IA 210 PLC Application: Materials Handling Process

*** Automation fundamentals system**
*** Handling demonstrator**
*** Simulation of a punching process**
*** Simulation of workpiece control**

Technical Description

IA 210 is a compact teaching and practice unit for the control of a materials handling process using a PLC. Two processes can be simulated: a punching process, or workpiece control in the form of a sort operation. All components are in a clearly laid out design.

Black and white cylindrical workpieces are fed from a container onto a conveyor belt. On the belt is a reflex photoelectric proximity switch which differentiates between light and dark and feeds the white items to the pre-selected process (punching or sorting). The black workpieces are always carried to the end of the belt, where they drop into a collector. Three 5/2-way solenoid valves, three double-acting cylinders and a pneumatic roller pushbutton can be operated via the PLC to execute the necessary steps: releasing the workpiece from the container; pushing the workpiece onto the conveyor belt; sorting or punching the workpiece. For punching, the workpiece is brought to a predefined position. The working cylinder can switch between sorting and punching modes by a simple sequence of actions.

The unit is designed for operation in conjunction with a PLC module. Use of PLC module IA 130 is recommended.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

Learning Objectives / Experiments

- familiarisation with and analysis of an automated materials handling process
  * understanding and analysis of the mechanical, pneumatic and electrical functions
  * familiarisation with the symbols, terms and modes of representation of pneumatic and electrical function diagrams
  * familiarisation with automation components: cylinders, solenoid valves, photoelectric proximity switches
- familiarisation with the use of a PLC
  * basic methods of programming
  * adapting the program to the given handling process
- simulation of a punching process
  * conveyor belt is stopped for punching
  * conveyor belt also stops as soon as workpiece drops from belt end
- workpiece control simulation
  * light-coloured workpieces are separated out; dark items reach the belt end

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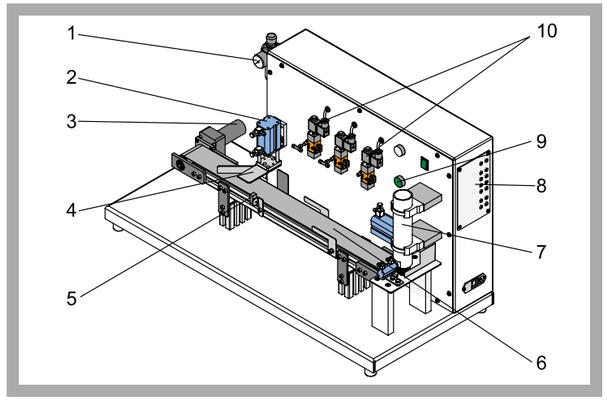
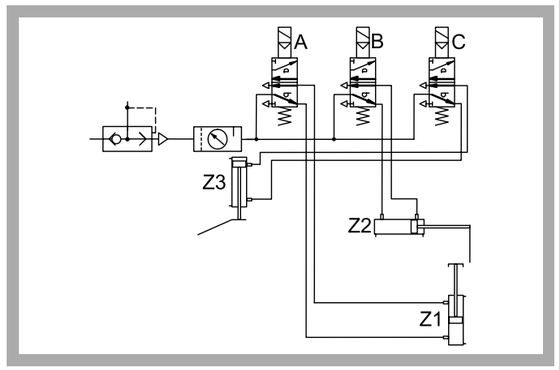
IA 210 PLC Application: Materials Handling Process



1 maintenance unit, 2 double-acting cylinder, 3 conveyor belt drive motor, 4 punching or sorting device, 5 reflex photoelectric proximity switch, 6 conveyor belt, 7 container for 11 workpieces, 8 electrical connections for solenoid valves and sensors, 9 display of limit switch, 10 5/2-way solenoid valve



Pneumatic connection diagram

Electrical connections of the solenoid valves and sensors

Specification

[1] compact unit for experiments in the field of automation
[2] handling device with solenoid valves
[3] double-acting cylinder (15mm stroke): fixing / discharge of workpieces to container
[4] double-acting cylinder (80mm stroke): pushes workpiece onto conveyor belt
[5] double-acting cylinder (40mm stroke): executes the process (sorting or punching)
[6] conveyor belt with guide plates and DC motor
[7] cylindrical Plexiglas storage container holding 11 workpieces
[8] 15 workpieces made of Polyoxymethylene (POM): 10x white, 5x black
[9] pneumatic components fitted with quick-release couplings for 4mm hoses
[10] operation of actuators with compressed air
[11] lab jacks to external PLC
[12] set of laboratory cables and pneumatic hoses
[13] compressed air supply: max. 6bar, 3bar recommended

Technical Data

3 electrically operated 5/2-way valves
- with spring return
- with pilot valve

Reflex photoelectric proximity switch
- pnp, light-switching
- 5...150mm

Geared DC motor
- reduction ratio: 142,5:1
- nominal torque 5,92Nm
- nominal speed: 22min^{-1}

Polyester weave conveyor belt
Workpieces, DxH: 40x20mm

Dimensions and Weight

LxWxH: 1000x450x580mm
Weight: approx. 46kg

Required for Operation

230V, 50/60Hz, 1 phase or 120V, 60Hz/CSA, 1 phase
Compressed air supply: max. 6bar, 3bar recommended

Scope of Delivery

1 experimental setup, complete,
15 workpieces
1 set of laboratory cables
2 collector bins
1 set of instructional material

Order Details

058.21000 IA 210 PLC Application: Material Handling Process

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RT 800 PLC Application: Mixing Process

*** Trainer for control of discontinuous mixing processes by PLC**

*** Use of standard industrial components**

*** Capacitive proximity switches as level sensors**

*** Built-in power supply unit to power all the components and the PLC**

Technical Description

This trainer for PLC applications can be used to create complex PLC control functions from the field of process engineering, particularly for processes involving metering and mixing. The system consists of the base frame with a storage tank, a centrifugal pump and a demonstration panel on which all components are clearly laid out. A pump delivers water to three tanks, controlled via solenoid valves. The level of water in the three tanks is monitored by capacitive proximity switches with adjustable sensitivity. The fluid from the three tanks can be mixed together in the downstream mixing tank. The mixing tank is also equipped with three proximity switches. A stirring machine assists the mixing process. All the tanks are transparent, so the conveying and mixing processes are clearly observable.

The trainer features a lab jack panel by which the signals from the capacitive proximity switches can be processed by PLC, and all the solenoid valves can be individually controlled. PLC systems from different manufacturers can be used. A rail on the model's front panel is provided so as to allow for connection of the PLC. Although a PLC is not included in the package, the operation of the system can be checked without one. We recommend the use of PLC module IA 130.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

Learning Objectives / Experiments

- planning and implementation of a PLC controlled mixing process
- familiarisation with terms and symbols
- presentation of circuits
- functionality test of all sensors and actuators
- sensitivity adjustment of the capacitive proximity switches
- procedure for connecting up the PLC
- together with PLC module: performance of complex PLC control functions using a complex example from the field of process engineering
- discontinuous metering and mixing

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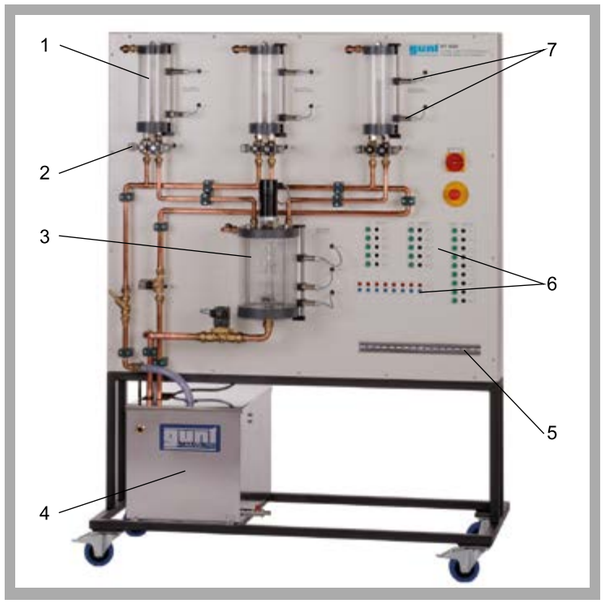
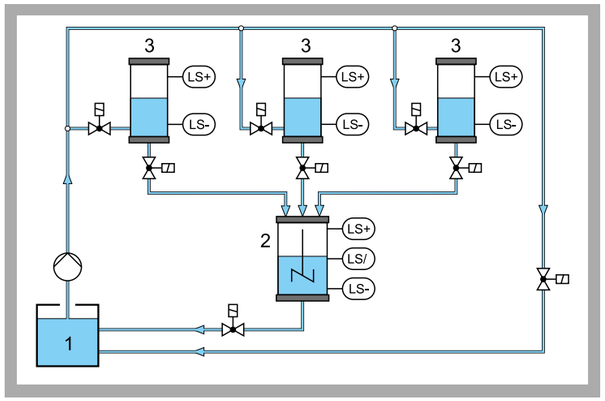
RT 800 PLC Application: Mixing Process



1 measuring tank, 2 solenoid valve, 3 mixing tank with stirring machine, 4 storage tank, 5 rail for mounting of a PLC system, 6 lab jack panel for connection of a PLC, 7 level sensor



Process schematic: 1 storage tank, 2 mixing tank, 3 measuring tank;
LS level sensors (+: high, /: middle, -: low)

Specification

[1] clearly laid out trainer as basis for the use of a PLC in a process control application involving mixing processes
[2] transparent mixing tank with 3 capacitive proximity switches to monitor the level
[3] 3 transparent measuring tanks, each with 2 capacitive proximity switches
[4] metering from the 3 measuring tanks into the mixing tank via solenoid valves
[5] mixing assisted by stirring machine in mixing tank
[6] proximity switch signals processed by PLC via lab jack panel
[7] control of the 8 solenoid valves, the pump and the agitator also by PLC via lab jack panel
[8] capacitive proximity switches with adjustable sensitivity
[9] closed water circuit with centrifugal pump and stainless steel storage tank
[10] power supply to all components and to PLC by built-in power supply unit

Technical Data

Centrifugal pump (submersible pump)
- power consumption: 430W
- max. flow rate: 150L/min
- max. head: 7m

Tanks
- storage tank: 70L
- 3 measuring tanks: each 1500mL
- mixing tank: 7L

Capacitive proximity switches, NO contacts
2/2-way solenoid valves DN 8 and DN 20
Power supply unit: 24VDC, 8A

Dimensions and Weight

LxWxH: 1380x610x1850mm
Weight: approx. 145kg

Required for Operation

230V, 50/60Hz, 1 phase or 120V, 60Hz/CSA, 1 phase

Scope of Delivery

1 trainer
1 set of instructional material

Order Details

080.80000 RT 800 PLC Application: Mixing Process

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IA 130 PLC Module

*** Self-contained PLC module for basic exercises**
*** Suitable for use in complex applications**
*** Programming software to IEC 61131-3**

Technical Description

The IA 130 can be used to perform basic exercises on a PLC (programmable logic controller). A PLC is essentially a computer adapted to the needs of industry. Its inputs and outputs are not designed for humans, but for use in the control of machines. Machine and operator interact solely by way of limit switches, momentary-contact switches or photoelectric switches.

The front panel is designed as a laboratory patchboard, where the input ports and output ports of the PLC can be connected to switches and displays via laboratory cables. In order to write programs the PLC must be connected to a PC (not supplied) via an RS232 interface.

The PLC programming software conforms to the international standard IEC 61131-3, and permits programming in the following languages: Statement List (STL), Ladder Diagram (LD), Structured Text (ST) and Function Block Diagram (FBD). Ladder Diagrams are based on graphical representations with contacts, coils and boxes, as per the circuit diagrams. Function Block Diagram language is based on graphical representation of the interlinking of logical function blocks, analogous to the logic diagrams. Statement List is an assembler-type language with a small, standardised non-hardware-dependent command set. Structured Text is a language similar to PASCAL, with mathematical expressions, assignments, function calls, iteration, condition selection, and PLC-specific add-ons. An example program is included in the module.

IA 130 can be used as a control element in conjunction with electrical, pneumatic or hydraulic applications, such as with the handling device IA 210 or the mixing process RT 800.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

Learning Objectives / Experiments

- familiarisation with a PLC
- familiarisation with the essential fundamentals such as
  * Boolean algebra
  * compiling statement lists
  * interconnection diagrams and block diagrams
- exercises in
  * programming
  * logical "AND" / "OR" gates
  * logic relays
  * output and input
- configuration of program sequences by way of connectors, incorporating
  * timers
  * counters
  * cascade circuits
  * higher-order monitoring relays etc.
- fault finding

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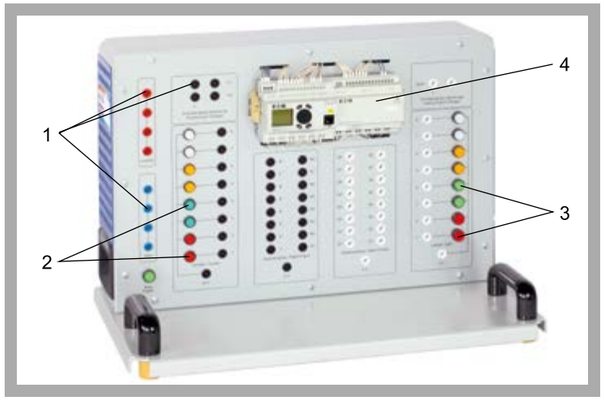
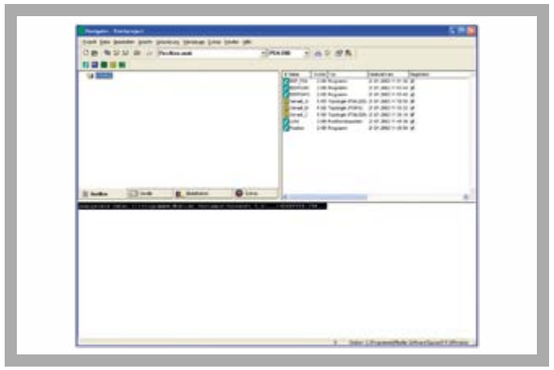
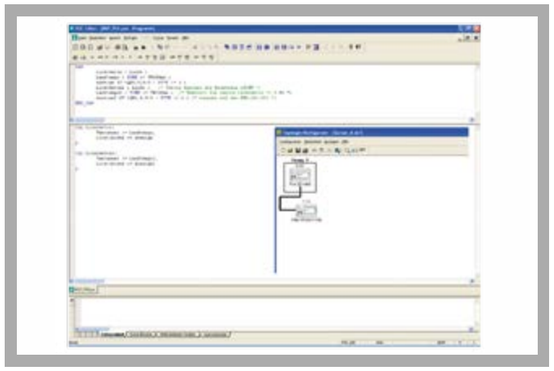
IA 130 PLC Module



1 lab jacks, 2 pushbutton, 3 lamps, 4 PLC



Screenshot of PLC software: start screen



Screenshot of PLC software: POU editor (POU = Program Organisation Unit) and topology configurator

Specification

[1] module for basic exercises on a programmable logic controller (PLC)
[2] self-contained PLC module, usable as part of a complex system
[3] integrated patchboard for creating circuits with input and output elements
[4] PLC with 2 integrated setpoint encoders
[5] programming software to IEC 61131-3
[6] example program supplied

Technical Data

PLC
- connections
  * 16 digital inputs
  * 16 digital outputs
  * 2 analogue inputs
  * 1 analogue output
- memory type: PLC back-up battery for 32kByte RAM and clock
- Rated voltage: 24VDC

Software
- graphical user interfaces
- programming languages to IEC/EN 61131-3:
  * statement list (STL)
  * ladder diagram (LD)
  * function block diagram (FBD)
  * structured text (ST)
- multiple dialogue languages (German, English, French, Spanish)
- graphical topology configurator
- system requirements: Windows Vista or Windows 7

Dimensions and Weight

LxWxH: 620x350x450mm
Weight: approx. 15kg

Required for Operation

230V, 50/60Hz, 1 phase or 120V, 60Hz/CSA, 1 phase

Scope of Delivery

1 PLC Module
1 PLC software with programming cable
1 set of laboratory cables
1 set of instructional material

Order Details

058.13000 IA 130 PLC Module

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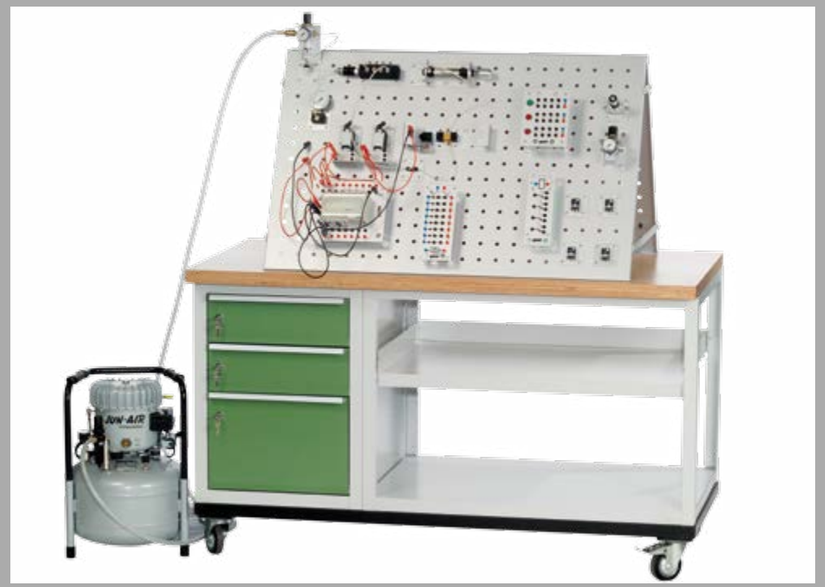
RT 770 Training System: Pneumatics, Electro-Pneumatics and PLC



*** Complete training system providing an experimental introduction to the fundamentals of pneumatics and electro-pneumatics - with PLC**

*** Experiment scope and configuration based on the tried and proven concept course developed by the Bundesinstitut für Berufsbildung (BIBB; Federal Institute for Vocational Training)**

*** 2 large-format metal assembly panels for fast, secure component mounting**

*** Sturdy base construction, mobile, with drawer system for storage**

Technical Description

The RT 770 is a fully equipped training system with all necessary components and aids to conduct a comprehensive training course in the fundamentals of pneumatic and electro-pneumatic controls. The didactic structure of the course is based on the long-established BIBB training concept. In addition to the BIBB course experiments, RT 770 also includes a PLC (programmable logic controller).

The system comprises standard industrial components. The board-mounted components are securely attached to the assembly panels by a special quick-clamping system. The assembly area consists of two panels that are arranged in a roof-like configuration and can be used simultaneously. Pneumatic and electro-pneumatic circuits are constructed with the aid of pneumatic hoses and laboratory cables. A miniature compressor supplies the experiments with compressed air.

The sturdy trolley provides clearly laid out storage for the components.

An extensive package of literature and media is supplied.

Learning Objectives / Experiments

- physical principles of pneumatics and electro-pneumatics
- fundamentals of, and terms used in, process control
- design and function of pneumatic components
- logic elements, logic diagram
- multi-way valves, pressure, shut-off and flow control valves
- controls with starting and setup conditions (automatic/manual/jog mode)
- controls with boundary conditions
- routing and time controls (process and time controlled sequencers)
- position-dependent controls
- troubleshooting and commissioning

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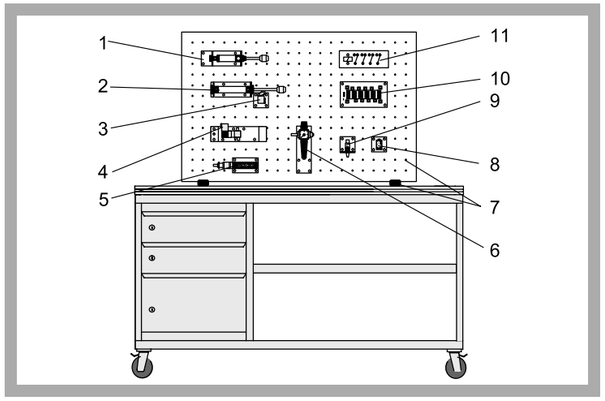
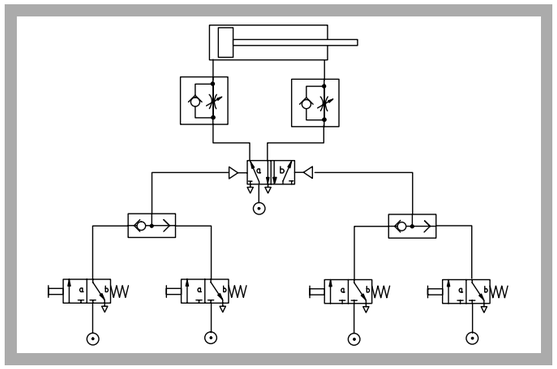
RT 770 Training System: Pneumatics, Electro-Pneumatics and PLC



1 cylinder, single-acting, 2 cylinder, double-acting, 3 3/2-way valve with roller lever, 4 3/2-way valve, 5 distributor block with hand valve, 6 maintenance unit, 7 assembly panel, 8 dual pressure valve (AND gate), 9 quick-vent valve, 10 sequencer, 11 relay board



Circuit diagram of experimental setup for logical OR element

Relay board

Specification

[1] comprehensive trainer for demonstration and exercises in pneumatics, electro-pneumatics and PLCs
[2] 2 perforated metal panels for quick component fixing
[3] standard industrial pneumatic and electro-pneumatic components
[4] various multi-way valves, pressure, shut-off and flow control valves
[5] electric limit switch, various proximity switches, solenoid valves, signal board
[6] PLC with programming software
[7] integrated power supply unit to supply the electro-pneumatics and the PLC
[8] 2x maintenance units + distributor block for simultaneous use of both panels
[9] hoses, cables and tools to construct the experiments
[10] miniature compressor for compressed air supply

Technical Data

2 assembly panels, LxH: 1100x700mm each
Compressor
- tank: 24L
- intake capacity: 50L/min
- power output: 32L/min at 8bar
- max. pressure: 8bar
- motor: 0,34kW

PLC with display
- inputs: 8
- outputs: 4
- EEPROM
- programming software

Size of components: nominal width 3
Pneumatic hose: 4/2mm
Power supply unit: 24VDC, 4A

Dimensions and Weight

LxWxH: 1530x750x1540mm
Weight: approx. 160kg

Required for Operation

230V, 50/60Hz, 1 phase or 120V, 60Hz, 1 phase

Scope of Delivery

1 training system, complete
1 miniature compressor
1 PLC with software
1 set of instructional material

Order Details

080.77000	RT 770	Training System: Pneumatics, Electro-Pneumatics and PLC

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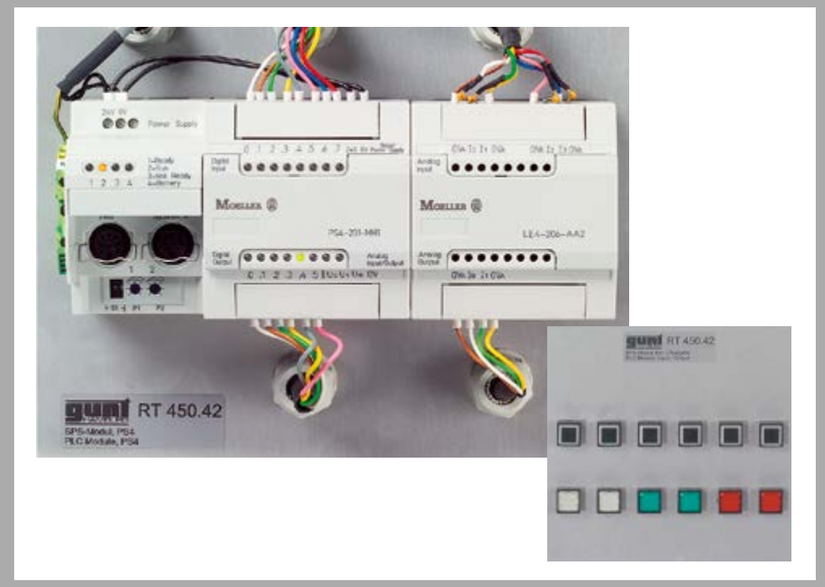
RT 450.42 PLC Module with Software



*** PLC with included programming software**

*** Module for Profibus communication available**

Technical Description

The programmable logic controller (PLC) is pre-installed on a panel which can be quickly and easily attached to the frame of the RT 450 base module. All the connections for the PLC are pre-configured on connector assemblies ready for plugging-in to terminals on the rear of the panel.

The PLC package also includes programming software supplied by the PLC manufacturer.

The PLC can be fitted with the Profibus module RT 450.43. This enables the PLC to communicate over the Profibus network. An input/output module is supplied.

Learning Objectives / Experiments

- functional range of a PLC
- programming a PLC using included programming software
- electrical connections and signal links
- Profibus communication

Scope of Delivery

1 PLC module
1 CD containing PLC programming software
1 input/output module
1 interface cable for digital signals

Specification

[1] module for exercises using a programmable logic controller (PLC)
[2] expansion of analog inputs and outputs
[3] RS232 port for programming on computer
[4] PLC programming software
[5] programming languages: Statement List (STL), Ladder Diagram (LD), Structured Text (ST), Function Block Diagram (FBD)
[6] Profibus module (RT 450.43) for communication with network available as an option

Technical Data

PLC
- 8 digital inputs: 24VDC
- 4 analog inputs: 10-bit, 4...20mA
- 6 digital outputs: 24VDC, max. 100mA
- 2 analog outputs: 12-bit, 4...20mA
- program memory: 24kB

Software
- programming language conforming to IEC61131-3

Dimensions and Weight

LxWxH: 215x86x110mm
Weight: approx. 1kg

Required for Operation

24VDC

Order Details

080.45042 RT 450.42 PLC Module with Software

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RT 450.12 Chart Recorder Module

The illustration shows a similar unit.

*** Colour 3-channel process recorder**

*** Analog recording of process variables conforming to the variables being measured or in the range 0...100%**

Technical Description

The recorder module is pre-installed on a panel which can be quickly and easily attached to the frame of the RT 450. The connections for the recorder module are pre-configured on connector assemblies for plugging-in to terminals on the rear of the panel.

Signals are recorded by a line recorder which continuously plots these signals as coloured lines.

The recorder module features a keypad and a display, used to program individual channels as well as the paper feed rate.

Learning Objectives / Experiments

- functional range of a line recorder
- adjusting and changing pens and graph paper
- operation, parameterisation and configuration via keyboard
- signal links and standard current signals

Specification

[1] recorder module to record control and process variables
[2] continuous recording of three independent standard analog signals as coloured lines
[3] interchangeable pens
[4] programmable paper feed rates
[5] drive controlled by stepper motor

Technical Data

Recorder module
- 3 channels
- measuring range: 4...20mA
- sampling time: 240ms per channel
- basic accuracy: +/- 0,1% of final value

Paper
- recorder drum
- feed rate: 0, 5, 10, 20, 60, 120, 240, 300, 360, 600, 720, 1800, 3600, 7200mm/h; also freely programmable

Pens
- blue, red, green

Dimensions and Weight

LxWxH: 240x144x144mm
Weight: approx. 4kg

Required for Operation

24VDC

Scope of Delivery

1 recorder module

Order Details

080.45012 RT 450.12 Chart Recorder Module

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RT 800 PLC Application: Mixing Process

*** Trainer for control of discontinuous mixing processes by PLC**

*** Use of standard industrial components**

*** Capacitive proximity switches as level sensors**

*** Built-in power supply unit to power all the components and the PLC**

Technical Description

This trainer for PLC applications can be used to create complex PLC control functions from the field of process engineering, particularly for processes involving metering and mixing. The system consists of the base frame with a storage tank, a centrifugal pump and a demonstration panel on which all components are clearly laid out. A pump delivers water to three tanks, controlled via solenoid valves. The level of water in the three tanks is monitored by capacitive proximity switches with adjustable sensitivity. The fluid from the three tanks can be mixed together in the downstream mixing tank. The mixing tank is also equipped with three proximity switches. A stirring machine assists the mixing process. All the tanks are transparent, so the conveying and mixing processes are clearly observable.

The trainer features a lab jack panel by which the signals from the capacitive proximity switches can be processed by PLC, and all the solenoid valves can be individually controlled. PLC systems from different manufacturers can be used. A rail on the model's front panel is provided so as to allow for connection of the PLC. Although a PLC is not included in the package, the operation of the system can be checked without one. We recommend the use of PLC module IA 130.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

Learning Objectives / Experiments

- planning and implementation of a PLC controlled mixing process
- familiarisation with terms and symbols
- presentation of circuits
- functionality test of all sensors and actuators
- sensitivity adjustment of the capacitive proximity switches
- procedure for connecting up the PLC
- together with PLC module: performance of complex PLC control functions using a complex example from the field of process engineering
- discontinuous metering and mixing

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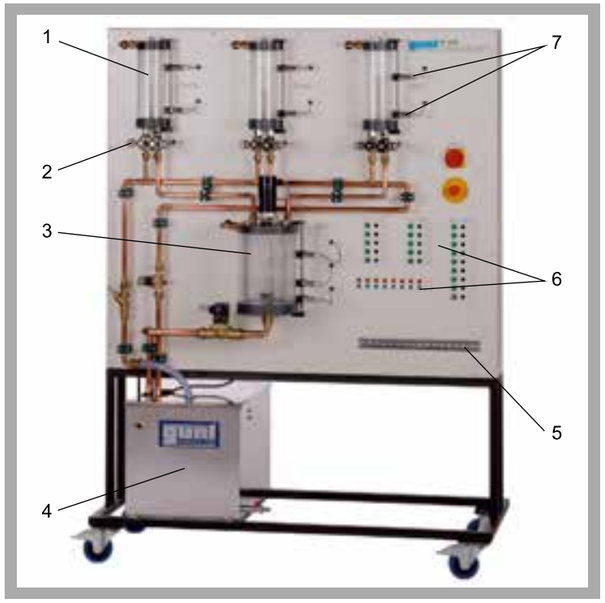
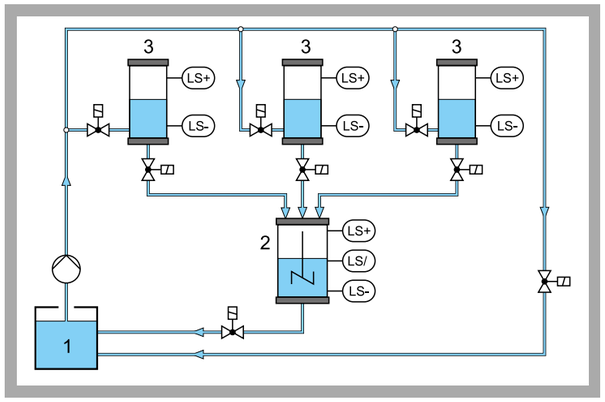
RT 800 PLC Application: Mixing Process



1 measuring tank, 2 solenoid valve, 3 mixing tank with stirring machine, 4 storage tank, 5 rail for mounting of a PLC system, 6 lab jack panel for connection of a PLC, 7 level sensor



Process schematic: 1 storage tank, 2 mixing tank, 3 measuring tank;
LS level sensors (+: high, /: middle, -: low)

Specification

[1] clearly laid out trainer as basis for the use of a PLC in a process control application involving mixing processes
[2] transparent mixing tank with 3 capacitive proximity switches to monitor the level
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[7] control of the 8 solenoid valves, the pump and the agitator also by PLC via lab jack panel
[8] capacitive proximity switches with adjustable sensitivity
[9] closed water circuit with centrifugal pump and stainless steel storage tank
[10] power supply to all components and to PLC by built-in power supply unit

Technical Data

Centrifugal pump (submersible pump)
- power consumption: 430W
- max. flow rate: 150L/min
- max. head: 7m

Tanks
- storage tank: 70L
- 3 measuring tanks: each 1500mL
- mixing tank: 7L

Capacitive proximity switches, NO contacts
2/2-way solenoid valves DN 8 and DN 20
Power supply unit: 24VDC, 8A

Dimensions and Weight

LxWxH: 1380x610x1850mm
Weight: approx. 145kg

Required for Operation

230V, 50/60Hz, 1 phase or 120V, 60Hz/CSA, 1 phase

Scope of Delivery

1 trainer
1 set of instructional material

Order Details

080.80000 RT 800 PLC Application: Mixing Process

G.U.N.T Gerätebau GmbH, Hanskampring 15-17, D-22885 Barsbüttel, Phone +49 (40) 67 08 54-0, Fax +49 (40) 67 08 54-42, E-mail sales@gunt.de, Web http://www.gunt.de
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IA 130 PLC Module

*** Self-contained PLC module for basic exercises**
*** Suitable for use in complex applications**
*** Programming software to IEC 61131-3**

Technical Description

The IA 130 can be used to perform basic exercises on a PLC (programmable logic controller). A PLC is essentially a computer adapted to the needs of industry. Its inputs and outputs are not designed for humans, but for use in the control of machines. Machine and operator interact solely by way of limit switches, momentary-contact switches or photoelectric switches.

The front panel is designed as a laboratory patchboard, where the input ports and output ports of the PLC can be connected to switches and displays via laboratory cables. In order to write programs the PLC must be connected to a PC (not supplied) via an RS232 interface.

The PLC programming software conforms to the international standard IEC 61131-3, and permits programming in the following languages: Statement List (STL), Ladder Diagram (LD), Structured Text (ST) and Function Block Diagram (FBD). Ladder Diagrams are based on graphical representations with contacts, coils and boxes, as per the circuit diagrams. Function Block Diagram language is based on graphical representation of the interlinking of logical function blocks, analogous to the logic diagrams. Statement List is an assembler-type language with a small, standardised non-hardware-dependent command set. Structured Text is a language similar to PASCAL, with mathematical expressions, assignments, function calls, iteration, condition selection, and PLC-specific add-ons. An example program is included in the module.

IA 130 can be used as a control element in conjunction with electrical, pneumatic or hydraulic applications, such as with the handling device IA 210 or the mixing process RT 800.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

Learning Objectives / Experiments

- familiarisation with a PLC
- familiarisation with the essential fundamentals such as
  * Boolean algebra
  * compiling statement lists
  * interconnection diagrams and block diagrams
- exercises in
  * programming
  * logical "AND" / "OR" gates
  * logic relays
  * output and input
- configuration of program sequences by way of connectors, incorporating
  * timers
  * counters
  * cascade circuits
  * higher-order monitoring relays etc.
- fault finding

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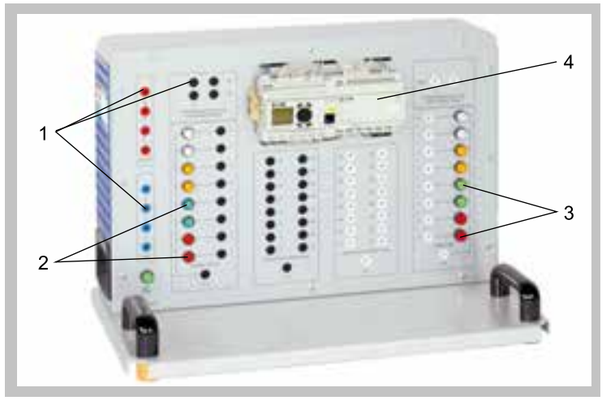
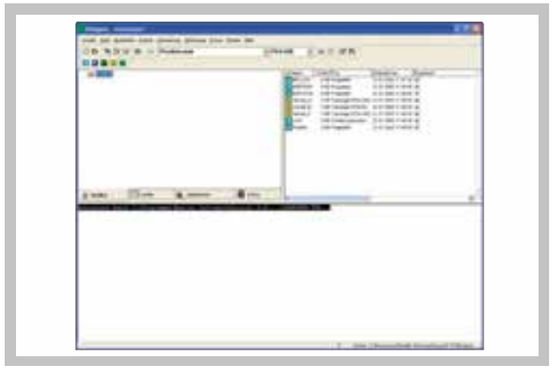
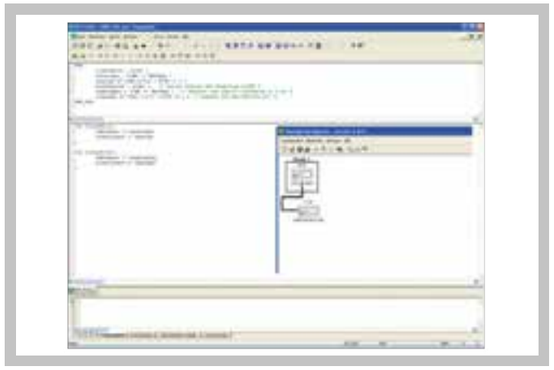
IA 130 PLC Module



1 PLC, 2 lab jacks, 3 pushbutton, 4 lamps



Screenshot of PLC software: start screen



Screenshot of PLC software: POU editor (POU = Program Organisation Unit) and topology configurator

Specification

[1] module for basic exercises on a programmable logic controller (PLC)
[2] self-contained PLC module, usable as part of a complex system
[3] integrated patchboard for creating circuits with input and output elements
[4] PLC with 2 integrated setpoint encoders
[5] programming software to IEC 61131-3
[6] example program supplied

Technical Data

PLC
- connections
  * 16 digital inputs
  * 14 digital outputs
  * 2 analogue inputs
  * 1 analogue output
- memory type: PLC back-up battery for 32kByte RAM and clock
- Rated voltage: 24VDC

Software
- graphical user interfaces
- programming languages to IEC/EN 61131-3:
  * statement list (STL)
  * ladder diagram (LD)
  * function block diagram (FBD)
  * structured text (ST)
- multiple dialogue languages (German, English, French, Spanish)
- graphical topology configurator
- system requirements: Windows XP or Windows Vista

Dimensions and Weight

LxWxH: 520x100x370mm
Weight: approx. 16kg

Required for Operation

230V, 50/60Hz, 1 phase or 120V, 60Hz/CSA, 1 phase

Scope of Delivery

1 PLC Module
1 PLC software with programming cable
1 set of laboratory cables
1 set of instructional material

Order Details

058.13000 IA 130 PLC Module

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RT 580 *Fault Finding in Control Systems*

*** Practical control of level, flow rate and temperature**
*** Simulation of typical faults**
*** PLC to monitor safety devices**
*** Refrigeration system for independent cold supply**

Technical Description

The RT 580 facilitates practical learning in the control of three controlled variables which are commonplace in process engineering.

A circuit with a collecting tank, pump and graduated tank is provided for control of level and flow rate. A pneumatic control valve is used as the actuator. There is a valve in the tank outlet to generate a disturbance variable in level control. Cascade control is possible whereby the level in the tank is controlled by way of the flow rate.

Two circuits are used in the control of the temperature. A refrigeration system cools the water in the collecting tank. A pump circulates the water via a heat exchanger (cooling circuit). A heater heats the water in the graduated tank. Another pump also circulates the warm water via the heat exchanger. In the heat exchanger the water in the cooling circuit is heated. The controlled variable is the temperature of the water in the cooling circuit after heating in the heat exchanger. The actuator is the pneumatic control valve which adjusts the flow rate of the warm water. Cascade control is also possible to control the temperature.

Two industrial controllers are supplied which can be employed as the master and slave in the implementation of cascade control. They have a Profibus DP interface. This enables the trainer to be controlled by way of a software. The software also permits recording of the process variables and parameterisation of the controllers on the PC.

The trainer is equipped with a PLC for monitoring of safety devices, such as a low water cut-off which protects the heater. On the switch cabinet there are also pushbuttons for the simulation of typical faults such as failure of sensors or cable breaks.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

Learning Objectives / Experiments

- familiarisation with industrial control loop components
- setup, parameterisation and configuration on the controller
- optimisation of controller settings
- level control
- flow rate control
- temperature control
- cascade control, level - flow rate
- cascade control, temperature - flow rate
- plotting step responses
- fault finding

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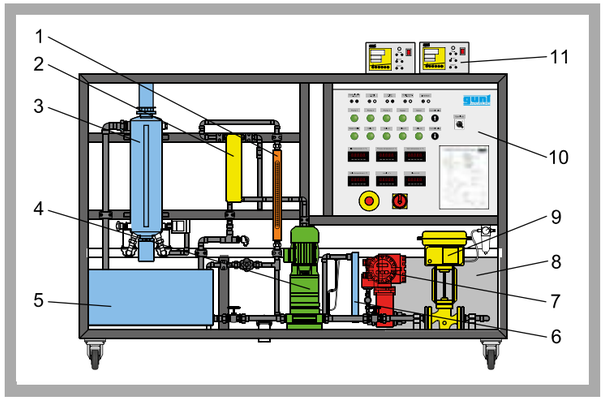
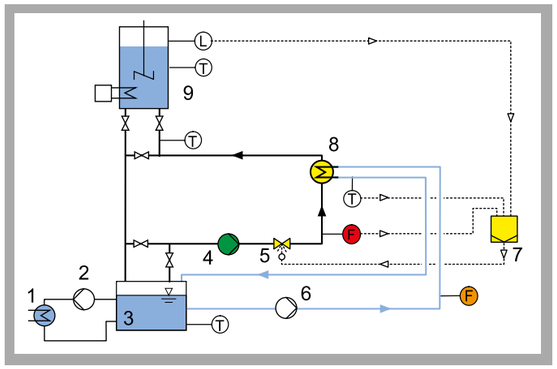
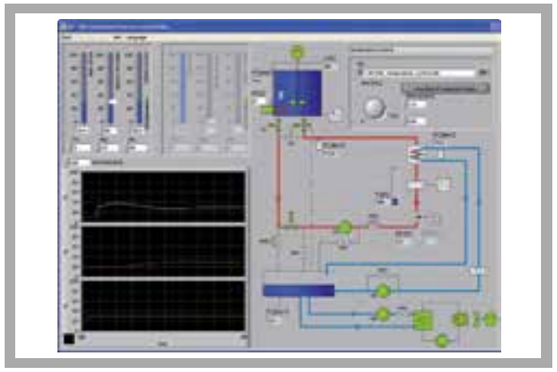
RT 580 *Fault Finding in Control Systems*



1 flow meter, 2 heat exchanger, 3 stirred tank with heater, 4 main circuit pump, 5 collecting tank, 6 refrigeration system evaporator, 7 flow rate sensor, 8 refrigeration system, 9 control valve, 10 switch cabinet, 11 controller



1 refrigeration system evaporator, 2 refrigeration system pump, 3 collecting tank, 4 main circuit pump, 5 control valve, 6 cooling circuit pump, 7 controller, 8 heat exchanger, 9 stirred tank with heater;
F flow rate, L level, T temperature



Process control software screenshot

Specification

[1] control of level, flow rate, temperature and cascade control
[2] main circuit with collecting tank, graduated stirred tank with heater, pneumatic control valve and centrifugal pump
[3] cooling circuit with pump, heat exchanger and rotameter
[4] refrigeration system and pump to cool the water in the collecting tank
[5] pneumatic control valve in main circuit as actuator for all controls
[6] sensors for the measurement of the controlled variables; level, flow rate and temperature
[7] 2 parameterisable industrial controllers
[8] 6 pushbuttons for fault simulation
[9] PLC to monitor safety devices
[10] GUNT process control software via Profibus DP interface under Windows Vista or Windows 7

Technical Data

Tanks
- stirred tank with scale: approx. 7L
- collecting tank: approx. 90L

Main circuit centrifugal pump
- max. flow rate: approx. 75L/min
- max. head: approx. 20m

2 pumps, cooling circuit and refrigeration system
- max. flow rate: approx. 60L/min
- max. head: approx. 4m

Heater power output: approx. 2kW
Controller parameterisable as
- P, PI or PID controller

Measuring ranges
- level: 0...350mm
- flow rate: 0...1999L/h
- temperature: 0...100°C

Dimensions and Weight

LxWxH: 1920x800x1530mm
Weight: approx. 245kg

Required for Operation

230V, 50/60Hz, 1 phase or 230V, 60Hz, 3 phases
compressed air: 3...8bar; 25...50L/min

Scope of Delivery

1 trainer
2 controllers
1 set of cables
1 Profibus card
1 CD with PLC programming software
1 GUNT software CD
1 set of instructional material

Order Details

080.58000	RT 580	Fault Finding in Control Systems

G.U.N.T Gerätebau GmbH, Hanskampring 15-17, D-22885 Barsbüttel, Phone +49 (40) 67 08 54-0, Fax +49 (40) 67 08 54-42, E-mail sales@gunt.de, Web http://www.gunt.de
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CE 640 Biotechnical Production of Ethanol

*** Practical process for production of ethanol from starch-based biological raw materials**

*** System control using a PLC, touch screen for display and operation**

*** PC aided data acquisition via USB interface**

Technical Description

As well as its great importance for the chemical and foodstuffs industries, ethanol (alcohol) is increasingly used as a fuel. The CE 640 can be used to conduct realistic experiments for the production of ethanol from starch-based raw materials such as potatoes. The experimental plant consists of three main components: a mash tank, a fermentation tank and a distillation unit.

A mixture of water, finely chopped potatoes and alpha-amylase (enzyme) is filled into the mash tank. To dissolve the tightly packed starch chains in the potatoes, heating steam is injected into the mixture via a nozzle (gelatinisation). This increases the flow resistance of the mash, which would prevent further processes. The alpha-amylase breaks up the starch chains (liquefying) thereby reducing the flow resistance. Gluco-amylase is used to convert the starch into sugar (saccharification). This enzyme requires lower temperatures and pH values. The temperature is reduced using the water cooling jacket around the mash tank, the pH value is adjusted by the addition of acid and caustic. After saccharification the mash is pumped into the fermentation tank. During the fermentation process in this tank, ethanol is produced. A water cooling system controls the temperature. After the fermentation process, the mash is pumped into the distillation unit. This is equipped with a bubble tray column for separation of the ethanol. Two tanks are available, one for the spent mash, the other for the distilled ethanol.

The experimental plant has comprehensive measurement, control and operating functions, which are controlled via a PLC. A touch screen displays measured values and permits the operation of the system.

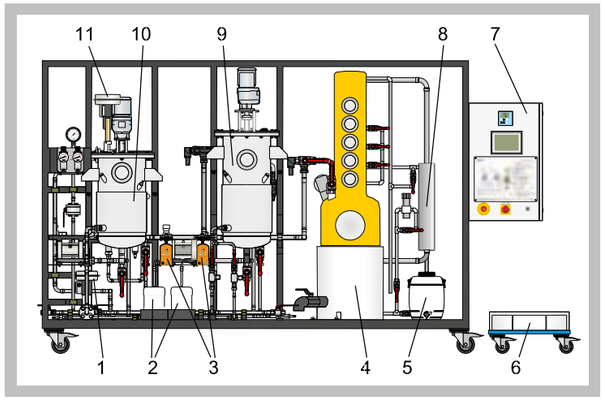
The steam supply occurs via laboratory network or an optionally available electrical steam generator (CE 715.01).

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

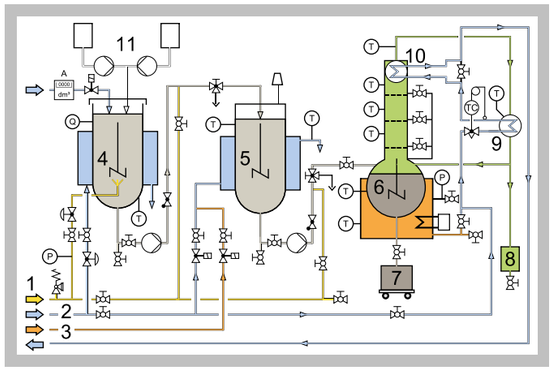
Learning Objectives / Experiments

- familiarization with the necessary individual steps and system components for production of ethanol:
  - * gelatinisation by steam injection
  - * liquefaction by use of alpha-amylase
  - * saccharification by use of gluco-amylase
  - * fermentation: conversion of sugar into ethanol by yeast cultures under anaerobic conditions
  - * distillation: separation of ethanol from the mash

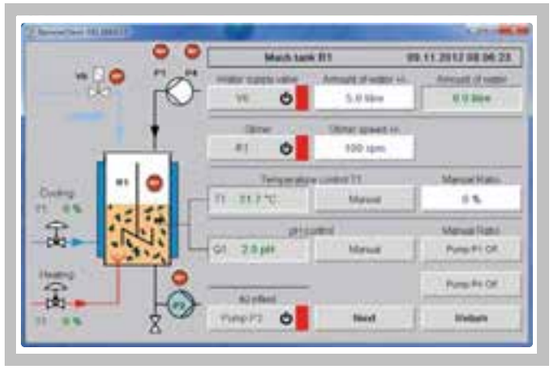
CE 640 Biotechnical Production of Ethanol



1 cooling water control valve, 2 acid/caustic tanks, 3 acid/caustic pumps, 4 distillation unit, 5 product tank, 6 spent mash tank (mobile), 7 switch cabinet, 8 condenser, 9 fermentation tank, 10 mash tank, 11 steam pressure control valve



1 heating steam, 2 cooling water, 3 heating water, 4 mash tank, 5 fermentation tank, 6 distillation unit, 7 spent mash tank, 8 product tank, 9 condenser, 10 dephlegmator, 11 acid/caustic pumps and tanks; P pressure, T temperature, A water quantity, Q pH value



Screenshot of the touch screen for the PLC control unit

Specification

[1] batch conversion of starch-based raw materials into ethanol
[2] open mash tank with water-jacket cooling, steam injection and stirrer
[3] closed fermentation tank with stirrer and water-jacket cooling/heating
[4] distillation unit with 3 bubble trays, dephlegmator, condenser and stirrer
[5] 2 pumps for delivering the mash
[6] pH value control in the mash tank with acid and caustic delivered by metering pumps
[7] adjustment of the amount of injected heating steam, the cooling water flow rates and the head temperature by means of PID controllers
[8] system control using a PLC; operated by touch screen
[9] GUNT software for data acquisition via USB under Windows Vista or Windows 7

Technical Data

Mash tank: 40L
Fermentation tank: 50L
Product tank: 10L
Spent mash: 30L
Distillation unit
- column: DxH: 220x1200mm
- sump capacity: 45L
- sump heater: 0...7500W

2 air-operated diaphragm pumps
- drive pressure: 2bar
- max. flow rate: 15L/min
- max. head: 20m
- max. solid lump size: 4mm

2 metering pumps (acid and caustic)
- max. flow rate: each 2,1L/h

Measuring ranges
- temperature: 10x 0...150°C
- water quantity mash tank: 0...20L
- pH value: 2...10
- pressure heating steam: 0...10bar

Dimensions and Weight

LxWxH: 3500x1200x2000mm
Weight: approx. 500kg

Required for Operation

400V, 50Hz, 3 phases or 230V, 60Hz, 3 phases
compressed air (1,5...6bar), cooling water (min. 400L/h), steam (15kg/h, min. 3bar), heating water (min. 400L/h, 40°C)

Scope of Delivery

1 experimental plant
1 set of enzymes etc.
1 areometer
1 set of accessories
1 GUNT software CD + USB cable
1 set of instructional material

Order Details

083.64000	CE 640	Biotechnical Production of Ethanol

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CE 642 Biogas Plant

The illustration shows from left to right: supply unit, trainer and post-fermentation unit

*** Two-stage biogas plant**

*** Extensive biogas analysis**

*** System control using a PLC, touch screen for display and operation**

Technical Description

In a biogas plant, microorganisms biologically degradate the organic starting substances (substrate) under exclusion of light and oxygen. The product of this anaerobic degradation is a gas mixture which primarily consists of methane. This gas mixture is called biogas.

The experimental plant CE 642 serves to demonstrate the generation of biogas in a practical manner. The substrate is a suspension of shredded organic solids. It is hydrolysed and acidified in the first stirred reactor. Here, anaerobic microorganisms convert the long-chain organic substances into short-chain organic substances. The biogas forms in the second stirred reactor in the last step of the anaerobic degradation. It contains mainly methane and carbon dioxide. This two-stage method enables the ambient conditions to be adjusted and optimised in both reactors separately. The digestate is collected in a separate tank.

Temperature and pH value are controlled in both reactors. The resulting biogas is dried in a column. The column is filled with silica gel. Subsequently, the flow rate, humidity, methane content, carbon dioxide content and temperature of the biogas are measured. The system is controlled by means of a PLC which is operated via a touch screen. The measured values can be transmitted to a PC via USB and analysed with the GUNT software.

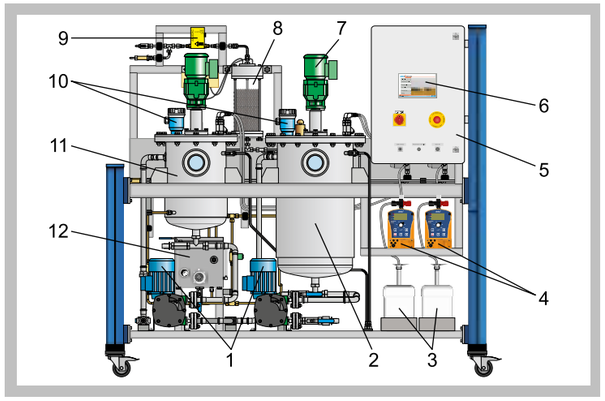
The experimental plant enables both a continuous and a discontinuous (batch) operation mode. Anaerobic biomass from a biogas plant is required for the experiments. E.g. potatoes or maize can be used to produce the substrate. An inert gas (e.g. carbon dioxide) is required to flush the experimental plant.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

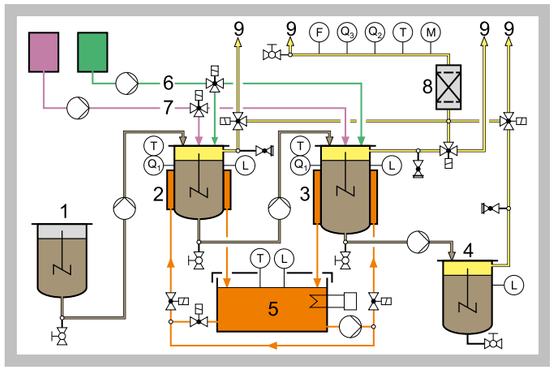
Learning Objectives / Experiments

- achieving a stable operating state
- influence of the following parameters on the biogas generation
  * temperature
  * substrate
  * volumetric loading
  * pH value
- influence of the operation mode on the biogas yield
  * single stage or dual stage
  * with and without post-fermentation
  * continuous and discontinuous
- determining the following parameters depending on the operating conditions
  * biogas yield
  * biogas flow rate
  * biogas quality

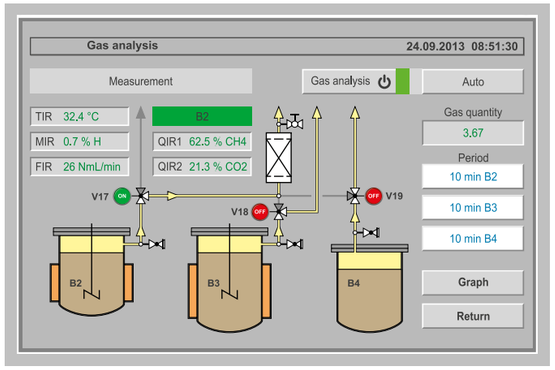
CE 642 Biogas Plant



1 peristaltic pumps, 2 reactor (stage 2), 3 tanks for acid and caustic, 4 metering pumps, 5 switch cabinet, 6 PLC with touch screen, 7 stirring machine, 8 drying column, 9 flow meter (biogas), 10 capacitive level sensors, 11 reactor (stage 1), 12 heating water tank,



1 substrate tank, 2 reactor (stage 1), 3 reactor (stage 2), 4 digestate tank, 5 heating water, 6 acid, 7 caustic, 8 drying column, 9 biogas;
F flow rate, L level, M humidity, Q_1 pH value, Q_2 methane content, Q_3 carbon dioxide content, T temperature



Operating interface of the PLC: menu item "gas analysis"

Specification

[1] two-stage biogas plant (continuous or discontinuous operation possible)
[2] 2 stirred reactors made of stainless steel with capacitive level sensors
[3] separate supply unit with substrate tank and feed pump
[4] control of temperature and pH value in the reactors
[5] 2 metering pumps for acid and caustic
[6] heating water circuit with tank, heater, temperature controller and pump
[7] biogas is dried with silica gel
[8] biogas analysis: flow rate, methane content, carbon dioxide content, humidity and temperature
[9] control of the experimental plant using a PLC, operated by touch screen
[10] GUNT software for data acquisition via USB under Windows Vista or Windows 7

Technical Data

Tanks made of stainless steel
- reactor (stage 1): approx. 20L
- reactor (stage 2): approx. 70L
- substrate tank: approx. 25L
- digestate tank: approx. 25L

Pumps
- 3 peristaltic pumps: each max. 25L/h
- 2 metering pumps: each max. 2,1 L/h
- heating water pump: max. 480L/h

Stirring machines
- substrate tank: max. 200min^{-1}
- reactors: each max. 120min^{-1}

Measuring ranges
- methane content: 0...100%,
- carbon dioxide content: 0...100%
- flow rate (biogas): 0…30NL/h
- pH value: 2x 1...14
- humidity: 0...100%
- temperature (reactors and biogas): 3x 0...100°C

Dimensions and Weight

LxWxH: 1100x790x1400mm (supply unit)
LxWxH: 2060x790x1910mm (trainer)
LxWxH: 1100x790x1400mm (post- fermentation unit)
Total weight: approx. 770kg

Required for Operation

400V, 50/60Hz, 3 phases or 230V, 60Hz, 3 phases
Biomass from a biogas plant, substrate (recommendation: potatoes or maize), caustic soda, hydrochloric acid, intert gas (e.g. carbon dioxide)

Scope of Delivery

1 experimental plant, 1 packing unit of silica gel,
1 set of accessories, 1 GUNT software CD,
1 USB cable, 1 set of instructional material

Order Details

083.64200 CE 642 Biogas Plant

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