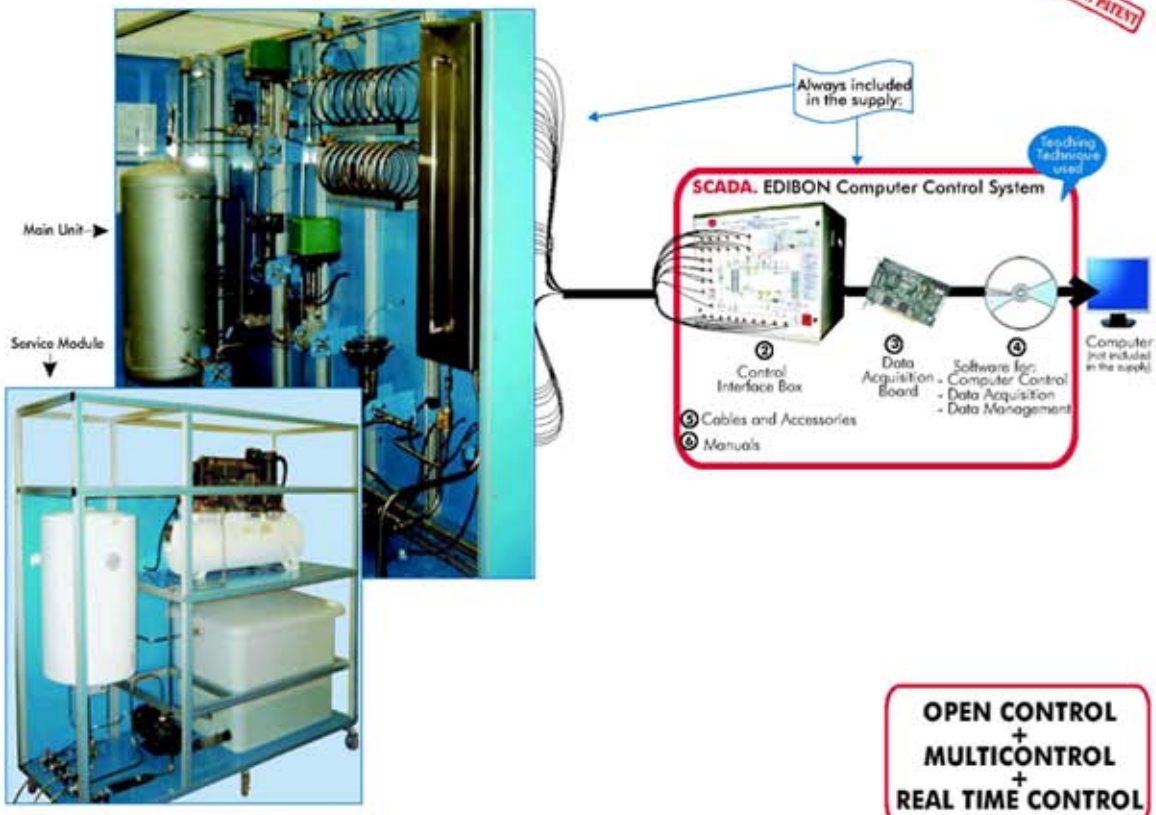
edibon
Technical Teaching Equipment

Computer Controlled **Process Control Plant with Industrial Instrumentation and Service Module** (Flow, Temperature, Level and Pressure)

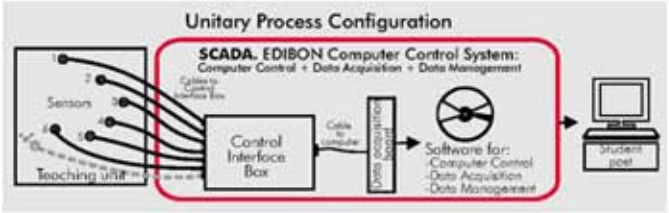
CPIC

EDIBON PATENT



OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL

① Unit: CPIC. Process Control Plant with Industrial Instrumentation and Service Module. (Flow, Temperature, Level and Pressure).



www.edibon.com
Products
Products range
Units
10.-Process Control

ISO 9001:2000
Certificate of Approval

European Union Certificate

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

Worlddidac Quality Charter Certificate
Worlddidac Member

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DESCRIPTION

CPIC is a "Computerized Industrial Process Control Plant", that offers, on a reasonable laboratory scale, the different process and elements that are commonly used by any kind the industry. It also shows the complexity that can take place while controlling in processes the same variable.

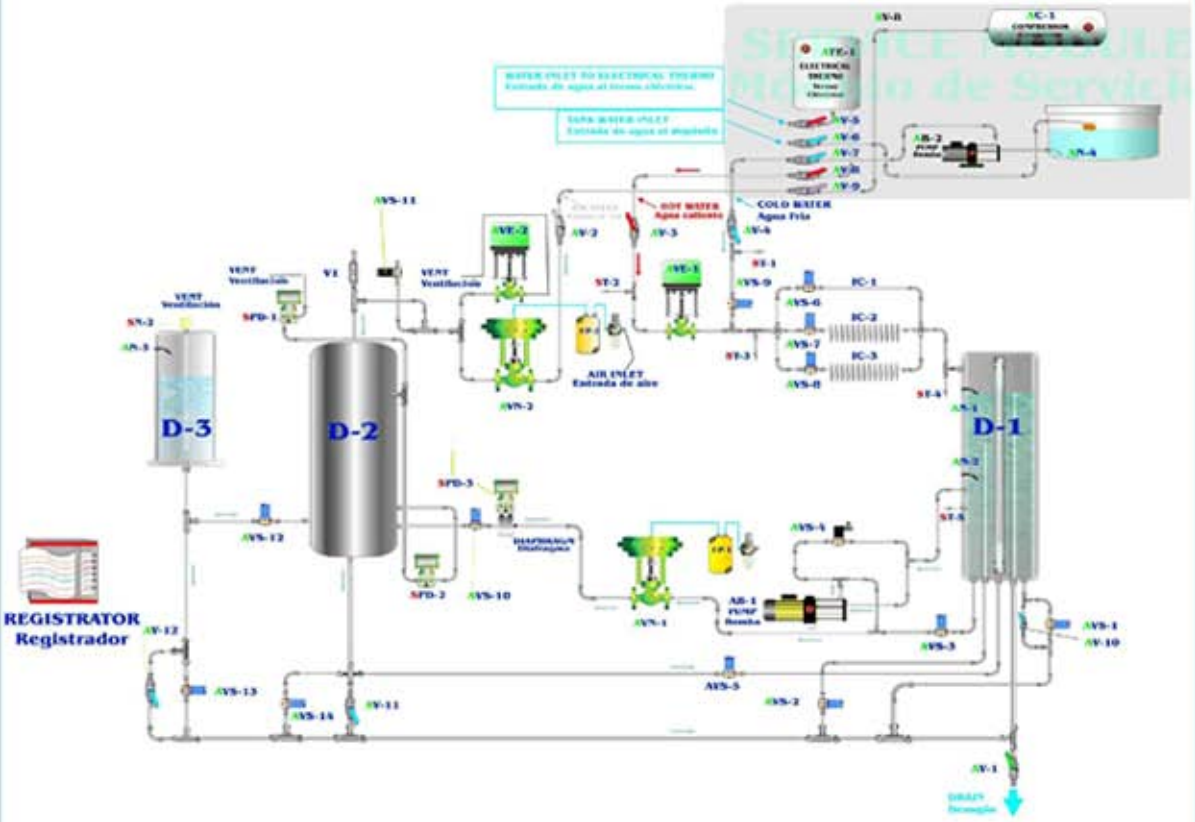
CPIC is made up of a main module where the different elements are installed and a service module that provides cold and hot water, as well as compressed air, neccesary for the unit to work.

This Computer Controlled 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.

PROCESS DIAGRAM AND ELEMENTS ALLOCATION

26 actuators and 9 sensors controlled from any computer, and working simultaneously

OPEN CONTROL + MULTICONTROL + REAL TIME CONTROL



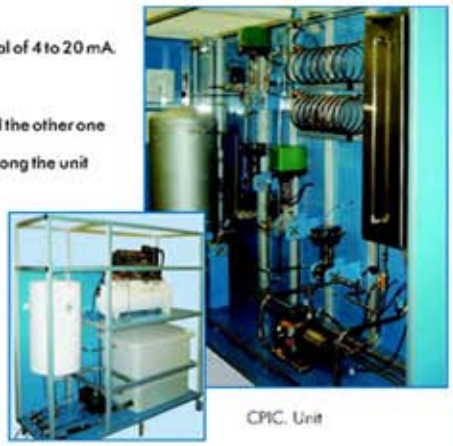
I/P	IP CONVERTER Convertidor IP	SPD	DIFFERENTIAL PRESSURE SENSOR Sensor de Presión Diferencial
IC	HEAT EXCHANGER Intercambiador de Calor	AVN	PNEUMATIC VALVE Válvula Neumática
D	VESSEL Depósito	AVE	ELECTRONIC VALVE Válvula Electrónica
ST	TEMPERATURE SENSOR Sensor de Temperatura	AVS	SOLENOID VALVE Válvula Solenoide
SC	FLOW SENSOR Sensor de Caudal	AV	VALVE Válvula
SN	LEVEL SENSOR Sensor de Nivel	AB	PUMP Bomba
SP	PRESSURE SENSOR Sensor de Presión	AN	LEVEL SWITCH Interruptor de Nivel

SPECIFICATIONS

Items supplied as standard

① CPIC. Unit:

Metallic structure. Panels and main metallic elements in stainless steel.
Diagram in the front panel with similar distribution that the elements in the real unit.
Main Unit contains the following elements:
Two pneumatics valves with C_v: 0.25. I/P. Actuator of 0.2 to 1.0 bar for electric signal of 4 to 20 mA.
Two motorised valves with 2000 N.
Twelve solenoid valves, normally closed.
Two solenoid valves, normally opened, placed in the air loop and flow loop.
Three differential pressure sensors; two of them with range of 0-1000 mm H_2O, and the other one with 0-10 bar.
Five temperature sensors, "J" type, range: -40 to 750ºC. These sensors are placed along the unit to control the temperature in different lines.
One level sensor, with 300 mm. of effective length.
Four level switches.
One water pump, with 7 bar of maximum pressure and 106 l/min. of maximum water flow.
Stain steel water tank with 100 l. of maximum capacity. In the inferior part has five drains. Two of them are placed at different height, middle and top of vessel.
Stainless steel tank with 200 l. Of maximum capacity:
Maximum pressure: 16 bar.
It has eight takings, but only six are used in this unit.
In the superior part, there is a safety valve that it opens when the pressure is superior to 4 bar.
Two takings are used to measure the water height by the means of the differential pressure sensor. Other differential pressure sensor gives the interior pressure.



CPIC. Unit

Service Module contains the following elements:
Heater unit:
A vessel with a maximum capacity of 80 litres and has a electrical resistance of 1.2 kW as maximum electrical power. The temperature control is placed in the electrical resistance.
It has a safety valve and purge valve.
The inferior part of the unit has the inlet pipe (cold water) and outlet pipe (hot water).
Compressor unit:
With 10 bar as maximum pressure.
This unit has a regulated valve with manometer to fix the exit maximum pressure.
Water system:
Water tank with capacity for 400 l.
Water pump with 3.0 bar and 2500 l/h.
The inlet pipe of the tank has a automatic filling system.
Drain valve in the water tank.

② CPIC/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.

CPIC/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. Maximum 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 DI Sample Clock frequency: 0 to 1 MHz.
Timing: **Counter/timers** = **2.** Resolution: Counter/timers: 32 bits.

DAB

④ CPIC/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 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.

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

Continue...

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SPECIFICATIONS

Complementary items to the standard supply

PLC. Industriol 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 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).

PLC-PI

⑧ CPIC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

Items available on request

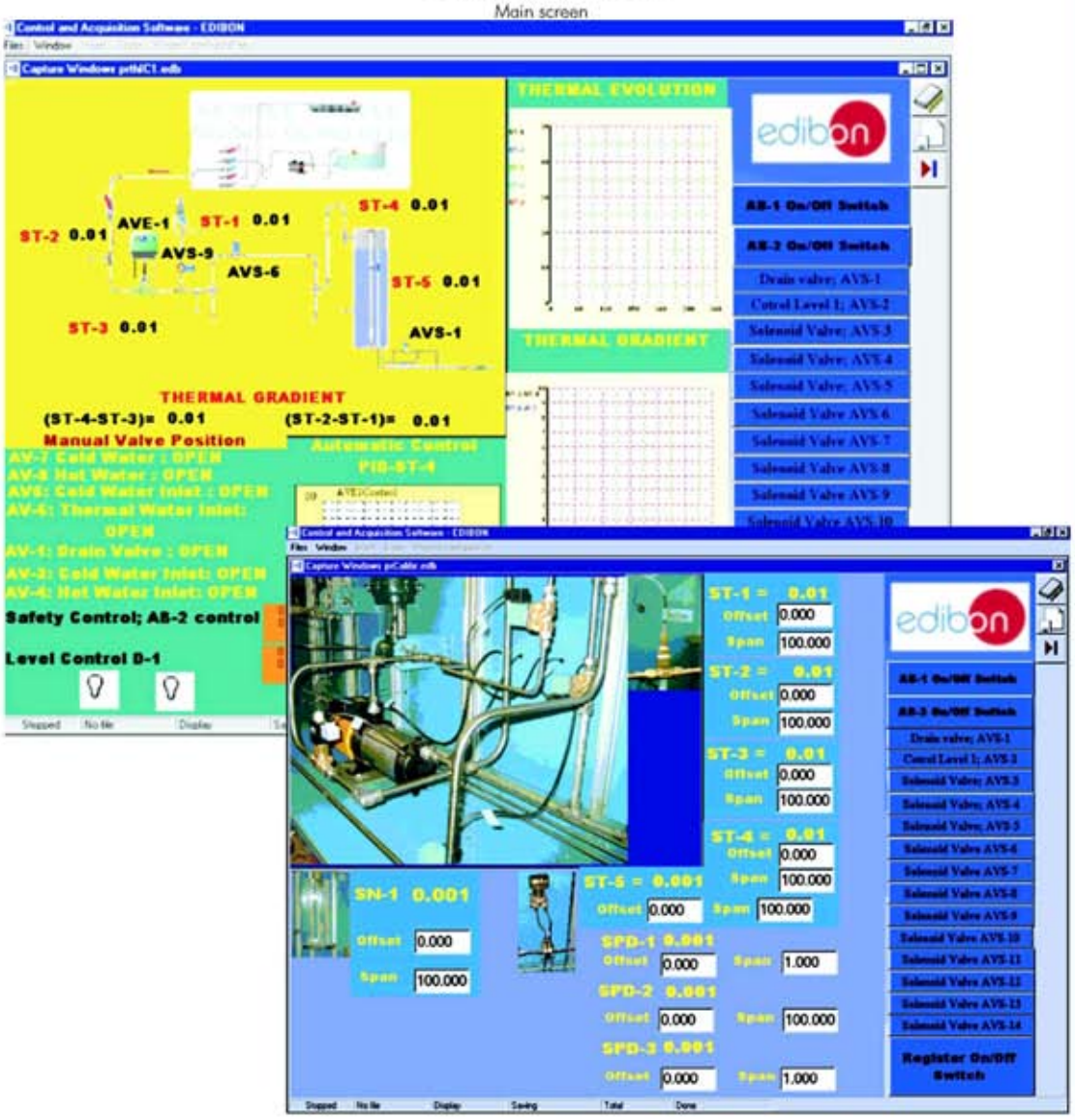
⑨ CPIC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

⑩ CPIC/FSS. Faults Simulation System.

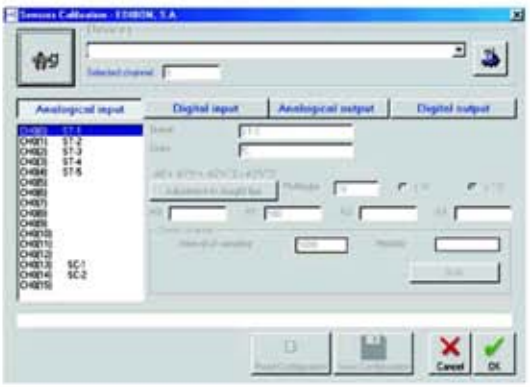
EDIBON Computer Control System

Software Main Screens

Main screen



Example of Sensors Calibration screen



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EXERCISES AND PRACTICAL POSSIBILITIES

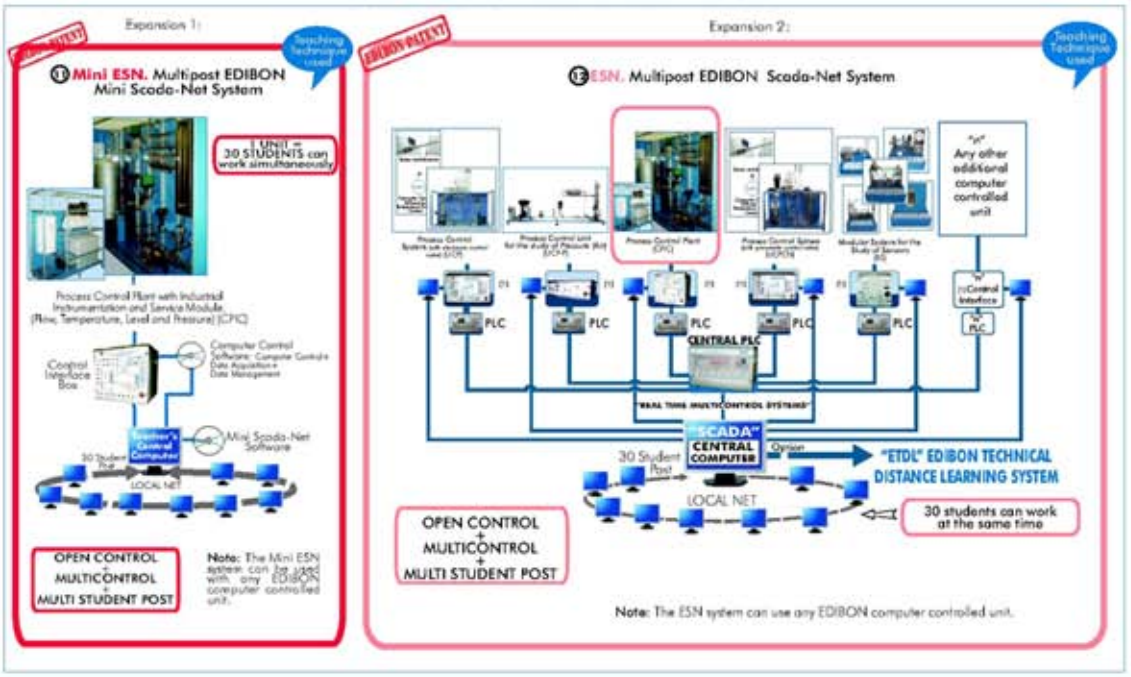
Some Practical Possibilities of the Unit:

1.- Familiarisation with the different components of the system and their symbolic representation. Identification of components and description of their functions.
2.- The auxiliary systems: air and hot water supply.
3.- Flow Sensors calibration.
4.- Temperature sensors calibration.
5.- Level sensors calibration.
6.- Pressure sensors calibration.
7.- Flow control loop (on/off).
8.- Flow control loop (proportional).
9.- Flow control loop (P+I).
10. Flow control loop (P+D).
11.-Flow control loop (P+I+D).
12.-Adjust of flow controller constants (Ziegler-Nichols).
13.-Adjust of flow controller constants (reaction curves).
14.-Search of simple shortcomings in the loop of flow control.
15.-Temperature control loop (on/off).
16.-Temperature control loop (proportional).
17.-Temperature control loop (P+I).
18.-Temperature control loop (P+D).
19.-Temperature control loop (P+I+D).
20.-Adjust of temperature controller constants (minimum area or reduction rate).
21.-Adjust of temperature controller constants (minimum disturbance criterion).
22.-Adjust of temperature controller constants (minimum width criterion).
23.-Study of the retards for speed/distance, exemplified through the temperature control loop.
24.-Study of the energy lost in the temperature control loop.
25.-Search of simple shortcomings in temperature control loop.
26.-Level control loop (on/off).
27.-Level control loop (proportional).
28.-Level control loop (P+I).
29.-Level control loop (P+D).
30.-Level control loop (P+I+D).
31.-Adjust of level controller constants (minimum area or reduction rate).
32.-Adjust of level controller constants (minimum disturbance criterion).
33.-Adjust of level controller constants (minimum width criterion)
34.-Search of simple shortcomings in level control loop.
35.-Pressure control loop (on/off).
36.-Pressure control loop (proportional).
37.-Pressure control loop (P+I).
38.- Pressure control loop (P+D).
39.- Pressure control loop (P+I+D).
40.- Adjust of pressure controller constants (minimum area or reduction rate).
41.- Adjust of pressure controller constants (minimum disturbance criterion).
42.- Adjust of pressure controller constants (minimum width criterion).
43.- Search of simple shortcomings in the pressure control loop.
44.- The use of the controllers in cascade, exemplified with the level/flow control loop.
45.- Adjust of cascade control constants (minimum area or reduction rate).
46.- Adjust of cascade control constants (minimum disturbance criterion).
47.- Adjust of cascade control constants (minimum width criterion).
48.- Search of simple shortcomings in cascade control loop.
49.- Practical operation of the control plant to some wanted specific values: transfers without interferences.
50.- Starting-up and operation of the plant WITHOUT supervision.

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

51.- Control of the CPIC unit process through the control interface box without the computer.
52.- Visualization of all the sensors values used in the CPIC unit process.
53.- Calibration of all sensors included in the CPIC unit process.
54.- Hand on of all the actuators involved in the CPIC unit process.
55.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
56.- 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).
57.- PLC hardware general use and manipulation.
58.- PLC process application for CPIC unit.
59.- PLC structure.
60.- PLC inputs and outputs configuration.
61.- PLC configuration possibilities.
62.- PLC program languages.
63.- PLC different programming standard languages (literal structured, graphic, etc.).
64.- New configuration and development of new process.
65.- Hand on an established process.
66.- To visualize and see the results and to make comparisons with the CPIC unit process.
67.- Possibility of creating new process in relation with the CPIC unit.
68.- PLC Programming Exercises.
69.- 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: CPIC. Process Control Plant with Industrial Instrumentation and Service Module. (Flow, Temperature, Level and Pressure).**
2. **CPIC/CIB. Control Interface Box.**
3. **DAB. Data Acquisition Board.**
4. **CPIC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
5. **Cables and Accessories,** for normal operation.
6. **Manuals.**

* **IMPORTANT: Under CPIC 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. CPIC/PLC-SOF. PLC Control Software.
9. CPIC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
10. CPIC/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

- Electric supply: three-phase, 380 V/ 50Hz or 220 V/ 60Hz, 10KW.
- Water supply: 45 l./min. with 3 bar of minimum pressure.
- Computer (PC).

DIMENSIONS & WEIGHTS

CPIC. Unit:	
-Main Unit:	-Dimensions: 5000 x 1500 x 2500 mm. approx.
	-Weight: 1000 Kg. approx.
-Service Module	-Dimensions: 2000 x 1500 x 2000 mm. approx.
	-Weight: 200 Kg. approx.
Control Interface Box:	-Dimensions: 490 x 450 x 470 mm. approx.
	-Weight: 20 Kg. approx.
PLC Module (PLC-PI):	-Dimensions: 490 x 330 x 310 mm. approx.
	-Weight: 30 Kg. approx.

AVAILABLE VERSIONS

CPIC.	Computer Controlled **Process Control Plant with Industrial Instrumentation and Service Module** (Flow, Temperature, Level and Pressure).
CPIC-C.	Computer Controlled **Process Control Plant with Industrial Instrumentation and Service Module** (only Flow).
CPIC-T.	Computer Controlled **Process Control Plant with Industrial Instrumentation and Service Module** (only Temperature).
CPIC-N.	Computer Controlled **Process Control Plant with Industrial Instrumentation and Service Module** (only Level).
CPIC-P.	Computer Controlled **Process Control Plant with Industrial Instrumentation and Service Module** (only Pressure).

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

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