CAMOZZI
TRAINING SIMULATORS

CAMOZZI

TABLE OF CONTENTS

LLC «Camozzi Pnevmatika» uses its own production facilities to design and manufacture simulators and complexes providing training in pneumatic and electric circuit engineering, relay logic, proportional control and controller programming.

By developing and expanding manufacture of pneumatic automation devices, Camozzi provides technical and didactic support for the whole line of its products.

For this purpose, a subdivision under the name Research Centre was established in 2003. The main task of this center is to provide training in fundamentals of pneumatic automation devices building and application: from separate components to drive engineering packages and mechatronic complexes on their basis. Development of this center is accompanied by opening of its own branches and training-research laboratories based on leading technical universities in largest industrial centers.

Resting on accumulated experience and worldwide recognition of the Camozzi-Didattica training system and considering a dynamically growing demand for training equipment on the Global market, in 2013 the company made a decision to develop its own line of training and research simulators. Application of components produced by leading global manufactures within didactic equipment, perfect technology of Camozzi assembly line and sophisticated Italian style allow creating refined and competitive products meeting global standards of quality, reliability and safety.

The catalogue includes training simulators for technical colleges and universities and also for laboratories and classrooms of industrial enterprises. The range of didactic equipment is designed for trainees of different levels: from fundamentals of pneumatic automation to R&D works related to thermodynamics, pneumatics, automatic control theory, mechatronics, and robotic engineering.

DID-BASE
Basic training complex

Pneumatic automation, electro-pneumatic automation, PLC programming

Basic didactic simulator is designed for
- laboratories of universities, colleges and schools
- training centers of industrial enterprises and corporate universities

The double-sided training complex is designed to provide training in fundamentals of pneumatic and electric circuit engineering, relay logic and controller programming.

- Double-sided training simulator
- Simultaneous work of up to 8 people
- Industrial pneumatic automation and electro-pneumatic automation
- Electric and pneumatic sensors
- Electric buttons and relays
- Programmable logic controller
- Methodological support (a manual and a set of laboratory works – 110 pcs.)

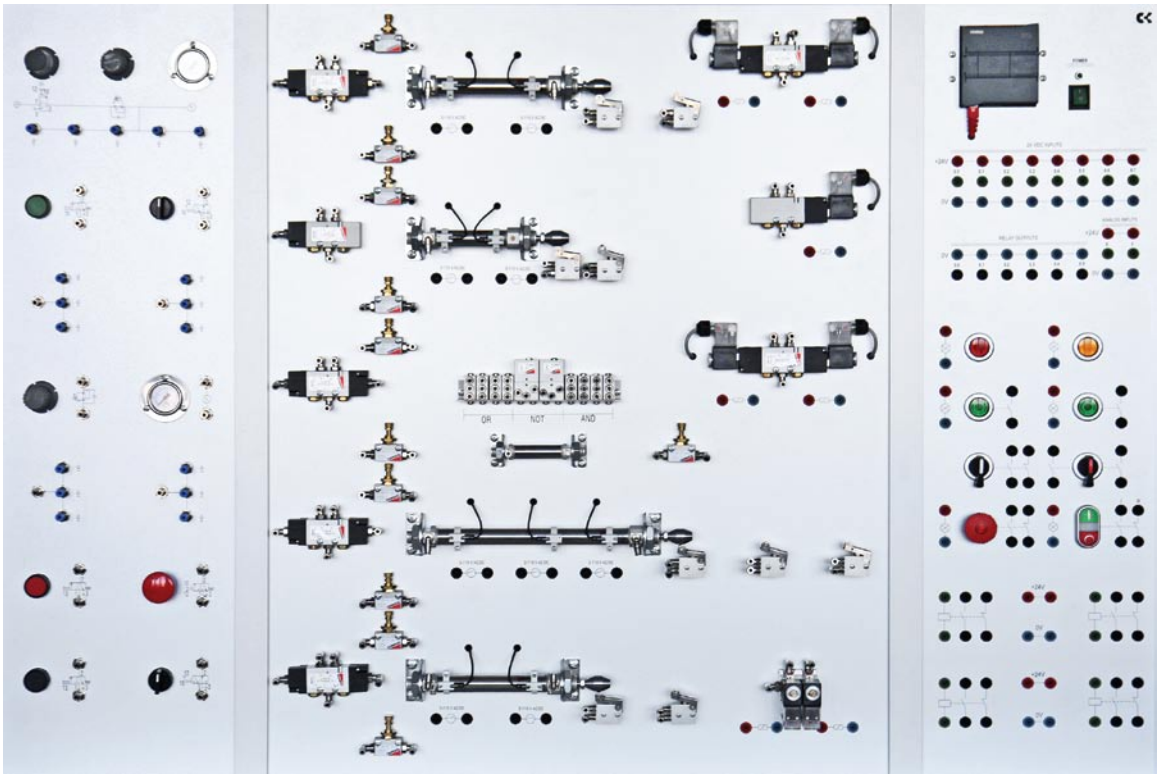
The simulator is delivered in basic configurations and can also be configured to fit individual requirements of laboratories and educational organizations.

GENERAL CHARACTERISTICS

Delivery options	■ simulator with a fixed set of pneumatic automation devices ■ simulator with an expanded set of pneumatic automation, electro-pneumatic automation, information and measuring devices ■ simulator with customized panels fitting the customer's requirements (pneumatic valve islands, vacuum equipment, proportional equipment, servo drives, etc.) ■ floor- and table-mounted versions
Materials	■ frame made of anodized aluminum profile ■ mounting pads – aluminum composite profiles ■ furniture (stand, tabletop) – chip board
Electric connection	safe power cable 220 V AC EURO
Pneumatic connection	plug 5150 1/4, if the set doesn't include a compressor it is required to provide tube 8/6 (pressure up to 10 bar) with a quick-release socket 5054 8/6
Operating pressure	nominal pressure: 6 bar (operating pressure: 2 ...10 bar)
Mounting	mobile wheeled base with wheel locking function
Dimensions	1500 x 780 x 1910 mm (length x depth x height, floor-mounted version)

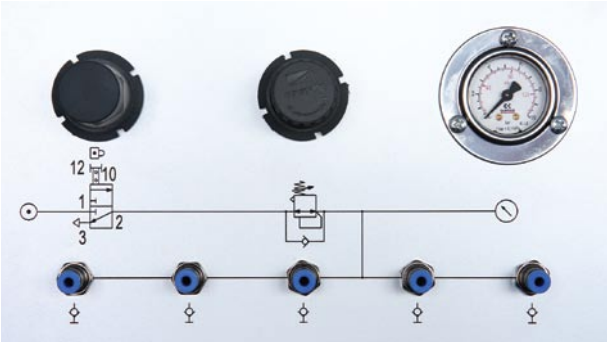
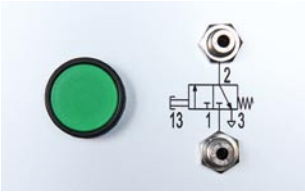
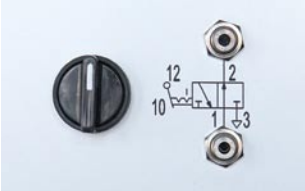
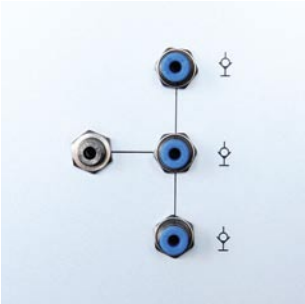
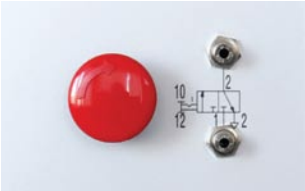
DID-BASE TRAINING SIMULATOR DELIVERY OPTIONS

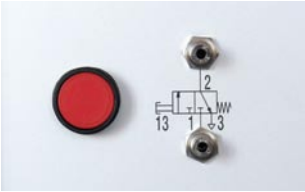
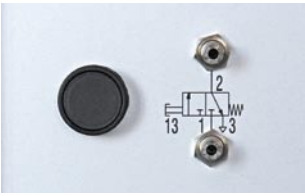
DID-BASE-V01 fixed set of pneumatic automation elements



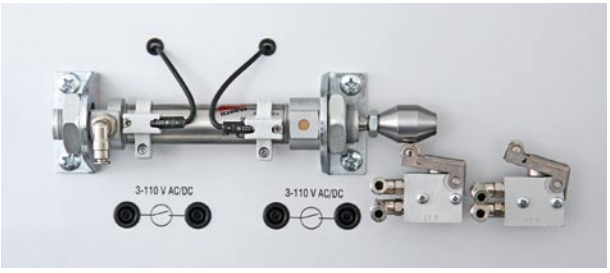
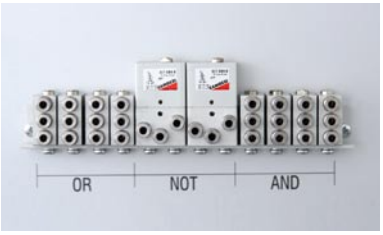
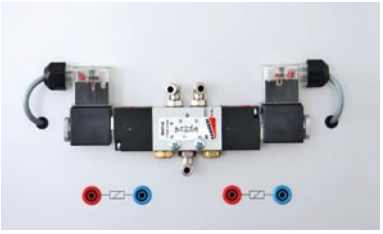
- The central panel is a set of pneumatic, electro-pneumatic and measuring devices designed both for individual operation of 1 to 4 pneumatic or electro-pneumatic drives and for their group operation according to the preset sequence. The left panel contains a source of air supply, drive start and shutdown devices, pressure control devices and emergency mode interlocking devices. The right panel contains PLC and relay control, electric drive control buttons.
- DID-BASE-V01 training simulator with elements fastening complies with the Plug-and-Play ideology – you just need to configure pneumatic tubes and electric wires and the simulator is ready for operation. It provides significant time saving when solving tasks, safety of elements and reliable vandalism protection.
- The set of element base is adapted for the DID-EX task book which is included into the set of simulator delivery or may be ordered separately.

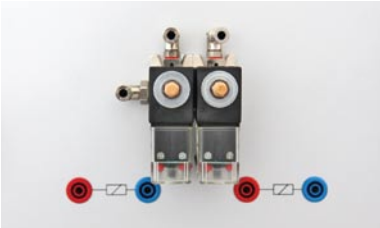
COMPONENTS OF THE LEFT PANEL

No.	Functional unit	Figure
1	FRL unit with a manifold – 1 pc. The unit includes: Lockable isolation valve MC104-V01 – 1 pc. Pressure regulator T108-R00 – 1 pc. Pressure gauge M043-F10 – 1 pc. Fitting with unidirectional valve – 5 pcs. Filter (invisible from outside) MC104-F00 – 1 pc.	
2	Valve 3/2 monostable, manual control, non-locking button, 234-895 – 1 pc.	
3	Valve 3/2 bistable, manual control, switch, 234-990 – 2 pcs.	
4	Manifold – 4 pcs. One unit includes: Fitting with unidirectional valve – 3 pcs. Fitting 6590 4 – 1 pc.	
5	Pressure regulator, T108-R00 – 1 pc.	
6	Pressure gauge, M043-F10 – 1 pc.	
7	Valve 3/2 bistable, manual control, locking Emergency button, 234-972 – 1 pc.	

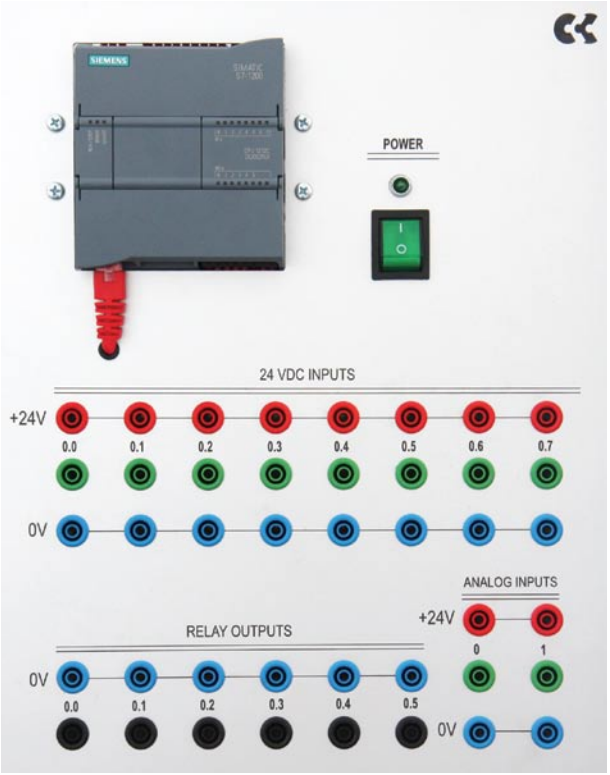
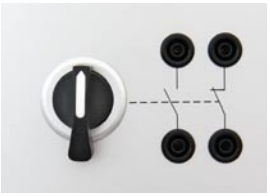
No.	Functional unit	Figure
8	Valve 3/2 monostable, manual control, non-locking button, 234-895 – 1 pc.	
9	Valve 3/2 monostable, manual control, non-locking button, 234-895 – 1 pc.	

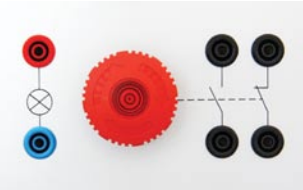
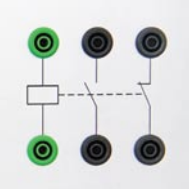
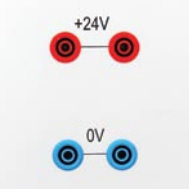
COMPONENTS OF THE CENTRAL PANEL

No.	Functional unit	Figure
1	Single-acting minicylinder with pneumatic and electric position sensors – 1 pc. Includes: Cylinder 24N1A20A050 – 1 pc. Valve 3/2 monostable, mechanical control of roller type, 235-955 – 2 pcs. Magnetic proximity switch type «reed» – 2 pcs.	
2	Block of logical elements – 1 pc. Includes: Logical element «NO» – 2LT-SB4-B – 2 pcs. Logical element «AND» – 2LD-SB4-B – 4 pcs. Logical element «OR» – 2LR-SB4-B – 4 pcs.	
3	Valve 5/2 bistable, electro-pneumatic control, connector with LED indicator, connection via safe contacts, 358-011-02 – 1 pc.	
4	Compressed air receiver 24N2A16A025M-UA01 – 1 pc.	

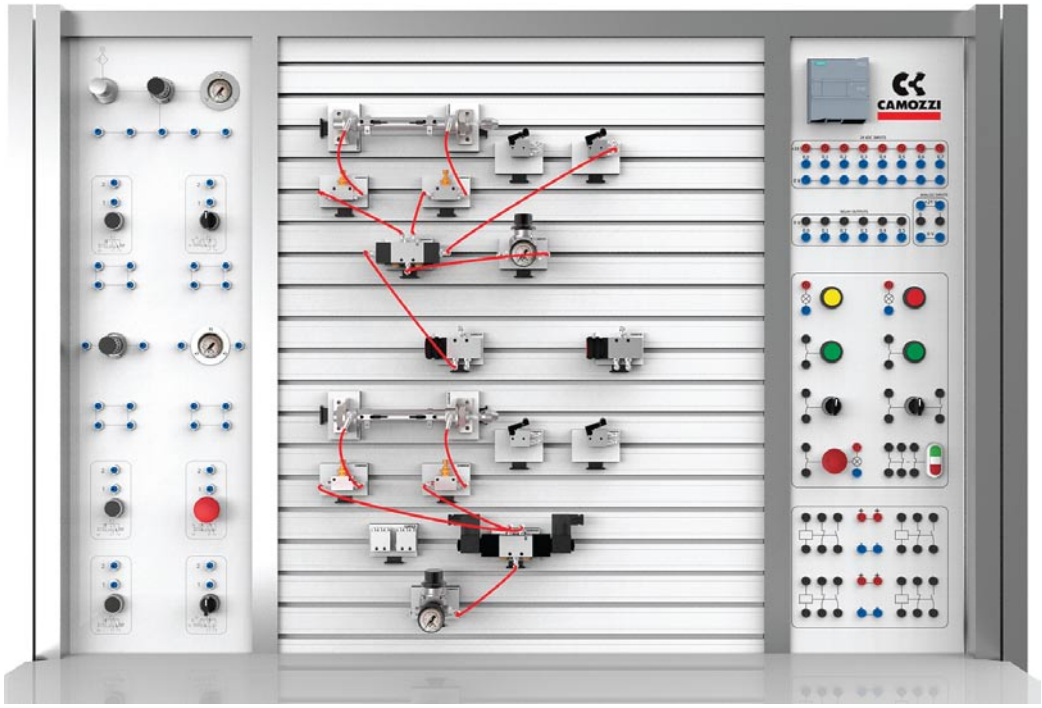
No.	Functional unit	Figure
5	Double-acting minicylinder with pneumatic and electric position sensors – 1 pc. Includes: Cylinder 25N2A20A200 – 1 pc. Valve 3/2 monostable, mechanical control of roller type 235-955 – 2 pcs., mechanical control of unidirectional roller type 235-965 – 1 pc. Magnetic proximity switch type «reed» – 3 pcs.	
6	Valve 5/2 bistable, pneumatic control, 358-033 – 4 pcs.	
7	Unidirectional flow control valve RFU 483-1/8 – 8 pcs.	
8	Double-acting minicylinder with pneumatic and electric position sensors – 2 pcs. One unit includes: Cylinder 25N2A20A100 – 1 pc. Valve 3/2 monostable, mechanical control of roller type, 235-955 – 2 pcs. Magnetic proximity switch type «reed» – 2 pcs.	
9	Valve 3/2, monostable, electro-magnetic control, connector with LED indicator, connection via safe contacts, AA31-0C2 – 2 pcs.	
10	Bidirectional flow control valve RFO 383-1/8 – 1 pc.	
11	Valve 5/2, monostable, pneumatic control, 358-035 – 1 pc.	

COMPONENTS OF THE RIGHT PANEL

No.	Functional unit	Figure
1	Siemens Simatic 6ES7-212-1HE31-0XB0 Programmable logic controller - 1 pc. Connection via safe contacts. 8 digital inputs 6 digital outputs 2 analog inputs	
2	Indicator lamp, yellow, connection via safe contacts, 1 pc.	
3	Indicator lamp, red, connection via safe contacts, 1 pc.	
4	Electric non-locking button with LED indicator, normally open contacts, connection via safe contacts, 2 pcs.	
5	Selector switch, white, normally open + normally closed contacts, connection via safe contacts, 1 pc.	
6	Selector switch, red, 2 x normally open contacts, connection via safe contacts, 1 pc.	

No.	Functional unit	Figure
7	Emergency shutdown button with LED indicator, normally open and normally closed contacts, connection via safe contacts, 1 pc.	
8	Double acting button with LED indicator, normally open and normally closed contacts, connection via safe contacts, 1 pc.	
9	Block of electromechanical relays with a group of normally open and normally closed contacts, connection via safe contacts, 4 pcs.	
10	Block of 24V DC power supply unit contacts, 2 pcs.	

Free-standing pneumatic automation elements DID-BASE-V02:

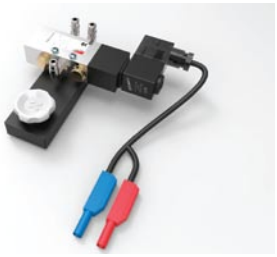
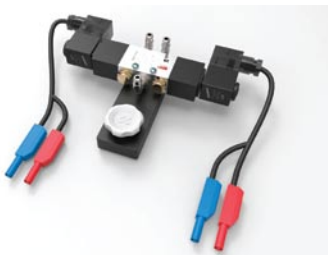


- Central panel is a profiled plate with T-slots. A universal DID-FIX plastic fastener may be installed in any place of the panel; this fastener can be delivered both together with elements and separately for free arrangement of any equipment required in the laboratory. For arrangement of large-size elements it is suggested to use a common base plate resting on two or four DID-FIX elements.
- The presented delivery option provides the trainee with absolute freedom of creation both when making circuit solutions "on paper" and when installing elements on the DID-TSLOT mounting panel.
- Set of elements with DID-FIX fasteners is also adapted to fit the DID-EX task book and may be expanded with customized electro-pneumatic automation modules, pneumatic valve islands, proportional and vacuum devices.

PNEUMATIC AUTOMATION ELEMENTS INCLUDED INTO BASIC DELIVERY

Central panel:

No.	Element with a fastener	Quantity	Code	Figure
1	Single-acting minicylinder, stroke 50 mm, with magnetic proximity switch type «reed» (2 pcs.)	1	24N1A20A050	
2	Double-acting minicylinder, stroke 100 mm, with magnetic proximity switch type «reed» (2 pcs.)	2	24N2A20A100	
3	Valve 5/2, monostable, pneumatic control	1	358-035	
4	Valve 5/2, bistable, pneumatic control	4	358-033	
5	Valve 3/2, monostable, mechanical control of roller type	6	235-955	
6	Unidirectional flow control valve	4	RFU483-1/8	
7	Logical element «NO»	2	2LT-SB4-B	

No.	Element with a fastener	Quantity	Code	Figure
8	Assembly with two logical elements «AND»	2	2LD-SB4-B	
9	Assembly with two logical elements «OR»	2	2LR-SB4-B	
10	Pressure gauge	1	M043-R12	
11	Receiver	1	24N2A16A025M-UA01	
12	Valve 3/2, monostable, electro-pneumatic control, connector with LED indicator, connection via safe contacts	1	338-015-02	
13	Valve 5/2, monostable, electro-pneumatic control, connector with LED indicator, connection via safe contacts	1	358-015-02	
14	Valve 5/2, bistable, electro-pneumatic control, connectors with LED indicator, connection via safe contacts	2	358-011-02	

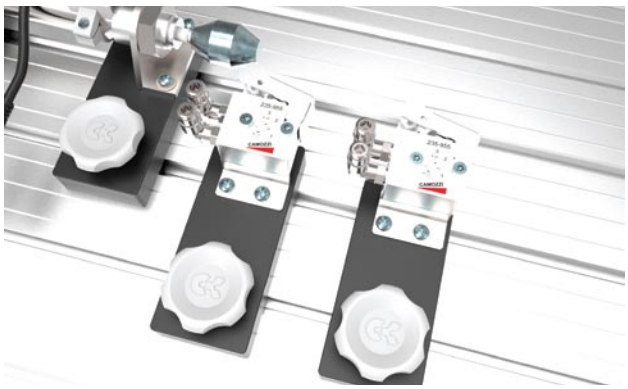
No.	Element with a fastener	Quantity	Code	Figure
15	Electromechanical limit switch	4	DID-SEM-V01	
16	Optical position sensor	2	DID-SO-V01	
17	Capacitance-type presence sensor	2	DID-SC-V01	
18	Inductive presence sensor	2	DID-SI-V01	
19	Pressure sensor with a display	2	DID-SP-V01	

ELEMENTS OF DELIVERY

DID-FIX
UNIVERSAL FASTENER

- Universal fastener is designed for mounting of cylinders, valves, throttles, valves, sensors and other elements on the DID-TSLOT panel
- Fastening with several movements

DID-TSLOT PANEL
WITH DID-FIX ELEMENTS



- DID-TSLOT profiled aluminum panel is universal and may be applied both with DID-BASE-V02 simulators and separately, for instance, for mounting of different devices in laboratories

DID-AIR-JA COMPRESSOR

- Oil-lubricated low-noise compressor ensures indoor noise level not exceeding 45 dB which is ideal for training laboratories
- Output pressure – up to 8 bar
- Flow rate – up to 50 Nl/min

DID-AIR-BB COMPRESSOR

- Oil-lubricated low-noise compressor ensures indoor noise level not exceeding 40 dB which is ideal for training process
- Output pressure – up to 8 bar
- Flow rate – up to 50 Nl/min

SET OF DID-WR
SAFE LEADS

- Safe electric leads with insulated contacts are ideal for electric switching in training simulators
- Quick-release design of conductors makes the training process fast and secures the guarded assembly

TRAINING AND METHODOLOGICAL SUPPORT

The basic set of simulator delivery includes a complex of laboratory works including 60 works on pneumatic automation, 30 works on electro-pneumatic automation and 20 works on programming of pneumatic drives by means of PLC.

Laboratory works are subdivided into the following groups on the basis of the subject:

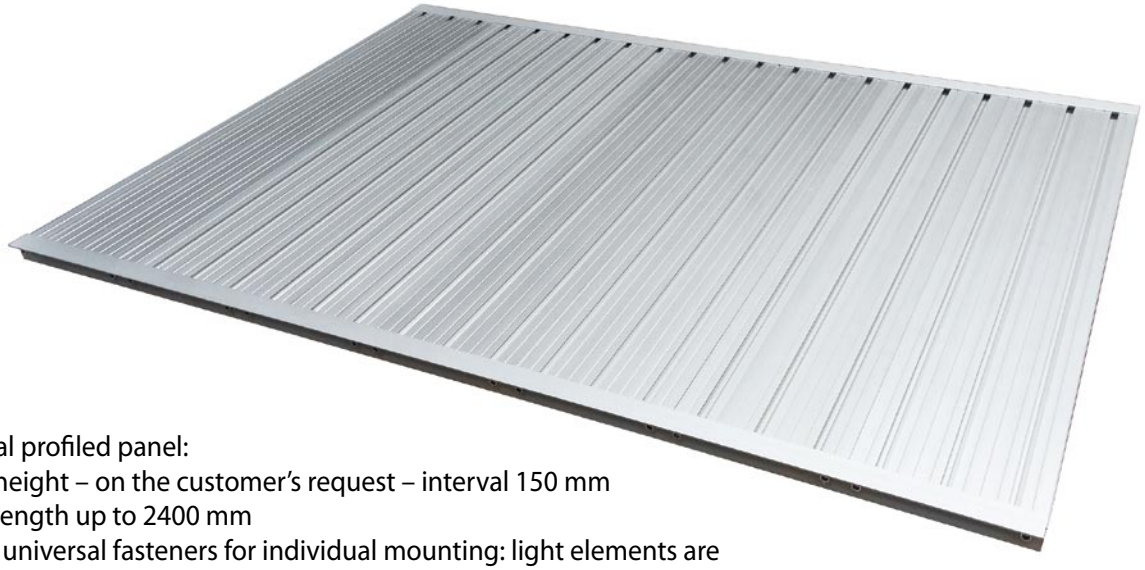
1. Studying the main methods of pneumatic drives control based on speed and position.
2. Implementation of logical functions in the course of pneumatic drives control.
3. Examination of time-controlled pneumatic drives.
4. Examination of pressure-controlled pneumatic drives.
5. Examination of pneumatic drives controlled by pneumatic impulse generators.
6. Synchronizing operation of several pneumatic drives by means of sensors with pneumatic and electric output signals.
7. Relay-contact control systems of electro-pneumatic drives.
8. Implementing cyclic movement of pneumatic drives by means of PLC.
9. Using timers and counters in PLC-based pneumatic drives control programs.
10. Synchronizing operation of several pneumatic drives by means of PLC
11. Matched operation of two PLCs.
12. Interrupt operation in PLC-based pneumatic drives control programs.
13. Work with sub-programs in the course of PLC-based control of pneumatic drives.

CODES FOR ORDERING DID-BASE BASIC TRAINING COMPLEX

Basic training complex with a fixed set of pneumatic automation elements	DID-BASE-V01
Basic training complex with free-standing pneumatic automation elements	DID-BASE-V02
Safe electric cable, red, 400 mm	DID-WR-RA0400
Safe electric cable, red, 800 mm	DID-WR-RA0800
Safe electric cable, red, 1200 mm	DID-WR-RA1200
Safe electric cable, blue, 400 mm	DID-WR-BA0400
Safe electric cable, blue, 800 mm	DID-WR-BA0800
Safe electric cable, blue, 1200 mm	DID-WR-BA1200
Safe electric cable, green, 1200 mm	DID-WR-GA1200
Set of plastic tubes	DID-BS-TUBE
Universal fastener with a rotating handle	DID-FIX-R
Low-noise compressor Jun-Air with a filter/regulator	DID-AIR-JA
Low-noise compressor Bambi with a filter/regulator	DID-AIR-BB
Task book. Volume 1. Basic pneumatics	DID-BS-EX-P
Task book. Volume 2. Joint operation of several drives	DID-BS-EX-PD
Task book. Volume 3. Electro-pneumatic drives	DID-BS-EX-E
Book «Pneumatic Automation»	DID-BS-BOOK
Computer with pre-installed programming environment	DID-BS-PC

Simulators based on DID-TSLOT profiled mounting panel and DID-FIX fasteners

Simulators consist of a profiled plate for arrangement of any training or demonstration equipment.



- Universal profiled panel:
  - height – on the customer's request – interval 150 mm
  - length up to 2400 mm
- DID-FIX universal fasteners for individual mounting: light elements are mounted on a quick-release fastener, large-size and loaded elements are mounted on a fastener with a T-shaped bolt

Universal panel has numerous design versions.
Installation: horizontal, vertical, at an angle to the horizon.
Working surface: double-sided or single-sided.
Mounting: on the wall or on the table.

Universal fasteners ensure individual mounting of small devices on the panel or mounting of large-size units on assemblies with several fasteners.

GENERAL CHARACTERISTICS

Delivery options	■ profiled panel according to the customer's requirements ■ quantity and type of fasteners according to the customer's requirements ■ packaged delivery of one assembled unit with necessary elements
Materials	■ panel – anodized aluminum profile ■ fasteners – metal and plastic
Installation	■ in any position according to the customer's requirements ■ development of customized accessories

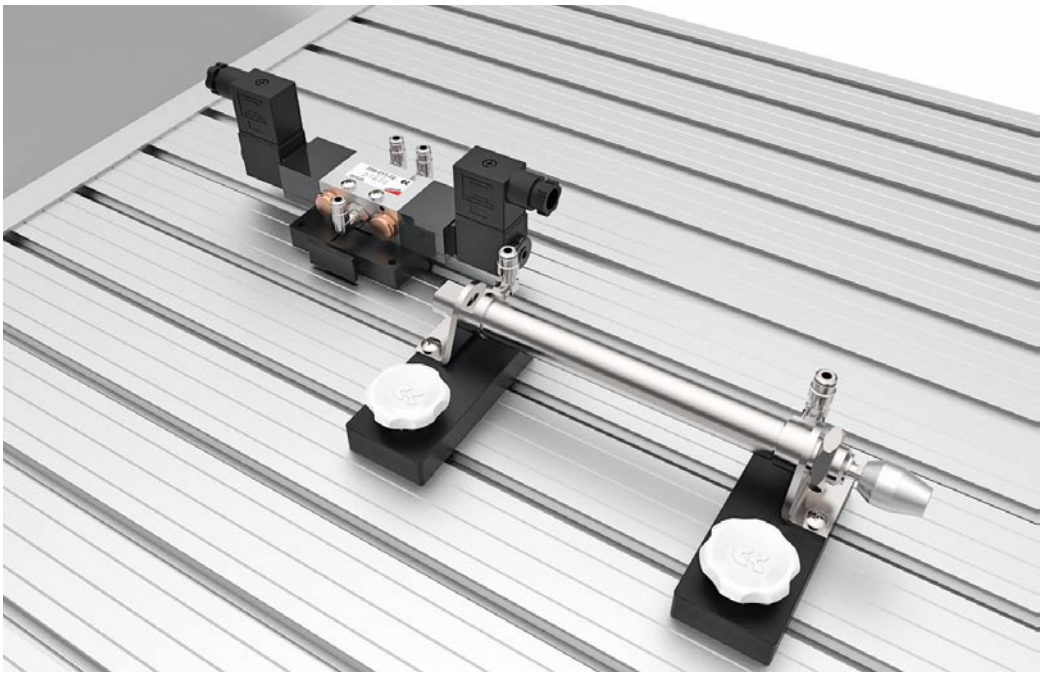
DID-FIX-R FASTENER

- Fastener with a T-shaped bolt

DID-FIX-F FASTENER

- Quick-release fastener

EXAMPLE: CONFIGURATION OF A PANEL WITH ELEMENTS ON REMOVABLE FASTENERS



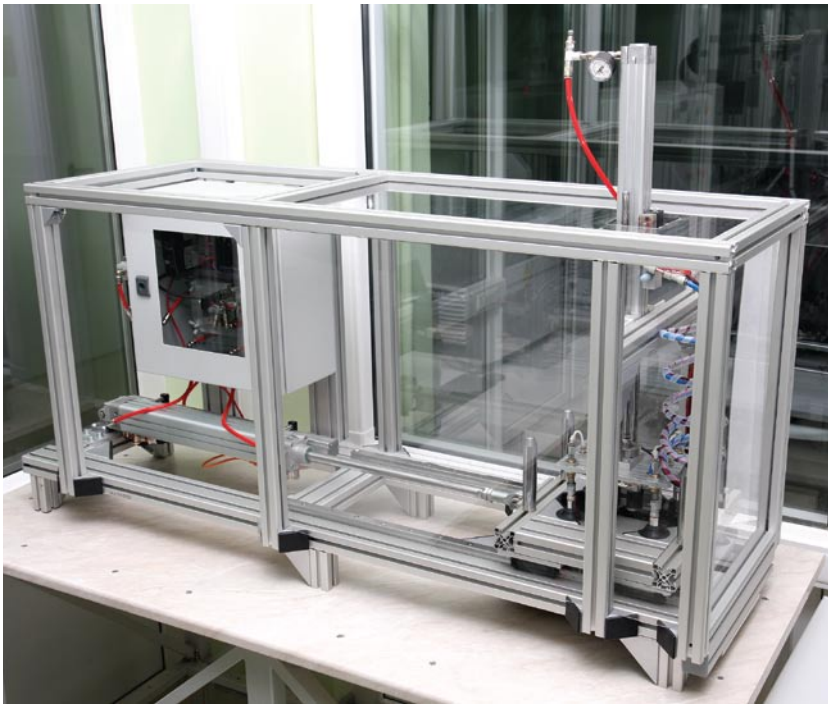
CODES FOR ORDERING DID-TSLOT MOUNTING PLATE

Profiled mounting panel	DID-TSLOT-H-L H – height, a number divisible by 150 mm (not exceeding 2400 mm) L – length – up to 2400 mm Example: DID-TSLOT-0750-1500
Plastic fastener with rotating mechanism and T-shaped bolt	DID-FIX-R
Plastic quick-release fastener	DID-FIX-F

DID-DYNAMIC training complex for analyzing dynamic characteristics of drives

Relay and proportional control of cyclic and servo drives

Training complex allows analyzing dynamic characteristics of cyclic and servo electro-pneumatic drives operating under external static, dynamic or inertial loading.



The simulator is designed for chairs of technical universities to prepare engineers' graduate qualification works as well as works for completing the Bachelor's and Master's Degree in specific areas.

- Pneumatic cylinder with position sensor and pressure sensors
- Variable external load
- Variable inertial load (carriage weight)
- Safe automated change of load weight by means of vacuum loader
- Different structures of the control system
- NI cRIO controller with real-time operating system and field programmable gate array
- Methodological support

Control modules allow analyzing dynamic properties of both cyclical drives with on-off valves and servo drives operating in the positioning or continuous control mode. Hardware restructuring of the drive takes not more than five minutes.

GENERAL CHARACTERISTICS

Delivery options	as agreed with the customer
Materials	■ frame made of anodized aluminum profile ■ protective coating - organic glass (polycarbonate)
Electric connection	safe power cable 220 V AC EURO
Pneumatic connection	tube 8/6, further – FRL unit (MC series)
Operating pressure	nominal pressure: 6 bar (operating pressure: 2 ...10 bar)
Dimensions	1520 x 622 x 1021 mm (length x depth x height)
Mounting	Delivery option – with and without table. **IMPORTANT!** The simulator should be rigidly connected to a fixed base!

COMPONENTS OF THE SIMULATOR

The DID-DYNAMIC simulator is available in standard configuration and can also be delivered with expansion modules.

The standard configuration of the simulator includes a frame made of anodized aluminum profile which accommodates a pneumatic cylinder with a position sensor and pressure sensors, a control cabinet, a mechanical controlled object with the possibility to change its weight, and a vacuum loader.

Control cabinet contains a National Instruments Compact RIO real-time controller, pneumatic piping and a universal quick-release plate accommodating a valve with the 5/3 structure and with a closed center (in the basic set of delivery). Coil terminals of this valve are coupled with the universal electric connector.

CONTROL CABINET

- Control cabinet with air preparation unit, NI Compact RIO controller and universal plate.
- The plate accommodates an electro-pneumatic valve with the 5/3 structure.

PNEUMATIC CYLINDER WITH POSITION SENSOR AND PRESSURE SENSORS

- Pneumatic cylinder is fitted with permanent magnet which ensures monitoring of piston position by means of magnetostrictive sensor.
- Cylinder is additionally fitted with four pressure sensors in working and cushion chambers.

Expansion modules allow to install the following devices to form a control unit of the pneumatic cylinder:

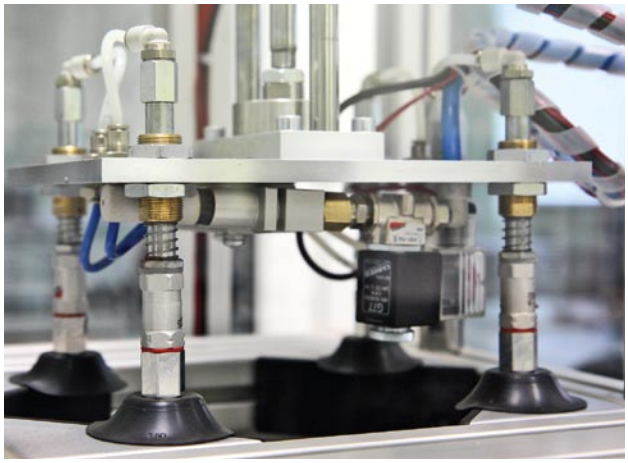
- two proportional electro-pneumatic pressure regulators (ER series);
- two proportional valves (LR series) with a spool valve;
- two proportional valves (LR series) forming the master/slave structure. The master valve contains a motion controller. Therefore, when this expansion module is used, the NI Compact RIO controller generates only a signal about the desired position of the drive on the valve and doesn't participate in the control circuit. A feedback signal from the position sensor is integrated into the valve.

A set of variable weight loads mounted on the movable carriage of guide rails is used as a controlled object in the standard configuration.

BASIC CONFIGURATION: VALVE 5/3 WITH A CLOSED CENTER

- Plate with electro-pneumatic valve with the 5/3 structure.

VACUUM LOADER WITH A CARRIAGE



- Vacuum loader with energy saving system executes engagement and placement of loads on the carriage which is mechanically connected to the pneumatic cylinder rod.

EXPANSION MODULE: PROPORTIONAL PRESSURE REGULATORS (ER SERIES)

- Proportional pressure regulators (ER series) set pressure in cylinder chambers according to the input analog control signal.

EXPANSION MODULE: PROPORTIONAL FLOW REGULATORS (LR SERIES)

- Proportional valves (LR series) control flow of air entering and leaving the cylinder cavity according to the input analog control signal.
- Three options for delivery of the module with LR series regulators:
  – two independent flow regulators DID-DYN-LRW
  – two independent pressure regulators DID-DYN-LRP
  – two servo control valves working in the master/slave structure DID-DYN-LRX.

OPERATION OF THE SIMULATOR

The delivered simulator is mounted on a rigid base. It is connected to sources of compressed air and power supply via a standard safe electric cable with EURO socket. Communication with the computer is implemented via Ethernet cable included into the set of delivery.

NI cRIO controller is delivered together with LabVIEW graphic programming environment. LabVIEW allows viewing status of all inputs and outputs.

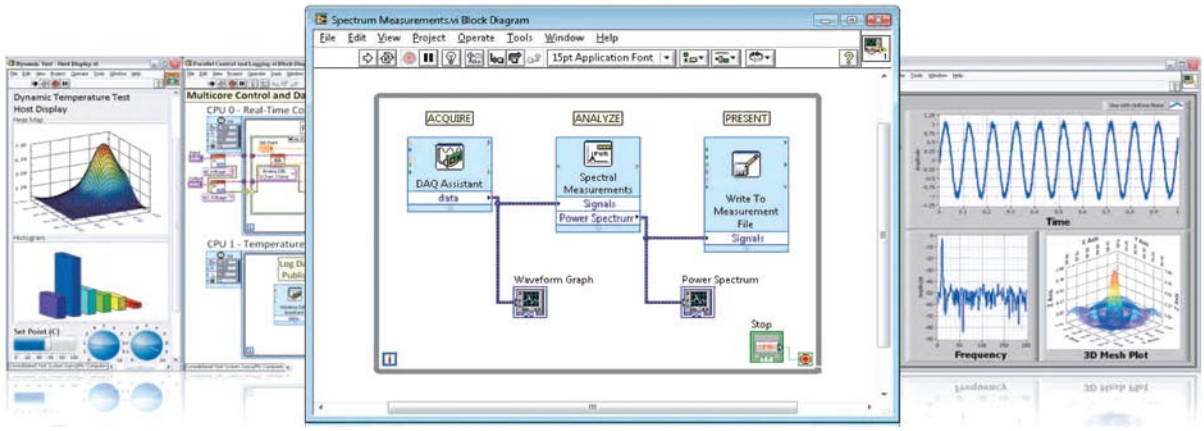
NI CRIO 9075 CONTROLLER

- NI cRIO 9075 chassis contains an integral field programmable gate array, a real-time controller and slots for connection of expansion modules.
- Controller is governed by the VxWorks real-time operating system.

CONTROLLER EXPANSION MODULE

- Expansion modules installed on the chassis allow receiving and generating analog and digital signals.

LABVIEW PROGRAMMING ENVIRONMENT



Controller receives signals from position sensor, four pressure sensors in cylinder chambers and vacuum relay of the gripping device. Coils of valve 5/3 (control channels of proportional regulators in case of expansion modules installation) and vacuum gripper control valves are connected to the controller.

LabVIEW environment is used to form control programs of the DID-DYNAMIC simulator on graphical programming language or C Scripting language: from cyclic motion of the cylinder piston between caps to implementation of servodrives drives with the possibility to perform automated change of the controlled object weight in the course of operation.

Connection of the expansion module takes 5 minutes:

- disconnect power and air supply;
- open the cabinet door;
- disconnect electric cable from the universal socket, unscrew knock-off nuts (disassembly is accomplished without tools);
- remove the installed plate;
- fix a new plate by means of nuts, connect electric cable to the universal socket;
- close the cabinet door and switch on power and air supply.

To observe safety rules when working with the simulator, moving parts are separated by transparent polycarbonate plates. When necessary, access to moving parts may be accomplished via a removable window using special tools.

Application of LabVIEW software package on a personal computer ensures not only hard real-time control of the object but also displaying of experimental data on the screen in the form of diagrams or report files for their further analysis.

The simulator is delivered together with a personal computer and pre-installed software: Windows operating system and LabVIEW software package.

Parameters of pneumatic cylinder (stroke and diameter) and range of controlled object weight variation are selected to show particular dynamic properties of pneumatic drives when controlling massive objects. Range of inertial load variation: 5 ... 55 kg, increment 5 kg.

DESCRIPTION OF THE SIMULATOR CONTROLLER

NI CompactRIO is a built-in instrumentation system which is based on NI RIO reconfigurable input/output technology. CompactRIO platform consists of chassis with integral field programmable gate array, real-time controller and input/output modules.

Characteristics of the platform:

- highly reliable built-in platform of autonomous or network functioning;
- real-time processor and reconfigurable field programmable gate array;
- connection of up to 4 input/output modules;
- parallel data recording and real-time processing on the field programmable gate array;
- reliable form factor;
- support of Ethernet, WiFi, USB, RS-232, RS-485, GPS, GPRS, GSM, ARINC, etc.;
- programming in LabVIEW environment (knowledge of Verilog, VHDL, SystemC not required).

Appendices:

- automation of scientific experiment;
- training and execution of practical laboratory courses in different technical disciplines including robotics and mechatronics, automation and automated process control systems, diagnostics of machines and mechanisms, measuring technologies, computer technologies, energy industry.

Modules included into the DID-DYNAMIC simulator:

- analog-to-digital converter, 8 channels, 16 bit, conversion time – not more than 4 μs;
- digital-to-analog converter, 8 channels, 16 bit, conversion time – not more than 10 μs;
- digital input/output modules 5.. .30 V DC, time of response – not more than 1 μs.

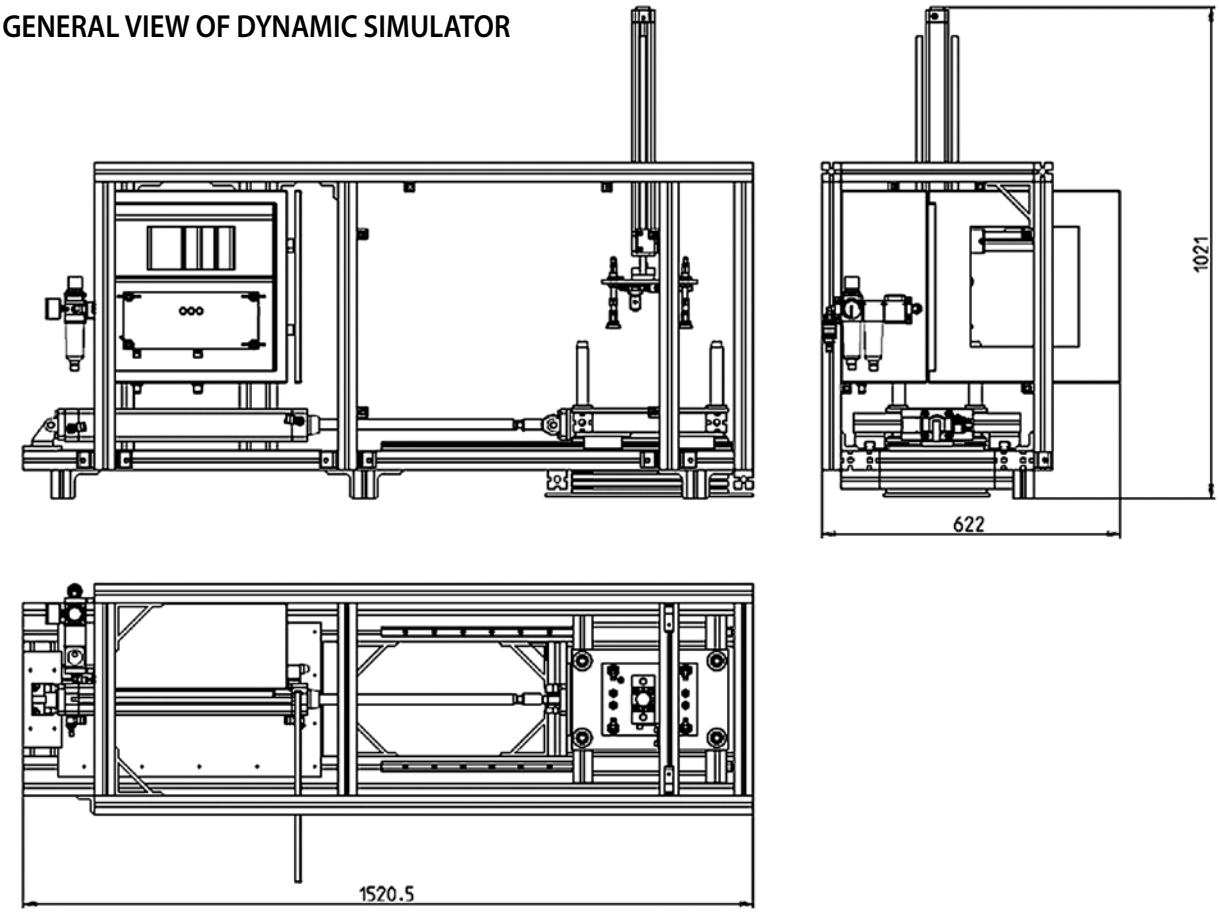
Ethernet interface is used to provide connection with PC and data transmission to LabVIEW.

LabVIEW software package allows to solve the following tasks:

- controller programming from PC;
- creation of control programs with the possibility to perform real-time alteration of control parameters;
- simple visualization of analog input signals in the form of diagrams and digital indicators.

Sampling period is set by the programmer. Actual clocking time is restricted by operating speed of connected modules and also by value and complexity of control code.

GENERAL VIEW OF DYNAMIC SIMULATOR



CODES FOR ORDERING DID-DYNAMIC TRAINING COMPLEX

Training complex for analyzing dynamic characteristics of electro-pneumatic drives	DID-DYNAMIC
Expansion module – two pressure regulators (ER series)	DID-DYN-ER
Expansion module – two flow regulators (LR series)	DID-DYN-LRW
Expansion module – two pressure regulators (LR series)	DID-DYN-LRP
Expansion module – two regulators (LR series) with the master/slave structure	DID-DYN-LRX
Low-noise compressor Bambi with increased capacity	DID-AIR-BB-FAST
Mounting table for the training complex	DID-DYN-TABLE
Computer with pre-installed programming environment	DID-DYN-PC
Book of laboratory works	DID-DYN-EX
Book LabVIEW and CompactRIO – fundamentals of application development	DID-DYN-BOOK

SHORT LIST OF LABORATORY WORKS

Laboratory work No. 1

Purpose of work: studying the NI cRIO controller, connection of sensors and actuation mechanisms. Basic principles of operation with real-time controller and field programmable gate array. Connection of peripherals, data processing.

Laboratory work No. 2

Purpose of work: studying dynamic properties of valves with permanent and variable volume of chambers using pneumatic cylinder as an example.

Laboratory work No. 3

Purpose of work: studying dynamics of pneumatic cylinder motion when throttling at the exhaust and braking at the end of stroke. Studying mechanical characteristics of pneumatic drives.

Laboratory work No. 4

Purpose of work: studying dynamic properties of pneumatic drive when controlling inertial loads.

Laboratory work No. 5

Purpose of work: fundamentals of building-up feedback systems using electro-pneumatic servo drive based on on-off valves as an example:

– tracking of stepwise, line and harmonic control signals (notion of static and dynamic error);

– influence of inertial loads on quality of the regulation process.

Laboratory work No. 6

Purpose of work: studying fundamentals of building-up vacuum systems with compressed air saving. Control of energy saving system (processing of signals from vacuum sensors, setting of operating zones, hysteresis).

WHEN USING EXPANSION MODULES

Laboratory work No. 7

Purpose of work: studying properties of proportional pressure regulators (ER series) when working with permanent and variable volume chambers.

Laboratory work No. 8

Purpose of work: studying fundamentals of building-up electro-pneumatic servo drives based on proportional elements. Studying PID-controller. Electro-pneumatic servo drive based on proportional pressure regulators (ER series). Setting of PID-controller gains. Influence of inertial loads on quality of the regulation process.

Laboratory work No. 9

Purpose of work: studying properties of proportional flow regulators (LR series).

Laboratory work No. 10

Purpose of work: studying fundamentals of building-up electro-pneumatic servo drives based on proportional servo regulators. Studying PID-controller. Electro-pneumatic servo drive based on proportional pressure regulators (LR series). Setting of PID-controller coefficients. Influence of inertial loads on quality of the regulation process. Analysis and comparison of experimental data with deliverables of laboratory work No.8.

DID-FC training complex for analyzing dynamic characteristics of pneumatic regulators

Proportional flow and pressure regulators

The training simulator enables examination of properties of proportional flow of pressure regulators when working with chambers of different volume under external disturbances.

- Basic configuration – proportional pressure regulator (ER series)
- Four volumes of independently connected and disconnected chambers (0.01 l; 2 l; 4 l; 6 l)
- External disturbance in the form of controlled leakage
- External disturbance in the form of supply pressure
- NI USB-6008 data acquisition card
- Flow meter with display and analog output
- Pressure sensors with displays and analog outputs in each chamber and main line
- Methodological support

Studying dynamic properties of proportional pressure regulators with different volumes of controlled objects and interferences. Control by hand and by personal computer.

The simulator is designed for chairs of technical universities to perform laboratory works and also to prepare graduate qualification works as well as works for completing the Bachelor's and Master's Degree in specific areas.

GENERAL CHARACTERISTICS

Delivery options	■ basic configuration – ER pressure regulator ■ free layout (any flow element may be installed at the place of ER pressure regulator)
Materials	■ housing – steel with powder painting ■ front panel – aluminum with powder painting
Electric connection	safe power cable 220 V AC EURO
Pneumatic connection	plug 5380 1/2, if the set doesn't include a compressor it is required to provide tube 10/8 (pressure up to 10 bar) with a quick-release socket 5084 10/8
Operating pressure	nominal pressure: 8 bar (operating pressure: 1 ... 9 bar)
Installation	on horizontal surface (legs are included into the delivery set)
Dimensions	640 x 450 x 500 mm (length x depth x height)

COMPONENTS OF THE SIMULATOR

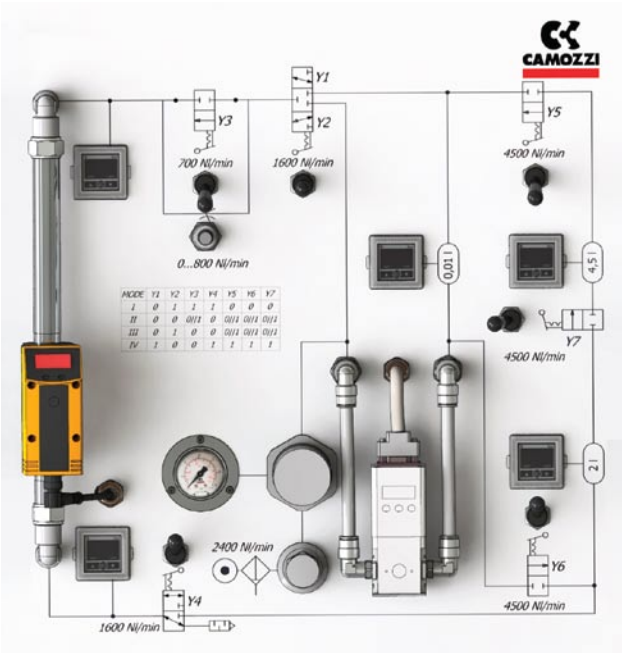
DID-FC simulator has a metal-sheet frame. The front panel includes handles of control elements, indicators, examined pressure regulator and pneumatic symbols which are combined into a pneumatic circuit by means of lines.

The simulator structure allows not only to get acquainted with pneumatic circuit but also to study full-scale samples of industrial pneumatic elements.

Structural diagram of the simulator and pneumatic and information-measuring devices of the simulator allow setting the supply pressure level, to measure responses of examined elements to changes in volume of the outlet chamber and external disturbances in the form of leaks or forced filling. Variable and controlled parameters of the system are displayed on indicators of the front panel.

The simulator has a USB-6008 data acquisition device connected to a personal computer or a laptop via USB interface (cable is included into the delivery set) to record responses to stepwise and continuous reference signals.

APPEARANCE OF THE FRONT PANEL



- The front panel contains a pneumatic circuit showing arrangement of elements inside the simulator housing.

EXTERNAL CONNECTION ELEMENTS

- Operation requires compressed air and power supply 220 V AC. If it is necessary to record response processes, the simulator is connected to a computer via USB port on the side panel.

Information-measuring part of the simulator is presented by a flow meter and pressure sensors. Disturbance in the form of air leakage from the receiver to the atmosphere and disturbance in the form of forced filling of the receiver chamber are simulated by means of valves on the front panel of the simulator according to the provided table of signals, regulated by means of throttle setting and controlled by a flow meter (this throttle and flow meter are also placed on the front panel).

Measured parameters of the system are displayed on the front panel in the form of figures and are sent to the USB-6008 data acquisition card in the form of electric voltage signals. Data acquisition card is also a source of external signal for proportional pressure regulator (ER series).

FLOW METER

- Flow meter allows to display volume flow rate value in appropriate units of measure and also to receive flow rate data from the analog voltage output. It may be also used as a compressed air meter.

PRESSURE SENSOR

Pressure sensor:

- displays the current pressure;
- sets analog output voltage level proportional to pressure;
- contains two configurable relay outputs with LED indicators connected to digital inputs of the NI USB-6008 DAQ card.

DATA ACQUISITION AND CONTROL UNIT

NI USB-6008 data acquisition unit is connected to a computer by means of full-speed USB interface which has a socket on the simulator housing. The module contains eight analog signal input channels (AI), two analog signal generation channels (AO), 12 digital input/output channels and a 32-digit counter.

NI USB-6008 DATA ACQUISITION UNIT

OPERATION OF THE SIMULATOR

Simulator is installed on horizontal surface, e.g. training table in the laboratory. Operation requires connection of power and air supply.

Simulator may be operated without a computer in the demo mode: pressure is manually set on the regulator by means of soft keys and digital display on the housing.

Digital indicators of flow meter and pressure sensors show current values of corresponding physical parameters.

Time referencing of transient processes and responses to continuous signals requires connection to a computer via USB port.

Basic version of LabVIEW programming environment (included into the set of simulator delivery) is installed on the computer. By setting global variables corresponding to inputs and outputs and by using software included into the set of simulator delivery, one may record the mentioned characteristics in the form of diagrams and data arrays which may be further processed on a computer in order to build up time and frequency characteristics.

SHORT LIST OF LABORATORY WORKS

Laboratory work No. 1

Purpose of work: connection of the DID-FC training simulator in the demo mode, acquaintance with element base. Studying technical characteristics and instructions on setting of proportional pressure regulator and sensors.

Laboratory work No. 2

Purpose of work: studying the NI USB-6008 data acquisition and control unit. Connection, setting, generation of control signals and processing of sensor data.

Laboratory work No. 3

Purpose of work: studying dynamic characteristics of pressure regulator when tracking step input signal. Notion of static error and studying other quality parameters of step response. Regulator operation with different volumes under conditions of external disturbing actions and without them.

Laboratory work No. 4

Purpose of work: studying dynamic characteristics of pressure regulator when tracking continuous input signals. Notion of dynamic error. Regulator operation with different volumes under conditions of external disturbing actions and without them.

Laboratory work No. 5

Purpose of work: receiving responses of the examined pressure regulator (ER series) to sinusoidal harmonic input actions in the operating range of amplitudes and cyclical frequencies. Studying the obtained data arrays and forming logarithmic amplitude-frequency and phase-frequency characteristics of the regulator on the basis of these data arrays.

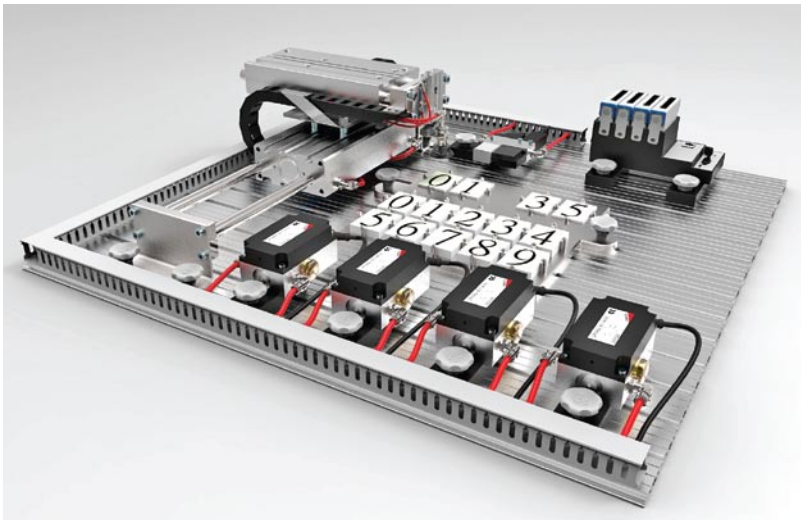
CODES FOR ORDERING DID-FC TRAINING SIMULATOR

Training simulator for analyzing dynamic characteristics of pressure regulators	DID-FC
Low-noise compressor Bambi with increased capacity	DID-AIR-BB-FAST
Computer with pre-installed programming environment	DID-FC-PC
Book of laboratory works	DID-FC-EX
Training course «Data acquisition systems»	DID-FC-BOOK

Training simulator
Pneumatic manipulator DID-ROBOT

Studying principles of building-up, control algorithms and programming of pneumatic manipulators

Training simulator allows studying dynamic properties of pneumatic manipulators to optimize control algorithms of separate drives and to solve the direct kinematic problem.



- Basic configuration – table-mounted design and three-axis pick-and-place mechanism with vacuum gripper which is implementing, for instance, the clock numbers rearrangement function tied to the current time
- X-axis and Y-axis – electro-pneumatic servo drives with LR series proportional valves
- Z-axis – adaptive drive with vacuum suction pad
- Vacuum system with energy saving function

The simulator is designed for chairs of technical universities to perform laboratory works and also to prepare engineer's graduate qualification works as well as works for completing the Bachelor's and Master's Degree in specific areas. The simulator may be also used to train in fundamental programming of robots and other multicoordinate systems at industrial enterprises.

The simulator performs training and demonstrating functions at the same time. Operation of the simulator is accompanied by acquaintance with very-high-speed servo-controlled flow regulators, controllers and programming environments.

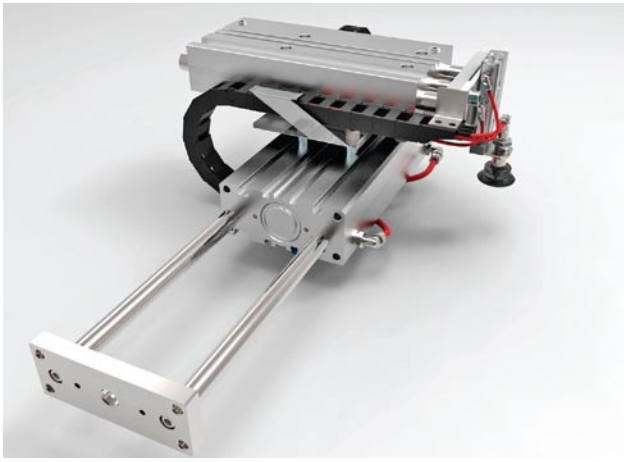
GENERAL CHARACTERISTICS

Delivery options	■ manipulator implementing clock on the basis of servo drives with LR series proportional valves ■ on request – simulator with ER series pressure regulators, with AP series proportional valves; configuration as agreed with the customer ■ controlled object may be also developed on the customer's request (rearrangeable load, laser pointer, etc.)
Materials	mounting plate – anodized aluminium profile
Electric connection	safe power cable 220 V AC EURO
Pneumatic connection	tube 8/6
Operating pressure	nominal pressure: 6 bar (operating pressure: 6 ... 10 bar)
Installation	on horizontal surface
Dimensions	755 x 750 x 180 mm (length x depth x height)

COMPONENTS OF THE SIMULATOR

DID-ROBOT simulator is a training-demonstrating complex consisting of a three-axis pneumatic manipulator with control system based on LR series proportional valves, a vacuum ejector with energy saving function and a NI CompactRIO controller (detailed description of the controller is given in the section DID-DYNAMIC).

THREE-AXIS PNEUMATIC MANIPULATOR



- Pneumatic manipulator has a design consisting of three pneumatic cylinders working in the XYZ axes.
- X-axis and Y-axis contain pneumatic cylinders with position sensors required for creation of servo drives ensuring precise stopping in the XY plane.
- Z-axis is presented by a cyclic drive providing the possibility to control pressure level in the cylinder's chamber, i.e. force of vacuum pad application to the object.

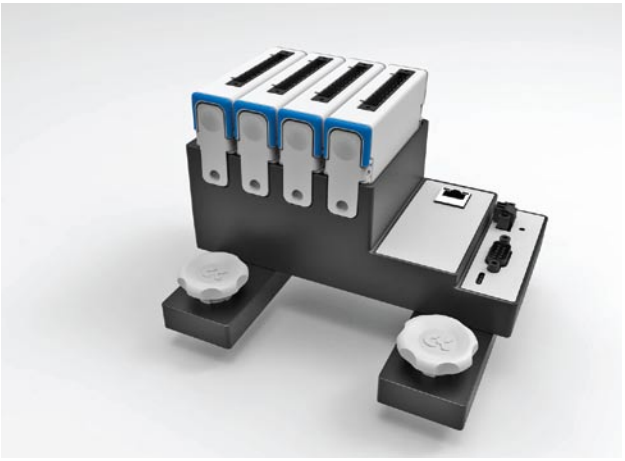
MANIPULATOR CONTROL SYSTEM

- Compressed air flows for cylinders in the axes X and Y are controlled by means of LR series proportional valves.

VACUUM EJECTOR WITH ENERGY SAVING SYSTEM

- Vacuum ejector with energy saving system controls vacuum level, i.e. force of part gripping according to the preset value.

NI CRIO 9075 CONTROLLER



- NI cRIO 9075 chassis contains an integral field programmable gate array, a real-time controller and slots for connection of expansion modules.
- Controller is governed by the VxWorks real-time operating system.

WORKING FIELD

- One of the working field options is presented by slots for plates with hour and minute indication.
- The upper row consists of four figures and implements clock indication.
- Two lower rows form a number field to implement current time in the 24-hour format.

OPERATION OF THE SIMULATOR

The delivered simulator is preprogrammed and ready for operation. For activation, it is required to connect sources of power and air supply, to set current time on the front panel using the set of number plates and to enter current time into controller memory. After that the simulator is working in the automatic mode.

To use the simulator for training purposes, it is required to connect the controller to a computer with pre-installed LabVIEW software (training license is included into the set of delivery) using Ethernet cable. Programming environment allows creating a unique control program, developing new structures for control part of drives and solving the task of manipulator control in the servo mode for any desired trajectory.

Description of the control program is given in the delivered guidance manual.

SHORT LIST OF LABORATORY WORKS

Laboratory work No. 1

Purpose of work: detailed acquaintance with hardware and software components of the simulator. Follow-up drives, proportional devices, vacuum gripper, control system. Start.

Laboratory work No. 2

Purpose of work: studying fundamentals of building-up electro-pneumatic servo drives.

Laboratory work No. 3

Purpose of work: studying fundamentals of building-up electro-pneumatic servo drives based on proportional elements. Studying PID-controller. Electro-pneumatic servo drive based on proportional pressure regulators (LR series). Setting of PID-controller gains. Studying non-linear laws of control by means of servo systems in order to increase dynamic and static accuracy.

Laboratory work No. 4

Purpose of work: joint operation of several electro-pneumatic drives:
– synchronizing operation of interrelated modules to ensure coordinated motion,
– processing of limit switch signals,
– time delays, program flags, interruptions (application).

Laboratory work No. 5

Purpose of work: studying fundamentals of building-up vacuum systems with compressed air saving. Control of energy saving system (processing of signals from vacuum sensors, setting of vacuum switch on/off time, operating zones, hysteresis).

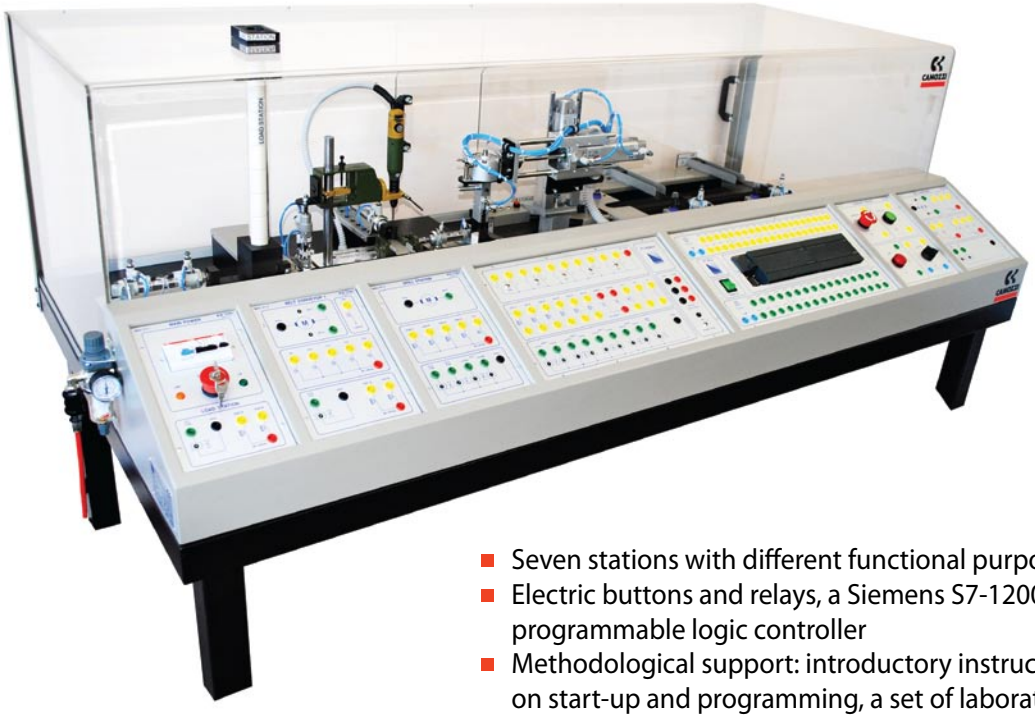
CODES FOR ORDERING DID-ROBOT TRAINING SIMULATOR

Training simulator – pneumatic manipulator	DID-ROBOT
Low-noise compressor Bambi with increased capacity	DID-AIR-BB-FAST
Computer with pre-installed programming environment	DID-RBT-PC
Book of laboratory works	DID-RBT-EX
Book LabVIEW and CompactRIO – fundamentals of application development	DID-RBT-BOOK

Training simulator – DID-APL automated production line

Electric drives, pneumatic automation, sensors, relay-contact control circuits, PLC on the example of an automated production line

DID-APL training simulator is a miniature copy of the real work cell designed for training in fundamentals of industrial automation.



- Seven stations with different functional purposes
- Electric buttons and relays, a Siemens S7-1200 programmable logic controller
- Methodological support: introductory instructions on start-up and programming, a set of laboratory works
- Safe switching of electric connections by means of fully insulated 4 mm contacts

DID-APL – a miniature model of the real production process including an automatic warehouse, a conveyor, a loading station, a sorting station and mechanical treatment stations.

The delivered simulator has a floor-mounted stationary design and full protection made of transparent plastic ensuring safety of application in the training process.

GENERAL CHARACTERISTICS

Delivery options	floor-mounted stationary design
Materials	■ welded frame – steel with powder painting ■ front panels – anodized aluminum ■ protective cover – plexiglas
Electric connection	safe power cable 220 V AC EURO
Pneumatic connection	tube 8/6
Operating pressure	nominal pressure: 6 bar (operating pressure: 3 ... 10 bar)
Installation	floor-mounted design
Dimensions	2000 x 1000 x 800 mm (length x depth x height)

COMPONENTS OF THE DID-APL SIMULATOR

The system consists of 7 modules which may be started independently or simultaneously ensuring technological process of the production line:

1) **loading station**: ensures loading of blank parts to the transfer conveyor and is presented by an automated station equipped with unloading mechanism; may be operated independently;

2) **belt conveyor 1**: automated belt conveyor; equipped with presence sensors; actuated by electric drive; has two motion speeds;

3) **drilling station**: drilling station with a pneumatic clamp for blank parts and feed drive, automated module with electrically-operated cartridge;

4) **PROBOT station**: electro-pneumatic robot with five degrees of freedom ensuring rotation of the platform by 180° in relation to the base, vertical feed for 100 mm, horizontal feed for 100 mm, rotation of the actuator by 180°, and also opening and closure of the robot gripper;

5) **belt conveyor 2**: automated part sorting system equipped with electrically-driven conveyor belt; the system is fitted with part position sensors, cylinders, limit switches, etc.

6) **automatic warehouse**: machined parts storage module with automated detection system setting correspondence between the part and its functional purpose;

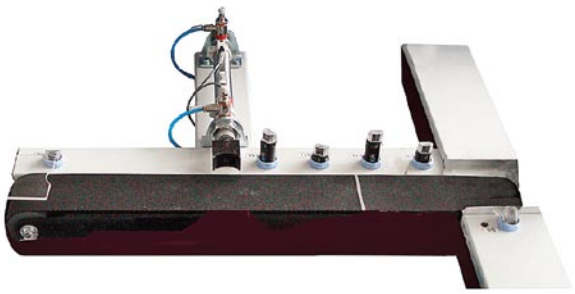
7) **PT-PLC station**: control module based on Siemens programmable logic controller, S7-1200 series (40 digital inputs, 32 digital outputs); controller is fitted with a remote panel with electric connectors. This station is delivered together with Step 7 MicroWin software, user's manual, controller programming manual and cable for connection to a computer.

ATTENTION: all electric inputs and outputs of the mentioned stations are made on the basis of standard connectors (standard size 4 mm) ensuring safe electrically insulated contact between conductors. All connectors are placed on the front panel of the simulator.

LOADING STATION

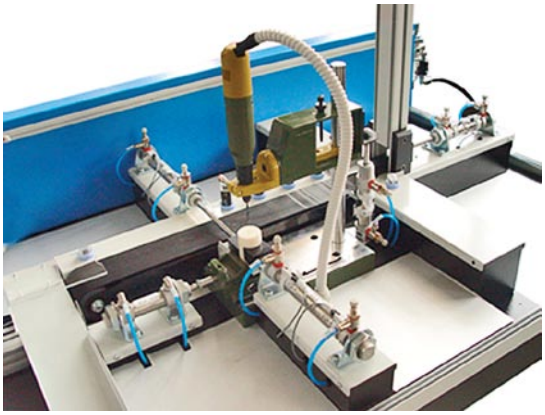
- 1 pneumatic cylinder.
- 1 monostable valve.
- 2 magnetic cylinder position sensors.

BELT CONVEYOR



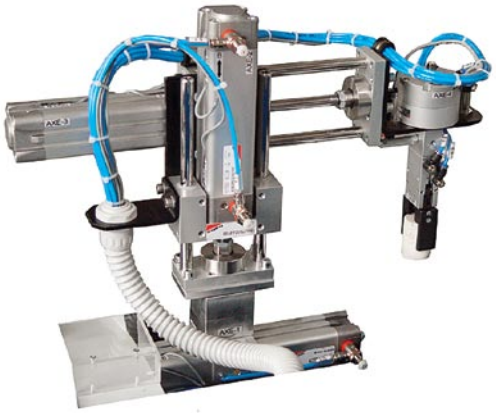
- 1 belt conveyor (600 mm long) with a DC motor.
- 6 blank part material and size identification sensors.
- 1 pneumatic cylinder.
- 2 magnetic cylinder position sensors.
- 1 monostable valve.

DRILLING STATION



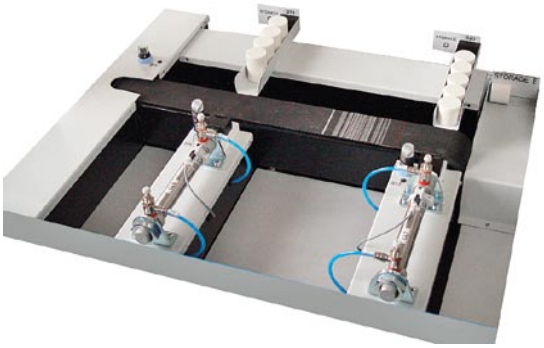
- 1 electric spindle
- 1 pneumatic vise
- 4 pneumatic cylinders
- 2 monostable valve-type valves
- 1 bistable valve
- 4 magnetic cylinder position sensors
- 1 pressure relay

P-ROBOT STATION



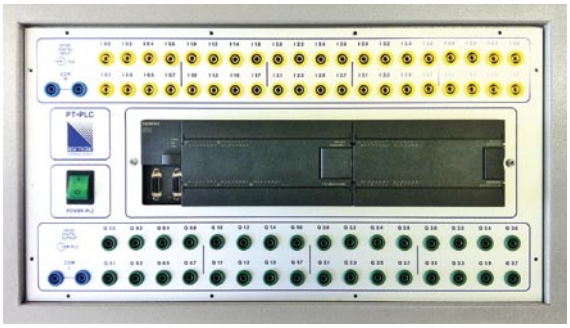
- 2 rotary cylinders (rotation angle 180°)
- 1 vertical feed cylinder (travel 100 mm)
- 1 horizontal feed cylinder (travel 100 mm)
- 1 pneumatic gripper
- 1 monostable valve
- 4 bistable valves
- 8 position sensors
- 1 pressure relay

BELT CONVEYOR 2 AND AUTOMATIC WAREHOUSE



- 1 belt conveyor (600 mm long) with a DC motor
- 2 limit switches
- 4 pneumatic cylinders
- 2 magnetic cylinder position sensors
- 2 sets of identification sensors
- 1 set of presence sensors
- 2 monostable valves
- 2 automated storage stations
- 2 limit switches

PT-PLC STATION



- Siemens S7-1200 controller has 40 digital inputs and 32 digital outputs
- MicroWin software and cable for communication with PC

OPERATION OF THE SIMULATOR

Functioning of the simulator requires a source of AC power supply 220 V AC and also a source of compressed air supply with supply pressure of 6 bar (included into the delivery set upon request). A computer or a laptop (included into the delivery set upon request) is required for usage of the controller and its programming.

The simulator may function in three different modes:

A) **Autonomous mode**: without usage of peripheral devices, you may check operability of sensors and also actuate separate cylinders by means of relay switches or control buttons located on the front panel of the simulator.

B) **Programming mode**: the robot may be connected to PLC which has been already mounted on the front panel and pre-programmed via PC (included into the delivery set upon request). This mode allows setting operation cycle of the automated cell by means of programming aids.

C) **Control mode provided by sequence relay (switching register) or any other peripheral device**: the robot may be connected to a switching register or any other peripheral device by means of safe electric contacts on the front panel of the simulator.

CODES FOR ORDERING DID-APL TRAINING SIMULATOR

Training simulator – automated work cell	DID-APL
Computer with pre-installed programming environment	DID-APL-PC
Low-noise compressor Jun-Air with filter-regulator	DID-AIR-JA
Low-noise compressor Bambi with filter-regulator	DID-AIR-BB

CAMOZZI

Air that moves the world

www.camozzi.ru

LLC «Camozzi Pnevmatika» proposes package solutions on automation of technological processes and production with the use of pneumatic and electro-mechanic equipment.

LLC «Camozzi Pnevmatika» also performs designing of any non-standard industrial equipment according to the customer's terms of reference.

1993 – foundation of LLC «Camozzi Pnevmatika»

2006 – opening of the manufacturing-logistical center in Russia (Chashnikovo settlement)

Since **2010** – leader of the pneumatic equipment market.

Turnover in **2014** – 2,9 billion rubles.

CAMOZZI in Russia

- 30 sales and technical support offices in Russia
- 320 employees
- 10 000 м^2 of manufacturing and storage areas
- Refined logistics. Delivery partner – TNT company
- Professional service
- Implementation of integrated automation projects
- Own manufacturing-logistical center in Chashnikovo (manufacture of pneumatic cylinders and control cabinets)
- Wide range of pneumatic equipment – nomenclature of more than 30,000 items
- Largest operating warehouse of pneumatic equipment in Eastern Europe (90% of products are constantly in stock)
- Over 50 training seminars for customers annually
- Over 40 exhibitions in regions and in Moscow annually
- Manufacture of training simulators, industrial manipulators and laboratory testing units

LLC «CAMOZZI PNEVMATIKA»
Head office, logistical and training centers, manufacture
141597, Moscow region,
Solnechnogorsk district, Chashnikovo settlement
+7 (495) 786 65 85 (multichannel)
info@camozzi.ru

CAMOZZI MOSCOW
141400, Moscow region,
Khimki, Leningradskaya str., 1-A,
14th floor (Rechnoy vokzal metro station)
+7 (495) 735 49 61
moscow@camozzi.ru

CAMOZZI VLADIVOSTOK
690014, Vladivostok,
Nekrasovskaya str., 52a, office 206
+7 (4232)2089 33
vladivostok@camozzi.ru

CAMOZZI VORONEZH
394026, Voronezh,
Moscovsky pr-t, 11, office 6
+7 (473) 20088 11
voronezh@camozzi.ru

CAMOZZI EKATERINBURG
620027, Ekaterinburg,
Lunacharskogo str., 31, office 1010
(UralNITI building)
+7 (343) 354 32 57
ural@camozzi.ru

CAMOZZI IRKUTSK
664025, Irkutsk,
Gagarina boulevard, 38, office 403
+7 (3952) 50 03 96
irkutsk@camozzi.ru

CAMOZZI KAZAN
420111, Kazan,
Moskovskaya str., 13a, office 302
+7 (843) 299 60 60
kazan@camozzi.ru

CAMOZZI KIROV
610000, Kirov,
Moskovskaya str., 25 G, office 208
т.: +7 (8332) 21 13 29
kirov@camozzi.ru

CAMOZZI KRASNODAR
350001, Krasnodar,
Mayakovskogo str., 163, office 2/1
+7 (861) 239 70 41
krasnodar@camozzi.ru

CAMOZZI KRASNOYARSK
660093, Krasnoyarsk,
Akademika Vavilova str., 2Zh, office 108
+7 (391) 236 58 21
krasnoyarsk@camozzi.ru

CAMOZZI NABEREZHNYE CHELNY
423810, Naberezhnye Chelny,
H. Tufana pr., business center «2.18»,
office 0608 (6th floor)
+7 (8552) 20 34 60
dielny@camozzi.ru

CAMOZZI NIZHNY NOVGOROD
603000, Nzhny Novgorod,
Korolenko str., 29, office 311, 3 floor
+7 (831) 220 55 41
nnov@camozzi.ru

CAMOZZI NOVOKUZNETSK
654066, Novokuznetsk,
Druzhby pr-t, 39, office 704
+7 (3843) 77 76 36
novokuznetsk@camozzi.ru

CAMOZZI NOVOSIBIRSK
630091, Novosibirsk,
Frunze str., 5, office 304
+7 (383) 218 60 09
nsk@camozzi.ru

CAMOZZI OBNINSK
249036, Kaluga region, Obninsk,
Korolyova str., 4, office 401.3,
BC «BRITANICA»
+7 (48439) 2 92 52
obninsk@camozzi.ru

CAMOZZI OMSK
644119, Omsk,
Stepantsa str., 10/4, 4 floor
+7 (3812) 71 94 94
omsk@camozzi.ru

CAMOZZI PERM
614022, Perm,
Mira str., 45a, office 301
+7 (342) 205 76 41
perm@camozzi.ru

CAMOZZI PYATIGORSK
357500, Pyatigorsk,
Kochubeya str., 67
+7 (8793) 97 53 03
kmv@camozzi.ru

CAMOZZI ROSTOV-ON-DON
344002, Rostov-on-Don,
Budyonnovsky pr., 3, office 408
+7 (863) 203 62 24, 299 01 63
rostov@camozzi.ru

CAMOZZI RYAZAN
390044, Ryazan,
Moskovskoye shosse, 16
+7 (4912) 427 150
ryazan@camozzi.ru

CAMOZZI SAMARA
443099, Samara,
Vodnikov str., 60, office 615
+7 (846) 276 68 92
samara@camozzi.ru

CAMOZZI SAINT-PETERSBURG
192029, Saint-Petersburg,
Babushkina str., 3, office 410
(Yelizarovskaya metro station)
+7 (812) 326 29 11
spb@camozzi.ru

CAMOZZI TOGLIATTI
445043, Togliatti,
Kommunalnaya str., 39, office 705
OC «Podsolnukhi»
+7 (8482) 20 63 11
+7 (917) 112 62 94
e-mail: togliatti@camozzi.ru

CAMOZZI UFA
450006, Republic of Bashkortostan, Ufa,
Parkhomenko str., 156/1a, office 111
+7 (347) 246 40 76
ufa@camozzi.ru

CAMOZZI KHABAROVSK
680013, Khabarovsk,
Shabadina str., 19a, office 512
+7 (4212) 26 03 96
khabarovsk@camozzi.ru

CAMOZZI CHELYABINSK
454091, Chelyabinsk,
Krasnaya str., 4, office 507
+7 (351) 265 87 64
chel@camozzi.ru

CAMOZZI CHEREPOVETS
162600, Cherepovets,
Mayakovskogo str., 40, office 7
+7 (812) 326 29 11
spb@camozzi.ru

CAMOZZI YAROSLAVL
150049, Yaroslavl,
Tolbukhina pr-t, 17/65, office 209
+7 (4852) 20 63 65, 20 63 66
yaroslavl@camozzi.ru