

# Training Systems for Automation



**i 4.0**  
INSIDE





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# The Drive & Control Academy

Access to unparalleled knowledge.

[www.boschrexroth.de/academy](http://www.boschrexroth.de/academy)



As a leading specialist in drive and control technology worldwide, Bosch Rexroth has unparalleled technological expertise. We are pleased to share this knowledge with trainees and students, as well as technical specialists and employees. At the Drive & Control Academy, we support customized training, development and qualification of technical specialists. Practical, tailored to the target audience, state-of-the-art.

### Knowledge is Everything

The specialized knowledge and expertise of employees provide a crucial advantage in a competitive global market. At the Drive & Control Academy, Rexroth offers trainees a practical portfolio of educational products in the field of drive and control technologies. The Academy sets the standard, especially in its didactic approach to specialized and integrated expertise, whether for customers, employees, or training institutions.

Everything we offer is based on the same principles:

1. Practical, state-of-the-art equipment
2. Training tailored to specific target groups
3. Cutting-edge instruction formats and media

The concept of the Drive & Control Academy is based on our four pillars of knowledge transfer: Training, Training Systems, Media and the Knowledge Portal.

### Training Systems

The modular training systems developed by our Rexroth specialists provide both novices and more advanced students with technical expertise and the competence to develop practical solutions. Industrial serial components – with international, standardized programming languages and open interfaces – turn sound, practical knowledge into true experience.

For further information please visit:

[www.boschrexroth.de/trainingsystems](http://www.boschrexroth.de/trainingsystems)

### Media

Rexroth aspires to offer training and learning material that are always at the leading edge of technology, and at the same time provide a high degree of practical relevance. This is why we provide state-of-the-art eLearning and training modules with abundant animations and simulation-based learning units. Furthermore, printed specialist and user manuals, eBooks, apps, software and helpful tools are included.

For further information please visit:  
[www.boschrexroth.de/trainingmedia](http://www.boschrexroth.de/trainingmedia)

### Training

Knowledge transfer at Rexroth is always at the highest technical level using state-of-the-art methods and media. Whether face-to-face training, eLearning or eTraining with online access via Rexroth LearnWorld; whether specialized practical training or blended learning, which provide an ideal combination with face-to-face training and eLearning – regardless which training method: the principle of customer focus is at center stage.

For further information please visit:  
[www.boschrexroth.de/training](http://www.boschrexroth.de/training)



# Training Systems for Automation

Rexroth's technical expertise and its competence to provide solutions for industrial applications flow seamlessly into the modular structure of our training systems – ensuring that they precisely fulfill the qualification levels required by the industry.

## **Bosch Rexroth Training Systems**

Bosch Rexroth's training systems are based on standard components from our various product ranges. Trainees on these systems will find the same industry components in machines and systems later in their careers – a distinct advantage!

In addition, there are exercises for each training system, which, together with the hardware, illustrate particular learning topics. Along with the exercises, trainers receive solutions that include additional learning points. With the help of our training systems, beginners and advanced students develop hands-on, technical expertise, step-by-step. In addition to the training systems for automation described here in the catalog, Bosch Rexroth offers training systems in the fields of hydraulics and pneumatics. Information on these and additional options by the Drive & Control Academy is available at the Bosch Rexroth website at:

<http://www.boschrexroth.com/academy>

## **Training Systems for Automation**

In the automation industry, Bosch Rexroth provides a broad range of training systems which are described in this catalog. In order to provide an overview of our training systems, a graphic representation of all the learning topics for automation was created. Besides this general overview, there are more detailed summaries for each technology. The learning path for automation begins with the individual technologies, which must be mastered by anyone who wants to join the world of automation.

The individual technologies offered are:

- ▶ Sensor Technology
- ▶ PLC
- ▶ Drive Technology:
  - Electric
  - Hydraulic
  - Pneumatic

Getting to know the individual technologies is the gateway to the world of mechatronics/automation. Bosch Rexroth divides the topics into Basic, Advanced and Professional, the content of which is based on the general curriculum for the industrial mechatronics engineer. For the Professional range, additional training systems for supplemental learning topics such as robotics or Industry 4.0 are offered. Thus, for all learning topics, Bosch Rexroth provides training systems that are perfectly suited for professional development and application not only in vocational and technical schools, but even at the university level. From imparting knowledge in PLC technology to complex systems with robotics – our systems for automation meet all the requirements in this industry.

## **Modular Mechatronics System mMS4.0**

The modular mechatronics system (mMS4.0) by Bosch Rexroth consists of three stations, which may be combined into an integrated system and thus replicate a complete manufacturing system. Each unit has its own PLC.



Therefore, the stations can also be used individually, so that more trainees can take advantage of the system. The mMS4.0 contains all technologies for driving, controlling and operating, such as pneumatics, hydraulics, electric drives, linear motion technology, sensors, control technology, PLC programming and bus technology. By installing different firmware, the PLC can also be used as a CNC control. The mMS4.0 system is the basic system for all learning topics for Industry 4.0.

### Robotics

Bosch Rexroth covers the field of robotics with three different robotic technologies: a 6-axis articulated robot, a SCARA robot and a collaborating robot (6-axis) that can interact with humans. This robot has been approved by the trade association. All robots are used in the industry and meet industry standards.

### Programmable Logic Controller (PLC)

The PLC used in the Bosch Rexroth training systems is a CoDeSys-based PLC, which can be programmed using Instruction List, Ladder Diagram, Function Block Diagram, Sequential Function Chart and Structured Text according to IEC 61131-3. The PLC has a flash card, on which the firmware and program can be installed and stored, and which enables conversion to a CNC control (flash card with different firmware required). Via OpenCore engineering, the PLC offers the additional ability to access the control via other programming languages (e.g. VBA, C++, C#, Java, etc.). It is also possible to communicate directly with the PLC using software programs (e.g. LabView, MatLab/Simulink, Excel, Power-Point, etc.), so that no PLC program is needed. Data can be read or written directly.



**Industry 4.0**

The PLC described above is the ideal interface between the automation and IT worlds. The various learning topics such as RFID, MES, tablet operation, cloud computing, energy efficiency, etc. are shown on the mMS4.0 with extension device sets. To achieve this, Bosch Rexroth applies experience from its own factories where i4.0 has already been implemented. Thus, Bosch Rexroth is no longer just a key user, but now becomes a key supplier.

**Special Topics**

Bosch Rexroth also offers training systems for additional topics such as linear technology, safety technology, or energy efficiency. We can provide customized training systems based on the knowledge gained through implementation of these topics in our own factories.



# Knowledge Transfer Using Learning Topics





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# Terminology

Learning Topic with Material Number for Device Set and Catalog Page

Multiple device sets with corresponding exercises can be used for a particular learning topic. This catalog contains the learning topics Sensor Technology, PLC, Drive Technology (Electric, Hydraulic, Pneumatic), Basic Mechatronics and Advanced-Professional Mechatronics. A device set is a combination of components for carrying out practical exercises.

Material Number for Device Expansion Set and Catalog Page

A device expansion set is the additional equipment needed to get from one learning topic to another.

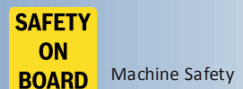
Additional Learning Topics with Material Number for Device Expansion Set and Catalog Page

Additional learning topics are, for example, the topics for Industry 4.0. These additional learning topics are offered to supplement and deepen special topics. They can then be taught with the help of device expansion sets and the corresponding exercises.

- Work Stations
- Training System
- Spare Parts
- Accessories
- BIBB

- Work stations allow the use of components from the device sets for carrying out the practical exercises in the exercise books.
- A training system combines work stations, device sets, and exercise books.
- Spare parts are parts that are installed into components or work stations.
- Accessories are complementary products that can be used optionally.
- Federal Institute for Vocational Education and Training (Bundesinstitut für berufliche Bildung)

## Icons





## Basic

- ▶ Structure and functionality of components and assemblies
- ▶ Information collection via sensors and measuring equipment
- ▶ Mode of operation and control of drive systems
- ▶ Reading and preparing technical documentation
- ▶ Analysis, creation, implementation and testing of basic circuits and functional relationships
- ▶ Creation and implementation of sequence and state controllers

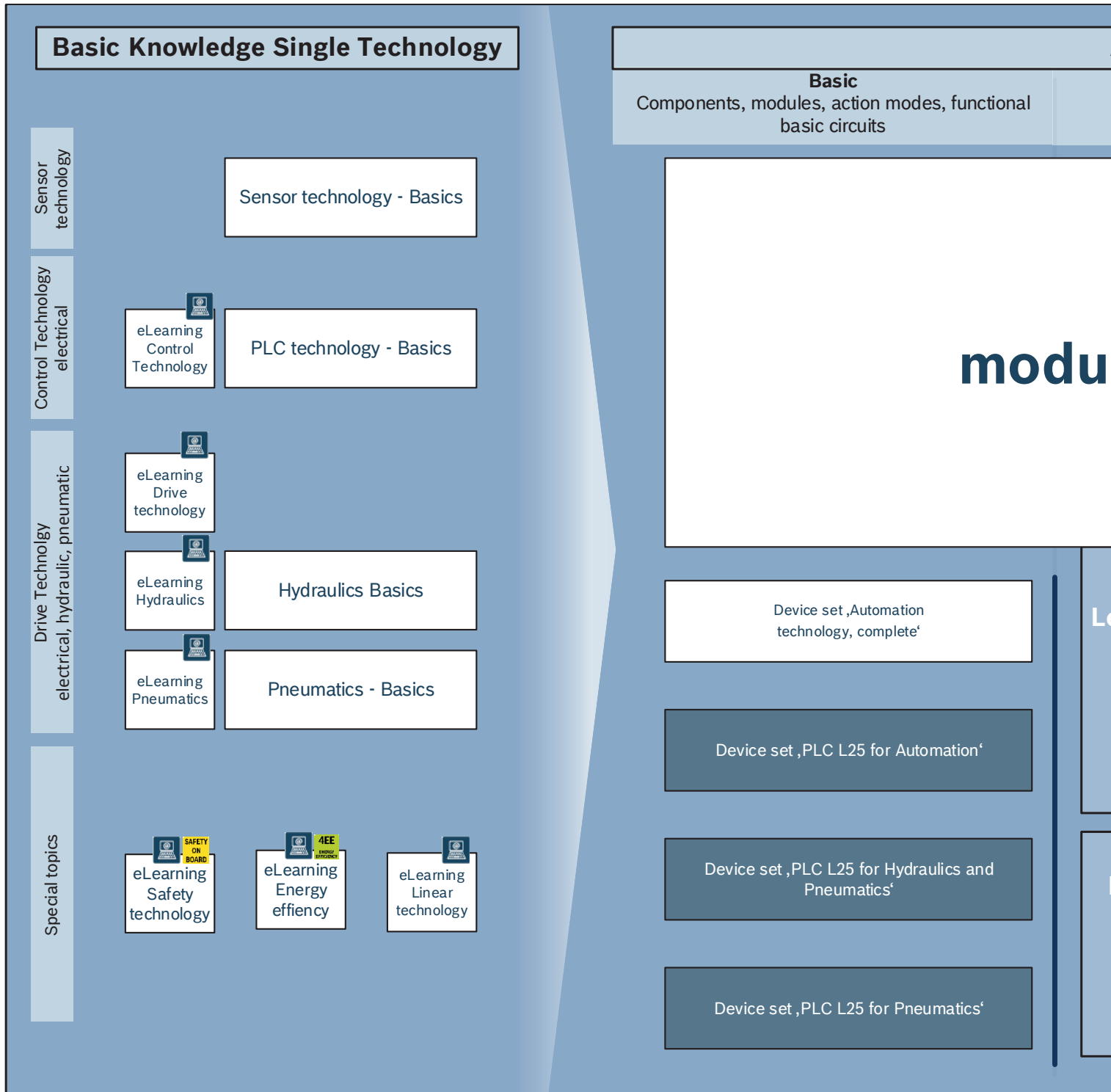
## Advanced

- ▶ Implementation of partial mechatronic systems
- ▶ Analysis of energy and information flow, and of security systems
- ▶ Commissioning, troubleshooting and repair
- ▶ Analysis, editing, supplementing and creation of extensive and complete technical documentation
- ▶ Programming of sequence and state controllers, and implementation of regulations

## Professional

- ▶ Use and operation of complex mechatronic systems
- ▶ Networking of communication and interfaces between applications and systems
- ▶ Maintenance concepts
- ▶ Programming, visualization and operation of machines, applications and processes
- ▶ Implementation and programming of safety systems

# General Overview of Learning Topics





## Automation / Mechatronics – Sensor technology

### Advanced

Mechatronics systems, information flow, control, closed loop

### Professional

Complex mechatronic systems, networking



Robotics cartesian

Robotics-Scara



Robotics-Articulated Arm



Robotics-Collaborating

# lar Mechatronic-System mMS 4.0

### Additional Learning topics at mMS 4.0



- eLearning SERCOS
- Expansion ,Machine Safety<sup>f</sup>
- Expansion ,HMI-Integration und Programmig<sup>f</sup>
- Expansion ,CNC-Technology<sup>f</sup>
- Additional Learn topics on mMS 4.0

### Additional Learning topics for Industry 4.0 at mMS 4.0



- Expansion ,OpenCore Engineering via Tablet-PC<sup>f</sup>
- Expansion ,RFID-Technology<sup>f</sup>
- Expansion, Interactive Visualization- and Control Board (Active Cockpit)<sup>f</sup>
- Additional Learning topics for Industry 4.0 on mMS 4.0

“Terminology” on page 13



# Learning Topics for Individual Technologies

## Sensor Technology

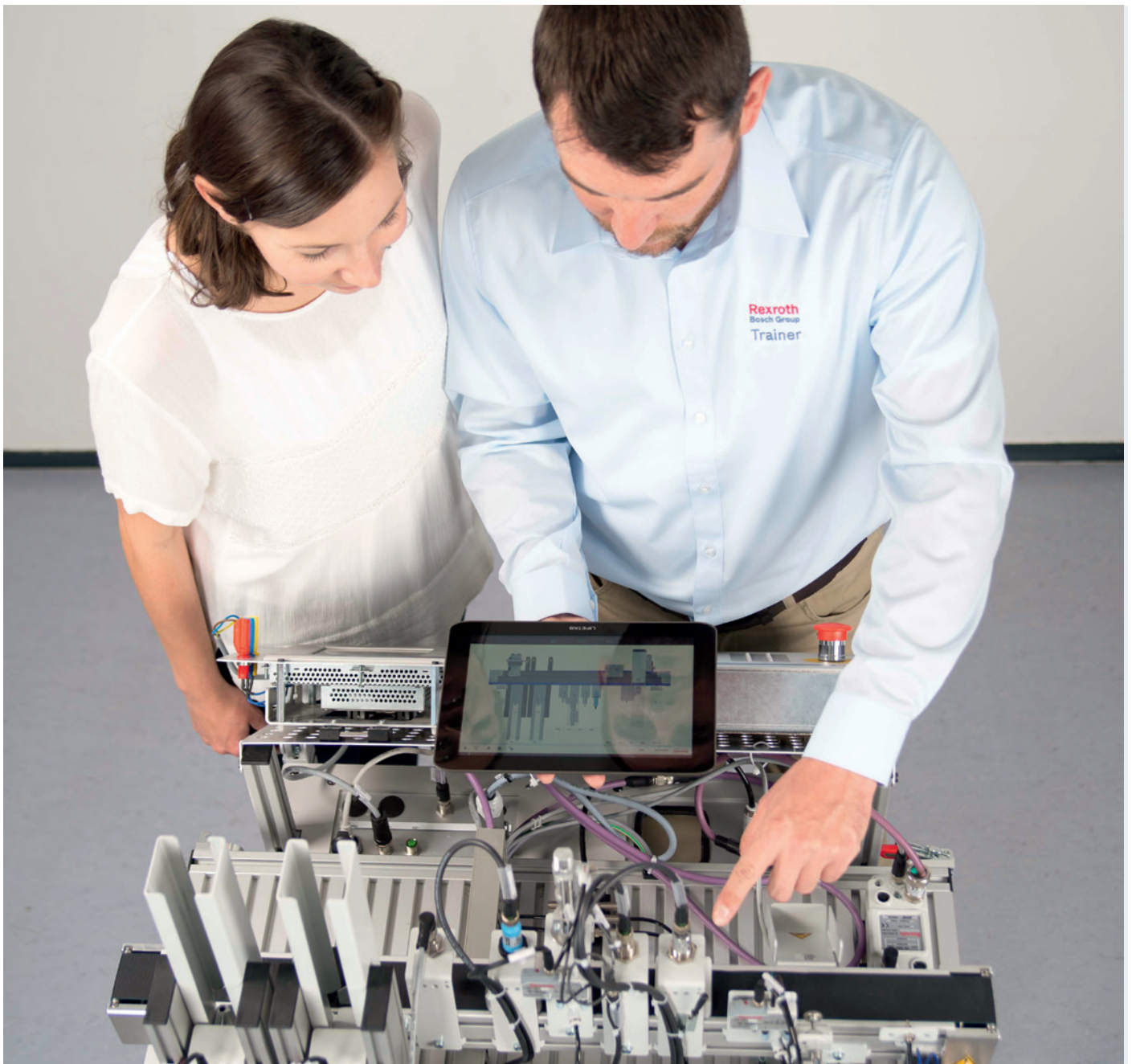




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Drive & Control Academy

Knowledge Transfer Using Learning Topics

Learning Topics Individual Technologies

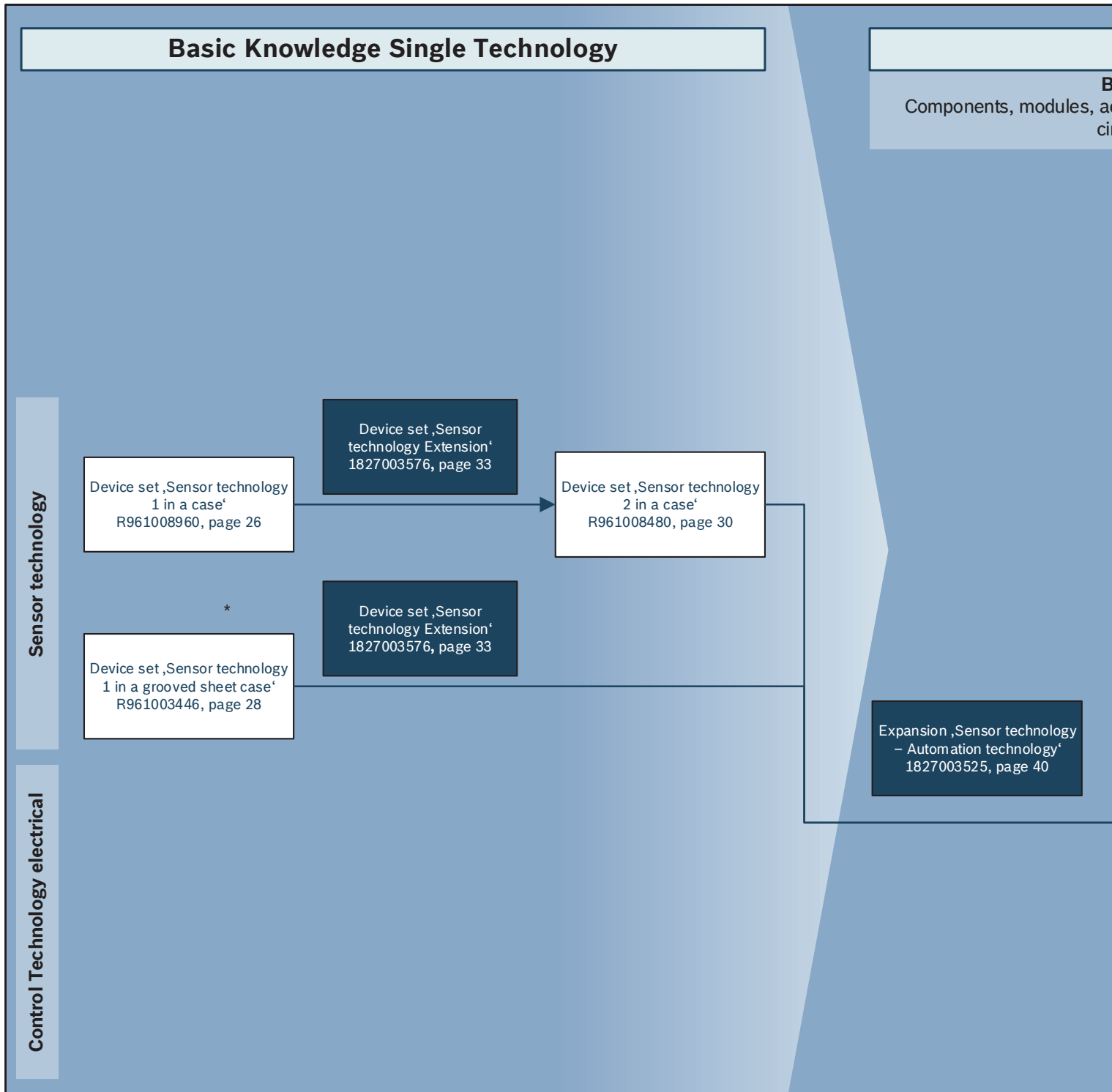
Learning Topics Mechatronics/Automation

Application-Specific Systems

Components and Spare Parts

Indices

# Learning Topics for Sensor Technology – Overview of Device Sets



## Automation / Mechatronics - Sensor technology

Basic Function modes, functional basic circuits	Advanced Mechatronic systems, information flow, control, closed loop	Professional Complex mechatronic systems, networking
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**modular Mechatronic System**

PLC-Sensor technology

**mMS 4.0**

**R901423235, page 138**

Device set ,Sensor technology  
 – Automation technology,  
 complete'  
 R901463160, page 38

Device set ,PLC L25 for  
 Automation'  
 R901420828, page 42

“Terminology” on page 13

## Sensor Technology – Basics

The learning goal is to acquire functionality principles, parameters and industrial implementation options, for inductive, capacitive, optoelectronic, magnet-field and ultrasonic sensors.

The successful completion of the practical exercises in the corresponding exercise books will result in the acquisition of knowledge about using sensors.

### Exercise Books

The exercise books coordinate with the device sets.

The exercises and tasks provide basic information and methods. They have a uniform structure and the execution of the individual exercises is explained step by step.

#### Two Versions

- ▶ Exercises with solutions: more extensive trainer information and content such as measured values, calculation results, etc.
- ▶ Exercises: independent completion of calculations and measured value tables, etc.

#### Learning Content

This exercise book contains a total of 56 exercises.

- ▶ The introductory exercises show the trainee typical behaviors of the sensors. The goal is to determine which sensors can detect which materials are used and which ones cannot
- ▶ In the basic exercises, the most important practical characteristics such as switching distance, scanning range and scope, hysteresis, reduction factor, response curve and switching frequency are transmitted to the individual sensors.
- ▶ The additional exercises provide the trainee with insight into the industries where sensors are used. For example, implementing a material selection or level measurement is illustrated. In addition, specific disruptive factors for individual sensors are investigated.



*Example Exercise Book*



<b>Exercise Books “Sensor Technology – Basics”</b>			
	<b>Lang.</b>	<b>Material Number</b>	<b>Typecode*</b>
Exercises with Solutions (Trainer Handbook)	DE	R961004455	UEBUNGSBUCH SEN LOESUNG GRUN- DLAG&
Exercises with Solutions (Trainer Handbook)	EN	R961004462	EXERCISE BOOK SEN LOESUNG GRUN- DLAG&
Exercises (Trainee Handbook)	DE	R961004454	UEBUNGSBUCH SEN UEBUNG GRUND- LAGEN
Exercises (Trainee Handbook)	EN	R961004463	EXERCISE BOOK SEN UEBUNG GRUN- DLAGEN

Drive & Control Academy

Knowledge Transfer Using Learning Topics

Learning Topics Individual Technologies

Learning Topics Mechatronics/Automation

Application-Specific Systems

Components and Spare Parts

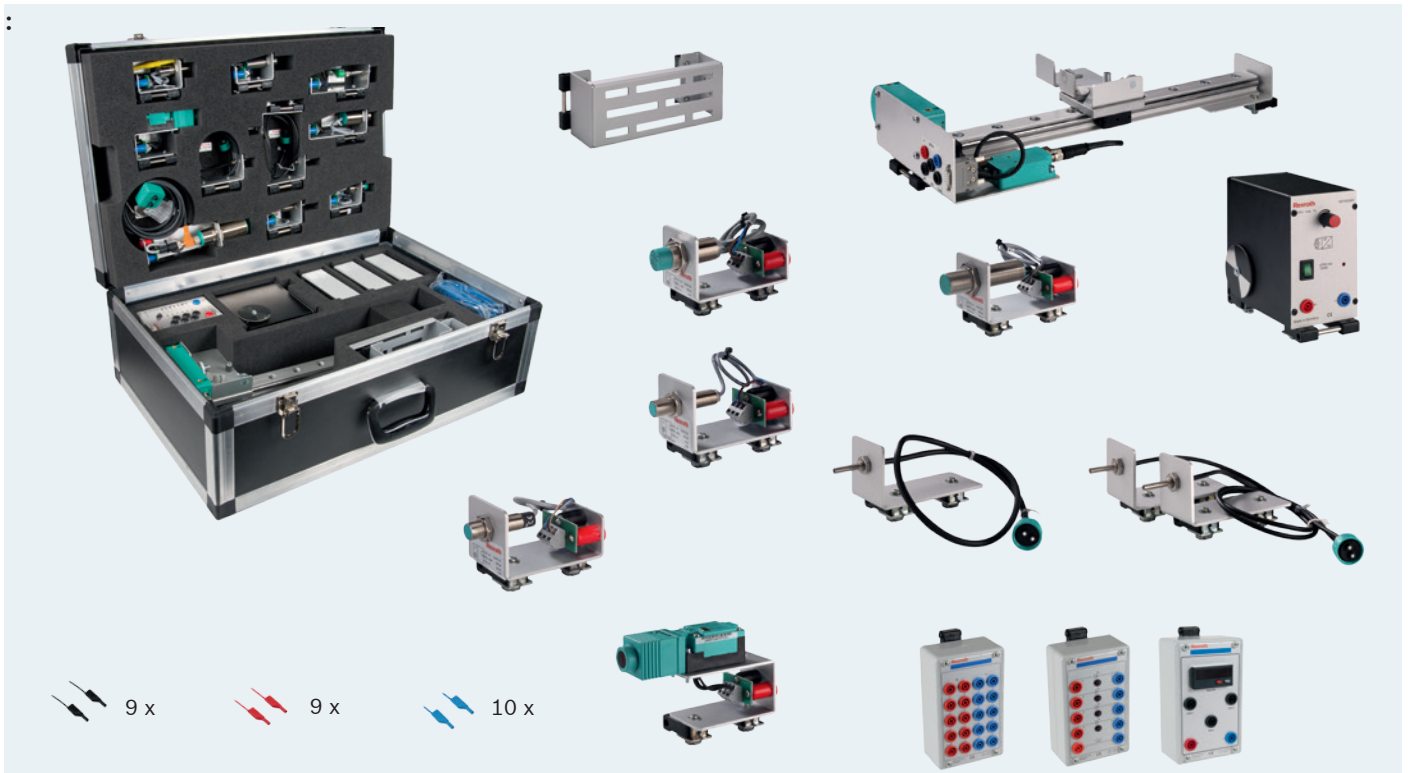
Indices

\* Note to our customers: The typecode is determined by our system. It is listed here so that you can recognize it on your delivery note.





**Device Set “Sensor Technology 1 in Case”**

Material Number R961008960  
Typecode EQUIPMENT SET TS-AS 101-2X-K

This device set is used to conduct practical exercises in the field of sensor technology. It coordinates with the exercise book “Sensor Technology – Basics,” and can be used to perform a selection of the (33) exercises for introductory, basic, and supplemental practice. The device set is delivered in a practical case system, which is equally suited for transport and storage. The case is prefabricated with cutouts already in place for the components of the device set “Sensor Technology – Expansion Set.”





**Device set R961008960 contains the following components:**

Item	Description of Individual Components	Material No. of Ind. Components	Quantity	Image	Page
1	Height adjuster for sensors	1827003640	1		213
2	Measuring cable 500 mm, red	1827003215	9		211
3	Measuring cables 500 mm, blue	1827003216	10		211
4	Measuring cables 500 mm, black	1827003217	9		211
5	Sensor technology guide unit, 385 mm	R961009383	1		213

<b>Device set R961008960 contains the following components:</b>					
<b>Item</b>	<b>Description of Individual Components</b>	<b>Material No. of Ind. Components</b>	<b>Quantity</b>	<b>Image</b>	<b>Page</b>
6	Motor control unit	1827003642	1		209
7	Clock frequency module	R961009625	1		208
8	Distributor, in housing, 10 ports	R961009614	1		212
9	Sensor, inductive, Sn = 8 mm	1827003645	1		203
10	Sensor, inductive, Sn = 2 mm	1827003647	1		203
11	Sensor, capacitive, Sn = 8 mm	1827003648	1		205
12	Sensor, magnet field, Sn = 60 mm	1827003649	1		206
13	Reflective light scanner, Sn = 200 mm	1827003654	1		208
14	Fiber-optic cables, scanning operation	1827003656	1		209
15	Fiber-optic cables, one-way operation	1827003657	1		209
16	Display unit, in housing, display 4x optical, 1x acoustic	R961009616	1		210

Additional learning content on the topic of sensor technology can be conducted with our modular mechatronics system mMS4.0 (beginning on page 138).

**Additional accessories required with device set “Sensor Technology 1 in Case – Automation Technology”**

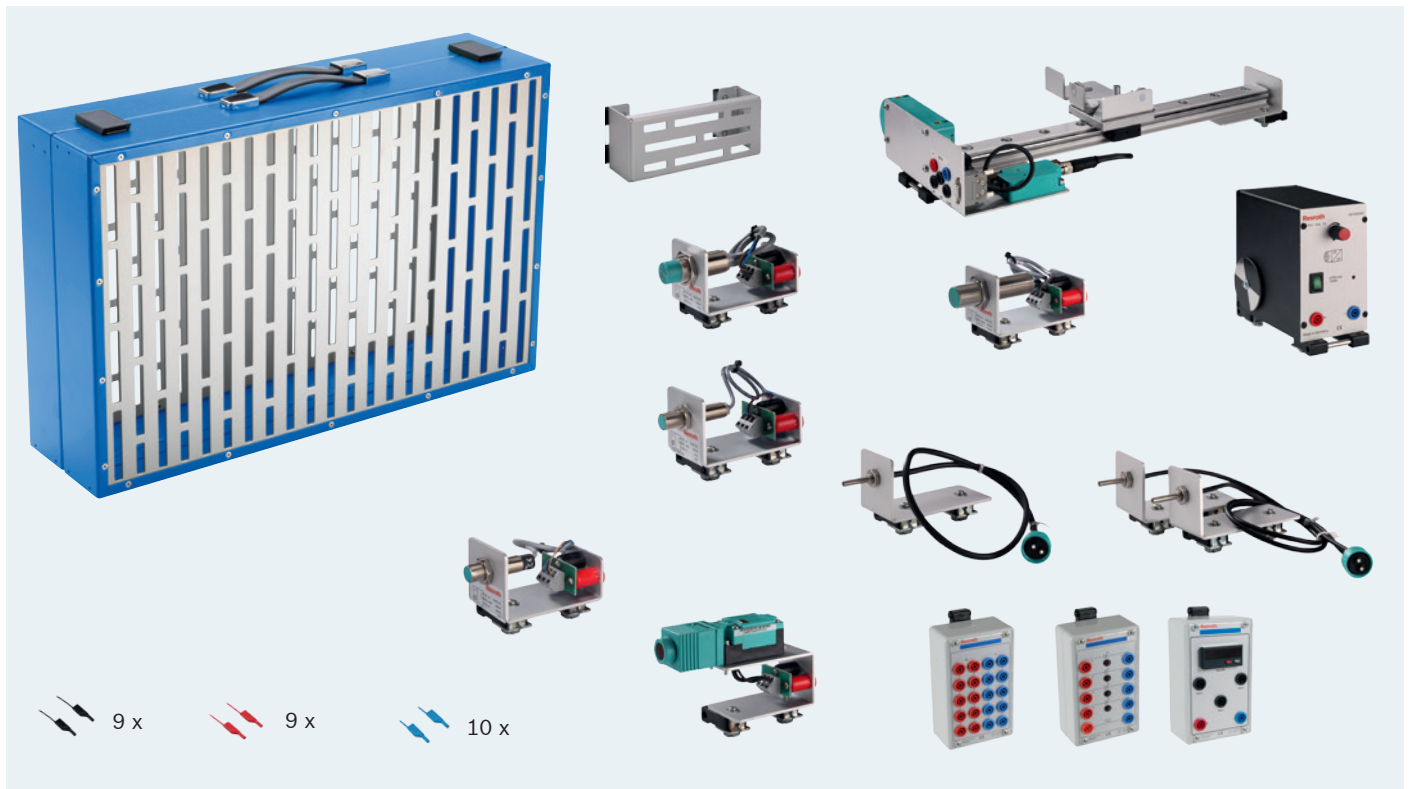
<b>Item</b>	<b>Component</b>	<b>Material No.</b>	<b>Quantity</b>	<b>Image</b>	<b>Page</b>
1	Material sample case	1827003524	1		44
Optional:					
	Power Supply 0-30V, Tabletop	R901229673	1		44

**Device Set “Sensor Technology 1 in Grooved Panel Case”**






Material Number R961003446







Typecode EQUIPMENT SET TS-AS 101-1X-K

The item pictured above, “Sensor Technology 1 in Case” (R961008960), can be shipped alternatively in a sheet metal case, which serves as the work surface for setting up the exercises, as well as being suitable for transport and storage. No additional work station is needed.





**Device set R961003446 contains the following components:**

Item	Description of Individual Components	Material No. of Ind. Components	Quantity	Image	Page
1	Height adjuster for sensors	1827003640	1		213
2	Measuring cables 500 mm, red	1827003215	9		211
3	Measuring cables 500 mm, blue	1827003216	10		211
4	Measuring cables 500 mm, black	1827003217	9		211
5	Sensor technology guide unit, 385 mm	R961009383	1		213

<b>Device set R961003446 contains the following components:</b>					
<b>Item</b>	<b>Description of Individual Components</b>	<b>Material No. of Ind. Components</b>	<b>Quantity</b>	<b>Image</b>	<b>Page</b>
6	Motor control unit	1827003642	1		209
7	Clock frequency module	R961009625	1		208
8	Distributor, in housing, 10 ports	R961009614	1		212
9	Sensor, inductive, Sn = 8 mm	1827003645	1		203
10	Sensor, inductive, Sn = 2 mm	1827003647	1		203
11	Sensor, capacitive, Sn = 8 mm	1827003648	1		205
12	Sensor, magnet field, Sn = 60 mm	1827003649	1		206
13	Light scanner, Sn = 200 mm	1827003654	1		208
14	Fiber-optic cable, scan mode	1827003656	1		209
15	Fiber-optic cable, one-way mode	1827003657	1		209
16	Display unit, in housing, display 4x optical, 1x acoustic	R961009616	1		210

**Additional accessories required with device set “Sensor Technology 1 in Grooved Panel Case”**

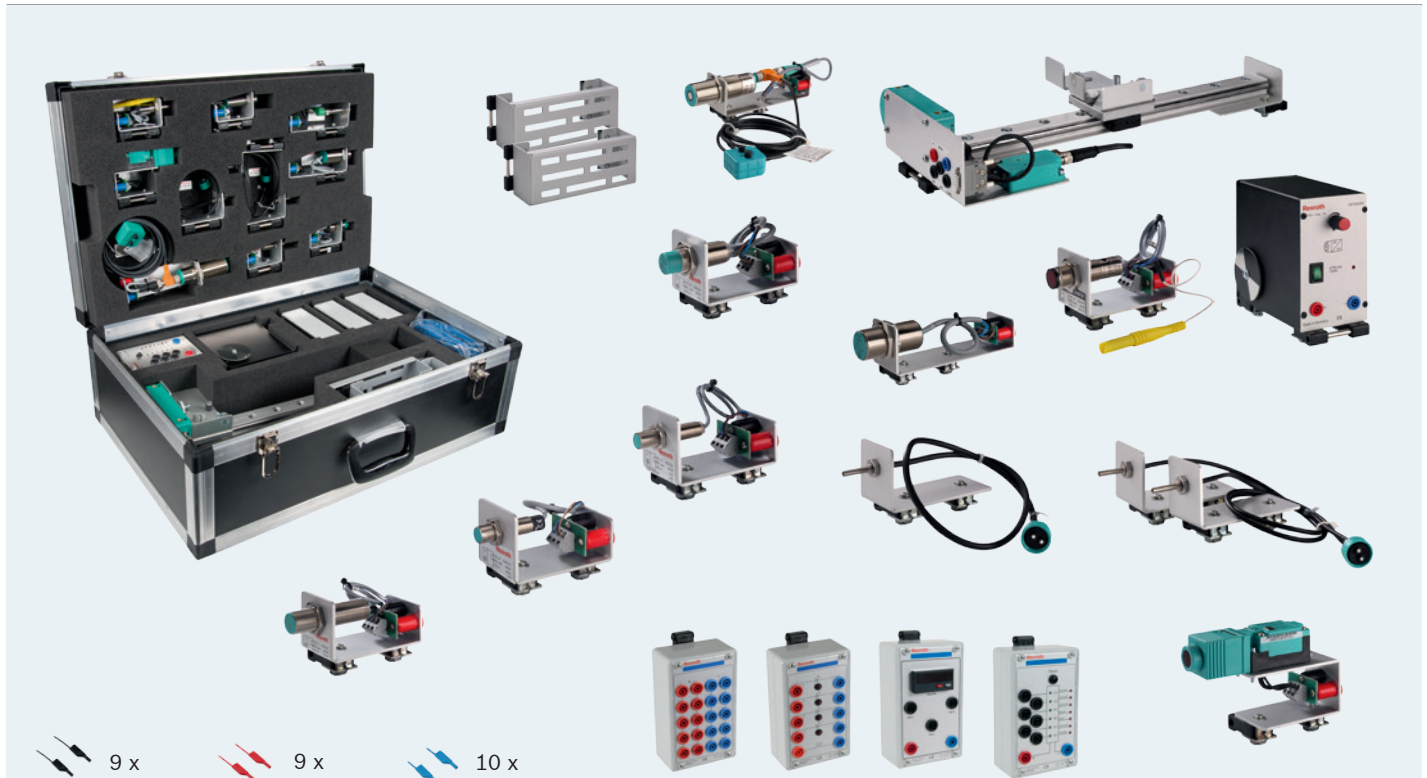
<b>Item</b>	<b>Component</b>	<b>Material No.</b>	<b>Quantity</b>	<b>Image</b>	<b>Page</b>
1	Material sample case	1827003524	1		44
Optional:					
	Power Supply 0-30V, Tabletop	R901229673	1		44

**Device Set “Sensor Technology 2 in Case”**

Material Number R961008480
















Typecode EQUIPMENT SET TS-AS 102-1X-K

This device set is used to conduct practical exercises in the field of sensor technology. It coordinates with the exercise book “Sensor Technology – Basics,“ which means that it can be used to complete all 56 of the exercises that encompass introductory, basic and supplemental practice. The device set, which consists of the basic kit and expansion kit, is equally suited for both transport and storage.



**Device set R961008480 contains the following components:**

Item	Description of Individual Components	Material No. of Ind. Components	Quantity	Image	Page
1	Height adjuster for sensors	1827003640	1		213
2	Measuring cables 500 mm, red	1827003215	9		211
3	Measuring cables 500 mm, blue	1827003216	10		211
4	Measuring cables 500 mm, black	1827003217	9		211
5	Sensor technology guide unit, 385 mm	R961009383	1		213

<b>Device set R961008480 contains the following components:</b>					
<b>Item</b>	<b>Description of Individual Components</b>	<b>Material No. of Ind. Components</b>	<b>Quantity</b>	<b>Image</b>	<b>Page</b>
6	Motor control unit	1827003642	1		209
7	Clock frequency module	R961009625	1		208
8	Distributor, in housing, 10 ports	R961009614	1		212
9	Sensor, inductive, Sn = 8 mm	1827003645	1		203
10	Sensor, inductive, Sn = 2 mm	1827003647	1		203
11	Sensor, capacitive, Sn = 8 mm	1827003648	1		205
12	Sensor, magnet field, Sn = 60 mm	1827003649	1		206
13	Reflective light scanner, Sn = 200 mm	1827003654	1		208
14	Fiber optic cable, scanning operation	1827003656	1		209
15	Fiber optic cable, one-way operation	1827003657	1		209
16	Display unit, in housing, display 4x optical, 1x acoustic	R961009616	1		210
17	Height adjustment for sensors	1827003640	1		213
18	Inductive analog encoder, linear measuring range 3 to 8 mm	1827003635	1		207
19	Evaluation unit, in housing, digital material distinction	R961009627	1		210
20	Ultrasonic sensor module, Sn = 30 - 500 mm	1827003637	1		206

Drive & Control Academy

Knowledge Transfer Using Learning Topics

Learning Topics Individual Technologies


Learning Topics Mechatronics/Automation

Application-Specific Systems

Components and Spare Parts



Indices

**Device set R961008480 contains the following components:**

Item	Description of Individual Components	Material No. of Ind. Components	Quantity	Image	Page
21	Reflective light barrier, Sn = 4000 mm	1827003638	1		207

Items 17 to 21 also available as device set “Sensor Technology – Expansion” (1827003576).

**Additional accessories required with device set “Sensor Technology 2 in Case”**

Item	Component	Material No.	Quantity	Image	Page
1	Material sample case	1827003524	1		44
Optional:					
	Power supply unit 0-30V, tabletop	R901229673	1		44



**Device Set “Sensor Technology – Expansion”**






Material Number	1827003576
Typocode	EQUIPMENT SET TS-AS 102-1X

This device set is used to conduct practical exercises in the field of sensor technology. It coordinates with the exercise book “Sensor Technology – Basic” and provides expansion for both device sets “Sensor Technology 1 in Case” and “Sensor Technology 1 in Grooved Panel Case” (R961008960 or R961003446).





The listed device sets and this one allow all 56 exercises in the exercise book “Sensor Technology – Basic” to be completed.



**Device set 1827003576 contains the following components:**

Item	Description of Individual Components	Material No. of Div. Components	Quantity	Image	Page
1	Height adjuster for sensors	1827003640	1		213
2	Inductive analog encoder, linear meas. range 3 to 8 mm	1827003635	1		207
3	Evaluation unit, digital material differentiation	R961009627	1		210
4	Ultrasonic sensor, Sn = 30 - 500 mm	1827003637	1		206
5	Reflective light barrier, Sn = 4000 mm	1827003638	1		207

**One of the following work stations is required for the exercises in learning topic “Sensor Technology – Basic”:**

<b>Work Station</b>	<b>Material No.</b>	<b>Image</b>	<b>Page</b>
Work station WS200 for pneumatics, double-sided, for 2 - 4 trainees – assembled, incl. packaging	R961008854		117
Grooved panel case	1827003552		48
Grooved panel (tabletop version, upright)	R961003826		48
Work station DS3 for pneumatics, double-sided for 4 - 6 trainees – assembled, incl. packaging	1827003700		50

Additional learning content on the topic of sensor technology can be conducted with our modular mechatronics system mMS4.0 (beginning on page 138).



## Sensor Technology – Automation

The learning goal is to commission a stepping motor with a geared belt drive using a PLC.

Prerequisite is knowledge of basic PLC programming, as well as electrical and Sensor Technology.

The successful completion of the practical exercises in the corresponding exercise books will result in the acquisition of knowledge at the various levels of automation (sensor) technology.

### Exercise Books

The exercise books coordinate with the device sets.

The exercises and tasks provide basic information and methods. They have a uniform structure and the execution of the individual exercises is explained step by step.

#### Two Versions

- ▶ Exercises with solutions: more extensive trainer information and content such as measured values, calculation results, etc.
- ▶ Exercises: independent completion of calculations and measured value tables, etc.

#### Learning Content

The logically-structured, practical exercises enable the trainee to:

- ▶ understand implementation and function of limit switches
- ▶ learn how to handle input and output signals for the PLC
- ▶ securely shut down an axis
- ▶ read and process sensor signals
- ▶ program PLC sequencers with IndraWorks and IndraLogic L25 software
- ▶ read and understand electrical switching symbols, circuit schematics and PLC program modules



*Example Exercise Book*

**The following exercises are included:**

No.	Exercise
01	Commissioning and Manual Procedure
02	Reading and Calculating Analog Values
03	Commissioning and Jog Mode with PLC
04	Visualization with IndraLogic
05	Operating Modes, Selection and Initial Positioning Run
06	Reading the Reflective Light Sensor
07	Impulse Evaluation
08	Coin Detection
09	Material Selection

Exercise Books "Sensor Technology – Automation"			
	Lang.	Material Number	Typecode
Exercises (Trainee manual)	DE	R961009270	UEBUNGSBUCH TW-AT-SH-1/X 201DE
Exercises (Trainee manual)	EN	R961009774	EXERCISE BOOK TW-AT-SH-1/X 201EN
Exercises with solutions (Trainer manual)	DE	R961009269	UEBUNGSBUCH TW-AT-LH-1/X 201DE
Exercises with solutions (Trainer manual)	EN	R961009775	EXERCISE BOOK TW-AT-LH-1/X 201EN

**Device Set "Sensor Technology – Automation, Complete"**






Material Number R901463160

Typecode EQUIPMENT SET TS-AS 208-1X

This device set is used to conduct practical exercises in the field of sensor technology. It is coordinated with exercises 1 to 9 in the exercise book "Sensor Technology – Automation."




**Device set R901463160 contains the following components:**

Item	Description of Individual Components	Material No. of Individ. Components	Quantity	Image	Page
1	Device expansion set "Sensor Technology – Automation"	1827003525	1		40
2	Device set "PLC L25 for Automation"	R901420828	1		42
3	Distributor, in housing, 10 ports	R961009614	1		212
4	Sensor technology guide unit, 385 mm	R961009383	1		213
5	Height adjuster for sensors	1827003640	2		213

**Device set R901463160 contains the following components:**

Item	Description of Individual Components	Material No. of Individ. Components	Quantity	Image	Page
6	Ultrasonic sensor module, Sn = 30 - 500 mm	1827003637	1		206
7	Reflective light barrier, Sn = 4000 mm	1827003638	1		207
8	Fiber-optic cables, scanning operation	1827003656	1		209
9	Sensor, capacitive, Sn = 8 mm	1827003648	1		205
10	Sensor, inductive, Sn = 8 mm	1827003645	1		203
11	Reflective light scanner, Sn = 200 mm	1827003654	1		208
12	Material sample case	1827003524	1		44

**Accessories required with device set “Sensor Technology – Automation, Complete”:**

Item	Component	Material No.	Quantity	Image	Page
1	Power supply 24 V, snap-in for grooved panel	R961008981	1		45
2	PC or laptop to run the exercises (not included)				

Drive & Control Academy

Knowledge Transfer Using Learning Topics

Learning Topics Individual Technologies

Learning Topics Mechatronics/Automation

Application-Specific Systems

Components and Spare Parts

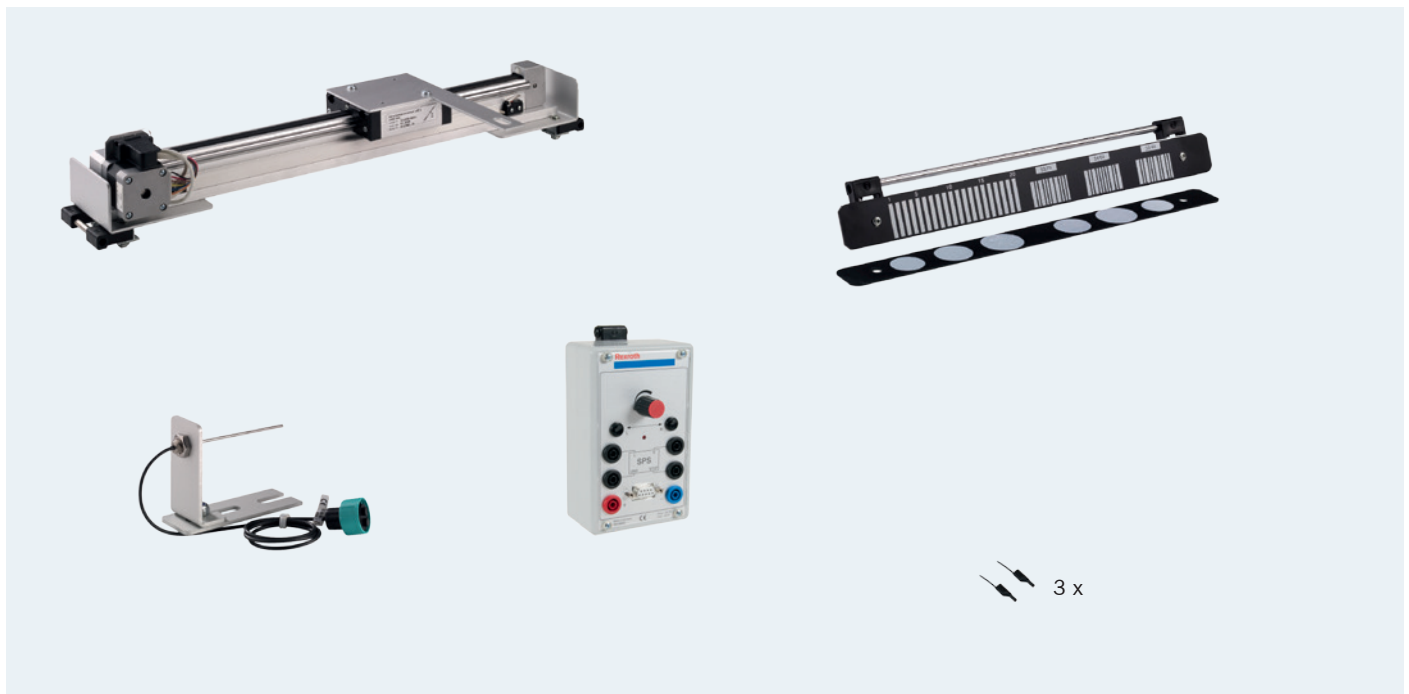
Indices

**Device Expansion Set “Sensor Technology – Automation”**






Material Number 1827003525

Typecode EQUIPMENT SET TS-AS 201-1X

This is a device expansion set for the learning topic “Sensor Technology – Basics.” The device set “PLC L25 for Automation” (R901420828) is also required so that the exercises can be performed. The device expansion set is coordinated with the exercise book “Sensor Technology – Automation.”





**Device set 1827003525 contains the following components:**


Item	Description of Individual Components	Material No. of Indiv. Components	Quantity	Image	Page
1	Stepping motor with geared belt drive	R961002165	1		212
2	Control electronics for stepping motor	R961009629	1		212
3	Optical waveguide with mounting brackets; scanning mode	1827003661	1		210
4	Rail with scanning sample	1827003662	1		211
5	Measuring cables, 500 mm, black	1827003217	3		211



**Additional device sets required with device expansion set “Sensor Technology – Automation”:**

Item	Component	Material No.	Quantity	Image	Page
1	Device set “Sensor Technology 2 in case”	R961008480	1		30
2	Device set "PLC L25 for automation"	R901420828	1		42

**Additional accessories required with device expansion set “Sensor Technology – Automation”:**

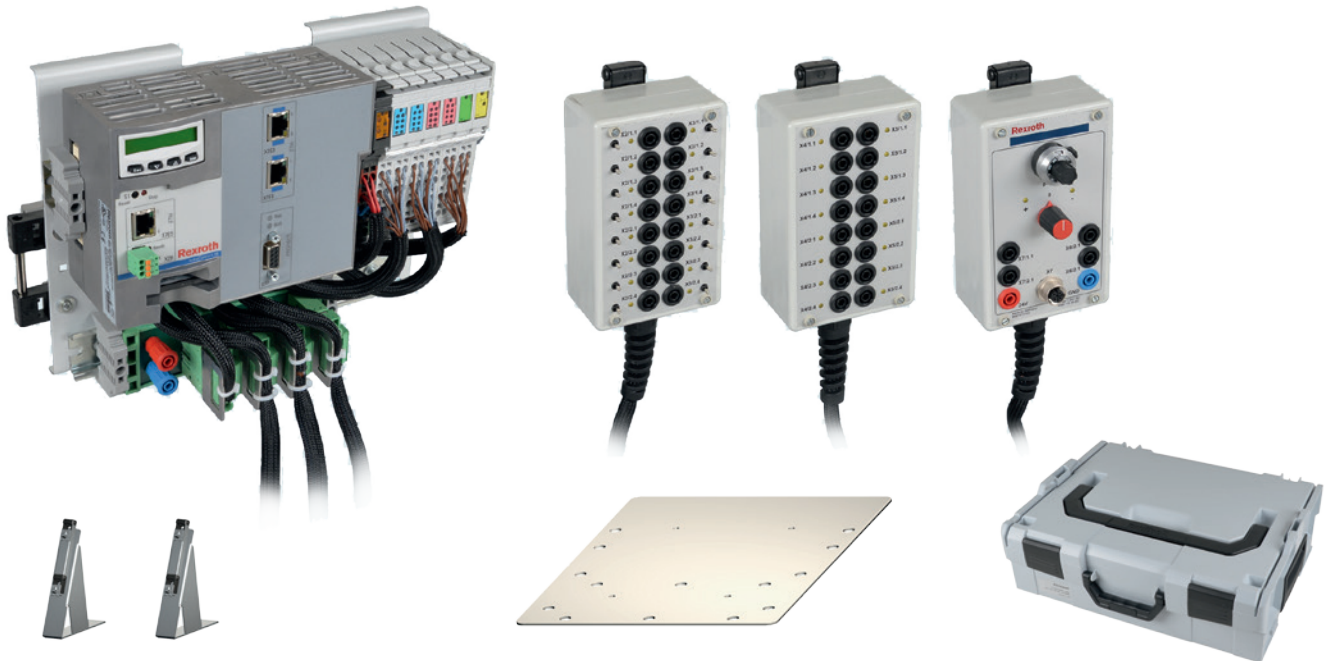
Item	Component	Material No.	Quantity	Image	Page
1	Power supply 24V, snap-in for grooved panel	R961008981	1		45
2	PC or laptop to conduct the exercises (not included)				

**Device Set “PLC L25 for Automation”**







Material Number R901420828

Typocode EQUIPMENT SET TS-AS 105-1X-K

This device set is used to conduct practical exercises in the field of controls, with a focus on automation. It consists of the control XLC L25 with quick-connect system Snap-In. 16 digital inputs are also accessible with a switch/sensor, and 16 digital outputs with an LED display. Analog inputs for voltage +/-10 V, current 0-20 mA or sensor with M12 plug. It coordinates with the exercise book “Sensor Technology – Automation.” The device set is delivered in a practical case (L-Boxx), which is equally suited for transport and storage.



**Device set R901420828 contains the following components:**

Item	Description of Individual Components	Material No. of Indiv. Components	Quantity	Image	Page
1	Indra Control L25 PLC (incl. IndraWorks software tool) with brackets for grooved panel	R901423029	1		216
2	Analog input/output module; input: voltage +/- 10V (potentiometer), current 0 to 20 mA or sensor with M12 plug	R901411104	1		219
3	Input module with 16 digital inputs via switch, sensor or outlet	R901411106	1		218
4	Output module with 16 digital outputs	R901411115	1		218
5	Mounting plate for PLC	R901439219	1		216
6	Mounting bracket for PLC tabletop setup	R901439222	2		217

**One of the following work stations is required to complete the exercises in the learning topic “Sensor Technology – Automation”:**

Work Station	Material No.	Image	Page
Work station WS200 for pneumatics, double-sided for 2 - 4 trainees – assembled, incl. packaging	R961008854		117
Grooved panel case	1827003552		48
Grooved panel (tabletop version, upright)	R961003826		48
Work station DS3 for pneumatics, double-sided for 4 - 6 trainees – assembled, incl. packaging	1827003700		50

Additional learning content on the topic of sensor technology can be conducted with our modular mechatronics system mMS4.0 (beginning on 138).

## Accessories

<b>Material Sample Case</b>		
Material Number	1827003524	
Typecode	TRUNK TS-AC-MAT-SEN	
Plastic case filled with various material samples and accessories for conducting exercises in sensor technology.		
Contents of the case:		
<ul style="list-style-type: none"> <li>▶ Metal and plastic samples in different thicknesses</li> <li>▶ Metal samples in different widths</li> <li>▶ Aluminum samples with slot or different holes</li> <li>▶ Plastic samples in different tones</li> <li>▶ Plastic samples in different colors</li> <li>▶ Magnet samples in various sizes</li> <li>▶ Samples with reflective foil, retro foil, foam or cardboard</li> <li>▶ Spool on circuit board</li> <li>▶ Retro reflector with Snap-In</li> <li>▶ Height adjuster for plastic material samples</li> <li>▶ Aluminum spacing plates</li> <li>▶ Screwdriver</li> </ul>		
Dimensions	mm (L x W x H)	420 x 330 x 110
Weight	kg	3.1



<b>Power Supply 0-30V, Tabletop</b>		
Material Number	R901229673	
Typecode	POWER SUPPLY UNIT TS-EC- VLP-1303PRO+2M	
Tabletop power supply with adjustable output 0-30 VDC/3 A and output 3-6 VDC/2 A, contact-protected 4 mm safety sockets (red for 24 V, blue for 0 V), display, power supply cable.		
Dimensions	mm (L x W x H)	255 x 245 x 110
Weight	kg	5,3
Protection Class	IEC 60529	IP20
Operating Voltage	VAC	230
Mains Frequency	Hz	50
Output Voltage	VDC	0-30 (adjustable) 3-6
Output Current	A	3 (adjustable) 2



**Accessories**

**Power supply, 24V, Snap-In for Grooved Panel**

Material Number	R961008981	
Typecode	Power supply TS-EC-230V/10A	
Power supply for direct current 24 VDC/10 A. Contact-protected 4 mm safety sockets (red for 24 V, blue for 0 V), operating lamp, power supply cable, aluminum front plate with scratch-proof labeling. For mounting in assembly carrier for 19" technology. Quick-connect system for grooved panel.		
Dimensions	mm (L x W x H)	280 x 150 x 140
Weight	kg	2.13
Protection Class	IEC 60529	IP20
Operating Voltage	VAC	110-230
Mains Frequency	Hz	50
Output Voltage	VDC	24
Output Current	A	10



**Power supply, 24V, 19" Technology**

Material Number	R901468181	
Typecode	Power supply TS-EC-230VAC/50HZ	
Power supply for direct current 24 VDC/6 A. Contact-protected 4 mm safety sockets (red for 24 V, blue for 0 V), operating lamp, power supply cable, aluminum faceplate with scratch-proof labeling. For mounting in assembly carrier for 19" technology.		
Height	HE	3
Width	TE	42
Depth	mm	172
Weight	kg	2.5
Protection Class	IEC 60529	IP20
Operating Voltage	VAC	100-240
Mains Frequency	Hz	50-60
Output Voltage	VDC	24
Output Current	A	6



## Accessories

Multimeter VC175		
Material Number	R913038027	
Typecode	MULTIMETER TS-EC-VC175	
Digital multimeter VC175. Robust entry-level device with automatic measuring range selection, incl. measuring cables.		
Equipment:		
<ul style="list-style-type: none"> <li>▶ Standard measuring ranges VDC, VAC, ADC, AAC</li> <li>▶ Resistance</li> <li>▶ Diode test</li> <li>▶ Acoustic continuity tester</li> <li>▶ Touchless AC voltage tester</li> <li>▶ hFE transistor test (with optional adapter)</li> <li>▶ Frequency measurement and duty cycle</li> <li>▶ Hold function</li> <li>▶ Low battery indicator</li> <li>▶ Robust housing with soft rubber guard</li> </ul>		
Dimensions	mm (L x W x H)	137 x 72 x 40
Weight	g	200
Current	A	10
Measurement Category	CAT III 250 V	
Display	Counts	4000



# Work Stations: Sensor Technology



#### Grooved Panel Case

Material Number	1827003552
Typecode	TRUNK TS-MC-CS2-NUT

This work station is outstanding for training in the field of automation technology. In the open position, the grooved panel case can be used as a work station for setting up exercises. The Snap-In quick-connect system provides for simple attachment and secure positioning of the components. In the closed position, the grooved panel case serves as storage for the components.

Dimensions	mm (L x W x H)	550 x 370 x 140
Number of Work Positions		1-2
Weight	kg	4.5
Work Surface	mm (W x H)	700 x 550



#### Grooved Panel (Tabletop Version, Upright)

Material Number	R961003826
Typecode	WORKSTATION TS-MC-ECODESK

This work station is outstanding for training in pneumatic and automation technologies. The pneumatic and automation components can be mounted on the tabletop grooved panel.

The Snap-In quick-connect system allows for easy attachment and secure mounting of the components. The double-sided version is designed so that 2-4 trainees in 2 groups can use the work station simultaneously. The work station is delivered as an assembly with components attached.

Dimensions	mm (L x W x H)	1150 x 640 x 730
Number of Work Positions		2-4
Weight	kg	22.5
Work Surface	mm (B x H)	1130 x 700





**Work Station WS200 Pneumatics, Double-Sided for 2 - 4 Trainees  
 – Assembled, Incl. Packaging**

Material Number	R961008854
Typecode	WORKSTATION TS-WS200-1X/ N1G0A0T1&

This work station is outstanding for training in pneumatic and automation technologies.

The mobile work station is equipped with a grooved panel, to which the pneumatic and automation components can be mounted. The Snap-In quick-connect system ensures easy attachment and secure mounting.

The double-sided version is designed so that two to four trainees can use the work station simultaneously in two groups.

Each included tray can be converted from an oil pan to a practical writing surface by simply flipping it over.

Included Items	▶ Base frame
	▶ 1 grooved panel, double-sided
	▶ Tray set

Dimensions	mm (L x W x H)	800 x 806 x 1772
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Number of Work Positions	2 - 4
--------------------------	-------

Weight	kg	45
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**Accessories**

Compressor 230 V/50 Hz	R900891168	1
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Compressor 230 V/60 Hz	R901464218	1
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Compressor 110 V/60 Hz	R961003963	1
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Accessory Set for compressor	R901471412	1
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For pneumatics accessories, see sales catalog Pneumatic Training System R999000217



**Work Station DS3 Pneumatics, Double-Sided for 4 - 6 Trainees – Assembled, Incl. Packaging**

Material Number	1827003700
Typecode	WORKSTATION TS-DS3-1X/ LK0E00T0-M

This work station is outstanding for training in pneumatic and automation technologies. The grooved panel of the mobile work station allows for the attachment of pneumatic and automation components on both sides. The Snap-In quick-connect system enables easy attachment and secure mounting of the components.

A perforated plate holds unused components. The double-sided version is designed so that 2-3 trainees can use the work station simultaneously in two groups.

Dimensions	mm (L x W x H)	1250 x 790 x 1610
Weight	kg	63





# Individual Technology: Control Technology – PLC

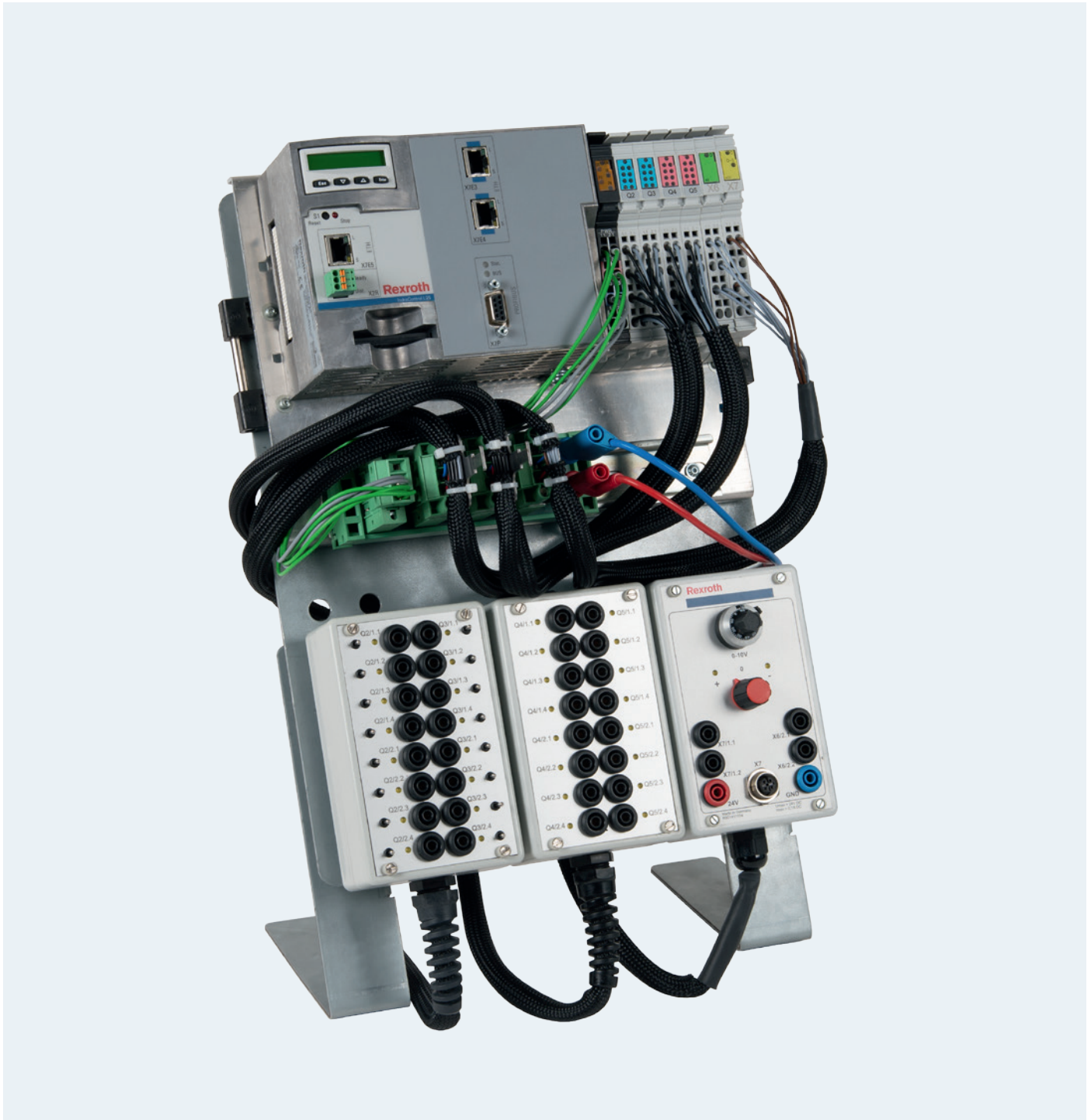


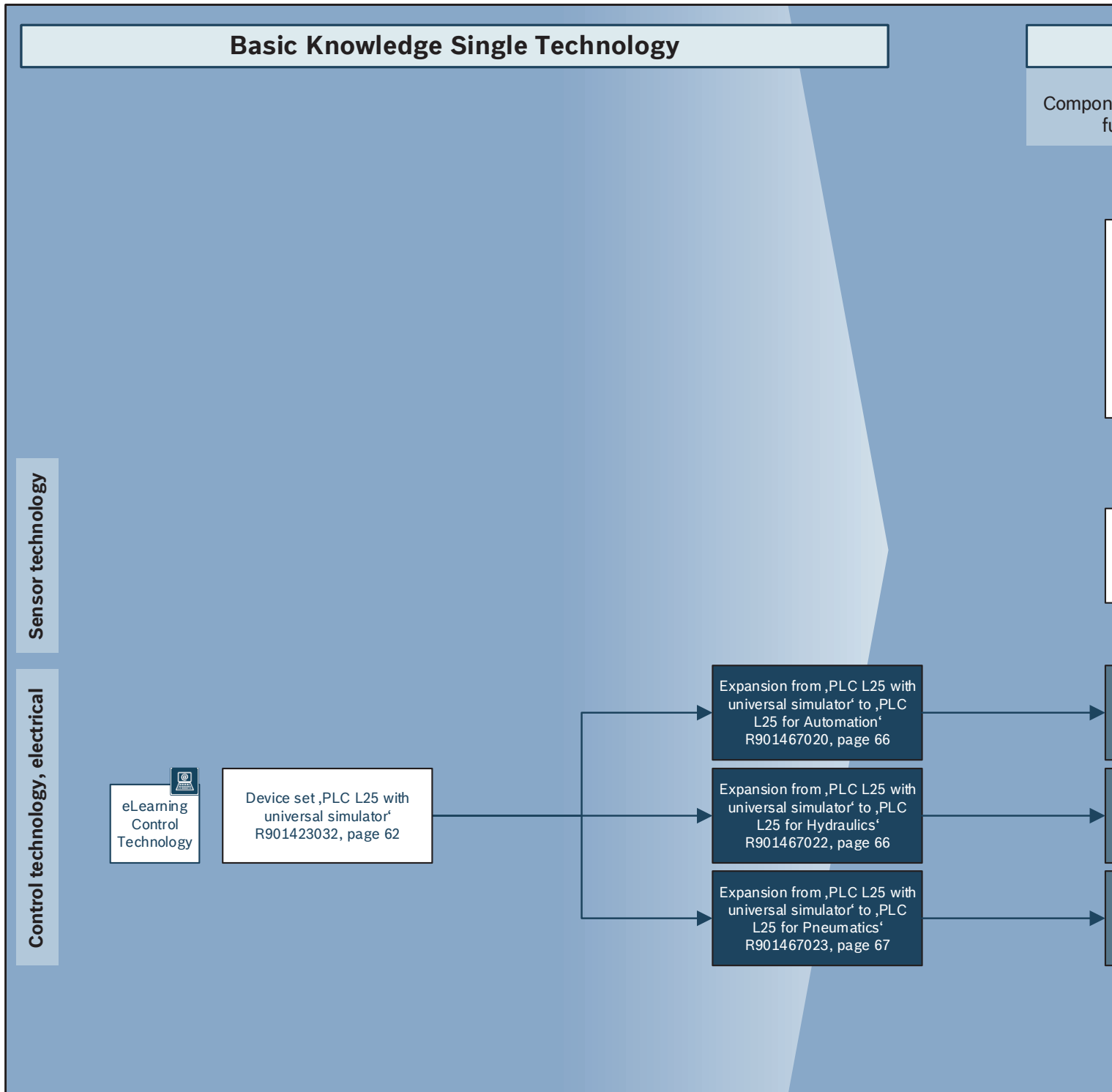


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Drive & Control Academy  
 Knowledge Transfer Using Learning Topics  
 Learning Topics Individual Technologies  
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 Components and Spare Parts  
 Indices

# Control Technology Learning Topics – PLC – Device Sets





## Automation / Mechatronics – Control Technology PLC

Basic	Advanced	Professional
ents, modules, action modes, functional basic circuits	Mechatronic systems, information flow, control, closed loop	Complex mechatronic systems, networking

# modular Mechatronic-System mMS 4.0

## R901423235, page 138

Device set ,Automation technology, complete' R901463160, page 38

Device set ,PLC L25 for Automation' R901420828, page 42

Device set ,PLC L25 for Hydraulics and Pneumatics' R901423033, page 90

Device set ,PLC L25 for Pneumatics' R901423035, page 65

“Terminology” on page 13



## eLearning – Basics of Electric Drive Technology – eESTG



- ▶ Basic introduction to electric control technology
- ▶ Programmable logic controls (PLC)
- ▶ Numeric controls (CNC)
- ▶ Motion controls (MC)
- ▶ Robotic controls (RC)
- ▶ Application examples and programming
- ▶ Interfaces

### Training Scope and Duration

- ▶ 6 learning modules, approx. 100 training pages, 34 test questions
- ▶ Learning time: 3 to 4 hours
- ▶ Languages: German and English

### Requirements

- ▶ PC with Internet access, Flash Player 10 or higher (<http://get.adobe.com/de/flashplayer>), if needed, web browser with Flash support
- ▶ Pop-up blocker turned off
- ▶ Email address for personal login

**Try selected modules of our eLearning library with free guest access:**

[www.boschrexroth.de/eLearning](http://www.boschrexroth.de/eLearning)

- Independent scheduling
- Learn at your own pace
- Repeat as often as you like within the licensing period
- Final exam + personal Rexroth certificate (per license)

### Product Description

This eLearning module provides the basics of electric control technology. The various control types are introduced step-by-step, differences shown, fields of application explained, and programming details presented. This modular eLearning system also illustrates the human and machine interfaces. eLearning is recommended for everyone who needs a basic knowledge of control technology or for continuing education.

### Licensing Periods

During the licensing period (12 months following activation) our eLearning is always accessible.

## Control Technology – PLC – Basics of PLC L25 with Universal Simulator

The learning goal is to acquire and broaden knowledge of the PLC programming standard according to IEC 61131-3. Programming languages used: Ladder Diagram, Function Block Diagram, Instruction List, Structured Text or Sequential Function Chart. Prerequisites are basic knowledge of PLC programming, and electrical and sensor technology. Successfully completing the practical exercises helps the user acquire knowledge of PLC technology at the various training levels.

### Exercise Books

The exercise books are coordinated with the device sets. The exercises and tasks provide basic information and methods. They have a uniform structure and the execution of the individual exercises is explained step by step. The proposed solution draws on programming with Bosch Rexroth control systems.

#### Two Versions

- ▶ Exercises with solutions: more extensive trainer information and content such as measured values, calculation results, etc.
- ▶ Exercises: independent completion of calculations and measured value tables, etc.

#### Learning Content

In this exercise book, each task has a template for the simulator, with a corresponding task scenario and a proposed solution.

The logical, practical tasks allow the trainee to:

- ▶ declare variables, program flags or times
- ▶ program sequences, create assignment lists
- ▶ query digital inputs
- ▶ set digital outputs
- ▶ input and output analog values
- ▶ select operating modes, as well as auto, manual and job modes
- ▶ simulate queries of sensors, switches and light barriers, as well as control magnet valves, relays, electric motors or indicator lights



*Example Exercise Book*

**The following exercises are included:**

No.	Exercise	No.	Exercise
01	Container – Filling System	13	Cleaning Bath
02	Monitoring Device	14	Buffer Memory
03	Pump Control 1	15	Pill Filling Machine
04	Belt Switch	16	Translation Stage
05	Gate Control	17	Stamping Machine
06	Star – Delta Startup	18	Bending Tool
07	Starter Motor Control	19	Drilling Device
08	Dahlander Control	20	Pipe Bending System
09	Oven Door Control	21	Door Control for a Lock
10	Reaction Vessel	22	Mixing System
11	Pump Control 2	23	Filling Level Control Loop
12	Construction Site Traffic Light	24	Compressed Air Network

**Exercise Books for “PLC L25 with Universal Simulator”**

	Lang.	Material No.	Typecode
Exercise Book with Solutions/Exercises (Trainer/Trainee)	DE	R961004276	UEBUNGSBUCH SPS UEBUNG TS STANDA&
Exercise Book with Solutions/Exercises (Trainer/Trainee)	EN	R961004285	EXERCISE BOOK SPS UEBUNG UNIVERSAL&

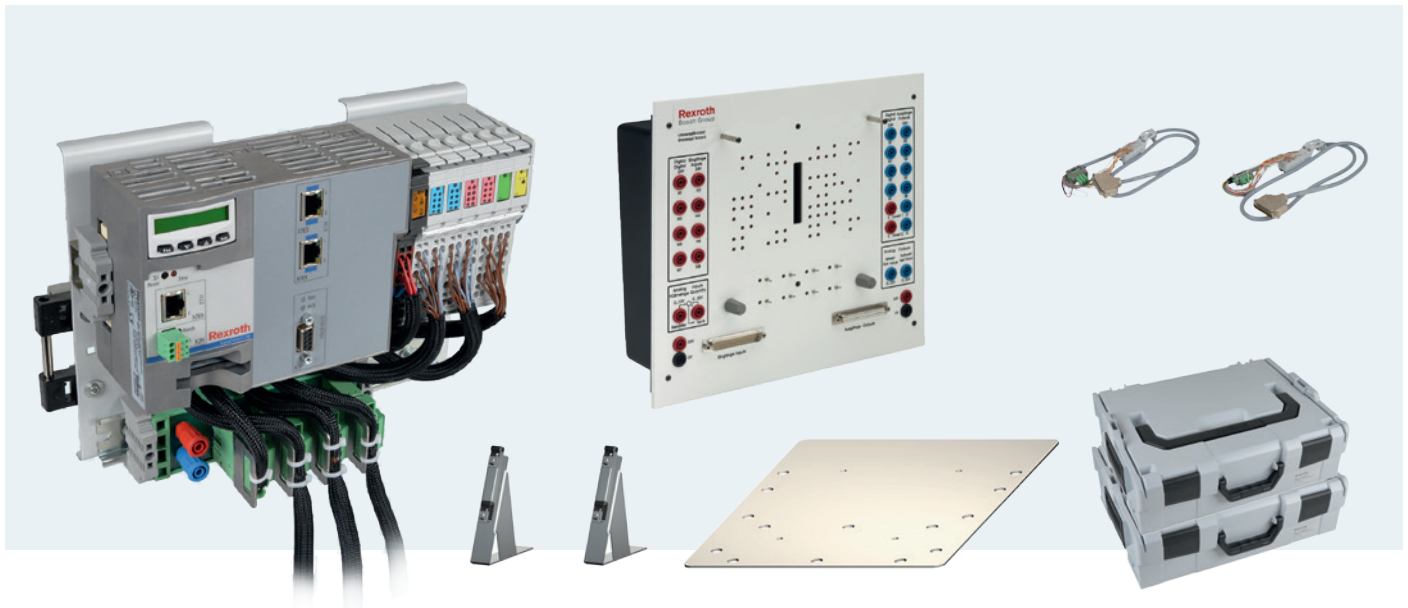
**Additional Documentation (Optional)**

	Lang.	Material No.	Typecode
Project Planning Manual "Rexroth IndraControl L25"	DE	R911328473	DOKUMENTATION DOK-CONTRL-IC*L25*****-PR03-DE-P
Project Planning Manual "Rexroth IndraControl L25"	EN	R911328474	DOKUMENTATION DOK-CONTRL-IC*L25*****-PR03-EN-P
Commissioning Description "Rexroth IndraLogic XLC 13VRS, First Steps"	DE	R911336349	DOKUMENTATION DOK-XLC***-F*STEP**V13-CORS-DE-P
Commissioning Description "Rexroth IndraLogic XLC 13VRS, First Steps"	EN	R911336350	DOCUMENTATION DOK-XLC***-F*STEP**V13-CORS-EN-P
Commissioning Description "Rexroth IndraWorks 13VRS, Software Installation"	DE	R911336879	DOKUMENTATION DOK-IWORKS-SOFTINS*V13-CORS-DE-P
Commissioning Description "Rexroth IndraWorks 13VRS, Software Installation"	EN	R911336880	DOCUMENTATION DOK-IWORKS-SOFTINS*V13-CORS-EN-P

**Device Set “PLC L25 with Universal Simulator”**

Material Number	R901423032
Typocode	EQUIPMENT SET TS-HS 503-1X


This device set is used to teach control technology basics via 24 exercises. It is coordinated with the exercise book “PLC L25 with Universal Simulator.” The device set consists of the PLC L25, including the software tool (with user license) for program creation, and a PLC universal simulator with 24 different exercise templates, which coordinate with the exercise books. No additional work station is needed. The provided PLC is a tabletop version, which is also equipped with a bracket for the grooved panel. To execute the 24 exercises, the corresponding templates are placed on the positioning pins of the base panel, thereby covering irrelevant labeling and LED indicators. Practice is provided for creating assignment lists and designing PLC programs. All programs are supplied as sample solutions. The PLC also has OCE (OpenCore Engineering), which enables programming using different programming languages, e.g. VisualBasic, and allows software control using programs like LabView and Excel. Thus, this control is i4.0 capable. The device set is delivered in two stackable plastic cases (L-Boxx).



**Device set R901423032 contains the following components:**

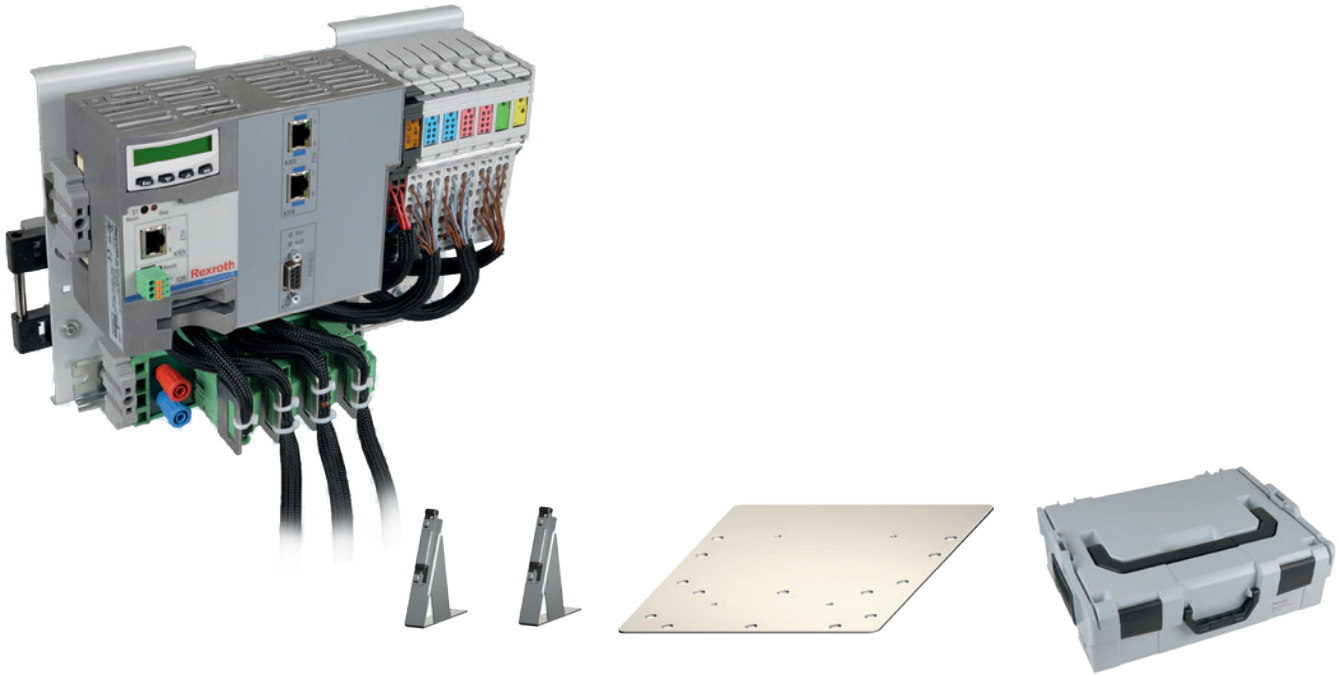
Item	Description of Individual Components	Mat. No. of Individ. Components	Quantity	Image	Page
1	Indra Control L25 PLC (incl. IndraWorks software tool) with bracket for grooved panel	R901423029	1		216
2	Power cable for universal simulator inputs	R901422494	1		220
3	Power cable for universal simulator outputs	R901422495	1		220
4	Universal simulator with 24 practice templates	R901423121	1		217
5	Retaining plate for PLC	R901439219	1		216
6	Mounting brackets for tabletop PLC	R901439222	2		217

**Additional accessories required with device set “PLC L25 with universal simulator”:**

Item	Components	Mat. No.	Quantity	Image	Page
1	Power supply, 24V, Snap;-In for grooved plate	R961008981	1		45
2	PC or laptop to run the exercises (not included)				

**Device Set “PLC L25 for Automation”**

Material Number	R901420828
Typocode	EQUIPMENT SET TS-AS 105-1X-K
Detailed description on page 42.	



**Device Set “PLC L25 for Hydraulics and Pneumatics”**

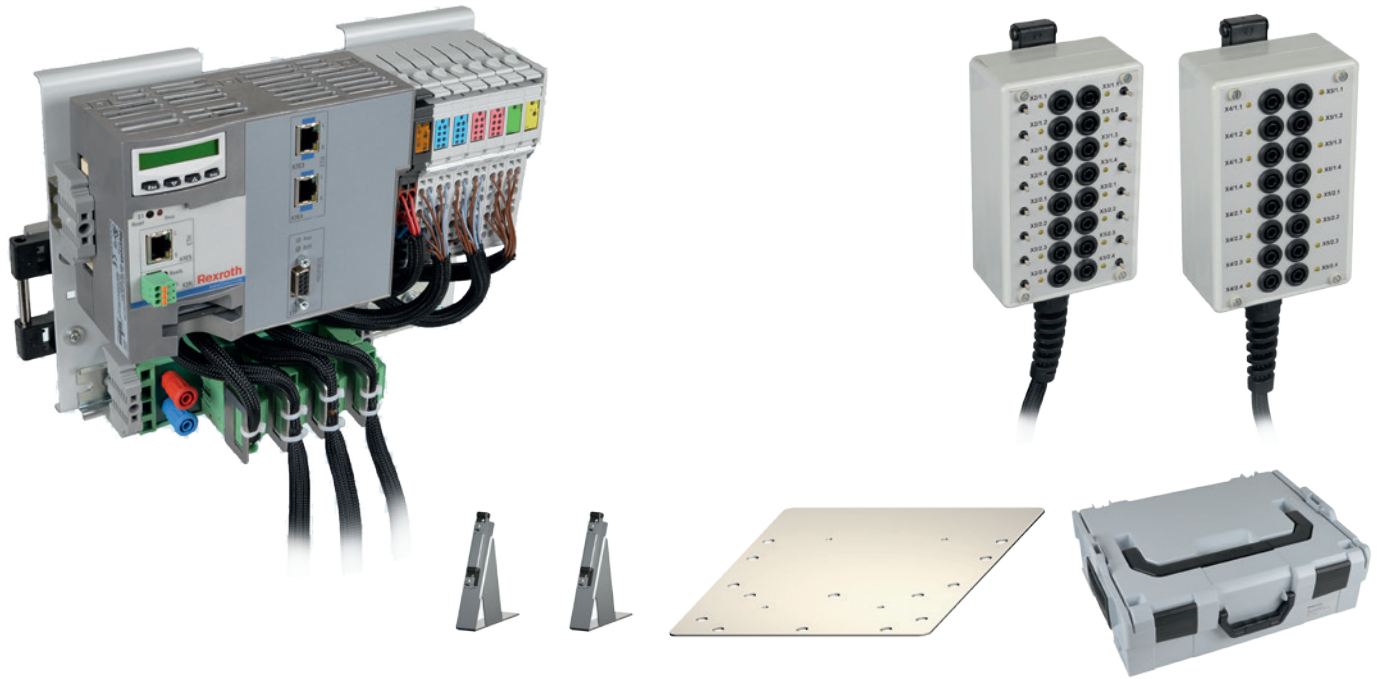
Material Number	R901423033
Typocode	EQUIPMENT SET TS-AS 107-1X-K
Detailed description on page 90.	





**Device Set “PLC L25 for Pneumatics”**

Material Number	R901423035
Typecode	EQUIPMENT SET TS-AS 108-1X-K
Detailed description on page 113.	



Additional learning content on the topic of “Control Technology – PLC” can be conducted with our modular mechatronics system mMS4.0 (beginning on page 138).

**Device Expansion Set to Adapt “PLC L25 with Universal Simulator” to “PLC L25 for Automation”**

Material Number R901467020

Typecode EQUIPMENT SET TS-AS 109-1X-K

This expansion set is for the customer who already owns a PLC. Detailed description on page 42.



**Device Expansion Set to Adapt “PLC L25 with Universal Simulator” to “PLC L25 for Hydraulics”**

Material Number R901467022

Typecode EQUIPMENT SET TS-AS 110-1X-K

This expansion set is for the customer who already owns a PLC. Detailed description on page 64.



**Device Expansion Set to Adapt “PLC L25 with Universal Simulator” to “PLC L25 for Pneumatics”**

Material Number R901467023

Typecode EQUIPMENT SET TS-AS 111-1X-K

This expansion set is for the customer who already owns a PLC. Detailed description on page 113.



**Additional learning content on the topic of “Control Technology – PLC” can be conducted with our modular mechatronics system mMS4.0 (beginning on page 138).**

## Accessories

<b>Power Supply, 0-30V, Tabletop</b>		
Material Number	R901229673	
Typocode	POWER SUPPLY UNIT TS-EC- VLP-1303PRO+2M	
Tabletop power supply with adjustable output 0-30 VDC/3 A and output 3-6 VDC/2 A, contact-protected 4 mm safety sockets (red for 24 V, blue for 0 V), display, power supply cable.		
Dimensions	mm (L x W x H)	255 x 245 x 110
Weight	kg	5.3
Protection Class	IEC 60529	IP20
Operating Voltage	VAC	230
Mains Frequency	Hz	50
Output Voltage	VDC	0-30 (adjustable) 3-6
Output Current	A	3 (adjustable) 2



<b>Power supply, 24V, Snap-In for Grooved Panel</b>		
Material Number	R961008981	
Typocode	Power supply TS-EC-230V/10A	
Power supply for 24 VDC/10 A. Contact-protected 4 mm safety sockets (red for 24 V, blue for 0 V), operating lamp, power supply cable, plastic housing, aluminum front plate with scratch-proof labeling. Quick-connect system for grooved panel.		
Dimensions	mm (L x W x H)	280 x 150 x 140
Weight	kg	2.13
Protection Class	IEC 60529	IP20
Operating Voltage	VAC	110-230
Mains Frequency	Hz	50
Output Voltage	VDC	24
Output Current	A	10



**Power supply, 24V, 19" Technology**

Material Number	R901468181
Typecode	Power supply TS-EC-230VAC/50HZ

Power supply for 24 VDC/6 A.  
 Contact-protected 4 mm safety sockets (red for 24 V, blue for 0 V),  
 operating lamp, power supply cable, aluminum front plate with  
 scratch-proof labeling. For mounting in assembly carrier for 19"  
 technology.

Height	HE	3
Width	TE	42
Depth	mm	172
Weight	kg	2.5
Protection Class	IEC 60529	IP20
Operating Voltage	VAC	100-240
Mains Frequency	Hz	50-60
Output Voltage	VDC	24
Output Current	A	6





# Work Stations for Control Technology – PLC



**Grooved Panel (Tabletop Version, Upright)**

Material Number R961003826

Typecode WORKSTATION TS-MC-ECODESK

This work station is outstanding for providing training in pneumatic and automation technologies. The pneumatic and automation components can be mounted on the tabletop grooved panel.

The Snap-In quick-connect system allows for easy attachment and secure mounting of the components. The double-sided version is designed so that 2-4 trainees in 2 groups can use the work station simultaneously. The work station is delivered as an assembly with components attached.

Dimensions	mm (L x W x H)	1150 x 640 x 730
Number of Work Positions		2-4
Weight	kg	22.5
Work Area	mm (WxH)	1130 x 700





**Work Station WS200 for Pneumatics, Double-Sided for 2 - 4 Trainees – Assembled, Incl. Packaging**

Material Number	R961008854
Typecode	WORKSTATION TS-WS200-1X/ N1G0A0T1&

This work station is outstanding for training in pneumatic and automation technologies.

The mobile work station is equipped with a grooved panel, to which the pneumatic and automation components can be mounted. The Snap-In quick-connect system ensures easy attachment and secure mounting.

The double-sided version is designed so that two to four trainees can use the work station simultaneously in two groups.

Each included tray can be converted from an oil pan to a practical writing surface by simply flipping it over.

Included Items	Base frame 1 Grooved panel, double-sided Tray set
----------------	---

Dimensions	mm (L x W x H)	800 x 806 x 1772
------------	----------------	------------------

Number of Work Positions	2 - 4
--------------------------	-------

Weight	kg	45
--------	----	----

**Accessories**

Designation	Material No.	Quantity
Compressor 230 V/50 Hz	R900891168	1
Compressor 230 V/60 Hz	R901464218	1
Compressor 110 V/60 Hz	R961003963	1
Accessory Set for compressor	R901471412	1

For pneumatics accessories, see sales catalog pneumatic training system R999000217.



**Work Station DS3 for Pneumatics, Double-Sided for 4 - 6 Trainees  
– Assembled, Incl. Packaging**

Material Number	1827003700
Typecode	WORKSTATION TS-DS3-1X/ LK0E00T0-M

This work station is outstanding for training in pneumatic and automation technologies. The grooved panel of this mobile work station allows for the attachment of pneumatic and automation components on both sides. The Snap-In quick-connect system enables easy attachment and secure mounting of the components.

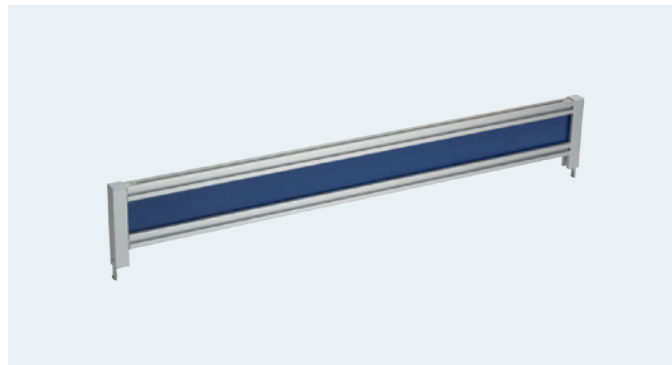
A perforated plate holds unused components. The double-sided version is designed so that 2-3 trainees can use the work station simultaneously in two groups.

Dimensions	mm (L x W x H)	1250 x 790 x 1610
Weight	kg	63



## Accessories

Bracket for Electrical Assemblies		
Material Number	1827003703	
Typecode	ATTACHMENT TS-MC-ELEK-DS3	
Bracket for electrical assemblies to build electrical circuits, accessible from both sides, suitable for the Snap-In quick-connect system. For attachment to the DS3 or for the grooved panel (upright).		
Dimensions	mm (L x W x H)	1130 x 165 x 30
Weight	kg	3.7
Work Area	mm (WxH)	1130 x 130





# Individual Technology: Hydraulics





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Drive & Control Academy

Knowledge Transfer Using Learning Topics

Learning Topics Individual Technologies

Learning Topics Mechatronics/Automation

Application-Specific Systems

Components and Spare Parts


Indices

# Learning Topics for Hydraulics – Overview Device Sets

## Basic Knowledge Single Technology

Comp

Drive Technology  
Electrical, hydraulic

  
eLearning  
Hydraulics

Device set for workstation  
WS200/WS290 ,On/off  
hydraulics – Electrical  
operation (BIBB, A-H),  
complete'  
R961009459, page 86  
+  
Device set for workstation  
WS200 ,On/Off hydraulics  
– Electrical operation  
(BIBB, A-H) with I/O-  
module'  
R901386158, page 88

Expansion for workstation  
WS200/WS290 from ,On/off  
hydraulics – Electrical  
operation (BIBB, A bis H)' to  
,On/off hydraulics – Electrical  
operation (BIBB, Z1 bis Z3)'  
R961009475, page 89

Additional Learning topics and Information to our Hydraulic  
Training Systems you'll find in the catalogue ,Training  
Systems for Hydraulic'



/ of

## Automation / Mechatronics - Hydraulics

**Basic**  
Components, modules, action modes,  
functional basic circuits

**Advanced**  
Mechatronic systems, information flow, control,  
closed loop

**Professional**  
Complex mechatronic systems,  
networking

Device set ,PLC L25 for  
Hydraulics and  
Pneumatics'  
R901423033, page 90

Drive & Control Academy

Knowledge Transfer Using  
Learning Topics

Learning Topics  
Individual Technologies

Learning Topics  
Mechatronics/Automation

Application-Specific  
Systems

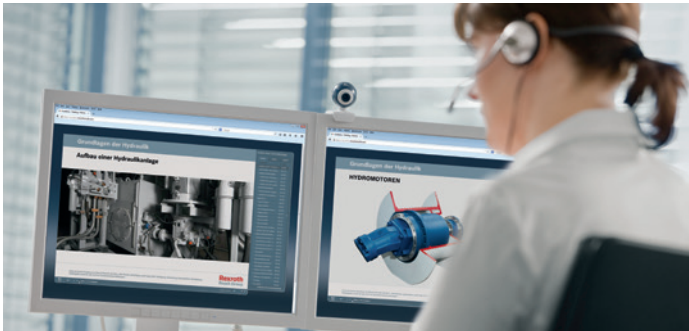
Components and  
Spare Parts

Indices

"Terminology" on page 13



## eLearning – Basics of Hydraulics – eHTG



### Contents

- ▶ Hydraulics basics (characteristics)
- ▶ Structure and function of a hydraulic system
- ▶ Physical basics (importance in hydraulics)
- ▶ Symbols according to DIN ISO 1219
- ▶ Hydraulic fluids
- ▶ Hydraulic pumps, hydraulic motors and cylinders
- ▶ Control technology (isolator, directional control, pressure control and flow control valves)
- ▶ Create and read simple circuit diagrams

### Training Scope and Duration

- ▶ 13 learning modules, 600 training pages, 120 test questions
- ▶ Duration approx. 25 to 32 hours
- ▶ Languages: German, English, Italian, French, Chinese, Russian, Hungarian and others

### Requirements

- ▶ PC with Internet access, Flash Player 10 or higher (<http://get.adobe.com/de/flashplayer>), if needed, web browser with Flash support
- ▶ Deactivated pop-up blocker
- ▶ Email address for personal login

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[www.boschrexroth.de/eLearning](http://www.boschrexroth.de/eLearning)

- Independent scheduling
- Learn at your own pace
- Repeat as often as you like within the licensing period
- Final exam + personal Rexroth certificate (per license)

### Product Description

From functionality and characteristics of selected components to building hydraulic circuit diagrams – many basics that the hydraulics professional needs are provided in the eLearning module “eHTG – Hydraulics Basics.”

### Licensing Periods

Within the licensing period (12 months from activation), the eLearning is always accessible.

## On/Off Hydraulics – Electrical Operation (BIBB, A-H and Z1-Z3)

The contents and goals of this learning topic correspond to the requirements of the Federal Institute of Vocational Education (Bundesinstitut für Berufsbildung – BIBB) and provide practical training at the various levels of on/off hydraulics.

After successfully completing the practical exercises, the trainee will have acquired knowledge about using electrically and manually operated on/off valves as well as the function and operation of the most important components and basic circuitry of on/off hydraulics.

### Exercise Books

The exercise books coordinate with the device sets.

The exercises and tasks provide basic information and methods. They have a uniform structure and the completion of the individual exercises is explained step by step.

#### Two Versions

- ▶ Exercises with solutions: more extensive trainer information and content such as measured values, calculation results, etc.
- ▶ Exercises: independent completion of calculations and measured value tables, etc.

#### Learning Content

The logical, practical tasks allow the trainee to:

- ▶ understand the physical principles of hydraulics like pressure difference, cross-section size and flow volume
- ▶ become familiar with and consider legal requirements and safety regulations
- ▶ understand the function of basic hydraulic circuitry
- ▶ recognize the typical behavior of hydraulic components in different operational circumstances
- ▶ identify characteristic values and from those, derive characteristics



*Example Exercise Book*

**The following exercises are included:**

No.	Exercise	BIBB Exercise
01	Hydraulic System	A1
02	Hydraulic Pump	A1
03	Differential Cylinder (Pressure Intensification)	B1
04	Differential Cylinder (Flow)	B1
05	Hydraulic Motor	G2
06	4/3 Directional Control Valve	B2
07	Non-Return Valve	C1
08	Non-Return Valve, Piloted	C1
09	Throttle Valve, Adjustable	D1
10	Throttle Check Valve	D3
11	Flow Control Valve	D2
12	Pressure Relief Valve, Direct Controlled/Piloted	E1/E2
13	Control with Pressure Relief Valves	E1
14	Pressure Reducing Valve	E3
15	Hydraulic Accumulator	F1
16	Differential Circuit	G1
17	Circulation Circuit	B2/G4
18	Commissioning, Troubleshooting	H1
19	Pressure Switch (Hysteresis)	E4
20	Rapid/Creep Motion Control	G3
21	Load Holding Circuit with Jerk-Free Deceleration	Z1
22	Rectifier Circuit	Z2
23	Circulator Circuit for Large-Volume Flows	Z3
24	Accumulator Charging Circuit	Z3

**Exercise Books “On/Off Hydraulics – Electrical Operation (according to BIBB)”**

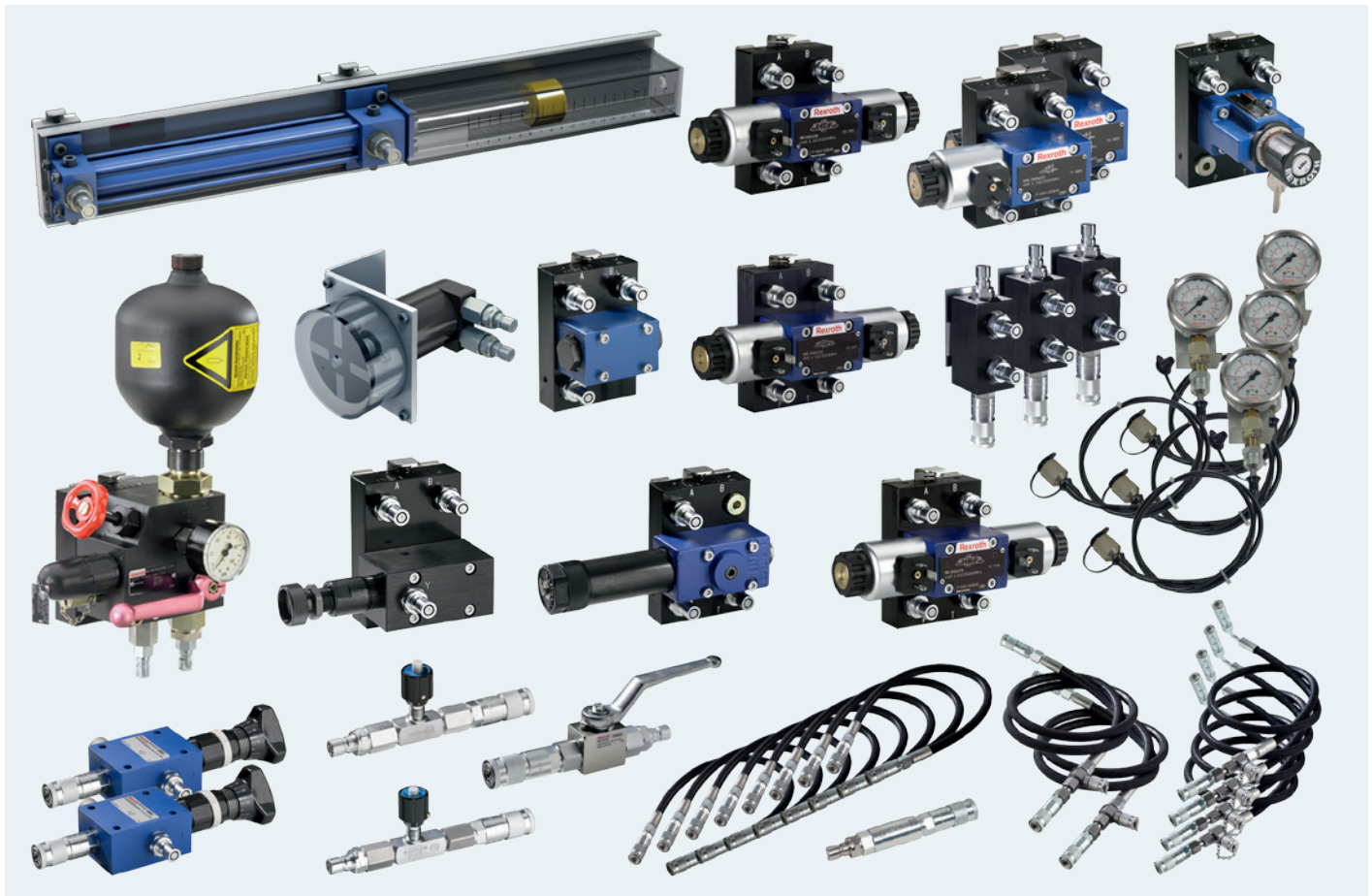
	Language	Material No.	Typecode
Exercises with Solutions (Trainer Manual)	DE	R901385278	UEBUNGSBUCH TW-HY-LH-1/X 202DE
Exercises with Solutions (Trainer Manual)	EN	R901385284	EXERCISE BOOK TW-HY-LH-1/X 202EN
Exercises with Solutions (Trainer Manual)	ES	R901385288	LIBRO DE EJERCICIOS TW-HY-LH-1/X 202ES
Exercises with Solutions (Trainer Manual)	FR	R901425711	LIVRE D’EXERCICES TW-HY-LH-1/X 202FR
Exercises (Trainee Manual)	DE	R901385279	UEBUNGSBUCH TW-HY-SH-1/X 202DE
Exercises (Trainee Manual)	EN	R901385285	EXERCISE BOOK TW-HY-SH-1/X 202EN
Exercises (Trainee Manual)	ES	R901385289	LIBRO DE EJERCICIOS TW-HY-SH-1/X 202ES
Exercises (Trainee Manual)	FR	R901425712	LIVRE D’EXERCICES TW-HY-SH-1/X 202FR

**Device Set for Work Station WS200/WS290 “On/Off Hydraulics – Electrical Operation (BIBB, A-H), Complete” WS200/WS290**

Material Number R961009459

Typecode EQUIPMENT SET TS-HS 202-2X

This device set is used to study basic hydraulics using exercises. Only size 6 industry standard components, which have been especially designed for use in training, are used. The device set coordinates with the exercise book “Switching Hydraulics – Electrical Operation (according to BIBB),” which contains BIBB exercises A-H and Z1-Z3. The exercises with the listed components can be completed on work stations WS200 and WS290.



**Device set R961009459 contains the following components:**

Item	Description of Individual Components	Mat. No. of Indiv. Components	Qty.	Image
1	Differential cylinder CD70F25/16-200 with protective housing and connection point for load unit in work station WS201	R961009526	1	
2	Planetary motor	R961008748	1	
3	4/2-directional control valve 4WE6C6X/	R961002547	2	
4	4/3-directional control valve 4WE6G6X/	R961002548	1	

**Device set R961009459 contains the following components:**

Item	Description of Individual Components	Mat. No. of Individ. Components	Qty.	Image
5	4/3 directional control valve 4WE6J6X/	R961002554	1	
6	4/3 directional control valve 4WE6E6X/	R961002549	1	
7	Pressure control valve DBDH6G1X/	R961002520	2	
8	Pressure control valve, pilot-operated, DB6K1-4X/50	R901460846	1	
9	Pressure reducing valve, direct-operated, DR6DP1-5X/	R961002544	1	
10	2-way flow control valve 2FRM6B36-3X/	R961002546	1	
11	Throttle valve DV06-1-1X/V	R961002539	1	
12	Throttle check valve DRV06-1-1X/V	R961002495	1	
13	Non-return valve S6A05-1X	R901462818	1	
14	Non-return valve, pilot-operated, SV 6 PB1-6X/	R961002513	1	
15	Accumulator module	R961002503	1	
16	Hydraulic distributor, 4 ports	R961002485	3	
17	Shut-off valve	R961002491	1	
18	Manometer, 0-100 bar, with measuring hose	R961002715	4	
19	Hose line, 630 mm	R961002474	8	
20	Hose line, 1000 mm, with 90° fitting and Minimes port	R961004330	4	
21	Hose line, 1500 mm, with Minimes port	R961002482	2	

The recommended accessories are listed on page 79.

**Electrical Device Set for Work Station WS200 “On/Off Hydraulics – Electrical Operation (BIBB, A-H) with I/O Module”**






Material No. R901386158

Typocode EQUIPMENT SET TS-HS 502-1X

All of the needed electrical components for the BIBB exercises A-H and Z1-Z3 are included in this device set. The electrical functions switch, sensor, relay and display are contained in one in one control unit inside a plastic housing. This device set is needed to complete the exercises in the exercise book “On/Off Hydraulics – Electrical Operation (according to BIBB)” at a WS200 work station. In this set, the control unit also contains an I/O module, to which sensors and valves can be connected. A simulation program can be connected to the hardware via a USB interface.



**Device set R901386158 includes the following components:**

Item	Description of Individual Components	Material No. of Indiv. Components	Qty.	Image
1	Control unit with housing – BIBB module + I/O module	R961009675	1	
2	Pressure switch, electrical	R961003488	1	
3	Proximity switch, inductive	R961003106	2	
4	Solenoid cable with form A plug, black, w/ LED, w/ protective circuit	R901457044	3	
5	Measuring line set, small	R900029597	1	



**Supplemental Learning Topic “On/Off Hydraulics – Electrical Operation (BIBB, Z1-Z3), Expansion**




Device expansion set for work station WS200/WS290 “On/Off Hydraulics – Electrical Operation (BIBB, A-H)” to “On/Off Hydraulics – Electrical Operation (BIBB, Z1-Z3)”

Material No. R961009475

Typecode EQUIPMENT SET TS-HS 412-1X



This device set coordinates with the exercise book “On/Off Hydraulics – Electrical Operation (according to BIBB),” which covers BIBB exercises Z1-Z3. The exercises with the listed components can be completed at work station WS200 or WS290.

**Device set R961009475 includes the following components:**

Item	Description of Individual Components	Material No. of Indiv. Components	Qty.	Image
1	Pressure control valve, pilot-operated DBW10A1-5X/	R961002553	1	
2	Non-return valve S6A05-1X	R901462818	3	
3	Pressure switch, electric	R961003488	1	

The recommended accessories can be found on p. 84.

**One of the following work stations is needed to complete the exercises on the learning topic of hydraulics:**

Work Station	Mat. No.	Image	Page
Work station WS200 for hydraulics and pneumatics, double-sided, for 2 - 4 trainees – assembled, incl. packaging	R901392535		117
Work station WS290 for hydraulics, 230V/50Hz, double-sided, for 4 - 6 trainees, complete – assembled, incl. packaging	R961009457		—

Additional learning content on the topic of hydraulics can be conducted with our modular mechatronics system mMS4.0 (beginning on page 138).

## PLC for Hydraulics

The exercises in the exercise books “On/Off Hydraulics – Electrical Operation (according to BIBB)” can also be completed with the device set “PLC for Hydraulics.” For this, the electrical control in the device set “PLC L25 for Hydraulics and Pneumatics” and a PLC program can be used. The required PLC programs can be found in Rexroth LearnWorld.







### Device Set “PLC L25 for Hydraulics and Pneumatics”

Material No.	R901423033
Typocode	EQUIPMENT SET TS-AS 107-1X-K

This device set is well-suited for completing the exercises on the topic of controls, with a focus in hydraulics. It includes the control XLC L25 with a bracket for the grooved panel, 16 digital inputs which can also be controlled with a switch/sensor, 16 digital outputs with an LED display and 4 digital outputs with a 2 A current load.



### Device set R901423033 includes the following components:

Item	Description of Individual Components	Material No. for Indiv. Component	Qty.	Image	Page
1	Indra Control L25 PLC (incl. IndraWorks software tool) with bracket for grooved panel	R901423029	1		216
2	Input module with 16 digital inputs via switch, sensor or socket	R901411106	1		218
3	Output module with 16 digital outputs	R901411115	1		218
4	Output module for hydraulic valves with 4 digital outputs, 2 A ea.	R901423044	1		219
5	Mounting plate for PLC	R901439219	1		216
6	Mounting brackets for tabletop PLC	R901439222	2		217

# Work Stations for Hydraulics



**Work Station WS200 for Hydraulics and Pneumatics,  
230 VAC/50 Hz, Double-Sided for 2 - 4 Trainees – Assembled, Incl.  
Packaging**

Material No.	R901392535
Typocode	WORKSTATION TS-WS200-1X/ N1G2A2T1&

This work station is outstanding for training in hydraulics basics, as well as in pneumatics and automation.

The mobile work station is equipped with a double-sided grooved panel, to which the pneumatic and automation components can be mounted. The Snap-In quick-connect system ensures easy attachment and secure mounting.

The mobile work station has two grates, on which the required hydraulics components can be securely mounted. It is accessible from both sides and can be used by two to four trainees simultaneously. The built-in hydraulics unit is equipped with a noise-reducing external gear pump and a single-phase asynchronous motor.

The switching case has one ON and one OFF sensor, as well as one E-STOP sensor. The voltage supply of the work station is connected with a mains cable (length approx. 1.8 m) with a safety plug.

A self-sealing coupling plug at the P/T distributor ensures the supply of hydraulic fluid.

Each included tray can be converted from an oil pan to a practical writing surface by simply flipping it over.

Included Items	<ul style="list-style-type: none"> <li>▶ Base frame</li> <li>▶ 1 grooved panel, double-sided</li> <li>▶ 2 grates</li> <li>▶ 2 hydraulic units, 230 V AC/50 Hz with pump, hose set, control box and P/T distributor</li> <li>▶ Control set</li> </ul>
----------------	--

Dimensions	mm (L x W x H)	800 x 806 x 1772
No. of Work Positions		2 - 4
Weight	kg	98
Supply Voltage	VAC	230
Nominal Current	A	2 x 1.6
Mains Frequency	Hz	50
Power	kW	2 x 0.37
Max. Operating Pressure (Hydraulic)	bar	50
Max. Flow Rate	l/min	3.2
Container	l	2x 6.2

**Work Station WS200 for Hydraulics and Pneumatics,  
230 VAC/60 Hz, Double-Sided, for 2 - 4 Trainees – Assembled, Incl.  
Packaging**

Material No.	R901465891
Typocode	WORKSTATION TS-WS200-1X/ N1G2A4T1&

Mains Frequency	Hz	60
Max. Flow Rate	l/min	3.0



Accessories		
Description	Material No.	Quantity
Compressor	1827008426	1

Hydraulic components and spare parts are available in our catalog Training Systems for Hydraulics R999000177.

**Work Station WS200, Component Carrier, Double-Sided – Installed, Incl. Packaging**

Material No.	R961008856
Typecode	WORKSTATION TS-WS200-1X/ NOG6A0T0&

The component carrier allows storage of all hydraulics components that are not needed at the moment in a space-saving and well-arranged manner. It has a total of four grates on a 50 mm grid and an oil pan, it is mobile and can be equipped on both sides.

Included Items	Base frame WS200 4 grates
----------------	------------------------------

Dimensions	mm (L x W x H)	800 x 758 x 1772
Weight	kg	47



**Work Station WS201 for Hydraulics, Load Unit Measuring Glass, Double-Sided, for 2 - 4 Trainees – Assembled, Incl. Packaging**

Material No.	R961009585
Typecode	WORKSTATION TS-WS201-1X/M2L2B0

Separate and mobile unit with two measuring glasses and two load units. Steering rollers with brakes for moving the unit are available. Easy transport due to well thought out dimensions (standard door, lift mechanism, vehicle). The mobile unit with two measuring glasses and two load units can be mechanically connected to a workstation.

**Load Units for WS201 Work Station**

The two load units can be moved by means of hydraulics. The cylinders required in the two load units are not part of the units but contained in the device sets for the learning topics. The load units have been designed for pulling and pushing loads. Scalable loads for 4, 8, 12 or 16 kg are available.

All movable parts are securely contained in a protective housing.

**Measuring Glasses for the WS201 Work Station**

The measuring glasses for measuring and displaying the flow rate are installed on the mobile unit in an ergonomically favorable position. A measuring scale, overflow protection, an air valve and a runner which has to be opened manually are available. The measurement range is 0 - 1.6 liters.

Included Items	Base frame
	2 load units
	2 measuring glasses
Dimensions	mm (L x W x H) 800 x 758 x 1772
Weight	kg 110



## Accessories

### 10 l Hydraulic Oil RSL22

Material No.	R913035362
Typecode	HYDRAULICS OIL AVIA FLUID RSL 22 (C&S)
10 liters of hydraulic fluid suitable for all WS200/WS290 power units; for safety data sheet, see: <a href="http://www.avia.de">www.avia.de</a>	
Product Name	AVIA Fluid RSL 22
Content	l 10

### 20 l Hydraulic Oil RSL22

Material No.	R913046494
Typecode	HYDRAULICS OIL AVIA FLUID RSL 22-20L
20 liters of hydraulic fluid suitable for all WS200/WS290 power units; for safety data sheet, see: <a href="http://www.avia.de">www.avia.de</a>	
Product Name	AVIA Fluid RSL 22
Content	l 20

### Filling Funnel with Hose

Material No.	R961009591
Typecode	FUNNEL 160 + SCHLAUCH
Filling funnel to fill the power units for WS200 and WS290 work stations with hydraulic fluid	



### Accessories

Filling and Test Equipment for Hydraulic Accumulator		
Material No.	0538103012	
Typecode	TEST AND FILLING DEVICE FUER MEMBRANSPEICHER	
By using the filling and test equipment, the hydraulic accumulator can be filled with nitrogen or the precharge pressure can be tested and adjusted.		
Dimensions	mm (L x W x H)	450 x 350 x 100
Manometer Display	bar	0-250



Pressure Release Sleeve		
Material No.	R961002927	
Typecode	COUPLING BOX TS-HC-1-15-005-9-XX0&	
For the relief of the space under pressure behind the coupling plug. A spindle is used to open the pressurized non-return valve on the coupling plug.		
Dimensions	mm (L x D)	79 x 50





**Accessories**

**Mounting Kit to Connect the WS200 Work Stations**

Material No.	R961008677
Typecode	CONNECTING KIT TS-MC-GN851-160-T2

The mounting kit can be easily attached to the WS200/WS201 work stations. The stainless steel closing bracket connects the work stations securely together.



**Hose Holder for 16 Hoses**

Material No.	R901448893
Typecode	HOSE HOLDER TS-MC-16F

The hose holder is an optional installation item for the WS200 work station. The hose holder is used to hold up to 16 hydraulic hose lines. The hose lines are placed into the openings of the two rake-like sides of the holder.

Dimensions	mm (L x W x H)	280 x 150 x 105
Weight	kg	0.825



**Additional components and spare parts are listed in our catalog “Training Systems for Hydraulics.”  
 R999000177 (DE), R999000178 (EN), R999000179 (ES)**



# Individual Technology: Pneumatics

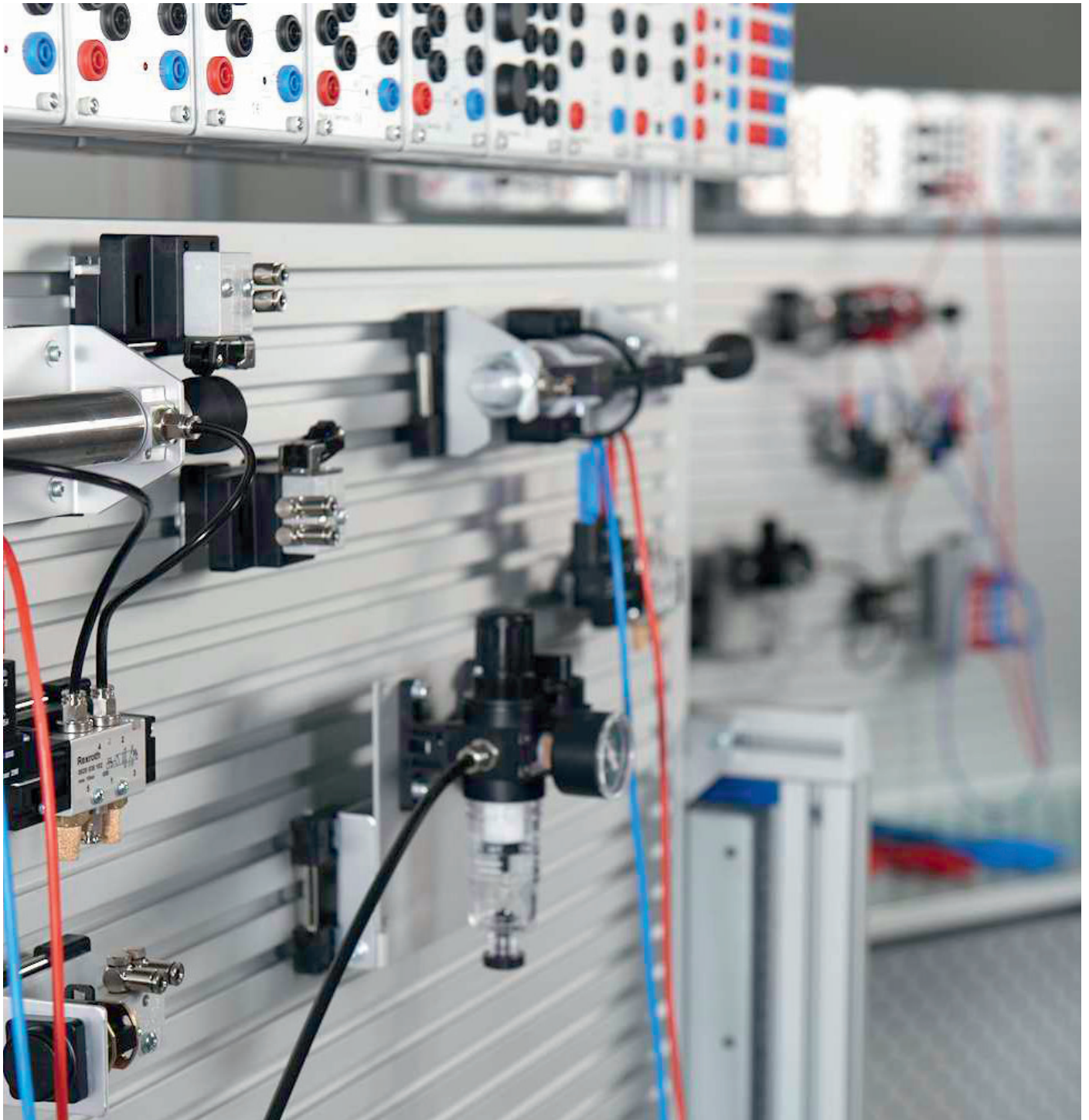




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Knowledge Transfer Using Learning Topics

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# Learning Topics for Pneumatics – Overview

## Basic Knowledge Single Technology

Compo  
f

Drive Technology  
Electrical, pneumatic

eLearning  
Pneumatics

Device set for workstation  
WS200/WS290  
,Pneumatics – Electrical  
operation (BIBB, exercises  
1 - 16), complete, in L-  
Boxx'  
R901386901, page 108  
+  
Device set for workstation  
WS200/DS3 ,Pneumatics –  
Electrical operation (BIBB,  
exercises 1 – 16), with  
I-/O- mudule'  
R901386905, page 110

Additional Learning topics and Information to our  
Pneumatic Training Systems you find in the catalogue  
,Training Systems for Pneumatic'

# w of Device Sets

## Automation / Mechatronic - Pneumatics

<b>Basic</b> lements, modules, action modes, functional basic circuits	<b>Advanced</b> Mechatronic systems, information flow, control, closed loop	<b>Professional</b> Complex mechatronic systems, networking
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### **modular Mechatronic-System mMS 4.0**

**R901423235, page 138**

Decice set ,PLC L25 for  
Pneumatics'  
R901423035, page 65

*"Terminology" on page 13*





## eLearning – Basics of Pneumatics – ePTG



- Independent scheduling
- Learn at your own pace
- Repeat as often as you like within the licensing period
- Final exam + personal Rexroth certificate (per license)

### Contents

- ▶ Introduction to pneumatics
- ▶ Basic physical principles of pneumatics
- ▶ Compressed air generation, compressor types, compressed air drying techniques
- ▶ Maintenance units to condition, compressed air networks
- ▶ Directional control, flow control, pressure control and isolator valves
- ▶ Pneumatic drives
- ▶ Graphic symbols, schematics according to DIN ISO 1219
- ▶ Basics on layout of components
- ▶ Basic pneumatic circuits

### Training Scope and Duration

- ▶ 9 learning modules, 330 pages, 56 test questions
- ▶ Duration approx. 10 to 15 hours
- ▶ Languages: German, English, French and others

### Requirements

- ▶ PC with Internet access, Flash Player 10 or higher (<http://get.adobe.com/de/flashplayer>), if needed, web browser with Flash support
- ▶ Deactivated pop-up blocker
- ▶ Email address for personal login

**Try selected modules of our eLearning library with free guest access:**

[www.boschrexroth.de/eLearning](http://www.boschrexroth.de/eLearning)

### Product Description

From functionality and characteristics of selected components to building pneumatic circuit diagrams – many basics that the pneumatics professional needs are provided in the eLearning module “ePTG – Basics of Pneumatics.”

### Licensing Periods

Within the licensing period (12 months from activation), the eLearning is always accessible.

## **Pneumatics – Electrical Operation (BIBB, Exercises 1 - 16)**

The contents and goals of this learning topic correspond to the requirements of the Federal Institute of Vocational Education (Bundesinstitut für Berufsbildung – BIBB) and provide practical training at the various levels of pneumatics.

After successfully completing the practical exercises, the trainee will have acquired knowledge about control technology, electro-pneumatics, and about the “GRAF CET” design language for sequence controls.

### **Exercise Books**

The exercise books coordinate with the device sets.

The exercises and tasks provide basic information and methods. They have a uniform structure and the execution of the individual exercises is explained step by step.

#### Two Versions

- ▶ Exercises with solutions: more extensive trainer information and content such as measured values, calculation results, etc.
- ▶ Exercises: independent completion of calculations and measured value tables, etc.

#### Learning Content

The logically-structured, practically-oriented tasks allow the trainee to:

- ▶ understand physical basics of pneumatics like pressure difference and compressibility
- ▶ become familiar with and consider legal requirements and safety regulations
- ▶ become familiar with and apply the most important pneumatic symbols
- ▶ understand the functions of basic pneumatic circuitry
- ▶ recognize the typical behavior of pneumatic components in different operational circumstances
- ▶ identify characteristic values



Example Exercise Book

**The following exercises are included:**

No.	Exercise
01	Direct Control with Single acting Cylinder
02	Direct Control with Double acting Cylinder
03	Holding Element Control with Double acting Cylinder
04	Basic Circuit with AND Connection
05	Basic Circuit with OR Connection
06	Basic Circuit with Electric Self-Locking Mechanism
07	Path-Dependent Control with Double acting Cylinder
08	Path-Dependent Control with Two Double acting Cylinders
09	Time-Dependent Control, Time-Delayed
10	Time-Dependent Control, Release-Delayed
11	Pressure-Dependent and Path-Dependent Control
12	Sequential Control with Two Double acting Cylinders, Intuitive
13	Sequential Control with Two Double acting Cylinders, Step Chain
14	Sequential Control with Three Double acting Cylinders, Impulse-Driven
15	Sequential Control with Three Double acting Cylinders, Spring-Returned
16	Pilot Control with Limit Condition

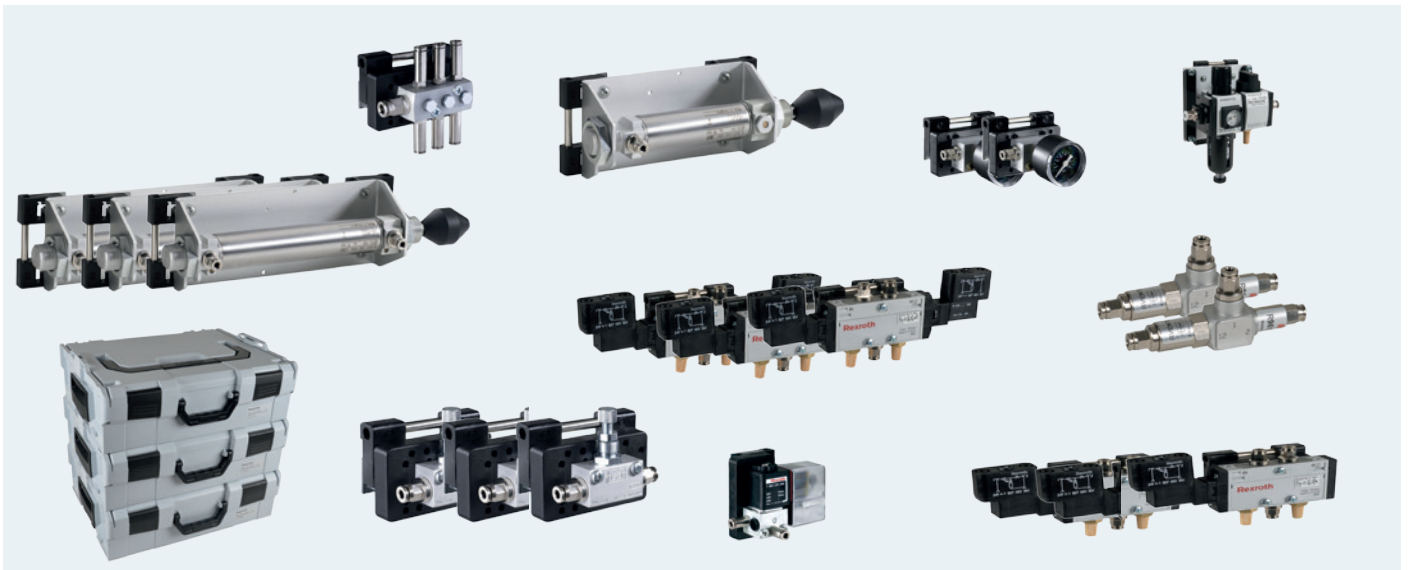
Exercise Books "Pneumatics – Electrical Operation (according to BIBB)"			
	Lang.	Material No.	Typecode
Exercises with Solutions (Trainer Manual)	DE	R901407757	UEBUNGSBUCH TW-PN-LH-2/X 202DE
Exercises with Solutions (Trainer Manual)	EN	R901408015	EXERCISE BOOK TW-PN-LH-2/X 202EN
Exercises with Solutions (Trainer Manual)	ES	R901408016	LIBRO DE EJERCICIOS TW-PN-LH-2/X 202ES
Exercises with Solutions (Trainer Manual)	FR	R901428298	LIVRE D'EXERCICE TW-PN-LH-2/X 202FR
Exercises (Trainee Manual)	DE	R901407759	UEBUNGSBUCH TW-PN-SH-2/X 202DE
Exercises (Trainee Manual)	EN	R901408018	EXERCISE BOOK TW-PN-SH-2/X 202EN
Exercises (Trainee Manual)	ES	R901408020	LIBRO DE EJERCICIOS TW-PN-SH-2/X 202ES
Exercises (Trainee Manual)	FR	R901428300	LIVRE D'EXERCICE TW-PN-SH-2/X 202FR

**Device Set for Work Station WS200/DS3 “Pneumatics – Electrical Operation (BIBB, Exercises 1 - 16), Complete, in L-Boxx”**

Material Number R901386901





Typecode EQUIPMENT SET TS-PS 202-1X-K

Device set “Pneumatics – Electrical Operation (BIBB, Exercises 1 - 16)” synthesize the learning goals and training content for technical-industrial training and continuing education with the basics of electro-pneumatics according to BiBB, using real industrial components. The device set is coordinated with the exercise book “Pneumatics – Electrical Operation (according to BIBB),” which covers BIBB exercises 1-16. The exercises with the listed components can be completed on work stations WS200 and DS3. The device set is delivered in three stackable plastic cases (L-Boxx).



**Device Set R901386901 contains the following components:**

Item	Description of Individual Components	Material No. of Individ. Components	Qty.	Image
1	Filter regulator 3/2 directional control valve, 0.5 - 10 bar	R901445603	1	
2	Pneumatic distributor 6 ports	1827003411	1	
3	Single acting cylinder d = 25 mm, h = 50 mm	1827003371	1	
4	Double acting cylinder d = 25 mm, h = 100 mm	1827003372	3	
5	Manometer 0 to 10 bar	1827003406	2	
6	Throttle check valve G1/8	1827003379	3	

7	Throttle valve, pilot-controlled	R961008838	2	
8	3/2 directional control valve, electrically operated, M5, spring-returned	1827003412	1	
9	5/2 directional control valve, electrically operated, G1/8, spring-returned	R901385293	3	
10	5/2 directional control valve, electrically operated, G1/8, Impulse	R901385294	3	

Drive & Control Academy

Knowledge Transfer Using Learning Topics

Learning Topics Individual Technologies

Learning Topics Mechatronics/Automation

Application-Specific Systems

Components and Spare Parts

Indices

**Device Set, Electric, for Work Station WS200/DS3 “Pneumatics – Electrical Operation (BIBB, Exercises 1 - 16), with I/O Module, in L-Boxx”**






Material Number R901386905

Typecode EQUIPMENT SET TS-PS 503-1X-K

All of the needed electrical components for BIBB exercises 1-16 are included in this device set. The electrical functions switch, sensor, relay and display are contained in one in one control unit. This device set is needed to complete the exercises in the exercise book “Pneumatics – Electrical Operation (according to BIBB)” at a WS200 work station. In this set, the control unit also contains an I/O module, to which sensors and valves can be connected. A simulation program can be connected to the hardware via a USB interface. All components except the control unit are delivered in a stackable plastic box (L-Boxx).



**Device set R901386905 contains the following components:**

Item	Description of Individual Components	Material No. of Indiv. Components	Qty.	Image	Page
1	Control unit in housing – BIBB Module + I/O Module	R961009675	1		—
2	Electrical cylinder switch with adapter	1827003437	6		—
3	Electrical limit switch with roller lever	1827003421	1		—
4	Mechanical pressure switch, 1 to 16 bar	1827003428	1		—
5	Sensor, inductive, 0.2 A; Sn = 2 mm	1827003422	1		204

6	Sensor, capacitive, 0.2 A; Sn = 4 mm	1827003423	1		204
7	Cable set, BIBB electro-pneumatic	1827003436	1		—

Drive & Control Academy

Knowledge Transfer Using Learning Topics

Learning Topics Individual Technologies




Learning Topics Mechatronics/Automation

Application-Specific Systems

Components and Spare Parts

Indices

**One of the following work stations is required to complete the exercises in the learning topic “Pneumatics”:**

<b>Work Station</b>	<b>Material No.</b>	<b>Image</b>	<b>Page</b>
Work station WS200 for pneumatics, double-sided for 2 - 4 trainees – assembled, incl. packaging	R961008854		117
Grooved panel (tabletop version, upright)	R961003826		48
Work station DS3 for pneumatics, double-sided for 4 - 6 trainees – assembled, incl. packaging	1827003700		50

**Additional learning content on the topic of pneumatics can be conducted with our modular mechatronics system mMS4.0 (beginning on page 138).**



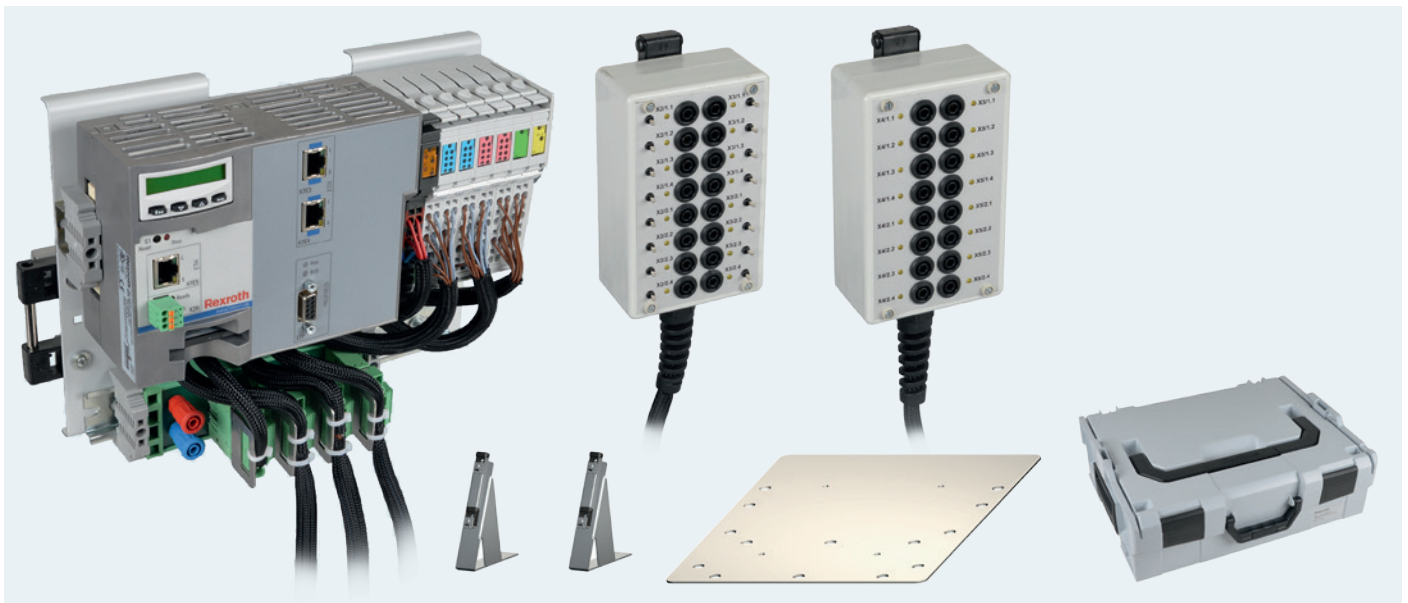
## PLC for Pneumatics

Some of the exercises in the exercise books “Pneumatics – Electrical Operation (according to BIBB, Exercises 1 - 16)” can also be completed with the device set “PLC L25 for Pneumatics.”. In this case, the electric circuit is replaced with the device set “PLC L25 for Pneumatics” and a PLC program. The required PLC programs can be found in the Rexroth LearnWorld.






### Device Set “PLC L25 for Pneumatics”

Material Number	R901423035
Typecode	EQUIPMENT SET TS-AS 108-1X-K

This device set is well-suited to complete exercises on the topic of controls, with a focus in pneumatics. It includes the control XLC L25 with a bracket for the grooved panel, 16 digital inputs which can also be controlled with a switch/sensor and 16 digital outputs with an LED display and 4 digital outputs. All components are delivered in a stackable plastic case (L-Boxx).



### Device set R901423035 contains the following components:

Item	Description of Individual Components	Material No. of Indiv. Components	Qty.	Image	Page
1	IndraControl L25 PLC (incl. IndraWorks software tool) with bracket for grooved panel	R901423029	1		216
2	Input module with 16 digital inputs via switch, sensor or socket	R901411106	1		218
3	Output module with 16 digital outputs	R901411115	1		218
4	Mounting plate for PLC	R901439219	1		216
5	Mounting brackets for tabletop PLC	R901439222	2		217



# Work Stations for Pneumatics



**Grooved Panel (Tabletop Version, Upright)**

Material Number	R961003826
Typecode	WORKSTATION TS-MC-ECODESK

This work station is outstanding for providing training in pneumatic and automation technologies. The pneumatic and automation components can be mounted on the grooved panel in tabletop mode. The Snap-In quick-connect system allows for easy attachment and secure mounting of the components. The double-sided version is designed so that 2-4 trainees in 2 groups can use the work station simultaneously. The work station is delivered as an assembly with components attached.

Dimensions	mm (L x W x H)	1150 x 640 x 730
Number of Work Spaces		2-4
Weight	kg	22.5
Work Surface	mm (W x H)	1130 x 700



**Work Station WS200 Pneumatics, Double-Sided, for 2 - 4 Trainees  
 – Assembled, Incl. Packaging**

Material Number	R961008854
Typecode	WORKSTATION TS-WS200-1X/ N1G0A0T1&

This work station is outstanding for training in pneumatic and automation technologies.

The mobile work station is equipped with a grooved panel, to which the pneumatic and automation components can be mounted. The Snap-In quick-connect system ensures easy attachment and secure mounting.

The double-sided version is designed so that two to four trainees can use the work station simultaneously in two groups.

Each included tray can be converted from an oil pan to a practical writing surface by simply flipping it over.

Included Items	Base frame 1 grooved panel, double-sided Tray set
----------------	---

Dimensions	mm (L x W x H)	800 x 806 x 1772
Number of Work Spaces		2 - 4
Weight	kg	45

Accessories		
Description	Material No.	Quantity
Compressor 230 V/50 Hz	R900891168	1
Compressor 230 V/60 Hz	R901464218	1
Compressor 110 V/60 Hz	R961003963	1
Accessory Set for compressor	R901471412	1

For pneumatics accessories, see sales catalog pneumatic training system R999000217



**Work Station DS3 for Pneumatics, Double-Sided, for 4 - 6 Trainees  
 – Assembled, Incl. Packaging**

Material Number	1827003700
Typecode	WORKSTATION TS-DS3-1X/ LK0E00T0-M

This work station is outstanding for training in pneumatic and automation technologies. The grooved panel of the DS3 mobile work station allows for the attachment of pneumatic and automation components on both sides. The Snap-In quick-connect system enables easy attachment and secure mounting of the components. A perforated plate holds unused components. The double-sided version is designed so that 2-3 trainees can use the work station simultaneously in two groups.

Dimensions	mm (L x W x H)	1250 x 790 x 1610
Weight	Kg	63
Work Surface	mm (W x H)	1300 x 700



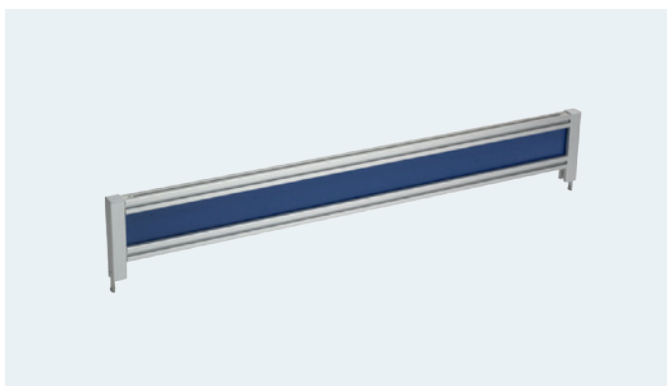
**Accessories**

**Mounting for Electrical Assemblies**

Material Number	1827003703
Typecode	ATTACHMENT TS-MC-ELEK-DS3

Mounting for electrical assemblies, for establishing circuits, can be used on both sides, suitable for the Snap-In quick mounting system. Provides mounting for the DS3 or grooved panel (upright).

Dimensions	mm (L x W x H)	1130 x 165 x 30
Weight	kg	3.7
Work Surface	mm (W x H)	1130 x 130



## Accessories

### Accessory Set for Pneumatics, in L-Boxx

Material Number R901385277

Typecode ACCESSORY SET TS-PC-KLTL-PN-K

Accessory set, suitable for device sets "Device Set for Work Station WS200/DS3 "Pneumatics – Electrical Operation (BIBB, Exercises 1 - 16)," Complete, in L-Boxx" and "Electric Device Set for Work Station WS200/DS3 "Pneumatics – Electrical Operation (BIBB, Exercises 1 - 16)," with I/O Module, in L-Boxx." All components are delivered in a stackable plastic case (L-Boxx).



### Accessory set R901385277 contains the following components:

Item	Description of Individual Components	Material No. of Indiv. Components	Quantity	Image
1	Plastic hose, 4 x 0.75, PU, black, packing unit: 10 m	R901395757	2	
2	Plastic hose, 6.0 x 1.05, PU, packing unit: 2 m	R961007739	1	
3	Pipe cutter	1823391390	1	
4	Loosening tool	1823391651	1	
5	Silencer, G1/8, packing unit: 10	1827000000	1	
6	T -plug connector, 4 mm, packing unit: 10	1823381043	1	
7	Blanking connector, 4 mm, packing unit: 20	2123204000	1	

## Accessories

### Compressors

Compressors for compressed air supply with manometer, pressure regulator, water separator and 2 compressed air connections, low noise level, suitable for operation in the classroom. Compressor unit for single-phase electrical connection, operating pressure of 8 bar, air volume of max. 50 l/min, volume of max. 40 dB.

### Types

#### Compressor 230 V/50 Hz

Material Number	R900891168
Typecode	COMPRESSOR TS-PC-230V/50HZ-8BAR

#### Compressor 230 V/60 Hz

Material Number	R901464218
Typecode	COMPRESSOR TS-PC-230V/60HZ-8BAR

#### Compressor 110 V/60 Hz

Material Number	R961003963
Typecode	COMPRESSOR TS-PC-110V/60HZ-8BAR



### Accessory Set for Compressor

Material Number	R901471412
Typecode	ACCESSORY SET TS-PC-COMPRESSOR

Accessory set, suitable for the various compressor types:

- ▶ Coupling plug with 2/2 directional control valve (R900891177)
- ▶ T-plug connector, 6 mm, packing unit: 1 (2121106000)
- ▶ Plastic hose, 6.0 x 1.05, PU, packing unit: 8 m (R961007740)





**Additional components and spare parts are available in our catalog Training Systems for Pneumatics R999000217 (DE), R999000218 (EN).**



# Learning Topics for Mechatronics/Automation



Drive & Control Academy

Knowledge Transfer Using Learning Topics

Learning Topics Individual Technologies

Learning Topics Mechatronics/Automation

Application-Specific Systems

Components and Spare Parts

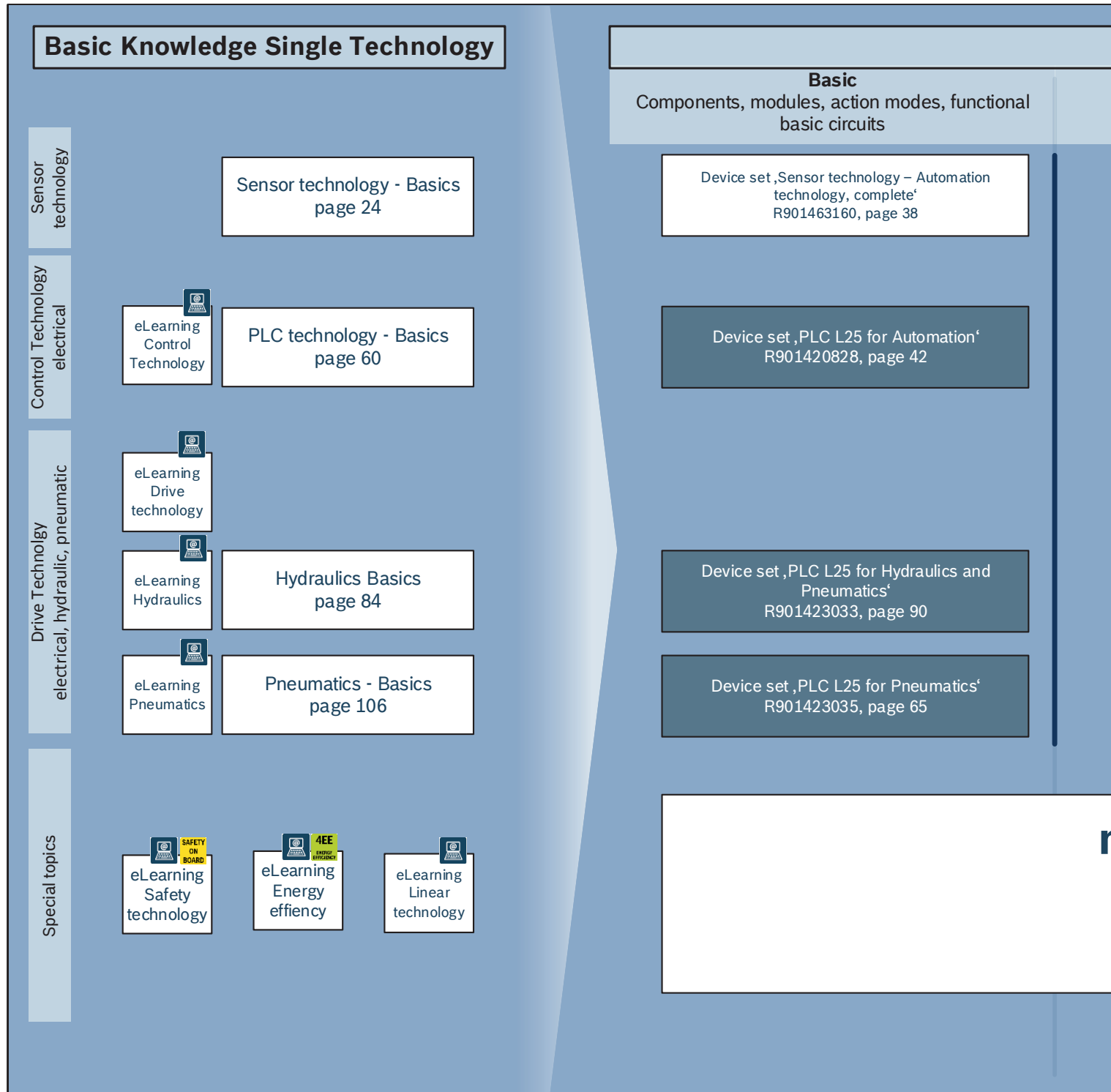
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# Learning Topics: Mechatronics – Basic – Overview of Device Sets



## Automation / Mechatronic - Basic

### Advanced

Mechatronic systems, information flow, control, closed loop

### Professional

Complex mechatronic systems, networking

# modular Mechatronic-System mMS 4.0

**R901423235, page 138**

Drive & Control Academy

Knowledge Transfer Using Learning Topics

Learning Topics Individual Technologies

Learning Topics Mechatronics/Automation

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*“Terminology” on page 13*

## eLearning – Basics of Electric Drive Technology– eEATG



- Independent scheduling
- Learn at your own pace
- Repeat as often as you like within the licensing period
- Final exam + personal Rexroth certificate (per license)

### Content

- ▶ Basic introduction to electric control technology
- ▶ Electric motors, operating principles and characteristics
- ▶ Knowledge of encoder systems

### Training Scope and Duration

- ▶ 5 learning modules, 175 training pages, 50 test questions
- ▶ Learning time: 10 to 15 hours
- ▶ Languages: German and English

### Requirements

- ▶ PC with Internet access, Flash Player 10 or higher (<http://get.adobe.com/de/flashplayer>), if needed, web browser with Flash support
- ▶ Pop-up blocker turned off
- ▶ Email address for personal login

**Try selected modules of our eLearning library with free guest access:**

[www.boschrexroth.de/eLearning](http://www.boschrexroth.de/eLearning)

### Product Description

This eLearning module is concerned with the functionality and characteristics of selected drive components. eLearning is recommended to everyone who would like to go on to attend advanced training. The participants get to know the relationships between electric drive systems and receive insight into industrial automation.

### Licensing Periods

During the licensing period (12 months following activation) our eLearning is always accessible.



Basic knowledge of mechatronics can be acquired using the device sets listed here.

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### **Mechatronics – Basic (Sensor Technology / PLC)**

The appropriate exercise manuals, device sets, work stations and accessories are listed in the Sensor Technology chapter beginning on page 53.



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### **Mechatronics – Basic (Drive Technology / PLC)**

- ▶ Device Set “PLC L25 for Automation“ on page 42
- ▶ Device Set “PLC L25 for Hydraulics and Pneumatics“ on page 90
- ▶ Device Set “PLC L25 for Pneumatics“ on page 113



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### **Mechatronics – Basic (Hydraulics)**

The appropriate exercise manuals, device sets, work stations and accessories are listed in the Hydraulics chapter beginning on page 77.



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### **Mechatronics – Basic (Pneumatics)**

The appropriate exercise manuals, device sets, work stations and accessories are listed in the Pneumatics chapter beginning on page 99.



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To help you become a mechatronics expert, beginning on page 138 we introduce you to our modular mechatronics system (mMS4.0), with which not only the learning topics for Mechatronics – Basic (from this chapter) but also the learning topics for Mechatronics Advanced/Professional (complete automation process) can be implemented.

**Modular Mechatronics System – Station 1, mMS4.0 (Material Transport and Detection) – Assembled, Incl. Packaging**

Material Number	R901423240
Typecode	EQUIPMENT UNIT TS-MMS4.0-1X/W4U-1V2Z&

For the mechatronics learning topics (Basic to Professional), real production equipment, a mechatronics system, is provided, which consists of 3 stations. All 3 work stations can be used individually or be connected to form a larger system. The work stations described here are made of industrial components (industry standard).

The stations have interfaces (compressed air, power, data, Ethernet) to connect more stations.

For connected stations, the emergency stop for each individual station is effective for the entire connected system. The individual stations are fully installed and fully functional on delivery.

The modular mechatronics system (mMS4.0) features the assembly of a cube-shaped housing. The 2 housing cubes are prepared, connected to each other or joined together and stored. In order to provide various product types, a different color is used for each housing cube.

At Station 1, the housing cubes are available on a conveyor. Using different sensors, position and color (light/dark) are detected and the housing cubes are forwarded or rejected. To wire the system components, a Profibus coupler is used on the grooved panel, to which the component cables are clamped. In addition, it is connected to the control with a Profibus cable.

Station 1 has its own control (IndraLogic L25).

The (industry-standard) control offers several specific possibilities:

1. PLC programming according to IEC61131-3 with the languages Instruction List, Ladder Diagram, Function Block Diagram, Sequential Function Chart, Structured Text
2. Convertible into a CNC control via Flash card (Station 3)
3. As preparation for Industry 4.0 (i4.0) learning topics: the control can be accessed with other programming languages (e.g. Visual-Basic, C++, C#, Java, ...) using OpenCore Engineering and control via a software program (e.g. LabView, MatLab/Simulink, Excel, Power Point,...) is possible. This is possible without PLC programming. By using high-level language programming it is possible to read data directly from the PLC, even parallel to a running PLC program (conversion of Big Data). Example of an i4.0 application that is possible with the control described above: direct control of a system with a LabView program (from the appropriate LabView lab) via the control, without needing to translate into a PLC programming language.



The following practice topics are addressed:

- ▶ Getting to know the system and PLC program
- ▶ Understanding the emergency stop circuit
- ▶ Detecting material with sensors
- ▶ Visualizing and operating equipment functions
- ▶ Visualizing system conditions
- ▶ Single-step and automatic modes
- ▶ PLC programming according to IEC 61131-3

The exercises are available online.

Exercises with solutions are available to the trainer.

The work station is equipped with the following components:

- ▶ Setup on an 800 x 550 mm aluminum profile plate
- ▶ Base: profile carriage 800 x 800 x 1350 mm (L x W x H) with electrically pre-wired control box, with the following and other components:
- ▶ IndraLogic L25 PLC, IEC 61131-3 compatible (see page 216 for description)
- ▶ Safety relay for emergency stop circuit
- ▶ Energy supply for 24V power supply
- ▶ Industrial machine control desk with quick-connect for grooved panel/perforated panel
- ▶ Maintenance unit for compressed air
- ▶ Conveyor with 24 V DC motor w/ 800m length to achieve transfer to next station with same conveyor
- ▶ Separator magazine for the housing cubes. These are pushed to the conveyor via a pneumatic cylinder
- ▶ Sensor, reed contact, pneumatic cylinder in out or in position
- ▶ Sensor, roller, housing detection in magazine
- ▶ Sensor, capacitive, housing on conveyor
- ▶ Sensor, inductive, metallic housing
- ▶ Sensor, optical, light or dark housing
- ▶ Sensor, light sensor, housing at end of conveyor
- ▶ Pneumatic cylinder for contour detection with analog path measurement sensor and reed contact
- ▶ Removal unit for sorting of rejected parts
- ▶ Profibus coupler on grooved panel for wiring the system components
- ▶ Housing cubes made of aluminum, PVC (white) and PVC (black)
- ▶ Programming software (IndraWorks license)
- ▶ Documentation CD (operating instructions, operating diagrams, etc.)
- ▶ Ethernet switch for other needed network participants, e.g. PC, route, RFID etc

Dimensions	mm (L x W x H)	800 x 780 x 1400
Required Space	m (L x W)	1.5 x 1.5
Number of Work Positions	opt. / max. per station	1 / 3
Weight	kg	67
Supply Voltage	VAC	115-230
Operating Pressure	bar	5...6

**Modular Mechatronics System – Station 2, mMS4.0 (Processing with Pneumatic Press) – Assembled, Incl. Packaging**

Material Number	R901423247
Typecode	EQUIPMENT UNIT TS-MMS4.0-1X/W7U-1V2Z&

For the mechatronics learning topics (Basic to Professional), real production equipment, a mechatronics system, is provided, which consists of 3 stations. All 3 work stations can be used individually or be connected to form a larger system. The work stations described here are made of industrial components (industry standard).

The stations have interfaces (compressed air, power, data, Ethernet) to connect more stations.

For connected stations, the emergency stop for each individual station is effective for the entire connected system. The individual stations are fully assembled and fully functional on delivery.

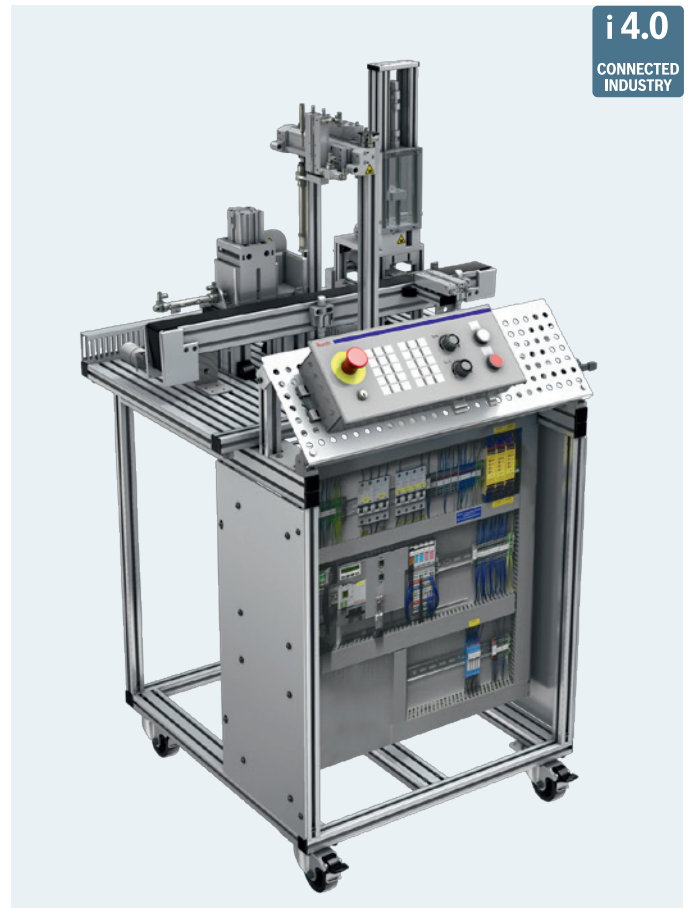
The modular mechatronics system (mMS4.0) features the assembly of a cube-shaped housing. Thus, 2 housing cubes are prepared, connected to each other or fit together and stored. In order to provide various product types, a different color is used for each housing cube.

This station assembles the housing cubes. This is accomplished with a pinning unit and a pneumatic press. The pinning unit is used to insert at least 2 pins into one housing cube. After the second housing cube is placed in the press and the press process is complete, the housing cubes are held together by the pins. The material transfer from the conveyor to the press and back is done with a pneumatic vacuum gripper. The housing cubes and pins are easily separated without tools in order to resume the manufacturing process. The system components can easily be connected to the PLC via a fieldline-M8 bus coupler using a cable with M8 plugs.

Station 2 has its own control (IndraLogic L25).

The (industry-standard) control offers several specific possibilities:

1. PLC programming according to IEC61131-3 with the languages Instruction List, Ladder Diagram, Function Block Diagram, Sequential Function Chart, Structured Text
2. Convertible into a CNC control via Flash card (Station 3)
3. As preparation for Industry 4.0 (i4.0) learning topics: the control can be accessed with other programming languages (e.g. VisualBasic, C++, C#, Java, ...) using OpenCore Engineering and control via a software program (e.g. LabView, MatLab/Simulink, Excel, Power Point,...) is possible. This is possible without PLC programming. By using high-level language programming it is possible to read data directly from the PLC, even parallel to a running PLC program (conversion of Big Data). Example of an i4.0 application that is possible with the control described above: direct control of a system with a LabView program (from the appropriate LabView lab) via the control, without needing to translate into a PLC programming language.



The following practice topics are addressed:

- ▶ Learning about and commissioning the equipment
- ▶ Understanding the emergency stop circuit
- ▶ Transporting material with electric drive technology
- ▶ Moving material with pneumatic drive and vacuum technology
- ▶ PLC programming according to IEC 61131-3
- ▶ PLC program reset – emergency stop circuit
- ▶ PLC program pinning unit
- ▶ PLC program portal – load press
- ▶ PLC program – press with two-hand activation
- ▶ PLC program portal – unload press
- ▶ Program entire process for Station 2

The exercises are available online.

Exercises with solutions are available to the trainer.

The work station is equipped with the following components:

- ▶ Setup on an 800 x 550 mm aluminum profile panel
- ▶ Base: profile carriage 800 x 800 x 1350 mm (L x W x H) with electrically pre-wired control box, with the following and other components:
- ▶ IndraLogic L25 PLC, IEC 61131-3 compatible (see above for description)
- ▶ Safety relay for emergency stop circuit
- ▶ Energy supply for 24V power supply
- ▶ Industrial machine control desk with quick-connect for grooved panel/perforated panel
- ▶ Maintenance unit for compressed air
- ▶ Conveyor with 24 V DC motor w/ 800m length to achieve transfer to next station with same conveyor
- ▶ Pinning unit to insert two pins in the housing cubes
- ▶ Light barrier with sensor and receiver for detection of housing at conveyor end
- ▶ Pick and place portal for equipping the press
- ▶ Pneumatic press for grouting the housing cubes
- ▶ Connection pins to hold the housing cubes together
- ▶ Decentralized fieldline I/O, connection of system components with control via cable w/ M8 plugs
- ▶ Housing cubes made from aluminum, PVC (white) and PVC (black)
- ▶ IndraWorks programming software (one license)
- ▶ Documentation CD (operating instructions, operating diagrams, etc.)
- ▶ Ethernet switch for other needed network participants, e.g. PC, route, RFID etc

Dimensions	mm (L x W x H)	800 x 780 x 1600
Required Space	m (L x W)	1.5 x1.5
Number of Work Positions	opt. / max. per Station	1 / 3
Weight	kg	77
Supply Voltage	VAC	115-230
Operating Pressure	bar	5...6

**Modular Mechatronics System – Station 3, mMS4.0 (High Rack Storage) – Assembled, Incl. Packaging**

Material Number	R901423254
Typecode	EQUIPMENT UNIT TS-MMS4.0-1X/ W8U1V2Z&

For the mechatronics learning topics (Basic to Professional), real production equipment, a mechatronics system, is provided, which consists of 3 stations. All 3 work stations can be used individually or be connected to form a larger system. The work stations described here are made of industrial components (industry standard).

The stations have interfaces (compressed air, power, data, Ethernet) to connect more stations.

For connected stations, the emergency stop for each individual station is effective for the entire connected system. The individual stations are fully installed and fully functional on delivery.

The modular mechatronics system (mMS4.0) features the assembly of a cube-shaped housing. Thus, 2 housing cubes are prepared, connected to each other or fit together and stored. In order to provide various product types, a different color is used for each housing cube.

This station features a storage system. The finished housings are placed in a high rack storage system by a cartesian robot with a pneumatic gripper (4-axis system).

Notes for Station 3:

Station 3 “high rack storage” can be converted to a CNC system. This is possible without any change to the control hardware, but only by switching the firmware (different flash card).

Station 3 has its own control (IndraLogic L45).

The (industry-standard) control offers several specific possibilities:

1. PLC programming according to IEC61131-3 with the languages Instruction List, Ladder Diagram, Function Block Diagram, Sequential Function Chart, Structured Text
2. Convertible into a CNC control via Flash card (Station 3)
3. As preparation for Industry 4.0 (i4.0) learning topics: the control can be accessed with other programming languages (e.g. VisualBasic, C++, C#, Java, ...) using OpenCore Engineering and control via a software program (e.g. LabView, MatLab/Simulink, Excel, Power Point,...) is possible. This is possible without PLC programming. By using high-level language programming it is possible to read data directly from the PLC, even parallel to a running PLC program (conversion of Big Data). Example of an i4.0 application that is possible with the control described above: direct control of a system with a LabView program (from the appropriate LabView lab) via the control, without needing to translate into a PLC programming language.



The following practice topics are addressed:

- ▶ Getting to know the system and PLC program
- ▶ Understanding the emergency stop circuit
- ▶ Commissioning of electric servo axes
- ▶ Monitoring and control of drive controllers with PLC
- ▶ Connecting power
- ▶ Moving to a specific point
- ▶ Loading and storing a workpiece (cartesian robot)
- ▶ PLC programming according to IEC 61131-3

The exercises are available online.

Exercises with solutions are available to the trainer.

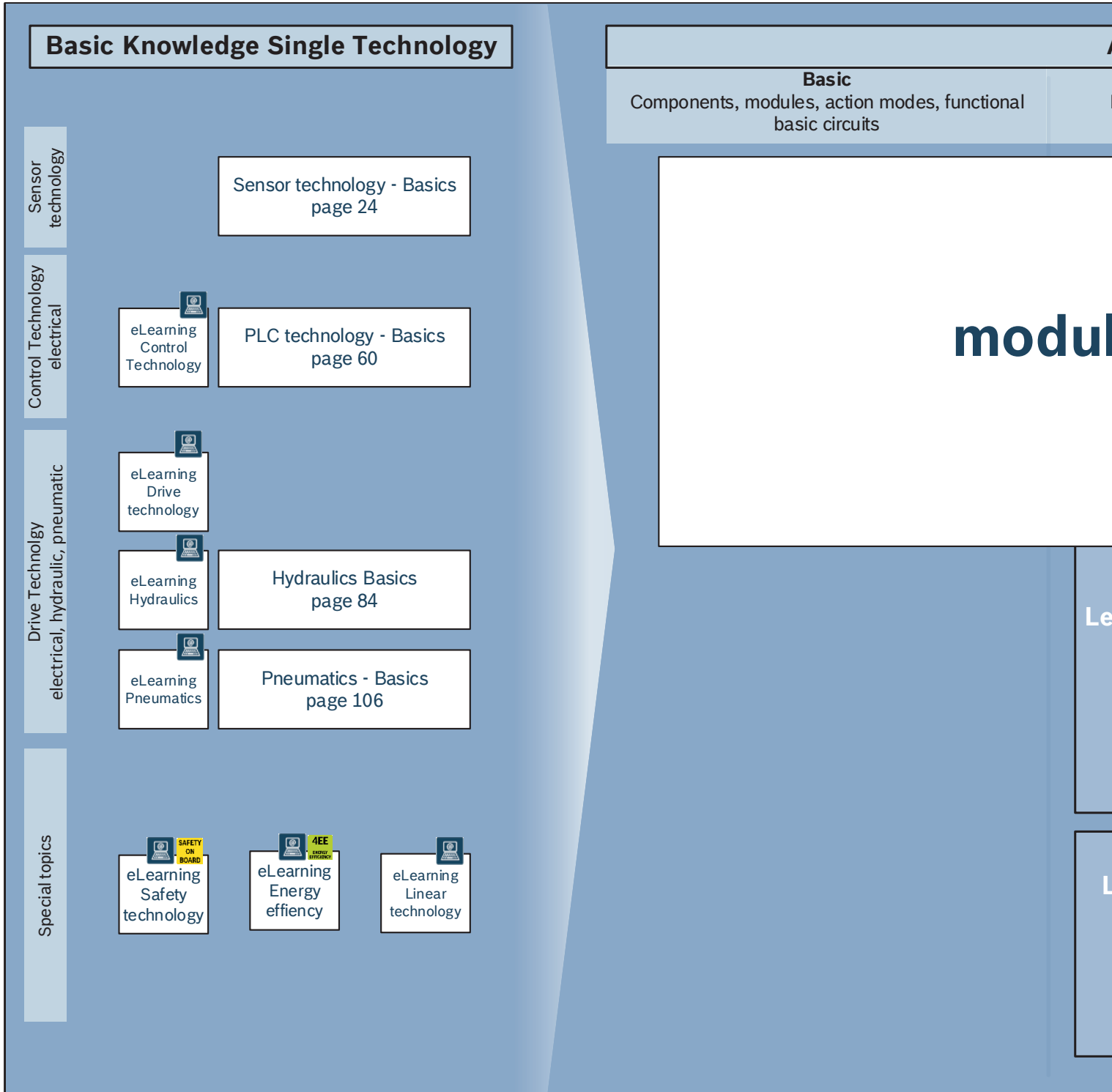
The work station is equipped with the following components:

- ▶ Setup on an 800 x 550 mm aluminum profile plate
- ▶ Base: profile carriage 800 x 800 x 1350 mm (L x W x H) with electrically pre-wired control box, with the following and other components:
- ▶ IndraLogic L45 PLC, IEC 61131-3 compatible, convertible to CNC (see description above)
- ▶ Safety relay for emergency stop circuit
- ▶ Energy supply for 24V power supply
- ▶ Industrial machine control desk with quick-connect for grooved panel/perforated panel
- ▶ Maintenance unit for compressed air
- ▶ Conveyor with 24 V DC motor w/ 800m length to achieve transfer to next station with same conveyor
- ▶ High rack storage with at least 3 x 5 positions
- ▶ Cartesian robot for placement on high rack storage system, consisting of 2 electric servo axes, one pneumatic gripper, one pneumatic rotary axis and a pneumatic axis for moving the gripper to the conveyor or into the storage area
- ▶ Protective housing with door made of aluminum profile and plexiglass for Station 3. The door must be equipped with a safety latch
- ▶ Decentralized fieldline I/O, connection of system components with PLC via cable with M8 plugs
- ▶ Housing cubes made of aluminum, PVC (white) and PVC (black)
- ▶ IndraWorks programming software (one license)
- ▶ Documentation CD (operating instructions, operating diagrams, etc.)
- ▶ Ethernet switch for other needed network participants, e.g. PC, route, RFID etc

Dimensions	mm (L x W x H)	800 x 780 x 1900
Required Space	m (L x W)	1.5 x1.5
Number of Work Positions	opt. / max. per station	1 / 3
Weight	kg	122
Supply Voltage	VAC	115-230
Operating Pressure	bar	5...6

# Learning Topics for Mechatronics – Advanced (mMS4.0)

## Overview of Device Sets





4.0) –

## Automation / Mechatronics - Sensor technology

### Advanced

Mechatronic systems, information flow, control, closed loop

### Professional

Complex mechatronic systems, networking



# ular Mechatronic-System mMS 4.0 page 138

Robotics  
cartesian  
page 134

Robotics-  
Scara  
page 179



Robotics-  
Articulated Arm  
page 175



Robotics-  
Collaborating  
page 177

### Additional Learning topics at mMS 4.0



eLearning SERCOS, page 143

Expansion ‚Machine Safety‘ R901437512, page 145

Expansion ‚HMI-Integration und Programming‘ R901467429, page 147

Expansion ‚CNC-Technology‘ R901430882, page 149

Additional Learn topics on mMS 4.0 see page 151

### Additional Learning topics for Industry 4.0 at mMS 4.0



Expansion ‚OpenCore Engineering via Tablet-PC‘, R901438601, page 152

Expansion ‚RFID-Technology‘, R961008475, page 154

Expansion, Interactive Visualization- and Control Board (Active Cockpit)‘, R901444320, page 158

Additional Learning topics for Industry 4.0 on mMS 4.0 see from page 160

“Terminology” on page 13

**WS511 – Work Station “Advanced/Professional Mechatronics – Modular Mechatronics System (mMS4.0) – Complete System, Stations 1-3, mMS 4.0 with Pneumatic Press – Assembled, Incl. Packaging”**

Material Number	R901423235
Typecode	EQUIPMENT UNIT TS-MMS4.0-1X/ W1U3V2Z&

For the mechatronics learning topics (Basic to Professional), real production equipment (a mechatronics system) is provided, which consists of 3 stations. All 3 work stations can be used individually or be connected to form a larger system. The work stations described here are made of industrial components (industry standard) and adapted for training purposes.

The stations have interfaces (compressed air, power, data, Ethernet) to connect more stations.

For connected stations, the emergency stop for each individual station is effective for the entire connected system. The individual stations are fully installed and fully functional on delivery.

The modular mechatronics system (mMS4.0) features the assembly of a cube-shaped housing. Thus, 2 housing cubes are prepared, connected to each other or fit together and stored. In order to provide various product types, a different color is used for each housing cube.

The individual stations 1-3 described above can be connected to form a total production system. The connections of power, compressed air, data and emergency stop can be made via plug connectors. The conveyors of the individual stations, when combined, fit together in such a way that the housing cubes or the whole housing is moved from one conveyor to the next. In addition, the emergency stop is effective for the entire, connected system.

Each station has its own control (IndraLogic L25/L45). The controls (industry standard) are described under each station.

The following accessories are offered for the work station:

Air compressor with accessories:

Specifications:

- ▶ Noise level: < 40 dB(A)
- ▶ Air volume, max. 50 l/min
- ▶ Tank contents: at least 15 l
- ▶ Max. operating pressure: 8 bar
- ▶ Supply voltage: 230 V/50 Hz or 230 V/60 Hz or 110 V/60 Hz
- ▶ 1 maintenance unit with manometer, pressure regulator and water separator
- ▶ 2 compressed air connections (quick-connect)

Accessory set to connect the compressor with the work station:

- ▶ Coupling plug (2/2-way ball valve with quick-connect and hose connection)
- ▶ T-plug connector, 6 mm
- ▶ Plastic hose 6 x 1.05 mm (length 8m)

The following practice topics are addressed:

- ▶ Getting to know the system and PLC program
- ▶ Understanding the emergency stop circuit
- ▶ Detecting material with sensors
- ▶ Visualizing and operating equipment functions
- ▶ Visualization of system conditions
- ▶ Single-step and automatic modes
- ▶ PLC programming according to IEC 61131-3
  
- ▶ Learning about and commissioning the equipment
- ▶ Understanding the emergency stop circuit
- ▶ Transporting material with electric drive technology
- ▶ Moving material with pneumatic drive and vacuum technology
- ▶ PLC programming according to IEC 61131-3
- ▶ PLC program reset – emergency stop circuit
- ▶ PLC program pinning unit
- ▶ PLC program portal – load press
- ▶ PLC program – press with two-hand activation
- ▶ PLC program portal – unload press
- ▶ Program entire process for Station 2
  
- ▶ Getting to know the system and PLC program
- ▶ Understanding the emergency stop circuit
- ▶ Commissioning of electric servo axes
- ▶ Monitoring and control of drive controllers with PLC:
- ▶ Connecting power
- ▶ Moving to a specific point
- ▶ Loading and storing a workpiece (cartesian robot)
- ▶ PLC programming according to IEC 61131-3

Dimensions	mm (L x W x H)	2400 x 780 x 1920
Required Space	m (L x W)	4 x 2.3
Number of Work Positions	opt. / max. per station	1 / 3
Weight	kg	270
Supply Voltage	VAC	115-230
Operating Pressure	bar	5...6



Drive & Control Academy

Knowledge Transfer Using Learning Topics

Learning Topics Individual Technologies

Learning Topics Mechatronics/Automation

Application-Specific Systems

Components and Spare Parts

Indices



# Learning Topics: Mechatronics – Advanced (mMS4.0) – Additional Learning Topics, mMS4.0

- ▶ eLearning – Sercos – the automation bus – eSER
- ▶ Machine safety
- ▶ HMI integration and programming (human-machine-interface)
- ▶ CNC Technology



## eLearning – Sercos – The Automation Bus – eSER



- Independent scheduling
- Learn at your own pace
- Repeat as often as you like within the licensing period
- Final exam + personal Rexroth certificate (per license)
- Free

### Content

- ▶ Overview of the Sercos Automation Bus
- ▶ Sercos Applications in Industrial Automation
- ▶ Technical Details about Sercos
- ▶ Characteristics of and Uses for Sercos

### Requirements

- ▶ PC with Internet access, Flash Player 10 or higher (<http://get.adobe.com/de/flashplayer>), if needed, web browser with Flash support
- ▶ Pop-up blocker turned off
- ▶ Email address for personal login

### Product Description

From Sercos basics to technical details and application examples – many things a user of controls, electric and hydraulic drives, valves and I/Os needs. This training is recommended to everyone who uses products with a Sercos interface or who would like to learn more about the automation bus Sercos.

### Licensing Periods

The eLearning is always available.

**Try selected modules of our eLearning library with free guest access:**

[www.boschrexroth.de/eLearning](http://www.boschrexroth.de/eLearning)

## Machine Safety

The functional safety of systems is a very important feature of automation systems. This learning topic shows how to handle safety components and safety controls.

The following practice topics are addressed:

- ▶ Measuring, integration and troubleshooting of safety components
- ▶ Programming a safety control
- ▶ Commissioning a system

The exercises are available online.

Exercises with solutions are available to the trainer.



<b>Device Expansion Set “Machine Safety”</b>	
Material Number	R901437512
Typocode	EQUIPMENT SET TS-AS 205-1X

This device expansion set consists of a light grid (transmitter and receiver), a door with a safety switch and a SafeLogic Compact safety control. The safety control is coupled to the modular mechatronics system via the emergency stop circuit. The components (light grid and safety door) are equipped with a quick-connect system for a grooved panel. The components are positioned vertically and horizontally on the grooved panel.



**Device Expansion Set R901437512 contains the following components:**

Item	Description of Individual Components	Material No. for Indiv. Components	Qty.	Image
1	Light grid (1 transmitter, 1 receiver), incl. cable	R961009849	1	
2	Safety door, incl. cable	R901384221	1	
3	Safe Logic safety control, compact with Profibus module (8 DI/DA) and programming software (incl. license), incl. cable	R901384338	1	

Requirements: Connection to the modular mechatronics system (mMS4.0).

## HMI Integration and Programming (Human-Machine-Interface)



There are different options for operating and displaying status messages for a production system. One of the possibilities to combine operation and status messages is the use of an HMI VR2107 (Human Machine Interface). Then, both the user interface and the status displays can both be freely designed (programmed).

i4.0: With an HMI, the first step of data display and evaluation can be done at the station level, which means that the data can be collected and sent on to a centralized system for evaluation.

The following practice topics are addressed:

- ▶ Integration of the control panels (HMI)
- ▶ Troubleshooting using the HMI
- ▶ Programming an HMI
- ▶ Commissioning a system

The exercises are available online.

Exercises with solutions are available to the trainer.



**Device Expansion Set “HMI Integration And Programming”**

Material Number	R901467429
Typecode	EQUIPMENT SET TS-AS 206-2X

The following HMI device set matching the mechatronics system is available:  
 Touch display for use with a PLC and for operating a machine. The HMI is programmable so it can be adapted for machine operation and control. It is connected to the PLC via Ethernet. It is a complete set that contains the HMI, programming software and Ethernet cables. The components are equipped with a quick-connect system for a grooved/perforated panel.



**Device Expansion Set R901467429 contains the following components:**

Item	Description of Individual Components	Material No. for Individ. Components	Qty.	Image
1	Industrial machine control panel with touch screen VR2107 (7“, programming software is available online)	R901445042	1	
2	Ethernet cable for connection of the HMI to the machine control	R901179251	1	

Requirements: Connection to the modular mechatronics system (mMS4.0).

## **CNC Technology**

The learning topic “CNC Technology” is the gateway into CNC programming.

As a CNC function, it is sufficient to be able to use the servo axes and a pen via the CNC program to draw text/graphics.

The pen is in contact with the paper or can be lifted, while the two servo axes move along the programmed path. A software program is available to learn CNC programming.

The following practice topics are addressed:

- ▶ System setup
- ▶ System commissioning
- ▶ Using the programming interface
- ▶ Writing CNC programs
- ▶ Understanding of hardware and software

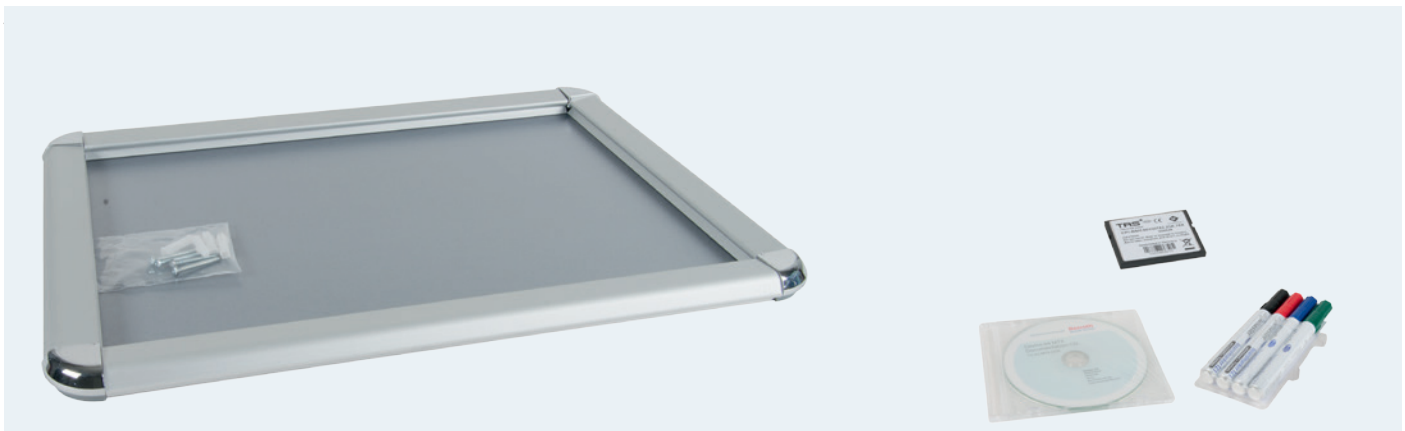
The exercises are available online.





Exercises with solutions are available to the trainer.

<b>Device Expansion Set “CNC Technology”</b>	
Material Number	R901430882
Typecode	EQUIPMENT SET TS-AS 207-1X

This device expansion set provides a gateway into CNC programming. There are two prerequisites to achieve this:

1. Station 3 of the mechatronics system has been converted with this device set, so that CNC exercises can be completed (Station 3 includes a CNC axis system).
2. Station 3 has been converted to a CLC control by replacing the firmware from a PLC control.



<b>Device Expansion Set R901430882 contains the following components:</b>				
Item	Description of Individual Components	Material No. for Individ. Components	Qty.	Image
1	Folding frame to hold DIN A3 paper	R913049731	1	
2	Pen for writing on folding frame with paper	R913049732	1	
3	Storage card with firmware to convert PLC into CNC control	R911337424	1	
4	Programming and training software for CNC applications	R911337416	1	_____
5	Software license “Operation” for CNC applications	R911331692	1	_____
6	Software license “Communication” for CNC applications	R911331696	1	_____
7	Software license “Engineering” for CNC applications	R911337570	1	_____
8	Documentation CD with master program, documents, examples	R901218018	1	

Requirements: Connection/operation of modular mechatronics system (mMS4.0) Station 3.



# Learning Topics for Mechatronics – Professional (i4.0) – Learning Topics for Industry 4.0

- ▶ OpenCore engineering via tablet PC
- ▶ RFID (Radio frequency IDentification)
- ▶ Interactive visualization and control board (Active Cockpit)
- ▶ Energy efficiency – current consumption metering
- ▶ Energy efficiency – air flow metering
- ▶ I/O link sensor technology
- ▶ SMS and email alerts
- ▶ Connection and control via ERP and MES system

## OpenCoreEngineering via Tablet PC



i4.0: Industry 4.0 is basically the connection of automation and IT. With the introduction of WLAN and the use of IT programming languages, data from automation can be displayed and processed on an IT level.

The learning topic OpenCoreEngineering via tablet PC includes connection of WLAN, programming with IT programming languages and use of a tablet PC/Apps for operating the production system.

The control can be accessed with other programming languages (e.g. VisualBasic, C++, C#, Java, ...) using OpenCore Engineering and control via a software program (e.g. LabView, MatLab/Simulink, Excel, Power Point,...) is possible. This is possible without PLC programming. By using high-level language programming, it is possible to read data directly from the PLC, even parallel to a running PLC program (conversion of Big Data). Example of an i4.0 application that is possible with the control described above: direct control of a system with a LabView program (from the appropriate LabView lab) via the control, without needing to translate into a PLC programming language.

The following practice topics are addressed:

- ▶ WLAN connection to a PLC
- ▶ Use of programming languages (Java, in this case) for machine control
- ▶ Operation of the modular mechatronics system (mMS4.0) via tablet PC
- ▶ Commissioning of a modular mechatronics system (mMS4.0)

The exercises are available online.

Exercises with solutions are available to the trainer.



**Device Expansion Set “OpenCore Engineering via Tablet PC”**

Material Number R901438601

Typocode EQUIPMENT SET TS-AS 303-1X

This device set (matched to the mechatronics system) consists of a tablet PC with preconfigured apps, a WLAN router and an Ethernet cable (connection of PLC router). Via the WLAN router, first the connection with the PLC is established. Over the Tablet PC connection, at least 2 different apps are available. The first app makes status analysis of the control possible. The second app allows for operation of one station of the mechatronics system. This second app is available as an “open” app so that it can be modified or expanded as needed (app programming in JAVA).



**Device Expansion Set R901438601 contains the following components:**

Item	Description of Individual Components	Material No. for Individ. Components	Qty.	Image
1	Tablet PC (Android) with preconfigured apps	R901377379	1	
2	WLAN router	R913058377	1	
3	Ethernet cable, 0.5 m	R911171484	1	

Requirements: Connection to the modular mechatronics system (mMS4.0).

## **RFID (Radio Frequency IDentification)**

i4.0: With Industry 4.0, every product can be clearly identified. With the start of production, the product status continuously follows the product itself and can be read and analyzed at any time. All test results can also be stored individually with each product. This can be utilized for the continued life cycle of the product, e.g. for service, maintenance, or repairs. One option for individual data storage for a product is equipping it with RFID.

The following practice topics are addressed:

- ▶ Description and explanation of the RFID system components
- ▶ Setup and commissioning of an RFID system at Station 1 of the modular mechatronics system (mMS4.0)
- ▶ Programming of decentralized data management on a mobile data carrier
- ▶ Event-oriented writing of data to a mobile data carrier
- ▶ Installation and commissioning of the RFID system at Station 2 of the modular mechatronics system (mMS4.0)
- ▶ Installation and commissioning of the RFID system at Station 3 of the modular mechatronics system (mMS4.0)
- ▶ Centralized/decentralized data transmission using OPC UA (with log book in each work piece)

The exercises are available online.

Exercises with solutions are available to the trainer.

**Device Expansion Set “RFID Technology”**

Material Number	R961008475
Typecode	EQUIPMENT SET TS-AS 302-1X

The available RFID device set meets the following requirements:

With various RFID antennas (with LED status display), information is written, overwritten, and then read again on data carriers. The mobile RFID data carriers are compatible to international norm ISO 15693 (13.56 MHz) and function without a battery and FRAM memory. They are securely attached into the housing cubes to be transported. Data storage can be centralized or decentralized. Communication modules are used which can establish the connection between antennas and the higher-level control system. The control program of the mechatronics system enables automatic integration of RFID components.



**Device Expansion Set R961008475 contains the following components:**

Item	Description of Individual Components	Material No. for Individ. Components	Qty.	Image
1	Communication module with Profibus DP	R961008682	2	
2	Sensor cable ID 200/K-ANT 3-2M	3842410110	2	
3	Connection cable ID 200/K-VCC 2M	R961008699	2	
4	Data cable ID 200/K-PDP R	3842410112	2	
5	Antenna, round ID 200/A-HR	3842410063	2	
6	Antenna, flat ID 200/A-HF	3842410065	1	
7	Assembly kit ID 200/MS-6	3842410097	1	—
8	Assembly kit ID 200/MS-2	3842410095	1	—

9	Bus plug 40-1291122	R913027806	4	
10	Connecting cable M12/F-M12/F 420-1000&	R913028555	2	
11	Interface cable, PROFIBUS DB	R113069579	2	
12	Housing cube with data carrier – SW	R901354944	5	
13	Housing cube with data carrier – WS	R901354946	5	

Requirements: Connection to the modular mechatronics system (mMS4.0).



## Interactive Visualization and Control Board (Active Cockpit)



i4.0: A key purpose of i4.0 is to have production data available quickly, react quickly to this data, and to be able to further process the data in the IT world. This is possible in the industry with an “Interactive Visualization and Control Board” (Active Cockpit).

The following practice topics are addressed:

- ▶ System description
- ▶ Setup and commissioning at the modular mechatronics system (mMS4.0)
- ▶ Use of the administrative interface (Administrator)
- ▶ Use of the board (user/operator)
- ▶ Examples for the i4.0 use of the board with the modular mechatronics system (mMS4.0)

The exercises are available online.

Exercises with solutions are available to the trainer.

**Device Expansion Set “Interactive Visualization and Control Board (Active Cockpit)”**

Material Number R901444320


Typocode EQUIPMENT SET TS-AS 304-1X

Device expansion set “Interactive Visualization and Control Board” is a system used in industry (both software and hardware). The following functionality is offered:

- ▶ Displaying, gathering and filtering information is possible.
- ▶ Information/status messages from the mechatronics system are displayed.
- ▶ Whiteboard function, extensive mail, chat and mobile functions (connection of Smart devices) and role-based user interfaces are included.
- ▶ The visualization software, as an open system via an app platform, allows for simple, intuitive operation.



**Device Expansion Set R901444320 contains the following components:**

Item	Description of Individual Components	Material No. for Individ. Components	Qty.	Image
1	Interactive visualization and control software Active Cockpit for PC	_____	1	_____
2	32” touch screen	R913054960	1	
3	Cable set for the screen	_____	1	_____
4	Aluminum profile bracket for the screen	_____	1	_____

**Accessories for “Device Expansion Set Interactive Visualization and Control Board (Active Cockpit)”**

Item	Components	Material No.	Qty.	Image
1	PC for Active Cockpit, Excel simulation and Cloud application (not included)	_____	1	_____

Requirements: Connection to the modular mechatronics system (mMS4.0).



## Energy Efficiency – Current Consumption Metering

i4.0: By storing current values dependent on the operating cycle, not only can the owner's system be continuously monitored, but the variations compared to similar systems can also be captured. Data can be networked and displayed via an interactive visualization and control board (Active Cockpit).

The following practice topics are addressed:

- ▶ System description
- ▶ Setup and commissioning at the modular mechatronics system (mMS4.0)
- ▶ Connection to a PLC
- ▶ Programming and operation
- ▶ Data transmission to higher-level systems (IT level, interactive visualization & control board [Active Cockpit])

The exercises are available online.

Exercises with solutions are available to the trainer.



**Device Expansion Set “Energy Efficiency – Current Consumption Measurement”**

Material Number R901462162

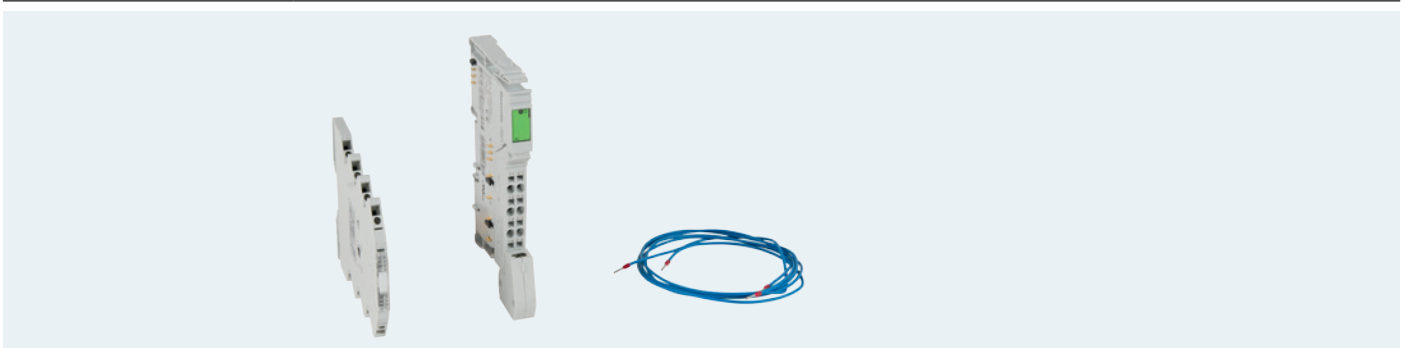
Typecode EQUIPMENT SET TS-AS 305-1X

This device set allows current consumption data and to be captured and transmitted to the PLC as analog data. This data is useful for presenting the current values for condition monitoring.

Specifications for the current transformer:

- ▶ Input signal AC/DC 0-5 A, ± 5 A
- ▶ True RMS (true effective measurement)
- ▶ Frequency range 15 Hz–400 Hz
- ▶ Working voltage range DC: 16.8–30 V
- ▶ Output signal, adjustable using DIP switches

The PLC Module is connected directly to the PLC control of the modular mechatronics system (mMS4.0). The software connection is made automatically via the PLC program.



**Device Expansion Set R901462162 contains the following components:**

Item	Description of Individual Components	Material No. for Indiv. Components	Qty.	Image
1	AC/DC transformer	R913056425	1	
2	PLC module, 2 analog inputs	R9111707084	1	
3	Cable set with ferrules for electrical wiring	R900016832	1	

Requirements: Connection to the modular mechatronics system (mMS4.0). Display of the values and comparisons via the "Interactive Visualization and Control Board" (Active Cockpit).

## Energy Efficiency – Air Flow Metering



i4.0: By storing compressed air values dependent on the operating cycle, not only can the owner's system be continuously monitored, but the variations compared to similar systems can also be captured. Data can be networked and displayed via an interactive visualization and control board (Active Cockpit).

The following practice topics are addressed:

- ▶ System description
- ▶ Setup and commissioning at the modular mechatronics system (mMS4.0)
- ▶ Connection to a PLC
- ▶ Programming and operation
- ▶ Data transmission to higher-level systems (IT level, interactive visualization & control board [Active Cockpit])

The exercises are available online.

Exercises with solutions are available to the trainer.

**Device Expansion Set “Energy Efficiency – Air Flow Metering”**

Material Number R901462163

Typecode EQUIPMENT SET TS-AS 306-1X

This device set enables the collection of compressed air usage data and their transmission to the PLC as analog data. The data allow the compressed air values to be displayed for condition monitoring.




Specifications for the air flow sensors:

- ▶ Display range, 0.00...18 Nm<sup>3</sup>/h
- ▶ Measurement range, 0.04...15 Nm<sup>3</sup>/h
- ▶ Temperature monitoring display range, -12...72 °C
- ▶ 4-digit alphanumeric display
- ▶ Operating voltage, 18 -30 V (DC)
- ▶ Output signal: switching signal, analog signal, impulse signal, I/O link; (configurable)

The PLC module is directly connected to the PLC control of the modular mechatronics system (mMS4.0). The software connection is made automatically via the PLC program.



**Device Expansion Set R901462163 contains the following components:**

Item	Description of Individual Components	Material No. for Individ. Components	Qty.	Image
1	Air flow sensor	R901462395	1	
2	Connection cable, 4-pole, data and current supply (Side 1: M12 plug / Side 2: open cable ends)	R901462727	1	
3	Bracket/mount for the air flow sensor on the mechatronics system	_____	1	_____
4	PLC module, 2 analog inputs	R911170784	1	
5	Plastic hose, 6.0 x 1.05, PU	_____	_____	_____

Requirements: Connection to the modular mechatronics system (mMS4.0). Display of the values and comparisons via the “Interactive Visualization and Control Board” (Active Cockpit).

## I/O Link for Sensor Technology



i4.0: The I/O link for sensor technology contains the following two points on the topic of i4.0:

First, even more information per sensor is available than before, and second, the issue of standardized interfaces is supported.

The following practice topics are addressed:

- ▶ System description
- ▶ Setup and commissioning at the modular mechatronics system (mMS4.0)
- ▶ Connection to a PLC
- ▶ Programming and operation
- ▶ Data transmission to higher-level systems (IT level, interactive visualization and control board [Active Cockpit])

The exercises are available online.

Exercises with solutions are available to the trainer.

**Device Expansion Set “I/O Link Sensors for mMS4.0”**

Material Number R901462247

Typecode EQUIPMENT SET TS-AS 308-1X

This device set consists of an I/O Link Master, an analog position sensor, a digital position sensor and an M18 ultrasonic sensor. The I/O link sensors are suitable to replace comparable sensors from Station 1 of the mechatronics system and thereby show the advantages of I/O link sensors.

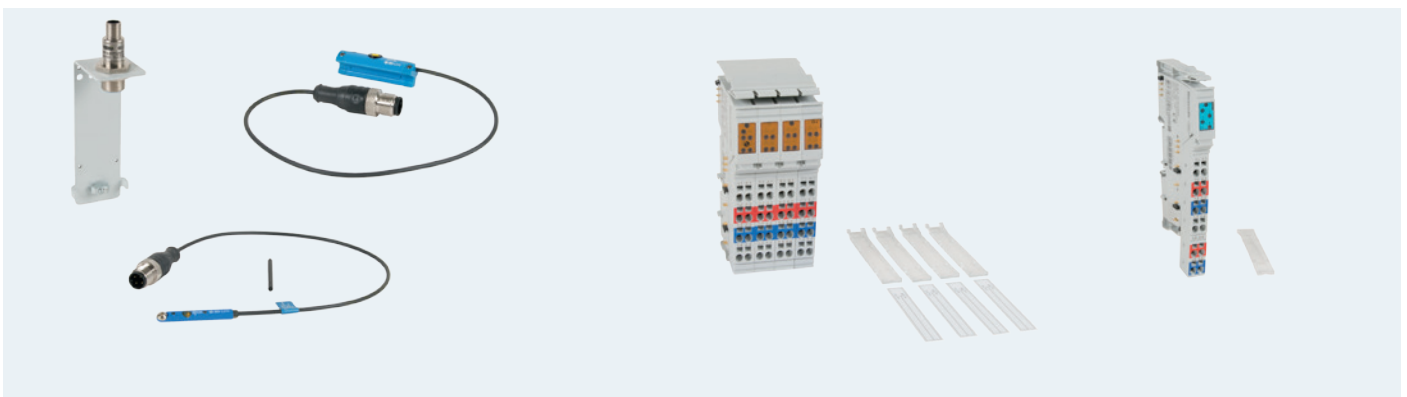
Specifications for I/O Link Master:

- ▶ 4 I/O link ports
- ▶ 12 digital inputs
- ▶ Nominal input voltage 24 V DC
- ▶ Nominal input current (SIO mode) 5.5 mA
- ▶ Nominal output voltage 3 V
- ▶ Nominal current per cable max. 200 mA
- ▶ Serial interface with adjustable transmission rate up to 250 kBaud, receive buffer 4 kByte, send buffer 1 kByte
- ▶ Operating temperature -25 to +55 degrees Celsius
- ▶ Allowable humidity 10 to 95 %
- ▶ Protection class IP20





The PLC module (I/O link master) is directly connected to the PLC control of the modular mechatronics system (mMS4.0). The software is connected automatically via the PLC program.

Specifications for I/O Link Sensors:

- ▶ Digital position sensor
- ▶ T-nut design (for PN cylinder)
- ▶ Supply voltage DC, 15 - 30V
- ▶ Output function NO contact
- ▶ Analog position sensor
- ▶ T-Nut design (for PN cylinder)
- ▶ DC supply voltage, 15 - 30V
- ▶ Resolution >= 0.05 mm
- ▶ M18 ultrasonic sensor
- ▶ DC supply voltage, 15 - 30V
- ▶ Precision +- 1%



**Device Expansion Set R901462247 contains the following components:**

Item	Description of Individual Components	Material No. for Individ. Components	Qty.	Image
1	I/O link master	R911171971	1	
2	Inductive position encoder for cylinder	R901462737	1	
3	Inductive position encoder for T-nut	R901462738	1	
4	M18 Ultrasonic sensor	R901462739	1	
5	PLC Module, 4 digital inputs	R911170750	1	

Requirements: Connection to the modular mechatronics system (mMS4.0). Reading sensor data into the PLC of the mechatronics system.

## SMS and Email Alerts



i4.0: In i4.0, data from the automation level of the industry must travel quickly to the IT level and to a company's employees. In the learning topic SMS- and Email Alarms, data is transmitted using telecommunications.

The following practice topics are addressed:

- ▶ System description
- ▶ Structure and commissioning at the modular mechatronics system (mMS4.0)
- ▶ Connection to a PLC
- ▶ Programming and operation
- ▶ Connection to a mobile cellular network

The exercises are available online.

Exercises with solutions are available to the trainer.

**Device Expansion Set “SMS and Email Alerts”**

Material Number	R901462310
Typocode	EQUIPMENT SET TS-AS 309-1X

This device set consists of an intelligent switching relay and its cable. It allows the monitoring of analog and digital values and sends programmed messages over the cellular network. Communication occurs via SMS or GPRS (sent by email). The required mobile data card is not included.

Specifications for the intelligent switching relay:




- ▶ 4 digital inputs
- ▶ 4 relay outputs
- ▶ 2 analog outputs
- ▶ Connection type: Mini USB Type B, 5-pole

Specifications for the antenna:

- ▶ Frequency ranges: 850, 900, 1800, 2100 MHz
- ▶ Connection type: SMA (male)



**Device Expansion Set R901462310 contains the following components:**

Item	Description of Individual Components	Material No. for Indiv. Components	Qty.	Image
1	Intelligent switching relay with software	R901462802	1	
2	Antenna	R913056523	1	
3	USB cable to connect with PC	R911379513	1	
4	Cable set with ferrules for electrical wiring	_____	1	_____

Requirements: Connection to the modular mechatronics system (mMS4.0). Coupling of status and error messages from the mechatronics system to telecommunication.

## Connection and Control via ERP and MES System

i4.0: The implementation of i4.0 into production requires the understanding of the entire process chain. The starting point for this topic is the order entry. This is implemented with an ERP/MES system.

An ERP/MES system is available for the control of production steps. With it, customer orders for different color combinations of the housings produced by the mechatronics system can be set up via the MES system and the housings that have been ordered can be automatically manufactured on the system. A real production process with the transfer of data (completion message for process steps) to other manufacturing stations is possible.

This is implemented with two separate MES sections (1 x production, 1 x storage). Direct connection to the control (PLC) is possible. An Excel program that communicates directly with the PLC is needed as an ERP/MES system. Connection of other ERP/MES systems (e.g. SAP ME) is possible. The display for the ERP/MES system occurs on a local PC. The PC is not included.

The following practice topics are addressed:

- ▶ System description
- ▶ Connection to a PLC
- ▶ Operation of the system

The exercises are available online.

Exercises with solutions are available to the trainer.

Corresponding to the learning topic, a software package is available:

- ▶ ERP/MES software (Excel-based)

Requirements: Connection to the modular mechatronics system (mMS4.0).



## Example Application: Augmented Reality



Using a component of the modular mechatronics system (mMS4.0) for the display of Augmented Reality.

i4.0: Using the IT (here: Augmented Reality) for better information transmission and as technical support (e.g.: Information for service technicians).

This modular mechatronics system (mMS4.0) contains an application for Augmented Reality. The exploded view of the real linear axis (Station 3) is shown. Direct access to the data sheets of the individual components within the drawing is possible. An app and a printable PDF is available online with the marker/tracker.

## Order Example / Learning Topics for Industry 4.0 using the mMS 4.0

The device expansion sets introduced on the previous pages convert the modular mechatronics system mMS 4.0 to a complete Industry 4.0 system.

Following is an order example:

Material No.	Typecode	Description	Qty.
R901423235	EQUIPMENT UNIT TS-MMS4.0-1X/ W1U3V2Z&	WS511 – Work Station “Advanced/Professional Mechatronics – Modular Mechatronics System – Complete System, Station 1-3, mMS 4.0 with Pneumatic Press – Assembled, Incl. Packaging”	1
R901467429	EQUIPMENT SET TS-AS 206-2X	Device Expansion Set “HMI Integration and Programming”	3
R901438601	EQUIPMENT SET TS-AS 303-1X	Device Expansion Set “OpenCore Engineering via Tablet PC”	1
R961008475	EQUIPMENT SET TS-AS 302-1X	Device Expansion Set “RFID Technology”	2
R901444320	EQUIPMENT SET TS-AS 304-1X	Device Expansion Set “Interactive Visualization and Control Board (Active Cockpit)”	1
R901462162	EQUIPMENT SET TS-AS 305-1X	Device Expansion Set "Energy Efficiency – Current Consumption Metering"	3
R901462163	EQUIPMENT SET TS-AS 306-1X	Device Expansion Set "Energy Efficiency – Air Flow Metering"	3
R901462247	EQUIPMENT SET TS-AS 308-1X	Device Expansion Set “I/O Link Sensors for mMS4.0”	1
R901462310	EQUIPMENT SET TS-AS 309-1X	Device Expansion Set "SMS and Email Alerts"	1
R900891168	COMPRESSOR TS-PC-30V/ 50HZ-8BAR	Compressor 230 V/50 Hz	1



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## Accessories

### Compressors

Compressors for compressed air supply with manometer, pressure regulator, water separator and two compressed air connections, low noise level, suitable for operation in the classroom. Compressor unit for single-phase electrical connection, operating pressure of 8 bar, air volume of max. 50 l/min, volume of max. 40 dB.

### Types

#### Compressor 230 V/50 Hz

Material Number R900891168

Typecode COMPRESSOR TS-PC-230V/50HZ-8BAR

#### Compressor 230 V/60 Hz

Material Number R901464218

Typecode COMPRESSOR TS-PC-230V/60HZ-8BAR

#### Compressor 110 V/60 Hz

Material Number R961003963

Typecode COMPRESSOR TS-PC-110V/60HZ-8BAR



### Accessory Set for Compressor

Material Number R901471412

Typecode ACCESSORY SET TS-PC-COMPRESSOR

Accessory set, suitable for the various compressor types:

- ▶ Coupling plug with 2/2 directional control valve (R900891177)
- ▶ T-plug connector, 6 mm, packing unit: 1 (2121106000)
- ▶ Plastic hose, 6.0 x 1.05, PU, packing unit: 8 m (R961007740)





## Professional Mechatronics – Robotics (Articulated Robot – KUKA)

The system consists of a single station with complete protective housing, which secures the motion range of the robot. The station is mechanically connected to the modular mechatronics system (mMS4.0). The dimensions of the individual stations are smaller than 1350 x 700 x 1900 mm (L x W x H) to ensure easy transport (standard door, lift, vehicle). The complete system has a maximum weight of 350 kg. The supply voltage is single-phase 230 V. All safety doors and the cell are equipped with safety technology. A safety circuit monitors the system. The robot is operated with a manual operating unit with a 10" display. The robot is designed as a 6-axis system (X-Y-Z axes, A-B-C axis, S, T). The robot is equipped with a pneumatic gripper with a 350° rotation angle. The load is 6 kg, and the repeat positioning precision is +/- 0.03 mm. The system contains a robotic control with an additional connected IEC 61131-3 PLC. Any movement of the robot is fully programmed via the PLC. The entire system is fully assembled and fully functional on delivery. The PLC (industry standard) control provides some specific possibilities:

- ▶ PLC programming according to IEC61131-3: with the languages Instruction List, Ladder Diagram, Function Block Diagram, Sequential Function Chart, Structured Text.

### Industry 4.0:

By using high-level language programming it is possible to read data directly from the PLC, even parallel to a running PLC program (conversion of Big Data). An app is available to diagnose the PLC. The communication between the PLC and the robotic control takes place via PROFINET.

The following practice topics are addressed:

- ▶ Description of individual components and commissioning of a robot system
- ▶ Basic knowledge to create programs; control types
- ▶ Creating programs in a PLC programming environment (IEC 61131-3)
- ▶ Programming individual movements and motion sequences
- ▶ Picking and placing of housings
- ▶ Teaching program points
- ▶ Programming the HMI to operate the robot via PLC

The exercises are available online.

Exercises with solutions are available to the trainer.

The work station contains:

- ▶ 6-axis articulated robot
- ▶ Robot control and PLC according to IEC61131-3
- ▶ Safety relay
- ▶ HMI for operating the robot via PLC
- ▶ Housing cube, aluminum
- ▶ Housing cube, plastic, black
- ▶ Pins (for assembling the housing cubes)
- ▶ Pneumatic maintenance unit
- ▶ Pre-wired control box
- ▶ Protective housing

The articulated robot meets industry standards. So that students can recognize it in their future work, it is a robot that is used in real-world automation applications.

**Work Station WS502, Automation, Complete Station, Articulated Robot (KUKA) – Assembled, Incl. Packaging**

Material Number	R901443001	
Typecode	WORKSTATION TS-WS502-KUKA	
Dimensions	mm (L x W x H)	1300 x 650 x 1880
Required Space	m (L x W)	3 x 3
Number of Work Positions	opt. / max. per Station	1 / 3
Weight	kg	300
Supply Voltage	VAC	230
Operating Pressure	bar	5...6
Number of Axes	6	
Work Space	mm	706.7
Load Capacity	kg	6
Repetition Accuracy	mm	<±0.03
Protection Class	IP54	



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## **Professional Mechatronics – Robotics (Collaborating Robot – APAS)**

This collaborating robot meets industry standards. The system is an individual station consisting of a robot with a capacitive outer skin, which secures the entire pivot range of the robot and enables human interaction. The entire system is fully assembled and fully functional on delivery.

- ▶ Safety certification through the trade association (Berufsgenossenschaft [BG])
- ▶ Sensor skin (capacitive), which reliably prevents collisions in the range of the robot arm
- ▶ Touchless collision protection with stop and automatic process continuation starting at the last position
- ▶ Retracting gripper fingers, which reliably prevent pinching injury in the direction of the finger axes
- ▶ Pinch protection with safe limiting of the clamping force of the gripper fingers
- ▶ Three-finger universal gripper, force and position controlled, with crush protection
- ▶ Securing of parts in the universal gripper in the event of power outage
- ▶ Camera head with:
  - ▶ three high-resolution cameras, two of which are stereo cameras
  - ▶ integrated LED-infrared-flash
  - ▶ an additional LED projector for 3D photography of the handling components
- ▶ Operating software with:
  - ▶ graphic representation of work plans
  - ▶ dialog-oriented creation and parameterization of work plans
  - ▶ dialog-led teaching of characteristics for 2D and 3D image processing
  - ▶ three password-protected user levels
  - ▶ extensive diagnostic options
- ▶ Touchpad control panel with E-Stop
- ▶ Remote interface (when permitted by the network connection)
- ▶ Mobile, portable and stable basic housing
- ▶ Four rollers, easily lockable with thumb screws
- ▶ Sturdy full-wrap handle
- ▶ Electric switch cabinet, integrated into the basic housing, for robotic control, control computer, safety PLC and electric network connection. Easily accessible via removable service covers.
- ▶ 16 digital inputs and outputs, 24 V optocoupled
- ▶ Self-adhesive labeling for reference
- ▶ 5 m power cable for 230 V supply voltage, Ethernet and digital I/O, built-in and lockable machine connector, heat exchanger with CEE network plug, RJ45 and Sub-D plugs

The following practice topics are addressed:

- ▶ Description of individual components, commissioning of a robotic system and first movements
- ▶ Basic knowledge to create programs
- ▶ Teaching of program points
- ▶ Creation of programs with the touchpad control panel
- ▶ Integration of the camera system

The exercises are available online.

Exercises with solutions are available to the trainer.

This work station includes:

- ▶ An operational robot system with sensor skin (capacitive), touchpad control panel, three-finger universal gripper, camera head and robot control



**Work Station WS503, Automation, Complete Station,  
 Collaborating Robot (APAS) – Assembled, Incl. Packaging**

Material Number	R901460896	
Typecode	WORKSTATION TS-WS503-APAS-I6	
Dimensions	mm (L x W x H)	775 x 730 x 1670
Required Space	m (L x W)	3 x 3
Number of Work Positions	opt. / max. per station	1 / 3
Weight	kg	230
Supply Voltage	VAC	230
Operating Pressure	bar	6
Number of Axes	6	
Work Space	mm	911
Load Capacity	kg	4
Repetition Accuracy	mm	<±0.03
Protection Class	IP54	
Supply Pressure	6	bar



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## **Professional Mechatronics – Robotics (SCARA)**

This system consists of a single station with complete protective housing, which secures the pivot range of the robot. The station is mechanically connected to the modular mechatronics system (mMS4.0). The dimensions of the individual stations are smaller than 1350 x 1350 x 1900 (L x W x H). In order to ensure easy transport, the system consists of two individual stations which may not be wider than 675 mm (standard door, lift, vehicle).

The entire system has a maximum weight of 300 kg. The supply voltage is 230 V single-phase. All protective doors and the cell are equipped with safety technology. A safety circuit monitors the system. The robot is operated with a hand-held control panel with 3.8" display. The robot is designed as a 4-axis system (X-Y-Z axes, pivoting Z axis). The robot's Z axis has a stroke of 400 mm and can execute 360° screwing movements. The robot is equipped with a pneumatic gripper. The load capacity is 5 kg, repetition accuracy for positioning is +/- 0.02 mm for the X/Y/Z axes and +/- 0.03 degrees for the rotary axis. The system is programmed with an IEC 61131-3 PLC. The robot's motions are fully programmable via the PLC. The whole system is completely assembled and delivered in fully functioning condition.

The PLC (industry standard) control provides some specific possibilities:

- ▶ PLC programming according to IEC61131-3: with the languages Instruction List, Ladder Diagram, Function Block Diagram, Sequential Function Chart, Structured Text.

Industry 4.0:

OpenCore Engineering enables direct reading of data from the PLC using high-level language programming, even parallel to a running PLC program (conversion of Big Data). An app is available to diagnose the PLC. The communication between the PLC and the robotic control takes place via PROFINET.

The following practice topics are addressed:

- ▶ Description of individual components and commissioning of a robotic system
- ▶ Basic knowledge to create programs; control types
- ▶ Creation of programs in a PLC programming environment (IEC 61131-3)
- ▶ Programming individual movements and motion sequences
- ▶ Gripping and positioning cube-shaped housings
- ▶ Teaching program points
- ▶ Programming the HMI to operate the robot via PLC

The exercises are available online.

Exercises with solutions are available to the trainer.

The work station includes:

- ▶ 4-axis swivel-arm robot
- ▶ Robot control with a PLC according to IEC61131-3
- ▶ Safety relay
- ▶ HMI for robot operation via PLC
- ▶ Housing cube, aluminum
- ▶ Housing cube, plastic, black
- ▶ Pins (for connecting the housing cubes)
- ▶ Pneumatic maintenance unit
- ▶ Pre-wired switch box
- ▶ Protective housing

The swivel-arm robot meets industry standards. So that students can recognize it in their future work, it is a robot that is used in real-world automation applications.

**Work Station WS500, Automation, Complete Station, SCARA Robot – Assembled, Incl. Packaging**

Material Number	R901344896	
Typecode	WORKSTATION TS-WS500-230V/50HZ	
Dimensions	mm (L x W x H)	1200 x 1200 x 2000
Number of Work Positions	opt. / max. per station	2 / 3
Weight	kg	300
Supply Voltage	VAC	230
Protection Class	DIN 40050	IP64
Nominal Frequency	50	Hz
Supply Pressure	6	bar



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Drive &amp; Control Academy

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## eLearning – Basics of Functional Safety – eFSI



- Independent scheduling
- Learn at your own pace
- Repeat as often as you like within the licensing period
- Final exam + personal Rexroth certificate (per license)

### Content

- ▶ Basics of machine safety
- ▶ Machine directive, laws, norms
- ▶ 10 steps to Performance level

### Training Scope and Duration

- ▶ 2 learning modules, 80 training pages, 20 test questions
- ▶ Learning time: 2 to 3 hours
- ▶ Languages: German or English (other languages by request)

### Requirements

- ▶ PC with Internet access, Flash Player 10 or higher (<http://get.adobe.com/de/flashplayer>), if needed, web browser with Flash support
- ▶ Pop-up blocker turned off
- ▶ Email address for personal login

**Try selected modules of our eLearning library with free guest access:**

[www.boschrexroth.de/eLearning](http://www.boschrexroth.de/eLearning)

### Product Description

As part of the eFSI eLearning module “Basics of Functional Safety,” we are providing training on the topics of “Basics of Machine Safety” and “10 Steps to Performance Level,” prepared in multimedia format according to the latest didactic findings is concerned with the functionality and characteristics of selected drive components.

### Licensing Periods

During the licensing period (12 months following activation) our eLearning is always accessible.

## eLearning – Basics of Linear Technology – eLTG



- Independent scheduling
- Learn at your own pace
- Repeat as often as you like within the licensing period
- Final exam + personal Rexroth certificate (per license)

### Content

- ▶ Introduction to linear technology
- ▶ Structure, function and application ranges of profiled rail systems
- ▶ Structure, function and application ranges of linear bushings and shafts
- ▶ Structure, function and application ranges of screw assemblies
- ▶ Setup of linear systems
- ▶ Overview of the pre-equipped linear systems

### Training Scope and Duration

- ▶ 7 learning modules, 400 training pages, 56 test questions
- ▶ Learning time: 12 to 18 hours
- ▶ Languages: German, English and others

### Requirements

- ▶ PC with Internet access, Flash Player 10 or higher (<http://get.adobe.com/de/flashplayer>), if needed, web browser with Flash support
- ▶ Pop-up blocker turned off
- ▶ Email address for personal login

**Try selected modules of our eLearning library with free guest access:**

[www.boschrexroth.de/eLearning](http://www.boschrexroth.de/eLearning)

### Product Description

From physical characteristics, to products, all the way to applications and setup basics, this eLearning is recommended to anyone who would like to attend additional training for professional development.

### Licensing Periods

During the licensing period (12 months following activation) our eLearning is always accessible.

## eLearning – Basics of Energy Efficiency – e4EE



### Content

- ▶ Energy – a limited commodity
- ▶ Definition of energy efficiency
- ▶ General conditions
- ▶ Energy efficiency in business
- ▶ Rexroth 4EE system
- ▶ Useful information about energy efficiency

### Training Scope and Duration

- ▶ 1 learning module, 43 training pages, 15 test questions
- ▶ Learning time: 1 to 2 hours
- ▶ Languages: German and English

### Requirements

- ▶ PC with Internet access, Flash Player 10 or higher (<http://get.adobe.com/de/flashplayer>), if needed, web browser with Flash support
- ▶ Pop-up blocker turned off
- ▶ Email address for personal login
- ▶ Interest in the topic of energy efficiency

### Licensing Periods

During the licensing period (12 months following activation) our eLearning is always accessible.

- Independent scheduling
- Learn at your own pace
- Repeat as often as you like within the licensing period
- Final exam + personal Rexroth certificate (per license)

### Product Description

Energy is becoming progressively more limited and more expensive. Therefore, technologies are coming into focus to help reduce the problem. Intelligent automation solutions make a significant contribution in making renewable energy usable.

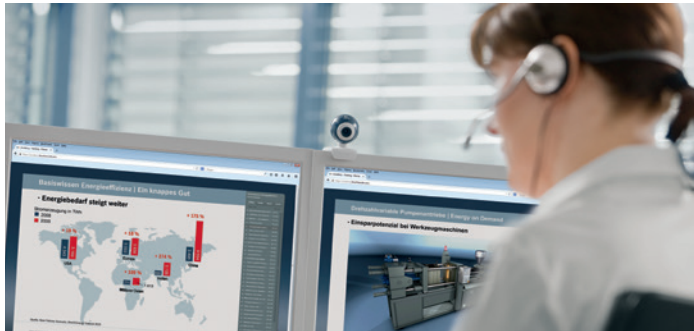
Prerequisite is a sensitivity toward the topic “Energy Efficiency” and the right selection of different technological tools. In this eLearning, we provide you with the necessary basic knowledge.

**Try selected modules of our eLearning library with free guest access:**

[www.boschrexroth.de/eLearning](http://www.boschrexroth.de/eLearning)

## eLearning – Sytronix – e4EE

### Energy Efficiency of Dynamic Pump Drives



- Independent scheduling
- Learn at your own pace
- Repeat as often as you like within the licensing period
- Final exam + personal Rexroth certificate (per license)

#### Content

- ▶ Basics of energy efficiency
- ▶ Valve and displacement control
- ▶ Demand control
- ▶ Components of dynamic pump drives
- ▶ Parameters for selecting this drive
- ▶ Circuit examples
- ▶ System comparison

#### Training Scope and Duration

- ▶ 2 learning modules, 110 training pages, 30 test questions
- ▶ Learning time: 3 to 4 hours
- ▶ Languages: German and English

#### Requirements

- ▶ PC with Internet access, Flash Player 10 or higher (<http://get.adobe.com/de/flashplayer>), if needed, web browser with Flash support
- ▶ Pop-up blocker turned off
- ▶ Email address for personal login
- ▶ Participation in the HTG/eHTG, EATG-1 and HTPPu training or comparable knowledge

**Try selected modules of our eLearning library with free guest access:**

[www.boschrexroth.de/eLearning](http://www.boschrexroth.de/eLearning)

#### Product Description

The reliability of powerful hydraulics and the energy efficiency and dynamics of compact electronics go hand in hand in Sytronix dynamic pump drives by Rexroth. In the eLearning “e4EE – Sytronix,” we provide the required basic knowledge along with technical details.

#### Licensing Periods

During the licensing period (12 months following activation) our eLearning is always accessible.

## Training System for Mechatronics – OpenCore

Material Number	R901389272
Typecode	EQUIPMENT SET TS-AS-OPEN-CORE

A standalone system for material detection and processing.

Two separator magazines can output 50 x 50 x 25 mm workpieces made of a variety of materials.

A conveyor moves the workpieces and allows the attachment of various sensors to detect the characteristics of the workpieces.

Inductive, capacitive and optical sensors are used.

Analog path measurement at a pneumatic cylinder is possible. Fiber optic technology and one-way light barriers are attached.

A ramp with corresponding cylinder to separate rejected parts is also attached to the conveyor.

The total motion sequence is controlled via a PLC (MLC L45).

It is also possible to program an app to control the same motion options.

A servo motor with a controller drives the conveyor.

A WLAN router, which is connected to the control, enables wireless connection of mobile devices.

Software libraries provide a simplified way to connect mobile devices via app interfaces. LabVIEW, MATLAB or Simulink can also be used for programming.

An example app for Android devices is included, so that the type of programming for mobile apps can be clearly explained.

Individual control functions can be implemented with Wind River Workbench.

Open interfaces (e.g. OPC) to information systems are available.

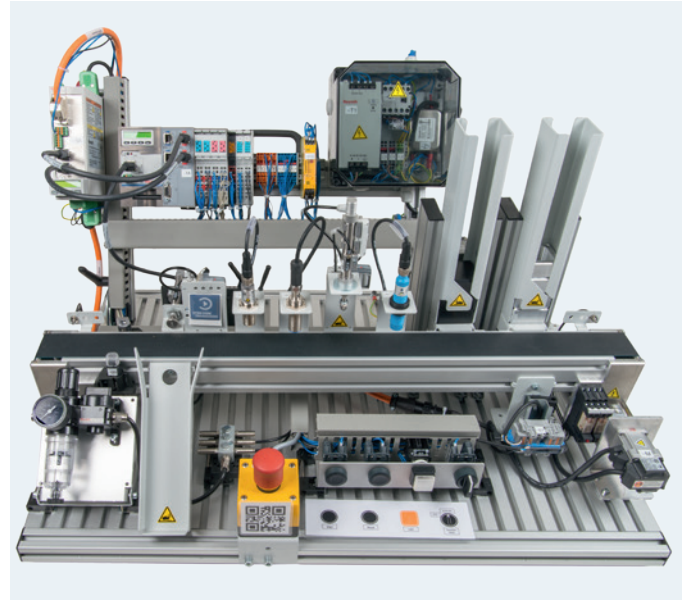
Functional setup and pre-programmed apps are included with delivery. IP address recognition via QR code.

The aluminum profile setup allows for modular expansion, by using RFID components, for example.

Direct access to drive and control data using common Office applications like Excel.

A tablet PC is not included.

Dimensions	mm (L x W x H)	800 x 550 x 500
Weight	kg	20
Operating Voltage	VDC	24
Supply Voltage	VAC	230
Supply Pressure	bar	5...6



## Training System for IndraDrive Cs

Material Number	R911326637
Typocode	PSP-I02.1-01-NN (IND-S*2ACHSIG*MSM019B)

This training system provides the complete range of functionality of a controlled servo drive in the IndraDrive family. In the area of maintenance, error simulations can be a tool to significantly reduce machine downtimes.

The training system is an outstanding tool in the area of training and professional development. Its compact and lightweight design also make it well-suited for use in the office and lab. The training system can be commissioned in a very short time using the engineering tool IndraWorks. Direct connection into a Euro wall outlet (AC230 V  $\pm$ 10%, 16 A, 50-60 Hz) is possible, however it cannot be operated while plugged into a GFCI socket.

Dimensions	mm (L x W x H)	280 x 225 x 360
No. of Work Positions		2
Weight	kg	13
Nominal Current	A	16
Mains Frequency	Hz	50 - 60
Operating Voltage	VDC	24
Supply Voltage	VAC	230



## Training System for IndraMotion MLC

Material Number	R911337312
Typecode	PST-C01.10-01-DE TRAININGSSYSTEM SLC

This training system applies to all components that are used in connection with the IndraMotion MLC system solution. The basic device consists of an IndraControl L65 drive (including MLC firmware), an IndraDrive Cs, the IndraDyn MSK30 motor, as well as a Sercos bus coupler with inline I/Os. It is well-suited to acquire project planning and commissioning knowledge for the IndraMotion MLC with the IndraWorks Engineering tool.

The system can also be used for acquiring more in-depth knowledge of maintenance and service. For example, error simulation can be used to train troubleshooting and debugging, which in turn can reduce machine downtimes. By expanding the system with the optional SafeLogic or SafeLogic compact module, the training system can also be used to demonstrate the coordination between IndraDrive Safety on Board (SafeMotion S4), safe peripheral interfacing and the Bosch Rexroth safety drives. In this case, commissioning and project planning is done using the SafetyManager (SafeLogic) or with the SafeLogic Designer (SafeLogic compact).

Its compact, lightweight design makes this training system ideal for use in the office and lab. Direct connection into a Euro wall outlet (AC230 V  $\pm$ 10%, 16 A, 50-60 Hz) is possible, however it cannot be operated while plugged into a GFCI socket.

Dimensions	mm (L x W x H)	540 x 320 x 500
Weight	kg	20
Supply Voltage	VAC	230
Nominal Current	A	16
Mains Frequency	Hz	50 - 60
Power	kW	0.5



## Training System for IndraMotion MTX

Material Number	R911342540
Typecode	PST-C01.1-01-DE TRAININGSSYSTEM 3-ACHSER

This training system is outstanding for becoming familiar with NC technology and acquire practical knowledge in the fields of NC technology and machine tool.

It is based on the IndraMotion MTX system solution and has a modular design:

- ▶ The first module is made up of a control cabinet PC, machine control field and NC control.
- ▶ As an additional module, a 3-axis model that includes electric drives is available.

All components (IndraMotion MTX performance L65, IndraDrive Cs, IndraDyn MS2N, Rexroth Inline I/Os and IndraControl VPP, and IndraControl VAM) are industrial serial components that are used in machine tools.

With the help of the 3-axis model, NC programming and use of the IndraWorks Operation NC operating software is clearly communicated.

The training system is also well-suited to train for commissioning and project planning, as well as for maintenance and repairs on the IndraMotion MTX system solution. This is done by using the IndraWorks Engineering tool.

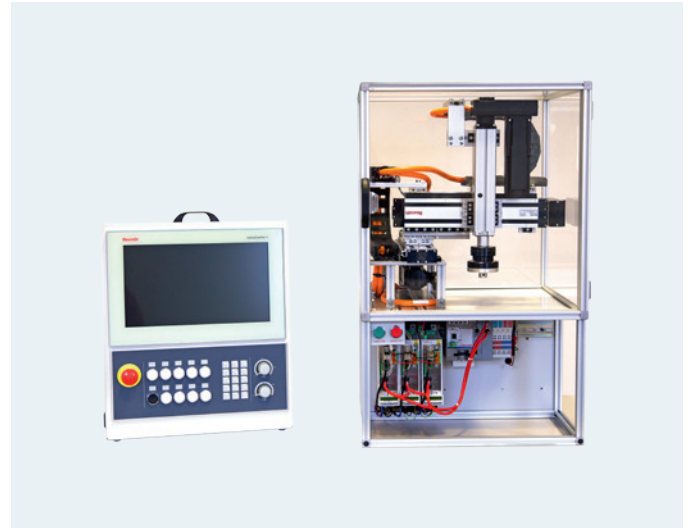
The training system is flexibly applicable:

- ▶ The 3-axis model (without HMI module) is well-suited for training on the drive-based Motion-Logic IndraMotion MLD.
- ▶ By exchanging the MTX firmware for the MLC firmware, robot control operation is also possible.

An functional safety technology upgrade to the system is in process.

The compact, lightweight design makes this training system ideal for use in the office and lab. Direct connection into a Euro wall outlet (AC230 V  $\pm$ 10%, 16 A, 50 - 60 Hz) is possible, however it cannot be operated while plugged into a GFCI socket.

Dimensions	mm (L x W x H)	500 x 500 x 900
Weight	kg	70
Supply Voltage	VAC	220
Nominal Current	A	16
Mains Frequency	Hz	50 - 60
Power	kW	1.5





## Training Unit for Tightening Systems

Material Number	R911340632
Typecode	PSP-S01-13-01-DE (DEMO SCHRAUBEN)

This Bosch Rexroth Tightening System 350 unit enables the user to fasten screws/nuts/bolts which emulate operations that occur in many manufacturing facilities. When used with the Rexroth BS350 software, this unit can be programmed to fasten on test joints, or even fasten actual assembly pieces in a training laboratory.

The unit is comprised of the BT356 System Rack, a VM350 Power Supply, an SE352M Controller with IM24V interface module, 2 x LTS350D Amplifiers, and 2 complete Size 3 Tightening Spindles (EC303 motor, 3GE27 / 3GE67 gear reducer, 3DMC060 transducer, the G2A152 output, and cables).

Additionally, the unit includes a KE350GIL communication unit with an IMpdp Profibus module, and an IM24V module for 24 V signals. Through this KE, complex rework and synchronization applications can be programmed with the two spindles. Bi-directional communication can also be configured thanks to the communication modules.

The training unit is suitable both for employee training and for simulating manufacturing changes before they are adopted in an assembly plant.

Because there are two complete tightening channels in a compact package, this unit is outstanding for use in the office, conference rooms, and the training lab. It is also easily transportable for easy set up at customer site.

Direct connection into a Euro wall outlet (AC230 V  $\pm$ 10%, 16 A, 50 - 60 Hz) is possible, however it cannot be operated while plugged into a GFCI socket.

Dimensions	mm (L x W x H)	560 x 680 x 500
Weight	kg	52
Supply Voltage	VAC	220
Nominal Current	A	16
Mains Frequency	Hz	50 - 60
Power	kW	0.6



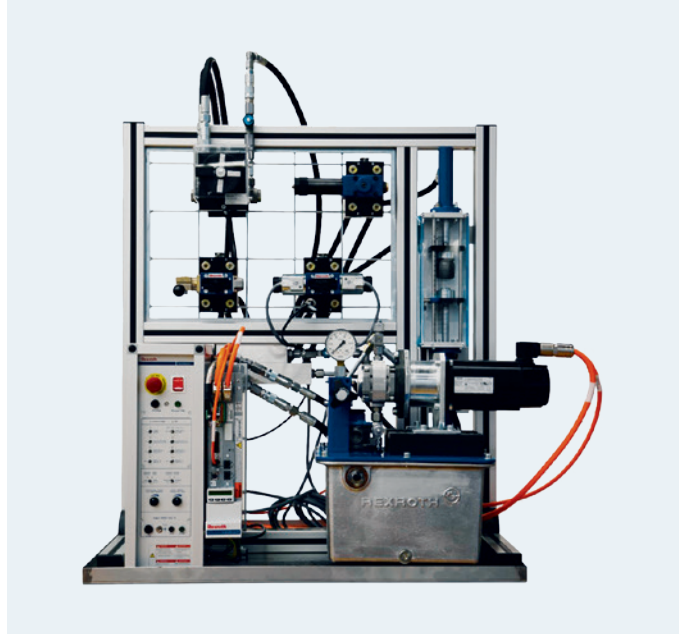
### Training System Sytronix SVP

Material Number	R911341269
Typocode	PST-H01.1-01-NN_SYTRONIX SVP IN-DRADR.C

This training system provides the basics for clearly understanding the operating characteristics of modern hydraulics applications. With the included configuration options, the training system can be optimized or expanded with optional modules. The SVP model is equipped with a servo drive package from the IndraDrive C device family.

The training system has outstanding implementation possibilities for use in beginner training and professional development. Direct connection into a Euro wall outlet (AC230 V  $\pm$ 10%, 16 A, 50 - 60 Hz) is possible, however it cannot be operated while plugged into a GFCI socket.

Dimensions	mm (L x W x H)	600 x 800 x 800
No. of Work Positions		2
Weight	kg	100
Supply Voltage	VAC	230
Nominal Current	A	16
Mains Frequency	Hz	50 - 60
Power	kW	1



### Training System Sytronix FCP

Material Number	R911341271
Typocode	PST-H01.3-01-NN_SYTRONIX FCP REX-ROTH-FV

This training system provides the basics for clearly understanding the operating characteristics of modern hydraulics applications. With the included configuration options, the training system can be optimized or expanded with optional modules.

The FCP model is equipped with the frequency converter package Rexroth FV. The training system has outstanding implementation possibilities for use in beginner training and professional development. Die FCP model can be plugged directly into a CEE wall outlet (3x AC, 400 V  $\pm$ 10%, 16 A, 50 - 60 Hz).

Dimensions	mm (L x W x H)	600 x 800 x 800
No. of Work Positions		2
Weight	kg	100
Supply Voltage	VAC	400
Nominal Current	A	16
Mains Frequency	Hz	50 - 60
Power	kW	1



## Training System PSI63C0

Material Number	R911337406
Typecode	PST-C01.20-01-DE TRAININGSSYSTEM PSI6XXX

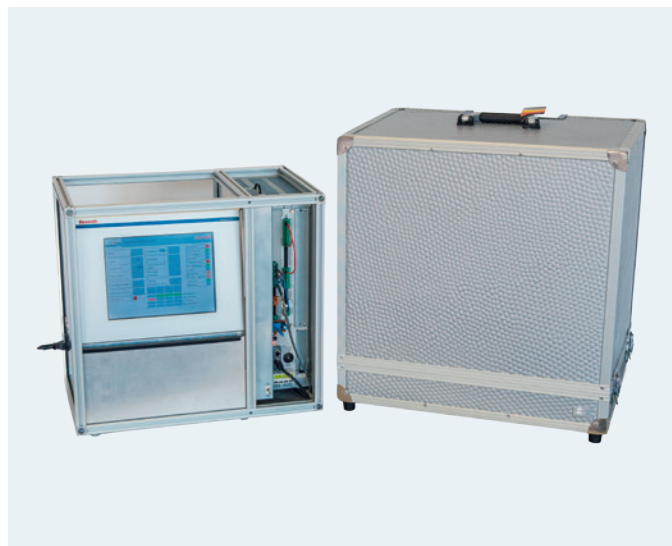
This training system enables reality-based work with the PRC7000 welding system in a safe, low-voltage environment.

With a laptop and the PRI7000 operating software, the trainee can safely practice all tasks in a welding system, such as:

- ▶ Programming welding parameters
- ▶ Programming point tables
- ▶ Simulation of a welding sequence bis 30 kA
- ▶ Diagnostics of control and robot communication
- ▶ Programming current monitoring with tolerances
- ▶ Programming milling cycles
- ▶ Simulation of the different current control options (KSR or UI operation)
- ▶ Analysis of logs (welding log, error log and data modification log)
- ▶ Data security and replay
- ▶ Creation of reference curves
- ▶ Analysis of the histogram

Can be plugged directly into a wall outlet (AC230 V  $\pm$ 10%, 16 A, 50 - 60 Hz)

Dimensions	mm (L x W x H)	580 x 450 x 600
Weight	kg	27
Supply Voltage	VAC	220
Nominal Current	A	16
Mains Frequency	Hz	50 - 60
Power	kW	0.5



## Training System PRC7000

Material Number	R911372425
Typocode	TRAINING EQUIPMENT PST-C01.30-01-DE TRA&

This training system enables reality-based work with the PRC7000 welding system in a safe, low-voltage environment. With a laptop and the PRI7000 operating software, the trainee can safely practice all tasks in a welding system, such as:

- ▶ Programming welding parameters
- ▶ Programming point tables
- ▶ Simulation of a welding sequence bis 30 kA
- ▶ Diagnostics of control and robot communication
- ▶ Programming current monitoring with tolerances
- ▶ Programming milling cycles
- ▶ Simulation of the different current control options (KSR or UI operation)
- ▶ Analysis of logs (welding log, error log and data modification log)
- ▶ Data security and replay
- ▶ Creation of reference curves
- ▶ Analysis of the histogram

Can be plugged directly into a wall outlet (AC230 V  $\pm$ 10%, 16 A, 50 - 60 Hz)

Dimensions	mm (L x W x H)	400 x 500 x 450
Weight	kg	15
Supply Voltage	VAC	220
Nominal Current	A	16
Mains Frequency	Hz	50 - 60
Power	kW	0.5



# Components and Spare Parts



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# Sensor Technology





**Sensor, Inductive, Sn = 8 mm**

Material Number	1827003645	
Typecode	SENSOR MODULE TS-AC-IND-8MM	
Inductive sensor NBN8-18GM50-E2 for scanning of metal objects, with switching state display, switching element function PNP NO contact, measuring distance mechanically adjustable, flush mount not possible. Protected 4 mm safety sockets, quick-connect system for grooved panel or grooved panel case.		
Dimensions	mm (L x W x H)	100 x 100 x 80
Weight	g	215
Protection Type	IEC60529	IP20
Supply Voltage	VDC	24
Operating Current	mA	0...200
Switching Frequency	Hz	0...500
Switching Distance	mm	8



**Sensor, Inductive, Sn = 2 mm**

Material Number	1827003647	
Typecode	SENSOR MODULE TS-AC-IND-2MM	
Inductive sensor NBB2-12GM50-E2 for scanning of metal objects, with switching state display, switching element function PNP NO contact, measuring distance mechanically adjustable, flush mount. Protected 4 mm safety sockets, quick-connect system for grooved panel or grooved panel case.		
Dimensions	mm (L x W x H)	100 x 100 x 80
Weight	g	190
Protection Type	IEC60529	IP20
Supply Voltage	VDC	24
Operating Current	mA	0...200
Switching Frequency	Hz	0...1500
Switching Distance	mm	2



<b>Sensor, Inductive, 0.2 A; Sn = 2 mm</b>		
Material Number	1827003422	
Typecode	PROXIMITY SWITCH TS-EC-IND-NJ2-12GM40&	
Inductive proximity switch NJ2-12GM40-E2 with PNP NO function, incl. switching cams, for fastening to the cylinder. Measuring distance mechanically adjustable. Flush mount, yellow switching state LED, protected 4 mm safety sockets, quick-connect for grooved panel or grooved panel case.		
Dimensions	mm (L x W x H)	70 x 92 x 84
Weight	g	318
Protection Type	IEC60529	IP20
Supply Voltage	VDC	24
Operating Current	mA	0...200
Switching Frequency	Hz	0...3000
Switching Distance	mm	2



<b>Sensor, Capacitive, 0.2 A; Sn = 4 mm</b>		
Material Number	1827003423	
Typecode	PROXIMITY SWITCH TS-EC-KAP-CBB4-12GH7&	
Capacitive proximity switch CBB4-12GH70-E2, with PNP NO function, adjustable via potentiometer. Flush mount, protected 4 mm safety sockets, quick-connect system for grooved panel or grooved panel case.		
Dimensions	mm (L x W x H)	70 x 95 x 84
Weight	g	185
Protection Type	IEC60529	IP20
Supply Voltage	VDC	24
Operating Current	mA	0...100
Switching Frequency	Hz	0...50
Switching Distance	mm	4



<b>Sensor, Capacitive, Sn = 8 mm</b>		
Material Number	1827003648	
Typecode	SENSOR MODULE TS-AC-KAP-8MM	
Capacitive proximity switch CJ8-18GM-E2 for touchless detection of objects, with switching state display, switching element function PNP NO contact, measuring distance mechanically adjustable, flush mount, protected 4 mm safety sockets, quick-connect system for grooved plate or grooved plate case.		
Dimensions	mm (L x W x H)	100 x 100 x 80
Weight	g	222
Protection Type	IEC60529	IP20
Supply Voltage	VDC	10...30
Operating Current	mA	0...300
Switching Frequency	Hz	0...100
Switching Distance	mm	8



<b>Sensor, Optical, 0.2 A; Sn = 200 mm</b>		
Material Number	1827003424	
Typecode	PROXIMITY SWITCH TS-EC-OPT-OF5010	
Optical reflective light sensor OF5010, green operating state LED, yellow function LED, switching element function PNP NO, bright/dark switching, electronically selectable, protected 4 mm safety sockets, quick-connect system for grooved panel or grooved panel case.		
Dimensions	mm (L x W x H)	70 x 98 x 84
Weight	g	184
Protection Type	IEC60529	IP20
Supply Voltage	VDC	24
Operating Current	mA	0...200
Switching Frequency	Hz	400
Switching Distance	mm	200



<b>Ultrasonic Sensor, Sn = 30 - 500 mm</b>		
Material Number	1827003637	
Typocode	SENSOR MODULE TS-AC-ULTRA-SCHALL-30&	
Ultrasonic sensor UB500-30GM-E5-V15, operating state LEDs, switching output PNP NO/NC configurable via parameters, measuring distance mechanically adjustable, flush mount. Five different output functions adjustable via learning input. Protected 4 mm safety sockets. Quick-connect system for grooved panel or grooved panel case.		
Dimensions	mm (L x W x H)	270 x 110 x 80
Weight	g	498
Protection Type	IEC60529	IP20
Supply Voltage	VDC	10...30
Operating Current	mA	0...300
Detection Range	mm	30...500



<b>Sensor, Magnetic Field, Sn = 60 mm</b>		
Material Number	1827003649	
Typocode	SENSOR MODULE TS-AC-MAG-60MM	
Sensor MB60-12GM50-E2 for scanning of magnetic fields, scanning with Hall sensors, switching state display via LED, switching element function PNP NO, measuring distance mechanically adjustable, flush mount. Protected 4 mm safety sockets, quick-connect system for grooved panel or grooved panel case.		
Dimensions	mm (L x W x H)	100 x 100 x 80
Weight	g	220
Protection Type	IEC60529	IP20
Supply Voltage	VDC	10...30
Operating Current	mA	0...300
Switching Frequency	Hz	0...5000
Switching Distance	mm	60



**Reflective Light Barrier, Sn = 4000 mm**

Material Number	1827003638
Typecode	PHOTOELEC LIGHT BA TS-AC-REFLEX-4000MM

Reflective light barrier OBS4000-18GM60-E5, operating state / function display via dual color LED. Switching element function PNP NO, bright/dark switching, electronically selectable, sensitivity adjustable. Protected 4 mm safety sockets. Quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	100 x 100 x 80
Weight	g	229
Protection Type	IEC60529	IP20
Supply Voltage	VDC	10...30
Operating Current	mA	0...100
Switching Frequency	Hz	≤500
Detection Range	mm	4000

**Inductive Analog Encoder, Linear Measurement Range 3 to 8 mm**

Material Number	1827003635
Typecode	SENSOR MODULE TS-AC-IND-ANALOG-3-8&

Inductive analog encoder IA8-30GM-I3, switching element function, analog current output, measuring distance mechanically adjustable, flush mount. Sensor bracket made of anodized aluminum sheet. Protected 4 mm safety sockets, quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	150 x 110 x 80
Weight	g	347
Protection Type	IEC60529	IP20
Supply Voltage	VDC	10...30
Analog Output	mA	0...20
Mounting		flush
Measuring Range	mm	3...8



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#### Reflective Light Scanner, Sn = 200 mm

Material Number	1827003654
Typecode	PHOTOELEC LIGHT BA TS-AC-REFLEX-200MM

Sensor OJ500-M1K-E01 for scanning of bright or dark objects, with operating state display, switching element function NPN NO, with selector switch for bright/dark switching, pre-failure display, pulse extension and switching frequency change via selector switch in terminal compartment, connectible via fiber-optic cable. Protected 4 mm safety sockets, quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	150 x 110 x 80
Weight	g	305
Protection Type	IEC60529	IP20
Supply Voltage	VDC	10...30
Switching Frequency	Hz	200/1500 switchable
Detection Range	mm	0...500



#### Clock Frequency Module

Material Number	R961009625
Typecode	COUNTER TS-EC-G-ZFB-A1-NN-T5&

Indicator unit CODIX 524 for showing integrated functions, selectable functions are pulse counter, frequency counter or timer. The module has two signal inputs and one reset input. LED display, protected 4 mm safety sockets for voltage supply and signal inputs. Quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	150 x 85 x 80
Weight	g	345
Protection Type	IEC60529	IP50
Supply Voltage	VDC	24





**Motor Control Unit**

Material Number	1827003642
Typecode	MOTOR CONTROL UNIT TS-AC-24V-9800UMIN

Motor control unit with controllable 24 V DC motor. Max. speed 15,000 U/min, Voltage supply via protected 4 mm safety sockets. Value preset connectible and continuously adjustable. 1 segment disc with 2 segments and one disc with 6 segments. Metal housing with integrated on/off switch, contact protection with monitoring. Quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	180 x 180 x 150
Weight	kg	1.14
Protection Type	IEC60529	IP50
Supply Voltage	VDC	24



**Fiber Optic Cable, Scanning Operation**

Material Number	1827003656
Typecode	FIBER-OPTIC CABLES TS-AC-LCR-18-3,2-0,5&

Light conductor LCR 18-3,2-0,5-K2 for scanning light-reflecting objects, transmission of light pulses from the reflective light sensor. Quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	100 x 100 x 80
Weight	g	180
Protection Type	IEC60529	IP65
Light Conductor Length	mm	500



**Fiber Optic Cable, One-Way Operation**

Material Number	1827003657
Typecode	FIBER-OPTIC CABLES TS-AC-LCE-18-2,3-0,5&

Light conductor LCE 18-2,3-0,5-K2 for scanning objects that move through a light barrier, transmission of light pulses from the reflective light sensor. Adapter for fastening the reflective light sensor. Quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	150 x 110 x 80
Weight	g	300
Protection Type	IEC60529	IP65
Light Conductor Length	mm	500



**Optical Waveguide with Mounting Brackets; Scanning Operation**

Material Number	1827003661
Typecode	FIBER-OPTIC CABLES TS-AC-LCR 18-1,1-0,5&

Optical waveguide LCR18-1.1-0,5-K13 for scanning objects and scan samples. Transmission of light pulses from the reflective light sensor. Height-adjustable bracket for fastening to guide unit with ultrasonic sensor, adapter for fastening to reflective light sensor.

Dimensions	mm (L x W x H)	100 x 100 x 80
Weight	g	100
Protection Type	IEC60529	IP65
Light Conductor Length	mm	500



**Evaluation Unit, Digital Material Differentiation**

Material Number	R961009627
Typecode	TONE-DECODER CARD TS-EC-G-AWE-NN-NN-NN

Module for material detection (digital) for clear plastic, black plastic, white plastic, solenoids, metals, non-metals and ferrous metal. Display of the detected material via red LED, sensor switching states displayed via green LED. Ultrasonic sensor performs the limit switch function. Resetting the switching states with reset button required following each cycle. Sensor signals and voltage supply via protected 4 mm safety sockets. Quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	85 x 150 x 74
Weight	g	345
Protection Type	IEC60529	IP50
Operating Voltage	VDC	24



**Display Unit, in Housing, Indicators 4x Optical, 1x Acoustic**

Material Number	R961009616
Typecode	INDICATOR UNIT TS-EC-G-AZE-NN-O4A1

Optical and acoustic signal display, optical display 4 x red LEDs, acoustic indicator with buzzer, indicators are active when voltage is applied to socket pair (+, -). Plastic housing with aluminum front plate, protected 4 mm safety sockets, designed as plug-in on circuit board, with quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	85 x 150 x 71
Weight	g	346
Protection Type	IEC60529	IP50
Operating Voltage	VDC	24
Current Consumption	mA	20



<b>Rail with Scanning Sample</b>		
Material Number	1827003662	
Typecode	STRIP TS-AC-310X55X30MM-AB&	
Strip with barcode as scanning sample and as circles of different sizes. Can be scanned in combination with guide unit, stepping motor with geared belt drive and optical waveguide. Quick-connect system for grooved panel or grooved panel case		
Dimensions	mm (L x W x H)	310 x 55 x 30
Weight	g	150

**Insulated Measuring Cable, 4 mm**  
Measuring cables for establishing safe, electrical plug-in connections for practice setups.

1 piece each:

<b>Measuring Cable, 250 mm, Red</b>		
Material Number	1827003212	
Typecode	MEASURING CABLE TS-EC-250MM-RD	

<b>Measuring Cable, 250 mm, Blue</b>		
Material Number	1827003213	
Typecode	MEASURING CABLE TS-EC-250MM-BU	

<b>Measuring Cable, 250 mm, Black</b>		
Material Number	1827003214	
Typecode	MEASURING CABLE TS-EC-250MM-BK	

<b>Measuring Cable, 500 mm, Red</b>		
Material Number	1827003215	
Typecode	MEASURING CABLE TS-EC-500MM-RD	

<b>Measuring Cable, 500 mm, Blue</b>		
Material Number	1827003216	
Typecode	MEASURING CABLE TS-EC-500MM-BU	

<b>Measuring Cable, 500 mm, Black</b>		
Material Number	1827003217	
Typecode	MEASURING CABLE TS-EC-500MM-BK	

<b>Measuring Cable, 1000 mm, Red</b>		
Material Number	1827003218	
Typecode	MEASURING CABLE TS-EC-1000MM-RD	

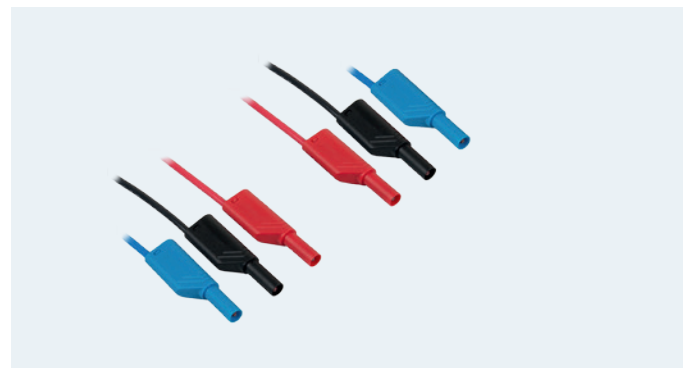
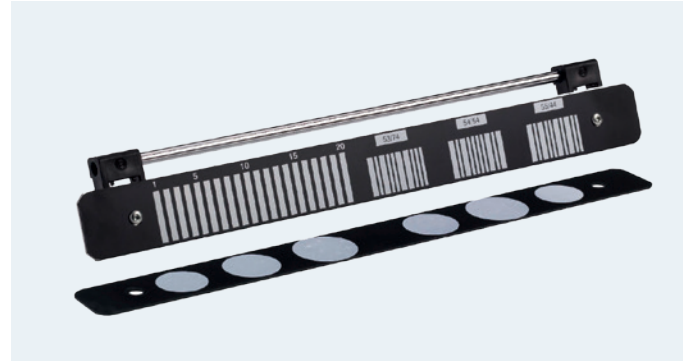
<b>Measuring Cable, 1000 mm, Blue</b>		
Material Number	1827003219	
Typecode	MEASURING CABLE TS-EC-1000MM-BU	

<b>Measuring Cable, 1000 mm, Black</b>		
Material Number	1827003220	
Typecode	MEASURING CABLE TS-EC-1000MM-BK	

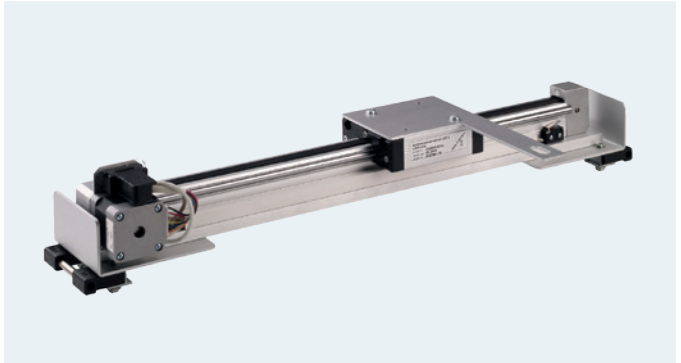
<b>Measuring Cable, 1500 mm, Red</b>		
Material Number	1827003464	
Typecode	MEASURING CABLE TS-EC-1500MM-RD	

<b>Measuring Cable, 1500 mm, Blue</b>		
Material Number	1827003465	
Typecode	MEASURING CABLE TS-EC-1500MM-BU	

<b>Measuring Cable, 1500 mm, Black</b>		
Material Number	1827003466	
Typecode	MEASURING CABLE TS-EC-1500MM-BK	



<b>Stepping Motor with Geared Belt Drive</b>		
Material Number	R961002165	
Typecode	STEPPER MOTOR TS-AC-ZAHNRIEMEN-TRIEB	
Stepping motor that drives the carriage of the guide in connection with the control electronics via a geared belt. 9-pole Sub-D connector for motor control. Quick-connect system for grooved panel or grooved panel case.		
Dimensions	mm (L x W x H)	500 x 160 x 80
Weight	kg	2.8



<b>Distributor, In-Housing, 10 Ports</b>		
Material Number	R961009614	
Typecode	DISTRIBUTOR TS-EC-G-VER-NN-NN-B10	
Distributor box for 24V and 0V, with 10 red and 10 blue protected 4 mm safety sockets each. Quick-connect system for grooved panel or grooved panel case		
Dimensions	mm (L x W x H)	150 x 85 x 71
Weight	g	369
Protection Type	IEC 60529	IP50
Operating Voltage	VDC	24



<b>Control Electronics for Stepping Motor</b>		
Material Number	R961009629	
Typecode	CONTROL ELECTRONIC TS-EC-G-ST5-NN-NN-NN	
Stepping motor control, velocity preset continuously adjustable, clockwise control, counterclockwise selectable with button, protected 4 mm safety sockets. Quick-connect system for grooved panel or grooved panel case.		
Dimensions	mm (L x W x H)	150 x 85 x 80
Weight	g	370
Protection Type	IEC 60529	IP50
Operating Voltage	VDC	24



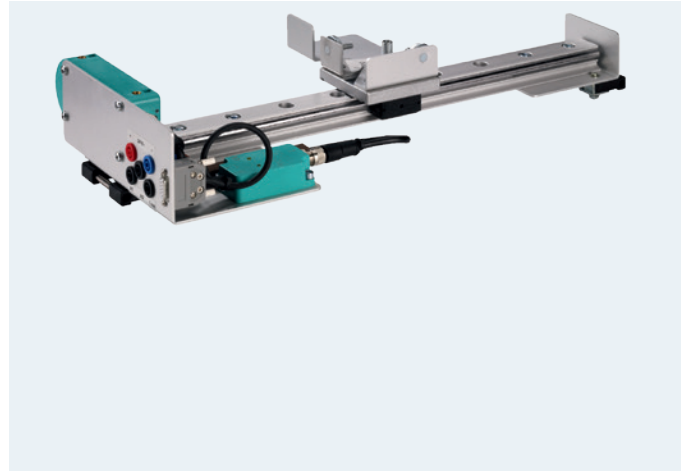
### Sensor Technology Guide Unit, 385 mm

Material Number	R961009383
Typecode	GUIDE UNIT TS-AC-385 MM

Guide unit with material sample holder for measuring the switching distance of different sensors. Material samples can be mounted in X and Y axis or using adjustable bracket. Guide unit consists of ultrasonic sensor UC300-F43-2KIR2-V17 with RS 232 interface for evaluation on a PC, as well as 2 switching outputs and one 4 ... 20 mA analog output.

Quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	510 x 211 x 100
Weight	kg	2.67
Protection Type	IEC 60529	IP65
Operating Voltage	VDC	24
Detection Range	mm	0...300



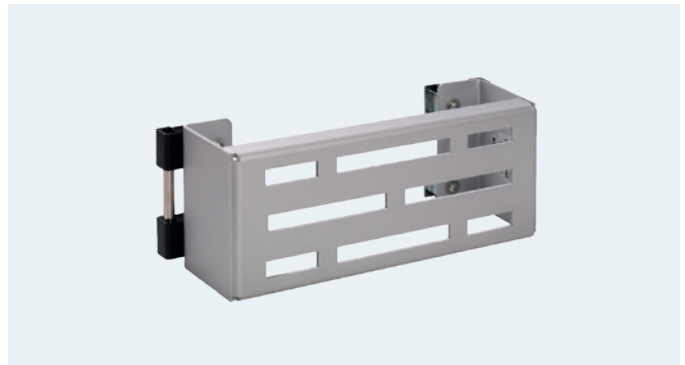
### Height Adjuster for Sensors

Material Number	1827003640
Typecode	BASE TS-MC-SEN-HOE AUSG

Height adjuster with adjustment height of 70 mm, for use with up to 3 sensors.

Quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	270 x 110 x 80
Weight	g	373





# Control Technology



Drive & Control Academy

Knowledge Transfer Using Learning Topics

Learning Topics Individual Technologies

Learning Topics Mechatronics/Automation

Application-Specific Systems

Components and Spare Parts

Indices

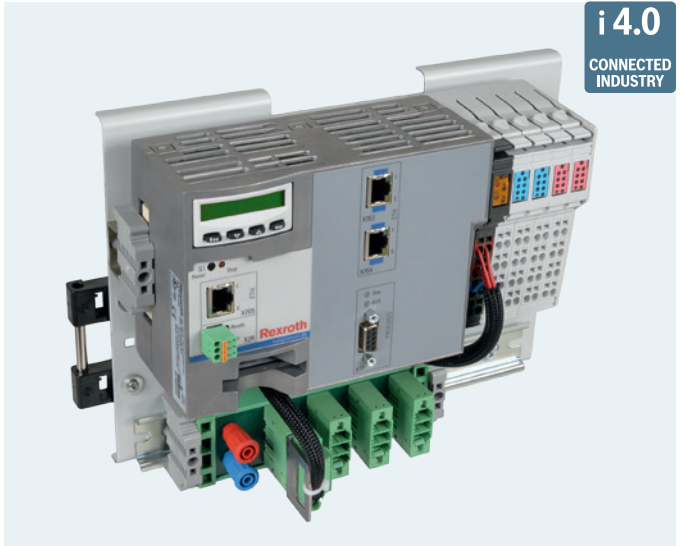
**Indra Control L25 PLC (Incl. IndraWorks Software Tool) with Bracket for Grooved Panel**

Material Number	R901423029
Typocode	CONTROL TS-EC-CML25.1-PN-16D&

The (industry-standard) control offers several specific possibilities:

1. PLC programming according to IEC61131-3 with the languages Instruction List, Ladder Diagram, Function Block Diagram, Sequential Function Chart, Structured Text
2. As preparation for Industry 4.0 (i4.0) learning topics: the control can be accessed with other programming languages (e.g. VisualBasic, C++, C#, Java, ...) and control via a software program (e.g. LabView, MatLab/Simulink, Excel, Power Point,...) is possible. This is possible without PLC programming.

OpenCoreEngineering enables the use of high-level language programming to read data directly from the PLC, even parallel to a running PLC program (conversion of Big Data). Example of an i4.0 application that is possible with the control described above: direct control of a system with a LabView program (from the appropriate LabView lab) via the control, without needing to translate into a PLC programming language.



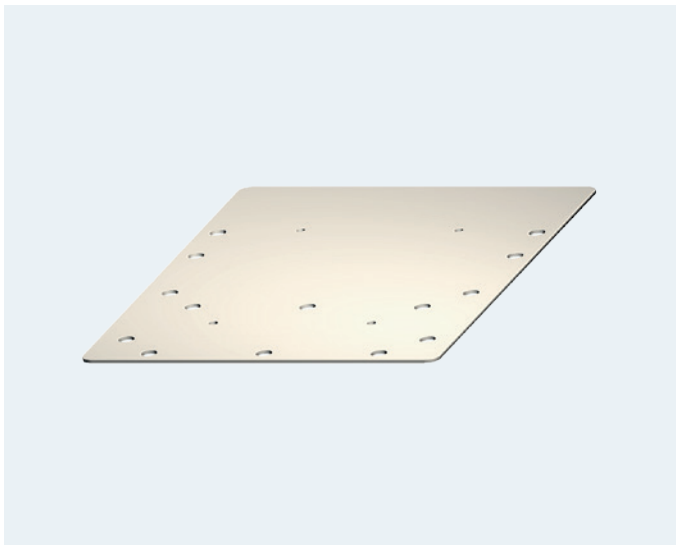
Dimensions	mm (L x W x H)	310 x 210 x 114
Weight	kg	1.8
Operating Voltage	VDC	24
Digital I/O	DI/DO	16/16

**Retaining Plate for PLC**

Material Number	R901439219
Typocode	PLATE TS-MC-2,5X375X280 4X&

Retaining plate for PLC tabletop setup and for fastening to work stations (WS200, WS290, DS3), to allow simple and ergonomic interaction with the PLC. Retaining plate for PLC and three digital/analog I/O boxes.

Dimensions	mm (L x W x H)	375 x 280 x 2
Weight	kg	2





Mounting Brackets for Tabletop PLC		
Material Number	R901439222	
Typecode	SUPPORT TS-MC-SI-TANDEM	
Two mounting brackets for PLC tabletop setup, to ensure secure positioning of the PLC and enable ergonomic work. Easy installation with Snap-In quick-connect system.		
Dimensions	mm (L x W x H)	127 x 200 x 45
Weight	kg	0.6
Quantity	2	



Universal Simulator with 24 Practice Templates		
Material Number	R901423121	
Typecode	SIMULATOR	TS-EC-UNI-SPS-O
Universal Simulator with 24 practice templates. For completing the individual exercises, the corresponding templates are placed on the positioning pins of the base panel, thereby covering irrelevant labeling and LED indicators. Creating assignment lists and PLC programs according to the exercises. Sample solutions provided. 2 Sub-D plugs for connection to the PLC included, connection to protected 4 mm safety sockets.		
Dimensions	mm (L x W x H)	300 x 325 x 90
Weight	kg	5.4
Operating Voltage	VDC	24



**Input Module with 16 Digital Inputs via Switch, Sensor or Outlet**

Material Number	R901411106
Typecode	DIGITAL I MODULE TS-EC-G-DEE-NN-NN-NN

Digital input box with 16 inputs. One switch with central position and LED per input. Protected 4 mm safety sockets. Quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	150 x 85 x 71
Weight	g	650
Protection Type	IEC60529	IP50
Operating Voltage	VDC	24



**Output Module with 16 Digital Outputs**

Material Number	R901411115
Typecode	DIGITAL O MODULE TS-EC-G-DEE-NN-NN-NN

Digital output box with 16 outputs. Output state indication via LED. Protected 4 mm safety sockets. Quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	150 x 85 x 71
Weight	g	650
Protection Type	IEC60529	IP50
Operating Voltage	VDC	24



**Analog Input/Output Module; Input: Voltage +/- 10V (Potentiometer), Current 0 to 20 mA or Sensor with M12 Plug**

Material Number	R901411104
Typecode	ANALOG I/O MODULE TS-EC-G-AEA-NN-NN-NN

Analog input/output box with protected 4 mm safety sockets. Voltage input connectible and adjustable +/- 10 VDC. Current input for 0-20 mA. M12 plug-in connector for direct current connection. 2 outputs 0-10 V. Quick-connect system for grooved panel.

Dimensions	mm (L x W x H)	150 x 85 x 71
Weight	g	650
Protection Type	IEC60529	IP50
Operating Voltage	VDC	24



**Output Module for Hydraulic Valves with 4 Digital Outputs, 2 A ea.**

Material Number	R901423044
Typecode	DIGITAL O MODULE TS-EC-G-DAE-NN-4A-2A

Digital output box with 4 outputs, with 2 A switching capacity each. Protected 4 mm safety sockets. Quick-connect system for grooved panel or grooved panel case.

Dimensions	mm (L x W x H)	150 x 85 x 71
Weight	g	650
Protection Type	IEC60529	IP50
Operating Voltage	VDC	24



**Power Cable for Universal Simulator Inputs**

Material Number	R901422494
Typecode	CONNECTION CABLE TS-EC-DI 106-1/X

Power cable, digital input, universal board for PLC, 37-pole Sub-D plug on PLC connector, voltage supply 24 VDC.

Length	m	1.3
Weight	g	380

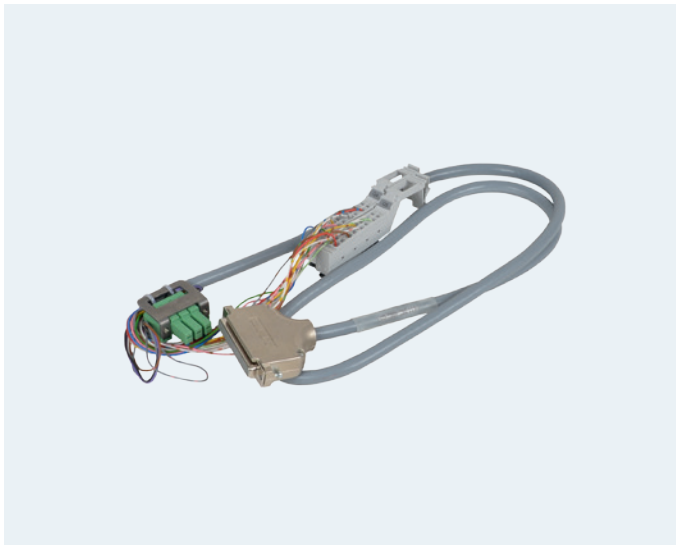


**Power Cable for Universal Simulator Outputs**

Material Number	R901422495
Typecode	CONNECTION CABLE TS-EC-DO 106-1/X

Power cable, digital output, universal board for PLC, 37-pole Sub-D socket on PLC connector, voltage supply 24 VDC.

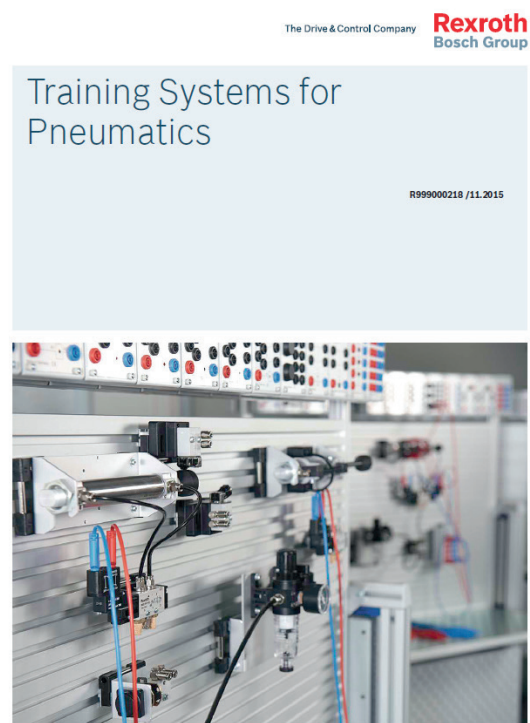
Length	m	1.3
Weight	g	380



# Hydraulics and Pneumatics

Hydraulics components and spare parts can be found in our catalog **Training Systems for Hydraulics R999000177 (DE) / R999000178 (EN) / R999000179 (ES)**

Pneumatics components and spare parts can be found in our catalog **Training Systems for Pneumatics R999000217 (DE) / R999000218 (EN)**





# Mechatronics



### Cube Halves

Cube Halves made of different materials. For use with the modular mechatronics system mMS4.0. Material detection, sorting of rejected material, processing of Cube Halves possible. Some of the Cube Halves for the Industry 4.0 applications contain RFID tags.

Dimensions mm (L x W x H) 50 x 50 x 25

#### Cube Half, mMS – Aluminum

Material Number 1827008137

Typecode Cube Half TS-MC-MMS-WUE-50X50X&

#### Cube Half, mMS – PVC, Black

Material Number 1827008138

Typecode Cube Half TS-MC-MMS-WUE-50X50X&

#### Cube Half, mMS – PVC, White

Material Number 1827008139

Typecode Cube Half TS-MC-MMS-WUE-50X50X&

#### Cube Half with Data Carrier – SW

Material Number R901354944

Typecode Cube Half TS-AC-MMS-RFID-50X50&

#### Cube Half with Data Carrier – WS

Material Number R901354946

Typecode Cube Half TS-AC-MMS-RFID-50X50&

#### Spare Pin for mMS Cube Half

Material Number 1827008147

Typecode PIN TS-MC-MMS-WUE-STFT

Pins for connecting two Cube Halves. For use with the mMS4.0 system.





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