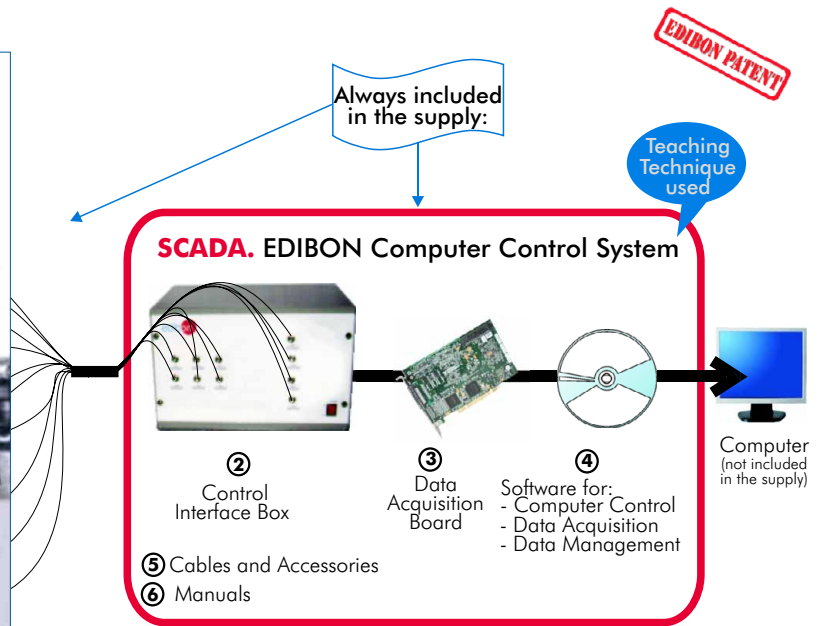
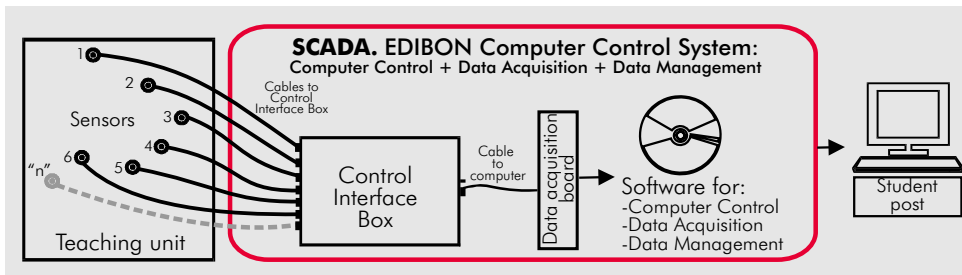




① Unit: TPTVC. Steam Power Plant



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 (total safety)



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**Worlddidac Quality Charter Certificate**  
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## DESCRIPTION

Laboratory scale steam power plant designed for technical training of power plant engineering and power engines and machines.

It demonstrates thermodynamics principles, energy conversion and mechanical power measurement.

This Computer Controlled Steam Power Plant 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 TPTVC. Unit:

Laboratory scale steam power plant.

Metallic structure and other main metallic elements in stainless steel.

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

Closed steam-water circuit.

An oil-heated instantaneous boiler generates wet steam, a superheater steam provides superheated steam.

Boiler: Thermal rating of 100 kW approx. Nominal steam amount: 120 Kg/h at bar (approx.).

Superheater: outputs 5.1 kW, 240°C approx.

Fuel tank.

Burner.

Steam turbine (single-stage impeller turbine with speed control), 1.5 kW at 3000 r.p.m. approx., vacuum or exhaust operation.

DC generator as turbine load.

Feed water tank with feed water treatment.

Water cooled condenser (100 kW approx.).

Condensate pump.

Feed water pump.

Pressure sensors.

Temperature sensors.

Flow sensors for fuel and cooling water.

Speed sensor.

Power meter.

Corrosion resistant materials used.

#### ② TPTVC/CIB. Control Interface Box:

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

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

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

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

Calibration of all sensors involved in the process.

Real time curves representation about system responses. Storage of all the process data and results in a file. Graphic representation, in real time, of all the process/system responses.

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

Shield and filtered signals to avoid external interferences.

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

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

Possibility of automatization of the actuators involved in the process.

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

#### ③ DAB. Data Acquisition Board:

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

Analog input: 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. Maximum output rate up to: 833 KS/s.

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

Digital Input/Output: Number of channels=24 inputs/outputs. DO or DI Sample Clock frequency: 0 to 1 MHz.

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

#### ④ TPTVC/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.

#### 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: TPTVC + TPTVC/CIB + DAB + TPTVC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.**

Continue...

**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.

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 VA AC/2 A).

**High-speed counter.**

**Multi-point PID control.**

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

Communication RS232 wire, to computer (PC).

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

For this particular unit, always included with PLC supply.



PLC-PI

**Items available on request**

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

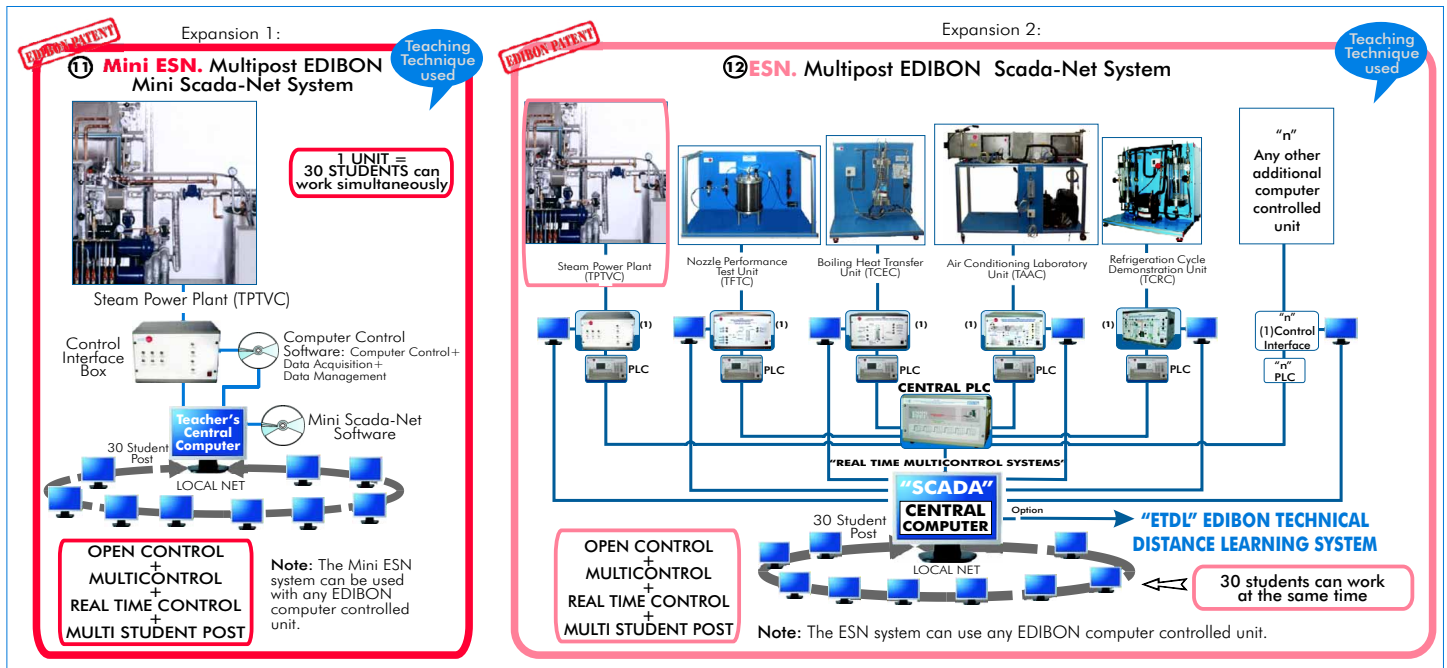
**⑩ TPTVC/FSS. Faults Simulation System.**

## EXERCISES AND PRACTICAL POSSIBILITIES

### Some Practical Possibilities of the Unit:

- 1.- Study of a steam power plant and its components.
  - 2.- Starting, operation and running down of a steam power plant.
  - 3.- Study of a simple feed water treatment.
  - 4.- Familiarisation with a closed steam-water circuit.
  - 5.- Determination of condenser efficiency.
  - 6.- Understanding of the First and Second Laws of Thermodynamics.
  - 7.- Determination of boiler efficiency.
  - 8.- Determination of fuel consumption.
  - 9.- Power generation.
  - 10.- Determination of mechanical/thermal efficiency of a turbine.
  - 11.- Heat balance and energy utilization.
  - 12.- Techniques for measuring and controlling pressure and temperature in a steam plant.
  - 13.- Steam flow-rate measurements.
- Other possible practices:
- 14.- Sensors calibration.
- Practices to be done by PLC Module (PLC-PI) + PLC Control Software:
- 15.- Control of the TPTVC unit process through the control interface box without the computer.
  - 16.- Visualization of all the sensors values used in the TPTVC unit process.
  - 17.- Calibration of all sensors included in the TPTVC unit process.
  - 18.- Hand on of all the actuators involved in the TPTVC unit process.
  - 19.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
  - 20.- 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).
  - 21.- PLC hardware general use and manipulation.
  - 22.- PLC process application for TPTVC unit.
  - 23.- PLC structure.
  - 24.- PLC inputs and outputs configuration.
  - 25.- PLC configuration possibilities.
  - 26.- PLC program languages.
  - 27.- PLC different programming standard languages.
  - 28.- New configuration and development of new process.
  - 29.- Hand on an established process.
  - 30.- To visualize and see the results and to make comparisons with the TPTVC unit process.
  - 31.- Possibility of creating new process in relation with the TPTVC unit.
  - 32.- PLC Programming Exercises.
  - 33.- 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: TPTVC. Steam Power Plant.
- ② TPTVC/CIB. Control Interface Box.
- ③ DAB. Data Acquisition Board.
- ④ TPTVC/CCSOF. Computer Control + Data Acquisition + Data Management Software.
- ⑤ Cables and Accessories, for normal operation.
- ⑥ Manuals.

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

### Complementary items to the standard supply

- PLC. Industrial Control using PLC (7 and 8):
- ⑦ PCL-PI. PLC Module.
- ⑧ TPTVC/PLC-SOF. PLC Control Software.
- ⑨ TPTVC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
- ⑩ TPTVC/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: Three-phase, 400 V./50 Hz. or 230 V./60 Hz.
- Cooling water supply 10 m<sup>3</sup>/h approx.
- Computer (PC).

## OPTIONAL ACCESSORIES

- TPTVC/TE. Cooling Tower.

## DIMENSIONS & WEIGHTS

- |                        |   |
|------------------------|---|
| TPTVC Unit:            | -Dimensions: 3230 x 2000 x 2200 mm. approx. |
|                        | -Weight: 2000 Kg. approx.                   |
| Control Interface Box: | -Dimensions: 490 x 330 x 310 mm. approx.    |
|                        | -Weight: 10 Kg. approx.                     |
| PLC Module (PLC-PI):   | -Dimensions: 490 x 330 x 310 mm. approx.    |
|                        | -Weight: 30 Kg. approx.                     |

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



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