Operating Instructions

Original Instructions

RoboTrex 96 Automation | 64000
RoboTrex 52 Automation | 66000

Item no.
64000
66000

Imprint

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Note in advance

Read the installation and operating instructions completely. Observe all safety instructions listed in this chapter.
Handling of documentation: Always keep the instructions and other documentation related to the RoboTrex automation system within easy reach in the immediate vicinity of the operating unit of the machine in which the automation is used.

Product modifications: Modifications to the product by the customer void the warranty. No modifications may be made to the product without the manufacturer's consent.

Use only original spare parts. There is no guarantee that parts sourced from third parties are designed and produced to withstand the intended use and safety requirements.
The manufacturer provides full warranty coverage only and exclusively for spare parts ordered from him.

The manufacturer is continually working to improve his products and reserves the right to make modifications to them. The manufacturer is therefore under no obligation to make subsequent modifications to products already delivered.

General Terms and Conditions of Sale and Delivery:
Our General Terms and Conditions of Sale and Delivery generally apply. These terms and conditions are available to the operator upon the signing of the contract.

Warranty and liability claims for personal injury and property damage are excluded if they are due to one or more of the following:

- Improper use
- Incorrect installation, commissioning, operation and maintenance
- Operation of the product when it is defective
- Inadequate monitoring of parts that are subject to wear
- Failure to follow the instructions in the documentation
- Catastrophic events caused by external influences or force majeure

Contents

1 Product Description

1.1 Unit

The RoboTrex automation system is used exclusively to automate the loading and unloading process of machine tools.
Only clamping devices from LANG that have an integrated receptacle for the RoboTrex gripper for automation may be stored in the RoboTrex. Clamping devices with workpieces up to a maximum workpiece weight of 25 kg (45 kg on request) can be stored in the RoboTrex automation system.

Heavier workpieces cannot be transported by the automation. Unauthorized conversions and modifications to the machine are strictly prohibited for safety reasons. The operating and installation conditions prescribed in these operating instructions must be strictly observed. No foreign parts may be used on the machine, otherwise the required safety-level cannot be guaranteed.

1.2 Areas of application

The RoboTrex automation system is a safety-compliant storage system connected to an articulated-arm robot for automating machine tool loading with automation clamps from LANG Technik GmbH. The RoboTrex automation system is exclusively designed to hold LANG automation fixtures in a machine tool or machining center and to allow automatic change of the clamping device.
Any other use of the system is prohibited and will result in the exclusion of liability on the part of LANG Technik GmbH. It is possible to load the machine tool using the RoboTrex automation system in two different ways:

- Front loading: Front loading requires an automated machine door
- Side loading: Side loading takes place through a side loading window

1.3 Accessories

The RoboTrex automation system consists of one to four mobile storage units designed to store LANG automation fixtures, an articulated-arm robot, fencing and a central control system.
Typically, the operator provides a machine tool or machining center to complete the system. The machine tool can be part of the separating protective device (fencing) or must close it completely, if necessary by means of add-on parts.
All the above components together form a single system. A conformity-assessment procedure with holistic risk assessment must be carried out for the resulting complete machine. The integrator is responsible for this. If no further agreement has been reached among the economic operators, the operator of the system is also the integrator.

2.1 GENERAL DATA

Name	Item number	Dimensions Width x depth x height	Weight
RoboTrex 96	64000	2000 x 2000 x 2000 mm	approx. 1200 kg
RoboTrex 52	66000	2100 x 1900 x 2300 mm	approx. 900 kg
Pallet dimensions of the trolley		1700 x 800 x 1200 mm	

2.2 TECHNICAL DATA

Coloring (standard)	IGP smooth/matt 5803E71386A10	
Compressed air	Working pressure pressure-stage 1 - 6 bar	
Grade	ISO 8573-1 / 1 - Particles	
Voltage	**RoboTrex 52** 400 V / 16 Ah	**RoboTrex 96** 400 V / 32 Ah
Apparent power	**RoboTrex 52** 3,0 kVA	**RoboTrex 96** 7,5 kVA

2.3 MAINTENANCE AND REPAIR

The manufacturer of the RoboTrex automation system is LANG Technik GmbH. The customer for the automation project is the operator of the machine tool or a company commissioned by them. It is also possible to commission LANG Technik for implementation of the automation project.
A service technician from LANG Technik must be commissioned for repairs that affect the mechanics or electrics of the RoboTrex automation system. Such repairs include, but are not limited to:
- Replacement of defective assemblies
- Elimination of faults in the electrics, control system, pneumatics and mechanics
- Upgrade of assemblies to the latest version

In case of damage or errors, please contact LANG Technik GmbH directly.
LANG Technik GmbH - Albstrasse 1–6 - D-73271 Holzmaden, Germany - Phone: +49 7023 9585-0

3 Design and Function

3.1 Assembly

Before commissioning the RoboTrex automation system, the commissioning personnel must ensure that the LANG RoboTrex Automation is in perfect condition by performing inspections and an automatic run! Before starting work, inspect the system by performing a visual and functional check.

- Wear tight-fitting clothing and safety shoes.
- Wear gloves when handling blanks with sharp edges.
- Switch off the system after use.
- Keep the space for moving around the system free from obstructions.
- Only operate the system if you are in a healthy physical and mental state.

Conditions for assembly and installation
Condition of the floor at the installation site:

- flat, without slope
- in solid state
- suitable for anchoring with dowels

Space required for operation and maintenance
There should be a free space of at least 1 m around the RoboTrex automation system.

Permissible ambient conditions
The RoboTrex automation system is designed for indoor operation.
The temperature should be between +5 °C and +40 °C.
Relative humidity should not exceed 50%.

Connection to the power supply
The operating voltage of the RoboTrex automation system is 400 V, 50 Hz (three-phase).
The connection is hardwired to a 32 Ah fused line.
The LANG RoboTrex can be disconnected via the main switch Q0.
Compressed air (min. 6 bar) is required to operate the RoboTrex automation system.
The compressed air valve must be set to max. 6 bar.
The connection is made via the quick-coupling supplied.

3.2 Use

Interlinking with a machine tool

Note in advance:

Machine is incomplete!

The following conditions must be met so that the incomplete machine can be properly assembled with other parts to form the complete machine without impairing the safety and health of persons:

Condition 1: The fixed, separating protective devices must be completely closed and meet the requirements of EN ISO 14120.

Condition 2: All access points to the system (also through/via the machine tool) must be equipped with movable protective devices in conjunction with interlocking devices in accordance with EN ISO 14119 and the requirements of EN ISO 13849-1 as per Performance Level d.

Condition 3: If a complete set of machines emerges, an overall emergency stop concept must be implemented in accordance with the requirements of EN ISO 13849-1 as per Performance Level d.

The RoboTrex automation system from LANG Technik is used to retrofit machine tool. An retrofitting automation system in its entirety is created for operator-free loading of the machine tool with blanks and removal of the finished parts from the machine tool. To this end, preparations must be made to enable the contractual partners to effectively implement the automation project. The following diagram serves as a summary of the activities involved in preparing for commissioning.

3.3 Operating elements

Minimum requirements for signal exchange
There are minimum requirements for signal exchange between the LANG RoboTrex Automation and the machine tool. More about this in Chapter 3.2 “Interlinking with a machine tool”. All control lines that are to be connected to terminals in the control cabinet of the machine tool are routed to the -XS3.1 connector.
The specification for the machine tool side part of this connector is:

- Han 16B surface-mount housing with two cross brackets and one M25 screw connection, type HARTING 19300161231,
- Harting hinged frame plus, module a-d 09140160371,
- Harting socket module 12 pin. 09140123101,
- Harting pin insert 12 pol. 09140123001,
- Harting pin contact R 15-STI-C-0.5 09150006103,
- Harting socket contact R 15-BU-C-0.5 09150006203.

If the integrator prefers a surface-mount housing, make sure that it protrudes directly into the control cabinet. The lower part of the housing is firmly connected to the machine tool.

4 Commissioning

4.1 Responsibilities of the integrator

The integrator has to perform the following tasks:

- The aim of the integration must be to eliminate possible hazards that can arise from the interlinking of the automation system and the machine tool.
- Hazards can arise from the fact that the fencing line of the interlinked system has not been completely closed and encroachment into the system area is possible by crawling in, reaching in with upper and lower extremities, reaching over and crossing over.
- Another hazard can arise from improper coupling of the electrical signals for the EMERGENCY STOP.
- Proof must be provided in the form of documentation. The integrator confirms standard-compliant execution of the interlinking.

4.2 RoboTrex electrical equipment

The following describes the electrical interface of the RoboTrex automation system. The interface of the safety-related signals supports electrical installations up to Performance Level PLd, EN ISO 13849-1.
It also shows which activities related to the interlinking of electrical signals must be performed by the contractors.
The RoboTrex automation system characterized by:

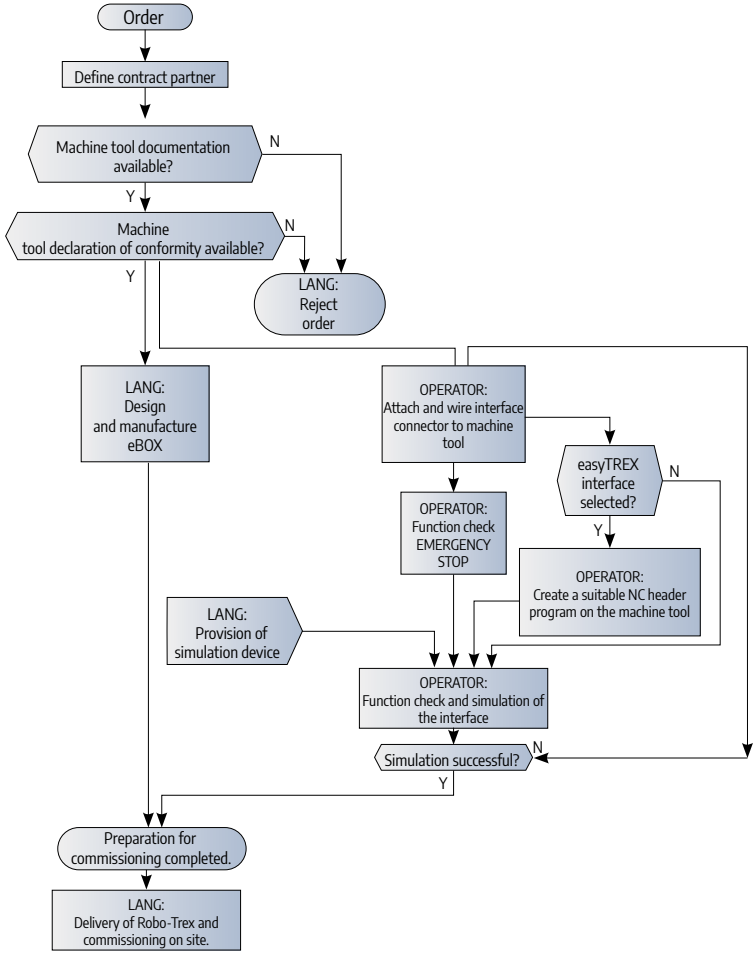
- a permanently installed electrical supply to a low-voltage 400 V, 3 AC, 50 Hz TN-S network DIN VDE 0100 and
- 6...8 bar compressed air connection, ISO 8573-1:2010[7:4:4]

The operator is responsible for the supply.
The transfer point is the terminals of the main switch or the supply side of the pneumatic maintenance unit.
The electrical energy supplies an industrial robot and a PLC control (equipment code +ZTR). The controls for the robot and the PLC are located in the base of the robot pedestal. The control is not visible to the viewer during normal operation. The PLC control is the key central part of the automation. This is where the safety-related signals and the signals for technological coupling combine.

4.3 RoboTrex automation system

The RoboTrex automation system is supplied in a disassembled state. Assembly is carried out by LANG Technik employees according to the floor plan prescribed by the integrator. If changes/additions are necessary on site, these must be clarified with the integrator in advance. The provision of lifting equipment
(forklift, crane, etc.) is indicated for the assembly.

After all components have been assembled, the electrical and pneumatic installation begins. All parts of the RoboTrex automation system are prepared ready to plug in.
The operator is individually responsible for connecting the media according to the floor plan (electrics, compressed air).
For commissioning to take place, all components of the RoboTrex automation system and the machine tool must be set up using interface -XS3.1. In addition, sufficient suitable automation clamping equipment must be kept on hand.
Commissioning is limited to the re-teaching of the already prepared robot positions by employees of LANG Technik.



4.4 MACHINE TOOL OPTIONS

RoboTrex PLC software is prepared for coupling to machine tools equipped in different ways. Depending on the level of equipment and selected option, it may be necessary to make an adjustment.
An eBox is used for this purpose, which acts as the transfer point for all signals from the machine tool for the standardized PLC control. The eBox is part of the RoboTrex electrical equipment. The contract partners are equally responsible for equipping this in a suitable fashion.
Machine tool options, which require a precise agreement from the partners, are

- the loading point of the machine tool
- the clamping device
- the technological interface

4.5 LOADING THROUGH MACHINE TOOL DOOR

The machine tool can be loaded by the robot itself through the machine tool door. The machine tool itself is then located inside the work surface of the connected system and cannot be reached by the operator during automated operation.
If manual operation with the machine tool is desired, the access door option must be selected. It is possible to enter the working area of the connected system through the access door, which itself is a part of the fencing. The access door is monitored to check whether it is closed. In automated operation, the closed access door is kept shut. It is impossible for the robot to move when the access door is open. During manual operation with the machine tool, the operator must ensure that the access door is not closed. It is assumed that the hazardous movements of the machine tool itself (spindle, axes) can only occur when the loading door is closed.

4.6 LOADING THROUGH SIDE WINDOW

The machine tool is not loaded by the robot through the machine tool door itself. There is a second opening to the machine tool working area, which is usually fitted on another side panel of the working area housing. This opening is also called the side window.
The side window must have an active closing device and it must be safely monitored to check whether it is closed. Pneumatic drives are usually used as actuators for opening/closing the side window.
The machine tool can be set up in relation to RoboTrex in such a way that the machine tool door is no longer in the working area.
This allows manual operation of the machine tool – here, it must be ensured that the side window is securely closed.

Automatic operation with RoboTrex is only permitted when the loading door is closed and safely monitored.

Note regarding signals to be expected on the eBox interface:
Safety monitoring of the loading window within the machine tool. This signal is given at the coupling point with the eBox.

4.7 CLAMPING DEVICE

The handling process of the RoboTrex system is based on the fact that all blanks and finished parts are transported in Makro-Grip® 5-axis vise, which match the gripper design.

These 5-axis vises are inserted into a zero-point clamping system, which is permanently mounted on the machine table of the machine tool, by means of a robot. Before machining can start, the 5-axis vise used must be locked in the zero-point clamping system. This can be done by a mechanical lever operated by the robot itself or pneumatically.
There are three different zero-point clamping systems for the automation system, which are classified and used as follows.

RoboTrex 52:

- Item no. 66500: Mechanical zero-point clamping system, is opened and clamped by the robot via a lever.
- Item no. 66600: Pneumatic zero-point clamping system, is actuated via the pneumatic interface of the gripper on the robot or controlled by the machine tool.

RoboTrex 96:

- Item no. 66600: Pneumatic zero-point clamping system, is actuated via the pneumatic interface of the gripper on the robot or controlled by the machine tool. Thanks to the gripper exchange interface, it can also be used together with the other RoboTrex 52 components in the larger RoboTrex 96 automation system and is replaced and removed using its gripper.
- Item no. 64500: Pneumatic zero-point clamping system, is actuated via the pneumatic interface of the gripper on the robot or controlled by the machine tool.

4.8 M-FUNKTION

RoboTrex has the ability to adapt to different interfaces.
On the part of the machine tool, such interface signals are realized by M-functions. These M-commands effect the setting of certain PLC outputs and the conditional stop of the CNC processing in the CNC program of the machine tool. The STOP state in the NC program is cancelled by a signal change at the associated PLC inputs. This enables a CNC program to run automatically.
ecoTower serves as the simplest interface. All that is required on the part of the machine tool is a pair of M-commands, consisting of a PLC output that is set at the end of part machining and stops NC processing, and a PLC input that resets the output and cancels the STOP state of the NC program.
Part selection is not possible.
RoboTrex ensures that at the end of the machining cycle, the vise with finished part is removed from the machine tool and replaced by a new one. After that, RoboTrex signals that the handling cycle is finished and approves NC processing again. The process ends when no more vises mit unmachined blanks are left in the automation system.
Additions that need to be inserted into an existing CNC program can be realized with little effort.

4.9 EASYTREX_HD AND EASYTREX_MT DIFFERENT-PARTS INTERFACE

EasyTrex_HD

With this different-part interface, handling takes over the role of communication master. The following signals are required for communication.

Machine tool			Handling	
OUT	NC_end	->	xCycleOfMachineTool_Finished	IN
IN	NC_Start	<-	xStart_CycleOfMachineTool	OUT
OUT	Trolley_1	->	aTrolley[1].Confirmed	IN
OUT	Trolley_2	->	aTrolley[2].Confirmed	IN
OUT	Trolley_3	->	aTrolley[3].Confirmed	IN
OUT	Trolley_4	->	aTrolley[4].Confirmed	IN
IN	Trolley_1	<-	aTrolley[1].Requiered	OUT
IN	Trolley_2	<-	aTrolley[2].Requiered	OUT
IN	Trolley_3	<-	aTrolley[3].Requiered	OUT
IN	Trolley_4	<-	aTrolley[4].Requiered	OUT
IN	EndOfWork	<-	xEndOfWork	OUT

Another requirement is the existence of 2 or 4 NC programs for the corresponding machining process on the NC control of the machine tool. Communication starts when the signal NC_End = TRUE is first given by the machine tool.
Handling starts with the loading of a vise/blank. The trolley with the smallest number is first.
The operator is responsible for activating a trolley. A trolley that has been started is processed completely. Each processed trolley is deactivated by the handling control. If a trolley is deactivated, it is ignored by the handling control.
This is illustrated by an example where the operator initially only activated trolley 2 and started the system. After the algorithm started processing the blanks on trolley 2, the operator subsequently activated trolley 1. Initially, this has no effect, since the handling control had already defined trolley 2 as the trolley to be processed. It is only possible to determine a new trolley number after processing trolley 2.
After the vise/blank is loaded into the machine tool, the corresponding trolley number of the machine tool is communicated in the 1-out-of-N code. This number has to mirror the machine tool control. If the handling control determines that the specified and the mirrored trolley number match, the HD control gives the start command NC_Start = TRUE.
The machine tool now starts the NC part program agreed by the trolley number.
At the end of trolley 1, there are no further trolleys activated in the example. Handling now initiates the after-work sequence: The robot moves to home position and IDLE mode is assumed. This state is displayed on the control panel and the signal EndOfWork = TRUE is set. Each key operation on a trolley icon or the IDLE display exits the IDLE state (EndOfWork = FALSE). The operator can now re-activate the required trolleys and start handling.

EasyTrex_MT

In this miscellaneous parts interface, the machine tool assumes the role of the communication master. The following signals are required for communication.

Machine tool			Handling	
OUT	NC_end	->	xCycleOfMachineTool_Finished	IN
IN	NC_Start	<-	xStart_CycleOfMachineTool	OUT
OUT	Trolley_1	->	aTrolley[1].Requiered	IN
OUT	Trolley_2	->	aTrolley[2].Requiered	IN
OUT	Trolley_3	->	aTrolley[3].Requiered	IN
OUT	Trolley_4	->	aTrolley[4].Requiered	IN
IN	Refuse	<-	xTrolReq_Refused	OUT
IN	EndOfWork	<-	xEndOfWork	OUT

EasyTrex_MT

Another requirement is the existence of 2 or 4 NC programs for the corresponding machining process on the NC control of the machine tool.
The HD does not have an algorithm for selecting the trolley to be machined, this is now the task of the machine tool. On the machine tool side, the selection of the trolley number is to be defined by its own algorithm. The operator of the machine tool is responsible for this and must have the desired algorithm ready to function on their machine tool when the system is commissioned at the latest.
It is not necessary for a trolley that has been started to be processed in full. If stored accordingly in the algorithm of the machine tool, the processing can always jump back and forth between the trolleys.
Communication starts with the machine tool having to specify the trolley number for the next part to be machined (trolley_1,.., trolley_4 in 1outN code). Then the HD starts when the signal NC_End = TRUE is first given by the machine tool. The HD first checks the specified trolley number for formal plausibility. The system then checks whether the trolley with the requested number is activated. If this is the case, the HD starts searching for a vise/blank on this trolley, otherwise the request is rejected. If the HD finds a blank on the trolley with the appropriate request, it is loaded into the machine tool. Otherwise, the trolley will be disabled and the request will be rejected.
If loading is successful, this is acknowledged with NC_Start = TRUE and Refuse = FALSE. The machine tool then starts processing the part program with the agreed trolley number. In case of a rejection this is indicated with NC_Start = FALSE and Refuse = TRUE. The machine tool now has the option of formulating a new request (trolley_1,.., trolley_4 in 1outN code) and sending it with NC_End = TRUE. The HD restarts the action described above.
If the HD detects that all trolleys are disabled when searching for a blank, it signals EndOfWork = TRUE and NC_Start = FALSE and Refuse = FALSE. The machine tool now does not need to send any further request and can enter ShutDown mode itself. IDLE mode is cancelled by the operator as described above.

4.10 BUS INTERFACE

In the case of an industrial fieldbus interface, the standard PLC signals are transmitted between the machine tool controllers and RoboTrex in series.
By default, RoboTrex PLC control supports MODBUS and Ethernet/IP protocols. Other protocols, such as ProfiBus, ProfiNet, InterBus or CANopen are possible on request.

5.1 TESTING THE INTERFACE

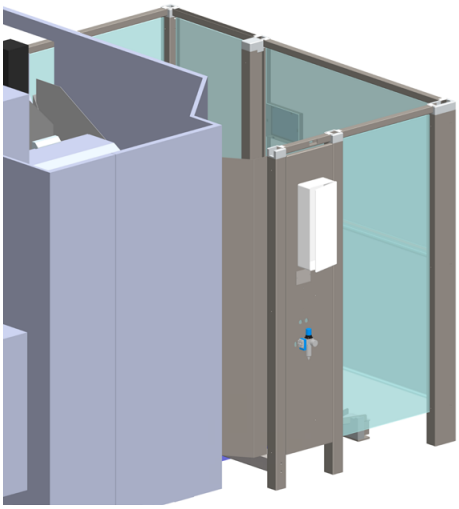
The functional test for the interface is carried out before the delivery of the automation with the help of a testing instrument. The testing instrument can be obtained from LANG Technik.

Proof of the interface's functionality must be logged by the integrator. It is possible to deliver the RoboTrex automation system after the protocol has been submitted.
After successful testing, the machine tool can continue to be operated in stand-alone mode using the testing instrument until the RoboTrex automation system arrives and is installed.

5.2 CONNECTING TO FENCE

The RoboTrex automation system closes off at each corner with a fence post. The fence posts have 3x M5 threads for attaching a corresponding plate to the machine.
The plates are prepared and applied by LANG Technik in a customer-specific and thus machine-specific manner. Responsibility for checking the plates lies with the operator! The diagram shows an example of how to install a protective plate.

Possible intervention points must be closed using protective plates!
The operator must check that the plates protect against reaching in and ensure that all danger points are covered.



6 Machine data for RoboTrex

Each system can be configured differently, according to the individual needs of the customer. Since the system is configured individually according to customer requirements, there may be deviations in the representation shown here.

6.1 Protective devices

The following protective devices serve to protect the operator.

Protective devices must not be removed, bridged or modified!

EMERGENCY STOP SYSTEM

The entire RoboTrex automation system is equipped with an emergency stop circuit. The emergency stop button is located on the right below the display on the system housing. The emergency stop system of the automation must be connected to the emergency stop system of the machine.

After an emergency stop, the system cannot restart independently!

- Unlock: The system is unlocked again by pressing the emergency stop button on the housing. A message appears on the display.

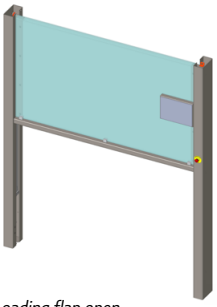
Parameters for emergency stop:
Interface of the emergency stop button from the machine tool to the eBox -> PFHd 7.95E-09
RoboTrex emergency stop button on the eBox in the direction of the machine tool -> PFHd 1.12E-08

Separating protective devices

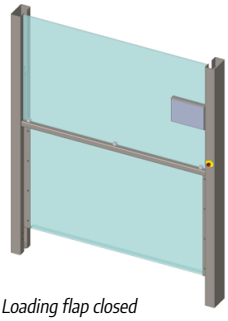
The RoboTrex automation system is supplied with separating protective devices. Here we differentiate between:

- fixed, separating protective device in the form of fencing
- movable separating protective device in the form of the doors and flaps.

The automatic mode only works when the loading flap is closed!



Loading flap open



Loading flap closed

Protection against unexpected startup

The RoboTrex automation system has protection against unexpected startup following voltage recovery.

Grounding

The RoboTrex automation system is grounded to prevent damage to the operator from electrical interference.

6.2 HOW THE ROBOTREX AUTOMATION SYSTEM WORKS

The articulated-arm robot is equipped with a gripper suitable for the clamping devices. The gripper is used to pick up clamping devices in sequence from the trolley (for a more detailed description, see the following description in Chapter 6.3 Automation trolleys) and insert them into a machine tool. Insertion into the machine can be done by a pneumatic or by a mechanical zero-point clamping system.
At the end of the machine cycle, the clamping device with the finished part is removed and placed in the empty space on the trolley. Only one clamping device is processed at a time, leaving only one space empty on the trolley.
The automation trolley is accessed through the loading flap. To do this, select "Open flap" on the display. After the system has been approved, the trolley can be removed. Depending on the type of system, it may also include an access door.
The loading flap and access door are protected by safety switches.

6.3 AUTOMATION TROLLEY

Technical data of the mobile storage unit

RoboTrex	HWD approx. 990 x 660 x 1270 mm
Automation trolley	Empty weight approx. 180 kg

The offer from the LANG company includes the following trolley types:
For RoboTrex 96:
Item No. 64015 – for holding up to 15 automation vises in 5 rows with 3 slots each.
Item No. 64016 – for holding up to 16 automation vises in 4 rows with 4 slots each
For RoboTrex 52:
Item No. 66030 – for holding up to 30 automation vises in 6 rows with 5 slots each
Item No. 66042 – for holding up to 42 automation vises in 7 rows with 6 slots each

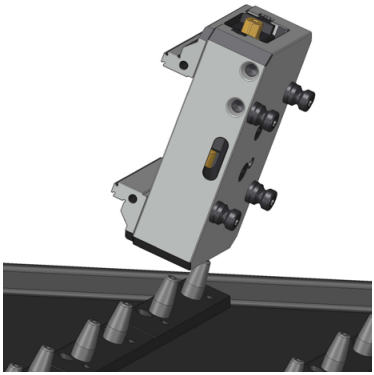
The type of the trolley is automatically detected and shown in the display.

At a working height of approx. 900 mm, plug-in bolts are arranged in such a way that the automation vises can be positively inserted in rows or their slots. It is also possible to work ergonomically since the clamping devices are arranged upright. The trolleys are loaded manually. Slots may also remain unused.

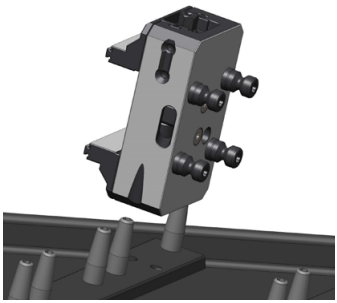
Dimensions	**(L x W x H)**
Part size on mobile storage unit 64015	205 x 205 x 90 mm
Part size on mobile storage unit 64016	205 x 205 x 150 mm
Part size on mobile storage unit 66030	120 x 120 x 100 mm
Part size on mobile storage unit 66042	120 x 100 x 70 mm

One or max. 4 trolleys (depending on the design) can be served with the system. A trolley does not have to be fully loaded, which means that empty spaces will be detected.

Vise arrangement RT96



Vise arrangement RT52



INSERTING AND ACTIVATING THE TROLLEY

The trolley is aligned on one of the two trolley entry systems and pushed in until the operator notices a click and the trolley is automatically fully retracted. The diagram below shows an example of the trolley entry systems.
If a trolley is detected, it is indicated in the display with an "X" with surrounded by a blue border. To activate the trolley, click the "X".

- A green tick with a yellow border appears.

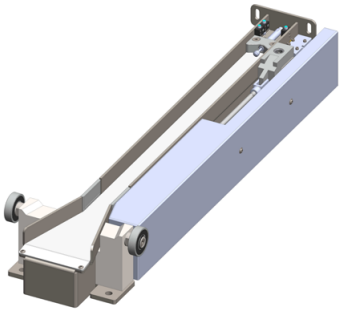


Figure
trolley entry system

REMOVING THE TROLLEY

The trolley must be unlocked before it is removed. To do this, pull the small hand lever (1) located beneath the push handle (2) towards you.

- This unlocks the trolley. The trolley can be pulled out.

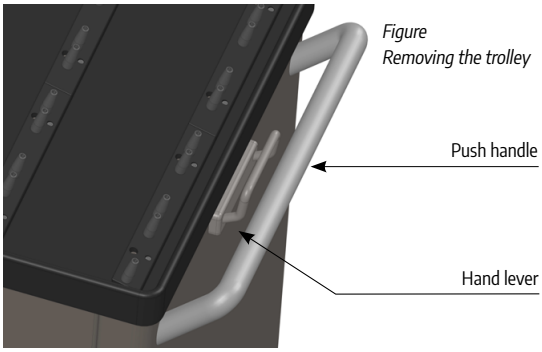


Figure
Removing the trolley

6.4 ARTICULATED-ARM ROBOT

The articulated robot is responsible for transporting an automation vise with a blank into the machine tool (loading the machine) and for transporting the automation vise with the finished part out of the machine tool (unloading the machine). The blank is unloaded and the finished part is placed in exactly the same position on the trolley.
The articulated-arm robot is equipped with a pneumatic gripper for the automation vises. The production parts cannot be gripped directly.

Technical data of the articulated-arm robot

Articulated-arm robot Type FANUC M-710iC	Max. robot handling weight 50 kg (M710iC/50) Max. workpiece weight (automation vise + blank) = 25 kg [Max. robot handling weight 70 kg (M710iC/70) Max. workpiece weight (automation vise + blank) = 45 kg]
Articulated-arm robot Type FANUC M-20iD	Max. robot handling weight 25 kg Max. workpiece weight (automation vise + blank) = 15 kg

The specifications of the max. workpiece weight refer to blanks with the max. dimensions specified in the Fanuc robot manual. If workpieces with large dimensions and/or higher weights are to be inserted, a load setting must be made according to the Fanuc robot manual.
The robot is delivered with a safety area permanently programmed for the respective system. This is set according to the Fanuc manual and prevents the robot from leaving the safe working area. The articulated-arm robot is not configurable.

Maintenance intervals
The robot must be maintained. Refer to the Fanuc manual for information on maintenance intervals!

6.5 SECURITY FENCING

The safety fencing is a safeguard to prevent the operator from entering the safety area of the robot. The safety fencing is assembled from standard components according to the individual configuration.

The safety fencing does not prevent the robot from remaining within the safety area. Software protection by Fanuc Dual Check Safety must be used for this purpose.
The integrator must draw up a floor plan of the system that is binding for all participating economic operators. This floor plan shows the fencing line, which delimits the outer limit of the system area. Suitable building elements (walls, columns, etc.) are permitted as part of the closed fencing line.
The fencing contains the following components:

- at least one, maximum two loading flaps: Each loading flap opens and closes access to two neighboring automation trolleys. Outside the system, access must be kept free in front of each loading flap to a distance of at least 1500 mm, and the connection to operational transport routes must be ensured.
- maximum of one access door: When the operator requests the access door to be opened, the robot moves to a safe parking position. The access door will not open until safe access is possible. The operator opens the door, which turns off the robot's axes. It is now possible for the operator to enter the RoboTrex automation system working area. This access option is mandatory when the machine tool is loaded through its loading door and manual operation of the machine without a robot is desired. There is no need for an access door if the machine tool is loaded through a side window and the machine tool is positioned so that its loading door is outside the fencing line of the system.
- at least one fence opening that must be closed for standard-compliant operation of the robot. Usually, the collaborating machine tool is placed here. The integrator is responsible for this.

6.6 MACHINE TOOL

The machine tool is not part of the RoboTrex automation system. Together, the automation and machine tool form a complete automated system. This system is then an independent machine in the sense of the Machinery Directive.
It must be possible to integrate the machine tool into the system for operation. If this is not already prepared by the manufacturer of the machine tool, this feature can often be set up with a subsequent intervention. The machine tool communicates with the central control of the automation via the interface.
Unless otherwise agreed in writing, the integrator is responsible for the execution of the appropriate interface.
The minimum requirements for this interface are:

- the machine tool's EMERGENCY STOP command devices are available on two channels and are potential-free
- an external EMERGENCY STOP signal, which is applied externally on two channels and potential-free, leads to a safe EMERGENCY STOP of the machine tool when it is triggered (simultaneous opening)
- the machine tool signals the end of an NC block with a special M-command (this signal may include automatic unlocking of the loading aperture and its open position. If this is not the case, it must be possible to control the commands from the central control).
- it must be possible to start the NC block of the machine tool by means of an external signal (the signal may include automatic closing and locking of the loading opening. If this is not the case, it must be possible to control the commands from the central control). Starting the NC block acknowledges the M-command issued at the end of the NC block.
- the last two signals mentioned can be an input or output signal from the machine tool control (PLC) or can occur in the form of a telegram from a suitable industrial field bus.

Depending on the type of the machine tool, there are various options for its integration into the system.

LOADING THROUGH THE MACHINE DOOR (OPTION: LOADING DOOR)

When loading through the machine door, the articulated-arm robot uses the same access as a machine operator during manual operation. The working area of the machine tool is part of the working area of the system.
The machine door must be located completely within the fencing line of the system. Further openings to the working area of the machine tool are not permitted.
The machine door must be designed in such a way that it can be securely locked when closed. The interlock is monitored by the machine control at all times during execution of the NC program. After completion of the NC block, the operator can request for the loading door to be unlocked, or it is unlocked automatically.

The loading door is opened and closed manually by the operator. In the case of heavy doors, it is possible for the manufacturer to provide an actuator for opening/closing. The loading door is suitable for automated system operation when:

- it has an actuator for opening and closing. If necessary, this actuator must be retrofitted. A signal transmitter (sensor) is required for the open position.
- the interlock can be released by a control signal after the NC block has been processed. Advantageously, this condition is fulfilled anyway if the machine control system does this automatically (automatic unlocking upon completion of the block).
- the interlock can be activated by a control signal before the NC block is started. Advantageously, this condition is fulfilled anyway if the machine control system does this automatically (automatic locking after closing the door).

SIDE WINDOW

When loading through a side window, the machine tool has another opening into the working area, in addition to its machine door. This option is advantageous if, in addition to the possibility of automated system operation, the operator wishes to operate the machine tool manually on a frequent basis.
For this purpose, the machine tool is integrated into the fencing line in such a way that the machine tool door is located outside and the side window inside the system area. A minor disadvantage here is the increased space requirement, because another workstation must be kept available outside the system area in front of the machine tool's door.
The side window is suitable for automated system operation when:

- it has an actuator for opening and closing. A signal transmitter (sensor) is required for the open position. The actuator can already be controlled by the control of the machine tool.
- its closed position is safely monitored for manual operation of the machine tool and a machine tool door lock can only be released when the side window is safely closed.
- a safe signal for the closed state of the machine tool door is available. Since the working area of the machine tool is by definition part of the system, opening the machine tool door results in the opening of the system fencing, which requires the articulated-arm robot to be shut down safely.

As a rule:
The robot must not enter through the side window when the loading door of the machine tool is open! A safe signal transmitter for the machine tool door can be retrofitted if necessary. For a qualified integration, you must define the responsibility for controlling the sensors and actuators of the loading window: The control of the machine tool or the central control of the RoboTrex automation system. Usually, this is determined according to who is the manufacturer of the side window.

6.7 CENTRAL CONTROL

The central control is part of the RoboTrex automation system.
This is permanently installed underneath the robot frame. It takes over the safety-compliant coupling and distribution of the EMERGENCY STOP signals of the machine tool and the robot, as well as other external EMERGENCY STOP command devices, and the signal-technical linking of all controls participating in system operation, as well as HMI functions.
The eBox provided by LANG Technik is used for customized adaptation of the interface to the machine tool. The eBox is mounted in a separate position from the central control on the maintenance plate. Utilization of the eBox, makes it possible to take central control to a higher level of standardization.

Central control components:

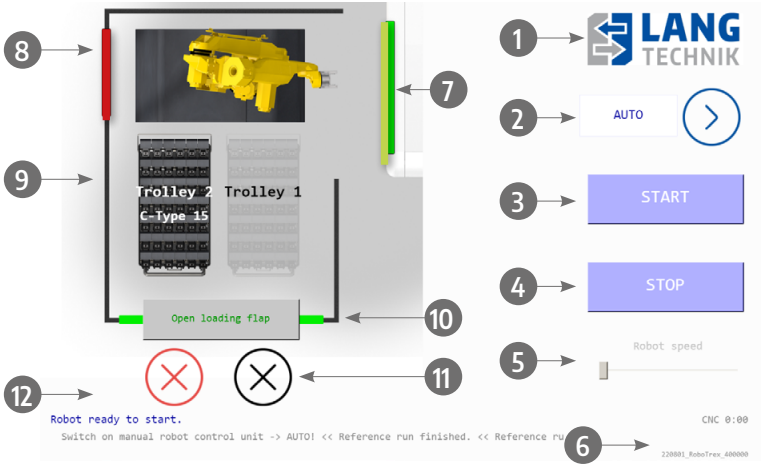
- consists of an industrial control system in a housing with dimensions WHD = 400 x 400 x 200 mm, which is placed directly next to the control cabinet of the robot (both to be found in the interior of the platform for the robot). From here, a large number of connectors lead to the other components of the system. This control has the location indicator +ZTR.
- possibly consists of a eBox for individual coupling of the central control unit with the machine tool. The eBox often has the dimensions WHD = 200 x 500 x 120 mm and has the location code +machine tool. It must be attached to the machine tool. Signals to be connected from the control cabinet of the machine tool to the eBox are routed via the external connector -XS3.1.
- an industrial display for operation and observation of the system. The display is mounted above the loading flap. In the following, the display is called HMI for short.

6.8 OPERATING THE AUTOMATION

The automation is largely operated intuitively. Visual controls and the use of colors and icons facilitate understanding. The main operating screen is sufficient for operating the system.

Further description can only be made using examples, because every main operating screen looks different depending on the individual design of the system.

In the main operating screen, the operator first sees the image of the actual floor plan of their system. The view is oriented in such a way that the HMI is always located in the horizontal bottom edge.



Legend home screen:

❶ LANG logo for language setting
The language can be set via the LANG logo 60 seconds after starting the automation. Tap on the logo and different country flags will show the different languages. Select and confirm a language.
After 60 seconds, it is no longer possible to change the language. You will need to restart the automation.

❷ Program selection
The program selection options are "AUTO" and "Reference" and "uniTrex".
System operation can only be started from a safe robot position. A safe position is the HOME POSITION, which can be approached with a special robot program, the reference run.

If only the reference run is to be executed, select the "Reference" program.
Select the "AUTO" program to start system operation.

- If the robot is not in HOME POSITION when system operation starts, "Reference" is first processed automatically and "AUTO" is used to continue processing without any further operator prompts.

The program "uniTrex" will be explained later (Section 6.8.9), this is an additional function.

❸ Start button
Functions:

- to start system operation
- to resume system operation after an interruption requested by the operator

❹ Stop button
Functions:

- to interrupt system operation
- to cancel system operation

System operation can only be cancelled if it has been interrupted before. To cancel, briefly press and hold the key (>2s).
If system operation is merely interrupted, it can be resumed by pressing the Start key.

❺ Robot speed
The robot speed must be selected depending on the part weight and the current moments of inertia with respect to the robot axes. The setting range is between 10-100% of a fixed reference value set in the robot program.

❻ CNC program runtime
Runtime of the current NC program.

❼ Machine tool symbol
When system operation has been carried out by the start button, approval of the machine tool is indicated on the machine tool with a green bar. Another option is to query a sensor, which can be represented by a green dot in the bar and indicates that the machine door or the loading window is open

❽ Access door symbol
It is only possible to start system operation when the access door is closed. A sensor monitors whether the door is closed.
A safety locking device prevents the access door from being opened while the system is running. The holding force is 50 kg. The request to open the access door can be executed in different ways. Generally, an illuminated push-button is located close to the corresponding access door. Opening can also be prompted by touching the icon in the operating area of the HMI. (Delete)
Actuation results in a request to open the access door. The robot will only stop when it has reached a safe position in system operation, and system operation will be interrupted by opening the access door. After closing the access door, system operation can be resumed by pressing the 'CONTINUE' key at the interrupted point.

❾ Illustration of trolley
The illustration of the trolley shows the trolley number, the trolley type and any function set on the trolley. A wide variety of functions can be set by tapping on the deactivated trolley.

❿ Button for opening/closing the loading flap
System operation can only be started when the loading flap is closed. A sensor monitors whether the door is closed.
Opening a loading flap leads to the safe shutdown of all robot movements, but not to the interruption of a running NC program of the machine tool.
Tap the key to open the loading flap. The robot will only stop when it has reached a safe position in system operation, and system operation will be interrupted by opening the loading flap. After closing the loading flap, system operation can be resumed by pressing the 'CONTINUE' key at the interrupted point.

⓫ Status display of the trolley and button for activation (in this case, trolley 1 and trolley 2)
Before system operation can be started, you must decide which loading trolley is to be included in system operation.
The symbols can be represented as follows:

- Black cross: Trolley not physically present
- Red cross: Trolley physically present, not activated
- Blue tick: Trolley activated
- Green tick: Trolley in process
- Red tick: Trolley has been removed, but still has active status

Activate one or more trolleys. To do this, tap the button of the respective trolley. Activation is shown by a blue tick. Only activated trolleys take part in system operation. If the operator tries to start system operation without activating a trolley beforehand, a message is displayed in the 'Message texts' area. Consequence: the start attempt is ignored. A trolley can only be activated if it is physically present. If more than one trolley has been activated before starting system operation, the control selects the trolley with the smallest number from those that have been activated and sets it to ‘Trolley in progress’ status and starts system operation.

If there is one trolley, always start at the front left with the first vise/blank and continue working row by row from left to right.
Only the trolley with the status ‘Trolley in progress’ is processed in system operation. Among all activated trolleys, there is only one with this status in system operation.
If an activated trolley does not have 'Trolley in progress' status, it can be deactivated by pressing the activation key again.

When the 'Trolley in progress' is completely processed, the control sets the status of this trolley from ‘Trolley activated' and ‘Trolley in progress' to ‘Trolley passive'. This trolley will not be considered in further system operation.

Among the remaining activated trolleys, the one with the smallest number is selected and delegated to the 'Trolley in progress' status.
When all trolleys have been processed, the robot automatically moves to HOME POSITION and sends a ready message.

⑫ Message texts
This field displays texts that inform the operator about certain states of the system. The first line contains the most recent message, followed by the messages listed in chronological order.

6.8.1 SPECIAL STATUS DISPLAY

Three special machine statuses are shown below, which trigger the inserted displays.

Case 1: When starting the program, a part is in the machine
The operator starts the program. The robot moves to all positions and scans them. A part has remained in the machine. This is detected by the sensor and the message appears. The operator is prompted to empty the zero-point system.

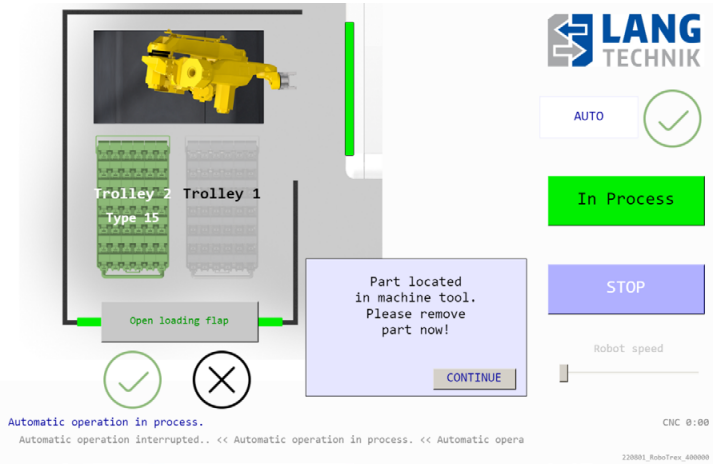


Figure 1: Part in the machine
The confirmation request allows the operator to verify that the zero-point system has been emptied successfully.

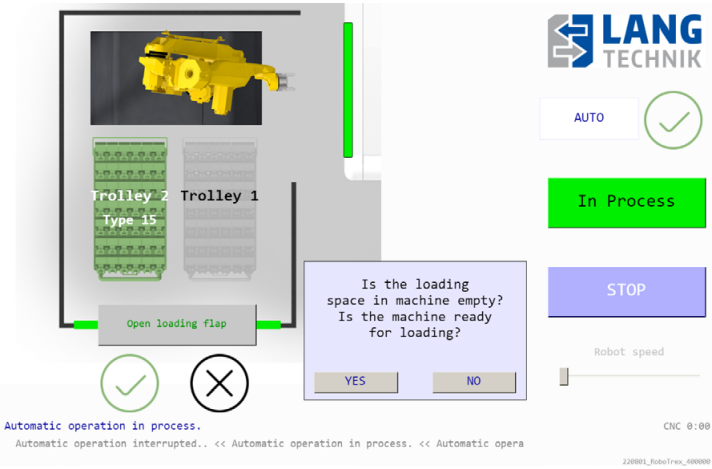


Figure 2: Part in the gripper – confirmation request

Case 2: When starting the program, a part is in the gripper
The operator starts the program. A part has remained in the gripper. This is detected by the sensor. The part is placed in the machine and must be removed manually by the operator as in case 1.

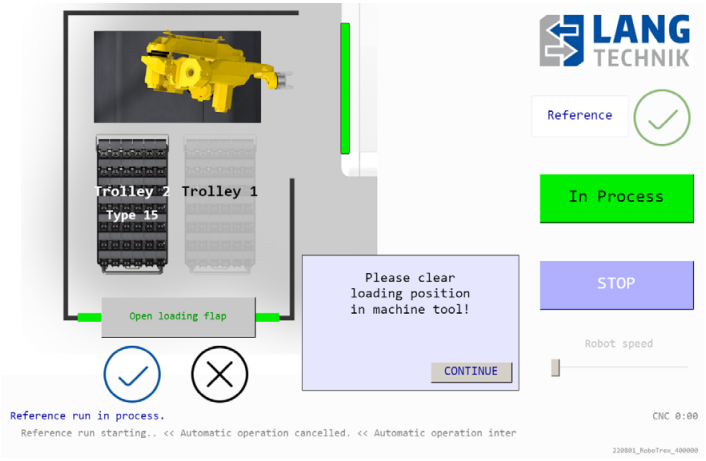


Figure 3: Empty the machine
The confirmation request allows the operator to verify that the zero-point system has been emptied successfully.

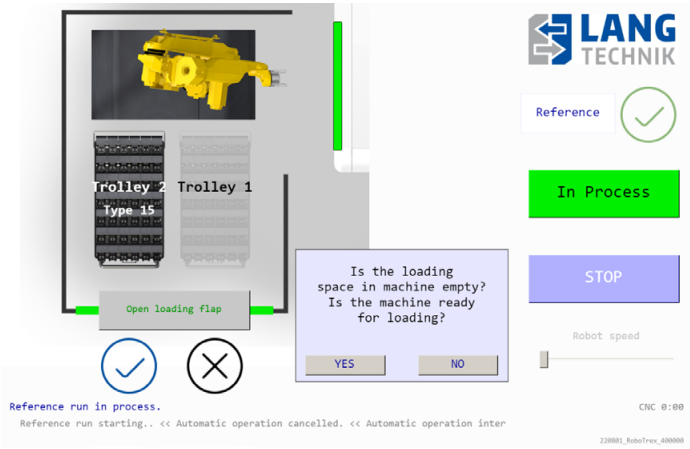


Figure 4: Confirmation request

Case 3: Trolley "in progress" is removed

The operator removes a trolley that has "In progress" status. The trolley must be pushed in again to continue machining. Here, it is important that the trolley remains unchanged when the work process continues. If a position is unexpectedly occupied, a collision may occur, which results in material damage!

Figure 5: Trolley has lost its position

The operator must confirm the marked empty slot of the vise in progress.

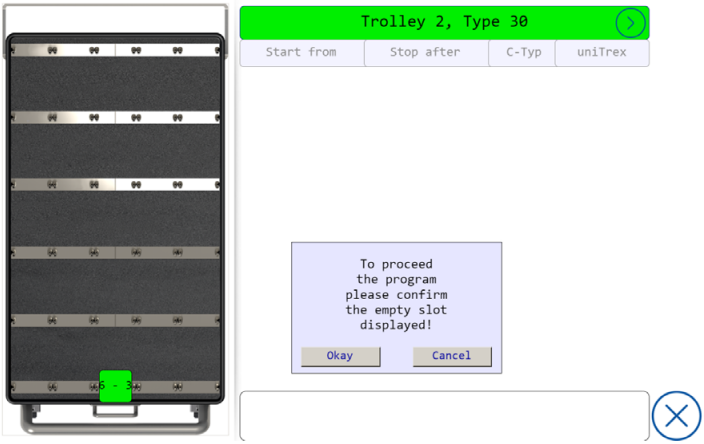


Figure 6: Trolley confirmation

6.8.2 REFERENCE RUN

The goal of the reference run is to move the robot to its reference point and empty the gripper.
During a system start, the reference run is executed if:

- the program 'Reference' has been selected
- if at the start time of the 'AUTO' program the robot is not in HOME POSITION

Problem cases: If there is an automation vise in the gripper when the reference run is started, it must be removed.
Since it is uncertain which position on a loading trolley this automation vise could come from, it is not placed on the loading trolley, but on the loading bay of the machine tool.
The situation on the zero-point system inside the machine tool is also undefined: It could be occupied, which means that automatic placement of the part in the gripper would not be possible. The conflict must be resolved manually. This means that the operator must ensure that the zero-point system inside the machine tool is emptied and that loading readiness is established.
If both conditions are met, the operator can confirm this in a dialog box. The robot then moves into the machine tool and deposits the clamping device in its gripper.
Recommendation for the operator: This procedure can be dispensed with if it is ensured that no automation vise is in the gripper when system operation is interrupted.

6.8.3 AUTOMATIC GRIPPER EXCHANGE

Each RoboTrex 96 automation system has the option to perform an automated gripper exchange. The basic requirement is that the gripper exchange interface is adapted to each robot as standard.
Whether the robot now performs an automated changeover depends on the equipment purchased, as both RoboTrex gripper versions and at least two authorized automation trolleys must be available.
By coding and thus recognizing the part size of the automation trolleys in the infeeds, RoboTrex knows which gripper it should use to pick up the vises from the respective trolley.

Assume the following situation:
There is an automation trolley with 15 automation vises (item no. 64015) in trolley position 1, this is activated and is being processed at the moment. An active automation trolley with 42 automation vises (item no. 66042) is located in trolley position 2.

After trolley position 1 has been completely processed, the control recognizes that there is another vise size in trolley position 2.
The robot now starts the automatic gripper exchange by removing the pneumatic zero-point clamping system from the storage rack and then loading it into the machine tool like a clamping device. The robot then places the gripper for the 96 mm system size in the associated storage location and now picks up the gripper for the 52 mm system size. Once the small gripper has been adapted, the robot loads the machine tool with the next vises as usual. The small gripper remains adapted until the control recognizes another vise size and automatically changes the gripper again.

6.8.4 START OF SYSTEM OPERATION

Starting point:
After a successful reference run, the robot stands on its reference point and the gripper is emptied. When starting system operation ("AUTO" program), an attempt is made to start loading the first blank into the machine tool. For this purpose, the zero-point system inside the machine tool must be free.
In order to determine whether the current loading bay of the machine tool is occupied, the robot moves to the loading bay once and checks the occupancy situation by means of an optical sensor. If it is determined that the zero-point system is occupied, a procedure is started requesting the operator to empty the machine tool (see Figure 3). Finally, manual removal must be confirmed in a dialog box (see Figure 4).
Recommendation for the operator: This procedure can be omitted if it is ensured that no automation vise is in the zero-point system when the program is started. In this case, the robot would enter the machine tool for inspection, but the result would not be critical.

6.8.5 OPENING A LOADING FLAP DURING SYSTEM OPERATION

During system operation, it may be necessary to open a loading flap.
A typical application occurs when a finished trolley, which has been passively switched by the control, is to be removed and replaced by a new trolley with blanks. This case can be easily managed by requesting the opening of the loading flap.
Select "Open loading flap" on the display. Opening continues until it is ensured that the robot is in a safe position. Now the loading flap opens (interruption of system operation) and the finished part trolley can be removed. A new trolley with blanks can now be placed in the empty trolley space. After the loading flap is closed, all that remains is to activate the new trolley with blanks. System operation can be resumed.
Another scenario, however, leads to a special procedure: During system operation, there is a need to remove finished parts from the activated "in progress" trolley (= current trolley) in order to check the quality of the latest finished parts. To do this, the operator would request the opening of the loading flap and wait until the robot parks and releases the loading flap. To access the finished part more easily, the operator would have to remove the current trolley. In doing so, the central control loses the signal that this trolley is in position. By definition, this leads to an error, since the trolley that is active and 'in progress' must not lose its presence message!
The status for this trolley initially remains 'active' and 'in progress', but the presence sensor does not report. To resolve the contradiction, an explicit operator instruction requires the trolley to be moved back to its position. This request remains in the display until the sensor reports the presence of the trolley again.
The loading flap can be closed and system operation can be continued.

The operator must ensure that the automation vise they have removed is either returned to the same position from which it was removed it or is removed completely. Otherwise, a collision may occur, which results in material damage!

Another peculiarity occurs if the loading flap is opened at a time when a part of the current trolley is being processed or in the robot gripper. In this case, a reserved empty slot is created on the loading trolley, which is necessary for depositing the part located in the system. In this case, if the current trolley is brought back into position, an additional operator query takes place in which the operator must confirm that the empty slot is actually free.

Recommendation for the operator: This procedure can be simplified if care is taken to send the request to open the loading flap at the exact moment when the robot has removed the just-finished part from the machine tool and placed it on the trolley. For a brief moment, the gripper and machine tool are then free of parts. If, after removing a part from the current trolley, the operator is unsure of the position it should be returned to, it is better to leave that part removed from the trolley.

6.8.6 CANCELLING SYSTEM OPERATION

System operation is interrupted by pressing the stop key.
By pressing the stop key again (it is now labeled CANCEL),
it is possible to cancel system operation.
Consequences: The part that is currently in the machine tool is finished. The final M-command set by the NC program is no longer received by the system.
The robot is switched off whether it is in a non-critical position or not. If there is still an automation vise in the gripper, it remains there.
The interlock for an access door is released. It is possible to enter the system area.
The current trolley, as well as all other activated trolleys, are changed to 'passive' status.
The position indicator for the part currently being machined is reset, and the information about the position where the vise is to be placed on the current trolley is thus lost. No loading trolley has the status 'in progress'.
In particular, the fact that the position indicator of the current trolley is reset means that the parts of the current trolley that have already been finished must be skipped using the "Start from" function before a restart, since they are not allowed to enter system operation again.

6.8.7 SET START-FROM POSITION ON TROLLEY

The start-from position of the machining procedure can be set manually.
If no specific start-from position is set manually, the machining procedure starts with the start position 1-1, first row on the left.

Set start-from position manually:
Select a trolley by clicking the trolley on the home screen.
Note: the trolley must be disabled = Red cross

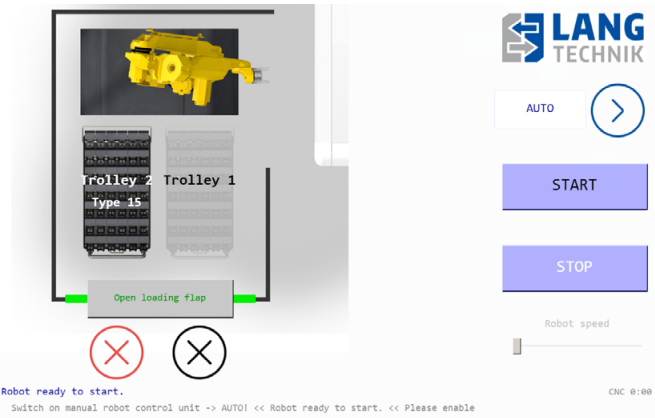


Figure 7: Start-from position

By selecting the trolley, you will get to the screen for selecting the start-from position. Select the 'Start-from' function in the function tab!

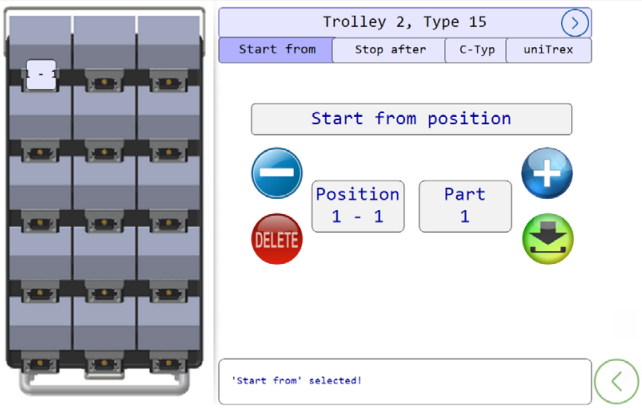


Figure 8: Start-from position

The box at the top of the screen shows the selected trolley position and trolley type for which you are making the setting. By clicking the arrow next to it, you will jump through the trolleys. Use the plus and minus signs to select the start-from position on the trolley. This is displayed on the trolley shown on the left.
It is also possible to set the 'Start-from' position on the trolley by clicking directly on the trolley shown on the left.

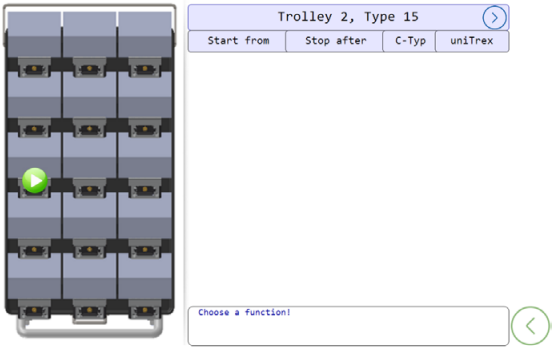


Figure 9: Start-from

Confirm your selection with the green save icon and save the start-from position of the trolley. Use the delete icon to delete your selection and reset the start position back to 1-1. As long as the green back arrow is displayed in the lower right corner, you can exit the screen and return to the home screen. If there is an X symbol at this point, you are in the active selection and must delete or confirm your choice. After successfully selecting the start position, return to the home screen. Here you will now see your selected start-from position on the corresponding trolley with, for example, "Start from 3-1".

Figure 10: Display of the start-from position

6.8.8 SET STOP-AFTER POSITION ON TROLLEY

The stop-after position of the machining procedure can be set manually.
If no specific stop-after position is set manually, the machining procedure is executed normally from the first to the last row.
Set stop-after position manually:
Select a trolley by clicking the trolley on the home screen.
Note: the trolley must be disabled = Red cross

Figure 11: Stop-after position

Selecting the trolley takes you to the screen for selecting the stop-after position. Select the 'Stop-after' function in the function tab!

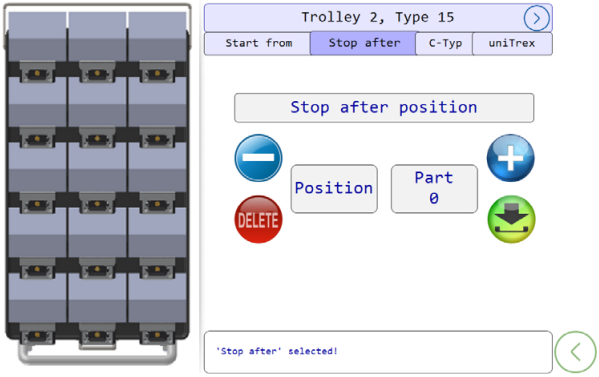


Figure 12: Stop-after position

The box at the top of the screen shows the selected trolley bay and trolley type for which you are making the setting. By clicking the arrow next to it, you will jump through the trolleys.

Use the plus and minus signs to select the stop-after position on the trolley. This is displayed on the trolley shown on the left. By clicking directly on the trolley shown on the left, it is also possible to set the stop-after position on the trolley.

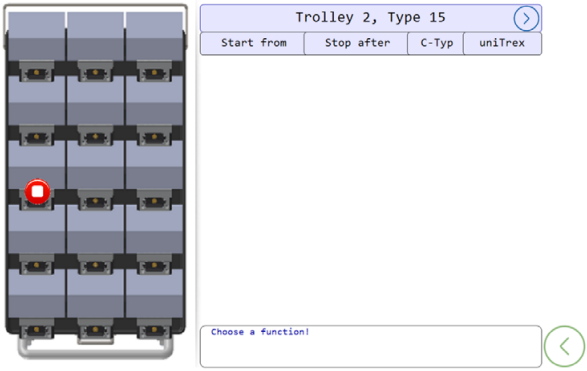


Figure 13: Stop-after position

Use the green save icon to confirm your selection and save the stop-after position of the trolley. Use the delete icon to delete your selection and reset the start position back to 1-1. As long as the green back arrow is displayed in the lower right corner, you can exit the screen and return to the home screen. If there is an X symbol at this point, you are in the active selection and must delete or confirm your choice.
After successfully selecting the start position, return to the home screen.

Here you will now see your selected stop-after position on the corresponding trolley with, for example, "Stop after 3-1".

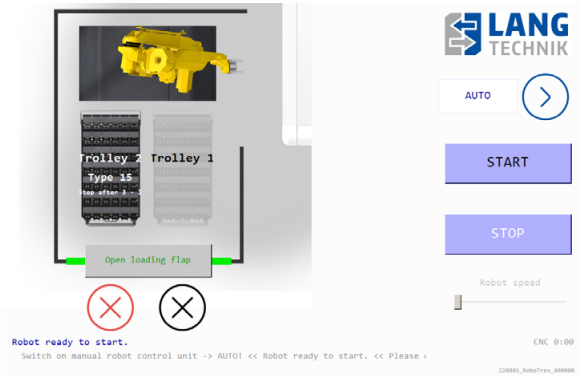


Figure 14: Display of the stop-after position

6.8.9 SET C-TYPE FUNCTION ON TROLLEY

C-Type Definition (CTD - Customized trolley Type Definition) is a software module for use on RoboTrex automation systems equipment.
This module makes it possible for the user to create and apply their own definitions of trolley types. This makes it possible, for example, to use extra-wide parts without running the risk of the gripper sensor system inadvertently detecting a component on an neigboring unoccupied position into which the blank protrudes. The CTD instructs the robot control to ignore positions specified by the user.

Set C-type function manually:

Select a trolley by clicking the trolley on the home screen.

Note: the trolley must be disabled = Red cross

Figure 15: C-Typ

The C-type definition allows the user to define a trolley type from an authorized standard or special trolley type by deselecting individual positions.

The resulting definition is stored on the RoboTrex control and can be used additionally as a virtual trolley type. A maximum of one C-type definition can be created for each authorized trolley type. This practically doubles the number of authorized trolley types. Under certain conditions, it is possible to dispense with special trolley types by using the C-type function. Selecting the trolley will take you to the screen for selecting the C-type function.

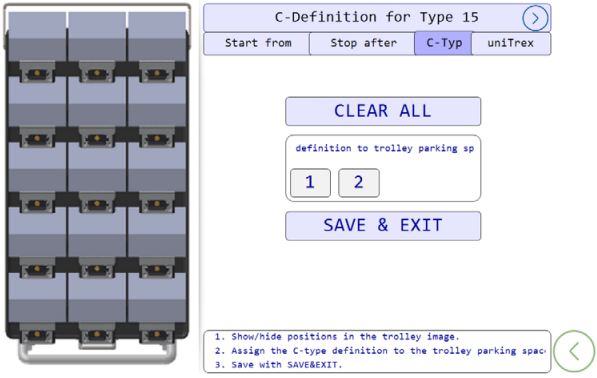


Figure 16: C-Typ

Select the C-type function in the function tab!

The first step is to check whether a suitable CTD already exists. If so, it will be loaded and displayed for further editing (edit mode). If no CTD exists yet for the set trolley type, the trolley diagram appears without deselection marks. This is the initial state, which means that all trolley positions are allowed.

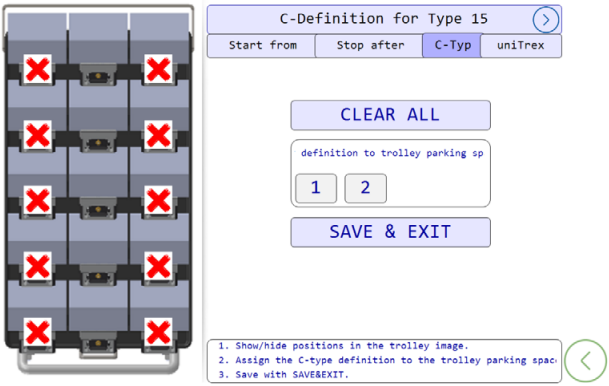


Figure 17: C-Typ

The deselection pattern is created directly in the trolley diagram, which is located on the left of the trolley image. Each time a part position on the diagram is touched, it changes state. A red cross on the trolley position means that this position has been deselected. The robot control will then ignore this position at runtime.

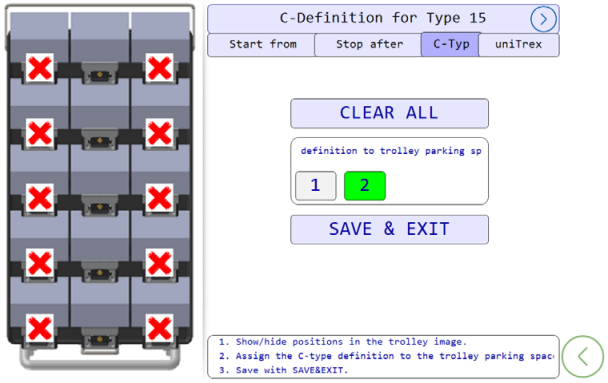


Figure 18: C-Typ

The next step is to define which trolley bays the C-type function is to be applied for. In this example, it is for bay 2.

Don't forget to close the CTD by pressing the <SAVE&EXIT> button!

If you only want to make an existing C-type definition ineffective for a short time because you only need the trolley types in the standard version, i.e. with all part positions, then simply deselect all trolley positions in this menu without deleting the deselection pattern. You can reactivate the trolley positions later.

Return to the home screen after successfully selecting the C-type function.
Here you will now see your selected C-type function on the corresponding trolley with, for example, "C-type 15".

Figure 19: Display of C-type

Influencing the behavior of other operating functions!

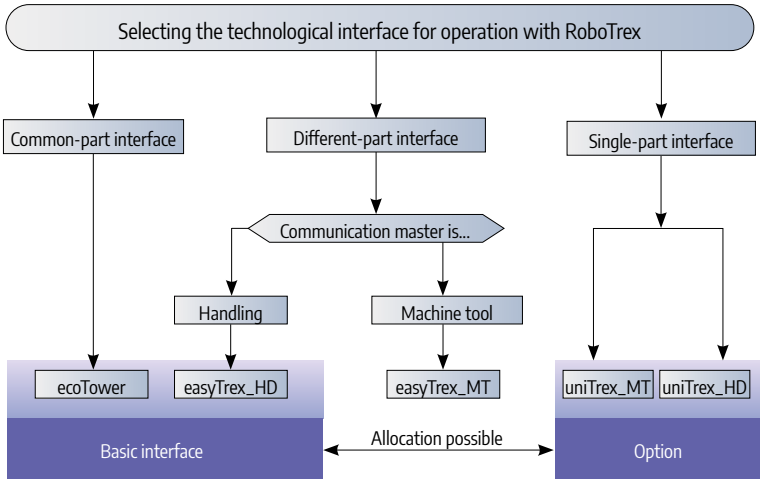
The application of the C-type function may possibly have an influence on the “Start-from" and “Stop-after” functions, but shared use is formally allowed.

If the start-from mark is in a position that is to be hidden by the C-type definition, then the start-from position moves to the next possible position that it is possible to occupy in the direction of higher position numbers. In the display of the trolley diagram, however, the start-from mark remains in the position specified by the operator.

If the stop-after mark is in a position that should be hidden by the C-type definition, the stop-after function will not be executed. When the corresponding automation trolley has been completely processed and is automatically deactivated by the handling control, the stop-after mark is removed at the same time. If it is necessary to use the stop-after function, the stop-after mark must be set to a position enabled by the CTD.

6.8.10 SET UNITREX FUNCTION ON TROLLEY

The uniTrex single-part interface (job manager) is an optional software extension for use on RoboTrex automation system equipment.
With this extension, it is possible for the user to realize single-part production in a simple way. The blanks are placed in automation vises as normal, and are then assigned to the automation trolleys of a RoboTrex handling system. Job lists are created directly on the operator display of the system. No additional hardware is required.
The uniTrex single-part interface is a software option. It can be used if the RoboTrex automation system is equipped with a suitable basic interface.
In addition, the machine control interface must be able to exchange program numbers with a data width of at least 1 byte (= 8 bits) with the automation. RoboTrex communicates with the machine control using the master/slave method (master = handling, slave = machine).



The illustration lists the suitable basic interfaces of the RoboTrex control: The uniTrex_HD single-part interface is possible if the RoboTrex system is equipped with one of the basic technological interfaces

- ecoTower common-part interface or
- EasyTrex_HD different-parts interface

and these are used.

The uniTrex_MT single-part interface is possible if the RoboTrex system is equipped with the basic technological interface

- easyTrex_MT different-parts interface and this is used.

Set uniTrex_HD function manually:

Select a trolley by clicking the trolley on the home screen.
Note: The trolley must be disabled = Red cross

Below is a graphical summary of how to create a job list.
Since the job list is exclusively assigned to a trolley position, the result is that you can only create as many different job lists as the system has trolley bays.
Assumptions: The RoboTrex system has the ecoTower base interface and the uniTrex_HD software module is loaded.
In the example, a RoboTrex system with two trolley bays is assumed. The authorized trolley types are type 15 and type 16.

At the beginning, the operator has set a type 16 automation trolley on trolley bay 1, and a type 15 automation trolley on trolley bay 2.
Task: A job list is to be generated for trolley bay 2. The job list should allow the machining of four blanks with one and the same CNC program 37. The CNC program 37 is located in the program folder of the machine and is suitable for machining the blanks used. The blanks are located next to each other and right-aligned in the second row of the automation trolley (type 15).
They are all to be manufactured with priority 1.
The automation trolleys that have already been inserted are displayed.

Figure 20: Job manager uniTrex_HD

Selecting the trolley takes you to the screen for selecting the uniTrex function. You can see the trolley diagram on the left-hand side. The job list will be filled later by successively filing individual job 'index cards'. The job list does not take the form of a table. Select uniTrex in the function tab!

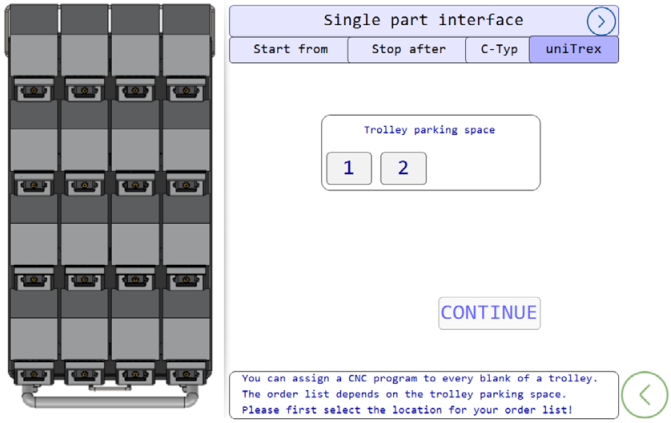


Figure 21: uniTrex

Now select the trolley bay for your job list! According to the task, press the Two button in the trolley bay data field.

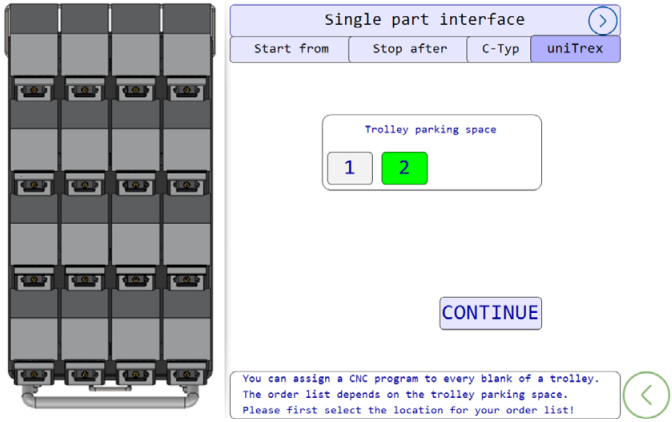


Figure 22: uniTrex

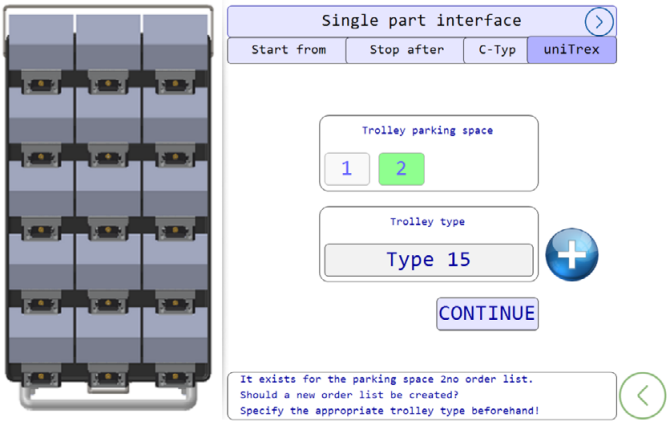


Figure 23: uniTrex

In the next field “trolley type”, the type of trolley that is located in the position is already suggested to you. Confirm the suggestion with CONTINUE or continue typing in the list of your authorized trolley types beforehand with the Plus key.
In the example, you therefore confirm the suggestion!
Trolley bay and trolley type are now defined for the job list.

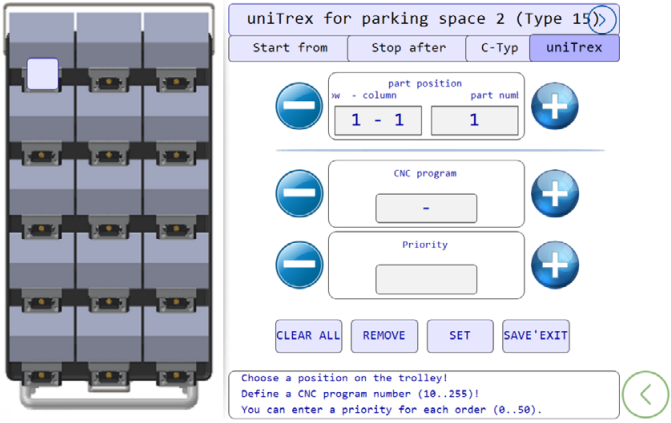


Figure 24: uniTrex

Since there is no job list for this trolley position/type yet, an empty field appears in the trolley diagram, only a cursor field is displayed. You can see the current position of the cursor field in the data field on the right. The first blank is in part position 5, which is in the second row and second column.
Tap the part position 5 in the trolley diagram or increase the part position in the data field with the plus key until the position number five appears. The cursor field jumps to position 5.

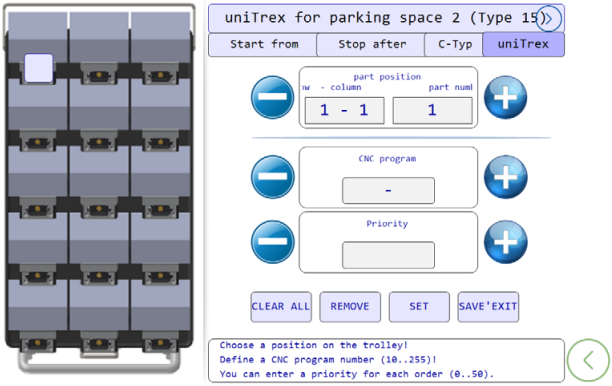


Figure 25: uniTrex

In the next step, enter the CNC program assigned to this blank. The blank is to be manufactured using the program with the name 37.
You can open direct input by tapping the program number field In the CNC program data field. Or you can use the plus and minus keys.

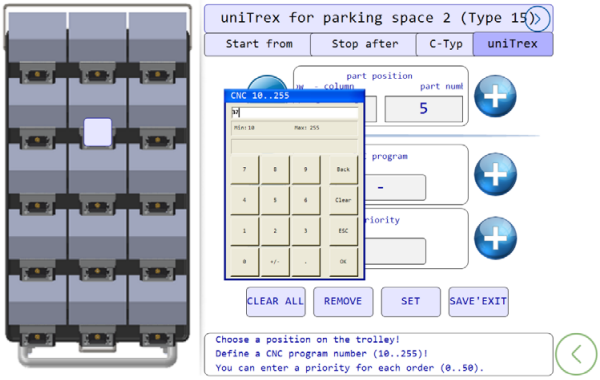


Figure 26: uniTrex

Close the direct input with the OK button! Use the same procedure analogously for entering the production priority (0 = lowest priority, 50 = highest priority)!
For the example set the priority as 1!

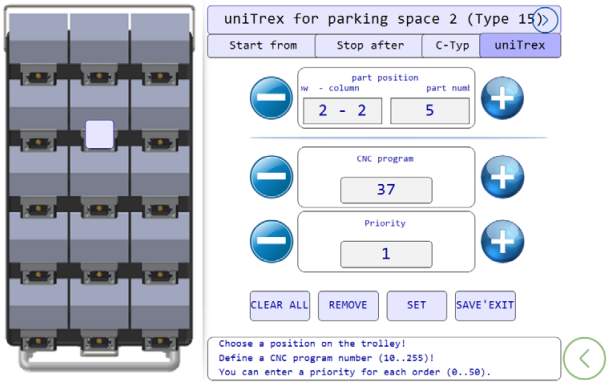


Figure 27: uniTrex
This defines the first job of the job list in the data field. Complete the entry of the first order with SET!

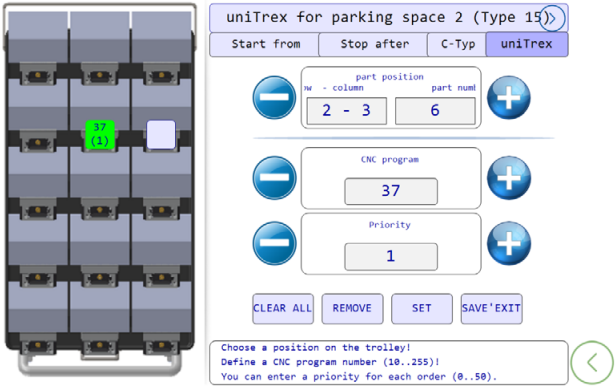


Figure 28: uniTrex
The first order now appears in the correct part position. The order is highlighted in green, which means that there is a blank in this position.
If the background color was gray, then it would be a finished part.
Orders 2 through 4, which are all copies of the first order, are easy to enter. Since the cursor field has already advanced by one part position, it is sufficient to press SET three times in succession.

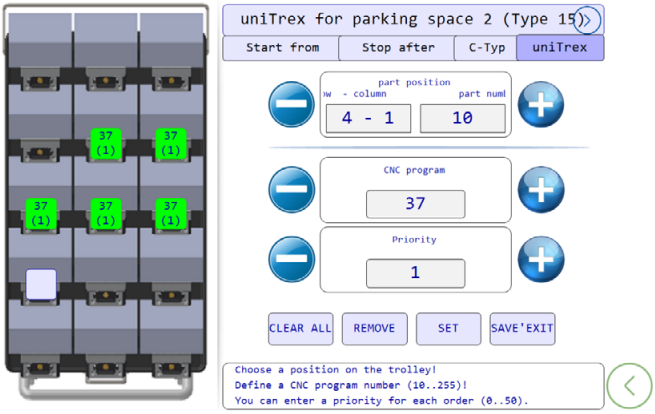


Figure 29: uniTrex

All blanks (positions 5 to 9) must be the same, they are machined with the same CNC-program 37.
Since the priority is also the same, processing starts with the smallest item number.
All jobs are entered, the job list only needs to be saved.
To do this, press the SAVE'EXIT button!
The job list is now ready.
Return to the home screen after successfully creating the uniTrex function.

Figure 30: uniTrex

To have the created job list processed automatically, set uniTrex in the program selection field, top right, and activate the associated trolleys.
Bring the CNC machine into an automation-ready mode and start the system!
The order of processing is controlled by the priority assigned in the job list. Orders with higher priority have priority over orders with lower priority.
Among orders with the same priority, the position number decides:
Smaller position numbers have priority.
The automatic program that is running may be interrupted or cancelled by the operator.

Delete a job list!
Note that the job list is stored permanently! In particular, this means that turning the RoboTrex system off and on again will not cause the job list to be cleared.
The job list is also maintained during the entire phase of its processing. Finished parts are stored internally so that the processing of a job list may be interrupted. Resuming at a later point causes the processing to continue with the first possible blank.
In the trolley diagram, a finished part is highlighted in gray.

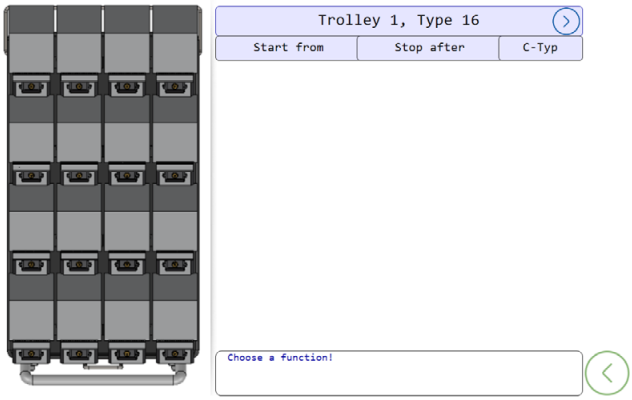
Even if the job list has been fully processed, it remains in place even though there are no blanks. A job list can only be deleted by explicit operator action. To do this, it must first be called up by its identifier (enter the trolley position and type, see Figures 23 and 24).
Then press CLEAR ALL and SAVE'EXIT! Now the job list is deleted.

Influencing the behavior of other operating functions!
Utilization of the uniTrex single-part interface is not compatible with the Start-from function. If you want to run an automation trolley with uniTrex, you must note that any start-from mark already in place is automatically removed at the program start.
Application of the uniTrex single-part interface is compatible with the function stop-after. If you have used a stop-after mark and it is in a position that will be affected by the processing of your job list, the RoboTrex system will interrupt the automation after this part. After that, the operator must decide whether to continue or abort the program run.
However, if the stop-after mark is placed on a position that is not affected by the job list, it will be ignored and automatically removed at the end of the job list.
When using the uniTrex single-part interface, any C- type definition already in place for the automation trolley is ignored, the affected automation trolley is always interpreted as a standard trolley type.

set uniTrex_MT function manually:

The uniTrex_MT single-part interface (job manager) is an optional software extension that refers to the basic easyTrex_MT interface.
With this type of interface, the machine control takes over the master communication, which means that an order list must be present on the machine. The operator can create their order list in such a way that they can use the basic easyTrex_MT interface, or the uniTrex_MT single-part interface.

In order to be able to distinguish between the individual trolley positions and part positions, the transmitted program number is now read out as a part position and processed in the handling control.
The operation of the handling control has changed in that it is now no longer possible to select a uniTrex option in the configuration menu, since the operator must now create their job list on the machine control.



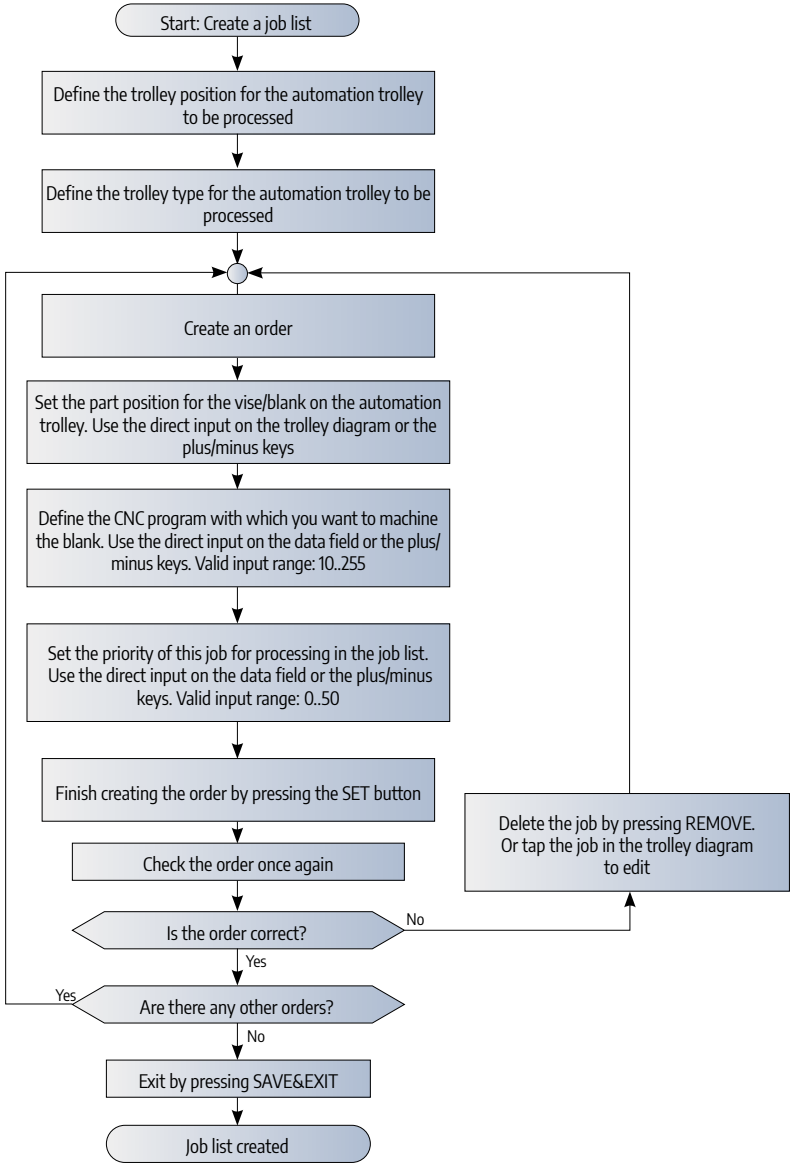
Once a job list has been successfully created on the machine control, the operator can now go to the home screen, select their authorized trolleys, and select uniTrex from the top right tab to start single part machining.

Influencing the behavior of other operating functions!

Application of the uniTrex_MT single-part interface is not compatible with the start-from function. If you want to process an automation trolley with uniTrex_MT, you must note that any start-from mark already in place is automatically removed at the program start.
Application of the uniTrex_MT single-part interface is compatible with the stop-after function. If you have used a stop-after mark and it is in a position that will be affected by the processing of your job list, the RoboTrex system will interrupt the automatic after this part. After that, the operator must decide whether to continue or abort the program run.
However, if the stop-after mark is placed on a position that is not affected by the job list, it will be ignored and automatically removed at the end of the job list.
When using the uniTrex_MT single-part interface, any existing
C- type definition for the automation trolley is ignored, the affected automation trolley is always interpreted as a standard trolley type.

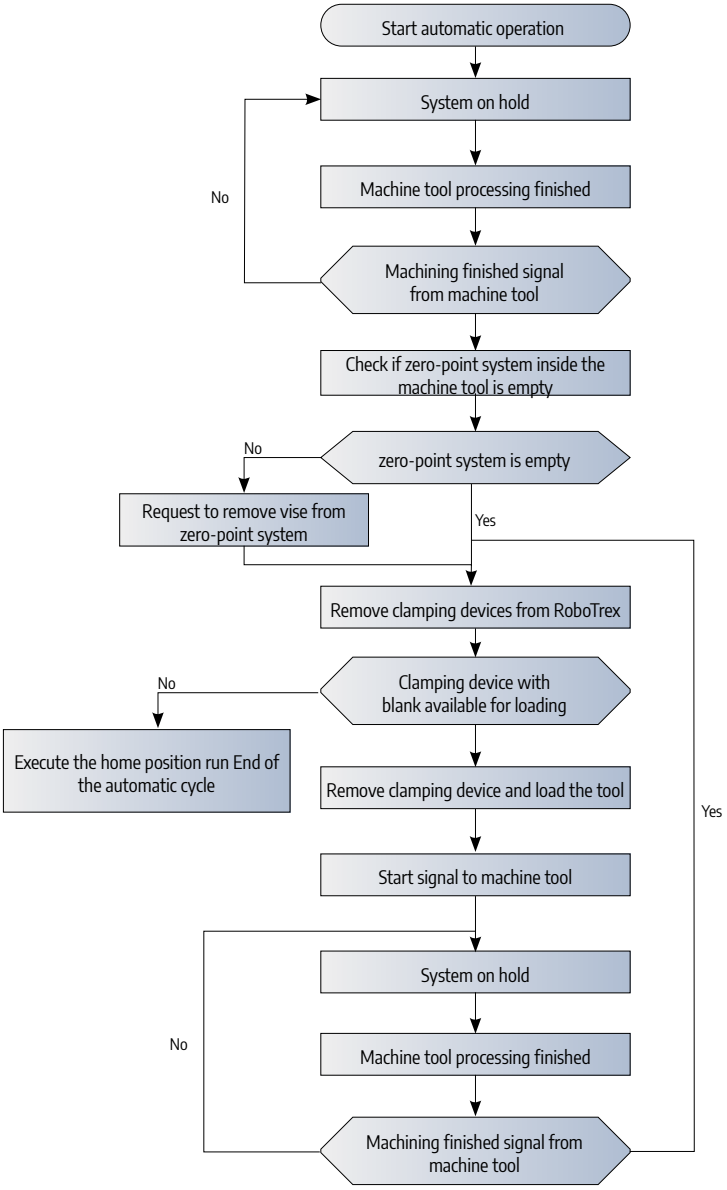
6.8.11 THE FOLLOWING DIAGRAM SHOWS THE WORKFLOW

appears in the overview again when creating a job list.



6.8.12 DESCRIPTION OF WORKPIECE CHANGE

The following flowchart shows an operating plan for the machine.



7.1 MALFUNCTIONS/ERRORS

The operator is obliged to shut down the machine immediately in case of faults that affect safety. The machine must not be put back into operation until the fault has been rectified. Troubleshooting must be carried out by qualified personnel.

Description of the actuators

Main switch: The main switch is used to switch the RoboTrex automation system on and off. It is located on the rear side of the system, usually on the connecting plate to the machine.

Emergency Stop: Is located on the display of RoboTrex. In case of emergency, pressing the pushbutton will de-energize the automation. If coupling to the machine tool is desired, this can also be de-energized. To restart the system, the latching function of the emergency stop button must be released by turning the pushbutton.

In case of emergency, shut down the system immediately!
Rectify faults immediately!
The emergency stop button is located to the right of the automation display.
In the event of the following electrical system malfunctions, additional attention should be paid:

Short circuit:

- Fuse out
- Have the fault in the system rectified by qualified personnel.

Cable fire:
The wiring of the system is sufficiently dimensioned to prevent cable fires.
If, contrary to expectations, a cable fire should occur, proceed as follows:

- Switch off the system via the main switch
- Disconnect the power plug from the mains
- Under no circumstances should a cable fire be extinguished with water
- Only extinguish with powder or CO2-extinguishers

Service, repair and maintenance work may only be carried out when the machine is at a standstill. The machine must be secured against unexpected start-up.
In case there is no access door on the automation, access takes place through the loading flap. First open the loading flap and then switch off the system to ensure safe entry into the system.

8.1 INTENDED USE

The operator is obliged to use the product properly, carefully and under the appropriate conditions. No liability or reimbursement will be accepted in the event of improper use.

Following maintenance: Operation of the RoboTrex automation system may only begin once the operating personnel are satisfied that all maintenance work has been performed. If it is discovered during operation that pending maintenance measures have not been carried out, operation must be stopped immediately.
In the event of incorrect operation or misuse there is a risk:

- to life and limb of operators, third persons and animals who are in the vicinity of the machine tool in which the clamping system is inserted.
- to the machine, the clamping system itself and other material assets of the operator.
- to the efficient operation of the machine tool in which the clamping system is installed.

8.2 PERSONNEL REQUIREMENTS

Maintenance by operator:

- Check the gripper bolt for wear
- Trolleys and the floor of the system should be regularly cleaned of dirt of any kind
- When using the mechanical zero-point clamping system, the clamping force must be checked regularly

The operator undertakes to:

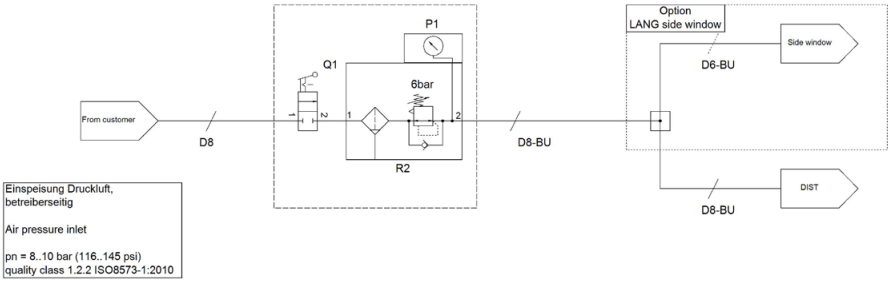
- Only allow fully-qualified, trained personnel (specialized in metal machining), e.g. CNC application engineer, to work with the product.
- Clearly define the responsibilities of personnel for installation, commissioning, operation, maintenance and repair.
- Only allow personnel to be trained to work with the product under the supervision of an experienced specialist (metal machining specialist) or a CNC application engineer.

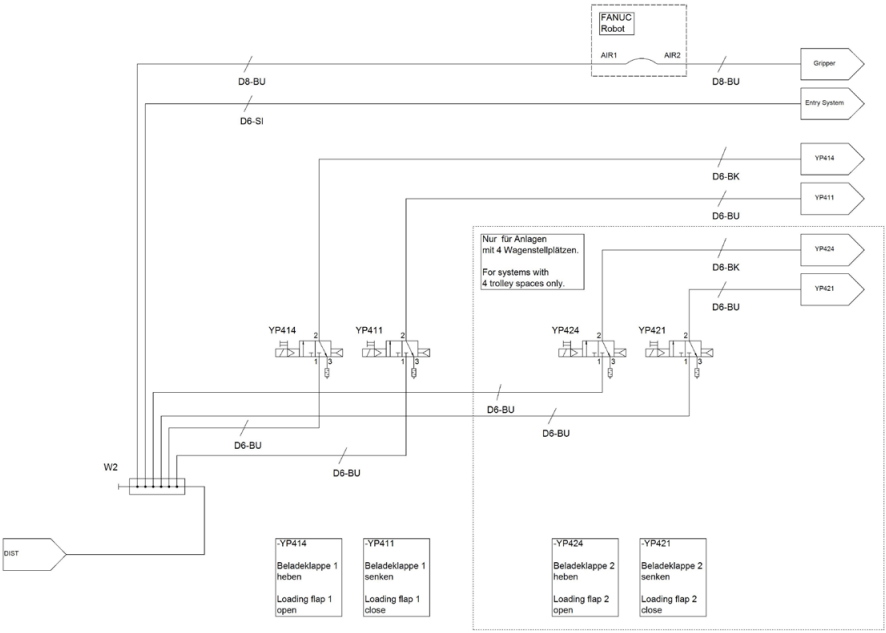
8.3 PERSONAL PROTECTIVE EQUIPMENT AND SAFETY OF PERSONNEL

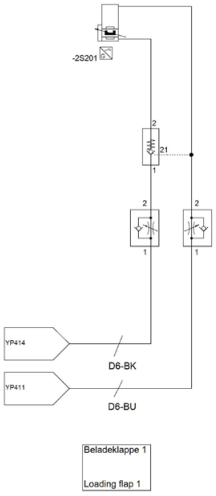
- Safety shoes and gloves are recommended while working with the RoboTrex automation system.

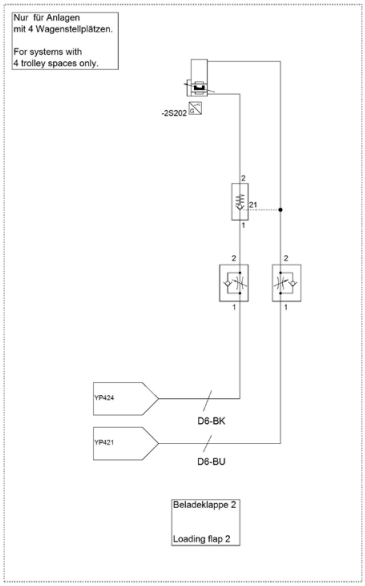
9 SKETCHES AND FLOOR PLANS

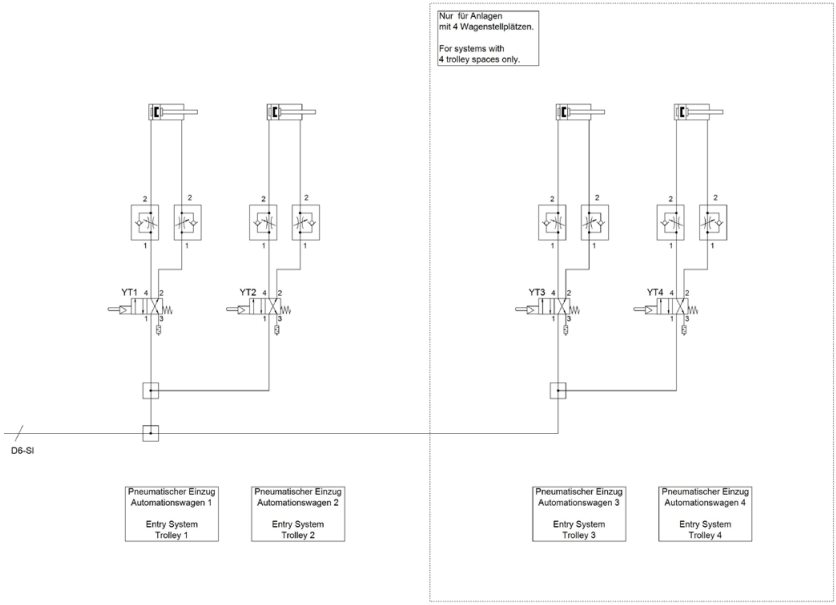
9.1 PNEUMATIC DIAGRAM OF ROBOTREX BASIC SYSTEM





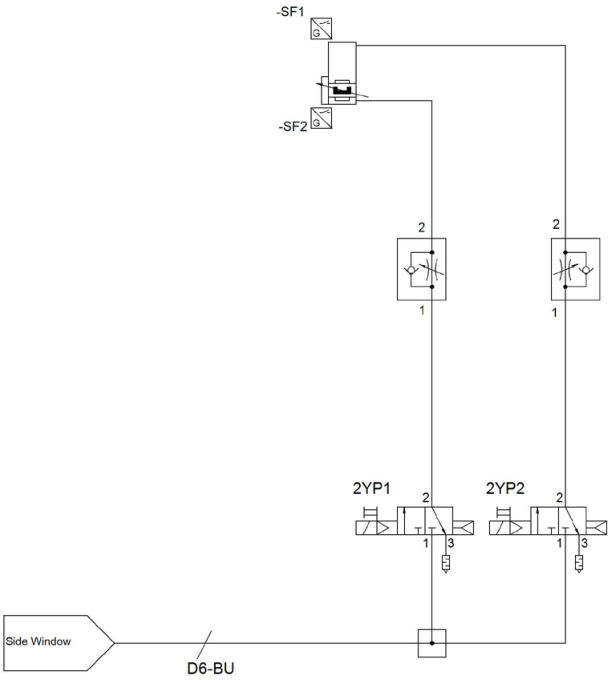

-2S201
2
21
1
2
2
1
1
YP414
YP411
D6-BK
D6-BU
Beladeklappe 1
Loading flap 1


Nur für Anlagen
mit 4 Wagenstellplätzen.
For systems with
4 trolley spaces only.
-2S202
2
21
1
2
2
1
1
YP424
YP421
D6-BK
D6-BU
Beladeklappe 2
Loading flap 2

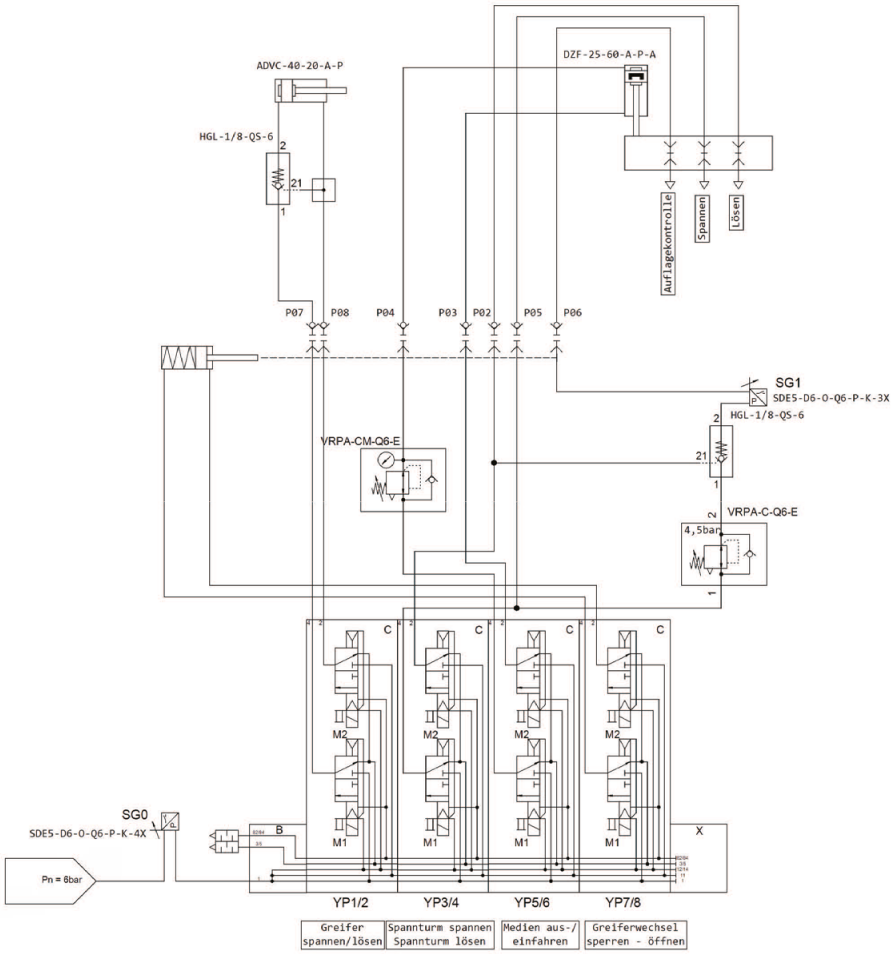

Nur für Anlagen
mit 4 Wagenstellplätzen.
For systems with
4 trolley spaces only.
2
1
YT1
YT2
YT3
YT4
D6-SI
Pneumatischer Einzug
Automationswagen 1
Entry System
Trolley 1
Pneumatischer Einzug
Automationswagen 2
Entry System
Trolley 2
Pneumatischer Einzug
Automationswagen 3
Entry System
Trolley 3
Pneumatischer Einzug
Automationswagen 4
Entry System
Trolley 4

9 Sketches and floor plans

9.1 Pneumatic diagram of RoboTrex basic system



9.2 PNEUMATIC DIAGRAM OF THE ROBOTREX 96 GRIPPER EXCHANGE INTERFACE



10 Decommissioning

10.1 Decommissioning and dismantling

- Unload the RoboTrex automation system.
- Switch off the RoboTrex automation system at the main switch.
- Disconnect the RoboTrex automation system from the power supply.
- Disconnect the RoboTrex automation system from the pressure supply.
- Secure the machine tool against unexpected start-up.
- Disconnect the plug to the machine tool -XS3.1 and fit it with dummy plug.

Dismantling:

- For removal, please observe the transport instructions in the chapter "Handling during transport".
- Ensure the inserter cannot move out of position.
- Removal by forklift or pallet truck.

The system may only be dismantled by an instructed person. Please contact LANG Technik for this.

10.2 Disposal as specified in EU directive 2018/851

Comply with country-specific disposal regulations when disposing of equipment.

LANG Technik products are not considered household waste.
Failure to comply with disposal requirements is a regulatory offense.

Accessories and packaging are recycled in an environmentally friendly manner.

The individual parts of the RoboTrex automation system can be recycled if disposed of properly and are therefore environmentally compatible. Refer to the table for details on disposal and recyclability.

Product	Material	Disposal
Housing, screws, nuts etc.	Metal	Separation of materials Supplied for recycling by melting down
Protective screens, hoods, housings, covers	Plastic	Supplied for recycling
Hoses	Rubber, PVC, steel	Separation of materials Supplied for recycling
Cables, housings, connectors, etc.	Silicone, polychloro-phrene	Separation of materials Supplied for recycling
Electronic assemblies	Plastics, metals, electrolytes	Disposal in special landfills in compliance with local regulations
PE films	Plastic	Supplied for recycling
Packaging material	Pallet wood	Supplied for recycling
Hydraulic oil	Mineral oil	According to local regulations

Painted products are to be recycled according to the paint material or disposed of in special landfills in compliance with local, official regulations.

11 Warranty and liability

11.1 For documentation

This documentation is intended only for the operator and their personnel. It contains instructions and notes that may not be reproduced, distributed or transmitted by data technology methods, in whole or in part, or exploited for competitive purposes without authorization. Always keep these operating instructions and the other documentation (e.g. manufacturer's documents) within easy reach in the immediate vicinity of the machine. Always observe all information, notes, instructions and guidance contained therein. In this way, you avoid accidents due to incorrect operation, retain the full manufacturer's warranty and always have a fully functional automated system.
Errors or omissions in the documentation are excepted. All rights to this documentation remain with LANG Technik.

11.2 Changes to the product

You must not make any modifications, additions or conversions to RoboTrex automation system without the manufacturer's approval. All conversion measures require written confirmation from the manufacturer.
Only use original spare and wear parts. In the case of externally supplied parts, there is no guarantee that they have been designed and manufactured to withstand the stresses and to meet safety requirements.
The manufacturer assumes the complete warranty service only and exclusively for spare parts ordered from them.

Changes by the customer:
Changes to the product will void the warranty.
Changes by the manufacturer:
The manufacturer is always striving to improve its products. They reserve the right to make changes and improvements. However, this does not imply any obligation to retrofit RoboTrex automation systems that have already been delivered.

11.3 General Terms and Conditions of Sale and Delivery

In principle, our General Terms and Conditions of Sale and Delivery shall apply. These shall be available to the operator at the latest when the contract is concluded.
Warranty and liability claims for personal injury and property damage are excluded if resulting from one or more of the following causes:

- Improper use the RoboTrex automation system
- Improper installation, commissioning, operation, and maintenance of the RoboTrex automation system
- Operating the RoboTrex automation system with defective safety devices on the machine or safety and protective devices on the machine that are not properly attached or are not functional

Failure to follow the instructions in the documentation regarding:

- Storage
- Installation
- Operation
- Maintenance and care
- Troubleshooting and error correction
- Unauthorized structural modifications to the zero-point system and the machine tool's fixture
- Inadequate monitoring of parts subject to wear and tear
- Improperly performed repairs
- Catastrophic events due to foreign body impact and force majeure

12.1 SYMBOLS

Please pay attention to the following warning symbols	
	*Read all the operating instructions carefully before commissioning for the first time and keep it in a safe place for future use*
	*Please read and follow the technical and safety instructions*
	*The use of protective gloves made of tough, resistant material is recommended*
	*A helmet and safety goggles are recommended for personal safety*
	*To reduce the risk of eye injuries, wearing protective goggles as specified in EN 166 is recommended*
	*Safety footwear are part of the protective equipment*
	*Materials are recycled in an environmentally friendly manner*
	*Do not dispose of the material in household waste*

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