight: 10 Kg. approx.

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



REPRESENTATIVE: