

TRAINING SYSTEMS FOR AUTOMATION TECHNOLOGY

Acquiring Practical Skills and Project-Oriented Expertise

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Qualifications through Quality

Training Systems for Automation Engineering

Technical advances ...

Automation technology is becoming ever more important thanks to the rapid developments taking place in industrial process automation. Developments here are very closely integrated into other related fields such as drive technology, automatic control or computer engineering. Due to the lightning fast pace of development, automation engineering has become one of the most innovative and rapidly changing fields in electrical engineering.



... have an enormous impact on vocational training and education

New industrial solutions necessitate new training systems. Innovations in decentralisation and visualisation, the introduction of the internationally applicable IEC1 131-3 standard, and thus the uniform PLC programming of controls according to uniform rules and regulations are just a few examples of the way vocational training is being revolutionised.

The need for modern, practice-oriented training systems that can convey state-of-the-art technology and the skills needed to master them arises from the demands being made on today's automation technicians.



A strong partnership with industry

That is what provides the guarantee for a hands-on, practical application. Lucas-Nülle has found an excellent partner in market leader Siemens AG. The most modern products to be found in automation technology have been provided by Siemens AG to be modified for teaching purposes and adapted for the precise requirements of training colleges and educational institutions. All of the curriculum requirements are covered regardless of the level of difficulty from the compact basic system version all the way to modular high-end systems with field bus interface and decentralised peripherals including operating and monitoring equipment. Safety technology, too, has of course been integrated into all of the systems in conformance with the latest European guidelines pertaining to machinery. The modular and scalable training system forms the innovative and future-proof foundation for excellent and in-depth training in the area of automation engineering.

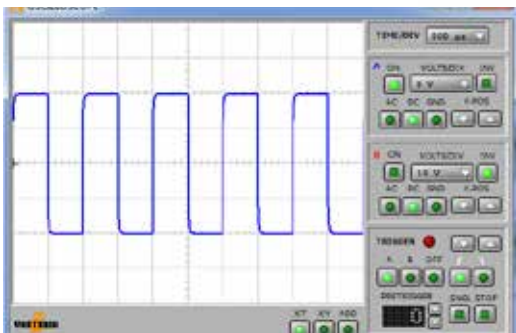


UniTrain – Designed to Systematically Motivate Students to Learn

A System to Cover the Entire Spectrum of Technical Vocational Training

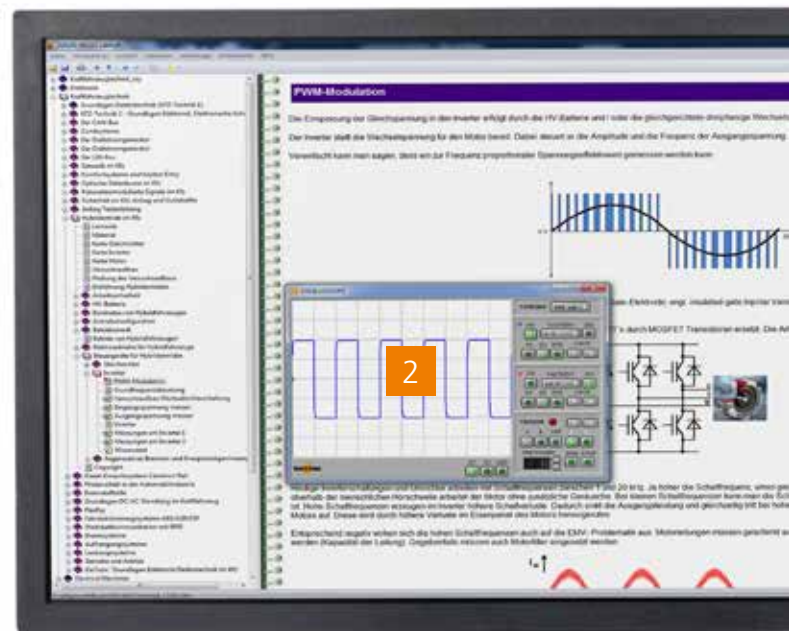
Gaining knowledge and skill to operate technical systems of ever greater complexity and in ever shorter periods of time is the critical challenge for technical vocational training, not only for today but for tomorrow as well. There is help on the way to mastering this challenge – it comes in the form of the UniTrain system, the computer-aided, multimedia experimenting and training system for electrical engineering and electronics.

The integration of learning programs with a fully-operational electrical laboratory in just one mobile interface permits both the theoretical as well as the practical to be taught in an efficient fashion anywhere and anytime.



2 Virtual instruments

120 virtual instruments available to operate the interface



New: Integrated WLAN module

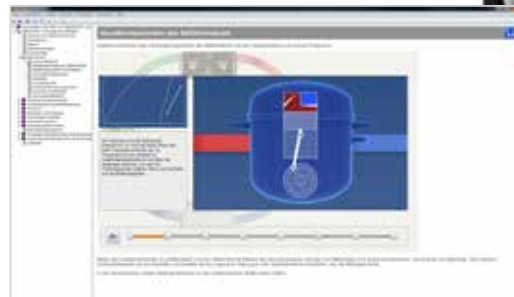
1 UniTrain interface

Measurement and control interface:
Analog/digital measurement inputs and power sources
for every experiment



Your benefits

- Combines theory and practice at the same place and time
- High student motivation thanks to integration of PC and modern media
- Students enjoy rapid learning success thanks to guided course design
- Understanding accelerated thanks to theoretical sections enriched with animations
- Skills and competence developed by performing experiments
- Continuous feedback thanks to comprehension questions and tests of knowledge
- Guided troubleshooting with integrated fault simulator
- Using safety extra-low voltage guarantees safety
- Huge selection of courses
- Sample solutions for teachers



3 LabSoft courses

Over 130 training programs with experiment hardware covering every area of electrical engineering and electronics

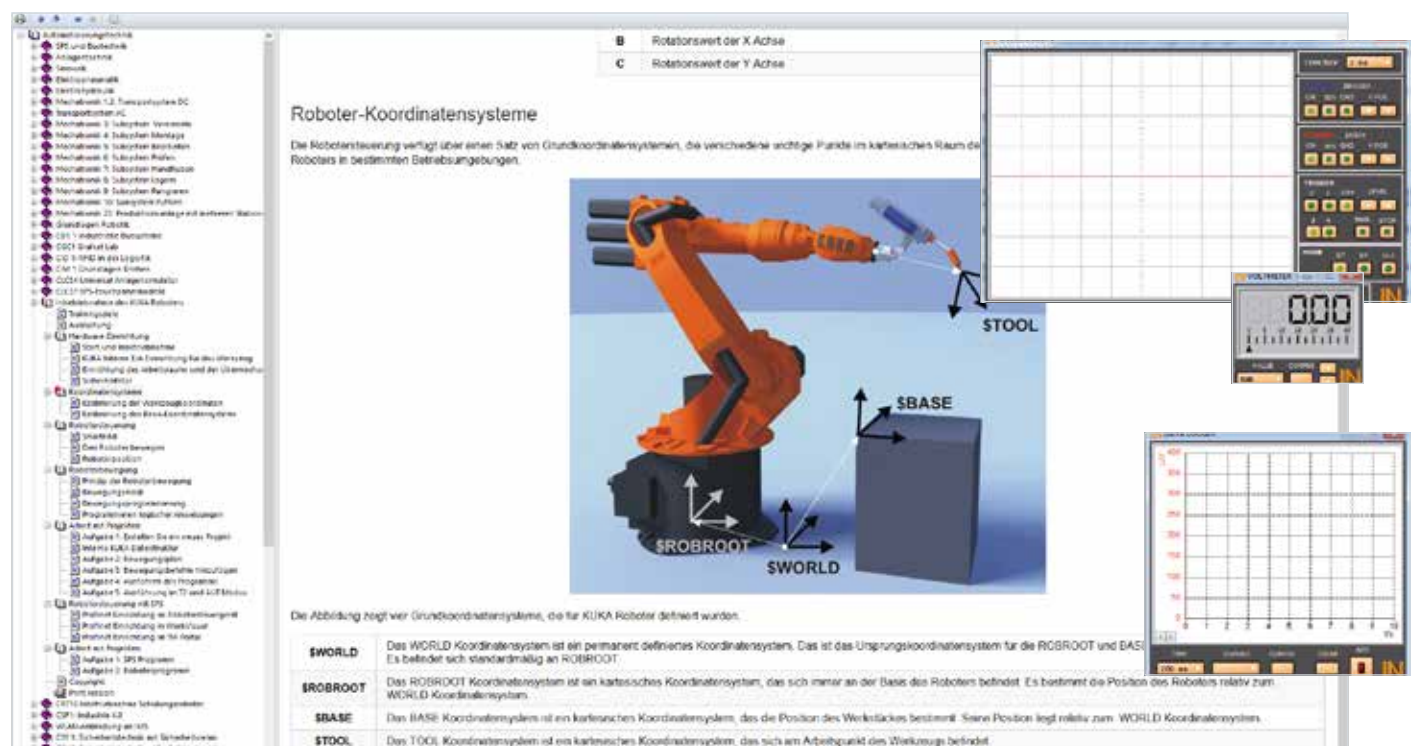
4 Experimenter

Accommodates the experiment cards and includes additional voltage outputs (three-phase current)

Animated Presentation of Complex Training Contents

Interactive Lab Assistant (ILA)

Interactive Lab Assistant (ILA) gives you all the support you need for carrying out experiments. It not only provides instructions, it also supplies valuable theoretical information, records measurements and automatically creates the necessary laboratory documentation in the background in the form of a printable document or a PDF file. If you want to change the experiment instructions, you can simply use Labsoft Classroom Manager to modify or add content.



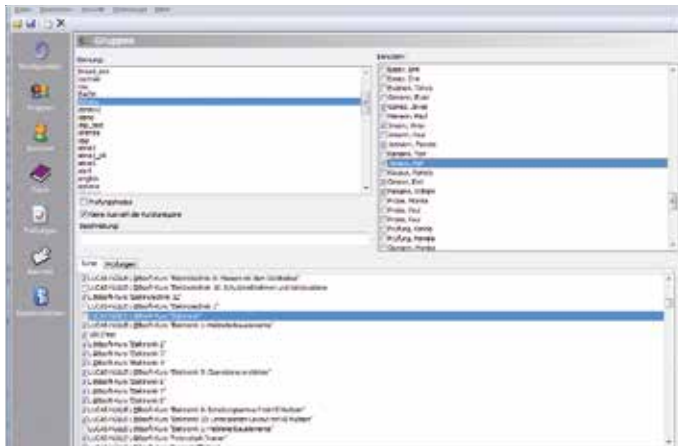
Interactive Lab Assistant (ILA) "Project planning with Kuka robot"

Your benefits

- Theory conveyed using easily understood animations
- Support whilst carrying out experiments
- Interactive display of experiment set-ups
- Access to actual measuring instruments and testers with extensive evaluation capabilities
- Practically oriented project exercises to perfect successful learning
- Integrated operating instructions
- Documentation of experiment results (creation of an experiment report)
- Knowledge tests including feedback function

LabSoft Classroom Manager

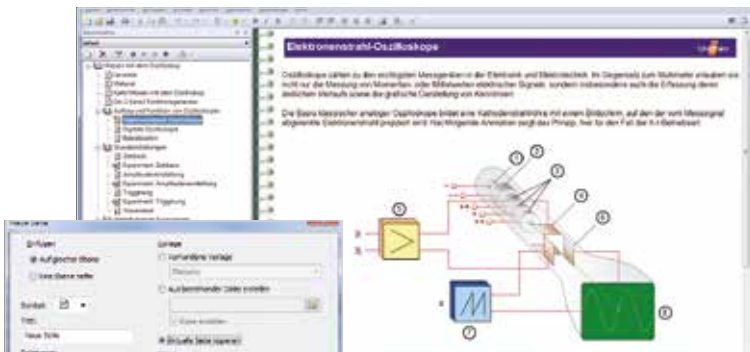
LabSoft Classroom Manager is an administration software package with extensive functionality. It allows practically oriented training and learning processes to be organised and managed in comfort. Classroom Manager is suitable for all LabSoft-based training programs, such as ILA, UniTrain, InsTrain and CarTrain. It consists of the following sub-programs:



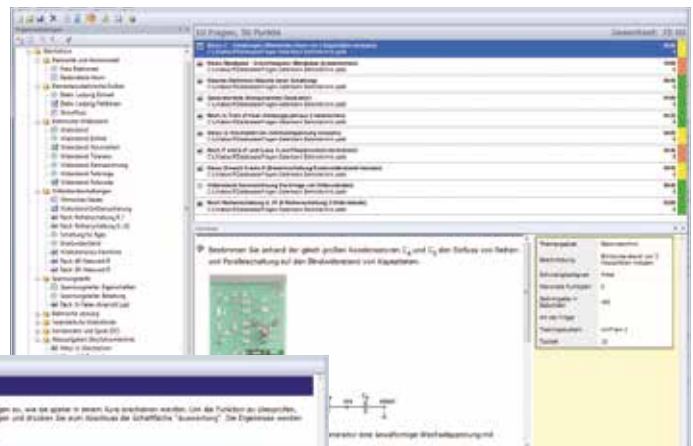
LabSoft Manager: Administer your LabSoft courses, students and student groups with LabSoft Manager. Then you can provide students with the right exercises for their needs at all times.



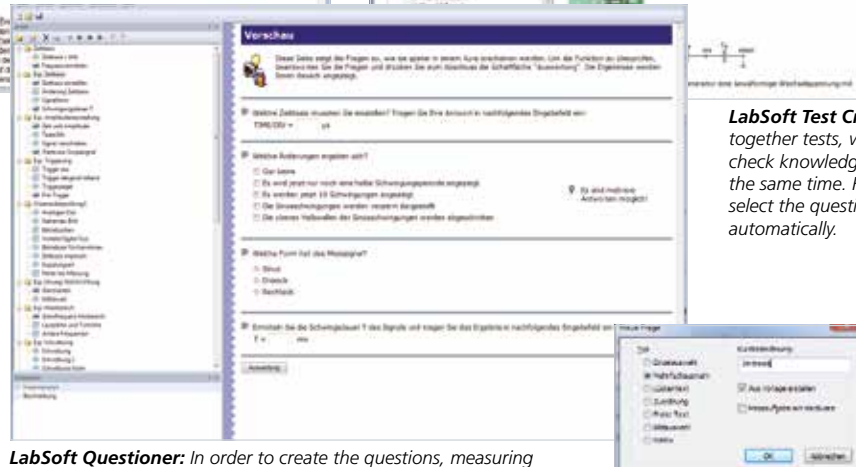
LabSoft Reporter: Progress and test results can be displayed using LabSoft Reporter. This provides multiple ways of assessing results of courses and tests for individuals or groups allowing you to quickly and specifically monitor progress.



LabSoft Editor: features several wizards to help you devise your own new courses and guide trainees step by step through the necessary tests.



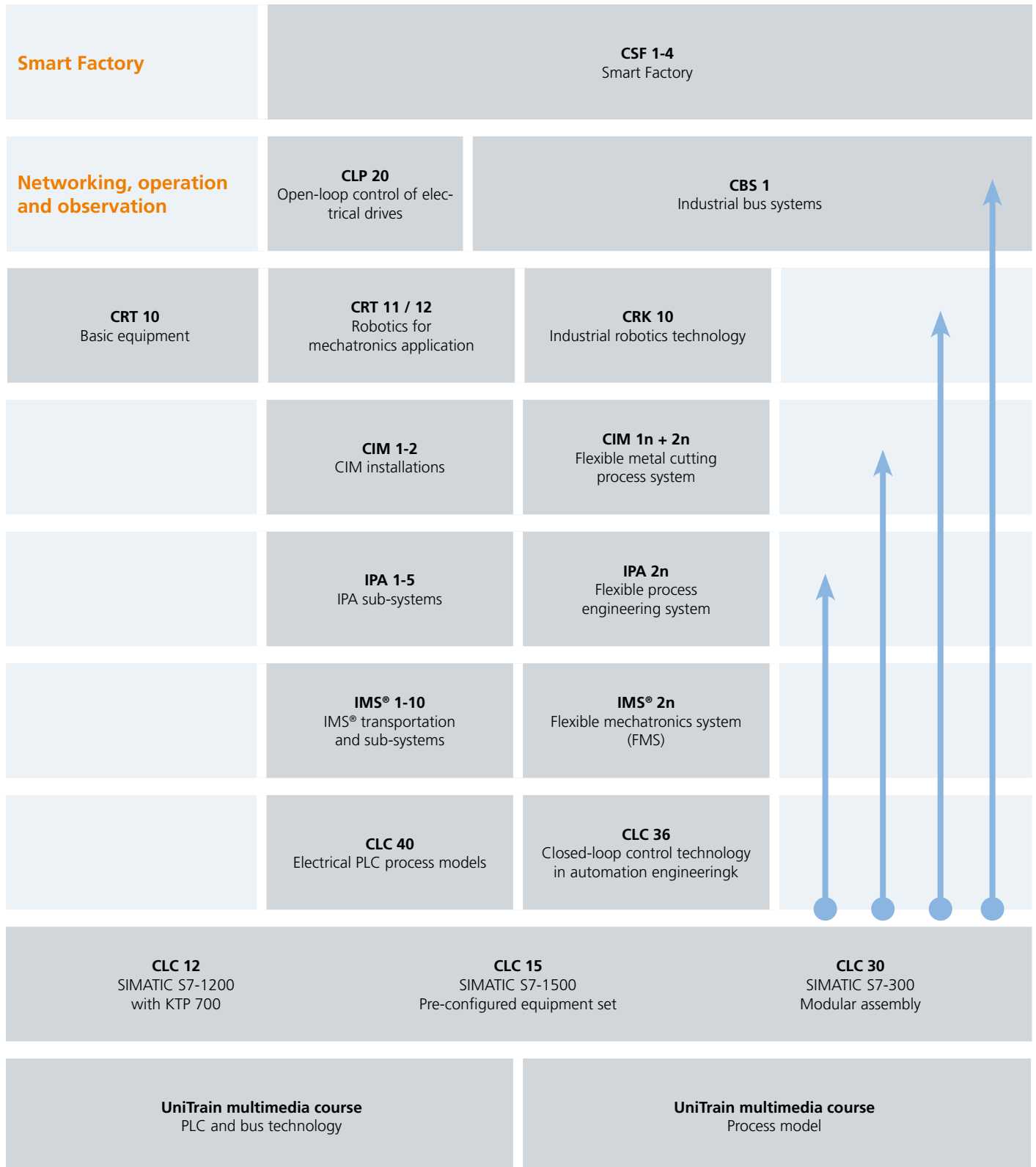
LabSoft Test Creator: is used to put together tests, which can be used to check knowledge and practical skills at the same time. Filter functions help to select the questions either manually or automatically.



LabSoft Questioner: In order to create the questions, measuring exercises and tests, LabSoft Questioner has various types of question available. Exercises and questions can then be inserted into courses and tests.

The Entire System at a Glance

Safety technology in automation engineering	CSY 1 Circuits with control relay	CSY 2 AS-Interface with safety motor	CSY 3 Fail-safe PLC PROFIsafe	CSY 4 / 5 Application of optical systems
Robotics	UniTrain multimedia course Fundamentals of robotics			
CIM Computer Integrated Manufacturing	ILA Interactive Lab Assistant course Machining technology with CIM installations			
IPA Industrial process engineering systems	UniTrain multimedia course Process engineering with IPA sub-systems			
IMS® Industrial Mechatronics System	UniTrain multimedia course Mechatronics with IMS® conveyor belt and sub-systems			
Process simulators Process system models Plant models	CLC 37 SPS touch panel model		CLC 34 PLC universal plant simulator	
Programmable logic controls	UniTrain multimedia course Automation engineering (PLC + bus technology)			
Fundamentals for automation technology	UniTrain multimedia course Sensor technology	UniTrain multimedia course Pneumatics	UniTrain multimedia course Hydraulics	



More than Just a Training System

A Total Solution – the Automation Laboratory


Presenting complex training content in a vivid way
using modern training media

Flexible process engineering
production systems with IPA

Simple introduction
to each IMS® sub-system
using multimedia
UniTrain courses

CNC programming directly
on the lathe and milling machine
or in 3D simulation

Flexible production systems with IMS®



Each IPA station can be operated using an industrial PLC unit or with the UniTrain process and automatic control

Complete solutions for process control systems:
PLC, AS-i, PROFIBUS, PROFINET, HMI, remote maintenance,
safety technology, drive technology

The system models and process simulators
offer a multitude of control assignments

With UniTrain, multimedia is used to
develop know-how and skills



Fundamentals for Automation Technology



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Sensor Technology in Automation

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Pneumatics

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Hydraulics/Electro-Hydraulics

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Multimedia-Based Automation,
PLC and Bus Technology

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Electrical PLC Process System Models

Fundamentals for Automation Technology

Multimedia-Based and Practice-Oriented Introduction
to Automation Technology



Your benefits

- Combines theory and practice at the same time and location
- High student motivation thanks to integration of PC and modern media
- Students enjoy rapid learning success thanks to guided course design
- Understanding accelerated thanks to theoretical sections enriched with animations
- Hands-on practical skills developed through autonomous experimenting
- Continuous feedback thanks to comprehension questions and tests of knowledge
- Guided troubleshooting with integrated fault simulator
- Using safety extra-low voltage guarantees safety
- Huge selection of courses
- Sample solutions for teachers

Sensor Technology in Automation

Industrial Sensors

Sensors are needed for the open-loop control of technical processes using programmable controllers. They convert physical variables into electrical output signals and assume the function of the human senses. As such, sensor technology is fundamental to this field and indispensable for any automation technician.



UniTrain course "Sensor technology in automation"

Training contents

- Working with capacitive and inductive proximity switches
- Working with various types of sensors such as magnetic field or optical sensors
- Exploring which sensor responds to which material
- Determining the switching gap, hysteresis and operating frequency
- Methods of testing various materials using sensors driven electrically along the X-axis

Pneumatics in Automation

Pneumatic Cylinders – Directional Control Valves – Process Control Elements

Use of compressed air to transmit power has become more and more attractive. Pneumatic systems are frequently being used for such tasks as transport, drilling, grinding, winding, sorting, and open- and closed-loop controls. This can be attributed to the fact that in some automation tasks there is simply no better or more efficient tool that can be used.



UniTrain course "Electropneumatics"

Training contents

- Basics of pneumatics
- How single- and double-acting cylinders work
- Familiarization with various directional control valves
- Operation and design of electropneumatic controls
- Hard-wired controls
- Programmable controls
- Recording displacement/time graphs
- Time-dependent controls

Hydraulics/Electro-Hydraulics

Hydraulics for Education

Due to the leakage from loose connecting tubes, it is possible to work safely and cleanly in a classroom, even with pressures of up to 40 bars. The accompanying UniTrain self-learning course guides students through all the fundamental topics of hydraulics. Set up logical operations in the circuit editor included in the software or wire up the required projects in conventional fashion using the control elements built into the board.



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SYSTEM

UniTrain course "Electro-hydraulics"

Training contents

- Fundamentals of hydraulics/electro-hydraulics
- Hydraulic and electric circuit diagrams
- Single- and double-acting cylinders
- Extending a cylinder by means of a button
- Extending a cylinder with self-holding
- Normally closed limit switches
- Hydraulic feed control with start requirement
- Start interlocking with random intermediate stop
- Pressure-dependent control
- Mechanical interlocking of a button contact
- Electrical interlocking of a button contact
- High-speed motion circuit
- Time-dependent control
- Recording of displacement/time diagrams

Multimedia-Based Automation, PLC and Bus Technology

Programmable Logic Control (PLC)

Today's highly automated industrial landscape is characterised by machines which operate more or less automatically. As a rule these systems are operated by programmable logic control. Developments are leading to more decentralised control systems utilising field bus systems.



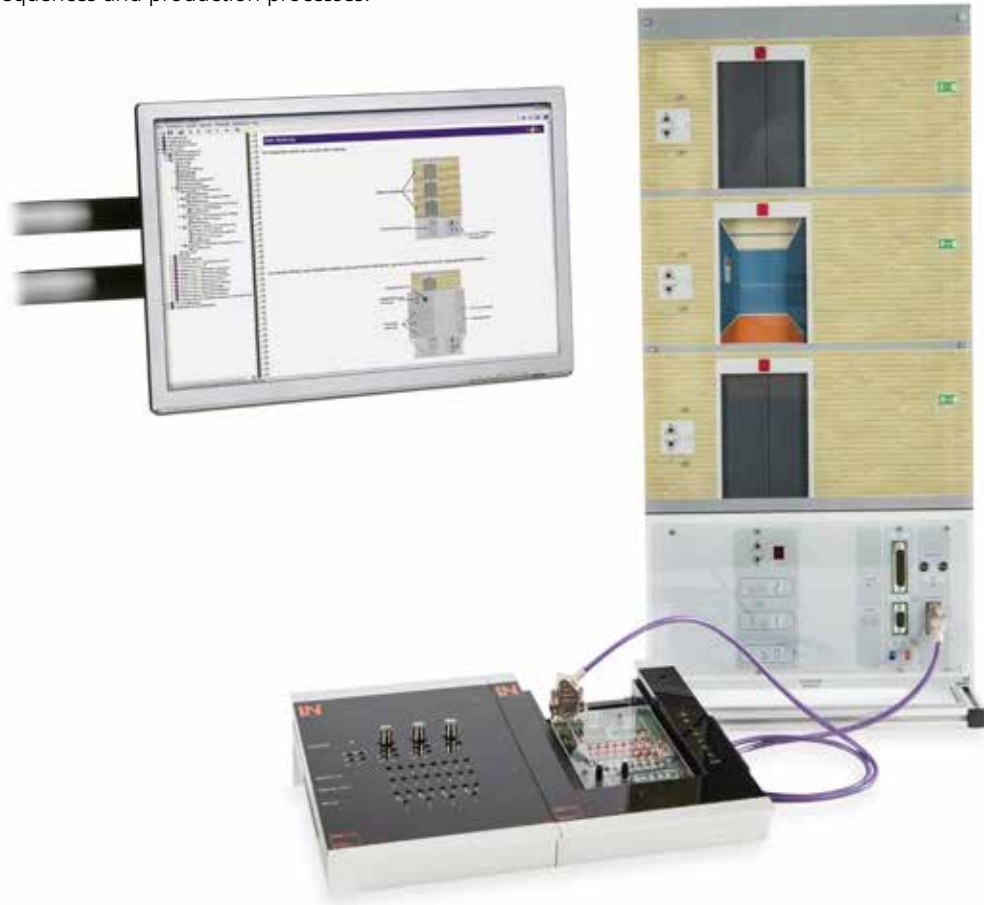
Training contents

- Introduction to the fundamentals and basic concepts of PLC systems and how they operate
- Introduction to PLC programming
- Implementing logical operations from storage elements all the way to more complex networks
- Programming of times, counters and self-written functions
- Designing a traffic light circuit
- Conversion of non-electrical measurement variables to electrical signals
- Programming with Instruction List (IL) and Structured Text languages using an editor in compliance with IEC 1131-1
- Programming in Function Block Diagram (FBD), Ladder Diagram (LD) and IL languages with STEP 7

Electrical PLC Process System Models

Direct Connection to the Control System

With these compact training systems, subjects such as handling as well as transport and positioning processes can be explored. These constitute real life industrial conditions. Consequently they are ideally suited for learning process-oriented control programs and complex movement sequences and production processes.



UNITRAIN
SYSTEM

Training contents

- Setting parameters, programming and operation of process controls
- Set-up and operation of hardware models, testing and fault finding
- Analysis of process sequences
- Programming in accordance with IEC 1131-1 (IL, LD, FBD)
- PLC sequence control systems
- Programming limit switches
- Manual operation, single-step and automatic operation



Programmable Logic Control



26 Programmable Logic Control
with SIMATIC S7-300

27 Programmable Logic Control (PLC)
Training System

28 Programmable Logic Control (PLC)
Training System

29 Operation and monitoring with KTP700
and TP700

Programmable Logic Control

An Integral Component of Automation Engineering

New focal points in training and education reflect new skills and qualifications in the disciplines of process control technology, electro-mechanics, electronics and computer-assisted control systems (PLC). The basics of PLC technology as well as how it works are graphically demonstrated using examples, explanatory texts and practical exercises.



Multidisciplinary applications

Nowadays, programmable logic control systems are an integral part of automation engineering. They are used, for example, to control automated processes in the machine industry, for transport and conveyor belts, process engineering, drive systems and in manufacturing plants.



Time to provide individual support

Basic topics are taught using the UniTrain "Automation Engineering" program. The self-study aspect of the courses means instructors have more time to provide personal attention to individual students or small groups. With the UniTrain PLC control system, students get hands-on training using realistic control tasks and assignments in line with industry standards.



Training systems

The training systems focus on conveying basic knowledge and information on programmable logic control (PLC) and demonstrate how such systems are networked with sensors and actuators. The fundamentals and operation of PLC systems are graphically explored using a multitude of examples, explanations, exercises and practical assignments:

- UniTrain PLC and bus technology
- Programmable logic controls with SIMATIC S7-300



Programmable Logic Control with SIMATIC S7-300

Fully Configured Basic Equipment Sets

In addition to the recommended basic set, all of the CPUs in the 300 series are available as fully configured units. To implement automation assignments comparable to those actually used in industry, the STEP 7 software package is employed. The system features object-oriented programming of automation units in line with the IEC 1131-1 standard. Editors are also available for the languages LD (Ladder Diagram), FBD (Function Block Diagram), IL (Instruction List), ST (Structured Text, designated Structured Control Language, SCL, in STEP 7) in addition to the GRAPH tool (for Sequential Function Chart programming) plus tools for software testing and hardware configuration.



Training contents

- Design and project configuration for a PLC
- Creating assignment lists
- Programming in accordance with IEC 1131-1 (IL, LD, FBD, ST/SCL, GRAPH) using STEP 7
- Programming of binary and word operations
- Programming of counters and timers, comparison and arithmetic functions
- Program structure, calling subroutines
- Commissioning, testing and fault finding on an automation system
- Diagnostic functions
- Documentation and archiving

Programmable Logic Control (PLC) Training System

The Training System at a Glance

The basic apparatus is equipped with a SIMATIC S7-1200, a KTP700 touch panel and a power supply. It therefore makes for a self-contained, compact and extensible training system. The KTP700 touch panel has an Ethernet port for communication and programming. All equipment can be networked easily using a 4-way Ethernet switch.



Your benefits

- SIMATIC S7-1200 with 1214C DC/DC/DC CPU
- Robust console housing with non-slip feet
- Built-in power supply: 24 V/5 A DC
- Sockets for emergency stop/shut-down circuit (cuts off the voltage to the output modules)
- Built-in touch panel
- 4-way Ethernet switch for networking PLC and touch panel
- 9-pin and 25-pin sockets for direct analysis of mechatronics systems

Programmable Logic Control (PLC) Training System

Training System for 1500-Series Control Units

Training system for PLC equipment from the SIMATIC S7-1500 range. The profile rail is universally accessible and is equipped with input and output modules from the SIMATIC S7-1500 range. The 4 digital input and output bytes are distributed in such a way that 2 bytes of each are accessed via 4-mm sockets as well as via 9-pin, 25-pin and 37-pin plug/socket connectors.



Your benefits

- 16 Digital inputs, 24 V DC, via 4-mm safety sockets
- 16 Latching switches for simulating digital inputs
- 16 Digital outputs, 24 V DC, via 4-mm safety sockets
- 16 Digital inputs, 24 V DC, via 9-pin, 25-pin and 37-pin system plugs
- 16 Digital outputs, 24 V DC, via 9-pin, 25-pin and 37-pin system plugs
- 8 Analog inputs, -10 V ... +10 V, and 0 ... 20 mA or 0...20 mA
- 4 Analog outputs, selectable between -10 V ... +10 V
- 1 Analog output, adjustable from -10 V to +10 V via potentiometer
- 1 Analog output, adjustable from 0 to 20 mA via potentiometer
- 9-pin and 25-pin sockets for direct control of mechatronics systems
- 37-pin plug and 37-pin socket

Automation Visualisation

Using the KTP700 and TP700 touch panels, whole applications can be depicted or merely their signals. Controlling mechanisms like push-buttons or switches complete the requirements needed for control operations and monitoring.



Your benefits

- Programming is carried out via the included visualization software, WinCC Advanced
- Full-graphic colour display (16 million colours)
- 7" touch screen
- Resolution: 800 x 480 pixels
- Ports MPI, PROFIBUS DP, PROFINET I/O, USB
- Display of fault and operating messages
- Formula management
- Large viewing angle
- Dimmable LED background lighting, adjustable between 0 and 100 %



Networked Systems in Automation Engineering



34 Industrial Bus Systems

35 GRAFCET Practical Set

36 RFID

37 Open-Loop Control of Drive Systems

Complete Solutions for Automation Systems

Open-Loop Control with AS-Interface, PROFIBUS and PROFINET

Present day trends in automation engineering are heading towards modular systems with distributed systems. PROFINET, PROFIBUS and AS-Interface offer all of the networking possibilities for various intelligent components – from the lowest field level up to and including process control and instrumentation. Any components needed to operate and monitor machines (HMI) are integrated into this bus environment and permit a high degree of process transparency.



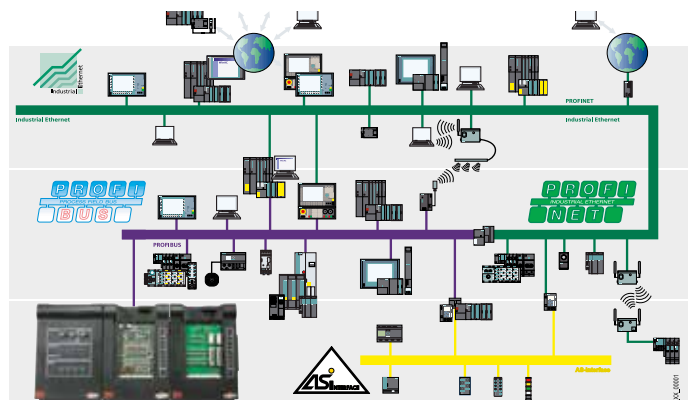
Wiring and maintenance

In order to dramatically reduce wiring and maintenance work on production lines, standardised field bus systems are increasingly being used to couple components together. This enables decentralised organisation of automation equipment, i.e. in close proximity to the actual sensors and actuators in the field. This eliminates the need for complex and error-prone parallel wiring of such actuators and sensors.



Field bus level

Thanks to standardised and open field bus protocols, systems stemming from different manufacturers are able to communicate. All automation components, including PLC systems, PCs, operating and monitoring equipment, as well as sensors and actuators themselves can all exchange data via the field bus. In order to meet demands for real-time process automation, field bus systems operate with very high data rates.



Training systems

The training systems cover all areas of control systems from simple bus structures to complex networks. One key benefit is common to all the systems and that is their rapid set-up times. By using typical industrial components, bus structures can be modified and expanded with a high degree of flexibility. Human Machine Interface (HMI) technology is naturally included as well.

The following network systems can be integrated:

- AS-Interface
- PROFIBUS
- PROFINET
- Industrial Ethernet



Industrial Bus Systems

Understanding and Using Bus Systems

It is essential nowadays to know about the most important industrial bus systems. With this compact equipment set you can learn about project planning for three different bus systems and how to use them. You will become familiar with these bus systems not merely from the extensive background theory but also from the detailed experiment instructions. The first assignment covers direct communication using the I/O of the PLC system. As an introduction to bus systems themselves, a conveyor belt will then be connected via an AS-i bus. The system most commonly used in industry, PROFIBUS, is covered second. Then finally, a conveyor belt will be controlled via PROFINET. One system can therefore be controlled by four different communications interfaces.



Sample experiment "Industrial bus systems CBS 1"

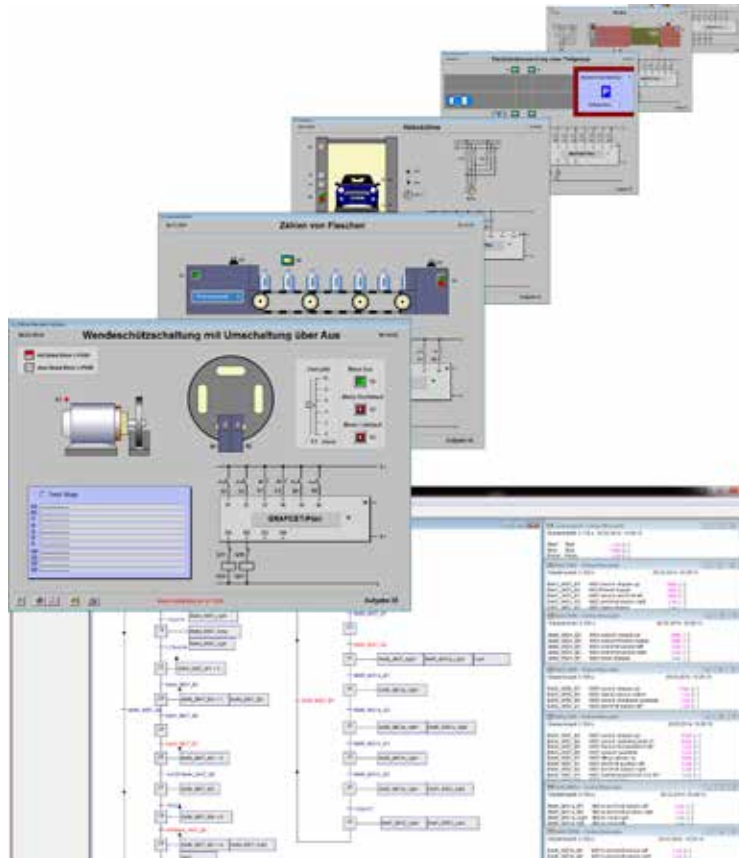
Training contents

- Fundamentals of TIA Portal
- Programming of a conveyor belt via I/O
- Fundamentals and project planning for AS-i bus
- Control of a conveyor belt via AS-i
- Fundamentals and project planning for PROFIBUS
- Control of a conveyor belt via PROFIBUS
- Fundamentals and project planning for PROFINET
- Control of a conveyor belt via PROFINET

Grafcet

GRAFCET Practical Set

In the GRAFCET practical set for the S7-1200 there are 15 process simulations available with practice-oriented exercises and representative solutions. The S7-1200 is connected to the PC via a standard Ethernet interface. GRAFCET plans are drafted on the PC and tested using the inputs and outputs of the PLC system.



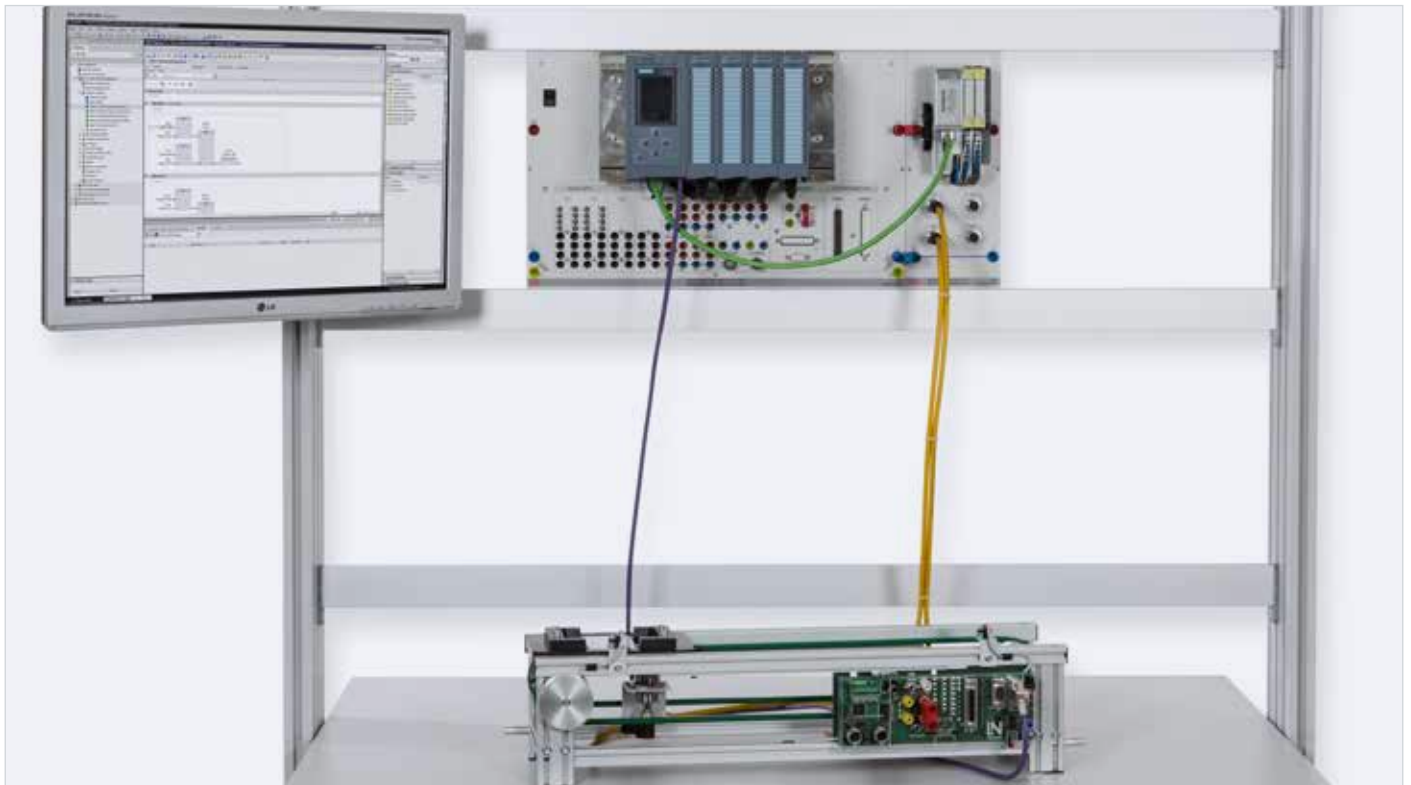
Equipment

- Temperature monitoring with indicator lights
- Heating up a furnace with a solar collector
- Temperature monitoring of a boiler
- Detection of rotation direction of a slowly rotating shaft
- Reversing contactor circuits with change-over via an off switch
- Reversing contactor circuits with direct switch-over
- Open-loop control of a reversible drive
- Continuous inching mode for a motor
- Parking space monitoring
- Bottle counting
- Gear lubrication
- Traffic light system
- Lifting platform
- Running lights
- Rolling shutters

RFID

RFID Chips as Product IDs

Standing for Radio Frequency Identification, RFID involves contactless identification and localization of objects and permits automatic registration, storage and networking of digital data. The "RFID" training system is a practical environment for learning how pallets at an automation facility are identified by means of system function modules (SFC). The system can also be used to provide instruction in network configuration by means of PROFINET.



Experiment example "CID 1"

Training contents

- Writing and reading RFID tags
- Using various RFID modules
- Fundamentals of network technology and practical applications using experiment setups
- Data transmission with TCP/IP
- PROFINET
- Diagnostics

Open-Loop Control of Drive Systems

Close Relationship between Drive and Automation Engineering

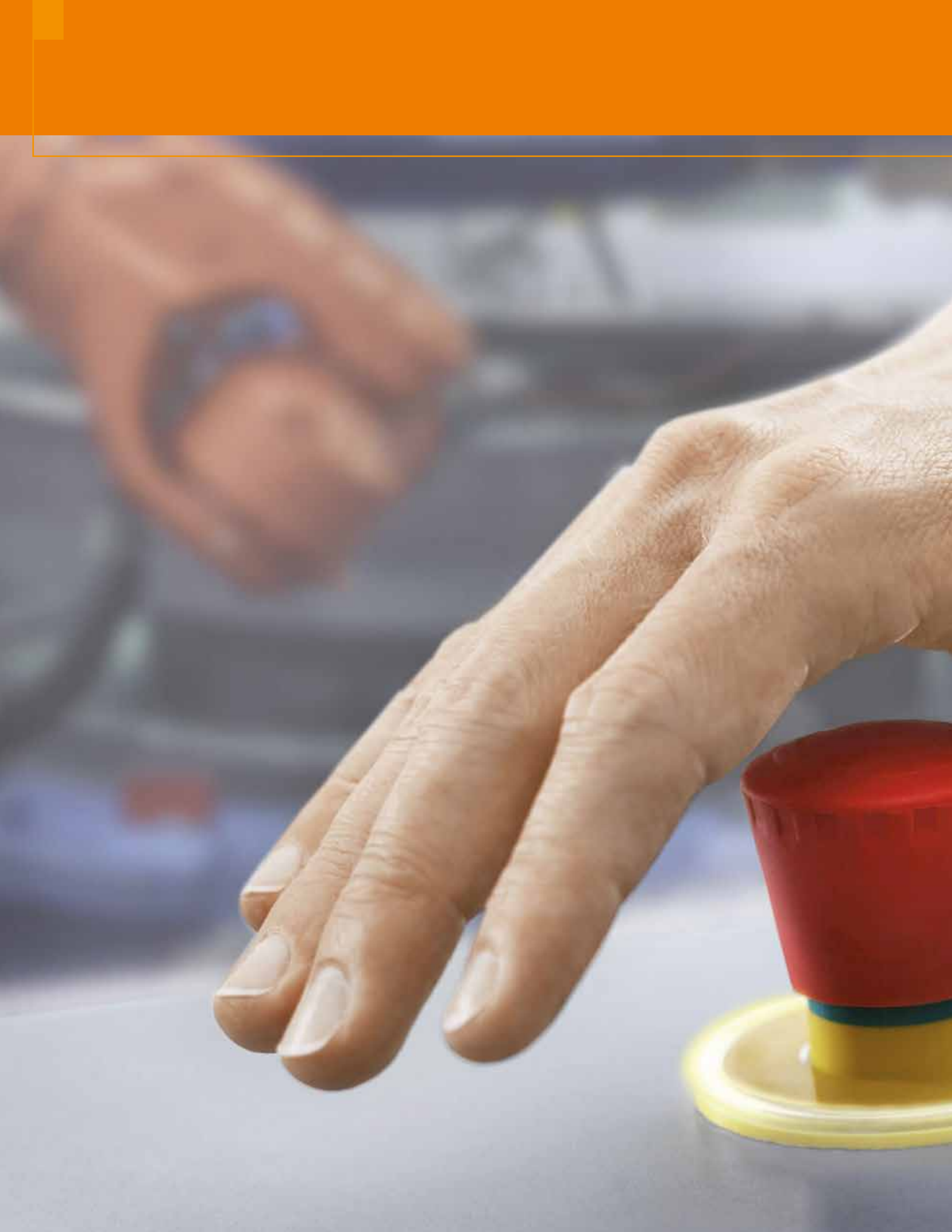
The main focus of this training system lies in project planning and programming the PLC and operator panel as well as putting a frequency converter into operation and setting its parameters via PROFIBUS DP. The training system employs a servo brake to subject the frequency converter-controlled drive machine to a load. This enables various working machines such as a fan, winding drive, calendar, compressor and a flywheel to be simulated using variable parameters.



Experiment example "Open-loop control of drive systems CLP 20"

Training contents

- Setting parameters, programming and utilising a programmable logic control unit
- Project planning and operation of an operator panel
- Setting parameters and operation of a frequency converter
- Project planning and operation of a field bus system
- Parameter optimisation on various adjustable working machines



Safety Technology in Automation Engineering



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Circuitry Involving Safety Relays

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AS-i-Safety

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PROFIsafe

45

Optical Systems

From Simple Circuits to Process Control Using PROFIsafe

In Accordance with European Machine Guidelines

The training systems dealing with the topic of "Safety Technology" cover the subject's entire spectrum from simple circuits using safety relays to AS-i Safety with a safety monitor through to fail-safe process controls with PROFIsafe. Optical systems such as light curtains or laser scanners can also be easily integrated into these systems. The heart of the model is the protective door with safety position switch on which a wide range of safety applications can be trained.

The systems on safety technology are an excellent complement to the "Industrial Mechatronics System" IMS®.

The following systems are available:

- Circuits with safety control equipment
- AS-i Safety
- PROFIsafe
- Optical systems



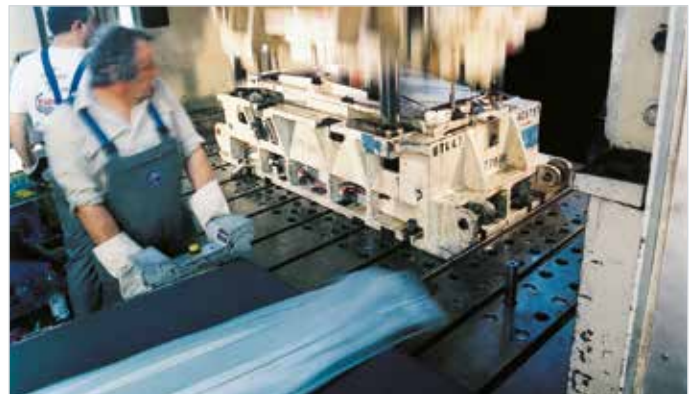
Armed against danger

The advances made in automation processes also mean more potential for hazards affecting numerous workstations. Yet it is not just individuals who are exposed to danger through faulty operation or application; the machinery itself is also extremely sensitive. If certain safeguards are not undertaken, there is a risk of incurring considerable damage and losses. For that reason, employees must acquire precise knowledge of potential application faults.



Standardised precautions

In almost all manufacturing facilities and production plants a greater degree of flexibility is required despite continuously rising productivity and its associated accelerated material flows. It is thus essential that trainees are already able to employ and master the equipment to guarantee safety in automation engineering. The required safety precautions have been defined in the standard IEC EN DIN 61508.



Project work leads to increased safety

It is easier for students and trainees to comply with these standards and internalise the proper approach to safety technology when training is hands-on and practice-oriented. The training equipment combines practical application with theoretical material. A special manual – a feature of all Lucas-Nülle training systems – assists students in performing the practical exercises.

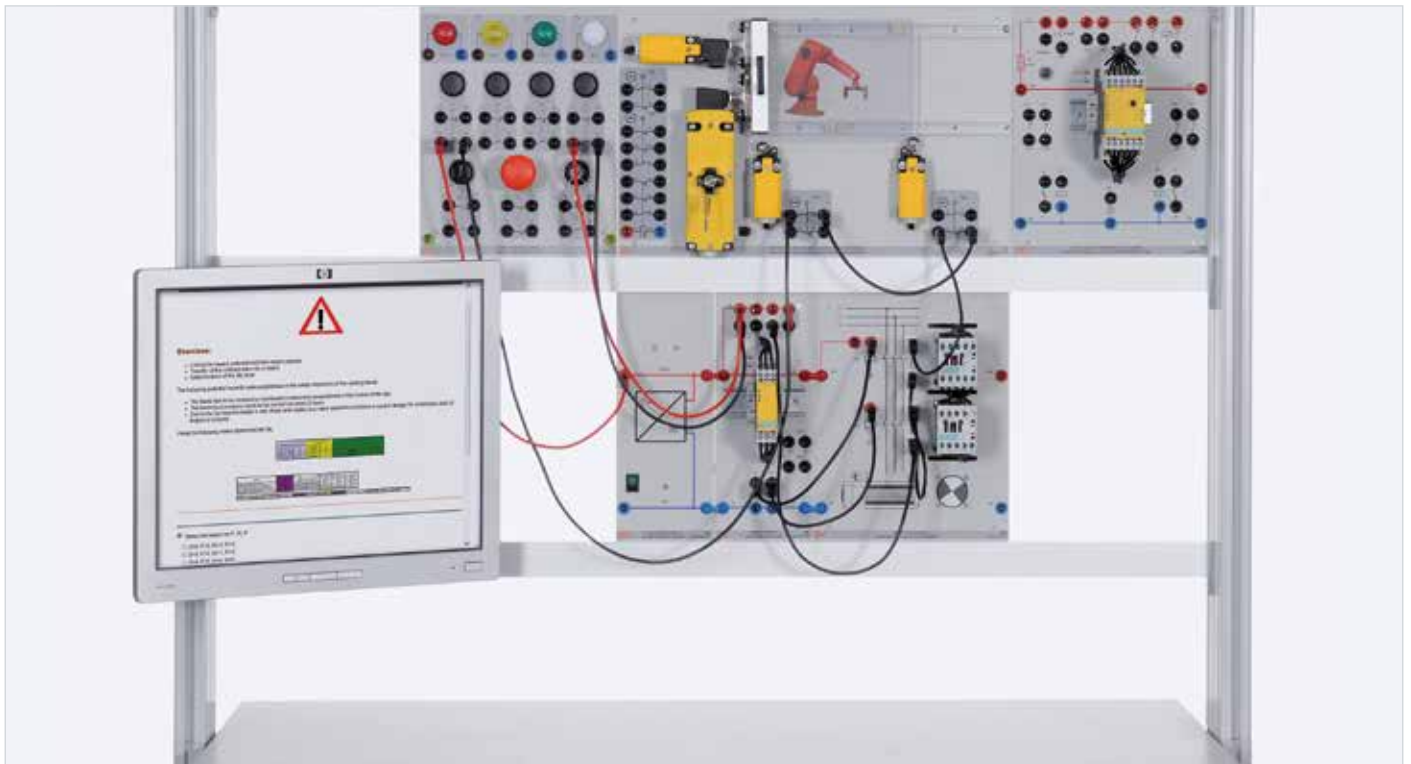


Circuitry Involving Safety Relays

Fundamentals: Safe and Secure with Contactors

The central model is a protective door with a safety position switch. Here various safety applications can be learned using the corresponding safety circuits:

- Safety position switch roller lever
- Safety position switch with separate actuator
- Safety position switch with tumbler
- Emergency shut-off



Experiment example "Circuits involving safety relays CSY 1"

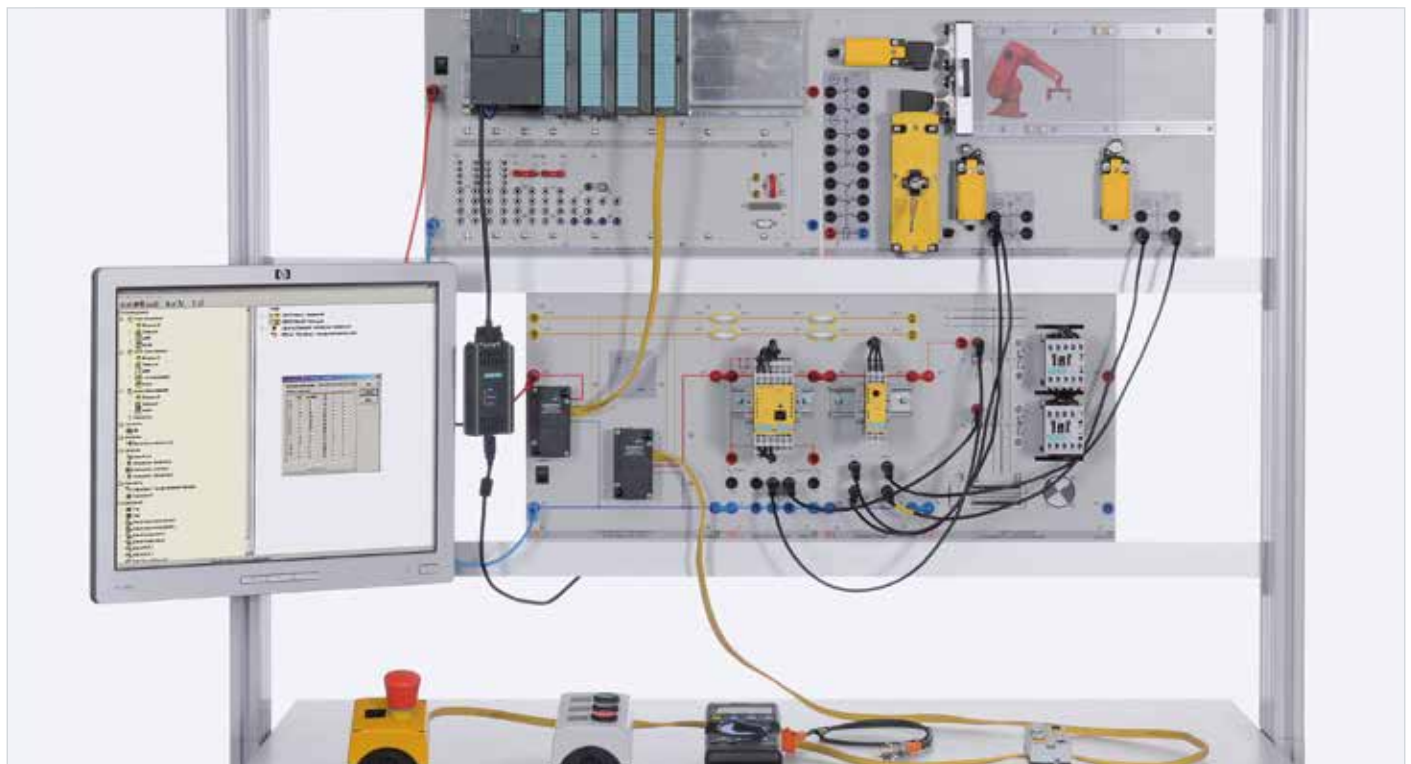
Training contents

- Safety categories according to EN 954-1
- Redundant design of safety circuits
- Signalling a system's operating states
- Setting parameters and operation of safety control equipment
- Emergency shut-off
- Direct shut-off via a tumbler on the protective door

AS-i Safety

Conveying All Aspects of Safety Technology

The new safety system with AS-i Safety components is an excellent complement to the AS-i equipment set and covers all aspects of safety technology. The AS-i Safety monitor serves to keep track of all secure AS-i slaves on an AS-Interface network. Configuration of the AS-i Safety monitor is quick and easy with the software contained in this package. As such, connecting up components like an emergency shut-off button, protective door switch or the safety light grid to the AS-i network is very easy.



Experiment example "AS-i Safety at work CSY 2"

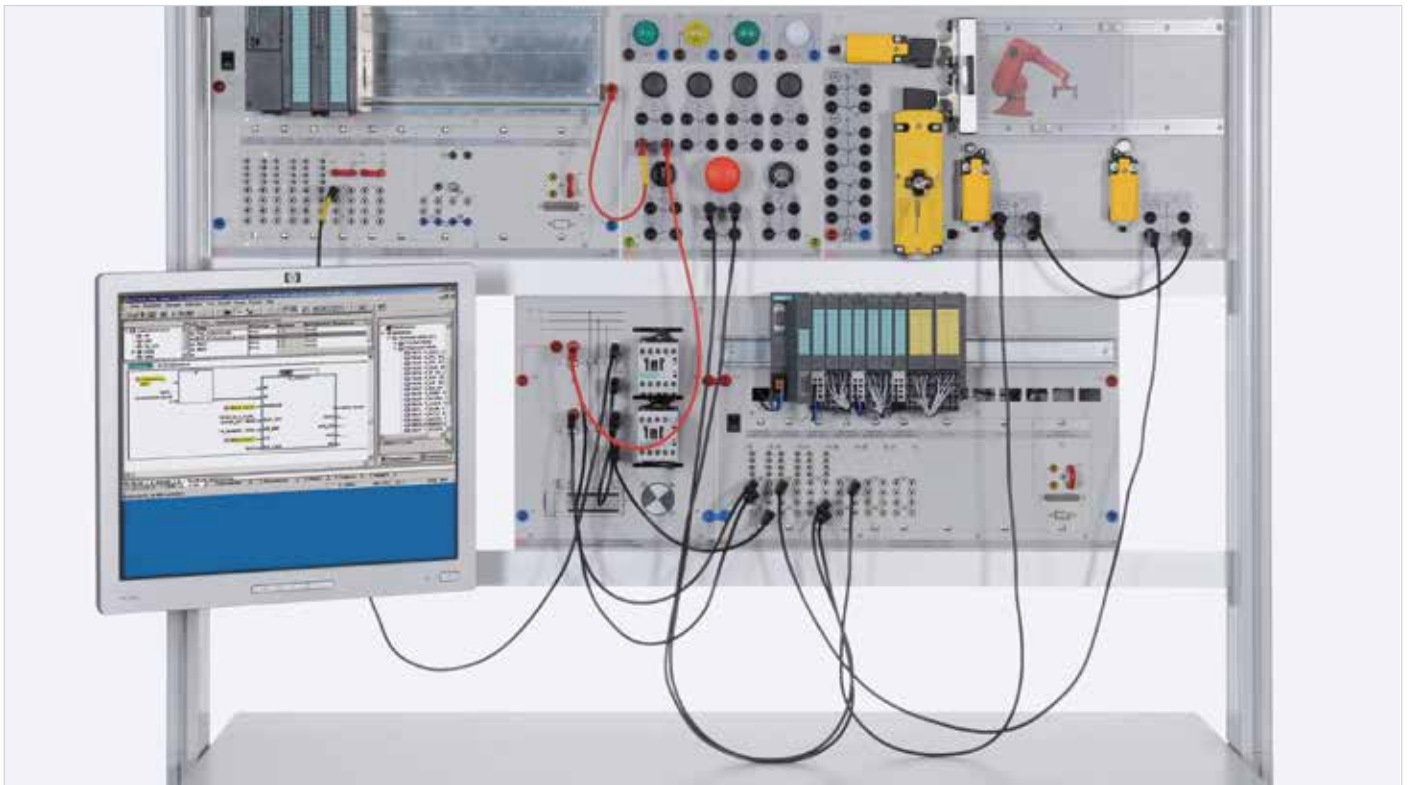
Training contents

- Safe AS-i sensors
- Putting safety application measures on an AS-Interface into operation
- Configuration of the AS-i Safety monitor
- Putting field bus systems into operation
- Combining normal and safe AS-i slaves

PROFIsafe

Networked Safety

Fail-safe signalling components monitor output and input signals. A CPU checks whether the control loop is operating properly by regularly initiating self-tests, instruction tests as well as logic- and time-dependent program operating checks. Furthermore, peripherals are also checked by polling them with a periodic watchdog signal.



Experiment example "PROFIsafe with 'safe' PLC CSY 3"

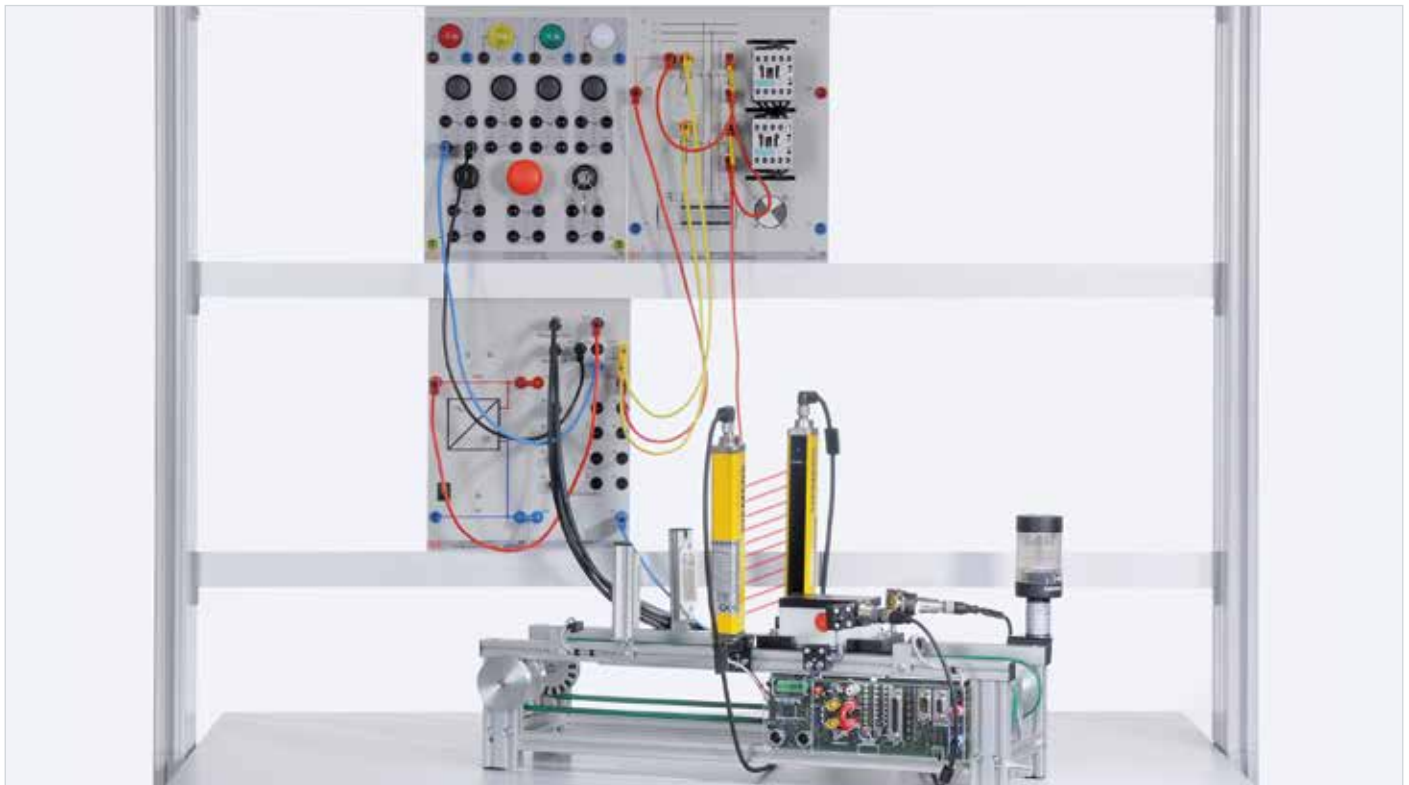
Training contents

- Operation of safety application measures on a PROFIBUS system (PROFIsafe)
- Programming with S7 Distributed Safety
- Deploying fail-safe function and data module

Optical Systems

All Systems Seen to Be Safe

Light curtains and light grids are used for non-contact safeguarding of hazardous areas. A light curtain or light grid consists of an emitter and a receiver. Infra-red LEDs on the emitter transmit a brief light pulse, which is captured by receiver diodes. The equipment set can be combined at will with all the other safety technology equipment sets.



Experiment example "Optical safety systems CSY 4/5"

Training contents

- Setting up a light curtain
- AS-i Safety
- PROFI-safe
- Muting (CSY 5)



System Models and Process Simulators

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PLC Universal Process System Simulator

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ProTrain Process Simulation

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PLC Touch Panel Models

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Electrical PLC Process System Models

System Models and Process Simulators

Ensuring Quality Early On – in the Planning Stage

Process simulation makes it possible to develop an optimum conceptual solution, which provides a competitive edge in terms of cost-efficiency, time and quality. This is how the planning stage is utilised to boost productivity and process reliability, put forward new visions and convert them into viable concepts.

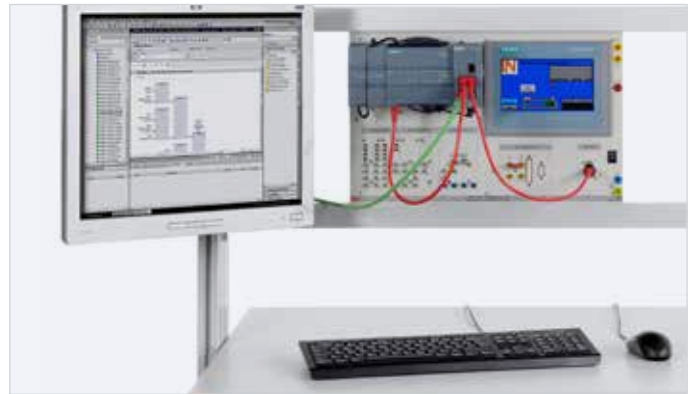
Example benefits of process simulation:

- Quality improvement
- Reduction in throughput times
- Optimisation of resource utilisation
- Acceleration of response potential
- Enhancement of flexibility
- Cost cutting
- Profit maximisation



Virtual production

Virtual imagery can practically reproduce real industrial applications. This makes it possible to simulate and analyse working procedures and processes without interrupting actual running production lines. The objective is to identify and exploit hidden potential in the production process.



Configurable production systems

The variety of different process models and simulations permits hands-on experiments and learning to be targeted towards practice-oriented training. Unlimited possibilities can be opened up by creating your own production processes.



Training systems

The following training systems are the foundation for conveying the basics as well as advanced knowledge of PLC programming:

- The UniTrain multimedia range "Automation engineering" is the ideal choice for starting initial programming exercises
- The PCB models offer cost-effective PLC system models for digital signal processing
- The system simulator provides you with the possibility of implementing any of 24 different processes in your syllabus
- The process model ProTrain features graphic depiction of complex processes
- The electrical system models are highly authentic hands-on system models



PLC Universal Process System Simulator

Set Up, Switch On and Practice

The PLC universal process system simulator has been designed especially for basic training in PLC technology. It is extremely well suited to graphic depiction and hands-on exploration of open-loop and closed-loop processes as found in industrial applications. By adding overlay masks, up to 24 different technical processes and models can be simulated. The projects are designed to precisely reflect official syllabuses.



Experiment example „PLC universal system simulator CLC 34“

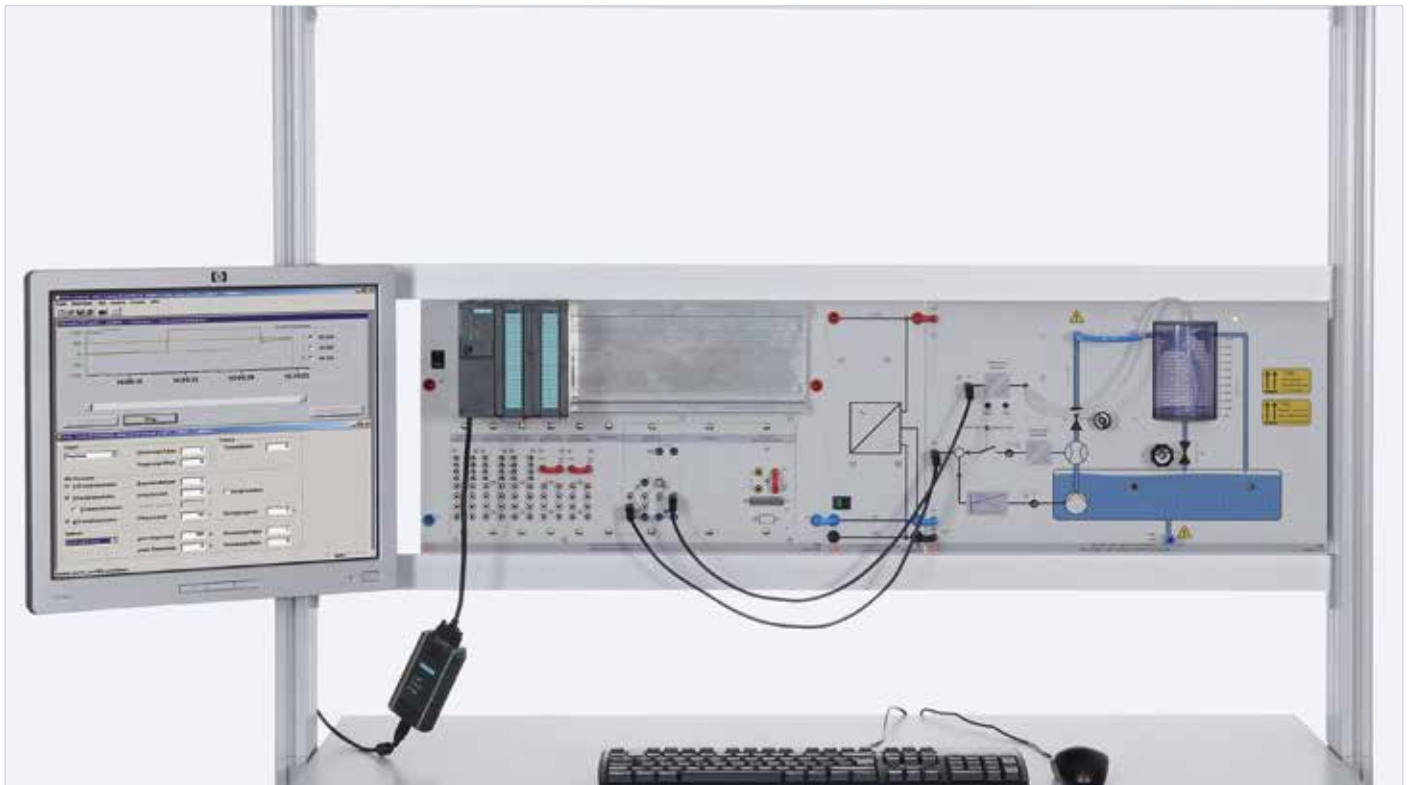
Projects

- Roadworks traffic lights
- Star-delta starting
- Dahlander circuit
- Starter control
- Monitoring facility
- Container filling system
- Sluice gate control
- Transfer platform
- Buffer storage
- Filling controlled system
- Mixing plant
- Compressed air network
- Cleaning tank
- Oven door control
- Bending tool
- Automatic stamping press
- Drilling device
- Selective band dividing filter
- Pipe bending system
- Door control
- Pump control 1
- Pump control 2
- Reaction vessel
- Pill filling machine

Automatic Control Technology in Automation Engineering

One Model – Two Functions: Automatic Liquid-Level and Flow-Rate Control

Due to the fact that the controlled variable, that is to say the level of liquid, is immediately visible, this experiment is a particularly graphic one and thus eminently suitable for an introduction to automatic control technology. The compact training unit contains a liquid reservoir and a pressure transducer to determine the actual liquid level, as well as reserve tanks including a pump. Disturbance variables can be simulated using adjustable throttle valves which modify the inlet and outlet flows at the reservoir.



Experiment example "Liquid-level controlled system CLC 36"

Training contents

Automatic liquid-level control

- Assembly, calibration and optimisation of a liquid-level control loop with variable system characteristics
- Two-position controller in an integration system and a controlled system with higher order delay
- Two-position controller with delayed feedback in a liquid-level control loop
- Two-position controller with float switch
- Automatic liquid-level control with disturbance variable forward feed and pre-control
- Second-order time delay controlled system with optional supplementary tank

Automatic flow-rate control

- Assembly, calibration and optimisation of a flow-rate control loop connected to a liquid level controlled system
- Principle, response and deployment of flow-rate measurement
- Investigation of closed-loop flow-rate control response to disturbance variables and set-point step changes

PLC Touch Panel Models

8 Models Introducing TIA Portal

The touch panel models are conceived in such a way that all the fundamental functions used in PLC programming are included. A self-learning course guides students through programming of data blocks, status and sequence programming and on to design of closed-loop controllers. The models are displayed in the form of an animation on the touch panel and controlled via the digital I/O of the connected PLC system. As with real models, programmers can view signals from sensors which are needed for further processing in the sequence.



Projects

- Transporter crane
- Roadworks traffic lights
- Container filling plant
- Conveyor belt
- 3-Storey lift
- Star-delta starter
- Double 7-segment display
- Room temperature control

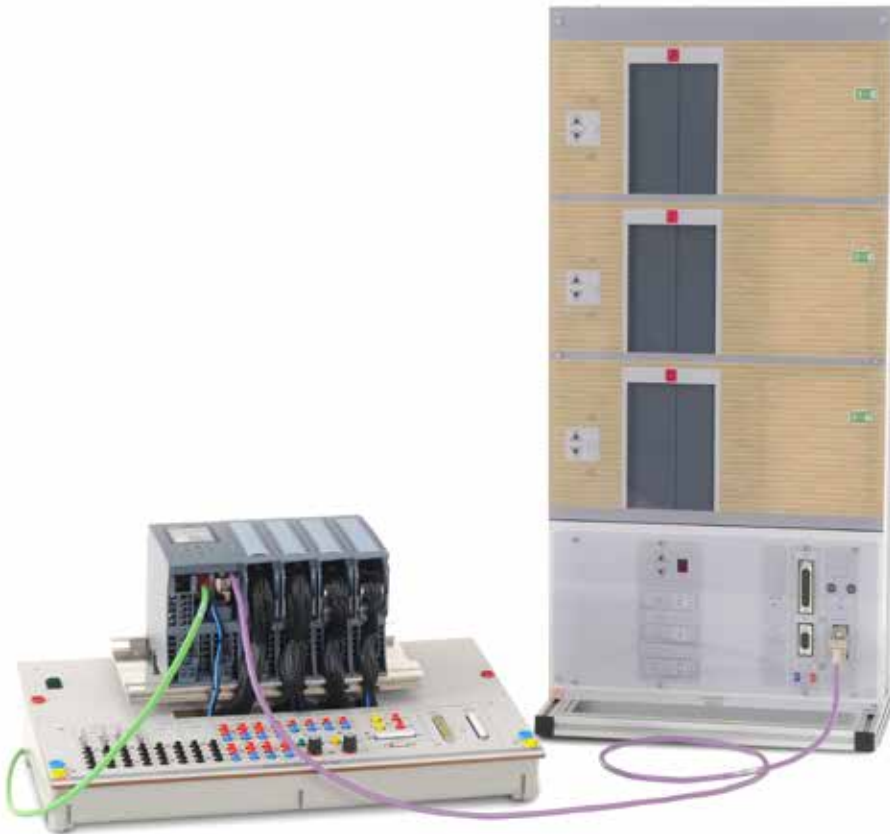
Your benefits

- Compact system (PLC, touch panel and models in one piece of apparatus)
- Programming via TIA Portal
- Programming and monitoring on screen. Alternative software solutions require separate screens
- Introduction to programming using TIA Portal standards and animated models

Electrical PLC Process System Models

Direct Connection to the Control System

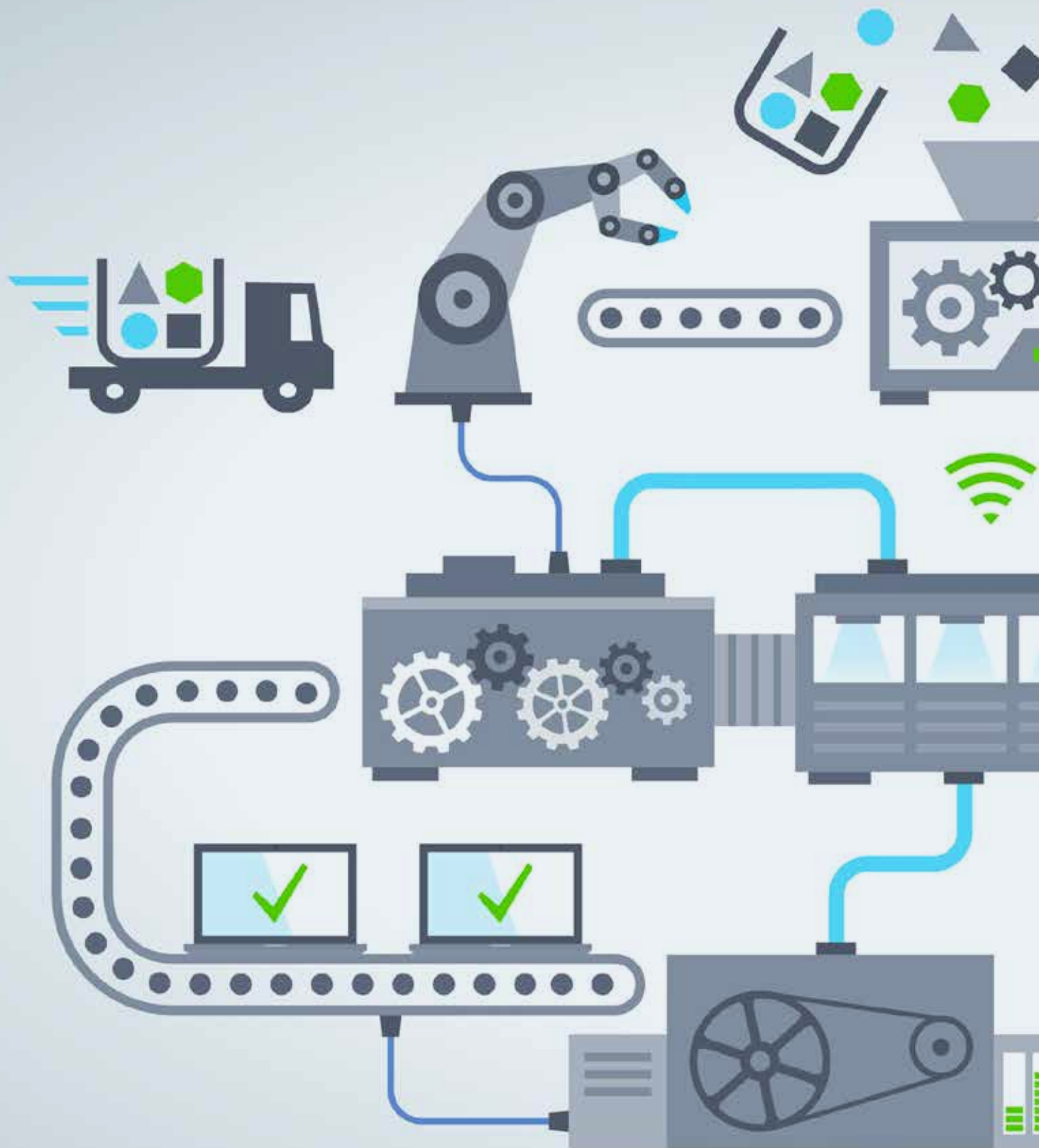
With these compact training systems, subjects such as handling as well as transport and positioning processes can be explored. These constitute real life industrial conditions. Consequently they are ideally suited for learning process-oriented control programs and complex movement sequences and production processes.



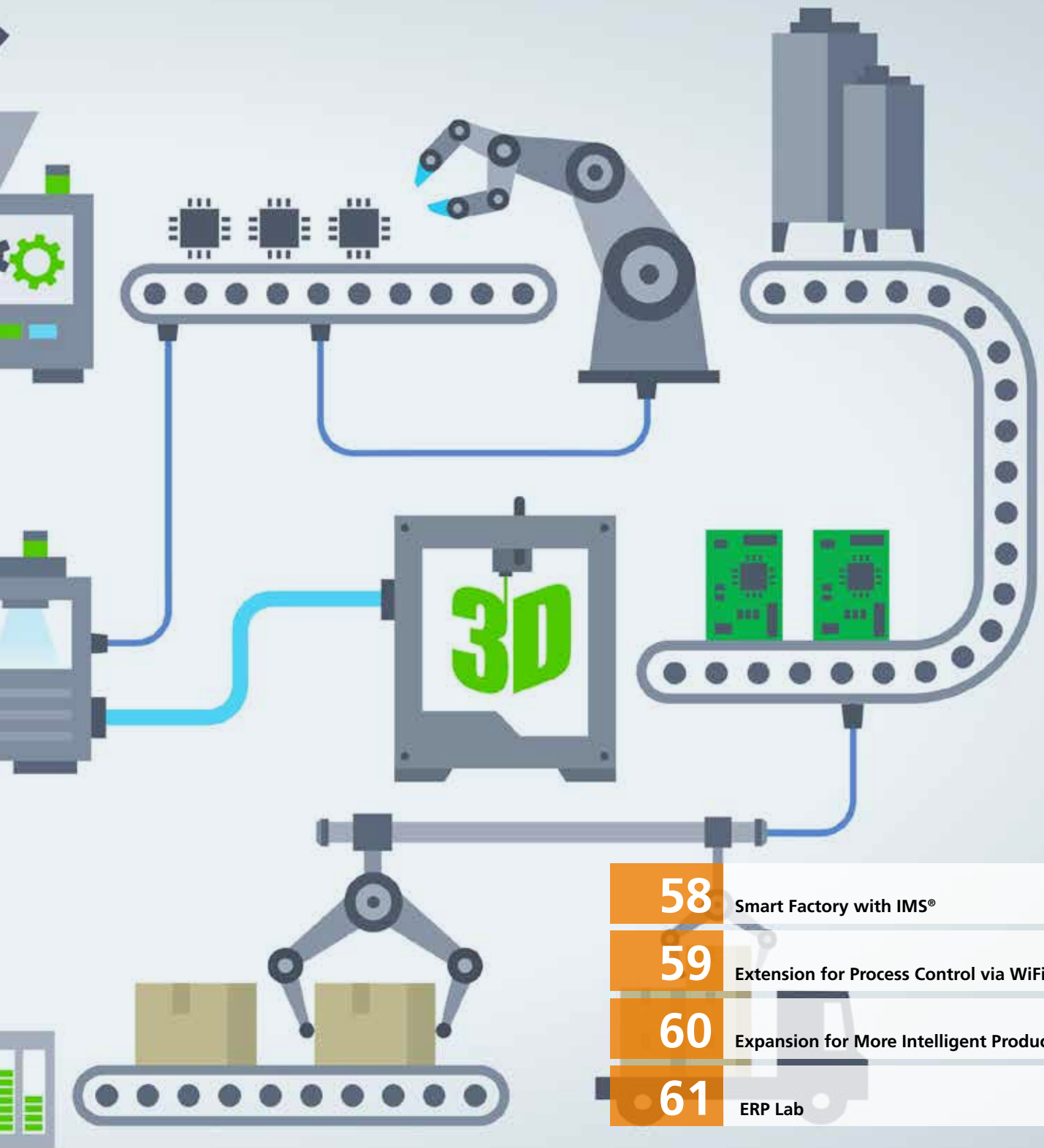
Experiment example "PLC lift system model CLC 40"

Training contents

- Setting parameters, programming and operation of process controls
- Set-up and operation of hardware models, testing and fault finding
- Analysis of process sequences
- Programming in accordance with IEC 1131-1 (IL, LD, FBD)
- PLC sequence control systems
- Programming limit switches
- Manual operation, single-step and automatic operation



Smart Factories



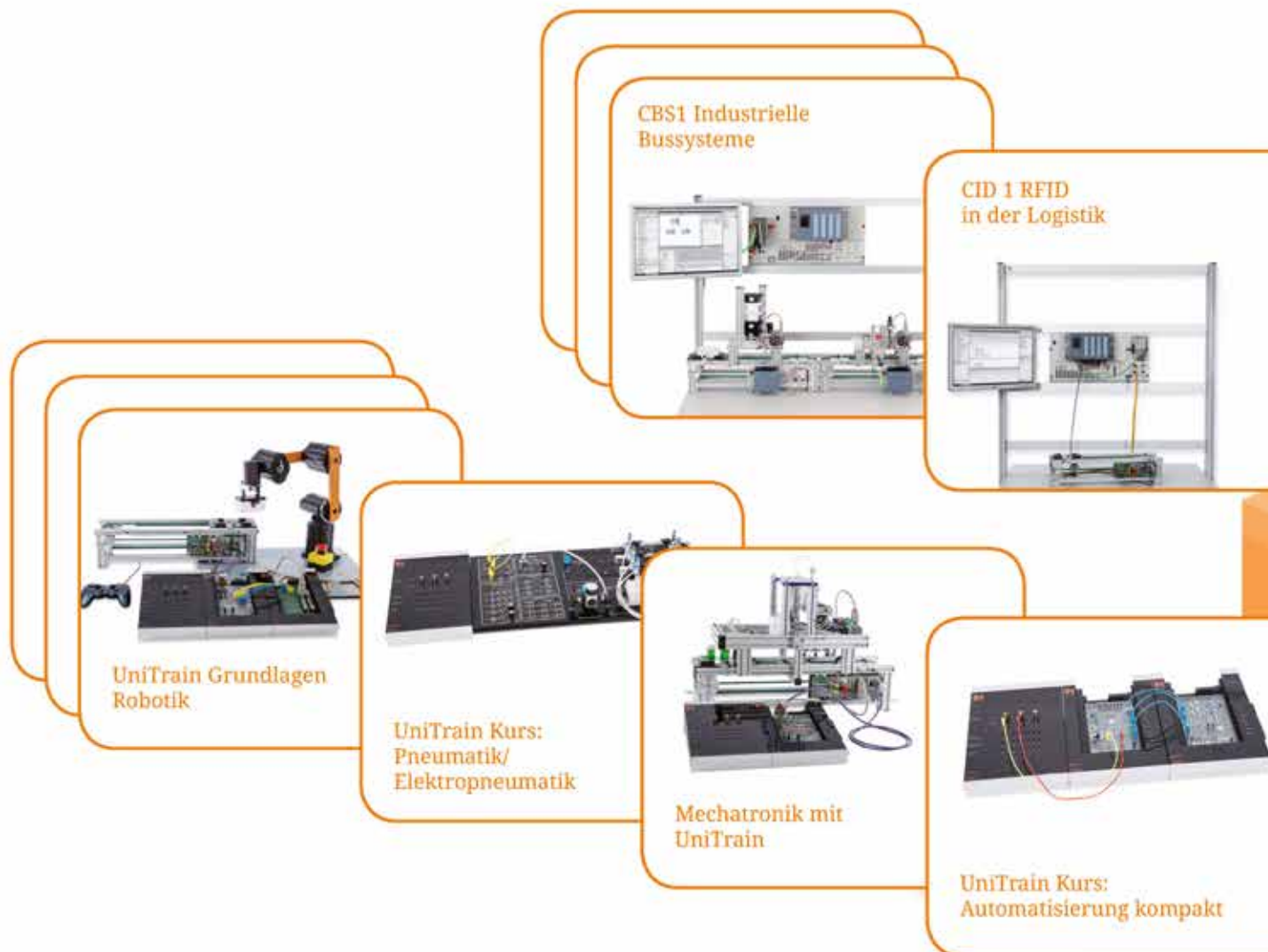
Smart Factories

Smart Factories are the Future of Digitalisation in Industry

So-called smart factories not only excel on account of their flexibility and efficient use of resources. Above all, their development means flexible production, system integration and networking and the capacity to utilise the cloud for accessing and communicating all information (cyber-physical systems, CPS for short). The main component is an ERP (enterprise resource planning) system which operates in the cloud.

Basic expertise for smart factories

For modern production to function successfully you need to do more than just have all of the installation's components interacting perfectly. In order to get this kind of operation off the ground and operating smoothly, you need extremely well-trained professionals who have also mastered the basics.



CSF Industrie 4.0:
flexibel nach
Kundenwunsch



3.

IMS-Virtual:
Virtuelle Inbetriebnahme
der Produktion



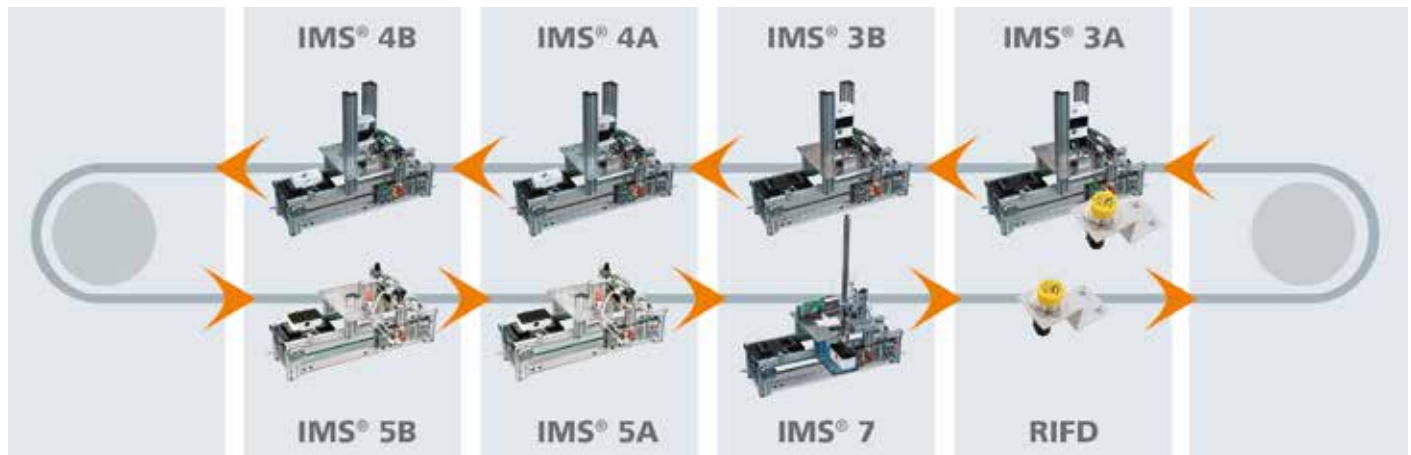
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1.

Smart Factory Basic Equipment Sets

Smart Factory with IMS®

A production line for a smart factory can be deployed for fully automatic manufacture of a workpiece comprised of three sections making a total of up to eight different variants. Using a touch panel, the desired composition of the workpiece is visually selected and stored on an RFID tag affixed to the workpiece carrier until released for production. Thanks to the total network integration of the stations via PROFIBUS or PROFINET, it is possible to have continuous operational monitoring and diagnostics.



Your benefits

- Transport system:
Double conveyor belt system with DC drive motors and variable-speed three-phase drive motor.
- Identification system:
An RFID Identification system is used to communicate the workpiece composition to the processing stations
- Command control level:
Creating manufacturing orders at a central control PC, process visualization and operational data acquisition
- Connection of process control centre to TCP/IP
- Networking via PROFIBUS or PROFINET

Extension for Process Control via WiFi

Process control and monitoring of your IMS system or also individual stations via any given WiFi-capable device, i.e. a tablet computer, smartphone or notebook computer. All you need is a browser to be able to access and call up the web interface of the PLC. There is no need for any software installation or downloading any apps.



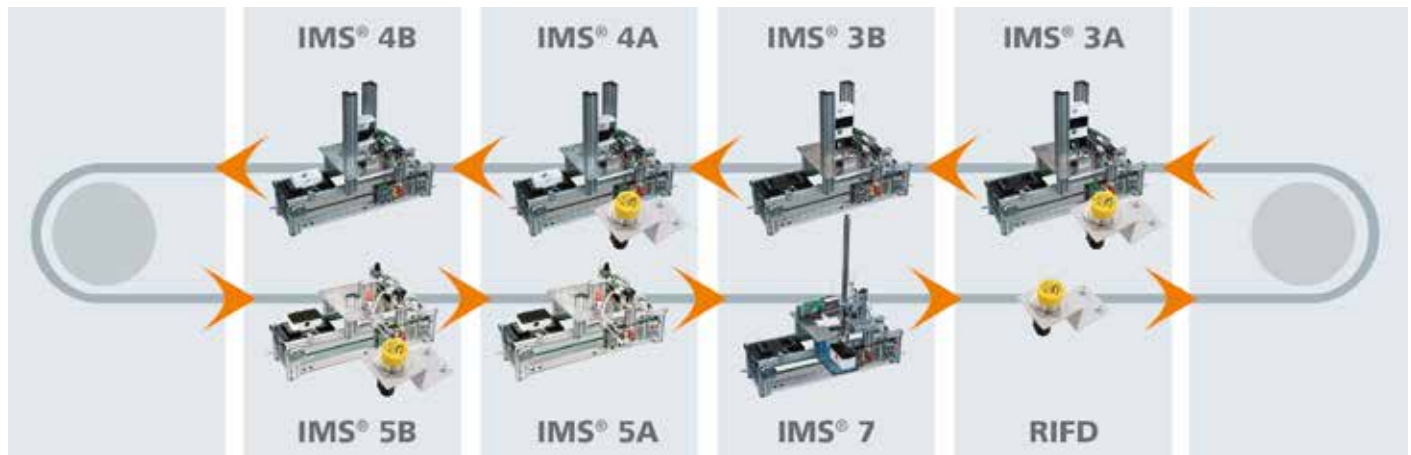
Your benefits

- Graphic depiction of the entire production line installation and the individual stations
- Process control and monitoring via WiFi-capable device with installed browser
- Control and monitoring performed via display
- Signal states are displayed directly via the WiFi-capable device
- WiFi device is used to set signals and thus operate production line actuators
- Individual station functions can be inspected in maintenance mode

Smart Factory Basic Equipment Sets

Expansion for More Intelligent Production

Expand your smart factory basic production plant CSF 1 by adding more RFID components. This makes it possible to continuously monitor the current production state. An expansion pack contains two additional write/read devices. This permits each processing step to be polled prior to each module type and the writing of the current status after each module.

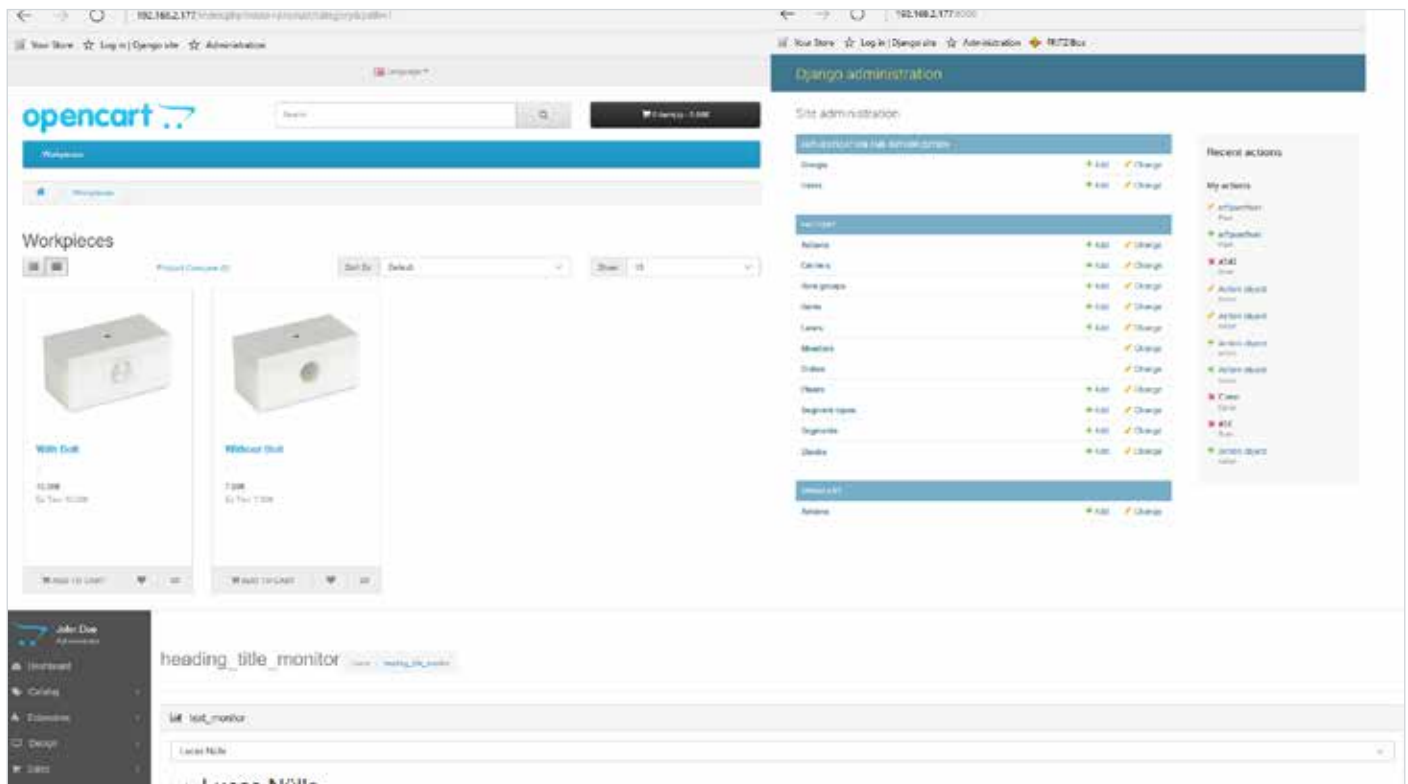


Following benefits are obtained with this expansion

- Expanded product selection: twelve different products are available for selection
- Adaptation and adjustment of visualisation
- Creation of an order list: up to eight products can be accommodated in the order list
- Permitting intelligent processing of orders
- Compilation of statistics
 - Product variation
 - Fault counts
 - Station work cycles

ERP Lab

ERP Lab is an educationally designed ERP system (ERP - enterprise resource planning). The software performs such business tasks as planning and control of resources, equipment, material including information and communications technology. A core function of the ERP lab is material requirement planning. Nowadays this task can only be performed adequately with the aid of IT systems and on the basis of modern IT and communications technology.



Your benefits

- Smart factory
- ERP Lab
- Configuration
- Project of integrating conveyor belt system with ERP Lab
- Project of configuring a production line
- Development of ERP Lab
- Integrated web shop
- Live visual monitoring of production process



Industrial Mechatronic System IMS®

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A Full-Scale Production Line “Industrial Mechatronics System” IMS®

From Individual Mechatronics Sub-Systems All the Way to Flexible FMS Production Lines

More complex training needs

Radical changes in the way people work have revolutionised the requirements and needs of how information and skills are taught and trained. As changes occur in company and factory processes, more and more importance is being assigned to such aspects as “operational competence” and “design of individual work processes” in day-to-day practice.

Integrating thought and action

Nowadays people being trained as automation engineers receive a broad “skills set” and qualifications in the most varied of technical disciplines. Performance objectives cover training in the assembly and mounting of system components and machinery, as well as in such practical applications as installation, operation and even maintenance of production lines, for which an understanding of the entire system is a prerequisite.

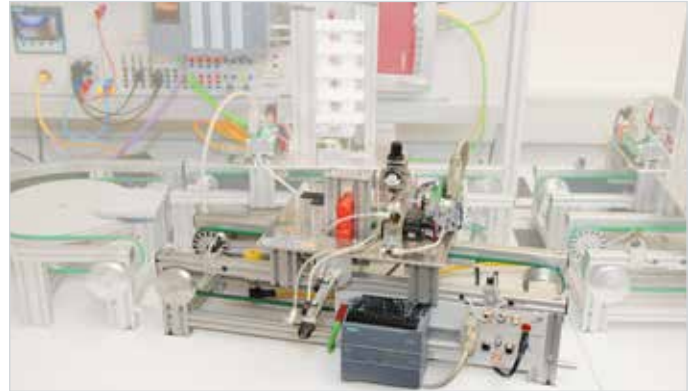
Changing educational approaches

These factors emphasise the need for a mechatronics training system to be the heart of a broad-based automation program to ensure to that theoretical technical knowledge is successfully cemented by means of realistically practical learning situations. The opportunity for students to learn using complex mechatronics training systems makes it easy for them to step up to industrial practice.



Modular design

IMS® is modularly designed so that functional systems of the most wide-ranging sizes can be designed. All of the sub-systems can be deployed individually or in any combination. For workpiece transport between individual sub-systems, a double conveyor belt system is used on which workpiece carriers travel.



Reflection of reality

With this training system, the industrial processes of a complex continuous production line are realistically simulated. The system exclusively employs industrial-type actuators and sensors. Furthermore, only industrial-type PLC systems with PROFIBUS and decentralised peripherals are used for process control.



Developing skills and expertise

The system promotes the training of skills and expertise during actual teamwork and enables the students and trainees to acquire the basics needed for the mastery of mechatronics systems in self-learning sessions. Each sub-system has been specially designed so that skills and knowledge are acquired gradually step-by-step right up to the point where a complete and sophisticated automatic production system has been created.



Education towards Industrial Standards

Simple Process Control

To control the individual work steps on a production line in order to put the entire system into operation is a process of some complexity. Therefore, achieving rapid set-up and installation is an important objective in training. By employing self-paced study using the UniTrain system and the Siemens SIMATIC S7-300 PLC, your students are optimally prepared for the task at hand. UniTrain offers a simple, didactically structured introduction to the control of each sub-system and is the preparation for integration and process control of production lines with industrial standard equipment using the Siemens SIMATIC S7-300 PLC.

- **UniTrain**
(Course work + experimenting + process control)

The individual sub-systems are controlled using UniTrain. This includes a fully integrated, fully fledged PLC with a PROFIBUS master. Your student will run his first PLC program within 10 minutes.

The multimedia courses convey the fundamentals of operation, design, definition and programming of process sequences for each of the sub-systems. Theory is reinforced with practical, hands-on experimenting.

- **Siemens SIMATIC S7-300**
(Process control with industrial standard equipment)

An entire production line comprising individual sub-systems can be controlled using, for example, the SIMATIC S7-300 from Siemens. This level of process control precisely reflects the realities found in industry.

Your benefits

- **UniTrain**
 - Multimedia-based self-study course
 - Including control system with PROFIBUS
 - Fast progress due to extremely rapid set-up
 - Integrated development platform
- **Siemens SIMATIC S7-300**
 - Process control of the entire production line with industrial standard equipment
 - Communication via PROFIBUS, PROFINET, PROFI-safe and AS-i
 - Industrial PLC
 - Use of STEP 7 as well as decentralised peripherals
 - Touch panel operation



Rapid Set-Up and Installation Guaranteed

Perfect Understructure

In order to put the "Industrial Mechatronic System" IMS® to optimal use, there is a mobile substructure available that was designed especially for this system.

More detailed information is available in the Laboratory systems and equipment catalogue.



UniTrain self-study system

- Small groups of students each set up and learn to operate a sub-system with the UniTrain control system
- Thanks to extremely fast set-up times, the students can be implementing their **first PLC program within 10 minutes**
- By the use of the accompanying multimedia-based self-study course, the instructor has **more time to provide individual instruction** to students and groups



Siemens SIMATIC S7-300 PLC control system

- A complete class of students can set up and operate a full-length IMS® production line with the S7 PLC control system
- Consequently the students are able to learn hands-on how to perform **process control** of production lines **with industrial standard equipment**

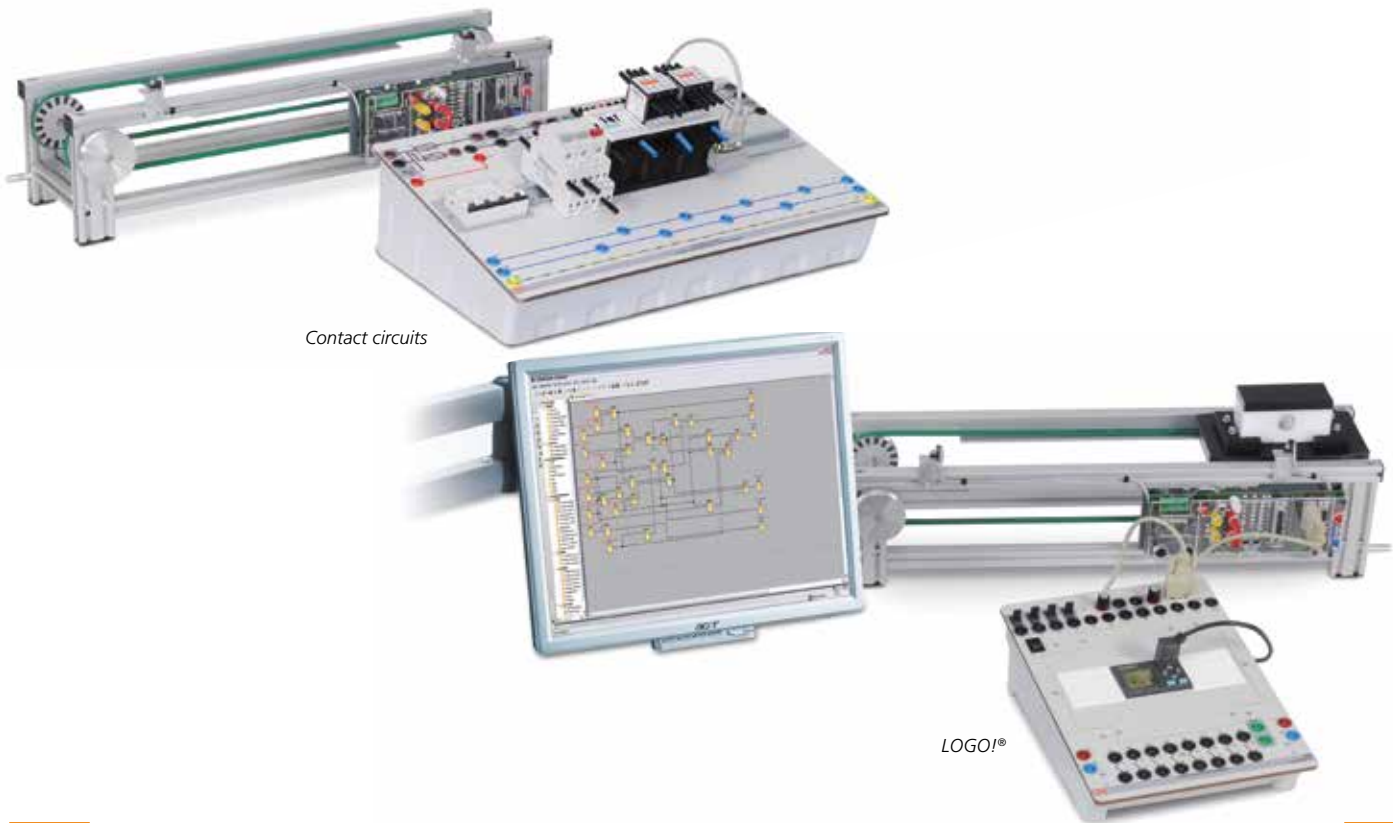


IMS® – Open to all Control Systems

Control via Contactor Circuits and LOGO!®

An introduction to IMS® can also be made via conventional electrical engineering. Hard-wired control techniques with the help of contactor circuits are eminently suitable for small projects using the IMS® conveyor belt. Projects employing LOGO!® also fit in splendidly and expand the range of possible control systems.

Our consultants are happy to provide the necessary information to help you.



Your benefits

• Contactor circuits

- Conventional, hard-wired control techniques
- Introduction to simple tasks
- Expandable to handle complex control needs
- Preparation and reimplementation of control projects to use programmed control techniques

• LOGO!®

- First steps in programmed control techniques
- Combination and enhancement of existing control projects
- Use of LOGO!® Soft Comfort
- Includes multimedia self-learning course

Easy Access to each Sub-System

Hands-On Training Guaranteed

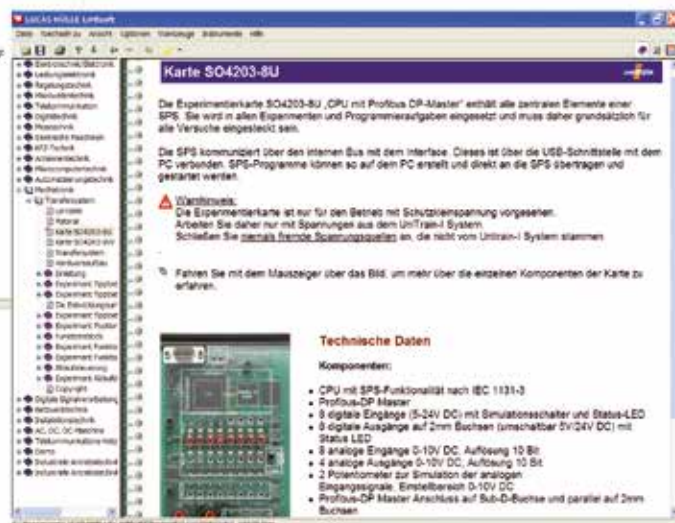
The UniTrain multimedia experiment and training system uses informative text, graphics and animations in a clearly structured course software to guide students through the experiments. In addition to the training software, each course comes with an experiment card including a control unit on which the practical exercises can be performed.

Your benefits

- Educationally designed implementation and operation of all conveyor belts and sub-systems
- Integration of both cognitive and "hands-on" training material
- Strong linkage between theory and practice
- Rapid learning advances thanks to structured course design
- Extremely rapid set-up and assembly
- Courses structured into:
 - Training objectives/content
 - Hardware description
 - Software description
 - Basic knowledge
 - Experiments
 - Fault simulation and competency testing



Systematic arrangement of training objectives



Sub-Systems at a Glance

Practical Hands-On Training Guaranteed

Modularity

Thanks to the modularity of the system it is possible to implement a large number of combinations and project variants . You can match the system design and complexity to your individual needs.

Adjustments in a matter of minutes

Going from instruction with a whole complex system to just single stations. Switching from one training situation to the other can be done in a matter of minutes without screwing and unscrewing of components or complicated shifting of tables and benches. The entire system can be assembled and disassembled easily thanks to the robust construction of the stations.

Industrial and authentic to modern practice

Virtually every component is a genuine industrial one. For that reason student s can easily transition to the real world of work.



Processing Stations



Transport (conveyor belt)



Processing



Routing



Intelligent transport system



Testing



Buffering



Sorting



Handling



Disassembly



Assembly



Storage



Drilling and milling

IMS® Conveyor Belt Systems and Sub-Systems



IMS® conveyor belt systems

The conveyor belt system is the element that connects all of the sub-systems and thus forms the backbone of the entire production line.

Your benefits

- In the IMS® production line the conveyor belt systems are self-contained modules, which can be integrated with the sub-systems as needed
- Each conveyor belt module is supplied with its own UniTrain course
- Basic processes like "positioning" and "speed" can be demonstrated with just this simple system



IMS® sub-systems

Every step of a manufacturing process can be emulated by the "Industrial Mechatronics System" IMS® and its sub-systems.

Your benefits

Lessons can be designed to suit your needs

- Practice on a specific sub-system or
- Practice on a set of individually selected sub-systems:
 - Subject matter can be adapted to varying degrees of trainees' existing knowledge
 - Particular sub-systems can be extended into custom assembled production lines
 - Each sub-system already possesses the control units, development environment and relevant multimedia training courses for self-paced study by students



IMS® 1.1 - Conveyor belt, unpowered

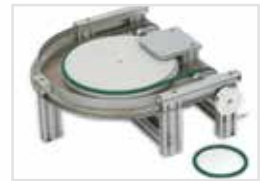
(For extensions to IMS® 1.2 and IMS® 1.3)

IMS® 1.2 - Conveyor belt, DC

(24 volt DC motor with variable speeds)

IMS® 1.3 - Conveyor belt, AC

(Three-phase frequency-controlled motor with frequency converter permits continuously variable speed)



IMS 180° curve



IMS 90° curve

Training contents

- Generating controlled movements along an axis
- Incremental positioning of a workpiece carrier
- Interlocking of forward motion and reverse motion
- Programming slip and standstill monitoring
- Working with different safety and interlocking circuits
- Understanding how sensors function and operate
- Connecting and using a PROFIBUS DP field bus system

IMS® 1.4 - Intelligent transport system**Situation**

A Siemens PLC systems on the front end is freely programmable and is responsible for controlling the module. The processing stations attached to the conveyor belt can be controlled via PLC using the 25-pin D-Sub connector. The conveyor belt and its control unit form a single compact unit. Without any major reconfiguring measures or modification to the wiring the system can be disconnected from the overall production process and operated as a single operating station. Thus any difficult retrofitting or disassembly is done away with.

**Training contents**

- Conveyor belt control with variable speed via PWM signal from PLC
- Incremental encoder disc for the purpose of position detection and speed measurement via optical sensor
- Measurement of energy consumption for the sake of energy management
- Top-hat rail for enhancing the PLC by adding analog or digital IO modules
- Expansion of PLC by adding a PROFIBUS master module or IO-link master module

IMS® Sub-Systems

IMS® 2 - Industrial sensors

Situation

Placed on the conveyor belt is a workpiece carrier with a machined workpiece.

- ▶ The conveyor belt transports the workpiece to the test station,
- ▶ Where various sensors and attachments are used to determine the workpiece's colour and material.
- ▶ Select the sensor most suited for the required application.
- ▶ The IMS sensor case is meant for experiments with industrial sensors in the IMS-System.



Training contents

- Assembly, setting and testing of various proximity switches
- Examining the sensors' operating principles using various experimental setups
- Assembly and functionality of the following sensors:
 - Inductive proximity switch
 - Capacitive proximity switch
 - Reflection light sensor
 - Reflection light barrier



IMS® 3 - Sorting

Example

A workpiece carrier is located on the conveyor belt

- ▶ The carrier is positioned under the shaft for the gravity-feed magazine
- ▶ The sorting station has a magazine that accommodates six top or bottom pieces
- ▶ The sorting station has a stack magazine for six workpiece substructures
- ▶ One piece is selected and placed in the carrier
- ▶ The carrier and its load are then conveyed to the end of the belt to be passed on to the next sub-system



Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Introduction to subsystems for workpiece substructures
- Defining processes for sorting
- Programming of production sequences in manual and automatic modes

IMS® 4 - Assembly

Example

A workpiece carrier is located on the conveyor belt with a substructure

- ▶ The carrier is positioned under the shaft for the gravity-feed magazine
- ▶ The sorting station has a stack magazine for six workpiece superstructures
- ▶ One piece is selected and placed in the carrier mounted on the substructure
- ▶ The carrier and its load are then conveyed to the end of the belt to be passed on to the next sub-system



Training contents

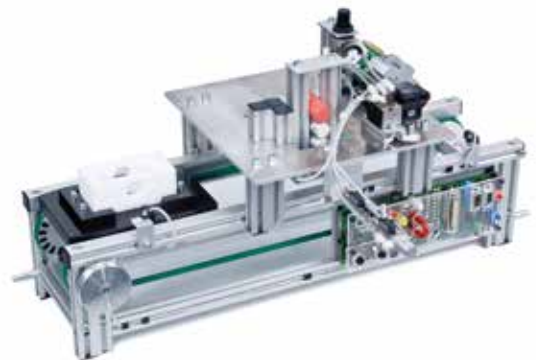
- Assembly, set-up and testing of pneumatic cylinders and valves
- Introduction to subsystems for workpiece superstructures
- Defining processes for assembly
- Programming of production sequences in manual and automatic modes

IMS® 5 - Processing

Example

A workpiece carrier is located on the conveyor belt. It is loaded with a fully assembled two-component workpiece (top and bottom pieces)

- ▶ The carrier and its load are positioned beneath the process module
- ▶ The workpiece is clamped for processing
- ▶ A bolt from the gravity-feed magazine is pressed into the hole in the workpiece
- ▶ The clamp opens and the carrier and load are conveyed to the end of the belt to be passed on to the next sub-system



Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Identification of workpieces
- Monitoring of a process sequence
- Definition of a process sequence for simple processing
- Programming of production sequence in manual and automatic modes

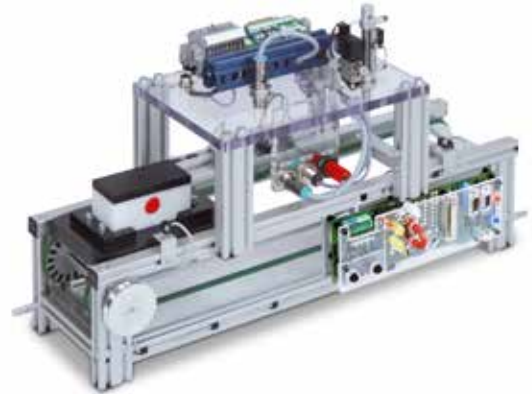
IMS® Sub-Systems

IMS® 6 - Testing

Example

A carrier with a fully assembled workpiece is located on the conveyor belt

- ▶ A stopper positions the piece alongside the sensors
- ▶ The sensors detect the colour of the piece, its material and optionally its height
- ▶ Test data will be saved for subsequent processes
- ▶ After each successfully completed test the carrier is conveyed to the end of the belt to be passed on to the next sub-system



Training contents

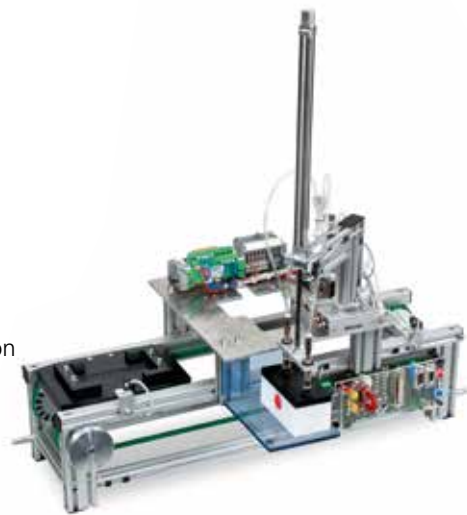
- Assembly, set-up and testing of pneumatic cylinders and valves
- Optical, inductive, capacitive and magnetic test sensors
- Definition of process sequence for simple testing
- Programming of testing sequence in manual and automatic modes

IMS® 7 - Handling

Example

A carrier with a fully assembled and tested workpiece is located on the conveyor belt

- ▶ A handling station is located above the middle of the conveyor belt
- ▶ The carrier is stopped at the removal position
- ▶ The handling module lifts up the workpiece and transfers it to a different position
- ▶ The empty carrier is conveyed to the end of the belt to be passed on to the next sub-system



Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Vacuum generator, suction mechanism with sensors
- Definition of process sequence for simple workpiece sorting
- Set-up and control of a pneumatic linear unit
- Programming of sorting sequence in manual and automatic modes

IMS® 8 - Storage

Example

A carrier with a fully assembled and tested workpiece is located on the conveyor belt

- ▶ The carrier is stopped at the removal position
- ▶ The handling module lifts up the workpiece and transfers it to one of twenty possible storage positions
- ▶ The storage positions can be chosen according to the production task and test results
- ▶ The empty carrier is conveyed to the end of the belt to be passed on to the next sub-system



Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Definition of process sequence for automated storage and retrieval systems
- Detection of storage coordinate by means of incremental sensors
- Programming of a process chain
- Programming of complete warehousing process in manual and automatic modes

IMS® 9 - Routing

Example

A workpiece carrier is located on the conveyor belt

- ▶ The routing unit receives the carrier and transfers it to a revolving transport unit
- ▶ The revolving unit can determine the further routing of the carrier
- ▶ The carrier can be picked up and passed on in any one of three positions



Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Introduction to a conveyor routing unit
- Definition of process sequence
- Programming of production sequence in manual and automatic modes

IMS® Sub-Systems

IMS® 10 - Buffering

Example

The conveyor belt is equipped with two lifting units for buffering or queuing workpieces in complex mechatronics systems

- ▶ The buffer controls the flow of materials
- ▶ The carrier is lifted from the conveyor belt by a lifting unit and deposited in a magazine, while the belt continues moving with other pieces
- ▶ Up to four laden or 10 unladen workpiece carriers can be held in store
- ▶ The lifting unit can set the workpiece back onto the conveyor when necessary



Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Introduction to a buffering unit
- Definition of process sequence
- Programming of production sequence in manual and automatic modes

IMS® 13 - Drilling and milling

Situation

There is a workpiece carrier on the conveyor belt with a workpiece bottom section.

- ▶ The drilling and milling station is equipped with a controllable milling head which glides along the interior contour of the bottom section of the workpiece.
- ▶ The milling head can move in three different axes to process the workpiece.
- ▶ The loaded workpiece carrier proceeds to the end of the conveyor belt where it moves onto for processing by the next sub-system.



Training contents

- Mounting, adjusting and testing of pneumatic cylinders and valves
- Defining the process sequence for drilling and milling
- Programming the production process for drilling and milling
- Commissioning and control of the milling unit

Miscellaneous IMS® Units

IMS® Transfer nodes

Up to four conveyor belts can be plugged into the IMS® transfer nodes featuring 90° curves. This allows materials to flow in a variety of directions.



IMS® Lifting platform

A lifting platform is integrated into a conveyor belt system. With this platform a work-piece carrier can be lifted, thus permitting the conveyor belt to continue to operate without having the workpiece carrier moved away.



Sensors for IMS®

Expand your IMS system by adding more sensors to permit even more options.

Reed contact

Used to detect the magnetic field of the positioning magnet on the workpiece carrier. Detects the precise position under a processing station.



Incremental sensor

Detects markings of the incremental encoder discs on the conveyor belt. This permits precise positioning.



Capacitive sensor

Detects whether or not a workpiece is located on the carrier. Acts as an additional production monitoring mechanism to ensure that the stations are operating properly.



From IMS® Sub-Systems to IMS® Production Lines

Advanced Teaching Structure

By assembling a variety of sub-systems, the "Industrial Mechatronics System" IMS® can integrate individual process steps to form a complete production line. This allows a realistic demonstration of interdependent production processes.

IMS® 23 - Production line with 3 sub-systems

IMS® 3 - Sorting, IMS® 6 - Testing, IMS® 7 - Handling

IMS® 3 - Sorting

An empty carrier is conveyed into the station and positioned under a gravity-feed magazine where a bottom section for a workpiece is selected and loaded onto the carrier.

IMS® 6 - Testing

A carrier with a separate bottom component is conveyed into the testing station. Sensors are used to detect the material of the workpiece and store the information for subsequent processes.

IMS® 7 - Handling

After testing, the workpiece is transported to a removal station. The component is then placed in one of two locations according to the results of the testing.



Your benefits

- Mix and match sub-systems to assemble custom production lines based on your design, available budget, and space
- One production line can be skilfully used to teach fundamentals and advanced applications
- Modular design allows future expansion
- Add conveyor belt system to create a continuous, self-repeating production process

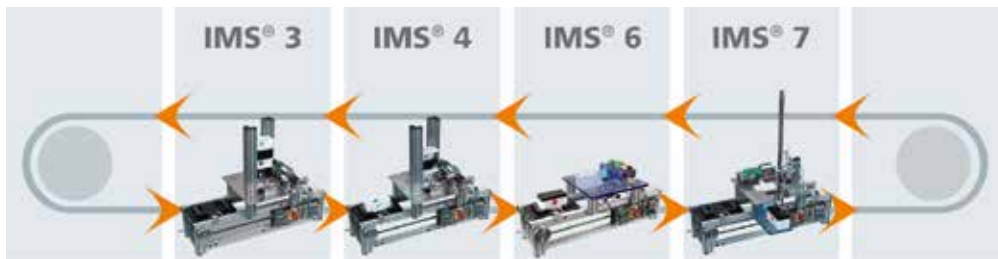
IMS® 24 - Production line with 4 sub-systems

IMS® 3 - Sorting, IMS® 4 - Assembly, IMS® 6 - Testing, IMS® 7 - Handling

As per IMS® 23, plus:

IMS® 4 - Assembly

A carrier loaded with a bottom piece arrives at the station and is positioned under the magazine. A top component is selected from the magazine and assembled on top of the bottom section.



IMS® 25 - Production line with 5 sub-systems

IMS® 3 - Sorting, IMS® 4 - Assembly, IMS® 5 - Processing, IMS® 6 - Testing, IMS® 8 - Storage

As per IMS® 24, with IMS® 7 omitted but including:

IMS® 5 - Processing

A fully assembled two-component workpiece loaded on a carrier is conveyed on a belt into the station. It is positioned in the processing module and clamped into place. A bolt is selected from the magazine and pressed into the hole in the workpiece.

IMS® 8 - Storage

The return system features a storage and retrieval system with twenty storage cells. Workpieces can be stored on the rack according to the production job and test results. Empty carriers are then returned to the start of the production line.



From IMS® Sub-Systems to IMS® Production Lines

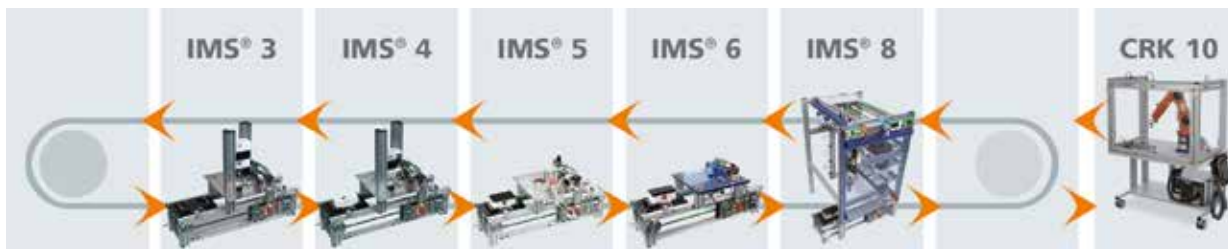
IMS® 26 - Production line with 6 sub-systems

IMS® 3 - Sorting, IMS® 4 - Assembly, IMS® 5 - Processing, IMS® 6 - Testing, IMS® 8 - CRK10 with disassembly project equipment

As per IMS® 25, plus:

CRK10 with disassembly project equipment set

The robot extracts the workpiece from the conveyor belt and places it in the disassembly station. There it disassembles the workpiece into its component parts. In conclusion it sorts the components into the storage sites provided for them.



IMS® 28 - Production line with 8 sub-systems

IMS® 3 - Sorting, IMS® 4 - Assembly, IMS® 5 - Processing, IMS® 6 - Testing, IMS® 8 - Storage, IMS® 9 - Routing, IMS® 10 - Buffering and CRK10 with disassembly project equipment

As per IMS® 26, plus:

IMS® 9 - Routing

The routing unit can move the workpiece carrier for a different sub-system or even change its direction.

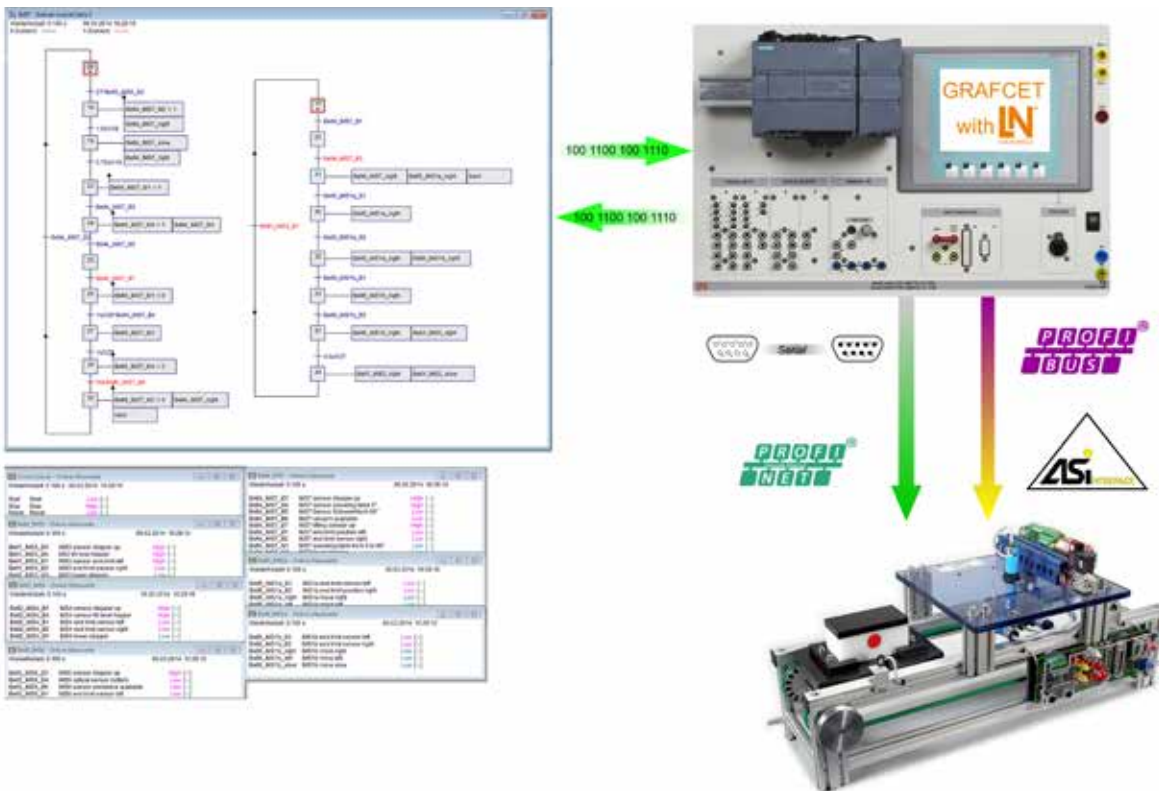
IMS® 10 - Buffering

Should more than one workpiece carrier be located on the conveyor belt, the buffering sub-system can control the material flow. The workpiece carrier is lifted using a lifting mechanism. The workpiece carrier can then be placed back onto the conveyor belt as needed.



Grafcet Lab for Controlling Hardware

Compile GRAFCET plans and implement them for controlling hardware. Use the editor to view the current steps in the processing and read the signal states directly using freely configurable signal tables. Using a Siemens S7-300/S7-1200/S7-1500 control system as its interface, GRAFCET Lab controls hardware connected to a PLC system. GRAFCET Lab has 40 digital inputs and 40 digital outputs. Another 8 analog inputs and 8 analog outputs can be used for control and evaluation on the basis of analog values.



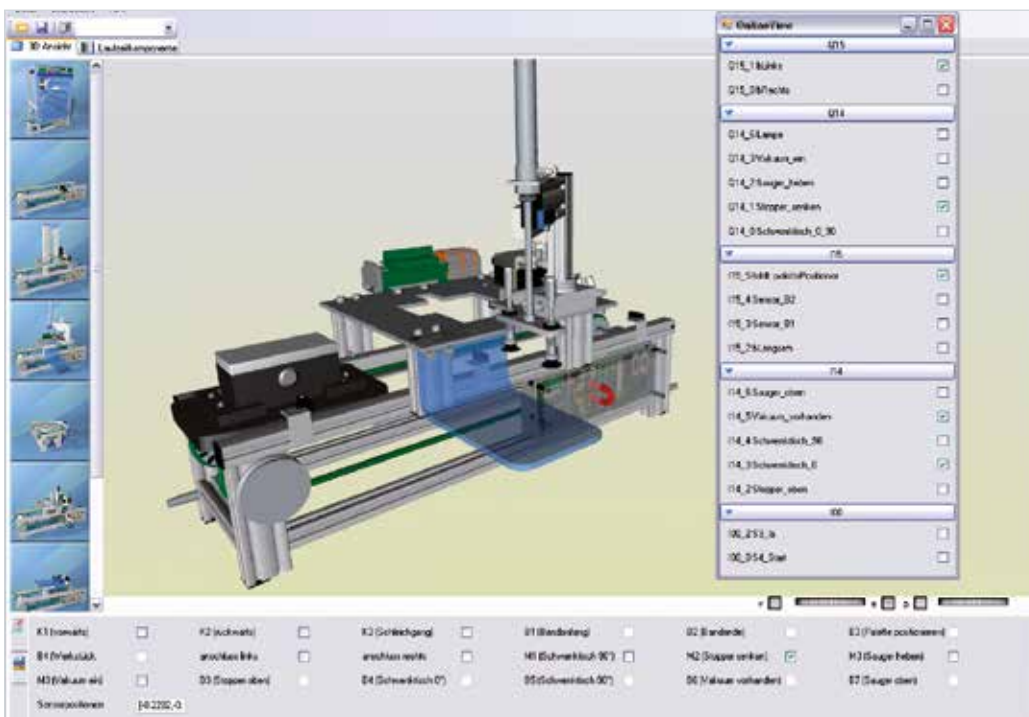
Your benefits

- 5 ms clock cycle
- 40 Digital inputs
- 40 Digital outputs
- 8 Analog inputs
- 8 Analog outputs
- Easy to link with Siemens PLC system
- Pre-configured projects lead to rapid success
- More than 50 templates and sample solutions for all IMS stations and plant configurations

IMS® Virtual

The “Digital Factory”: Realistic, Dynamic 3D Display

IMS® Virtual is a PC-based, graphical 3D simulation program, which provides a virtual learning environment for the IMS® mechatronics training system. The virtual sub-systems and production lines are depicted in real-time as a dynamically animated virtual 3D scene featuring all the components. The 3D scene can be programmed using STEP 7 just like a real production control system and is controlled by the “PLCSIM” software.



Teacher/student version of IMS® Virtual



Real hardware: IMS® 7 – Handling

Training contents

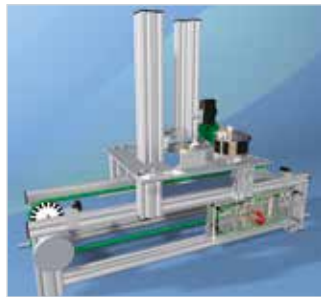
- Simulation and visualisation of technical processes
- PLC programming in accordance with IEC 1131-1 (IL, LD, FBD)
- Control and monitoring of technical processes
- Parameter setting, programming and commissioning of technically differing systems
- Systematic troubleshooting of production lines
- Central operation and monitoring of plant and processes
- Functions and system structure for a production line
- How an industrial robot operates within a production facility

Example Models of IMS® Sub-Systems and Production Lines

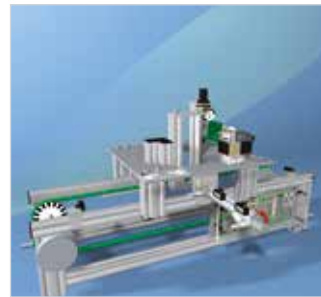
In the trainer/instructor version, with a few mouse clicks you can create almost any configuration of IMS® production line out of a library of virtual IMS® models.



IMS® 1 - Conveyor belt



IMS® 3 - Sorting
and IMS® 4 - Assembly



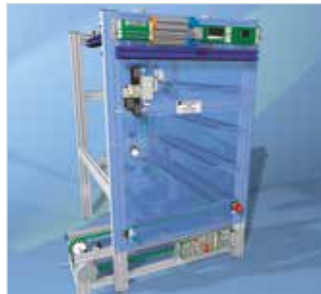
IMS® 5 - Processing



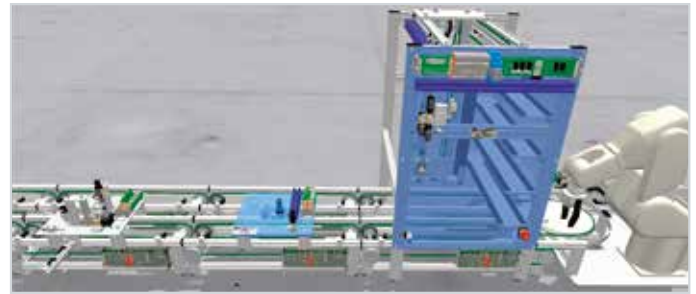
IMS® 6 - Testing



IMS® 7 - Handling



IMS® 8 - Storage



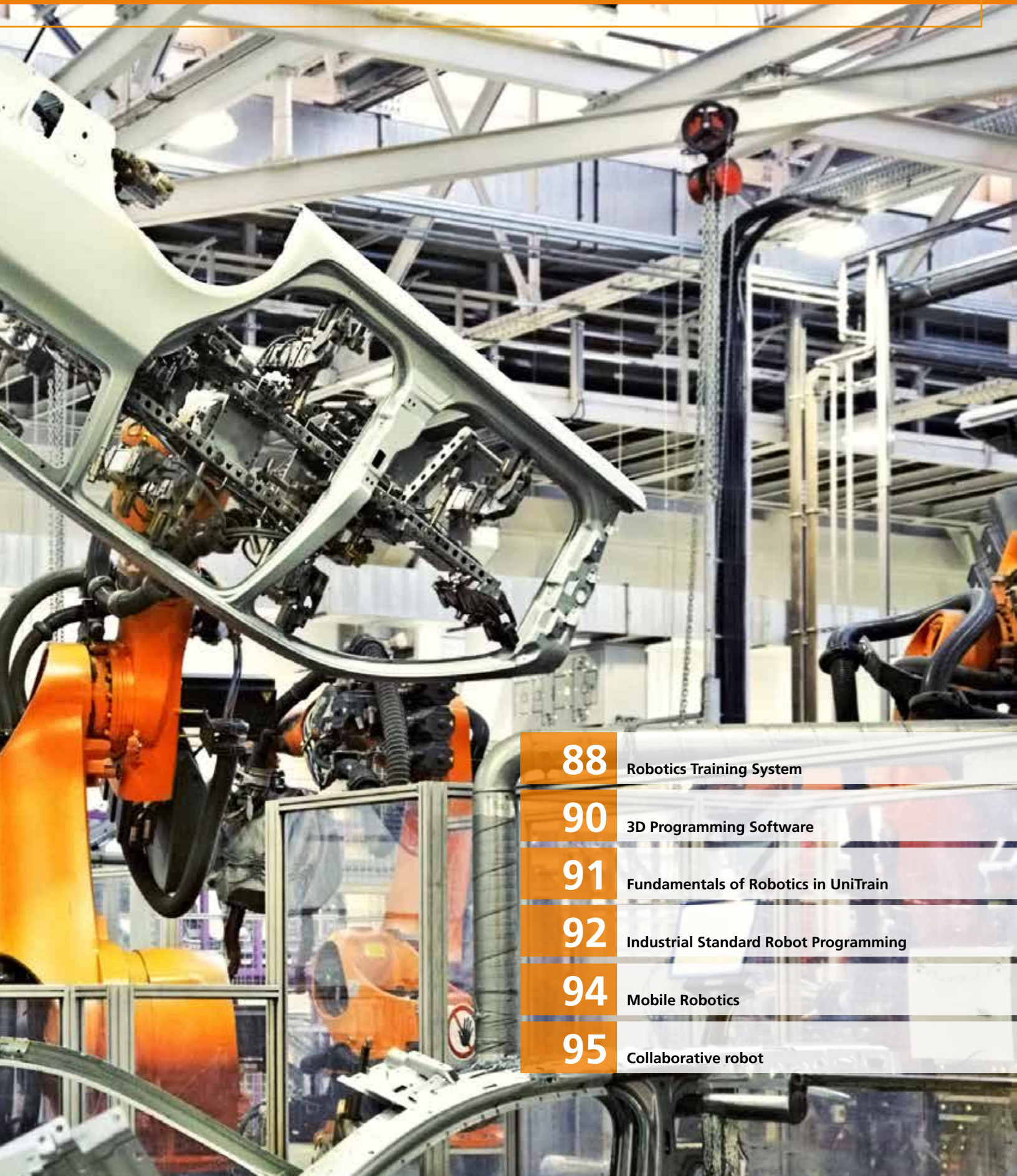
Production line IMS® 26 with industrial robot

Your benefits

- Design and behaviour of processes are accurate in detail and clearly modelled in 3D
- A library is provided with working mechatronics sub-systems and production plants
- Real-time simulation
- Collision detection
- Fault simulation: configuration of errors in the adjustment of sensors or in electrical or physical properties of components
- Classroom licence including student and trainer/instructor versions
- Development of self-written process models with the expert version



Robotics



88 Robotics Training System

90 3D Programming Software

91 Fundamentals of Robotics in UniTrain

92 Industrial Standard Robot Programming

94 Mobile Robotics

95 Collaborative robot

Robotics Training Systems

Starting in the World of Robotics

Robots now play a key role in modern, highly automated and efficient production processes. This training package “Fundamentals of robotics” guides the automation or mechatronics engineers of the future step by step through the basics of robotics, how to handle and program robots and shows how they can work in optimum fashion with automated systems.

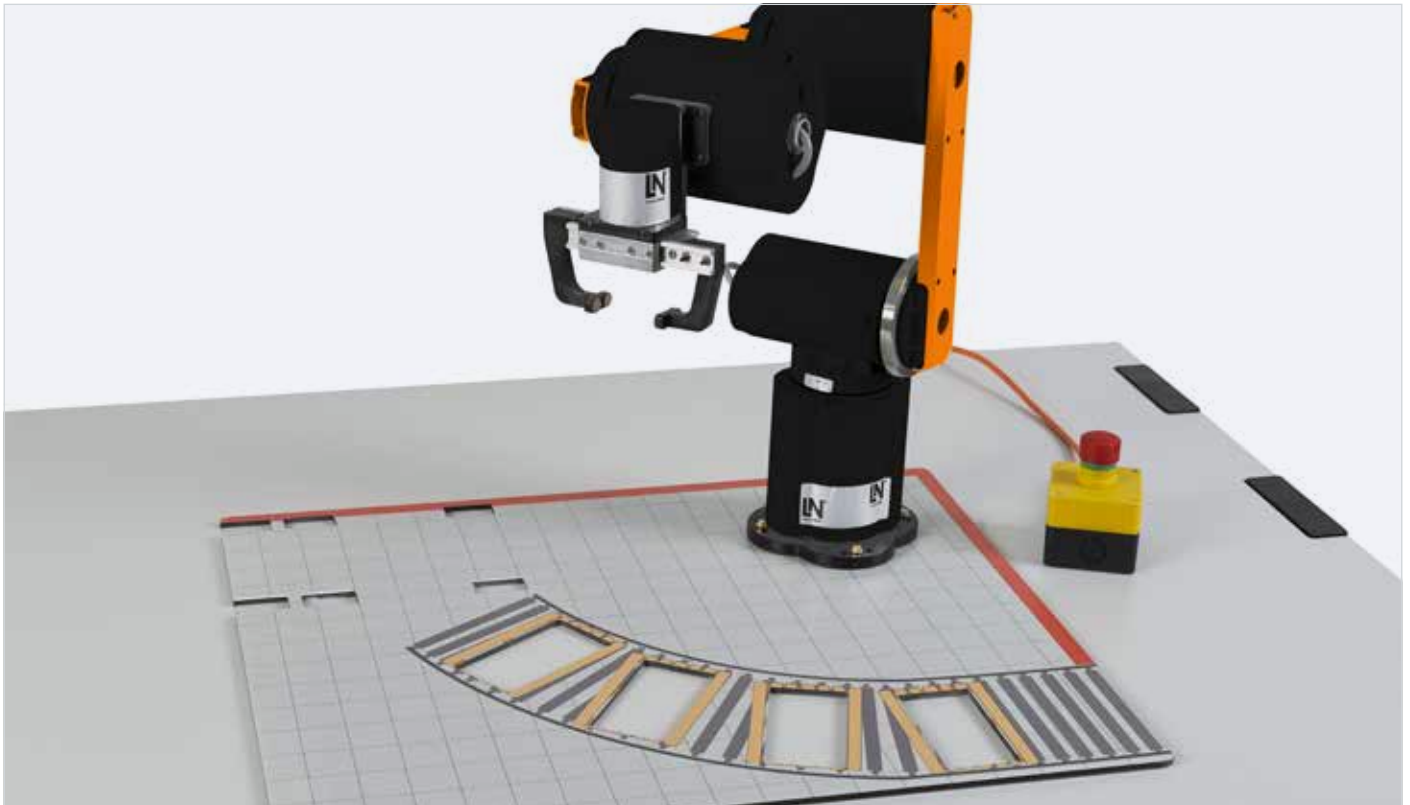


Your benefits

- Multimedia courses with theory, animation, experiment instructions and evaluation capability
- Comprehensive background theory in order to understand multiple-axis robots and the safety systems they require
- The apparatus is intrinsically safe (no safety measures need to be taken)
- Many interesting experiments with a 4-axis robot, conveyor belt and a PLC system
- Robot can be programmed via supplied 3D simulation software
- The material learned can easily be applied to actual industrial robots

Training System

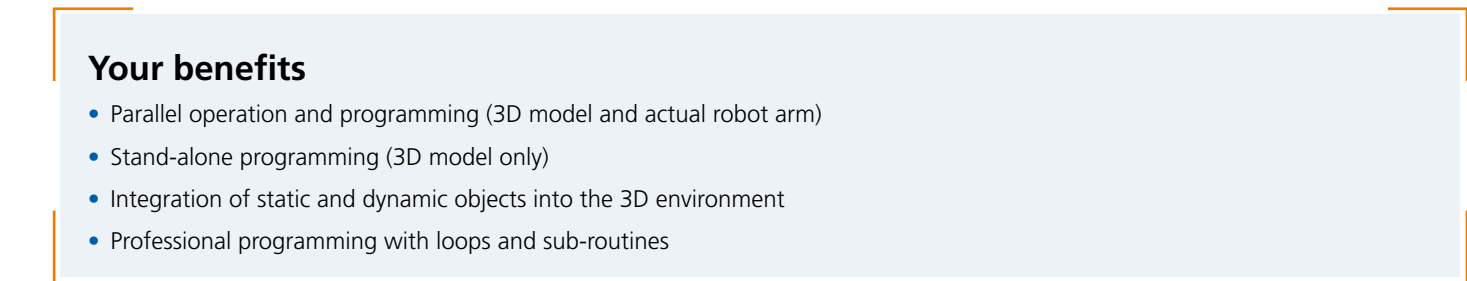
The **Mover4** is a four-axis robot arm designed for use in schools and colleges. The Mover4 HD allows realistic automation scenarios to be simulated. It can be set up as a movement platform and combines physics, mathematics and information technology in such a way that they are made tangibly real. The robot arm has four serial axes and can therefore move through three dimensions and tilt its gripper hand to specific angles.



Your benefits

- 3D programming software
- Payload: 500 g
- Max. range: 550 mm including gripper hand
- Electrically operated parallel grippers
- Ports: 9-pin I/O, CAN programming interface
- Positioning accuracy: 1 mm
- Weight: 3.5 kg
- Power: 12 V via 230 V plug-in power supply, < 60W
- A PC is required to control operations

The **CPRog control software** provides a modern user interface and control of a robot arm. The robot can be operated via keyboard or joystick.

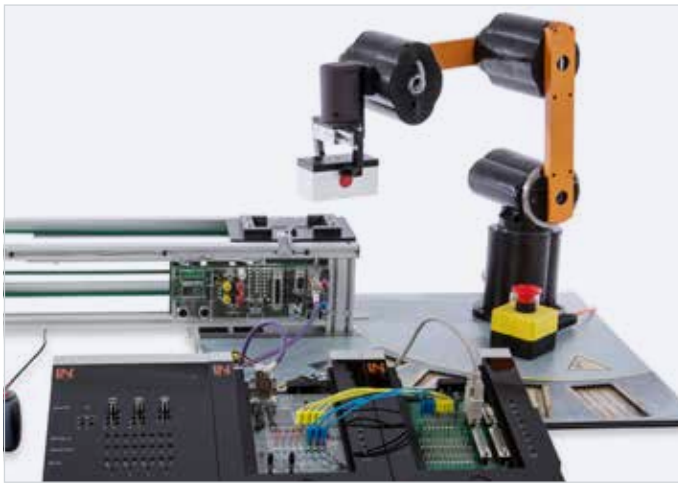


- Parallel operation and programming (3D model and actual robot arm)
- Stand-alone programming (3D model only)
- Integration of static and dynamic objects into the 3D environment
- Professional programming with loops and sub-routines

Our mechatronics system (IMS®) provides numerous different ways of setting up a production line. Whatever IMS® stations you use, the robot can be a useful enhancement to any of them. Its base plate is designed for universal use meaning it can easily be connected to a conveyor belt or production line.

Fundamentals of Robotics with UniTrain

The UniTrain course “Fundamentals of robotics” lets you learn the basic terminology and the techniques for controlling robots quickly and easily. You can apply what you have learned to any industrial robot. This means that equipment set CRT 11 eliminates any obstacles to a start in robotics.

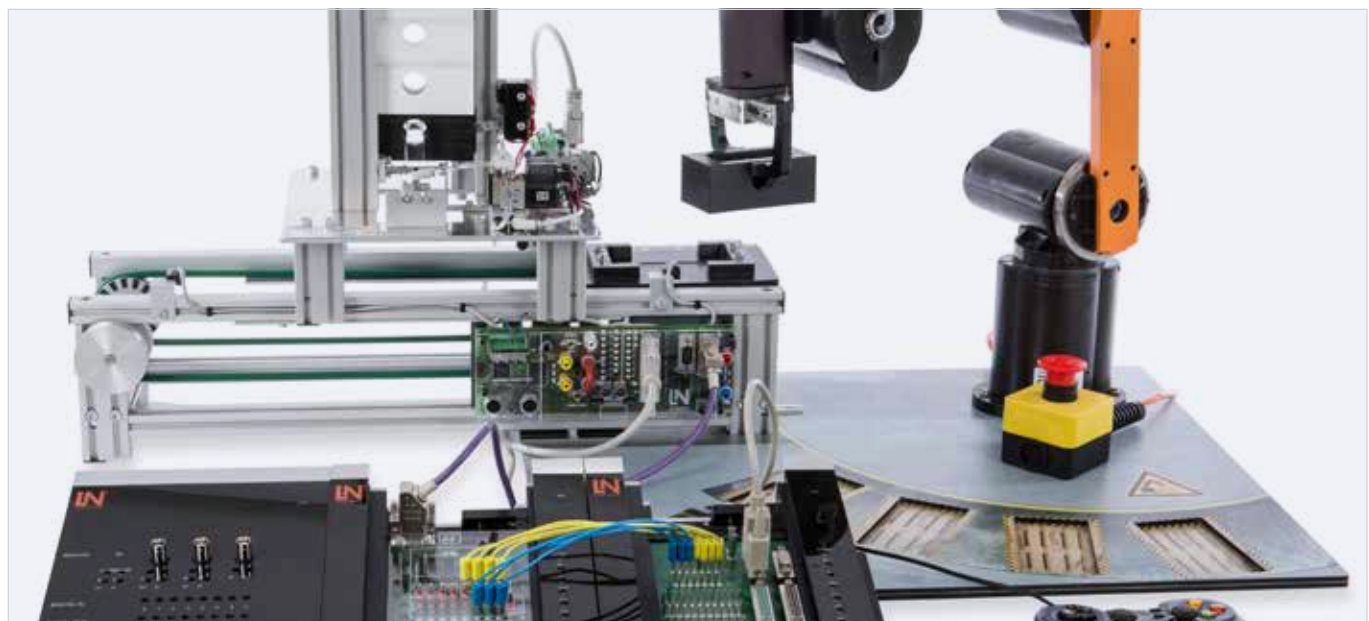


Training contents

- Gripping methods for a robot
- Programming of movements
- Coordinate systems for a robot
- Speed and acceleration
- Singularities and symmetries
- Digital inputs and outputs
- Typical programming patterns
- Program structures
- Final experiment

Robots in Mechatronics Applications

You can extend equipment set CRT 11 by adding a mechatronics station. Use the four pallet storage positions on the base plate and program the complete function sequence for a mechatronics application.



CRK 10 – Robot programming to industrial standards

Situation

The Kuka KR6 R700 sixx model is a 6-axis industrial robot which allows for work, control and programming on a professional level. The straightforward design of the Teach Pendant software ensures that there is an easy introduction to programming for the students. Project work can be transferred between robots and PCs using direct connection via Ethernet.



Your benefits

- Compact, fast acting industrial robot with 6 degrees of freedom
- Professional learning system: permits true-to-life learning
- International automobile standard: corresponds to conventional industrial design
- Programming via Teach Pendant
- Project planning possible via included software
- Connection to PLC via PROFINET

Project Work with Robot

Project equipment for testing

Situation

After a workpiece has been manufactured, the robot retrieves the finished component and deposits it in the "Testing" station. A variety of sensors are used to determine whether the workpiece has been assembled properly. After inspection the finished part is returned to the production line.



Project equipment for disassembly

Situation

After a workpiece has been manufactured, it is determined that this part has not been properly assembled. The robot retrieves the part from the production line and deposits it at the disassembly station. With the aid of the robot, this station dismantles the workpiece into its component parts. The robot then uses a sorting operation to place the individual component parts in their storage locations.



Mobile Robotics

AGV – automated guided vehicle system with collaborative 6-axis robot arm

The system is comprised of a collaborative, mobile robot with an additional collaborative 6-axis robot arm. These new-generation autonomous, mobile robots are currently revolutionising the way materials are being transported within the facilities of companies. Operation of automated guided vehicle systems (AGV) is ensured using camera systems without any magnetic loops installed in the flooring.

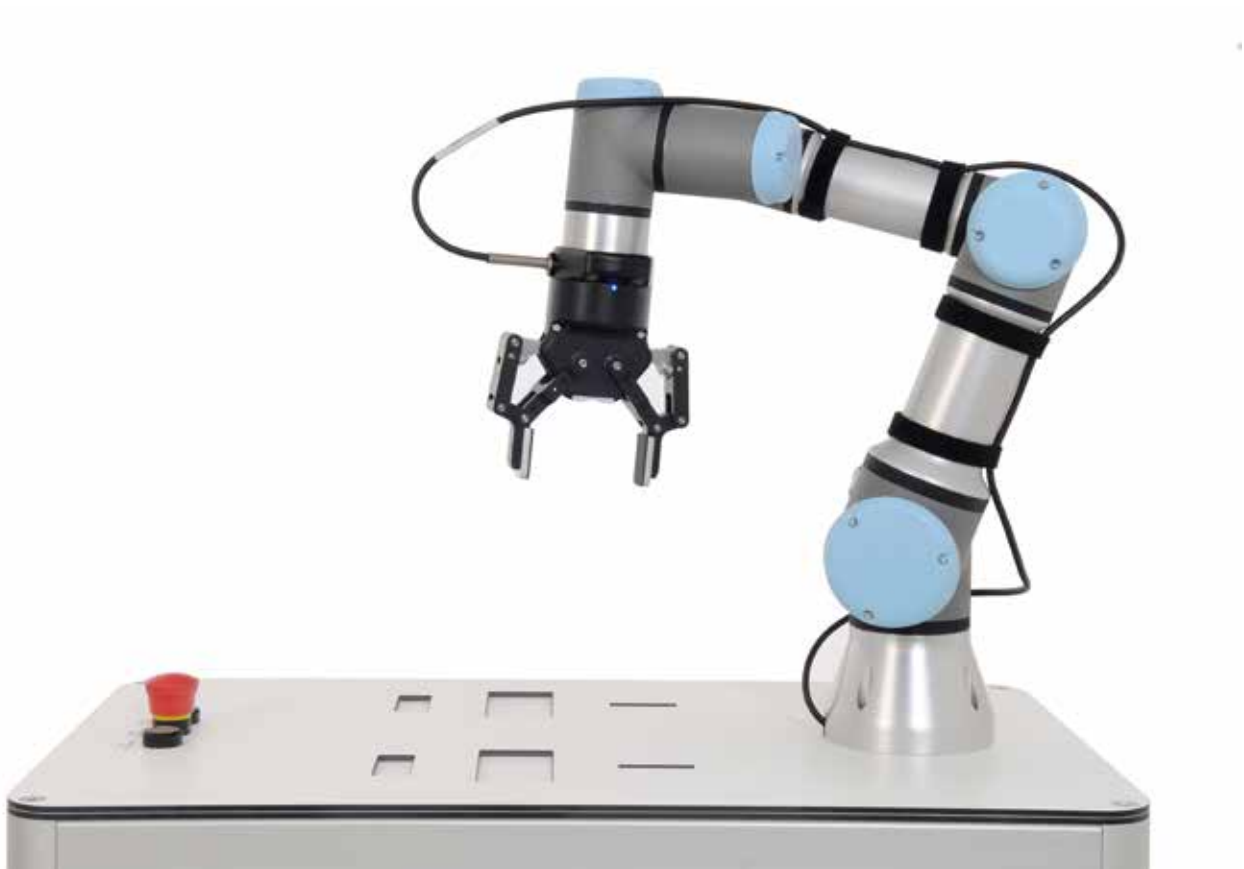


Your benefits

- Remote monitoring and control
- Interface to the Lucas-Nülle production planning system for the commissioning of orders
- Route planning based on destination coordinates/destination stations
- Travelling proceeds on planned route to destination
- Obstacle detection en route, deceleration/stop
- Determination and tracking of evasion paths
- Creation of a map from scanner data and localisation and movement within it
- Manual creation of local area maps with walls, work stations and permitted paths
- Emergency stop button

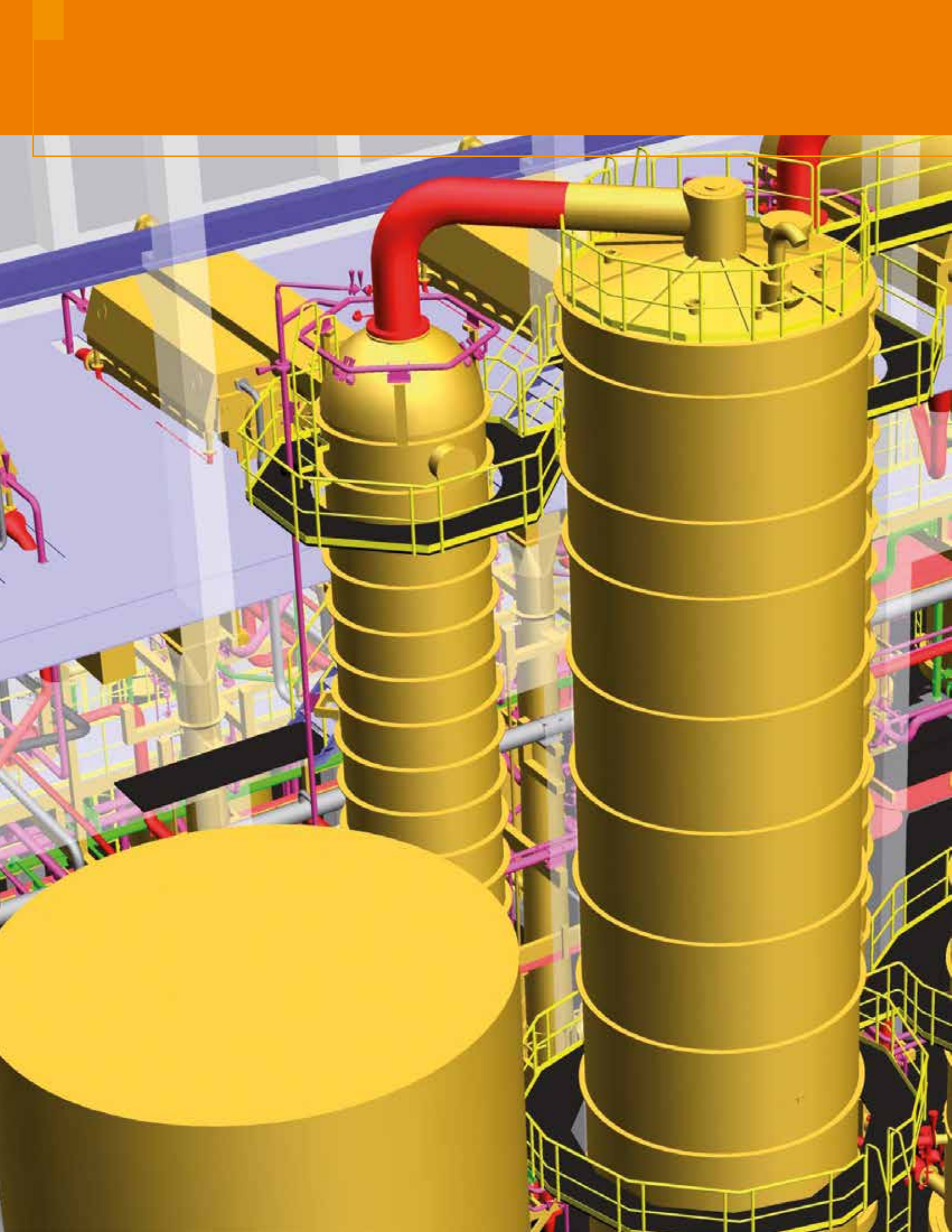
Collaborative robots

The robot is easy to program and can be set-up quickly and features safe and collaborating operating response. Thanks to its intuitive software even inexperienced operators can quickly learn the basics of programming. Desired path points are entered simply by moving the robot arm into the desired position.

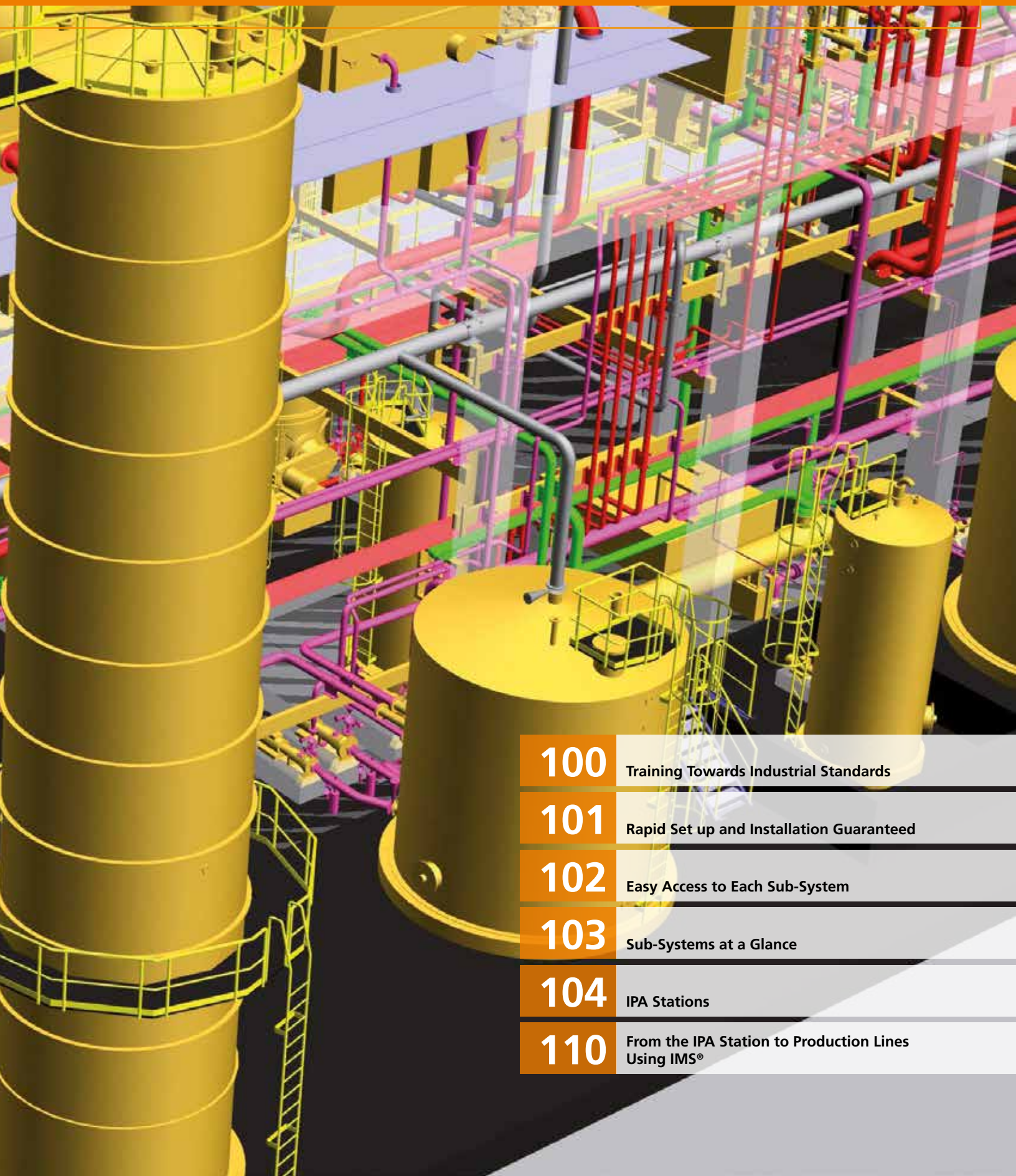


Your benefits

- Electrical gripper: adjustable grip force from 3 N up to 40 N
- Adjustable grip stroke up to 110 mm
- Camera system for object recognition, taught-in objects are reliably gripped regardless of their location
- Robot arm can be moved freely by hand
- PROFINET connection to PLC possible
- Safety: Operational safety tested and approved by TÜV NORD in compliance with: EN ISO 13849:2008 PL d



Industrial Process Automation IPA



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From the IPA Station to Production Lines
Using IMS®

Industrial Process Automation

From the Automatic Control of Individual Controlled Systems to Flexible, Full-scale Process Automation

A more complex world of training and education

Radical changes in the way people work have revolutionised the requirements and needs of how information and skills are now conveyed and trained. As changes occur in company and factory processes, more and more importance is assigned to such topics as “operational competence” and “the design of individual work processes” in day-to-day practice.

Integrating thought and action

Today people being trained as process engineers receive a broad “skills set” and qualifications in the most varied of technical disciplines. Performance objectives cover training in the assembly and mounting of system components and machinery, as well as practical applications such as installation, operation and even maintenance of processes, for which an understanding of the entire system is a prerequisite.

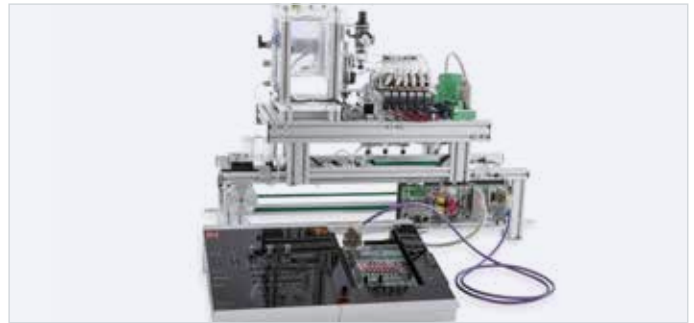
Changing didactic approaches

These factors emphasise the need to put process engineering training at the heart of vocational education. As such, the theory of the subject is embedded in hands-on practical training situations which leads to successful retention. By working with complex process engineering training systems, the student and trainee are given an easier introduction to industrial practice.



Modular design

The IPA system has a modular design so that functional systems covering the widest range of sizes can be designed. All of the sub-systems can be deployed individually or in any combination. For sixpack transport between individual sub-systems, a double conveyor belt system is used on which workpiece carriers travel.



Reflection of reality

With this training system, the automatic industrial control systems and processes of a complex process engineering production plant are realistically simulated. The system exclusively employs industrial-type actuators and sensors. Furthermore, only industrial-type PLC systems with PROFIBUS and decentralised peripherals are used for open-loop and closed-loop process control.



Developing skills and expertise

The system's self-learning sessions promote the training of skills and expertise during actual teamwork and enable the students and trainees to acquire the basics needed for mastering process engineering systems. Each sub-system has been specially designed so that skills and knowledge are acquired gradually step-by-step right up to the point where a complete and sophisticated automatic control program has been created.



Your benefits

- Practical training using real industrial components
- Process technology sensors for different variables
- Can be combined with any open-loop or closed-loop control system from industry or education
- Can be expanded as desired with additional IPA stations and IMS® (Industrial Mechatronic System)
- Modular design permits quick and easy assembly
- Safer experimentation environment without leakages or loss of fluids
- Immediate start up thanks to minimum wiring
- Explore and understand how a process works
- Operation and monitoring via touch panel

Training Towards Industrial Standards

Simple Process Control

Controlling the individual work steps on a production line in order to put the entire system into operation is a process of some complexity. Therefore, achieving rapid setup and installation is an important objective in training. By employing self-paced study using the UniTrain system and the Siemens SIMATIC S7-300, your students are optimally prepared for the task at hand. UniTrain offers a simple, didactically structured introduction to the control of each sub-system and forms the preparation for process and automatic control of production lines with standard industrial equipment using the Siemens SIMATIC S7-300.

- **UniTrain**
(Course work + experimenting + process control)

With the aid of animations and numerous experiments conducted on real systems, various courses enable you to explore the fundamentals, principles and attributes of components used in automated process engineering and production plants. In a large number of practical experiments, controlled systems are studied, step responses are investigated and control loops optimised. In real experiments, students are trained how to handle and operate important tools and aids such as Bode diagrams

and locus curves.

- **Siemens SIMATIC S7-300**
(Process control with standard industrial equipment)

An entire production line comprising individual sub-systems can be controlled using, for example, the SIMATIC S7-300 including the Touch Panel TP177 from Siemens. This level of process control precisely reflects the realities found in industry.

Your benefits

- **UniTrain**
 - Multimedia-based self-study course
 - Including control system with PROFIBUS
 - Fast progress due to extremely rapid setup
 - Integrated development platform
- **Siemens SIMATIC S7-300**
 - Process control of the entire production line with standard industrial equipment
 - Communication via PROFIBUS, PROFINET, PROFIsafe and AS-i
 - Industrial PLC
 - Use of STEP 7 as well as decentralised peripherals
 - Touch Panel operation



Rapid Setup and Installation Guaranteed

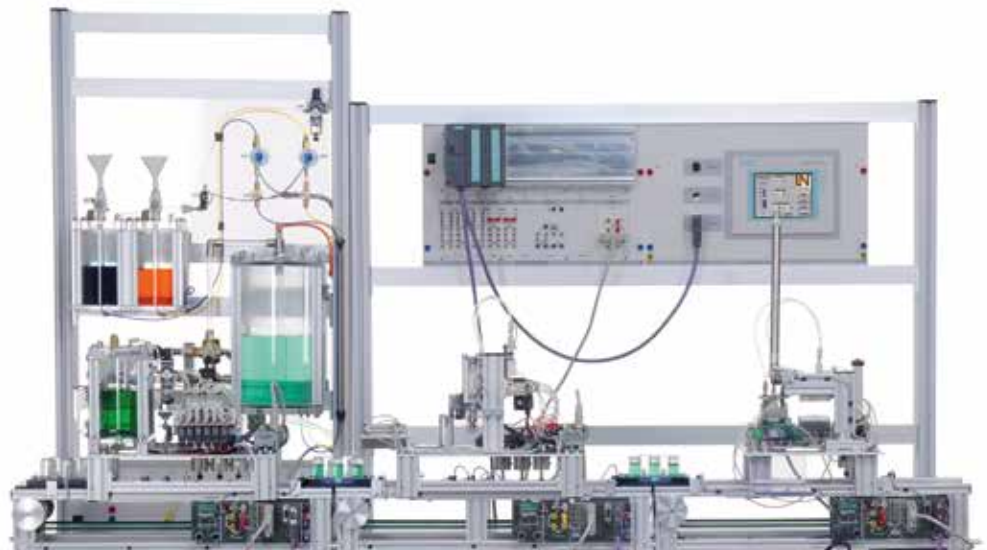
UniTrain self-study system

- Small groups of students each set up and learn to operate a sub-system with the UniTrain control system
- Thanks to extremely fast setup times, the students can be implementing their **first PLC program within 10 minutes**
- By using the accompanying multimedia-based self-study course, the instructor has **more time to provide individual instruction** to students and groups



Siemens SIMATIC S7-300 control system

- A complete class of students can set up and operate a full-length IPA production plant with the SIMATIC S7-300 control system and Touch Panel
- Consequently the students are able to learn hands-on how to perform **process control** of a production plant with **standard industrial equipment**



Simple Introduction to each Sub-System

Learning with the Multimedia-based UniTrain Courses

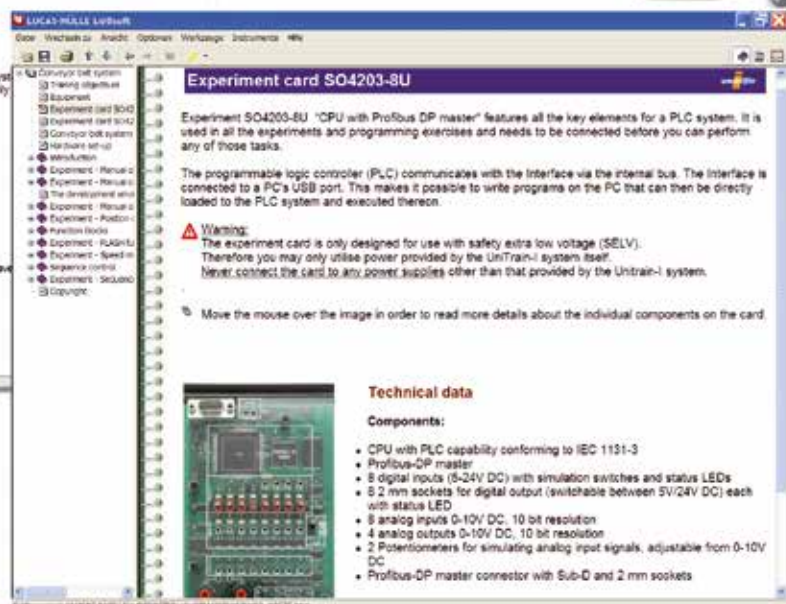
The UniTrain multimedia experiment and training system uses informative text, graphics, animations and knowledge tests in clearly structured course software to guide students through the experiments. In addition to the training software, each course comes with an experiment card including a control unit on which the practical exercises can be performed.

Your benefits

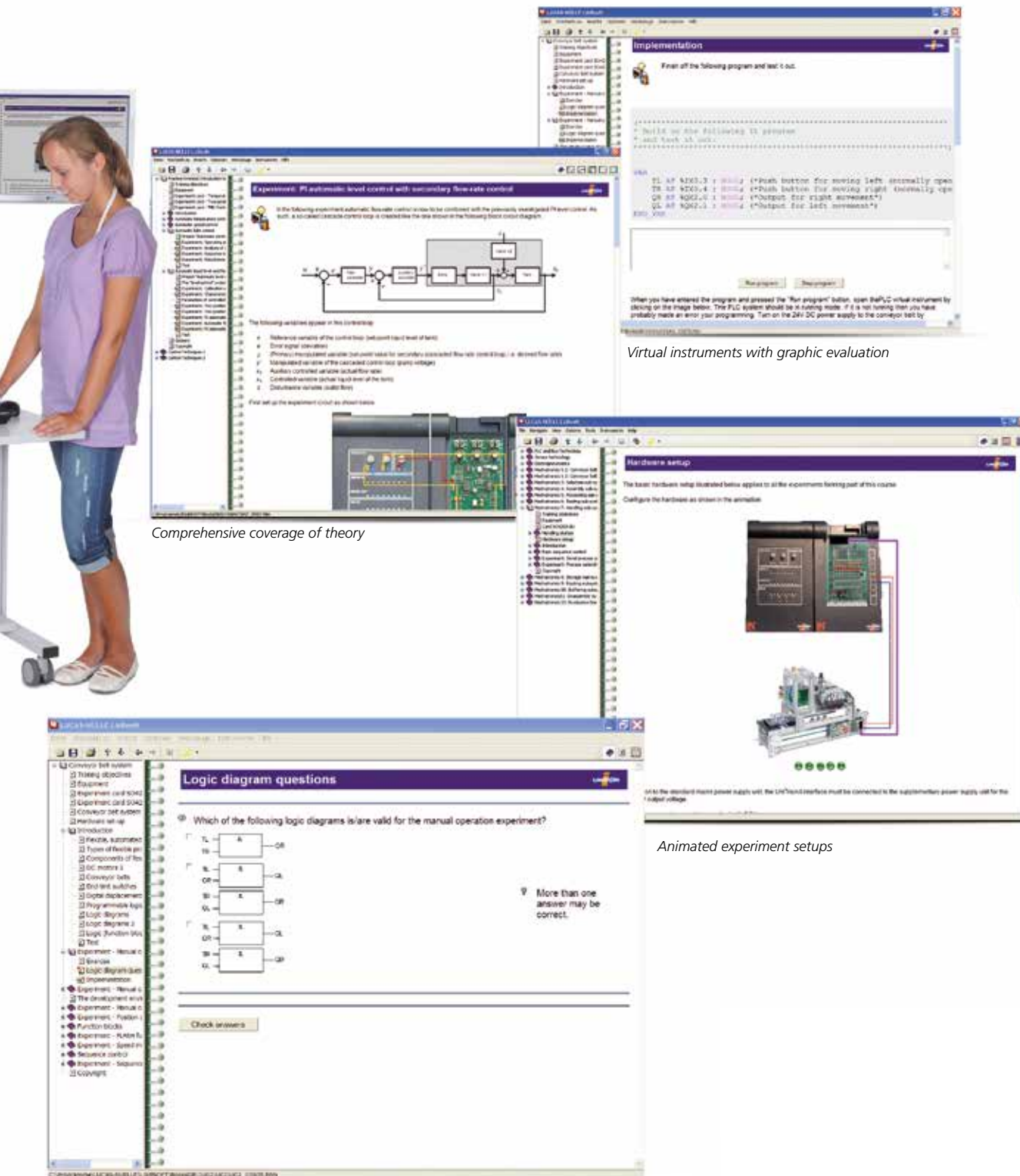
- Educationally designed implementation and operation of all conveyor belts and sub-systems
- Integration of both cognitive and "hands-on" training material
- Strong linkage between theory and practice
- Rapid learning progress thanks to structured course design
- Extremely rapid setup and assembly
- Courses structured into:
 - Training objectives/content
 - Hardware description
 - Software description
 - Basic knowledge
 - Experiments
 - Fault simulation and knowledge tests



Systematic arrangement of training objectives



Experiment cards – contain all central elements of a PLC



Implementation

First off the following program and test it out.

```

// *****
// Build up the following IS position
// Load Rack 1.5, 2.0
// *****

// *****
// Build up the following IS position
// Load Rack 1.5, 2.0
// *****

// *****
// Build up the following IS position
// Load Rack 1.5, 2.0
// *****
  
```

When you have entered the program and pressed the "Run program" button, open the FUC virtual instrument by clicking on the image below. The FUC system should be in running mode. If it is not running then you have probably made an error your programming. Turn on the 24V DC power supply to the conveyor belt by:

Hardware setup

The basic hardware being illustrated below applies to all the experiments forming part of this course. Configure the hardware as shown in the animation.

Logic diagram questions

Which of the following logic diagrams is/are valid for the manual operation experiment?

More than one answer may be correct.

Animated experiment setups

Sub-Systems at a Glance

Hands-on Training Guaranteed



*Compact station**Mixing station**Filling station**Corking station*

Suitable stations from the IMS® System

*Transport**Handling**Buffering**Storage**Routing*

IPA Stations

IPA 1 – Compact Station

Professional automatic control of pressure, temperature, volumes and flow rates: The compact station with four integrated controlled systems is the optimum solution for typical production processes in the most varied of industries. The system's modularity permits various configurations to be implemented in the safety of the laboratory environment.



Process control using an industrial PLC

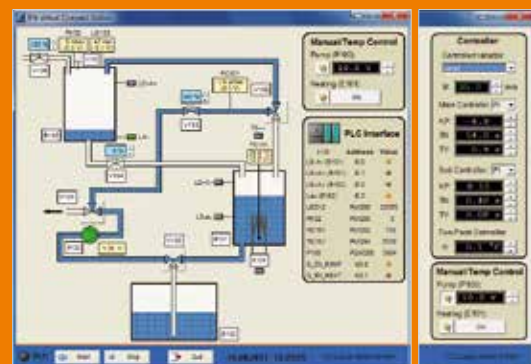
Training contents

- Design, wiring and commissioning of a process control installation
- Measurement of electrical and process control variables like liquid level, flow-rate, pressure and temperature
- Design and commissioning of control loops
- Analysis of controlled systems and control loops
- Commissioning of continuous and discontinuous controllers
- Setting parameters and optimising P-action, PI-action and PID controllers
- Cascade control
- Design of open-loop and closed-loop control programs
- Operating and monitoring control processes

Your benefits

- Process engineering sensors for temperature, liquid-level, flow-rate and pressure
- Extensible as needed with additional IPA stations: mixing, filling, capping and uncapping
- Direct pump control or speed-control
- Manual operation without additional equipment directly via simulation switches

Also available as IPA-Virtual Compact virtual model



IPA 2 – Mixing Station

Mixing formulations: The IPA mixing station allows for precise mixing of pre-defined formulations of two differently coloured liquids. A control system permits accurate dosage and mixing of the components. The finished liquid can be conveyed to a further station.



Process control using an industrial PLC

Training contents

- Setup, wiring and start-up of a process plant
- Selection, application and connection of various sensors
- Measurement of electrical and process variables such as filling level and flow rate
- Formulation control
- Use and connection of measurement transducers
- Setup and operation of control loops
- Analysis of controlled systems and control loops
- Operation of continuous and discontinuous controllers
- Parameterisation and optimisation of P-action, PI-action and PID controllers
- Design of open-loop and closed-loop control programs
- Process handling and monitoring
- Inspection, maintenance and repair
- Networking of process engineering plants

Your benefits

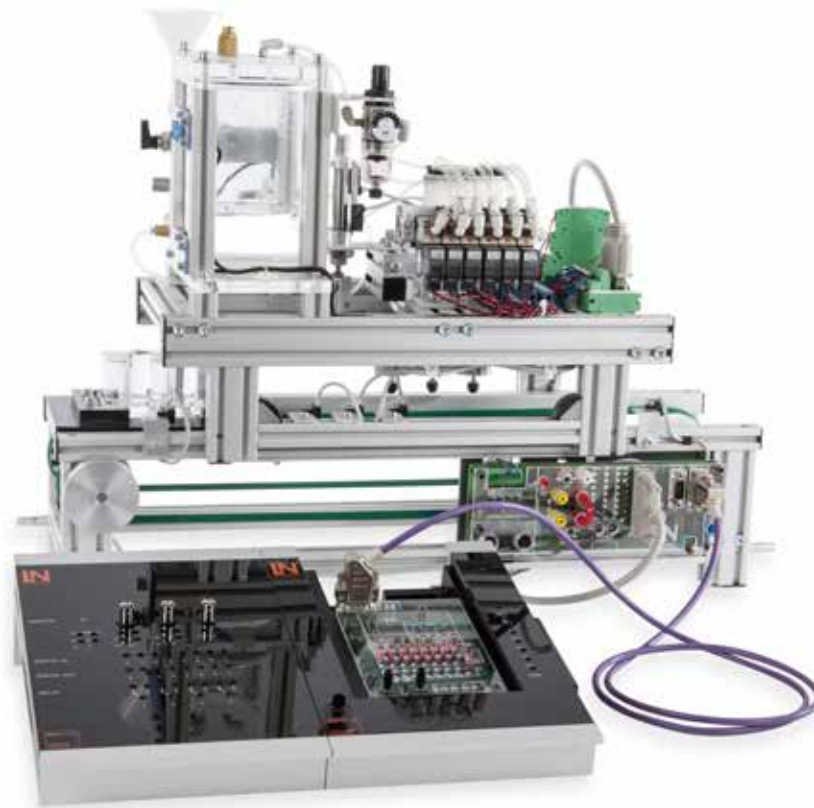
- Typical process engineering sensors for filling level and flow rate
- Can be expanded using additional IPA stations: compact station, filling and corking
- Fast changes to the flow scheme and integration of other components thanks to flexible plug-in system
- Pump controlled either directly or via speed
- Direct manual operation without additional devices via simulation switch
- Optional automatic pH control implementable

IPA Stations

IPA 3 – Filling Station

Bottle filling: The IPA filling station is mounted on a conveyor belt and allows the metered filling of several bottles. Six bottles placed on a carrier are positioned below the filling station. The bottles are filled with a coloured liquid to a defined level. Once all bottles have been filled, the carrier is transported to the next station.

Process control using an industrial PLC



Training contents

- Setup, wiring and start-up of a process plant
- Selection, application and connection of various sensors
- Measurement of electrical and process engineering variables such as filling level
- Use and connection of measurement transducers
- Design of open-loop and closed-loop control programs
- Process handling and monitoring
- Inspection, maintenance and repair

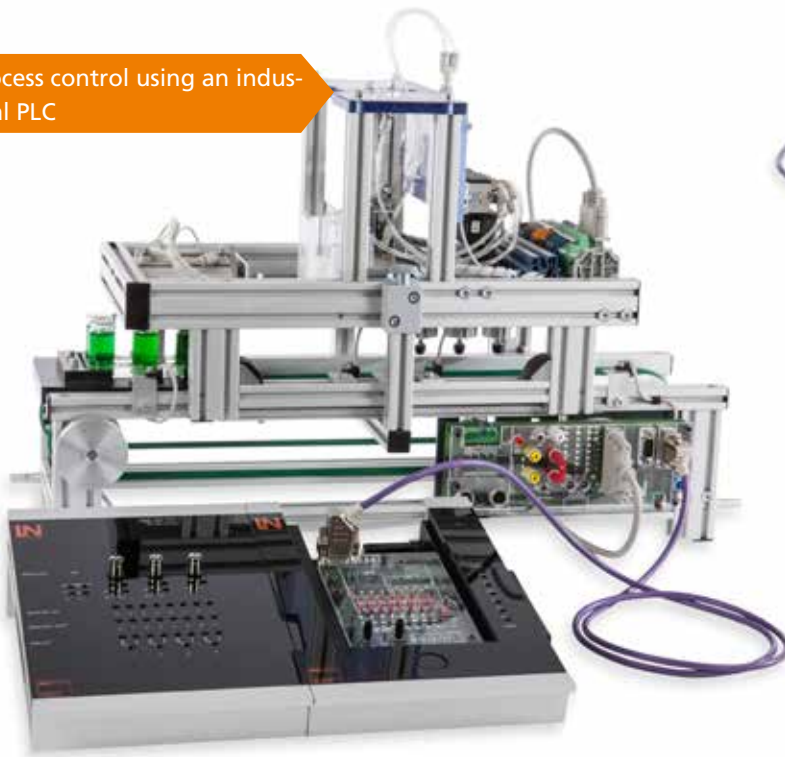
Your benefits

- Can be expanded using additional IPA stations: compact station, mixing and corking
- Network capable using PROFIBUS DP via the IMS® conveyor belt system

IPA 4 – Corking Station

Bottle corking: The IPA filling station is mounted on a conveyor belt and allows the water-tight corking of bottles by means of plastic caps. Six bottles filled with coloured liquid and placed on a carrier are positioned below the filling station. The bottles are then sealed by means of a pressing cylinder. Once all bottles have been corked, the carrier is transported to the next station.

Process control using an industrial PLC



With optional expansion: cap transfer

Training contents

- Setup, wiring and start-up of a process plant
- Selection, application and connection of various sensors
- Use and connection of measurement transducers
- Design of open-loop and closed-loop control programs
- Process handling and monitoring
- Inspection, maintenance and repair
- Networking of process plants

Your benefits

- Can be expanded using additional IPA stations: compact station, mixing and filling
- Network capable using PROFIBUS DP via the IMS® conveyor belt system
- With extension – loading station
- Vacuum generator, vacuum sensor including sensor technology
- Put into operation and control a pneumatically operated linear unit
- Programming of the loading sequence

From the IPA Station to the Production Line Using IMS®

Advanced Instruction

By assembling a variety of sub-systems, the “Industrial Process Automation” IPA can integrate individual process steps to form a complete production line. This permits the realistic simulation and demonstration of interdependent production processes.

IPA 23 – Production line with 3 sub-systems

IPA 2 – Mixing, IPA 3 – Filling and IPA 4 – Corking

IPA 2 – Mixing

Two differently coloured liquids are mixed in accordance with a prescribed formula to form a new liquid. This finished liquid is then supplied to the filling station.

IPA 3 – Filling

Six bottles placed on a carrier are positioned below the filling station. The bottles are filled with a coloured liquid to a defined level. Once all bottles have been filled, the carrier is transported to the next station.

IPA 4 – Corking

Six bottles placed on a carrier are positioned below the filling station. The bottles filled with coloured liquid are then sealed by means of a pressing cylinder. Once all bottles have been corked, the carrier is transported to the next station.



Your benefits

- Thanks to its modular design, seamless integration is quickly implemented into the proven “Industrial Mechatronic System” IMS®
- The modularity of the system permits any number of configurations to be realised in the extremely safe environment of the laboratory
- Optimum solution for typical production processes in the widest range of sectors
- Individual configuration of the single subsystems to make up a fully-fledged and customised production plant in keeping with specific requirements and space
- A teaching and training system designed to meet any content requirements
- Open for further expansion
- Integration of a carrier return system possible

IPA 24 – Production line with 4 sub-systems

IPA 2 – Mixing, IPA 3 – Filling, IPA 4 – Corking, IMS® 7 – Handling

As per IPA 23, plus:

IMS® 7 – Handling

After corking, the workpiece carrier is moved to a position at the extraction point. The sixpack is placed on the storage location by a robot.



IPA 25 – Production line with 5 sub-systems

IPA 2 – Mixing, IPA 3 – Filling, IPA 4 – Corking, IMS® 7 – Handling, IMS® 8 – Storage

As per IPA 24, plus:

IMS® 8 – Storage

The return system features a storage and retrieval system with twenty storage cells. Sixpacks can be stored on the rack according to the production job. Empty carriers are then returned to the start of the production line.





Computer Integrated Manufacturing CIM



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Automated Machining Technology

Tried and true machining technology ...

Machining technology is a fundamental aspect of many industrial sectors. In order to keep manufacturing cost-efficient it has been necessary to automate manufacturing processes. We provide this solution.



... in combination with robotics

Today, in the industrial serial production of mass volumes of goods, the use of one or more robots is a must to ensure that the manufacturing processes are working at maximum efficiency. In our training system a robot operates in combination with CNC machines.



Integration into automation engineering

CNC programming and machine tooling is an important task in many metal working factories and puts huge demands on student and trainee alike. In keeping with and complimentary to our IMS® program, Lucas Nülle is offering CNC training solutions. The CIM training system is a teaching program that lives up to the demands of modern training and advanced education in the area of metal working. Workpieces can be manufactured for further use in IMS® applications during project work.



Your benefits

- High-quality machines
- Professional software with simulation of machining operations
- Construction and quality correspond to current industrial standards
- Long working life and consistent manufacture of high-precision components
- Functionality comparable to modern industrial machinery
- All machines set up to cover all of the subjects contained in the training schedule

Optional automation accessories permit integration of IMS® stations, e.g. for the coupling of the CNC machine to the IMS® robot station, which then performs the loading and unloading of the CNC machine.

Lathe Machine

CIM 1

The compact **lathe** is perfectly suited for training applications and corresponds to industrial standards both in terms of design as well as function. Using this device all of the processes essential to modern manufacturing techniques can be illustrated and realistically demonstrated. Sensible simplification, elegant machine configuration and easy operability guarantee rapid learning success.



ILA course:

Ranging from the basic principles of lathe operations to the manufacture of a workpiece

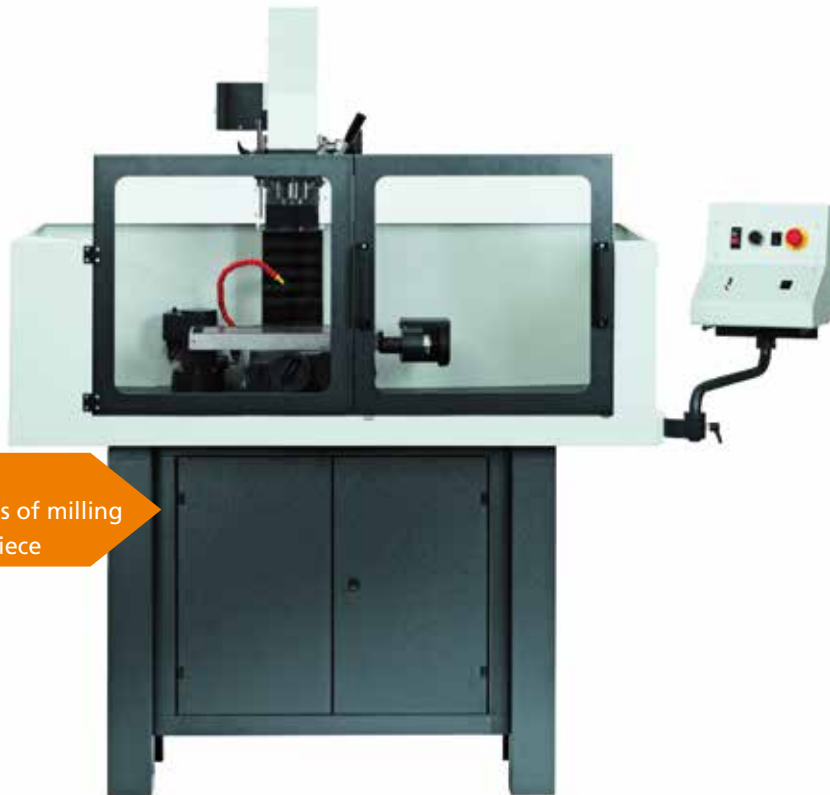
Your benefits

- Compact CNC lathe
- Industry-standard, hardened V-shaped cast iron bed
- Direct control either using included programming software or by means of conventional manual operation
- Safety machining cabinet
- Spindle features clockwise and anticlockwise rotation
- Continuously controllable main drive
- Automatic 8-fold tool changer
- Entire manufacturing process can be automated thanks to robot integration
- IMS® integration possible
- Manufacturing the bolts for IMS®
- **ILA course:**
 - Material properties
 - Geometrical and technological fundamentals
 - Project-related workpiece manufacture

Milling Machine

CIM 2

The compact **milling machine** is perfectly suited for training applications and corresponds to industrial standards both in terms of design as well as function. Using this device all of processes essential to modern manufacturing techniques can be illustrated and realistically demonstrated. Sensible simplification, elegant machine configuration and easy operability lead to rapid learning success.



ILA course:

Ranges from the basic principles of milling to the manufacture of a workpiece

Your benefits

- Compact 3-axis CNC milling machine
- Direct control either using the programming software included or by conventional manual operation
- Safety machining cabinet
- Spindle features clockwise and anticlockwise rotation
- Continuously controllable main drive
- Entire manufacturing process can be automated through

robot integration

- IMS® integration possible
- Manufacture of an upper and lower workpiece section for IMS®
- **ILA course:**
 - Material properties
 - Geometrical and technological fundamentals
 - Project-related workpiece manufacture

Total Automation and IMS® Integration

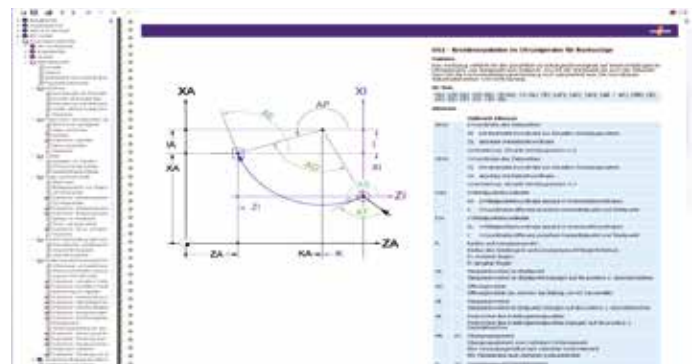
CIM 11/12 – Lathe and milling machine fully integrated into IMS®

Subjecting the individual station to full automation is the first step towards total integration in a production line. This is achieved with the aid of a robot that functions as a link between the machining equipment and the IMS® station. The robot undertakes the steady loading of the workpiece blanks and subsequently the unloading of the machined (lathed and cut) workpieces. The finished workpieces are then safely loaded into the magazine of the corresponding IMS® station.



ILA course on lathe and milling machine integration into IMS®

The Interactive Lab Assistant course is an easy introductory course on lathe and milling machines and covers the basics of machining technology. After completing the course you will be able to construct, program, simulate and ultimately manufacture workpieces by yourself. The transition from individual machine solutions to full integration into the IMS® system via robot proceeds without a hitch so that there is practically no additional technical know-how required.



Large section on fundamentals with lots of graphics and animations to visualise content

Your benefits

- Easy introductory course on machining technology
- Basics of material properties
 - Tools
 - Technologies
 - Geometries
 - Calculations
- Positioning speeds
- Project: workpiece manufacture
- IMS® integration
- Automated manufacturing process

Ranging from a CIM Station to Full Production Plant with IMS®

CIM 11 – Lathe production lines with 3 subsystems

IMS® 5 – Processing, IMS® 11.2 – Robot, CIM 1 – Lathe

IMS® 5 – Processing

The processing station is filled with bolts by the robot. A workpiece carrier loaded with a workpiece is positioned under the station. A bolt from the gravity feed magazine is inserted into the bore hole of the workpiece.

CRK 10 – Robot

The robot supplies blanks to the lathe. After the manufacturing process has been completed the robot extracts the finished bolt from the lathe and places it into the magazine of the processing station.

CIM 1 – Lathe machine

The lathe comes with an automation installation kit included. Thanks to the pneumatically controllable slide door on the rear wall, the robot is able to remove the workpiece or insert it into the collet's pneumatically controlled quick-action chuck. The solenoid valve permits PLC control of the lathe.

CIM 12 – Milling machine production line with 3 subsystems

IMS® 3 – Sorting, IMS® 11.2 – Robot, CIM 2 – Milling machine

IMS® 3 – Sorting

The sorting station is filled with workpiece subsections by the robot. A workpiece carrier is positioned under the station. A workpiece subsection is deposited on the carrier from the gravity magazine.

CRK 10 – Robot

The robot supplies blanks to the milling machine. After the manufacturing process is complete the robot removes the finished subsection from the milling machine and places this into the magazine of the sorting station.

CIM 2 – Milling machine

The milling machine is equipped with a pneumatic-hydraulic machining vice. The solenoid valve permits PLC control of the milling machine.



Ranging from a CIM Station to Full Production Plant with IMS®

CIM 21-23 – Realistic modelling of an integrated production processes

When CIM machines are integrated into the production plant, the system covers everything from workpiece production to end product assembly and includes warehousing and disassembly into individual parts. The production lines CIM 21 to CIM 23 contain nine to twelve subsystems for the realisation of one's own production plant. The production lines offer the choice of manufacturing all workpiece parts completely or partial manufacture, whereby the missing parts for the end product are included in the delivery.



CIM 21 – Production plant with 9 subsystems

IMS® 3 – Sorting, IMS® 4 – Assembly, IMS® 5 – Processing, IMS® 6 – Testing, IMS® 8 – Storage, 2 x CRK 10 – Robot, CIM 1 – Lathe, CIM 2 – Milling Machine

Same as IMS® 25, but also includes:

2 x CRK 10 – Robot

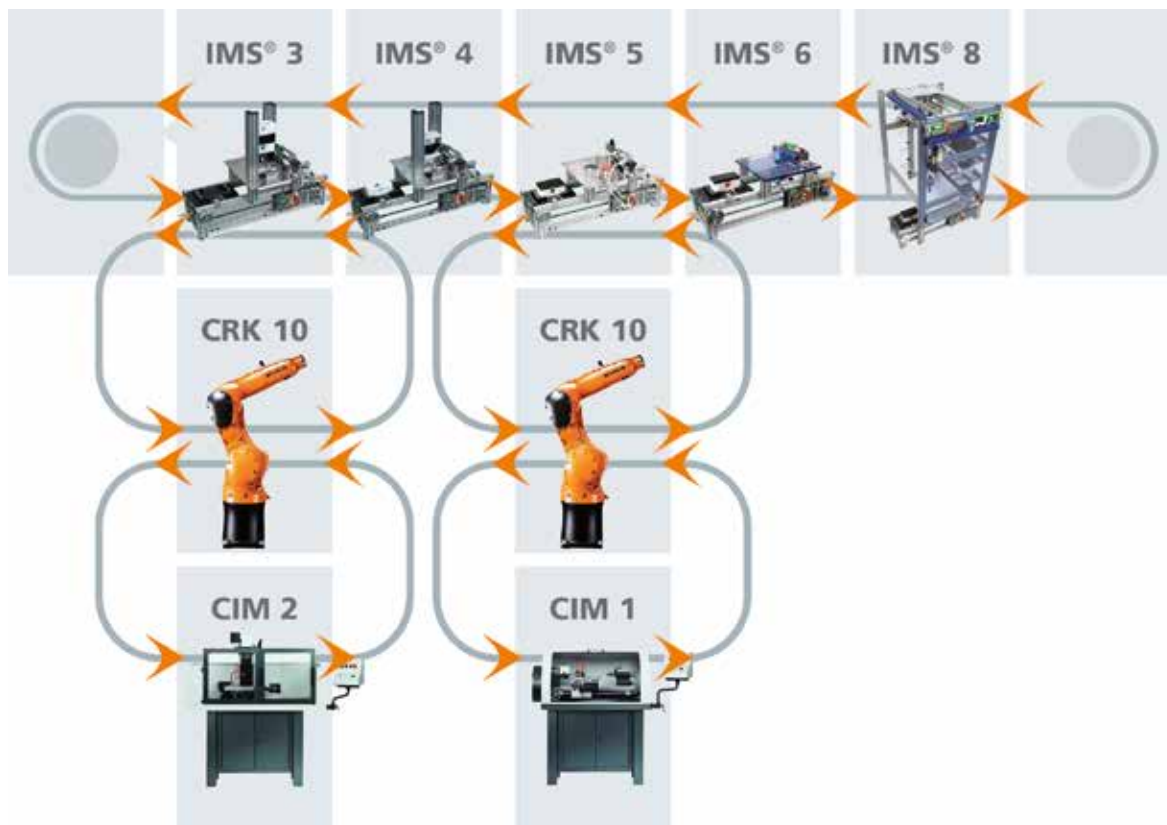
Two robots are used to place blanks into the machining tools which then upon completion of the manufacturing process load the finished workpieces from the lathe or milling machine into the magazine of the sorting or processing station.

CIM 1 – Lathe machine

The lathe is equipped with an automation retro kit. Thanks to the pneumatically controllable sliding door on the rear wall, the robot is able to remove the workpiece or insert it into the collet's pneumatically controlled quick-action chuck. The solenoid valve permits PLC control of the lathe.

CIM 2 – Milling machine

The milling machine is equipped with a pneumatic-hydraulic machining vice. The solenoid valve permits PLC control of the milling machine.



From the CIM Station to IMS®-equipped Production Plants

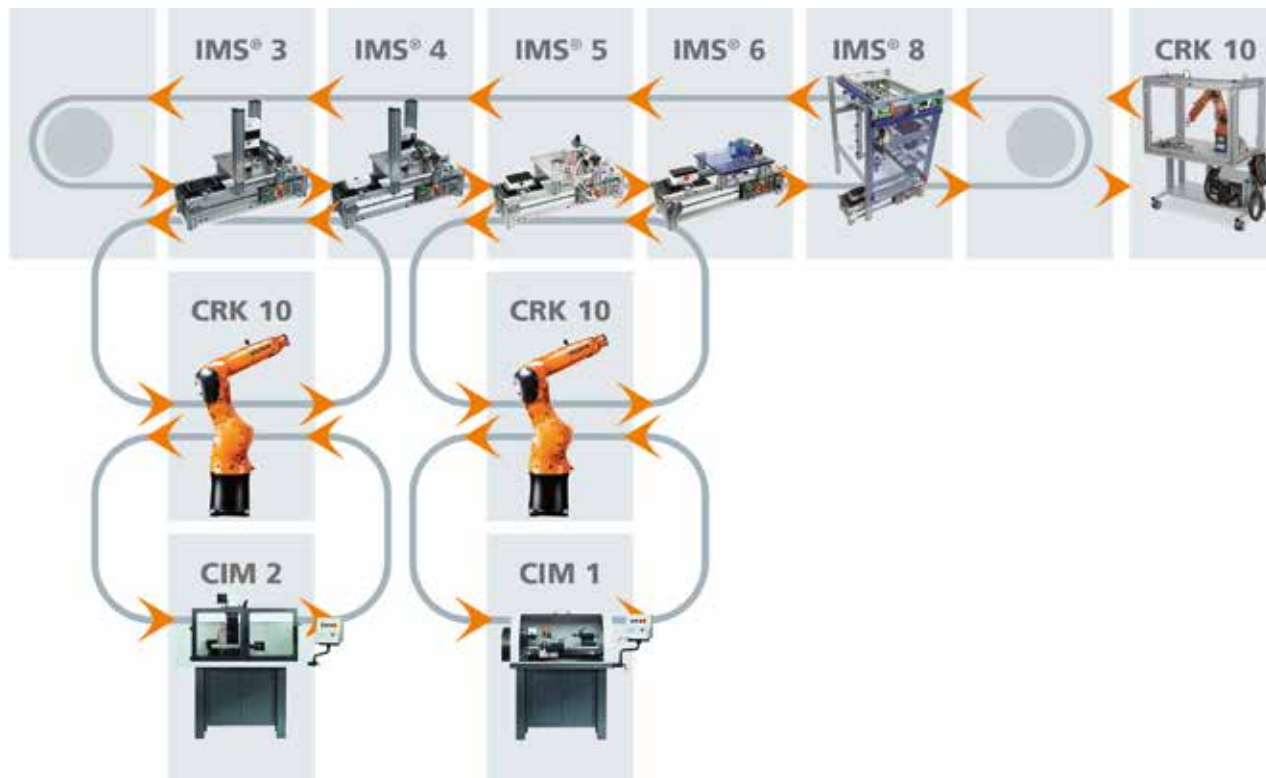
CIM 22 – Production lines with 10 subsystems

IMS® 3 – Sorting, IMS® 4 – Assembly, IMS® 5 – Processing, IMS® 6 – Testing, IMS® 8 – Storage, CRK 10 – Disassembly, 2 x CRK 10 – Robot, CIM 1 – Lathe, CIM 2 – Milling machine

Same as CIM 21, but also includes:

CRK 10 – Disassembly

The robot extracts the workpiece from the conveyor belt and places it in the disassembly station. There it dismantles the workpiece into its component parts. When this has been completed, the robot sorts the components into the appropriate storage destinations.



CIM 23 – Production lines with 12 subsystems

IMS® 3 – Sorting, IMS® 4 – Assembly, IMS® 5 – Processing, IMS® 6 – Testing, IMS® 8 – Storage, IMS® 9 – Routing, IMS® 10 – Buffering, CRK 10 – Disassembly, 2 x CRK 10 – Robot, CIM 1 – Lathe Machine, CIM 2 – Milling Machine

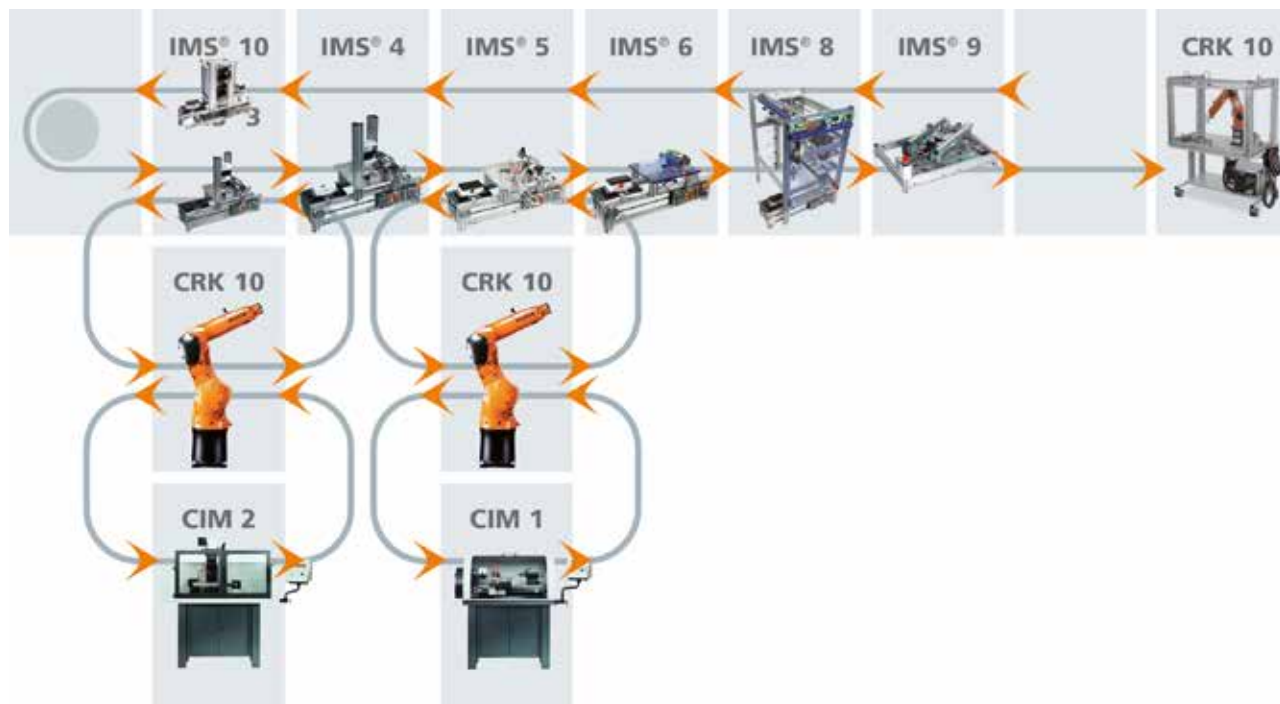
Same as CIM 22, but also includes:

IMS® 9 – Routing

The routing unit can route the workpiece to a different subsystem or reverse its direction of motion.

IMS® 10 – Buffering

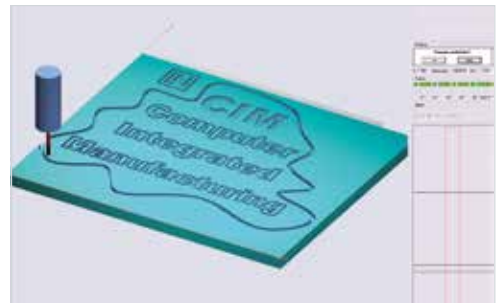
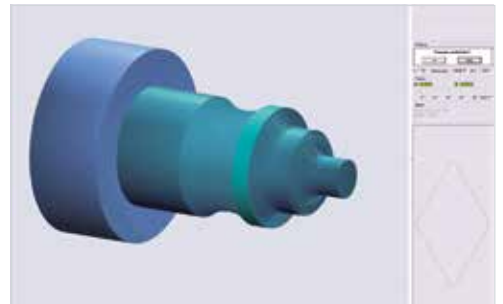
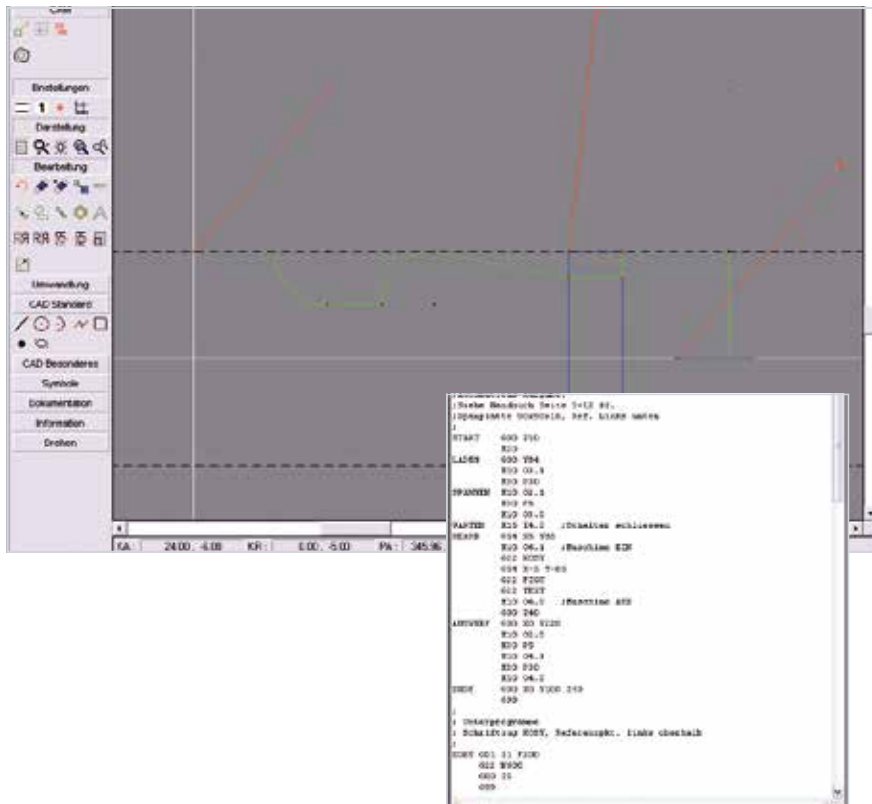
If more than one workpiece carrier is located on the conveyor belt, the buffering subsystem controls the flow of materials. The workpiece carrier is raised by means of a lifting device. If needed the workpiece carrier can be returned to the conveyor belt.



Programming Software

Creating programs

The software provided with the machinery gives you the easiest way to go from product construction to finished workpiece. Thanks to straightforward and intuitive operation, complex contours from any given drawing in DSX or HPGL format can be loaded into the CNC machine for processing.



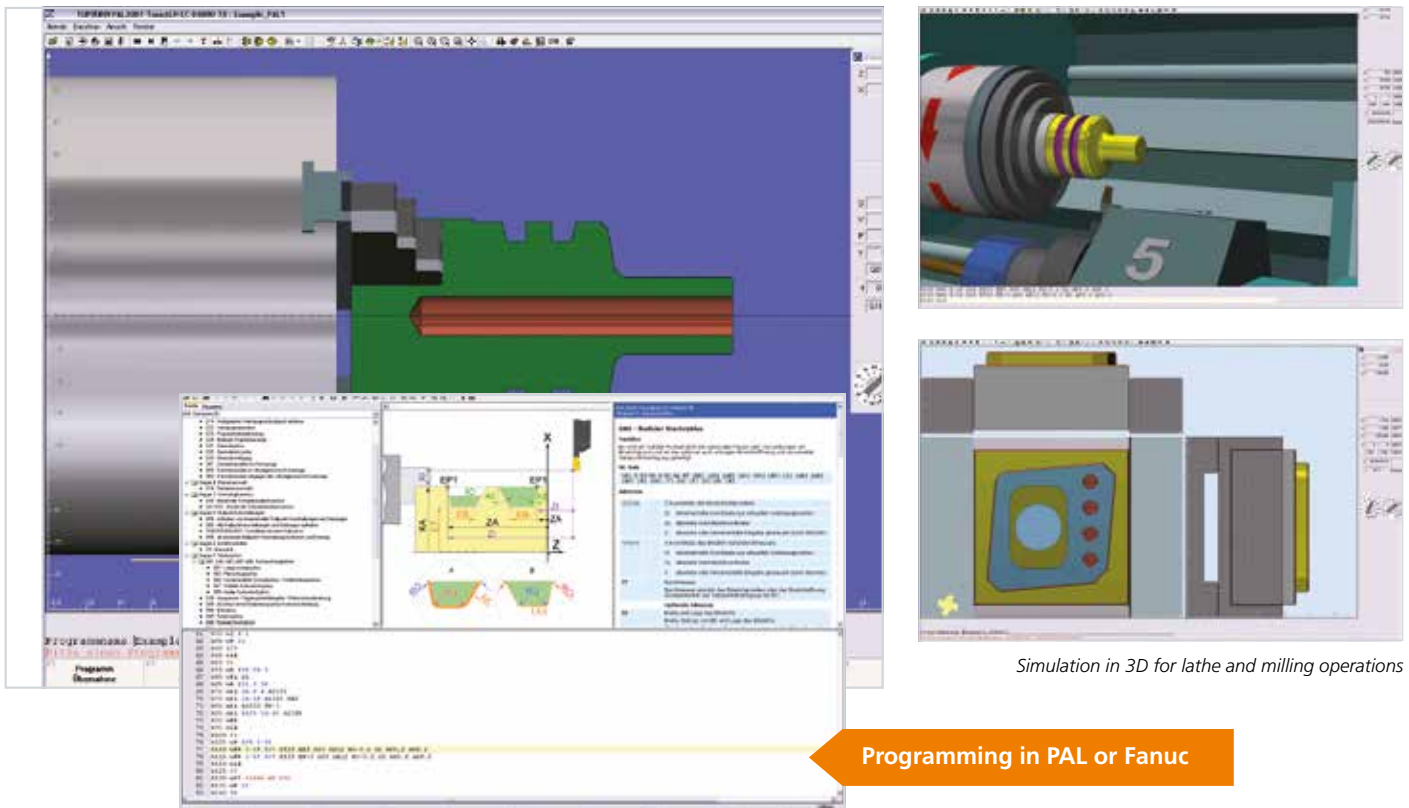
Simulation in 3D for machining using lathe and milling machine

Scope of functions

- Program input in accordance with DIN 66025 using G and M functions, as well as graphic programming
- 3D or 2D simulation of machining operation with tool depicted
- Automatic CNC programming
- Manual operating panel
- Data transfer from DXF or CAD files and conversion into a working program
- Input of technology values
- Machine-independent programming

Professional 3D programming software

Direct programming of CNC machines is possible using the professional 3D programming software. These programs can be created in PAL or Fanuc and simulated in 3D, tested and converted into machine G-code using a post-processor especially adapted for CIM 1/2 machines. The professional 3D software is available in the lathe and milling machine version. Automated manufacture feature is also possible. This is achieved by deploying a tool changer, a thread cutter in CNC operation, an electronic handwheel as well as the use of higher processing speeds.



Simulation in 3D for lathe and milling operations

Programming in PAL or Fanuc

Scope of functions

- Program input according to DIN 66025 with G and M functions, as well as PAL programming
- 3D or 2D simulation of the machining process with machine and tool depicted
- Data transfer from PAL or Fanuc source code and conversion into a working G program code
- Input of technology values
- Machine-independent programming
- Cutting radius compensation

Essential Product Benefits

Ensuring Long-Term Customer Satisfaction



Michael Lorf, lecturer at the Leopold-Hoesch vocational college, Dortmund, Germany:

I'm a great fan of the "Industrial Mechatronics System" IMS. It's a flexible system that can always be put together in a different way depending on your needs. No other manufacturers offer anything like it. Its tremendous extensibility makes it quite simple to adapt it from parallel wiring to a bus system. The integration of frequency converters and RFID labels is also very useful from a training point of view.

We are using the "Industrial Mechatronics System" IMS in a pallet return system and have added safety equipment to it as well. That too was implemented without any difficulties.

The documentation is great as well.

IMS corresponds to genuine industrial standards. It is therefore ideal for use in project work involving authentic conditions. Components can easily be added, removed or relocated. It is ideal for **working in a classroom environment**. The robust design matches up to the tough demands of everyday life in schools and colleges.

Now we have a really great system that impresses not only teachers and students but also a great many of our visitors.

The Whole is Greater than the Sum of its Parts

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