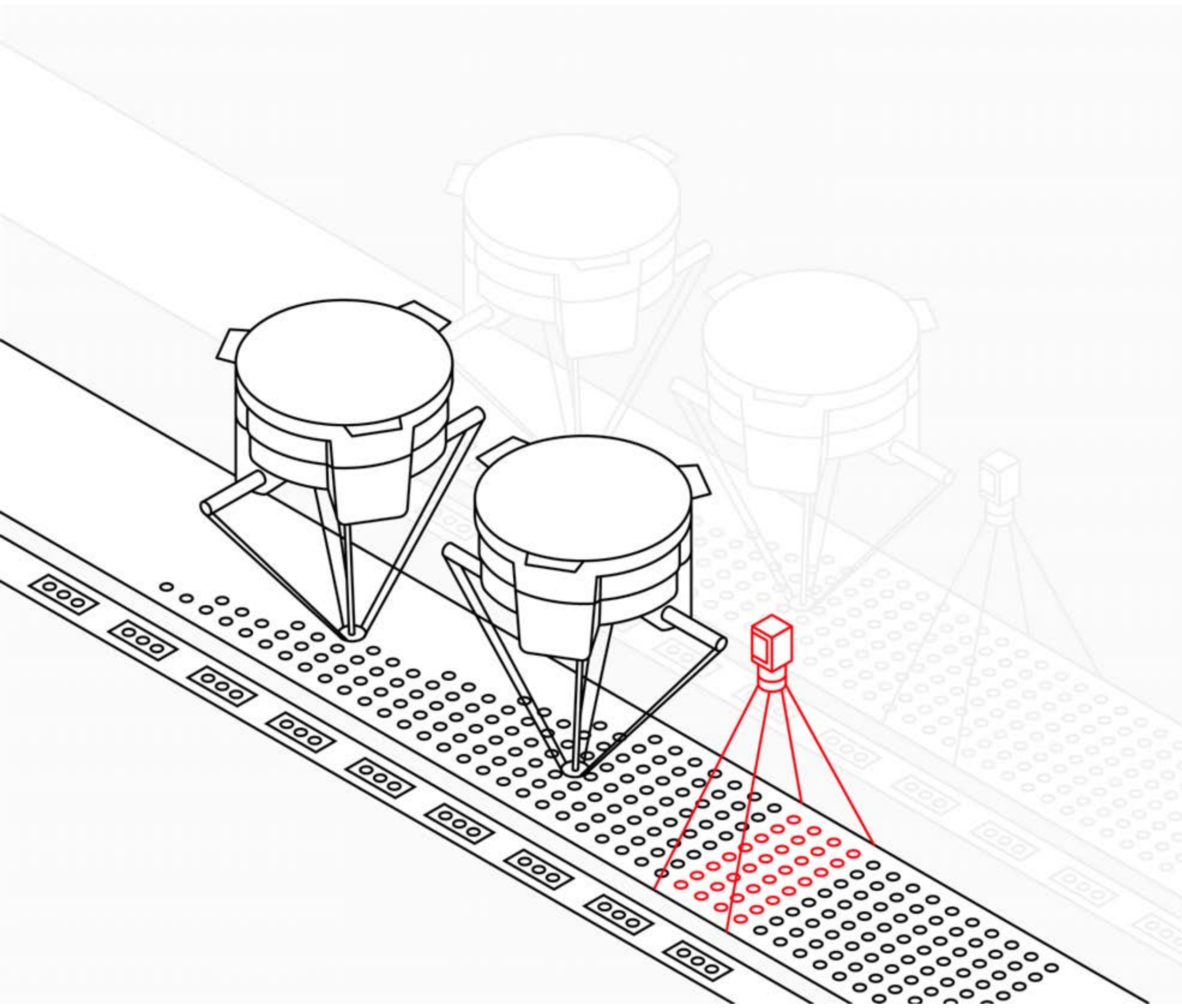
ROBOTICS

Application manual

PickMaster® Twin - PowerPac



Trace back information:
Workspace Main version a410
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Application manual

PickMaster® Twin - PowerPac

IRC5 and OmniCore

Document ID: 3HAC064218-001

Revision: C

Keep for future reference.

Additional copies of this manual may be obtained from ABB.

Original instructions.

Table of contents

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Overview of this manual

About this manual

This manual contains instructions for installation, configuration, and operation of PickMaster PowerPac.

Note

All safety information for working with the controller is described in the product manual for the controller.

Usage

This manual should be used during installation, configuration, and maintenance of a PickMaster system.

PickMaster PowerPac is intended for use as an engineering tool on a portable laptop PC for offline use and online connection to a host computer in the installation for commissioning purposes. PickMaster PowerPac is not intended for use on the host computer under production conditions.

Who should read this manual?

This manual is intended for:

- Installation personnel
- Programmers
- Integrators
- Operators

Prerequisites

Any maintenance/repair/installation personnel working with an ABB robot must be trained by ABB and have the required knowledge of mechanical and electrical installation/repair/maintenance work.

Cybersecurity

This product is designed to be connected to and to communicate information and data via a network interface. It is your sole responsibility to provide, and continuously ensure, a secure connection between the product and to your network or any other network (as the case may be).

You shall establish and maintain any appropriate measures (such as, but not limited to, the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB Ltd and its entities are not liable for damage and/or loss related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

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References

> **Tip**
>
> All documents can be found via myABB Business Portal, *www.abb.com/myABB*.

OmniCore

Reference	Document ID
Product specification - PickMaster Twin	*3HAC073650-001*
Circuit diagram - PickMaster Twin	*3HAC024480-020*
Application manual - PickMaster Twin - Operator	*3HAC069977-001*
Safety manual for robot - Manipulator and IRC5 or OmniCore controller [i]	*3HAC031045-001*
Product manual - OmniCore C30	*3HAC060860-001*
Operating manual - OmniCore	*3HAC065036-001*
Application manual - Controller software OmniCore	*3HAC066554-001*
Technical reference manual - Lubrication in gearboxes	*3HAC042927-001*
Technical reference manual - System parameters	*3HAC065041-001*

i This manual contains all safety instructions from the product manuals for the manipulators and the controllers.

External references

Reference	Description
Cognex Ethernet Camera Tool	For configuring camera networks.
Gigabit Ethernet Performance Driver	For camera communication.
aca1440-73gc	Information about Basler Ace Gigabit Ethernet cameras and the switch for Gigabit Ethernet cameras.
sca1300-32gc	Information about Basler Scout Gigabit Ethernet cameras and the switch for Gigabit Ethernet cameras.
CognexPCConfigGuide	Detailed information about PC requirements for the vision system.

Revisions

Revision	Description
A	First edition.

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Revision	Description
B	Published in release 21A. The following updates are made in this revision: • Added information on supporting OmniCore controller. • Added description of accounts management and http protocol safety issue. • Minor corrections. • Added a note on refreshing the controller system list when adding a controller in PickMaster PowerPac. • Added notes for real Runtime connection. • Added description for new time sync service. • Added note for RW7.2 about the firewall settings on WAN. • Updated **Job** Tab option to **Recipe**. • Added a note that the PickMaster 3 and PickMaster Twin are not recommended to be installed on a same PC. • Updated the operation of editing users in PickMaster PowerPac. • Updated the definition of Adjustment speed in section *Six axes robot configuration on page 44*.
C	The following updates are made in this revision: • Minor corrections. • Added calibrating circular conveyor procedure in section *Calibrating circular conveyor on page 206*.

1 Welcome to PickMaster PowerPac

1.1 Introduction

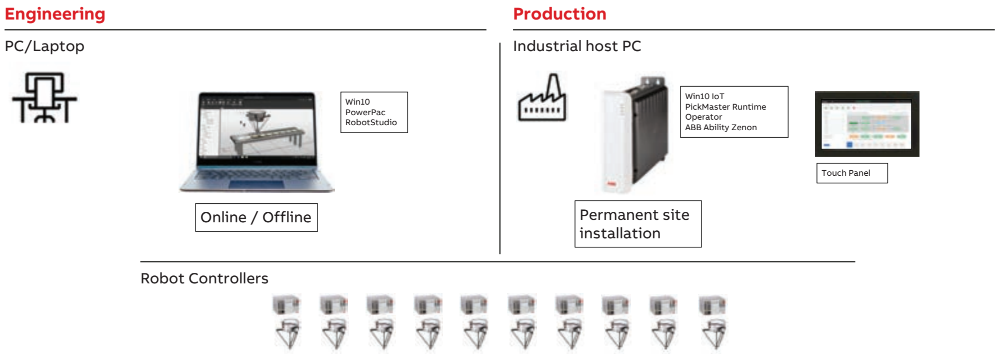
About PickMaster® Twin

PickMaster® Twin is an application product designed for vision based high speed picking of random flow products on the fly. PickMaster® Twin supports ease-of use configuration, simulation and operation of a big variation of smaller or larger line layouts composed of a multitude of robots, cameras, conveyors and fixed work areas. It comprises all steps in the life cycle of a picking installation from proposal, engineering, commissioning, operation to maintenance and support.

PickMaster PowerPac can be customized for some of the following special needs:

- With the integrated vision it can be used for full random operation on a continuously moving conveyors and for absolute accurate positioning on indexed feeders or trays.
- Without vision recognition it can be used as a tool for the efficient production with guided product flows on multiple conveyors.
- For efficient quality inspection and product categorization alone or together with the position recognition.

PickMaster® Twin is a modular product for controlling ABB robots in picking applications through the robot controller. It is a configurable to perform pick and place operations of items. A vision system is used to find randomly placed items on conveying belts. PickMaster PowerPac is the engineering software aimed at configuring and validating the application in offline simulation with a virtual system and in online mode directly connected to the real installation. It uses comprehensive graphical interfaces to configure powerful applications, where it can control multiple robots picking and placing sensor-detected items on different conveying belts.



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PickMaster Twin comprises the following modules:

PickMaster® PowerPac

Ease of Use software for offline and online configuration and commissioning in a visual 3D environment, powered by RobotStudio™.

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PickMaster® Operator

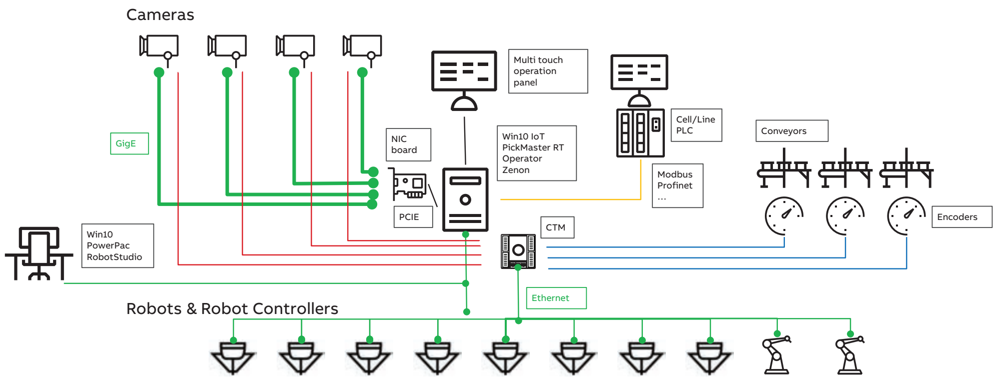
State-of-the art user interface for operating PickMaster on the shop floor, built on ABB's Ability™ Zenon data management software.

PickMaster® Runtime

Efficient runtime operation software for orchestrating the coordination of the packaging process for a multitude of robots and conveyors including integrated vision software for precise robot guidance and quality inspection.

- Virtual Runtime: running the PickMaster process in a simulated virtual environment on a client system connected to virtual robot controllers.
- Real Runtime: running the PickMaster process in the real production installation on the host computer.

The following illustration is showing an installation example with 10 robots, 4 cameras and 3 conveyors.



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> **Note**
>
> PickMaster® Twin is delivered with different hardware configurations. For more information, see *Product specification - PickMaster Twin*.

> **Note**
>
> `Http` protocol is uesd between PickMaster® PowerPac/PickMaster® Operator and PickMaster® Runtime. This could be unsafe if the user has specific safety rules. Please take necessary measurements to protect your information.

About PickMaster PowerPac

This manual describes how to install and use PickMaster PowerPac as the engineering software in two modes:

- Configuring and validating the application in offline simulation with a virtual system.
- Commissioning in online mode directly connected to the real installation.

This manual also describes the components of the real system, their installation, configuration and calibration.

1.2 PickMaster PowerPac terms

About these terms

Some words have a specific meaning when used in this manual. Definitions of these words in this manual are listed below. Some of the terms are put in their context when describing a picking and placing process.

Term list

Words that have italic font style in the definition column are included in the term list and have their own definitions.

Term	Definition
PickMaster PowerPac	The market name of PickMaster PC software that is used for configuration and simulation.
PickMaster Operator	The market name of PickMaster Tablet software that is used for configuration and simulation.
PickMaster Virtual Runtime	The core engine that does all the calculation of virtual pick and place operation.
PickMaster Runtime	The core engine that does all the calculation of pick and place operation. It's also called as Runtime.
PickMaster Twin Client	The installation package which contains PickMaster PowerPac, PickMaster Virtual Runtime and PickMaster Runtime.
PickMaster Twin Host	The installation package which contains PickMaster Operator and PickMaster Runtime.
Work area	A defined picking and placing areas for the robots.
Circular Conveyor	A conveyor that is in a circular type.
Item	The generic term for a specific object to be picked or placed in a PickMaster PowerPac application.
Item source	Defines how to generate *item* positions and which *work area* to send them to.
Container	Defines which patterns to use and what *items* to use for each position in the patterns.
Recipe	'Project' in PickMaster 3, a collection of parameters with regard to the process of Pick and Place.
Emulation	An activity of imitating the behavior of real cell or line and display the activity on screen.
Ghost picking	A kind of dry run, when production uses virtual item to pick, thus no real item to pick.
Offline Simulation	A kind of simulation process when connected to the virtual robot.

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2 Installation

2.1 PickMaster package

Concepts of using PickMaster Twin

PickMaster PowerPac is designed to be installed on a laptop computer that can host solutions for many different installations that can be connected for commissioning, new recipe introduction, maintenance and servicing purposes to the several physical installations, where each one of those have their own permanent host computer.

There are two software installation packages: PickMaster Twin Client for the portable engineering system and PickMaster Twin Host for the permanent factory system.

The Client installation does not require any physical equipment installations. All physical component installations, configurations and calibrations are doneon the host system.

PickMaster Twin Client

The installations package for PickMaster Twin offline configuration, simulation and testing is named as PickMaster Twin Client. It installs the following softwares:

- PickMaster PowerPac
- PickMaster Virtual Runtime
- PickMaster Real Runtime

Note

This package is only intended for engineering and not for the final factory production installation. The ability to switch to real runtime on the same computer is only intended for test purposes and it can be used for creating and editing vision models offline. For this purpose a vision demo dongle can be used.

Software Installation Package

Registered ABB customers can download the latest version of the PickMaster Twin Client and the user documentation for PickMaster PowerPac from the ABB download center.

Tip

The download center address is https://new.abb.com/products/robotics/application-software/pickmaster.

Note

The PickMaster software is available in 64-bit version.

Continues on next page

When the PickMaster Twin Client is installed successfully, the user documentation for PickMaster PowerPac and the calibration papers are available in the installation folder *Documentation*.

Note

Any old version of PickMaster PowerPac must be uninstalled before installing a newer version of PickMaster PowerPac.

2.2 System requirements

2.2.1 Hardware and software requirements

Hardware requirements

Following are the hardware requirements

- A log on account with administrator rights on the computer.
- CPU: 2.0 GHz or faster processor. Multicore processor is recommended.
- Memory: 3 GB if running Windows 32-bit edition. 8 GB if running Windows 64 bit edition. 16 GB or more if working with heavy CAD models.
- Free disk space: 10+ GB free space, solid state drive (SSD) recommended.
- Graphics card: High-performance, DirectX 11 compatible, gaming graphics card from any of the leading vendors. For the Advanced lightning mode Direct3D feature level 10_1 or higher is required.
- Display settings: 1920 x 1080 pixels or higher resolution is recommended.
- Dots per inch (DPI): Only Normal size supported for Integrated Vision.
- Mouse: Three-button mouse
- 3D Mouse (optional): Any 3D mouse from 3DConnexion. See http://www.3dconnexion.com.

Note

When running the software, close other software that consumes a lot of memory, otherwise it will affect the software normal use.

CAUTION

If robot movement can be initiated from an external control panel then an emergency stop must also be available.

Software requirements

Following are the software requirements:

- Windows 10 (64 bit).
- Acrobat reader
- Robotstudio 2020.1 or later
- RobotWare 6.11 or later

2.2.2 Ethernet switch

Overview

An Ethernet switch is used to connect the PC with multiple robot controllers. It is recommended to use an unmanaged industrial switch with a communication speed of 100 Mbit/s or higher. Switches that implement the 1588 PTP protocol have been known to interfere with the robot controller communication and should not be used.

2.2.3 Vision system

Overview

PickMaster PowerPac can acquire images and generate targets by using cameras that communicate over Ethernet. An Ethernet network (network interface card, cables, switches) is used for communication between the cameras and the Runtime PC. Trigger/Strobe and power voltage is connected to a Hirose 12-pin/6-pin connector on the camera housing. Preferably the power voltage to the Ethernet camera is supplied from a separate source that is independent of the robot controller.

Vision system requirements

The supported network card for Ethernet camera communication is Intel Pro/1000PT Dual Port Server Adapter. Other network interface cards can work, but have not been tested.

A Cognex USB license is required for the Gigabit Ethernet vision system. The USB stick must be connected when Runtime is running.

The maximum number of cameras that can be used is ten.

Insert the vision network card in a free compatible PCI-express slot (PCI-express x4, x8, or x16).

Color vision

Color vision is available as a standard function and has the following features:

- connectivity for color cameras
- white balance calibration
- color filter configuration

> **Note**
>
> This allows you to define colour filters that will run as a prestep to PatMax and Blob. The filter is available in Standalone, alignment, and sub inspection modes.

The vision system has been tested with the `Basler Scout ScA1300-32gc`, `Basler Scout scA1390-17gm` and `Basler Ace acA1440-73gc` cameras.

2.2.4 Camera requirements

Mounting

The cameras must be mounted in a very stable way to avoid vibration and other dynamic movement. The cameras can be mounted in any orientation to the image area.

Lighting

Even lighting of the image area is very important to obtain reliable results.

Other camera requirements

If the camera is mounted on a moving conveyor then it is necessary to have a progressive scan camera (non-interlaced).

We recommend using a camera that supports electronic shutter control. Then it is possible to set the exposure from PickMaster PowerPac, otherwise the exposure time must be manually set on the camera.

Camera configuration

Some cameras will need manual configuration to fulfill the above conditions. For detailed information about camera settings, see *Cognex manual* and *PickMaster Release Notes*.

For specific information about Basler Gigabit Ethernet cameras, see *References on page 10*.

Recommendation for lenses

When planning a cell it is important to choose a suitable camera/lens setup that gives an appropriate field of view (FOV).

The FOV of a camera is determined by three factors:

- The distance between the camera and the scene.
- The focal length of the lens.
- The size of the camera's sensor chip (normally specified as the distance of the diagonal of the chip, expressed in inches).

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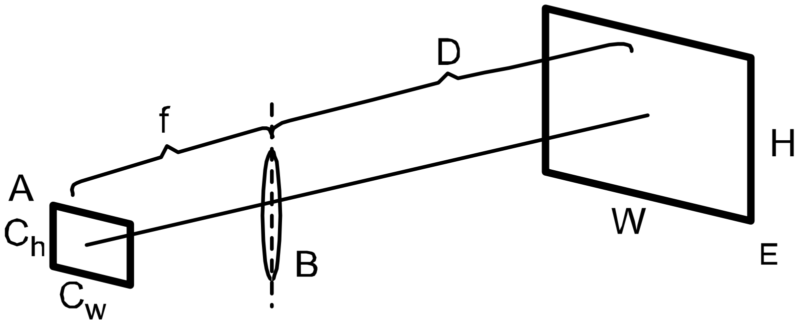
The graphic below shows the geometry of the optical setup.



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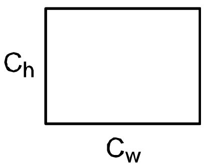
A	Sensor chip
B	Lens
C	Chip height (mm)
C	Chip width (mm)
D	Distance from lens to scene (mm)
E	Scene
f	Focal length of camera (mm)
H	Scene height (mm)
W	Scene width (mm)

To select a suitable lens, measure the distance between the camera and the items (D), and the size of the image area (W*H).

To calculate the appropriate focal length of the lens:

- If the height of the image area is most important: `f = (D/W)*Cw`
- If the length of the image area is most important: `f = (D/H)*Ch`



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The table below lists the width and height of some common sensor chip sizes, expressed in millimeters.

Sensor chip size (inch)	C_h (mm)	C_w (mm)
1/4"	2.4	3.2
1/3"	3.6	4.8
1/2"	4.8	6.4
2/3"	6.6	8.8

A shorter focal length gives a wider field of view, that is the returned value is the maximum focal length to obtain the specified W and H.

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Example: lens calculation

This example is based on a 1/2" sensor chip, such as the Basler Scout 1390-17gm.

- The FOV should cover a conveyor belt with a width of 500 mm.
- The minimum height of the FOV is not restricted.
- The distance between the camera and the conveyor is 800 mm.
- The camera is mounted with the belly facing the robot (PickMaster default).

Because the width of the conveyor determines the minimum FOV the required focal length is calculated using:

```
f = (D/W)*Cw
```

Enter the known data, C_w is 6.4mm (see graphic above).

```
f = (800/500)*6.4 = 10.24 mm
```

The resulting height H of the FOV is calculated as:

```
H = D*CH/f = 800*4.8/10.24 = 375 mm
```

Alternative with increased height

To increase the height of the FOV (H), the camera can be rotated 90° so that the height dimension of the sensor chip (4.8 mm) is aligned with the width dimension of the conveyor. The width dimension (6.4 mm) is aligned with the x-axis of the conveyor.

```
f = (800/500)*4.8 = 7.68 mm
```

The resulting height H of the FOV is now:

```
H = 800*6.4/7.68 = 666 mm
```

Normally lenses are available in some standard focal lengths. Choose a lens that has a focal length shorter than the calculated value to be sure to capture the entire scene.

2.3 PickMaster PowerPac license

Introduction to licensing

A license activation key provided by ABB must be installed and activated to run PickMaster PowerPac.

PickMaster PowerPac depends on the activation of Robotstudio. You can use PickMaster PowerPac normally only if you activate RS with a license that includes the PickMaster PowerPac option. It can also be activated separately from PickMaster PowerPac, but still invokes the RS activation procedure.

PickMaster PowerPac license options

Two license options are available for PickMaster PowerPac, Basic and Premium.

Users can obtain the Basic option for free and work with limited functions. The Premium option provides more functions for professional integrators and commissioners.

Comparison between license options

The following table lists the main application scenarios and differences between two license options.

	Basic	Premium
RobotWare option	PickMaster cell ready	PickMaster cell ready
RobotStudio requirment	Unactivated	Activated
Runtime	Real (default)	Virtual (default)
Solution/layout	Adjust/Save	Create/Save
Recipe	Create/Save	Create/Save
Simulation	Offline simulation Ghost picking/emulation	Offline simulation Ghost picking/emulation

Information about the current license

Use the following procedure to get information about the current license.

	Action	Note
1	Start the Robotstudio 2019.	
2	Click the **File** tab.	
3	Click **Options**.	
4	Click **Licensing**.	
5	Click the **View install license...** to get information about the current license.	

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Activating a license key

Activating a license key automatically over the Internet

Use this procedure to activate a license key automatically over the Internet.

	Action
1	To start the licencing application, either use: • In the PickMaster PowerPac, on the **Options** menu, click **Activate License**.
2	Under **Standalong License**, choose **I want to Activate a standalong license key** and click **Next**.
3	Under **Automatic Activation**, choose **Activate RobotStudio over the internet** and click **Next**.
4	Enter your 25 character Activation Key (xxxxx-xxxxx-xxxxx-xxxxx-xxxxx) and click **Next**. Your activation request will be sent to ABB over the Internet. If you are using a valid Activation Key that has not expired or exceeded the number of activations allowed, your PickMaster PowerPac license will be activated immediately, and your PickMaster PowerPac is ready for use when started next time.

Activating a license key manually

If the computer with PickMaster PowerPac installed does not have an Internet connection, you must activate the license manually. This is done in three steps:

1. Create a license request file (`*.licreqx`).
2. Download a license file (`*.bin`) using an Internet connected computer.
3. Install the license file (`*.bin`).

Use this procedure to activate a PickMaster PowerPac license manually.

	Action
1	To start the licensing application either use: • In the PickMaster PowerPac, on the **Options** menu, click **Verify License**.
2	In the licensing application, click **PickMaster License Activation Wizard...**.
3	Under **Automatic Activation**, select **Step 1: Create a license request file** and click **Next**.
4	Enter your 25 character Activation Key (xxxxx-xxxxx-xxxxx-xxxxx-xxxxx) and click **Next**.
5	Click **Save Request**.
6	Type a name for a license request file (*.licreqx), browse to a suitable folder, and click **Save**.
7	Click **Finish**.
8	Use a removable medium, such as a USB device, to transfer the license request file to a computer with an Internet connection.
9	On the computer with internet connection, start the internet browser, and go to the link http://www.manualactivation.e.abb.com/ and follow the instructions to activate your license manually. You are instructed to browse for the saved license request file. The result will be a license file (*.bin) that you must save.
10	Transfer the license file to the PickMaster PowerPac PC.
11	On the PickMaster PowerPac computer, start the licensing application.
12	Under **Automatic Activation**, select **Step 3: Install a license file (*.bin)** and click **Next**.

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	Action
13	Follow the wizard instructions. The PickMaster license will now be activated for the PickMaster PowerPac and the Runtime, and the PickMaster installation ready to use.

2.4 PickMaster time synchronization service

Time synchronization service

PickMaster Twin uses a time synchronization service to synchronize the time between the robot controllers and the host PC running PickMaster. The synchronization is performed over the same network used for communication between PickMaster Runtime and the robot controllers.

Note

To enable the time synchronization service, the user should select the local IP address which is connected to the real controller during installing the PickMaster Twin Client.

If the computer is not yet connected to a real controller, the IP address could also be configured after the installation.

Settings

The synchronization service is based on the precision time protocol (PTP), which in turn implements the IEEE 1588 standard. This protocol uses multicast messages over UDP/IP and requires that UDP port 319 and 320 are available (for both incoming and outgoing traffic). It is therefore necessary that any firewall is not blocking these ports. Please contact your system administrator to make sure that the proper configurations are performed.

PTP was originally defined in the IEEE 1588-2002 standard, officially entitled "Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems" and published in 2002. In 2008, IEEE 1588-2008 was released as a revised standard; also known as PTP Version 2, it improves accuracy, precision and robustness but is not backward compatible with the original 2002 version.

The time synchronization service must be set to operate on the correct PC network interface port, that is, the network port which communicates with the robot controllers.

2.5 Software installation

Note

Anyone working with installation of an ABB robot must be trained by ABB and have the required knowledge of mechanical and electrical installation work.

Continues on next page

2.5.1 Installing RobotStudio

Instruction

For the detailed RobotStudio installation procedure, see *Operating manual - RobotStudio*, *3HAC032104-001*.

2.5.2 Installing PickMaster Twin Client

Procedure

Installing PickMaster Twin Client

Note

The PickMaster 3 and PickMaster Twin Client are not recommended to be installed on a same PC.

They may influence each other.

Note

The PickMaster Twin Client and PickMaster Twin Host are not recommended to be installed on a same PC.

Note

The PickMaster Twin 1.0 is for IRC5 controller.

The PickMaster Twin 1.1 is for OmniCore controller.

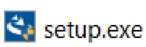
Note

Make sure that you have installed RobotStudio on your computer before installing PickMaster Twin Client. For the installation procedure of RobotStudio, see *Operating manual - RobotStudio*.

Use the following procedure to install the PickMaster Twin Client:

1. Browse to the PickMaster Twin Client installation package and double-click `Setup.exe`.

   The installation starts.

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2. Click **Next**.
3. Read the **license agreement** and accept the terms.
4. Click **Next**.
5. Choose to install the **Congnex vision driver** and click **Next**.
6. Click **Next**.

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7 Choose an IP address for network adaptor configuration and click **Next**.

> **Note**
>
> To enable the time synchronization service, the user should select the local IP address which is connected to the real controller during installing the PickMaster Twin Client.
>
> If the computer is not yet connected to a real controller, the IP address could also be configured after the installation. For detailed information, see *Configuring local IP address on page 32*.

8 Click **Next** to start the installation.

9 When the installation is complete, choose to restart the computer now or later and click **Finish**..

Configuring local IP address

The local IP address should be reconfigured in the PickMaster Runtime (RRT) in the following cases:

- Previous IP configuration during installation is wrong.
- The network interface currently used for connecting the real controller has been changed.

Start Runtime, click File - Options to open a pop-up dialog. Select the corresponding interface in the list box and click OK.

Note that the network interface configurated in Runtime must be the IP address of the local computer connected to the controller using WAN interface.

Use the following procedure to configure the local IP address in the PickMaster Runtime (RRT):

1 Start Runtime.

2 Click **File** - **Options** to open a pop-up dialog.

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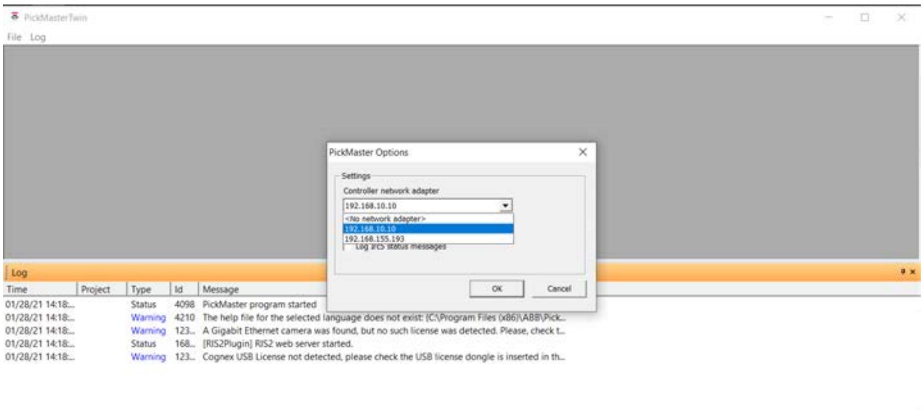
3 Select the corresponding IP address in the list box and click **OK**.



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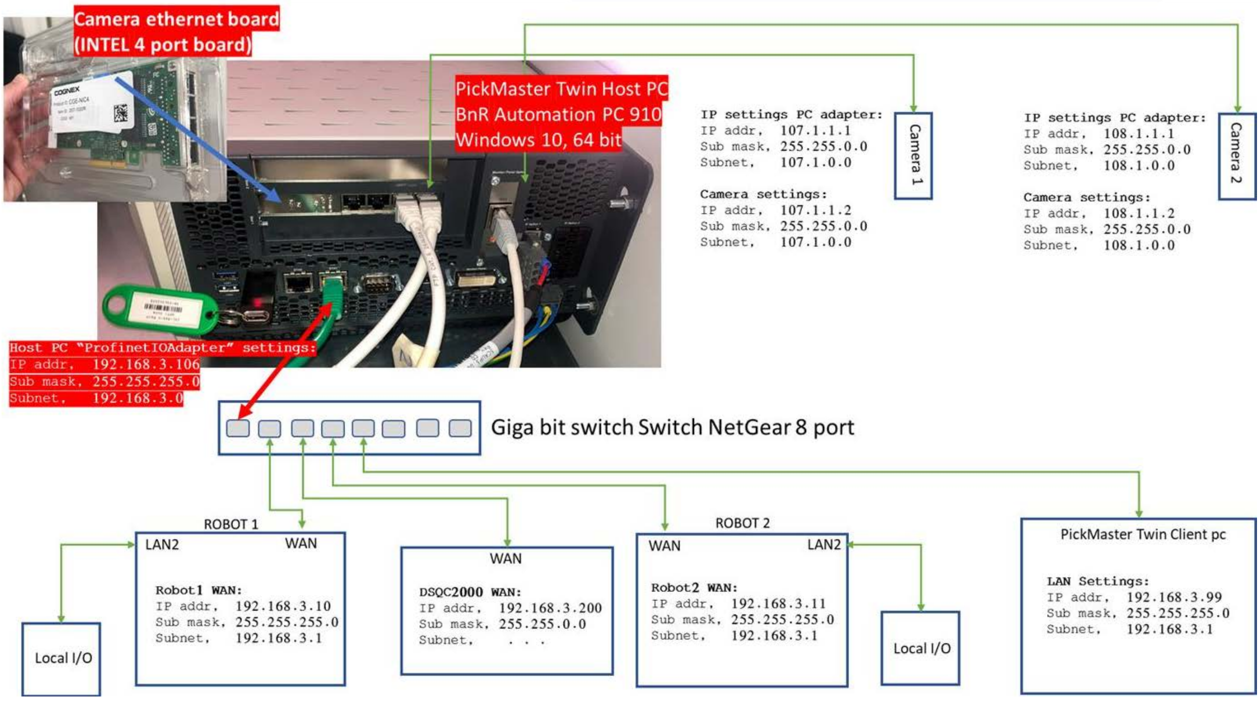
2.6 Electrical connection

2.6.1 PickMaster® Twin Hardware connection illustration

Example



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2.6.2 Connecting cameras

Introduction to camera connections

The camera does not receive power voltage through the Ethernet cable. A separate connection provides power and I/O functions, this is the power/trig/strobe cable.

We recommend using an external power supply for the Gigabit Ethernet cameras. This way, they will receive power regardless if the robot controller is turned on or not. If the camera is supplied with power directly from the robot controller it will shut down when the controller is turned off. Runtime can not reconnect to a camera that has been shut down and restarted. This means that if Runtime is running when a controller that serves as a camera power supply is shut down, Runtime must be restarted after the controller has been switched on again. This problem is avoided by using an external power supply.

A 4-port NIC board in the options must be used for the Gigabit Ethernet cameras. And the cameras cannot use the same network card with the controller. Or the pictures will be affected.

The jumbo packet function of the network card is to be turned on when using with the camera.

The schematics of how the trigger strobe and power wires from the camera must be connected to the robot controller I/O board can be seen in the circuit diagrams, see *Circuit diagram - PickMaster Twin*, *3HAC024480-020*. Detailed information about avoiding EMI/ESD problems is described in *Avoid_EMI_ESD_in_camera_installations*, see *References on page 10*.

Note

All safety information for working with the controller is described in the product manual for the controller.

Prerequisites

Make sure all power is switched off before connecting cameras.

Validated cameras

The following cameras are supported for the PickMaster PowerPac:

- acA1440 - 73gc
- scA1300 - 32gc
- scA1390 - 17gm

Continues on next page

> **CAUTION**
>
> Personal injury hazard and risk of damage to camera in case of short circuits.
>
> Short circuits may cause an extreme rise in temperature of the camera's housing. This may damage the camera and may also lead to person injuries, for example, burns. In the worst case, the overheating may cause a fire.
>
> In order to prevent that, limit the current flowing through each individual wire during a short circuit. The maximum current allowed is 2 A. Use a fuse or use a limited power supply.

Connecting the cameras

Use this procedure to connect the cameras.

1. Connect the Ethernet cable with screw connector to the camera.
2. Connect the other end of the Ethernet cable to the PC or the switch (if used).
3. If a switch is used, connect the switch to the PC.
4. Connect the power wires of the power/trig/strobe cable to the external power supply accordingly.

   In case no external power supply is used, connect to the controller.
5. Connect the trig/strobe wires of the power/trig/strobe cable to the robot controller.

> **Note**
>
> If Runtime is shut down and restarted quickly, and with several Gigabit Ethernet cameras, the Gigabit Ethernet performance driver may not be loaded properly for some cameras. The symptom is that the camera for which the driver is not loaded may occasionally fail to acquire an image, if the system is stressed. This can be avoided by waiting for 15 seconds between shutting down and restarting.

Related information

Circuit diagram - PickMaster Twin, *3HAC024480-020*.

2.6.3 Connecting I/O signals

Introduction to I/O connections

The Runtime concept consists of a number of I/O components that need to be connected physically.

Robot controller I/O board

At least one standard DI/DO board is required. Encoder boards are needed for conveyor tracking.

The encoder boards are delivered with a standard address that can differ from the I/O configuration. This address can be changed.

For further information about how to read the encoder board address, see the product manual for the controller, see *References on page 10*.

Prerequisites

Make sure all power has been switched off.

Connecting the I/O signals

Use this procedure to connect the I/O signals.

1. If conveyors are used, connect each conveyor controller to the standard DI/DO board for control from Runtime.

   The drawings in *Circuit diagram - PickMaster Twin*, *3HAC024480-020*, uses ACS 301-1P6-3 as conveyor controller, but other conveyor controllers can be used. The same applies to the encoder used, a Lenord-Bauer Gel 260-V-02500A001.
2. Connect the trig/strobe wires of the power/trig/strobe cables from the cameras to the robot controller.
3. Connect the I/O cables from any external tool signals to the robot controller.
4. Connect the I/O cables for other external devices, such as sensors to the robot controller.
5. Connect the encoders, see *Application manual - Conveyor tracking*.

I/O connections

The trigger strobe loop enables very precise synchronization between the robot controller and the image acquired. The I/O port of the Gigabit Ethernet camera closes this loop.

To be able to use more than one connection in input number 9 (StartSig) on the encoder board we recommend using diodes, for example HER105/Taw diode 1A 400V DO41 (the diodes are not supported by ABB). This will eliminate any possibilities of reverse currents.

When connecting a camera to multiple robot controllers it is important to consider how the system should work if one of the controllers is turned off. We recommend using an external 24V power supply to power the cameras. This way the cameras will have both power and I/O regardless if the controllers are turned off.

Continues on next page

Related information

Circuit diagram - PickMaster Twin, *3HAC024480-020*

I/O signals on page 177.

Predefined I/O signals on page 177.

2.6.4 Configuring networks

Introduction to the controller network

The PickMaster PowerPac and the robot controller communicate through Ethernet. If you have problems in connecting to the network, contact the local network administrator.

Note

The PickMaster PowerPac must be conntected to the LAN port on the controller. Do not use the service port.

Configuring the controller network

If a new local area network (LAN) is created specifically for PickMaster PowerPac the following settings can be used.

- Use static IP numbering with different addresses for both the computer and the robot controller.
- IP addresses: 192.168.1.X (where X is between 1 and 253).
- Subnet mask: 255.255.255.0
- Gateway: 192.168.1.254
- DNS: N/A.
- Wins: N/A.

Note

The robot controller has a service Ethernet card configured with an IP address (192.168.125.1). Therefore, the same subnet (192.168.125.X) must not be used for the standard LAN Ethernet card.

For more information, see *the Windows documentation and the product manual for the robot controller* to set up the IP configuration.

Note

It's not allowed to use any of the following IP addresses which are allocated for other functions:

- 192.168.127.0 - 255

The IP address cannot be on a subnet which overlaps with any of the above reserved IP addresses. If a subnet mask in the class B range has to be used, then a private address of class B must be used to avoid any overlapping. Contact your local network administrator regarding network overlapping.

See the section *Communication* in *Technical reference manual - System parameters*.

Continues on next page

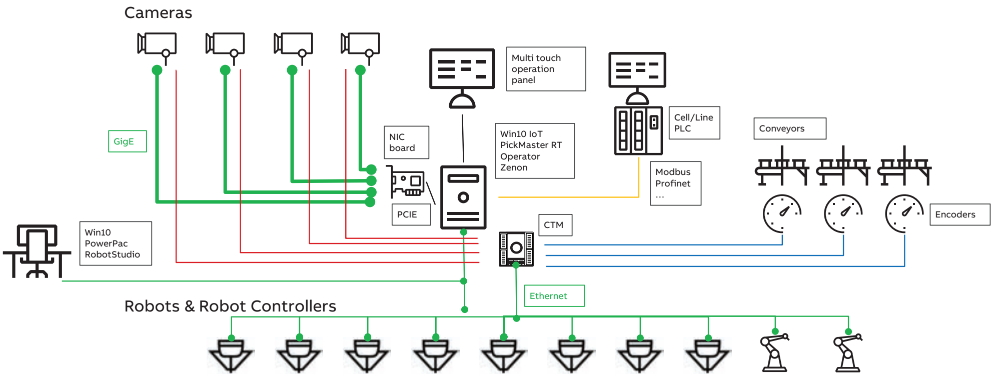
Prerequisites for vision networks

The vision network settings must be configured similar to the robot controller network settings.

Use a separate network for the vision system, that is controllers and cameras cannot be connected to the same network port on the PC.

To use more cameras than the number of available Ethernet ports on the PC, use one or two additional GigE cards.

The maximum number of cameras that can used with one PC is 10. Distribute them evenly on the dedicated vision network ports on the PC. Use cables with fastening screws between GigE card and camera. See example below of camera network topologies.



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> **Note**
>
> Changes made to the camera settings outside Runtime will not be applied until Runtime is restarted. This means that if a camera is restarted (power on/off) or a camera's IP address is changed, thenRuntimer must be restarted to function properly. Therefore, Runtime and the *Ethernet camera tool* program should not be run simultaneously, to avoid unpredictable behavior. Instead, shut down Runtime before making changes, then start Runtime after changes are saved.

Configuring the vision network

Use this procedure to configure the vision network.

1. Assign each camera with its own IP-address. The same rules apply as for other Ethernet networks, that is each camera and vision network card must have a unique IP address, and be located on the same subnet. The communication with cameras and controllers should be separated on different subnets. See *Example of suitable network architecture on page 41*.
2. Configure the IP addresses for the cameras using Cognex's *Ethernet camera tool* (available on the Windows Start menu in the Runtime folder). It can be used to set IP addresses of both cameras and network interface cards.
3. When all cameras are configured, install the *Performance Driver* for Gigabit Ethernet vision for each port, see steps 4-6.

Continues on next page

4 In the **Ethernet Camera Tool**, select one of the vision network ports in the tree view and click **Set Performance Driver**. A warning about installing unsigned software will appear, click **OK** and neglect any Windows message asking to install new hardware.

5 Reboot the PC when the installation has finished.

6 Start **Ethernet Camera Tool** and verify that the driver has been successfully installed for each vision network port, in the **Configure Performance Driver** part. Repeat steps 4-6 for the next vision network port (if more than one port is used).

Note

Running the Ethernet Camera Tool and Runtime at the same time may result in unpredictable behavior. To avoid this, use only one of the programs at a time.

Note

Install Gigabit Ethernet *Performance Driver*. This provides fast and reliable camera communication, as well as decreased CPU load.

CAUTION

Running camera traffic and controller traffic on the same network can cause serious communication failure.

Configuring the Runtime network

If a new local area network (LAN) is created specifically for Runtime the following settings can be used.

- Use static IP numbering with different addresses for the PickMaster PowerPac and the robot controller.
- IP addresses: 192.168.1.X (where X is between 1 and 253).
- Select **Connect to RRT**, the **Sign in** window is displayed. How to connect to RRT, see *RunTime on page 57*.

Example of suitable network architecture

The following example provides a suitable network architecture.

- Use static IP numbering with different addresses for both the computer and the camera(s).
- IP addresses of Port #1 and the cameras connected to it: 192.168.101.X (where X is between 1 and 253).
- IP addresses of Port #2 and the cameras connected to it: 192.168.102.X (where X is between 1 and 253).
- Subnet mask: 255.255.255.0
- Gateway: Not Needed.
- DNS: N/A.
- Wins: N/A.

2.6.5 Setting up robot controller

CAUTION

If robot movement can be initiated from an external control panel then an emergency stop must also be available.

RobotWare

PickMaster PowerPac supports IRC5 and OmniCore robot controller. RobotWare is installed on the robot controller. The option *PickMaster Ready* is required to run Runtime.

Note

The PickMaster Twin 1.0 is for IRC5 controller.

The PickMaster Twin 1.1 is for OmniCore controller.

For more information see the product manual for the controller, see *References on page 10*.

System parameters

The number of conveyors must be specified in the system parameters. Some other parameters must also be defined, such as motion, process, and encoder I/O parameters for the conveyors.

System parameters can be changed using the FlexPendant or RobotStudio.

I/O signals

How to configure I/O signals and boards is described in the section *I/O signals on page 177*.

The predefined I/O signals are described in the section *Predefined I/O signals on page 177*.

Related information

Product manual for the controller, see *References on page 10*.

Technical reference manual - System parameters.

Six axes robot configuration on page 44.

2.6.6 Optional robot and process configuration

Conveyor process modification

Fewer modifications can be done on the system parameters

Topic Process

The following parameter can be modified in the topic *Process*. It belongs to the type *Conveyor systems*.

Parameter	Description
maximum distance	Defines the standard tracking distance of a conveyor work object before it is switched to a new work object. This is by default set to 20000mm. The work object switch is done automatically and fast but may steal some process time for a high speed picking application. Increasing the value may improve the cycle time slightly.

2.6.7 Six axes robot configuration

Modifications for six axes robots

When using PickMaster with a six axes robot, some modifications must be done in the system parameters to optimize the robot motion with the conveyor tracking process.

Topic Process

The following three parameters can be modified in the topic *Process*. They belong to the type *Conveyor systems*.

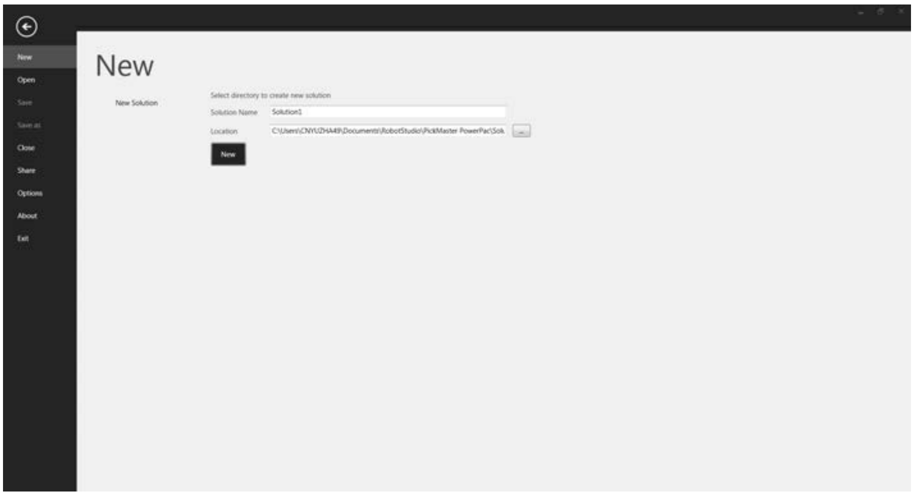
Parameter	Description
Start ramp	This is the correction start filter ramp that is used when connecting to a moving conveyor. This is by default set to 5 (steps). Tune this parameter if higher accuracy is needed. A lower value gives better accuracy but the manipulator may jerk when connecting to the moving object.
Stop ramp	This is the correction stop filter ramp that is used when disconnecting from a moving conveyor. This is by default set to ten (steps). Tune this parameter to eliminate manipulator jerks when leaving the moving object. A lower value gives better accuracy when leaving the conveyor.
Adjustment speed	The speed (in mm/s) at which the robot should catch up to the conveyor. The general recommended value is 130% of the conveyor speed. As minimum, the value should be more than 100% with some margin. If the robots speed is very fast compared to the conveyor speed, a further increase of the value is often necessary. If the value is set too low, robot movements may become jerky or the conveyor tracking accuracy may become reduced. On the other hand, if the value is set too high, the drive system may become overloaded, causing motion supervision errors. Generally, the maximum recommended value is 200%. For IRB360 in applications with high robot speed, the maximum recommended value is 500%.

3 Navigating PickMaster PowerPac

3.1 Start page

Overview

This chapter describes about the start page of the PickMaster PowerPac.



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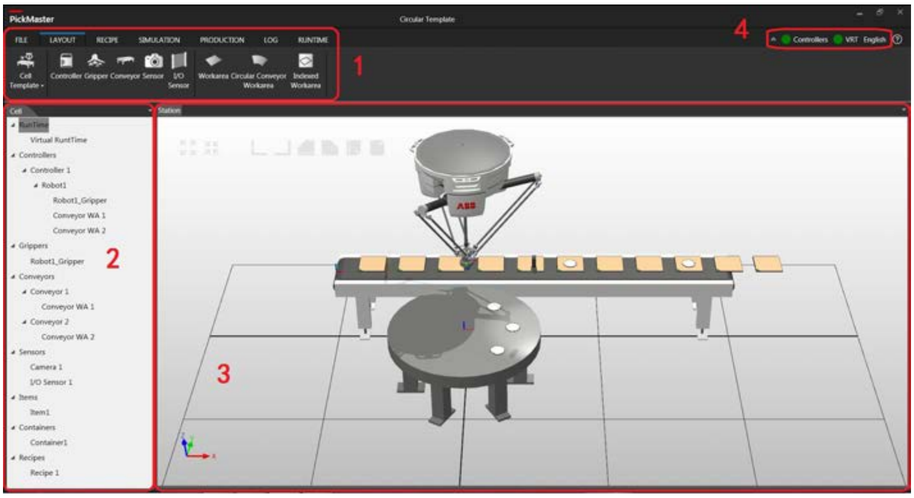
3.2 Main window

Overview

This chapter describes about the user interface of the PickMaster PowerPac. The following figure and table provides information regarding the major elements in the user interface.



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	Item	Description
1	Ribbon tab	Contains the general functions for PickMaster PowerPac. When creating a new solution, the work flow is usually from left to right. For more details, see the section *Ribbon tab on page 47*.
2	Tree view browser	Organizes the programmable objects (for example, robots, sensors, and conveyors) of the picking application in a tree structure. It is separated into line and job tabs. For more details, see the section *Tree view browser on page 56*.
3	Station view	Realistic 3D display of the picking application. The objects in the station view are highlighted when selected or edited using the tree view browser.
4	Status view	Shows the status of the controller and system at present.

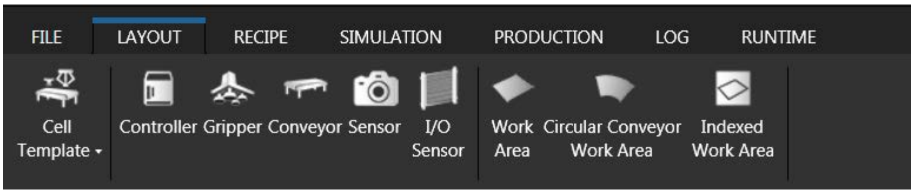
3.3 Ribbon tab

3.3.1 Introduction

Overview

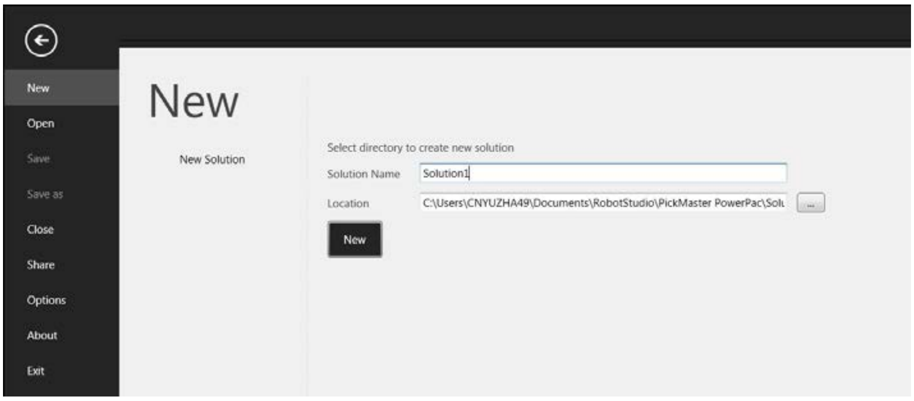
The PickMaster PowerPac ribbon contains elements arranged in various groups. The following figures and tables provide more information regarding the elements in the PickMaster PowerPac ribbon.

Following are the objects and configurations saved in the ribbon tab.

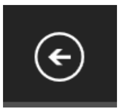


xx1800001171

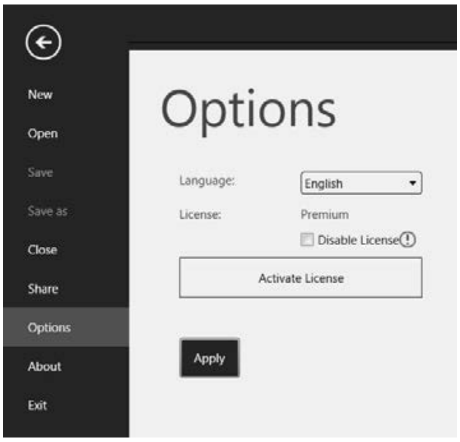
File



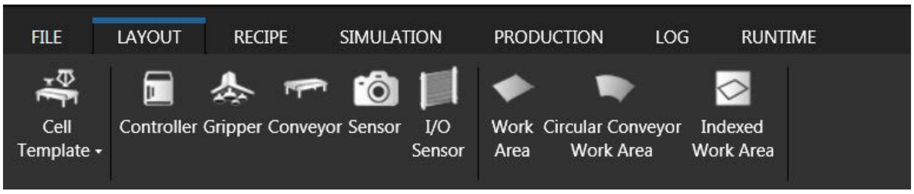
xx1800001384

Button	Description
 xx1900000571	Allows you to back to the main window.
New	Allows you to create a new empty solution.
Open	**Recent** allows you to open the last solution which has been opened on this computer. **Local folder** allows you to open other solutions or any solutions saved in your local folder.
Save	Allows you to save the changes for the solution at present. **Note** If the solution will be used in the PickMaster PowerPac, it must have been connected to a real controller with the same configuration on PickMaster PowerPac.

Continues on next page

Button	Description
Save as	Allows you to save your present solution as a new solution in your local folder. **Note** If the solution will be used in the PickMaster PowerPac, it must have been connected to a real controller with the same configuration on PickMaster PowerPac.
Close	Allows you to close your present solution.
Share	**Pack&GO** allows you to pack all the information of current solution, controller used in the solution and 3D models into a file so that it makes sharing files between users. **UnPack&GO** allows you to unpack the sharing files which contains all the information of a solution, controller used in the solution and 3D models. **Pack As Template** allows you to pack your present solution as a template in your local folder.
Options	**Language** allows you to choose the applied language. **License** allows you to choose a license type. **Disable licensing** check box allows you to disable the license function. **Verify License** icon allows you to verify your license is valid or not. **Apply** icon allows you to apply the change of the license to your PickMaster PowerPac.  xx1800001385
About	Allows you to get the basic version information.
Exit	Allows you to close and exit the PickMaster PowerPac.

LAYOUT



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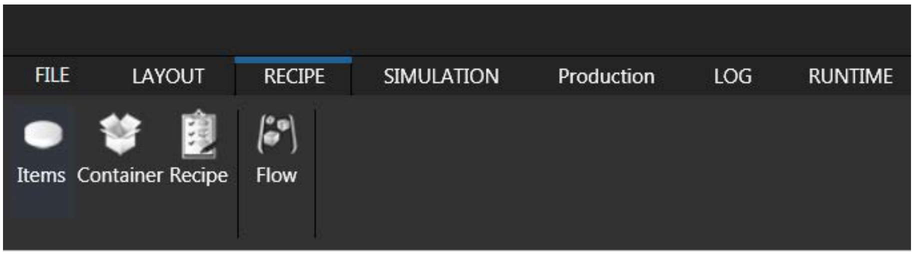
Continues on next page

Button	Description
Cell Template	Allows you to create a solution from the predefined templates. More details about creating a controller is available in the section *Opening a solution from the Template on page 72*.
Controller	Allows you to add a controller with a robot system in the station view. More details about creating a controller is available in the section *Adding Controller on page 75*.
Gripper	Allows you to create a gripper. More details about creating a gripper is available in the section *Adding Gripper on page 81*.
Conveyor	Allows you to create a conveyor. More details about creating a conveyor is available in the section *Adding Conveyor on page 85*.
Sensor	Allows you to create a sensor. More details about creating a sensor is available in the section *Adding Sensor on page 88*.
I/O Sensor	Allows you to create an I/O sensor. More details about creating an I/O sensor is available in the section *Adding an I/O sensor on page 90*.
Work Area	Allows you to create a work area. More details about creating a work area is available in the section *Adding work area on page 93*.
Circular Conveyor Work Area	Allows you to create a circular conveyor work area. More details about creating a circular conveyor work area is available in the section *Adding a circular conveyor work area on page 96*.
Indexed Work Area	Allows you to create an indexed work area. More details about creating an indexed work area is available in the section *Adding a indexed work area on page 98*.

RECIPE



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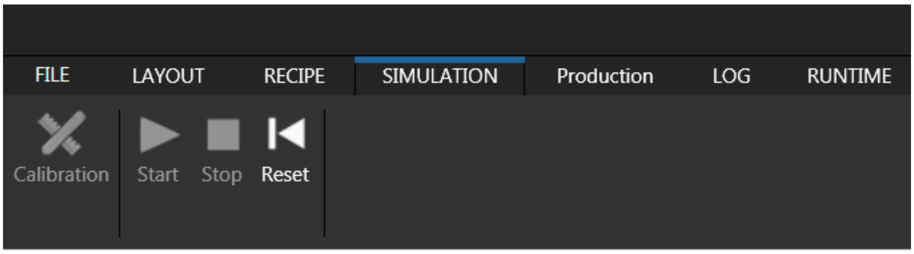
Button	Description
Items	Allows you to create items. More details about creating an item is available in the section *Adding Item on page 101*.
Container	Allows you to create containers. More details about creating an container is available in the section *Adding Container on page 105*.

Continues on next page

Button	Description
Recipe	Allows you to create a recipe. More details about creating a recipe is available in the section *Adding Recipe on page 119*.
Flow	Allows you to define how the items and containers are to be generated in the simulation. More details about creating a flow is available in the section *Adding Flow on page 135*.

SIMULATION



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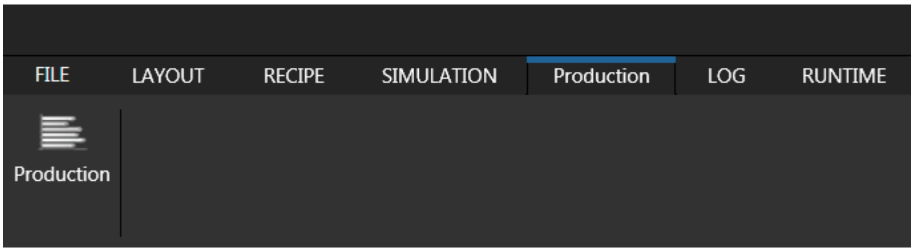
Button	Description
Calibration	Allows you to calibrate the created solution. More details about calibrating the created solution. is available in the section *Calibration on page 157*.
Start	Allows you start or pause a simulation.
Stop	Allows you stop the simulation.
Reset	Allows you reset the station view from objects temporarily created in the previously run simulation.

PRODUCTION



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Button	Description
Production	Allows you start a production. More details about how to run the production is available in the section *Simulation on page 159* and *Emulation on page 293*.

Continues on next page

LOG

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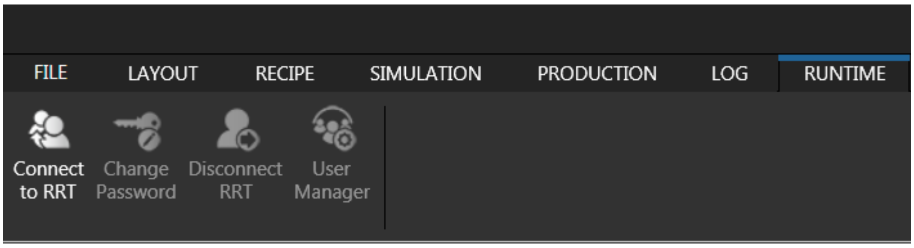
Button	Description
Viewer	Allows you to open the log viewer.
Save	Allows you to save the log as `csv` file to your local folder.

RUNTIME



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Button	Description
Connect to RRT	Allows you to connect to the real Runtime.
Change password	Allows you to change your password.
Disconnect RRT	Allows you to disconnect from the real Runtime.
User Manager	Allows you to create or delete the users, and add groups for different users.

User Manager

Introduction

PickMaster PowerPac manages different users and groups. Each user has a use group and each use group is associated with an ability. Users, groups, and abilities are all defined in `auth.conf`. This file is located in the Pickmaster Runtime installation folder under `RIS\RIS2\auth\`.

The groups "administrator", "technicist"and "operator" are provided. The administrator has the ability to “manage” and the operator has the ability to “operate”.

A default user and password have been created for each group.

Administrator Username: `admin` with Password: `password`

Technicist Username: `superuser` with Password: `ABB1998`

Continues on next page

Operator Username: `operator` with Password: `password`

Note

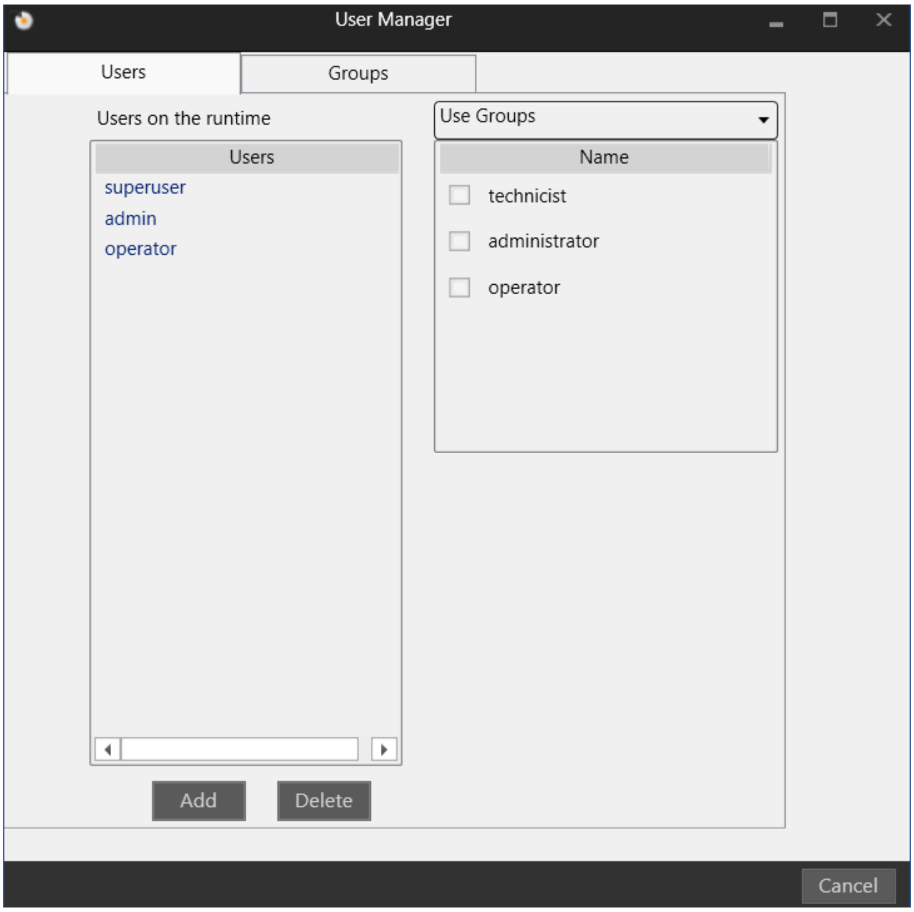
The default user `admin` cannot be deleted.

To improve the safety of the default user account, the user can change the password.

Note

The Username and Password are case sensitive.

Adding a new user to a group is done in two steps, that is, by creating a user and then assigning it to a group.



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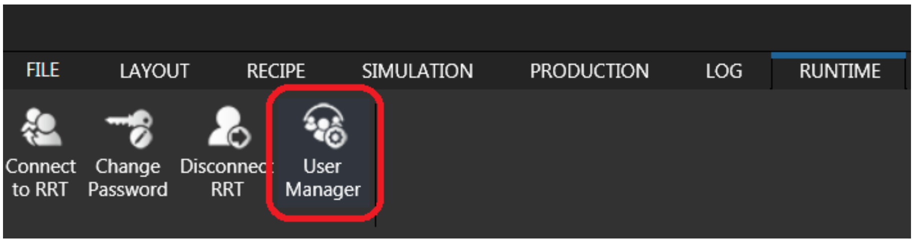
Creating a user

To create a user:

1. Click **File** and select **User Manager**.



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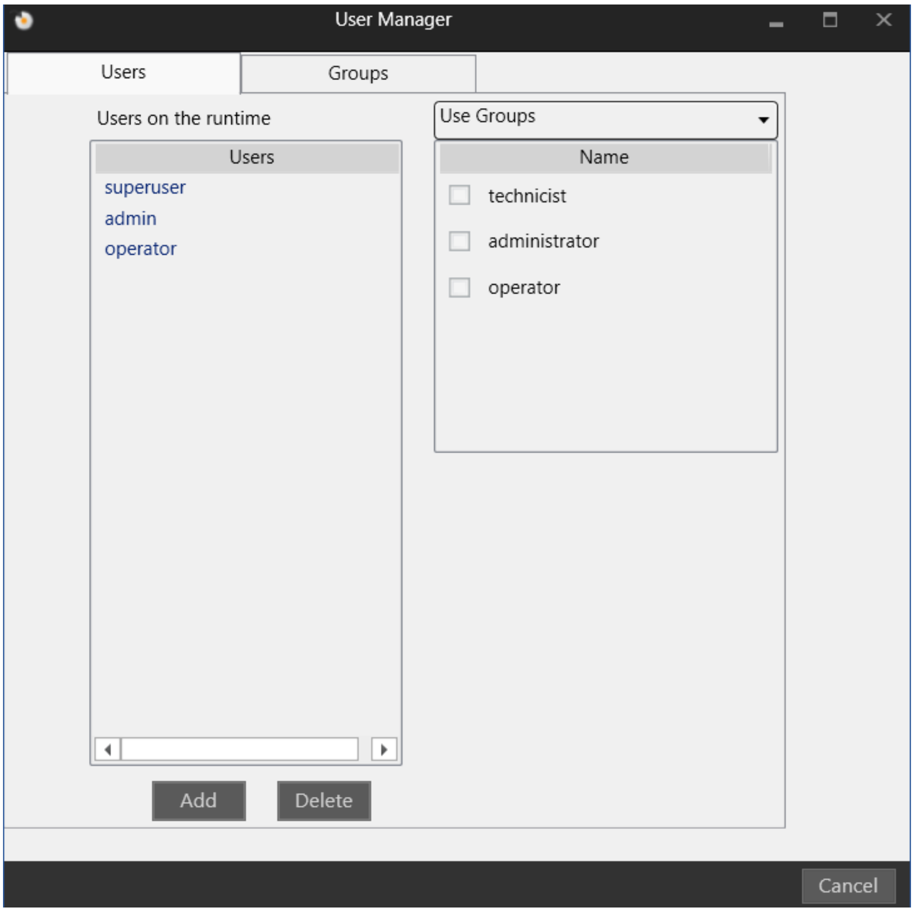
The **User Manager** window is displayed.



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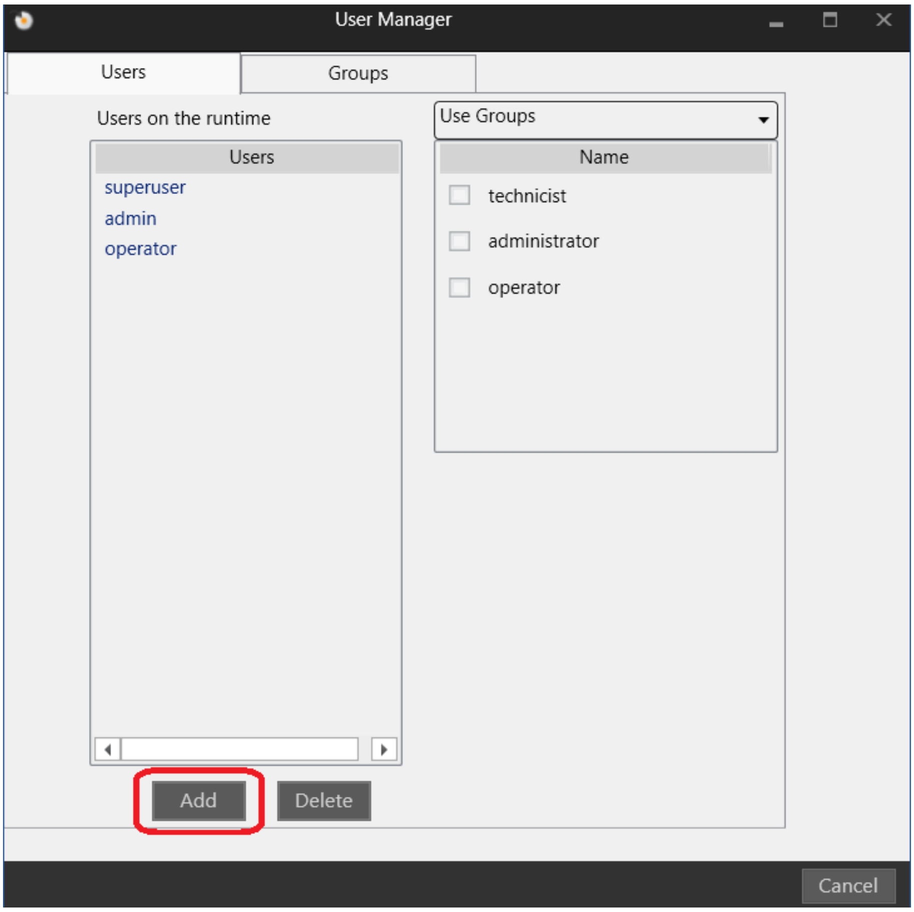
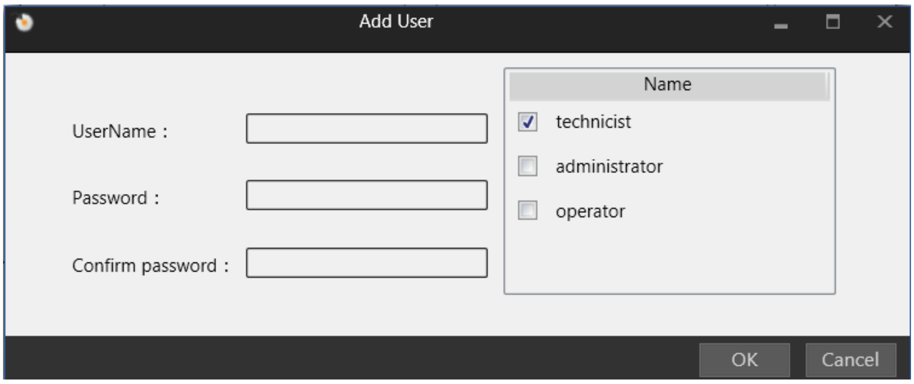
2 In the **Users** section, click **Add**.



xx1900000566

The **Add user** window is displayed.



xx1900000567

3 Type a name for the new user in the **User Name** field.

4 Type a password in the **Password** field.

5 Retype the password in the **Confirm Password** field.

6 Select the role to assign to the user in the **Role** list.

7 Click **OK**.

The user is created and added to the user list with the selected role assigned.

Continues on next page

> **Note**
>
> Restart the Runtime to activate a new added user.

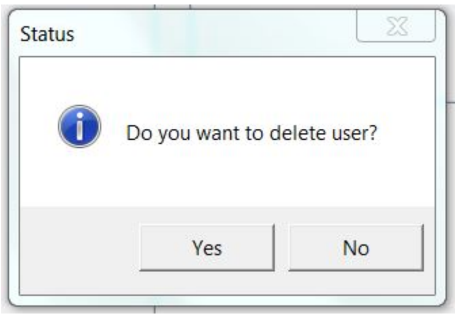
Deleting a user

To delete a user:

1. Click **File** and select **User Manager**.

   The **User Manager** window is displayed.
2. Select the user that you want to delete from the **Users** list.
3. Cick **Delete user.**

   A confirmation window to delete the selected user is displayed.

   xx1900000672
4. Click **Yes**.

   The selected user is deleted and removed from the **Users** list.

> **Note**
>
> Restart the Runtime to deactivate the deleted user.

3.4 Tree view browser

3.4.1 Cell

Overview

The tree view browser in the PickMaster PowerPac consists of a **Cell** tab.

The **Cell** tab displays the RunTime and the application hardware objects such as robots, cameras, conveyors, and recipes.

Following are the objects and configurations saved in the **Cell** tab.

xx1800001383

- RunTime
- Controllers
- Grippers
- Conveyors
- Sensors
- Items
- Containers

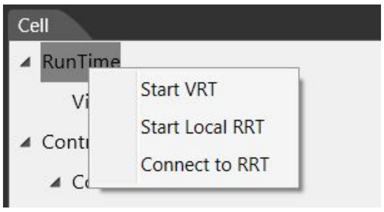
Continues on next page

- Recipes

RunTime

Right-click on **RunTime** and switch between the **RunTime** and **Virtual RunTime.**

Click **Start Local RRT** to start the **RunTime** on the computer. Select **Connect to RRT**, the **Sign in** window is displayed. The following figure and table provide more details about the window.



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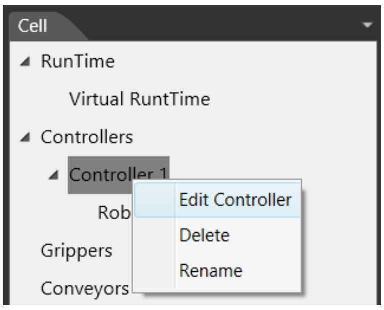
	Description
IP Address	Allows you to locate the IP address of the Runtime computer.
Runtime Account	
UserName	Allows you to enter the user name of your account in the Runtime.
Password	Allows you to enter the password of your account in the Runtime.
Enter your PC admin user name and password	
UserName	Allows you to enter the user name of the administrator account for the computer which the Runtime is installed.
Password	Allows you to enter the password of the administrator account for the computer which the Runtime is installed.

Continues on next page

Controller

Managing controller

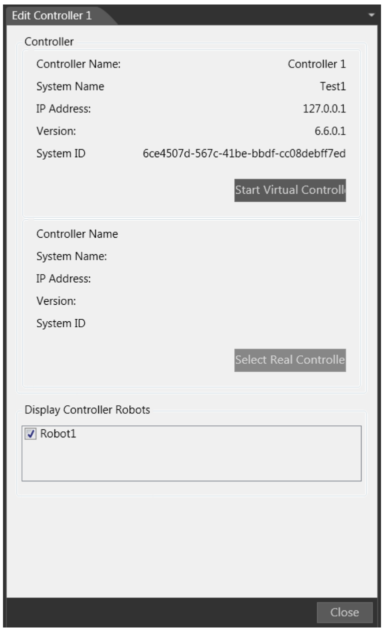
Right-click on a **Controller** icon. The following window is displayed.



xx1800001389

	Description
Edit controller	Allows you to change the settings for the selected controller. When you right-click on a controller and select **Edit controller**, the **Edit controller** window is displayed. See the following section for more details about managing a selected controller.
Delete	Allows you to delete the selected controller.
Rename	Allows you to change the name of the selected controller.

The following figure and table provides details about the **Edit controller** window.



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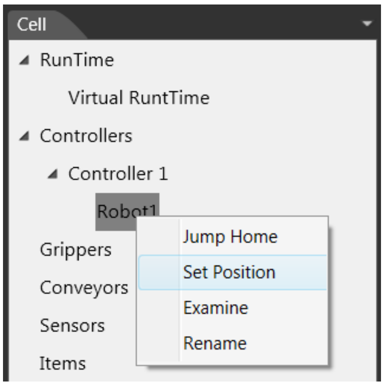
	Description
Controller Name	Displays the name of the selected controller.
System Name	Displays the name of the system.
IP Address	Displays the IP address of the selected controller.
Version	Displays the version of the system.

Continues on next page

	Description
System ID	Displays the ID of the system.
Start Virtual controller	The **Start Virtual controller** icon allows you to start the selected virtual controller.
Select Real controller	The **Select Real controller** icon allows you to select a real controller when running production.

Managing robot

Right-click on a **Robot** icon. The following window is displayed

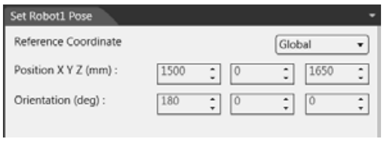


xx1800001391

	Description
Jump Home	Allows you to move the robot to the home position.
Set Position	Allows you a set a position for the selected robot. When you right-click on a robot and select **Set Position**, the **Set Robot Pose** window is displayed. See the following section for more details about managing the position of a selected robot.
Examine	Allows you to examine the robot in the Station view.
Rename	Allows you to change the name of the selected robot.

Set pose

The following figure and table provides details about the **Set Pose** configuration window.



xx1800001392

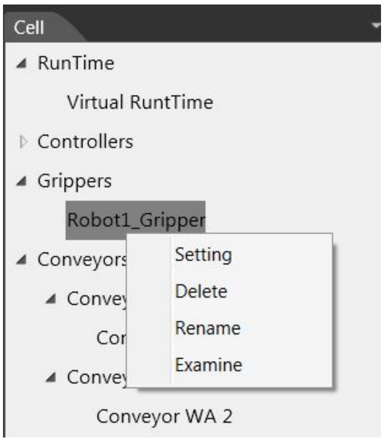
	Description
Reference	Allows you to select a coordinate system.
Position X,Y,Z (mm)	Allows you to set a new position for the selected robot.
Orientation (deg)	Allows you to set a new orientation for the selected robot.

Continues on next page

Grippers

Managing grippers

Right-click on a **Gripper** icon. The following window is displayed.



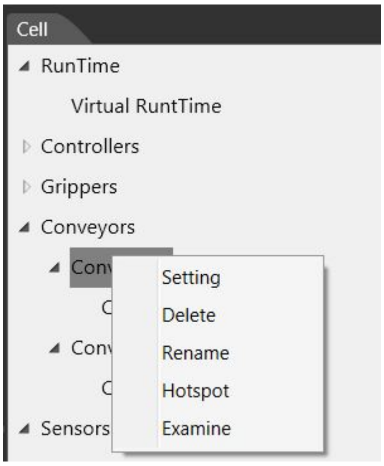
xx1800001393

	Description
Settings	Allows you to manage the settings of the selected gripper. When you select **Setting**, the **Robot_Gripper Setting** window is displayed. More details about managing a selected gripper is available in the section *Adding Gripper on page 81*.
Delete	Allows you to delete the selected gripper.
Rename	Allows you to change the name of the selected gripper.
Examine	Allows you to examine the selected gripper in the Station view.

Conveyor

Managing conveyor

Right-click on a **Conveyor** icon. The following window is displayed.

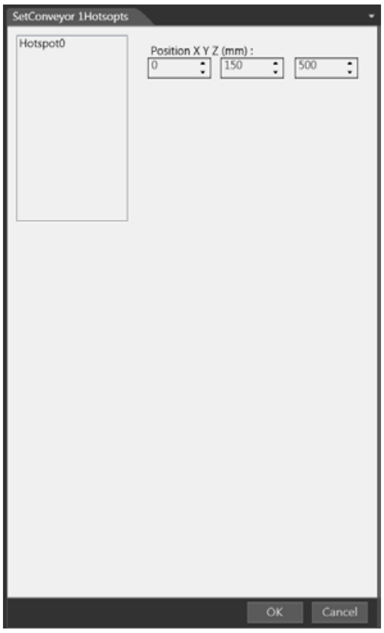


xx1800001394

Continues on next page

	Description
Setting	Allows you to manage the settings of the selected conveyor. When you select **Setting**, the **Conveyor Setting** window is displayed. More details about managing a selected conveyor is available in the section *Adding Conveyor on page 85*.
Delete	Allows you to delete the selected conveyor.
Rename	Allows you to change the name of the selected conveyor.
Hotspot	Allows you to manage the hotspots. When you select **Hotspot**, the **Set Conveyor hotspots** window is displayed. See the following section for more details about the **Set Conveyor hotspots** window. **Note** The hotspot is a saved location on the conveyor. A hotspot is used to define where on the conveyor the flow shall be generated. There is always a default hotspot, Hotspot0, located at the beginning of the conveyor. If the flow appears at a wrong location, modify the hotspot location to adjust it.
Examine	Allows you to examine the selected conveyor in the Station view.

The following figure and table provides details about the **Set Conveyor hotspots** window.



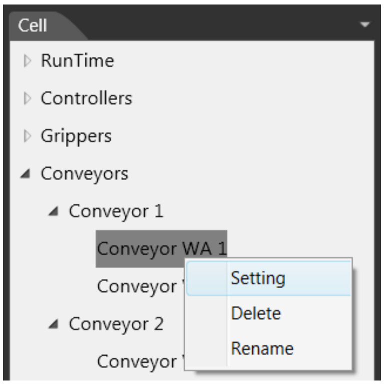
xx1800001395

	Description
Hotspots list	Displays the available hotspots.
Position X Y Z	Allows you define the position of the hotspot.

Continues on next page

Manage work area

Right-click on a **Conveyor WA** icon. The following window is displayed.



xx1800001396

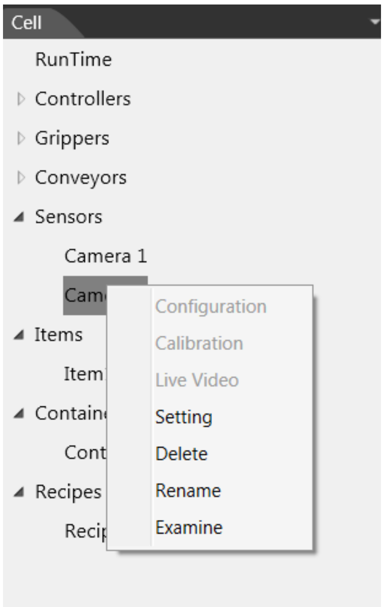
	Description
Setting	Allows you to manage the settings of the selected work area. When you right-click on a conveyor work area and select **Setting**, the **Conveyor WA Setting** window is displayed. More details about managing a conveyor work area is available in the section *Adding work area on page 93*. When you right-click on a circular conveyor work area and select **Settings**, the **Circular Conveyor WA Setting** window is displayed. More details about managing an indexed work area is available in the section *Adding a indexed work area on page 98*. When you right-click on an indexed work area and select **Settings**, the **Indexed WA Setting** window is displayed. More details about managing an indexed work area is available in the section *Adding a indexed work area on page 98*.
Delete	Allows you to delete the selected conveyor work area.
Rename	Allows you to change the name of the selected conveyor work area.

Continues on next page

Sensors

Managing camera

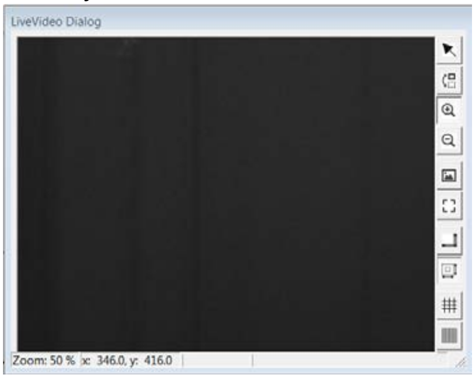
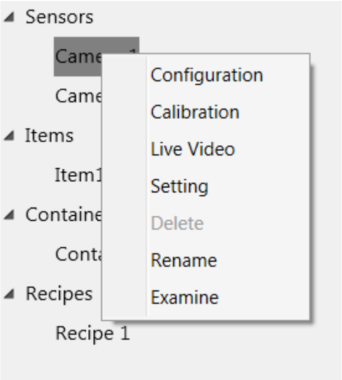
Right-click on a **Camera** icon. The following window is displayed.



xx1800001397

	Description
Configuration	Allows you to configure the selected camera. When you right-click on a camera and select **Configuration**, the **Camera Configuration** window is displayed. More details about managing a camera is available in the section *Configuring camera on page 181*.
Calibration	Allows you to calibrate the selected camera. When you right-click on a camera and select **Calibration**, the **Camera Calibration** window is displayed. More details about managing a camera is available in the section *Calibrating camera on page 243*.

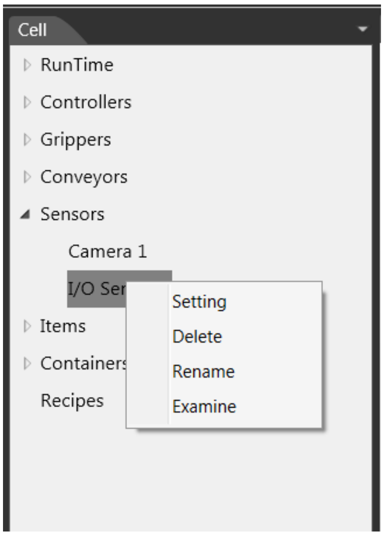
Continues on next page

	Description
Live Video	Allows you to have a view of the scene of the real camera.  xx1900000562 When you started the live video, you can stop it by click the **Stop Video** after right click on the sensor.  xx1900000684
Setting	Allows you to manage the settings of the selected camera. When you right-click on a camera and select **Setting**, the **Camera Setting** window is displayed. More details about managing a camera is available in the section *Adding Sensor on page 88*.
Delete	Allows you to delete the selected camera.
Rename	Allows you to change the name of the selected camera.
Examine	Allows you to examine the selected camera in the Station view.

Continues on next page

Managing I/O sensor

Right-click on an **I/O Sensor** icon. The following window is displayed.



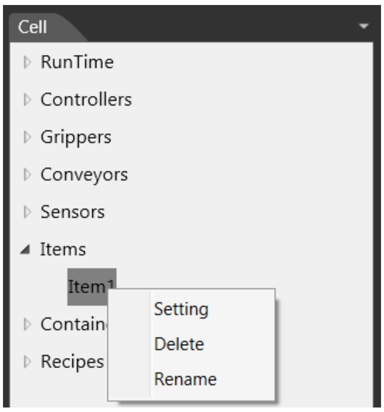
xx1800001398

	Description
Setting	Allows you to manage the settings of the selected I/O senor. When you right-click on an I/O sensor and select **Setting**, the **I/O Sensor Setting** window is displayed. More details about managing an I/O sensor is available in the section *Adding an I/O sensor on page 90*.
Delete	Allows you to delete the selected I/O sensor.
Rename	Allows you to change the name of the selected I/O sensor.
Examine	Allows you to examine the selected I/O sensor in the Station view.

Items

Managing item

Right-click on an **item** icon. The following window is displayed.



xx1800001399

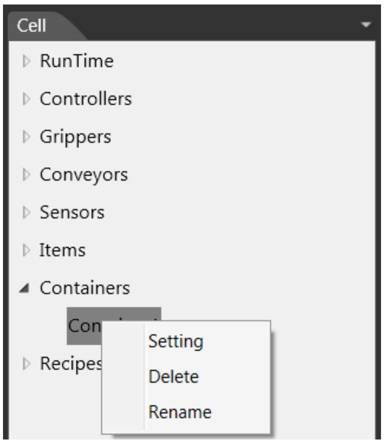
Continues on next page

	Description
Setting	Allows you to manage the settings of the selected item. When you select **Setting**, the **Item Setting** window is displayed. More details about managing a selected conveyor is available in the section *Adding Item on page 101*.
Delete	Allows you to delete the selected item.
Rename	Allows you to change the name of the selected item.

Containers

Managing container

Right-click on a **Container** icon. The following window is displayed.



xx1800001400

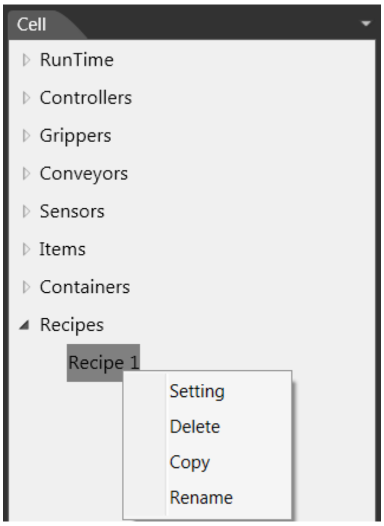
	Description
Setting	Allows you to manage the settings of the selected conveyor. When you select **Setting**, the **Container Setting** window is displayed. More details about managing a selected container is available in the section *Adding Container on page 105*.
Delete	Allows you to delete the selected container.
Rename	Allows you to change the name of the selected container.

Continues on next page

Recipes

Managing recipe

Right-click on a **Recipe** icon. The following window is displayed.



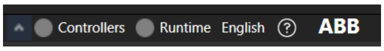
xx1800001409

	Description
Setting	Allows you to manage the settings of the selected recipe. When you select **Setting**, the **Recipe Setting** window is displayed. More details about managing a selected recipe is available in the section *Adding Recipe on page 119*.
Delete	Allows you to delete the selected recipe.
Copy	Allows you to copy the selected recipe.
Rename	Allows you to change the name of the selected recipe.

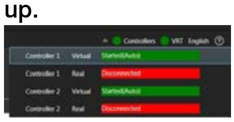
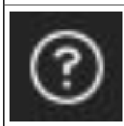
3.5 Status view

Status

When the system starts, the status of the controller and the Runtime will show up on the right top corner as the illustration.



xx1800001410

	Description	Note
Controllers	**Red**: There is at least one controller stopped. **Green**: All controllers are started and auto-running. **Yellow**: There is at least one controller started and under manual controlling or just connected. **Grey**: No controller is added in the existing solution. **Note** The **Red** has the highest priority.	 xx1800001745
Controller	**Red**: Controller is stopped **Green**: Controller is started and auto-running. **Yellow**: Controller is started and under manual controlling or just connected.	Click on the **Controllers** button , the detailed status for each controller will show up.  xx1800001746
Runtime	**Grey**: No solution is opened.	
VRT	**Red**: The connection to the virtual Runtime fails. **Green**: The connection to the virtual Runtime successes. **Yellow**: The connection to the virtual Runtime is progressing.	
RRT	**Red**: The connection to the real Runtime fails. **Green**:The connection to the real Runtime successes. **Yellow**: The connection to the real Runtime is progressing.	
English	The using language of the system.	
 xx2000000307	Allows you to open the PickMaster PowerPac application manual.	

4 Working with PickMaster PowerPac

4.1 Overview

Overview

Working with PickMaster PowerPac in virtual Runtime is to fulfill the simulation function in a visual status.

Working with PickMaster PowerPac in real Runtime is to fulfill the emulation and production function in real stations with real robots and controllers.

Simulation is a previous debugging procedure to save cost and time when creating real stations.

The following is a recommended flow for working with PickMaster PowerPac. After you complete the workflow, you can perform these task in any order.

Note

The controller (contains at least one robot system) should be set up in RobotStudio environment before starting PickMaster PowerPac, as the PickMaster PowerPac provides only a method for creating paths but not functions for creating a virtual controller.

Note

If any firewall or antivirus software is installed, add `pickmasteru.exe`, `sshd.exe`, and `visionclient. exe` to the white list.

Otherwise the PickMaster PowerPac cannot connect Runtime and the vision function cannot work normally.

Continues on next page

Workflow for PickMaster PowerPac

Use this procedure to work with PickMaster PowerPac:

		Task	Description
VRT	1	Create an empty solution.	For detailed information, see *Creating Solution on page 71*.
	2	Add a controller.	For detailed information, see *Adding Controller on page 75*.
	3	Add a gripper.	For detailed information, see *Adding Gripper on page 81*.
	4	Add a conveyor.	For detailed information, see *Adding Conveyor on page 85*.
	5	Add a sensor.	For detailed information, see *Adding Sensor on page 88*.
	6	Add a work area.	For detailed information, see *Adding work area on page 93*.
	7	Add an items.	For detailed information, see *Adding Item on page 101*.
	8	Add a container.	For detailed information, see *Adding Container on page 105*.
	9	Add a recipe.	For detailed information, see *Adding Recipe on page 119*.
	10	Calibrate the solution.	For detailed information, see *Calibration on page 157*.
	11	Do simulation	For detailed information, see *Simulation on page 159*.
RRT	12	Switch to real **Runtime**.	For detailed information, see *Switching to real Runtime on page 171*.
	13	Configure the cameras.	For detailed information, see *Configuring camera on page 181*.
	14	Calibrate the robots.	For detailed information, see *Calibrating robot on page 185*.
	15	Calibrate the linear conveyors.	For detailed information, see *Calibrating linear conveyor on page 186*.
	16	Calibrate the circular conveyors.	For detailed information, see *Calibrating circular conveyor on page 206*.
	17	Calibrate the indexed work area.	For detailed information, see *Calibrating indexed work area on page 227*.
	18	Verify the calibrations.	For detailed information, see *Verifying conveyor calibrations on page 241*.
	19	Calibrate the cameras.	For detailed information, see *Calibrating camera on page 243*.
	20	Add a vision model.	For detailed information, see *Adding vision model on page 254*.
	21	Start the production.	For detailed information, see *Starting production on page 292*.

4.2 Setting up Solution and Recipe in virtual Runtime (VRT)

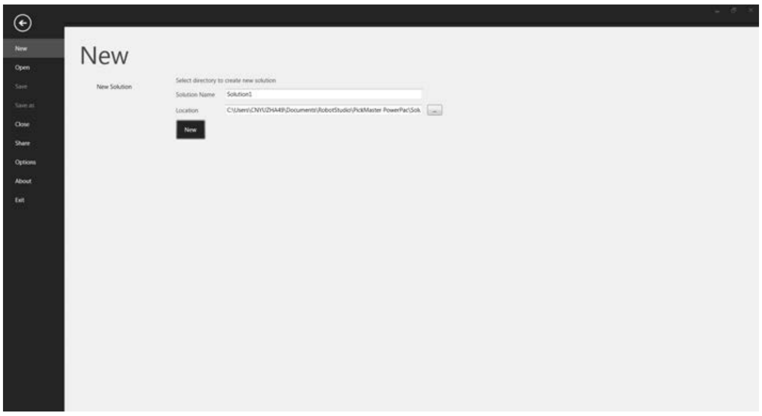
4.2.1 Creating Solution

Creating an empty solution

Use this procedure to create an empty solution:

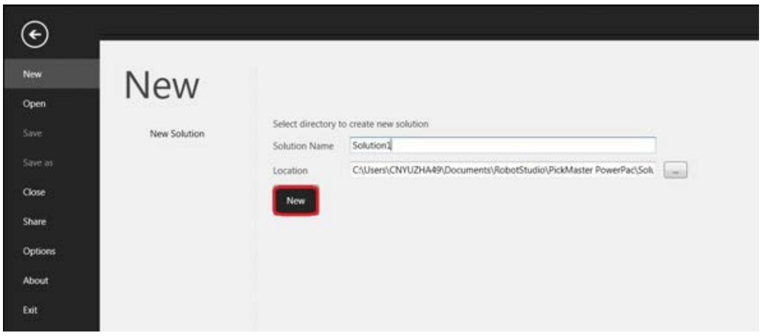
1. Run the PickMaster PowerPac as administrator.

   The PickMaster PowerPac opens.

   xx1800000839

2. Click **New**.

   xx1800000840

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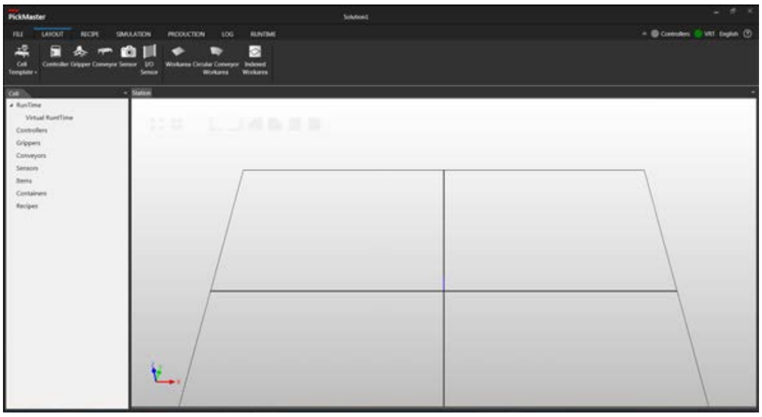
An empty solution is created.

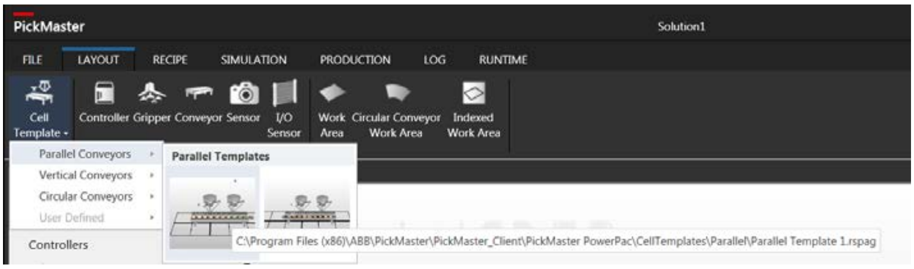


xx1800000841

Opening a solution from the Template

Open template from LAYOUT

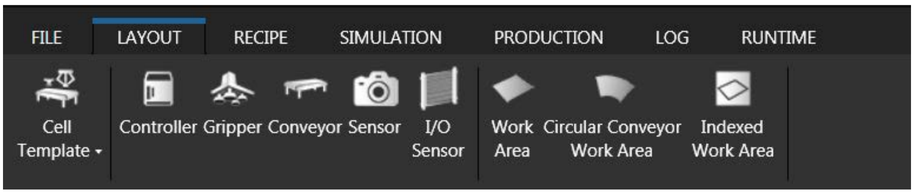
You can also open a solution from the **Cell Template** when a solution is opened.



xx1800001386

Item	Description
Parallel Conveyors	**Parallel Templates** allows you to choose one predefined parallel template.
Vertical Conveyors	**Vertical Conveyors** allows you to chose one predefined vertical template.
Circular Conveyors	**Circular Conveyors** allows you to choose one predefined circular template.
User defined	**User defined** allows you to choose one template which saved by the users in the local computer folder.

1 On the PickMaster PowerPac ribbon-tab, click **Layout**.



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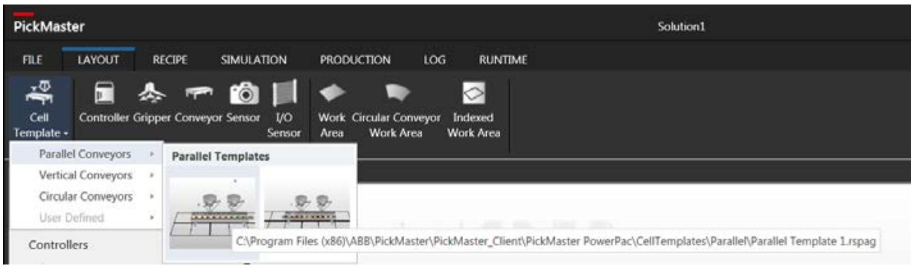
2 On the ribbon-tab, click **Cell Template**.



xx1800001386

3 Click to choose one template from the popup list according to your requirements.

The template is opening. A **Please wait** window shows up.

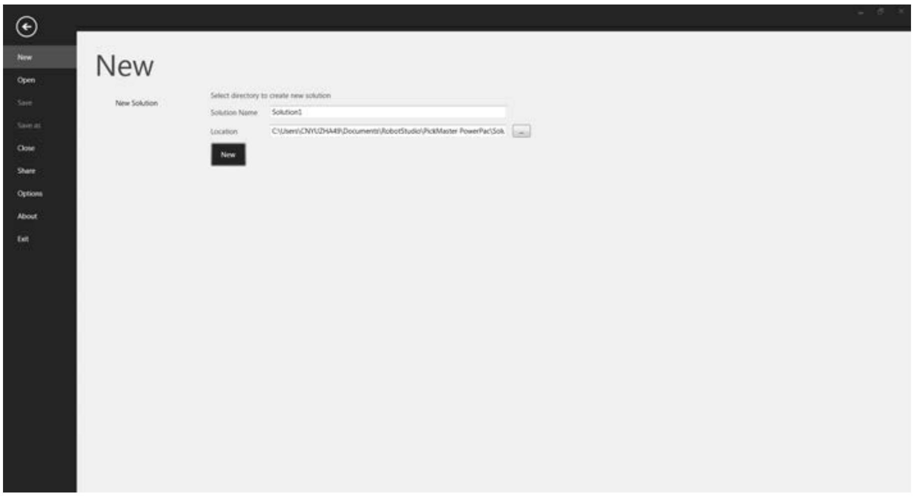
The main window for the chosen template shows up.

Opening a recent solution

If you have opened a solution before, use this procedure to open a recent solution:

1 Run the PickMaster PowerPac as administrator.

The PickMaster PowerPac opens.



xx1800000839

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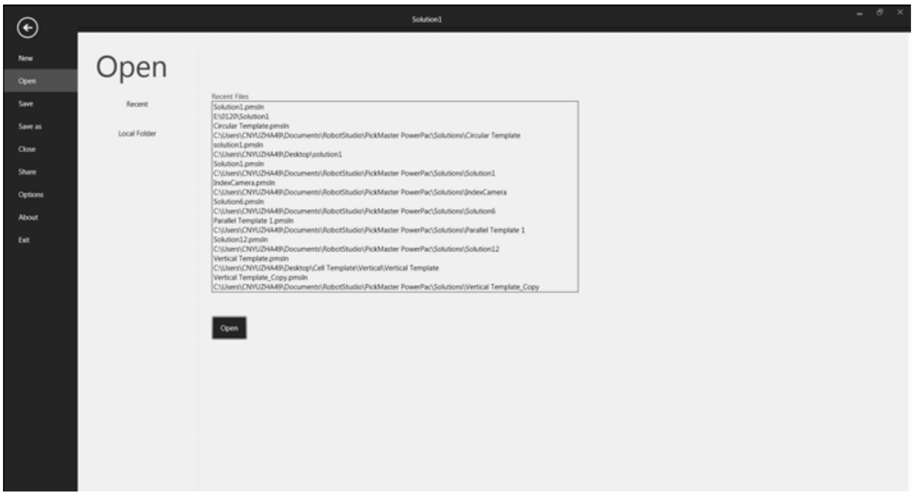
2 Click to select the **Open**.



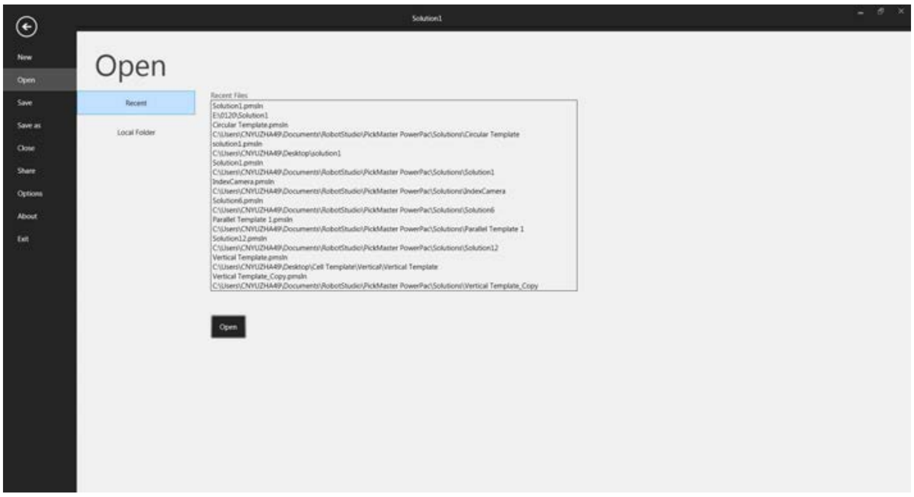
xx1800001460

3 Click to choose one recent file according to your requirements.

The chosen recent file is opening. A **Please wait** window shows up.

The main window for the chosen recent file shows up.

You can also open a recent file from the **Open** when a solution is opened.

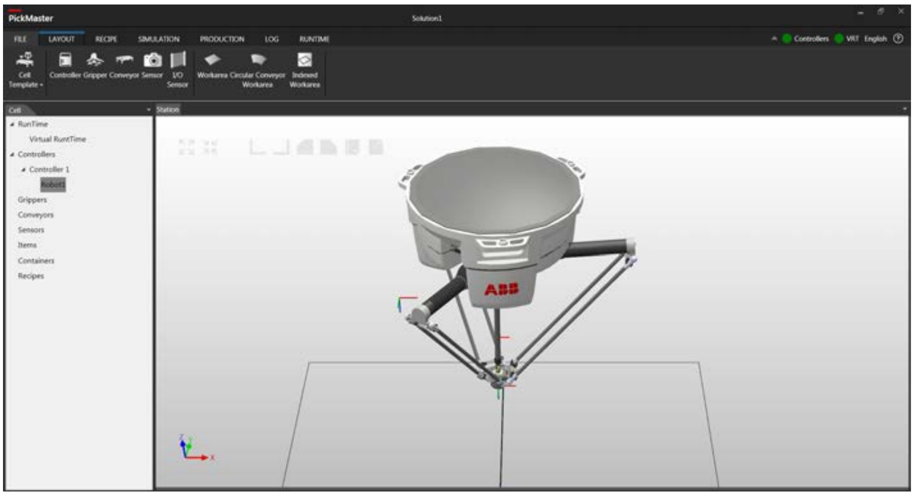


xx1800001461

4.2.2 Adding Controller

Overview

This section describes how to add and modify a controller.



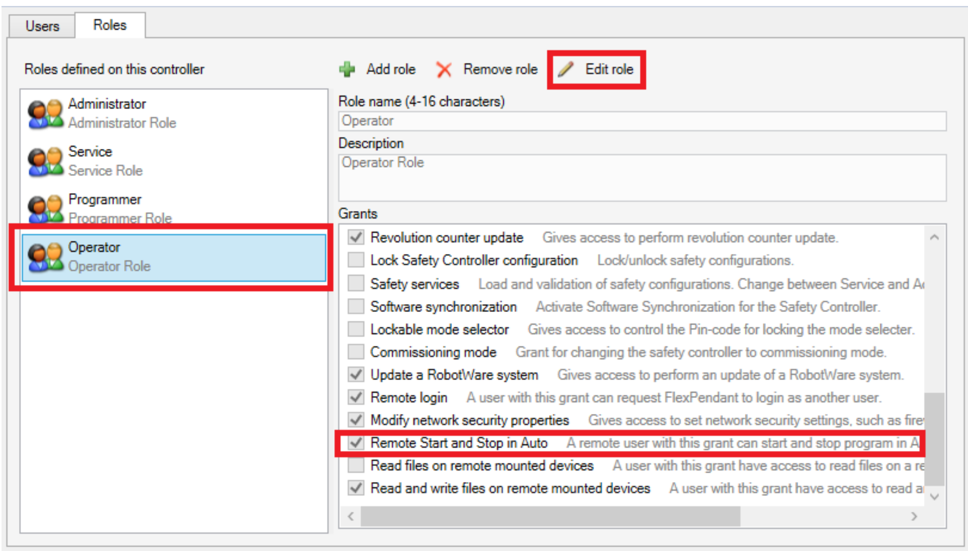
xx1900000572

Create a controller

For more information on how to create a controller, refer to *Operating manual - RobotStudio*.

WARNING

When creating an OmniCore controller, the **Remote Start and Stop in Auto** must be selected. Or the PickMaster PowerPac CANNOT run simulation or production.



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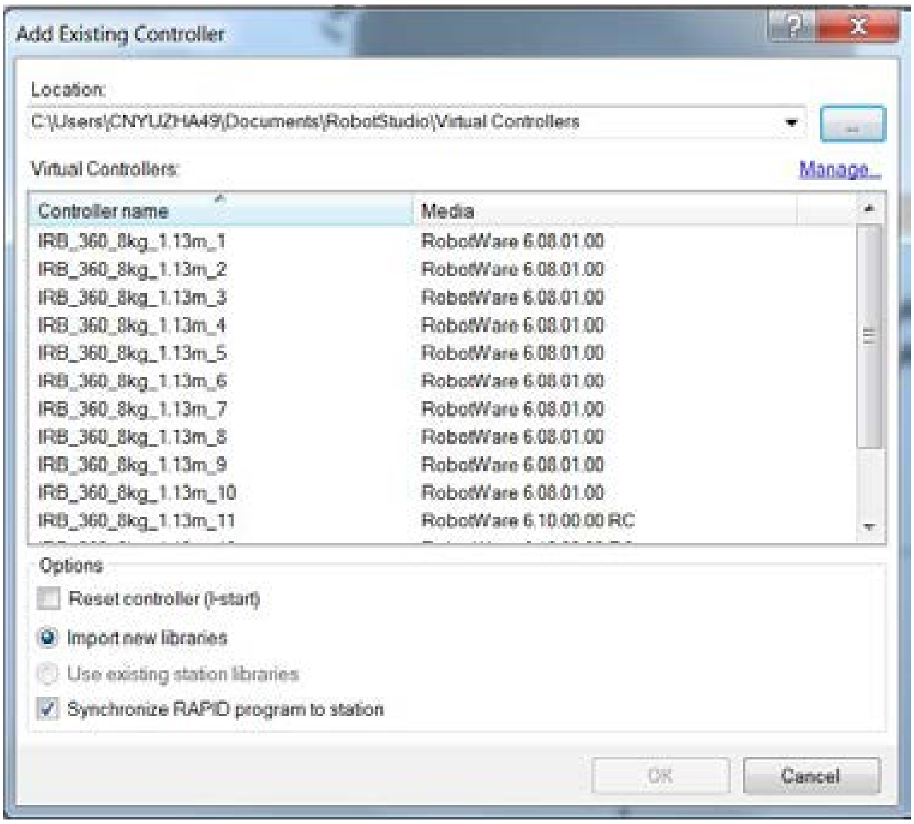
Adding a controller

The **Add Existing System** dialog box opens as illustrated below.



xx1800000846

Note

Only the **Controller** that is created before this page is opened can be found in the **System Found**.

If a new **Controller** is created, the user need to refresh the **Add Existing System** dialog box.

Item	Description
System Pool	**System Pool** specify the location and folder of your PC where the required controller systems are stored. **Add** icon allows you to choose the folder **system** from the list that you pre-defined in the RobotStudio. **Remove** icon allows you to remove the folder **system** from the list that you pre-defined in the RobotStudio
Manage System	Allows you to create or work with a robot system.
System Found	Lists the systems found in the selected **system** folder.
Reset system(I-start)	The controller will restart when this is selected.
Import new libraries	Add the predefined robot to the PickMaster PowerPac.
Use existing station librar-ies	Open an existed system from the **RobotStudio**.

Continues on next page

Item	Description
Sync RAPID program to station	Sync the application program to the solution.

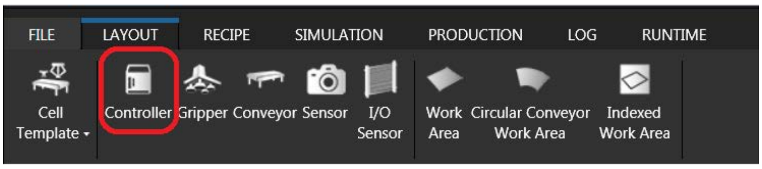
Procedure

On the PickMaster PowerPac ribbon-tab, click **Layout**.

Use this procedure to add a controller:

> **Note**
>
> You can only add the existed controller in the system to the solution. For more information about create controller, see *Create a controller on page 75*.
>
> > **Note**
> >
> > The controller must be created before this step.

1 On the ribbon-tab, click **Controller**.



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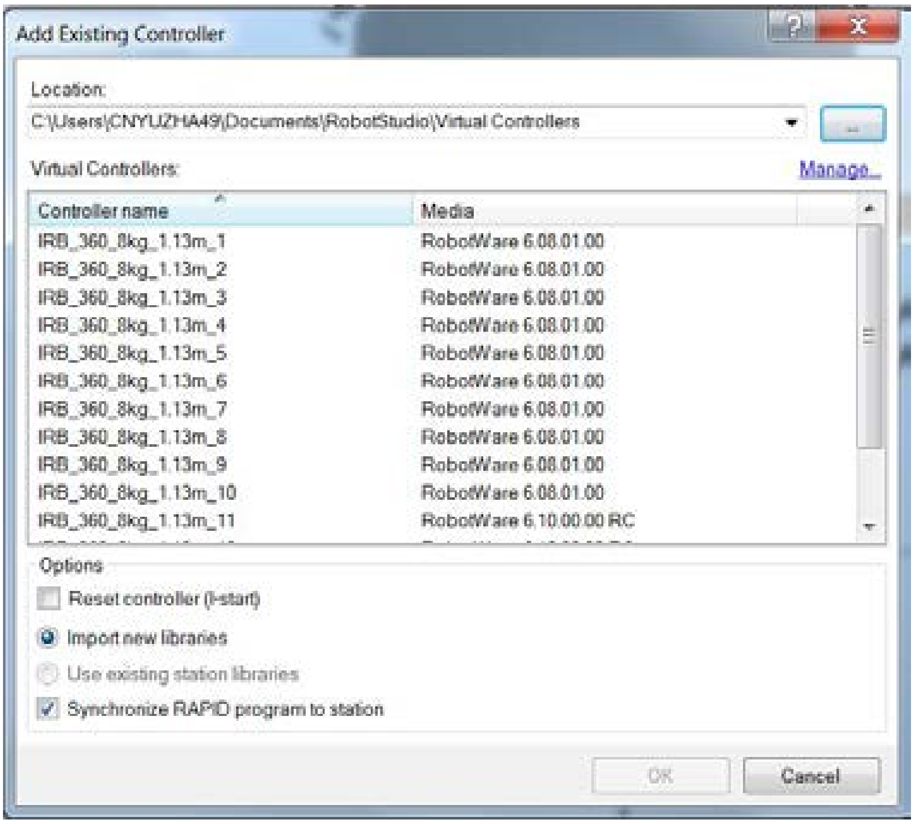
The **Add Existing System** dialog box is opened.



xx1800000846

2 To add a folder to the **System Pool** list, click **Add** and then browse and select the folder to be added. To remove a folder from the list, click **Remove.**

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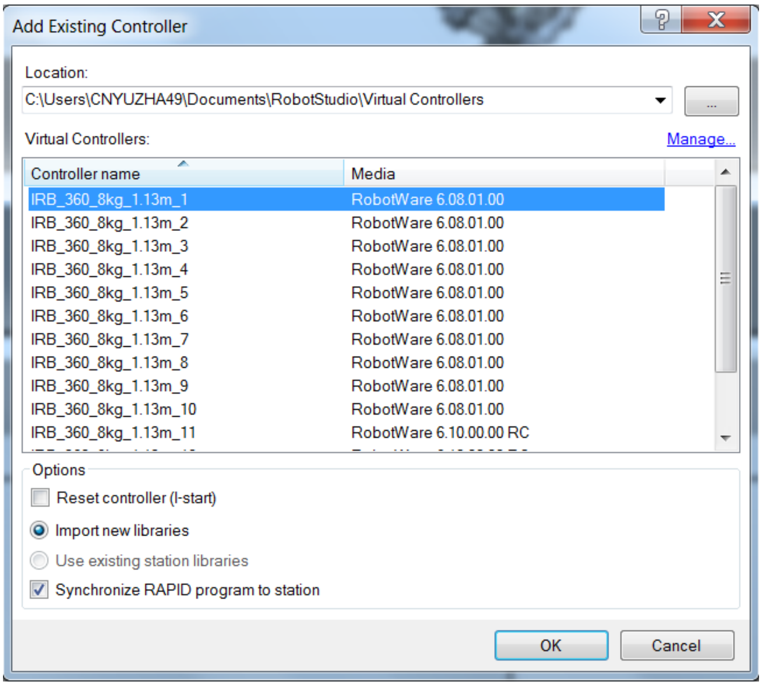
3 The *Systems Found* table lists the virtual controller systems found in the selected system folder. Click a system to select it for the new solution.



xx1800000847

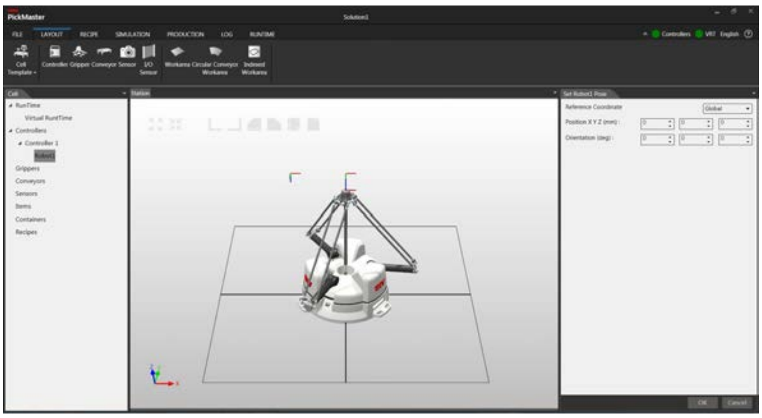
4 Select the required check boxes in **Options**.

Note

A virtual controller system that has been modified using the **Modify System** function of the System Builder must be restarted with the **Reset System** option for the changes to take effect.

5 In the dialog box, click **OK** to add the selected controller to the solution.

The selected controller is added into the solution. The new added controller shows up in the **Cell** window **Controller** list.



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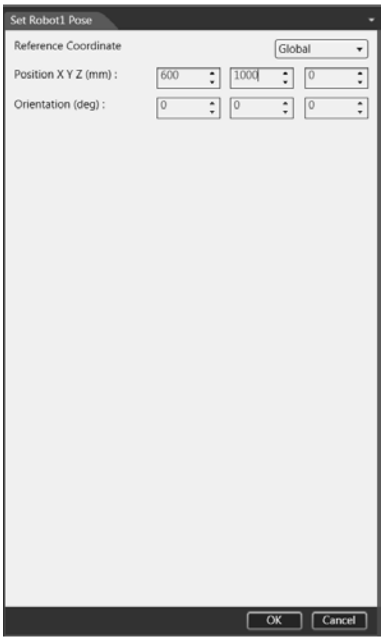
6 In the **Set Robot1 Pose** window, enter numbers in the **Position X Y Z (mm)** text box and **Orientation (deg)** text box according to your requirements.



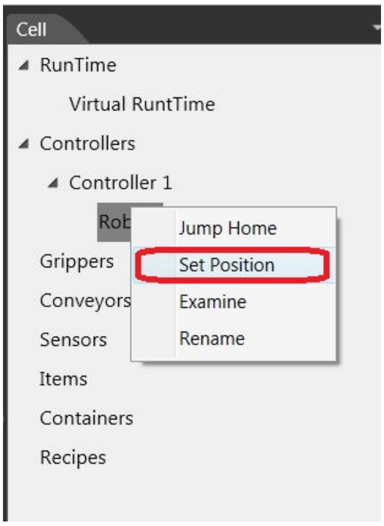
xx1800000849

7 Click **OK**.

Note

The pose can be adjusted when the other parts are added.

Right click on the **Robot1** in the **Cell** window **Controller** list.

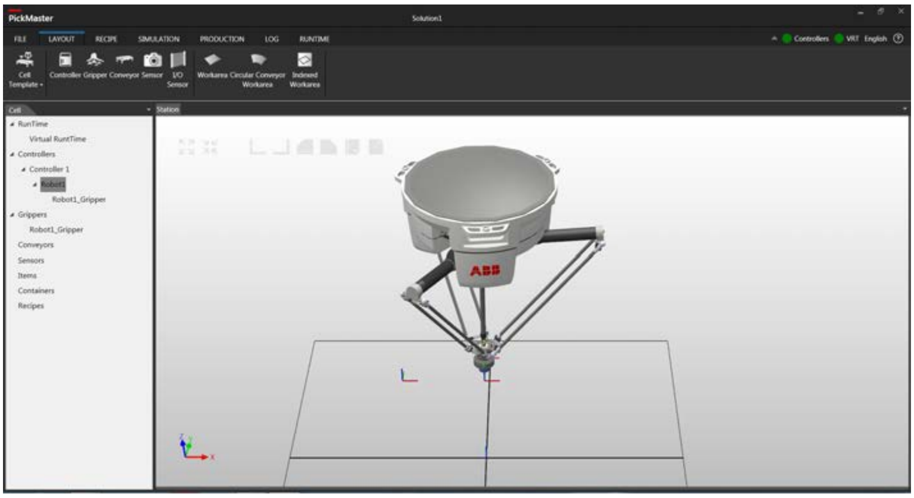


xx1800000850

4.2.3 Adding Gripper

Overview

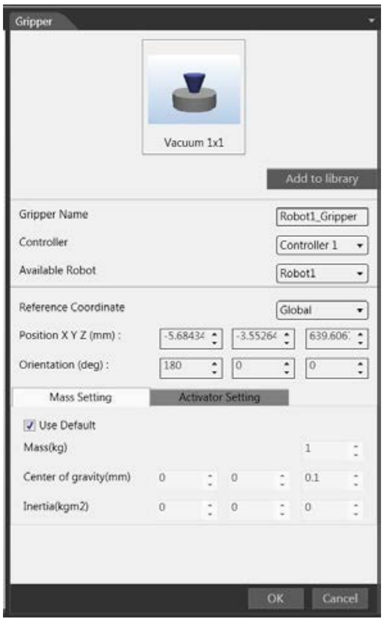
This section describes how to add a gripper.



xx1900000573

Adding a gripper

The **Gripper** window opens as illustrated below.



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4.2.3 Adding Gripper
Continued

Item	Description
Add to library	Allows you to import a pre-defined gripper from the library or upload an user defined gripper to the library. **Note** To upload an user defined gripper, click **Add to library**, browse to the local folder and select the `*.rslib` file, the gripper will be added to the library automatically.
Gripper Name	Type a name for the tool in the Name field.
Controller	Select a controller from the Controller list.
Available Robot	Select a robot from the Robot list.
Reference Coordinate	Allows you to select the reference coordinate for the gripper.
Position XYZ(mm)	Allows you to set the position of the gripper.
Orientation XYZ(deg)	Allows you to set the orientation of the gripper.
Mass Setting	For more details, see following section.
Activator Setting	For more details, see following section.

Mass Setting	Description
Use Default	Use default setting for the mass setting.
Mass	Type the mass of the tool in the Mass (kg) field.
Center of gravity	Type the coordinates of the center of gravity.
Inertia	Type the values of the inertia in Inertia (kgm^2).

xx1900001416

Continues on next page

Activator Setting	Description
Activator Using	Allows you to select the activator to be used.
Add icon	Allows you to add a new activator. **Note** When you need to do multiple pick, you should add enough activators for each pick. For example, if you need to pick four items and then place them, you need to add another three activators besides the default one. To do multiple pick, the Multiple-Pick rapid file in the installation package should be imported to the recipe for the required robots.
Delete icon	Allows you to delete a selected activator.
Rapid tooldata	Select a RAPID tooldata from **Tool data**. The selected tooldata shall be used by the RAPID program when picking with this activator. **Note** The RAPID program needs to be updated if more than one activator is used. For more details see, *Example: Double pick single place on page 417*.
TCP Position	Type the coordinates of the tool center point. The tool center point defines the location on the tool where an item is attached. **Note** The coordinates are applied to the selected tooldata during the simulation.
TCP Orientation	Type the orientation of the tool center point. The TCP orientation defines the desired orientation of the tool while picking up an item. The orientation shall be specified as Euler XYZ angles (degrees). **Note** The orientation is applied to the selected tooldata during the simulation.
Signal	Allows you to choose the setting of the signal.
Default Settings	Use default setting for the the signal.
Customized Settings	Allows you to change the setting of the signal.

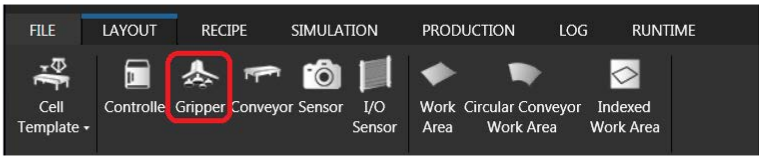
Procedure

Use this procedure to add grippers:

Continues on next page

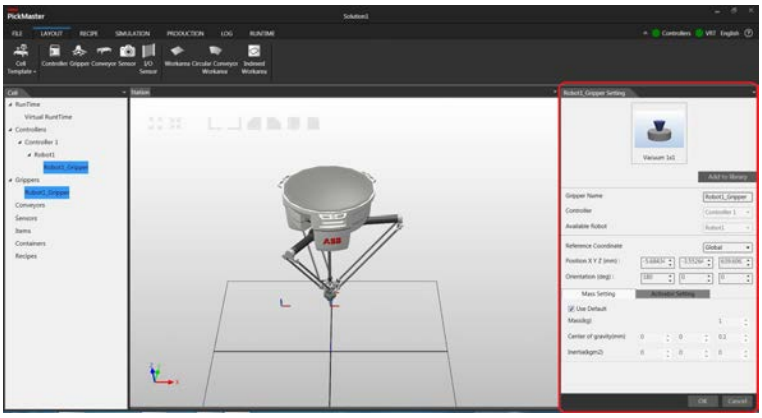
On the PickMaster PowerPac ribbon-tab, click **Layout**.

1 On the ribbon-tab, click **Gripper**.



xx1800000852

The **Gripper** window opens.



xx1800000853

2 In the **Gripper** window, enter a name in the **Gripper Name** text box or use the default one.

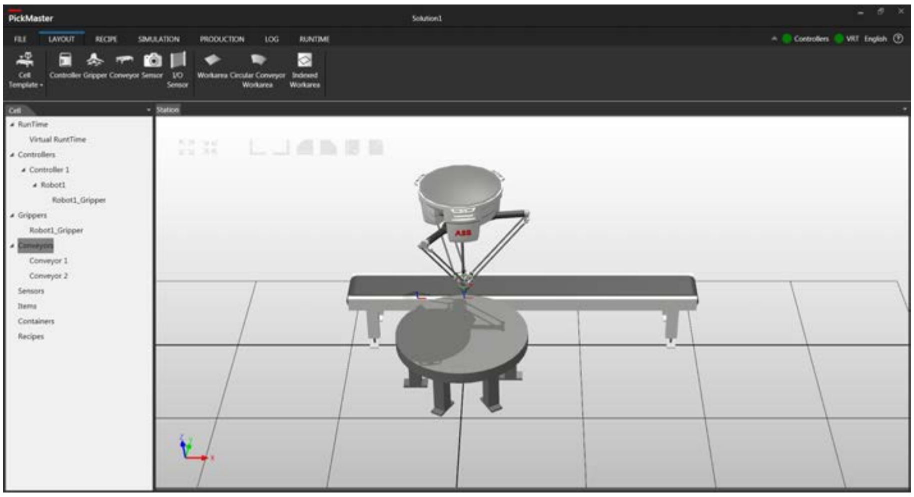
3 In the **Gripper** window, use default for the **Mass Setting** and **Activator Setting**.

4 Click **OK**.

4.2.4 Adding Conveyor

Overview

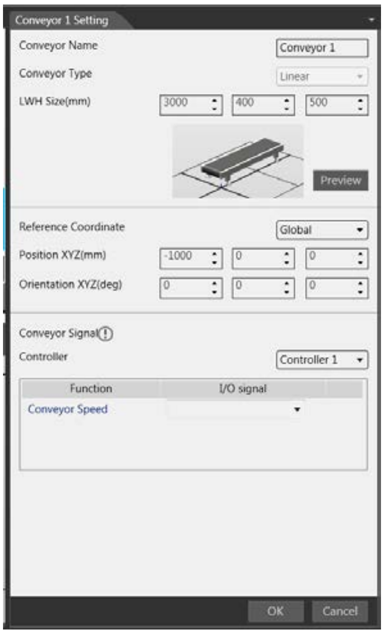
This section describes how to add a conveyor.



xx1900000576

Adding a conveyor

The **Conveyor** window opens as illustrated below.



xx1800000857

Item	Description
Conveyor Name	The name of the new conveyor. Make sure the name is unique in the current task.
Conveyor Type	Allows you to select the a liner conveyor or a circular conveyor.
LWH Size(mm)	Allows you to define the size of the conveyor.

Continues on next page

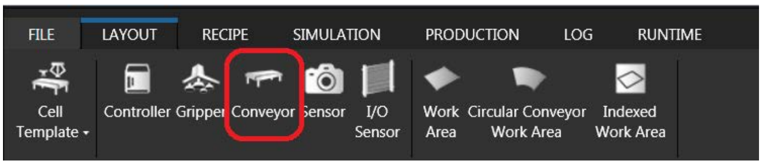
Item	Description
Preview icon	Click to preview the new conveyor.
Reference Coordinate	Allows you to select the reference coordinate for the conveyor.
Position XYZ(mm)	Allows you to set the position of the conveyor.
Orientation XYZ(deg)	Allows you to set the orientation of the conveyor.
Conveyor Signal	Allows you to choose the setting of the signal.
Controller	Allows you to choose the controller to be used.

Procedure

On the PickMaster PowerPac ribbon-tab, click **Layout**.

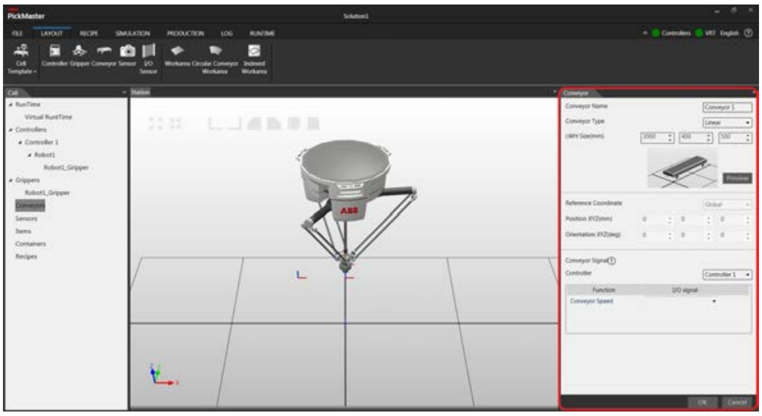
Use this procedure to add conveyors:

1 On the ribbon-tab, click **Conveyor**.



xx1800000855

The **Conveyor** window opens.



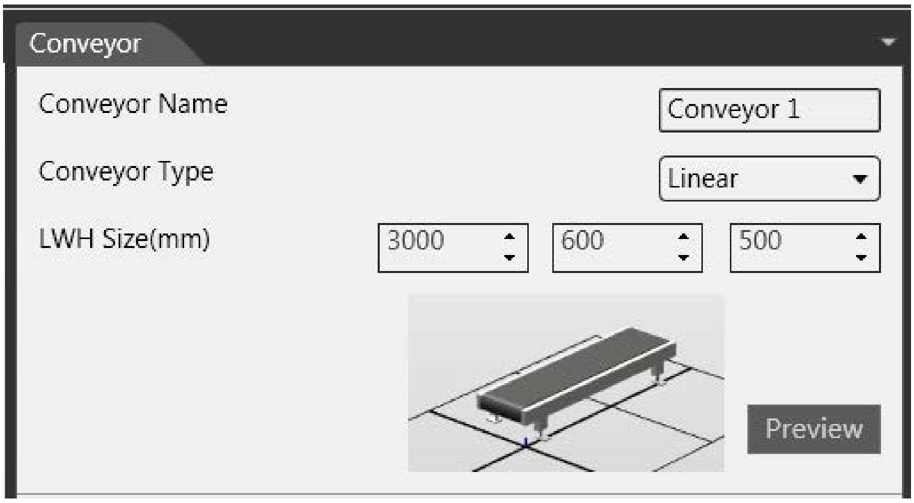
xx1800000856

2 In the **Conveyor** window, enter a name in the **Conveyor Name** text box or use the default one.

3 In the **Conveyor** window, select a type as liner or circular in the **Conveyor Type** drop-down list.

Continues on next page

4 If you select a liner conveyor, in the **Conveyor** window, enter numbers in the **LWH Size(mm)** text box to define the size of the conveyor according to your requirements.



xx1900000574

5 If you select a circular conveyor, in the **Conveyor** window, enter numbers in the **RH Size(mm)** text box to define the size of the conveyor according to your requirements.

xx1900000575

6 Click **Preview**, the conveyor preview appears in the station view. The conveyor position setting text box is activated.

7 In the **Conveyor** window, enter numbers in the **Position X Y Z (mm)** text box and **Orientation (deg)** text boxes to define the location of the conveyor according to your requirements.

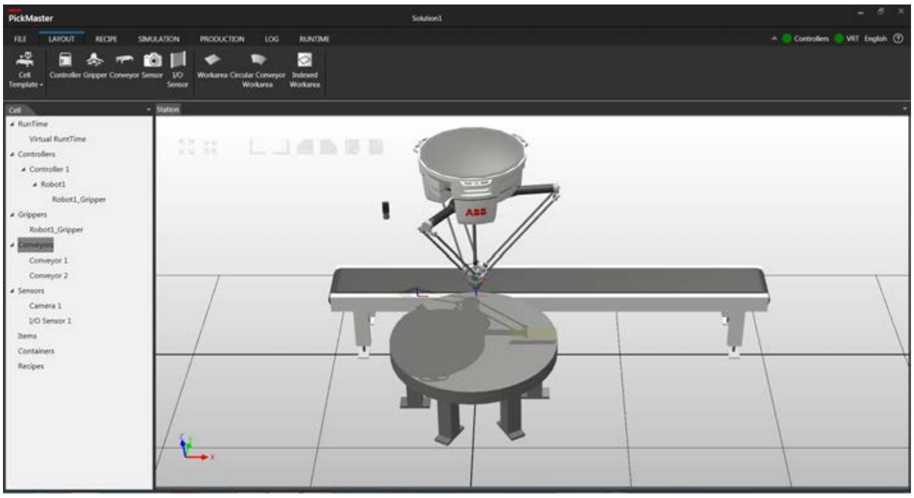
8 In the **Conveyor** window, use default for the **Conveyor Signal** and **Controller**.

9 Click **OK**.

4.2.5 Adding Sensor

Overview

This section describes how to add a sensor.

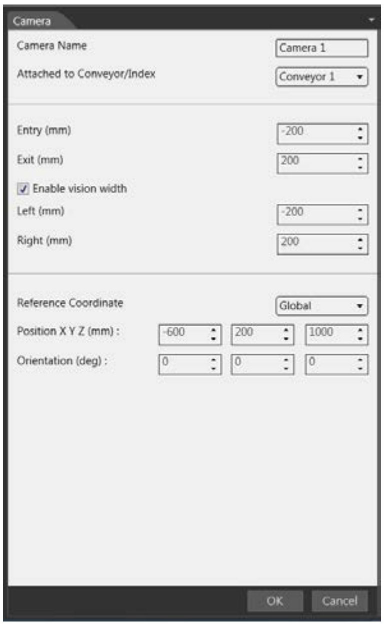


xx1900000577

Figure 4.1:

Adding a sensor

The **Camera** window opens as illustrated below.



xx1800001413

Item	Description
Camera Name	The name of the new camera. Make sure the name is unique in the current task.

Continues on next page

Item	Description
Attached to Conveyor/Index	Allows you to choose the conveyor if the sensor shall be attached to a conveyor.
Entry (mm)	Type an entry limit for the visible area below the camera along a conveyor. A negative value is used if the visible area starts upstreams from the camera location.
Exit (mm)	Type an exit limit for the visible area below the camera along a conveyor. A positive value is used if the visible area ends downstreams from the camera location.
Enable vision width	Select this to enable a width limitation of the visible area.
Left (mm)	Type a limit value for the left side of the visible area. A negative value is used if the visible area ends on the left side of the camera location (from an upstream viewpoint).
Right (mm)	Type a limit value for the right side of the visible area. A positive value is used if the visible area ends on the right side of the camera location (from an upstream viewpoint).
Reference Coordinate	Allows you to select the reference coordinate for the camera.
Position XYZ(mm)	Allows you to set the position of the camera.
Orientation XYZ(deg)	Allows you to set the orientation of the camera.

Note

The visible area is not limited if the camera is used with an indexed work area .

Note

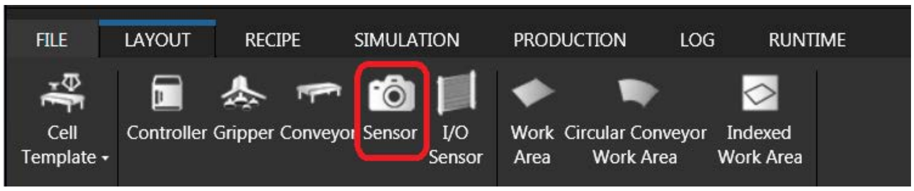
The camera will not detect any objects created or placed on the other conveyors or indexed work areas.

Procedure

On the PickMaster PowerPac ribbon-tab, click **Layout**.

Use this procedure to add conveyors:

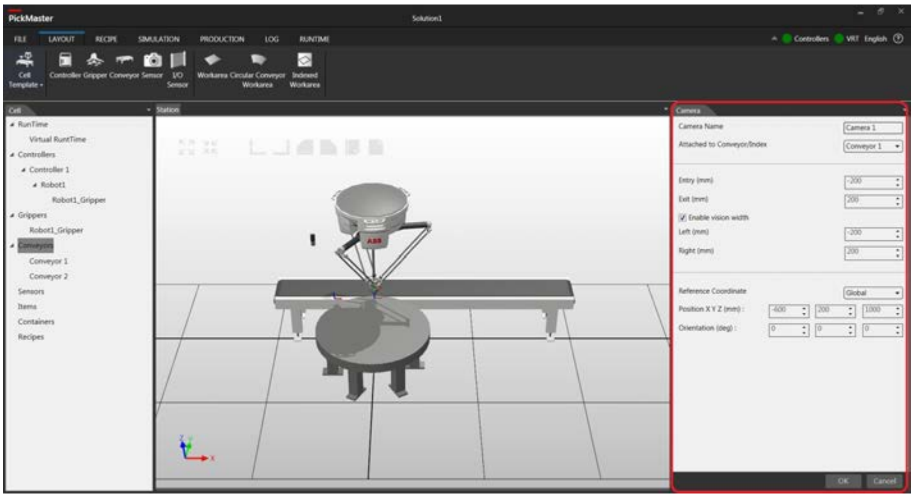
1 On the ribbon-tab, click **Sensor**.



xx1800001411

Continues on next page

The **Camera** window opens.

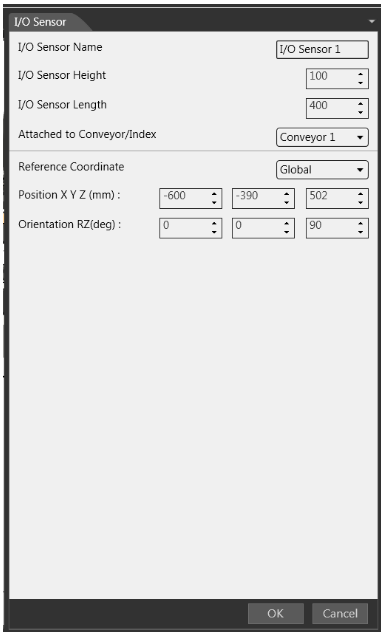


xx1800001412

2. In the **Camera** window, enter a name in the **Camera Name** text box or use the default one.
3. In the **Camera** window, choose a conveyor in the **Attached to Conveyor/Index** box to define which conveyor the new camera is attached to according to your requirements.
4. In the **Camera** window, use default for the other settings.
5. Click **OK**.

Adding an I/O sensor

The **I/O sensor** window opens as illustrated below.



xx1800001416

Continues on next page

Item	Description
I/O sensor Name	The name of the new I/O sensor. Make sure the name is unique in the current task.
I/O sensor Height	The height of the new I/O sensor.
I/O sensor Length	The length of the new I/O sensor.
Attached to Conveyor/In-dex	Allows you to choose the conveyor if the sensor shall be at-tached to a conveyor.
Reference Coordinate	Allows you to select the reference coordinate for the I/O sensor.
Position XYZ(mm)	Allows you to set the position for the I/O sensor.
Orientation XYZ(deg)	Allows you to set the orientation of the I/O sensor.

Note

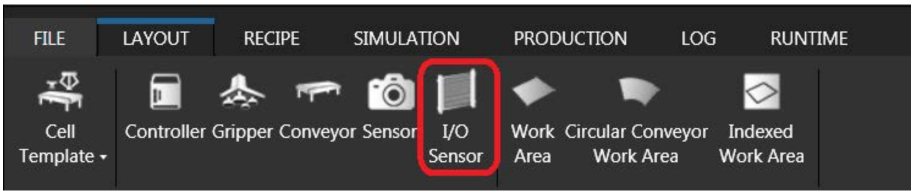
To function correctly, an I/O sensor must not be in contact with other stationary objects, for example, the conveyor.

Procedure

On the PickMaster PowerPac ribbon-tab, click **Layout**.

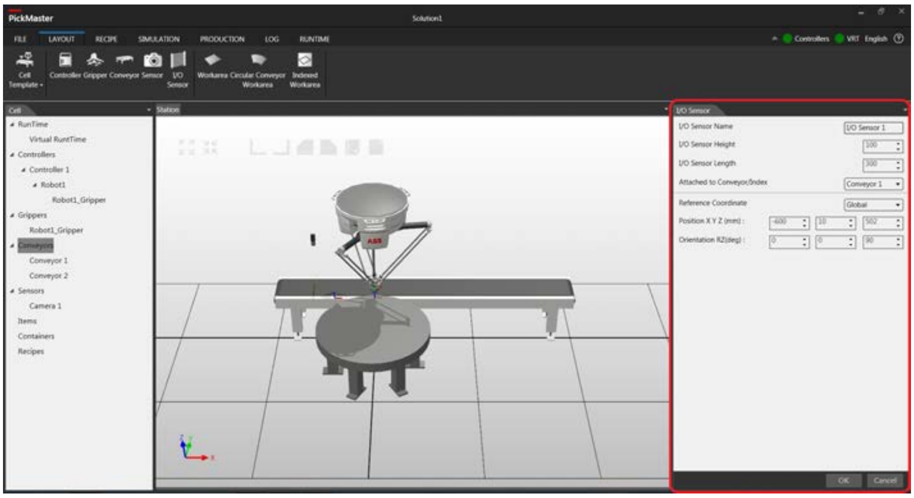
Use this procedure to add conveyors:

1 On the ribbon-tab, click **I/O sensor**.



xx1800001414

The **I/O sensor** window opens.



xx1800001415

2 In the **I/O sensor** window, enter a name in the **I/O sensor Name** text box or use the default one.

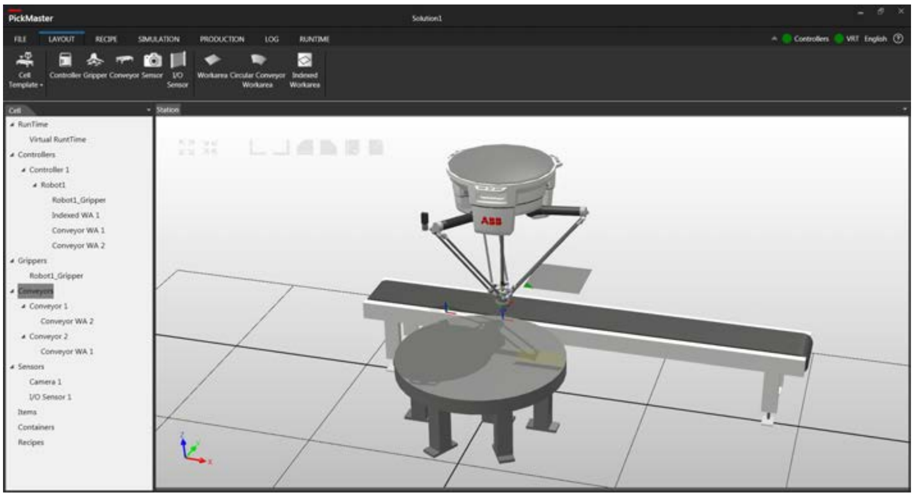
Continues on next page

3 In the **I/O sensor** window, enter numbers in the **I/O sensor Height** text box to define the height of the I/O sensor according to your requirements or use default settings.
4 In the **I/O sensor** window, enter numbers in the **I/O sensor Length** text box to define the length of the I/O sensor according to your requirements or use default settings.
5 In the **I/O sensor** window, choose a conveyor in the **Attached to Conveyor**/**Index** box to define which conveyor the new camera is attached to according to your requirements.
6 Click **OK**.

4.2.6 Adding work area

Overview

This section describes how to add a work area.

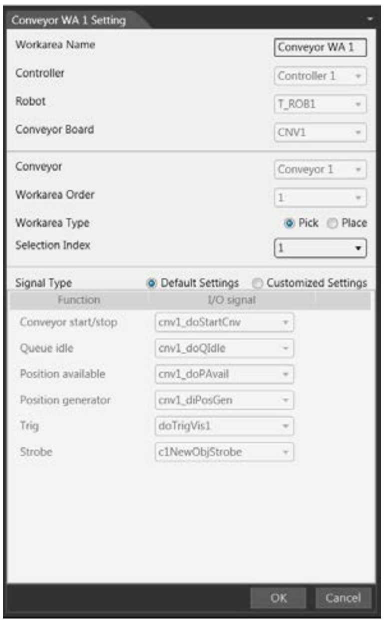


xx1900000578

Adding a work area

The conveyor work area is an area on the conveyor where the robot picks or places items. One conveyor board is required for each conveyor work area. A robot usually has only one conveyor work area on each related conveyor, but there is no restriction.

The **Conveyor Work Area** window opens as illustrated below.



xx1800001419

Item	Description
Work Area Name	Type a name for the conveyor work area.

Continues on next page

Item	Description
Controller	Select a picking controller from the list.
Robot	Select a robot from the list.
Conveyor Board	Select a conveyor board from the list.
Conveyor	Select a conveyor from the list.
Work Area Order	Indicates the upstream order of this work area among other work areas on this conveyor. For example, “2” indicates that this is the second most upstream work area on this conveyor.
Work Area Type	Select work area type from the available options. • **Pick**: Select this if the work area is a picking area. • **Place**: Select this if the work area is a placing area.
Selection Index	Select an index to specify the pick or place order in the RAPID program when using more than one pick work area and one place work area with the selected robot
Signal Type	Configure the signals. Use the **Customized Settings** options to manage the signals. For more information regarding Conveyor work area signals see the following section. Select the **Default Settings** check box to use the default signal configuration.

Conveyor work area signals

Item	Description
Conveyor start/stop	Digital output signal. This signal is used if an overflow shall be avoided by letting the conveyor movement be controlled by the work area. The signal goes high when the conveyor shall start moving and goes low when the conveyor shall stop to avoid an overflow.
Queue idle	Digital output signal. This signal is high when the queue for this work area is empty. The signal goes high when the last item is retrieved from the queue.
Position available	Digital output signal. This signal is high when there is one or more items between the enter and exit limits for the work area.
Position generator	Digital input signal that tells that it is time to generate a new vision image or generate new predefined positions. This signal is ignored if a distance triggered conveyor is used.
Trig	If vision is used this digital output signal must be connected to the trigger input on the I/O port on the camera. If predefined positions are used this output signal must be connected directly to the start input on the conveyor encoder board. This is best done using the *doManSyncX* signal. If predefined positions are distributed only to this work area (For instance, Runtime with a single robot),the encoder signal *cXSoftSyncSig* can be used instead of *doManSyncX*, that is, without the need of connecting a signal to the start input of the encoder board.
Strobe	This is the input signal name for the strobe signal and is the start signal for the encoder board for the conveyor. The signal name is set to *cXNewObjStrobe*. If vision is used the signal must be generated from the strobe output on the I/O port of the camera. When predefined positions are used, the strobe may be generated directly from the *doManSyncX* signal, which is directly connected to the start signal on the encoder board.

Continues on next page

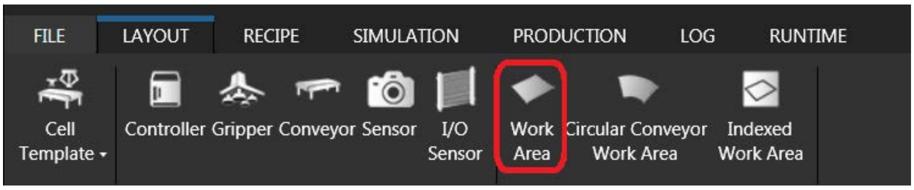
> **Note**
>
> Using distance triggered Positions Source with DSQC2000, camera or predefined source, configure `cxTrigVis` as **Trig** signal. From RW6.10 and later, the Strobe signal is automatically configured and can therefore be omitted in the work area signal configuration.

Procedure

On the PickMaster PowerPac ribbon-tab, click **Layout**.

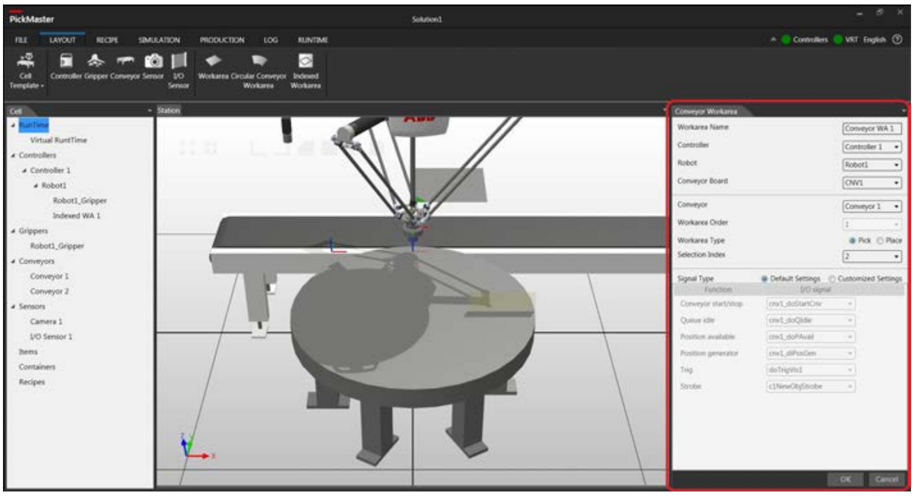
Use this procedure to a work area:

1. On the ribbon-tab, click **Work Area.**

   xx1800001417

   The **Conveyor Work Area** window opens.

   xx1800001418

2. In the **Conveyor Work Area** window, enter a name in the **Work Area Name** text box or use the default one.
3. Select the required work area type and configure the settings.
4. Click **OK.**

Continues on next page

Adding a circular conveyor work area

The conveyor work area is an area on the conveyor where the robot picks or places items. One conveyor board is required for each conveyor work area. A robot usually has only one conveyor work area on each related conveyor, but there is no restriction.

The **Circular Conveyor Work Area** window opens as illustrated below.

xx1800001425

	Description
Work Area Name	Type a name for the conveyor work area.
Controller	Select a picking controller from the list.
Robot	Select a robot from the list.
Conveyor Board	Select a conveyor board from the list.
Conveyor	Select a conveyor from the list.
Work Area Order	Indicates the upstream order of this work area among other work areas on this conveyor. For example, “2” indicates that this is the second most upstream work area on this conveyor.
Work Area Type	Select work area type from the available options. • **Pick**: Select this if the work area is a picking area. • **Place**: Select this if the work area is a placing area.
Selection Index	Select an index to specify the pick or place order in the RAPID program when using more than one pick work area and one place work area with the selected robot
Signal Type	Configure the signals. Use the **Customized Settings** options to manage the signals. For more information regarding Conveyor work area signals see the following section. Select the **Default Settings** check box to use the default signal configuration.

Continues on next page

Conveyor work area signals

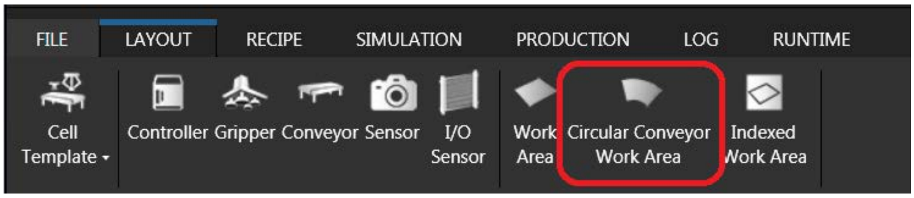
Signal	Description
Conveyor start/stop	Digital output signal. This signal is used if an overflow shall be avoided by letting the conveyor movement be controlled by the work area. The signal goes high when the conveyor shall start moving and goes low when the conveyor shall stop to avoid an overflow.
Queue idle	Digital output signal. This signal is high when the queue for this work area is empty. The signal goes high when the last item is retrieved from the queue.
Position available	Digital output signal. This signal is high when there is one or more items between the enter and exit limits for the work area.
Position generator	Digital input signal that tells that it is time to generate a new vision image or generate new predefined positions. This signal is ignored if a distance triggered conveyor is used.
Trig	If vision is used this digital output signal must be connected to the trigger input on the I/O port on the camera. If predefined positions are used this output signal must be connected directly to the start input on the conveyor encoder board. This is best done using the *doManSyncX* signal. If predefined positions are distributed only to this work area (For instance, Runtime with a single robot),the encoder signal *cXSoftSyncSig* can be used instead of *doManSyncX*, that is, without the need of connecting a signal to the start input of the encoder board.
Strobe	This is the input signal name for the strobe signal and is the start signal for the encoder board for the conveyor. The signal name is set to *cXNewObjStrobe*. If vision is used the signal must be generated from the strobe output on the I/O port of the camera. When predefined positions are used, the strobe may be generated directly from the *doManSyncX* signal, which is directly connected to the start signal on the encoder board.

Procedure

On the PickMaster PowerPac ribbon-tab, click **Layout**.

Use this procedure to a work area:

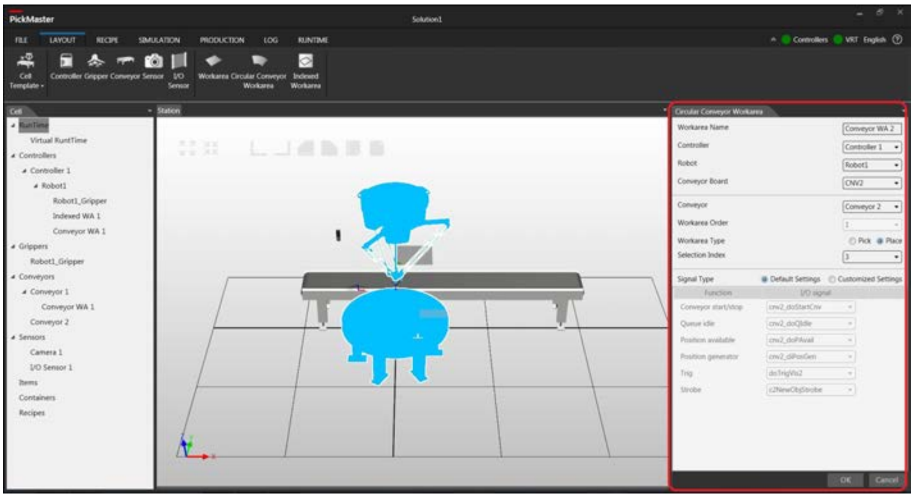
1. On the ribbon-tab, click **Circular Conveyor Work Area**.



xx1800001420

Continues on next page

The **Conveyor** window opens.



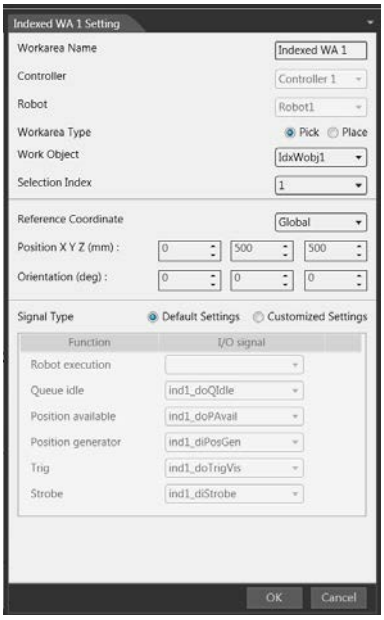
xx1800001424

2 In the **Circular Conveyor Work Area** window, enter a name in the **Work Area Name** text box or use the default one.
3 Select the required work area type and configure the settings.
4 Click **OK**.

Adding a indexed work area

An indexed work area is a fixed area where a robot picks or places items without conveyor tracking.

The **Indexed Work Area** window opens as illustrated below.



xx1800001428

	Description
Work Area Name	Type a name for the indexed work area.

Continues on next page

	Description
Controller	Select a controller from the list.
Robot	Select a robot from the list.
Work Area Type	Select work area type from the available options. • **Pick**: Select this if the indexed work area is a picking area. • **Place**: Select this if the indexed work area is a placing area.
Work object	Select a RAPID work object data (`wobjdata`). The associated `wobjdata` is automatically used with the indexed work area. **Note** No work object calibration is needed. The selected `wobjdata` is automatically updated when a simulation is started.
Selection Index	Select an index to specify the pick or place order in the RAPID program when using more than one pick work area and one place work area with the selected robot.
Reference Coordinate	Allows you to select the reference coordinate for the indexed work area.
Position XYZ(mm)	Allows you to set the position for the indexed work area.
Orientation XYZ(deg)	Allows you to set the orientation of the indexed work area.
Signal Type	Configure the signals. Use the **Customized Settings** options to manage the signals. For more information regarding indexed work area signals see the following section. Select the **Default Settings** check box to use the default signal configuration.

Indexed work area signals

Signal	Description
Robot execution	This optional digital input I/O signal is used to indicate that it is allowed for the robot to execute an item target in the RAPID program. Execution starts when the signal is high and stops when the signal goes low. If the signal goes low, all remaining items in the currently executing scene is dropped, so when the signal goes high again, the item targets for the next scene is executed. The signal must also go low after one scene is finished and then go high again to start executing item targets for the next scene.
Queue idle	Digital output signal. This signal is high when the queue for this work area is empty. The signal goes high when the last item is retrieved from the queue. **Note** If the robot needs to repeat the motion, this signal should be the same with the signal in **Strobe**.
Position available	This output signal is high when there are one or more items when the *Robot execution* signal is high for the work area. If no *Robot Execution* signal is used the `Position Available` signal will go high as soon as there are any items in the queue.
Position generator	Digital input signal that tells that it is time to generate a new vision image or generate new predefined positions. This signal is ignored if a distance triggered conveyor is used.

Continues on next page

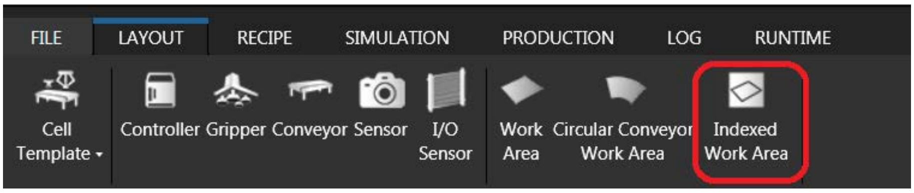
Signal	Description
Trig	If vision is used this digital output signal must be connected to the trigger input on the I/O port on the camera.
Strobe	This is the input signal name for the strobe signal and is the start signal for the encoder board for the conveyor. If only select the **Strobe** signal, the robot will pick and place for just one time. If a continuous picking and placing is needed, set the **Strobe** signal and **Queue idle** signal as the same one. And a sensor from the customer is needed to trigger the cycle.

Procedure

On the PickMaster PowerPac ribbon-tab, click **Layout**.

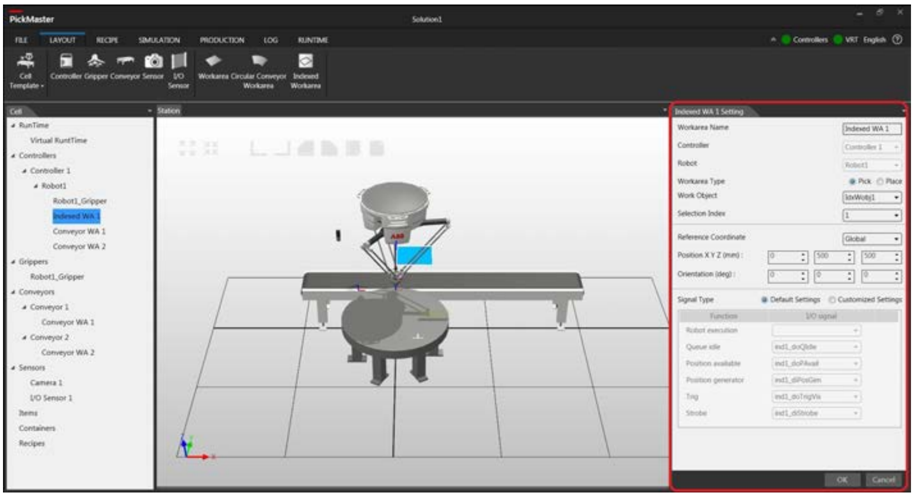
Use this procedure to add a indexed work area:

1 On the ribbon-tab, click **Indexed Work Area.**



xx1800001426

The **Conveyor** window opens.



xx1800001427

2 In the **Indexed Work Area** window, enter a name in the **Work Area Name** text box or use the default one.

3 Select the required work area type and configure the settings.

4 Click **OK**.

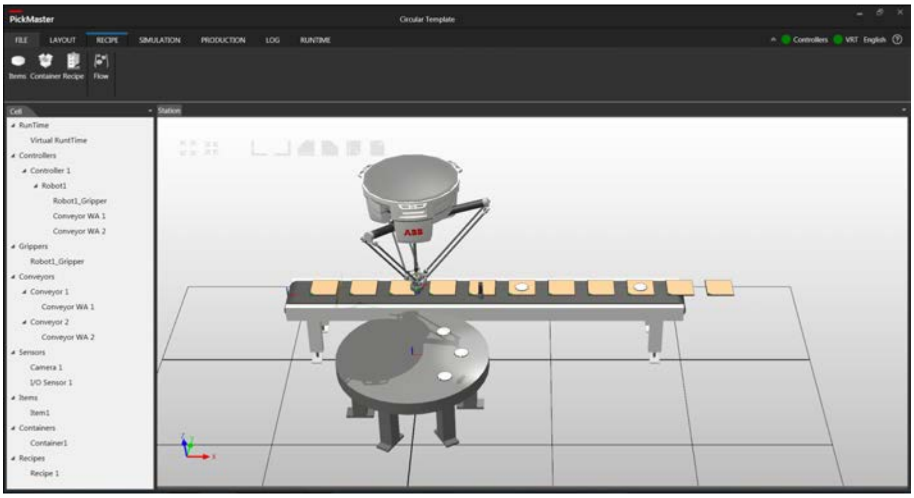
4.2.7 Adding Item

Overview

An item is the object that is picked and placed by the robot. It is most common to use only one item for both pick and place but any number of items can be created.

The grip location of an item defines the pick/place position relative to the item position.

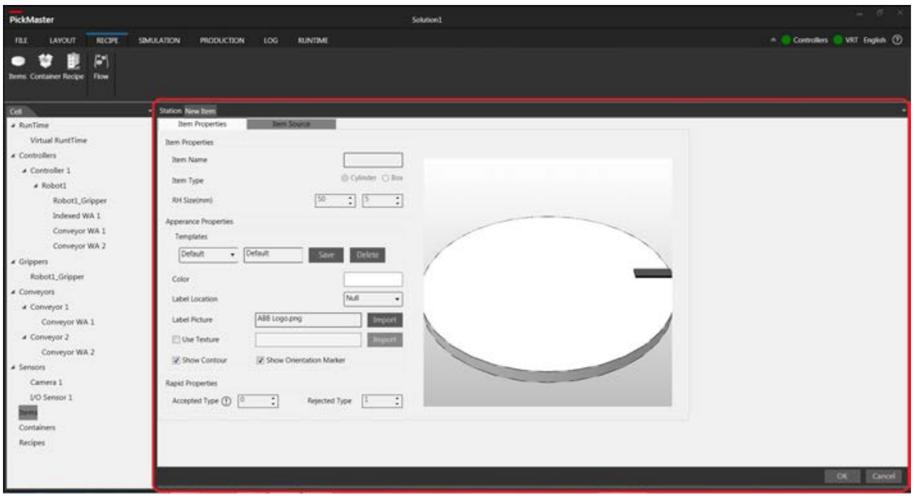
This section describes how to add an item.



xx1900000591

Adding an item

The **New Item** window opens as illustrated below.



xx1800001432

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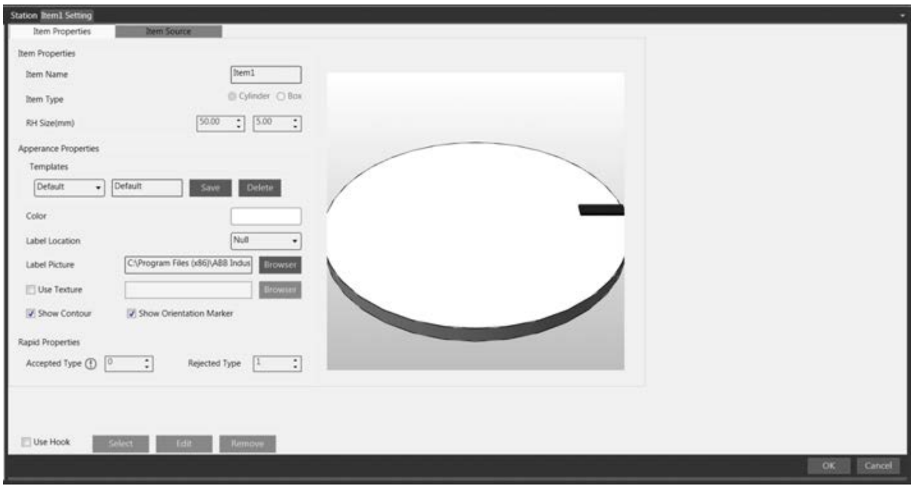
Item Properties



xx1800001430

Item Properties

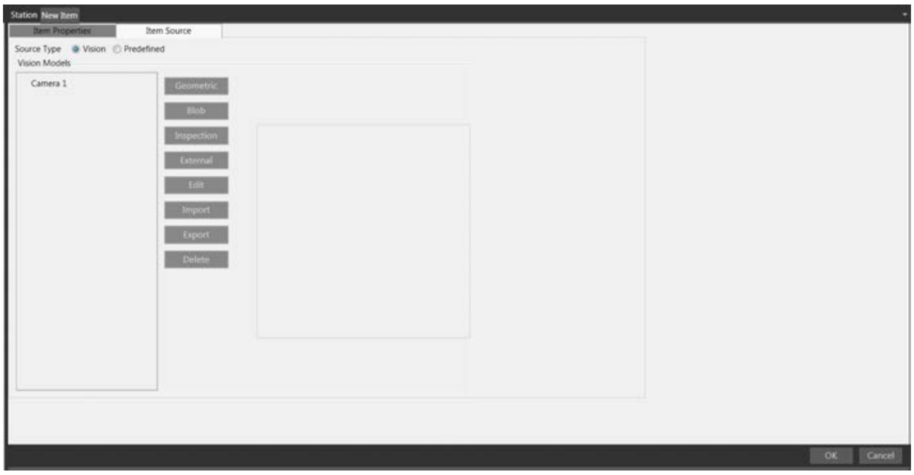
	Description
Item Name	Allows you to change the name.
Item Type	Allows you to change the shape of the item.
RH Size (mm)	Allows you to configure the size of the item.

Appearance Properties

	Description
Templates	**Default Settings** tab allows you to choose one of the preset templates. **Default Name** text box allows you to enter the name for a new template. **Save** icon allows you to save your new template. **Delete** icon allows you to delete your templates.
Color	Allows you to change the color of the new item.
Label Location	Allows you to set the location of the label on the item.
Label Picture	Allows you to select an image file for the label picture.
Use Texture	Allows you to use a texture image file for the item or container.
Show Contour	Allows you to choose to show the contour or not.
Show Orientation Marker	Allows you to choose to show the orientation maker or not.
Rapid properties	Allows you to define the values for accepted or rejected item types. The values for the accepted and rejected item type are sent to the RAPID program and are supplied with the item targets. For more details see, *GetItmTgt - Get the next item target on page 374*.

Continues on next page

Item Source



xx1800001431

	Description
Source Type	**Vision:** If the source type is set to **Vision**, a camera and vision models are used to find the object positions. The vision models are described in section *Adding vision model on page 254*. **Predefined**: If the source type is set to **Predefined**, the positions generated by the position source are statically defined and no camera is used. **Note** If the user changes the source type of an item, the user need to redo the selection in the related recipe setting accordingly.
Vision Models	For more information regarding Vision Models see the following section.

Vision Models

	Description
Geometric	Allows you to add a gemetric vision model. A geometric sub inspection model is configured in the same way as a *PatMax* model. See *Configuring a geometric model with PatMax on page 255*. In addition, the relative positions of the found items and the corresponding alignment hit must be trained.
Blob	Allows you to add a blob vision model. A blob sub inspection model is configured in the same way as a blob model. See *Configuring blob models on page 266*. In addition, the number of required hits must be configured.
Inspection	Allows you to add an inspection vision model. A blob sub inspection model is configured in the same way as a blob model. See *Configuring blob models on page 266*. In addition, the number of required hits must be configured.
External	Allows you to add an external sensor. This function is reserved for next version.
Import	Allows you to import a selected vision model.
Export	Allows you to export a selected vision model.
Delete	Allows you to delete a selected vision model.

Continues on next page

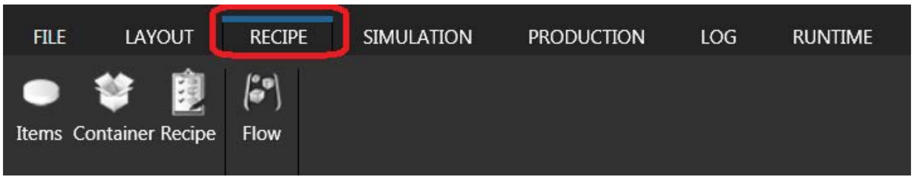
Procedure

On the PickMaster PowerPac ribbon-tab, click **Recipe**.

xx1800001438

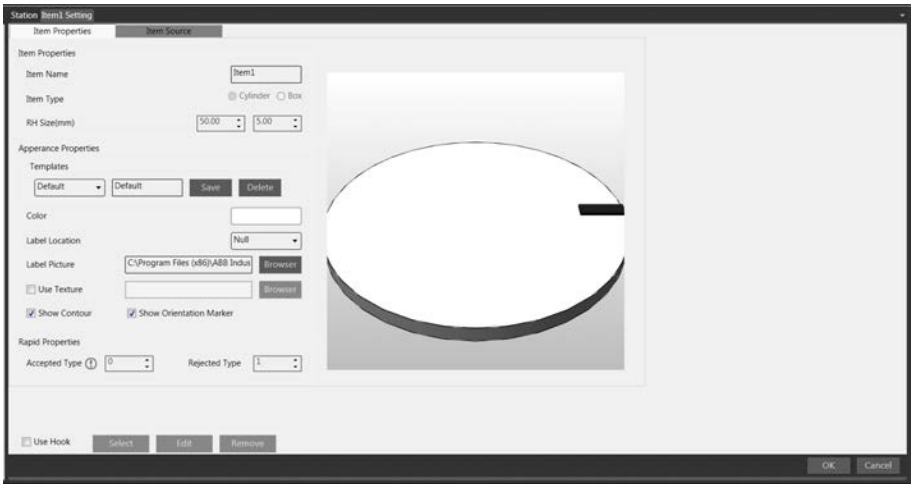
Use this procedure to add an item:

1. On the ribbon-tab, click **Item**.



xx1800001429

The **New Item** window opens.



xx1800001430

2. If needed, define levels for accepted or rejected item types.

   When inspection is used, a found item will be marked as either accepted or rejected. The values for accepted and rejected item type in the **Item Configuration** dialog are sent to the RAPID program and are processed there. See *Configuring inspection models on page 273*.
3. In the **RH Size** part, define the item's size.

   The height of the item defines the pick height and is always added to items found by a vision model or a position defined by a predefined position source.
4. Click **OK**.

Related information

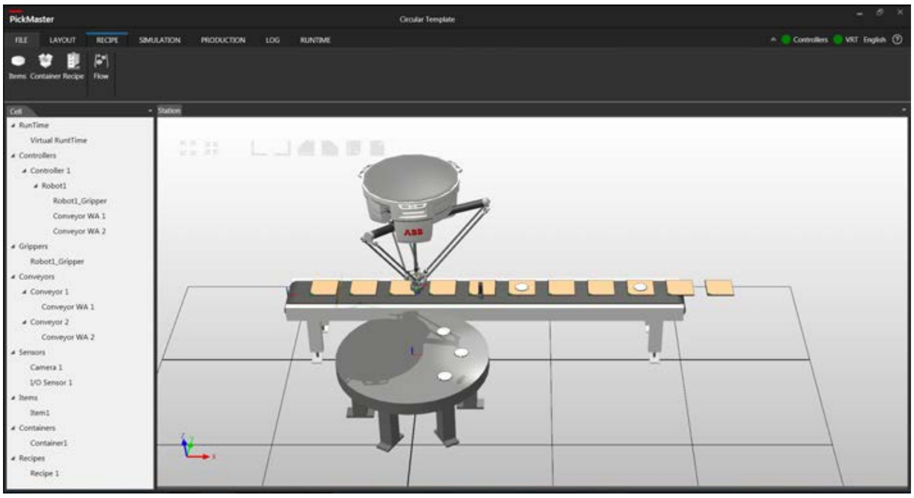
Configuring inspection models on page 273.

4.2.8 Adding Container

Overview

A container defines which patterns to use and what items to use for each position in the patterns. This way, different containers can use the same patterns but with different items.

This section describes how to add a container.



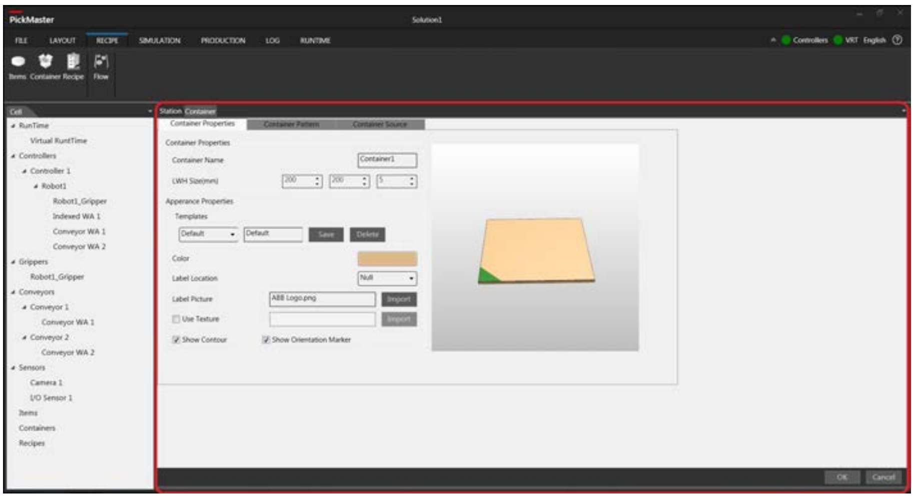
xx1900000591

Prerequisites

At least one item must be defined in the solution before configuring the container.

Adding a container

The **Container** window opens as illustrated below.



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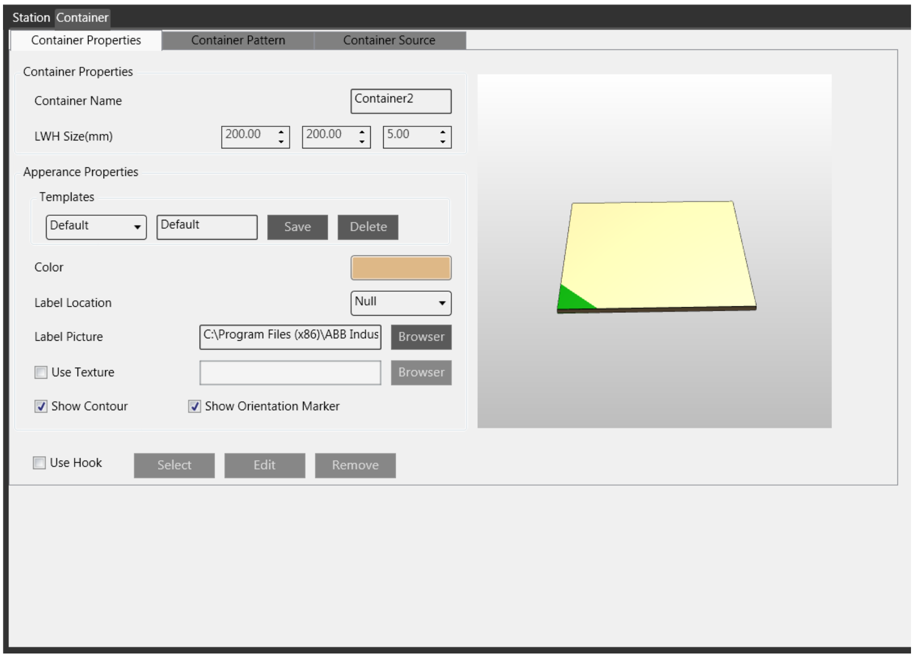
Container Properties



xx1800001434

Container Properties

	Description
Container Name	Allows you to change the name.
LWH Size (mm)	Allows you to configure the size of the container.

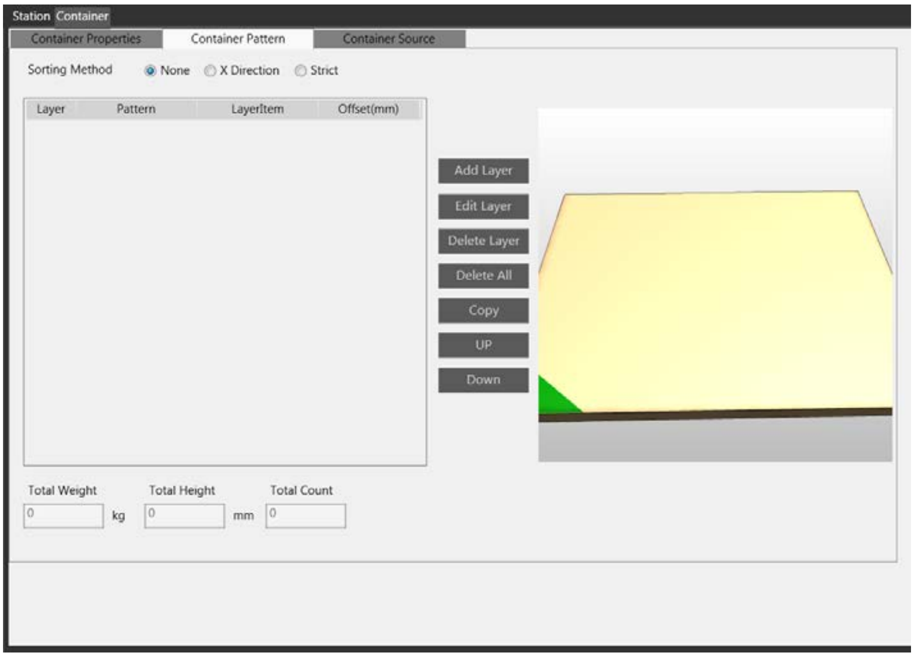
Appearance Properties

	Description
Templates	**Default Settings** tab allows you to choose one of the preset templates. **Default Name** text box allows you to enter the name for a new template. **Save** icon allows you to save your new template. **Delete** icon allows you to delete your templates.
Color	Allows you to change the color of the new item.
Label Location	Allows you to set the location of the label on the item.
Label Picture	Allows you to select an image file for the label picture.
Use Texture	Allows you to use a texture image file for the item or container.
Show Contour	Allows you to choose to show the contour or not.
Show Orientation Marker	Allows you to choose to show the orientation maker or not.

Continues on next page

Container Pattern

A pattern defines a collection of positions. For example, a box with predefined locations for certain objects. You can change the order, delete, or rearrange the selected layers using the available options. You can adjust the vertical position of each layer by modifying the **Offset** (mm). You can also manage the sorting method. The **Sorting Method** section defines the order in which the items in the container pattern shall be handled by the robots.



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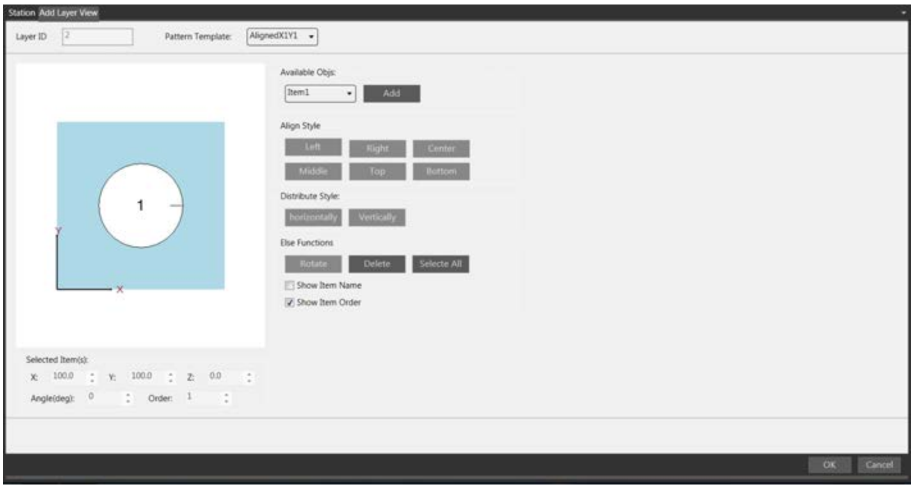
	Description
Sorting Method	Configure the signals. Use the **Customized Settings** options to manage the signals. **None** options: The items in the layer shall be accessed in the same order as they are defined in the layout for each layer, but if the next item cannot be reached the next one after that is used. **X Direction** options: The items shall be accessed in the X direction for each layer, that is, in the order they travel along a conveyor. **Strict** options: The items shall be used in the same order as they are defined in the layout for each layer. If a robot cannot access the next item position in a layer, that robot does not use any more item positions in the container pattern.
Add Layer	Allows you to add a new layer. For more information regarding Add Layer see the following section.
Edit Layer	Allows you to edit the selected layer.
Delete Layer	Allows you to delete the selected layer.
Delete All	Allows you to delete all the existing layers.
Copy	Allows you to copy the selected layer.
Up	Allows you to move the selected layer to a upper level.
Down	Allows you to move the selected layer to a lower level.
Total Weight	Enter the total weight of all the items.

Continues on next page

	Description
Total Height	Enter the total height of all the items.
Total Count	Enter the total count of all the items.

Add Layer



xx1900000561

	Description
Layer ID	Allows you to rename the layer.
Pattern Template	Allows you to select a predefined pattern template.
Available Items	The drop down list allows you to select one item you have created for this system. **Add** icon allows you to add the selected item onto the layer.
Align Style	Allows you to define the align style when you have more than one item in the layer. **Left** icon allows you to align all the items in this layer from the left. **Right** icon allows you to align all the items in this layer from the right. **Center** icon allows you to align all the items in this layer from the center. **Middle** icon allows you to align all the items in this layer from the middle. **Top** icon allows you to align all the items in this layer at from top. **Bottom** icon allows you to align all the items in this layer from the bottom.
Distribute Style	Allows you to define the distribution style when you have more than one item in the layer. **Horizontally** icon allows you to distribute all the items in the horizontal direction. **Vertically** icon allows you to distribute all the items in the vertical direction.
Else Functions	**Rotate** icon allows you to rotate the selected items. **Delete** icon allows you to delete the selected items. **Select All** icon allows you to select all the items in the layer. **Show Item Name** checkbox allows you to show the name of the items. **Show Item Order** checkbox allows you to show the added order of the items.
Selected Item(s)	Allows you to define the location and position of each items.

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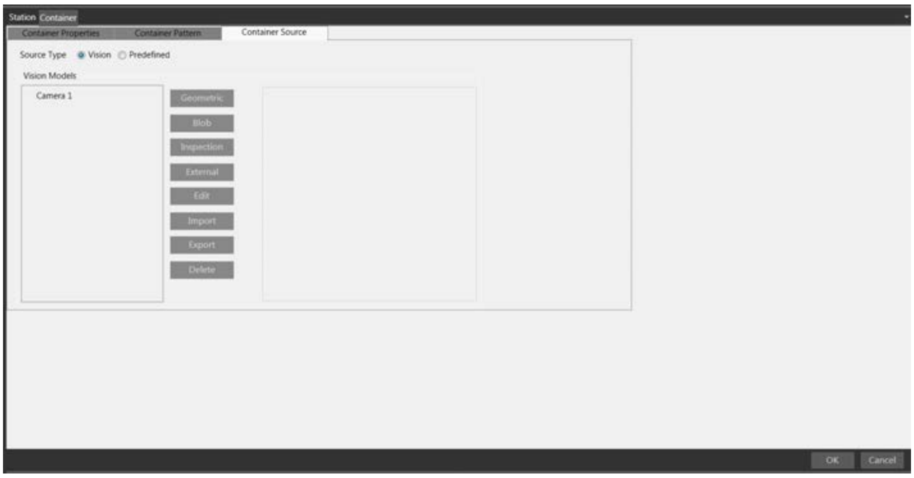
Continued

Container Source



xx1800001436

	Description
Source Type	**Vision**: If the source type is set to **Vision**, a camera and vision models are used to find the object positions. The vision models are described in section *Adding vision model on page 254*. **Predefined**: If the source type is set to **Predefined**, the positions generated by the position source are statically defined and no camera is used.
Vision Models	For more information regarding Vision Models see the following section.

Vision Models

	Description
Geometric	Allows you to add a gemetric vision model. A geometric sub inspection model is configured in the same way as a *PatMax* model. See *Configuring a geometric model with PatMax on page 255*. In addition, the relative positions of the found items and the corresponding alignment hit must be trained.
Blob	Allows you to add a blob vision model. A blob sub inspection model is configured in the same way as a blob model. See *Configuring blob models on page 266*. In addition, the number of required hits must be configured.
Inspection	Allows you to add an inspection vision model. A blob sub inspection model is configured in the same way as a blob model. See *Configuring blob models on page 266*. In addition, the number of required hits must be configured.
External	Allows you to add an external sensor. This function is reserved for next version.
Import	Allows you to import a selected vision model.
Export	Allows you to export a selected vision model.
Delete	Allows you to delete a selected vision model.

Continues on next page

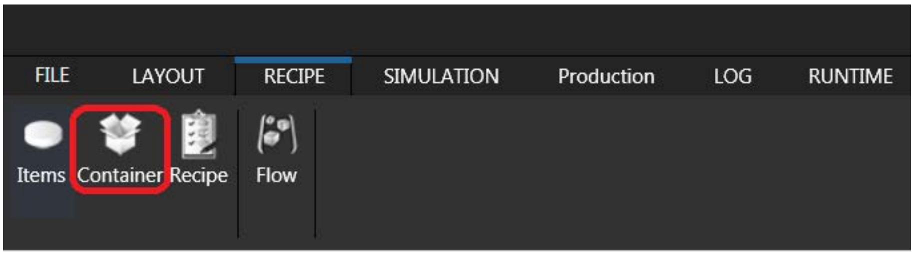
Procedure

On the PickMaster PowerPac ribbon-tab, click **Recipe**.

xx1800001438

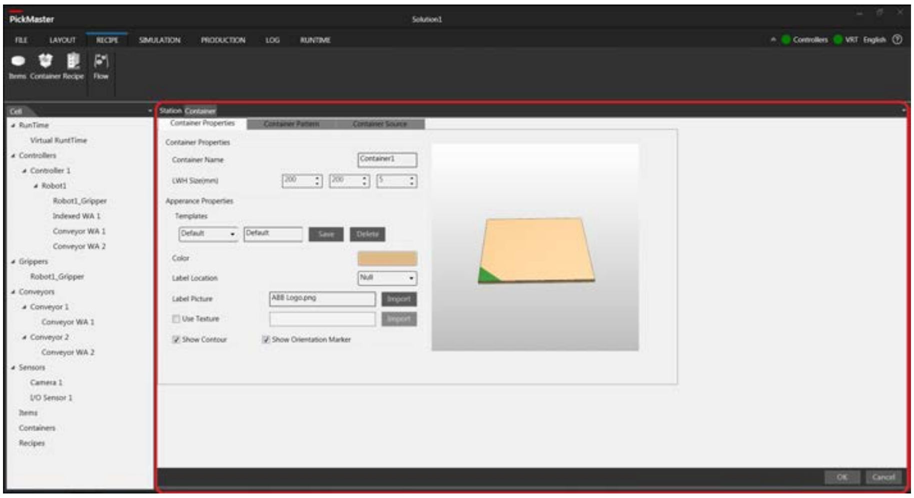
Use this procedure to add a container :

1 On the ribbon-tab, click **Container**.



xx1800001433

The **Container** window opens.



xx1800001437

2 Define the container with your requirements in the **Container Properties** tab.

3 Define the container pattern with your requirements in the **Container Pattern** tab.

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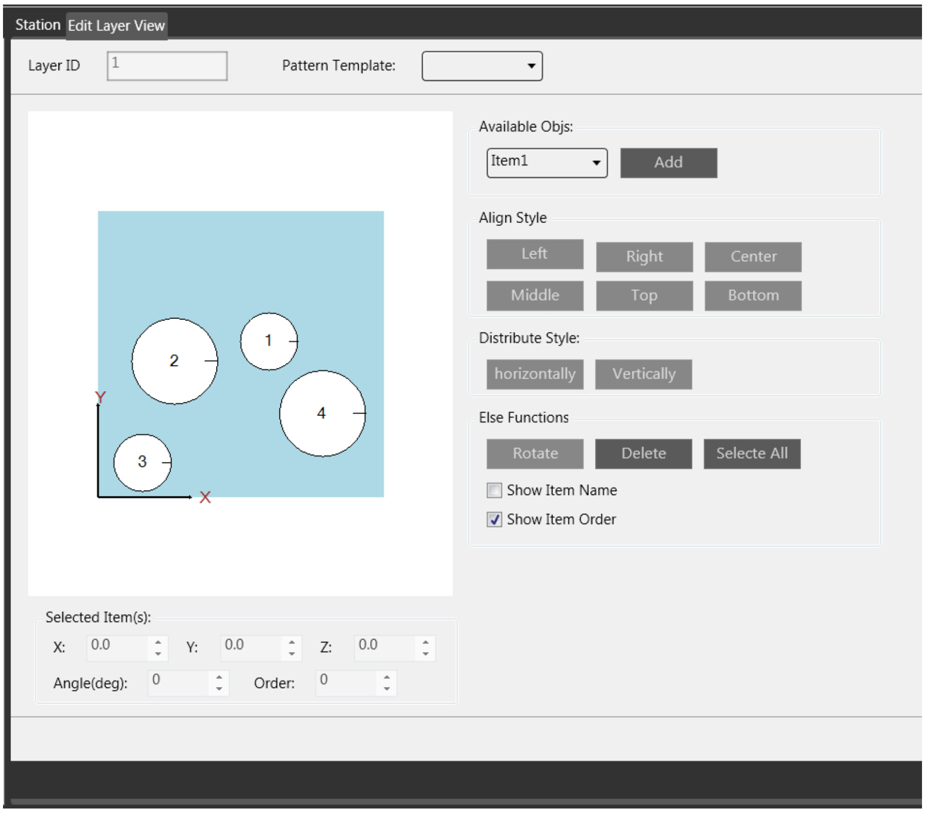
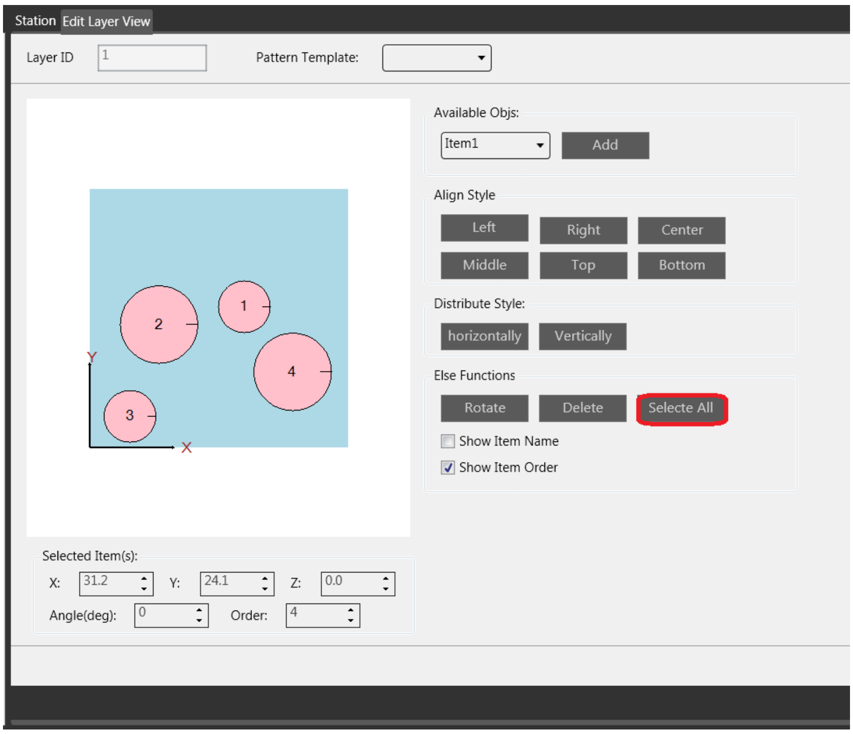
4 If need, adjust the layout of the items on the layer.



xx2000000294

A Select all items on the layer.



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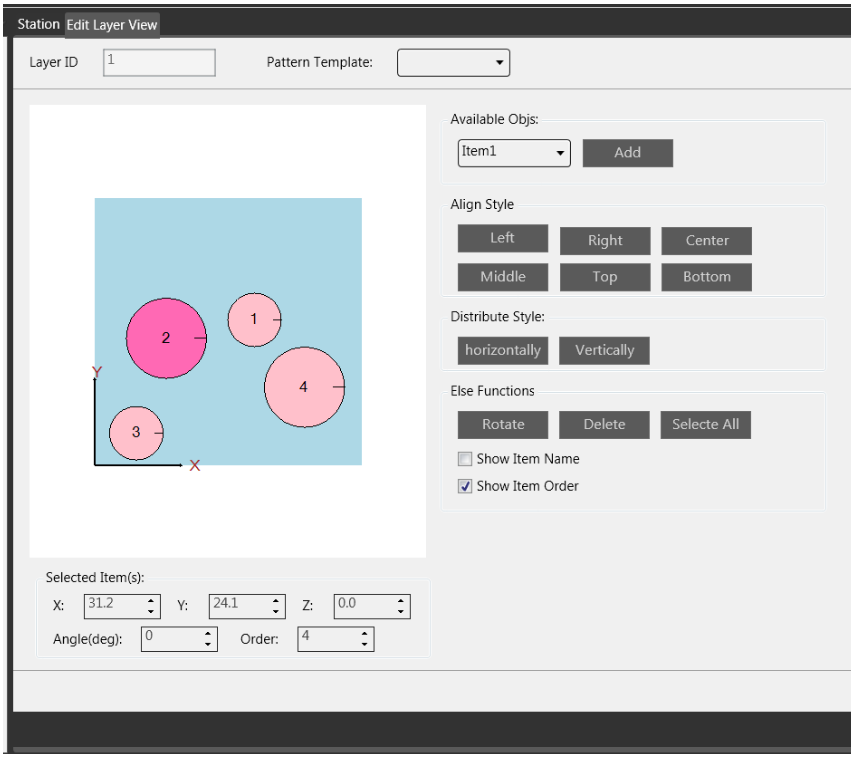
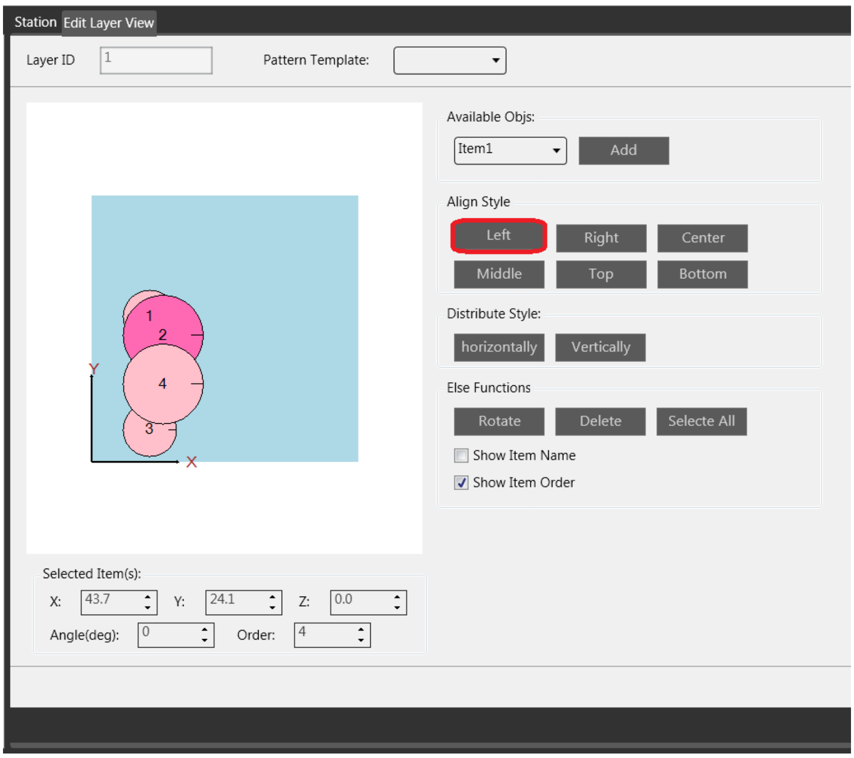
B Click 'Ctrl' and select the base item at the same time.



xx2000000296

C Click **Left** to align all items on the left edge according to the base item.



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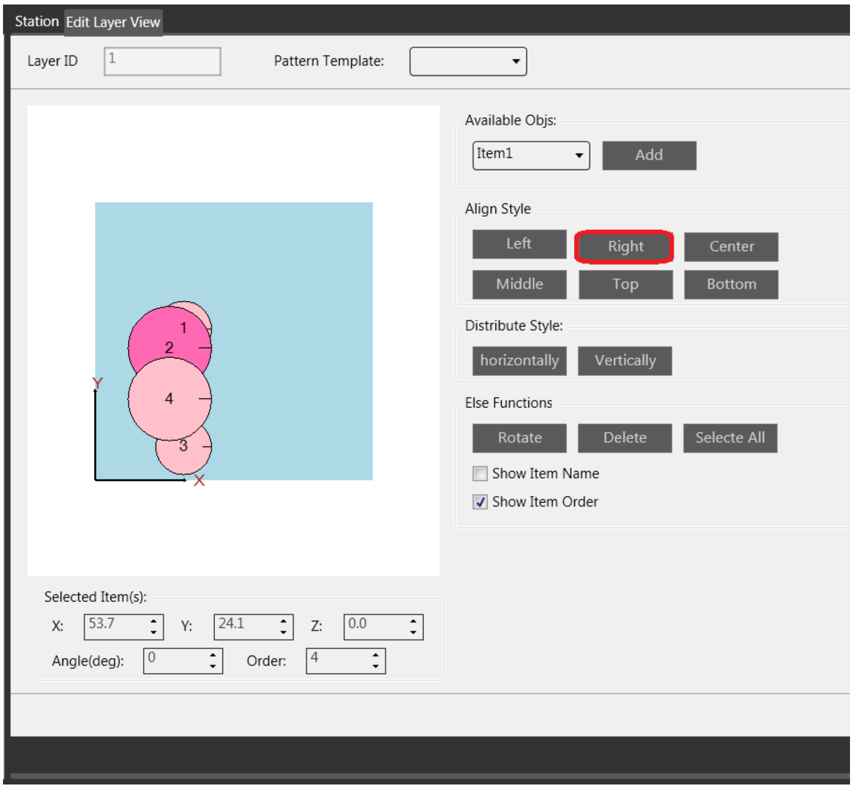
Click **Right** to align all items on the right edge according to the base item.



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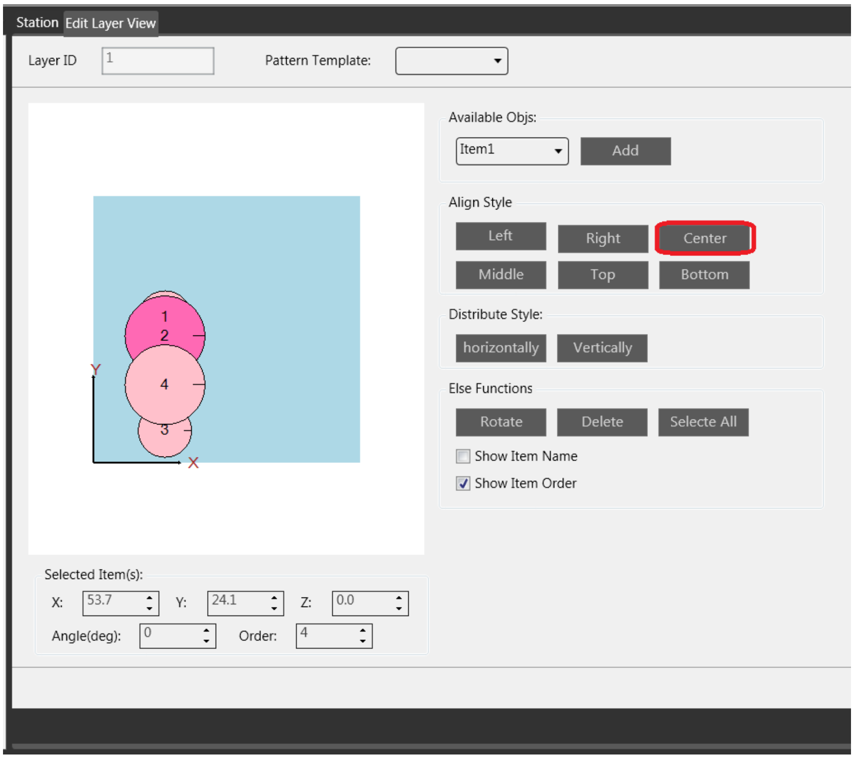
Click **Center** to align all items on the centre line vertically according to the base item.



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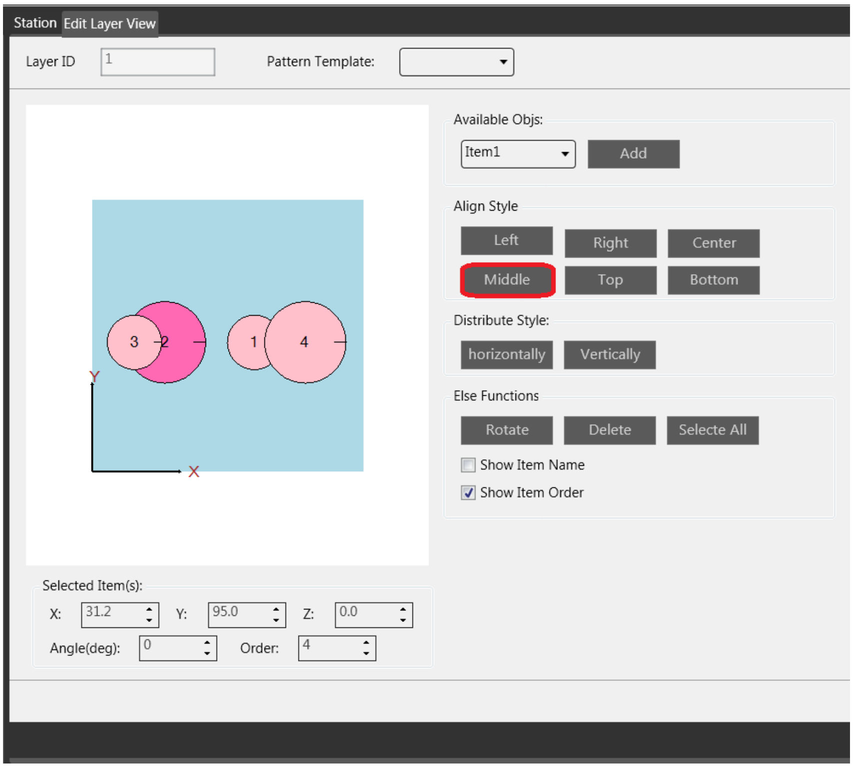
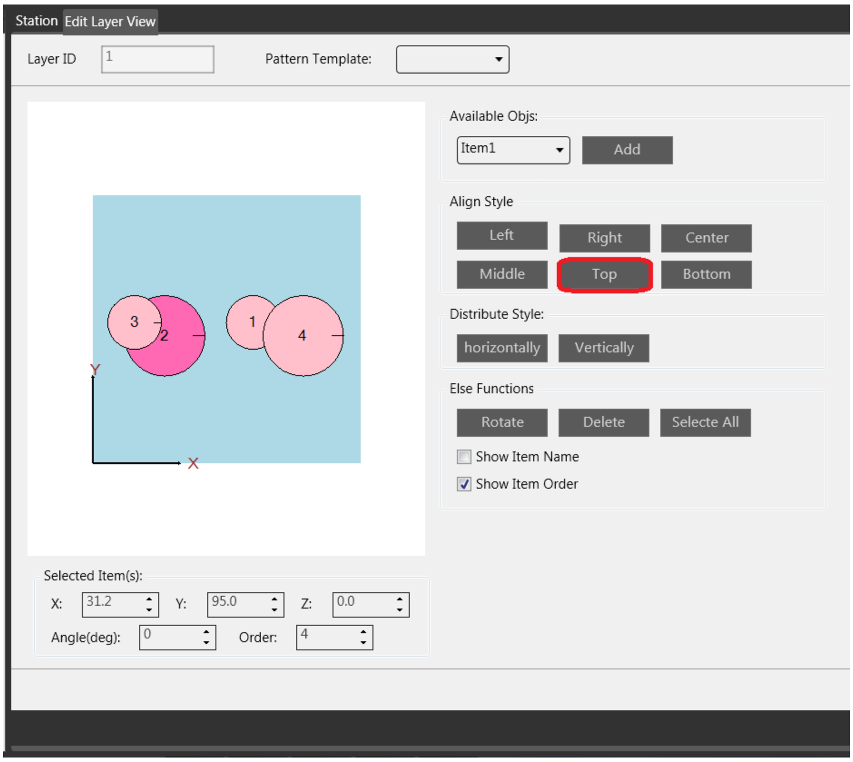
Click **Middle** to align all items on the centre line horizontally according to the base item.



xx2000000300

Click **Top** to align all items on the top edge according to the base item.



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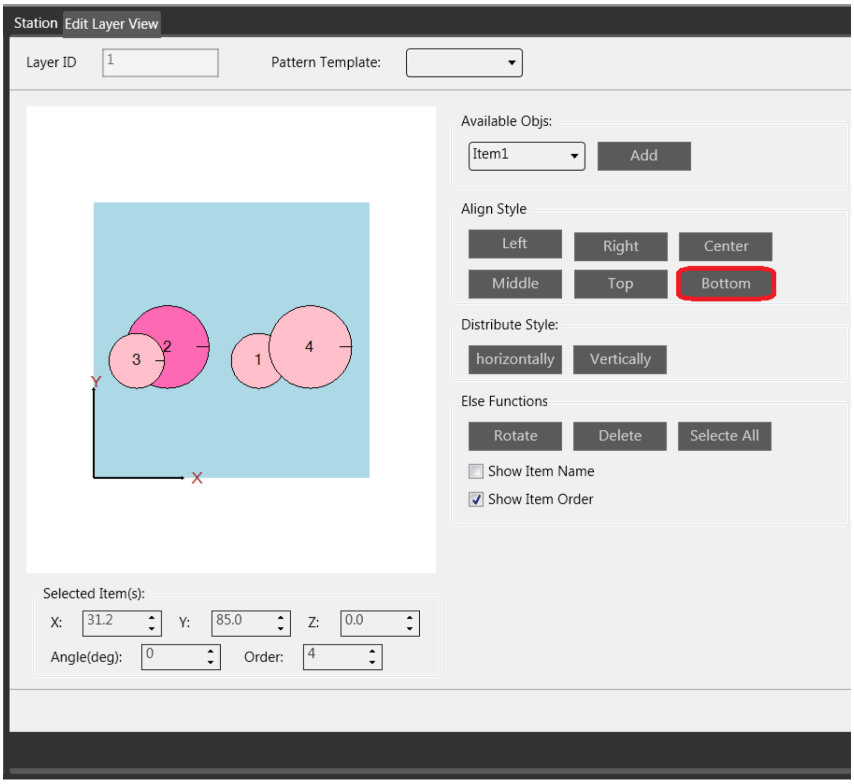
Click **Bottom** to align all items on the bottom edge according to the base item.



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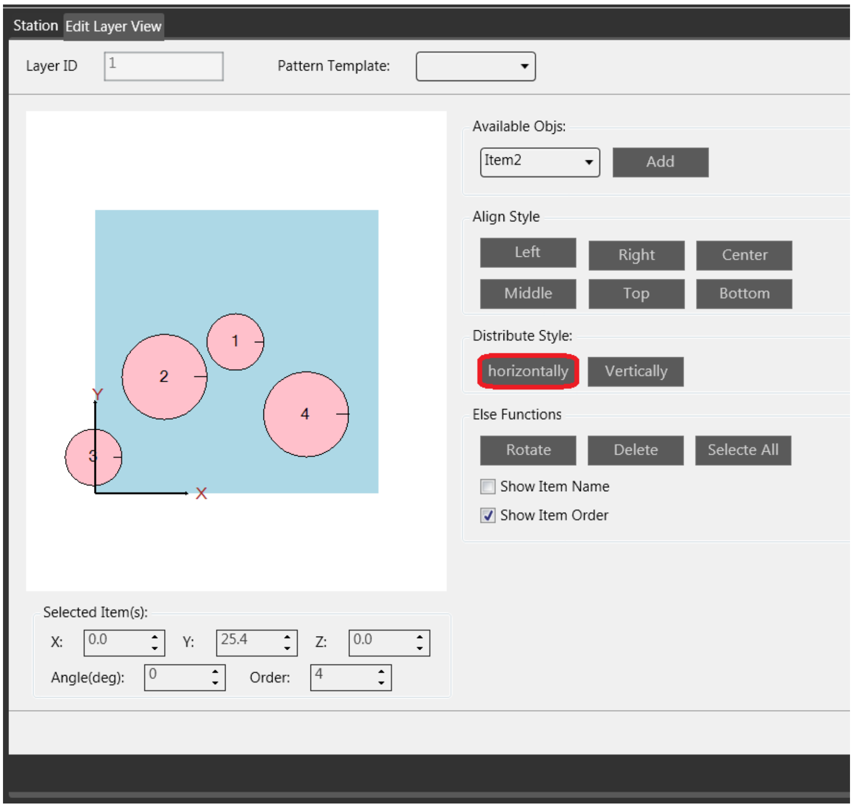
D Click **Horizontally** to set all items tangent in horizontal direction.



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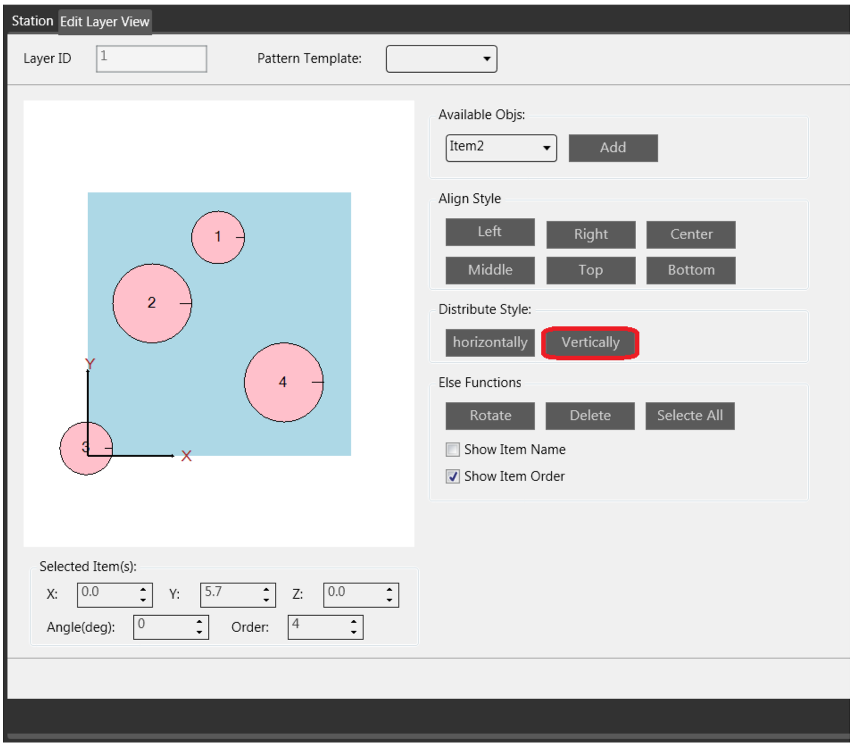
Click **Vertically** to set all items tangent in vertical direction.



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5. Click **OK**.

   The container is saved and the window is closed.

4.2.9 Adding Recipe

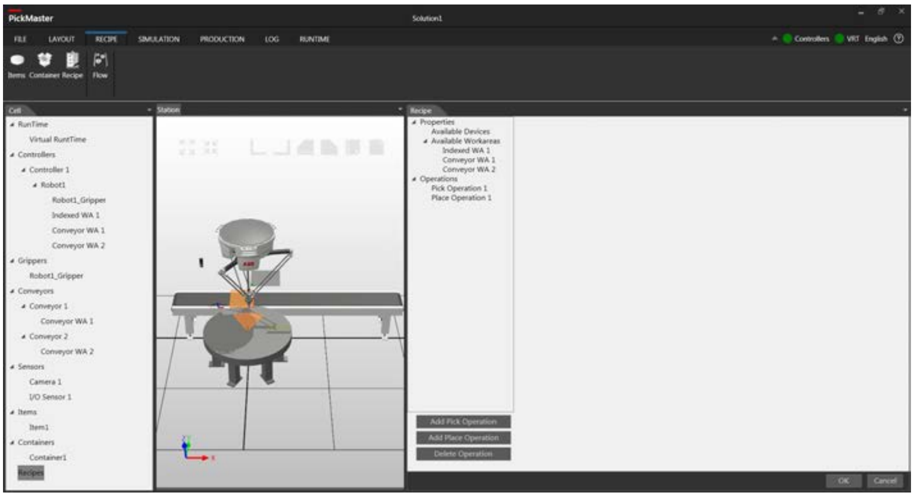
Overview

This section describes how to add a recipe.

In one solution, several recipes can be created. All elements (Robots, sensor and so on) in this solution can be added to any recipes with no limits.

Adding a recipe

The **Recipe** window opens as illustrated below.



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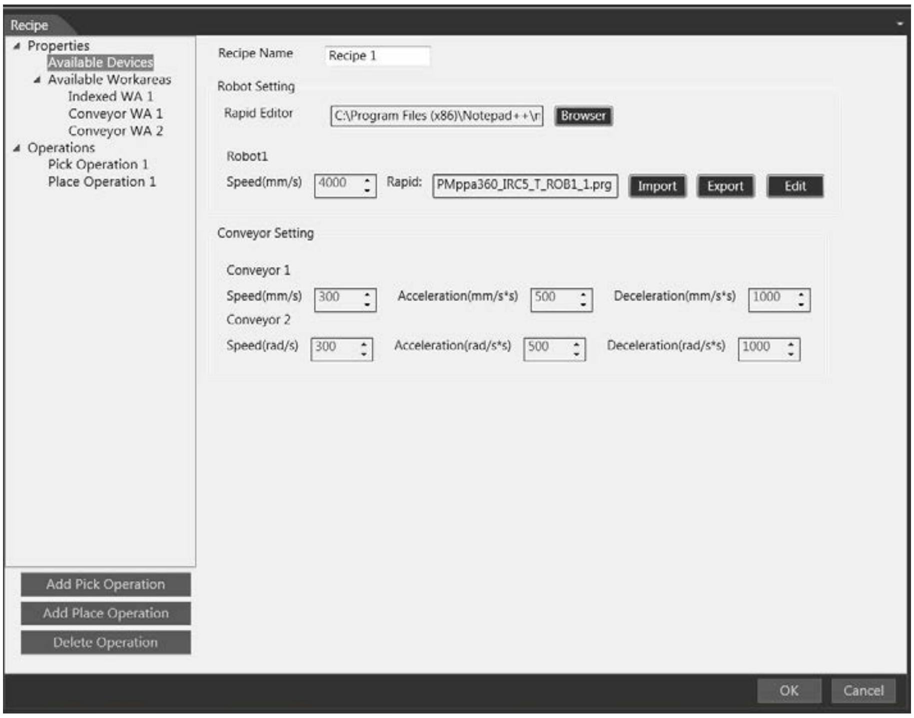
Properties



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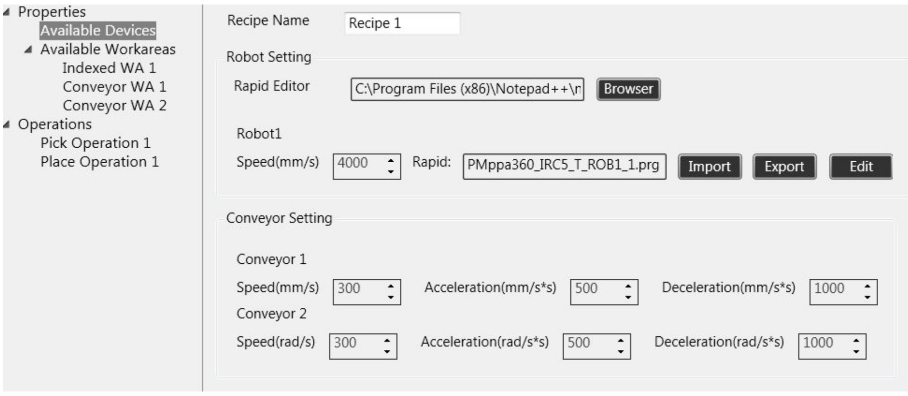
	Description
Available Devices	Allows you to define the available devices, including robots and conveyors. For more information regarding Available Device see the following section.
Available Workareas	Allows you to define the available work areas. For more information regarding Available Work Areas see the following section.

Available Devices



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	Description
Recipe Name	Allows you to rename the recipe.
Robot Setting	**Note** If there are more than one robot in this system, all the robot will be listed here with their defined name. **Rapid Editor** allows you specify the editor to open Rapid. **Speed** allows you to change the speed of the robot. **Rapid** allows you to import/export/edit the rapid of the robot. **Note** To do multiple pick, import the Multiple-Pick rapid file in the installation package for the required robots.
Conveyor Setting	**Speed** allows you to change the speed of the conveyor. **Acceleration** allows you to change the acceleration of the conveyor. **Deceleration** allows you to change the deceleration of the conveyor.

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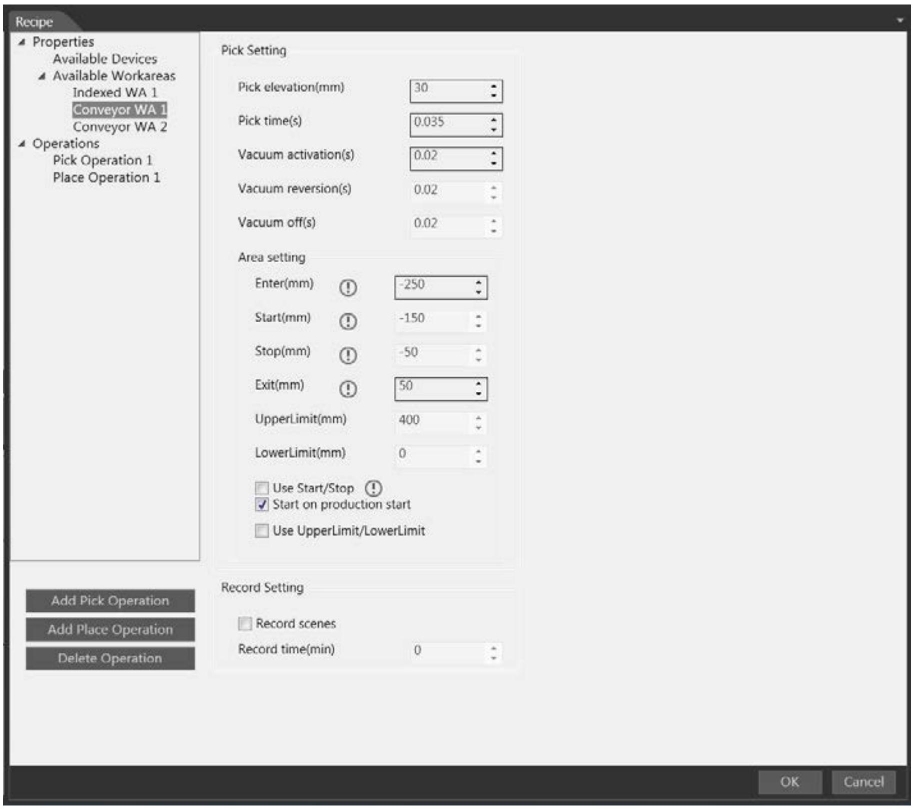
Available Work Areas



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	Description
Pick Setting	**Pick/place elevation** is the distance, in negative z-direction relative to the tool, from where the robot approaches the item target. **Pick/place time** is the time the robot is in the pick/place position. If the conveyor is moving during the pick/place time, the robot will track along the conveyor to keep the relative position on the moving conveyor. **Vacuum activation** is the time in seconds before the middle of the corner path of the approaching position, when the vacuum I/O should be set. If a negative value is entered, the vacuum I/O will be set the time after the middle of the corner path. This value is only valid for work areas of type **Pick** or **Other**. **Note** Vacuum activation does not affect the picking of items in simulation. Items are attached to the picking tool using `SimAttach` events, for example, in the Pick Routine. **Vacuum reversion** is the time in seconds before the half place time in the place position, when the blow I/O should be set. If a negative value is entered, the blow I/O will be set the time after the half place time in the place position. This value is only valid for work areas of type **Place** or **Other**. **Note** Vacuum reversion does not affect the placing of items in simulation. Items are detached from the picking tool using `SimDetach` events, for example, in the Place Routine. **Vacuum off** is the time in seconds after the half place time in the place position, when the blow I/O should be reset. If a negative value is entered, the blow I/O will be reset the time before the half place time in the place position. This value is only valid for work areas of type **Place** or **Other**. **Note** Vacuum Off does not affect the placing of items in simulation. Items are detached from the picking tool using **SimDetach** events, for example, in the Place Routine.

Continues on next page

	Description
Area Setting	After you define a start entry in a work area which may called Start X , you can define a same start entry which may called Start Y at the vertical direction of the Start X. **Enter** is the limit from where the robot starts to execute item targets on the work area (Start X). The distance is calculated in millimeters from the center of the robot. The range is positive if the limit is beyond the center of the robot, relative to the moving direction of the conveyor. Make sure that the enter limit can be reached by the robot. **Start** is when the next item to execute on the conveyor is above this limit, the conveyor is started. The distance is calculated in millimeters from the center of the robot. The range is positive if the limit is beyond the center of the robot, relative to the moving direction of the conveyor. **Stop** is when an item on the conveyor reaches this limit, the conveyor is stopped. The distance is calculated in millimeters from the center of the robot. The range is positive if the limit is beyond the center of the robot, relative to the moving direction of the conveyor. **Exit** is the limit from where the robot considers an item target as lost on the work area (Start X). The distance is calculated in millimeters from the center of the robot. The range is positive if the limit is beyond the center of the robot, relative to the moving direction of the conveyor. When the tracked item passes beyond this limit it will be dropped. This limit must be chosen well within the maximum reach of the robot. The robot must be able to reach this position from an arbitrary position in the robot's working area before the position is out of reach. Select the **Use Start**/**Stop** checkbox if the work area should supervise the start and stop limits. This is handled by the *Conveyor start/stop* signal, see *Adding work area on page 93*. Select the **Start with production checkbox** checkbox if the work area should work with the conveyor when the production is started, and stopped when the production is stopped. **UpperLimit** is the limit form where robot considers an item target as lost on the work area in End Y.The distance is calculated in milli-meters from the center of the robot. The range is positive if the limit is beyond the center of the robot, relative to the moving vertical direction of the conveyor.Make sure that the enter limit can be reached by the robot. **LowerLimit** is the limit form where robot starts to execute item targets on the work area in Start Y. The distance is calculated in milli-meters from the center of the robot. The range is positive if the limit is beyond the center of the robot, relative to the moving vertical direction of the conveyor.If the y coordinate value of the item's position is greater than the UpperLimit, the robot will not grab the item. So when the tracked item passes beyond this limit it will be dropped. This limit must be chosen well within the maximum reach of the robot. **Use UpperLimit**/**LowerLimit** checkbox if the work area should supervise the upper and lower limits.

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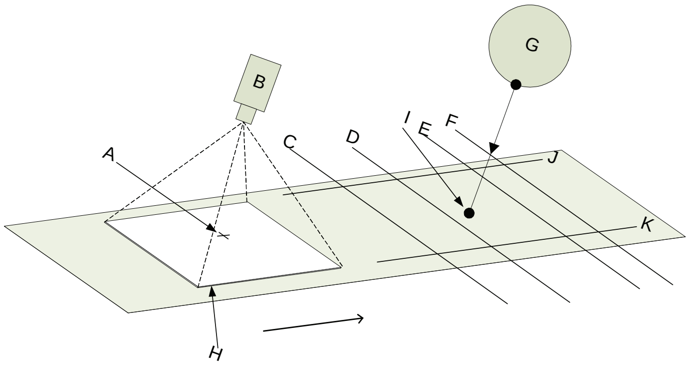
	Description
	 xx1800001747 A: Camera and Baseframe origin B: Camera C: Enter D: Start E: Stop F: Exit G: Robot H: Image frame I: Center of Robot J: UpperLimit K: LowerLimit
Record Setting	Allows you to record the position of the items and containers in simulation and production.

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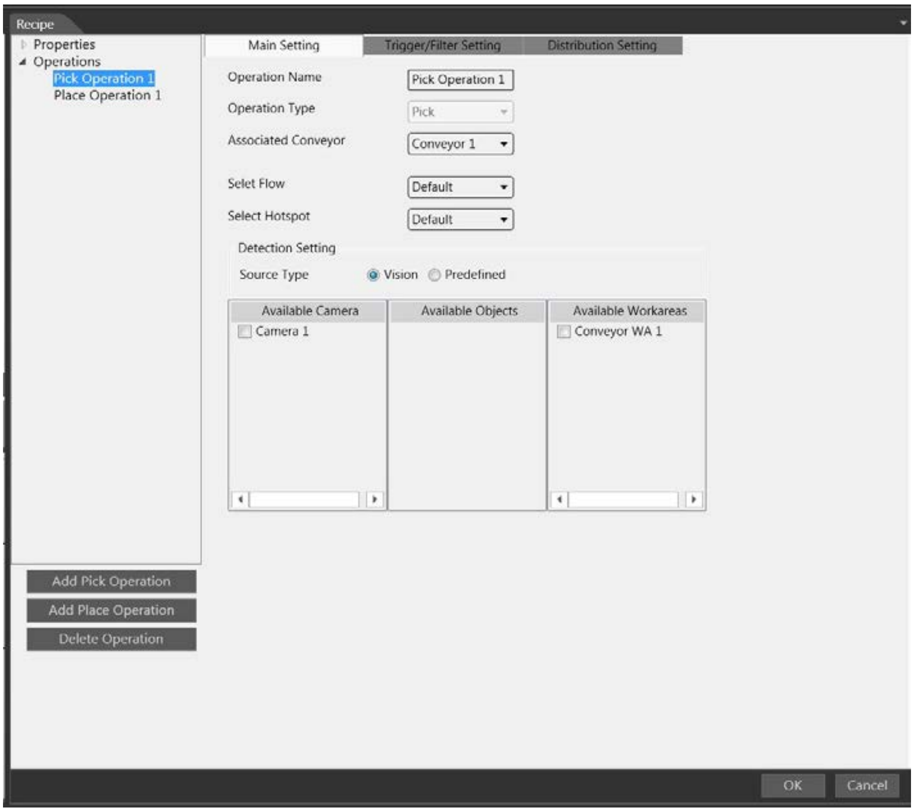
Operation

The operation contains pick operation and place operation.



xx1800001443

	Description
Main Setting tab	Allows you to define some basic settings for the operation, such as operation name, flow, source type. For more information regarding Main Setting see the following section.
Trigger/Filter Setting	Allows you to define the trigger and filter setting for the operation. For more information regarding Trigger/Filter Setting see the following section.
Distribution Setting	Allows you to define the distribution setting for the operation. For more information regarding Distribution Setting see the following section.

Main Setting

	Description
Operation Name	Allows you to rename the operation.

Continues on next page

	Description
Operation Type	Show you the type of the operation. This is predefined when you add a conveyor work area. **Note** The type of the operation cannot be changed here. You can only access to another kind of operation by click on that operation.
Associated Conveyor	Show you the associated conveyor. This is predefined when you add a conveyor work area.
Select Flow	Allows you to select the flow you defined. For more detail on how to add a flow, see *Adding Flow on page 135*.
Select Hotspot	Allows you to select the hotspot you defined.
Detection Setting	**Source Type** allows you to select the input signal source type: • **Vision**: If the source type is set to **Vision**, a camera and vision models are used to find the object positions. The vision models are described in section *Adding vision model on page 254*. **Tip** If the source type is set to **Vision**, all available cameras and related items will be listed in the **Available Camera**. • **Predefined**: If the source type is set to **Predefined**, the positions generated by the position source are statically defined and no camera is used. **Available Camera** allows you to select the camera with your requirements for this operation. **Available Objects** allows you to select the objects with your requirements for this operation. **Available Work Areas** allows you to select the work area with your requirements for this operation. Every picking or placing operation must be associated with a properly configured work area. The item to be operated by this pick or place needs to be set in recipe. If you use a camera to detect the position of the item, the corresponding camera also needs to be set in recipe too.

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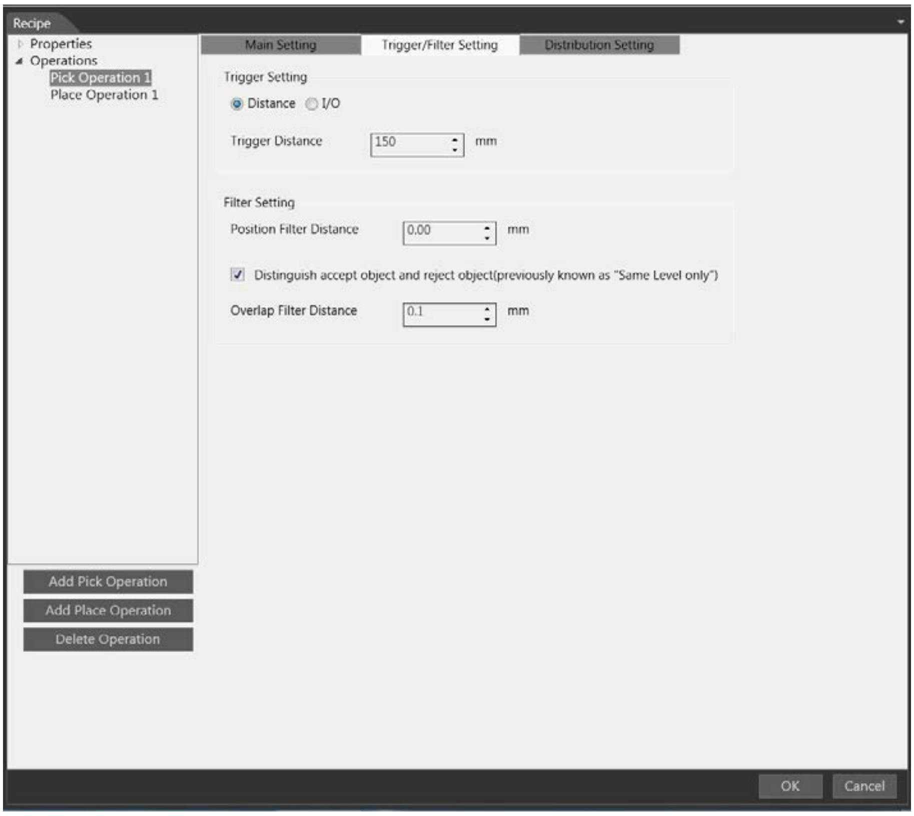
Trigger/Filter Setting



xx1800001444

	Description
Trigger Setting	Select **Trigger type** to define when to generate new item positions. If the trigger type is set to **Distance** the trigger distance must be defined in the **Trigger distance** box. A distance trigger can only be used with a conveyor work area and the entered value is the distance the conveyor should move between consecutive triggers. If the trigger type is set to **I/O**, the trigger distance are predefined. **CAUTION** If the **Predefined** and IO sensor are selected in the recipe, tune the pick location in the **Tuning** for a radial distance to make up the offset.

Continues on next page

	Description
Filter Setting	In the **Position Filter Distance** part, define the minimum allowed distance between two item positions found by a camera or an external sensor. For example, if two or more models are used to identify the same object, there might be one hit for each model at almost the same location. If two positions for the same item are closer in either x- or y-direction than the defined minimum item distance, only the position with the highest sort value will be sent to the robot controller. The sort value can be set for each vision model, see *Adding vision model on page 254*. In the **Overlap filter** define the overlap distance. For example, items can be identified in two consecutive frames due to the overlap. The models can have a small variation in the pick/place position between these frames. Items that are found in two consecutive frames and whose pick/place position between these two frames does not vary by more than the overlap filter distance will be regarded as one item. The first identified hit is sent to the robot, and any subsequent hit is filtered out.

Position filter

The position filter defines the minimum allowed distance between the different item positions found by a camera or an external sensor. For example, if two or more models are used to identify the same object, there might be one hit for each model at about the same location. If the two positions for the same item are closer in either X- or Y-direction the given minimum item distance, only the position with the highest sort value is sent to the robot controller. The sort value can be set for each vision model. For more details, see *Adding vision model on page 254*. If **Same level only** is selected, the filtering will only be done between item positions with the same inspection level.

Note

The position filter is not used while predefined positions are used . The position filter is therefore disabled in the **Position Source Configuration** window when **Predefined** is selected.

Overlap filter

Items can be identified in two consecutive frames due to the overlap. The models can have a small variation in the pick/place position between these frames. The items that are found in two consecutive frames and whose pick/place position between these two frames does not vary more than the overlap filter distance are regarded as one item.

Distribution Setting

By default all positions are sent to the same work area. It is possible to distribute item positions to more than one work area to balance the load between several robots or to guarantee that all positions are accessed.

Continues on next page

All positions for a specific item type are distributed to the robots by a single item distributor. There are four types of item distributors.

- Work area: The item positions are handled by a single conveyor or indexed work area.
- ByPass: The item positions are discarded, that is not handled by any work area. If no distributor is selected for an item type it will be considered as ByPass.
- LB group: The item positions are handled by the work areas included in a load balance group. Aload balance group is a collection of Work area, ByPass, and ATC group distributors. Item positions will be distributed among the work areas in an optimal way to avoid sending two adjacent positions to the same work area.
- ATC group: Positions are handled by the work areas included in an *Adaptive Task Completion* (ATC) group. An ATC group is a collection of ordered work areas that will get the same item positions. The first robot accesses as many positions as possible. The other robots in the ATC group will access any missed positions. If the last work area in the group is a conveyor work area with start and stop it is guaranteed that all positions will be accessed.

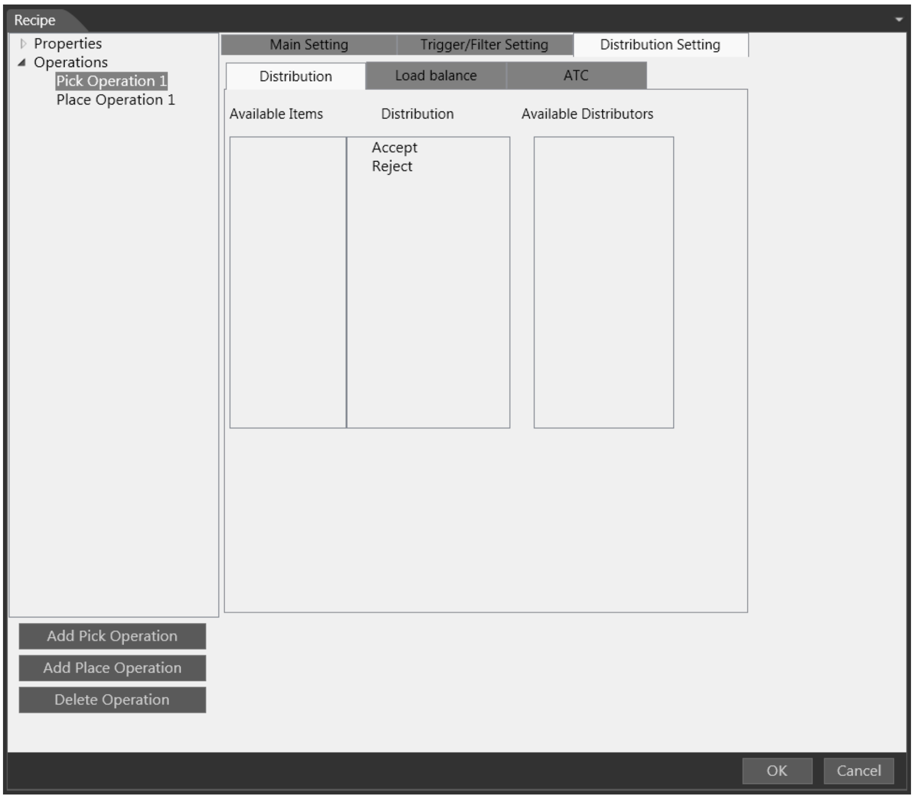
To use either load balancing or ATC the work areas must be arranged in the order that they occur after the position source (for example: the camera or sensor).

The work area that triggers the position source is set automatically. When starting a production, the work area for the robot that is first up and running is set to be the trigger work area. If the robot for a trigger work area is stopped, a work area for another robot that is running will be the one that triggers the position source.

Continues on next page

The item distribution tree control shows the items for which positions are to be generated. Accepted and rejected items can be distributed differently.

Distribution



xx1800001445

	Description
Available Items	Show you the available items for this operation.
Distribution	Allows you to set the distribution strategy as accept or Reject.
Available Distributor	Show you the available distributor for this operation.

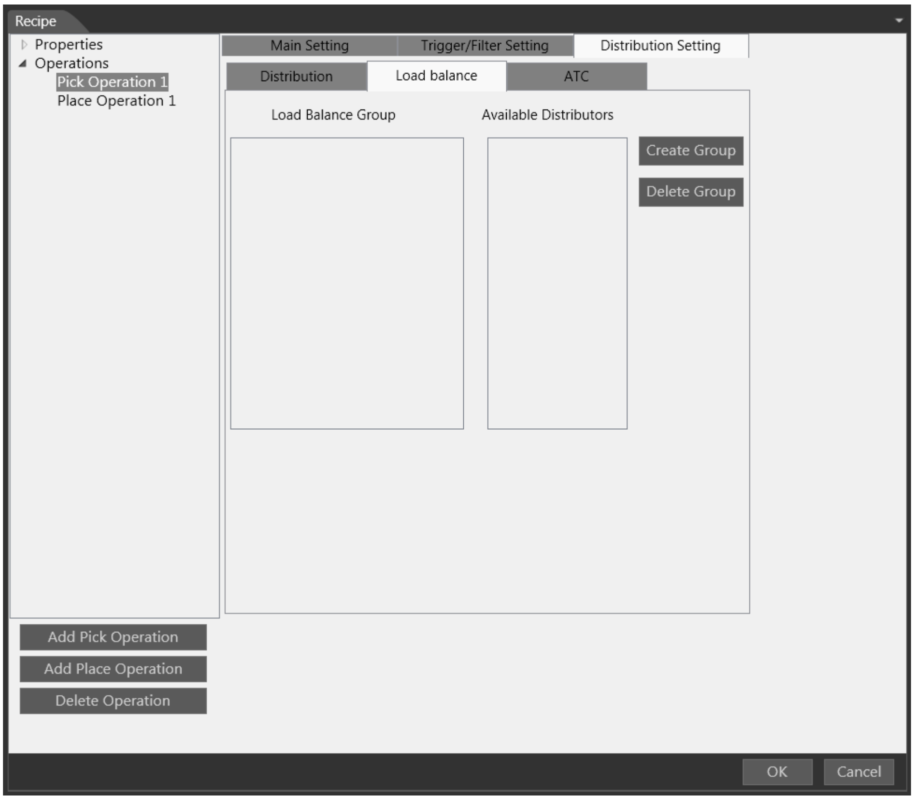
Load balance

Item positions that are distributed by a load balance group are divided among the distributors in the group. A load balance group can contain any number of item distributors and a single distributor can appear several times. The ratio between the number of times a single distributor is added and the total number of distributors defines the ratio of the item positions that are sent by that particular distributor. Item positions are arranged to the distributors in the group in an optimal way to avoid adjacent positions to be sent to the same work area.

If *Adaptive Task Completion* is selected, any defined ATC groups will be listed among the available distributors. Additionally, ATC groups can be added to load

Continues on next page

balance groups. However, to achieve task completion, the load balance group should only contain ATC groups.



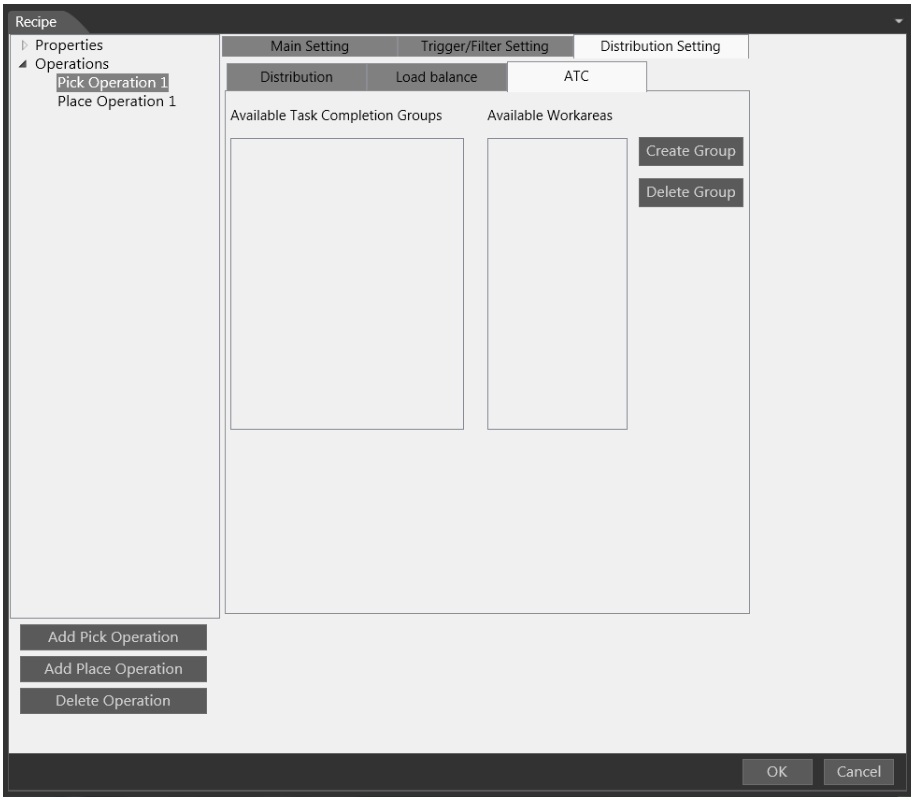
xx1800001446

	Description
Load Balance Group	Show you the created load balance group.
Available Distributor	Show you the available distributor for this operation.
Create Group	Allows you to create a load balance group.
Delete Group	Allows you to delete a load balance group.

Continues on next page

ATC

Adaptive Task Completion guarantees the item positions to be accessed by any robot in an ATC group. An ATC group contains ordered work areas and a single work area is allowed to exist once in a group. All item positions distributed to an ATC group are sent to every work area in the group and the positions not accessed by the first work area will be accessed by any of the other work areas. If the last work area is on a conveyor with start and stop it is guaranteed that all item positions will be accessed by one of the robots in the ATC group.



xx1800001447

	Description
Adaptive Task Completion Group	Show you the created adaptive task completion group.
Available Distributor	Show you the available distributor for this operation.
Create Group	Allows you to create a adaptive task completion group.
Delete Group	Allows you to delete a adaptive task completion group.

Continues on next page

Procedure

On the PickMaster PowerPac ribbon-tab, click **Layout**.

xx1800001438

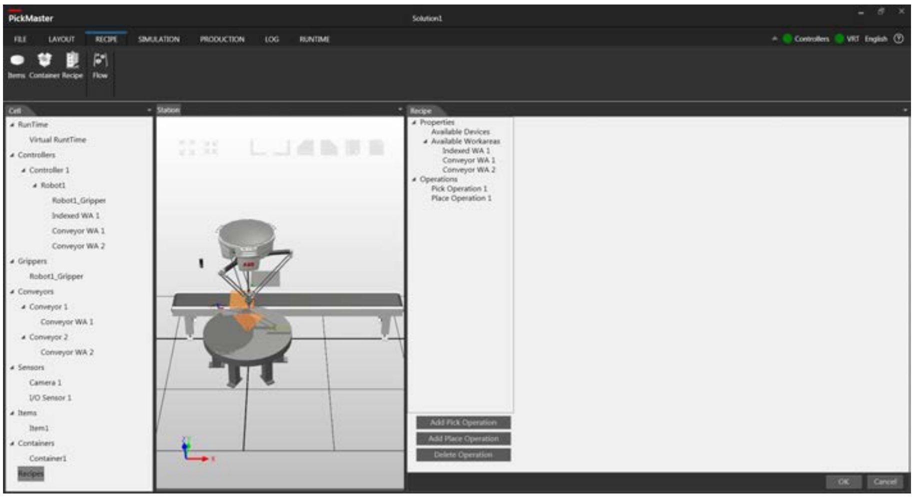
Use this procedure to add a recipe:

1. On the ribbon-tab, click **Recipe**.

   xx1800001438

   The **Recipe** window opens.

   xx1800001439

2. Click on the **Pick Operation1** to open the setting window for the pick operation.
3. Select the **Source Type** according to your requirements.

   > **Note**
   >
   > **Predefined** in the **Source Type** and **Flow** cannot be selected together.

4. If need, click to select the cameras in **Available Camera**.
5. If need, click to select the applicable flow in **Select Flow**.
6. Click to select the item in **Available Objects**.
7. Click to select the work area in **Available Work Areas**.

Continues on next page

8. In the **Trigger/Filter Setting** tab, define the trigger or filter setting according to your requirements.
9. In the **Distribution** tab, drag distributors from the **Available distributors** list to the **Distribution** list.

   There can be only one distributor for each item type. If an item type is missing a distributor, it will be regarded as ByPass.
10. If using load balancing, in the **Load balance** tab, drag a distributor from the **Available distributors** list to a group in the list **Load balance groups**.

    To create a new load balance group, double-click <**New LbGroup**> in the **Available distributors** list.

    Select rebalancing strategy.
11. If using Adaptive Task Completion, in the **ATC** tab, drag a work area from the **Available work areas** list to the **Adaptive Task Completion groups** list.
12. Click **OK**.

    The window is closed.

Redistributing items from one robot to downstream robots

It is possible to modify the distribution of alredy distributed item positions when they enter a conveyor work area of a robot. The Rapid program, that controls the robot, based on current flow conditions decides to skip an item position and change the type of it. As a result, PickMaster PowerPac will redistribute the item position to downstream robots according to the configured distribution strategy for the selected item type.

4.2.10 Adding Flow

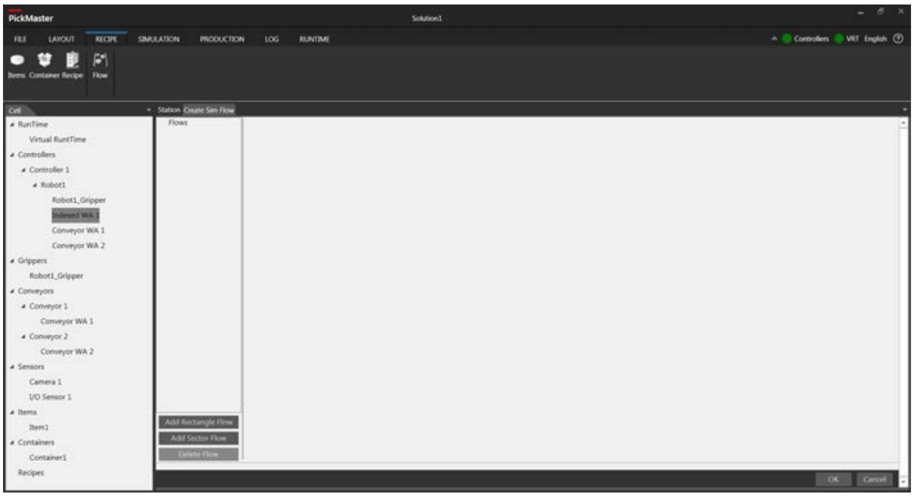
Overview

A flow is used to define how the items and containers are to be generated in the simulation. A flow is attached to a hot spot on a conveyor or an indexed work area in the job configuration. When attaching the flow, the hot spot becomes a source from where items and containers appear in the simulation according to the flow configuration. Following are the two types of flows:

- Layout: A Layout flow is a predefined layout that is periodically regenerated at the hot spot. The layout may have some random variation regarding the locations of items or containers and the availability of them. The layout may consists of different items or container patterns.
- Recorded: A recorded flow is a recording of a sensor from a real solution in operation. The recording is exported from PickMaster PowerPac as an xml file having information of all the detected items and containers during a time interval. When the file is imported, the items detected are mapped to the configured items and container patterns.

Adding a flow

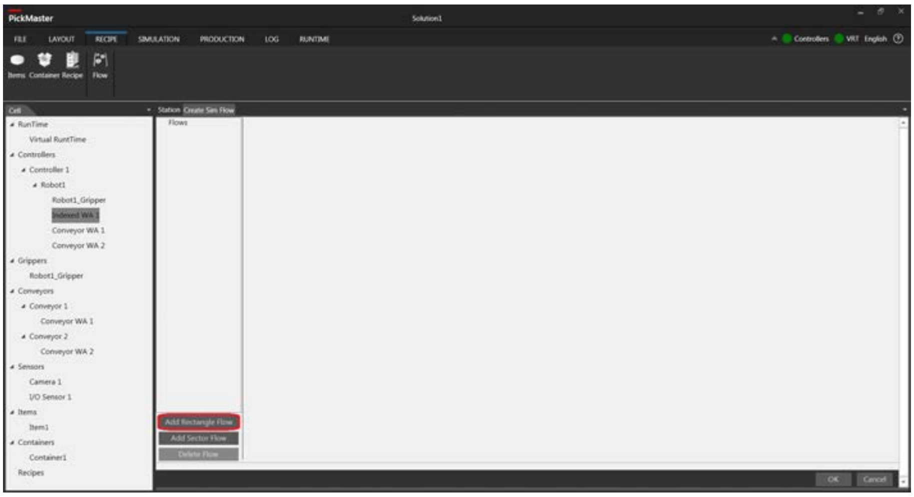
The **Flow** window opens as illustrated below.



xx1800001743

Continues on next page

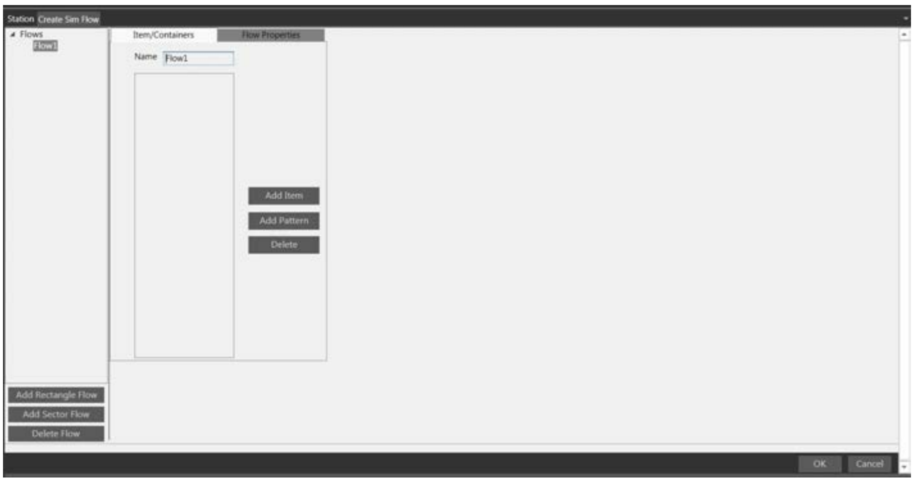
Add Rectangle Flow



xx1900000581

	Description
Item/Containers	Allows you to add items and containers for the flow. For more information regarding Item/Containers see the following section.
Flow properties	Allows you to define the flow. For more information regarding Flow properties see the following section.

Item/Containers



xx1900000580

	Description
Name	Allows you to rename the flow.
Add item	Allows you to add an item for the flow.
Add pattern	Allows you to add pattern for the flow.
Delete	Allows you to delete the selected item or pattern in the flow.

Continues on next page

Flow properties

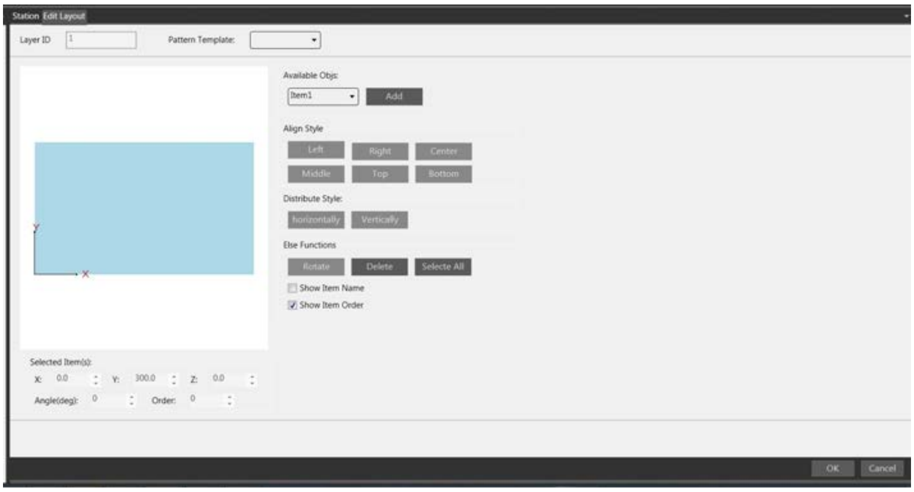
xx1900000583

	Description
Flow Type	Allows you to choose the type the flow. **LAYOUT**: the position of the items and containers in the flow. **Recorded**: run a simulation according to the recorded position of the items and containers. **GhostPicking**: run a production according to the recorded position of the items and containers without entities.
Layout Regenerate Dist	The distance between consecutive flow layouts generated on a conveyor. Not used with recorded flows.
Conveyor Speed	When select this radio button, you can change the speed of the conveyor when the flow is assigned to a conveyor. **Note** You can only choose one from **Conveyor Speed** and **Throughput**.
Throughput	When select this radio button, you can change the item throughput of the conveyor when running the flow. **Note** You can only choose one from **Conveyor Speed** and **Throughput**.
Stability	If set to 100%, all the items in the layout are generated on every trigger without losses. A lower value defines the probability that an item in the layout is generated.
Position Stability	If set to 100%, the generated items always have correct position. A lower value defines the probability that an item gets the correct position.
Orientation Stability	If set to 100%, the generated items always have correct orientation. A lower value defines the probability that an item gets correct orientation.
X pos dev min/max	Defines the minimum and maximum deviation of the **X** position from the correct value.
Y pos dev min/max	Defines the minimum and maximum deviation of the **Y** position from the correct value.

Continues on next page

	Description
Z pos dev min/max	Defines the minimum and maximum deviation of the **Z** position from the correct value.
Rejection Ratio	Defines the probability that an item becomes rejected by a camera. If set to 0%, the item setting “Rejected” in the Layout will decide if the item is rejected.
Layout Size	Allows you to edit the size of the layout. **Edit Layout** allows you to edit the selected flow. For more information regarding Edit Layout see the following section.

Edit Layout



xx1900000584

	Description
Layer ID	Allows you to rename the layer.
Pattern Template	Allows you to select a predefined pattern template.
Available Objs	The drop down list allows you to select one item you have created for this system. **Add** icon allows you to add the selected item onto the layer.
Align Style	Allows you to define the align style when you have more than one item in the layer. **Left** icon allows you to align all the items in this layer from the left. **Right** icon allows you to align all the items in this layer from the right. **Center** icon allows you to align all the items in this layer from the center. **Middle** icon allows you to align all the items in this layer from the middle. **Top** icon allows you to align all the items in this layer at from top. **Bottom** icon allows you to align all the items in this layer from the bottom.
Distribute Style	Allows you to define the distribution style when you have more than one item in the layer. **Horizontally** icon allows you to distribute all the items in the horizontal direction. **Vertically** icon allows you to distribute all the items in the vertical direction.

Continues on next page

	Description
Else Functions	**Rotate** icon allows you to rotate the selected items. **Delete** icon allows you to delete the selected items. **Select All** icon allows you to select all the items in the layer. **Show Item Name** checkbox allows you to show the name of the items. **Show Item Order** checkbox allows you to show the added order of the items.
Selected Item(s)	Allows you to define the location and position of each items.

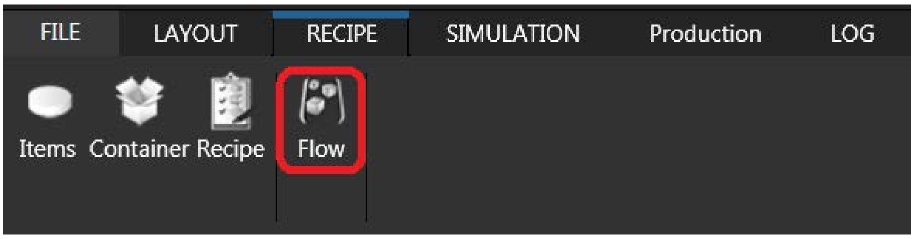
Add a rectangle flow procedure

On the PickMaster PowerPac ribbon-tab, click **Recipe**.

xx1800001438

Use this procedure to add a rectangle flow:

1. On the ribbon-tab, click **Recipe**.



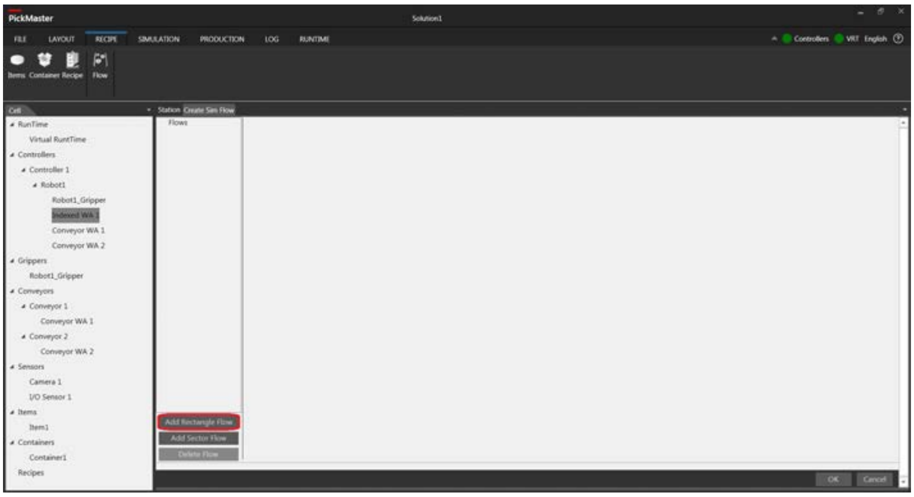
xx1800001721

The **Create Sim Flow** window is opened.

xx1800001722

Continues on next page

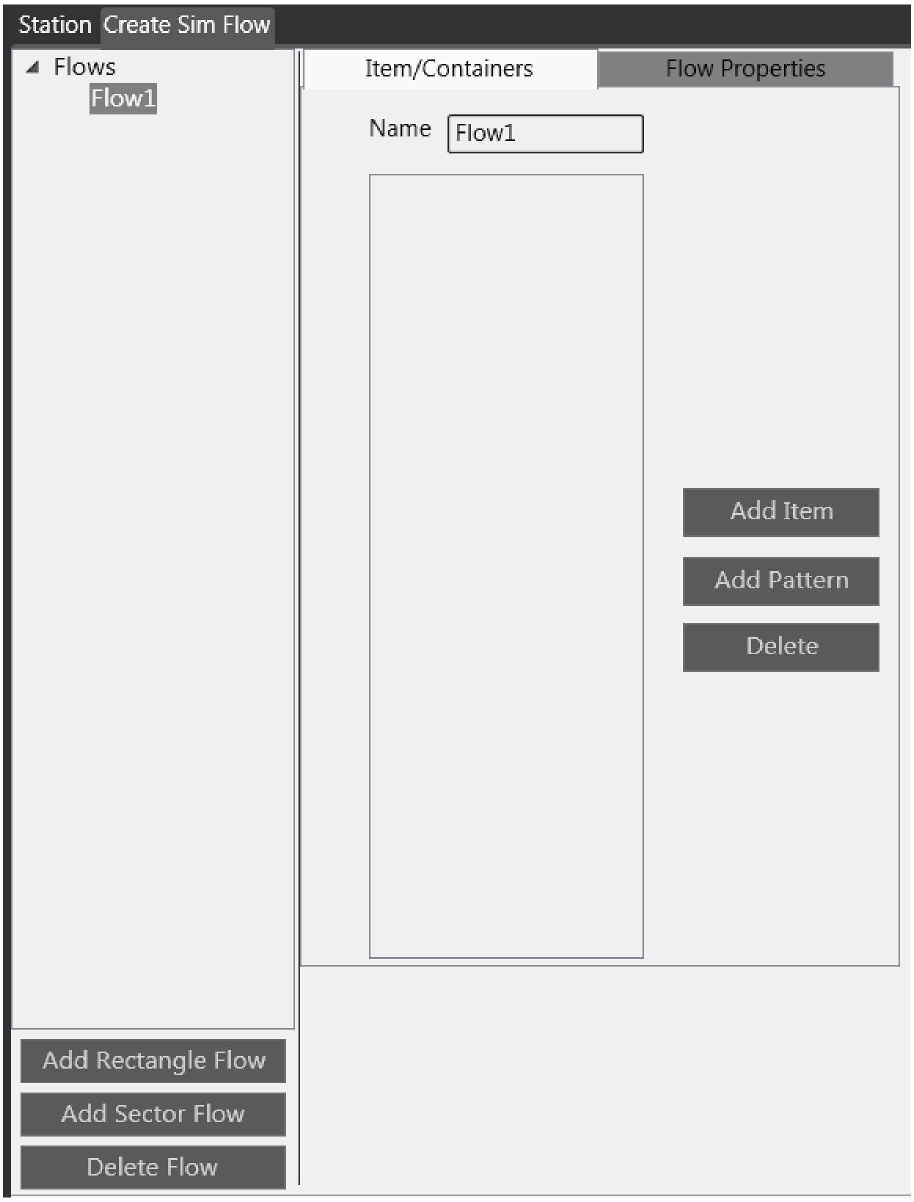
2 Click **Add Rectangle Flow** to add a rectangle flow.



xx1900000581

Continues on next page

A new rectangle flow is created.

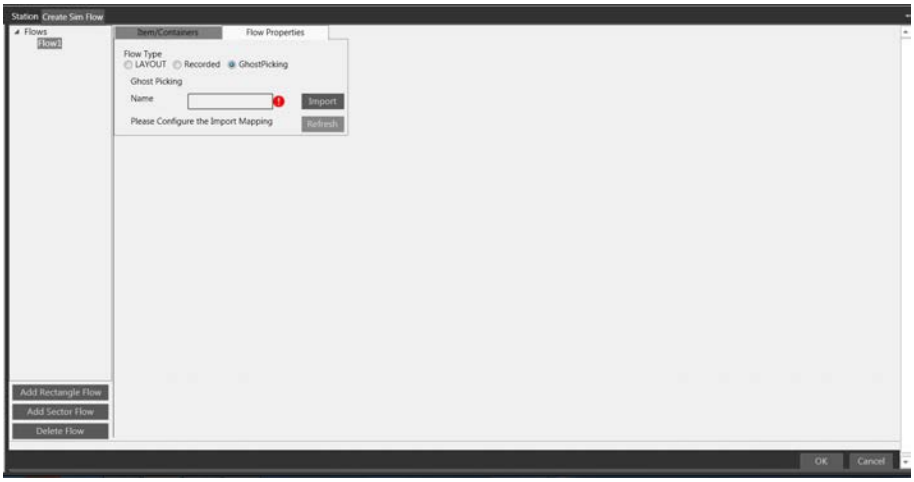


xx1800001723

3 Click **Add Item** in the **Item**/**Container** tab to add an item for the flow.
4 Click **Add Pattern** in the **Item**/**Container** tab to add a pattern for the flow.

Continues on next page

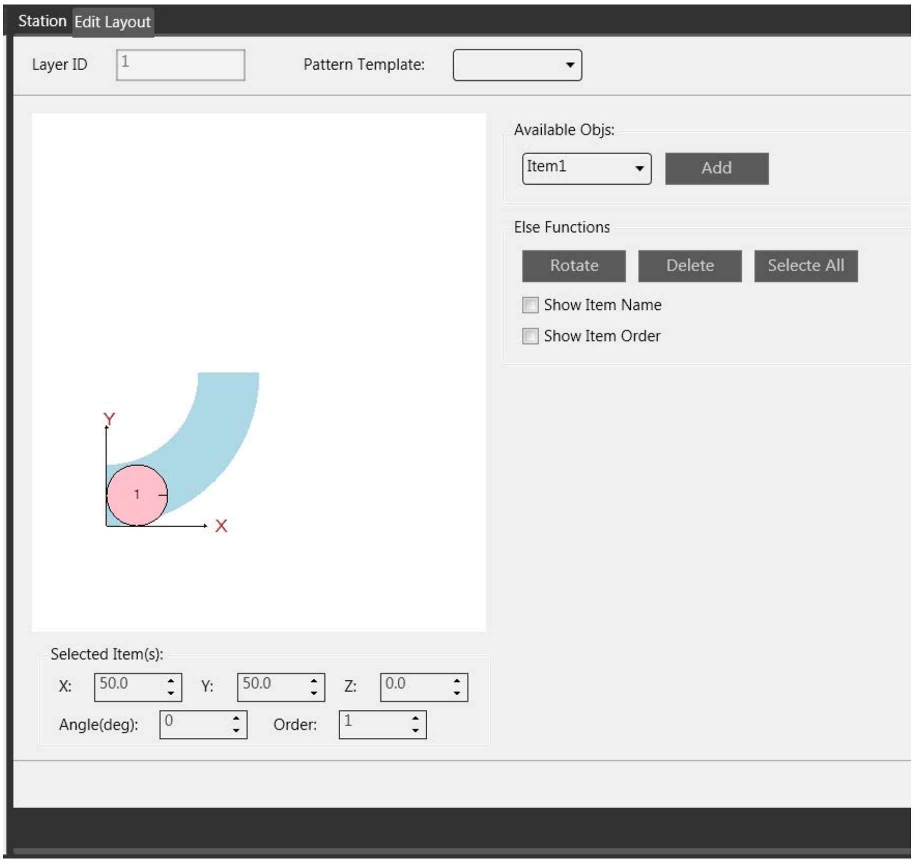
5 Click **Flow properties** in the **Item**/**Container** tab to edit the data according to the requirements..



xx1800001724

6 Click the **Edit Layout** icon to open the dialog.

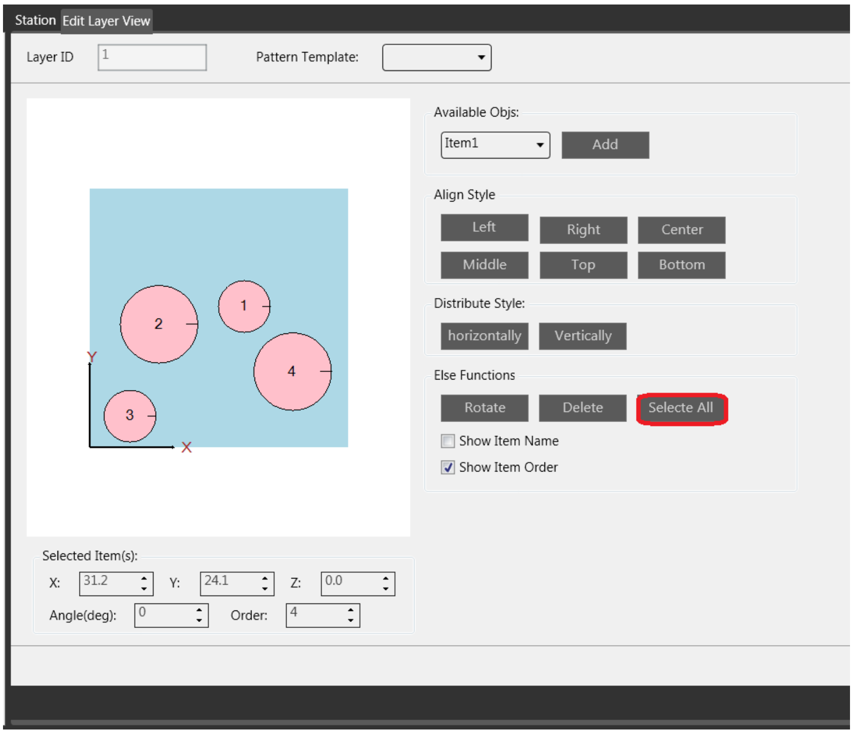
7 Click the **Add** icon in the **Edit Layout** dialog to add an item.



xx1800001726

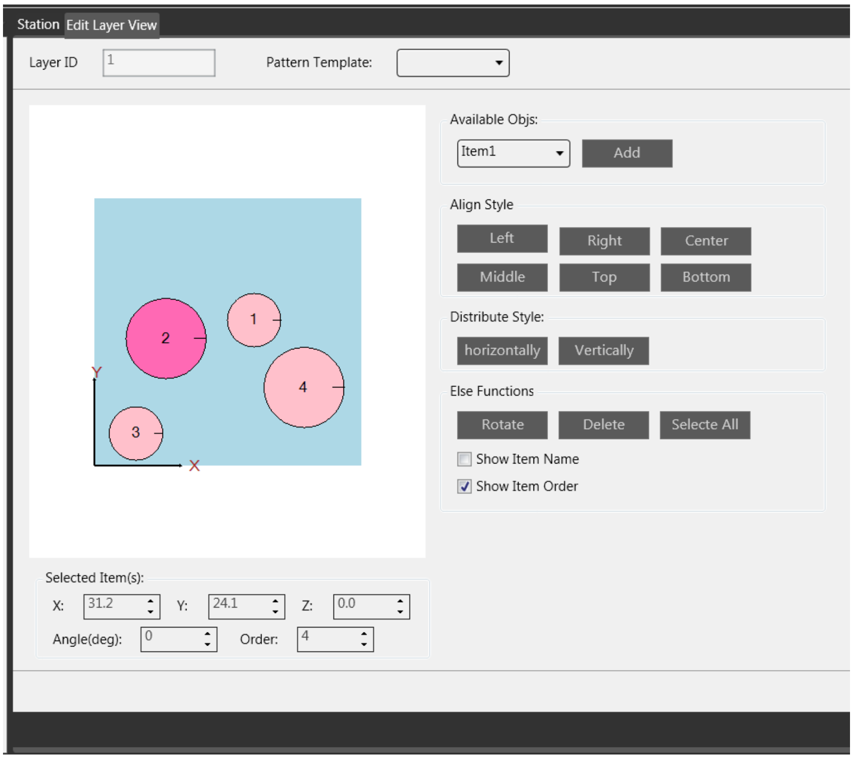
Continues on next page

A Select all items on the layer.



xx2000000295

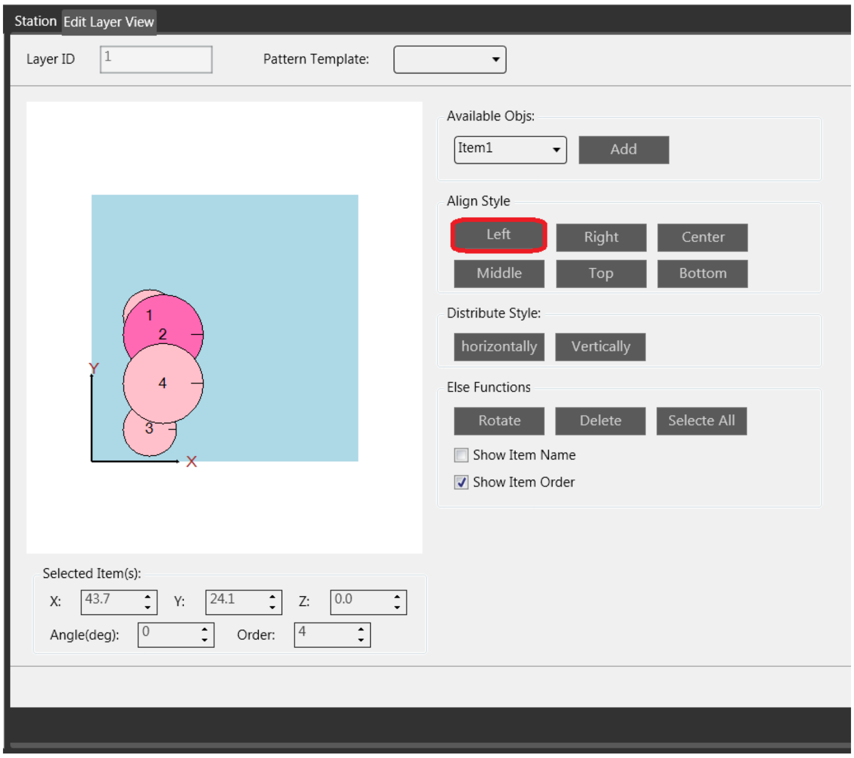
B Click 'Ctrl' and select the base item at the same time.



xx2000000296

Continues on next page

C Click **Left** to align all items on the left edge according to the base item.



xx2000000297

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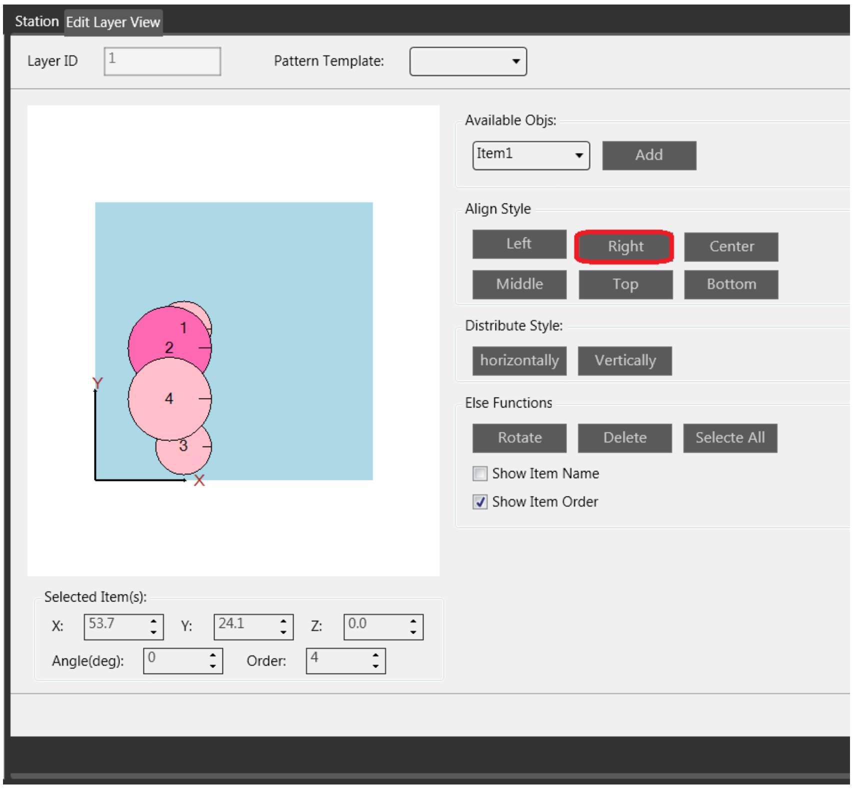
Click **Right** to align all items on the right edge according to the base item.



xx2000000298

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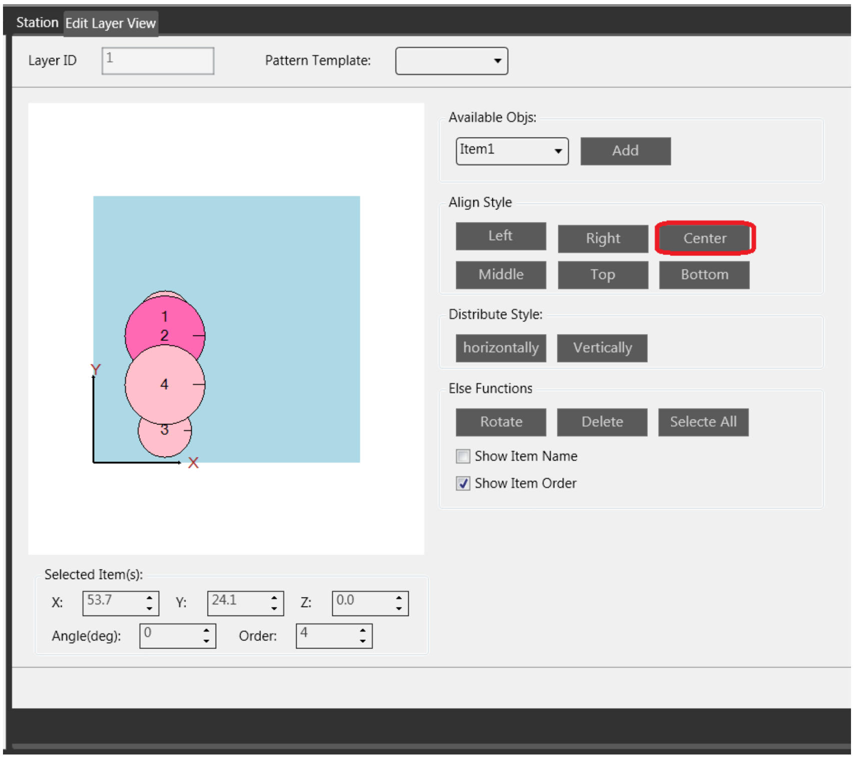
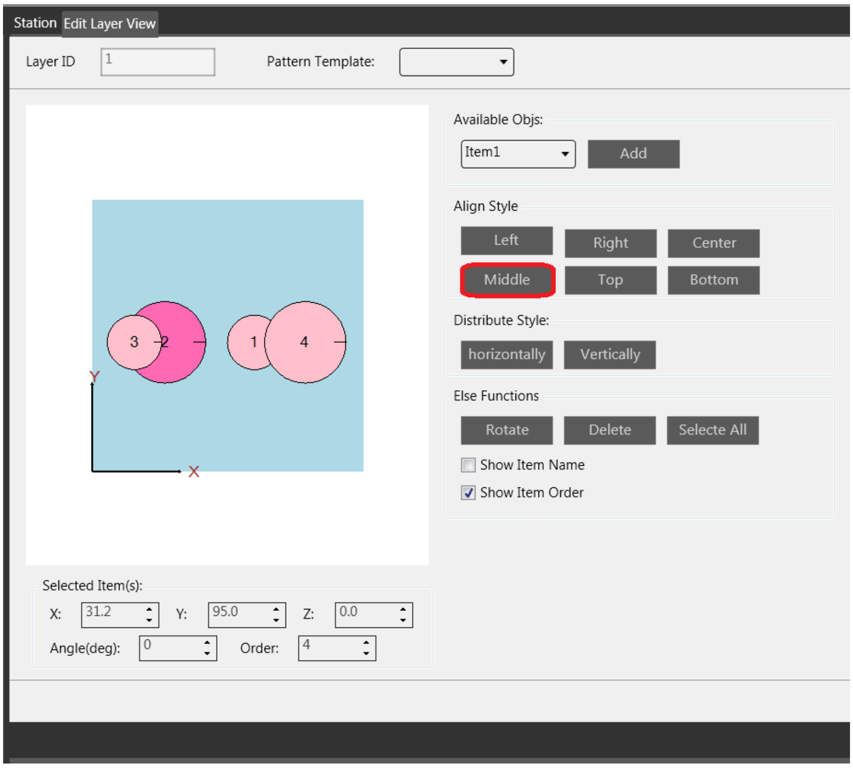
Click **Center** to align all items on the centre line vertically according to the base item.



xx2000000299

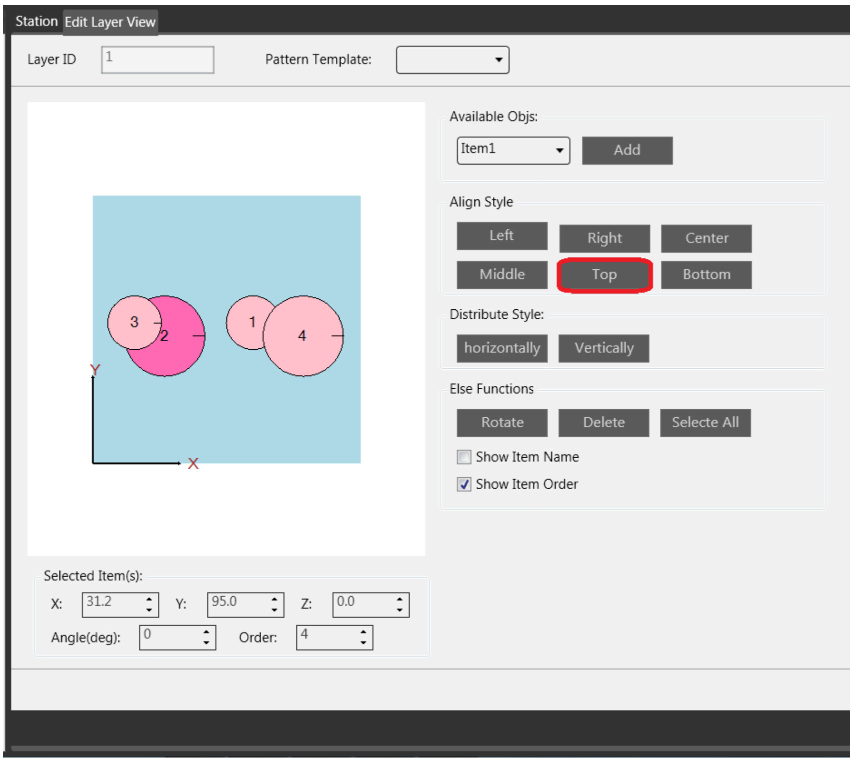
Continues on next page

Click **Middle** to align all items on the centre line horizontally according to the base item.



xx2000000300

Click **Top** to align all items on the top edge according to the base item.



xx2000000301

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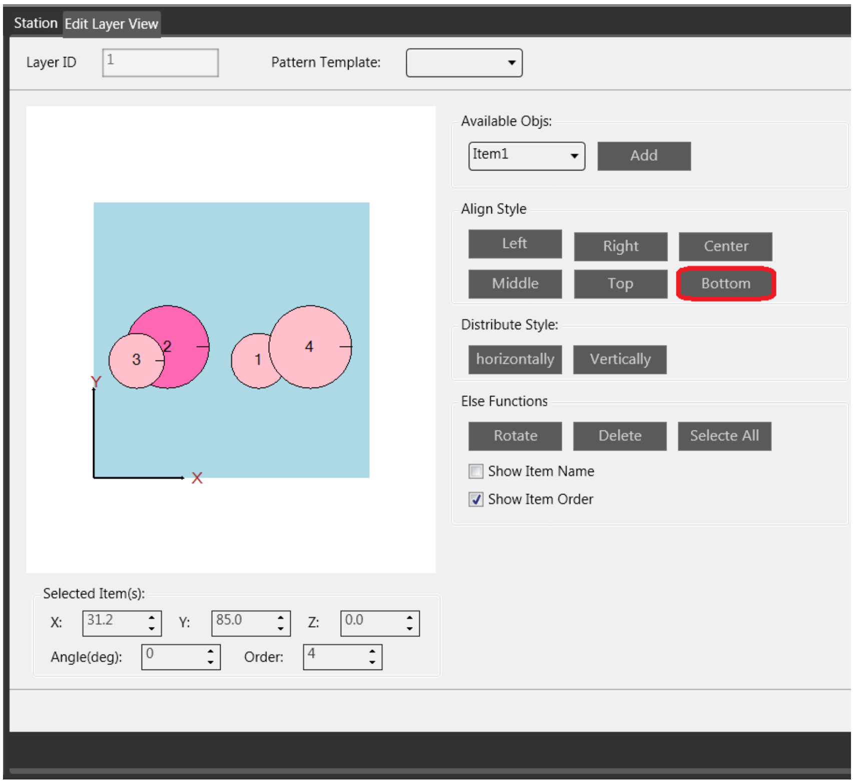
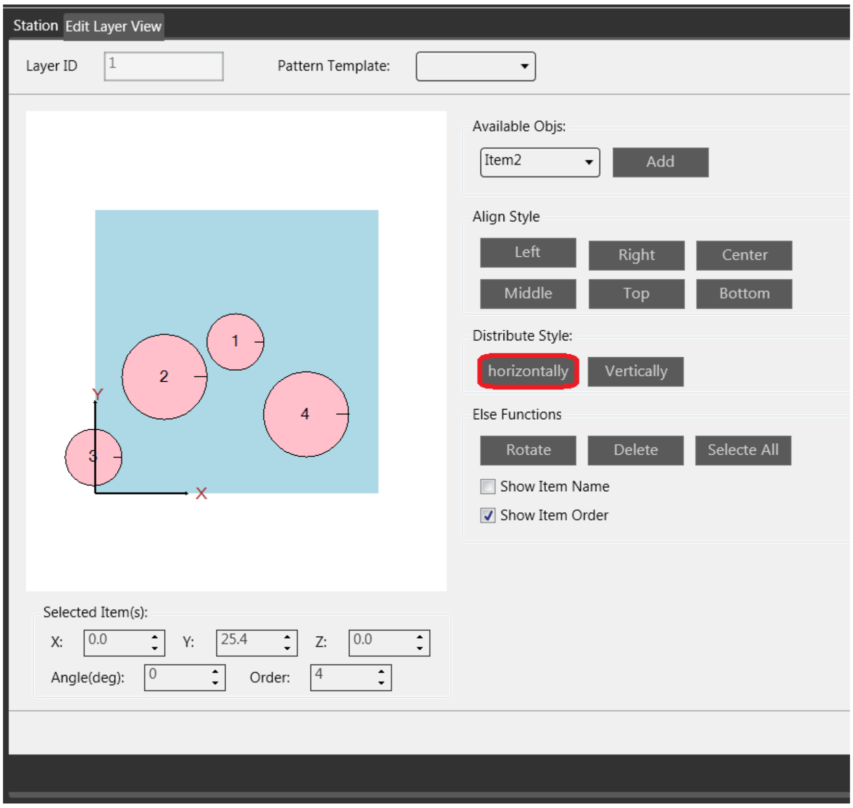
Click **Bottom** to align all items on the bottom edge according to the base item.



xx2000000302

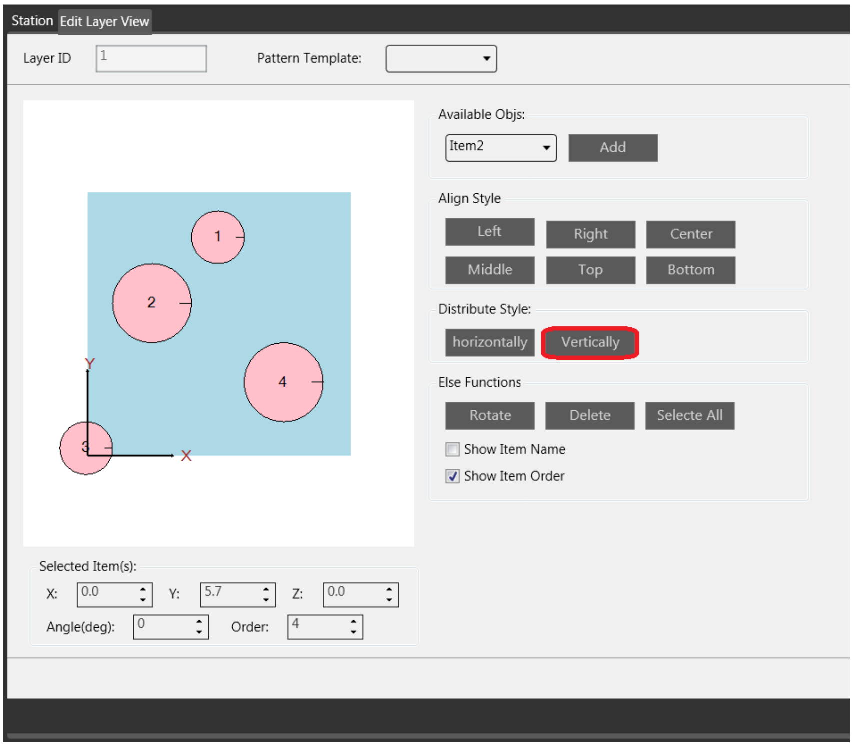
Continues on next page

D Click **Horizontally** to set all items tangent in horizontal direction.



xx2000000303

Click **Vertically** to set all items tangent in vertical direction.

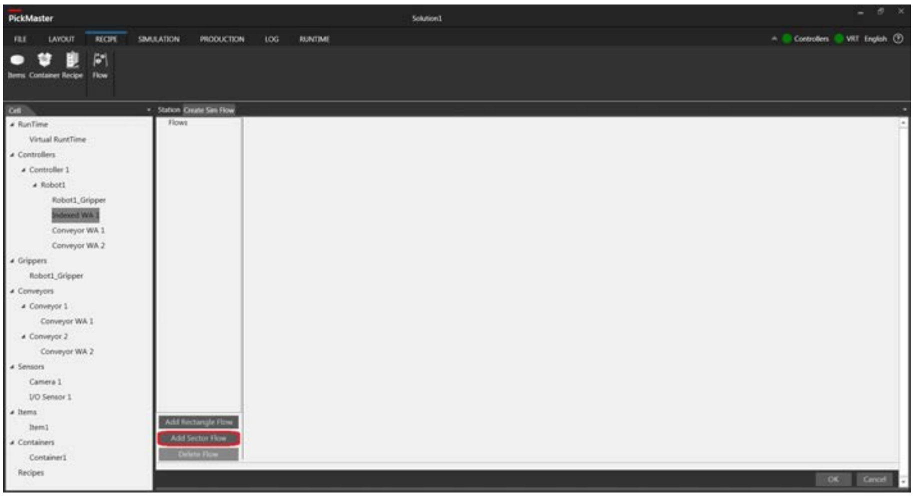


xx2000000304

Continues on next page

8 Click **OK** to apply the configuration.
9 Click **OK** to close the **Create Sim Flow** dialog.

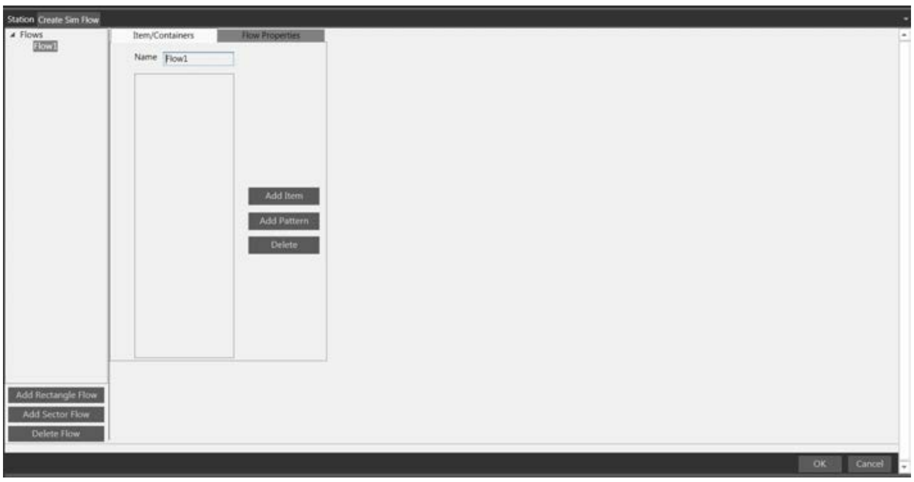
Add Sector Flow



xx1900000582

	Description
Item/Containers	Allows you to add items and containers for the flow. For more information regarding Item/Containers see the following section.
Flow properties	Allows you to define the flow. For more information regarding Flow properties see the following section.

Item/Containers



xx1900000580

	Description
Name	Allows you to rename the flow.
Add item	Allows you to add an item for the flow.
Add pattern	Allows you to add pattern for the flow.
Delete	Allows you to delete the selected item or pattern in the flow.

Continues on next page

Flow properties

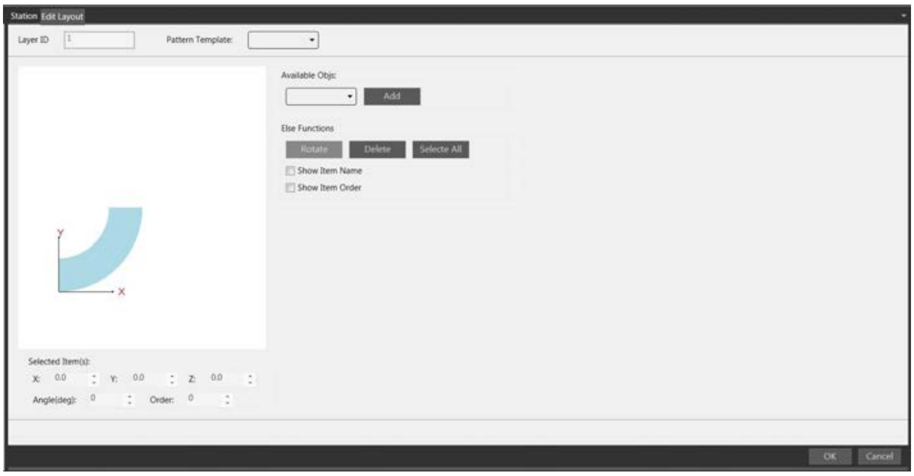
xx1900000583

	Description
Flow Type	Allows you to choose the type the flow. **LAYOUT**: the position of the items and containers in the flow. **Recorded**: run a simulation according to the recorded position of the items and containers. **GhostPicking**: run a production according to the recorded position of the items and containers without entities.
Layout Regenerate Dist	The distance between consecutive flow layouts generated on a conveyor. Not used with recorded flows.
Conveyor Speed	When select this radio button, you can change the speed of the conveyor when the flow is assigned to a conveyor. **Note** You can only choose one from **Conveyor Speed** and **Throughput**.
Throughput	When select this radio button, you can change the item throughput of the conveyor when running the flow. **Note** You can only choose one from **Conveyor Speed** and **Throughput**.
Stability	If set to 100%, all the items in the layout are generated on every trigger without losses. A lower value defines the probability that an item in the layout is generated.
Position Stability	If set to 100%, the generated items always have correct position. A lower value defines the probability that an item gets the correct position.
Orientation Stability	If set to 100%, the generated items always have correct orientation. A lower value defines the probability that an item gets correct orientation.
X pos dev min/max	Defines the minimum and maximum deviation of the **X** position from the correct value.
Y pos dev min/max	Defines the minimum and maximum deviation of the **Y** position from the correct value.

Continues on next page

	Description
Z pos dev min/max	Defines the minimum and maximum deviation of the **Z** position from the correct value.
Rejection Ratio	Defines the probability that an item becomes rejected by a camera. If set to 0%, the item setting “Rejected” in the Layout will decide if the item is rejected.
Inner Outer Radius	Allows you to edit the inner and outer radius of the working area. **Edit Layout** allows you to edit the selected flow. For more information regarding Edit Layout see the following section.
Sector Angle(deg)	

Edit Layout



xx1900000585

	Description
Layer ID	Allows you to rename the layer.
Pattern Template	Allows you to select a predefined pattern template.
Available Objs	The drop down list allows you to select one item you have created for this system. **Add** icon allows you to add the selected item onto the layer.
Else Functions	**Rotate** icon allows you to rotate the selected items. **Delete** icon allows you to delete the selected items. **Select All** icon allows you to select all the items in the layer. **Show Item Name** checkbox allows you to show the name of the items. **Show Item Order** checkbox allows you to show the added order of the items.
Selected Item(s)	Allows you to define the location and position of each items.

Continues on next page

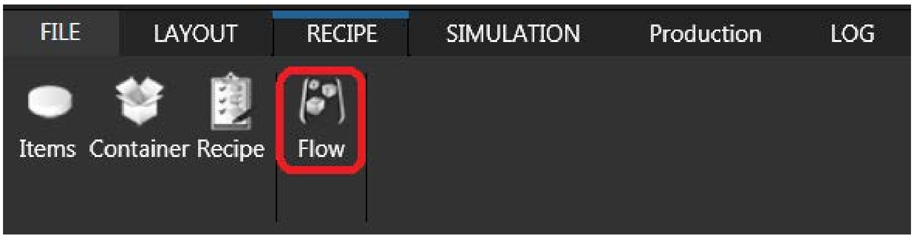
Add a sector flow procedure

On the PickMaster PowerPac ribbon-tab, click **Recipe**.

xx1800001438

Use this procedure to add a sector flow:

1 On the ribbon-tab, click **Flow**.



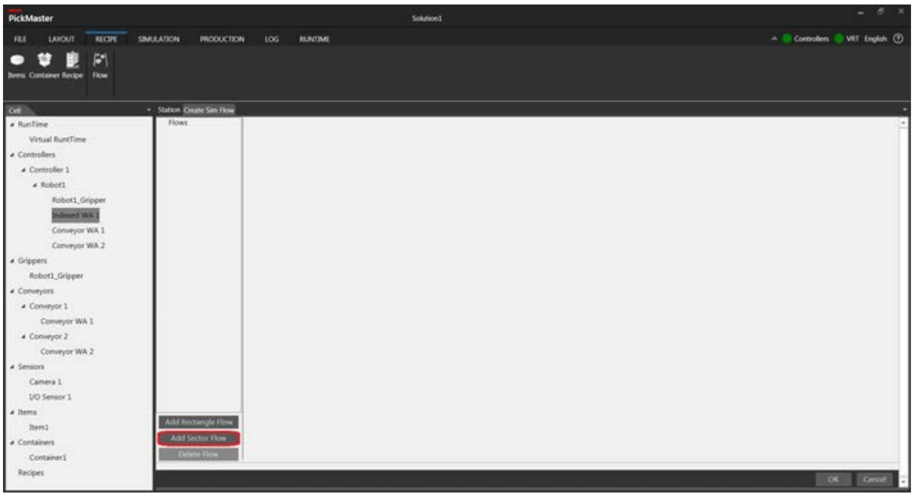
xx1800001721

The **Create Sim Flow** window is opened.

xx1800001722

Continues on next page

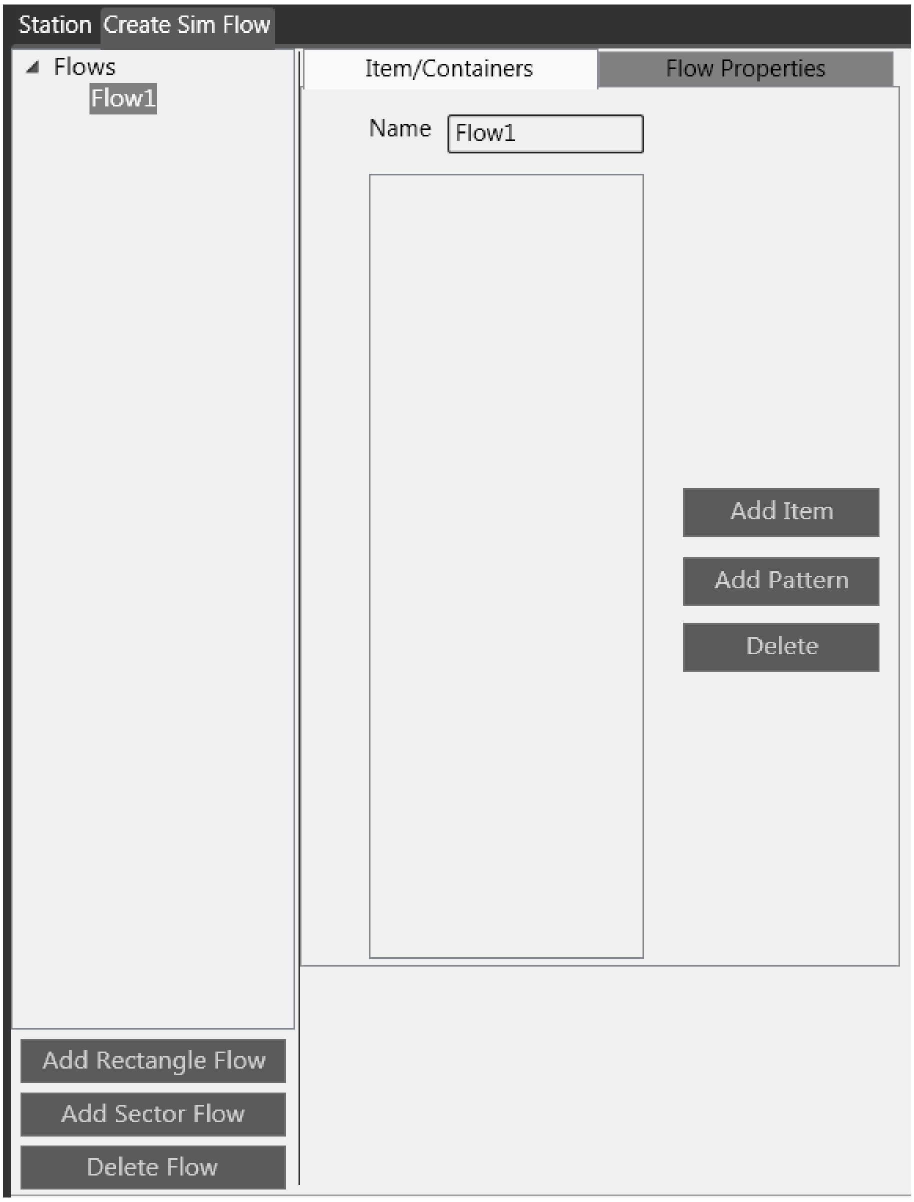
2 Click **Add Sector Flow** to add a sector flow.



xx1900000582

Continues on next page

A new flow is created.

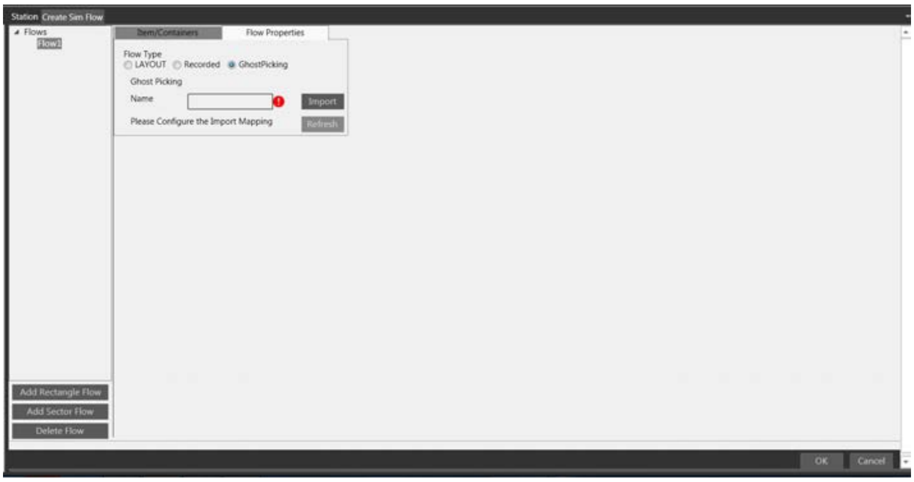


xx1800001723

3 Click **Add Item** in the **Item**/**Container** tab to add an item for the flow.
4 Click **Add Pattern** in the **Item**/**Container** tab to add a pattern for the flow.

Continues on next page

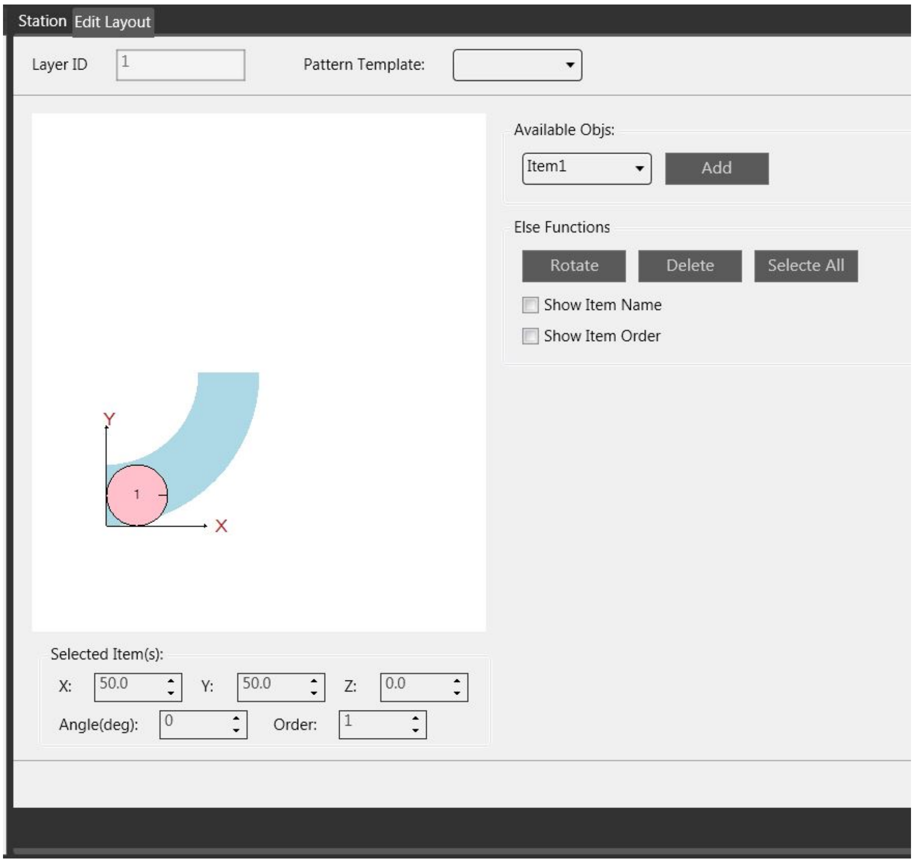
5 Click **Flow properties** in the **Item/Container** tab to edit the data according to the requirements.



xx1800001724

6 Click the **Edit Layout** icon to open the dialog.

7 Click the **Add** icon in the **Edit Layout** dialog to add an item.



xx1800001726

8 Click **OK** to apply the configuration.

9 Click **OK** to close the **Create Sim Flow** dialog.

4.2.11 Calibration

Overview

This section describes how to calibrate the created solution.

The calibration in PickMaster PowerPac is a prerequisite for running the simulation. The calibration is different with the calibration of the actual hardware (camera, conveyor, IO sensor, etc.). Running this calibration does not mean that the actual hardware calibration has been completed.

The calibration in PickMaster PowerPac is used to establish the relative relationship between the conveyor base frame and the robot base coordinate system in the virtual controller.

If a camera is used for a linear conveyor in the solution, the base frame of the conveyor is directly below the camera after calibration (x is the forward direction). If an IO sensor is used for a linear conveyor, the base frame of the conveyor is located at the IO sensor. If a pre-defined point is not used for a linear conveyor, the base frame of the conveyor overlaps the hot spot.

Indexed work area calibration is consistent with linear conveyor's calibration.

The calibrated base coordinate system of the circular conveyor belt is located at the center of the conveyor belt, and the x-direction points directly below the camera or along the IO sensor. If the circular conveyor uses a predefined point, the x direction points to a predefined coordinate point.

Calibration

On the PickMaster PowerPac ribbon-tab, click **Simulation**.

Use this procedure to calibrate:

1 Click to select the recipe that need to calibrate.

> **Note**
>
> If the layout in the solution changes, such as changing the camera position or robot position, redo the calibration.

> **Note**
>
> Each recipe in a solution needs to be individually calibrated.
>
> If different recipes use different layouts, after running a simulation of recipe A, you need to use another recipe B for simulation, then you must calibrate recipe B first.

Continues on next page

2 Click **Calibration** on the ribbon-tab. Then it will start to calibrate the created solution automatically.

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The calibration runs automatically.

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4.2.12 Simulation

Overview

This section describes how to do the simulation with the created solution.

Production

All operations in the simulation production are reflected in the station view, and all data comes from the solution.

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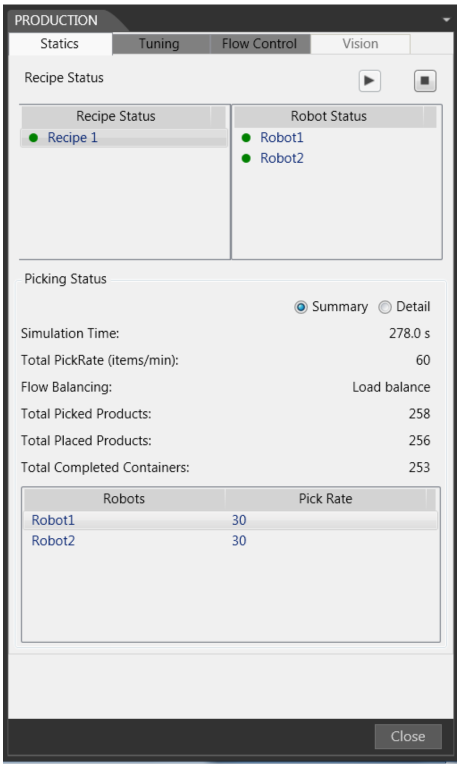
	Description
Statics	Allows you to control the status of the production and have an overview of the production data. For more information regarding Statics see the following section.
Tuning	Allows you to adjust the parameters of the item, work area and robot. For more information regarding Tuning see the following section.
Flow Control	Allows you to adjust the speed of the conveyor. For more information regarding Flow Control see the following section.
Vision	Allows you to see the live video of the camera. This function is only available in the real production and emulation. For more information, see *Vision on page 293*.

Continues on next page

Statics



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	Description
Recipe Status	Allows you to control the status of the production.
Picking Status	Allows you to have an overview of the picking status in summary or detail.

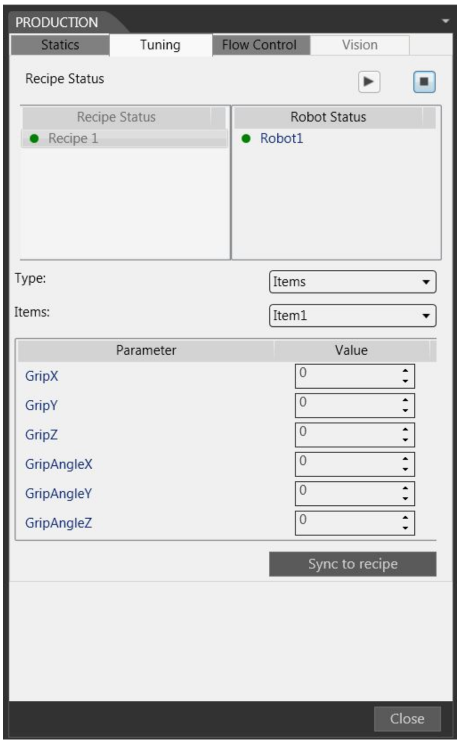
Tuning

Sometimes, the exact pick and place positions are not exactly where expected. This might be caused by a small error in the calibration of either the camera or the work area. It is possible to adjust the positions while running a project. This is called tuning.

	Description
Recipe Status	Allows you to control the status of the production.
Type	Allows you to choose the objects in the solution and change their parameters.

Continues on next page

Tuning the item



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	Description
GripX	Allows you to set the location of the gripper when doing the picking and placing operation in X direction.
GripY	Allows you to set the location of the gripper when doing the picking and placing operation in Y direction.
GripZ	Allows you to set the location of the gripper when doing the picking and placing operation in Z direction.
GripAngleX	Allows you to set the angle of the gripper when doing the picking and placing operation in X direction. **Note** The angle cannot be out of the physical limits. Or the robot will not work normally. For example, trying to rotate the gripper of an IRB 360 robot in X or Y direction will cause an error. Redo the simulation after the error occurred.
GripAngleY	Allows you to set the angle of the gripper when doing the picking and placing operation in Y direction. **Note** The angle cannot be out of the physical limits. Or the robot will not work normally. For example, trying to rotate the gripper of an IRB 360 robot in X or Y direction will cause an error. Redo the simulation after the error occurred.

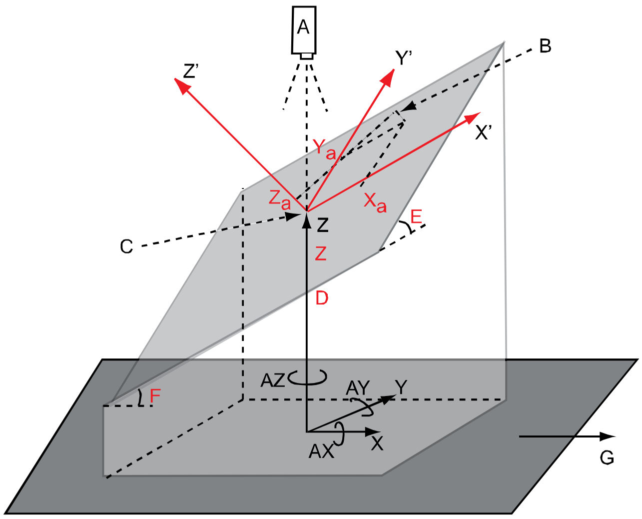
Continues on next page

	Description
GripAngleZ	Allows you to set the angle of the gripper when doing the picking and placing operation in Z direction. **Note** The angle cannot be out of the physical limits. Or the robot will not work normally.

Configuring the grip location

Use this procedure to configure the item's grip location.

1. Select the **Type** as **Item** and select the required item.
2. Define the positions in millimeters for the grip position of the item specified in X', Y', and Z' coordinates. The positions are relative to the origin of the taught model (Vision model grip point). See the following graphic.



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A	Camera
B	Adjusted grip point
C	Vision model grip point
D	Item height
E	Angle X
F	Angle Y
G	Conveyor direction

3. Define the Euler orientation in degrees for the grip orientation on the item.

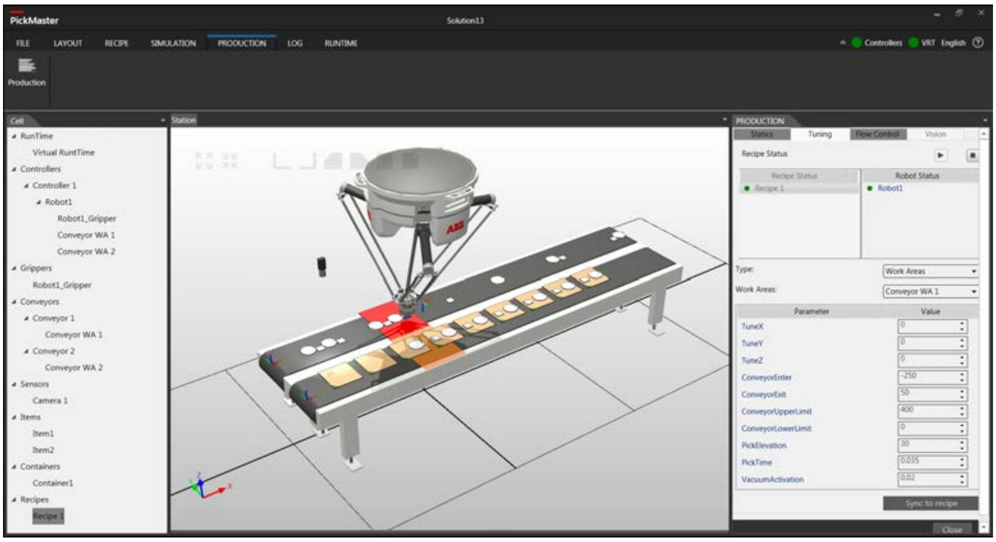
   A four axes robot (that is IRB 360) can only rotate around the z-axis and therefore only **GripAngleZ** can be used.

   Six axes robots can pick/place 3D items by defining Euler orientation **GripAngleX**, **GripAngleY** and the item height. The grip orientation has an orientation in relation to the origin of the taught model (Vision model grip point). The item height must be specified in the **Item configuration** dialog, as a distance from the base frame to the item origin (vision model grip point).

Continues on next page

It is important to define a correct calibration tool when calibrating the base frame of the conveyor, so the orientation in relation to the items grip point (place/pick) will be correct. It is also important to do the camera calibration at the same height as the item's grip point, that is vision model grip point.

Tuning the work area



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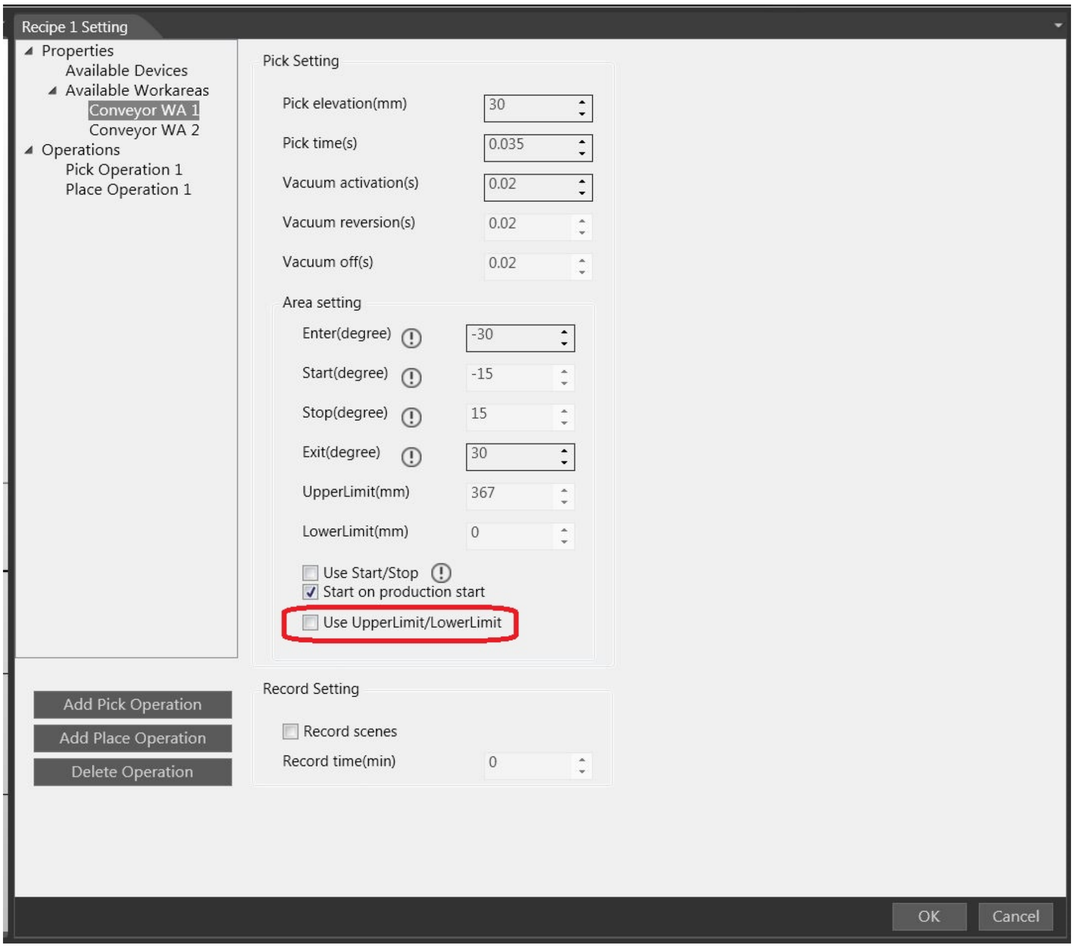
	Description
TuneX	Allows you to tune the position of the work area along the X direction when running simulation or production. Tuning the position of the work area along the X direction is equivalent to offsetting the conveyor base frame along the X direction.
TuneY	Allows you to tune the position of the work area along the Y direction when running simulation or production. Tuning the position of the work area along the Y direction is equivalent to offsetting the conveyor base frame along the Y direction.
TuneZ	Allows you to tune the position of the work area along the Z direction when running simulation or production. Tuning the position of the work area along the Z direction is equivalent to offsetting the conveyor base frame along the Z direction.
ConveyorEnter	**Enter** is the limit from where the robot starts to execute item targets on the work area. The distance is calculated in millimeters from the center of the robot. The range is positive if the limit is beyond the center of the robot, relative to the moving direction of the conveyor. Make sure that the enter limit can be reached by the robot.
ConveyorExit	**Exit** is the limit from where the robot considers an item target as lost on the work area. The distance is calculated in millimeters from the center of the robot. The range is positive if the limit is beyond the center of the robot, relative to the moving direction of the conveyor. When the tracked item passes beyond this limit it will be dropped. This limit must be chosen well within the maximum reach of the robot. The robot must be able to reach this position from an arbitrary position in the robot's working area before the position is out of reach.

Continues on next page

<table>
<tr><th></th><th>Description</th></tr>
<tr><td>ConveyorUpperLimit</td><td>

Note

To enable this function, you need to select the **checkbox** for this function in the recipe configuration page.



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Note

The **UpperLimit/LowerLimit** function in the **Tunning** window has a slight delay.

UpperLimit is the limit form where robot considers an item target as lost on the work area in End Y.The distance is calculated in milli-meters from the center of the robot. The range is positive if the limit is beyond the center of the robot, relative to the moving vertical direction of the conveyor.Make sure that the enter limit can be reached by the robot.

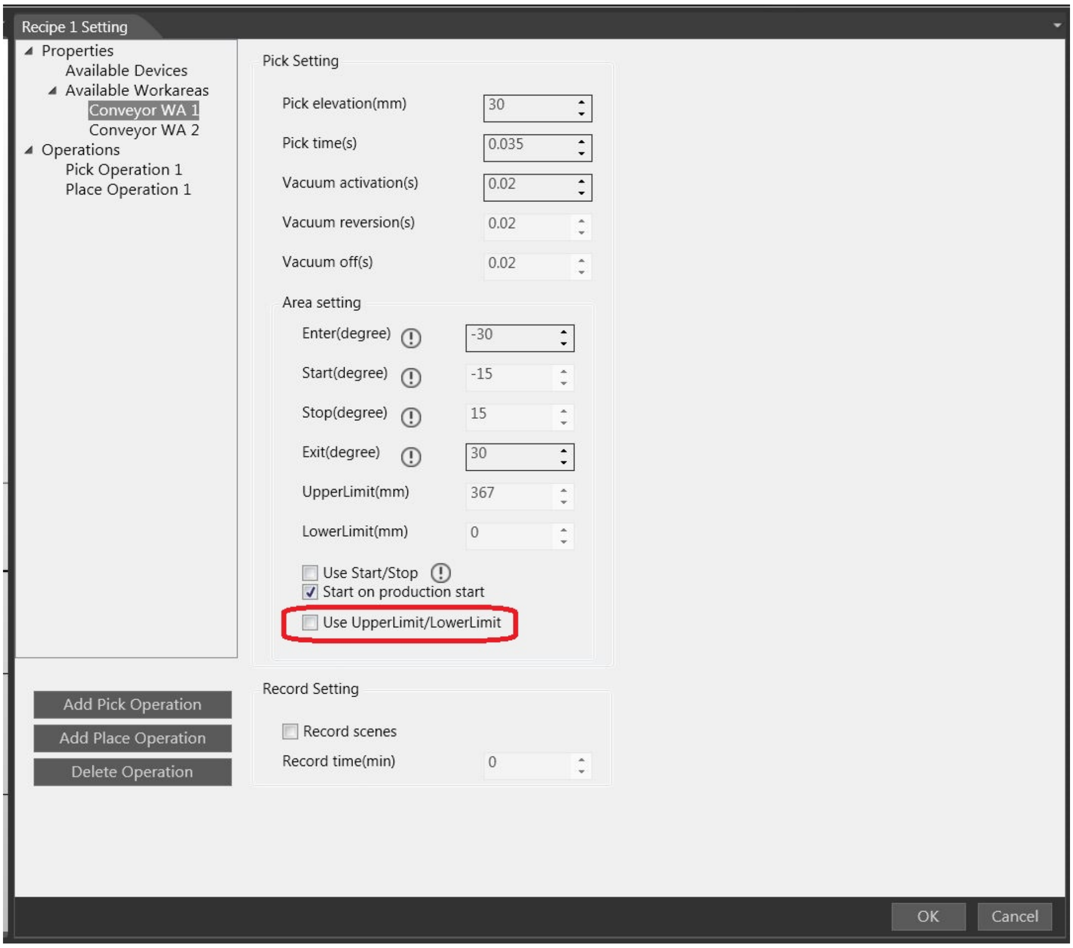
</td></tr>
</table>

Continues on next page

<table>
<tr><th></th><th>Description</th></tr>
<tr><td>Conveyor-LowerLimit</td><td>

Note

To enable this function, you need to select the **checkbox** for this function in the recipe configuration page.



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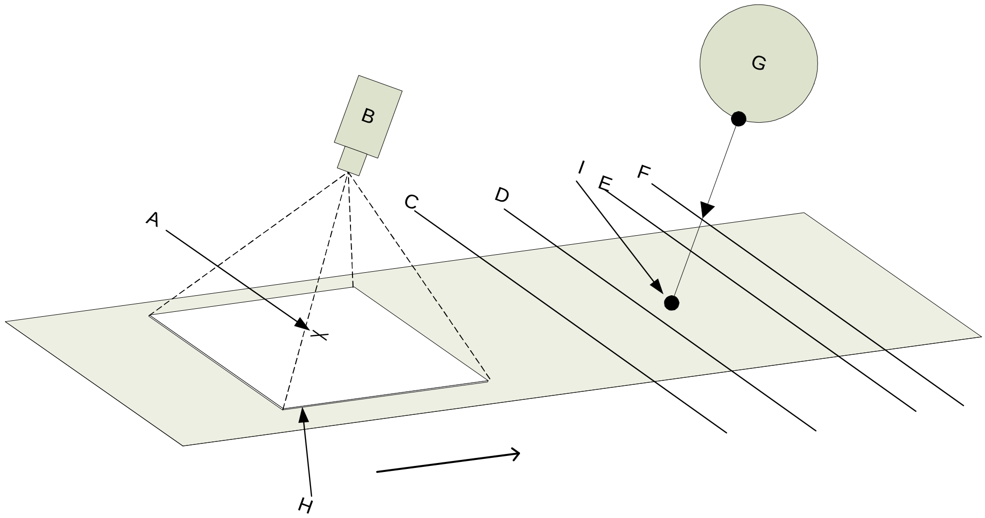
Note

The **UpperLimit**/**LowerLimit** function in the **Tunning** window has a slight delay.

LowerLimit is the limit form where robot starts to execute item targets on the work area in Start Y. The distance is calculated in milli-meters from the center of the robot. The range is positive if the limit is beyond the center of the robot, relative to the moving vertical direction of the conveyor.If the y coordinate value of the item's position is greater than the UpperLimit, the robot will not grab the item. So when the tracked item passes beyond this limit it will be dropped. This limit must be chosen well within the maximum reach of the robot.

</td></tr>
</table>

Continues on next page

<table>
<tr><th></th><th>Description</th></tr>
<tr><td></td><td>

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<table>
<tr><td>A</td><td>Camera and Baseframe origin</td></tr>
<tr><td>B</td><td>Camera</td></tr>
<tr><td>C</td><td>Enter</td></tr>
<tr><td>D</td><td>Start</td></tr>
<tr><td>E</td><td>Stop</td></tr>
<tr><td>F</td><td>Exit</td></tr>
<tr><td>G</td><td>Robot</td></tr>
<tr><td>H</td><td>Image frame</td></tr>
<tr><td>I</td><td>Center of Robot</td></tr>
</table></td></tr>
<tr><td>Pick/placeElevation</td><td>Pick/place elevation is the distance, in negative z-direction relative to the tool, from where the robot approaches the item target.</td></tr>
<tr><td>Pick/place-Time</td><td>Pick/place time is the time the robot is in the pick/place position. If the conveyor is moving during the pick/place time, the robot will track along the conveyor to keep the relative position on the moving conveyor.</td></tr>
<tr><td>VacuumActivation</td><td>Vacuum activation is the time in seconds before the middle of the corner path of the approaching position, when the vacuum I/O should be set. If a negative value is entered, the vacuum I/O will be set the time after the middle of the corner path. This value is only valid for work areas of type Pick or Other.

Note

Vacuum activation does not affect the picking of items in simulation. Items are attached to the picking tool using <code>SimAttach</code> events, for example, in the Pick Routine.</td></tr>
<tr><td>VacuumReversion</td><td>Vacuum reversion is the time in seconds before the half place time in the place position, when the blow I/O should be set. If a negative value is entered, the blow I/O will be set the time after the half place time in the place position. This value is only valid for work areas of type Place or Other.

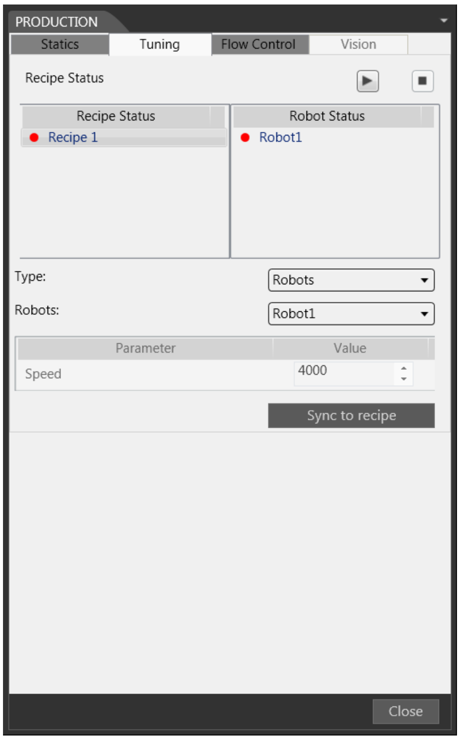
Note

Vacuum reversion does not affect the placing of items in simulation. Items are detached from the picking tool using <code>SimDetach</code> events, for example, in the Place Routine.</td></tr>
</table>

Continues on next page

	Description
VacuumOff	**Vacuum off** is the time in seconds after the half place time in the place position, when the blow I/O should be reset. If a negative value is entered, the blow I/O will be reset the time before the half place time in the place position. This value is only valid for work areas of type **Place** or **Other**. **Note** Vacuum Off does not affect the placing of items in simulation. Items are detached from the picking tool using **SimDetach** events, for example, in the Place Routine.

Tuning the robot



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	Description
Speed	Allows you to tune the speed of the selected robot.

The robot settings can be tuned when a production is running, using the **Tuning the robot** window.

Limitations

All tunings, including robot tuning, item tuning, and work area tuning, are only valid while the simulation or production is running.

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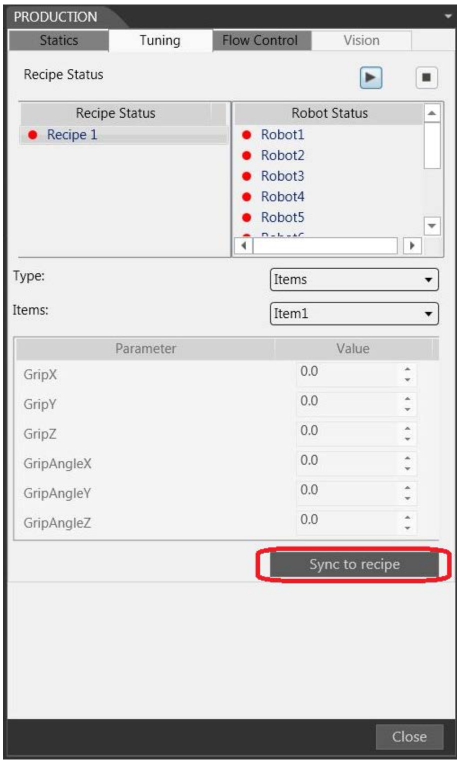
Sync to recipe

Once the tuning value is modified, clicking **Sync to recipe** button allows you to sync the value in the tuning into the recipe. Otherwise the data will not be saved to the recipe.



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Flow Control

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	Description
Recipe Status	Allows you to control the status of the production.
Conveyors	Allows you to adjust the speed of the conveyor.

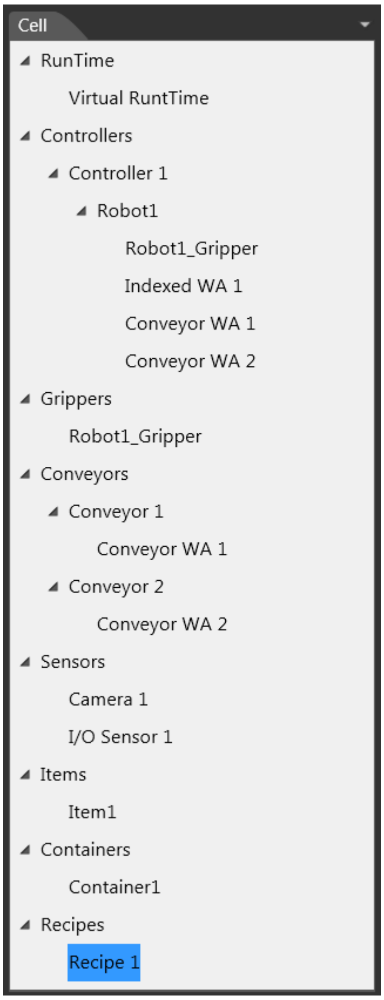
Simulation

On the PickMaster PowerPac ribbon-tab, click **Simulation**.

Continues on next page

Use this procedure to do the simulation:

1 Click to choose one recipe from the tree view browser.



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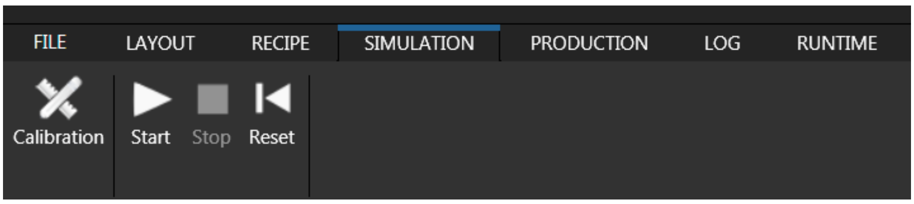
2 Click **Start** on the ribbon-tab. Then it will start the simulation of created solution.



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The simulation runs automatically.

3 Click **Stop** on the ribbon-tab. Then it will stop the simulation.

4.3 Configuration in real Runtime (RRT)

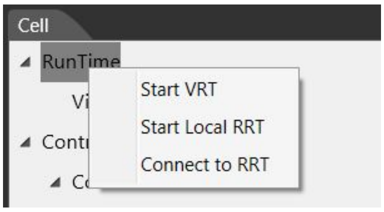
4.3.1 Switching to real Runtime

Switch Runtime

> **Note**
>
> After install PickMaster Twin Client and PickMaster Twin Host on different PC as recommended, there will be two real Runtime available but only the one connected to controller or camera should be used. This is the one that user should connect PickMaster PowerPac with and login.
>
> The real Runtime on Host PC and Client PC are identical but the one on Host is for production. Robot controllers and cameras should also be connected to this one.

Right-click on **RunTime** to switch to the **Runtime** from **Virtual Runtime**.

Click **Start Local RRT** to start the **RunTime** on the computer. Select **Connect to RRT**, the **Sign in** window is displayed. The following figure and table provide more details about the window.



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	Description
IP Address	Allows you to locate the IP address of the Runtime computer. **Note** It's not allowed to use any of the following IP addresses which are allocated for other functions: • 192.168.127.0 - 255 The IP address cannot be on a subnet which overlaps with any of the above reserved IP addresses. If a subnet mask in the class B range has to be used, then a private address of class B must be used to avoid any overlapping. Contact your local network administrator regarding network overlapping. See the section *Communication* in *Technical reference manual - System parameters*.
Runtime Account	
UserName	Allows you to enter the user name of your account in the Runtime.
Password	Allows you to enter the password of your account in the Runtime.
Enter your PC admin user name and password	
UserName	Allows you to enter the user name of the administrator account for the computer which the Runtime is installed.
Password	Allows you to enter the password of the administrator account for the computer which the Runtime is installed.

A default user and password have been created for each role.

Administrator Username: `admin` with Password: `password`

Technicist Username: `superuser` with Password: `ABB1998`

Operator Username: `operator` with Password: `password`

Note

The Username and Password are case sensitive.

Note

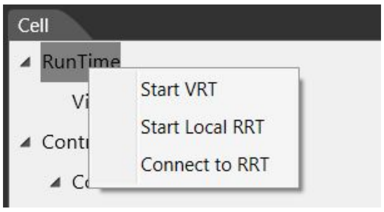
If the solution will be used in the PickMaster PowerPac, it must have been connected to a real controller with the same configuration on PickMaster PowerPac.

Continues on next page

Procedure

To connect to Runtime.

1. Right-click the **RunTime** in the tree view **Cell** and select **Start Local RRT**.



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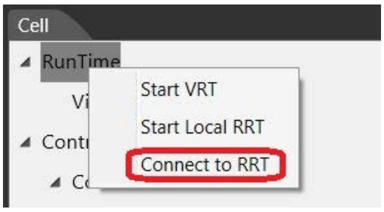
2. Right-click the **RunTime** in the tree view **Cell** and select **Connect to RRT**.



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The **Sign in** window is opened.

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3. In the **Sign in** dialog, enter the correct information.

> **Note**
>
> A default admin user, with full access, is provided with the following credentials:
>
> - User: admin
> - Password: password

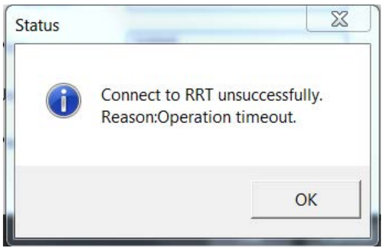
Continues on next page

4 Click **OK**.

Tip

If switch failed, the status window will show up.

The **Status** window is opened.



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Note

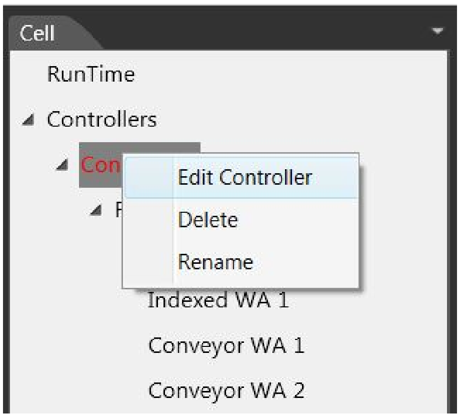
If the user meets any problem when building connection between PickMaster PowerPac and real Runtime, please check from below possible reasons:

1. Using a host account that is not administrator;
2. Firewall blocking;
3. VPN interference;
4. SSH not installed or down or stuck (Occasionally due to computer environment the SSH.exe cannot be installed successfully);
5. Host IP address incorrect, or not in the same IP segment as the client port.

Select a real controller

Use this procedure to select a real controller:

1. Right-click the **Controller** in the tree view **Cell** and select **Edit Controller**.



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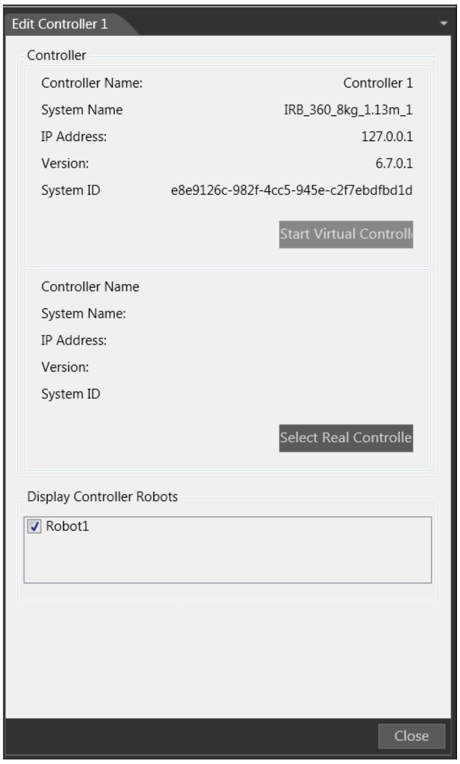
The **Edit Controller** dialog is opened.



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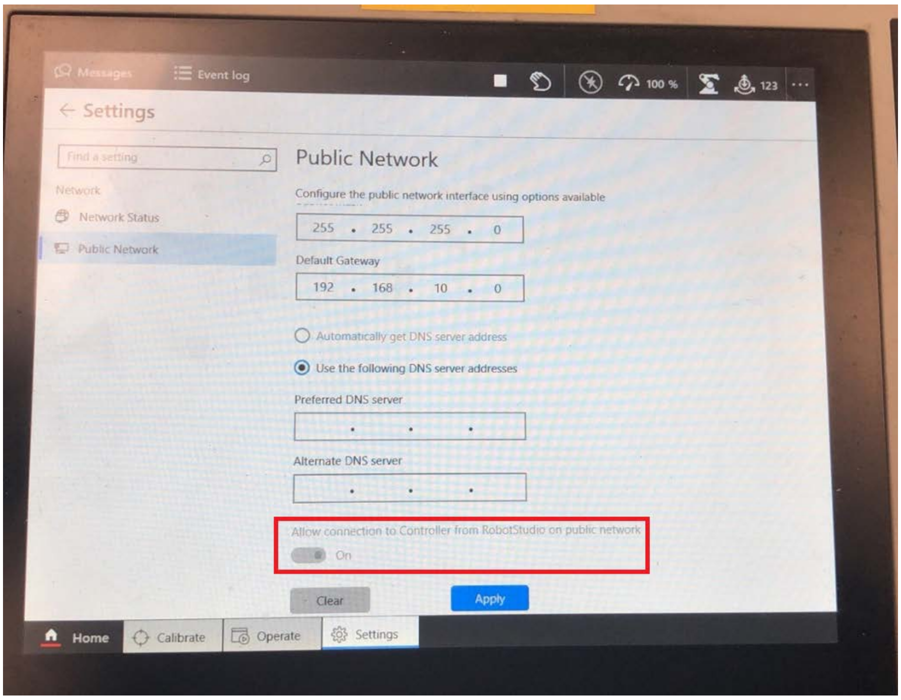
2 Click on the **Select Real Controller** icon to open the **Select Real Controller** dialog.

> **Note**
>
> User must modify the firewall settings before selecting a real controller in PickMaster PowerPac.
>
> For WAN port, under Configuration/Communication/Firewall Manager, the following functions must be enabled.
>
> "syslog" -EnableOnPublicNet
>
> "Bonjour" -EnableOnPublicNet
>
> "RobICI" -EnableOnPublicNet
>
> "EtherNetIP" -EnableOnPublicNet
>
> "RapidSockets" -EnableOnPublicNet
>
> "RobotWebServices" -EnableOnPublicNet
>
> "IEEE1588" -EnableOnPublicNet
>
> "Netscan" -EnableOnPublicNet
>
> "RobAPI" -EnableOnPublicNet

Continues on next page

Note

Make sure that the setting 'Allow connection to controller from RobotStudio on public network' is enabled.



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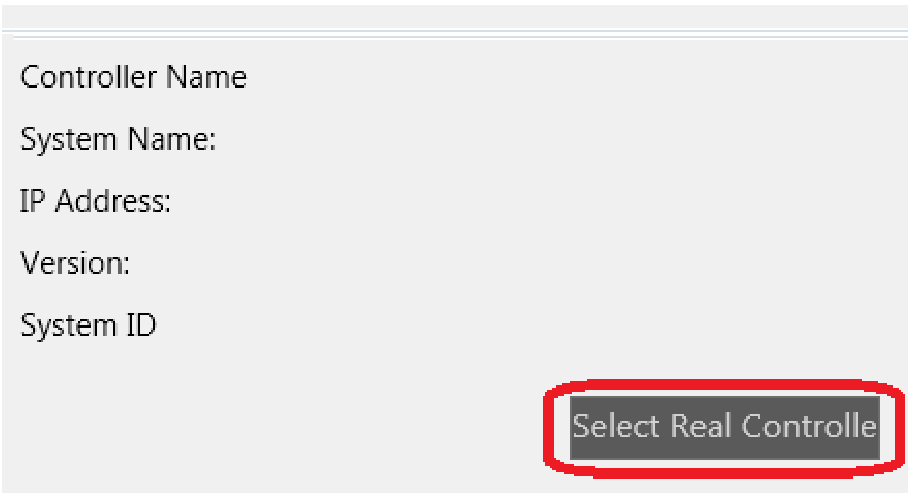

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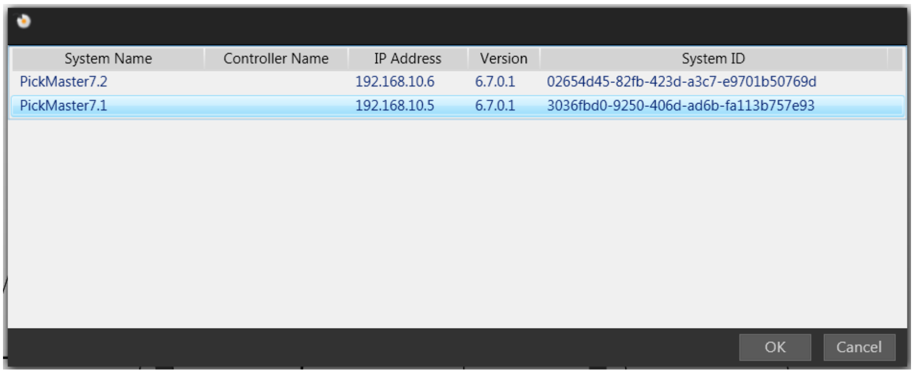
The **Select Real Controller** dialog is opened.



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3 In the dialog box, choose the real controller to be connected.
4 Click **OK** to apply the configuration.
5 Click **Close** to close the **Edit Controller** dialog.

Configuring the I/O

I/O signals

I/O signals are configured using RobotStudio or the FlexPendant. Then they can be used from Runtime.

The predefined signals can be used without modifications. Edit the predefined signals or add additional signals if needed.

Note

The maximum name length for a work area signal is 15 characters.

Predefined I/O signals

The following I/O signals are predefined on delivery. Some of them are used or referenced to when configuring the line. The encoder signals are described in *Application manual - Conveyor tracking*.

I/O signal name	Description
di*X*_1	Digital input signals for custom use, such as generating I/O triggered position or checking a gripper pressure switch.
doStartCnv*X*	Digital output for starting/stopping conveyors.
doTrigVis*X*	Digital output for triggering an image acquisition. This signal is used by Runtime to order the camera to acquire an image.
doManSync*X*	Digital output used for triggering predefined positions in a conveyor work area. For DSQC 377, this output should be connected to the StartSig (input 9) on the corresponding encoder board. For DSQC 2000, this output should be connected to the cXTrigVis . For more detail information, see the circuit diagram.

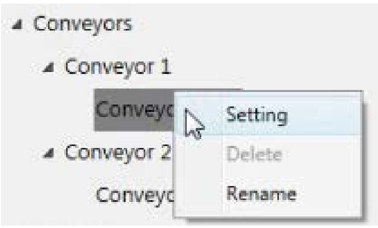
Continues on next page

I/O signal name	Description
`doVacuumX`	Digital output for activating vacuum. For example, for gripping a product. The output signal is set when an item shall be attached to the tool. **Note** The signal is controlled from the RAPID program. In simulation, the RAPID `triggdata SimAttachX` controls when the signal is set. On a real robot, the RAPID `triggdata VacuumActX` controls when the signal is set.
`doBlowX`	Digital output for activating air blow. For example, for releasing a product gripped by the robot. The output signal is set when an item shall be detached from the tool. **Note** The Release signal is controlled from the RAPID program. In simulation, the RAPID `triggdata SimDetachX` controls when the signal is set. On a real robot, the RAPID `triggdatas VacuumRevX` and `VacuumOffX` controls when the signal is set/pulsed.
`goVacBlowX`	Digital I/O group containing *doVacuumX* and *doBlowX*.

Modify I/O signals in work area

Use this procedure to create a ghost picking flow:

1 Right-click on **Conveyor WA 1** in the tree view **Cell** and select **Setting**.



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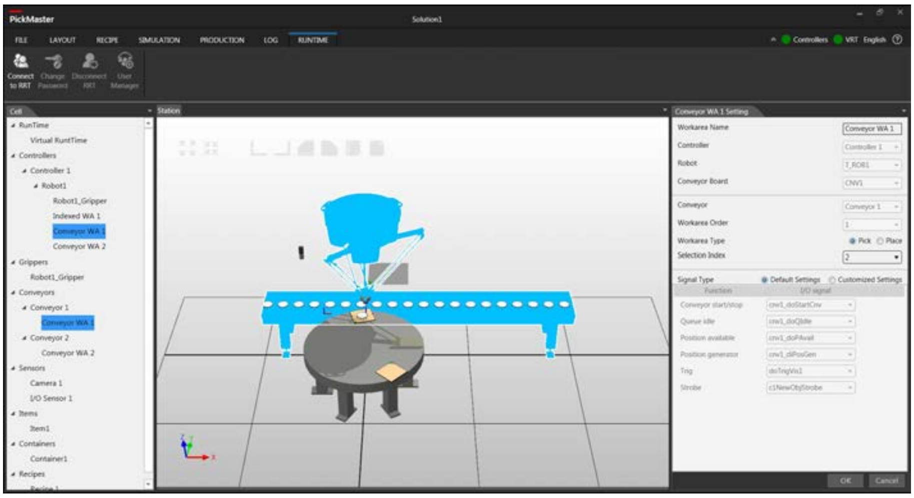
The **Conveyor work area setting** window is opened.



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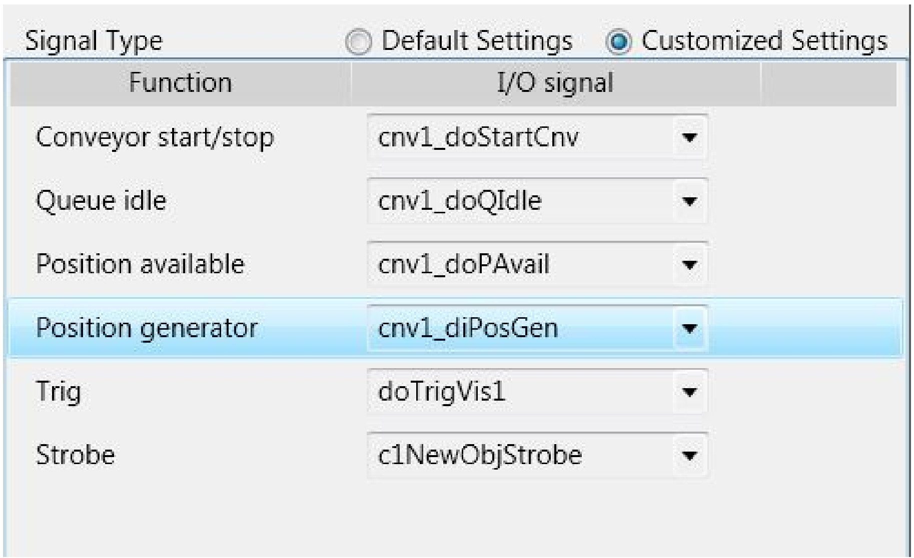
2 Select the **Customized Settings** in the **Signal Type** tab.



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3 Enter the required data into the **I/O signal** setting table.

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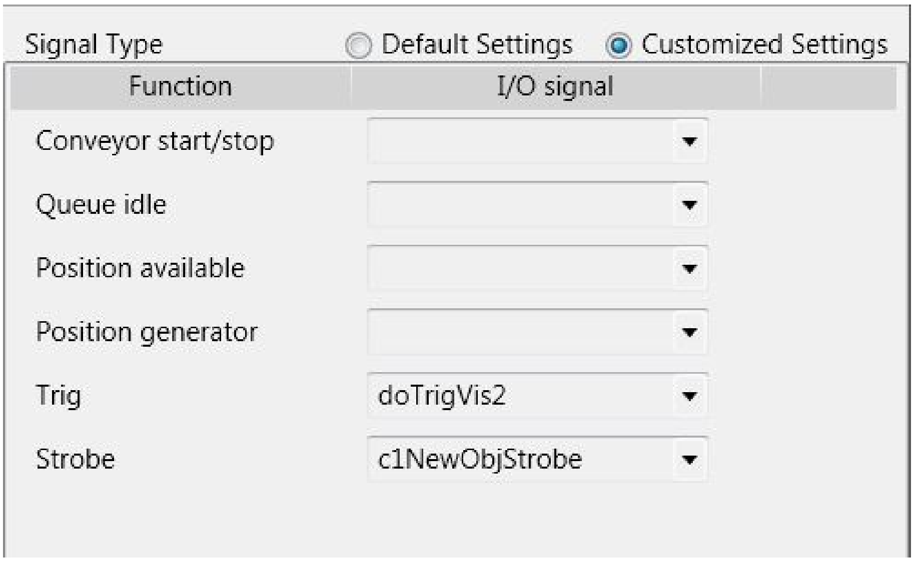
For example:



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4. Click **OK** to close the **Recipe setting** window.
5. Repeat step1 - 4 to the other **Conveyor WA.**

4.3.2 Configuring camera

Introduction

Note

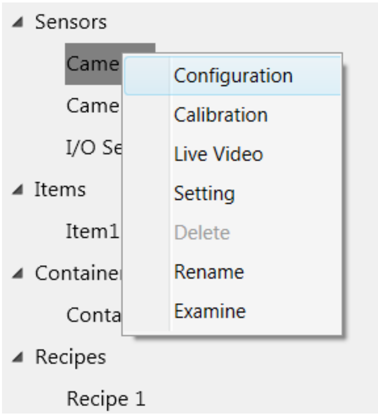
If any firewall or antivirus software is installed, add `pickmasteru.exe`, `sshd.exe`, and `visionclient. exe` to the white list.

Otherwise the PickMaster PowerPac cannot connect Runtime and the vision function cannot work normally.

Cameras together with vision models are used to locate objects in a specific area. When a camera is created in the tree view, it is not connected to any physical camera. This must be done manually in the camera configuration dialog box. The camera in the tree view is configured to use one specific physical camera. The camera should also be configured to give an optimal image.

To configure a camera.

1 Right-click the camera in the tree view **Cell** and select **Configuration**.



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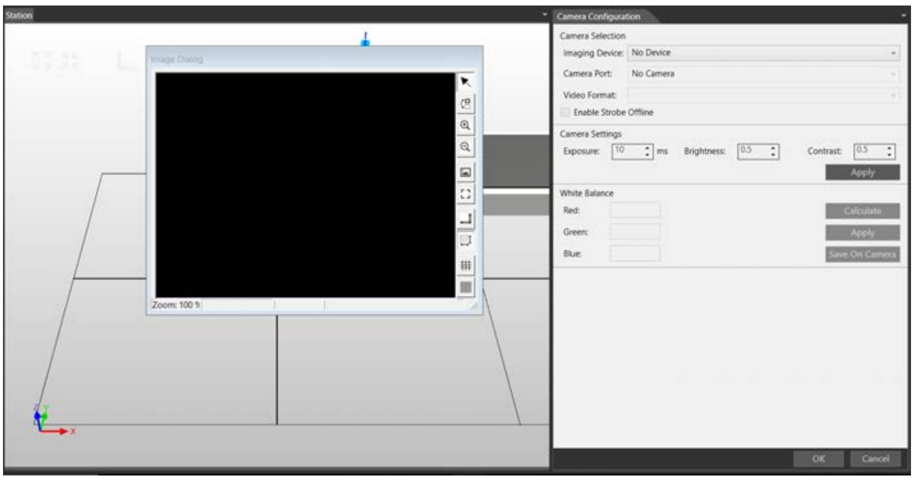
The **Camera Configuration** dialog and the **Image dialog** are opened.



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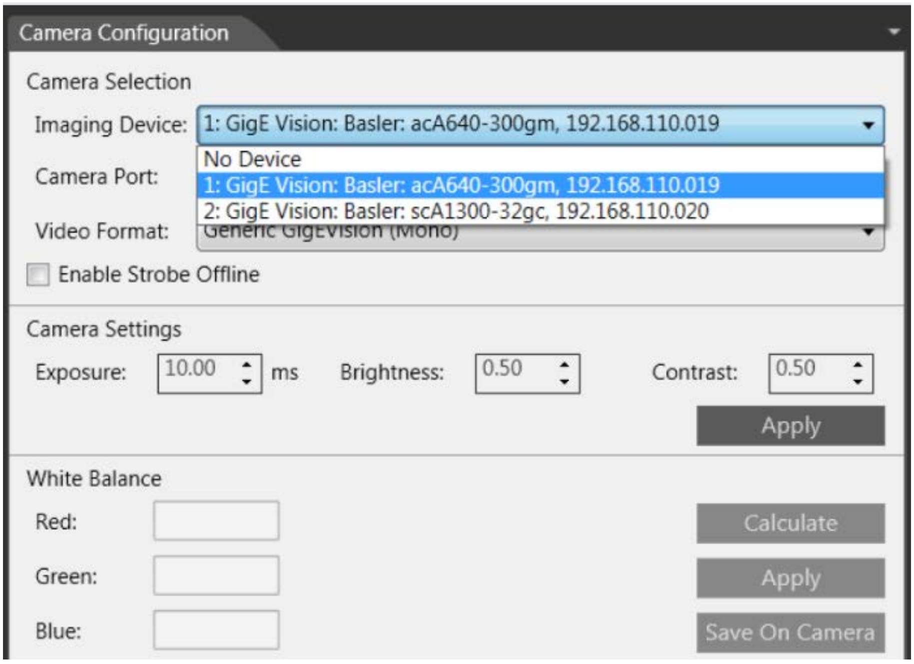
2 In the **Imaging device** list, select the Gigabit Ethernet camera to which the camera is connected.



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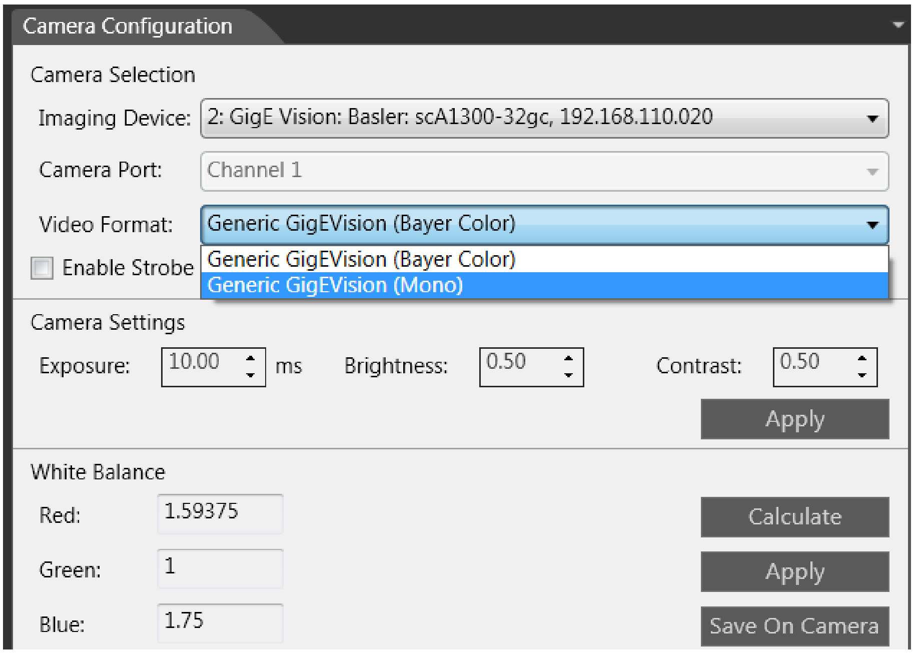
3 In the **Video format** list, select the type of the connected camera.



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The image in **Image dialog** shows up.

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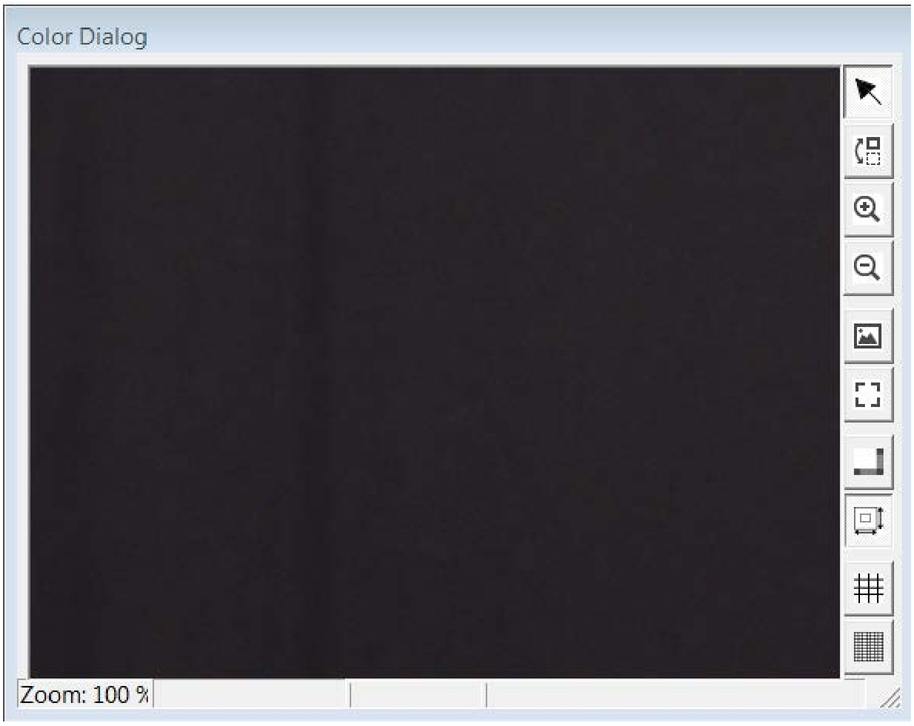

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4. If the camera should strobe when it is not in production mode, select the **Enable strobe offline** checkbox. This is necessary if, for example, the camera is used together with a strobe light. This setting applies only to Gigabit Ethernet cameras.
5. If the selected camera is a color camera and will be used together with the color video format, it is necessary to calibrate the white balance of the camera using this procedure:
   a. Put a white sheet of paper under the camera. The sheet must cover the entire field of view.
   b. Adjust the light settings so that the image looks medium gray. Use either the camera aperture or the exposure time.
   c. In the **White balance** part, click **Calculate**. This will calculate the white balance calibration parameters.
   d. Click **Apply**. This will modify the camera's internal settings.
   e. Click **Save on camera**. This will store the settings in the camera.

   For more information about color vision, see *Using color vision on page 298*.
6. If needed, adjust **Exposure**, **Brightness**, and **Contrast** and click **Apply** in the **Camera settings** part.

   Adjust the exposure to achieve the best image possible. The exposure together with the camera aperture defines the focus depth and possible motion blur. These two parameters must be suitably adjusted depending on the type of objects to look for and the speed of the conveyor.

Continues on next page

Brightness and contrast can be changed to give an optimal image. Some objects might be easier to find by adjusting the ambient lighting together with the brightness and contrast parameters.

The effect of changing these parameter values is not seen until clicking **Apply**.

7 Click **OK**.

Related information

Using color vision on page 298.

Calibrating camera on page 243.

4.3.3 Calibrating robot

Instruction

Detailed information about how to calibrating the robot are described in the robot product manual.

4.3.4 Calibrating linear conveyor

Overview

> **Note**
>
> The following calibration process is required when running production and emulation. Calibration under the simulation tab in PickMaster PowerPac will not complete the following calibration process.

The calibrations needed for the conveyors are camera and work area calibrations. The work area calibration is a base frame calibration for conveyor work areas and a work object definition for indexed work areas. The key concept is to define a coordinate system origin that is the same for a camera and a robot base frame or work object.

Each camera must be calibrated separately. The base frame calibration is needed whenever conveyor systems are used.

The camera calibration is stored in the solution so all recipe in that solution could share the same calibration. If you need to re-calibrate a camera, all recipes in the solution will be updated with the new calibration.

The camera calibration and the work area calibration can be performed independently of each other, but it is very hard to make an accurate new camera calibration after the work area is calibrated.

The work area calibration is stored in the robot controller.

To calibrate the linear conveyor:

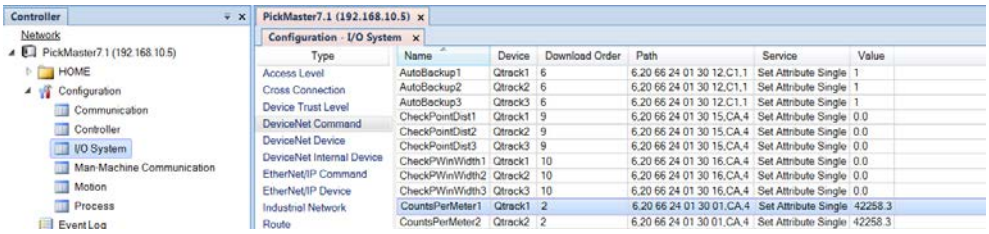
1. Define the parameter *Counts Per Meter* (for conveyors only), see *Defining the parameter Counts Per Meter (DSQC 377) on page 187*, *Defining the parameter Counts Per Meter (DSQC 2000) on page 189*.
2. Calibrate the camera, see *Defining the base frame (IRC5) on page 191*, *Defining the base frame (OmniCore) on page 194*.

Continues on next page

4.3.4.1 Defining the parameter Counts Per Meter (DSQC 377)

Introduction

The *Counts Per Meter* system parameter is used to calibrate the conveyor encoder. The *Counts Per Meter* system parameter belongs to the type *DeviceNet Command*, in the topic *I/O System*.



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Calculation for Counts Per Meter

The value for the *Counts Per Meter* system parameter is calculated as follows:

`(position1*old_counts_per_meter)/measured_meters`

Value	Description
`position1`	The conveyor position after moving. Read from FlexPendant Jogging window.
`old_counts_per_meter`	The encoder's old value. **Note** The encoders delivered from factory have a preset value. For an IRC5 system this value is 20,000. This value can be used to start the calibration with.
`measured_meters`	The manually measured distance in meters that the conveyor has been moved.

Defining Counts Per Meter

Use the following procedure to define *Counts Per Meter* for the conveyor encoder.

1. Put a mark on the conveyor belt, for example draw a line or attach a piece of tape, and a mark on the side of the conveyor at the same location.
2. In the FlexPendant **Program Editor**, load and run the program ppacal.prg.

   This sets the current position of the conveyor to zero. The value is shown as **CNV** value in the **Position** part of the FlexPendant **Jogging** window.
3. Run the conveyor belt approximately 1 meter.
4. In the FlexPendant **Jogging** window, read the position of the conveyor. This is `position1`.
5. Measure the physical distance between the two marks. This is the value `measured_meters`.
6. Calculate *Counts Per Meter* using the read and measured values.

   For example: `(1010*20000)/1005 = 20099`

Continues on next page

7. In RobotStudio, click **Configuration** and select topic **I/O System** and type **DeviceNet Command.**
8. Select the unit *Qtrackx* (where x is the number of the conveyor) and update the value for parameter *Counts Per Meter*.
9. Tap **OK**.
10. Restart the controller.

Related information

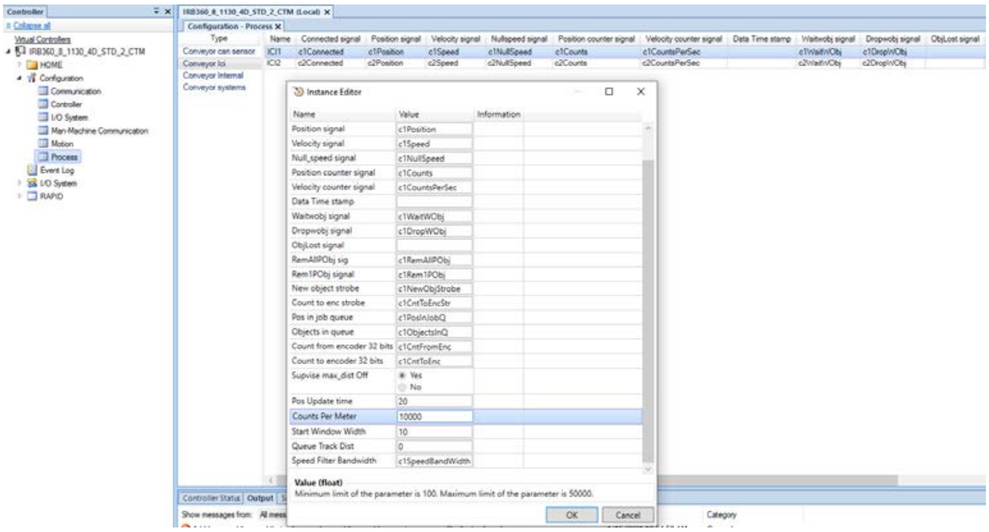
Application manual - Conveyor tracking.

Technical reference manual - System parameters.

4.3.4.2 Defining the parameter Counts Per Meter (DSQC 2000)

Introduction

The *Counts Per Meter* system parameter is used to calibrate the conveyor encoder. The *Counts Per Meter* system parameter belongs to the type *Conveyor Ici*, in the topic *Process*.



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Calculation for Counts Per Meter

The value for the *Counts Per Meter* system parameter is calculated as follows:

`counts value/measured_meters`

Value	Description
`counts value`	The conveyor position after moving. For DSQC 2000: Read from predefined I/O signal on the FlexPendant or RobotStudio. For example, CNV1, the signal name is c1counts.
`measured_meters`	The manually measured distance in meters that the conveyor has been moved.

Defining Counts Per Meter

Use the following procedure to define *Counts Per Meter* for the conveyor encoder.

1. Put a mark on the conveyor belt, for example draw a line or attach a piece of tape, and a mark on the side of the conveyor at the same location.
2. In the FlexPendant **Program Editor**, load and run the program ppacal.prg.

   This sets the current position of the conveyor to zero. The value is shown as **CNV** value in the **Position** part of the FlexPendant **Jogging** window.
3. Run the conveyor belt approximately 1 meter.
4. In the FlexPendant **Jogging** window, read the position of the conveyor. This is `position1`.
5. Measure the physical distance between the two marks. This is the value `measured_meters`.

Continues on next page

6. Calculate *Counts Per Meter* using the read and measured values.

   For example: `20200000/1005 = 20099`
7. In RobotStudio, click **Configuration** and select topic **Process** and type **Conveyor Ici**.
8. Edit the unit *ICIx* (where x is the number of the conveyor) and update the value for parameter *Counts Per Meter*.
9. Tap **OK**.
10. Restart the controller.

Related information

Application manual - Conveyor tracking.

Technical reference manual - System parameters.

4.3.4.3 Defining the base frame (IRC5)

Introduction

For each conveyor work area on a conveyor, a conveyor base frame calibration must be performed. The base frame calibration gives a reference point for the robot when a picking or placing sensor detects objects at the work area.

Preparations

- Define the `Counts Per Meter` system parameter for each conveyor work area. For more details, see *Defining the parameter Counts Per Meter (DSQC 377) on page 187*, *Defining the parameter Counts Per Meter (DSQC 2000) on page 189*.
- Prepare a calibration tool that can be mounted temporarily on the robots. The calibration tool shall have a pointed TCP. Measure the TCP offset accurately.
- Create a tooldata for the calibration tool in the rapid program for each robot. Update the TCP offset with the measured values. In the FlexPendant **Jogging Window**, select the tooldata for the robot.
- If a camera is used, calibrate the camera, see *Calibrating camera on page 243*. After calibrating the camera, keep the camera calibration pattern attached to the conveyor.

Procedure

Use the following procedure to calibrate all the base frames for a conveyor in the line with IRC5 controller:

1. Make sure the reference point for calibration is marked accurately on the conveyor belt.
   - If a camera is used, the reference point is the local origin of the camera view. If the camera has been just calibrated, the reference point is already marked by the origin of the camera calibration pattern that is attached to the conveyor.
   - If an I/O sensor is used to generate predefined positions, the reference point should be marked on the conveyor at the point where the objects are detected by the sensor. This point becomes the local origin of the detected items or containers.
2. Reset the conveyor (encoder board) positions.

   Note

   Do not move the conveyor until this step is completely finished.

   Do the following for all the robots having work areas that needs to be calibrated along the conveyor:

   - In the FlexPendant **Program Editor**, load the program `ppacal.prg`(DSQC 377)/ `PrepareCalib.prg`(DSQC 2000). If the robot is a MultiMove robot, load `ppacal.prg`(DSQC 377)/

Continues on next page

`PrepareCalib.prg`(DSQC 2000) for this robot task (for example, `T_ROB1`), and select only this task for execution.

- Start the loaded rapid program
  - Select calibration type: Conveyor.
  - Select conveyor: for example, CNV1.
  - Wait for the message **READY FOR CALIB**. The conveyor position in the jogging window for CNV1 should now be displayed as “0” mm.

3 Move the conveyor belt forward until the reference point is just inside the working range of the next robot to calibrate.

The conveyor positions for all the conveyor work areas, in the jogging window should indicate the same total travel distance for the reference point. The nearest robot to the camera or sensor is calibrated first, followed by the next nearest robot and so on until all the robots along the conveyor have been calibrated.

4 Mount the calibration tool on the robot.

5 Open the Calibration window on the FlexPendant.

6 Select the conveyor, for example, CNV1.

7 Tap **Base Frame**.

8 Tap **4 Point**.

9 Select the robot, for example, **T_ROB1**.

This step is required for MultiMove robots.

10 Select the first point **Point 1**.

11 Jog or move the robot by hand. Point out the reference point on the conveyor accurately with the calibration tool TCP.

12 Modify the selected point (**Point 1**) by tapping the **Modify Position** function key.

13 Move the conveyor belt forward a distance where the reference point still can be reached by the robot.

Long and equally spaced distances between the four calibration points (Point 1-4) are preferred since this increases the accuracy of the calibration.

14 Repeat the steps 10-13 for the points **Point 2**, **Point 3**, and **Point 4**.

15 Tap **OK** to calculate the base frame.

16 Check if the displayed mean error and max error of the base frame calculation is acceptable. If the estimated error is acceptable, tap OK to confirm and store the new base frame.

Note

A mean error of less than 1 mm is acceptable in most cases.

Continues on next page

If the estimated error is not ok, this base frame must be re-calibrated:

- Move the conveyor belt backward until the reference point is just inside the working range of the robot. Repeat the steps 10-13 for all the points **Point1**, **Point 2**, **Point 3**, and **Point 4**.
- If the conveyor belt cannot be moved backward, start over from step 1.

17 If there are more robots to calibrate along the conveyor, continue from step 3.

18 Restart the controllers to activate the new base frames.

4.3.4.4 Defining the base frame (OmniCore)

Introduction

For each conveyor work area on a conveyor, a conveyor base frame calibration must be performed. The base frame calibration gives a reference point for the robot when a picking or placing sensor detects objects at the work area.

Preparations

- Define the `Counts Per Meter` system parameter for each conveyor work area. For more details, see *Defining the parameter Counts Per Meter (DSQC 377) on page 187*, *Defining the parameter Counts Per Meter (DSQC 2000) on page 189*.
- Prepare a calibration tool that can be mounted temporarily on the robots. The calibration tool shall have a pointed TCP. Measure the TCP offset accurately.
- Create a tooldata for the calibration tool in the rapid program for each robot. Update the TCP offset with the measured values. In the FlexPendant **Jogging Window**, select the tooldata for the robot.
- If a camera is used, calibrate the camera, see *Calibrating camera on page 243*. After calibrating the camera, keep the camera calibration pattern attached to the conveyor.

Procedure

Use the following procedure to calibrate all the base frames for a conveyor in the line with OmniCore controller:

1. Make sure the reference point for calibration is marked accurately on the conveyor belt.
   - If a camera is used, the reference point is the local origin of the camera view. If the camera has been just calibrated, the reference point is already marked by the origin of the camera calibration pattern that is attached to the conveyor.
   - If an I/O sensor is used to generate predefined positions, the reference point should be marked on the conveyor at the point where the objects are detected by the sensor. This point becomes the local origin of the detected items or containers.
2. Reset the conveyor (encoder board) positions.

   Note

   Do not move the conveyor until this step is completely finished.

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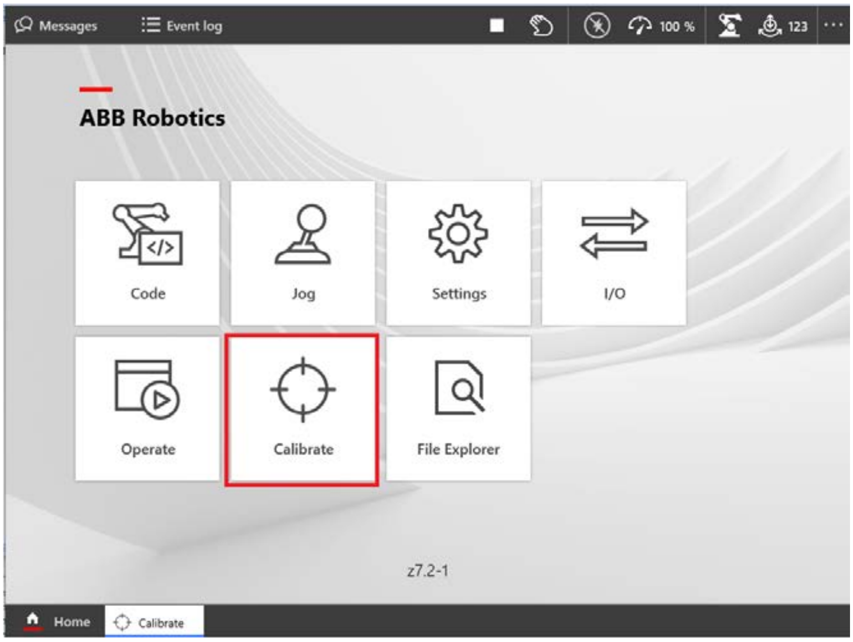
Do the following for all the robots having work areas that needs to be calibrated along the conveyor:

- In the FlexPendant, click **Calibrate**.



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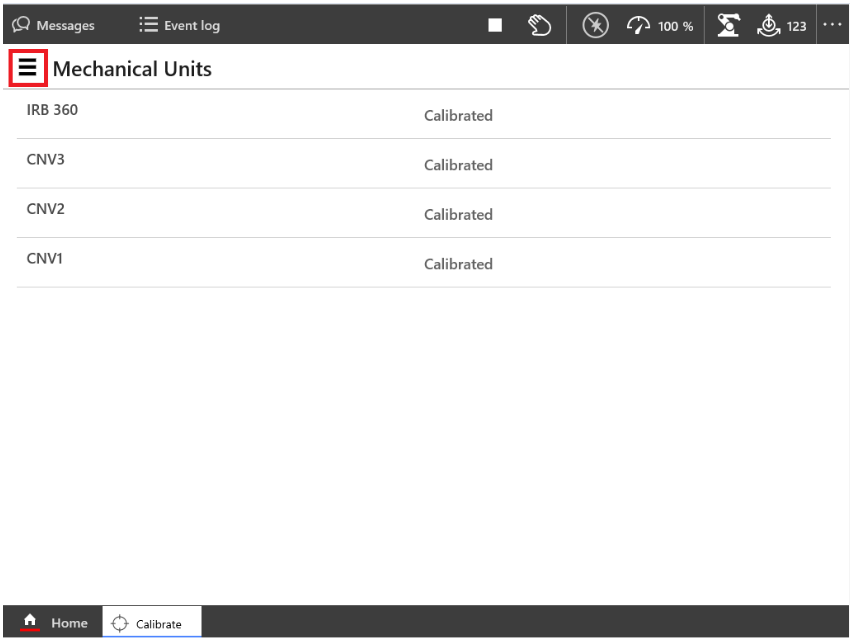
- Click **Option Tab** on the up left corner.



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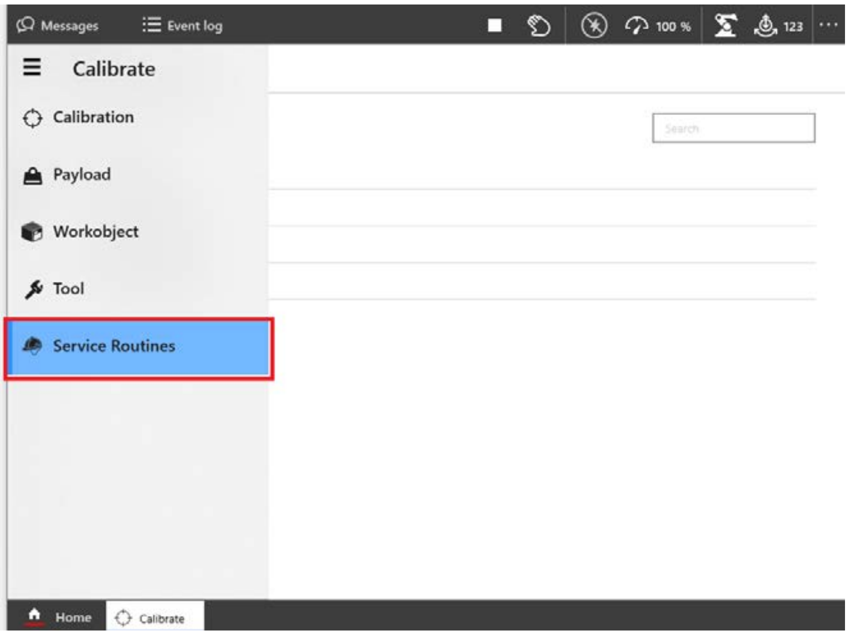
- Click **Service Routines.**



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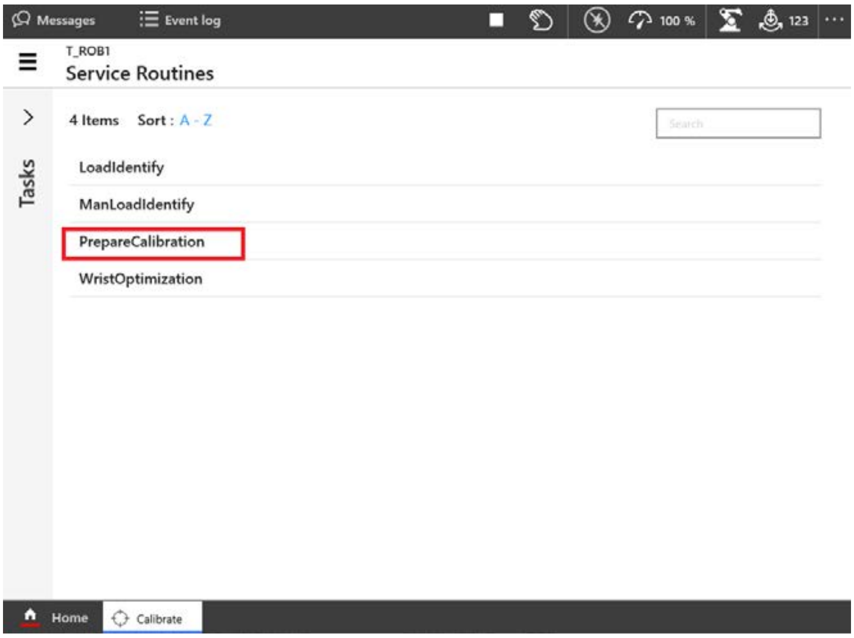
- Click **PrepareCalibration.**



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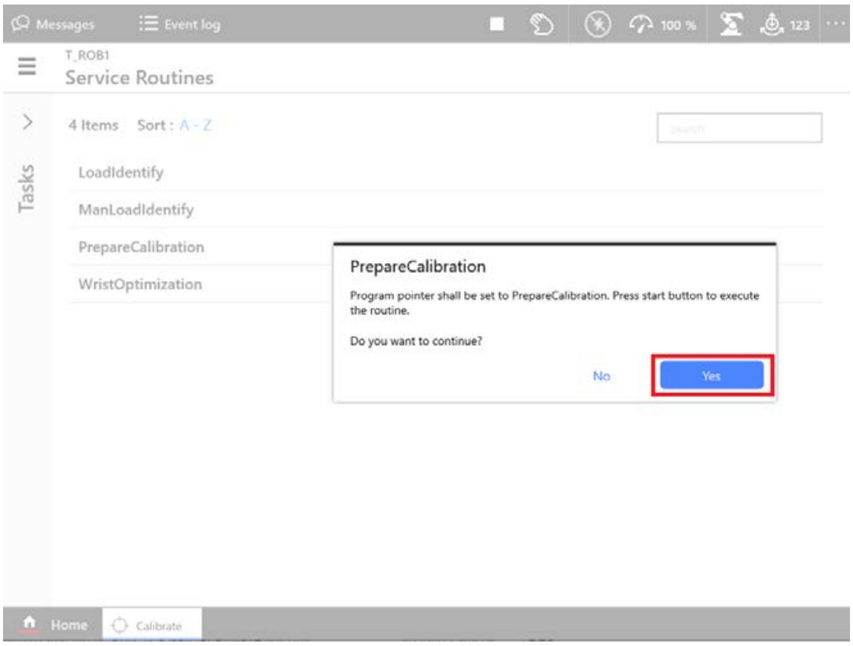
- Click **Yes** in the popped up dialog.



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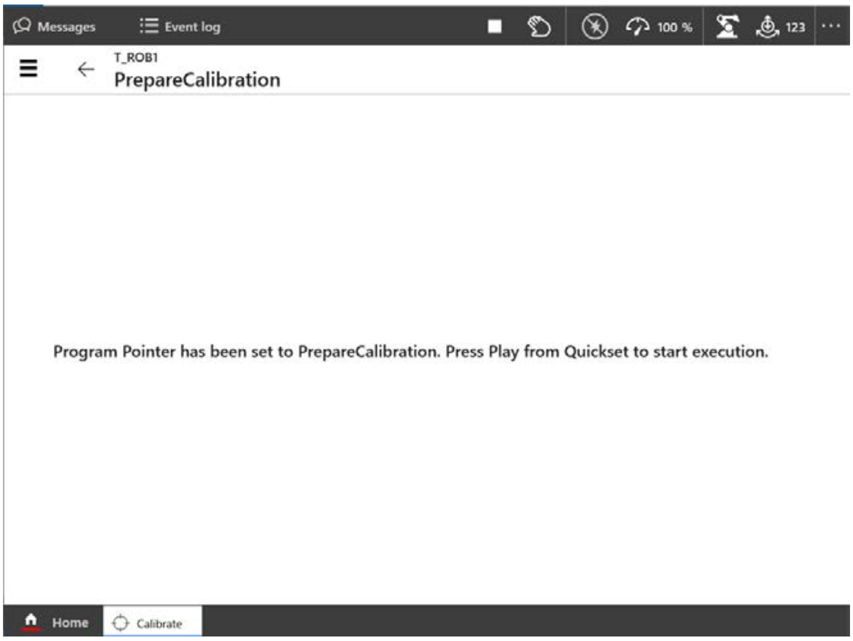

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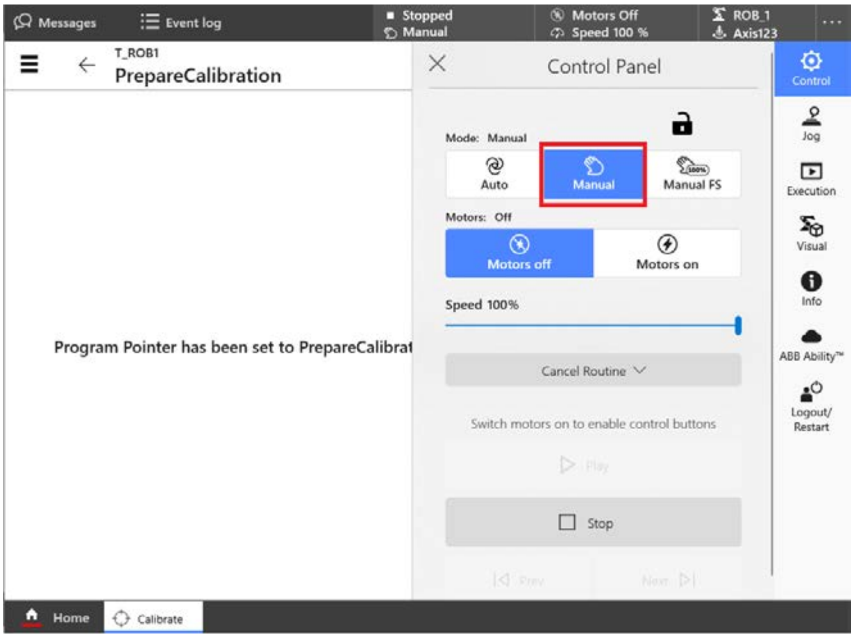
- Set the controller to **Manual** mode.



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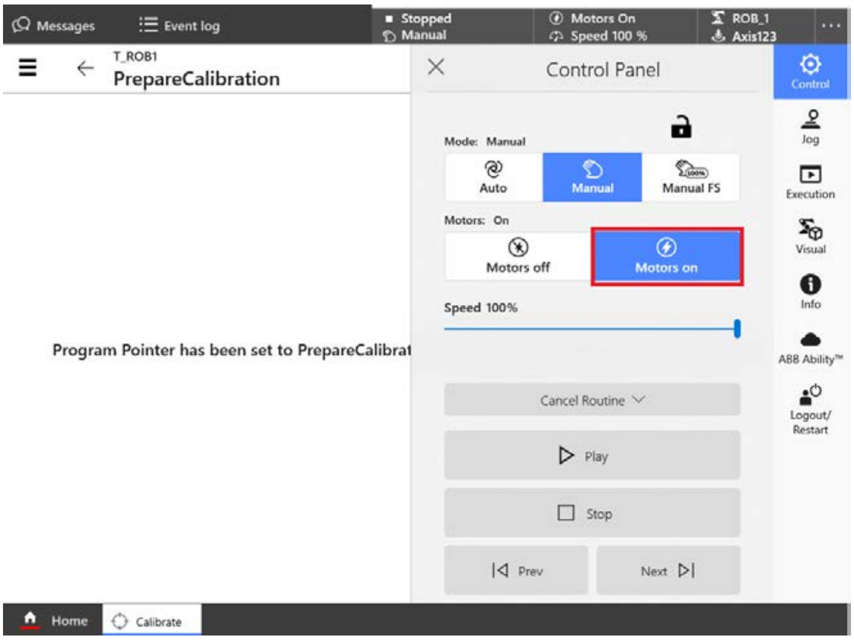
- Enable the Thumb button to motors on the controller.



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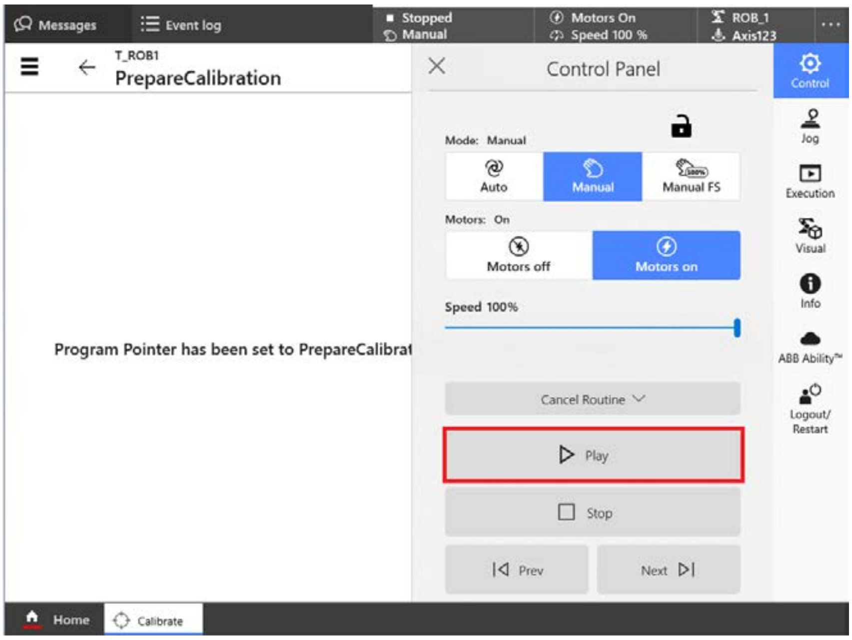
- Click **Play**.



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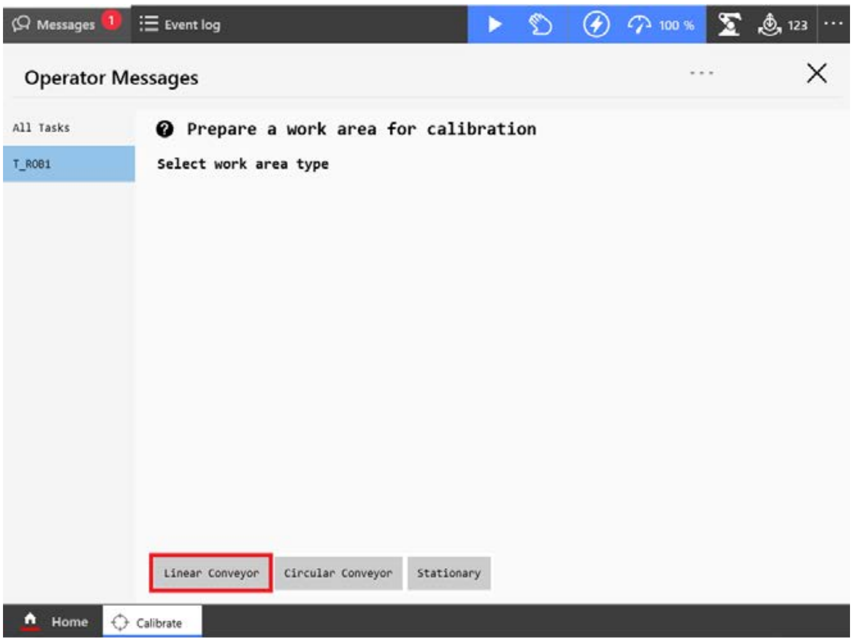
- Select the work area type **Linear Conveyor**.



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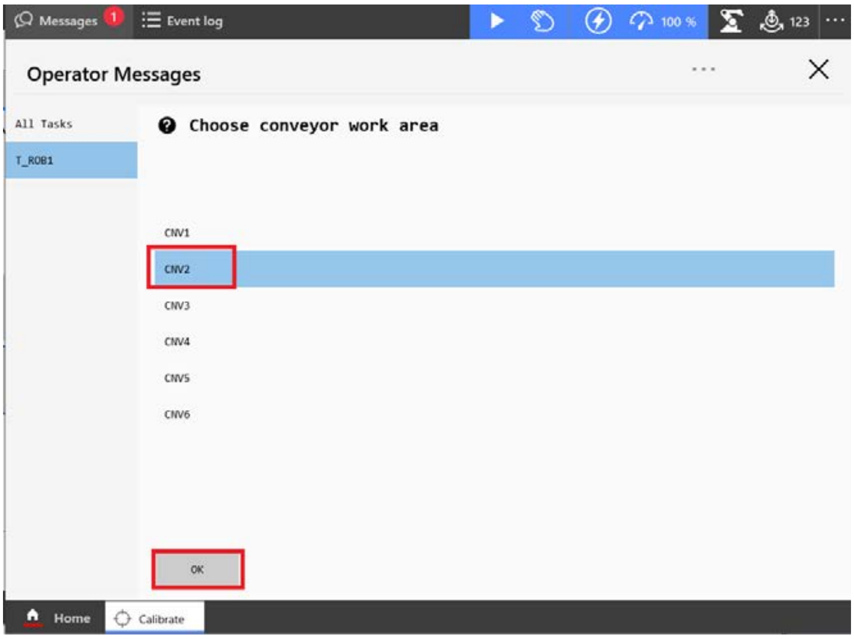
- Select conveyor: for example, CNV2. Then click **OK**



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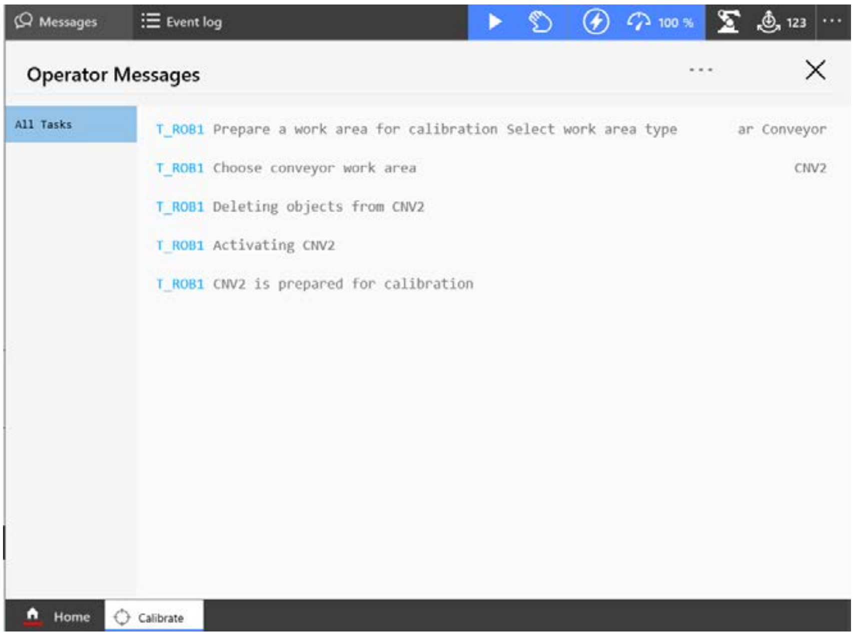
- Wait for the message **...is prepared for calibration**. The conveyor position in the jogging window for CNV2 should now be displayed as “0” mm.



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3 Move the conveyor belt forward until the reference point is just inside the working range of the next robot to calibrate.

The conveyor positions for all the conveyor work areas, in the jogging window should indicate the same total travel distance for the reference point. The nearest robot to the camera or sensor is calibrated first, followed by the next

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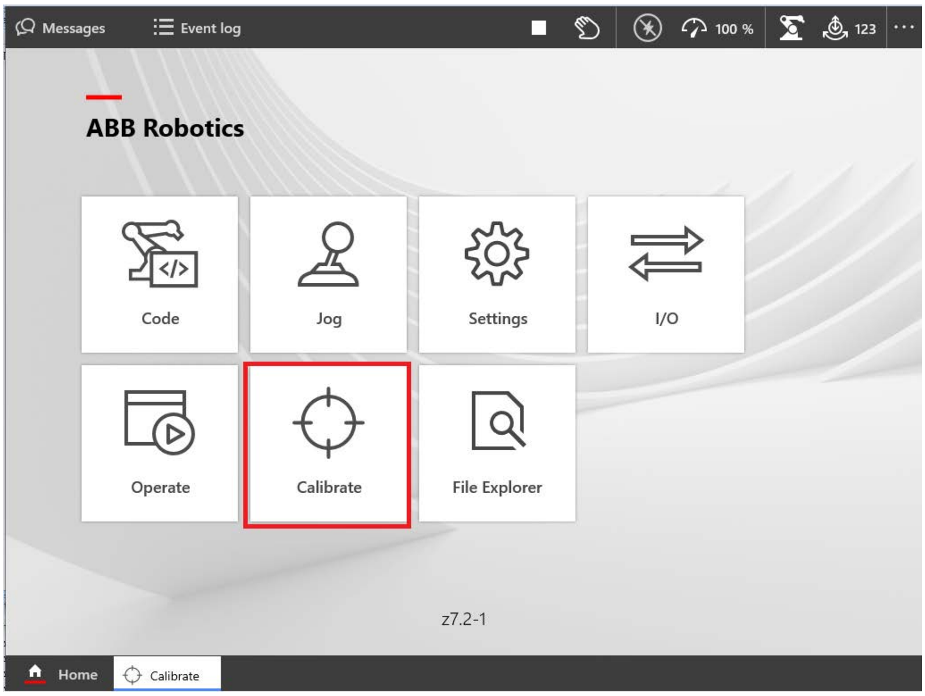
nearest robot and so on until all the robots along the conveyor have been calibrated.

4. Mount the calibration tool on the robot.
5. Open the **Calibration** window in **Calibrate** on the FlexPendant.



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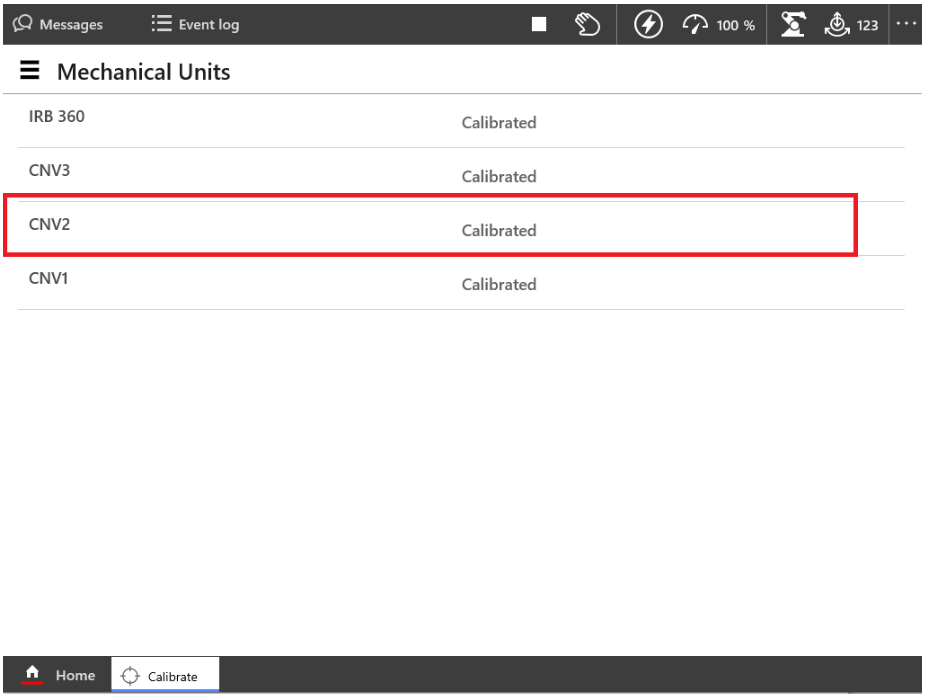
6. Select the conveyor, for example, CNV2.



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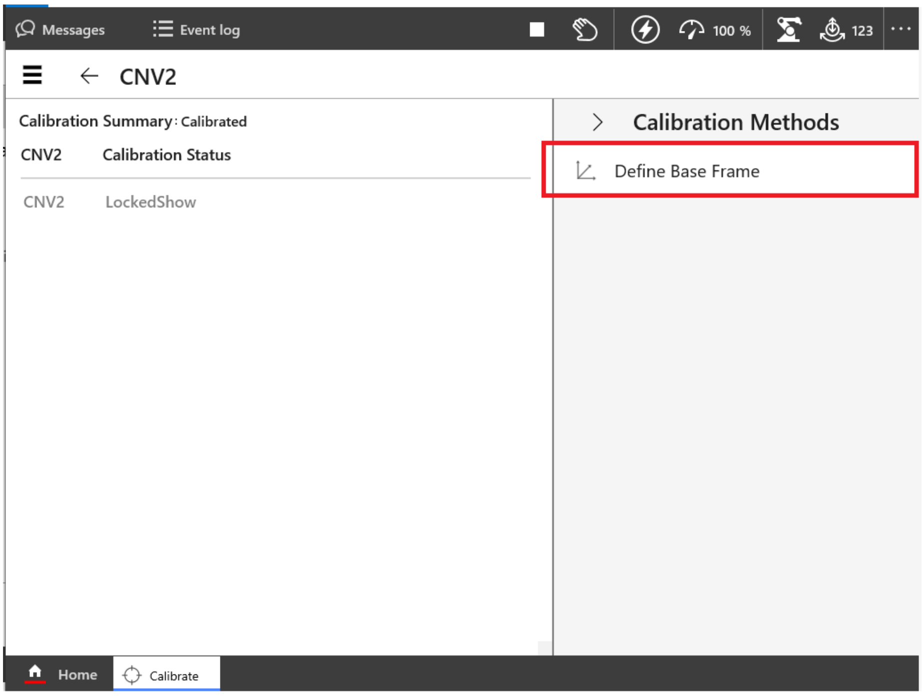
7 Tap **Define Base Frame**.



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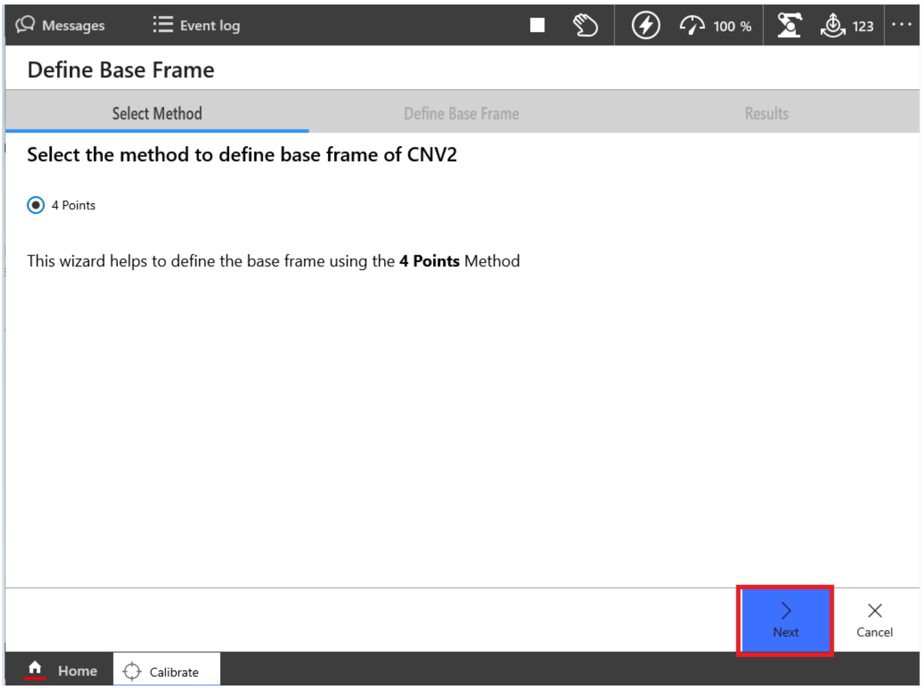
8 Tap **4 Point** and click **Next**.



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9 Select the robot, for example, **T_ROB1**.

This step is required for MultiMove robots.

10 Select the first point **Point 1**.

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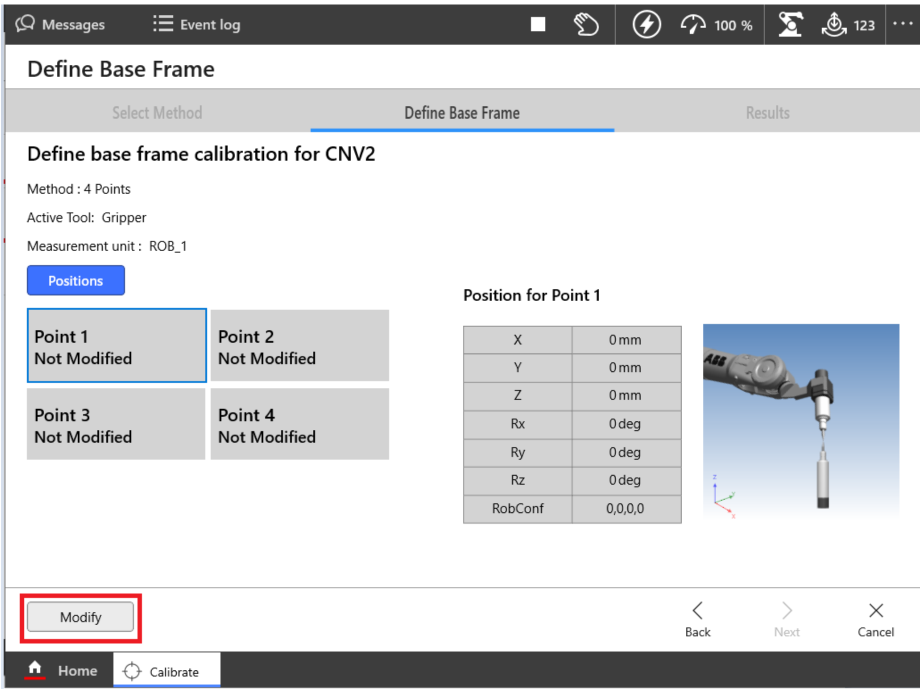
11 Jog or move the robot by hand. Point out the reference point on the conveyor accurately with the calibration tool TCP.

12 Modify the selected point (**Point 1**) by tapping the **Modify Position** function key.



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13 Move the conveyor belt forward a distance where the reference point still can be reached by the robot.

Long and equally spaced distances between the four calibration points (Point 1-4) are preferred since this increases the accuracy of the calibration.

14 Repeat the steps 10-13 for the points **Point 2**, **Point 3**, and **Point 4**.

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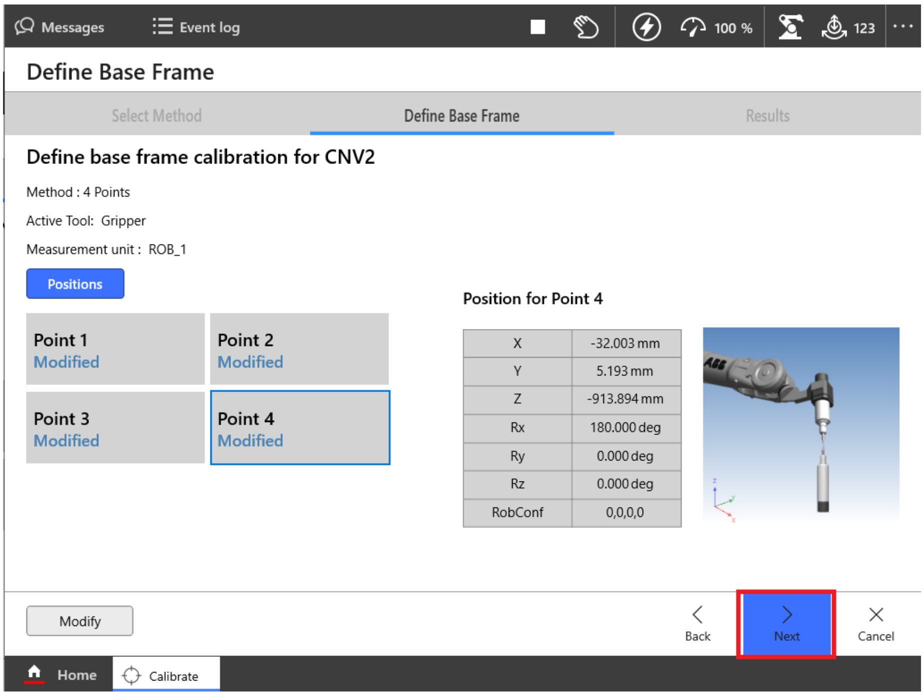
15 Tap **Next** to calculate the base frame.



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16 Check if the displayed mean error and max error of the base frame calculation is acceptable. If the estimated error is acceptable, tap **Finish** to confirm and store the new base frame.

Note

A mean error of less than 1 mm is acceptable in most cases.

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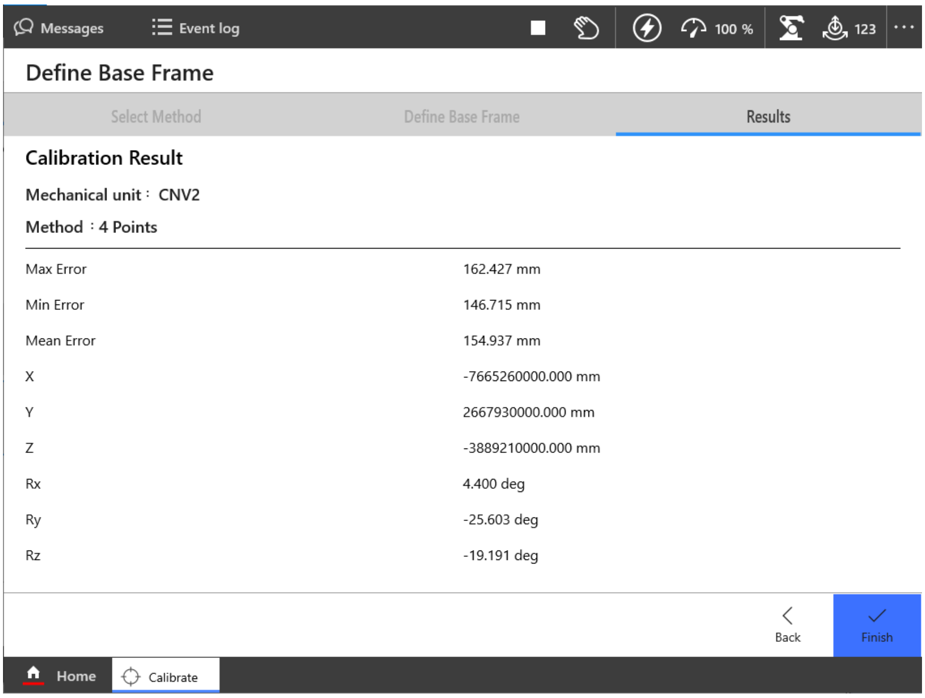

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If the estimated error is not ok, this base frame must be re-calibrated:

- Move the conveyor belt backward until the reference point is just inside the working range of the robot. Repeat the steps 10-13 for all the points **Point1**, **Point 2**, **Point 3**, and **Point 4**.
- If the conveyor belt cannot be moved backward, start over from step 1.

17 If there are more robots to calibrate along the conveyor, continue from step 3.

18 Restart the controllers to activate the new base frames.

4.3.5 Calibrating circular conveyor

Overview

Note

The following calibration process is required when running production and emulation. Calibration under the simulation tab in PickMaster PowerPac will not complete the following calibration process.

The calibrations needed for the circular conveyors are camera and work area calibrations. The work area calibration is a base frame calibration for conveyor work areas and a work object definition for indexed work areas. The key concept is to define a coordinate system origin that is the same for a camera and a robot base frame or work object.

Each camera must be calibrated separately. The base frame calibration is needed whenever conveyor systems are used.

The camera calibration is stored in the solution so all recipe in that solution could share the same calibration. If you need to re-calibrate a camera, all recipes in the solution will be updated with the new calibration.

The camera calibration and the work area calibration can be performed independently of each other, but it is very hard to make an accurate new camera calibration after the work area is calibrated.

The work area calibration is stored in the robot controller.

To calibrate the circular conveyor:

1. Define the parameter *Counts Per Meter* (for conveyors only), see *Defining the parameter Counts Per Meter (DSQC 377) on page 207*, *Defining the parameter Counts Per Meter (DSQC 2000) on page 209*.

   Note

   In the circular conveyor, the parameter *Counts Per Meter* indicates counts per radian.

2. Define the base frame, see *Defining the base frame (IRC5) on page 211*, *Defining the base frame (OmniCore) on page 215*.

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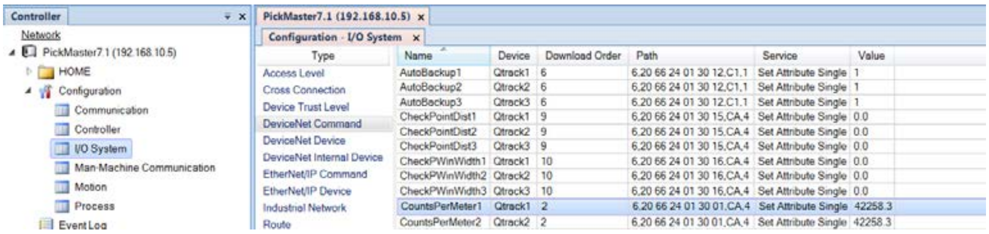
4.3.5.1 Defining the parameter Counts Per Meter (DSQC 377)

Introduction

The *Counts Per Meter* system parameter is used to calibrate the conveyor encoder. The *Counts Per Meter* system parameter belongs to the type *DeviceNet Command*, in the topic *I/O System*.



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Calculation for Counts Per Meter

The value for the *Counts Per Meter* system parameter is calculated as follows:

`(position1*old_counts_per_meter)/measured_radians`

Value	Description
`position1`	Read from FlexPendant Jogging window.
`old_counts_per_meter`	The encoder's old value. **Note** The encoders delivered from factory have a preset value. For an IRC5 system this value is 20,000. This value can be used to start the calibration with.
`measured_radians`	The manually measured radians that the conveyor has been moved.

Defining Counts Per Meter

Use the following procedure to define *Counts Per Meter* for the conveyor encoder.

1. Put a mark on the conveyor belt, for example draw a line or attach a piece of tape, and a mark on the side of the conveyor at the same location.
2. In the FlexPendant **Program Editor**, load and run the program ppacal.prg.

   This sets the current position of the conveyor to zero. The value is shown as **CNV** value in the **Position** part of the FlexPendant **Jogging** window.
3. Rotate the conveyor belt approximately 180 degrees.
4. In the FlexPendant **Jogging** window, read the position of the conveyor. This is `position1`.
5. Measure the physical radians between the two marks. This is the value `measured_radians`.
6. Calculate *Counts Per Meter* using the read and measured values.

   For example: `(1.5*20000)/0.5 = 60000`

When this variable is applied to a circular conveyor, the actual meaning is *counts per radian*.

Continues on next page

7. In RobotStudio, click **Configuration** and select topic **I/O System** and type **DeviceNet Command.**
8. Select the unit *Qtrackx* (where x is the number of the conveyor) and update the value for parameter *Counts Per Meter*.
9. Tap **OK**.
10. Restart the controller.

Related information

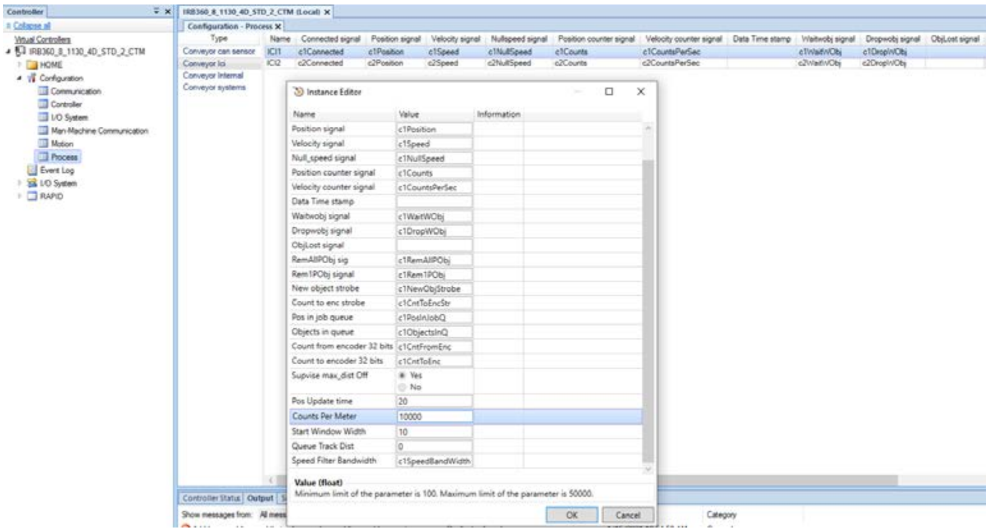
Application manual - Conveyor tracking.

Technical reference manual - System parameters.

4.3.5.2 Defining the parameter Counts Per Meter (DSQC 2000)

Introduction

The *Counts Per Meter* system parameter is used to calibrate the conveyor encoder. The *Counts Per Meter* system parameter belongs to the type *Conveyor Ici*, in the topic *Process*.



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Calculation for Counts Per Meter

The value for the *Counts Per Meter* system parameter is calculated as follows:

`counts value/measured_radians`

Value	Description
`position1/counts value`	Read from predefined I/O signal on the FlexPendant or RobotStudio. For example, CNV1, the signal name is c1counts.
`old_counts_per_meter`	The encoder's old value. **Note** The encoders delivered from factory have a preset value. For an IRC5 system this value is 20,000. This value can be used to start the calibration with.
`measured_radians`	The manually measured radians that the conveyor has been moved.

Defining Counts Per Meter

Use the following procedure to define *Counts Per Meter* for the conveyor encoder.

1. Put a mark on the conveyor belt, for example draw a line or attach a piece of tape, and a mark on the side of the conveyor at the same location.
2. Hot start it to set the current position of the conveyor to zero.

When this variable is applied to a circular conveyor, the actual meaning is *counts per radian*.

Continues on next page

This sets the current position of the conveyor to zero. The value is shown as **CNV** value in the **Position** part of the FlexPendant **Jogging** window.

3. Rotate the conveyor belt approximately 180 degrees.
4. In the FlexPendant **Jogging** window, read the position of the conveyor. This is `position1`.
5. Measure the physical radians between the two marks. This is the value `measured_radians`.
6. Calculate *Counts Per Meter* using the read and measured values.

   For example: `30000/0.5 = 60000`
7. In RobotStudio, click **Configuration** and select topic **Process** and type **Conveyor Ici**.
8. Edit the unit *ICIx* (where x is the number of the conveyor) and update the value for parameter *Counts Per Meter*.
9. Tap **OK**.
10. Restart the controller.

Related information

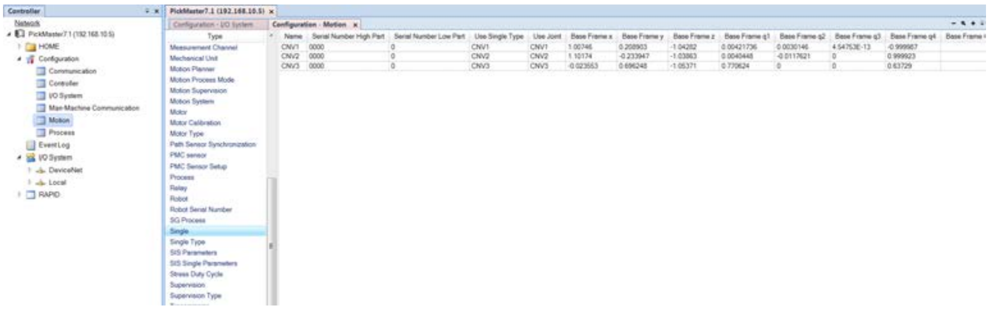
Application manual - Conveyor tracking.

Technical reference manual - System parameters.

4.3.5.3 Defining the base frame (IRC5)

Introduction

For each conveyor work area on a circular conveyor, a conveyor base frame calibration must be performed. The base frame calibration gives a reference point for the robot when a picking or placing sensor detects objects at the work area.



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Preparations

- Define the `Counts Per Meter` system parameter for each conveyor work area. For more details, see *Defining the parameter Counts Per Meter (DSQC 377) on page 207*, *Defining the parameter Counts Per Meter (DSQC 2000) on page 209*.
- Prepare a calibration tool that can be mounted temporarily on the robots. The calibration tool shall have a pointed TCP. Measure the TCP offset accurately.
- Create a tooldata for the calibration tool in the rapid program for each robot. Update the TCP offset with the measured values. In the FlexPendant **Jogging Window**, select the tooldata for the robot.
- If a camera is used, calibrate the camera, see *Calibrating camera on page 243*. After calibrating the camera, keep the camera calibration pattern attached to the conveyor.

Recommendation

This section describes how to use TCP measurements and RAPID programs to calculate the conveyor base frame position and quaternion for a circular conveyor.

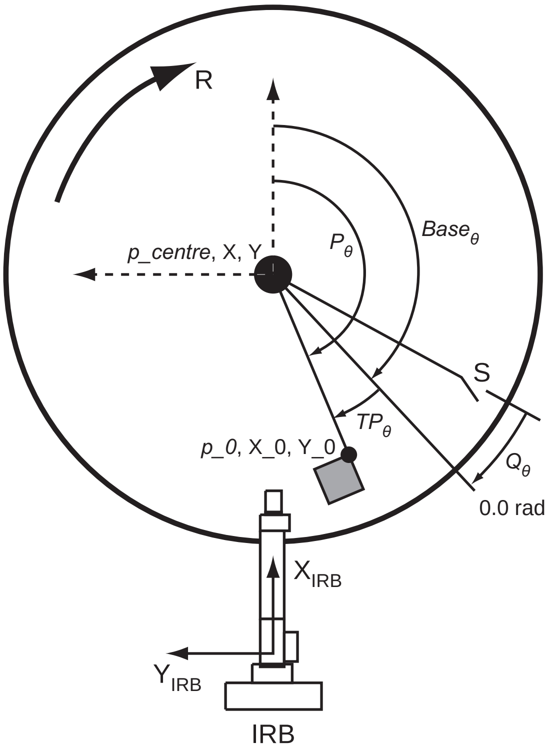
This method uses three measured points on the circular conveyor to calculate the center of rotation. The three points should be spaced as far apart as possible around the periphery.

Continues on next page

Defining the base frame orientation and start window start calibration

The base frame quaternion defines where the 0.0 rad point is for the robot motion.

The following figure shows an example of the angles that are used when defining the base frame orientation for the circular conveyor.



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R	Direction of rotation
S	Synchronization switch
Q_θ	Queue tracking distance angle
TP_θ	Angle shown on FlexPendant
P_θ	Angle calculated from p_0 position
$Base_\theta$	Base frame angle to be converted to a quaternion

Calculating the x and y positions for the base frame

Use this procedure to calculate the x and y positions for the base frame.

1. Use `Wobj0` on the FlexPendant. Pick out a reference point on the circular conveyor, jog the TCP to this point and record *p_0*.
2. Run the conveyor to another position. Jog the TCP to the reference point and record *p_1*.
3. Run the conveyor to a third position, jog the TCP to the reference point and record *p_2*.
4. Use the function `CNVUTL_cirCntr` with the points *p_0*, *p_1*, and *p_2*, to calculate the center of the circle, *p_centre*.

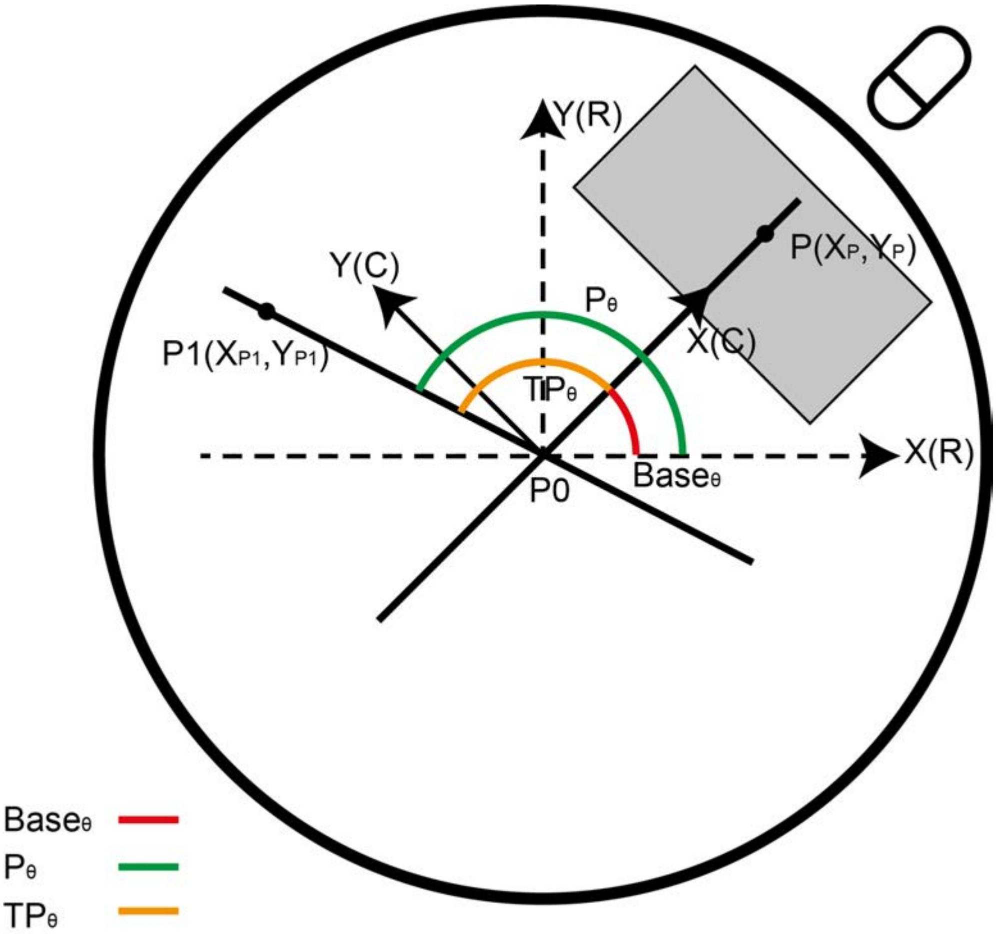
   The system module `cnv_utl.sys` can be found in Robotware.

Continues on next page

5 Take the x and y values from *p_centre* and enter them into the base frame values for the conveyor, converting to meters, see *Application manual - Conveyor tracking*. The z value will be entered later, once the work object zero position has been chosen.

Calculating the quaternion

Use this procedure to calculate the quaternion for the base frame orientation.



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1 With the recorded angle in step 5 when calculating the x and y positions for the base frame. This is angle TP_{θ}, see example measurement points in *Defining the base frame orientation and start window start calibration on page 212*.

2 Calculate Pθ from the *XP1* and *YP1* coordinates of *P0* and the atan function. If the point is at first quartile or frouth quartile: Pθ = arctan(YP1/XP1)

Continues on next page

If the point is at second quartile or third quartile: Pθ = π + arctan(YP1/XP1)

> **Tip**
>
> If the calculation tool provide the arctan2 function, there is no need to judge the quartile and use Pθ = arctan2 (XP1, YP1) directly.

3 Calculate the value of Base.

$$Base_\theta = P_\theta - TP_\theta$$

4 Calculate the quaternion for the base frame taking into account the direction of rotation:

Counter clockwise rotation:

```
q1 = cos(Base θ /2)
q2 = 0.0
q3 = 0.0
q4 = sin(Base θ /2)
```

Clockwise rotation:

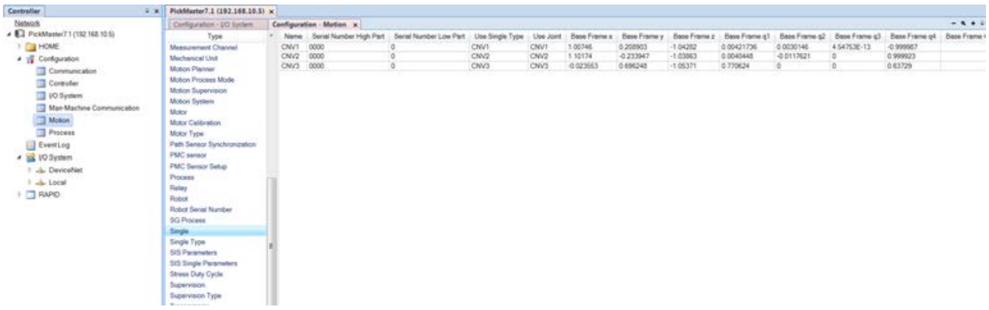
```
q1 = 0.0
q2 = cos(Base θ /2)
q3 = -sin(Base θ /2)
q4 = 0.0
```

5 Enter the value for z (in meters) from *p_0*, and the values for the quaternions, *q1*, *q2*, *q3*, and *q4*, into the base frame for the conveyor.

4.3.5.4 Defining the base frame (OmniCore)

Introduction

For each conveyor work area on a circular conveyor, a conveyor base frame calibration must be performed. The base frame calibration gives a reference point for the robot when a picking or placing sensor detects objects at the work area.



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Preparations

- Define the `Counts Per Meter` system parameter for each conveyor work area. For more details, see *Defining the parameter Counts Per Meter (DSQC 377) on page 207*, *Defining the parameter Counts Per Meter (DSQC 2000) on page 209*.
- Prepare a calibration tool that can be mounted temporarily on the robots. The calibration tool shall have a pointed TCP. Measure the TCP offset accurately.
- Create a tooldata for the calibration tool in the rapid program for each robot. Update the TCP offset with the measured values. In the FlexPendant **Jogging Window**, select the tooldata for the robot.
- If a camera is used, calibrate the camera, see *Calibrating camera on page 243*. After calibrating the camera, keep the camera calibration pattern attached to the conveyor.

Recommendation

This section describes how to use TCP measurements and RAPID programs to calculate the conveyor base frame position and quaternion for a circular conveyor.

This method uses three measured points on the circular conveyor to calculate the center of rotation. The three points should be spaced as far apart as possible around the periphery.

Procedure

Use the following procedure to calibrate all the base frames for a circular conveyor with OmniCore controller:

1. Make sure the reference point for calibration is marked accurately on the conveyor belt.
   - If a camera is used, the reference point is the local origin of the camera view. If the camera has been just calibrated, the reference point is

Continues on next page

already marked by the origin of the camera calibration pattern that is attached to the conveyor.

- If an I/O sensor is used to generate predefined positions, the reference point should be marked on the conveyor at the point where the objects are detected by the sensor. This point becomes the local origin of the detected items or containers.

2. Move the conveyor belt forward until the reference point is just inside the working range of the next robot to calibrate.

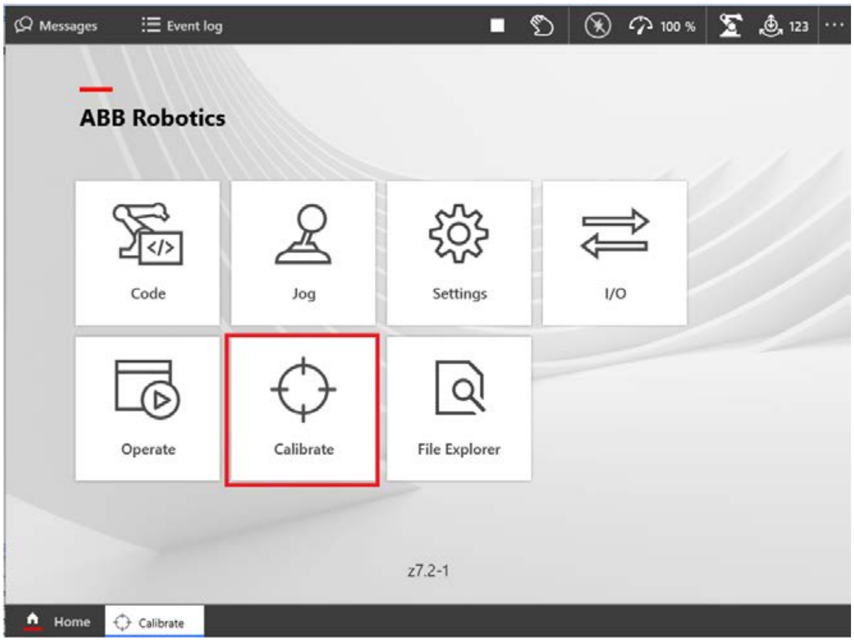
   The conveyor positions for all the conveyor work areas, in the jogging window should indicate the same total travel distance for the reference point. The nearest robot to the camera or sensor is calibrated first, followed by the next nearest robot and so on until all the robots along the conveyor have been calibrated.
3. Mount the calibration tool on the robot.
4. Reset the conveyor (encoder board) positions.

   Note

   Do not move the conveyor until this step is completely finished.

   Do the following for all the robots having work areas that needs to be calibrated along the conveyor:

   - In the FlexPendant, click **Calibrate**.



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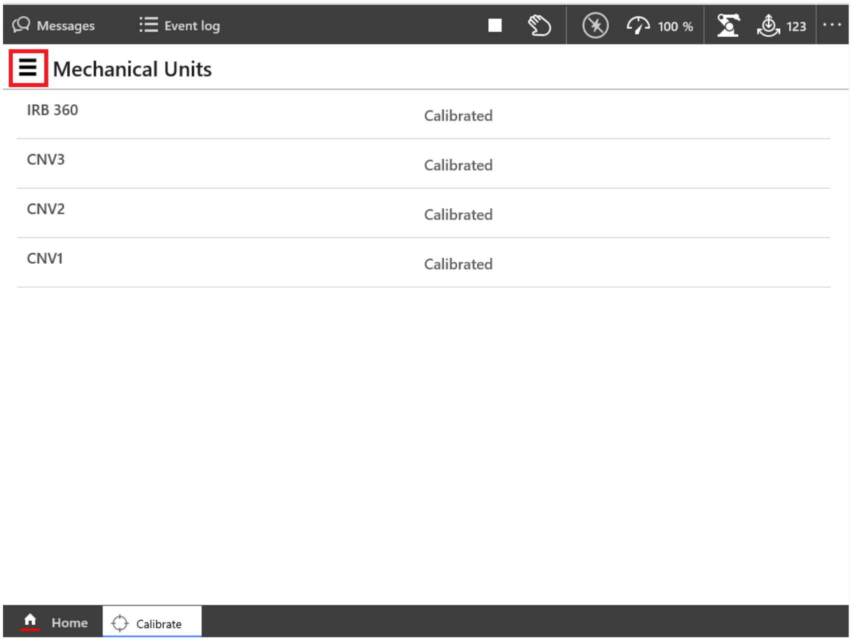
- Click **Option Tab** on the up left corner.



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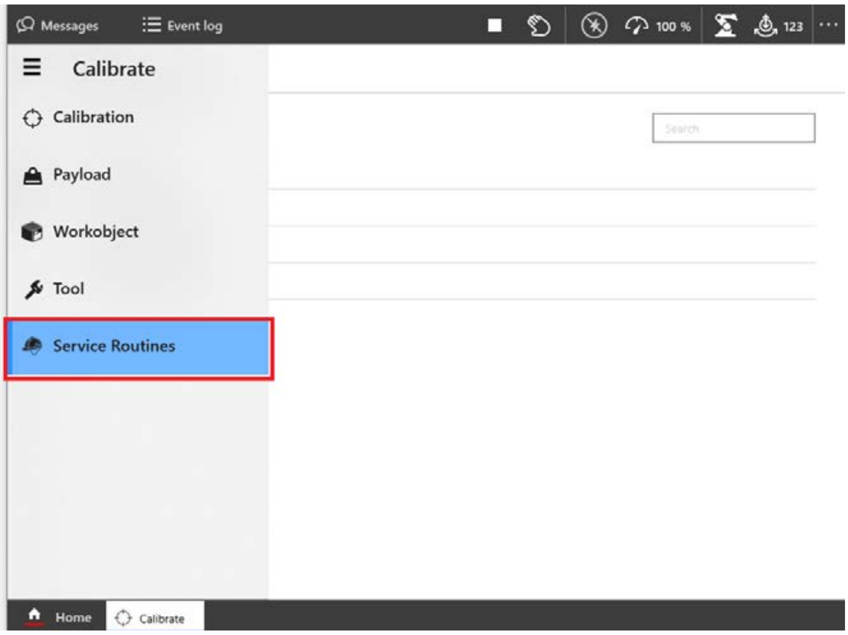
- Click **Service Routines.**



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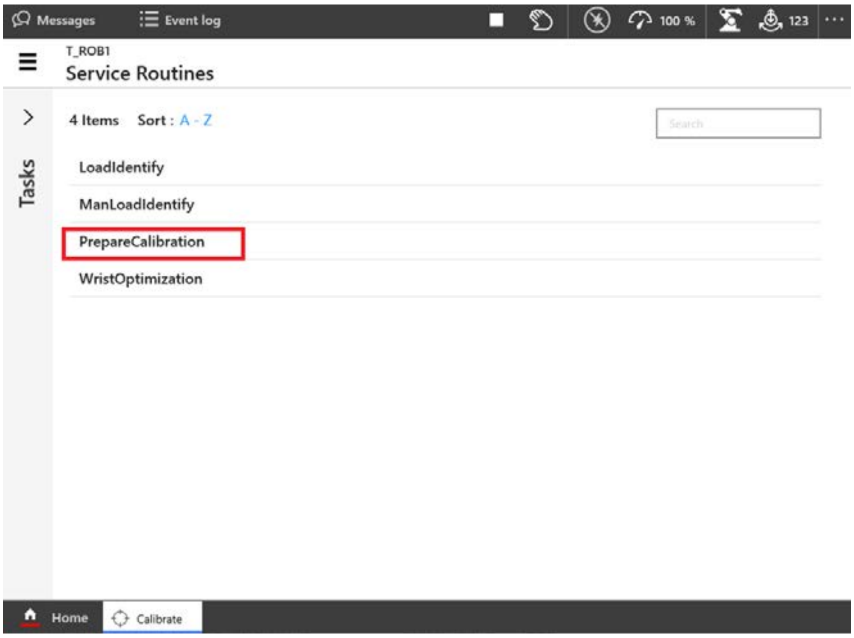
- Click **PrepareCalibration**.



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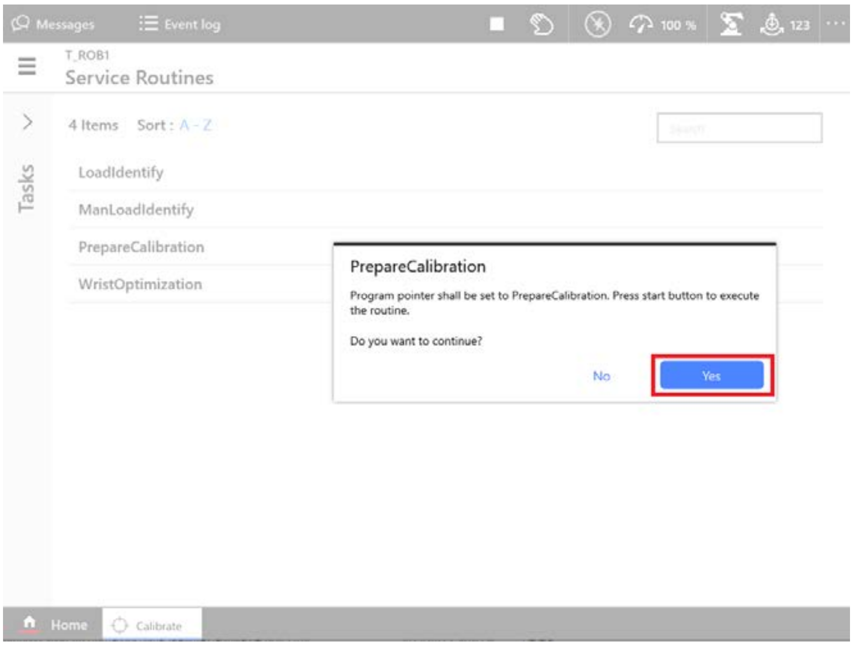
- Click **Yes** in the popped up dialog.



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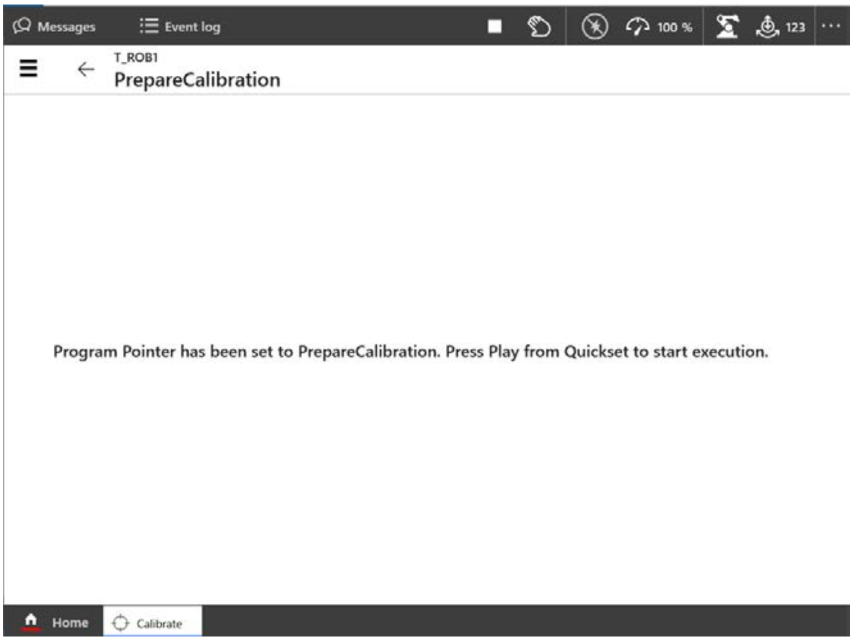

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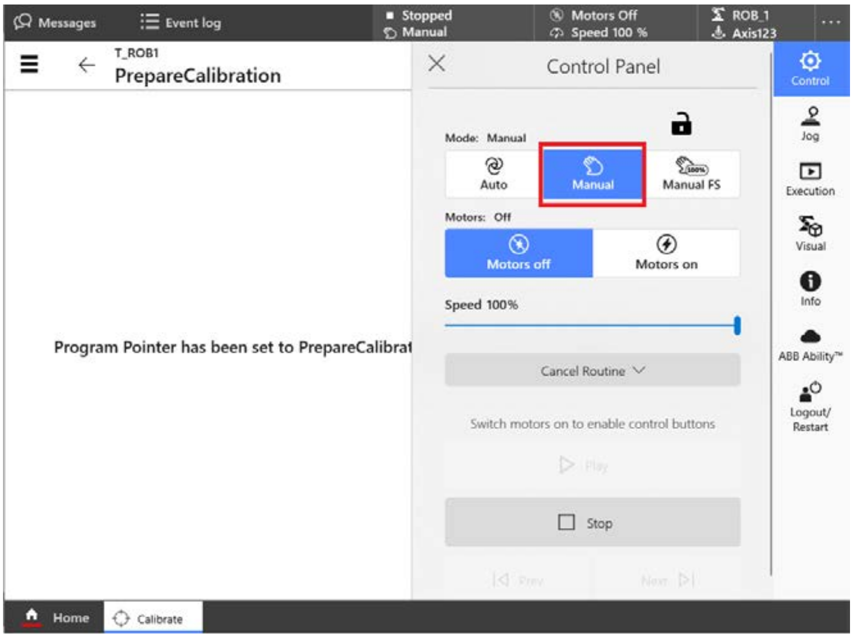
- Set the controller to **Manual** mode.



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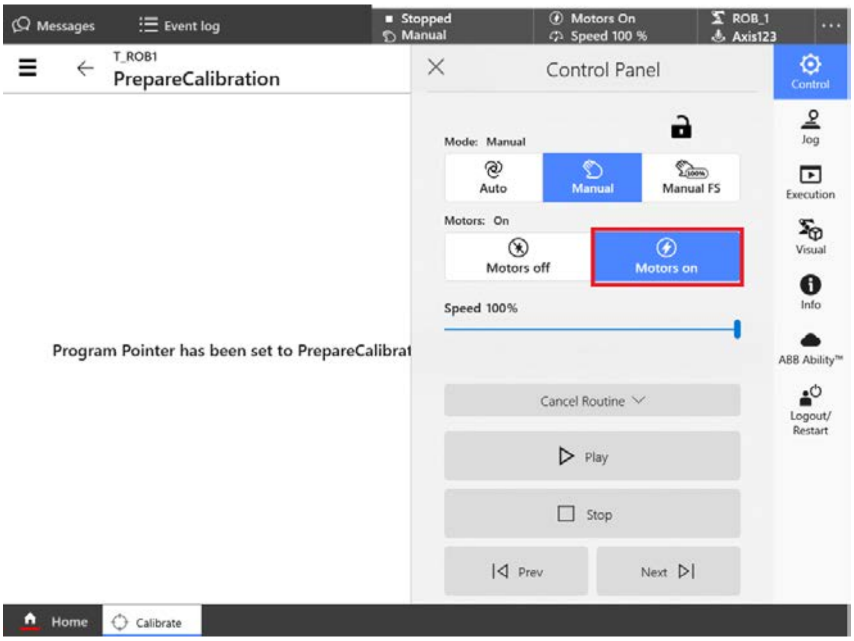
- Enable the Thumb button to motors on the controller.



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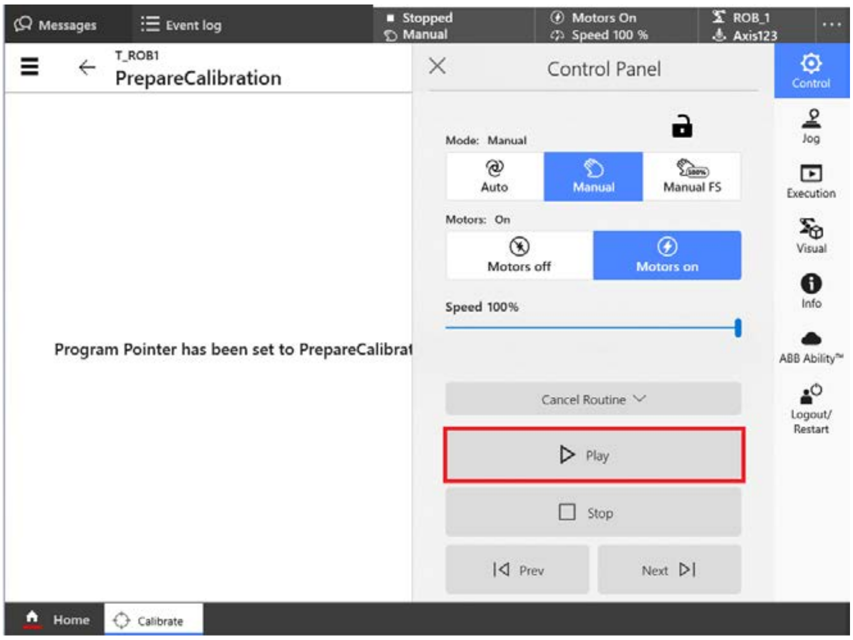
- Click **Play**.



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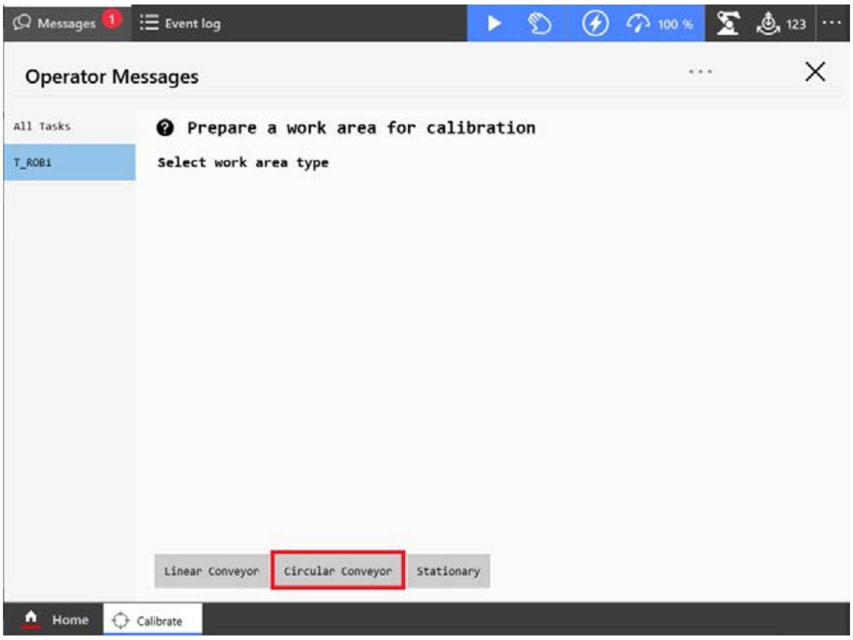
- Select the work area type **Circular Conveyor**.



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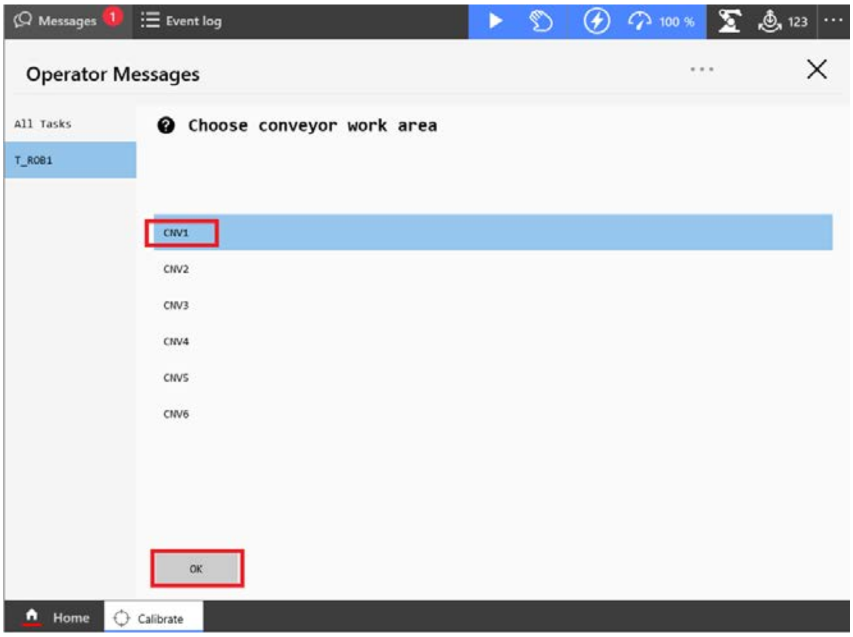
- Select conveyor: for example, CNV1. Then click **OK**



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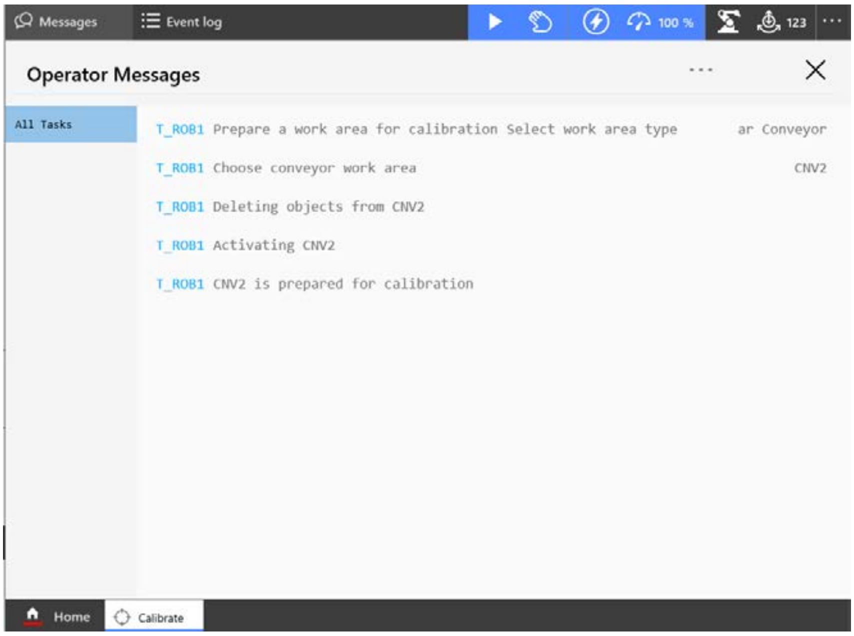
- Wait for the message **...is prepared for calibration.** The conveyor position in the jogging window for CNV1 should now be displayed as “0” mm.



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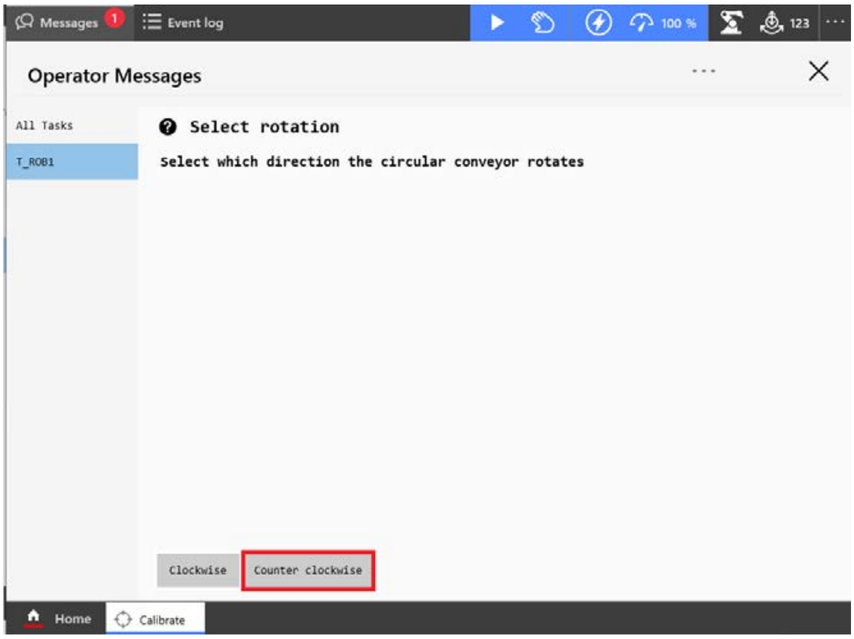
- Wait for the message **Select rotation** and click the direction of the conveyor.



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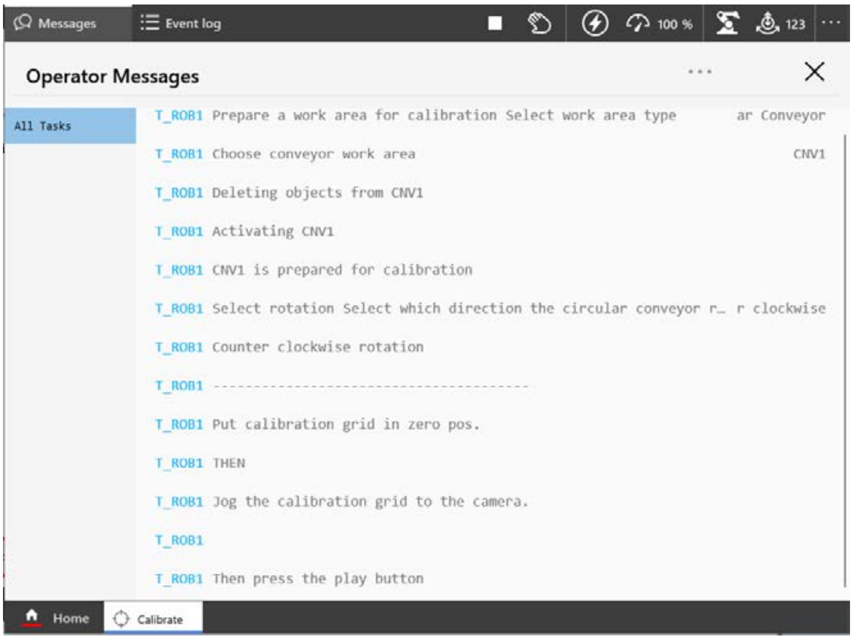
- The program will continue automatically.



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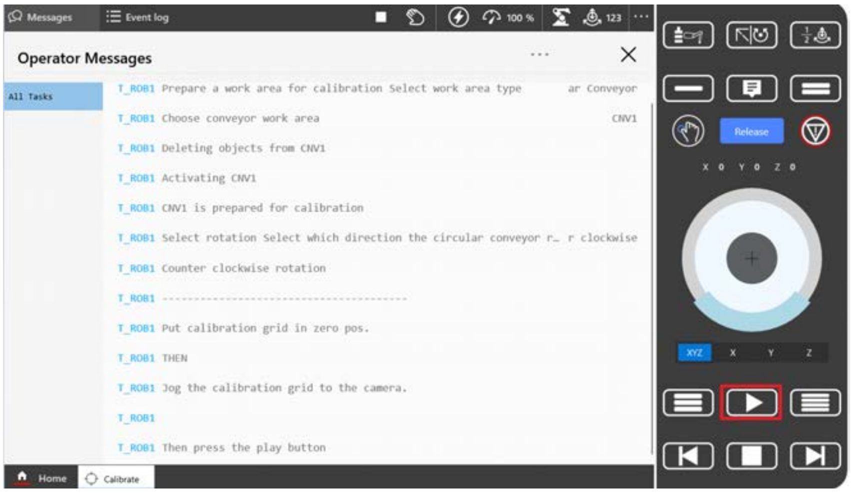
- Click **Play**.



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5 Modify the point (**Pos 1**) by tapping **Play**.

6 Repeat the steps for the points **Pos2**, **Pos 3**, and **Pos 4**.

7 Check if the displayed mean error and max error of the base frame calculation is acceptable. If the estimated error is acceptable, restart the system to confirm and store the new base frame.

> **Note**
>
> A mean error of less than 1 mm is acceptable in most cases.

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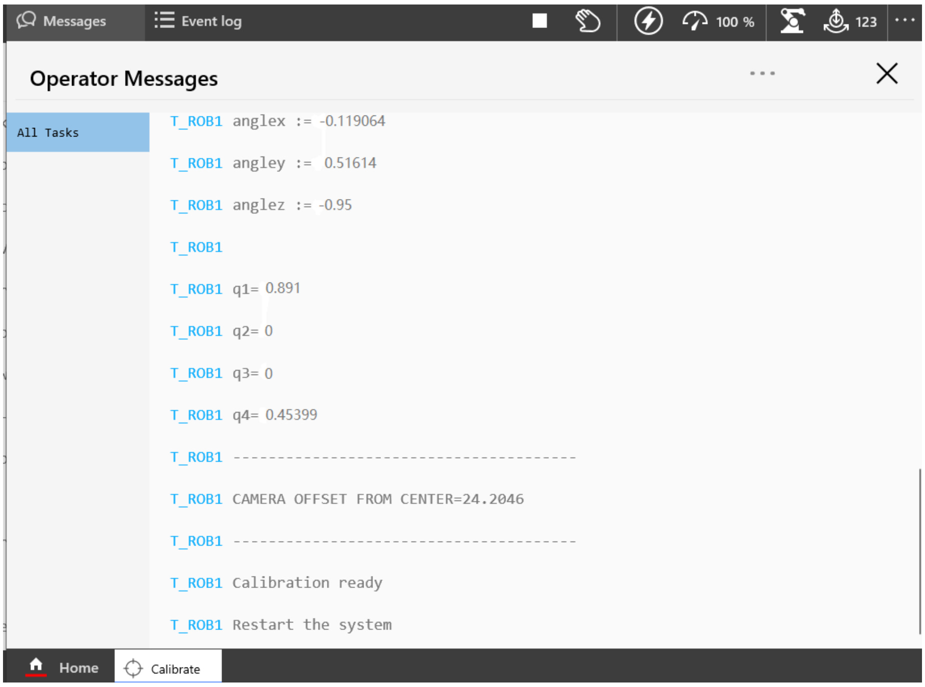

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If the estimated error is not ok, this base frame must be re-calibrated.

8 If there are more robots to calibrate along the conveyor, continue from step 2.

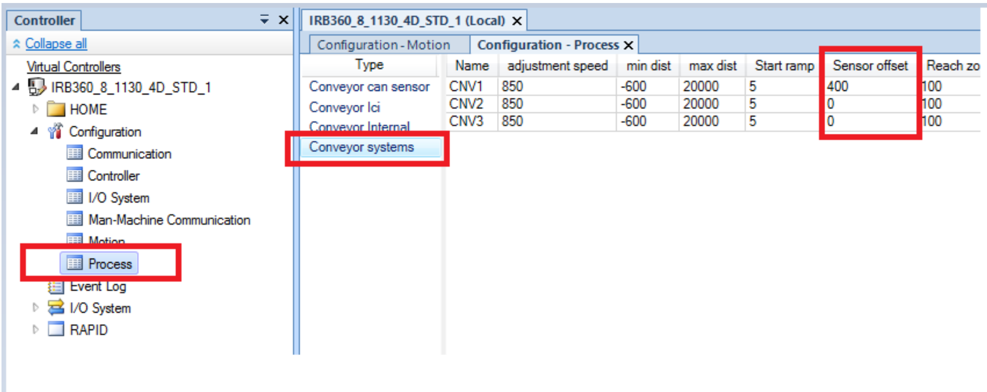
4.3.5.5 Type configuration for circular conveyor

Introduction

For each conveyor work area on a circular conveyor, the type parameters, `Sensor offset`, `Mechanics` and `Rotating Move`, must be set.

`Sensor offset` defines the distance between the sensor and the conveyor base frame original point. For example, when using a camera, this parameter represents the distance of the projection point of the camera on the conveyor belt from the center of the circle.

> **Note**
>
> The distance for `Sensor offset` is measured manually.



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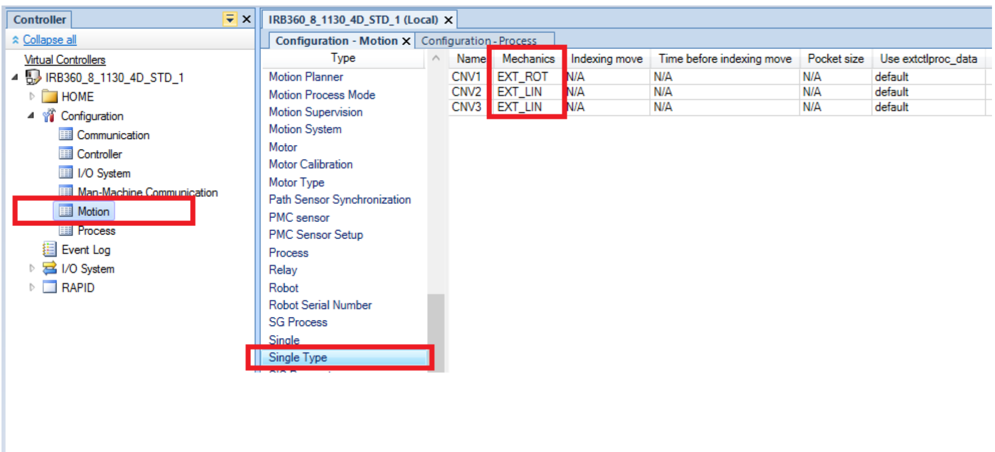
`Mechanics` defines the moving trajectory of the conveyor. The default value is `EXT_LIN` (linear conveyor). So when the circular conveyor is used, this parameter must be set as `EXT_ROT`.



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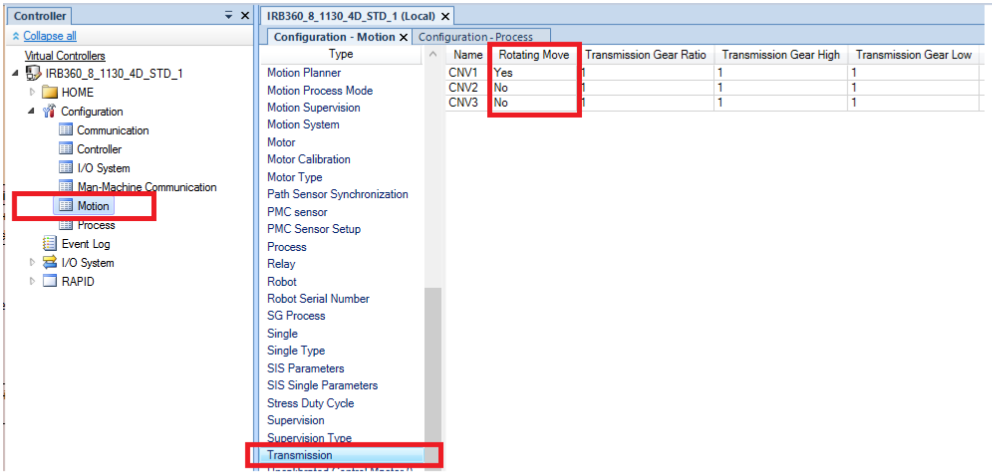
`Rotating Move` defines the conveyor's rotating status. The default value is `No` (linear conveyor). So when the circular conveyor is used, this parameter must be set as `Yes`.



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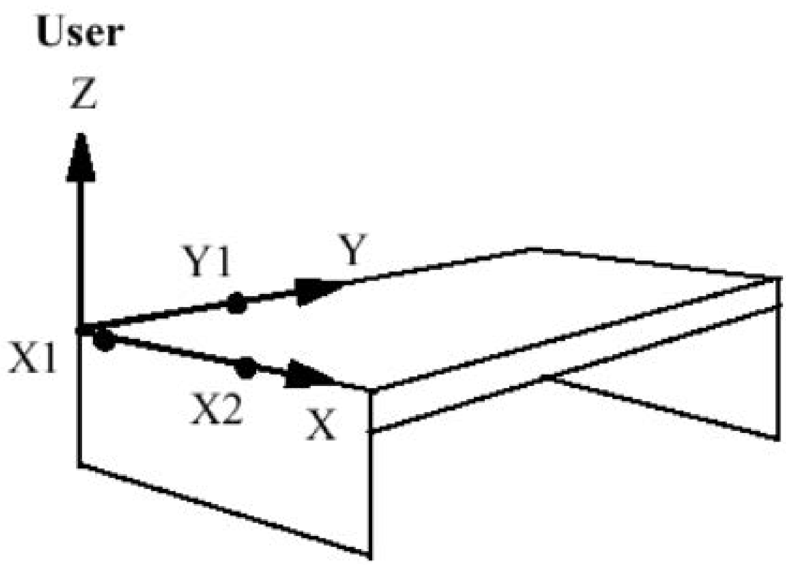
4.3.6 Calibrating indexed work area

Introduction

For indexed work areas a work object calibration must be performed. The work object calibration gives a reference point for the robot when picking or placing sensor detected objects at the work area.

Preparations for calibrating the indexed work area

- Prepare a calibration tool that can be mounted temporarily on the robot. The calibration tool shall have a pointed TCP. Measure the TCP offset accurately.
- Create a tooldata for the calibration tool in the rapid program for the robot. Update the TCP offset with the measured values. In the FlexPendant Jogging Window, select the tooldata for the robot.
- Calibrate the camera, see *Calibrating camera on page 243*. After calibrating the camera, keep the camera calibration pattern attached to the conveyor.
- Make sure the reference x- and y-axes for work object calibration is marked accurately on the indexed work area. Three reference points are needed for the calibration: two points on the x-axis and one point on the y-axis.
  - If a camera is used, the reference x- and y-axes should be marked with respect to the local origin of the camera view. If the camera just has been calibrated, the local origin is marked by the camera calibration pattern attached to the indexed work area.
  - If a position generator I/O signal is used to generate predefined positions, the reference x- and y-axes should be marked at the desired location for the local origin where items or containers are to be generated.



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Procedure(IRC5)

1 Select the work object to be calibrated.
   - In the FlexPendant **Program Editor**, load the program `ppacal.prg`(DSQC 377)/ `PrepareCalib.prg`(DSQC 2000). If the robot is a MultiMove robot, load `ppacal.prg`(DSQC 377)/ `PrepareCalib.prg`(DSQC 2000) for this robot task (for example, `T_ROB1`), and select only this task for execution.
   - Start the loaded rapid program
     - Select calibration type: Fixed/Indexed.
     - Select work object: For example, `IdxWobj1`.
     - Wait for the message **DEFINE CURRENT WORKOBJECT**.

     Note

     Do not move the program pointer until the calibration has been completed. Otherwise, the calibration is not properly saved.

2 In the FlexPendant **Jogging** window, tap and select **Workobject**. Then tap **Edit** and select **Define**.

3 Select **Object method**: No Change. Select User method: 3 points.

4 Select **User Point X 1**. Point out a point on the x-axis close to the origin with the robot's TCP. Press Modify Position.

5 Select **User Point X 2**. Move the TCP a distance in the direction the x-axis. Point out a point on the x-axis with the robot's TCP. Press Modify Position.

6 Select **User Point Y 1**. Point out a point on the positive y-axis with the robot's TCP. Press Modify Position.

7 Tap **OK**.

8 Restart the RAPID program (without moving the PP) to save the selected work object definition.

   The definition is saved in the rapid data array `NonCnvWOData` located in the `ppaUser` system module.

Procedure(OmniCore)

1 Make sure the reference point for calibration is marked accurately on the conveyor belt.
   - If a camera is used, the reference point is the local origin of the camera view. If the camera has been just calibrated, the reference point is already marked by the origin of the camera calibration pattern that is attached to the conveyor.
   - If an I/O sensor is used to generate predefined positions, the reference point should be marked on the conveyor at the point where the objects are detected by the sensor. This point becomes the local origin of the detected items or containers.

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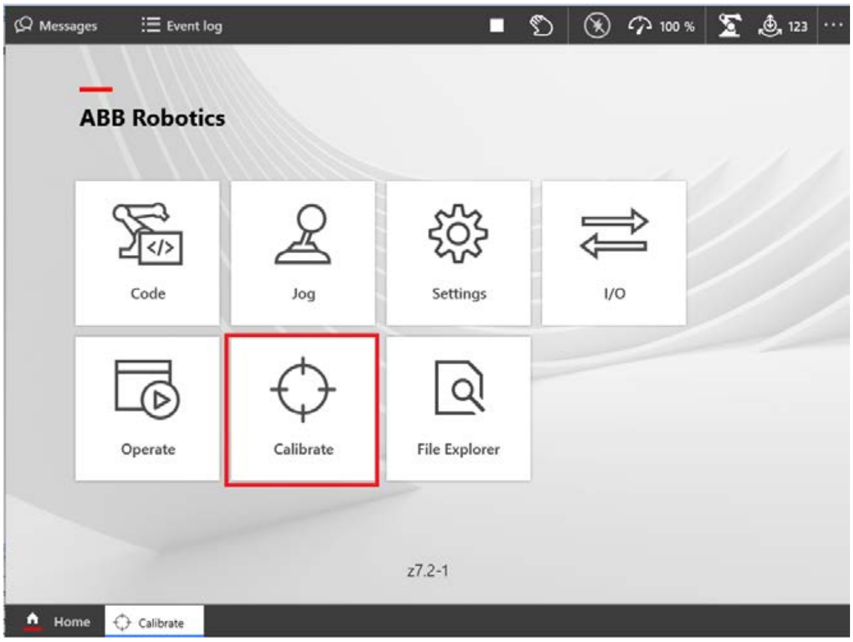
2 Reset the conveyor (encoder board) positions.

Note

Do not move the conveyor until this step is completely finished.

Do the following for all the robots having work areas that needs to be calibrated along the conveyor:

- In the FlexPendant, click **Calibrate**.



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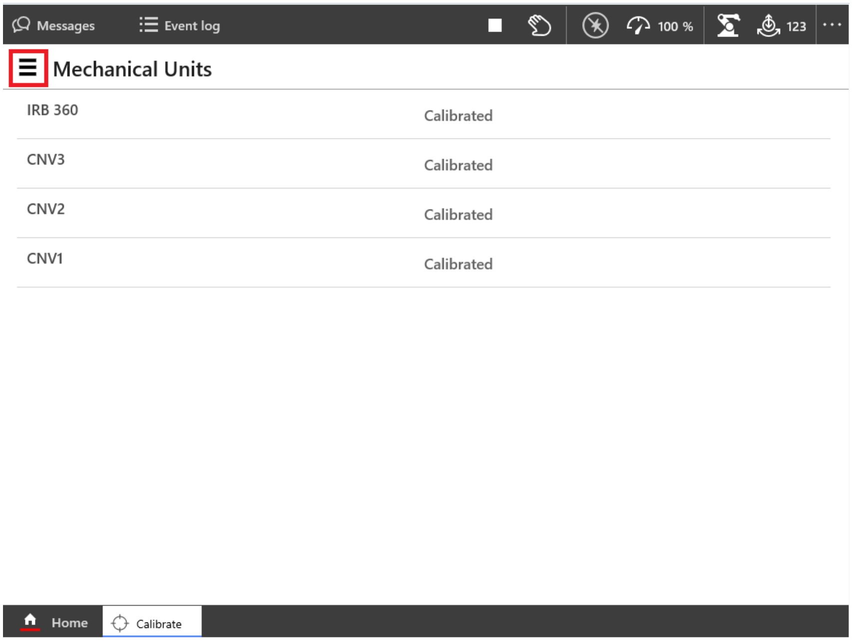
- Click **Option Tab** on the up left corner.



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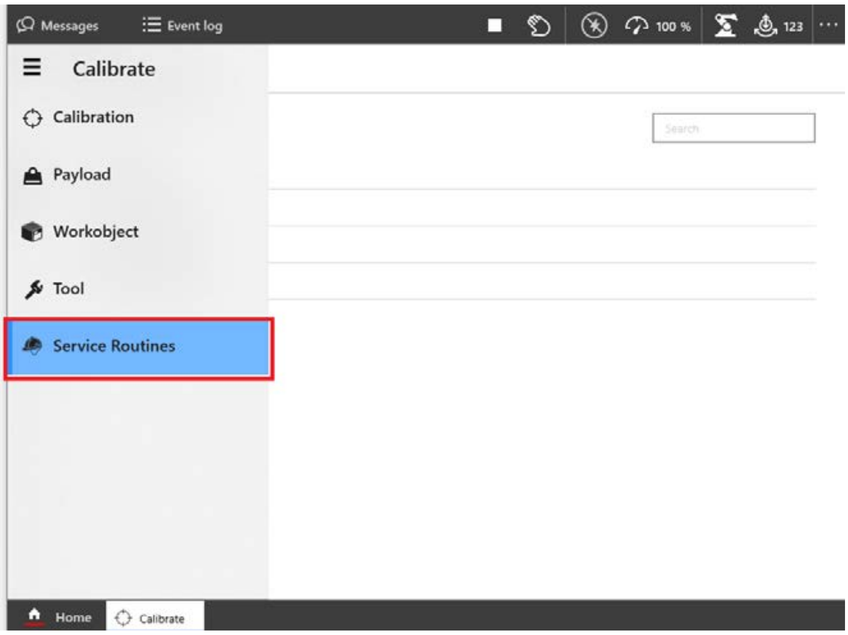
- Click **Service Routines.**



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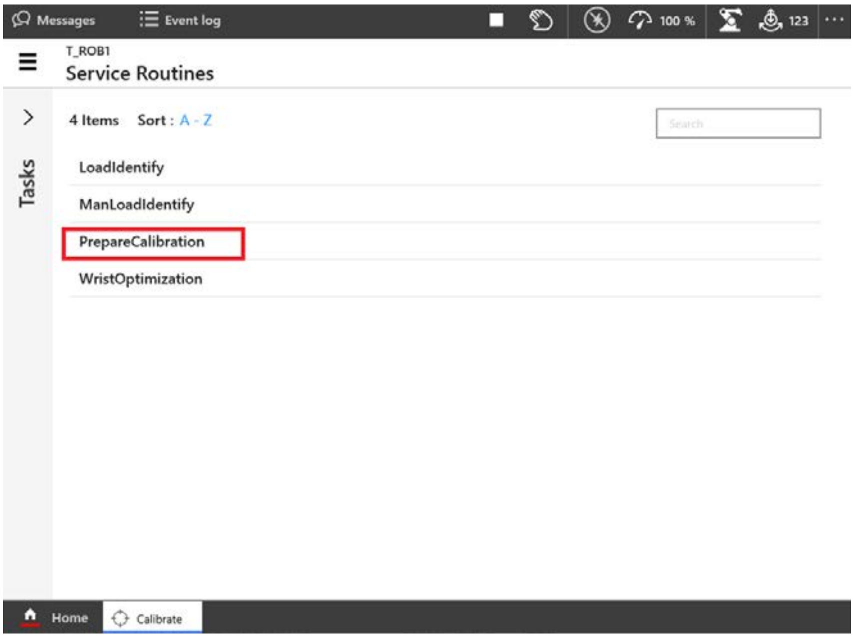
- Click **PrepareCalibration.**



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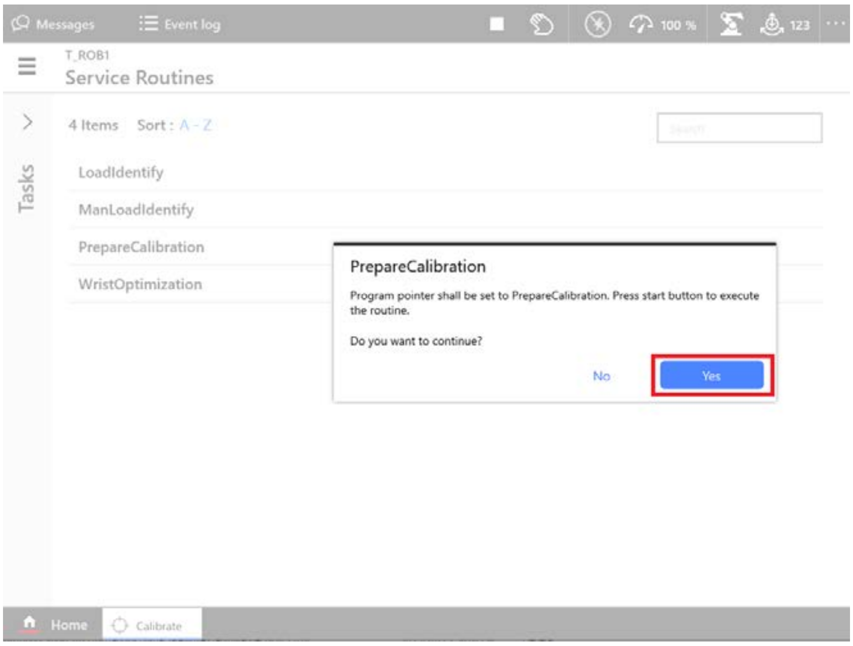
- Click **Yes** in the popped up dialog.



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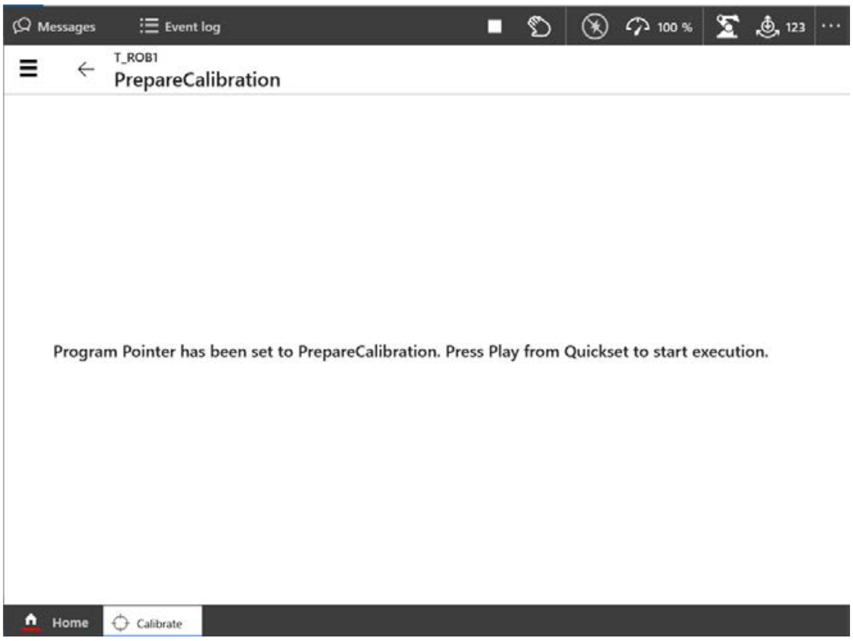

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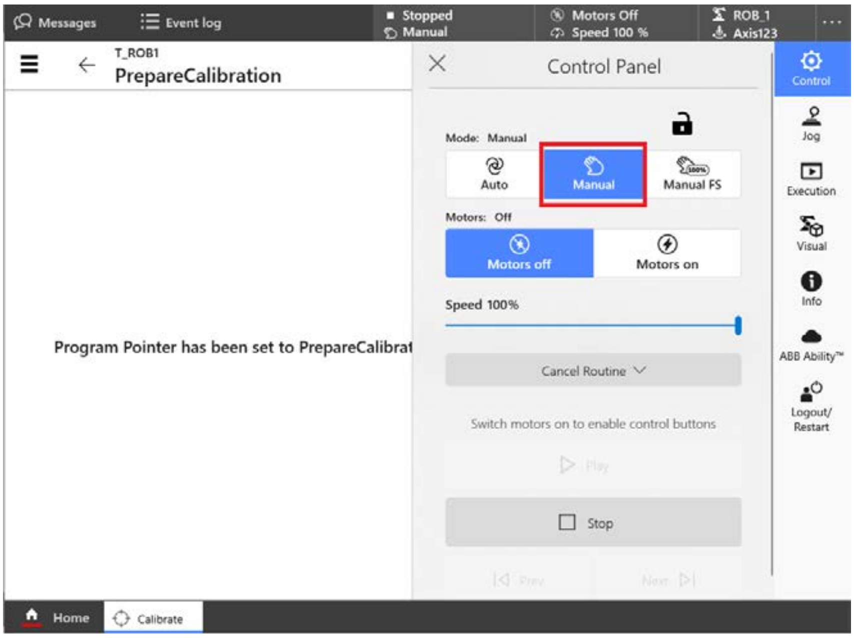
- Set the controller to **Manual** mode.



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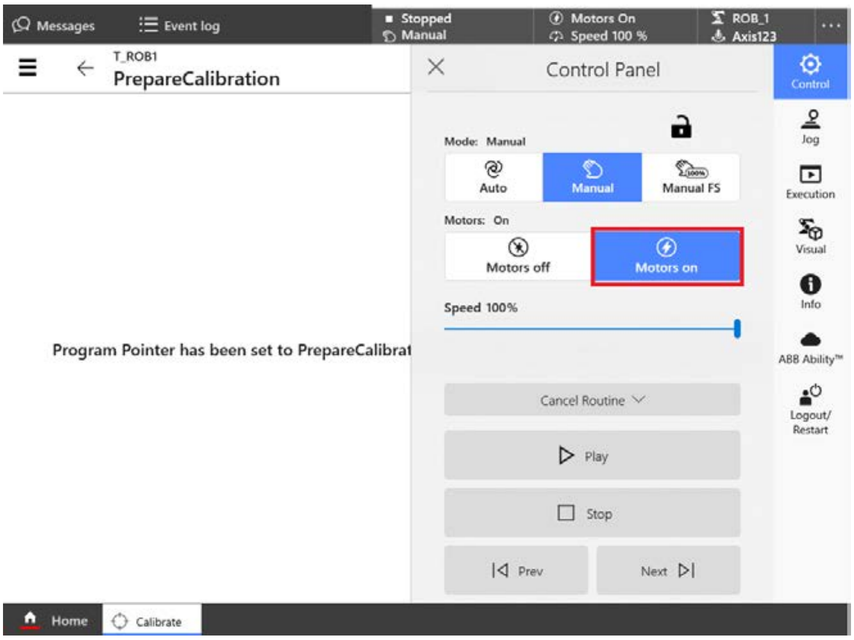
- Enable the Thumb button to motors on the controller.



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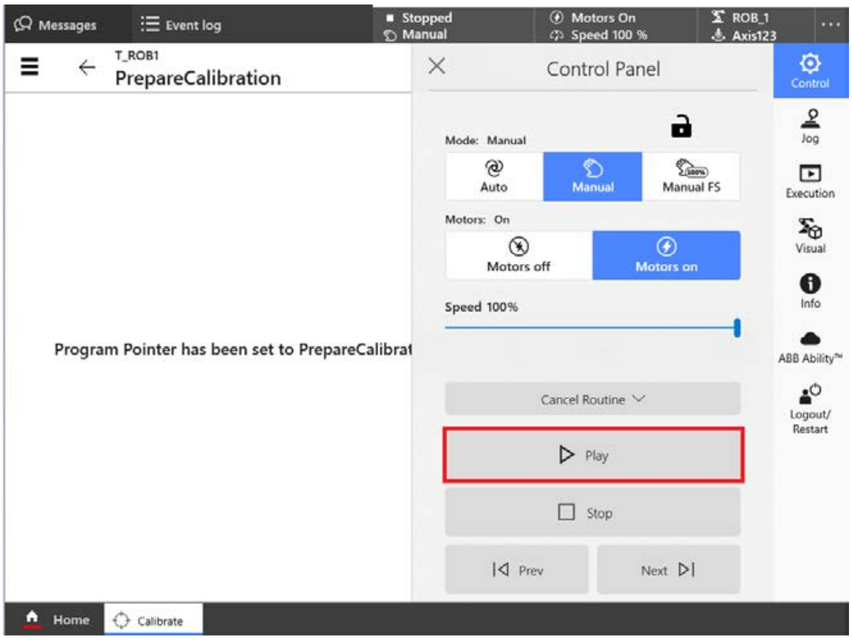
- Click **Play**.



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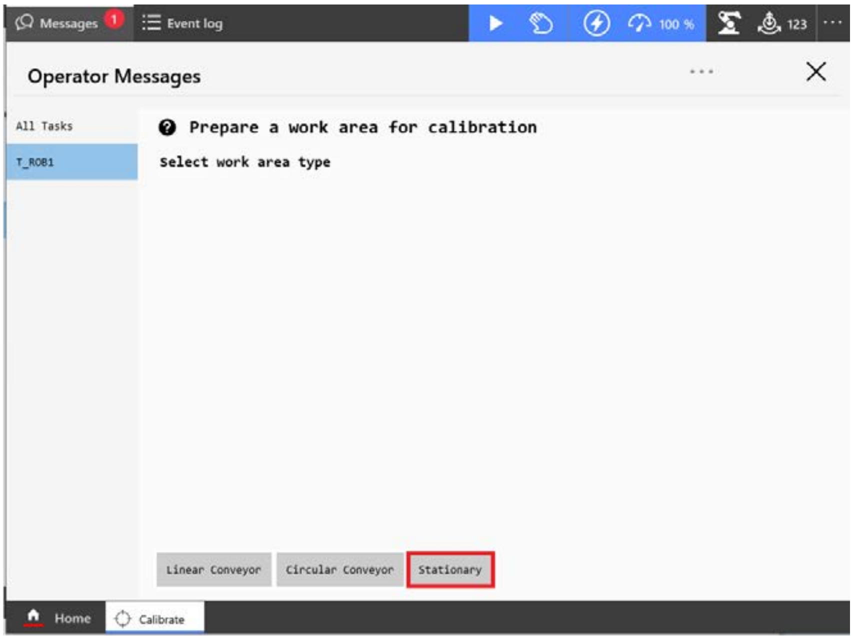
- Select the work area type **Stationary**.



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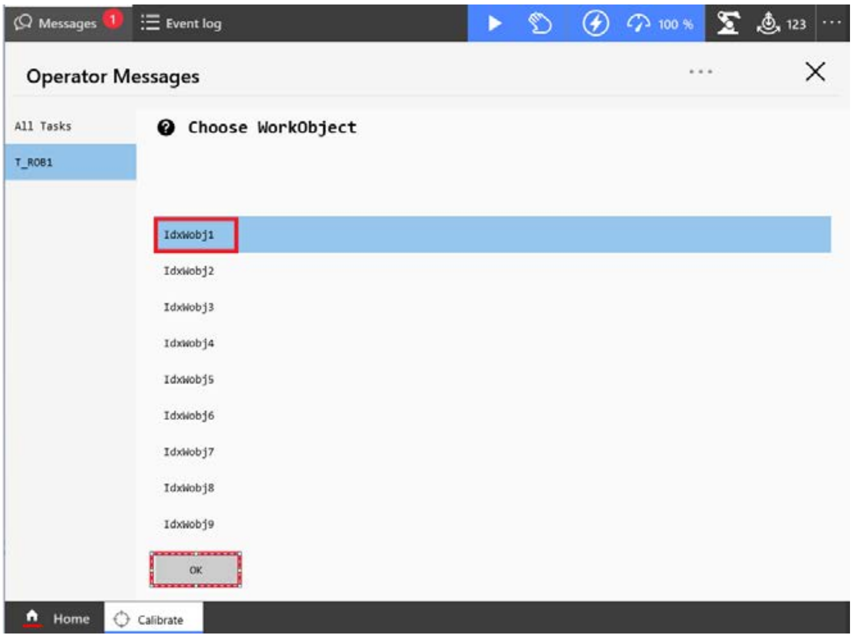
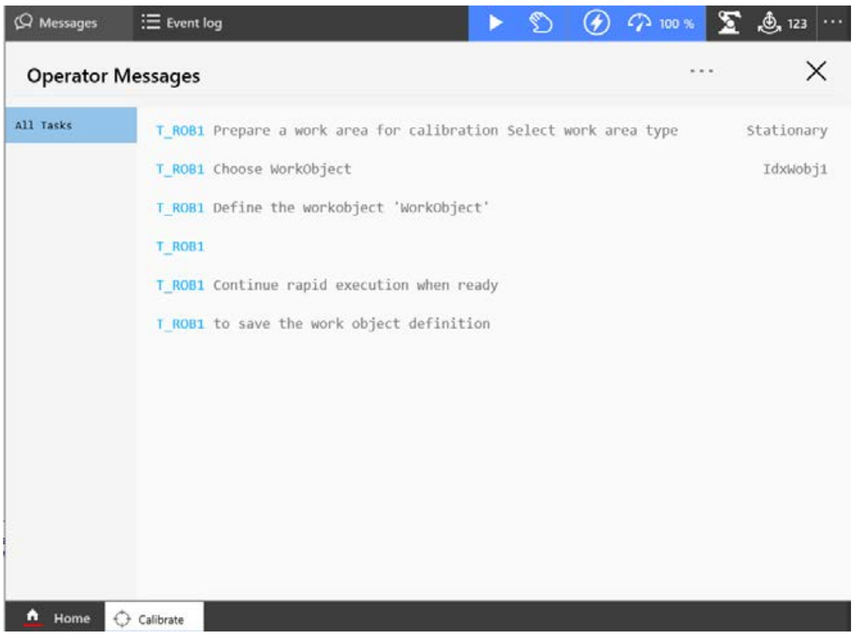
- Select conveyor: for example, Idxwobj1. Then click **OK**



xx2100000397

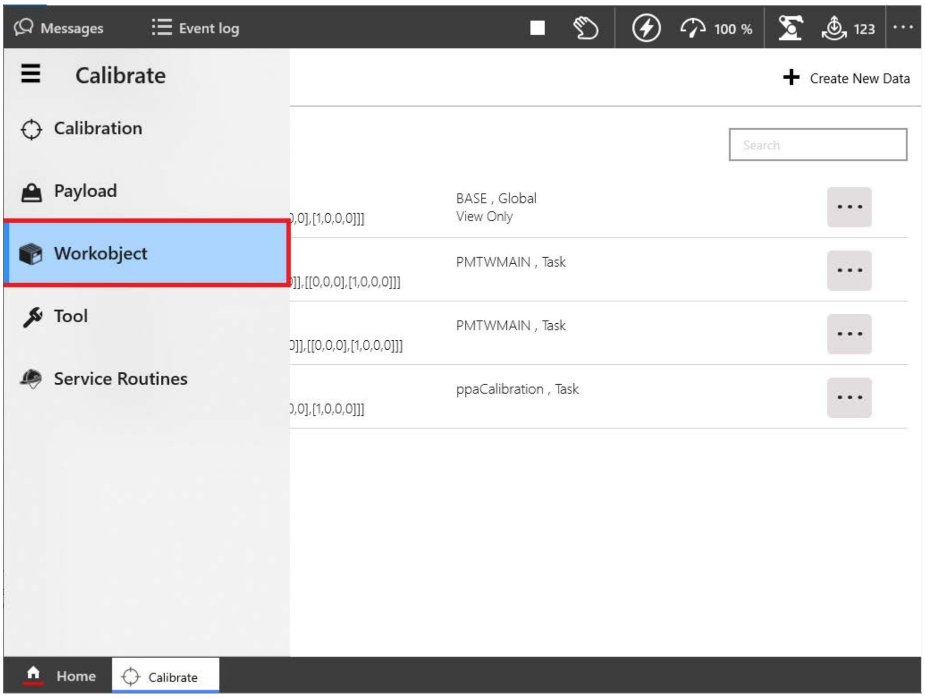
- Wait for the message **...is prepared for calibration.** The conveyor position in the jogging window for CNV1 should now be displayed as “0” mm.



xx2100000398

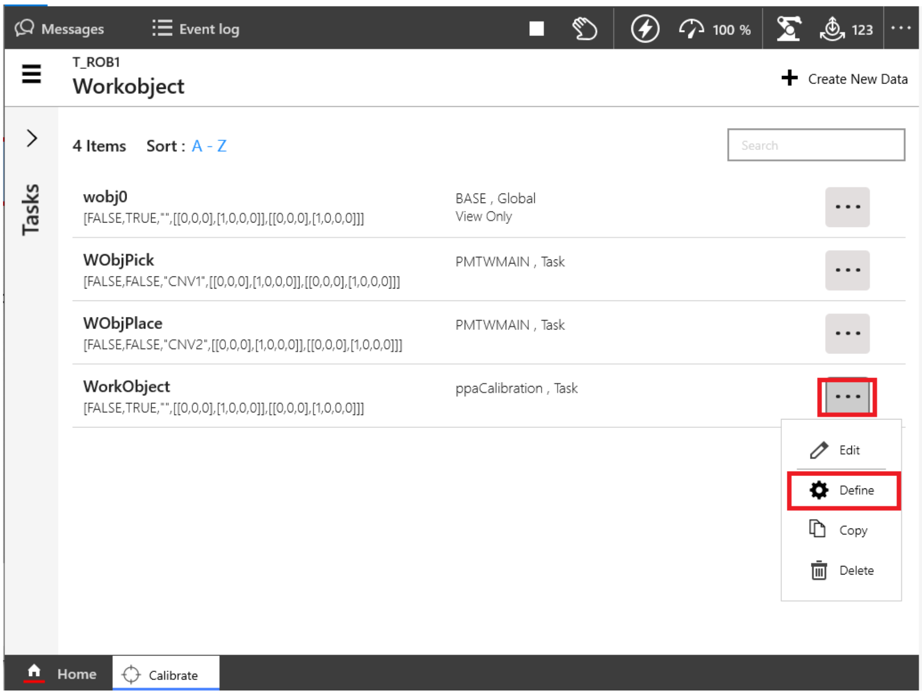
Continues on next page

3 Select the **Workobject** in the Option Tab.



xx2100000380

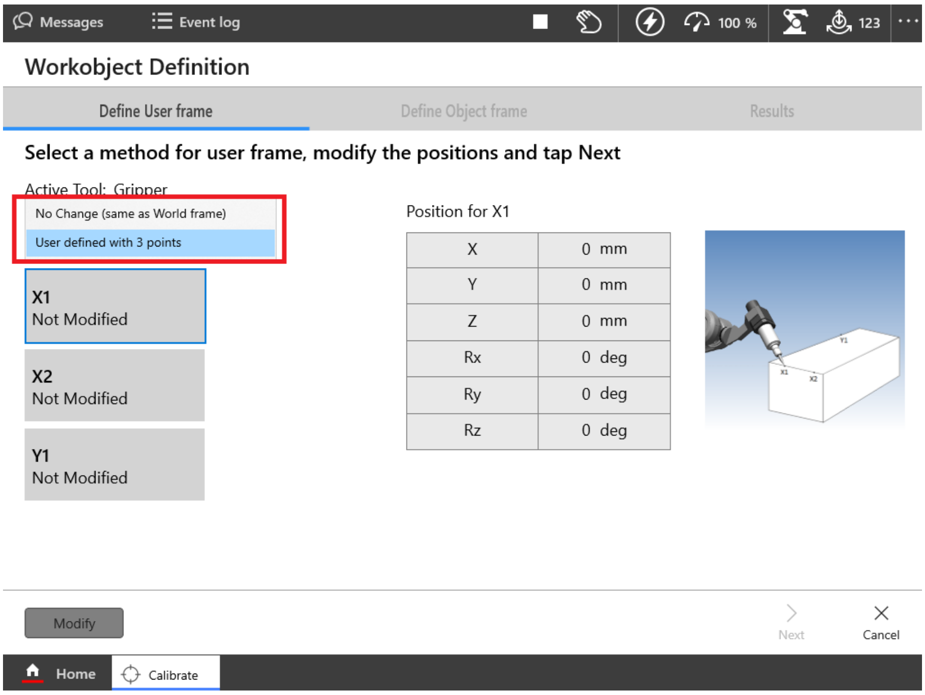
4 In the Workobject, tap on the ... to select **Define**.



xx2100000381

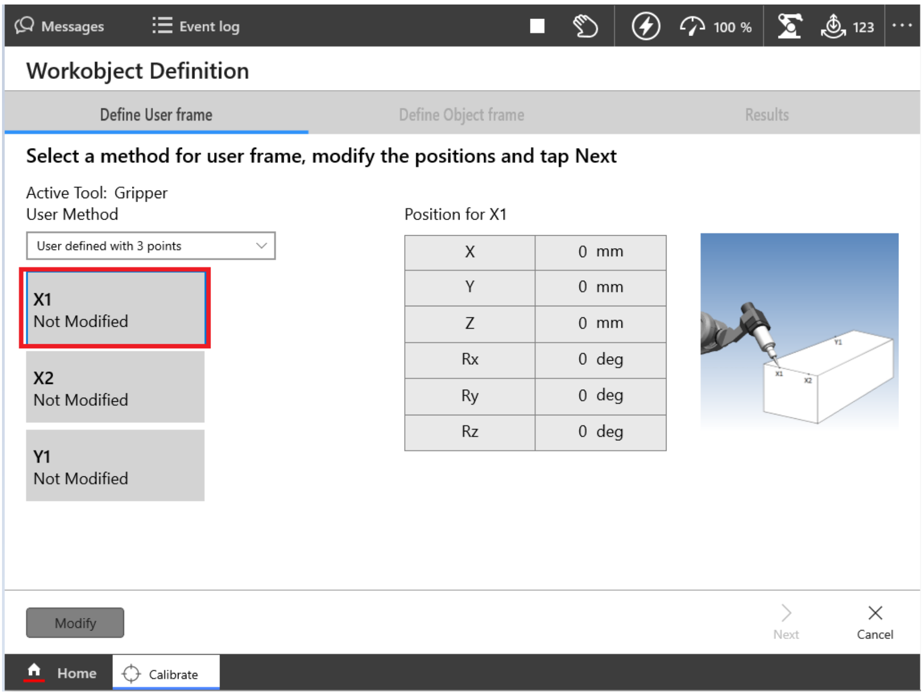
Continues on next page

5 In the **Define User frame** window, set the **User Method** as `User defined with 3 points`.



xx2100000382

6 Select **X1**. Point out a location on the x-axis close to the origin with the robot's TCP.



xx2100000383

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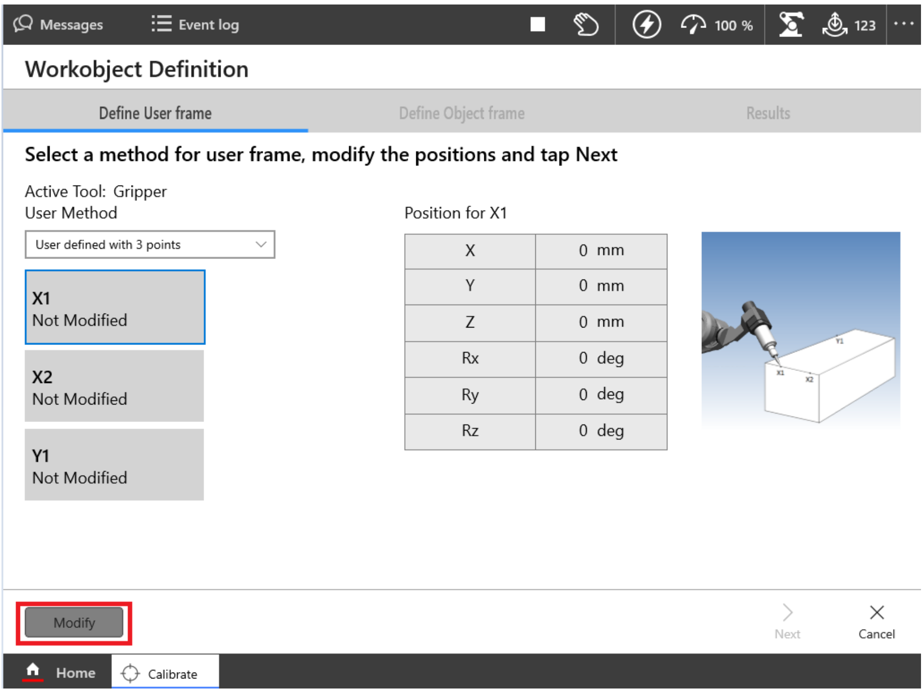
7 Press **Modify**.



xx2100000384

8 Select **X2**. Move the TCP a distance in the direction the x-axis. Point out a location on the x-axis with the robot's TCP.

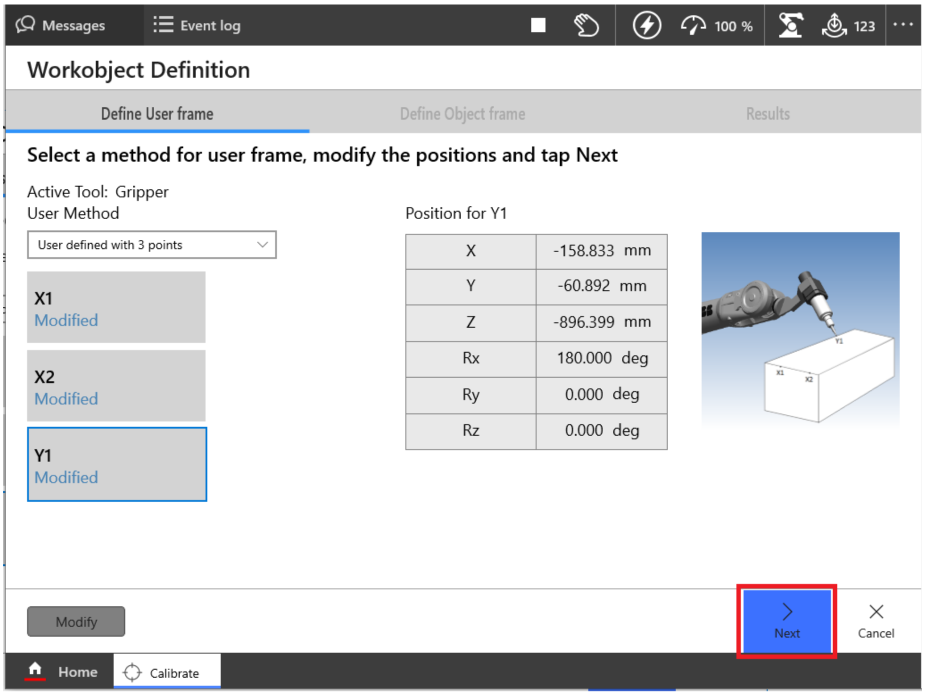
9 Press **Modify**.

10 Select **Y1**. Point out a location on the positive y-axis with the robot's TCP.

11 Press **Modify**.

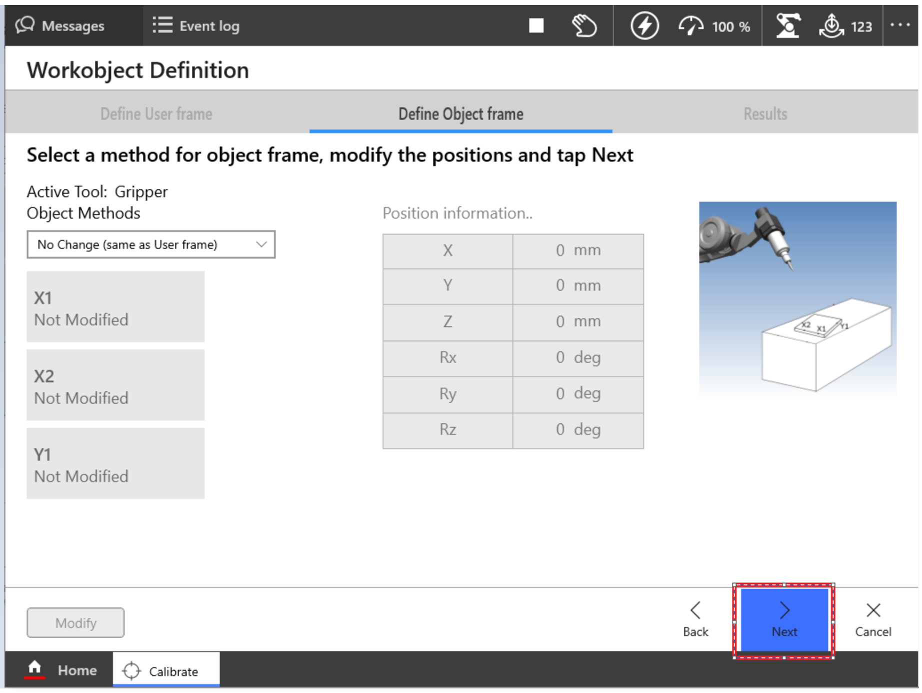
Continues on next page

12 Tap **Next.**



xx2100000385

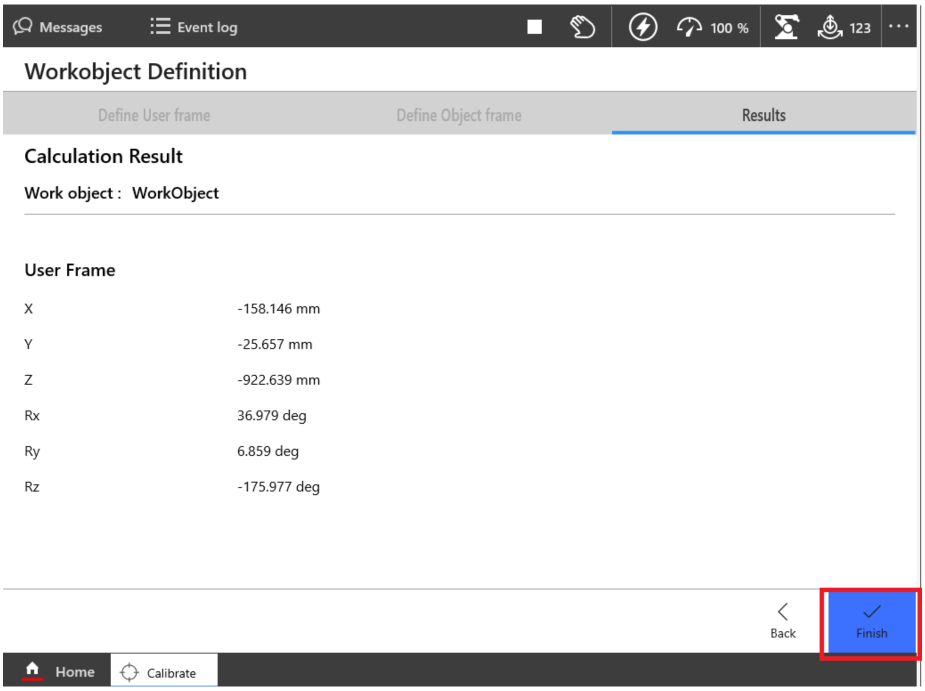
13 In the **Define Object frame** window, tap **Next.**



xx2100000386

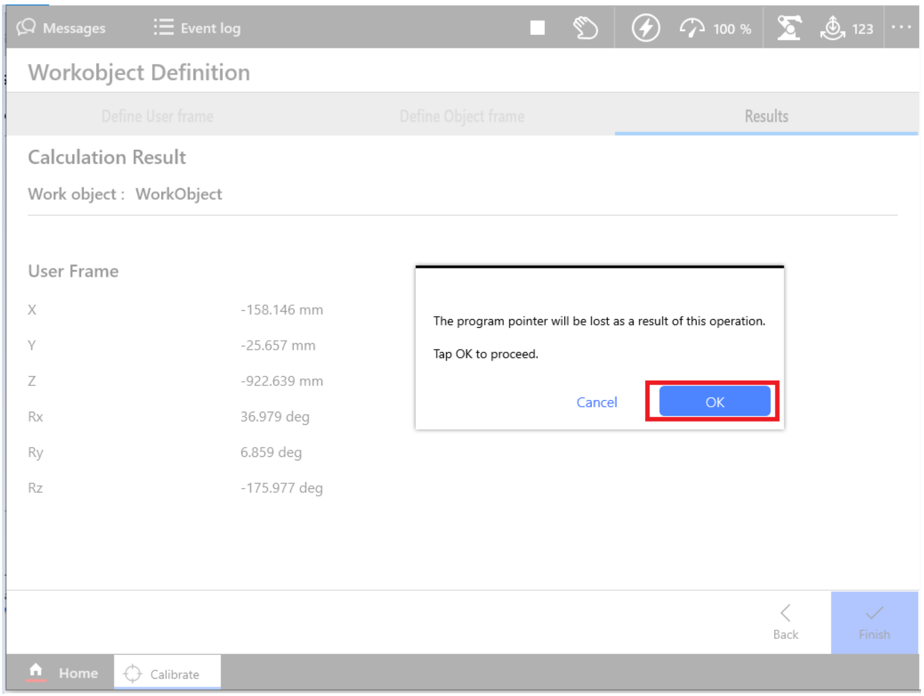
Continues on next page

14 Check if the displayed mean error and max error of the user frame calculation is acceptable. If the estimated error is acceptable, tap **Finish** to confirm and store the new user frame.



xx2100000391

15 Click **OK** on the popped up dialog.



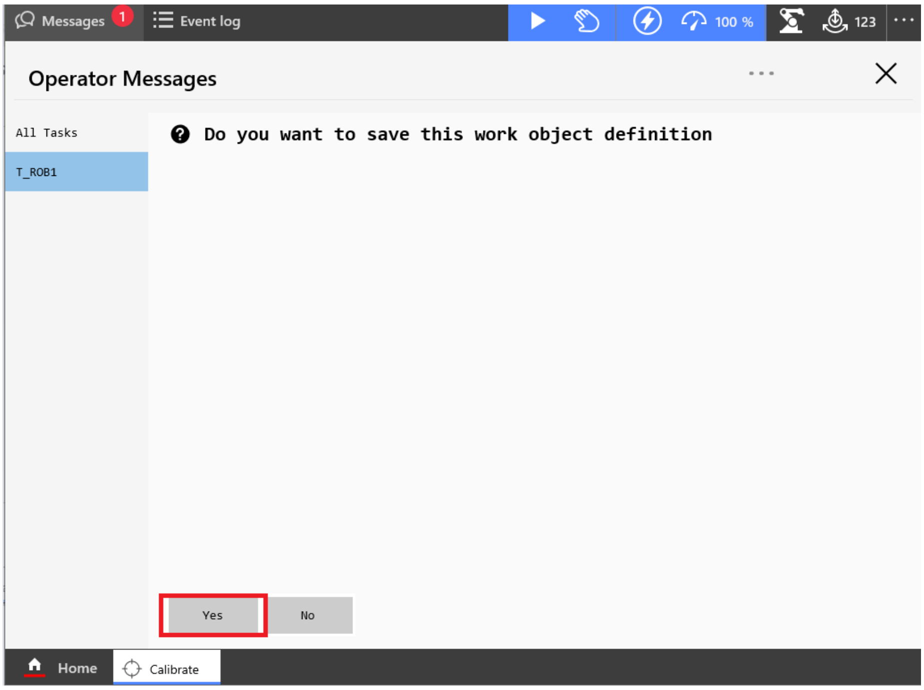
xx2100000392

16 Enable the Thumb button to motors on the controller.

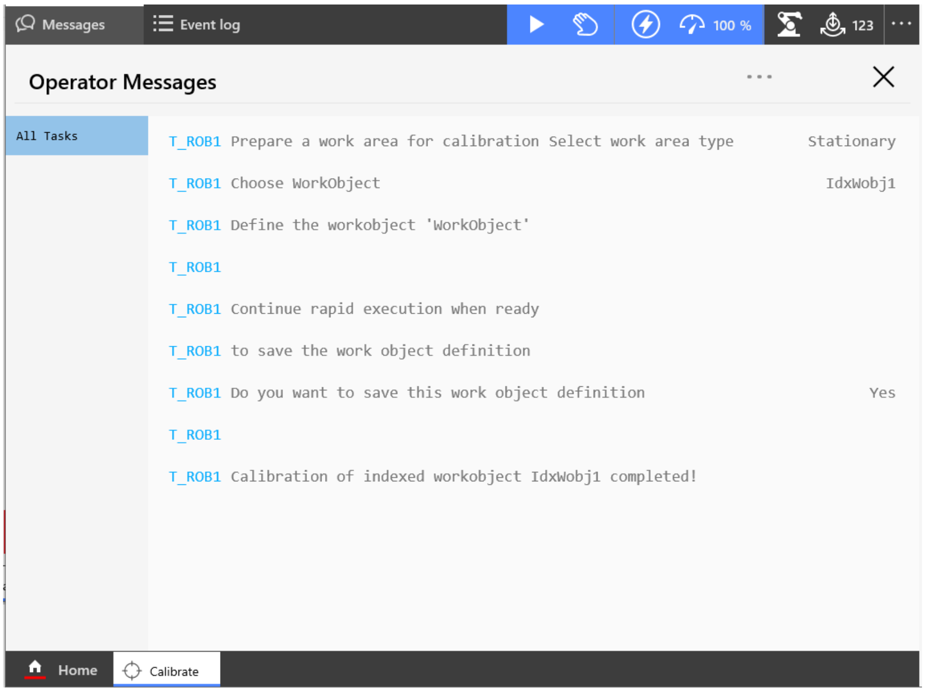
17 Click **Play**.

Continues on next page

18 Click **Yes** on the question: `Do you want to save this work object definition`.



xx2100000393



xx2100000394

19 The definition is saved in the rapid data array `NonCnvWOData` located in the `ppaUser` system module.

4.3.7 Verifying conveyor calibrations

Introduction

The calibration is verified by using a calibration verification paper. The paper has a model that is taught and used as a bull's eye for the robot to find. The same tool is used here as for the base frame calibration.

The file with the calibration verification paper is found in the PickMaster package.

To achieve a very good calibration, the camera calibration tune and the base frame calibration tune steps can be performed more than once. Each time the result should be closer to the optimal calibration.

Note

The calibration tuning should only be used for small errors. If the error is large then the line should be recalibrated.

Tuning the camera and base frame calibrations

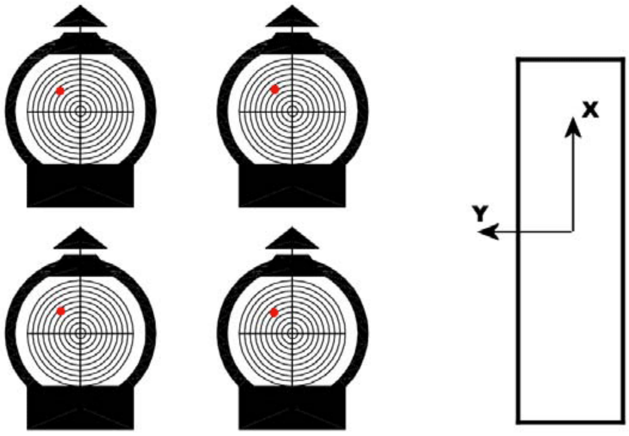
Use this procedure to tune the camera and base frame calibrations.

1. Place the calibration verification paper on the conveyor under the camera. The center column of object should be placed close to the center of the camera view. Align the paper with the conveyor as accurately as possible.
2. Use one of the objects on the calibration verification paper as model. See *Calibrating camera on page 243*.
3. Place the grip position in the center of the model.
4. Examine how the robot is placing the holes to adjust possible errors in the camera calibration or the base frame calibration.

xx0900000649

Continues on next page

If the holes are rotated too much compared to the center of the objects, which affects the accuracy of the grasp, then recalibrate the cameras.



xx0900000650

If the holes are off center of the objects too much, which affects the accuracy of the grasp, then recalibrate the base frame of the conveyor.

4.3.8 Calibrating camera

Introduction

Overview

The camera calibration defines the origin for the coordinate system shared by the camera and the robot base frame or work object. If the camera is used with a conveyor work area the camera calibration must be performed before the base frame calibration because the camera calibration origin works as a common reference point for the two calibrations. When a camera calibration is done, the origin is saved and the user can graphically display this origin when the base frame calibration is performed.

> **Note**
>
> If any firewall or antivirus software is installed, add `pickmasteru.exe`, `sshd.exe`, and `visionclient. exe` to the white list.
>
> Otherwise the PickMaster PowerPac cannot connect Runtime and the vision function cannot work normally.

Checkerboard calibration

The camera calibration method is called *checkerboard calibration*. The calibration is performed in two steps. First the whole image is analyzed and warped into a correct image and then the region of the resulting image is defined.

The algorithm uses the scale in the center of the image, which means that it makes all the tiles the same size as the tile at the center of the original image.

Multi-view calibration

The camera can be calibrated using one or several images. Multi-view calibration can compensate for parallax error.

The accuracy of the multi-view calibration increases with the number of input images. Use at least three images at different tilt angles and altitudes. Using multiple images of calibration plates in parallel planes does not increase accuracy.

Prerequisites

Camera calibration is done using calibration papers that you must print out. The calibration papers are found in the PickMaster package.

The printed image must have a high contrast and the paper must not be reflective (high gloss). Verify with a ruler that the squares are proportional. If the square width or height differs from 10 mm, make a note of the actual measures.

The calibration paper must be adequately illuminated and free from shadows.

If a conveyor is used, the x-axis of the calibration paper must be aligned with the motion of the conveyor.

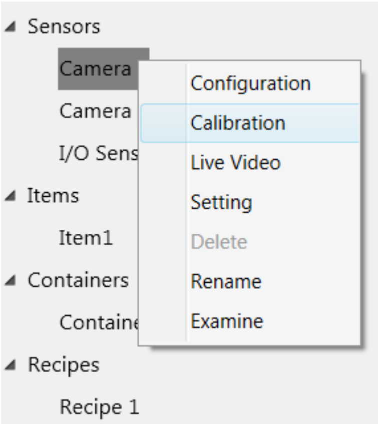
Calibrating the camera

The **Camera Calibration** dialog can be used to handle camera calibrations for the specified camera. Calibrations can be created, edited, imported, and exported.

Continues on next page

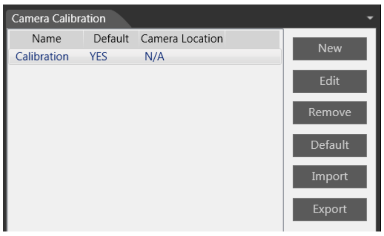
Use this procedure to calibrate the camera.

1 Right-click the camera in the tree view **Cell** and select **Calibration**.



xx1800001467

The **Camera Calibration** window is opened.



xx1800001468

2 Select the default calibration from the list and click **Edit.**

The **Camera Calibration Feature** and **Calibration** dialog are opened.

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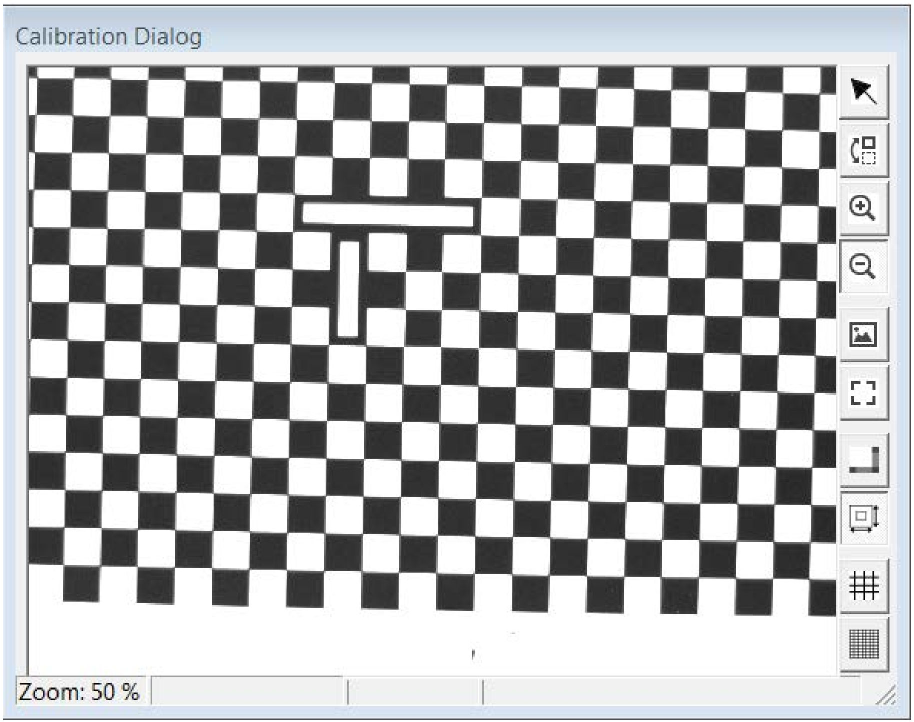
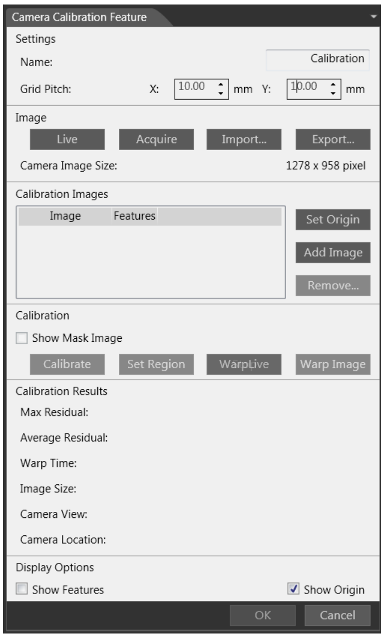


xx1800001469



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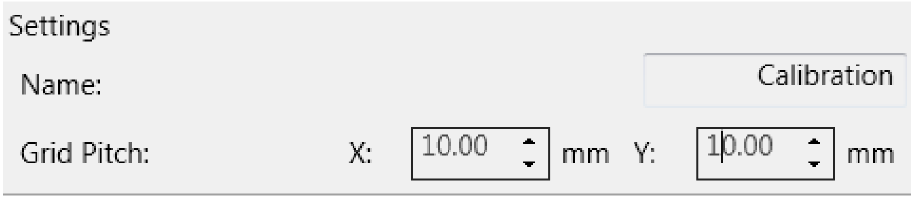
Continues on next page

3 In the **Settings** part, adjust the grid pitch if the squares on the printed calibration paper differs from 10.0 mm. Enter an appropriate name for the calibration.



xx1800001701

Tip

Using precise measurements improves accuracy. A good way to get a more precise measurement of the grid pitch is to measure for example 10 tiles and calculate the average size.

4 In the **Image** part, click **Live** to get and show new images continuously, or click **Acquire** to get one new image. To use an image from file or save the current image, click **Import** or **Export**.

5 For single-view calibration: When the calibration plate is in position, acquire an image and click **Set Origin** in the **Calibration images** part. This stores the image and marks it as the origin image (the origin of this image will be the physical origin of the camera's coordinate system).

xx1800001702

6 For multi-view calibration: When calibrating a camera with multiple images it is important that the origin image is still in place after finishing the camera calibration. This is because the origin image is used to define the coordinate system of the robot.

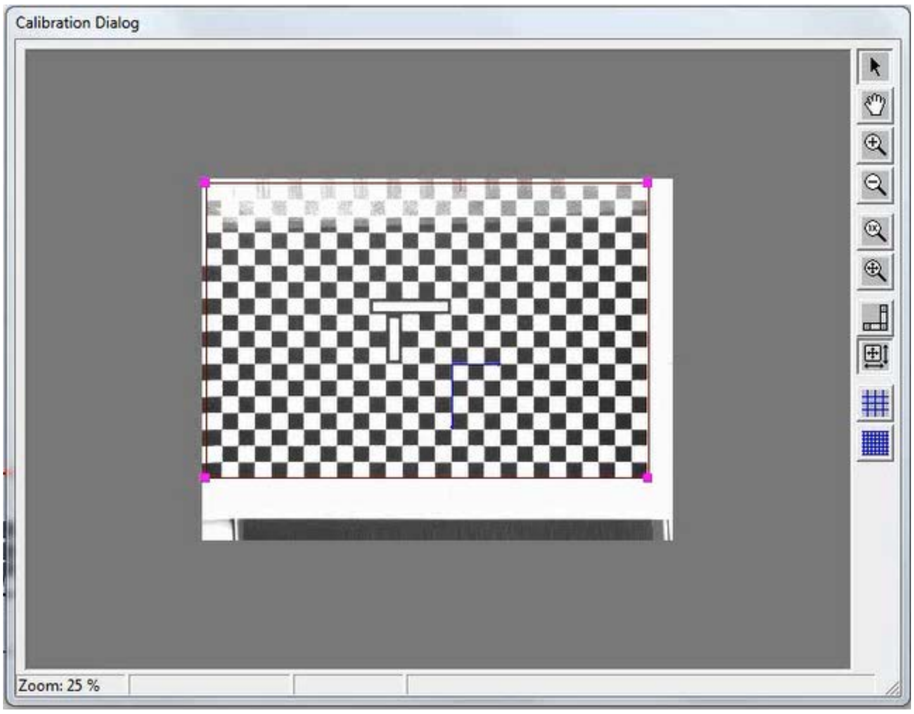
There are two ways of achieving this. One way is to acquire additional views first (click **Acquire** and **Add**) and acquire the origin image last (click **Acquire** and **Set origin**), leaving the calibration plate in the correct place for calibration of the work object/base frame.

The other way is to use two calibration plates with the exact same grid pitch. Put one calibration plate in the position to represent the origin of the camera. Acquire an image and click **Set origin**. Leave this plate in place while acquiring images of the second calibration plate at different angles and altitudes and click **Add** to save them to the list.

Continues on next page

7 In the **Calibration** part, click **Calibrate** to start calibration.

The image is analyzed and calibration is performed with the specified parameters. A corrected image is shown together with an adjustable rectangle used to define the final image area. The calibration is not complete until the region is defined.



xx1800001703

8 Adjust the rectangle to the desired region and click **Set Region** to define the resulting image size.

The calibration is now completed and the result is displayed in the **Calibration result** part. See *Calibration result on page 248*.

9 If needed, click:

- **Calib Image** to show the original image used to calibrate the camera.
- **Warp Live** to show continuously acquired and corrected images.
- **Warp Image** to correct the current image.

10 If needed, click:

- **Show features** to show the checkerboard vertices used during the calibration. The features are only shown in the calibration images.
- **Show origin** to show the origin of the resulting coordinate system. The origin is only shown in corrected images.

11 Click **OK**.

Tip

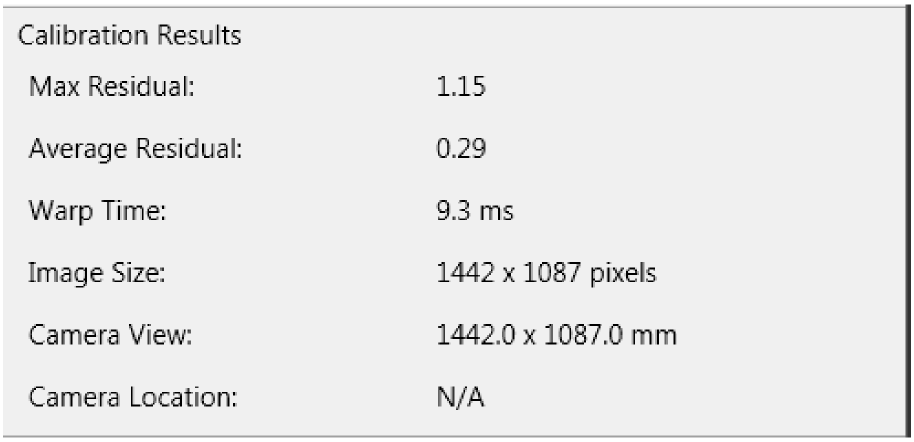
For conveyors, leave the calibration paper as it is until the base frame has been calibrated.

Continues on next page

Note

You can export or import camera calibrations. The exported file is stored in `.pmcalib` format. It is also possible to export images from the camera calibration window for storing the images used for a certain calibration.

Calibration result



xx1900000552

Result	Description
Max residual	The maximum residual error for the calibration.
Average residual	The average residual error for the calibration.
Warp time	The time required correcting an image. This time has to be considered when calculating the total time for the image analysis.
Image size	The resulting size in pixels of the corrected image
Camera view	The resulting size of the camera view calculated with the new calibration.
Camera location	The position of the camera in relation to the origin of the origin calibration plate.

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4.3.8.1 Showing live images

Live images

It is possible to view images from each camera when a production is running.

Note

Showing Runtime images requires much processing power and should not be used for a long period of time if complex vision models are used.

Showing live images

To show images, click **Production**. The camera images are shown in the **Vision** tab.

The found objects are shown as green or blue crosses, depending on if they are marked as accepted or rejected by the vision model. See *Vision modeling on page 254*.

4.3.8.2 Detailed vision information

Detailed vision information

More detailed information than given by the live images is shown in the **Detailed Vision Information** dialog. This dialog box keeps a buffer of images and information about the corresponding vision model hits.

Sequences of images can be record to the buffer and then analyzed individually.

While recording, images are saved in the buffer in a first in, first out basis and the latest image is shown in the dialog.

When clicking pause, images are no longer added and the images in the buffer can be analyzed. Save the images in the current buffer to file for later analysis with the Vision Analyzer program, see *Vision Analyzer on page 252*.

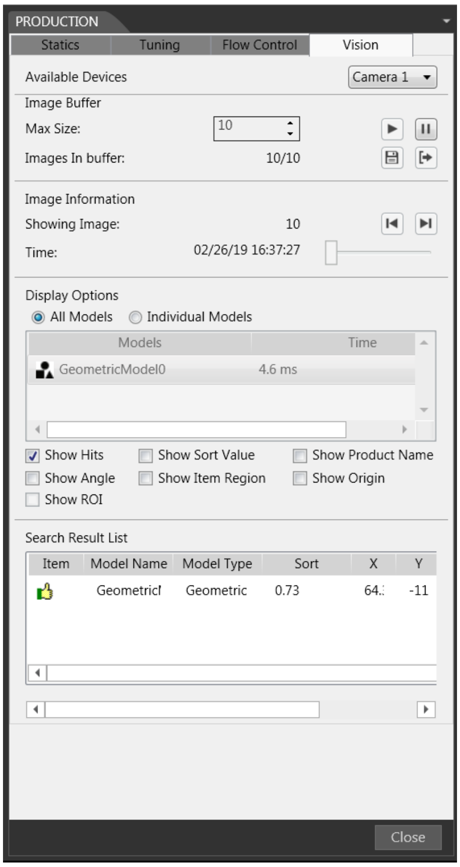
One dialog can be opened for each vision defined position source (the name of the camera and the solution is shown in the title bar). You can continue working with the solution while the dialog is opened. Reduce the window size if the window is blocking other information.

The maximum size of the buffer depends on the RAM memory on the computer. If several dialogs are opened at the same time and the maximum memory size is reached, you can reduce the buffer for one dialog to increase the buffer for another.

Continues on next page

Illustration, Detailed Vision Information

Click **Detailed Vision Information** on the popup menu of a vision defined position source to open the dialog. By default, the recording state is activated and the buffer is set to 10 images.



xx1900000926

Image buffer	Used to switch between recording or pause and set the image buffer size. Click **Save** to save all images in the buffer to a .pmv file.
Display options	Select which vision models to display, all together or individually, and other settings for what to show in the images. The settings are valid both for recording and pause.
Image information	Step through the image buffer when recording is paused. ALT + LEFT or RIGHT ARROW can also be used to step. Click **Export** to save he current image to file (.bmp format).
	The list view at the bottom shows information about all the hits. When an individual model is selected, the columns change depending on its type.
	The pan and zoom buttons can be used to analyze the image more closely.

Note

Only overlapping item regions in the same image are marked as overlapped but no robot will access items with regions that overlap with item regions in consecutive images.

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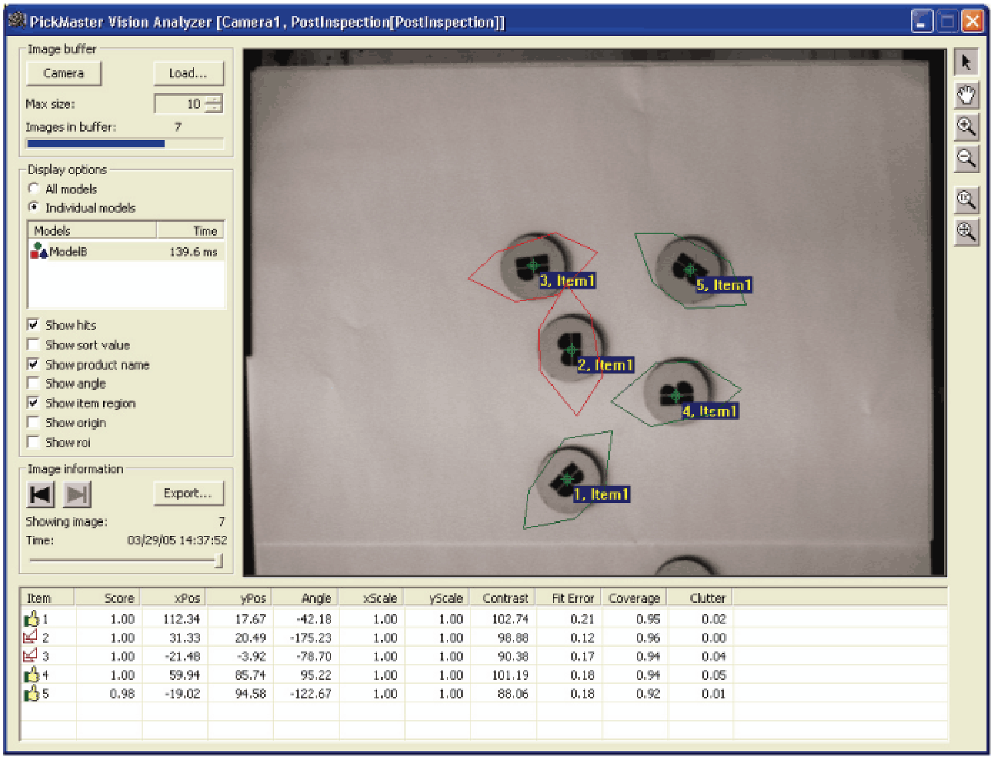
Vision Analyzer

Image buffers recorded in the **Detailed Vision Information** dialog can be saved as .pmv files. These files can be viewed with a separate program called PickMaster Vision Analyzer.

Start Vision Analyzer from the PickMaster Twin Client installation folder or from Windows Start menu.



xx0800000342

Click **Load** to open a .pmv file.

Click **Vision** to see detailed information about the camera that took the images.

Other settings in Vision are identical to settings in **Detailed Vision Information**.

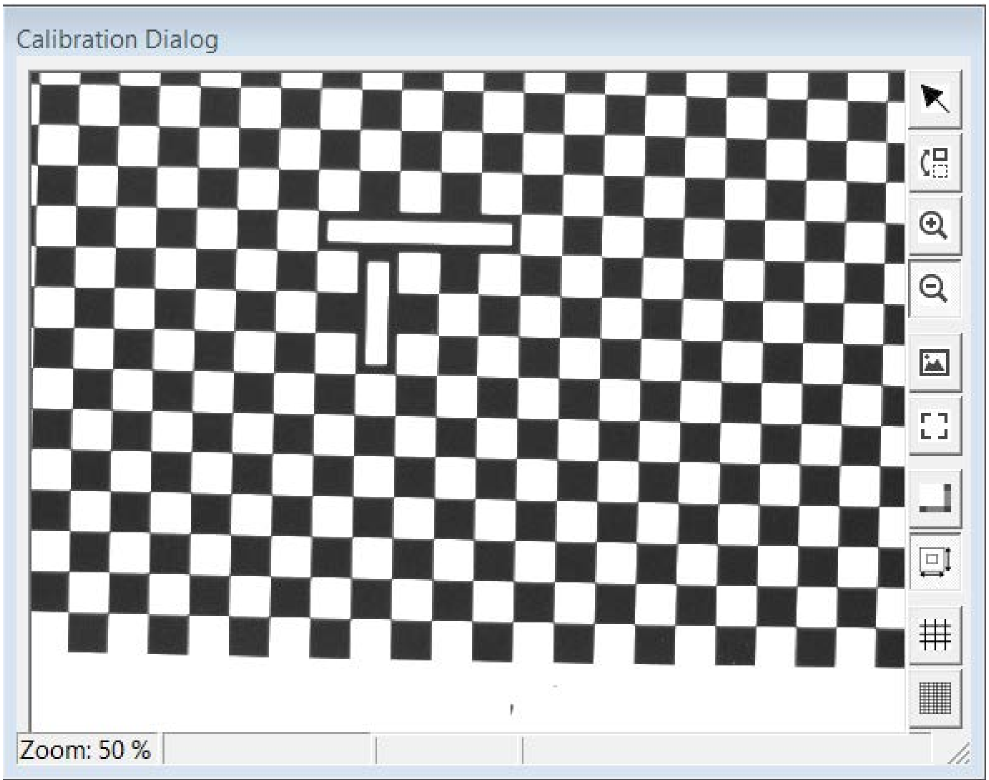
4.3.8.3 The image windows

The image windows

When configuring a camera or a vision model the camera image is shown in a separate window. The image window is resizable and provides tools to quickly zoom and pan the shown image. Some tools change the appearance of the mouse pointer.

To zoom using the keyboard and mouse, place the pointer over the image, press CTRL and scroll the mouse wheel.

The current zoom level and the world coordinate of the mouse pointer is shown in the status bar. When live images are shown, the current frame rate is also shown in the status bar.



xx1800001469

4.3.9 Adding vision model

4.3.9.1 Vision modeling

Introduction to vision modeling

There are three different tools available for generating models in a solution and the possibility to add customized external models. The three tools are:

- *Geometric PatMax* which is a pattern recognition tool. See *Configuring a geometric model with PatMax on page 255*.
- *Blob* which is a detection of two-dimensional shapes within images. See *Configuring blob models on page 266*.
- *Inspection tool* (Inspection II) which makes it possible to combine the *PatMax*, blob, histogram, Caliper, and external tool to generate a model. See *Configuring inspection models on page 273*.

> **Note**
>
> Vision modeling can only be created or edited when the software is connected to a real controller.

Classification of items

Items identified by vision models can be classified as either accepted or rejected. These two types can be distributed to different work areas and be given different item type values accessible from the RAPID program. Item classification can be done by *PatMax*, *Blob*, and the *Inspection tool*.

Vision model parameters in item targets

Item targets identified by a vision model can store a selection of upto 5 vision model parameters in the components `Val1`, `Val2`, `Val3`, `Val4`, and `Val5`. These parameters can be accessed in user hooks and in the RAPID program.

Item targets identified by an *inspection model* can store a selection of parameters from the alignment model and from the included subinspection models.

For each kind of vision model, a *target storage* can be selected for some vision parameters.

External vision models

This function is reserved for next version.

Related information

Configuring a geometric model with PatMax on page 255.

Configuring blob models on page 266.

Configuring inspection models on page 273.

4.3.9.2 Configuring a geometric model with PatMax

Introduction to the geometric model PatMax

PatMax is a pattern location search technology. This tool measures:

- Position of the pattern.
- Size relative to the originally trained pattern.
- Angle relative to the originally trained pattern.

PatMax differs from other pattern location technologies as it is not based on pixel grid representations that cannot be efficiently and accurately rotated or scaled. Instead, *PatMax* uses a feature based representation that can be transformed quickly and accurately for pattern matching.

When creating a pattern the following things should be considered.

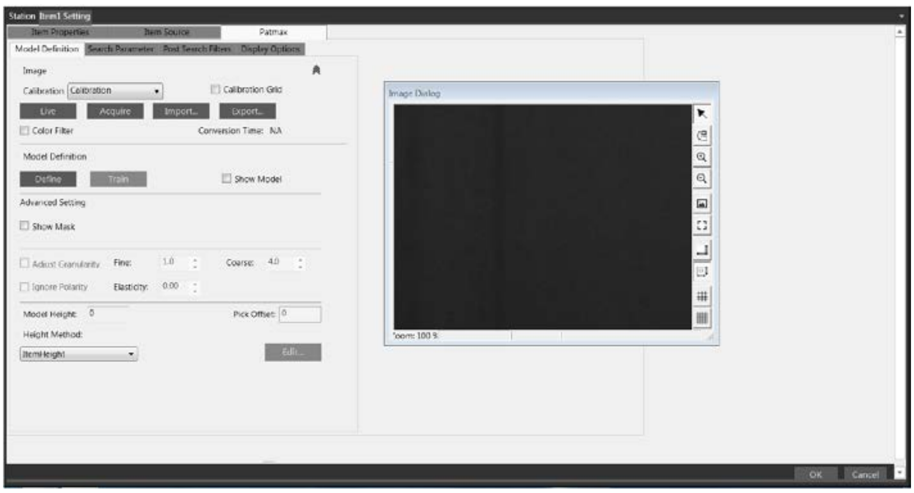
- Select a representative pattern with consistent features. Reduce needless features and image noise. Train only important features. If necessary, export the image and use an external program to erase noise.
- Larger patterns will provide greater accuracy because they contain more boundary points to resolve at run-time.
- High frequency features are more significant at the outer edges of the pattern.

Models can be classified with the function *Inspection I*. A model can either be defined as accepted or rejected, see *Item Properties on page 102*.

To increase the contrast in images where parts have similar grayscale tone, it is possible to use color filtering. See *Using color vision on page 298*.

There are several parameters that can be adjusted to make an efficient model. The configuration is done in the **PatMax Model Configuration** dialog and the result is displayed in the **PatMax Image** and the **PatMax Result** dialogs:

Illustration PatMax Model Configuration



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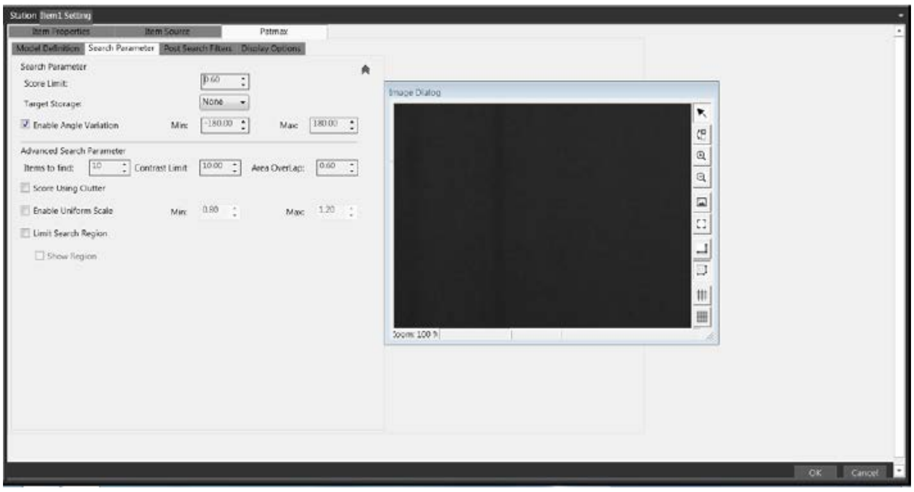
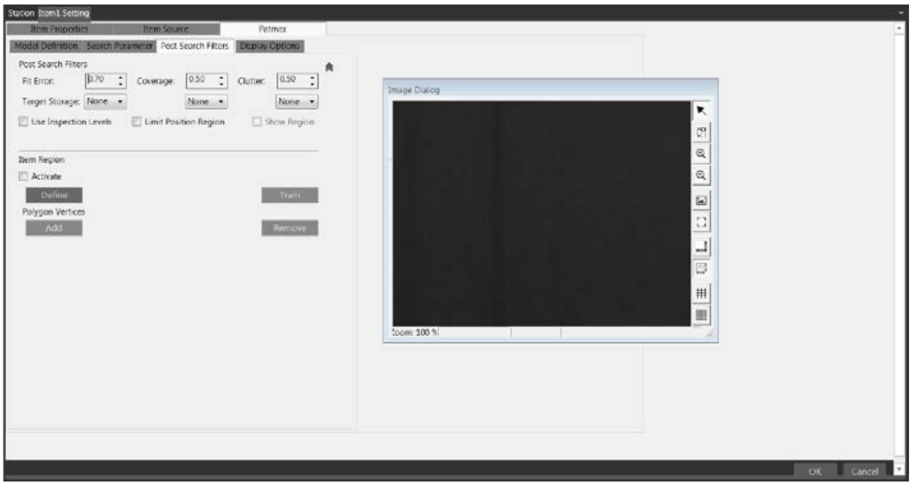
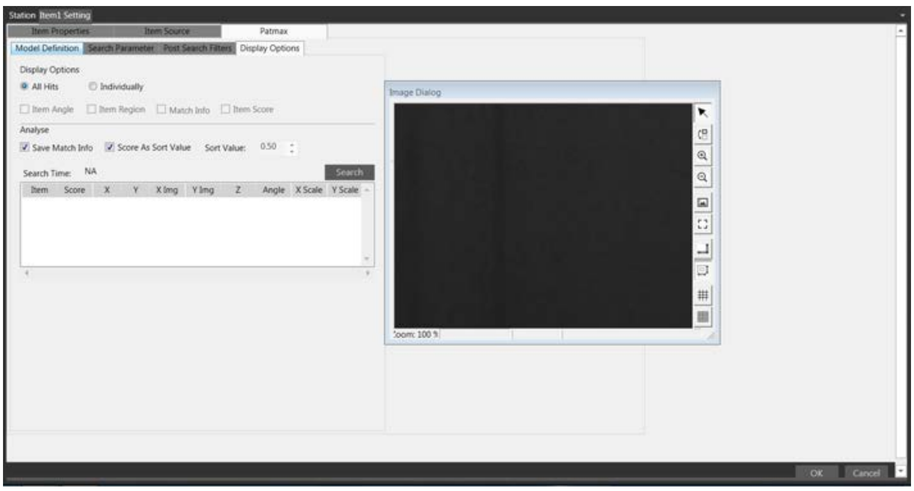


xx1900000558



xx1900000559



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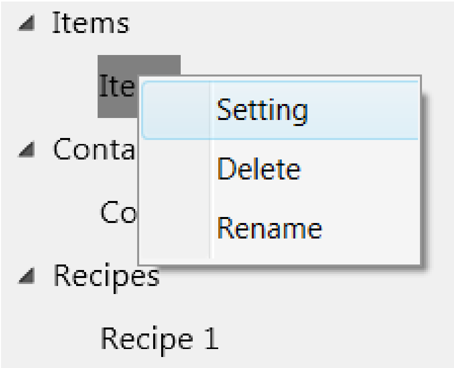
Configuring a PatMax vision model

Use this procedure to configure a *PatMax* vision model.

1. Right-click on one **Item** in the tree view **Cell** and select **Setting**.



xx1800001704

The **Item Setting** window is opened.

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2. In the **Item Source** dialog, click **Geometric.**

   The **Image Dialog** and **Geometric** dialog are opened.

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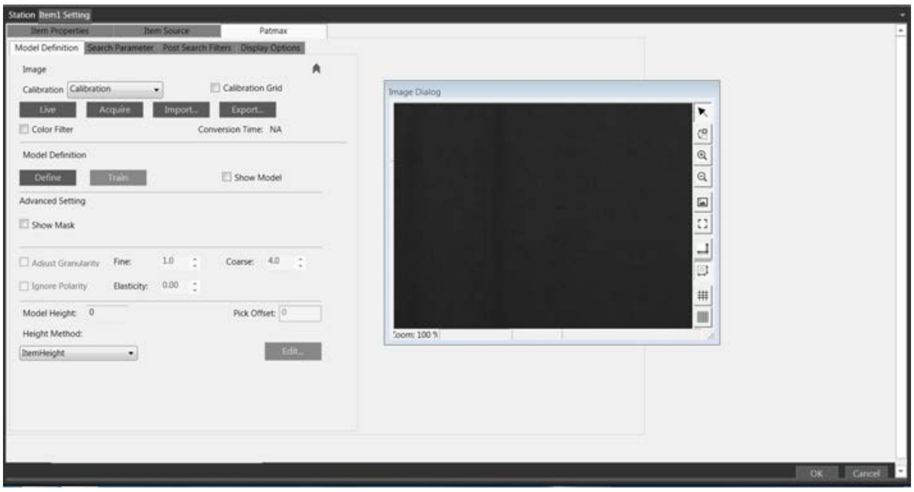

xx1800001706

3 In the **Image** under **Model Definition**, click **Live**, **Acquire**, or **Import** to get an image. Select the calibration that has set in the **Camera Calibration** from

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the **Calibration** list. Select the **Calibration grid** checkbox to display help lines for the coordinate system.

xx1800001707

The help lines can be moved with the mouse to make it easier to train a pattern.

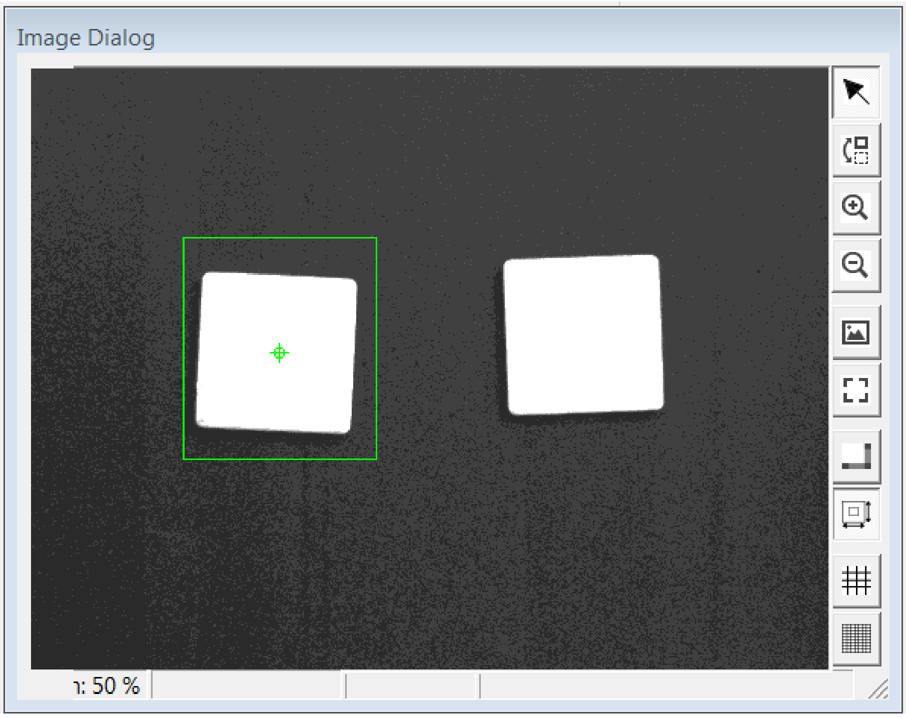
4 If color filtering should be used select the **Color filter** checkbox to enable the filter. Click **Set** to configure the filter. See *Using color vision on page 298*.

Continues on next page

5 In the **Model definition** part, define a model for the pattern using an image in front of the camera or using an imported image. The selected calibration will be used.

> **Note**
>
> When importing a vision model it is required to enter model configuration and re-select which calibration to use from the calibration drop-down menu. This is required even if there is only one calibration defined. If this is not performed then further actions may produce the error `No valid calibration for the PatMax model`.

a Click **Define** to define a model. Drag the rectangle so it covers the pattern and move the cross to the desired pick/place position. To maintain the greatest accuracy, the pick/place position should be placed close to the center of the trained pattern.



xx1800001708

b Click **Train** to train the pattern.

c Select **Show Model** to show the features of the trained models in the search image.

d If needed, click **Advanced** to access more model settings.

e Increase the value of **Elasticity** to allow for any expected non-linear shape distortion, for example, for organic products and so on. The value represents the maximum distance between a trained feature and a matched feature in pixels. The lower limit is 0 and upper limit is 25. This setting is useful for products of varying shape.

Continues on next page

f Select **Ignore polarity** to ignore if the features are dark on bright or bright on dark.

> **Note**
>
> PatMax will not care if a product is light on a dark background or dark on a light background. This is useful when the background is, for example, a grid.

g Click **Adjust Granularity** to define the levels in the **Fine** and **Coarse** boxes. Granularity is a radius of influence, in pixels, which determines the detection of a feature in a pattern. *PatMax* locates patterns in the search image by first searching only for large features. After locating one or more pattern instances, it uses smaller features to determine the precise transformation between the trained pattern and the pattern in the search image. *PatMax* uses the same range of granularity that is computed when training the pattern to detect features in the search image. The granularity parameters *fine* and *coarse* are auto-selected when training the pattern and often these values are the best. These can also be set manually. The lower limit is 1 and upper limit is 25.5.

h Click **Show mask** to edit a mask that determines what parts of the model region to ignore. The effect can be verified by pressing the **Train** button and checking the **Show Model** checkbox. This tool is useful when the training scene contains a lot of clutter (reflections and so on). For more information regarding the effect of the edit controls, hover the mouse pointer over the corresponding control. Click **Adjust Granularity** to define the levels in the **Fine** and **Coarse** boxes.

6 In the **Search parameters** part, set parameters to limit the search procedure and the analysis time.

Score Limit indicates how closely the found item matches the trained model. A score of 1 indicates a perfect match while a score of 0 indicates that the pattern does not match at all. The higher a score threshold is defined the faster *PatMax* will be able to perform a search.

Angle variation defines the acceptable rotation for the items. If an item has a rotation outside the valid range it will be discarded by the vision system. Default +/- 180 degrees.

If more settings are required, click **Advanced** to open the **Advanced Search Settings** dialog where the following settings are found:

Items to Find is the number of items that is expected to be present in the image. If there are more items present in the image these will not be reported by *PatMax*.

Contrast Limit defines the minimum image contrast of each item that is found in the image. The contrast is the average difference in gray-level values for all of the boundary points that *PatMax* matched between the trained model and the found item in the search image. *PatMax* considers only items with a contrast value that exceeds the contrast limit.

Continues on next page

Area Overlap defines how much multiple patterns in the image are allowed to largely overlap each other. *PatMax* assumes that these patterns actually represent the same item in the image. When two patterns overlap by a percentage greater than the area overlap threshold they are treated as a single pattern.

Uniform Scale is a threshold that accepts hits that differ in size relative to the taught vision model. A scale value of 1 indicates that there are no differences between the found item and the taught vision model. A value <1 indicates a smaller model.

Score Using Clutter defines a measure of the extent to which the found item contains features that are not present in the trained vision model. By default the *PatMax* analysis ignores clutter when scoring which means that the patterns receive the same score regardless of the presence of extra features. If this checkbox is selected, clutter is included in the calculation of the score. If the application is an alignment application in which the background does not change, **Score Using Clutter** should be selected.

Limit Search Region limits the search area for the *PatMax* analysis. Only objects within this area will be found. A smaller search area will decrease the search time.

Note

When combining **Fine**/**Coarse Granularity** and **Uniform Scale** a slight difference in the score can appear between design time and Runtime. Therefore, the model should be tested in Runtime to verify that items are identified as expected.

7 In the **Post search filters** part, define the score values for each pattern in the search image.

Fit Error Limit is a measure of the variance between the shape of the trained pattern and the shape of the pattern found in the search image. If the found pattern in the search image is a perfect fit for the trained pattern, the fit error is 0.

Coverage Limit is a measure of the extent to which all parts of the trained pattern are also present in the search image. If the entire trained pattern is also present in the search image, the coverage score is 1. Lower coverage scores indicate that less of the pattern is present. This parameter can be used to detect missing features.

Clutter limit is a measure of the extent to which the found pattern contains features that are not present in the trained pattern. A clutter of 0 indicates that the found pattern contains no extra features. A clutter score of 1 indicates that for every feature in the trained pattern there is an additional extra feature in the found pattern. The clutter can exceed 1.0.

Inspection Levels - Inspection I, this inspection is also called *Inspection I* in PickMaster PowerPac. With this function it is possible to classify the found models into two categories. A model can either be classified as accepted or rejected. An accepted model has better search results than the rejected

Continues on next page

model. The item type number is defined for the accepted and rejected model in the **Item** dialog, see *Item Properties on page 102*. An item type can be read in the RAPID code, see *RAPID programs on page 401*.

Click **Set** to open the **Inspection Parameter** dialog. All models that fulfill the conditions specified for the search parameters and the post filters will be classified. Select **Use Inspection Levels** and click **Set** to open the dialog and define the parameter that will divide the found items into the two categories. If **Use inspection levels** is not selected all found models are classified as an accepted model.

For **Score**, **Contrast**, and **Coverage**, items with a value larger than the defined value in **Inspection Parameter** will be defined as accepted.

For **Angle** and **Uniform Scale**, items with a value between the defined values in **Inspection Parameter** will be defined as accepted.

For **Fit Error** and **Clutter** a value less than the defined one will be classified as accepted.

Limit Position Region defines if the *PatMax* analysis is done on the whole image. Objects found within this area will be handled as normal. Object found outside this area will be discarded.

Click **Advanced** to open the **Advanced Post Search Settings** dialog. To define an item region, select the **Activate** checkbox and click **Define**. Adjust the polygon showed around the found object using vertices. Then click **Train**. The polygon can have 2 to 16 vertices.

8. In the **Display options** part, select the type of information to display in graphics.

   Item angle displays the angle of the item that will be sent to the robot. This angle is relative to the trained model.

   Match Info displays the quality of the matched boundary points in the search image. **Save Match Info** must be selected before doing the analysis. Boundary points drawn in:

   - Red are poor matches.
   - Yellow are fair matches.
   - Green are good matches.

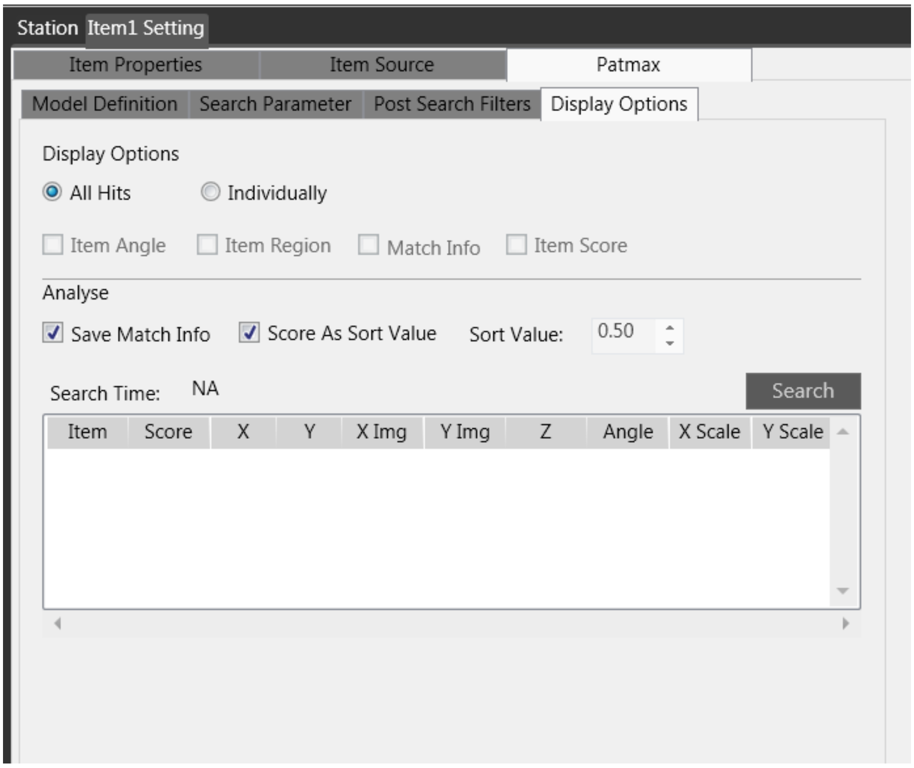
   Item score displays the score for the selected item in the image window.

   Item region displays the regions in the image window. Red regions indicate an overlap and the corresponding hits will be considered as discarded.

> **Note**
>
> Item regions cannot be used, if the item positions are modified by a user hook.

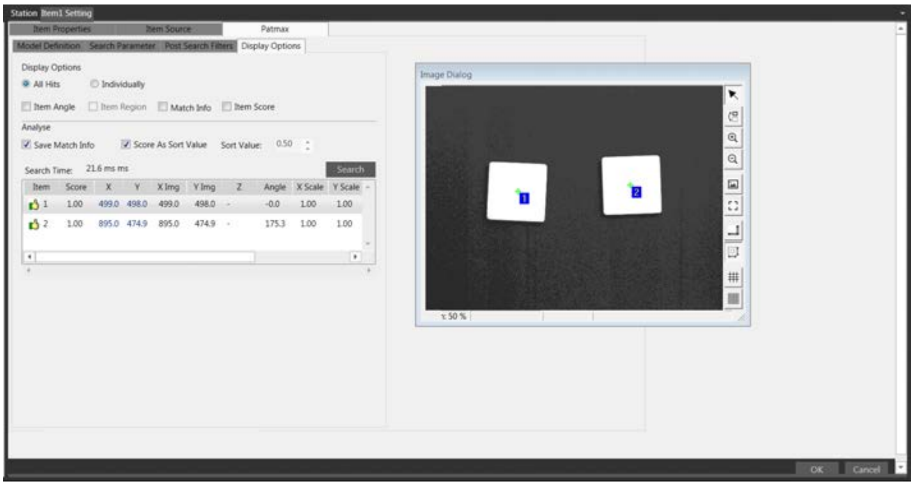
Continues on next page

9 In the **Analyze** part, click **Search** to analyze the image. If needed, define sort value.



xx1800001709

The result is displayed as an image with numbered hits in the **Image** dialog, and a corresponding result list.



xx1800001710

Model hits are normally classified as accepted. If inspection is used, hits can be classified as either accepted or rejected. See *Item Properties on page 102*. Hits that do not fulfill all the requirements or hits with overlapping regions will not be accessed by any robot and are classified as discarded. The hits shown in the result list are marked with an icon identifying its classification.

Continues on next page

For hits that are not accepted, the parameter that failed is marked with either red or blue in the result list.

Save Match Info is used to save the match information for every found model. Searches where match info is generated and stored takes more time. To show the match information, select the **Match Info** checkbox in the **Display options** part.

Sort value is used if there is more than one hit for the same item. Only the hit with the highest sort value will be sent to the robot controller. The sort value can be set individually for all models or the *PatMax* score can be used by selecting **Score as sort value**.

Search Time displays the time it takes to analyze the image in .

10 Click **OK**.

Note

Items located after a search operation in the PatMax configuration window is presented as discarded due to item region overlap even if they are actually rejected due to another parameter (fit error, clutter, and so on). This happens only if the item region is activated and the item regions overlap with each other in Runtime. However, the discarded items are removed before applying the item region.

PatMax parameters in item targets

The PatMax parameters `Score`, `fit error`, `coverage`, and `clutter` can be selected for the target storage.

Related information

Item Properties on page 102.

Using color vision on page 298.

RAPID programs on page 401.

4.3.9.3 Configuring blob models

Introduction to blob models

The simplest kinds of images that can be used for machine vision are two-dimensional shapes or blobs. Blob analysis is the detection of two-dimensional shapes within images. It finds objects by identifying groups of pixels that fall into a predefined grayscale range.

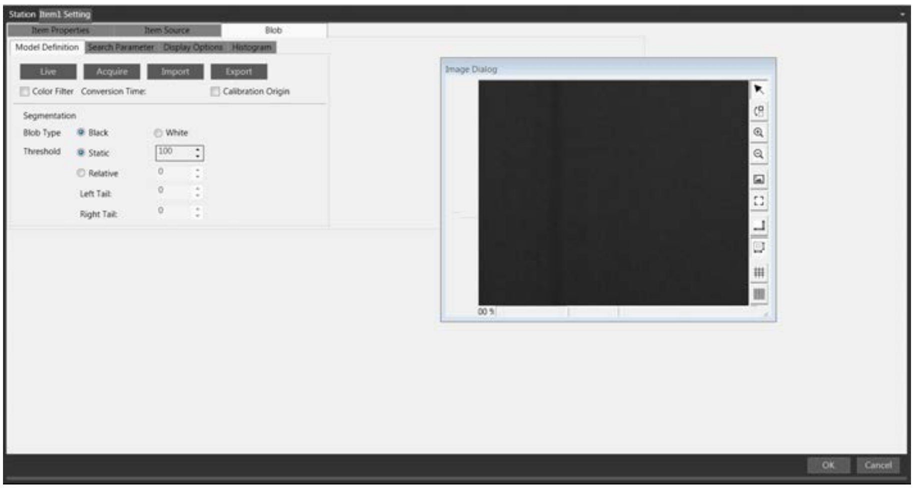
This kind of analysis is well suited for applications where:

- Objects vary much in size, shape, and/or orientation.
- Objects are of a distinct shade of gray not found in the background.

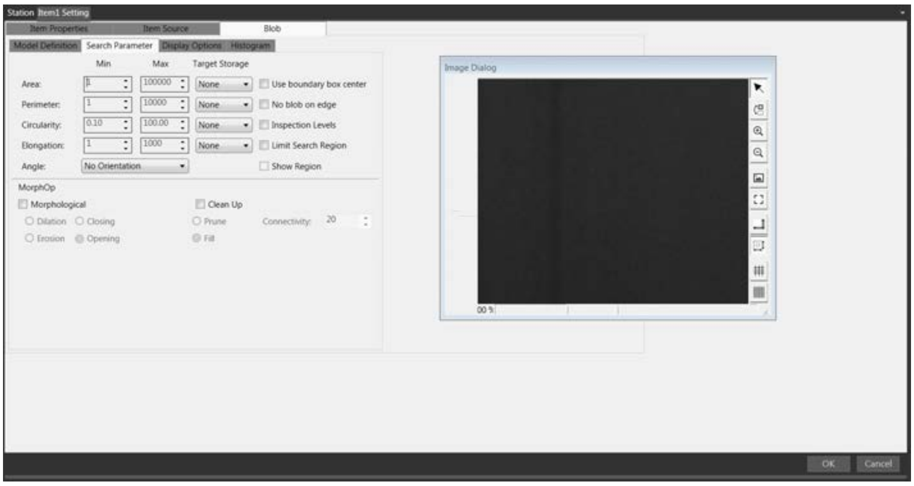
Blob analysis works best with images that can be easily segmented into foreground and background pixels. Typically, strong lighting of scenes with opaque objects of interest produces images suitable for an analysis like this.

To increase the contrast in images where parts have similar grayscale tone, it is possible to use color filtering. See *Using color vision on page 298*.

Illustration Blob Configuration



xx1900000553



xx1900000554

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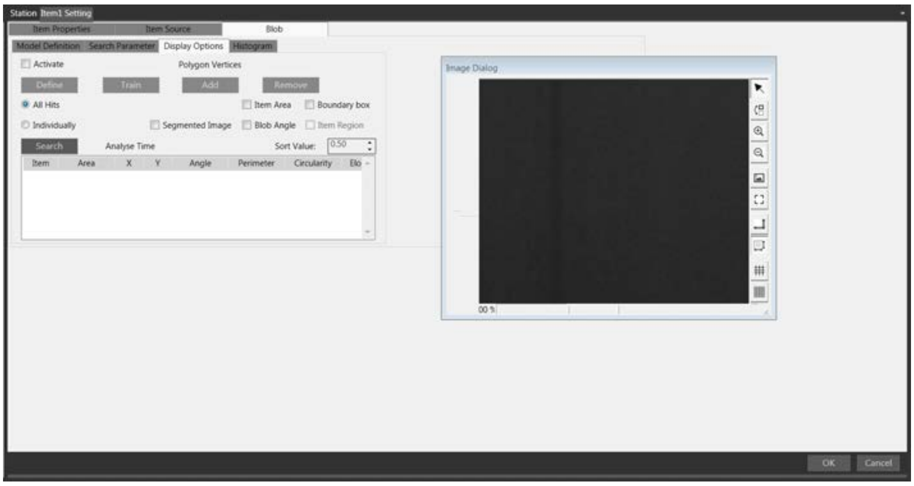
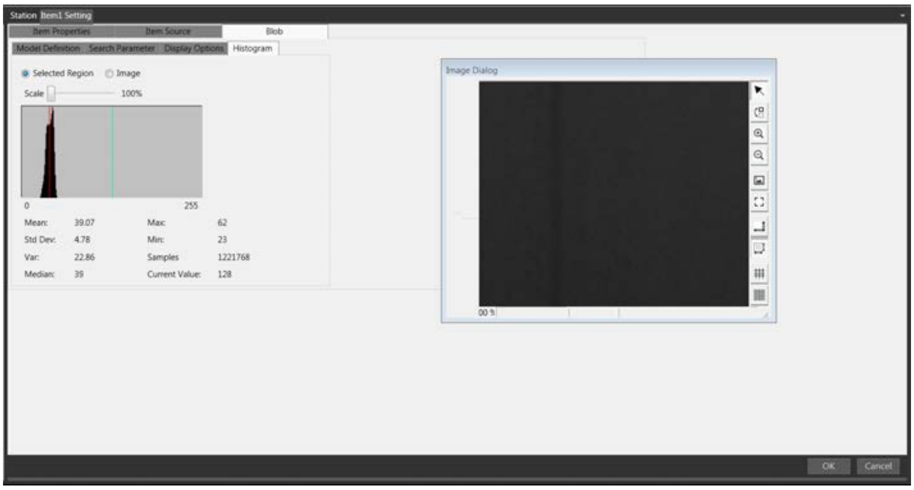


xx1900000555



xx1900000556

Configuring a blob vision model

Use this procedure to configure a blob vision model.

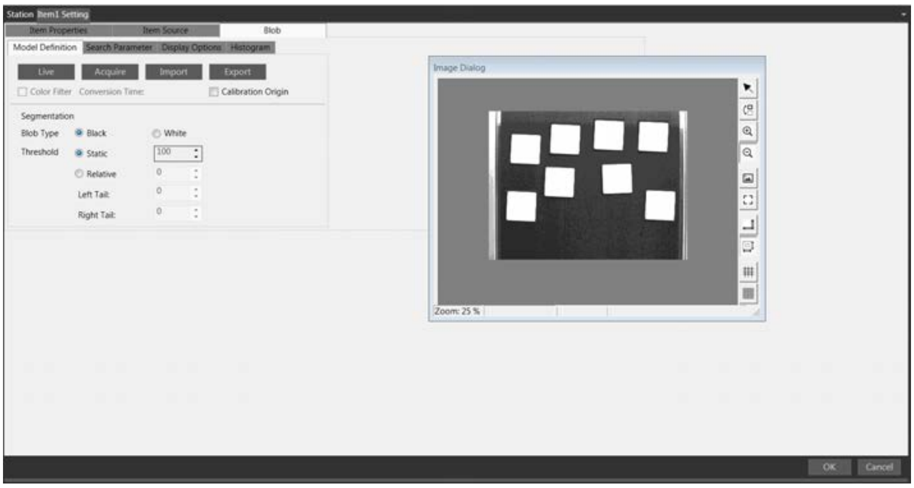
1. Select the camera in the **Vision Models** under **Item Source**.
2. Click on **Blob.**
3. In the **Image** part, click **Live**, **Acquire**, or **Import** to get an image. Select the **Calibration origin** checkbox to display help lines for the coordinate system. Click **Histogram** to display a graph of the pixel distribution in the acquired image.

   If color filtering should be used, select the **Color filter** checkbox to enable the filter and click **Set** to configure the filter. See *Using color vision on page 298*.

   In the histogram, the horizontal axis represents the pixel values of the image from black to white (0 to 255). The vertical axis indicates the number of pixels at each value. There are also a number of statistical values representing various properties of the histogram such as the value of the darkest and

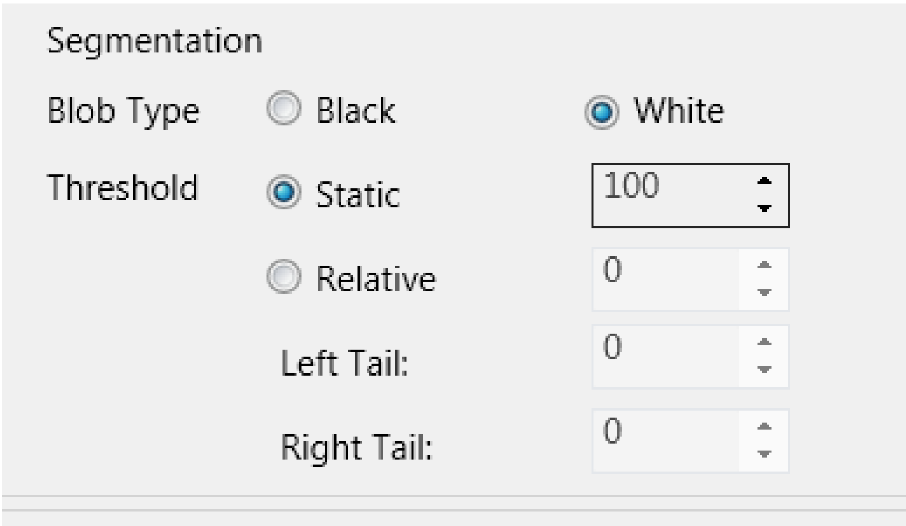
Continues on next page

brightest pixels as well as the mean value and standard deviation of the collection of pixels. For more information, see *Histogram on page 281*.



xx1900000927

4 Click to select **White** in the **Segmentation** under **Model Definition**.



xx1900000928

In the **Segmentation** part, select segmentation method and blob type.

Segmentation is the division of the pixels in an image into object pixels and background pixels. Typically objects are assigned a value of 1 while background pixels are assigned a value of 0.

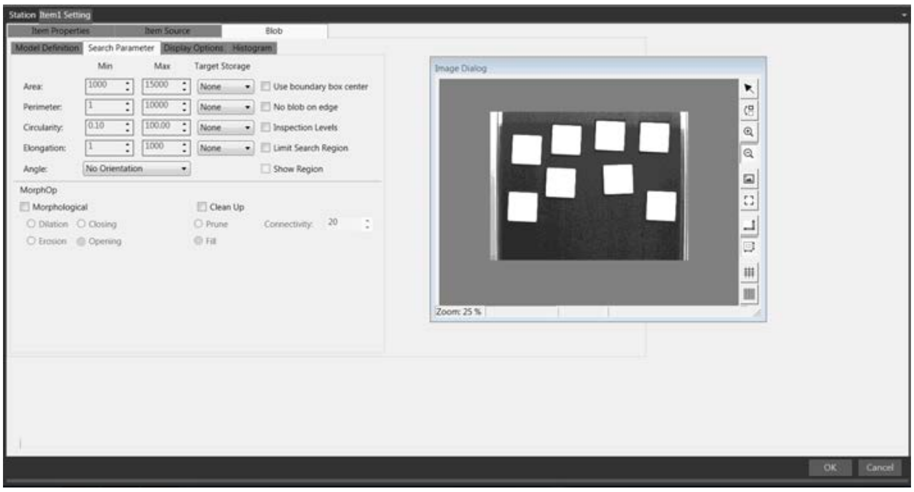
Static method uses gray values to divide blob pixels and background pixels. All pixels with a grayscale value below the threshold are assigned as object pixels, while all pixels with values above the threshold are assigned as background pixels.

Relative method uses a relative threshold expressed as the percentages of the total pixels between the left and right tail to divide blob pixels and background pixels. Tails represent noise-level pixels that lie at the extremes of the histogram (the lowest and the highest values).

Continues on next page

Static is faster than relative segmentation because the gray levels corresponding to the percentages do not have to be computed. Static segmentation can test for absence of a feature in a scene, whereas relative segmentation will always find a blob in the scene.

5 Adjust the parameters in the **Search Parameter** according to your requirements.



xx1900000929

In the **Search Parameters** part, define the values for the feature.

Area is expressed in mm^2.

Perimeter is expressed in mm.

Circularity defines the circularity. A value of 1 means perfectly circular and completely filled (no holes).

Elongation is the ratio of the feature's second moment of inertia about its second principal axis to the feature's second moment of inertia about its first principal axis.

Angle defines how the found item is sent to the controller.

- **No Orientation** means that the found item is sent to the controller with angle 0 (zero).
- **First Principal Axis** means that the found item is sent down with the angle around the first principal axis. The angle is relative to the x-axis and can be ±90 degrees.

Use boundary box center defines if the position of a blob will be at the center of its boundary box instead of at its center of mass.

No Blob On Edge defines if a blob connected to the edge of the search area should be reported.

Use Inspection Levels defines if the found models should be classified. See *Item Properties on page 102*. The item type can be read in the RAPID code, see *RAPID programs on page 401*. Select **Set levels** to open the **Blob Inspection Parameters** dialog.

Continues on next page

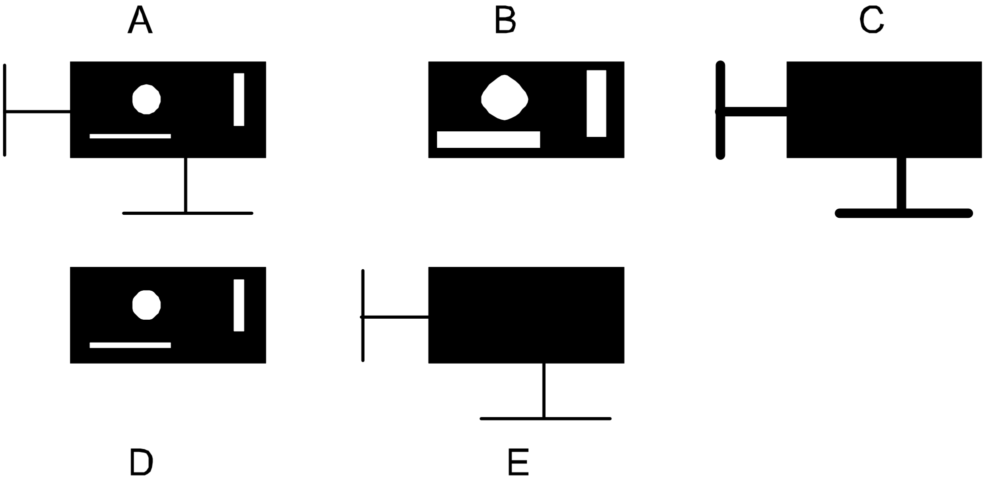
If **Use Inspection Levels** is not selected all found models are classified as accepted. All models that fulfill the conditions specified for the **Search Parameters** will be classified.

Limit Search Region limits the search area for the blob analysis. Only objects within this area will be found.

Note

Tune the blob tool by pressing **Search** and the blob algorithm lists all the blobs. Adjust the size threshold limit to filter out blobs that are too large or too small. Tune other parameters if necessary..

6 If needed, in the **MorphOp** part, select the **Morphological** and/or **Clean Up** checkboxes and define the settings.



xx0900000542

A	Original
B	Erosion
C	Dilation
D	Opening
E	Closing

Morphological settings:

- **Erode** reduces or eliminates object features, increases the thickness of holes within an object. This operation replaces each pixel in the image with the maximum value of the pixels and each of its eight vertical and horizontal neighbors.
- **Dilation** reduces or eliminates holes within an object, increases the thickness of an object's features. This operation replaces each pixel in the image with the minimum value of the pixel and each of its eight vertical and horizontal neighbors.
- **Closing** eliminates holes. Preserves small features. An erosion operation is applied to the image, followed by a dilation operation.

Continues on next page

- **Opening** preserves holes. Eliminates small object features. A dilation operation is applied to the image, followed by an erosion operation.

Clean up settings:

- **Prune** is used to ignore, but not remove features, that are below a specified size (connectivity size). When an image is pruned of all features below a certain size, the blob measures returned for the blob that enclosed the pruned features are computed as though the pruned features still existed, but the pruned features themselves are not counted.
- **Fill** is used to fill in pruned features with gray values from neighboring pixels on the left. The pixels value that is used to fill the feature is the value of the pixel to the immediate left of the feature being filled. As each row of pixels in the feature is filled, the pixel value to the immediate left of that row of pixels is used as the fill value for that row.
- **Connectivity** defines the minimum size (in pixels) that a blob can have to be considered. Is used with either prune or fill.

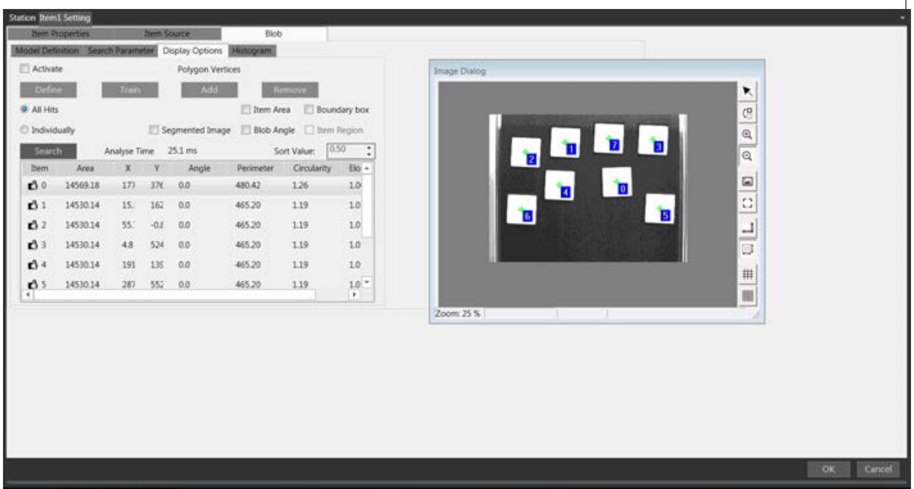
7 In the **Item region** part, select the **Activate** checkbox and click **Define**. Adjust the polygon showed around the found object using vertices. Then click **Train**.

The polygon can have 2 to 16 vertices.

8 Click **Search** in the **Display Options**

Tip

If the search result matches with the **Image Dialog**, the configuration success.



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In the **Display options** part, select **Segmentation image** to display the processed image. Select how the result will be displayed.

- **Item angle** displays the angle of the item that will be sent to the robot.
- **Item score** displays the score for the selected item in the image window.
- **Item area** displays the area of the blob in the image window.

Continues on next page

- **Boundary box** displays the minimum horizontal rectangle that contains the whole blob.
- **Item region** displays the regions in the image window. Red regions indicate an overlap and the corresponding hits will be considered as discarded.

9 Click **OK**.

Blob parameters in item targets

The blob parameters `Area`, `perimeter`, `circularity`, and `elongation` can be selected for the target storage.

Related information

Using color vision on page 298.
Histogram on page 281.
Item Properties on page 102.
RAPID programs on page 401.

4.3.9.4 Configuring inspection models

Introduction to inspection models

Inspection models make it possible to combine several models of *PatMax*, blob, histogram, *Caliper*, and external models. This is sometimes referred to as *Inspection II*.

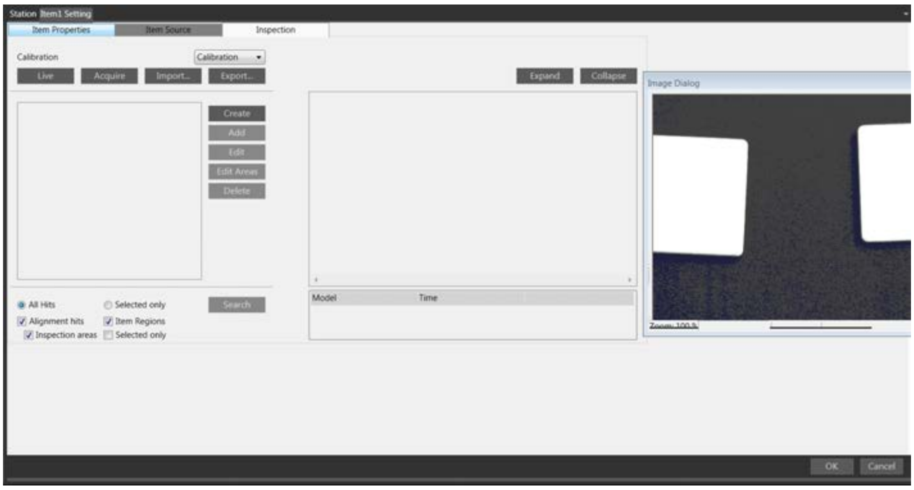
An inspection model always consists of an alignment model. The alignment model can either be a *PatMax*, blob, or external model and works as the reference for the inspection model. It is this model's position and rotation that is the pick/place position and rotation for the item.

Inspection areas are defined relative to the alignment model and either blob, *PatMax*, histogram, *Caliper*, or external analysis can be done within each of these areas. Conditions such as number of found items and location relative to the alignment model can be set.

For a found item to be classified as accepted, all inspection areas and the alignment model must be classified as accepted. If one of the inspection areas does not fulfill the given conditions the corresponding item is classified as rejected.

> **Tip**
>
> A more advanced accept or reject decision can be implemented with a user hook. By adding a selection of upto 5 vision parameters for storage in the item targets, a user hook can implement an advanced accept or reject decision based on the selected parameters and other item target data (for example, position and orientation). For example, the combination of 5 measured caliper distances can be evaluated for the accept or reject decision instead of having a fixed allowed maximum or minimum interval for each caliper distance.

Illustration Inspection Configuration



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Configuring inspection models

Use this procedure to configure inspection models.

1. Select the camera in the **Vision Models** under **Item Source**.
2. Click on **Inspection**.
3. In the **Image** part, click **Live**, **Acquire**, or **Import** to get an image.
4. In the **Inspection model** part, define the relationships between the alignment model and its corresponding inspection areas.

   The created models are shown in a tree view.

   Alignment model defines the position and orientation of any found items. If an alignment model is already defined, it will be replaced. For more information on the alignment model configuration dialog, see *Vision modeling on page 254*.

   Sub inspection model adds inspection areas to an alignment model. See *Sub inspection models on page 280*.

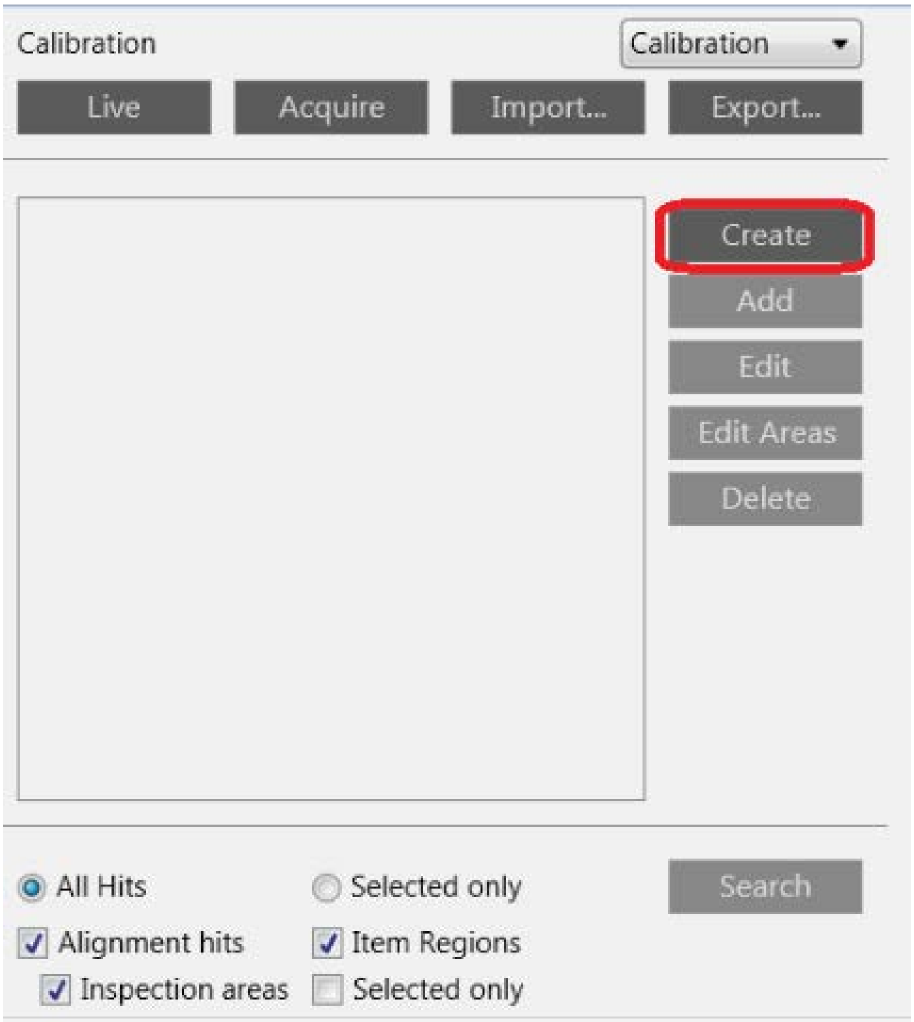
   Edit opens the configuration dialog for the selected model. When an existing alignment model is modified the relations to the inspection areas must be retrained.

   Delete is used to delete the selected model and corresponding inspection area.

   Edit Areas shows all inspection areas. The areas can be rearranged for the selected sub inspection model.

Continues on next page

5 Click **Create** to open the **Select Model Type** dialog.

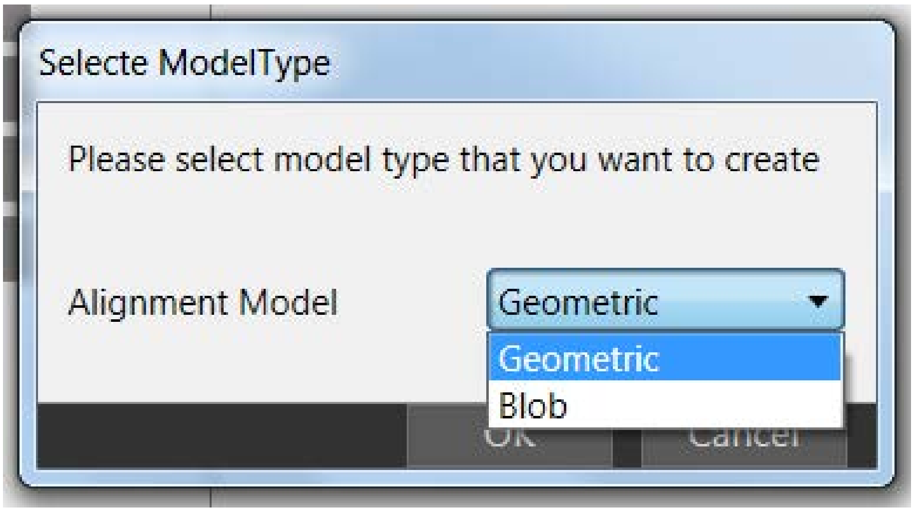


xx1900000955

6 Select **Geometric** or **Blob** in the drop-down list to create the main model in the **Select Model Type** dialog and click **OK** button. For detail procedures on

Continues on next page

how to create a geometric model or a blob model, see *Configuring a geometric model with PatMax on page 255* or *Configuring blob models on page 266*.



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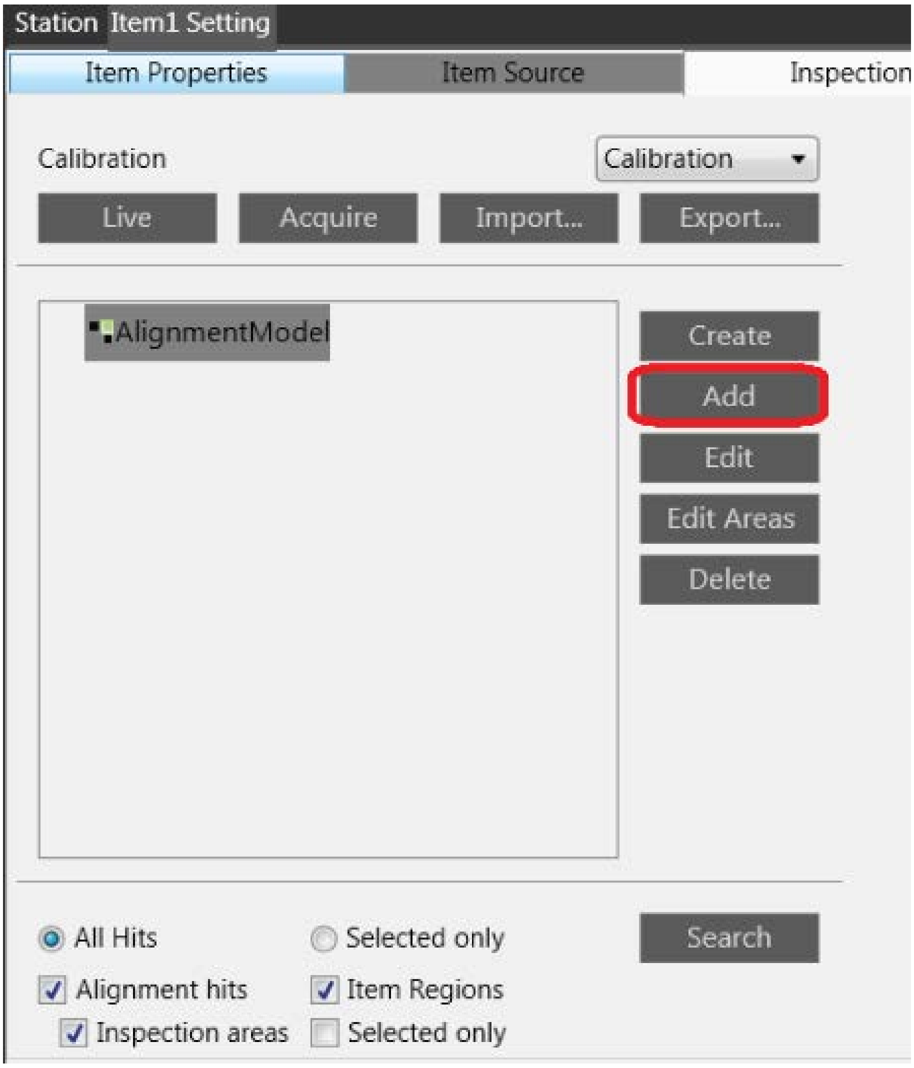
7 Click **Add** to open the **Select Model Type** dialog.



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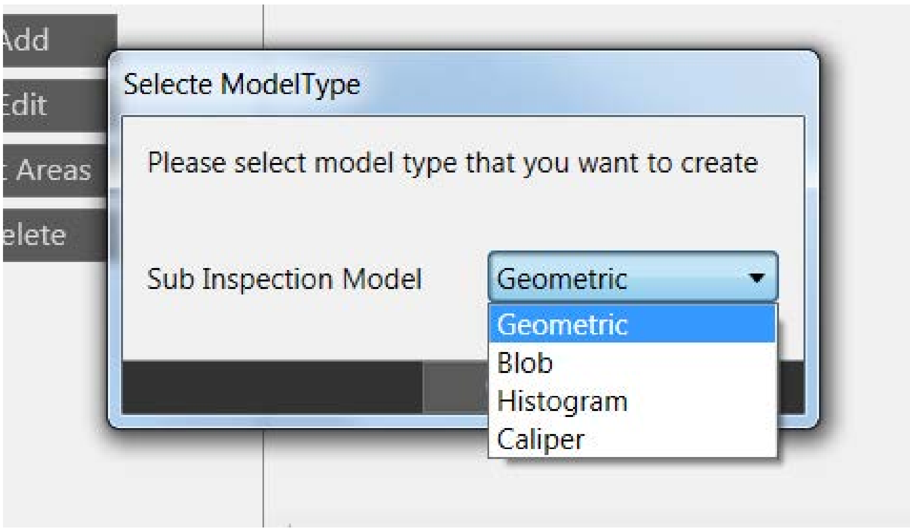
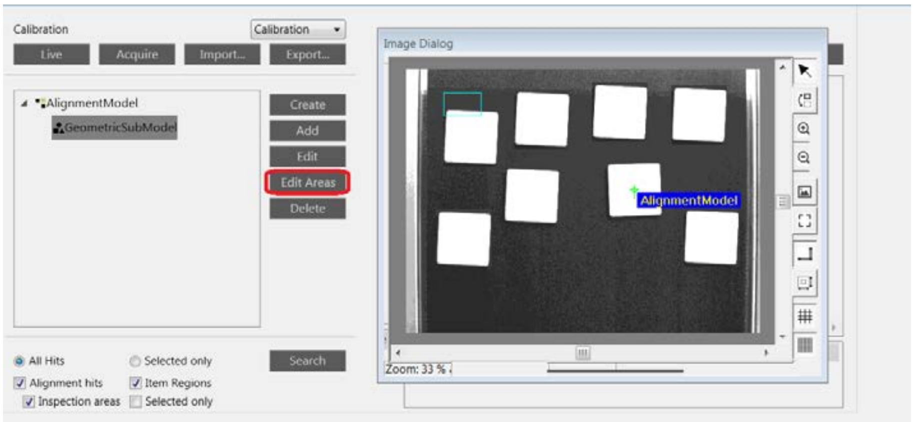
8 Select **Geometric**, **Blob**, **Histogram** or **caliper** in the drop-down list to create the sub model in the **Select Model Type** dialog and click **OK** button.



xx1900000958

9 Click **Edit Areas**.



xx1900000959

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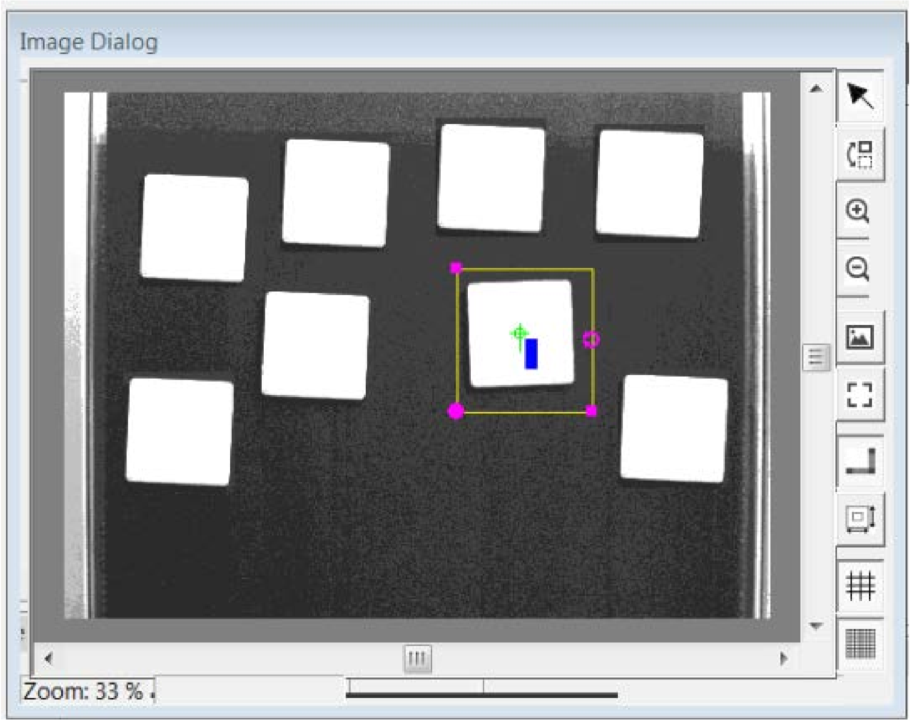
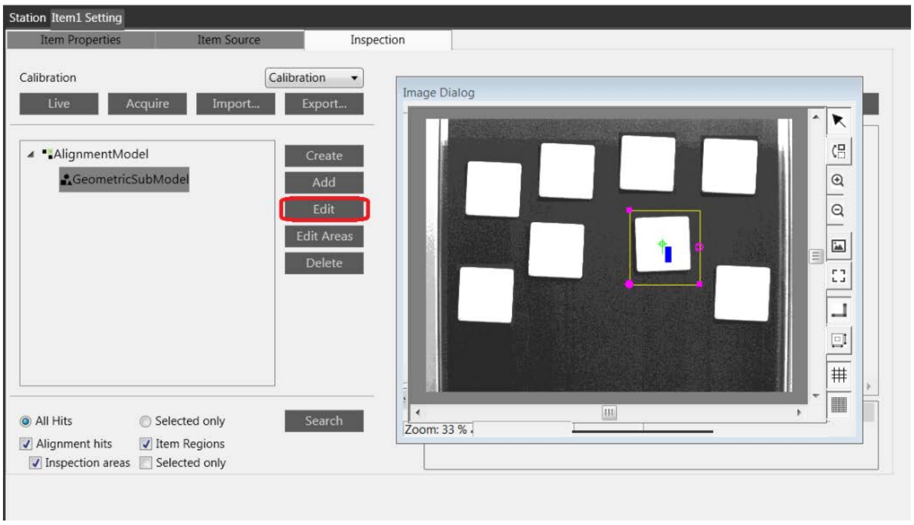
10 Drag the rectangle so it covers the pattern.



xx1900000960

11 Click **Edit** to open the corresponding model creating window. For detail procedures on how to create a geometric model or a blob model, see *Configuring a geometric model with PatMax on page 255*, *Configuring blob models on page 266*, *Histogram on page 281* and *Caliper on page 286*.



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Continues on next page

12 Click **Search**.

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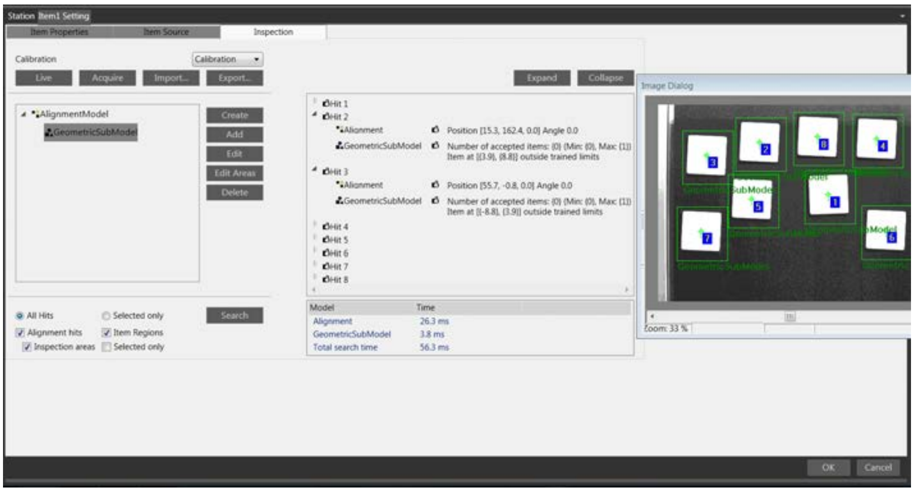
The result is displayed as an image with numbered hits in the **Inspection Image** dialog, and a corresponding detailed list in the **Inspection Result** dialog.



xx1900000963

> **Tip**
>
> If the search result matches with the **Image Dialog**, the configuration success.

13 Click **OK**.

Sub inspection models

Introduction

Sub inspection models are used to add inspection areas to an alignment model. Each area uses a specified sub inspection model. The inspection area defines where the sub model is to perform its analysis relative the alignment model. The areas are shown in the image and should be moved and resized to cover the area to analyze.

Sub inspection models are configured in their own dialogs. When testing a sub inspection model the alignment hit is shown in the image window together with the corresponding inspection area. Sub inspection models only analyze the part of the image defined by its inspection area.

Continues on next page

Geometric

A geometric sub inspection model is configured in the same way as a *PatMax* model. See *Configuring a geometric model with PatMax on page 255*. In addition, the relative positions of the found items and the corresponding alignment hit must be trained.

Required hits defines the number of hits with the sub inspection model within the inspection area that are required for the result to be considered as accepted.

Deviation limits defines the allowed deviations from the trained positions.

After a search and the items are found within the inspection area their positions must be trained. The relative positions are listed as **xDiff**, **yDiff**, and **AngleDiff.**

Click **Train** to save the positions of the found items relative to the alignment hit.

Geometric subinspection parameters in item targets

The parameter `Number of hits` can be selected for the target storage.

Blob

A blob sub inspection model is configured in the same way as a blob model. See *Configuring blob models on page 266*. In addition, the number of required hits must be configured.

Required hits defines the number of hits with the sub inspection model within the inspection area that are required for the result to be considered as accepted.

Blob subinspection parameters in item targets

The parameter `Number of hits` can be selected for the target storage.

Histogram

The histogram tool measures the color or the gray level within any given area. While using a monochrome camera the histogram tool measures the gray level within a given area. Similarly, if a color camera is used each of the three color channels (Red, Green, and Blue) is measured separately. The histogram tool is useful when the objects to be identified and classified have similar shapes but different colors.

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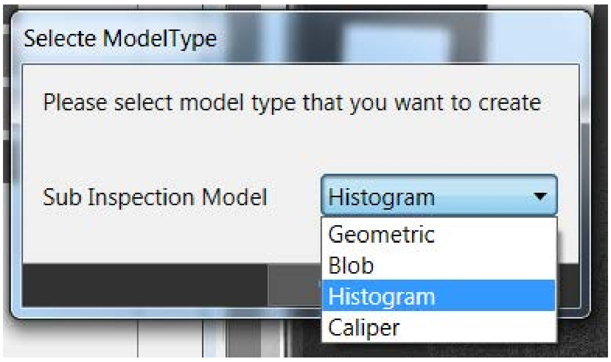
The inspection area for a histogram sub inspection model is graphically represented as a circle. But the area used in the histogram analysis is actually a square aligned with the image but enclosed by the inspection area.

1 On the **Sub Inspection Model** in the **Select Model Type** dialog box, select **Histogram** in the drop-down list and click **OK** button.

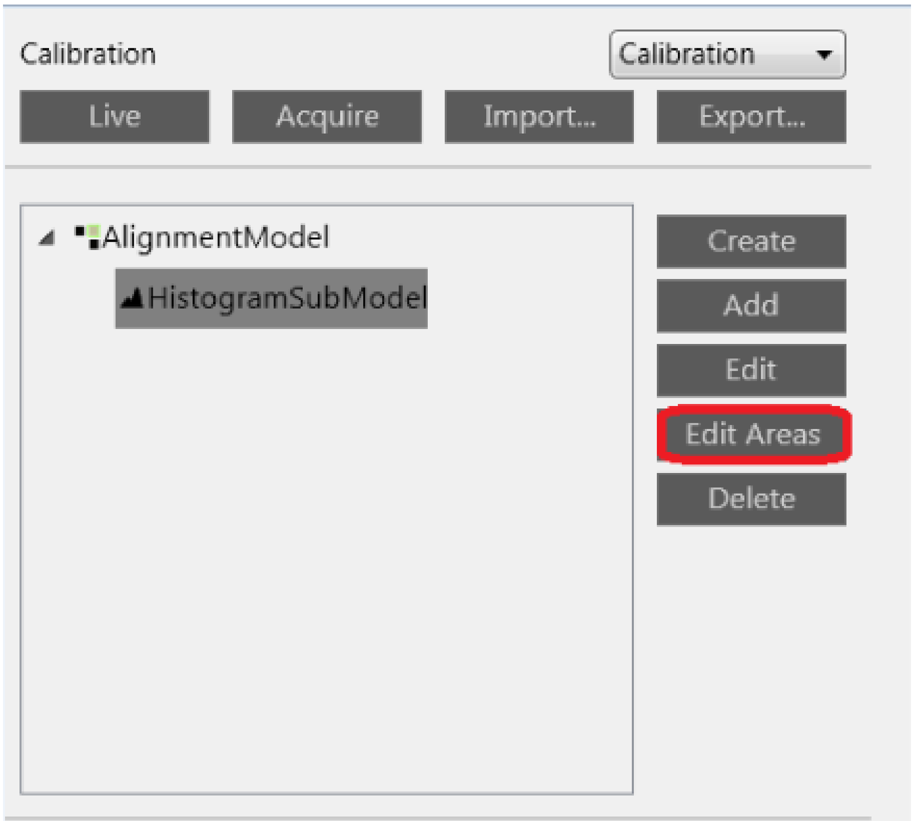


xx1900000950

The **Histogram** dialog appears. It displays a graph of the pixel distribution of the acquired image.In monochrome mode the **Histogram** dialog displays a graph of the pixel distribution of the acquired image. The horizontal axis represents the pixel values of the image from black to white (0 to 255). The vertical axis indicates the number of pixels at each value. While using color vision, three graphs each representing the contents of the different color channels (RGB or HSI), are displayed. For more information, see *Using color vision on page 298*.

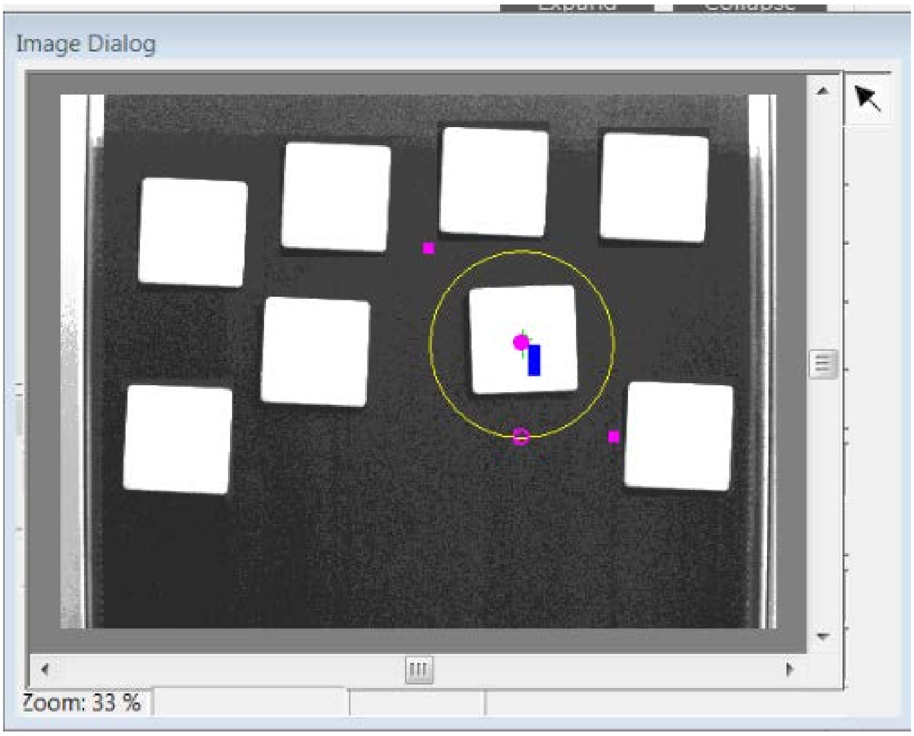
Continues on next page

2 Click **Edit Areas**.



xx1900000951

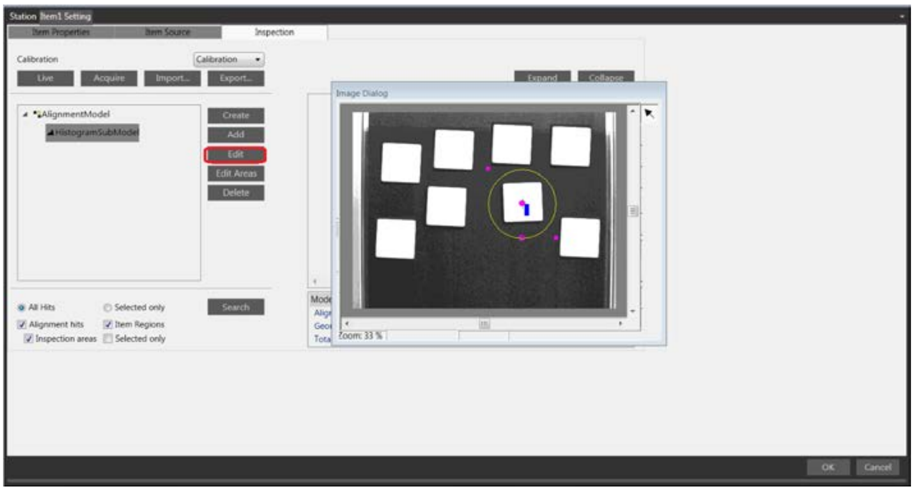
3 Drag the rectangle so it covers the pattern.



xx1900000952

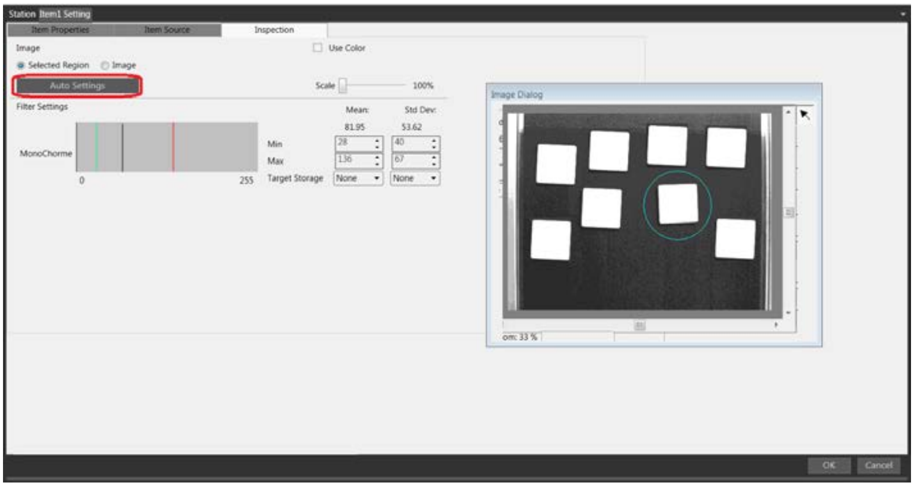
Continues on next page

4. Click **Edit** to open the inspection model creating window.



xx1900000953

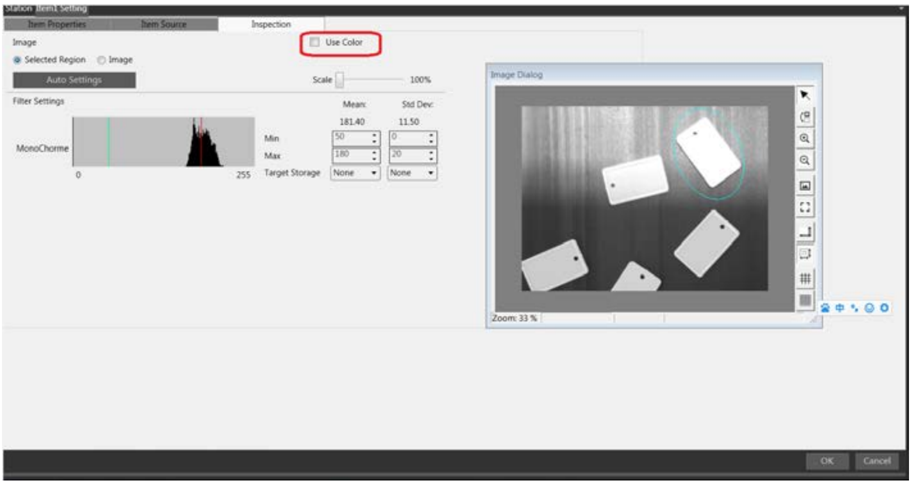
5. Press **Auto Settings** to automatically get a appropriate range limits(**Min.** and **Max.** values) for the histogram. Alternatively, the **Min.** amd **Max.** values can be set manually by sliding the red and green bars across the histogram or by simply entering values into the text boxes. For a product to be accepted, both the standard deviation and the mean value have to be within the specified limits. When using color vision the histograms for all channels must fall within the limits.



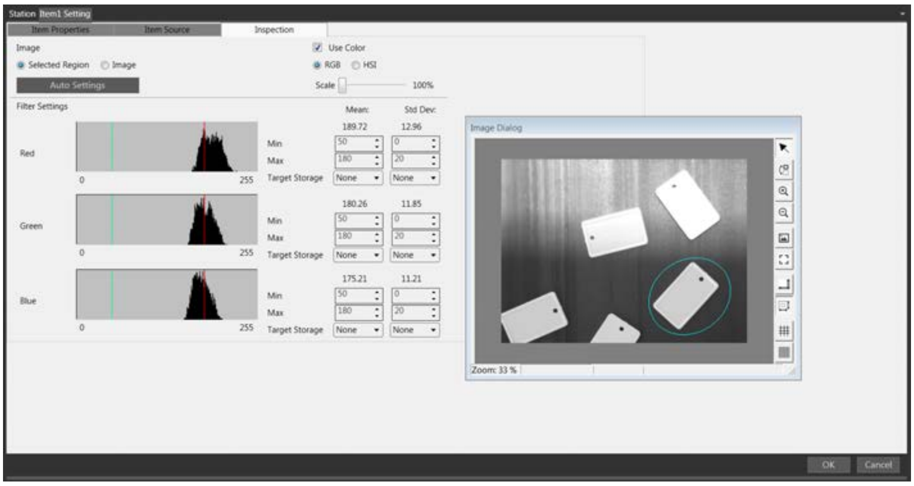
xx1900000954

Continues on next page

6 If select **Use Color**, the window for the colors will show up.



xx1900000948



xx1900000949

7 Click **OK**.

To classify the inspection area as accepted or rejected the histogram tool evaluates two different magnitudes within the specified region:

Mean defines the min and max value for the inspection model. If the inspection area has a mean value less than min or higher than max the inspection area will be classified as rejected.

Std dev is a statistical measure that illustrates how closely all the various pixel values are clustered around the mean value. An even color tone gives a narrow histogram with low standard deviation while a speckled pattern gives a wide histogram and a high value for **Std dev**.

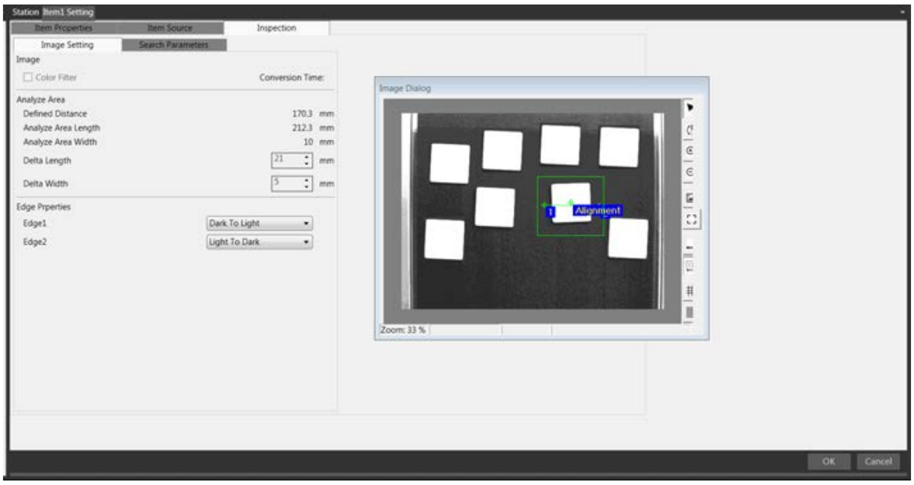
Histogram subinspection parameters in item targets

The `Mean` and `standard deviation` parameters can be selected for the target storage.

Continues on next page

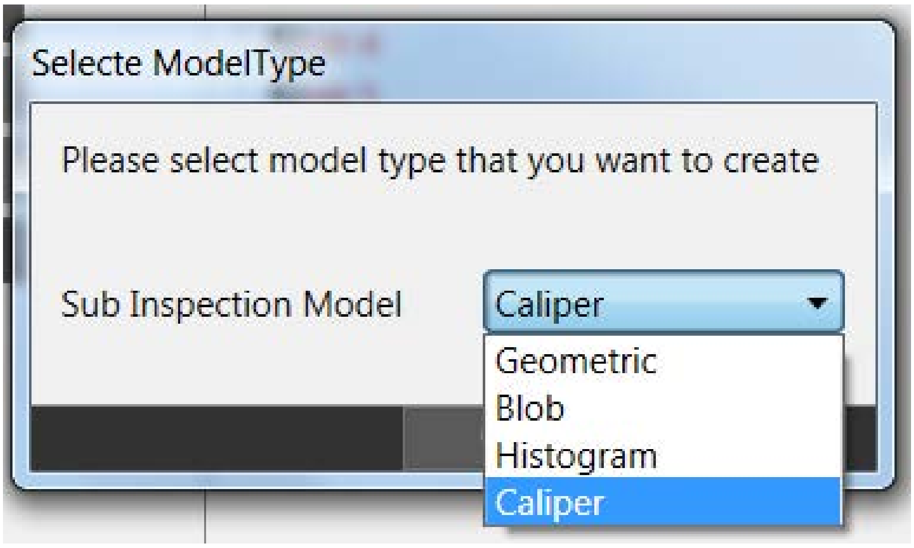
Caliper

The *Caliper* tool identifies edges and measures the distance between them. The analysis is only done within the corresponding inspection area. To increase the contrast in images where parts have similar grayscale tone, it is possible to use color filtering. For more information, see *Using color vision on page 298*



xx1900000932

1 On the **Sub Inspection Model** in the **Select Model Type** dialog box, select **Caliper** in the drop-down list and click **OK** button.

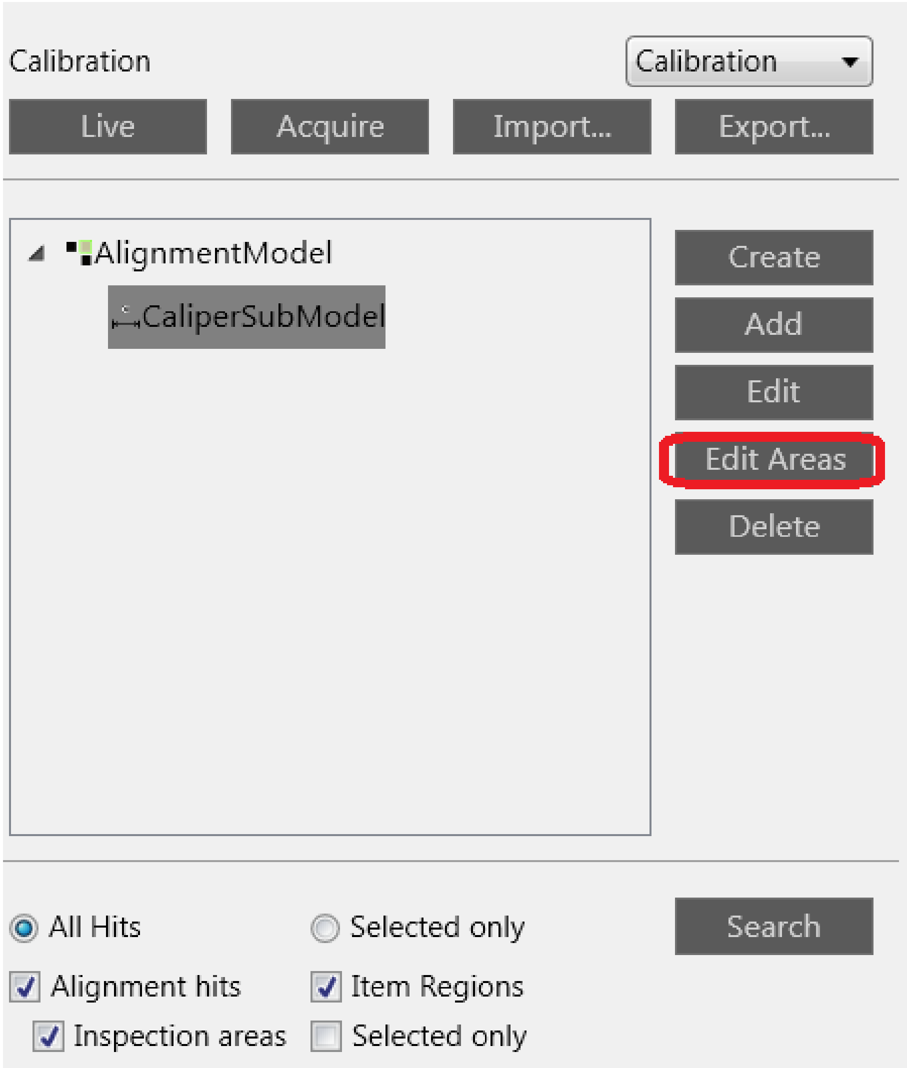


xx1900000933

Figure 4.2:

Continues on next page

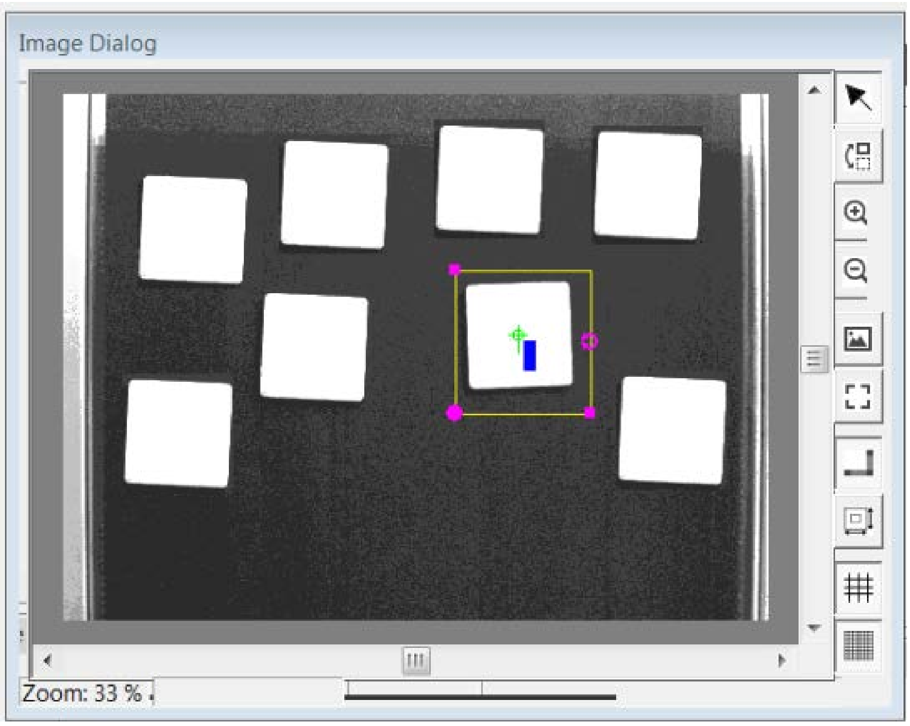
2 Click **Edit Areas**.



xx1900000934

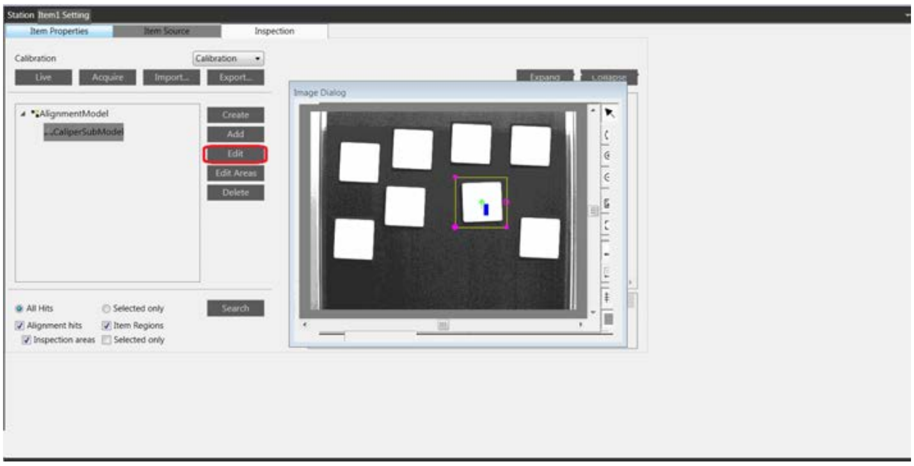
Continues on next page

3 Drag the rectangle so it covers the pattern.



xx1900000935

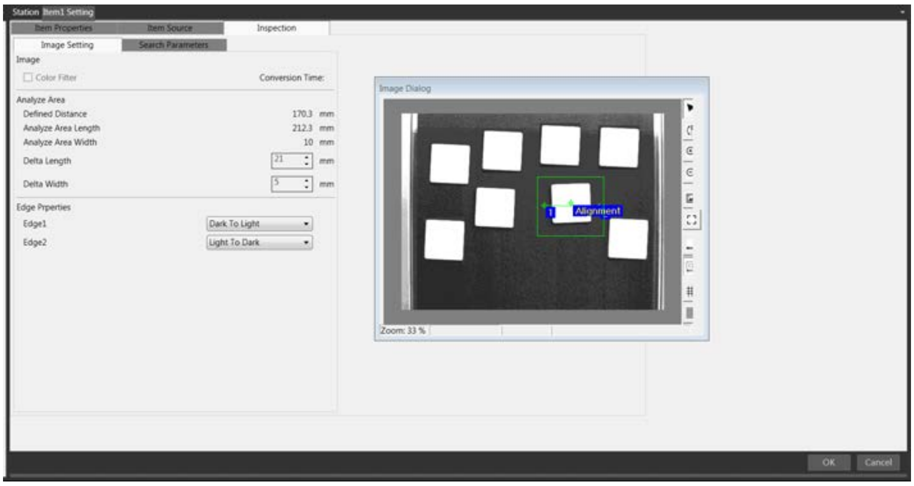
4 Click **Edit** to open the inspection model creating window.



xx1900000936

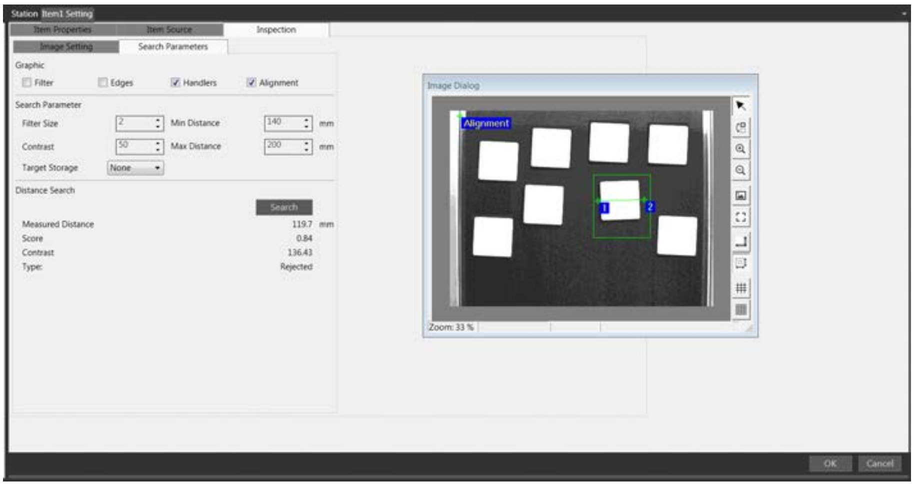
Continues on next page

5 Move the line so the end points are located on the edges of the area under the **Image Setting.**



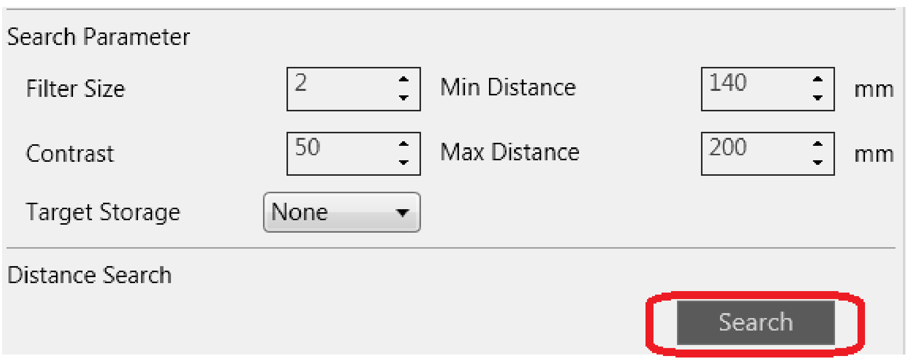
xx1900000937

6 Adjust the **Search Parameter** in the **Search Parameters** according to the **Defined Distance** in the **Analyze Area.**



xx1900000938

7 **Click Search.**



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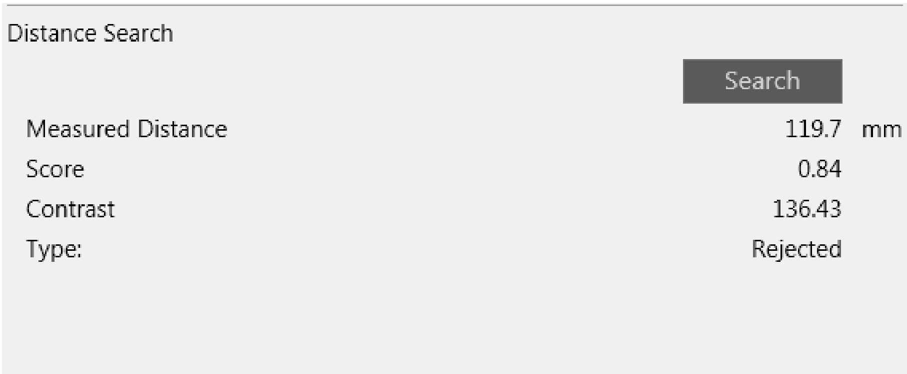
Continues on next page

The result is displayed in the **Distance Search**



xx1900000940

8. Click **OK**.

To make a *Caliper* analysis a rectangle is defined around the search line.

Defined Distance is the distance between the end points of the green line located in the **Caliper Image** dialog. Move the line so the end points are located on the edges of the area.

Analyze Area Length is the length of the rectangle within which the Caliper analysis will be performed. To increase the **Analyze Area Length** either increase the **Delta Length** value or resize the **Defined Distance** line.

Analyze Area Width is the width of the rectangle within which the Caliper analysis will be performed. To increase the **Analyze Area Width** increase the **Delta Width** value.

Delta Length define the extra mm to add to the **Defined Distance** to get an **Analyze Area Length.**

```
Analyze Area Length=2*Delta Length + Defined Distance
```

Delta Width defines the width of the analyze area.

```
Analyze Area Width=2*Delta Width
```

From the analyze area a production image is created. The operation sums all the information in the analyze area, accentuating the strength of edges that lie parallel to the **Analyze Area Width** and reducing the effects of noise.

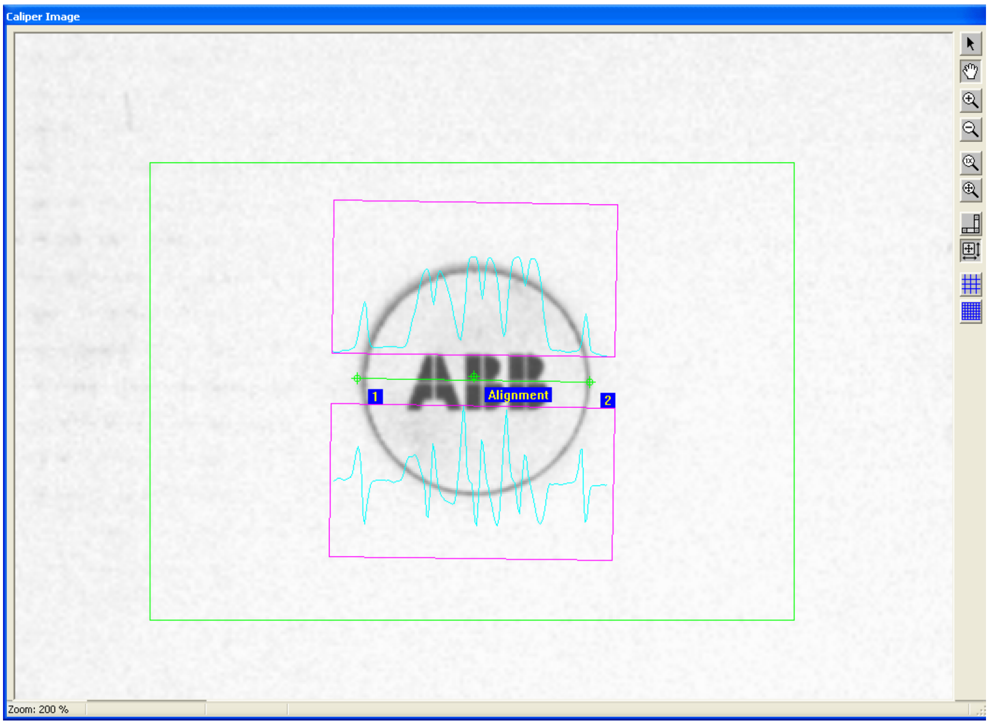
Edge Properties defines the polarity of the edge. The polarity is defined as the measure from **Edge1** to **Edge2.**

The **Search Parameters** defines filters using a Gaussian curve. The filter controls how the *Caliper* tool removes noises, how it accentuates the peaks of interest in the image, contrast, and distance.

The **Distance Search** is used to search for two edges with the specified distance (**Defined Distance**) and the defined polarity.

Continues on next page

The **Graphic** checkboxes define which results should be displayed in the **Caliper Image** dialog.



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Caliphar subinspection paramters in term targets

The `Distance` parameter can be selected for the target storage.

External

This function is reserved for next version.

4.3.10 Starting production

Production

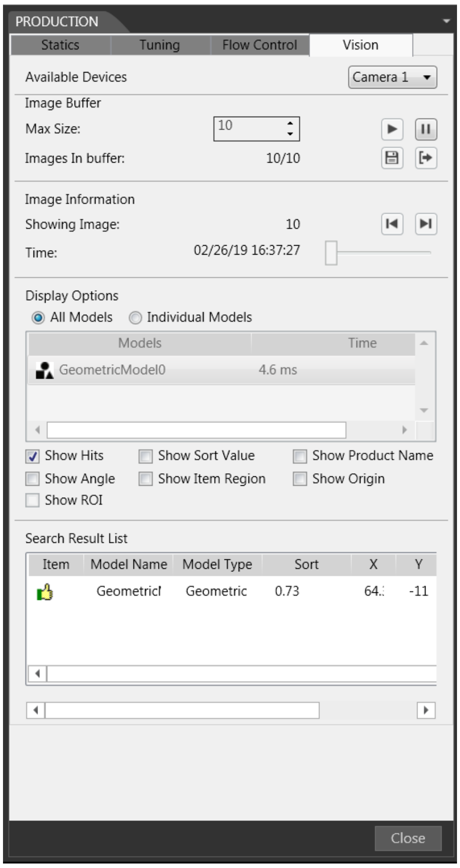
After switching to the real controller and real Runtime, all operations in the production are reflected in the real cell, and all data comes from the real system.

xx1800001738

	Description
Statics	Allows you to control the status of the production and have an overview of the production data. For more information regarding Statics see *Statics on page 160*.
Tuning	Allows you to adjust the parameters of the item, work area and robot. For more information regarding Tuning see *Tuning on page 160*.
Flow Control	Allows you to adjust the speed of the conveyor. For more information regarding Flow Control see *Flow Control on page 169*.
Vision	Allows you to see the live video of the camera. For more information regarding Vision see *Vision on page 293*.

Continues on next page

Vision

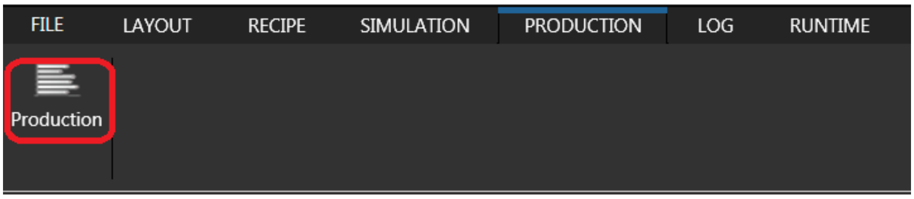


xx1900000569

Emulation

Use this procedure to do the emulation:

1 On the **Production** ribbon-tab, click **Production**.



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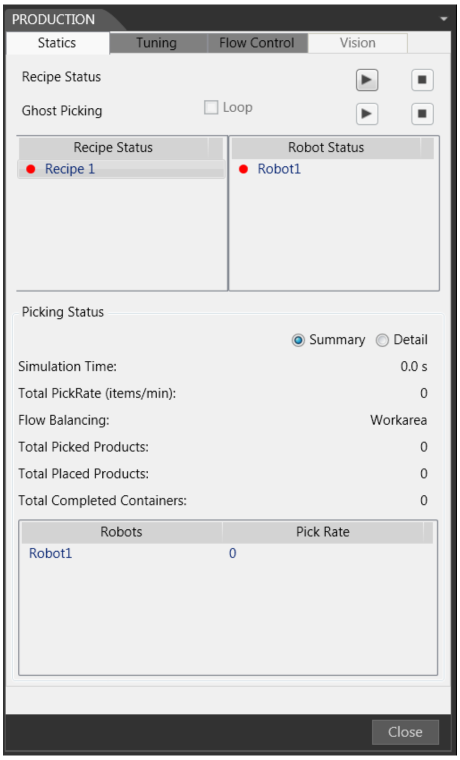
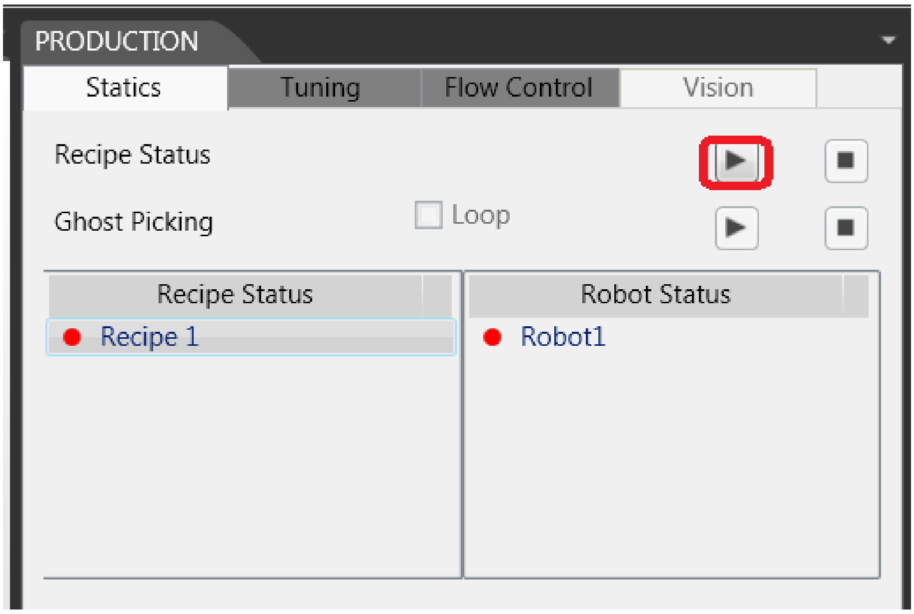
The **Production** dialog is opened.



xx1800001718

2 Click **Recipe** and **Start** to run the production



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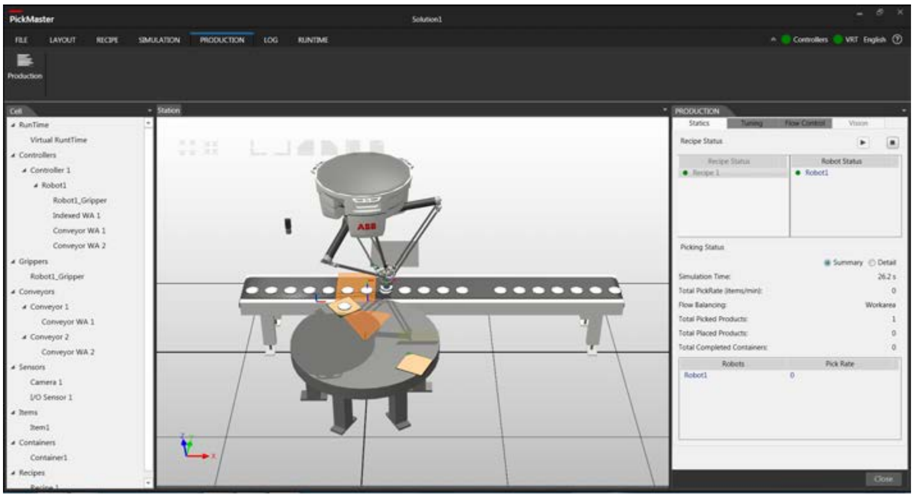
Continues on next page

The emulation starts running.



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3 Click **Stop** to stop the emulation.

Note

When running the production, the movement of 3D models in PickMaster PowerPac follows the actual system. However, since the 3D models dimension in PickMaster PowerPac cannot be completely consistent with the real cell. The layout of item, conveyor, and robot in the emulation may need to be adjusted according to the actual dimension to make the emulation as close to the actual system as possible.

If the item is missing during the emulation, it may be caused by that the size of the PickMaster PowerPac station is not exactly the same with the real station. The item is hidden in the conveyor model.

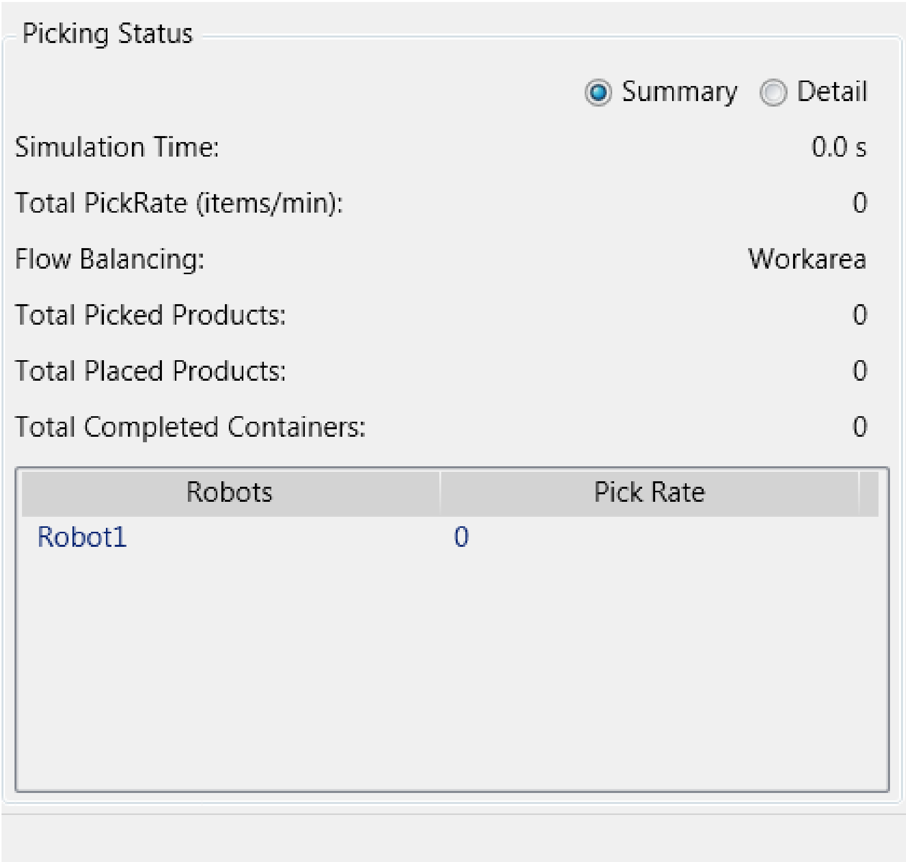
Adjust the height of the conveyor model to show the item normally.

4.3.11 Managing the robot in production

Starting production

Start and stop the production from the **Production** menu.

During runtime, the robots are accessed from the **Production** tab in the **Workspace** area. For more details, see *Production on page 292*.



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Prerequisites

The solution must be configured to start production.

The recipe must be open and active.

Pick rate

The pick rate is shown as icons in the **Production** tab when a robot is running.

The following values are shown:

- Number of pick during the last minute.
- Total number of picks since the production was started.

Continues on next page

Robot states

The robot can be in different states.

State	Description
Running	The robot can pick and place items.
Paused	The robot is paused in motors off state, or the RAPID program has stopped.
Emergency State	The robot is in emergency stop state.
Stopped	The robot is stopped, that is no items are handled by the robot or distributed to the robot.

Stopping and resuming the robot

It is possible to stop a robot during runtime.

Click a robot icon in the **Production** tab and select action from the popup menu.

If more than one robot is connected to a controller (*MultiMove*):

- Restart from stopped state must be performed at the same time for all robots. To do this, right-click the controller icon in the production tab and select **Restart Robots**.
- Stopping one robot will also stop the other robots on the same robot controller.

Emergency stop

In case of emergency:

1. Press the emergency stop button on the robot controller or the FlexPendant to stop the robot immediately.

   This sets the controller in emergency state and a warning is displayed on the FlexPendant and in PickMaster PowerPac and Runtime.
2. Fix the problem.
3. Release the emergency button.
4. Then acknowledge and reset the emergency state on the FlexPendant or using the popup menu before you restart the robot.

CAUTION

Emergency stop should not be used for normal program stops as this causes extra, unnecessary wear on the robot.

4.4 Using color vision

Introduction to color vision

PickMaster PowerPaccan either be used with monochrome or color cameras. The difference between the two is that an image acquired with a color camera represents each pixel with three 8-bit values (decimal 0-255) instead of only one 8-bit value for monochrome (grayscale) images. In a monochrome image the 8-bit value represents the gray level from white to black, whereas in a color image the three values represent the content of three separate color channels. These three channels represent red, green, and blue (color space RGB) or hue, saturation, and intensity (color space HSI). Which color space to work with, depends on the content of the image.

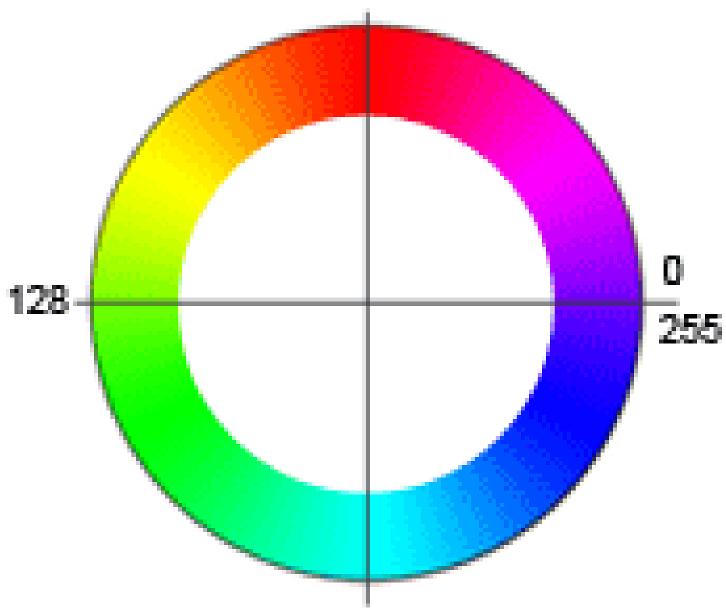
Color spaces

When working with RGB the color of each pixel is represented by its content of red, green, and blue. The numerical representation is straightforward for the three base colors - red (255, 0, 0) green (0, 255, 0), and blue (0, 0, 255). However, it can be difficult to understand the composition of other mixed colors.

HSI is a color space that is more easily translated to the human perception of colors.

- Hue: The location of the color on the on the electromagnetic spectrum. See graphic below.
- Saturation: The purity of the color.
- Intensity: The brightness of the color.

Because the hue spectrum wraps around (both 0 and 255 represent red), it is suitable to display it as a circle.



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When using color filtering it is easier to distinguish between colors if they are dissimilar. The level of similarity may be interpreted as the distance between the colors in color space. The difference may be more pronounced in one or the other of the two color spaces and for this reason it is wise to try out filters in both color spaces.

Lighting

Because a color system provides more information about the color contents of an image it is also more sensitive to lighting conditions. It is very important to provide uniform light, that is consistent over time.

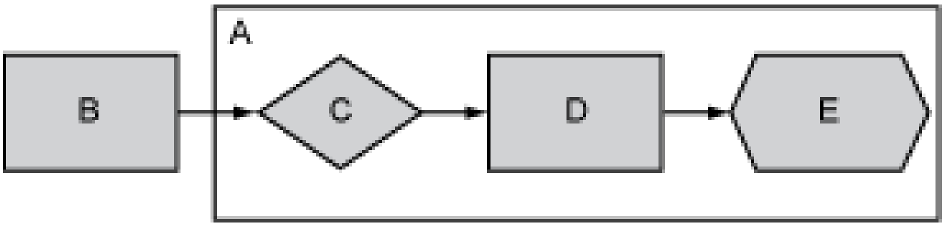
Computer performance

Color vision is very resource consuming; acquisition, warping, and filtering all take more time. It is important to keep the number of cameras and frame rate moderate. The performance limit can vary greatly as it is a combination of the vision task and the computer resources.

Color vision in PickMaster PowerPac

PickMaster PowerPac provides color vision in the form of a filter except the histogram. This filter is accessible from the PatMax, Blob and Caliper configuration dialogs, both as standalone, alignment and sub-inspection models. The filter is a pre-processing step which takes place before the object recognition or measurement. Every model can have its own individual filter setting.

The camera acquires a color image, that is converted into a grayscale image by passing it through a color filter, as shown in the following figure. The histogram tool takes a slightly different approach to color vision as it skips the filtering step and instead performs the measurement directly on each of the three color channels of the image.



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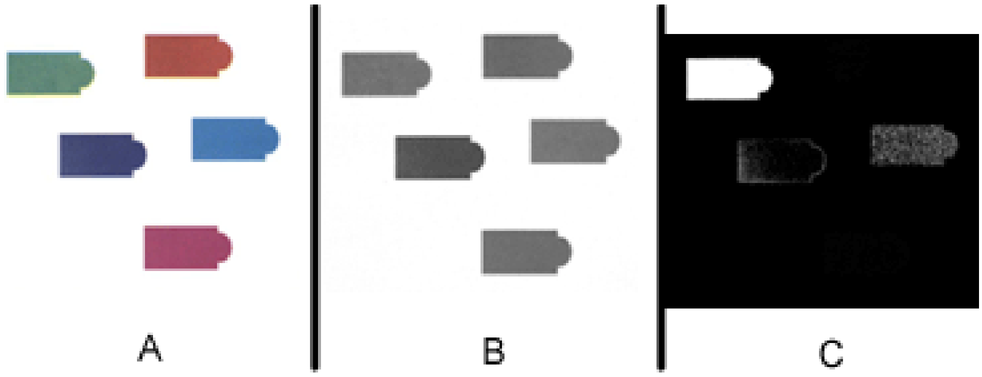
A	Vision model
B	Color image
C	Color filter
D	grayscale image
E	Object recognition

Continues on next page

The result of the color filter is a grayscale image in which certain colors have been accentuated or attenuated according to the filter settings. The object recognition tools (*Blob*/*PatMax*) operate on this grayscale image.



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A	An image acquired with a color camera.
B	The same scene acquired with a monochrome camera.
C	The color image after having passed through a filter which is set to extract green. This is the image that will be used by *PatMax/Blob*.

Prerequisites

The camera must be a color camera.

The color video format must be configured for the camera.

The Cognex vision license must contain the color tool option.

Calibrating the camera's white balance

A camera is delivered with default settings. These include three parameters which represent the white balance of the camera. Depending on the light source, the image can get an undesired color tone. Different light sources emit light of different temperatures (color content) and the camera needs to be color calibrated in order to compensate for this light.

The basic concept is to present the camera with a gray scene, that is a scene that has equal contents of red, green, and blue. The most accurate method is to take a sheet of white paper and adjust the light settings of the camera in order to make the scene appear gray.

Use this procedure to calibrate the white balance for the camera.

1. In the line view, right-click on the camera and select **Edit**.

   The **Camera Configuration** dialog is opened
2. Place a white sheet of paper under the camera. The sheet must cover the whole field of view.
3. Adjust the light settings (aperture or exposure time) to make the scene appear mid-gray. The number of saturated pixels (completely black or white) should be kept to a minimum.
4. Press Calculate. This will calculate the white balance calibration parameters.

Continues on next page

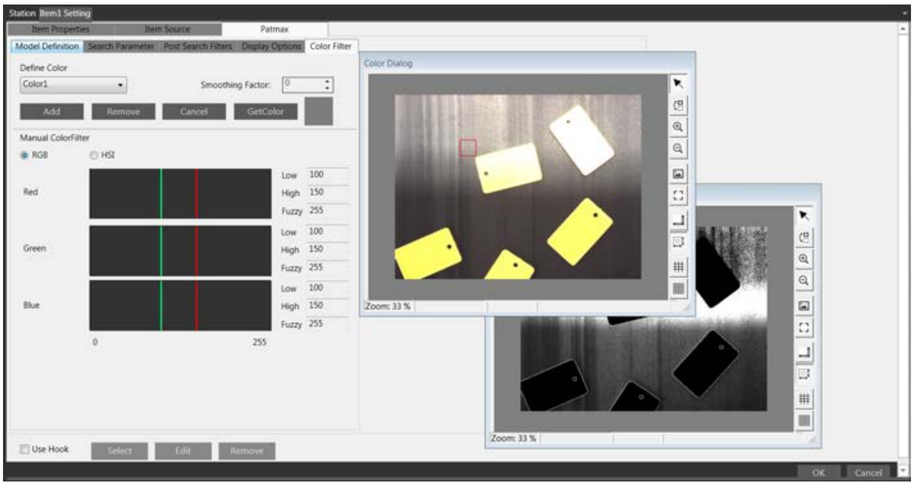
5 Click **Apply**.

The camera's internal settings are now modified. If the calibration is successful the color image and the grayscale image of the white paper sheet should now look the same (gray).

6 Right-click the camera and select **Save**.

The settings are stored in the camera. If the parameters are not saved, the camera will loose the calibration when PickMaster PowerPac is restarted.

Illustration Color Filter Settings



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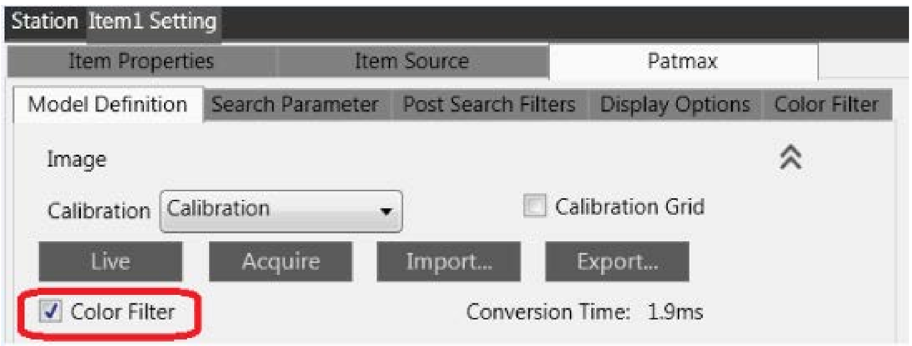
Configuring color vision

The *PatMax* and *Blob* configuration dialogs contain a checkbox to enable color filtering (**Color filter**), and a button to display the filter settings (**Set**).

Use this procedure to configure color vision.

1 In the **Image** part of the *PatMax* or *Blob* configuration dialog, select **Color Filter**. This will enable the filter.



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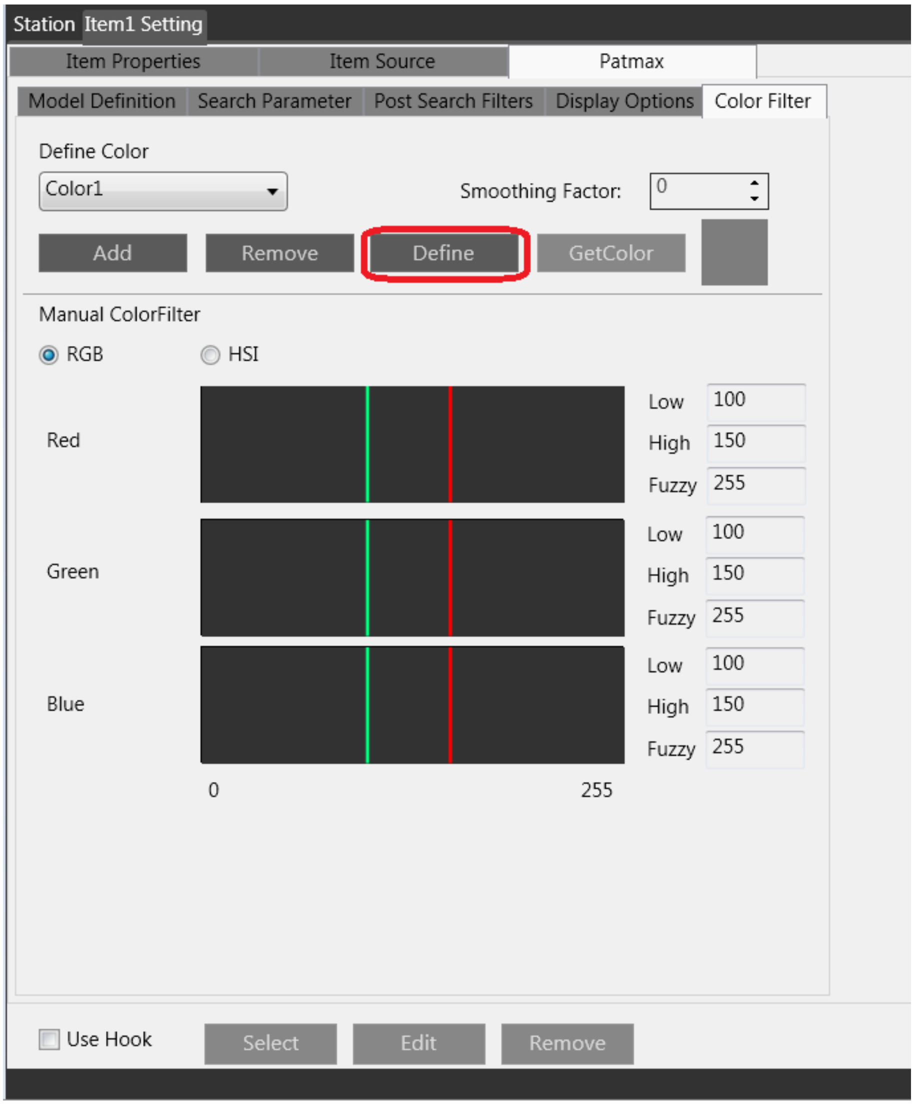
The **Color Filter Settings** dialog is opened together with a second video window showing the color image.

2 In the **Color Filter** part, select **RGB** or **HSI**.

Continues on next page

3 In the **Define color** part, color samples can be collected from the display to indicate which colors should be enhanced.

a Click **Define**. An adjustable rectangle will appear in the color dialog.



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b Move/resize the rectangle to indicate what color should pass through the filter. The indicated color range will be converted to white in the

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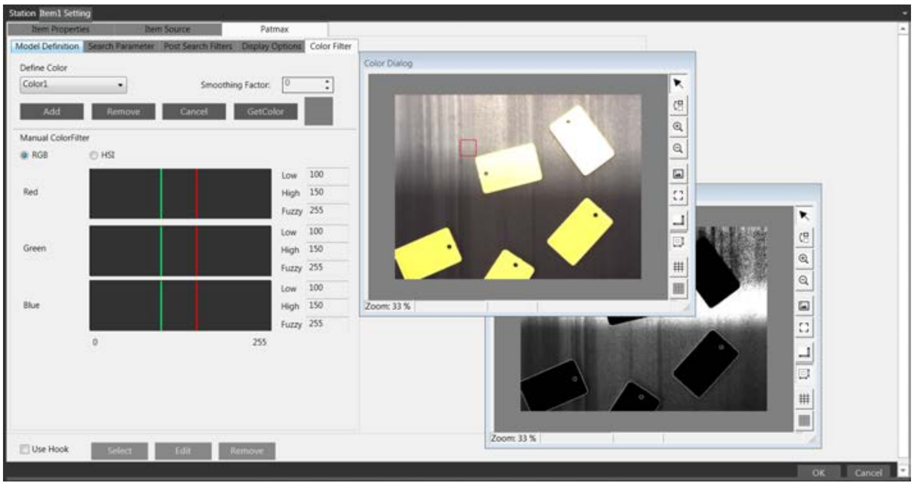
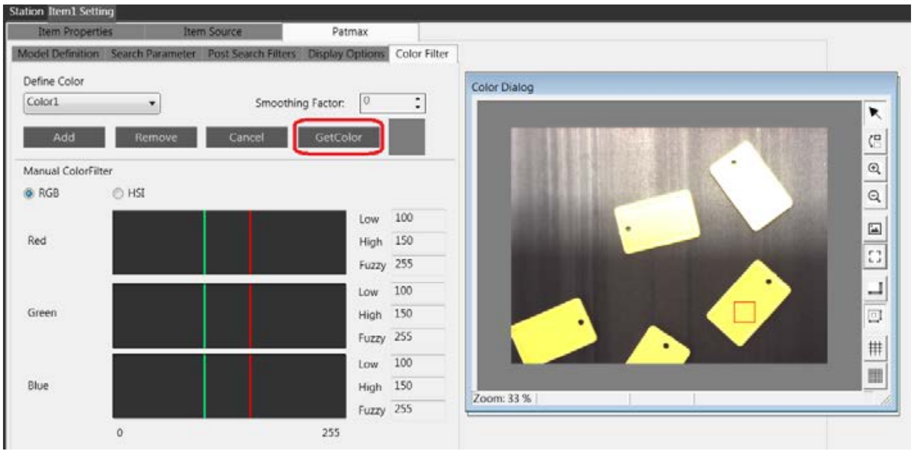
output grayscale image. Colors that are dissimilar to the specified color will be converted to black.



xx1900000943

c Click **Get color** to store this color range.



xx1900000944

4 In the **Manual color filter** part, adjust each color channel to improve the result if needed.

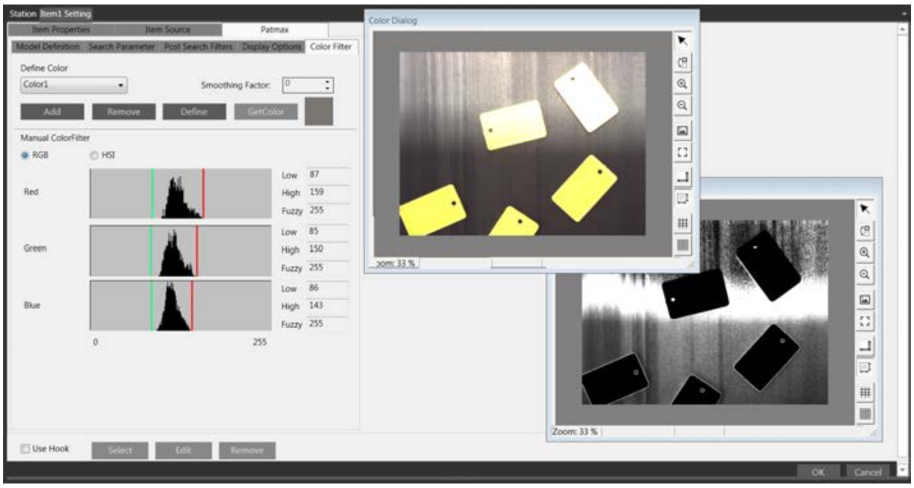
- **Low** specifies the lower limit of the color range that will translate into white pixels in the output image. Minimum is 0 and maximum is 255, except for Hue which has no boundary.
- **High** specifies the upper limit of the color range that will translate into white pixels in the output image. Minimum is 0 and maximum is 255 except for Hue which has no boundary.
- **Fuzzy** specifies how colors outside the minimum and maximum thresholds should be filtered to the output grayscale image. A value of 0 indicates that colors outside the range specified by Low and High will be completely removed by the filter - the result is a black and white image. A non-zero value means that colors outside the Low/High range

Continues on next page

will be weighted in the output image. A higher value produces a smoother grayscale image. Minimum is 0, maximum is 255.

5. If needed, add a new color range to the list in the **Colors** section.

   Each pixel of the output image is computed as the corresponding maximum output pixel of all individual color range filters.
6. If needed, adjust the smoothing factor to reduce noise in the resulting grayscale image.
7. Click **OK** to close the dialog.



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8. Proceed to define the object recognition model.

Tip

Filter ranges should be narrow to provide an output image with high contrast. From an image quality perspective, it is often better to select small homogeneously colored samples and add several ranges to the list of colors.

Tip

Try to filter with both RGB and HSI. Sometimes one may work significantly better than the other.

Example 1

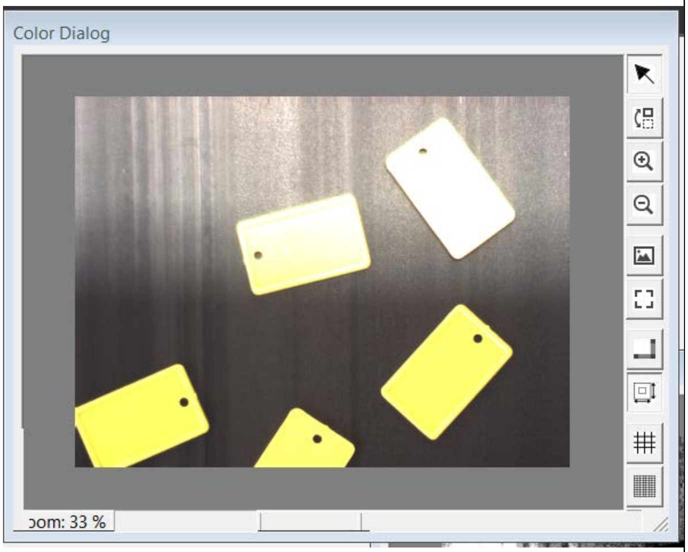
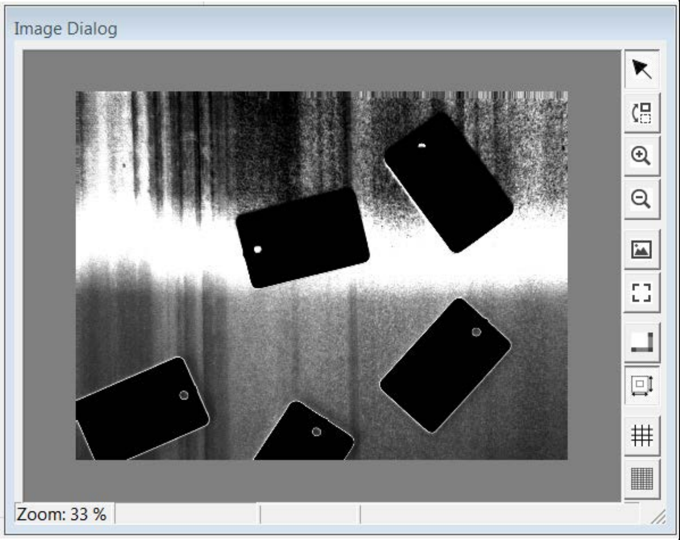
This example describes how to locate a part with *PatMax* and inspect the color with *Blob*.

1. Create an inspection model, see *Configuring inspection models on page 273*.
2. Create a *PatMax* alignment model. Use color filtering if contrast needs to be increased, or use the unfiltered monochrome image if there is sufficient contrast.

Continues on next page

3 Add a *Blob* sub inspection model.
   a Select **Color filter** and click **Set**. This opens the **Color Filter Settings** dialog.
   b Extract the color to be inspected by clicking **Define color**. This filters the desired color into white in the Blob image window.
   c Click **Set filter** to close the **Color Filter Settings** dialog.
   d Adjust the Blob settings so as to find the white blob.
   e If necessary, adjust the settings of the color filter and the Blob analysis.
4 Test the result in the Inspection Configuration dialog.

Example 2

Color image before filter	 xx1900000946
Black and white image after filter	 xx1900000947

4.5 Ghost Picking

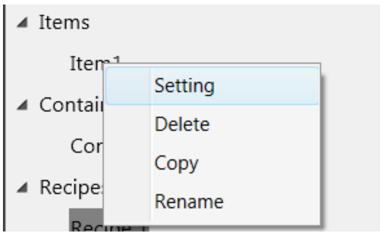
Overview

Ghost picking flow is used by the application engineer to run the dry cycle function before the production. The user sees the robot picking up empty objects. This feature differs from the production in that its incoming material is virtual and is provided by the flow generated by the previous record.

Creating a ghost picking flow

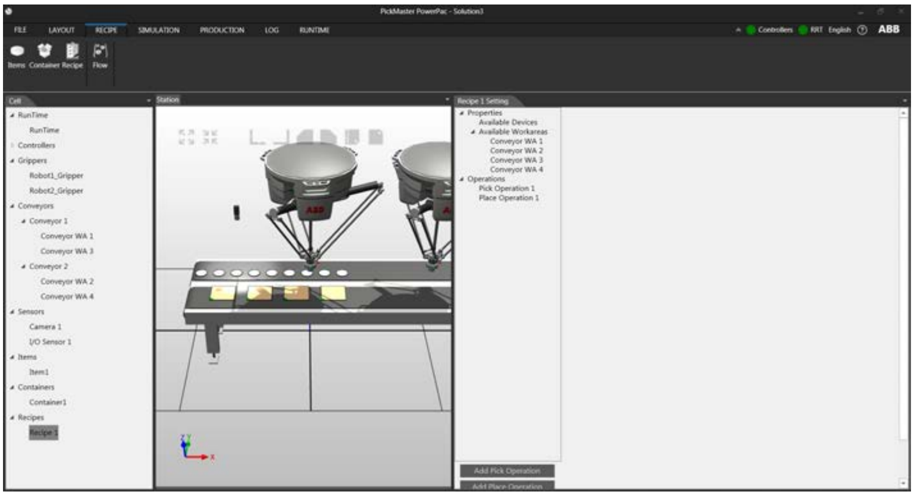
Use this procedure to create a ghost picking flow:

1. Open the solution need to do the ghost picking.
2. Right click **Recipe** in the tree view **Cell** and select **Setting**.



xx1800001727

The **Recipe setting** window is opened.



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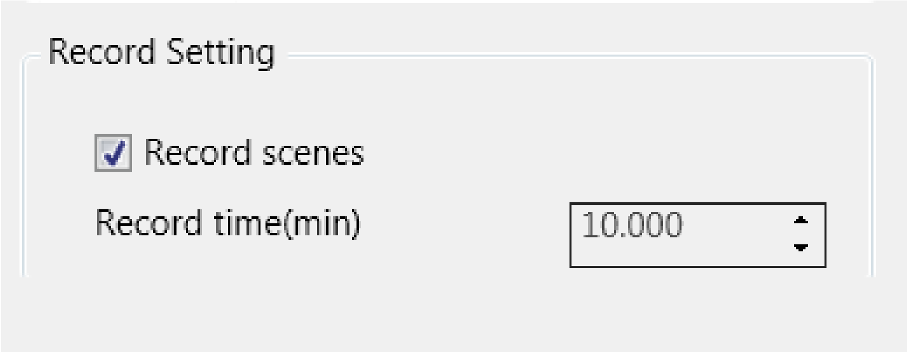
3. Click the **Conveyor WA** in the **Available worarea** which need to be recorded to open the work area setting window.

Continues on next page

4 Select **Record Scenes** checkbox in the **Record Setting**.



xx1900000593

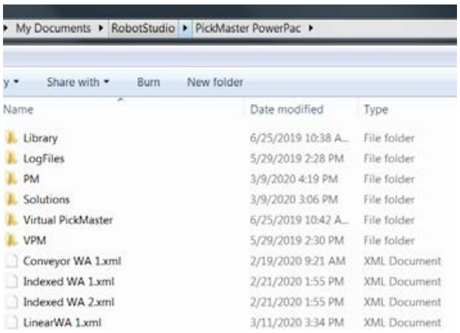
5 Set the record time according to your requirements.

6 Click **OK** to apply the configuration.

7 Click **OK** to close the **Recipe** dialog.

8 Run the production to start the recording.

The created `.xml` file is stored in the **Documents\RobotStudio\PickMaster PowerPac** folder.



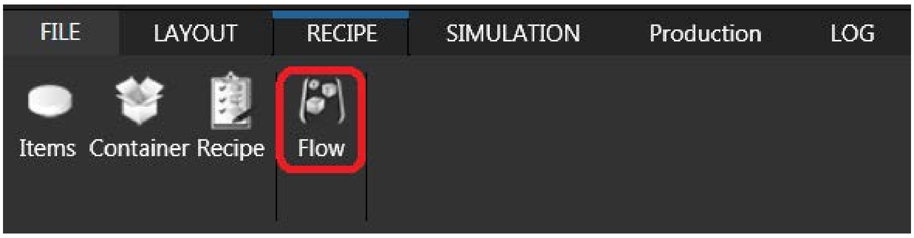
xx1900000548

Adding a ghost picking flow to a solution

Use this procedure to add a ghost picking flow:

1 On the PickMaster PowerPac ribbon-tab, click **Recipe**.

2 On the ribbon-tab, click **Flow**.



xx1800001721

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The **Create Sim Flow** window is opened.

xx1800001722

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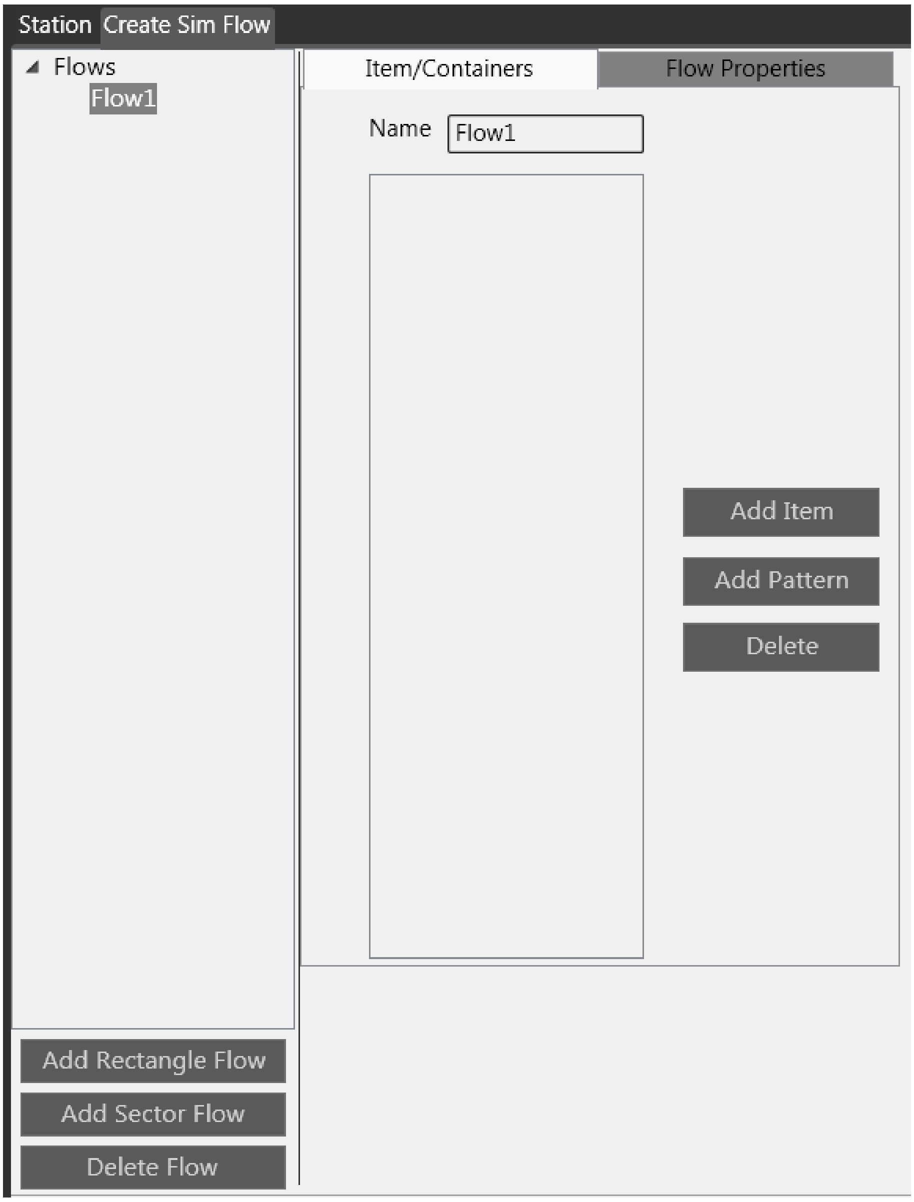
3 Click **Add Rectangle Flow** or **Add Sector Flow** to add a flow.

A new flow is created.



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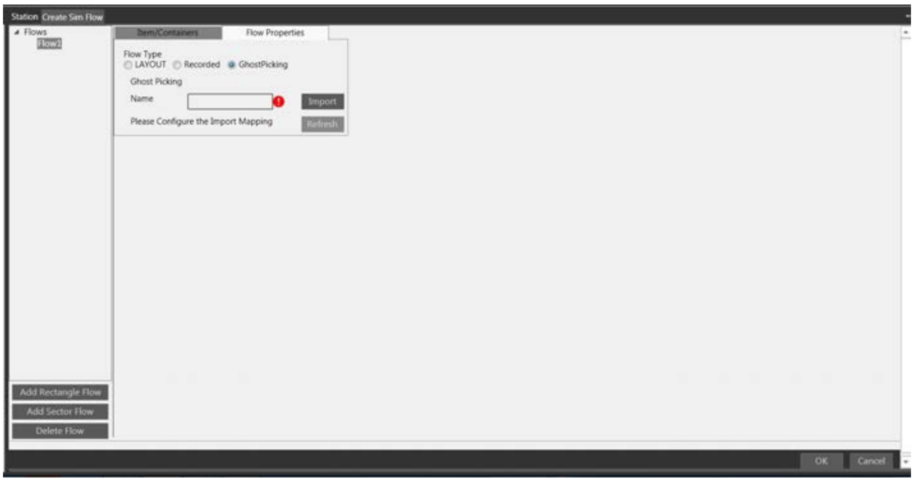
4 Click **Add Item** in the **Item**/**Container** tab to add an item for the flow.

5 Click to open the **Flow Properties** window.

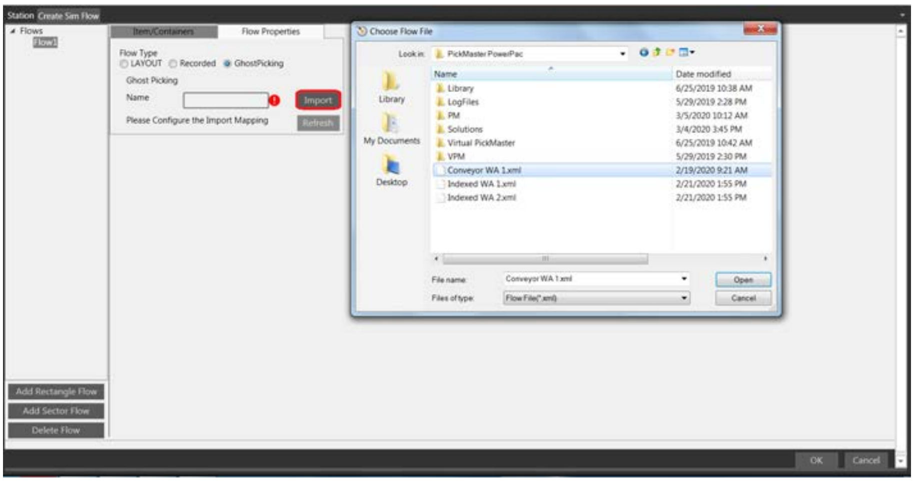
Continues on next page

6 Click to choose the **Ghost Picking** radio button in the **Flow Type**.



xx1800001724

7 Click the **Import Flow** icon to import the predefined work area `.xml` file.



xx1900000549

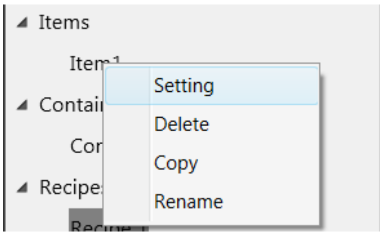
8 Click **OK** to apply the configuration.

9 Click **OK** to close the **Create Sim Flow** dialog.

Select ghost picking flow (Modify recipe)

Use this procedure to select a ghost picking flow:

1 Right-click on one **Recipe** in the tree view **Cell** and select **Setting**.



xx1800001727

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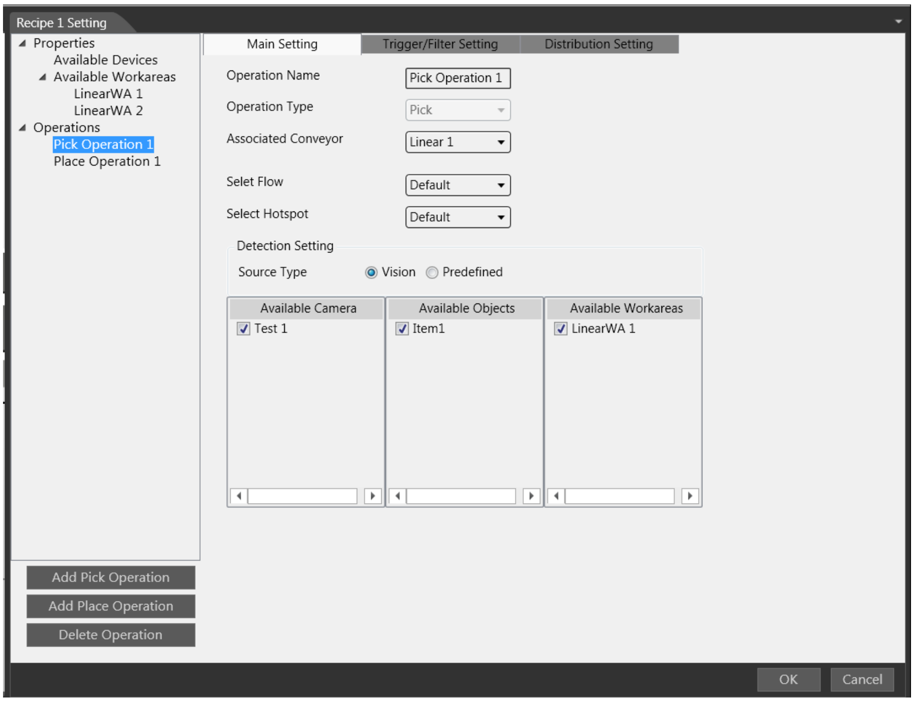
The **Recipe setting** window is opened.



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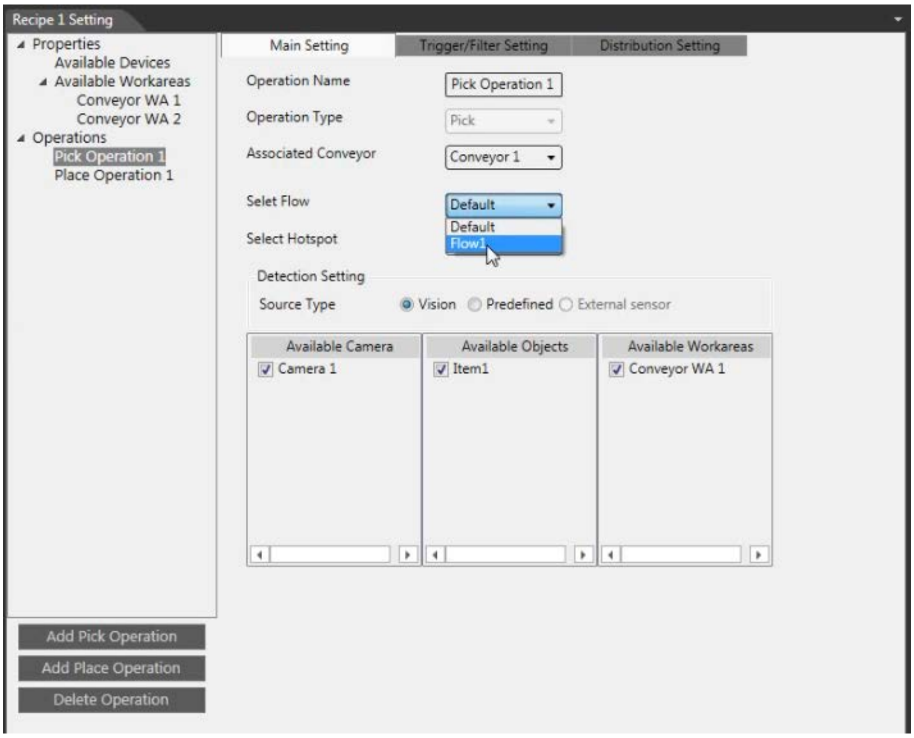
2 Click on the **Pick Operation1** to open the setting window for the pick operation.

3 In the **Select Flow** under **Main Setting**, select **Flow1** in the drop down list.



xx1800001729

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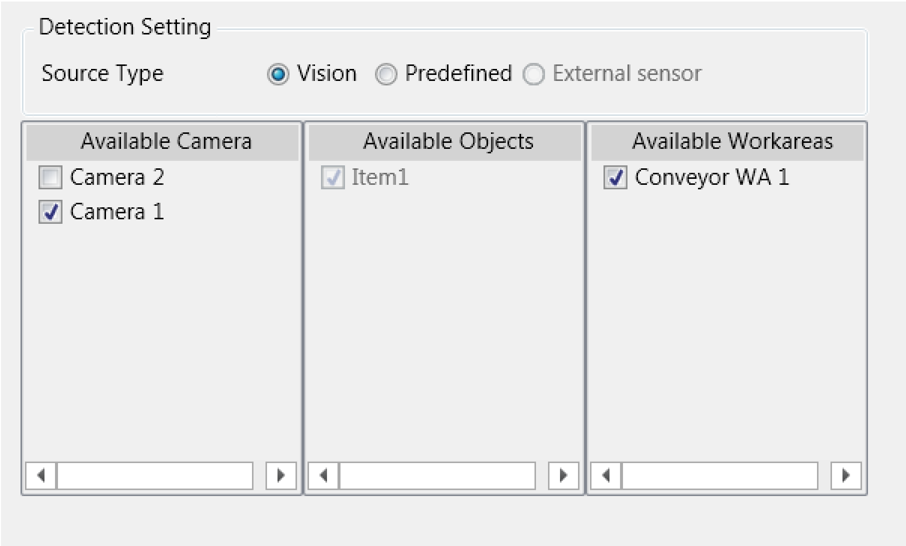
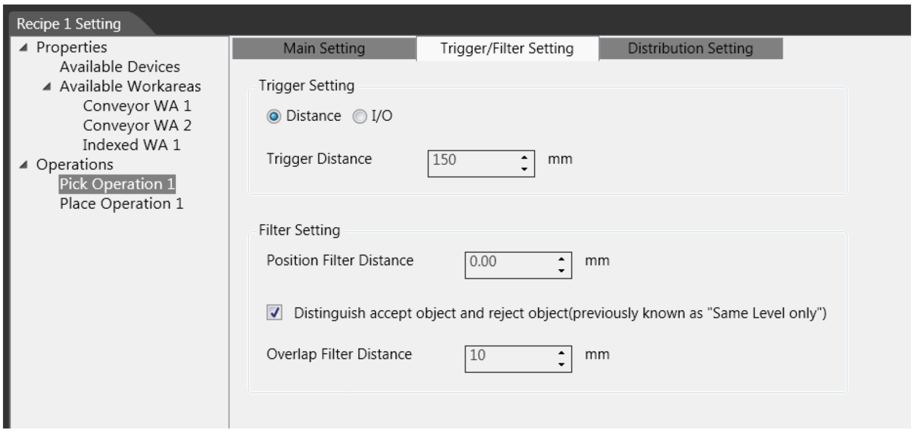
4. Select the **Camera** checkbox in the **Available Camera**.



xx1800001730

5. If needed, select the **Vision** in the **Source Type.**
6. Select **Distance** in the **Trigger/Filter Setting** tab.



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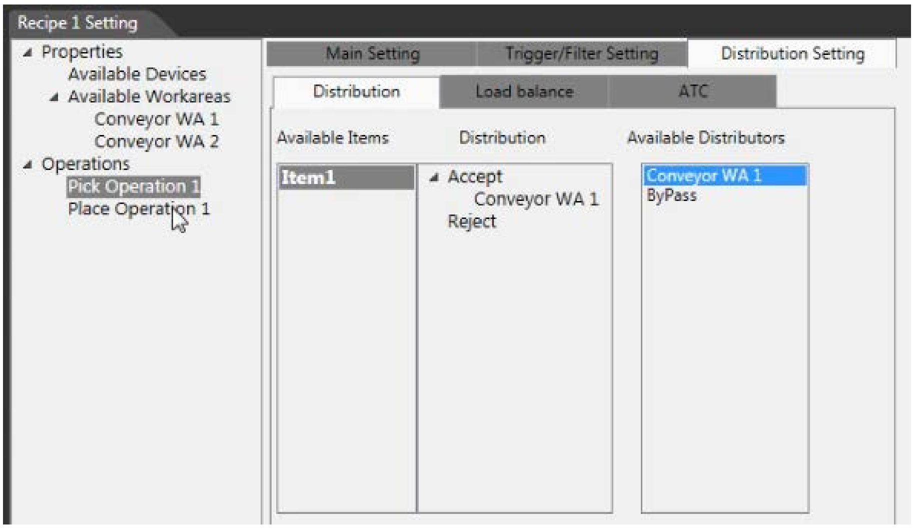
7 Add the **Conveyor WA 1** to the **Accept** by dragging under the **Distribution Setting** tab.



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8 Click **OK** to close the **Recipe setting** window.

Ghost picking flow

> **Note**
>
> To run the ghost picking, the work area signals need to be set as predefined signals.

Use this procedure to run a ghost picking flow:

1 On the PickMaster PowerPac ribbon-tab, click **Production**.

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The **Production** window is opened.

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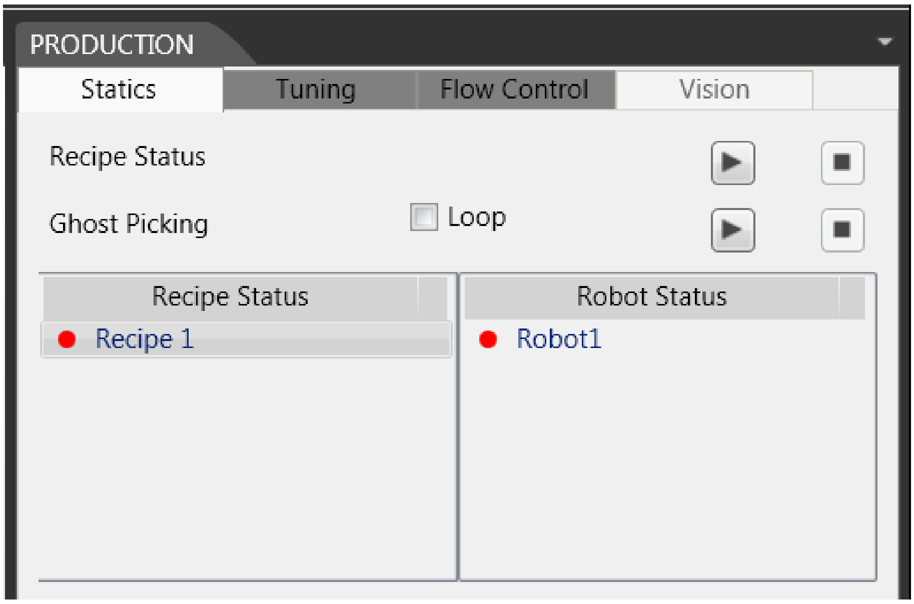
2 Select the recipe which will be running.



xx1800001739

3 If need, select the **Loop** checkbox in the **Ghost Picking**.

> **Note**
>
> If the **Loop** checkbox is selected, the ghost picking will repeat sending the recorded position data to the real controller until the **Stop** icon is clicked.
>
> If the **Loop** checkbox is not selected, the ghost picking will send the recorded position data to the real controller for just one time and stopped automatically.

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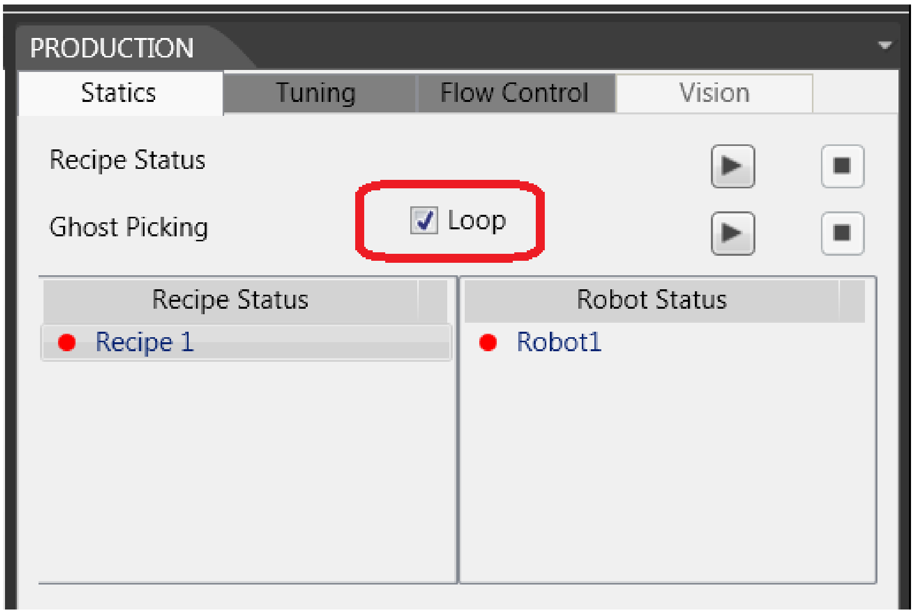
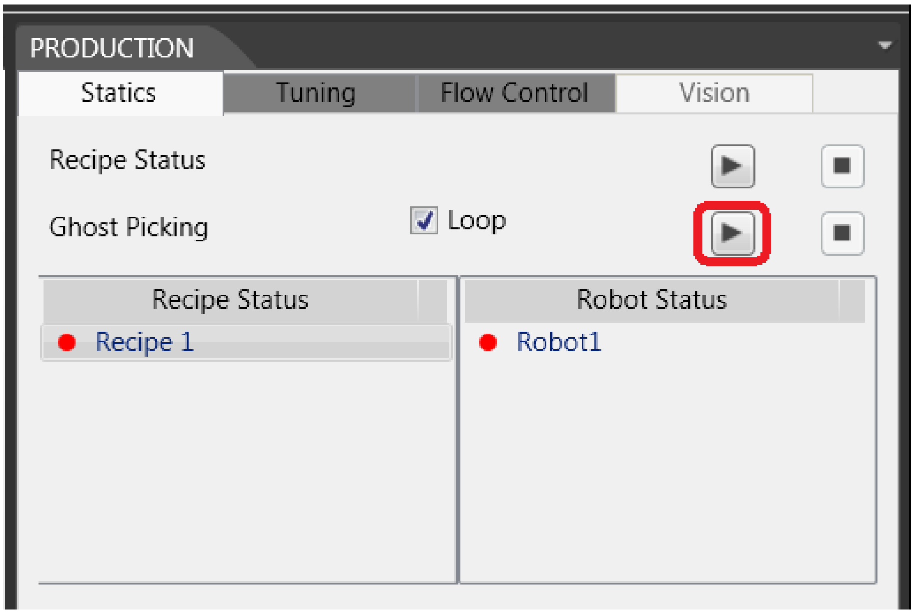


xx1800001740

4 Click the **Start** icon to start the ghost picking in the production.



xx1800001741

5 Click the **Stop** icon to stop the ghost picking in the production.

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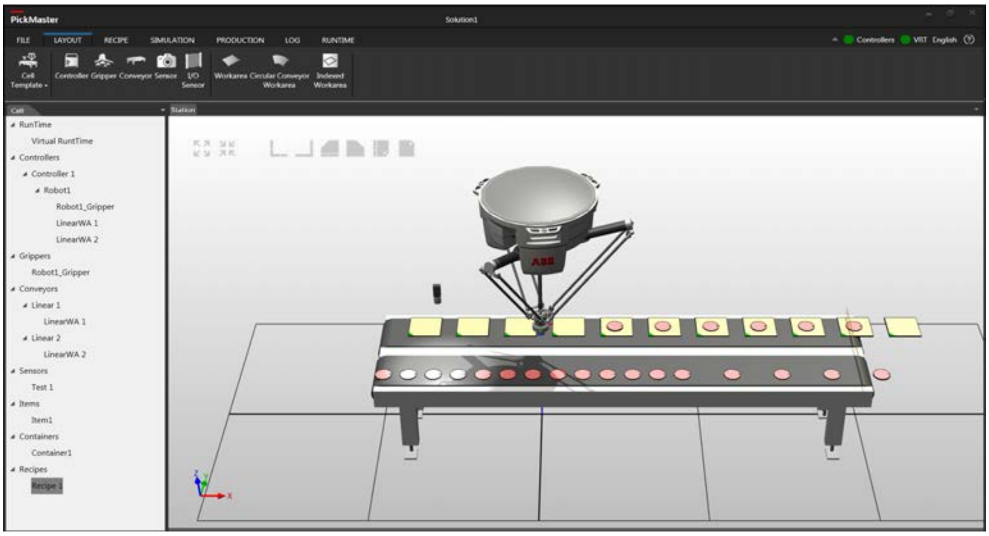
5 Production examples

5.1 Example: One pick work area and one place work area

Overview

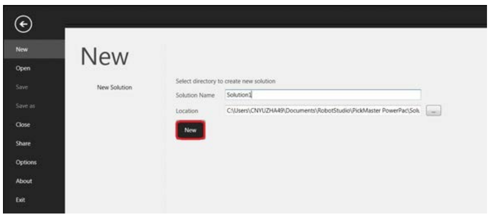
This example describes a solution which contains one robot, two liner conveyors. The robot picks the items from one liner conveyor and place them into the containers on the second liner conveyor.



xx1900000667

Creating the solution

Opening the solution

	Action	Note/Illustration
1	Double click to open the PickMaster PowerPac.	 xx1900000470
2	Click the **New** to create a new solution.	 xx1800000840

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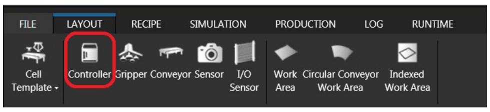
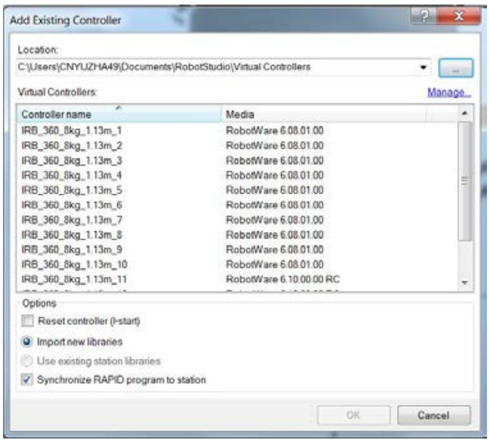
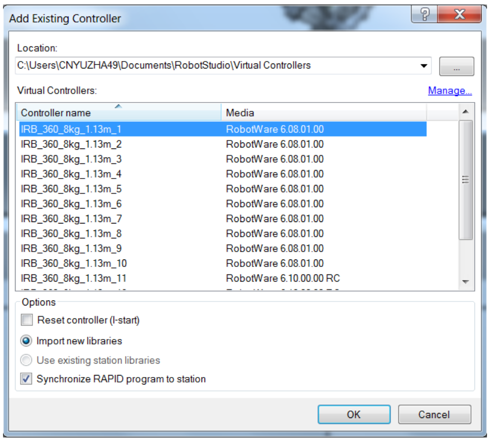
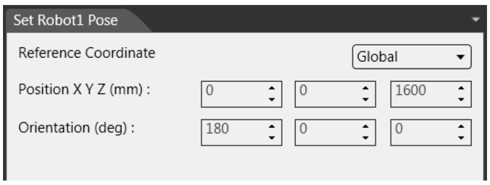
Adding the controller

	Action	Note/Illustration
1	Click the **Controller** under **Layout** to open the **Add Existing System** dialog box.	 xx1800000845
2	Click **Add** and then browse and select the folder to be added to the **System Pool**. To remove a folder from the list, click **Remove**.	 xx1800000846
3	Click a system to select it for the new solution in the *Systems Found* table lists.	 xx1800000847
4	In the **Set Robot1 Pose** window, enter numbers (0,0,1600) in the **Position X Y Z (mm)** text box and (180,0,0) in the **Orientation (deg)** text box.	 xx1900000472
5	Click **OK** to finish the adding of the controller.	

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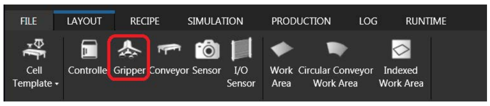
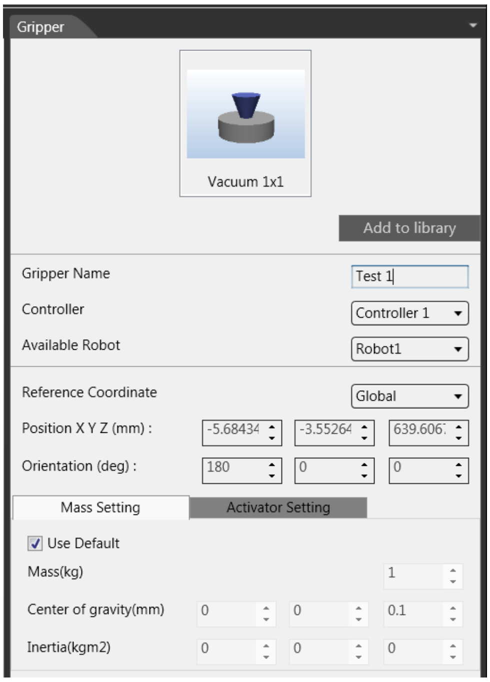
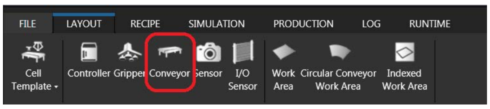
Adding the gripper

	Action	Note/Illustration
1	On the ribbon-tab, click **Gripper** under **Layout**.	 xx1800000852
2	In the **Gripper** window, enter "Test1" in the **Gripper Name** text box.	 xx1900000473
3	Click **OK** to finish the adding of the gripper.	

Adding the conveyor

	Action	Note/Illustration
1	On the ribbon-tab, click **Conveyor** under **Layout**.	 xx1800000855

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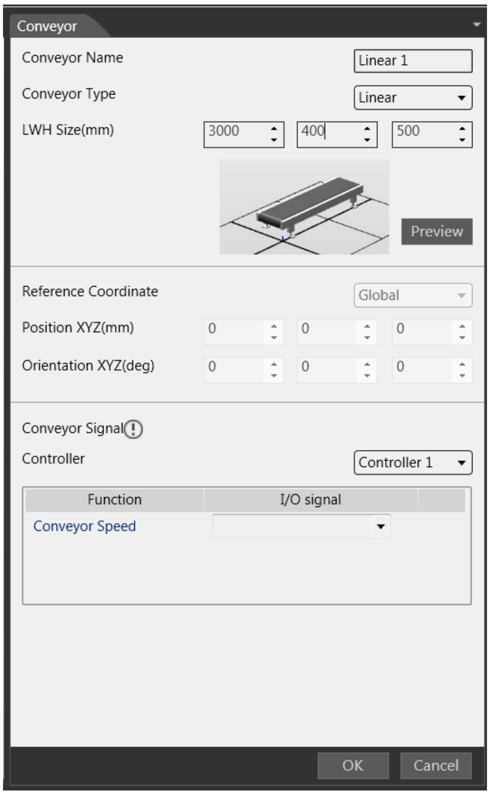
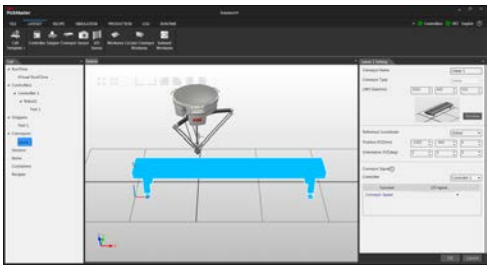
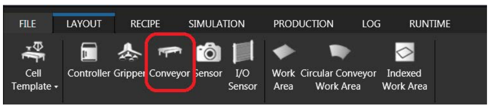
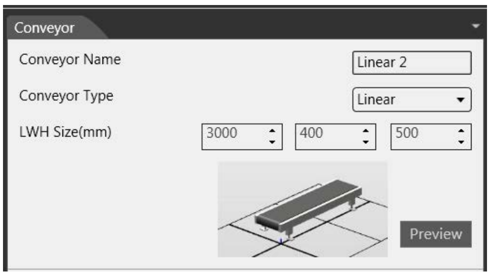
<table>
<tr><th></th><th>Action</th><th>Note/Illustration</th></tr>
<tr><td>2</td><td>In the Conveyor window, enter "Linear1" in the Conveyor Name text box.</td><td rowspan="2">

xx1900000653</td></tr>
<tr><td>3</td><td>In the Conveyor window, select the type as "Linear" in the Conveyor Type drop-down list.</td></tr>
<tr><td>4</td><td>Click on the Preview button to set the preference of the conveyor.</td><td rowspan="3">
xx1900000654</td></tr>
<tr><td>5</td><td>Enter numbers (3000,400,500) in the LWH Size(mm) text box to define the size of the conveyor.</td></tr>
<tr><td>6</td><td>In the Conveyor window, enter numbers (-1000,-400,0) in the Position X Y Z (mm) text box and (0,0,0) in the Orientation (deg) text boxes to define the location of the conveyor.</td></tr>
<tr><td>7</td><td>Click OK to finish the adding of the conveyor.</td><td></td></tr>
<tr><td>8</td><td>On the ribbon-tab, click Conveyor under Layout.</td><td>

xx1800000855</td></tr>
<tr><td>9</td><td>In the Conveyor window, enter "Linear2" in the Conveyor Name text box.</td><td rowspan="2">

xx1900000655</td></tr>
<tr><td>10</td><td>In the Conveyor window, select the type as "Linear" in the Conveyor Type drop-down list.</td></tr>
</table>

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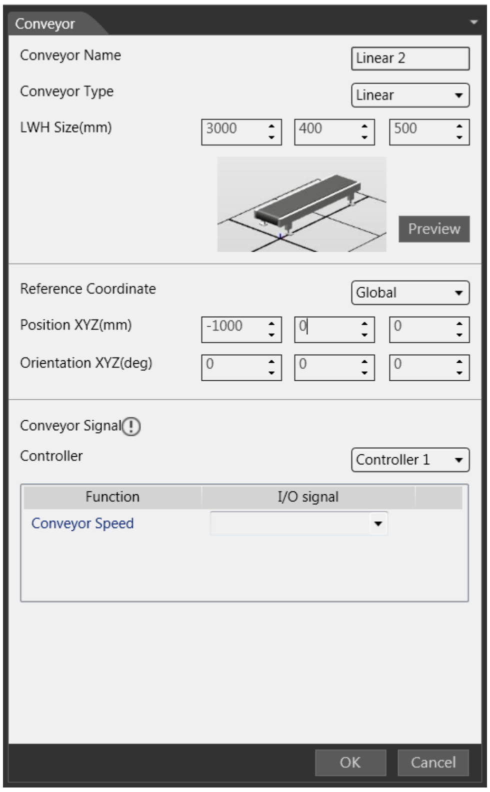
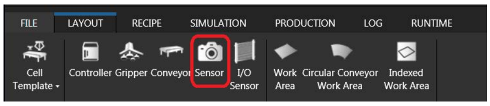
	Action	Note/Illustration
11	Click on the **Preview** button to set the preference of the conveyor.	 xx1900000656
12	Enter numbers (3000,400,500) in the **LWH Size(mm)** text box to define the size of the conveyor.	
13	In the **Conveyor** window, enter numbers (-1000,0,0) in the **Position X Y Z (mm)** text box and (0,0,0) in the **Orientation (deg)** text boxes to define the location of the conveyor.	
14	Click **OK** to finish the adding of the conveyor.	

Adding the sensor

	Action	Note/Illustration
1	On the ribbon-tab, click **Sensor** under **Layout**.	 xx1800001411

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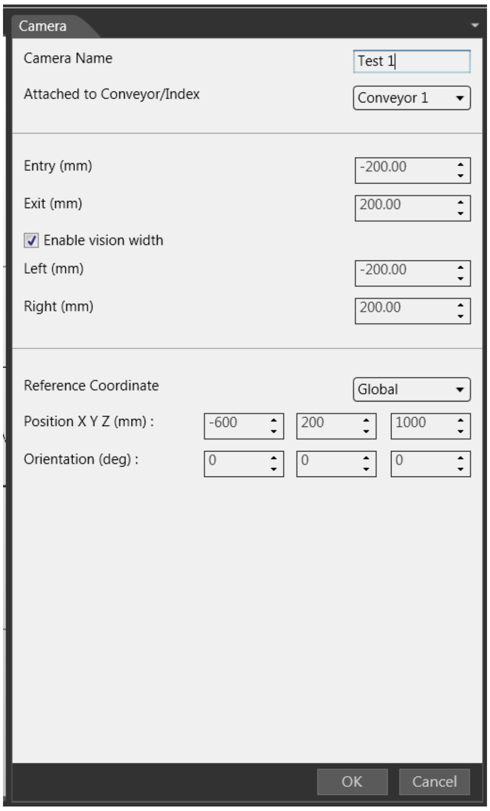
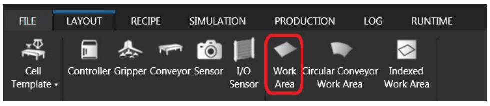
<table>
<tr><th></th><th>Action</th><th>Note/Illustration</th></tr>
<tr><td>2</td><td>In the Sensor window, enter "Test1" in the Camera Name text box.</td><td rowspan="3">

xx1900000657</td></tr>
<tr><td>3</td><td>In the Camera window, select "Linear1" in the Attached to Conveyor/Index drop-down list.</td></tr>
<tr><td>4</td><td>Click OK to finish the adding of the sensor.</td></tr>
</table>

Adding the work area

<table>
<tr><th></th><th>Action</th><th>Note/Illustration</th></tr>
<tr><td>1</td><td>On the ribbon-tab, click Workarea under Layout.</td><td>

xx1800001417</td></tr>
</table>

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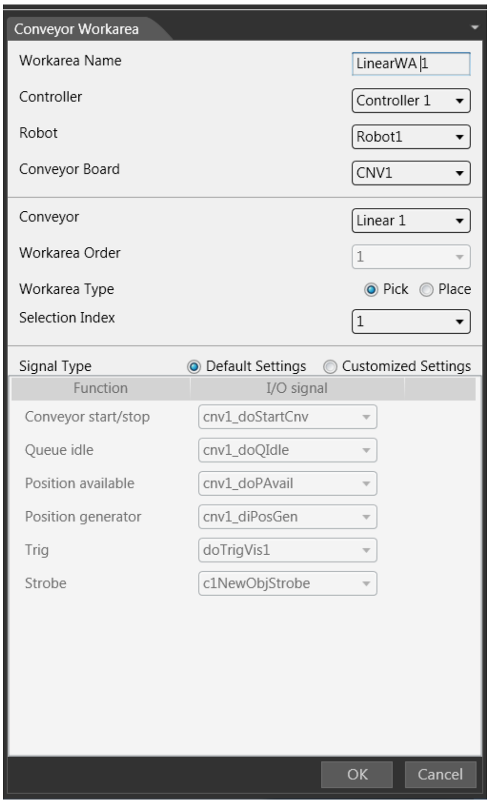
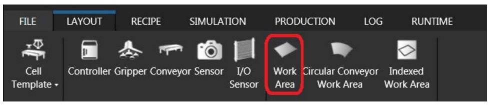
	Action	Note/Illustration
2	In the **Conveyor Work Area** window, enter "LinearWA1" in the **Work Area Name** text box.	 xx1900000658
3	In the **Conveyor Board** drop down list, select the correct conveyor board which has been connected to the liner conveyor. **Tip** The connection between the conveyor board and the conveyor are defined by users.	
4	In the **Conveyor** drop down list, select the **"Linear1"** conveyor.	
5	In the **Work Area Type** radio box, select the "Pick" option.	
6	Click **OK** to finish the adding of the linear 1 conveyor work area.	
7	On the ribbon-tab, click **Work Area** under **Layout**.	 xx1800001417

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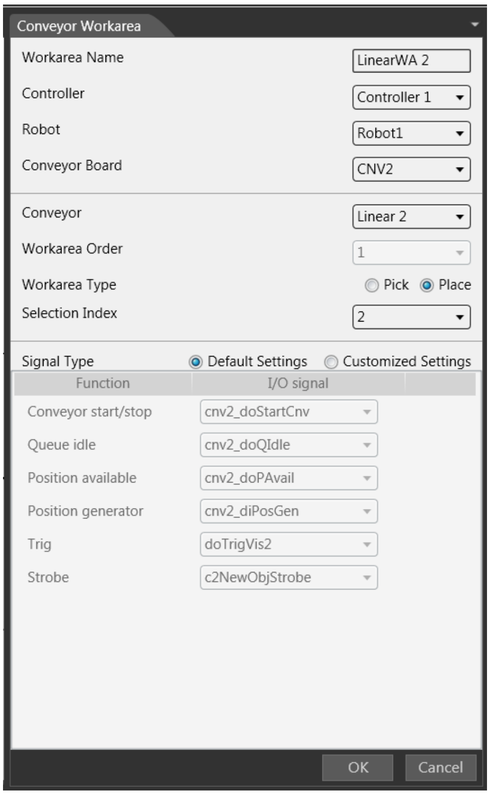
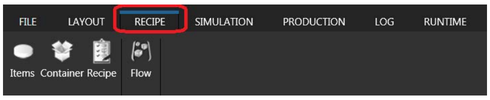
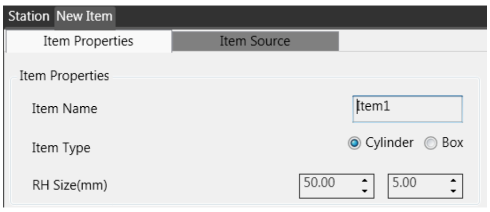
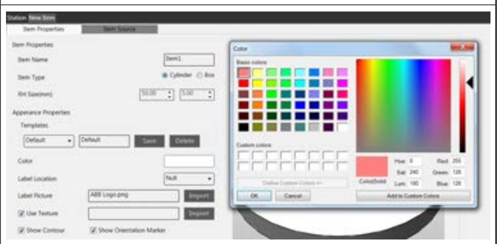
	Action	Note/Illustration
8	In the **Conveyor Work Area** window, enter "LinearWA2" in the **Work Area Name** text box.	 xx1900000659
9	In the **Conveyor Board** drop down list, select the correct conveyor board which has been connected to the liner conveyor. **Tip** The connection between the conveyor board and the conveyor are defined by users.	
10	In the **Conveyor** drop down list, select the **"Linear2"** conveyor.	
11	In the **Work Area Type** radio box, select the "Place" option.	
12	Click **OK** to finish the adding of the linear 2 conveyor work area.	

Adding the item

	Action	Note/Illustration
1	On the ribbon-tab, click **Item** under **Recipe**.	 xx1800001429
2	In the **Item Type** part under **Item Properties**, select the **Cylinder** radio box.	 xx1900000660
3	In the **RH Size** part under **Item Properties**, define the item’s size as (50, 5).	
4	In the **Color** part under **Item Properties**, define the item's color as RGB (255,128,128).	 xx1900000485

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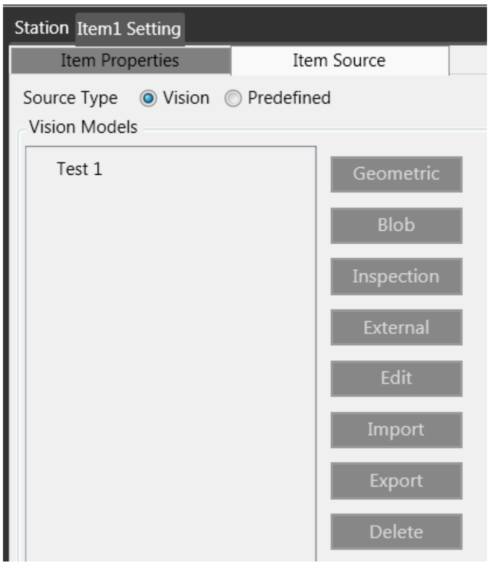
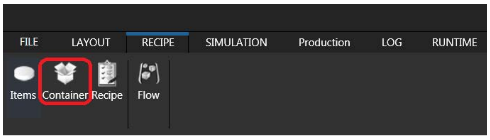
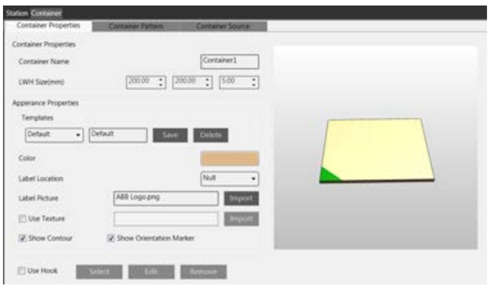
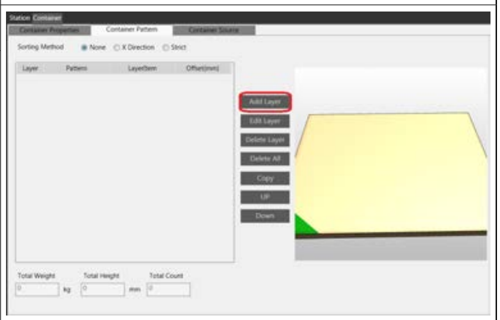
	Action	Note/Illustration
5	In the **Source Type** under **Item Source**, select the **Vision** radio box.	 xx1900000487
6	Click **OK** to finish the adding of the item.	

Adding the container

	Action	Note/Illustration
1	On the ribbon-tab, click **Container** under **Recipe**.	 xx1800001433
2	Use the default settings in the **Container Properties**.	 xx1900000491
3	Click on the **Container Pattern** tab.	 xx1900000492
4	Click **Add layer**.	

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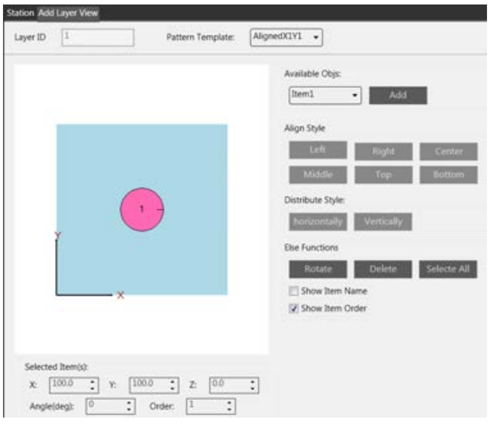
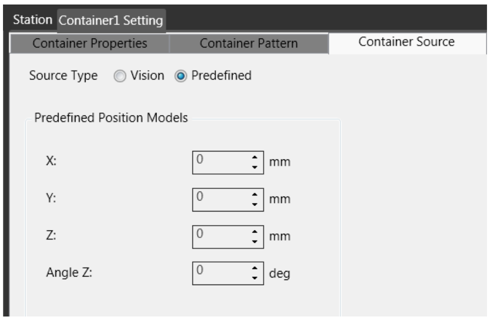
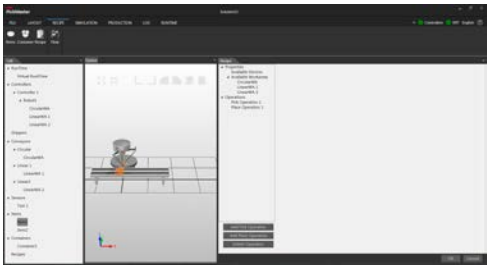
	Action	Note/Illustration
5	In the **Add Layer View** window, click to select the item, and enter numbers (100,100,0,0,1) in the **Selected Item(s)** text box.	 xx1900000493
6	Click **OK** to finish the adding of the new layer.	
7	In the **Source Type** under **Container Source tab**, select the **Predefined** radio box.	 xx1900000494
8	Click **OK** to finish the adding of the container.	

Adding the recipe

	Action	Note/Illustration
1	On the ribbon-tab, click **Recipe** under **Recipe**.	 xx1800001438  xx1900000505

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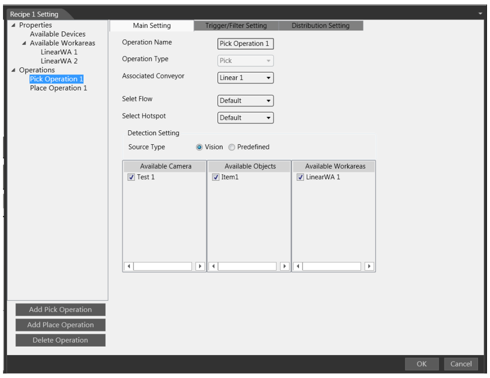
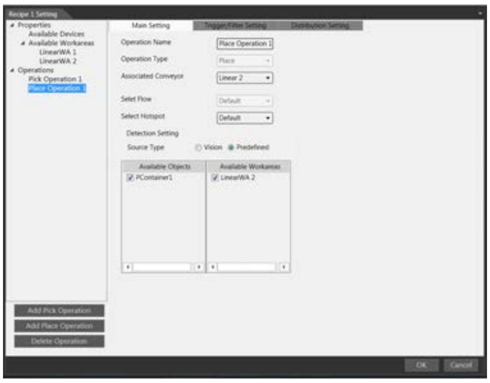
	Action	Note/Illustration
2	Click on the **Pick Operation1** to open the setting window for the pick operation.	 xx1900000661
3	In the **Source Type** under **Detection Setting**, select the **Vision** radio box.	
4	Click to select the **Test1** in **Available Camera**.	
5	Click to select the **Item1** in **Available Objects**.	
6	Click to select the **LinearWA1** in **Available Work Areas**.	
7	In the **Distribution** tab under **Distribution Setting**, click on **Item1** in the **Available Items** and drag **LinearWA1** from the **Available distributors** list to the **Distribution Accept** list.	 xx1900000662
8	Click on the **Place Operation1** to open the setting window for the place operation 1.	 xx1900000663
9	In the **Source Type** under **Detection Setting**, select the **Predefined** radio box.	
10	Click to select the **PContainer1** in **Available Objects**.	
11	Click to select the **LinearWA2Available Work Areas** in **Available Work Areas**.	

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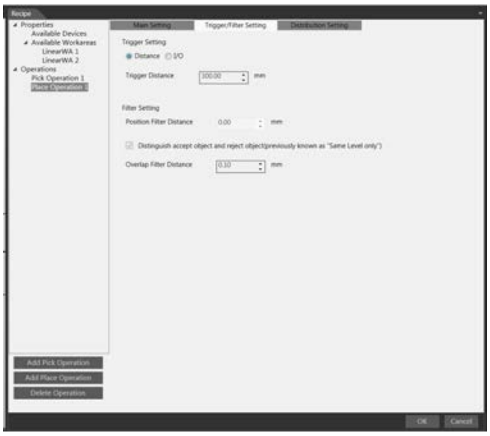
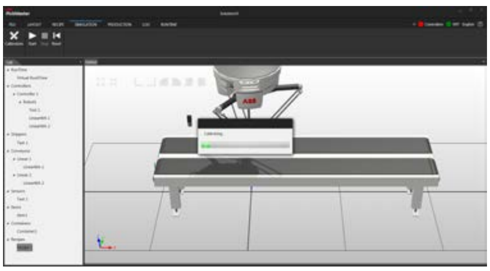
	Action	Note/Illustration
12	In the **Trigger/Filter Setting** tab, click to select the **Distance** radio button.	
13	In the **Trigger/Filter Setting** tab, define the **Trigger Distance** as 300 mm.	 xx1900000664
14	In the **Distribution** tab under **Distribution Setting**, click on **Item1** in the **Available Items** and drag **LinearWA2** from the **Available distributors** list to the **Distribution Accept** list.	
15	Click **OK** to finish the adding of the recipe.	 xx1900000665

Calibration

	Action	Note/Illustration
1	On the ribbon-tab, click **Calibration** under **Simulation**.	 xx1900000520
2	The **Calibration** runs automatically.	 xx1900000666

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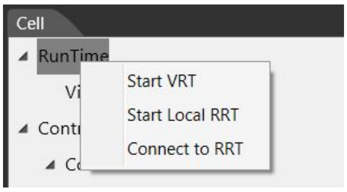
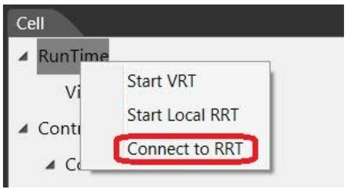
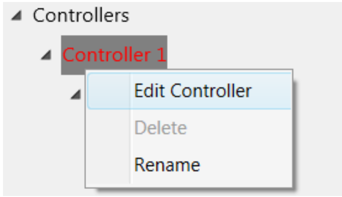
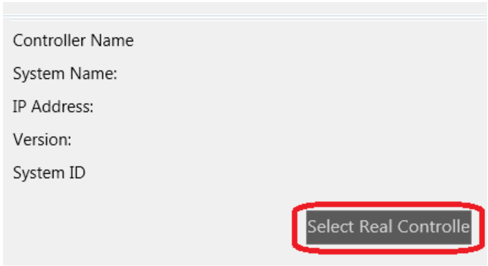
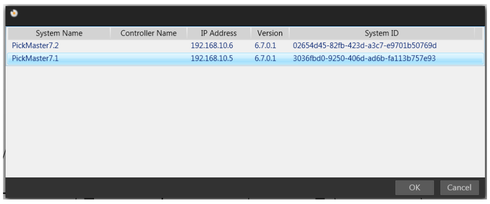
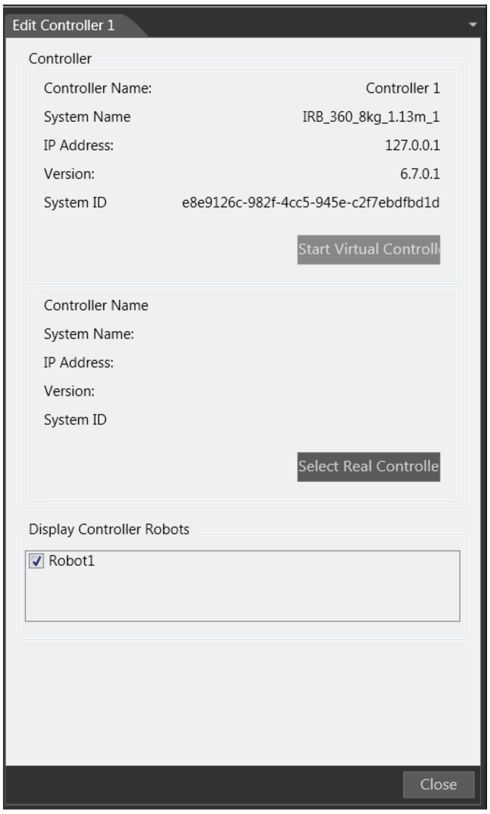
Simulation

	Action	Note/Illustration
1	On the ribbon-tab, click **Start** under **Simulation** to start the simulation.	 xx2000000317
2	On the ribbon-tab, click **Stop** under **Simulation** to stop the simulation.	 xx2000000318
3	On the ribbon-tab, click **Reset** under **Simulation** to clean up the items on the conveyors in the solution.	 xx2000000319

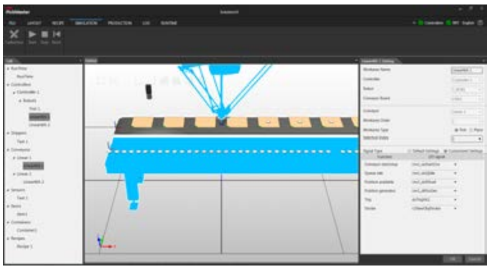
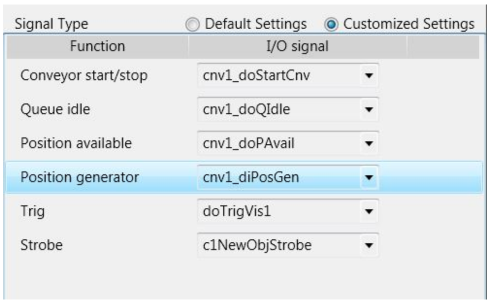
Switching to Online environment and configuration

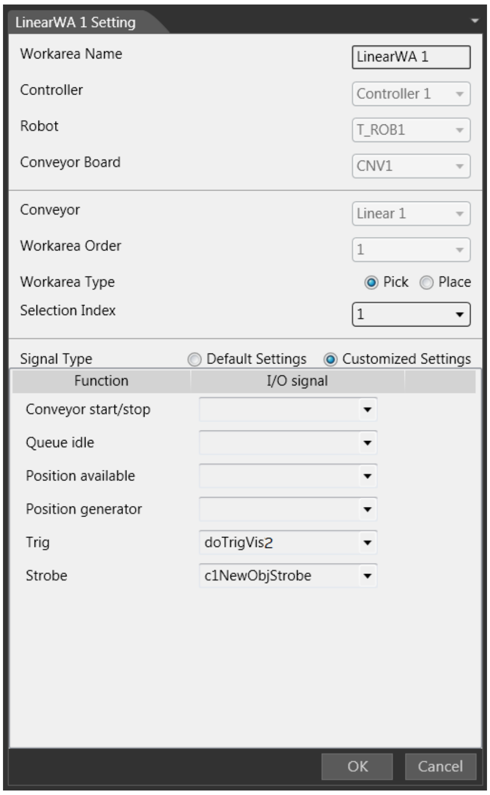
	Action	Note/Illustration
1	Right-click the **RunTime** in the tree view **Cell** and select **Start Local RRT**.	 xx1800001387
2	Right-click the **RunTime** in the tree view **Cell** and select **Connect to RRT**.	 xx2000000314
3	In the **Sign in** dialog, enter the correct information. **Note** A default admin user, with full access, is provided with the following credentials: • User: admin • Password: password	 xx1800001388
4	Click **OK**.	

Continues on next page

	Action	Note/Illustration
5	Right-click the **Controller** in the tree view **Cell** and select **Edit Controller**.	 xx1900000677
6	Click on the **Select Real Controller** icon to open the **Select Real Controller** dialog.	 xx1800001714
7	In the dialog box, choose the real controller to be connected.	 xx1800001715
8	Click **OK** to apply the configuration.	
9	Click **Close** to close the **Edit Controller** dialog.	 xx1800001713

Continues on next page

<table>
<tr><th></th><th>Action</th><th>Note/Illustration</th></tr>
<tr><td>10</td><td>Right-click on one LinearWA1 in the tree view Cell and select Setting.</td><td>
xx1900000681</td></tr>
<tr><td>11</td><td>Select the Customized Settings in the Signal Type tab.</td><td>

xx1800001735</td></tr>
<tr><td>12</td><td>Enter the required data into the I/O signal setting table.</td><td rowspan="2">

xx1900000668</td></tr>
<tr><td>13</td><td>Click OK to close the Recipe setting window.</td></tr>
</table>

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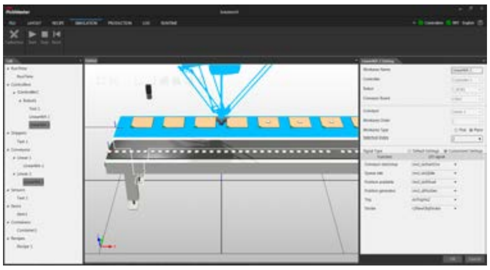
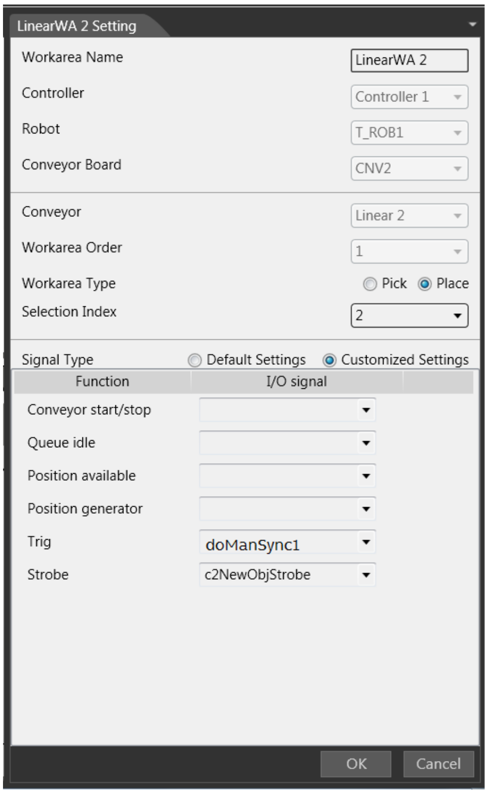
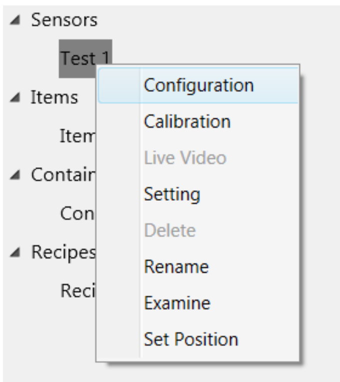
	Action	Note/Illustration
14	Right-click on one **LinearWA2** in the tree view **Cell** and select **Setting**.	 xx1900000682
15	Select the **Customized Settings** in the **Signal Type** tab.	 xx1900000669
16	Enter the required data into the **I/O signal** setting table.	
17	Click **OK** to close the **Recipe setting** window.	
18	Right-click the **Test1** in the tree view **Sensor** and select **Configuration**.	 xx1900000670

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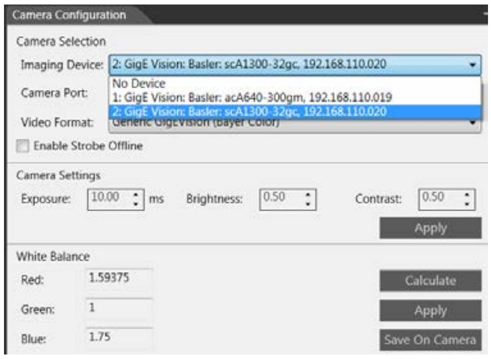
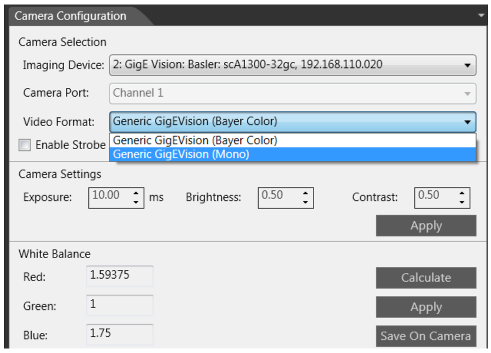
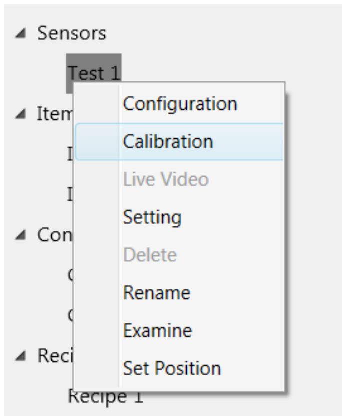
	Action	Note/Illustration
19	In the **Imaging device** list, select the Gigabit Ethernet camera to which the camera is connected.	 xx1900000671
20	In the **Video format** list, select the type of the connected camera. **Tip** Select the type is to choose the color of the camera.	 xx1900000645
21	Click **OK** to finish the configuration of the camera.	
22	Right-click the **Test1** in the tree view **Sensor** and select **Calibrate**.	 xx1900000529

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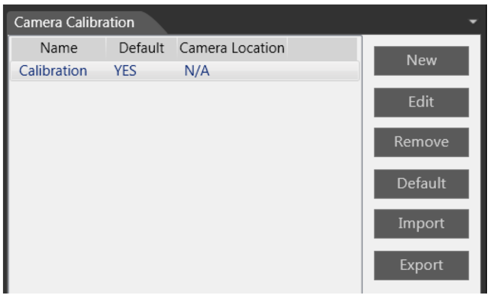
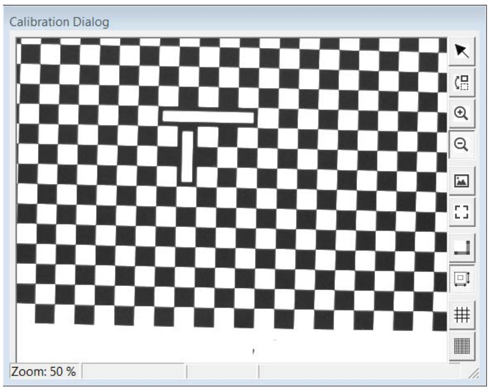
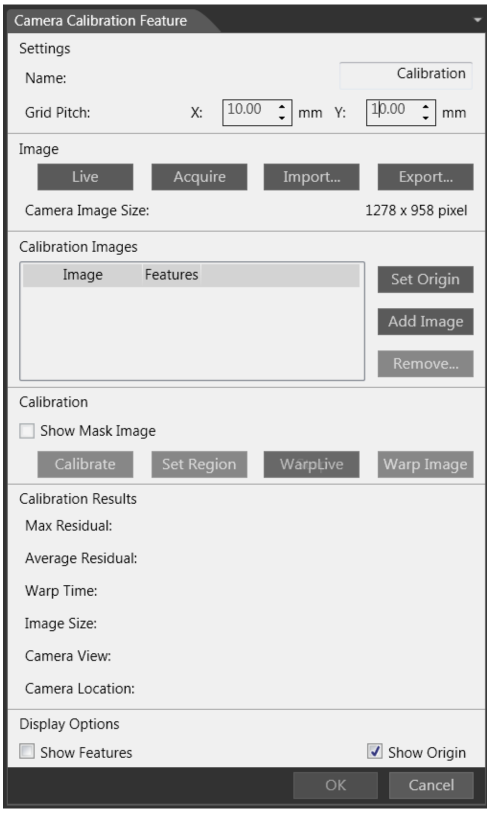
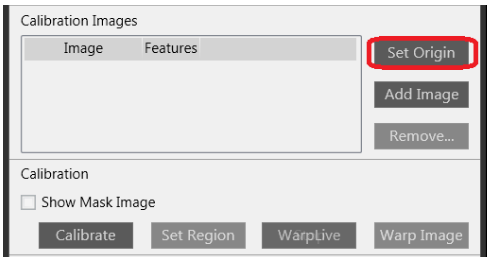
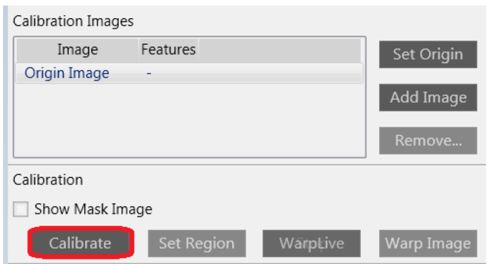
	Action	Note/Illustration
23	Select the default calibration from the list and click **Edit**.	 xx1800001468  xx1800001469
24	In the **Settings** part, adjust the grid pitch if the squares on the printed calibration paper differs from 10.0 mm. Enter an appropriate name for the calibration.	 xx1800001701

Continues on next page

	Action	Note/Illustration
25	In the **Image** part, click **Live** to get and show new images continuously, or click **Acquire** to get one new image. To use an image from file or save the current image, click **Import** or **Export**.	 xx1800001470
26	For single-view calibration: When the calibration plate is in position, acquire an image and click **Set Origin** in the **Calibration images** part. This stores the image and marks it as the origin image (the origin of this image will be the physical origin of the camera's coordinate system).	 xx1900000646
27	In the **Calibration** part, click **Calibrate** to start calibration.	 xx1900000647

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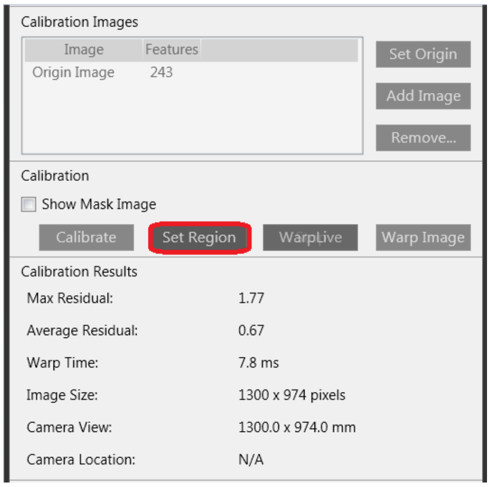
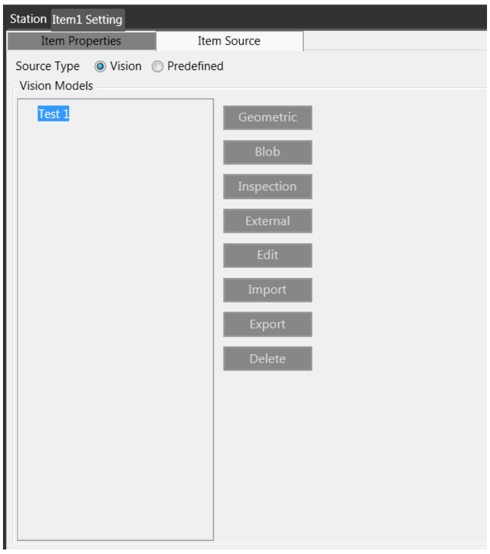
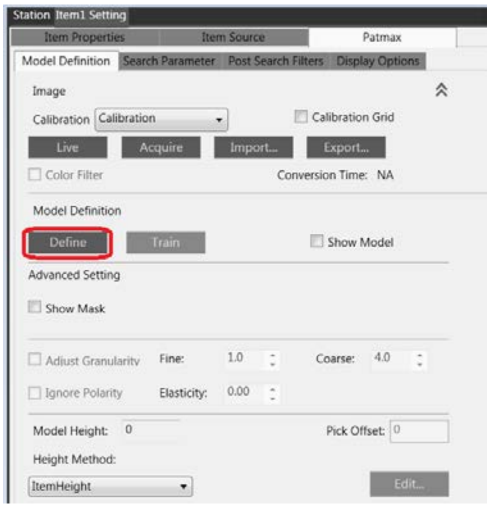
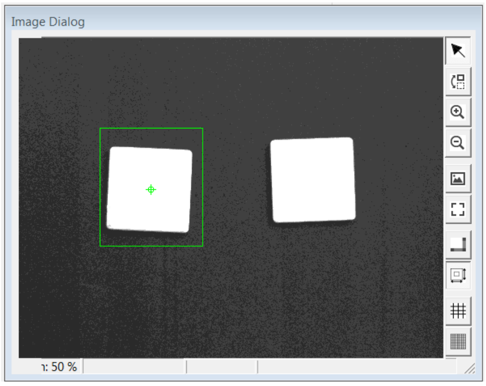
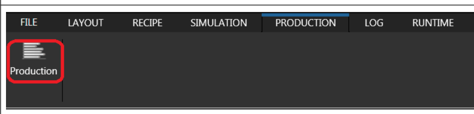
	Action	Note/Illustration
28	Adjust the rectangle to the desired region and click **Set Region** to define the resulting image size.	 xx1900000648
29	Click **OK** to finish the calibrating of the camera.	
30	Right-click on the **Item1** in the tree view **Cell** and select **Setting**.	
31	Click to select **Test1** in the **Vision Models** and click **Geometric** to open the geometric window.	 xx1900000530
32	In the **Image** part, click **Live** to get and show new images continuously, or click **Acquire** to get one new image. To use an image from file or save the current image, click **Import** or **Export**.	 xx1900000649

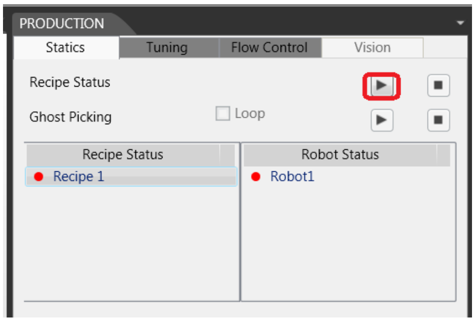
Continues on next page

	Action	Note/Illustration
33	Click **Define**to open the train shape of the item1.	 xx1900000650
34	Drag the train shape center point to the item's center.	 xx1800001708
35	Click **Train** to open the train shape of the item1.	 xx1900000651
36	Click OK to close and save the PatMax model.	
37	Click Ok to close and save the **Item1 setting**.	

Production

	Action	Note/Illustration
1	Click to select the **Recipe** in the tree view **Cell**.	 xx1800001716
2	On the **Production** ribbon-tab, click **Production**.	 xx1800001717

Continues on next page

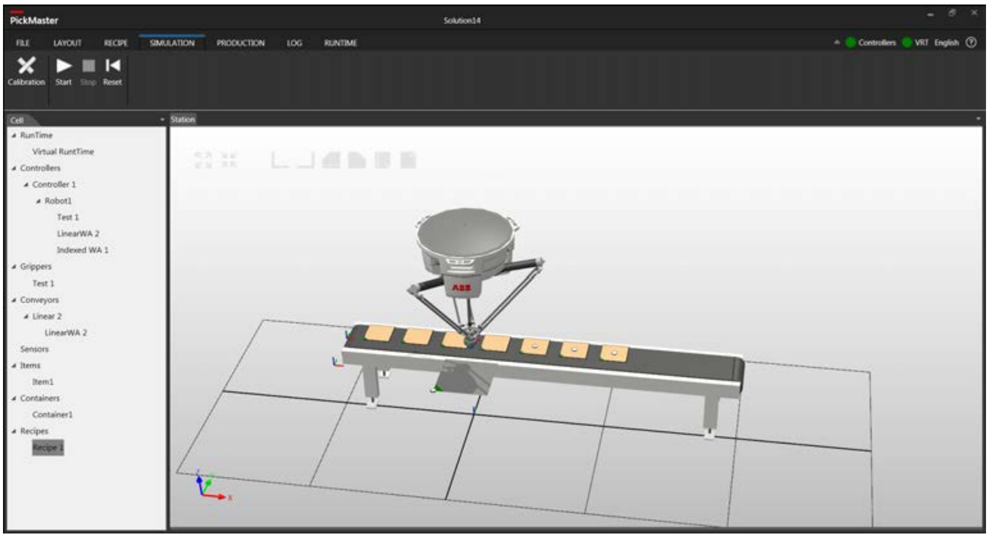
	Action	Note/Illustration
3	Click to select **Recipe** in the **Recipe Status** and click triangle mark (**Start**) to run the production.	 xx1800001719
4	Click **Stop** to stop the production.	

5.2 Example: One pick from indexed work area and one place work area

Overview

This example describes changing a solution which contains one robot, two linear conveyors (both using predefined sensor) to a solution which contains one robot, one linear conveyor and one index work area. The robot picks the items from the index work area and place them into the containers on the linear conveyor.

This example uses the previous example as a basis to do the subsequent operations.



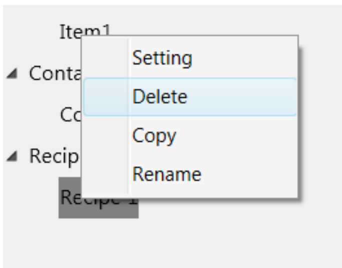
xx1900000680

Changing the solution

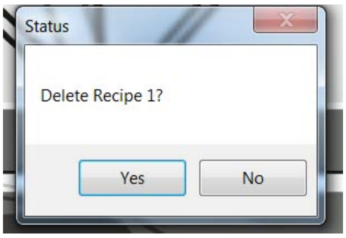
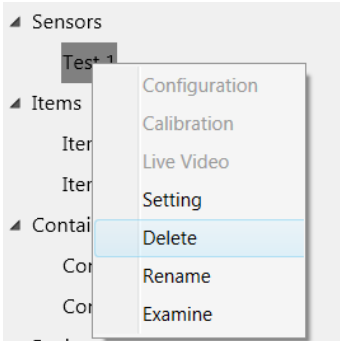
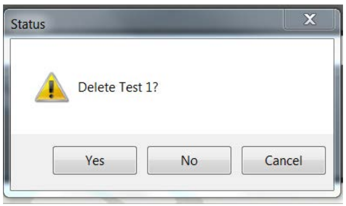
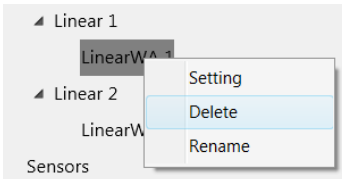
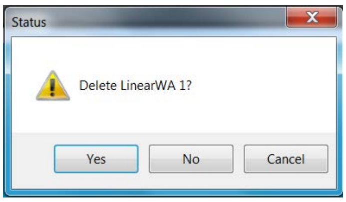
Opening the solution

For detail procedure in opening the solution, see *Opening the solution on page 317*.

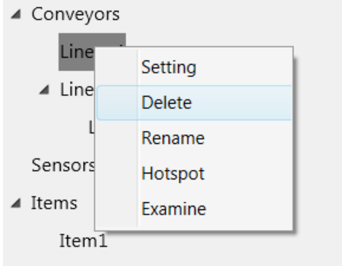
Deleting the linear conveyor from the solution

	Action	Note/Illustration
1	Right click on the **Recipe** under **Recipes** in the tree view browser and click **Delete**.	 xx1900000532

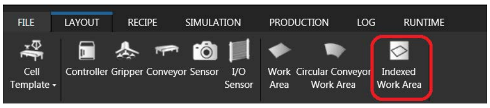
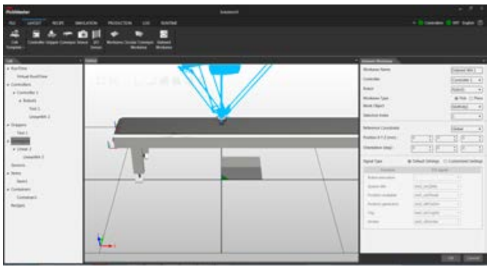
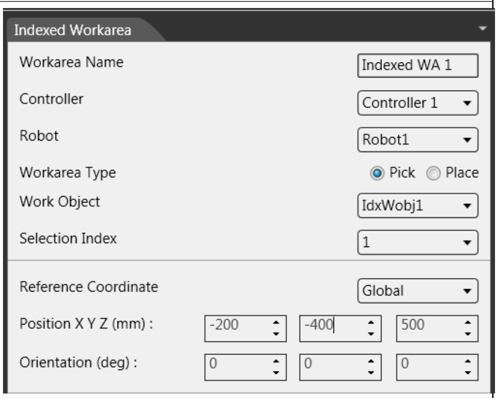
Continues on next page

	Action	Note/Illustration
2	Click **Yes** in the pop-up window to delete the recipe.	 xx1900000533
3	Right click on the **Camera** under **Sensor** in the tree view browser and click **Delete**.	 xx1900001569
4	Click **Yes** in the pop-up window to delete the camera.	 xx1900001570
5	Right click on the **Linear WA1** under **Conveyors** in the tree view browser and click **Delete**. **Tip** The linear WA1 is for the picking operation.	 xx1900000534
6	Click **Yes** in the pop-up window to delete the **Linear WA1**.	 xx1900000535

Continues on next page

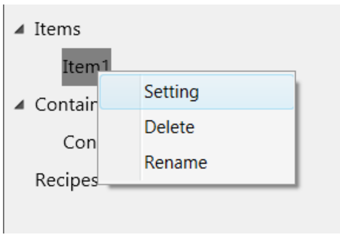
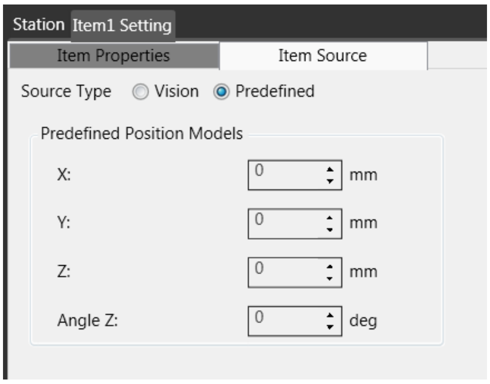
	Action	Note/Illustration
7	Right click on the **Linear1** under **Conveyors** in the tree view browser and click **Delete**. **Tip** The linear1 is for the picking operation.	 xx1900000536

Adding the index work area

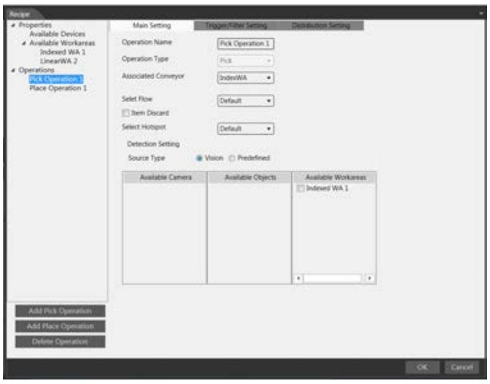
	Action	Note/Illustration
1	On the ribbon-tab, click **Indexed Work Area** under **Layout**.	 xx1800001426
2	In the **Conveyor Work Area** window, enter "IndexedWA1" in the **Work Area Name** text box.	 xx1900000537
3	In the **Work Area Type** radio box, select the "Pick" option.	
4	In the **Work Object** drop down list, select the correct object. **Tip** The connection between the conveyor board and the conveyor are defined by users.	
5	Enter numbers (-200,-400,500) in the **Position X Y Z (mm)** text box and (0,0,0) in the **Orientation (deg)** text boxes to define the location of the indexed work area.	 xx1900000539
6	Click **OK** to finish the adding of the indexed work area.	

Continues on next page

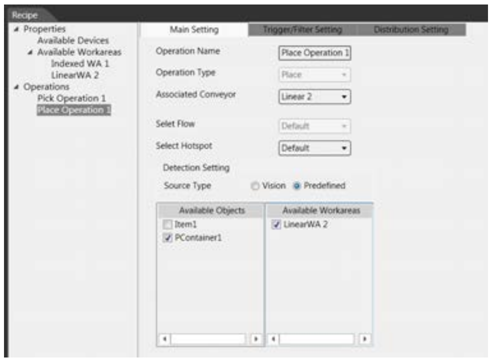
Editing the item source type

	Action	Note/Illustration
1	Right click on **Item1** under **Items** in the tree view browser and click **Setting.**	 xx2000000315
2	In the **Item Source** under **Item1 Setting**, select the **Predefined** radio box.	 xx2000000316
3	Click **OK** to finish the adding of the item.	

Adding the new recipe

	Action	Note/Illustration
1	On the ribbon-tab, click **Recipe** under **Recipe.**	 xx1800001438
2	Click on the **Pick Operation1** to open the setting window for the pick operation.	 xx1900000540
3	In the **Associated Conveyor** under **Main Setting**, select **IndexWA** in the drop down list.	

Continues on next page

	Action	Note/Illustration
4	In the **Source Type** under **Detection Setting**, select the **Predefined** radio box.	 xx1900000541
5	Click to select the **Item1** in **Available Objects**.	
6	Click to select the **Indexed WA 1** in **Available Work Areas.**	
7	In the **Distribution** tab under **Distribution Setting**, click on **Item1** in the **Available Items** and drag **Indexed WA 1** from the **Available distributors** list to the **Distribution Accept** list.	 xx1900000542
8	Click on the **Place Operation1** to open the setting window for the place operation 1.	
9	In the **Associated Conveyor** under **Main Setting**, select **Linear 2** in the drop down list.	 xx1900000543
10	In the **Source Type** under **Detection Setting**, select the **Predefined** radio box.	
11	Click to select the **PContainer1** in **Available Objects**.	
12	Click to select the **Linear WA2** in **Available Work Areas.**	
13	In the **Trigger/Filter Setting** tab, click to select the **Distance** radio button.	 xx1900000544
14	In the **Trigger/Filter Setting** tab, define the **Trigger Distance** as 300 mm.	

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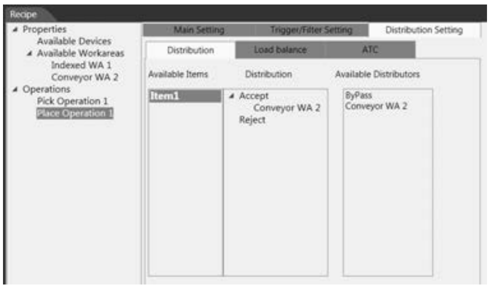
	Action	Note/Illustration
15	In the **Distribution** tab under **Distribution Setting**, click on **Item1** in the **Available Items** and drag **Linear WA 2** from the **Available distributors** list to the **Distribution Accept** list.	 xx1900000545
16	Click **OK** to finish the adding of the recipe.	

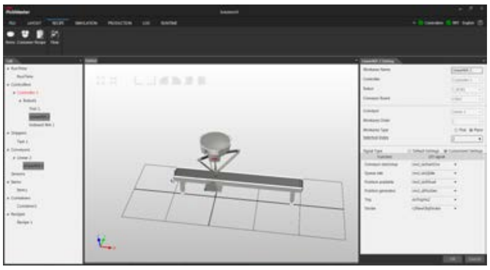
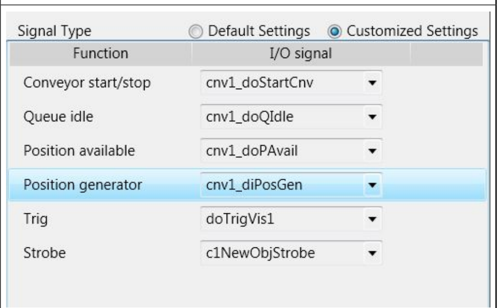
Calibration

For detail procedure on calibrating the solution, see *Calibration on page 328*.

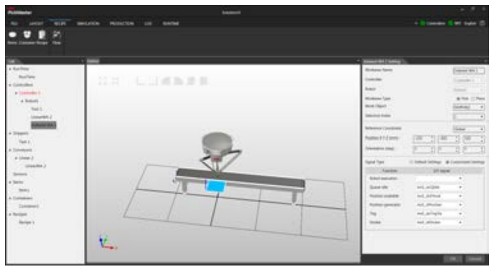
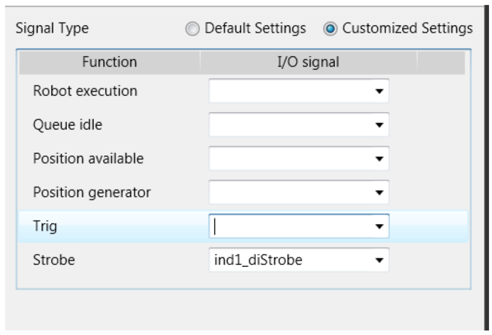
Simulation

For detail procedure on simulating the solution, see *Simulation on page 329*.

Switching to Online environment and configuration

	Action	Note/Illustration
1	Connect to the real **RunTime**.	For more details, see *Switching to Online environment and configuration on page 329*.
2	Select the real controller.	For more details, see *Switching to Online environment and configuration on page 329*.
3	Right-click on one **Linear WA2** in the tree view **Cell** and select **Setting**.	 xx1900000673
4	Select the **Customized Settings** in the **Signal Type** tab.	 xx1800001735

Continues on next page

	Action	Note/Illustration
5	Enter the required data into the **I/O signal** setting table.	 xx1900000523
6	Click **OK** to close the **Recipe setting** window.	
7	Right-click on one **Indexed WA** in the tree view **Cell** and select **Setting**.	 xx1900000674
8	Select the **Customized Settings** in the **Signal Type** tab.	 xx1900000675
9	Enter the required data into the **I/O signal** setting table.	
10	Click **OK** to close the **Recipe setting** window.	

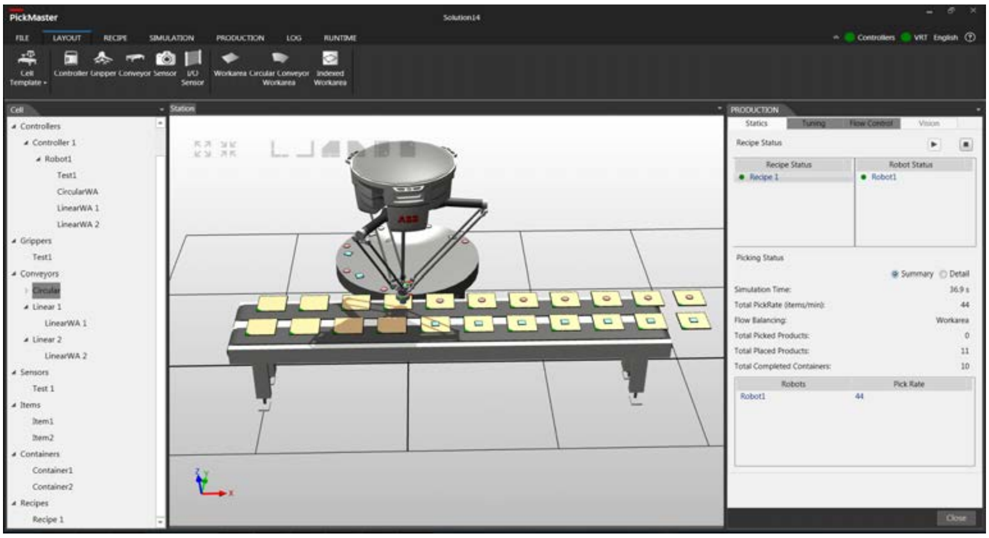
Production

For detail procedure on production, see *Production on page 337*.

5.3 Example: Mixing one pick work area and two place work areas

Overview

This example describes a solution which contains one robot, two linear conveyors and one circular conveyor. The robot picks the cylinder items from circular conveyor and place them into the containers on the first linear conveyor and the box items from circular conveyor and place them into the containers on the second linear conveyor separately at the same time.



xx1900000531

Creating the solution

Opening the solution

For detail procedure in opening the solution, see *Opening the solution on page 317*.

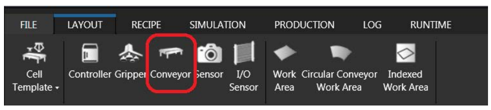
Adding the controller

For detail procedure in adding the controller, see *Adding the controller on page 318*.

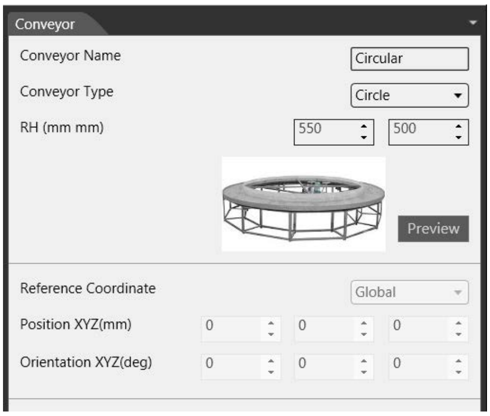
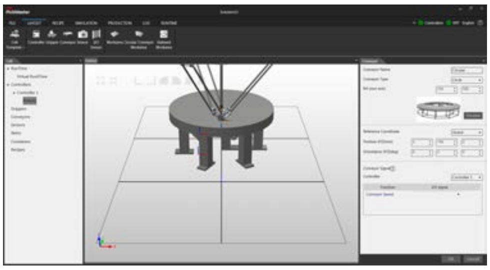
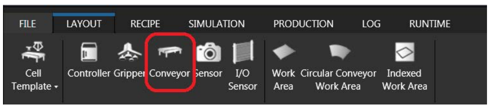
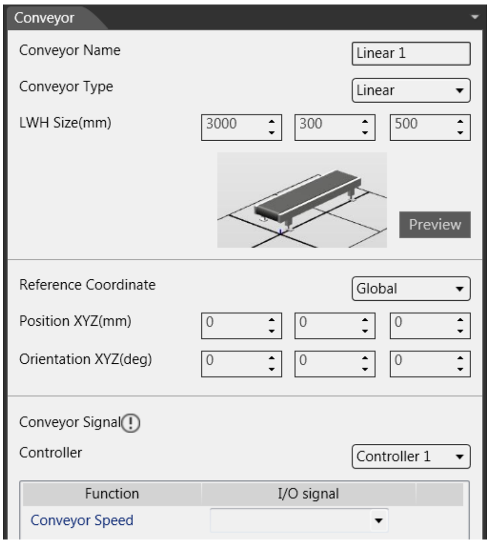
Adding the gripper

For detail procedure in adding the controller, see *Adding the gripper on page 319*.

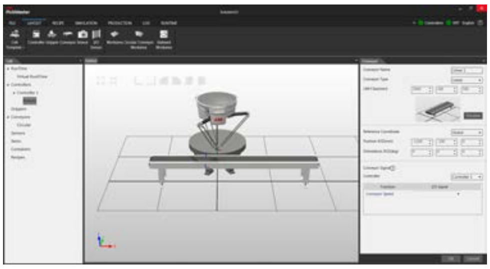
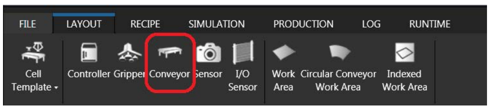
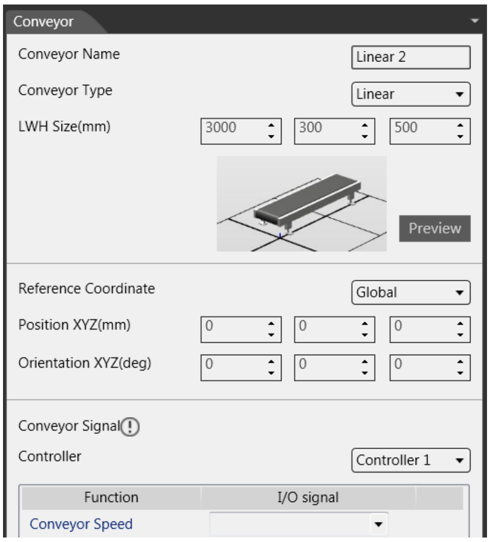
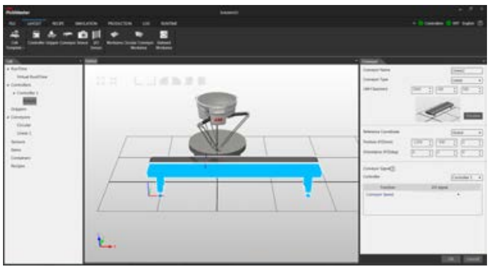
Adding the conveyor

	Action	Note/Illustration
1	On the ribbon-tab, click **Conveyor** under **Layout**.	 xx1800000855

Continues on next page

	Action	Note/Illustration
2	In the **Conveyor** window, enter "**Circular**" in the **Conveyor Name** text box.	 xx1900000474
3	In the **Conveyor** window, select the type as "**Circle**" in the **Conveyor Type** drop-down list.	
4	Click on the **Preview** button to set the preference of the conveyor.	 xx1900000475
5	Enter numbers (550,500) in the **RH Size(mm)** text box to define the size of the conveyor.	
6	In the **Conveyor** window, enter numbers (0,700,0) in the **Position X Y Z (mm)** text box and (0,0,90) in the **Orientation (deg)** text boxes to define the location of the conveyor.	
7	Click **OK** to finish the adding of the conveyor.	
8	On the ribbon-tab, click **Conveyor** under **Layout**.	 xx1800000855
9	In the **Conveyor** window, enter "**Linear1**" in the **Conveyor Name** text box.	 xx1900000476
10	In the **Conveyor** window, select the type as "**Linear**" in the **Conveyor Type** drop-down list.	

Continues on next page

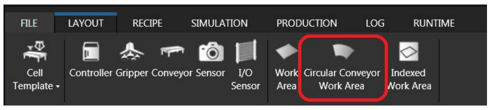
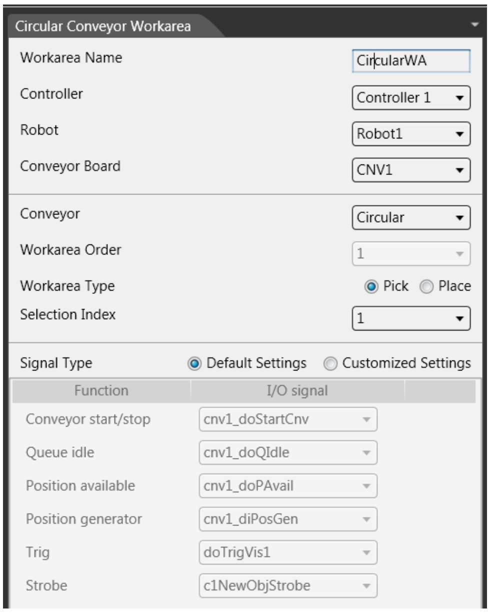
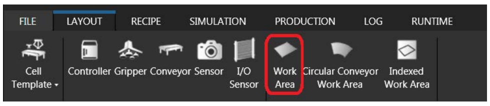
	Action	Note/Illustration
11	Click on the **Preview** button to set the preference of the conveyor.	 xx1900000477
12	Enter numbers (3000,300,500) in the **LWH Size(mm)** text box to define the size of the conveyor.	
13	In the **Conveyor** window, enter numbers (-1200,-200,0) in the **Position X Y Z (mm)** text box and (0,0,0) in the **Orientation (deg)** text boxes to define the location of the conveyor.	
14	Click **OK** to finish the adding of the conveyor.	
15	On the ribbon-tab, click **Conveyor** under **Layout**.	 xx1800000855
16	In the **Conveyor** window, enter "**Linear2**" in the **Conveyor Name** text box.	 xx1900000478
17	In the **Conveyor** window, select the type as "**Linear**" in the **Conveyor Type** drop-down list.	
18	Click on the **Preview** button to set the preference of the conveyor.	 xx1900000479
19	Enter numbers (3000,300,500) in the **LWH Size(mm)** text box to define the size of the conveyor.	
20	In the **Conveyor** window, enter numbers (-1200,-500,0) in the **Position X Y Z (mm)** text box and (0,0,0) in the **Orientation (deg)** text boxes to define the location of the conveyor.	
21	Click **OK** to finish the adding of the conveyor.	

Adding the sensor

For detail procedure in adding the controller, see *Adding the sensor on page 321*.

Continues on next page

Adding the work area

	Action	Note/Illustration
1	On the ribbon-tab, click **Circular Conveyor Work Area** under **Layout**.	 xx1800001420
2	In the **Conveyor Work Area** window, enter "CircularWA" in the **Work Area Name** text box.	 xx1900000481
3	In the **Conveyor Board** drop down list, select the correct conveyor board which has been connected to the circular conveyor. **Tip** The connection between the conveyor board and the conveyor are defined by users.	
4	In the **Conveyor** drop down list, select the "**Circular**" conveyor.	
5	In the **Work Area Type** radio box, select the "Pick" option.	
6	Click **OK** to finish the adding of the circular conveyor work area.	
7	On the ribbon-tab, click **Work Area** under **Layout**.	 xx1800001417

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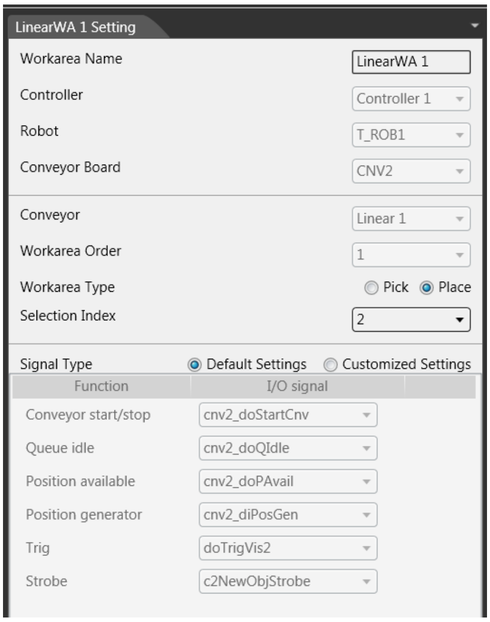
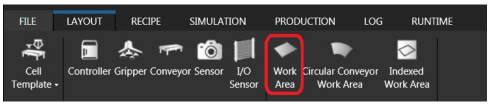
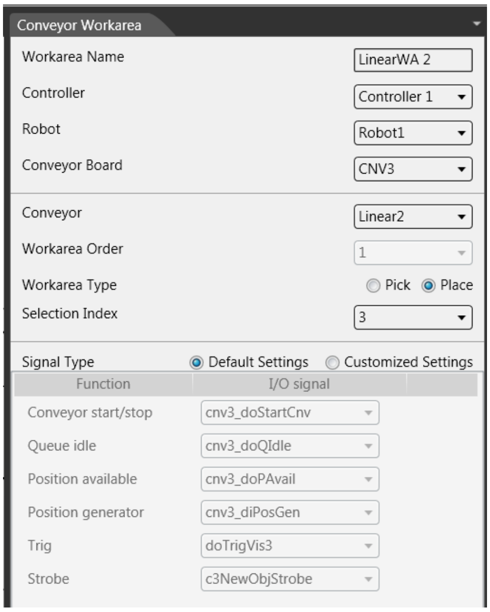
<table>
<tr><th></th><th>Action</th><th>Note/Illustration</th></tr>
<tr><td>8</td><td>In the Conveyor Work Area window, enter "LinearWA1" in the Work Area Name text box.</td><td rowspan="4">

xx1900000482</td></tr>
<tr><td>9</td><td>In the Conveyor Board drop down list, select the correct conveyor board which has been connected to the liner conveyor.

Tip

The connection between the conveyor board and the conveyor are defined by users.</td></tr>
<tr><td>10</td><td>In the Conveyor drop down list, select the "Linear1" conveyor.</td></tr>
<tr><td>11</td><td>In the Work Area Type radio box, select the "Place" option.</td></tr>
<tr><td>12</td><td>Click OK to finish the adding of the linear 1 conveyor work area.</td><td></td></tr>
<tr><td>13</td><td>On the ribbon-tab, click Work Area under Layout.</td><td>

xx1800001417</td></tr>
<tr><td>14</td><td>In the Conveyor Work Area window, enter "LinearWA2" in the Work Area Name text box.</td><td rowspan="4">

xx1900000483</td></tr>
<tr><td>15</td><td>In the Conveyor Board drop down list, select the correct conveyor board which has been connected to the second liner conveyor.

Tip

The connection between the conveyor board and the conveyor are defined by users.</td></tr>
<tr><td>16</td><td>In the Conveyor drop down list, select the "Linear2" conveyor.</td></tr>
<tr><td>17</td><td>In the Work Area Type radio box, select the "Place" option.</td></tr>
<tr><td>18</td><td>Click OK to finish the adding of the linear 2 conveyor work area.</td><td></td></tr>
</table>

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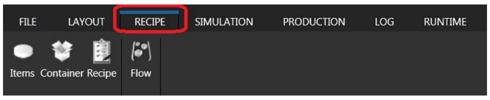
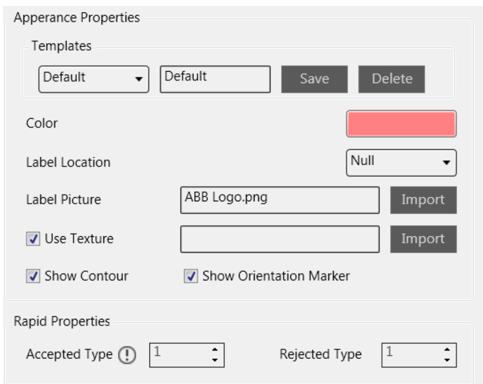
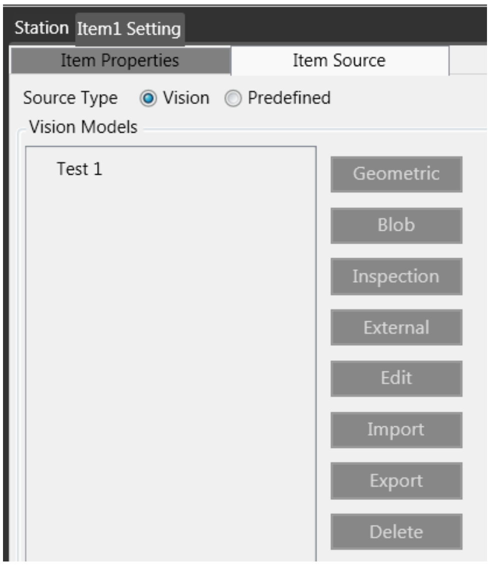
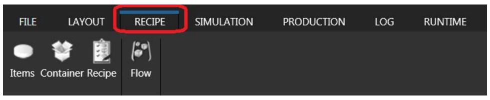
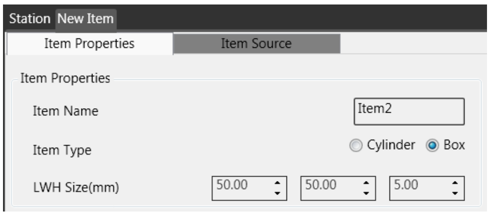
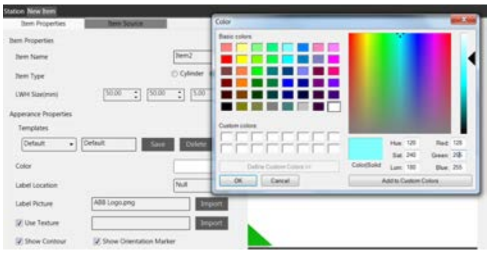
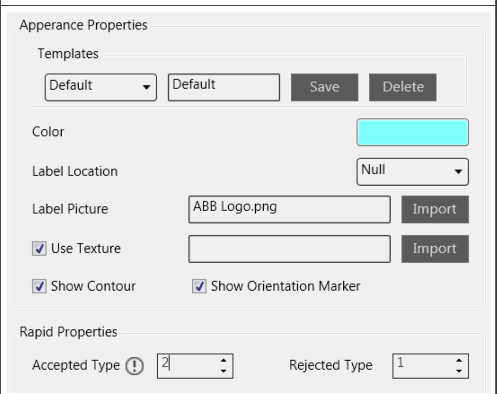
Adding the item

	Action	Note/Illustration
1	On the ribbon-tab, click **Item** under **Recipe**.	 xx1800001429
2	In the **Item Type** part under **Item Properties**, select the **Cylinder** radio box.	
3	In the **RH Size** part under **Item Properties**, define the item’s size as (50, 5).	
4	In the **Color** part under **Item Properties**, define the item's color as RGB (255,128,128).	 xx1900000485
5	In the **Rapid Properties** part under **Item Properties**, define the item's **Accepted Type** as "1". **Tip** The **Accepted Type** defines the class of different items.	 xx1900000486
6	In the **Source Type** under **Item Source**, select the **Vision** radio box.	 xx1900000487

Continues on next page

	Action	Note/Illustration
7	Click **OK** to finish the adding of the item.	
8	On the ribbon-tab, click **Item** under **Recipe**.	 xx1800001429
9	In the **Item Type** part under **Item Properties**, select the **Box** radio box.	 xx1900000488
10	In the **LWH Size** part under **Item Properties**, define the item's size as (50,50, 5).	
11	In the **Color** part under **Item Properties**, define the item's color as RGB (128,255,255).	 xx1900000489
12	In the **Rapid Properties** part under **Item Properties**, define the item's **Accepted Type** as "2". **Tip** The **Accepted Type** defines the class of different items.	 xx1900000490

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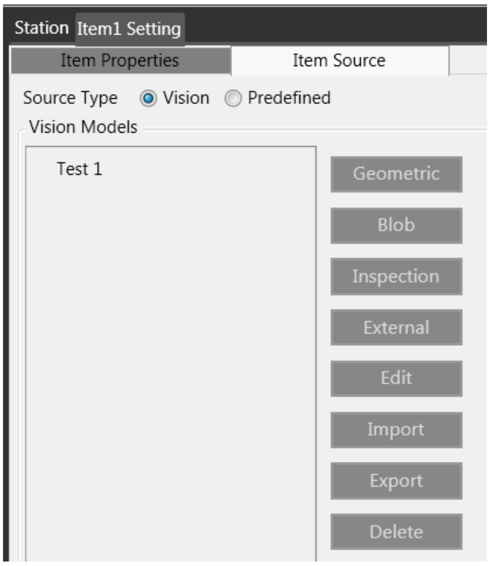
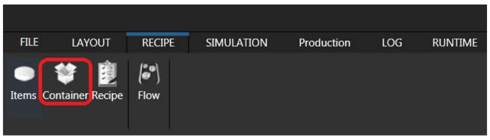
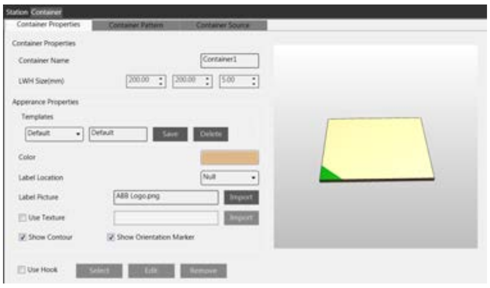
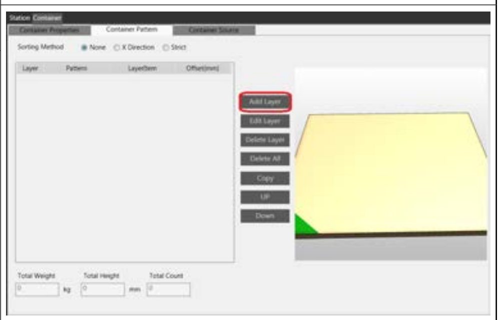
	Action	Note/Illustration
13	In the **Source Type** under **Item Source**, select the **Vision** radio box.	 xx1900000487
14	Click **OK** to finish the adding of the item.	

Adding the container

	Action	Note/Illustration
1	On the ribbon-tab, click **Container** under **Recipe**.	 xx1800001433
2	Use the default settings in the **Container Properties**.	 xx1900000491
3	Click on the **Container Pattern** tab.	 xx1900000492
4	Click **Add layer**.	

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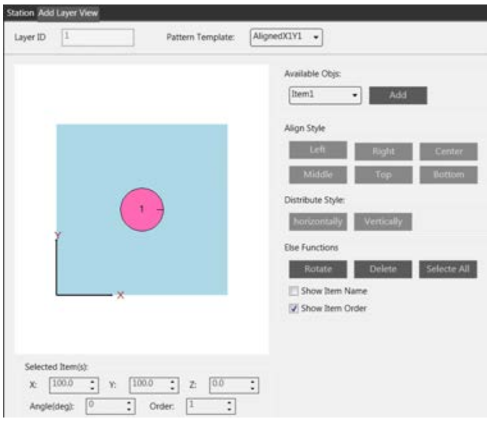
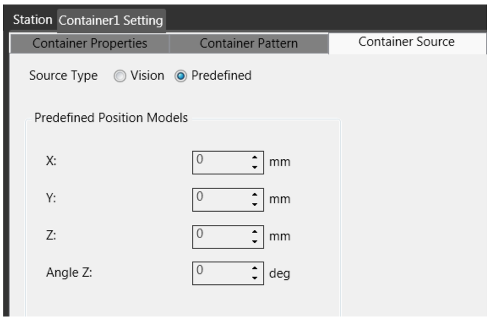
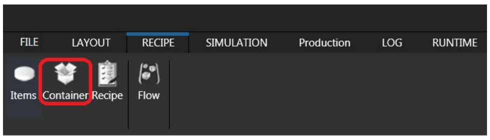
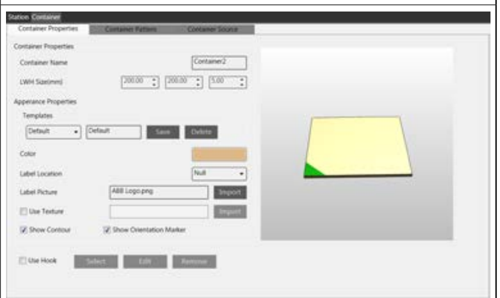
	Action	Note/Illustration
5	In the **Add Layer View** window, enter numbers (100,100,0,0,1) in the **Selected Item(s)** text box.	 xx1900000493
6	Click **OK** to finish the adding of the new layer.	
7	In the **Source Type** under **Container Source tab**, select the **Predefined** radio box.	 xx1900000494
8	Click **OK** to finish the adding of the container.	
9	On the ribbon-tab, click **Container** under **Recipe**.	 xx1800001433
10	Use the default settings in the **Container Properties**.	 xx1900000495

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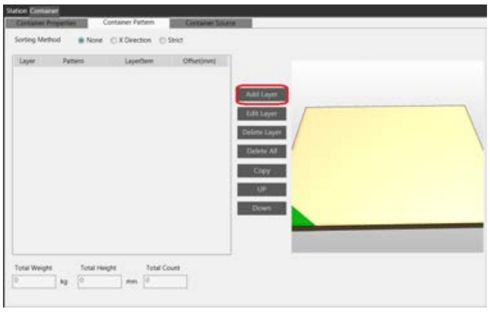
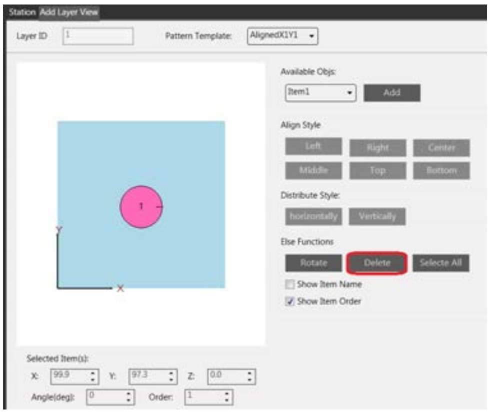
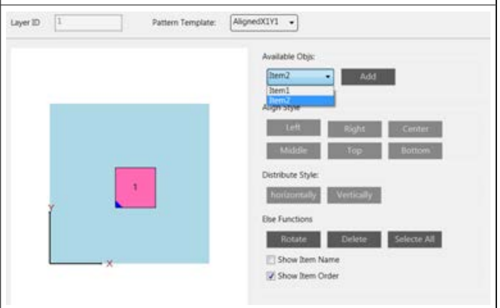
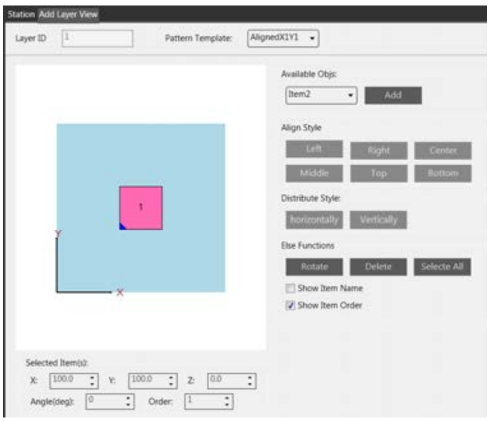
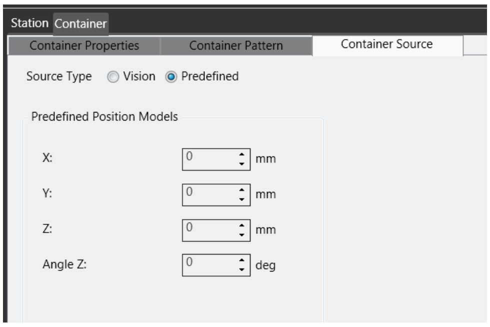
	Action	Note/Illustration
11	Click on the **Container Pattern** tab.	 xx1900000492
12	Click **Add layer**.	
13	Click on the item in the container and click **Detele** to delete the default item in the container in the **Add Layer View** window.	 xx1900000496
14	Select the **Item2** in the **Available Objs** drop down list.	 xx1900000497
15	Click **Add** to add item2 to the container2.	 xx1900000498
16	In the **Add Layer View** window, enter numbers (100,100,0,0,1) in the **Selected Item(s)** text box.	
17	Click **OK** to finish the adding of the new layer.	

Continues on next page

	Action	Note/Illustration
18	In the **Source Type** under **Container Source tab**, select the **Predefined** radio box.	 xx1900000499
19	Click **OK** to finish the adding of the container.	

Adding the flow

	Action	Note/Illustration
1	On the ribbon-tab, click **Flow** under **Recipe**.	 xx1800001721
2	Click the **Add Sector Flow** button to open the preference of Flow 1 window.	 xx1900000500
3	Click the **Add item** in the **Item/Containers** tab to add **Item1** and **Item2** to this flow.	
4	Click **Edit Layout** button on the right corner of **Flow Properties** tab.	 xx1900000501

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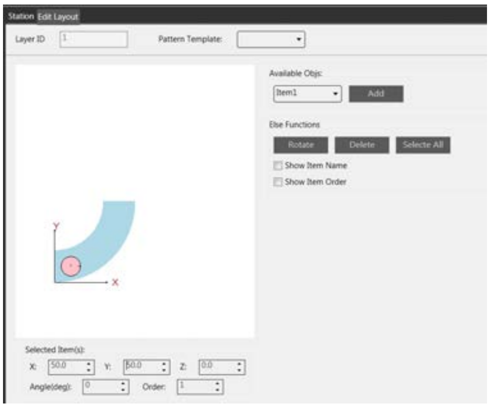
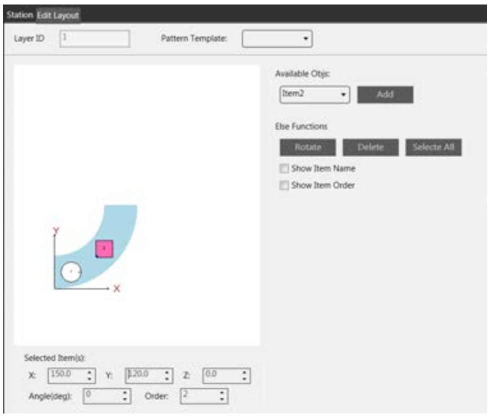
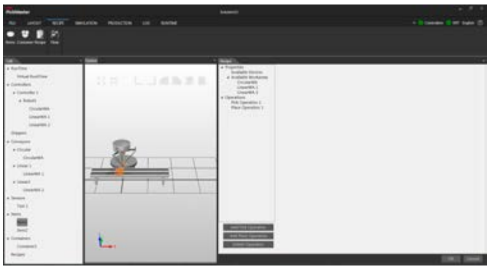
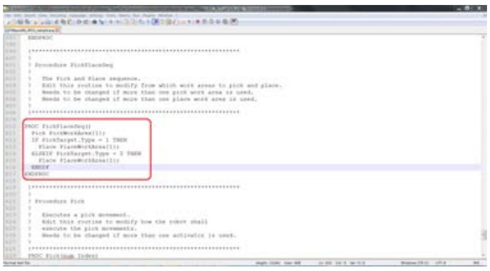
	Action	Note/Illustration
5	Click **Add** in the **Available Objs** to add the **Item1** into the flow.	 xx1900000502
6	In the **Edit Layout** window, enter numbers (50,50,0,0,1) in the **Selected Item(s)** text box.	
7	Select the **Item2** in the **Available Objs** drop down list and click **Add** to add the **Item1** into the flow.	 xx1900000503
8	In the **Edit Layout** window, enter numbers (150,120,0,0,2) in the **Selected Item(s)** text box.	 xx1900000504
9	Click **OK** to finish the editing layout.	
10	Click **OK** to finish the adding of the flow.	

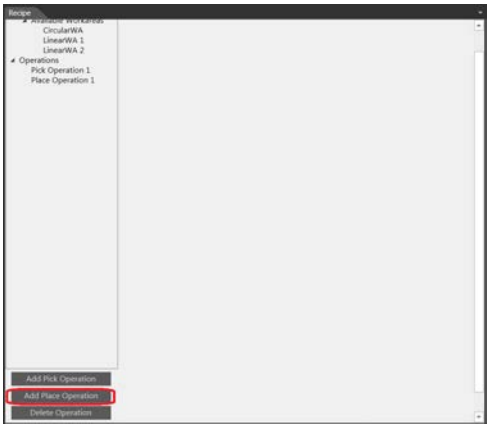
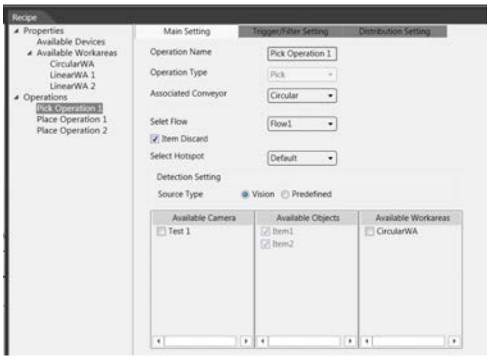
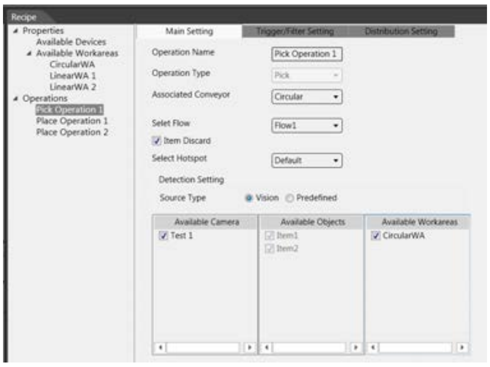
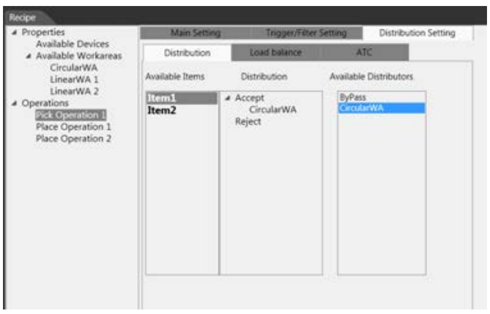
Continues on next page

Adding the recipe

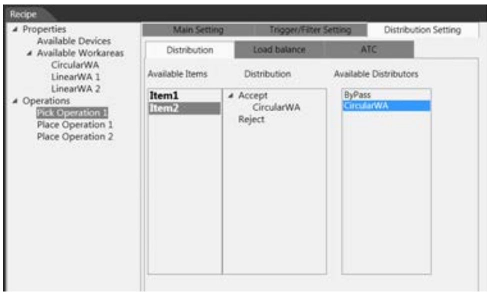
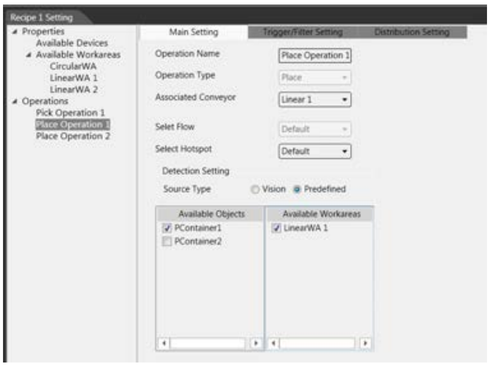
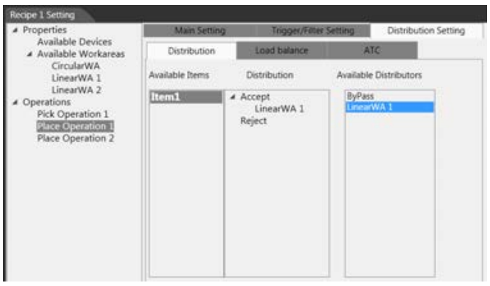
	Action	Note/Illustration
1	On the ribbon-tab, click **Recipe** under **Recipe**.	 xx1800001438  xx1900000505
2	Click on the **Available Devices** to open the setting window for the recipe.	 xx1900000508
3	Click the **Import** in the **Robot1** under **Robot Setting** to choose the rapid.	 xx1900000506
4	Click the **Browser** in the **Rapid Editor** under **Robot Setting** to choose the editor.	

5	Click the **Edit** button in the **Rapid Editor** under **Robot Setting** and change the file.
	Tip
	Replace the old code:
	`PROC PickPlaceSeq()`
	`Pick PickWorkArea{1};`
	`! Pick PickWorkArea{2};`
	`Place PlaceWorkArea{1};`
	`! Place PlaceWorkArea{2};`
	`ENDPROC`
	with the new code:
	`PROC PickPlaceSeq()`
	`Pick PickWorkArea{1};`
	`IF PickTarget.Type = 1 THEN`
	`Place PlaceWorkArea{1};`
	`ELSEIF PickTarget.Type = 2 THEN`
	`Place PlaceWorkArea{2};`
	`ENDIF`
	`ENDPROC`
		
		xx1900000507

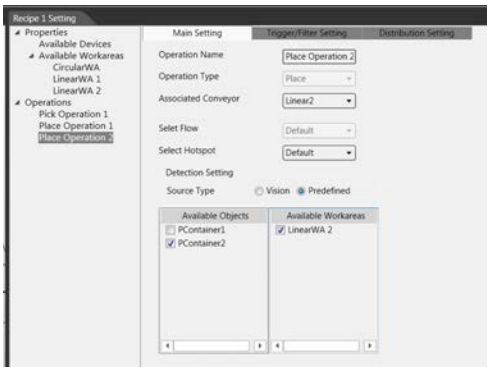
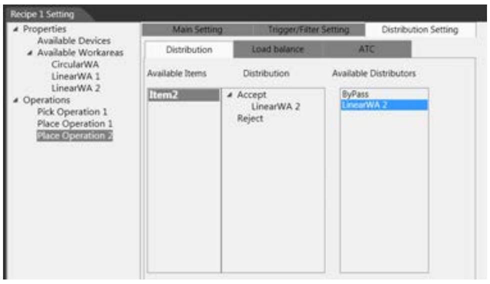
Continues on next page

	Action	Note/Illustration
6	Click on the **Add Place Operation** button to add one more place operation.	 xx1900000509
7	Click on the **Pick Operation1** to open the setting window for the pick operation.	 xx1900000510
8	In the **Select Flow** under **Main Setting**, select **Flow1** in the drop down list.	
9	Click to select the **Item Discard** checkbox under **Main Setting**.	
10	In the **Source Type** under **Detection Setting**, select the **Vision** radio box.	
11	Click to select the **Test1** in **Available Camera**.	 xx1900000511
12	Click to select the **CircularWA** in **Available Work Areas**.	
13	In the **Distribution** tab under **Distribution Setting**, click on **Item1** in the **Available Items** and drag **CircularWA** from the **Available distributors** list to the **Distribution Accept** list.	 xx1900000512

Continues on next page

	Action	Note/Illustration
14	In the **Distribution** tab under **Distribution Setting**, click on **Item2** in the **Available Items** and drag **CircularWA** from the **Available distributors** list to the **Distribution Accept** list.	 xx1900000513
15	Click on the **Place Operation1** to open the setting window for the place operation 1.	 xx1900000514
16	In the **Source Type** under **Detection Setting**, select the **Predefined** radio box.	
17	Click to select the **PContainer1** in **Available Objects**.	
18	Click to select the **LinearWA1** in **Available Work Areas**.	
19	In the **Trigger/Filter Setting** tab, click to select the **Distance** radio button.	 xx1900000515
20	In the **Trigger/Filter Setting** tab, define the **Trigger Distance** as 300 mm.	
21	In the **Distribution** tab under **Distribution Setting**, click on **Item1** in the **Available Items** and drag **LinearWA1** from the **Available distributors** list to the **Distribution Accept** list.	 xx1900000516

Continues on next page

	Action	Note/Illustration
22	Click on the **Place Operation2** to open the setting window for the place operation 2.	 xx1900000517
23	In the **Source Type** under **Detection Setting**, select the **Predefined** radio box.	
24	Click to select the **PContainer2** in **Available Objects**.	
25	Click to select the **LinearWA2** in **Available Work Areas**.	
26	In the **Trigger/Filter Setting** tab, select the **Distance** radio button.	 xx1900000518
27	In the **Trigger/Filter Setting** tab, define the **Trigger Distance** as 300 mm.	
28	In the **Distribution** tab under **Distribution Setting**, click on **Item2** in the **Available Items** and drag **LinearWA2** from the **Available distributors** list to the **Distribution Accept** list.	 xx1900000519
29	Click **OK** to finish the adding of the recipe.	

Calibration

For detail procedure on calibrating the solution, see *Calibration on page 328*.

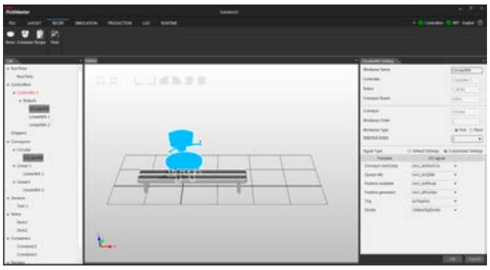
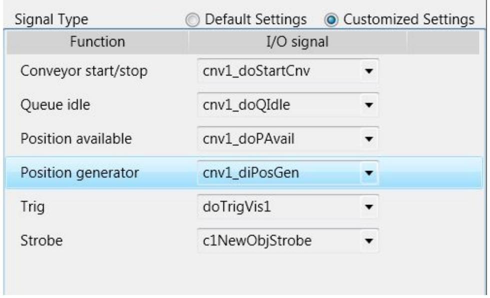
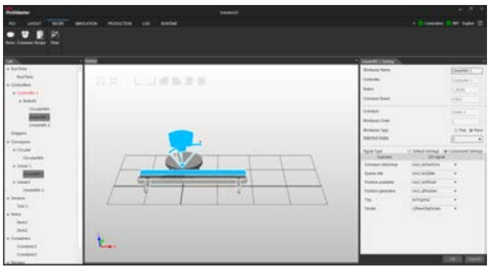
Simulation

For detail procedure on simulating the solution, see *Simulation on page 329*.

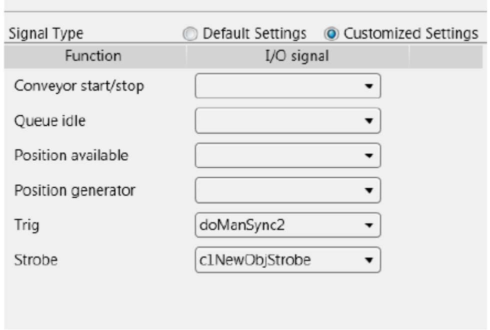
Switching to Online environment and configuration

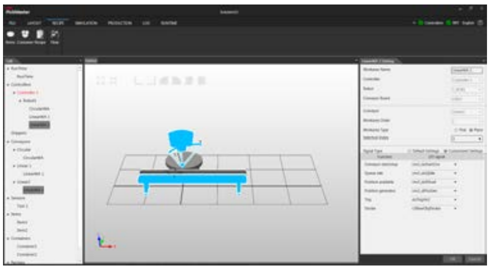
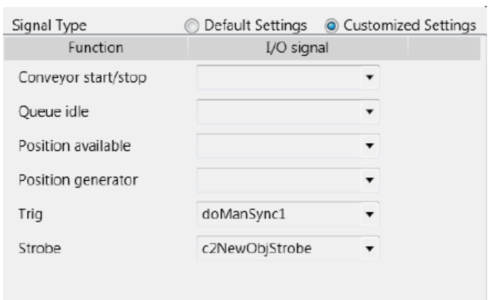
	Action	Note/Illustration
1	Connect to the real **RunTime**.	For more details, see *Switching to Online environment and configuration on page 329*.
2	Select the real controller.	For more details, see *Switching to Online environment and configuration on page 329*.

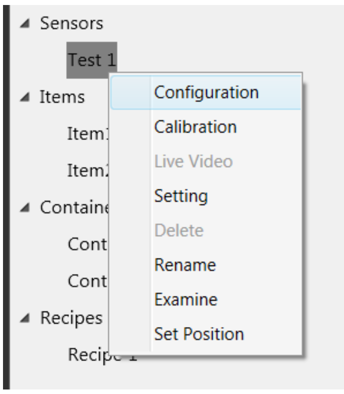
Continues on next page

	Action	Note/Illustration
3	Right-click on one **CircularWA** in the tree view **Cell** and select **Setting.**	 xx1900000522
4	Select the **Customized Settings** in the **Signal Type** tab.	 xx1800001735
5	Enter the required data into the **I/O signal** setting table.	 xx1900000523
6	Click **OK** to close the **Recipe setting** window.	
7	Right-click on one **LinearWA1** in the tree view **Cell** and select **Setting.**	 xx1900000524

Continues on next page

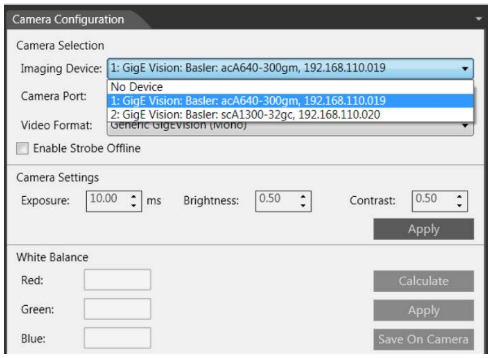
<table>
<tr><th></th><th>Action</th><th>Note/Illustration</th></tr>
<tr><td>8</td><td>Select the Customized Settings in the Signal Type tab.</td><td rowspan="2">

xx1900000525</td></tr>
<tr><td>9</td><td>Enter the required data into the I/O signal setting table.</td></tr>
<tr><td>10</td><td>Click OK to close the Recipe setting window.</td><td></td></tr>
<tr><td>11</td><td>Right-click on one LinearWA2 in the tree view Cell and select Setting.</td><td>
xx1900000526</td></tr>
<tr><td>12</td><td>Select the Customized Settings in the Signal Type tab.</td><td rowspan="2">

xx1900000527</td></tr>
<tr><td>13</td><td>Enter the required data into the I/O signal setting table.</td></tr>
<tr><td>14</td><td>Click OK to close the Recipe setting window.</td><td></td></tr>
<tr><td>15</td><td>Right-click the Test1 in the tree view Sensor and select Configuration.</td><td>

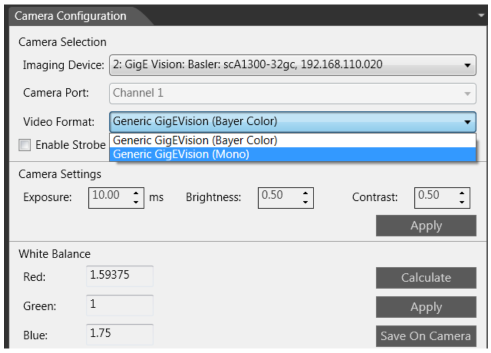
xx1900000528</td></tr>
</table>

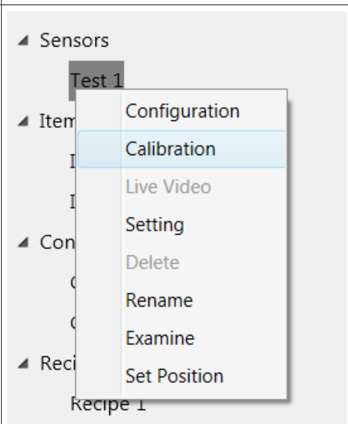
Continues on next page

<table>
<tr><th></th><th>Action</th><th>Note/Illustration</th></tr>
<tr><td>16</td><td>In the Imaging device list, select the Gigabit Ethernet camera to which the camera is connected.</td><td>

xx1800001465</td></tr>
<tr><td>17</td><td>In the Video format list, select the type of the connected camera.

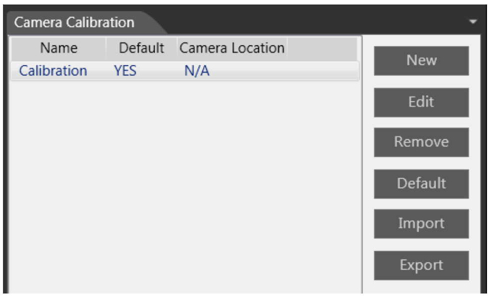
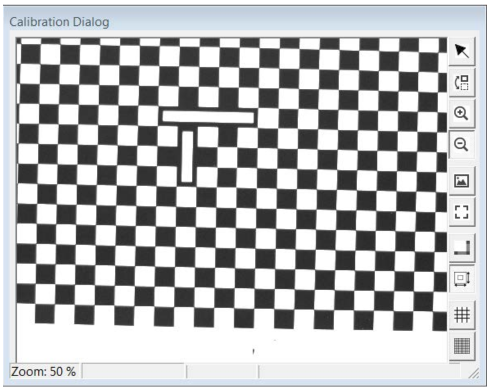
Tip

Select the type is to choose the color of the camera.</td><td>

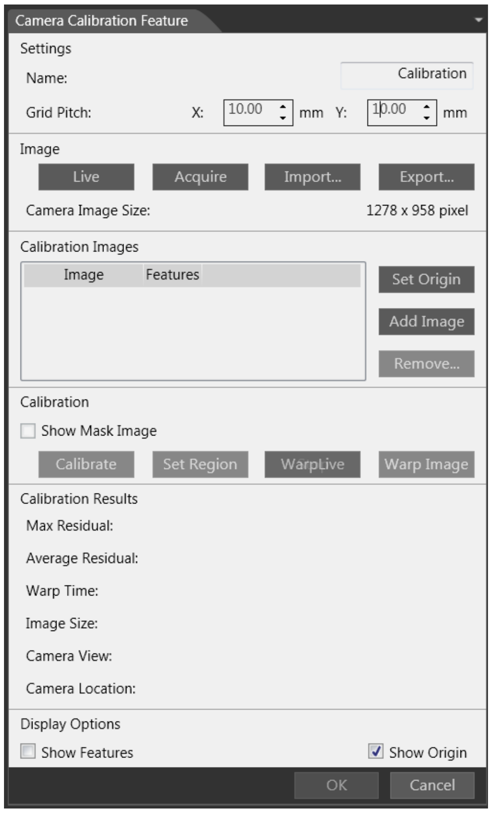
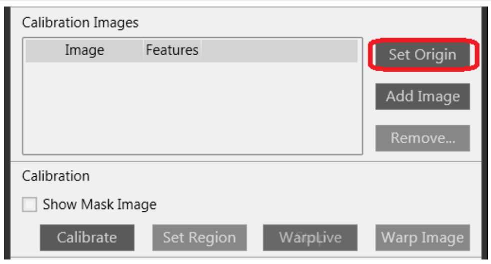
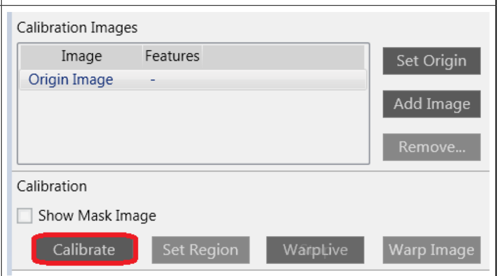
xx1900000645</td></tr>
<tr><td>18</td><td>Click OK to finish the configuration of the camera.</td><td></td></tr>
<tr><td>19</td><td>Right-click the Test1 in the tree view Sensor and select Calibration.</td><td>

xx1900000529</td></tr>
</table>

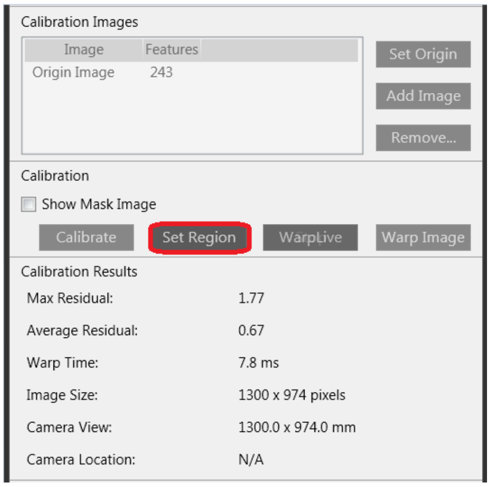
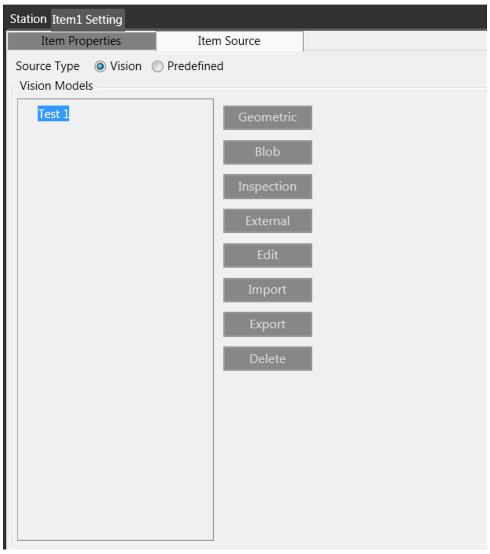
Continues on next page

	Action	Note/Illustration
20	Select the default calibration from the list and click **Edit**.	 xx1800001468  xx1800001469
21	In the **Settings** part, adjust the grid pitch if the squares on the printed calibration paper differs from 10.0 mm. Enter an appropriate name for the calibration.	 xx1800001701

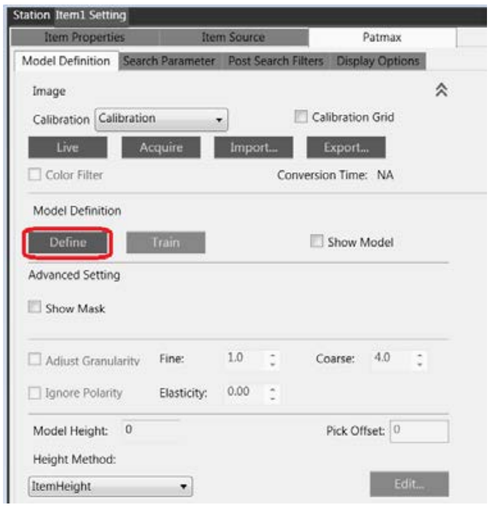
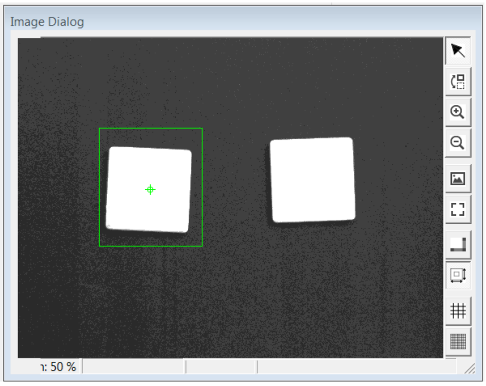
Continues on next page

	Action	Note/Illustration
22	In the **Image** part, click **Live** to get and show new images continuously, or click **Acquire** to get one new image. To use an image from file or save the current image, click **Import** or **Export**.	 xx1800001470
23	For single-view calibration: When the calibration plate is in position, acquire an image and click **Set Origin** in the **Calibration images** part. This stores the image and marks it as the origin image (the origin of this image will be the physical origin of the camera's coordinate system).	 xx1900000646
24	In the **Calibration** part, click **Calibrate** to start calibration.	 xx1900000647

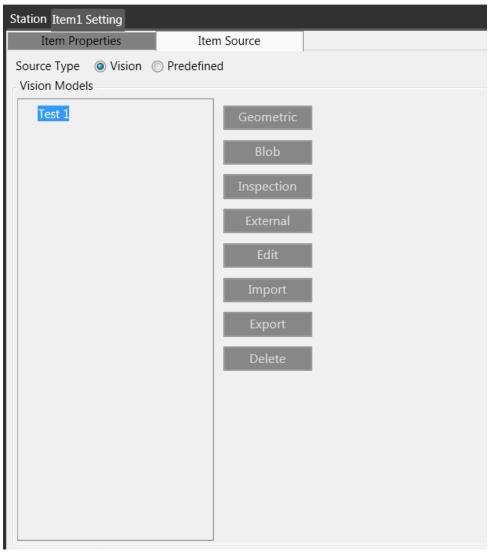
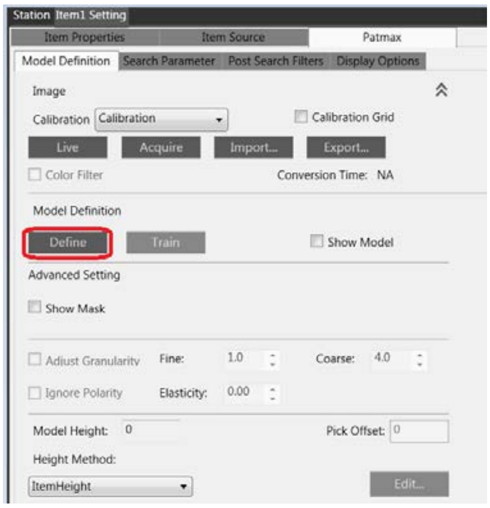
Continues on next page

	Action	Note/Illustration
25	Adjust the rectangle to the desired region and click **Set Region** to define the resulting image size.	 xx1900000648
26	Click **OK** to finish the calibrating of the camera.	
27	Right-click on the **Item1** in the tree view **Cell** and select **Setting**.	
28	Click to select **Test1** in the **Vision Models** and click **Geometric** to open the geometric window.	 xx1900000530
29	In the **Image** part, click **Live** to get and show new images continuously, or click **Acquire** to get one new image. To use an image from file or save the current image, click **Import** or **Export**.	 xx1900000649

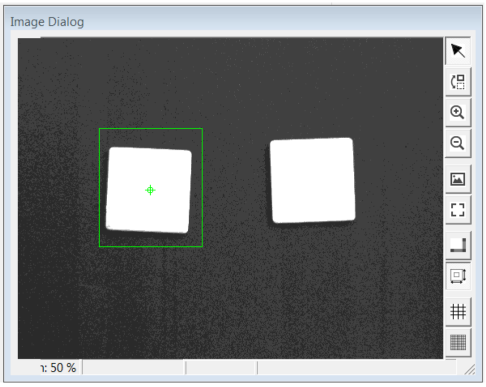
Continues on next page

	Action	Note/Illustration
30	Click **Define** to open the train shape of the item1.	 xx1900000650
31	Drag the train shape center point to the item's center.	 xx1800001708
32	Click **Train** to open the train shape of the item1.	 xx1900000651
33	Click OK to close and save the PatMax model.	
34	Click Ok to close and save the **Item1 setting**.	
35	Right-click on the **Item2** in the tree view **Cell** and select **Setting**.	

Continues on next page

	Action	Note/Illustration
36	Click to select **Test1** in the **Vision Models** and click **Geometric** to open the geometric window.	 xx1900000530
37	In the **Image** part, click **Live** to get and show new images continuously, or click **Acquire** to get one new image. To use an image from file or save the current image, click **Import** or **Export**.	 xx1900000649
38	Click **Define** to finish the train.	 xx1900000650

Continues on next page

	Action	Note/Illustration
39	Drag the train shape center point to the item's center.	 xx1800001708
40	Click **Train** to open the train shape of the item2.	 xx1900000651
41	Click OK to close and save the PatMax model.	
42	Click Ok to close and save the **Item2 setting**.	

Production

For detail procedure on production, see *Production on page 337*.

6 RAPID reference

6.1 Instructions

6.1.1 AckItmTgt - Acknowledge an item target

Usage

`AckItmTgt` is used to acknowledge that an `itmtgt` received with `GetItmTgt` from an item source has been used (For example, handled by the robot, skipped or put back in the queue for later usage). Normally, acknowledge is setup as a `TriggL` event on the path (using the `Ack` or `Nack` triggdata from sourcedata) to make sure acknowledge does not occur before any movements related to the target has been finished. However, if the received `itmtgt` shall be skipped or put back in the queue for later usage, movements related to the target may not be needed. Then it is convenient to use this instruction instead. Only after the acknowledge has been made, a new `itmtgt` can be fetched from the item source.

Basic example

```
VAR itmtgt PlaceTarget;
GetItmTgt ItmSrcData{Index}.ItemSource, PlaceItem;
AckItmTgt ItmSrcData{Index}.ItemSource, PlaceItem, FALSE
     \Skip:=TRUE;
```

Arguments

```
AckItmTgt ItemSource ItemTarget Acknowledge [\Skip] [\Type]
```

`ItemSource`

Data type: `itmsrc`

The item source from where the item target has been received with `GetItmTgt`.

`ItemTarget`

Data type: `itmtgt`

The item target to acknowledge.

`Acknowledge`

Data type: `bool`

The status of acknowledge. TRUE if the `itmtgt` has been handled (picked or placed)by the robot and FALSE otherwise, in which case the `itmtgt` is put back into the queue.

`Skip`

Data type: `bool`

Indicates if the `itmtgt` shall be skipped. If set to TRUE it will not be possible to receive the `itmtgt` again with `GetItmTgt`. If combined with `Acknowledge` = FALSE the `itmtgt` will be passed on for possible handling by downstream robots. If combined with `Acknowledge` = TRUE, skip will have no effect. If Skip is set to FALSE the `itmtgt` will either be considered as handled by the robot (when

Continues on next page

combined with `Acknowledge` = TRUE), or put back in the queue for later usage (when combined with `Acknowledge` = FALSE).

`Type`

Data type: `num`

Modifies the type of the `itmtgt`. If combined with `Acknowledge` = FALSE and `Skip` = TRUE, the item will be passed on to downstream robots according to the configured distribution of the new item type.

If combined with `Acknowledge` = FALSE and `Skip` = FALSE, the item will be put back in the queue with the new item type and can still be received with `GetItmTgt`. The item type will only be changed locally; the item type and the distribution of the item will not change for downstream robots.

If combined with `Acknowledge` = TRUE, type change will have no effect.

Error handling

The following recoverable errors can be generated. The errors can be handled in an error handler. The system variable ERRNO will be set to:

Error code	Description
`ERR_ITMSRC_UNDEF`	`itmsrc` undefined.

Limitations

The `itmtgt` must be received with the instruction `GetItmTgt`.

Syntax

```
AckItmTgt
  [ItemSource ':=' ] <variable (VAR) of itmsrc>,
  [ItemTarget ':=' ] <var or pers (INOUT) of itmtgt>,
  [Acknowledge':=' ] <expression (IN) of bool>,
  [\Skip ':=' ] <expression (IN) of bool>,
  [\Type ':=' ] <expression (IN) of num>;
```

Related information

For information about	See
The data type `itmtgt`	*itmtgt - Item target data on page 394*.

6.1.2 FlushItmSrc - Flush an item source

Usage

`FlushItmSrc` is used to flush an item source. The instruction clears the item source buffers, sets the scene number to one and flushes the encoder board.

Basic example

```
FlushItmSrc PlaceSource;
```

Flushes the earlier created item source object *PlaceSource*.

Arguments

```
FlushItmSrc ItemSource
```

`ItemSource`

Data type: `itmsrc`

The created item source.

Error handling

The following recoverable errors can be generated. The errors can be handled in an error handler. The system variable `ERRNO` will be set to:

Error code	Description
`ERR_ITMSRC_UNDEF`	`itmsrc` undefined

Limitations

To avoid potential problems, this instruction should be executed only when the last item target definitely has been acknowledged.

Syntax

```
FlushItmSrc
  [ItemSource ':=' ] <variable (VAR) of itmsrc>;
```

6.1.3 GetItmTgt - Get the next item target

Usage

`GetItmTgt` is used to get the next available `itmtgt` in the item source queue between the enter and the exit limit of the work area. The RAPID program waits in this instruction until the next item is possible to reach or the timeout occurs.

Basic examples

Basic examples of the instruction `GetItmTgt` are illustrated below.

Example 1

```
GetItmTgt PlaceSource, PlaceItem;
```

Receives a place item from the PlaceSource when there is one that can be used.

Example 2

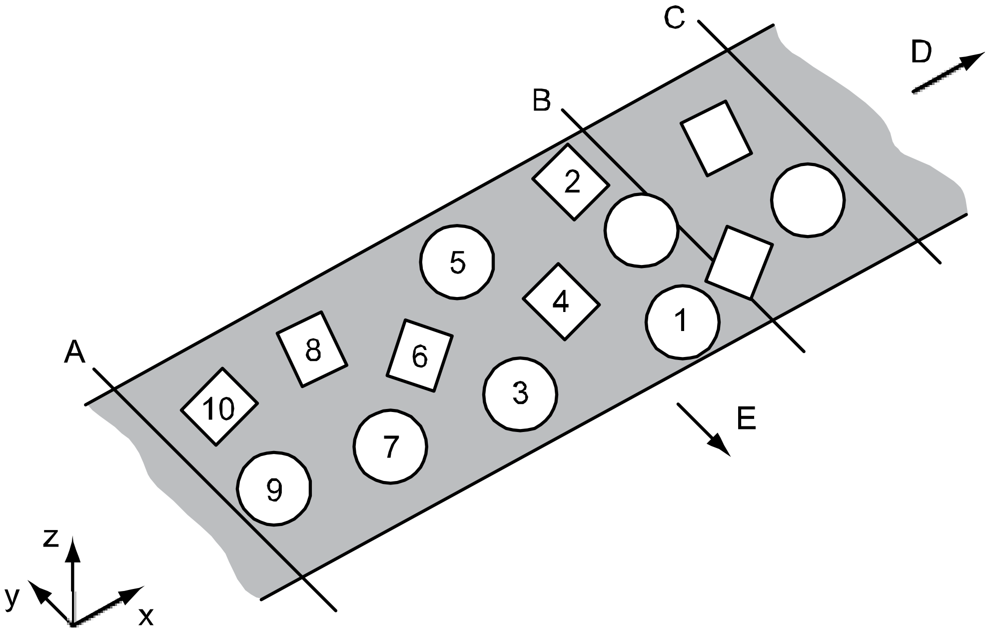
```
...
VAR selectiondata neg_y_sort;

neg_y_sort.ShapeType:=BOX;
neg_y_sort.ConsiderType:=BitOr(ITEMS_TO_USE,ITEMS_BYPASS);
neg_y_sort.GeometricData.x:=60;
neg_y_sort.GeometricData.y:=500;
neg_y_sort.GeometricData.z:=10;
neg_y_sort.GeometricData.radius:=0;
neg_y_sort.Offset.OffsetRelation:=FRAME_COORD_DIR;
neg_y_sort.Offset.OffsetPose.trans.x:=0;
neg_y_sort.Offset.OffsetPose.trans.y:=-500;
neg_y_sort.Offset.OffsetPose.trans.z:=0;
neg_y_sort.Offset.OffsetPose.rot.q1:=1;
neg_y_sort.Offset.OffsetPose.rot.q2:=0;
neg_y_sort.Offset.OffsetPose.rot.q3:=0;
neg_y_sort.Offset.OffsetPose.rot.q4:=0;
IF pick_type = 2 THEN pick_type := 1; ELSE
  pick_type := 2
ENDIF

GetItmTgt PickSource, PickItem \ItemType:=pick_type \Limit:=100
     \Selection:=neg_y_sort;
```

Retrieves a pick item from the *PickSource* with negative y-sorting and type request. The type is alternating between two types. The `Limit` argument tells from where to start the search.

In the example graphic below, the sorting is in positive x-direction, negative y-direction, and operating on two different object types. The two object types should

Continues on next page

be chosen in an alternating pattern starting with the circular. This will give the order as numbered 1-10 in the graphic.



xx0900000451

A	Enter
B	Check limit
C	Exit
D	Product flow direction
E	Sort direction
1-10	Sort order

Arguments

```
GetItmTgt ItemSource, ItemTarget [\MaxTime] [\TimeFlag] [\ItemType]
     [\Limit] [\SortData] [\Selection] [\Val1Min] [\Val1Max]
     [\Val2Min] [\Val2Max] [\Val3Min] [\Val3Max] [\Val4Min]
     [\Val4Max] [\Val5Min] [\Val5Max]
```

`ItemSource`

Data type: `itmsrc`

The item source from which the item target should be received.

`ItemTarget`

Data type: `itmtgt`

The received item target.

`[\MaxTime]`

Data type: `num`

The maximum waiting time permitted, expressed in seconds. If this time runs out before the item target is retrieved and no `TimeOut` flag is given, the error handler

Continues on next page

will be called with the error code ERR_PPA_TIMEOUT. If there is no error handler, the execution will be stopped.

[\TimeFlag]

Data type: bool

The output parameter that contains the value TRUE if the maximum permitted waiting time runs out before an item target is received. If this parameter is included in the instruction, it is not considered to be an error if the max time runs out. This argument is ignored if the MaxTime argument is not included in the instruction.

[\ItemType]

Data type: num

Specifies which item type number is requested. The instruction waits until an item target with the requested type number is available to be executed.

[\Limit]

Data type: num

Modifies the distance from where the item target is received. The instruction will return the next item target above this limit. If this argument is excluded, the instruction will return the next item target above the exit limit.

The distance is specified in millimeters from the center of the robot. The value is positive if the limit is beyond the center of the robot, in the moving direction of the feeder. This argument is only valid when a conveyor is used.

[\SortData]

Data type: sortdata

This data structure defines how the items shall be sorted.

[\Selection]

Data type: selectiondata

This data structure defines how the items are selected.

[\Val1Min]

Data type: num

Specifies minimum value for itmtgt parameter Val1. The instruction waits until an item target fulfilling this condition is available for execution.

[\Val1Max]

Data type: num

Specifies maximum value for itmtgt parameter Val1. The instruction waits until an item target fulfilling this condition is available for execution.

[\Val2Min]

Data type: num

Specifies minimum value for itmtgt parameter Val2. The instruction waits until an item target fulfilling this condition is available for execution.

[\Val2Max]

Data type: num

Continues on next page

Specifies maximum value for `itmtgt` parameter Val2. The instruction waits until an item target fulfilling this condition is available for execution.

`[\Val3Min]`

Data type: `num`

Specifies minimum value for `itmtgt` parameter Val3. The instruction waits until an item target fulfilling this condition is available for execution.

`[\Val3Max]`

Data type: `num`

Specifies maximum value for `itmtgt` parameter Val3. The instruction waits until an item target fulfilling this condition is available for execution.

`[\Val4Min]`

Data type: `num`

Specifies minimum value for `itmtgt` parameter Val4. The instruction waits until an item target fulfilling this condition is available for execution.

`[\Val4Max]`

Data type: `num`

Specifies maximum value for `itmtgt` parameter Val4. The instruction waits until an item target fulfilling this condition is available for execution.

`[\Val5Min]`

Data type: `num`

Specifies minimum value for `itmtgt` parameter Val5. The instruction waits until an item target fulfilling this condition is available for execution.

`[\Val5Max]`

Data type: `num`

Specifies maximum value for `itmtgt` parameter Val5. The instruction waits until an item target fulfilling this condition is available for execution.

Program execution

If there is no item target in buffer or any item targets available in the working area, the program execution waits in this instruction until an item is considered as inside the working area.

If the `MaxTime` argument is specified then the wait time is supervised. If the waiting time exceeds the value of `MaxTime` and the `TimeFlag` argument is used, then the program will continue. If `TimeFlag` is not used, then an error is raised. If `TimeFlag` is specified, it will be set to TRUE if the time is exceeded, otherwise it will be set to `FALSE`.

The `Limit` argument modifies the limit from where the item target shall be received.

If the `SortData` argument is specified the instruction will return the item target that is the closest to the exit limit in x-direction and depending of the absence of other objects in direction of the sorting, the first object in the sort direction will be selected. The `CheckBoundry` distance defines the required clearance distance

Continues on next page

around an object. The sorting will check both upwards and downwards the production flow for presence of other item targets. If this argument is combined with the `Limit` argument the sorting algorithm will also take all objects between the limit and the exit limit into consideration when checking the safety distance for the nearest objects. If more than one robot is used in a shared position source system, that is load balancing or `ATC`, we strongly recommend using the `Selection` argument instead with a proper selection data, as `SortData` does not take items that are bypassing in consideration when sorting.

If the `Selection` argument is specified, the instruction will return the item target that is the closest to the exit limit in x-direction, which has no other item targets inside the specified shape. If this argument is combined with the `Limit` argument the selection algorithm will also take all objects between the limit and the exit limit into consideration when checking the distance for the nearest objects. This is highly recommended to avoid collisions.

If values are specified for the optional arguments `Va1Xmin` or `Va1Xmax`, the instruction will return an item target that fulfills the required maximum and minimum values for `Va1X`.

Error handling

The following recoverable errors can be generated. The errors can be handled in an error handler. The system variable `ERRNO` will be set to:

Error code	Description
`ERR_ITMSRC_UNDEF`	`itmsrc` undefined.
`ERR_PPA_TIMEOUT`	Timeout without any error flag.

Syntax

```
GetItmTgt
  [ItemSource ':=' ] <variable (VAR) of itmsrc>,
  [ItemTarget ':=' ] <var or pers (INOUT) of itmtgt>
  [\MaxTime ':=' ] <expression (IN) of num>
  [\TimeFlag ':=' ] <var or pers (INOUT) of bool>
  [\ItemType ':=' ] <expression (IN) of num>
  [\Limit ':=' ] <expression (IN) of num>
  [\SortData ':=' ] <expression (IN) of sortdata>
  [\Selection ':=' ] <expression (IN) of selectiondata>
  [\Val1Min ':=' ] <expression (IN) of num>
  [\Val1Max ':=' ] <expression (IN) of num>
  [\Val2Min ':=' ] <expression (IN) of num>
  [\Val2Max ':=' ] <expression (IN) of num>
  [\Val3Min ':=' ] <expression (IN) of num>
  [\Val3Max ':=' ] <expression (IN) of num>
  [\Val4Min ':=' ] <expression (IN) of num>
  [\Val4Max ':=' ] <expression (IN) of num>
  [\Val5Min ':=' ] <expression (IN) of num>
  [\Val5Max ':=' ] <expression (IN) of num>;
```

Continues on next page

Related information

For information about	See
The data type `itmtgt`	*itmtgt - Item target data on page 394*.
The data type `selectiondata`	*selectiondata - Selection data on page 397*.
The data type `sortdata`	*sortdata - Sort data on page 400*.

6.1.4 NextItmTgtType - Get the type of the next item target

Usage

`NextItmTgtType` is used to get the type of the next item target (`itmtgt`) in the item source buffer. If the `Limit` distance parameter is given, the instruction will return the type of the next item target above the limit. The RAPID program waits in this instruction until there is an item in this queue.

Basic examples

```
NextItmTgtType PlaceSource, PlaceType
```

Retrieves the type of the next `itmtgt` in the *PlaceSource*.

Arguments

```
NextItmTgtType ItemSource ItemType [\Limit] [\MaxTime] [\TimeFlag]
```

`ItemSource`

Data type: `itmsrc`

The item source that the item target type should be retrieved from.

`ItemType`

Data type: `num`

The retrieved item target type.

`[\Limit]`

Data type: `num`

This is the limit from where the type is retrieved. The instruction will return the type of the next item target above this limit. If this argument is excluded, the instruction will return the type of the next item target above the exit limit.

The distance is calculated in millimeters from the center of the robot. The value is positive if the limit is beyond the center of the robot, in the moving direction of the conveyor.

This argument is only valid when a conveyor is used.

`[\MaxTime]`

Data type: `num`

The maximum waiting time permitted, expressed in seconds. If this time runs out before the item target is retrieved and no `TimeOut` flag is given, the error handler will be called with the error code `ERR_PPA_TIMEOUT`. If there is no error handler, the execution is stopped.

`[\TimeFlag]`

Data type: `bool`

The output parameter that contains the value `TRUE` if the maximum permitted waiting time runs out before an item target is retrieved. If this parameter is included in the instruction it is not considered to be an error if the max time runs out.

This argument is only used if the `MaxTime` argument is used.

Continues on next page

Program execution

If there is no item target in buffer or any item targets above the `Limit`, the program execution waits in this instruction until there is an item in the buffer.

If the `MaxTime` argument is specified then the wait time is supervised. If the waiting time exceeds the value of `MaxTime` and the `TimeFlag` argument is used, then the program will continue. If `TimeFlag` is not used, then an error is raised. If `TimeFlag` is specified, this will be set to TRUE if the time is exceeded, otherwise it will be set to FALSE.

Error handling

The following recoverable errors can be generated. The errors can be handled in an error handler. The system variable `ERRNO` will be set to:

Error code	Description
`ERR_ITMSRC_UNDEF`	`itmsrc` undefined.
`ERR_PPA_TIMEOUT`	Timeout without any error flag

Syntax

```
NextItmTgtType
  [ItemSource ':=' ] <variable (VAR) of itmsrc>,
  [ItemType ':=' ] <var or pers (INOUT) of num>
  [\Limit ':=' ] <expression (IN) of num>
  [\MaxTime ':=' ] <expression (IN) of num>
  [\TimeFlag ':=' ] <var or pers (INOUT) of bool>;
```

Related information

For information about	See
The data type `itmtgt`	*itmtgt - Item target data on page 394*.

6.1.5 QStartItmSrc - Start queue in item source

Usage

`QStartItmSrc` is used to start the queue in an item source. This instruction must be used when starting a new program or after flushing.

Basic example

```
QStartItmSrc PlaceSource;
```

The queue of objects in the item source *PlaceSource* is started.

Arguments

```
QStartItmSrc ItemSource
```

`ItemSource`

Data type: `itmsrc`

The started item source.

Error handling

The following recoverable errors can be generated. The errors can be handled in an error handler. The system variable `ERRNO` will be set to:

Error code	Description
`ERR_ITMSRC_UNDEF`	`itmsrc` undefined

Syntax

```
QStartItmSrc
  [ItemSource ':=' ] <variable (VAR) of itmsrc>;
```

Related information

For information about	See
The instruction `QStopItmSrc`	*QStopItmSrc - Stop queue in item source on page 383*.

6.1.6 QStopItmSrc - Stop queue in item source

Usage

`QStopItmSrc` is used to stop the queue in an item source.

Basic example

```
QStopItmSrc PlaceSource;
```

The queue of objects in the item source *PlaceSource* is stopped.

Arguments

```
QStopItmSrc ItemSource
```

`ItemSource`

Data type: `itmsrc`

The stopped item source.

Error handling

The following recoverable errors can be generated. The errors can be handled in an error handler. The system variable `ERRNO` will be set to:

Error code	Description
ERR_ITMSRC_UNDEF	`itmsrc` undefined

Syntax

```
QStopItmSrc
  [ItemSource ':=' ] <variable (VAR) of itmsrc>;
```

Related information

For information about	See
The instruction `QStartItmSrc`	*QStartItmSrc - Start queue in item source on page 382*.

6.1.7 ResetFlowCount - Reset flow counter

Usage

`ResetFlowCount` is used to reset the flow counter. The flow counter indicates the number of objects that has passed the exit limit of a conveyor work area since last reset. The value of the flow counter can be retreived with the function `GetFlowCount`

Basic example

```
ResetFlowCount PlaceSource;
```

Resets the flow counter for an item source.

Arguments

```
ResetFlowCount ItemSource
```

`ItemSource`

Data type: `itmsrc`

The item source.

Error handling

The following recoverable errors can be generated. The errors can be handled in an errorhandler. The system variable `ERRNO` will be set to:

Error code	Description
`ERR_ITMSRC_UNDEF`	`itmsrc` undefined

Syntax

```
ResetFlowCount[ItemSource ':=' ] <variable (VAR) of itmsrc>;
```

Related information

For information about	See
The function `GetFlowCount`	*GetFlowCount - Get number of passed items on page 393*.

6.1.8 ResetMaxUsageTime - Reset max measured usage time

Description

ResetMaxUsageTime is used to reset the maximum measured usage time of the previously handled objects. This is the time between receiving a target with *GetItmTgt*, until the object is handled by the robot (acknowledge time). *ResetMaxUsageTime* is only available with the *PickMaster Ready*.

Example

```
ResetMaxUsageTime ItmSrcData{PickWorkArea{1}}.ItemSource;
```

Resets the maximum usage time for an item source.

Arguments

```
ResetMaxUsageTime ItemSource
```

`Item Source`

ItemSource

Data type: `itmsrc`

The item source.

Error handling

The following recoverable errors are generated. They are handled in an error handler. The system variable `ERRNO` will be set to:

`ERR_ITMSRC_UNDEF`	The itmsrc is undefined.

Syntax

```
ResetMaxUsageTime[ItemSource ':=' ] <variable (VAR) of itmsrc>;
```

6.1.9 UseReachableTargets - Use reachable targets

Description

UseReachableTargets is used to activate a functional mode, where the robot only receives reachable targets for object handling. When activated, non-reachable targets are filtered out for target requests with *GetItmTgt*, see *Application manual - PickMaster 3*.

UseReachableTargets sets an optimal target release zone with a variable size. The size of the release zone depends on the robot's reach and the real-time speed of the conveyor. When the conveyor speed increases, the size of the release zone decreases, thereby decreasing the amount of targets available for use. If the conveyor speed is too high, the release zone disappears completely and no targets will be received until the speed is reduced.

UseReachableTargets is available only with the *PickMaster Ready* option.

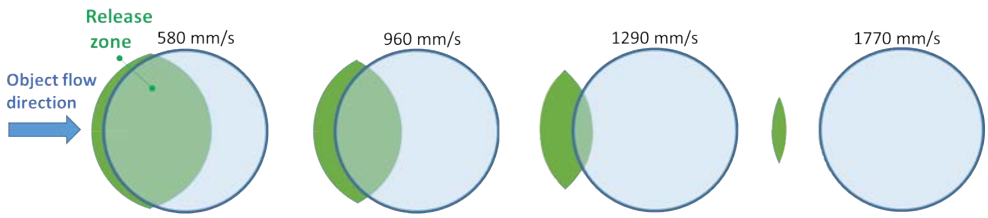
WARNING

The target release zone depends on the selection of the enter/exit limits, see *Application manual - PickMaster 3*. The resulting target release zone will be the intersection of the optimal target release zone and the enter/exit region.

The recommended exit/enter values to avoid any impact on the optimal target zone are as follows:

- Enter = -10000 mm (this signifies, a distance well outside the robot reach in an upstream direction)
- Exit = 10000 mm (this signifies, a distance well outside the robot reach in a downstream direction)

The following figure shows the target release zone for an IRB 360 (as seen from above) at 4 different conveyor speeds. The light blue area is the working range of the robot and the green area is the target release zone.



xx1800000383

Example

```
UseReachableTargets ItmSrcData{PlaceWorkArea{1}}.ItemSource, TRUE,
     0.7 \ReleaseTime:=0.1;
GetItmTgt PlaceSource, PlaceItem;
```

Activate *UseReachableTargets* in the place work area of a linear conveyor. The targets in use are expected to be placed within a maximum time of 0.7 seconds after being received with *GetItmTgt*. Targets become available for use 0.1 second

Continues on next page

before they enter robot reach. Then, the targets remain available for use until they leave the release zone.

Arguments

```
UseReachableTargets ItemSource, Enable, UsageTime [\ReleaseTime]
```

`Item Source`

ItemSource

Data type: `itmsrc`

The item source where *UseReachableTargets* is activated.

`Enable`

Enable

Data type: `bool`

This activates/deactivates *UseReachableTargets*.

`Usage Time`

UsageTime

Data type: `num`

The expected usage time of the targets. This is the time between receiving the target with *GetItmTgt*, until the object is handled (for example picked) by the robot (acknowledge time). The actual usage time is continuously measured and the maximum measured usage time can be received with *GetMaxUsageTime*. To avoid reach errors, the *UsageTime* value should be defined as a sum of the maximum measured usage time and a margin. For example, set UsageTime = Maximum measured usage time + 0.1 second. The drawback of having a large safety margin is an unnecessary reduction of the target release zone, which may decrease the pick rate.

`[\ReleaseTime]`

Release Time

Data type: `num`

The *ReleaseTime* defines the time when the targets enter the release zone, before entering robot reach. If the value is negative, targets enter the release zone after they enter robot reach. A value of 0.1 or less is recommended to avoid reach errors. A higher value can be useful to handle high speed conveyors. The drawback of a higher value is an increasing risk of having upstream reach errors at low speeds.

Note

It is possible to change *UsageTime* or *ReleaseTime* at any time. For example, a temporary reduction in the robot speed requires a longer usage time to avoid reach errors.

Syntax

```
UseReachableTargets
  [ItemSource ':=' ] <variable (VAR) of itmsrc>,
  [Enable ':=' ] <var or pers (IN) of bool>
```

Continues on next page

```
[UsageTime ':=' ] <var or pers (IN) of num>
[\ReleaseTime ':=' ] <expression (IN) of num>;
```

Limitations

If the robot work area is limited in motion configuration, there is a possibility that targets upto 20 mm outside of the working area perpendicular to the conveyor moving direction, may be retrieved by the `GetItmTgt` instruction.

A work around to avoid the outside reach errors is to put an extra check on the Y-value of the `itemtarget` before moving towards it.

6.2 Functions

6.2.1 GetMaxUsageTime - Get max measured usage time

Description

GetMaxUsageTime is used to get the maximum measured usage time of the previously handled objects. It is the time between receiving a target with *GetItmTgt*, until the object is handled by the robot (acknowledge time). The actual usage time is continuously measured for each handled object. *GetMaxUsageTime* is only available with the *PickMaster Ready*

Example

```
VAR num usetime;
usetime := GetMaxUsageTime(ItmSrcData{PickWorkArea{1}}.ItemSource);
```

usetime is the the maximum measured usage time since starting production or since executing *ResetMaxUsageTime*.

Return value

Data type: `num`

The maximum measured usage time since starting production or since executing *ResetMaxUsageTime*.

Arguments

```
GetMaxUsageTime (ItemSource)
```

`Item Source`

ItemSource

Data type: `itmsrc`

The item source.

Error handling

The following recoverable errors can be generated. They can be handled in an error handler. The system variable `ERRNO` will be set to:

ERR_ITMSRC_UNDEF	The *itmsrc* is undefined.

Syntax

```
GetMaxUsageTime '('[ItemSource ':=' ] <variable (VAR) of itmsrc>
    ')';
```

This function returns the value of the data in num type.

6.2.2 GetQueueLevel - Get queue level

Usage

GetQueueLevel is used to get current number of item targets in an item source fulfilling certain conditions.

Basic example

```
reg1 := GetQueueLevel(PlaceSource);
```

reg1 is assigned the current number of item targets in the item source PlaceSource.

Return value

Data type: num

The current number of item targets in the item source.

Arguments

```
GetQueueLevel (ItemSource [\ItmType] [\MinLimit] [\MaxLimit])
```

ItemSource

Data type: itmsrc

The item source that the current number of item targets should be retrieved from.

\ItmType

Data type: num

Only items of the specified type number will be counted.

\MinLimit

Data type: num

Defines the minimum distance to the robot center from where an item will be counted. A negative value indicates that the limit is upstreams from the robot center. A positive value indicates that the limit is downstreams. The parameters does not affect indexed work areas.

\MaxLimit

Data type: num

Defines the maximum distance to the robot center from where an item will be counted. A negative value indicates that the limit is upstreams from the robot center. A positive value indicates that the limit is downstreams. The parameter does not affect indexed work areas.

Error handling

The following recoverable errors can be generated. The errors can be handled in an error handler. The system variable ERRNO will be set to:

Error code	Description
ERR_ITMSRC_UNDEF	itmsrc undefined

Continues on next page

Syntax

```
GetQueueLevel '('
  [ItemSource ':=' ] <variable (VAR) of itmsrc> ')'
  [\ItmType ':=' ] <expression (IN) of num>
  [\MinLimit ':=' ] <expression (IN) of num>
  [\MaxLimit ':=' ] <expression (IN) of num>;
```

A function with a return value of the data type `num`.

6.2.3 GetQueueTopLevel - Get queue top level

Usage

`GetQueueTopLevel` is used to get the maximum number of item targets that simultaneously have been in the buffer of an item source.

Basic examples

```
reg1 := GetQueueTopLevel(PlaceSource);
```

reg1 is assigned the maximum number of item targets that simultaneously have been in the item source *PlaceSource*.

Return value

Data type: `num`

The maximum number of item targets that simultaneously have been in the item source.

Arguments

```
GetQueueTopLevel (ItemSource)
```

`ItemSource`

Data type: `itmsrc`

The item source that the current number of item targets should be retrieved from.

Error handling

The following recoverable errors can be generated. The errors can be handled in an error handler. The system variable `ERRNO` will be set to:

Error code	Description
`ERR_ITMSRC_UNDEF`	`itmsrc` undefined

Syntax

```
GetQueueTopLevel '('
  [ItemSource ':=' ] <variable (VAR) of itmsrc> ')';
```

A function with a return value of the data type `num`.

6.2.4 GetFlowCount - Get number of passed items

Usage

`GetFlowCount` is used to get the total number of items that has passed the exit limit of a conveyor work area since `ResetFlowCount` was executed. Items that the robot handles will not be counted (even if they pass the exit limit before picking/placing occurs).

Basic example

```
VAR num counter;
ResetFlowcount PlaceSource;
WaitTime 10;
counter := GetFlowCount(PlaceSource);
```

counter is assigned the number of items originating from `PlaceSource` that has passed the exit limit.

Return value

Data type: `num`

The number of items that has passed the exit limit since `ResetFlowCount` was executed.

Arguments

`GetFlowCount (ItemSource)`

`ItemSource`

Data type: `itmsrc`

The item souce.

Error handling

The following recoverable errors can be generated. The errors can be handled in an errorhandler. The system variable `ERRNO` will be set to:

Error code	Description
`ERR_ITMSRC_UNDEF`	`itmsrc` undefined

Syntax

```
GetFlowCount '('[ItemSource ':=' ] <variable (VAR) of itmsrc> ')';
```

A function returns value of the data type num.

Related information

For information about	See
The instruction `ResetFlowCount`	*ResetFlowCount - Reset flow counter on page 384*.

6.3 Data types

6.3.1 itmtgt - Item target data

Usage

`itmtgt` is used to describe one pick or place item.

Description

`Itmtgt` identifies an item to pick or place. It contains the position and some additional data.

Components

`tag`

Data type: `num`

Sequential number identifying the item. Can be modified by a user hook for free usage. Is restricted to integer values.

`type`

Data type: `num`

Type of item.

`scene`

Data type: `num`

Sequential number identifying the scene, corresponding for example to a picture taken by the vision system.

`robtgt`

Data type: `robtgt`

The pick or place position.

`val1`

Data type: `num`

Optional. Can be used to carry additional item specific information, for example, from a user hook. It is of data type float.

`val2`

Data type: `num`

Optional. Can be used to carry additional item specific information, for example, from a user hook. It is of data type float.

`val3`

Data type: `num`

Optional. Can be used to carry additional item specific information, for example, from a user hook. It is of data type float.

`val4`

Data type: `num`

Continues on next page

Optional. Can be used to carry additional item specific information, for example, from a user hook. It is of data type float.

`val5`

Data type: `num`

Optional. Can be used to carry additional item specific information, for example, from a user hook. It is of data type float.

Examples

Example 1

```
CONST itmtgt pickpos :=
     [1,2,1,0,0,0,0,0,[[20,40,8],[1,0,0,0],[0,0,0,0],
     [9E+9,9E+9,9E+9,9E+9,0,0]]];
```

A pick position is defined. The external axis related to the used conveyors must be set to zero, that is not marked as unused (by stating 9E+9). Example: if you have two conveyors, set the two last external axis positions to zero.

Structure

```
<dataobject of itmtgt>
  <tag of num>
  <type of num>
  <scene of num>
  <val1 of num>
  <val2 of num>
  <val3 of num>
  <val4 of num>
  <val5 of num>
  <dataobject of robtarget>
    <trans of pos>
      <x of num>
      <y of num>
      <z of num>
    <rot of orient>
      <q1 of num>
      <q2 of num>
      <q3 of num>
      <q4 of num>
    <robconf of confdata>
      <cf1 of num>
      <cf4 of num>
      <cf6 of num>
      <cfx of num>
    <extax of extjoint>
      <eax_a of num>
      <eax_b of num>
      <eax_c of num>
      <eax_d of num>
      <eax_e of num>
      <eax_f of num>
```

Continues on next page

Related information

For information about	See
Positioning instructions	*Technical reference manual - RAPID Overview*
Coordinate systems	*Technical reference manual - RAPID Overview*
Handling configuration data	*Technical reference manual - RAPID Overview*
Configuration of external axes	*Technical reference manual - System parameters*
What is a quaternion?	*Technical reference manual - RAPID Overview*

6.3.2 selectiondata - Selection data

Usage

`selectiondata` is used to describe the selection criteria. It is also used to describe item sorting.

Description

`selectiondata` is used to set the criteria for sorting and clearance area when retrieving item targets from an item source.

Components

`ShapeType`

Data type: `shapetype`

Specifies the shape of the clearance area that should be used.

- `SHAPE_UNDEFINED` specifies that no selection is used.
- `BOX` specifies that there must be a clear box shape around the item target position where no other item targets are present.
- `CYLINDER` specifies there must be a clear cylinder shape around the item target position where no other item targets are present.
- `SPHERE` specifies that there must be a clear sphere shape around the item target position where no other item targets are present.

`ConsiderType`

Data type: `aconsidertype`

Specifies which items in the queue that should be taken in consideration when selecting.

- `ITEMS_TO_USE` specifies that only items marked for use by this queue are considered in the selection.
- `ITEMS_BYPASS` specifies that only items marked to pass by this queue are considered in the selection.
- `ITEMS_PICKED` specifies that only items marked as already picked, by this queue or by a former queue in the line, are considered in the selection.
- `ITEMS_PLACED` specifies that only items marked as already placed, by this queue or by a former queue in the line, are considered in the selection.

If items with different marks should be taken into consideration when selecting an item, then use a bit-or operation with the consideration types. (RAPID function `BitOr(<byte>,<byte>)`.)

`GeometricData`

Data type: `geodata`

The data that defines the geometric shape dimensions (x, y, z and radius).

- A `BOX` shape is defined by the x, y, and z-values.
- A `CYLINDER` shape is defined by the radius value and the height is defined by the z-value.

Continues on next page

- A `SPHERE` shape is defined by the radius value.

The orientation of the shape's coordinate system is defined by the offset data component. By default it is the coordinate system of the shape aligned to the workobject or conveyor frame. Note that all shapes origin are placed in the center of the shape and the values are the distance to every plane in both positive and negative direction. That is, if a box is defined as x: 10, y: 15 and z: 20 the box will have a size of 20 mm in x-direction, 30 mm in y-direction and 40 in z-direction. If no offset is used the check for other items in range will be done 10 mm before, 10 mm after, 15 mm left of, 15 mm right of, 20 mm above, and 20 mm underneath every item.

`Offset`

Data type: `offsetdata`

The offset consists of `OffsetRelation` (`offsetreltype`) and `OffsetPose` (`pose`).

The `OffsetRelation` can be of two different types.

- `FRAME_COORD_DIR` indicates that the rotation in the `OffsetPose` is relative to the workobject or conveyor frame coordinate system.
- `ITEM_COORD_DIR` indicates that the rotation in the `OffsetPose` is relative to the item coordinate system of the item to check.

The `OffsetPose` is used to move the center of the shape away from the item position, for example, if the grip position of the item is not at the center of real object to pick.

Examples

```
VAR selectiondata clear_rect:= [BOX,ITEMS_TO_USE,[22,15,5,0],
     [FRAME_COORD_DIR,[[0,7,0],[1,0,0,0]]]];
```

Limitations

The orientation must be normalized; that is the sum of the squares must equal 1.

$q1^2 + q2^2 + q3^2 + q4^2 = 1$

Structure

```
<dataobject of selectiondata>
  <ShapeType of shapetype>
  <ConsiderType of considertype>
  <GeometricData of geodata>
    <x of num>
    <y of num>
    <z of num>
    <radius of num>
  <Offset of offsetdata>
    <OffsetRelation of offsetreltype>
    <OffsetPose of pose>
      <trans of pos>
        <x of num>
        <y of num>
        <z of num>
```

Continues on next page

```
<rot of orient>
  <q1 of num>
  <q2 of num>
  <q3 of num>
  <q4 of num>
```

Related information

For information about	See
The data type `pose`	*Technical reference manual - RAPID Instructions, Functions and Data types*.
The function `BitOr`	*Technical reference manual - RAPID Instructions, Functions and Data types*.
What is a quaternion?	*Technical reference manual - RAPID Overview*.
Example using `selectiondata`	*Example: Selecting item depending on clearance zone on page 422*.

6.3.3 sortdata - Sort data

Usage

`sortdata` is used to describe the sorting criteria.

Description

`sortdata` is used to set the criteria for sorting item targets from an item source.

Components

`SortType`

Data type: `sorttype`

Type of sorting that is going to be used.

- `UNSORT_TYPE` tells that no sorting is used.
- `POS_Y_SORT_TYPE` tells that the sorting shall be done from the positive y-direction of the work area.
- `NEG_Y_SORT_TYPE` tells that the sorting shall be done from the negative y-direction of the work area.

`CheckBoundary`

Data type: `num`

The clearance distance for sorting, in millimeters. The distance is defined as the minimum distance to the next item in the sorting direction.

`SortDirOffset`

Data type: `num`

An offset distance beyond the item target in the sort direction. Is used to define the inner limit for the corridor in which no other item targets are allowed.

Examples

```
VAR sortdata y_sort:=[NEG_Y_SORT_TYPE ,78, 52];
```

Structure

```
<dataobject of sortdata>
  <SortType of sorttype>
  <CheckBoundary of num>
  <SortDirOffset of num>
```

6.4 RAPID program

6.4.1 RAPID programs

Introduction

Overview

Each robot has a default RAPID program that can be edited using a normal text editor from the robot settings of the job dialog. When a job is started, the program is downloaded by PickMaster in the picking controller. The program contains the Main routine where the program execution starts.

Note

Due to the download procedure, this program cannot be modified directly on the robot system.

The installation contains the following program template files:

Template	Customized for
`PMppa360_IRC5.prg`	Four axes FlexPicker IRB 360.
`PMppa360_IRC5_MM2.prg`	Four axes FlexPicker IRB 360. To be used for a second multi move robot.
`PMppa360_IRC5_DoublePick.prg`	Four axes FlexPicker IRB 360. Adapted for double pick, single place.
`PMppa360_IRC5_6_02.prg`	Four axes FlexPicker IRB 360. To be used with RobotWare 6.02.
`PMppa360_IRC5_6_02_DoublePick.prg`	Four axes FlexPicker IRB 360. Adapted for double pick, single place. To be used with RobotWare 6.02.
`PMppa_6Axes_IRC5.prg`	Six axes robots of articulated arm type, for example, IRB 120.
`PMppa_6Axes_IRC5_6_02.prg`	Six axes robots of articulated arm type, for example, IRB 120. To be used with RobotWare 6.09.

Template	Customized for
`PMppa360_OmniCore`	Four axes FlexPicker IRB 360.
`PMppa360_OmniCore_DoublePick`	Four axes FlexPicker IRB 360. Adapted for double pick, single place.
`PMppa_6Axes_OmniCore`	Six axes robots of articulated arm type, for example, IRB 120.

Program execution - General

The RAPID program is loaded and started from the Main routine by PickMaster when a new job is started.

For every cycle, the default RAPID program performs:

- a pick on a pick work area.
- a place on a place work area.

Continues on next page

If there are more than one pick work area with a robot, it uses the one having the lowest configured work area index. If there are more than one place work area with a robot, it uses the one having the lowest configured work area index. The RAPID program can be modified to implement another sequence, for example, to double pick with single place.

Program execution – Work areas

In RAPID, a work area is always associated with an item source object. The item source is sometimes referred to as a queue. The item source holds all target positions related to this work area. Target positions are continuously received in the item source, while being detected with the associated flow handler sensor.

Program execution – Target positions

For each pick, a pick target is fetched from the pick item source. The target position gives the location of the next item to be picked.

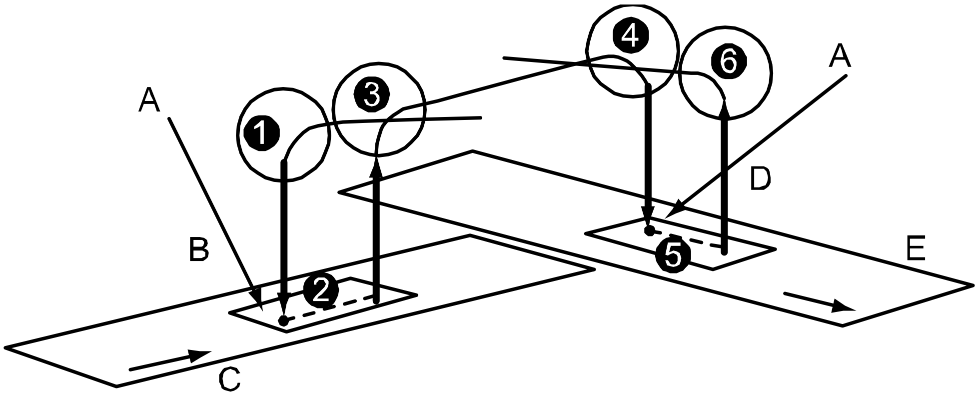
For each place, a place target is fetched from the place item source. The target position gives the location of the next empty place location for the item to be placed.

Movements

The RAPID program is built with six different movements.

For a six axis robot, the following two intermediate points must be used:

- Between position 3 and position 4.
- Between position 6 and the next loop’s position 1.



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The following six movements are included.

	Description
1	Approach position above the pick target. The distance above the pick target is the pick elevation value, in negative z-direction of the tool, given in the **Work Area Properties** dialog in the job dialog. The target is of corner path type and the vacuum activation occasion is calculated as the time before the middle of the corner path. The time is entered in the **Work Area Properties** dialog.
2	This is the pick target. The robot TCP is coordinated relative to the conveyor during the pick time entered in the **Work Area Properties** dialog. The TCP follows the pick target during the pick time.

Continues on next page

	Description
3	Last position in the pick sequence. The distance above the pick target is calculated in the same way as the approach position. The position is coordinated to the conveyor until the middle of the corner path. Therefore the used item target must be acknowledged, so the item source can start tracking the next item target in the pick work area buffer. The target cannot be a fine point.
4	Approach position above the place target. The distance above the place target is the pick or place elevation value, in negative z-direction of the tool, given in the **Work Area Properties** dialog.
5	This is the place target. The robot TCP is coordinated relative to the conveyor during the place. The moment for the vacuum reversion event is calculated as the time before the half place time. The vacuum off moment is calculated as a time after the half place time.
6	Last position of the sequence. The position is coordinated to the conveyor until the TCP passes the middle of the corner path or goes into the fine point. Therefore the used item target must be acknowledged, so the item source can start tracking the next item target in the pick work area buffer. The target cannot be a fine point.

Note

When running a pick and place cycle over moving conveyors, the RAPID program pointer runs in advance and picks out a target long before it is going to be used. By the time the robot uses the target it may already have moved past the exit limit. RAPID moves the program pointer in advance about 100ms. In a coordinated fine point the "running in advance" is triggered at the beginning of the fine point movement as the robot locks above the conveyor. If the PickTime is long (for example, 50ms) the next target will be taken out of the queue long before (50ms) the robot is physically going to go there. If the conveyor speed is high 50ms may mean that the target to pick is already beyond the exit limit. Still the robot will try to pick it.

Program modules

The default RAPID program contains three program modules.

Module	Description
PPAMAIN	Handles the main program initiations and execution sequence. Do not edit this module for customization purpose.
PPASERVICE	Contains the service routines and service variables that can be executed and set from PickMaster.
PPAEXECUTING	Handles the pick and place operations. Customize this module for your purposes.

Continues on next page

System modules

An ABB robot controller with the RobotWare option *PickMaster Ready* will always contain the loaded system modules *ppaBase* (crypted) and *ppaUser* (open).

Module	Description
ppaBase	Contains variables for communication with PickMaster, event routines and routines for creating, initiating, and deleting item sources.
ppaUser	Contains declarations of public data types and holds the work object data for indexed work areas. It also contains the declaration of default tool data, for example, `PickAct1` and `PickAct2`.

Public data types

Overview

The system module *ppaUser* contains two record definitions, *sourcedata* and *noncnvwobjdata*.

sourcedata

The *sourcedata* is used in the variable array *ItmSrcData*. This array holds data about every item source.

The record can be extended for other purposes, but do not change or delete any component in the structure.

Name	Alias	Description
`Used`	bool	Flag to indicate that the array index is used.
`ItemSource`	itmsrc	Descriptor to the item source.
`SourceType`	itmsrctype	Type of source, `PICK_TYPE`, `PLACE_TYPE` or `UNDEFINED_TYPE`.
`Ack`	`triggdata`	Triggdata for acknowledging the item targets.
`Nack`	`triggdata`	Triggdata for negative acknowledging the item targets.
`SimAttach1`	`triggdata`	Triggdata for attaching a nearby item to activator 1 in simulation.
`SimAttach2`	`triggdata`	Triggdata for attaching a nearby item to activator 2 in simulation.
`SimDetach1`	`triggdata`	Triggdata for detaching an item held by activator 1 in simulation.
`SimDetach2`	`triggdata`	Triggdata for detaching an item held by activator 2 in simulation.
`VacuumAct1`	`triggdata`	Triggdata for vacuum activation on real robot.
`VacuumAct2`	`triggdata`	Triggdata for vacuum activation on real robot.
`VacuumRev1`	`triggdata`	Triggdata for vacuum blow on real robot.
`VacuumRev2`	`triggdata`	Triggdata for vacuum blow on real robot.
`VacuumOff1`	`triggdata`	Triggdata for vacuum off on real robot.
`VacuumOff2`	`triggdata`	Triggdata for vacuum off on real robot.
`Wobj`	`wobjdata`	Work object data for the source

Continues on next page

Name	Alias	Description
`VacActDelay`	`num`	Vacuum activation delay
`VacRevDelay`	`num`	Vacuum reversion delay
`VacOffDelay`	`num`	Vacuum off delay
`TunePos`	`pos`	Position tuning for the work area.
`TrackPoint`	`stoppointdata`	Follow time data.
`OffsZ`	`num`	Height for the offset point above the pick or place position.

noncnvwobjdata

The *noncnvwobjdata* is used in the persistent variable array *NonCnvWOData*. This is only used for indexed work areas. The work object data is stored in this array. This data is then used when the item sources are created.

The record can be extended for other purposes, but do not change or delete any component in the structure.

Name	Alias	Description
Used	bool	Flag to indicate that the array index is used.
NonCnvWobjName	string	Name of the work area.
Wobj	wobjdata	The stored work object data.

AlwaysClearPath

Clear path

The robot path is cleared before the restart when a stop occurs during a motion that is coordinated to a moving work object. Otherwise the coordinated motion continues the stored path, but the position of the object in the conveyor may have changed to a position that is out of reach by the robot.

Unconditional path clearing

The `AlwaysClearPath` (bool always) routine unconditionally clears the path before the restart, if the input parameter value is set to TRUE.

6.4.2 Variables

Introduction to variables

The PickMaster robot controller contains many RAPID variables. The variables are declared in both `ppaBase` and `ppaUser`. Many are not used in customized programs.

Public variables in ppaUser

Overview

The following variables in `ppaUser` can be used.

VAR sourcedata ItmSrcData{MaxNoSources}

This array variable keeps information about all work areas. The index given in the work area configuration is the index of the `ItmSrcData` array.

PERS noncnvwobjdata NonCnvWOData{MaxNoSources}:=[[…

This array variable stores the work object frames for the indexed work areas. The key to find a certain work object calibration is the name, that must be same as the name in the work area configuration.

TASK PERS tooldata PickAct1:=[…]

This tooldata is used for pick and place operations.

Note

The direction of tool must fit the direction of items that are retrieved from the queue. The target positions of the items, which are retrieved from the queue, are rotated 180 degrees around their x-axis from the defined direction.

In an installation with a hanging IRB 360 and items lying on a horizontal conveyor, the tool's z-direction will point out from the nose and down into the conveyor, like `tool0`.

Public variables in ppaBase

The following variables in `ppaBase` can be used.

TASK PERS num Vtcp:=1000

Used for speed adjustment from PickMaster.

TASK PERS speeddata MaxSpeed:=[…]

Highest speed used for movements.

TASK PERS speeddata LowSpeed:=[…]

Low speed used for movements.

TASK PERS speeddata VeryLowSpeed:=[…]

Lowest speed used for movements.

Continues on next page

Public variables in PickMaster template programs

The following public variables are used in the PickMaster template program.

VAR num PickWorkArea{X}:=0

The PickWorkArea array is used to specify from which work area the robot will pick an item. The pick work areas are ordered with respect to selection index.

`PickWorkArea{1}` has the lowest work area selection index.

`PickWorkArea{2}` has the second lowest selection index.

VAR num PlaceWorkArea{X}:=0

The PlaceWorkArea array is used to specify on which work area the robot will place an item. The place work areas are ordered with respect to selection index.

`PlaceWorkArea{1}` has the lowest work area selection index.

`PlaceWorkArea{2}` has the second lowest selection index.

VAR num OtherWorkArea{X}:=0

The OtherWorkArea array is used to specify to which work area the robot will go for a user defined purpose. The other work areas are ordered with respect to selection index.

`OtherWorkArea{1}` has the lowest work area selection index.

`OtherWorkArea{2}` has the second lowest selection index.

VAR itmtgt PickTarget:=[...]

Used to retrieve a pick target from a pick item source.

VAR itmtgt PlaceTarget:=[...]

Used to retrieve a place target from a place item source.

TASK PERS wobjdata WObjPick:=[…]

Holds the wobjdata for the work area. The information is moved from `ItmSrcData` to `WObjPick` in the Pick routine because the motion instructions need to have the wobjdata as `PERS` type.

TASK PERS wobjdata WObjPlace:=[…]

Holds the `wobjdata` for the work area. The information is moved from `ItmSrcData` to `WObjPlace` in the Place routine because the motion instructions need to have the `wobjdata` as `PERS` type.

TASK PERS robtarget SafePos:=[…]

Defined start position for the robot. Edit this robtarget to fit the application.

TASK PERS robtarget IntPosPickX:=[…]

Defined intermediate position for every pick work area robot. Edit this robtarget to fit each work area.

TASK PERS robtarget IntPosPlaceX:=[…]

Defined intermediate position for every place work area robot. Edit this robtarget to fit each work area.

Continues on next page

TASK PERS loaddata ItemLoad:=[…]

Load data (`loaddata`) used for pick and place operations. Edit this `loaddata` to fit the picked item. If different item types are used, declare one loaddata for each type. It is important that correct loaddata is used to get the best performance of the robot.

The default loaddata is the same as `tooldataload0`.

6.4.3 Routines

Introduction to routines

The PickMaster RAPID modules contain many routines, some are very useful for the end user, others are only to be used internally by the PickMaster program.

Public routines in PickMaster template programs

The following public routines are available in the PickMaster template programs.

PROC main()

Start routine for the RAPID program. The program will always start from this routine.

PROC InitSafeStop()

Initiates the SafeStop trap. It must be executed at the beginning of the program execution to get a correct robot stop when the PickMaster project is paused or stopped.

PROC InitTriggs()

Sets trigger events for the vacuum activation, reversion and turning off, at the project start for every used work area index. See more at `SetTriggs`.

PROC InitPickTune()

Initiates the PickTune trap. Must be executed at the beginning of the project start so the work areas can be tuned.

PROC SetTriggs(num Index)

Sets trigger events for the vacuum activation, reversion and turning off. The default program only sets up events for one vacuum ejector on the I/O group `goVacBlow1`. If more than one vacuum ejector is used, the new vacuum ejector I/O group must be setup for the correct work area and the default routine must be edited to get the right vacuum ejector to each work area.

PROC InitSpeed()

Sets the robot speed used in the program. The instruction `VelSet` is executed in this routine, which sets the maximum allowed speed for the robot. If a six axes robot is used, this limit can be tuned to avoid motion errors.

PROC PickPlace()

Starts the item queues and initiates the final settings. The pick and place sequence is called from this routine. Do not make changes in this routine.

This routine is called when the pick and place execution is started.

PROC SafeStop()

When the project is stopped or paused this routine will be called either from the `SafeStopTrap` routine or the `PickPlace` routine. The slow motion to the safe position is called from this routine.

Continues on next page

PROC GotoRestartPos()

Runs the slow motion to the safe position and sends a negative acknowledge to all item sources. This must be done to tell the sources that the execution was interrupted.

PROC Home()

Service routine that moves the robot to the safe position.

PROC WashDown()

Wash down service routine.

PROC TestCycle()

Test service routine.

PROC Homepos()

Service routine that moves the robot to the synchronization position.

PROC EnumerateWorkAreas()

Sets up the arrays of work areas for Pick, Place, and Other.

PROC PickPlaceSeq()

Specifies the sequence of the application, that is the logic of how the robot will pick and place from different queues.

This routine is called once every loop, which is counted as one pick in the pick rate statistics shown in the PickMaster production tab.

PROC Pick(num Index)

Executes one pick. The index defines which work area the item will be picked from.

PROC Place(num Index)

Executes one place. The given index defines which work area the item will be placed on.

PROC GoInterMidP(robtarget Pos)

Executes a motion to the intermediate position `Pos` (Used only for six axes robots).

TRAP SafeStopTrap

Trap routine to catch the stop I/O signal. This is executed if the stop I/O signal is set before `SafeStop` is called from the `PickPlace` routine.

TRAP PickTuneTrap

Trap routine to attach the tuned values from the PickMaster to the corresponding variables.

Hidden routines in ppaBase module

Overview

Following are the hidden routines in the `ppaBase` module.

PROC ResetEvent()

Resets some variables. This routine is only executed in the `RESET` system event shelf.

Continues on next page

PROC PowerOnEvent()

Resets some variables. This routine is executed only in the `POWER_ON` system event shelf.

PROC StopEvent()

Clears the robot path if the robot is in a coordinated motion when the stop occurs. This routine is only executed in the `STOP` system event shelf.

PROC RestartEvent()

This routine is only executed in the `RESTART` system event shelf. If the robot is currently in a coordinated motion, this routine will force the program to restart the program from the level that has an error handler for the raised error `PPA_RESTART`.

PROC NewSource()

Creates a new item source and initiates the `ItmSrcData` variable. PickMaster calls this routine for each work area when the project starts.

PROC ClearAll()

Resets all important variables and deletes all item sources. This routine is called when the project is stopped.

PROC PickRateInit()

Initiates the pick rate calculation.

PROC PickRateReset()

Resets the pick rate calculation.

PROC CheckAx4Rev ()

Checks if it is necessary to reset the fourth axis on the IRB340.

PROC ResetAx4 (VAR mecunit MechUnit)

Resets the fourth axis.

PROC NotifyClearAll ()

Tells PickMaster that `ClearAll` is executed.

PROC NotifySafeStop ()

Tells PickMaster that `SafeStop` is executed.

PROC NotifyRunning ()

Tells PickMaster that the process is running.

PROC NotifyWaitForExe ()

Tells PickMaster that the RAPID program is waiting for new order.

```
PROC WaitForExeOrder ()
```

PROC IncrPicks ()

Increments the pick calculation.

PROC ppaDropWobj(PERS wobjdata Wobj)

Encapsulates the `DropWobj` instruction. See *Application manual - Conveyor tracking* for more information

Continues on next page

PROC ppaWaitWobj(PERS wobjdata Wobj, \num RelDist \num MaxTime \bool TimeFlag)

Encapsulates the `WaitWobj` instruction. See *Application manual - Conveyor tracking* for more information

PROC ppaCnvGenInstr(VAR mecunit MechUnit, num cnvcmd, cnvgendata Data)

Encapsulates the `CnvGenInstr` instruction. See *Application manual - Conveyor tracking* for more information

PROC WalkTheData()

Traces the content of the array variables *ItmSrcData* and *NonCnvWOData*, which can be useful when trying to find an error. It prints the file TheData.log on the system directory on the controller.

TRAP PickRateTrap

Trap routine to calculate the correct pick rate for the robot.

6.4.4 Service routines

User defined service routines

It is possible to create new routines and variables. All procedure in the `PPASERVICE` module can be executed as service routines. All service variable names must be set in a `ServiceVarX`.

The service variables can only be of type `num`.

Maximum number of service variables is ten.

6.5 Program examples

6.5.1 Example: Mixing one pick work area and two place work areas

Description of example

In this example we use one pick work area with two types of items. The items are put on two out work areas depending on type of item.

1. Pick item from pick work area
2. Define type of item
3. Place on out work area

Example code

```
PROC PickPlaceSeq()
  Pick PickWorkArea{1};
  IF PickTarget.Type = 1 THEN
    Place PlaceWorkArea{1};
  ELSEIF PickTarget.Type = 2 THEN
    Place PlaceWorkArea{2};
  ENDIF
ENDPROC
```

6.5.2 Example: Mixing two pick work areas and one place work area

Description of example

In this example, we use the place work area as master to decide which item is needed to fill a pattern, which in turn defines pick work area to pick from.

1. Check next item target type
2. Decide which work area to pick from
3. Pick item from pick work area
4. Place on out work area

Example code

```
PROC PickPlaceSeq()
  VAR num PlaceType:=0;

  NextItmTgtType
    ItmSrcData{PlaceWorkArea{1}}.ItemSource,
    PlaceType;
  IF PlaceType = 1 THEN
    Pick PickWorkArea{1};
  ELSEIF PlaceType = 2 THEN
    Pick PickWorkArea{2};
  ENDIF
  Place PlaceWorkArea{1};
ENDPROC
```

6.5.3 Example: Mixing with one pick and one place work area

Description of example

In this example we use the place work area as master to decide which item is needed to fill a pattern, which in turn defines which item to pick.

1. Check next item target type
2. Pick item from pick work area
3. Place on out work area

Note

It's recommended to use the **Use Start/Stop** in the **Available Work Areas** setting.

Example code

```
PROC Pick(num Index)
  VAR num PickType:=0;
  VAR num PlaceType:=0;

  WObjPick:=ItmSrcData{Index}.Wobj;
  NextItmTgtType
    ItmSrcData{PlaceWorkArea{1}}.ItemSource,PlaceType;
  TEST PlaceType
  CASE 4:
    PickType:=1;
  CASE 5:
    PickType:=2;
  CASE 6:
    PickType:=3;
  ENDTEST
  GetItmTgt ItmSrcData{Index}.ItemSource, PickTarget
        \ItemType:=PickType;
  TriggL \Conc, RelTool(PickTarget.RobTgt, 0, 0,
        -ItmSrcData{Index}.OffsZ), MaxSpeed,
        ItmSrcData{Index}.VacuumAct1, z20, PickAct1 \WObj:=WObjPick;
  MoveL \Conc, PickTarget.RobTgt, LowSpeed, z5 \Inpos:=
        ItmSrcData{Index}.TrackPoint, PickAct1 \WObj:=WObjPick;
  GripLoad ItemLoad;
  TriggL RelTool(PickTarget.RobTgt, 0, 0, -ItmSrcData{Index}.OffsZ),
        LowSpeed, ItmSrcData{Index}.Ack, z20, PickAct1
        \WObj:=WObjPick;
ENDPROC
```

6.5.4 Example: Double pick single place

Description of example

The robot shall pick up two items, one-by-one, on the infeeder conveyor, and then place both items on the outfeed conveyor. This operation requires a picking tool with two vacuum ejectors.

Implementation

As a starting point, create a simple working setup with one robot.

The RAPID program needs to be modified. To edit the RAPID program, go to the **Recipe Setting**, select a robot and display the drop down menu, select the **Rapid program** and select **Edit...**.

The `PickPlaceSeq` routine shall perform two Pick routine calls to handle the first and the second pick. It will then perform one Place routine call to handle the simultaneous placing of the picked up items. See the following example code.

```
!
! Procedure PickPlaceSeq
!
! The Pick and Place sequence.
! Edit this routine to specify how the robot shall execute the
    movements.
!

!***********************************************************
PROC PickPlaceSeq()
  Pick PickWorkArea{1}, 1;
  Pick PickWorkArea{1}, 2;
  Place PlaceWorkArea{1};
ENDPROC
```

For the Pick routine, see the following example code. Note the usage of `PickAct2` and `VacuumAct2` for the second pick.

```
!***********************************************************
!
! Procedure Pick
!
! Executes a pick movement.
! Edit this routine to modify how the robot shall
! execute the pick movements.
! Needs to be changed if more than one activator is used.
!
!***********************************************************
PROC Pick(num Index, num pickNo)
  IF Index > 0 THEN
    WObjPick:=ItmSrcData{Index}.Wobj;
    GetItmTgt ItmSrcData{Index}.ItemSource,PickTarget;
    IF pickNo = 1 THEN
      TriggL\Conc,RelTool(PickTarget.RobTgt,0,0,
      -ItmSrcData{Index}.OffsZ),
```

Continues on next page

```
            MaxSpeed,ItmSrcData{Index}.VacuumAct1,z20,
            PickAct1\WObj:=WObjPick;
            TriggL\Conc,PickTarget.RobTgt,LowSpeed,ItmSrcData{Index}.SimAttach1,
            z5\Inpos:=ItmSrcData{Index}.TrackPoint,
            PickAct1\WObj:=WObjPick;
            GripLoad ItemLoad;
            TriggL
            RelTool(PickTarget.RobTgt,0,0,-ItmSrcData{Index}.OffsZ),
            LowSpeed,ItmSrcData{Index}.Ack,z20,PickAct1\WObj:=WObjPick;
          ELSEIF pickNo = 2 THEN
            TriggL\Conc,RelTool(PickTarget.RobTgt,0,0,-ItmSrcData{Index}.OffsZ),
            MaxSpeed,ItmSrcData{Index}.VacuumAct2,
            z20,PickAct2\WObj:=WObjPick;
            TriggL\Conc,PickTarget.RobTgt,LowSpeed,ItmSrcData{Index}.SimAttach2,
            z5\Inpos:=ItmSrcData{Index}.TrackPoint,
            PickAct2\WObj:=WObjPick;
            GripLoad ItemLoad;
            TriggL
            RelTool(PickTarget.RobTgt,0,0,-ItmSrcData{Index}.OffsZ),
            LowSpeed,ItmSrcData{Index}.Ack,z20,
            PickAct2\WObj:=WObjPick;
          ENDIF
        ELSE
          ErrWrite "Missing item distribution", "Cannot pick because no
               item distribution contains current work area."
          \RL2:="Please check configuration";
          SafeStop;
        ENDIF
      ENDPROC
```

The tooldata `PickAct1` is used at the first pick. The tooldata `PickAct2` is used at the second pick. Update `PickAct1` and `PickAct2` (defined in module `ppaUser.sys`): Define the tool center point in the center of the controlled vacuum ejector. Update also the weight and the center of mass. Save the updates of the RAPID program, close the editor, and apply the updates.

For the Place routine see the following example. Note the usage of `VacuumOff1` and `VacuumOff2` for the simultaneous placing of both held items.

```
!***********************************************************
!
! Procedure Place
!
! Executes a place movement.
! Edit this routine to modify how the robot shall
! execute the place movements.
! Needs to be changed if more than one activator is used.
!
!***********************************************************
PROC Place(num Index)
  IF Index > 0 THEN
    WObjPlace:=ItmSrcData{Index}.Wobj;
    GetItmTgt ItmSrcData{Index}.ItemSource,PlaceTarget;
```

Continues on next page

```
    MoveL\Conc,RelTool(PlaceTarget.RobTgt,0,0,-ItmSrcData{Index}.OffsZ),
    MaxSpeed,z20,PlaceAll\WObj:=WObjPlace;
    TriggL\Conc,PlaceTarget.RobTgt,LowSpeed,ItmSrcData{Index}.VacuumRev1\T2:=
    ItmSrcData{Index}.VacuumOff1\T3:=ItmSrcData{Index}.VacuumOff2\T4:=
    ItmSrcData{Index}.VacuumRev2\T5:=ItmSrcData{Index}.SimDetach1\T6:=
    ItmSrcData{Index}.SimDetach2,z5\Inpos:=
    ItmSrcData{Index}.TrackPoint,PlaceAll\WObj:=WObjPlace;
    GripLoad load0;
    TriggL RelTool(PlaceTarget.RobTgt,0,0,-ItmSrcData{Index}.OffsZ),
    LowSpeed,ItmSrcData{Index}.Ack,z20,PlaceAll\WObj:=WObjPlace;
  ELSE
    ErrWrite "Missing item distribution", "Cannot place because no
         item distribution contains current work area."
    \RL2:="Please check configuration";
    SafeStop;
  ENDIF
ENDPROC
```

The tooldata `PlaceAll` (defined in module `ppaUser.sys`) is used at place. Update `PlaceAll`: Define the tool center point in the center of the controlled vacuum ejectors. Update also the weight and the center of mass. Save the updates of the RAPID program, close the editor, and apply the updates.

Note

Use the same method to setup a tool with more than two activators. However, a few additional setup steps are required. For example, using a tool with 3-4 activators requires the following additional steps:

1. Select two I/O boards as controller option. Alternatively, create additional signals `goVacBlow3`, `goVacBlow4`, `doVacuum3`, `doVacuum4`, `doBlow3`, and `doBlow4`. The first bit of `goVacBlowX` shall overlap the signal `doVacuumX`. The second bit of `goVacBlowX` shall overlap the signal `doBlowX`.
2. Update the `SetTriggs` routine. Enable the `TriggEquip` events `VacuumAct3`, `VacuumOff3`, `VacuumAct4`, and `VacuumOff4` by removing the comments on these lines.

6.5.5 Example: Placing a predefined pattern on indexed work area

Description of example

In this example we place a predefined pattern on an indexed work area. The position generator signal is triggered from RAPID.

Four new signals must be defined.

1. Position generator signal set from RAPID, `doSIMPosGen`.
2. Position generator signal that generates an event from the controller to the computer, `diSIMPosGen`.
3. Trigger signal that tells the system on the computer to send a predefined position, `doSIMTrig`.
4. Strobe signal that tells the system a position is sent, `diSIMStrobe`.

The signals can be defined on the PPASIM board. For example:

```
-Name "doSIMPosGen" -SignalType "DO" -Unit "PPASIM" -UnitMap "6"
     -Access "ALL"
-Name "doSIMTrig" -SignalType "DO" -Unit "PPASIM" -UnitMap "7"
     -Access "ALL"
-Name "diSIMPosGen" -SignalType "DI" -Unit "PPASIM" -UnitMap "6"
     -Access "ALL"
-Name "diSIMStrobe" -SignalType "DI" -Unit "PPASIM" -UnitMap "7"
     -Access "ALL"
```

Cross connect the trigger and strobe signal and the position generator signals. For example:

```
EIO_CROSS
  -Res "diSIMPosGen" -Act1 "doSIMPosGen"
  -Res "diSIMStrobe" -Act1 "doSIMTrig"
```

In the RAPID code, create a control of the place queue. If the queue is empty (all positions in the pattern are used) set the signal `doSIMPosGen` high (in the RAPID code). This signal is cross connected with the `diSIMPosGen` and an event will be sent to the computer from the controller that a new pattern has to be sent to the controller. The trigger strobe signals are also cross connected and the `diSIMStrobe` will be used to strobe the system.

Example code

```
PROC Place(num Index)
  VAR bool flagplace:=TRUE;

  WObjPlace:=ItmSrcData{Index}.Wobj;
  flagplace:=TRUE;

  WHILE flagplace=TRUE DO
    GetItmTgt ItmSrcData{Index}.ItemSource,
         PlaceTarget\MaxTime:=1\TimeFlag:=flagplace;
    IF flagplace=TRUE THEN
      PulseDO\PLength:=0.2,doSIMPosGen;
    ENDIF
  ENDWHILE
```

Continues on next page

```
  MoveL\Conc, RelTool(PlaceTarget.RobTgt, 0, 0,
       ItmSrcData{Index}.OffsZ), MaxSpeed, z20,
       PickAct1\WObj:=WObjPlace;
  TriggL\Conc, PlaceTarget.RobTgt, LowSpeed,
       ItmSrcData{Index}.VacuumRev1
       \T2:=ItmSrcData{Index}.VacuumOff1, z5
       \Inpos:=ItmSrcData{Index}.TrackPoint,
       PickAct1\WObj:=WObjPlace;
  GripLoad load0;
  TriggL RelTool(PlaceTarget.RobTgt, 0, 0, ItmSrcData{Index}.OffsZ),
       LowSpeed, ItmSrcData{Index}.Ack, z20,
       PickAct1\WObj:=WObjPlace;
ENDPROC
```

6.5.6 Example: Selecting item depending on clearance zone

Description of example

In this example, we select items on a conveyor belt depending on the clearance zone around the item, that is if there is any other item target within a specified area. This is useful when it is important that the gripper does not touch surrounding objects.

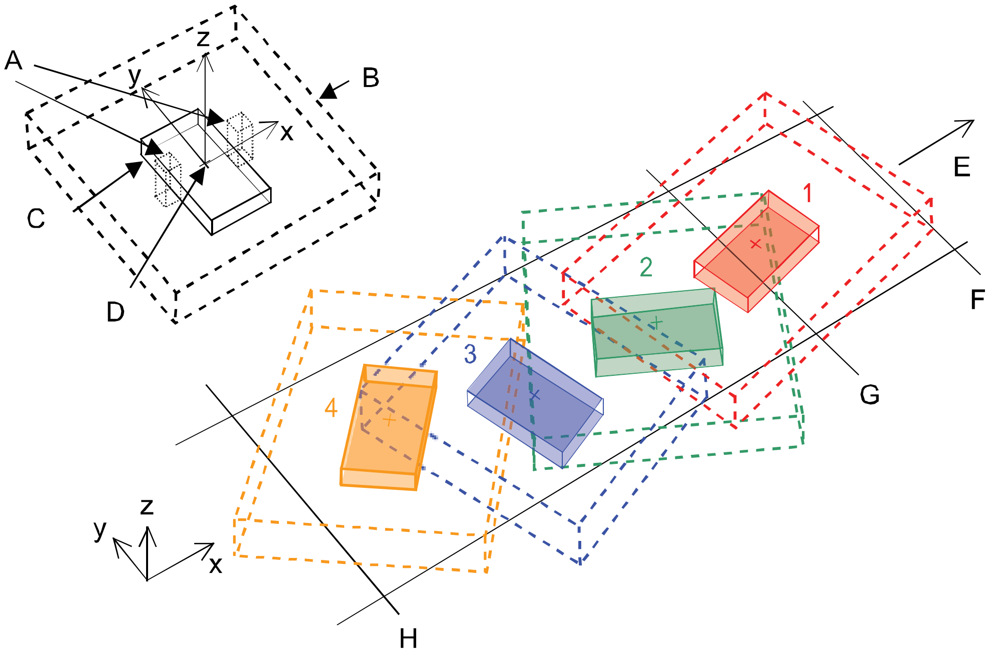
The selection algorithm selects the object that is closest to the exit limit in x-direction and has no locking objects in the selection shape.

Use the check limit in x-direction as a parameter to the `GetItmTgt` instruction. This makes it possible to define the starting point from where the first object will be picked. The instruction will try to retrieve the first object between the check and enter limits. This will cause the selection algorithm to take all objects between the check limit and the exit limit into consideration when checking for the nearest objects. Therefore the distance between the check limit and the exit limit will be at least the diameter of the largest item.

The illustration below shows how the items are selected depending on the position and the orientation. The robot will first pick item 4 and then item 3. The other two will never be picked.

- Item 1 cannot be picked because it has passed the check limit, and item 2 is inside its selection shape.
- Item 2 cannot be picked because the positions of items 1 and 3 are inside its selection shape.
- Item 3 cannot be picked because item 4 is inside its selection area.
- Item 4 can be picked because no other item is its selection shape.
- Item 3 will be picked after item 4 is no longer present.

Continues on next page



xx0800000323

A	Grippers
B	Selection shape
C	Item
D	Item target position
E	Product flow direction
F	Exit
G	Check limit
H	Enter

See *selectiondata - Selection data on page 397*.

Example code

```
PROC Pick(num Index)
  VAR selectiondata sel_data;
  VAR robtarget draw_target;
  VAR num check_limit;

  sel_data.ShapeType:=BOX;
  sel_data.ConsiderType:=BitOr(ITEMS_TO_USE,ITEMS_BYPASS);
  sel_data.GeometricData.x:=60;
  sel_data.GeometricData.y:=70;
  sel_data.GeometricData.z:=10;sel_data.GeometricData.radius:=0;
  sel_data.Offset.OffsetRelation:=ITEM_COORD_DIR;
  sel_data.Offset.OffsetPose.trans.x:=0;
  sel_data.Offset.OffsetPose.trans.y:=0;
  sel_data.Offset.OffsetPose.trans.z:=0;
  sel_data.Offset.OffsetPose.rot.q1:=1;
  sel_data.Offset.OffsetPose.rot.q2:=0;
```

Continues on next page

```
    sel_data.Offset.OffsetPose.rot.q3:=0;
    sel_data.Offset.OffsetPose.rot.q4:=0;
    check_limit:=150;

    WObjPick:=ItmSrcData{Index}.Wobj;
    GetItmTgt ItmSrcData{Index}.ItemSource,PickTarget
         \Limit:=check_limit\Selection:=sel_data;
    TriggL \Conc, RelTool(PickTarget.RobTgt, 0, 0,
         -ItmSrcData{Index}.OffsZ), MaxSpeed,
         ItmSrcData{Index}.VacuumAct1, z20, PickAct1\WObj:=WObjPick;
    MoveL \Conc, PickTarget.RobTgt, LowSpeed, z5 \Inpos:=
         ItmSrcData{Index}.TrackPoint, PickAct1\WObj:=WObjPick;
    GripLoad ItemLoad;
    TriggL RelTool(PickTarget.RobTgt, 0, 0, -ItmSrcData{Index}.OffsZ),
         LowSpeed, ItmSrcData{Index}.Ack, z20,
         PickAct1\WObj:=WObjPick;
  ENDPROC
```

6.5.7 Example: Sorting in negative y-direction

Description of example

In this example, we shuffle items off a conveyor belt without touching surrounding objects. The shuffle movement is done perpendicular on the horizontal plane to the right side of the conveyor and the manipulator motion is coordinated with the conveyor motion.

The sorting algorithm selects the item closest to the exit limit in x-direction and has no locking objects in its selection shape.

The selection shape is defined as a long box. The shape's x-value is used to define the corridor width, the y-value must be more than half the width of the conveyor belt and the z-value must be greater than the largest difference in height among all items.

Set the y-value in the `OffsetData` to the negative y-value of the shape, the selection box will be moved out to the right.

As a result there must be a clear corridor to the right of every item before it is shuffled.

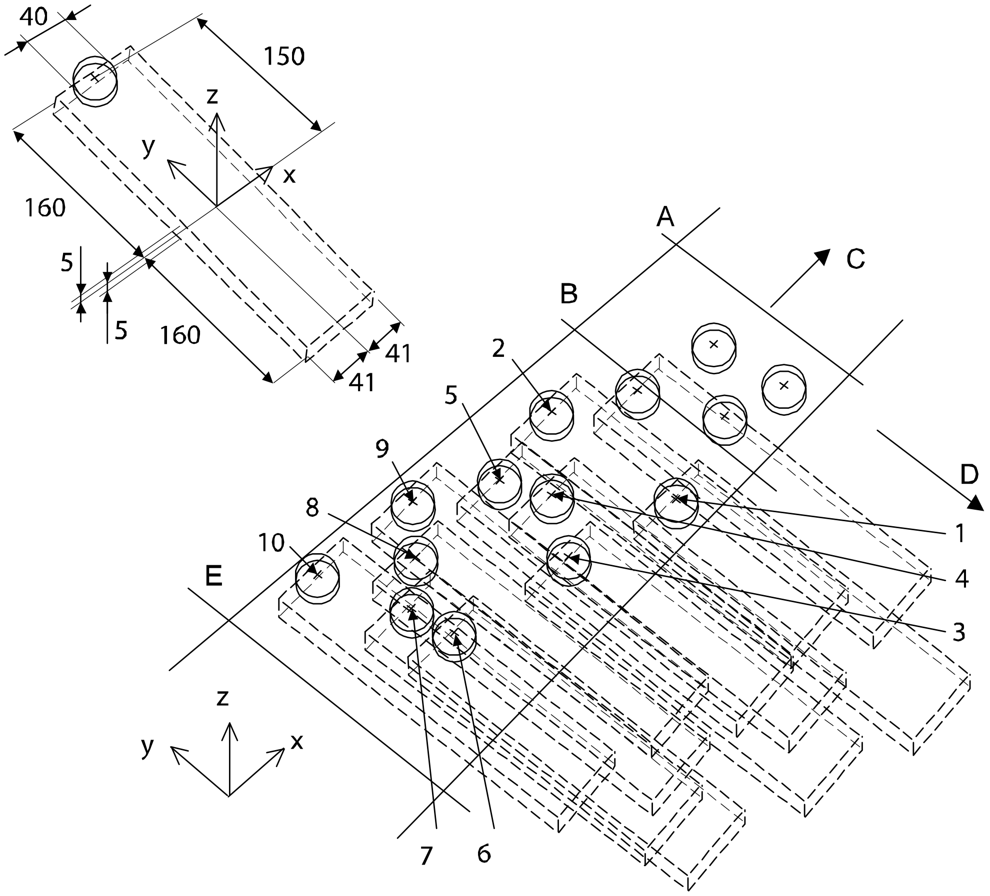
The algorithm will check both upwards and downwards the production flow for other items.

Use the check limit in the x-direction as a parameter to the `GetItmTgt` instruction, to define the starting point from where the first item will be shuffled. The instruction will try to shuffle the first item between the check and enter limits. This will also cause the selection algorithm to take all items between the check limit and the exit limit into consideration when checking for the nearest items. Therefore the distance between the check limit and the exit limit will be at least the diameter of the largest item.

In the illustration below, all items will be shuffled off to the right side of the conveyor belt. Because each item needs a clear zone, that is the shape of the *ShapeType*,

Continues on next page

the items will be shuffled off in the order 1 to 10 as numbered in the illustration below.



xx0800000324

A	Exit
B	Check limit
C	Product flow direction
D	Sort direction
E	Enter

Example code

```
PROC Pick(num Index)
  VAR selectiondata y_sort;
  VAR robtarget draw_target;
  VAR num check_limit;

  y_sort.ShapeType:=BOX;
  y_sort.ConsiderType:=BitOr(ITEMS_TO_USE,ITEMS_BYPASS);
  y_sort.GeometricData.x:=41;
  y_sort.GeometricData.y:=160;
  y_sort.GeometricData.z:=5;
  y_sort.GeometricData.radius:=0;
  y_sort.Offset.OffsetRelation:=FRAME_COORD_DIR;
```

Continues on next page

```
  y_sort.Offset.OffsetPose.trans.x:=0;
  y_sort.Offset.OffsetPose.trans.y:=-150;
  y_sort.Offset.OffsetPose.trans.z:=0;
  y_sort.Offset.OffsetPose.rot.q1:=1;
  y_sort.Offset.OffsetPose.rot.q2:=0;
  y_sort.Offset.OffsetPose.rot.q3:=0;
  y_sort.Offset.OffsetPose.rot.q4:=0;
  check_limit:=150;

  WObjPick:=ItmSrcData{Index}.Wobj;
  GetItmTgt ItmSrcData{Index}.ItemSource,PickTarget
       \Limit:=check_limit\Selection:= y_sort;
  TriggL\Conc, RelTool(PickTarget.RobTgt, 0, 0,
       -ItmSrcData{Index}.OffsZ), MaxSpeed,
       ItmSrcData{Index}.VacuumAct1, z20, Gripper\WObj:=WObjPick;
  MoveL\Conc, PickTarget.RobTgt, LowSpeed, z5
       \Inpos:=ItmSrcData{Index}.TrackPoint, Gripper
       \WObj:=WObjPick;
  GripLoad ItemLoad;
  draw_target:=PickTarget.RobTgt;
  draw_target.trans.y:=-200;
  draw_target.rot:=[0,1,0,0];
  TriggL draw_target, LowSpeed, ItmSrcData{Index}.Ack, z20,
       Gripper\WObj:=WObjPick;
ENDPROC
```

6.5.8 Example: Indexed work area with predefined position

Description of example

In this example we use an indexed work area with predefined positions.

When using predefined positions with the indexed work area, we must modify the configuration, that is the EIO.cfg file. We will cross connect the trigger and strobe signals because with predefined positions there is no system generating the strobe signal. Without the predefined positions, the trigger signal is sent to the vision system to acquire an image. The strobe is then sent back from the vision system to acknowledge that the image has been acquired.

This is an example setup for a line that is triggered externally by an I/O signal and the position source is a predefined positions type. We recommend defining unique signal names for all new signals when setting up a system that is much different from the standard system.

Two new signals are used in this line:

- The trigger signal, `doTrigSignal`.
- The strobe signal, `diStrobeSignal`.

Modify the signal configurations by adding the two signals.

```
EIO_SIGNAL:
-Name "doTrigSignal" -SignalType "DO" -Unit "PPASIM" -UnitMap "6"
     -Access "ALL"
-Name "diStrobeSignal" - SignalType "DI" -Unit "PPASIM" -UnitMap
     "6" -Access "ALL"
```

The trigger and strobe signals are cross connected since there is no vision system that can send back a strobe signal.

```
EIO_CROSS
-Res "diStrobeSignal" -Act1 "doTrigSignal"
```

The Position generator signal in this case is `di1_1`, which is connection 1 on the DSQC 328A:X3 board, see *Circuit diagram - PickMaster Twin*, *3HAC024480-020*.

When the `di1_1` goes high (by an external I/O signal) the trigger signal is pulsed. Since the trigger and strobe signals are cross connected, the strobe will be received immediately. An event will then be sent from the controller to the computer, which it is ready for new item positions and the predefined positions will then be sent to the controller. If a pattern is used, several positions are sent for every signal.

In this example the robot execution signal is not used and was therefore removed.

6.5.9 Example: Automatically generating new positions to indexed work area

Description of example

In this example we configure an indexed work area and the queue will automatically be refilled with new positions when it is empty.

The trigger and strobe signals are set up as in *Example: Indexed work area with predefined position on page 428*.

Instead of using an external input I/O signal, we will use a new simulated input I/O signal as position generator signal. This signal is set by a cross connected simulated output signal.

Two new signals are used in this line:

- The output position generator signal, `doPosGenSignal`.
- The input position generator signal, `diPosGenSignal`.

Modify the signal configurations by adding the two signals.

```
EIO_SIGNAL:
-Name "doPosGenSignal" - SignalType "DO" -Unit "PPASIM" - UnitMap
     "7" -Access "ALL"
-Name "diPosGenSignal" - SignalType "DI" -Unit "PPASIM" - UnitMap
     "7" -Access "ALL"
```

The position generator signals are cross connected.

```
EIO_CROSS
-Res "diPosGenSignal" -Act1 "doPosGenSignal"
```

`diPosGenSignal` is defined in the line as the position generator signal and `doPosGenSignal` is defined as queue idle signal.

When the queue goes empty the queue idle signal `doPosGenSignal` will go high. This cross connection will make `diPosGenSignal` go high and new positions will be pushed to the queue according to the earlier described principles.

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7 Troubleshooting

7.1 Introduction to troubleshooting

Troubleshooting

This chapter describes some of the most common troubles known when installing, configuring, or running PickMaster PowerPac.

A fault in the robot system first appears as a symptom, which can be:

- An event log message that can be viewed using PickMaster PowerPac, FlexPendant, RobotStudio, or Windows Event Viewer.
- The system is performing poorly or displaying mechanical disturbances.
- The system can not be started or displays irrational behavior during start.
- Indications on the hardware, such as LEDs.
- Other types of symptoms. The robot system is complex and has a large number of functions and function combinations.

Related information

Generic troubleshooting and all error messages in the robot system are listed in *Operating manual - Troubleshooting IRC5*.

Administering the log on page 433.

7.2 Safety during troubleshooting

General

All normal service work; installation, maintenance and repair work, is usually performed with all electrical, pneumatic and hydraulic power switched off. All manipulator movements are usually prevented by mechanical stops etc.

Troubleshooting work differs from this. While troubleshooting, all or any power may be switched on, the manipulator movement may be controlled manually from the FlexPendant, by a locally running robot program or by a PLC to which the system may be connected.

Dangers during troubleshooting

This implies that special considerations **unconditionally** must be taken when troubleshooting:

- All electrical parts must be considered as *live*.
- The manipulator must at all times be expected to perform any movement.
- Since safety circuits may be disconnected or strapped to enable normally prohibited functions, the system must be expected to perform accordingly.

DANGER

Troubleshooting on the controller while powered on must be performed by personnel trained by ABB or by ABB field engineers.

7.3 Administering the log

The log

The log messages that are displayed in the log area of PickMaster PowerPac.

Administering the log

Use this procedure to administer the event log.

1. Click the **LOG** ribbon
2. If you need to view the event log in the PickMaster PowerPac, select **Viewer**. The event log will show up.
3. If you need to view the event log without the PickMaster PowerPac, select **Save**. The event log will be saved as `xlsx` file.

7.4 Fault symptoms or errors

7.4.1 Warnings 4326 - 4329

Verification actions

The following are the general verification actions for the warning 4326, 4327, 4328, and 4329. For more detailed explanation, see *Warning 4326 on page 435*, *Warning 4327 on page 435*, *Warning 4328 and 4329 received together on page 436*, *Warning 4328 received without 4329 on page 437*, and *Warning 4329 received without 4328 on page 437*.

Action 1

Check the selection of signals for trigger and strobe in the work area configuration of the PickMaster line. Check that the I/O configurations of these signals correspond to the wiring.

Action 2

Check all the trig/strobe wiring. Check if the trig and strobe cables are mixed up. Make sure that the cables are shielded, properly attached and grounded the right way. There should be no current in the shield. Make sure that sources for 24 volt are not mixed. The controller system parameter *SyncSeparation*(Topic: I/O, Type: Fieldbus Command, Name: CNVX) can be modified to filter strobe input events from a camera or sensor.

Action 3

Check all the LAN cables on the robot network. Make sure that the cables are shielded and properly attached. Check that the right IP address, default gateway, and subnet mask is defined (on both PC and robot controller). Note that all three values must be defined even if there is only one computer and one robot controller on the network. For more information, see *Configuring networks on page 39*.

Action 4

See *Configuring networks on page 39*..

Action 5

Check that the IP address (goto **File** and click **Options**) in the field "Controller Network Adapter" is the address of the network interface card in the PC that communicates with the robot controller. Check if time sync service has trouble to connect to controller. Stop the service for 30 seconds and then restart it again. Check that there are no firewalls active that are affecting the time synchronization services.

Action 6

Reduce the trigger frequency Sometimes the trigger distance is very short causing the system to trigger much more often than it can handle. How often a trigger can be handled depends on how complicated the models are that are used on the system. Sometimes the frequent triggering can be caused by faulty trigger/strobe wiring or electrical noise.

Continues on next page

Action 7

Some switches are buffering data that needs to be present. This buffering time might be too long. Try to switch to a simple hub or to decrease this buffer time. Make sure that you have the newest software running on the hub/switch. Make sure that there are no infinite loops in the RAPID code because it will affect the robot network communication .

Action 8

Debug the implementation of the external sensor.

Action 9

For external sensors there might be a small constant delay between the strobe pulses and the recording of time stamps (For example, if the trigger signal is cross connected with the strobe). Modify the Position Source parameter *Synchronization tune* to modify all time stamps sent to PickMaster with a constant time value.

Warning 4326

For verification actions, see the preceding section.

Error description:

4326 Item positions lost on %s due to missing strobe. See Application manual.

Probable causes:

The following table provides the probable causes of the warning 4326:

Probable cause	Verfication actions
If work area is conveyor:	
The conveyor board does not receive any strobe pulses on the start input.	*Action 1 on page 434*, *Action 2 on page 434*
The strobe signal is not configured as cXNewObjStrobe.	*Action 1 on page 434*
PickMaster has no connection with the robot controller.	*Action 3 on page 434*
If work area is indexed:	
The configured strobe signal does not receive a strobe pulses.	*Action 1 on page 434*, *Action 2 on page 434*
PickMaster has no connection with the robot controller.	*Action 3 on page 434*

Warning 4327

Error description:

4327 Expected item positions missing from %s. See Application manual.

Probable causes:

The following table provides the probable causes of the warning 4327:

Probable cause	Verfication actions
If source type is camera:	
The camera does not receive trigger pulses.	*Action 1 on page 434*, *Action 2 on page 434*
PickMaster has no connection with the camera.	*Action 4 on page 434*

Continues on next page

Probable cause	Verfication actions
If source type is external sensor:	
The external sensor does not receive any trigger pulses.	*Action 1 on page 434*, *Action 2 on page 434*
The external sensor does not send any positions to PickMaster.	*Action 8 on page 435*
If source type is external sensor:	
The external sensor does not receive any trigger pulses.	*Action 1 on page 434*, *Action 2 on page 434*
The external sensor does not send any positions to PickMaster.	*Action 8 on page 435*
If source type is predefined and work area is conveyor:	
The conveyor board does not receive any strobe pulses on the start input.	*Action 1 on page 434*, *Action 2 on page 434*
The strobe signal is not configured as cXNewObjStrobe.	*Action 8 on page 435*
PickMaster has no connection with the robot controller	*Action 3 on page 434*
If source type is predefined and work area is indexed:	
The configured strobe signal does not receive an strobe pulses.	*Action 1 on page 434*, *Action 2 on page 434*
PickMaster has no connection with the robot controller.	*Action 3 on page 434*

Warning 4328 and 4329 received together

Error description:

Typically, a pair of 4328 and 4329 is received for one, several or every trigger/strobe related to a work area.

4328 Trigger/strobe time mismatch (%.1f s). Item positions from %s to %s lost. See Application manual.

4329 Trigger/strobe time mismatch (%.1f s). Strobe from %s was ignored. See Application manual.

Probable causes:

The following table provides the probable causes of the warning 4328 and 4329:

Probable cause	Verfication actions
In order of probability:	
The time synchronisation between controllers and PickMaster is not working.	*Action 6 on page 434*
The trigger frequency is set too high.	*Action 5 on page 434*
Low robot network performance	*Action 7 on page 435*
Low camera network performance	*Action 4 on page 434*
Additional causes for external sensors:	
Time stamps are not enough synchronized with strobes.	*Action 9 on page 435*
The external sensor does not send positions with a correct time stamp..	*Action 8 on page 435*

Continues on next page

Warning 4328 received without 4329

Error description:

4328 Trigger/strobe time mismatch (%.1f s). Item positions from %s to %s lost. See Application manual.

Probable causes:

The following table provides the probable causes of the warning 4328 and 4329:

Probable cause	Verfication actions
The trigger signal is not stable.	*Action 2 on page 434*

Warning 4329 received without 4328

Error description:

4329 Trigger/strobe time mismatch (%.1f s). Strobe from %s was ignored. See Application manual.

Probable causes:

The following table provides the probable causes of the warning 4328 and 4329:

Probable cause	Verfication actions
The strobe signal is not stable.	*Action 2 on page 434*

7.4.2 The camera does not take pictures

Error description

The camera does not take pictures.

Probable causes

There can be several causes why the camera does not take pictures. To check all the possible causes the following must be verified.

- Check that the trig cable is properly connected.
- Check that the camera cable is connected to the correct port.

If the camera is distance trigged, the encoder might not be recording any conveyor movement due to

- bad encoder connection or
- wrong conveyor selected in the work area.

If the camera is I/O trigged, the photo eye might not be sensing any part, due to:

- Wrong connection.
- Bad reflection.

7.4.3 Robot does not move

Error description

The camera is identifying objects, but the robot does not move.

Probable causes

There can be several causes why the robot does not move although the camera takes pictures properly. To check all the possible causes the following must be verified.

- To check that the strobe cable is connected, check the StartSig LED on the encoder board.
- Check the distribution in the Position Source.
- Check the AI *c*Speed* in the I/O list if any speed is detected. If not, check encoder signals.
- Check the AI *c*Position* in the I/O list if any position is tracked. If not, check the distribution in the Position Source.
- Check the direction of travel on the DI *c*DirOfTravel*.
- Monitor the signal *Queue Idle*, to see if the queue gets any positions.
- Monitor the *Position Available* signal, to see if the parts are detected.

7.4.4 Bad or varying position accuracy

Error description

The position accuracy is bad or varying.

Probable causes

There can be several causes why the position accuracy is bad or varying. To check all the possible causes the following must be verified.

- Verify that the *Counts Per Meter* calibration is accurate. Verify several times. Include verification in scheduled maintenance.
- Avoid drive shaft encoders, since belt slippage between roller and belt can vary.
- Check the camera calibration. Poor quality of calibration grid will give inaccurate calibration result.
- Check if there are differences between calibration paper height and product height.
- Check if there are parallax errors when identifying high products.
- Make sure that the camera is not mounted on robot frame because this can cause camera vibrations.

7.4.5 Positions are used twice

Error description

The robot uses every position twice.

Probable causes

There can be several causes why the robot uses every position twice. To check all the possible causes the following must be verified.

- If I/O trigged predefined positions or containers are used, set the *SyncSeparation* filter distance to avoid double and ghost triggers.
- If vision is used, increase the overlap and position filter.
- Clear the checkbox **Same level only** in the Position Source.

If a robot downstream in an ATC group tries to use an already used item, then the Work Area order in the Position Source is incorrect.

7.4.6 Problem with camera resolution in PickMaster

Error description

Camera image size decreases to lower resolution as compared to calibration image resolution.

Probable causes

There can be several causes why camera resolution is decreased. To check all the possible causes the following must be verified:

- Is the factory default configuration is active.
- There could be custom configuration activated. Verify if the custom configuration is having reduced ROI (region of interest).

7.5 Error codes

Common error codes

Error code	Type	Description
4097	Error	Undefined error Reason: The occurred error has not been given a correct error ID but the error message should explain the reason.
4098	Status	Information only
4099	Error	Command line options Reason: PickMaster was given an unknown command line option, e.g. /p, at startup.
4100	Error	Description: Unexpected error Reason: An unexpected error occurred in PickMaster. See the log message for more information.
4101	Error	XML parsing error Reason: There was a problem reading either a pmline or pmproj file. See the log message for further information about where in the file the error occurred.
4197	Error	The project has been upgraded to a later version and the file is marked as modified. The file needs to be saved to make changes permanent.
4198	Error	The line has been upgraded to a later version. If the line itself was opened it is marked as modified and needs to be saved. If a project was opened, the line should be opened and saved before continuing.
4199	Error	The project file has an invalid format. It was either created with a beta version of PickMaster or the file is corrupt.
4200	Error	The PickMaster program failed to access the Windows registry when writing or reading its configuration
4202	Warning	The project is not designed on the current line. When trying to open a project, there is already a project open that is built upon a different line. Reason: Only one line can be used at the same time. Solution: Close any open projects and try to open the project again.
4203	Error	Failed to load the corresponding line when opening a project. The line file may be corrupt
4204	Error	Failed to load a line. The file may be corrupt.
4205	Error	The imported line may need to be recalibrated Reason: If the imported line was designed with other cameras or lenses, the cameras as well as the robot's base frame must be recalibrated.
4206	Error	The selected RIS plug-in could not be loaded at program startup. The file may be corrupt.
4207	Error	The selected RIS plug-in could not be found at program startup.
4208	Error	One of the previously available lines has been overwritten by another line. The old line will not show up as an available line and projects designed on that line cannot be used.

Continues on next page

Error code	Type	Description
4209	Error	The line file is invalid and cannot be opened.
4210	Error	Failed to load resources for the selected language. The default language (English) will be used instead
4211	Status	A notification about the total number of picks done by a robot until the project was stopped.
4212	Error	Failed to remove the line file. The file must be removed manually.
4213	Warning	Failed to find the html help file for the selected language. Make sure the "Application manual xxx.chm" file is in the Documentation folder in the PickMaster folder.
4216	Error	An attempt to open a file not recognized by PickMaster.
4217	Error	No time synchronization service available. Reason: The **PickMaster Time Synchronization Service** might not be properly installed or not started. Solution: Verify the service is installed and try to restart the service.
4218	Warning	Two or more network adapters are configured on the same subnet: x.x.x Refer to the user guide and review the recommended network settings.
4297	Status	Attempt to start a project that is already running.
4298	Status	Attempt to stop a project that was not started.
4300	Error	A camera is currently in use by another project. Reason: When starting a project, one of the position sources is configured with a camera that is currently in use by another project. Solution: A camera can only be used in production in one project at the same time. Reconfigure one project or run them one at a time.
4301	Error	Failed to start project execution Reason: Internal error probably caused by out of memory. Solution: Try restarting the PickMaster program.
4302	Error	When starting a project, a vision defined position source has no camera defined. Solution: Either remove the position source or configure it with the camera to use.
4303	Error	When starting a project, a position source has no work area defined Solution: Either remove the position source or configure it with the work area to use
4304	Warning	When starting a project, a vision defined position source has no configured vision models. Solution: Either remove the position source or define which vision models to use.
4305	Error	When starting a project, a predefined position source has no object defined. Solution: Edit the position source and define the predefined object to use.

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Error code	Type	Description
4306	Status	A model was edited on a different camera than it was created on. Solution: Check that the correct camera is selected in the position source and retrain the model.
4307	Warning	A vision model was created on a camera that has not been calibrated. Solution: Open the corresponding line and calibrate the camera. Then retrain the model.
4308	Error	When running a project, a vision model found an object but could not find the item or container to refer to. Solution: Stop the project, remove the vision model in question and create a new one for the correct item.
4309	Warning	A container is incorrectly configured. Solution: Check the error message for more information.
4310	Status	Production was successfully started.
4311	Status	Production was successfully stopped.
4312	Warning	Indication that PickMaster is running on a demo license with limited production time. Reason: There is only a demo license installed Solution: Request a fully qualified license to run projects for an unlimited time.
4313	Error	PickMaster is running on a demo license and the allowed production time is exceeded. Solution: Request a fully qualified license or restart the PickMaster program to be able to start a project again
4314	Error	Got scene information from an unknown work area.
4315	Status	The work area that triggers a Position Source has changed. This occurs at project startup or when the robot controller with the previous trigger work area has stopped.
4319	Warning	Received item acknowledgment from an unknown work area.
4320	Warning	A project that used load balancing has been upgraded and a work area order was generated. The work area order must be verified in the Position Source configuration dialog box
4321	Warning	An item acknowledge was received from a work area but the corresponding item position could not be found. Following work areas will not be notified that an item position has already been accessed.
4326	Warning	Item positions lost on work area due to missing strobe. For more information, see *Warnings 4326 - 4329 on page 434*.
4327	Warning	Expected item positions missing from position source. For more information, see *Warnings 4326 - 4329 on page 434*.
4328	Warning	Trigger/strobe time mismatch. Item positions from position souce to work area lost. For more information, see *Warnings 4326 - 4329 on page 434*.
4329	Warning	Trigger/strobe time mismatch. Strobe from work area was ignored. For more information, see *Warnings 4326 - 4329 on page 434*.
4396	Error	A COM error occurred in when using an External Sensor. The log message provides more information.

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Error code	Type	Description
4397	Error	An error occurred when calling a function on an External Sensor COM object. The log message provides more information.
4398	Error	When opening a project with en external position generator, its corresponding sensor could not be found in the used line.
4399	Error	An external sensor failed to start when the project was started. The position source will not be used during production.
4596	Error	General User Hook error. See description for more information.
4797	Error	General license error. See description for more information.
4798	Error	More cameras are used than allowed by the currently installed license. Solution: Either remove cameras or request a new license.
4799	Error	More robot controllers are used than allowed by the currently installed license. Solution: Either remove robot controllers or request a new license.
4800	Error	More cameras are using inspection vision models than allowed by the currently installed license. Solution: Either remove inspection models or request a new license.
4804	Error	More robot controllers are using camera distribution than allowed by the currently installed license Solution: Either make sure not to use more camera distribution than allowed or request a new license.
4805	Error	Attempt to start a project with ATC without an appropriate license. Solution: Request a new license including the ATC option or remove ATC from the project.
4806	Warning	The licence will expire in less than 14 days. Solution: Request a new license.
4807	Error	More External Sensors are used than allowed by the currently installed license. Solution: Either remove External Sensors or request a new license.
4808	Error	Attempt to start a project with conveyors without an appropriate license. Solution: Request a new license including the ATC option or remove all conveyors from the project.
4809	Error	The network adapter (IP-address) not found. Solution: Make sure that the specified network card is enabled and that the IP address of the card has not changed.
4810	Error	Access to Service denied. Reason: PickMaster cannot Access Windows Services.
4811	Error	Cannot access PickMaster Time Synchronization Service. Reason: PickMaster Time Synchronization Service is not installed.
4812	Error	Cannot stop PickMaster Time Synchronization Service.
4813	Error	Cannot start PickMaster Time Synchronization Service.

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Robot error codes

Error code	Type	Description
8193	Status	The robot is running.
8194	Status	The robot is stopped.
8195	Status	The robot is paused
8196	Warning	Please set the robot in auto mode. Reason: The robot is started but the controller is not set to auto mode. Solution: Switch the controller to auto mode.
8197	Warning	Please confirm auto mode (on the FlexPendant). Reason: The robot is started and is set to auto mode but the auto mode is not confirmed. Solution: Confirm the auto mode on the FlexPendant.
8198	Status	The robot is in auto mode.
8199	Error	Robot error X (where X is the robot error number). Solution: See the robot documentation for the specific error.
8200	Warning	Robot warning X (where X is the robot warning number). Solution: See the robot documentation for the specific warning.
8201	Warning	Robot program controller in unknown state. Reason: The robot was started but the program controller is in an unknown state.
8202	Warning	Guard stop Reason: The robot has been stopped because a guard has been activated.
8203	Warning	Emergency stop Reason: The robot has been stopped because of an activation of the emergency stop Solution: Remove the reason for the stop and reset the emergency stop. Restart the robot (can be done without stopping the project).
8204	Status	Rapid program stopped
8205	Status	Rapid program has been restarted
8209	Status	Robot controller is in system failure Reason: See event log on the controller for more information
8211	Error	Lost connection Reason: The computer lost the connection to the controller. The network connection can be down. The controller can be shut off or lost its power. Solution: Make sure that the controller is on and has power supply. Also make sure that the network connection is working.
8212	Warning	A robot controller is used by another project Reason: A robot controller may only be used by one project at a time
8213	Warning	Robot controller not in use and may not be accessed. Reason: An attempt was made to access a robot controller that was not configured to be used in the project.

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Error code	Type	Description
8293	Error	Failed to set motors on. Reason: PickMaster failed to set motors on. Some system state prevents PickMaster from setting the motors to on (e.g. emergency stop, guard stop etc.).
8294	Error	Failed to start the RAPID program.
8295	Error	Failed to prepare the RAPID program for start.
8297	Error	Failed to set the RAPID variable "RoutineName" to "ClearAll" Reason: The variable "RoutineName" is probably missing or is of the wrong type (should be a string type).. Solution: Ensure that the variable exists and is of the string type.
8298	Error	Failed to get the robot controller states. Solution: Ensure that the controller is up and running OK. If not, reboot the controller.
8299	Error	Failed to get events from the robot controller. Solution: Ensure that the controller is up and running OK. If not, reboot the controller. Ensure that the correct network adapter is used for the specific controller in the line.
8300	Error	Failed to set the RAPID variable "StopProcess" to TRUE. Solution: Ensure that the RAPID variable" StopProcess" exists and is of type bool.
8302	Error	Failed to set the RAPID variable "RoutineName" to "PickPlace". Reason: The variable "RoutineName" is probably missing or is of the wrong type (should be a string type). Solution: Ensure that the variable exists and is of the string type.
8303	Internal Error	The system failed to apply a new work area tune because the work area ID does not exist.
8304	Internal Error	The system failed to apply new work area settings because the work area ID does not exist.
8305	Internal Error	The system failed to apply a new work area setting.
8306	Error	Failed to set DO signal "doSafeStop". Solution: Verify that the signal exists and is correctly set-up.
8307	Error	Failed to connect to the controller. Solution: Verify that the network address (IP address) to the controller is correct. Verify that the network settings on the computer are correct. Verify that the correct network adapter is used (in the line) to connect to the robot controller.
8308	Error	Failed to write the IP address to the controller. Solution: Verify that the RAPID variable" RemoteIPNode" exists and is of the correct type (should be of the string type).
8309	Error	Failed to initiate events from the robot controller. Solution: Verify that the robot controller is up and running correctly. If not, reboot the controller.
8310	Error	Failed to get the robot controller states. Solution: Ensure that the controller is up and running OK. If not, reboot the controller.

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Error code	Type	Description
8313	Error	Failed to set the IO signal ppaExe. Solution: Ensure that the signal ppaExe exists and is set-up correctly.
8314	Error	Failed to set the RAPID variable “RoutineName” to “NewSource”. Reason: The variable “RoutineName” is probably missing or is of the wrong type (should be a string type). Solution: Ensure that the variable exists and is of the string type.
8315	Error	The system failed to apply the new robot speed.
8316	Error	Failed to set the IO signal doTune. Solution: Ensure that the signal doTune exists and is set-up correctly.
8317	Error	The system failed to apply a new work area tune. Solution: Verify that the following RAPID variables exist. Num SourceIndex Num TunePosX Num TunePosY Num TunePosZ
8318	Error	Failed to load the RAPID program. Solution: Verify that there are no errors in the RAPID program (otherwise it will fail to load).
8319	Error	Failed to download the RAPID program to the controller.
8320	Error	Failed to stop execution of the RAPID program.
8321	Error	Failed to delete the RAPID program.
8322	Error	Failed to reset emergency stop.
8323	Error	Failed to restart the RAPID program. Solution: Stop the project and restart it.
8324	Error	Failed to get local IP address. Reason: The network set-up is not correct (e.g. wrong IP settings, faulty network adapter configuration, etc.). Solution: Solve the local network problem on the computer.

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Error code	Type	Description
8325	Error	Failed to init queues. Reason: PickMaster failed to initiate an item queue. The queue is initiated by setting several RAPID variables. Those variables must not be removed or changed. The variables are: String ItmSrcName String CnvName String NonCnvWobjName Num SourceType Num SourceIndex Num TunePosX Num TunePosY Num TunePosZ Num FollowTime Num Vtcp Num OffsZ Num VacActDelay Num VacRevDelay Solution: Ensure that all variables exist and are of the correct type (string or num etc.) in the RAPID program or in the PPA sys module (*ppasys.sys*).
8326	Error	Failed to synchronize the time on the robot controller with the PickMaster compute
8327	Error	There is no Rapid program defined for a robot controller when starting a project. Reason: Attempt to start a project without having configured which Rapid program to use for a robot controller. Solution: Select a Rapid program to use for the robot controller in question and restart the project.
8337	Error	Failed to flush item source queue (ItmSrcCnvxx). C0040403: No response from the controller. Reason: For large robots where working range is large, CPU takes more time for indexing it because of `GetReachableTarget` functionality. Solution: The accuracy of the release zone (indexed working range) associated with the function UseReachableTargets can be adjusted from 0% to 100% with a new process system parameter, `Reach Zone Accuracy`, in Type `Conveyor`. Default value is 100%. To make CPU load less make this value zero or very low. If the UseReachableTargets functionality is not used, it may be turned off by setting the `Reach Zone Accuracy` value to 0.
8338	Error	Not connected to controller. Reason: The communication with the controller could not be completed.
8339	Error	Unexpected error when using ABB Industrial Robot Communication Runtime to communicate with controller. Reason: See error log for more information.
8340	Error	Unexpected robot error. Reason: See error log for more information.
8341	Error	Failed to get write access to controller.

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Error code	Type	Description
8342	Error	Item source failed to send positions to the controller. No response from the controller.
8343	Error	The RobotWare version is later than the ABB Industrial Robot Communication Runtime on the PC. The Communication Runtime needs to be updated. Solution: If possible update PickMaster to the latest version. If this dose not solve the problem or for some reason is not possible, update the ABB Industrial Robot Communication Runtime on the PC. The installation can be downloaded from the *RobotStudio Online Community*, where it is included in the *Tools and Utilities* package.
8345	Error	Failed to start program in Auto. Possible reason: The RW role setting 'Remote start/stop program in Auto' is not selected.
8393	Error	The motion server already exists as an instance (only one instance is allowed).
8394	Error	The robot ID already exists (IDs shall be unique).
8395	Error	No robot defined with that ID.
8396	Error	Work areas still exist. The conveyor cannot be removed before the work areas are removed. Solution: Remove all work areas for the conveyor.
8397	Error	A work area with that ID already exists. (All IDs shall be unique).
8398	Error	No work area with that ID exists. An operation was executed on a non-existing work area. The work area has probably been removed.
8399	Error	Settings on the work area failed due to a bad work area ID.
8400	Error	The system failed to apply new work area settings due to a bad work area ID.
8401	Error	The system failed to set a new work area because the work area ID does not exist.
8402	Error	The system failed to apply a new work area tune because the work area ID does not exist.
8403	Error	The system failed to apply new robot settings because the robot ID does not exist.
8404	Error	The system failed to set new robot settings because the robot ID does not exist.
8406	Error	The system failed to set a new robot speed because the robot ID does not exist.
8407	Error	Failed to update the work area due to wrong work area type (indexed work area / conveyor work area).
8408	Warning	There are no work areas defined for the robot. Solution: Define work areas and set up position sources for the work areas for the robot before project start
8418	Status	Downloading elog files from controller. Reason: If elog files are missing at production start they will be downloaded automatically.

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Vision error codes

Error code	Type	Description
12298	Status	There is no frame grabber/Gigabit Ethernet camera installed
12299	Internal Error	Could not find the camera in question in the vision server.
12300	Internal Error	Could not find the vision model in question in the vision server.
12301	Internal Error	The camera is locked.
12302	Internal Error	Attempt to create or load a camera that already exists.
12305	Error	The current frame grabber does not support the selected video format.
12306	Internal Error	Failed to create camera.
12307	Internal Error	The vision server could not find the acquired camera during runtime.
12308	Warning	A camera is triggered too fast. Reason: A camera was triggered before it was done analyzing the last image. As long as there only are a few messages there will be no lost images. Solution: Adjust the vision models on the camera to yield a faster analyzing time. Adjust models on other cameras since it is the system performance in total that should be improved. Lowering the conveyor speed will also reduce the problem, if applicable.
12309	Error	Failed to get an image from a camera when running a project. Reason: This error probably occurred because the system is too heavily loaded or the frame grabber is triggered way too fast. Solution: Verify system load and make sure the robot controller does not send faulty vision triggers.
12310	Internal Error	Failed to create a geometric model. Reason: See error message for more information.
12312	Internal Error	Attempt to access a camera port on a frame grabber that does not exist.
12313	Internal Error	There is no camera port on the frame grabber specified for the camera. Solution: Open the corresponding line and configure the camera with a camera port.
12315	Error	Could not initiate the camera at project start. Reason: The system is probably out of resources.
12316	Error	External model failed to analyze image. Reason: See log message for more information
12317	Error	Failed to initiate external model at project start. Reason: See log message for more information
12318	Error	Failed to convert image to a format supported by external vision model.

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Error code	Type	Description
12319	Error	External model failed to inspect image. Reason: See log message for more information
12321	Error	When the line was opened, more than one camera was defined to use the same port on the same frame grabber. Only one camera can be configured to use a single camera port and hence the other cameras were reset and must be configured again.
12322	Error	When the line was opened, a camera was defined on a frame grabber that was not available. The camera was reset and must be configured again.
12323	Error	Could not initiate the camera. More information is provided in the log message.
12324	Error	Failed to save camera configuration. More information is provided in the log message
12325	Error	Failed to load camera configuration. More information is provided in the log message.
12326	Error	Failed to load vision model configuration. More information is provided in the log message
12329	Warning	Failed to communicate with Gigabit Ethernet camera. Reason: Bad Ethernet connection or excessive Ethernet communication.
12330	Warning	Images are triggered too frequently. Solution: Adjust vision models to be less time consuming, or decrease trigger frequency.
12331	Warning	Connection to camera is lost, attempting to reconnect. Reason: Ethernet cable or power cable has been disconnected.
12332	Warning	Image Buffer Full. More information is provided in the log message.
12333	Warning	A Gigabit Ethernet camera was found, but no such license was detected. Reason: No USB stick with vision license is inserted in the PC.
12334	Warning	A license for Gigabit Ethernet vision was detected, but no such camera was found. Reason: Camera is not connected, not turned on, or has an invalid IP-address.
12337	Warning	Failed to read parameter from camera. Reason: Check if the appropriate Cognex Drivers are installed. If the problem persits, check network connections.
12341	Status	Cognex USB License dongle is attached.
12342	Warning	Cognex USB License dongle is removed.

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8 Spare parts

Camera parts

Spare part list

	Spare part number	Description	Type
-	3HAC072146-001	Cognex camera kit	

For more details on the camera's installation, see the documentation on the Basler Ace website, *Basler Ace*.

USB dongle parts

Spare part list

	Spare part number	Description	Type
-	3HAC072139-001	USB dongle (small)	
-	3HAC073341-001	USB dongle (large)	
-	3HAC039556-001	USB dongle (sim)	

The dongle can be connected to any USB interface on host computer.

GigE Network card parts

Spare part list

	Spare part number	Description	Type
-	3HAC069300-001	GigE network card	

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9 Circuit diagram

9.1 Circuit diagrams

Overview

The circuit diagrams are not included in this manual, but are available for registered users on myABB Business Portal, *www.abb.com/myABB*.

See the article numbers in the tables below.

Controllers

Product	Article numbers for circuit diagrams
Circuit diagram - IRC5	*3HAC024480-011*
Circuit diagram - IRC5 Compact	*3HAC049406-003*
Circuit diagram - IRC5 Panel Mounted Controller	*3HAC026871-020*
Circuit diagram - Euromap 67, design 14	*3HAC024120-005*
Circuit diagram - Spot welding cabinet	*3HAC057185-001*

RobotWare options

Product	Article numbers for circuit diagrams
Circuit diagram - PickMaster Twin	*3HAC024480-020*

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