edibon
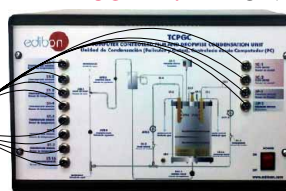
Technical Teaching Equipment

Computer Controlled **Film and Dropwise Condensation Unit**

TCPGC

Always included in the supply:
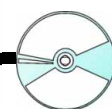
EDIBON PATENT

Teaching Technique used

SCADA. EDIBON Computer Control System
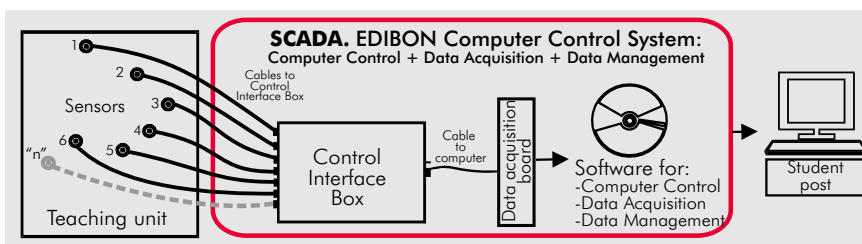
② Control Interface Box

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

① Unit: TCPGC. Film and Dropwise Condesation Unit

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

SCADA. EDIBON Computer Control System:
Computer Control + Data Acquisition + Data Management

Sensors
1
2
3
4
5
6
"n"

Teaching unit

Cables to Control Interface Box

Control Interface Box

Cable to computer

Data acquisition board

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

Student post

The TCPGC unit has been specially designed for students use and to provide visual results and quantitative results related to heat transfer during condensation. Self-contained unit, which has its own steam generator and air extraction system, as well as condensers to provide dropwise and filmwise condensation.

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.

PROCESS DIAGRAM AND ELEMENTS ALLOCATION

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL
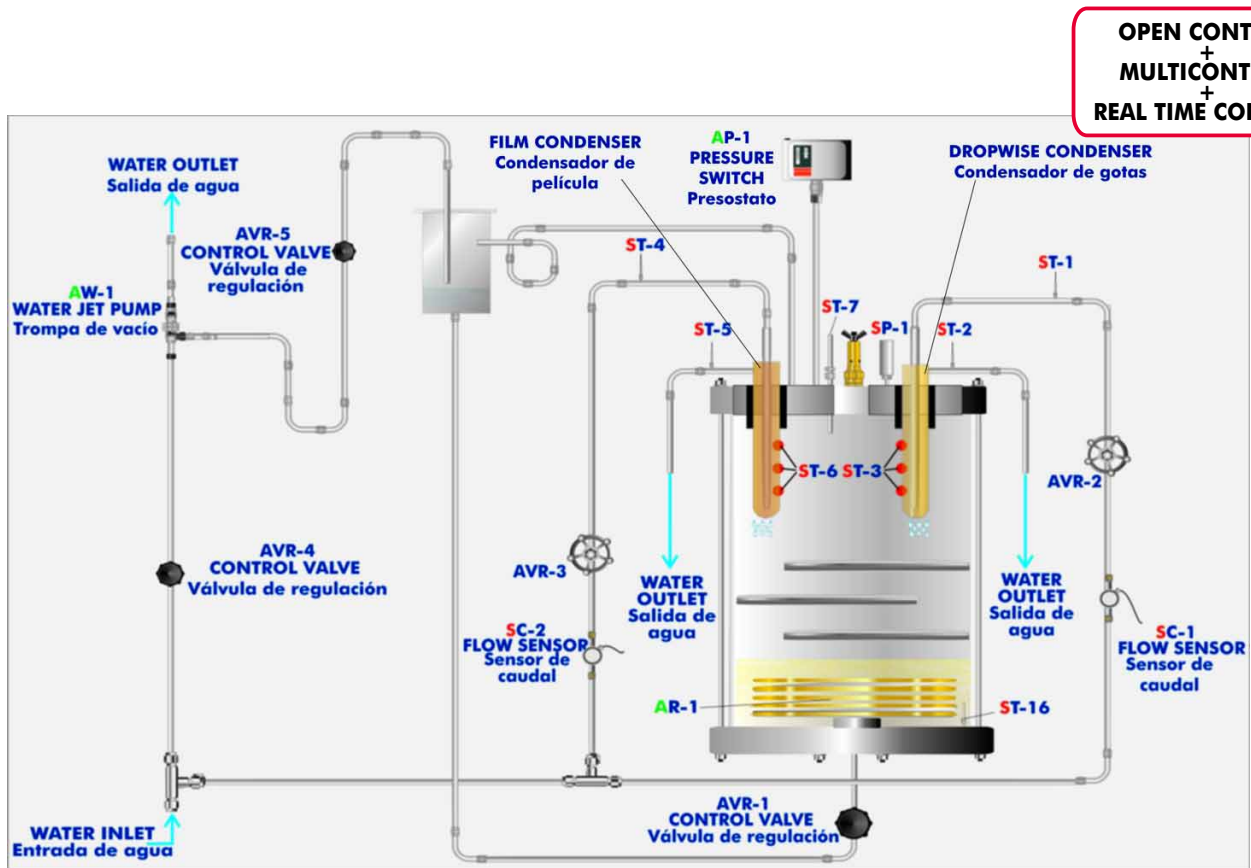
Note: **SP** = Pressure sensor.   **ST** = Temperature sensor.   **SC** = Flow sensor.   **AR** = Heating resistance, computer controlled.   **AVR** = Control valve.
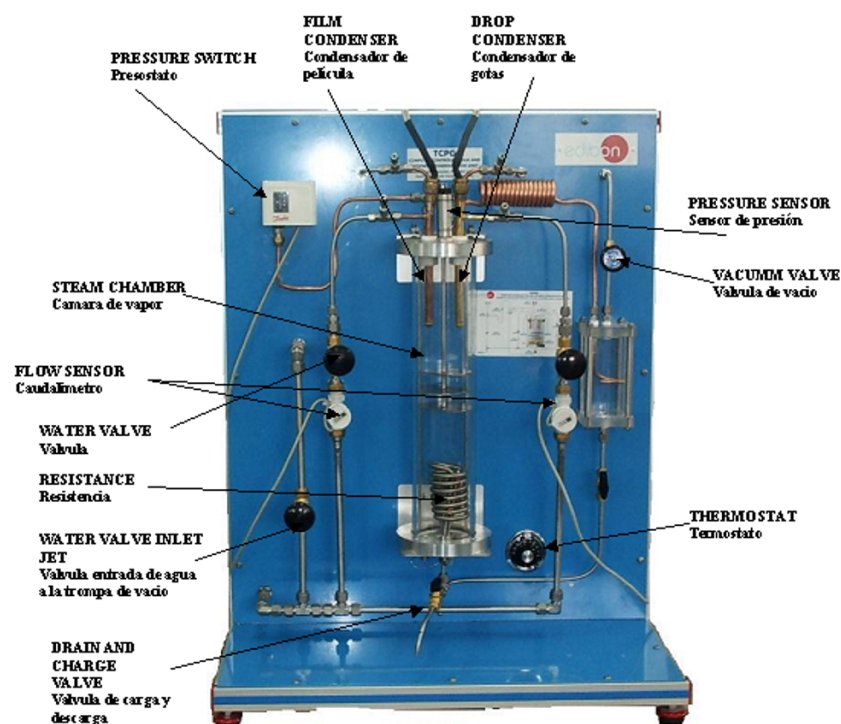
Items supplied as standard

① TCPGC. Unit:

Bench-top unit, which has its own steam generator and air extraction system, as well as condensers to provide dropwise and filmwise condensation.

Anodized aluminium structure and panels in painted steel (epoxy paint).

Main metallic elements in stainless steel.

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

Steam chamber: thick-walled glass cylinder with aluminium ends and P.T.F.E. seals. Capacity: aproximately 0.5 - 1 Kg. of distilled water.

2 Water cooled condensers, mounted in the upper cylinder cover. Dimensions: 12.7 mm. external diameter and 90 mm. effective length. They are specially designed and manufactured of cooper, incorporating a heat exchanger in order to reduce the surface temperature variation to a minimum:

Dropwise condenser-gold plated.

Filmwise condenser-natural finish.

Each condenser is provided with three connected temperature sensors ("K" type) to measure the mean metal temperature, and two temperature sensors ("J" type) to measure the inlet and outlet water temperatures, respectively.

Electric heating element (3 KW. resistance) with thermal protection. Power of the resistance computer controlled.

Air extraction system, composed by air cooler, separator and water jet vacuum pump with the necessary valves.

Pressure sensor, to measure the chamber pressure. Range: 0-6 bar.

2 Water flow sensors (0-6.5 l./min.), to measure the water flow rate through the condensers.

Power measurement from the computer (PC).

Safety:

Pressure relief valve fitted to upper cylinder cover.

Pressure switch (fix to 2 bar)

Heater thermal protection (120°C thermostat).

All electrical elements/components are earthed and fused.

TCPGC Unit

② TCPGC/CIB. **Control Interface Box :**

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

All sensors, with their respective signals, are properly manipulated from -10V. to +10V computer output. Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors.

Single cable between the control interface box and computer.

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

Simultaneously visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process.

Real time curves representation about system responses.

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

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

All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process. All the actuators and sensors values and their responses are placed in only one computer screen.

Shield and filtered signals to avoid external interferences.

Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Real time PID and on/off control for pumps, compressors, resistances, control valves, etc. **Real time PID control for parameters involved in the process simultaneously. Proportional control, integral control and derivative control, based on the real PID mathematical formula, by changing the values, at any time,** of the three control constants (proportional, integral and derivative constants).

Possibility of automatization of the actuators involved in the process.

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.
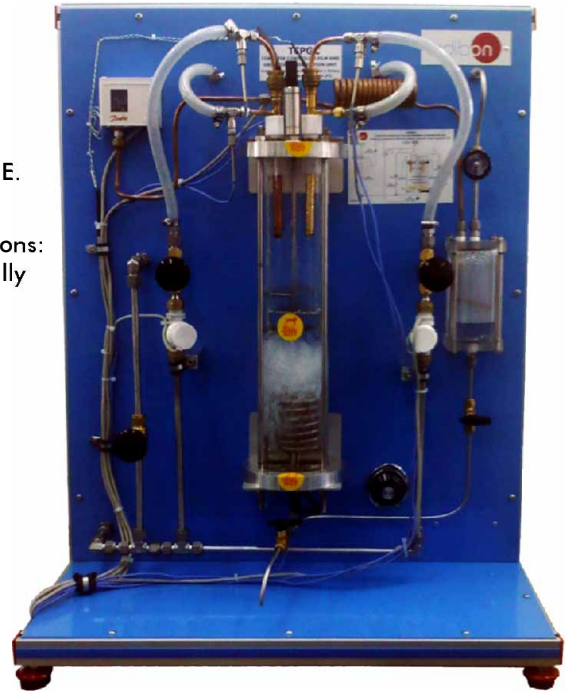
TCPGC/CIB

Continue...

Items supplied as standard (continuation)

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 KSPS (Kilo samples per second).

Input range (V) = ±10V.

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

Number of DMA channels = 6.

Analog output:

Number of **channels = 2**.

Resolution = 16 bits, 1 in 65536.

Maximum output rate up to: 833 KSPS.

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.

DAB

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

Compatible with actual Windows operating systems.

Graphic and intuitive simulation of the process in screen.

Compatible with the industry standards.

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

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

Analog and digital PID control.

Menu for PID and set point selection required in the whole work range.

Management, processing, comparison and storage of data.

Sampling velocity up to 250,000 data per second guaranteed.

Calibration system for the sensors involved in the process. It allows the registration of the alarms state and the graphic representation in real time.

Comparative analysis of the obtained data, after 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.

TCPGC/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: TCPGC + TCPGC/CIB + DAB + TCPGC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.**
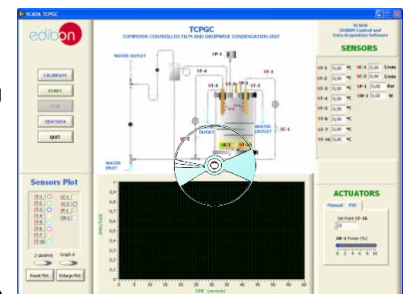
Additional and optional items to the standard supply

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.

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.

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).

⑧ **TCPGC/PLC-SOF. PLC Control Software:**

For this particular unit, always included with PLC supply.

PLC-PI

Items available on request

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

⑩ **TCPGC/FSS. Faults Simulation System.**

Software Main Screens

Main screen
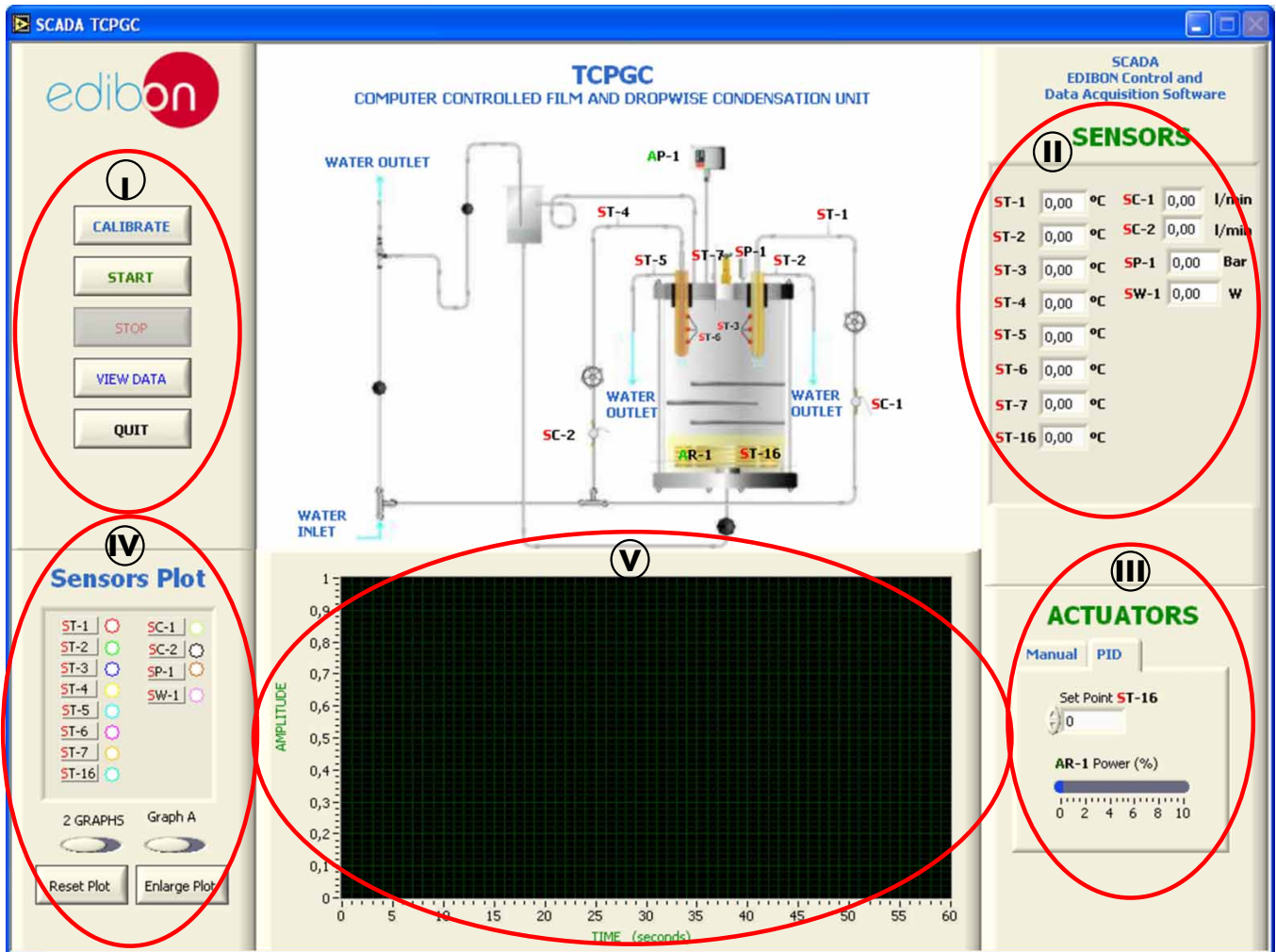
(I) Main Controls.
(II) Sensors displays and extra output parameters. **Sensors:** ST=Temperature sensor.   SC=Flow sensor.   SP=Pressure sensor.   SW=Wattmeter.
(III) Actuators controls. **Actuators:** AR=Heating element (resistance).
(IV) Channel selection and other plot parameters.
(V) Graphical Display.

Software for Sensors Calibration

Some Practical Possibilities of the Unit:

1.- Investigation of the saturation pressure/temperature relationship for H_2O between about 20^0 C and 100^0 C.

2.- Visual demonstration of filmwise and dropwise condensation, and of nucleate boiling.

3.- Measurement of heat flow and surface heat transfer coefficient in both filmwise and dropwise condensation at pressures up to atmospheric.

4.- Demonstration and investigation of the effect of air in condensers.

5.- Demostration of Dalton's Law.

Other possible practices:

6.- Sensors calibration.

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

7.- Control of the TCPGC unit process through the control interface box without the computer.

8.- Visualization of all the sensors values used in the TCPGC unit process.

9.- Calibration of all sensors included in the TCPGC unit process.

10.- Hand on of all the actuators involved in the TCPGC unit process.

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

12.- 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).

13.- PLC hardware general use and manipulation.

14.- PLC process application for TCPGC unit.

15.- PLC structure.

16.- PLC inputs and outputs configuration.

17.- PLC configuration possibilities.

18.- PLC program languages.

19.- PLC different programming standard languages.

20.- New configuration and development of new process.

21.- Hand on an established process.

22.- To visualize and see the results and to make comparisons with the TCPGC unit process.

23.- Possibility of creating new process in relation with the TCPGC unit.

24.- PLC Programming Exercises.

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

POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS

Expansion 1:

EDIBON PATENT

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

Teaching Technique used

1 UNIT = 30 STUDENTS can work simultaneously

Film and Dropwise Condensation Unit (TCPGC)

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
+
REAL TIME CONTROL
+
MULTI STUDENT POST

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

Expansion 2:

EDIBON PATENT

⑫ **ESN.** Multipost EDIBON Scada-Net System

Teaching Technique used

"n" Any other additional computer controlled unit

Heat Conduction Unit (TCCC)

Heat Exchangers Training System (TICC)

Film and Dropwise Condensation Unit(TCPGC)

Free and Forced Convection Heat Transfer Unit (TCLFC)

Cross Flow Heat Exchanger (TIFCC)

(1) PLC

(1) PLC

(1) PLC

(1) PLC

(1) PLC

"n" (1)Control Interface

"n" PLC

CENTRAL PLC

"REAL TIME MULTICONTROL SYSTEMS"

"SCADA" **CENTRAL COMPUTER**

30 Student Post

Option

"ETDL" EDIBON TECHNICAL DISTANCE LEARNING SYSTEM

LOCAL NET

30 students can work at the same time

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

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

ORDER INFORMATION

Items supplied as standard

Minimum configuration for normal operation includes:

① Unit: TCPGC. Film and Dropwise Condensation Unit.

② TCPGC/CIB.Control Interface Box.

③ DAB.Data Acquisition Board.

④ TCPGC/CCSOF. Computer Control + Data Acquisition + Data Management Software.

⑤ Cables and Accessories, for normal operation.

⑥ Manuals.

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

Additional and optional items to the standard supply

PLC. Industrial Control using PLC (7 and 8):
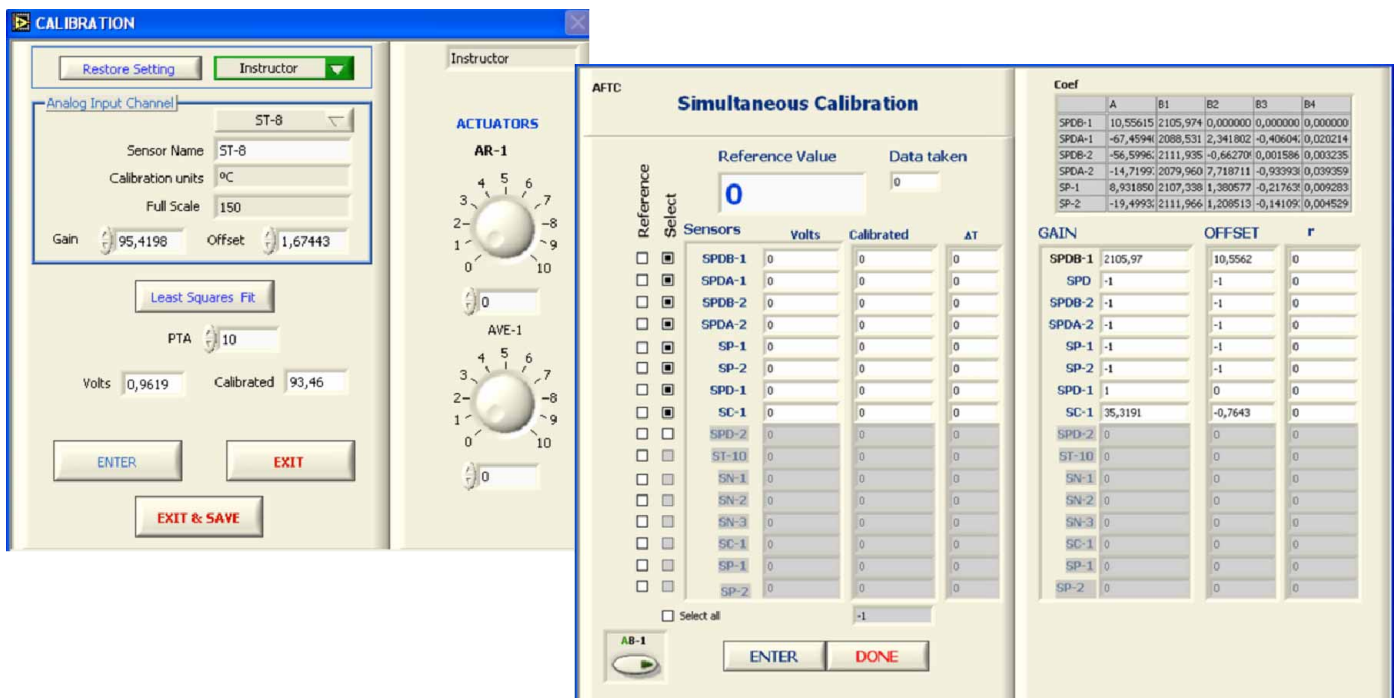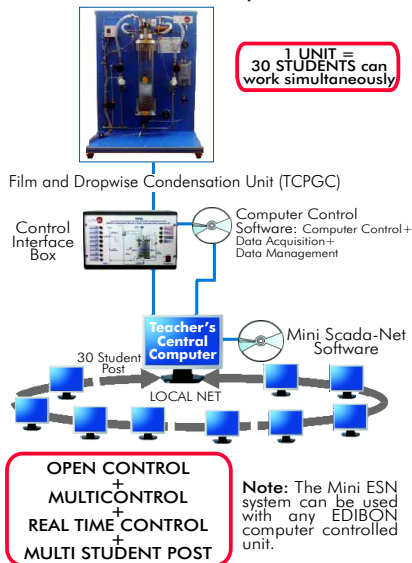
⑦ PCL-PI.PLC Module.

⑧ TCPGC/PLC-SOF. PLC Control Software.

⑨ TCPGC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request)

⑩ TCPGC/FSS. Faults Simulation System. (Available on request).

Expansions

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

⑫ ESN. Multipost EDIBON Scada-Net System.

REQUIRED SERVICES

-Electrical supply: 3 KW, single-phase, 220V./50Hz or 110V./60Hz.

-Water supply.

-Computer (PC).

DIMENSIONS & WEIGHTS

TCPGC Unit: -Dimensions: 700 x 570 x 770 mm. approx.

                       -Weight: 60 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:

-TCPGC. Computer Controlled **Film and Dropwise Condensation Unit.**

Offered in other catalogue:

-TCPGB. **Film and Dropwise Condensation Unit.**

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

INTERNATIONAL

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Issue: ED01/11
Date: July/2011