EN

DNNF012
DNNF020

uniVision software

Operating Instruction

Subject to change without notice
Available as PDF file only
Version 2.6.1
Revision level: 30.10.2023
www.wenglor.com

Table of Contents

1. General

1.1 Information Concerning these Instructions

- These instructions apply to the products with ID codes DNNF012 and DNNF020.
- They make it possible to use the product safely and efficiently.
- These instructions are an integral part of the product and must be kept on hand for the entire duration of its service life.
- Local accident prevention regulations and national work safety regulations must be complied with as well.
- The product is subject to further technical development, and thus the information contained in these operating instructions may also be subject to change. The current version can be found at www.wenglor.com in the product's separate download area.

NOTE!
The operating instructions must be read carefully before using the product and must be kept on hand for later reference.

1.2 Explanations of Symbols

- Safety precautions and warnings are emphasized by means of symbols and attention-getting words.
- Safe use of the product is only possible if these safety precautions and warnings are adhered to.

The safety precautions and warnings are laid out in accordance with the following principle:

ATTENTION-GETTING WORD!
Type and Source of Danger!
Possible consequences in the event that the hazard is disregarded.
- Measures for averting the hazard.

The meanings of the attention-getting words, as well as the scope of the associated hazards, are listed below:

DANGER!
This word indicates a hazard with a high degree of risk which, if not avoided, results in death or severe injury.

Warning!
This word indicates a hazard with a medium degree of risk which, if not avoided, may result in death or severe injury.

CAUTION!
This word indicates a hazard with a low degree of risk which, if not avoided, may result in minor or moderate injury.

ATTENTION!
This word draws attention to a potentially hazardous situation which, if not avoided, may result in property damage.

NOTE!
A note draws attention to useful tips and suggestions, as well as information regarding efficient, error-free use.

1.3 Limitation of Liability

- The product has been developed taking into account the state of the art as well as the applicable standards and guidelines.
- We reserve the right to make technical changes.
- A valid declaration of conformity can be found at www.wenglor.com in the download area of the product.
- wenglor sensoric elektronische Geräte GmbH (hereinafter „wenglor“) accepts no liability for:
  - » Failure to observe the operating manual,
  - » Unsuitable or improper use of the product,
  - » Excessive use, incorrect or negligent treatment of the product,
  - » Incorrect installation or commissioning,
  - » Use of untrained personnel,
  - » Use of unauthorized spare parts or
  - » Improper or unauthorized changes, modifications or repair work to the products.
- This operating manual does not contain any guarantees/warrantees from wenglor with regard to the processes described or certain product properties.
- wenglor assumes no liability with regard to printing errors or other inaccuracies contained in this operating manual, unless it can be proven that wenglor was aware of the errors at the time the operating manual was created.

1.4 Copyrights

- The contents of these instructions are protected by copyright law.
- All rights are reserved by wenglor.
- Commercial reproduction or any other commercial use of the provided content and information, in particular graphics and images, is not permitted without previous written consent from wenglor.

2. For Your Safety

2.1 Use for Intended Purpose

2.1.1 uniVision for Smart Cameras

The uniVision software enables Smart Cameras to be parametrized for evaluating image data. A wide range of tools are available that can be combined as desired. This enables dimensional accuracy checks, object counting, presence checks, pattern matchings, optical character readings and 1D-/2D code readings to be carried out.

NOTE!
Further information regarding the mode of operation of the Smart Cameras is included in the operating instructions of each respective sensor.

This product can be used in the following industry sectors:

- Special machinery manufacturing
- Heavy machinery manufacturing
- Logistics
- Automotive industry
- Food industry
- Packaging industry
- Pharmaceuticals industry
- Plastics industry
- Woodworking industry
- Consumer goods industry
- Paper industry
- Electronics industry
- Glass industry
- Steel industry
- Aviation industry
- Chemicals industry
- Alternative energy
- Raw materials extraction

2.1.2 uniVision for Vision Systems

uniVision software makes it possible to configure parameters for uniVision applications. Images from Machine Vision Cameras are evaluated in the uniVision application. Numerous tools are available for this purpose, which can be combined as desired. This makes it possible to conduct presence checks, dimensional accuracy checks and pattern matching, and to read in plain text and 1D/2D codes.

2.1.3 uniVision for Smart 2D/3D Profile Sensors

The uniVision software makes it possible to parameterize smart 2D/3D profile sensors for flexible evaluation of height profiles. Numerous tools are available for this purpose, which can be combined as desired. This allows, for example, object measurement, edge detection, and tracking tasks to be solved.

2.1.4 uniVision for Control Units with 2D/3D Profile Sensors

The uniVision software enables parameterization of uniVision applications on the control unit. In the uniVision application, the point clouds of 2D/3D profile sensors are evaluated. A wide range of tools are available that can be combined as desired. This enables object measurements, edge detection and tracking tasks to be carried out.

NOTE!
Further information regarding the mode of operation of the 2D/3D profile sensors is included in the operating instructions of each respective sensor.

2.2 Use for Other than the Intended Purpose

- Not a safety component in accordance with 2006/42/EC (Machinery Directive)
- The product is not suitable for use in potentially explosive atmospheres.
- The product may only be used with accessories supplied or approved by wenglor, or in combination with approved products. A list of approved accessories and combination products can be accessed at www.wenglor.com on the product detail page.

DANGER!
Risk of personal injury or property damage in case of use for other than the intended purpose!
Use for other than the intended purpose may lead to hazardous situations.
- Instructions regarding use for intended purpose must be observed.

2.3 Personnel Qualifications

- Suitable technical training is a prerequisite.
- In-house electronics training is required.
- Trained personnel who use the product must have uninterrupted access to the operating instructions.

DANGER!
Risk of personal injury or property damage in case of incorrect initial start-up and maintenance!
Personal injury and damage to equipment may occur.
- Adequate training and qualification of personnel.

2.4 General Safety Precautions

NOTE!
- These instructions are an integral part of the product and must be kept on hand for the entire duration of its service life.
- In the event of possible changes, the respectively current version of the operating instructions can be accessed at www.wenglor.com in the product's download area.

3. Technical Data

Technical Data / Order Number	DNNF012 uniVision for Linux	DNNF020 uniVision for Windows
Function		
Configuration software	Yes	Yes
Diagnostics software	Yes	Yes
Operating system		
Linux	Yes	No
Windows 7, 64 bit	No	Yes
Windows 10, 64 bit*	No	Yes
Interface		
Ethernet	Yes	Yes
General data		
Usage	For uniVision application	For Smart Camera, smart 2D/3D profile sensors and uniVision application
Languages	DE, EN, FR, IT, ES, PT, NL, HU, TR, ZH, RU	
Licensing model	Freeware	Freeware
System requirements		
Cycle rate	Can only run on the wenglor control unit	2 GHz
RAM	Can only run on the wenglor control unit	2 GB
Free hard disc space	Can only run on the wenglor control unit	500 MB
Minimum screen resolution	1280 × 1024	

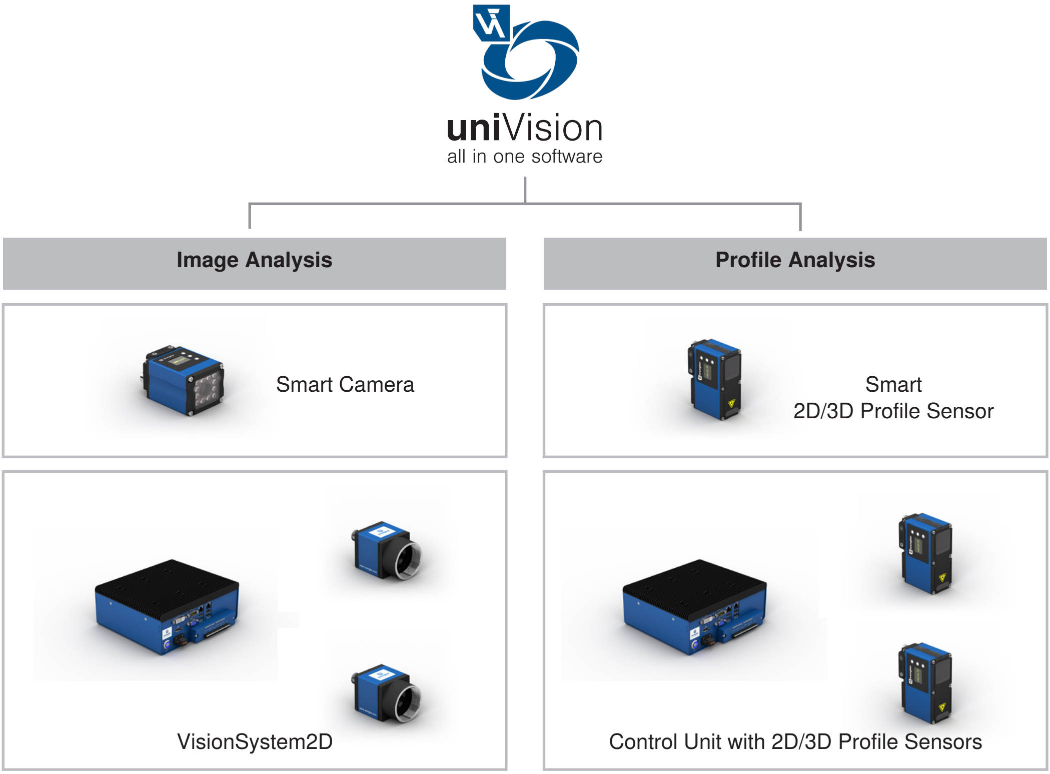
* Tested and supported up to build 2004. Newer versions of Windows are not tested. Install uniVision software for Windows on newer Windows builds at your own risk.

NOTE!
Use of uniVision for Windows software on virtual machines is not supported. Additionally, simultanuous run of the Software uniVision for Windows and other programms that use Halcon libraries is not possible.

NOTE!
The Software uniVision for Windows on Windows 7 PCs requires Windows 7 Service Pack 1.

4. System Overview

The following products can be configured with uniVision software:
- Smart Cameras
- Vision Systems
- Smart 2D/3D Profile Sensors
- Control Units with 2D/3D Profile Sensors



NOTE!
Machine Vision Cameras and 2D/3D profile sensors can also be combined at a single control unit.

4.1 uniVision for Smart Cameras

In the case of Smart Cameras, image recording and evaluation take place directly within a single housing. Smart cameras are available with auto-focus and integrated illumination, as well as with C mount threaded connection, C mount lenses and external illumination.

NOTE!
The following overview shows which modules are licensed in which software package:

Software package	Licensed modules
Smart Camera	All modules are licensed.
Vision Standard	Filter, threshold, HSV threshold, tracking, coordinate system, region, cluster, image comparison, measuring, spreadsheet, counter, statistics, match code, logic, mathematics, numerical comparison,
Vision Standard with pattern matching	Filter, threshold, HSV threshold, tracking, coordinate system, region, cluster, image comparison, pattern matching, measuring, spreadsheet, counter, statistics, match code, logic, mathematics, numerical comparison
Decode	Filter, threshold, tracking, coordinate system, region, 1D code, 2D code, logic, mathematics, numerical comparison, match code, statistics, spreadsheet, counter
OCR	Filter, threshold, tracking, coordinate system, region, OCR, statistics, match code, logic, mathematics, numerical comparison, spreadsheet, counter

4.1.1 Product Overview for Smart Cameras with Auto-Focus

Software		Image Chip	Light Source	Communication	Order No.
weQube – the Smart Camera	**Smart Camera**	Color	white light	Ethernet	B50M001
				PROFINET, EtherNet/IP™	B50M100
		Monochrom	white light	Ethernet	B50M002
				PROFINET, EtherNet/IP™	B50M101
			infrared light	Ethernet	B50M003
				PROFINET, EtherNet/IP™	B50M102
			red light	Ethernet	B50M004
				PROFINET, EtherNet/IP™	B50M103
weQubeVision Standard	**Vision Sensor**	Color	white light	Ethernet	B50S001
				PROFINET, EtherNet/IP™	B50S100
		Monochrom	white light	Ethernet	B50S002
				PROFINET, EtherNet/IP™	B50S101
			infrared light	Ethernet	B50S003
				PROFINET, EtherNet/IP™	B50S102
weQubeVision Standard with Pattern Matching	**Vision Sensor**	Color	white light	Ethernet	B50S004
				PROFINET, EtherNet/IP™	B50S103
		Monochrom	white light	Ethernet	B50S005
				PROFINET, EtherNet/IP™	B50S104
			red light	Ethernet	B50S006
				PROFINET, EtherNet/IP™	B50S105
weQubeDecode	**1D/2D and Barcode Scanners**	Monochrom	white light	Ethernet	C50C001
				PROFINET, EtherNet/IP™	C50C100
			infrared light	Ethernet	C50C002
				PROFINET, EtherNet/IP™	C50C101
			red light	Ethernet	C50C003
				PROFINET, EtherNet/IP™	C50C102
weQubeOCR	**OCR Reader**	Monochrom	white light	Ethernet	B50R001
				PROFINET, EtherNet/IP™	B50R100
			infrared light	Ethernet	B50R002
				PROFINET, EtherNet/IP™	B50R101

4.1.2 System Overview for Smart Cameras with Autofocus

The system overview can be found at www.wenglor.com.

4.1.3 Product Overview for Smart Cameras with C Mount

Software		Image Chip	Communication	Order No.
weQube – the Smart Camera	Smart Camera	Color	Ethernet	B50M011
			PROFINET, EtherNet/IP™	B50M110
		Monochrom	Ethernet	B50M012
			PROFINET, EtherNet/IP™	B50M111
weQubeVision Standard	Vision Sensor	Color	Ethernet	B50S011
			PROFINET, EtherNet/IP™	B50S110
		Monochrom	Ethernet	B50S012
			PROFINET, EtherNet/IP™	B50S111
weQubeVision Standard with Pattern Matching	Vision Sensor	Color	Ethernet	B50S013
			PROFINET, EtherNet/IP™	B50S112
		Monochrom	Ethernet	B50S014
			PROFINET, EtherNet/IP™	B50S113
weQubeDecode	1D/2D and Barcode Scanners	Monochrom	Ethernet	C50C011
			PROFINET, EtherNet/IP™	C50C110
weQubeOCR	OCR Reader	Monochrom	Ethernet	B50R011
			PROFINET, EtherNet/IP™	B50R110

4.1.4 System Overview for Smart Cameras with C Mount

The system overview can be found at www.wenglor.com.

4.1.5 Additional Accessories for the weQube Smart Camera

Licenses

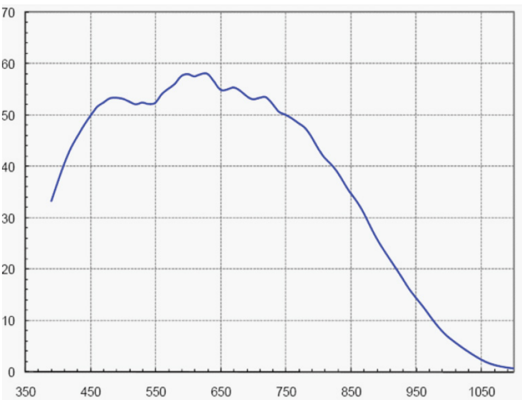
DNNL001	weQube license upgrade, vision modules (Measuring, clusters, image comparison)
DNNL002	weQube license upgrade, 1D code module, 2D code module
DNNL003	weQube license upgrade, OCR module
DNNL006	weQube license upgrade, pattern matching module
ZNN1004	Window PC license, offline operation for 1D and 2D code modules and image-based pattern matching

NOTE!
Additional info about licenses can be found in section "17. License Management" on page 329.

Image Chips in Smart Cameras

Smart Camera with monochrome image chip:

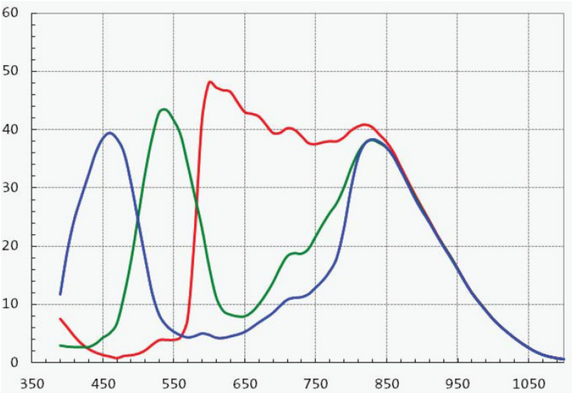
Quantum efficiency (%)



Wavelength (nm)

Smart Camera with color image chip:

Quantum efficiency (%)



Wavelength (nm)

NOTE!
The following points must be observed when using external illumination:
- Always use white light illumination for Smart Cameras with color image chip.
- Amongst other types, illumination with visible or IR light can be used for Smart Cameras with monochrome image chips.
- In the case of Smart Cameras with monochrome image chip and auto-focus, the same type of light source must be used for external illumination as is also the case for internal illumination because the internal barrier filters suppress ambient light.

4.2 uniVision for Vision Systems

The vision system consists of one or more Machine Vision Cameras with a control unit. Images are recorded with the Machine Vision Cameras and transmitted to the control unit where image evaluation takes place, and the results are read out via the control unit’s interfaces. Up to 16 Machine Vision Cameras can be connected to a control unit.

NOTE!
The maximum number of Machine Vision Cameras per control unit depends on the recording frequency of the Machine Vision Cameras, overall network load and total processing times of all uniVision applications connected to the control unit.

- For example, two monochrome Machine Vision Cameras with 1.6 MP can be used at a control unit with a recording frequency of 10 Hz and total processing time of 20 ms for each uniVision application.
- Network load:
  - The vision system supports a maximum network load of 1 Gbps. For example, a monochrome Machine Vision Camera with 5 MP (1 pixel corresponds to 1 byte) and approximately 22 frames per second consumes nearly the entire network load capacity (22 x 8 x 5,000,000 bps = 0.88 Gbps).
  - Any further communication via the network (e.g. read-out of process data or LIMA communication via TCP/IP or UDP, uniVision software) generates additional network load which must be taken into account.
  - Network load must be laid out for the vision system’s applications such that 1 Gbps is not exceeded. In the event of an error, the vision system reads out error messages for non-evaluated images.
  - Via a vnc connection or a connected monitor to the control unit, it is possible to observe the network load in the task bar.
  - To avoid overloading the network, it is advisable to activate the bandwidth limitation on the Machine Vision Cameras (if present) for multi-camera applications. Further information can be found in the Machine Vision Camera module in section “12.3.3.3 Device Control” on page 158.
- Overall processing time for uniVision applications:
  - Several uniVision applications can conduct evaluations at a single control unit. Overall processing time for a uniVision application depends to a great extent on the project and the utilized modules.
  - Fundamentally, data evaluation must be faster than data recording or transmission. In the event of an error, the uniVision application reads out error messages for non-evaluated data.
  - Each additional process running at the control unit requires additional processing time (e.g. uniVision software for Linux).
  - Overall processing time for all uniVision applications should be selected such that CPU utilization at the control unit is less than 50 %.
  - Via a vnc connection or a connected monitor to the control unit, it is possible to observe the cpu load in the task bar.

4.2.1 Product and System Overview

The system overview can be found at www.wenglor.com.

4.2.2 Licenses for Vision Systems

The following overview shows which modules are included in which software package:

Software package	Licensed modules
uniVision Image	Coordinate system, filter, region, measurement, BLOB, threshold, HSV threshold, image comparison, tracking, OCR
uniVision Image Extended	Coordinate system, filter, region, measurement, BLOB, threshold, HSV threshold, image comparison, tracking, OCR, 1D code, 2D code, pattern matching

The following re-licensing options exist:

Item number	Modules
DNNL009	Control unit license upgrade, profile analysis (Point cloud calculus, point cloud coordinate system, point cloud filter, point cloud measurement, point cloud region, point cloud pattern matching)
DNNL010	Control unit license upgrade, image analysis (Coordinate system, filter, region, measurement, BLOB, threshold, HSV threshold, image comparison, tracking, OCR)
DNNL011	Control unit license upgrade, decoding and image-based pattern matching (1D code, 2D code, pattern matching)
DNNL016	Control unit license upgrade, weld seam tracking (point cloud weld seam tracking)
ZNN1004	Windows PC license, offline operation for 1D and 2D code modules and image-based pattern matching

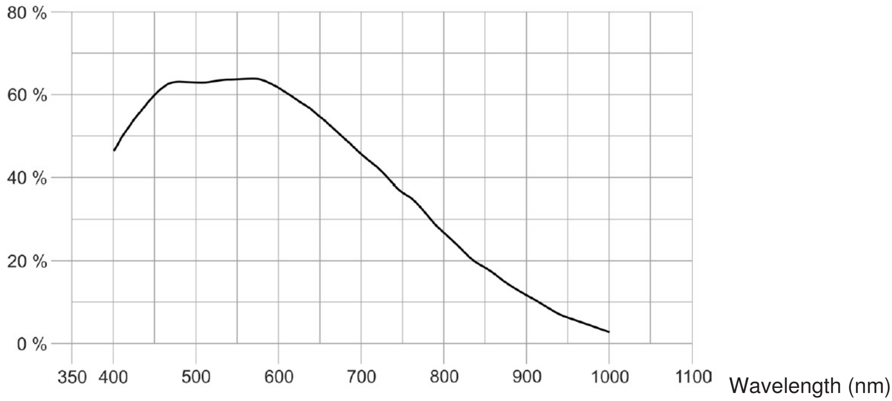
NOTE!
Products of the category “control unit with 2D/3D profile sensors” are required for the use of profile-based license upgrades. Details are included in the system overview.

Additional info about licenses can be found in section “17. License Management” on page 329.

4.2.3 Image Chips of Machine Vision Cameras

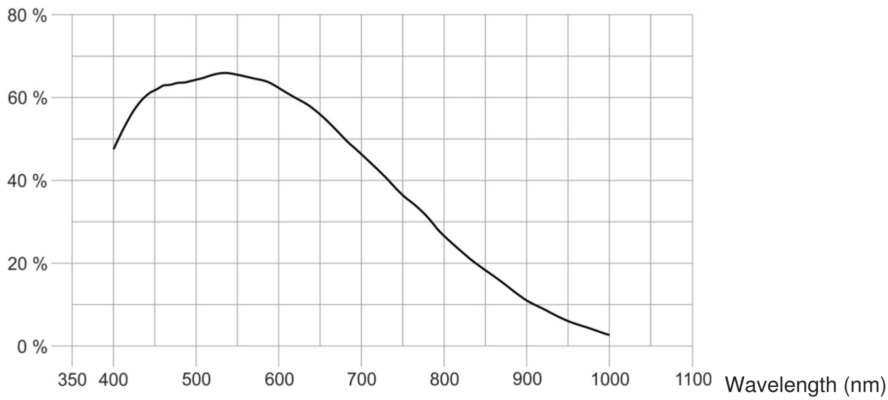
BB6K001 and BBZK001:

Quantum efficiency (%)



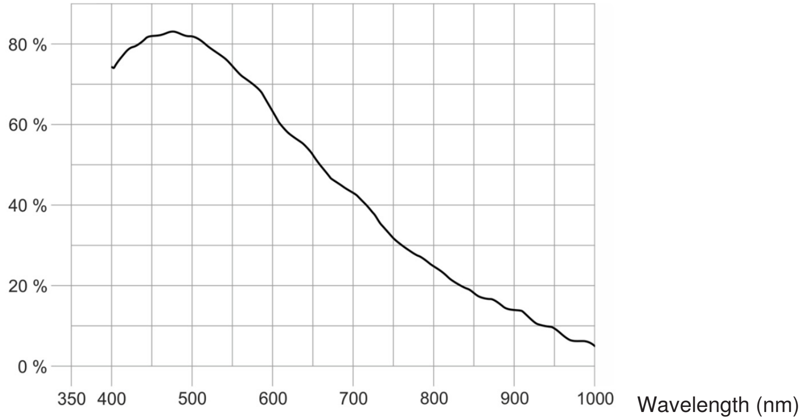
BB6K003 and BBZK003:

Quantum efficiency (%)



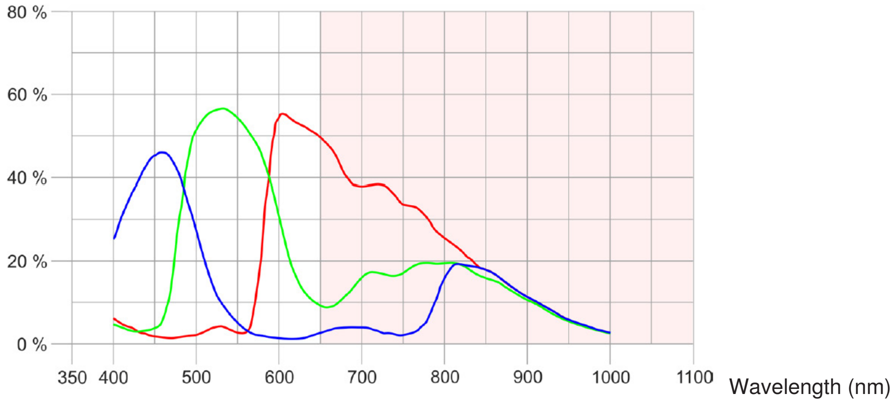
BB6K005 and BBZK005:

Quantum efficiency (%)



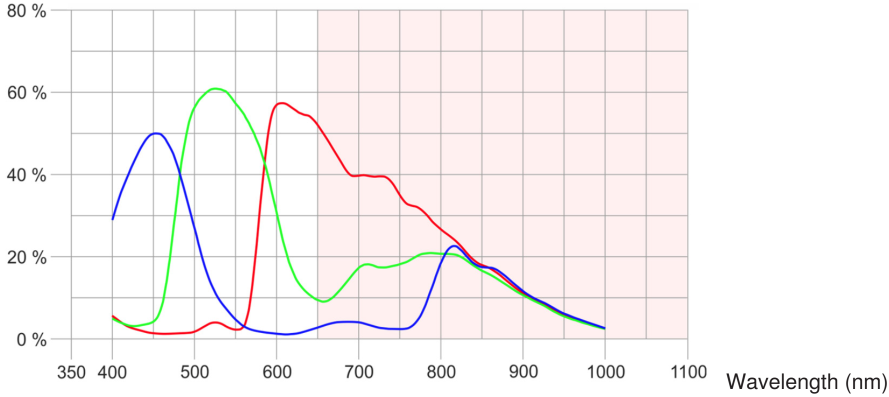
BB6K002 and BBZK002:

Quantum efficiency (%)



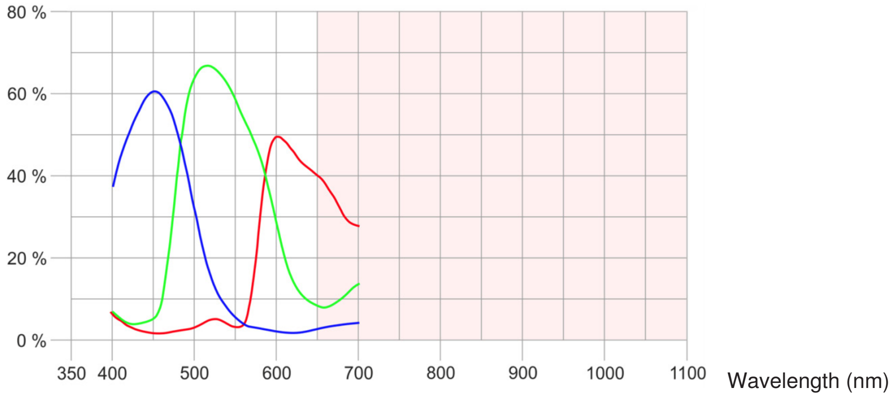
BB6K004 and BBZK004:

Quantum efficiency (%)



BB6K006 and BBZK006:

Quantum efficiency (%)



NOTE!

- Use white light illumination for Machine Vision Cameras with color image chip.
- Use illumination with visible or IR light for Machine Vision Cameras with monochrome image chip.

4.3 uniVision for Smart 2D/3D Profile Sensors

With smart 2D/3D profile sensors, profile recording and evaluation is performed directly in a housing.

4.3.1 Product and System Overview

The system overview can be found at www.wenglor.com.

4.3.2 Licenses for Smart 2D/3D Profile Sensors

The following re-licensing options exist:

Item Number	Modules
DNNL015	weCat3d license upgrade, profile analysis (point cloud calculus, point cloud co-ordinate system, point cloud filter, point cloud measurement, point cloud region, point cloud pattern matching)
DNNL017	weCat3D license upgrade, weld seam tracking (point cloud weld seam tracking)

NOTE!
Additional information on licensing can be found in section “17. License Management” on page 329.

4.4 uniVision for Control Units with 2D/3D Profile Sensors

Height profiles are recorded with the 2D/3D profile sensors and transmitted to the control unit where image evaluation takes place, and the results are read out via the control unit's interfaces. Up to 16 2D/3D profile sensors can be connected to a control unit.

NOTE!
The maximum number of 2D/3D profile sensors per control unit depends on the recording frequency of the Machine Vision Cameras, overall network load and total processing times of all uniVision applications connected to the control unit.

- For example, two 2D/3D profile sensors can be used at a control unit with a recording frequency of 200 Hz and total processing time of 1 ms for each uniVision application.
- Network load:
  – The control unit with 2D/3D profile sensors supports a maximum network load of 1 Gbps. For example in the case of a single 2D/3D profile sensor, roughly 10 kilobytes are transferred per height profile without any restriction of the read-out range.
  – Any further communication via the network (e.g. read-out of process data or LIMA communication via TCP/IP or UDP, uniVision software) generates additional network load which must be taken into account.
  – Network load must be laid out such that 1 Gbps is not exceeded. In the event of an error, the system reads out error messages for non-evaluated height profiles.
  – Via a vnc connection or a connected monitor to the control unit, it is possible to observe the network load in the task bar.
- Overall processing time for uniVision applications:
  – Several uniVision applications can conduct evaluations at a single control unit. Overall processing time for a uniVision application depends to a great extent on the project and the utilized modules.
  – Fundamentally, data evaluation must be faster than data recording or transmission. In the event of an error, the uniVision application reads out error messages for non-evaluated data.
  – Each additional process running at the control unit requires additional processing time (e.g. uniVision software for Linux, robot interface).
  – Overall processing time for all uniVision applications should be selected such that CPU utilization at the control unit is less than 50 %.
  – Via a vnc connection or a connected monitor to the control unit, it is possible to observe the cpu load in the task bar.

4.4.1 Product and System Overview

The system overview can be found at www.wenglor.com.

4.4.2 Licenses for Control Units with 2D/3D Profile Sensors

The following overview shows which modules are included in which software package:

Software package	Licensed modules
uniVision Profile	Point cloud calculus, point cloud coordinate system, point cloud filter, point cloud measurement, point cloud region, point cloud pattern matching
uniVision Profile Seam Tracking	Point cloud calculus, point cloud coordinate system, point cloud filter, point cloud measurement, point cloud region, point cloud pattern matching, point cloud weld seam tracking, Robot Interfaces
uniVision Profile Extended	Point cloud calculus, point cloud coordinate system, point cloud filter, point cloud measurement, point cloud region, point cloud pattern matching, VisionApp360 (GigE Vision 1.0 module)

The following re-licensing options exist:

Item number	Modules
DNNL009	Control unit license upgrade, profile analysis (Point cloud calculus, point cloud coordinate system, point cloud filter, point cloud measurement, point cloud region, point cloud pattern matching)
DNNL010	Control unit license upgrade, image analysis (Coordinate system, filter, region, measurement, BLOB, threshold, HSV threshold, image comparison, tracking, OCR)
DNNL011	Control unit license upgrade, decoding and image-based pattern matching (1D code, 2D code, pattern matching)
DNNL016	Control unit license upgrade, weld seam tracking (point cloud weld seam tracking)
DNNP007	**Plugin Fanuc Robot Interface**
DNNP008	**Plugin Yaskawa Robot Interface**
DNNP009	**Plugin Kuka Robot Interface**
DNNP010	**Plugin ABB Robot Interface**
DNNP011	**Plugin VisionApp 360**
DNNP012	Plugin Kawasaki Interface

NOTE!
Vision system products are required in order to use image-based license upgrades. Details are included in the system overview for the vision system.

Additional info about licenses can be found in section “17. License Management” on page 329.

5. Fundamentals

This section explains the interfaces of the relevant products, as well as the fundamentals of data recording and evaluation.

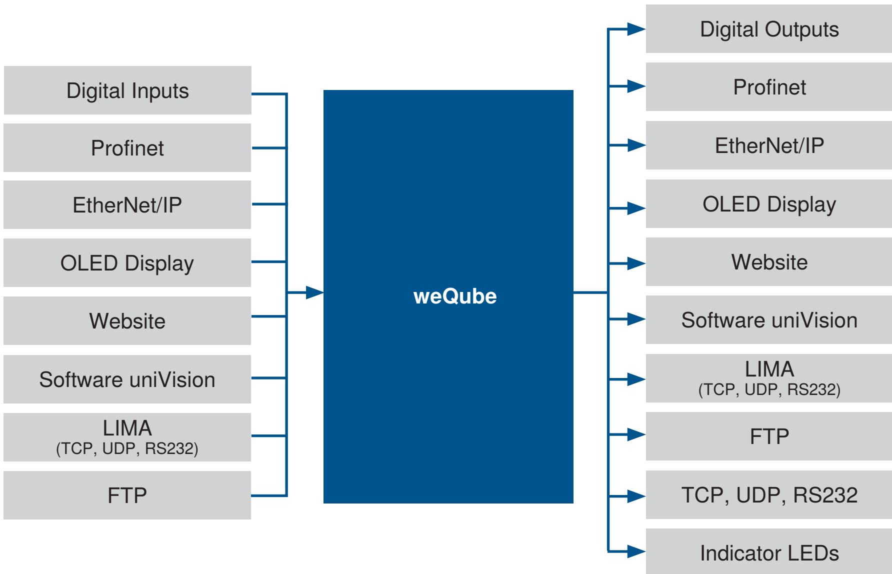
5.1 Interface Overview

The interface overview shows the inputs and outputs for all products.

NOTE!
The LIMA interface is described in a separate interface protocol.

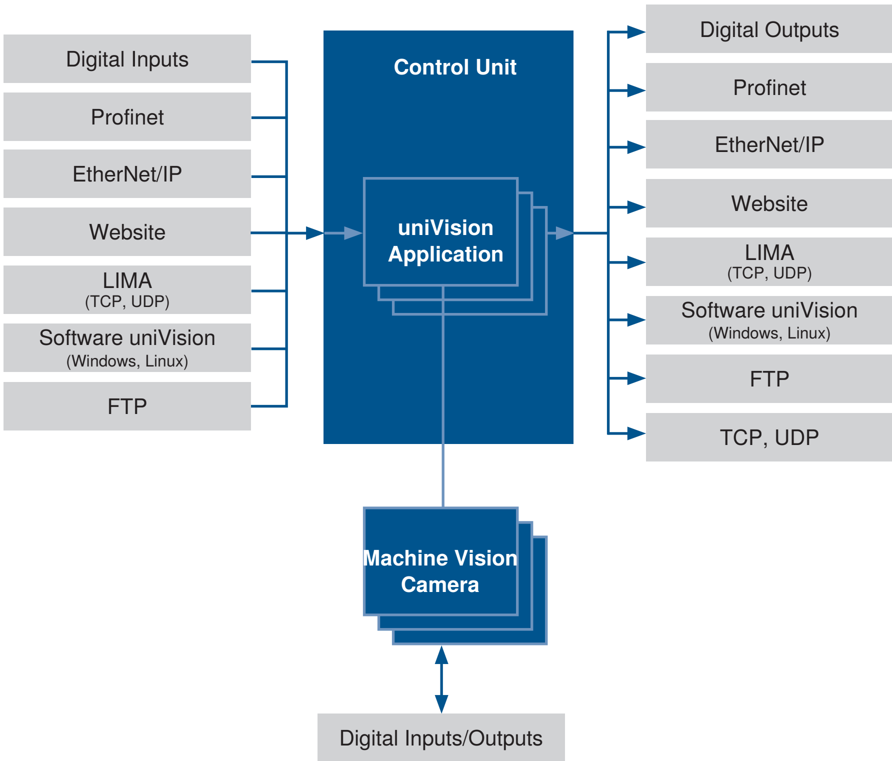
5.1.1 weQube Smart Camera

The weQube Smart Camera is equipped with the following inputs and outputs.



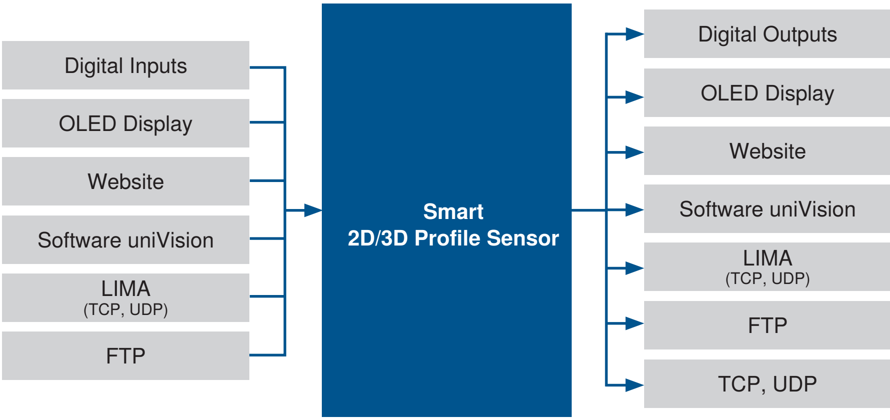
5.1.2 Vision System

The vision system consists of a control unit and one or more Machine Vision Cameras. Several uniVision applications can independently evaluate images at the control unit from different Machine Vision Cameras. The inputs and outputs of the Machine Vision Cameras and the uniVision applications are shown in the following overview.



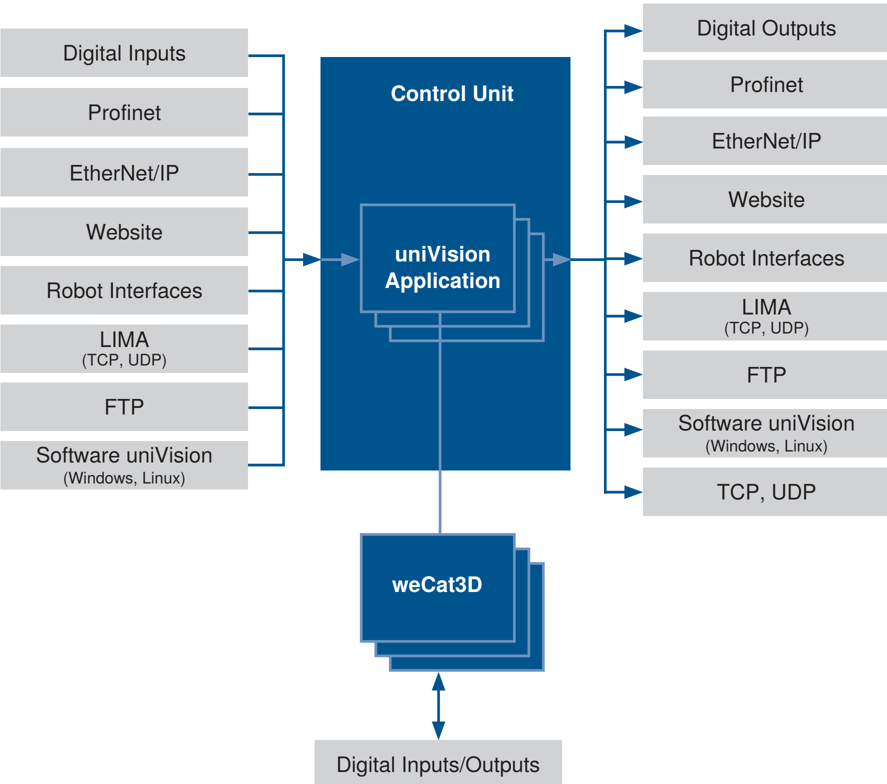
5.1.3 Smart 2D/3D Profile Sensors

With the smart 2D/3D profile sensor, profile recording and evaluation is performed directly in the compact sensor housing. The inputs and outputs of the smart weCat3D are shown in the following overview.



5.1.4 Control Unit with 2D/3D Profile Sensors

The control unit with 2D/3D profile sensors consists of a control unit and one or more 2D/3D profile sensors. Several uniVision applications can independently evaluate profiles at the control unit from different Machine Vision Cameras. The inputs and outputs of the 2D/3D profile sensors and the uniVision applications are shown in the following overview.



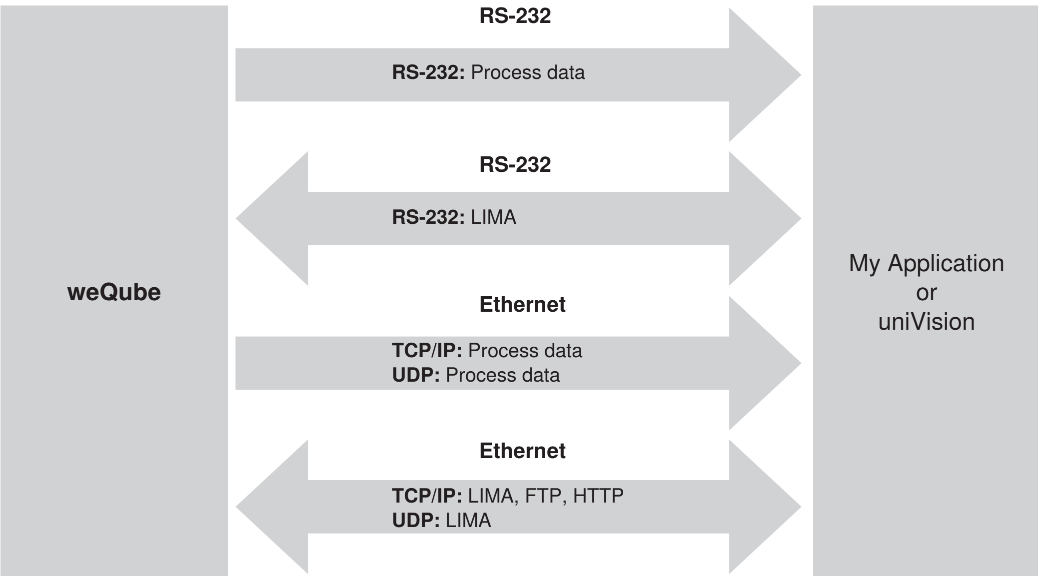
NOTE!
The robot interfaces are described in a separate manual. The combination of multiple height profiles via the VisionApp 360 plugin is also explained in a separate manual.

5.2 The System’s Network Protocols

The network interfaces are described in more detail below.

5.2.1 weQube Smart Camera

Various options for communication with the weQube Smart Camera via TCP/IP socket, UDP and RS-232 are depicted in the following graphic.



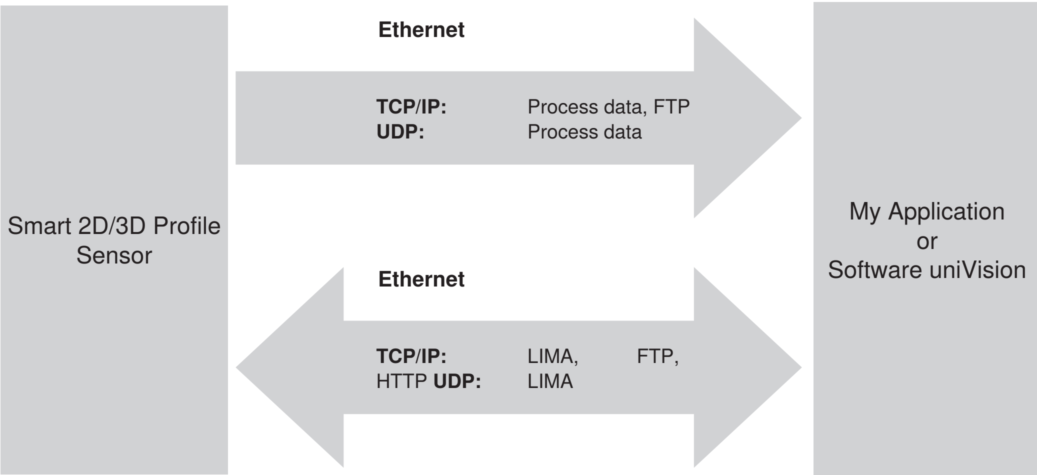
Basic RS-232 settings:
- Baud rate: 115,200 bps
- 8 data bits
- No parity
- 1 stop bit

Protocol	Port	Description
TCP/IP	32001	Fixed port for communication via the LIMA protocol. Write and read commands can be transmitted via this port. Only one connection is permissible via this port. **NOTE!** uniVision software communicates with the Smart Camera via this port.
TCP/IP	32002	Standard port for transmitting process data. The port can be configured via the TCP device module.
UDP	32002	Port for transmitting the device status of the weQube Smart Camera. Fixed port for transmitting process data via the UDP device module. **NOTE!** It is possible to define how often the device status is sent via UDP in the device settings.
UDP	32003	Fixed port for transmitting LIMA commands. **NOTE!** Up to 65,535 bytes can be transmitted via UDP. Longer commands can be transmitted via TCP/IP.
UDP	32004	Fixed port for receiving LIMA responses. A LIMA response is received for LIMA commands sent via port 32003. **NOTE!** uniVision software blocks port 32004 and must therefore be closed in order to receive LIMA responses.

NOTE!
Detailed information on the LIMA communication can be found in the interface protocol.

5.2.2 Smart 2D/3D Profile Sensor

Various options for communicating with the smart 2D/3D profile sensors via TCP/IP socket and UDP are described in the following graphic.

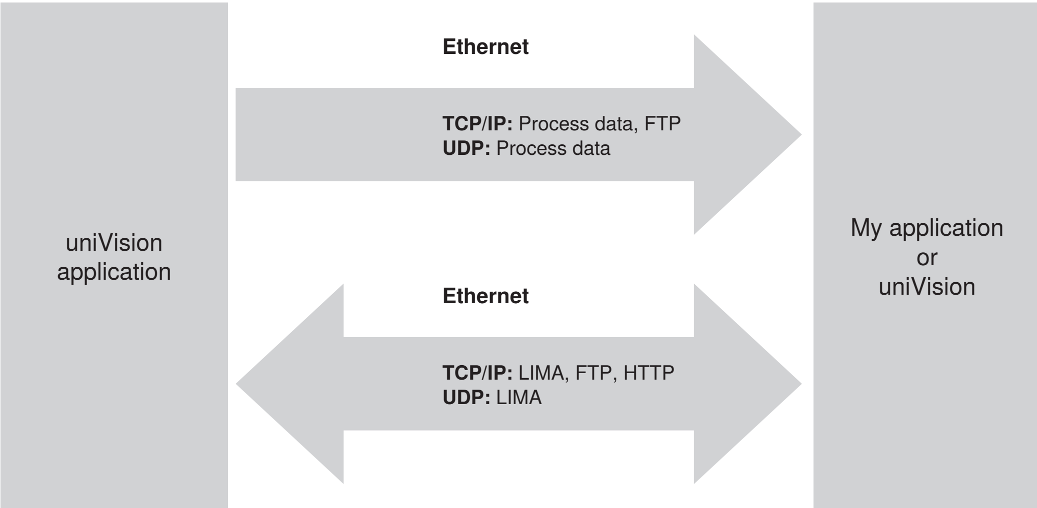


Protocol	Port	Description
TCP/IP	32001	Fixed port for communication via the LIMA protocol. Write and read commands can be transmitted via this port. Only one connection is permissible via this port. **NOTE!** uniVision software communicates via this port in the processing mode.
TCP/IP	32002	Standard port for transmitting process data. The port can be configured via the TCP device module.
TCP/IP	32005	Fixed port for communication via the LIMA protocol. Only read commands can be transmitted via this port. Up to five simultaneous connections are possible via the port. **NOTE!** The uniVision application communicates via this port in the live mode.

Protocol	Port	Description
UDP	32002	Port for transmitting the device status of smart 2D/3D profile sensors. Fixed port for transmitting process data via the UDP device module. **NOTE!** It is possible to define how often the device status is sent via UDP in the device settings.
UDP	32003	Fixed port for transmitting LIMA commands. **NOTE!** Up to 65,535 bytes can be transmitted via UDP. Longer commands can be transmitted via TCP/IP.
UDP	32004	Fixed port for receiving LIMA responses. A LIMA response is received for LIMA commands sent via port 32003. **NOTE!** uniVision software blocks port 32004 and must therefore be closed in order to receive LIMA responses.

5.2.3 Control Unit with uniVision Application

One or more uniVision applications evaluations can be executed on a single control unit. Various options for communication with the uniVision applications via TCP/IP socket and UDP are depicted in the following graphic.



Protocol	Port	Description
TCP/IP	32001	Fixed port for communication via the LIMA protocol. Write and read commands can be transmitted via this port. Only one connection is permissible via this port. **NOTE!** The uniVision Application's IP Address is displayed in the device list. **NOTE!** uniVision software communicates via this port in the edit mode.
TCP/IP	32002	Standard port for transmitting process data. The port can be configured via the TCP device module. **NOTE!** The uniVision Application's IP Address is displayed in the device list.

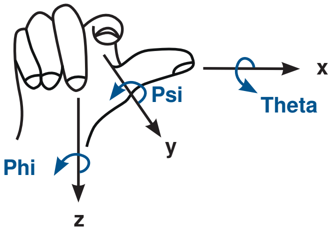
Protocol	Port	Description
TCP/IP	32005	Fixed port for communication via the LIMA protocol. Only read commands can be transmitted via this port. Up to five simultaneous connections are possible via the port. **NOTE!** The uniVision Application's IP Address is displayed in the device list. **NOTE!** The uniVision Application communicates via this port in the run mode.
UDP	32002	Port for transmitting the device statuses of the: • control unit • uniVision application Fixed port for transmitting process data via the UDP device module. **NOTE!** It is possible to define how often the device status is sent via UDP in the device settings.
UDP	32003	Fixed port for transmitting LIMA commands. **NOTE!** Up to 65,535 bytes can be transmitted via UDP. Longer commands can be transmitted via TCP/IP.
UDP	32004	Fixed port for receiving LIMA responses. A LIMA response is received for LIMA commands sent via port 32003. **NOTE!** uniVision software blocks port 32004 and must therefore be closed in order to receive LIMA responses.

NOTE!
Detailed information on the LIMA communication can be found in the interface protocol.

5.3 Basic Principles for Data Recording and Evaluation

In uniVision, data can be recorded and evaluated in the form of images or profiles. The image and profile information is output with reference to an original coordinate system.

A right-handed coordinate system is used in uniVision software. The following angles and rotations around the axis are indicated.

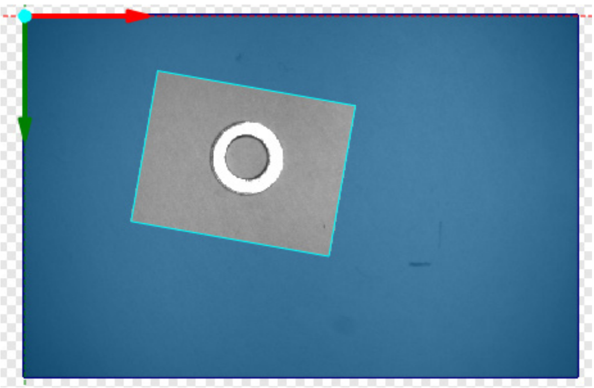


Phi (Z rotation)	Rotation around the Z-axis
Theta (X rotation)	Rotation around the X-axis
Psi (Y rotation)	Rotation around the Y-axis

5.3.1 Image Analysis

The Smart Camera can be used to take and evaluate images. The origin of the coordinate system is located in the top left corner of the image. The image information is output in the x-y plane:
- X-axis: Positive to the right
- Y-axis: Positive to the bottom

Geometry rotations are thus possible around the Z-axis (Phi). The example shows a rectangle with a rotation of 10°.

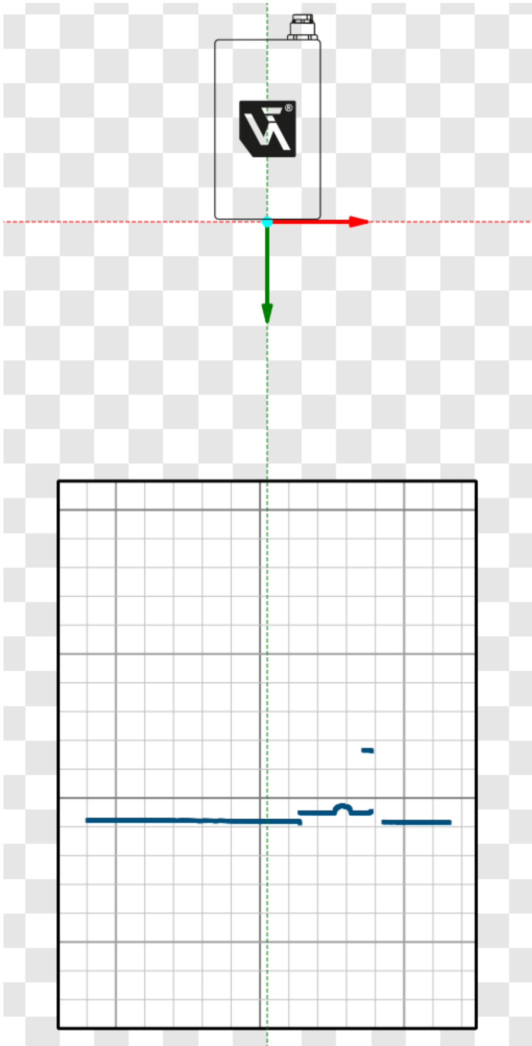


NOTE!
In the x-y plane, angular values for found geometries are always in clockwise direction.

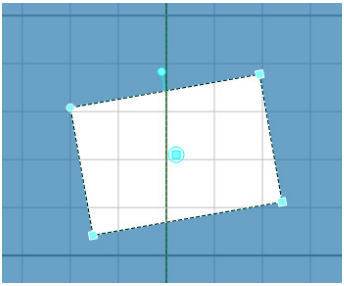
5.3.2 Profile Analysis

The smart 2D/3D profile sensors and the control unit with 2D/3D profile sensors can be used to record profiles and evaluate. The profile is a height section along the laser line and consists of numerous points in the x-z plane. The origin of the coordinate system is located in the sensor – in the center on the laser outlet.

- X-axis: Positive to the right (in the direction of the laser line)
- Y-axis: Positive out of the plane (in the conveyor belt's advancing direction or in the direction of sensor motion)
- Z-axis: Positive to the bottom (height information)



Geometry rotations are thus possible around the Y-axis (Psi). The example shows a rectangle with a rotation of 10°.



NOTE!
In the x-z plane, angular values for found geometries are always in counterclockwise direction.

5.4 Data Evaluation

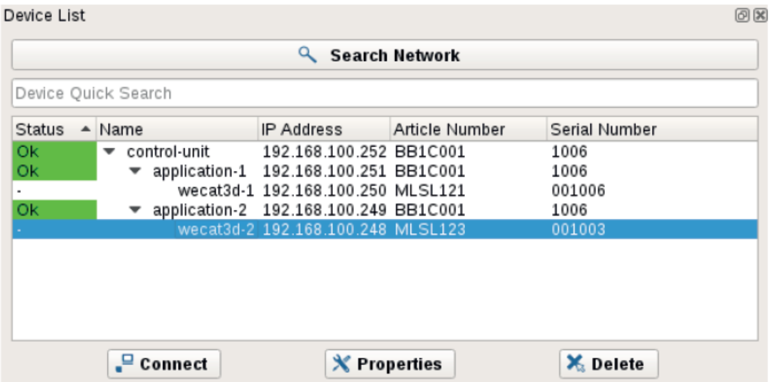
5.4.1 uniVision Application and uniVision Software

The recorded data is evaluated in the uniVision Application. The uniVision Application can carry out evaluations of images or profiles both on smart devices (e.g. Smart Camera or smart 2D/3D profile sensor) and on the control unit.

The uniVision software can be used to set up uniVision Applications. A connection between the uniVision software and the device can be established for this. Following the parametrization, the connection can be disconnected and the device carries out evaluations independently.

- uniVision Application: Processing unit for evaluating images or profiles
- uniVision software: Software for parameterizing uniVision Applications

uniVision Applications Independent of Each Other:
Multiple uniVision Applications can carry out evaluations independently of each other on a control unit. Each uniVision Application contains data from different sensors and evaluates the data according to the loaded project. The allocation of sensors and uniVision Applications to each other is displayed in the device list.



Sensor “wecat3d-1” is used in “application-1” and sensor “wecat3d-2“ is used in “application-2” in the example.

5.4.2 uniVision Project, Module Status and Error Handling

With every recorded profile or image, the project runs through the uniVision application and a result is output. This means that there is a result for every trigger signal. Every uniVision project contains one or multiple modules. The modules can be arranged in any desired order, because the project tree is run through until all results are available. If all results have not been calculated after 10 runs, the evaluation is aborted and an error is output.

One or multiple results are calculated in every module. If a valid result is calculated, this is displayed in the software. If a valid result can not be calculated (e.g. if there are no measurement points in the search area of a line), an error is displayed as the result and the module signals the error using the color red.

Module Status

Each module has a module status.
- 0: No errors
- Module State not 0: Error

NOTE!

The complete overview of all module statuses can be found in section “25.5 Module Status” on page 358.

Overview of the Most Common Module Statuses with Possible Solutions:

Module Status	Description	Possible Solution
1010	A value that is linked in the module as an input value is invalid.	Check the linked input quantities of the module and analyze which module the error status was inherited from.
1011	A value that is calculated in the module as an output value is invalid.	Check the settings in the module. (E.g.: If no points are present in the search area in the point cloud measuring module, no line search is possible and the module enters the error state.)
1040	The input image is not linked in the module.	Link an input image or input point cloud in the module.
1041	The input points cloud is not linked in the module.	Link an input points cloud in the module.
1100	The module is not licensed.	A license must be purchased to use the module (see section “17. License Management” on page 329.)
1102	The connected device (e.g. 2D/3D profile sensor) is not available.	• Check the power supply on the device (for example 2D/3D profile sensor). • Check the network cable between the device (e.g. 2D/3D profile sensor) and control unit. • Wait until the device has completely booted up. • Ensure that the device (e.g. 2D/3D profile sensor) is not already in use in another uniVision application.
1104	The module is not taught in.	Carry out the teach-in procedure in the module.

1112	Error when accessing the SD card or the SSD in the control unit, e.g. due to: • SD card missing (with Smart Camera) • Data recording and evaluation too fast, meaning that not all data can be saved on the SD card or the SSD via the FTP device.	• Ensure that there is a SD card in the device (with Smart Camera) • Reduce the speed of the data recording or evaluation, e.g. by reducing the recording frequency, shorter evaluation in the uniVision project, data compression via JPG format or by adjusting the observer in the FTP device module.
1113	Error in the FTP interface caused by the following: • FTP server not available or cannot be reached • No write permissions for the FTP user in the relevant folder • Data recording and evaluation too fast, meaning that not all data can be saved via the FTP device.	• Check whether the FTP server is available • Ensure that write permissions are activated for the FTP user • Reduce the speed of the data recording or evaluation, e.g. by reducing the recording frequency, shorter evaluation in the uniVision project, data compression via JPG format or by adjusting the observer in the FTP device module.
70010	Loss of data, because data (images or profiles) is recorded too quickly and the data processing takes too long.	• Reduce the total processing time of the uniVision project. • Reduce the recording frequency of the sensor (e.g. 2D/3D profile sensor).
70030, 70031, 70032	Loss of data due to excessive network load	• Reduce network load, e.g. by reducing the recording frequencies of the devices or reducing the bandwidth for the devices.
1012, 70050	Data (images or profiles) could not be loaded in Teach+ file offline.	• Ensure that all data (images and profiles) can be saved correctly during the recording with Teach+. Reduce the recording frequency, check the trigger signals or reduce the total processing time for the uniVision project where necessary.

Error Handling

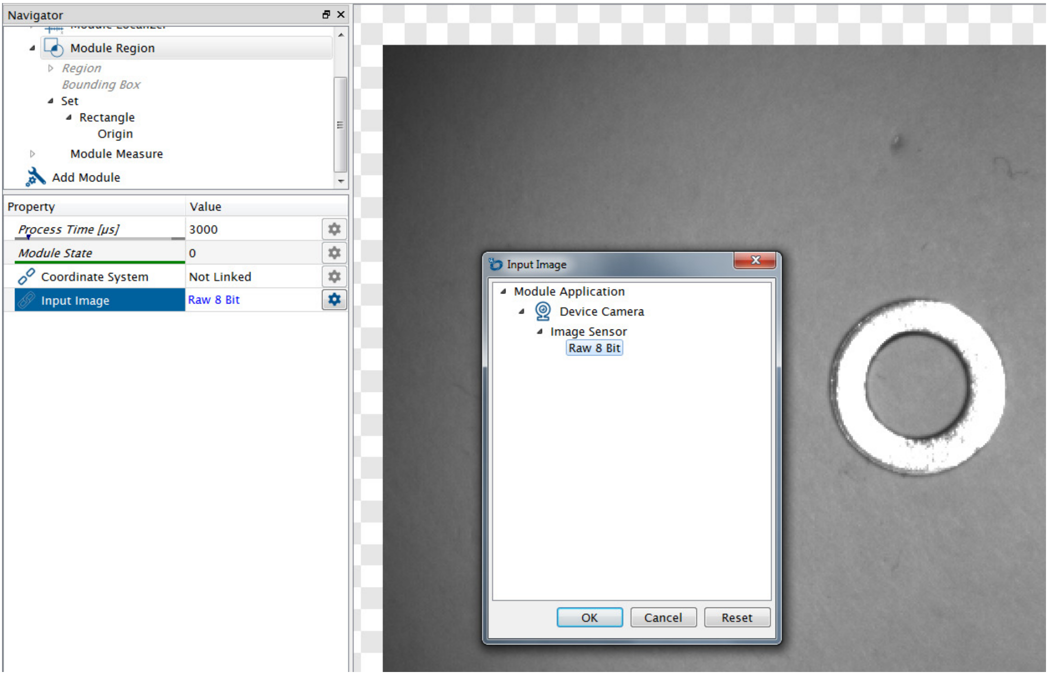
If a value that is in the error state is linked on an interface module, the Error Handling is triggered. For each interface module, there is the option of defining the behavior in case of an error via the Error Handling.

Example:

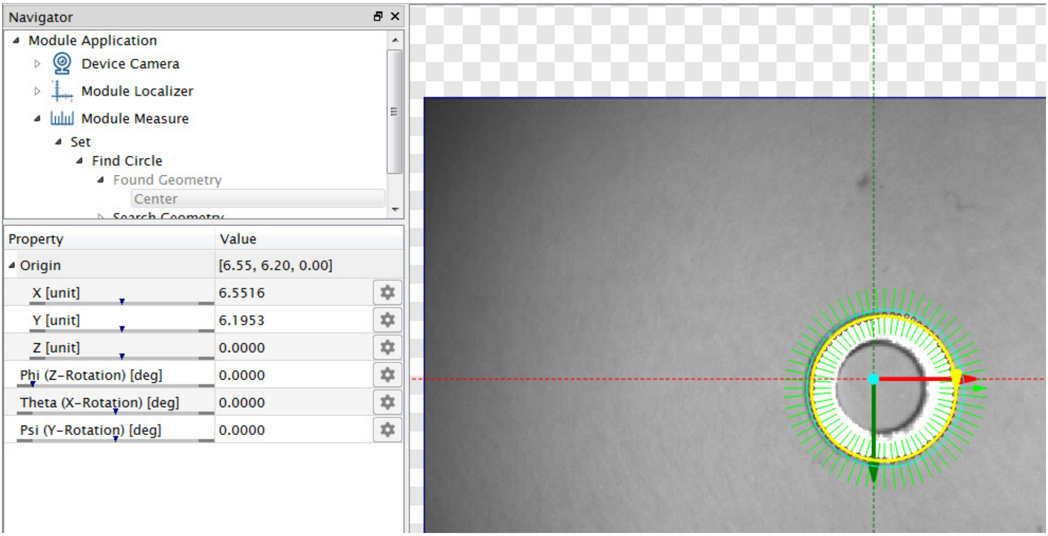
In the device input and output module, the behavior of the digital outputs in the event of an error can be defined. This enables a decision to be made regarding whether the output should be active or inactive in the event of an error.

5.4.3 Input Images/Point Clouds, Input Coordinate System

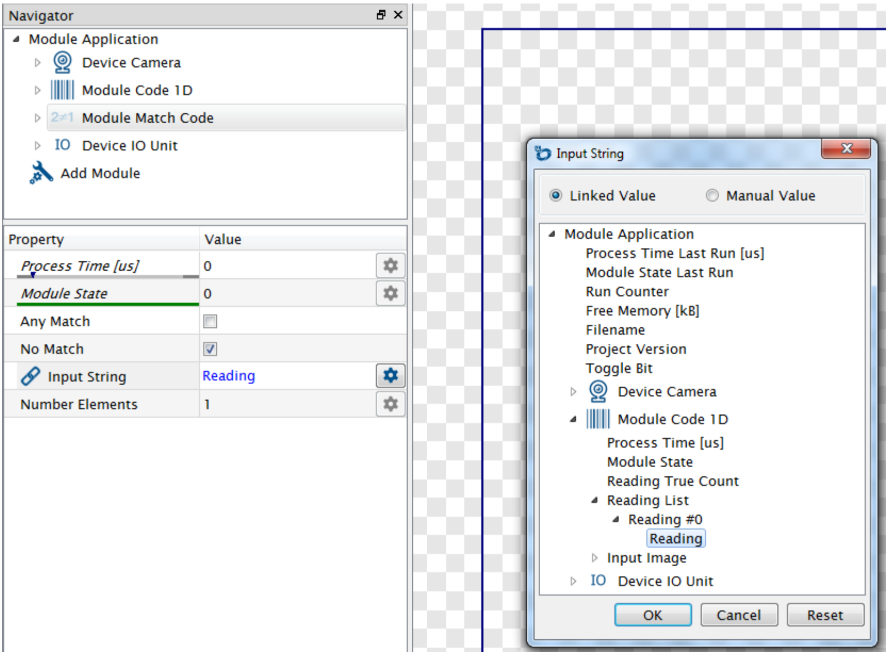
An input image or input point cloud can be linked in some modules. Each available input image or input point cloud from the project can be linked in the module.



Some modules also have an input coordinate system. This may deviate from the original coordinate system and can be moved statically to any position or tracked dynamically on the object. This enables testing tasks to be carried out on the object, even though the position of the object may vary from recording to recording. If a coordinate system is linked in the module, all determined values are output in relation to the linked coordinate system. In the example, the coordinate system is found dynamically via the tracking module and aligned to the washer. The dynamic coordinate system is linked in the measuring module as an input coordinate system. This means that the search geometry (circle) is tracked on the object. The coordinates of the found geometry (circle) are output in relation to the input coordinate system.



In addition to point clouds, images and coordinate systems, further results from the module can also be linked in a different module. For example, a read code from the 1D-code module can be linked in the match code module as an input value to compare the read code with a match code.



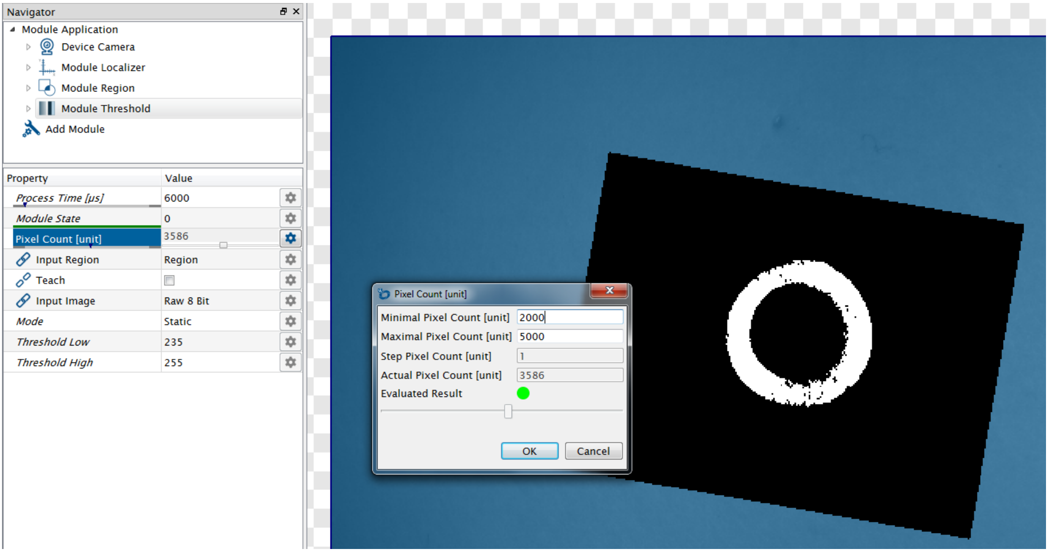
5.4.4 Data Types

The following data types are used in uniVision:
- BOOL: For outputting good and bad results
- DINT: For outputting numerical values (without decimal places)
- REAL: For outputting numerical values with decimal places
- CHAR: For outputting character strings

Results of a module are available in other modules, possibly as input values. The linking of a data type to another data type takes place as follows:
- BOOL (as input):
  – Link BOOL result: Returns true or false depending on value of bool
  – Link DINT or REAL result: Returns true if the current value is within thresholds (between the minimum and maximum thresholds) and returns false if the current value is out of tolerance (lower than the minimum or higher than the maximum thresholds).
  – Link CHAR result: Returns true if the character string is not empty and returns false if the character string is empty.
- DINT (as input):
  – Link BOOL result: Returns 0 for bool value false and 1 for bool value true.
  – Link DINT result: Returns the number.
  – Link REAL result: Returns the number without decimal places (not rounded!).
  – Link CHAR result: Returns the character number for the character string.
- REAL (as input):
  – Link BOOL result: Returns 0 for value false and 1 for the value true.
  – Link DINT or REAL result: Returns the number with decimal places.
  – Link CHAR result: Returns the character number for the character string.
- CHAR (as input)
  – Link BOOL result: Returns false for bool value false and true for bool value true.
  – Link DINT or REAL result: Returns the number.
  – Link CHAR result: Returns the character string.

Example: Conversion of number values into true/false values (BOOL)

To link a numeric value to a digital output, the minimum and maximum limit values must be defined. If the numerical value is between the set limit values, the result is output as true. If the numerical value is outside the set limit values, the result is evaluated as false.



5.4.5 System Startup and Project Changes

After the device has been started, the start-up project specified in the device settings is loaded. A specific start-up project can be specified for all devices, or the last used project is started.

NOTE!
After the startup behavior is changed to "Last loaded project", a project load cycle is required before the device can be restarted.
After the device start without trigger signal, all results are initialized – the run counter therefore starts at 0, for example, and the toggle bit is not active.

A project change command can be transmitted to the device in order to change to another project.
After the project change without trigger signal, all results are also initialized – the run counter therefore starts at 0, for example, and the toggle bit is not active.

NOTE!
It is not possible to exchange projects between the weQube Smart Camera and the control unit. Projects can only be used on the device type they were created on.

5.4.6 Connection Between the Project and Recording Device on the Control Unit

The uniVision applications on the control unit have no fixed connection with a recording device (e.g. Machine Vision Camera), but can establish a connection flexibly with an available recording device. In the project, the recording device is identified via the device name. The device name is identified in the Machine Vision Camera device module or in the weCat3D device module.

This means:

- When loading the project, the uniVision application establishes a connection with the recording device, which has the device name saved in the project.
- The recording device can be replaced in the project. All available recording devices are displayed here.
- If the device name of a recording device is subsequently changed (not recommended!), a connection can no longer be established with the device when opening previously created projects and the new device name must be selected in all projects.
- In order to copy uniVision projects for use on two different uniVision applications, the recording device must be changed in one of the two projects.

NOTE!
A recording device can not be used in multiple uniVision applications at the same time. When used in multiple applications, it is shown as not available in the applications used multiple times (via the module status 1102 in the Machine Vision Camera device module or in the weCat3D device).

6. Installation

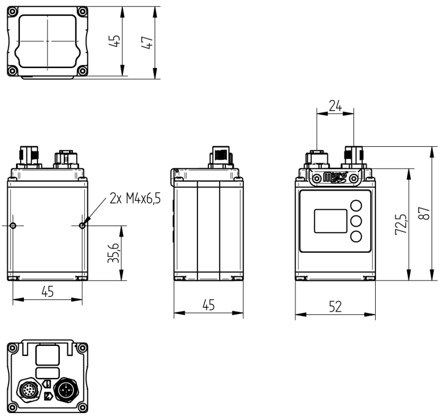
- Electrical and mechanical regulations, standards, and safety rules must be complied with.
- Ensure mechanically secure mounting.
- Specified torque values must be complied with.

CAUTION!
Risk of personal injury or property damage during installation!
Personal injury and damage to the product may occur.
- Ensure a safe installation environment.

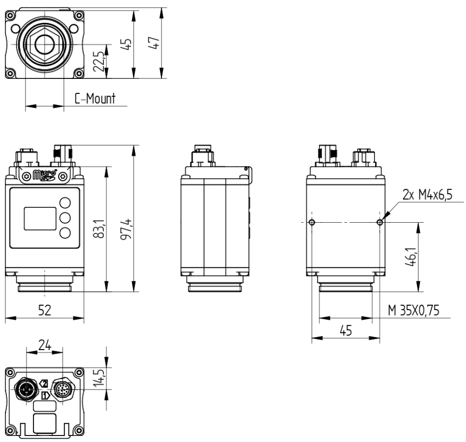
6.1 weQube Smart Camera

Mount the Smart Camera with the two included M4 screws.

Smart Camera with Auto-Focus



Smart Camera with C Mount



NOTE!
Suitable mounting solutions can be found on the product detail page for the Smart Camera under mounting technology.

6.2 Control Units BB1C0xx and BB1C1xx

The control units BB1C0xx and BB1C1xx can be mounted in two different ways:

- Wall mounting (included in scope of delivery)
- H-rail mounting (order number: ZB1Z001)

NOTE!
Sources of electromagnetic interference in direct proximity to the device may cause malfunctioning.
• Position the device at an adequate distance from sources of interference.
• It's advisable to mount the device inside the control cabinet.

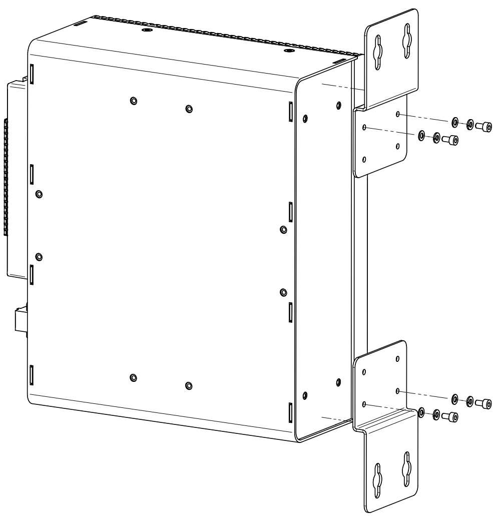
Proceed as following in order to mount the control unit:
1. Attach the two mounting brackets or the H-rail mounting system to the back or the side of the control unit with the included screws.
2. Secure the control unit to the wall with the two mounting brackets or to the DIN rail with the H-rail mounting system.

NOTE!
In the case of the H-rail mounting system, the lock must point down.

NOTE!
Ensure adequate open space around the cooling fins in order to permit effective heat exchange between the control unit and the environment.

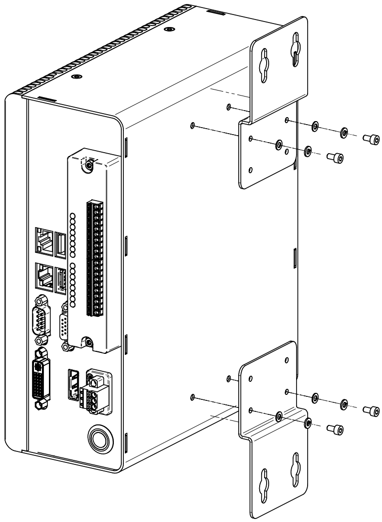
6.2.1 Standard Installation Position

- Interfaces at the front
- Mounting system attached to the back of the control unit



6.2.2 Alternative Installation Position

- Interfaces at the top, at the bottom or at the side
- Mounting system attached to the side opposite the cooling fins



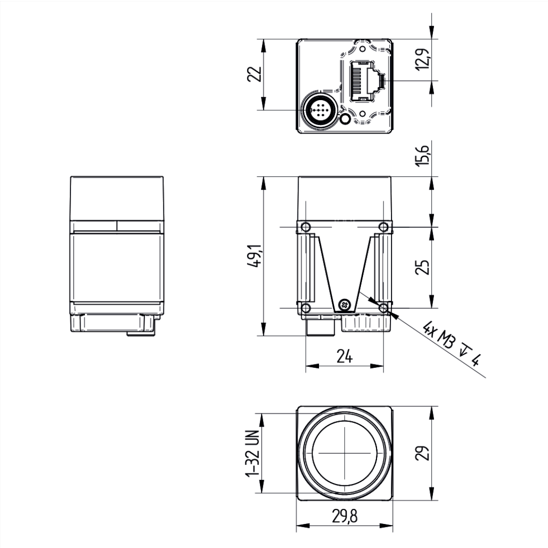
6.3 Control Unit BB1C5xx

Details on the installation of the BB1C5xx control unit can be found in the hardware manual.

6.4 Machine Vision Camera BB6K

Mount the Machine Vision Camera with the four included M3 screws.

- Use the screws with a length of 6 mm for installation with the ZB6Z001 mounting system (order number, 6 mm screws: ZB6E002).
- Use the screws with a length of 6 mm for installation with the ZB6Z001 mounting system and mounting bracket ZMWZF0001 for attaching the ring light around the Machine Vision Camera (order number, 8 mm screws: ZB6E001).

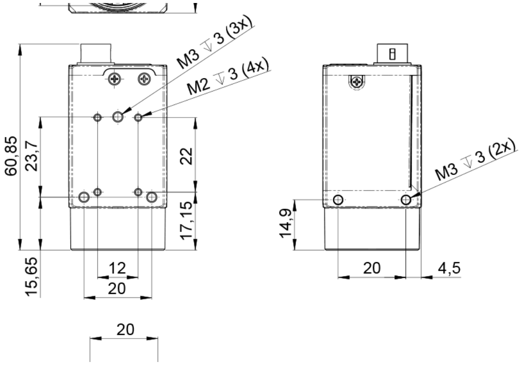


NOTE!
Mount the Machine Vision Camera on a heat conducting surface for ideal heat exchange with the environment and assure adequate heat dissipation.

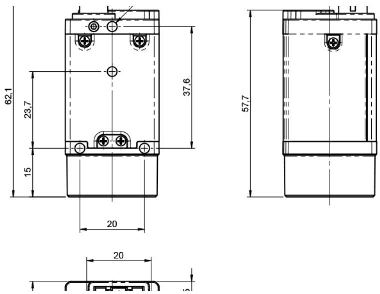
6.5 Machine Vision Camera BBZK

Attach the machine vision camera using the enclosed screws.

For BBZK001-004:



For BBZK005-006:



6.6 weCat3D – 2D/3D Profile Sensor

Mount the 2D/3D profile sensors with the included screws. Further information on mounting the 2D/3D profile sensors can be found in the operating instructions for the sensors.

NOTE!
Suitable mounting solutions can be found on the product detail page for the 2D/3D profile sensors under "Mounting Technology".

7. Electrical Connection

DANGER!

Risk of personal injury or property damage due to electric current.

Voltage conducting parts may cause personal injury or damage to equipment.

- The electric device may only be connected by appropriately qualified personnel.

Legend

+	Supply Voltage +	
–	Supply Voltage 0 V	
~	Supply Voltage (AC Voltage)	
A	Switching Output	(NO)
Ā	Switching Output	(NC)
V	Contamination/Error Output	(NO)
V̄	Contamination/Error Output	(NC)
E	Input (analog or digital)	
T	Teach Input	
Z	Time Delay (activation)	
S	Shielding	
RxD	Interface Receive Path	
TxD	Interface Send Path	
RDY	Ready	
GND	Ground	
CL	Clock	
E/A	Output/Input programmable	
	IO-Link	
PoE	Power over Ethernet	
IN	Safety Input	
OSSD	Safety Output	
Signal	Signal Output	
BI_D+/–	Ethernet Gigabit bidirect. data line (A-D)	
ENo RS422	Encoder 0-pulse 0-0̄ (TTL)	

PT	Platinum measuring resistor
nc	not connected
U	Test Input
Ū	Test Input inverted
W	Trigger Input
W –	Ground for the Trigger Input
O	Analog Output
O –	Ground for the Analog Output
BZ	Block Discharge
AMV	Valve Output
a	Valve Control Output +
b	Valve Control Output 0 V
SY	Synchronization
SY–	Ground for the Synchronization
E+	Receiver-Line
S+	Emitter-Line
⏚	Grounding
SnR	Switching Distance Reduction
Rx+/–	Ethernet Receive Path
Tx+/–	Ethernet Send Path
Bus	Interfaces-Bus A(+)/B(–)
La	Emitted Light disengageable
Mag	Magnet activation
RES	Input confirmation
EDM	Contactor Monitoring

ENA RS422	Encoder A/Ā (TTL)
ENB RS422	Encoder B/B̄ (TTL)
ENA	Encoder A
ENB	Encoder B
AMIN	Digital output MIN
AMAX	Digital output MAX
AOK	Digital output OK
SY In	Synchronization In
SY OUT	Synchronization OUT
OLT	Brightness output
M	Maintenance
rsv	reserved

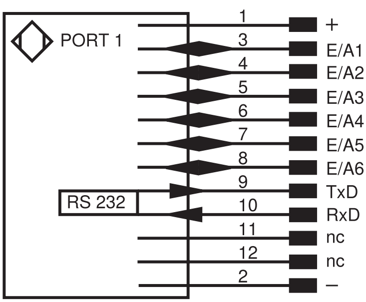
Wire Colors according to IEC 60757

BK	Black
BN	Brown
RD	Red
OG	Orange
YE	Yellow
GN	Green
BU	Blue
VT	Violet
GY	Grey
WH	White
PK	Pink
GNYE	Green/Yellow

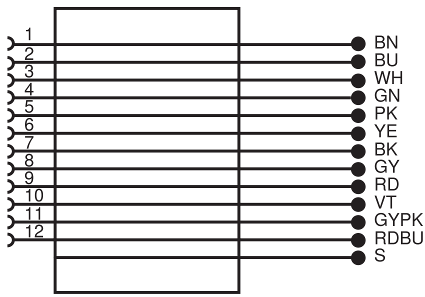
7.1 weQube Smart Camera

- Connect port 1 of the Smart Camera to 18 to 30 V DC. Connect pin 1 to the plus pole and pin 2 to the minus pole to this end.

1008



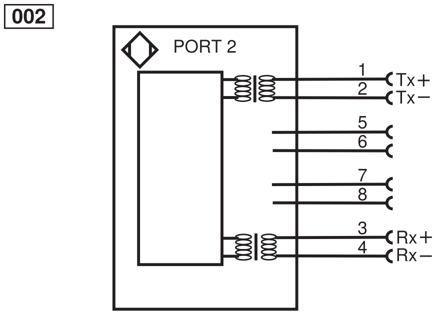
S89



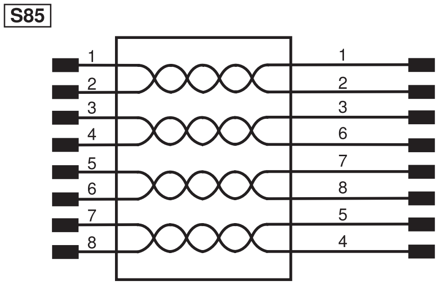
Connection Diagram, weQube Smart Camera, Port 1

Matching wenglor Connection Equipment

• Connect port 2 of the Smart Camera to the network or a laptop in order to set up the Smart Camera with uniVision software, or to communicate with the Smart Camera via the network.

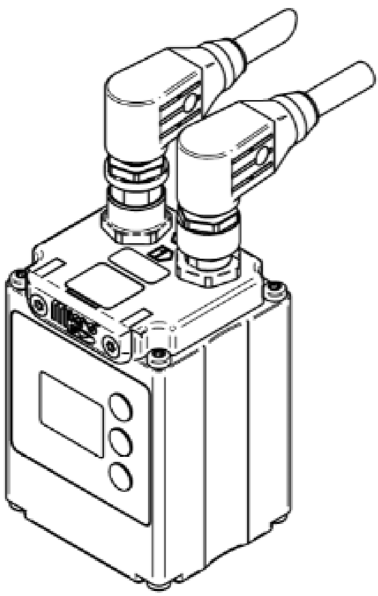


Connection Diagram, weQube Smart Camera, Port 2



Matching wenglor Connection Equipment

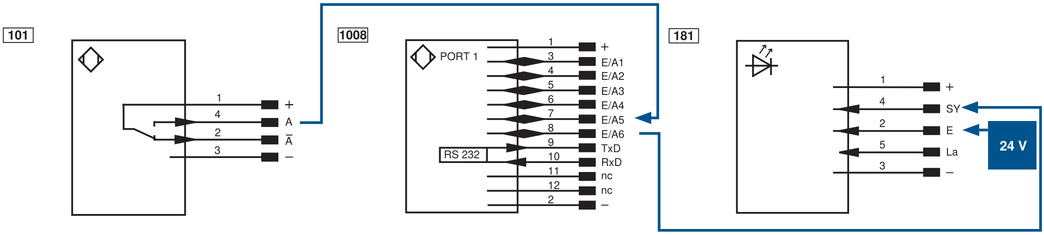
NOTE!
The following graphic shows the cable outlet on the Smart Camera when wenglor connection cables with angle plugs are used.



Smart Cameras with Trigger Sensor and External Illumination in Flash Mode

- Connect the trigger sensor's trigger signal to the Smart Camera's trigger input (standard: I/O5 on the Smart Camera).
- Connect the Smart Camera's flash output (standard: I/O6 on the Smart Camera) to the illumination synchronization pin.
- It's advisable to use the same reference ground for the trigger sensor, the Smart Camera and external illumination.

Connection overview with external illumination ZVZF1 / ZVZF2 / ZVZF3 / ZVZF4



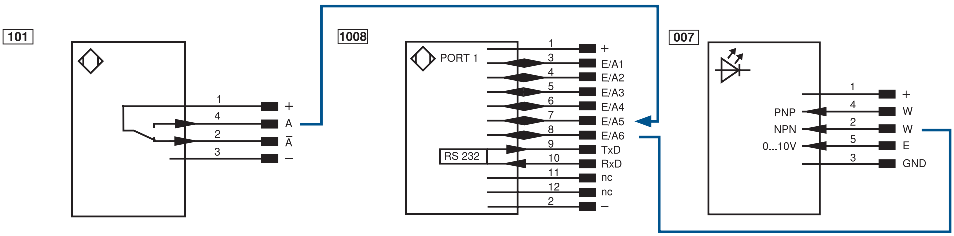
Trigger

Smart Camera

External illumination ZVZF1 / ZVZF2 / ZVZF3 / ZVZF4

NOTE!
- Wiring of Smart Cameras and illumination is valid for wenglor illumination with order numbers ZVZF1xx, ZVZF2xx, ZVZF3xx and ZVZF4xx.
- Pin 2 (E) must be connected to 24 V DC at the illumination in order to activate the flash mode.

Connection overview with external illumination L



Trigger

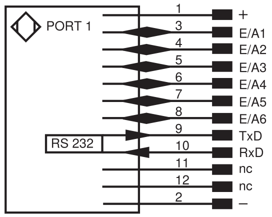
Smart Camera

External illumination L

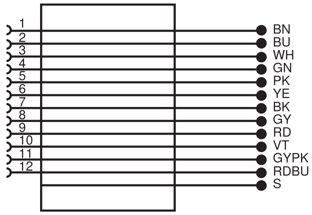
Manual Wiring

weQube with connection cable

1008

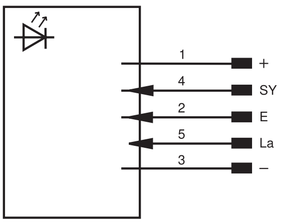


S89

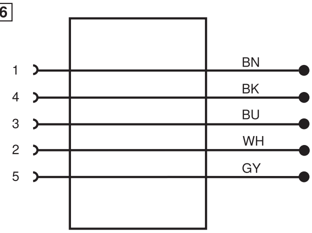


Illumination (ZVZF1xx, ZVZF2xx, ZVZF3xx, ZVZF4xx) with ZDDL connection cable

181

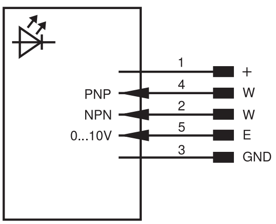


S06

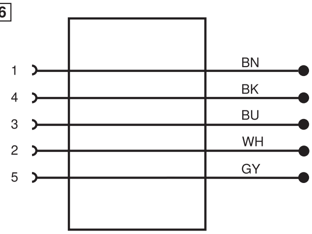


L illumination with ZDDL connection cable

007



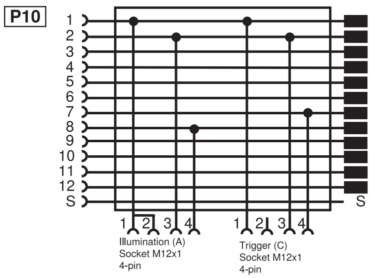
S06



Connection Modules for external illumination ZVZF1 / ZVZF2 / ZVZF3 / ZVZF4

Connection Module, from Smart Camera to Trigger Sensor and to External Illumination.

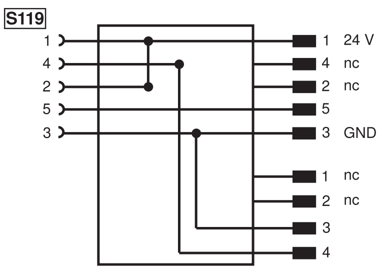
ZDCG001



NOTE!
The connection module ZDCG001 can be connected multiple times in succession to operate multiple external illuminations in flash mode on a Smart Camera.

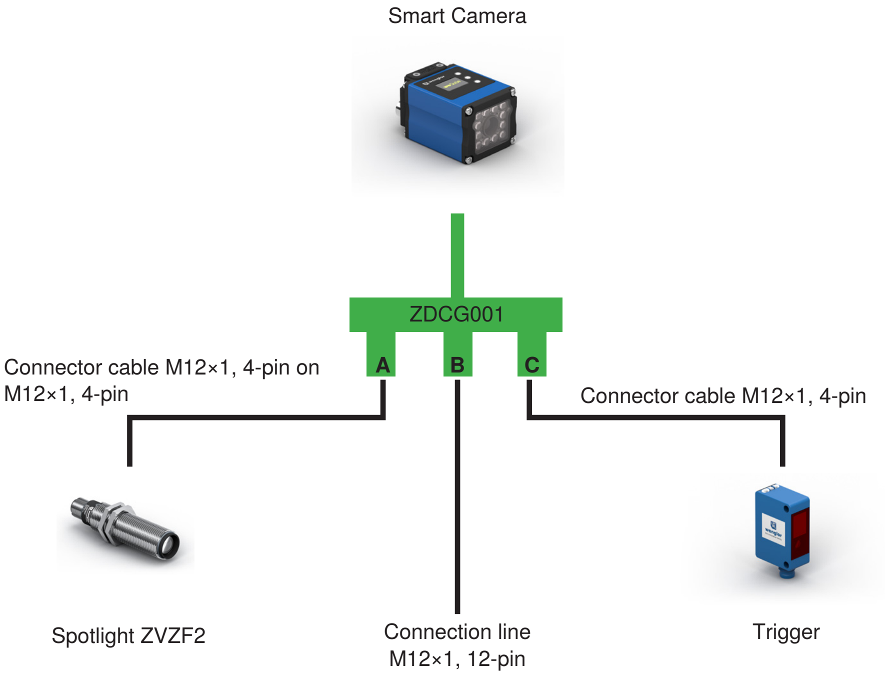
Connection module for illumination in flash mode for disconnecting camera synchronization signal and illumination supply voltage (for ring light and backlight ZVZF1 / ZVZF3 / ZVZF4).

ZC4G001



Smart Camera with spotlight ZVZF2 in flash mode:

- Voltage supply for trigger sensor, illumination and Smart Camera via 12-pin connection line, M12×1



Using the connection module ZDCG001 and the wenglor connection cables M12×1, 12-pin, the following color coding is valid:

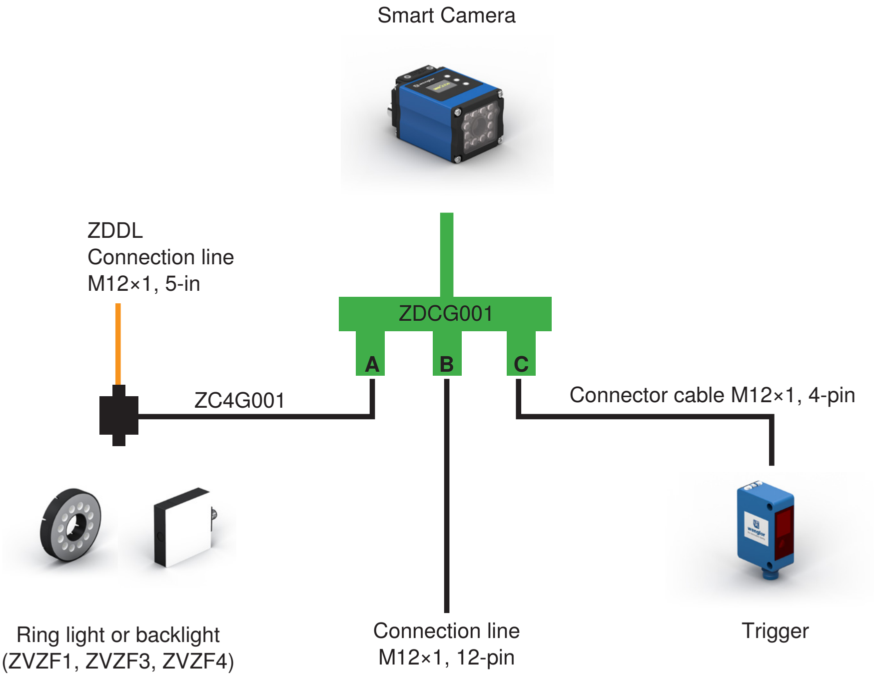
wenglor connection cable M12×1, 12-pin:
- BN: +
- BU: -
- WH: E/A1
- GN: E/A2
- PK: E/A3
- YE: E/A4
- BK: E/A5 (Trigger, pre-configured by ZDCG001)
- GY: E/A6 (Synchronization illumination, pre-configured by ZDCG001)
- RD: TxD
- VT: RxD
- GYPK: nc
- RDBU: nc

Wire Colors according to IEC 60757

BK	Black
BN	Brown
RD	Red
OG	Orange
YE	Yellow
GN	Green
BU	Blue
VT	Violet
GY	Grey
WH	White
PK	Pink
GNYE	Green/Yellow

Smart Camera with ring light or backlight (ZVZF1, ZVZF3, ZVZF4) in flash mode:

- Voltage supply for trigger sensor and Smart Camera via 12-pin connection line, M12×1
- The ZC4G001 disconnects supply voltage from illumination, as well as the Smart Camera's synchronization signal in flash mode.
- Supply voltage for illumination via separate connection line with large wire cross-section (ZDDL) for temporary high current consumption in illumination flash mode



Using the connection modules ZDCG001 and ZC4G001 together with the wenglor connection cables M12×1, 12-pin and M12×1, 5-pin, the following color coding is valid:

wenglor connection cable M12×1, 12-pin:
- BN: +
- BU: –
- WH: E/A1
- GN: E/A2
- PK: E/A3
- YE: E/A4
- BK: E/A5 (Trigger, pre-configured by ZDCG001)
- GY: E/A6 (Synchronization illumination, pre-configured by ZDCG001)
- RD: TxD
- VT: RxD
- GYPK: nc
- RDBU: nc

Wire Colors according to IEC 60757

BK	Black
BN	Brown
RD	Red
OG	Orange
YE	Yellow
GN	Green
BU	Blue
VT	Violet
GY	Grey
WH	White
PK	Pink
GNYE	Green/Yellow

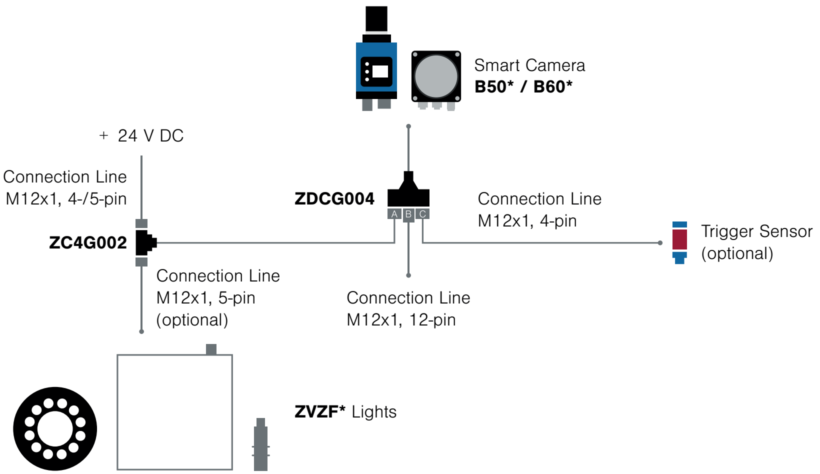
wenglor connection cable M12×1, 5-pin (ZDDL):

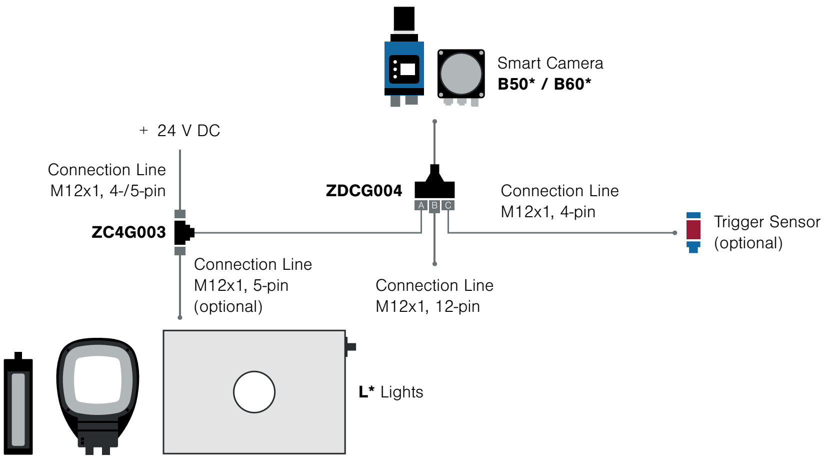
- BN: 24 V
- BK: nc
- BU: GND
- WH: nc
- GY: La

Wire Colors according to IEC 60757

BK	Black
BN	Brown
RD	Red
OG	Orange
YE	Yellow
GN	Green
BU	Blue
VT	Violet
GY	Grey
WH	White
PK	Pink
GNYE	Green/Yellow

Alternatively, the following cabling modules can be used:





NOTE!

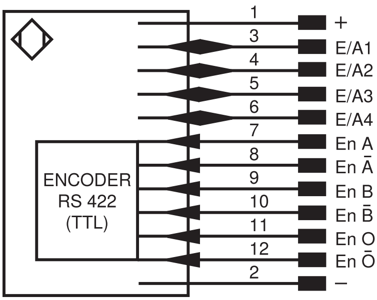
The following points must be observed when using external illumination:

- Always use white light illumination for Smart Cameras with color image chip.
- Amongst other types, illumination with visible or IR light can be used for Smart Cameras with monochrome image chips.
- In the case of Smart Cameras with monochrome image chip and auto-focus, the same type of light source must be used for external illumination as is also the case for internal illumination because the internal barrier filters suppress ambient light.
- Details about the image chips can be found in section “4.2.3 Image Chips of Machine Vision Cameras” on page 25.

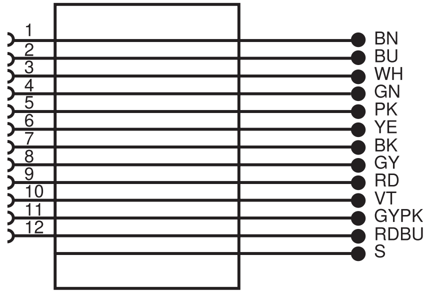
7.2 Smart 2D/3D Profile Sensor

- Connect port 1 of the 2D/3D profile sensor to 18 to 30 V DC. Connect pin 1 to the plus pole and pin 2 to the minus pole to this end.

1034



S89

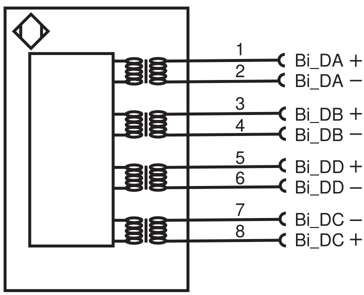


Connection diagram: port 1 of the 2D/3D profile sensor

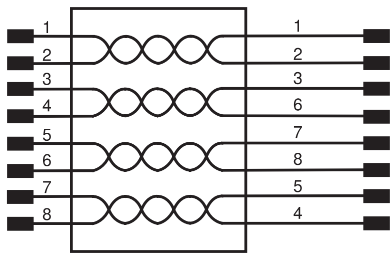
Suitable wenglor connection equipment

- Connect port 2 of the 2D/3D profile sensor to the network or laptop in order to set up the smart 2D/3D profile sensor with uniVision software or to communicate with the smart 2D/3D profile sensor via the network.

1022



S85

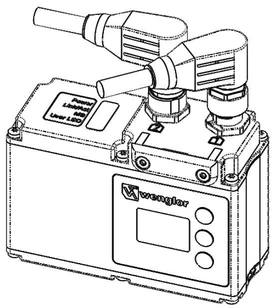
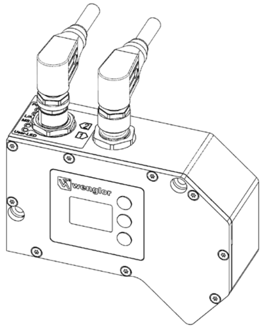
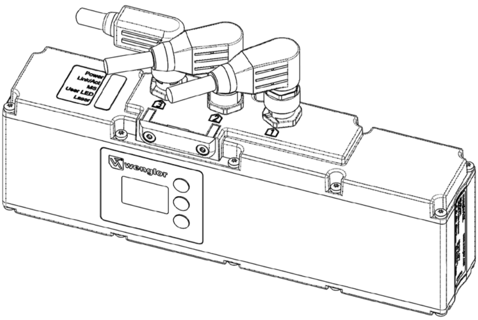
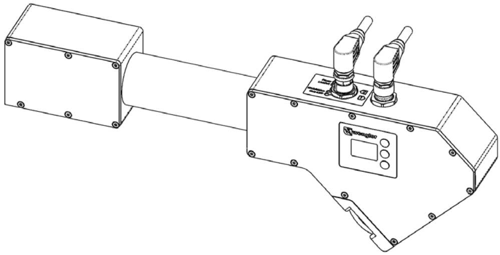


Connection Diagram, Smart 2D/3D Profile Sensor, Port 2

Suitable wenglor connection equipment

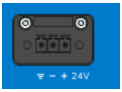
NOTE!
Further information concerning electrical connection of the 2D/3D profile sensors can be found in the operating instructions for the sensors.

NOTE!
The following diagram shows the cable outlet on the smart 2D/3D profile sensor when using angled wenglor connecting cables.

MLSL	MLWL
	
	

7.3 Control Units BB1C0xx and BB1C1xx

- Connect the control units BB1C0xx and BB1C1xx to 18 to 36 V DC.

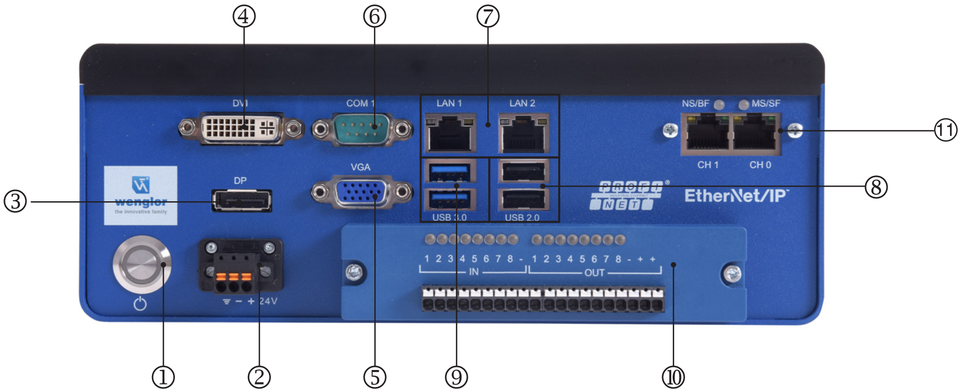


Pin	Description
1	Protective conductor
2	Ground
3	18 ... 36 V DC

- Connect the control unit's LAN interfaces directly or via a switch to the sensors (e.g. Machine Vision Cameras, 2D/3D profile sensors) and to the network or laptop. This makes it possible to set up the control unit with uniVision for Windows software or communicate with the control unit via a network.

NOTE!
The control unit can also be set up with its preinstalled uniVision for Linux software by simply connecting a monitor, a mouse and a keyboard to the control unit. Connected monitors must be compatible with VESA standards.

Control Unit Interfaces of control units BB1C0xx and BB1C1xx

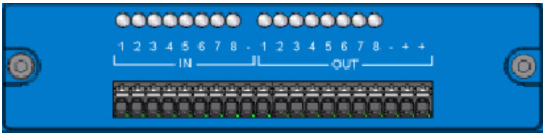


Nr.	Description	Explanation
1	Button	Illuminated on/off button
2	Voltage supply	18…36 V DC
3	Displayport	DisplayPort socket connector for monitor
4	DVI	DVI socket connector for monitor
5	VGA	VGA socket connector for monitor
6	RS-232	Serial port (not used)
7	Network interfaces	10/100/1000 MBit network interface
8	USB 2.0	Two USB 2.0 ports for mouse, keyboard, external hard disk etc.
9	USB 3.0	Two USB 3.0 ports for mouse, keyboard, external hard disk etc.
10	Digital inputs/outputs	8 optically isolated inputs and 8 optically isolated outputs with LED display
11	Industrial Ethernet (Prof-inet and EtherNet/IP)	2 ea. Industrial Ethernet interface (only available with certain control units)

Meaning of the LEDs on the LAN interfaces:

- Left: LAN port link LED
  - Off: No link
  - Orange: 1 Gbps
  - Green: 100 Mbps
- Right: LAN port activity LED
  - Off: No connection
  - Lit up yellow: Link
  - Yellow blinking: Active

Digital inputs and outputs:
The control unit is equipped with eight inputs and eight outputs. They are electrically isolated from the control unit. Inputs and outputs are connected to separate grounding

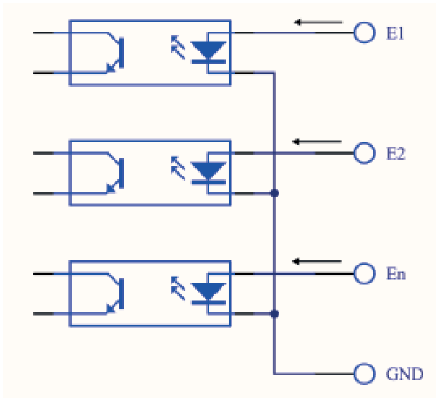


Inputs

- Low level: 0 to 1.5 V
- High level: 5 to 24 V
- Electrically isolated
- Reverse polarity protected and short-circuit proof
- Display of input signals via LEDs
- Input resistance: 1.2 kΩ at 0.5 W
- Max. Insulation voltage: 2500 V rms

Example:
If input 1 at the control unit is used, the input signal must be connected to E1. Furthermore, the minus pole (“–”) of the input pins must be connected to ground.

Wiring of the Optically Isolated Inputs

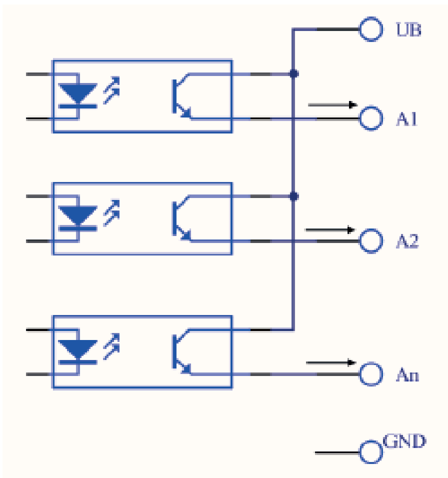


Outputs

- Maximum switching current, PNP outputs: 100 mA
- Output voltage: 5 to 35 V DC
- Electrically isolated
- Reverse polarity protected and short-circuit proof
- Display of output signals via LEDs
- Two equivalent “+” pins at the outputs

Example:
If input 1 at the control unit is used, the output signal comes from A1. Furthermore, one of the two plus pins (“+”) must be connected to supply voltage, and GND must be connected to ground.

Wiring of the Optically Isolated Outputs



7.4 Control Unit BB1C5xx

Details on the electrical connection of the BB1C5xx control unit can be found in the corresponding hardware manual.

NOTE!
- The digital IOs on the BB1C5xx control unit are not supported.
- The 4 LAN interfaces on the rear of the BB1C5xx control unit are not supported.
- LAN1 and LAN2 on the front can be used for normal network communication.

7.5 Machine Vision Camera BB6K

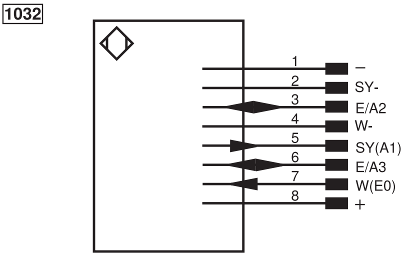
7.5.1 Voltage Supply

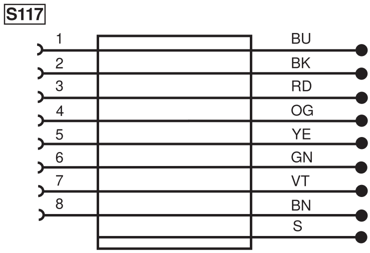
- The Machine Vision Camera can be supplied with voltage via the Hirose plug, or via Power over Ethernet (PoE).

ATTENTION!
Risk of damage to the Machine Vision Camera if supplied with voltage simultaneously via the Hirose plug and Power over Ethernet (PoE)
Simultaneous voltage supply via the Hirose plug and via Power over Ethernet (PoE) may result in irreparable damage to the camera.
- Implement voltage supply either via the Hirose plug or via Power over Ethernet (PoE).

Voltage supply via Hirose plug:
- Connect the Machine Vision Camera to 12 to 24 V DC via the Hirose plug.
- The status LED on the back of the Machine Vision Camera blinks.

NOTE!
The Hirose cable must be shielded and may not exceed a length of 30 m.
The shield must be connected to ground in order to reduce noise.





Connection Diagram: Hirose Plug – Machine Vision Camera

Matching wenglor Connection Equipment

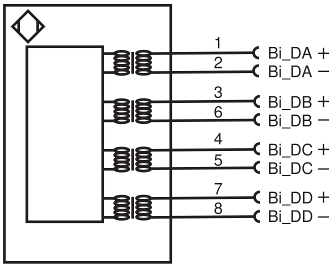
Voltage supply via Power over Ethernet (PoE):

- Connect the Machine Vision Camera to a switch with PoE function via an Ethernet cable.
- The status LED on the back of the Machine Vision Camera blinks.

7.5.2 Network Connection

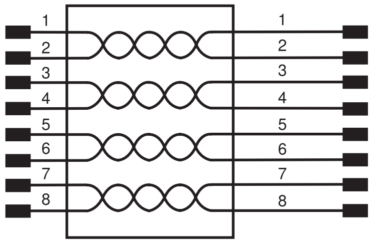
- Connect the Machine Vision Camera to the control unit either directly or via a switch.

1033



Connection Diagram: Network – Machine Vision Camera

S81



Matching wenglor Connection Equipment

NOTE!
- In order to optimize network utilization, it’s advisable to connect the Machine Vision Camera directly to a one of the control unit’s LAN ports.
- Network cable length may not exceed 100 m.
- Cabling must be capable of 1 Gbit/s throughout the entire network.
- When using a switch, it’s advisable to activate jumbo frames at the switch.

7.5.3 Connection Overview for Trigger, Machine Vision Camera and Illumination in Flash Mode

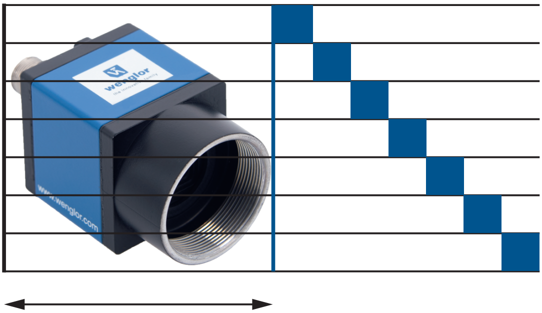
Machine Vision Cameras are equipped with a trigger input and a flash output for synchronizing illumination in flash mode. The trigger input and the flash output are electrically isolated.

Trigger input W (E0/Line0):
- Connect W- to GND.
- Connect W to one of the trigger sensor’s digital outputs:
  - High range: 5…24 V DC
  - Low range: 0…1 V DC
  - Current demand: 10 mA
  - Trigger pulse width: at least 10 µs
  - Trigger edge pitch: at least 35 V/ms

Flash output for flash mode SY (A1/Line1):
- Connect SY- to GND.
- Connect SY to the synchronization pin at the illumination.
- Maximum output current: 150 mA
- Reverse Polarity Protection, Overload Protection: no

NOTE!
- Use white light illumination for Machine Vision Cameras with color image chip.
- Use illumination with visible or IR light for Machine Vision Cameras with monochrome image chip.
- Details about the image chips can be found in section “4.2.3 Image Chips of Machine Vision Cameras” on page 25.
- It’s advisable to use the same reference ground for the trigger sensor, the Machine Vision Camera and illumination.

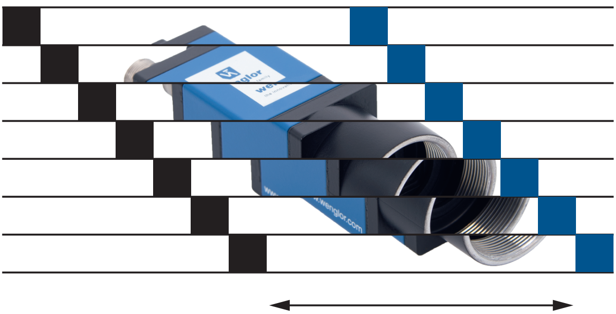
Machine Vision Cameras with Global Shutters:
On Machine Vision Cameras with global shutters (e.g. BB6K001, BB6K002, BB6K003, BB6K004), illumination can be used without restrictions in both continuous and flash mode since all lines are exposed at the same time. Static and dynamic applications are therefore possible without restrictions.



Exposure

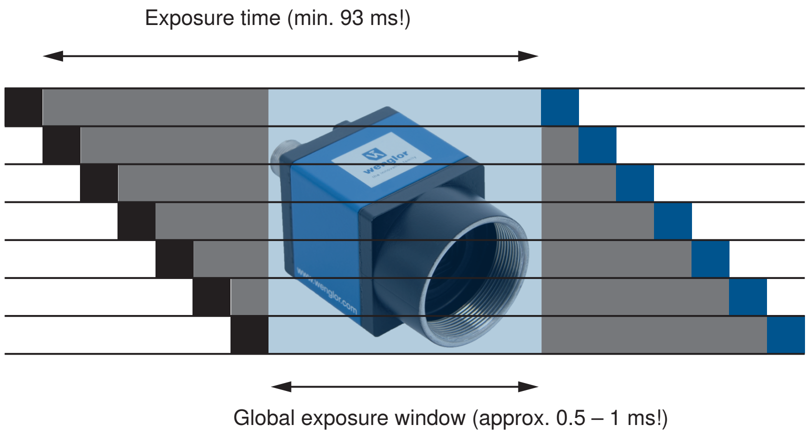
Machine Vision Cameras with Rolling Shutters:
On Machine Vision Cameras with rolling shutters (e.g. BB6K005, BB6K006), the lines are exposed one after the other. This means that illumination in continuous mode can only be used for static applications.

Dynamic applications with illumination in continuous mode are not possible due to the resulting distortions in the image (rolling shutter effect).

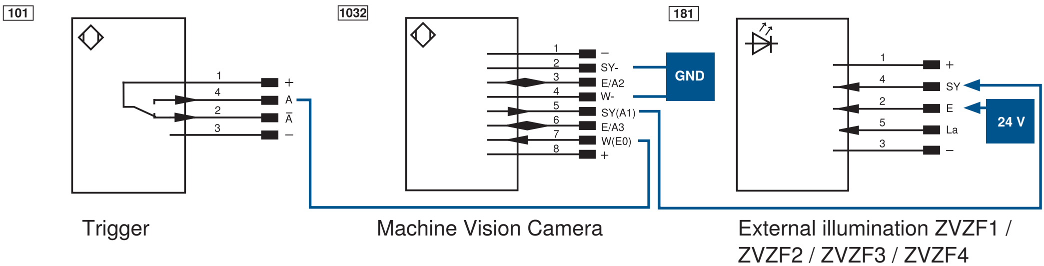


Exposure

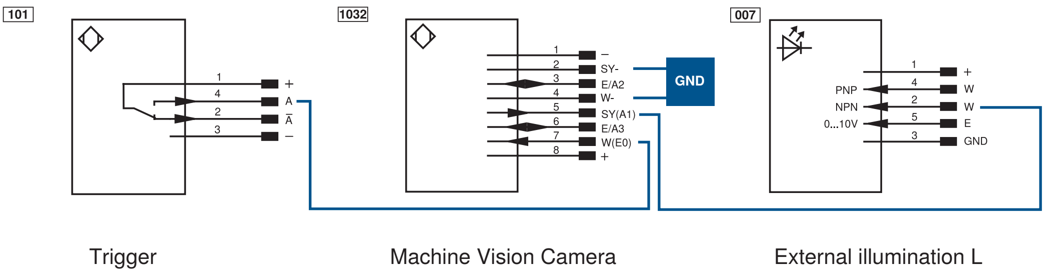
Dynamic applications for Machine Vision Cameras with rolling shutters are only possible when illuminating in flash mode with a global exposure window! For this purpose, a very long exposure time (at least 93 ms for BB6K005 and BB6K006) must be set, as this is the only way to create the global exposure window! An enclosure for the application is then also required to protect against ambient light!



The following figure shows a wiring example with the external illuminations ZVZF1 / ZVZF2 / ZVZF3 and ZVZF4::



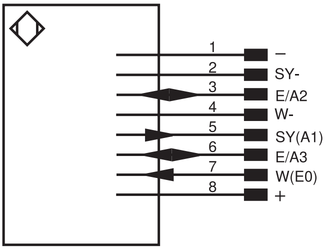
The following graphic shows an example of wiring with the external illumination L:



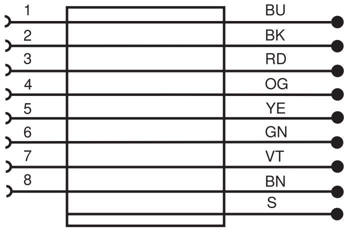
Manual Wiring

Machine Vision Camera BB6K with Connection Cable ZDML

1032



S117



Illumination (ZVZF1xx, ZVZF2xx, ZVZF3xx and ZVZF4xx) with Connection Cable ZDDL

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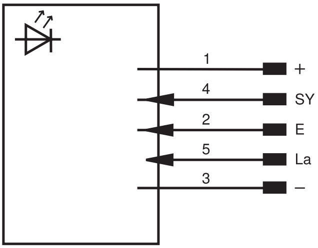
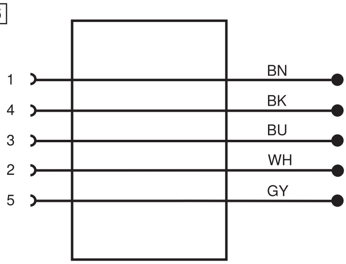
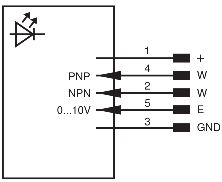


S06

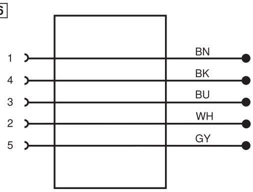


Illumination L with connection cable ZDDL

007



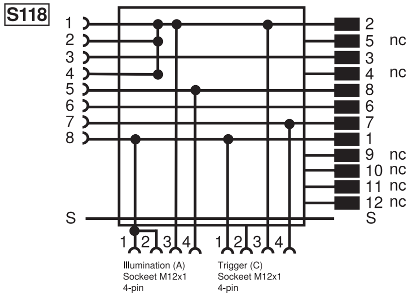
S06



Connection Modules for external illumination ZVZF1 / ZVZF2 / ZVZF3 / ZVZF4

Connection Module, from Machine Vision Camera to Trigger Sensor and to Illumination ZVZF1 / ZVZF2 / ZVZF3 / ZVZF4

ZDMG001

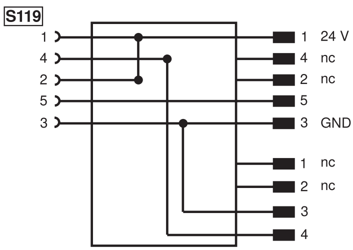


NOTE!
The connection module can be used if the output of the trigger signal is either a PNP output or a push-pull output.

NOTE!
The connection module ZDCG001 can be connected to the connection module ZDMG001 multiple times in succession to operate multiple external illuminations in flash mode on a Machine Vision Camera.

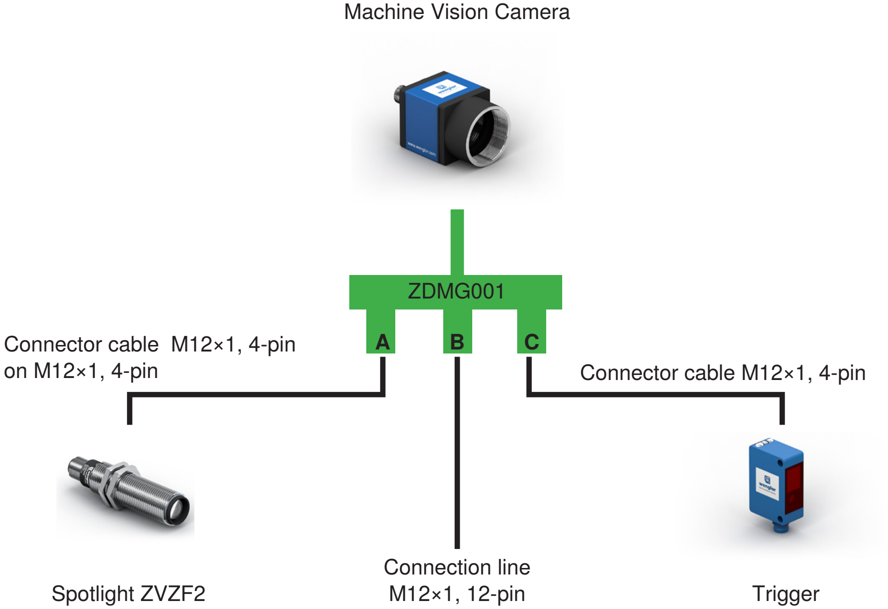
Connection module for illumination in flash mode for disconnecting camera synchronization signal and illumination supply voltage (for ring light and backlight ZVZF1, ZVZF3, ZVZF4)

ZC4G001



Machine Vision Camera with spotlight ZVZF2 in flash mode:

- Voltage supply for trigger sensor, spotlight and Machine Vision Camera via 12-pin connection line, M12×1



Using the connection module ZDMG001 and the wenglor connection cable M12×1, 12-pin, the following color coding is valid:

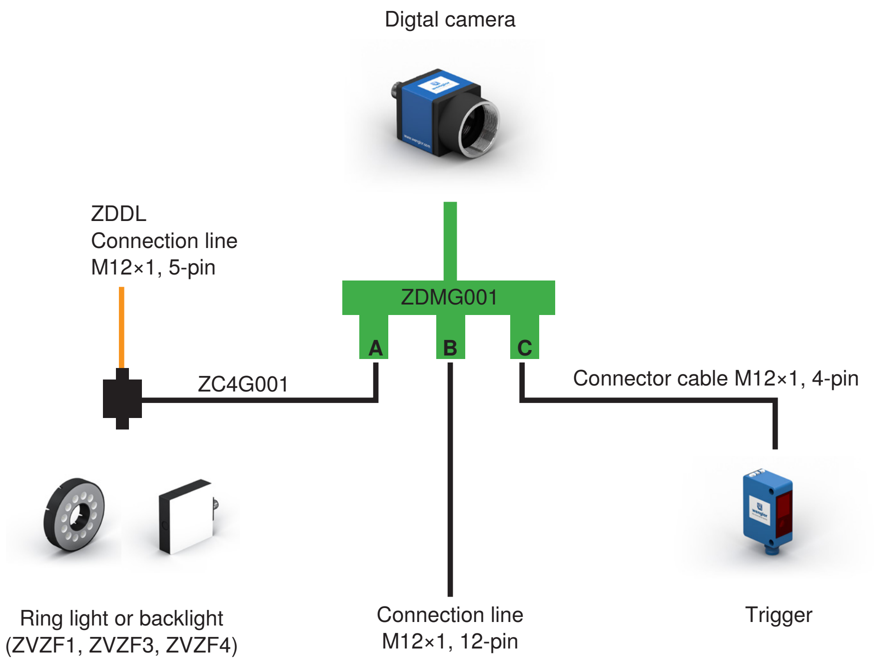
wenglor connection cable M12×1, 12-pin:
- BN: +
- BU: –
- WH: E/A2, Line2 (Voltage range: 0…3,3 V DC, ATTENTION: No protective circuits!)
- GN: nc
- PK: nc
- YE: E/A3, Line3 (Voltage range: 0…3,3 V DC, ATTENTION: No protective circuits!)
- BK: W (E0, Line0) (Trigger, pre-configured by ZDMG001)
- GY: SY (A1, Line1) (Synchronization illumination, pre-configured by ZDMG001)
- RD:nc
- VT: nc
- GYPK: nc
- RDBU: nc

Wire Colors according to IEC 60757

BK	Black
BN	Brown
RD	Red
OG	Orange
YE	Yellow
GN	Green
BU	Blue
VT	Violet
GY	Grey
WH	White
PK	Pink
GNYE	Green/Yellow

Machine Vision Camera with ring light or backlight (ZVZF1, ZVZF3, ZVZF4) in flash mode:

- Voltage supply for trigger sensor and Machine Vision Camera via 12-pin connection line, M12×1.
- The ZC4G001 disconnects supply voltage from illumination, as well as the Machine Vision Camera's synchronization signal in flash mode.
- Supply voltage for illumination via separate connection line with large wire cross-section (ZDDL) for temporary high current consumption in illumination flash mode



Using the connection modules ZDMG001 and ZC4G001 together with the wenglor connection cables M12 x 1, 12-pin and M12 x 1, 5-pin, the following color coding is valid:

wenglor connection cable M12 x 1, 12-pin:
- BN: +
- BU: –
- WH: E/A2, Line2 (Voltage range: 0...3,3 V DC, ATTENTION: No protective circuits!)
- GN: nc
- PK: nc
- YE: E/A3, Line3 (Voltage range: 0...3,3 V DC, ATTENTION: No protective circuits!)
- BK: W (E0, Line0) (Trigger, pre-configured by ZDMG001)
- GY: SY (A1, Line1) (Synchronization illumination, pre-configured by ZDMG001)
- RD:nc
- VT: nc
- GYPK: nc
- RDBU: nc

wenglor connection cable M12 x 1, 5-pin (ZDDL):
- BN: 24 V
- BK: nc
- BU: GND
- WH: nc
- GY: La

Wire Colors according to IEC 60757

BK	Black
BN	Brown
RD	Red
OG	Orange
YE	Yellow
GN	Green
BU	Blue
VT	Violet
GY	Grey
WH	White
PK	Pink
GNYE	Green/Yellow

7.5.4 GPIO

The Machine Vision Camera is additionally equipped with two GPIOs (E/A2 or Line2, E/A3 or Line3):
- High range: 1.7…3.3 V DC
- Low range: –0.3…0.8 V DC
- Maximum output current: 8 mA

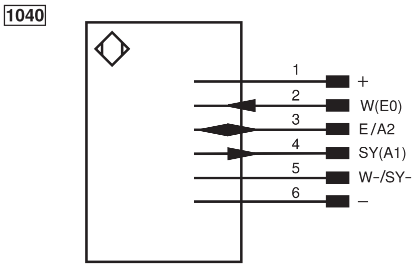
ATTENTION!
Risk of property damage if the GPIOs are incorrectly wired!
The GPIOs are not equipped with protective circuits. Overvoltage or undervoltage at a GPIO may cause damage to the electronics.
- Wire GPIOs in accordance with the specification only.

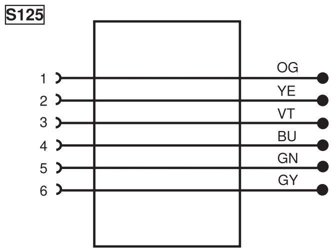
7.6 BBZK Machine Vision Camera

7.6.1 Voltage Supply

The BBZK machine vision camera can be supplied with voltage via the Hirose connector or via Power over Ethernet (PoE).

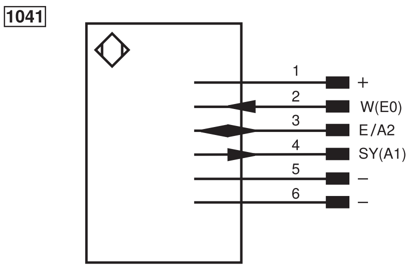
Voltage supply via Hirose connector:
- Connect the Machine Vision Camera to 9…24 V DC via the Hirose connector.
- The PWR LED on the back of the machine vision camera lights up.

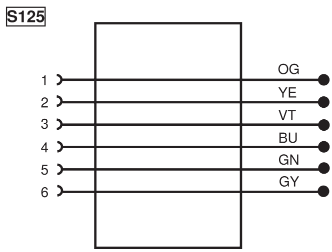




Connection Diagram BBZK001-004

Connection Diagram ZDEL001





Connection Diagram BBZK005-006

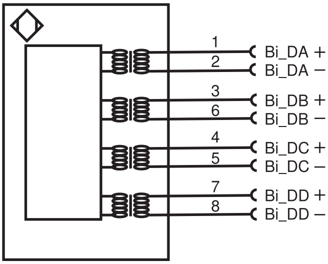
Connection Diagram ZDEL001

Voltage supply via Power over Ethernet (PoE):
- Connect the machine vision camera to a switch with PoE functionality via an Ethernet cable.
- The PWR LED on the back of the machine vision camera lights up.

7.6.2 Network Connection

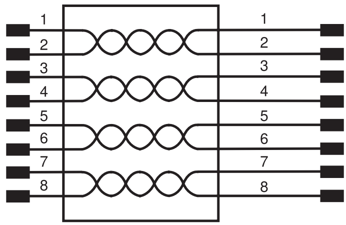
Connect the machine vision camera to the control unit either directly or via a switch.

1033



Connection Diagram **Network** BBZK Machine Vision Camera

S81



Suitable wenglor connection equipment

7.6.3 Connection Overview for Trigger, Machine Vision Camera, and Illumination in Flash Mode

Trigger input W (I0) for BBZK001-004:

- Connect W-/SY- to GND.
- Connect W (I0) to the trigger sensor's digital output.
  - High range: 3.3…24 V DC
  - Low range: 0…1 V DC
  - It is a PNP trigger.
  - The breakthrough voltage is 30 V DC. Keep the voltage stable.
  - The maximum input current is 25 mA.

Trigger input W (I0) for BBZK005 and 006:

- Connect pin 5/pin 6 to GND.
- Then connect W (I0) to the trigger sensor's digital output.
  - High range: 3.3…24 V DC
  - Low range: 0…0.3 V DC
  - It is a NPN trigger.
  - The breakthrough voltage is 30 V DC. Keep the voltage stable.

Flash output for flash mode SY (O1) for BBZK001-004:

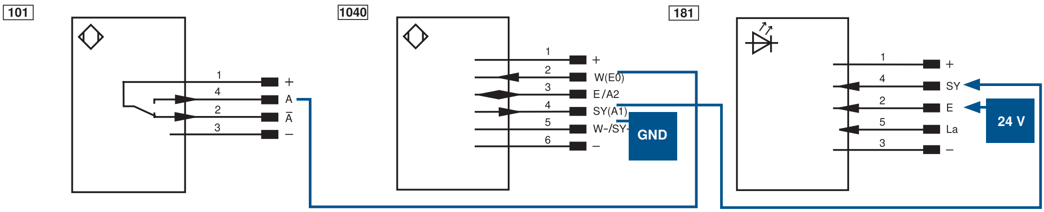
- Connect W-/SY- to GND.
- Connect SY (O1) to the synchronization pin for the illumination.

NOTE!
External illumination can be used only in continuous mode with the BBZK005 and BBZK006 rolling shutter cameras. In addition, only static applications are possible due to the rolling shutter image sensor.

GPIO (I/O2) for BBZK001-006:

- To avoid damaging the GPIO pin, connect pin 6 to GND first and then connect the input voltage to pin 3 (I/O2).
  - High range: 3.3…24 V DC
  - Low range: 0…0.3 V DC
- The breakthrough voltage is 30 V DC. Keep the voltage stable.

The following graphic shows an example wiring for BBZK001-004 with ZVZF1/ZVZF2/ZVZF3/ZVZF4 external illumination:

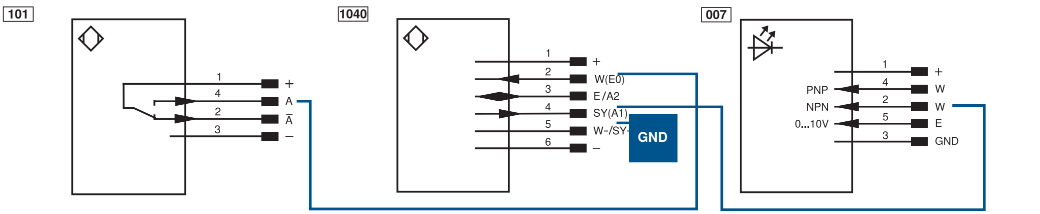


Trigger

Machine vision camera

External illumination ZVZF1, ZVZF2, ZVZF3, ZVZF4

The following graphic shows an example wiring for BBZK001-004 with the L external illumination:

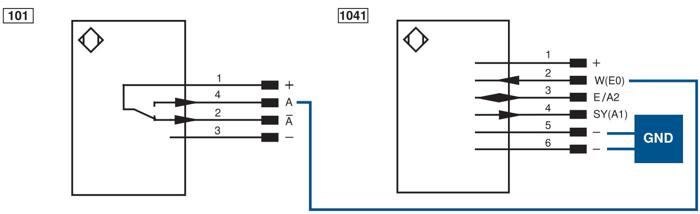


Trigger

Machine vision camera

L external illumination

The following graphic shows an example wiring for BBZK005-006 (external illumination in continuous mode):



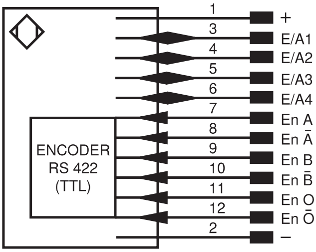
Trigger

Machine vision camera

7.7 weCat3D – 2D/3D Profile Sensor

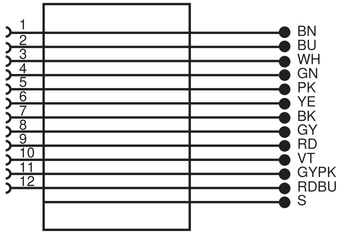
- Connect port 1 of the 2D/3D profile sensor to 18 to 30 V DC. Connect pin 1 to the plus pole and pin 2 to the minus pole to this end.

1034



Connection Diagram: Port 1 of the 2D/3D Profile Sensor

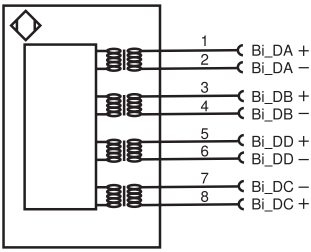
S89



Matching wenglor Connection Equipment

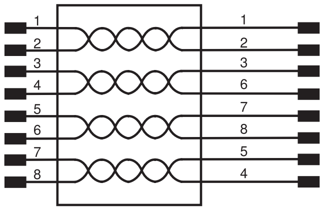
- Connect port 2 of the 2D/3D profile sensor to the control unit either directly or via a switch.

1022



Connection Diagram: Port 2 of the 2D/3D Profile Sensor

S85

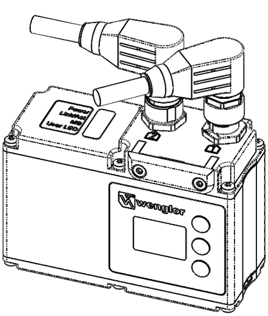
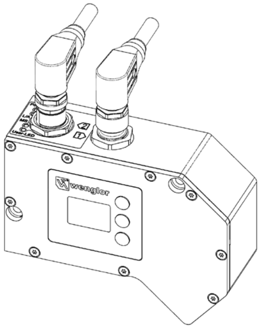
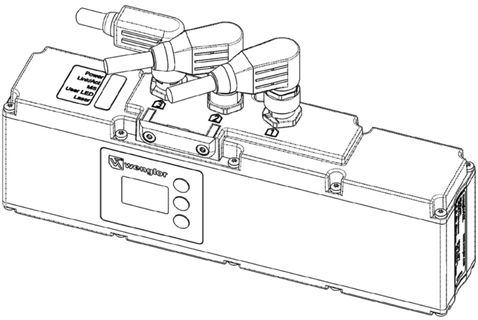
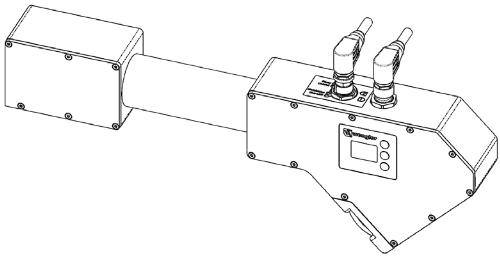


Matching wenglor Connection Equipment

NOTE!
- Cabling must be capable of 1 Gbit/s throughout the entire network.
- Further information concerning electrical connection of the 2D/3D profile sensors can be found in the operating instructions for the sensors.

NOTE!

The following diagram shows the cable outlet on the smart 2D/3D profile sensor when using angled wenglor connecting cables.

MLSL	MLWL
	
	

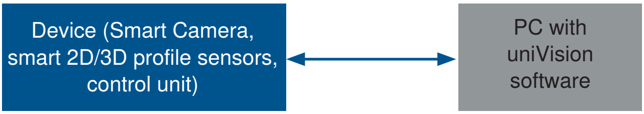
8. Establishing a Connection with uniVision Software

uniVision software is used to configure the parameters of the devices (Smart Camera, smart 2D/3D profile sensors and control unit). Once the projects have been set up, the software can be disconnected from the device which then runs autonomously.

NOTE!
uniVision software should not be used to visualize results because updating the data has a significant effect on device performance (especially during operation in the live mode). The website can be used to visualize results.

8.1 Network Settings

In order to establish a connection from uniVision software to the device (Smart Camera, smart 2D/3D profile sensors and control unit), the device and the PC with uniVision parameters configuring software must be in the same network.



The network portion of the device's IP address must match the network portion of the IP address of the PC with uniVision parameters configuring software. However, the device portion of the IP address must be different for the device and the PC.

	Network Portion	**Device Portion** (host portion)
IP address	192.168.100.	001
Subnet mask	255.255.255.	000

The network settings can be entered statically or assigned to the device automatically via a DHCP server within the network.

NOTE!
- The device has to be restarted after changing the network configuration.
- Setting up a fixed network configuration and changing the PC's IP address is described in separate operating instructions for various operating systems. Details can be found in the download area for uniVision software.
- In the event of incorrect network settings, it may no longer be possible to contact the device within the network.

8.1.1 Smart Camera

The Smart Camera is shipped with the following default network settings:
- IP address: 192.168.100.1
- Subnet mask: 255.255.255.0

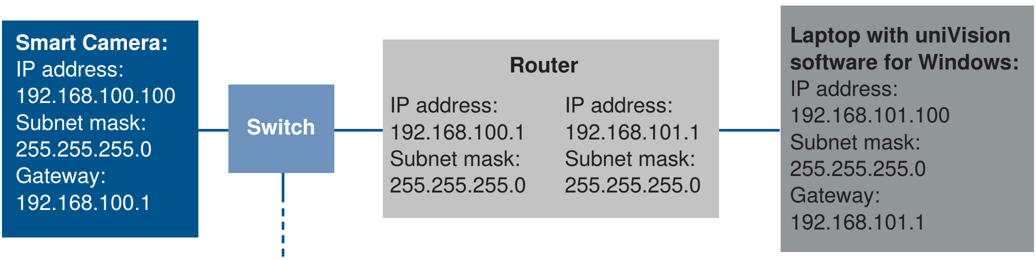
As an example, the following network configuration can be used for the Smart Camera and the laptop with uniVision for Windows software.

In addition to a static network configuration, a valid network configuration can also be assigned to the Smart Camera via DHCP by the DHCP server within the network. The DHCP setting must be activated at the Smart Camera to this end.

NOTE!
If DHCP is activated at the device although no DHCP server is available, a valid network configuration is not assigned to the device and the device cannot be fully started. The DHCP setting can be temporarily disabled by pressing the key at the middle of the OLED display on the Smart Camera during start-up.

The network settings of the Smart Camera can be configured via the software uniVision, via the website and via the OLED display.

weQube Smart Cameras can now also be set up with uniVision software for Windows using a router. The following graphic shows an example with different subnets for the Smart Camera and the laptop with uniVision software for Windows.



NOTE!
UDP commands are blocked by the gateway and cannot be used in this specific application. For example, it is not possible to search for devices via UDP or open and edit global settings when using a gateway.

8.1.2 Smart 2D/3D profile sensor

The smart 2D/3D profile sensor comes with the following network settings as default:

- IP address: 192.168.100.1
- Subnet mask: 255.255.255.0

As an example, the following network configuration can be used for the smart 2D/3D profile sensors and the laptop with uniVision software for Windows.

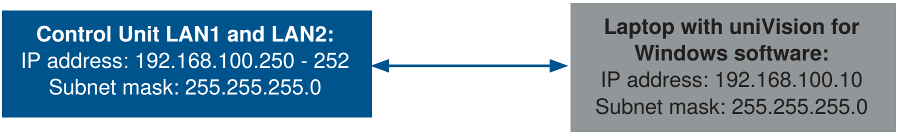
The network settings of the smart weCat3D sensor can be adjusted via the website and the OLED display.

By default, the operating mode is set to “Profile Generator”. In order to use the sensor as a smart 2D/3D profile sensor, the operating mode must be switched to “Smart weCat3D” via the website or OLED display.

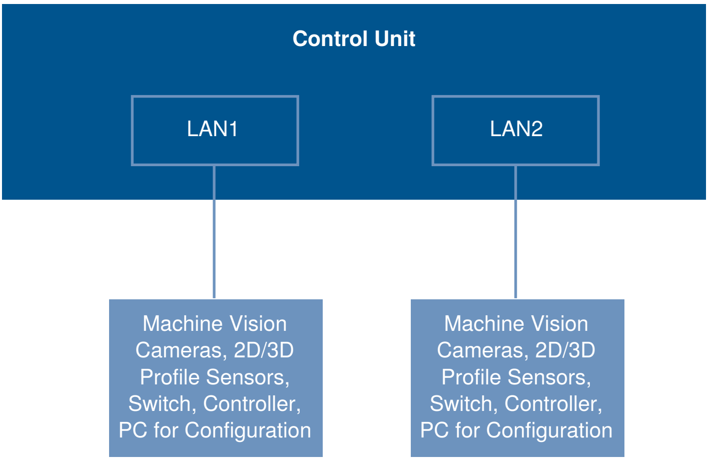
8.1.3 Control Unit

The control unit is shipped with the following default network settings:

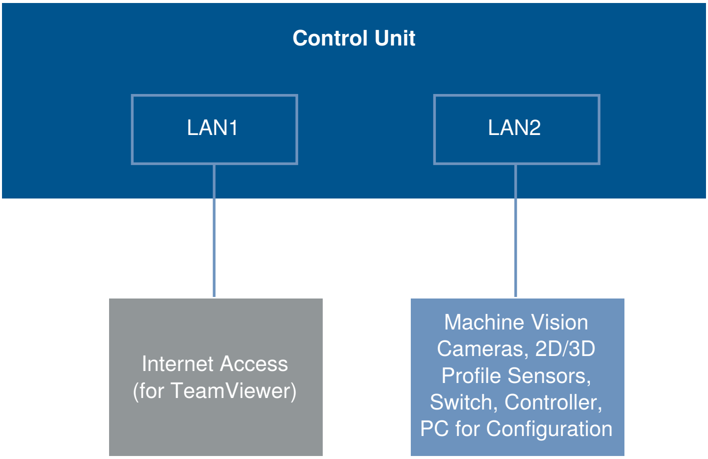
- Bridge: LAN1 + LAN2
- Bridge:
  - Beginning of IP address range: 192.168.100.250
  - End of IP address range: 192.168.100.252
  - Subnet mask: 255.255.255.0



If the default settings are retained, LAN1 and LAN2 are bridged and the same IP address range is used for both LAN interfaces. And thus Machine Vision Cameras, 2D/3D profile sensors, switches, controllers and PCs used for configuration can be connected as desired to LAN1 or LAN2. The IP address range can only be set statically for this purpose.



If the “Bridge” setting is changed from “LAN1 and LAN2” to “LAN2” only, only LAN2 can be used for Machine Vision Cameras, 2D/3D profile sensors, switches, controllers and configuration PCs. The network configuration for LAN1 can be set up separately. A static IP address can be assigned to LAN1, or a valid network configuration can be automatically assigned via a DHCP server within the network. If DHCP is activated at LAN1, and if LAN1 is connected to a company network with Internet access and active DHCP server, TeamViewer can be used, for example.



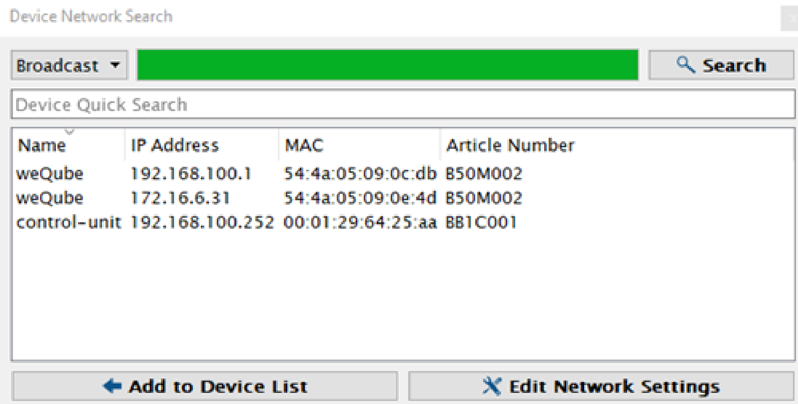
NOTE!
The control unit can also be set up with uniVision for Linux software which is preinstalled to the control unit. A monitor, a mouse and a keyboard must be connected to this end, or a VNC connection must be established.

The network settings of the control unit can be configured via the software uniVision.

8.2 Connecting a Device

- Start uniVision 2 software.
- Click “Connect to Device”.

- By default, the device list is empty and the “Device Network Search” is started. All devices available within the network (Smart Cameras, 2D/3D profile sensors in the “Smart weCat3D” operating mode, control units) are listed.

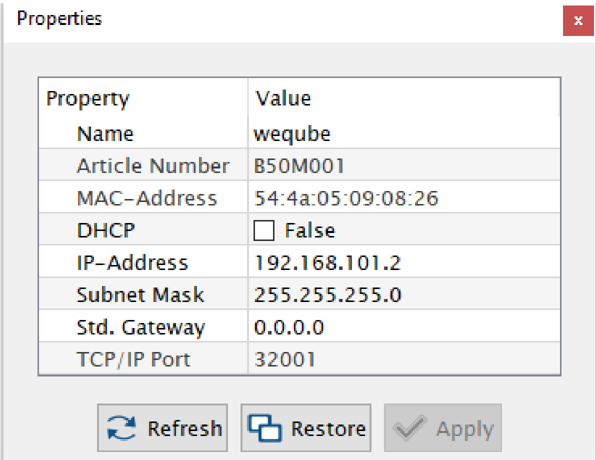


NOTE!

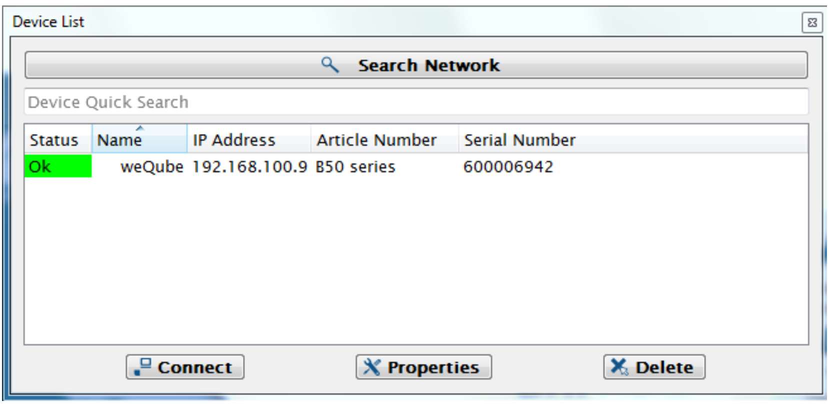
If the device is not found, the following points can be checked:

- The PC with uniVision software and the device must be connected to each other via a network.
- The device is connected to supply power and the boot-up process has been completed.
- The Windows firewall is disabled.
- You can also search for a specific IP address by setting the “Broadcast” function to “IP Search” and entering the IP address.
- The 2D/3D profile sensor is not in Smart weCat3D mode of operation (the mode of operation is therefore set to Profile Generator or GigE Vision). First set the mode of operation to Smart weCat3D so that you can find the sensor in the device network search

- The device’s network settings can be changed by clicking “Edit Network Settings”, making it possible to adapt the device’s network configuration to the existing infrastructure. See section “8.1 Network Settings” on page 86.



- Then add the device to the device list.

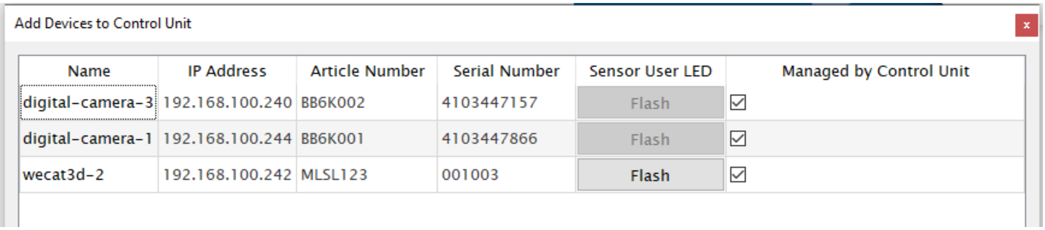


- A connection is established by double-clicking the device or clicking “Connect”.

8.2.1 Connection

8.2.1.1 Control Unit

If the control unit is selected and the Connect button is clicked, the following dialog opens:



After clicking “Flash”, the user LED at the back of the 2D/3D sensor blinks.

NOTE!
2D/3D profile sensors in the “Profile Generator” operating mode are listed. 2D/3D profile sensors in the “Smart weCat3D” operating mode are not found by the control unit as they are self-sufficient. Smart 2D/3D profile sensors are found via network search. The 2D/3D profile sensor is not in Smart weCat3D mode of operation (the mode of operation is therefore set to Profile Generator or GigE Vision). First set the mode of operation to Smart weCat3D so that you can find the sensor in the device network search.

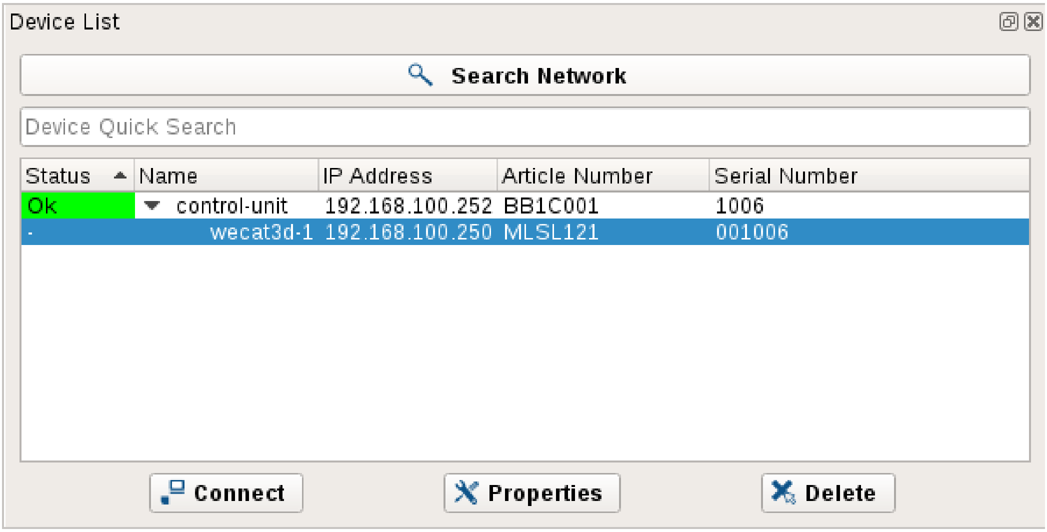
NOTE!
The BB6K and BBZK machine vision cameras must not be combined on control units. Only BB6K cameras or BBZK cameras may be used on one control unit.

Procedure for adding a device to the control unit:

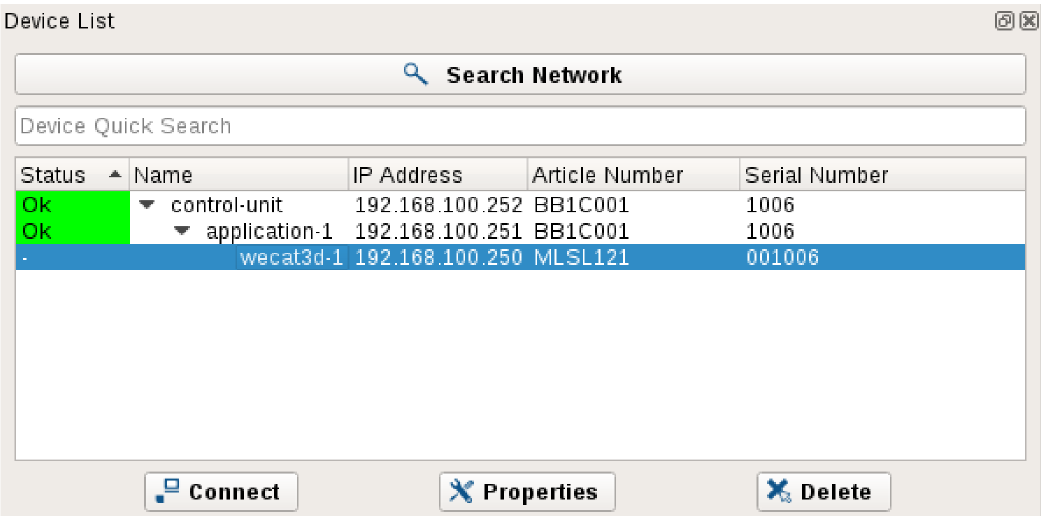
- Select “Managed by control unit” for the corresponding device.
- There is the option of assigning a unique name to the corresponding device. Any given name may only be used once. In each project, the device is assigned to the respective sensor by means of its name.

NOTE!
After projects have been created, the device name should not be changed because allocation of the device its projects is otherwise lost. If the name is changed subsequently, the sensor must be selected once again in all projects.

Added devices are attached to the control unit.



Select the device in the device list and click on Connect to generate a uniVision Application. The data of the device is evaluated in the uniVision Application. After closing the connection to the uniVision Application, the device is listed in the device list under a uniVision Application.



Supplement: Replacing Sensors at a Control Unit

1. Open the device list, select the control unit and click on Connect. Remove the checkmark from the old sensor under "Controlled by control unit".
2. Remove the old sensor.
3. Mount and connect the new sensor.
4. Open the device list in uniVision software.
5. Select the control unit and click "Connect".
6. The newly added sensor is displayed as an available device.
7. Insert a checkmark next to "Managed by control unit".
8. Rename the sensor to the device name of the old sensor.
9. Connect to the sensor and select the desired project.

NOTE!
In each project, the device is assigned to the respective sensor by means of its name. If the device name of the old sensor is used for the new one, all projects can be run without making any changes.

NOTE!
Removing of devices (e.g. Machine Vision Cameras) is only possible if no uniVision Application is connected to it and if no other device in the network has the standard IP address 192.168.100.1

Supplement: Expanding the Control Unit with Additional Sensors

1. Mount and connect the additional sensor.
2. Open the device list in uniVision software.
3. Open the control unit's properties window.
4. Make sure that the IP Address range includes enough IP Addresses for the required number of sensors.

The following formula applies in this respect:
required number of IP Addresses = 2 x number of sensors + 1.

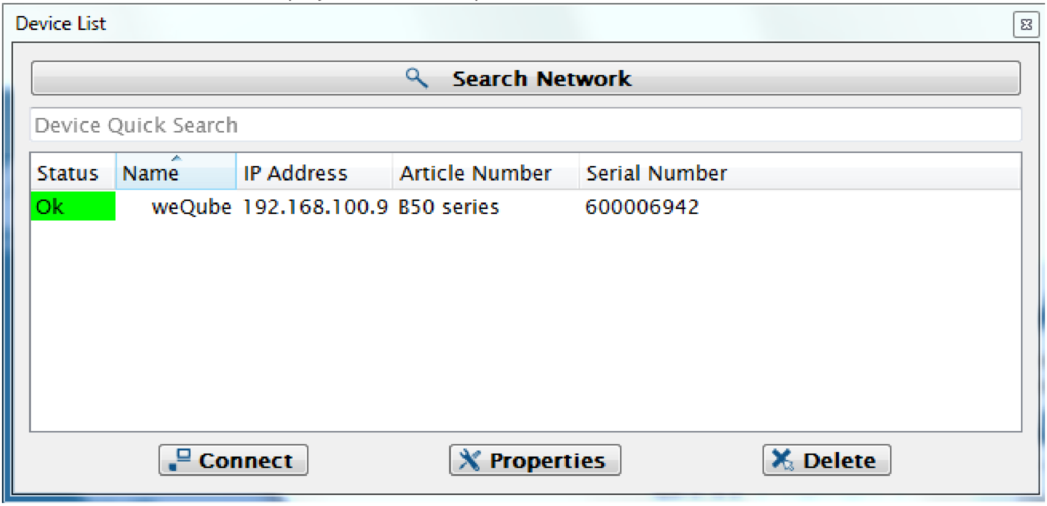
If enough IP Addresses are available, the properties window can be closed. If additional IP Addresses are required for the control unit, they have to be added at the beginning of the IP Address range.

NOTE!
The end of the IP Address range must not be changed because a new address would otherwise also be assigned to the control unit itself. As a result, all sensors and applications would no longer be available.

- Select the control unit in the device list and click "Connect".
- The added sensor is displayed as an available device.
- Insert a checkmark next to "Managed by control unit".
- Assign a unique device name for easier identification.

8.2.1.2 weQube Smart Camera

If a weQube Smart Camera is selected in the device list, followed by a click on “Connect”, a connection is established with the device and the project can be set up.



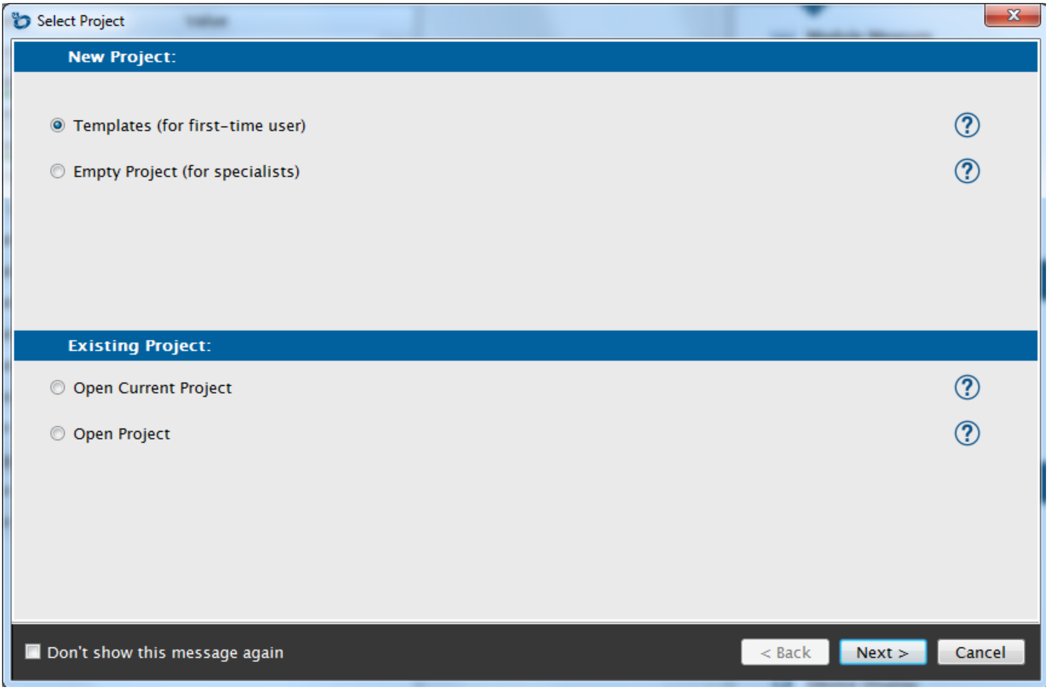
8.2.1.3 Smart 2D/3D Profile Sensor

If you select a smart 2D/3D profile sensor in the device list and click “Connect”, a connection to the device is established and the project can be set up.

NOTE!
The 2D/3D profile sensor in “Smart weCat3D” operating mode may no longer be attached to a control unit, as otherwise no connection can be established via the uniVision software in editing mode.

8.2.1.4 Project Selection

The following options are available after the connection has been established.



Template	For standard applications, a template can be loaded on the device.
Empty Project	An empty project is loaded on the device. (Only for specialists)
Open Current Project	The project currently running on the device is opened.
Open Project	An existing project can be loaded on the device.

8.2.2 Properties

8.2.2.1 Control Unit

If the control unit is selected and “Properties” is clicked, the following setting options open:

Name	Settable device name
Article Number	Article Number of the device
Serial Number	Serial Number of the device
Description	Unchangeable device type
Product Version	Firmware Version of the device
Date and Time	Date and Time
MAC Address	MAC Address of the device
TCP/IP Port	TCP/IP Port of the device
UDP State Interval	Interval in seconds with which a status signal of the device (UDP broadcast) is sent via the port 32002.
Bridge Netmask	Netmask for bridge
Bridge IP Address Range Start	Beginning of the IP Address range. **NOTE!** In order to subsequently add additional sensors, shift the Start of the IP Address range two IP Addresses per sensor.
Bridge IP Address Range End	End of the IP Address range **NOTE!** The IP Address entered as the end of the IP Address range is used by the control unit itself. If this IP Address is changed, the existing applications must be deleted and the sensors selected again.
LAN1 DHCP	Via a DHCP server in the network, the LAN1 interface can be assigned a network configuration. Activate DHCP for this.
LAN1 IP address	The static IP address is used for LAN1 if “Bridge” is set to LAN2 and DHCP is disabled for LAN1. When DHCP is active on LAN1, the IP address assigned to LAN1 is displayed.
LAN1 subnet mask	The static subnet mask is used for LAN1 if “Bridge” is set to LAN2 and DHCP is disabled for LAN1. When DHCP is active on LAN1, the subnet mask assigned to LAN1 is displayed.
Standard Gateway	Standard Gateway of the control unit

Bridge	LAN1 and LAN 2	Both LAN interfaces receive the same network configuration (default setting). This means that 2D-/3D sensors, process data and the LIMA communication with uniVision Applications can take place via both LAN interfaces.
	LAN2	Only on LAN2 can 2D-/3D sensors be connected, process data received and communication take place with uniVision Applications via LIMA commands. LAN1 can thus be used separately for TeamViewer or VNC.

NOTE!
Further information on network configuration can be found in section “8.1.3 Control Unit” on page 89.

The following rules apply to the internal assignment of IP Addresses:
- The highest IP Address is always used for the control unit.
- Two additional IP Addresses are required for each additional sensor:
  – An IP Address for the uniVision Application
  – An IP Address for the sensor

8.2.2.2 uniVision Application

If the uniVision Application is selected and “Properties” is clicked, the following setting options open:

Name	Settable device name
Article Number	Article Number of the device
Serial Number	Serial Number of the device
Description	Unchangeable device type
Product Version	Firmware Version of the device
MAC Address	MAC Address of the device
TCP/IP Port	TCP/IP Port of the device
UDP Status Interval	Interval in seconds with which a status signal of the device (UDP broadcast) is sent via the port 32002.
Start Project	Project that is loaded as standard when the device starts up. The start behavior must be set to start project for this.
Startup Policy	The device can start with the most recent loaded project or with a fixed start project. **NOTE!** After the startup behavior is changed to “Last loaded project”, a project load cycle is required before the device can be restarted.

FTP Remote IP Address	IP Address of the FTP Server in the Network. **NOTE!** Projects stored to an FTP server within the network can be uploaded to uniVision applications via the LIMA interface. Details can be found in the separate interface protocol. Process data can also be saved on a FTP server (e.g images, profiles or text files).
FTP Remote User Name	FTP user name
FTP Remote Password	FTP password
Website Password	Password for protection against changes to the visualization (password in factory settings: admin)

8.2.2.3 weQube Smart Camera

If the weQube Smart Camera is selected and "Properties" is clicked, the following setting options open:

Name	Settable device name
Article Number	Article Number of the device
Serial Number	Serial Number of the device
Description	Unchangeable device type
Product Version	Firmware Version of the device
MAC Address	MAC Address of the device
DHCP	Via a DHCP server in the network, the device can be assigned a network configuration. Activate DHCP for this.
IP Address	Static IP Address of the device.
Fallback IP Address	If DHCP is activated on the device without a DHCP server in the network, the device starts with the fallback IP Address.
Subnet Mask	Static subnet mask of the device
Fallback Subnet Mask	If DHCP is activated on the device without a DHCP server in the network, the device starts with the fallback subnet mask.
Standard Gateway	Standard Gateway of the device
Fallback Standard Gateway	If DHCP is activated on the device without a DHCP server in the network, the device starts with the fallback standard gateway.
TCP/IP Port	TCP/IP Port of the device.
Fallback TCP/IP Port	If DHCP is activated on the device without a DHCP server in the network, the device starts with the fallback TCP/IP Port.
UDP State Interval	Interval in seconds with which a status signal of the device (UDP broadcast) is sent via the port 32002.
Type of Industrial Ethernet	Industrial Ethernet can be deactivated or set to Profinet or EtherNet/IP. **NOTE!** After changing the Industrial Ethernet protocol, the Smart Camera must be restarted.
Ethernet mode	Selection of Ethernet transmission speed (auto negotiation (standard)) or 10 or 100 MBit half or full duplex.

ACD control	Address conflict detection. The automatic checking for address conflicts can be turned on or off (EtherNet/IP only).
ACD PDU	Specifies the corresponding IP address in the event of an IP address conflict (EtherNet/IP only).
Inactivity timeout	Describes the time after which a TCP/IP port is closed if it was not active (EtherNet/IP only).
Start Project	Project that is loaded as standard when the device starts up. The start behavior must be set to start project for this.
Startup Policy	The device can start with the most recent loaded project or with a fixed start project. **NOTE!** After the startup behavior is changed to “Last loaded project”, a project load cycle is required before the device can be restarted.
Start Focus Value	Not supported
FTP Remote IP Address	IP address of the FTP server in the network. **NOTE!** Projects stored to an FTP server within the network can be uploaded in weQube via the LIMA interface. Details can be found in the separate interface protocol. Process data can also be saved on a FTP server (e.g. images or text files).
FTP Remote User Name	FTP user name
FTP Remote Password	FTP password
Web Interface Password	The default website password is: admin
Display Rotation	The OLED display can be rotated by 180°.
Display Password	The default password for the OLED display is: 2013
Display Locked	The OLED display can be blocked.
Display Mode	Selection of the display mode on the OLED display
Display Intensity	Selection of the intensity of the OLED display
Display Language	Selection of the language of the OLED display

8.2.2.4 Smart 2D/3D Profile Sensor

Selecting the smart 2D/3D profile sensor and clicking on "Properties" opens the following setting options:

Name	Editable device name
Item Number	Item number of device
Serial Number	Serial number of device
Description	Non-changeable device type
Firmware Version	Firmware version of device
MAC Address	MAC address of device
TCP/IP Port	TCP/IP port of device
UDP Status Interval	Interval in seconds at which a status signal of the device (UDP broadcast) is sent via port 32002.
Start-up Project	Project that is loaded by default when the device is started. To do this, the start-up behavior must be set to “Start-up Project”.
Start-up Behavior	The device can start with the last loaded project or with a fixed start-up project. **NOTE!** After the startup behavior is changed to “Last loaded project”, a project load cycle is required before the device can be restarted.
FTP Remote IP Address	IP address of the FTP server in the network **NOTE!** Projects stored to an FTP server within the network can be uploaded in weQube via the LIMA interface. Details can be found in the separate interface protocol. Process data can also be saved on a FTP server (e.g. images or text files).
FTP Remote Username	FTP username
FT Remote Password	FTP password
Website Password	Password to protect against changes to the visualization (Password in factory settings: admin)

9. Software and Firmware Updates

9.1 Installing or Updating uniVision for Windows Software

1. Access the product detail page for uniVision for Windows software DNNF020 at www.wenglor.com. The latest software update file can always be found there in the download area.
2. Download and run the update file.
3. Follow the steps displayed in the installation wizard and install the software.

NOTE!
The Windows firewall may block some functions of uniVision software by default. In order to prevent this, the software must be granted access for communication via private and public networks.

NOTE!
- Starting with version 2.3.0, uniVision software for Windows no longer includes older software versions for setting up uniVision devices or projects with older versions.
- To set up uniVision devices or projects with older versions, the appropriate version of uniVision software for Windows must be installed (uniVision 2.2.5, 2.1.4 or 2.0.6 software). These versions can also be installed in parallel.
- All other versions prior to 2.3.0 also contain older software versions in the installation package, which therefore cannot be installed in parallel to 2.2.4, 2.2.5, 2.1.3, 2.1.4, 2.0.5 or 2.0.6.
- Before installing the uniVision 2.6.1 for Windows software, it is recommended to uninstall the uniVision 2.6.0 for Windows.

9.2 Updating the Smart Camera’s Firmware

The Smart Camera’s firmware can be updated via uniVision for Windows software, or via the FTP interface.

9.2.1 Firmware Update via uniVision Software

First install the latest version of uniVision software, and then update the firmware via uniVision software.

1. Open the product detail page for the weQube Smart Camera at www.wenglor.com (e.g. B50M001). The latest firmware update file can always be found there in the download area.
2. Download and save the update file.
3. Start uniVision software and click “Connect to Device”.
4. Access the Smart Camera context menu with a right click and then click “Update Firmware”.
5. Select the firmware file and start the update process.
6. The Smart Camera is restarted and the firmware update is executed.

NOTE!
The update process takes a few minutes. The device must not be disconnected from supply voltage during the update.

9.2.2 Firmware Update via FTP Interface

First of all establish an FTP connection to the device. Enter ftp:// + the device's IP address in the file manager to this end.

Example with the Smart Camera's standard IP address: ftp://192.168.100.1
User data:
- User name: ftpuser
- Password:

NOTE!
The password field must remain empty.

The following steps must be performed in order to upgrade or downgrade the firmware:
1. Open the firmware folder.
2. Copy the update file into the firmware folder.
3. Restart the device (e.g. via the OLED display, the website or uniVision software).
4. The Smart Camera is restarted and the firmware update is executed.

NOTE!
The update process takes a few minutes. The device must not be disconnected from supply voltage during the update.

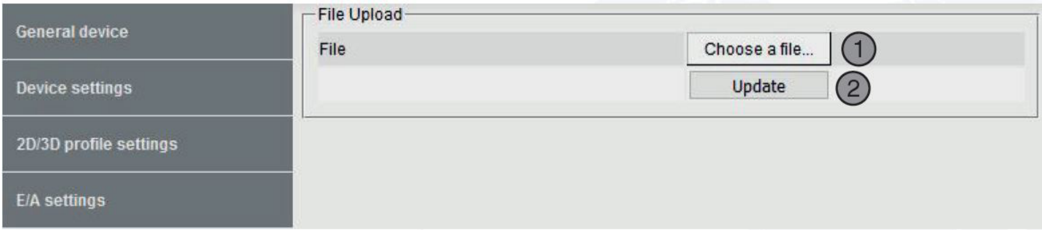
9.3 Updating 2D/3D Profile Sensor Firmware

NOTE!
Before updating the firmware, close all open software connections to the 2D/3D profile sensor and restart the sensor. The update process can be started as soon as the sensor is online.

The following steps must be performed in order to upgrade or downgrade the firmware:

1. www.wenglor.com Bring up the product detail page for the 2D/3D profile sensors (e.g. MLSL123). The latest firmware update file can always be found there in the download area.
2. Download, save and unpack the update file.
3. Open browser.
4. Enter the IP address of the sensor + “administration.html” (e.g. for the standard network settings of the 2D/3D profile sensor: 192.168.100.1/administration.html)

5. Click on "Choose a file...“ (1), select the update file (run file) and start the update process by clicking on “Update” (2).



NOTE!
The sensor voltage supply must not be interrupted during the update! The firmware update takes a few minutes!

6. The website shows the end of the firmware update.

NOTE!
The installed firmware version can be checked on the sensor website under “Device General” -> “Firmware Version”.

9.4 Updating the Control Unit's Firmware

The control unit's firmware can be updated via uniVision software, via the FTP interface or directly at the device.

NOTE!
A firmware update uninstalls installed plug-ins and configuration files (e.g. for PROFINET or EtherNet/IP). Therefore, it is necessary to reinstall the plug-in or the respective configuration file after the firmware update to the control unit.

NOTE!
The BB1C4xx and BB1C5xx control units are only supported from firmware 2.6.1.

9.4.1 Firmware Update via uniVision Software

First install the latest version of uniVision software, and then update the firmware via uniVision software.

NOTE!
uniVision for Linux software, which is installed to the control unit, is updated by the firmware update for the control unit. There's no need to separately update uniVision software for Linux.

1. Access the product detail page for uniVision for Linux software DNNF012 at www.wenglor.com. The latest firmware update file can always be found there in the download area.
2. Download and save the update file.
3. Start uniVision software and click "Connect to Device".
4. Access the control unit's context menu with a right click and then click "Update Firmware".
5. Select the firmware file and start the update process.
6. The control unit is restarted and the firmware update is executed.

NOTE!
The update process takes a few minutes. The device must not be disconnected from supply voltage during the update.

9.4.2 Firmware Update via FTP Interface

1. Access the product detail page for uniVision for Linux software DNNF012 at www.wenglor.com. The latest firmware for the control unit can always be found there in the download area.
2. Download and save the file.
3. Enter ftp:// + the control unit's IP address in the file manager.

Example with the control unit's standard IP address: ftp://192.168.100.252

User data:
- User name: ftpuser
- Password: ftpvision

4. Open the firmware folder.
5. Copy the firmware file into the firmware folder.
6. Restart the device (e.g. via uniVision software, via VNC or directly at the control unit)

7. The control unit is restarted and the firmware update is executed.

NOTE!
- The control unit cannot be restarted for the firmware update using the control unit's power supply. It must be restarted using the uniVision software, VNC, or directly on the control unit.
- The update process takes a few minutes. Do not disconnect the device from the power supply during the update.

9.4.3 Firmware Update via the Control Unit

1. Access the product detail page for uniVision for Linux software DNNF012 at www.wenglor.com. The latest firmware for the control unit can always be found there in the download area.
2. Download the file and save it to a USB stick.
3. Connect the USB stick to one of the USB ports on the control unit.
4. Select the update file and copy it to the /media/card/firmware folder.
5. Restart the control unit via "Menu" → "Reboot". The control unit cannot be restarted using the power supply.
6. The update process is executed automatically after restarting.
7. After updating has been successfully completed, the new software version is displayed at the uniVision start screen.

NOTE!
- The update process takes a few minutes. The device must not be disconnected from supply voltage during the update.
- To update the control unit from a 1.x.x version to the 2.x.x version, the firmware version 1.1.3 must be installed first. Only then is an update to a 2.x.x version possible, as the update format has changed from 1.x.x (rpm file) to 2.x.x (tgz file).

9.5 Updating the BB6K Machine Vision Camera's Firmware

The BB6K Machine Vision Camera's firmware can be updated via uniVision software.
1. Access the product detail page for the Machine Vision Camera (e.g. BB6K001) at www.wenglor.com. The latest firmware for the Machine Vision Camera can always be found there in the download area.
2. Start uniVision software and click "Connect to Device".
3. Access the Machine Vision Camera's context menu with a right click and then click "Update Firmware".
4. Select the firmware file and start the update process.
5. The Machine Vision Camera is restarted and the firmware update is executed.

NOTE!
- When updating the firmware, the camera must not be in use in any application. The application must be deleted to this end, or the Machine Vision Camera must be removed from the current project.
- The update process takes a few minutes. The device must not be disconnected from supply voltage during the update.
- The BBZK machine vision camera firmware cannot be updated.

9.6 Compatibility

The following uniVision products each have their own version number:
- uniVision software
- weQube firmware
- weCat3D firmware (in “Smart weCat3D” operating mode)
- Control unit firmware
- uniVision projects

The version numbers of software and firmware products consist of three digits (e.g. Software_uniVision_2.3.0):
- Major release: The first digit is changed (no project compatibility)
- Feature release: The second digit is changed (projects must be converted)
- Bugfix release: The third digit is changed (projects are compatible)

The following generally applies with regard to the compatibility of uniVision project files:
- For uniVision projects, there are only two digits in the version number, as the project format does not change for bug fixes (third digit changed).
- Projects with a specific two-digit version number can only be opened on devices with a suitable version of the firmware or set up using a suitable version of the software.
- After a firmware update with new features (second digit changed) on a device (e.g. Smart Camera), the corresponding software version must be installed and existing projects must be converted (see chapter “9.8 Project Conversion” on page 110).

NOTE!
- Starting with version 2.3.0, uniVision software for Windows no longer includes older software versions for setting up uniVision devices or projects with older versions.
- To set up uniVision devices or projects with older versions, the appropriate version of uniVision software for Windows must be installed (uniVision 2.2.5, 2.1.4 or 2.0.6 software). These versions can also be installed in parallel.
- All other versions prior to 2.3.0 also contain older software versions in the installation package, which therefore cannot be installed in parallel to 2.2.4, 2.2.5, 2.1.3, 2.1.4, 2.0.5 or 2.0.6!

Project version 1.x:

weQube firmware	Project version	Software
1.3.x	1.3	weQube 1.3.x software
1.4.x	1.4	weQube 1.4.x software

NOTE!
The major release of the weQube firmware from 1.x.x to 2.x.x changes the setting software from the weQube software to the uniVision software.

Project version 2.x:

weQube firmware	Project version	Software uniVision	Control unit firmware	WeCat3D Firmware ("Smart weCat3D" operating mode)
Not available	2.0	Not available	1.0.x	Not available
Not available	2.1	Not available	1.1.x	Not available
2.0.x	2.2	2.0.5	2.0.x	Not available
2.1.x	2.3	2.1.3	2.1.x	Not available
2.2.x	2.4	2.2.4	2.2.x	Not available
2.3.x	2.5	2.3.x	2.3.x	Not available
2.4.x	2.6	2.4.x	2.4.x	2.0.x
2.5.x	2.7	2.5.x	2.5.x	2.1.x and 2.2.x
2.6.x	2.8	2.6.x	2.6.x	2.3.x

9.7 Upgrading the weQube Firmware from Version 1.x.x to Version 2.x.x

NOTE!
To update the weQube firmware to version 2.x.x, firmware version 1.4.6 must be installed on the Smart Camera. If a different firmware version is installed on the device, a firmware update to version 1.4.6 must be carried out first.

The following steps must be carried out due to the major release:
1. Install the weQube 1.4.5 software. (Older software versions do not support the major release update!)
2. Establish a connection to the Smart Camera with the weQube software.
3. Click "Firmware Update" in the help menu.
4. Select the firmware file with version 2.x.x and start the update process.
5. The Smart Camera is restarted and the firmware update is carried out.

NOTE!
After the weQube firmware has been updated to 2.x.x, connection to the device is no longer possible with the weQube software.

6. Download and install the uniVision software.
7. The Smart Camera can now be set up with the uniVision software.

9.8 Project Conversion

If existing projects will still be used after a feature update (change of the second digit in the version number), project conversion is required.

NOTE!
If the firmware is updated via uniVision software, the project converter starts automatically after the firmware update.

Project conversion procedure:
1. Start the project converter via uniVision software (Help -> Project Conversion)
2. Select the projects to be converted and the target project version.
3. Start conversion.
4. All selected projects are converted to the desired project version.

NOTE!
- The original projects are saved in a backup folder and the converted projects are saved in the projects folder.
- Project conversion is only possible after a firmware upgrade, not after a downgrade.

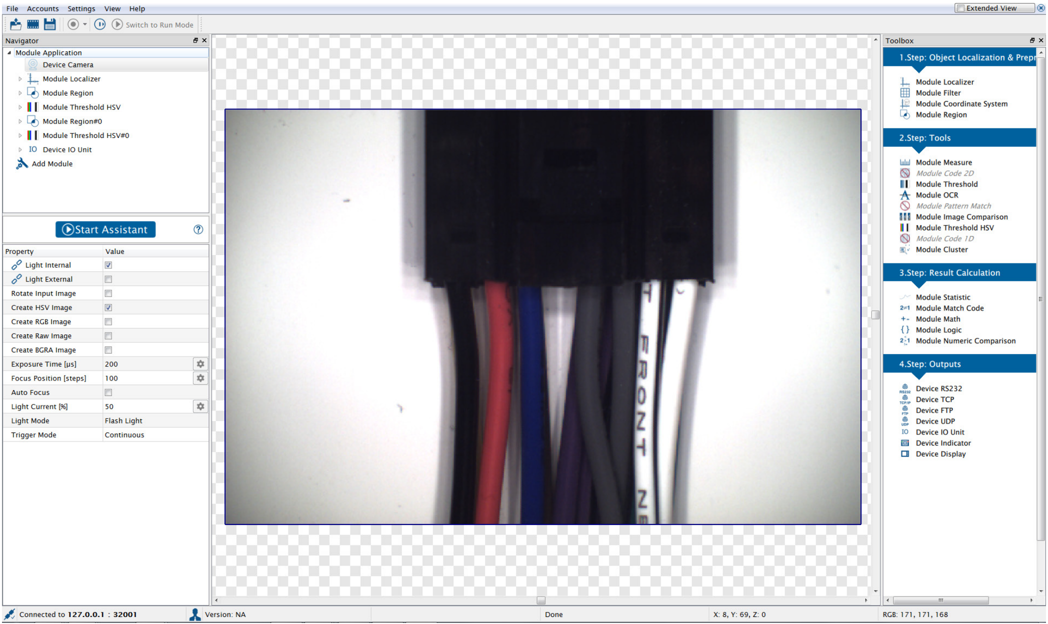
10. Setting Up the uniVision Software

10.1 Start Screen

Once the uniVision software is started, the start screen appears with the following options.

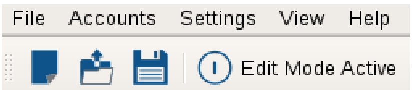
Connect to device	The device list is opened.
Open	The local project folder is opened. A project can be selected and opened offline. **NOTE!** On the uniVision software for Windows, the local project folder can be found at: C:/ProgramData/wenglor/univision/card/projects On the control unit, the local project folder can be found at: /media/card/projects
Examples	Different sample projects are available and can be opened offline.

10.2 User Interface



10.2.1 Menu Bar

The following actions are available in the menu bar:



10.2.1.1 File

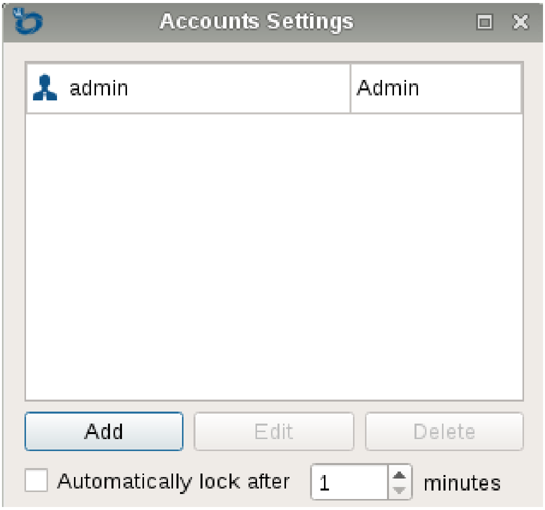
New	A new project is created on the device (offline not possible).
Open	A project can be opened. **NOTE!** Location (Windows): C:\ProgramData\wenglor\uniVision\card\projects. Location (control unit): media\card\projects Storage location (Smart Camera): \projects Storage location (smart 2D/3D profile sensor): \projects
Templates/Examples	Open a template on the device or an example offline.
Save	The currently open project is saved.
Save as	The currently open project can be saved to any desired folder. **NOTE!** Location (Windows): C:\ProgramData\wenglor\uniVision\card\projects. Location (control unit): media\card\projects Strage location (Smart Camera): \projects Storage location (smart 2D/3D profile sensor): \projects If a template file is to be saved, it is advisable to record a Teach+ file so that the correct sensor data is also recorded and no profiles or images from another recording device are present in the file.
Close Project	The connection between the uniVision software and the device is terminated.
Exit	The program is exited.

10.2.1.2 User Accounts

Various settings can be selected for user administration.

Log Off	Logs the active user out.
Lock Screen	The monitor screen is disabled. The software can only be enabled again with the user password.
Settings	Further information on settings is included throughout this section.
Auto Login	If this function has been activated, the last active user is logged in again.

After clicking the “Settings” menu, an overview of existing users appears:



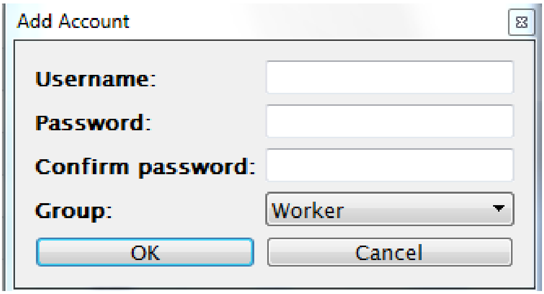
The following user is created as the standard user after installation:

User name: admin
Password: admin

Click the “Add” button in order to set up a new user.

If several users are set up, wenglor recommends changing the password for the user name “admin”.

If the administrator password is lost, please contact wenglor’s support department.



A new user can be set up in the following window. The password must have a length at least 5 characters.

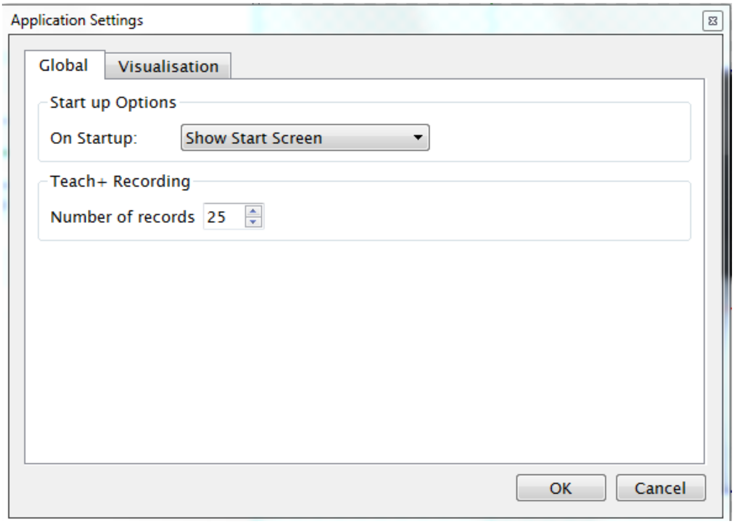
The user can be assigned to one of the following groups:

	Operator	Limited Setter	Setter	Admin
Load project	Yes	Yes	Yes	Yes
Edit projects	No	No	Yes	Yes
Set up a new project	No	No	Yes	Yes
Change user account	Yes	Yes	Yes	Yes
Manage user account	No	No	No	Yes
Disable software	No	No	Yes	Yes
Software – extended view	No	Yes	Yes	Yes
Change visibility of values	No	Yes	Yes	Yes
Change sensor settings	No	No	No	Yes
Change software settings	No	No	No	Yes

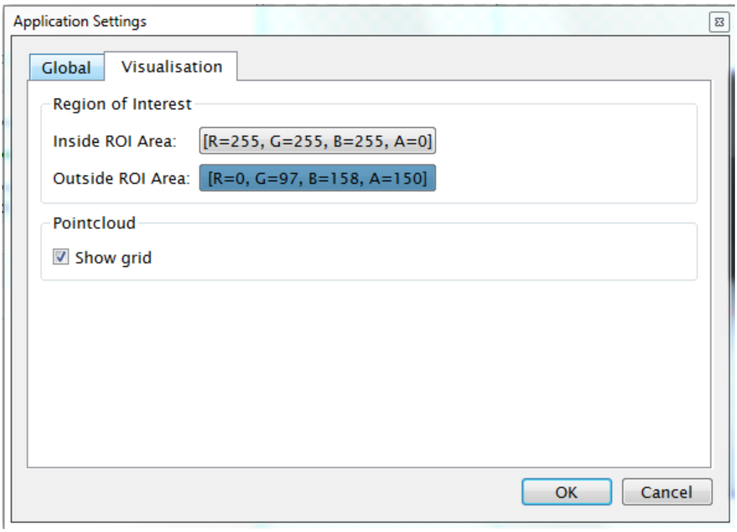
10.2.1.3 Settings

Options

Further settings can be selected under options.



During the software start, the start screen can be shown or a connection to a specific device can be established. The number of recordings for the Teach+ recording can be defined.



Inside ROI Area	Select color for the area within the region of interest (active area).
Outside ROI Area	Select color for the area outside of the region of interest (active area).
Show Grid	The grid in the measuring range can be activated or deactivated.
Language	uniVision is available in the following languages: • German • English • Chinese • Turkish • Dutch • Hungarian • Russian • Portuguese • Spanish • Italian • French

10.2.1.4 View

Various windows can be activated or deactivated in the “View” menu.

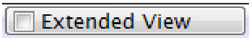
NOTE!
Detailed information regarding the individual areas is included in the following sections.

Image Container Viewer	Window with recordings of a Teach+
Histogram	Window for frequency distribution of the gray-scale values within a certain surface area.
Navigator	Window with an overview of the current project.
Profile	Window for analyzing gray-scale values along a line.
Toolbox	Window with all available modules.
Online Data Monitoring	Window for online data monitoring.
Properties	The device’s properties can be opened and edited.
Device List	Window with an overview of all devices.
Search Network	Window with all devices available in the network.
Project Tools	Menu bar for the entire project.
Module Toolbar	Menu bar for the selected module.

10.2.1.5 Help

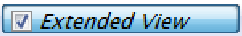
About	Information on the software version.
Manual	The operating instructions describe the functions of the uniVison software.
Software Changelog	Directory of the software changes.
Vision Portal	Link to the World of Innovations with additional information on the devices
Licenses	Window with license management
Firmware Update	Carry out a firmware update on the connected device.
Project Converter	Opens the project converter.

10.2.1.6 User View



Only visible modules appear in the project tree. Modules which will not be edited can be hidden (see "10.2.3.1 Project Tree, Settings/Results", page 118).

NOTE!
Module visibility can only be changed in the extended view.



All modules and settings can be edited in the project tree.

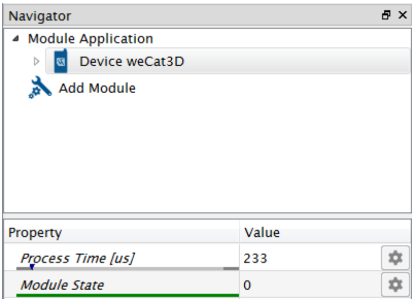
10.2.2 Closing the Project

The connection to the device is closed.

10.2.3 Modifiable Windows and Areas

The windows and areas listed below can be shown or hidden.

10.2.3.1 Project Tree, Settings/Results



The project tree lists all available modules. Further modules can be added via the tool list.

Settings and results for the selected module appear in the “properties” area. Furthermore, available functions are changed in the module toolbar according to the selected module.

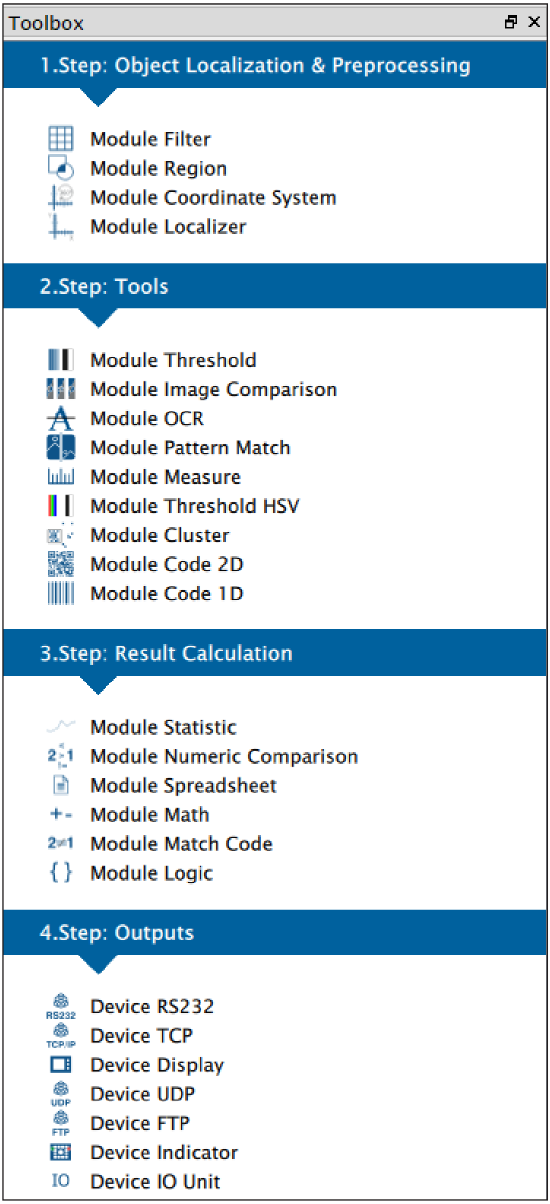
Various settings can be selected after right clicking a module. A module can be moved to the desired position within the project tree by clicking it and holding the mouse key depressed.

Copy node path to clipboard	Copying the node value to the clipboard can be helpful in making it easier to create your own LIMA commands.
Visible	The module can be made invisible for normal view and thus protected against any alteration of its settings.
Rename	The module’s name can be changed.
Delete	The selected module is deleted from the project tree.
Copy Module	Copies the module along with all of its settings.

Various settings can be selected after right clicking on the value of a module.

Copy node path to clipboard	Copying the node value to the clipboard can be helpful in making it easier to create your own LIMA commands.
Visible	The module can be made invisible for normal view and thus protected against any alteration of its settings.
Use value for color-coded feed-back	If a result is in error state, the relevant module is shown in red. The displaying of the module in red can be prevented by not using individual values for the color-coded feedback.

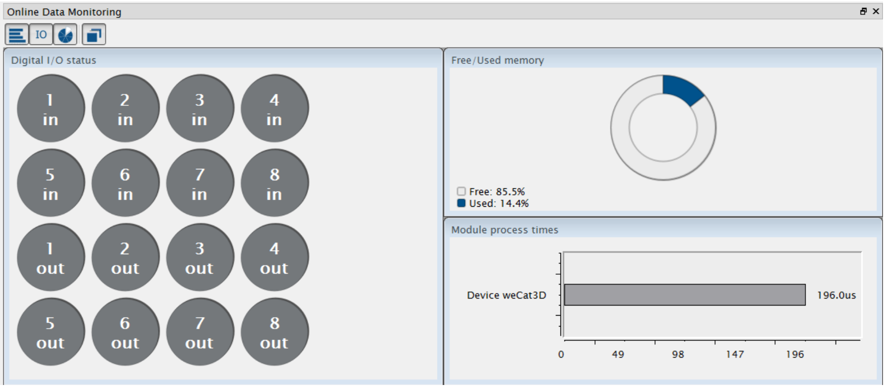
10.2.3.2 Toolox



Modules can be added to the navigator by double clicking, or by dragging and dropping them from the toolbox.

10.2.3.3 Online Data Monitoring

The process times, the status of the digital inputs and outputs and the memory usage are shown.



10.2.3.4 Network Tools

Various windows can be accessed from the “Network tools” menu.

Device List	Opens the device list.
Search Network	Opens “Search Network”.

10.2.3.5 Project Tools

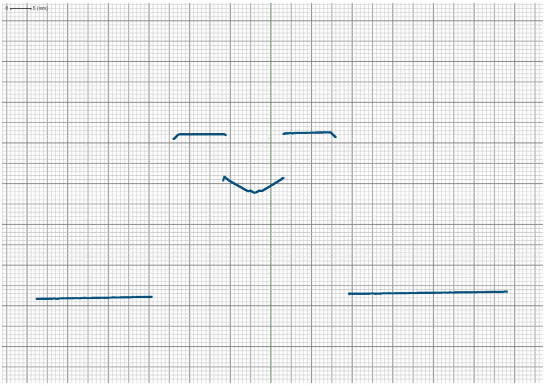
New Project	Opens a new project.
Open Template/ Example	Opens a template/example file.
Open File	Opens an existing project.
Save File	Saves a project file.
Teach+ Recording	Saves a project with all project settings and a certain number of recordings (images or point clouds). Via the Teach+ downloader, a Teach+ file recorded via the OLED display can be downloaded from the device.
Live Mode	The device's values are continuously displayed in the live mode. However, no changes can be made to the software settings in this mode. **NOTE!** The live mode should not be used during productive operation because the uniVision application is slowed down considerably due to cyclic data retrieval. This is especially problematic in time-critical applications or when constant time periods are required between triggering and read-out of results.
Edit Mode	The settings can be changed in edit mode. Current data is only retrieved from the sensor in the event that the module is replaced or the settings are changed.

10.2.3.6 Module Toolbar

There are specific functions for each module which are described in the sections for each respective module.

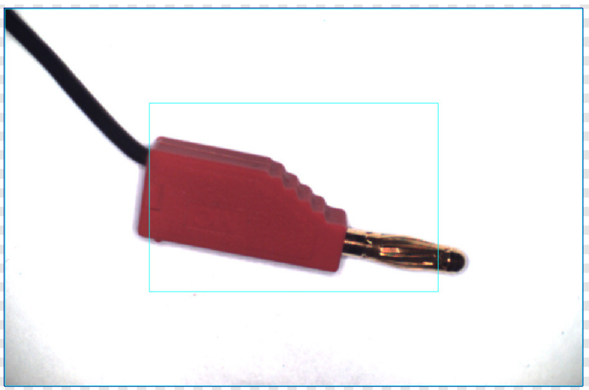
10.2.4 Camera Image or Measuring Range

10.2.4.1 Smart 2D/3D Profile Sensors And Control Units With 2D/3D Profile Sensors



The measuring range of the 2D/3D sensor is displayed, and the scale provides information concerning the dimensions. The point cloud transmitted by the sensor is visualized by means of blue points within the measuring range.

10.2.4.2 Smart Camera and Vision System

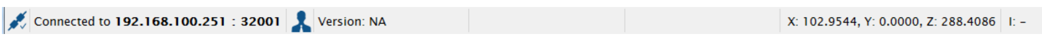


The camera image is displayed.

10.2.5 The Status Bar

The following Information is displayed in the status bar:

- Status and IP Address of the device
- Information on the logged in user
- Coordinates of the mouse position
- Intensity of measuring points or gray values of pixels

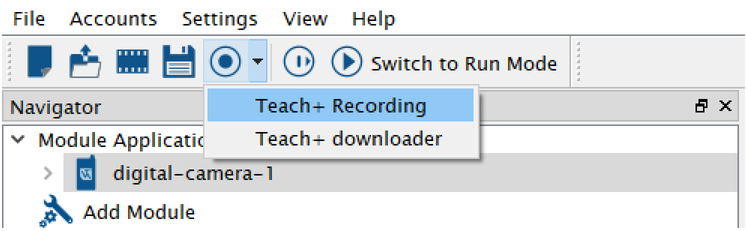


10.3 Teach+ Recording and Playback

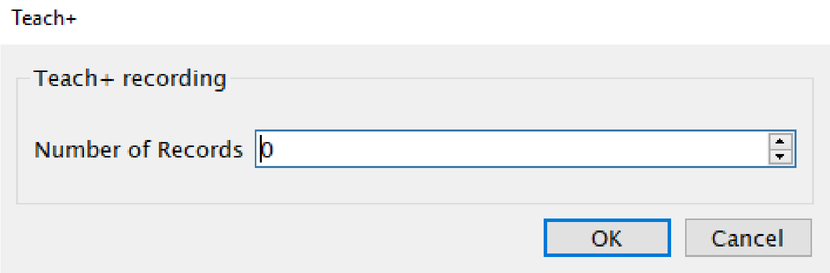
A Teach+ is a project file with a certain number of images (images or point clouds).

10.3.1 Procedure for Recording Teach+ Files

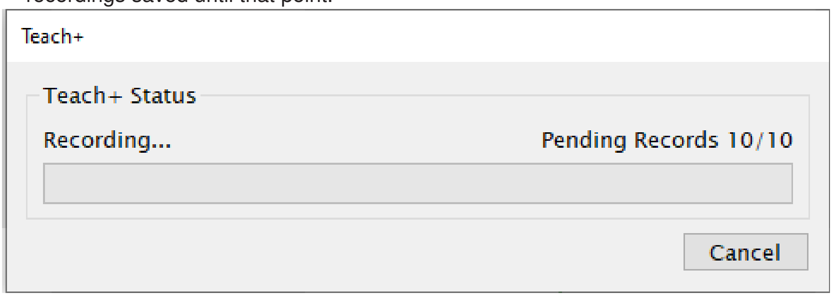
1. Start uniVision software.
2. Establish a connection with the device.
3. Click “Teach+ Recording”.



4. Enter the number of recordings to be saved in the Teach+ file.



5. Trigger the device until the set number of recordings is reached. A recording is created for each trigger signal. The progress of the recordings already saved is shown. Clicking on abort saves the Teach+ file with the recordings saved until that point.



6. On a Windows PC, the Teach+ file is saved in the project folder under C:\ProgramData\wenglor\uniVision\card\projects and on the control unit under /media/card/projects.

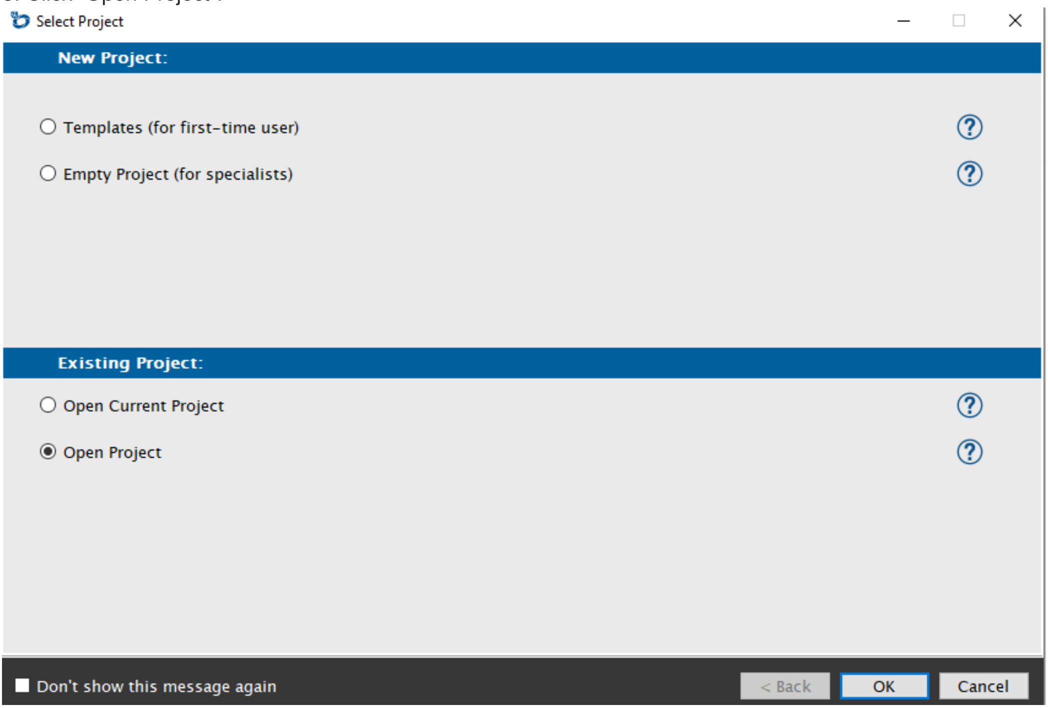
NOTE!
Recordings are generated in accordance with the selected trigger. Beyond this, manual triggering is possible via the F5 key for the weQube Smart Camera in the “Trigger” trigger mode and for the smart 2D/3D profile sensor and the uniVision application in the “Software” trigger mode.

10.3.2 Procedure for Offline Editing of Teach+ Files

1. Start uniVision software.
2. Click “Open” in the start screen.
3. Select the Teach+ file from the local project folder. On a Windows PC, the project file can be found under: C:\ProgramData\wenglor\uniVision\card\projects and on the control unit under /media/card/projects.
4. The Teach+ file can now be edited and saved **offline**.
5. The project can be closed via File -> Close Project.

10.3.3 Procedure for Transferring the Teach+ File to Devices

1. Start uniVision software.
2. Establish a connection with the device.
3. Click “Open Project”.



4. Select the Teach+ file.
5. The Teach+ file is uploaded to the device.

10.3.4 Downloading a Teach+ File from Device

If, for example, Teach+ recording is started via the OLED display, via the website or with a LIMA command, the file is then located in the “teach-plus” folder at the device. The file can be transferred to a PC via FTP connection (see section “20. FTP Server” on page 344).

The file can also be downloaded via uniVision software:
1. Start uniVision software.
2. Establish a connection to the device (Smart Camera, uniVision application).
3. Click “Teach+ downloader”.
4. The Teach+ file is stored in the project folder on the PC.

11. Application Module

11.1 Overview

Objective

Higher-level results are obtained for each evaluation which are not related to a specific module. These are listed in the application module.

Procedure

Values from the application level can be used in the project, for example the run counter.

11.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [µs]	Processing time for the entire project for the current execution. **NOTE!** With smart 2D/3D profile sensors and uniVision applications on the control unit, the process time includes the time from loading data to the uniVision application to outputting results via the interfaces. The process time displayed in uniVision therefore does not include data recording or, if necessary, network transfer times.
Module State	Error codes for troubleshooting support (see section "25.5 Module Status" on page 358).
Process Time, last run	Processing time for the entire project during the last evaluation
Module Status, last run	Module status for the last evaluation.
Run counter	With each run, the run counter increases by one. After a device start or a project change, the run counter starts at 0. **NOTE!** The minimum value of the run counter is 0 and the maximum value is 2147483647. After overrun, the counter starts again at 0.
Free memory [kB]	Available memory capacity is displayed.
Filename	The filename is displayed.
Project version	The project version is displayed.
Toggle bit	The toggle bit changes with each run. If the value is linked to an output, it can be determined whether or not new results are available. After a device start or project change, the toggle bit is set to inactive.
Author	An author can be entered for the project.
Info	Additional information about the project can be entered.

12. Software Modules for Data Recording

12.1 Module Device Camera (For Smart Camera weQube)

12.1.1 Overview

Objective Set up the camera for optimized preparation of image processing.

Procedure Various image recording settings can be changed in order to obtain the best possible camera image for subsequent image processing. For example focal point, exposure time and illumination can be adapted to the respective ambient conditions.

Furthermore, the camera area which is read out can be reduced in size. In this way, sensor processing time can be reduced and the refresh rate can be increased.

12.1.2 Setting Parameters

Image Area If connection to the sensor has been established, the live image is displayed in the image area.

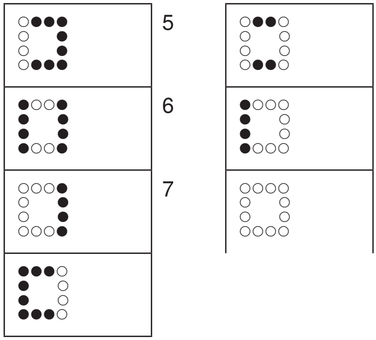
Property The following settings/results are displayed:

Process Time [μs]	Process Time for process steps in the camera device module.
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 358).
Capture Duration [μs]	Process Time for the exposure of the CMOS sensor and reading out the image chip.
Buffer Position	Number of images, which are currently in the input buffer.
Color Mode	Displays the sensor’s image chip variant (color or monochrome).
Light Internal	Internal illumination can be switched on and off. Integrated illumination is switched on by activating the checkbox.
Light External	The use of external illumination is advisable for certain applications. The output which activates external illumination is switched on by activating the checkbox. One of the outputs in the I/O module must be configured as output flash (see section “16.1.3.2 Digital I/Os 1 to 6 Submodule” on page 305).
Rotate Input Image	After activation, the input image is automatically rotated 180°.

Property

Exposure Time [μs]	Exposure time is the period of time during which the CMOS sensor receives light. Exposure time can be selected within a range of 17 μs to 30,000 μs. • Short exposure times are used for dynamic processes in order to avoid motion blur. • Long exposure times are used for static processes. **Note:** Long exposure times (>1000 μs) reduce the maximum possible illumination intensity that can flow through the LEDs. Reducing the illumination intensity serves as a safety mechanism and prevents overloading of the LEDs.
Gain	Gain is the factor by which CMOS sensor sensitivity is increased. Please note that image interference (snow), which is associated with the CMOS sensor, is amplified as well. Amplification should be kept as low as possible in order to avoid unnecessary diminishing of the quality of the image.
Focus Position [steps]	The focus position can be changed manually for the purpose of precision adjustment
Subsampling	In the case of subsampling, transmission of brightness information, and thus the resolution of the camera image, is greatly **reduced.** This reduces the required amount of storage space and **increases** the transmission speed (only available with monochrome image chip versions).
Auto Focus	An in-focus range can be selected within the field of vision. In the submodule automatic focus range, the size and position of the rectangle for the automatic focus can be changed. Then put a check mark next to automatic focus and the sensor focuses automatically.
Light Current [%]	The light current specifies the intensity of the utilized illumination. The LEDs brightness can be influenced by adjusting amperage. Various brightness levels are available. **Note:** The light current setting is limited by exposure time. As a safety mechanism, a limited light current value can be selected in the case of long exposure times.
Light Mode	There are two different illumination variants: Flash Light: Illumination is only activated at the moment at which image recording takes place. In flash mode, more brightness can be achieved and the service life of the illumination is increased. Continuous Light: Continuous illumination can be used if the flash is perceived as disturbing.

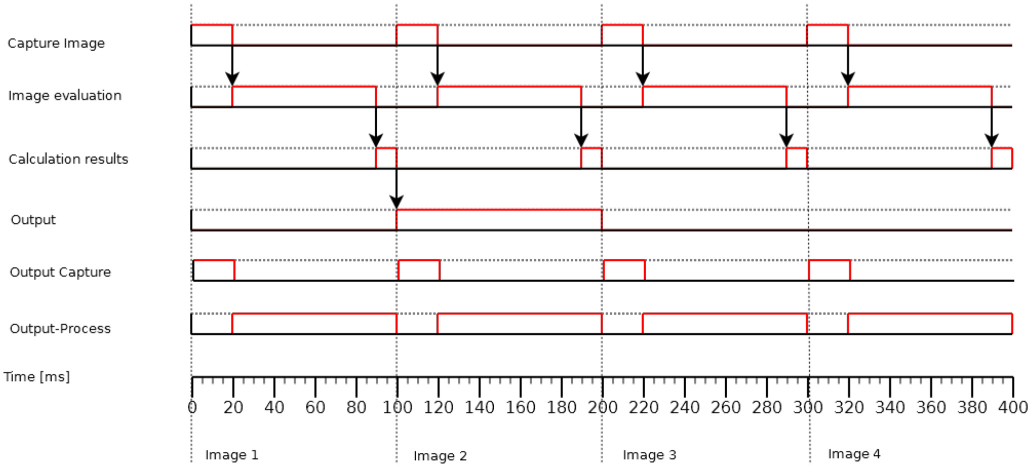
Property

Light Segments	If reflection or a shadows impairs the image, individual LEDs can be switched off. The following table shows the assignment of numbers to the **active (white point)** and **inactive (black point)** LEDs (front view facing the LEDs). 1 2 3 4 5 6 7 
Trigger Mode	Selection can be made between three trigger variants. Continuous: Images are recorded and evaluated continuously and as quickly as possible. As soon as the last image evaluation is complete, the next image recording starts. Trigger: Trigger pulses are generated by the application with the help of a trigger input. One input has to be set up as a trigger input in the I/O module (see section “16.1.3.2 Digital I/Os 1 to 6 Submodule” on page 305). An image can be recorded manually by pressing the “F5” key. Image recording and evaluation take place independently of each other here. **Stop**: Only one trigger pulse is processed, after which all following trigger pulses are ignored.
Blue Gain	The image’s blue content is changed by means of automatic white balancing of the color camera. This changed value can also be adjusted manually.
Red Gain	The image’s red content is changed by means of automatic white balancing of the color camera. This changed value can also be adjusted manually.

Trigger continuous:

Sequence in Live Mode

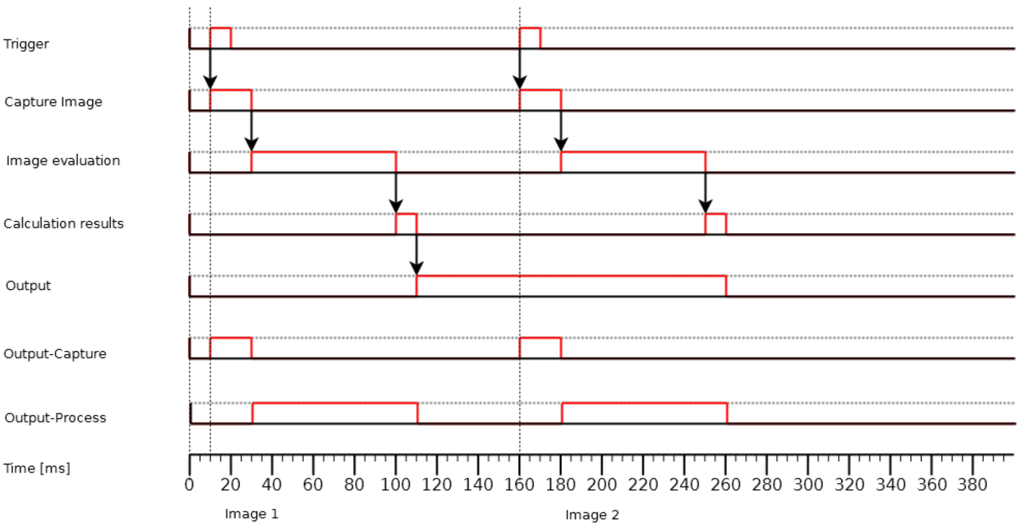
Trigger Delay = 0
Output Hold Time = 0
Event 1 Delay = 0



Trigger:

Sequence in Trigger mode

Trigger Delay = 0
Output Holde Time = 0
Event 1 Delay = 0



12.1.3 Configuration

The camera device module includes the following configuration options:

- Read-out Area
- White balancing

12.1.3.1 Submodule Read-out Area

Objective	The camera range which should actually be read out can be selected. Using a smaller read-out range **reduces** the transmission time and **increases** the image refresh rate.

NOTE!
The area to be examined must be lie **completely** within the read-out range.

Image area	As a default feature, the read-out area encompasses the entire camera image. It appears in the image area as a dashed frame, where it can be adjusted.

12.1.3.2 Submodule White Balance

Activating white balancing

Procedure	The view is changed to the module's input image when the "White Balancing" tool is activated. Clicking the place in the image which should be defined as "white" in the application ascertains coordinates and forwards them to the algorithm. The algorithm calculates the new values for the image's red and blue value. The image is then redisplayed with the changed values.

NOTE!
The white balancing function is only available with color versions of the weQube.

12.2 Module Device weCat3D and smart-wecat3d

12.2.1 Overview

Objective

Adjust the 2D/3D profile sensor to create an easily evaluable height profile.

Abbreviated procedure

Adjust the settings of the 2D/3D sensor such that a stable point cloud is displayed within the measuring range.

NOTE!

- Detailed information concerning the settings for the 2D/3D profile sensors can be found in the operating instructions and in the GigE Vision interface description for the respective sensors.
- Details about the maximum number of devices per control unit and about the maximum performance of the control unit can be found in section “4.3 uniVision for Smart 2D/3D Profile Sensors” on page 28.
- Not all available parameters are supported in the uniVision use case. If parameters are not supported by uniVision, this will be mentioned for the respective parameter.
- Only chunk data (see section “12.2.3.11 Chunk Data” on page 147) is consistent with the profile data and can be used in further evaluations. No other results in the wecat3d or smart-wecat3d device (e.g. I/O status) are regularly updated. These should therefore not be used in further evaluations.
- Sensor parameters may only be set in the uniVision software (and not additionally on the website, for example) so that they can be saved in the uniVision project.

Supplement: Synchronization of several 2D/3D sensors

Synchronization of several 2D/3D sensors is necessary when the laser line of one sensor lies within the scanning range of at least one other sensor.

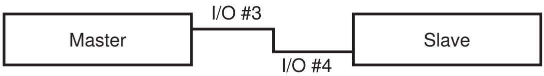
NOTE!

A 2D/3D sensor with red laser light and a 2D/3D sensor with blue laser light do not influence each other.

Abbreviated procedure

Procedure for synchronizing two 2D/3D sensors:
Wire the two 2D/3D sensors to each other so that one of the pins of the first sensor (master) is connected to one of the pins of the second sensor (slave).

Example: I/O #3 at the master is connected to I/O #4 at the slave.



Configure one I/O pin at the master as an output with time delay. Delay should be at least as long as the master's exposure time. The output signal may not be any longer than the slave sensor's exposure time.

Example for the master:
- Exposure time: 200 µs
- Line Selector: I/O #3
  - Line mode: Output
  - Line source: Timer 1 active
- Timer selection: Timer 1
  - Timer duration: 100 µs
  - Timer delay: 200 µs

NOTE!
The master sensor can be triggered as desired.

Configure one of the slave's Line pins as an input.

Example for the slave:
- Exposure time: 200 μs
- Trigger selection: Line start
  - Trigger mode: On
  - Trigger source: I/O 4
  - Trigger activation: Rising edge

NOTE!
If the master is triggered internally, trigger delay at the master must be at least as long as the slave sensor's exposure time.

12.2.2 Setting Parameters

Image area If the sensor is connected, the transmitted point cloud id displayed.

Property The following settings/results are displayed:

Process Time [us]	Process Time for process steps in the current module.
Module State	Error codes provide support for troubleshooting.
Device Name	The name of the current device is displayed. Furthermore, any other available 2D/3D profile sensor can be selected for the uniVision application when using a control unit with 2D/3D profile sensors. **NOTE!** On control units with 2D/3D profile sensors, each 2D/3D profile sensor can only be used in one uniVision application at the same time! If an already used device is selected, this is indicated by the module status with an error code. Details can be found in section “5.4.6 Connection Between the Project and Recording Device on the Control Unit” on page 51.
Error Handling	In the event of an error, the default setting is value replacement. Thus, in the event of an error, the value is replaced with the value defined under Error Handling.

12.2.3 Configuration

The weCat3D device module and smart-wecat3d module include the following configuration options:
- Error Handling
- Image format
- Acquisition
- Transport layer
- Digital I/O
- Counter and timer
- Encoder
- Signal
- 3D Scan
- Device
- Chunk Data

12.2.3.1 Error Handling

Set a replacement value to be used when a linked value is in error state.
If, for example, an output value is linked to a test result in the case of digital outputs, the digital output assumes the replacement value in the error state of the test result.

12.2.3.2 Image Format

Objective

The image chip's read-out range can be restricted. With a smaller read-out range, the recording frequency of the 2D/3D profile sensors can also be increased if necessary.

NOTE!
- Alignment of the image chip of 2D/3D profile sensors depends on device type.
- Details concerning the relationships between recording frequency and read-out range can be found in the operating instructions for the 2D/3D profile sensors.

Property

The following settings/results are displayed:

Component ID Value	ID of the data stream defined in "Component Selection".
Sensor width	Width of the integrated image chip in pixels
Sensor height	Height of the integrated image chip in pixels
Scan 3D Sort X	By default, the measuring points are output according to the reading in the x-direction of the image chip. If sorting in the x-direction is activated, the measuring points are sorted in ascending order according to the x-values of the actual measuring points.

Property			
Region selector	The following regions are available.		
	Region0	The image chip's read-out range can be restricted via Region0.	
		Width	The width of the image chip which will be read out can be set. The value is specified in pixels.
		Height	The height of the image chip which will be read out can be set. The value is specified in pixels.
		Offset X	Defines the first pixel for the width of the image chip, as of which read-out starts.
		Offset Y	Defines the first pixel for the height of the image chip, as of which read-out starts. **NOTE!** The y axis of the image chip is equivalent to the z axis of the height profile.
	Scan3D Selection0	The read-out range is displayed in the X-Y plane via Scan3D Selection0.	
		Width	Defines the width of the output image which is equal to the width of the camera chip (read only).
		Height	Defines the number of profiles to be read out together. The value is set to 1 by default so that each profile in the uniVision application is evaluated separately. A value greater than 1 is currently not supported in uniVision.
		Offset X	Not used in Scan3D Selection0 (read only).
		Offset Y	Not used in Scan3D Selection0 (read only).
Component Selector	For the "Intensity" and "Range" components, the display will indicate whether the component is used and which pixel format is set. • The intensity must always be activated in uniVision, and the pixel format "Mono10Packed" is recommended for performance reasons. • The range must always be activated in uniVision, and the pixel format "Coord3D_ABC32f" is recommended for performance reasons. **NOTE!** The pixel format "Mono 16" is not recommended for performance reasons. It also does not support a reduced read-out range.		

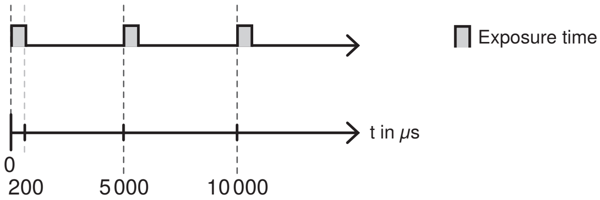
12.2.3.3 Recording

Objective

The following standard trigger modes are available.

1. Continuous with fixed Acquisition Line Rate:
The sensor acquires a specified number of lines per second without external triggering.

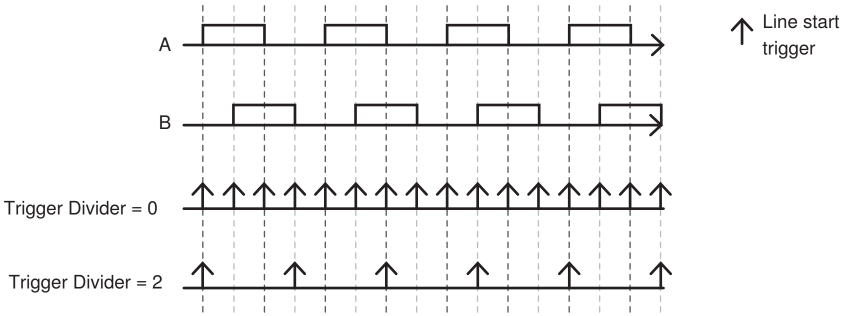
Sample settings:
- Acquisition mode: Continuous
- Acquisition Line Rate: 200 Hz
- Exposure time: 150 μs
- Trigger Selector: Line start
  - Trigger mode: Off



2. Continuous with encoder:
Recording is triggered by an encoder so that a line is acquired for all x encoder steps.

Sample settings with an HTL encoder:
- Acquisition mode: Continuous
- Trigger selector: Line start
  - Trigger mode: On
  - Trigger source: Encoder 1 (HTL)
- Encoder selection: Encoder 1
  - Encoder source A: I/O 1
  - Encoder source B: I/O 2
  - Encoder output mode: Motion

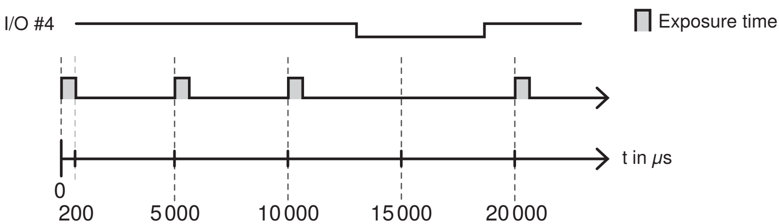
Objective



3. Continuous with active recording:
Continuous operation (with fixed recording line rate or encoder triggering) can be used with an acquisition active signal. As long as the signal is applied to one of the sensor's pins, lines are acquired.

Example:

- Acquisition mode: Continuous
- Acquisition Line Rate: 200 Hz
- Exposure time: 150 μs
- Trigger selector: Line start
  – Trigger mode: Off
- Trigger selector: Acquisition active
  – Trigger mode: On
  – Trigger source I/O 3
  – Trigger activation: Level High



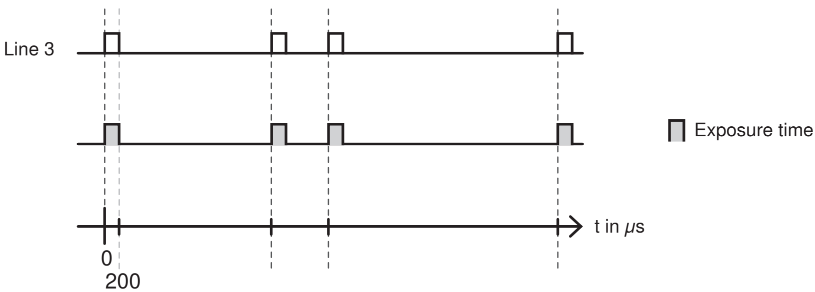
Objective

NOTE!
The acquisition active signal can also be transmitted to the associated application by means of a LIMA command. The start signal for activation starts the line recording and the stop signal ends the line recording. Further information can be found in the interface protocol.

The recording frequency cycle is maintained even if recording is stopped. This means that after the recording active signal, the next profile is not recorded until the cycle of the set recording frequency has been completed.

4. Continuous with trigger:
The trigger command can be transferred to the relevant application via one of the sensor's I/O pins, as well as via software by means of a LIMA command.

Example with triggering via an I/O pin at the sensor:
- Acquisition mode: Continuous
- Exposure time: 200 μs
- Trigger selector: Line start
  - Trigger mode: On
  - Trigger source: I/O 3
  - Trigger activation: Rising edge



In order to control recording at the associated application by means of a LIMA command, the trigger source must be set to software. Further information can be found in the interface protocol.

NOTE!
In the case of time-critical applications and strict timing requirements for triggering, the trigger signal must be used via digital input directly at the sensor.

Property

The following settings/results are displayed:

<table>
<tr><td rowspan="2">Acquisition Mode</td><td>Continuous</td><td>After the acquisition active command, each trigger signal results in recording until a an acquisition stop command is issued.</td></tr>
<tr><td>Single Frame</td><td>During single recording, only one trigger signal causes data recording after the start command has been recorded. Further trigger signals are ignored until a command to start recording is sent to the uniVision application again.</td></tr>
<tr><td>Acquisition Line Rate</td><td colspan="2">Number of lines per second (only used if “Line Start Trigger” is set to trigger mode “OFF”).

NOTE!
The maximum acquisition frequency depends on the read-out range of the 2D/3D profile sensor, network bandwidth, the number of devices per control unit and the evaluation program of the respective uniVision application. Details can be found in section “4.3 uniVision for Smart 2D/3D Profile Sensors” on page 28.</td></tr>
<tr><td>Resulting Acquisition Line Rate</td><td colspan="2">Displays the actual recording frequency.</td></tr>
<tr><td>Exposure Time</td><td colspan="2">Exposure time in μs</td></tr>
<tr><td rowspan="5">Trigger Selector</td><td colspan="2">The following trigger options are available:</td></tr>
<tr><td>Line start</td><td>A profile acquisition is started with the line start trigger.</td></tr>
<tr><td>Frame Start</td><td>A recording with several profiles can be started with the frame start trigger. The frame start trigger is currently not supported in uniVision.</td></tr>
<tr><td>Acquisition active</td><td>If the acquisition trigger is active, the 2D/3D profile sensor is ready to receive trigger signals that result in profile acquisition. If the acquisition trigger is not active, all trigger signals are ignored and no profile acquisition takes place.</td></tr>
<tr><td colspan="2">The corresponding parameters (trigger mode, trigger source and trigger activation) are displayed depending on the selected trigger. The different triggers can be combined with each other.</td></tr>
</table>

<table>
<tr><th>Property</th><th colspan="2"></th></tr>
<tr><td rowspan="3">Trigger Mode</td><td colspan="2">The selected trigger can be switched on or off.</td></tr>
<tr><td>On</td><td>The selected trigger is activated.</td></tr>
<tr><td>Off</td><td>The selected trigger is deactivated.

NOTE!
If the trigger mode is set to OFF for the line start trigger, height profiles are recorded with the set recording frequency.</td></tr>
<tr><td rowspan="5">Trigger Source</td><td colspan="2">Select the trigger source:</td></tr>
<tr><td>Line 1...4</td><td>Use an I/O pin at the sensor for triggering.</td></tr>
<tr><td>Encoder 1</td><td>Use the HTL encoder input at the sensor for triggering.

NOTE!
Encoder triggering is only possible with the line start trigger.</td></tr>
<tr><td>Encoder 2</td><td>Use the TTL encoder input at the sensor for triggering.

NOTE!
Encoder triggering is only possible with the line start trigger.</td></tr>
<tr><td>Software</td><td>Cause triggering at the associated application by means of LIMA commands.

NOTE!
In the case of time-critical applications, the trigger signal must be transmitted directly to the sensor’s digital input.</td></tr>
<tr><td rowspan="6">Trigger Activation</td><td colspan="2">The following options are available for line start triggers via digital inputs:</td></tr>
<tr><td>Rising edge</td><td>Only the rising edge results in triggering.</td></tr>
<tr><td>Falling edge</td><td>Only the falling edge results in triggering.</td></tr>
<tr><td colspan="2">The following options are available with the acquisition active signal:</td></tr>
<tr><td>Level high</td><td>If the level at the I/O pin is high, acquisition is active.</td></tr>
<tr><td>Level low</td><td>If the level at the I/O pin is low, acquisition is active.</td></tr>
<tr><td>Trigger Delay</td><td colspan="2">Delay time in μs until the trigger signal of the respective trigger selector leads to triggering.</td></tr>
</table>

Property

Trigger Divider	Number of transmitted trigger pulses. In the case of 0, no trigger pulses are transmitted and in the case of two, every third trigger pulse results in line start triggering. Only available for the line start trigger for trigger sources of encoder and I/O 1-4.

12.2.3.4 Transport Layer

Objective User data size is displayed.

The following settings/results are displayed:

Property

Payload size	Value in bytes that determines how much data per profile is transferred.

12.2.3.5 Digital I/O

Objective Configure the digital I/Os at the sensor.

Property The following settings/results are displayed:

Line Selector	Select the Line pin at the sensor. **NOTE!** When an I/O pin at the sensor is selected, the associated parameters are displayed.
Line Mode	The Line pin can be configured as an input or an output.
Line Inverter	Digital inputs can be run normally (default setting) or inverted.
Line Status	Displays the status of the input or output.
Line Source	Only available when output is selected: • User output • Timer 1 active
User Output Value	With user-defined output, a result from the uniVision project can be linked to the digital output.
Output Function	Selection between Push Pull, PNP and NPN
Input Load	The 2 mA internal load can be activated or deactivated at the input. An internal resistor is connected to the input (pull-down).

12.2.3.6 Counter and Timer

Objective Set time delay at the sensor's digital I/Os.

Property The following settings/results are displayed:

Timer Selector	Select the timer.
Timer trigger Selector	Defines which event the timer should start with (incl. line start trigger).
Timer duration	Duration of the timer signal in μs
Timer delay	Timer signal delay in μs

12.2.3.7 Encoder

Objective Configure the encoder input at the sensor.

Property The following settings/results are displayed:

Encoder Selector	**Encoder 1**	HTL encoder at the sensor
	Encoder 2	TTL encoder at the sensor
Encoder source A	Specify the I/O pin at the sensor for the HTL encoder's first signal.	
Encoder source B	Specify the I/O pin at the sensor for the HTL encoder's second signal.	
Encoder output mode	Select the encoder output mode:	
	Position high	The sensor is only triggered when the encoder value is higher than before.
	Position low	The sensor is only triggered when the encoder value is lower than before.
	Direction up	Any increase in the encoder value triggers the sensor.
	Direction down	Any decrease in the encoder value triggers the sensor.
	Motion	Any change to the encoder value triggers the sensor.
Encoder reset source	The encoder value can be reset via one of the sensor's I/O pins.	
Encoder reset activation	Only when encoder reset source is selected:	
	Rising edge	The rising edge causes resetting of the encoder value.
	Falling edge	The falling edge causes resetting of the encoder value.
	Any edge	Any edge causes resetting of the encoder value.
Encoder Value	Shows the current encoder value	

12.2.3.8 Signal

Objective Carry out the signal settings on the sensor.

Property The following settings/results are displayed:

Signal activated	The 2D/3D profile sensor can read out a maximum of two y-values (measurement points) on the image chip for every x-value on the image chip. Signal activated defines whether the first, the second or both signals are read out. This setting is useful for semitransparent materials so that both the semi-transparent material and the object below it are detected. **NOTE!** If the first and second signal are active, both measurement points, where present, are transferred within the height profile immediately one after the other. If specific algorithms require a maximum of one signal to be read out, this is mentioned explicitly for the relevant algorithms in the manual. If an algorithm like this is used, either the first or the second signal must be evaluated (not both).
Signal selection	The signal top, bottom, the strongest signal or the signal with the highest signal width can be selected.
Signal width min	Minimum signal width
Signal width max	Maximum signal width
Signal strength min	Minimum signal strength

12.2.3.9 3D Scan

Objective Display the values for the coordinates.

Property The following settings/results are displayed:

<table>
<tr><td rowspan="5">Scan 3d coordinate selector</td><td colspan="2">The following settings/results are displayed:</td></tr>
<tr><td>CoordinateA</td><td>Corresponds to the X-value.</td></tr>
<tr><td>CoordinateB</td><td>Corresponds to the Y-value.</td></tr>
<tr><td>CoordinateC</td><td>Corresponds to the Z-value.</td></tr>
<tr><td colspan="2">Corresponding results appear depending on the selection.</td></tr>
<tr><td>Scan 3d coordinate scale</td><td colspan="2">Factor for converting a pixel or an encoder value to millimeters.</td></tr>
<tr><td>Scan 3d coordinate offset</td><td colspan="2">Coordinate offset of the selected coordinate</td></tr>
<tr><td>3D Scan, Coordinate Source</td><td colspan="2">Only available for coordinate B. Defines if the encoder value or time stamp should be used for the y-value. The value is currently not supported in uniVision.</td></tr>
<tr><td>Scan 3d, invalid data flag</td><td colspan="2">Flagging of invalid data is always active for CoordinateC in uniVision.</td></tr>
<tr><td>Scan 3d, invalid data value</td><td colspan="2">The value that identifies invalid data when the invalid data flag is enabled. The value is read-only and amounts to 0.</td></tr>
<tr><td>Scan 3d axis min.</td><td colspan="2">Smallest value of the selected coordinate</td></tr>
<tr><td>Scan 3d axis max.</td><td colspan="2">Largest value of the selected coordinate</td></tr>
<tr><td>3D Scan, Distance Unit</td><td colspan="2">The values are given in mm.</td></tr>
<tr><td>3D Scan, Coordinate System</td><td colspan="2">The Cartesian coordinate system is used.</td></tr>
</table>

12.2.3.10 Device Information

Objective Display the sensor information.

Property The following settings/results are displayed:

Device type	Device type (fixed)
Device Recording Type	Device recording type (fixed)
Device Model Name	Article Number (fixed)
Device Vendor Name	Manufacturer (fixed)
Device Version	Version (fixed)
Device Firmware Version	Firmware Version (fixed)
Device Serial Number	Serial Number (fixed)
Device type TL	Device type GigE Vision
ASCII Command	An ASCII command can be sent to the sensor. ASCII commands are currently not supported by uniVision.
Device Temperature Selector	The CPU device temperature is displayed.

12.2.3.11 Chunk Data

Objective In addition to the height profile, other data can be transferred as chunk data together with the profile. The data can be used in further evaluations as it is updated with each profile.

Property The following settings/results are displayed:

<table>
<tr><td>Chunk Data Selector</td><td>Shows the value currently selected under Data Selector.</td></tr>
<tr><td>Chunk selector</td><td>Different results are available as Chunk Data:

Chunk Picture Counter: Profile number
(Value Range: 0 – 65535)
Chunk Timestamp: Time when the profile was captured in μs
(Value Range: 0 – 4294967295)

Note on exposure counter and timestamp:
When the maximum value is reached, the counter or time stamp starts again at 0.

Chunk Device Temperature: Temperature in °C within the housing
Chunk Line Status All: Status of IO pins at device weCat3D
Bit 0: IO 1
Bit 1: IO 2
Bit 2: IO 3
Bit 3: IO 4
Chunk Encoder Value: Current encoder position
Chunk Scanner Status: Information about current device status
Bit 0: 2D/3D sensor OK
Bit 1: Exposure Time OK
Bit 2: Laser On Time OK
Bit 3: Not used
Bit 4: Not used
Bit 5: Scanning frequency too fast
Bit 6: Not used
Bit 7: Not used

Notes to Line Status All and Scanner Status:

The decimal value (e.g. 95 for Scanner Status) has to be transferred in a binary number (e.g. 1011111).
Last digit represents Bit 0, the next to last represents Bit 1 and so on
For the example with Scanner Status 95 the 2D/3D sensor, the exposure time and the Laser On Time are ok and the scanning frequency is not too fast.
</td></tr>
<tr><td>Chunk Enable</td><td>The selected chunk data can be enabled or disabled.</td></tr>
</table>

12.3 Machine Vision Camera Module for BB6K

12.3.1 Overview

Objective

Set up the Machine Vision Camera to record best possible images for subsequent image processing.

NOTE!

- Details about the maximum number of devices per control unit and about the maximum performance of the control unit can be found in section “4.2 uniVision for Vision Systems” on page 23.
- Not all available parameters and categories are supported in the uniVision use case. If parameters or categories are not supported by uniVision, this will be mentioned for the respective parameter.
- Only chunk data (see section “12.2.3.11 Chunk Data” on page 147) is consistent with image data and can be used in further evaluations. No other results in the Machine Vision Camera device (e.g. I/O status) are updated regularly. These should therefore not be used in further evaluations.
- Different functions are supported depending on the camera model. Binning, for example, is only supported by special camera models.

Abbreviated procedure

1. Adjust image brightness by setting the aperture on the C mount lens, and exposure time.
2. Adjust focus at the lens so that a sharp image is recorded.
3. Set triggering.
4. To avoid overloading the network, it is advisable to activate the bandwidth limitation on the Machine Vision Cameras for multi-camera applications (under Device control → Device Link Throughput Limit).

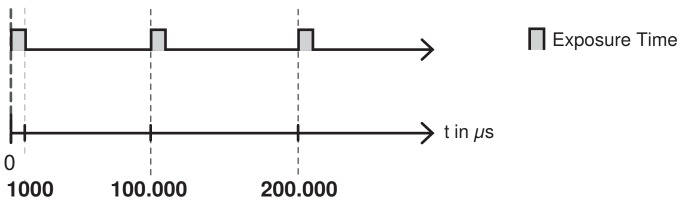
The following standard trigger modes are available.

1. Fixed recording frequency:

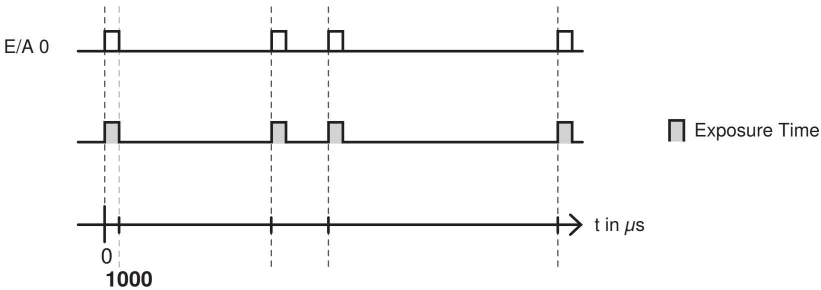
The Machine Vision Camera records a specified number of images per second without external triggering.

Abbreviated procedure

Sample settings:
- Acquisition mode: Continuous
- Exposure time: 1000 µs
- Target Recording Frequency Enabled: ON
- Target Recording Frequency: 10 Hz
- Trigger selector: Exposure start
  - Trigger mode: Off



2. Hardware trigger
The trigger command is issued via the digital trigger input at the Machine Vision Camera.
Sample settings:
- Acquisition mode: Continuous
- Exposure time: 1000 μs
- Trigger selector: Exposure start
  - Trigger mode: On
  - Trigger source: Line 0
  - Trigger activation: rising edge



3. Software trigger via LIMA command:
The trigger command is issued to the associated uniVision application via software uniVision using a LIMA command (see details in the interface protocol). A software trigger command can also be generated with the software by pressing the F5 key.

Sample settings:
- Acquisition mode: Continuous
- Exposure time: 1000 μs
- Trigger selector: Exposure start
  - Trigger mode: On
  - Trigger source: software

4. Fixed recording frequency with activation signal
As long as the signal is applied to one of the pins at the Machine Vision Camera, images are acquired at a given acquisition frequency.

Sample settings:
- Acquisition mode: Continuous
- Exposure time: 1000 μs
- Trigger selector: Exposure start
  - Trigger mode: On
  - Trigger source: PWM 0
  - Trigger activation: rising edge
- PWM frequency: PWM 0
  - PWM trigger source: Line 0
  - PWM frequency: 15 Hz
  - PWM trigger activation: high level
  - PWM duty cycle: 50 %

Property	Value
PWM Selector	PWM 0
PWM Trigger Source	Line 0
PWM Frequency	15.0000
PWM Trigger Activation	Level High
PWMDutyCycle	50

12.3.2 Setting Parameters

Image area If a connection has been established, the image from the Machine Vision Camera is displayed.

Property The following settings/results are displayed:

Process time [μs]	Processing time for process steps in the current module
Module state	Error codes provide support for troubleshooting.
Device name	The name of the current device is displayed. Furthermore, any other available Machine Vision Camera can be selected for the uniVision application. **NOTE!** Each Machine Vision Camera can only be used in one uniVision application at any given time! If an already used device is selected, this is indicated by the module status with an error code. Details can be found in section “5.4.6 Connection Between the Project and Recording Device on the Control Unit” on page 51.
Error Handling	In the event of an error, the default setting is value replacement. Thus, in the event of an error, the value is replaced with the value defined under Error Handling.
Creating HSV, RGB or BGRA image	On Machine Vision Cameras with a color image chip, other images (e.g. RGB or BGRA image) can also be calculated in addition to the HSV image (standard for uniVision). **NOTE!** The Machine Vision Camera transmits the image in the pixel format “BayerRG8”. The HSV image, and other images depending on the setting, are calculated on the control unit.

12.3.3 Configuration

The Machine Vision Camera module includes the following configuration options:
- Error handling
- Acquisition control
- Device control
- Analog control
- Counter and timer control
- LUT Controller
- Test control
- Transfer control
- GigE Vision
- Brightness auto control
- PWM control
- Image correction control
- User set control
- Image format control
- Subregion control
- Digital IO control
- Chunk data control
- Transport layer control
- Flash control
- Sequence control
- Optics control
- PTP control
- File access control

12.3.3.1 Error handling

Set a replacement value to be used when a linked value is in error state. If, for example, a user output value is linked to a test result, the replacement value is used on the device in the event of an error in the linked value.

12.3.3.2 Acquisition Control

Objective Specify the trigger mode.

NOTE!
- The “Acquisition Start” trigger is used to define that the device is ready to receive trigger signals for the exposure.
- With the “Exposure Start” trigger, a specific image recording can be triggered.
- All triggers can be combined with each other.

Property

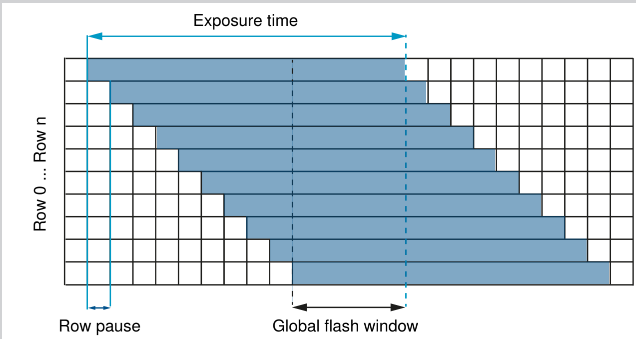
Acquisition mode	The following settings/results are displayed: Specify the acquisition mode. The “Continuous” acquisition mode is used by uniVision as a default setting. There is no need to switch to a different acquisition mode for standard applications. **NOTE!** After loading a project, the uniVision application sends an acquisition start command to the Machine Vision Camera as standard so that the camera is ready to receive triggers to start the exposure.	
	Single Frame	Following a command to start the recording via the “Acquisition Start” trigger, an image is only recorded with the first command to start the exposure via the “Exposure Start” trigger. Further triggers for “Exposure Start” are ignored until a new command to start the acquisition is issued via the “Acquisition Start” trigger.
	Multi frame	Following a command to start the acquisition via the “Acquisition Start” trigger, an image is recorded with each of the next x commands to start the exposure via the “Exposure Start” trigger. The number of images can be set via the “Acquisition Frame Count” value. Further triggers for “Exposure Start” are ignored until a new command to start the acquisition is issued via the “Acquisition Start” trigger.
	Continuous	Each trigger signal to start the exposure results in an image recording. **NOTE!** After loading a project, the uniVision application sends an acquisition start command to the Machine Vision Camera as standard so that the camera is ready to receive triggers to start the exposure.

Property

Acquisition Frame Count	The number of images to be recorded via the “Exposure Start” trigger is only defined for the “Multi Frame” Acquisition mode. Further trigger signals via the “Exposure Start” trigger are ignored until a new command is issued to start acquisition.
Exposure Auto	Automatic exposure can be set as follows for the Machine Vision Camera. Off: Automatic exposure is disabled as a default setting. Exposure time can be set manually to a fixed value via exposure time. Once: Best possible exposure time is automatically determined during the next image recording and is used for all subsequent recordings. Continuous: Exposure time is automatically determined for each image recording in order to compensate for fluctuating ambient conditions. **NOTE!** It is advisable not to use single and continuous automatic exposure when using external illumination. Further values for single or continuous automatic exposure can be set under brightness auto control.
Sensor shutter mode	The Machine Vision Camera’s shutter mode is displayed. **NOTE!** With global shutter cameras, all pixels are exposed at the same time. Rolling shutter cameras expose the lines one after the other. Details on shutter variants can be found in section “7.4.3 Connection Overview for Trigger, Machine Vision Camera and Illumination in Flash Mode” on page 73.
Exposure mode	The exposure mode is displayed depending on which trigger mode is selected for Exposure Start and Exposure End: • Time-based: The exposure time or the automatic exposure time setting defines the value for the exposure time. The image recording starts with the trigger “Exposure Start” • Trigger-based: If a trigger is used to start and end the exposure, Trigger-based appears as the exposure mode.

Trigger controlled exposure time min	A minimum exposure time can be set for the trigger-based exposure mode. If the trigger for “Exposure End” takes place too early, the exposure is ended after “Trigger-controlled minimum exposure time”.
Trigger controlled exposure time max	A maximum exposure time can be set for the trigger-based exposure mode. If the trigger for “Exposure End” takes place too late, the exposure is ended after “Trigger-controlled maximum exposure time”.

Property

Trigger controlled exposure time min	A minimum exposure time can be set for the trigger-based exposure mode. If the trigger for “Exposure End” takes place too early, the exposure is ended after “Trigger-controlled minimum exposure time”.
Trigger controlled exposure time max	A maximum exposure time can be set for the trigger-based exposure mode. If the trigger for “Exposure End” takes place too late, the exposure is ended after “Trigger-controlled maximum exposure time”.
Exposure time	Exposure time can be set manually. **NOTE!** • Exposure time should be as short as possible for dynamic applications with global shutters in order to avoid blurring due to motion. • For dynamic applications with rolling shutter cameras, a minimum exposure time of 93 ms must be selected for 12 MP cameras (BB6K005 and BB6K006) to use the global exposure window. This will create the global exposure window in the first place. The global exposure window will then be a few ms (for example 1 ms). It is also necessary to enclose the application to block out ambient light. 

Acquisition Frame Rate Target Enable	If this value is enabled, an attempt is made to apply the recording frequency set under “Acquisition Frame Rate Target” for the “Start Exposure” trigger with trigger mode to OFF. The value is activated by default so that the “Acquisition Frame Rate Target” is retained when changing trigger mode.
Acquisition Frame Rate Target	If “Acquisition Frame Rate Target Enable” is set to ON, the recording frequency set under “Acquisition Frame Rate Target” is applied.

<table>
<tr><th>Property</th><th></th></tr>
<tr><td>Acquisition frame rate</td><td>Number of recordings per second.

NOTE!
Acquisition frequency is used when the trigger mode for the “Exposure Start” trigger is set to “Off”.
If Target Recording Frequency Enabled is set to ON, the actual recording frequency is displayed.
If Target Recording Frequency Enabled is set to OFF, the recording frequency can be set using the "Recording Frequency" parameter.
The Acquisition Frame Rate has to be selected that the network load and the cpu load of the control unit is within the allowed values. For details see section “4.2 uniVision for Vision Systems” on page 23.</td></tr>
<tr><td>Trigger selector</td><td>The following trigger modes can be selected:

NOTE!
The “Acquisition Start” or “Acquisition End” trigger is used to define that the device is ready to receive trigger signals for the exposure.
With the “Exposure Start” or “Exposure End” trigger, a concrete image recording can be triggered.
All triggers can be combined with each other.
Rolling shutter cameras do not support the “End Exposure” trigger.
<table>
<tr><td>Acquisition Start</td><td>Defines whether or not and how an acquisition start signal is transmitted to the Machine Vision Camera.</td></tr>
<tr><td>Acquisition End</td><td>Defines whether or not and how an acquisition end signal is transmitted to the Machine Vision Camera.</td></tr>
<tr><td>Exposure start</td><td>Defines when the Machine Vision Camera starts exposure.

NOTE!
The “Exposure start” trigger is deactivated as a default setting so that the Machine Vision Camera records images at a given frequency.</td></tr>
<tr><td>Exposure End</td><td>Defines when the Machine Vision Camera stops exposure.</td></tr>
</table></td></tr>
</table>

Property

<table>
<tr><td rowspan="6">Trigger selector</td><td colspan="2">The following options can be specified for the selected trigger:</td></tr>
<tr><td>Trigger mode</td><td>The selected trigger mode can be activated or deactivated.</td></tr>
<tr><td>Trigger source</td><td>Defines the internal signal or the physical input used as a trigger input for the selected trigger mode.

The trigger input can be set to software, I/O pin, user output, timer, counter or PWM.</td></tr>
<tr><td>Trigger activation</td><td>Defines how the trigger is activated.

The trigger can be started via the rising, falling or any other edge, or via high or low level.</td></tr>
<tr><td>Trigger delay</td><td>Defines delay in microseconds before a trigger signal results in image recording.</td></tr>
<tr><td>Trigger divider</td><td>Defines a division factor for incoming trigger signals. And thus only every X^{th} trigger signal results in image recording.</td></tr>
</table>

12.3.3.3 Device Control

Objective Display or adjust device settings.

Property The following settings/results are displayed:

Device boot status	Displays the device's boot status.
Device vendor name	Displays the name of the device manufacturer.
Device model name	Displays the device's article number.
Device family name	Displays the family name.
Device manufacturer info	Displays manufacturer information.
Device firmware version	Displays the device's firmware version.
Device FPGA Version	Shows the FPGA version of the device
Device serial number	Displays the Machine Vision Camera's serial number.
Device user ID	Editable device name
Device stream channel endianness	Displays the byte sequence.
Device stream channel packet size	Displays the packet size.
Device link heartbeat mode	Transmission of connection statuses at regular intervals can be enabled or disabled.
Device heartbeat timeout	Defines the connection timeout.
Device link command timeout	Defines the command timeout.
Device Connection, Lost Packets	Shows the number of lost packets
Device link speed	Defines connection speed.
Device SFNC version, major	GenICam XML version
Device SFNC version, minor	GenICam XML version
Device SFNC version, sub-minor	GenICam XML version
Device temperature selector	Selection of the device temperature
Device temperature	Device temperature is displayed. **NOTE!** The device temperature must not exceed 70° at the mainboard!

Property

Device link throughput limit	Limits the maximum bandwidth in bytes per second that can be used by the Machine Vision Camera. For multi-camera applications in particular, the bandwidth must be limited for all cameras to prevent the network from being overloaded. The sum of the bandwidth of all Machine Vision Cameras must not exceed 125 MByte per second with a 1 Gigabit Ethernet network. **NOTE!** • Default setting: 125,000,000 bytes per second (suitable for one Machine Vision Camera at the control unit) • The following formula applies in the case of more than one camera: • 125,000,000 / number of Machine Vision Cameras • Example for 10 Machine Vision Cameras at one control unit: 12,500,000 bytes per second
Device link calculated throughput	Displays the calculated bandwidth in bytes per second of the Machine Vision Camera with the current settings. The actual bandwidth is restricted by bandwidth limitation.
Device link recording frame rate limit	Displays the maximum possible recording frequency for the selected bandwidth limit.
Device optical filter type	Optical filter type: • GL: glass filter • HQ: IR filter
Device scan type	Acquisition mode
Sensor operation mode	Mode of operation
Device clock selector	Clock selection
Device clock frequency	Clock frequency

12.3.3.4 Analog Control

Objective Set gain values.

Property The following settings/results are displayed:

<table>
<tr><td>Gamma</td><td>Gamma correction of pixel intensity.

NOTE!
• A value of greater than 1 increases brightness.
• A value of less than 1 reduces brightness.</td></tr>
<tr><td>White Balancing Auto</td><td>White balancing can be applied automatically.
<table>
<tr><td>Off</td><td>White balancing is disabled by default.</td></tr>
<tr><td>One time only</td><td>For the next recording, white balancing is applied once for the region defined under “Subregion Control”.</td></tr>
<tr><td>Continuous</td><td>For each scan, white balancing is automatically applied for the region defined under “Subregion Control”.</td></tr>
</table></td></tr>
<tr><td>Gain auto</td><td>Gain is set automatically.
<table>
<tr><td>Off</td><td>Gain is deactivated as a default setting.</td></tr>
<tr><td>Once</td><td>Ideal gain is determined one time only for the next recording and applies to all subsequent recordings as well.</td></tr>
<tr><td>Continuous</td><td>Ideal gain is automatically determined and set for each recording.</td></tr>
</table></td></tr>
<tr><td>Gain selector</td><td>Select the channel to which gain will apply.</td></tr>
<tr><td>Gain</td><td>Gain factor for the selected channel.

NOTE!
For optimum image quality, gain should be as low as possible. It’s advisable to increase exposure time instead of gain.</td></tr>
</table>

ADC Gain Correction	Enables/disables predefined gain correction values (only available with “Analog All” gain selection)
Black Level Selection	Shows the black level for each bit depth defined by the pixel format.

12.3.3.5 LUT Control

Objective Create characteristic curves for images with lookup tables (LUTs).

Property The following settings/results are displayed:

LUT selector	Select an LUT.
LUT enable	The selected LUT can be activated or deactivated.
LUT index	Select an index in order to address the corresponding entry in the LUT. The LUT has 64 intervals.
LUT value	Defines the X^{th} value of the LUT
LUT preset selector	Select an LUT preset: • Identify: The values are unchanged. • Invert: All colors are inverted. • Binarize: The colors are binarized to black and white. • Digital gain 2: All color values are multiplied by a factor of 2. • Extended contrast: Contrast is increased by darkening shadows and brightening bright areas.

12.3.3.6 Counter and Time Control

Objective Set up the timer and the counter at the Machine Vision Camera, for example in order to capture the number of recorded images, triggers or missed triggers.

Property The following settings/results are displayed:

Counter selector	Select a counter.
Counter event source	Defines the event which results in incrementing the counter.
Counter reset source	Defines the event which results in resetting of the counter.
Counter trigger source	Defines the trigger which starts the counter.
Counter value	Counter value. **NOTE!** The counter value must first be reset. Only then is it possible to count events.
Counter value at reset	Displays the counter value after reset.
Counter duration	Defines counting duration until the counter stop event is triggered.
Counter status	Displays the counter's status.
Timer selector	Select a timer.
Timer duration	Duration of the timer signal in μs
Timer value	Current timer value
Timer delay	Timer signal delay in μs
Timer status	Displays the timer's status.
Timer trigger source	Defines the trigger which starts the timer.

12.3.3.7 Transfer Control

Objective The data transmission settings are displayed.

Property The following settings/results are displayed:

Transfer queue current block count	Returns the current number of blocks in the buffer.
Transfer queue max block count	Returns the maximum number of data blocks that can be stored in the buffer.
Transfer control mode	Transmission is controlled automatically.

12.3.3.8 GigE Vision

Objective Display the Machine Vision Camera’s GigE Vision settings.

Property The following settings/results are displayed:

GEV MAC address	MAC address
Gev current IP configuration persistent IP	Specifies whether a permanent or dynamic IP address is used.
Gev current IP configuration LLA	Current IP configuration enabled
Gev current IP configuration DHCP	Current DHCP setting
Gev current IP address	Current IP address
Gev current subnet mask	Current subnet mask
Gev current default gateway	Current standard gateway
Gev persistent IP address	Permanent IP address
Gev persistent subnet mask	Permanent subnet mask
Gev persistent default gateway	Permanent standard gateway
GEV SCDA	Target IP address
GEV GVCP pending ack	GVCP acknowledgement can be activated or deactivated.
GEV SCP host port	SCP host port
GEV SCPD	Delay for data packets. **NOTE!** It’s advisable not to use delay and to activate bandwidth limitation instead.

12.3.3.9 Auto-Brightness Control

Objective Set automatic brightness balancing at the Machine Vision Camera.

Property The following settings/results are displayed:

Brightness auto percentile	Defines a percentage of pixels of the image chip that has to be brighter than “Brightness auto target”.
Brightness auto target	Defines the target value for automatic brightness balancing. With the pixel format “Mono 8”, the target value is set to the gray-scale value 150 as standard.
Brightness auto target tolerance	Defines a range that envelops the “Brightness auto target” value.
Brightness auto framerate limit mode	Defines how recording frequency is limited.
Brightness auto exposure time limit mode	The minimum and maximum limits for automatic exposure time can be activated or deactivated.
Brightness auto exposure time min	Minimum exposure time when using automatic exposure time
Brightness auto exposure time max	Maximum exposure time when using automatic exposure time
Brightness auto gain limit mode	The minimum and maximum limits for automatic gain can be activated or deactivated.
Brightness auto gain min	Minimum gain when using automatic gain.
Brightness auto gain max	Maximum gain when using automatic gain.

12.3.3.10 PWM Control

Objective Adjust PWM settings at the Machine Vision Camera.

Property The following settings/results are displayed:

PWM selector	Defines which pulse width modulation will be configured.
PWM trigger source	Defines the internal signal or physical input that causes PWM to start.
PWM frequency	Defines the frequency of the PWM signal in Hz.
PWM trigger activation	Defines when the trigger source is activated.
PWM duty cycle	Defines the PWM sampling rate.

12.3.3.11 Image Correction Control

Objective Set up image correction at the Machine Vision Camera.

Property The following settings/results are displayed:

Color correction matrix	HQ: Predefined color correction matrix for IR filters
Color correction mode	Specifies whether color correction is enabled or disabled.

12.3.3.12 User Set Control

Objective Various user configurations can be loaded to the Machine Vision Camera.

NOTE!
Use of user configuration 0 is always recommended so that wenglor illumination can be used.

Property The following settings/results are displayed:

User set selector	Specifies which user configuration is loaded.
User set default	Defines which user configuration is loaded as the default setting when the device is reset.

12.3.3.13 Image Format Control

Objective Set the Machine Vision Camera's image format, for example in order to limit its read-out range.

Property The following settings/results are displayed:

Sensor width	Read-out width of the integrated image chip in pixels
Sensor height	Read-out height of the integrated image chip in pixels
Width max	Maximum width of the image chip in pixels
Height max	Maximum height of the image chip in pixels
Width	Specifies the width of the image chip in pixels which will be read out.
Height	Specifies the height of the image chip in pixels which will be read out. **NOTE!** If the read-out height of the image chip is reduced, the Machine Vision Camera's recording frequency can be increased.
Offset X	Horizontal offset in pixels from origin to region of interest
Offset Y	Vertical offset in pixels from origin to region of interest
Test pattern	The Machine Vision Camera is capable of generating various test images. As a default setting, no test pattern is active and the Machine Vision Camera displays the current camera image.
Reverse X	When enabled, the image is rotated horizontally (only available on certain camera models).
Reverse Y	When enabled, the image is rotated vertically (only available on certain camera models).
Pixel size	Number of bits per pixel
Pixel color filter	Color filter applied to the image
Sensor name	Name of the image chip
Sensor pixel width	Physical width of the pixels
Sensor pixel height	Physical height of the pixels
Binning Selector	Vertical and/or horizontal binning can be set. The pixels are grouped horizontally and/or vertically, thus reducing the image resolution. Binning is only available on certain camera models.

Decimation selector	Selection of the region for subsampling. **NOTE!** Higher recording frequencies are not possible with subsampling. Subsampling is only available on certain camera models.
Decimation horizontal	Horizontal subsampling of the image in order to reduce resolution or bandwidth.
Decimation vertical	Vertical subsampling of the image in order to reduce resolution or bandwidth.
Component Selector	The “Intensity” component is always enabled and is transmitted in pixel format Mono 8 with monochrome Machine Vision Cameras and in pixel format BayerRG8 with colored Machine Vision Cameras.

12.3.3.14 Subregion Control

Objective Select a subregion from the currently read region of the image chip. The subregion is relative to the currently read region of the image chip. The subregion can be used, for example, for functions such as automatic brightness control.

Property The following settings/results are displayed:

Subregion Selector	Select the subregion.
Subregion Source Selector	Defines within which region the subregion is located.
Subregion Follow Source	If enabled, the size of the region defined in “Subregion Source Selection” will be used. If not enabled, the size of the subregion can be set.
Subregion Width	Defines the width of the subregion
Subregion Height	Defines the height of the subregion
Subregion Offset X	Defines the offset in X of the subregion
Subregion Offset Y	Defines the offset in Y of the subregion

12.3.3.15 Digital I/O Control

Objective Set up the Machine Vision Camera’s digital inputs and outputs.

Property The following settings/results are displayed:

Line status all	Current status of all available inputs and outputs
User output value all	Sets all user outputs at once.
User output value all mask	Sets the mask for “User output value all” before the user outputs are written.
Line selector	Select the input/output.
Line mode	Specifies whether the pin is used as an input or an output.
Line inverter	Specifies whether the input or output signal is normal or inverted.
Line status	Displays the status of the input or output.
Line source	Specifies what will be read out via the output. **NOTE!** Only available for outputs.
Line format	Electrical format of the input or output
Line Noise Filter Enable	The filter on the digital input can be enabled so that short interference signals on the digital input do not lead to faulty trigger signals.
Line Noise Filter Duration	The digital input filter duration is used when I/O Noise Filter Enabled is set to ON. By default, the filter on the trigger input (I/O 0) is enabled and set to 500 μs.
User output selector	Select a user output.
User output value	The selected user output can be enabled or disabled or linked to a result. **NOTE!** Writing Machine Vision Camera digital output from the control unit over the network takes time. For time-critical applications, instead use the control unit digital outputs.

12.3.3.16 Chunk Data Control

Objective Set up data control at the Machine Vision Camera. Additional data (so-called chunk data) can be transmitted with each image.

Property The following settings/results are displayed:

Chunk mode active	The “chunk data” function can be activated and deactivated. **NOTE!** Chunk data can only be activated when the trigger mode is on as of trigger exposure start.
Data selector	Various chunk data can be selected.
Chunk enable	The selected chunk data can be activated. As a result, the selected value is transmitted with each image.
Chunk gain selector	Specifies how much gain is selected.

12.3.3.17 Transport Layer Control

Objective User data size is displayed.

Property The following settings/results are displayed:

Payload size	Value in bytes which determines how much data per image is transferred from the Machine Vision Camera to the control unit.

12.3.3.18 Flash Control

Objective Set the flash output on the Machine Vision Camera

Property The following settings/results are displayed:

Flash Start Delay	Set a delay for flash start.
Flash End Delay	Set a delay for flash end.
Flash Duration	Shows the current flash duration. If the value 0 is displayed, no flash signal is generated (for example, this is possible with rolling shutter cameras with exposure times that are too short!) **NOTE!** For example, with 12 MP Machine Vision Cameras (BB6K005, BB6K006), an exposure time of at least 93 ms must be set in order to create the global exposure window. The global exposure window then lasts for a few ms (for example 1 ms). For details, see section "7.4.3 Connection Overview for Trigger, Machine Vision Camera and Illumination in Flash Mode" on page 73.
Flash Reference	For Machine Vision Cameras with global shutters, only "Exposure Active" can be selected. For Machine Vision Cameras with rolling shutters, the global flash window is selected by default. This means that the flash signal is only active if all lines are exposed at the same time. Dynamic applications with rolling shutter cameras can thus also be solved via the global flash window. This requires long exposure times and enclosure of the application to block out ambient light.

12.3.3.19 Sequence Control

uniVision does not currently support sequence control.

12.3.3.20 Optics Control

uniVision does not currently support optics control.

12.3.3.21 PTP Control

uniVision does not currently support the Precision Time Protocol.

12.3.3.22 File Access Control

uniVision does not currently support file access.

12.4 Machine Vision Camera Module for BBZK

12.4.1 Overview

Objective

To set up the machine vision camera to record the best possible images for subsequent image processing.

NOTE!
- More information on the maximum number of devices per control unit and the maximum control unit performance can be found in section “4.2 uniVision for Vision Systems” on page 23.
- Not all available parameters and categories are supported in the uniVision application. If parameters or categories are not supported by uniVision, this will be mentioned for the respective parameter.
- Only chunk data (see section “12.4.10 Data Control” on page 177) is consistent with the image data and can be used in further evaluations. No other results in the machine vision camera device (such as I/O status) are updated regularly. They should therefore not be used in further evaluations.
- Different functions are supported depending on the camera model.

Property

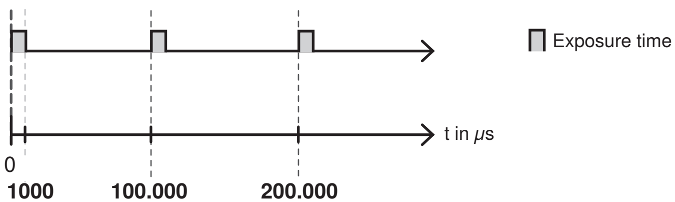
1. Adjust the brightness by configuring the aperture on the C mount lens as well as the exposure time.
2. Adjust the focus at the lens so that a sharp image is recorded.
3. Set triggering.

The following standard trigger modes are available.

1. Fixed recording frequency:

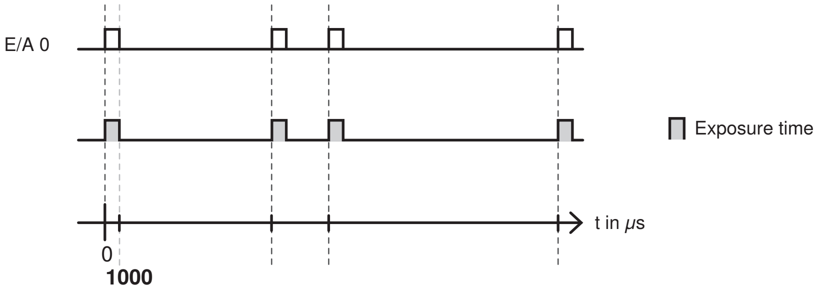
The machine vision camera records a specified number of images per second without external triggering.

Sample settings:
- Recording mode: Continuous
- Recording frequency: 10 Hz
- Exposure time: 1,000 μs
- Trigger selection: FrameBurstStart trigger
  - Trigger mode: OFF



2. Hardware trigger
The trigger command is issued via the digital trigger input at the Machine Vision Camera.

Sample settings:
- Recording mode: Continuous
- • Exposure time: 1000 μs
- • Trigger selection: FrameBurstStart trigger
  - Trigger mode: ON
  - Trigger source: I/O 0
  - Trigger activation: Rising edge



3. Software trigger via LIMA command:
The uniVision software issues the trigger command to the associated uniVision application using a LIMA command (more information in the interface protocol). The software can also be used to issue a software trigger command by pressing the F5 key.

Sample settings:
- Recording mode: Continuous
- Exposure time: 1,000 μs
- Trigger selection: FrameBurstStart trigger
  - Trigger mode: ON
  - Trigger source: Software

12.4.2 Setting Parameters

Image area If a connection has been established, the image from the machine vision camera is displayed.

Property The following settings/results are displayed:

Processing time [μs]	Processing time for the process steps in the current module.
Module status	Error codes assist with troubleshooting.
Device name	The name of the current device is displayed. In addition, any other available machine vision camera can be selected for the uniVision application. **NOTE!** Each machine vision camera can be used in one uniVision application only at any given time! If a device already in use is selected, the module status indicates this with an error code. More information can be found in section „5.4.6 Connection Between the Project and Recording Device on the Control Unit“ auf Seite 51.
Error handling	In the event of an error, the default is value replacement. Therefore, in the event of an error, the value is replaced with the value defined under error handling.
Creating an HSV, RGB, or BGRA image	On machine vision cameras with a color image chip, other images (such as an RGB or BGRA image) can also be calculated in addition to the HSV image (standard for uniVision). **NOTE!** The machine vision camera transmits the image in the pixel format BayerRG8. The control unit calculates the HSV image and other images depending on the settings.

12.4.3 Configuration

The machine vision camera module contains the following relevant configurations
- Error handling
- Device control
- Image format control
- Recording control
- Analog control
- Digital I/O control
- Data control

The following categories are not required or not supported in the uniVision application:
- Color transformation control
- Super palette control
- LUT control
- Action control
- Counter and time control
- File access control
- Event control
- Transport layer control
- User data configuration control

12.4.4 Error Handling

Set a replacement value to be used when a linked value is in error state. If, for example, a user output value is linked to a test result, the replacement value is used on the device in the event of an error in the linked value.

12.4.5 Device Control

Device model name	Item number of the original product.
Device version	Version of the device.
Device firmware version	Firmware version of the device.

NOTE!
The remaining parameters are not relevant for, or not supported by, the uniVision application.

12.4.6 Image Format Control

Max. width	Maximum width of the image chip.
Max. height	Maximum height of the image chip.
Invert X	If enabled, the image chip columns are inverted.
Invert Y	If enabled, the image chip rows are inverted.
Pixel format	Only Mono 8 (default setting) is supported in the uniVision application.
Horizontal subsampling	Horizontal subsampling can be enabled.
Vertical subsampling	Vertical subsampling can be enabled.
Region selection	The width, height, X offset and Y offset of the image chip can be restricted.
Binning selection	Horizontal and vertical binning can be enabled.

NOTE!
The remaining parameters are not relevant for, or not supported by, the uniVision application.

12.4.7 Acquisition Control

Acquisition mode	Only the continuous acquisition mode is supported in the uniVision application.
Acquisition frame rate (fps)	Number of acquisitions per second.
Acquisition frame rate control enabled	Must be enabled in the uniVision application.
Resulting acquisition frequency	Displays the actual acquisition frequency.
Exposure time (us)	Exposure time in μs
Trigger selection	The following options are available for the FrameBurstStart trigger: • Trigger mode: OFF to use acquisition frame rate. ON to trigger via digital input or software. • Trigger source: Use the digital input (I/O 0) to trigger or send trigger signals via software. • Trigger activation: Use only rising or falling edges for triggering or use each edge change for triggering. • Trigger delay (us): Delays the image acquisition after the trigger signal in µs.

NOTE!
The remaining parameters are not relevant for, or not supported by, the uniVision application.

12.4.8 Analog Control

Gain and white balance can be performed especially for cameras with a color image chip.

NOTE!
The remaining parameters are not relevant for, or not supported by, the uniVision application.

12.4.9 Digital I/O Control

I/O selection	Set up trigger input I/O 0: • I/O mode: Shows the function as input. • Line debounce time (us): The debounce time prevents short interfering signals at the input from generating faulty trigger signals (default: 50 µs). • I/O status: Displays the input's status. Set up flash output I/O 1: • I/O mode: Shows the function as strobe output. • I/O source: The output is activated together with the start of the exposure. • I/O inverter: Invert the flash output (not inverted by default; suitable for wenglor L and ZVZF1/ZVZF2/ZVZF3/ZVZF4 illuminations). • Strobe enable: Must be activated for the flash output to be active (not activated by default). • I/O status: Displays the output's status.

NOTE!
The remaining parameters are not relevant for, or not supported by, the uniVision application.

12.4.10 Chunk Data Control

Chunk mode active	If chunk mode is activated (deactivated by default), further data is transferred together with the image if it is activated under data selector (such as time stamp, image counter).
Data selector	Various chunk data (such as time stamp, image counter) can be individually activated or deactivated.

13. Software Modules for Image Analysis

13.1 Module Localizer

13.1.1 Overview

Objective

Objects can be tracked and reliably detected. The following image processing functions are set up on the basis of this coordinate system.
The tracking module allows for translatory tracking. The coordinate system's X and Y positions are adjusted to this end, but **not** its rotary position.
Tracking is thus suitable for objects, for which the rotary position is irrelevant. Furthermore, an easy to detect feature which stands out from the rest of the image (especially high-contrast area, special shape, edge or corner) is helpful for successful tracking.

NOTE!
In addition to translatory tracking, rotary tracking is also possible. This can be set up in the coordinate system module (see section "13.2 Module Coordinate System" on page 180).

Procedure

The module contains a movable region to be taught in. This can be taught in on a reliably detectable area (especially high-contrast area, special shape, edge or corner) and under settings in the tracking module. Alternatively, the location with the highest contrast can be taught in automatically.
In every recorded image, the area within the specified search region is then detected which **most closely** coincides with the taught in area. The **gray-scale values** in the areas serve as a basis for comparison. The coordinate system is aligned to the point of closest correspondence to the taught-in image, and the object is thus translatorally tracked.
Note: No rotary tracking with rotation of the coordinate system can be executed with this module. The coordinate system must be used in order to perform rotary tracking (see section "13.2 Module Coordinate System" on page 180).

13.1.2 Setting Parameters

Image area

The coordinate system, which can be aligned to an taught in feature, is displayed. The X-axis appear red, the Y-axis green.

Settings/ Results

The following settings/results are displayed:

Process Time [µs]	Process Time for the process steps in the module localizer.
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 358).
Smallest difference	The difference in the number of pixels between the taught-in image and the best match in the current image is read out. The results provide an indication of the probability that the currently found reference is the correct reference.
Teach Reference Auto	A possible position (area with the **highest contrast**) is searched for automatically within the specified search region. The coordinate system for tracking is aligned to the region to be taught in. The results may serve as a good starting value. However, it may also be advisable to specify the reference position manually.
Teach Reference	The current position of the teach-in region can be taught in. The best possible match is searched for in all subsequent images. The coordinate system for tracking is aligned to this region. **NOTE!** Before the teach-in process, the teach-in region must be positioned in a place with the highest possible contrast.
Input image	Selection of the channel for the image input
Tracking method	Position the coordinate system statically on the origin or dynamically on the best match.

13.2 Module Coordinate System

13.2.1 Overview

Objective

Objects can be tracked and reliably detected. Additional image processing functions can also be set up on the basis of this coordinate system.

The coordinate system module allows for **translatory and rotary** tracking. The coordinate system's X and Y positions, as well as its rotary position, are adjusted to this end.

The coordinate system is suitable for tracking objects whose rotary position can change.

Note: In addition to rotary tracking, translatory tracking is also possible. Pure translatory tracking is possible with the module localizer (see section "13.1 Module Localizer" on page 178).

Abbreviated procedure

First of all, how the coordinate system is laid out can be individually specified. Various algorithms are available.

Search lines can then be used to detect edge transitions along search rays. A point is generated at these transitions, which can be defined as an origin or a point along the X or the Y-axis.

13.2.2 Setting Parameters

Image area The coordinate system set up by means of the specified method is displayed.

Property The following settings/results are displayed:

Process Time [µs]	Process Time for the process steps in the coordinate system module.
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 358).
Input image	Selection of the channel for the image input
Construction Method	The coordinate system can be set up in different ways: **1 pt. origin** – 1 point defines the origin of the translatory coordinate system. **1 pt. X-axis, 1 pt. Y-axis** – 1 point defines the X-axis and 1 point defines the Y-axis, by means of which a translatory coordinate system is formed. **1 pt. origin, 1 pt. X-axis** – One point defines the origin and one point defines the X-axis of the translatory/rotary coordinate system. **1 pt. origin, 1 pt. Y-axis** – One point defines the origin and one point defines the Y-axis of the translatory/rotary coordinate system. **1 pt. X-axis, 1 pt. Y-axis** – Two points define the X-axis and one point / defines the Y-axis of the translatory/rotary coordinate system.
Tracking method	The way in which the points should be tracked can be specified. **No** – The points are not tracked. **Yes** – The point are tracked in the X and Y directions. **Horizontally** – The points are only tracked in the X direction. **Vertically** – The points are only tracked in the Y direction. Only available if the construction method uses more than one point. 1st pt.: All points are tracked according to the first point. 2nd pt.: All points are tracked according to the second point. 3rd pt.: All points are tracked according to the third point.

13.2.3 Configuration

The coordinate system module includes the following configuration options:
- Find point

13.2.3.1 Submodule Find Point

Objective Specify a point for setting up the X or Y-axis within the image. Various algorithms are available.

Image area Depending on the construction method, either a fixed point or a search ray is displayed in the image area. In the case of the search ray, the detected point appears purple.

Property The following settings/results are displayed: Either one, two or three points appear depending on the previously selected construction method.

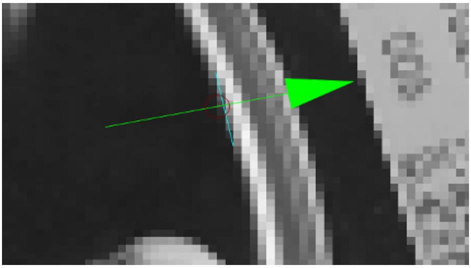
Found point	The found point is shown.	
Input point	A fixed point or a found point from a different module can be linked.	
Find method	Selection for the construction method:	
	Point (fixed or linked)	A fixed point or a found point from a different module can be linked.
	Edge on line	An edge transition is looked for along a search line.
	Edge on arc	An edge transition is looked for along an arc.
	Segment on line	Segments are looked for on a line.
	Segment on arc	Segments are looked for on an arc. Available points of the arc segments can be used.
	Segment on circle	Segments are looked for on a circle. Available points of the circle segments can be used.
	Find line	Special points on a line can be used.
	Find arc	Special points on an arc can be used.

Construction Method

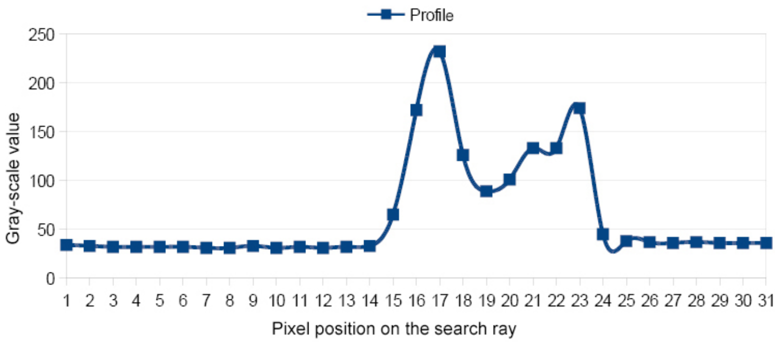
Edge on line or arc

First of all, the search line's gray-scale values are determined. Then a derivative is generated from the gray-scale values in order to ascertain where an edge is located. If several edges are found, polarity and the "find by" specification determine which edge will be used as a point for the coordinate system.

Example: The first transition from dark to bright should be detected as an edge in the following image.

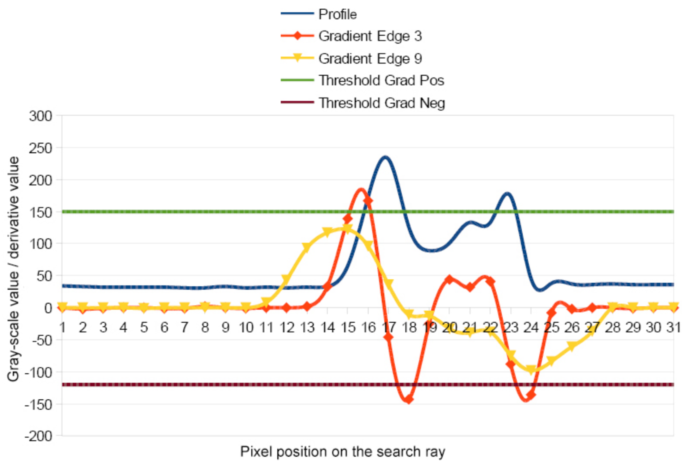


The search line's gray-scale values are represented in the profile.



The profile's derivatives are shown in this diagram for edge widths of both 3 and 9. If the positive threshold gradient is 150 and the threshold is -120, edges are detected at pixels 16, 18 and 24 (if an edge width of three has been selected), because the derivative exceeds the positive threshold gradient or falls short of the negative threshold gradient at these points. In contrast, no edges would be detected with an edge width of 9.

Construction Method



By selecting “First score” or via the “Dark to bright” polarity, it can be assured that the first transition from dark to bright is used as a point for the coordinate system.

The edge width dictates how long a new brightness value has to be retained in order for the transition to be recognized as an edge. In the above example, the new value is retained only briefly, which causes flattening and shifting to the left of the derivative with the larger edge width. The amount of change in brightness an edge has to demonstrate in order to be accepted can be adjusted by setting the threshold gradients. The higher the value is, the sharper the edge has to be. In order to be able to detect unsharp edges. The values have to be set accordingly low.

Edge point	The coordinates of the detected edge transition are displayed under Edge point.
Edge polarity	Expected brightness characteristics Either: Both bright to dark and dark to bright transitions are searched for. Light to dark: Only bright to dark transitions are searched for. Dark to light: Only dark to bright transitions are searched for.

Construction Method

Find by	This parameter can be used to specify which of the detected edges will be used on the search line. Best score: If several edge transitions are detected on the search line, the transition with the greatest contrast is selected. First score: If several edge transitions are detected on the search line, the first transition in the search direction is selected. Last score: If several edge transitions are detected on the search line, the last transition in the search direction is selected.
Edge width [unit]	"Edge width" influences detection sensitivity for brightness fluctuations. **Note**: An edge width of 3 pixels reacts to even the smallest contrast change in the image. An edge width of 9 pixels smooths the brightness profile over a distance of 9 pixels and ignores small irregularities.
Threshold gradient positive (GrM)	Positive threshold gradient specifies the positive acceptance threshold. **Note:** The gradient corresponds to the change in brightness from one pixel to the next. The higher the edge's contrast, the larger the gradient.
Threshold gradient negative (GrM)	The negative threshold gradient specifies the negative acceptance threshold. **Note:** The gradient corresponds to the change in brightness from one pixel to the next. The higher the edge's contrast, the larger the gradient.
Orientation	Default: The edge transition search direction corresponds to the direction in which the search ray has been drawn. Swap: The edge transition search direction is opposite of the direction in which the search ray has been drawn.

Construction Method

Segment on line, arc or circle

The construction method is the same as that for edge on line or arc. The difference is that adjacent segments are looked for in the search geometry. The beginning or end of a segment is defined by an edge. Only the additional settings are provided.

Segments True Count	The number of segments detected in the search geometry is displayed. The upper and lower thresholds can be adjusted manually. **NOTE!** The number of segments found is independent of the maximum number of segments.
Segments Max Count	Maximum number of segments to be expected. **NOTE!** The number of segments found is independent of the maximum number of segments.
Segments Minimal Length	Minimum length of the segments
Segments Maximal Length	Maximum length of the segments
Sort Rule	The rule used for sorting segments can be defined. Position on search geometry: The segments are listed in search direction. Size: Segments are sorted by size in ascending or descending order.

Construction Method

Find Geo Line or Arc

The setting parameters are the same as those for the search for edges on lines or arcs. In contrast to the search for edges on lines or arcs, the search here is carried out based on vertically arranged search rays for edge transitions. The following additional settings are available:

Quality of Fit [%]	Proportion of the valid points in relation to all found points.
Threshold Outliers Distance [unit]	Maximum permissible distance from points to the found shape
Search Ray Length [unit]	Definition of the search ray length
Search Ray wInterval [unit]	Definition of the search ray intervals
Points to Use [%]	The percentage indicates how many points will be used to ascertain the shape.

Points to Use Strategy	The points which are used to ascertain the shape are specified. Selection can be made between the first and the last points on the search geometry. The search direction is made apparent by the direction of the arrow.
Fit Maximal Geometry	The search for start and end points can be switched on or off.
Maximal Gap Between Valid Points	Start and end points of geometries are found if the distance between two successive valid points is larger than the space specified by this value.
Maximal Outlier in a Row	Start and end points of geometries are found if there is a larger number of successive outliers than specified by this value.

13.3 Region Module

13.3.1 Overview

Objective	The relevant region of interest used for evaluation should be as large as necessary and as small as possible. The **smaller** and more precise the surface, the **faster** the evaluation and the **higher** the image refresh rate. This allows for faster application runtimes because image recording and processing are quicker. Furthermore, the object or feature detection is more **reliable** because fewer noise pixels can occur within the evaluated area. The object to be detected must lie **fully** within the selected area, because reliable object detection cannot otherwise be assured.
Abbreviated procedure	**Any** desired area can be specified as the "region of interest" by adding, removing or customizing shapes. In addition to existing standard shapes, any number of various shapes can also be added and linked by means of mathematical set theories.

13.3.2 Setting Parameters

Image area The region of interest is highlighted in color in the image area.

Property The following settings/results are displayed:

Process Time [µs]	Process Time for the process steps in the module.
Module State	Error codes for troubleshooting support (see section "25.5 Module Status" on page 358).
Input image	Selection of the channel for the image input
Coordinate system	A selection can be made regarding how the region should be tracked.
Variant	The displayed algorithm type is used.

Function field

New shapes can be added.

1. Select the mathematical operation

	**Add**	The new shape should be added to the overall shaped.
	**Subtract**	The new shape should be removed to the overall shaped.
	**Symmetrical Subtract**	The common area of the new shape is removed from the overall shape.
	**Intersection**	The common area of the new shape and the overall shape should be selected.

Note: The order of the shapes is dictated by the order in which they are created and cannot be subsequently changed. As a result, the overall shape of all previously existing shapes is always used for the offsetting of shapes.

2. Select a new shape

	**Rectangle through two points**	A rectangle is drawn with 2 points. The first corner of the rectangle is specified within the image area by left clicking with the mouse. The diagonally opposite corner of the rectangle is specified with a second click.
	**Rectangle through three points**	A rectangle is drawn with 3 points. The first corner of the rectangle is specified within the image area by the first click. The next click specifies one of the neighboring corners and the third click specifies the side opposite the side defined by the two points.
	**Circle through 2 points**	A circle is drawn with 2 points. The first click specified the center of the circle. The radius of the circle is specified by means of the second click.
	**Circle through 3 points**	A circle is drawn with 3 points. 3 points around the circumference of the circle are specified with 3 mouse clicks.
	**Polygon**	A polygon can be created with any desired number of clicks. Each click specifies one of the polygon's corners. Processing of the shape is ended by double clicking the last corner. Polygons can be specially processed within the image area. Individual points can be deleted by pressing and holding the Ctrl+Shift key and clicking the respective point with the left mouse key. A new point can be added to the polygon by pressing and holding the Alt+Shift key and left-clicking at the desired side of the polygon.

3. Draw a new shape within the image area as described.

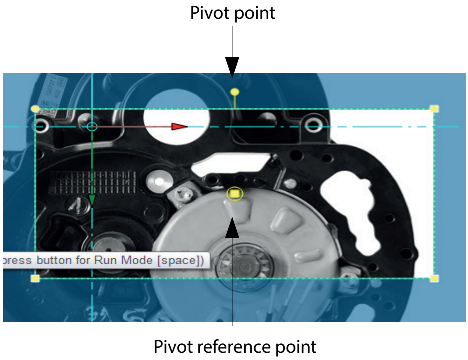
13.3.3 Configuration

As a standard feature, the region module includes the following configuration options:
- Quantity.

13.3.3.1 Submodule Set

Objective All of the individual shapes used in the image area, as well as the overall shape, can be adapted to the application. A rectangle is present as standard.

Image area The selected shapes are displayed in the image area and can be edited there as well.

Change position	Click the respective shape in the image area and hold the mouse key depressed until the shape has been dragged to the desired position.
Change size	Click one of the corners of the respective shape in the image area. Hold the mouse key depressed until the shape reaches the desired size.
Rotate shape	1. Position the pivot reference point. 2. Rotate the shape at the pivot point. 

13.4 Module Filter

13.4.1 Overview

Objective Filters are used to emphasize or suppress a property of an image or image section or to improve the image quality. This property can be an edge or an area, for example. Filters therefore prepare for the image processing.

Procedure The desired type of filter can be selected and applied to the desired region.

13.4.2 Setting Parameters

Image area Current filter settings are displayed in the selected region of interest.

Property The following settings/results are displayed:

Process Time [µs]	Process Time for the process steps.
Module State	Error codes for troubleshooting support (see section "25.5 Module Status" on page 358).
Input region	Selection of the region to which the filter will be applied.
Input image	Selection of the channel for the image input
Filter type	Pre-defined, performance-optimized filters can be selected directly. Free filters can be defined with kernel sizes 3x3 and 5x5. **Off** Output image = input image **Sobel** Edge and smoothing filters: • Homogeneous areas appear in black. • Edges are shown in white. • Edges are highlighted, even if they have relatively low gray-scale transitions. **Gauss** "Low-pass filter" (smaller structures are lost, larger ones are retained): • The image becomes softer. • Noise is reduced. • Inhomogeneous surfaces become more homogeneous. • Edges are highlighted, even if they have relatively minimal gray-scale transitions.

Filter type	**Opening**	The opening filter refers to the sequence of an erosion and dilatation. Erosion closes spaces between dark structures, while dilatation reverses the thickening of dark objects again. The enlarging effect on the area of the dark objects during erosion is reversed again by dilatation. Effects of the opening filter: • Contours are highlighted significantly, even if they have relatively low gray-scale transitions.
	Closing	Like the opening filter, a closing filter relates to the sequence of dilatation and erosion. Erosion closes spaces between light structures, while dilatation reverses the thickening of light objects again. The enlarging effect on the area of the light objects during dilatation is reversed again by erosion. Effects of the closing filter: • Contours are highlighted significantly, even if they have relatively low gray-scale transitions.
	Sharpen	Filter amplifies the edges, but also any noise in the image. This can even result in noise becoming visible after the filter is applied, which was not visible before.
	Matrix	Creating your own filters – 3×3 or 5×5: Where filters are used, the surrounding pixels are generally analyzed for each pixel. This results in a calculated value for the respective pixel, which is used in the output image of the filter module. With some filters it's possible to specify how heavily the gray-scale values of the surrounding pixels will be weighted into the calculation of the pixels for the output image. Example of a vertical edge filter: The following weighting can be used with the 3×3 filter in order to create a vertical edge filter.

–1	0	1
–1	0	1
–1	0	1

The gray-scale value of the output image needs to be determined for the following central pixel. The gray-scale values of the input image's surrounding pixels are ascertained first of all to this end.

Filter type	**Matrix**	(see below)

50	120	105
90	80	60
80	100	100

During calculation, each gray-scale value is multiplied by the weighting factor. The individual values are added up and then divided by 9. The result is the gray-scale value of the central pixel for the output image.

$50\times(-1)+90\times(-1)+80\times(-1)+120\times0+80\times0+100\times0+105\times1+60\times1+100\times1=45$

$45\div9=5$

Kernel size	The filter size can be set (3×3 or 5×5).
Variant	The displayed algorithm type is used.

13.5 Module Threshold

13.5.1 Overview

Objective

In order to be able to evaluate or count objects, the images have to be converted to black and white binary images as a preparatory step. The objective is to separate the foreground from the background. This is the only way to assure simple subsequent evaluation of the images.

Procedure

The limits for the gray-scale values which will determine which pixels appear black and which appear white can be specified.
The **histogram** or the **profile** showing the brightness values and distribution may be helpful with the threshold process.

13.5.2 Setting Parameters

Image area

A preview of the threshold analysis appears in the image area.
The threshold value process is only applied within the selected region of interest. Depending on the gray-scale values and the selected settings, the pixels in the region of interest become either black or white.

Property

The following settings/results are displayed:

Process Time [µs]	Process Time for the process steps.
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 358).
Pixel Count [unit]	Display of the number of white pixels counted in the region of interest. The upper and lower thresholds of the pixel value can be adjusted.
Input region	Selection of the region for the threshold process.
Input image	Selection of the channel for the image input
Teach	The current number of detected pixels is taught in. The window width between minimum and maximum remains unchanged, but the minimum and maximum values of the pixel count value are adjusted such that the current number of detected pixels is half way between the two values.

Property

<table>
<tr><td rowspan="4">Mode</td><td colspan="2">Threshold values can be adjusted statically or dynamically.

NOTE!
Threshold values can be dynamically corrected in order to compensate for minimal brightness fluctuation or different surface finishes. However, brightness differences can only be compensated for in settings which are already relatively stable by means of this adaptive adjustment.</td></tr>
<tr><td>Static</td><td>The threshold values are set and fixed via Threshold Low and Threshold High.</td></tr>
<tr><td>Adaptive by Reference</td><td>The threshold values are determined dynamically for each image. Two reference areas are available for this – an area for the Threshold Low and an area for the Threshold High. The mean gray-scale value of the pixels within the defined area is determined for each area. The minimum and maximum threshold is determined for each image via the set offset.</td></tr>
<tr><td>Adaptive by histogram</td><td>The threshold values are determined dynamically for each image. They are defined by the quantiles from the histogram.
• The quantile for the Threshold Low determines the percentage value of the gray-scale value for the Threshold Low.
• The quantile for the Threshold High determines the percentage value of the gray-scale value for the Threshold High.
NOTE!
In the function field, the histogram can be opened for this purpose in order to define the quantiles there.

With the set offset values, this provides the values for the minimum and Threshold High.</td></tr>
</table>

Property

Threshold Low/ Threshold High	The lower and upper gray-scale threshold values can be set in the **static mode**: a) The lower threshold is less than the upper threshold. • Pixels with gray-scale values between the two thresholds appear white. • Pixels with gray-scale values which fall short of the lower threshold or exceed the upper threshold appear black. b) The lower threshold is greater than the upper threshold • Pixels with gray-scale values between the two thresholds appear black. • Pixels with gray-scale values which fall short of the upper threshold or exceed the lower threshold appear white. **NOTE!** The profile or the histogram showing the gray-scale values or distribution makes defining the gray-scale thresholds easier. Via the profile, the limit values can be specified on both sides of edges and the thresholds adapted accordingly. In dynamic mode, the calculated threshold values are shown.

Function field

A window can be opened in the function field which serves as an adjustment tool for the “Dynamically via histogram” mode.

Opening the adjustment tool

The gray area identifies the area for black pixels.
The red area identifies the area for white pixels.

Magic Wand

The “wand” tool is an adjustment tool for the “Threshold value module” and the “Threshold value module HSV”. This tool can be used for the initial setting for the individual threshold values. The threshold values may have to be adjusted afterwards.

Opening the adjustment tool

Procedure:

The view is changed to the module’s input image when the “wand” tool is activated. Clicking the place in the image which should be defined as the foreground in the application ascertains coordinates and forwards them to the algorithm. The algorithm calculates the new binarization thresholds (minimum threshold and maximum threshold). The result is then shown.

Calculation of the threshold values:

Threshold Low = brightness value in click position – 20
Threshold High = brightness value in click position + 20
Both threshold values are limited to the range [0...255].

NOTE!

In the threshold value module HSV, the threshold values are calculated for all 3 channels.

13.6 Threshold Value Module HSV

13.6.1 Overview

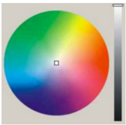
Objective

Teach in certain colors and differentiate them from other colors.

Procedure

A binary black and white image must be generated in order to be able to process objects. The objective is to separate the foreground from the background. Suitable parameter values are selected for the respective application to this end (hue, saturation and brightness). In order to make best possible use of options offered by the filters, a brief overview of the HSV color space is provided in the following.

A color is broken down into three channels in HSV color space.



H (hue)
S (saturation)
V (value)

Hue H can have a value within a range of 0° to 360° and is generally depicted as a circle. All colors are represented within the circle. Red is at 0°, green is at 120° and blue is at 240°. All of the various hues lie between these points. Black and white are not included as hues. They are achieved by means of saturation and brightness. The circle is divided into steps of 0 to 255 for the vision sensor.
Saturation S is the luminosity of a given color. If saturation is set to its maximum value, a pure color appears. If saturation is set to its minimum value, a gray-scale value appears, which is dependent upon the current brightness value (V). All colors between gray and the pure color can be found between these minimum and maximum values.
Brightness value V is the brightness of a color ranging from black to maximum brightness. Attainable maximum brightness is dependent upon saturation.
A color with a brightness value of 0 appears black regardless of H and S. A color with a maximum brightness value appears as the brightest variant of the respective H-S combination, regardless of its H and S values.

Examples:

H = 0 (red)
S = 255
V = 128

H = 0 (red)
S = 255
V = 255

H = 170
(blue)
S = 0
V = 128

H = 85
(green)
S = 255
V = 255

Advantages for digital image processing

This results in a decisive advantage for digital image processing. A hue can be detected regardless of its brightness. For example, a shade of blue can be recognized independent of ambient luminosity. This is not possible in RGB color space.

Application

The setting selected at the color filter determines which colors will be allowed to pass through the filter and which will not.
If all shades of red need to be filtered out of a colorful image, the H value filter must be utilized. The filter thresholds must be set above and below the desired shade of red. All colors between the two thresholds are allowed to pass through the filter.
If all shades of red between the H thresholds should be allowed to pass through the filter for this application regardless of saturation and brightness, the S and V filters can be deactivated. However, if only the luminous shades of red should be allowed to pass through the filter, the saturation filter must be activated and all colors beginning with a given gray-scale value up to maximum saturation must be allowed to pass through.
If only the dark shades of red should be allowed to pass through the filter, the brightness filter must be adjusted such that the upper threshold is set to the brightest desired value and the lower threshold to 0 (black).

The hue and saturation filters cannot be used in applications for which a gray image or a single-color imprint needs to be evaluated. An image which consists exclusively of identical hues with varying brightness values can only be analyzed with the brightness.

If a color image includes black, white or gray areas and certain shades of color must be permitted to pass through the filter, the saturation filter has to be used and must be set for colors with high saturation values. Black, white and gray tones do not have any defined H values, and are thus allocated a color at random. These must be sorted out by means of their characteristic saturation value (= 0).

Example:

If the red area in this image needs to be detected (allowed to pass through the filter), the H filter must be set so that all red are allowed to pass. However, due to that fact that white areas are included (white frame) which need to be suppressed, the saturation filter must also be used.
The settings required for each individual filter are described in the following. One or more filters can be selected in order to generate the digitized black and white image.
The **histogram** or the **profile** showing the brightness values and distribution may be helpful with this.

13.6.2 Setting Parameters

Image area A preview of the threshold HSV analysis appears in the image area. The preview is for the selected region only.

Property The following settings/results are displayed:

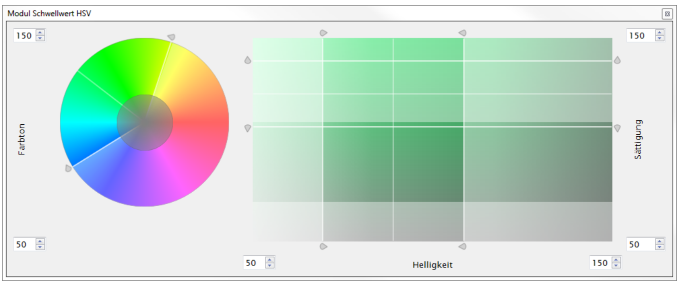
Process Time [µs]	Process Time for the process steps.
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 358).
Pixel Count	Display of the number of white pixels counted in the region of interest.
Input region	Selection of the region for the threshold process.
Input image	Selection of the channel for the image input
Teach	The current number of pixels is taught in by adapting the minimum and maximum values for the number of pixels.

Function field A window can be opened in the function field which serves as an adjustment tool for the HSV threshold module.


Opening the adjustment tool


Opening the magic wand tool

Graphic shifting of thresholds



13.6.3 Configuration

The HSV threshold module includes the following configuration options:
- Hue
- Saturation
- Value

13.6.3.1 Submodule Hue

Objective The filter can be adjusted for the hue.

Property The following settings/results are displayed:

Active	The filter for the hue can be activated or deactivated.
Threshold Low	Sets the lower threshold for brightness.
Threshold High	Sets the upper threshold for brightness.

13.6.3.2 Submodule Value

Objective The brightness filter can be adjusted.

Property The following settings/results are displayed:

Active	The brightness filter can be activated or deactivated.
Threshold Low	Sets the lower threshold for brightness.
Threshold High	Sets the upper threshold for brightness.

13.6.3.3 Submodule Saturation

Objective The saturation filter can be adjusted.

Property The following settings/results are displayed:

Active	The saturation filter can be activated or deactivated.
Threshold Low	Sets the lower threshold for saturation.
Threshold High	Sets the upper threshold for saturation.

13.7 Module Cluster (for Smart Camera Only)

13.7.1 Overview

Objective Detect, count or sort objects reliably in order to check for presence and correct quantity.

Procedure The minimum and maximum number of neighboring pixels which make up a cluster need to be specified. It's also possible to specify the maximum number of objects to be counted, as well as the criteria according to which the objects will be sorted.

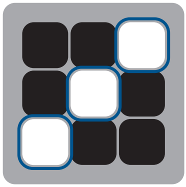
13.7.2 Setting Parameters

Image area Detected clusters appear in the image area with a red frame.

Property The following settings/results are displayed:

Process Time [µs]	Process Time for the module.
Module State	Error codes for troubleshooting support (see section "25.5 Module Status" on page 358).
Cluster True Count	The number of objects in the image area which has been detected using the corresponding settings is displayed. The upper and lower thresholds for the number of clusters can be adjusted manually. **NOTE!** The number of clusters found is independent of the maximum number of clusters.
Input image	Selection of the channel for the image input Only binary black-white images can be linked as an input image.
Cluster Size Min	The minimum number of adjoining white pixels can be specified, so that the respective area is counted as a cluster.
Cluster Size Max	The maximum number of adjoining white pixels can be specified, so that the respective area is still counted as a cluster.

Property

Cluster gap	Connected 4	Only directly adjacent white pixels (above, below to the left and to the right) are interpreted as belonging together to a single object.  Three clusters are counted in the example.
	Connected 8	Pixels joined by their corners are also interpreted as belonging together to a single object.  Only one cluster is counted in the example.
Cluster Size Max	Defines the size of the cluster list. **NOTE!** The number of clusters found is independent of the maximum number of clusters.	
Sort Rule	The rule used for sorting clusters can be defined.	
	Size	Detected clusters can be sorted according to size. The detected clusters appear in the cluster list in order of descending surface area.
	Center of gravity X	Detected clusters are sorted according to the location of their center of gravity along the X-axis, and objects appear from left to right in the cluster list.
	Center of gravity Y	Detected clusters are sorted according to the location of their center of gravity along the y-axis, and objects appear from top to bottom in the cluster list.
	Center of gravity YX	Detected clusters are sorted according to the location of their center of gravity along the X and Y-axes, and objects appear from top left to bottom right in the cluster list.

Property

Variant	The variant of the algorithm used is shown. **NOTE!** • Only variant A works on the weQube (online) • Only variant B works on the Windows computer (offline) • When switching between online and offline, the cluster module variant must be changed manually. • A maximum of 255 clusters can be found on the Windows computer with variant B.

13.7.3 Configuration

The cluster module includes the following configuration options:
- Cluster list.

13.7.3.1 Submodule Cluster List

Objective Detected clusters are listed in this sub-module in order to subsequently transmit their position, number of pixels etc. via an output.

Property The following settings/results are displayed for any selected cluster:

Pixel size	The number of pixels in the cluster is displayed.

The coordinates of the cluster’s center of gravity are displayed under Center of gravity.

13.8 Blob Module (for Vision System Only)

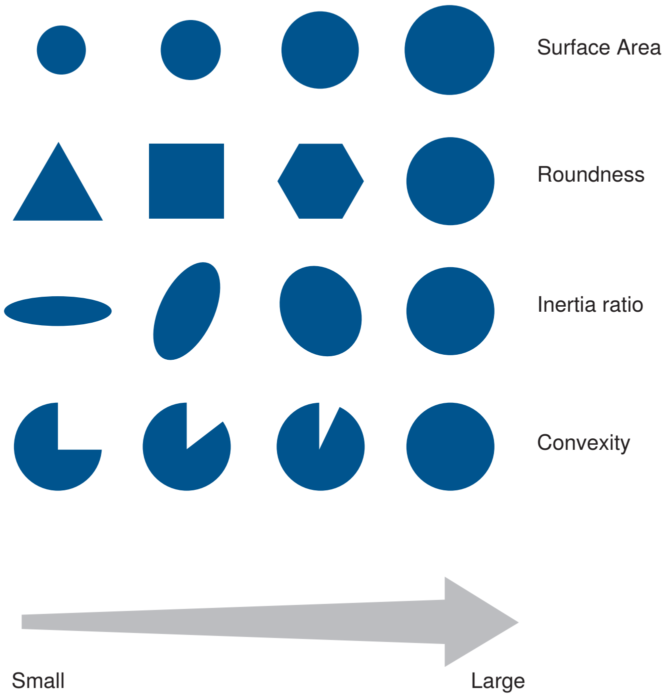
13.8.1 Overview

Objective

Adjacent white pixels are detected as a blob (object). Blobs can be limited with different criteria (e.g. area, circumference, convexity), for example so that only blobs with a certain area can be found.
The coordinates of blobs or the number of detected blobs can be used for presence or completeness checks, or for exchanging coordinates.

Abbreviated procedure

A binary black-and-white image must be linked as the input image. A project module is required to this end which generates a binary image of this sort (e.g. threshold module). The criteria for limiting the blobs can then be activated and suitable minimum and maximum values can be assigned to them. In this way, only objects which meet the criteria are detected. Several criteria can be activated. The following graphic shows various characteristics from “small” to “large” for several characteristics.



The number of detected blobs is read out. Any desired sorting of the objects is also possible. Depending on the active filter, different values (e.g. center of gravity, area) are calculated for detected blobs in the blob list.

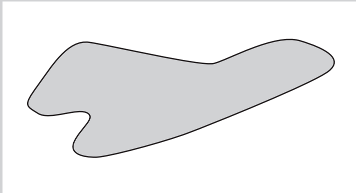
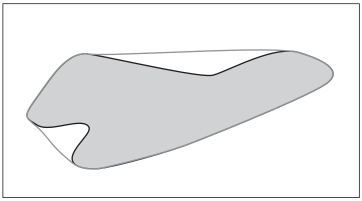
13.8.2 Setting Parameters

Property

The following settings/results are displayed:

Process time [µs]	Processing time for the module
Module state	Error codes for troubleshooting support (see section "25.5 Module Status" on page 358).
Blob true count	The number of detected blobs that match the criteria is displayed. Minimum and maximum limit values can be assigned to this value, e.g. in order to apply the value to a digital output. **NOTE!** The number of detected blobs is independent of the value for "Blob max count".
Input image	Selection of the channel for the image input Only binary black-and-white images (e.g. from the threshold module) can be linked as input images.
Blob max count	Maximum number of blobs defines the size of the blob list. **NOTE!** The number of detected blobs is independent of this value.
Contour Mode	It can be adjusted if all blobs (also blobs within blobs) or only outer blobs should be detected.
Sort rule	Detected blobs can be sorted according to different criteria (e.g. descending surface area).
Blob bounding box orientation	The box enclosing the blobs is defined by the maximum width and height of the blobs. If this function is not active, the enclosing box is without orientation. If this function is active, the orientation of the blobs is also used for the enclosing box. In this case, width corresponds to the largest value and height to the smallest value of the blob.
Create output blob image	If a checkmark is entered here, the blob module generates a binary output image containing all detected blobs.

Property

Feature area [unit]	If this criterion is active, minimum and maximum limit values can be entered for area. In this way, only those blobs are detected whose area lies within the limit values. Area is defined as the number of conjoining white pixels. 
Feature area hull [unit]	If this criterion is active, minimum and maximum limit values can be entered for envelope area. In this way, only those blobs are detected whose envelope area lies within the limit values. Envelope area is the area of an imaginary band surrounding the blob. Indentations are thus included in the blob. 
Feature circularity	If this criterion is active, minimum and maximum limit values can be entered for circularity. In this way, only those blobs are detected whose roundness lies within the limit values. Blob circularity is determined by means of the following formula: $\frac{\text{Area}}{\text{Circumference}^2} \times 4\,\pi$ Circularity can only assume values within a range of 0 to 1. An ideal circle has a value of 1.

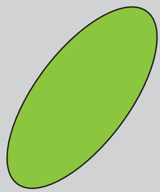
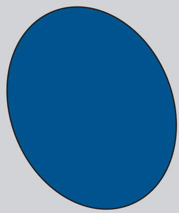
Property

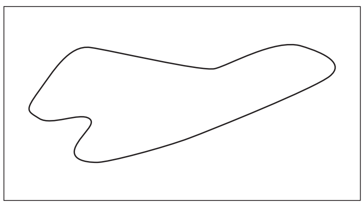
<table>
<tr><td>Feature convexity</td><td>If this criterion is active, minimum and maximum limit values can be entered for convexity. In this way, only those blobs are detected whose convexity lies within the limit values.

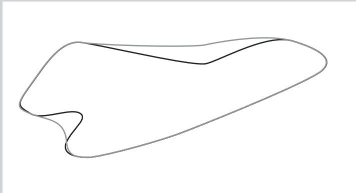
Convexity is defined as area divided by envelope area. This criterion can be used, for example, to detect indentations in blobs.

Convexity can only assume values within a range of 0 to 1. An ideal circle has a value of 1.</td></tr>
<tr><td>Feature inertia ratio</td><td>If this criterion is active, minimum and maximum limit values can be entered for inertia ratio. In this way, only those blobs are detected whose Inertia ratio lies within the limit values.

Inertia ratio is defined as the inertial resistance of the blob to rotation about its principal axes. The value has to be analysed in experiment for certain blobs.

Inertia ratio can only assume values within a range of 0 to 1. An ideal circle has an Inertia ratio of 1 and a line has an Inertia ratio of 0.
<table>
<tr><th>Low value</th><th>High value</th></tr>
<tr><td></td><td></td></tr>
</table></td></tr>
<tr><td>Feature perimeter [unit]</td><td>If this criterion is active, minimum and maximum limit values can be entered for perimeter. In this way, only those blobs are detected whose perimeter lies within the limit values.

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

Property	**Feature perimeter hull [unit]**	If this criterion is active, minimum and maximum limit values can be entered for perimeter hull. In this way, only those blobs are detected whose perimeter hull lies within the limit values. Perimeter hull is the perimeter of an imaginary band surrounding the blob. Indentations are thus included in the blob. 

13.8.3 Configuration

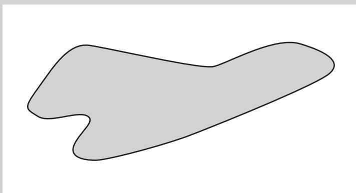
The blob module includes the following configuration options:

- Blob list

13.8.3.1 Blob List Submodule

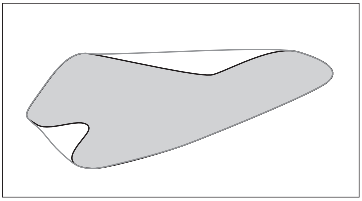
Objective Detective blobs are listed in the blob list submodule according to the sorting rule. Calculated results (e.g. area, center of gravity) are indicated for each blob.

Property The following settings/results are displayed:

Area [unit]	The area of the selected blob is displayed. Area is defined as the number of conjoining white pixels. 

Property

Area hull [unit]	Area hull of the selected blob is displayed. Area hull is the area of an imaginary band surrounding the blob. Indentations are thus included in the blob.
Circularity	The circularity of the selected blob is displayed. Blob circularity is determined by means of the following formula: $\frac{\text{Area}}{\text{Circumference}^2} \times 4\pi$ Circularity can only assume values within a range of 0 to 1. An ideal circle has a value of 1.
Convexity	The convexity of the selected blob is displayed. Convexity is defined as area divided by envelope area. This criterion can be used, for example, to detect indentations in blobs. Convexity can only assume values within a range of 0 to 1. An ideal circle has a value of 1.
Inertia ration	The inertia ratio of the selected blob is displayed. Inertia ratio is defined as the inertial resistance of the blob to rotation about its principal axes. The value has to be analysed in experiment for certain blobs.
Perimeter [unit]	The perimeter of the selected blob is displayed.
Perimeter hull [unit]	Perimeter hull of the selected blob is displayed.



Furthermore, center of gravity including orientation and the result region with the origin, orientation, width and height of the blob are read out for each blob.

13.9 Module Measure

13.9.1 Overview

Objective	Specify and perform dimensional conformance inspections of removals, lengths, diameters or angles. Lines and circles are found with the help of search rays. Distances and angles can be measured between detected lines or points.
Abbreviated procedure	Specify and perform dimensional accuracy checks on removals, length, diameter or angle. Lines and circles are found with the help of search rays. Distances and angles can be measured between detected lines or points.

13.9.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [µs]	Process Time for the module.
Module State	Error codes for troubleshooting support (see section "25.5 Module Status" on page 358).
Input image	Selection of the channel for the image input
Coordinate system	Selection can be made regarding how the functions should be tracked.

Function field

	Point	A fixed point can be specified, or a point can be linked from another module.
	Line	A line is drawn. An edge is detected on the basis of this search line.
	Circle	A circle is drawn which is defined by means of two points. An edge is detected on the basis of this search circle.
	Circle	A circle is drawn which is defined by means of three points. An edge is detected on the basis of this search circle.
	Distance	The distance between different points or lines is calculated.
	Angle	The angle between two lines is ascertained. A line is defined by a starting point and an end point. The angle between the lines is here calculated from the first to the second line in clockwise direction and output from –180...180°. **NOTE!** Positive angles in the x-y plane are clockwise, negative angles in the x-y plane are counter-clockwise.
	Segment on line	A line is drawn. Segments are looked for on this line.
	Segment on circle	A circle is drawn which is defined by means of two points. Segments are looked for on this circle.
	Segment on arc	An arc is drawn which is defined by means of a starting point, an end point and a radius. Segments are looked for on this arc.
	Property of Geometry	Special points of a shape such as start, middle or end points can be found.

13.9.2.1 Submodule Find Point

Objective Find a point.

Procedure A fixed point can be specified, or a point can be linked from another module.

Property The following settings/results are displayed:

Found point	The found point is shown.
Input point	A fixed point can be specified, or a point can be linked from another module.

13.9.2.2 Submodule Find Line, Circle or Arc

Objective Detect a line, circle or arc.

Procedure First of all, activate the function in the toolbar. After the tool has been activated, the shape can be drawn in the image area.
Search rays are generated perpendicular to the search geometry. An edge is searched for on each of these search rays according to the settings. These detected edges form a point cloud through which the searched for shape is placed, for which the clearance to the point cloud is as small as possible. Individual points may be detected as outliers and ignored during the next iteration step (renewed best-fit calculation). This best-fit calculation is executed as many times as selected under fitting iterations.

Property The following settings/results are displayed:

Quality of Fit [%]	Proportion of the valid points in relation to all found points.
Edge polarity	Expected brightness characteristics Either: Both bright to dark and dark to bright transitions are searched for. Light to dark: Only bright to dark transitions are searched for. Dark to light: Only dark to bright transitions are searched for.
Find by	This parameter can be used to specify which of the detected edges will be used on the search line. Best score: If several edge transitions are detected on the search geometry, the transition with the greatest contrast is selected. First score: If several edge transitions are detected on the search geometry, the first transition in the search direction is selected. Last score: If several edge transitions are detected on the search geometry, the last transition in the search direction is selected.
Edge width [unit]	“Edge width” influences detection sensitivity for brightness fluctuations. **Note:** • An edge width of 3 pixels reacts to even the smallest contrast change in the image. • An edge width of 9 pixels smooths the brightness profile over a distance of 9 pixels and ignores small irregularities.

Property

Threshold gradient positive	Positive threshold gradient specifies the positive acceptance threshold. **Note:** The gradient corresponds to the change in brightness from one pixel to the next. The higher the edge's contrast, the larger the gradient.
Threshold gradient negative	The negative threshold gradient specifies the negative acceptance threshold. **Note:** The gradient corresponds to the change in brightness from one pixel to the next. The higher the edge's contrast, the larger the gradient.
Threshold outlier distance [unit]	Maximum distance to the detected shape which must be maintained by a point, in order for it to be used in the next iteration. Points which are farther away than this distance are treated as outliers.
Search ray length	Length of the search rays, along which an edge transition is searched for.
Search ray interval	Distance between the search rays, along which an edge transition is searched for. Generally speaking, the use of several search rays increases accuracy, but also requires more computing time. **Note:** Enlarging the interval is especially effective for faster evaluation.
Search Ray Orientation	The direction of the search ray can be turned 180° with this setting.
Points to Use [%]	The percentage indicates how many points will be used to ascertain the shape.
Points to Use Strategy	The points which should be used to ascertain the geometry are specified. Selection can be made between the first and the last points on the search geometry. The search direction is made apparent by the direction of the arrow in the search geometry in the image.
Fit Maximal Geometry	The search for start and end points can be switched on or off.
Maximal Gap between Valid Points	Start and end points of geometries are found if the distance between two successive valid points is larger than the space specified by this value.
Maximal Outliers in a Row	Start and end points of geometries are found if there is a larger number of successive outliers than specified by this value.

Property

The following results are calculated for the geometries detected, depending on the geometry.

For lines:
- Point 1 and 2 as well as the midpoint of the line detected
- Length of the line
- The angle from the search geometry to the detected geometry (positive counter-clockwise)

For arcs:
- Diameter of arc detected
- Angle start and circumference (depending on the input coordinate system; positive clockwise)
- Coordinates from the beginning, center and end of the arc
- Length of arc detected
- Angle from search geometry to detected geometry (positive clockwise). The orientation of the arcs is hereby defined from the midpoint of the arc to the center on the arc.

For circles:
- Diameter

13.9.2.3 Submodule Distance

Objective

Ascertain distance between two points, or between a point and a line.

Procedure

First of all, activate the function in the toolbar.
Click the first point or the first line, and then click the second point or second line.

Property

The following settings/results are displayed:

Output distance [unit]	Distance is displayed in pixels. The value can be furnished with any desired upper and lower thresholds. Click the ascertained value to this end, and then click the button. Enter the desired upper and lower threshold values to the window which then appears.
Calculation method	The type of distance calculation to be used is specified: Geometrical distance: Shortest path from a point to a line (perpendicular) Center to point: Shortest path between two center points.

13.9.2.4 Submodule Intersection

Objective The angle between two lines is measured.

Procedure First of all, activate the function in the toolbar.
Click the first line, and then the second.

Property The following settings/results are displayed:

Output Intersection Point	The coordinates of the found intersection are displayed.
Output angle [deg]	The angle between the two lines is displayed. A line is defined by a starting point and an end point. The angle between the lines is here calculated from the first to the second line in clockwise direction and output from –180...180°. **NOTE!** Positive angles in the x-y plane are clockwise, negative angles in the x-y plane are counterclockwise.

13.9.2.5 Find Segments on Line, Arc or Circle Submodule

Objective Segments should be found on a line, circle or an arc.

Procedure First of all, activate the function in the toolbar. After the tool has been activated, a shape can be defined.
Edge transitions are searched for on the search geometry according to the settings.
The detected edges serve as starting and end points of the various segments. There are different parameters which influence the number and length of the segments.

Property The following settings/results are displayed:

Segments True Count	The number of detected segments is displayed. **NOTE!** The number of segments found is independent of the maximum number of segments.
Edge width	“Edge width” influences detection sensitivity for brightness fluctuations. **Note:** • An edge width of 3 pixels reacts to even the smallest contrast change in the image. • An edge width of 9 pixels smooths the brightness profile over a distance of 9 • pixels and ignores small irregularities.
Threshold gradient positive [GrM]	Threshold value Gradient Pos specifies the positive gradient acceptance threshold. **Note:** The gradient corresponds to the change in brightness from one pixel to the next. The higher the edge’s contrast, the larger the gradient.
Threshold gradient negative [GrM]	Threshold Gradient Neg specifies the negative gradient acceptance threshold. **Note:** The gradient corresponds to the change in brightness from one pixel to the next. The higher the edge’s contrast, the larger the gradient.
Segments Count Max	Maximum number of segments to be expected. **NOTE!** The number of segments found is independent of the maximum number of segments.
Segments Length Min	Minimum length of the segments
Segments Length Max	Maximum length of the segments

Sort Rule	The rule used for sorting segments can be defined. Position on search ray: Sorting is based on the position on the search ray. The results depend on the orientation setting. Size [longest first]: Segments are sorted in descending order beginning with the longest segment. Size [shortest first]: Segments are sorted in ascending order beginning with the shortest segment.
Segment brightness	This setting specifies whether bright or dark segments will be evaluated.
Orientation	The search direction can be turned 180° with this setting.

The following results are calculated for the geometries detected, depending on the geometry.

For segments on lines:
- Point 1 and 2 as well as the midpoint of the line detected
- Length of the line

For segments on arcs and circles:
- Diameter of arc detected
- Angle start and circumference (depending on the input coordinate system; positive clockwise)
- Coordinates from the beginning, center and end of the arc
- Length of arc detected

13.10 Module Code 1D

13.10.1 Overview

Objective

All common 1D codes can be read with the 1D code module.

The following 1D codes can be read: Code39, Code128, 2/5 Industrial, 2/5 Interleaved, Codabar, EAN-13, EAN-13 Add-On 2, EAN13 Add-On 5, EAN-8, EAN-8 Add-On 2, EAN-8 Add-On 5, UPC-A, UPC-A Add-On 2, UPC-A Add-On 5, UPC-E, UPC-E Add-On 2, UPC-E Add-On 5, Code 93, MSI, PharmaCode, RSS-14, RSS-14 Truncated, RSS-14 Stacked, RSS-14 Stacked Omnidir, RSS Limited, RSS Expanded, RSS Expanded Stacked.

Procedure

Various code settings can be entered in order to assure reliable code recognition.

13.10.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [µs]	Process Time for the process steps.
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 358).
Reading True Count	The number of codes detected in the read image.
Input image	Selection of the channel for the image input
Code type	The type of code can be selected: Code39, Code128, 2/5 Industrial, 2/5 Interleaved, Codabar, EAN-13, EAN-13 Add-On 2, EAN13 Add-On 5, EAN-8, EAN-8 Add-On 2, EAN-8 Add-On 5, UPC-A, UPC-A Add-On 2, UPC-A Add-On 5, UPC-E, UPC-E Add-On 2, UPC-E Add-On 5, Code 93, MSI, PharmaCode, RSS-14, RSS-14 Truncated, RSS-14 Stacked, RSS-14 Stacked Omnidir, RSS Limited, RSS Expanded, RSS Expanded Stacked The code to be read can be identified with the “Auto” mode. If the code was identified correctly, this must be selected to receive the decoded code content.
Read Timeout [µs]	The time during which the sensor attempts to read the code. If reading is not successful within this period of time, the process is aborted and the reading results are rendered invalid. The time can be selected within a range of 0 to 20 s. Aborting the read attempt takes about 20 ms. The module’s minimum processing time is thus also 20 ms.
Reading Max Count	The maximum number of codes to be read from the image is specified.
Quality grading	Quality grading of the code in accordance with ISO/IEC 15416 can be activated. Note: Activation of this functions extends the module’s deciphering time. **Note:** The results of the code evaluation in accordance with the standard can be found in the configuration reading list.

13.10.3 Configuration

The 1D code reading module includes the following configuration:
- Reading list
- Extended parameters

13.10.3.1 Submodule Reading List

Property

The following settings/results are displayed:

<table>
<tr><th>Reading #0</th><th colspan="2">Scanned code</th></tr>
<tr><td rowspan="11">Quality</td><td colspan="2">If quality according to ISO 15416 is activated, the results of quality testing are displayed at this level.
The evaluation of code quality is specified as a number between 0 and 4, 0 being the worst and 4 the best evaluation.</td></tr>
<tr><td>Overall quality</td><td>Minimum value of all remaining degree values</td></tr>
<tr><td>Decode</td><td>Is set to 4 if the inspected barcode symbol could be read, otherwise is set to 0.</td></tr>
<tr><td>Symbol Contrast</td><td>The difference between the maximum and minimum reflection value of the gray-scale value profile: strong contrast results in a better value.</td></tr>
<tr><td>Minimal Reflectance</td><td>Is set to 4 if the minimum reflection value of the gray-scale value profile is lower than or equal to 0.5 of the maximum reflection value, otherwise is set to 0.</td></tr>
<tr><td>Minimal edge contrast</td><td>Evaluates the minimum edge contrast in the gray-scale value profile.</td></tr>
<tr><td>Modulation</td><td>Evaluates the amplitude between the symbol elements. Higher amplitudes mean that bars and holes can be differentiated more reliably and that this degree is evaluated higher.</td></tr>
<tr><td>Defects</td><td>Are irregularities in the gray-scale value profile within individual symbol elements of the quiet zones. The presence of these irregularities is evaluated with a lower degree.</td></tr>
<tr><td>Decodability</td><td>Refers to deviations in the symbol element widths from their nominal value, which is defined in the relevant symbology standard.</td></tr>
<tr><td>Additional requirements</td><td>Are further symbology-specific requirements, such as the quiet zone width, the wide/narrow ratio, inter character gaps, guarding patterns or others.</td></tr>
<tr><td colspan="2">Note: More detailed information regarding the results of quality testing can be found in the corresponding standard.</td></tr>
</table>

13.10.3.2 Extended Parameters Submodule

Element size min	The minimum size of an element, i.e. the minimum width of all bars and spaces. For extremely narrow barcodes, the value should be reduced to 1.5. For extremely large barcodes, the value can be made larger accordingly, resulting in shorter runtimes. Typical value range: [1.5…10.0] Standard: 2.0
Element size max	The maximum size of an element, i.e. the maximum width of all bars and spaces. This value should be large enough that the candidate region is found for the complete symbol. On the other hand, it must not be so large that two neighboring barcodes merge into a single candidate. Typical value range: [4.0…60.0] Standard: 8.0
Element height min	The minimum height of the barcode element. The presetting with –1 means that, internally, the height of the barcode is selected automatically according to the other setting. With extremely flat barcodes with a height of less than 16 pixels, it is advisable to set the height manually so that the barcode is found and can be read. The minimum height is 8 pixels. With extremely high barcodes, e.g. with 70 pixels and more, the manual setting to the relevant height can result in an acceleration during reading. Typical value range: [–1, 8…64] Standard: –1
Number of scan lines	The maximum number of scan lines used when scanning a (candidate) symbol. If 'Number of Scanlines' is not set (the parameter has a value of 0), the number of scan lines is determined based on an internal rule: 10 for all single-line barcodes, 20 for RSS-14 Stacked or RSS-14 Stacked Omnidirectional and 55 for RSS Expanded Stacked. With this parameter, the speed can be increased in two cases. In the first case, the image contains a high number of incorrect candidates. While the barcode can usually be decoded after one or two scanning processes (except for stacked arcs, see below), an incorrect candidate is scanned with the standard value of 10 scan lines, which increases the runtime unnecessarily. Logically, the speed can be increased with a reduced number of scan lines. Generally speaking, we can say that images of higher quality require fewer scan lines than images of poorer quality. For an average image, a value between 2 and 5 should be sufficient. However, should a barcode no longer be found after the scan lines are reduced, the number of scan lines must be increased again. The second case refers to stacked barcodes (currently RSS-14 Stacked, RSS-14 Stacked Omnidirectional and RSS Expanded Stacked). In this case, all scan lines are evaluated – in contrast to single-line barcodes (e.g. Code 128, EAN 13 or RSS Limited), where the scanning is ended once the code has been successfully decoded. The scanning process is one of the most time-consuming phases of the algorithm. Adjusting the parameter 'Number of Scanlines' can therefore offer major advantages with regard to speed. This applies in particular for RSS Expanded Stacked. A RSS Expanded Stacked Symbol can usually consist of up to 11 lines. To ensure that each line is read reliably by 5 scan lines each, Operator 55 includes scan lines for the general situation. If only symbols with a low number of lines are to be expected, 'Number of Scanlines' should be reduced to between 1.5 and 5 scan lines per expected line. Typical values: [0, 5, 10, 20 …] Standard: 0

Identical Scan-lines Min	The minimum number of scanning lines which deliver the same result, which is necessary in order to accept the deciphering of a symbol. If this parameter has not been set (i.e. if it has a value of 0), the barcode is deciphered as soon as a scanning line has been successfully decoded. The probability that the barcode will be read incorrectly can be reduced with this parameter. The standard value of 0 is recommended for all barcode types except for 2/5 Industrial and 2/5 Interleaved. In the case of code types 2/5 Industrial and 2/5 Interleaved, a value of at least 2 is recommended in order to minimize incorrect reading. It's also advisable to select a value of 2 or higher in order to prevent reading barcodes inadvertently, especially when image quality is poor or the edges of the bars can't be clearly detected.
Orientation	Expected barcode orientation angle. A potential (candidate) barcode has bars with a similar orientation. The parameters 'Orientation' and 'Orientation tolerance' can be adjusted to define the value range ['Orientation '-'Orientation tolerance', 'Orientation '+'Orientation tolerance']. The barcode algorithm only processes candidate regions with bars with an average orientation angle within the upper value range. If the barcodes only appear with a specific orientation in the processed images, the value range can be reduced accordingly so that incorrect candidates are detected earlier, thus reducing the execution time for the operator. This strategy is particularly beneficial if the processed images contain lots of background texture with incorrectly oriented candidates. The scanning direction is not taken into account and only angles in the value range [–90.0…90.0] are of interest. Typical value range: [–90.0…90.0] Standard: 0.0
Orientation tolerance	Tolerance for the orientation. See 'Orientation' for further details. As already explained, only the value range [-90.0…90.0] is taken into account, which is covered completely with an 'Orientation Tolerance' of 90.0. The 'Orientation Tolerance' values are therefore limited to the value range [0.0…90.0]. The value 90.0 means that there is no orientation restriction for the candidates. Typical value range: [0.0…90.0] Standard: 90.0
Start stop tolerance	Requires a tolerant ('high') or a strict ('low') matching criteria during the search for start or stop patterns in a scan line. A tolerant criteria increases the scanning rate in general, particularly in images with poor contrast. On the other hand, this setting can result in invalid decodings in images with noise or in images with symbols from other barcode types. A strict criteria increases the reliability against incorrect decoding, but can also reduce the general scanning rate. It should be noted that two different criteria are only implemented for Code 128. Values: ['high', 'low'] standard: 'high'
Threshold	Edges are found within a scan line with the help of a threshold value. 'Threshold value' determines how this threshold value is calculated relative to the dynamic gray-scale value range along the scan line. If irregularities are present in the search region of if the noise is too great, the value settings for 'Threshold value' should be incre ased. Typical value range: [0.05…0.2] Standard: 0.05

Threshold absolute	The parameter 'Threshold value absolute' is used to prevent incorrect edge detection. If a scan line enters an image region with a dynamic range that is too small (e.g. a predominantly white region with gray-scale values close to 255), the threshold value for edge detection is calculated too small. This often leads to larger quantities of incorrect edges being detected. If the threshold value based on the parameter 'Threshold value' is smaller than the value of parameter 'Threshold value absolute', the latter value is taken as the threshold value. 'Threshold value absolute' is set to 5.0 as standard. If images with a higher noise level are processed, it may be beneficial to increase the parameter value. On the other hand, if noise-free images with low contrast are processed, this parameter could impede the detection of correct edges. In these cases, it is advisable to reduce the parameter value or even to deactivate the parameter (set to 0.0). Typical value range: [0.0…10.0] Standard: 5.0
Maximum orientation deviation	A potential barcode region consists of bars and also edges with a uniform orientation. The parameter 'Max different orientation' shows how significant the difference in orientation of neighboring edges can be. 'Max orientation deviation' is a difference angle in degrees. If a barcode is frayed, i.e. the bar edges are faulty, a high 'orientation deviation' value should be selected. With small values, on the other hand, the number of incorrect barcode candidates can be reduced. Typical value range: [2…20] Standard: 10
Check character	This parameter decides whether, for a barcode with optional check character, this is taken into account and whether or not it is output in the resulting character sequence. Barcodes with an optional check character are e.g. Code 39, Codabar, 2/5 Industrial or 2/5 Interleaved. As standard, the check character is interpreted as a normal data character and output in the character sequence – 'Check Character' is then equal to 'absent'. If the user knows that the searched for code contains a check character, this should also be tested – 'Check character' must be set to 'present'. With a positive test, the check character is then not output in the resulting character sequence. With a negative test on the check character, the relevant bardcode is not returned as a result. Values: ['absent', 'present'] Standard: 'absent'
Composite code	A 2D composite code can be attached to EAN.UPC barcodes. If 'Composite Code' is set to 'CC-A/B', the composite component is localized and decoded. 'Composite Code' is set to 'not available' as standard and the composite component next to the barcode is ignored. If a barcode of the searched-for type contains no composite components, only the result of the barcode is returned. Composite codes are only supported together with an arc of type RSS-14 Stacked or RSS-14 Stacked Omnidirectional. Values: ['none', 'CC-A/B'] Standard: 'none'
UPCE Encodation	UPC-E-barcodes can be returned in different output formats. 'UPCE coding' is set to 'ucc-12' as standard and the decoded string is returned in the UCC-12 format (consisting of 12 characters). If 'UPCE coding' is set to 'zero-suppressed', the result is returned in zero-suppressed- format (i.e. with suppressed zeros at defined points). This format consists of a leading zero, six coded characters and an implicitly coded check character. This corresponds to the format required by ISO/IEC 15420. Values: ['ucc-12', 'zero-suppressed'] Default: 'ucc-12'
Code length min	Minimum code length

13.11 Module Code 2D

13.11.1 Overview

Objective

All common 2D codes can be read with the 2D code reading module.
The following 2D codes can be read:

- Data Matrix ECC 200
- QR Code
- PDF417

Procedure

An object with a corresponding 2D code is scanned.

13.11.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [µs]	Process Time for the module.
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 358).
Reading True Count	The number of 2D codes which have been read is displayed.
Teach	Reading of the current 2D codes is adjusted to the respective conditions.
Input image	Selection of the channel for the image input
Code type	The type of 2D code can be selected. • Data Matrix ECC 200. • QR Code. • PDF417.
Recognition	In the case of poor code quality, it is advisable to set this parameter to enhanced or maximum. Standard: Easily legible 2D codes are recognized quickly and reliably in the standard mode. Enhanced: Difficult 2D codes can be read in the enhanced mode. However, processing takes longer.
Read Timeout [µs]	The time during which the sensor attempts to read the code. If reading is not successful within this period of time, the process is aborted and the reading results are rendered invalid. The time can be selected within a range of 0 to 20 s. Aborting the read attempt takes about 20 ms. The module’s minimum processing time is thus also 20 ms.

Reading Max Count	The maximum number of code to be read simultaneously can be specified. Up to 20 codes can be read during one image recording operation.
Quality Grading	Quality grading of the code can be activated. Attention: Activation of this functions extends the module's decoding rate. None — No quality grading. ISO/IEC 15415 — Quality grading in accordance with ISO/IEC15415. AIM DPM-1-2006 — Quality grading in accordance with AIM DPM-1-2006. **Note:** Only available for ECC200 and QR Code. **Note:** The results of the code evaluation in accordance with the selected standard can be found in the configuration reading list.

13.11.3 Configuration

The 2D code module includes the following configuration:

- Reading List
- Extended parameters

13.11.3.1 Submodule Reading List

Property The following settings/results are displayed:

Reading #0	Scanned code	
Quality	In accordance with the standard, the individual degrees are evaluated with a value between 0 to 4, where 0 stands for the lowest and 4 for the highest degree. It is important to note that, although this implementation adheres strictly to the standard, the evaluation of the degrees depends on the data code decoding procedure. This means that the evaluation results may deviate slightly from the results of other datacode readers (from other providers).	
	Overall quality	Minimum value of all remaining degree values Contrast.
	Contrast	Difference between black and white code modules with regard to brightness.
	Modulation	Evaluates the amplitude between the data code modules. Higher amplitudes mean that dark and bright modules can be differentiated more reliably and that this degree is evaluated higher. It should also be noted that the evaluation of modulation depends on the error correction capacity of the symbol. This means that modulation for symbols with a higher error correction capacity degrades more slowly.
	Fixed Pattern Damage	Position inspection of the fixed pattern (L-border, clock pattern and quiet zones).
	Decode	Is always set to 4 if the code could be read.
	Axial Nonuniformity	Data code symbols usually have square modules, i.e. the width and height of a module are equal. Their ratio may also be unequal due to an angled camera view or incorrect generation of a symbol. This deviation is evaluated via the degree of axial unevenness.
	Grid Nonuniformity	If the symbol is suffering from a perspective deformation in addition to an affine deformation, this is evaluated in the unevenness grid accordingly.
	Unused error correction	The unused error correction capacity of the investigated symbol is calculated in the degree of unused error correction. In a certain respect, this degree reflects the reliability of the decoding process. It should be noted that some codes with a degree of unused error correction of 0 can still be decoded. This is because a more reliable decoding algorithm is used than the reference decoding algorithm recommended as standard.

	Mean Light	The mean gray-scale value for the modules is not defined as a degree in AIM DPM-1-2006. It is an evaluation of the quality of the processed image and is defined as a mean gray-scale value for the centers of the bright data code symbol modules. The mean gray-scale value of the modules can have a value between 0.0 to 1.0, which corresponds to between 0% and 100% of the maximum gray-scale value
	Note: Detailed information on the quality calculation can be found in the relevant standards.	

13.11.4 General Settings for All Code Types

Property The following settings/results are displayed:

Polarity	Describes the polarity of the symbol in the image and determines whether the symbol in the image is dark on a bright background or bright on a dark background. Value list: ‘dark on bright’, ‘bright on dark’, ‘all’. Standard: ‘dark on bright’ (extended ‘all’)
Mirrored	Information on a possible mirror-inversion of the symbol (corresponds to a mix-up between columns and lines). Value list: ‘No’, ‘Yes’, ‘All’ Standard: ‘all’
Contrast Min	Minimum contrast between the symbol foreground and the image background. This value can not be determined exclusively by the difference between the gray-scale values of the foreground and background, but also correlates with the rise in the module edges and thus the sharpness of the image. Value range: [1…100] Standard: 30 (Extended: 10)
Small modules robustness	Robustness of the decoding with data codes with an extremely small module size. If the parameter ‘Small Modules Robustness’ is set to ‘High’, the probability that data codes can be decoded with extremely small modules increases. In this case, the minimum module size should also be adapted accordingly, i.e. ‘Module size min’ or ‘Module width min’ (PDF417) should be set to the assumed minimum module size or module width. If ‘Small Modules Robustness’ is set, the internal memory requirements can increase significantly. ‘Small Modules Robustness’ should therefore usually be set to ‘low’. Value list: ‘low’, ‘high’ Standard: ‘low’ (extended: ‘high’)
Strict model	Controls the behavior during the detection of symbols, which do not correspond to the module specifications in terms of symbol size. These can either be rejected (’Yes’) or returned as a result despite the difference in size (’No’). Value list: ‘Yes’ (strict), ‘No’ (not strict) Standard: ‘Yes’

13.11.5 Data Matrix ECC 200

Property

<table>
<tr><td>Symbol Columns min</td><td>Minimum number of columns of the symbol in modules. Value range: [10…144] - straight Standard: 10</td></tr>
<tr><td>Symbol Columns max</td><td>Maximum number of columns of the symbol in modules. Value range: [10…144] - straight Standard: 144</td></tr>
<tr><td>Symbol Rows min</td><td>Minimum number of lines of the symbol in modules. Value range: [8…144] - straight Standard: 8</td></tr>
<tr><td>Symbol Rows max</td><td>Maximum number of lines of the symbol in modules. Value range: [8…144] - straight Standard: 144</td></tr>
<tr><td>Symbol Shape</td><td>Possible restrictions with regard to the shape of the symbol (rectangle and/or square). Attention: Setting the symbol shape changes any previously applied restrictions with regard to the symbol size. For ‘Square’, the minimum values of ‘Symbol columns min’ and ‘Symbol lines min’ and the maximum values of ‘Symbol columns max’ and ‘Symbol lines max’ are used. The restrictions in accordance with the following table also apply:
<table>
<tr><th></th><th>'all'</th><th>'Rectangle'</th><th>'Square'</th></tr>
<tr><td>'Symbol columns min'</td><td>10</td><td>18</td><td>10</td></tr>
<tr><td>'Symbol columns max'</td><td>144</td><td>48</td><td>144</td></tr>
<tr><td>'Symbol lines min'</td><td>8</td><td>8</td><td>10</td></tr>
<tr><td>'Symbol lines max'</td><td>144</td><td>16</td><td>144</td></tr>
</table>
If ‘Symbol columns min’ is larger than ‘Symbol rows max’, ‘Symbol shape’ is set to ‘Rectangle’. If ‘Pattern detection tolerance’ is set to ‘High’ or ‘All’, the value of ‘Symbol shape’ can speed up the symbol search significantly if ‘Rectangle’ or ‘Square’ is selected. Value list: ‘Rectangle’, ‘Square’, ‘All’ Standard: ‘All’</td></tr>
<tr><td>Module size min</td><td>Minimum size of the modules in the image in pixels. Value range: [1…100] Standard: 6 (Extended: 2, Maximum: 1)</td></tr>
<tr><td>Module size max</td><td>Maximum size of the modules in the image in pixels. Value range: [2…100] Standard: 20 (Extended: 100)</td></tr>
<tr><td>Module Gap min</td><td>Minimum space in the direction of the symbol columns and rows. Value list: ‘No’, ‘Small’, ‘Large’ Standard: ‘No’</td></tr>
<tr><td>Module Gap max</td><td>Maximum space in the direction of the symbol columns and rows. Value list: ‘No’, ‘Small’, ‘Large’ Standard: ‘Small’ (Extended: ‘Large’)</td></tr>
</table>

Property

Slant max	Maximum deviation of the angle in the L-shaped finder pattern from (ideally) the right angle (the information is provided as a radian measure and corresponds to perspective distortions which can occur when printing the symbol or during image recording). Value range: [0.0…0.5235] Standard: 0.1745 = 10° (Extended: 0.5235 = 30°)
Find Pattern Tolerance	Tolerance of the search against a distorted or missing finder pattern. The finder pattern contains both the L-shaped and the opposite alternating side. Depending on this parameter, different algorithms are used for the search. In one case ('low'), it is assumed that the finder pattern is mostly present with hardly any distortions. In the other case ('high'), the finder pattern can be heavily distorted or missing completely without impeding the detection. It must be noted, however, that, with this version, the parameters for the symbol search should be restricted as much as possible, as an increased processing time can otherwise be expected. It is also important to remember that both algorithms differ slightly in terms as their robustness. This can mean that, even with symbols with intact finder patterns, different results are achieved depending on the 'Finder Pattern Tolerance'. If 'high' is selected, for example, only symbols with a fixed grid can be found (see below), which reduces the robustness against perspective distortions. With 'All', both algorithms are carried out. Value list: 'Low', 'High', 'All' Standard: 'low' (extended: 'All')
Module grid	Information on whether or not the size of the modules can vary to a certain extent. Depending on this parameter, different algorithms are used for calculating the module positions. In one case ('Fixed') a fixed grid is used, where the spaces between the module center points are all equal. In the other case ('Variable'), the grid is oriented on the alternating side of the finder pattern. With 'All', both variants are tried out for the grid one after the other. It is important to remember that the value of 'Module grid' is ignored if the 'Pattern detection tolerance' is set to 'High'. In this case, a fixed grid is always assumed. Value list: 'Fixed', 'Variable', 'All' Standard: 'Fixed' (Extended: 'All')

13.11.6 QR Code

Property

Model type	Type of the QR code mode. The older QR Code Mode 1 and the new Mode 2 are supported. Value list: 1, 2, 'All' Default: 'All'
Version min	Smallest symbol version to be read. The symbol version corresponds directly with the symbol size. Version 1 corresponds to a symbol with 21×21 modules, Version 2: 25×25 modules etc. up to version 40: 177×177 modules. The maximum symbol size with Mode 1 is 73×73 or Version 14. Value range: [1…40] (Model type 1: [1…14]) Standard: 1
Version Max.	Biggest symbol version to be read: Value range: [1…40] (Model type 1: [1 … 14]) Standard: 40
Symbol size min	Smallest symbol size to be read in modules. This parameter can be used as an alternative to 'Version Min': Value range: [21 … 177] (Mode type 1: [21 … 73]) Standard: 21
Symbol size max	Largest symbol size to be read in modules. This parameter can be used as an alternative to 'Version Max': Value range: [21 … 177] (Mode type 1: [21 … 73]) Standard: 177
Module size min	Minimum size of the modules in the image in pixels. Value range: [1 … 100] Standard: 6 (Extended: 2, Maximum: 1)
Module size max	Maximum size of the modules in the image in pixels. Value range: [2 … 100] Standard: 20 (Extended: 100)
Module Gap min	Minimum space in the direction of the symbol columns and rows. Value list: 'No', 'Small', 'Large' Standard: 'No'
Module Gap max	Maximum space in the direction of the symbol columns and rows. Value list: 'No', 'Small', 'Large' Standard: 'small' (Extended: 'Large')
Position pattern min	Number of position detection patterns that must be clearly visible in the image for a symbol candidate to be generated. Value range: [2, 3] Standard: 3 (Extended: 2)

13.11.7 PDF417

Property	**Symbol columns min**	Minimum number of data columns for the symbol in code words, i.e. excluding the two code words of the start/stop pattern and the two code words of the row indicators. Value range: [1…30] Standard: 1
	Symbol columns max	Maximum number of data columns for the symbol in code words, i.e. excluding the two code words of the start/stop pattern and the two code words of the row indicators. Value range: [1…30] Standard: 20 (Extended: 30)
	Symbol Rows min	Minimum number of lines of the symbol in modules. Value range: [3…90] Standard: 5 (Extended: 3)
	Symbol Rows max	Maximum number of lines of the symbol in modules. Value range: [3…90] Standard: 45 (Extended: 90)
	Module width min	Minimum width of the modules in the image in pixels. Value range: [1…100] Standard: 3 (Extended: 2, Maximum: 1)
	Module width max	Maximum width of the modules in the image in pixels. Value range: [2…100] Standard: 15 (Extended: 100)
	Module Aspect min	Minimum side ratio of the modules in the image (height to width). Value range: [0.5…20.0] Standard: 1.0
	Module Aspect max	Maximum side ratio of the modules in the image (height to width). Value range: [0.5…20.0] Standard: 4.0 (Extended: 10.0)

13.12 Module Image Comparison

13.12.1 Overview

Objective

The image comparison module allows you to compare images or regions of an image with a reference image. Defects, for example, can thus be reliably detected as deviations from the reference image.

Procedure

1. Link the image comparison input image.
2. Link an input region to perform the image comparison on a specific region only. The region can also be tracked for this purpose by linking a coordinate system in the region module.
3. Position a good part as a reference object in the region and start the teach-in process. The reference image can also be averaged from several images by selecting the number of teach-in images greater than one.
4. If necessary, adjust the settings for the background and the edge areas (edges) to become, for example, less sensitive to slight differences in brightness in the background.

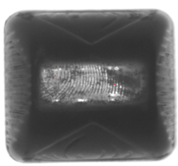
NOTE!
- In image comparison, the reference image is divided into background and edge areas (edges).
- The edge area (edges) can be adjusted by the edge sensitivity and edge expansion.

5. The number of pixels shows how large the deviation is. The output image with the deviations is also available.

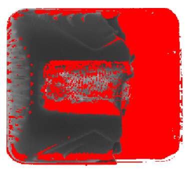
13.12.2 Setting Parameters

Image area

Deviations from the reference object are displayed as red pixels in the image area.



Reference object



Displayed deviation from the reference object

Property The following settings/results are displayed:

Process Time [us]	Sensor processing time for the module
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 358).
Pixel Count [unit]	Specifies how many pixels differ from the reference image. The larger the number of pixels, the greater the deviation from the reference image. A tolerance can be entered for the number of pixels so that the value can be linked to a digital output, for example.
Input image	Selection of the channel for image input
Input region	Selection of the region for image comparison. The region can also be tracked for this purpose by linking a coordinate system in the region module.
Threshold background	Threshold values for differences in the background brightness. The higher the value, the less sensitive the module is to differences in background brightness.
Threshold Border	Threshold value for differences in brightness in the peripheral area (with gray value transitions).
Edge Broadening [unit]	Pixel width of the edges; a sort of virtual sleeve is placed around the edge transitions.
Teach Image Count	The number of images whose characteristics are combined into a reference image.
Teach	Activation of the teach-in process. After a successful teach-in process, a display appears indicating how many of the image recordings have been combined into a reference image.
Edge sensitivity [%]	A setting which determines which percentage of the detected edges will be evaluated as edges for the reference image. The default values is 20 %.
Variant	Algorithm type A is used for the evaluation.

13.12.3 Configuration

The image comparison module includes the following configuration options:

- Output image
- Reference image
- Threshold Image

13.13 Module OCR (Optical Character Reader)

13.13.1 Overview

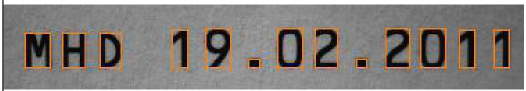
Objective	Read letters, numbers and symbols.
Procedure	First specify the search region within which the characters are located. Then select the segmentation settings. The next step involves associating the detected character with a letter or a number. This section is intended to explain the basic requirements for setting up wenglor's OCR Reader. By considering several important attributes, it can be determined whether or not this product is suitable for the respective application.

OCR tips
In actual practice, a great number of ambient conditions influence whether or not reading will be successful. This document only deals with the issues of geometry and contrast.

The most important attributes are:
- Character geometry
- Quiet zone
- Background / contrast

Basic character geometry
- The OCR Reader functions ideally as of a character height of 25 pixels. In this case, the gaps between the characters are as a rule large enough for the characters to be separated.
- The OCR Reader functions ideally when the gap between the characters is half as large as the character width.
- If "non-linear calculation of the binarization threshold" is used, the gap between the characters should not be any larger than one character. Otherwise the gap itself might be recognized as a character under certain circumstances. In this case, two objects should be used.
- Process Time has a quadratic relationship to character size. If a character string with a character height of 25 pixels requires 20 ms for the reading algorithm, time is increased to 80 ms for a character height of 50 pixels.

Examples

Font: Arial Standard Height: 30 pixels → “02” cannot be segmented.	
Font: OCR B Height: 30 pixels → All characters can be readily segmented.	
Font: OCR B Height: 30 pixels Binarization: “non-linear calculation” → Excessively large spaces are seen as separate segments.	

Size of the ROI

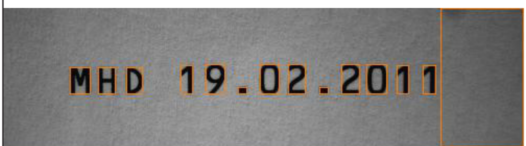
If the region of interest is too large, the algorithm for determining the binarization threshold does not function reliably.

The following rule of thumb applies:
Edge spacing left, right: 1× character width
Edge spacing top, bottom: 0.5× character height
This “quiet zone” should not be interfered with by other characters or objects.

Furthermore, processing time also increases when the ROI is too large.

If the position of the character string to be read is not consistent in actual practice, it’s usually better to use localization instead of a very large ROI. Process Time for localization plus reading is usually less than required for a large ROI.

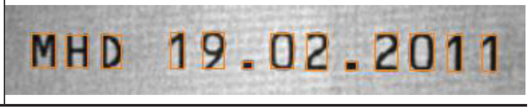
Examples

Ideal edge spacing Reading time: 25 ms	
Edge spacing too large → The segmentation function detects additional object because an incorrect binarization threshold is calculated due to the large surface area of the image. Reading time: 120 ms	

Background

A homogeneous background is always ideal for character segmentation. Structures included in the background which have an intensity similar to that of the characters make reading impossible.

Under certain circumstances, colored structures can be eliminated by using the right illumination color. If fine structures are present in the background, it may be helpful to make use of a Gaussian filter or set the optics slightly out of focus depending upon character size.

Character string with structure in background → Segmentation is not possible	
Character string with structure in background → Segmentation functions correctly	

Contrast

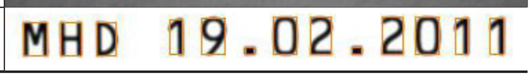
The "binarization" stage must find a suitable binarization threshold for separating the characters from the background on the basis of image contrast. The OCR module is equipped with various binarization functions to this end.

If contrast (difference in intensity between characters and background) is constant over the entire ROI, 20 intensity values are enough for display.

If contrast varies within the ROI (e.g. due to inhomogeneous illumination), there should be a plain difference between the characters and the background. The sensor functions ideally if the image is set up with black characters (intensity = 0) and a gray background. In this case, brightness differences within the characters are outside of the image chip's dynamic range, and the characters are entirely black.

On the other hand, an attempt can be made to fully over-illuminate the background (white, i.e. intensity = maximum). In this way, structures in the background can no longer be detected and only the characters are gray.

Examples

Dark illumination, structures in the characters are not visible.	
Background over-illuminated, small structures in the background are not visible.	

13.13.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [µs]	Sensor processing time for the module
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 358).
Segments True Count	Number of detected characters. **NOTE!** The number of segments found is independent of the maximum number of segments.
Reading result	Read-out of all reading results for all detected lines. The lines are separated from each other by a line feed (LF).
Input image	Selection of the channel for image input
Coordinate system	Selection can be made regarding how the module should be tracked. **NOTE!** It is important to ensure that the search area is always completely in the read-out area of the camera, otherwise no character recognition is possible.
Read Timeout [µs]	The time during which an attempt is made to read the characters. If reading is not successful within this period of time, the process is aborted. The reading results are rendered invalid.
Segment Max Count	The maximum String Count is adjustable. **NOTE!** The maximum number of segments has no influence on the number of segments found.
Variant	The algorithm type used is displayed.

13.13.3 Configuration

The OCR module includes the following configuration options:
- Reading List
- Segment List
- Search Box
- Row Find
- Binarization
- Segmentation
- Classification
- Fielding

13.13.3.1 Reading List

Property The following settings/results are displayed:

Reading #0…n	The characters read from the detected line are displayed.

Reading results are read out for each detected line.

13.13.3.2 Segment List

Objective Detected characters are listed in the sub-module in order to provide information concerning the detected segment. This information can be used to further optimize the overall settings.

Property The following settings/results are displayed for any given selected segment

Assigned character	If an appropriate character has been found in the character set, it's displayed. Otherwise, the default replacement character appears, namely a question mark (?).
Lower threshold	Lowest binarization value that has been used to binarize the character.
Upper threshold	Highest binarization value that has been used to binarize the character.
Height	Height of the character
Width	Width of the character
Score	Quality of the character detection

13.13.3.3 Row Find

Objective The module can read out several lines from a search region. The presettings for the lines to be expected are entered under “find lines”.

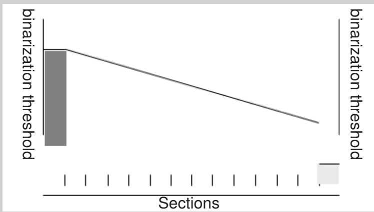
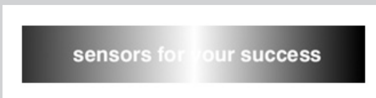
Property The following settings/results are available

Row Recognition	This function is initially deactivated. The search algorithm is activated by switching the mode to standard.
Angle [deg]	If the angle range is set to 0, the module automatically calculates the angle of the rows with reference to the search region. The resulting value is displayed.
Row True Count	Number of lines found
Row Max Count	The number of lines to be expected is specified.
Angle range [deg]	The angle between the search region and the expected lines is specified. If this value is set to 0, the module calculates the angle automatically.
Row Height Min [unit]	Minimum height of the expected lines
Row Height Max [unit]	Maximum height of the expected lines
Row Space Min [unit]	The search algorithm for each line is extended in positive direction by a third of a line spacing value.

13.13.3.4 Binarization

Objective The characters are separated from the background with the help of the binarization threshold. It must be determined which type of character is involved and which operating mode needs to be used. Selection can be made between several binarization modes.

Property The following settings/results are displayed for any given selected segment

<table>
<tr><td>Contrast</td><td>How the characters are implemented is defined. Dark characters on a bright background or bright characters on a dark background.</td></tr>
<tr><td>Threshold mode</td><td>The following options are available:
<table>
<tr><td>Manual</td><td>The binarization threshold is set manually by specifying the lower and upper threshold values.</td></tr>
<tr><td>Computed</td><td>The binarization threshold is calculated automatically by the OCR algorithm.</td></tr>
<tr><td>Linear</td><td>This mode is used when a linear brightness profile can be detected in the image.

</td></tr>
<tr><td>Non-linear</td><td>This mode is used when the image is not homogeneously illuminated. In the case of non-linear calculation of the binarization threshold, the image is broken down into predetermined sections, and the best possible binarization threshold is calculated for each.

</td></tr>
</table></td></tr>
<tr><td>Linear/non-linear threshold value splitting</td><td>This value specifies into how may parts the search region will be split up in order to calculate the individual threshold values.</td></tr>
</table>

13.13.3.5 Segmentation

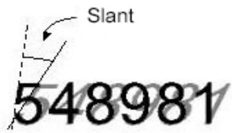
Objective The characters are separated from each other with the help of segmentation. The module makes use of various automatic methods. If these automatic methods do not lead to the desired results, various segmentation settings can be entered manually.

Property The following settings/results are available

Character Height Min [unit]	The minimum height of the character to be detected is specified.
Character Height Max [unit]	The maximum height of the character to be detected is specified.
Character Width Min [unit]	The minimum width of the character to be detected is specified.
Character Width Max [unit]	The maximum width of the character to be detected is specified.
Cluster Size Min [unit]	The minimum number of pixels which must be contained by a segment in order to be detected as a character
Cluster Size Max [unit]	The maximum number of pixels which may be contained by a segment in order to be detected as a character

<table>
<tr><td>Discard Under-sized</td><td colspan="2">If the requirements concerning height, width and cluster size are fallen short of, the detected segment is disregarded.</td></tr>
<tr><td>Discard Oversized</td><td colspan="2">If the requirements concerning height, width and cluster size are exceeded, the detected segment is disregarded.</td></tr>
<tr><td>Dot Space Vertical [unit]</td><td colspan="2">The vertical pixel pitch for fonts which are made up of individual pixels is specified.</td></tr>
<tr><td>Dot Space Horizontal [unit]</td><td colspan="2">The horizontal pixel pitch for fonts which are made up of individual pixels is specified.</td></tr>
<tr><td rowspan="4">Splitting</td><td colspan="2">The following options are available:</td></tr>
<tr><td>Default</td><td>Fixed distribution of the characters is assumed. Character spacing and angle do not vary.</td></tr>
<tr><td>Variable</td><td>Distribution of the characters with regard to spacing, angle and size may vary.</td></tr>
<tr><td>Dynamic</td><td>Distribution of the characters with regard to spacing, angle and size may vary greatly.</td></tr>
</table>

Character Space [unit]	Character spacing specifies the expected number of pixels between the segments.
Substitution character	If a detected character cannot be found in the taught-in character set, the replacement character is displayed.
De-Slanting mode	The inclination of the search regions for the segments can be determined automatically or set manually.
De-Slanting angle [degree]	The inclination angle of the characters can be specified. The value can lie within a range of –45° to +45°.



13.13.3.6 Classification

Objective Classification specifies as of which degree of conformity a character is selected from the character set. The higher the degree of conformity, the more precisely the characters must conform.

Property The following settings/results are available

Acceptance Level	The current character is compared with the character from the character set and coincidence is evaluated. The higher the value the greater the coincidence. The acceptance value specifies the minimum degree of coincidence which must be achieved for the character to be read out as recognized.

13.13.3.7 Fielding

Objective This function makes it possible to filter the detected characters on the basis of certain criteria.

Property The following settings/results are available

Pattern	This is used to specify at which place which character can be used in the results read-out. Which characters are associated with which abbreviation is defined in the set sub-step.

One letter from the defined set must be entered per place in the output value. If the field is empty, the reading results from the OCR module are read out without restriction.

Quantity

The following patterns have already been specified:

N	0123456789
A	ABCDEFGHIJKLMNOPQRSTUVWXYZ (uppercase letters)
a	abcdefghijklmnopqrstuvwxyz (lowercase letters)
H	0123456789ABCDEF (hexadecimal, uppercase)
h	0123456789abcdef (hexadecimal, lowercase)
O	1234567 (octal numbers only)
N	A set of characters can be defined by the user. An explicit letter must be assigned to the subset as a characteristic.

13.13.3.8 Teaching-in Characters

Objective

If characters from the fonts OCR-A or OCR-B need to be read, the included OCR-A and OCR-B fonts can be used. If the characters are from any other font, they first have to be taught in.

Function field

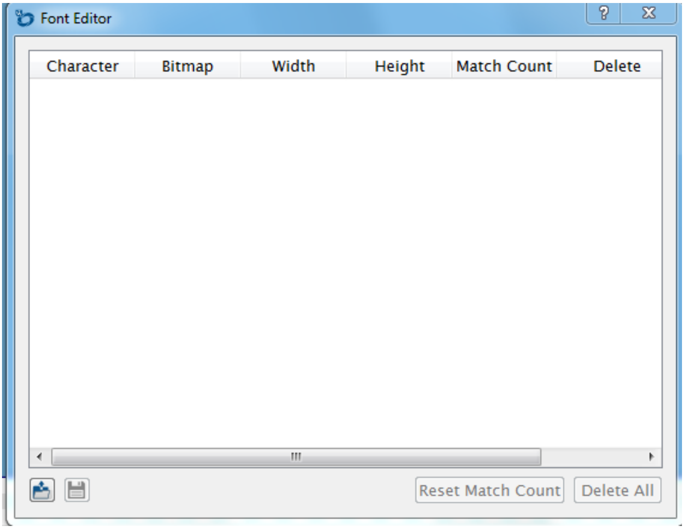
New characters can be taught in to the module toolbar. Taught-in characters can be managed with the help of a character editor.

	Train Line	All of the characters within the search region are taught in.
	Font editor	The font editor is a separate window which makes it possible to manage taught-in characters, as well as to save and load fonts.

The font editor manages the currently used character set. Additional information is available for each font, such as height and width. The number of hits indicates how frequently the character has been used since the program was last started. If the same character has been taught in more than once, information concerning the number of hits is helpful for finding out whether or not a character is actually necessary for the current application. After clicking the small image, a larger image of the taught-in font is displayed.

Each character can be individually removed from the character set by clicking the X in the respective column.

Note: The smaller the font set, the higher the evaluation speed.



The entire character set can be saved as a wenglor character set. Previously saved character sets can be loaded to the character editor. The weQube installation directory contains the standard font types OCR-A and OCR-B.

13.14 Module Pattern Match

13.14.1 Overview

Objective Recognize objects in an image

Procedure First of all, specify the object or a distinctive element of the object which needs to be recognized. Then specify tolerances for rotational orientation. Teach in and you're done.

Tips
Make sure you have a sharp image with high contrast.

- Move the search region into the middle of the object. Enlarge the search region such that the object or feature you want to detect is enclosed.
- Teach the object in. It may take several seconds until the device teach-in process has been completed. Detected contours are displayed in the image. If additional, unnecessary contours are displayed which are not necessarily required for object detection, they should be removed with the help of the contour model editor. A larger number of contours to be searched for extends evaluation time, but it also improves the quality of the results. The ideal relationship between a minimal number of contours and best possible quality varies from application to application.
- Is it possible for the object to turn in the application? If so, the starting angle and the angle range should be set. For example, if it's possible for an object to turn 30 %, set the starting angle to –15 and the angle range to 30. With these settings, the object can rotate within a range of –15° to +15° from the previously taught-in position, and it's still recognized. It must be kept in mind that finding rotated objects requires computing time at the device. For this reason, the rotation angle should only be as large as necessary in order to prevent the need for unnecessary computing time.

The following parameters influence evaluation speed:

- Increase the minimum coincidence value step-by-step until the object is no longer detected. Then return to the last value that worked.
- Increase the aggressiveness parameter until pattern matching fails, and then reduce the coincidence value. If this doesn't deliver the desired results, return to the last values with which the object was found.
- Reduce the permissible rotation angle to a minimum.
- Reduce the search region to the size which is actually required for the application.
- Be sure to use contour models which demonstrate prominent structures that differ from the rest of the image. When recording the image, make sure that the prominent structures can be easily detected in the image. It's better to use large, prominent structures then small, faint structures. This can have a significant effect on speed.

NOTE!
If the pattern is changed (e.g. rotation, scaling, etc.), it is necessary to teach in all patterns used again. Furthermore, from performance point of view, it is recommended to change parameters (e.g. scaling and rotation) first and teach the shape models afterwards.

13.14.2 Setting Parameters

Property The following settings/results are displayed:

Process Time [µs]	Sensor processing time for the module
Module State	Error code for troubleshooting support (see section “25.5 Module Status” on page 351).
Reading True Count	The number of detected objects is displayed. **NOTE!** The number of segments found is independent of the maximum number of segments.
Input image	Selection of the channel for image input
Read Timeout [µs]	The time during which the sensor attempts to detect the object. If nothing has been successfully detected after this duration has expired, the search is aborted and the result is set to invalid. Time can be set within a range of 0 to 20 seconds in steps of 1 μs. Aborting the search process takes about 20 ms. The module’s minimum processing time is thus also 20 ms.
Reading Max Count	The maximum number of objects to be detected can be selected. Up to 20 objects can be detected simultaneously. **NOTE!** The number of segments found is independent of the maximum number of segments.
Shape Models	Number of different models which should be detected. Up to 10 different models can be taught in.
Pyramid Levels	With a value of 0, the algorithm automatically optimizes the number of model points. A value of 1 specifies that model points will be looked for in the original image, and thus this setting is the slowest. If the value is increased to 2, the resolution of the original image is reduced by means of subsampling. Possible model points are thus also reduced and the process is accelerated. It must be noted that although processing time is reduced as the pyramid steps value is increased, accuracy is also reduced. We recommend leaving the setting at a value of 0, i.e. automatic. **NOTE!** With the pyramid levels parameter, not all levels can be selected. After the value is changed, the algorithm returns a viable value automatically.

Property

Angle Start [deg]	This parameter specifies in which negative direction the model can be turned from the taught-in position. It describes the start angle from which the angle of rotation is determined on the basis of angle range. For example, if a start angle of –15° and an angle range of 30° are selected, the model can move within a range of –15° to +15°. **NOTE!** Initially, angle size must be larger than 0° so that angle start can be set. After the value is changed, all patterns used must be retaught. Not all values can be selected with this parameter. After the value is changed, the algorithm automatically returns a viable value.
Angle Extent [deg]	Angle Extent specifies the possible range of angles of rotation for the model. **NOTE!** After the value is changed, all patterns used must be retaught. Not all values can be selected with this parameter. After the value is changed, the algorithm automatically returns a viable value.
Angle Step [deg]	The angle increment parameter specifies the individual increments within the selected angle range. The angle increment parameter should be set on the basis of the object's size. Smaller models have only a number of different discrete rotations within the image. For this reason, a larger angle increment should be selected for smaller objects. **NOTE!** • With the angle increment parameter, not all values can be selected. After the value is changed, the algorithm returns a viable value automatically. • After the value is changed, all patterns used must be retaught. • When selecting value 0, an optimal value for Angle Step is calculated automatically.
Scale Min	This parameter specifies the lower limit of the possible scaling range which will be searched. A value of 1 corresponds to the model's original size. **NOTE!** After the value is changed, all patterns used must be retaught. Not all values can be selected with this parameter. After the value is changed, the algorithm automatically returns a viable value.
Scale Max	This parameter specifies the upper limit of the possible scaling range which will be searched. A value of 1 corresponds to the model's original size. **NOTE!** After the value is changed, all patterns used must be retaught. Not all values can be selected with this parameter. After the value is changed, the algorithm automatically returns a viable value.

Property

<table>
<tr><td rowspan="1">Scale Step</td><td colspan="2">Scaling increment specifies the increment within the scaling range. As is also the case with the angle increment parameter, scaling increment should be set on the basis of the object's size.

NOTE!
• With the scaling increment parameter, not all values can be selected. After the value is changed, the algorithm returns a viable value automatically.
• After the value is changed, all patterns used must be retaught.
• When selecting value 0, an optimal value for Angle Step is calculated automatically.</td></tr>
<tr><td rowspan="9">Optimization</td><td colspan="2">In the case of especially large models, it may be advisable to select the number of model points by setting the optimization parameter to a value other than "–". In the case of smaller models, reducing the number of points does not result in any acceleration.</td></tr>
<tr><td>Auto</td><td>The number of points is reduced automatically by the algorithm.</td></tr>
<tr><td>None</td><td>No optimization is conducted. All object points are saved.</td></tr>
<tr><td>Point Reduction Low</td><td rowspan="3">There are three different levels for reducing the number of points of a taught-in model. Reducing the number of points can be very helpful for large objects.</td></tr>
<tr><td>Point Reduction Medium</td></tr>
<tr><td>Point Reduction High</td></tr>
<tr><td>Pregeneration</td><td>If this parameter is selected, a new model is generated each time an image is recorded. It must be noted that regeneration in the case of large rotation or scaling values increases memory occupation. Regeneration also takes a great deal of time.</td></tr>
<tr><td>No pregeneration</td><td>Regeneration of models is deactivated.</td></tr>
</table>

Property

Metric	The metrics setting specifies the conditions under which the sample will still be recognized within the image.	
	Polarity – active	The object in the image must demonstrate the same contrast characteristics as the model. For example, if the model is a bright object against a dark background, the object is only detected within the image if it's brighter than the background.
	Global polarity – ignore	The model is also detected when the contrast characteristics are exactly the opposite of those of the taught-in object.
	Local polarity – ignore	If this value is selected, contrast polarity may only change amongst various parts of the model, but the polarity of model points within the same part of the model may not change The term "Local polarity – ignore" must be correctly understood. It means that changes in polarity between neighboring parts of the model don't influence the score and are thus ignored.
Contrast	The contrast parameter specifies which gray-scale contrast the model's points must demonstrate. Contrast is a measure of local gray-scale differences between the object and the background, as well as between the parts of the object.	
	Auto	Contrast, upper and lower threshold values, and hysteresis are calculated automatically.
	Auto-contrast	Only the contrast values are determined automatically.
	Auto-contrast hysteresis	The hysteresis threshold values are determined automatically.
	Auto Min Size	The minimum contrast magnitude is only used for creating the model – the other influencing variables are not used.
	Numeric value	This value specifies the minimum contrast value of an edge transition which must be achieved. The edge is only used for model generation if this value is reached.

Property

Min contrast	The minimum gray-scale contrast which the model will have to have within the image later on during detection is specified here. In other words, this parameter represents a demarcation of the sample from noise within the image. For this reason, a good value corresponds to the range of gray-scale change which is caused by noise within the image. For example, if gray-scale values fluctuate within a range of 10 due to noise, the value should be set to 10. The value must be less than the contrast parameter value. When selecting value 0, an optimal value for Angle Step is calculated automatically.
Min Score	Specify the quality of coincidence – the higher the value is set the more quickly evaluation is completed, but quality is reduced.
Max overlap	This parameter specifies how much of a taught-in model may be covered up, and nevertheless still detected as present.

<table>
<tr><td>Subpixel</td><td>The sub-pixel parameter defines whether the position and the orientation of the detected model will be read out with accuracy down to the pixel or the sub-pixel.
<table>
<tr><td>---</td><td>The object’s coordination and angle of rotation are read out with an accuracy of down to 1 pixel.</td></tr>
<tr><td>Interpolation</td><td>When interpolation is activated, the algorithm examines the position of the object on the basis of neighboring pixels, angles and scaling around the best coincidence match. The results are accurate down to roughly one twentieth of a pixel.
Interpolation is very fast and can be activated for most applications.</td></tr>
<tr><td>Smallest Squares</td><td rowspan="3">The smallest squares parameter works against the interpolation parameter. This function requires a great deal of computing time.</td></tr>
<tr><td>Smallest squares – high</td></tr>
<tr><td>Smallest squares – very high</td></tr>
<tr><td>Max deformation 1</td><td rowspan="2">Sometimes no objects are found, or only objects with a minimal coincidence value, because they’re highly deformed relative to the taught-in model. The max. deformation parameter specifies by how many pixels the detected object can differ from the taught-in object.</td></tr>
<tr><td>Max deformation 2</td></tr>
</table></td></tr>
<tr><td>Aggressiveness</td><td>“Agressiveness” of the search heuristics (0: reliable but slow, 1: fast but matches may be overlooked).</td></tr>
</table>

13.14.3 Configuration

The pattern matching module includes the following configuration options:
- Reading list
- Search Box
- Teach Box
- Shape models

13.14.3.1 Submodule Reading List

Property The following settings/results are displayed:

Reading #1	The name of the detected object is displayed.
Score	The displayed number describes the quality of coincidence between the detected object and the taught-in models. The number can lie between 0 (not recognized) and 1 (full coincidence to the taught-in model).
Coordinate system	Details concerning the initial coordinate system are displayed.

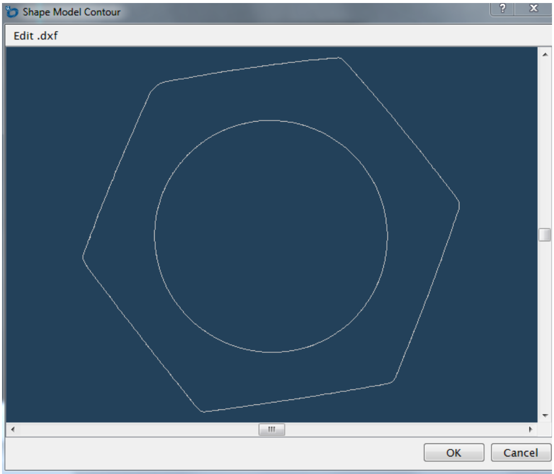
13.14.3.2 Shape Model

Objective Several objects can be taught in. Each object is saved to the sensor as a separate contour model.

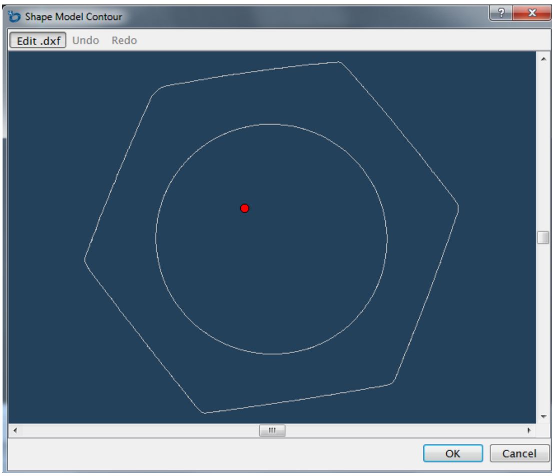
Teach-in Each contour model has a “Teach-in” button. Clicking on the “Teach-in” button teaches in the current object as a contour model.

NOTE!
Before teaching a contour model, all other parameters (e.g. angle settings, scaling, pyramid levels etc.) must be set correctly to get the most benefit from the internal optimization of the algorithm.

After a model has been taught in successfully, its drawn into the camera image. It's possible to subsequently edit the taught-in contour model in order to eliminate any interference. An additional window can be opened to this end via the Contour model outline parameter. The window appears after clicking the icon [...]. The following window appears:



After clicking "Edit.dxf", the mouse pointer turns into a red dot. This dot can be used to delete individual lines from the detected model. After correction of the model has been completed, the new contour is transmitted to the sensor by clicking OK. The "Undo" function negates the last change. The "Redo" function is the opposite of the "Undo" function and thus deletes the restored areas.



14. Software Modules for Profile Analysis

14.1 Module Point Cloud Coordinate System

14.1.1 Overview

Objective Tracking and reliably detecting objects. Additional functions can also be set up on the basis of this coordinate system.

Procedure The coordinate system can be unequivocally defined on the basis of one, two or three points. These can specified in a fixed manner, linked from another module or selected from any of the other suggested options.

14.1.2 Setting Parameters

Measuring range Display of the coordinate system.

Property The following settings/results are displayed:

<table>
<tr><td>Process Time [us]</td><td colspan="2">Process Time for process steps in the current module.</td></tr>
<tr><td>Module State</td><td colspan="2">Error codes provide support for troubleshooting.</td></tr>
<tr><td>Input point cloud</td><td colspan="2">Selection of the point cloud.</td></tr>
<tr><td rowspan="6">Construction method</td><td colspan="2">Construction of the coordinate system.</td></tr>
<tr><td>1 pt. origin</td><td>1 point defines the origin of the translatory coordinate system.</td></tr>
<tr><td>1 pt. X-axis,
1 pt. Z-axis</td><td>1 point defines the X-axis and 1 point defines the Z-axis, by means of which a translatory coordinate system is formed.</td></tr>
<tr><td>1 pt. origin,
1 pt. X-axis</td><td>One point defines the origin and one point defines the X-axis of the rotary coordinate system</td></tr>
<tr><td>1 pt. origin,
1 pt. Z-axis</td><td>One point defines the origin and one point defines the Z-axis of the rotary coordinate system.</td></tr>
<tr><td>2 pt. X-axis,
1 pt. Z-axis</td><td>2 points define the X-axis and 1 point defines the Z-axis of the rotary coordinate.</td></tr>
</table>

Property

Tracking method	Only available if the coordinate system is made up of more than one point. It can be specified whether or not and how the coordinate system's points will be tracked at the desired point.	
	No	The coordinate system's points will not be tracked.
	Yes	The coordinate system's points are tracked in the X and Z direction.
	Horizontal	The coordinate system's points are tracked in the X direction only.
	Vertical	The coordinate system's points are tracked in the Z direction only.
Tracking point	Only available if the coordinate system is made up of more than one point and the tracking method is set to yes, horizontal or vertical. All of the coordinate system's points are tracked at the selected point.	
	1st pt.	All points are tracked according to the first point.
	2nd pt.	All points are tracked according to the second point.
	3rd pt.	All points are tracked according to the third point.

14.1.3 Configuration

The coordinate system module includes the following configuration options:

- Coordinate system
- Find point 1 (2 or 3)

14.1.3.1 Submodule Find Point 1 (2 or 3)

Objective Select a point for construction of the coordinate system. Various algorithms are available.

Property The following settings/results are displayed:

Found point	The coordinates of the found point are displayed.	
Find method	**Point (fix or linked)**	A fixed point can be specified, or a point can be linked from another module.
	Point of line	A line with a starting point and an end point is looked for with a search line. The center, start or end point of the found line can be used as a point for the coordinate system.
	Point of arc	An arc is looked for with a search arc. The center, start or end point of the found arc can be used as a point for the coordinate system.
	Point of circle	An circle is looked for with a search circle. The center, start or end point of the found circle is used as a point for the coordinate system.

Settings for finding lines, circles and arcs correspond with the values in the measuring module “14.5 Module Point Cloud Measure” on page 268.

14.2 Module Point Cloud Filter

14.2.1 Overview

Objective

Eliminate interfering reflections in the point clouds, suppress the influence of individual outliers and increase the stability of the evaluation.

Abbreviated procedure

Define the input point clouds and select the required filer type. The filtered point cloud is available to other modules as an input point cloud.

NOTE!
With certain filter types, an unsorted height profile occurs when the height profile is filtered. This means that no functions requiring a sorted height profile can be carried out with the filtered height profile (including area calculation in the point cloud region module).

14.2.2 Setting Parameters

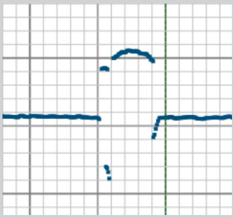
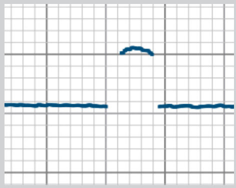
Property

The following settings/results are displayed:

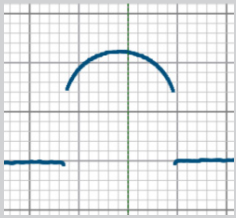
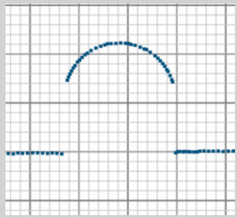
<table>
<tr><td>Process Time [us]</td><td colspan="3">Process Time for process steps in the current module.</td></tr>
<tr><td>Module State</td><td colspan="3">Error codes provide support for troubleshooting.</td></tr>
<tr><td>Input point cloud</td><td colspan="3">Any available point cloud can be selected.</td></tr>
<tr><td rowspan="7">Filter type</td><td colspan="3">The following filter types are available. Additional setting parameters appear depending on the selected filter type.</td></tr>
<tr><td>Off</td><td colspan="2">Unfiltered point cloud.</td></tr>
<tr><td>Mean</td><td colspan="2">The arithmetic mean is determined for each point using its closest neighbors. The point itself is also included in the number of neighbors.
Filtering can only be applied to the Z values or the X, Y and Z values. (Coordinate filter type)

NOTE!
An unsorted height profile occurs with this filter type.</td></tr>
<tr><td rowspan="4">Weighted mean</td><td colspan="2">Analogous to the mean value. Weighting is adjustable for the value of each neighbor.

NOTE!
An unsorted height profile occurs with this filter type.</td></tr>
<tr><td>Filter weighting #1</td><td>Weighting for the point itself</td></tr>
<tr><td>Filter weighting #2</td><td>Weighting for the closest neighbors</td></tr>
<tr><td>Filter weighting #3</td><td>Weighting for the second closest neighbors</td></tr>
</table>

Property	Filter type		
		Median	The mean value (median) is determined for each point using its closest neighbors. The point itself is also included in the number of neighbors. Filtering can only be applied to the Z values or the X, Y and Z values (filter type coordinates). **NOTE!** An unsorted height profile occurs with this filter type.
		Intensity	The filtered point cloud contains all points whose intensity values lie between the selected limits. Points with lesser or greater intensity are removed. If the lower threshold is greater than the upper threshold, the filtered point cloud contains all points with an intensity which exceeds the lower the threshold or falls short of the upper threshold.
		Remove outliers	Standard filter for eliminating outliers. Closest neighbors are ascertained for each point, as well as the arithmetic mean from the point to all of its neighbors. If distance is greater than the selected outlier threshold value, the point is deemed an outlier and is removed  Unfiltered point cloud  Filtered point cloud **NOTE!** An unsorted height profile occurs with this filter type.

Property

Filter type		
	Downs-ampling	The measuring range is subdivided into voxels (squares) of equal size with adjustable edge length (voxel size). The arithmetic mean is determined for all of the points within a voxel. The output point cloud contains the arithmetic mean of each voxel. The sampling filter can be used to reduce the point density.  Unfiltered point cloud  Sampled pointc loud **NOTE!** An unsorted height profile occurs with this filter type.

14.3 Module Point Cloud Region

14.3.1 Overview

Objective	The relevant region used for evaluation should be as large as necessary and as small as possible. The simpler the region, the quicker the evaluation. In the simplest case, the region consists of just a rectangle. The smaller the initial point cloud of the region module, the quicker the evaluation of the subsequent modules which have linked this point cloud as an initial value. The area below or above the point cloud and the centroid of the area are additionally available.
Abbreviated procedure	Any desired area can be specified as the region of interest by adding, removing or customizing shapes. In addition to existing standard shapes, any number of various shapes can also be added and linked by means of simple set operations. The area calculation can be activated below, above or between the height profile as required.

14.3.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [us]	Process Time for process steps in the current module.
Module State	Error codes provide support for troubleshooting.
Points Inside region	The number of points inside the selected region.
Points outside region	The number of points outside of the selected region.
Input point cloud	Any available point cloud can be selected.
Coordinate system	The module can be linked to a coordinate system if necessary. All search geometries within the module are thus aligned to the selected coordinate system.

Property

<table>
<tr><td rowspan="1">Simplification Tolerance</td><td colspan="2">The smaller the value the more precise the overall region. However, this leads to longer processing time.
Standard value: 0.2
Value 0: maximum possible accuracy with longest processing time.

NOTE!
Only available in the extended mode.

NOTE!
This value is based on the Ramer-Douglas-Peucker algorithm.</td></tr>
<tr><td rowspan="5">Area calculation</td><td colspan="2">If area calculation is activated, the point cloud is joined into a polygon. The polygon is intersected by the drawn region and the corresponding area is read out.

NOTE!
The height profile must be sorted for the area calculation and only one signal may be read out on the 2D/3D profile sensor (not both).

The following area calculation options are available:</td></tr>
<tr><td>Off</td><td>Area calculation is deactivated as a standard feature.</td></tr>
<tr><td>Above the profile</td><td>The area above the point cloud is intersected by the area within the region. The common section and the centroid of the area are read out.</td></tr>
<tr><td>Below the profile</td><td>The area below the point cloud is intersected by the area within the region. The common section and the centroid of the area are read out.</td></tr>
<tr><td>Enclosed by profile</td><td>The area enclosed by the profile is calculated. All measurement points are joined for this. The last measuring point is joined with the first measuring point.

NOTE!
A 360° closed contour is required for this, which was created by several 2D/3D profile sensors arranged in a circle in the VisionApp 360 plugin. The height profile must be sorted correctly for this – this is the only way to achieve a viable calculation (setting of the VisionApp 360 plugin). Only one signal (not both) may also be read out on all 2D/3D profile sensors.</td></tr>
</table>

Property		
	Area type	With the options for the area calculation below or above the profile, it is possible to define whether the first or the last measurement point should be connected with the sensor origin (sensor perspective) or parallel to the z-axis of the sensor coordinate system (sensor z-axis). **NOTE!** With the “sensor perspective” area type, it is possible to prevent overlaps in the region for a sorted profile during the area calculation.

Function field

New shapes can be added from the module tool list.

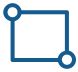
1. Select the mathematical operation

	**Add**	Add the new shape to the overall shape.
	**Subtract**	Subtract the new shape from the overall shape.
	**Symmetrical subtraction**	The common area of the new shape and the overall shape without the intersection.
	**Intersection**	The intersection of the new shape and the overall shape.

NOTE!
The order of the shapes is dictated by the order in which they are created and cannot be subsequently changed. As a result, the overall shape of all previously existing shapes is always used for the offsetting of shapes.

Function field

2. Select a new shape

	**Rectangle via two points**	A rectangle is drawn with 2 points. The first corner of the rectangle is specified within the image area by left clicking with the mouse. The diagonally opposite corner of the rectangle is specified with a second click.
	**Rectangle via three points**	A rectangle is drawn with 3 points. The first corner of the rectangle is specified within the image area by the first click. The next click specifies one of the neighboring corners and the third click specifies the side opposite the side defined by the two points.
	**Circle via 2 points**	A circle is drawn with 2 points. The first click specified the center of the circle. The radius of the circle is specified by means of the second click.
	**Circle via 3 points**	A circle is drawn with 3 points. 3 points around the circumference of the circle are specified with 3 mouse clicks.
	**Polygon**	A polygon can be created with any desired number of clicks. Each click specifies one of the polygon's corners. Processing of the shape is ended by double clicking the last corner. Polygons can be specially processed within the image area. Individual points can be deleted by pressing and holding the Ctrl+Shift key and clicking the respective point with the left mouse key. A new point can be added to the polygon by pressing and holding the Alt+Shift key and left-clicking at the desired side of the polygon.

3. Draw a new shape within the image area as described.
Newly added shapes also appear in the list under "Set".

14.3.3 Configuration

The point cloud region module includes the following configuration options:

- Output point cloud
- Intersection Area
- Area Centroid
- Set: List of individual shapes

14.4 Point Cloud Pattern Matching Module

14.4.1 Overview

Objective

Teach in a prominent position in the profile and find it again in subsequent profiles.

The module can be used for simple tracking. Furthermore, the coordinate system of a detected pattern can be used to conduct detailed examinations at this point.

The module can also be used to count detected patterns and to distinguish between different, previously taught-in patterns.

Abbreviated procedure

Proceed as follows to set up the module:
1. Link an input point cloud.
2. Place the search region at a prominent position within the profile.
3. Teach in the current search region. Open the “Search Pattern” submodule to this end and select one of the search patterns.

Performance can be optimized and the algorithm’s robustness and reliability can be improved with the help of additional parameters:
- Permissible rotation of the pattern can be limited with start angle, circumference and increment.
- Minimum coincidence, aggressiveness, pyramid steps and accuracy are additional parameters which can be used to optimize processing time and robustness.

The number of detected patterns is read out. Furthermore, the coincidence value, the center of gravity and rotation of the pattern are read out to the results list for each detected pattern. This information can be used for each pattern as an input coordinate system in other modules.

Various patterns can be found in a point cloud pattern matching module. The number of patterns can be set for this purpose. All search patterns can be taught in and set up separately.

14.4.2 Setting Parameters

Property

The following settings/results are displayed:

Process time [µs]	Processing time for the module
Module state	Error codes for troubleshooting support (see section “25.5 Module Status” on page 351).
Pattern True Count	The number of detected patterns is displayed. Minimum and maximum limit values can be assigned to this value, e.g. in order to apply the value to a digital output. **NOTE!** The number of detected patterns is independent of the value for “Pattern Max Count”.
Input point cloud	The point cloud of any desired module must be used as the input point cloud for the point cloud pattern matching module.
Pattern Max Count	Max. number of patterns defines the size of the results list. **NOTE!** The number of detected patterns is independent of this value.
Search patterns	The number of different search patterns which will be taught in to and retrieved within a module can be set. A maximum of ten different patterns can be taught in to a module.
Max. overlap	Max. overlapping defines how large the maximum overlap of two patterns may be so that both are still recognized as valid patterns. The area of the taught-in rectangle which is positioned over the detected patterns is relevant for the overlap test. If two patterns are recognized as overlapping, only the pattern with the higher coincidence value is counted as a detected pattern and included in the results list.
Sort rule	Detected patterns can be sorted according to coincidence value or the X or Z coordinates of the center of gravity of the detected pattern.

14.4.3 Configuration

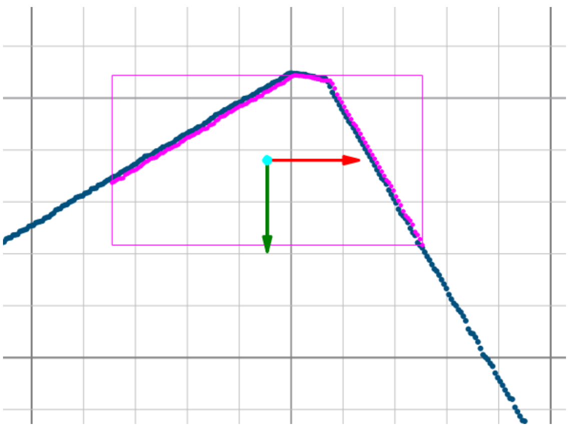
The point cloud pattern matching module includes the following configuration options:

- Result list
- Search patterns

14.4.3.1 Results List Submodule

Objective All detected patterns are included in the results list. The number of results in the results list is defined by the “max. number of patterns” value.

Property The following results are available for each detected pattern:

Reading	The “Result” value indicates to which search pattern the detected pattern belongs. If several patterns are taught in, it’s possible to distinguish amongst several patterns.
Score	The coincidence value indicates the coincidence of the detected pattern with the taught-in pattern. This value always lies within a range of 0 to 1. A result of 1 corresponds to maximum coincidence.
Coordinate system	Center of gravity and rotation are also determined for the detected pattern. As a result, this information results in a coordinate system which can be used in other modules as an input coordinate system. **NOTE!** The center of gravity is defined by the measurement points of the found pattern. 

14.4.3.2 Search Pattern Submodule

Objective Depending on the “Max. number of patterns” value, a corresponding number of search patterns is created. Each search pattern can be taught in individually with its own pattern. Different patterns can thus be recognized.

Property The following settings are available for each search pattern:

Teach	The current point cloud within the positioned rectangle is taught in as a pattern.
Angle start [deg]	Together with the angle range, start angle defines how much rotation is permissible for pattern searching. Beginning with the start angle, a range of angles is set up which encompasses the scope specified by the angle range. For example, if a start angle of –20° and an angle range of 40° are specified, the pattern can vary with and a range of –20° to +20°. **NOTE!** In the X-Z plane, a positive angular value indicates counterclockwise rotation.
Angle Extend [deg]	Angle range specifies the range of angles for relevant pattern rotation. The smaller the angle range the less evaluation time is required. **NOTE!** In the X-Z plane, a positive angular value indicates counterclockwise rotation.
Angle Step [deg]	Angle increment specifies the individual increments within the selected angle range. This value has considerable influence on evaluation time. The smaller the increment the longer the algorithm’s evaluation time. It’s advisable to select the largest possible value which still permits reliable detection. If required, the position can be examined in detail with other modules in order to increase rotational position accuracy.
Min. Score	A pattern is only listed as such if the coincidence value is greater than the selected minimum coincidence value.

Property

Aggressiveness	The aggressiveness function provides a slider for selection between fast evaluation and most comprehensive possible investigation for pyramid steps of greater than zero. The larger the value the faster the evaluation – resulting in the effect that any patterns on higher pyramid steps can be discarded. The smaller the value the more time is required to search for possible patterns on higher pyramid steps.
Pyramid Levels	With each successive pyramid step, resolution is first cut in half and a rough search for patterns is performed. Afterwards, searching at full resolution is only conducted at interesting locations. The pyramid steps value specifies how many preliminary steps should be carried out for the coarse search at half resolution. Evaluation time can be greatly optimized by using a high value of 3 or 4 pyramid steps. A high pyramid steps value is especially suitable for large patterns. It's better to use a small pyramid steps value for very small patterns with fine details so that resolution is sufficient for the rough search.
Accuracy	Accuracy defines pattern matching resolution. Accuracy can assume a value within a range of 0 to 1, where 1 corresponds to maximum accuracy. The greater the accuracy the greater the resolution used for pattern matching. A higher accuracy value also results in longer evaluation time. Beyond this, accuracy also influences the coincidence value because pattern coincidence values decrease as accuracy increases. And thus in the case of a higher accuracy value, a smaller value for angle increment should also be selected in order to permit reliable detection in the event of rotation. **NOTE!** After changing the accuracy value, the values for pyramid steps and aggressiveness should be recalculated for the new situation.

14.5 Point Cloud Weld Seam Tracking Module

The point cloud weld seam tracking module is explained in a separate manual. It describes all relevant information on weld seam tracking and the robust 2D/3D profile sensor from the MLZL series. The manual can be found at www.wenglor.com on the product detail page for the MLZL sensors or the BB1C009 control unit.

14.6 Module Point Cloud Measure

14.6.1 Overview

Objective	Check the profile for dimensional accuracy and detect edges, columns or seams. Enter tolerances for any ascertained dimensions.
Abbreviated procedure	Search for lines, arcs or circles on a height profile and output the coordinates of found points, such as end points of lines, center points of circles and start or rake angles of arcs. Also find, sort and count segments on a line or an arc. Determine spaces between points and found lines and determine the angle and intersections of geometries. Intersections with the axes of the coordinate system are also possible. Values for a given shape such as the center of the surface or start and end points are determined. Furthermore, turning points in the profile can be found relative to the linked coordinate system.

14.6.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [us]	Process Time for process steps in the current module.
Module State	Error codes provide support for troubleshooting.
Input point cloud	Any available point cloud can be selected.
Coordinate system	The module can be linked to a coordinate system if necessary. All search geometries within the module are thus aligned to the selected coordinate system.

Function field	**Point**	A fixed point can be positioned, or a point can be linked from another module.
	Line	A search line is drawn. All points within the search area are used to define the line.
	Arc	An arc is defined by means of its center, as well as its starting and end points. All points within the search area are used to define the arc.
	Circle	A circle is drawn over two or three points. All points within the search area are used to define the circle.
Function field	**Segments on Line**	Lines are looked for in the search range which is defined by the search line and the search width.
	Segments on Arc	Arc segments are looked for within the search range, which is defined by the search arc and the search width.
	Turning points	Look for turning points such as global minimum and maximum.
	Distance	The distance between different points or lines is calculated.
	Angle	The intersection and the angle between two lines are ascertained. Furthermore, the angle of a line can be determined relative to the axes of the coordinate system.
	Property of Geometry	Attributes such as the center of a shape can be selected.

14.6.3 Configuration

The measuring module includes the following configuration options:

- Find point
- Find line
- Find arc
- Find circle
- Find segments on line
- Find segments on arc
- Find turning points
- Calculate distance
- Calculate intersection
- Property of Geometry

14.6.3.1 Finding the Submodule Point

Properties	**Found point**	The coordinates of the found point are displayed.
	Input point	A fixed point can be positioned, or a point can be linked from another module.

14.6.3.2 Submodule Find Line, Arc or Circle

Objective

Find a line, circle or arc within the selected search area.

Abbreviated procedure

First of all, activate the function in the toolbar. The search line, search circle or search arc can then be drawn within the measuring range. The search range is determined by means of the search width. All points within this area are used to find the shapes, and the setting for the RANSAC distance threshold influences the stability of the search algorithm.

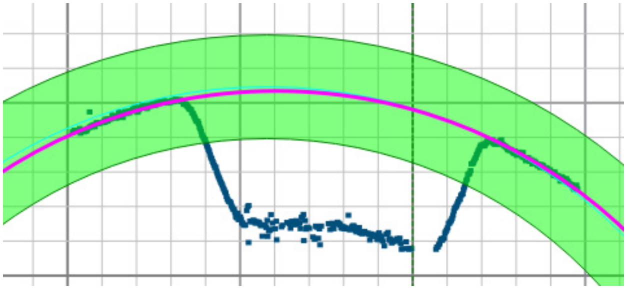
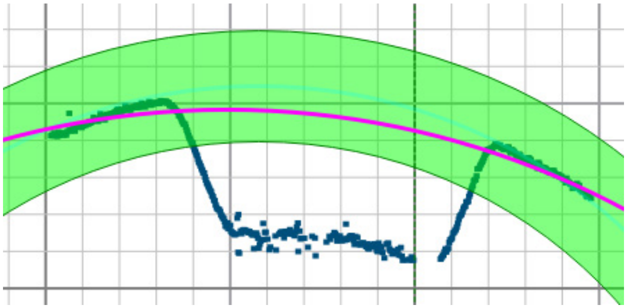
Where necessary, the search can be determined via the start and end of the geometry. Searching for a certain number of consecutive outliers is conducted to this end from the longest found segment in both directions, or the distance between two consecutive, valid points is analyzed. If the distance between two valid points is greater than the selected value, or if more consecutive outliers occur than tolerated, the starting or end point is set there and the parameters of the detected shape are set accordingly.

Property

The following settings/results are displayed:

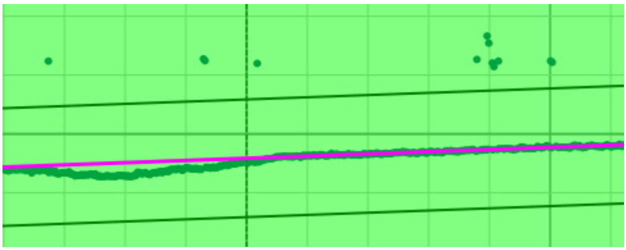
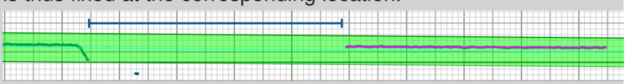
Quality of Fit [%]	Percentage which indicates the relationship of the valid points to all points within the search area. Differentiation between valid points and outliers is determined by means of the outlier threshold distance value.
Search width [unit]	Specify the width of the search geometry.
Distance threshold RANSAC [unit]	The RANSAC distance threshold is used initially to ignore outliers when determining the geometry. The RANSAC distance threshold value specifies the threshold beyond which a point is deemed an outlier by the RANSAC filter. The search algorithm is executed until 80 % of the points have a distance from the geometry which is less than the selected threshold. **NOTE!** • Default setting: 2.5. • A small filter value (e.g. 0.5) increases the accuracy of the search algorithm because it will now ignore a larger number of outlier points when searching for the geometry. However, the evaluation time is also increased. • The following example shows a circle with a RANSAC distance threshold value of 0.1:

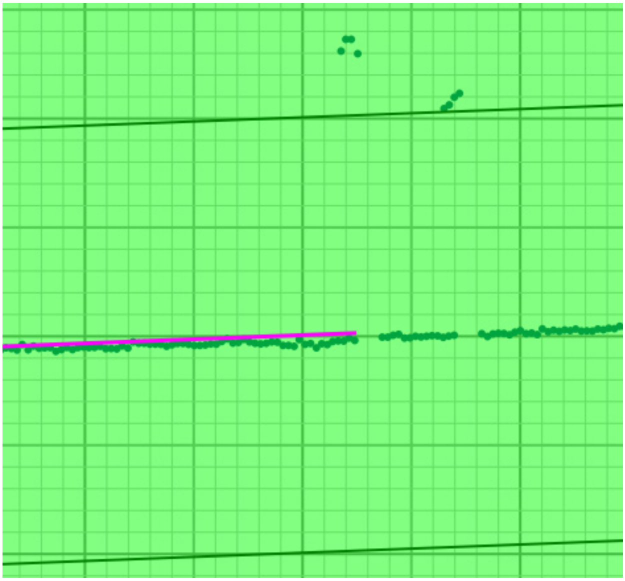
Property

Distance threshold RANSAC [unit]	 • With a large pre-filter value (e.g. 10), there are fewer outlier points, which means that more points are used in order to determine the geometry. The evaluation time is reduced. The following example shows a circle with a RANSAC distance threshold value of 10:  **NOTE!** Only available in the extended mode.
Point usage [%]	The percentage indicates how many points will be used to determine the geometry.
Point usage	Specifies which points should be used to determine the geometry. Users can choose between the first and the last points on the search geometry.

Property			
	Adjust maximum geometry	For performance reasons, the search for start and end points of a geometry is deactivated as a default setting.	
		Off	In the case of a line, the intersections of the detected line with the edge of the search area are read out as start and end points. In the case of a circle or an arc, the starting angle 0° and the end angle (360°) are indicated.
		On	Further parameters for searching for the start and end points of the geometry appear. The start and end points of the line, as well as the start and locating angles of the arc, are found if a certain number of consecutive outliers occur, or if there is an excessively large distance between two consecutive, valid points.
			NOTE! This value is not available when searching for a circle.

If the “Adapt maximum geometry” value is activated, the following additional settings appear as well:

Property		
	Threshold Outlier distance [unit]	Permissible distance from points to the detected geometry. If the distance to the point is greater than the selected threshold value, the point is evaluated as an outlier. The outlier threshold value is displayed in the search area.  This setting is used for consensus and the determination of the beginning and end of a geometry.
	Maximum gap between valid points	If the distance between two consecutive, valid points is greater than the selected value, the start and end points of the line, as well as the start and locating angles of the arc, are defined there. The distance between the projected points on the detected geometry is relevant. In our example, the tolerated gap between two valid points is smaller than the actually occurring gap. The geometry’s end point is thus fixed at the corresponding location. 

Property	Maximum outliers in series	The start and end points of a line, or the start and locating angles of an arc, can also be found by means of a certain number of consecutive outliers. The value determines how many directly consecutive outliers are tolerated. In our example, zero directly consecutive outliers are tolerated.  **NOTE!** • Value 0: No outliers are tolerated. The beginning and end of the geometry are set at the first outlier. • Value 2 (default setting): Two consecutive outliers are tolerated. If there are three or more consecutive outliers, the starting and end points are set there. • Using a large value makes the search for the beginning and end of the geometry more resistant to numerous consecutive outliers. Outliers are specified with the outlier threshold value.

Property

The following results are calculated for the geometries detected, depending on the geometry.

For lines:
- Point 1 and 2 as well as the midpoint of the line
- Length of the line
- Angle from search geometry to detected geometry (positive clockwise).

For arcs:
- Diameter of arc detected
- Angle start and circumference (depending on the input coordinate system; positive counterclockwise)
- Coordinates from the beginning, center and end of the arc
- Length of arc detected
- Angle from search geometry to detected geometry (positive counterclockwise). The orientation of the arcs is hereby defined from the midpoint to the center of the arc.

For circles:
- Diameter of circle

14.6.3.3 Submodule Find Segments on Line or Arc

Objective

Find, sort and count several segments on a search line or a search arc.

Abbreviated procedure

Activate the function in the toolbar. Draw the search line or the search arc into the measuring range. The search range is determined by means of the search width. All points within this area are used to find the shapes, and the setting for the RANSAC distance threshold influences the stability of the search algorithm.

Specify the number of segments, minimum and maximum segment lengths and the sorting rule for segments. Length, as well as starting point, middle point and end point, are read out for each segment. The number of detected segments is also available.

Property

The following settings/results are displayed:

Quality of Fit [%]	Percentage which indicates the relationship of the valid points to all points within the search area. Differentiation between valid points and outliers is determined by means of the outlier threshold distance value.
Segments True Count	Number of detected segments. The upper and lower thresholds of the value are adjustable. **NOTE!** The number of segments found is independent of the maximum number of segments.
Search width [unit]	Specify the width of the search geometry.

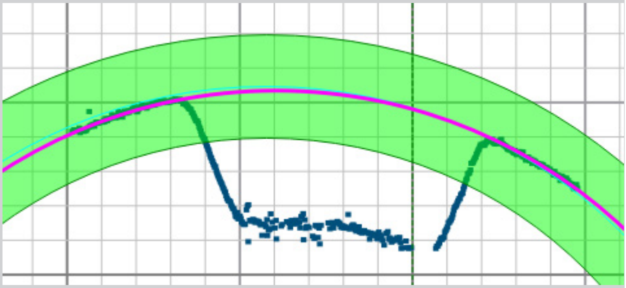
Property

Threshold Ransac Distance [unit]

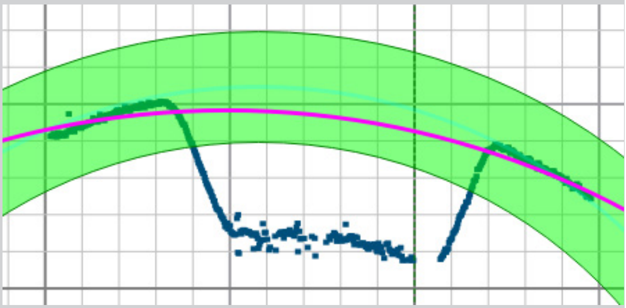
The RANSAC distance threshold value is used initially in order to ignore outliers when determining the shape.
The RANSAC distance threshold value specifies the threshold as of which a point is deemed an outlier when the RANSAC filter is used. The search algorithm is executed until 80% of the points have a distance from the shape which is less than the selected threshold.

NOTE!
Default setting: 2.5.

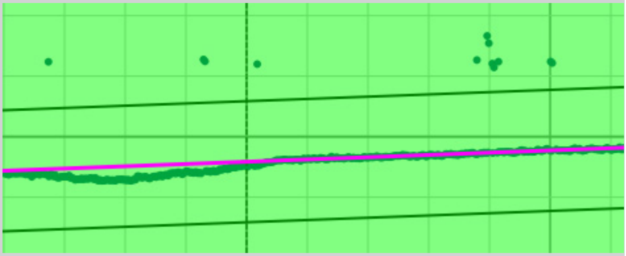
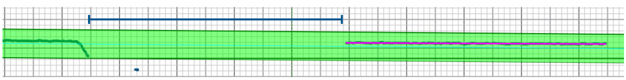
- A small filter value (e.g. 0.5) increases the accuracy of the search algorithm, because a larger number of outlier points are ignored when searching for the shape. However, evaluation time is also increased.
- The following example shows a circle with a RANSAC distance threshold value of 0.1:

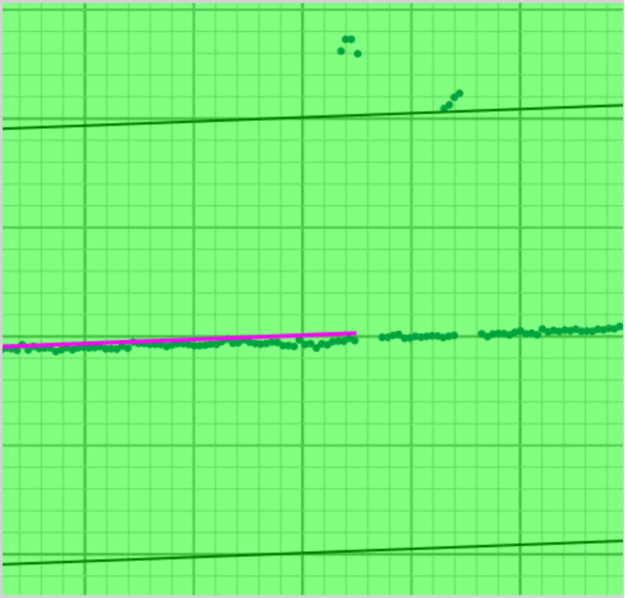


- With a large pre-filter value (e.g. 10) there are fewer outlier points which means that more points are used in order to ascertain the shape. Evaluation duration is reduced. The following example shows a circle with a RANSAC distance threshold value of 10:



NOTE!
Only available in the extended mode.

Property	**Segment Max Count**	Maximum number of expected segments. **NOTE!** The number of segments found is independent of the maximum number of segments.
	Segments Minimal Length	Minimum length of the segments.
	Segments Maximal Length	Maximum length of the segments.
	Threshold outlier spacing [unit]	Permissible geometric distance from points to the found shape. If the distance to the point is greater than the selected threshold value, the point is evaluated as an outlier. The outlier threshold value is displayed in the search area.  This setting is used for consensus and the ascertainment of the beginning and end of a shape.
	Maximal Gap Between Valid Points	If the distance between two consecutive, valid points is greater than the selected value, the starting and end points of the line, as well as the launching and rake angles of the arc, are defined here. The distance between the projected points on the found shape is relevant. In our example, the tolerated gap between two valid points is smaller than the actually occurring gap. The shape's end point is thus fixed at the corresponding location. 

<table>
<tr><td>Property</td><td>Maximum outliers in a Row</td><td>The starting and end points of a line or the launching and rake angles of an arc can also be found by means of a certain number of consecutive outliers. The value determines how many directly consecutive outliers are tolerated. In our example, zero directly consecutive outliers are tolerated.

NOTE!
• Value 0: No outliers are tolerated. The beginning and end of the shape are set at the first outlier.
• Value 2 (default setting): Two consecutive outliers are tolerated. If there are three or more consecutive outliers, the starting and end points are set there.
• Using a large value makes the search for the beginning and end of the shape more resistant to numerous consecutive outliers.

Outliers are specified with the outlier threshold value.</td></tr>
<tr><td></td><td>Sorting rules</td><td>Sort detected segments:<table>
<tr><td>Size [longest first]</td><td>Sort segments in descending order according to size.</td></tr>
<tr><td>Size [shortest first]</td><td>Sort segments in ascending order according to size.</td></tr>
<tr><td>Position on search geometry</td><td>Sort segments according to position on the search geometry.</td></tr>
</table></td></tr>
</table>

Property

Segments Minimal Angle	The minimum segment angle can be used to define which minimum angle is required for a segment to be recognized as such. This prevents incorrectly aligned segments from being detected. **NOTE!** The angle of geometries is defined by the search geometry to the detected geometry (positive clockwise). For arcs, the direction from the midpoint of the circle to the center of the arc is defined.
Segments Maximal Angle	The maximum segment angle can be used to define which maximum angle is required for a segment to be recognized as such. This prevents incorrectly aligned segments from being detected. **NOTE!** The angle of geometries is defined by the search geometry to the detected geometry (positive clockwise). For arcs, the direction from the midpoint of the circle to the center of the arc is defined.

The following results are calculated for the geometries detected, depending on the geometry.

For lines:
- Point 1 and 2 as well as the midpoint of the line
- Length of the line
- Angle from search geometry to detected geometry (positive clockwise).

For arcs:
- Diameter of arc detected
- Angle start and circumference (depending on the input coordinate system; positive counterclockwise)
- Coordinates from the beginning, center and end of the arc
- Arc length of arc detected
- Angle from search geometry to detected geometry (positive counterclockwise). The orientation of the arcs is hereby defined from the midpoint of the circle to the center on the arc.

14.6.3.4 Submodule Find Turning Point

Objective
Ascertain turning points such a high and low points relative to the linked coordinate system.

Abbreviated procedure
Activate the function in the module toolbar and select the required turning points.

Property
The following settings/results are displayed:

<table>
<tr><td>Points True Count</td><td colspan="2">Display of the number of detected points.</td></tr>
<tr><td rowspan="5">Find method</td><td colspan="2">The following turning points can be selected:</td></tr>
<tr><td>Global minimum</td><td>The point with the largest Z value relative to the linked coordinate system.</td></tr>
<tr><td>Global maximum</td><td>The point with the smallest Z value relative to the linked coordinate system.</td></tr>
<tr><td>Local minimum</td><td>A search region is found around every point, which is defined by the radius. If the difference in the height values between the relevant point and the points in the search region (maximum or average height difference) is larger than the set threshold value, a local minimum is found at this point. The local minimums can be sorted by x-value, z-value or z-distance.</td></tr>
<tr><td>Local maximum</td><td>A search region is found around every point, which is defined by the radius. If the difference in the height values between the points in the search region (maximum or average height difference) and the relevant point is larger than the set threshold value, a local maximum is found at this point. The local maximums can be sorted by x-value, z-value or z-distance.</td></tr>
<tr><td>Points Max Count</td><td colspan="2">Maximum number of points.</td></tr>
<tr><td>Radius [unit]</td><td colspan="2">For local maximums and minimums, the size of the search range can be defined by the radius.</td></tr>
<tr><td>Threshold [unit]</td><td colspan="2">The height difference that must be exceeded for a point to be detected as a local minimum or maximum.</td></tr>
<tr><td>Distance mode</td><td colspan="2">From the points in the search range, the average or the maximum z-value can be used.</td></tr>
<tr><td>Sort Rule</td><td colspan="2">The found local minimums or maximums can be sorted by x-value, z-value or z-distance.</td></tr>
</table>

14.6.3.5 Distance Calculation Submodule

Objective Ascertain distance between two points, or between a point and a line.

Abbreviated procedure Activate the function in the toolbar first.
Click on the first point or the first line. Then click on the second point or the second line.

Property The following settings/results are displayed:

<table>
<tr><td>Output distance</td><td colspan="2">The distance value is shown. The value can be furnished with any desired upper and lower thresholds.</td></tr>
<tr><td rowspan="3">Calculation method</td><td colspan="2">The type of distance calculation is specified.</td></tr>
<tr><td>Geometric distance</td><td>Shortest path from a point to a line (perpendicular).</td></tr>
<tr><td>Center to center</td><td>Shortest path between two segment center points.</td></tr>
</table>

14.6.3.6 Submodule Intersection Point

Objective The angle and the intersection between two lines or a line and an axis of the coordinate system are measured.

Abbreviated procedure First activate the function in the module toolbar.
Click the first line and then mark the second line or an axis of the coordinate system.

Property The following settings/results are displayed:

<table>
<tr><td>Output Intersection Point</td><td>The intersection’s coordinates are displayed.</td></tr>
<tr><td>Output angle [degree]</td><td>The angle between the two shapes is displayed.

The orientation of each line is defined by the starting and end points. The angle between the lines is here calculated from the first to the second line in counterclockwise direction and output from –180...180°.

NOTE!
Positive angles in the x-z plane are counterclockwise, negative angles in the x-z plane are clockwise.</td></tr>
</table>

14.6.3.7 Submodule Property of Geometry

Objective Special characteristics of a shape, such as its center, can be ascertained.

Abbreviated procedure Activate the function in the module toolbar and then click the relevant shape.

Property The following settings/results are displayed:

Output point	The coordinates of the relevant point are displayed.	
Property type	**Center of surface**	The center of the surface is found.
	Start of surface	The starting point of the shape is found.
	End of surface	The end point of the shape is found.
	Highest Point	The point on the geometry with the lowest z value is found.
	Lowest Point	The point on the geometry with the highest z value is found.
	Leftmost Point	The point on the geometry with the lowest x value is found.
	Rightmost Point	The point on the geometry with the highest x value is found.

14.7 Module Point Cloud Calculus

14.7.1 Overview

Objective

Read out the highest or lowest point of the original sensor coordinate system.

NOTE!
The global minimum or maximum relative to the linked coordinate system is detected in the measuring module under turning points (see “14.6.3.4 Submodule Find Turning Point”, page 279).

Edge points can also be found.

Abbreviated procedure

Click the required function in the module toolbar. The coordinates of the special point are displayed.

14.7.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [us]	Process Time for process steps in the current module.
Module State	Error codes provide support for troubleshooting.
Input point cloud	Any available point cloud can be selected.
Coordinate system	The module can be linked to a coordinate system if necessary.

Function field

Find highest point	The point with the smallest Z value (highest point) is read out.
Find lowest point	The point with the largest Z value (lowest point) is read out.
Find edges	Edge points can be found on the height profile. For this, the z-value differences are analyzed according to the first derivation or the derivation of the z-value differences evaluated according to the second derivation.

14.7.3 Configuration

The calculus module includes the following configuration options:
- Set

14.7.3.1 Submodule Find Heighest Point

Objective

The point with the smallest Z value is read out from the original coordinate system of the 2D/3D sensor.
In the case of a linked coordinate system as well, this setting is retained for performance reasons.

Property

The following settings/results are displayed:

Output highest point	The coordinates of the highest point are read out relative to the linked coordinate system.

14.7.3.2 Submodule Find Lowest Point

Objective

The point with the largest Z value is read out from the original coordinate system of the 2D/3D sensor.
In the case of a linked coordinate system as well, this setting is retained for performance reasons.

Property

The following settings/results are displayed:

Output lowest point	The coordinates of the lowest point are read out relative to the linked coordinate system.

14.7.3.3 Submodule Find Edges

Objective

Edge points are output by the origin coordinate system of the 2D/3D sensor. In the case of a linked coordinate system as well, this setting is retained for performance reasons. Edges can only be found on horizontal height profiles, as the algorithm searches for differences in the z-values independently from the linked input coordinate system.

NOTE!
The “Find edges” function requires a sorted height profile. Only one signal may be read out on the 2D/3D profile sensor (not both!).

Property

The following settings/results are displayed:

Edges True Count	The number of detected edges is output.
Edges Max Count	The maximum number of edges to be found is adjustable.
Neighbors	A direct filtration is possible via the number of neighbors, so that individual outlier points do not result directly in an edge detection.
Threshold gradient positive	Positive threshold value that must be exceeded as a minimum for an edge to be detected.
Threshold gradient negative	Negative threshold value that must be exceeded as a minimum for an edge to be detected.
Minimum length	Minimum space between the minimum and maximum of the height profile (1st derivation) or between the minimum and maximum of the first derivation of the height profile (2nd derivation) for the point to be detected as an edge.
Maximal length	Maximum space between the minimum and maximum of the height profile (1st derivation) or between the minimum and maximum of the first derivation of the height profile (2nd derivation) for the point to be detected as an edge.
Edge selection	The center point, the start or the end point of the found edge can be output.
Edge type	Only rising, only falling or both edge types can be output.
Sort Rule	The found edges can be sorted by x-value, z-value, edge value or read-in sequence.
Method	The first or the second derivation can be used for the edge search.
Length mode	The x-distance or the xz-distance can be used to analyze the minimum and maximum length.

15. Software Modules for Results Calculation

15.1 Spreadsheet Module

15.1.1 Overview

Objective	Results can be offset against each other as desired, compared or logically combined with the spreadsheet module. Furthermore, IF/THEN queries can also be executed with the module.
Abbreviated procedure	Results from the project can be added to the spreadsheet. Multiple results can be linked and combined using different operations. Calculated results can be used as outputs and exported. Lower and upper limit values can also be defined for exported cells, so that the value can be linked to a digital output, for example.

15.1.2 Setting Parameters

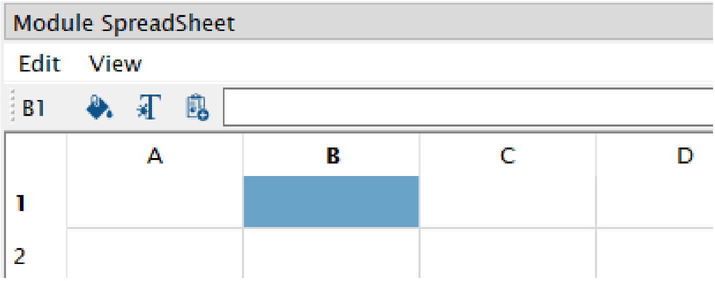
Property

The following settings/results are displayed:

Process Time [us]	Process time for the selected module.
Module state	Error codes for troubleshooting support (see section "25.5 Module Status" on page 351)

Toolbar module

In the toolbar module, a spreadsheet can be opened in a separate window by clicking "Open Spreadsheet".



Cell content can be copied, cut or pasted via the spreadsheet menu bar. The display can also be switched to show formulas instead of results.

The following can be specified for each cell:

Background color	Background color of the cell
Text color	Text color of the cell
Add project result	After clicking "Add result", a result from the project can be added to the selected cell.
Open formula assistant	Clicking on "Open formula assistant" opens the formula assistant for the selected cell. An overview of the available formulas and an input assistant for the required formulas can be found there.

The following functions can be executed using the context menu of any selected cell:

Cut	Cell content of the selected cell is cut.
Copy	Cell content of the selected cell is copied.
Paste	Previously cut or copied cell content is pasted into the cell.
Delete	Cell content of the selected cell is deleted.
Insert row	A new empty row is inserted above the selected cell.
Insert column	A new empty column is inserted to the left of the selected cell.
Delete row	The selected row is deleted.
Delete column	The selected column is deleted.
Add result	After clicking "Add result", a result from the project can be added to the selected cell.
Use as output	Export cell content. There must be a value in the cell to this end. Cell content is then displayed under output. It can then be used in other modules.

Toolbar module

Formulas:
- Formulas begin with an equal sign.
- Individual elements of formulas are separated by semicolons.
- Comparisons can be made with =; >=; <=, < or >.

Available formulas

Designation	Explanation	Example
Reference to other cells	Reference to the content of other cells can be created in a cell.	=B1
Reference to results	Results from the project can be added to cells.	=INPUT (“application module. run counter”)
Linking numerical values	Two or more numerical values can be linked. A simple addition of numerical values is triggered with a plus sign as standard. Several numbers can be linked with the apostrophe sign.	Examples: =A1+““+B1 =1+““+2=12
Comparing numeri-cal values	Two values can be compared with each other.	=A1>A2
Addition	Two or more values can be added to-gether.	=(2+3)
Subtraction	One value can be subtracted from an-other.	=(2-1)
Negation of values	A value can be negated.	=(-3)
Multiplication	Two or more values can be multiplied by each other.	=(2*3)
Division	One value can be divided by another.	=(4/2)
Modulo	Remainder after division of one value by another.	=(8%3)
Exponent	The exponential value can be calcu-lated.	=(2^3)
Min, Max	Determine the minimum or maximum of two or more values.	=MIN(2;3;1)
PI	Use the Pi value.	=PI()

Toolbar module

Designation	Explanation	Example
Sin, cos, tan, asin, acos, atan, atan2	Various trigonometric functions (e.g. sin, cos, tan ...) can be calculated. The angle must be specified in radians. **NOTE!** A simple conversion of angles in degrees to angles in radians is possible using the following formula: $X = \frac{\pi}{180°} \times \alpha$ "X": Angle in radians "Alpha": Angle in degrees	=SIN(10)
Sqrt, log, ln	The root or logarithm of values is determined.	=SQRT(100)
AND, OR	Execute logical AND or OR operations with two or more values.	=AND(2>1;3>2)
NOT	Logically negate a value.	=NOT(1<2)
IF-Then-Else	IF/THEN queries check to determine whether the first element of the formula is true or false. If the condition is true, the result of the IF/THEN query is the second element of the formula. If the condition is false, the result of the IF/THEN query is the third element of the formula.	=IF(2<3;4;5)
ISERROR	The ISERROR formula is used to check whether a value is in error state or whether the value is valid. The result itself is always valid and returns a 1 in the event of an error and a 0 if the value is valid. **NOTE!** The ISERROR function can be used to define an individually adjustable error behavior in the project for any value. The IF function can be combined with the ISERROR function for this, for example, e.g. =IF(ISERROR(A1);1;0)	=ISERROR(A1)

DEC2BIN, DEC2HEX, HEX2DEC, HEX2DEC, BIN2DEC, BIN2HEX	Convert a number between decimal, binary and hexadecimal. **NOTE!** The maximum size of BIN, HEX and DEC values must be taken into account for this. 255 is the maximum decimal number that can be converted to a binary number, for example. If the number of digits is exceeded, an error is returned.	=DEC2BIN(A1)
LEFT, RIGHT	Output the first x digits of a character or character string, from left or right. For example, the first two left digits of the number 12345 can be output with the formula =LEFT(12345;2). The result here is 12. **NOTE!** • The result of the formula is always a character string. This means that calculations are no longer possible once the result is produced! • If the number of characters is larger than the value, blank characters are not used as fillers, but rather the available value is output (e.g. LEFT(ABC;5) = ABC)	=LEFT(A1;2)

Toolbar module

TEXT	A number can be formatted with the TEXT formula. It is possible to define how many of the digits before or after the comma are output. **NOTE!** • Only DINT, REAL and BOOL data types can be formatted (no character strings). • The formatting requires at least one number before and after the decimal point, e.g. “0.0”, and the number before the decimal point must be high enough for all occurring values. Otherwise, an error is output. • The result of the formula is always a character string. This means that calculations are no longer possible once the result is produced!	=TEXT(A1;“0.00“)

The following error messages may appear.

Designation	Explanation	Example
ERROR_INPUT	The result added to the spreadsheet is not available because, for example, the module has been deleted or the result is in an error state.	Check the input data from the spread-sheet module and, if necessary, recom-bine or determine what caused the error.
ERROR_PARSER	Syntax error in case of incorrect use of characters, e.g.: =(2+3	Check and correct the syntax of the formula.
ERROR_INF	The value is plus or minus infinity.	Check the mathe-matical formula.
ERROR_NAN	Division by 0 or root of a negative number.	Check the mathe-matical formula.
ERROR_VALUE	Semantic error, e.g. in the subtraction of two numerical values.	Check the formula.

15.1.3 Configuration

The spreadsheet module includes the following configuration options:
• Output

15.1.3.1 Output Submodule

Objective	All exported spreadsheet values are listed. The values can then be used as inputs for other modules.
Property	All exported cells are listed. Lower and upper limit values can be defined for each numerical value, e.g. in order to link a numerical value directly to a digital output.

15.2 Module Logic

15.2.1 Overview

Objective

Logically link several values with each other.

Procedure

Define several values to be linked with each other. Fixed values can be used, as well as values that come from a result.

15.2.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [us]	Process Time for process steps in the current module.
Module State	Error codes provide support for troubleshooting.
Output	The results are displayed
Logic function	The type of mathematical function is specified: • A and B • A or B • A xor B • A nand B • A nor B
Inputs Max Count	Number of inputs. In the inputs submodule, the number of inputs appear that can be linked with a fixed value or with a result from the application. **NOTE!** If more than two inputs are used, the selected logical function is initially applied to the first two inputs. The same logical function is then applied to this result and the third input and so on. This results in a nesting with multiple logical gates one after the other. If a single gate with multiple inputs is required, this can be achieved in the spreadsheet module.

15.3 Mathematics Module

15.3.1 Overview

Objective	Calculate several numbers with each other.
Procedure	First of all, the mathematical operands are specified which will be used to perform a mathematical operation with the numeric values. Fixed values can be used, as well as values that come from a result.

15.3.2 Setting Parameters

Property The following settings/results are displayed:

Process Time [us]	Process Time for process steps in the current module.
Module State	Error codes provide support for troubleshooting.
Output	The calculated results are displayed.
Math function	The type of mathematical function is specified: • A + B • A – B • A * B • A / B
Inputs Max Count	Number of inputs. In the inputs submodule, the number of inputs appear that can be linked with a fixed value or with a result from the application.

15.4 Module Numeric Comparison

15.4.1 Overview

Objective Compare two numeric values with each other.

Procedure First of all, the mathematical operands are specified which will be used to compare the two numeric values with each other. Fixed values can be used, as well as values that come from a result.

15.4.2 Setting Parameters

Property The following settings/results are displayed:

Process Time [us]	Process Time for process steps in the current module.
Module State	Error codes provide support for troubleshooting.
Output	The calculated results are displayed.
Compare function	The type of mathematical function is specified: • A > B: A is larger than B • A < B: A is smaller than B • A >= B: A is larger than or equal to B • A <= B: A is smaller than or equal to B • A == B: A is equal to B • A != B: A is not equal to B
Input A	Fixed value or variable event from the application
Input B	Fixed value or variable event from the application

15.5 Module Match Code

15.5.1 Overview

Objective Check whether a value matches the taught-in match code.

Procedure A match code with the appropriate settings can be entered via this module.

15.5.2 Setting Parameters

Property The following settings/results are displayed:

Process Time [us]	Process Time for process steps in the current module.
Module State	Error codes provide support for troubleshooting.
Any match	If any character string is identical to the input character string, the parameter is set to 1 (checkbox activated).
No match	If no character string is identical to the input character string, the parameter is set to 1 (checkbox activated).
Input string	The match code can either be entered statically as text or a combination of text and characters, or dynamic reference can be made to a software parameter via a link.
Number elements	Number of possible texts for comparison.

15.5.3 Configuration

The match code module includes the following configuration options:
- Match code #1

15.5.3.1 Match Code #1

Property

The following settings/results are displayed:

<table>
<tr><td>Match</td><td>Display indicating whether or not the match code comparison was successful. Box activated – evaluation successful.</td></tr>
<tr><td>Mismatch</td><td>Display indicating whether or not the match code comparison was successful. Box activated – evaluation not successful.</td></tr>
<tr><td>Match code</td><td>The text or combination of characters on which comparison will take place is selected.
The following place holders are also available for the characters:
<table>
<tr><th>Place holder</th><th>For character</th></tr>
<tr><td>*
?
[abc]
[^A]</td><td>Any String Count.
Exactly one character.
a, b or c may appear at this position.
Any character other than “A” can appear at this position.</td></tr>
</table></td></tr>
<tr><td>Match Teach</td><td>The current text or combination of characters is saved as a match code.</td></tr>
</table>

15.6 Module Statistic

15.6.1 Overview

Objective The application can be fine-tuned on the basis of statistical sensor data.

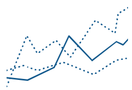
Procedure Various statistical data can be calculated and displayed. Up to 100 most recently acquired values can be analyzed.

15.6.2 Setting Parameters

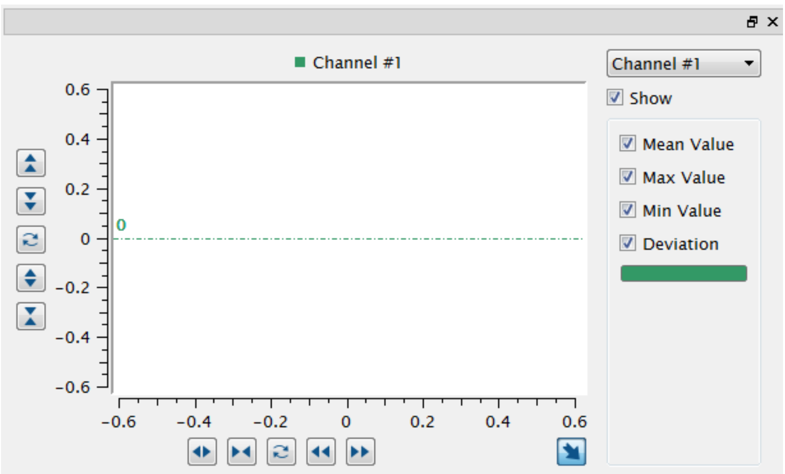
Property The following settings/results are displayed:

Process Time [us]	Process Time for process steps in the current module.
Module State	Error codes provide support for troubleshooting.
Channel Count	Number of parameters which will be acquired for statistical purposes.

Function field Insertion of the statistics field

	The statistical evaluations are displayed in a separate area.

Statistics window



15.6.3 Configuration

The number of channels determines the number of listed channels. The respective statistics value can be displayed in the channel.

- Channel #1

15.6.3.1 Submodule Channel #1

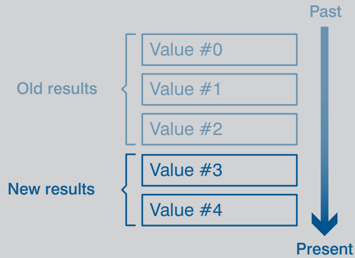
Objective A certain value can be analyzed.

Property The following settings/results are displayed:

Minimum	The lowest value of the most recently observed measured value results is indicated.
Maximum	The highest value of the most recently observed measured value results is indicated.
Mean	The arithmetic mean value is calculated from the most recently observed measured value results.
Median	All values are sorted according to magnitude. The point in the middle (central) location is read out as the median.
Standard deviation	Standard deviation is determined on the basis of the most recently observed measured value results. Standard deviation is the square root of the sum of the squared differences from the mean value divided by the number of values. $s = \sqrt{\frac{1}{n} * \sum_{i=1}^{n} (x_i - \bar{x})^2}$
Trend	All observed measured value results are equally subdivided into new and old events by means of the trend ratio. The arithmetic mean value is determined for the old, as well as for the new measured values. The difference between these arithmetic mean values is the trend. **NOTE!** If the trend is close to 0, the measured value has remained relatively constant during the observation time period.
Good	The most recently observed measured value results are used to determine how often the measured value is within the specified tolerance. The good portion is indicated as a percentage of all analyzed values.

Property

<table>
<tr><td>Input to Track</td><td>A variable application result can be linked to statistical evaluation.</td></tr>
<tr><td>Reset statistic</td><td>All most recently observed measured value results, listed under result values, are deleted.</td></tr>
<tr><td>Ratio for Trend</td><td>All observed measured value results are equally subdivided into new and old events. The ratio of the number of old results to the number of new results is indicated as the trend ratio. This ratio is set to 1 as a default value. Example of a trend ratio of 1.5 for 5 observed values:



This setting is used for the calculation of the trend.

NOTE!
The larger the trend ratio, the more influence individual outliers have on the trend.</td></tr>
<tr><td>Number of values</td><td>Specify the number of most recent events to be observed.</td></tr>
</table>

15.7 Counter Module

15.7.1 Overview

Objective Count any number of good and bad parts.

Procedure

1. Define the number of counters.
2. Link an event for each counter. The status of the linked value is used to count good parts (within the tolerance or active), bad parts (outside the tolerance or inactive) and errors (in error state).
3. Define the counting mode and counting method.

15.7.2 Setting Parameters

Property The following settings/results are displayed:

Processing time (us)	Processing time for the module in μs.
Module status	Error codes provide support for troubleshooting.
Global reset	All counters of the module can be reset at the same time via the global reset function. The reset takes place if the value is active.
Number of counters	The number of counters can be defined. There is a maximum of 10 different counters per module.

15.7.3 Configuration

The counter module includes the configuration
- Counter
  - Counter #1

15.7.3.1 Counter #1

Property The following settings/results are displayed:

Counter value	The current counter value is displayed. **NOTE!** After the maximum counter value of 2,147,483,647 is reached, an overrun occurs and the counter value starts at 0 again. After a device start-up, a project change and counter value reset, the counter value is reset to the default counter value (default: 0).
Counter event	Link an event for the counter. The status of the linked value is used to count good parts (within the tolerance or active), bad parts (outside the tolerance or inactive) and errors (in error state). **NOTE!** The counter is only started when a counter event is linked.

Reset	Reset the counter value for the selected counter. The reset takes place if the value is active.
Counting method	The counting can take place in increasing or decreasing order.
Counting mode	The following counting modes are available: **All**: All trigger signals are counted. **Within tolerance**: If the linked counter event is within the tolerance or active, the counter value is increased or decreased by one. **Out of tolerance**: If the linked counter event is out of the tolerance or inactive, the counter value is increased or decreased by one. **Error**: If the linked counter event is in error state, the counter value is increased or decreased by one.
Default counter value	The default counter value applied when the device is started, during a project change and after the counter is reset, can be defined. Every counter starts at 0 by default after a device start, a project change and counter value reset.

16. Software Modules for Data Output

16.1 Module Device Input and Output (weQube Only)

16.1.1 Overview

Objective

The inputs and outputs of the weQube Smart Camera can be configured in order to specify which action will take place as the result of a given event.

Procedure

Any desired results can be assigned to an output.
Any desired inputs can be configured as well.

16.1.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [μs]	Sensor processing time for the module
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 351).
Error Handling	Performance of the following read-out options, for example an output, in the event of an error

16.1.3 Configuration

The I/O device module includes the following configuration options:

- I/O timings
- Digital I/O #1
- Digital I/O #2
- Digital I/O #3
- Digital I/O #4
- Digital I/O #5
- Digital I/O #6
- Error handling

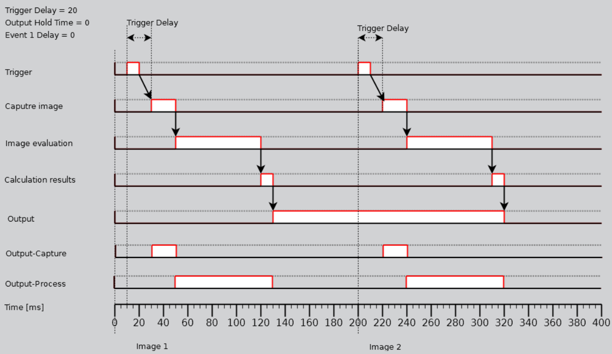
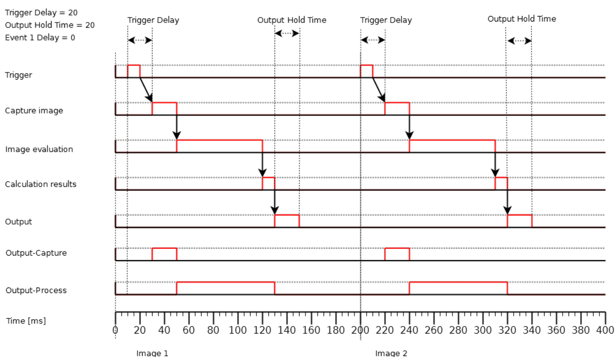
The digital I/O are preset as follows when initially added to the project:

Digital I/O	No.	Type	Polarity	Mode	Linking/function
	1	Output	Positive	PNP	-
	2	Input	Positive	-	Input Level
	3	Output	Positive	PNP	-
	4	Output	Positive	PNP	Output process
	5	Input	Positive	-	Trigger
	6	Output	Negative	Push-pull	Output Flash (external illumination)

16.1.3.1 IO Timings

Objective Time settings can be selected for the inputs and outputs.

Property

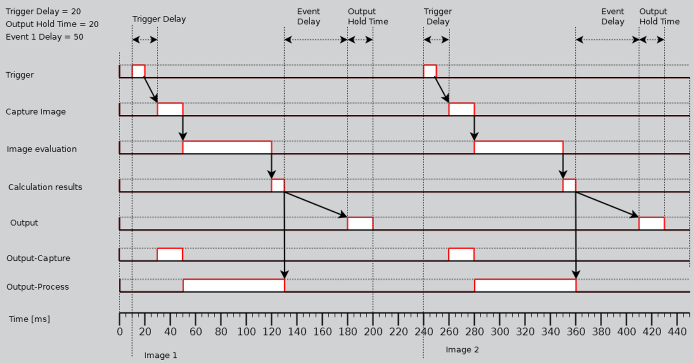
<table>
<tr><td>Processing time (us)</td><td>Sensor processing time for the module</td></tr>
<tr><td>Module State</td><td>Error codes for troubleshooting support
(see section “25.5 Module Status” on page 351).</td></tr>
<tr><td>Time unit</td><td>Milliseconds / quadrature pulse
If “Timing unit” is set to quadrature pulse, all other time values must also be, entered in pulses, and not in any unit of measure for time. The internal counter is triggered either by a millisecond tick or by quadrature pulses.</td></tr>
<tr><td>Trigger delay</td><td>The delay time between the trigger signal and image recording can be set within a range of 0 to 10,000 ms or pulses.
Sequence in Trigger mode with Trigger Delay

</td></tr>
<tr><td>Output Hold Time</td><td>The output hold time specifies the duration of the output signal. Output signal duration can be set within a range of 0 to 10,000 ms.
NOTE!
With an output hold time of 0 (default value), the output retains its status until a subsequent calculation causes its status to change.
Sequence in Trigger mode with Trigger Delay and Output Hold Time

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

Property

Event 1 Delay

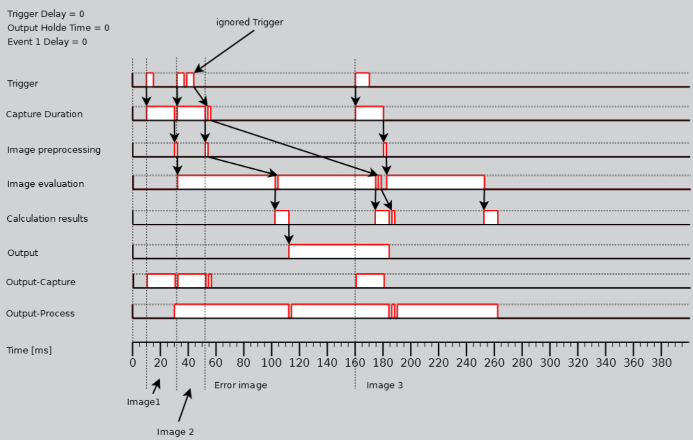
Output signal delay can have a value within a range of 0 to 10,000 ms or pulses (in the case of a rotary encoder input). The output must be linked to the corresponding event to this end. Up to 4 different delays can be selected, which can be linked as often as desired to corresponding outputs.

Sequence in Trigger mode and Trigger Delay/Event Delay/Output Holdtime



Note: In trigger mode, the next trigger signal for renewed image recording might be generated although the sensor is still busy with image evaluation or calculation. In this case, the output process signal has not yet been reset to “0”, so that the trigger signal does not cause renewed image recording at the sensor. An “empty” image is generated which is subjected to the entire image processing sequence, thus leading to negative results. This assures that there’s a result for each and every trigger pulse.

Sequence in Trigger mode with Trigger-Queue and ignored Trigger



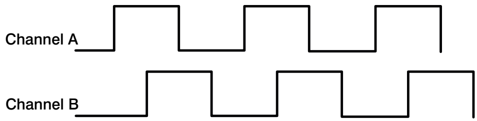
16.1.3.2 Digital I/Os 1 to 6 Submodule

Objective The digital inputs and outputs can be configured.

Property

<table>
<tr><td>Process Time [µs]</td><td>Sensor processing time for the module</td></tr>
<tr><td>Module State</td><td>Error codes for troubleshooting support
(see section “25.5 Module Status” on page 351).</td></tr>
<tr><td>I/O value</td><td>The input’s status is displayed.
With an output, this value can be linked with a result from the application.</td></tr>
<tr><td>I/O type</td><td>The type of input or output can be specified:
• Type not used.
• Type input.
• Type output.</td></tr>
<tr><td>I/O logic</td><td>The logic is defined.
• Positive logic.
• Negative logic.</td></tr>
<tr><td>I/O function</td><td>The function is defined.
<table>
<tr><td>Output</td><td>The output can be defined fixed or linked with a result from the project.</td></tr>
<tr><td>Output Flash</td><td>The flash output is active during image chip exposure in order to synchronize external illumination in flash mode.</td></tr>
<tr><td>Output Process</td><td>The output process is active during image evaluation. The Smart Camera is ready for new trigger signals during this time.</td></tr>
<tr><td>Output Capture</td><td>The image recording output is active during image recording. If a trigger pulse is generated during this time, an empty image is generated and an internal error occurs. This error image is forwarded to the downstream processes. It’s assured that no trigger pulses are lost.</td></tr>
<tr><td>Output Project Selection</td><td>This output is used to acknowledge successful switching from one project to another.</td></tr>
<tr><td>Input Level</td><td>A digital input can be used as a process data input on the device. With “Input Level”, the status of the digital input at the time of each image evaluation initiated by a trigger is read out.
NOTE!
The digital input can then be linked into other modules for teaching or comparison.</td></tr>
</table>
</td></tr>
</table>

I/O function	**Input Edge**	A digital input can be used as a process data input on the device. With “Input Edge”, information on whether an edge change has taken place on the digital input since the last image evaluation is read out at the time of every image evaluation initiated by a trigger. **NOTE!** The digital input can then be linked into other modules for teaching or comparison.
	Input Trigger	The sensor generates an image recording as soon as a trigger pulse is applied to the input. This input is exclusively responsible for image recording. **NOTE!** If the next trigger signal is already sent to the Smart Camera during image recording (image recording output active), the Smart Camera is not yet ready for the next image recording and it generates an “empty” image. The image evaluation results in a corresponding error handling. This ensures that each trigger signal has a result.
	Input Quadrature	The input is used as a rotary encoder input. **Note:** In the case of a rotary encoder, two signals are read out which are out of phase with each other.

Input Quadrature	 These two signals have to be connected to two sensor pins, regardless of order. The selected pins have to be connected to quadrature input in the weQube software. The time unit must also be set to the quadrature pulses unit for the IO timings. All IO timings are now shown in pulses, not milliseconds. **Example:** A further pin can now be used as a hardware trigger input and the number of pulses required to cause image recording after the hardware trigger signal has occurred can be entered to the trigger delay settings. You can also set up an event delay in order to specify after how many pulses certain outputs will be switched.
Input Project Selection	The input is used to change projects and reacts to the project change pulse sequence. **NOTE!** Details concerning project changes launched via digital inputs can be found in section “19. Project Changes via Digital Inputs and Outputs” on page 342.
Output Mode	The polarity of the output is specified. • PNP. • NPN. • PushPull.
Event Link	The output can be linked to one of the 4 events. As a result, the output is switched with a delay amounting to the time selected under IO timings.

16.1.3.3 Error Handling

This setting can be used to set performance of the outputs when a linked event demonstrates an error status.

Property The following settings are displayed:

Substitute BOOL types by	If this checkbox has been activated, all results of the Boolean type are replaced by the active value, if the linked file type demonstrates an error.

16.2 Module Device Input and Output (Control Units)

16.2.1 Overview

Objective Configure the inputs and outputs at the control unit.

Abbreviated procedure Any desired results can be assigned to an output. The inputs can be configured as well.

NOTE!
The Input and output device module can be used in several applications, where different outputs must be used for each. The same digital output may not be linked in several applications at the same time.

16.2.2 Setting Parameters

Property The following settings/results are displayed:

Process Time [us]	Process Time for process steps in the current module.
Module State	Error codes provide support for troubleshooting.
Error Handling	Performance of the following read-out options, for example an output in the event of an error.

16.2.3 Configuration

The I/O device module includes the following configuration options:

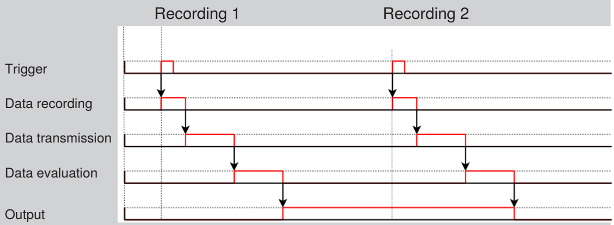
- I/O Timings
- Digital input #1
- Digital input #2
- Digital input #3
- Digital input #4
- Digital input #5
- Digital input #6
- Digital input #7
- Digital input #8
- Digital output #1
- Digital output #2
- Digital output #3
- Digital output #4
- Digital output #5
- Digital output #6
- Digital output #7
- Error Handling

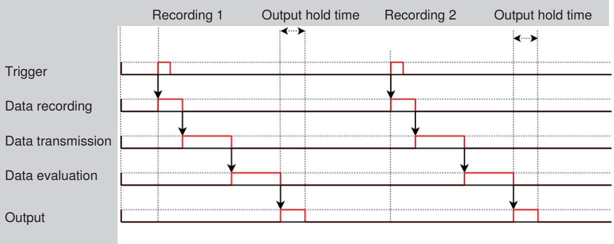
16.2.3.1 I/O Timings

Objective Time settings can be selected for the inputs and outputs.

Property The following settings/results are displayed:

<table>
<tr><td>Processing time (us)</td><td>Processing time for the module</td></tr>
<tr><td>Module status</td><td>Error codes for error handling support (see section “25.5 Module Status” on page 351).</td></tr>
<tr><td>Time unit</td><td>The time is displayed in the unit milliseconds.</td></tr>
<tr><td>Output hold time</td><td>The output hold time indicates the duration of the output signal. It is applied to digital outputs with the I/O function “Output”.

NOTE!
• By default, the output hold time is set to 0. Thus, all digital outputs retain the status until the next result is available.


• If an output hold time other than 0 is used, the digital outputs are reset after the set time. This makes it easy to evaluate when new results are available.

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

16.2.3.2 Submodule Digital Input 1–8

Objective Configure the digital inputs.

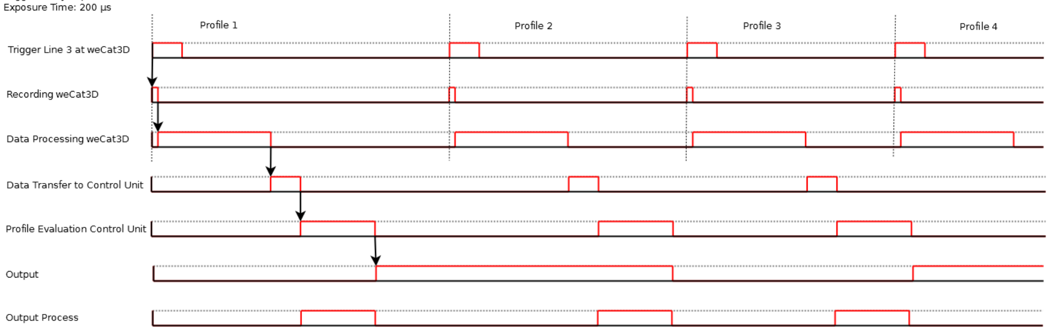
Property The following settings/results are displayed:

<table>
<tr><td colspan="1">Process Time [us]</td><td colspan="2">Process Time for process steps in the current module.</td></tr>
<tr><td>Module State</td><td colspan="2">Error codes provide support for troubleshooting.</td></tr>
<tr><td>I/O value</td><td colspan="2">The input’s status is displayed.</td></tr>
<tr><td>I/O type</td><td colspan="2">Input</td></tr>
<tr><td>I/O logic</td><td colspan="2">Input logic is specified.
• Positive logic
• Negative logic</td></tr>
<tr><td rowspan="2">I/O function</td><td>Input Level</td><td>A digital input can be used as a process data input on the control unit. With “Input Level”, the status of the digital input at the time of each data evaluation (image or profile evaluation) initiated by a trigger is read out.
NOTE!
The digital input can then be linked into other modules for teaching or comparison.</td></tr>
<tr><td>Project change input</td><td>With the help of a pulse sequence, the digital input can be used for project changes. At the control unit, only digital inputs 1 and 2 can be used for project changes. Pertinent details can be found in section “19. Project Changes via Digital Inputs and Outputs” on page 342.</td></tr>
</table>

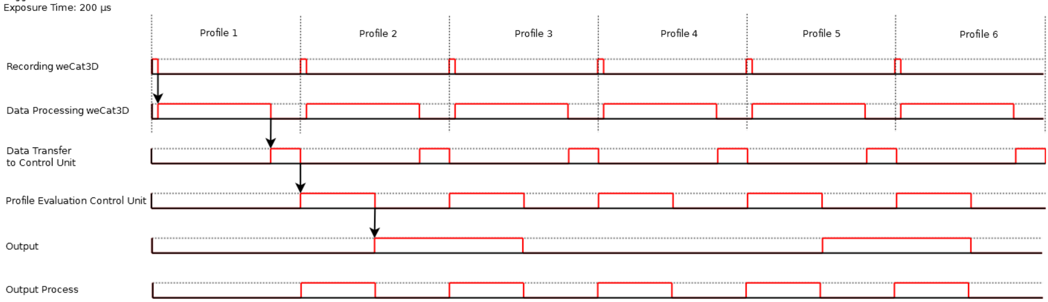
16.2.3.3 Submodule Digital Output 1–8

Objective Configure the digital outputs.
The graphics show the switching behavior of the digital outputs for different trigger modes.

Trigger Selector: Line Start
Trigger Source: Line 3
Trigger Activation: Rising Edge
Trigger Delay: 0 µs
Exposure Time: 200 µs



Trigger Selector: Line Start
Trigger Source: Intern
Exposure Time: 200 µs



16.2.3.4 Submodule Error Handling

Objective This setting can be used to set performance when a linked event demonstrates an error status.

Property The following settings/results are displayed:

Substitute BOOL types by	If this checkbox has been activated, all settings of the Boolean type are replaced by the active value, if the linked data type demonstrates an error.

16.3 Industrial Ethernet Device Module

The Industrial Ethernet device module is explained in a separate interface description.

NOTE!
The interface description is available in the download area for the relevant product on the wenglor website. The relevant interface protocol also describes which minimum firmware version is required for which protocol.

16.4 Module Device Display (weQube only)

16.4.1 Overview

Objective The OLED display can be adapted to meet you individual needs.

Procedure After the type of display has been specified, the desired values or results can be displayed depending on the selected setting.

NOTE!
After the device start, project change or a change in the display mode, the OLED display is only updated after the evaluation of the first trigger signal. The maximum number of characters for displaying on the OLED display must not be exceeded. Only normal characters (not special characters) can be shown on the display.

16.4.2 Setting Parameters

Property The following settings/results are displayed:

Process Time [µs]	Sensor processing time for the module
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 358).
Output mode	The results can be output formatted or unformatted.
Error Handling	If a linked value is in error state, the value used to replace the result can be defined.

16.4.3 Configuration

The display module includes the following configuration options:

- Text
- Indication
- Numeric
- Match code
- Teach
- Formatted
- Error Handling

16.4.3.1 Submodule Text

Objective Individual texts and specific results can be displayed.

Property The following settings/results are displayed:

Text 1	Line 1 can be entered statically, or it can be linked to a value in the software.
Text 2	Line 2 can be entered statically, or it can be linked to a value in the software.
Text 3	Line 3 can be entered statically, or it can be linked to a value in the software.
Text 4	Line 4 can be entered statically, or it can be linked to a value in the software.

16.4.3.2 Submodule Indicator

Objective Six different Boolean states can be displayed, for example output switching statuses.

Property

Indication 1	Link to the desired parameter.
Indication 2	Link to the desired parameter.
Indication 3	Link to the desired parameter.
Indication 4	Link to the desired parameter.
Indication 5	Link to the desired parameter.
Indication 6	Link to the desired parameter.

16.4.3.3 Submodule Numeric

Objective Display a line of text and a numeric value, including a bar graph.

Property

Description	A descriptive text or any desired parameter can be entered.
Value	Link to the desired parameter.

16.4.3.4 Submodule Match Code

Property

Match element	Link to the desired match code result.

16.4.3.5 Submodule Teach

Objective

Individual values can be taught in subsequently via the OLED display. If, for example, the number of pixels in the threshold module changes due to changing production conditions, the limit values for the number of pixels can simply be adjusted via the OLED display.
One of the six teach-in inputs at the OLED display must first be linked under teach-in within the respective module to this end. For example, “Teach-in 1” at the device display module can be linked in the threshold module under “Teach-in”. The linked value can then be taught in via the OLED display by teaching “Teach-in 1”.

Property

Teach 1	Value 1 for teaching in a value
Teach 2	Value 2 for teaching in a value
Teach 3	Value 3 for teaching in a value
Teach 4	Value 4 for teaching in a value
Teach 5	Value 5 for teaching in a value
Teach 6	Value 6 for teaching in a value

16.4.3.6 Submodule Formatting Options

Objective

Carry out the formatting of the characters.

NOTE!
For the formatting to function correctly, the number of digits (before the comma) must be set at least as high as the maximum number of digits (before the comma) for the results used (or their error substitute values).

Property

The following settings/results are displayed:

Integer	The number of digits can be defined. The plus/minus sign can also be read out if required.
Floating point	The number of digits before and after the comma can be defined. The plus/minus sign can also be read out if required.
Boolean	A Boolean value can be output as 0/1 or as true/false.

16.4.3.7 Submodule Error Handling

This setting can be used to set performance of the property when a linked event demonstrates an error status.

Property The following settings are displayed:

Substitute BOOL types by	If this checkbox has been activated, all properties of the Boolean type are replaced by the active value, if the linked file type demonstrates an error.
Substitute INT types by	The numeric value can be specified which is used as a substitute value in the event of a linked data type which is faulty.
Substitute STRING types by	The text is specified which is used as a substitute text, when the linked data type is faulty.

16.5 Module Device Indicator (weQube Only)

16.5.1 Overview

Objective

The signal LEDs can be used for visualizing parameter states such as the correctness or error frequency of objects.

Note

For using signal LEDs on the weQube, the light mode must be set to flash (see “12.1.2 Setting Parameters”, page 127). In continuous illumination mode, the signal LEDs are inactive to avoid influencing the image recording.

Procedure

The red and green indicator LEDs included in the sensor’s internal illumination can be assigned to events, so that they light up when the respective event occurs.

NOTE!
The indicator LEDs are only updated after the device start or project change following the evaluation of the first trigger signal.

16.5.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [µs]	Sensor processing time for the module
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 358).
Green Indicator Value	The green LED can be statically switched on or off permanently. Dynamic linking with other project data for visualization is also possible.
Red Indicator Value	The red LED can be statically switched on or off permanently. Dynamic linking with other project data for visualization is also possible.
Green Logic	Logic for the green LED can be edited. • Positive logic. • Negative logic.
Red Logic	Logic for the red LED can be edited. • Positive logic. • Negative logic.

16.5.2.1 Submodule Error Handling

This setting can be used to set performance of the property when a linked event demonstrates an error status.

Property The following settings are displayed:

Substitute BOOL Types by	If this checkbox has been activated, all properties of the Boolean type are replaced by the active value, if the linked file type demonstrates an error.

16.6 Module Device RS232 (weQube Only)

16.6.1 Overview

Objective Sensor communication dictates how data can be transmitted to the sensor, and how the sensor itself transmits data.

Property The following settings/results are displayed:

Process Time [µs]	Sensor processing time for the module
Module State	Error codes for troubleshooting support (see section “25.5 Module Status” on page 358).
Preamble	The characters specified here precede the output data.
Postamble	The characters specified here follow the output data.
Delimiter	The delimiter used to separate the individual data packets from each other is specified here.
Output	The preview of the output value is displayed, which consists of preamble, delimiter and postamble.
String Count	The number of character strings can be specified. A maximum of 100 character strings can be output.
Output mode	The results can be output formatted or unformatted.
Error Handling	If a linked value is in error state, the value used to replace the result can be defined.

16.6.2 Configuration

16.6.2.1 Character String

Objective	Reading results out via the interface.
Property	The number of elements included in the list depends on the String Count: Character string #1 Enter a static value or link a result from the application.

16.6.2.2 Submodule Formatting Options

Objective Carry out the formatting of the characters.

NOTE!
For the formatting to function correctly, the number of digits (before the comma) must be set at least as high as the maximum number of digits (before the comma) for the results used (or their error substitute values).

Property The following settings/results are displayed:

Integer	The number of digits can be defined. The plus/minus sign can also be read out if required.
Floating point	The number of digits before and after the comma can be defined. The plus/minus sign can also be read out if required.
Boolean	A Boolean value can be output as 0/1 or as true/false.

16.7 Module Device FTP

16.7.1 Overview

Objective

Process data (e.g. images, profiles or text files) can be saved locally on the device (e.g. Smart Camera or control unit) or on an FTP server in the network. Process data is therefore saved for every image or profile evaluation triggered by a trigger signal depending on the setting.

Save process data in the local "output" folder:

1. Add FTP device to the project.
2. Link input image, point cloud or character string for the text file.
3. The condition for when process data is saved is defined via the "Observer".
4. The process data is saved in the local "output" folder. Access is possible via FTP, among other options (see section "20. FTP Server" on page 344).

Save process data in the FTP server:

1. Set up an FTP server on any device (e.g. Windows PC) with user name, password and folder (e.g. FileZilla server software). The write permissions must be activated for the user name.
2. Open the device settings (e.g. Smart Camera or uniVision application) in the device list via the uniVision software.
3. Enter the FTP remote IP address, the FTP remote user name and the FTP remote password. The IP address for the device on which the FTP server is running and the user name and password used in the FTP server must be entered here (see section "8.2.2.3 weQube Smart Camera" on page 100).
4. Establish a connection with the device (Smart Camera, uniVision application) with the uniVision software.
5. Add the FTP device to the project
6. Link input image, point cloud or character string for the text file
7. The condition for when process data is saved is defined via the "Observer".
8. The process data is saved in the defined folder on the FTP server.

NOTE!
The standard ports 20 and 21 are used for saving process data via FTP. Saving via SFTP is not supported – only saving via FTP.

NOTE!
- It is not possible to ensure that all process data is saved via the FTP device during fast recording frequencies in particular. If the data could not be saved for performance reasons, this is displayed in the module status in one of the next evaluations and in the device status.
- If the memory capacity on the device or on the FTP server is full, no further data can be saved. The user must ensure that sufficient space is available and that the memory is emptied regularly.

Property

Process Time [µs]	Sensor processing time for the module
Module State	Error codes for troubleshooting support. **NOTE!** If the memory cannot be accessed or process data cannot be saved for performance reasons (e.g. data recording or evaluation too quick), this is indicated by the module status in one of the next evaluations: 1112: Error with the SD card or SSD hard drive 1113: Error in the FTP interface
Filename	The file name for image, profile or text files is made up of: • Fixed date and time information (to guarantee clear file names) • Flexible part of the file name: A fixed value can be entered manually or a result from the project can be linked (standard manual value: Record). **NOTE!** The date and time information from the control unit is used. The internal time from the Smart Camera is used. Fixed and flexible components of the name are separated by an underscore. This results, for example, in the file name “20210401_134349702_Record.bmp” for the control unit.
Input point cloud	A point cloud available in the project to be saved can be selected.
Observer	The “Observer” value defines whether the process data for the FTP module should be saved or not. If the value is inactive, process data is saved. If the value is active, no process data is saved.
Preamble	Value that is added at the front of the character string in the text file.
Postamble	Value that is added at the end of the character string in the text file.
Delimiter	Value that is placed between the character strings in the text file.
String Count	Number of values to be saved in the text file.

Property

Output mode	The character strings saved in the text file can be saved either formatted or unformatted. The number of characters before or after the comma can be defined for each data type under formatting options.
Error handling	If a value, which is linked in the text file as a character string, is in error state, the substitute value to be output can be defined via the error handling function.
Input image	An image available in the project to be saved can be selected. **NOTE!** If the image type “Color image 32 Bit” is selected, BGRA images from color cameras can be saved. A camera with a color image chip must be used for this purpose and the calculation of the BGRA image must be activated under the camera device (for Smart Cameras) or the Machine Vision Camera device.
Data sink	The process data can either be saved in the local “output” folder or on an FTP server. The process data can be accessed via FTP, among other options (see section “20. FTP Server” on page 344).
Save image type	Images can be saved as monochrome 8 bit images or as 32 bit color images.
Save image compression	Images can be saved in BMP or in compressed JPG format. **NOTE!** In BMP format, the images can subsequently be added to a Teachplus file offline. This is not possible with compressed JPG images. Saving the images in JPG format reduces the memory usage and, when saved on an FTP server, the network load too.

16.7.2 Configuration

16.7.2.1 Submodule String Count

Objective Select the character strings for a text file.

Property The number of elements included in the list depends on the String Count:
Character string #1 Enter a static value or link a result from the project.

16.7.2.2 Submodule Error Handling

Action can be used to set performance when a linked event demonstrates an error status.

Property The following settings/results are displayed:

Substitute STRING types by	The text is specified which is used as a substitute text, when the linked data type is in error state.

16.7.2.3 Formatting Options

Objective Carry out the formatting of the character strings.

NOTE!
For the formatting to function correctly, the number of digits (before the comma) must be set at least as high as the maximum number of digits (before the comma) for the results used (or their error substitute values).

Property The following settings/results are displayed:

Integer	The number of digits can be defined. The plus/minus sign can also be read out if required.
Floating point	The number of digits before and after the comma can be defined. The plus/minus sign can also be read out if required.
Bool	A Boolean value can be output as 0/1 or as true/false.

16.8 Module Device TCP

16.8.1 Overview

Objective

Configure process data via TCP/IP.

Abbreviated procedure

Set the data transmission format and link the values of the results. The uniVision application behaves as a TCP server. Process data can be received via the selected port (default setting: 32002). Establish a connection to the respective application to this end.

NOTE!
The application's IP Address is in the device list.

NOTE!
After a system start-up or a project change, connection must be reestablished so that process data can be received via the TCP device.

16.8.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [us]	Process Time for process steps in the current module.
Module State	Error codes provide support for troubleshooting.
Interface type	TCP
Output	Preview of the output value which is comprised preamble, linked value, delimiter and postamble.
Preamble	The characters specified here precede the output data.
Postamble	The characters specified here follow the output data.
Delimiter	The delimiter used to separate the individual data packets from each other is specified.
String Count	The number of desired values to be transmitted is defined. **String Count: 1...100** Any value can be set statically or linked to a value from the evaluation. This value is then transmitted via the interface.
Error Handling	Performance of the following read-out options in case of error.

Property

Connections	Number of permissible connections for receiving process data via TCP.
TCP port	Port for transmitting TCP process data (default setting: 32002).
Blocking mode	If the lock mode is active, an attempt is made to send each result. This makes it possible to ensure that all information is transmitted. If the lock mode is not active, data might not be sent under certain circumstances. For example, this may be the case if the network is very slow. **NOTE!** If the lock mode is active and no TCP/IP client is connected, or if the data cannot be sent, the application enters a fatal error state.

16.8.3 Configuration

The TCP device module includes the configuration:

- String Count
- Error Handling
- Formatting options

16.8.3.1 Submodule String Count

Objective Read out results from the application via the interface.

Property The number of elements included in the list depends on the String Count:

String #1	Enter a static value or link a result from the application.

16.8.3.2 Submodule Error Handling

Objective Define performance in the event of an error.

Property Specify with which value linked string types will be replaced in the event of an error.

Substitute STRING types by	The text is specified which is used as a substitute text, when the linked data type is faulty.

16.8.3.3 Submodule Formatting Options

Objective Carry out the formatting of the characters.

NOTE!
For the formatting to function correctly, the number of digits (before the comma) must be set at least as high as the maximum number of digits (before the comma) for the results used (or their error substitute values).

Property The following settings/results are displayed:

Integer	The number of digits can be defined. The plus/minus sign can also be read out if required.
Floating point	The number of digits before and after the comma can be defined. The plus/minus sign can also be read out if required.
Bool	A Boolean value can be output as 0/1 or as true/false.

16.9 Module Device UDP

16.9.1 Overview

Objective

Configure process data via UDP.

Abbreviated procedure

Set the data transmission format and link the values of the results.
UDP process data are transmitted via non-configurable port 32002.

NOTE!
Furthermore, the status of the device is transmitted per UDP via port 32002. Depending on the selected UDP status interval, the device transmits a sign-of-life signal at regular intervals. Details can be found in section “8.2.2 Properties” on page 98.

16.9.2 Setting Parameters

Property

The following settings/results are displayed:

Process Time [us]	Process Time for process steps in the current module.
Module State	Error codes provide support for troubleshooting.
Interface type	UDP
Output	Preview of the output value which is comprised preamble, linked value, delimiter and postamble.
Preamble	The characters specified here precede the output data.
Postamble	The characters specified here follow the output data.
Delimiter	The delimiter used to separate the individual data packets from each other is specified.
Number of characters	The number of desired values to be transmitted is defined. **String Count: 1...100** Any value can be set statically or linked to a value from the evaluation. This value is then transmitted via the interface.
Error Handling	Performance of the following read-out options in case of error.

16.9.3 Configuration

The UDP device module includes the following configuration options:

- String Count
- Error Handling
- Formatting options

16.9.3.1 String Count Submodule

Objective Read out results from the application via the interface.

Property

The number of elements included in the list depends on the String Count:	
Character string #1	Enter a static value or link a result from the application.

16.9.3.2 Error Handling Submodule

Objective Define performance in the event of an error.

Property Specify with which value linked string types will be replaced in the event of an error.

Substitute STRING types by	The text is specified which is used as a substitute text, when the linked data type is faulty.

16.9.3.3 Formatting Options

Objective Carry out the formatting of the characters.

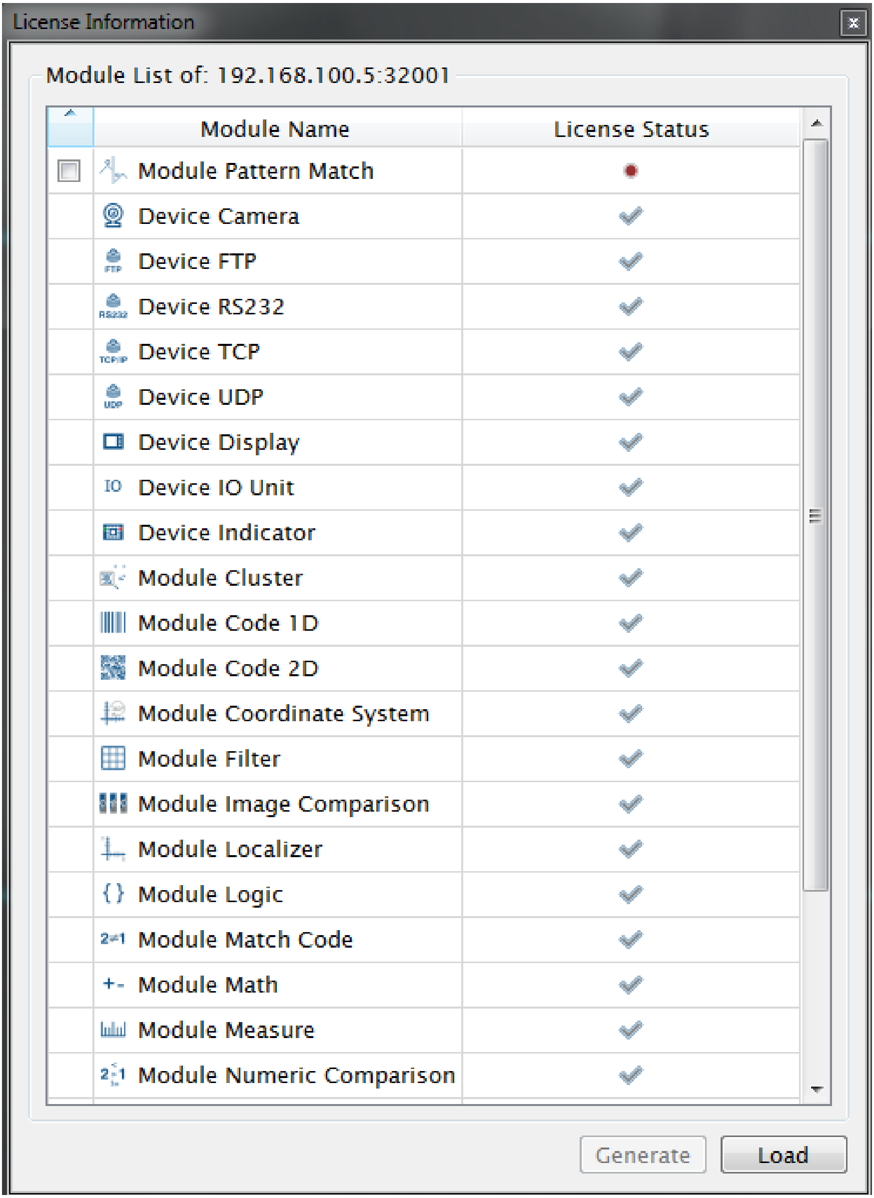
NOTE!
For the formatting to function correctly, the number of digits (before the comma) must be set at least as high as the maximum number of digits (before the comma) for the results used (or their error substitute values).

Property The following settings/results are displayed:

Whole number	The number of digits can be defined. The plus/minus sign can also be read out if required.
Floating point	The number of digits before and after the comma can be defined. The plus/minus sign can also be read out if required.
Bool	A Boolean value can be output as 0/1 or as true/false.

17. License Management

Different modules are licensed or not licensed depending on the device type. If there is a connection between the uniVision software and the device, the license management can be accessed via -> Help -> Licenses.



17.1 Order Numbers

Order Number	For Product	Modules
ZNN1004	PC license	For offline operation of the following modules on a Windows PC: • 1D code module • 2D code module • Pattern matching module
DNNL001	weQube	• Measuring module • Cluster module • Image comparison module
DNNL002	weQube	• 1D code module • 2D code module
DNNL003	weQube	• OCR module
DNNL006	weQube	• Pattern matching module
DNNL009	Control Unit	• Point cloud region module • Point cloud coordinate system module • Point cloud filter module • Point cloud measuring module • Point cloud calculus module • Point cloud pattern matching module
DNNL010	Control Unit	• Region module • Coordinate system module • Tracking module • Filter module • Measuring module • Blob module • Threshold module • HSV threshold module • Image comparison module • OCR module
DNNL011	Control Unit	• 1D code module • 2D code module • Pattern matching module
DNNL015	weCat3D in “Smart” operat-ing mode	• Point cloud region module • Point cloud coordinate system module • Point cloud filter module • Point cloud measuring module • Point cloud calculus module • Point cloud pattern matching module
DNNL016	Control Unit	• Point cloud weld seam tracking module
DNNL017	weCat3D in “Smart” operat-ing mode	• Point cloud weld seam tracking module

NOTE!
Control unit licenses are valid for all uniVision applications running on the control unit.

17.2 Procedure for Ordering License Files

1. Establish a connection to the device with the uniVision software.
2. Access the license management under -> Help -> Licenses.
3. Select the required license files and generate license request files for them.
4. Send the *.u_k files together with the order via e-mail to wenglor customer service (order@wenglor.com).

NOTE!
Processing the license files can take approx. one working week. The licensed files are returned via e-mail.

5. Once the *.u_l files are received, call up the license management again.
6. Click on Load and select the *.u_l files.
7. The licenses for the relevant modules are now available.

17.3 License for Offline Use of uniVision for Windows Software

USB dongle ZNN1004 can be purchased for offline use of 1D code, 2D code and pattern matching modules with uniVision for Windows software.
1. Plug the USB dongle into the PC.
2. Start uniVision for Windows software and open a project in the offline mode (e.g. sample project).
3. Access license management under -> Help -> Licenses.
4. Click load and select the *.u_l files located on the included CD.
5. The licenses are now available for the corresponding modules.

NOTE!
None of the other modules require a license for offline use of uniVision for Windows software.

18. Device Website

A web server runs on Smart Cameras, 2D/3D profile sensors and uniVision applications at control units, which can be used to visualize results and change values (e.g. project change). Each uniVision application running on a control unit has its own web server. A web browser can be used to open the devices' website. The following or higher versions of the supported web browsers are required:

- Internet Explorer 11
- Microsoft Edge 38
- Firefox 52
- Chrome 59
- Chromium 59

NOTE!
- The minimum version of the web browsers are tested on Windows 7 and Windows 10 platforms and on the control unit.
- The supported minimum resolution for displaying the website is 1280 x 1024 pixels.

Procedure for opening the website:
1. Start the web browser.
2. Enter the IP address of the Smart Camera, the 2D/3D profile sensor or the uniVision application.

Example based on the Smart Camera's and the 2D/3D profile sensor's default settings:
http://192.168.100.1

Example based on the default settings of the first uniVision application on a control unit:
http://192.168.100.251

3. Enter user name and password.

Example based on default settings:
- User name: admin
- Password: admin

NOTE!
- Details on the website of the 2D/3D profile sensor can be found in the instructions for the respective sensor.
- The password can be changed on the website, or in the properties of the Smart Camera, the 2D/3D profile sensor or the uniVision application via the device list in uniVision software (see section "8.2.2 Properties" on page 98).

The Smart Camera and the 2D/3D profile sensors have a fixed, project-independent website. There's also a flexible, project-dependent website for the Smart Camera, the 2D/3D profile sensor and the uniVision applications for visualizing results.

18.1 Fixed Device Website for the Smart Camera

The Smart Camera has a fixed, project-independent website for basic device settings (e.g. network settings) and for displaying the live image.

Further subpages can be accessed by clicking one of the categories.

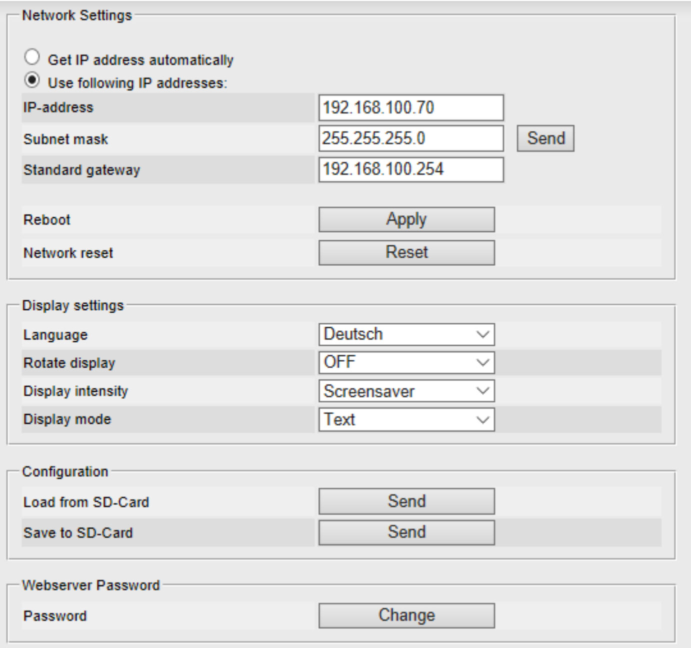
- Device general: Overview page with general information regarding the Smart Camera
- Device settings: Network and display settings
- Projects: Project management settings
- Teach: Teach+ recording and Smart Camera teach-in
- Live image: Display camera image
- Visualization: Create a flexible, project-dependent website (see section “18.3 Flexible, Project-Dependent Device Website for Visualization” on page 339)
- Browser data: The browser information is shown.

The website can be changed from English (default language) to other languages with the language selection function.
The content of the Smart Camera’s OLED display also appears on the website.

18.1.1 General Device Information

Order number	The Smart Camera’s article number
Product version	The Smart Camera’s firmware version
Manufacturer	Manufacturer of the Smart Camera
Description	Device name
Serial number	Unique serial number of the Smart Camera
MAC address	Unique MAC address of the Smart Camera

18.1.2 Device Settings



Network Settings

The Smart Camera's network settings can be specified. A static IP address can be entered or an IP address can be assigned to the Smart Camera by a DHCP server within the network. For communication purposes, the Smart Camera and the remote peer (e.g. PC with browser) must be in the same network segment (details concerning network configuration can be found in section "8.1 Network Settings" on page 86).

NOTE!

In the event of an incorrect network configuration, it may no longer be possible to contact the device within the network.

Get IP address automatically	DHCP is activated at the Smart Camera. A DHCP server in the network assigns a valid network configuration to the Smart Camera.
Use the following IP address	Use a static network setting: **IP address**: Smart camera's IP address **Subnet mask**: Smart camera's subnet mask **Standard gateway**: Smart camera's standard gateway The Smart Camera has to be restarted after changing the network configuration. The network configuration can be reset to its default settings which then become active after the next restart: • IP address: 192.168.100.1 • Subnet mask: 255.255.255.0 • Standard gateway: 192.168.100.254

Display Settings

Language	Select OLED display language.
Rotate display	Change the orientation of the OLED display.
Display intensity	Adjust display intensity.
Display mode	Select the OLED display mode.

Configuration

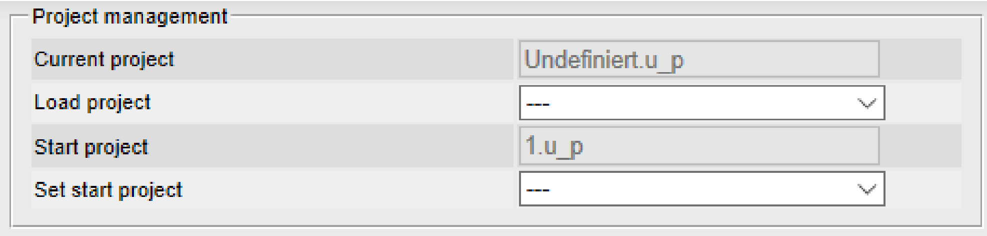
Project-independent device settings can be stored to the device's SD card and uploaded from the SD card in the case of device replacement. This includes the network configuration and other general, project-independent settings (e.g. start-up project). All project-independent parameters can also be edited with uniVision software via the device's properties in the device list.

Uploading from an SD card	Stored, project-independent device settings can be uploaded from the SD card.
Save to SD card	The project-independent device settings can be stored to the SD card.

Web server password

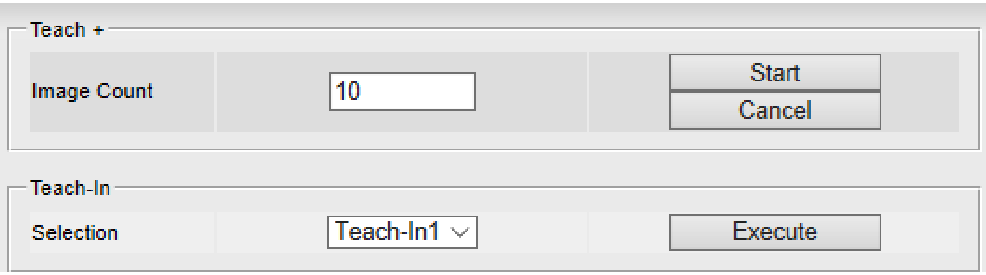
The website's password can be changed. The password must be entered twice in order to confirm correct entry.

18.1.3 Projects



Current project	The currently loaded project is displayed.
Upload project	Any project on the SD card can be selected and uploaded to the Smart Camera.
Start-up project	The current start-up project is displayed. The project is loaded when the system is started up.
Select start-up project	Any project on the SD card can be defined as the start-up project. The specified start-up project is loaded after the system has been started.

18.1.4 Teach



Teach+	The number of images recorded for a Teach+ file can be specified. Furthermore, a Teach+ file can be recorded by clicking start. The Teach+ file is stored to the Smart Camera's SD card in the "teach-plus" folder. The file can be transferred to a PC via FTP or with the help of uniVision software. Details can be found in section "10.3 Teach+ Recording and Playback" on page 123.
Teach-in	A value linked within the project can be taught in via the OLED display or the website in order to adapt this value to changing environmental conditions after project configuration. For example, the threshold values for the number of pixels can be adjusted in the threshold module quickly and without software in this way. Details concerning teach-in via the OLED display or the website can be found in section "16.4.3.5 Submodule Teach" on page 315.

18.1.5 Live Image

The Smart Camera's live image is displayed. Display can be stopped and restarted.

18.1.6 Visualization

Details on this can be found in section "18.3 Flexible, Project-Dependent Device Website for Visualization" on page 339.

18.1.7 Browser Data

The data for the browser used can be called up for support purposes.

18.2 Fixed Device Website for the 2D/3D Profile Sensor

The weCat3D 2D/3D profilse sensors have a fixed website to change the settings. Details can be found in the operating instructions for the respective sensors.

NOTE!
Sensor parameters may only be set in the uniVision software (and not on the sensor website) so that they can be saved in the uniVision project.

18.3 Flexible, Project-Dependent Device Website for Visualization

An individual visualization can be created for each project and saved together with the project. Any desired results can thus be displayed at a screen or PC in a project-dependent fashion. Data are updated at regular intervals in the visualization.

Procedure for opening the website:
1. Start the web browser.
2. Enter the device's IP address + /Visualization

Example based on the Smart Camera's default settings:
http://192.168.100.1/visualization

Example based on the default settings of the first uniVision application on a control unit:
http://192.168.100.251/visualization

Procedure for creating a flexible visualization:

1. Exit live mode visualization and switch to the edit mode.
2. Drag and drop elements from the toolbox into the visualization area.
3. Save the project together with the visualization (e.g. via the website or uniVision software).

Toolbox elements:

Fixed elements	
Text	Add a text field to the visualization area and enter a fixed text (e.g. a project name).
Date and time	PC date and time are displayed in the visualization area.
Static Image	A static image or OK/NOK images can be displayed in the visualization area.
Results	
OK/NOK	A red/green LED indicates the status of an OK/NOK result. Any value from the project can be linked for this purpose. For example, the threshold module's "number of pixels" value can be linked. If the current "number of pixels" value is between the selected minimum and maximum limit values, the green LED lights up. If it's not within the limit values, the red LED lights up.
Result	A project result is displayed. Any value from the project can be linked for this purpose, for example the code read from the 2D code module.

Image/point cloud	An image or point cloud is displayed. Any image or point cloud from the project can be linked to this end. For example, the camera image from the camera device module can be displayed. However, the filtered image from the filter module can also be used, for example. A fixed frame color around the image or the point cloud can also be defined or linked with a result from the project to achieve a dynamic good/bad display with the colors red and green. Overlays can also be added in the image and profile. The following overlays are available: • Point • Line • Arc • Circle • Coordinate system • Rectangle • Box • Polygon • Image • Area For each overlay, a selection can be made from the geometries available in the project (e.g. all dots available in the project are displayed for the dot). The display, size and color of the overlay can also be defined as desired.
Parameters	
Unfreeze/freeze	Add the “Refresh/Freeze” button. If the button is clicked in the website’s live mode, the current values are frozen for the analysis of associated results. Current data is once again retrieved at regular intervals after clicking “Refresh”.
Trigger	Add the “Trigger” button. If the button is clicked in the website’s live mode, a trigger command is sent to the device if the trigger mode has been correctly selected. **Smart camera:** In the “Trigger” trigger mode, a trigger command is sent to the Smart Camera and a new result is displayed in the visualization. The trigger command is ignored in the “Stop” trigger mode. **uniVision application:** In the “Software” trigger mode, a trigger command is sent to the Machine Vision Camera or 2D/3D profile sensor and a new result is displayed in the visualization. The trigger command is ignored in all other trigger modes.

Open project	Add the “Open Project” button. If the button is clicked in the website’s live mode, a list appears showing all projects available on the device. One of these projects can be selected and loaded to the device. **NOTE!** After the project change, the visualization of the loaded project appears on the website.
Settings	
Save project	Save the project together with the visualization.
Language selection	Select a website language.
Change password	Change the website’s password.

Firefox web browser on the control unit
The visualization can also be set up or configured using the Firefox web browser installed to the control unit. Details can be found in section “24.6 Web Browser” on page 350.

Web browser with touch support
In order to be able to edit the visualization on devices with touchscreen (e.g. a tablet), browser-dependent settings may have to be adjusted.

Chrome:
1. Open the Chrome web browser.
2. Enter “chrome://flags” to the address line.
3. Activate “Touch Events AP” and “Touch initiated drag and drop”.

19. Project Changes via Digital Inputs and Outputs

Project changes can be initiated via digital inputs and outputs at the control units BB1C0xx, BB1C1xx, BB1C4xx and at the Smart Camera. A pulse sequence triggers a project change at the device via a digital input and successful project change can be confirmed via a pulse sequence from a digital output.
All of the names of the relevant projects have to be saved in the following format: “xxx_testproject.u_p” (x = any integer from 0 to 9). Up to 255 projects can be addressed via the digital inputs.

Example: 01_testproject.u_p

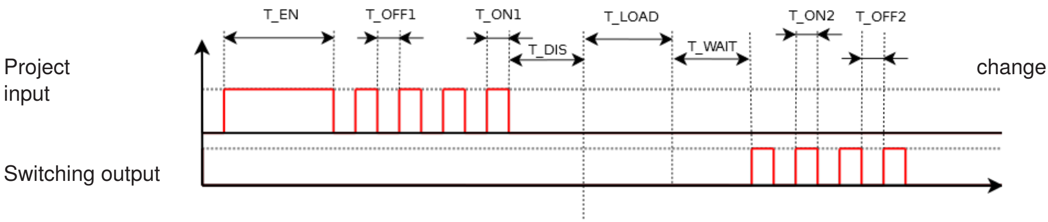
NOTE!
- In all relevant projects, the same digital input must be selected as the project change input and the same digital output must be selected as the project change output. For example, input 3 is specified in all projects as the project change input and output 4 is specified in all projects as the project change output.
- The application is only ready for data evaluation once the project change has been confirmed via the digital output. Commands sent to the uniVision device in the meantime are ignored.
- The loading of unavailable uniVision projects is ignored, and the last loaded project remains open.
- When loading an invalid project (e.g. incompatible projects), an empty project is generated (by default without device input and output) and the device goes into a fatal error state. In this state, other input sequences on the digital input are ignored.

Procedure for correct project configuration:
1. Start uniVision software.
2. Establish a connection to the device.
3. Specify the same digital input as the “project change input” in all projects.
4. Specify the same digital output as the “project change output” in all projects.

NOTE!
The digital inputs and outputs are set up in the I/O device module (see section “16.1 Module Device Input and Output (weQube Only)” on page 302 and section “16.2 Module Device Input and Output (Control Unit Only)” on page 308.
- Only digital inputs 1 and 2 at the control unit can be used as inputs for project changes via digital inputs.

Procedure for project changes via digital inputs and outputs:

1. Apply voltage (> 7 V) for a duration of T_EN to the digital input for project changes. The project change mode is now active.
2. Each positive edge is counted in the project change mode (one positive edge = project 1, two positive edges = project 2 etc.), until a voltage of less than 2 V has been applied to the project change input for a duration of T_DIS.
3. If an output has been set up as a project change output, the project selection is read out from this output using the number of pulses to identify the project number.



Designation	Typical	Min	Max
T_EN	2000 ms	1050 ms	5000 ms
T_OFF1	250 ms	150 ms	1000 ms
T_ON1	250 ms	150 ms	1000 ms
T_DIS	1000 ms	1000 ms	-
T_LOAD	Device dependent	Device dependent	Device dependent
T_WAIT	1000 ms	-	-
T_OFF2	250 ms	-	-
T_ON2	250 ms	-	-

20. FTP Server

An FTP server runs on the Smart Cameras, smart 2D/3D profile sensors and control units. This makes it possible to exchange files between the PC and the device via a network. For example, project files can be exchanged with the device.

NOTE!
This is only possible if the PC and the device are in the same network. Details concerning network configuration can be found in section “8.1 Network Settings” on page 86.

20.1 Smart Camera

Procedure for exchanging files:
- Open the file manager at the Windows PC.
- Enter the device’s IP address to the ftp:// path.

Example based on the Smart Camera’s default settings: ftp://192.168.100.1
- Enter user name and password (cannot be changed).
  – User name: ftpuser
  – The password field must be left empty.
- Select the relevant folder and exchange the files.

NOTE!
The ftp password is not checked.

20.2 Smart 2D/3D Profile Sensor

Procedure for Exchanging Files:
- Open the file manager on the Windows PC.
- Enter the device’s IP address in the ftp://ftpuser@ path.

Example with default settings for the smart 2D/3D profile sensor: ftp://ftpuser@192.168.100.1
- Enter user name and password (cannot be changed).
  – User name: ftpuser
  – Password: ftpvision
- Select the relevant folder and exchange the files.

NOTE!
With smart 2D/3D profile sensors, no firmware update can be performed via the firmware folder and a device restart! Firmware updates for the 2D/3D profile sensor are applied by the device website (see section “9.3 Updating 2D/3D Profile Sensor Firmware” on page 105).

20.3 Control Unit

Procedure for exchanging files:
- Open the file manager at the Windows PC.
- Enter the device's IP address to the ftp:// path.

Example based on the control unit's default settings: ftp://192.168.100.252

- Enter user name and password (cannot be changed).
  - User name: ftpuser
  - Password: ftpvision
- Select the relevant folder and exchange the files.

21. LIMA Interface

The LIMA interface for Smart Cameras, smart 2D/3D profile sensors, and uniVision applications running on control units is explained in the separate interface protocol. It can be accessed at www.wenglor.com in the download area on the product detail page for DNNF020 (uniVision software for Windows).

22. Robot Interfaces Plugins

The plugins for the robot interfaces can be installed on the control unit to transfer the tracking point found in the uniVision application for robot-controlled welding applications directly to the robot control and to take over the communication between the uniVision application and the robot control in general.

There is a plugin for the following robot types:
- DNNP007: Plugin for Fanuc robots
- DNNP008: Plugin for Yaskawa robots
- DNNP009: Plugin for KUKA robots
- DNNP010: Plugin for ABB robots

A license is required to use the plugins which must be ordered for the relevant control unit.

NOTE!
A separate manual for the robot plugins is available on the wenglor website in the download area for the relevant robot plugin.

23. VisionApp 360 Plugin for Combined Height Profiles

The VisionApp 360 plugin can be installed on the control unit to calibrate and combine the height profiles of multiple 2D/3D profiles sensors. The combined height profile is transferred to the uniVision application for flexible evaluation.

The license for the VisionApp 360 plugin is already pre-installed on certain control units. Alternatively, the license can be activated later with the following order number:
DNNP011: VisionApp 360 plugin license

NOTE!
A separate manual for the plugin is available on the wenglor website in the download area for the relevant product.

24. Further Control Unit Settings

24.1 Using a Monitor

A monitor can be connected to the control unit via DisplayPort, DVI or VGA.

NOTE!
- The monitor must be connected before starting the control unit in order to assure that the system is started with correct resolution.
- More information concerning minimum monitor resolution can be found in section “3. Technical Data” on page 16.

24.2 Restoring Default Settings

NOTE!
The existing license files must be backed up before restoring default settings. The license files are located on the control unit in the file system under: /var/opt/wenglor.com-univision/licenses/

If monitor, keyboard and mouse are connected to the control unit, the backup mode can be initiated during the control unit’s boot-up phase.

Procedure for restoring default settings:

1. System start-up can be prevented and the backup mode can be entered during the boot-up phase with the help of the scroll down key.
2. The following options can be selected:
- Restore only network settings to default values.
- Restore the system to default settings (without network settings).
- Restore the entire system to default settings.
3. Enter user name and password to confirm resetting:
- User name: support
- Password: helpAT
4. Restoring default settings takes a few minutes.
5. After successfully restoring the control unit to default settings, it has to be restarted (Menu -> Restart).

Save the backed up license files (if no longer present) in the file system on the control unit under: /var/opt/wenglor.com-univision/licenses/

24.3 Control Unit Auto Start

The control unit starts up as soon as power is supplied to the control unit as standard. The setting can be changed in the boot menu:

1. Connect the monitor, mouse and keyboard to the control unit.
2. Restart the control unit.
3. Press the F7 key on the keyboard during start-up.
4. Click on “Enter Setup” and select “Advanced”.
5. Define the Auto Start behavior of the control unit under “Super IO Configuration” (default: Set to Power On).

24.4 VNC

A VNC server runs on the control unit. As a result, the control unit can be accessed from any PC with a VNC client.

NOTE!
This is only possible if the PC and the control unit are in the same network. Details concerning network configuration can be found in section “8.1 Network Settings” on page 86.

Procedure for establishing a VNC connection:
1. Start the VNC client (e.g. VNC Viewer) at any PC.
2. Enter the control unit’s IP address (example based on the control unit’s default settings: 192.168.100.252).
3. Enter password (cannot be changed): vision
4. If necessary, adjust the settings of the VNC client to optimize the display.

NOTE!
- If a monitor is connected to the control unit and VNC is used at the same time, the monitor must already be connected when the system is started up so that the monitor’s resolution setting is also used for the VNC connection.
- If no monitor is connected, the default resolution of 1240×1024 is used for the VNC connection.

24.5 TeamViewer

In the event of technical questions or problems, wenglor's technical support department can establish a connection to the control unit via remote access with TeamViewer. The control unit must be equipped with Internet access and active approval for remote access is required to this end.

How to use TeamViewer:

1. Open the device list in uniVision software.
2. Select the control unit and access its settings.
3. Switch the "Bridge" setting from "LAN1 + LAN2" to "LAN2". In this way, LAN1 receives a separate network configuration and can be used for TeamViewer.
4. Activate DHCP at LAN1.
5. Save the changed settings.
6. Connect LAN1 to a company network with an existing DHCP server (a valid network configuration is assigned to LAN1 by the DHCP server).
7. Use LAN2 to connect sensors (Machine Vision Cameras, 2D/3D profile sensors).
8. Click the SOS wenglor support button.
9. Enter customer name and description and contact wenglor support by phone.
10. Allow remote access from wenglor support.

NOTE!
Details concerning the control unit's network configuration can be found in section "8.1.3 Control Unit" on page 89.

24.6 Web Browser

The Chrome web browser is preinstalled to the control unit. It can be used to display the websites of uniVision applications or 2D/3D profile sensors. As a default setting, the visualization of the first uniVision application is displayed when the web browser is started (valid for the control unit's default network settings).

Examples based on the control unit's default network settings:
- Address for the website of the first uniVision application: http://192.168.100.251
- Address for the website of the first 2D/3D profile sensor: http://192.168.100.250

The web browser's start page can be changed:
1. Start the Chrome web browser at the control unit.
2. Click "Preferences".
3. The address which is accessed when the web browser is started can be specified under "Startup".

The web browser can be added to auto-start:
1. Click "Menu" → "Settings" → "Settings Manager".
2. Select "Settings".
3. Select "Application Autostart".
4. Enter a check mark next to "Google Chrome (browser)".

24.7 Screen Recording Program

The "RecordMyDesktop" program for recording screens is preinstalled to the control unit.

Procedure for recording screens:
1. Start "RecordMyDesktop" software at the control unit.
2. If applicable, click "Save as" and specify a storage location and filename.
3. If applicable, limit the portion of the screen to be recorded – otherwise the entire screen will be recorded.
4. Click "Record" to Acquisition Start.
5. Record the screen.
6. Click the red dot in the taskbar to stop recording. The file is saved automatically.

NOTE!
- The files are stored to the reports folder as a default setting.
- Screen recordings can be played back on the control unit using the Chrome browser.

25. Appendix

25.1 Change Index, Operating Instructions

Version	Date	Description/change	Associated software version
1.0.0	31.08.2016	Official version for market launch	Software: 1.0.0
1.1.0	27.03.2017	• System overview • Software language DE • Network protocols • Sensor connection • weCat3D device module • Point cloud filter module • Point cloud measuring module (find segments, turning points) • Point cloud region module (area, center of gravity) • Device replacement and expanding a control unit	Software: 1.1.0
2.0.0	13.07.2018	uniVision for Smart Cameras: • New products are supported: weQube Smart Camera • Templates and uniVision assistant for specific modules • Measuring module: Find tool point • Measuring/coordinate system module: Adjust maximum geometry • TCP device module uniVision for 2D-/3D sensors: • weCat3D device module: Further sensor parameters and sensor data • Templates • Teach+ recording and offline processing of projects • uniVision for Windows for editing uniVision Applications • Point cloud measuring module: Find tool point • Point cloud measuring module: Find point usage for the tools line and arc • Point cloud measuring module: Local minimum and maximum • Calculus module: Find edges • Additional languages	Software: 2.0.0
2.0.1	05.10.2018	Small bugfixes	Software 2.0.1
2.0.2	08.02.2019	Add info to changelog	Software 2.0.2
2.0.3	21.03.2019	Extend changelog	Software 2.0.3
2.0.4	28.10.2019	Updated Third-Party Software Licenses	Software 2.0.4

Version	Date	Description/change	Associated software version
2.1.0	31.07.2019	• Description of the new software functions (see software changelog) • Detailed description of the following sections: – System overview – Interface overview – Installation – Electrical connection – Establishing connection • Bug fixes	Software 2.1.0
2.1.1	28.10.2019	• Updated minimum timings for project change via digital inputs and outputs • Small bugfixes	Software 2.1.1
2.1.2	24.03.2020	• Minor fixes • Update of changelog	Software 2.1.2
2.2.0	28.05.2020	• Description of the new software functions (see software changelog) • Bug fixes	Software 2.2.0
2.3.0	20.10.2020	• Description of the new software functions (see change log software) • Bug fixes	Software 2.3.0
2.4.0	10.05.2021	• Description of the new software functions (see change log software) • Bug fixes	Software 2.4.0
2.5.0	03.01.2022	• Description of the new software functions (see changelog software) • Bug fixes	Software 2.5.0
2.5.1	22.06.2022	• Minor fixes	Software 2.5.1
2.6.0	05.09.2022	• Description of the new software functions (see software change log) • Minor bug fixes	Software 2.6.0
2.6.0	27.04.2023	• Update in section "7.5.3 Connection Overview for Trigger, Machine Vision Camera, and Illumination in Flash Mode" on page 82	Software 2.6.0
2.6.1	26.05.2023	• Addition of the control units BB1C4xx and BB1C5xx • Small bug fixes	Software 2.6.1
2.6.1	12.06.2023	• Small bug fixes	Software 2.6.1
2.6.1	30.10.2023	• Remove BB1C4 Control Units • B50 Properties: Set "Start Focus Value" to not supported	Software 2.6.1

25.2 Status Information

The status information of uniVision devices is output as a hex value. The hex value must be converted to a binary number to enable the error code to be encrypted. Then number the bit positions from the back starting with 0. On bit positions where 1 is output, the relevant error described in the following tables has occurred.

Example:
If the hex value 2002 is output as the error code, this corresponds to the binary number 10 0000 0000 0010.

Bit	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binärzahl	1	0	0	0	0	0	0	0	0	0	0	0	1	0

With bit 1 and bit 13, 1 is output in each case. A warning is therefore present and there is a problem with the FTP interface – for example, data recording is too fast.

25.2.1 Common Error Status Information and Causes

The most common error status information, causes and possible remedies are listed here.

Error status information	Possible cause	Possible solution
Hex: 2002 Binary: 10 0000 0000 0010	Error in the FTP interface caused by the following: • FTP server not available or cannot be reached • No write permissions for the FTP user in the relevant folder • Data recording and evaluation too fast, meaning that not all data can be saved by the FTP device.	• Check whether the FTP server is available • Ensure that write permissions are activated for the FTP user • Reduce the speed of the data recording or evaluation, e.g. by reducing the recording frequency, shorter evaluation in the uniVision project, data compression via JPG format or by adjusting the observer in the FTP device module.
Hex: 4 0008 Binary: 0100 0000 0000 0000 1000	Compatibility error with the following possible causes: • Firmware update without project conversion	Ensure that the firmware and project version are compatible, e.g. by: • Up-/downgrading the firmware • Converting the project

25.2.2 weQube Smart Camera

Via the UDP interface, the device status is sent in the set interval. The status is also shown on the OLED display of the device.

Bit	Section	Signal	Description
0	General	Information	Busy
1		Warning	There is at least one bit set, level = Warning
2		Critical Error	There is at least one bit set, level = Critical Error
3		Fatal Error	There is at least one bit set, level = Fatal Error
6	Peripheral	TCP/IP	There is an error concerning the TCP/IP socket
7		UDP	There is an error concerning the UDP socket
8		Industrial Ethernet	There is an error concerning industrial ethernet
12		UART	There is an error concerning the UART device
13		FTP	There is an error concerning the FTP interface.
14	Memory	Flash	There is an error concerning the flash access
15		RAM	There is an error concerning the RAM access
16		SD-Card	There is an error concerning the SD card access
17		File access	There is an error concerning a general file access.
18		Compatibility	There is an error concerning the version of the loaded project
19		Reserved	for future use, value=0
24	Image Processing	Sequencing	There is an error concerning IData vision engine
25		Processing	There is an error concerning a vision module.
26		Trigger	There is an error concerning HW trigger

25.2.3 uniVision Application

Via the UDP interface, the device status of the uniVision Application is sent in the set interval.

Bit	Section	Signal	Description
0	General	Information	Busy
1		Warning	There is at least one bit set, level = Warning
2		Critical Error	There is at least one bit set, level = Critical Error
3		Fatal Error	There is at least one bit set, level = Fatal Error
6	Peripheral	TCP/IP	There is an error concerning the TCP/IP socket
7		UDP	There is an error concerning the UDP socket
8		Industrial Ethernet	There is an error concerning industrial ethernet
14	Memory	Flash	There is an error concerning the flash access
15		RAM	There is an error concerning the RAM access
16		SSD	There is an error concerning the SDD access
18		Compatibility	There is an error concerning the version of the loaded project.
24	Image Processing	Sequencing	There is an error concerning IData vision engine
25		Processing	There is an error concerning a vision module.
26		Trigger	There is an error concerning HW trigger

25.2.4 Control Unit

Via the UDP interface, the device status of the control unit is sent in the set interval.

Bit	Section	Signal	Description
0	General	Information	Busy
1		Warning	There is at least one bit set, level = Warning
2		Critical Error	There is at least one bit set, level = Critical Error
3		Fatal Error	There is at least one bit set, level = Fatal Error
6	Peripheral	TCP/IP	There is an error concerning the TCP/IP socket
7		UDP	There is an error concerning the UDP socket
14	Memory	Flash	There is an error concerning the flash access
15		RAM	There is an error concerning the RAM access
16		SSD	There is an error concerning the SSD access

25.3 Glossar

uniVision Software	Software for configuring the parameters of weQube and the control unit (i.e. uniVision applications) Differentiation according to operating system: • uniVision for Windows: for Laptop/PC • uniVision for Linux: already included in the control unit's firmware Differentiation according to device: • uniVision for Smart Cameras • uniVision for 2D/3D Sensors
uniVision Application	Application (engine) for evaluating images or point clouds (can be run on smart devices or the control unit)
uniVision Project	Testing task which is executed by the uniVision application
Template	Ready-made project for certain standard applications (e.g. check presence, find highest point) • Picture analysis templates (for weQube) • Profile analysis templates (for weCat3D)
uniVision Assistant	Step-by-step explanation of a module
Control Unit	Brand name of wenglor's IPC
weQube firmware	Firmware update file for weQube
Control Unit firmware	Firmware update file for the control unit
Machine Vision Camera firmware	Machine Vision Camera firmware update file
2D/3D profile sensor firmware	2D/3D profile sensor firmware
Picture analysis	Evaluation of images using image processing algorithms
Profile analysis	Evaluation of height profiles using point cloud algorithms
Module	A tool in uniVision software for a special task (e.g. measuring module, 1D code module)
License	File required in order to activate a module
Plugin	Software expansion that can be installed on a uniVision device to enable additional functions to be used outside uniVision.

25.4 Utilized Third-Party Software Licenses

Third-party software licenses used with uniVision are shown directly on the product and on the website at:

https://www.wenglor.com/license/

25.5 Module Status

The following module statuses are available in uniVision:

NOTE!
Section "5.4.2 uniVision Project, Module Status and Error Handling" on page 45 lists the most important module statuses with relevant explanations and solution suggestions.

0	no error
1001	undefined
1010	Input value error
1011	Return value error
1012	Internal data error
1020	Alignment error
1030	Function not implemented
1040	Image not linked
1041	Point cloud not linked
1050	Invalid operation
1060	Module Timeout
1098	Exception bad allocation
1099	Exception
1100	Module unlincensed
1101	Module init failed
1102	Device not available
1103	Data Loss
1104	Module not taught
1105	Unsupported pixel format
1111	Module configuration error
1112	There is an error concerning the SD card access or the SSD access.
1113	There is an error concerning the FTP interface
1114	There is an error concerning the TCP interface
10000-19999	Internal error of data structure
21201	Wrong type of control parameter: 1
21202	Wrong type of control parameter: 2
21203	Wrong type of control parameter: 3
21204	Wrong type of control parameter: 4
21205	Wrong type of control parameter: 5
21206	Wrong type of control parameter: 6
21207	Wrong type of control parameter: 7
21208	Wrong type of control parameter: 8
21209	Wrong type of control parameter: 9
21210	Wrong type of control parameter: 10
21211	Wrong type of control parameter: 11
21212	Wrong type of control parameter: 12
21213	Wrong type of control parameter: 13
21214	Wrong type of control parameter: 14
21215	Wrong type of control parameter: 15
21216	Wrong type of control parameter: 16
21217	Wrong type of control parameter: 17
21218	Wrong type of control parameter: 18

21219	Wrong type of control parameter: 19
21220	Wrong type of control parameter: 20
21301	Wrong value of control parameter: 1
21302	Wrong value of control parameter: 2
21303	Wrong value of control parameter: 3
21304	Wrong value of control parameter: 4
21305	Wrong value of control parameter: 5
21306	Wrong value of control parameter: 6
21307	Wrong value of control parameter: 7
21308	Wrong value of control parameter: 8
21309	Wrong value of control parameter: 9
21310	Wrong value of control parameter: 10
21311	Wrong value of control parameter: 11
21312	Wrong value of control parameter: 12
21313	Wrong value of control parameter: 13
21314	Wrong value of control parameter: 14
21315	Wrong value of control parameter: 15
21316	Wrong value of control parameter: 16
21317	Wrong value of control parameter: 17
21318	Wrong value of control parameter: 18
21319	Wrong value of control parameter: 19
21320	Wrong value of control parameter: 20
21350	Wrong value of component (see reset_obj_db())
21351	Wrong value of gray value component (see reset_obj_db())
21401	Wrong number of values of control parameter: 1
21402	Wrong number of values of control parameter: 2
21403	Wrong number of values of control parameter: 3
21404	Wrong number of values of control parameter: 4
21405	Wrong number of values of control parameter: 5
21406	Wrong number of values of control parameter: 6
21407	Wrong number of values of control parameter: 7
21408	Wrong number of values of control parameter: 8
21409	Wrong number of values of control parameter: 9
21410	Wrong number of values of control parameter: 10
21411	Wrong number of values of control parameter: 11
21412	Wrong number of values of control parameter: 12
21413	Wrong number of values of control parameter: 13
21414	Wrong number of values of control parameter: 14
21415	Wrong number of values of control parameter: 15
21416	Wrong number of values of control parameter: 16
21417	Wrong number of values of control parameter: 17
21418	Wrong number of values of control parameter: 18
21419	Wrong number of values of control parameter: 19
21420	Wrong number of values of control parameter: 20
21500	Number of input objects too big
21501	Wrong number of values of object parameter: 1
21502	Wrong number of values of object parameter: 2
21503	Wrong number of values of object parameter: 3
21504	Wrong number of values of object parameter: 4
21505	Wrong number of values of object parameter: 5

21506	Wrong number of values of object parameter: 6
21507	Wrong number of values of object parameter: 7
21508	Wrong number of values of object parameter: 8
21509	Wrong number of values of object parameter: 9
21510	Number of output objects too big
22000	Wrong specification of parameter (error in file: xxx.def)
22001	Initialize Halcon: reset_obj_db (width, heights, components)
22002	Used number of symbolic object names too big
22003	No license found
22004	Lost connection to license server
22005	No modules in license (no VENDOR_STRING)
22006	No license for this operator
22007	Time zone offset from GMT is > 24 hours
22008	Vendor keys do not support this platform
22009	Bad vendor keys
22010	Unknown vendor key type
22011	malloc() call failed
22012	Vendor keys have expired
22013	Second call to lc_init() (multiple jobs), and vendor keys do not support multiple jobs
22014	Vendor key data not supplied
22015	lmclient.h/liblmgr.a version mismatch
22016	Networking software not available on this machine
22017	Old vendor keys supplied
22018	License key in license file does not match other data in file
22019	Encryption handshake with daemon failed
22020	'key' structure is incorrect type, or feature Err:520 NULL, or num_licenses Err:520 0
22021	System clock has been set back. This error can only occur when the FEATURE line contains an expiration date
22022	Version argument is invalid floating point format
22023	License server busy starting another copy of itself -0 retry
22024	Cannot establish a connection with a license server
22025	Feature is queued. lc_status will determine when it is available
22026	Vendor keys do not support this function
22027	Checkout request filtered by the vendor-defined filter routine
22028	Checkout exceeds MAX specified in options file
22029	All licenses in use
22030	No license server specified for counted license
22031	Can not find feature in the license file
22032	Server has different license file than client -0 client's license has feature, but server's does not
22033	License file does not support a version this new
22034	This platform not authorized by license -0 running on platform not included in PLATFORMS list
22035	License server busy -0 the request should be retried. (This is a rare occurrence.)
22036	Could not find license.dat
22037	Invalid license file syntax
22038	Cannot connect to a license server
22039	No TCP license service exists
22040	No socket connection to license manager server
22041	Invalid host
22042	Feature has expired
22043	Invalid date format in license file

22044	Invalid returned data from license server
22045	Cannot find SERVER hostname in network database
22046	Cannot read data from license server
22047	Cannot write data to license server
22048	Error in select system call
22049	Feature checkin failure detected at license
22050	Users are queued for this feature
22051	License server does not support this version of this feature
22052	Request for more licenses than this feature supports
22053	Cannot read /dev/kmem
22054	Cannot read /vmunix
22055	Cannot find ethernet device
22056	Cannot read license file
22057	Feature not yet available (wrong time/date set?)
22058	No such attribute
22059	Clock difference too large between client and server
22060	Feature database corrupted in daemon
22061	Duplicate selection mismatch for this feature
22062	User/host on EXCLUDE list for feature
22063	User/host not on INCLUDE list for feature
22064	Feature was never checked out
22065	Invalid FLEXlm key data supplied
22066	Clock setting check not available in daemon
22067	Date too late for binary format
22068	FLEXlm not initialized
22069	Server did not respond to message
22070	Request rejected by vendor-defined filter
22071	No FEATURESET line present in license file
22072	Incorrect FEATURESET line in license file
22073	Cannot compute FEATURESET line
22074	Socket() call failed
22075	setsockopt() failed
22076	Message checksum failure
22077	Cannot read license file from server
22078	Not a license administrator
22079	lmremove request too soon
22080	Attempt to read beyond the end of LF path
22081	SYS$SETIMR call failed
22082	Internal FLEXlm Error -0 Please report to Globetrotter Software
22083	FLEXadmin API functions not available
22084	Invalid PACKAGE line in license file
22085	Server FLEXlm version older than client's
22086	Incorrect number of USERS/HOSTS INCLUDED in options file – see server log
22087	Server doesn't support this request
22088	This license object already in use
22089	Future license file format or misspelling in license file
22090	Feature removed during lmreread or wrong SERVER line hostid
22091	This feature is available in a different license pool
22092	Network connect to THIS_HOST failed
22093	Server node is down or not responding
22094	The desired vendor daemon is down

22095	The decimal format license is typed incorrectly
22096	All licenses are reserved for others
22097	Terminal Server remote client not allowed
22098	Cannot borrow that long
22099	License server out of network connections
22100	Wrong index for output object parameter
22101	Wrong index for input object parameter
22102	Wrong index for image object (too big or too small)
22103	Wrong number region/image component (see: HGetComp)
22104	Wrong relation name
22105	Access to undefined gray value component
22106	Wrong image width
22107	Wrong image height
22108	Undefined gray value component
22200	Inconsistent data of data base (typing)
22201	Wrong index for input control parameter
22202	Data of data base not defined (internal error)
22203	Number of operators too big
22205	User extension not properly installed
22206	Number of packages too large
22207	No such package installed
22300	Dongle not attached, or can't read dongle
22301	Missing dongle driver
22302	FLEXlock checkouts attempted
22303	SIGN= attribute required
22304	CRO not supported for this platform
22305	BORROW failed
22306	BORROW period has expired
22307	FLOAT_OK license must have exactly one dongle hostid
22308	Unable to delete local borrow info
22309	Support for returning aborrowed license early is not enabled
22310	Error returning borrowed license on server
22311	Error when trying to checkout just a PACKAGE(BUNDLE)
22312	Composite Hostid not initialized
22313	An item needed for Composite Hostid missing or invalid
22314	Borrowed license doesn't match Alle known server license
22315	Error enabling event log
22316	Event logging is disabled
22317	Error writing to event log
22318	Timeout
22319	Bad message command
22320	Error writing to socket, peer has closed socket
22321	Attempting to generate version specific license tied to a single hostid, which is composite
22322	Version-specific signatures are not supported for uncounted licenses
22323	License template contains redundant signature specifiers
22324	Invalid V71_LK signature
22325	Invalid V71_SIGN signature
22326	Invalid V80_LK signature
22327	Invalid V80_SIGN signature
22328	Invalid V81_LK signature

22329	Invalid V81_SIGN signature
22330	Invalid V81_SIGN2 signature
22331	Invalid V84_LK signature
22332	Invalid V84_SIGN signature
22333	Invalid V84_SIGN2 signature
22334	License key required but missing from the license certificate
22335	Bad AUTH= signature
22336	TS record invalid
22337	Cannot open TS
22338	Invalid Fulfillment record
22339	Invalid activation request received
22340	No fulfillment exists in trusted storage which matches the request
22341	Invalid activation response received
22342	Can't return the fulfillment
22343	Return would exceed max count(s)
22344	No repair count left
22345	Specified operation is not allowed
22346	User/host on EXCLUDE list for entitlement
22347	User/host not in INCLUDE list for entitlement
22348	Activation error
22349	Invalid date format in trusted storage
22350	Message encryption failed
22351	Message decryption failed
22352	Bad filter context
22353	SUPERSEDE feature conflict
22354	Invalid SUPERSEDE_SIGN syntax
22355	SUPERSEDE_SIGN does not contain a feature name and license signature
22356	ONE_TS_OK is not supported in this Windows Platform
22357	Internal error -178
22358	Only one terminal server remote client checkout is allowed for this feature
22359	Internal error -180
22360	Internal error -181
22361	Internal error -182
22362	More than one ethernet hostid not supported in composite hostid definition
22363	The String Count in the license file paths exceeds the permissible limit
22364	Invalid TZ keyword syntax
22365	Invalid time zone override specification in the client
22366	The time zone information could not be obtained
22367	License client time zone not authorized for license rights
22368	Invalid syntax for VM_PLATFORMS keyword
22369	Feature can be checked out from physical machine only
22370	Feature can be checked out from virtual machine only
22371	Vendor keys do not support Virtualization feature
22372	Checkout request denied as it exceeds the MAX limit specified in the options file
22373	Binding agent API -0 Internal error
22374	Binding agent communication error
22375	Invalid Binding agent version
22452	HALCON id out of range
22800	Wrong hardware knowledge file format
22801	Wrong hardware knowledge file version

22802	Error while reading the hardware knowledge
22803	Error while writing the hardware knowledge
22804	Tag in hardware knowledge file not found
22805	No cpu information in hardware knowledge file found
22806	No aop information in hardware knowledge file found
22807	No aop information for this HALCON variant found
22808	No aop information for this HALCON architecture found
22809	No aop information for specified Operator found
22810	Unknown aop model
22811	Wrong tag derivate in hardware knowledge file
22812	Internal error while processing hardware knowledge
22813	Optimizing aop was canceled
22830	Wrong access to global variable
22831	Used global variable does not exist
22832	Used global variable not accessible via GLOBAL_ID
22835	Halcon server to terminate is still working on a job
22837	No such HALCON software agent
22838	Hardware check for parallelization not possible on a single-processor machine
22839	Sequential HALCON does not support parallel hardware check (use Parallel HALCON instead)
22840	Initialization of agent failed
22841	Termination of agent failed
22842	Inconsistent hardware description file
22843	Inconsistent agent information file
22844	Inconsistent agent knowledge file
22845	The file with the parallelization information does not match to the currently HALCON version/revision
22846	The file with the parallelization information does not match to the currently used machine
22847	Inconsistent knowledge base of HALCON software agent
22848	Unknown communication type
22849	Unknown message type for HALCON software agent
22850	Error while saving the parallelization knowledge
22851	Wrong type of work information
22852	Wrong type of application information
22853	Wrong type of experience information
22854	Unknown name of HALCON software agent
22855	Unknown name and communication address of HALCON software agent
22856	cpu representative (HALCON software agent) not reachable
22857	cpu refuses work
22858	Description of scheduling resource not found
22859	Not accessible function of HALCON software agent
22860	Wrong type: HALCON scheduling resource
22861	Wrong state: HALCON scheduling resource
22862	Unknown parameter type: HALCON scheduling resource
22863	Unknown parameter value: HALCON scheduling resource
22864	Wrong post processing of control parameter
22867	Error while trying to get time (time query)
22868	Error while trying to get the number of processors
22869	Error while accessing temporary file
22900	Error while forcing a context switch
22901	Error while accessing the cpu affinity

22902	Error while setting the cpu affinity
22950	Wrong synchronization object
22952	Wrong thread object
22953	Input Object was not initialized
22954	Input control parameter is not initialized
22955	Output Object parameter is not initialized
22956	Output control parameter is not initialized
22970	creation of pthread failed
22971	pthread-detach failed
22972	pthread-join failed
22973	Initialization of mutex variable failed
22974	Deletion of mutex variable failed
22975	Lock of mutex variable failed
22976	Unlock of mutex variable failed
22977	failed to signal pthread condition variable
22978	failed to wait for pthread condition variable
22979	failed to init pthread condition variable
22980	failed to destroy pthread condition variable
22981	failed to signal event
22982	failed to wait for an event
22983	failed to init an event
22984	failed to destroy an event
22985	failed to create a tsd key
22986	failed to set a tsd key
22987	failed to get a tsd key
22988	failed to free a tsd key
22989	aborted waiting at a barrier
22990	'Free list' is empty while scheduling
22991	Communication partner not checked in
22992	you can not start the communication system while running it
22993	Communication partner not checked in
23010	Region completely outside of the image domain
23011	Region (partially) outside of the definition range of the image
23012	Intersected definition range region / image empty
23013	Image with empty definition range (=> no gray values)
23014	No common image point of two images
23015	Wrong region for image (first row < 0)
23016	Wrong region for image (column in last row >= image width)
23017	Number of images unequal in input parameters
23018	Image height too small
23019	Image width too small
23020	Internal error: multiple call of HRLInitSeg()
23021	Internal error: HRLSeg() not initialized
23022	Wrong size of filter for Gauss
23033	Filter size exceeds image size
23034	Filter size have to be odd
23035	Filter is too big
23036	Input region is empty
23040	Row value of a coordinate > 2ˆ15-1
23041	Row value of a coordinate < -2ˆ15

23042	Column value of a coordinate > 2ˆ15-1
23043	Column value of a coordinate < -2ˆ15
23100	Wrong segmentation threshold
23101	Unknown feature
23102	Unknown gray value feature
23103	Internal error in HContCut
23104	Error in HContToPol: distance of points too big
23105	Error in HContToPol: contour too long
23106	Too mAlle rows (IPImageTransform)
23107	Scaling factor = 0.0 (IPImageScale)
23108	Wrong range in transformation matrix
23109	Internal error in IPvvf: no element free
23110	Number of input objects is zero
23111	At least one input object has an empty region
23112	Operation allowed for rectangular images 2**n only
23113	Too mAlle relevant points (IPHysteresis)
23114	Number of labels in image too big
23115	No labels with negative values allowed
23116	Wrong filter size (too small ?)
23117	Images with different image size
23118	Target image too wide or too far on the right
23119	Target image too narrow or too far on the left
23120	Target image too high or too far down
23121	Target image too low or too far up
23122	Number of channels in the input parameters are different
23123	Wrong color filter array type
23124	Wrong color filter array interpolation
23125	Homogeneous matrix does not represent an affine transformation
23126	Inpainting region too close to the image border
23127	Source and destination differ in size
23128	To mAlle Features
23129	Reflection axis undefined
23131	Coocurrence Matrix: too little columns for quantisation
23132	Coocurrence Matrix: too little rows for quantisation
23133	Wrong number of columns
23134	Wrong number of rows
23135	Number has too mAlle digits
23136	Matrix is not symmetric
23137	Matrix is too big
23138	Wrong structure of file
23139	Lesser than 2 matrices
23140	Not enough memory
23141	Can not read the file
23142	Can not open file for writing
23143	Too mAlle lookup table colors
23145	Too mAlle Hough points (lines)
23146	Target image has got wrong height (not big enough)
23147	Wrong interpolation mode
23148	Region not compact or not connected
23170	Wrong filter index for filter size 3

23171	Wrong filter index for filter size 5
23172	Wrong filter index for filter size 7
23173	Wrong filter size; only 3/5/7
23175	Number of suitable pixels too small to reliably estimate the noise
23200	Different number of entries/exits in HContCut
23250	Wrong XLD type
23252	Internal error: border point is set to FG
23253	Internal error: maximum contour length exceeded
23254	Internal error: maximum number of contours exceeded
23255	Contour too short for fetch_angle_xld
23256	Regression parameters of contours already computed
23257	Regression parameters of contours not yet entered! Please compute them by calling regress_ cont_xld
23258	Data base: XLD object has been deleted
23259	Data base: object has no XLD-ID
23260	Internal error: wrong number of contour points allocated
23261	Contour attribute not defined
23262	Ellipse fitting failed
23263	Circle fitting failed
23264	All points classified as outliers (ClippingFactor too small)
23265	Quadrangle fitting failed
23266	No points found for at least one side of the rectangle
23267	A contour point lies outside of the image
23274	Not enough valid points for fitting the model
23275	No ARC/INFO world file
23276	No ARC/INFO generate file
23278	Unexpected end of file while reading DXF file
23279	Cannot read DXF-group code from file
23280	Inconsistent number of attributes per point in DXF file
23281	Inconsistent number of attributes and names in DXF file
23282	Inconsistent number of global attributes and names in DXF file
23283	Cannot read attributes from DXF file
23284	Cannot read global attributes from DXF file
23285	Cannot read attribute names from DXF file
23286	Wrong generic parameter name
23289	Internal DXF I/O error: Wrong data type
23290	Isolated point while contour merging
23291	Constraints (MaxError/MaxDistance) cannot be fulfilled
23300	Syntax error in file for training
23301	Maximum number of attributes per example exceeded
23302	Not possible to open file for training
23303	Too mAlle data sets for training
23304	Wrong key for data for training
23305	Too mAlle examples for one data set for training
23306	Too mAlle classes
23307	Maximum number of cuboids exceeded
23308	Not possible to open classificator's file
23309	Error while saving the classificator
23310	Not possible to open protocol file
23311	Classificator with this name is already existent

23312	Maximum number of classificators exceeded
23313	Name of classificator is too long, >= 20
23314	Classificator with this name is not existent
23315	Current classificator is not defined
23316	Wrong id in classification file
23317	The version of the classifier is not supported
23318	Serialized item does not contain a valid classifier
23330	Wrong covariance initialization
23331	The version of the GMM training samples is not supported
23332	Wrong training sample format
23333	Invalid file format for Gaussian Mixture Model (GMM)
23334	The version of the Gaussian Mixture Model (GMM) is not supported
23335	Internal error while training the GMM
23336	Singular covariance matrix
23337	No samples for at least one class
23338	Too few samples for at least one class
23340	GMM has not been trained yet
23341	No training samples stored in the classifier
23342	Serialized item does not contain a valid Gaussian Mixture Model (GMM)
23350	Unknown output function
23351	Target vector not in 0-1 encoding
23352	No training samples stored in the classifier
23353	Invalid file format for MLP training samples
23354	The version of the MLP training samples is not supported
23355	Wrong training sample format
23356	MLP is not a classifier; use OutputFunction = ‘softmax’ in create_class_mlp
23357	Invalid file format for multilayer perceptron (MLP)
23358	The version of the multilayer perceptron (MLP) is not supported
23359	Wrong number of image channels
23360	Number of MLP parameters too large
23361	Serialized item does not contain a valid multilayer perceptron (MLP)
23370	Wrong number of image channels
23371	A look-up table can be build only for a 2 or 3 channel classifier
23372	Cannot create a look-up table. Please choose a larger ‘bit_depth’ or select ‘fast’ for ‘class_selection’.
23380	No training samples stored in the classifier
23381	Invalid file format for SVM training samples
23382	The version of the SVM training samples is not supported
23383	Wrong training sample format
23384	Invalid file format for support vector machine (SVM)
23385	The version of the support vector machine (SVM) is not supported
23386	Wrong class
23387	Nu was chosen too big
23388	SVM training failed
23389	Old SVM and new SVM do not match
23390	SVM contains no trained support vectors
23391	Kernel is not an RBF kernel
23392	Train data does not contain all classes
23393	SVM not trained
23394	Classifier not trained

23395	Serialized item does not contain a valid support vector machine (SVM)
23401	Wrong rotation number
23402	Wrong letter for Golay element
23403	Wrong reference point
23404	Wrong number of iterations
23405	Mophology: system error
23406	Wrong type of boundary
23407	Morphology: wrong number of input objects
23408	Morphology: wrong number of output objects
23409	Morphology: wrong number of input control parameter
23410	Morphology: wrong number of output control parameter
23411	Morphology: structuring element is infinite
23412	Morphology: wrong name for structuring element
23500	Wrong number of run length rows (chords): smaller than 0
23501	Number of chords too big. Increase ‘current_runlength_number’ using set_system!
23502	Run length row with negative length
23503	Run length row >= image height
23504	Run length row < 0
23505	Run length column >= image width
23506	Run length column < 0
23507	For CHORD_TYPE: Number of row too big
23508	For CHORD_TYPE: Number of row too small
23509	For CHORD_TYPE: Number of column too big
23510	Exceeding the maximum number of run lengths while automatical expansion
23511	Internal error: Region->compl neither TRUE/FALSE
23512	Internal error: Region->max_num < Region->num
23513	Internal error: number of chords too big for num_max
23514	Operator cannot be implemented for complemented “
23520	Image width < 0
23521	Image width > MAX_FORMAT
23522	Image height < 0
23523	Image height > MAX_FORMAT
23524	Image width <= 0
23525	Image height <= 0
23550	Too mAlle segments
23551	’int8’ images are available on 64 bit systems only
23600	Point at infinity cannot be converted to a Euclidean point
23601	Covariance matrix could not be determined
23602	RANSAC algorithm didn’t find enough point correspondences
23603	RANSAC algorithm didn’t find enough point correspondences
23604	Internal diagnosis: fallback method had to be used
23605	Projective transformation is singular
23606	Mosaic is under-determined
23607	Input covariance matrix is not positive definite
23620	Inconsistent number of point correspondences
23621	At least one image cannot be reached from the reference image
23622	The image with specified index does not exist
23623	Matrix is not a camera matrix
23624	Skew is not zero
23625	Illegal focal length

23626	Distortion is not zero
23627	It is not possible to determine all parameters for variable camera parameters
23628	No valid implementation selected
23629	Kappa can only be determined with the gold-standard method
23630	Conflicting number of images and projection mode
23631	Error in projection: Point not in Alle cube map
23632	No solution found
23640	Illegal combination of estimation method and parameters to be determined
23650	Invalid file format for FFT optimization data
23651	The version of the FFT optimization data is not supported
23652	Optimization data was created with a different HALCON variant (Sequential HALCON / Parallel HALCON)
23653	Storing of the optimization data failed
23654	Serialized item does not contain valid FFT optimization data
23660	No contours suitable for self-calibration found
23661	No stable solution found: please change the inlier threshold or select contours manually
23662	Instable solution: please choose more or different contours
23663	Not enough contours for calibration: please select contours manually
23700	Epipoles are within the image domain: no rectification possible.
23701	Fields of view of both cameras do not intersect each other.
23750	Invalid sheet-of-light handle
23751	No sheet-of-light model available
23752	Wrong input image size (width)
23753	Wrong input image size (height)
23754	The bounding-box around the profile region does not fit the domain of definition of the input image
23755	Calibration extend not set
23756	Undefined disparity image
23757	Undefined domain for disparity image
23758	Undefined camera parameter
23759	Undefined pose of the lightplane
23760	Undefined pose of the camera coordinate system
23761	Undefined transformation from the coordinate system of the camera to the coordinate system of the lightplane
23762	Undefined movement pose for xyz calibration
23763	Wrong value of scale parameter
23764	Wrong parameter name
23765	Wrong type of parameter method
23766	Wrong type of parameter ambiguity
23767	Wrong type of parameter score
23768	Wrong type of parameter calibration
23769	Wrong type of parameter number_profiles
23770	Wrong type of element in parameter camera_parameter
23771	Wrong type of element in pose
23772	Wrong value of parameter method
23773	Wrong type of parameter min_gray
23774	Wrong value of parameter ambiguity
23775	Wrong value of parameter score_type
23776	Wrong value of parameter calibration
23777	Wrong value of parameter number_profiles

23778	Wrong type of camera
23780	Wrong number of values of pose
23850	The light source positions are linearly dependent
23851	No sufficient image indication
23852	Internal error: Function has equal signs in HZBrent
23900	Kalman: Dimension n,m or p has got a undefined value
23901	Kalman: File does not exist
23902	Kalman: Error in file (row of dimension)
23903	Kalman: Error in file (row of marking)
23904	Kalman: Error in file (value is no float)
23905	Kalman: Matrix A is missing in file
23906	Kalman: Matrix C is missing in file
23907	Kalman: Matrix Q is missing in file
23908	Kalman: Matrix R is missing in file
23909	Kalman: G or u is missing in file
23910	Kalman: Covariant matrix is not symmetric
23911	Kalman: Equation system is singular
24050	Image data management: object is a object tupel
24051	Image data management: object has been deleted already
24052	Image data management: wrong object-ID
24053	Image data management: object tupel has been deleted already
24054	Image data management: wrong object tupel-ID
24055	Image data management: object tupel is a object
24056	Image data management: object-ID is NULL (0)
24057	Image data management: object-ID outside the valid range
24058	Image data management: access to deleted image
24059	Image data management: access to image with wrong key
24060	Image data management: access to deleted region
24061	Image data management: access to region with wrong key
24062	Image data management: wrong value for image channel
24063	Image data management: index too big
24064	Image data management: index not defined
24100	No OpenCL available
24101	OpenCL Error occured
24102	No compute device available
24104	Out of compute device memory
24105	Invalid work group shape
24106	Invalid compute device
25100	Wrong (logical) window number
25101	Error while opening the window
25102	Wrong window coordinates
25103	It is not possible to open another window
25104	Device resp. operator not available
25105	Unknown color
25106	No window has been opened for desired action
25107	Wrong filling mode for regions (fill or margin)
25108	Wrong gray value (0..255)
25109	Wrong pixel value (use value of get_pixel(P) only)
25110	Wrong line width (see: query_line_width(Min,Max))
25111	Wrong name of cursor

25112	Wrong color table (see: query_lut(Name)
25113	Wrong representation mode (see: query_insert(Mode))
25114	Wrong representation color (see: query_color(List))
25115	Wrong dither matrix (binary image representation)
25116	Wrong image transformation (name or image size)
25117	Unsuitable image type for image transformation
25118	Wrong zooming factor for image transformation
25119	Wrong representation mode
25120	Wrong code of device
25121	Wrong number for father window
25122	Wrong window size
25123	Wrong window type
25124	No current window has been set
25125	Wrong color combination or range (RGB)
25126	Wrong number of pixels set
25127	Wrong value for comprise (object or image)
25128	set_fix with 1/4 image levels and static not valid
25129	set_lut not valid in child windows
25130	Number of concurrent used color tables is too big
25131	Wrong device for window dump
25132	Wrong window size for window dump
25133	System variable DISPLAY (setenv) not defined
25134	Wrong thickness for window margin
25135	System variable DISPLAY has been set wrong (<host>:0.0)
25136	Too mAlle fonts loaded
25137	Wrong font name
25138	No valid cursor position
25139	Window is not a textual window
25140	Window is not a image window
25141	String too long or too high
25142	Too little space in the window rightwards
25143	Window is not suitable for the mouse
25144	Here Windows on a equal machine is permitted only
25145	Wrong mode while opening a window
25146	Wrong window mode for operation
25147	Operation not possible with fixed pixel
25148	Color tables for 8 image levels only
25149	Wrong mode for pseudo real colors
25150	Wrong pixel value for LUT
25151	Wrong image size for pseudo real colors
25152	Error in procedure HRLUT
25153	Wrong number of entries in color table for set_lut
25154	Wrong values for image area
25155	Wrong line pattern
25156	Wrong number of parameters for line pattern
25157	Wrong number of colors
25158	Wrong value for mode of area creation (0,1,2)
25159	Spy window is not set (set_spy)
25160	No file for spy has been set (set_spy)
25161	Wrong parameter output depth (set_spy)

25162	Wrong window size for window dump
25163	Wrong color table: wrong file name or query_lut()
25164	Wrong color table: empty string ?
25165	Using this hardware set_lut('default') is allowed only
25166	Error while calling online help
25167	Row can not be projected
25168	Operation is unsuitable using a computer with fixed color table
25169	Computer represents gray scales only (no colors)
25170	LUT of this display is full
25171	Internal error: wrong color code
25172	Wrong type for window attribute
25173	Wrong name for window attribute
25174	Negative height of area (or 0)
25175	Negative width of area (or 0)
25176	Window not completely visible
25177	Font not allowed for this operation
25178	Operation not possible (window was created in different thread)
25179	Depth was not stored with window
25180	Internal error: only RGB-Mode
25181	No more (image-)windows available
25182	Object index was not stored with window
25183	Operator does not support primitives without point coordinates
25184	Operator not available with Windows Remote Desktop
25185	No OpenGL support available
25186	No depth information available
25187	OpenGL error occurred
25188	Required framebuffer object is unsupported
25189	OpenGL accelerated hidden surface removal not supported on this machine
25190	Invalid window parameter
25191	Invalid value for window parameter
25192	Unknown mode
25195	Invalid value for navigation mode
25196	Internal file error
25197	Error while file synchronization
25198	Insufficient rights on file
25199	Bad file descriptor
25200	File not found
25201	Error while writing image data (sufficient memory ?)
25202	Error while writing image descriptor (sufficient memory ?)
25203	Error while reading image data (format of image too small ?)
25204	Error while reading image data (format of image too big ?)
25205	Error while reading image descriptor: file too small
25206	Image matrices are different
25207	Help file not found (setenv HALCONROOT <Halcon- Homedirectory>)
25208	Help index not found (setenv HALCONROOT <Halcon- Homedirectory>)
25209	File <standard_input> can not be closed
25210	<standard_output/error> can not be closed
25211	File can not be closed
25212	Error while writing to file
25213	Exceeding of maximum number of files

25214	Wrong file name
25215	Error while opening the file
25216	Wrong file mode
25217	Wrong type for pixel (e.g. byte)
25218	Wrong image width (too big ?)
25219	Wrong image height (too big ?)
25220	File already exhausted before reading an image
25221	File exhausted before terminating the image
25222	Wrong value for resolution (dpi)
25223	Wrong output image size (width)
25224	Wrong output image size (height)
25225	Wrong number of parameter values: format description
25226	Wrong parameter name for operator
25227	Wrong slot name for parameter
25228	Operator class is missing in help file
25229	Wrong or inconsistent help/*.idx or help/*.sta
25230	File help/*.idx not found (setenv HALCONROOT <Halcon- Homedirectory>)
25231	File help/*.sta not found (setenv HALCONROOT <Halcon- Homedirectory>)
25232	Inconsistent file help/*.sta
25233	No explication file (.exp) found
25234	No file found in known graphic format
25235	Wrong graphic format
25236	Inconsistent file halcon.num
25237	File not a TIFF file
25238	Wrong file format
25239	gnuplot could not be started
25240	Output file for gnuplot could not be opened
25241	Not a valid gnuplot output stream
25242	No PNM format
25243	Inconsistent or old help file ($HALCONROOT/help)
25244	Wrong file handle
25245	File not open
25246	No files in use so far (none opened)
25247	Invalid file format for regions
25248	Error while reading region data: Format of region too big.
25250	Invalid handle for a serial connection
25251	Serial port not open
25252	No serial port available
25253	Could not open serial port
25254	Could not close serial port
25255	Could not get serial port attributes
25256	Could not set serial port attributes
25257	Wrong baud rate for serial connection
25258	Wrong number of data bits for serial connection
25259	Wrong flow control for serial connection
25260	Could not flush serial port
25261	Error during write to serial port
25262	Error during read from serial port
25270	Serialized item does not contain valid regions
25271	The version of the regions is not supported
25272	Serialized item does not contain valid images

25273	The version of the images is not supported
25274	Serialized item does not contain valid XLD objects
25275	The version of the XLD objects is not supported
25276	Serialized item does not contain valid objects
25277	The version of the objects is not supported
25280	File has not been opened in text format
25281	File has not been opened in binary file format
25282	Cannot create directory
25283	Cannot remove directory
25300	No image recording device opened
25301	Image recording: wrong color depth
25302	Image recording: wrong device
25303	Image recording: determination of video format not possible
25304	Image recording: no video signal
25305	Unknown image recording device
25306	Image recording: failed grabbing of an image
25307	Image recording: wrong resolution chosen
25308	Image recording: wrong image part chosen
25309	Image recording: wrong pixel ratio chosen
25310	Image recording: handle not valid
25311	Image recording: instance not valid (already closed?)
25312	Image recording: device cannot be initialized
25313	Image recording: external triggering not supported
25314	Image recording: wrong camera input line (multiplex)
25315	Image recording: wrong color space
25316	Image recording: wrong port
25317	Image recording: wrong camera type
25318	Image recording: maximum number of recording device classes exceeded
25319	Image recording: device busy
25320	Image recording: asynchronous grab not supported
25321	Image recording: unsupported parameter
25322	Image recording: timeout
25323	Image recording: invalid gain
25324	Image recording: invalid field
25325	Image recording: invalid parameter type
25326	Image recording: invalid parameter value
25327	Image recording: function not supported
25328	Image recording: incompatible interface version
25329	Image recording: could not set parameter value
25330	Image recording: could not query parameter setting
25331	Image recording: parameter not available in current configuration
25332	Image recording: device could not be closed properly
25333	Image recording: camera configuration file could not be opened
25334	Image recording: callback type not supported
25335	Image recording: device lost
25400	Image type is not supported
25401	Invalid pixel format
25402	Internal JPEG-XR error
25403	Invalid format string
25404	Maximum number of channels exceeded

25405	Unspecified error in JPEG-XR library
25406	Bad magic number in JPEG-XR library
25407	Feature not implemented in JPEG-XR library
25408	File read/write error in JPEG-XR library
25409	Invalid file format in JPEG-XR library
25500	Error while closing the image file
25501	Error while opening the image file
25502	Premature end of the image file
25503	Image dimensions too large for this file format
25504	Image too large for this HALCON version
25505	Too mAlle iconic objects for this file format
25510	File is no PCX-File
25511	PCX: unknown encoding
25512	PCX: More than 4 image plains
25513	PCX: Wrong magic in color table
25514	PCX: Wrong number of bytes in span
25515	PCX: Wrong number of bits/pixels
25516	PCX: Wrong number of plains
25520	File is no GIF-File
25521	GIF: Wrong version (not 87a/89a)
25522	GIF: Wrong descriptor
25523	GIF: Wrong color table
25524	GIF: Premature end of file
25525	GIF: Wrong number of images ';'
25526	GIF: Wrong image extension '!'
25527	GIF: Wrong left top width
25528	GIF: Cyclic index of table
25529	GIF: Wrong image data
25530	File is no Sun-Raster-File
25531	SUN-Raster: Wrong header
25532	SUN-Raster: Wrong image width
25533	SUN-Raster: Wrong image height
25534	SUN-Raster: Wrong color map
25535	SUN-Raster: Wrong image data
25536	SUN-Raster: Wrong type of pixel
25540	XWD: Wrong type of pixel
25541	XWD: Wrong visual class
25542	XWD: Wrong X10 header
25543	XWD: Wrong X11 header
25544	XWD: Wrong X10 colormap
25545	XWD: Wrong X11 colormap
25546	XWD: Wrong pixmap
25547	XWD: unknown version
25548	XWD: Error while reading an image
25550	TIFF: Error while reading a file
25551	TIFF: Wrong colormap
25552	TIFF: Too mAlle colors
25553	TIFF: Wrong photometric interpretation
25554	TIFF: Wrong photometric depth
25555	TIFF: Image is no binary file

25556	TIFF: Image format not supported by HALCON
25557	TIFF: Wrong specification of the TIFF file format
25558	TIFF: TIFF file is corrupt
25559	TIFF: A required TIFF tag is missing the the TIFF file
25560	File is no BMP-File
25561	BMP: Premature end of file
25562	BMP: Incomplete header
25563	BMP: Unknown bitmap format
25564	BMP: Unknown compression format
25565	BMP: Wrong color table
25566	BMP: Write error on output
25567	BMP: File does not contain a binary image
25570	JPEG: wrong number of components in image
25571	JPEG: unknown error from libjpeg
25572	JPEG: no implemented feature in libjpeg
25573	JPEG: file access error in libjpeg
25574	JPEG: tmp file access error in libjpeg
25575	JPEG: memory error in libjpeg
25576	JPEG: Error in input image
25580	PNG: File is not a PNG file
25581	PNG: Unknown interlace type
25582	PNG: Unsupported color type
25583	PNG: Image is no binary file
25590	JPEG-2000: File corrupt
25591	JPEG-2000: Image has more than 28 significant bits
25592	JPEG-2000: Error while encoding
25600	Socket can not be set to block
25601	Socket can not be set to unblock
25602	Received data is no tuple
25603	Received data is no image
25604	Received data is no region
25605	Received data is no xld object
25606	Error while reading from socket
25607	Error while writing to socket
25608	Illegal number of bytes with get_rl
25609	Buffer overflow in read_data
25610	Socket can not be created
25611	Bind on socket failed
25612	Socket information is not available
25613	Socket cannot listen for incoming connections
25614	Connection could not be accepted
25615	Connection request failed
25616	Hostname could not be resolved
25617	No data on socket
25618	Unknown tuple type on socket
25619	Timeout occured on socket
25620	No more sockets available
25621	Socket is not initialized
25622	Invalid socket
25623	Socket is NULL

25624	Received data type is too large
25625	Wrong socket protocol
25626	Received data does not contain packed data
25627	Error when handling the parameter
25628	Format specification does not match the data
25629	Invalid format specification
25630	Received data is no serialized item
25678	XLD object data can only be read by HALCON XL
25700	Too mAlle contours/polygons for this file format
25750	The version of the quaternion is not supported
25751	Serialized item does not contain a valid quaternion
25752	The version of the homogeneous matrix is not supported
25753	Serialized item does not contain a valid homogeneous matrix
25754	The version of the homogeneous 3D matrix is not supported
25755	Serialized item does not contain a valid homogeneous 3D matrix
25756	The version of the tuple is not supported
25757	Serialized item does not contain a valid tuple
25758	Tuple data can only be read on 64-bit systems
25759	The version of the camera parameters (pose) is not supported
25760	Serialized item does not contain valid camera parameters (pose)
25761	The version of the internal camera parameters is not supported
25762	Serialized item does not contain valid internal camera parameters
26000	Access to undefined memory area
26001	Not enough memory available
26002	Memory partition on heap has been overwritten
26003	HAlloc: 0 bytes requested
26004	Tmp-memory management: Call freeing memory although nothing had been allocated
26005	Tmp-memory management: Null pointer while freeing
26006	Tmp-memory management: could not find memory element
26007	Memory management: wrong memory type allocated
26021	Not enough video memory available
26040	System parameter for memory-allocation inconsistent
26041	No memory block allocated at last
26500	Process creation failed
27000	Wrong index for output control parameter
27001	Wrong number of values: output control parameter (see: HPut*Par
27002	Wrong type: output control parameter (see: HPut*Par)
27003	Wrong data type for object key (input objects)
27004	Range for integer had been passed
27005	Inconsistent Halcon version
27006	Not enough memory for strings allocated
27007	Internal error: Proc is NULL
27100	Wrong list structure using input objects
27101	Wrong input object parameter (not bound)
27102	Wrong input control parameter (not bound)
27103	Wrong output object parameter (already bound)
27104	Wrong output control parameter (already bound)
27105	Unknown symbolic object key (input objects)
27200	Wrong number of output object parameter
27300	Wrong number of input parameter

27400	System error: output type <string> expected
27401	System error: output type <long> expected
27402	System error: output type <float> expected
27403	Object parameter is a zero pointer ('_' not allowed)
27404	Tupel had been deleted; values are not valid Alle more
27430	CPP-interface internal error: wrong object mode
27431	Wrong number of regions (> 1) for type HRegion
27432	Wrong number of images (> 1) for type HImage
27433	Tupel with undefined values
27500	No contact to RPC server
27501	Error in remote procedure call
27600	Parameter value is neither a list nor a atom
28000	Unknown operator name
28001	register_comp_used is not activated (see set_system)
28002	Unknown operator class
28101	convol/mask: error while opening the file
28102	convol/mask: premature end of file
28103	convol/mask: conversion error
28104	convol/mask: wrong row-/column number
28105	convol/mask: mask size overflow
28106	convol/mask: too mAlle elements entered
28107	convol: wrong margin type
28108	convol: no mask object has got empty region
28110	convol: Weight factor is 0
28111	convol: inconsistent number of weights
28112	rank: wrong rank value
28113	convol/rank: error while handling margin
28114	Error while parsing filter mask file
28120	Wrong number of coefficients for convolution (sigma too big?)
28200	No valid ID for data set
28201	No data set active (set_bg_esti)
28202	ID already used for data set (is not possible)
28204	No data set created (create_bg_esti)
28205	Not possible to pass an object list
28206	Image has other size than the background image in data set
28207	Up-date-region is bigger than background image
28208	Number of statistic data sets is too small
28209	Wrong value for adapt mode
28210	Wrong value for frame mode
28300	Maximum number of fonts exceeded
28301	Wrong ID (Number) for font
28302	OCR internal error: wrong ID
28303	OCR not initialised: no font was read in
28304	No font activated
28305	OCR internal error: wrong threshold in angle determination
28306	OCR internal error: wrong attribute
28307	The version of the OCR classifier is not supported
28308	OCR File: inconsistent number of nodes
28309	OCR File: File too short
28310	OCR: internal error 1

28311	OCR: internal error 2
28312	Wrong type of OCR tool (no ‘box’ or ‘net’)
28313	The version of the OCR training characters is not supported
28314	Image too large for training file
28315	Region too large for training file
28316	Protected training file
28317	Wrong password for protected training file
28318	Serialized item does not contain a valid OCR classifier
28320	Invalid file format for MLP classifier
28321	The version of the MLP classifier is not supported
28322	Serialized item does not contain a valid MLP classifier
28330	Invalid file format for SVM classifier
28331	The version of the SVM classifier is not supported
28332	Serialized item does not contain a valid k-NN classifier
28333	Invalid file format for k-NN classifier
28340	Invalid text model
28341	Invalid text result
28350	OCV system not initialized
28351	The version of the OCV tool is not supported
28353	Wrong name for an OCV object
28354	Training has already been applied
28355	No training has been applied to the character
28356	Serialized item does not contain a valid OCV tool
28370	Wrong number of function points
28371	List of values is not a function
28372	Wrong ordering of values (not ascending)
28373	Illegal distance of function points
28374	Function is not monotonic
28375	Wrong function type
28400	You have to indicate at least 3 calibration points
28402	No calibration table found
28403	Error while reading calibration table description file
28404	Minimum threshold while searching for ellipses
28405	Read error / format error in calibration table description file
28406	Error in projection: s_x = 0 or s_y = 0 or z = 0
28407	Error in inverse projection
28408	Not possible to open camera parameter file
28409	Format error in file: no colon
28410	Format error in file: 2. colon is missing
28411	Format error in file: semicolon is missing
28412	Not possible to open camera parameter (pose) file
28413	Format error in camera parameter (pose) file
28414	Not possible to open calibration target description file
28415	Not possible to open postscript file of calibration target
28416	Error while norming the vector
28417	Fitting of calibration target failed
28418	No next mark found
28419	Normal equation system is not solvable
28420	Average quadratic error is too big for 3D position of mark
28421	Non elliptic contour

28422	Wrong parameter value slvand()
28423	Wrong function results slvand()
28424	Distance of marks in calibration target description file is not possible
28425	Specified flag for degree of freedom not valid
28426	Minimum error did not fall below
28427	Wrong type in Pose (rotation / translation)
28428	Image size does not match the measurement in camera parameters
28429	Point could not be projected into linescan image
28430	Diameter of calibration marks could not be determined
28431	Orientation of calibration plate could not be determined
28432	Calibration plate does not lie completely inside the image
28433	Wrong number of calibration marks extracted
28434	Unknown name of parameter group
28435	Focal length must be non-negative
28436	Function not available for cameras with telecentric lenses
28437	Function not available for line scan cameras
28438	Ellipse is degenerated to a point
28439	No orientation mark found
28440	Camera calibration did not converge
28441	Error in calibration data, try to recalibrate with improved input data!
28442	Point cannot be distorted
28451	Model not optimized yet -0 no results can be queried
28452	Model not postprocessed yet -0 no auxiliary results can be queried
28453	Calibration setup: fields of view do not intersect
28454	Camera type and camera parameters incompatible
28455	Calibration setup: incompatible camera types
28456	Camera type not supported
28457	Invalid camera index
28458	Invalid calibration object index
28459	Invalid calibration object pose index
28460	Undefined camera
28461	Indices: ambiguous observation index
28462	Undefined calibration object
28463	Invalid file format for calibration data model
28464	The version of the calibration data model is not supported
28465	Zero-motion in line scan camera parameters
28466	Calibration setup: multiple cameras and/or calibration objects not supported for camera type
28467	Incomplete observation data
28468	Invalid file format for camera setup model
28469	The version of the camera setup model is not supported
28470	Full HALCON calibration plate description required
28471	Invalid observation index
28472	Serialized item does not contain a valid camera setup model
28473	Serialized item does not contain a valid calibration data model
28474	Invalid tool pose index
28475	Undefined tool pose
28476	Feature or operation not supported for current calibration data model type
28490	Feature or operation not supported for current stereo model type
28491	Feature or operation available only in ‘persistent’ mode
28492	Invalid bounding box

28493	Image sizes must be identical with the corresponding camera parameters from the camera setup
28494	Bounding box lies partially or completely behind the base line of at least one camera pair
28495	Ambiguous calibration: Please, recalibrate with improved input data!
28496	Pose of calibration plate could not be determined!
28500	Invalid file format for template
28501	The version of the template is not supported
28502	Error during changing the file mode (t/b)
28503	Inconsistent match file: coordinates out of range
28505	The image(s) is not a pyramid (wrong zooming factor?)
28506	Number of template points too small
28507	Template data can only be read by HALCON XL
28508	Serialized item does not contain a valid NCC model
28509	Serialized item does not contain a valid template
28510	Number of shape model points too small
28511	Gray-value-based and color-based shape models cannot be searched simultaneously
28512	Shape model data can only be read by HALCON XL
28513	Shape model was not created from XLDs
28514	Serialized item does not contain a valid shape model
28530	Initial components have different region types
28531	Solution of ambiguous matches failed
28532	Computation of the incomplete gamma function not converged
28533	Too mAlle nodes while computing the minimum spanning arborescence
28534	Component training data can only be read by HALCON XL
28535	Component model data can only be read by HALCON XL
28536	Serialized item does not contain a valid component model
28537	Serialized item does not contain a valid component training result
28540	Size of the training image and the variation model differ
28541	Variation model has not been prepared for segmentation
28542	Invalid variation model training mode
28543	Invalid file format for variation model
28544	The version of the variation model is not supported
28545	Training data has already been cleared
28546	Serialized item does not contain a valid variation model
28550	No more measure objects available
28551	Measure object is not initialized
28552	Invalid measure object
28553	Measure object is NULL
28554	Measure object has wrong image size
28555	Invalid file format for measure object
28556	The version of the measure object is not supported
28557	Measure object data can only be read by HALCON XL
28558	Serialized item does not contain a valid measure object
28570	Metrology model is not initialized
28571	Invalid metrology model
28572	Invalid metrology object
28573	Not enough valid measures for fitting the metrology object
28575	Invalid file format for metrology model
28576	The version of the metrology model is not supported
28577	Fuzzy function is not set

28578	Serialized item does not contain a valid metrology model
28600	Dynamic library could not be opened
28601	Dynamic library could not be closed
28602	Symbol not found in dynamic library
28650	Not enough information for radiometric calibration
28700	Unknown bar code
28701	Wrong number of modules
28702	Wrong number of elements
28703	Unknown character (for this code)
28705	wrong name for attribute in barcode descriptor
28706	Wrong thickness of element
28707	No region found
28708	Wrong type of bar code
28720	Invalid bar code handle
28721	List of bar code models is empty
28722	Training cannot be done for multiple bar code types
28723	Cannot get bar code type specific parameter with get_bar_code_param. Use get_bar_code_param_specific
28724	Cannot get this object for multiple bar code types. Try again with single bar code type
28725	Invalid file format for bar code model
28726	The version of the bar code model is not supported
28800	Specified code type is not supported
28801	Wrong foreground specified
28802	Wrong matrix size specified
28803	Wrong symbol shape specified
28804	Wrong generic parameter name
28805	Wrong generic parameter value
28806	Wrong symbol printing mode
28807	Symbol region too near to image border
28808	No rectangular module boundings found
28809	Couldn’t identify symbol finder
28810	Symbol region with wrong dimension
28811	Classification failed
28812	Decoding failed
28813	Reader programing not supported
28820	General 2d data code error
28821	Corrupt signature of 2d data code handle
28822	Invalid 2d data code handle
28823	List of 2d data code models is empty
28825	Invalid ‘Candidate’ parameter
28829	Unexpected 2d data code error
28830	Invalid parameter value
28831	Unknown parameter name
28832	Invalid value for ‘polarity’
28833	Invalid value for ‘symbol_shape’
28834	Invalid symbol size
28835	Invalid module size
28836	Invalid value for ‘module_shape’
28837	Invalid value for ‘orientation’
28838	Invalid value for ‘contrast_min’

28839	Invalid value for 'measure_thresh'
28840	Invalid value for 'alt_measure_red'
28841	Invalid value for 'slant_max'
28842	Invalid value for 'L_dist_max'
28843	Invalid value for 'L_length_min'
28844	Invalid module gap
28845	Invalid value for 'default_parameters'
28846	Invalid value for 'back_texture'
28847	Invalid value for 'mirrored'
28848	Invalid value for 'classificator'
28849	Invalid value for 'persistence'
28850	Invalid model type
28851	Invalid value for 'module_roi_part'
28852	Invalid value for 'finder_pattern_tolerance'
28853	Invalid value for 'mod_aspect_max'
28854	Invalid value for 'small_modules_robustness'
28863	Invalid module aspect ratio
28864	Invalid layer num
28865	Wrong data code model file version
28866	Serialized item does not contain a valid 2D data code model
28900	Unknown parameter name
28901	Invalid value for 'num_levels'
28902	Invalid value for 'optimization'
28903	Invalid value for 'metric'
28904	Invalid value for 'min_face_angle'
28905	Invalid value for 'min_size'
28910	The projected model is too large "
28920	Invalid value for 'longitude_min'
28921	Invalid value for 'longitude_max'
28922	Invalid value for 'latitude_min'
28923	Invalid value for 'latitude_max'
28924	Invalid value for 'cam_roll_min'
28925	Invalid value for 'cam_roll_max'
28926	Invalid value for 'dist_min'
28927	Invalid value for 'dist_max'
28928	Invalid value for 'num_matches'
28929	Invalid value for 'max_overlap'
28933	Invalid value for 'border_model'
28940	Pose is not well-defined
28941	Invalid file format for 3D shape model
28960	Invalid file format for descriptor model
28961	The version of the descriptor model is not supported
28962	Invalid value for 'radius'
28963	Invalid value for 'check_neighbor'
28964	Invalid value for 'min_check_neighbor_diff'
28965	Invalid value for 'min_score'
28966	Invalid value for 'sigma_grad'
28967	Invalid value for 'sigma_smooth'
28968	Invalid value for 'alpha'
28969	Invalid value for 'threshold'

28970	Invalid value for ‘depth’
28971	Invalid value for ‘number_trees’
28972	Invalid value for ‘min_score_descr’
28973	Invalid value for ‘patch_size’
28974	Invalid value for ‘tilt’
28975	Invalid value for ‘guided_matching’
28976	Invalid value for ‘subpix’
28977	Too few feature points can be found
28978	Invalid value for ‘min_rot’
28979	Invalid value for ‘max_rot’
28980	Invalid value for ‘min_scale’
28981	Invalid value for ‘max_scale’
28982	Invalid value for ‘mask_size_grd’
28983	Invalid value for ‘mask_size_smooth’
28984	Model broken
28985	Invalid value for ‘descriptor_type’
28986	Invalid value for ‘matcher’
28987	Too mAlle point classes -0 model storing in a file is not possible
28988	Serialized item does not contain a valid descriptor model
29000	Function not implemented on this machine
29001	Image to process has wrong gray value type
29002	Wrong image component (see: get_system(obj_images,H))
29003	Undefined gray values
29004	Wrong image format for operation (too big or too small)
29005	Wrong number of image components for image output
29006	String is too long (max. 1024 characters)
29007	Wrong pixel type for this operation
29008	Operation not realized yet for this pixel type
29009	Image is no color image with three channels
29010	Image recording devices are not supported in the demo version
29011	Packages are not supported in the demo version
29020	Internal error: Unknown value
29021	Image domain too small.
29022	Input dimension too small
29023	Draw operator has been canceled
29050	Operator is not available in this restricted version of HALCON
29051	Packages are not available in this restricted version of HALCON
29052	The selected image recording interface is not available in this restricted version of HALCON
29100	Too mAlle unknown variables in linear equation
29101	No (unique) solution for the linear equation
29102	Too little equations in linear equation
29200	Matrix is not invertible
29201	Singular value decomposition did not converge
29202	Matrix has too few rows for singular value partition
29203	Eigenvalue computation did not converge
29204	Eigenvalue computation did not converge
29205	Matrix is singular
29206	Function matching did not converge
29207	Input matrix undefined
29208	Input matrix with wrong dimension

29209	Input matrix is not quadratic
29210	Matrix operation failed
29211	Matrix is not positive definite
29212	One element of the matrix is zero: Division by zero
29213	Matrix is not an upper triangular matrix
29214	Matrix is not a lower triangular matrix
29215	One element of the matrix is negative
29216	Matrix file: Invalid character
29217	Matrix file: Matrix incomplete
29218	Invalid file format for matrix
29219	Resulting matrix has complex values
29220	Wrong value in matrix of exponents
29221	The version of the matrix is not supported
29222	Serialized item does not contain a valid matrix
29230	Internal error: wrong Node
29231	Inconsistent red black tree
29250	Internal error: Wrong LAPACK parameter
29260	Number of points too small for spherical triangulation
29261	First three points are collinear in spherical triangulation
29262	Spherical triangulation contains identical input points
29263	Internal error: array not allocated large enough for spherical triangulation
29264	Spherical Voronoi diagram contains degenerate triangle
29265	Internal error: inconsistent spherical triangulation
29266	Spherical Voronoi diagram contains self-intersecting polygon
29267	Internal error: inconsistent spherical polygon data
29268	Internal error: Ambiguous great circle arc intersection
29269	Internal error: Ambiguous great circle arc
29270	Internal error: Illegal parameter
29280	Not enough points for planar triangular meshing
29281	The first three points of the triangular meshing are collinear
29282	Planar triangular meshing contains identical input points
29283	Invalid points for planar triangular meshing
29284	Internal error: allocated array too small for planar triangular meshing
29285	Internal error: planar triangular meshing inconsistent
29300	Eye point and reference point coincide
29400	Timeout occurred
29401	Invalid value for timeout
29450	Invalid value for 'sub_object_size'
29451	Invalid value for 'min_size'
29452	Invalid number of least-squares iterations
29453	Invalid value for 'angle_step'
29454	Invalid value for 'scale_r_step'
29455	Invalid value for 'scale_c_step'
29456	Invalid value for 'max_angle_distortion'
29457	Invalid value for 'max_aniso_scale_distortion'
29458	Invalid value for 'min_size'
29459	Invalid value for 'cov_pose_mode'
29460	Model contains no calibration information
29461	Generic parameter name does not exist
29462	Provided camera parameters have different resolution than image

29463	Invalid file format for deformable model
29464	The version of the deformable model is not supported
29465	Invalid ‘deformation_smoothness’
29466	Invalid ‘expand_border’
29467	Model origin outside of axis-aligned bounding rectangle of template region
29468	Serialized item does not contain a valid deformable model
29500	3D Object Model has no points
29501	3D Object Model has no faces
29502	3D Object Model has no normals
29506	Invalid file format for 3D surface model
29507	The version of the 3D surface model is not supported
29508	Serialized item does not contain a valid 3D surface model
29510	Invalid 3D file
29511	Invalid 3D object model
29512	Unknown file type
29513	The version of the 3D object model is not supported
29514	Required attribute missing in 3D object model
29515	Required points missing in 3D object model
29516	Required normals missing in 3D object model
29517	Required triangulation missing in 3D object model
29518	Required polylines missing in 3D object model
29519	Required triangle neighborhood missing in 3D object model
29520	Required polygons missing in 3D object model
29521	Required 2D mapping missing in 3D object model
29522	Required primitive missing in 3D object model
29523	Required 3D shape model missing in 3D object model
29524	Required extended attribute missing in 3D object model
29525	Serialized item does not contain a valid 3D object model
29526	Primitive in 3D object model has no extended data
29527	Operation invalid, 3D object model already contains triangles
29528	Operation invalid, 3D object model already contains lines
29529	Operation invalid, 3D object model already contains faces or polygons
29530	For at least one input 3D object model no neighbor with sufficient surface overlap is available.
29531	All components of points must be set at once
29532	All components of normals must be set at once
29533	Number of values doesn’t correspond to number of already existing points
29534	Number of values doesn’t correspond to number of already existing normals
29535	Number of values doesn’t correspond to already existing triangulation
29536	Number of values doesn’t correspond to length of already existing polygons
29537	Number of values doesn’t correspond to length of already existing polylines
29538	Number of values doesn’t correspond to already existing 2D mapping
29539	Number of values doesn’t correspond to already existing extended attribute
29550	Triangles of the 3D object model are not suitable for this operator
29551	Too few suitable 3D points in the 3D object model
29580	Invalid file format for serialized items
29581	Serialized item: premature end of file
29600	Invalid value for ‘image_resize_method’
29601	Invalid value for ‘image_resize_value’
29602	Invalid value for ‘rating_method’
29603	At least one type of image information must be added

29604	Sample identifier does not contain color information
29605	Sample identifier does not contain texture information
29606	Sample image does not contain enough information
29607	Sample identifier does not contain unprepared data (use add_sample_identifier_preparation_data)
29608	Sample identifier has not been prepared yet (use prepare_sample_identifier)
29609	Sample identifier does not contain untrained data (use add_sample_identifier_training_data)
29610	Sample identifier has not been trained yet (use train_sample_identifier)
29611	Sample identifier does not contain result data
29612	Sample identifier must contain at least two training objects (use add_sample_identifier_training_data)
30000	no error
30001	Input invalid
30002	Input negative
30003	Input exceeded range
30004	Memory exceeded boundary
30004	Memory allocation failure
30006	Memory pointer null
30007	DMA failure
30008	File open failure
30009	File read failure
30010	File write failure
30011	File close failure
30012	File format failure
30013	Warning low memory
40000	No error occurred in camera device.
40001	Initialization of image chip driver failed.
40002	Converting image to RGB or HSV failed.
40003	The capture process timed out.
40004	Arming video driver failed -> driver is in error state.
40005	Setting up image chip failed while changing size.
40006	Setting up video driver failed while changing size.
40007	Setting up image chip failed while changing brightness.
40008	Setting light mode failed -> typically UART communication.
40009	Setting focus pos. failed -> typically UART communication.
40010	Auto focus process failed -> typically UART communication.
50001	Indicates the configuration is invalid.
50002	Indicates the configuration API was not initialized.
50003	Indicates the configuration API was already initialized.
50004	Indicates that a function argument was invalid.
50005	Indicates a channel was defined twice.
50006	One has tried to define more than 2 quadrature channels.
50007	Indicates that more than 1 TRIGGER inputs is defined.
50008	Indicates that more than 1 READY signal is defined.
50009	Indicates that more than 1 FLASH output is defined.
50010	Indicates that more than 1 PROCESS output is defined.
50011	Indicates that more than 1 CAPTURE output is defined.
50012	Indicates that more than 1 PROJECT_SELECT feedback output defined.
50013	Indicates that more than 1 PROJECT_SELECT input is defined.
50014	Indicates invalid configuration of timer/quadrature.

50015	Indicates PRU couldn‘t started.
70010	Frame dropped because the queue was full
70011	Frame lost in the GigE interface
70020	Payload type not supported
70021	Pixel format not supported
70030	Receive timeout
70031	Too many GigE resend requests sent
70032	Failed to recover frame
70040	Frame partially received
70041	Frame not received
70050	File load error
70051	File format error
70052	Frame unavailable
80001	Invalid pointer
80002	Timeout
80003	Not initialized
80004	No cameras
80005	Bad index
80006	Bad category
80007	Bad feature
80008	Bad feature type
80009	Bad value
80010	Out of range
80011	Socket error
80012	Bad reply
80013	Access denied
80014	Exception
80015	Overload
80016	Unknown error
80017	No more features
80018	No more enums