ROBOTICS

Product specification

PickMaster® 3

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Product specification
PickMaster® 3

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Overview of this specification

About this product specification

It describes the functionality, performance and options available for PickMaster 3 in terms of:

- Application environment setting
- Basic concepts
- Ease of use of the software application configuration
- Interactions with robots, cameras, sensors, conveyors, and other peripheral equipment
- Operation and controls
- Software and hardware options and licenses

Usage

Product specifications are used to find data and performance about the product, for example to decide which product to buy. How to handle the product is described in the product manual.

Users

It is intended for:

- Product managers and product personnel
- Sales and marketing personnel
- Order and customer service personnel

References

Reference	Document ID
Product specification - Controller software IRC5	*3HAC050945-001*
Product specification - Controller IRC5	*3HAC047400-001*
Product specification - Robot user documentation, IRC5 with RobotWare 6	*3HAC052355-001*
Application manual - PickMaster ®3	*3HAC031978-001*
Cognex vision system documentation is included in the PickMaster installation package.	
PickMaster SDK documentation, software interface description for the integration of external sensors using Microsoft ATL COM concept. The corresponding Microsoft .NET interface is described in *Application manual - PickMaster ®3* (*3HAC031978-001*).	3HAC031978-001
PickMaster® External Sensor Solution Simplified PickMaster Generic Sensor Protocol	9AKK107045A0348

Revisions

Revision	Description
-	First edition

Revision	Description
A	Editorial changes
B	Standards updated, minor corrections
C	Released with PickMaster 3.33. • Updated the screenshot in *Integrated vision (optional) on page 17*
D	Released with PickMaster 3.34. • PickMaster 3 is compatible with Windows 7, see *Required equipment on page 30* • Updated Option 942-1 - Vision Simulation is now possible, see *Support tools on page 39*. • Added RIS2 functionlity.
E	Released with PickMaster 3.35. This revision includes the following update: • Removed RIS2
F	Released with PickMaster 3.41. This revision includes the following updates: • Replaces article number 3HAC5842-12 • Updated the section *Remote Integration Services on page 34*
G	Released with PickMaster 3.43. This revision includes the following update: • Information about the support for Windows XP SP3 is updated.
H	Released with PickMaster 3.45. This revision includes the following update: • Information about the compatibility with S4Cplus is updated.
J	Released with PickMaster 3.51. Minor corrections.
K	Released with PickMaster 3.55. This revision includes the following update: • Added information about DSQC2000 in the section *Encoder on page 33*. • Updated the section *PickMaster related controller options for IRC5 on page 40*. • Updated the section *Vision hardware on page 38*.
L	Released with 19B. • The option 896-1 is phased out and hence removed. • Updated the section *PickMaster related controller options for IRC5 on page 40*.
M	Released with 23A. • Updated the section *Gigabit Ethernet Vision on page 31*. • Moved Spare parts chapter to the Application manual.
N	• Company name updated to reflect current legal entities.
P	Released with 25D Minor corrections.

1 Welcome to PickMaster® 3

1.1 Introduction

Overview

Thank you for your interest in PickMaster® 3. This document gives you an overview of the product characteristics and how it can be used. PickMaster® 3 the PC-based control software from ABB is a plug and produce high-end integration of our high performance IRC5 robot controller and of all IRB types. PickMaster® 3 is a configurator and cell controller of flexible packaging lines with moving conveyors.

For position recognition of random production flows as well as powerful quality inspection PickMaster® 3 uses a reliable powerful vision system from Cognex. It enables recognition of a wide variety of both regular and irregular shaped objects, which makes PickMaster® 3 the ideal tool for controlling packaging robots in the consumer industry, but it also makes it well suited for generic vision robot guidance applications.

PickMaster® 3 can control up to 10 robots and 10 cameras - simultaneously in the same application or concurrently in independent cells. Each robot can track 6 conveyors simultaneously.

By the use of Remote Integration Services (RIS) PickMaster® 3 can be operated from any production panel or automation system through an integrated support for field buses and TCP/IP.

Benefits of PickMaster

PickMaster® 3 gives you the benefit of:

- Fast installation and configuration of one or multiple robots in an Ethernet network. No programming is required.
- Instant product change-over
- Cell controller capability for extensive operational control of process and connected robot controllers
- Risk reduction offering a product-based repeat solution, configurable for a multitude of operational cases.
- High performance vision recognition and product quality inspection including Gigabit Ethernet color cameras with high resolution for the highest demands.
- Advanced information sharing between cameras and robots
- Powerful sorting functions
- Tailored robot controller ProcessWare for best cycle time performance through enhanced built-in high volume flow conveyor tracking and optimal position transfer pipe line
- Self contained robots in a line
- Customization tools for user defined software enhancements and extensions.

Advantages

PickMaster® 3 is a modular product, which can be composed to your special needs:

- With integrated vision for full random operation, working with continuously moving conveyors
- Without vision recognition as a tool for efficient production with guided product flows on multiple conveyors
- With integrated vision for random operation and absolute accurate positioning on indexed feeders or trays
- For efficient quality inspection and product categorization alone or together with position recognition.
- Integration of external sensor systems (on request) other than the included standard vision system
- Dynamic position alteration through user hook software additions.

PickMaster® 3 runs with the IRC5 robot controller and RobotWare. Required RobotWare software option is *Prepared for PickMaster - PickMaster3* which includes all necessary software options to interface PickMaster® 3 as well as efficient conveyor tracking.

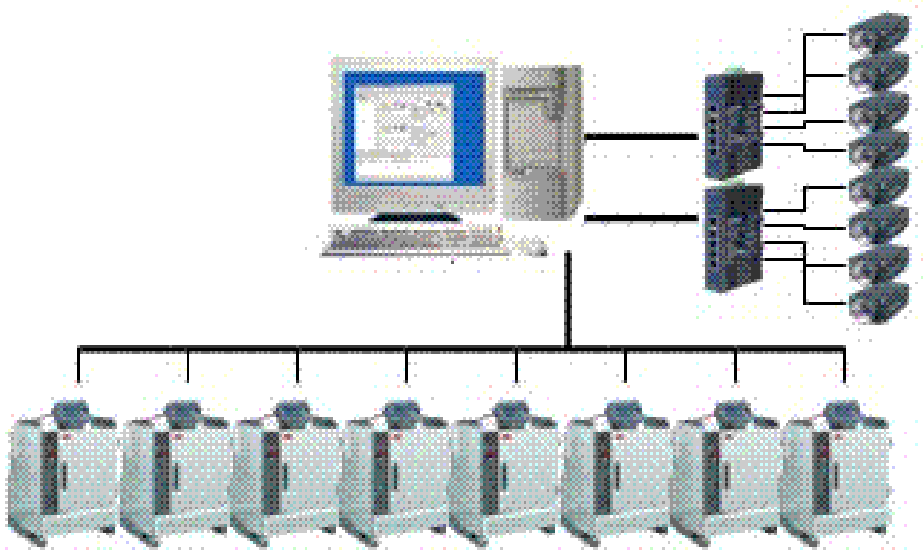
2 Introduction

2.1 Features of PickMaster® 3

Scope

PickMaster® 3 is tailored for advanced high speed picking of random object on moving conveyors. The flexibility and modularity of the product makes it suitable for a wide range of customer applications, including generic vision recognition integration for robot guidance. PickMaster® 3 is available for all robot types. The scope of PickMaster® 3 are:

- Ten robots and ten cameras per PickMaster® 3 running together in one process or in a multitude of independent concurrent processes on the same PC.
- 25 work areas per robot whereof six conveyors.



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- Project execution is easily started and stopped from a single button in the PickMaster® 3 studio interface. Individual robots can be controlled separately at any time and status changes are reported back to PickMaster® 3.
- Line PLC and custom operator's panel connectivity through TCP/IP and fieldbuses. This function, called RIS (Remote Integration Services), gives full control over the PickMaster packaging process and the individual robots.
- Runtime process tuning of positions, motion path, dwell times, tool activation, etc.
- Camera distribution and position information sharing as well as capability to control the work capacity distribution of the robots.
- Wide range of enhancements in the RAPID program through dedicated RAPID instructions.
- Advanced sorting functions.

- User hooks for changing/removing or adding positions or position types enabled by the Microsoft® .NET platform interface.
- When operating with IRC5, PickMaster® 3 supports MultiMove. It is possible to configure the controllers with more than one robot.

2.2 Application and processes

General

PickMaster can handle a wide variety of applications in packaging as it has integrated support for mixing, sorting, collating, blister patterns, etc.

The way the robot shall pick and place from different work areas is easily enhanced by PickMaster RAPID instructions. The order and priority including exception handling is possible to program with the RAPID instruction set provided with PickMaster.

However, in most cases, no programming adoptions are needed at all. The PickMaster software package contains predefined RAPID modules.

Random flow

Random flow is the most flexible way of feeding products. There is no need for fixtures and many different products or packages can be transported on the same feeders without mechanical adoptions.

Predefined flow

The products and place trays may be placed in predefined positions. With PickMaster many robots and products with various patterns are easily configured and the process is executed with highest performance and efficiency with included work area limit supervision.

All positions Generated in PickMaster may be tracked or changed through the User Hooks concept based on the Microsoft® .NET platform. By the use of external software in the preferred choice of programming language (i.e. VisualBasic .NET, C#, e.a.), the vision or trigger information can be extended by information coming from external devices like sensor devices or production/batch information systems. It may as well just be used as to extract hit-data to a production logging system. The User hooks also allow enhancements as to connect information form multiple position source locations to conclude to a result.

Dynamic positioning

All positions generated in PickMaster may be tracked or changed through the User Hooks concept based on the Microsoft® .NET platform. By the use of external software in the preferred choice of programming language that is VisualBasic .NET, C#, and so on, the vision or trigger information can be extended by information coming from external devices like sensor devices or production/batch information systems. It may as well just be used as to extract hit-data to a production logging system. The User hooks also allow enhancements as to connect information from multiple position source locations to conclude to a result

Indexing conveyors and fixed work areas

In many cases the products are presented to the robots on indexed tables or indexing conveyors. In this case conveyor tracking is not used, but the products may be randomly placed and vision recognition is then needed.

Double/multiple pick, single/double/multiple place

If higher performance is required, double picking is easily configured. However, heavier special grippers and a less flexible configuration are the disadvantages of this solution.

Configurable Pick and place sorting order

The items are normally picked and placed in direction of the production flow on the conveyors, i.e. first in, first out. It is also possible to extract the items from the flow in any three dimensional direction.

Mixing and sorting

Single product types, generated by PickMaster can be selected and extracted from the inflow and diverted to different positions.

Alternative operations can be executed if products or specific product types are missing from the inflow. A so called queue level signal can be used for evaluating if a position queue is empty and thus requires new input.

Sorting directions makes it possible to optimize the capacity of the robot, i.e. to make sure the robot runs the shortest distance, etc.

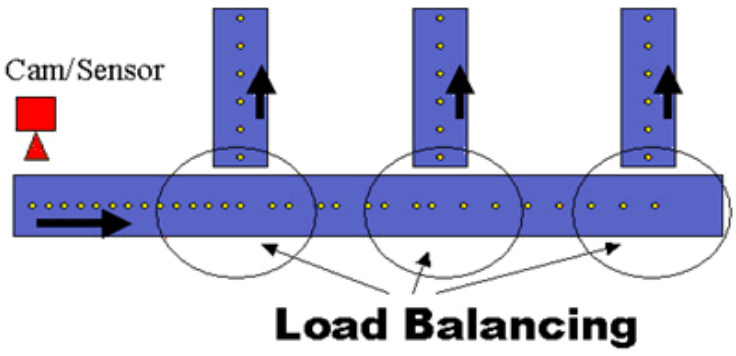
Clearance areas can be declared to reject touching objects.

Camera distribution (optional)

Multiple robots can be connected to the same camera. This is useful to save the hardware and installation costs. It is essential that the objects are well separated and the neighbouring objects are not touched while picking or placing. If the robots are away from the trigger point the elasticity of the conveyors may decrease the accuracy.

Load balancing and bypassing

With simple drag and drop the load of a production flow can be balanced among multiple robots. The position information is acquired at one initial point on the line either through a position trigger of predefined positions or through a camera using the camera distribution option. The production can easily be balanced with equal or biased loads on all robots involved. The function can be used to avoid upstream robots to consume most of the products on the conveyors and thereby leaving too little to the other robots.

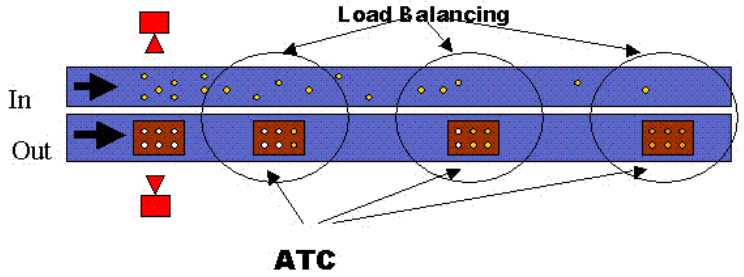


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The Load Balancing function can also be applied on robots with individual trigger points (separate camera or sensor per robot). Simply decide, how much of the passing production shall be used and bypass the rest.

Adaptive Task Completion (optional)

PickMaster® can be configured to ensure that every object is picked and every position is filled as a joint operation of multiple robots, this is called Adaptive Task Completion (ATC). Without the need to assign objects to specific robots, the ATC function makes sure that one, but only one, robot consumes the position. This option can be used for progressively filling cases, which pass multiple robots.



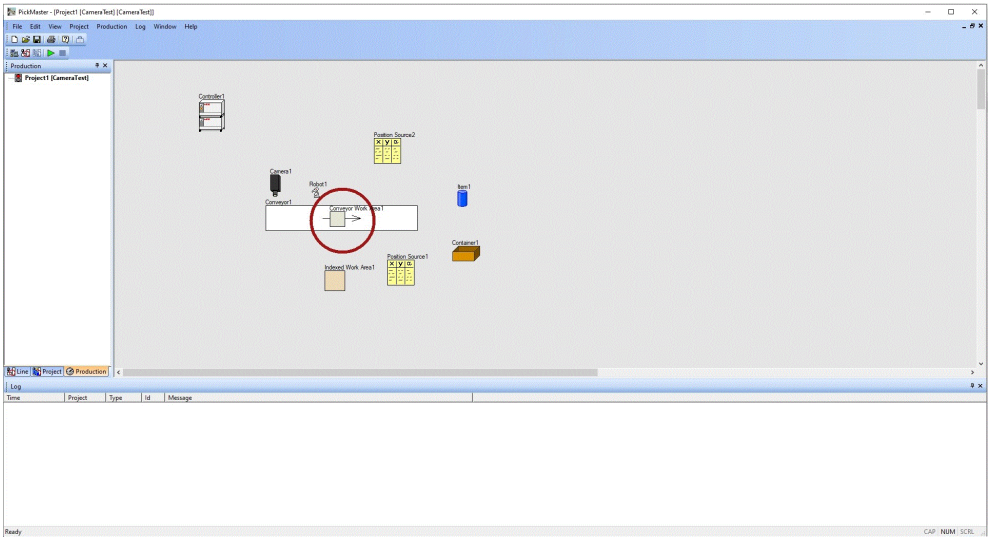
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Robot stops and exceptions

A single robot can be paused, stopped or even powered down during production. The way the remaining robots are reacting is configurable. If load balancing is used, the workload designated to a paused robot can be redistributed automatically among the running robots. If ATC is used, the specific positions are redistributed to the next robot.

2.3 PC interface

PickMaster® 3 GUI



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Graphical components are easily introduced and edited by right mouse click

- Plug-and-Produce installation and configuration limits on-site software and hardware engineering to a few hours.
- Graphical concept with line and project configurator. Studio application with workspace area, symbolic line/project view, log and runtime vision display.
- Online context-sensitive help for fast navigation through the use of PickMaster, identical to *Application manual - PickMaster ®3*.
- Fast project start-up (2-3 seconds for the complete line).
- Line and project information is stored in XML-format (*.pmline) and (*.pmproject)-files.
- Immediate task change-over and fully automatic one button production start.
- Status control of process as well as individual robots.
- Definitions of single objects as well as single/multi-layer pattern and container.
- Pre-programmed RAPID code downloaded at process start.
- Several processes can be handled in concurrent and self-contained operations from one PickMaster.
- Event logging to Microsoft Event Viewer database.
- Available in seven languages: English, German, French, Italian, Spanish, Japanese, and Swedish.

2.4 Integrated vision (optional)

General

Leading Cognex vision technology using standard cameras with high speed communication over Gigabit Ethernet and built-in algorithms, provides the integrated vision. Backward compatibility is maintained, including support for Cognex framegrabber solutions.

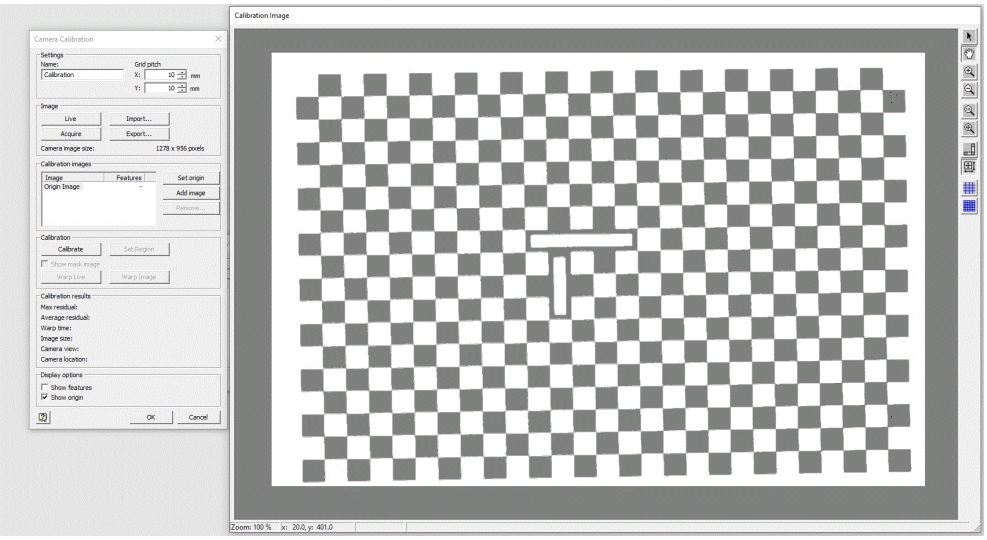
The vision system is capable of recognizing regular as well as irregular forms. This includes unwrapped food like chicken, meat, etc or more geometrical accurate products or wrapped and packaged forms.

The vision capability is optional. Efficient object search and inspection is provided by the Gigabit Ethernet Vision system, where camera is connected to Gigabit Ethernet network card on the PC. The powerful vision search algorithms are executed on the MMX accelerated PC. They provide fast and reliable robot guidance as well as concurrent inspection capability. A maximum of ten cameras can be connected on one PC (through multiple quad-port Gigabit Ethernet network cards or industrial switches).

With PatMax^{TM}, many vision recognition tasks are easily solved, which normally require extensive custom image processing or which may be impossible to solve. PatMax^{TM} is a patented method by Cognex, which is top of the line in vision technology. PatMax^{TM} returns reliable, accurate and repeatable 2-dimensional positions and orientations.

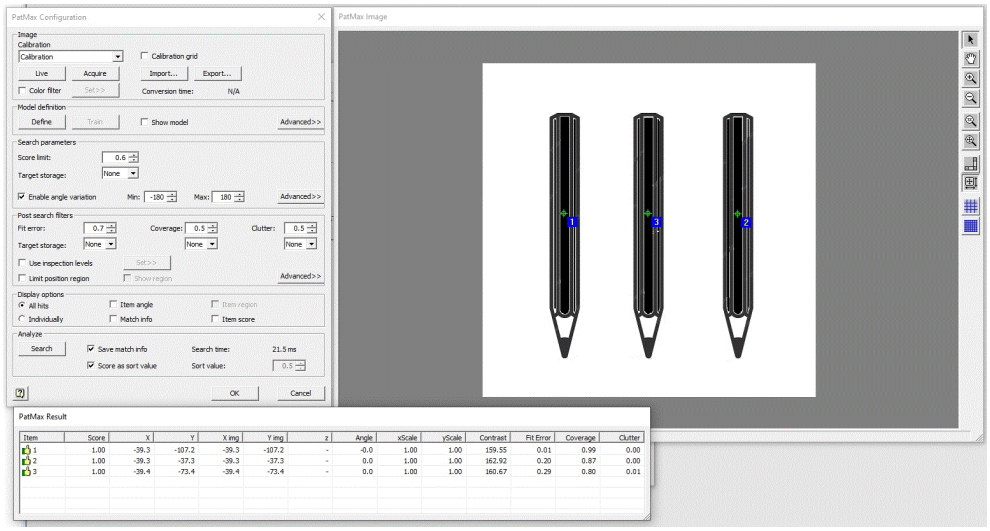
List of vision features:

- Concurrent camera acquisitions and vision processing on multiple cameras.
- Fast image updates
- Fast and accurate calibration, linear or higher order algorithms for short focal lenses



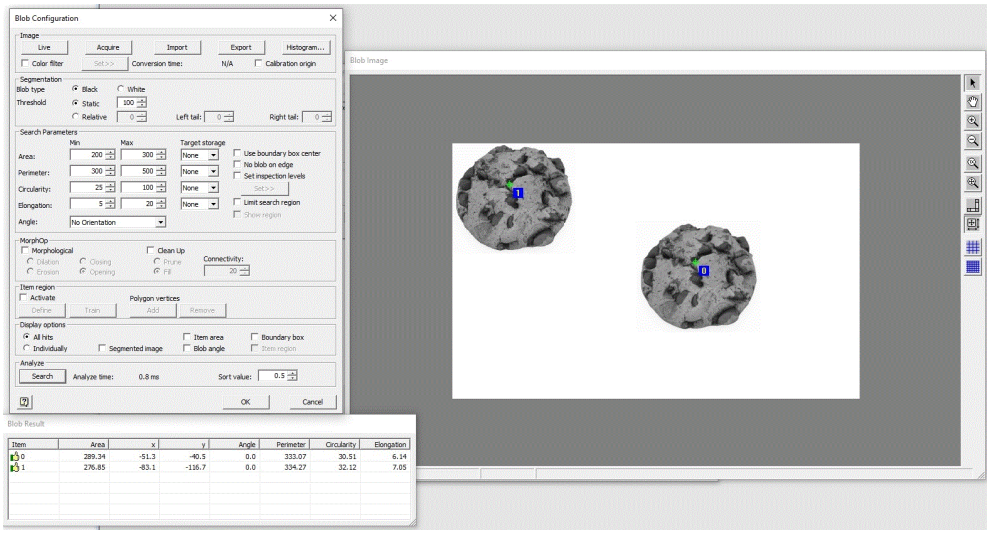
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- For geometric model search, enhanced use of PatMax™ solves many difficult search tasks. Well suited for geometric search of both regular and irregular shapes.



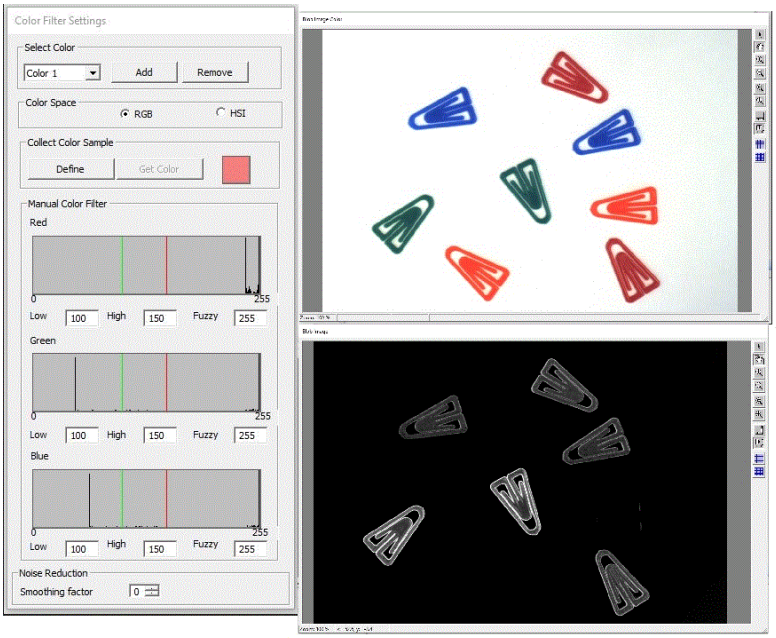
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- Sub score parameters for adequate fine tuning, e.g. items to find, score limit, contrast limit, area overlap, clutter, scale, angle, granularity
- Enhanced Blob modeling for fast and simple search operations without the need for taught models can find many different types of objects based on pixel features like area, perimeter, etc.



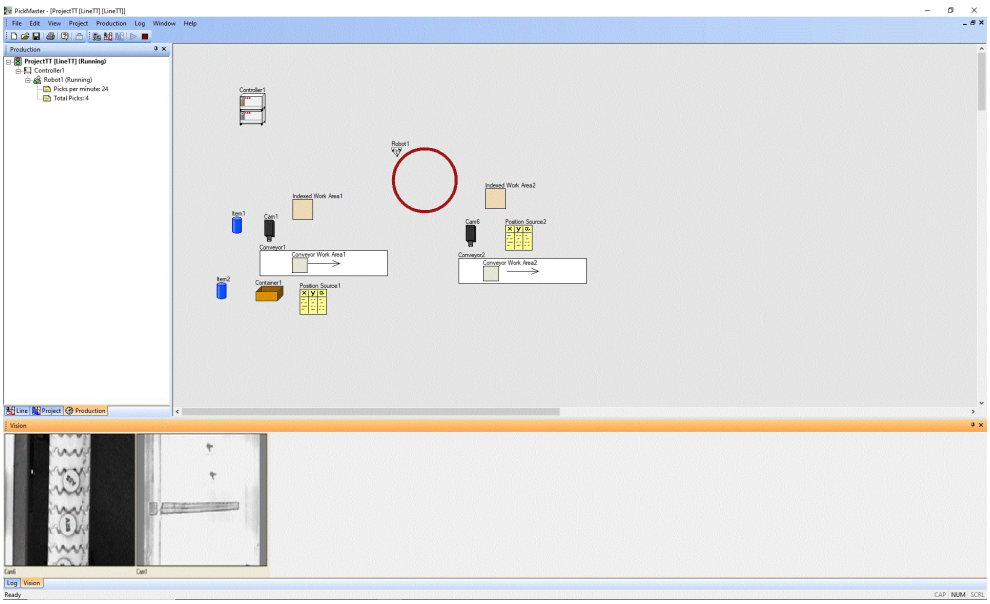
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- Multiple models per object possible
- Color vision for enhancing contrast and inspecting colors combined with interactive filter controls for maximum ease-of-use (available from version 3.31). The filter runs as a pre-step to PatMax and Blob (both in alignment and inspection mode).



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- Vision model import/export for bitmap editing of camera images. Allows corrective changes the image by any paint or draw program in order to optimize the modeling.
- Zoom, pan, etc of the camera view simplifies accurate modeling
- Auto camera trigger
- Quality inspection with reject and type categorization: level I
- Quality inspection through multiple inspection areas: level II



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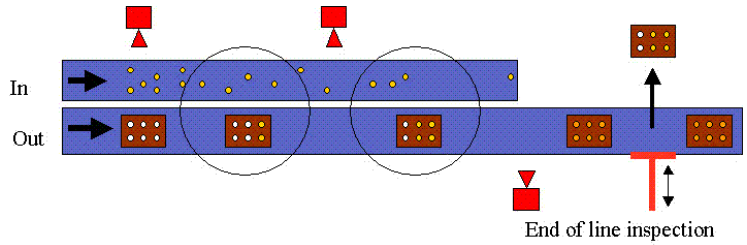
- Runtime vision analyzer

Post inspection

PickMaster can be configured for object recognition and inspection and connect an I/O signal in the robot controller instead of a complete robot operation coordinated to a conveyor. The function can be used to inspect objects after they have passed the robot zone or before they enter and to take appropriate action by the use of simple pushers.

This solution requires the following additional options for PickMaster:

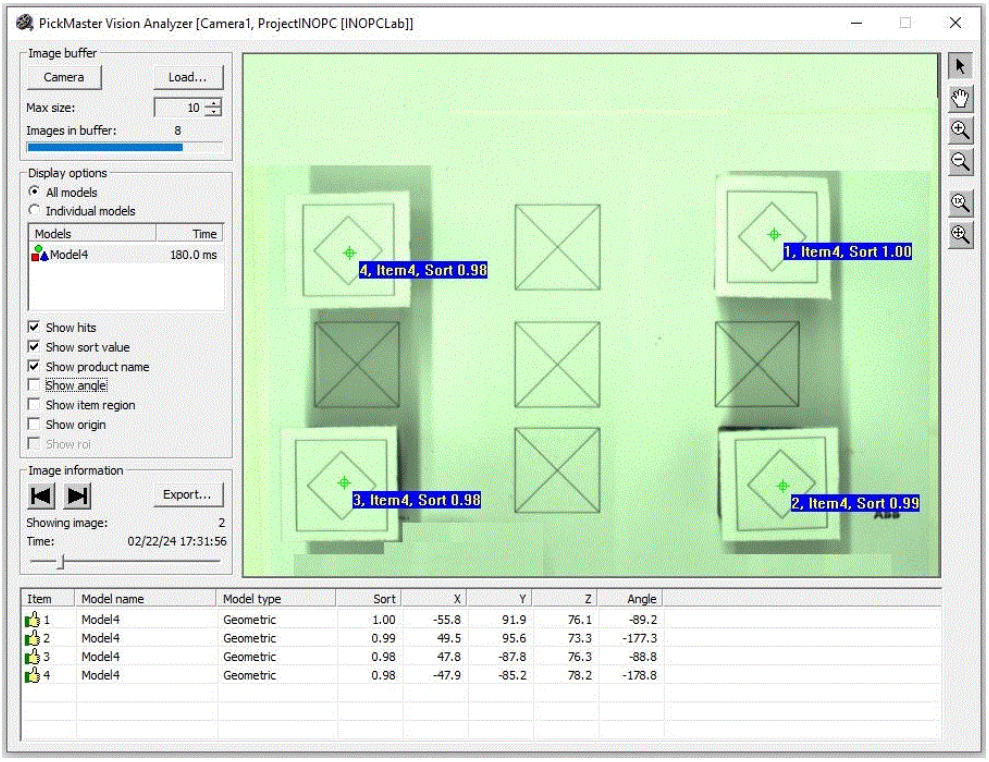
- One extra camera option
- Robot controller: One extra encoder connection



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Detailed vision information and run time Vision Analyzer

The vision and inspection results can be checked in detail in runtime for each individual camera. The images and results are saved in a buffer. The results can be saved to a file (.pmv) and analyzed online or offline in a separate executable Vision Analyzer, which is also provided with the PickMaster software. Camera information and time stamps for each camera acquisition are also saved with this file.



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2.5 Inspection

General

Visual inspection capability is an enhanced use of the vision integration, used to verify the quality and categorization of the products for picking or placing. It is also used for enhanced feature recognition and accurate identification of similar looking objects (level II).

It is possible to identify untaught defects like scratches or burn marks.

Both inspection levels II and I can be used for quality inspection even if the positions are pre-defined.

The inspection results are sent with the positions to the robot controller, where the decision may be done to pick and place accepted or rejected items.

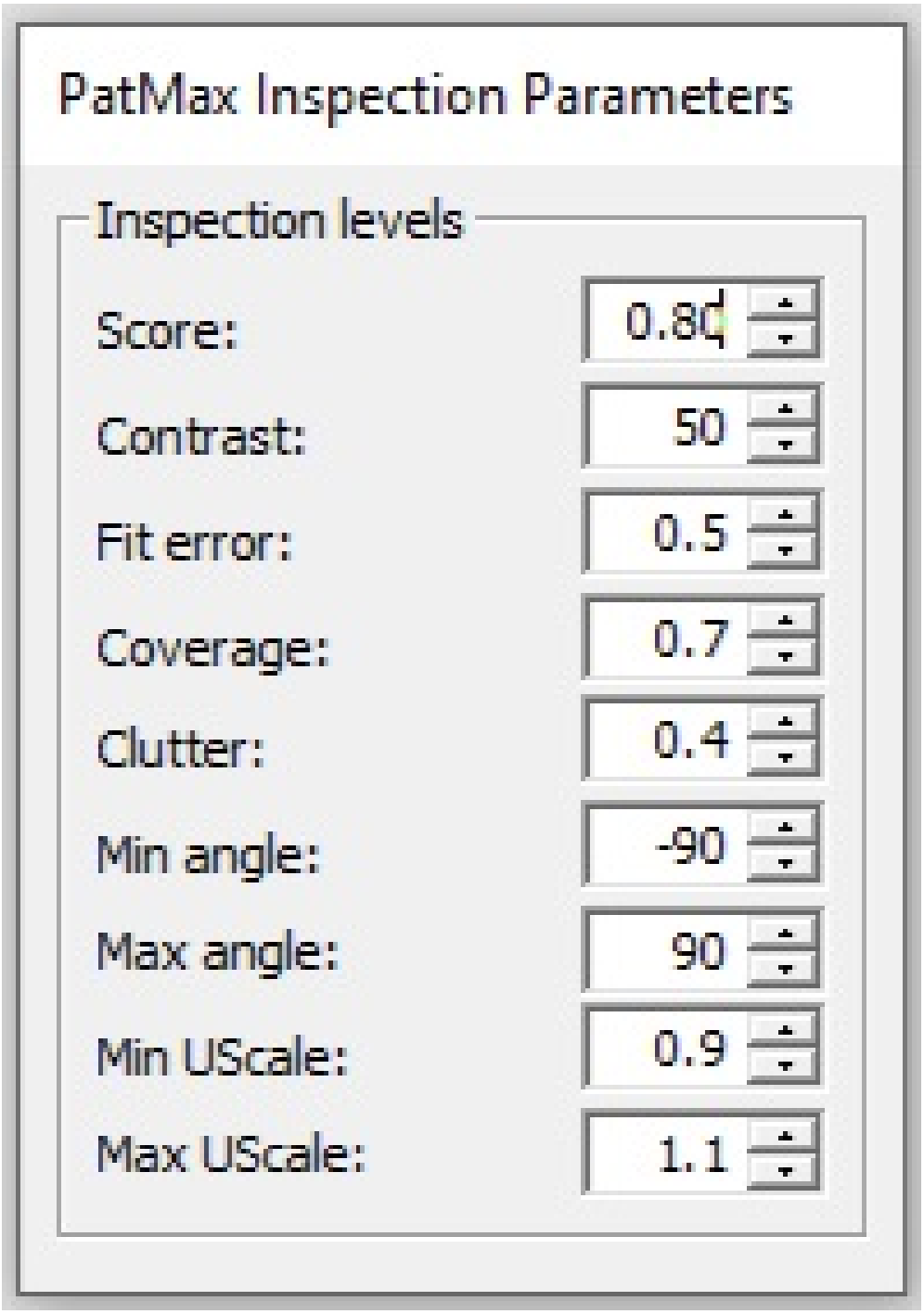
PickMaster can pick only the accepted items or it can also be configured to pick out only the rejected items.

Level I: Type categorization and reject by parameter variance profiles

This inspection type is included in the camera option.

With Inspection Level I acceptance profiles can be defined and used as type categorization for a vision model as a combination of the parameters.

Categorization is based on the geometric or blob model parameters, depending on the type of model used.



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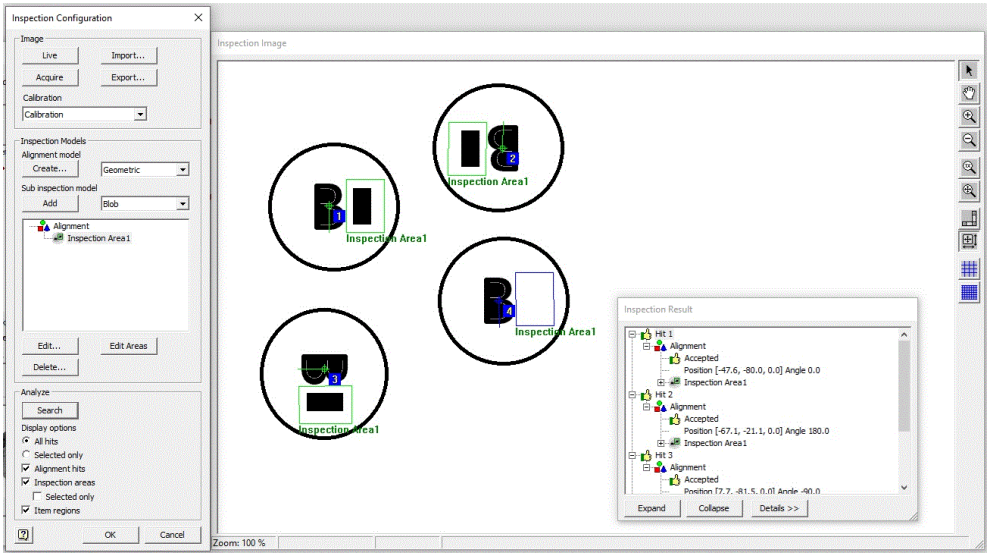
On blob models, histogram analysis can be applied.

For PatMax models, a boundary check and filtering is possible. A protected multi-edge area can be defined around an item. This function will reject any objects of which the boundary area is touching or overlapping another.

Level II (optional): Inspection area selection through combinations of models and criteria

Level II inspection is accessible when the inspection option is included. The inspection models can be of type geometric, blob, histogram, and length measurement.

The level II inspection is used to inspect additional features inside a given area in relation to a base search model. Multiple inspection areas can be evaluated at the same time and with different types of models.



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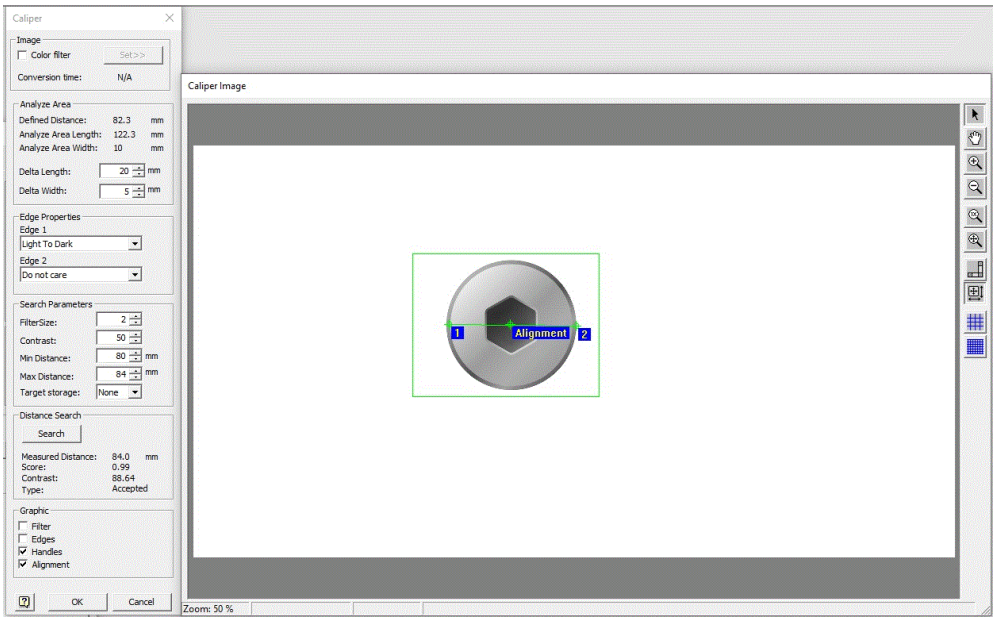
The following types of inspection are available inside an inspection area:

- Geometric: presence of taught features. Evaluates numbers of hits, positions and orientations in relation to the base model. Inspection of labels, right side up, distinction of minor features for type selection, etc are common use cases.
- Blob: presence of untaught features by blob analysis. Evaluation of pixel size, numbers, etc is possible. Untaught defects like burn marks on baked products, scratches other defects can be detected after the object was found.
- Histogram: inspection of the grey scale characteristics in the inspection area by tolerances in mean value, standard deviation, etc of the pixel values.



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- Size: definition of size measurement lines and configuration of acceptance levels in mm.



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2.6 External Sensor SDK (on request)

General

With the External Sensor SDK (ESS) any type of external sensor systems can be integrated in PickMaster – both through access in design time and by providing position information in run-time. Interfaces exists on three levels: UDP, Microsoft .NET, and COM/DCOM.

The external sensor can be a 3D vision system or a bar code reader, and so on, and it can reside on another computer system.

ABB does not take any responsibility for the proper functioning of an external software and hardware. The support is limited to the interface specification.

2.7 Controller side process flexibility

General

Optimized real-time control of positions and conveyors are provided by the RobotWare option *Prepared for PickMaster*.

With Prepared for PickMaster the robot is configured to work together with a PickMaster PC.

Prepared for PickMaster contains a set of RAPID instructions, functions, variables, and data types. There are also predefined system and program modules as well as RAPID routines included in Prepared for PickMaster. The RAPID modules are part of the project definition and downloaded to the robot controller at project start. The RAPID modules may be adapted to fit specific application needs, but in most cases, very little or nothing needs to be changed.

Prepared for PickMaster takes care of the communication, initialization of enhanced conveyor tracking and makes it possible to perform advanced mixing, sorting and collating as well as exception handling as timeout or error handling.

Functions for executing service routines directly from PickMaster are also included.

For more information, see *Application manual - PickMaster ®3* for the full set of instructions.

3 Technical specification

3.1 Software

Product content

PickMaster® 3 Software package

PickMaster® 3 Hardware

Software package

PickMaster® 3 includes

- PickMaster® 3 software with line and project configurator, vision modeler, inspection modeler (optional), event logging, production panel, Remote Integration Services (RIS)
- PickMaster Vision Analyzer
- Cognex Vision Software CVL 7.2, including configuration tool for Gigabit Ethernet Cameras
- PickMaster SDK - External Sensor
- License manager

Projects made in PickMaster® 3 are not compatible with PickMaster 1.x versions and vice versa. PickMaster® 3 is compatible with Cognex Gigabit Ethernet vision.

3.2 Hardware

Required equipment

Robot controller

- IRC5 robot controller.
- RobotWare: For IRC5 robot controller, RobotWare 5.12 or later.
- At least one 24 V digital I/O board
- Encoder interface board or conveyor tracking module (CTM)
- *Prepared for PickMaster* option

PC

PickMaster runs on Windows 10 (64-bit version).

The recommended processor is IPC, quad-core, 2GHz or higher. Color vision is especially resource demanding.

The Gigabit Ethernet vision system requires one PCI Express x4 slot with standard height. It is also compatible with PCI express x8 and x16. Note that it is not compatible with PCI express x1 nor with the special type of x16 slots intended for graphics cards only. Ethernet network port is required. Optionally one additional free slot is needed to use a RIS fieldbus card.

The PC should be equipped with a monitor of at least 17 inches with minimum resolution 1024x768 pixels. Recommended is a resolution with 1280x1024 pixels.

Cameras and cables

For more information, see *Vision* section.

Vision equipment options

- Gigabit Ethernet vision system, including 1 to 10 GigE cameras, cables, network interface card, switches (if required) and a Cognex license provided on a USB stick.

3.3 Specifications

Maximum configuration

- One PickMaster/PC
- Ten robots/PickMaster
- Ten cameras/PickMaster
- Twenty five work areas/PickMaster
- Six conveyors/PickMaster

Vision

- Search tools PatMax™ /Blob.
- Vision quality inspection tools Level I and Level II (optional).
- Checkerboard calibration with distortion compensation.
- Camera acquisition time and transfer rates: typically 50-200 ms on a high performance PC. Complex models can affect performance.
- Up to ten simultaneous camera acquisitions.

Hardware

Introduction

PickMaster uses a Gigabit Ethernet vision system. This means that the PC communicates with the camera using a standard Gigabit Ethernet network interface card. The network card is mounted on the PCI bus of the PickMaster PC (PCI Express x4 or higher).

Gigabit Ethernet Vision

The PickMaster GigE vision system supports 1-10 cameras. It is delivered with a 4-port GigE network interface card through which the PC communicates with the cameras. If more than four cameras are used, additional GigE network cards or GigE switches are required.

The camera has a built in I/O system, which enables triggering directly from the robot controller, without the need for additional hardware.

The Cognex GigE Vision system functions are enabled by a hardware license key on a USB dingle, which must be plugged into the computer during runtime, preferably on an internal USB port to make sure it is not lost.

The following camera option is delivered as standard:

- *Basler acA1440-73gc with 1/2.9*: Standard resolution (resolution 1296x966, sensor size 1/3”) digital CCD camera



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Further information about specific components can be found on the corresponding web sites.

- GigE network card: DSQC1083 Gig ethernet card
- Lens cannot be purchased directly from ABB. However, suitable lenses can be found through the following links: *FA Camera/Lens | Industrial Products | Ricoh* and *Lenses:Schneider Kreuznach*.
- Network switches: unmanaged GigE switches of 100Gbit/s or higher and capable of handling jumbo frames or alternatively purchase additional GigE communication boards from AfterSales. (Not included in the product.)

Please observe that the difference in sensor size (“Basler acA1440-73gc with 1/2.9”) affects the size of the field of view. A larger sensor will give a wider field of view than a smaller sensor, using the same lens.

It is advisable to secure the USB license to an internal USB port or a wire lock, as it contains the run-time license for the vision components.

Performance

The image recognition time and transfer time for one type of objects in a scene is typically about 50-250 ms. Variations occur depending on the complexity and geometric accuracy of the models as well as if inspection is included.

The vision recognition and inspection perform the most CPU consuming calculations on the PC. Recommended is to use state of the art powerful computers to avoid restrictions in speed or performance loss.

Accuracy

The vision absolute accuracy is 1/40 pixel. This makes it possible to obtain accuracy levels of a few 1/100 mm. To obtain the total positioning accuracy and repeatability, the following parts are contributing to the total result:

- Camera resolution and field of view.
- Accuracy of the calibration sheet. This is very much dependent on the type of the reproduction technologies (printing) to obtain the calibration pattern.
- Lens distortions affect the peripheral positions. Non-linear calibration calculation gives the best result.
- The robot repeatability.
- Conveyor accuracy is highly dependent on an accurate calibration.

Robot controller and I/O signals

The robot controller must be equipped with at least one digital I/O board.

The detailed use of required I/O signals is as follows:

- Gripper vacuum and blow: two signals per vacuum tool
- Position generator trigger, e.g. camera: one signal per work area, e.g. pick and place area.

> **Note**
>
> This signal is not needed when using CTM (DSQC 2000).

- Conveyor start and stop order: one signal per conveyor if this function is used

Detailed hardware connection diagrams are shown in *Application manual - PickMaster ®3*.

Robots

Approved for use on all robot types with IRC5 controller.

Conveyor tracking

Introduction

Continuously moving conveyor belts are the preferred way to feed items and packages. It gives a high flexibility since the robot can operate on the items on the fly for the full time they are within the working area of the robot.

Speed

The system has been tested with a maximum conveyor speed at 1600 mm/s with an IRB 360 without vision recognition. The capability to follow conveyors at high speeds is dependent on the acceleration and speed limitations of the actual robot. When changing the speed of the conveyors, that is, when using them for stop and go, the accuracy is decreased dependent on the acceleration and deceleration slopes. Indexing feeders cannot be used for regular conveyor tracking.

On conveyors with vision recognition the speed is limited by the following factors:

- Camera trigger frequency. The vision model search time and position transfer time limits the trigger frequency. For an average time of 250 ms the maximum frequency is 4 Hz.
- Motion blurs. On high-speed conveyors the camera shutter time needs to be very short which again requires very good light.

Drive Unit

External drive units connected to I/O controls operate the conveyors. Drive units like the ABB AC300 has a 24V I/O interface allowing forward, backwards, and stop operations, speed preset, and increment and decrement.

Encoder

One or more encoders measure the position of a conveyor. Usually an encoder is placed close to an identification and operation area in order to minimize errors caused by the elasticity and inaccurate guidance. The encoder measurement sample rate is configured in the robot controller and by default set to 20 ms.

The interface unit DSQC2000 can handle upto 4 encoders and share tracking with several robot controllers. DSQC 377 may also be used for conveyor tracking. For more details, see *Application manual - Conveyor tracking*.

The encoder should be of type Open collector PNP output, two phases with 90 degrees phase shift, voltage 10-30V and current 50 - 100 mA

- Normally supplied by 24 VDC from DSQC377/DSQC2000

The pulse ratio from the encoder should be in the range of 5000 - 10000 pulses per meter of conveyor motion (see wiring diagrams in *Application manual - PickMaster ®3*). The pulses from channels A and B are used in quadratures to multiply the pulse ratio by four to get the counts. This means that the control software will measure 20000 - 40000 counts per meter for an encoder with the pulse ratio given above. Reducing the number of measured counts below 20000 will reduce the accuracy of the robot tracking.

Increasing the number of measured counts beyond 40000 will have no significant effect as inaccuracies in robot and cell calibration will be the dominating factors for accuracy. The encoder board (DSQC377/DSQC2000) is able to handle min 500 and max 50000 counts per meter.

The maximum frequency is 50 kHz (may occur with high conveyor speed and many pulses per meter).

The encoder should be connected to the robot by a screened cable to reduce noise.

> **Note**
>
> If this cable is long, the inductance in the cable will produce spike pulses on the encoder signal, which may, over a period of time, damage the opto-couplers in the encoder board. The spike pulses can be removed by installing a capacitor between the signal wire and ground for each of the 2 phases. The capacitors should be connected to the terminal board where the encoder is connected and not on the encoder interface.

The number and speed of the conveyors are CPU consuming factors on the robot controller. Maximum six conveyors may be used in one project. Maximum four encoders can be connected to one DSQC2000. The older DSQC377 can only connect to one encoder.

Remote Integration Services

PickMaster can be operated remotely by use of the function called Remote Integration Services (RIS). With this option, PickMaster can be operated from a remote place like an operator panel, thus making it possible to integrate PickMaster in the overall line control also protecting the once designed and fine tuned projects from being changed by an operator. RIS provides the runtime interface as well as the configuration menus to set up the command codes.

Following are the available RIS interfaces:

- PickMaster supports Hilscher CIFx Ethernet card. See *https://www.hilscher.com* for more specifications.
- TCP/IP, accessible from any programming language from the PickMaster PC or any other computer in the Ethernet network.

RIS include interfaces to configure the commands to run PickMaster. RIS is configured per PickMaster project and there are interfaces exposed for project commands and for robot commands.

Following are the project commands:

- Open
- Close
- Start
- Stop
- Status: Project running/Stopped/Configuration Error/No License/Error

Robot commands for selected robot:

- Start
- Pause
- Stop
- Reset E-stop
- Pick rate

RobotWare

For IRC5 robot controller, RobotWare 5.12 or later is required.

The *Prepared for PickMaster - PickMaster3* option is needed.

The *Prepared for PickMaster - PickMaster3* option is the RobotWare option installed in the robot controller. Each robot controller in a PickMaster line needs the *Prepared for PickMaster - PickMaster3* option, which includes all the necessary functions for conveyor tracking, communication with PickMaster, and running stereotype pick and place movements. The enhanced conveyor tracking included in the *Prepared for PickMaster - PickMaster3* option can track six conveyors simultaneously.

The *Prepared for PickMaster - PickMaster3* option is exclusively offered together with PickMaster.

4 Specification of variants and options

4.1 PickMaster options

Basic options

Introduction

PickMaster can be composed from a set of options in order to tailor the product scope to the needs of the production line and the processes. PickMaster can run with or without vision.

PickMaster is configured through basic options and additional options separated by either software licenses or hardware parts. For each order of the product PickMaster, one, but only one basic license is required.

The vision system consists of standard resolution color camera with two types of USB licenses to operate in monochrome or color mode.

42-6 - Basic PickMaster license

This option does not include any robot or vision options. To be able to run a PickMaster the necessary Additional options have to be selected separately.

Deliver with this option:

- PickMaster Software license key

42-7 - Extension license for additional licenses on PickMaster

This option requires a valid PickMaster 2.x or 3.x license and must be installed on the same PC as the original product and the new additional options will be accumulated to the existing options. The product reference of the existing PickMaster will be asked for when ordering this option.

No licenses are included in this option.

No physical items are delivered with this option.

Additional options

Robot licenses

559-1

License for one robot

License to use one robot. Maximum number of robots is ten

On each connected robot, the RobotWare option *Prepared for PickMaster* is required.

No physical items are delivered with this option.

Vision and sensor licenses

558-1

Licenses for one camera

License to use one camera with inspection level I. Maximum number of cameras is ten. The license is compatible with all vision hardware choices.

No physical items are delivered with this option.

551-1

Inspection

License to use one camera with inspection level II. Maximum number of cameras is ten. Each of this option requires one 558-1, i.e. this option adds on to the camera license.

No physical items are delivered with this option.

523-1

Camera Distribution

License to distribute the results from cameras to multiple robot work areas.

The number of licenses designates the maximum number of additional work areas, which can share the result from a camera with the first work area. The maximum number of licenses is ten, which also corresponds to unlimited number of distributed work areas.

No physical items are delivered with this option.

553-1

External Sensor

License to use an external sensor through the PickMaster SDK. Maximum number of sensors is ten. The license does not require any vision hardware from ABB.

No physical items are delivered with this option. Note: the option is offered on request.

Vision hardware

895-1

GigE Vision Ready

License for Cognex vision tools, and Gigabit network interface card. This license does not allow the use of color tools.

Physical items delivered with this option:

- 1 Cognex license for up to ten monochrome cameras on USB stick
- GigE network card DSQC1083 (3HAC078753-001)

One free PCI Express x4 slot (also compatible with x8 and x16, but **not** x1) and one USB slot is required on the PC.

895-2

GigE Color Vision Ready

License for Cognex vision tools, and Gigabit network interface card. This license allows the use of color tools.

Physical items delivered with this option:

- 1 Cognex license for up to ten color cameras on USB Stick
- GigE network card DSQC1083 (3HAC078753-001)

One free PCI Express x4 slot (also compatible with x8 and x16, but **not** x1) and one USB slot is required on the PC.

913-1

Standard Resolution Camera (can be used in color mode with 895-2 and monochrome mode with 895-1)

Includes cameras and cables.

Physical items delivered with this option:

- Camera Basler acA1440-73gc (according to amount)
- 20m Ethernet cable with screw lock at camera end (according to amount)
- 10m Power Trigger Strobe cable (according to amount)

Process licences

524-1

Adaptive Task Completion

License to distribute positions dynamically between robot work areas. When a robot misses a position, the following robots will handle it. Used to make sure that no position is lost. If the positions are distributed from a camera, at least one option 523-1 is required.

No physical items are delivered with this option.

Support tools

942-1

PickMaster Vision Simulation

Enables vision simulation and programming without a real camera. Vision models can be trained and verified using image files.

Physical items delivered with this option:

- Cognex license on a USB stick. The license does not allow connecting to a real camera.

4.2 PickMaster related controller options for IRC5

Overview

The following options need to be ordered for the IRC5 robot controller operating with PickMaster® 3. See also the related robot controller product specification.

RobotWare options

642-1 Prepared for PickMaster - PickMaster3

Each robot operating with PickMaster requires the *Prepared for PickMaster - PickMaster 3* option. The option contains all the necessary functions to interface PickMaster and improves conveyor tracking for picking applications.

1552-1 Tracking Unit Interface

To support conveyor tracking on up to six conveyors, the software option *Tracking unit interface* [1552-1] is needed [1]. This option is included with *Conveyor Tracking unit* options [1550-1] and [1551-1].

For more information about the software, see *Application manual - Conveyor tracking*.

Hardware options

1550-1 or 1551-1 Conveyor Tracking unit

This option is required to support 1-4 conveyors [1] and 1-8 object detecting sensors, for example, cameras. This option can be shared remotely with neighboring controllers via a local network, if software option 1552-1 is available for these controllers.

154x-1 or 154x-2 Local IO

At least one digital I/O board DSQC1031/DSQC1032 or similar is required for exchanging signals between PickMaster and the robot controller. For more information, see hardware description for the number of signals required.

1 Alternatively, one encoder interface unit [726-1] is needed for each conveyor work area.

4.3 Examples of PickMaster configurations

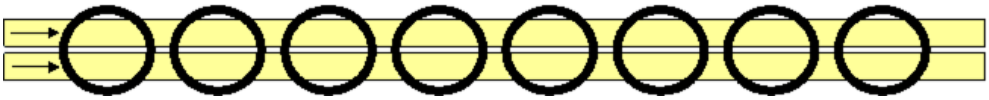
Overview

This chapter describes some installation cases and their related PickMaster options.

Use case 1

Eight robots along two conveyors with predefined product positions





xx0900000917

Basic license

Quantity	Option	
1	42-6	Basic license

Additional licenses

Quantity	Option	
8	559-1	Lic for one robot

Robot 1

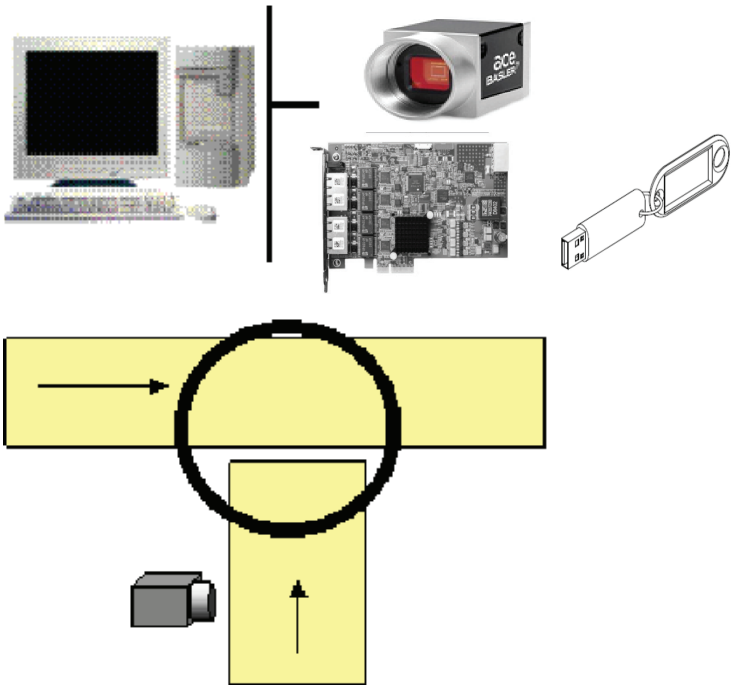
Quantity	Option	
1	642-1	Prepared for PickMaster - PickMaster3
1	1550-1 or 1551-1	Conveyor Tracking unit

Robot 2 to 8

Quantity	Option	
1	642-1	Prepared for PickMaster - PickMaster3
1	1552-1	Tracking Unit Interface

Use case 2

One robot along conveyors with one camera



xx0900000918

Basic license

Quantity	Option	
1	42-6	Basic license

Additional licenses

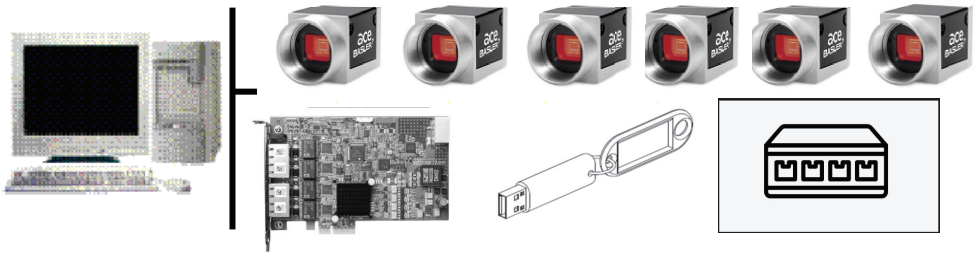
Quantity	Option	
1	895-1	GigE Vision Ready
1	559-1	Lic for one robot
1	558-1	Lic for one camera
1	551-1	If Inspection is used on the camera

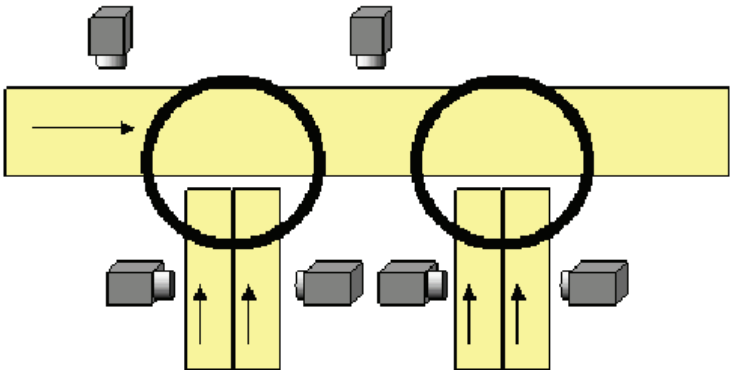
Robot options per robot

Quantity	Option	
1	642-1	Prepared for PickMaster - PickMaster3
1	1550-1 or 1551-1	Conveyor Tracking unit

Use case 3

Two robots along five conveyors with six cameras





xx0900000919

Note

Switch is not supplied with ABB delivery.

Basic license

Quantity	Option	
1	42-6	Basic license

Additional licenses

Quantity	Option	
1	895-2	GigE Color Vision Ready
6	913-1	Std Resolution Camera
2	559-1	Lic. for one robot
6	558-1	Lic. for one camera
(n	551-1	Inspection on n cameras)

Robot 1 options

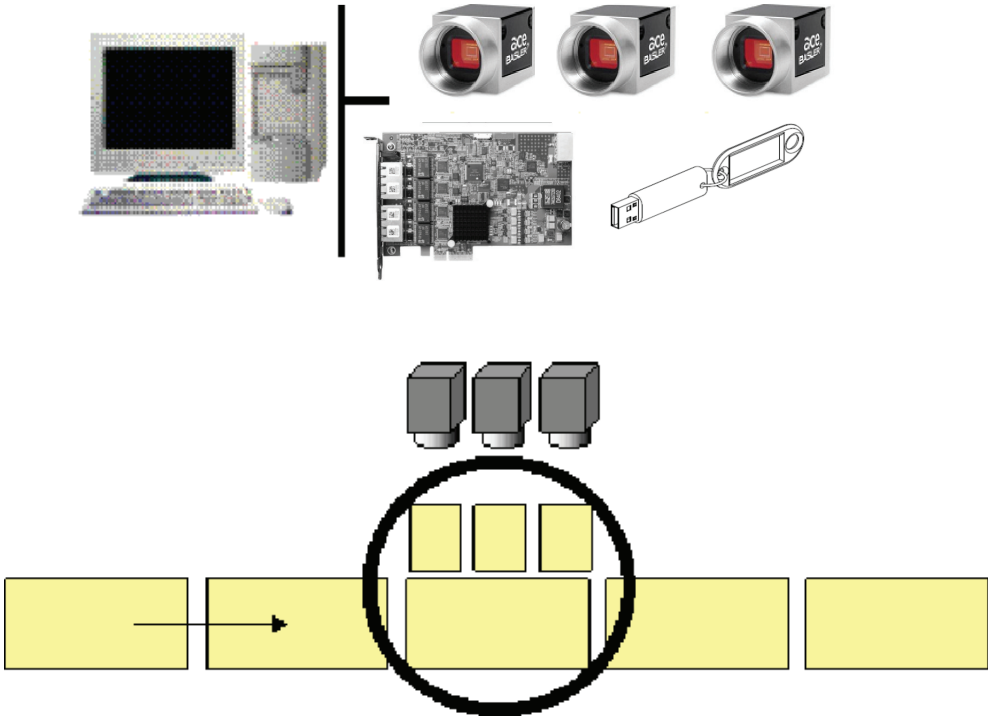
Quantity	Option	
1	642-1	Prepared for PickMaster - PickMaster3
1	1550-1 or 1551-1	Conveyor Tracking unit

Robot 2 options

Quantity	Option	
1	642-1	Prepared for PickMaster - PickMaster3
1	1552-1	Tracking Unit Interface

Use case 4

One robot along indexing feeders with three cameras



xx0900000920

Basic license

Quantity	Option	
1	42-6	Basic license including one robot

Additional licenses

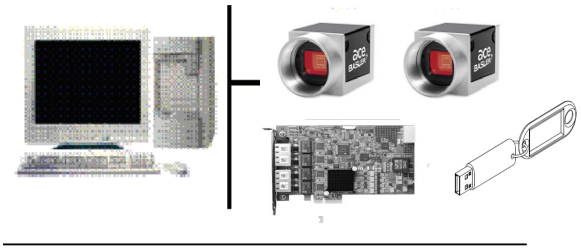
Quantity	Option	
1	895-1	GigE Vision Ready
1	559-1	Lic. for one robot
3	558-1	Lic. for one camera
(n	551-1	Inspection on n cameras)

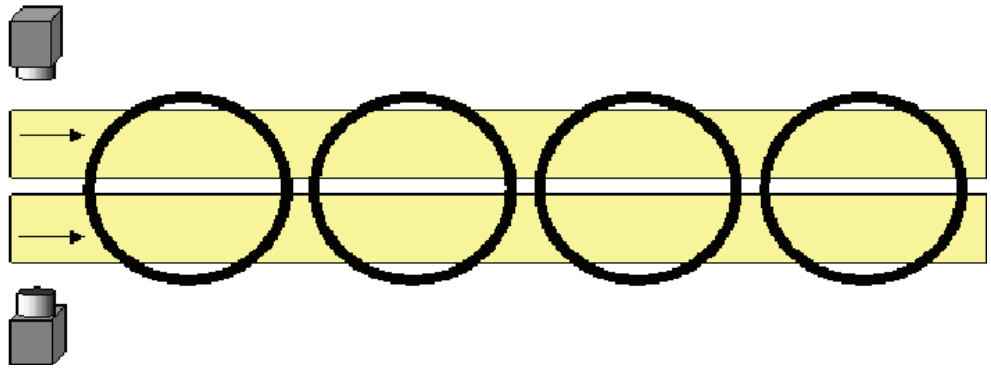
Robot options

Quantity	Option	
1	642-1	Prepared for PickMaster - PickMaster3

Use case 5

Four robots along conveyors with two cameras





xx0900000921

Basic license

Quantity	Option	
1	42-6	Basic license

Additional licenses

Quantity	Option	
1	895-2	GigE Color Vision Ready
2	913-1	Std Resolution Camera
4	559-1	Lic for one robot
2	558-1	Lic for one camera
6	523-1	Camera Distribution
(n	551-1	Inspection on n cameras)

Robot 1 options

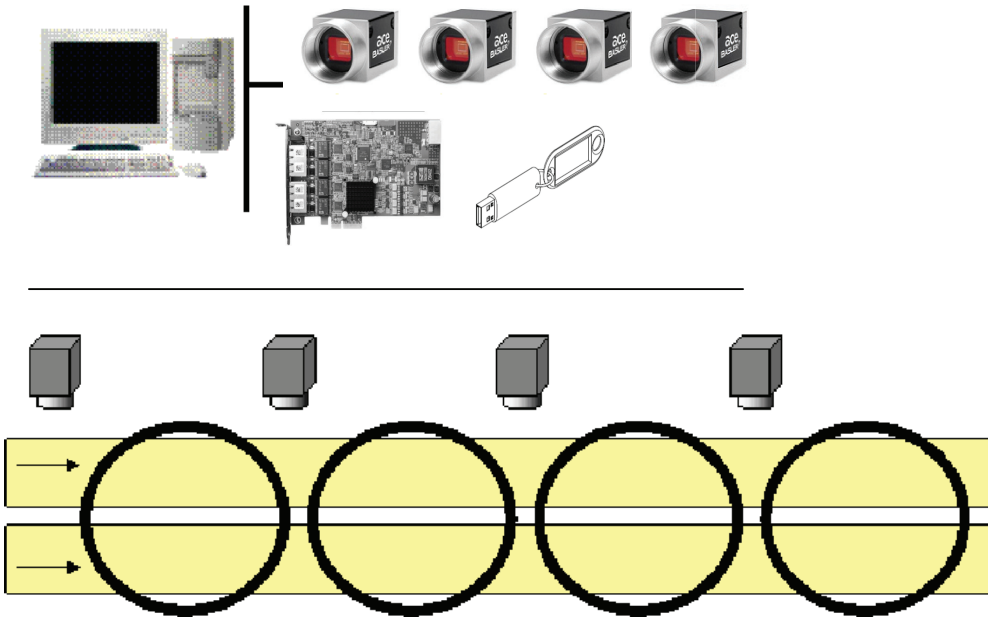
Quantity	Option	
1	642-1	Prepared for PickMaster - PickMaster3
1	1550-1 or 1551-1	Conveyor Tracking unit

For Robot 2, 3, and 4

Quantity	Option	
1	642-1	Prepared for PickMaster - PickMaster3
1	1552-1	Tracking unit interface

Use case 6

Four robots along conveyors with four cameras and ATC



xx0900000922

Basic license

Quantity	Option	
1	42-6	Basic license

Additional licenses

Quantity	Option	
1	895-1	GigE Vision Ready
4	559-1	Lic for one robot
4	558-1	Lic for one camera
x	524-1	Adaptive Task Completion
(n	551-1	Inspection on n cameras)

Robot 1 options

Quantity	Option	
1	642-1	Prepared for PickMaster - PickMaster3
1	1550-1 or 1551-1	Conveyor Tracking unit

For Robot 2, 3, and 4

Quantity	Option	
1	642-1	Prepared for PickMaster - PickMaster3
2	1552-1	Tracking unit interface

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