

8175461

Cobot UR3e

FESTO


CP Systems

Original operating
instructions



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Authors: Schober, Weiss
Layout: Frank Ebel
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 +49 711 3467-0  www.festo-didactic.com
 +49 711 34754-88500  did@festo.com

Original operating instructions

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Where only pronouns such as he and him are used in these operating instructions, these pronouns are of course intended to refer to both male and female persons. The use of a single gender (e.g. he, him) should not be construed as gender discrimination; it is intended solely to make the manual easier to read and the formulations easier to understand.

	 CAUTION
	<p>These operating instructions must be available to the user at all times. The operating instructions must be read before commissioning. The safety instructions must be observed. Non-observance may result in severe personal injury or damage to property.</p>

Main document

Associated documents attached:

Safety instructions concerning transport (print/electronic)
Component datasheets (print/electronic)
Circuit diagram (print/electronic)

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1 Safety instructions



1.1 Warning notice system



These operating instructions contain notes that must be observed for your personal safety and in order to prevent property damage. The notes concerning your personal safety are indicated by a safety symbol.


Notes that only concern property damage are not indicated by a safety symbol.

The notes below are listed in order of hazard level.

	 DANGER
	<p>... indicates an imminently hazardous situation that will result in fatal or severe personal injury if not avoided.</p>

	 WARNING
	<p>... indicates a potentially hazardous situation which may result in fatal or severe personal injury if not avoided.</p>

	 CAUTION
	<p>... indicates a potentially hazardous situation that may result in moderate or slight personal injury or severe property damage if not avoided.</p>

	NOTE
	<p>... indicates a potentially hazardous situation that may result in property damage or loss of function if not avoided.</p>

In cases where more than one hazard level applies, the safety note with the highest hazard level will be shown. A safety note may concern both personal injury and property damage.

Hazards that will only result in property damage are indicated with the word "Note".

1.2 Pictograms

This document and the hardware described in it include warnings concerning possible hazards which may arise if the system is used incorrectly.

The following pictograms are used:



Hazard warning



Warning - dangerous electric voltage



Read and observe the operating and safety instructions prior to commissioning.



Switch off the device and unplug the connection for power supply from the plug socket before commencing installation, repair, maintenance or cleaning work.



Warning – hand injuries



Warning – lifting heavy loads



Information and/or references to other documentation

1.3 General prerequisites for installing the product

- Festo Didactic products must only be used for the applications specified in their respective operating instructions. Products or components supplied by other manufacturers must only be used if recommended or approved by Festo.
- The products must be transported, stored, installed, assembled, commissioned, operated and maintained properly in order to ensure their safe operation.
- The approved ambient conditions must be observed. The specifications in the relevant operating instructions must be observed.
- The safety equipment must be tested every working day.
- Connecting cables must be checked for damage before each use. In case of damage, they must be replaced.

Connecting cables must correspond to the minimum specifications.

1.4 General prerequisites for operating the devices

General requirements for safe operation of the system:

- In industrial facilities, the national accident prevention regulations must be observed.
- The laboratory or classroom must be overseen by a supervisor.
 - A supervisor is a qualified electrician or a person who has been trained in electrical engineering, knows the respective safety requirements and safety regulations, and whose training has been documented accordingly.

The laboratory or the classroom must be equipped with the following devices:

- An emergency-off device must be provided.
 - At least one emergency-off device must be located inside the laboratory or the classroom, and at least one outside it.
- The laboratory or classroom must be secured so that the operating voltage and compressed air supply cannot be activated by any unauthorized persons, for example by means of:
 - e.g. a keyswitch
 - e.g. lockable shut off valves
- The laboratory or classroom must be protected by residual current devices (RCDs).
 - RCDs with a differential current of ≤ 30 mA, Type B. When operating machinery with unavoidable leakage current, suitable measures must be implemented and documented in the corresponding workplace risk assessment.
- The laboratory or classroom must be protected by overcurrent protection devices.
 - Fuses or circuit breakers
- Devices must not be used if they are damaged or defective.
 - Damaged devices must be barred from further use and removed from the laboratory or classroom.
 - Damaged connecting cables, pneumatic tubing and hydraulic hoses represent a safety risk and must be removed from the laboratory or classroom.
- Safety devices must be checked every working day to ensure that they are fully functional.
- Connecting cables and accessories must be checked for damage before each use.

2 Intended use

Festo Didactic systems and components must only be used:

- For their intended use in teaching and training applications
- When their safety functions are in perfect condition

The components and systems are designed in accordance with the latest technology and recognized safety rules. However, life and limb of the user and third parties may be endangered and the components may be impaired if they are used incorrectly.

The Festo Didactic learning system has been developed and produced exclusively for education and training in the field of automation technology. The training company and/or trainers must ensure that all trainees observe the safety precautions described in these operating instructions.

Training with complex machinery is a highly hazardous activity. The operating company must draw up and document a workplace risk assessment. The trainees must be briefed on all the relevant safety aspects before work commences.

Festo Didactic hereby excludes any and all liability for damages suffered by apprentices, the training company and/or any third parties, which occur during use of the device in situations which serve any purpose other than training and/or vocational education, unless such damages have been caused by Festo Didactic due to malicious intent or gross negligence.

All extensions and accessories must be approved by Festo Didactic, and are only permitted for use for their intended purpose.

The machine fulfils the requirements of the European directives that applied when it was commissioned. Any modification to the machine shall render the manufacturer's CE Declaration of Conformity null and void. The CE Declaration of Conformity must be renewed following each major modification.

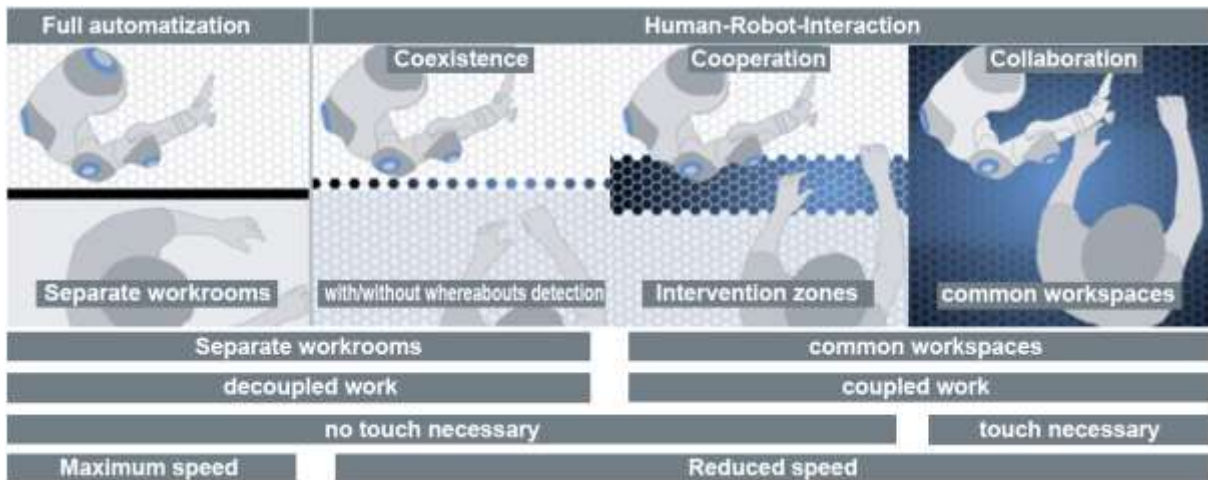
Robot application

This is a collaborative robot system that falls under the EC Machinery Directive 2006/42/EC. It includes the collaborating robot, the tool, the workpieces and all devices that together form a machine according to the EC Machinery Directive. Large, angular and heavy workpieces are not suitable for this collaboration according to the current state of the art.

In the case of human-robot collaboration (HRC), high demands are placed on safety, since collisions between humans and robots cannot be ruled out. Method 4 of ISO/TS 15066 describes the power and force limitation of collaborative robots with which robot applications can be operated without protection fences.

Robot systems are designed in such a way that biomechanical limit values (force, pressure) are not exceeded in the event of contact between humans and robots (e.g. collisions with gripper or workpiece). The force or pressure effect depends on active technical protective measures in the robot system, such as sensors for force and speed monitoring, as well as passive protective measures.

The limit values for various body regions (e.g. hand and finger, arm, shoulder, etc.) are specified in ISO/TS 15066, DGUV FB-HM 080 and RIA TR R15.806-2018 and were verified by corresponding measurements. Not only the robot system but the entire application was considered. Changes to the structure or the control program must be re-evaluated in terms of safety. The responsibility lies with the operator or their delegate.





3 For your safety

3.1 Important information

Knowledge of the basic safety instructions and safety regulations is a fundamental prerequisite for safe handling and trouble-free operation of Festo Didactic components and systems.

These operating instructions include the most important instructions for safe use of the components and systems. In particular, the safety instructions must be adhered to by all persons who work with these components and systems. Furthermore, all pertinent accident prevention rules and regulations that are applicable at the respective place of use must be adhered to.

	 WARNING
	Malfunctions which could impair safety must be eliminated immediately!

	 CAUTION
	Improper repairs or modifications may result in unforeseeable operating statuses. Do not carry out any repair or alternation work on components or systems that is not described in these operating instructions.

3.2 Qualified persons

- The product described in these operating instructions is only permitted for operation by persons who are qualified for the task in question in accordance with the operating instructions, especially the safety instructions.
- Qualified persons are defined as persons whose training and experience enables them to recognize risks and avoid potential dangers when working with this product.

3.3 Obligations of the operating company

It is the responsibility of the operating company to ensure that the station is operated safely.

The operating company undertakes to allow only those persons to work with the components and systems who:

- Are familiar with the basic regulations regarding occupational safety, with the safety instructions, and with the accident prevention regulations, and who have been instructed in the use of the components and systems
- Have read and understood the safety chapter and warnings in these operating instructions
- Are qualified to operate the components and systems in question
- Are governed by and trained in suitable organizational measures to ensure safe training

Personnel should be tested at regular intervals to ensure that they are safety-conscious in their work habits.



3.4 Obligations of the trainees

All persons who have been entrusted to work with the components and systems undertake to complete the following steps before beginning work:



- Read the chapter concerning safety and the warnings in these operating instructions
- Familiarize themselves with the basic regulations regarding occupational safety and accident prevention



4 Basic safety instructions

4.1 General information



	 CAUTION
	<ul style="list-style-type: none"> • General hazard situation <ul style="list-style-type: none"> – Trainees must be supervised by an instructor at all times when working with the components and systems. – Observe the specifications included in the technical data for the individual components, and in particular all the safety instructions! – Wear your personal protective equipment (safety goggles, safety shoes). – Never leave objects lying on the top of protective enclosures. Vibrations could cause such objects to fall off.



4.2 Mechanical components


	 WARNING
	<ul style="list-style-type: none"> • Switch off the power supply! <ul style="list-style-type: none"> – Work on the superstructures may only be carried out by qualified persons or must be checked by a qualified person before the superstructure is operated. – Switch off both the working energy and the control energy before working on the superstructure. – Only reach into the superstructure when it is at a standstill and ensure that no automatic start-up is possible. – Observe possible overrun times of drives. • Risk of injury during troubleshooting! <ul style="list-style-type: none"> – Use a tool such as a screwdriver for actuating sensors.

	 CAUTION
	<ul style="list-style-type: none"> • Risk of burns due to hot surfaces <ul style="list-style-type: none"> – Devices can reach high temperatures during operation, as a result of which they can cause burns if touched. – Allow the device to cool off before commencing work. – Use suitable personal protective clothing, e.g. safety safety gloves.



4.3 Electrical components



	 WARNING
	<ul style="list-style-type: none"> • Electric shock if the protective earth conductor is interrupted! <ul style="list-style-type: none"> – Devices / machines with a protective conductor (protection class 1) may only be operated with the protective conductor connected. • Electric shock due to connection to an unsuitable power supply! <ul style="list-style-type: none"> – Connect the device / plant a suitable power supply, see Technical data. – Only use power supplies that comply with SELV (Safety Extra Low Voltage) or PELV (Protected Extra Low Voltage) output voltages for all connections and terminals of the electronic modules. • Fire hazard due to the use of an unsuitable power supply! <ul style="list-style-type: none"> – If devices are connected to an unsuitable power supply, the components may overheat and cause a fire. – Use only limited power supplies (LPS) for all connections and terminals of the electronic modules. • Fire hazard due to the use of incorrect fuses! <ul style="list-style-type: none"> – Replace defective fuses only with the same type and rating. If the device contains a replaceable fuse, this is described in the operating instructions. • Electric shock due to series connection of power supply units! <ul style="list-style-type: none"> – Touch voltages > 25 V AC resp. > 60 V DC are not allowed. Voltages > 50 V AC or 120 V DC can be fatal if touched. – Do not connect floating voltage sources in series. • Danger from electric shock! <ul style="list-style-type: none"> – Components and lines with voltages that are dangerous to touch must be installed so that they are inaccessible to laypersons or must be insulated accordingly. – Detachable mains cables may only be replaced by equivalent mains cables. – Switch off the power supply and secure against being switched on again before working on the setup. – Note that electrical energy may be stored in individual components. Information on this can be found in the data sheets and operating instructions for the components. – Some devices have a high leakage current. These devices must be additionally grounded with a protective earth conductor. • Danger due to malfunction as a result of moisture! <ul style="list-style-type: none"> – No open liquids may be stored at the station (e.g. beverages) or used. – In case of condensation (moisture on the surface), the station must not be switched on. – Do not lay any pipes / hoses with liquid media near the machine.

	 CAUTION
	<ul style="list-style-type: none"> • Danger due to electric shock! <ul style="list-style-type: none"> – Only use connecting cables intended for this purpose for the electrical connections. – Lay the connection and connecting lines so that they are not kinked, sheared or crushed. Cables laid on the floor must be protected with a cable bridge. • Danger from damaged cables <ul style="list-style-type: none"> – Do not lay cables over hot surfaces. Hot surfaces are marked accordingly with a warning symbol. – Ensure that connecting cables are not permanently under tension. • Danger due to damage! <ul style="list-style-type: none"> – visible damage, – defective function, – improper storage or – improper transport <p style="margin-left: 20px;">safe operation of the device is no longer possible.</p> <ul style="list-style-type: none"> – Immediately switch off the voltage. • Danger from electric shock! <ul style="list-style-type: none"> – Switch cabinet may only be opened by qualified persons. – Switch cabinet key must be stored safely. – Protect the device against unintentional restart. – Switch cabinet with movable separating protective device.

	NOTE
	<ul style="list-style-type: none"> • High heat generation! <ul style="list-style-type: none"> – No additional electrical devices may be operated in the control cabinet of the robot station. • PC KL application <ul style="list-style-type: none"> – The PC for the AI application must not be operated in the control cabinet of the robot station; position the PC on a fixed, vibration-free surface.




4.4 Pneumatic components



	 WARNING
	<ul style="list-style-type: none">• Danger from working on pneumatic superstructures!<ul style="list-style-type: none">– Before working on pneumatic superstructures, switch off the compressed air supply and secure it against being switched on.– Use pressure gauges to check whether the complete circuit is depressurized.– Use only suitable compressed air hoses with 4mm or 6mm outer diameter for the connections.– Insert the hose into the plug-in connection as far as it will go.– Shorten the hoses only with a hose cutter.– When disconnecting hoses, press down on the blue release ring to pull off hose.– Do not disconnect hoses under pressure.– Do not attempt to close hoses or connectors with your fingers or hand.– Note that energy may be stored in pressure accumulators. Information on this can be found in the data sheets and operating instructions of the components.• Danger from hoses coming off!<ul style="list-style-type: none">– Use the shortest possible hose connections.– Fix connecting hoses in fixed setups with a cable tie as close as possible to the connection point.– When hoses jump off: Switch off the compressed air supply immediately.– Do not exceed the permissible pressure of 600 kPa (6 bar).– Do not switch on the compressed air until you have made and secured all hose connections.• Danger when switching on the compressed air!<ul style="list-style-type: none">– Cylinders can extend and retract automatically.• Danger of crushing/ jamming due to cylinder movement!<ul style="list-style-type: none">– Always place pneumatic cylinders in such a way that the working space of the piston rod is free over the entire stroke range.– Ensure that there are no pinch points over the entire piston travel.

	 CAUTION
	<ul style="list-style-type: none">• Noise due to escaping compressed air<ul style="list-style-type: none">– Noise caused by escaping compressed air may damage your hearing. Reduce noise by using mufflers, or wear hearing protection if the noise cannot be avoided.– All of the exhaust ports on the components included in the equipment set are equipped with mufflers. Do not remove these mufflers.• Regularly check the level of condensate in the maintenance unit.<ul style="list-style-type: none">– If necessary, drain the condensate and dispose of it properly.

4.5 Robot

The safety functions of the robot system comply with EN ISO 13849-1 PLd, category 3.

 WARNING	
 	<ul style="list-style-type: none">• Risk of injury due to collision with robot arm/gripper.<ul style="list-style-type: none">– The control program has been safety evaluated for this application. If the program or the setup is changed, the safety must be rechecked.– Mark a safety area on the ground around the working area of the robot. Refer to the "Installation" chapter for the specifications.– Do not wear loose clothing or jewelry when working near the robot. Long hair must be tied back when working.– If there is obvious damage, the robot must not be switched on or must be taken out of operation immediately. • Danger of crushing due to grippers at the workpiece positions.<ul style="list-style-type: none">– Do not reach into the area at the stopper position on the CP-Lab belt.– Risk of injury due to collision with robot arm/gripper.– The robot system is approved for collaborative operation.– The operator may exchange the workpieces during operation after professional instruction and under consideration of all safety measures.– Changes to the setup or the control program must be re-evaluated from a safety point of view. The responsibility lies with the operator or their delegate.

	 WARNING
	<ul style="list-style-type: none">• Danger from changed safety configuration parameters<ul style="list-style-type: none">– Safety configuration parameters other than those specified in the integrator's risk assessment can result in hazards and risks that cannot be adequately and adequately eliminated or reduced.

4.5.1 Enabling switch

The robot controller does not have an enabling switch. For the sample applications, all clampings and collisions were evaluated in terms of safety on the basis of ISO TS 15066. The safety functions



- Safe working area
- Safety stop (stop category 1)
- Safe collision detection (stop category 2)
- Safe orientation monitoring


are always active.

If the customer changes the application (hardware / program / safety concept), the safety functions must always be active. In a risk analysis, the possible hazards must be assessed and, if necessary, risk-minimizing measures must be taken. Changes to the system are the responsibility of the operator.

4.5.1 Danger from movement with and without drive energy

Should an emergency situation arise in which it becomes necessary to move one or more robot joints manually and the power supply is not possible or not desired, there are two ways to move the robot joints.

	 WARNING
	<ul style="list-style-type: none">• Danger from manually moving the robot arm The robot arm can fall due to gravity if the brake is released manually.<ul style="list-style-type: none">– Carefully support the robot arm, the attachment or the tool before releasing the brake.

	NOTE
	<p>The brakes on the joints can be released for maintenance situations without a power supply.</p> <p>The joints of the robot arm can be damaged by the manual movements of the robot arm, this function is only intended for urgent emergencies.</p>

Robot drive freely

1. Forced backdrive:

In order to move a joint, it is possible to move it by forcefully pulling or pressing it. A high forced torque makes it possible to overcome the slipping clutch of every joint brake and to enable movement to joints.

2. Manually releasing the brakes:

to remove the hinge cover, unscrew the M3 screws. By pressing the bolt (item 1 following graphic) on the electromagnet, it is possible to release the brake manually.



Example of opened joint cover

4.5.2 Remote maintenance robot

The robot can be controlled via remote maintenance. The operator must explicitly agree to this operating state. Ensure that these activities are only carried out by qualified persons.

4.6 Guarantee and liability for application examples

The application examples are not legally binding, and we cannot guarantee their completeness in terms of their configuration, their equipment or any events that may occur. The application examples are not representations of any specific customer solution; they are merely intended to illustrate typical tasks for which the product in question could be used. You bear the responsibility for ensuring that the products described here are operated properly. These application examples do not in any way relieve you of your responsibility to ensure that the system is handled safely when it is being used, installed, operated or maintained.



4.7 Cyber security

Note

Festo Didactic offers products with industrial security functions that aid the safe operation of plants, systems, machines and networks. In order to protect plants, systems, machines and networks from cyber threats, a comprehensive industrial security concept must be implemented and continuously updated.

Festo's products and services only constitute one part of such a concept.

The customer is responsible for preventing unauthorized access to their plants, systems, machines and networks. Systems, machines and components should only be connected to a company's network or the Internet if and as necessary, and only when the suitable security measures (e.g. firewalls and network segmentation) are in place. Furthermore, Festo's guidelines on suitable security measures should be observed. Festo products and solutions are constantly being developed further in order to make them more secure. Festo strongly recommends that customers install product updates as soon as they become available and always use the latest versions of its products. Any use of product versions that are no longer supported or any failure to install the latest updates may render the customer vulnerable to cyber attacks.






	 WARNING
	<ul style="list-style-type: none"> • Unsecure operating conditions due to software tampering <ul style="list-style-type: none"> – Forms of software tampering (e.g. viruses, Trojans, malware and worms) can lead to unsecure operating conditions in your system, which may in turn lead to severe or fatal injury or property damage. – Keep your software up to date. – Integrate the automation and actuator components into an overarching and comprehensive industrial security concept for the installation or machine in question that is in line with the latest technological developments. – Make sure that all the products you have installed are incorporated into your overarching industrial security concept. – Use suitable measures, such as a virus scanner, to protect files save on exchangeable storage media from malware.

4.8 Guarantee and liability

Our General Terms and Conditions of Sale and Delivery shall apply at all times. These shall be made available to the operating company no later than upon conclusion of the sales contract. Guarantee and liability claims resulting from personal injury and/or property damage are excluded if they can be traced back to one or more of the following causes:

- Use of the equipment for purposes other than its intended use
- Improper installation, commissioning, operation or maintenance of the system
- Operation of the system with defective safety equipment, or with improperly attached or non-functional safety equipment and protective guards
- Non-compliance with directions included in the operating instructions with regard to transport, storage, installation, commissioning, operation, maintenance and setup of the system
- Unauthorized modifications to the system
- Improperly executed repairs
- Disasters resulting from the influence of foreign bodies and acts of God
- Dust generated during construction work must be kept away from the system (use coverings).
See the Environmental Requirements section (contamination level) for more details.

4.9 Transport

	<p style="text-align: center;"> WARNING</p> <ul style="list-style-type: none">• Danger due to tipping over<ul style="list-style-type: none">– Suitable packaging and transport equipment must be used when transporting the station. The station can be lifted from underneath using a forklift truck. Please note that eccentric centers of gravity can cause the station to tip over.– Stations with attachments at height will have a high center of gravity.– Take care to avoid tipping over during transportation.
	<p style="text-align: center;"> CAUTION</p> <ul style="list-style-type: none">• Danger due to broken castors!<ul style="list-style-type: none">– The castors on the device are not designed to be used for transportation.– The castors are designed merely for positioning the station. Safety shoes must be worn when transporting the station!
	<p style="text-align: center;">NOTE</p> <ul style="list-style-type: none">• Station contains delicate components!<ul style="list-style-type: none">– Take care not to shake during transportation– The station is only permitted for installation on solid, non-vibrating surfaces.– Make sure that the ground underneath the station has sufficient load-bearing capacity.

4.10 Name plates





Name plate example

Position	Description
1	Type code
2	Material number
3	Production code
4	Technical data
5	Technical data
6	Technical data
7	Safety note
8	Manufacturer address
9	UK importer address
10	Country of origin
11	Internet address service portal
12	CE Mark
13	UKCA mark
14	Warning mark
15	Symbol read manual
16	WEEE Marking
17	QR Code (Type-and serial number)

4.11 CE Declaration of Conformity



Attached.

4.12 General product safety

	 WARNING
	<ul style="list-style-type: none">• General product safety, CE conformity<ul style="list-style-type: none">– The product fulfills the requirements of all applicable EU directives. We confirm this with the CE mark.– As a consequence of Changes (hardware / software) Additions or improper use– Product safety can no longer be guaranteed by the operator.– In this case, the manufacturer's CE declaration of conformity expires. The operator must re-evaluate the safety and determine the CE conformity.

4.13 Protective devices

In order to reduce risks, this machine contains guards to prevent access to dangerous areas. These guards must not be removed or tampered with.

	 WARNING
	<ul style="list-style-type: none">• Damage to the safety window<ul style="list-style-type: none">– Windows must not be cleaned using aggressive or alcoholic cleaning agents. Risk of brittleness and breakage!– This protective device must be replaced if it shows any signs of damage. Please contact our Service department to arrange this.

4.13.1 Panel doors on underground control cabinet

Transparent, impact-resistant, polycarbonate plate with lock.

Can only be accessed with tool (control cabinet key); tool must be kept in a secure place!

Access reserved for qualified electricians.

The safety door is not monitored! Make sure the safety door is always closed.

The station must be set up in such a way that all safety doors can be fully opened and do not obstruct escape routes.

4.13.2 Emergency stop

The robot station contains three emergency stop push buttons.

1. Emergency stop on the right side.
2. Emergency stop on the front side.
3. Emergency stop at the touch pendant.

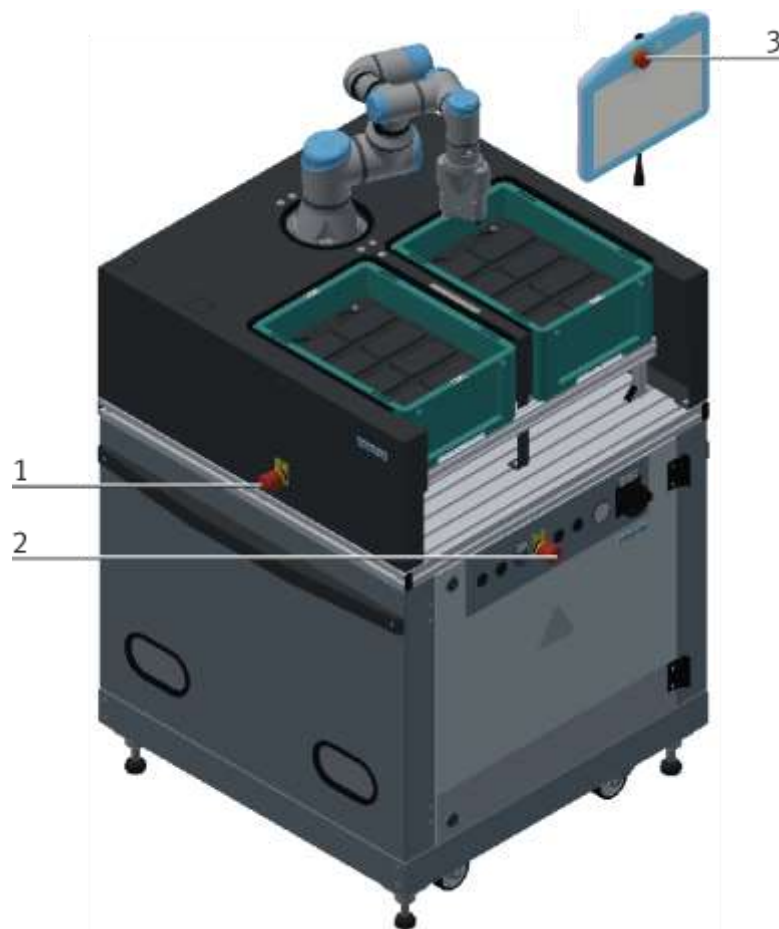


Illustration similar

- The emergency stop buttons trigger a stop of stop category 1 according to IEC 60204-1. The robot movement is stopped in a controlled manner and a category 1 safety stop is triggered.
- The performance level is PLd in category 3 (according to IEC 13849-1).
- Emergency stop command devices must always be accessible.
- The effectiveness of the emergency stop device must be checked regularly.

4.13.3 Safety control

The safety control permanently monitors the two virtual balls (blue marked) around the gripper with the safety levels (red marked).

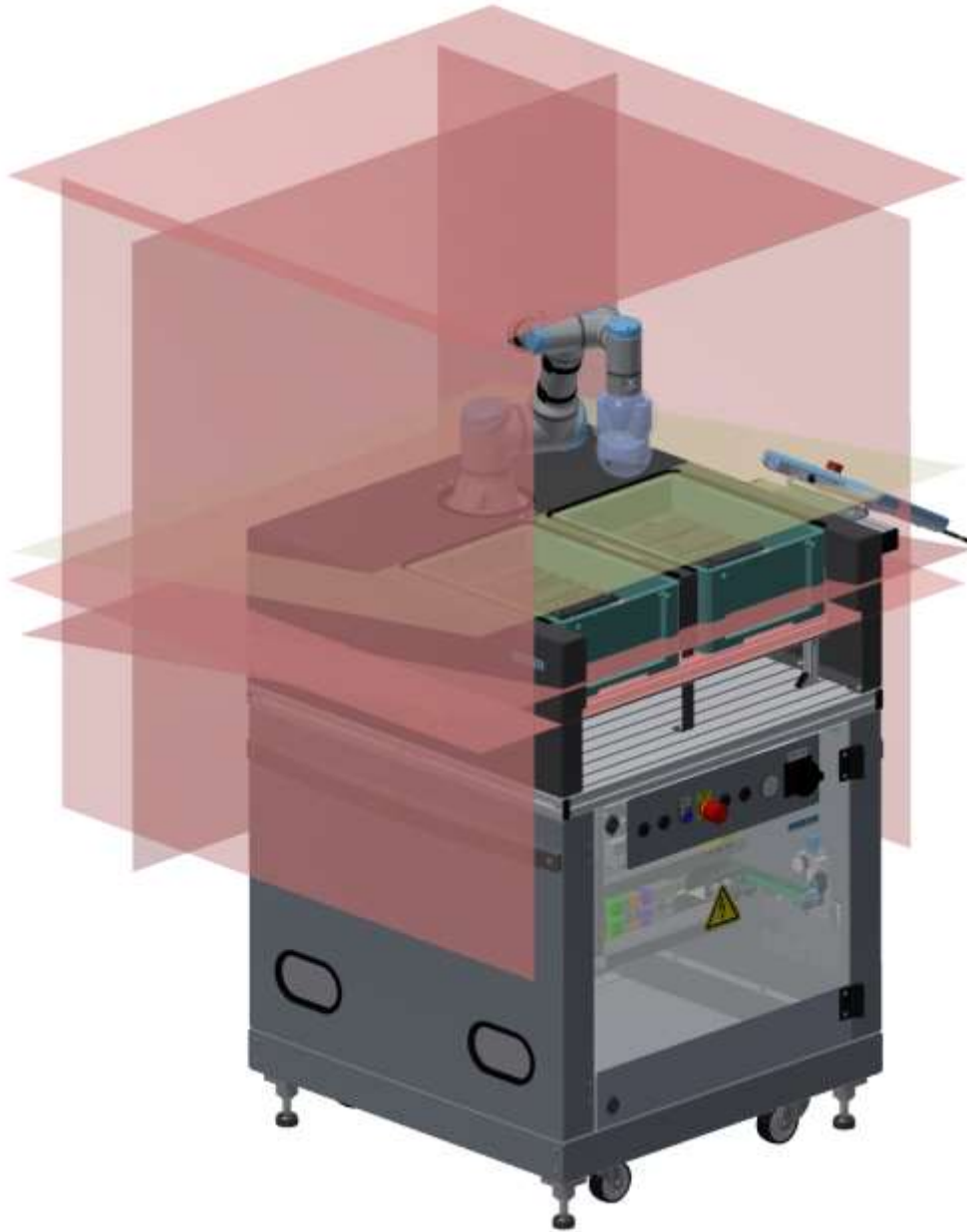


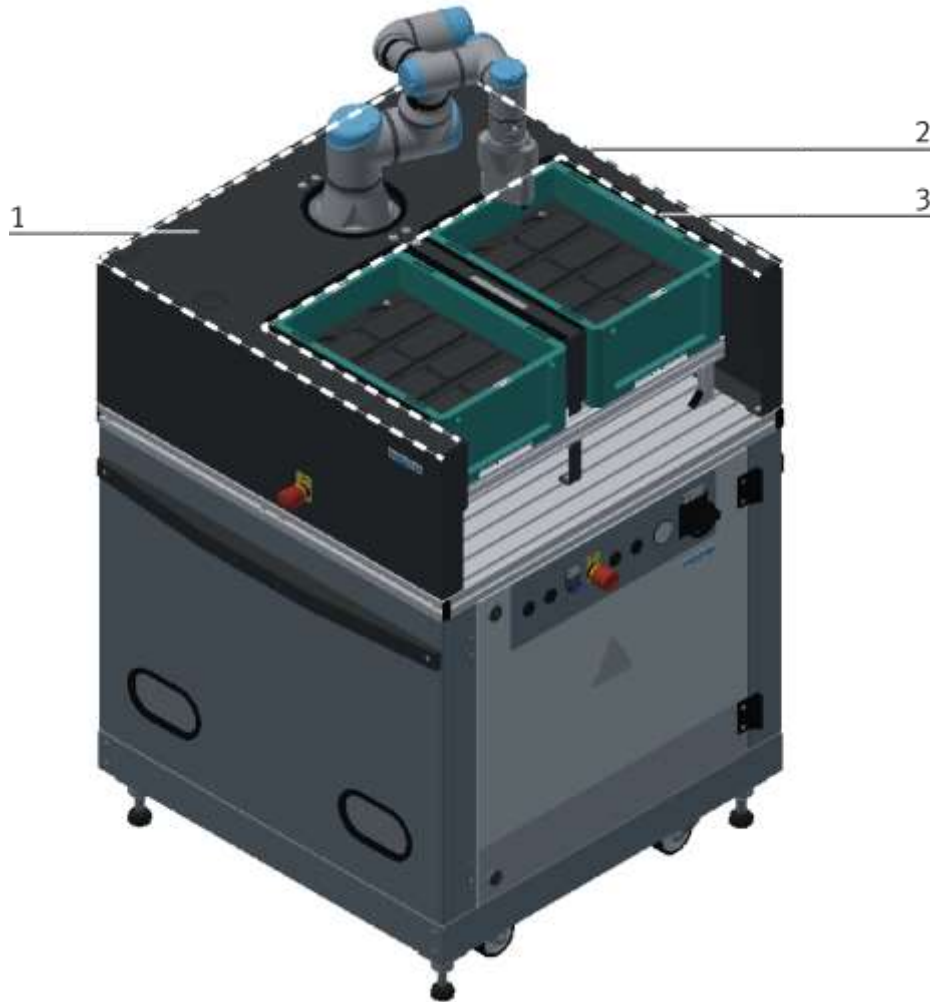
Illustration similar

The working area of the robot is limited by a virtual axis area monitoring and virtual safety planes. The area above the table surface and the area of the camera and its mount are separated by further virtual safety planes.

In the safety area directly above the table surface, travel is only possible at reduced speed.

4.13.4 Further protective devices

The individual components such as power supplies and controllers have integrated safety functions such as short-circuit protection, overcurrent protection, overvoltage protection or thermal monitoring. If necessary, refer to the manual of the corresponding device.



	CAUTION
	<ul style="list-style-type: none"> • CAUTION, mechanical hazards! <ul style="list-style-type: none"> – do not place any objects on the cover (position 1 in the picture above)

	NOTE
	<ul style="list-style-type: none"> – No fixed elements that can cause crushing/shearing or other hazards may be attached to the spatial boundaries. Positions in the picture above (pos. 2 - edge of cover outside, pos. 3 - edge of cover inside)

5 Technical Data

Parameter	Value
Electrics	
Operating voltage	1AC 115-240 V±10%, 50/60 Hz
Power supply system	TNC-S, mains conductor L1, neutral conductor N, protective grounding PE
Full load power	325 W
Control voltage, Voltage for small actuators	24 V DC Protective extra-low voltage (PELV)
Power supply connection	Safety plug, CEE 7/7, type E. Length of supply line 3 m
Max. backup fuse for installation	8 - 16 A
Leakage current	≤ 1,2 mA
Protection class	I, Operation with protective grounding only.
Overvoltage category	CAT II, Operation in building installation only
Short circuit current rating (SCCR)	10 kA
Compressed air	
Supply pressure	6 bar, 90 psi
Supply rate	≥ 40 l/min
Compressed air quality	EN ISO 8573-1
Pressure dew point (Class 4)	≤ +3°C
Ambient conditions	
Operating environment	Use inside building only
Ambient temperature	5°C ... 40°C
Rel. air humidity	80% up to 31°C
Pollution degree	2, Dry, non-conductive contamination
Operating height	Up to 2000 m above NN (sea level)
Noise emission level	L _{pA} < 70 dB
Certification	
CE marking in accordance with:	Machinery Directive EMC Directive RoHS Directive
EMC environment	Industrial environment, Class A (in acc. with EN 55011)
Subject to change	

	 WARNING
	<ul style="list-style-type: none"> • This product is designed for industrial environments and may cause malfunction in small business or domestic environments.

Parameter	Value
Robot	
Type	UR 3e
Controller	eSeries
Programming	Graphical user interface
Communication	TCP/IP 1000 Mbit, IEEE 802.3u 100 Base-T Ethernet plug Modbus TCP, EtherNet/IP-Adapter, Profinet
Degree of freedom	6 axis
Power limit	100 N
Security category	Performance Level d (PLd)
Power	80 W
Momentum	25.0 kg m/s
Stopping time	100 ms
Stopping distance	50 mm
Tool speed	250 mm/s (normal) / 160 mm/s (reduced)
Tool force	50.0 N
Elbow speed	5000 mm/s
Elbow force	50.0 N
Tool direction Pan	44 Grad
Joint Limits	Shoulder (-145 bis 363 Grad), Elbow (15 bis 150 Grad)
Check sum for security functions	See acceptance report
Detailed technical data can be found in the manufacturer's operating instructions.	

5.1 Electrical connection

The electrical connection is made via an IEC 60320 C13/C14 (IEC connector) plug connection. A country-specific connection cable is included in the delivery.

5.2 Measurements

Measurement	Value
Width	873 mm
Depth	869 mm
Hight	1917 mm
Subject to changes	

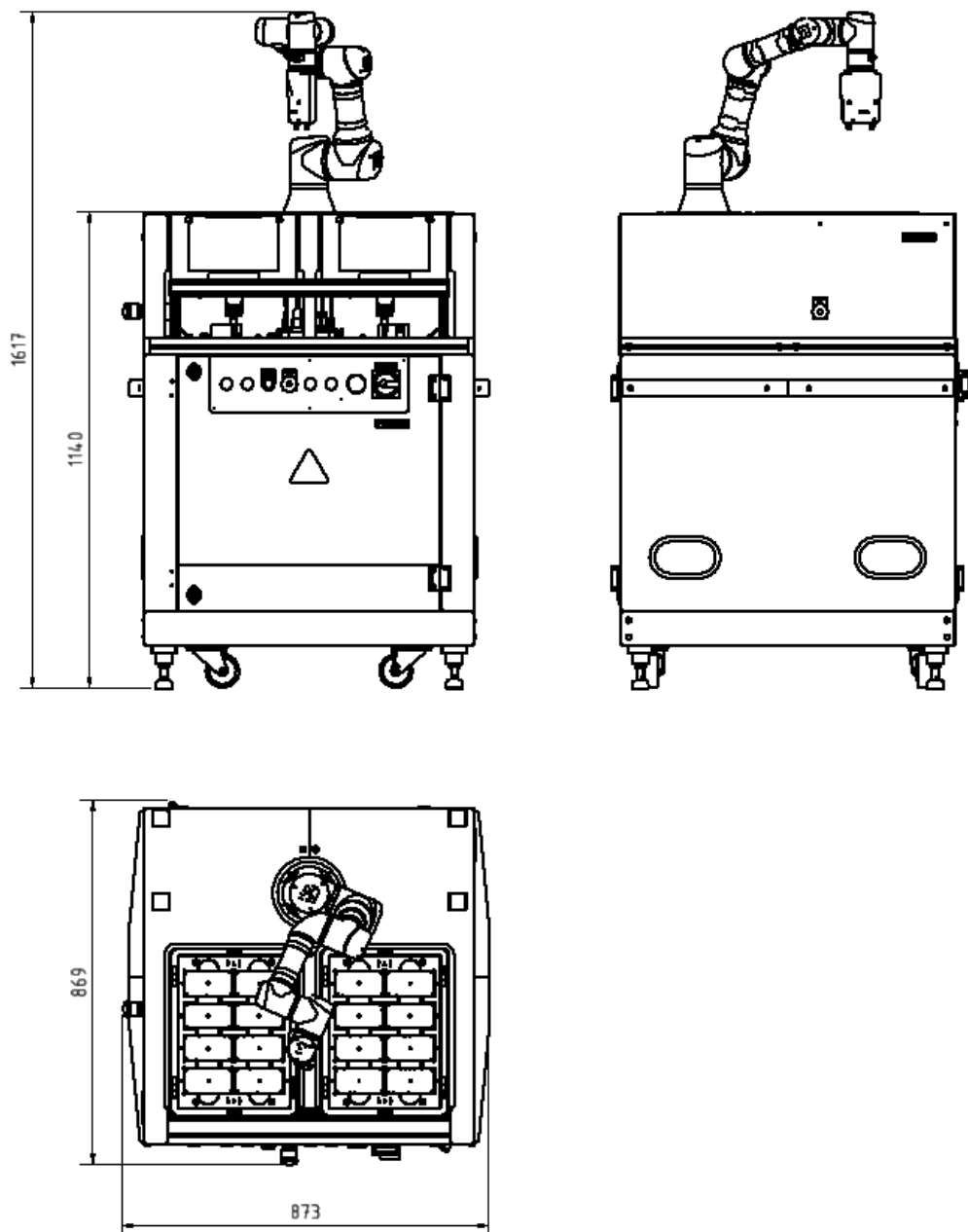


Illustration similar

6 Risk assessment

A risk assessment according to EN ISO 12100, EN 10218-2 was carried out for the robot system. ISO / TS 15066 was used to assess the forces.



Considering all safety devices and organizational measures, the system offers the security to be expected. Safety can only be guaranteed if the machine is operated in the delivery condition. Changes to the structure or the control program must be reassessed in terms of safety. The responsibility lies with the operator or their delegate.



The risk assessment is based on the following safety devices:



- closed control cabinet, IP20
- suitable protection of the electrical control
- The robot arm moves force-sensitive, force / torque limited
- The robot arm moves in a defined space
- The pick / place position is approached with reduced speed
- Gripper shape without corners / edges
- The workpiece is gripped by the vacuum gripper
- No corners / edges on the robot arm
- only one defined workpiece with safety cover
- Robot movement runs without possible crush areas
- marked area
- instruction


7 Design and Function

7.1 Transport

	 WARNING
	<ul style="list-style-type: none"> • Damage to transport equipment when moving heavy machines/machine sections <ul style="list-style-type: none"> – When the stations are shipped out, extra care must be taken to ensure that heavy machines/machine sections are always transported using a suitable forklift truck. A single station can weigh up to 500 kg. – Always use suitable transport equipment. – Always use the lifting points provided to move the machine/machine sections. – Always use the designated load take-up point.

	 WARNING
	<ul style="list-style-type: none"> • Securing transit routes <ul style="list-style-type: none"> – The supply routes must be cleared prior to transport, and must be suitable for the forklift truck to pass through. If necessary, warning signs or barrier tape must be set up to keep the routes clear. • Caution <ul style="list-style-type: none"> – When opening transport boxes, care must be taken to ensure that any additional components delivered in the same box, such as computers, do not fall out.

	 WARNING
	<ul style="list-style-type: none"> • Danger of crushing for hands/feet <ul style="list-style-type: none"> – It is not permitted to grip onto or under the feet when handling the machine, as there is an increased risk of hands or feet getting crushed or trapped in these areas. – When setting down the station, make sure no persons have their feet under the machine's feet.

NOTE	
	<ul style="list-style-type: none">– When opening the transport box, any additional components must be secured to prevent them from falling out, and removed first.– Once this is done, the transport box can be removed/opened up fully, and the station can be taken out and moved to its intended location.– Care must be taken with all components projecting from the machine, as sensors and similar small parts can easily be damaged if the machine is not transported correctly.– Check that all the profile connectors are seated correctly using a size 4 – 6 Allen key. Unavoidable vibrations can loosen the connectors during transport.

7.2 Installation







The robot station is intended for the following application scenarios:

- Stand alone operation
- Operation on a CP-Lab conveyor
- Operation on the CP application module output
- Operation at the CP Factory Station Bypass

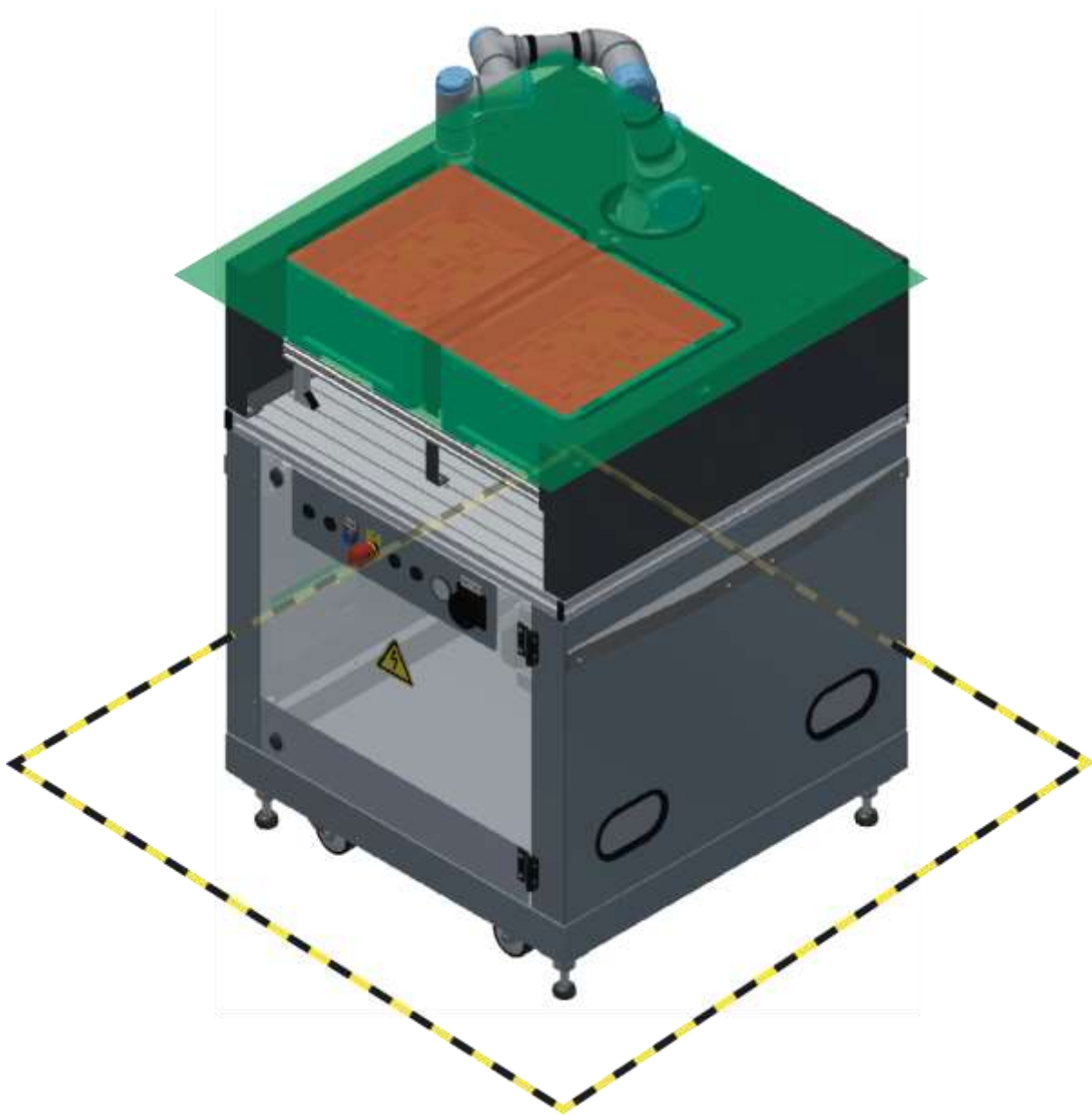
For each application scenario, there is a control program for which machine safety has been evaluated. In the event of changes to the structure or changes in the control program, the safety must be re-evaluated by the operator. In this case, the manufacturer's CE declaration of conformity must be re-evaluated.

For application scenarios in connection with CP stations, the cell_behind safety level must be removed.

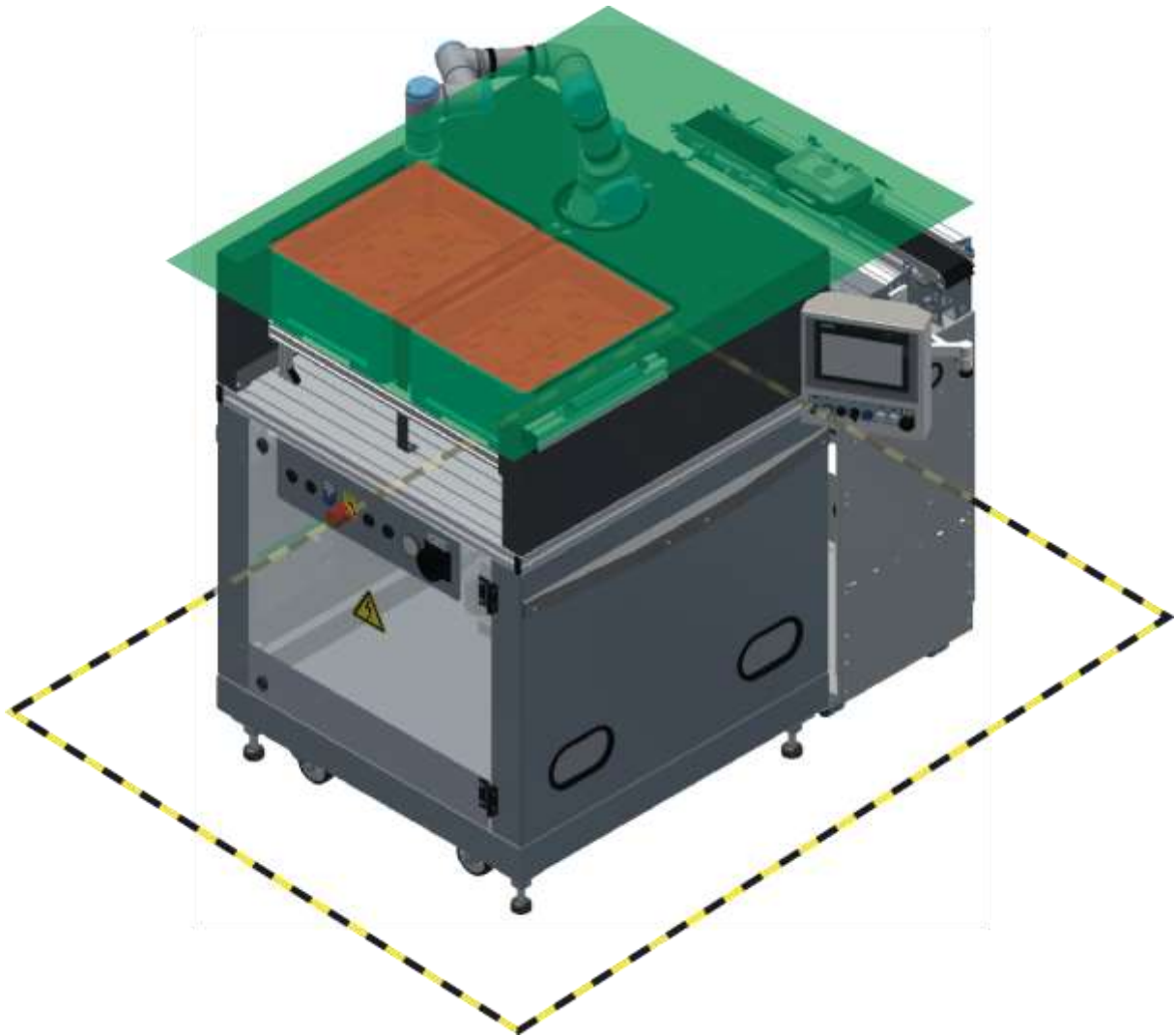
7.2.1 Legend

Marking	Meaning
	<p>Safety area around the robot station. No unauthorized persons may be present within the safety area during operation of the robot.</p> <p>We recommend marking a perimeter area around the robot station. The workplace hazard analysis should be used for the distance. Place a suitable marking on the floor</p> <p> Danger due to collision with the robot!</p> <p style="padding-left: 40px;">Do not stay in this area</p> <p style="padding-left: 40px;">Do not store any objects in this area</p>
	<p>Green area Working area of the robot - Normal speed $v = 250 \text{ mm/s}$</p> <p> Danger due to collision with the robot!</p> <p style="padding-left: 40px;">Do not reach into the movement range of the robot arm</p>
	<p>Red area / this level is approx. 4 cm above the boxes. Working area of the robot - reduced speed $v = 160 \text{ mm/s}$</p> <p> Danger due to collision with the robot!</p> <p style="padding-left: 40px;">Do not reach into the movement range of the robot arm</p>
Subject to changes	

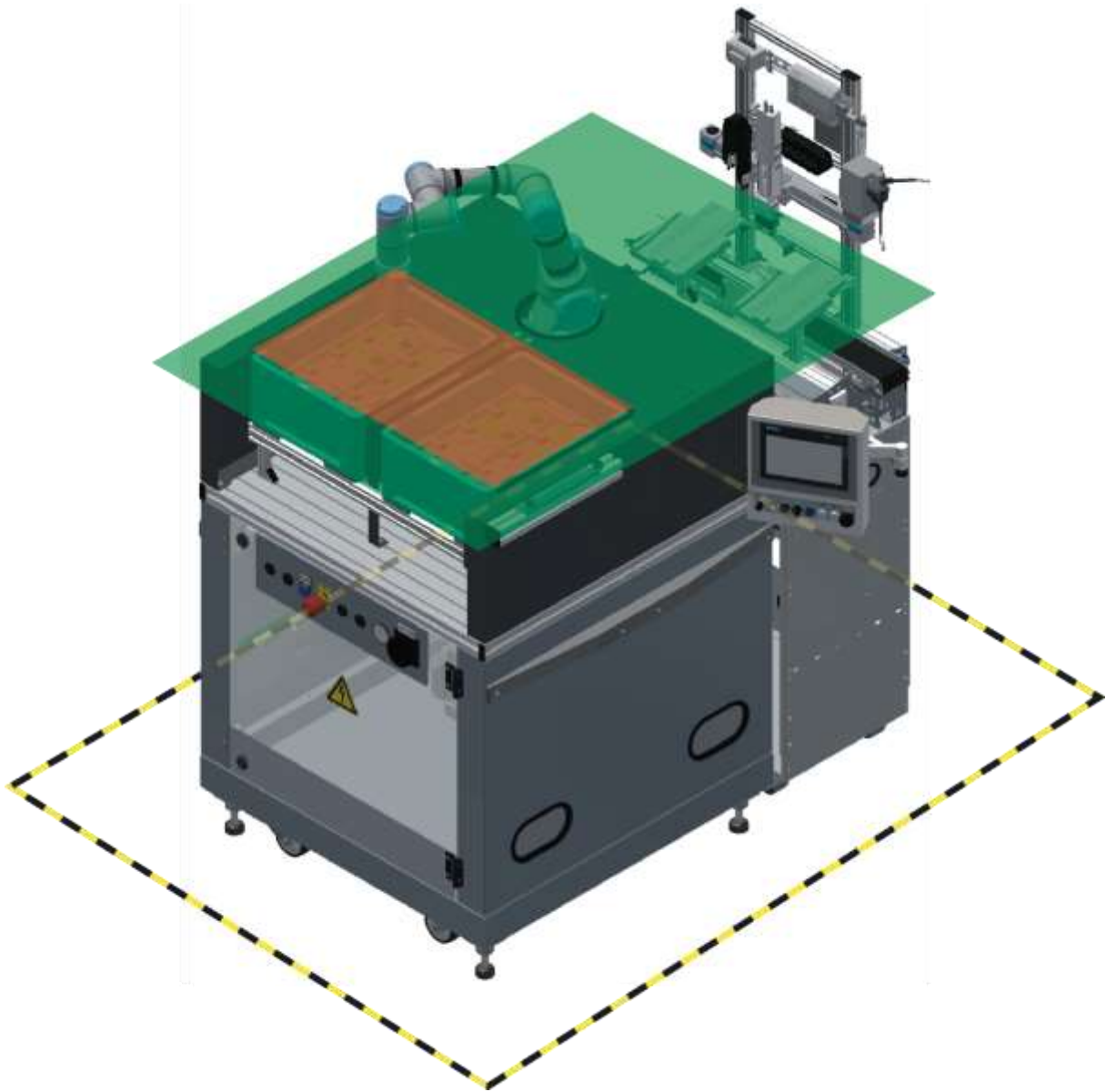
7.2.2 Standalone operation



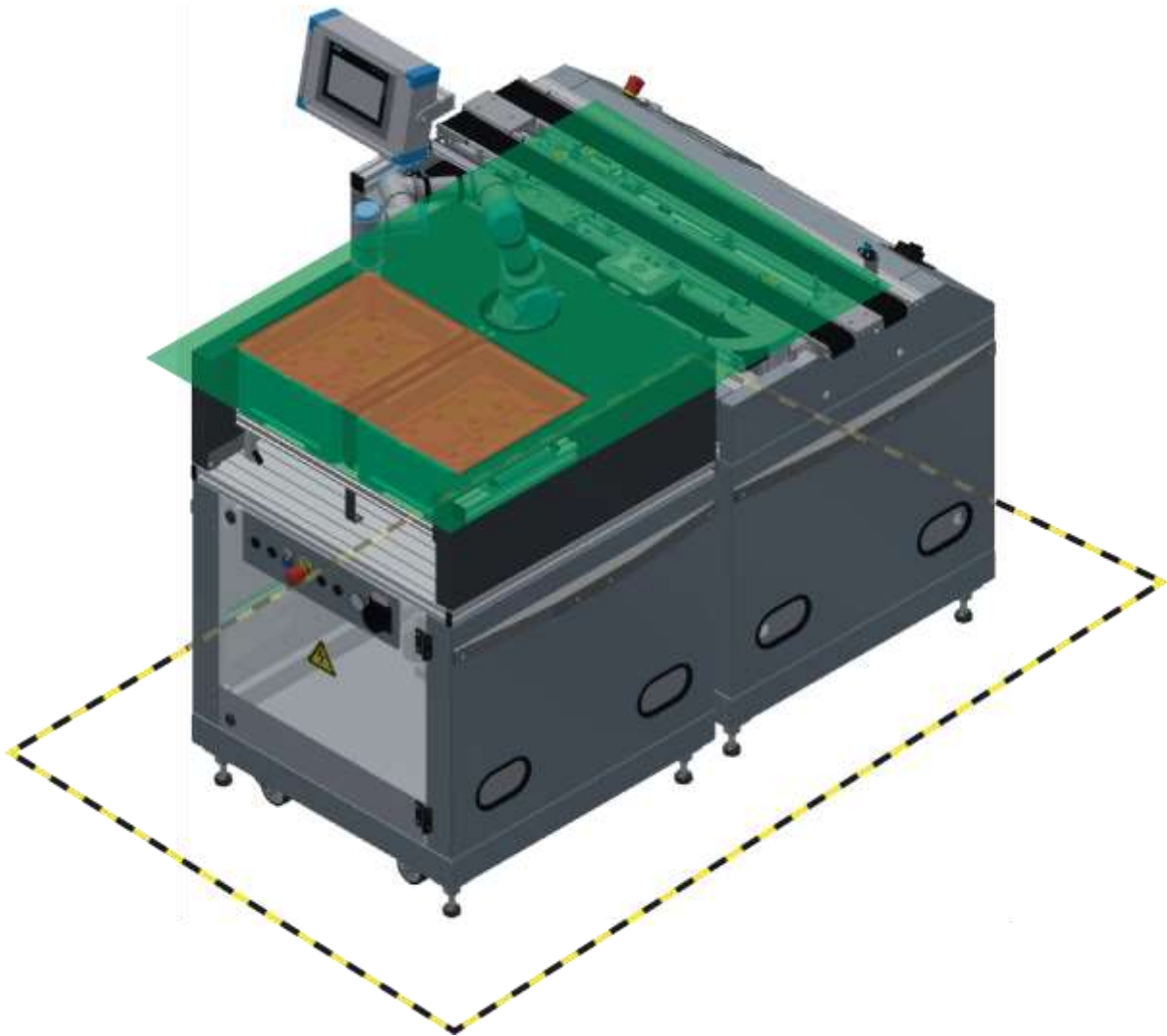
7.2.3 Operation at CP-Lab conveyor



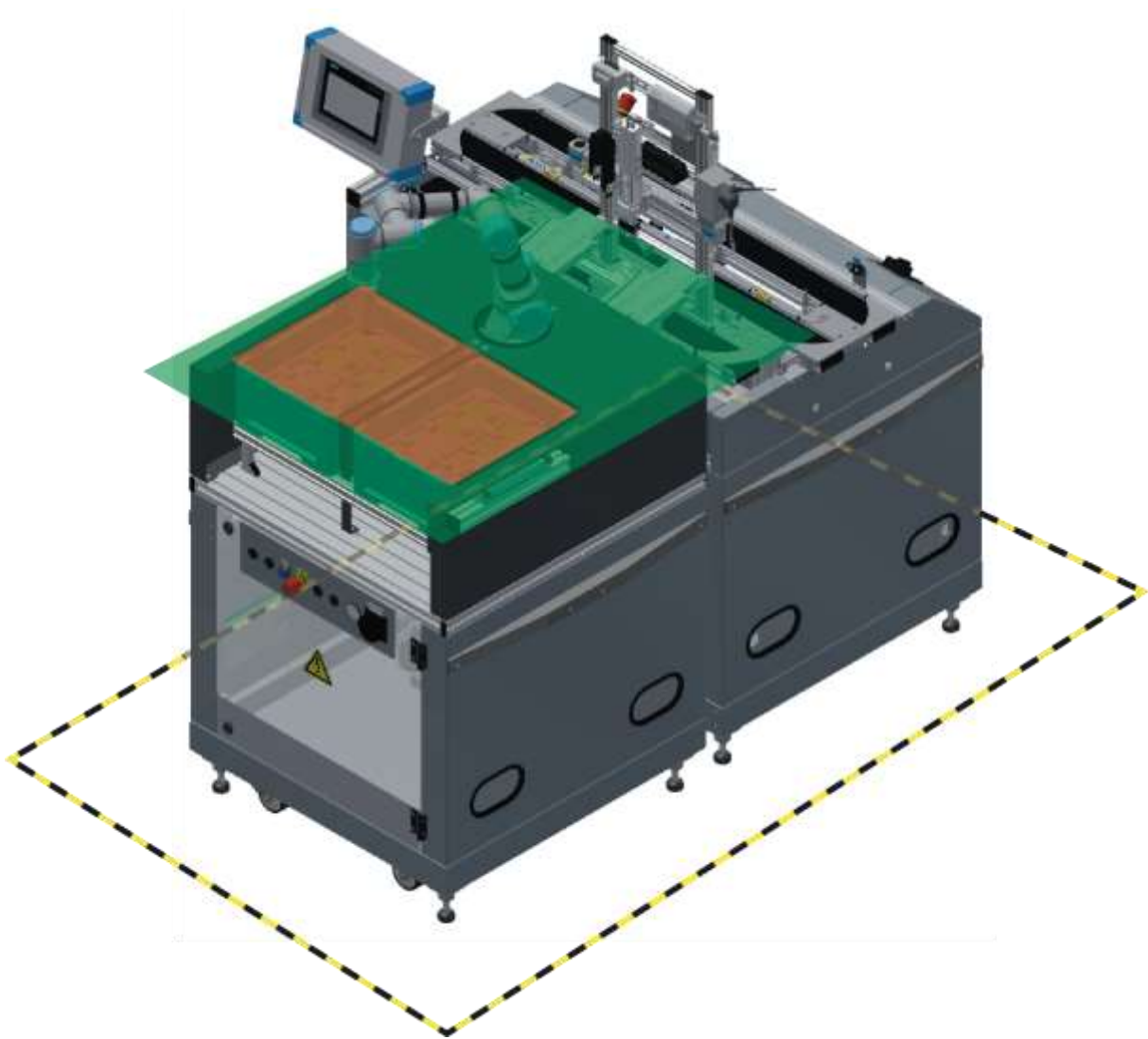
7.2.1 Operation at CP Lab conveyor with CP application module output



7.2.1 Operation at CP-Factory station „Bypass“



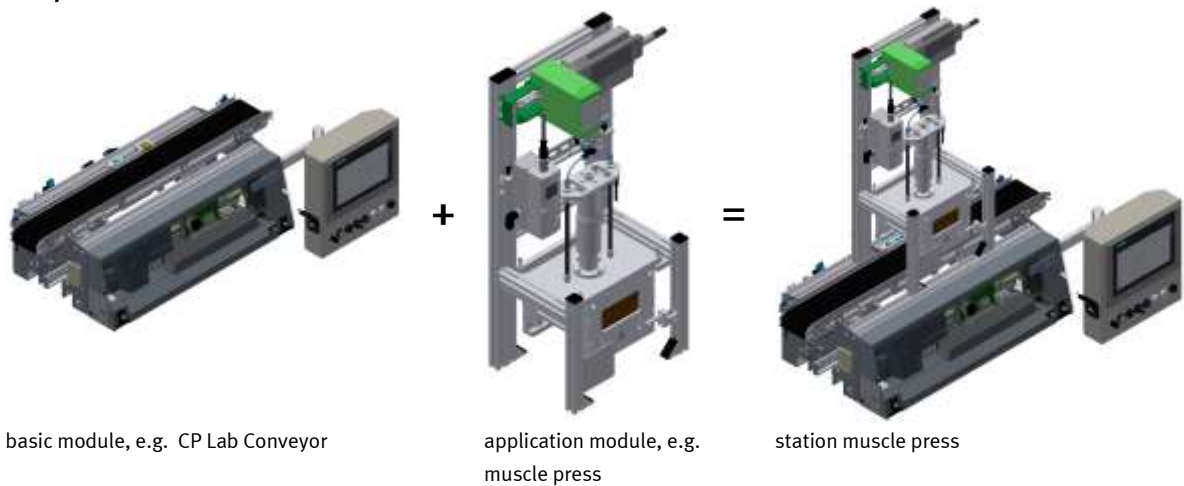
7.2.1 Operation at CP Factory station bypass with CP application module output



7.3 Overview of the System

CP Lab Conveyor, CP Factory Linear, CP Factory Shunt and CP Factory Bypass are called basic modules. If an application module, e.g. the CP Application Module muscle press is attached to a basic module, it becomes a station.

Example



If several stations are put in a row one behind the other, this will form a production line.



Carriers are transported on the conveyors of the basic modules. And on the carriers, there are pallets with a fixed workpiece reception placed. The workpieces are placed on the workpiece reception or taken from it. Pallets can also be placed on a carrier in some stations or gripped from there.

The typical workpiece of a CP Factory/Lab System is the roughly simplified version of a mobile phone. The workpiece consists of a front cover, of a back cover, of a board and of a maximum of two fuses.



7.4 Cobot UR5

7.4.1 General

The Cobot UR3e module consists of a base frame, a robot and a fixture for 2 boxes. The fixture for the boxes is equipped with a read/write identification system. This identification system is an important point of the CP Factory system. The boxes are written with the current data of the workpieces to be transported. All information necessary for the process is carried along with the boxes and is available at every working position.



The base frame is equipped with a fixture for 2 boxes and a collaborative 6-axis robot. The robot is responsible for handling all processes within the module. A specially shaped vacuum gripper is used as the gripper.

The station can be operated as an application module on a CP-Lab/CP-Factory station to transport lower and upper shells between belt and transport boxes.



The station can be used both a) as a free-standing robot training cell and b) next to a CP Lab or a CP Factory transport station.

Case a): Up to 2 transport boxes KTB 300x400mm with inlays suitable for the CP workpieces can be placed manually in the working area of the robot. In this operating mode, the station can be used for programming exercises in handling and palletizing.

Case b): If the station is used next to a CP Lab or next to a CP Factory transport station bypass, the following function is added compared to case a): The robot can access pallets arriving via the transport system and place or remove housing parts or PCBs. Back covers can also be placed loosely on front covers, which corresponds to an assembly step.

	 WARNING
	<ul style="list-style-type: none"> • Risk of crushing / pinching <ul style="list-style-type: none"> – Do not reach into the robot arm or in the area of the gripper – Since the area in which the robot is moving is not demarcated from areas in which people are present, unintentional collisions between people and robots can be assumed in principle.

7.4.2 Usable workpieces of the CP system

Front cover	Back cover
	
Front cover, all available colors are allowed	Back cover, all available colors are allowed

7.4.3 Operation on an application module Output

If the module is operated at an application module output, there is no communication between the module Cobot and the application module output. The L6_SlidePick program must be selected for this operation. In this case, two sensors are mounted on the output slides of the application module and connected directly to the robot controller. If one of the sensors detects a workpiece on one of the slides, an automatic sequence starts on the robot.

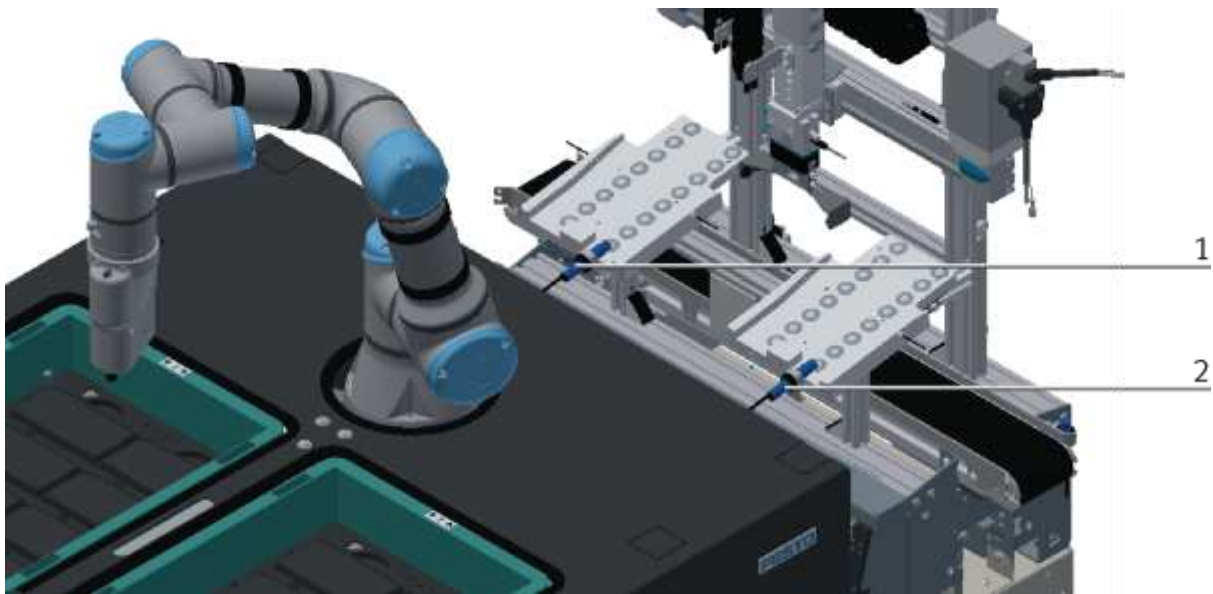


Illustration similar

Pos.	Name
1	Sensor slide 1 is connected to CI0 of the robot controller
2	Sensor slide 2 is connected to CI0 of the robot controller

7.4.4 Operation with worker collaboration/ML (machine learning)

The module can optionally be extended by a camera system. A separate operating manual is available for this purpose; information concerning the robot is also listed in this operating manual.

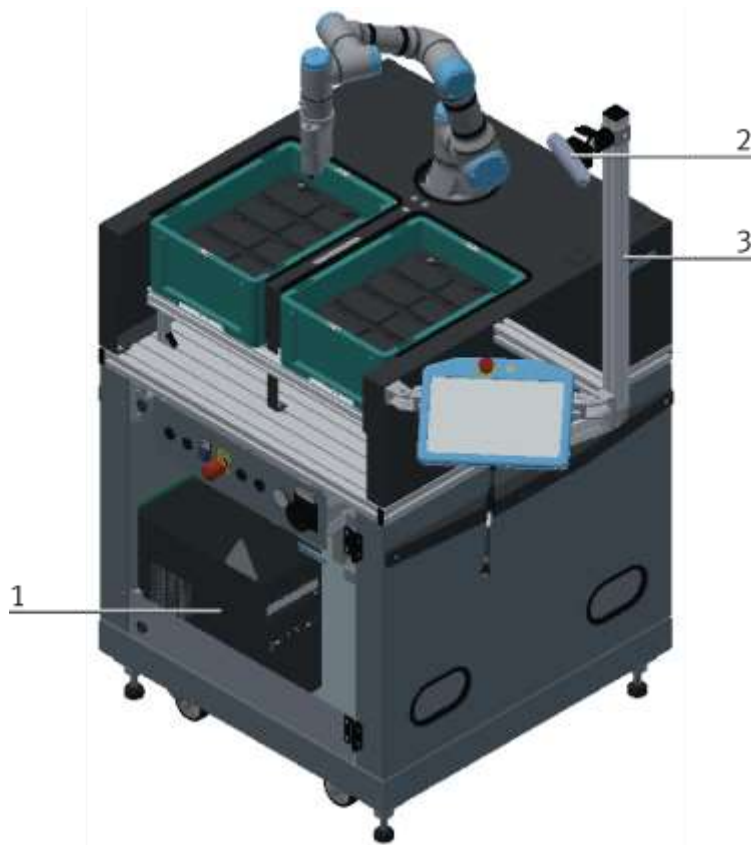


Illustration similar

Pos.	Name
1	ML-PC (MachineLearning)
2	Camera system
3	Camera gallows

7.4.5 Setup

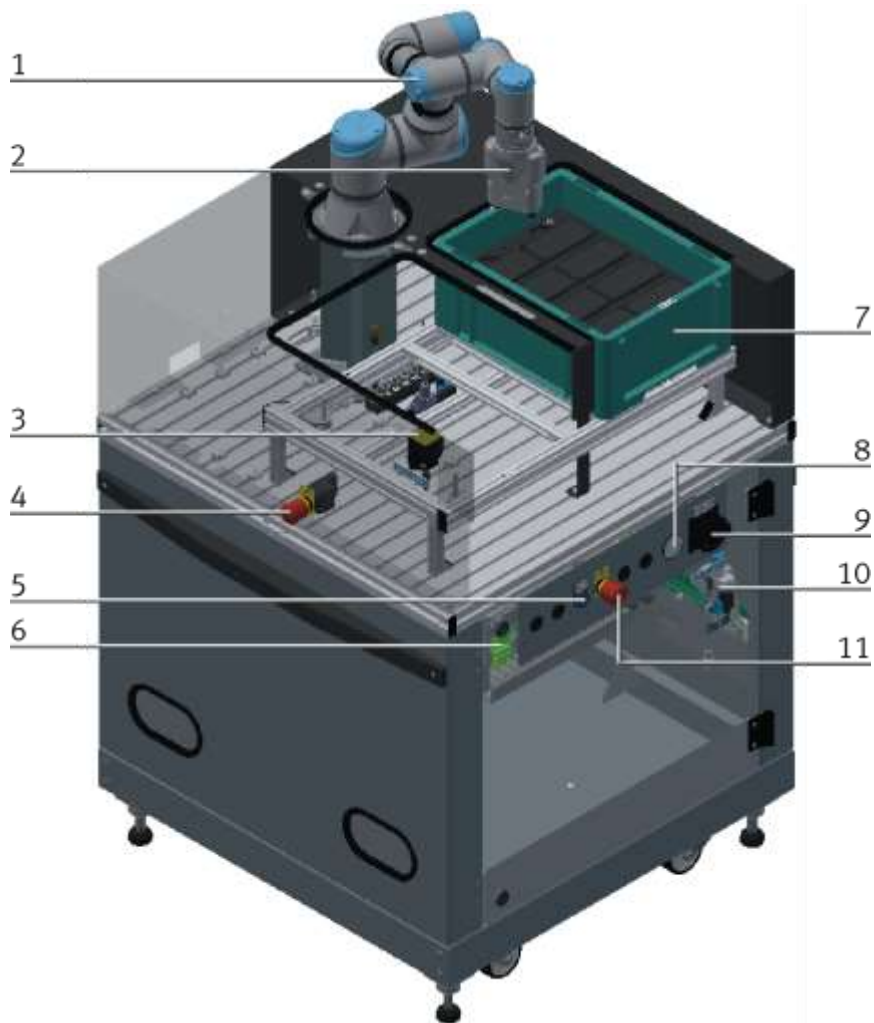


Illustration similar

Position	Designation
1	Robot Universal UR3e
2	Vacuum gripper
3	Position box 1 (under the box there is the RFID sensor TF80)
4	Emergency stop left (F2-SF3)
5	Pressure switch Reset (S1-F2-SF2)
6	Electric board
7	Position box 2 (under the box there is the RFID sensor TF81)
8	Manometer
9	Main switch (S1-QB1)
10	Pneumatic maintenance unit
11	Emergency stop at operation panel (S1-F2-SF1)
12	Controller eSeries

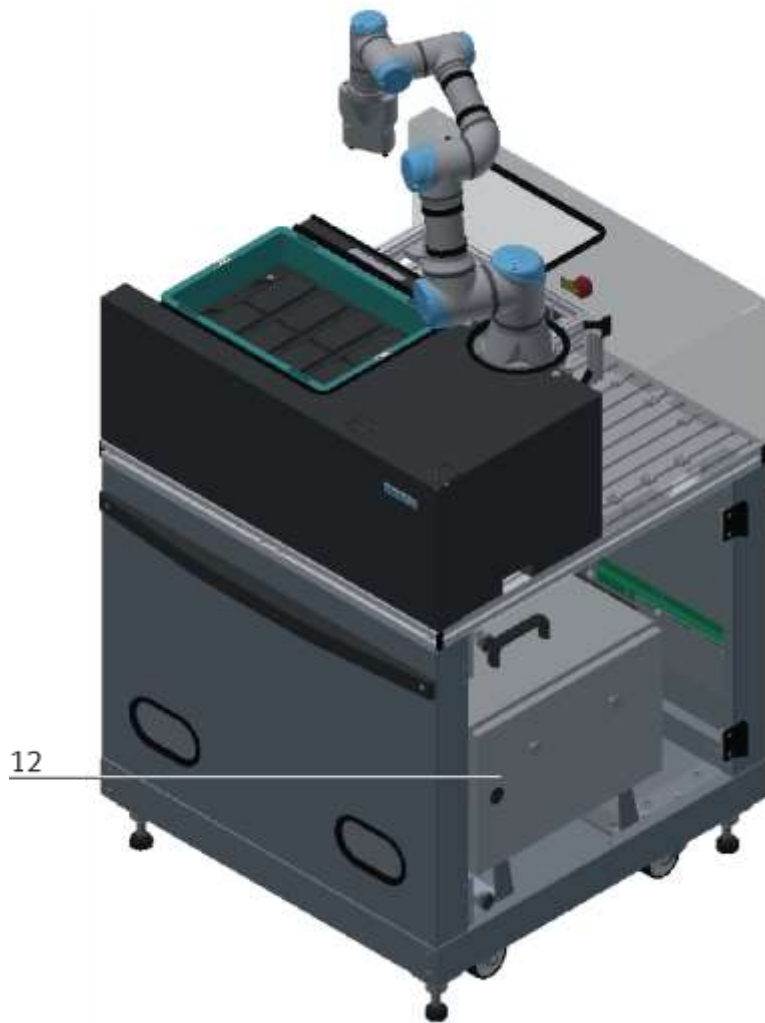




Illustration similar

8 Commissioning

	NOTE
	<ul style="list-style-type: none"> – The following applies to the start-up as well as to the restart.

- The station is delivered pre-assembled.
- All attachment parts are individually packaged.
- All components, tubings and cablings have been clearly marked in order to guarantee a problem-free retrieving of all connections.

	NOTE
	<ul style="list-style-type: none"> – You can read the general installation instructions in the manual of your basic module. The following instructions apply particularly to station.

8.1 Workplace

The commissioning of the station requires:

- The station itself
- a basic module CP Factory or a basic module CP Lab Conveyor for the communication to the system (optional)
- a workpiece carrier with pallet and a workpiece to align the station (option)
- an on-site electrical connection in the room, see data sheet
- an on-site pneumatically connection in the room, see data sheet



8.2 Initial start-up

Before switching on for the first time, ensure that the following have been installed as intended:

1. Mechanical attachment, alignment, stability
2. Electrical connection
3. Signal connections
4. Pneumatic connection
5. Safety-relevant markings (marking on the floor)
6. Further organizational measures that relate to the safety of the plant
e.g. instruction

After switching on the power, make sure that

1. Emergency stop circuits are functional
2. The robot program controls the required sequence of movements
3. The speed reduction at the pick / place positions works.
4. Speed reduction in the safety levels works.

	 WARNING
	<ul style="list-style-type: none"> • Danger from strange start! The robot can be started via the UR3e teach pendant (PolyScope) or via external signaling. <ul style="list-style-type: none"> – Only start the robot via the PolyScope control panel when you have a line of sight. Make sure that there are no unauthorized persons on the robot. – In automatic mode, you must always expect the robot arm to move. – Unpredictable movements of the robot are possible due to the optional gesture control. – Only reach into the movement area when the visual display requests interaction.

8.3 Visual Inspection

	 WARNING
	<ul style="list-style-type: none">• Any damages must always be repaired instantly.

Visual inspection has to be carried out prior to every commissioning!

Before you start, you must always inspect the following parts regarding visual damages and function:

- Electrical connections
- Mechanical components and connections
- Emergency Stop devices



8.4 Safety Regulations

	 WARNING
	<ul style="list-style-type: none">• Any damages must always be repaired instantly.

The station may only be operated on the following conditions:

- The technical condition – mechanically and electrically – of the station is perfect.
- The station is used in accordance with the regulations.
- The operating instructions have been read and understood.
- All safety devices are available and active.

8.5 Safety note

	 WARNING
	<ul style="list-style-type: none">• Danger due to head and torso being crushed / clamped between the robot arm and camera mount.• Do not place the upper body between the robot arm and the camera holder. Upper body must be outside the movement radius of the robot.

8.6 Set the vacuum generator

8.6.1 Commissioning

- Make sure that: – nobody is standing under the work load or in the area in which it is to be transported – no objects lie within this path (e.g. by providing a protective grill).
- Avoid long tubing and large volumes between the work load and the vacuum suction nozzle. A large volume leads to long evacuation times and possibly to incorrect settings on the vacuum switch.
- When setting the VADM(I)-... make sure of the following:
 - that the LED for the switching point signalizes correct operation
 - that the minimum vacuum (lower switching point) is sufficient for holding the work load safely.
 - that high vacuum values increase the time required for evacuation.
- When setting the necessary holding force, take into account any accelerations, external influences etc. on the work load.

When carrying out the basic setting of the vacuum switch with the VADM(I)-...- P/N,

- turn the potentiometers for:
 - vacuum switching point in a clockwise direction as far as possible (maximum setting)
 - hysteresis in a clockwise direction as far as possible (maximum setting).
- The following applies to all variants.
 1. Pressurize the VADM...-... . The following variables are assigned to the input pressure:
 - air consumption
 - maximum vacuum
 - noise level created
 - time required for evacuation
 2. Position the vacuum nozzle with the suction cup on the work load.
 3. Apply DC voltage to the electric connections for vacuum generation (supply voltage $V_b = 24 \text{ V DC}$). The work load is held by the vacuum.
- Setting the upper switching point (SP) on the VADM(I)-...-P/N
 4. Check whether the switching point LED is alight. If this is not the case, turn the potentiometer for vacuum switching point in an anti-clockwise direction until the LED lights up. When the nominal value vacuum is reached (upper switching point), the outputs of the vacuum switch will be switched.
- With the VADMI-...-LS-P/N
 5. Check whether the suction process is operating at fixed intervals (pulsed operation = vacuum generation switched on and off continually). If this is not the case, turn the potentiometer for vacuum switching point in an anti-clockwise direction until vacuum generation is interrupted. The pulse frequency is a measure of the vacuum leak on the work load (high pulse frequency = high leakage).

- Setting the hysteresis (lower switching point) on the VADM(I)-...-P/N
 6. Remove the work item. If the LED still lights up, reduce the hysteresis in an anti-clockwise direction until the switching point LED goes out. By removing the work item again, check whether the work load is held firmly and whether the LED reacts as follows:
 - LED lights up: work load is held
 - LED does not light up: work load removed.
- Reducing the vacuum on all variants:
 7. Interrupt the electric supply to the connections for vacuum generation . The vacuum nozzle is exhausted via the silencer.
- With vacuum nozzle with release pulse function and vacuum switch (VADMI-...- P/N)

Please note that a one-way flow control valve will prevent fast reduction of the vacuum. The vacuum will also be reduced by leakage (e.g. rough or permeable surfaces).

In conjunction with a higher-order logic (e.g. PLC), vacuum generation on the VADM(I)-...-P/N (without economy function) can be interrupted in the hysteresis range [from a) to b)] (economy function = SF). This economy function is already incorporated in the VADMI-...-LS-... . The correct suction process is confirmed by a signal and also by the switching point LED . If a fault occurs (e.g. a work item has fallen down) and the vacuum sinks 150 mbar below the switching point for the suction process, signal (A) will be set to 0. The suction process will not be interrupted.

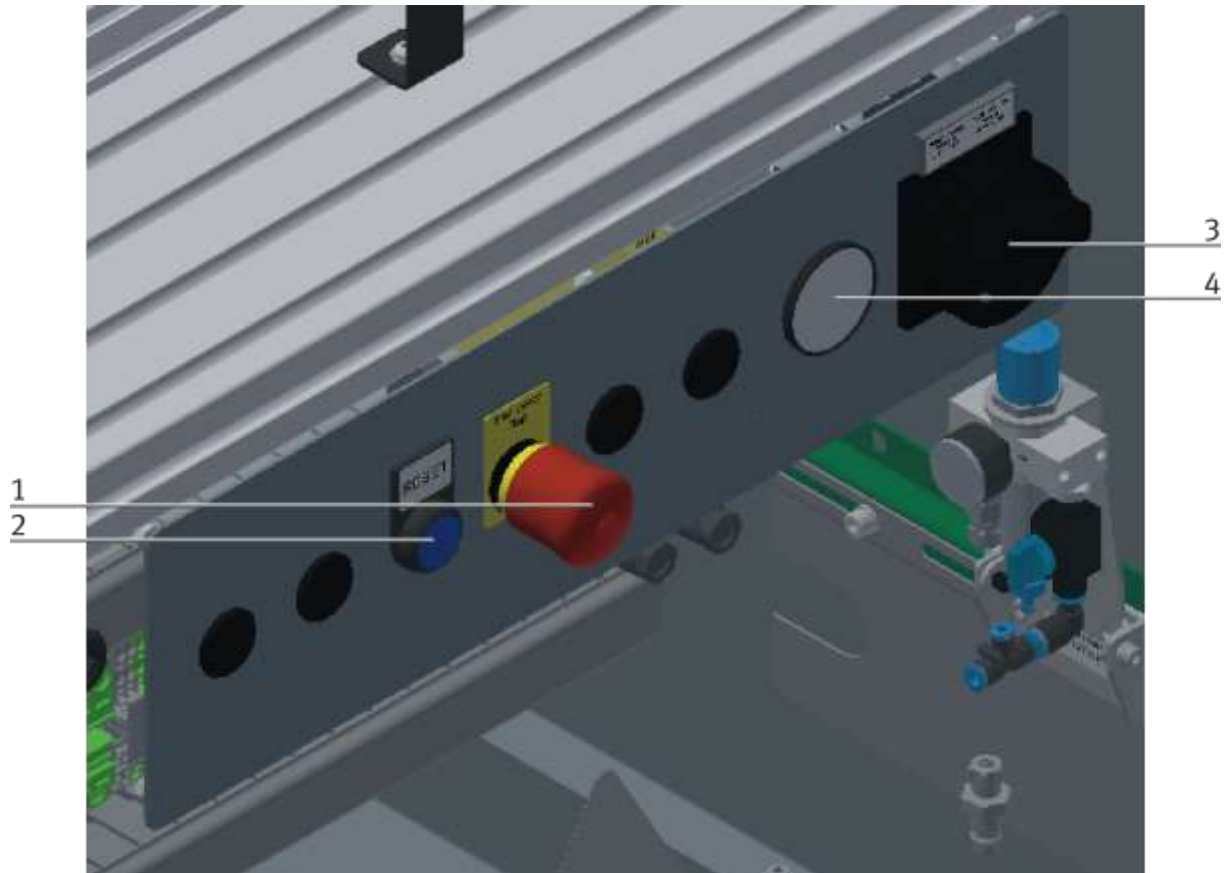
- Speeding up the reduction in vacuum on the vacuum nozzle with release pulse function (VADMI-...)
 8. Apply current to the electric connections for the release pulse.

The vacuum will be reduced quickly by compressed air pouring in (release pulse). Adhesion forces can then be reduced.

The intensity of the release pulse can be adjusted with the flow control screw of the release pulse (turning in an anti-clockwise direction increases the intensity of the release pulse).
- For all variants 9. Exhaust the VADM..-...

9 Operation

9.1 The control units of the cobot module UR3e



Position	Description
1	Emergency- stop switch – S1 F2-SF1
2	Reset button – S1-F2-SF2
3	Manometer
4	Main switch -S1 QB1

The Teach Pendant (PH1) is described in the Robot chapter.

9.2 Process sequence

The initial filling of the boxes must be carried out before each program start.

The material boxes are not detected by the controller. It is recommended to remove or insert the boxes when the robot arm is not in the area of the boxes. A possible movement of the robot arm does not represent a danger, since all safety functions of the robot are permanently active.

9.2.1 Program L1_Standalone

Initial filling: the left box is filled with back covers; the right box is empty.

Sequence

- The robot is in automatic mode
- The operator presses the vacuum gripper from left to right
- The robot removes a back cover from the right box and stacks it in the left box.
- If the worker presses the vacuum gripper from right to left, the robot takes a workpiece from the left box and stacks it in the right box.


9.2.2 Program L2_StandaloneML

Option if a ML System is installed.

Initial filling: the left box is filled with back covers; the right box is filled with front covers. The position of the workpieces must be observed.

Sequence

- The robot is in automatic mode
- The operator presses the vacuum gripper from left to right
- The robot removes a back cover from the right-hand box and remains in its basic position.
- The operator holds an open palm in the camera's field of view.
- Once the hand is detected by the ML system, the robot sensitively places the cover on the operator's open palm. If the operator moves his hand, the robot follows this movement until the palm is held still. Only then is the workpiece placed on the open palm of the operator.

NOTE	
	<p>In the following cases, the robot does not move to the hand position, it stops and a message appears on the Machine Learning PC.</p> <ul style="list-style-type: none"> • The hand is too close above the table • The hand is outside the table • The hand is too close to the camera holder

- If the worker presses the vacuum gripper from right to left, the robot takes a workpiece from the left box - the further procedure is the same as described above.

9.2.3 Program L3_StandaloneML

Option if a ML System is installed.

Initial filling: the left box is filled with back covers; the right box is filled with front covers. The number as well as the position of the workpieces is insignificant, the camera recognizes the workpieces.

Sequence

The robot takes a back cover from the left box and mounts it on a front cover in the right box. The assembly is divided into 2 steps. In the first step the operator has to push the gripper in the desired direction so that the robot starts.

Step 1 of the assembly

- Push from right to left, the robot takes a red back cover and moves to its home position
- Pressure from left to right, the robot picks up a blue back cover and moves to its home position.
- Pressure from the front to the back, the robot picks up a black back cover and moves to its home position.
- Pressure from the back to the front, the robot picks up a white back cover and moves to its home position.

Once a back cover has been picked up and the robot has reached its home position, the worker must press the gripper again in one direction.

Step 2 of assembly

- Pressure from right to left, the robot mounts the sucked-in back cover and mounts it on a red front cover
- Pressure from left to right, the robot mounts the aspirated back cover and mounts it on a blue front cover
- Pressure from the front to the back, the robot mounts the aspirated back cover and mounts it on a black front cover.
- Pressure from the back to the front, the robot mounts the aspirated back cover and mounts it on a white front cover

9.2.4 Program L4_cpSystem

Initial filling: controlled by MES

Sequence

- The robot is in automatic mode
- The robot takes a workpiece from the conveyor and places it in one of the crates, depending on the selected MES parameter, into one of the boxes.
- The robot takes a workpiece from a box, depending on the selected MES parameter, and places it on the workpiece carrier on the conveyor.

9.2.5 Program L5_cpSystemML

Optional if a ML system is installed.

Initial filling: controlled by MES

Sequence

- The robot is in automatic mode
- The robot picks up a workpiece from the conveyor and places it, depending on the selected MES parameter, into one of the boxes.
- The robot picks up a workpiece from the conveyor and, depending on the selected MES parameter, places it in the worker's hand.
- The robot takes a workpiece, depending on the selected MES parameter, from a box and places it on the workpiece carrier on the conveyor.

9.2.6 Program L6_SlidePick

Optional if an application module output is mounted on a conveyor. (Sensors must be mounted on application module and connected directly to the robot control).

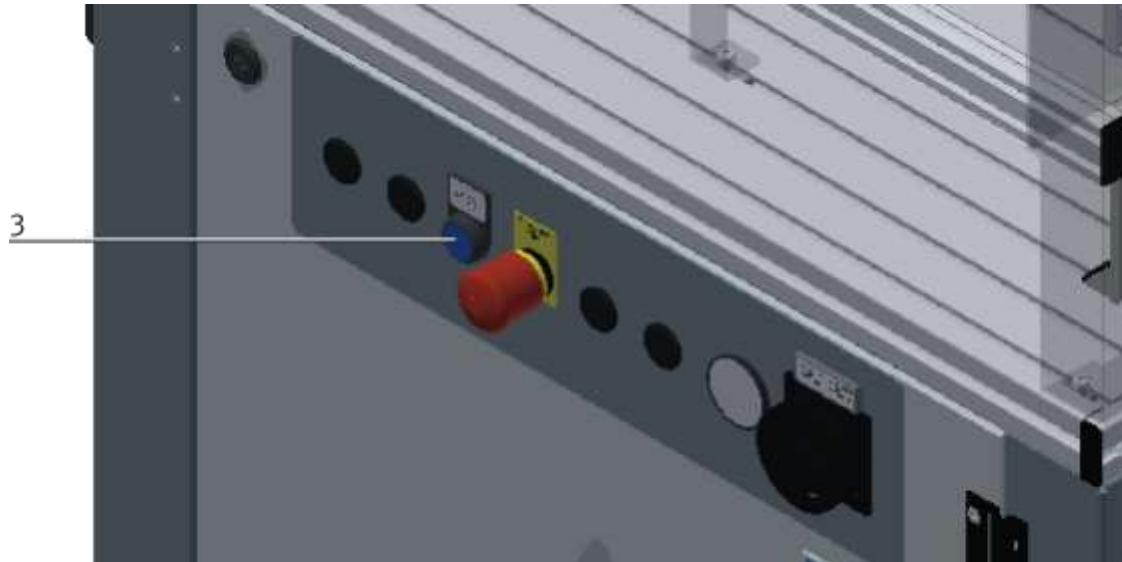
Initial filling: both boxes are empty.

Sequence

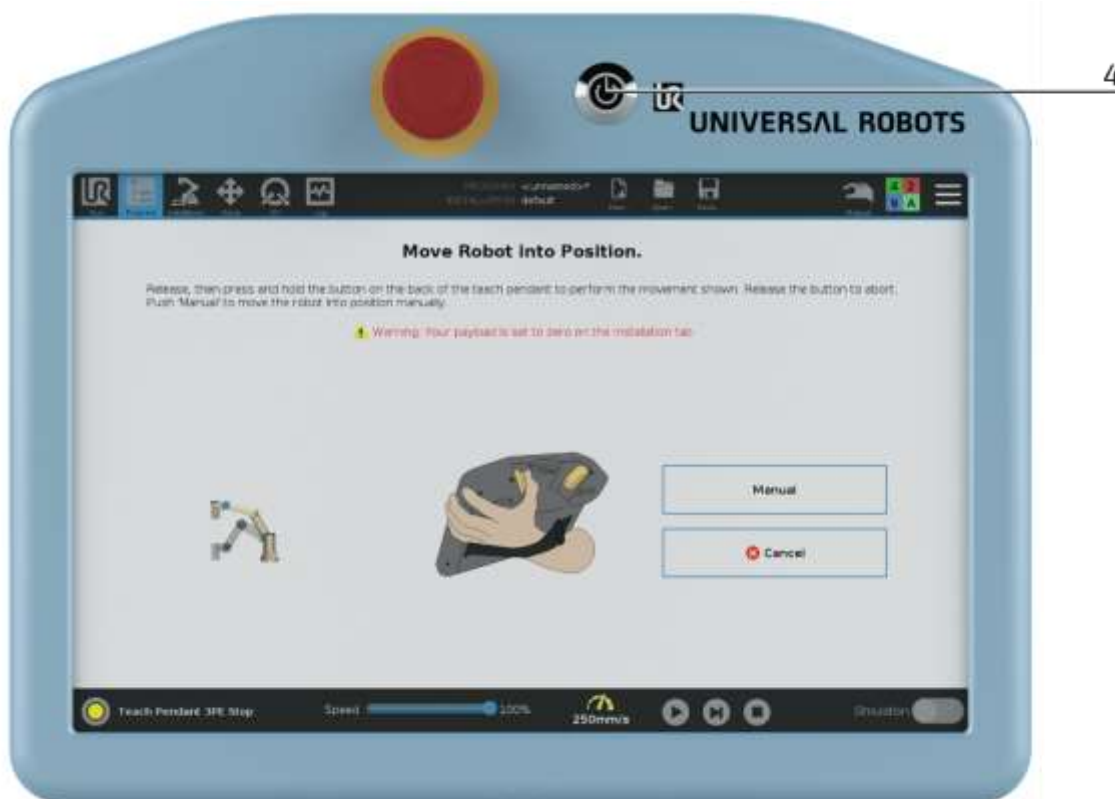
- The robot is in automatic mode
- If one of the sensors reports that a workpiece is on one of the chutes, the robot takes it from the corresponding chute and places it in the left box at the right/rear position. All other depositing positions are approached by the robot one after the other in order to deposit the workpieces.

9.3 Switch on module

1. All EMERGENCY STOP signaling devices are not actuated or activated and unlocked.
2. Switch on the main switch
3. Press the reset button on the control panel.



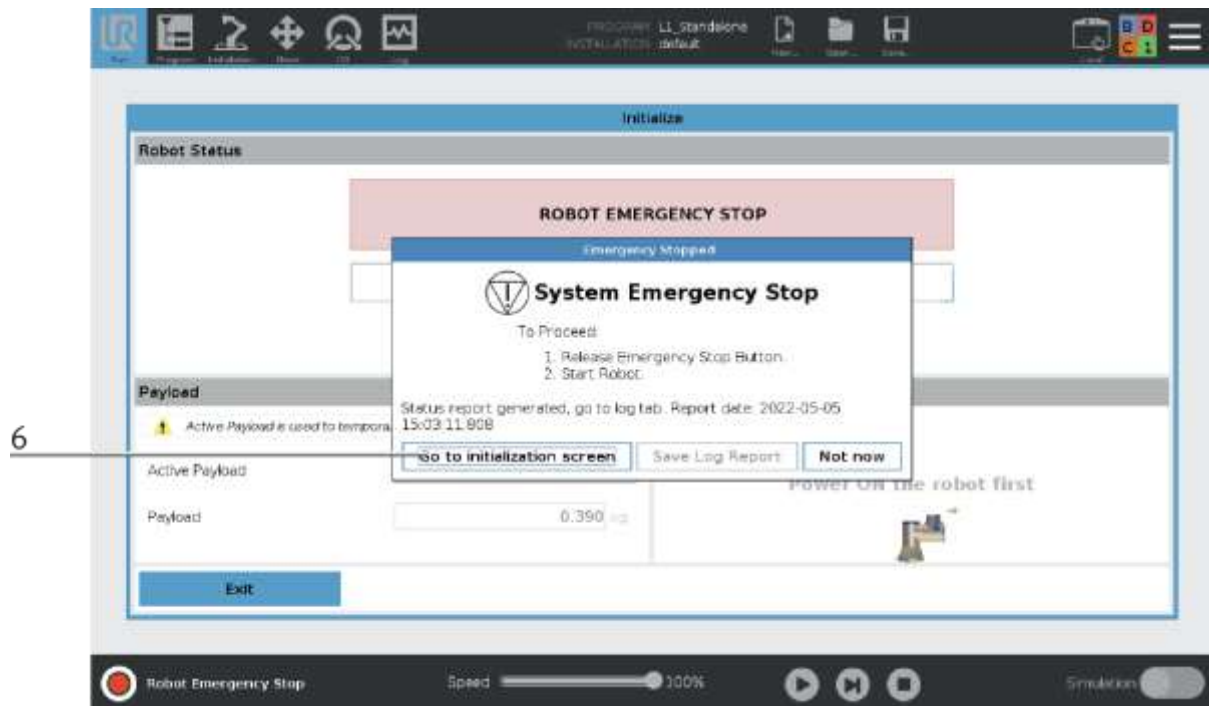
4. Press the Power Button (1) on the control panel of the robot



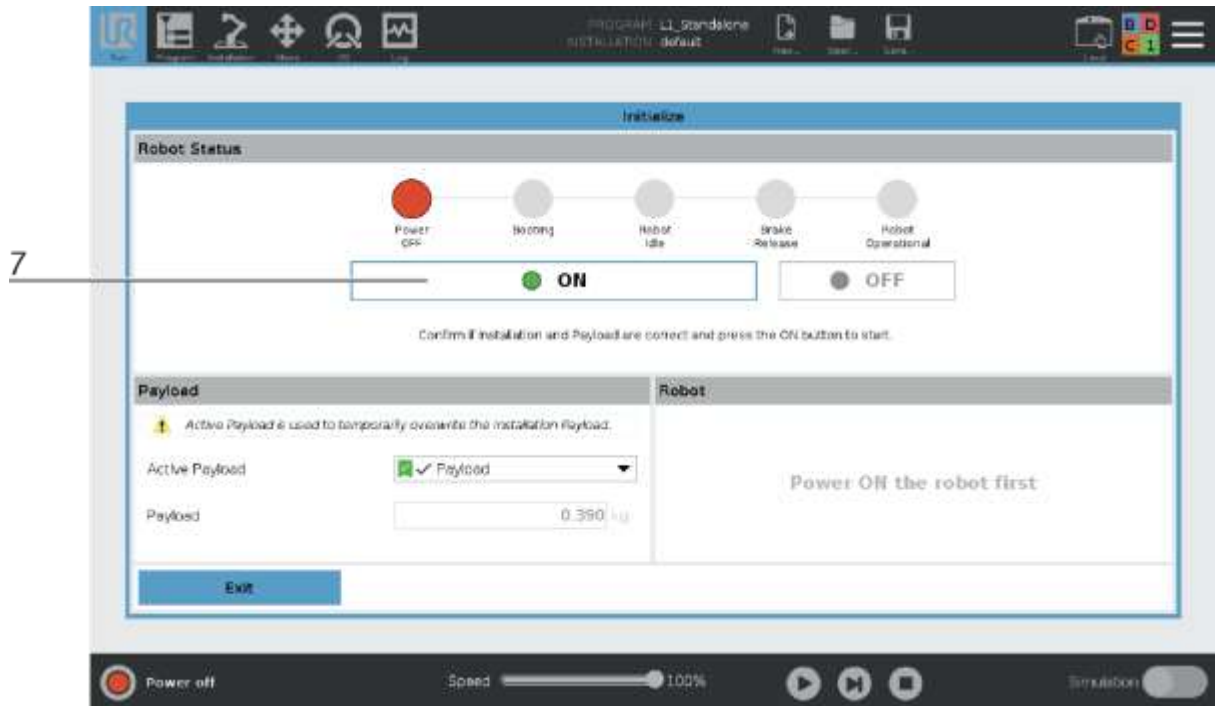
5. The controller of the robot is booting



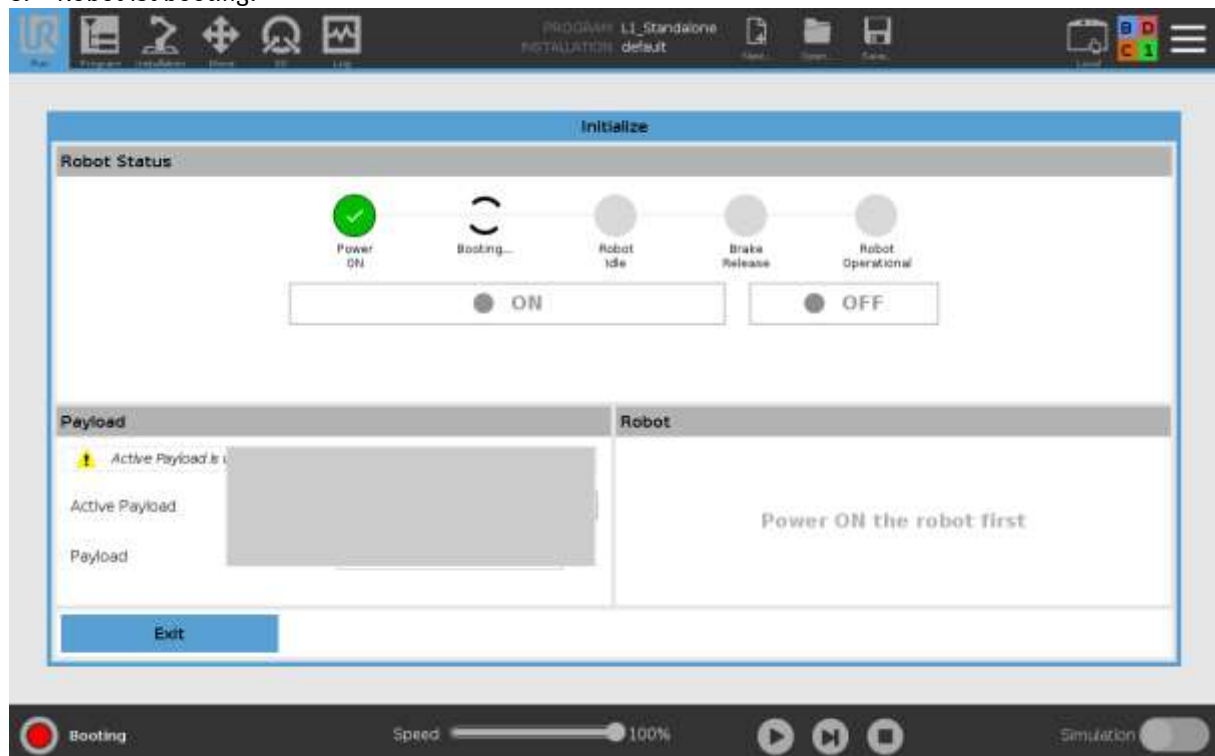
6. Press the "Go to initialization screen" button.




7. Press ON button



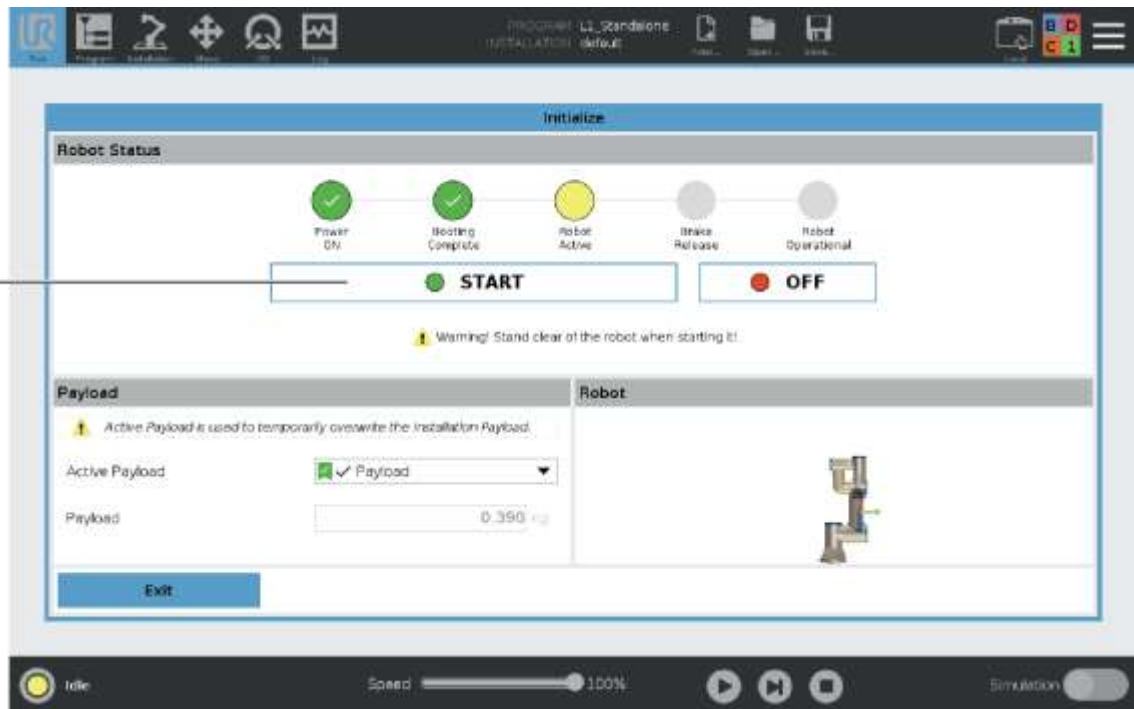
8. Robot is booting.



9. Press „START“ Button.

	NOTE
<p>Attention the danger area of the robot arm must be free.</p>	

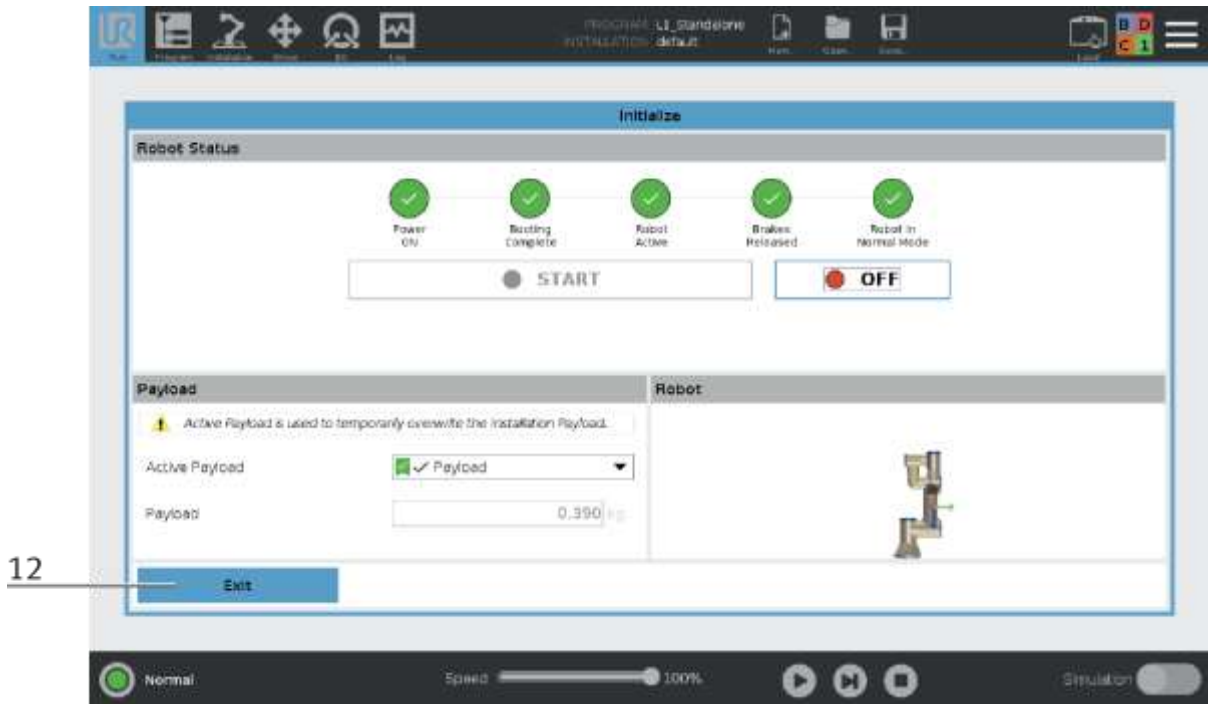
9



10. The robot performs its reference run.

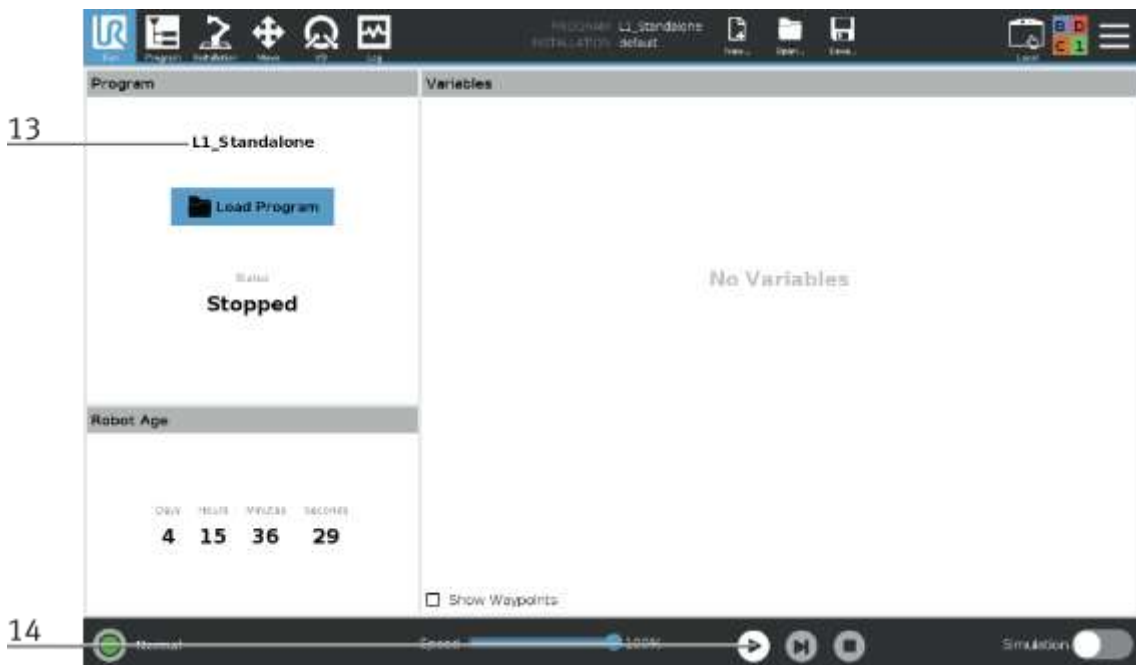
11. The current step is displayed in the Robot status field.

12. Press the Exit key to complete the initialization and exit this view.



13. The preselected program is displayed here. If another program is to be started, see the description Program change.

14. Press the arrow key (Play) to start the preselected program.

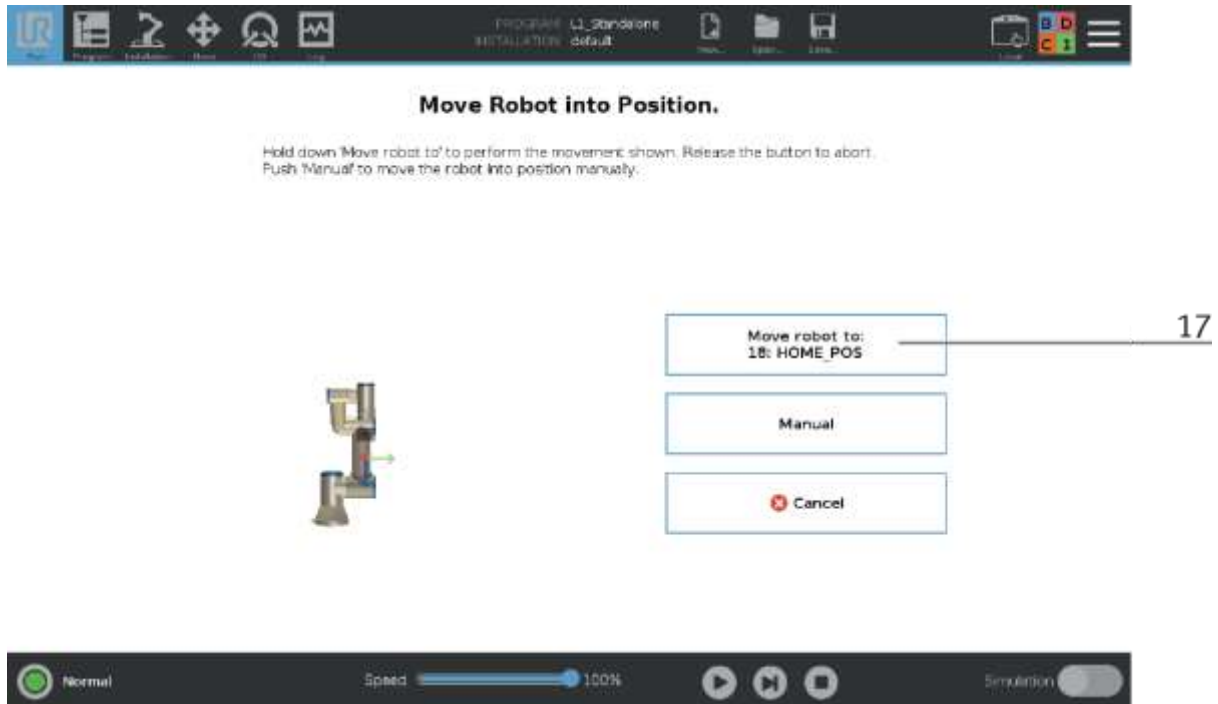


15. Press the Play button from the beginning of the robot program.

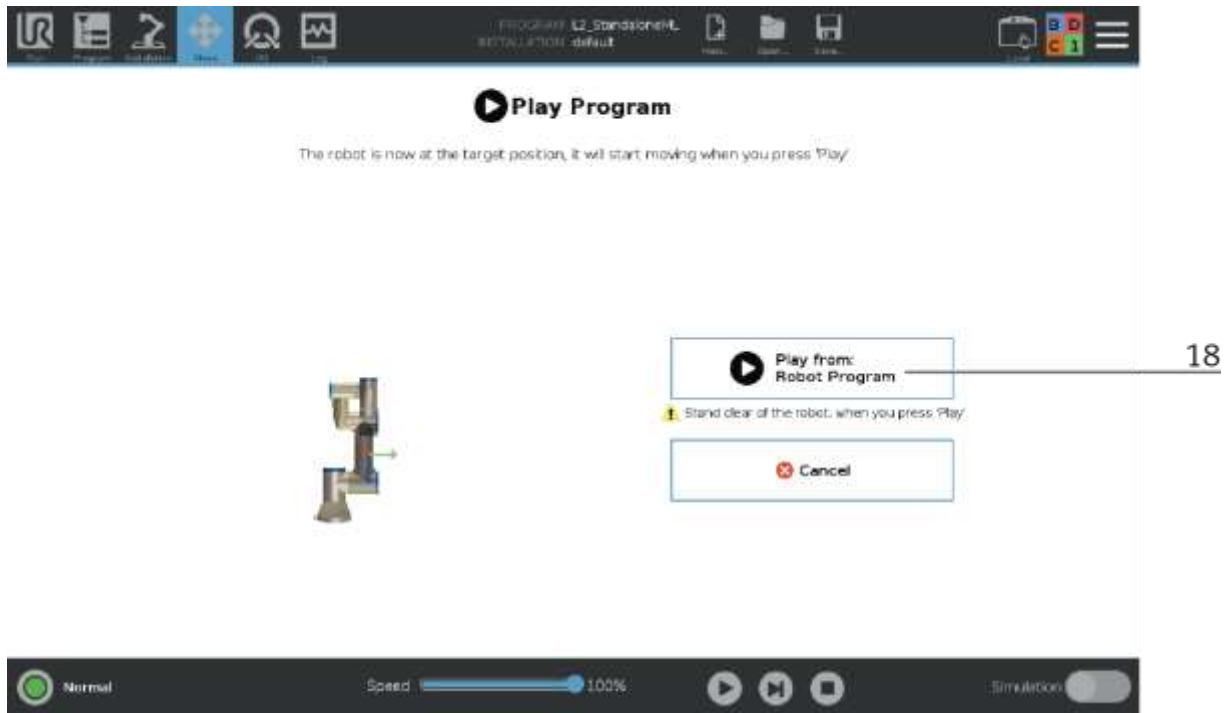


16. If the robot is not in the home position, the following screen will be displayed.

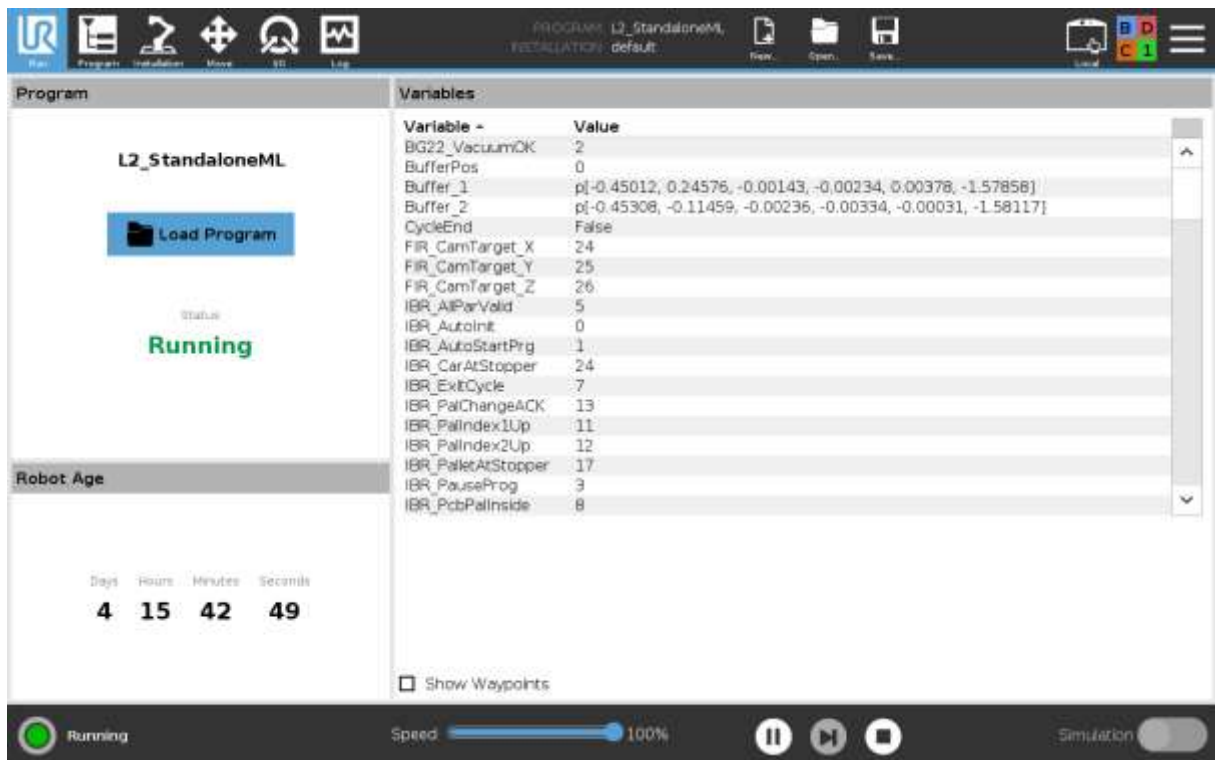
17. Press the 18: HOME_POS button to move the robot, button must remain pressed until the robot is in home position. Make sure that the robot is not in any collision area (e.g. at the CP Lab belt). If this is the case, the robot must be moved manually out of this area. (See description of manual movement)



18. Now press the Play from: Robot program key to start the program.



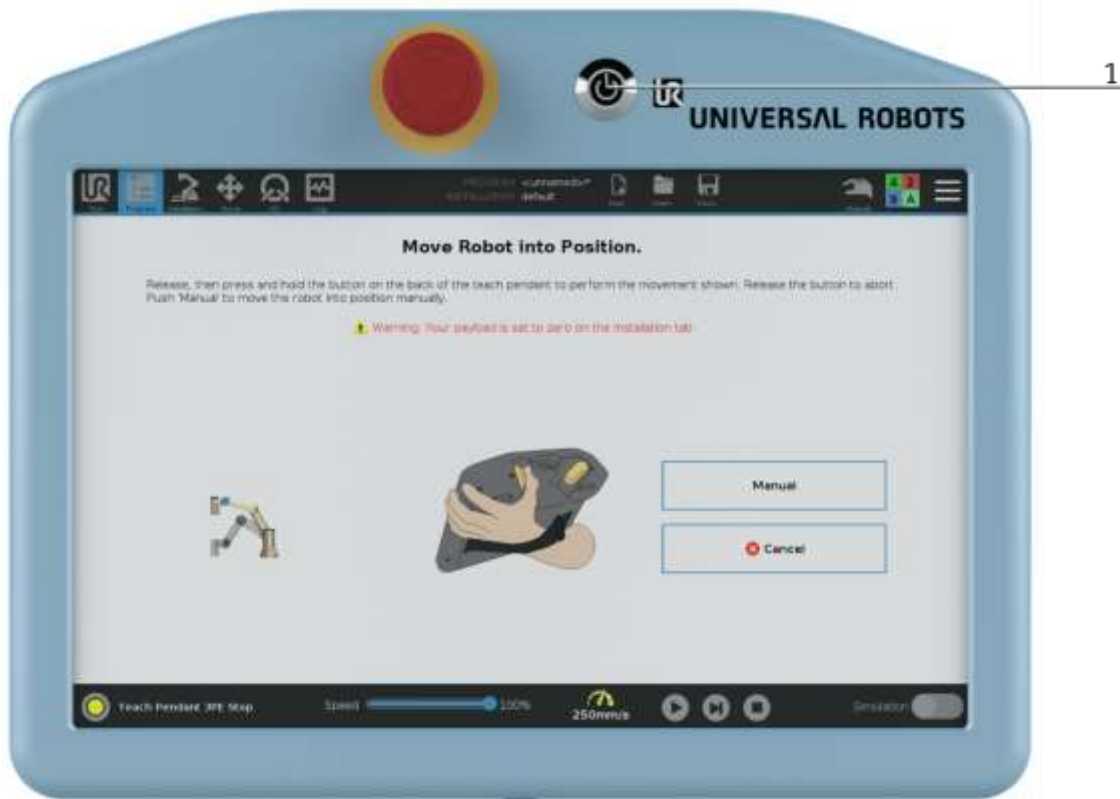
19. Now the robot is in automatic mode.



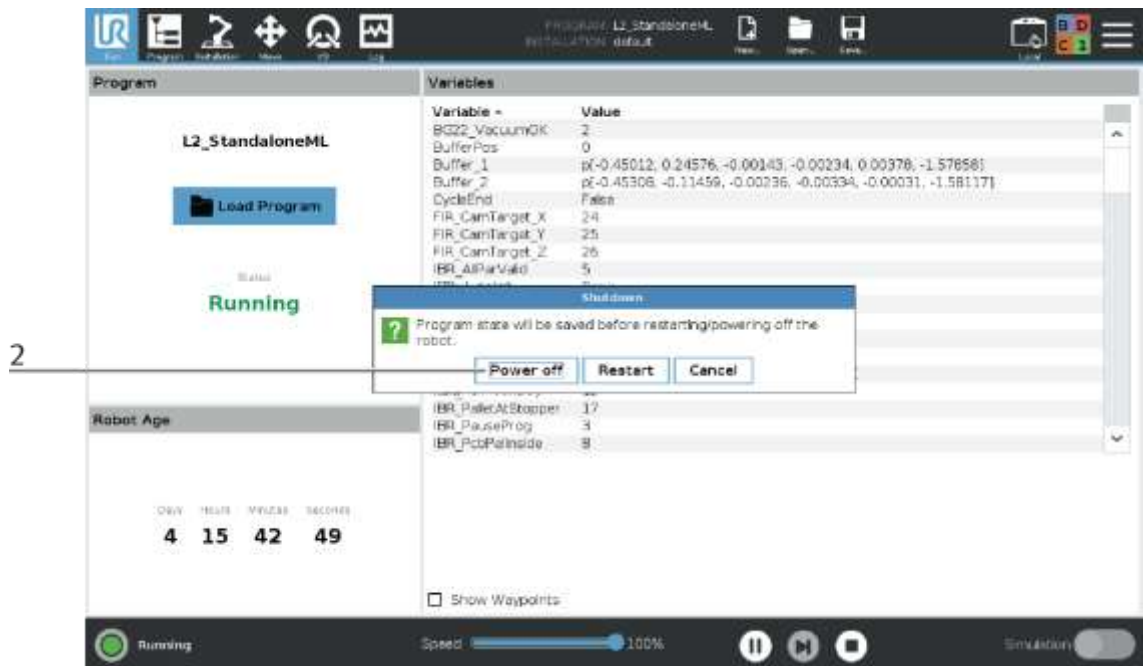
Example

9.4 Switching off the module

1. press the power button (1) on the control panel of the robot.



2. Press Power off Button.



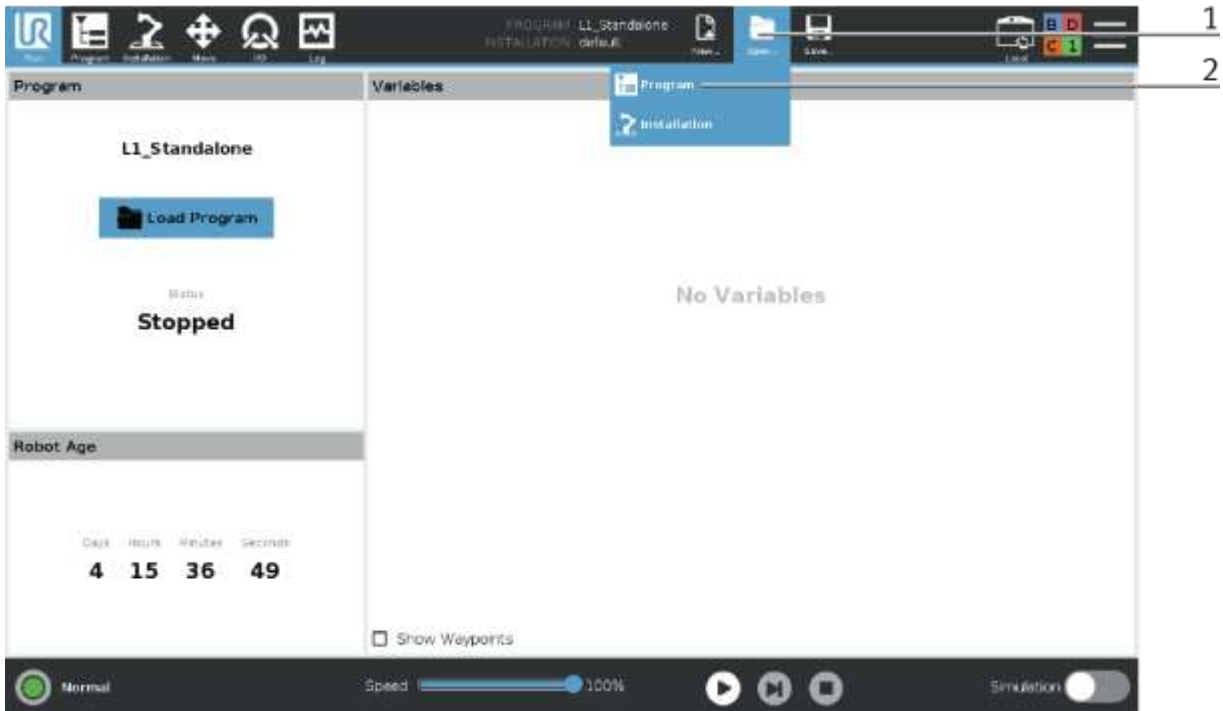
3. ML PC must be shut down in a controlled manner.
4. switch off main switch

9.5 Further operating functions on the robot teach pendant

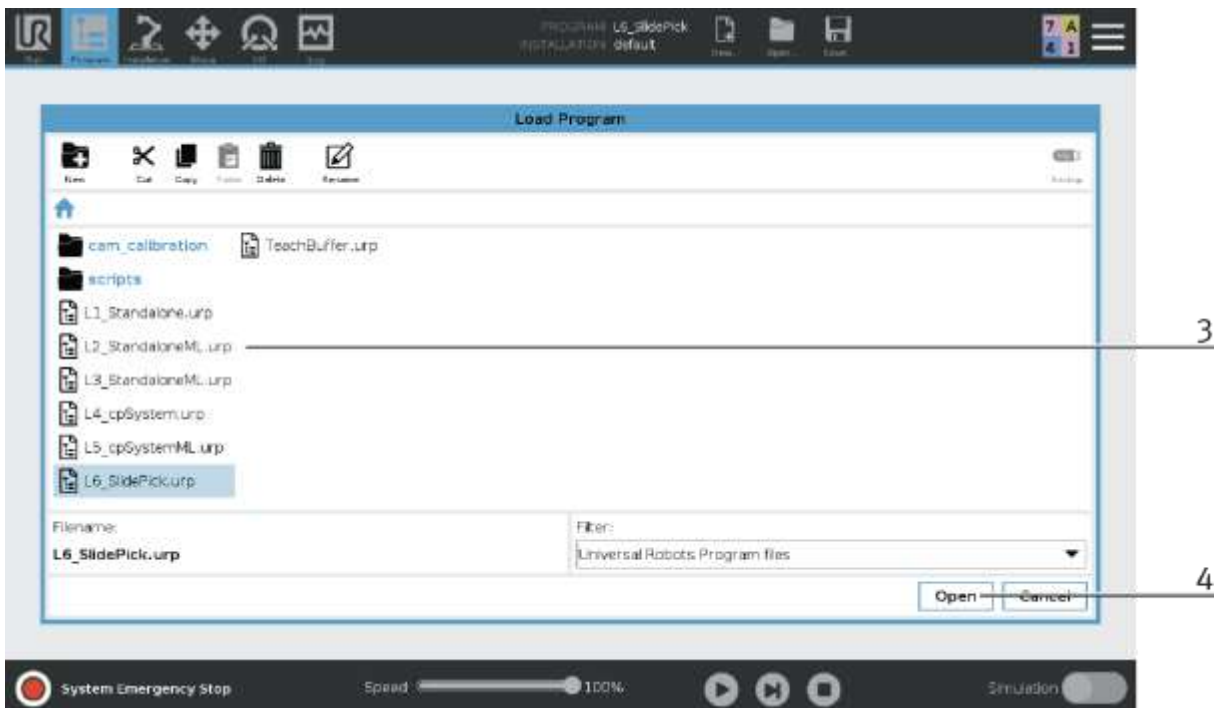
9.5.1 Change / edit program

If you want to change/edit the program of the robot, proceed as follows:

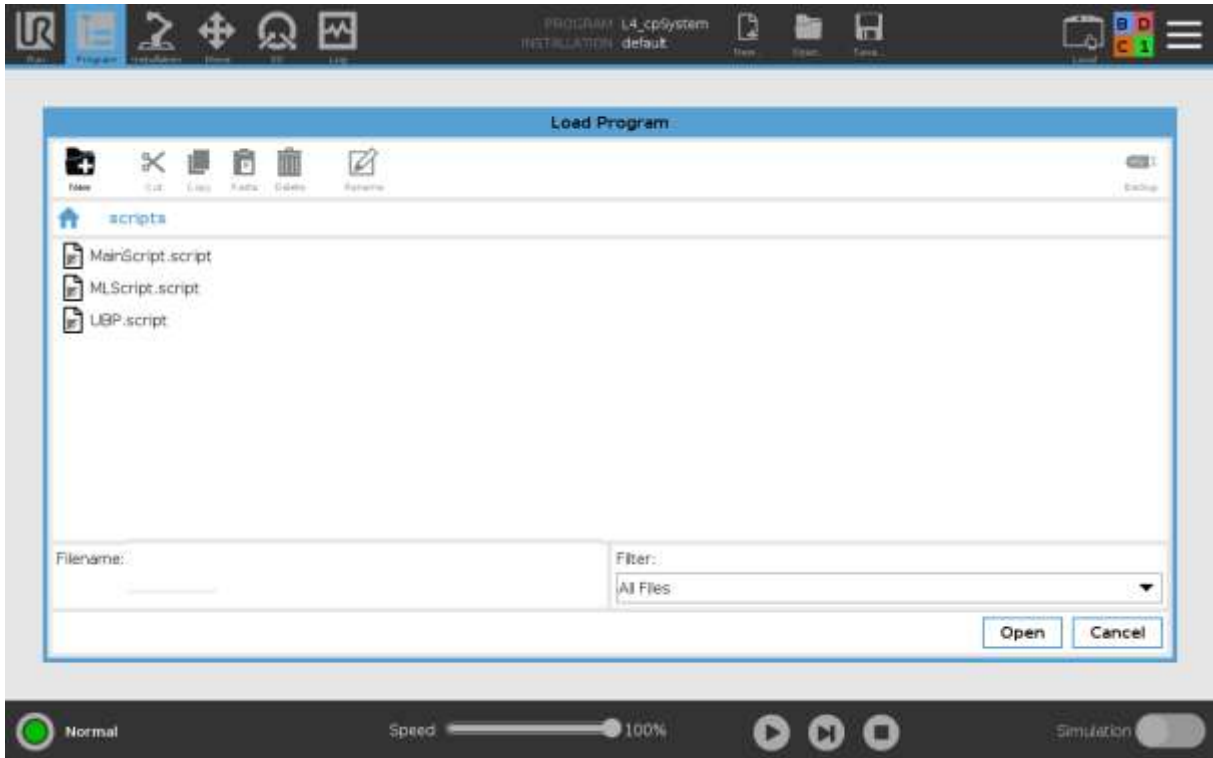
1. Click on the Open button
2. Click on the Program button



3. In this area, the desired program can be selected.
4. Click on the Open button to open the program.



9.5.2 Script



The script files are located in this area. The script files are auxiliary programs that are called from the main programs.

The following script files are available:

- **Mainscript.script**
Contains auxiliary functions that are used by all programs.
e.g. suction the workpiece; check sensors; set status LED
- **MLScript.script** - will only be loaded if ML is also used
Contains the functions for the worker collaboration.
e.g. communication with the ML-PC.
- **UBPScript.script**
Contains the user based program, it is initialized at every program start and contains all global variables.

9.5.3 Robot function Move

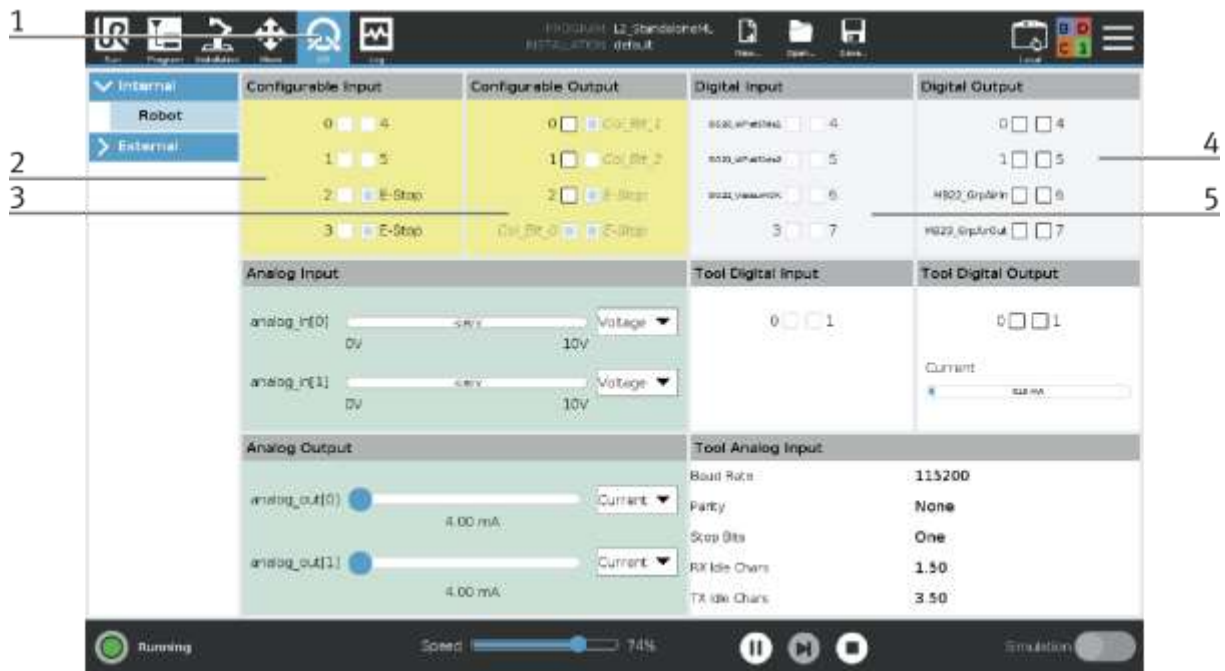
1. If you want to move the robot manually, switch to the motion mode



2. In this area it is possible to move the robot with the arrow keys in X, Y, Z (translatory movement).
3. With the
 - Home Button it is possible to move the robot to its home position.
 - Align Button
 - Freedrive Button it is possible to move the robot manually to the desired position - hold the button pressed.
4. In this area it is possible to rotate the robot with the arrow keys in X, Y, Z (rotational movement).
5. In this area, the tool position is announced.
6. In this area it is possible to move the robot in each of its axes (axis specific movement).

9.5.4 Robot function I/O

1. If you want to view or control the inputs and outputs of the robot, switch to I/O mode.



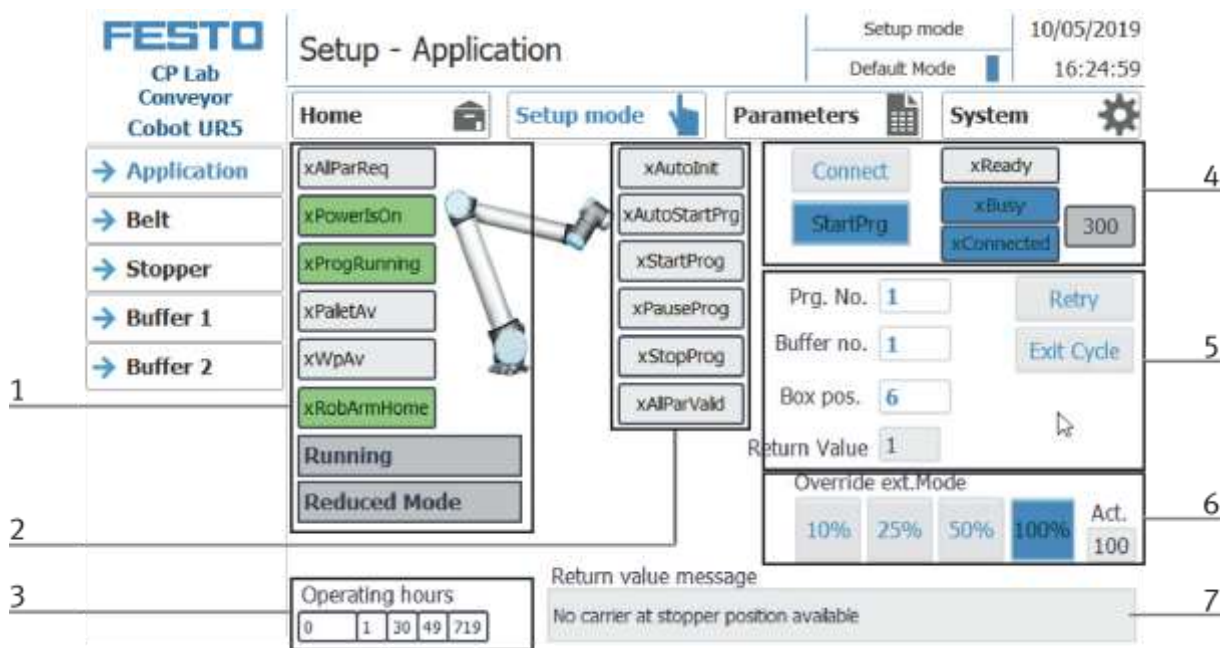
2. In this area it is possible to observe the configurable inputs of the robot. (Fields are highlighted in blue if the input is active.
 0-5 are currently not assigned
 E-Stop - Emergency stop active / double secured
 E-Stop - Emergency stop active / double secured
3. In this area it is possible to activate and observe the configurable outputs of the robot. (Fields are highlighted in blue if the output is active)
 0-2 are currently not assigned
 Col_Bit_0 - Status LED Bit 0 (See table Status LED)
 Col_Bit_1 - Status LED Bit 1 (See table Status LED)
 Col_Bit_2 - Status LED Bit 2 (See table Status LED)
 E-Stop - Activate emergency stop / double secured
 E-Stop - activate emergency stop / double secured
4. In this area it is possible to operate and observe the digital outputs of the robot. (Fields are highlighted in blue if the output is active)
 0-1/4-7 are currently not assigned
 MB22_GrpAirIn - Switch on vacuum at gripper
 MB23_GrpAirOut - Switch off vacuum at gripper
5. In this area it is possible to observe the digital inputs of the robot. (Fields are highlighted in blue if the input is active.
 BG20_WPatSlide1 (only needed if module is operated at a CP-AM-OUT)
 BG21_WPatSlide2 (only needed if module is connected to a CP-AM-OUT)
 BG22_VacuumOK
 3-7 are currently not used

9.6 HMI operation on a CP-Lab conveyor

If a Cobot Station is operated at a CP Lab conveyor, there are various displays for this on the HMI of the conveyor; these are described below. All other displays on the HMI are associated with the conveyor and are explained in the operating instructions for the conveyor.

9.6.1 Setup operating mode application

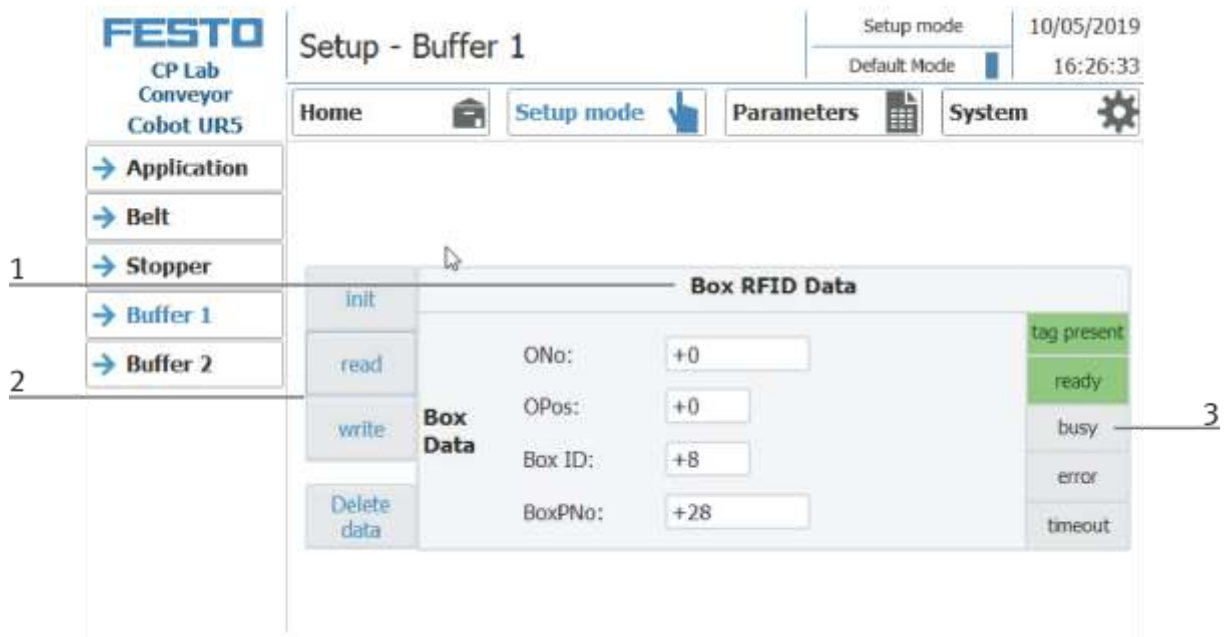
In setup mode, all sensors can be displayed and actuators controlled from the HMI. This is used for troubleshooting or during commissioning. Only the pages required for the UR5 are explained, all other functions of the HMI are listed in the manual for the CP-Lab conveyor.



Position number	description
1	Display robot outputs / from robot to PLC (green if active) xAllParReq – all parameters are requested xPowerIsOn – all drives are active xProgRunning – a program is running xPalletAv – palette available xWpAv – workpiece available xRobArmHome – robot is in home position Running – the robot is active Reduce Mode – robot moves with reduced speed
2	Display robot inputs / from PLC to robot (orange if active) xAutoInit – reset the robot xAutoStartPrg – robot automatic is started/ program is running in a loop xStartPrg – robot program is started / program is running step by step xPauseProg – break robot program / program is running from stopped point xStopProg - stop robot program / program is started new xAllParValid – all robot parameters are valid

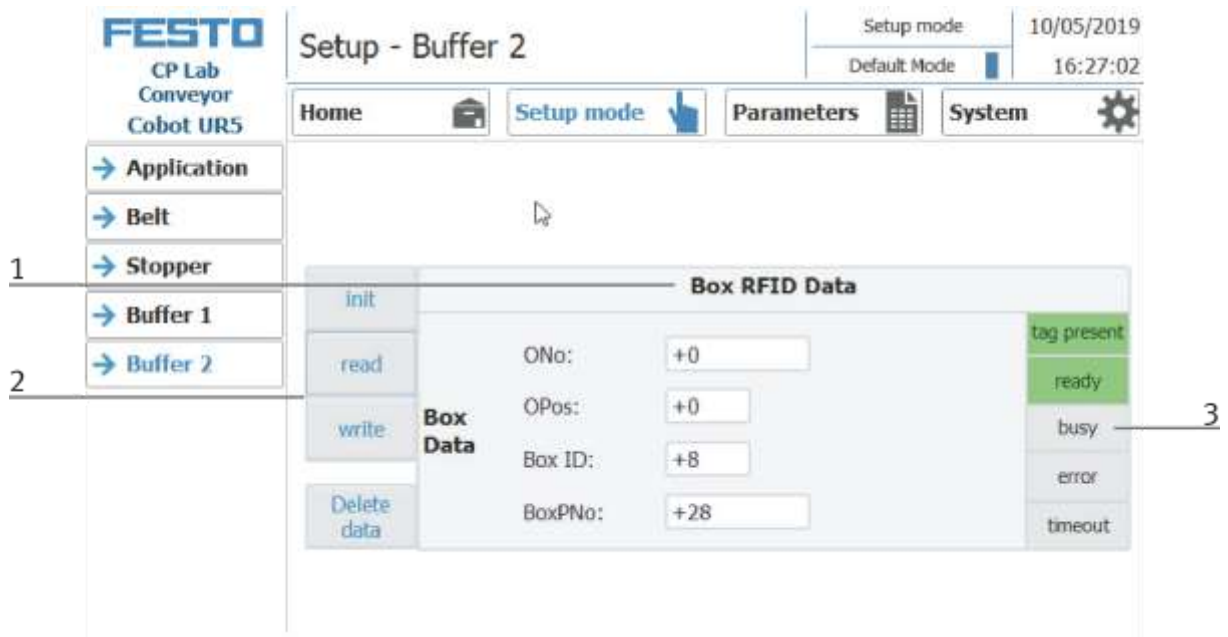
Position number	description
3	Operating hours counter
4	Control robot (blue if active) Connect – connect to drive unit Start Prog. - start the robot program xReady - the robot is ready xBusy - the robot is busy (display current step) xConnected – connection to drive unit is active iStep – Display of actual step Program number - Program number as in the drive unit
5	PrgNo. – program number in Drive Unit Buffer no. – Box 1 or 2 Box Pos. - Position of the board inside the box Retry - try again Exit Cycle - end the current cycle Return Value – return value from robot program
6	Override Ext. Mode – here the override speed can be adjusted 10 / 25 / 50 / 100% speed for the override are available, on the right the actual chosen speed is announced
7	Textual description of the return value

Setup – Buffer 1




Position number	description
1	Area RFID Box 1 MES Mode: Display of order data Default Mode: Display of the RFID state
2	Describe and read the RFID area initialize: set RFID data to zero read: Read out RFID data write: write current data on RFID Delete data: all data in the input mask is deleted - not directly on the RFID (for easier entry)
3	Display of the RFID read status

Setup – Buffer 2



Position number	description
1	Area RFID Box 2 MES Mode: Display of order data Default Mode: Display of the RFID state
2	Describe and read the RFID area initialize: set RFID data to zero read: Read out RFID data write: write current data on RFID Delete data: all data in the input mask is deleted - not directly on the RFID (for easier entry)
3	Display of the RFID read status

9.6.2 Operation mode parameter
Sub menu transitions



FESTO
CP Lab
Conveyor
Cobot UR5





Parameters - Transitions

Setup mode

 10/05/2019

Default Mode

 16:28:33

Home 
Setup mode 
Parameters 
System 

→ Application

→ Transitions

→ Belt, Stopper

No.	Start condition	Application execute	Parameter				End condition	
			Prog. no.	Buffer no.	Box pos.	---	OK	NOK
Init	none	<input type="checkbox"/>	0	0	0	0	1	0
1	1	<input checked="" type="checkbox"/>	1	1	1	0	2	20
2	2	<input checked="" type="checkbox"/>	1	1	2	0	3	30
3	3	<input checked="" type="checkbox"/>	1	2	1	0	1	40
4	0	<input type="checkbox"/>	0	0	0	0	0	0
5	0	<input type="checkbox"/>	0	0	0	0	0	0
6	0	<input type="checkbox"/>	0	0	0	0	0	0
7	0	<input type="checkbox"/>	0	0	0	0	0	0
8	0	<input type="checkbox"/>	0	0	0	0	0	0
9	0	<input type="checkbox"/>	0	0	0	0	0	0
10	0	<input type="checkbox"/>	0	0	0	0	0	0

9.6.3 Sequence Description Automatic

1. Press the Automatic button on the module's control cabinet.
2. Stoppers at CP Lab conveyor are retracted
3. Workpiece is transported in circulation mode
4. If a carrier moves into the module / application module, this will execute your automatic process. The operation of the module / application module is, however, only started if the operation in MES is intended for this resource and the resource can also carry out this operation.
5. The Busy displays become active.
6. During this time, the automatic sequence is executed in the application.
7. The next resource and operation are written to the RFID chip
8. When the module / application module is ready, the display changes back to the original state and the stopper is retracted
9. The product carrier moves out of the working position and is available to further modules / application modules.

9.6.4 Process description clock end

1. An automatic sequence is active
2. Press the Clock End key
3. The module / application module executes its cycle at the end of the cycle. During this time the button End of the clock is highlighted in red.
4. The stoppers are extended
5. The conveyor belts stop

9.7 Parameter (COBOT)



Default:

There is no defaultmode available

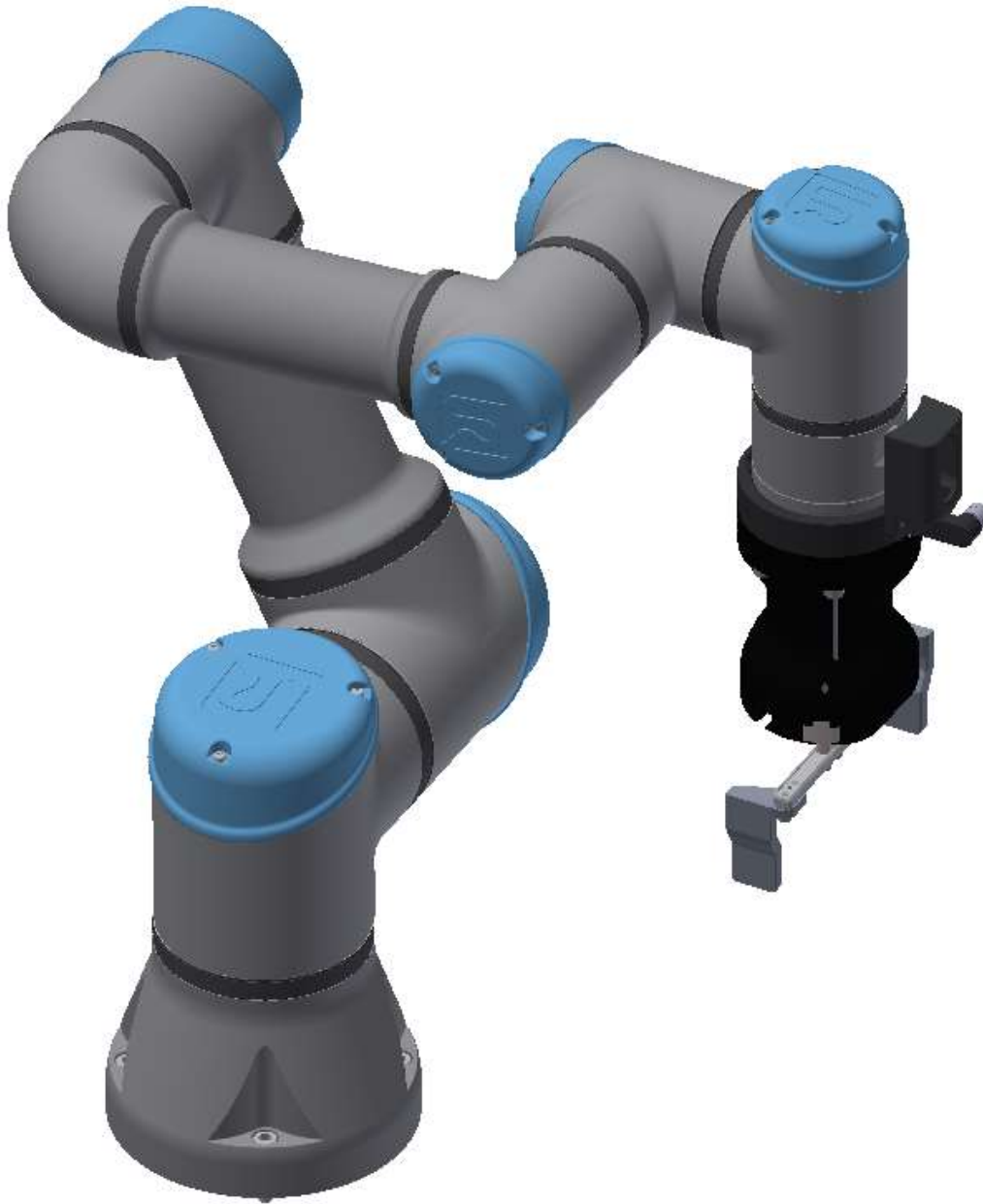
MES:

Operation		Parameter-number	Description
No.	Name		
310	start a program	1	Program number limit: 0, Value: 1, changeable
		2	Buffer position limit: 0-2, Value: 0, on runtime
		3	Box position limit: 0-10, Value: 0, on runtime
		4	Offset X limit: -20 - +20, Value: -15, changeable
		5	Offset Y limit: -20 - +20, Value: 0, changeable
		6	Offset Z /limit: -20 - +20, Value: -20, changeable
		7	Part limit: 0, Value: 120, changeable

10 Components

10.1 Universal Robots UR3e

The robot is responsible for the workpiece handling.



UR3e / illustration similar

10.1.1 Controller eSeries

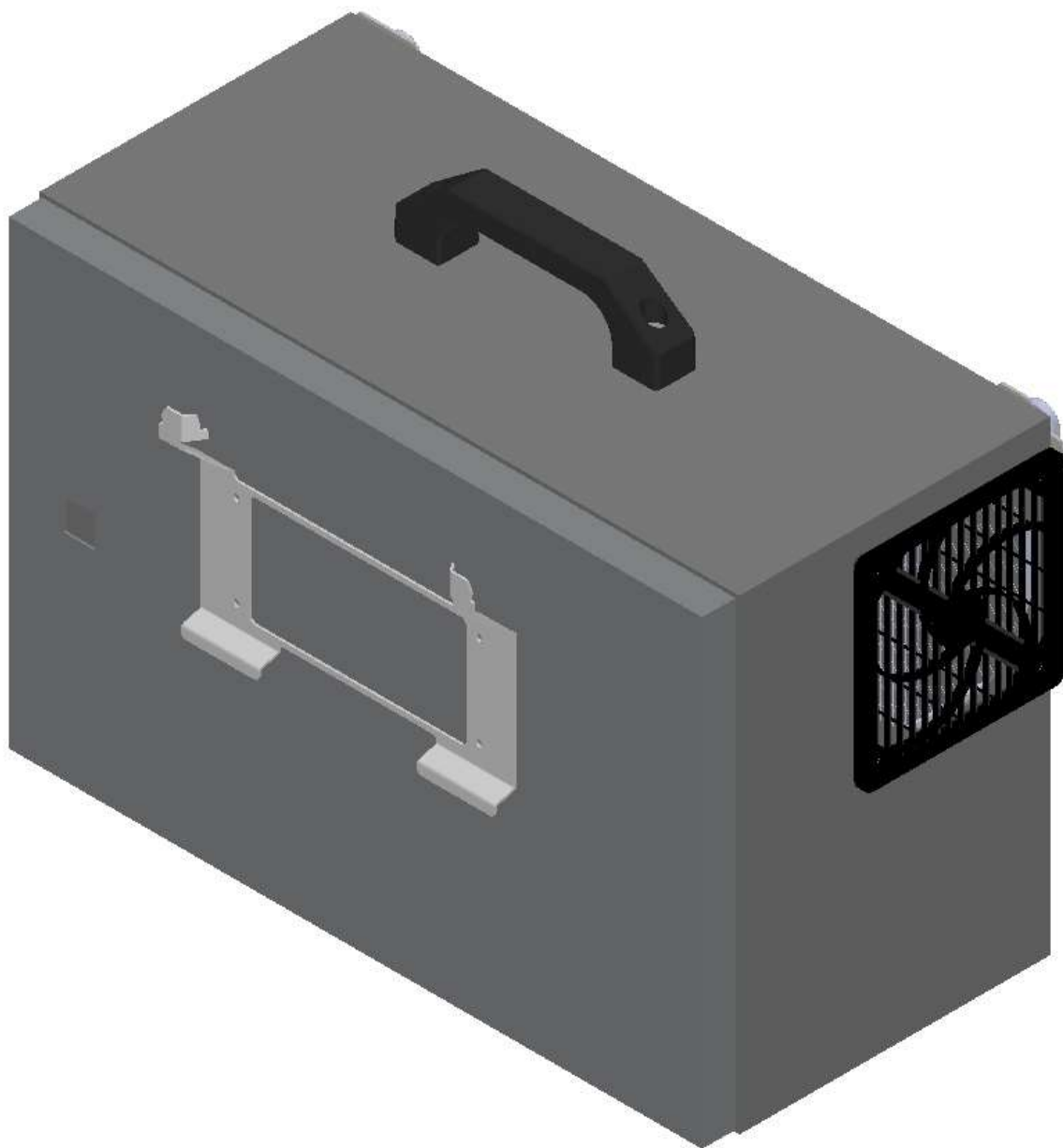


Illustration similar

The controller is the control system for the robot.

10.1.2 Teach Pendant Robot

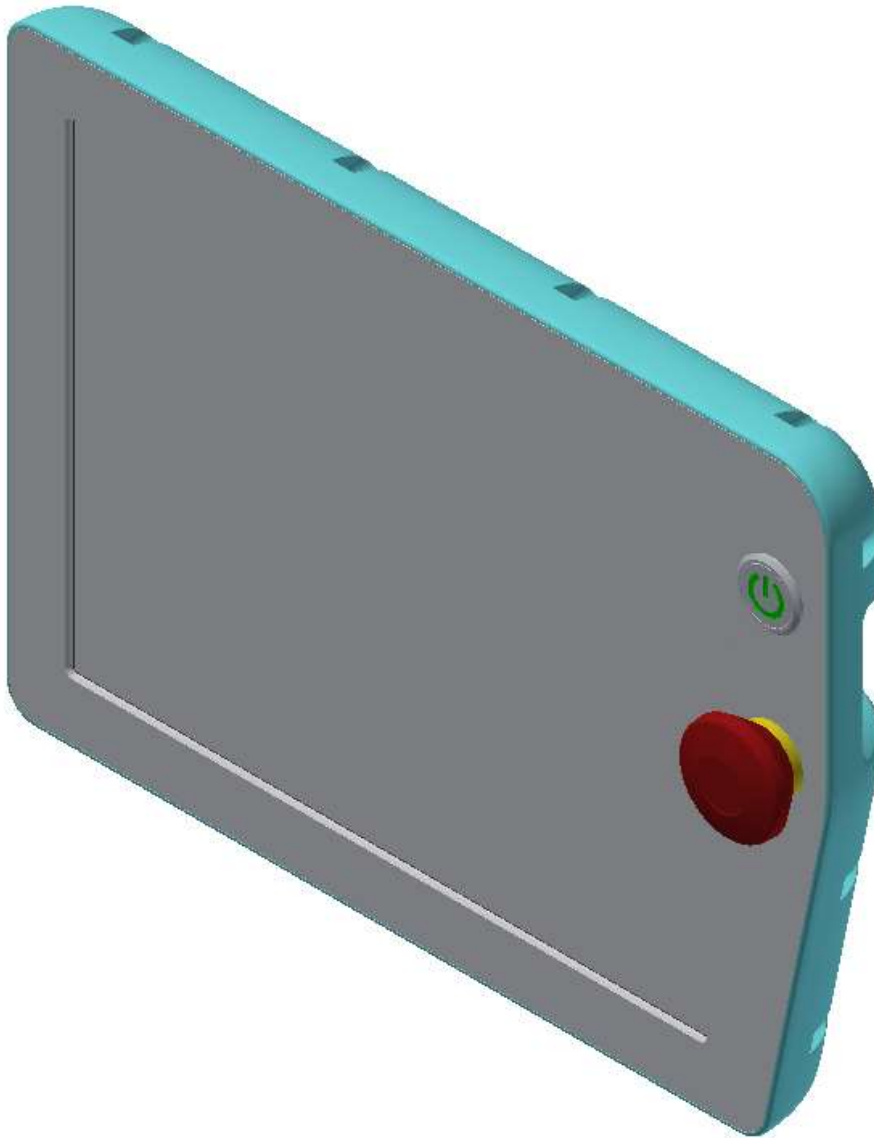


Illustration similar

- The teach pendant is used to operate the robot.
- When controlling the robot via the teach pendant, the robot must be visible.
- The teach pendant must never be located in the working area of the robot. Use the holder provided.

10.1.3 I/O interface robot

Inputs

Sensor Name		Variable Name	Input/Output	Robot start Address/Value	Type	Comment
Connected to Robot I/O card	BG20	BG20_WPatSlide1	INPUT	CIN_0	Bit	Workpiece on slide 1 available
	BG21	BG21_WPatSlide2	INPUT	CIN_1	Bit	Workpiece on slide 2 available
	BG22	GB22_VacuumOK	INPUT	CIN_2	Bit	Vacuum OK
		NA	INPUT	CIN_3	Bit	Not used
		NA	INPUT	CIN_4	Bit	Not used
		NA	INPUT	CIN_5	Bit	Not used
		NA	INPUT	CIN_6	Bit	Not used
Robot State Info Region		DI_AutoInit	INPUT	GP_Bit_In[0]	Bit	Automatically initialize the robot/break release
		DI_AutoStartPrg	INPUT	GP_Bit_In[1]	Bit	Automatically start the default program in run tab
		Start Program	INPUT	GP_Bit_In[2]	Bit	Start the selected program
		Pause Program	INPUT	GP_Bit_In[3]	Bit	Pause the current running program
		Stop program	INPUT	GP_Bit_In[4]	Bit	Stop the current running program
		DI_AllParValid	INPUT	GP_Bit_In[5]	Bit	All the parameters transmitted is valid
		DI_RetryStep	INPUT	GP_Bit_In[6]	Bit	Retry the failed step
		DI_ExitCycle	INPUT	GP_Bit_In[7]	Bit	Exit the current execution cycle
		Reserve_RobState1		8 - 19		Reserved for future expansion
Robot Variable Info Region		GI_RunProgNo	INPUT	GP_int_In[0]	Int	Program number to be executed on the robot
		GI_BoxNo	INPUT	GP_int_In[1]	Int	Box number to pick the part from
		GI_BoxPosNo	INPUT	GP_int_In[2]	Int	Box position number to pick part from
		GI_Parameter3	INPUT	GP_int_In[3]	Int	Free parameter 3 used in robot program
		GI_Parameter4	INPUT	GP_int_In[4]	Int	Free parameter 4 used in robot program
		GI_Parameter5	INPUT	GP_int_In[5]	Int	Free parameter 5 used in robot program
		GI_Parameter6	INPUT	GP_int_In[6]	Int	Free parameter 6 used in robot program
Connected to PLC I/O		NA	INPUT	GP_Bit_In[23]	Bit	Not used
		NA	INPUT	GP_Bit_In[24]	Bit	Not used
		NA	INPUT	GP_Bit_In[25]	Bit	Not used

Outputs

Sensor Name		Variable Name	Input/Output	Robot start Address/Value	Type	Comment
Connected to Robot IO card		NA	OUPUT	CO_0	Bit	Not used
		NA	OUPUT	CO_1	Bit	Not used
	MB22	GrpAirIn	OUPUT	CO_2	Bit	Switch on vacuum at gripper
	MB23	GrpAirOut	OUPUT	CO_3	Bit	Switch off vacuum at gripper
		NA	OUPUT	CO_4	Bit	Not used
		NA	OUPUT	CO_5	Bit	Not used
		NA	OUPUT	CO_6	Bit	Not used
		NA	OUPUT	CO_7	Bit	Not used
Robot State Info Region		DO_AllParReq	OUPUT	GP_Bit_out[0]	Bit	Request the PLC to send all the parameters
		Reserve_RobState1	OUPUT	1 - 25		Reserved for future expansion
		DO_IsRbtArmHome	OUPUT	GP_Bit_out[23]	Bit	Robot arm is in Home position
Robot Variable Info Region		GO_ReturnCode	OUPUT	GP_int_Out[0]	Word	Return code of the robot
Connected to PLC IO		NA	OUPUT	GP_Bit_Out[23]	Bit	Not used
		NA	OUPUT	GP_Bit_Out[24]	Bit	Not used
		NA	OUPUT	GP_Bit_Out[25]	Bit	Not used

10.1.4 Return codes

Return codes	Var_Name	Description
1	Var_NoCarrier	No carrier at stopper position
2	Var_PlaceColl	Collision during placing the workpiece
3	Var_PickColl	Collision during picking the workpiece
4	Var_UnknownProg	Unknow program number started
11	Var_UndefBoxNo	Undefined box number requested
12	Var_UndefBoxPos	Undefined box position number requested
13	Var_NoPartInBox	No part found at the box position to grip

10.1.5 Robot positions

- The working position for MRK applications is in front of the crates.
- The working position for operating is at the operating panel.
- It is not permitted to stay in the area of the robot outside the working position.
- Install suitable floor markings or access restrictions.
- Only one person is allowed in the working area.
- When interacting with the robot, the robot must be observed at all times.

10.1.6 Robot positions stand alone

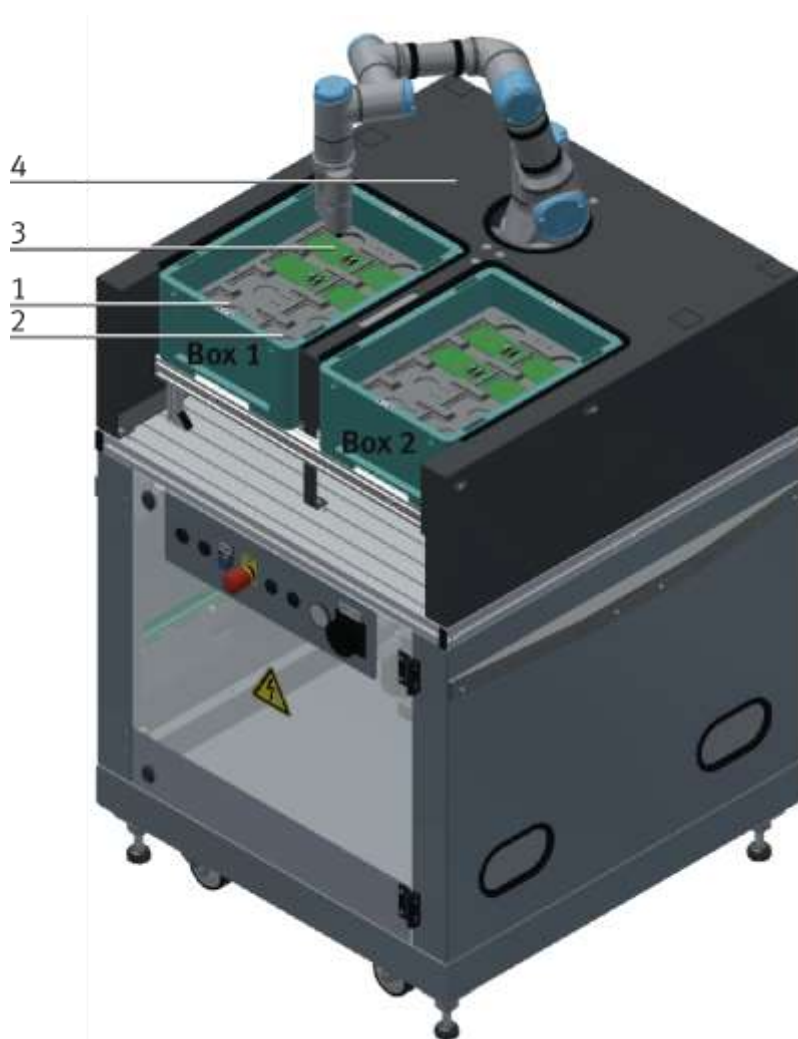


Illustration similar

No	Description
1	Position workpiece 1 in box 1 / Pos_Box1WP1
2	Position workpiece 2 in box 1 / Pos_Box1WP2
3	Position workpiece 7 in box 1 / Pos_Box1WP7
4	Basic position robot / Pos_Home

The basic position of the robot does not have to be taught.

Positions 1-3 are queried one after the other during the teaching process and can be taught. The positions in box 1 and box 2 are identical, the selection of the respective box is made during the teach process, (see Teach robot positions) are taught, all other positions in the box are calculated.

10.1.7 Robot positions at CP-Lab conveyor



Illustration similar

No	Description
1	Position workpiece 1 in box 1 / Pos_Box1WP1
2	Position workpiece 2 in box 1 / Pos_Box1WP2
3	Position workpiece 7 in box 1 / Pos_Box1WP7
4	Position at stopper / Pos_Stopper
5	Basic position robot / Pos_Home

The basic position of the robot does not have to be taught.

Positions 1-3 are queried one after the other during the teaching process and can be taught. The positions in box 1 and box 2 are identical, the selection of the respective box is made during the teach process, (see Teach robot positions) are taught, all other positions in the box are calculated.

10.1.8 Robot positions at CP-Lab conveyor with CP application module output

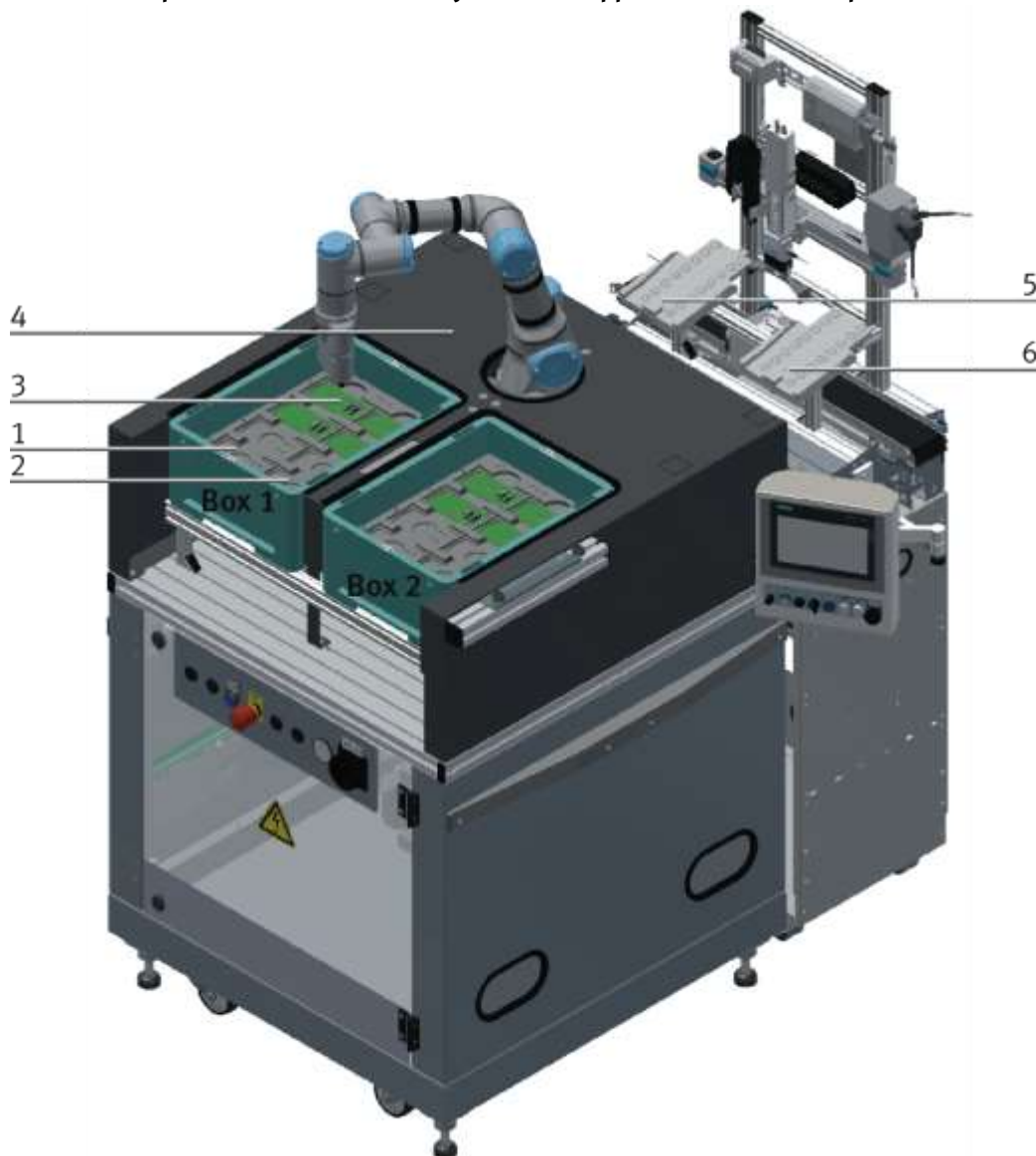


Illustration similar

No	Description
1	Position workpiece 1 in box 1 / Pos_Box1WP1
2	Position workpiece 2 in box 1 / Pos_Box1WP2
3	Position workpiece 7 in box 1 / Pos_Box1WP7
4	Basic position robot / Pos_Home
5	Position at application module output slide left
6	Position am application module output slide right

The basic position of the robot does not have to be taught.

Positions 1-3 are queried one after the other during the teaching process and can be taught. The positions in box 1 and box 2 are identical, the selection of the respective box is made during the teach process, (see Teach robot positions) are taught, all other positions in the box are calculated.

10.1.9 Robot positions at CP-Factory station Bypass

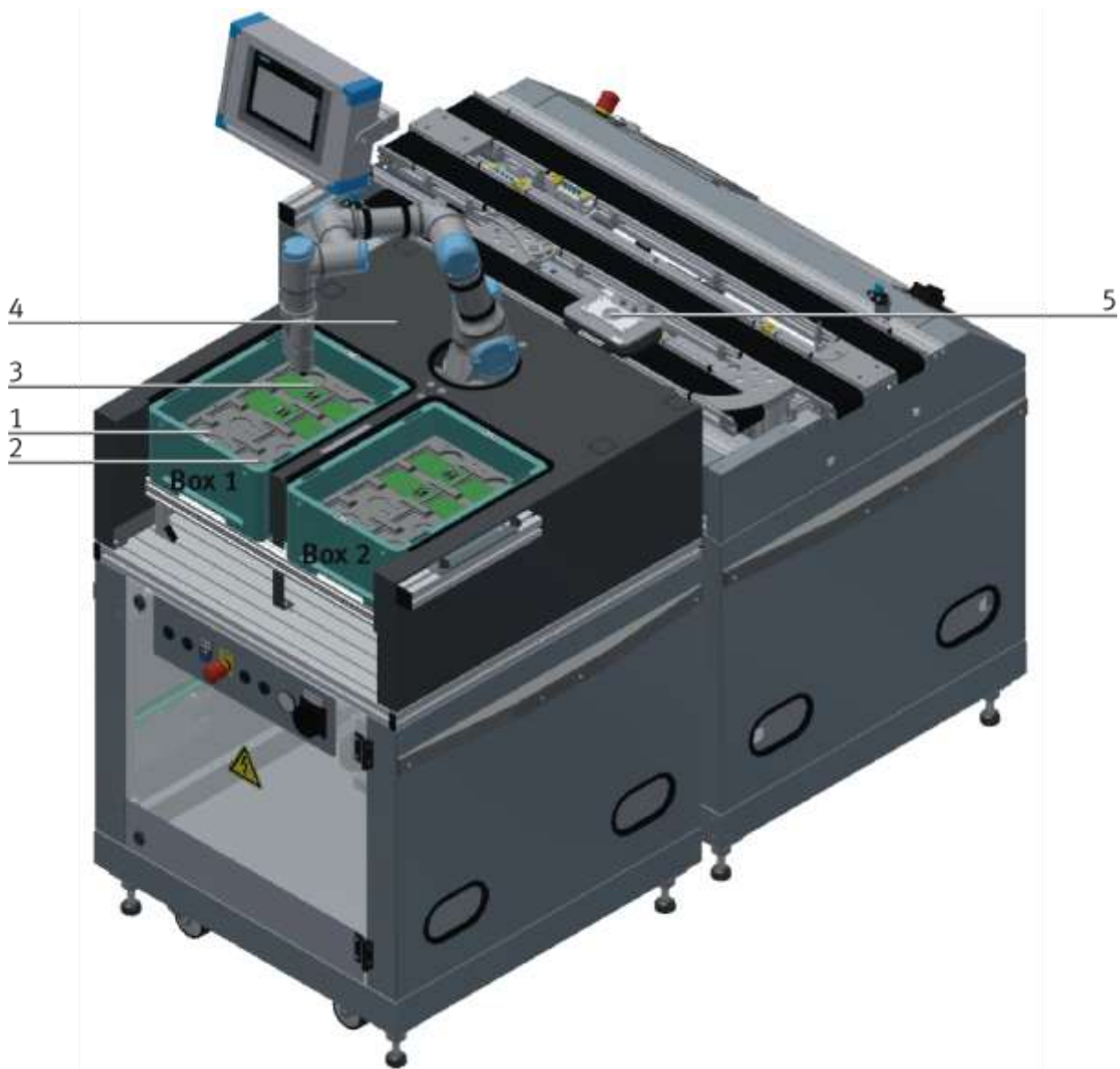


Illustration similar

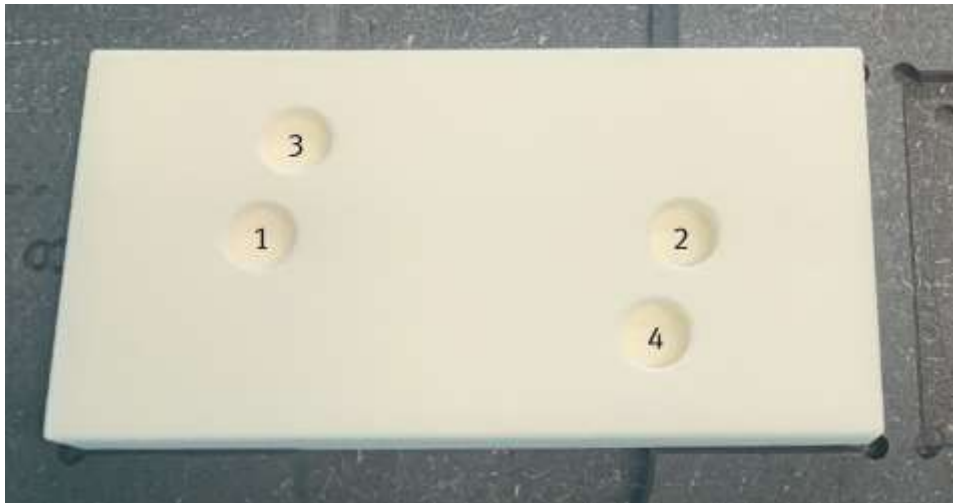
No	Description
1	Position workpiece 1 in box 1 / Pos_Box1WP1
2	Position workpiece 2 in box 1 / Pos_Box1WP2
3	Position workpiece 7 in box 1 / Pos_Box1WP7
4	Position at stopper / Pos_Stopper
5	Basic position robot / Pos_Home

The basic position of the robot does not have to be taught.

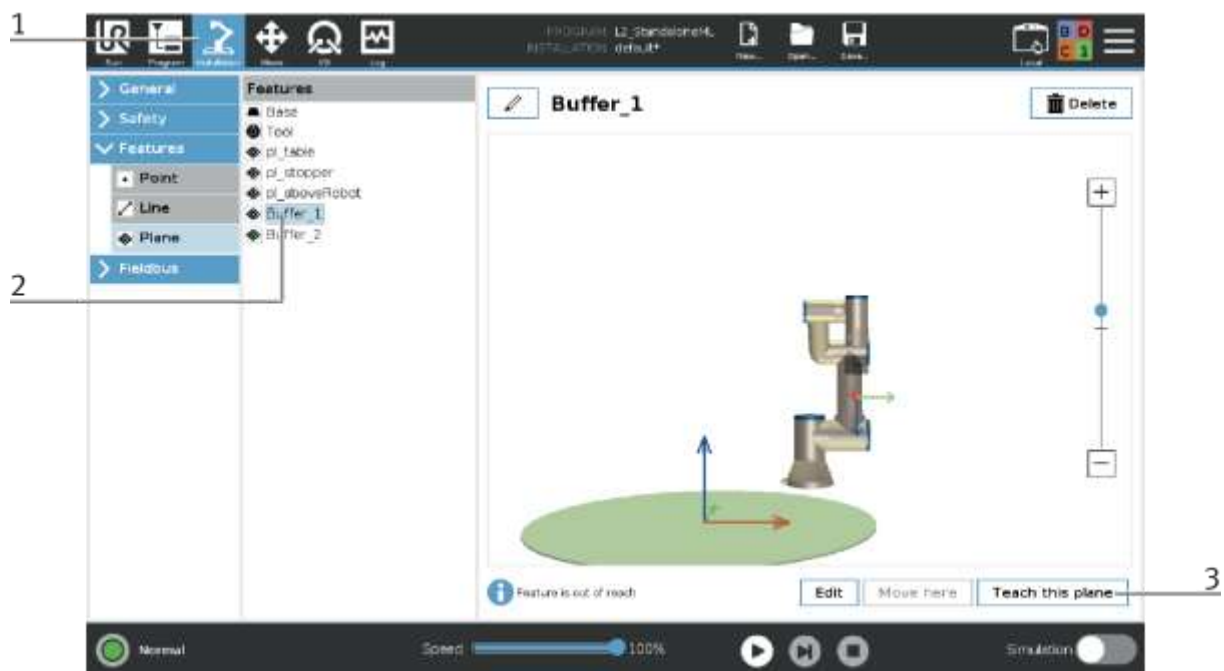
Positions 1-3 are queried one after the other during the teaching process and can be taught. The positions in box 1 and box 2 are identical, the selection of the respective box is made during the teach process, (see Teach robot positions) are taught, all other positions in the box are calculated.

10.1.10 Position teachen (example)

To teach a position the TeachWerk piece is required.

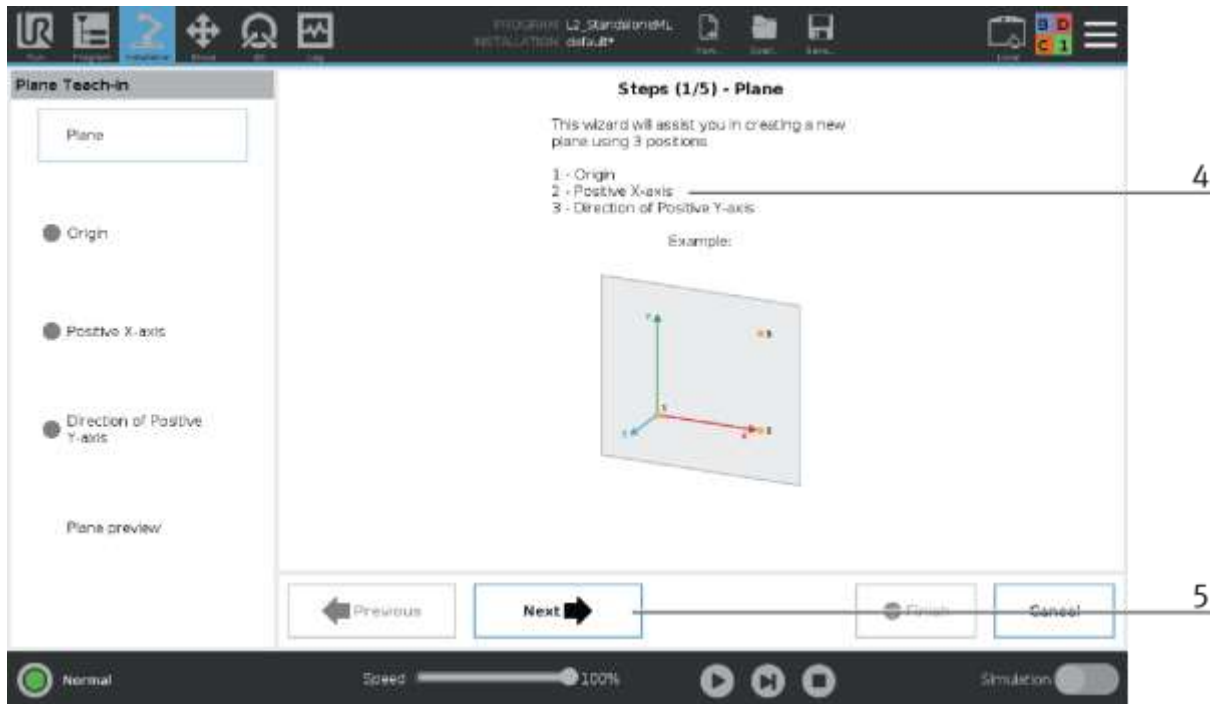


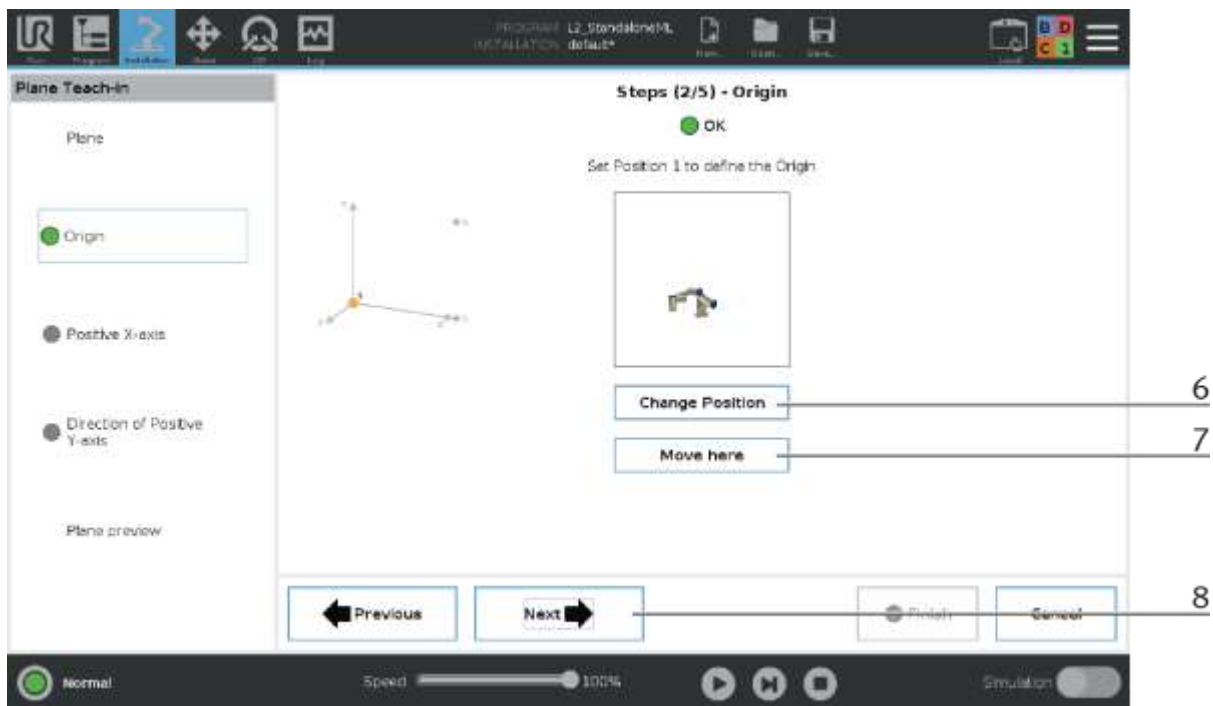
Only holes 1+2 are required for suctioning the workpiece, 3+4 are not taken into account.



1. Switch to the Installation function
2. Under Features, select the desired position e.g. Buffer_1
3. Press Teach this plane button Step 1/5 opens

4. The sequence of points to be taught is displayed here.
5. Press the Next button to go to the next step (Step2/5).



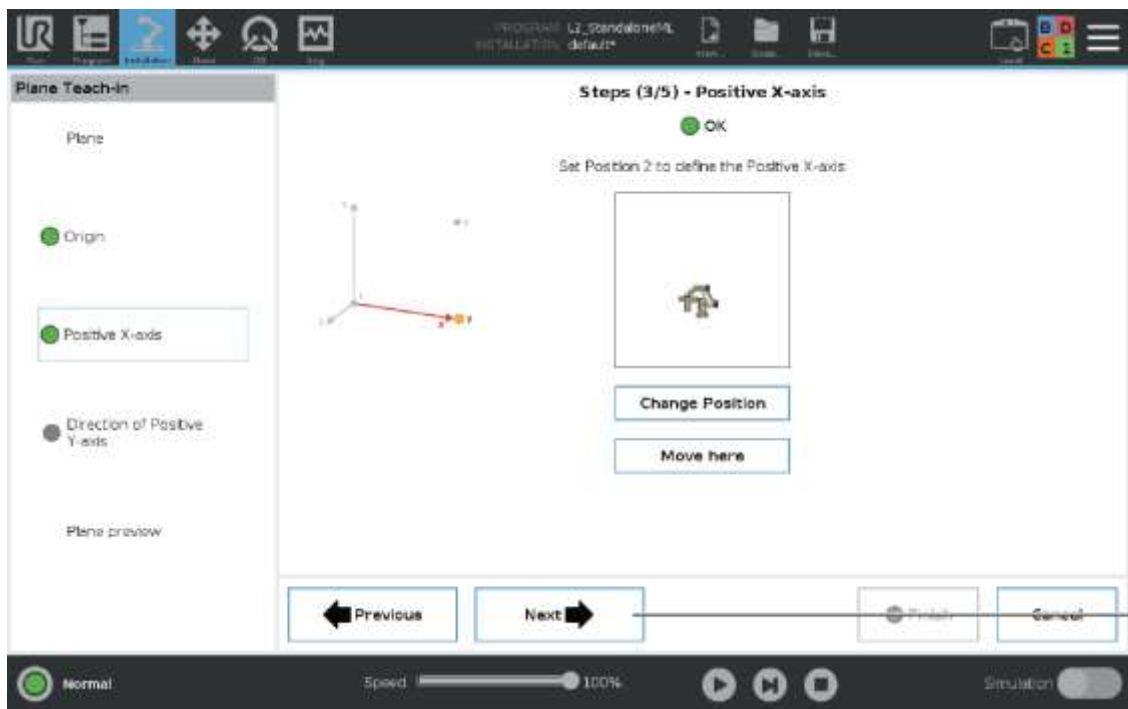


The Origin Position is located at the front left of the box. 1.

6. If the position is to be moved to and changed, press the Change Position button. The Move function is called up and the position can be moved to/changed. (see following picture - valid for all following steps)
7. If you want to move the robot to this position (e.g. to check the position), press the Move here button. The button must remain pressed until the robot has completed the movement. (applies to all following steps)
8. Press the Next button to go to the next step (3/5).



9. The robot has changed to Move function - positions can now be moved to manually.
10. In this area it is possible to move the robot with the arrow keys in X, Y, Z (translatory movement).
11. With the
 - Home Button the robot can be moved to its home position.
 - Align Button
 - Freedrive Button it is possible to move the robot manually to the desired position - keep the button pressed.
12. In this area it is possible to rotate the robot with the arrow keys in X, Y, Z (rotational movement).
13. In this area the tool position is announced.
14. In this area it is possible to move the robot in each of its axes (axis specific movement).
15. If the position has been moved to, this is confirmed with the OK button.

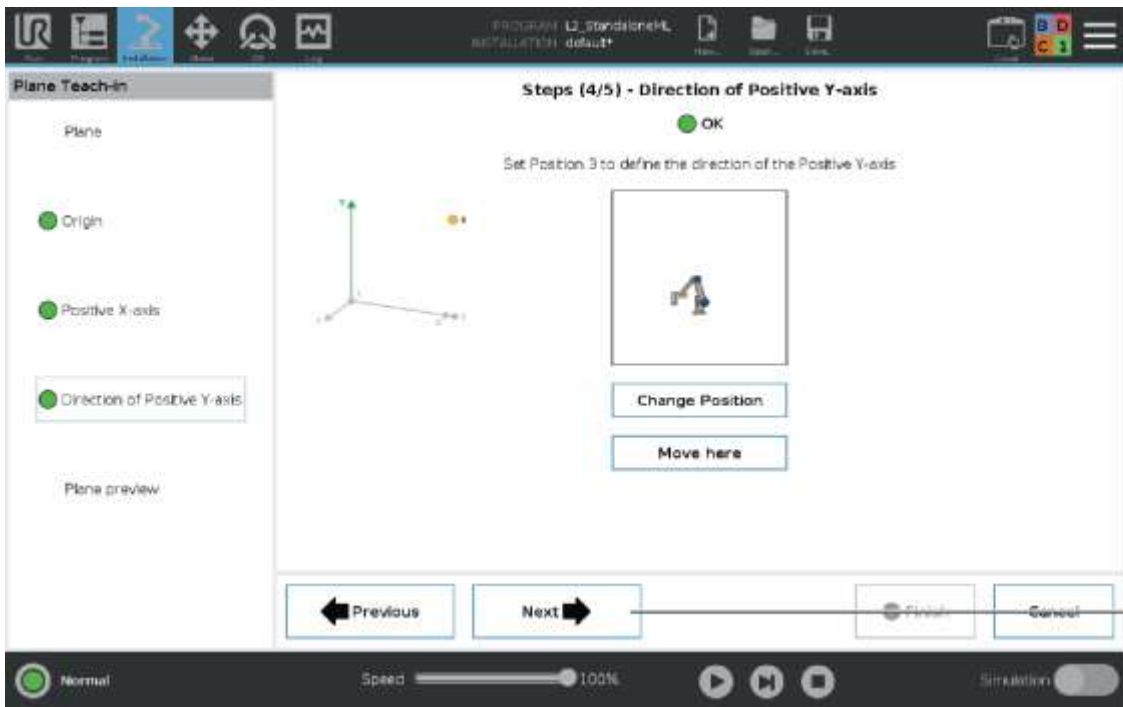


17



The position to teach the positive X-axis is located in the front right of the box.

16. Press the Next button to go to the next step (4/5).



18



The position to teach the positive Y-axis is located at the back left of the box.

17. Press the Next button to go to the next step (5/5).

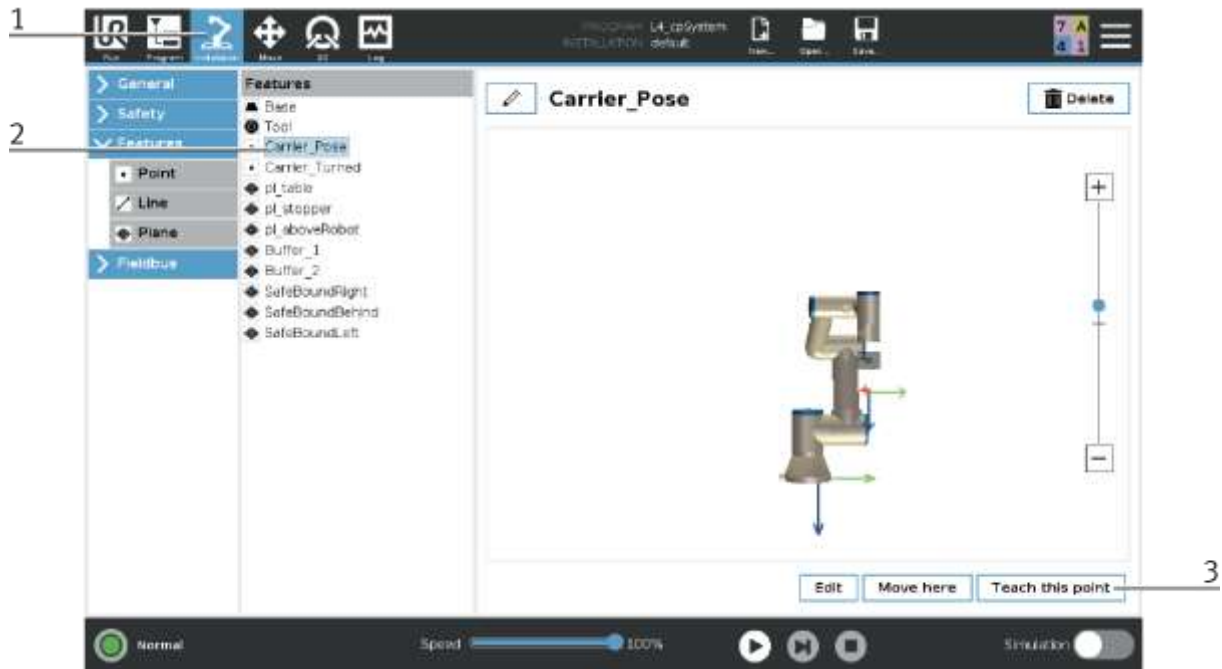


18. Press the Cancel button to cancel the teaching process.

19. Press the Finish button to save the teaching process with the new positions.

10.1.11 Teaching the conveyor belt position

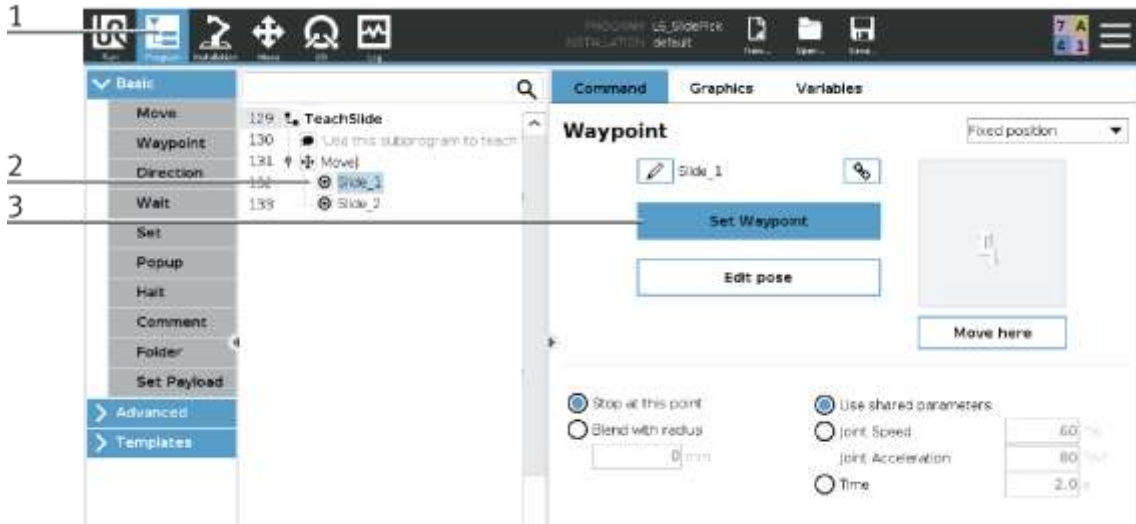
The procedure for teaching the conveyor position is basically the same as for the buffer positions. However, the position data is located under Installation / Features / Carrier_Pose.



1. go to Installation
2. select Carrier_Pose
3. press "Teach this point" to teach the position again

10.1.12 Teach slide position

The procedure for teaching a slide position is basically the same as for buffer positions. However, the position data is located under Program / Basic / Slide_1 / Slide_2



1. go to Program
2. select the desired slide
3. press Set Waypoint to teach the position again

10.1.13 Status LED states

Col_Bit0	Col_Bit1	Col_Bit2	Ergebnis	Funktion
Wrong	Wrong	Wrong	Lamp is off	Robot program stoped
True	Wrong	Wrong	Lamp lights red	Program runs in automatic at reduced speed of 160 mm/s, since the robot is near a potential clamping point.
Wrong	True	Wrong	Lamp lights green	Program runs in automatic mode at normal speed of 250 mm/s.
Wrong	Wrong	True	Lamp lights yellow	External force detected. The speed is reduced to 10% of the current speed during this time.
True	True	Wrong	Lamp lights blue	Robot waits for input by tapping on the gripper (from left/right/back/front, depending on the program set).
Wrong	True	True	Lamp red animated	An error message has appeared on the HMI. The program is waiting for input.
True	True	True	Lamp blue animated	Robot in hand tracking state (only with "Worker collaboration" option)

10.1.14 Error codes (only in PLC mode)

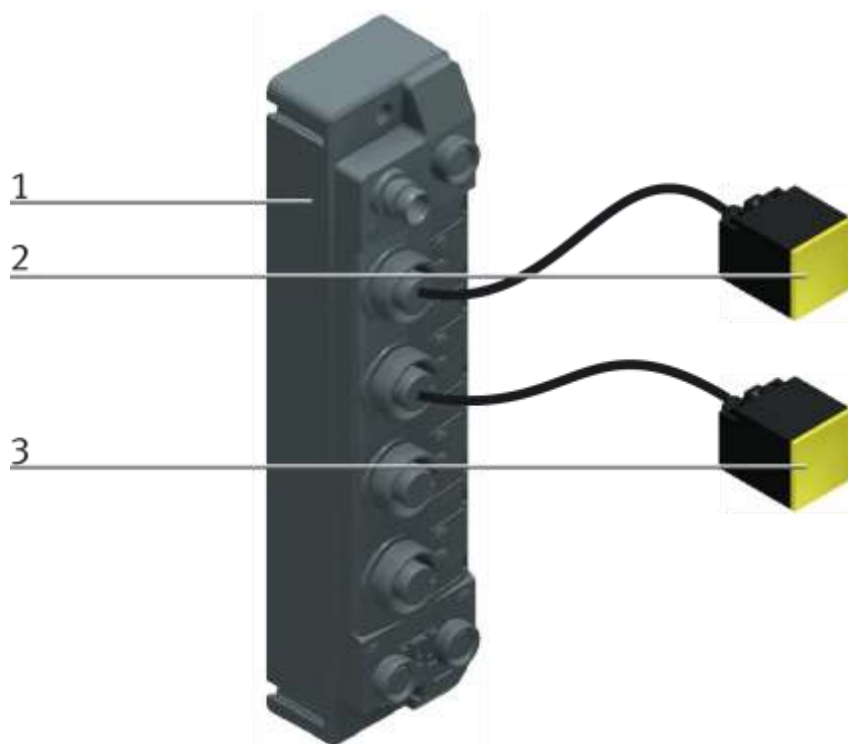
Variable	Number	Result
NoError	0	No error
err_WrongOffset	5	Offset wrong
err_RobotToolError	11	Unknown tool type clamped
err_NoPaAtStopper	12	No pallet at stopper
err_UnknownProg	22	Unknown program loaded
err_NoWPAAtStopper	23	No workpiece on the pallet at the stopper position
err_NoCarAtStopper	24	No workpiece carrier at the stopper position
err_CameraError	31	The camera does not find a workpiece
err_WPAsmPoseFull	41	Workpiece mounting position occupied
err_WPNotPresent	42	No workpiece deposited at assembly position
err_WPUpSideDown	43	Workpiece is oriented upside down
err_WPWrongOrient	44	Workpiece orientation is incorrect
err_WPNotClamped	45	Workpiece is not clamped at mounting position
err_BoxNotInFront	51	No box present at pickup position (only in conjunction with RobotinoDocking).
err_WrongInlayIdx	52	Invalid inlay position
err_UndefPCBPalNo	52	Unknown PCB pallet number
err_NoPCBAtPalNo	53	No PCB found at the requested pallet number
err_BoxNotLocked	56	Box not fixed
err_FuseMagEmpty	61	All fuse magazines are empty
err_UndefFuseNo	62	Unspecified fuse magazine number
err_WrongBoxPos	104	Wrong box position

10.1.15 More information on the robot

Please refer to the robot manual in order to obtain the operating information.

10.2 Electrical components

10.2.1 RFID



Turck RFID Controller

Pos.	Module	Order number	Comment
1	Turck TBEN-S2-2RFID-4DXP	6814029	Basic modul RFID
2	TN-CK40-H11147	7030006	Read/write head 40x40
3	TN-CK40-H11147	7030006	Read/write head 40x40

10.2.2 Mini Terminal



Multi-pin plug distributor

The multi-pin plug distributor is designed for the inputs and outputs of the station. You can connect PNP sensors and two-pole actuators there. The connection is effected by three-pole M8x1 plugs, and the bus terminal by a 15pole sub-D plug connector. The operating status is displayed on yellow LEDs.

Pin allocation on the multi pin plug distributor

Pin allocation 15pole sub-D plug connector

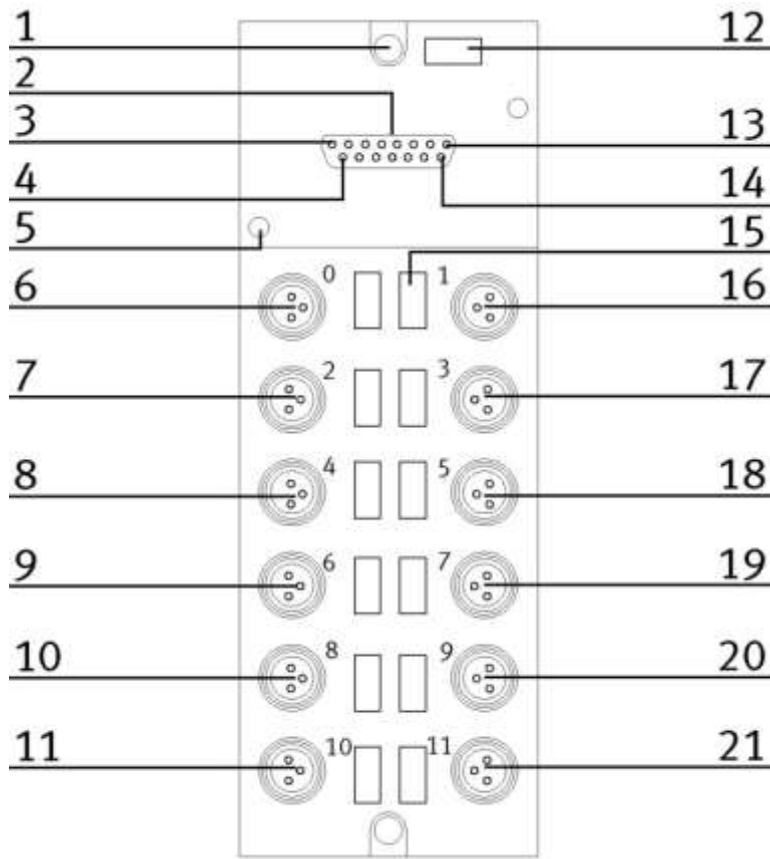
- Signal lines Pin 1 to Pin 12
- DC 24V Pin 13
- 0V Pin 14 and Pin 15

Pin allocation M8 socket corresponding to IEC 947-5-2

- slots 0 to 11
- Signal line socket 4
- DC 24V socket 1
- 0V socket 3

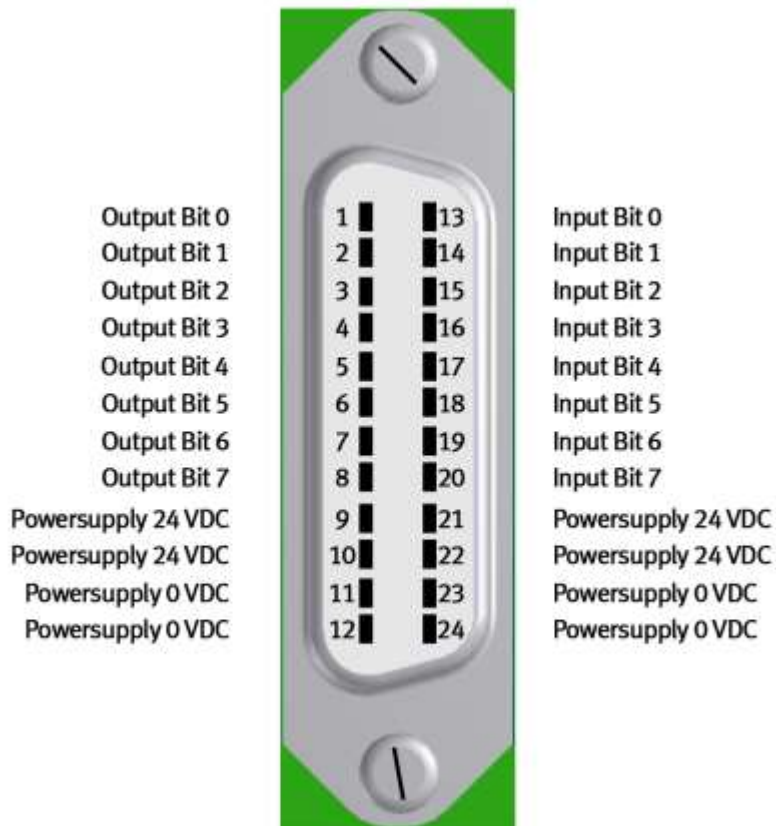
XD20 – Multi pin distributor MPV1

15-pole D-Sub Pin	Bit	Name
1	Bit 0	Workpiece output 1 / -BG20
2	Bit 1	Reserve
3	Bit 2	Workpiece output 2 / -BG21
4	Bit 3	Reserve
5	Bit 4	Workpiece suckt / -BG22
6	Bit 5	Switch on vacuum / MB22
7	Bit 6	Reserve
8	Bit 7	Release impuls / MB23
9	Bit 8	Reserve
10	Bit 9	Reserve
11	Bit 10	Reserve
12	Bit 11	Reserve
13	+24 V	
14 and 15	0V	



Pos	Designation	Pos	Designation
1	Mounting hole	12	Inscription label
2	15 pole sub-D plug	13	PIN 8
3	PIN 1	14	PIN 15
4	PIN 9	15	Inscription label
5	Mounting hole M3	16	OUT 0
6	IN 0	17	OUT 1
7	IN 1	18	OUT 2
8	IN 2	19	OUT 3
9	IN 3	20	OUT 4
10	IN 4	21	OUT 5
11	IN 5		

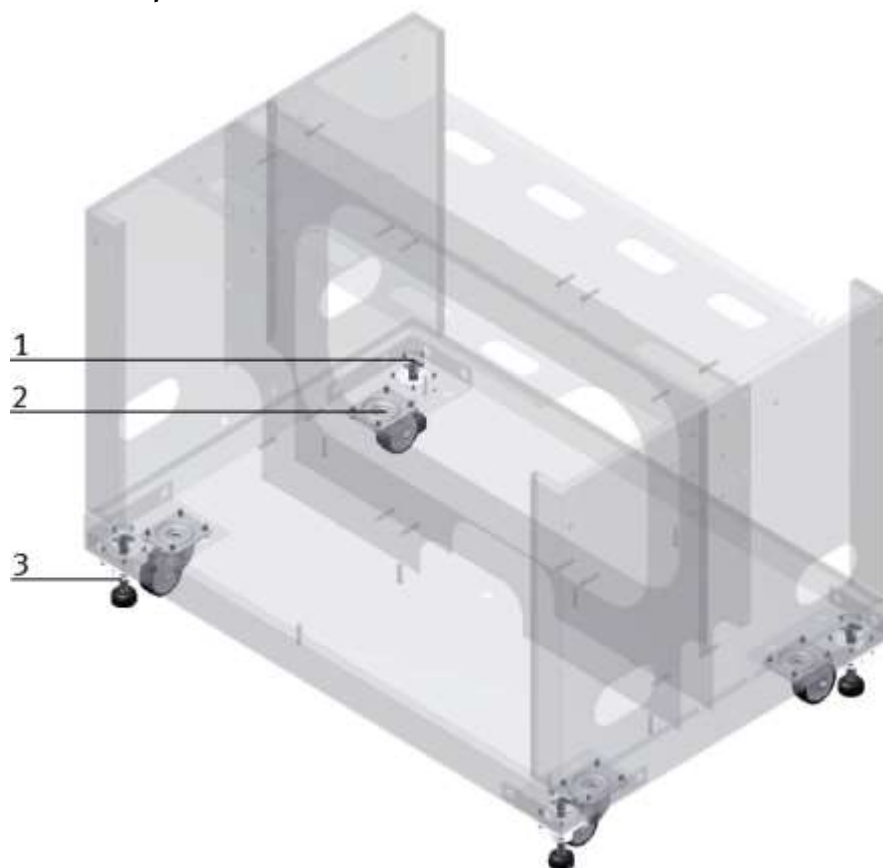
10.2.3 SYS link interface



Syslink allocation

SYSlink PIN	Bit	Description	Syslink PIN	Bit	Function
01	0	Output AX.0	13	0	Input EX.0
02	1	Output AX.1	14	1	Input EX.1
03	2	Output AX.2	15	2	Input EX.2
04	3	Output AX.3	16	3	Input EX.3
05	4	Output AX.4	17	4	InputEX.4
06	5	Output AX.5	18	5	Input EX.5
07	6	Output AX.6	19	6	InputEX.6
08	7	Output AX.7	20	7	Input EX.7
09	24V	Power Supply	21	24V	Power Supply
10	24V	Power Supply	22	24V	Power Supply
11	0V	Power Supply	23	0V	Power Supply
12	0V	Power Supply	24	0V	Power Supply

10.2.4 Transportation of the basic module



CP Factory Transportation method

With the help of mechanically adjustable feet, you can lower the basic module and then put it on the rollers. In this way, an easy transport is possible. If you wind up the machine mounts, you can move the basic module easily to another place.

Position	Description
1	Star knob for adjusting the height of the machine mount
2	Roller
3	Lock nut for locking the machine mount in the position required

WARNING

- Danger of crushing for hands/feet
 - It is not permitted to grip onto or under the feet when handling the machine, as there is an increased risk of hands or feet getting crushed or trapped in these areas.
 - When setting down the station, make sure no persons have their feet under the machine's feet.

11 Message texts and interactive error messages at the HMI

In general, there are three different reporting classes. These are designed as follows

- Message class 0 (displayed red in the message line)
 - the program is immediately stopped and the automatic mode is terminated
 - the cause of the error has to be fixed
 - Then acknowledge the fault and restart the station
- Message class 1 (displayed red in the message line)
 - the program and the automatic mode are stopped at the end of the cycle
 - the cause of the error has to be fixed
 - Then acknowledge the fault and restart the station
- Message class 2 (displayed yellow in the message line)
 - the program and the automatic mode are executed further
 - If the cause of the fault is fixed, the error is automatically acknowledged
- Note
 - Displayed on the HMI but not processed in MES

11.1 Message texts

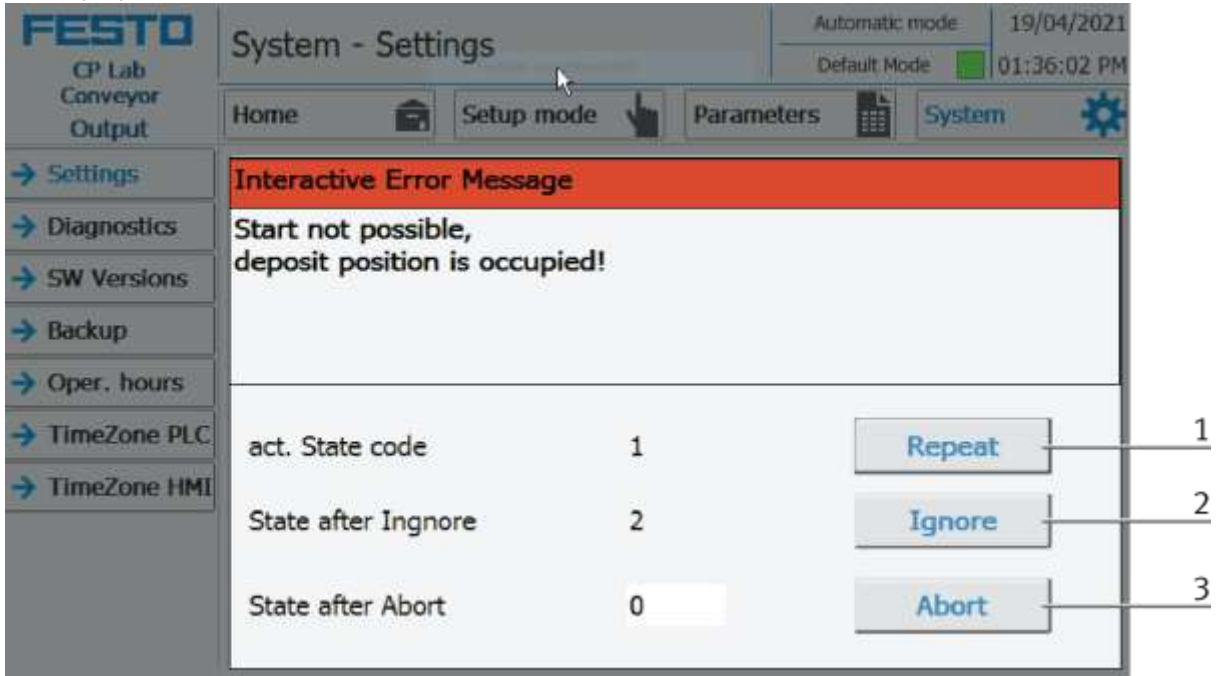
There are now message texts available.

11.2 Interactive error messages

11.2.1 Default operation

Interactive messages are displayed via a pop-up window at HMI

The Pop Up has three buttons.



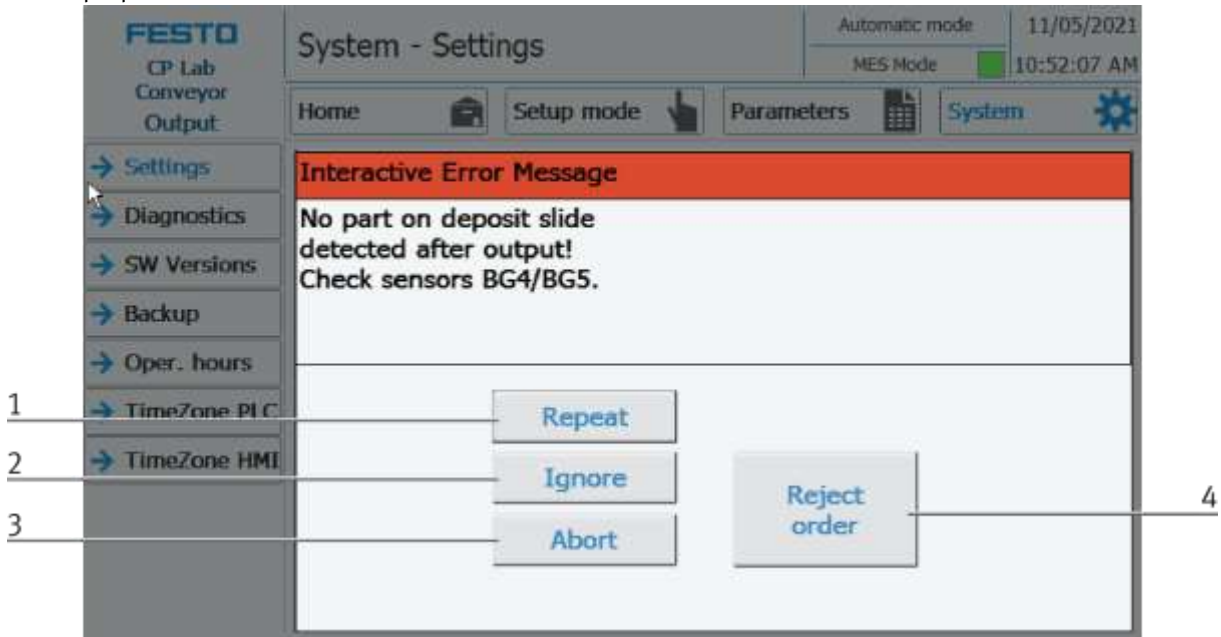
Example application module output - interactive error message in default mode

Position	Note
1	Repeat - An attempt is made to run the application again.
2	Ignore – The error status is ignored; the workpiece carrier receives the status code as indicated in the transition table in the "Initial status" column. The application is no longer executed.
3	Abort – The error status is ignored; the workpiece carrier receives the status code as shown in the input / output field next to the value displayed. This can be changed in this interactive error message window.

11.2.2 MES Operation

Interactive messages are displayed via a pop-up window at HMI

The Pop Up has four buttons.



Example application module output - interactive error message in default mode

Position	Note
1	Repeat - An attempt is made to run the application again with the same parameters.
2	Ignore – The application is not executed, but is treated in the MES as if the order step had been executed without errors.
3	Abort – The application is no longer executed. In the MES, this order position is terminated with an error and canceled, depending on whether an error step has been defined or not.
4	Reject order - the application will not be executed. In the MES, the step of this order position is reset and restarted the next time the workpiece carrier arrives.

11.2.3 General

Value	Text	Fix error
100	Order aborted with errors!	Start order again

11.2.4 Application module UR3e

Value	Text	Fix error
5150	Requested workpiece not available in box!	Please check the buffer in the MES4.

12 Service and cleaning

The components and systems from Festo Didactic are maintenance-free.

At regular intervals you should have checked:

- the lenses of the optical sensors, fibre optics and reflectors
- the active surface of the proximity switch
- the entire station

can be cleaned with a soft, lint-free cloth or brush.



NOTE

Do not use aggressive or abrasive cleaners.

Protective covers must not be cleaned with alcoholic cleaning agents, there is a risk of embrittlement.


13 Further information and updating

Further information and updates on the technical documentation of Festo Didactic components and systems can be found on the Internet at:

www.ip.festo-didactic.com



14 Disposal

	<p style="text-align: center;"><i>NOTE</i></p> <p>Electronic waste contains recyclable materials and must not be disposed of with the domestic waste. Bring electronic waste to a designated municipal collection point.</p>
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Festo Didactic SE

Rechbergstraße 3
73770 Denkendorf
Germany



+49 711 3467-0



+49 711 34754-88500



www.festo-didactic.com



did@festo.com