

# Delta Robot

## User Manual

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### **Translation from German**

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## Contents

<b>1</b>	<b>Introduction</b> .....	<b>3</b>
<b>2</b>	<b>Main Page</b> .....	<b>4</b>
2.1	<b>Navigation:</b> .....	<b>4</b>
2.2	<b>Moving the Robot</b> .....	<b>5</b>
2.3	<b>Display Positions</b> .....	<b>7</b>
<b>3</b>	<b>Robot Parameters</b> .....	<b>8</b>
3.1	<b>Simulation and Motion Mode</b> .....	<b>8</b>
3.2	<b>Path Parameter</b> .....	<b>9</b>
3.3	<b>Z Axis Limits</b> .....	<b>9</b>
3.4	<b>Workspace</b> .....	<b>9</b>
<b>4</b>	<b>Delta Robot Settings</b> .....	<b>10</b>
<b>5</b>	<b>Axes Parameters</b> .....	<b>12</b>
5.1	<b>Axis Configuration</b> .....	<b>13</b>
5.2	<b>Axes Parameters</b> .....	<b>13</b>
5.3	<b>Axis Actions</b> .....	<b>14</b>
<b>6</b>	<b>Conveyor Belt</b> .....	<b>17</b>
6.1	<b>Conveyor Belt Configuration</b> .....	<b>18</b>
<b>7</b>	<b>Pick and Place</b> .....	<b>19</b>

## 1 Introduction

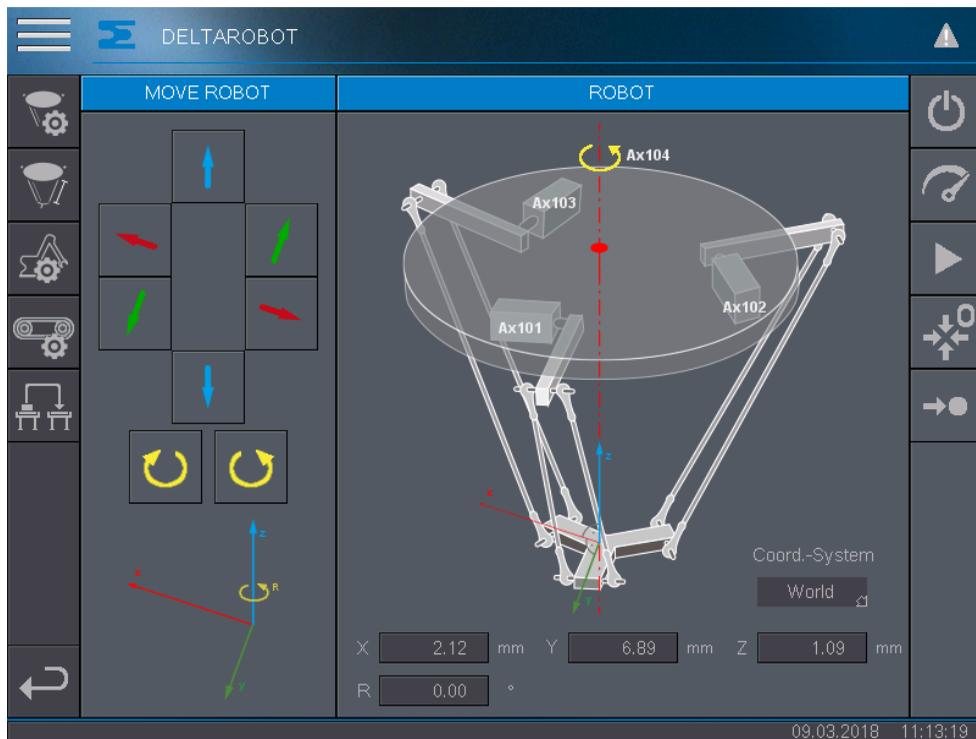
This add-on is used as the basis for the initial start-up of the delta robot.

The functions most frequently required for setting and operating the robot are included in delivery:

- Defining motor axes parameters
- Moving the motor axes
- Defining robot parameters
- Moving the robot in the respective axis direction
- Configuring two conveyor belts
- Configuring a "Pick and Place" application
- Running the "Pick and Place" application

A corresponding button for opening the main screen is provided as an object (@DELTAROB\_Button\_Main) - the user can place this anywhere in the screen project (help can be found in the programming manual for this AddOn).

## 2 Main Page



### 2.1 Navigation:

The buttons on the left side are used to change between the pages



Robot Parameters



Delta Robot Settings



Axes Parameters



Conveyor Belt



Pick and Place

## 2.2 Moving the Robot

The delta robot can be manually operated via the main page. The buttons located on the right side are used to turn the robot on/off.



The robot is turned off and can be turned on by pressing the button



The robot is turned on and can be turned off by pressing the button



This button is used to open an area in which speed of the robot can be adjusted.



The speed can be changed as percentage of the maximum speed of the robot. The adjustment can be made via the input field or by shifting the bar.



Pick and Place procedure is inactive and can be activated by pressing this button.



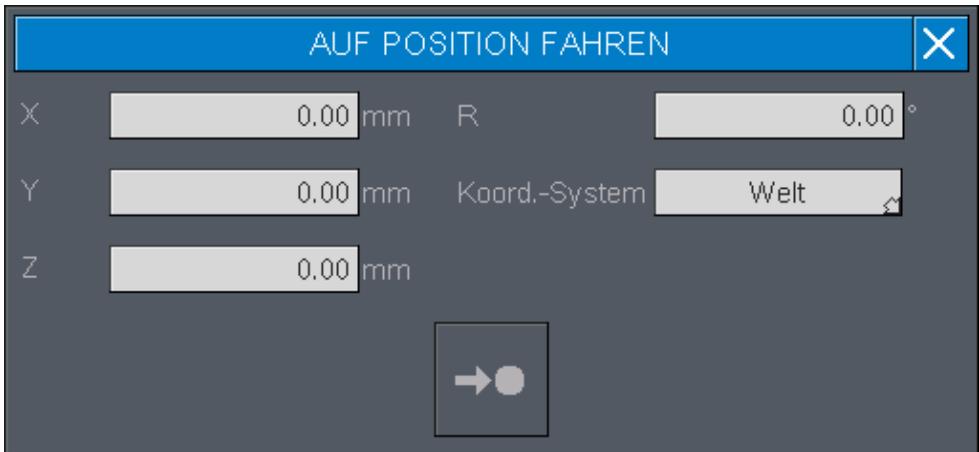
Pick and Place procedure is active and can be deactivated by pressing this button. The procedure is not stopped automatically, but an object is stored. The icon blinks from stop command until motion stop.



Pressing this button drives the robot to the coordinate origin. The motion continues as long as the button is pressed and is stopped as soon as the coordinate origin is reached.



This button opens a window to configure points for a MoveLinear in the given coordinate system.



Axis	Value	Unit	Parameter	Value	Unit
X	0.00	mm	R	0.00	°
Y	0.00	mm	Koord.-System	Welt	
Z	0.00	mm			

Here, parameters for an absolute movement can be defined, like coordinate system and the coordinates of the target position.



Then pressing this button (in the open window) moves the robot to the desired position as long as the button is pressed. After reaching the target position the robot is stopped.

If the robot is turned on, it can be moved in the axis direction with the buttons located in the "MOVE ROBOT" area.



Move robot in the positive X direction.



Move robot in the negative X direction.



Move robot in the positive Y direction.



Move robot in the negative Y direction.



Move robot in the positive Z direction.



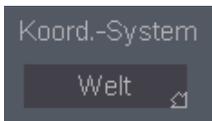
Move robot in the negative Z direction.



Turn the rotary axis clockwise.



Turn the rotary axis counter-clockwise

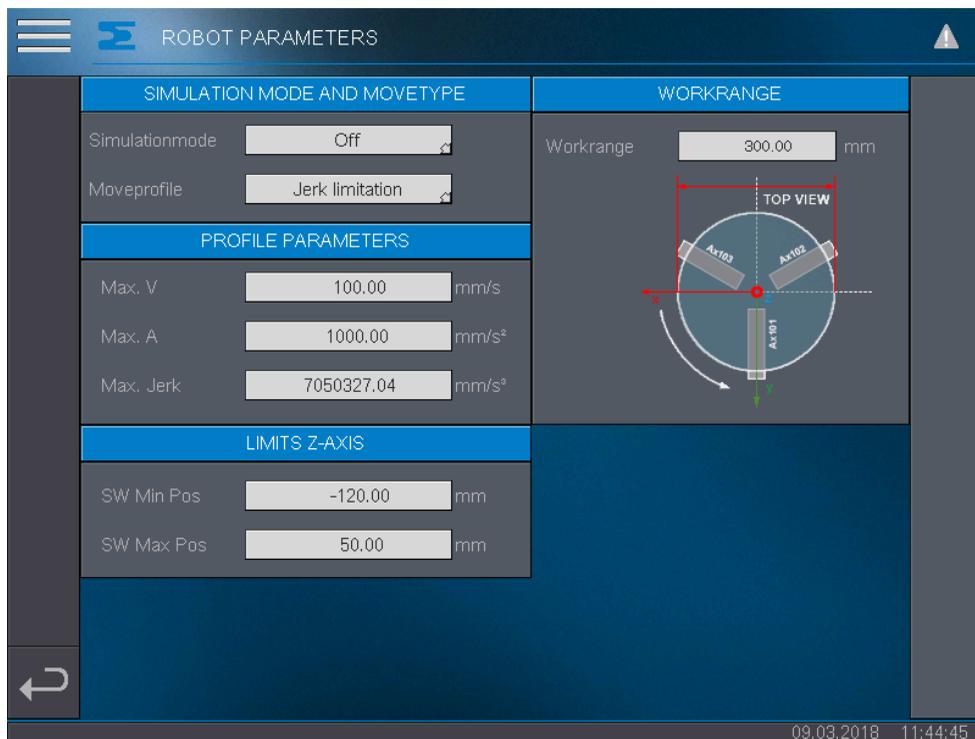


Depending on the operation this button is active resp. inactive. In manual operation it is possible to choose between the available coordinate systems, during a Pick and Place procedure the currently active coordinate system is shown.

## 2.3 Display Positions

In the "ROBOT" area, the current positions of the individual axes are displayed.

### 3 Robot Parameters



On the "ROBOT PARAMETERS" page, the following settings must be made (changes are only possible, if the robot is switched off):

#### 3.1 Simulation and Motion Mode

- **Simulation mode:** If the simulation mode is active, no preset values are sent to the controller.
- **Motion profile:** Here, the selection between trapezoid (acceleration curve corresponds to a trapezoid) or jerk reduction can be made. With jerk reduction, the jerk is limited to the maximum value which can be set in the "PATH PARAMETER" area.

### 3.2 Path Parameter

- **Max. V:** Maximum path speed setting.
- **Max. A:** Maximum path acceleration/deceleration setting.
- **Max. Jerk:** Maximum path jerk setting. Active only with motion profile jerk reduction.

### 3.3 Z Axis Limits

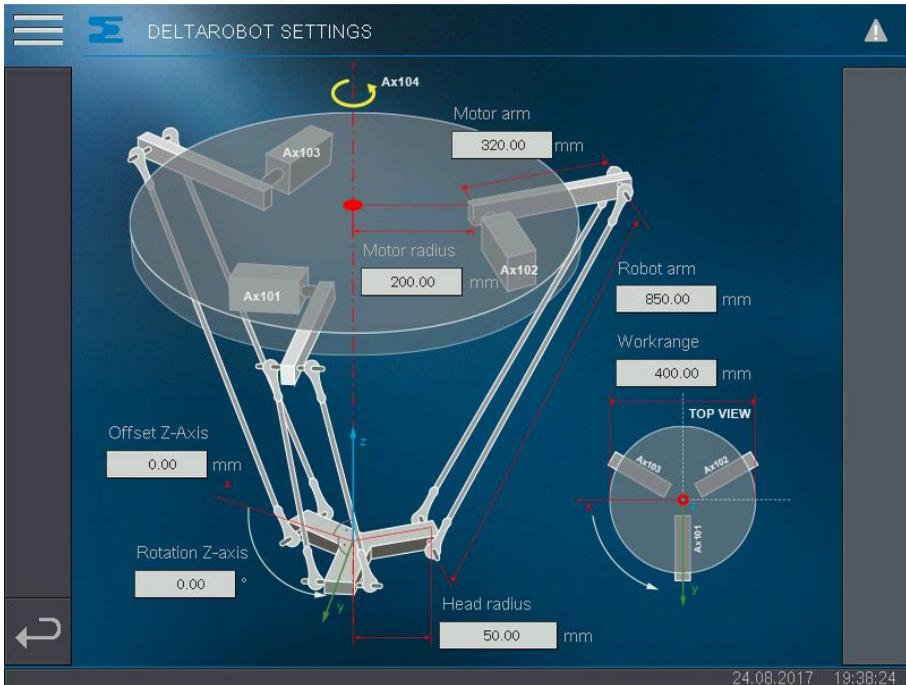
So that the robot does not run into mechanical limits, the limits must be set for respective axes. All movements that violate these limits are stopped.

- **SW Min Pos:** Minimum Z position to which can be traveled.
- **SW Max Pos:** Maximum Z position to which can be traveled.

### 3.4 Workspace

Via the workspace, the range of motion for the X and Y axis is defined. The limits for movement in the X and Y direction are thereby generated.

## 4 Delta Robot Settings



On this page, the dimensions of the delta robot can be set. The following settings can be made:

- **Motor arm:** Length of the motor arm measured between the center of the motor or gear shaft and the center of the steering rod.
- **Motor radius:** Distance between the center of the motor or gear shaft and the center of the delta robot.
- **Robot arm:** Length of the robot arm
- **Head end radius:** Distance between the robot arm mount and the center of the head.
- **Rotation Z:** Via this parameter, the world coordinate system can be rotated.
- **Shift Z:** With this parameter, the Z coordinate of the robot can be manipulated to include the gripper height calculation, for example. If 0 is entered as the offset,  $Z = 0$  when all motor arms are parallel to the X, Y plane. If a value unlike 0 is entered, the 0-position is shifted along the Z axis by the corresponding value.

- **Workspace:** Via the workspace, the range of motion for the X and Y axis is defined. The limits for movement in the X and Y direction are thereby generated.

## 5 Axes Parameters

AXIS-CONFIGURATION		AXIS-PARAMETER	
Feedrate constant =	2.81 °	Max. Velocity	1161.00 °/s
	15872 Inc	Max. Acceleration	58050.00 °/s²
Moveprofile	Trapeze	SW Min Pos	-90.00 °
Modulo	0.00 °	SW Max Pos	30.00 °

_LMCAxisM1			
Pos	0.00 °	V	36.00 °/s
Override	20.0 %	A	360.00 °/s²
Act. Pos	1.01 °	[Power] [Stop] [Home]	
Akt. V	0.00 °/s	[Warning] [Left] [Right]	

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Via the axis parameters, settings for the motor axes can be made and the axes operated. The settings can only be made when the axis is off. The buttons located on the left frame are used to switch between the four motor axes.

## 5.1 Axis Configuration

- **Feed constant:** As the feed constant, ratio of the movement on the gear shaft ( $^{\circ}$ ) to the motor feedback is entered (increments). E.g.: 65536 increments of the motor means that a movement of  $1^{\circ}$  on the gear shaft.
- **Motion profile:** The following motion profiles are available to choose from:
  - **Trapezoid:** simple speed ramp without jerk reduction.
  - **Jerk filter:** Via the jerk filter, the preset position is filtered and a rounding of the acceleration phase is generated. If this motion profile is selected, an input field appears in the "AXIS PARAMETER" area. The filter time can then be set via this input field. After this time has elapsed, the systems ramps from the start of acceleration to the defined acceleration.
  - **Jerk reduction:** In this mode, the jerk is limited to a maximum. This limit can then be set in the "AXIS PARAMETER" area via the input field "Max. Jerk".
- **Modulo:** This value determines at which position an overflow should occur. E.g.: Modulo =  $360^{\circ}$  -> if the actual position is  $361^{\circ}$ , an overflow is calculated here and  $1^{\circ}$  is determined as the actual position.

## 5.2 Axes Parameters

- **Max. Speed:** Maximum speed of the axis.
- **Max. Acceleration:** Maximum acceleration of the axis.
- **SW. Min Pos:** Minimum position, to which the axis can travel.
- **SW. Max Pos:** Maximum position, to which the axis can travel.
- **Jerk time (only with jerk filter motion profile):** Filter time for position rounding.
- **Max. Jerk (only with jerk reduction motion profile):** Minimum axis jerk.

### 5.3 Axis Actions



In this area, axis actions can be performed. The header with the blue background indicates the axis object.

- **Pos:** Position used for "Move to Point" and "Move Relative".
- **Override:** Percentage of the speed used for the profile movement.
- **V:** Speed with which to travel.
- **A:** Acceleration or deceleration for the profile.
- **Pos:** Current position of the axis
- **V:** Current speed of the axis.

   In this area, important information is displayed.  
  

 Axis is off.

 Axis is on.

 Axis is not referenced.

 Axis is referenced.

 Axis is not in position.

 Axis is in position.

 Axis has no errors.

 Axis has an error.

 No violation of the minimum software end position.

 Minimum software end position violated.

 No violation of the maximum software end position.

 Maximum software end position violated.



In this area, axis actions can be performed.

 Travel to position.

 Move relative.

 Turn axis on/off.

 Set the current position to null. (window with security query is opened)

 Travel in negative direction to minimum software end position. The axis moves as long as the button is pressed.

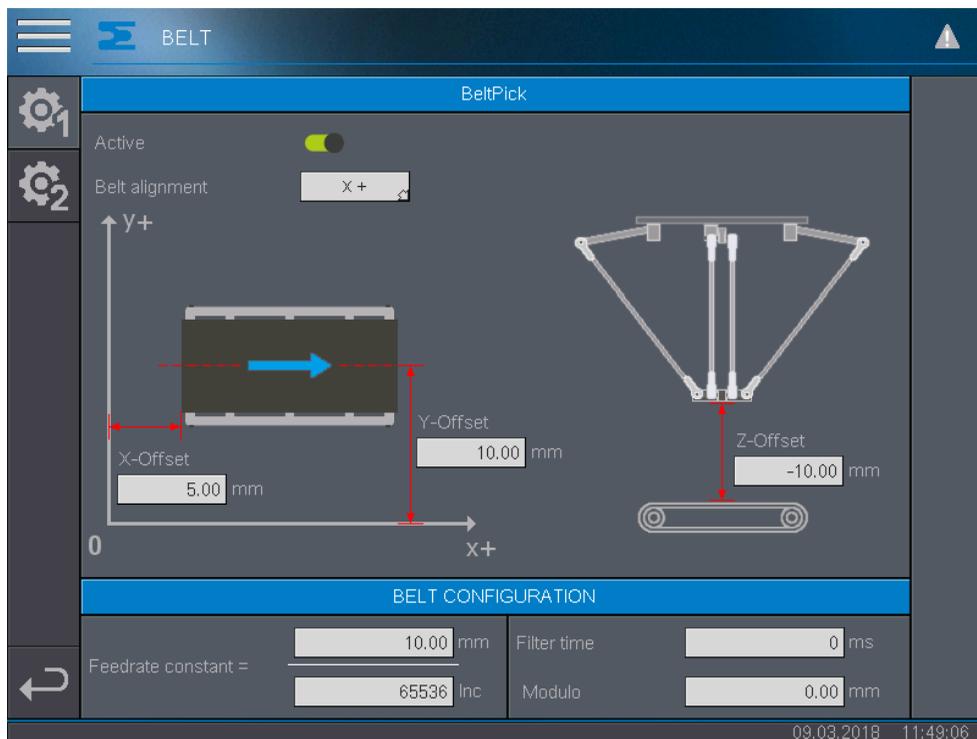


Travel in the positive direction to maximum software end position. The axis moves as long as the button is pressed.



Stop from motion command "Move to Point" and "Move Relative".

## 6 Conveyor Belt



This page is used to configure conveyor belts. An on-loading conveyor (pick) and off-loading belt can be configured. Conveyors can also be switched to inactive if a fixed on-loading or off-loading position is required.

The following conveyor belt alignments are available to choose from:

- X+: The conveyor moves in the positive X direction of the robot.
- X-: The conveyor moves in the negative X direction of the robot.
- Y+: The conveyor moves in the positive Y direction of the robot.
- Y-: The conveyor moves in the negative X direction of the robot.

To define the on-load or off-load positions, the offsets must be entered in the respective axis direction.

Conveyor belt alignment X+/X-:

- **X-Offset:** Defines the point at which coupling occurs as soon as a part is detected (e.g.: distance to light barrier)
- **Y-Offset:** Offset on the Y-axis to the center of the conveyor belt.

Conveyor belt alignment Y+/Y-:

- **Y-Offset:** Defines the point at which coupling occurs as soon as a part is detected (e.g.: distance to light barrier)
- **X-Offset:** Offset on the X-axis to the center of the conveyor belt.

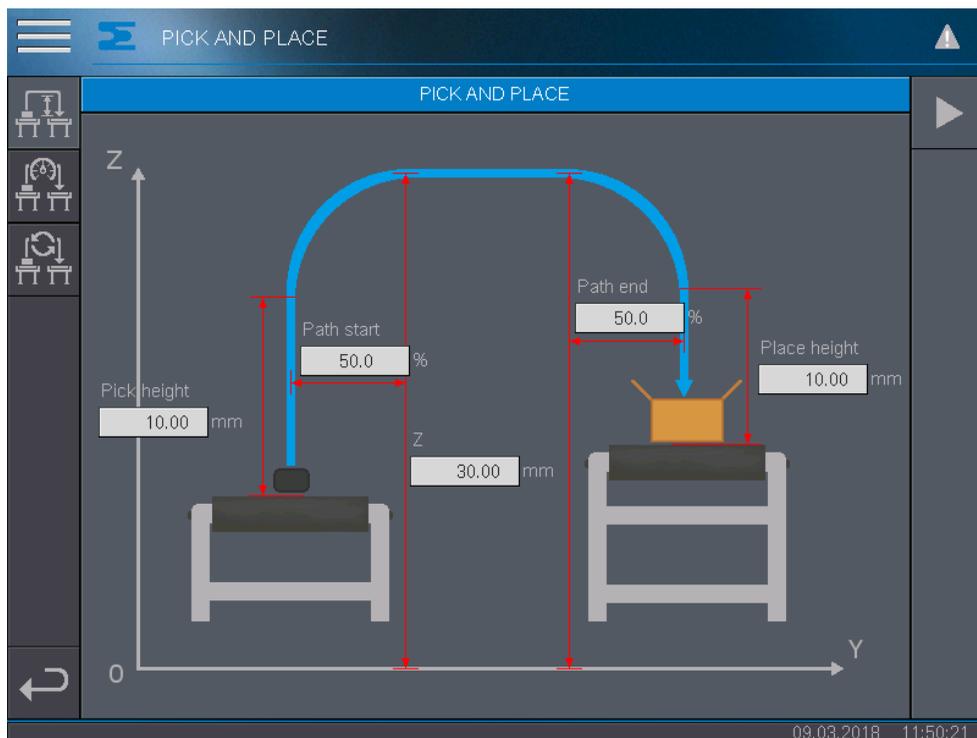
The Z-offset defines the position at which an object is taken over or off-loaded.

## 6.1 Conveyor Belt Configuration

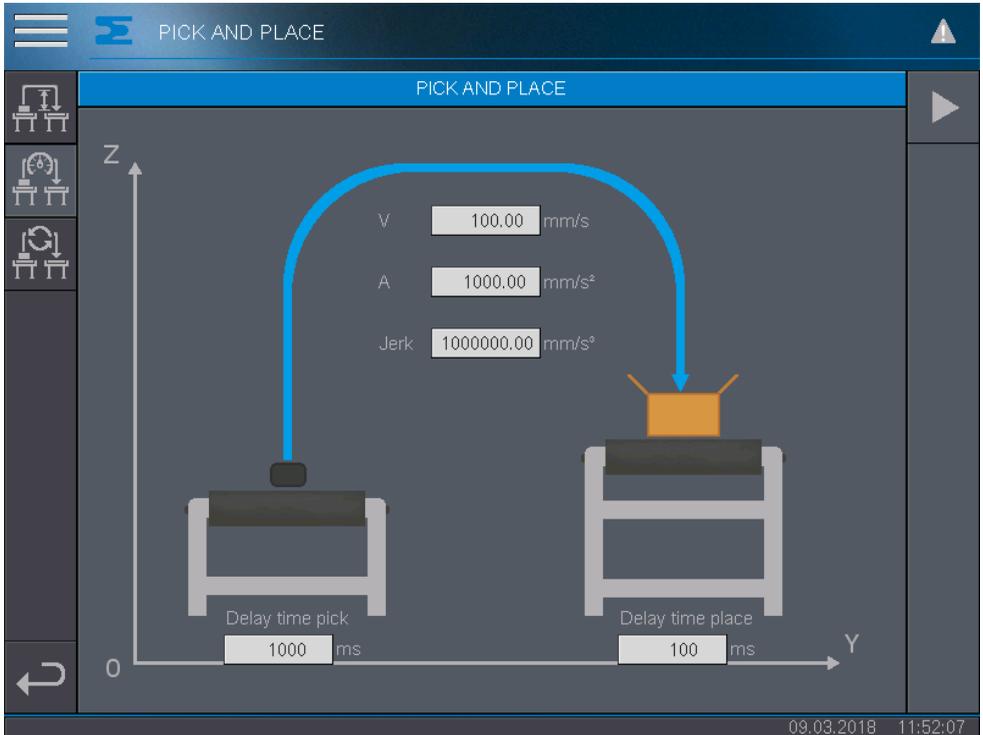
- **Feed constant:** The feed constant is generated from the ratio between the linear feed of the conveyor belt (mm) and the feedback signal (increments).
- **Filter time:** If a time  $> 0$  is entered, the position provided by the feedback is filtered. Required for corrupted encoder signals to enable an optimal motion sequence when coupling the robot.
- **Modulo:** As with the axis objects, this parameter can be used to achieve a targeted overflow. (See 5.1 Axes Parameters)

## 7 Pick and Place

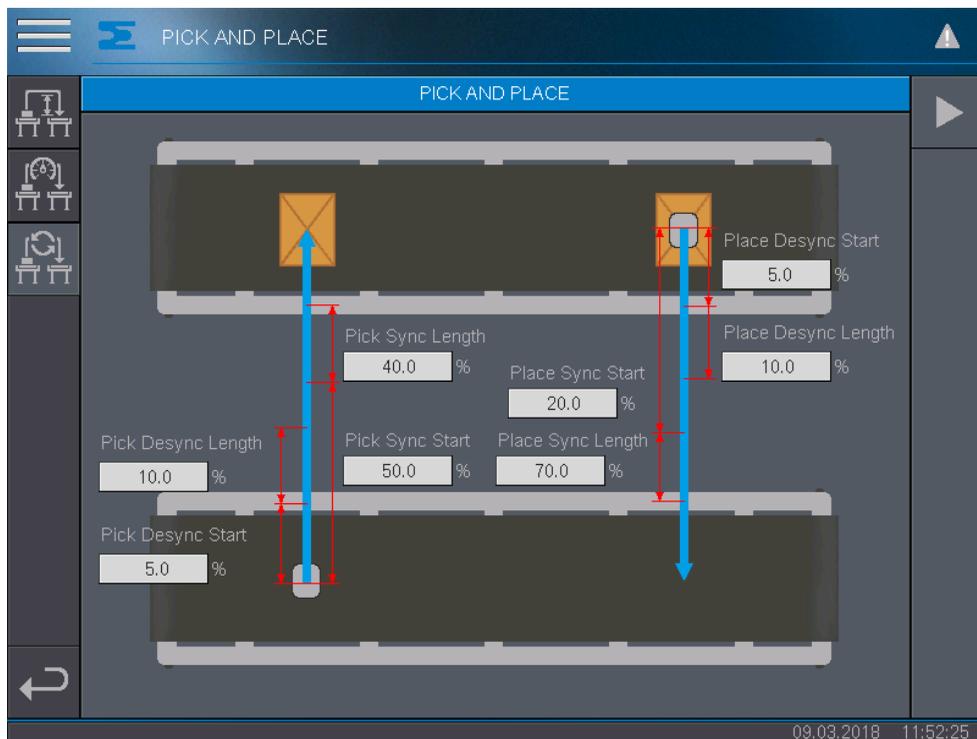
Via this page, on-loading/off-loading motion can be configured and started.



- **Pick height:** Defines the vertical distance (Z-direction) traveled before or after on-loading Required for example, to remove objects from a container.
- **Place height:** Defines the vertical distance (Z-direction) traveled before or after off-loading Required for example, to place objects in a crate.
- **Z:** Height traveled after on-loading the objects.
- **Path start:** Refers to the horizontal movement between the on-loading conveyor and the off-loading conveyor in percent. After reaching this distance, the robot is located at the height Z.
- **Path end:** Similar to Path Start, a percentage of the horizontal motion for the off-loading conveyor is specified. When this distance is reached before the end of the horizontal movement, the robot is then located at the height Z.



- **Wait time pick:** Time the gripper requires to pick up the object.
- **Wait time place:** Time the gripper requires to place the object.
- **V:** Speed with which the movement should be performed.
- **A:** Acceleration or deceleration with which the movement should be performed.
- **Jerk:** Reduction of the jerk for the on-loading/offloading movement.



- **Pick Desync Start:** After this distance, the decoupling of the Pick conveyor belt is started.
- **Pick Desync Length:** After this distance, the decoupling from the Pick conveyor belt is finished.
- **Pick Sync Start:** After this distance, the coupling of the robot to the Pick conveyor belt is started.
- **Pick Sync Length:** After this distance, the coupling of the robot to the Pick conveyor belt is finished.
- **Place Desync Start:** After this distance, the decoupling from the Place conveyor belt is started.

- **Place Desync Length:** After this distance, the decoupling from the Place conveyor belt is finished.
- **Place Sync Start:** After this distance, the coupling of the robot to the Place conveyor belt is started.
- **Place Sync Length:** After this distance, the coupling of the robot to the Place conveyor belt is finished.



Start the "Pick and Place" movement.



Stop the "Pick and Place" movement. After having been pressed, the button starts to blink and the robot places the current object down. Afterwards, the robot moves to a safe height (the larger Z-position of Z1/Z2) and remains in place.

## Documentation Changes

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Change date	Affected page(s)	Chapter	Note

