ROBOTICS

Product specification

Integrated Vision

Trace back information:
Workspace 23B version a5
Checked in 2023-06-09
Skribenta version 5.5.019

Product specification
Integrated Vision
IRC5

Document ID: 3HAC044266-001
Revision: H

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Overview of this specification

About this product specification

This product specification describes the functionality, performance, and options available for Integrated Vision 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*
Application manual - Integrated Vision	[1 Document.ID not defined in /bl(150728)/bl(150724)/lang(en)/ABFiles/Robots/Manuals/Vision/Recipes/id(265440)ix(1184504)v(a7)AM-3HAC044251_en.rcp, located in file: /bl(150728)/bl(150724)/lang(en)/ABFiles/Robots/Manuals/Vision/Master/id(265408)ix(1488300)v(a33)PS Integrated Vision -superspecification_en.xml]
Product specification - Robot user documentation, IRC5 with RobotWare 6	*3HAC052355-001*

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Revisions

Revision	Description
-	New specification
A	Minor corrections/update
B	Minor corrections/update
C	Added the IRB 14000-specific stationary camera, In-Sight Micro 1402.
D	Note deleted in *Licensing on page 25*.
E	Minor corrections/update
F	Released with RobotWare 6.12. • Added new cameras, DSQC1063 and DSQC1064.
G	Released with RobotWare 6.14. • Updated Camera firmware versions of, DSQC1063 and DSQC1064.
H	Released with RobotWare 6.15.03. • Cameras DSQC1098 and DSQC1099 added in sections: *Required equipment on page 12*, *Overview of the product on page 13*, *Technical specification on page 15*, *Specification of variants and options on page 27* and *Spare parts on page 29*.

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1 Integrated Vision

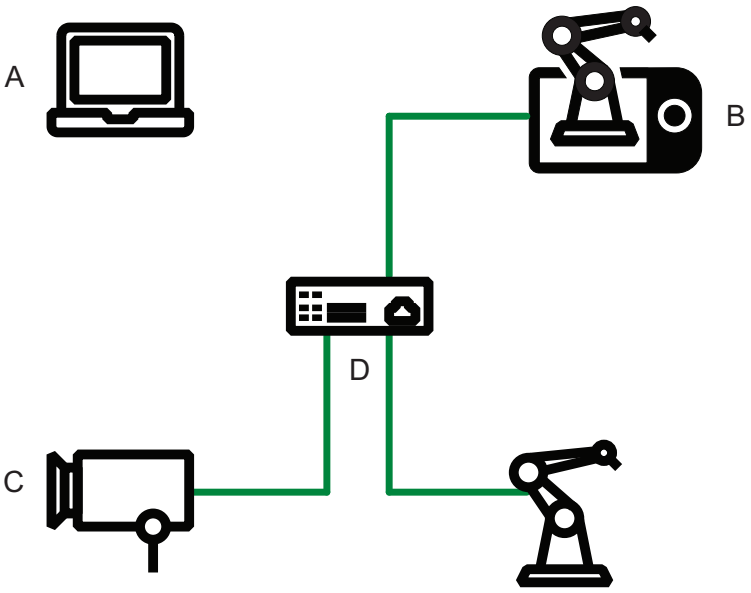
1.1 What is Integrated Vision

General

The purpose of ABB's Integrated Vision system is to provide a robust and easy-to-use vision system for general purpose Vision Guided Robotics (VGR) applications.

The system includes a complete software and hardware solution that is fully integrated with the ABB robot controller and the RobotStudio programming environment. The vision capability is based on the Cognex In-Sight® smart camera family, with embedded image processing and an Ethernet communication interface.

RobotStudio is equipped with a vision programming environment that exposes the full palette of Cognex EasyBuilder® functionality with robust tools for 2D part location, part inspection, and identification. The RAPID programming language is extended with dedicated instructions and error tracing for camera operation and vision guidance.



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Position	Description
A	PC (configuration from RobotStudio)
B	FlexPendant (monitoring and simple maintenance)
C	ABB Smart camera
D	IRC5 (connect up to 3 cameras)

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1.2 Typical applications

Typical usage

The Integrated Vision system can reduce the need for hard automation and in some cases solve tasks that can only be implemented using vision technology. Typical applications include part positioning, visual part inspection, sorting, identification, and more. The time from acquiring an image until the image processing has completed typically ranges from 50ms up to 2s or more, depending on the complexity of the task. For more information, see *Does Integrated Vision solve your application? on page 21*.

Locating the part

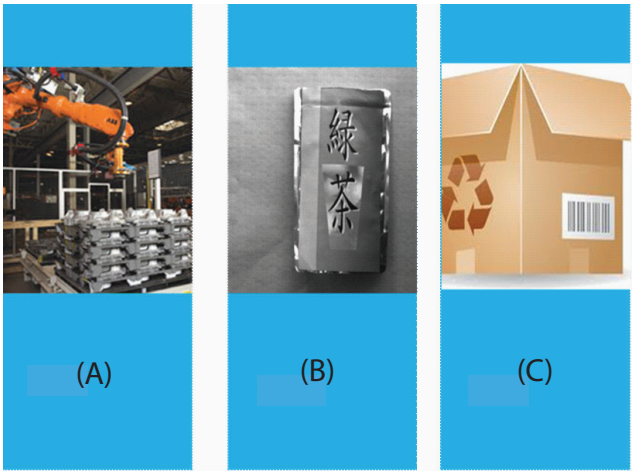
The vision system may be used as an alternative to mechanical fixtures to find the location and angle of the part in 2D. The vision system can be configured to find multiple types of parts – even simultaneously in the same scene if needed. Various vision tools are available ranging from simple and fast segmentation models that execute in a few milliseconds and up to complex feature based object recognition models with superior robustness.

Inspecting the part

The system comes with a large set of easy-to-use inspection tools tuned to a multitude of applications. Choose from simple operations such as brightness or sharpness measurements to complex pattern recognition operations. Multiple inspection tools and logic can be added as needed.

Identifying the part

With the Integrated Vision system the robot now also has the means to read text, bar codes, matrix codes etc. Thanks to the wide range of capabilities provided by the vision system it replaces an array of traditional sensors used in robotic applications.



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Position	Description
A	Find it

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Position	Description
B	Verify it
C	Trace it

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1.3 Required equipment

Software and hardware requirements

The following software and hardware is required to run Integrated Vision:

- RobotWare version: 5.60 or later
- RobotWare option: 1341-1 Integrated Vision
- A PC with RobotStudio installed (for configuration, not required for production)
- RobotStudio: To get the latest ABB and Cognex camera firmware support, make sure to always use an up to date version of RobotStudio.
- Main computer: DSQC10xx
- Camera firmware:
- - DSQC1020, DSQC1021, and In-Sight Micro 1402: 4.10.05
  - DSQC1063 and DSQC1064: 5.07 or 6.2.1
  - DSQC1098 and DSQC1099: 6.2.1
  - AE3 Smart Gripper: 4.09.04
- FlexPendant: SxTPU3 or later (optional - FlexPendant can be used for viewing images)

Note

RobotStudio is downloaded from *www.robotstudio.com*. Integrated Vision can be used with the free version of RobotStudio.

Cameras and RobotStudio connect through the service port of the main computer.

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2 Overview of the product

Hardware

The camera system is based on the Cognex In-Sight® 7000 series, but any Cognex In-Sight® camera can be used. The camera is supplied with 24 VDC and Ethernet from the controller.

The kit cameras feature IP67 protection and C-mount lensing. Up to three cameras can be connected to the supplied Ethernet switch.

Note

The functionality in Integrated Vision is verified with the following cameras (with ABB numbers):

- DSQC1020, DSQC1021, and In-Sight Micro 1402 (ABB branded)
- DSQC1063 and DSQC1064
- DSQC1098 and DSQC1099

For other camera models all features might not work, for example, color is not supported.

Software

- Integrated Vision provides easy-to-use vision guidance for the robot controller.
- Simple installation and configuration of both cameras and robots from RobotStudio.
- Rich toolset of industry proven vision algorithms for various situations.
- Find, inspect and categorize parts using dedicated vision tools such as pattern matching, caliper measurements and barcode reading.
- Save time with dedicated RAPID instructions for camera communication.
- Monitor and record images from the FlexPendant during production.

Integrated Vision is installed as part of the RobotStudio and RobotWare software. The functionality is enabled with a RobotWare option (*1341-1 Vision Interface*).

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3 Technical specification

3.1 Hardware

Cameras

The following tables provide the basic characteristics of the kit cameras provided by ABB. For additional details, see the technical specification of the camera, available on the Cognex website.

The ABB kit cameras DSQC1020 and DSQC1021 are electrically and mechanically equivalent to In-Sight 7200 and 7402 respectively.

The ABB kit cameras DSQC1063 corresponds to In-Sight 7600 and DSQC1064 corresponds to In-Sight 7601. In-Sight 7601 is basically same camera as In-Sight 7600 but has higher resolution and sensor properties according to table below.

DSQC1098 corresponds to In-Sight 7802 and DSQC1099 corresponds to In-Sight 7905.

Specifications for DSQC1020, DSQC1021, DSQC1063 and DSQC1064

Specification	DSQC1020	DSQC1021	DSQC1063	DSQC1064
Resolution	800x600	1280x1024	800x600	1280x1024
Sensor properties	5.3 mm diagonal, 5.3 x 5.3 µm sq. pixels, monochrome	8.7 mm diagonal, 5.3 x 5.3 µm sq. pixels, monochrome	4.5 mm diagonal, 4.5 x 4.5 µm sq. pixels	7.38 mm diagonal, 4.5 x 4.5 µm sq. pixels
Job/program memory	512 MB		7.2 GB non-volatile flash memory	
Image processing memory	256 MB SDRAM		512 MB SDRAM	
Sensor type	1/1.8-inch CMOS		1/1.8-inch CMOS, global shutter	
Shutter speed	16 µs to 950 ms		14 µs to 550 ms	17 µs to 750 ms
Acquisition	Rapid reset, progressive scan, full frame integration			
Lens type	C-mount			
Protection	IP67 with lens cover properly installed		IP67 with all cables properly attached (or the provided connector plug installed), the IP67-rated cover properly installed, and the Micro SD card cover fastened in place.	
Power consumption	24VDC ±10%, 2 A External light - Continuously on; output 24V, 500mA max. External light - Strobe; output 24V, 1A max. at 50% duty cycle (max. on time of 100 ms)		24VDC ±10%, 1.5 A maximum	
C-mount lens, configuration, dimensions	75 mm (2.95") to 83 mm (3.27") x 84.8 mm (3.34") x 55 mm (2.17") with lens cover installed. 42.7 mm (1.68") x 84.8 mm (3.34") x 55 mm (2.17") without lens cover installed.		81.7 mm (3.21") x 60.5 mm (2.38") x 90.1 mm (3.55") with C-mount cover. 35.7 mm (1.41") x 60.5 mm (2.38") x 90.1 mm (3.55") without C-mount cover.	
Operating temperature	0°C to 45°C (32°F to 113°F)		0°C to 50°C	

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Specifications for DSQC1098 and DSQC1099

Specification	DSQC1098	DSQC1099
Resolution	1600x1200	2448x2048
Sensor properties	9 mm diagonal, 4.5 x 4.5 µm sq. pixels	11.1 mm diagonal, 3.45 x 3.45 µm sq. pixels
Job/program memory	7.2 GB non-volatile flash memory; unlimited storage via remote network device.	
Image processing memory	512 MB SDRAM	
Sensor type	1/1.8-inch CMOS, global shutter	2/3-inch CMOS, global shutter
Shutter speed	20 µs to 940 ms	21 µs to 1,000 ms
Acquisition	Rapid reset, progressive scan, full frame integration	
Lens type	C-Mount or S-Mount/M12	C-Mount
Protection	IP67 with all cables properly attached (or the provided connector plug installed), the IP67-rated cover properly installed, and the Micro SD card cover fastened in place.	
Power consumption	24VDC ±10%, 1.5 A maximum	
C-mount lens, configuration, dimensions	35.7 mm (1.41") x 60.5 mm (2.38") x 90.1 mm (3.55"). 81.7 mm (3.21") x 60.5 mm (2.38") x 90.1 mm (3.55") with C-Mount cover accessory. 102.7 mm (4.04") x 60.5 mm (2.38") x 90.1 mm (3.55") with C-Mount cover accessory. 77.5 mm (3.05") x 88.9 mm (3.50") x 97.2 mm (3.83") with Illumination accessory.	49.4 mm (1.94") x 60.5 mm (2.38") x 90.1 mm (3.55"). 95.3 mm (3.21") x 60.5 mm (2.38") x 90.1 mm (3.55") with C-Mount cover accessory. 116.3 mm (4.58") x 60.5 mm (2.38") x 90.1 mm (3.55") with C-Mount cover accessory. 131.7 mm (5.19") x 68.0 mm (2.68") x 90.1 mm (3.55") with C-Mount cover accessory. 161.7 mm (6.37") x 68.0 mm (2.68") x 90.1 mm (3.55") with C-Mount cover accessory and C-Mount cover extender accessory. 91.1 mm (3.59") x 88.9 mm (3.50") x 97.2 mm (3.83") with illumination accessory.
Operating temperature	0°C to 50°C (32°F to 122°F)	
Ethernet ports	Occupies 1-3.	

Lenses

It is important to select the correct lens before ordering a vision system. To select the correct lens, use *Cognex Lens Advisor*, see:

http://www.cognex.com/ExploreLearn/UsefulTools/LensAdvisor/?id=8341

When using the *Lens Advisor*, select product and model as follows:

- DSQC1020: In-Sight 7200
- DSQC1021: In-Sight 7402
- DSQC1063: In-Sight 7600 - VGA
- DSQC1064: In-Sight 7601 (In-Sight 7601 does not exist in *Lens Advisor* so when calculating lens for In-Sight 7601, use In-Sight 7801 it has the same resolution and field of view as In-Sight 7601)

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- DSQC1098: In-Sight 7802
- DSQC1099: In-Sight 7905

ABB can provide lenses with focal length 8 mm, 12.5 mm, 16 mm, and 25 mm. Lenses with other focal lengths can be purchased from Cognex, if needed.

Example of selecting lens

Below is an example showing how to calculate the proper lens to be used, knowing the working distance between camera and work piece, and the required field of view. The example uses DSQC1021.

Camera	DSQC1021
Maximum distance between camera and product	500 mm
Minimum field of view	200 x 200 mm

The example specifies that the FOV must be at least 200 mm in both vertical and horizontal directions. Since the image is rectangular rather than square, it means that the shortest dimension, the height, must be greater than 200 mm.

In this case an 8 mm lens would also work, but the resolution of the camera would not be fully utilized since the field of view would be larger than needed.

YuMi-specific stationary vision

Camera

The following table provides the basic characteristics of the YuMi-specific stationary camera, In-Sight Micro 1402.

Specification	In-Sight Micro 1402
Resolution	1280x1024
Sensor properties	8.7 mm diagonal, 5.3 x 5.3 µm sq. pixels
Job/program memory	128 MB non-volatile flash memory; unlimited storage via remote network device
Image processing memory	256 MB
Sensor type	1/1.8-inch CMOS
Shutter speed	16 µs to 1,000 ms
Acquisition	Rapid reset, progressive scan, full frame integration
Lens type	CS-mount and C-mount (with 5 mm extension, included)
Protection	IP51 with cables and lens attached
Power consumption	6.49 W maximum per Class 2 PoE
Dimensions	30 x 30 x 60 mm (1.18 x 1.18 x 2.36 in) without mounting block 30 x 38.2 x 60 mm (1.18 x 1.50 x 2.36 in) with mounting block
Operating temperature	0°C to 45°C (32°F to 113°F)

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Lens

HF 12.5HA-1B is the lens used together with the YuMi-specific stationary camera In-Sight Micro 1402. The following table details the basic specifications of the lens.

Specification	HF 12.5HA-1B
Focus length (mm)	12.5
Iris range	F1.4-F16
Operation	Focus: manual Iris: manual
Angle of view (H x V)	2/3": 38"47' x 29"35' 1/2": 28"43' x 21"44' 1/3": 21"44' x 16"23'
Focusing range (from front of the lens) (m)	∞ - 0.1
Object dimensions at M.O.D. (H x V) (mm)	2/3": 78 x 58 1/2": 57 x 42 1/3": 42 x 32
Back focal distance (in air) (mm)	15.09
Exit pupil position (from image plane) (mm)	-31.3
Filter thread (mm)	M25.2 x 0.5
Mount	C
Mass (g)	45

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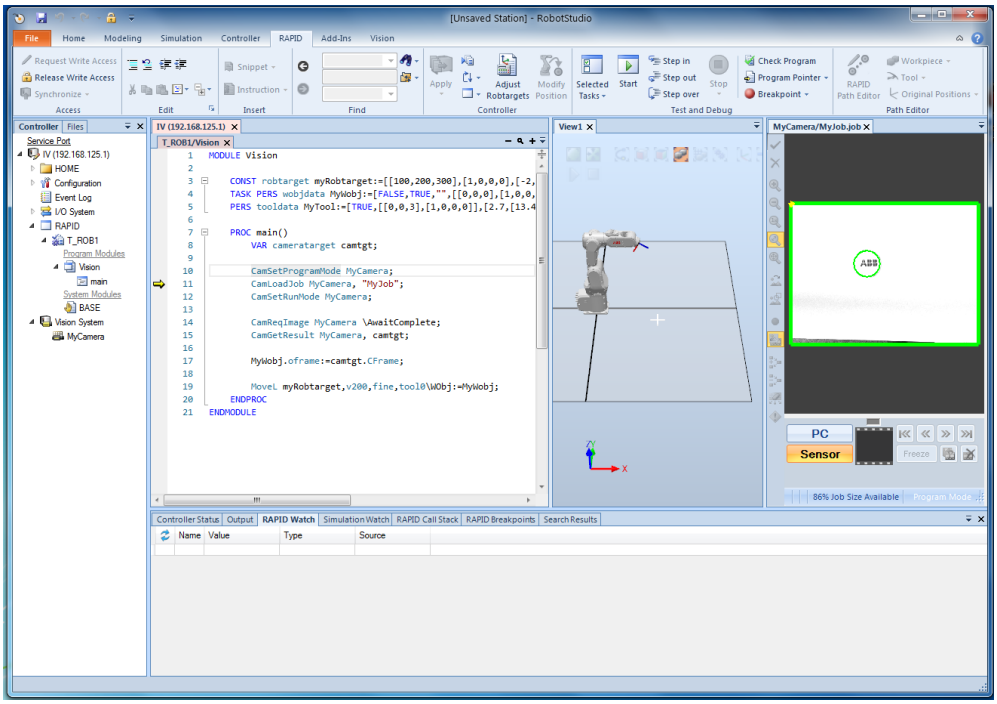
3.2 Software

RobotStudio

RobotStudio is equipped with an additional tab that can be launched when connected to a robot controller with the option Integrated Vision. A graphical interface provides point-and-click instructions to assemble a vision task or *job*. The vision tab offers a rich set of vision tools that can be used to solve a wide variety of applications. Rapid snippets are available to get off to a quick start.



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> **Note**
>
> The ABB kit cameras cannot be programmed with Cognex In-Sight Explorer.

Robot controller

The RobotWare option Integrated Vision enables a set of dedicated instructions for communicating with the camera in an efficient manner. The instructions include commands for acquiring images, queue handling for the output as well as generic instructions for changing various parameters during runtime.

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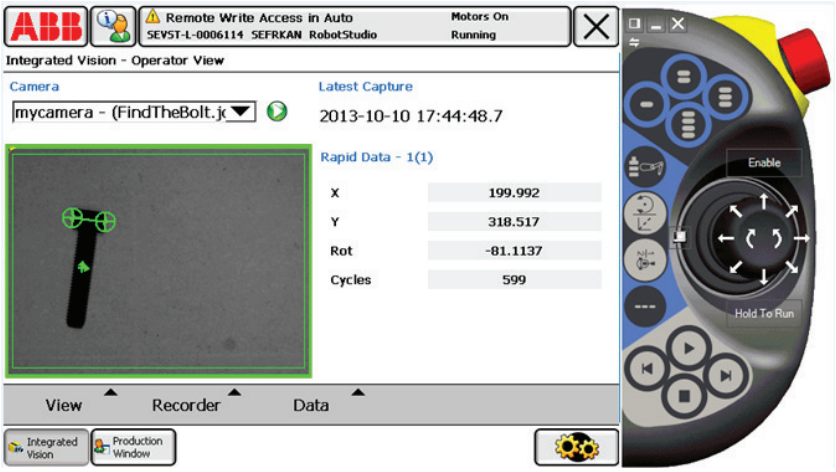
FlexPendant

To eliminate the need for an additional operator panel the FlexPendant includes a vision application for monitoring images, observing result output, and saving images during run-time. The application can be configured so that the user may add favorite data to be displayed alongside the image.



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4 Does Integrated Vision solve your application?

When deciding to deploy a vision solution it is of critical importance to evaluate if the expected result can be achieved. The best way to make sure that required results can be achieved is to perform a test, and the closer the test setup is to the intended installation the better the result.

As good practice, the following requirements shall be identified/quantified and verified:

Requirement	Description
Samples	Collect good and bad samples of the actual customer product to be used for evaluation.
Accuracy	What accuracy is required? The overall number combines robot accuracy, influence by part variation, lighting etc.
Tolerance	Can the part vary in size? Uniformly or irregularly?
Cycle time	The vision system requires processing time. Depending on the application this may or may not affect the cycle time.
Part positioning	Make sure you know the perspective from which the camera will observe the object. A simple thing like looking at the object from the side may affect the result.
Variations in the process	Apart from the verified variables, can something else change?
Lighting needs	Lighting is extremely important. Shield out ambient light and applying light that brings out the desired features of the part. Experimentation is the only reliable method.
Physical space constraints	Taking all factors into consideration such as field of view, lighting solution, point of view – does everything fit together?

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5 Stationary camera or mounted on the robot

General

Depending on the application requirements and physical constraints the camera may be mounted in different ways. Generally it can be said that mounting the camera on a fixed structure is more efficient unless requirements are such that the camera must be carried by the robot. When mounted on a robot the camera may be subjected to substantial force. For special considerations, see *Hardware on page 15*.

Stationary

A stationary camera generally provides faster cycle times since the robot does not have to stop on its path to acquire an image. Setup and calibration is generally easier with fixed cameras since the point from which the image is acquired is fixed. When mounting the camera on a fixed structure it is important that the camera is not subject to vibrations which can cause motion blur.

Mounted on the robot

When placing a camera on a moving position it is the responsibility of the user to make sure that the camera is not subjected to mechanical forces greater than what is specified in the camera specification. The cables are of a flexible type, but wear depends greatly on both the cable routing and the programmed robot path.

CAUTION

When using a robot held camera, or by other means moving camera, it is important to have a good cable routing.

When routing the cables caution has to be taken to avoid mechanical stress on the connectors, allowing sufficient bend radius for the cables, and minimizing the wear on the cables. It is also recommended to fit the cables with extra wear protection at the attachment points and at especially exposed areas.

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6 Sales options

Licensing

Integrated Vision is licensed as RobotWare option 1341-1. The software option enables the RAPID programming interface and FlexPendant operator panel. The vision programming tool in RobotStudio is free to use.

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7 Specification of variants and options

Options

Option	Description	Remark	Description
1341-1	Integrated Vision interface	Requires 24V [727-1 or 727-3]	The option provides the software option that enables use of the RAPID vision instructions and the FlexPendant operator panel. The controller is also fitted with the necessary hardware to enable connection of up to three cameras.
Integrated Vision cameras			
1342-1	(1-3) Medium resolution camera	Requires Integrated vision interface [1341-1]	Camera DSQC1063 as specified in section *Cameras on page 15*. 10 m cables for EtherNet and Power I/O included with each camera.
1343-1	(1-3) High resolution camera	Requires Integrated vision interface [1341-1]	Camera DSQC1064 as specified in section *Cameras on page 15*. 10 m cables for EtherNet and Power I/O included with each camera.
1592-1	2MPx resolution camera	Requires Integrated vision interface [1341-1]	Camera DSQC1098 as specified in section *Cameras on page 15*. 10 m cables for EtherNet and Power I/O included with each camera.
1587-1	5MPx resolution camera	Requires Integrated vision interface [1341-1]	Camera DSQC1099 as specified in section *Cameras on page 15*. 10 m cables for EtherNet and Power I/O included with each camera.
Camera lenses			
1348-1	(1-3) 8 mm camera lens	Requires Integrated vision interface [1341-1] Requires Medium resolution camera [1342-1] or High resolution camera [1343-1] or 2MPx resolution camera [1592-1].	Camera lens with focal length 8 mm as specified in section *Lenses on page 16*.
1352-1	(1-3) 12.5 mm camera lens	Requires Integrated vision interface [1341-1] Requires Medium resolution camera [1342-1] or High resolution camera [1343-1] or 2MPx resolution camera [1592-1].	Camera lens with focal length 12.5 mm as specified in section *Lenses on page 16*.
1349-1	(1-3) 16 mm camera lens	Requires Integrated vision interface [1341-1] Requires Medium resolution camera [1342-1] or High resolution camera [1343-1] or 2MPx resolution camera [1592-1].	Camera lens with focal length 16 mm as specified in section *Lenses on page 16*.
1350-1	(1-3) 25 mm camera lens	Requires Integrated vision interface [1341-1] Requires Medium resolution camera [1342-1] or High resolution camera [1343-1] or 2MPx resolution camera [1592-1].	Camera lens with focal length 25 mm as specified in section *Lenses on page 16*.

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Continued

Option	Description	Remark	Description
1588-1	8 mm-5 MPx Cam Lens	Requires Integrated vision interface [1341-1] Requires 2 MPx resolution camera [1592-1] or 5 MPx resolution camera [1587-1].	Camera lens with focal length 8 mm as specified in section *Lenses on page 16*.
1589-1	12.5 mm-5 MPx Cam Lens	Requires Integrated vision interface [1341-1] Requires 2 MPx resolution camera [1592-1] or 5 MPx resolution camera [1587-1].	Camera lens with focal length 12.5 mm as specified in section *Lenses on page 16*.
1590-1	16 mm-5 MPx Cam Lens	Requires Integrated vision interface [1341-1] Requires 2 MPx resolution camera [1592-1] or 5 MPx resolution camera [1587-1].	Camera lens with focal length 16 mm as specified in section *Lenses on page 16*.
1591-1	25 mm-5 MPx Cam Lens	Requires Integrated vision interface [1341-1] Requires 2 MPx resolution camera [1592-1] or 5 MPx resolution camera [1587-1].	Camera lens with focal length 25 mm as specified in section *Lenses on page 16*.

YuMi-specific option

Option	Description	Remark	Description
YuMi-specific stationary vision			
1521-1	(1-2) High res. PoE camera	Requires IRB 14000-0.5/0.5 [435-131]	This option provides a package specific to IRB 14000, including camera, lens, adapter, cables and so on. Camera ISM1402 and related lens as specified in sections *YuMi-specific stationary vision on page 17*.

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8 Spare parts

Spare parts for Integrated Vision

Article number	Description
3HAC053944-001	8 mm C-mount lens
3HAC053944-002	12.5 mm C-mount lens
3HAC053944-003	16 mm C-mount lens
3HAC053944-004	25 mm C-mount lens
3HAC053953-001	DSQC1020 Camera Std Resolution for C-mount lens
3HAC053954-001	DSQC1021 Camera High Resolution for C-mount lens
3HAC075182-001	DSQC1063 Camera Std Resolution for C-mount lens
3HAC075207-001	DSQC1064 Camera High Resolution for C-mount lens
3HAC087074-001	DSQC1098 Integrated vision camera 2MPx
3HAC087075-001	DSQC1099 Integrated vision camera 5MPx
3HAC087266-001	8 mm camera lens, LMC-ML-M0822UR
3HAC087267-001	12.5 mm camera lens, LMC-ML-M1218UR
3HAC087268-001	16 mm camera lens, LMC-ML-M1616UR
3HAC087269-001	25 mm camera lens, LMC-ML-M2516UR
3HAC075443-002	Ethernet cable 10 m
3HAC051736-004	Ethernet cable 15 m
3HAC051753-003	Power cable 10 m
3HAC051753-004	Power cable 15 m

Spare parts for YuMi-specific stationary vision

Article number	Description
3HAC053166-001	Cognex camera, ISM1402-11
3HAC053167-001	Cognex LFC-12.5F lens
3HAC053168-001	Standard Ethernet cable 5 m
3HAC053227-001	PoE adapter
3HAC024254-009	Ethernet cable, straight con. 3 m

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Warnings

1 *Document.ID not defined in /bl(1507203)/bl(1507204)/lang(en)/ABB/Files/Robots/Manuals/Vision/Recipes/id(265440)ix(1184504)v(a7)AIM-3HAC044251_en.rcp, located in file: /bl(1507203)/bl(1507204)/lang(en)/ABB/Files/Robots/Manuals/Vision/Master/id(265408)ix(1488300)v(a33)PS Integrated Vision -superspecification_en.xml*

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3HAC044266-001, Rev H, en

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