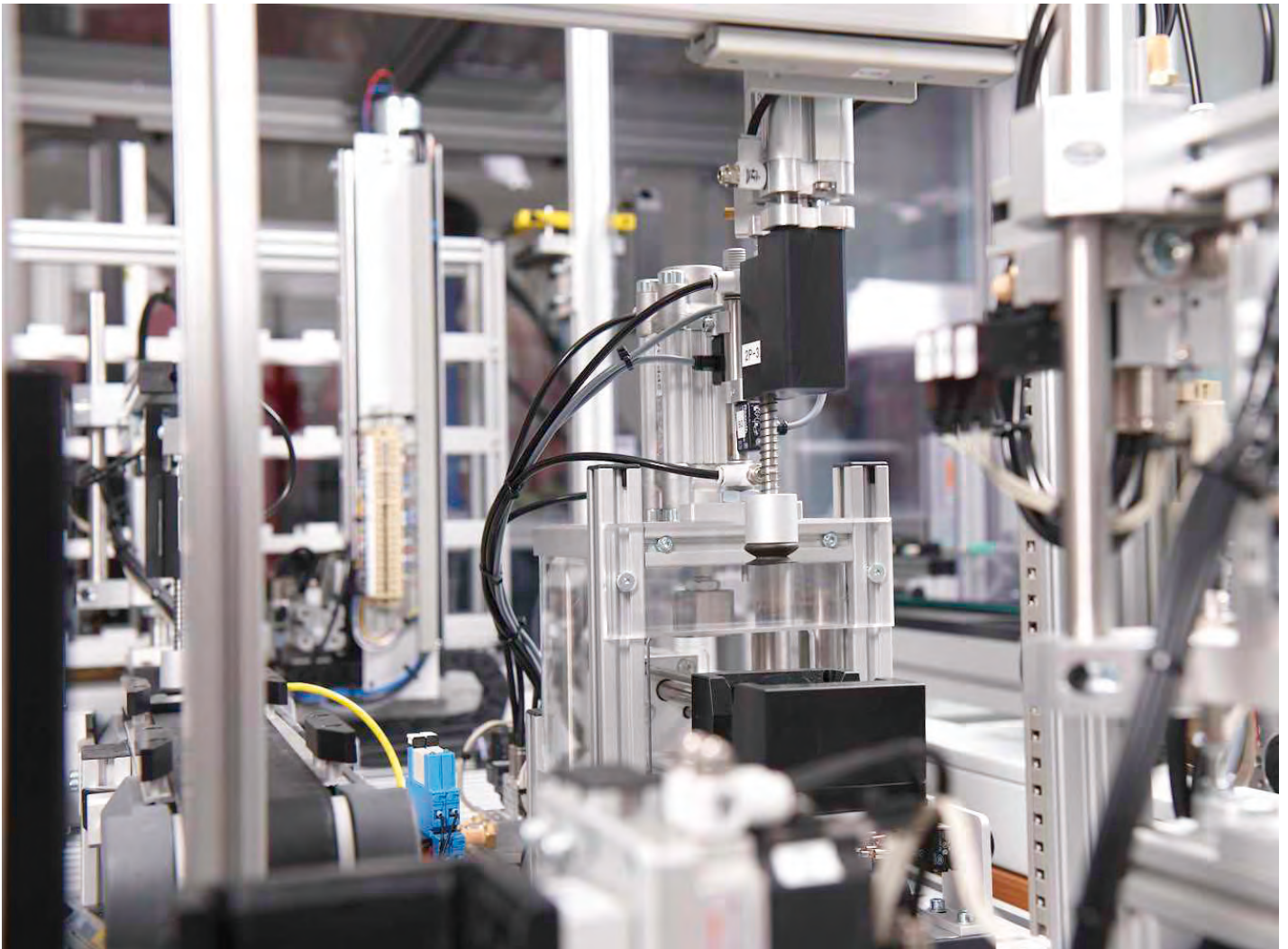


Training systems for automation

Amtek Company
1244 Ritchie Highway, Suite 10
Arnold, MD 21012
800.926.8359 (Ph.)
410.315.9249 (Fax)
info@amtekcompany.com

R999000216/09.2012





Drive & Control Academy 4

Training systems for automation 6

Mechatronics 9

Learning topics	11
Systems	18
Individual stations	21
Assemblies	23

Sensor technology 31

Learning topics	33
Components	45

PLC 61

Learning topics	63
Systems	64

Learning topics on control technology 67

Electropneumatic control technology	69
Hydraulic control technology	73

Directories 77

Material number overview	79
Index	83

Drive & Control Academy

Knowledge - the decisive competitive advantage



Bosch Rexroth is one of the globally leading specialists in drive and control technology and has unique technological know-how. The Drive & Control Academy passes this knowledge on and supports the customized training and further development as well as the qualification of technical experts.

Knowledge is everything

Technical knowledge and competence of the employees provide a company with the decisive advantage in global competition. Under the roof of the Drive & Control Academy, Rexroth offers an extensive portfolio of knowledge products in the area of drive and control technologies which is continuously based on the industrial practice. The Drive & Control Academy sets particularly standards in the didactic presentation of specialized and integrated know-how for customers, employees and facilities for training and further development. Our offers have been compiled according to the following principles:

- ▶ Practice-oriented, state-of-the-art equipment
- ▶ Target group-specific training offers
- ▶ The latest training methods

Training

New training courses and the continuous further development of the training guarantee that the knowledge transfer is always state-of-the-art. The method repertoire includes attendance training, eLearning, practical training and Blended Learning, combining the advantages of attendance training sessions and eLearning. With customer training sessions, the customer proximity principle is of utmost importance.



Training systems

The training systems impart inexperienced and experienced users practice-oriented knowledge in the areas hydraulics, pneumatics, electric drive and control technology, mechatronics and automation. They comprise industrial serial components and have internationally standardized programming languages and open interfaces.

Media

Rexroth's software-based training and learning media distinguish themselves by high practical relevance and are adjusted exactly to the training courses and training systems. They contain eLearning modules, technology and application trainers, animations of components and systems as well as simulation-based learning units. Apart from that there are dictionaries, technical books, manuals for trainers and trainees as well as working equipment.

Knowledge portal

The Knowledge portal will become the multimedia contact point for all drive, control and movement technology topics in industrial and academic further education and training as well as qualification.

This unique contact point on the Internet will offer the user access to high-quality information and structured exchange of knowledge and experience.

Training systems for automation

Rexroth's technical know-how and the solution competence in the area of industrial applications are smoothly integrated into the modularly structured training systems – and in this way meet the qualification levels requested by the industry exactly.

Rexroth training systems

Bosch Rexroth's training systems are based on standard components from the different Bosch Rexroth product areas.

A training system consists of the hardware and the exercise and project manuals for trainers and trainees. By means of the training systems, inexperienced and experienced users gradually acquire practice-oriented and technical expert knowledge.

The trainees will come across the standard components used in the training system later, in their professional career, in machines and systems.

Apart from the training systems for automation described here in the catalog, Bosch Rexroth also offers training systems in the technology fields Hydraulics and Pneumatics. Information on suitable teachware and all other offers of the Drive & Control Academy are available on the Bosch Rexroth website at: <http://www.boschrexroth.com>

Training systems for automation

From the transfer of knowledge in the PLC technology to complex systems with a robot system - our systems for automation cover almost all requirements in this area.

mMS

Rexroth's modular Mechatronics System (mMS) consists of three units that can be combined in one overall system. Each unit has an own PLC. In this way, a maximum of 9 trainees can work at this system. The mMS comprises all drive, control and movement technologies such as pneumatics, hydraulics, electric drives, linear technology, sensor technology, control technology, PLC programming or bus technology (Profibus DP).

CMS

The Cartesian Motion System (CMS) is a robot system that is used for exercises in the area of robot programming and safety technology.

TS1

The TS1 Transfer System is a transfer system which allows you to perform exercises in the area of PLC programming in connection with electric drives in combination with sensor technology.

ATS

The ATS training system is a combination of mMS, CMS and TS1. This results in a system demonstrating a complete production cycle, from the material supply to the transport of the manufactured products.



Sensor technology

Our sensor technology range comprises different device kits: a basic kit, an extension kit, an automation technology kit as well as two kits for AS interface. Together with the material sample case, it can be used to transfer the knowledge of which sensor type is to be used when.

PLC with universal simulator

Using this system, 24 different exercises can be performed at one universal simulator.

PLC with quick fastening system

Allows you to use the PLC on a grooved plate. Use of the standard PLC does not require any tools, the inputs and outputs can be plugged using normal measuring lines.

Practical exercises with suitable teachware

Technical knowledge and competence of the employees provide a company with the decisive advantage in global competition.

- ▶ Trainer/trainee project manuals
- ▶ Technical books
- ▶ Teaching media

Safety

The training systems have been developed and tested according to the directives of the Machinery Directive 2006/42/EC. A CE certificate is contained in the operating instructions.

Compilation of your configuration

Exactly adjust your training system to your requirements. We are willingly prepared to support you in the compilation of your training system. Please contact us!

Mechatronics

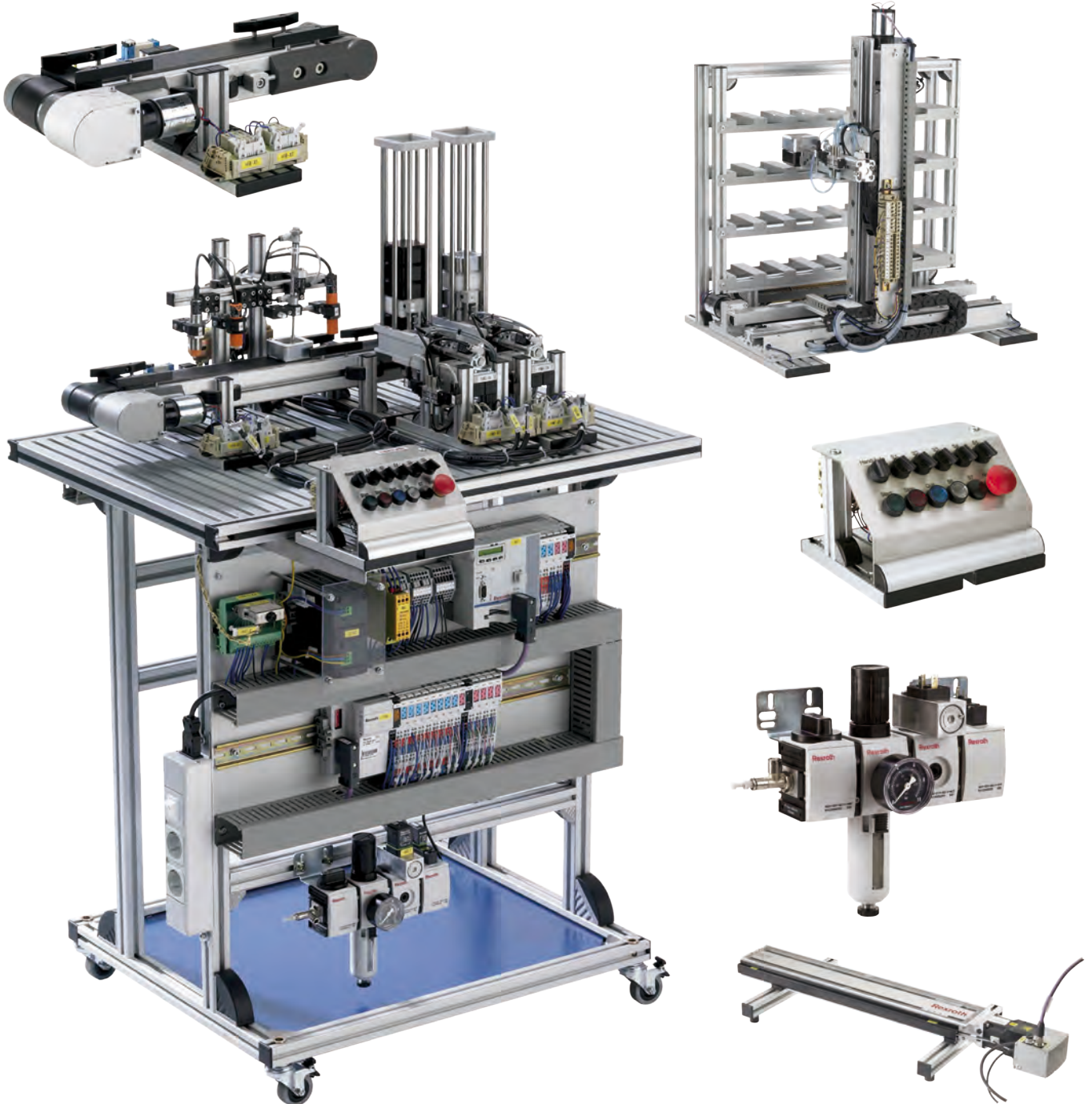


Table of Contents Mechatronics

Learning topics	11
Systems	18
Individual stations	21
Assemblies	23

Learning topics / handling technology

Project exercises on handling technology

The handling technology with pneumatics has changed considerably over the last years. Components, workpieces and products become increasingly smaller; at the same time, the economic pressure requiring higher levels of automation has increased.

In order to satisfy the complex requirements, practical concepts in the training are required.

Exercise manuals for trainers and trainees

The present manual contains project exercises on the topics: controls (pneumatics, relay, PLC), handling technology (positioning, grabbing) as well as installation technology (valve support systems, BUS systems).

The exercises impart core and technical qualifications like the independent planning, execution and controlling of work which is required for the fulfillment of the project order.



Numbers of the project exercises and the relevant topic			
1	Easy2Combine handling system	3	Area portal handling system
2	Handling system for Pick & Place	4	Handling system with Profibus

Trainer manuals	Language	Mat. no.	Manual title	Document no.
	DE	R961004655	Projekthandbuch Elektropneumatische Handhabungstechnik, Lehrerhandbuch	RD 09974
	EN	R961004826	Project manual Electropneumatic handling technology, Trainer's manual	RE 09974
Trainee manuals	Language	Mat. no.	Manual title	Document no.
	DE	R961004865	Projekthandbuch Elektropneumatische Handhabungstechnik, Schülerhandbuch	RD 09975
	EN	R961004827	Project manual Electropneumatic handling technology, Trainee's manual	RE 09975

Learning topics / handling technology

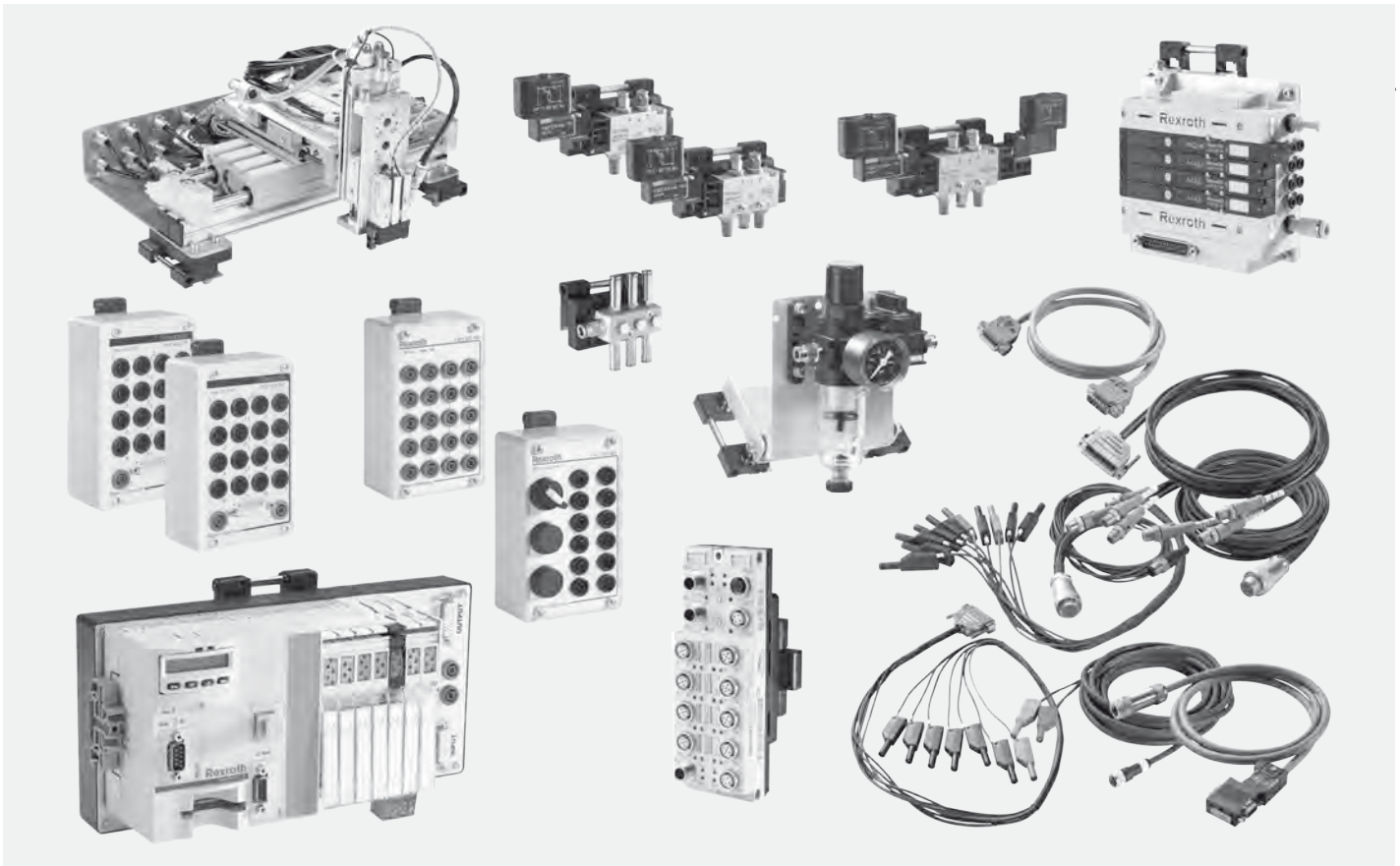
E2C handling module device kit

Material no. R961004472













The device kit is suitable for implementing courses on electropneumatic control, installation and handling technology. It comprises the handling module, PLC with 12 inputs and outputs, valve support system, Profibus module with 8 inputs and outputs, cable set, filter controller with 3/2 directional valve, pn. distributor, 2x el. operated 5/2 directional valves with spring return, el. operated 5/2 directional solenoid pulse valve, 2x input/output box, el. distributor and switch box.

Accessories

Compressor 230 V incl. accessories	1827008426	1
Stand-alone device carrier EcoDesk	R961003826	1
Power supply unit 230 V/24 V with distributor	R961001099	1



Learning topics / handling technology

Item	E2C handling module device kit components	Mat. no.	Quantity	Figure
1	3-axis handling device E2C	R961003949	1	
2	PLC L20, 12 I/O	R961004428	1	
3	Valve support system LP04 multi-pole	R961004464	1	
4	Profibus module 8 I/O	R961004467	1	
5	E2C handling module cable set	R961004466	1	
6	Distributor box 24 V	1827003587	1	
7	Switch and button box 24 V	1827003588	1	
8	Input / output box 24 V, 16-fold	1827003595	2	
9	Filter controller 3/2 directional valve, 0.5 - 10 bar	1827003410	1	
10	Distributor 6-fold	1827003411	1	
11	5/2 directional solenoid valve G1/8, spring return	1827003413	2	
12	5/2 directional solenoid pulse valve G1/8	1827003414	1	

Learning topics / mMS

Project exercises on mMS

This teachware has been prepared as collection of tasks, solutions and software projects for Rexroth's modular Mechatronics System mMS which is used for the industrial initial and further vocational training as mechatronics engineer. The modular tasks satisfy the professional requirements.

Exercise manuals for trainers and trainees

The practical exercises basically deal with the contents of the textbook "Mechatronik in Theorie und Praxis" (Mechatronics in theory and practice) and their level of difficulty varies from newcomer to expert. The training experience from the successful mechatronics training sessions of the last year has been used for this manual. So the Sequential Function Chart programming language according to IEC 61131-3 is to be preferably used for the seminar implementation with newcomers; however, knowledge of all necessary languages of IEC 61131-3 will be imparted.



Numbers of the project exercises and the relevant topic			
1	Observing, analyzing and documenting in the newcomer application for the mMS reality with station 2 – Process	6	Programming the hardware in the expert application for handling device station 2
2	Understanding basic technologies in the newcomer application for electrics / sensor technology with station 2	7	Implementing 04 and 06 on the programmed overall system in the expert application for the PLC project structure station 2
3	Basics of PLC programming with L20 in the newcomer application for electrical conveyor belt	8	Commissioning of stations and overall systems in the expert application for commissioning order station 2
4	Programming the hardware in the newcomer application for pneumatic press	9	Troubleshooting in the expert application for troubleshooting method with exchanged cables station 2
5	Machine safety, emergency stop, CE marking in the newcomer application for emergency stop with PNOZ station 2		

Trainer manuals	Language	Mat. no.	Manual title	Document no.
	DE	R961003760	Projekthandbuch Mechatronik, Lehrerhandbuch	RD 00852
	EN	R961003762	Project Manual Mechatronics, Trainer's manual	RE 00852
Trainee manuals	Language	Mat. no.	Manual title	Document no.
	DE	R961003761	Projekthandbuch Mechatronik, Schülerhandbuch	RD 00853
	EN	R961003763	Project Manual Mechatronics, Trainee's manual	RE 00853

Exercise equipment

The mechatronics systems with material numbers R961003177 and R961004148 on pages 19 and 20 in this catalog are suitable for performing the project exercises on the mMS.

Learning topics / linear technology

Project exercises on linear technology

Using the eCKK eLINE compact module, the user can try the selection, assembly and particularly the commissioning of a linear axis in a simplified manner.

The 24 VDC stepping motor which has already been attached communicates with superior controls via digital inputs. The eCKK eLINE compact modules with eLINE ball screw assembly have the same principal dimensions and connection dimensions as the tried and tested Rexroth standard compact modules.

So the eLINE compact modules combine high travel velocity with high precision and smoothness.

Exercise manuals for trainers and trainees

The present manual contains project exercises on the topics:

- ▶ Set-up and commissioning of a linear system
- ▶ Programming the hardware in the newcomer application and first manual moving of the linear system
- ▶ Programming the hardware in the expert application and creating automatic travel cycles
- ▶ Calculation and design of linear systems and their components
- ▶ Understanding of the emergency stop circuit with stop category 2
- ▶ Troubleshooting at the linear system and the components



Numbers of the project exercises and the relevant topic			
1	Understanding basic technologies and being able to transfer them to the concrete application	5	Calculation and design of linear systems and their components
2	Set-up and commissioning of a linear system	6	Machine safety, emergency stop function and referencing
3	Programming the hardware in the newcomer application and first manual moving of the linear system	7	Integration of a second axis into the project
4	Programming the hardware in the expert application and creating automatic travel cycles	8	Troubleshooting in the expert application

Trainer manuals	Language	Mat. no.	Manual title
	DE	R961007695	HANDBUCH MEC LIN PROJEKTUEBUNGEN LH DE
Trainee manuals	Language	Mat. no.	Manual title
	DE	R961007696	HANDBUCH MEC LIN PROJEKTUEBUNGEN SH DE

Learning topics / linear technology

Device kit linear technology

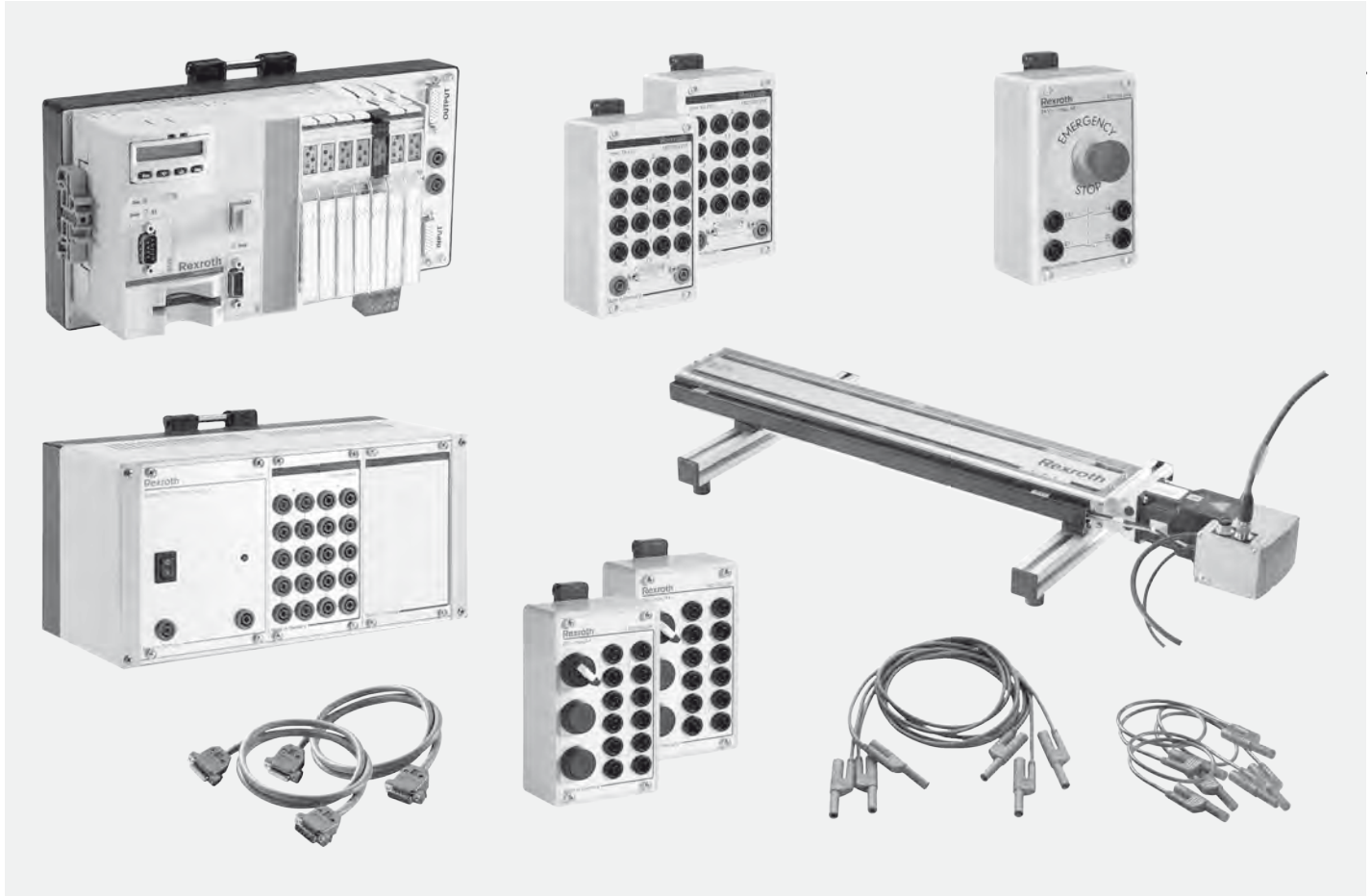
Material no. R961007787

The device kit is suitable for implementing courses on control, linear and handling technology.








It contains one linear axis with sensor technology and Profibus cable, PLC with 12 inputs and 12 outputs, cable set, 1x input/output box, 2x el. distributor and switch box, power supply unit and one emergency stop box.

Accessories

Grooved plate 565 x 700 x 30 mm	1827003299	1
---------------------------------	------------	---



Learning topics / linear technology

Item	E2C handling module device kit components	Mat. no.	Quantity	Figure	Page
1	Linear axis with stepping motor	R961007602	1		18
2	Training system PLC L20 for pneumatics	R961004023	1		62
3	Power supply unit 230 V/24 V with distributor	R961001099	1		
4	Switch box emergency stop 24 V	1827003591	1		
5	Switch and button box 24 V	1827003588	2		
6	Measuring line 500 mm, red	1827003215	16		55
7	Measuring line 500 mm, blue	1827003216	6		55

Systems

Linear axis with stepping motor		
Material no.	R961007602	
eLINE compact modules with integrated compact drive are cost-effective linear systems ready for installation with compact dimensions, favorable price/performance ratio and short delivery times.		
eCKK: eLINE compact modules with ball rail system and ball screw assembly 12x10, L = 560 mm		
- With Profibus interface		
- Stepping motor 24 VDC with output stage and Profibus interface, already pre-parameterized		
- Compact drive already attached, pre-assembled cable set - with contact-protected 4 mm laboratory connectors, easy commissioning		
- With reference switch (Reed, HALL), switch activation without cam		
- Functional components according to PLCopen available		
- Can be installed on a table, with contact protection		
Dimensions	(LxWxH)	780x310x120
Workplaces	opt./max. in each case	1/2
Weight	kg	5.6
Supply voltage	V DC	24
Accessories		
Mat. no.	Quantity	Recommended accessories
R961004023	1	Training system PLC L20 for pneumatics
R961001099	1	Power supply unit 230 V/24 V with distributor
1827003588	1	Switch and button box 24 V
1827003591	1	Switch box emergency stop 24 V



Systems

mMS system processing with pneumatic press

Material no. R961003177

The system for the cube assembly consists of the three stations:

- Rack station
- Processing with pneumatic press station
- Warehouse station

The rack, processing with pneumatic press and warehouse stations are put next to each other. Afterwards, they are mechanically, pneumatically and electrically connected.

The cube assembly system allows for the set-up, operation and observation of a complete automation process.

Moveable frame made of aluminum profiles, with 12 lockable rollers; 3 stations, can be operated individually or are mechanically, pneumatically and electrically connected.

For more descriptions, refer to the individual data sheets of the stations.

Dimensions	mm (LxWxH)	2400x780x1480
Workplaces per station	opt./max.	1/3
Space required	m (LxW)	4 x 2.3
Weight	kg	190
Supply voltage	V AC	230
Operating pressure	bar	5...6

Accessories

Mat. no.	Quantity	Recommended accessories
1827008426	1	Device set compressor 230 V incl. accessories

mMS system processing with hydraulic press

Material no. R961003178

The system for the cube assembly consists of the three stations:

- Rack station
- Processing with hydraulic press station
- Warehouse station

The rack, processing with hydraulic press and warehouse stations are put next to each other. Afterwards, they are mechanically, pneumatically and electrically connected.

The cube assembly system allows for the set-up, operation and observation of a complete automation process.

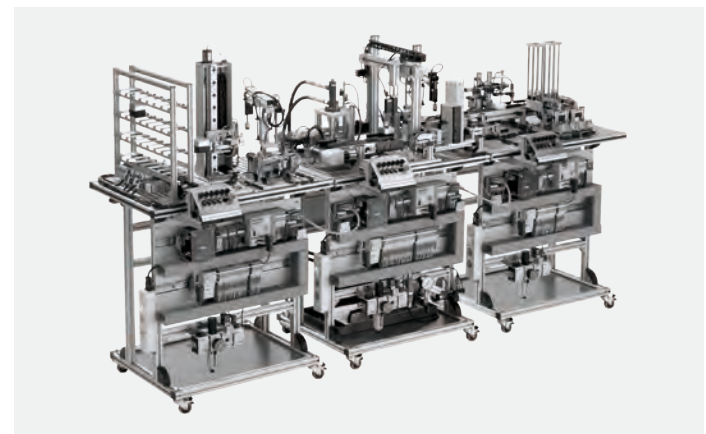
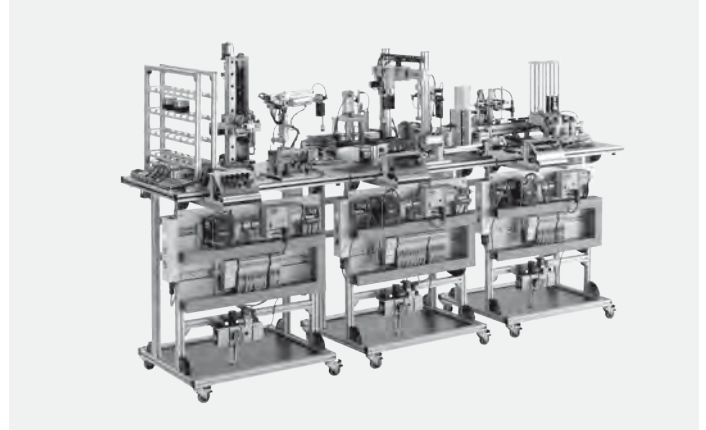
Moveable frame made of aluminum profiles, with 12 lockable rollers; 3 stations, can be operated individually or are mechanically, pneumatically and electrically connected.

For more descriptions, refer to the individual data sheets of the stations.

Dimensions	mm (LxWxH)	2400x780x1480
Workplaces per station	opt./max.	1/3
Space required	m (LxW)	4 x 2.3
Weight	kg	215
Supply voltage	V AC	230
Operating pressure	bar (pn)	5...6
	bar (hy)	50

Accessories

Mat. no.	Quantity	Recommended accessories
1827008426	1	Device set compressor 230 V incl. accessories



Systems

mMS system with pneumatic press 115 V AC

Material no. R961004148

The system for the cube assembly consists of the three stations:

- Rack station
- Processing with pneumatic press station
- Warehouse station

The rack, processing with pneumatic press and warehouse stations are put next to each other. Afterwards, they are mechanically, pneumatically and electrically connected.

The cube assembly system allows for the set-up, operation and observation of a complete automation process.

Moveable frame made of aluminum profiles, with 12 lockable rollers; 3 stations, can be operated individually or are mechanically, pneumatically and electrically connected.

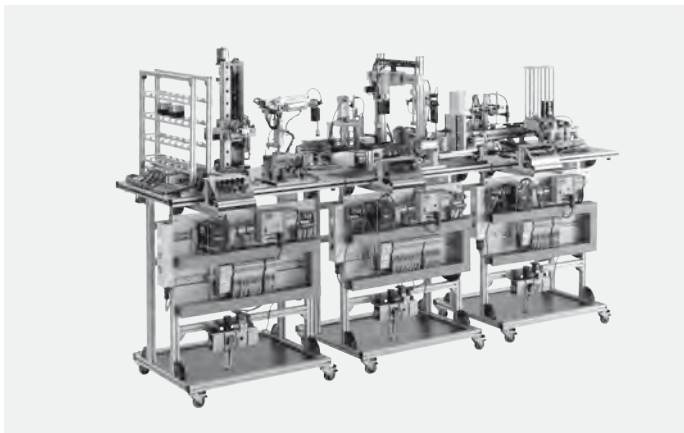
For more descriptions, refer to the individual data sheets of the stations.

Connection voltage 115 V AC

Dimensions	mm (LxWxH)	2400x780x1480
Workplaces per station	opt./max.	1/3
Space required	m (LxW)	4 x 2.3
Weight	kg	190
Supply voltage	V AC	115
Operating pressure	bar	5...6

Accessories

Mat. no.	Quantity	Recommended accessories
R962003964	1	Device set compressor 115 V incl. accessories



Individual stations

mMS Warehouse station

Material no. R961003448

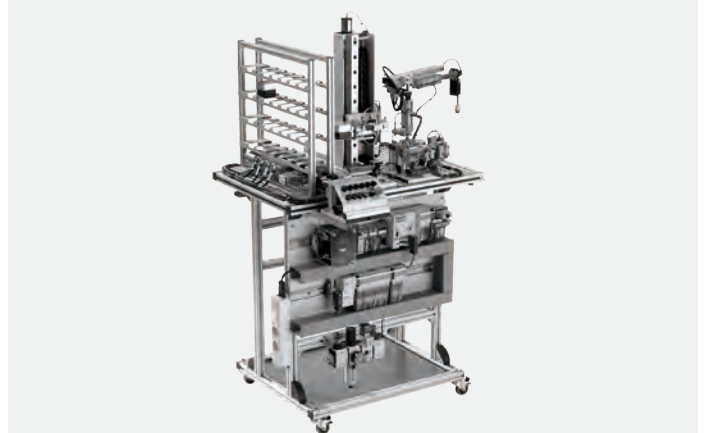
Moveable frame made of aluminum profiles, with 4 lockable rollers; 1 high rack warehouse, 1 cartesian robot, 1 handling device, 1 control panel, 1 maintenance unit, electr. supply with signal processing and programmable logic control with software.

One workpiece is taken up by the vacuum exhauster of the handling device, swiveled by 180° and handed over to the robot of the high rack warehouse. The robot stores the workpiece at the assigned storage place.

Dimensions	mm (LxWxH)	800x780x1480
Workplaces	opt./max.	1/3
Space required	m (LxW)	2.4 x 2.3
Weight	kg	60
Supply voltage	V AC	230
Operating pressure	bar	5...6

Accessories

Mat. no.	Quantity	Recommended accessories
1827008426	1	Device set compressor 230 V incl. accessories



mMS station processing with pneumatic press

Material no. R961003449

Moveable frame made of aluminum profiles, with 4 lockable rollers; 1 handling device, 1 portal with vacuum gripper, 1 pin unit, 1 pneumatic press, 1 turning unit, 1 conveyor belt short, 1 control panel, 1 maintenance unit, electr. supply with signal processing and programmable logic control with software.

Workpieces are transported on the station with the handling device and the portal. In the pneum. turning unit, workpieces are tilted by 90°. Using a pneumatic cylinder, the pin unit inserts two locking pins into one of the cube halves.

Two workpieces are transported into the press. The workpieces are pressed together in the press by a pneumatic cylinder. The portal vacuum gripper transfers the workpiece to a conveyor belt for transport.

Dimensions	mm (LxWxH)	800x780x1350
Workplaces	opt./max.	1/3
Space required	m (LxW)	2.4 x 2.3
Weight	kg	72
Supply voltage	V AC	230
Operating pressure	bar	5...6

Accessories

Mat. no.	Quantity	Recommended accessories
1827008426	1	Device set compressor 230 V incl. accessories



Individual stations

mMs Rack station

Material no. R961003450

Moveable frame made of aluminum profiles, with 4 lockable rollers; 2 separation racks, 1 conveyor belt long, 1 test unit, 1 control panel, 1 maintenance unit, electr. supply with signal processing and programmable logic control with software.

Two pneumatic cylinders push one workpiece each from the rack onto a conveyor belt and it passes by four test stations.

The material properties are determined by one optical, one capacitive and one inductive sensor. The contour is identified by a pneumatic cylinder.

The test result is stored in the control. The workpiece is then ready for transfer at the end of the conveyor belt.

Dimensions	mm (LxWxH)	800x780x1260
Workplaces per station	opt./max.	1/3
Space required	m (LxW)	2.4 x 2.3
Weight	kg	57
Supply voltage	V AC	230

Operating pressure bar 5...6

Accessories

Mat. no.	Quantity	Recommended accessories
1827008426	1	Device set compressor 230 V incl. accessories



mMS station processing with hydraulic press

Material no. R961003451

Moveable frame made of aluminum profiles, with 4 lockable rollers; 1 handling device, 1 portal with vacuum gripper, 1 pin unit, 1 hydraulic press, 1 turning unit, 1 conveyor belt short, 1 control panel, 1 maintenance unit, electr. supply with signal processing and programmable logic control with software

Workpieces are transported on the station with the handling device and the portal. In the pneum. turning unit, workpieces are tilted by 90°. Using a pneumatic cylinder, the pin unit inserts two locking pins into one of the cube halves.

Two workpieces are transported into the press. The workpieces are pressed together in the press by a hydraulic cylinder. The portal vacuum gripper transfers the workpiece to a conveyor belt for transport.

Dimensions	mm (LxWxH)	800x980x1350
Workplaces per station	opt./max.	1/3
Space required	m (LxW)	2.4 x 2.3
Weight	kg	98
Supply voltage	V AC	230
Operating pressure	bar (pn) bar (hy)	5...6 50

Accessories

Mat. no.	Quantity	Recommended accessories
1827008426	1	Device set compressor 230 V incl. accessories



Assemblies

mMS Rack assembly

Material no. 1827008117

In the separating rack, up to 10 stacked workpieces can be stored. The lowest workpiece is in each case pushed out off the stack by a pneumatic cylinder which is activated by a 5/2 directional valve. An end switch checks the fitting status of the rack.

As transfer modules, there are two 8-bit transfer connectors for connection to a PLC.

Dimensions	mm (LxWxH)	300x110x405
Weight	kg	2.6
Supply voltage	V DC	24
Supply pressure	bar	5...6
Digital I/O	I / O	3 / 2



mMS Long conveyor belt assembly

Material no. 1827008118

The conveyor belt functional assembly consists of a 680 mm long and 50 mm wide belt section.

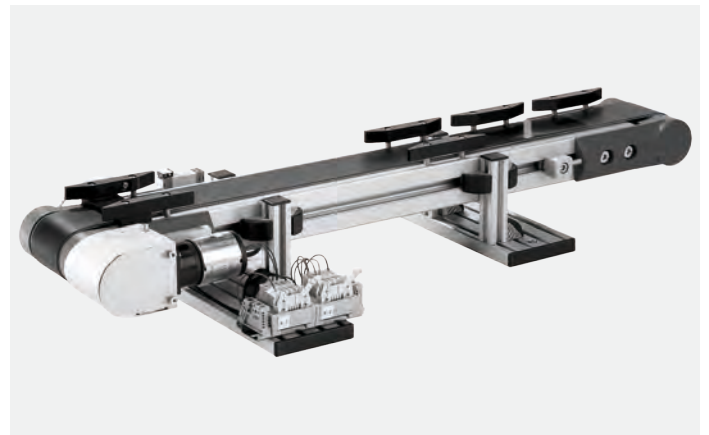
At the end of the conveyor belt section, a sensor (light sensor with fiber optical amplifier) is attached.

By means of a relay control, the conveyor belt can be alternately moved in both running directions.

For operation, a 24 Volt DC gear motor, 2 relays for the direction of rotation and two 8-bit transfer connectors are available.

For connecting the functional assembly, a digital input and two digital outputs should be available at the PLC.

Dimensions	mm (LxWxH)	700x290x125
Weight	kg	6.3
Supply voltage	V DC	24
Digital I/O	I / O	1 / 2



mMS Test unit assembly

Material no. 1827008119

The test unit functional assembly consists of four test stations at which workpieces and their material properties as well as their contour are checked.

One optical, one capacitive and one inductive sensor are used to test the material properties. To check the workpiece contour, a double-acting pneumatic cylinder is used as mechanical button.

Dimensions	mm (LxWxH)	200x295x300
Weight	kg	1.42
Supply voltage	V DC	24
Supply pressure	bar	5...6
Digital I/O	I / O	4 / 2



Assemblies

mMS Hydraulic press assembly

Material no. 1827008121

In the hydraulic press, workpieces can be processed with a force of approx. 1500 N.

After insertion of the workpieces, the workpiece holder transports the workpieces into the pressing chamber. Afterwards, the safety door closes and the pressing cylinder starts to extend.

After the processing, the safety door opens, the workpiece is pushed out off the working space and is available for further transport.

Thanks to the safety door, the working space of the press is closed on all sides during the pressing; however, the protective walls made of Perspex allow for the observation of the pressing process.

To realize two-hand operation, two buttons are available.

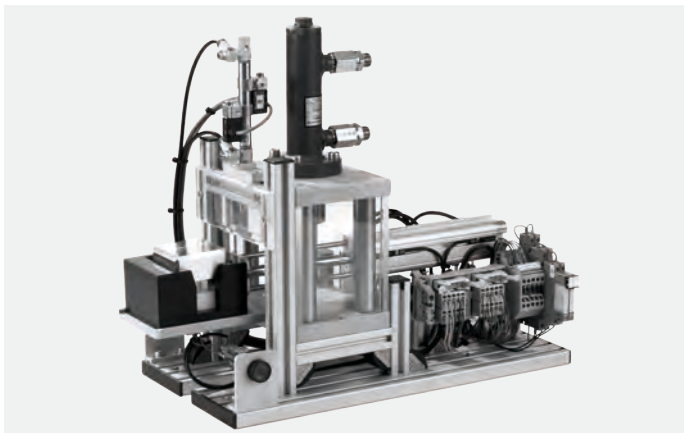
Dimensions	mm (LxWxH)	410x200x320
------------	------------	-------------

Weight	kg	8
--------	----	---

Supply voltage	V DC	24
----------------	------	----

Supply pressure	bar (pn)	5...6
	bar (hy)	50

Digital I/O	I / O	6 / 6
-------------	-------	-------



mMS High rack warehouse assembly

Material no. 1827008124

The high rack warehouse functional assembly consists of the vertical axis, horizontal axis and rack assemblies which are mounted on two assembly platforms together.

The combination of vertical and horizontal axis allows for filling of the rack in two dimensions.

Workpieces are taken over at the transfer position which is marked by a double bore in the position angle of the horizontal axis. From here, the workpiece is then stored in a free shelf.

The slide of the horizontal axis transports the vertical axis. A double-acting pneumatic cylinder with a fork for holding workpieces is attached at the slide of the vertical axis.

Both axes are positioned by means of bores that are in each case identified by a fork light barrier. Micro switches are used to detect the slide end positions.

One of the micro switches serves in each case as hard stop (fixedly wired); the other one supplies a signal to the control.

Seven shelves on four levels each, i.e. a total of 28 shelves are available.

The intended workpieces should have a square base area of 50x50 mm and may be up to 50 mm high.

Dimensions	mm (LxWxH)	395x500x580
------------	------------	-------------

Weight	kg	12
--------	----	----

Supply voltage	V DC	24
----------------	------	----

Supply pressure	bar	5...6
-----------------	-----	-------

Digital I/O	I / O	9 / 5
-------------	-------	-------



Assemblies

mMS Control panel assembly

Material no. 1827008125

The control panel functional assembly provides 10 switches and buttons as well as one EMERGENCY STOP switch for operation of one or several functional assemblies or stations in the form of a panel.

1 x EMERGENCY STOP switch, 1 x illuminated pushbutton green, 1 x illuminated pushbutton red, 1 x illuminated pushbutton blue, 1 x illuminated pushbutton clear, 1 x toggle switch 1-0-2, 5 x toggle switch 0-1

As transfer modules, there are three 8-bit transfer connectors for connection to two digital inputs and one digital output for a control system. The supply voltage of the functional assembly is 24 VDC

Dimensions	mm (LxWxH)	160x170x115
Weight	kg	1.57
Operating voltage	V DC	24
Digital I/O	I / O	13 / 4



mMS AS2 Maintenance unit assembly

Material no. R961003342

The maintenance unit is used to filter contamination of the compressed air in the form of humidity, rust and dirt particles.

In many cases, this contamination leads to faults in the compressed air system as well as to destruction of the pneumatic elements.

With the Maintenance unit functional assembly, the connected mechatronical system is

- supplied with treated compressed air,
- the operating pressure is set and displayed and
- the compressed air supply is released and/or blocked.

1 T plug distributor 6 mm at the input

Angular connector 4 mm at the output

Dimensions	mm (LxWxH)	120x265x225
Weight	kg	1.44
Operating voltage	V DC	24
Operating pressure	bar	1...10
Digital I/O	I / O	1 / 1



mMS Turning unit assembly

Material no. 1827008129

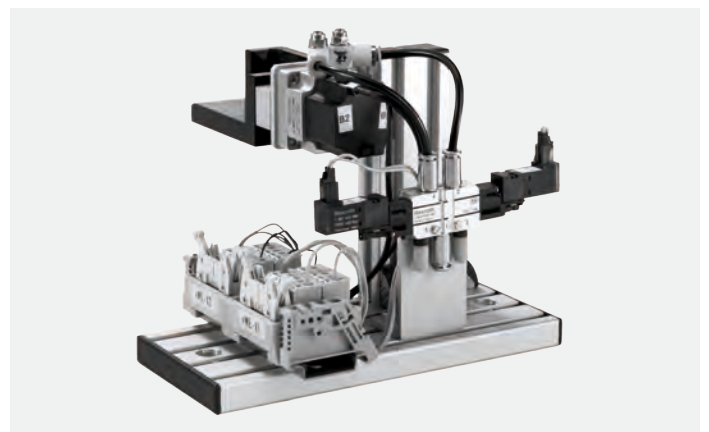
The turning unit functional assembly is used to rotate workpieces by 90°.

For that purpose, the workpiece is put into a holder and rotated by means of a pneumatic rotary vane drive.

Upon insertion of a workpiece into the holder, it is positioned by the insertion chamfer.

The intended workpieces have a size of 50x50x25 mm.

Dimensions	mm (LxWxH)	185x190x150
Weight	kg	0.98
Supply voltage	V DC	24
Supply pressure	bar	5...6
Digital I/O	I / O	2 / 2



Assemblies

mMS Pinning unit assembly

Material no. 1827008134

It is the task of the pin unit functional assembly to press locking pins into workpieces. For that purpose, pins are kept available in two racks.

The pin unit consists of the workpiece holder, pin rack and pin insertion press assemblies.

For pressing in pins, the following sequence is completed: A vertically positioned aluminum workpiece is put into the holder with the opening facing in the direction of the rack. The pneumatic cylinder of the holder presses the workpiece against the front side of the rack. From the opposite side, the pin insertion press approaches which uses the two ejectors to push one half of two locking pins into the receiving holes of the workpiece.

Afterwards, the cylinder of the holder moves back and the pin insertion press is completely extended. While doing so, it pushes the workpiece further back in the holder and the locking pins are released from the rack.

This completes the process and the workpiece provided with the locking pins can be removed from the holder.

Dimensions mm (LxWxH) 520x185x350

Weight kg 6

Supply voltage V DC 24

Supply pressure bar 5..6

Digital I/O I / O 4 / 2



mMS Pneumatic press assembly

Material no. 1827008135

In the pneumatic press, workpieces can be processed with a force of approx. 480 N.

After insertion of the workpieces, the workpiece holder transports the workpieces into the pressing chamber. Afterwards, the safety door closes and the pressing cylinder starts to extend.

After the processing, the safety door opens and the workpiece is pushed out off the working space and is available for further transport.

Thanks to the safety door, the working space of the press is closed on all sides during the pressing; however, the protective walls made of Perspex allow for the observation of the pressing process.

To realize two-hand operation, two buttons are available.

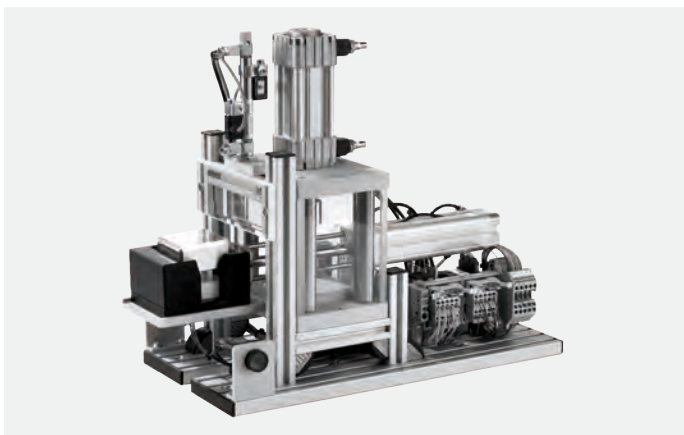
Dimensions mm (LxWxH) 410x200x320

Weight kg 6.8

Supply voltage V DC 24

Supply pressure bar 5..6

Digital I/O I / O 6 / 8



Assemblies

mMS Y-A Handling device assembly

Material no. 1827008187

Using the handling device, so-called "Pick-and-Place" tasks can be realized. Workpieces are picked from one shelf and placed on another shelf.

The present three-axis handling device covers a working range of 200°. Within this working range, any number of positions can be approached.

The "X axis" is driven by a DC gear motor with integrated encoder which can be controlled with the related evaluation electronics and a PLC.

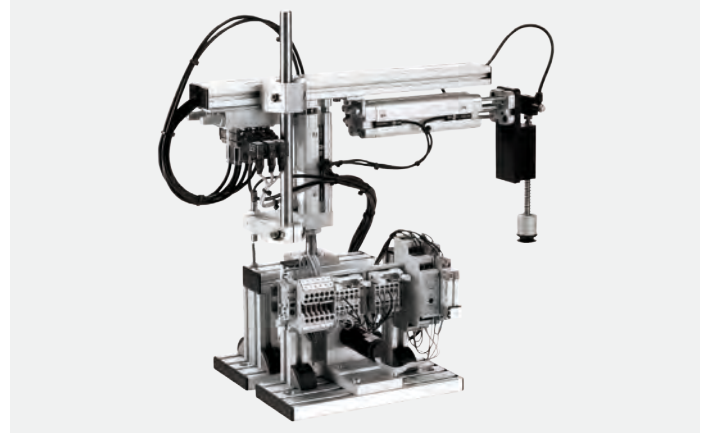
Counterclockwise and/or clockwise rotation of the drive is realized by means of a relay.

A double-acting pneumatic cylinder with anti-rotation feature and a stroke of 60 mm moves the "Y axis" up and down.

The "Z axis" is moved by a double-acting pneumatic cylinder with anti-rotation feature and a stroke of 100 mm.

To take up the workpieces, the handling device is equipped with a vacuum gripper.

Dimensions	mm (LxWxH)	410x230x390
Weight	kg	3.88
Supply voltage	V DC	24
Supply pressure	bar	5...6
Digital I/O	I / O	7 / 5



mMS Portal assembly

Material no. 1827008189

It is the task of the portal functional assembly to remove processed workpieces from the press and to transport them to the next assembly.

The workpieces are taken up by the vacuum gripper. To this end, the vacuum gripper is extended downwards.

After take-up, the vacuum gripper returns into the top position and the slotted cylinder performs the actual workpiece transport in horizontal direction.

At the end of the stroke, the workpiece is put down again by the extending exhauster unit.

Dimensions	mm (LxWxH)	210x444x500
Weight	kg	4.2
Supply voltage	V DC	24
Supply pressure	bar	5...6
Digital I/O	I / O	4 / 3



Assemblies

mMS Short conveyor belt assembly

Material no. 1827008191

The conveyor belt functional assembly consists of a 405 mm long and 50 mm wide belt section.

At the end of the conveyor belt section, a sensor (light sensor with fiber optical amplifier) is attached.

By means of a relay control, the conveyor belt can be alternately moved in both running directions.

For operation, a 24 Volt DC gear motor, 2 relays for the direction of rotation and two 8-bit transfer connectors are available.

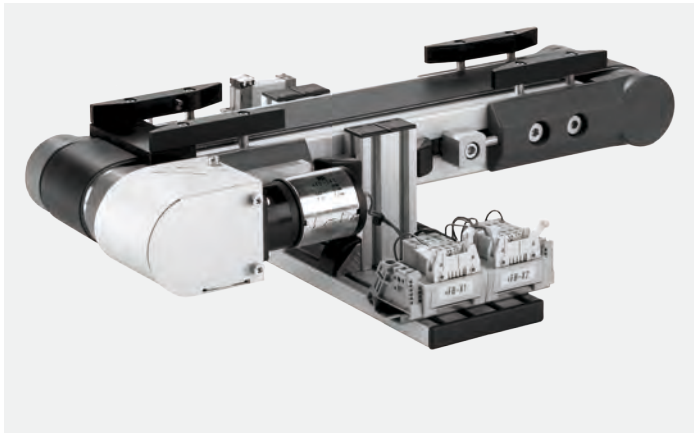
For connecting the functional assembly, one digital input and two digital outputs should be available at the PLC.

Dimensions	mm (LxWxH)	700x290x125
------------	------------	-------------

Weight	kg	4.7
--------	----	-----

Supply voltage	V DC	24
----------------	------	----

Digital I/O	I / O	1 / 2
-------------	-------	-------



Cable set mMS 3M CPL.

Material no. R961003113

Cable for connecting a functional assembly to a PLC. With 10-pole connector on one side; the other side with 10 lines and wire end ferrules. 2 units are required per functional assembly.

Length	mm (L)	3000
--------	--------	------

Weight	kg	0.2
--------	----	-----

Line cross-section	mm ²	0.75
--------------------	-----------------	------



Assemblies

CMS handling training system

Material no. R961003955

The 3-axis CMS handling system is used to handle and transport cubes (50x50x50 mm).

The cubes are individually transported by a gripper arm from a high rack warehouse with a max. of 28 cubes into a workpiece carrier with 4 storage positions.

The CMS handling system can be operated as training system alone or in combination with the mMS and the TS1 transfer system.

The CMS handling system is provided with a protective housing made of aluminum profiles and Perspex as contact protection. There are two safety doors allowing for the insertion and/or removal of the workpiece carrier and the high rack warehouse.

Two integrated safety switches per axis limit the travel distance in the end positions. 1 servo motor and 1 "Rexroth EcoDrive Cs" drive per axis each. Operation and programming via a "Rexroth IndraControl VCP 08" operating terminal.

Dimensions	m (LxWxH)	1.3x1.6x1.9
Workplaces	opt./max.	1/3
Length	m (LxW)	3.3x3.2
Weight	kg	220
Operating pressure	bar	5...6

Accessories

Mat. no.	Quantity	Recommended accessories
1827008426	1	Device set compressor 230 V incl. accessories



TS1 transfer training system

Material no. R961003956

The TS1 transfer system is used to transport 4 cubes (50x50x50 mm) on a workpiece carrier.

The transport route between supply side and removal position is 1900 mm.

Moveable frame made of aluminum profiles, with 8 lockable rollers.

1 belt section with gear motor and 2 toothed belts running in parallel, frequency converter, pneumatic positioning units at both ends, inductive sensors and ultrasonic sensors, 2 light barriers and 1 light grid.

Electr. supply with signal processing and programmable logic control with software.

Dimensions	mm (LxWxH)	2400x550x1155
Workplaces	opt./max.	1/3
Length	m (LxW)	4x2.2
Weight	kg	110
Operating pressure	bar	5...6



Assemblies

ATS

Material no. without

Automation Training System (ATS) for the simulation of complete workflows.

In the simulated high rack warehouse, up to 28 cubes can be transported to four storage positions. The heart of the transport system is a gripper arm moveable in three axes for handling and transporting the cubes.

The ATS training system is a combination of mMS, CMS and TS1.

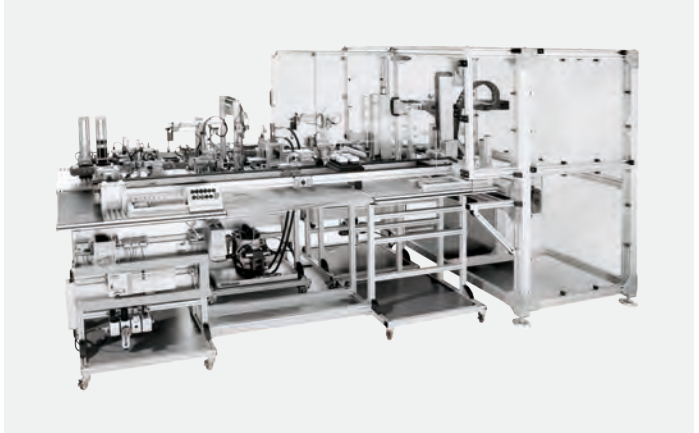


Table of contents Sensor technology

Learning topics	33
Components	45

Learning topics / sensor technology basics

Exercise manual Sensor technology basics

The extensive exercise manual Sensor technology basics with 56 exercises is divided into the areas introductory practices, basic practices and additional practices.

The **introductory practice** group is used to show the learner the typical behavior of sensors. It is to be determined which sensor can detect which materials and which not.

In the **basic practice** group, the characteristic values of the individual sensors, which are most important for use in practice such as switching distance, scanning range, response curve and switching frequency are determined.

The **additional practice** group gives the learner insight into the areas in which the sensors are used. It is for example shown how material selection of filling level measurements can be realized. In addition, special interference factors for individual sensors are to be examined.

To perform all tests, you need the basic kit and the extension kit.

The solution manual contains the sample solution and other detailed information on the relevant practices.

	Language	Mat. no.	Manual title	Document no.
Übungshandbuch Sensorik Grundlagen	DE	R961004454	Trainingssystem Sensorik Grundlagen - Übungshandbuch	RD 09966
Practice Manual Sensorics	EN	R961004463	Sensorics training system - Practice Manual	RE 09966
	Language	Mat. no.	Manual title	Document no.
Lösungshandbuch Sensorik Grundlagen	DE	R961004455	Trainingssystem Sensorik Grundlagen - Lösungshandbuch	RD 09967
Solution Manual Sensorics	EN	R961004462	Sensorics training system - Solution Manual	RE 09967

Learning topics

Sensor technology basic kit with suitcase



Material no. R961003446

This training system allows you to impart functional principles and possible applications of inductive, capacitive, optoelectronic, magnetic field and ultrasonic sensors.














Apart from the portable device carrier, the training system comprises sensors, a guide unit with ultrasonic measuring device, a motor unit with controller and a counter-frequency module.

The components have a quick fastening system.



Item	Component	Mat. no.	Quantity	Figure	Page
1	Height compensation for sensors	1827003640	1		57
2	Measuring line 500 mm red	1827003215	9		55
3	Measuring line 500 mm blue	1827003216	10		55
4	Measuring line 500 mm black	1827003217	9		55

Learning topics

Item	Component	Mat. no.	Quantity	Figure	Page
5	Guide unit, 450 mm with ultrasonic measuring device	1827003641	1		57
6	Motor unit with controller	1827003642	1		50
7	Counter-frequency module	1827003655	1		51
8	Distributor box 24 V	1827003587	1		56
9	Inductive sensor, Sn = 8 mm	1827003645	1		45
10	Inductive sensor, Sn = 2 mm	1827003647	1		45
11	Capacitive sensor, Sn = 8 mm	1827003648	1		47
12	Magnetic field sensor; Sn = 60 mm	1827003649	1		49
13	Reflection light sensor, Sn = 200 mm	1827003654	1		50
14	Optical waveguide, scanning operation	1827003656	1		52
15	Optical waveguide, one-way operation	1827003657	1		52
16	Display box 24 V/opt./acoustic	1827003586	1		
17	CS2 - grooved plate case, empty	1827003552	1		

Learning topics

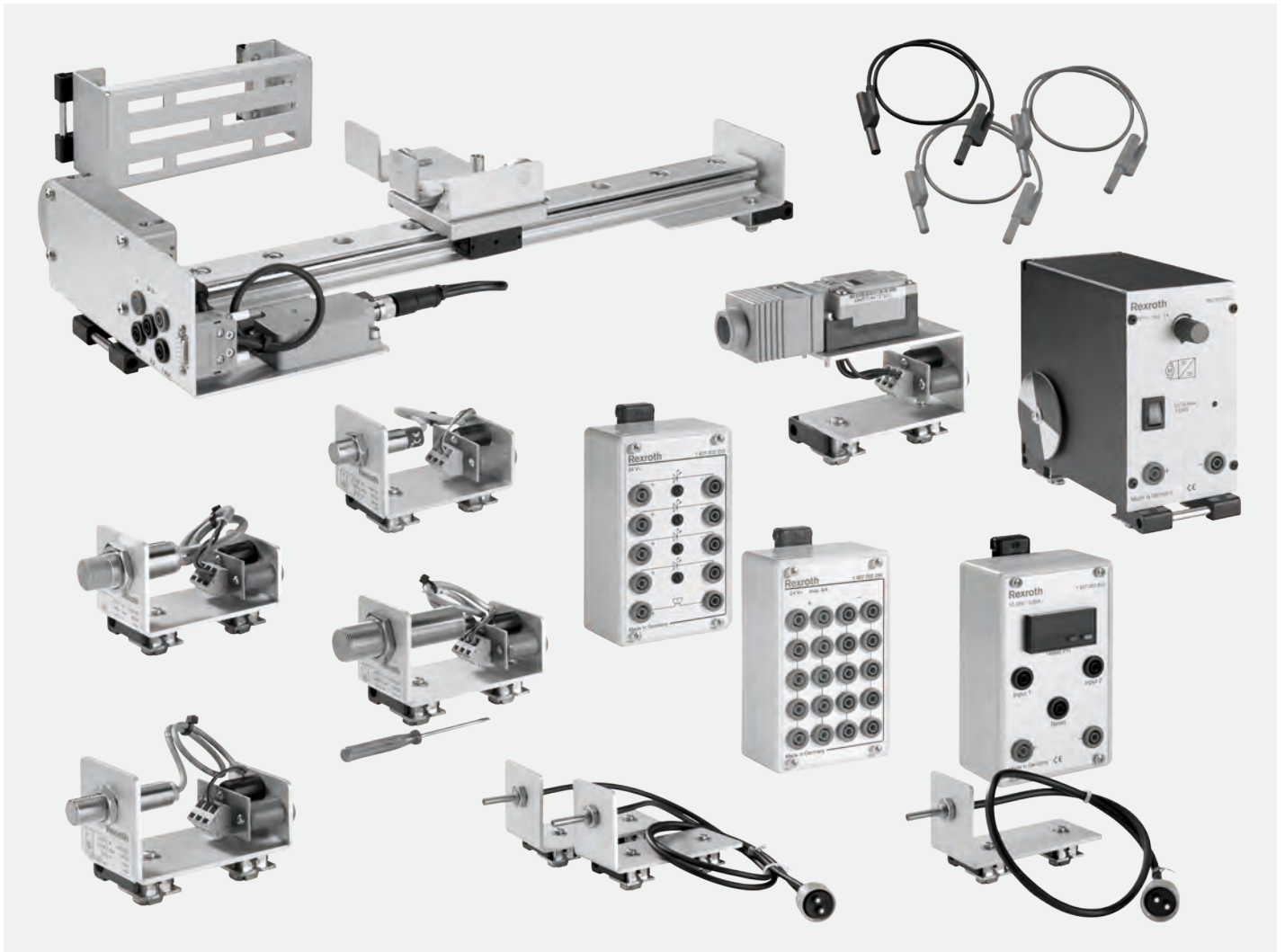
Sensor technology basic kit

Material no. 1827003575










This training system allows you to impart functional principles and possible applications of inductive, capacitive, optoelectronic, magnetic field and ultrasonic sensors.

Accessories




Mat. no.	Quantity	Recommended accessories
	1	Power supply unit 24 V
	1	Oscilloscope
R913020275	1	Multimeter VC 170
1827003524	1	Material sample case
1827003587	1	Indicator unit optical, acoustic



Learning topics

Item	Component	Mat. no.	Quantity	Figure	Page
1	Height compensation for sensors	1827003640	1		57
2	Measuring line 500 mm, red	1827003215	9		55
3	Measuring line 500 mm, blue	1827003216	10		55
4	Measuring line 500 mm, black	1827003217	9		55
5	Guide unit, 450 mm with ultrasonic measuring device	1827003641	1		57
6	Motor unit with controller	1827003642	1		50
7	Counter-frequency module	1827003655	1		51
8	Distributor box 24 V	1827003587	1		56
9	Inductive sensor, Sn = 8 mm	1827003645	1		45
10	Inductive sensor, Sn = 2 mm	1827003647	1		45
11	Capacitive sensor, Sn = 8 mm	1827003648	1		47
12	Magnetic field sensor, Sn = 60 mm	1827003649	1		49
13	Reflection light sensor, Sn = 200 mm	1827003654	1		50






Learning topics

Item	Component	Mat. no.	Quantity	Figure	Page
14	Optical waveguide, scanning operation	1827003656	1		52
15	Optical waveguide, one-way operation	1827003657	1		52
16	Display box 24 V, optical / acoustic	1827003586	1		

Learning topics

TS sensor technology extension		
Material no.	1827003576	
The extension kit is suitable for imparting more detailed and advanced knowledge of the sensor technology on the basis of real industrial products.		
Inductive analog sensor detects Fe metals and other metals,		
ultrasonic sensor detects non-metal materials,		
reflection sensor detects plastics white, black, clear.		
For practices EV6, EV7, V19...V26, ZV4, ZV12...ZV19.		
Accessories		
Mat. no.	Quantity	Recommended accessories
	1	Power supply unit 24 V



Item	Component	Mat. no.	Quantity	Figure	Page
1	Height compensation for sensors	1827003640	1		57
2	Inductive analog encoder, linear measuring range (3 - 8 mm)	1827003635	1		51
3	Evaluation unit digital material differentiation	1827003669	1		53
4	Ultrasonic sensor, Sn = (60 - 500) mm	1827003637	1		48
5	Reflection light barrier, Sn = 3000 mm	1827003638	1		49

Learning topics

TS sensor technology automation technology

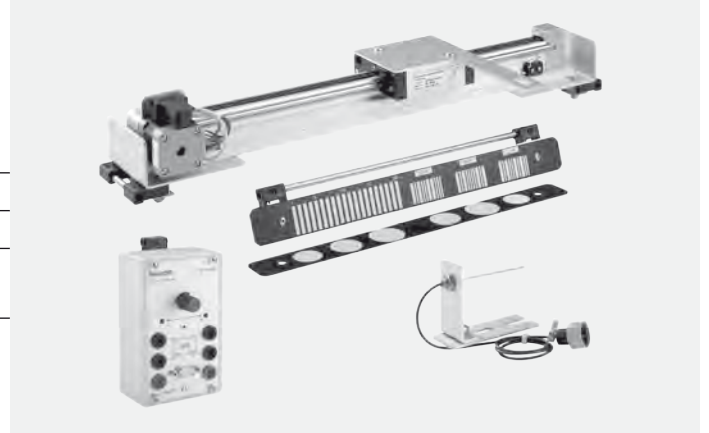
Material no. 1827003525





Extension kit for the sensor technology basic kit for the performance of the exercises on automation technology.

Center of gravity, optical scanning of a strip with bar code

Accessories

Mat. no.	Quantity	Recommended accessories
R961003551	1	PLC-PLC L20 16DI/DO PLC training system (stand-alone)



Item	Component	Mat. no.	Quantity	Figure	Page
1	Stepping motor with geared belt drive	R961002165	1		56
2	Control electronics for stepping motor	1827003664	1		57
3	Optical waveguide (scanning operation) with holding angle	1827003661	1		52
4	Strip with scanning sample	1827003662	1		54









Learning topics

TS sensor technology AS interface



Material no. 1827003632

The device kit is suitable for imparting basic knowledge of the AS interface bus technology on the basis of real industrial products



Item	Component	Mat. no.	Quantity	Figure	Page
1	AS Interface Control Master RS232	1827003672	1		58
2	Power extender, VAN-G4-PE	1827003066	1		53
3	Proximity switch NCN8-18GM60-B3B-V1 BG	R901168910	2		46
4	2 IO module VAA-2EA-G2-ZA/EA2	1827003644	1		53
5	Inductive sensor, two-wire	1827003532	2		44
6	Measuring line 500 mm, yellow	1827003523	2		55
7	Measuring line 500 mm, black	1827003217	2		55
8	AS-I flat cable 1000 mm, yellow	1827003068	1		55

Learning topics

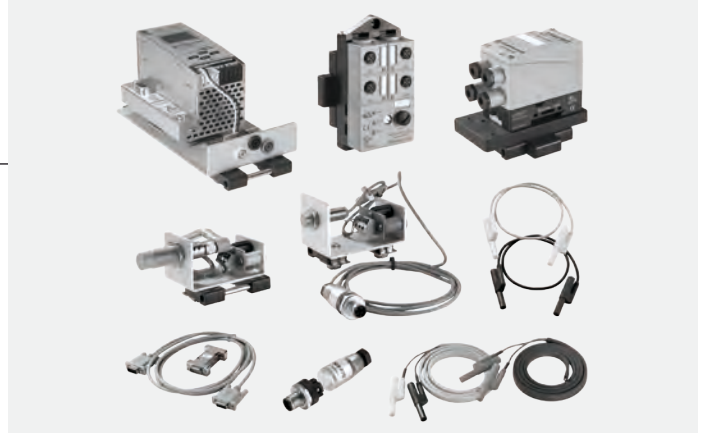
Item	Component	Mat. no.	Quantity	Figure	Page
9	AS-I flat cable 1000 mm, black	1827003069	1		55
10	Connector for 2 IO module, V1-G connector	1827003070	2		54










Learning topics

TS sensor technology AS interface with Profibus DP gateway



Material no. 1827003673

The device kit is suitable for imparting basic knowledge of the AS interface bus technology and the Profibus technology on the basis of real industrial products



Item	Component	Mat. no.	Quantity	Figure	Page
1	Control Master AS-I with Profibus DP interface, VAG PB-KFR4	1827003674	1		58
2	Profibus DP simulator, VAZ-PB-SIM	1827003675	1		54
3	Power extender, VAN-G4-PE	1827003066	1		53
4	Proximity switch NCN8-18GM60-B3B-V1 BG	R901168910	2		46
5	2 IO module VAA-2EA-G2-ZA/EA2	1827003644	1		53
6	Inductive sensor, two-wire	1827003532	2		44
7	Measuring line 500 mm, yellow	1827003523	2		55
8	Measuring line 500 mm, black	1827003217	2		55
9	AS-I flat cable 1000 mm, yellow	1827003068	1		55

Learning topics

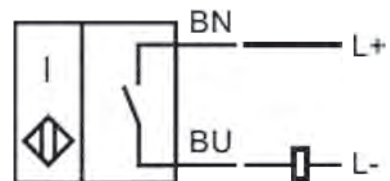
Item	Component	Mat. no.	Quantity	Figure	Page
10	AS-I flat cable 1000 mm, black	1827003069	1		55
11	Connector for 2 IO module, V1-G connector	1827003070	4		54

Components

Material sample case		
Material no.	1827003524	
Plastic case filled with different material samples and accessories for the performance of practices.		
Suitcase contents:		
<ul style="list-style-type: none"> - Metal and plastic samples in different thicknesses - Metal samples in different widths - Aluminum samples with groove or different bores - Plastic samples in different shades - Solenoid samples in different sizes - Samples with reflective foil, retro foil, foam or cardboard - Coil on printed circuit board - Retroreflector with quick fastening system - Height adapter for material samples made of plastic - Distance plates made of aluminum - Screwdriver 		
Dimensions	mm (LxWxH)	420x330x110
Weight	kg	2.91



Inductive sensor, two-wire		
Material no.	1827003532	
Sensor inductive proximity switch NBB2-12GM40-Z0 with DC NO contact function, switching distance 2 mm, flush mounting, voltage supply 5...60 V (DC), bracket for sensor made of anodized aluminum sheet, contact protected 4 mm safety sockets.		
Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.		
Dimensions	mm (LxWxH)	130x55x65
Weight	g	140
Protection class	IEC60529	IP20
Supply voltage	V DC	5...60
Operating current	mA	2...100
Switching frequency	Hz	0...1000
Switching distance	mm	2
Installation type	Flush	



Components

Inductive sensor, Sn = 8 mm

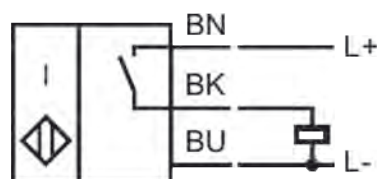
Material no. 1827003645

Inductive sensor NBN8-18GM50-E2 for scanning metal objects with switching status display, switching element function PNP NO contact, switching distance 8 mm, measuring distance mechanically adjustable, flush mounting not possible.

Bracket for sensor made of anodized aluminum sheet, voltage type DC, contact protected 4 mm safety sockets.

Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	120x55x65
Weight	g	170
Protection class	IEC60529	IP20
Supply voltage	V DC	24
Operating current	mA	0...200
Switching frequency	Hz	0...500
Switching distance	mm	8
Installation type		Not flush



Inductive sensor, Sn = 2 mm

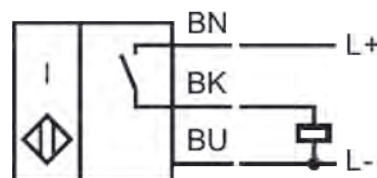
Material no. 1827003647

Inductive sensor NBB2-12GM50-E2 for scanning metal objects, with switching status display, switching element function PNP NO contact, measuring distance mechanically adjustable, flush mounting.

Bracket for sensor made of anodized aluminum sheet, voltage supply 10...30V (DC) contact protected 4 mm safety sockets.

Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	130x55x65
Weight	g	140
Protection class	IEC60529	IP20
Supply voltage	V DC	24
Operating current	mA	0...200
Switching frequency	Hz	0...1500
Switching distance	mm	2
Installation type		Flush



Components

Proximity switch NCN8-18GM60-B3B-V1 BG

Material no. R901168910

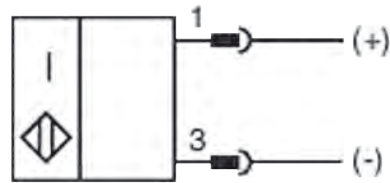
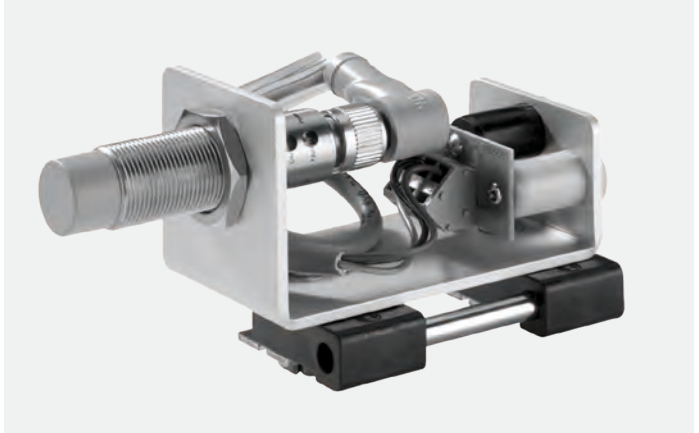
Inductive sensor NCN8-18GM60-B3B-V1 for scanning metal objects with switching status display, suitable for AS interface, programmable switching element function NC/NO contact, measuring distance mechanically adjustable, flush mounting not possible.

Switching distance 8 mm, voltage type DC via AS-I bus system, bracket for sensor made of anodized aluminum sheet.

3 contact protected 4 mm safety sockets,

Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	120x55x65
Weight	g	187
Protection class	IEC60529	IP20
Supply voltage	V DC	26.5...31.9
Switching frequency	Hz	0...100
Switching distance	mm	8
Installation type		Not flush



Inductive sensor; 0.2 A; Sn = 2 mm

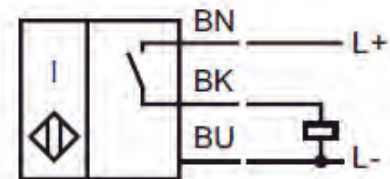
Material no. 1827003422

Sensor inductive proximity switch NJ2-12GM40-E2 with PNP NO contact function, switching distance 2 mm, measuring distance mechanically adjustable.

Flush mounting, voltage supply 10...60 V (DC), switching status display, LED yellow, bracket for sensor made of anodized aluminum sheet, contact protected 4 mm safety sockets.

Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	70x92x84
Weight	g	318
Protection class	IEC60529	IP20
Supply voltage	V DC	24
Operating current	mA	0...200
Switching frequency	Hz	0...3000
Switching distance	mm	2
Installation type		Flush



Components

Capacitive sensor; 0.2 A; Sn = 1-4 mm

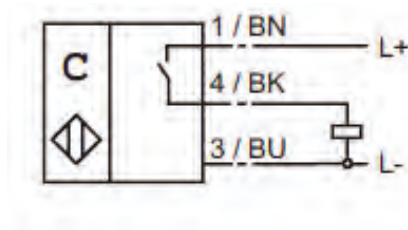
Material no. 1827003423

Capacitive proximity switch CBB4-12GH70-E2, with PNP NO contact function, switching distance 4 mm, adjustable via potentiometer.

Flush mounting, operating voltage 10...36 V (DC), bracket for sensor made of anodized aluminum sheet, contact protected 4 mm safety sockets.

Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	70x95x84
Weight	g	185
Protection class	IEC60529	IP20
Supply voltage	V DC	24
Operating current	mA	0...100
Switching frequency	Hz	0...50
Switching distance	mm	4
Installation type		Flush



Capacitive sensor, Sn = 8 mm

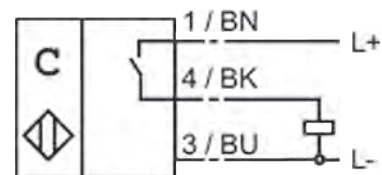
Material no. 1827003648

Capacitive proximity switch CJ8-18GM-E2 for the contactless scanning of objects with switching status display, switching element function PNP NO contact, measuring distance mechanically adjustable, flush mounting, switching distance 8 mm.

Bracket for sensor made of anodized aluminum sheet, contact protected 4 mm safety sockets.

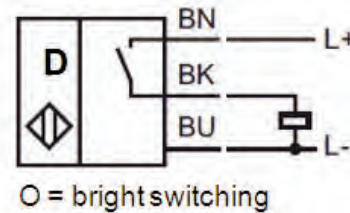
Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	150x55x65
Weight	g	175
Protection class	IEC60529	IP20
Supply voltage	V DC	10...30
Operating current	mA	0...300
Switching frequency	Hz	0...100
Switching distance	mm	8
Installation type		Flush

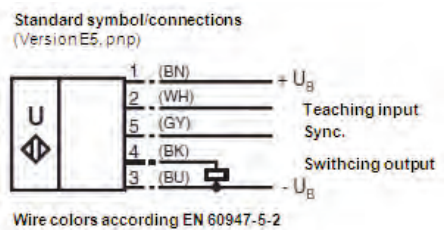


Components

Optical sensor; 0.2 A; Sn = 1-200 mm		
Material no.	1827003424	
Optical sensor reflection light scanner OF5010, operating display LED green, functional display LED yellow, current carrying capacity 200 mA, switching frequency 400 Hz.		
Switching element function PNP NO contact, bright-/dark-switching electronically switchable.		
Bracket for sensor made of anodized aluminum sheet, 3 contact protected 4 mm safety sockets for voltage supply 10...36 V (DC) and switching signal.		
Quick fastening system can be mounted with one hand for grooved plate or grooved plate case		
Dimensions	mm (LxWxH)	70x98x84
Weight	g	184
Protection class	IEC60529	IP20
Supply voltage	V DC	24
Switching frequency	Hz	400
Scanning width	mm	200



Ultrasonic sensor, Sn = (60 - 500) mm		
Material no.	1827003637	
Ultrasonic sensor UB500-30GM-E5-V15, operating display LEDs, switching output PNP NO/NC contact parameterizable, detection area adjustable, measuring distance mechanically adjustable, flush mounting possible.		
5 different output functions adjustable via learning input, operating voltage: 10... 30 V (DC), detection area: 60 ... 500 mm.		
Bracket for sensor made of anodized aluminum sheet, 3 contact protected 4 mm safety sockets for voltage supply 10...30 V (DC) and switching signal.		
Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.		
Dimensions	mm (LxWxH)	210x55x65
Weight	g	400
Protection class	IEC60529	IP20
Supply voltage	V DC	10...30
Operating current	mA	200
Detection area	mm	60...500



Components

Sensor magnetic field; Sn = 60 mm

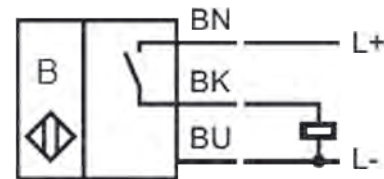
Material no. 1827003649

Sensor MB60-12GM50-E2 for scanning magnetic fields, scanning with Hall probes, switching status display by means of LED, switching element function PNP NO contact, measuring distance mechanically adjustable, flush mounting possible.

Bracket for the sensor made of aluminum sheet, scanning distance 60 mm, contact protected 4 mm laboratory sockets for voltage supply 24 V (DC) and switching signal.

Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	110x55x65
Weight	g	145
Protection class	IEC60529	IP20
Supply voltage	V DC	10...30
Operating current	mA	0...300
Switching frequency	Hz	0...5000
Switching distance	mm	60
Installation type		Flush



Reflection light barrier, Sn = 3000 mm

Material no. 1827003638

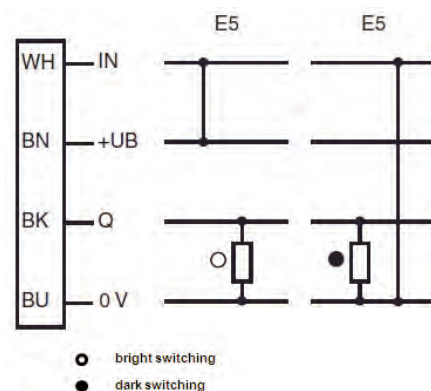
Sensor reflection light barrier OBS4000-18GM60-E5, detection area 0-4000 mm, operating/functional display via dual color LED, response time ≤ 1 ms, switching current max 100 mA.

Switching element function PNP NO contact, bright-/dark-switching electronically switchable, sensitivity adjustable.

Bracket made of anodized aluminum sheet, 3 contact protected 4 mm safety sockets for voltage supply 10...30 V (DC) and switching signal.

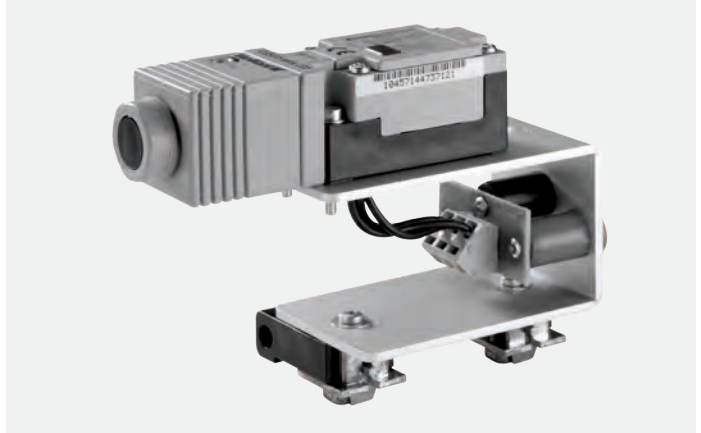
Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	140x55x65
Weight	g	180
Protection class	IEC60529	IP20
Supply voltage	V DC	10...30
Switching frequency	Hz	≤ 500
Detection area	mm	4000

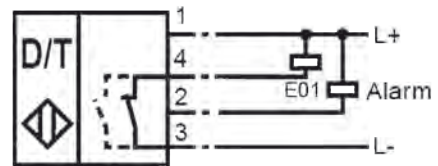


Components

Reflection light sensor, Sn = 200 mm		
Material no.	1827003654	
Sensor OJ500-M1K-E01 for scanning bright or dark objects, with operating display, switching element function NPN NO function, with selector switch for bright- or dark-switching, pre-failure display, pulse extension and switching frequency change adjustable via selector switch in the clamping space, detection area 0-500 mm, glass fiber light conductor connectable.		
Bracket for the sensor made of aluminum sheet, contact protected 4 mm laboratory sockets for voltage supply 24 V (DC) and switching signal.		
Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.		
Dimensions	mm (LxWxH)	120x55x100
Weight	g	236
Protection class	IEC60529	IP20
Supply voltage	V DC	10...30
Switching frequency	Hz	200 / 1500 switchable
Detection area	mm	0...500



E01:



Motor unit with controller		
Material no.	1827003642	
Motor unit with controllable DC motor, max. speed 9800 rpm, voltage supply via 4 mm laboratory sockets.		
Command value specification connectable 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 fastening system can be mounted with one hand for grooved plate or grooved plate case.		
Dimensions	mm (LxWxH)	160x88x160
Weight	kg	1.68
Supply voltage	V DC	24



Components

Inductive analog encoder, linear measuring range (3-8 mm)

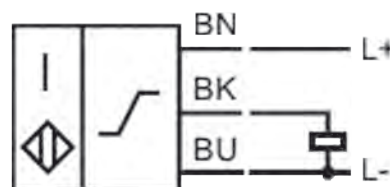
Material no. 1827003635

Inductive analog sensor IA8-30GM-I3, measurement range 3...8 mm, switching element function analog current output, measuring distance mechanically adjustable, flush mounting.

Operating voltage 10...32 V (DC), bracket for sensor made of anodized aluminum sheet, contact protected 4 mm safety sockets, quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Analog output 0...20 mA

Dimensions	mm (LxWxH)	190x55x65
Weight	g	285
Protection class	IEC60529	IP20
Supply voltage	V DC	10...30
Installation type		Flush
Detection area	mm	3...8



Counter-frequency module

Material no. 1827003655

Indicator unit CODIX 524 for presenting the integrated functions, selectable functions are pulse counter, frequency counter or timer. The assembly has two signal inputs and one reset input.

Plastic housing with aluminum front plate in 19" installation technology, 6-digit LED display, contact protected 4 mm laboratory sockets for the voltage supply and signal inputs.

Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	150x85x80
Weight	g	345
Protection class	IEC60529	IP50
Supply voltage	V DC	24



Components

Optical waveguide, scanning operation		
Material no.	1827003656	
Light conductor LCR 18-3,2-0,5-K2 for scanning light-reflecting objects, transmission of the light pulses of the reflection light sensor.		
Bracket made of aluminum sheet with M8 threaded connection for optical waveguide.		
Dimensions	mm (LxWxH)	115x55x65
Weight	g	130
Protection class	IEC60529	IP65
Light conductor	mm	500



Optical waveguide, one-way operation		
Material no.	1827003657	
Light conductor LCE 18-2,3-0,5-K2 for scanning objects moving through a light barrier, transmission of the light pulses of the reflection light sensor.		
Two brackets made of aluminum sheet with M8 threaded connection for the fastening of the optical waveguides, adapter for connection to reflection light sensor, light conductor length 500 mm.		
Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.		
Dimensions	mm (LxWxH)	150x110x80
Weight	g	240
Protection class	IEC60529	IP65
Light conductor	mm	500



Optical waveguide (scanning operation) with holding angle		
Material no.	1827003661	
Optical waveguide LCR18-1,1-0,5-K13 for scanning objects and scanning samples, transmission of the light pulses of the reflection light sensor.		
Height-adjustable holding angle made of aluminum sheet and aluminum angle for fastening on guide unit with ultrasonic sensor, M8 threaded connection for fastening the optical waveguide, adapter for connection to reflection light sensor.		
Dimensions	mm (LxWxH)	120x30x70
Weight	g	60
Protection class	IEC60529	IP65
Light conductor	mm	500



Components

Evaluation unit digital material differentiation

Material no. 1827003669

Module for material detection (digital) for plastic clear, plastic black, plastic white, solenoids, metals, non-metals and FE metal. Display of the detected material via LED red, sensor switching conditions are displayed via LED green.

Ultrasonic sensor performs the function of the end switch. Resetting of the switching conditions by means of the reset button required after each cycle.

Plastic housing with aluminum front plate in 19" installation technology, sensor signals and voltage supply via contact protected safety sockets (4 mm).

Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Dimensions mm (LxWxH) 150x85x80

Weight g 375

Protection class IEC60529 IP50

Supply voltage V DC 24



Power extender, VAN-G4-PE

Material no. 1827003066

AS interface VAN-G4-PE for power supply with module bottom part U-G1FF for connection of two AS-I flat cables, LED display of the AS interface voltage.

During the assembly of upper and bottom part, the flat cables for the AS interfaces and the external auxiliary voltage are pushed onto penetrating swords and thus contacted.

Quick fastening system can be mounted with one hand for grooved plate and grooved plate case.

Dimensions mm (LxWxH) 110x70x110

Weight g 365

Protection class IEC60529 IP67

Supply voltage V DC 30

Operating current A 2.8



2 IO module VAA-2EA-G2-ZA/EA2

Material no. 1827003644

AS interface module VAA-2EA-G2-ZA/EA2 for connection of 2 sensors and 2 actuators which are not AS-I-compatible to the AS interface, with LED display.

Fastening of the module on aluminum plate, flat cable connection with penetration technology.

Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Dimensions mm (LxWxH) 130x75x65

Weight g 350

Protection class IEC60529 IP67

Supply voltage V DC 21...31

Operating current mA Max. 190



Components

Strip with scanning sample

Material no. 1827003662

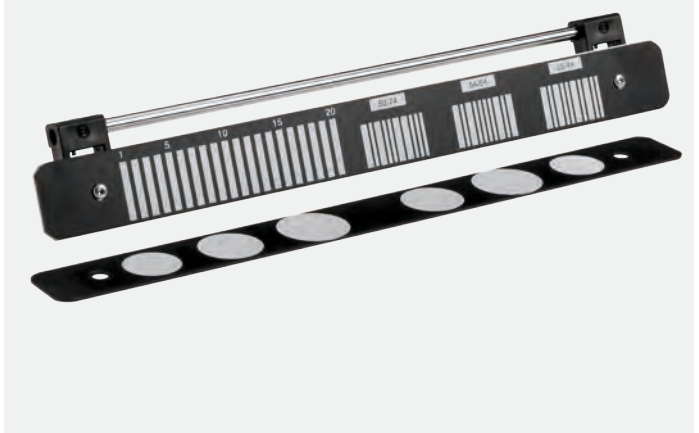
Strip with bar code sample that can be scanned in combination with guide unit, stepping motor with geared belt drive and the optical waveguide with holding angle.

Strip made of aluminum sheet with quick mounting system for grooved plate or grooved plate case.

Bar code consisting of different bright stripes and/or circular areas of different size.

Dimensions mm (LxWxH) 310x55x30

Weight g 150



Profibus DP simulator, VAZ-PB-SIM

Material no. 1827003675

The Profibus master simulator VAZ-PB-SIM is a simple, universal tool for the data exchange with Profibus slaves.

Connection with Profibus slaves also possible without GSD file.

Consists of interface converter, RS 232 cable and software.

No external voltage supply necessary.

For the transmission, the Profibus protocol DP V0 is used, transmission rate 19200 bit/s.

Weight g 200



Connector for 2 IO module, V1-G connector

Material no. 1827003070

V1S-G cable connector, which can be assembled, for connection to the 2IO module.

Straight connector, 4-pole with gold-plated contacts, PG7 fitting, screw terminal for max. 0.75 mm².

Dimensions mm (LxWxH) 60x20x20

Weight g 20



Components

AS-I flat cable 1000 mm, yellow

Material no. 1827003068

AS interface flat cable VAZ-FK-S-YE, wire cross-section 1.5 mm, for connection with penetration technology, energy bus line, inverse-polarity protection due to cable geometry.

Copper cable tin-plated, finely stranded with insulation made of rubber mixture.

Length	mm	1000
Weight	g	90
Color		Yellow
Line cross-section	mm ²	1.5



AS-I flat cable 1000 mm, black

Material no. 1827003069

AS interface flat cable VAZ-FK-S-BK, wire cross-section 1.5 mm, for connection with penetration technology, energy bus line, inverse-polarity protection due to cable geometry.

Copper cable, finely stranded with insulation made of rubber mixture.

Length	mm	1000
Weight	g	90
Color		Black
Line cross-section	mm ²	1.5



Measuring line 500 mm, yellow

Material no. 1827003523

Flexible laboratory cable with 4 mm laboratory connector, socket and pin part with contact protection, length 500 mm, stackable, for establishing safe electrical plug-in connections for exercise installations.

Length	mm	500
Weight	g	30
Color		Yellow
Protection class	IEC 60529	IP20
Connection cross-section	mm ²	1

Measuring line 500 mm, red

Material no. 1827003215

Color Red

Measuring line 500 mm, blue

Material no. 1827003216

Color Blue

Measuring line 500 mm, black

Material no. 1827003217

Color Black



Components

Stepping motor with geared belt drive

Material no. R961002165

Stepping motor that in connection with the control electronics drives the carriage of the guide unit via toothed belts.

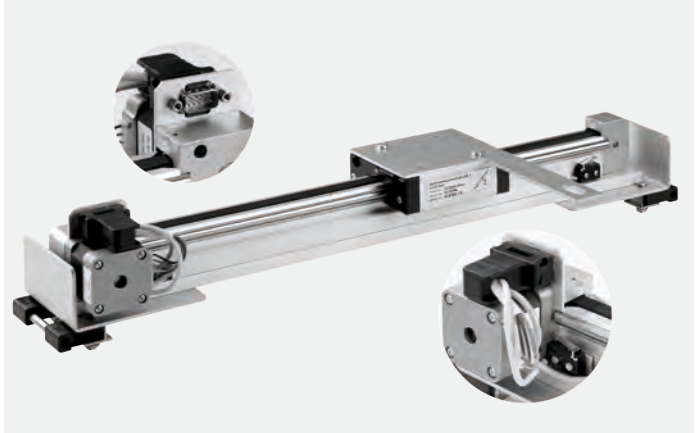
Brackets made of aluminum sheet, aluminum bar with attached linear guide rail, stepping motor, toothed belt, deflection rollers, end switch on both sides and 9-pole Sub-D connector for motor control.

Carrier plate connected to driving sheet.

Quick mounting system for grooved plate or grooved plate case.

Dimensions mm (LxWxH) 620x210x100

Weight kg 2.8



Distributor box 24 V

Material no. 1827003587

Distributor box for 24 V and 0 V, 10 sockets (red for 24 V) are electrically connected, 10 sockets (blue for 0 V) likewise.

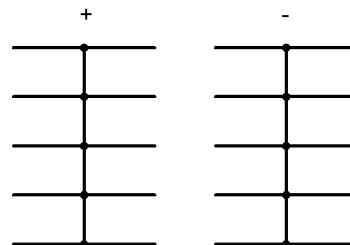
Plastic housing with aluminum front plate, with 10 red and 10 blue contact protected 4 mm measuring sockets, designed as slide-in unit on printed circuit board, with mounting system for grooved plate or for electrical attachment.

Dimensions mm (LxWxH) 150x85x71

Weight g 369

Protection class IEC 60529 IP 50

Operating voltage V DC 24



Components

Control electronics for stepping motor

Material no. 1827003664

Stepping motor control, velocity signal is continuously adjustable, activation clockwise, counterclockwise rotation optionally with button or via laboratory sockets.

Plastic housing with aluminum front plate in 19" installation technology, contact protected 4 mm laboratory sockets.

Quick fastening system can be mounted with one hand for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	150x85x80
------------	------------	-----------

Weight	g	430
--------	---	-----

Protection class	IEC60529	IP50
------------------	----------	------

Supply voltage	V DC	24
----------------	------	----



Guide unit, 450 mm with ultrasonic measuring device

Material no. 1827003641

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 changeable angle.

The guide unit consists of ultrasonic sensor UC300-F43-2KIR2-V17 with RS 232 interface for analysis at the PC, and 2 switching outputs and one analog output 4...20 mA.

Brackets made of aluminum sheet with contact protected 4 mm laboratory sockets for the voltage supply 24 V (DC), analog output and 2 switching outputs.

Quick mounting system for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	520x270x110
------------	------------	-------------

Weight	kg	2.67
--------	----	------

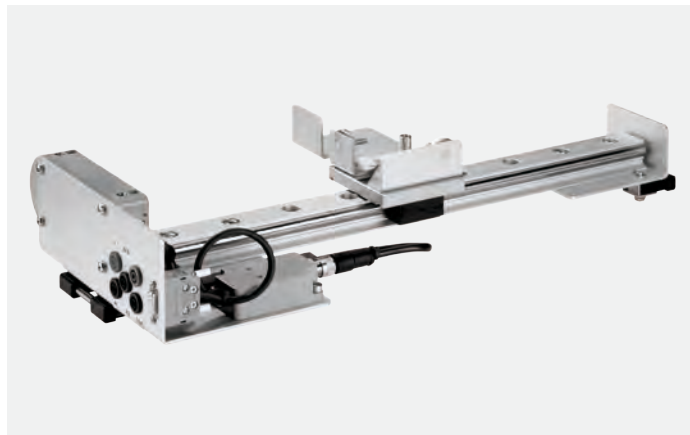
Protection class	IEC60529	IP65
------------------	----------	------

Supply voltage	V DC	24
----------------	------	----

Detection area	mm	0...300
----------------	----	---------

Accessories

Software Ultra 3000



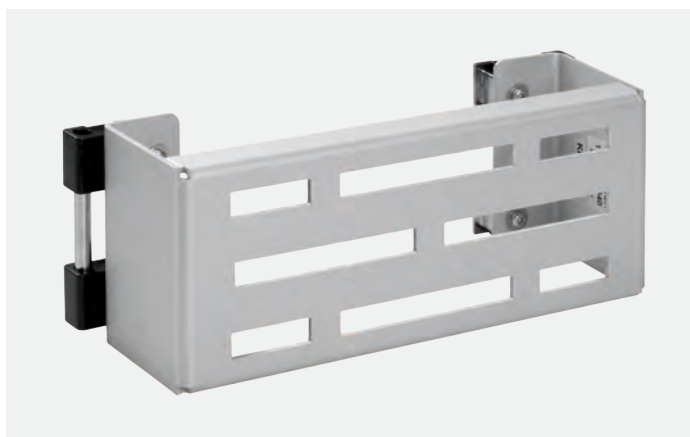
Height compensation for sensors

Material no. 1827003640

Height adjustment with an adjustment height of 70 mm, use of up to 3 sensors, anodized, angled aluminum sheet, quick mounting system for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	210x80x75
------------	------------	-----------

Weight	g	373
--------	---	-----



Components

AS Interface Control Master RS232

Material no. 1827003672

Programmable stand-alone master VBM-CTR-K20-R2 according to AS interface specification 3.0 with RS 232 interface.
 Address assignment, acceptance of the target configuration and setting of the baud rate are possible via a button.
 Two-digit LC display and state display by means of LEDs.
 Bracket for AS-I control master made of anodized aluminum sheet, 3 contact protected 4 mm safety sockets.
 Quick mounting system for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	210x100x110
Weight	g	720
Protection class	IEC60529	IP20
Supply voltage	V DC	24



Control Master AS-I with Profibus DP interface, VAG PB-KFR4

Material no. 1827003674

AS-I Profibus gateway, VBG-PB-K20-D connection to PROFIBUS DP, 9-pole D-Sub socket, 2-digit LC display, LED display for operating state, earth fault monitoring, commissioning without Profibus communication, voltage supply via contact protected 4 mm safety sockets, brackets made of anodized aluminum sheet.
 Quick mounting system for grooved plate or grooved plate case.

Dimensions	mm (LxWxH)	210x100x110
Weight	g	720
Protection class	IEC60529	IP20
Supply voltage	V DC	30



PLC



Table of contents PLC

Learning topics Systems	63
--------------------------------	-----------

Systems	64
----------------	-----------

Learning topics / PLC programming

Project exercises on the PLC training system (stand-alone) with universal simulator

This teachware has been prepared as collection of tasks, solutions and software projects for Rexroth's PLC training system (stand-alone) with universal simulator which is used for the industrial initial and further vocational training. The 24 exercises satisfy the professional requirements.

Exercise manual PLC training system (stand-alone) with universal simulator

The present Bosch Rexroth exercise manual contains one task with corresponding solution proposal for each template of the PLC universal modulator.

The tasks are of general nature. The solution proposal refers to programming with control systems supplied by Bosch Rexroth. Nevertheless, one tried to not make use of control-specific functions.

So the manual can also be used as model for other control types. One prerequisite for the use of the universal simulator is a PLC with 37-pole Sub-D connectors for inputs and outputs. For the last 3 exercises, you need analog input and output assemblies.

Numbers of the project exercises and the relevant topic			
1	Tank - Filling system	13	Cleaning bath
2	Monitoring equipment	14	Buffer memory
3	Pump control 1	15	Tablet filling machine
4	Belt switch	16	Transmission stage
5	Gate control	17	Embossing machine
6	Star-delta start-up	18	Bending tool
7	Starter control	19	Drilling jig
8	Dahlander control	20	Pipe bending machine
9	Oven door control	21	Door control of a lock
10	Reaction vessel	22	Mixing plant
11	Pump control 2	23	Filling level section
12	Construction site traffic lights	24	Compressed air network

Exercise Manual	Language	Mat. no.	Manual title	Document no.
	DE	R961004276	HANDBUCH SPS UEBUNG TS STANDALONE	RD 09949
	EN	R961004285	HANDBUCH SPS UEBUNG TS STANDALONE	RE 09949

To perform the exercises, the L20 PLC stand-alone and the universal simulator are required.

Systems

Training system PLC L20 (stand-alone)

Material no. R961003551

Programmable logic control L20 installed on aluminum frame with power supply unit, digital inputs/outputs, analog inputs/outputs and double moving-coil instrument, with connection for universal simulator to perform exercises on the PLC programming.

Device for transport in industrial case with removable hood, aluminum frame: Power supply unit 24 V / 2 A (+ / - 10 V integrated), 16 digital inputs with 4 mm safety socket incl. status LED and key/pushbutton switch, 16 digital outputs as 4 mm safety socket.

Incl. status LED, 2 analog inputs +/- 10 V as 4 mm safety socket with +/- 10 V potentiometer, 2 analog outputs +/- 10 V as 4 mm safety socket with +/- 10 V double moving-coil instrument, 2 Sub-D connectors / socket for universal simulator connection.

Dimensions	mm (LxWxH)	530x380x440
------------	------------	-------------

Weight	kg	15
--------	----	----

Operating voltage	V DC	24
-------------------	------	----

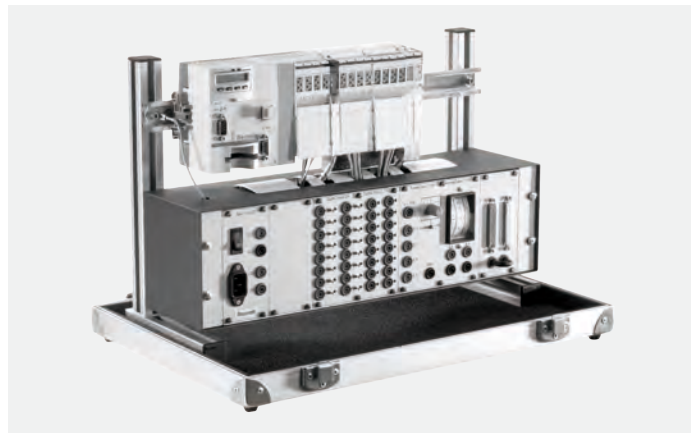
Supply voltage	V AC	230
----------------	------	-----

Analog I/O	AI / AO	2 / 2
------------	---------	-------

Digital I/O	DI / DO	16 / 16
-------------	---------	---------

Accessories

R961002179	1	Universal simulator for L20/L40 training system (stand-alone)
------------	---	---



Universal simulator for TS L20/L40 stand-alone; 24 exercises

Material no. R961002179

PLC base board with LED display, key/pushbutton switches and potentiometers.

2 Sub-D connectors for PLC connection, 4 mm contact-protected safety sockets.

To perform exercises, corresponding templates are put into the positioning pins of the base board.

Labels and LED displays which are not relevant for the test are concealed.

Creation of assignment lists and the PLC programs according to the tasks. Sample solutions available. All programs for Bosch Rexroth IndraLogic controls.

PLC universal simulator consists of the base board, 24 exercise templates, 2 Sub-D connection cables (37-pole) and 2 cables with contact-protected laboratory connectors 4 mm (red/black) each.

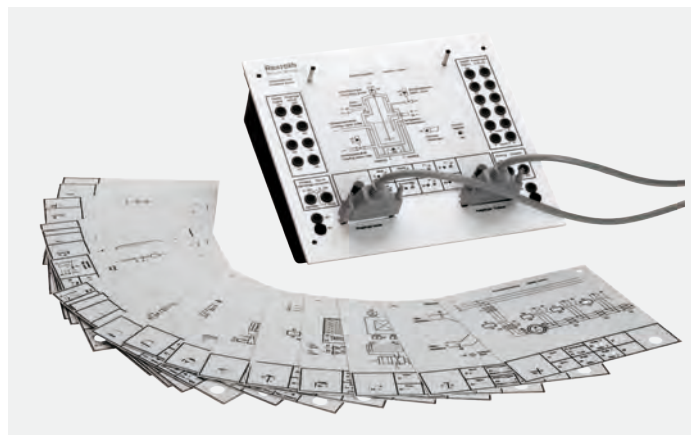
Dimensions	mm (LxWxH)	0
------------	------------	---

Weight	kg	2.34
--------	----	------

Operating voltage	V DC	24
-------------------	------	----

Accessories

R961003551	TS-PLC L20 16DI/16DO (PLC stand-alone)
------------	---



Systems

Training system PLC L20 for pneumatics

Material no. R961004023

Programmable logic control L20 with digital inputs/outputs, 2 Sub-D sockets that are connected with the connection cables to the I/O boxes. Firmware on CompactFlash card.

1 IndraControl L20 with PROFIBUS DP, Ethernet, RS232, 1 CompactFlash card firmware L20, 12 digital inputs, 12 digital outputs 0.5 A, mounting system for grooved plate and grooved plate case.

2 safety sockets 4 mm (red/blue), 2 Sub-D sockets 26-pole, 2 Sub-D connection cables 1.5 m, 2 I/O boxes with 4 mm safety sockets, IndraWorks software.

Dimensions	mm (LxWxH)	280x150x140
------------	------------	-------------

Weight	kg	1.7
--------	----	-----

Operating voltage	V DC	24
-------------------	------	----

Digital I/O	DI / DO	12 / 12
-------------	---------	---------



PLC training system IndraControl L20 (snap-in)

Material no. R961002934

Programmable logic control L20 with digital inputs/outputs, 2 A outputs for hydraulic valves.

2 Sub-D sockets that can be connected with the connection cables to the I/O boxes.

Firmware on CompactFlash card. For pneumatics and hydraulics.

1 IndraControl L20 with PROFIBUS DP, Ethernet, RS232, 1 CompactFlash card firmware L20, 16 digital inputs, 12 digital outputs 0.5 A, 6 digital outputs 2 A, mounting system for grooved plate and grooved plate case.

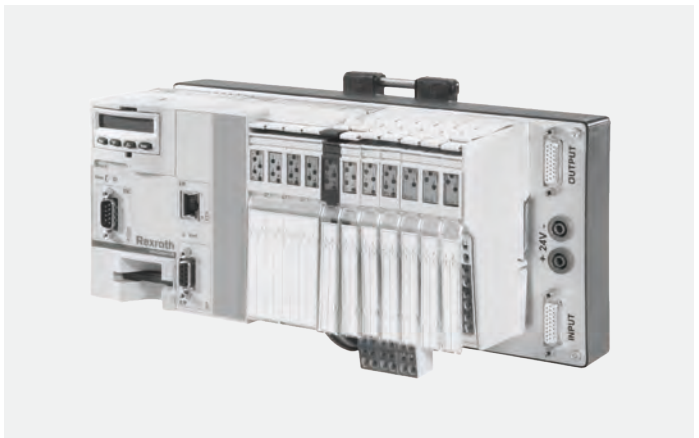
2 safety sockets 4 mm (red/blue), 2 Sub-D sockets 26-pole, 2 Sub-D connection cables 1.5 m, 2 I/O boxes with 4 mm safety sockets, IndraWorks software.

Dimensions	mm (LxWxH)	290x150x140
------------	------------	-------------

Weight	kg	1.84
--------	----	------

Operating voltage	V DC	24
-------------------	------	----

Digital I/O	DI / DO / DO-2A	16 / 12 / 6
-------------	-----------------	-------------



Learning topics on control technology



Table of contents Learning topics on control technology

Electropneumatic control technology	69
--	-----------

Hydraulic control technology	73
-------------------------------------	-----------

Electropneumatic control technology

Project exercises on control technology

In the pneumatics area, the project manuals are used as accompanying document and work book so as to transfer knowledge of the pneumatic control and regulation technology. This also includes basic knowledge of pneumatic and electrical technologies, the basic understanding of PLCs as well as the handling of programming devices.

All project tasks impart core and technical qualifications like the independent planning, execution and controlling of work which is required for the fulfillment of the project order.



Numbers of the project exercises and the relevant topic

1	Constant pressure control	4	Electropneumatic position control with spring
2	Force control	5	Properties of the electropneumatic position control with spring
3	Basic principles of PID control		

Trainer manuals	Language	Mat. no.	Manual title	Document no.
HANDBUCH PN PROJEKT REGELUNGSTECH LH DE	DE	R961004419	Projekthandbuch Elektropneumatische Regelungstechnik, Lehrerhandbuch	RD 09963
HANDBUCH PN PROJEKT REGELUNGSTECH LH DE	EN	R961004436	Project manual Electropneumatic control technology, Trainer's manual	RE 09963
HANDBUCH PN PROJEKT REGELUNGSTECH LH DE	ES	R961004515		RS 09963

Trainee manuals	Language	Mat. no.	Manual title	Document no.
HANDBUCH PN PROJEKT REGELUNGSTECH SH DE	DE	R961004420	Projekthandbuch Elektropneumatische Regelungstechnik, Schülerhandbuch	RD 09964
HANDBUCH PN PROJEKT REGELUNGSTECH SH DE	EN	R961004437	Project manual Electropneumatic control technology, Trainee's manual	RE 09964
HANDBUCH PN PROJEKT REGELUNGSTECH SH DE	ES	R961004514		RS 09964

Electropneumatic control technology

Electropneumatic control technology

Material no. R961004131

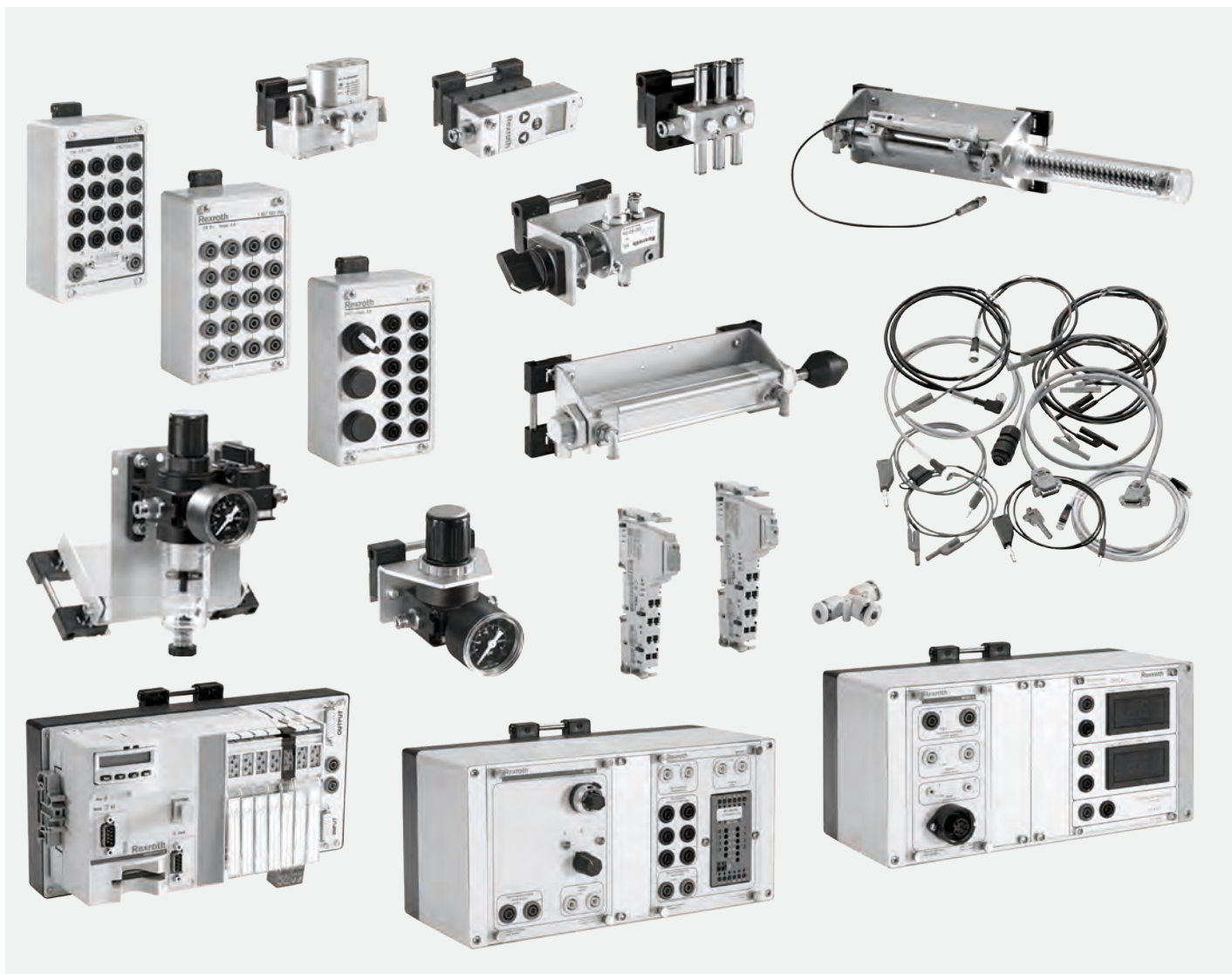
The device set is suitable for implementing courses on the electropneumatic control technology.

It comprises e.g. a PLC with integr. PID controller as well as pressure control valve, cylinder with position measurement system and pressure sensor. In connection with especially developed project exercises, currently required core and technical competencies for the industrial practice can be imparted.












Control pneumatics kit consisting of pressure control valve, pressure switch, double-acting cylinder, double-acting cylinder with position measurement system, PLC with 12 inputs and outputs, 2 analog inputs and outputs, command value module, command value/actual value display, cable set, filter controller with 3/2 directional valve, pressure controller, pn. distributor, input/output box, el. distributor and switch box.

Accessories








Compressor 230 V incl. accessories	1827008426	1
Stand-alone device carrier EcoDesk	R961003826	1
Power supply unit 230 V/24 V with distributor		1



Electropneumatic control technology

Item	Electropneumatic control technology components	Mat. no.	Quantity	Figure
1	Pressure control valve PN-ED02	R961003950	1	
2	Pressure switch 0 to 16 bar	R961003948	1	
3	Double-acting cylinder with measurement system	R961006487	1	
4	Double-acting cylinder, d = 25 mm, H = 100 mm	R961004426	1	
5	PLC L20, 12 I/O	R961004428	1	
6	Operating module BPS 5.2 and BPS 20.0	R961004431	1	
7	Operating module BPS 6.1 and BPS 21.0	R961004432	1	
8	Cable set electropneumatic control technology	R961004433	1	
9	R-IB IL AI 2/SF	R911289306	1	
10	R-IB IL AO 2/U/BP	R911289381	1	
11	R-IB IL SCN-6 SHIELD-TWIN	R911289332	2	
12	R-IB IL FIELD 2	R911289341	2	
13	Filter controller 3/2 directional valve, 0.5 - 10 bar	1827003410	1	

Electropneumatic control technology

Item	Electropneumatic control technology components	Mat. no.	Quantity	Figure
14	Distributor 6-fold	1827003411	1	
15	3/2 directional valve G1/8, rotary switch	1827003469	1	
16	Pressure controller G1/8, 0.5-10 bar	1827003386	1	
17	T plug-in connector 4 mm	2121104000	2	
18	Input / output box 24 V, 16-fold	1827003595	1	
19	Distributor box 24 V	1827003587	1	
20	Switch and button box 24 V	1827003588	1	
21	Slotted screwdriver 0.4x2.5	R900040800	1	

Information on pneumatic components:

For more information on the necessary pneumatic components, refer to our "Pneumatics training system" catalog, RE 00847.

Hydraulic control technology

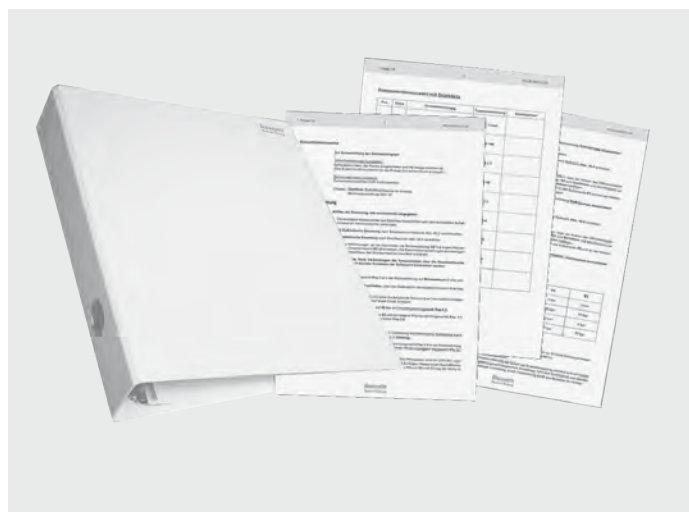
For performing qualified professional work, the trainees are to work in a practical and largely independent manner and learn how to act in the overall operational context. So all practice-related project tasks impart core and technical qualifications including independent planning, execution and controlling.

Delivery range:

- ▶ Project manual: "Analog position control circuit" for trainers and trainees
- ▶ List of the necessary hydraulic components
- ▶ List of the necessary electric components
- ▶ List of the necessary measuring devices

Exercise manuals for trainers and trainees:

The present project manual "Analog position control circuit" describes practical exercises on the understanding of the hydraulic control technology. These exercises are to provide introduction to the practical control technology. This project manual is not intended to impart detailed theoretical control technology basics but to impart the practical application of a simple electro-hydraulic position control circuit. First of all, one deals with the problem of keeping a position under different loads with an open control distance. Thus, the necessity and the advantages of a closed control loop become clear. Afterwards, components of the electro-hydraulic control loop are presented, its set-up and function are explained and the basic safety instructions for performing the exercises are specified.



Project exercises and the relevant topic:

- ▶ 01 Setting the position using a 4/3 directional valve
- ▶ 02 Setting the position using a proportional servo valve
- ▶ 03 Position control

Trainer manuals	Language	Mat. no.	Manual title	Document no.
Projekthandbuch Analoger Positionsregelkreis, Lehrerhandbuch, de	DE	R961005011	Projekthandbuch, Analoger Positionsregelkreis, Lehrerhandbuch	RD 09979
Project manual, Analog position control loop, Trainer's manual, en	EN	R961005091	Project Manual, Analog position control loop, Trainer's manual	RE 09979

Trainee manuals	Language	Mat. no.	Manual title	Document no.
Projekthandbuch Analoger Positionsregelkreis, Schülerhandbuch, de	DE	R961005010	Projekthandbuch Analoger Positionsregelkreis, Schülerhandbuch	RD 09980
Project manual, Analog position control loop, Trainee's manual, en	EN	R961005092	Project Manual, Analog position control loop, Trainee's manual	RE 09980

Hydraulic control technology

The necessary hydraulic components:

For the production of the training components, one uses exclusively components corresponding to the industrial standard. The listed training components have been designed for use at the Bosch Rexroth DS4 training system. Required equipment features of the training stand include: Measuring glass, rack for electronic operating modules, power supply unit, power unit with 50 bar and 8 l/min, rotatable load unit, hydraulic fast locking couplings.




Device kit hydraulic control technology

Material no. R961008169



Item	Hydraulic component	Mat. no.	Quantity	Figure
1	Horizontal load unit	R961004486	1	
2	High-response valve size 6 OBE	R961002509	1	
3	Pressure relief valve DBDH6G1X/	R961002520	1	
4	Hydraulic distributor 3-fold	R961002485	2	
5	4/2 directional valve 4WE6C6X/	R961002547	1	
6	4/3 directional valve 4WE6E6X/	R961002549	1	
7	Pressure reducing valve, direct operated DR6DP1-5X/	R961002544	1	






Hydraulic control technology

Item	Hydraulic component	Mat. no.	Quantity	Figure
8	Pressure gauge 0 to 100 bar with measuring hose	R961002715	4	
9	Hose line 1000 mm with Minimes connection	R961002476	3	
10	Hose line 630 mm	R961002474	7	






The necessary electric components:

The operating modules are suitable for installation into the 19" rack.



Item	Electric component	Mat. no.	Quantity	Figure
1	Operating module BPS 20.0 for command value generation, 21TE	R961000107	1	
2	Operating module BPS 5.2 with 1 potentiometer +/- 10 Volt output, 21TE	R961001957	1	
3	Operating module BPS 21.0, adapter 4 mm sockets to 7-pole connection connector, 14TE	R961001630	1	
4	Operating module BPS 6.1 command/actual value display, 21TE	R900711665	1	
5	Operating module BPS 13.1, distributor 21TE	R900897345	1	

Hydraulic control technology

Item	Electric component	Mat. no.	Quantity	Figure
6	Operating module BPS 7.4, switch, 42TE	R900719908	1	
7	Operating module BRS 1.2, relay, 42TE	R900897337	2	
8	Proximity switch, inductive	R961003106	1	
9	Control plate for DS4 training system with MACAS controller module, 30TE	R961004782	1	
10	Cable, 7-pole, for integrated electronics	R961003550	1	

The necessary measuring devices:

No additional measuring devices are necessary for performing the exercises themselves. In practice, faulty circuits might sometimes result during set-up of the exercises. For the subsequent troubleshooting, we recommend having the basic equipment for the performance of measurements according to the current industrial standard ready.

Item	Measuring device	Mat. no.	Quantity	Figure
1	Measuring device kit 3020	R913002273	1	
2	Flow meter DZ30 N	R961002508	1	
3	Multi measuring device	R913020275	1	
4	Stop watch, digital	R900061256	1	

Information on hydraulic components:

For more information on the necessary hydraulic components, refer to our "DS4 hydraulics training system" catalog, RE 00843.

Directories

Material number overview

Mat. no.	Product name	Page
1827003066	Power extender, VAN-G4-PE	53
1827003068	AS-I flat cable 1000 mm, yellow	55
1827003069	AS-I flat cable 1000 mm, black	55
1827003070	Connector for 2 IO module, V1-G connector	54
1827003215	Measuring line 500 mm, red	55
1827003216	Measuring line 500 mm, blue	55
1827003217	Measuring line 500 mm, black	55
1827003422	Inductive sensor; 0.2 A; Sn = 2 mm	46
1827003423	Capacitive sensor; 0.2 A; Sn = 1-4 mm	47
1827003424	Optical sensor; 0.2 A; Sn = 1-200 mm	48
1827003523	Measuring line 500 mm, yellow	55
1827003524	Material sample case	44
1827003525	TS sensor technology automation technology	39
1827003532	Inductive sensor, two-wire	44
1827003575	Sensor technology basic kit	35
1827003576	TS sensor technology extension	38
1827003587	Distributor box 24 V	56
1827003632	TS sensor technology AS interface	40
1827003635	Inductive analog encoder, linear measuring range (3-8 mm)	51
1827003637	Ultrasonic sensor, Sn = (60 - 500) mm	48
1827003638	Reflection light barrier, Sn = 3000 mm	49
1827003640	Height compensation for sensors	57
1827003641	Guide unit, 450 mm with ultrasonic measuring device	57
1827003642	Motor unit with controller	50
1827003644	2 IO module VAA-2EA-G2-ZA/EA2	53
1827003645	Inductive sensor, Sn = 8 mm	45
1827003647	Inductive sensor, Sn = 2 mm	45
1827003648	Capacitive sensor, Sn = 8 mm	47
1827003649	Sensor magnetic field; Sn = 60 mm	49
1827003654	Reflection light sensor, Sn = 200 mm	50
1827003655	Counter-frequency module	51
1827003656	Optical waveguide, scanning operation	52
1827003657	Optical waveguide, one-way operation	52
1827003661	Optical waveguide (scanning operation) with holding angle	52
1827003662	Strip with scanning sample	54
1827003664	Control electronics for stepping motor	57
1827003669	Evaluation unit digital material differentiation	53

Material number overview

Mat. no.	Product name	Page
1827003672	AS Interface Control Master RS232	58
1827003673	TS sensor technology AS interface with Profibus DP gateway	42
1827003674	Control Master AS-I with Profibus DP interface, VAG PB-KFR4	58
1827003675	Profibus DP simulator, VAZ-PB-SIM	54
1827008117	mMS Rack assembly	23
1827008118	mMS Long conveyor belt assembly	23
1827008119	mMS Test unit assembly	23
1827008121	mMS Hydraulic press assembly	24
1827008124	mMS High rack warehouse assembly	24
1827008125	mMS Control panel assembly	25
1827008129	mMS Turning unit assembly	25
1827008134	mMS Pinning unit assembly	26
1827008135	mMS Pneumatic press assembly	26
1827008187	mMS Y-A handling device assembly	27
1827008189	mMS Portal assembly	27
1827008191	mMS Short conveyor belt assembly	28
R901168910	Proximity switch NCN8-18GM60-B3B-V1 BG	46
R961002165	Stepping motor with geared belt drive	56
R961002179	Universal simulator for TS L20/L40 stand-alone; 24 exercises	61
R961002934	PLC training system IndraControl L20 (snap-in)	62
R961003113	Cable set mMS 3M CPL.	28
R961003177	mMS system processing with pneumatic press	19
R961003178	mMS system processing with hydraulic press	19
R961003342	mMS AS2 maintenance unit assembly	25
R961003446	Sensor technology basic kit with suitcase	33
R961003448	mMS Warehouse station	21
R961003449	mMS station processing with pneumatic press	21
R961003450	mMs Rack station	22
R961003451	mMS station processing with hydraulic press	22
R961003551	Training system PLC L20 (stand-alone)	61
R961003955	CMS handling training system	29
R961003956	TS1 transfer training system	29
R961004023	Training system PLC L20 for pneumatics	62
R961004131	Electropneumatic control technology	66
R961004148	mMS system with pneumatic press 115 V AC	20
R961004419	HANDBUCH PN PROJEKT REGELUNGSTECH LH DE	65
R961004420	HANDBUCH PN PROJEKT REGELUNGSTECH SH DE	65

Material number overview

Mat. no.	Product name	Page
R961004436	MANUAL PN PROJECT CONTROL TECH LH EN	65
R961004437	MANUAL PN PROJECT CONTROL TECH SH EN	65
R961004472	E2C handling module device kit	12
R961004514	HANDBUCH PN PROJEKT REGELUNGSTECH SH ES	65
R961004515	HANDBUCH PN PROJEKT REGELUNGSTECH LH ES	65
R961004655	Lehrerhandbuch Elektropneumatische Handhabungstechnik de	11
R961004826	Trainer's manual, Electropneumatic handling technology en	11
R961004827	Trainee's manual, Electropneumatic handling technology en	11
R961004865	Schülerhandbuch Elektropneumatische Handhabungstechnik de	11
R961005010	Projekthandbuch Analoger Positionsregelkreis, Schülerhandbuch, de	69
R961005011	Projekthandbuch Analoger Positionsregelkreis, Lehrerhandbuch, de	69
R961005091	Project manual, Analog position control loop, Trainer's manual, en	69
R961005092	Project manual, Analog position control loop, Trainee's manual, en	69
R961007602	Linear axis with stepping motor	18
R961007695	Trainer's manual	15
R961007696	Trainee's manual	15
R961007787	Device kit linear technology	16
R961008169	Device kit hydraulic control technology	70
	ATS	30

Index

Product name	Mat. no.	Page
2 IO module VAA-2EA-G2-ZA/EA2	1827003644	53
AS Interface Control Master RS232	1827003672	58
AS-I flat cable 1000 mm, yellow	1827003068	55
AS-I flat cable 1000 mm, black	1827003069	55
ATS		30
Evaluation unit digital material differentiation	1827003669	53
Control Master AS-I with Profibus DP interface, VAG PB-KFR4	1827003674	58
Electropneumatic control technology	R961004131	66
Guide unit, 450 mm with ultrasonic measuring device	1827003641	57
E2C handling module device kit	R961004472	12
Device kit hydraulic control technology	R961008169	70
Device kit linear technology	R961007787	16
HANDBUCH PN PROJEKT REGELUNGSTECH LH DE	R961004419	65
HANDBUCH PN PROJEKT REGELUNGSTECH LH EN	R961004436	65
HANDBUCH PN PROJEKT REGELUNGSTECH LH ES	R961004515	65
HANDBUCH PN PROJEKT REGELUNGSTECH SH DE	R961004420	65
HANDBUCH PN PROJEKT REGELUNGSTECH SH EN	R961004437	65
HANDBUCH PN PROJEKT REGELUNGSTECH SH ES	R961004514	65
Height compensation for sensors	1827003640	57
Inductive analog encoder, linear measuring range (3-8 mm)	1827003635	51
Cable set mMS 3M CPL.	R961003113	28
Trainer's manual	R961007695	15
Lehrerhandbuch Elektropneumatische Handhabungstechnik de	R961004655	11
Trainer's manual, Electropneumatic handling technology en	R961004826	11
Strip with scanning sample	1827003662	54
Optical waveguide (scanning operation) with holding angle	1827003661	52
Optical waveguide, one-way operation	1827003657	52
Optical waveguide, scanning operation	1827003656	52
Linear axis with stepping motor	R961007602	18
Material sample case	1827003524	44
Measuring line 500 mm, blue	1827003216	55
Measuring line 500 mm, yellow	1827003523	55
Measuring line 500 mm, red	1827003215	55
Measuring line 500 mm, black	1827003217	55
mMS system processing with hydraulic press	R961003178	19
mMS system processing with pneumatic press	R961003177	19
mMS system with pneumatic press 115 V AC	R961004148	20

Index

Product name	Mat. no.	Page
mMS Control panel assembly	1827008125	25
mMS Short conveyor belt assembly	1827008191	28
mMS Long conveyor belt assembly	1827008118	23
mMS Y-A handling device assembly	1827008187	27
mMS High rack warehouse assembly	1827008124	24
mMS Hydraulic press assembly	1827008121	24
mMS Rack assembly	1827008117	23
mMS Pneumatic press assembly	1827008135	26
mMS Portal assembly	1827008189	27
mMS Test unit assembly	1827008119	23
mMS Pinning unit assembly	1827008134	26
mMS AS2 maintenance unit assembly	R961003342	25
mMS Turning unit assembly	1827008129	25
mMS station processing with hydraulic press	R961003451	22
mMS station processing with pneumatic press	R961003449	21
mMS Warehouse station	R961003448	21
mMs Rack station	R961003450	22
Motor unit with controller	1827003642	50
Proximity switch NCN8-18GM60-B3B-V1 BG	R901168910	46
Power extender, VAN-G4-PE	1827003066	53
Profibus DP simulator, VAZ-PB-SIM	1827003675	54
Projekthandbuch Analoger Positionsregelkreis, Lehrerhandbuch, de	R961005011	69
Project manual, Analog position control loop, Trainer's manual, en	R961005091	69
Projekthandbuch Analoger Positionsregelkreis, Schülerhandbuch, de	R961005010	69
Project manual, Analog position control loop, Trainee's manual, en	R961005092	69
Reflection light barrier, Sn = 3000 mm	1827003638	49
Reflection light sensor, Sn = 200 mm	1827003654	50
Stepping motor with geared belt drive	R961002165	56
Trainee's manual	R961007696	15
Schülerhandbuch Elektropneumatische Handhabungstechnik de	R961004865	11
Trainee's manual, Electropneumatic handling technology en	R961004827	11
Inductive sensor, Sn = 2 mm	1827003647	45
Inductive sensor, Sn = 8 mm	1827003645	45
Inductive sensor, two-wire	1827003532	44
Inductive sensor; 0.2 A; Sn = 2 mm	1827003422	46
Capacitive sensor, Sn = 8 mm	1827003648	47
Capacitive sensor; 0.2 A; Sn = 1-4 mm	1827003423	47

Index

Product name	Mat. no.	Page
Sensor magnetic field; Sn = 60 mm	1827003649	49
Optical sensor; 0.2 A; Sn = 1-200 mm	1827003424	48
Sensor technology basic kit with suitcase	R961003446	33
PLC training system IndraControl L20 (snap-in)	R961002934	62
Connector for 2 IO module, V1-G connector	1827003070	54
Control electronics for stepping motor	1827003664	57
CMS handling training system	R961003955	29
TS1 transfer training system	R961003956	29
Training system PLC L20 (stand-alone)	R961003551	61
Training system PLC L20 for pneumatics	R961004023	62
TS sensor technology AS interface	1827003632	40
TS sensor technology AS interface with Profibus DP gateway	1827003673	42
TS sensor technology automation technology	1827003525	39
TS sensor technology extension	1827003576	38
Sensor technology basic kit	1827003575	35
Ultrasonic sensor, Sn = (60 - 500) mm	1827003637	48
Universal simulator for TS L20/L40 stand-alone; 24 exercises	R961002179	61
Distributor box 24 V	1827003587	56
Counter-frequency module	1827003655	51

Bosch Rexroth AG

Drive & Control Academy

Bahnhofplatz 2

97070 Würzburg

Phone: +49 (0) 9352 18-1920

Fax: +49 (0) 9352 18-6882

Email: academy@boschrexroth.de

www.boschrexroth.com/academy

For your local contact partner, please refer to:

www.boschrexroth.com/adressen-dcl