

Key features:

- **Advanced Real-Time SCADA and PID Control.**
- **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 CAL software helps the user perform calculations and comprehend the results.**
- **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**

www.edibon.com
Products range
Units
11.-Chemical Engineering

For more information about Key Features, click here:



ISO 9000: Quality Management
(for Design, Manufacturing,
Commercialization and After-sales service)



European Union Certificate
(total safety)



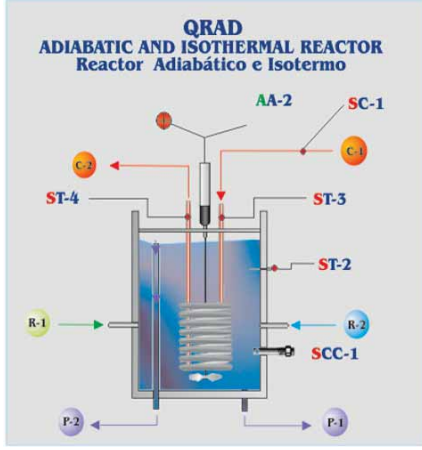
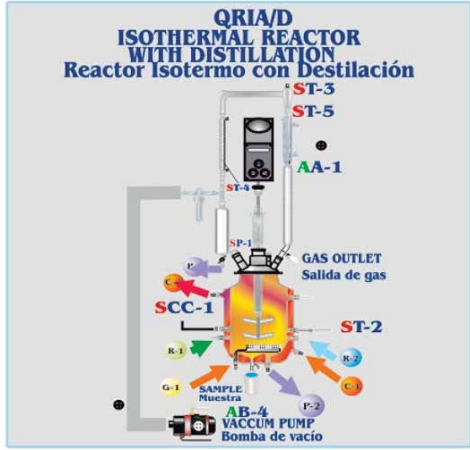
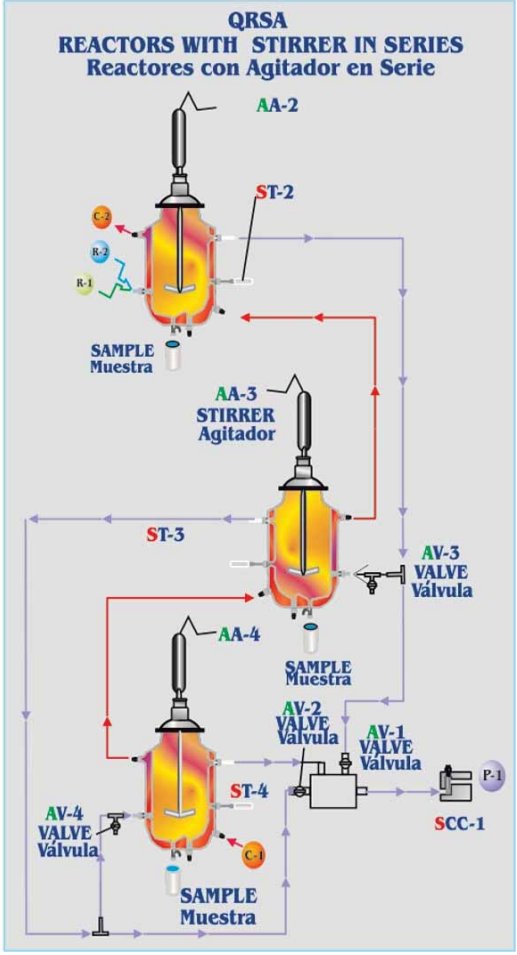
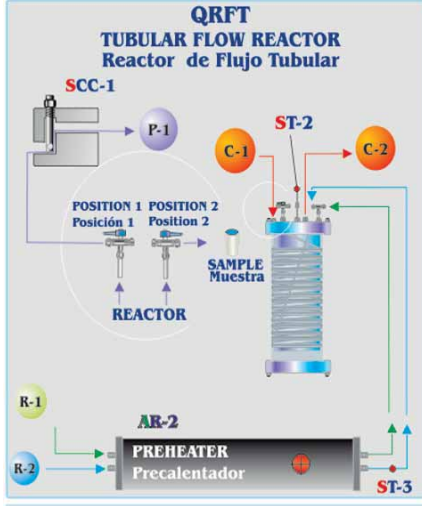
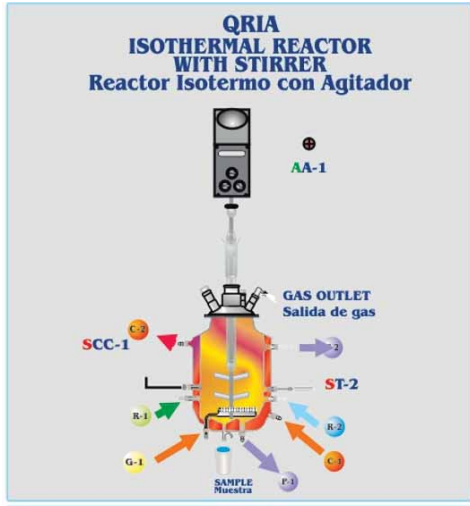
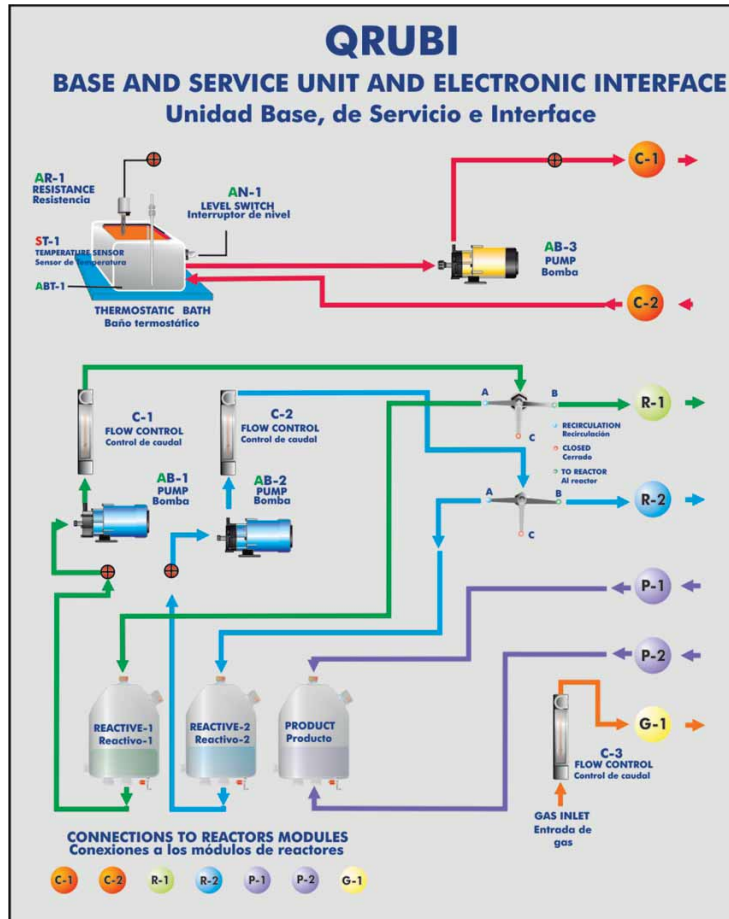
Certificates ISO 14000 and
ECO-Management and Audit Scheme
(environmental management)



Worlddidac Quality Charter
Certificate
(Worlddidac Member)

10 actuators and 7 sensors controlled from any computer, and working simultaneously

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL



Note: AB= Pump. AR= Heater resistance. ST= Temperature sensor. SCC= Conductivity sensor. AA= Stirrer.

Common items for the Chemical Reactors

① QRUBI. Base Service Unit:

This unit is common for the Chemical Reactors and can work with one or several reactors.
 Installation and exchange system of the reactors quick and easy to handle.
 It supplies all the services for the operation of each reactor.
 Anodized aluminium structure and panels in painted steel.
 Main metallic elements in stainless steel.
 This unit includes wheels for its mobility.
 Diagram in the front panel with similar distribution to the elements in the real unit.
 2 dosing pumps, computer controlled.
 3 tanks of 10 litres made of Pyrex-glass: two of them for the reagents and the other one for the product.
 2 flow meters to measure the flow of liquids. Flow range: 0.7-7 and 0.54-5.4 l./h.
 Flow meter to measure the flow of gas for a maximum flow of 1440N l/h and maximum pressure of 0.5 Kg cm⁻².
 Thermostatic bath of 9 litres that regulates the temperature between T_{environment} + 5° and 70°C.
 Level switch.
 A pump, computer controlled, to impel the water that comes from the thermostatic bath and goes to the reactor.
 Type "J" temperature sensor to get the temperature of the reactor in a continuous way.
 Temperature control through the computer.
 Control system of the reaction. The control of the reaction is carried out by means of a conductivity cell and a conductimeter, connected to the control interface box.
 All elements of this unit are chemically resistants.



QRUBI

② QRQC/CIB. Control Interface Box :

This control interface is common for the Chemical Reactors and can work with one or several reactors.
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.
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 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.**
Open control allowing modifications, at any moment and in real time, of 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.
Three safety levels, one mechanical in the unit, other electronic in the control interface and the third one in the control software.



QRQC/CIB

③ DAB. Data Acquisition Board:

This board common for the Chemical Reactors.
 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. D0 or DI Sample Clock frequency: 0 to 1 Mhz.
 Timing: **Counter/timers=2**. Resolution: Counter/timers: 32 bits.



DAB

Continue...

④ **Chemical Reactors**

④.1 **QRIA. Isothermal Reactor with Stirrer:**

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. Reactor insulated made of Pyrex-glass, with a maximum volume of 2 litres. Inlets of reagents. Outlet of products. Conductivity cell connection. Water outlet. Water inlet. Temperature sensor connection. Gas inlet. Gas outlet. Agitation system with agitation speed control, from 0 to 2000 rpm. Temperature sensor. Conductivity sensor. Safety, easy and quick connections. All elements of this unit are chemically resistant. This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals. Computer Control Software:

Computer Control+Data Acquisition+Data Management Software for Isothermal Reactor with Stirrer (QRIA). 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. 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. 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 to different work levels. **This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.**



QRIA

④.2 **QRIA/D. Isothermal Reactor with Distillation:**

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. Reactor insulated made of Pyrex-glass, with a maximum volume of 2 litres. Inlets of reagents. Outlet of products. Conductivity cell connection. Water outlet. Water inlet. Temperature sensor connection. Gas inlet. Gas outlet. Agitation system with agitation speed control, from 0 to 2000 rpm. Distillation column. Balls coolant. Coil coolant. Vacuum pump. Vacuum tramp. Graduated funnel. Temperature sensors. Conductivity sensor. Safety, easy and quick connections. All elements of this unit are chemically resistant. This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals. Computer Control Software:

Computer Control+Data Acquisition+Data Management Software for Isothermal Reactor with Distillation (QRIA/D). 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. 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. 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 to different work levels. **This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.**



QRIA/D

④.3 **QRFT. Tubular Flow Reactor:**

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. Temperature controlled by a jacket of water, through a temperature sensor "J" type. Electrical preheater with power of 265 W for both feeding lines. Reactor with inner coil made of teflon of 6mm of interior diameter, length 14.5 m, volume: 0.393 litres. Temperature sensor "J" type, that controls the preheating temperature. Conductivity sensor. Safety, easy and quick connections. All elements of this unit are chemically resistant. This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals. Computer Control Software:

Computer Control+Data Acquisition+Data Management Software for Tubular Flow Reactor (QRFT). 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. 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. 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 to different work levels. **This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.**



QRFT

Continue...

④ **Chemical Reactors** (continuation)

④.4 **QRAD. Adiabatic and Isothermal Reactor:**

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.
 Reactor insulated made of Pyrex-glass, with a maximum volume of 2 litres.
 Nickel-plated cooper coil of 2500mm long, outer diameter of 6.7mm and inner one of 4.1 mm.
 Stirrer.
 Water flow control of 0-6 l./min.
 Outer jacket made of anodised aluminium and inner jacket made of expanded polyurethane foam rubber.
 3 Temperature sensors. Conductivity sensor.
 Safety, easy and quick connections.
 All elements of this unit are chemically resistant.
 This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.
Computer Control Software:
 Computer Control+Data Acquisition+Data Management Software for Adiabatic and Isothermal Reactor (QRAD).
 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.
 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. 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 to different work levels.
 This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.



QRAD

④.5 **QRSA. Reactors with Stirrer in Series:**

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.
 3 Reactors insulated made of Pyrex-glass, with a maximum volume of 1 litre each one.
 Agitation system with agitation speed control, from 0 to 2000 rpm. , for each reactor.
 3 Temperature sensors.
 Conductivity sensors.
 Safety, easy and quick connections.
 All elements of this unit are chemically resistant.
 This unit is supplied with 8 manuals: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.
Computer Control Software:
 Computer Control+Data Acquisition+Data Management Software for Reactors with Stirrer in Series (QRSA).
 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.
 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. 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 to different work levels.
 This unit allows the 30 students of the classroom to visualize simultaneously all results and manipulation of the unit, during the process, by using a projector or an electronic whiteboard.



QRSA

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

⑥ **Manuals:**

This system is supplied with 8 manuals for each Chemical Reactor: Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

Additional and optional items

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

⑦ PLC-PI. PLC Module:

This unit is common for the Chemical Reactors and can work with one or several reactors.

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.

Power supply input (100 to 240 V AC).

DC input: 16 (24 VDC).

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).

⑧ QRQC/PLC-SOF. PLC Control Software.

Always included with PLC supply.

Each Chemical Reactor has its own Software.



PLC-PI

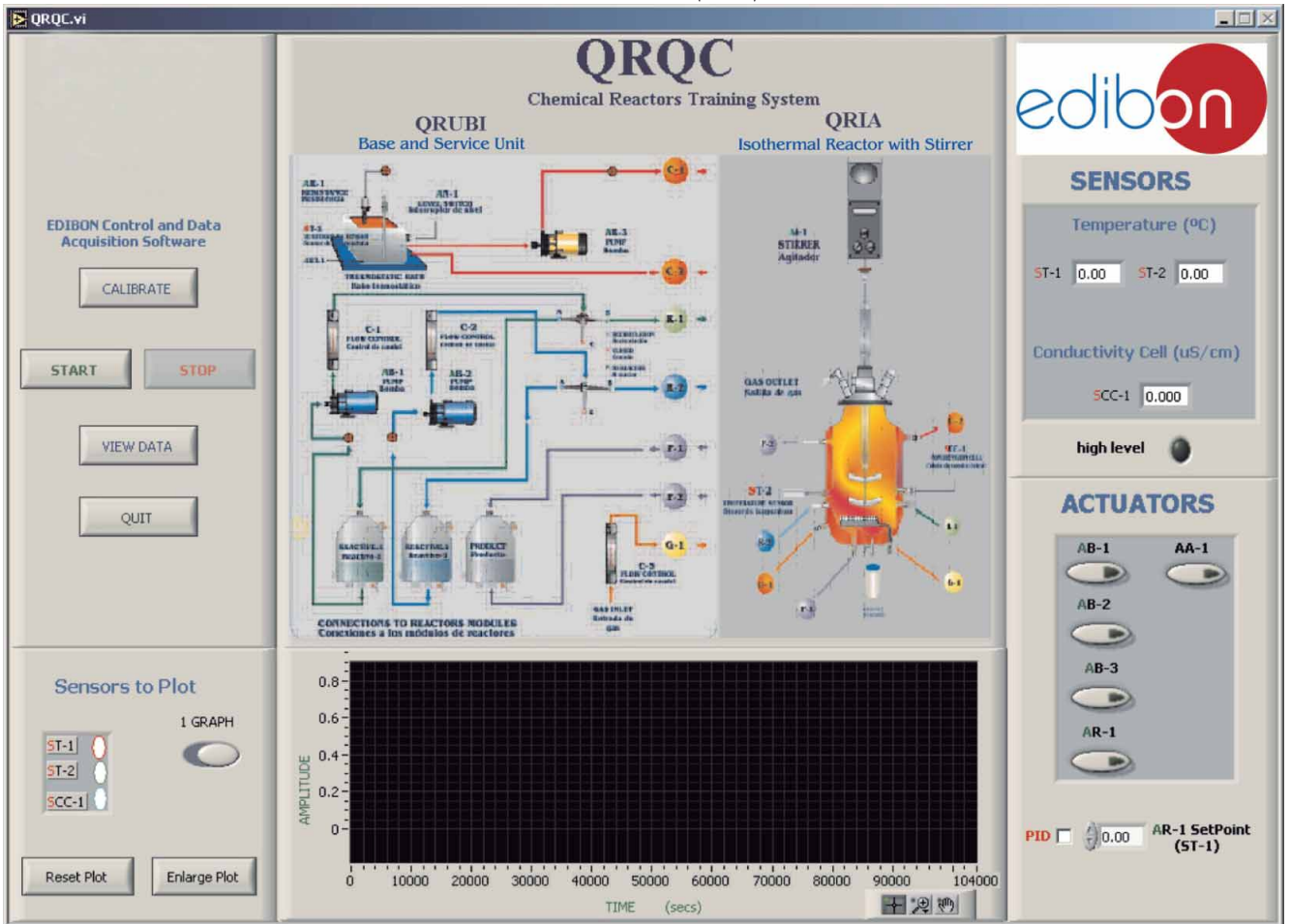
Items available on request

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

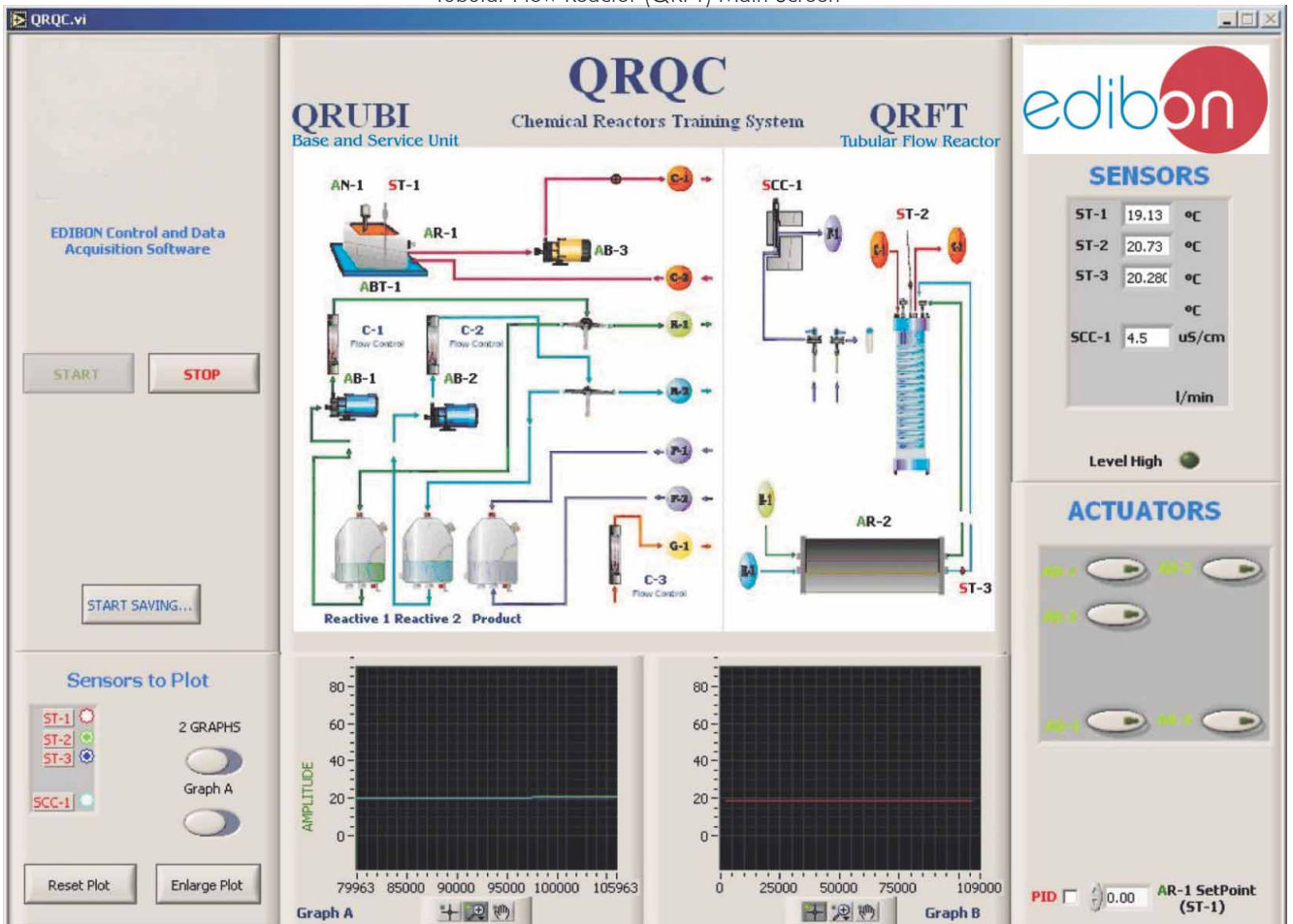
⑩ QRQC/FSS. Faults Simulation System.

Software Main Screens

Isothermal Reactor with Stirrer (QRIA) Main Screen



Tubular Flow Reactor (QRFT) Main Screen

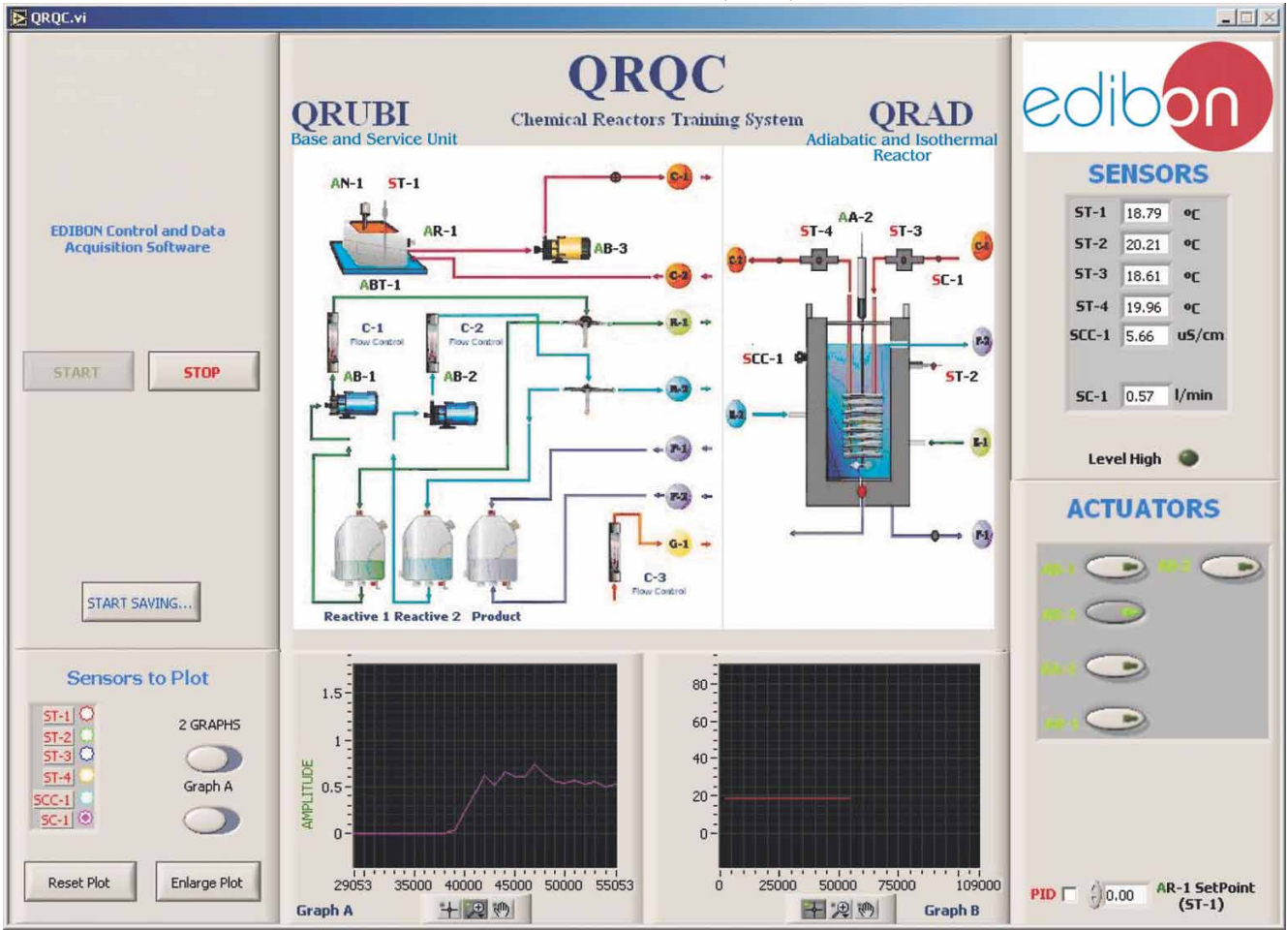


Note: ST= Temperature sensor. SCC= Conductivity sensor. AB= Pump. AR= Heater resistance. AA= Stirrer.

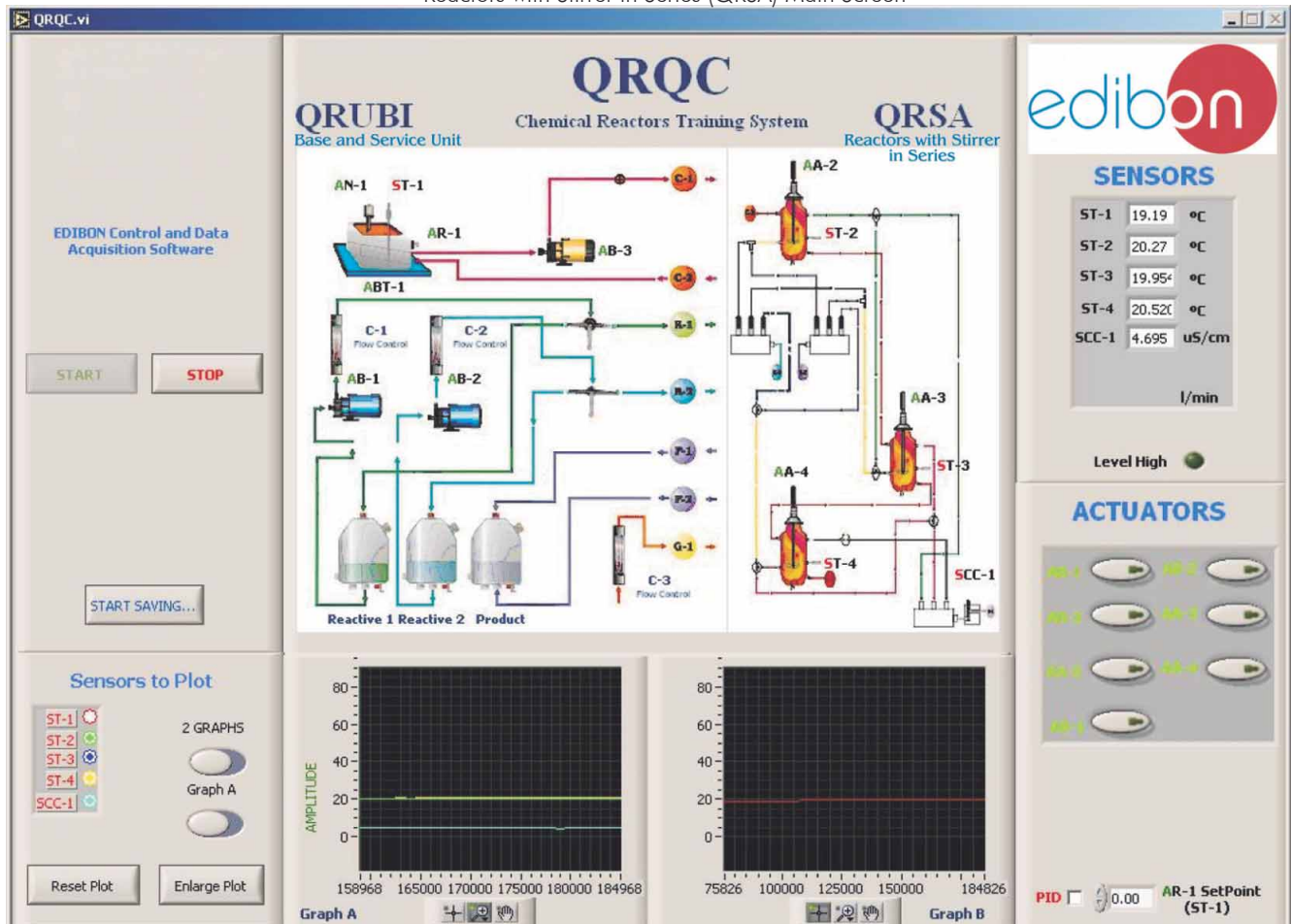
Continue...

Software Main Screens (continuation)

Adiabatic and Isothermal Reactor (QRAD) Main Screen



Reactors with Stirrer in Series (QRSA) Main Screen



Note: ST= Temperature sensor. SCC= Conductivity sensor. AB= Pump. AR= Heater resistance. AA= Stirrer. SC=Flow sensor.

Continue...

Examples of Sensors Calibration screens

CALIBRATION

Restore Setting Instructor

Analog Input Channel: ST-1

Sensor Name: ST-1

Calibration units: °C

Full Scale: 100

Gain: 95,7706 Offset: -0,391638

Least Squares Fit

PTA: 10

Volts: 0,2338 Calibrated: 22

ENTER EXIT

EXIT & SAVE

Technical Support

AR-1

AA-1 **ACTUATORS** AB-1

0

AVE-1

MULTICALIBRATE

Signed Technical Support

Reference Value: 23,2113

AT Full Scale: 100 Tolerance (%): 1

Reference Select	Sensors	Volts	Calibrated	Err (%)
<input checked="" type="checkbox"/>	ST-1	0,2046	22,3821	0,82
<input checked="" type="checkbox"/>	ST-2	0,2292	23,483	0,28
<input checked="" type="checkbox"/>	ST-3	0,2353	23,1522	0,05
<input checked="" type="checkbox"/>	ST-4	0,2301	23,2113	0,01
<input type="checkbox"/>		0,1527	13,1629	10,04
<input type="checkbox"/>	SCC-1	-5,2792	172,5164	149,31
<input type="checkbox"/>		-0,2362	-22,6609	45,87
<input type="checkbox"/>	SC-1	-0,1774	0,0319629	23,17
<input type="checkbox"/>		-0,2681	-60,4623	83,67
<input type="checkbox"/>		-0,2251	0,4208	22,78
<input type="checkbox"/>		-0,2529	+0,2529	23,46
<input type="checkbox"/>		-0,2063	-0,1178	23,32
<input type="checkbox"/>		-0,2581	-226,9384	250,14
<input type="checkbox"/>		-0,3634	-0,3634	23,57
<input type="checkbox"/>		-0,275	+0,275	23,48
<input type="checkbox"/>		-0,2005	-0,2005	23,41

Select all Data taken: 0

ENTER DONE

AB-1 AB-2 AB-3 AA-2

AR-1

Port 0 Port 1 Port 2

Restore Restore Instructor

	GAIN	OFFSET	p
ST-1	97,7605	2,3804	0
ST-2	97,7997	1,0627	0
ST-3	95,8345	0,6041	0
ST-4	96,6188	0,9823	0
	93,9573	-1,1855	0
SCC-1	162,04	1027,9537	0
	97,4967	0,3678	0
SC-1	0,679363	0,1525	0
	41,2123	-49,4113	0
	0,27089	0,4817	0
	1	0	0
	0,417958	-0,0315	0
	879,1	0	0
	1	0	0
	1	0	0
	1	0	0

Some Practical Possibilities of the System:**Practices to be done with the Isothermal Reactor with Stirrer (QRIA):**

- 1.- Determination of the ionic conductivities.
- 2.- Discontinuous operation. Obtaining the reaction order respect to ethyl-acetate. Initial velocity method.
- 3.- Discontinuous operation. Obtaining the reaction order respect to sodium hydroxide. Initial velocity method.
- 4.- Discontinuous operation. Velocity Constant Computation. Constant sodium hydroxide initial concentration.
- 5.- Discontinuous Operation. Velocity Constant Computation. Constant ethyl-acetate initial concentration.
- 6.- Velocity equation formulation.
- 7.- Discontinuous Operation. Variation of the kinetic constant with temperature. Arrhenius Equation.
- 8.- Discontinuous Operation. Theoretical and experimental conversion comparative. Deviation from ideality.
- 9.- Discontinuous Operation. Mixture effects.
- 10.- Continuous Operation.
- 11.- Continuous Operation. Mixture effects.
- 12.- Measurement conductivity system: conductimeter.
- 13.- Calibration of the temperature sensors.
- 14.- Calibration of the conductivity cell.

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

- 15.- Control of the QRIA unit process through the control interface box without the computer.
- 16.- Visualization of all the sensors values used in the QRIA unit process.
- 17.- Calibration of all sensors included in the QRIA unit process.
- 18.- Hand on of all the actuators involved in the QRIA 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 QRIA unit.
- 23.- PLC structure.
- 24.- PLC inputs and outputs configuration.
- 25.- PLC configuration possibilities.
- 26.- PLC program languages.
- 27.- PLC different programming standard languages (literal structured, graphic, etc).
- 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 QRIA unit process.
- 31.- Possibility of creating new process in relation with the QRIA unit.
- 32.- PLC Programming Exercises.
- 33.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with Isothermal Reactor with Distillation (QRIA/D):

- 34.- Determination of the ionic conductivities.
- 35.- Discontinuous operation. Obtaining the reaction order respect to ethyl-acetate. Initial velocity method.
- 36.- Discontinuous operation. Obtaining of the reaction order respect to sodium hydroxide. Initial velocity method.
- 37.- Discontinuous operation. Velocity Constant Computation. Constant sodium hydroxide initial concentration.
- 38.- Discontinuous Operation. Velocity Constant Computation. Constant ethyl-acetate initial concentration.
- 39.- Velocity equation formulation.
- 40.- Discontinuous Operation. Variation of the kinetic constant with temperature. Arrhenius Equation.
- 41.- Discontinuous Operation. Theoretical and experimental conversion comparative. Deviation from ideality.
- 42.- Discontinuous Operation. Mixture effects.
- 43.- Continuous Operation.
- 44.- Continuous Operation. Mixture effects.
- 45.- Measurement conductivity system: conductimeter.
- 46.- Study of the reactive distillation.
- 47.- Study of alcohols condensation.

- 48.- Study of the organic anhydrides.
- 49.- Synthesis of esters.
- 50.- Calibration of the temperature sensors.
- 51.- Calibration of the conductivity cell.

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

- 52.- Control of the QRIA/D unit process through the control interface box without the computer.
- 53.- Visualization of all the sensors values used in the QRIA/D unit process.
- 54.- Calibration of all sensors included in the QRIA/D unit process.
- 55.- Hand on of all the actuators involved in the QRIA/D unit process.
- 56.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
- 57.- 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).
- 58.- PLC hardware general use and manipulation.
- 59.- PLC process application for QRIA/D unit.
- 60.- PLC structure.
- 61.- PLC inputs and outputs configuration.
- 62.- PLC configuration possibilities.
- 63.- PLC program languages.
- 64.- PLC different programming standard languages (literal structured, graphic, etc).
- 65.- New configuration and development of new process.
- 66.- Hand on an established process.
- 67.- To visualize and see the results and to make comparisons with the QRIA/D unit process.
- 68.- Possibility of creating new process in relation with the QRIA/D unit.
- 69.- PLC Programming Exercises.
- 70.- Own PLC applications in accordance with teacher and student requirements.

Practices to be done with the Tubular Flow Reactor (QRFT):

- 71.- Analysis of reagents and products.
- 72.- Ionic conductivities determination.
- 73.- Theoretical conversion of the tubular reactor.
- 74.- Experimental determination of the conversion of the tubular reactor.
- 75.- Dependence in the residence time.
- 76.- Determination of the reaction order.
- 77.- Dependence of the speed constant and the conversion with the temperature.
- 78.- Measurement conductivity system: conductimeter.
- 79.- Complete emptying of the unit.
- 80.- Calibration of the temperature sensors.

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

- 81.- Control of the QRFT unit process through the control interface box without the computer.
- 82.- Visualization of all the sensors values used in the QRFT unit process.
- 83.- Calibration of all sensors included in the QRFT unit process.
- 84.- Hand on of all the actuators involved in the QRFT unit process.
- 85.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
- 86.- 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).
- 87.- PLC hardware general use and manipulation.
- 88.- PLC process application for QRFT unit.
- 89.- PLC structure.
- 90.- PLC inputs and outputs configuration.
- 91.- PLC configuration possibilities.
- 92.- PLC program languages.
- 93.- PLC different programming standard languages (literal structured, graphic, etc).
- 94.- New configuration and development of new process.
- 95.- Hand on an established process.
- 96.- To visualize and see the results and to make comparisons with the QRFT unit process.
- 97.- Possibility of creating new process in relation with the QRFT unit.
- 98.- PLC Programming Exercises.
- 99.- Own PLC applications in accordance with teacher and student requirements.

Some Practical Possibilities of the System: (continuation)

Practices to be done with the Adiabatic and Isothermal Reactor (QRAD):

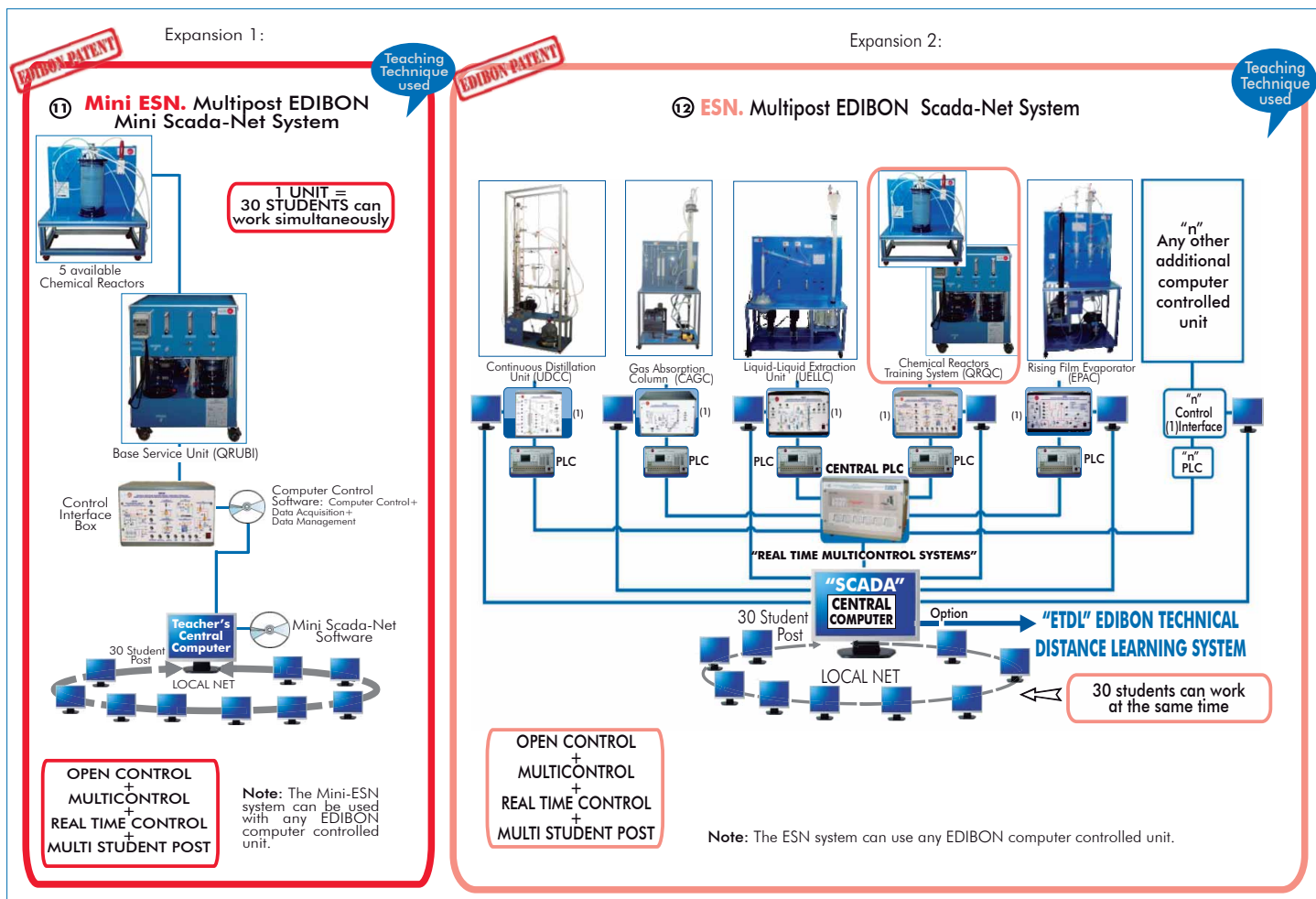
- 100.-Determination of the ionic conductivities.
 - 101.-Discontinuous work. Calculation of the order of the reaction referred to the ethyl-acetate. Initial velocity method.
 - 102.-Discontinuous operation. Determination of the order of the reaction referred to the sodium hydroxide. Initial velocity method.
 - 103.-Discontinuous operation. Determination of the speed constant, the initial concentration of the sodium hydroxide is constant.
 - 104.-Discontinuous operation. Determination of the speed constant, the initial concentration of the ethyl acetate is constant.
 - 105.-Formulation of the speed equation.
 - 106.-Discontinuous operation. Variation of the kinetic constant when the temperature is not constant: Arrhenius equation.
 - 107.-Discontinuous operation. Comparison of the theoretical and the experimental conversion: Deviation from the ideality.
 - 108.-Calculation of the heat transfer coefficient of the coil.
 - 109.-Calculation of the hydrolysis reaction enthalpy.
 - 110.-Discontinuous operation. Mixture effects.
 - 111.-Continuous operation.
 - 112.-Measurement conductivity system: conductimeter.
 - 113.-Calibration of the temperature sensors.
 - 114.-Calibration of the flow sensor.
 - 115.-Calibration of the conductivity sensor.
- Practices to be done by PLC Module (PLC-PI)+PLC Control Software:
- 116.-Control of the QRAD unit process through the control interface box without the computer.
 - 117.-Visualization of all the sensors values used in the QRAD unit process.
 - 118.-Calibration of all sensors included in the QRAD unit process.
 - 119.-Hand on of all the actuators involved in the QRAD unit process.
 - 120.-Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
 - 121.-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).
 - 122.-PLC hardware general use and manipulation.
 - 123.-PLC process application for QRAD unit.
 - 124.-PLC structure.
 - 125.-PLC inputs and outputs configuration.
 - 126.-PLC configuration possibilities.
 - 127.-PLC program languages.
 - 128.-PLC different programming standard languages (literal structured, graphic, etc).
 - 129.-New configuration and development of new process.
 - 130.-Hand on an established process.
 - 131.-To visualize and see the results and to make comparisons with the QRAD unit process.
 - 132.-Possibility of creating new process in relation with the QRAD unit.
 - 133.-PLC Programming Exercises.
 - 134.-Own PLC applications in accordance with teacher and student requirements.

- 148.-PLC process application for QRSA unit.
- 149.-PLC structure.
- 150.-PLC inputs and outputs configuration.
- 151.-PLC configuration possibilities.
- 152.-PLC program languages.
- 153.-PLC different programming standard languages (literal structured, graphic, etc).
- 154.-New configuration and development of new process.
- 155.-Hand on an established process.
- 156.-To visualize and see the results and to make comparisons with the QRSA unit process.
- 157.-Possibility of creating new process in relation with the QRSA unit.
- 158.-PLC Programming Exercises.
- 159.-Own PLC applications in accordance with teacher and student requirements.

Practices to be done with the Reactors with Stirrer in Series (QRSA):

- 135.-Determination of the ionic conductivities.
 - 136.-Work with just one reactor in continuous.
 - 137.-Work with just one reactor in continuous with mixture effects.
 - 138.-Work with 3 reactors in continuous.
 - 139.-Calibration of the temperature sensors.
 - 140.-Calibration of the conductivity cell.
- Practices to be done by PLC Module (PLC-PI)+PLC Control Software:
- 141.-Control of the QRSA unit process through the control interface box without the computer.
 - 142.-Visualization of all the sensors values used in the QRSA unit process.
 - 143.-Calibration of all sensors included in the QRSA unit process.
 - 144.-Hand on of all the actuators involved in the QRSA unit process.
 - 145.-Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
 - 146.-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).
 - 147.-PLC hardware general use and manipulation.

POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS



ORDER INFORMATION

Items always supplied as minimum configuration

Common items for the Chemical Reactors:

- ① QRUBI. **Base Service Unit.** (Common for the Chemical Reactors and can work with one or several reactors).
- ② QRQC/CIB. **Control Interface Box.** (Common for the Chemical Reactors and can work with one or several reactors).
- ③ DAB. **Data Acquisition Board.** (Common for the Chemical Reactors).

④ Available Chemical Reactors:

- ① QRIA. **Isothermal Reactor with Stirrer, and/or**
 - ② QRIA/D. **Isothermal Reactor with Distillation, and/or**
 - ③ QRFT. **Tubular Flow Reactor, and/or**
 - ④ QRAD. **Adiabatic and Isothermal Reactor, and/or**
 - ⑤ QRSA. **Reactors with Stirrer in Series.**
- ⑤ **Cables and Accessories,** for normal operation.
 - ⑥ **Manuals:** This system is supplied with **8 manuals for each Chemical Reactor:** Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

Additional and optional items

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

- ⑦ PCL-PI. PLC Module. (Common for the Chemical Reactors and can work with one or several reactors).
- ⑧ QRQC/PLC-SOF. PLC Control Software. (Each Chemical Reactor has its own Software).
- ⑨ QRQC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
- ⑩ QRQC/FSS. Faults Simulation System. (Available on request).

Expansions

- ① Mini ESN. Multipost EDIBON Mini Scada-Net System.
- ② ESN. Multipost EDIBON Scada-Net System.

REQUIRED SERVICES

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

RECOMMENDED ACCESSORIES

- Chemical reagents: ethyl acetate, sodium acetate and sodium hydroxide.
- Cylinder of carbon dioxide.
- Laboratory materials as: burettes, test tubes, glasses and a 1 litre glass flask.

DIMENSIONS & WEIGHTS

QRUBI Unit:	-Dimensions: 1100 x 1000 x 980 mm. approx. -Weight: 100 Kg. approx.
QRIA Unit:	-Dimensions: 750 x 500 x 700 mm. approx. -Weight: 50 Kg. approx.
QRIA/D Unit:	-Dimensions: 750 x 500 x 700 mm. approx. -Weight: 70 Kg. approx.
QRFT Unit:	-Dimensions: 700 x 500 x 500 mm. approx. -Weight: 75 Kg. approx.
QRAD Unit:	-Dimensions: 1000 x 600 x 400 mm. approx. -Weight: 100 Kg. approx.
QRSA Unit:	-Dimensions: 1000 x 1000 x 1000 mm. approx. -Weight: 100 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:

- QRQC. **Computer Controlled Chemical Reactors Training System.**

Offered in other catalogues:

- QR. **Chemical Reactors Trainer.**
- QRC. **Computer Controlled Chemical Reactors Trainer.**

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



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