IPF ELECTRONIC

Technical Documentation
opti-check

Content

1 Welcome

Welcome to this Help Guide.

Please read these operating instructions carefully and observe the safety instructions!

Target group:

These operating instructions are intended for users that want to perform feature checks with the Vision Sensor.

2 Imprint

ipf electronic gmbh

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Revisions in the course of technical progress and possible errors reserved.

3 Safety instructions

Explanations of safety instructions

NOTE

Gives helpful notes on operation or other general recommendations.

ATTENTION!

Indicates a possibly dangerous situation. If this is not avoided,
slight or minor injury could result or the device may be damaged.

WARNING!

Indicates an immediate imminent danger. If this is not avoided, death or serious injury may occur.

General notes / Safety instructions for the Vision Sensor

NOTE

There is a scratch-resistant foil on the glass cover of the tube for devices with interchangeable lenses. Remove the foil before carrying out inspection tasks.

NOTE

For UL-compliant installations, the cables used must meet the following requirements:

- Shielding for optimum interference immunity
- IP67 protection
- UL approval
- Dielectric strength in line with the operating voltages used
- Temperature resistance in the specified device temperature range
- Minimum cross-section of the cable in line with the max. output current

NOTE

Networking problems can occur for a number of different reasons, such as power saving modes on portable computers, defective cables or other defective components, or incorrect settings on the PC. Should an error occur, contact a technician to locate the source of the problem.

NOTE

Characters allowed in file names and job names:

0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz
ÀÁÂÃÄÅÈÉÊËÌÍÎÏ
àáâãäåèéêëìíîï
ĐÑÒÓÔÕÖÙÚÛÜÝß
ðñòóôõöùúûüýÿÇ,
¦!#$%&'+-÷×±,.
¡@_`()[]{}«»~

ATTENTION!

Connection, installation and initial set-up may only be carried out by specialized personnel.
Protect optical areas from moisture and dirt.

ATTENTION!

The IP protection class is only valid if **all** connectors are connected as described in the technical documentation.

ATTENTION!

Disconnection of power to the device during booting can result in damaged files.

Never disconnect the power supply during booting. Booting is finished when intermittent blinking of the PASS / FAIL – LED or blinking of the POWER LED has stopped.

ATTENTION!

The device may become very warm during operation. High temperatures may damage the device. Ensure that any heat generated is dispersed by installing it with the rear to a good heat conductor (aluminium). The housing temperature must not exceed 50°C.

Direct mounting on a solid metal (aluminium) object without using a retaining bracket is required when operated in the limit zone (e.g. full load on the flash controller and utilisation of the maximum operating temperature)!

For devices with integrated Industrial Ethernet only:

These devices are equipped with an internal temperature monitor for built-in protection.

There may be a warning message or emergency shutdown if the device is operated outside its specified range.

ATTENTION!

Incorrect supply voltage will destroy the device!

Pin 1: Power (⎓ 24 V ± 25 %)
Pin 2: Ground

ATTENTION!

The device can become damaged by strong radiation or electrical fields.
For this reason, never place the device near strong radiation sources or strong electrical fields. These can occur in close proximity to lasers, for example.

ATTENTION!

The Vision Sensor is a class A device (DIN EN 55022:2011). It can cause radio interference in residential environments. Should this happen, you must take reasonable measures to eliminate the interference.

WARNING!

The device emits bright, pulsed light (Risk group 1, low risk, EN 62471:2008).
Bright, pulsed light can cause damage to the eyes and seizures.
Never look directly into the pulsed light from the LEDs!

NOTE

For devices with infra-red illumination

The devices use LED illumination of the risk group RG 0 (exempt group, no risk) as per IEC/EN 62471.

The radiation of the LEDs does not pose a hazard to the human eye if the devices are used for their intended purpose.

Even so, do not look directly into the light source – there is a danger of dazzle and irritation. Mount the devices so that it is not possible to look directly into the light source.

4 Correct Use

Depending on the device, the Vision Sensors in combination with the Application Suite software are used to monitor and verify:

- Completeness
- Presence
- Position
- Correct position
- Barcode and matrix code
- Numbers and characters
- Colour features

e.g. for objects passing the Vision Sensor on conveyor belts.

The vision sensors have a compact, industrial-grade housing and are designed exclusively for indoor use. Use in wet areas is permissible under consideration of the IP protection class.

You can find an overview as to which Vision Sensors check which features under: *Technical Data (Overview of feature checks).*

NOTE

The colour devices are suitable for tasks such as sorting objects by colour. They are not suitable for measuring colours or determining colour deviations (ΔE).

NOTE

These devices are not suitable for use in the food sector as per EN 1672-2.

ATTENTION!

Only use the devices for its intended purpose! The guarantee becomes void in the case of any application not described in the technical documentation!

If the equipment or device is used in a manner not specified by the manufacturer, the protection provided by the equipment or device may be affected.

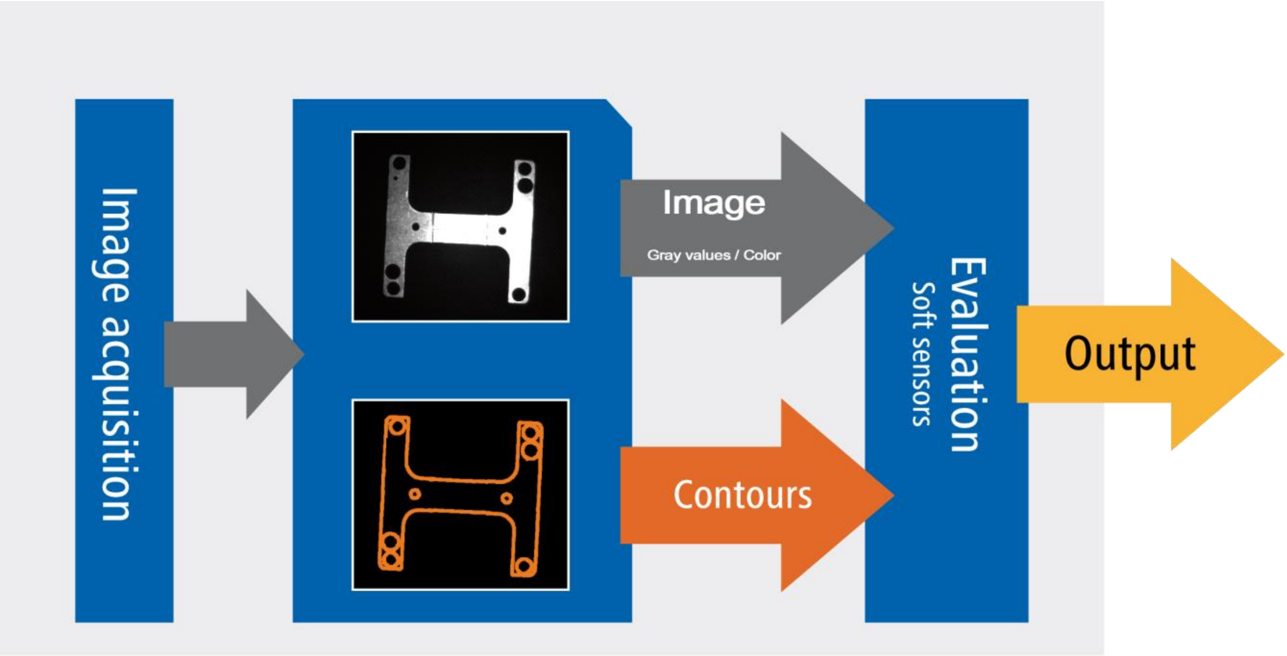
The device may only be connected to in-factory Ethernet networks and not be exposed to Telecom Network Voltages (TNVs).

5 Mode of operation

In contrast with conventional photoelectric sensors, this sensor operates with digital images and is capable of conducting several feature checks with parameters set by the software.

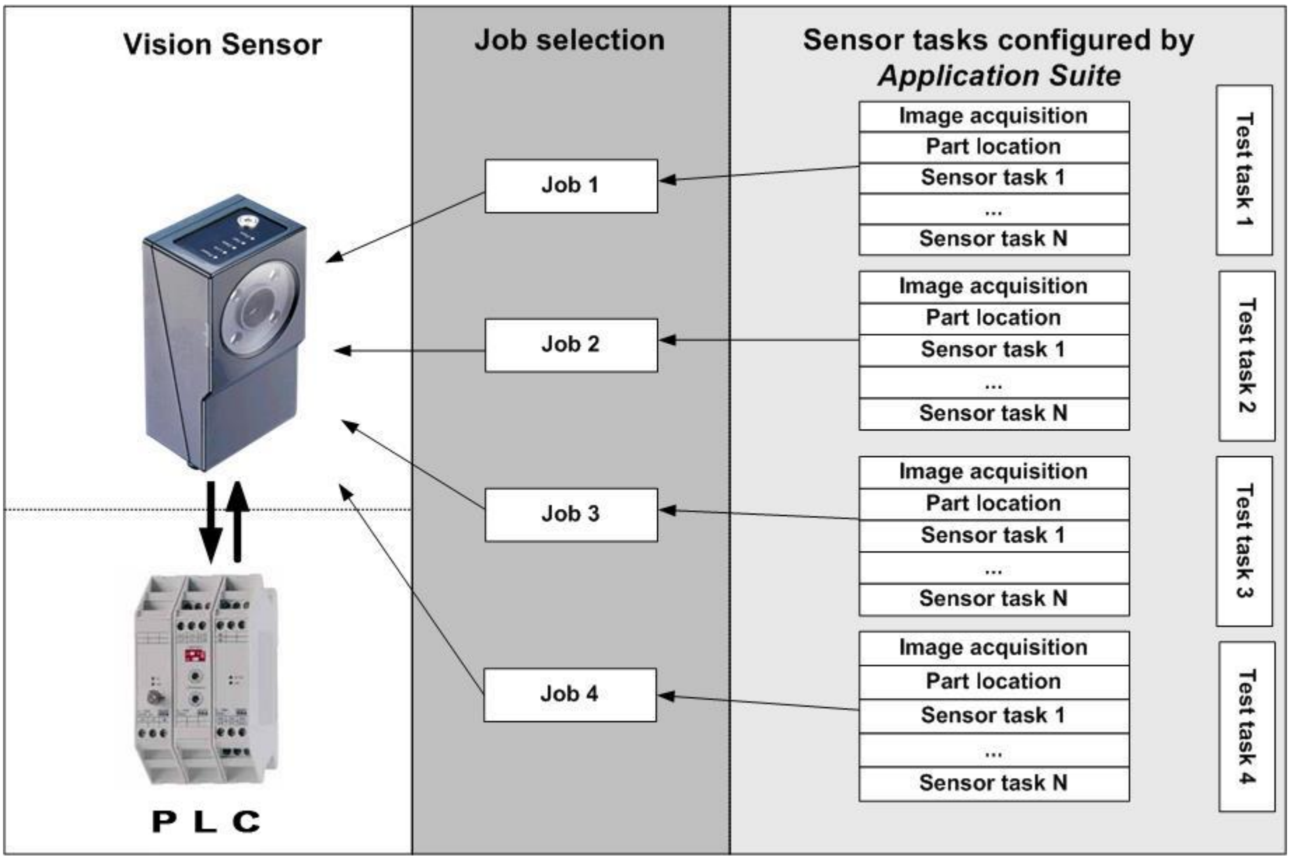
The strength of the device lies in the detection of contours. With the procedure, differences in brightness can be optimally tolerated, as contours are usually independent of the absolute brightness (e.g. variations in illumination).
Because a test object can normally be definitively described by its relevant contours, the device provides powerful tools to check their presence, position, completeness or colour. The high quality of the method ensures that a reliable result is always achieved even with a rapid sequence of objects.

The diagram shows the schematic mode of operation with the corresponding parts of the sensor.



Here, each inspection task ("*job*") is divided into several *feature checks*. Each feature check executes one task and returns an associated pass/fail result or the associated measured values. For this purpose, a field of view must be defined that is either circular, an arc, rectangular or polygonal. The contours can be given via search arrows for geometrical feature checks.

Then you can link the results from the feature checks into one result and output it via a digital interface. With the device, the stored jobs can be selected via external switching inputs.



The device operates in two operating modes:

- *Activated*
- *Configuration*

In *activated* mode, the inspection task is conducted. The device operates autonomously in this mode and can communicate directly with a PLC. The device receives all commands such as trigger or job number from the external control system and mainly returns a pass or fail result. In activated mode you can also use the *Application Suite* to monitor your inspection tasks.

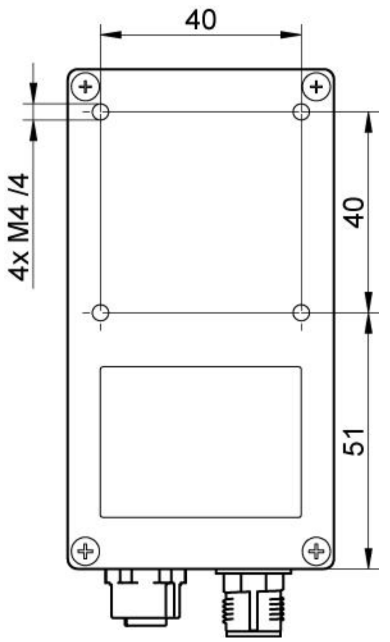
In the *Configuration mode* you can configure and set the parameters for the jobs and features to be checked. This is conducted using the *Application Suite*.
Because a high-quality digital image provides many means of visual inspection, the parameters of the jobs have to be set according to the inspection task and the application. For this purpose, the *Application Suite* provides a pre-configured input mask for each feature to be checked, which supports the determination of the optimum settings.

6 Installation and initial set-up

6.1 Mechanical set-up (image)

You can operate the device in any position.

Attach the device to the M4 screws provided for this purpose.



Align the device so that the image centre indicated below points directly at the object to be inspected.

The device should be installed so that it vibrates as little as possible during operation to avoid negative influences on the image quality (blurred images).

Install the device so that there are no obstacles between the sensor and the object that could block the view or cause reflections. Ensure that the device is protected as well as possible against dust.

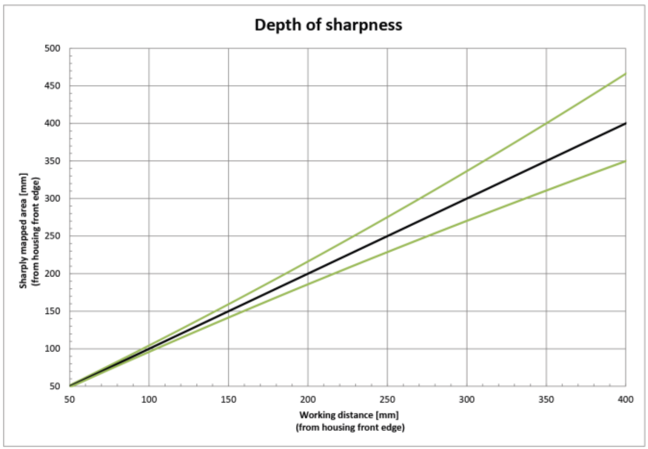
Devices and its built-in lens can inspect fixed areas at fixed distances.

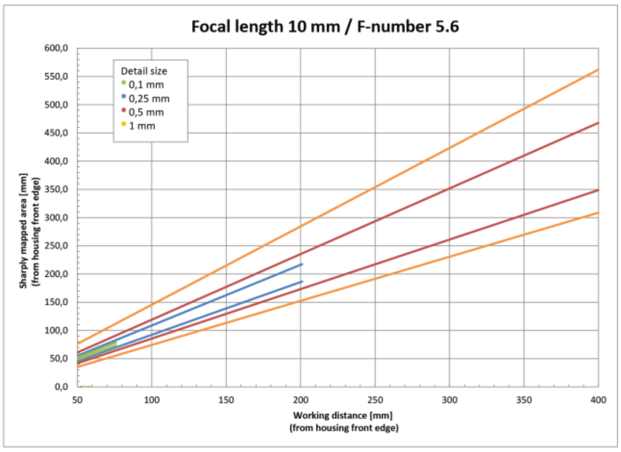
NOTE

The field of view and minimum module size for devices with interchangeable lenses depends on the lens installed.

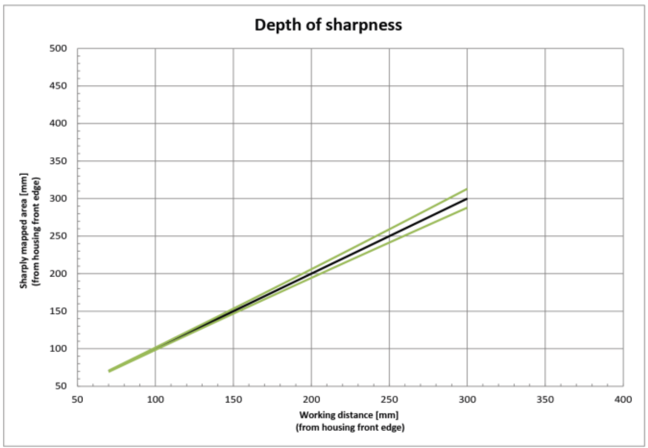
Obtain the depth of field and the area in focus from the following diagrams:

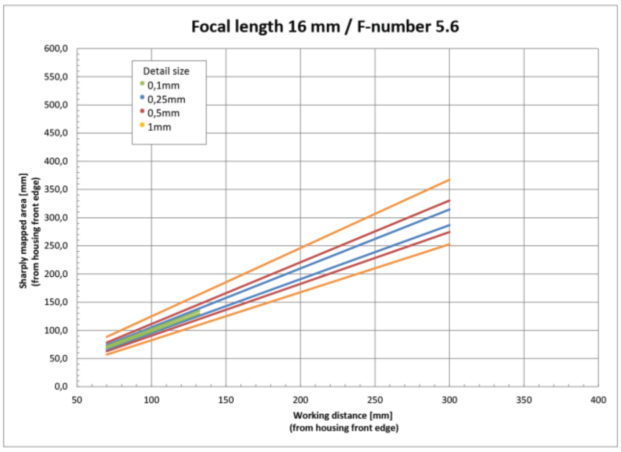
Devices without Industrial Ethernet / focal distance 10 mm / aperture 5.6



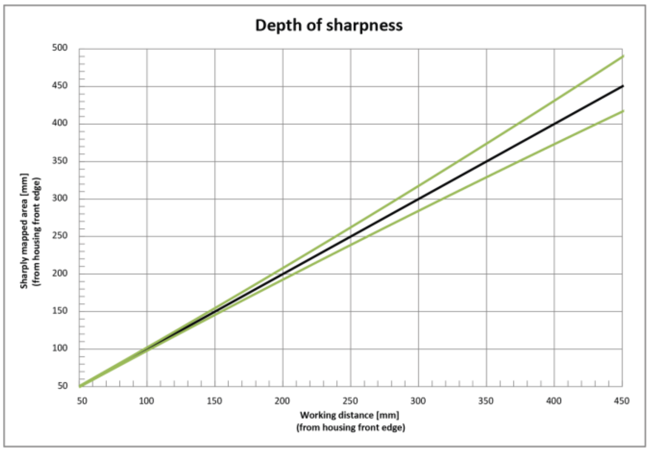


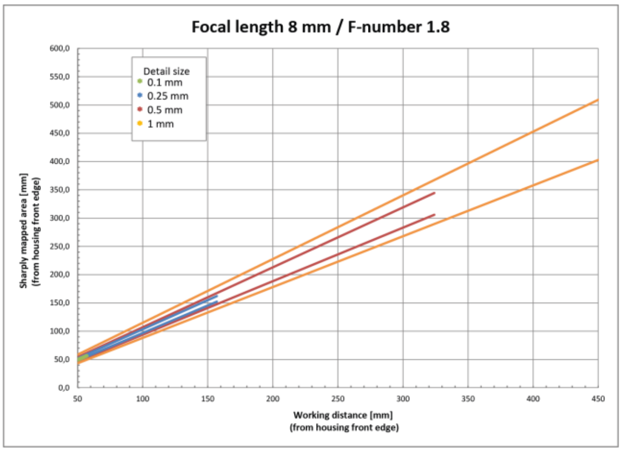
Devices without Industrial Ethernet / focal distance 16 mm / aperture 5.6



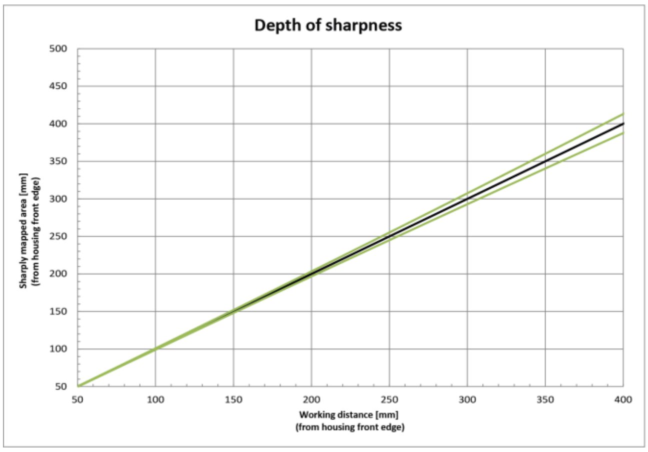


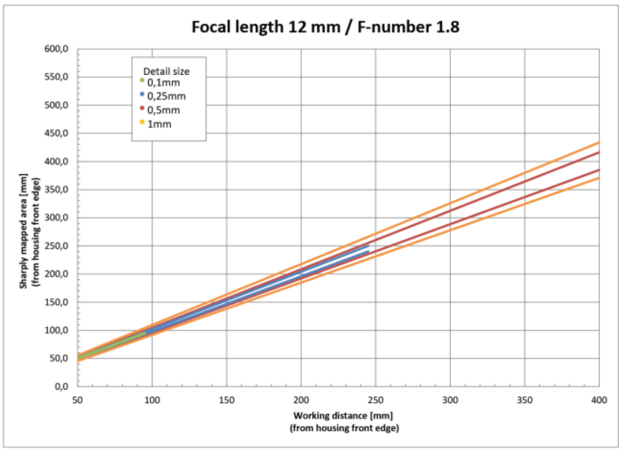
Devices with Industrial Ethernet / focal distance 8 mm / aperture 1.8



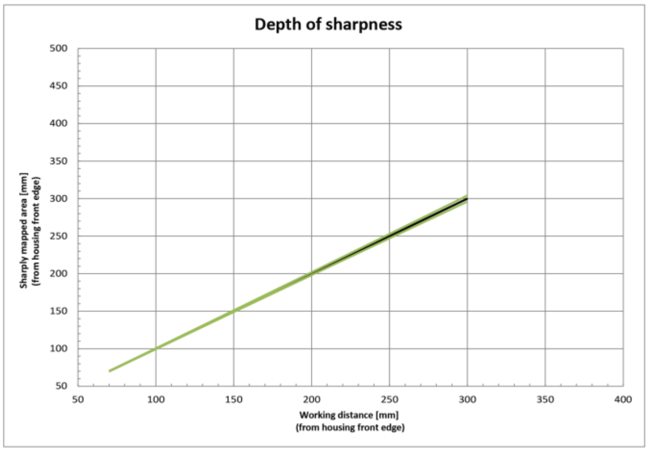


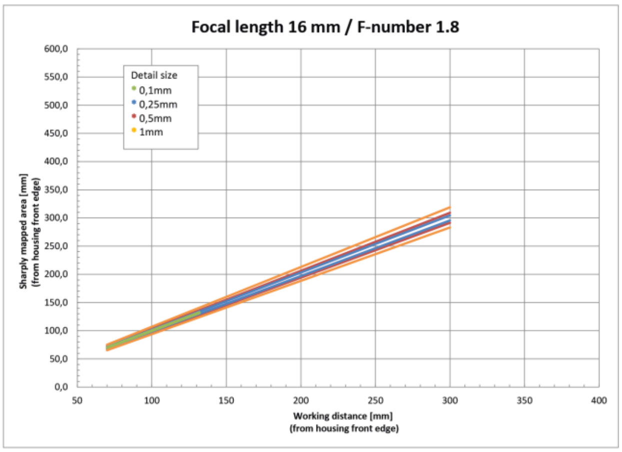
Devices with Industrial Ethernet / focal distance 12 mm / aperture 1.8





Devices with Industrial Ethernet / focal distance 16 mm / aperture 1.8





6.2 Mechanical set-up (heat dissipation)

ATTENTION!

The device may become very warm during operation. High temperatures may damage the device. It is vital to ensure that heat is dissipated by appropriate assembly. The housing temperature must not exceed 50°C at the temperature measuring point.

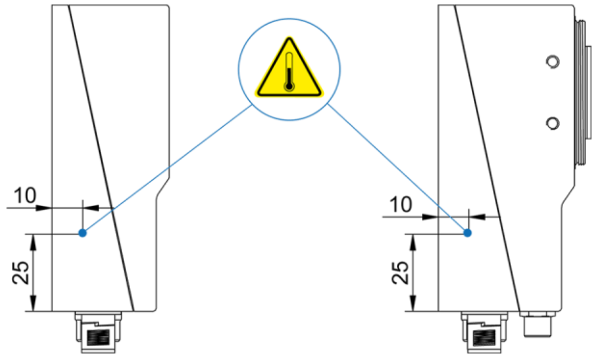
Direct mounting on a solid metal (aluminium) object without using a retaining bracket is required when operated in the limit zone (e.g. full load on the flash controller and utilisation of the maximum operating temperature)!

If there is a protective foil on the back of the vision sensor, it must be removed during the final integration into the machine at the latest so that there is sufficient heat transfer to the metallic connection!

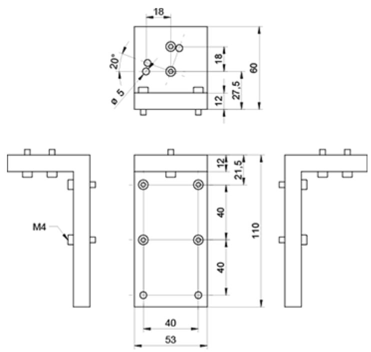
The following are our recommendations for installation of the device to dissipate heat:

- Install the mounting bracket across the full surface of the device and also across the full surface onto heat conductive material on the system (aluminium profile 60 mm x 60 mm). In the case of devices with integrated Industrial Ethernet, the offered mounting bracket should consist of 12 mm thick aluminium; or a rear bracket at least comparable in rear attachment and heat dissipation capacity should be used.
- Avoid mounting onto stainless steel. Stainless steel has a roughly 10-fold lower thermal conductivity compared to aluminium.
- Do not install the device at the end of a profile; this will allow heat to dissipate on both sides (higher temperature drops over a larger area)!
- Matt coated surfaces (irrespective of colour) and anodised surfaces dissipate heat better than bare metal surfaces (heat radiation). Use coated or anodised profiles for installing the device.
- Every form of convection around the device and mounting helps reduce temperature. Prevent heat from becoming trapped!
- Do not operate other devices in close proximity to the Vision Sensor. Their waste heat could additionally heat the Vision Sensor.

Temperature measurement point



Mounting bracket (aluminium)



6.3 IP protection classes

The devices continue working in an industrial environment to meet the requirements of various protection classes.

IP protection classes

IP 67 (all devices)	Sealed against dust, protection against short-term submersion

ATTENTION!

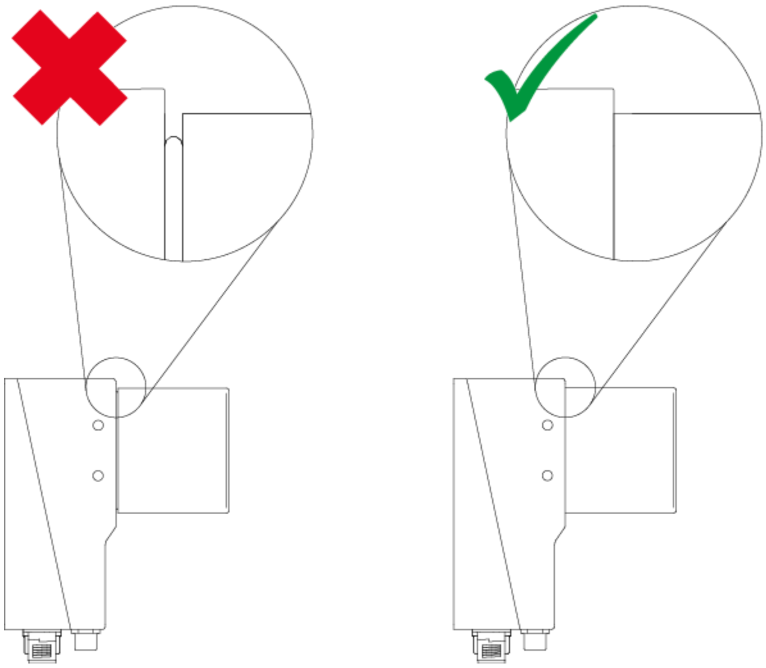
The respective IP protection class is only valid if **all** connectors are connected as described in the technical documentation.

A protective cap must be installed on unused electrical screw connections. The use of the following protective caps is recommended:

- Connector M8 Cover IP67, Phoenix Contact, PROT-M8, order no.: 1682540
- Ethernet connector M12 Cover IP67, Franz Binder GmbH & Co., order no.: 08 2769 000 000

The electrical hose connections on the device must be tightened with a torque of 0.4 Nm.

The tube on devices with replaceable lens must be screwed without a gap as depicted in the figure below in order to achieve the stated protection class.



6.4 Electrical installation

For initial set-up, you will require:

- the Vision Sensor,
- die *Application Suite* (Download unter: www.ipf-electronic.de Produkte / Kamerasensoren / Typ / Downloads)
- a M12-connecting cable (not supplied)
- an Ethernet cable (not supplied)
- a normal PC with Ethernet interface (not supplied).

NOTE

For optimum electrical noise immunity, the use of shielded cables is recommended. The appropriate cables can be obtained from the manufacturer.

ATTENTION!

The IP protection class is only valid if all connectors are connected as described in the technical documentation.

ATTENTION!

When connecting the power, ensure that all cables are connected correctly according to their colour codes!

You will find the voltages necessary, the pin assignment and the corresponding electrical power under *Technical Data*.

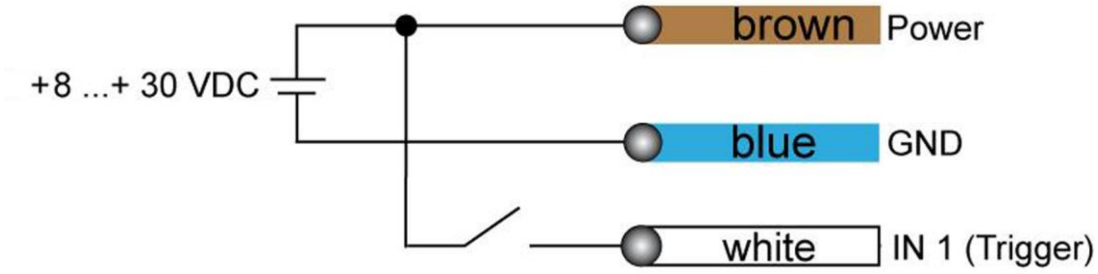
Screw the 12-pin power cable with M12 plug onto the power supply connection on the device.

NOTE

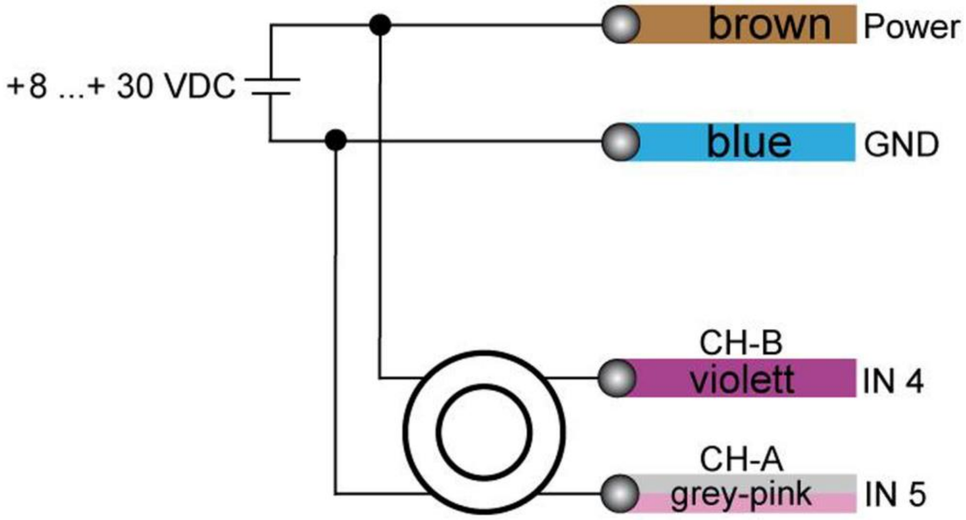
After installing the software, you can check the correct assignment of the digital connections in the menu: *Device → Digital I/O-Assistant.*

6.5 Wiring

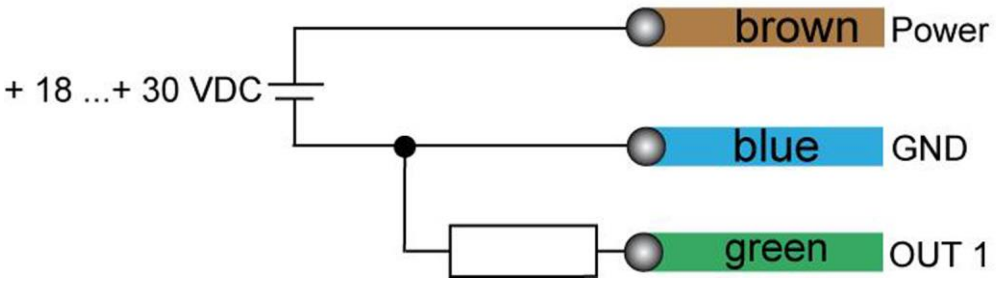
Input



Encoder



Output



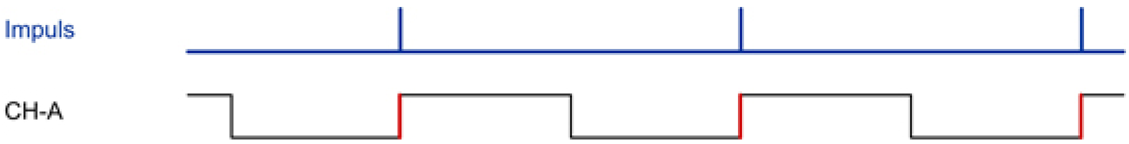
6.5.1 Notes on using an incremental encoder

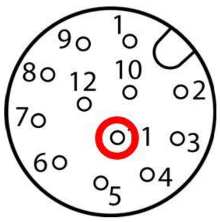
You have two options for operating the device with an encoder:

> **NOTE**
>
> After installation, the inputs must be defined in the software using:
>
> *Device → Device settings → Digital I/Os / Inputs* tab
>
> .

- **1-channel operation (CH-A)** In this mode, every **rising edge** of the signal corresponds to one pulse for the timing control of the device.
  It is not possible to detect the travel direction of the belt.

  The maximum frequency of 500 kHz should not be exceeded for reliable operation.



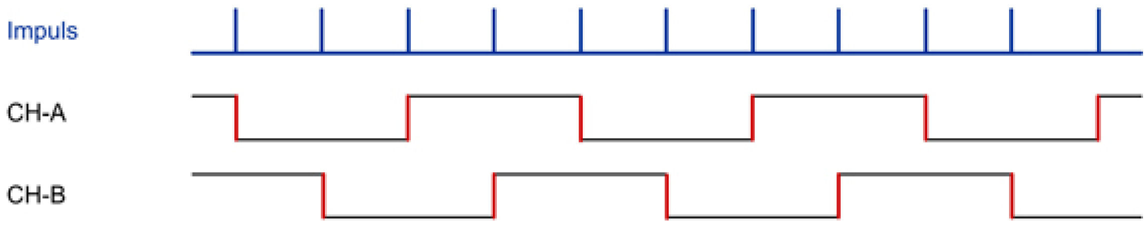


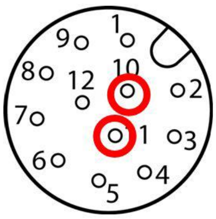
Pin assignment of the power cable

Connect the encoder CH-A to pin 11 (IN 5; grey-pink).

- **2-channel operation (CH-A and CH-B)** In this mode, every **rising and falling edge** of the signal corresponds to one pulse for the timing control of the device. The signals must alternate for the CH-A and CH-B channels.
  It is possible to detect the travel direction of the belt.

  The maximum frequency of 500 kHz/channel should not be exceeded for reliable operation.





Pin assignment of the power cable

Connect the encoder CH-A to pin 11 (IN 5; grey-pink).

Connect the encoder CH-B to pin 10 (IN 4; violet).

6.6 Software installation

The following is a list of system requirements necessary for a proper operation of the *Application Suite*:

- **Operating system:** Microsoft® Windows® Vista (32 bit / 64 bit), Microsoft® Windows® 7 (32 bit / 64 bit), Microsoft® Windows® 8 (32 bit / 64 bit), Microsoft® Windows® 10 (32 bit / 64 bit)
- **Processor**: min. 500 MHz, 2 GHz recommended
- **Memory:** min. 512 MB RAM, > 1 GB recommended
- **Hard disk:** min. 150 MB of free disk space; including examples, about 400 MB
- **Display:** Resolution min. 1024 x 768 pixel, true colour recommended
- **Network:** Network connection for 10 Base-T / 100 Base-TX or faster

NOTE

Please note that you will require administrator rights to install the *Application Suite* and device drivers; alternatively, you can use the version which does not require installation.

Connect the device to the Ethernet interface of your computer or connect the device and your computer in a common network:

1. Download the *Application Suite* (download at: www.ipf-electronic.de Products / camera sensors / Type / Downloads)

2. Unzip the downloaded file.

3. Start the set-up program and follow the installation instructions.
   →A link will be created on your desktop.

4. Double-click the generated link to start the *Application Suite*.
   

5. Check the *network settings* to connect to the device.

When the device has been correctly connected and the software is successfully installed, the Vision Sensor can be commissioned using the software.

NOTE

You can launch the Application Suite using a command line parameter and automatically connect to the device via an IP address.

Example: `appsuite2.exe /ip=192.168.0.250` (default IP adresse)

There is also the option to launch the *Application Suite* in different languages using a command line parameter.

/l=de (German)
/l=en (English)
/l=fr (French)
/l=es (Spanish)
/l=zh (Chinese)
/l=ja (Japanese)
/l=ko (Korean)
/l=it (Italian)
/l=th (Thai)

Example: appsuite2.exe /ip=192.168.0.250 /l=en
(Start the *Application Suite* in English with the default IP address)

6.7 Initial set-up of the Ethernet interface on your computer

1. Assigning an IP address
To use the device in your network, you must assign a unique IP address to the device. Below is the default factory configuration:

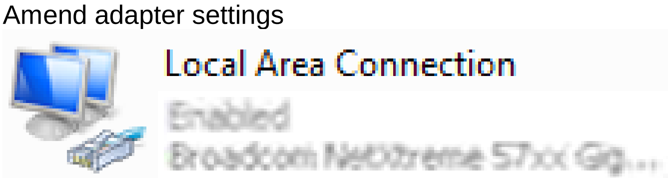
1. If you have a DHCP server integrated into your network, the IP address is requested from this server. No additional manual actions are necessary on your part.

2. If a valid IP address cannot be obtained within 15 seconds, the default IP address of **`192.168.0.250`** (subnet mask: `255.255.255.0`) is used.

> **NOTE**
>
> To avoid network malfunctions, ensure that each IP address is unique within your network and has not already been assigned!

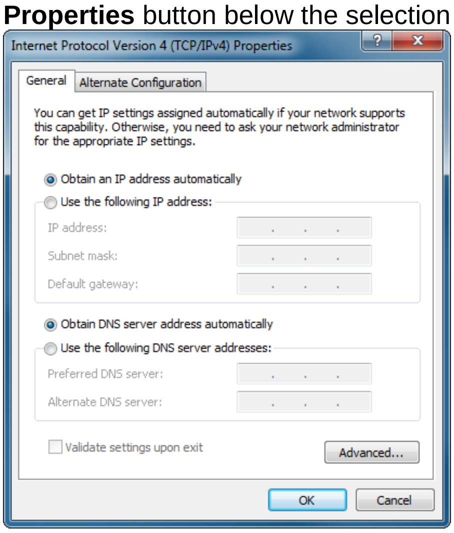
Now, link your PC into the same network as the device. Under certain circumstances, you may need to configure the IP address of your PC for this purpose. With Microsoft® Windows® 7, proceed as follows:

1. Open: Start menu → System controller → Network and Internet (display network status and tasks) → Amend adapter settings



2. Select your network (e.g., "Local Area Connection") and then the "Properties" entry in the context menu.

3. Select the "Internet protocol version 4 (TCP/IPv4)" entry in the list of elements and then click the **Properties** button below the selection list. The following dialogue box opens:



Activate the **Use the following IP address** option and select an address in the range `192.168.0.xxx` that has not yet been used for the IP address. Enter `255.255.255.0` for the subnet mask and confirm these settings.

NOTE

For device communication via Ethernet, the following ports are used:

▪ *Application Suite:*	51972 (default setting, programmable)
▪ Web interface:	80 („HTTP")
▪ Process interface:	23 (default setting, programmable)
▪ Cockpit:	8080
▪ FTP:	21 (default setting, programmable)
▪ SFTP:	22 (default setting, programmable)

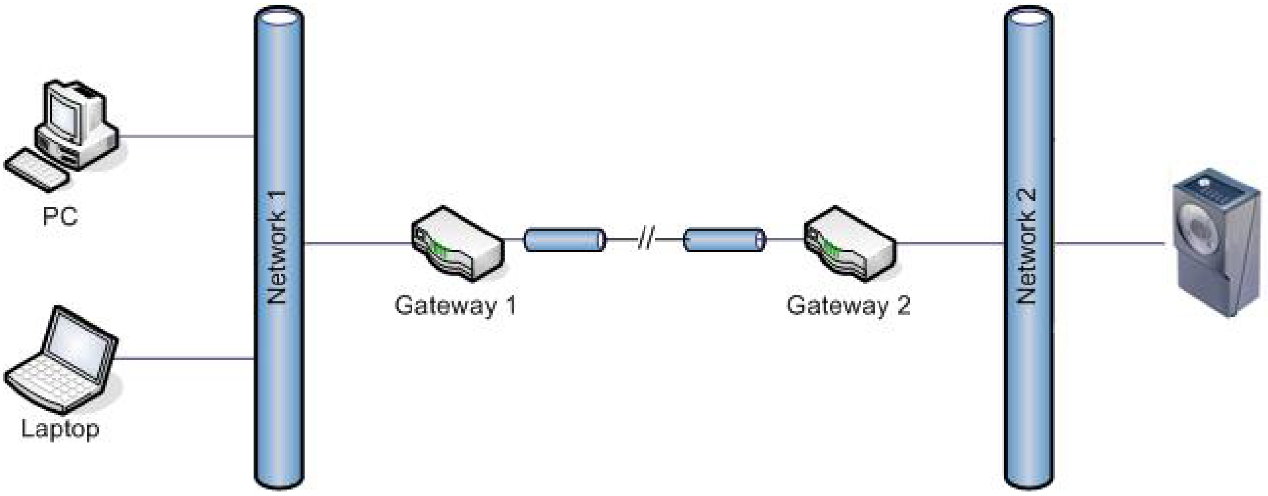
These ports must not be occupied by other programs or used for communication by the process interface!

Check that these ports are enabled in your firewall! You can find details on this topic in the firewall manufacturer's documentation.

6.8 Notes on using gateways in a network

With this device, it is possible to establish a connection and to configure the device by way of a gateway.

> **NOTE**
>
> The public IP address of the device must be known in order to communicate across gateway boundaries. Automatic detection of the device is only possible in the local network.
>
> To establish the connection, use the options in the selection list of available devices.



To do this, set your PC and the *device* as follows:

- **PC:** The gateway of the PC's local network (Gateway 1) must be set in the configuration of the network adapter.
- ***Device:*** The gateway of the device's local network (Gateway 2) must be set in the network configuration.

The following items must be kept in mind when an address conversion using NAT (Network Address Translation) is being used for at least one of the gateways:

- To connect the device using the *Application Suite*, you must specify the public address and port number of the **gateway** to which the device is connected (Gateway 2).
- A separate port for communications must be used in the device settings.
  You can find this setting under *Device → Device settings → IP address / Network*. Change the **Port** setting from *Standard* to the *desired port number*.
- Keep in mind that changes to the network settings of the device are only valid in the local network. If necessary, make sure that the NAT settings of the gateway are also configured to make communication possible.

6.9 Important network terms

Term	Meaning
ActiveX	Software technology from Microsoft® to extend programs with additional functions.
DHCP	(*Dynamic Host Configuration Protocol)* Protocol for automatic assignment of the IP addresses.
Ethernet	Wired data network technology for local data networks.
Firewall	Software that checks and prevents access via the network.
HTML	*(Hypertext Markup Language)* Document language describing the formatting of text and graphics.
IP address	"Mailing address" of a device in a network
JavaScript	Programming language for websites allowing, among other features, dynamic actions within websites.
MAC address	*(Media Access Control)* 6-byte address, hardware identification number for network devices unique throughout the world.
Ping	Program for determining whether a computer is available in a network.
Port	(Additional) address of data packets in a network Describes the Internet services used, e.g., 21 – FTP, 25 – e-mail, 80 – websites (HTTP).
TCP	*(Transmission Control Protocol)* Reliable protocol for data transfer All data packets are transferred in the proper sequence
UDP	*(User Datagram Protocol)* Faster but less reliable protocol for data transfer. Under certain circumstances, data packets may be lost or received in a different sequence
Domain name	arbitrary address that you enter into the address line of a browser in place of the IP.

6.10 LED panel (device dependant)

A screw and 5 LEDs are located on the Vision Sensor for displaying the various states.

Image focus setting screw: Used to set the image focus.

NOTE

For devices with interchangeable lenses, the image focus is set on the installed lens.

LED	Meaning
POWER	Indicates that the Vision Sensor is being supplied with electricity.
LINK	Indicates that the Vision Sensor is connected to a network.
DATA	Indicates that data is being transferred.
FAIL	Lights up when a feature check has been failed.
PASS	Lights up when a feature check has been passed.

NOTE

Pass/Fail flash quickly and alternately: Vision Sensor starts

Pass/Fail flash simultaneously: Vision Sensor is in Recovery mode

6.11 LED panel (devices with integrated Industrial Ethernet)

A screw and 5 LEDs are located on the Vision Sensor for displaying the various states.

Image focus setting screw: Used to set the image focus.

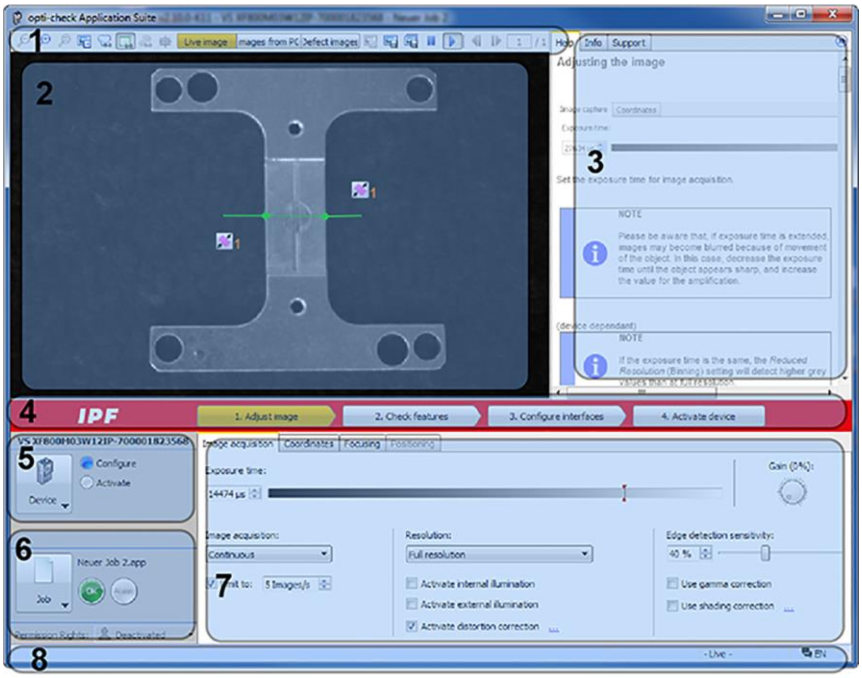
> **NOTE**
>
> For devices with interchangeable lenses, the image focus is set on the installed lens.

LED	Meaning
POWER	Indicates that the Vision Sensor is being supplied with electricity.
LINK / ACT	Indicates that the Vision Sensor is connected to a network. • On: Network connection established • Blinking: Data traffic active
NET RUN	Indicates that data is being transferred via Industrial Ethernet. • Off: Industrial Ethernet will not be used • Long blinking: Waiting for the first cyclical connection • On: Cyclical connection active • Short blinking: Cyclical connection ended (waiting for next connection) • 3 seconds of regular blinking: Device identification in the system
FAIL	Lights up when a feature check has been failed.
PASS	Lights up when a feature check has been passed.

> **NOTE**
>
> **POWER blinking:** Vision Sensor starts
>
> **Pass/Fail flash simultaneously:** Vision Sensor is in Recovery mode

7 Overview of the Application Suite

The *Application Suite* is used for the initial set-up, job creation, configuration, service and maintenance of the device. You can monitor the progress of the job in the *Activated* mode.



1 Image display options

2 Display screen

3 Help, info and support window

4 Job bar

5 Device menu / Operating mode display

6 Job menu / Result and user display

7 Parametrization area

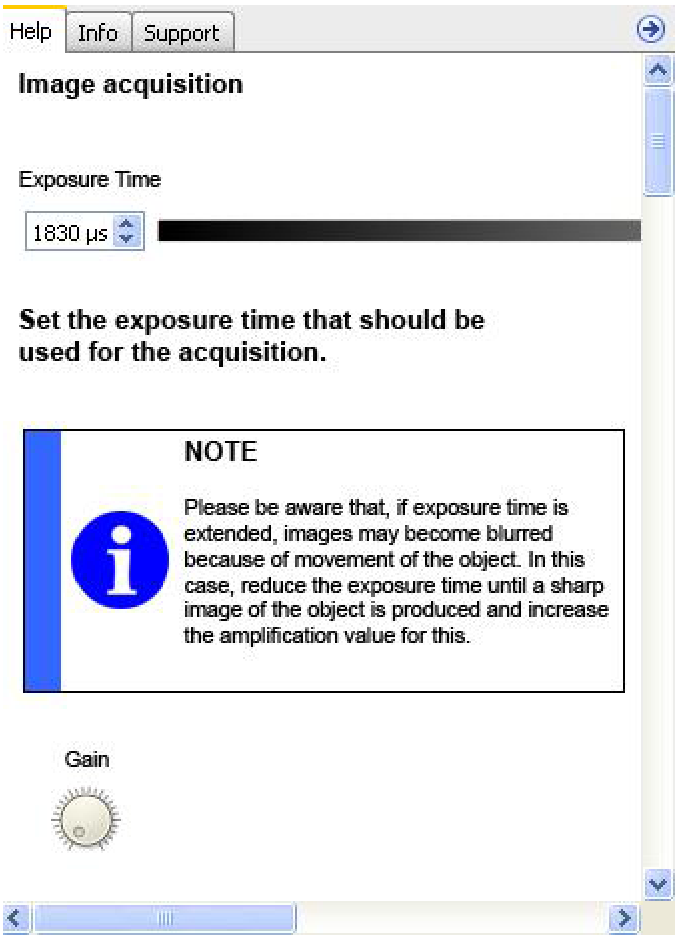
8 Status bar

7.1 Operating modes of the device

The device has two operating modes which differ mainly in the allocation of the priorities:

	Mode	Priority	Job processing	I/Os
1	***Activated***	Trigger (Image transfer only when permitted by the processing time)	on the Vision Sensor	active
2	***Configuration***	Image transfer (trigger is ignored if necessary)	to the computer	inactive

7.2 Help, Info, Support and Notifications

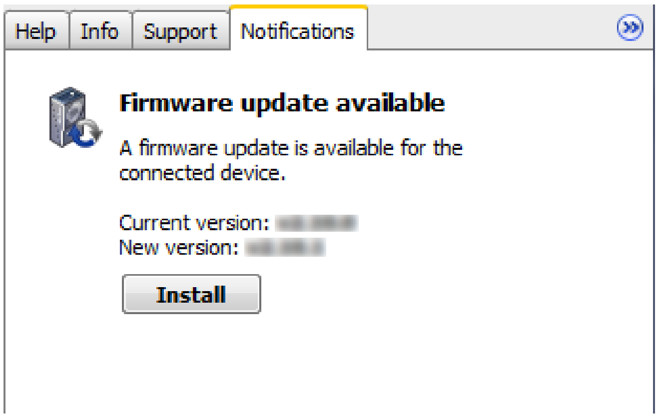


On the *Help* tab, there is a corresponding online help page for each dialogue.

The *Info* tab displays information about the system.

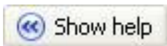
The image is an example and does not correspond to the current version of the software!

On the Support tab, there is a form for online support. You can attach images, jobs or log files to your support request.



The *Notifications* tab notifies you, for example, when more up-to-date firmware is available than is installed on the device, when additional language packs can be installed, or when the daylight saving time changes.

With this button you have the option to hide the help.



With this button, you can show the hidden Help again.

NOTE

To improve clarity, the Help window is shown lightly greyed out when the mouse pointer is not over it.

8 Image display options

The following display options are available:

You can zoom into or out of the displayed image using the magnifier and adjust the image to fit the window.

If the image has been enlarged and can no longer be seen as a whole, you can select another clip by moving the area marked in red. The overview is only displayed if the entire image is not visible.

These buttons can be used to switch on and off:

the clockwise rotation of the image by 90° (angle of rotation is displayed in the status bar)

the contour points display

the field of view display

the model display

and the cross-hair display.

Click on this button to display the current Vision Sensor image.

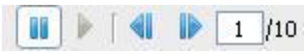
8.1 Images from PC

Here you can load images for evaluation that you have saved previously from your computer. Click on *Images from PC.*

Click on the green tick to hide the selection.

Click on Browse to select the directory that contains the images.

Choose the directory where the images are located and click *OK*.

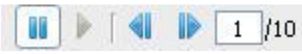


You can view the images that you have loaded here.

8.2 Defect images

The device can store up to 32 defect images in *Activated* mode, depending on the device model. The last defect images to occur are stored.

Click on defect images to load the fault images.



You can see the last fault images to occur.

Use this button to save the single exposure currently being displayed to your PC.

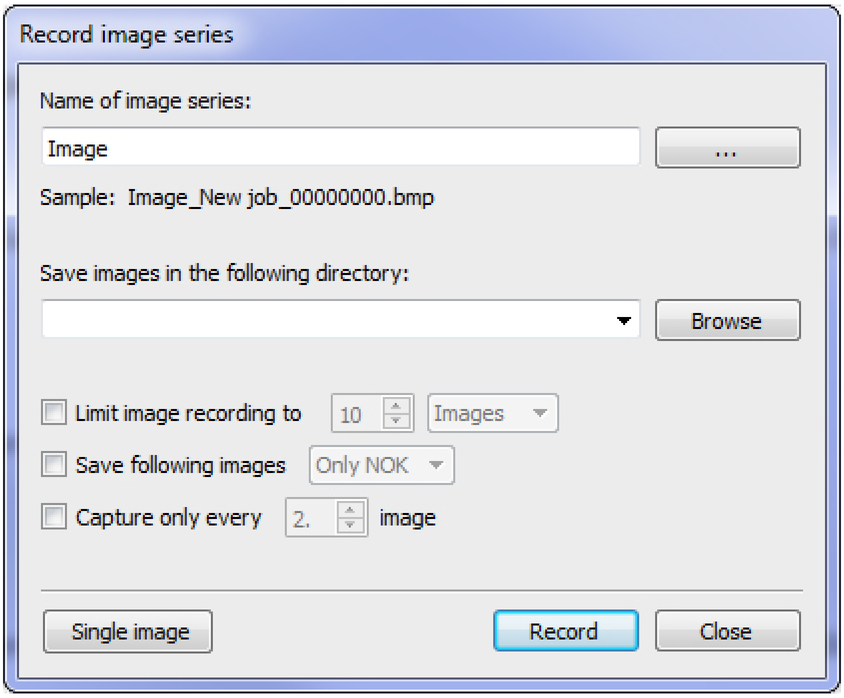
Use this button to save all defect images to your PC.

8.3 Loading, saving and recording images

Use this button to load images saved on your computer for further processing.

Use this button to save the image currently being displayed to your PC.

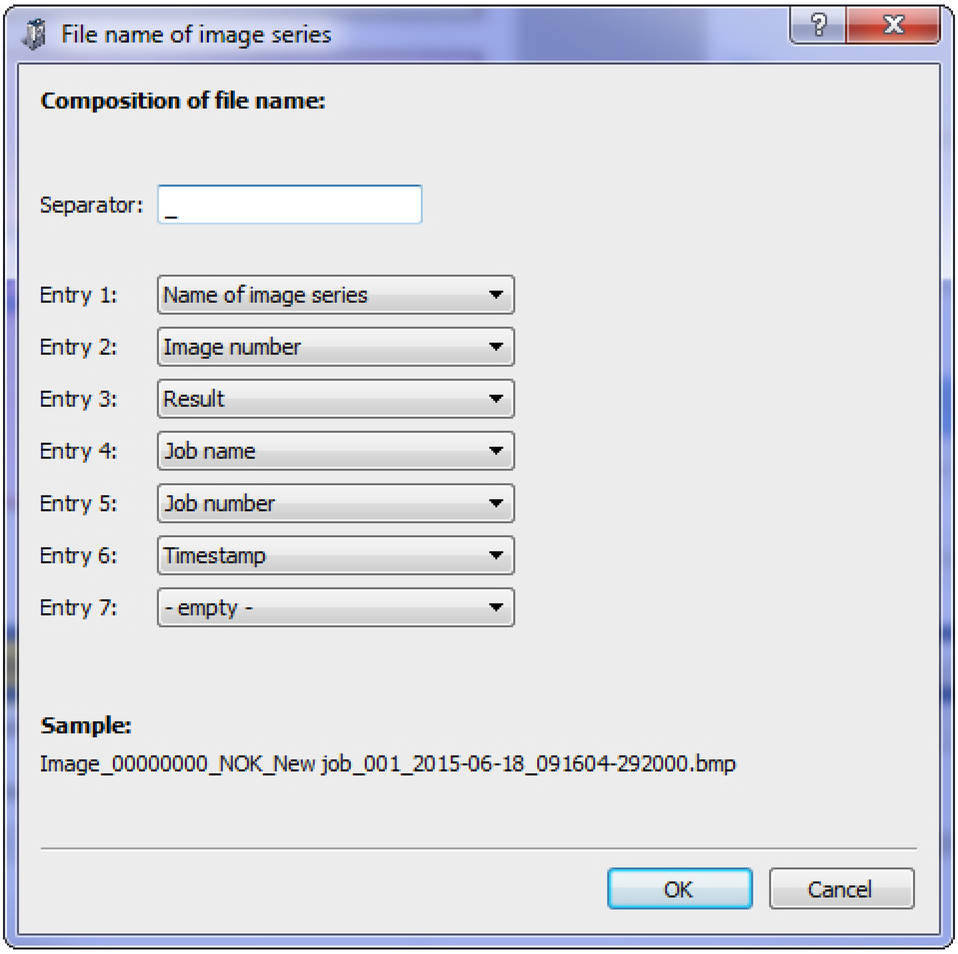
Use this button to record live images. The "*Record images*" dialogue box opens after clicking.



Make the settings required for the image series in this dialogue box.

Use the *Single image* button to save just one image in the selected directory. Use the *Acquisition* button to keep acquiring images until you click on *Stop* or have limited image acquisition.

You can configure the structure of the file name.



The file name configuration gives you the option to freely arrange up to seven entries. You can also define separation markers.

The entry options for the device are:

- The chosen name of the image series
- Sequential numbers generated by the system (00000001 – 99999999)
- The result of the analysis
- The job name
- The job number
- a time stamp (time is taken from the connected PC)

8.4 Job features

The *Application Suite* helps you to create, manage and test jobs and to configure them for operation.
Each inspection task is processed by the device in the course of a job. For each job required an image will be acquired in which you mark the features to be checked. A pass/fail result will then be determined.

The following individual steps are used to create a job:

1. **Adjusting the image:** Each inspection with the device is based on image data. The image quality depends on the internal camera settings, the illumination settings and lens adjustments. Here, you can set all parameters concerned with the primary image acquisition and its control.

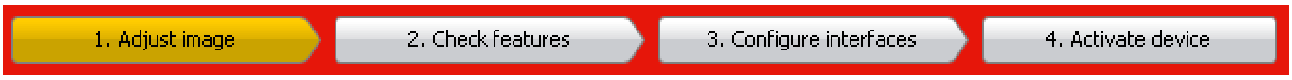
2. **Checking features:** Checking the features is the actual evaluation. Each feature check operates in a field of view, determines one or more values and compares the result with preset switching points. In a second step, you can link the results of the sensor tasks to produce a result.

3. **Configure interface I/Os:** This includes settings for digital outputs (output time and duration of output, among other settings) and configuration for datagrams of the process interface.

   You can also set which feature checks and their functions can be operated via the web interface. This information is saved separately for each job, while pin assignment for the digital I/Os is set in the device settings.

9 Creating a job

Jobs are created in three main steps, using the *Job bar.* The individual parameters can be set in this bar.



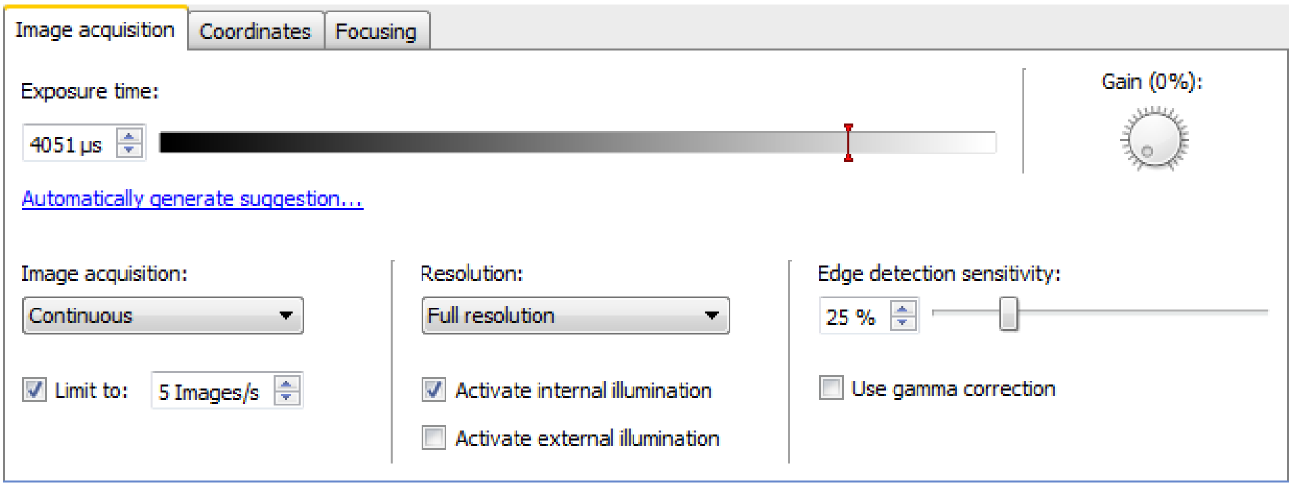
9.1 Adjusting the image (image focus)

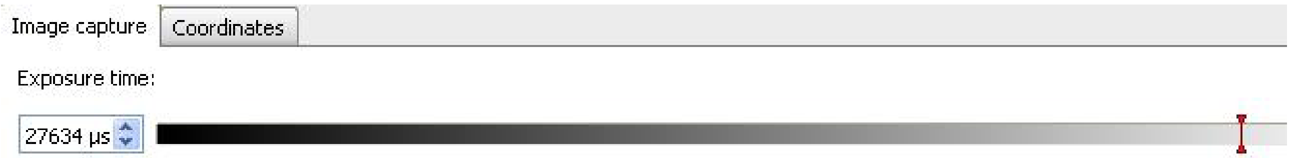
To implement reliable inspection with the Vision Sensor, the features to be inspected must be clearly visible.

Set the image focus directly on the Vision Sensor installed at the check location using an Allen key.

For devices with interchangeable lenses, the image focus is set on the installed lens.

9.1.1 Adjusting the image (additional parameters)





Set the exposure time for image acquisition.

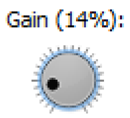
NOTE

Please be aware that, if exposure time is extended, images may become blurred because of movement of the object. In this case, decrease the exposure time until the object appears sharp, and increase the value for the amplification.

(device dependant)

NOTE

For technical reasons, if the exposure time is the same, the *Reduced Resolution* (Binning) setting will detect higher grey values than at full resolution.



The image can also be brightened using the control gain (Amplification).

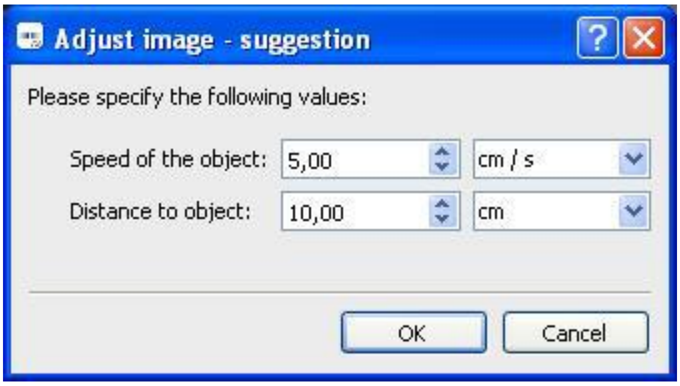
NOTE

Higher amplification values result in increased image graininess and make stable analysis more difficult. If sufficient image brightness is not achieved, use external illumination.

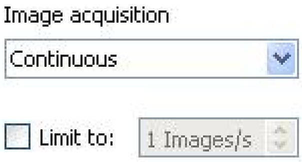
(device dependant)

Generating automatic suggestion...

Click on *Generating automatic suggestion...* to view a suggestion for illumination settings.



Enter the speed of the objects, and their distance from the camera, during inspection. The *Application Suite* automatically calculates the associated parameters. If the image is then still too dark or bright, you can adjust this using the control gain (*Amplification*).

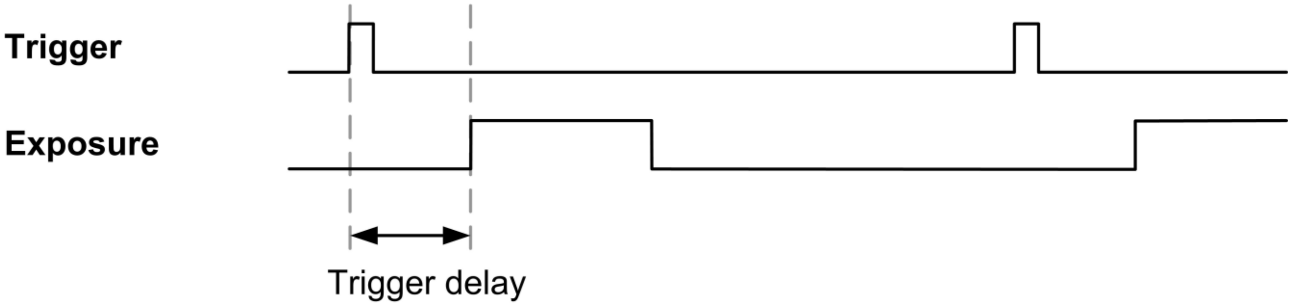


(device dependant)

> **NOTE**
>
> Depending on the form of construction, devices with CMOS sensors may experience brightness deviations during the first images taken after a longer break in image exposure and the associated variations in temperature.
>
> This is not an issue in Run mode (*Continuous*), since images are taken continuously.
>
> In Trigger mode (*External trigger*), however, the device only records an image after a trigger event.
>
> Longer breaks between triggers should be avoided to prevent brightness deviations.

Continuous: A new image acquisition is made as soon as an image analysis is complete. You can also limit the number of images depending on the exposure time.

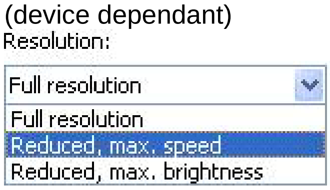
External trigger: A new image is acquired upon the occurrence of a corresponding external event.
If an encoder is connected, you can also specify the delay time or distance (ft = feet) between the trigger signal and the actual image acquisition. Any other trigger signals received during this period are ignored!
If necessary, activate the "invalid trigger" entry (trigger during image acquisition or job switching) in *Device settings*, so that the alarm output is activated in such cases.



(device dependant)

Click on *Configure external illumination…* to make the settings for a connected external illumination system or a flash controller.

(device dependant)

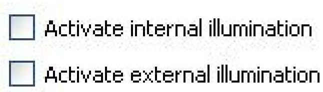


You can choose between two resolutions for the device, for the reduced resolution, additional profiles optimised for speed or brightness are available.

NOTE

The reduced setting will always detect 2 x 2 pixels and only one in four pixels will be read out. By using the "Reduced, max. speed" setting, the image acquisition time is reduced. By using the "Reduced, max. brightness" setting, a much brighter image can be acquired with the same length of exposure.

This is particularly useful with fast moving objects. Choose the mode in which the feature to be checked appears most clearly. Due to the smaller image size, image processing will generally be faster in both cases.



With the illumination settings, you can switch off the internal illumination and possibly activate external illumination with the *Flash sync output.* If you wish to use the external *Flash sync output,* this must be chosen accordingly in the *Digital I/O* menu. You can also activate both type of illumination.

The *Flash Sync Signal* is located parallel to the exposure time on the digital I/Os. The exception to this is the 4-pin connection on devices with interchangeable lenses. Here the signal is available at a maximum of 1 metre per second if the operating mode *Activate external flash controller* (max. 1 ms) is selected.

(device dependant)

This function enables a previously calibrated lens distortion correction to be activated or the configuration page to be opened.

> **NOTE**
>
> Only use contour recognition sensitivity when all of the other image settings have been performed successfully.

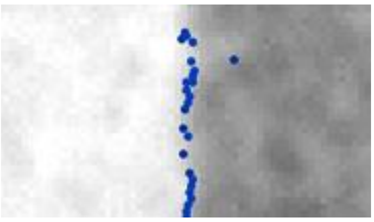
(device dependant)

To ensure consistent evaluation, all contours must be calculated consistently. This means that the image is sharply focused and no over biases occur.
For critical objects, it may be appropriate to adjust the sensitivity of edge detection manually. Set the Edge detection sensitivity to a value where the feature to be inspected is clearly recognizable.

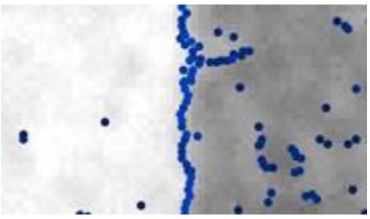
Make sure that the contours of the test object are consistently obtained and that not too many "pseudo-contours" are created.

You can make the contours visible using the following button from the image display options:

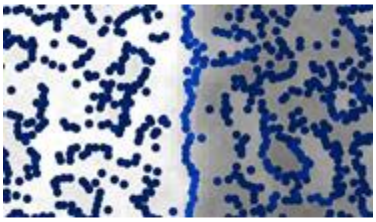
Example images of contours



Too few contours
(contour recognition sensitivity must be decreased)



Good contours
(optimum contour recognition sensitivity)



Too many contours
(contour recognition sensitivity must be increased)

> **NOTE**
>
> Error message: "Too much contour points! Please reduce the number of contour points."
>
> You may avoid this error with the following corrective actions:
>
> - Adjust the application set-up:
>   - For example, change the position of the object being examined so that interfering structures that create unnecessary contour points are outside of the image area
>   - Cover up the interfering structures.
> - Adjust the edge detection sensitivity.
> - Reduce the image noise using lower amplification and correspondingly longer exposure or stronger illumination.

(device dependant)

☐ Use gamma correction

Activate the function "Use gamma correction" if you wish to emphasize contours in dark areas of the image. This option may also be appropriate to reduce the effects of reflections when the image is acquired. This makes the sensitivity of the acquisition non-linear, brightening darker areas of the image and diminishing the contrast of brighter areas of the image.

> **NOTE**
>
> When using gamma correction, the "Reference surface" function can only be used to a limited extent for individual feature checks (e.g. Brightness etc.)!

(device dependant)

☐ Use shading correction ...

This function enables a previously calibrated shading correction to be activated or the configuration page to be opened.

The following value can be set via the process interface:

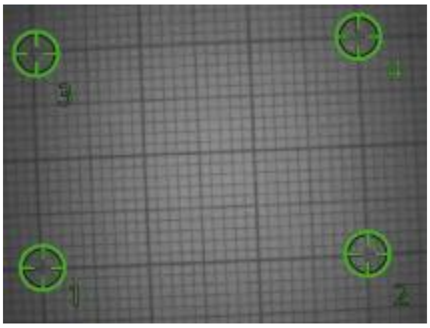
Entry value	Data type	Range of values	Unit
Exposure time	Integer	device dependent	µs
Amplification	Integer	0 – 100	
Edge sharpness	Integer	5 – 100	
Trigger mode	Integer	1 – continuously 4 – external trigger	
Trigger delay	Integer	0 – 6000	ms

9.1.2 Coordinates (device dependant)

With the Vision Sensor, there is an option to convert the internal image coordinate system (which uses pixel as its unit) to a user-defined coordinate system (e.g. using millimetres). To do this, it is necessary to specify the real coordinates for a few data points in the image referenced to a world coordinate system in order to teach the Vision Sensor the distance in your unit.

Convert image coordinates to world coordinates

If you want to convert the coordinates, activate this option. Following configuration, the unit you have defined can be selected as the [Units] option for the corresponding feature checks.

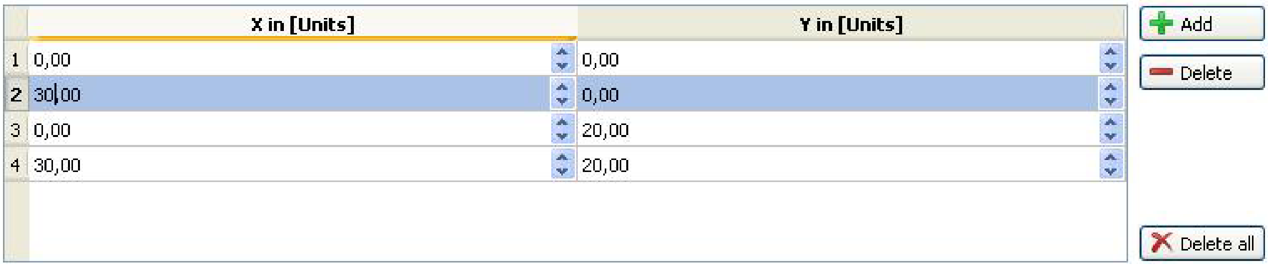


Process

1. Place a defined test image of your choice (e.g. graph paper) into the field of view of the sensor.
2. Activate: *Convert image coordinates to world coordinates.*
3. Mark at least four coordinates on the image with defined distances between them. Base this on your defined test image. The order is not important.

To achieve high conversion accuracy, ensure that the marked coordinates:

- are positioned in the image as precisely as possible,
- are uniformly distributed throughout the image,
- do not lie on one line.



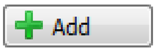
4. Enter the values for the marked coordinates. In this example, it is millimetres. Keep in mind that the coordinates must be specified with respect to a right-handed coordinate system (X towards the right, Y towards the top). The *Application Suite* suggests values for you, correct them if necessary.

5. During the coordinate conversion process, the individual points are checked for validity. Points whose coordinates deviate too greatly from the calculated position following conversion are marked in yellow or red.

   In this case, check all points for the correctness of position and of the coordinates. If necessary, shift the points or adjust the entered coordinates. A small line indicates the direction in which the point should be shifted.

If you now allow the results of the corresponding feature checks to be given in [Units], the value produced conforms with your defined coordinates in millimetres.

There is an option to define more than four coordinates. Having more coordinates makes the conversion more precise. To do this, use the following buttons.



Use the *Add* button to add additional coordinates to increase the accuracy of the conversion.

Delete individual points using the *Delete* button.

The *Delete all* button deletes all coordinates.

To increase the precision of the calculated coordinates, you can also correct for the distortion of the camera lens. In this case, you will need at least eight coordinates.

9.1.3 Coordinates (with distortion correction enabled – device dependend)

When distortion correction is enabled there is an option to convert the internal image coordinate system (which uses pixel as its unit) to a user-defined coordinate system.

This requires the real coordinates in the image to be calibrated to a world coordinate system with a calibration template or manually.

NOTE

A calibration template is required for calibration using the *Point, Target grid and SmartGrid* methods.

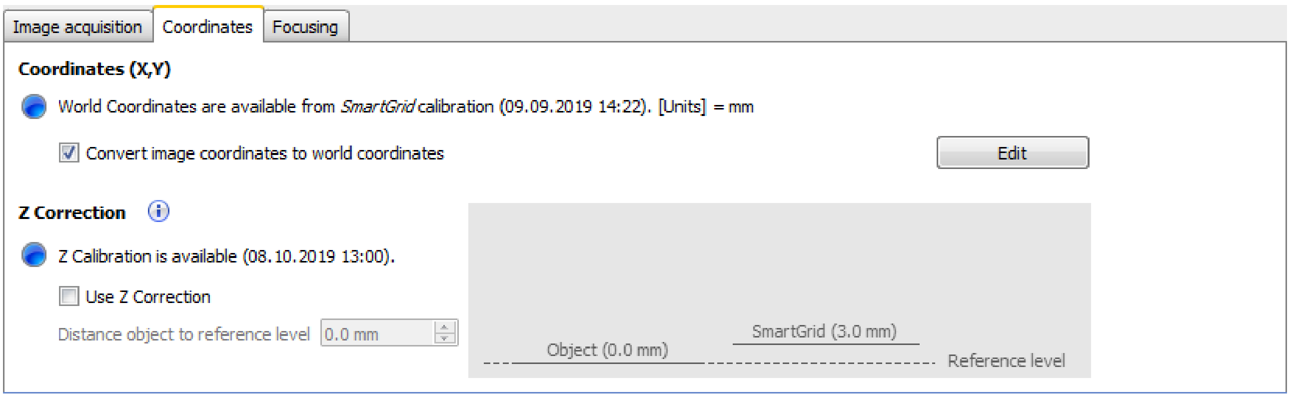
After successful installation, the calibration templates can be found in the directory:

<installation path>\AppSuite\calibration

on your PC.

NOTE

The Image recording tab has to be used to activate *Enable distortion correction…* to allow configurations to be entered here.

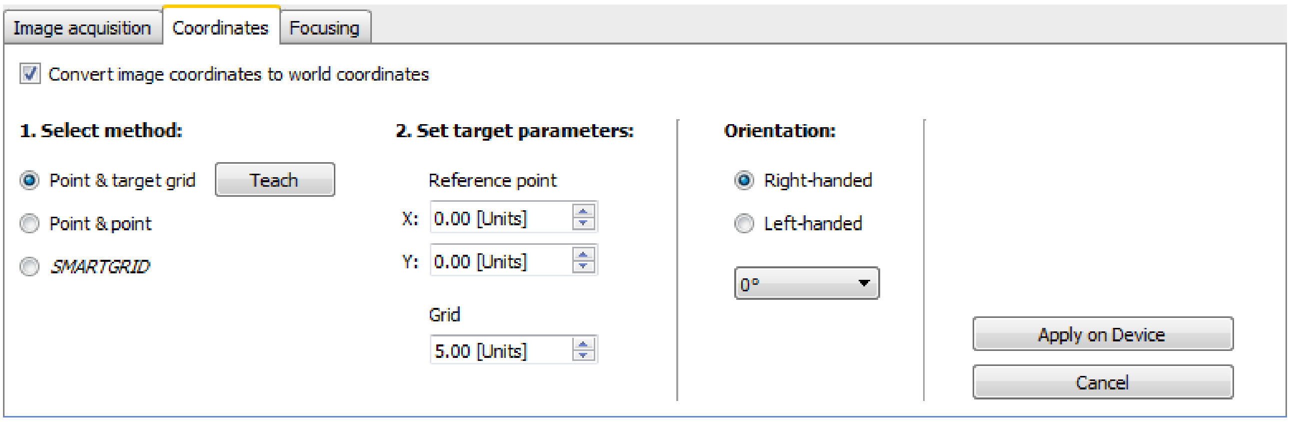


Procedure (coordinates X, Y)

There are three methods for determining coordinates:

- **Point and target grid** (automatic version that orients itself to the target grid)
- **Point & point** (manual version without target in which two reference points are established)
- **SmartGrid** (automatic variant based on *SmartGrid*, where the reference point, orientation and units are learned)

Point and target grid



1. Place the desired target grid with world coordinate system orientation into the Vision Sensor's field of view. If a *SmartGrid is* used for this purpose, only the chessboard pattern is used; other information (reference point, orientation, units) is ignored.

2. Press the *Edit button*.

3. Select the *Point and target grid method.*

4. Press the *Teach* button.

   → The grid points will be programmed and marked with a small orange cross. A reference point will also be inserted.

NOTE

Should this teaching fail, a user defined coordinate system could be programmed. Causes could be:

- The target squares are too small (minimum size 20 x 20 pixels)
- There are too few squares in the field of view (at least 5 x 7 squares are required, preferably more)
- The target is partially covered

5. Drag the reference point onto a grid point of your choice.

6. Set the target parameters. Assign coordinates to the reference point. Determine the units for the grid.

7. Determine the orientation for the coordinate system (left-handed / right-handed).

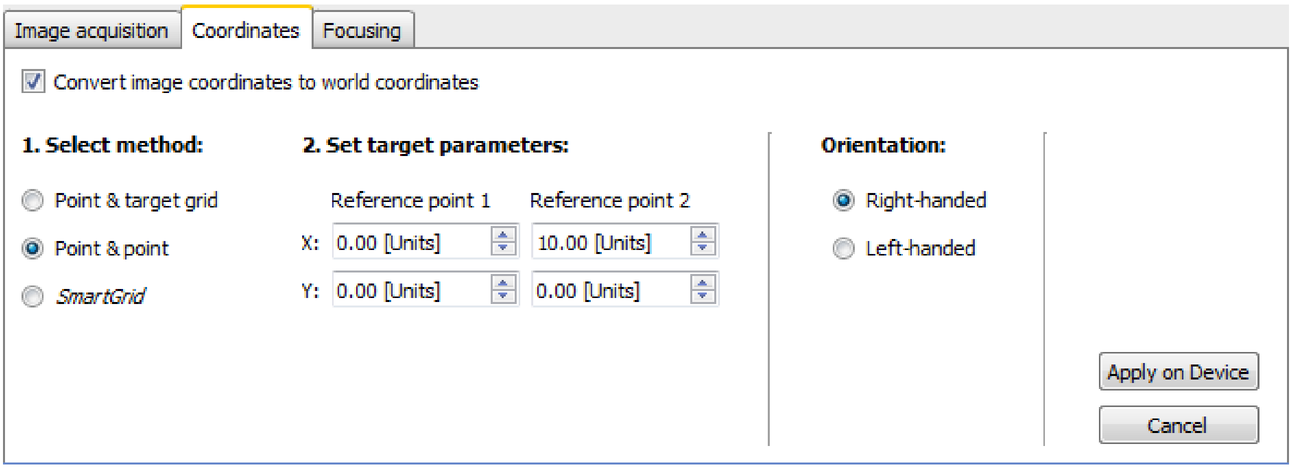
> **NOTE**
>
> The overlaid coordinate system only specifies the orientations (X,Y) and does not necessarily show the zero point!

8. Determine a main orientation for the coordinate system. These orientations will be aligned to the target grid. Rotation is thus only possible in steps of 90°.

9. Press the *Transfer to device button.*
   → The programmed coordinates will be transferred to the Vision Sensor.

> **NOTE**
>
> A reference point cannot be moved once it has been programmed. Renewed teaching is required to determine a new reference point.

Point & point

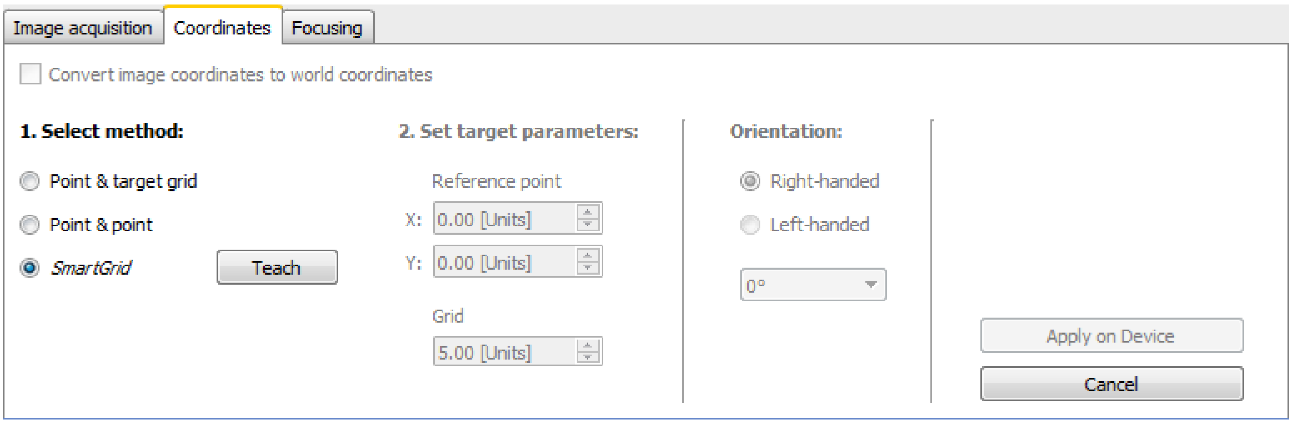


1. Place the desired target grid with world coordinate system orientation into the Vision Sensor's field of view. If a *SmartGrid is* used for this purpose, only the chessboard pattern is used; other information (reference point, orientation, units) is ignored.
2. Press the *Edit button*.
3. Select the *Point and point method.*
4. Now move both reference points to a mark of your choice.
5. Assign coordinates to each of the reference points.
6. Determine the orientation for the coordinate system (left-handed / right-handed).

> **NOTE**
>
> The overlaid coordinate system only specifies the orientations (X,Y) and does not necessarily show the zero point!

7. Press the *Transfer to device button.* The programmed coordinates will be transferred to the Vision Sensor.

SmartGrid



1. Place the *SmartGrid* with world coordinate system orientation into the Vision Sensor's field of view.
2. Press the *Edit button*.
3. Select the *SmartGrid* method.
4. Press the *Teach* button.

   → The grid points will be programmed and marked with a small orange cross. Furthermore, a representative reference point is inserted and the alignment is determined according to *SmartGrid*. The reference point can optionally be moved by mouse, the corresponding coordinates are displayed in the greyed out Reference Point field.

NOTE

Should this teaching fail, a user defined coordinate system could be programmed. Causes could be:

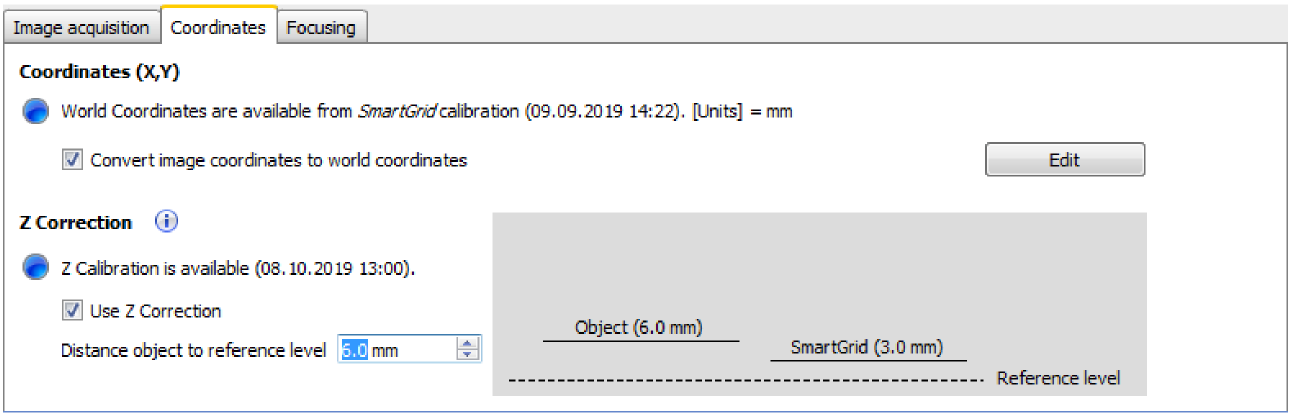
- The SmartGrid squares are too small (minimum size 20 x 20 pixels)
- There are too few squares in the field of view (at least 6 x 8 related squares are required, preferably more)

NOTE

The overlaid coordinate system only specifies the orientations (X,Y) and does not necessarily show the zero point!

5. Press the *Transfer to device button.*
   → The programmed coordinates will be transferred to the Vision Sensor.

Z correction (device dependent)



Here you have the option of adjusting the X, Y coordinates to a different height Z. This may be necessary if the distance set during the distortion correction (*SmartGrid* surface to the reference plane) deviates from the current height.

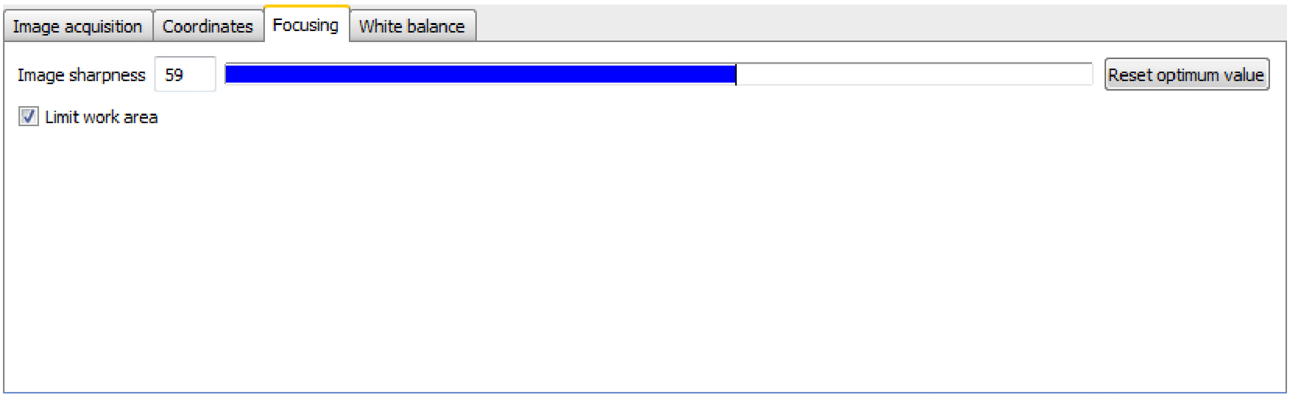
NOTE

A *distortion correction* and *Z-calibration* must be performed before the Z-correction can be performed.

1. Set the checkmark for *Convert image coordinates to world coordinates*
2. Set the checkmark for *Apply Z Correction*.
3. Enter the desired distance for *Distance object to reference plane*.

9.1.4 Focus

The focus option uses a graphical display to help you focus the Vision Sensor.



Focussing the Vision Sensor

1. Point the device's field of view towards a model piece. Limit the field of view as required.
2. Now adjust the focus on the Vision Sensor. To do this, use the focus setting screw and the installed lens.

   → You will see how the focus changes. The best value may also increase.
3. Adjust the focus until you have achieved the optimum result (highest focus value).

Reset best value: Use this to reset the best value to the current focus value.

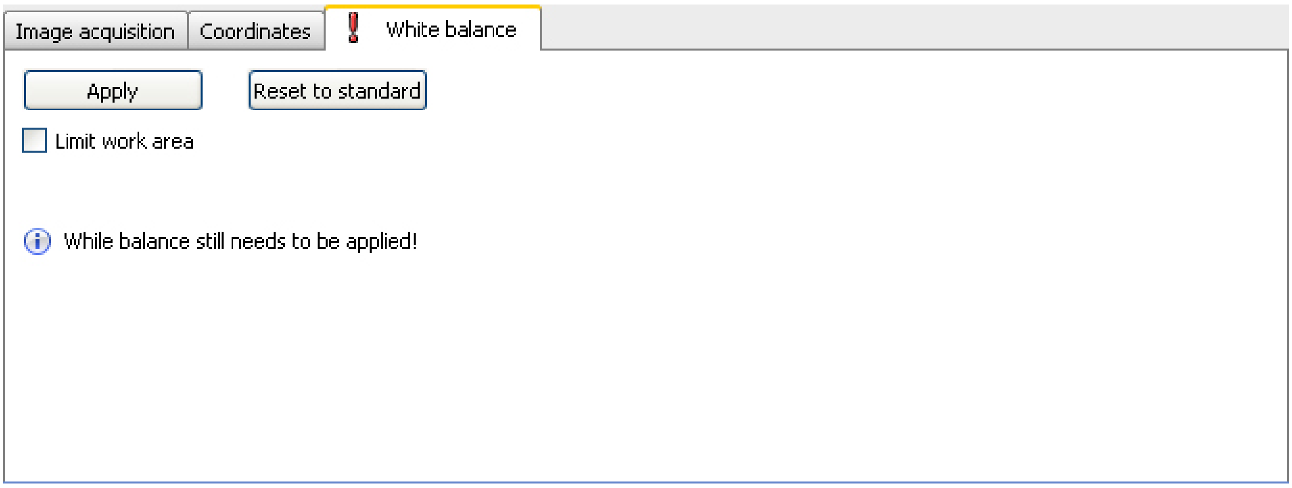
Limit field of view: Use this function to limit the field of view, otherwise the entire image area will be used to calculate the focus.

9.1.5 White balance (device dependant)

The white balance adjusts the colour sensitivity of the device to the current lighting situation. The white balance setting is stored in the respective job.

NOTE

If the white balance has not yet been carried out, an exclamation mark is shown on the tab above.



Run white balance

1. Direct the device's field of view onto a white surface (e.g. white paper) or limit the field of view to a white area in the image.
2. Now click on the *Image acquisition* tab and change the exposure time to create an image that is as homogeneous as possible and slightly grey.
3. Click on the *White balance* tab again and then on the Run button. The three RGB values should now be similar to one another, see the status bar below.

Once the white balance has been run, you can reconfigure the exposure time on the *Image acquisition* tab to suit your requirements.

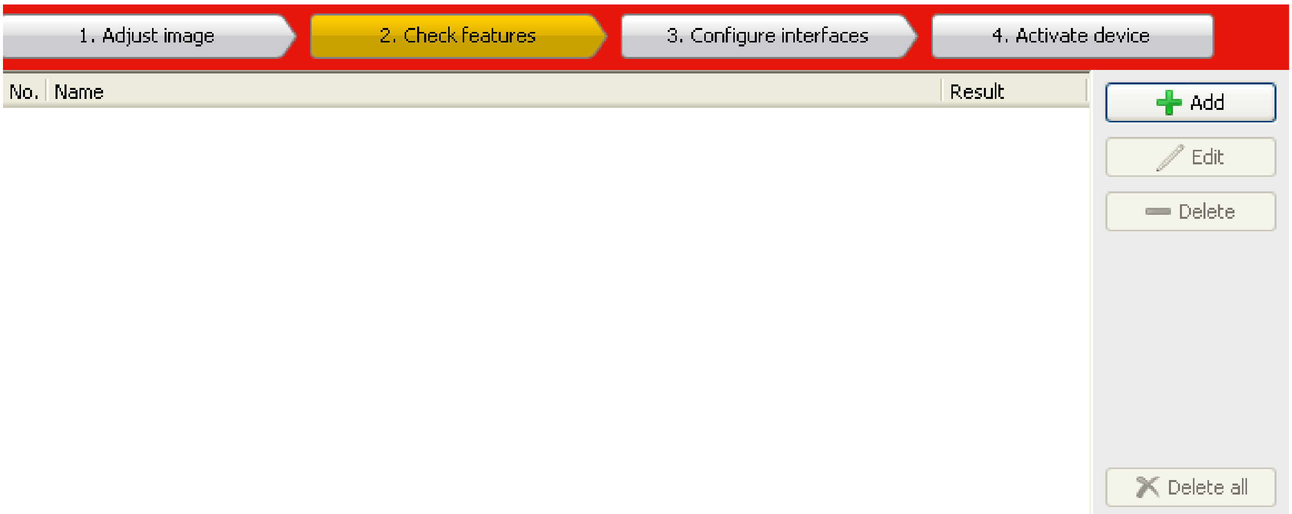
Run: Run white balance with currently displayed image.

Reset to standard: reset to the factory white balance setting.

Limit field of view: Limit the area used for the white balance. This may be necessary if only part of the image is suitable for white balancing.

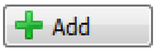
9.2 Checking features

The features to be checked are composed and their parameters set in this step.



> **NOTE**
>
> Please note that even the best feature check can only calculate a satisfactory result if the associated feature is clearly visible in the image.
>
> If necessary, check the parameters for the image exposure again to obtain an optimum image quality for your task!

> **NOTE**
>
> As each inspection task has tolerances with regard to the position of the test object, most jobs begin with part location. The part location feature searches for the reference edges of the test object and aligns all subsequent feature checks according to these reference edges.

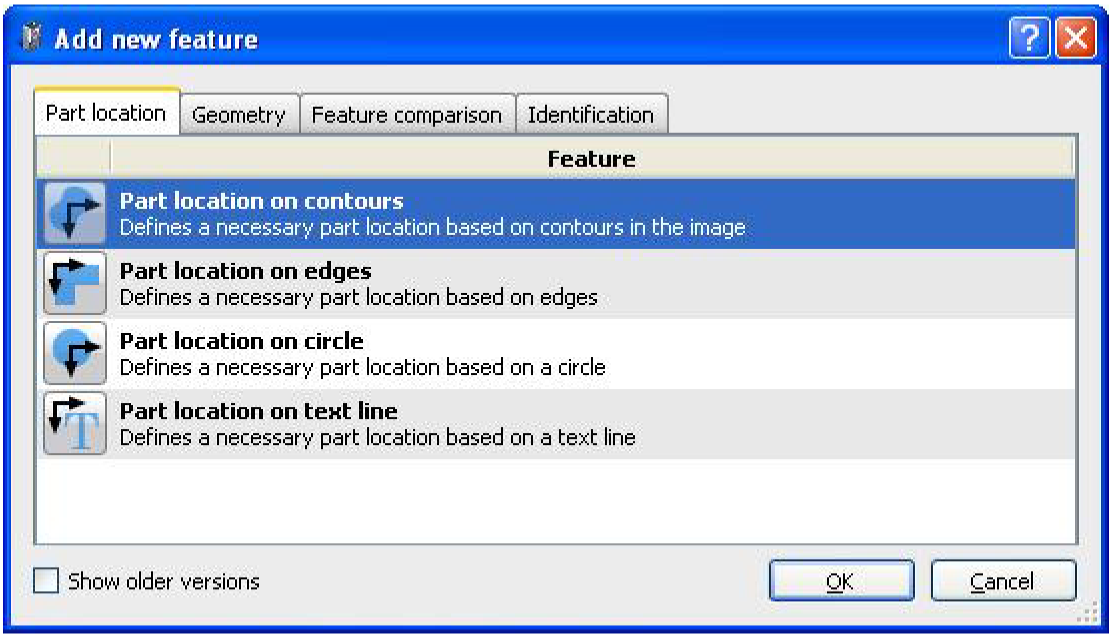


Add opens the New feature check dialogue. In this, a list of all available feature checks is presented. When a feature to be checked has been selected, this appears automatically in the feature list, with its current result and the associated status.

A previously selected feature check is edited here.

Deletes a selected feature check from the list of features.

Deletes all feature checks from the list of features.



Each feature is optimized for just one inspection task and supplies a Pass or Fail result. Partial results (e.g. brightness - mean brightness) can also be delivered via the process interface.

Show older versions: This function shows you versions of feature checks from earlier releases (labelled accordingly) along with the current ones, e.g. to use in already successfully implemented applications. We recommend that you use the current feature checks. It is not possible to convert from an older to a newer version.

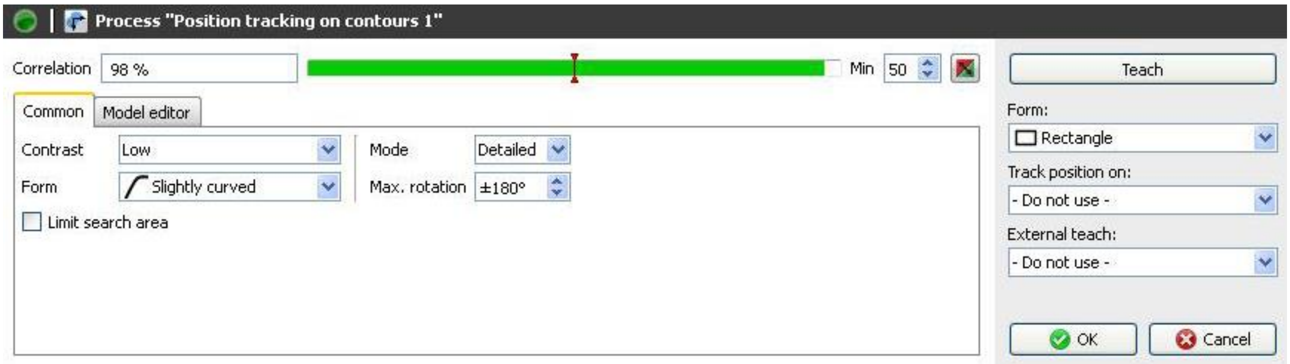
> **NOTE**
>
> The results of the feature checks can be connected at a later stage (device dependant).

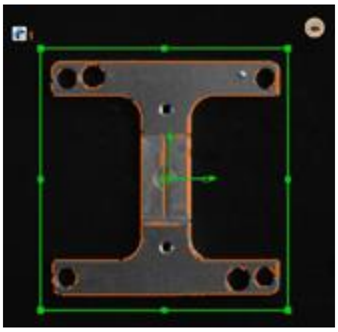
Right click on a configured feature check to access further functions.

Example: Feature comparison brightness with part location on contours

Part location on contours:

With this feature check, the position of an object is determined using contours.





- Choose the shape of the area from which the contours are adopted.

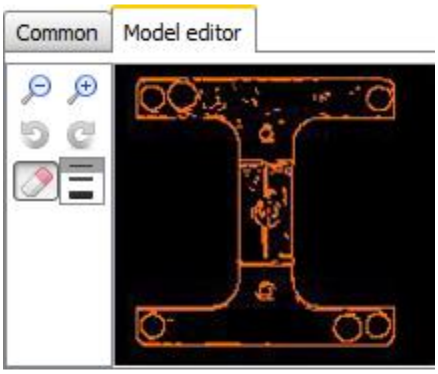
Adopt the contours by pressing "Teach". A search is then made for the object in the entire image.

- The match of the contours with the found object in the image is displayed here.
- Using the appropriate switching points, set how good the match must be so that the object is found. The button on the extreme right inverts the set point.

- **Contrast:** Set the minimum contrast of the contours that should be adopted in the model.
- **Form:** Select the shape of the contour that corresponds to the test object and that should be adopted in the model. (Limiting the angular range reduces processing time.)
- **Mode:** Set the amount of detail to be used in the inspection. (The more detailed the mode, the higher the processing time.)
- **Max. rotation:** If you want to find the object only in a limited angular range, you may specify the maximum rotational position here.

- If you do not wish to search for the object in the entire image, set the tick and then limit the detection area.

Model editor tab



- With the displayed model, you can now use the mouse to delete contour points which clearly do not belong to the reference object.

- Use this button to restore the model to its original state.

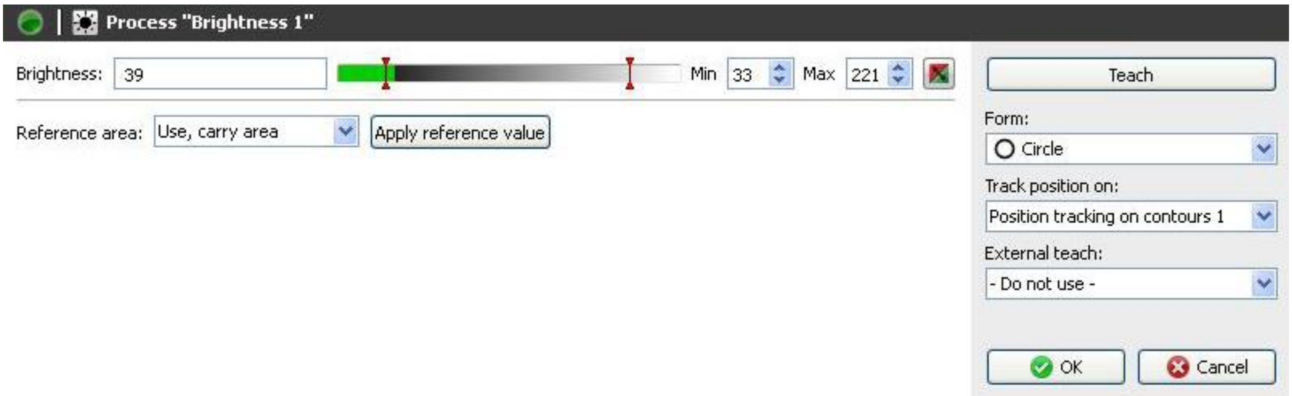
- You can use these two buttons to enlarge or reduce the model.

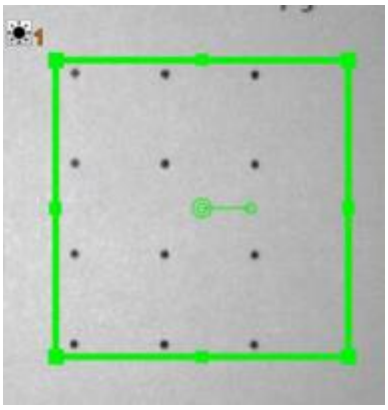
- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

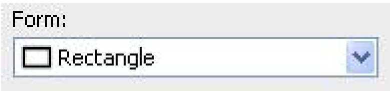
Feature check Brightness

This sensor task measures the mean brightness in a field of view and compares the result with the specified switching points.

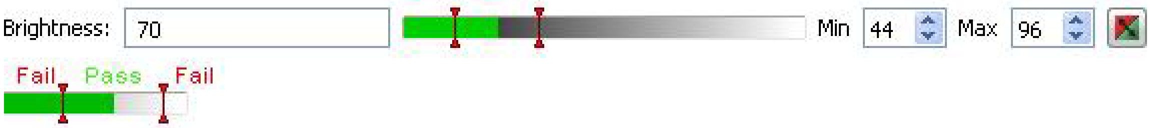
This feature check supports external Teach. The switching points are adjusted as an absolute to the current measured value.



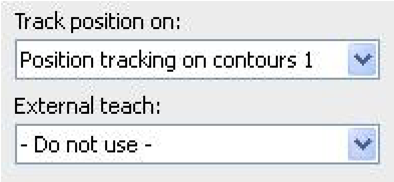




- Select the shape of the field of view. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by correspondingly dragging the lever in the centre with your mouse.



- The current result for brightness is shown as a mean grey scale value. The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

In order to be independent of fluctuations in the ambient light, the device offers a means of automatically correcting the brightness.

- **Use, do not carry reference area:** Here, a field of view is defined as a reference area, for example by attaching a white label to the edge of the conveyor belt (static). The brightness correction is now guided by the brightness of this area.

- **Use, carry reference area:** This function is only available in connection with part location. A field of view is still used as the reference area. However, this is carried with the position correction. The brightness correction is now guided by the brightness of this carried area.

The mean brightness in the field of view of the reference area should exceed a grey scale value of 128 to ensure reliable operation.

NOTE

If "Use, carry area" cannot be selected, then you have not defined part location.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

NOTE

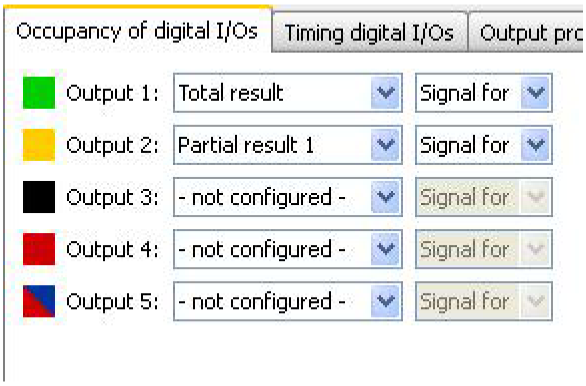
Once installation is complete, you will find a range of application examples that provide you with typical solutions for various inspection tasks and for the use of the individual feature checks. After successful installation, the examples can be found in the subdirectory:

`<installation path>\AppSuite\Samples`

9.3 Configuring interfaces

9.3.1 Occupancy of digital I/Os

You can adjust the settings for the digital interface on this dialogue page.



NOTE

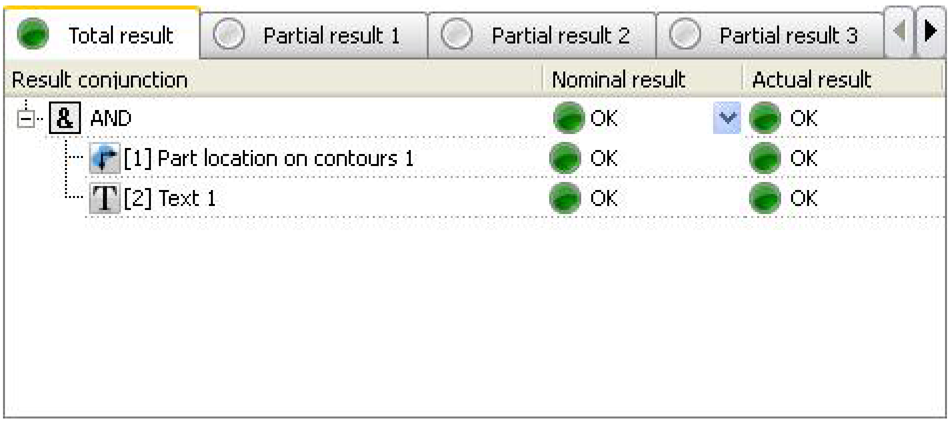
Please keep in mind that, during job switching, the device is not active and the "Camera Ready" output is deactivated. Please wait with the next image analysis operation until the "Active" state is displayed again by this signal. If the switch could not be performed, for example, because the job number was invalid, an alarm signal is also output until the next trigger.

Output 1-5

Enter how the outputs are to be activated here. You can choose between these three options: Total result, Partial result, Alarm. For the results output, you may also choose whether you want a signal to switch for a pass or a fail result.

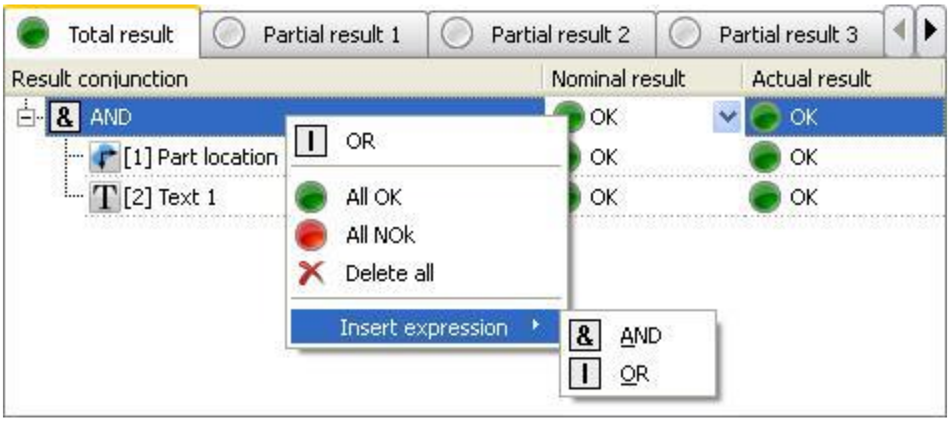
You may output the Total result and the Partial results via the digital interfaces. To do so, configure the required output in *Device menu*.

Flexible result conjunction (device dependant)



In this dialogue, you can specify how the feature check results are to be logically linked together to produce the result of the job.

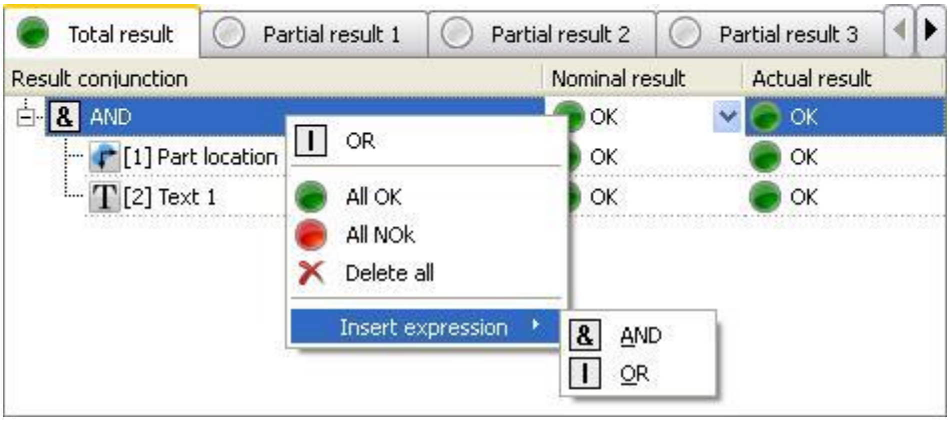
You can specify one Total result and several Partial results for each job. In addition, it is possible to use the Partial results for the configuration of the Total result.



It is possible to link the results with the following operations for configuration:

- AND ("The results of all feature checks are OK.")
- OR ("The result of at least one feature check is OK.")

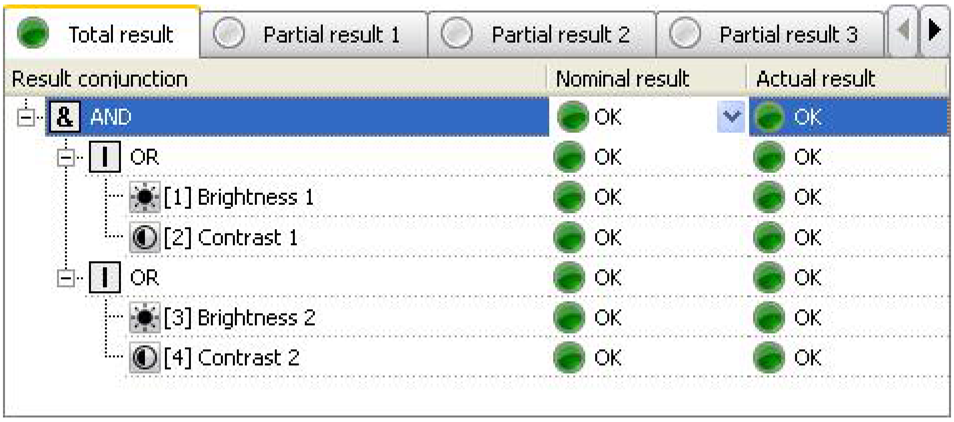
You can also invert and ignore the result of a link by selecting the entry "NOK" or "Ignore" in column "Nominal result".



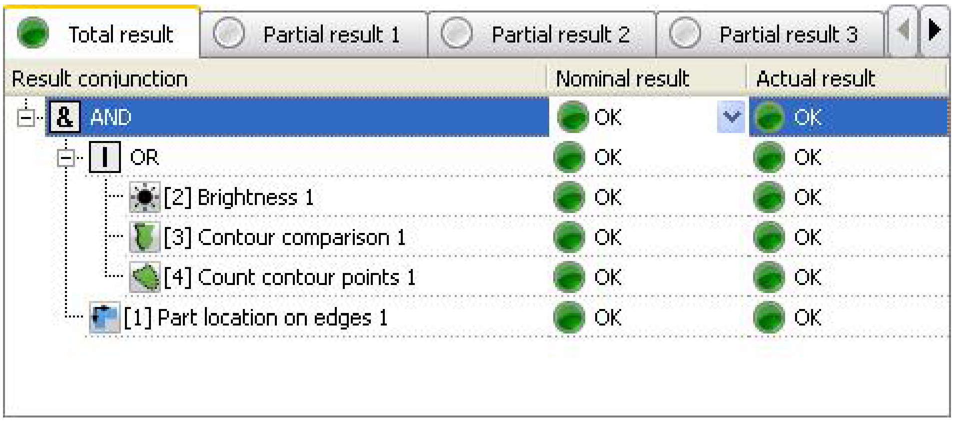
It is possible to nest the links to any desired depth to achieve even more complex expressions. You can insert new levels by selecting the "Insert expression" value in the context menu and then the appropriate type of link. For each sub-link, you can now select the corresponding feature checks to be used for the evaluation. Each feature check can appear any number of times in the overall expression, but only once at each level.

Example

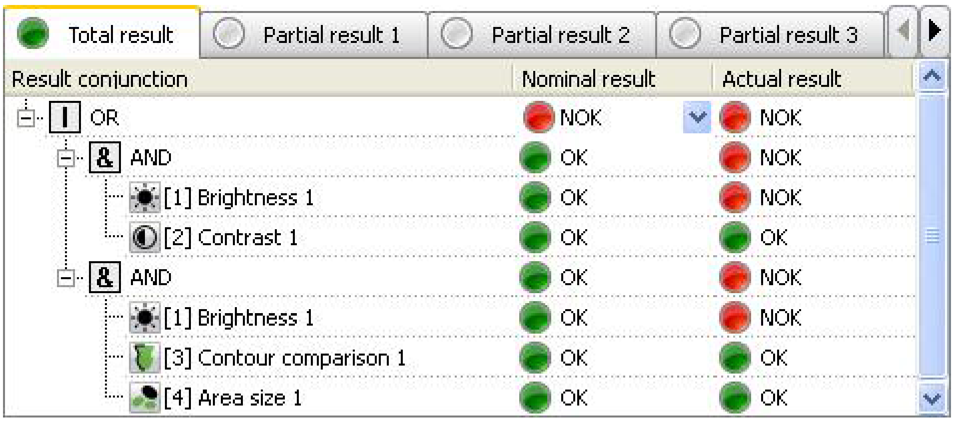
(Brightness 1 OR Contrast 1) AND (Brightness 2 OR Contrast 2)



Part location on edges 1 AND (Contour comparison 1 OR Count contour points OR Brightness 1)



NOT (Brightness 1 AND Contrast 1) OR (Brightness 1 AND Area size 1 AND Contour comparison 1)



Digital inputs in results conjunction (device dependent)

You can also include the states of the digital inputs in the total result. They can be nested just like the other feature checks.

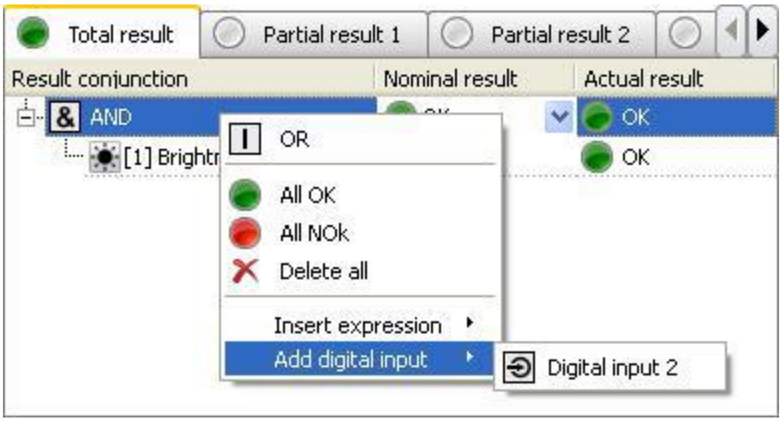
The states of the digital inputs are captured at the trigger point or at the start of image acquisition.

The states of the digital inputs alone cannot be linked; there must be at least one feature check!

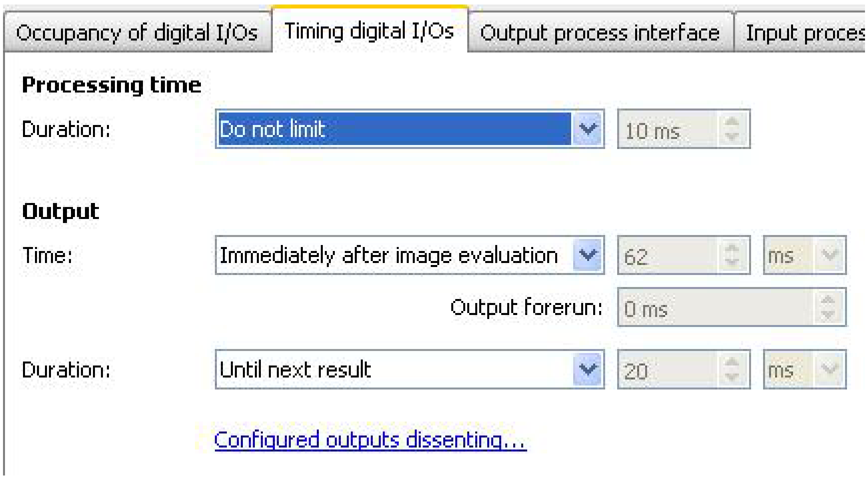
NOTE

To use the digital inputs in the result conjunction, you must select the relevant *External Sensor* input in the device settings.

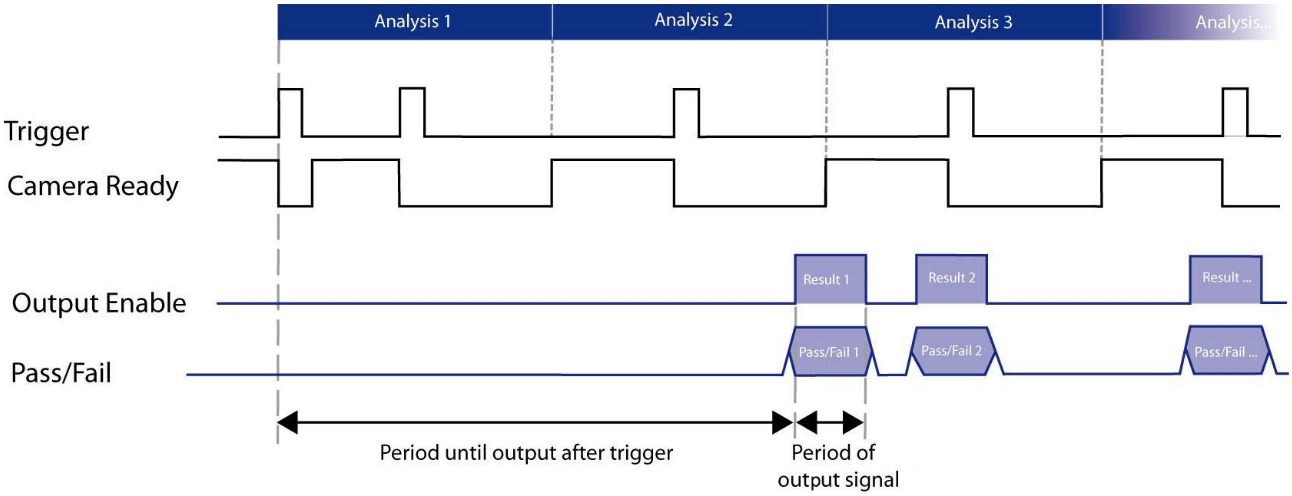
Device → Device Settings → Digital I/Os



9.3.2 Timing digital I/Os



In this dialogue, you can define when the output time is reached and how long the output is to be. The timing diagram displays the process visually and you can mouse over various positions to bring up further details.



Following image acquisition, the *Image trigger permitted* signal is deactivated. The *Image trigger permitted* signal is activated again at the end of image acquisition and another image acquisition operation is possible immediately.

The Pass/Fail signal then switches at the set output time even if additional analyses have already been performed. The Result *valid* signal is active during this time.

A maximum of 64 results can be temporarily saved.

NOTE

If the set output time has been reached prematurely, the calculation in the Vision Sensor is aborted. The result and all partial results are then NOK.

The duration of the output signal is used to specify for how long the output signal (Result valid, Pass/Fail, Alarm) should be produced. Depending on the settings, the signal will either be reset once the set pulse has elapsed, or reset with the next result.

NOTE

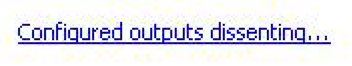
If you have connected an encoder, you may set output time and duration as a distance.

In addition, you can specify an "output run-up" in milliseconds to activate the Pass/Fail signal before reaching a specific position.

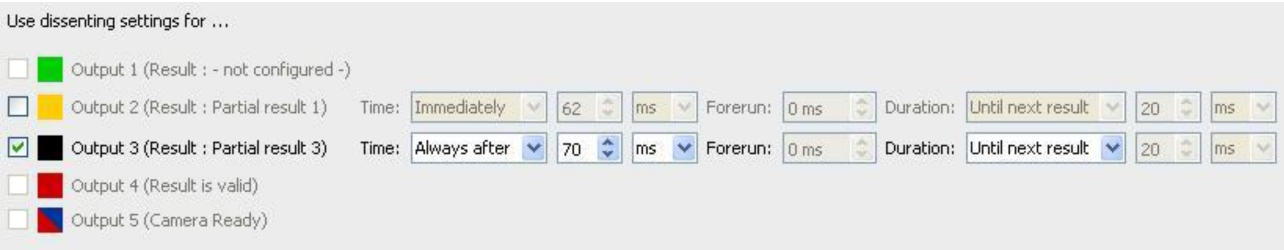
This option is available if an exact output time has been specified (identical earliest and latest output times) and this is specified as a distance.

Keep in mind that, in this case, the conveyor speed must be constant!

There is also the option to set different times for individual outputs.



In the drop-down menu, different individual timings can now be set for outputs with a result. These are selected with the checkbox.



In this example, only output 3 has a different output time, although output 2 is also in use. They both follow the general output time.

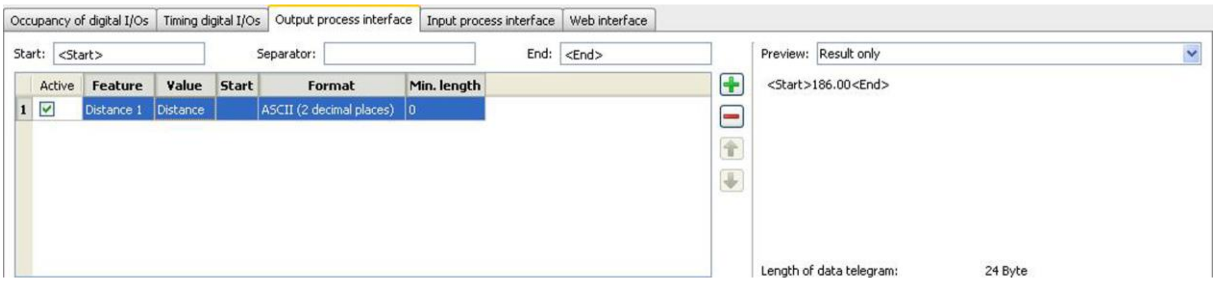
The different settings can be viewed in the timing diagram once you have left the menu.

9.3.3 Output process interface (device dependant)

In this dialogue, you can configure the data outputs via the process interface.

A detailed description of the process interface can be found in the section *Communications via the process interface*.

You can configure the technical parametrization of this interface in the *Device settings*.



The length of the datagram includes the header and end identifier.

You may select as many entries for the transfer as you wish in the table.

With the + and – buttons, you may add a new line or erase the currently selected line, respectively. Each line contains one feature to be transferred. Using the arrow keys, the currently selected line can be moved upward or downward thereby changing the data sequence in the data packet.

General settings

Parameters	Meaning
Start	Character string as a start sequence preceding the data block. This character string is freely selectable (e.g. <Start>).
Separator	Character string included as a delimiter between each individual result of the feature check (e.g.)
End	Character string as an end sequence concluding the data block. This character string is freely selectable (e.g. <End>).

NOTE

To enter binary characters, you may use the `\` symbol in the text. The value can then be specified in hexadecimal format. To add a backslash, enter `\\`. The character `\00` cannot be used.

Example:

`\\09` correspondents to a tab
`\0D\0A` corresponds to <CR><LF>

Data table settings

The following items are selected in the table:

Column	Meaning
Active	If this entry is marked, the selected value is entered in the datagram.
Feature	The setting or the feature check from which a value is to be transferred is selected here.
Value	The result of the feature check that is to be transferred is selected here. The "Result" option (for the OK/NOK result of the feature check) is always available. All other results depend on the relevant feature check or setting. Should a value consist of multiple components (e.g. a point consists of the X and Y coordinates), these are separated with the separator set within the general configuration.
Start	This character string prefixes the result to be transferred and can make it easier for the receiver to interpret or make the data packet readable for human users. **NOTE** Amendment option device dependant.
Format	The format used to represent the data to be transferred is set here. The options provided depend in principal on the values available. Customarily, the following possible options are offered: • ASCII (2 decimal places) • ASCII (Exponent) • Decimal • Binary (Little Endian) • Binary (Big Endian) **NOTE** This means that the data packet can contain characters that are normally used as control characters for serial interfaces or in the protocol. This setting is only recommended if the operating conditions are appropriately secured! **NOTE** Amendment option device dependant.
Min. length	The minimum length of the values is adjusted here. - Should the value be larger than the set minimum length, the length will be exceeded accordingly - Modifications of the length depend on the data type, for example, a binary value is 4 bytes long - The modification is carried out by prefixing or suffixing with zeros or spaces (depending on the data type) **NOTE** Amendment option device dependant.

The following table explains the meaning of various settings for features and values.

Parameters		**Meaning**
Feature	**Value**	
Time	Image acquisition	Provides the time of the image acquisition in milliseconds since the device was switched on. A 32-bit wide counter (0 - 4294967295) is used, which starts again at 0 after reaching the maximum.
Result Result	Total result Partial result	If this selection is activated, the total result or the partial result of the job is transferred. **Result (2 characters):** 1. Characters: "P" or "F" for a Pass or Fail result 2. Characters: "A" or space for "Alarm triggered" or "No alarm triggered". **Partial result (1 character):** "P" or "F" for a Pass or Fail result "I" if the partial result was not output during the job
Statistics Statistics	Total result Partial result	If this option is activated, the statistics for the result are included. The total number of images, the number of OK images and the number of images for the total result that triggered an alarm are all transferred, with the individual values separated with a separator.
Trigger	Additional data trigger	If this selection is activated, the string transferred via the TD command is mirrored back as a control option.
Trigger	Image counter	If this selection is activated, a 16 bit wide counter (0-65535) is used. This increases by 1 with each image acquired and resets to 0 once it reaches 65535.

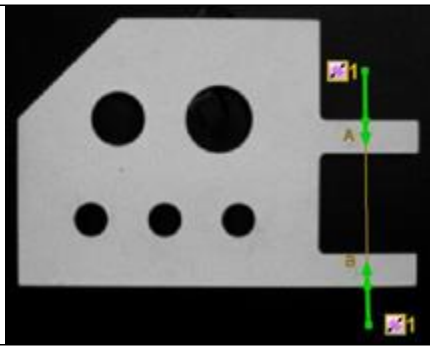
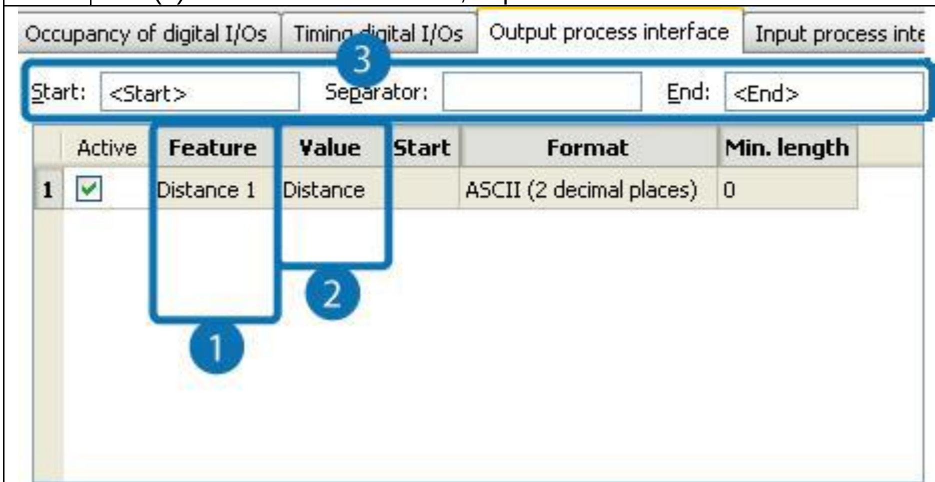
NOTE

Following the descriptions of the individual feature checks, there is a table containing the values which can be output via the process interface.

Example

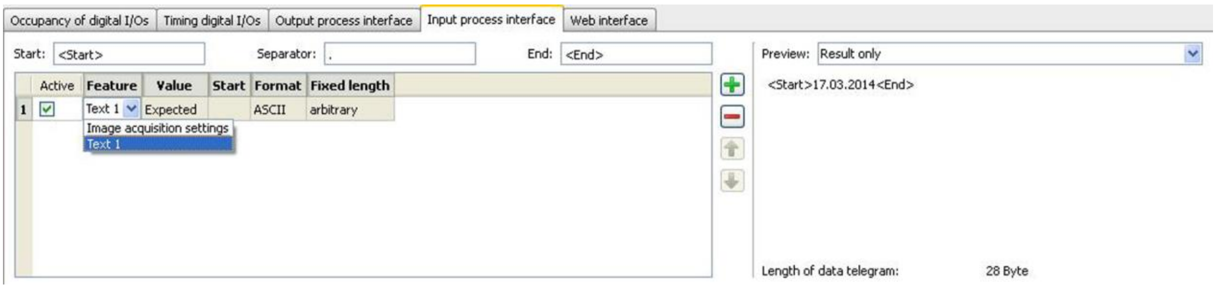
Output via the process interface of the data read from the Spacing feature check.

> **NOTE**
>
> The preview window on the right shows you in real time how your settings affect the data to be transferred.

1.	Configure the *Distance* feature check.	
2.	Go to the *Configure interface → Output process interface* step.	
3.	Configure all of the settings in the overview for the data output (see Data table settings). (1) Select the feature check / setting to be output. (2) Select the value to be output. (3) Set the start character, separator and end character for the datagram.	
		
4.	Now the preview window on the right will show how the data will be output via the process interface. The RD (**R**esponse **D**ata) and the number of characters (4 byte ASCII-Hex) will still be prefixed (see RD Reply).	`<Start>186.00<End>`
5.	In this case the device would send to the controller:	`RD0013<Start>186.00<End>` (Note: $0013_{HEX} = 19_{DEZ}$, length is therefore 19 characters)

9.3.4 Input process interface (device dependant)

Via the *input process interface* it is possible to set, for example, the expected values of the identification (barcode, matrixcode, text) sensors using the SP ("Set Parameter") command. You can also set parameters for image acquisition.



The length of the datagram includes the header and end identifier.

You may select as many entries for the transfer as you wish in the table.

With the + and – buttons, you may add a new line or erase the currently selected line, respectively. Each line contains one feature to be transferred. Using the arrow keys, the currently selected line can be moved upward or downward thereby changing the data sequence in the data packet.

General settings

Parameters	Meaning
Start	Character string as a start sequence preceding the data block. This character string is freely selectable (e.g. <Start>).
Separator	Character string included as a delimiter between each individual result of the feature check (e.g.)
End	Character string as an end sequence concluding the data block. This character string is freely selectable (e.g. <End>).

NOTE

To enter binary characters, you may use the `\` symbol in the text. The value can then be specified in hexadecimal format. To add a backslash, enter \\ . The character `\00` cannot be used.

Example:

`\\09`	correspondents to a tab
`\0D\0A`	corresponds to <CR><LF>

Data table settings

The following items are selected in the table:

Column	Meaning
Active	If this entry is marked, the desired value is entered in the datagram.
Feature	The setting or the feature check from which a value is to be transferred is selected here.
Value	The result of the feature check that is to be transferred is selected here. The results depend on the relevant feature check.
Start	This character string prefixes the result to be transferred and can make it easier for the receiver to interpret or make the data packet readable for human users.
Format	The format used to represent the data to be transferred is set here. The options provided depend in principal on the values available. Customarily, the following possible options are offered: • ASCII (2 decimal places) • ASCII (Exponent) • Decimal • Binary (Little Endian) • Binary (Big Endian) **NOTE** This means that the data packet can contain characters that are normally used as control characters for serial interfaces or in the protocol. This setting is only recommended if the operating conditions are appropriately secured!
Fixed length	The length of the expected values is adjusted here. Missing characters are filled with zeros (numbers) or spaces (text).

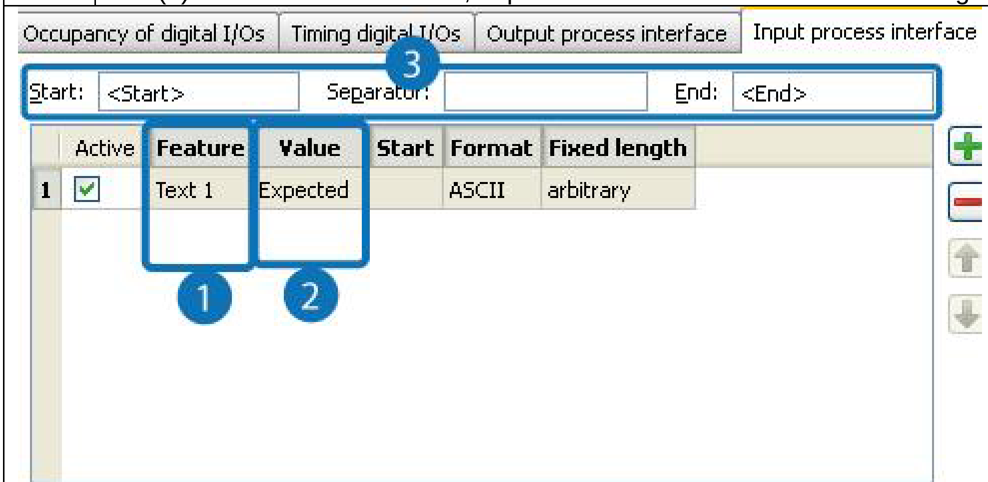
NOTE

Following the descriptions of the individual feature checks, there is a table containing the values which can be input via the process interface.

Example

Setting an expected value for the *Text* feature check via the process interface and determining the required command.

> **NOTE**
>
> The preview window on the right shows you in real time how your settings affect the data to be sent.

<table>
<tr><td>1.</td><td>Configure the Text feature check.</td><td>
</td></tr>
<tr><td>2.</td><td colspan="2">Go to the Configure interface → Input process interface step.</td></tr>
<tr><td>3.</td><td colspan="2">Configure all of the settings in the overview for the data input (see Data table settings).
(1) Select the feature check / setting to be set.
(2) Select the value to be output.
(3) Set the start character, separator and end character for the datagram.</td></tr>
<tr><td colspan="3">
</td></tr>
<tr><td>4.</td><td>You will now see the current set value in the preview window on the right. The SP (Set Parameter) and the number of characters (4 byte ASCII-Hex) will also be prefixed (see SP command)</td><td><code><Start>17.03.2014<End></code>

NOTE

If no value is set as "expected" during configuration of the feature check, no value will be shown in the preview window!</td></tr>
<tr><td>5.</td><td>The command to set the expected value for the device to this date is therefore:</td><td><code>SP0017<Start>17.03.2014<End></code>

(Note: $0017_{HEX} = 23_{DEZ}$, length is therefore 23 characters)</td></tr>
</table>

9.3.5 Web interface

In this step, there is the option to assign functions to the upper 9 buttons of the web interface view.

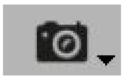
You can assign configured feature checks and the *Parameters for image acquisition* button to the 9 buttons.

Configurable parameters for 'Distance 1':

	User	☑ Profi
Working area edge/circle A	☐	☑
Working area edge/circle B	☐	☑
Distance	☐	☑

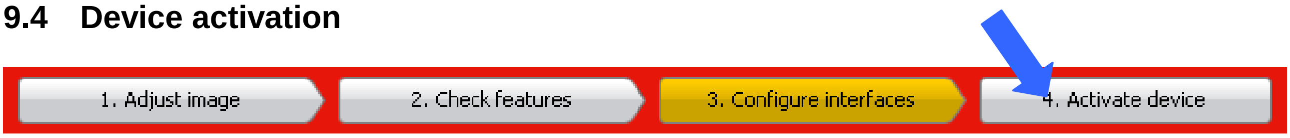
Once a button has been assigned a function, you can set which parameters for these functions can be configured in the web interface by which user profiles.

If no user profile is used, only the "Expert" column will be used and the "Operator" column will be greyed out.



If you assign this function to a button, you can set parameters for image acquisition (exposure time, amplification, edge sharpness, gamma correction) via the web interface.

9.4 Device activation

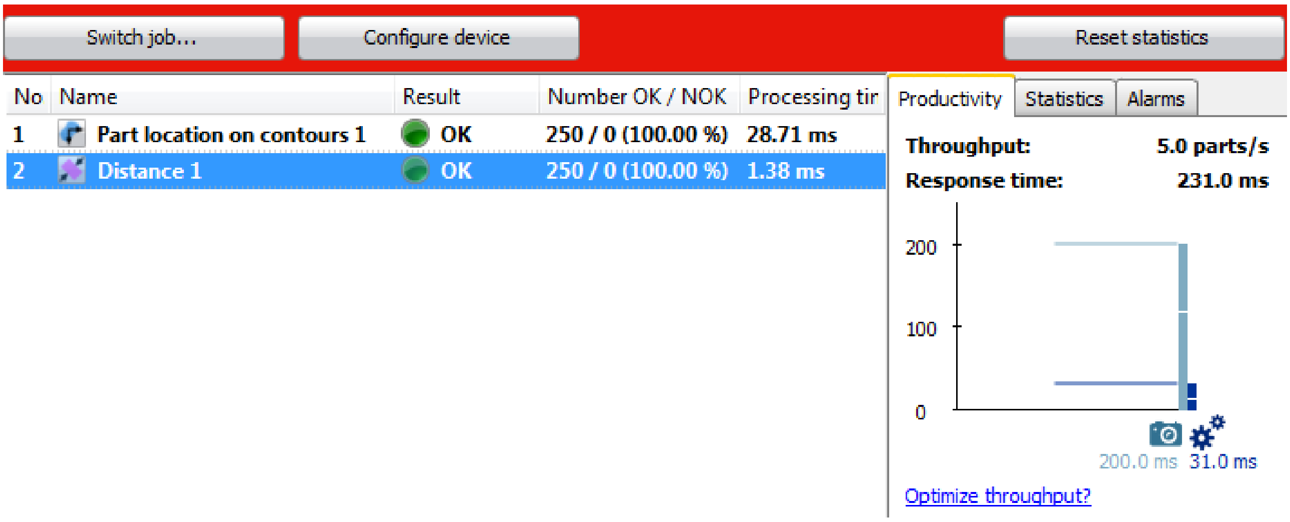


Click on *Activate device*.

Confirm the question with *Yes*.

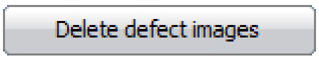
The device is now in *Activated* mode and processes the created job. The tabs *Productivity / Statistics and Alarms* are displayed on the right in the configuration area.

> **NOTE**
>
> While the Vision Sensor is processing the job, you may continue to retrieve defect images and to save images.
>
> There is also the option to save the current job and all jobs to the PC via the Job menu.



Click on *Switch job...*, to change to a different job stored in the Vision Sensor.

Click on *Configure Device* to return to *Configuration* mode and to make new settings.



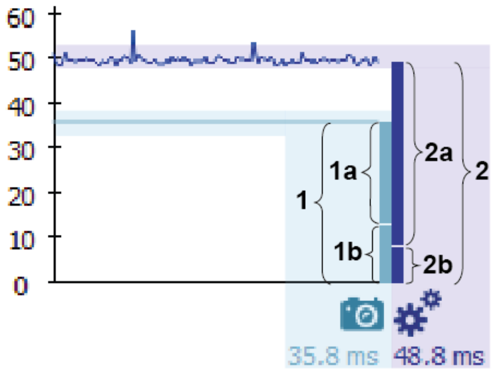
Click on *Delete defect images* to delete stored defect images (button only appears when you click on *Defect images* in the display options).

Click on *Reset statistics* to reset the statistics values (number of parts, number OK, NOK, number of alarms).

9.4.1 Productivity / Statistics / Alarms

The three tabs *Productivity, Statistics and Alarms* provide the following information.

Productivity



The productivity window displays the following values:

- Total number of parts tested; part per second (throughput)
- Overall device computing time in ms (image capture + job evaluation)

The time progression for image capture and job evaluation is displayed graphically.

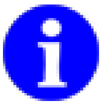
Breakdown of computing times

- **1** Total time for image capture in ms
- **1a**: Image capture proportion
- **1b**: Trigger delay proportion (if set)

- **2**: Total time for job evaluation in ms
- **2a**: Job evaluation proportion
- **2b**: Proportion of computing time not job-dependent

The total job evaluation time can be reduced by restricting feature tests (e.g. restricting the angular range for part location to contours).

A tool tip with more information will be displayed if you hold the mouse pointer over the bar.



NOTE

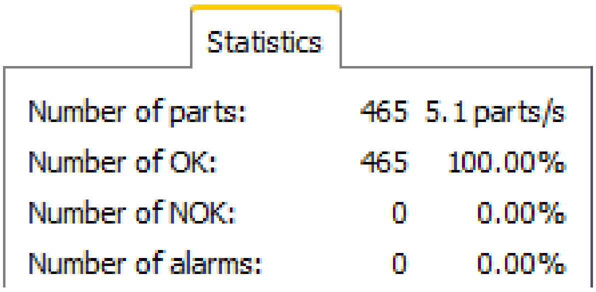
The throughput denotes how many items the device is processing per second.

Throughput is higher than the response time suggests. This is because the device is already loading the next image during result calculation and is thus working faster when viewed across all items.

Optimisation:
Parallel processing can be optimised by reducing the time-consuming activity as necessary. Device internal waiting times are avoided if image loading and result calculation have the same duration.

Disadvantage for devices without integral Industrial Ethernet: The device communication response time can be delayed in the case of absolutely parallel execution, since the device is already fully occupied by image processing.

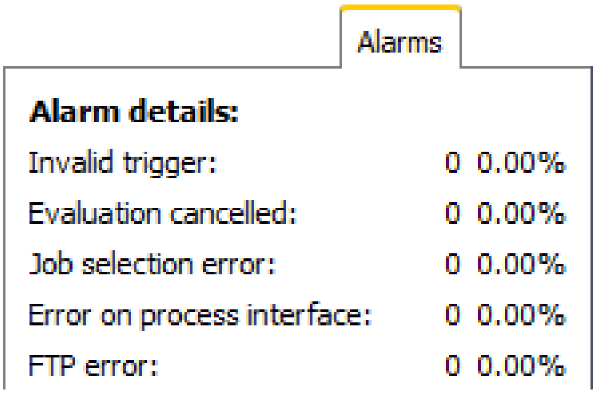
Statistics



The statistics window displays the following values:

- Total number of parts tested; part per second
- Number of passed parts (OK) (number/percent)
- Number of failed parts (NOK) (number/percent)
- Number of alarms (number/percent)

Alarms



The Alarms window displays the following values:

- Invalid trigger: Alarms due to mistimed triggering (number/percent)
- Analysis aborted: Aborted operations due to processing timeout (number/percent)
- Error in job selection: Alarm during job selection (number/percent)
- Errors at process interface: Errors at process interface (number/percent)
- FTP error: Error during transfer via FTP (number / percent)

10 Device menu

In the device menu, the basic parameters are set which apply equally to all jobs.

You can find the device menu when you click on *Device*.

NOTE

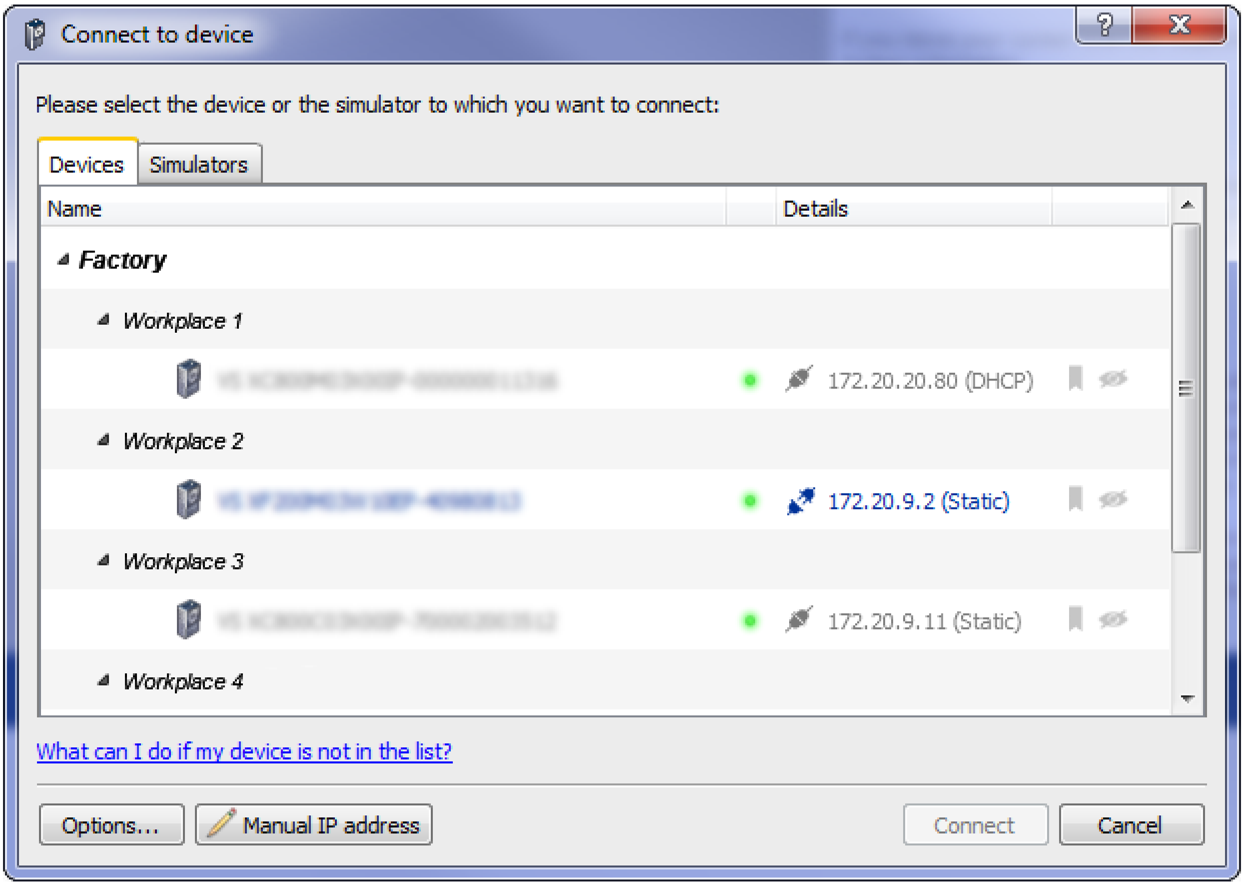
Please observe that it may be necessary to configure the stored jobs if you change these settings.

10.1 Connect to device...

Click on *Connect to the device.* Now you can see a list of all located devices on the Devices tab. If a device's device settings contain the location, the corresponding devices will be displayed as a topology ("device tree"). This makes it easier to manage even larger installation bases.

The operating mode and connection status to an *Application Suite* are displayed with a pictogram.

If you move your cursor over the respective device, you will see a tool tip with further information.



Options: Here you have the option of limiting the address area in which devices are searched for and of selecting an alternative port for communication. You can also activate the *User-defined list of known devices*.

User-defined list of known devices

The *User-defined list of known devices* allows you to manage devices from one central location. Different users thus have easy access to the same pool of recorded devices or can view their status (e.g. all those in the same plant) without a device disappearing from view or from the access bar due to an amended IP address or a power failure, for instance.

All devices saved here correspond to the devices with bookmarks. If a bookmark is placed against a device, it is automatically adopted into the list and if the bookmark is deleted it is removed from the list.

NOTE

Make security copies of this list on a regular basis.

Process

1. Save a file ending in .txt (e.g. *knownDevices.txt*) on a drive to which all required users have access.
2. Place a check against *Options → User-defined list of known devices*
3. Use *Search* to select the .txt file saved as per 1. above.
4. Confirm the entries made with *OK*.

→ All bookmarked devices will now be listed by name and serial number in the saved file and be displayed in the connection dialogue.

Manual IP address: This is where you can call up a device directly via its known IP address or place a bookmark.

NOTE

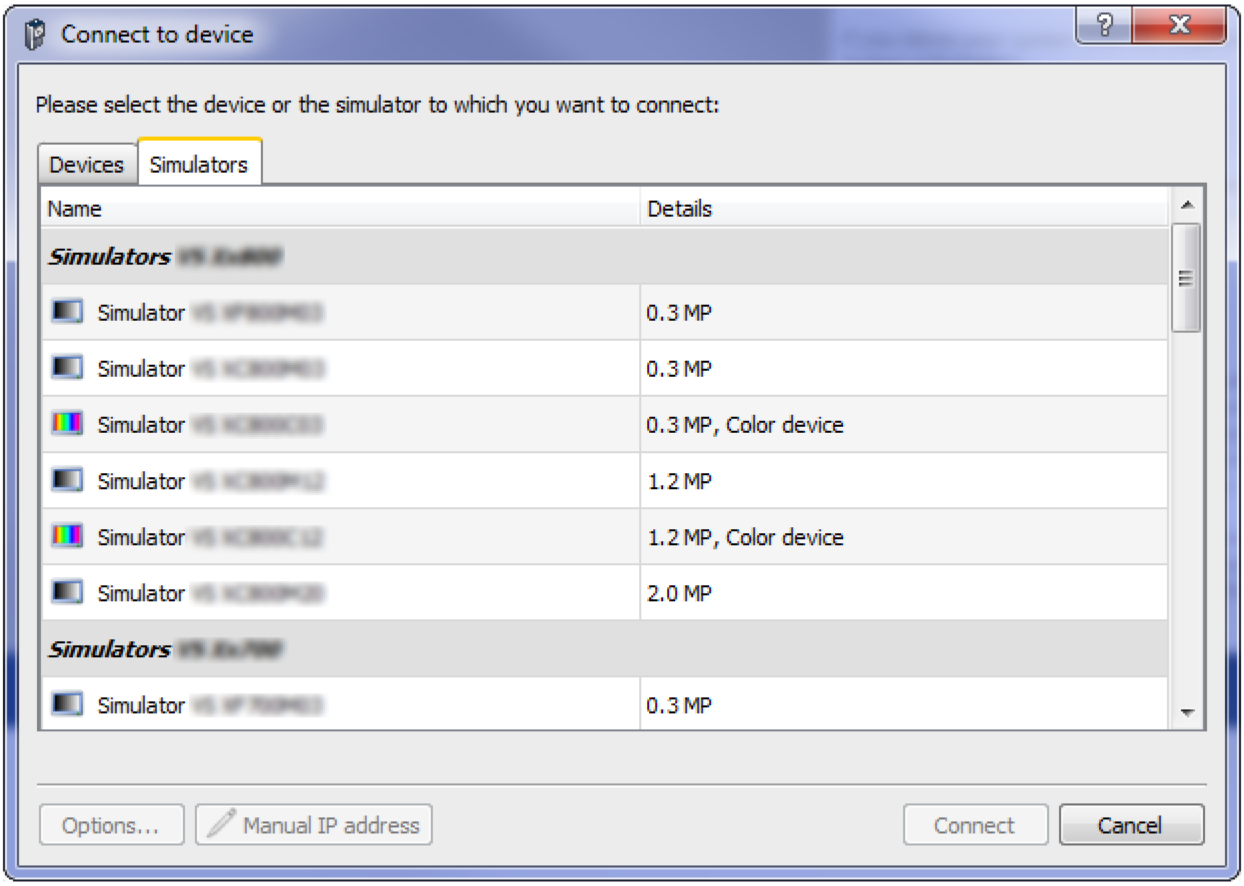
Once a device is installed in a machine it is typically assigned an IP address. In the event of temporary access via an external PC from another sub-network (e.g. for resetting parameters) the IP address is temporarily amended when connection is established.

In order for the machine to be able to access the device as usual again after the temporary amendment in IP address, it needs to recognise the previous IP address again.

This occurs by means of a device restart. Please therefore confirm the corresponding question with *Yes*.

Connection: Create a connection to the selected device.

	The Vision Sensor is in the *Activated* operating mode.
	The Vision Sensor is in the *Configuration* operating mode.
	The Vision Sensor is in *Restore* mode.
	The Vision Sensor is not connected to an *Application Suite*.
	The Vision Sensor is connected to an *Application Suite*.
	Mark the Vision Sensor as a favourite. Now it will remain in the list even if it is temporarily unavailable.
	Here you have the option to hide devices. You can reveal hidden devices with the *Display hidden devices* function.



On the *Simulators* tab, you can connect with one of the simulators to simulate a device and modify job settings and device settings without having to connect to an actual device.

Select the desired simulator and click on *Connect*.

NOTE

The device names and device location can be edited under *Device → Device settings → Device name.*

NOTE

You can launch the *Application Suite* using a command line parameter and automatically connect to the device via an IP address.

Example: `appsuite2.exe /ip=192.168.0.250` (default IP adresse)

There is also the option to launch the *Application Suite* in different languages using a command line parameter.

/l=de (German)
/l=en (English)
/l=fr (French)
/l=es (Spanish)
/l=zh (Chinese)
/l=ja (Japanese)
/l=ko (Korean)
/l=it (Italian)
/l=th (Thai)

Example: appsuite2.exe /ip=192.168.0.250 /l=en
(Start the *Application Suite* in English with the default IP address)

NOTE

Should the device no longer be reachable due to adverse factors (e.g. corrupt job data), and cannot be rebooted into Recovery mode independently, it can normally be forced to start in Recovery mode by starting the *Application Suite* with the following command line parameters:

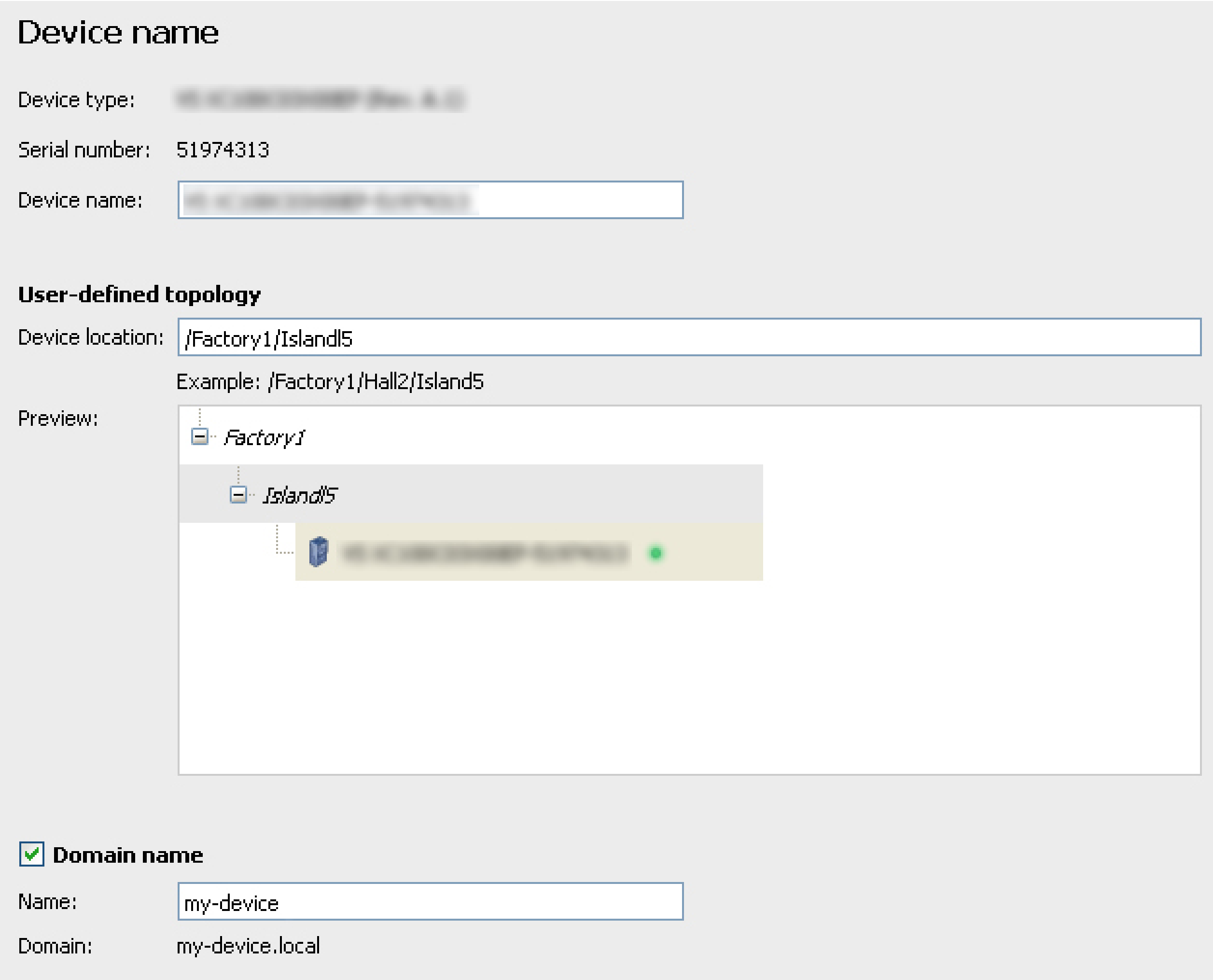
appsuite2.exe /ip=<device IP address> /rebootrecovery

This process normally takes a little over a minute. Once complete, the device will be in Recovery mode and jobs can be deleted, device settings can be changed or new firmware can be loaded.

10.2 Device settings...

The following generally applicable settings are made under the menu option *Device settings*.

10.2.1 Device name



Device type: The device type is permanently stored in the device and is only displayed.

Serial number: The serial number is permanently stored in the device and is only displayed.

Device name: You can assign a name to the device. This is then shown in the device status.

User-defined topology

Device location: You can enter the device location here. The preview changes as you enter the details.

Domain name: Activate this function if you wish to enter a device domain name for your Vision Sensor. This means that you will not only be able to enter the device's IP address to access it via the browser, but also be able to use a preset domain name (e.g. `http://my-device.local`), which has the advantage of being a fixed URL.

10.2.2 Access rights (device dependant)

10.2.2.1 Application Suite

ATTENTION!

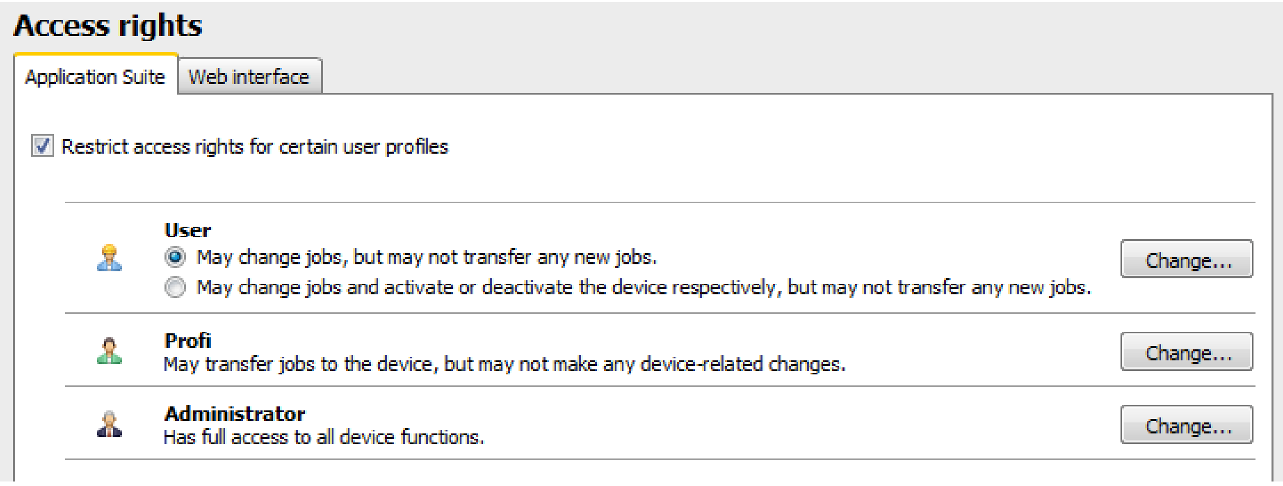
An assigned password cannot be reset without providing the assigned password.

Please remember your passwords!

Three user levels are available for you to avoid unauthorized changes on the device. The individual privileges for these levels are set as follows:

Function	Operator	Expert	Administrator
Activate / deactivate device	+*	+	+
Change the active job	+	+	+
Store and transfer the job to the device		+	+
Process interface assistant		+	+
Change device settings		+	+
Firmware update			+
Backup / restore device			+
Password management / encryption			+

*) if activated

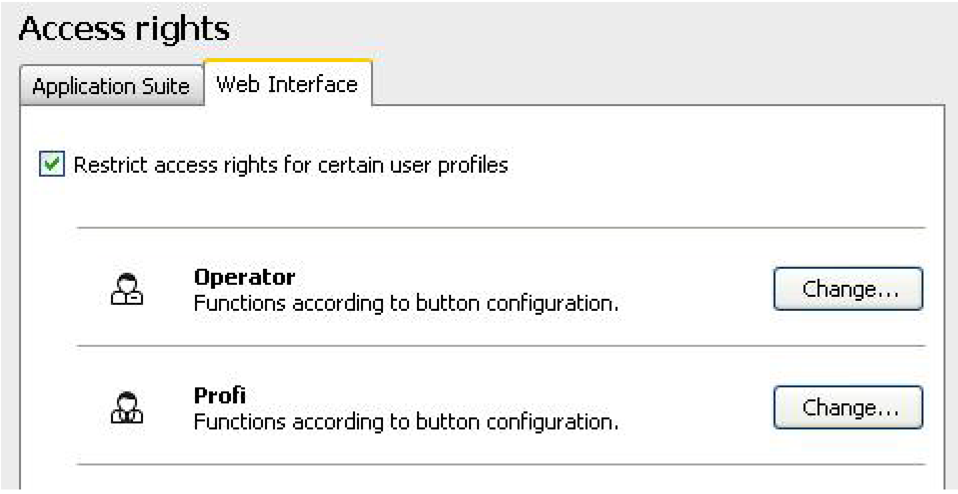


Activate the option *Restrict access rights for certain user profiles* for using user profiles.

10.2.2.2 Web interface

Two user levels are available for you to use to avoid unauthorized changes being made via the web interface.

The user levels for the web interface can be configured independently and differently to the *Application Suite* user levels. All functions of the web interface are therefore deactivated under factory settings.



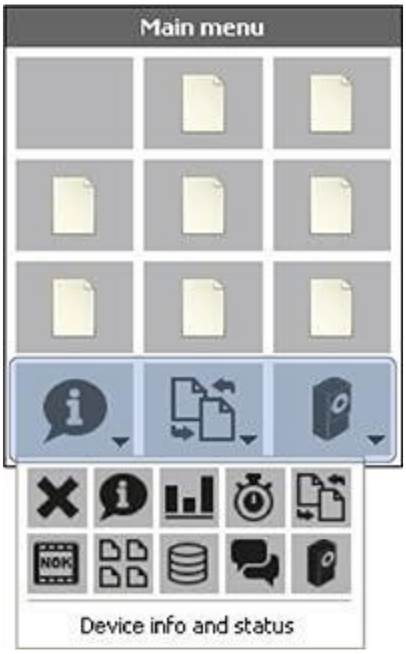
Activate the option *Restrict access rights for certain user profiles* for using user profiles.

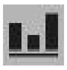
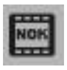
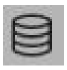
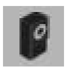
> **NOTE**
>
> The rights to change individual functions relating to a job can be set during job creation as part of the *Configure interface* → *Web interface* step.
>
> Rights for device-specific functions are set under *Device* → *Device settings* → *Configure web interface.*

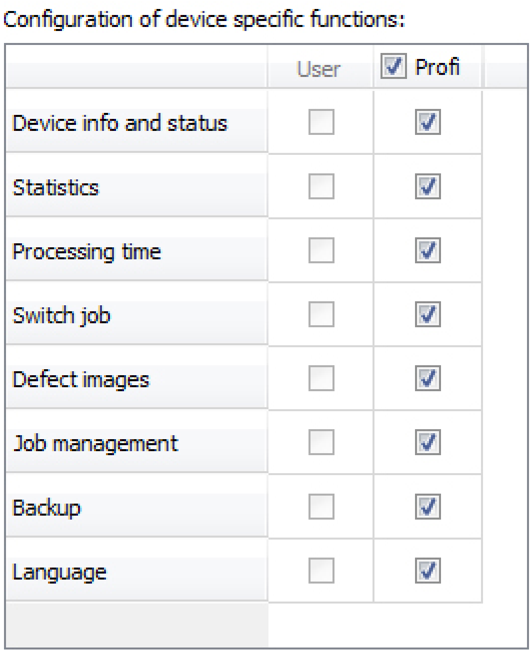
10.2.3 Web interface

10.2.3.1 Functions

In this dialogue, you have the option to assign device-specific functions to the three lower buttons in the web interface view.



Icon	Description
	Button has not been assigned a function
	Device info and status
	Statistics
	Processing time
	Change job
	Defect images
	Job management
	Backup
	Language
	Device-specific functions (provides access to all device-specific functions via an additional menu level.)



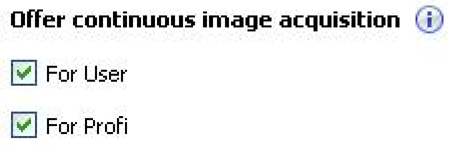
NOTE

Setting web interface access rights: *Device → Device settings → Access rights / Web interface*

Furthermore, you can define the rights for the different user groups for selected device-specific functions under "*Device-specific function configuration*".

Language: Select the language for the web interface here

Save the selection via the web interface: Activate this function if you wish to save the changes you have made to the language via the web interface. It will then be active immediately when you next start the web interface. You can only save this setting if a language has been set.



ATTENTION!

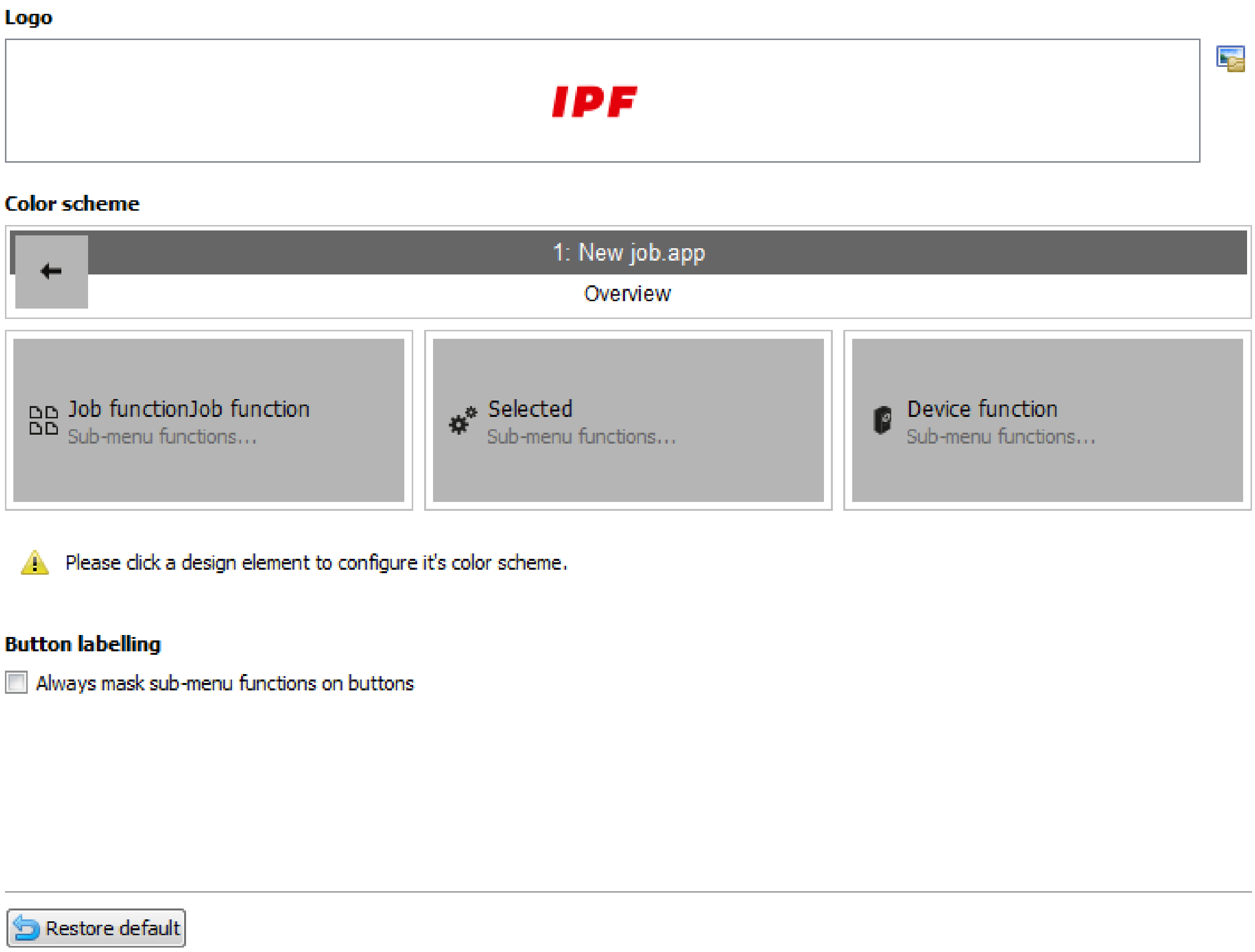
The live image function puts the device into "free running" mode, i.e. it runs without the external trigger signal. Please be aware of the effects this may have on later processes.

No live image will be available in the web interface when reconfiguring feature checks in the web interface for trigger-controlled image acquisition and stationary analysis.

Here, you can set the user level that has the access rights to temporarily set image acquisition to continuous rather than trigger-controlled using the *Live image* button.

Using this button, you can restore the original settings.

10.2.3.2 Design



In this dialogue, you have the option to adjust the colour representation of the web interface to suit you, and to integrate your own logo (max. 184 x 23 pixels) into the interface.

Click on the design element you wish to adjust and use the controls to adjust the colour.

In Expert mode, you have the option to enter colour values using hex format (RGB).

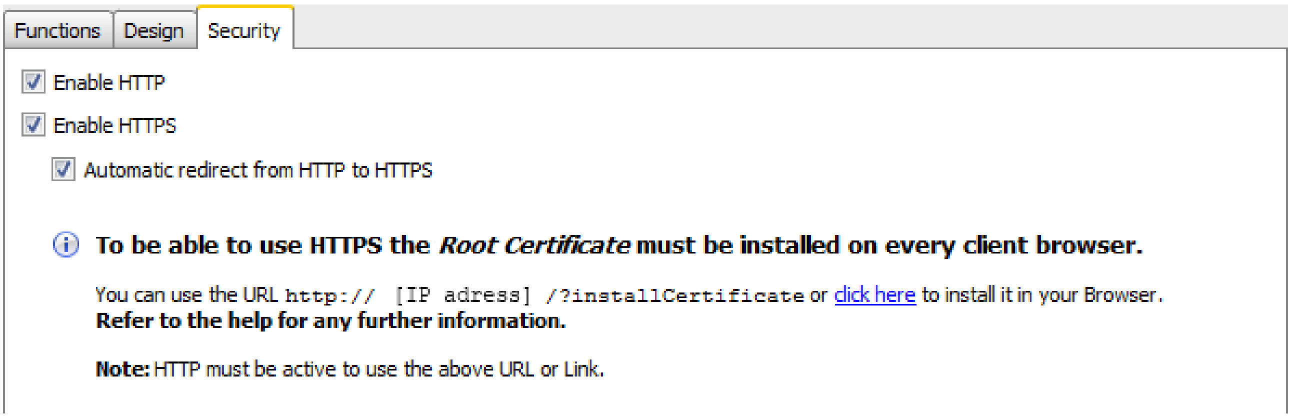
Button labels: Activate this function if you do not wish the second row of the buttons to be displayed in the web interface. This is particularly useful for smaller monitors.

Using this button, you can restore the original settings.

10.2.3.3 Security

There is a secure communication option of using SSL/TLS encryption to transmit data between the Vision Sensor web server and the web browser (device dependent).

There is also the option of completely disabling the web interface.



HTTP activation: Enable this function to transmit the data in unencrypted form.

HTTPS activation: Enable this function to encrypt the data. Installation of the respective SSL root certificate is required for activation (device dependend).

> **NOTE**
>
> The web interface on the Vision Sensor will be disabled if neither of these two options is enabled.

Automatic switching from HTTP to HTTPS: The address in the browser can start as usual with `[http://...]` if this function is enabled. The browser will automatically switch to `[https://...]` if it supports it (device dependend).

Click *OK* to restart the Vision Sensor and import the settings.

The use of HTTPS requires installation of the SSL root certificate in each browser used. Follow the instructions below to install the certificate for your browser.

Installation of the SSL root certificate

> **NOTE**
>
> HTTP must be active on the device to enable installation of the certificate.

Internet Explorer®

1. Launch the browser on your device. (E.g. `http://[IP address]/?installCertificate`)
2. Confirm that you want to install a certificate.
3. Confirm the opening of certificate *RootCA*.cer.
4. Click Certificate installation… → and the *Certificate import wizard* will be launched.
5. Click *Continue*.
6. Select *Save all certificates in the following memory.*
7. Click *Search*.
8. Select *Trusted root certification location.* Confirm with *OK*.
9. Click *Continue*.
10. Click *Finish*.
11. Confirm the Security warning with *Yes*.
12. Close and restart your browser.

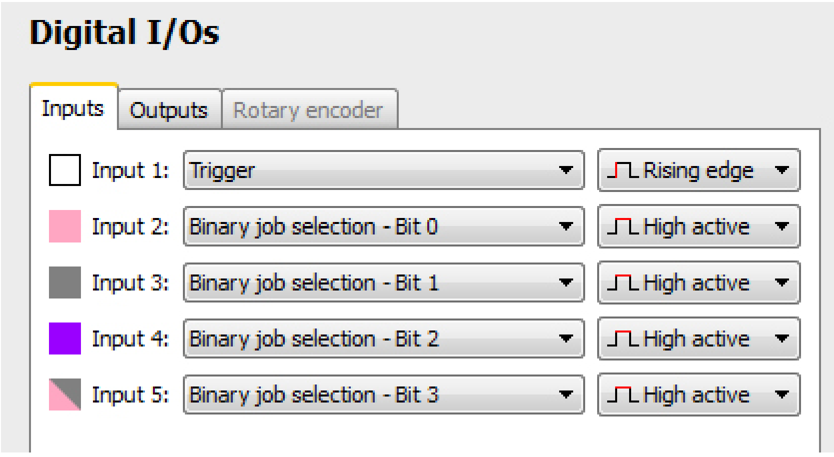
Firefox

1. Launch the browser on your device. (E.g. `http://[IP address]/?installCertificate`)
2. Confirm that you want to install a certificate.
3. Insert a check mark against *Trust this CA to identify web pages.*
4. Close and restart your browser.

10.2.4 Digital I/Os

You can adjust the settings for the digital interface on this dialogue page. You can also configure an incremental encoder and specify the polarity of the digital inputs and outputs.

Inputs

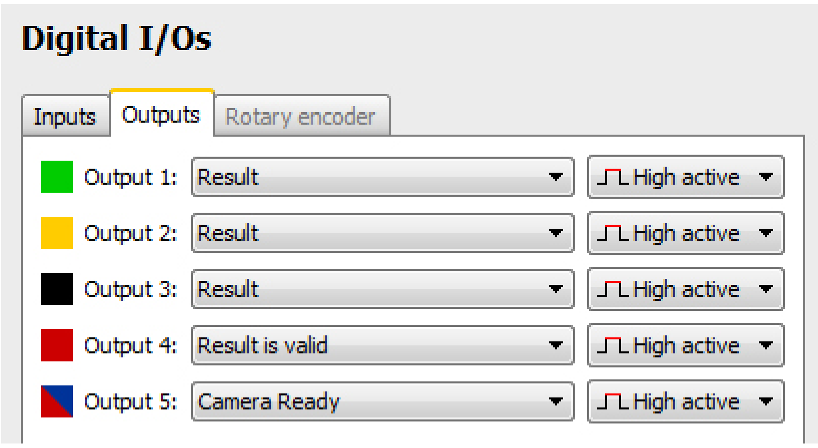


Input 1 is reserved for the trigger. For other inputs you can specify how you want to switch the active job. It is also possible to connect an incremental encoder to the Inputs 5 (CH-A) and 4 (CH-B).

Outputs

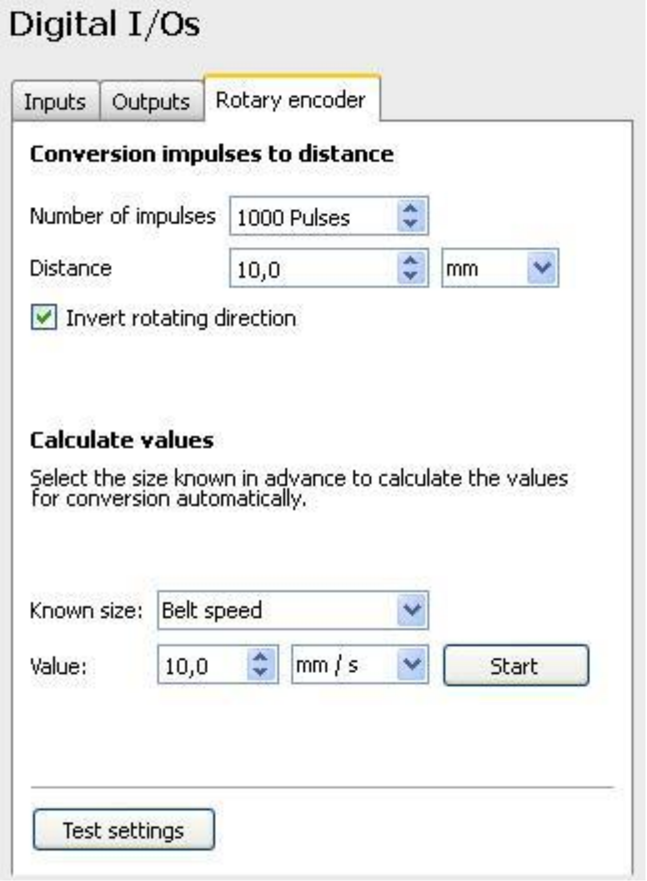
NOTE

The number of configurable outputs is device dependant.



Enter how the outputs are to be activated here. Hardware signals (image trigger permitted, result valid, result, alarm, flash sync, device activated, heat warning, heat shutdown) can be issued for each output or the output configured for issuing job results.

Encoder



If an incremental encoder is connected, you must also set the factor between the distance travelled and the number of pulses from the encoder.

To determine this factor, either you must know the conveyor speed or you must move the conveyor belt over a defined distance.

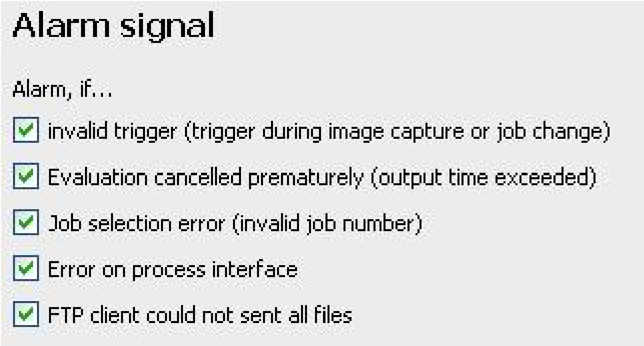
Determine the conversion factor as follows:

- Select the known quantity and set the corresponding value.
- Activate pulse measurement by pressing the *Start* button.
- Move the conveyor belt by the set value.
- Terminate the measurement using the *Stop* button.

Press the Test configuration button to check the current setting.

> **NOTE**
>
> All specifications during configuration refer to the forward motion of the conveyor belt. If necessary, reverse the direction of rotation to allow the device to function correctly.
>
> Make sure that Inputs 4 and 5 are set up correctly if you are using an encoder. If not, operation of the device may be impaired.

10.2.5 Alarm signal

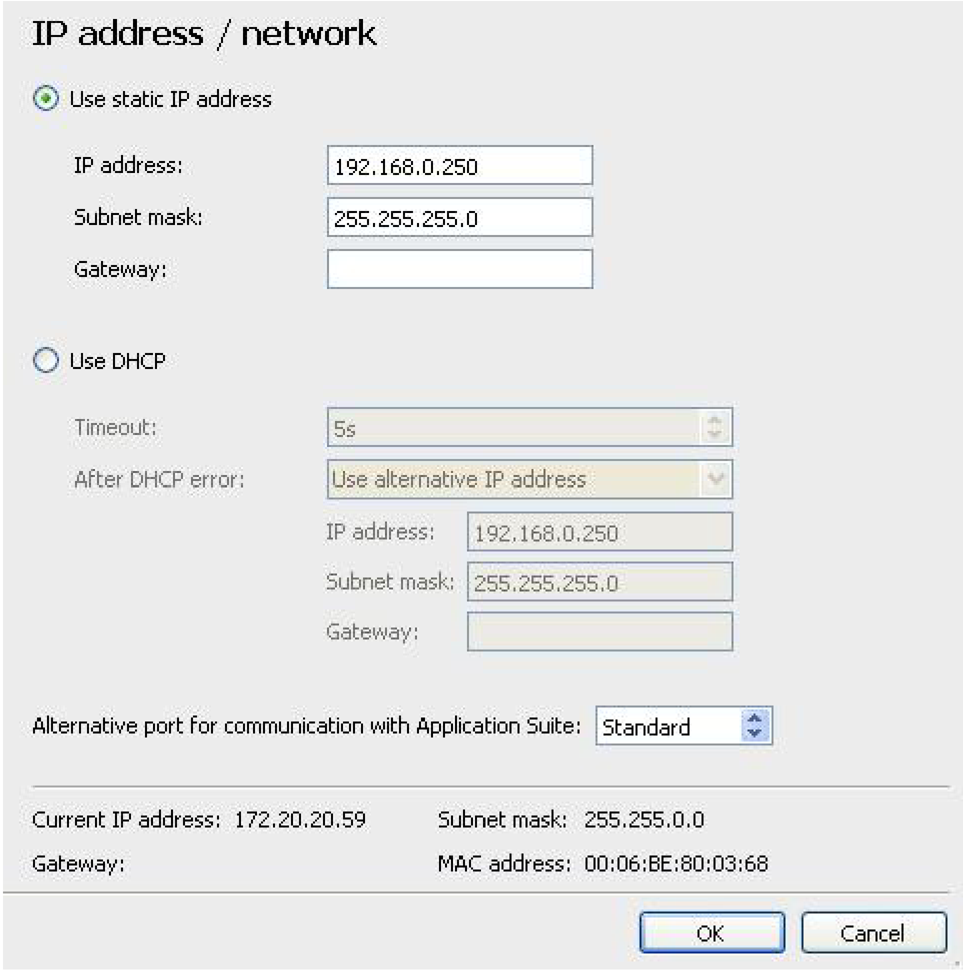


You can define the conditions which cause an alarm to be initiated here. Alarm signals indicate that an irregularity has occurred in the sensor.

The following causes may trigger the alarm:

Invalid trigger	Trigger during image acquisition, job switching or during parameter setting via the process interface ("SP"-Datagram)
Evaluation cancelled prematurely	The result of computing was not present at the latest output time.
Error in job selection	Invalid job number or job could not be loaded, e.g. because it is not correctly configured.
Error at process interface	An error occurred during data transfer to the process interface, e.g. an invalid command is received.
FTP client could not send all files	An error occurred while transferring the images via the FTP client. Possible causes could include: Device or server overloaded, incorrect access details or server cannot be reached.

10.2.6 IP address / network



Set the IP address of the device here. There are two choices for this.

- Static IP address
  The device uses a set IP address.

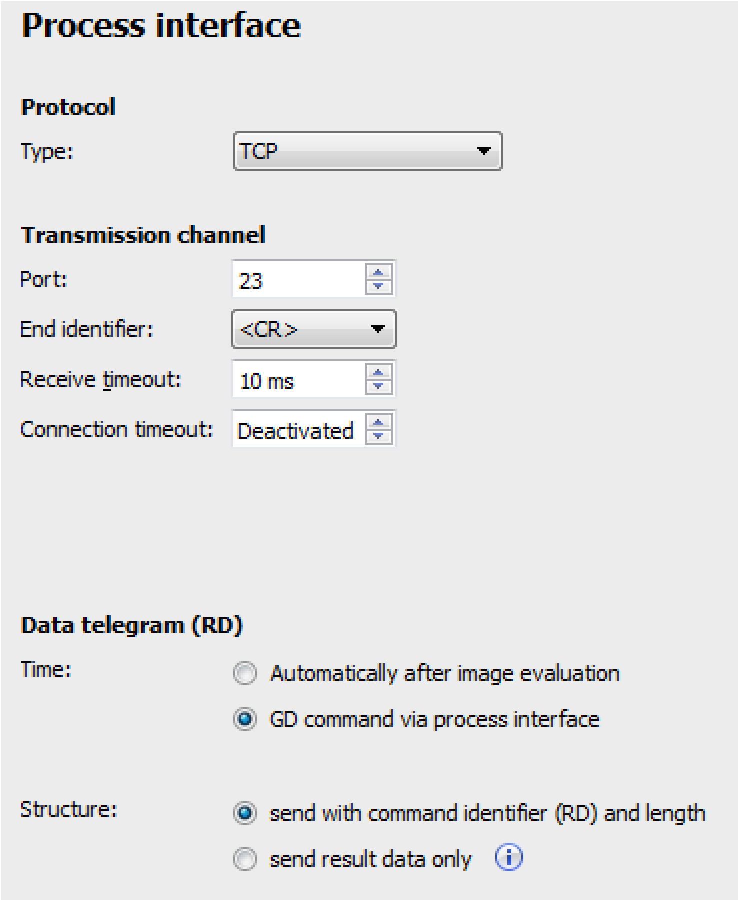
- **DHCP (Dynamic Host Configuration Protocol)**
  If you have integrated a DHCP server in your network, the IP address is obtained there. If this does not happen within a specific time and a timeout occurs, you can choose whether:
  - the last IP address obtained via DHCP is used
  - another fixed IP address is set

If the port `51.972` (standard) is already being used in your network, you may specify a different port for communication between the connection of the device and the *Application Suite*.

NOTE

This port must also be set in the dialogue *Connect to device - Options*, in order to create a connection.

10.2.7 Process interface (device dependant)



Here, you will find all parameters which can be used to configure data exchange via the interfaces.

Protocol

Type: Set the protocol here. The selection shown is dependant on the device.

Port: Set the port for the device's Ethernet interface here.
End identifier: Shows which control character is expected or sent at the end of each datagram.
Receipt timeout: Here, you can set the time after which receipt is stopped.

Connection timeout: The connection is closed if no contact is received within a given time.

> **NOTE**
>
> A TCP/IP connection can be monitored, for example for when the PLC cyclically sends the "GS" command. If the connection is broken, this is shown on the Vision Sensor page and the connection is reset.

Protocol (RS485) (device dependant)

Here, you will find all parameters which can be used to configure data exchange via the RS485 interface. Select device number 1 and the "Bus (without checksum)" protocol type and adjust the other parameters as necessary.

Baud rate: Speed of data transfer (bit/s).
Data bits: Number of bits per character
Device number: If you have multiple devices on one RS485 bus, each device must be assigned a number. (1-254)
Receipt timeout: Here, you can set the time after which receipt is stopped.
Response delay: Duration between reception of a command and transmission of the response
RS485 terminating resistor: Disable the terminating resistor if more than 6 devices are being operated on an RS485 bus.
Parity: Control of the parity bit
Stop bits: Number of stop bits as end code (1)
Protocol: Protocol type (point-to-point, bus without checksum, bus with checksum)

Protocol (PROFINET) (integrated, device dependant)

Here you will find all parameters which can be used to configure data exchange directly over the embedded PROFINET interface. As a rule this generally only relates to changing the IP address to 0.0.0.0. There is also the option of editing the device’s PROFINET name. Although this should be assigned using the PROFINET tool and not edited on the device.

NOTE

Once the request has been confirmed and the IP address and subnet mask have been set to `0.0.0.0` the device can never again be accessed via the *Application Suite* and can no longer be reconfigured in this manner. The FTP connection and web interface communication will also be set.

The device can only be accessed via the Application Suite again if a PROFINET tool is used to reconfigure it to an IP address other than `0.0.0.0`

Device name: The device name is usually assigned by the PROFINET tool. There is the option here for changing the device name in exceptional cases.

Datagram (RD)

Time:

Automatically following image analysis: the device sends the datagram independently
GD command via process interface: the device's result is requested with the GD command

Structure:

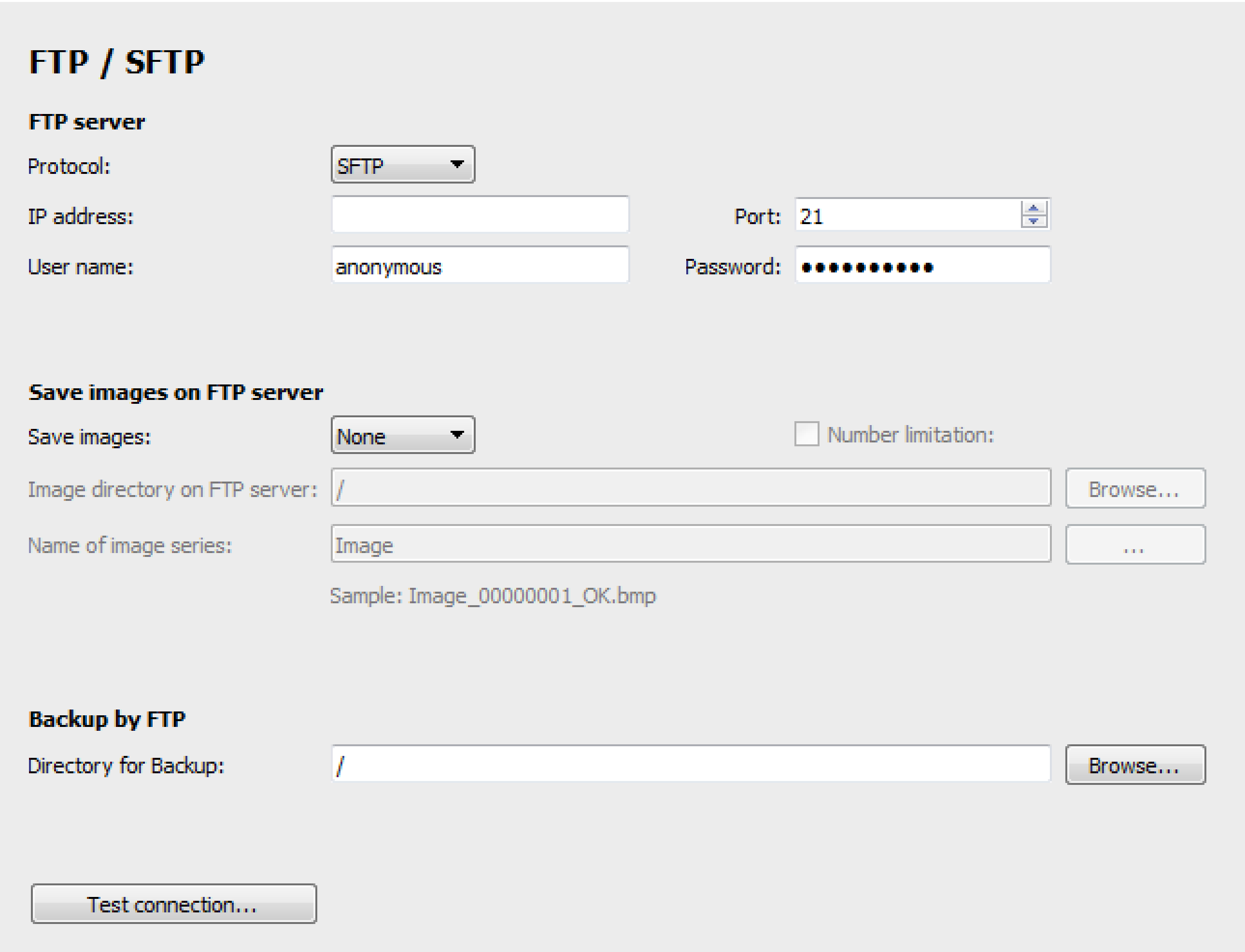
Send with command designator (RD) and length: the device also sends the RD command designator and the length of the result data (prefixed as a header)

Send result data only: the device only sends the result with no additional information. One suitable use for this would be if the application only requires the result data from the device (without header information).

10.2.8 FTP / SFTP

Using the FTP - / SFTP function, you can save selected images on an FTP server during production. This data can be transmitted in encrypted form (SFTP) depending on your device and your server.

It is also possible to save backups of the device to FTP servers and to access them up from there.



FTP server
Protocol: SFTP (device dependent, encrypted data transmission) / FTP (unencrypted data transmission)
IP address: IP address of the FTP servers
User name: Enter the user name for FTP access.

Port: Port number of the FTP servers
Password: Enter the password for FTP access.

NOTE

To use the FTP server successfully, the device requires read, write and delete access.
The device and the FTP server must also be located in the same subnetwork.

The FTP server must support encryption to be able to use SFTP.

Do not save the images and backup file to the same directory on the FTP server. This can lead to long load times.

Saving images to the FTP server

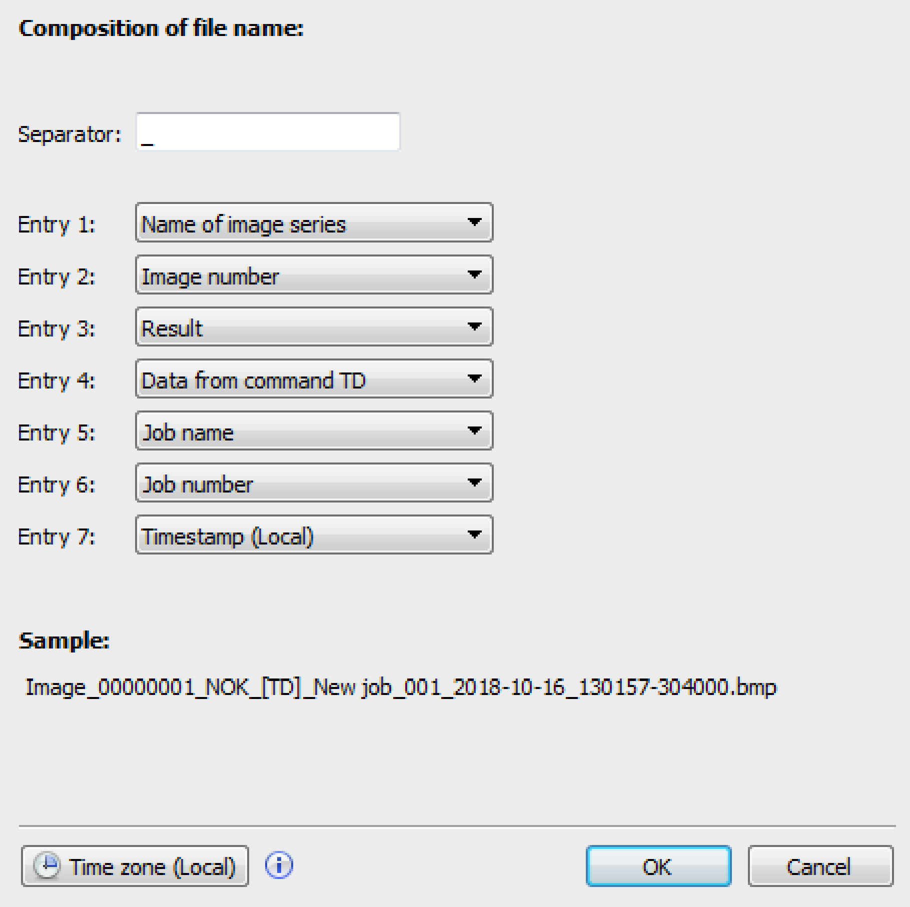
Saving images: Select the images to be stored on the FTP server.
(NOK only = all images with the total result of "Fail", OK only = all images with the total result of "Pass")

Number limit: Use this function to limit the number of images stored. If the limit is reached, the older images will be overwritten.

Image directory on the server: Select a directory on the FTP server where images are to be stored.

Name of image series: Provide a name for the image series.

... You can configure the structure of the file name.



The file name configuration gives you the option to freely arrange up to seven entries. You can also define separation markers.

The entry options for the device are:

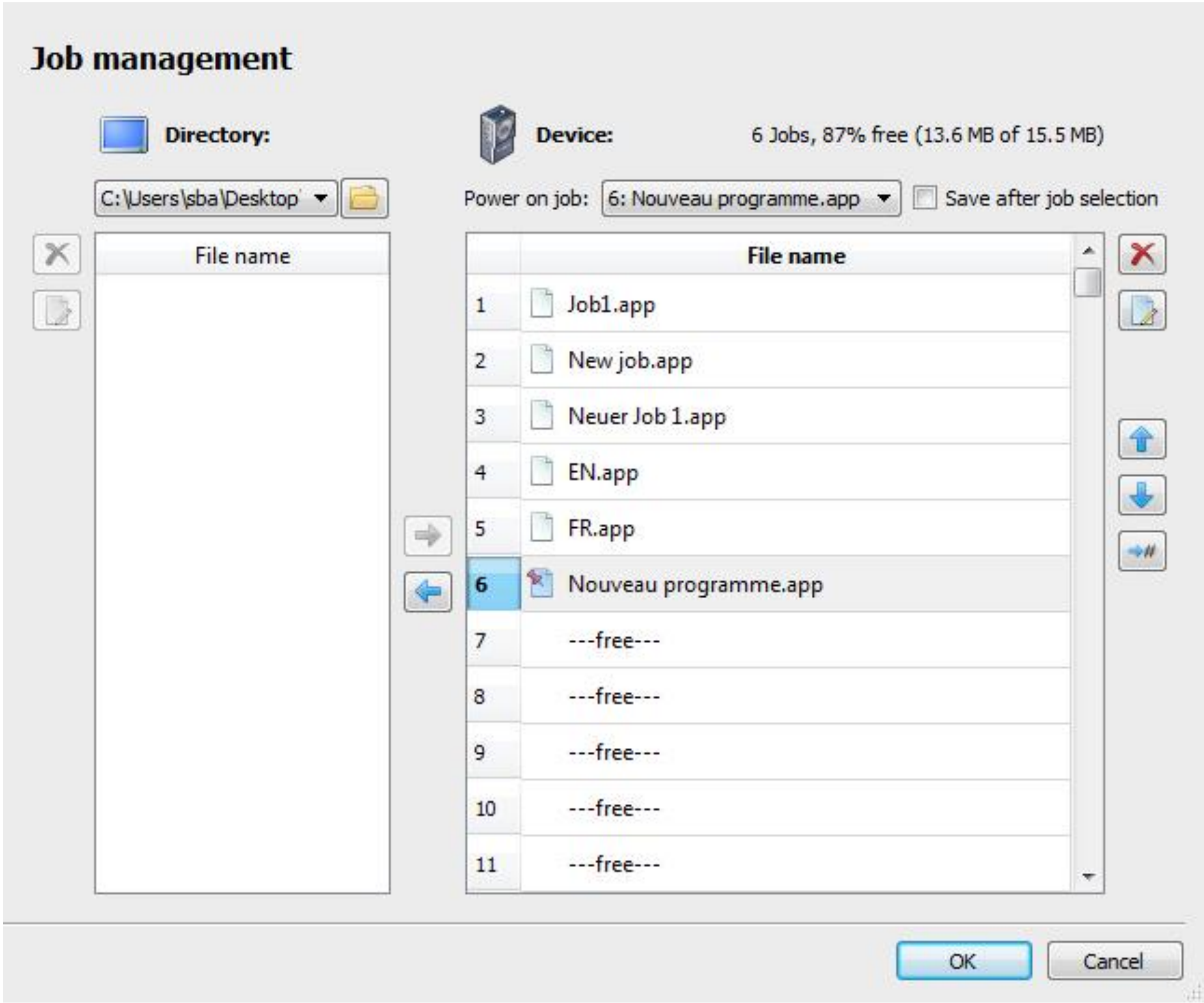
- The chosen name of the image series
- Sequential numbers generated by the system (00000001 – 99999999)
- The result of the analysis
- The additional data applied to the image using the TD command
- The job name
- The job number
- A time stamp (local): FTP server time similar to Time stamp (*UTC*), although here a local offset can additionally be configured under Time zone (*local*). This value consists of the chosen time zone and – if selected – the consideration of summer time. Switching between summer time and winter time then occurs automatically within the device and matches the chosen time zone.
- A time stamp (UTC): Time from the FTP server (the Vision Sensor time is synchronised with the FTP server every time it is restarted).

Backup via FTP

Directory for backup: Select a directory on the FTP server where the backups are to be stored.

10.2.9 Job management

With this dialogue, you can easily and conveniently copy your jobs between a folder on your computer and the Vision Sensor.



Choose the folder on your computer with: off. The jobs available in this folder are then displayed on the left hand side.

On the right hand side you will see the jobs on the device and their job numbers, as well as remaining storage space available for jobs on the device.

> **NOTE**
>
> Even if no job is available, part of the storage space is occupied by internal files.

Observe that the job number directly corresponds to the binary code with which the jobs are selected in Real time mode via the Job selection via digital inputs.

Power on job: Here you can also choose which job will be loaded when the Vision Sensor is switched on. This job is then marked with this symbol.

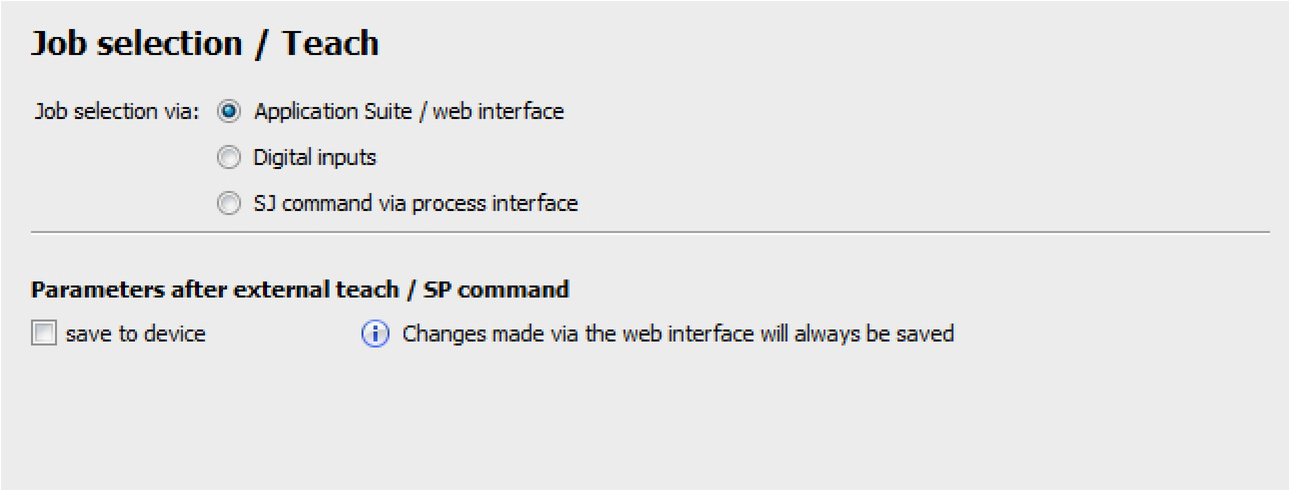
When jobs are switched by the binary method via the digital inputs, no job is active when the device is switched on. In this case, the desired job is selected using the levels present at the inputs.

Save after job selection: Activate this function if you would like the most recently active job to be activated the next time the device is started.

Transfer the jobs using the horizontal arrows and move jobs to the corresponding storage locations in the device with the vertical arrows. You can also use the bottom button to enter the target position for the job directly.

Use the cross to delete jobs.

10.2.10 Job selection / Teach



Here you can basically set how you want to make the job selection.

Job selection via:

Application Suite / Web interface: The job can only be changed manually via the *Application Suite* or via the web interface.

Digital inputs: Jobs are selected via the digital inputs.

Command SJ via process interface: Jobs are selected via the process interface.

Parameters following external teach / SP command

If the "save to device" option is activated, changes resulting from external teach or process interface commands in the job are saved to the device. If this option is not activated, changes are discarded when the device is rebooted. In this case, the originally saved job is executed.

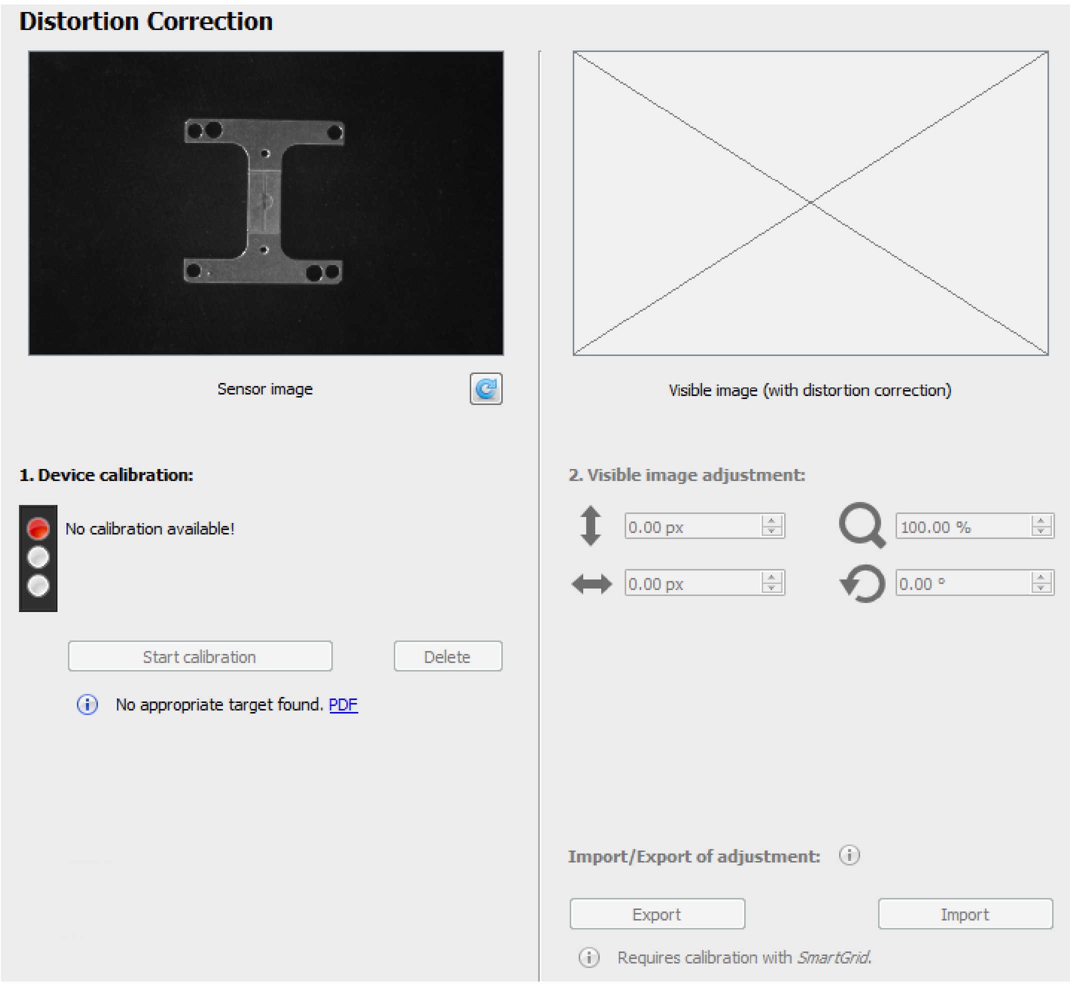
10.2.11 Distortion correction (device dependend)

The recorded images can be contorted by lens distortion or inclined positioning of the Vision Sensor.

The *Distortion correction* function can be used to compensate for these distortions .

The location of the lens will determine the degree to which the image can be compensated for such inclined positioning of the Vision Sensor. A value of around 30° to the ideal location (Vision Sensor is parallel to the object surface) can be assumed as a "rule of thumb", whereby both non-achievement and exceedance of this value is possible.

> **NOTE**
>
> A *SmartGrid* or target is required for calibration of this function.
>
> After successful installation, the *SmartGrids* can be found in the directory:
>
> `<installation path>\AppSuite\calibration`
>
> on your PC.
>
> You can also open the folder directly from the dialogue.



Performing distortion correction

1. Print the required *SmartGrid* (PDF). Alternatively, ready-made *SmartGrids* are offered.

   Requirements
   - The *SmartGrids* must have a minimum size of 20 x 20 pixels
   - At least 6 x 8 squares are required in the Vision Sensor's field of view, preferably more

2. Place the *SmartGrid* as straight as possible in the entire field of view of the vision sensor. Use the Refresh button to renew the sensor image as necessary. Any image display options, such as a preset rotation, will be ignored.

3. Press *Start calibration*.

   → Distortion correction is performed and coordinates are learned. The yellow light will flash on the display whilst calibration is being performed. Successfully calibrated distortion correction and learned coordinates are indicated by a green light on the display. The date and time of calibration are also displayed.

> **NOTE**
>
> A constant red light means that distortion correction could not be successfully performed.
>
> Causes could be:
>
> - The *SmartGrid* squares are too small (minimum size 20 x 20 pixels)
> - There are too few squares in the field of view (at least 6 x 8 squares are required, preferably more)
> - the *SmartGrid* is partially covered

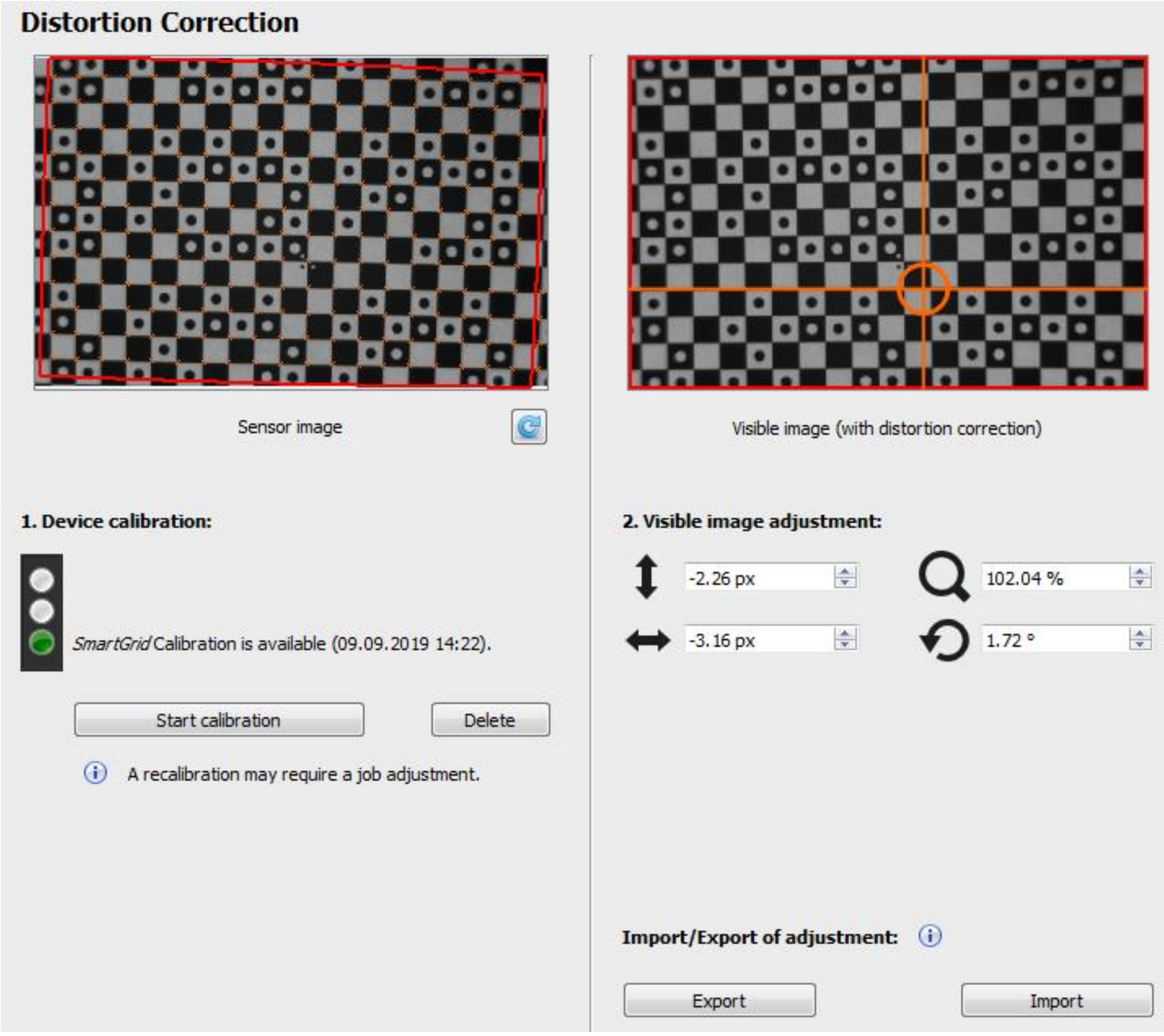
4. The preview images will now display the used image area (left pane) and the resulting image (right pane) with a red frame. The generated image will be rotated to match the target's orientation, as long as this rotation lies within the range supported by the Vision Sensor. If you performed the calibration with a *SmartGrid*, you will also be shown the reference point.

   You will see a tool tip with accuracy specifications if you move your cursor over the right pane.

5. You can adjust the automatically determined image area if you wish (vertical shift, horizontal shift, magnification and rotation).

> **NOTE**
>
> The larger the corrective rotation, the lower the maximum frame rate to be achieved and thus the part throughput for jobs!

6. Press *OK* to transfer the distortion correction to the Vision Sensor.



NOTE

This function can increase the Vision Sensor's start-up time.

You can reduce the start-up time by pressing *Delete* if this function is not required.
Disabling the function within image settings is not sufficient for this!

Import / export of the customisation

These functions allow you to export visible image settings and transfer them to another device by importing. This makes it easy to change devices.

After import, the visible image shows the same image detail as before during export.

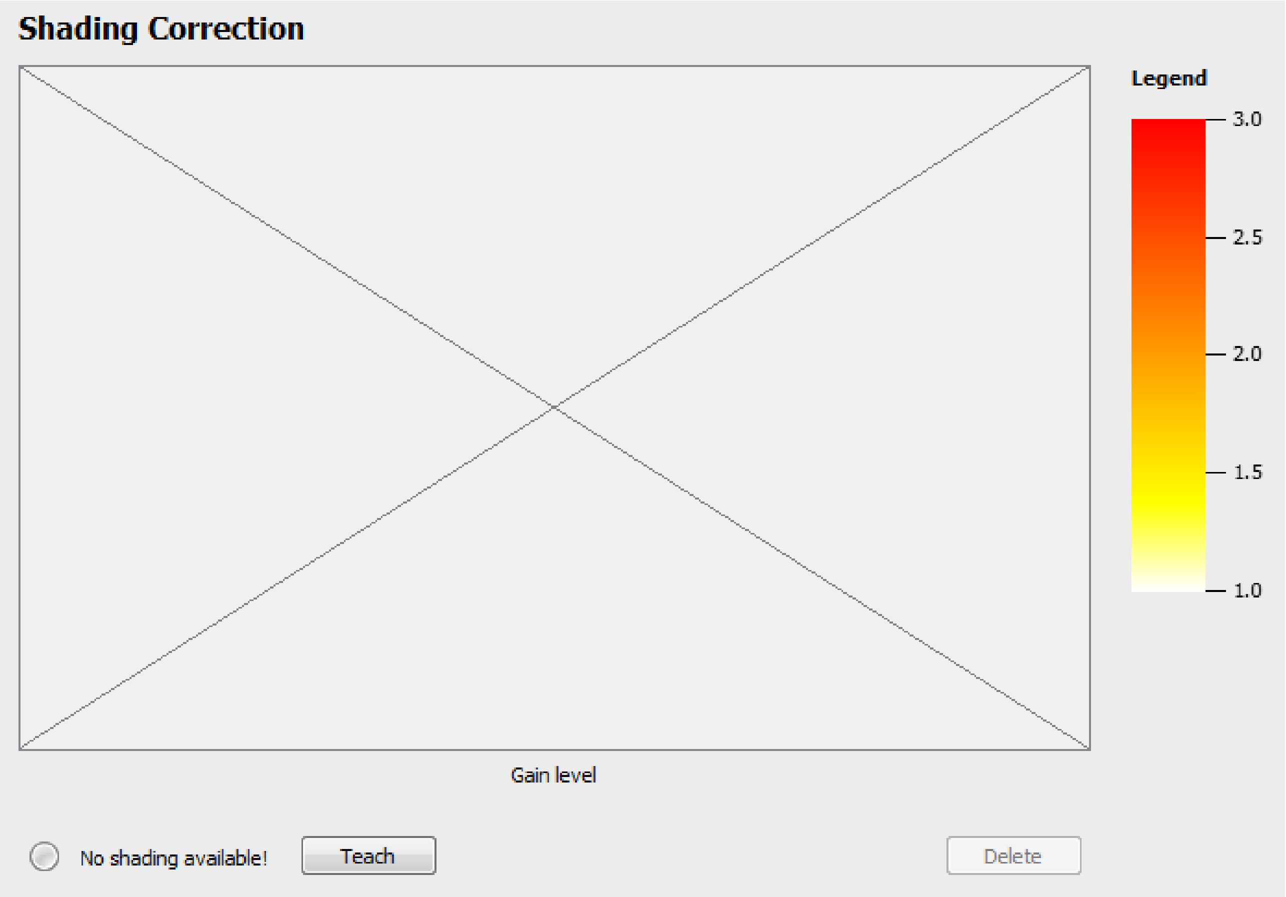
NOTE

Importing and exporting only work with coordinates learned by *SmartGrid*

10.2.12 Shading correction (device dependend)

Uneven lighting can result in some areas of the image being darker than others.

Shading correction provides the option to compensate for brightness irregularities in the image.



Performing shading correction

1. Use the *Image recording* tab to first configure the lighting situation as it will be for the planned feature checks. Activate the internal lighting, for example.

2. Place an homogeneous white or grey template in the Vision Sensor's field of view. Any image display options, such as a preset rotation, will be ignored.

3. Press the *Teach* button.

   → Shading correction will be performed. The teaching of shading correction is performed on the original sensor image and is applicable with or without distortion correction.

4. The gain factor for the individual image areas will be displayed in the preview window for the original sensor image.

NOTE

It may not be possible to fully offset all differences in brightness if the maximum gain factor (3.0) is reached in many areas of the image.

Please check the lighting situation and the homogeneity of the template and perform shading correction again.

5. Press *OK*. The programmed shading correction is saved on the Vision Sensor.

NOTE

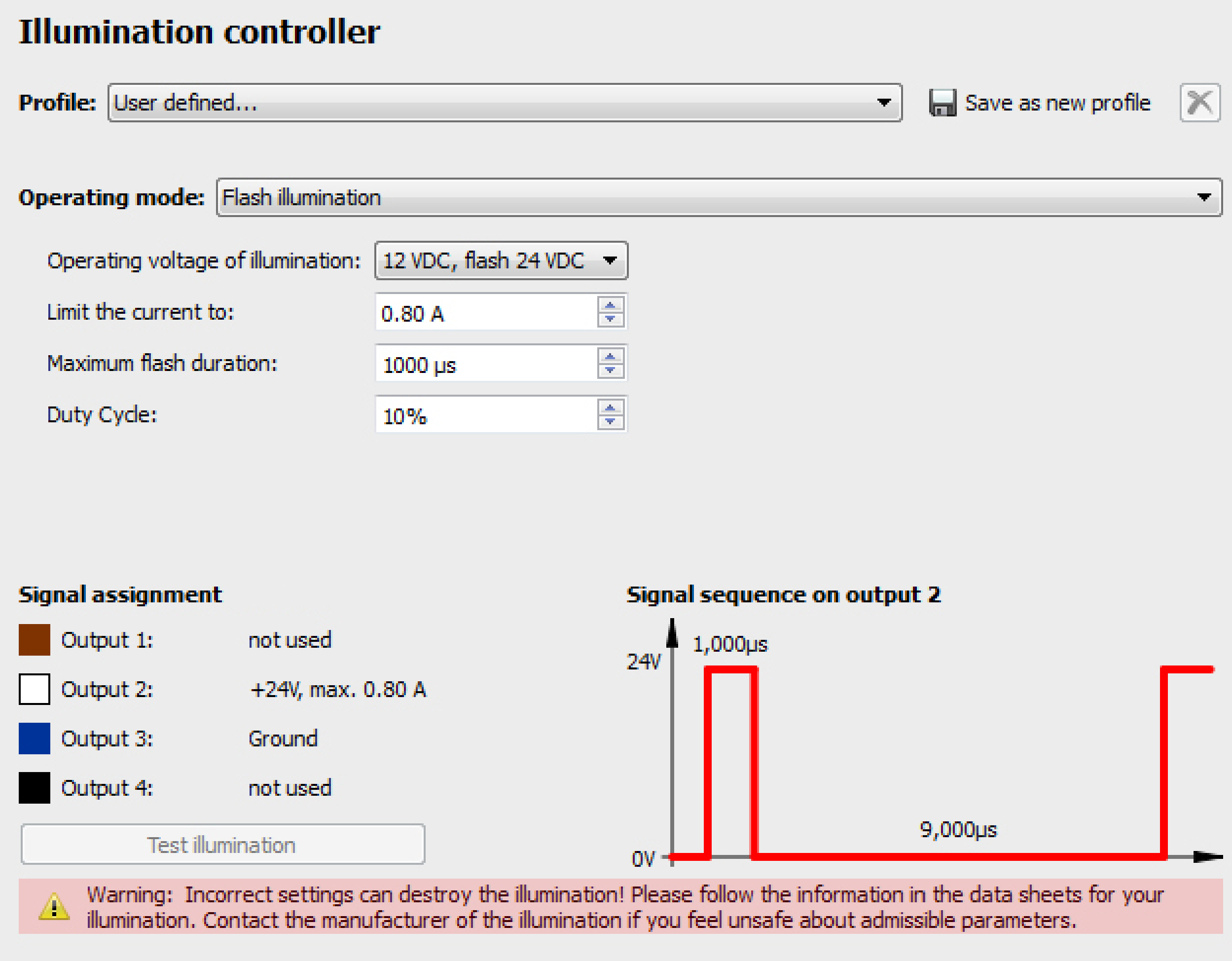
This function can increase the Vision Sensor's start-up time. You can reduce the start-up time by pressing *Delete* if this function is not required.

Disabling the function within image settings is not sufficient for this!

10.2.13 Illumination controller (device dependant)

ATTENTION!

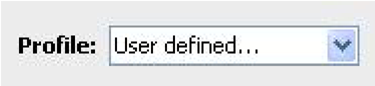
Erroneous settings can destroy the illumination! Please follow the information in the data sheets for your illumination. Contact the manufacturer of the illumination if you are unsure about admissible parameters.



Using the illumination controller, you can make the settings at the outputs of the illumination port.

You can also use a direct "flash" (flash controller function) alongside directly controlling external illumination. Alternatively, an unamplified signal can be output to an external flash controller.

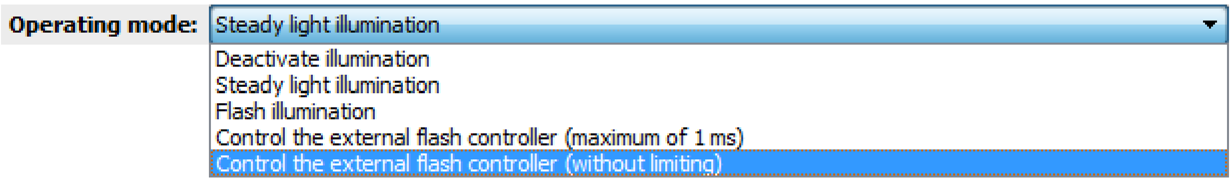
To use the illumination controller, the device must be in *Configuration* mode. If the menu item is not visible, your device does not support this function.



As soon as you have saved a profile that you created, it is available here.

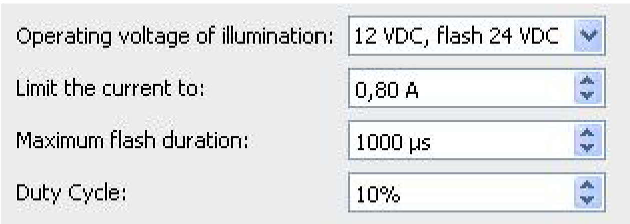
If you have made your own settings, you may save them as a new profile.

Using this function, you can delete a profile that you created.



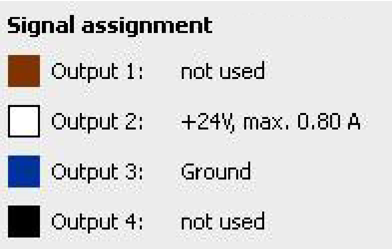
You have various operating modes available.

Operating Mode	Description
Deactivate illumination	No settings possible / illumination port deactivated
Steady light illumination	Settings possible (limit operating voltage/current)
Flash illumination	All settings possible
Control the external flash controller	No settings possible, flash sync active
Control the external flash controller (max. 1 ms)	No settings possible, flash sync active (max. 1 ms)
Control the external flash controller (without limit)	No settings possible, flash sync synchronous to exposure active

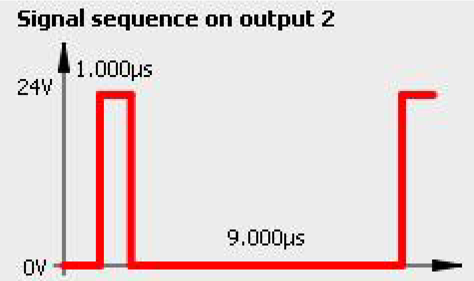


Here, you can define settings in the current operating mode.

Function	Setting Possibilities
Operating voltage of illumination:	12VDC/24VDC
Limit the current to:	<u>Steady light illumination</u> 0.1A…0.8A (increments of 0.1A) <u>Flash illumination</u> 0.1A…4.0A (increments of 0.1A)
Maximum flash duration:	1µs…1000µs
Duty Cycle:	1%...10%



This view shows how the signals at the 4 outputs of the illumination port are connected for the current settings.



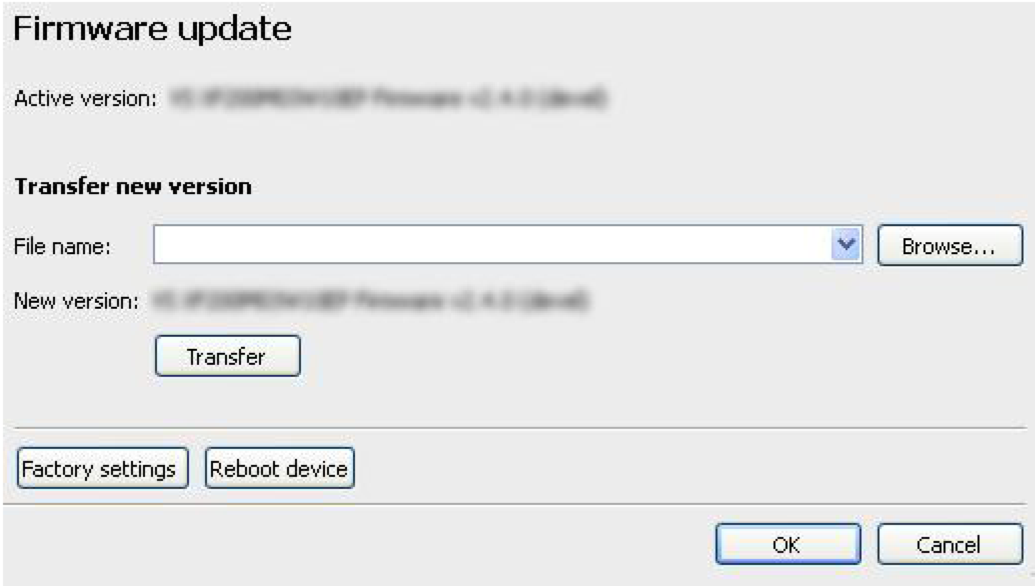
This diagram shows the current waveform at output 1 and output 2.

10.2.14 Firmware update

NOTE

During restoration of a backup or firmware, the operation of the device by uninvolved programme components (web interface, *Application Suite* or process interface) is not blocked. This means it is possible to interrupt these during the restoration process.

Do not undertake any other actions during the restoration process!



This dialogue provides support in the installation of new firmware.

ATTENTION!

Only use the most recently released version of the firmware for updating. You may wish to ask the Support before updating firmware. Create a device backup of your Vision Sensors before updating firmware!

Click on the button *Browse* and select the firmware file to be transferred.
(File extension *.vsf).

Click on the button *Transfer* to carry out the update.

The *Factory settings* button permits the factory settings to be restored. The current firmware will be retained.

NOTE

Restoring the factory settings deletes all of your previous settings and jobs.

Confirm the request with *Yes* to restore the sensor to the factory settings.

Use the *Restart device* button to restart the device. The functionality is equivalent to switching the power supply off
and back on.

Confirm the request with *Yes* to restart the sensor.

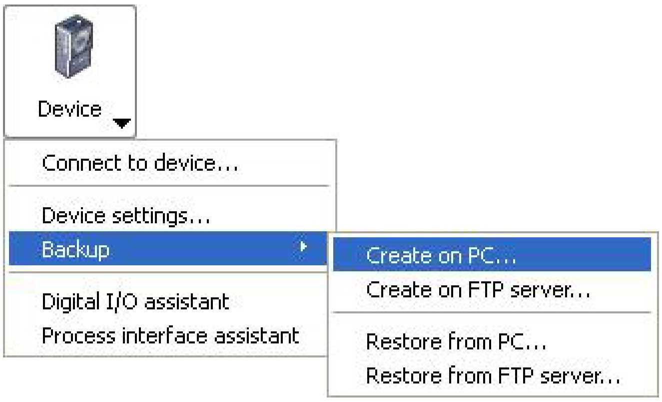
10.3 Backup

NOTE

During the creation and restoration of a backup or firmware, the operation of the device by uninvolved programme components (web interface, *Application Suite* or process interface) is not blocked. This means it is possible to interrupt these during the restoration process.

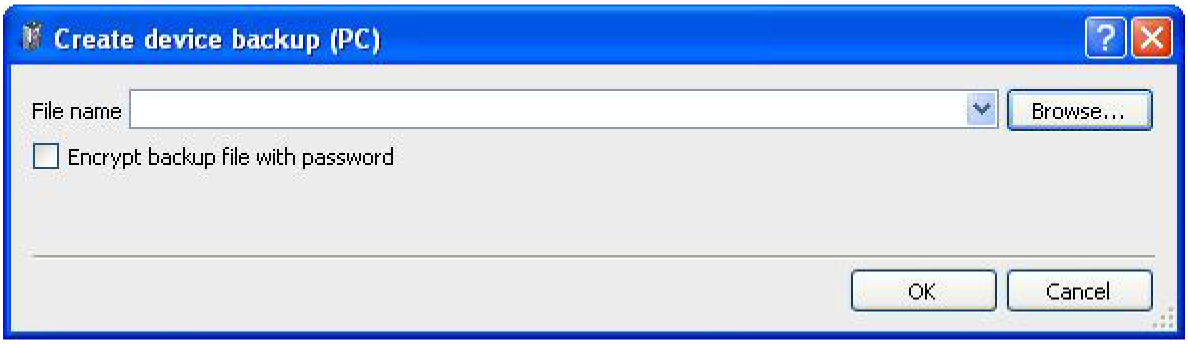
Do not undertake any other actions during the creation and restoration process!

10.3.1 Backup - using the PC...



This dialogue page supports you in making a complete device backup of your device on the PC. Here device settings, jobs and firmware are saved in a file.

Activate the option "Encrypt backup file with a password" if the backup file is to be stored in protected mode.



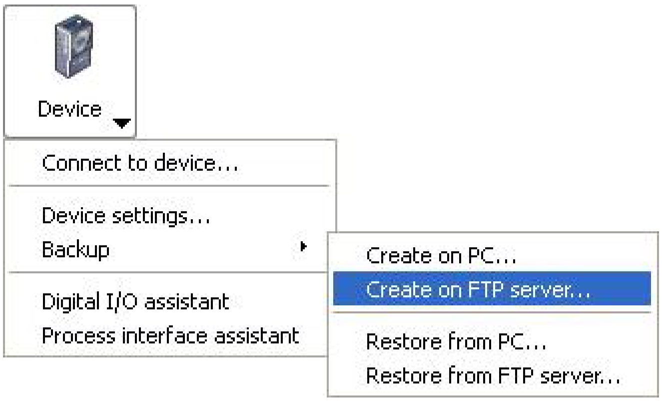
NOTE

The device backup cannot be reloaded without knowing the password!

Specify a storage path and a file name for the backup file or click on *Search*. The file extension must be `*.vsb`.

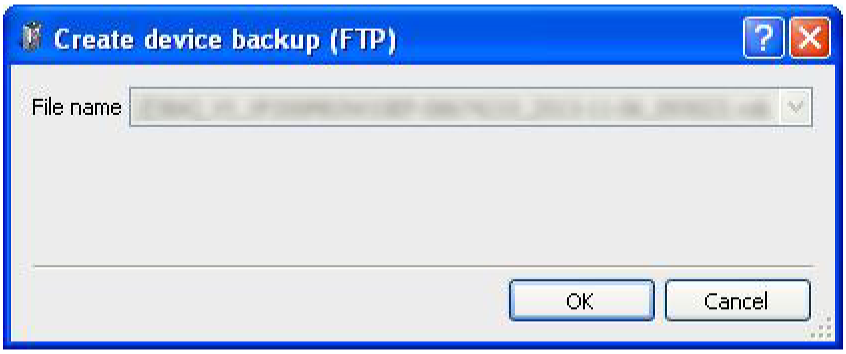
Click on *OK*. The required file is created. During this process, all device settings and jobs are transferred. This process may take a few minutes.

10.3.2 Backup – using the FTP server...



This dialogue page allows you to create a complete device backup of your device on the FTP. Here device settings, jobs and firmware are saved in a file.

The backup file cannot be protected with a password, and a file name for it cannot be assigned manually.



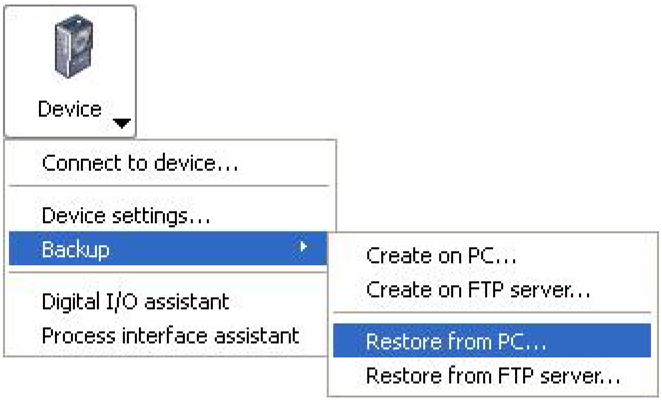
NOTE

Do not save the images and backup file to the same folder on the FTP server. This can lead to long load times.

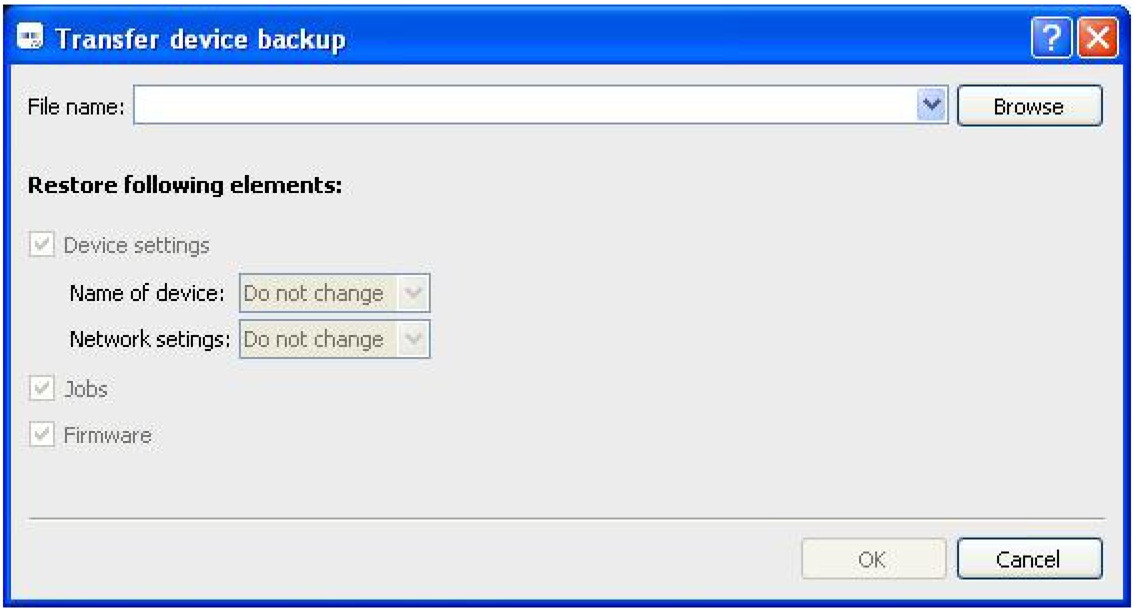
FTP settings: *Device* → *Device settings* → *FTP*

Click on *OK*. The required file is created. During this process, all device settings and jobs are transferred. This process may take a few minutes.

10.3.3 Backup – restoring from the PC...

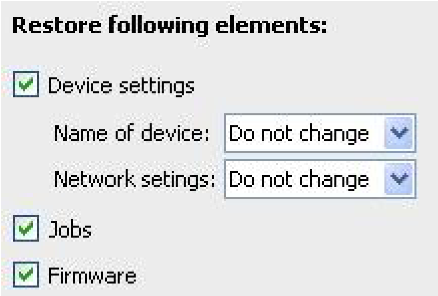


Use this dialogue to transfer a device backup file from the PC to the device.



Specify the storage path of the backup file or click on *Browse*. The file extension must be `*.vsb` .

If this is a protected backup file, you must then enter the password.



Here you select what components are to be transferred during the restore process.

NOTE

If you restore the factory settings of the Vision Sensor, all unsaved files will be lost!

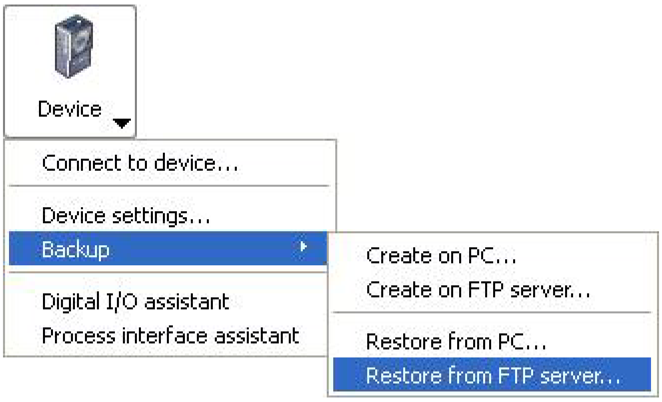
Now transfer the selected settings and jobs to the device with *OK*. This process may take a few minutes.

(device dependant)

NOTE

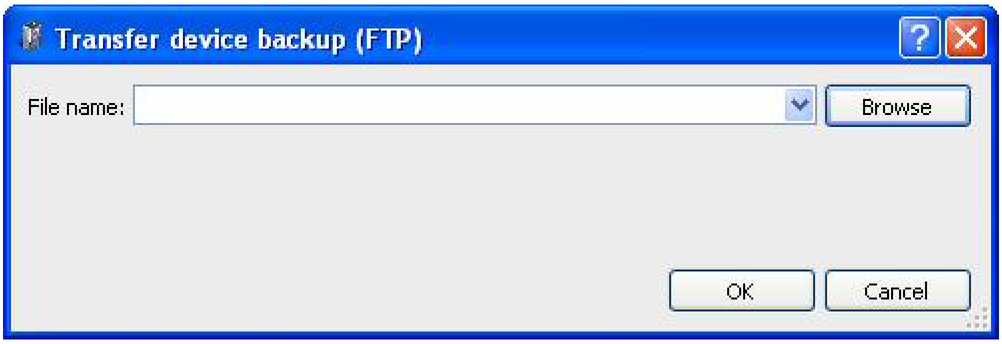
If the device backup contains a calibrated lens distortion or shading correction, then the backup will only be completed when the device has been switched to set-up mode after recovery (*Device configuration*).

10.3.4 Backup - restoring from the FTP server



Use this dialogue to transfer a device backup file from the FTP server to the device.

With this dialogue, you can transfer a complete device backup from the FTP server to the device. Device settings, jobs and firmware are all restored.



Specify the storage path of the backup file or click on *Browse*. The file extension must be `*.vsb` .

NOTE

If you restore the factory settings of the Vision Sensor, all unsaved files will be lost!

Now transfer the selected settings and jobs to the device with *OK*. This process may take a few minutes.

(device dependant)

NOTE

If the device backup contains a calibrated lens distortion or shading correction, then the backup will only be completed when the device has been switched to set-up mode after recovery (*Device configuration*).

10.4 Digital I/O Assistant

With the Digital I/Os assistant, you can test whether all cables are connected correctly to the digital inputs and outputs. To use the illumination controller, the device must be in Configuration mode.

If the menu option is still greyed, your device may have the wrong firmware version.

ATTENTION!

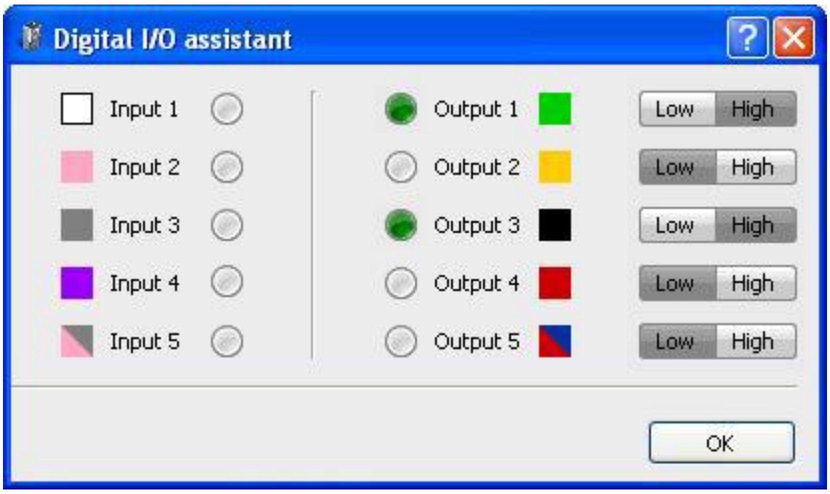
If your Vision Sensor has already been permanently integrated into your system, it is advisable during initial testing to check the outputs with a meter. Keep in mind that switching of the outputs will be transmitted to any connected controllers!

NOTE

If encoders are defined for the inputs 4 and 5, you cannot test these using this assistant! You can change the settings under:

Device → Device settings → Digital I/Os.

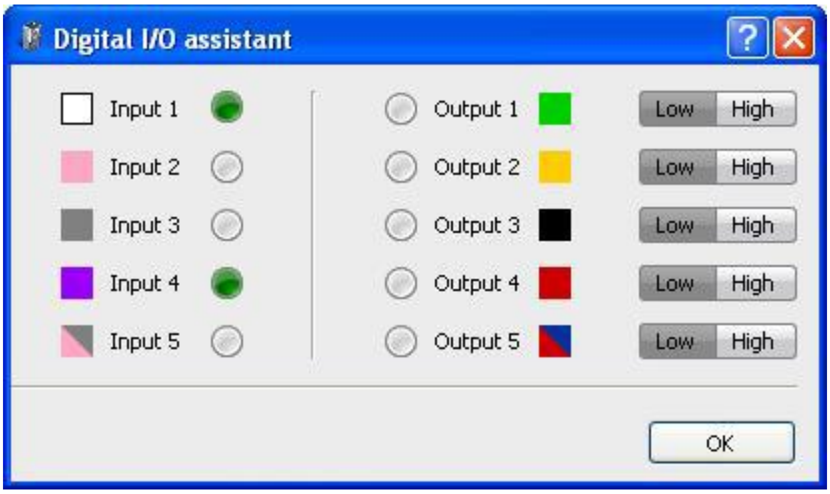
Example using outputs



Set the appropriate output on or off using the Low/High button.

In the example, Output 1 and Output 3 are set. This means that power is now applied to Output 1 and Output 3.

Example using inputs



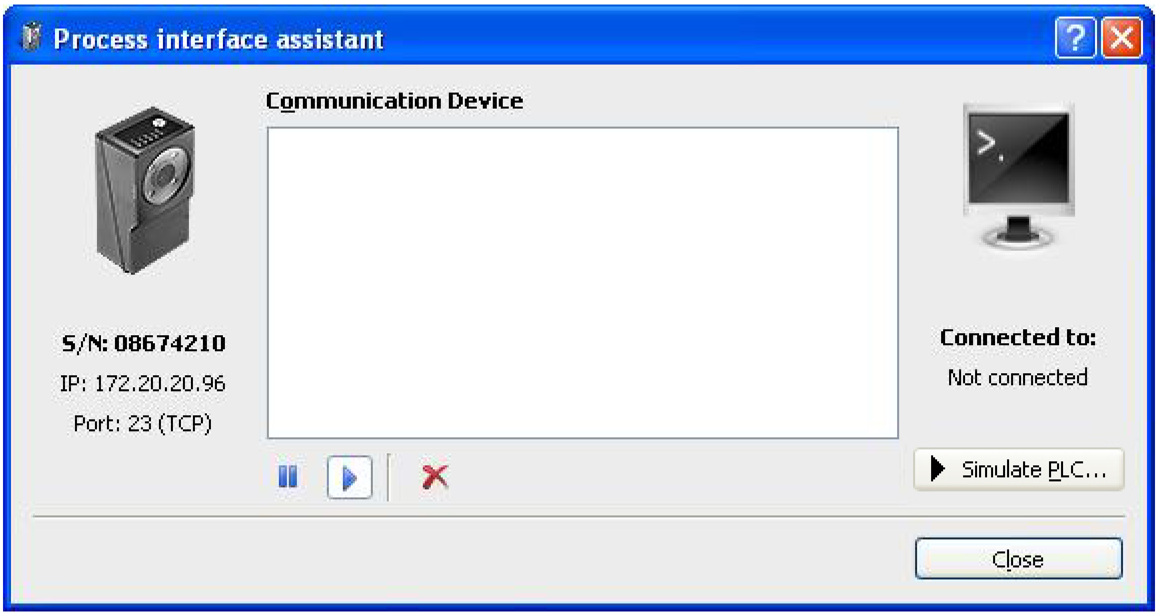
In the example, applied power is registered on Input 1 and Input 4.

10.5 Process interface assistant (device dependent)

You can use the process interface assistant to check what data is being sent and received via the device process interface. It appears in chronological order in the *Device communication* field.

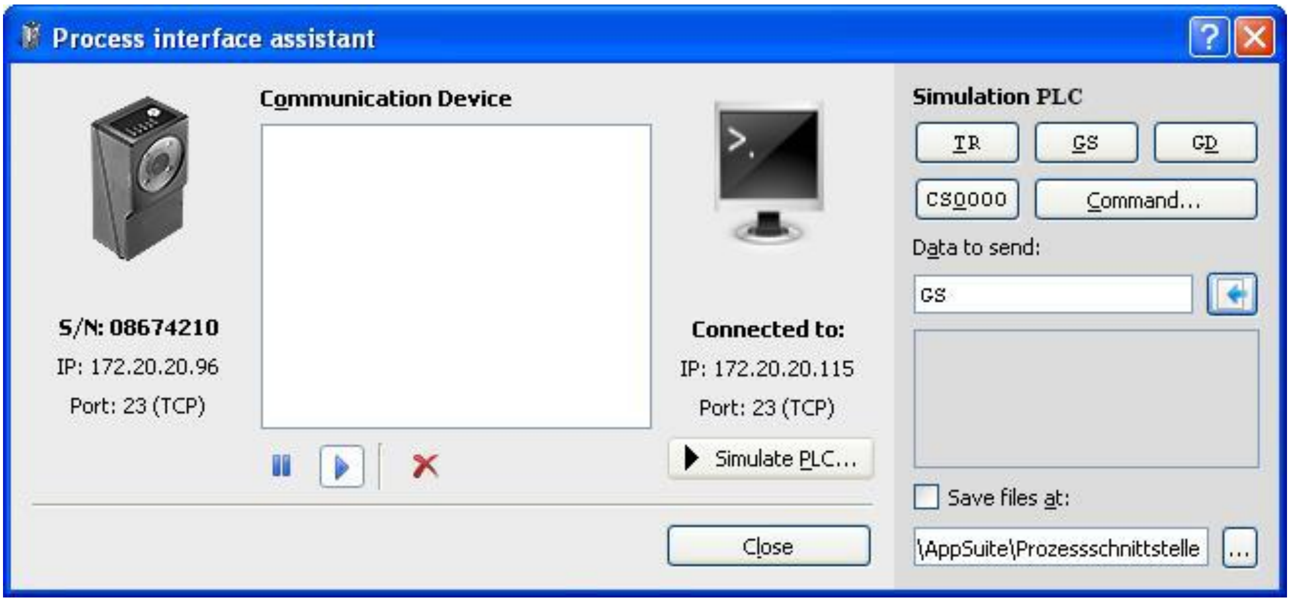
This window is updated immediately when a datagram is transferred through the process interface, regardless of whether it was sent from your PLC or PC.

You can use the corresponding buttons to pause the window, resume a paused image and delete.



You can also use this dialogue page to send commands without connecting a physical PLC.

To do this, click the *Simulate PLC...* button.

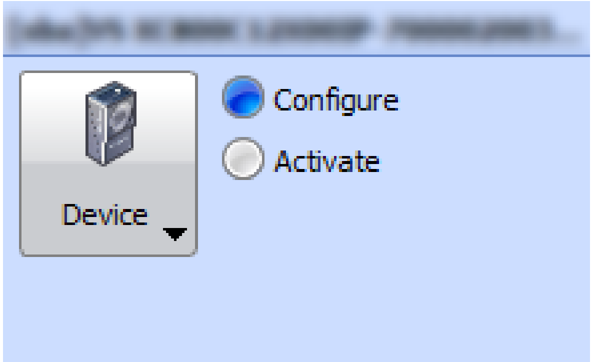


On the right, you will now see buttons to select common commands, a field to amend the commands or enter your own, and a protocol field showing the data transfer for the simulation.

You can use the *Command...* button to select your chosen command from a list, and then add arguments before using the Send button to transfer it to the connected device.

You can also access data (images, jobs, backups) and select where they should be stored. To do this, activate the option *Store files under:*

10.6 Operating mode display



The current operating data of your Vision Sensor are displayed here:

- Device name
- Operating mode (*Configuration, Activated*)

NOTE

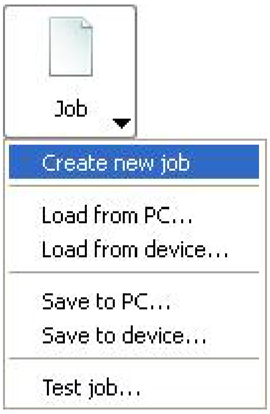
Clicking on the relevant displays allows you to change operating modes in the same way as the buttons.

11 Job menu

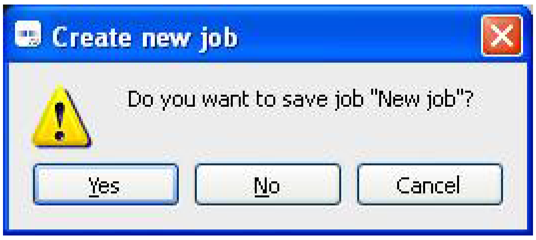
Actions are performed in this menu that affect jobs. Here you can create new jobs and load and save jobs from different sources. You can also test jobs.

> **NOTE**
>
> Use job management to copy jobs between your computer and the device. This is found under
>
> *Device menu → Device settings → Job management.*

11.1 Create new job



This menu option is used for creating a new job.



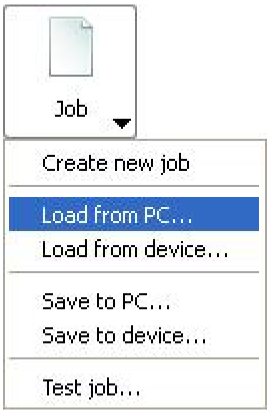
Decide whether you want to save the current job.

Select a new name of the job and save it.

Click on *Save*.

You can now configure the job.

11.2 Load job from PC...



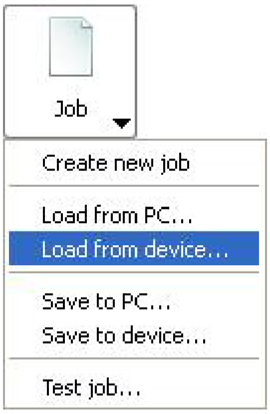
This menu option is used for loading jobs that have already been saved from the PC for processing.

Select the saved file and click on *Open*.

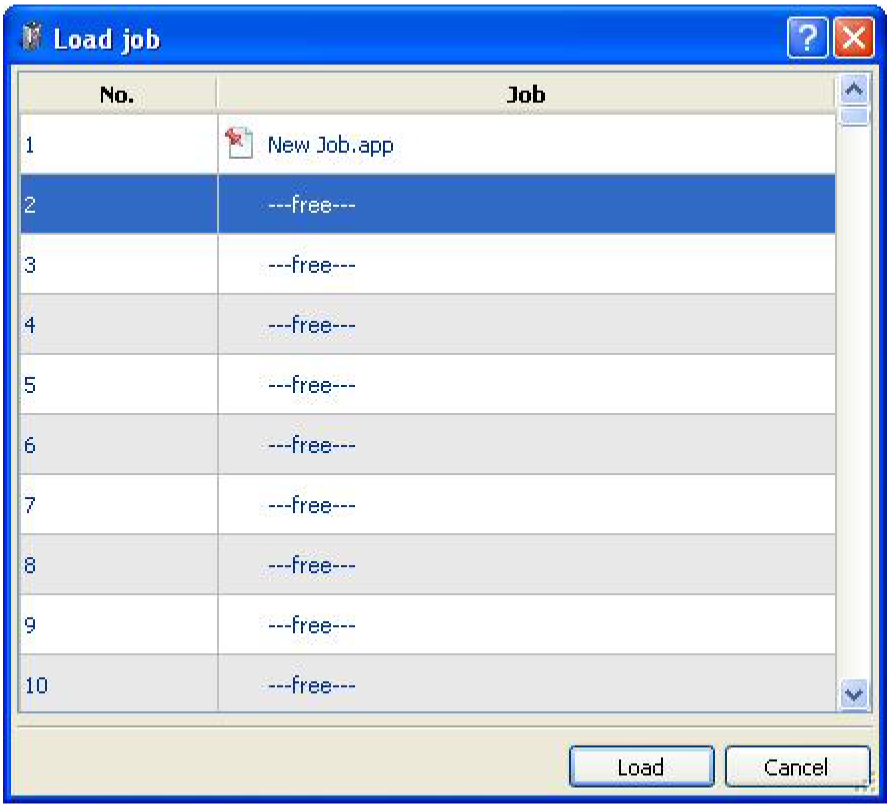
> **NOTE**
>
> Password protected files cannot be loaded if the password is not known!

You can now process the loaded job.

11.3 Load job from device...



This menu option is used to load a job that has already been saved on the device for processing in the *Application Suite*.

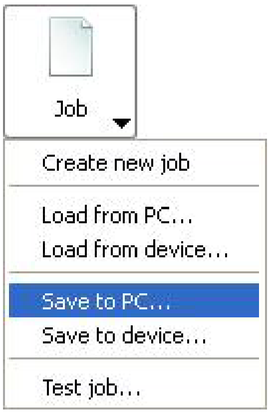


 This pin shows that the job is active at power on.

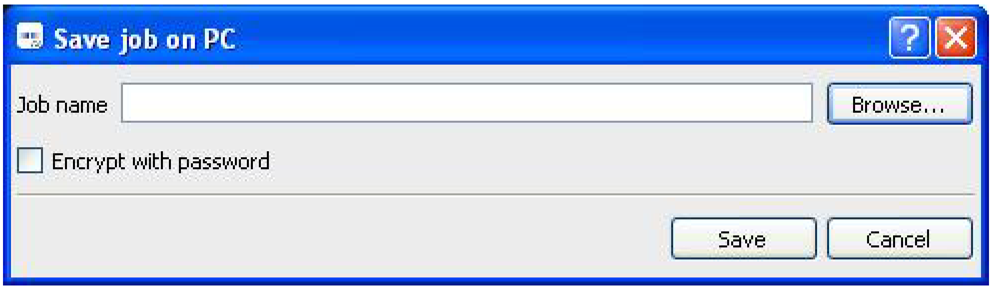
Select the job and click on *Load*.

> **NOTE**
>
> Password protected files cannot be loaded if the password is not known!

11.4 Save job to PC...



This menu option is used to save a job created with the *Application Suite* to the PC.



NOTE

The job name including the file extension ".app" can be a maximum of 31 characters.

Use *Browse* to select a directory where you would like to save the job.

Activate the option *Encrypt with password* if the file is to be saved in protected mode.

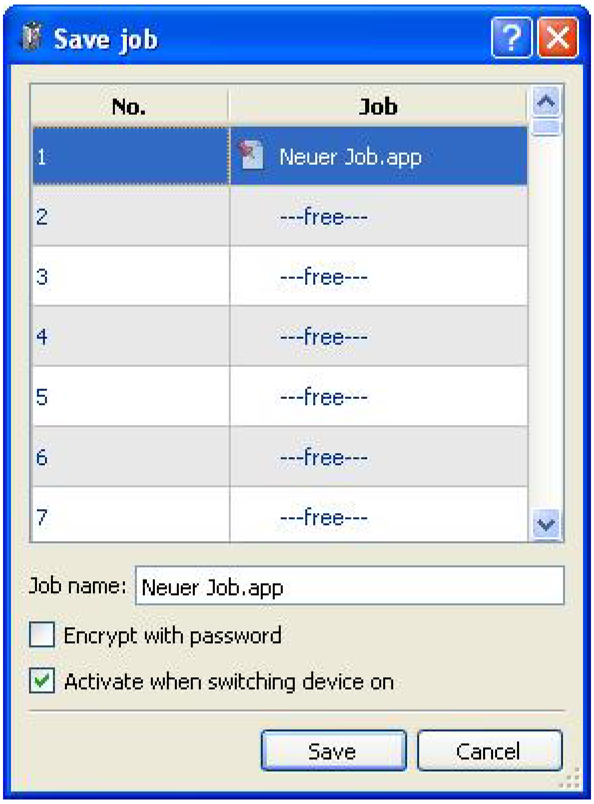
NOTE

The file cannot be reloaded afterwards without knowing the password!

Click on *Save* to create the file.

11.5 Save to the device...

This menu option is used to save a job created with the *Application Suite* to the device.



Enter a name for the job into the Job Name field and click on Save.

NOTE

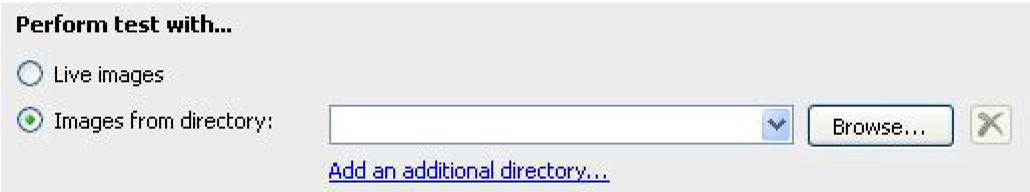
The job name including the file extension ".app" can be a maximum of 31 characters.

Encrypt with password: Activate this option if the file is to be saved in protected mode.
Activate when switching the device on: Activate this option if you want to activate the saved job when you switch on the Vision Sensor.

This pin shows that the job is active at power on.

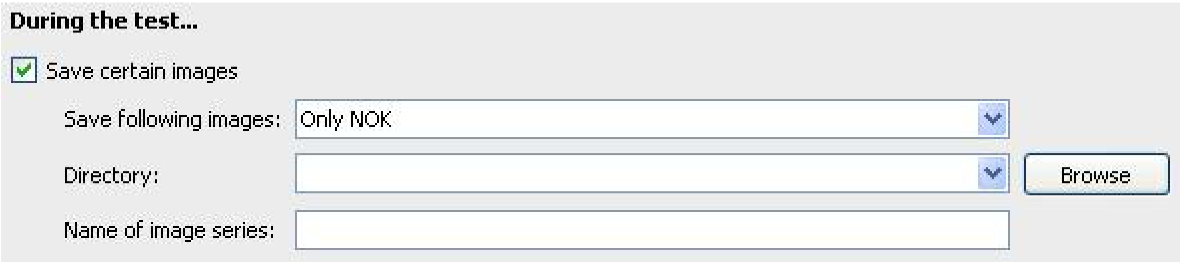
11.6 Test job...

Here, you can test your job using live images or images from one or more sample directories.



If you wish to use images from a folder for the test, you must select the appropriate folder with *Browse*.

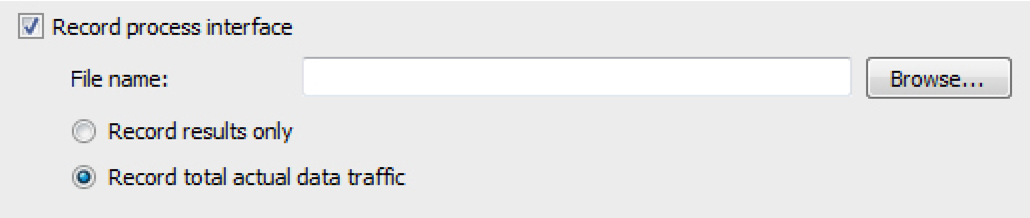
Using *Add an additional directory…* you may add additional directories containing images to be tested. You may remove the added directories again by clicking on the X icon.



During the test you have the option of saving only certain images. This is related to the results of the sensor tasks. Choose between "NOK only, OK only and All".

Specify the directory where the pre-selected images will be saved by using *Browse*.

Give a name to the image series to be recorded.



You have the option of recording the output of the process interface. Select a directory using Browse to determine where the file will be saved.

Record results only: If you only want to save the actual result data, select this option.

Record all actual data traffic: check this option if you want to record all data traffic. Here all data that is actually transferred is recorded and the file will remain empty if no data is transferred!

You can limit the duration of the test. Select a value and choose between seconds and images. You can also activate or deactivate the outputs.

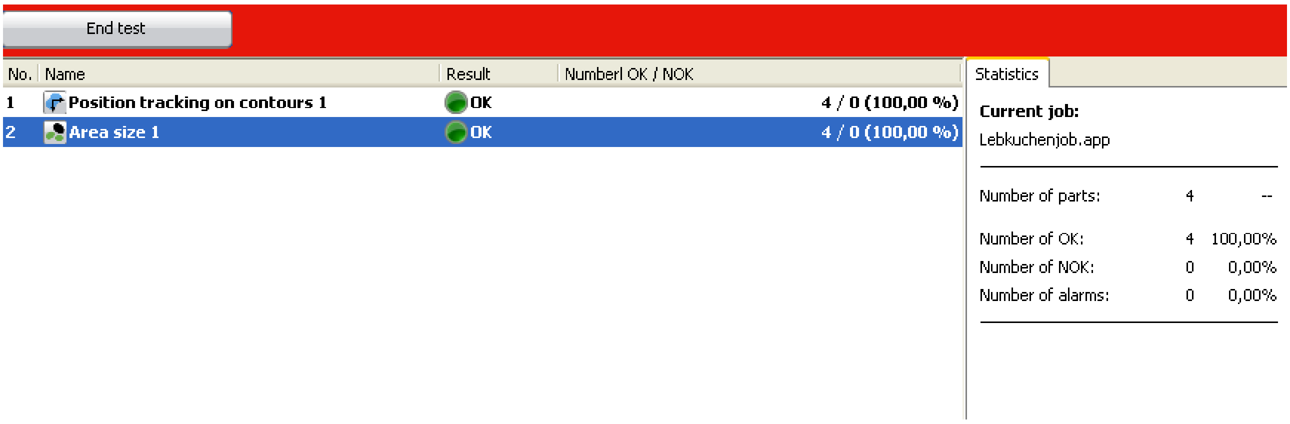
NOTE

If you do not limit the test sequence you may terminate the test at any time using the *Finish* button.

ATTENTION!

If your Vision Sensor is already integrated in your machine, it is often advisable to deactivate the outputs during the first tests to avoid incorrect behaviour of your machine.

The test is activated with the *Start test* button. In the list of features you will see the current results of the feature checks and the statistics window will give an overview of the results.

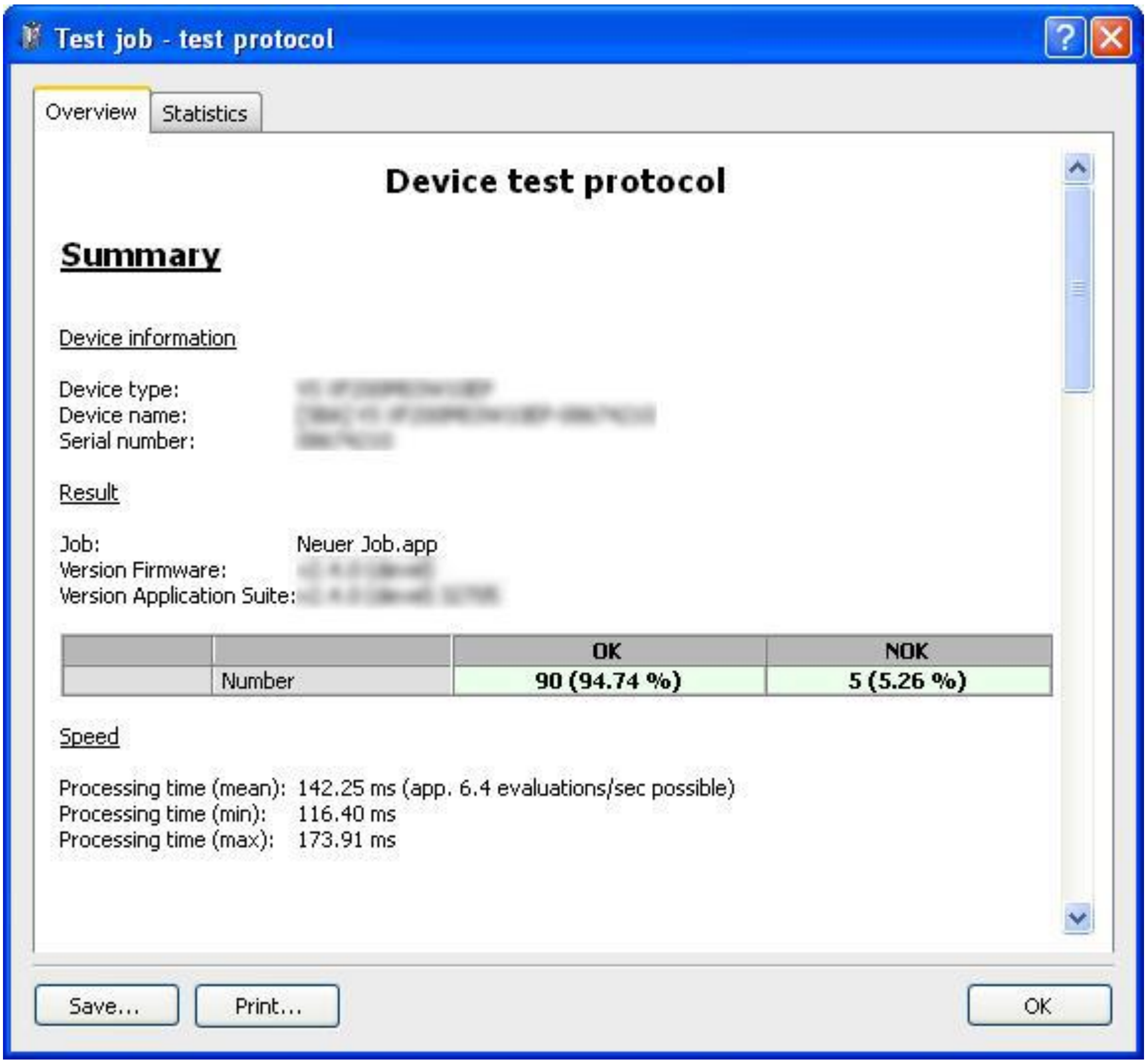


Click on *End test* when you want to end the test.

11.6.1 Test Protocol – Overview

When the test has been completed, the results are displayed in a test protocol, which you can save and print.

When you have completed the test with pictures from different directories, in the test protocol are indicated in different colours.

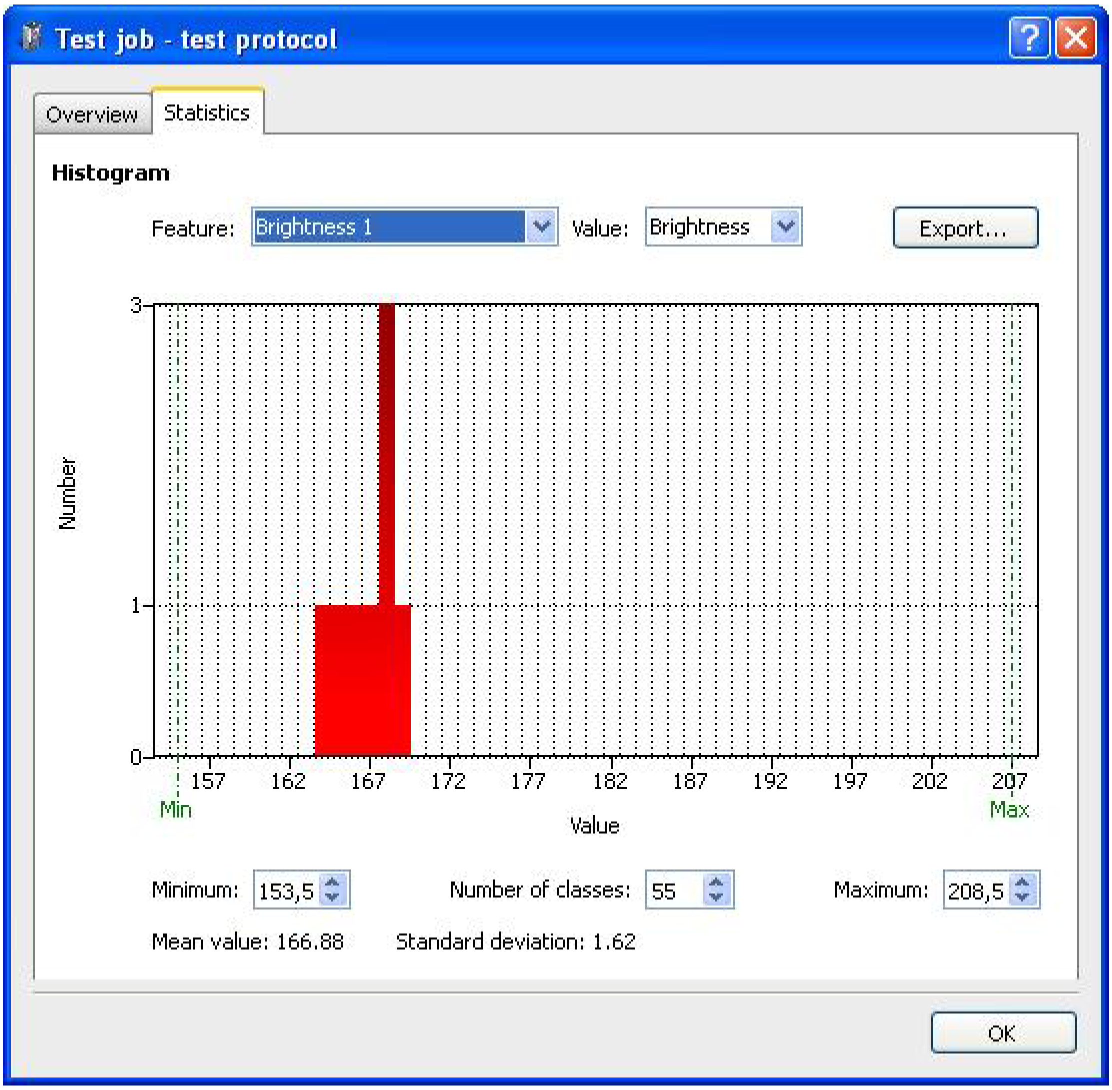


11.6.2 Test Protocol – Statistic

On the Statistics tab, you can even evaluate the job just tested using its individual feature checks according to various criteria. The results are displayed graphically using a histogram.

The currently displayed result can be exported as a *.csv or *.txt file.

Under *Feature*, select the feature of the tested job or the entire job (number of OK/NOK) to be evaluated. Under *Value*, you may evaluate the numerical results of the feature check (the angle of the object's rotation in the event of a part location).



Minimum: Set the minimum of the range of values here.
Number of classes: You can set the scaling between the Minimum and Maximum here.
Maximum: Set the maximum of the range of values here.

If you move the mouse pointer over the histogram, a tool tip appears containing the values of the current mouse pointer position.

The average and the standard deviation of the evaluation are displayed in the lower region.

11.7 Result and user display

The current job information for your Vision Sensor is displayed here. The information consists of:

- Job name
- OK, NOK or Alarm
- Current user (device dependant)

12 Feature checks

All feature checks are described below. Note that not all feature checks are supported by all devices.

You can find an overview as to which Vision Sensors check which features under: *Technical Data (Overview of feature checks).*

NOTE

Once installation is complete, you will find a range of application examples that provide you with typical solutions for various inspection tasks and for the use of the individual feature checks. After successful installation, the examples can be found in the subdirectory:

<installation path>\AppSuite\Samples

NOTE

Jobs are compatible between devices if they work with at least the same feature checks and identical functions for the same field of view.

Feature checks from the *identification* area are not compatible between those devices with and without Industrial Ethernet. *Part location on contours* is supported as an *older version* on devices with integrated Industrial Ethernet.

NOTE

Most feature checks support the *Teach* function. Initially, the contours / edges of the sample piece will be learned or switching thresholds set absolutely or as a percent (± 10%) to the actually determined value. A relative amendment will be retained if possible when the switching thresholds are altered manually.

The corresponding expected values will be imported during *Teach* in the case of identification feature checks.

NOTE

Older graphics cards, such as the on-board Intel HD 3000, do not fully support OpenGL in our experience. This can for instance result in 3D-view presentation problems with interactive colour assistants.

NOTE

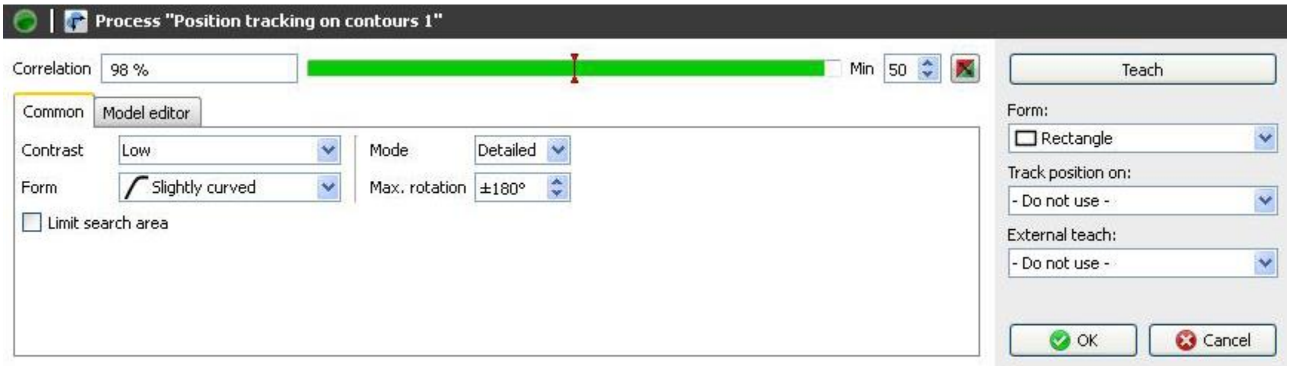
Automatic configuration of the area limits occurs with higher resolution than the display in pixels would suggest. Rounding can result in the limit and specified value being exceeded by one pixel in limit cases.

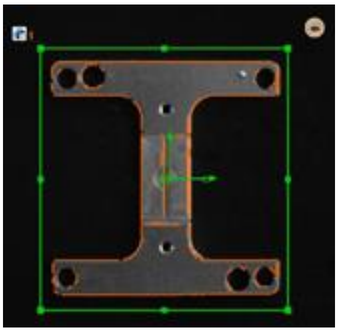
This can be prevented by manual configuration or readjustment of the limit areas.

12.1 Part location

12.1.1 Part location on contours

With this feature check, the position of an object is determined using contours.





- Choose the shape of the area from which the contours are adopted.

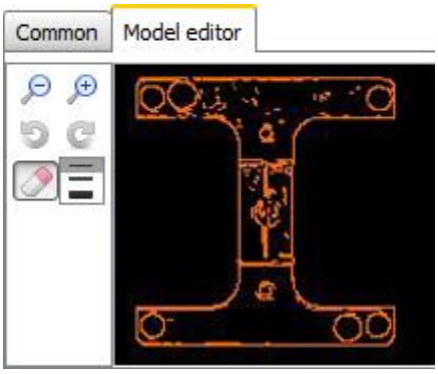
Press *Teach* to search for new contours if you move the area.

- The match of the contours with the found object in the image is displayed here.
- Using the appropriate switching points, set how good the match must be so that the object is found. The button on the extreme right inverts the set point.

- **Contrast:** Set the minimum contrast of the contours that should be adopted in the model.
- **Form:** Select the shape of the contour that corresponds to the test object and that should be adopted in the model.
- **Mode:** Set the amount of detail to be used in the inspection. (The more detailed the mode, the higher the processing time.)
- **Max. rotation:** If you want to find the object only in a limited angular range, you may specify the maximum rotational position here. (Limiting the angular range reduces processing time.)

- If you do not wish to search for the object in the entire image, set the tick and then limit the detection area.

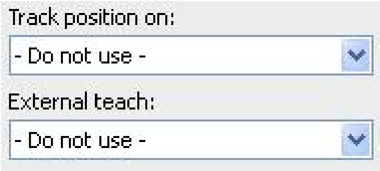
Model editor tab



- You can use these two buttons to enlarge or reduce the model.

- You can gradually undo or redo the changes using these buttons.

- With the displayed model, you can use the mouse to delete contours which clearly do not belong to the reference object. Select the required tool strength to do this.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. The location of the detection area will be refreshed when this is activated. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

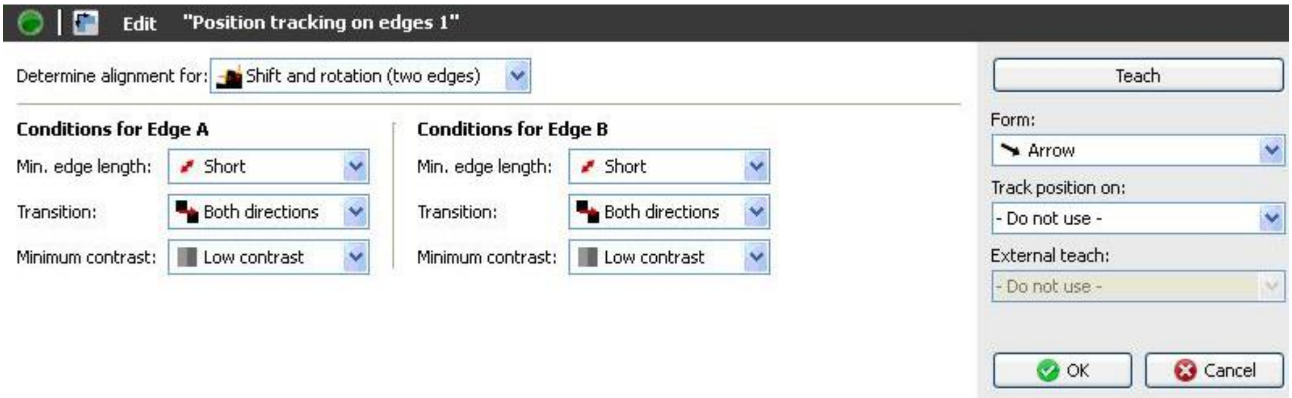
This feature check has the following output values for the datagram at the process interface:

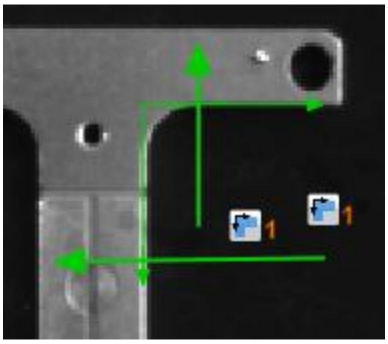
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Conformity	Integer	Match of the model (%)
Centre of object	Float point	Position of the object in the image (px)
Angle of object's rotation	Float	Angle of the object (degrees)

12.1.2 Part location on edges

This feature check localizes an object using edges. The detected position is used as a reference for the subsequent feature checks. In this way, tilted or displaced objects can also be examined. All fields of view and search beams for which part location is activated are corrected according to the current position of the test object.

This feature check does not support external teach. If a teach procedure is still executed, the parameters set will be maintained.

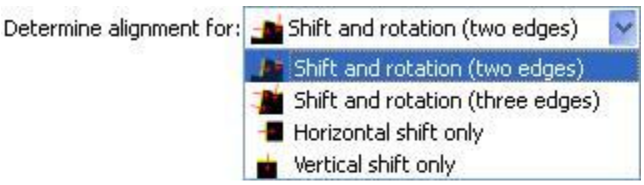




In this example, two edges of a test object are found, with a horizontal and a vertical search line, and the reference point for part location is determined at the intersection of the detected edges.

- If you wish to change the reference position of the part location, press the *Teach* button and the new position will be adopted.

Configuring of the part location as follows:



- **Determine alignment for:** Select the type of part location. You can determine either offset and rotation on two edges, offset and rotation on three edges, only horizontal or only vertical offset. A shorter processing time is required with fewer edges.

- Depending on whether you wish to align to one or two edges, you must then draw the search lines directly in the image using the mouse. Hold the left mouse button depressed during this.
- Position the search lines such that the sought contour is intersected as closely as possible to the middle. The first contour is detected which intersects the search line along the search axis. You can correct the positioning at any time.
- With long edges it is advisable to search the main reference edge with two search lines.

Enter the criteria:

- **Min. edge length:** You must also specify whether a short, medium or long edge is to be sought. Using *User defined*, you may manually enter the length of an edge (5-1000 pixels).

- **Transition:** You must specify whether each edge can progress from bright to dark or from dark to bright (device dependant).
- **Minimum contrast:** Specify whether you are searching for an edge with sharp or weak contrast.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

This feature check has the following output values for the datagram at the process interface:

Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Centre of object	Float point	Position of the object in the image (px)
Angle of object's rotation	Float	Angle of the object (degrees)
Edge A (2)	Float	Coordinates (1) of the found edge A: Start point X – separator Start point Y – separator Rising of edge Δx – separator Rising of edge Δy – separator
Edge B	Float	Coordinates of the found edge B: Start point X – separator Start point Y – separator Rising of edge Δx – separator Rising of edge Δy – separator

The output values for the data frame of the process interface describes the edge (2) as a line defined by the starting point (1) and the increase (gradient triangle: Δx, Δy).

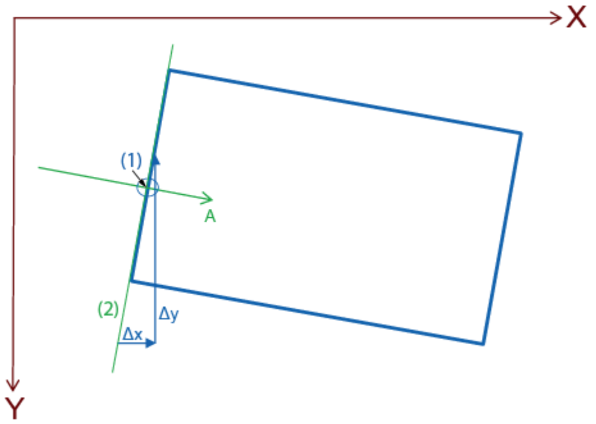


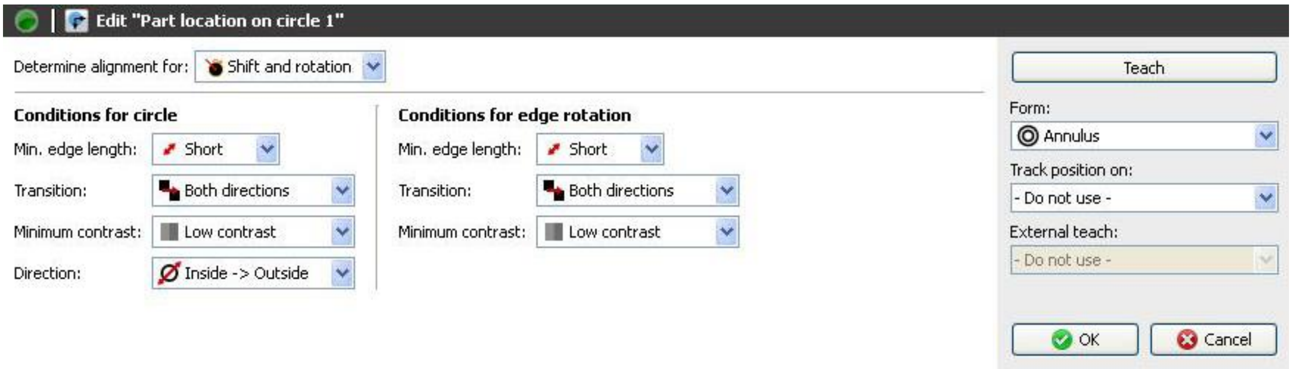
Illustration of the output values for a search arrow in part location tracking.

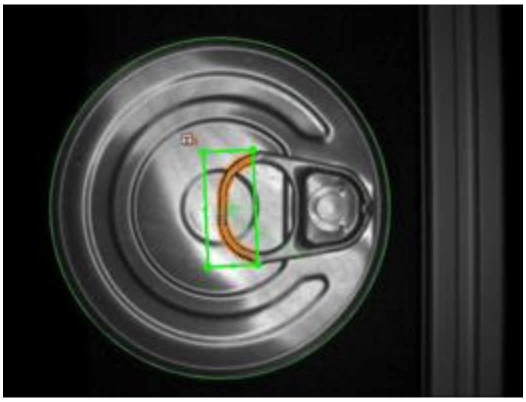
12.1.3 Part location on circle

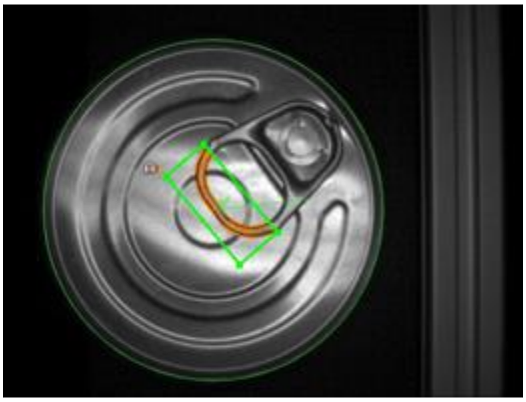
With this feature check, you can align a round object with regard to its centre. It is also possible to correct the angle of rotation on the basis of an edge along the object.

In this example, the shape of the ring-pull on a drinks can is examined. The angle of rotation is determined and corrected by the soft sensor "Part location in a circle".

This feature check does not support external teach. If a teach procedure is still executed, the parameters set will be maintained.



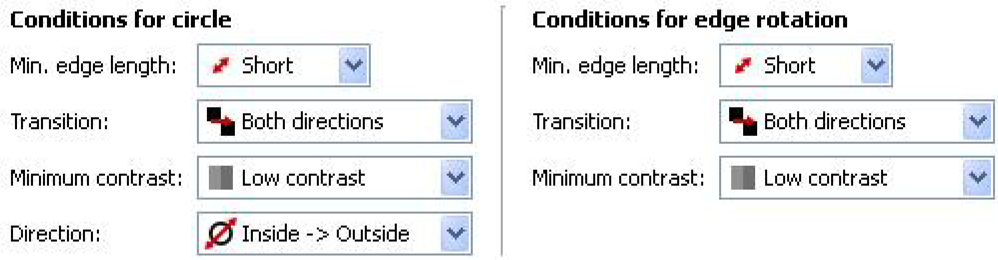




Configuration for part location on a circle as follows:

- Select the shape of the field of view. A circular ring and a circular ring sector can be chosen.
- Draw the inner and outer reference circles with the mouse.
- The inspection of a circle is always conducted along the individual segments from circle A to circle B and in the direction indicated by the blue arrows.
- Adjust the edge length, transition type and contrast until the circle is reliably detected.

- Select the type of part location. You can either search for a circle and thereby compensate displacement or also detect rotation of the object by an edge in close proximity.
- Draw the arc with the mouse to search for the associated edge.



Enter the criteria:

- **Min. edge length:** You must also specify whether a short, medium or long edge is to be sought. Using *User defined*, you may manually enter the length of an edge (5-1000 pixels).
- **Transition:** You must specify whether each edge can progress from bright to dark or from dark to bright or in both directions (device dependant).
- **Minimum contrast:** Specify whether you are searching for an edge with sharp or weak contrast.
- **Direction:** Select the direction of the search

- If you wish to change the reference position of the part location, press the *Teach* button and the new position will be adopted.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

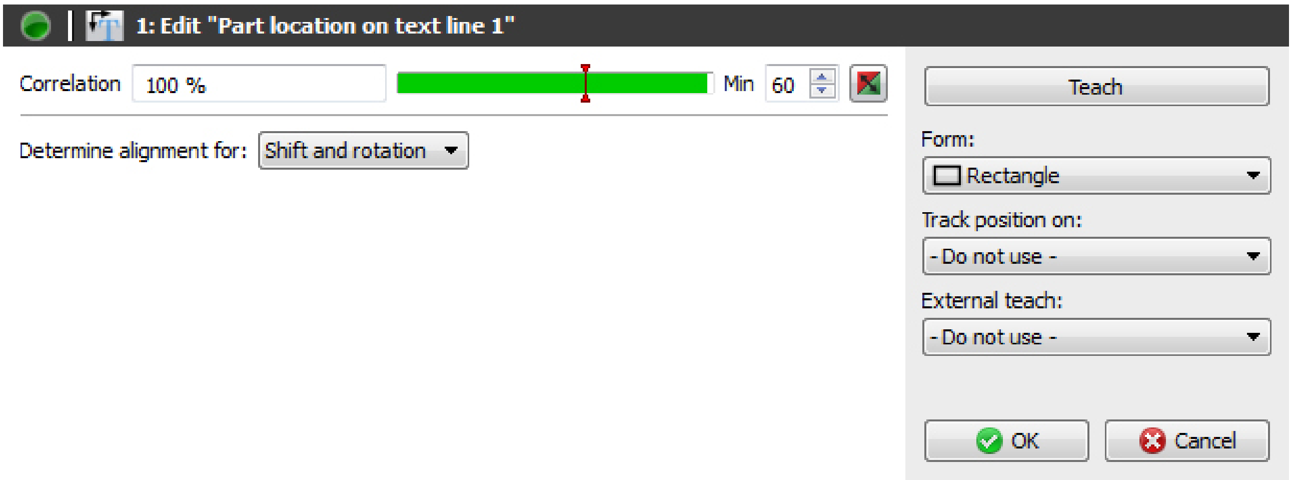
This feature check has the following output values for the datagram at the process interface:

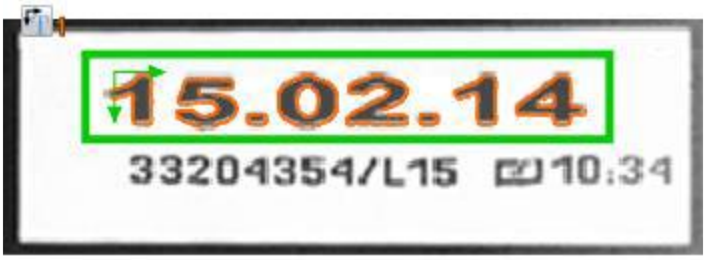
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Circle centre	Float point	X – *Separator* – Y
Circle diameter	Integer	
Edge for rotation	Integer	Coordinates of the found edge for rotation correction: Start point X – *separator* Start point Y – *separator* Rising of edge Δx – *separator* Rising of edge Δy – separator

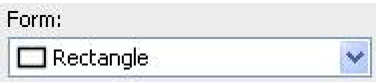
12.1.4 Part location on text line

With this feature check, the position of the text within a field of view can be determined. To do this, the field of view must be positioned roughly parallel to the text with deviations of +/- 15
degrees being tolerated. The background of the text should be homogeneous to achieve a stable analysis. The position found can then be used to align other feature checks, for example, the "Text" feature check.

This feature check supports external Teach. The position of the text line will be re-taught.







- The conformance of the current object with the taught-in model is displayed directly. You can set the associated switching point in the graphic display.
- The button on the extreme right inverts the set point.
- The switching point *Min* can also be edited manually.

Select which alignment should be determined:

- Offset and rotation
- Offset only

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

This feature check has the following output values for the datagram at the process interface:

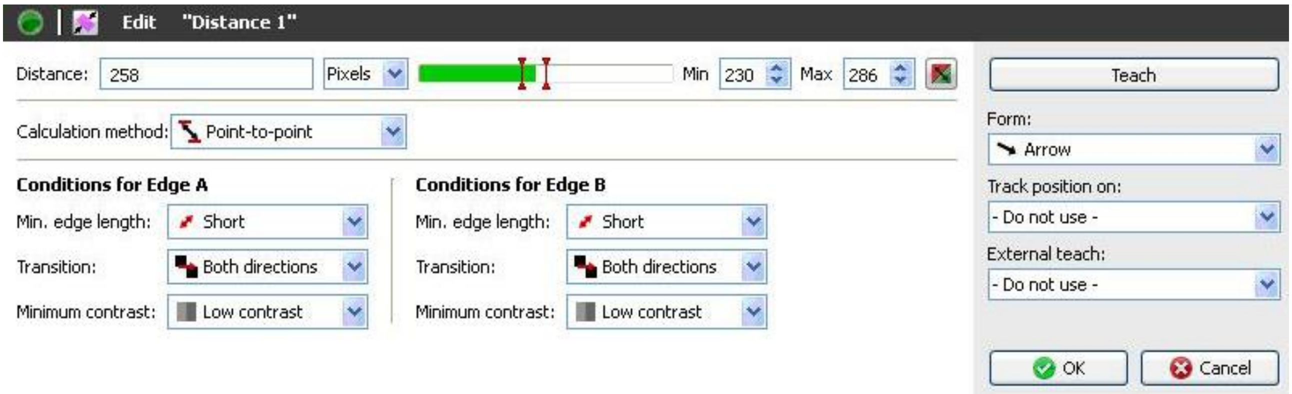
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Conformity	Integer	Match between the current object and the taught-in model (%)
Text position	Float point	X – *Separator* – Y
Text angle	Float	

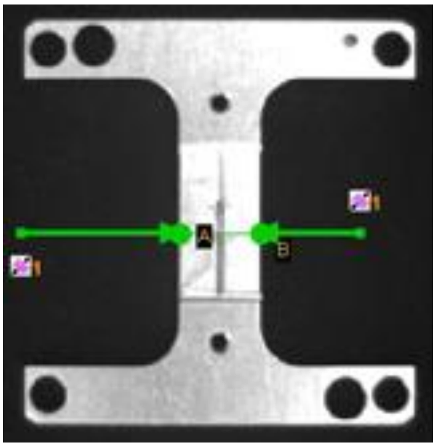
12.2 Geometry

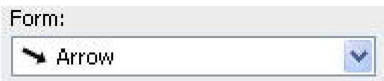
12.2.1 Distance

This feature check determines the distance between two points, the right angular distance between two points and the distance of an edge in relation to a reference edge (a taught-in edge) and compares the distance found with the associated switching points.

This feature check supports external Teach. The switching points are adjusted as a percentage to the current measured value.

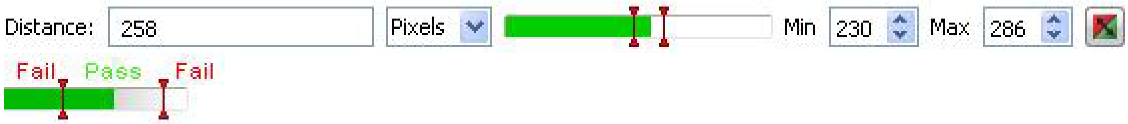






- Select the shape of the field of view. A search line and an arc can be chosen.
- Adjust the field of view by holding the left mouse button depressed.

In this example, two points on a test object are detected with one search line each. The distance between the intersections is indicated directly in the display:



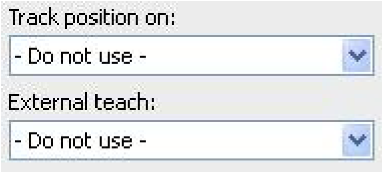
- The current result is displayed directly in the dialogue as the distance. The switching points designated ***Min*** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.

Select the computation method.

- **Point-to-point:** Distance between two points
- **Rectangular distance:** Right angular distance between two points
- **To reference:** Distance to a reference edge
- **Edge to circle:** Distance from one edge to the centre of a circle
- **Circle to circle:** Distance between centres of two circles

- Click on Teach to retrain a new reference.

- **Min. edge length:** With short, medium or long, select the anticipated length of the sought contour to achieve a consistent result. Using *User defined*, you may manually enter the length of an edge (5-1000 pixels).
- **Transition:** You must specify whether each edge can progress from bright to dark or from dark to bright (device dependant).
- **Minimum contrast:** You can specify whether you are searching for an edge with sharp or weak contrast.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

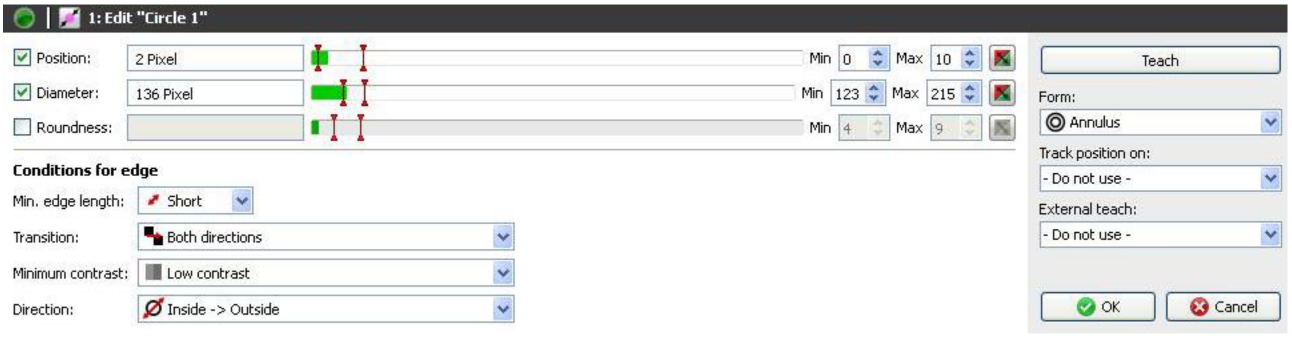
This feature check has the following output values for the datagram at the process interface:

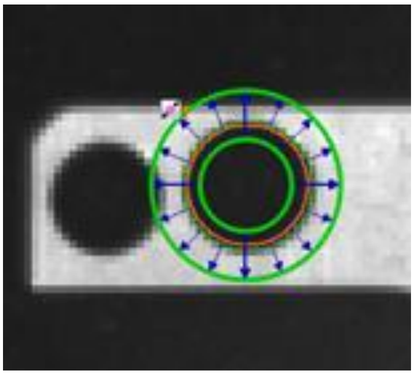
Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Distance	Float	

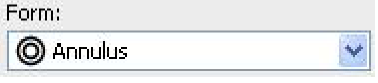
12.2.2 Circle

This feature check determines the position, the diameter and the roundness of a circle in comparison to a reference circle that is taught in. The detection area for a circle is defined by selecting a minimum inner circle and a maximum outer circle. Both the position and the diameter of the detected circle are compared with switching points.

This feature check supports external Teach. The switching points for the diameter are adjusted as a percentage to the current measured value. The thresholds for the distance remain unchanged as the newly programmed circle is adopted as a reference and the distance reverts to zero.

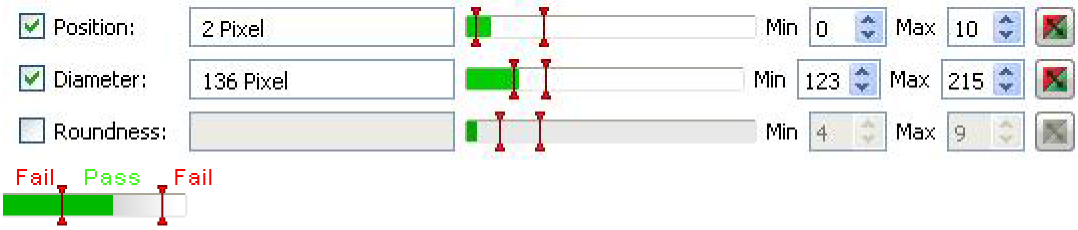






- Select the shape of the field of view. A circular ring and a circular ring sector can be chosen.
- Adjust the field of view by holding the left mouse button depressed.

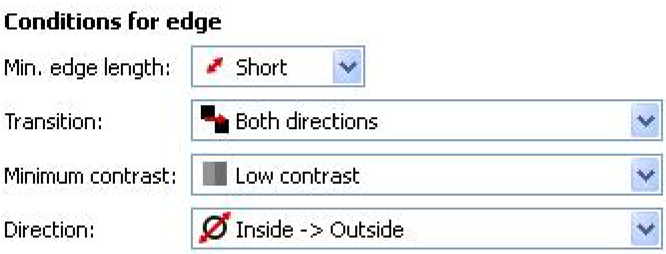
In this example, the diameter, position and roundness of a hole are determined by measuring from the outer circle towards the inner circle. Both results appear directly on the display:



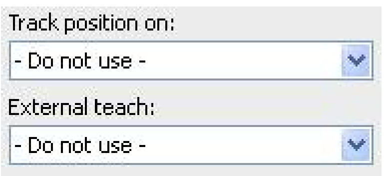
- **Position:** Determine the switching points of the position.
- **Diameter:** Determine the switching points for the diameter.
- **Roundness:** Determine the switching points of the roundness.

The right button is used to invert the result of the feature check.

- If you wish to change the reference position of the centre of the circle, simply press the *Teach* button and the new position will be adopted.



- **Min. edge length:** With short, medium long or user defined, select the anticipated length of the sought contour to achieve a consistent result. Using *User defined*, you may manually enter the length of an edge (5-1000 pixels).
- **Transition:** You must specify whether each edge can progress from bright to dark or from dark to bright (device dependant).
- **Minimum contrast:** You can also specify whether you are searching for an edge with sharp or weak contrast.
- **Direction:** Select the direction of the search.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

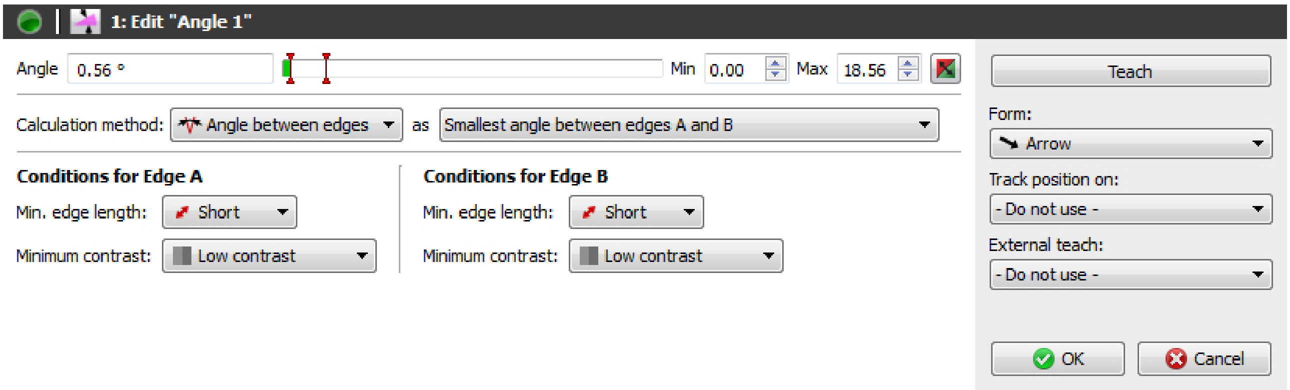
This feature check has the following output values for the datagram at the process interface:

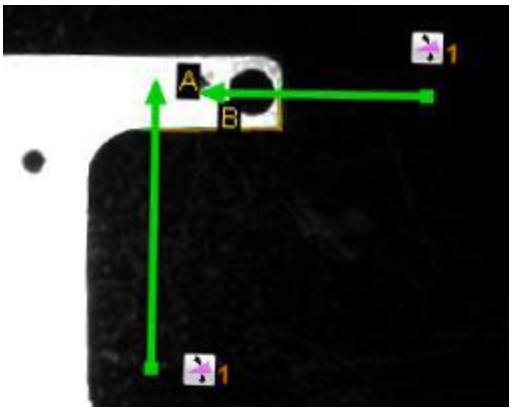
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Circle centre	Float point	
Circle diameter	Float	
Distance of the centre to the reference	Float	
Difference of the diameter to the reference	Float	
Roundness	Integer	

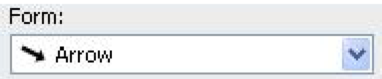
12.2.3 Angle

This feature check determines the angle between two edges or to a reference. The angle is compared with the associated switching points.

This feature check supports external Teach. The switching points are adjusted as an absolute to the current measured value.

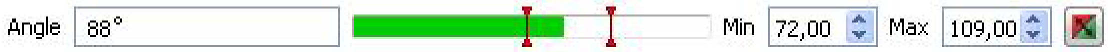


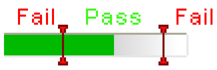




- Select the shape of the field of view. A search line and an arc (radial search for edges) can be chosen.
- Adjust the field of view by holding the left mouse button depressed.

In this example, the angle between a vertical edge and a horizontal edge on a test object is determined by one horizontal and one vertical search line. The angle between the detected edges is indicated directly in the display:





- The current result is displayed directly in the dialogue as the angle. The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.

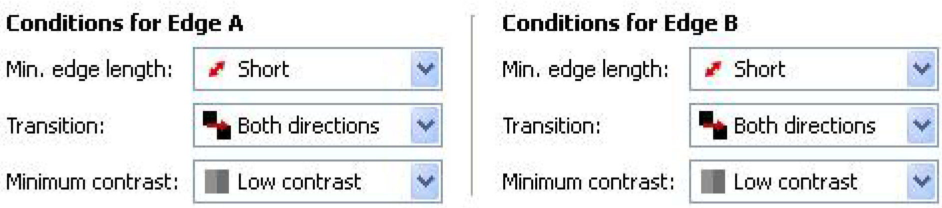
Select the calculation method and orientation of the angle.

- **Calculation method:**
  Angle between edges: Angle between two edges
  Angle to reference: Angle to a reference edge

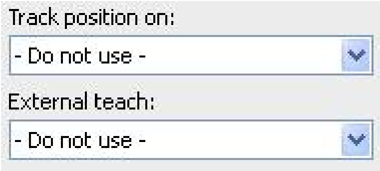
- **Orientation of the angle:**
  Smallest angle between edge A and B
  Angle between edge A and B, clockwise
  Angle between edge A and B, anticlockwise

- You can teach in a new reference with this button.

Configure of the sensor as follows:



- **Min. edge length:** With short, medium or long, select the anticipated length of the sought contour to achieve a consistent result. Using *User defined*, you may manually enter the length of an edge (5-1000 pixels).
-
- **Transition:** You must specify whether each edge can progress from bright to dark or from dark to bright (device dependant).
- **Minimum contrast:** You can also specify whether you are searching for an edge with sharp or weak contrast.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

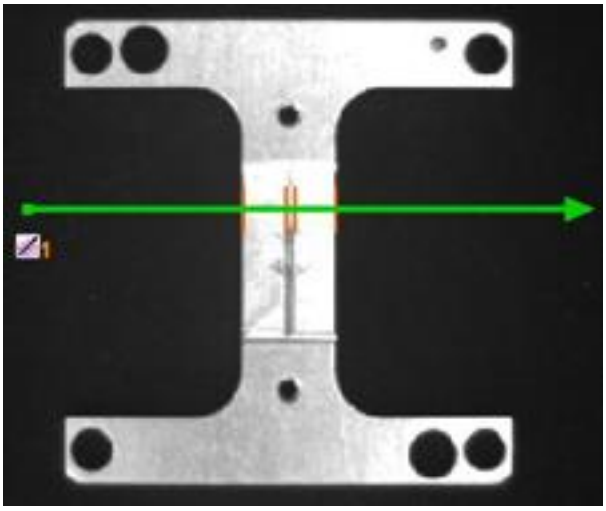
This feature check has the following output values for the datagram at the process interface:

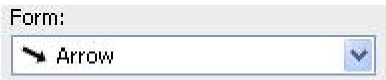
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Corner position	Float point	Coordinates of where the edges intersect
Angle of the corner	Float	Size of the angle between the edges (in degrees)
Position of corner	Float	Rotational position of edge 1 (in degrees, 0° == horizontal, 90° == vertical)
Distance	Float	Distance between the current corner position and the corner position of the reference angle
Angle difference	Float	Difference between the current angle and the reference angle (in degrees)
Deviation of position	Float	Difference between the current rotational position and that of the reference angle (in degrees)

12.2.4 Count edges

This feature check inspects the number of edges along a search beam.

This feature check supports external Teach. The switching points are adjusted as an absolute to the current measured value.





- Select the shape of the field of view. A search line and an arc can be chosen.
- Adjust the field of view by holding the left mouse button depressed.

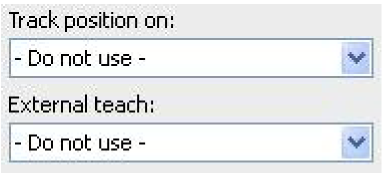
In this example, the edges of a test object are detected at both the bright/dark and the dark/bright transitions. The number of detected edges is indicated directly in the display in *Number*.

- The current result is displayed directly in the dialog as the *Number*. The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.

Configure of the sensor as follows:

- Position the search line by holding the left mouse button depressed in the image.

- **Min. edge length:** With short, medium or long, select the anticipated length of the sought contour to achieve a consistent result. Using *User defined*, you may manually enter the length of an edge (5-1000 pixels).
- **Transition:** You must specify whether each edge can progress from bright to dark or from dark to bright (device dependant).
- **Minimum contrast:** You can also specify whether you are searching for an edge with sharp or weak contrast.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

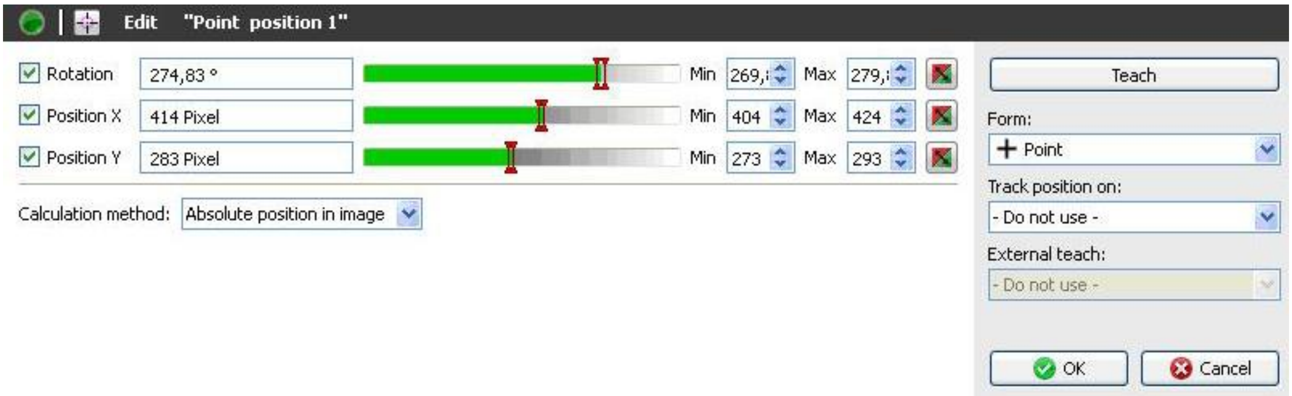
This feature check has the following output values for the datagram at the process interface:

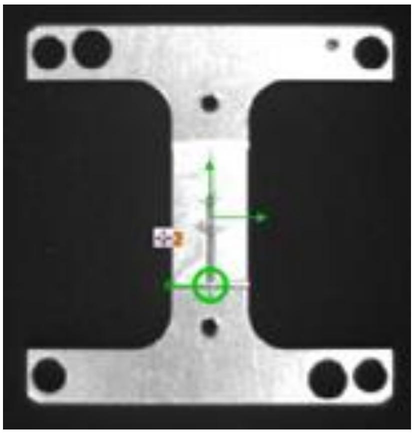
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Number of edges	Integer	

12.2.5 Point position

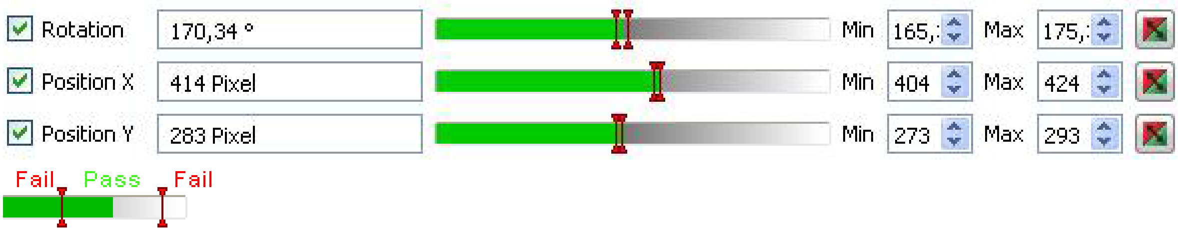
This feature check determines the position and rotational position of a point, as an absolute in the picture or relative to a reference. It is therefore advisable that it is only used with part location. This feature check can, e.g. be used to determine the grasp position for robots (pick and place).

This feature check supports external Teach. The switching points are adjusted as an absolute to the current measured value.





- Set the point on the position to be determined. You may need to rotate it with the lever.

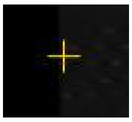


Select the features that should be checked.

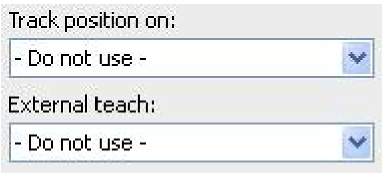
- **Rotation:** Determine the switching points of the rotation.
- **Position X:** Determine the switching points of the X position.
- **Position Y:** Determine the switching points of the Y position.

The right button is used to invert the result of the feature check.

- **Calculation method:** Absolute position in image (If you set this, you will get the coordinates of this point.) Relative to reference (show the deviations to the taught point.)



The reference point set using Teach is identified with a cross.



- Here, select the part location with which the feature check should be corrected.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

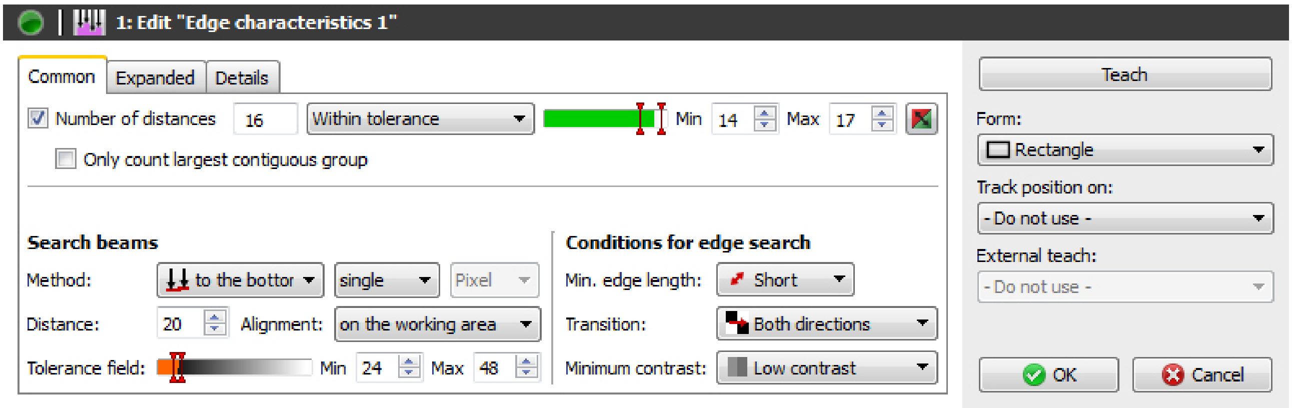
This feature check has the following output values for the datagram at the process interface:

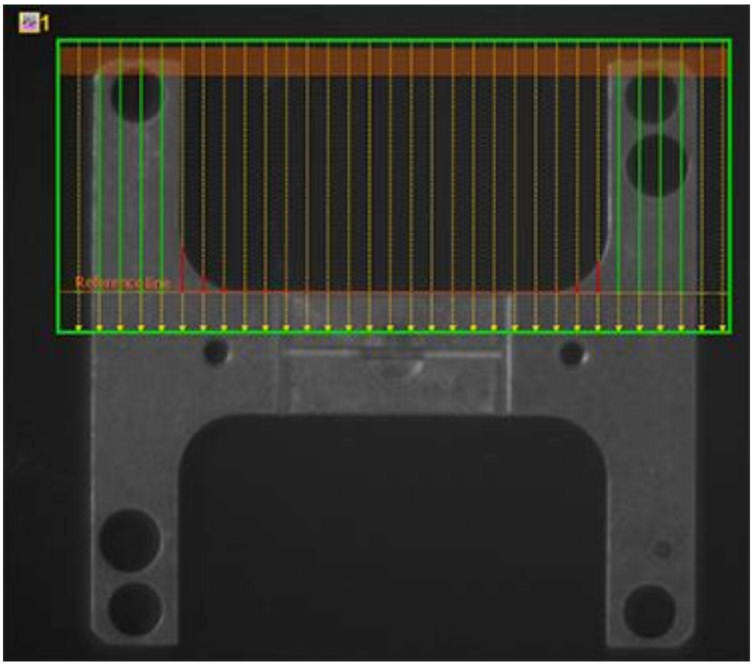
Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Rotation	Float	
Position X	Float	
Position Y	Float	

12.2.6 Edge characteristics

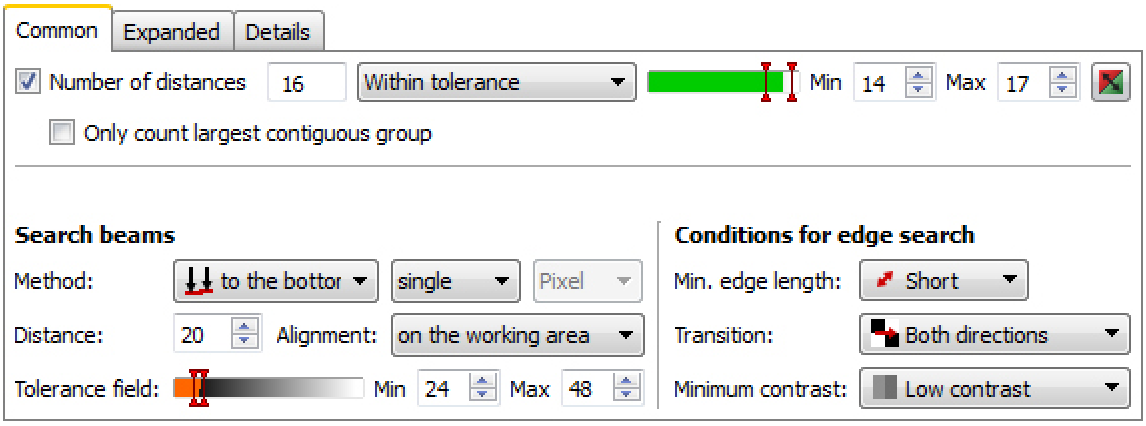
This feature check scans an edge with search beams and compares the distances detected with the defined conditions.

This feature check does not support external teach.

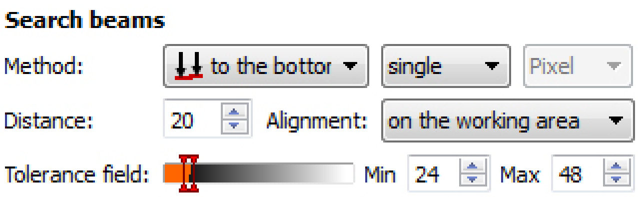




- Select the shape of the field of view. A rectangle, a circular ring and a circular ring sector can be chosen.



- The current number of distances calculated is displayed as *Number of distances* in the dialog by default.
- You can also select which located distances should be counted. You can select whether to count the number of distances within or outside of the tolerance range.
- The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The button on the right inverts the result of the *Number of distances* partial check.
- If you activate *Only count largest related group*, only the number of distances located within the largest group will be counted – i.e. the distances which fulfil the set criteria and appear directly next to one another.



- **Methods:** Here you can define the methods the search beams should use to search for edges. The search direction is indicated by a yellow arrow in the field of view. The methods available depend upon the shape of the field of view.

NOTE

For horizontal edge searches, you must rotate the field of view.

single: The system searches for an edge in a single direction from each search beam position. The reference point used to calculate the distance is the edge of the field of view (field of view alignment) or the located reference line (object alignment).

double: The system searches for an edge in two directions from each search beam position. The distance between the two located edges on the search beam is calculated.

downwards (single): The search for edges starts at the top edge of the field of view.
upwards (single): The search for edges starts at the bottom edge of the field of view.
inwards (single): The search for edges starts at the outer edge of the circle.
outwards (single): The search for edges starts at the inner edge of the circle.
to the centre line (double): The search for edges begins from both sides.
outwards (double): The search for edges begins from the centre line.

The following table provides an overview of which methods are available for which types of field of view.

	Rectangle		Circle / sector	
	single	double	single	double
downwards	x			
upwards	x			
inwards			x	
outwards			x	
to the centre line		x		x
outwards		x		x

Pixel: Pixels are used as the default preset value if you have not defined your own unit.
[Units]: If you have defined your own unit (*Adjust image → Coordinates*), you can select it here.

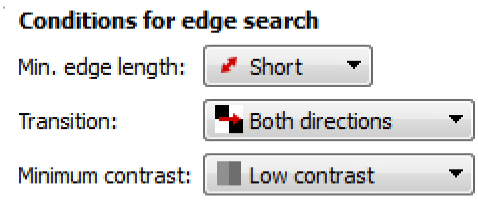
- **Distance:** Here, you can set the spacing between the search beams.

- **Alignment:** Define how the search beams are to be aligned.

  to the field of view: The search beams are aligned according to the orientation of the field of view.

  to the object: The system searches for a straight (rectangular field of view) or circular (circular or sector field of view) reference line. The search beams are aligned perpendicular to the reference line.

- **Tolerance field:** Here, you have the option to configure the size of the tolerance range. The tolerance range is the range between the set minimum and maximum values. The system will test whether each distance located falls within or outside of this range. It is shown as a transparent orange area in the field of view.

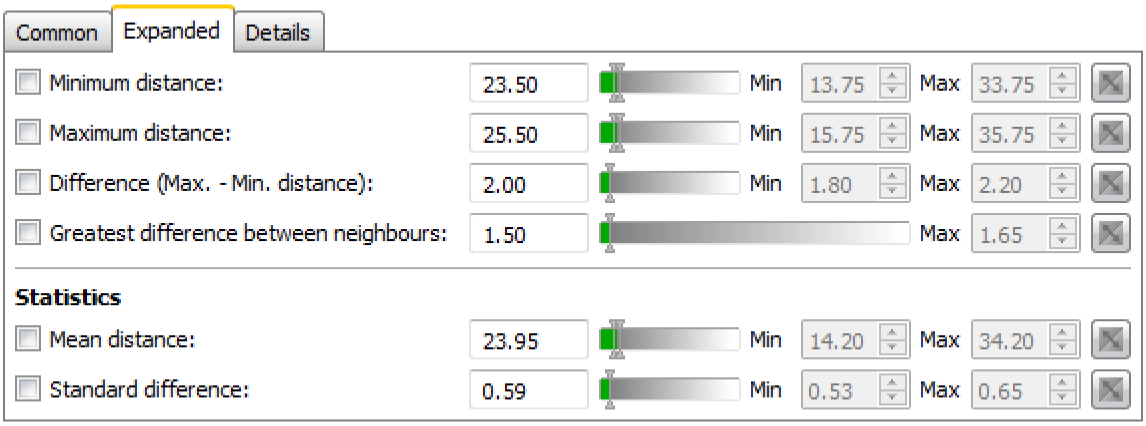


Specifications for the edge search

Define the specifications for the edge search.

- **Min. edge length:** You must also specify whether a short, medium or long edge is to be sought. Using *User defined*, you may manually enter the length of an edge (5-1000 pixels).

- **Transition:** For each edge, you must specify whether the edge progresses from bright to dark or from dark to bright.
- **Minimum contrast:** Specify whether you are searching for an edge with sharp or weak contrast.



On the *Extended* tab, there are further options for influencing the result of the feature check.

- The switching points designated **Min** and **Max** are adjusted on the right hand side. To do this, the corresponding criterion must be activated. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The button on the right inverts the result of the respective partial check for this feature check.

- **Minimum distance:** Define the criteria for the smallest distance value located.

- **Maximum distance:** Define the criteria for the largest distance value located.

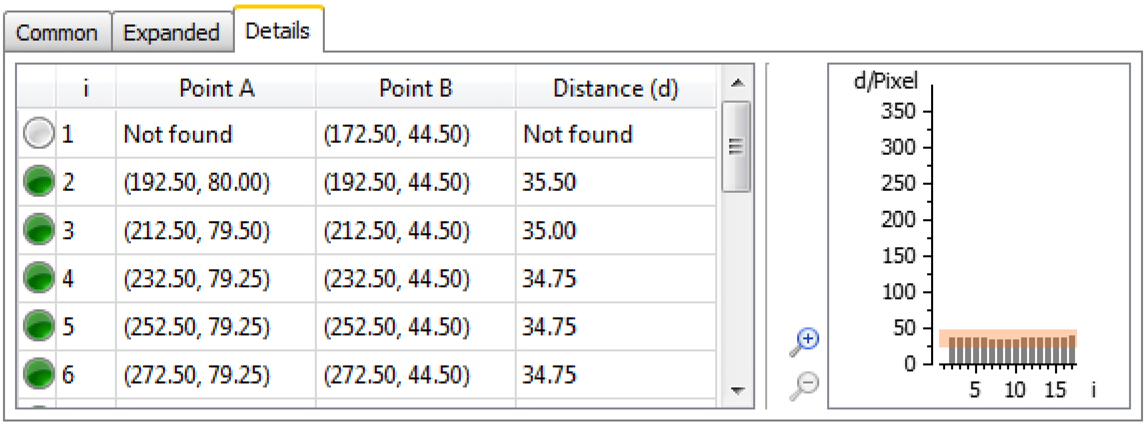
- **Difference (max. - min. distance):** Define the criteria for the difference between the smallest and largest distance values located.

- **Greatest difference between adjacent distances:** Determine the criteria for the greatest difference between directly adjacent distances.

Statistics

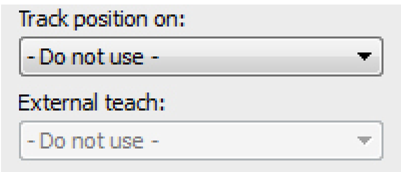
- **Mean distance:** Define the criteria for the average of all distance values located.

- **Standard difference:** Define the criteria for the standard difference for all distance values located.



On the *Details* tab, there is a table showing the results for the individual search beams and a bar chart. This tab is only used to display the values. You can zoom into the bar chart with the magnifying glass.

If you hover your cursor over one of the values in the table or a bar in the bar chart, the corresponding search line, point or distance will be highlighted in the field of view.



- If the feature check is to be corrected by the result of the part location, you can choose this option here.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

This feature check has the following output values for the datagram at the process interface:

Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Number of distances	Float	
Minimum distance	Float	
Maximum distance	Float	
Difference Max-Min	Float	
Greatest difference between adjacent distances	Float	
Mean distance	Float	
Standard difference	Float	
Distance list	Float list	
Edge point A list	Float-Point list	Intersection between search beam and located edge X – *separator* – Y, "NaN" if point is not found

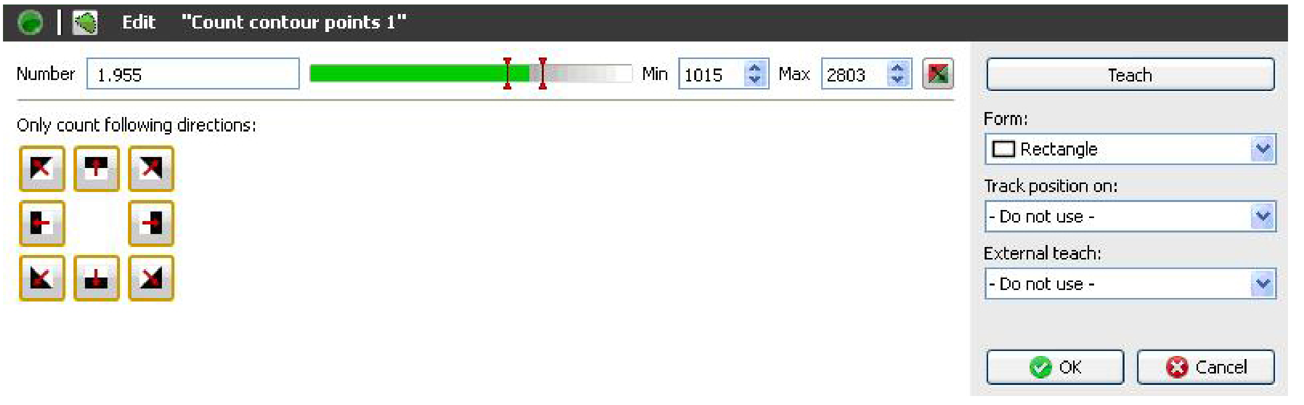
Output value	Data type	Description
Edge point B list	Float-Point list	Intersection between search beam and located edge X – *separator* – Y, "NaN" if point is not found

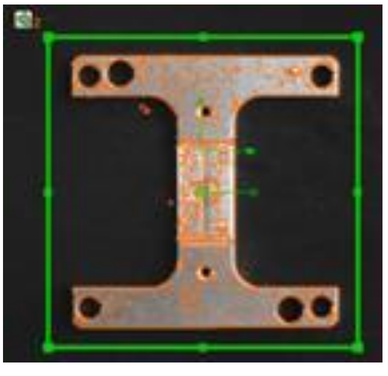
12.3 Feature comparison

12.3.1 Count contour points

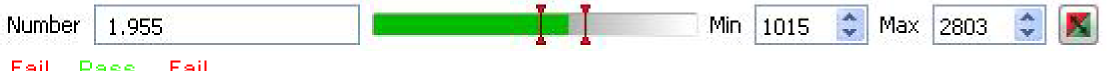
This feature check examines the number of contour points within the field of view.

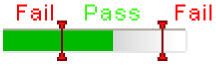
This feature check supports external Teach. The switching points are adjusted as a percentage to the current measured value.



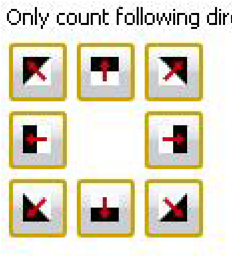


- Choose the shape of the field of view in this menu.

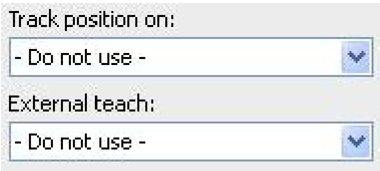




- The current result is displayed directly in the dialog as the *Number*. The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.



- Determine the direction of the contour points that should be taken into consideration (device dependant).



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

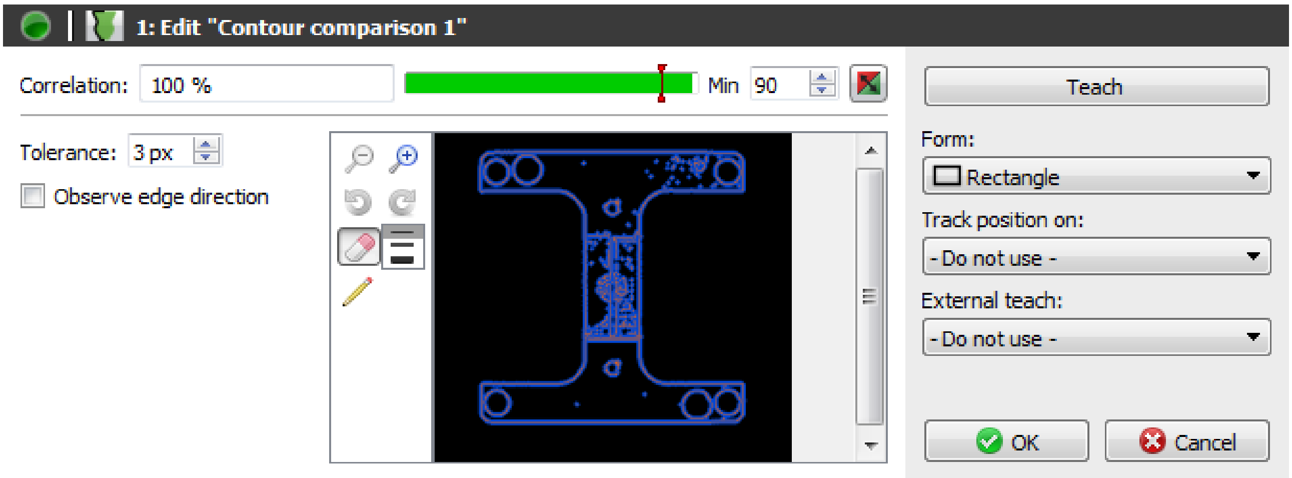
This feature check has the following output values for the datagram at the process interface:

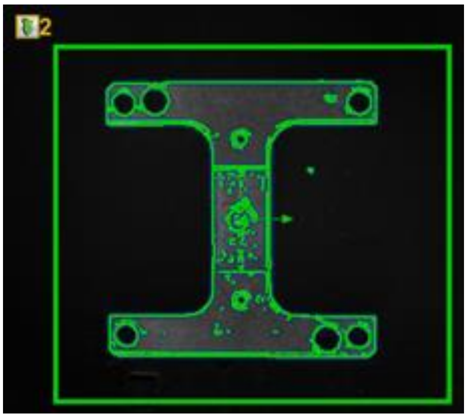
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Number of contour points	Integer	

12.3.2 Contour comparison

This feature check compares the contour of a taught-in object with the contour of the current object. In the comparison, adjacent pixels are counted and correspondence is determined on the basis of switching points. To use this feature check to its best effect, it is highly advisable to combine it with part location.

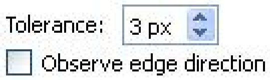
This feature check supports external Teach. Here all of the contours will be adopted in the model, but the switching points remain unchanged.



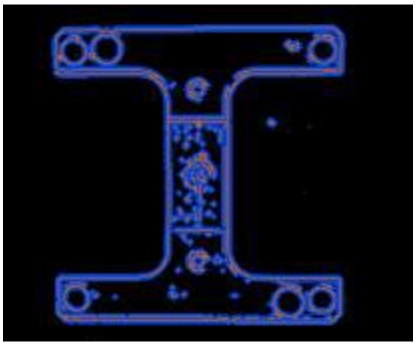


- The field of view must firstly be defined.

- The corresponding object is then taught in.

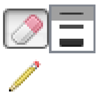


- **Tolerance:** Now adjust the size of the pixel field in which a pixel-by-pixel search is conducted for adjacent pixels. *Distance* specifies the detection area size in each direction up/down and right/left.
- **Observe edge direction:** Mark this option to increase accuracy during the examination.



- You can use these two buttons to enlarge or reduce the model.

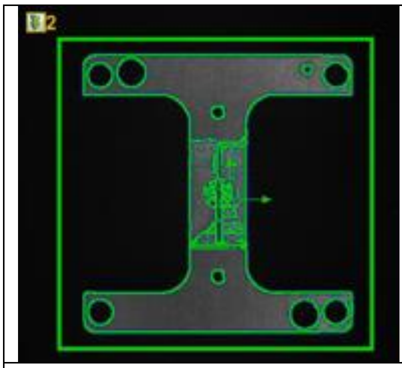
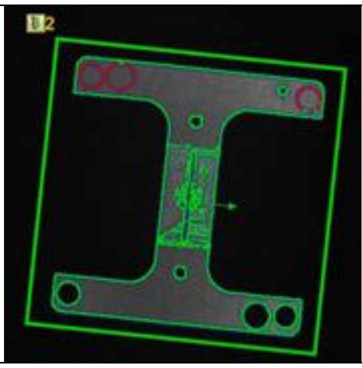
- You can gradually undo or redo the changes using these buttons.

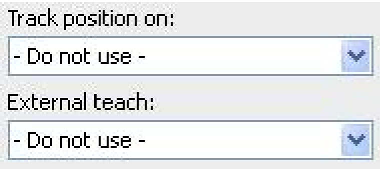


- With the displayed model, you can then use the mouse to delete contour points that clearly do not belong to the reference object or to supplement missing contour areas.

- The current result is displayed directly in the dialog as the *Match*. The switching point designated **Min** is adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.

The differences between the inspected items are marked in red following comparison between correct and defective items.

	
correct item	defective item (the upper holes are missing)



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

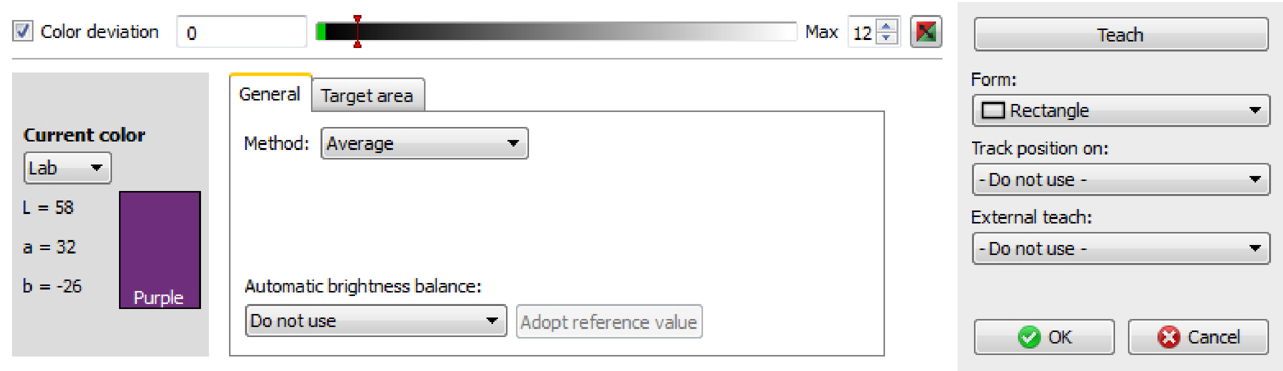
This feature check has the following output values for the datagram at the process interface:

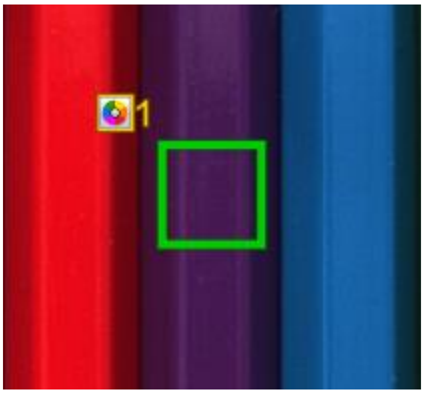
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Conformity	Integer	

12.3.3 Colour identification

This feature check identifies the colour in a field of view and checks whether the result is within a preset tolerance.

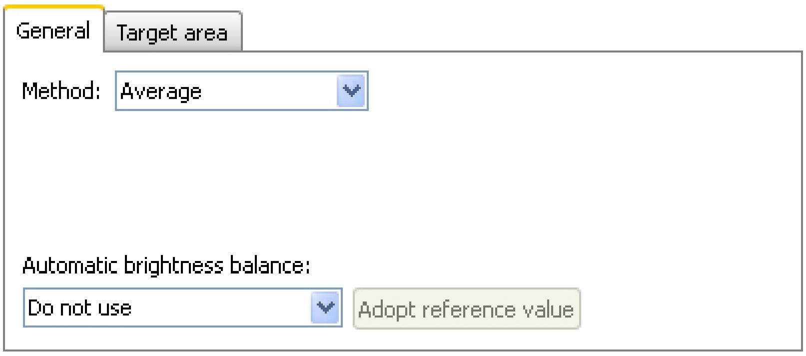
This feature check supports external Teach. The current colour is taught as the target colour.





- Select the shape of the field of view.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by correspondingly dragging the lever in the centre with your mouse.

- Tick here if you want to calculate the colour deviation, otherwise it will produce the current colour of the field of view rather than the result (OK, NOK).
- The current result (in ΔE - distance between two colour coordinates in the CIELab colour coordinate system) is displayed under *Colour deviation*. The switching point designated **Max** (max. 50) is adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.



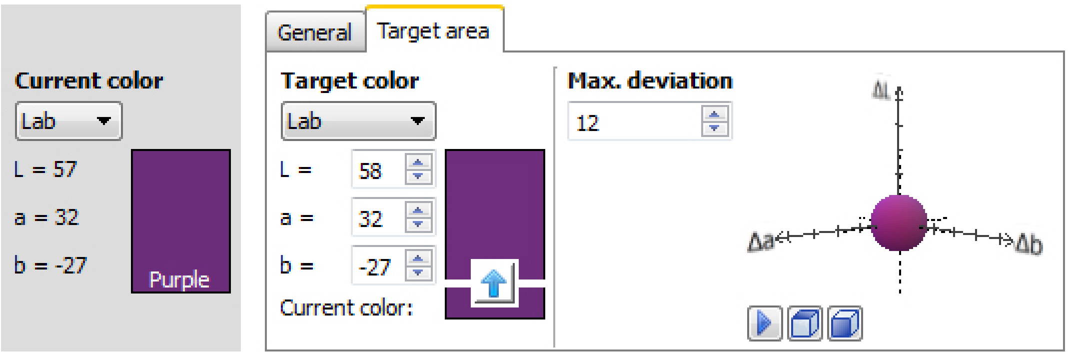
- **Methods: Average value:** The average value of all the pixels in the marked area is used.
- **Methods: Dominant single colour:** The dominant colour in the spectrum in the marked field of view is calculated and used. This means that any small errors such as dirt or reflections can be ignored.

Automatic brightness correction

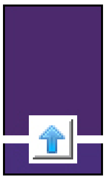
In order to be independent of fluctuations in the ambient light, the device offers a means of automatically correcting the brightness.

Use, do not carry reference area: Here, a field of view is defined as a reference area, for example by attaching a white label to the edge of the conveyor belt (static). The brightness correction is now guided by the brightness of this area.

Use, carry reference area: This function is only available in connection with part location. A field of view is still used as the reference area. However, this is carried with the position correction. The brightness correction is now guided by the brightness of this carried area.



- **Current colour:** The colour currently detected is displayed here. You can view the values for the colour currently detected in various colour spaces (RGB, Lab, LCh, HSV).



- **Target colour:** In this area, you can set the colour that should be searched for in each field of view. Use the arrow to accept the colour currently detected as the target colour.

NOTE

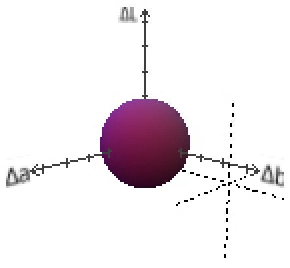
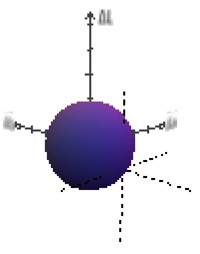
We recommend that you calculate the target colour with a correct model piece. Entered values may deviate from the model piece.

- **Max. deviation:** Here, you can set the maximum permissible colour deviation (in ΔE - distance between two colour coordinates in the CIELab colour coordinate system). This change is displayed to you in the CIELab colour coordinate system. The cover of the sphere represents the maximum deviation.

CIELab colour coordinates system

The cover of the sphere represents the maximum permissible colour deviation (ΔE) from the target colour and changes as you make entries. This means that all colour values of the current colour that lie within the ball are evaluated as *OK*.

The current colour is represented by a coordinate cross with dotted lines.

	
Current colour outside of the target colour - Result: NOK	Current colour inside of the target colour - Result: OK

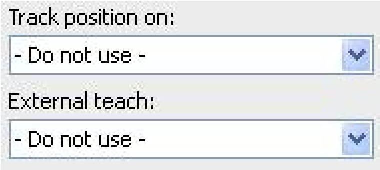
> **NOTE**
>
> The scales of the CIELab colour coordinate system are divided into increments of 10 and show up to 50.

CIELab colour coordinate system scale

Δ L = brightness (difference from target colour)
Δ a = red / green parts (difference from target colour)
Δ b = blue / yellow parts (difference from target colour)

Control buttons

You can move the CIELab coordinate system freely with the mouse and zoom with mouse wheel. There are also buttons to stop the animation and tilt the CIELab colour coordinate system.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

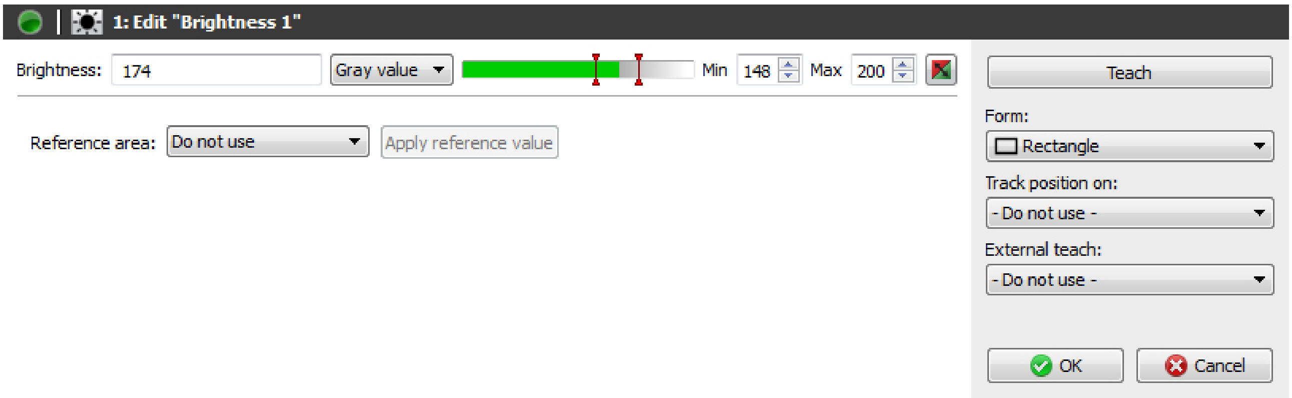
This feature check has the following output values for the datagram at the process interface:

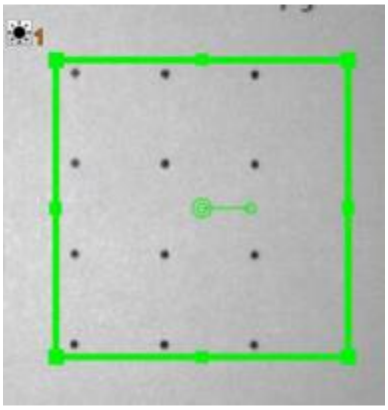
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Reference area brightness	Integer	
Colour deviation (ΔE)	Integer	
Colour (Lab)	Triple integer	
Colour (RGB)	Triple integer	
Colour (HSV)	Triple integer	
Colour (LCh)	Triple integer	

12.3.4 Brightness

This sensor task measures the mean brightness in a field of view and compares the result with the specified switching points.

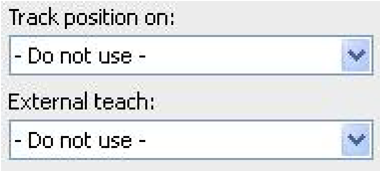
This feature check supports external Teach. The switching points are adjusted as an absolute to the current measured value.





- Select the shape of the field of view. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by correspondingly dragging the lever in the centre with your mouse.

- The current result for brightness is shown as an average grey scale value or as a percentage. The lightness value calculated during the teach process is 100%. The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

In order to be independent of fluctuations in the ambient light, the device offers a means of automatically correcting the brightness.

The mean brightness in the field of view of the reference area should exceed a grey scale value of 128 to ensure reliable operation.

- **Use, do not carry reference area:** Here, a field of view is defined as a reference area, for example by attaching a white label to the edge of the conveyor belt (static). The brightness correction is now guided by the brightness of this area.

- **Use, carry reference area:** This function is only available in connection with part location. A field of view is still used as the reference area. However, this is carried with the position correction. The brightness correction is now guided by the brightness of this carried area.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

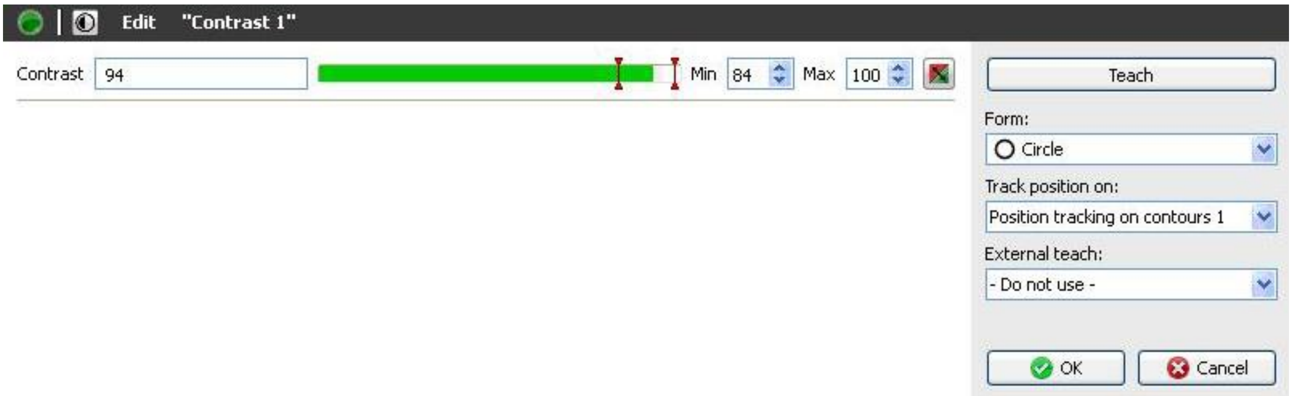
This feature check has the following output values for the datagram at the process interface:

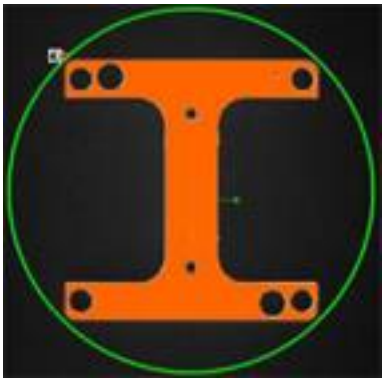
Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Brightness	Integer	
Reference area brightness	Integer	

12.3.5 Contrast

The feature check measures the contrast in a field of view and compares the result with the specified switching points.

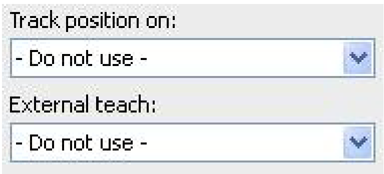
This feature check supports external Teach. The switching points are adjusted as an absolute to the current measured value.





- Select the shape of the field of view. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by correspondingly dragging the lever in the centre with your mouse.

- The current result of the contrast feature check is displayed directly in the dialogue as the *Contrast*. The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

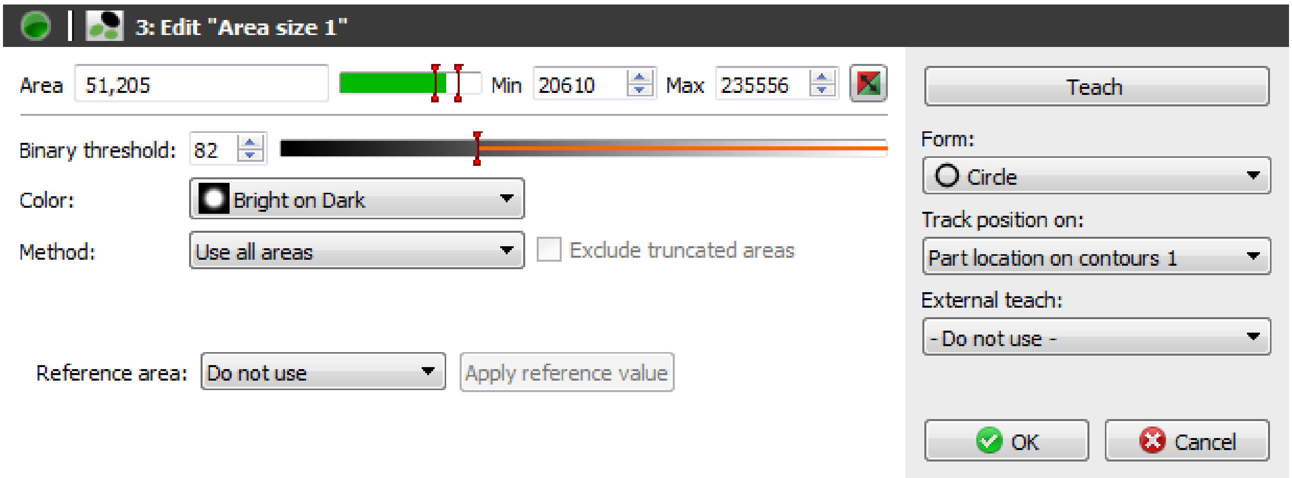
This feature check has the following output values for the datagram at the process interface:

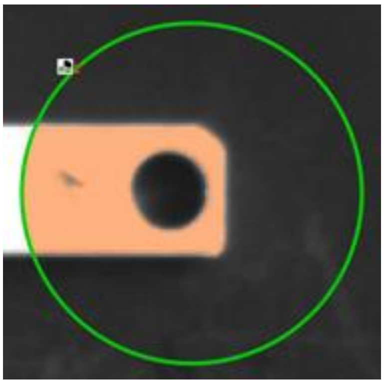
Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Contrast	Integer	
Reference area brightness	Integer	

12.3.6 Area size

The feature check calculates the number of bright or dark pixels in a field of view and compares the result with specified switching points.

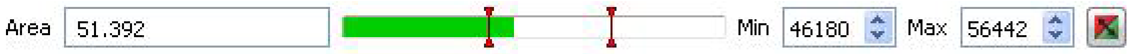
This feature check supports external Teach. The switching points are adjusted as a percentage to the current measured value.

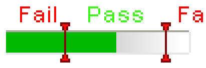




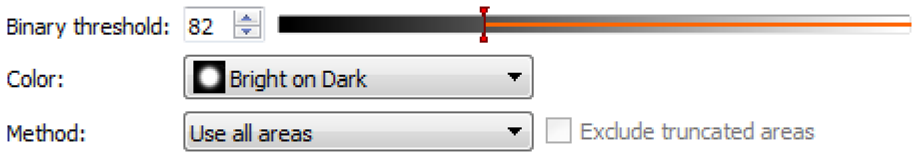
Proceed as follows for configuration:

- Select the shape of the field of view. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by correspondingly dragging the lever in the centre with your mouse.

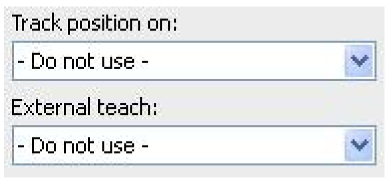




- The current result of the feature check is displayed directly in the dialogue as the *Area*. The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.



- **Binary switching point:** Set the switching point between 0 and 255, from which bright or dark pixels will be counted.
- **Colour:** This is where you enter the phenomenon that differentiates the pixels to be counted from their surroundings.
- **Methods:** Choose whether you want to count all areas or just the largest related areas.
- **Exclude cropped areas:** Areas which touch the edge of the field of view are excluded from the analysis. (only available for the *largest related areas*).



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

In order to be independent of fluctuations in the ambient light, the device offers a means of automatically correcting the brightness.

The mean brightness in the field of view of the reference area should exceed a grey scale value of 128 to ensure reliable operation.

- **Use current field of view:** The current defined field of view is used as a reference. It should only be used if the pattern being checked is very similar.

- **Use, do not carry reference area:** Here, a field of view is defined as a reference area, for example by attaching a white label to the edge of the conveyor belt (static). The brightness correction is now guided by the brightness of this area.

- **Use, carry reference area:** This function is only available in connection with part location. A field of view is still used as the reference area. However, this is carried with the position correction. The brightness correction is now guided by the brightness of this carried area.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

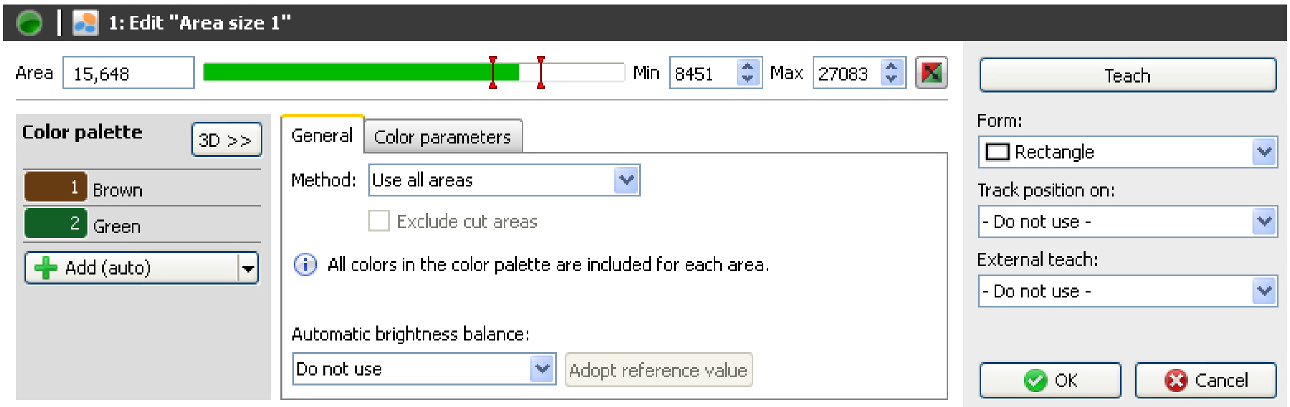
This feature check has the following output values for the datagram at the process interface:

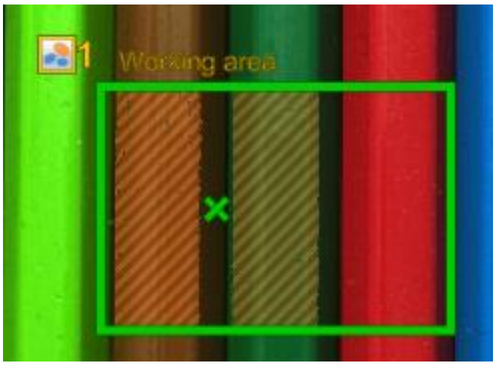
Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Area	Integer	
Centre	Integer	Output always in pixels
Reference area brightness	Integer	
Centre of gravity (float point)	Float point	Output switchable between pixels and coordinates (*Adjusting the image – coordinates*)

12.3.7 Area size (colour)

This feature check calculates the number of pixels of particular colours in a field of view and compares the result with specified switching points.

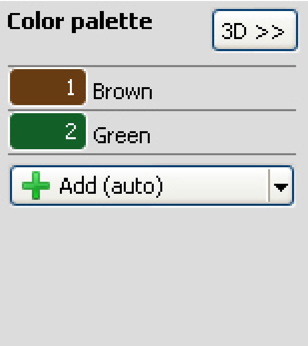
This feature check supports external Teach. The switching points are adjusted for the current calculated value.





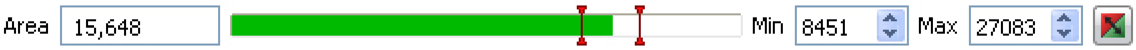
Proceed as follows for configuration:

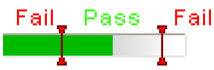
- Select the shape of the field of view. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by correspondingly dragging the lever in the centre with your mouse.



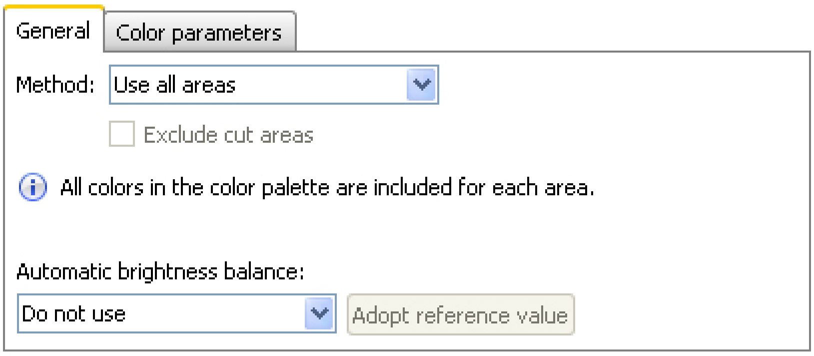
- Now select *Add* on the colour palette to teach in the first target colour.
- In the next step, mark the first target colour to be added on the image. This target colour can be located in any part of the image area and does not have to be in the field of view. However, only target colours in the defined field of view are assessed as *OK / NOK.* The marked target colours are displayed with a hatched pattern in the field of view.
- You can add up to 8 target colours to the colour palette. With *Add (auto)*, an area is automatically suggested for you to add as a new colour. Move the suggested area to the desired area and adjust its size if necessary.

  3D>>: Here you can see where the defined colours are in a CIELab colour coordinate system. Unlike the CIELab colour coordinate system on the *Colour parameters* tab, the complete colour area is displayed and is not limited to 50 values per axis. The current target colour is marked with a grid.





- The current result of the feature check is displayed directly in the dialogue as the *Area*. The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.



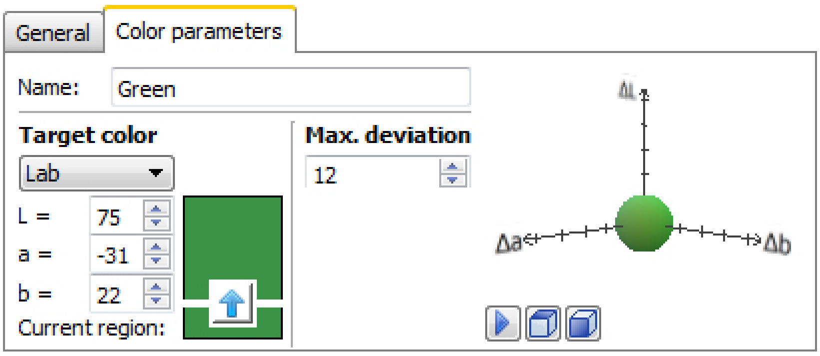
- **Methods:** Choose whether you want to count all areas or just the largest related areas.
- **Exclude cropped areas:** Areas which touch the edge of the field of view are excluded from the analysis. (only available for o*nly the largest related areas*).

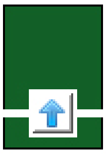
Automatic brightness correction

In order to be independent of fluctuations in the ambient light, the device offers a means of automatically correcting the brightness.

Use, do not carry reference area: Here, a field of view is defined as a reference area, for example by attaching a white label to the edge of the conveyor belt (static). The brightness correction is now guided by the brightness of this area.

Use, carry reference area: This function is only available in connection with part location. A field of view is still used as the reference area. However, this is carried with the position correction. The brightness correction is now guided by the brightness of this carried area.





- **Target colour:** In this area, you can set the colour that should be searched for in each field of view. Use the arrow to accept the colour currently detected as the target colour.

> **NOTE**
>
> We recommend that you calculate the target colour with a correct model piece. Entered values may deviate from the model piece.

- **Max. deviation:** Set the maximum permissible colour deviation (in ΔE - distance between two colour coordinates in the CIELab colour coordinate system) (max. 50) here. This change is displayed to you in the CIELab colour coordinate system. The cover of the sphere represents the maximum deviation. Only the current target colour is displayed as a coloured sphere, the other target colours are displayed as abstract spheres.

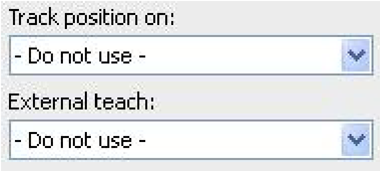
CIELab colour coordinate system scale

> **NOTE**
>
> The scales of the CIELab colour coordinate system are divided into increments of 10 and show up to 50.

Δ L = brightness (difference from target colour)
Δ a = red / green parts (difference from target colour)
Δ b = blue / yellow parts (difference from target colour)

Control buttons

You can move the CIELab coordinate system freely with the mouse and zoom with mouse wheel. There are also buttons to stop the animation and tilt the CIELab colour coordinate system.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

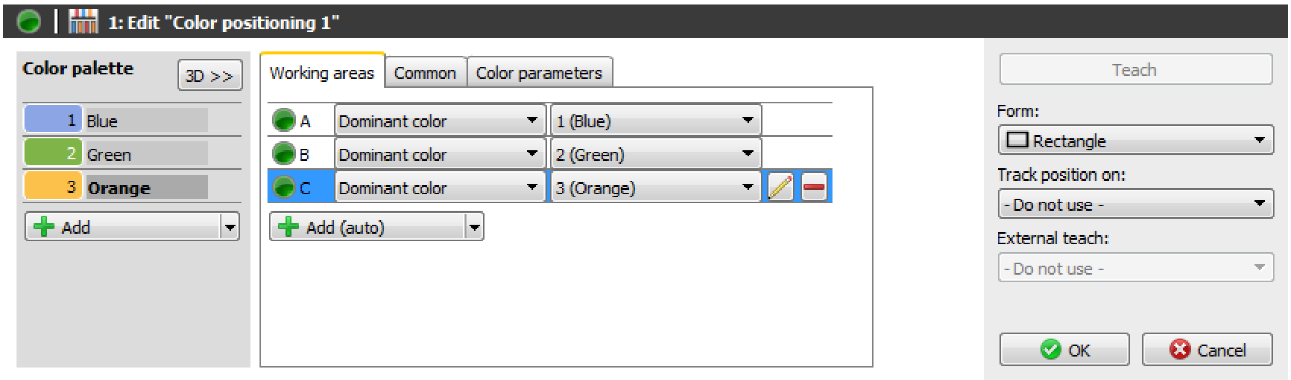
- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

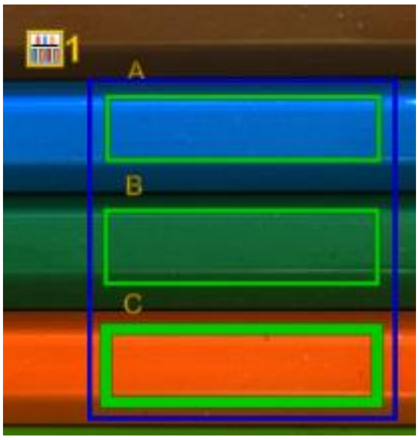
This feature check has the following output values for the datagram at the process interface:

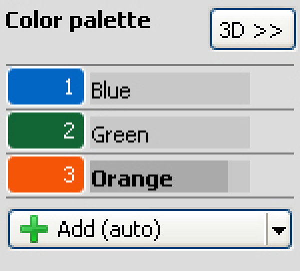
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Area	Integer	
Centre	Float point	Output switchable between pixels and coordinates (*Adjusting the image – coordinates*)
Reference area brightness	Integer	
Structure	Integer	Number of contour points on hatched areas

12.3.8 Colour positioning

This feature check checks the dominant colour or the presence of individual colours in one or more fields of view. This can be used to classify colours, for example.





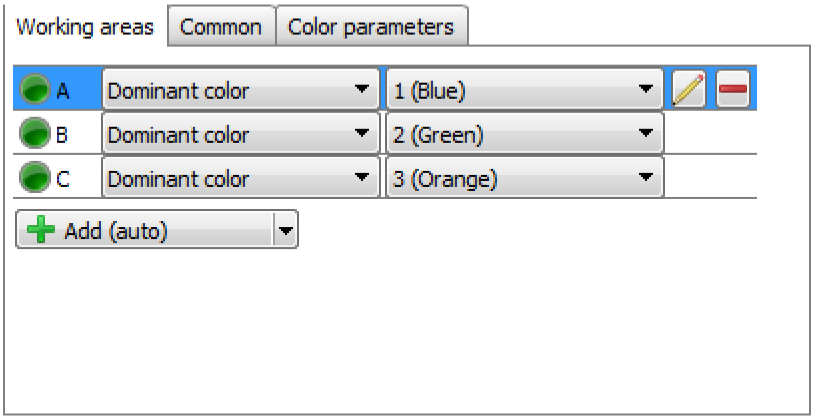


- Select *Add* on the colour palette to teach in the first target colour.

- In the next step, mark the first target colour to be added on the image. This target colour can be found anywhere across the entire image area. The marked target colour in the image is displayed with a hatched pattern. If the target colours touch each other (spheres on the Colour parameters tab), this is indicated with a warning triangle. A tool tip gives you information as to which other target colour it is touching.

- You can add up to 24 target colours to the colour palette. With *Add (auto)*, an area is automatically suggested for you to add as a new colour.
- Move the suggested area to the desired area and adjust its size if necessary.

  3D>>: Here you can see where the defined colours are in a CIELab colour coordinate system. Unlike the CIELab colour coordinate system on the *Colour parameters* tab, the complete colour area is displayed and is not limited to 50 values per axis. The current target colour is marked with a grid. Only colour areas that do not overlap can be definitively detected.



- Select *Add* on the Fields of view tab and mark the first field of view in the image. You can define up to 32 fields of view.

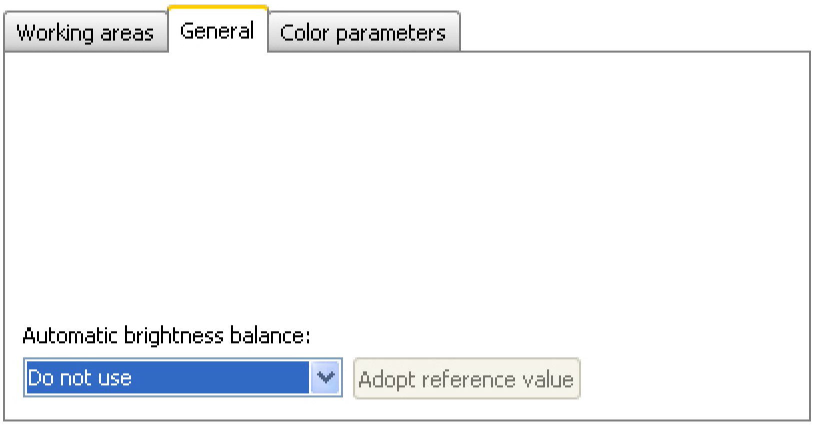
- Now select the method according to which the field of view should be analysed. The entire feature check will only be assessed as OK if all of the individual fields of view are OK, i.e. meet the defined criteria.

  Dominant colour: The selected colour must be the most frequently occurring colour in the field of view This method is automatically selected if one colour in the colour palette is dominant in the field of view.

Contains a colour from („or“): The field of view must contain one of the selected colours, the minimum colour proportion (in %) that must be present can also be adjusted.

Contains all colours from („and“): The field of view must contain all of the selected colours.

- You can use the buttons on the right to edit the minimum areas of the colours for the respective field of view, or to delete the entire field of view.

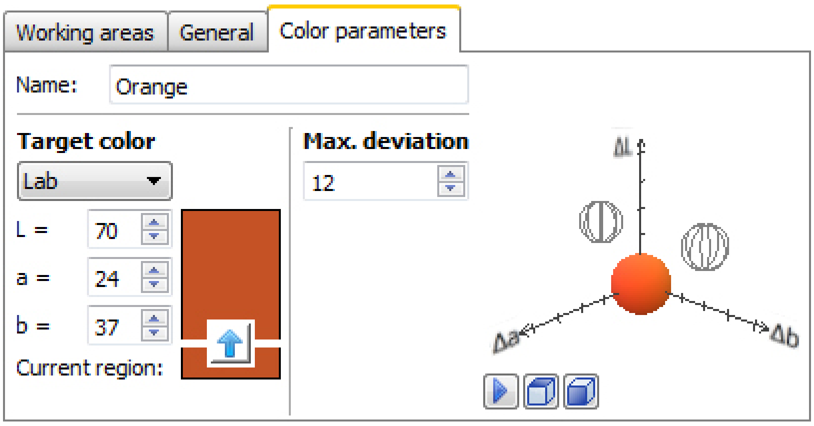


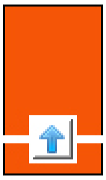
Automatic brightness correction

In order to be independent of fluctuations in the ambient light, the device offers a means of automatically correcting the brightness.

Use, do not carry reference area: Here, a field of view is defined as a reference area, for example by attaching a white label to the edge of the conveyor belt (static). The brightness correction is now guided by the brightness of this area.

Use, carry reference area: This function is only available in connection with part location. A field of view is still used as the reference area. However, this is carried with the position correction. The brightness correction is now guided by the brightness of this carried area.





- **Target colour:** In this area, you can set the colour that should be searched for in each field of view. Use the arrow to accept the colour currently detected as the target colour.

NOTE

We recommend that you calculate the target colour with a correct model piece. Entered values may deviate from the model piece.

- **Max. deviation:** Set the maximum permissible colour deviation (in ΔE - distance between two colour coordinates in the CIELab colour coordinate system) (max. 50) here. This change is displayed to you in the CIELab colour coordinate system. The cover of the sphere represents the maximum deviation. Only the current target colour is displayed as a coloured sphere, the other target colours are displayed as abstract spheres.

CIELab colour coordinate system scale

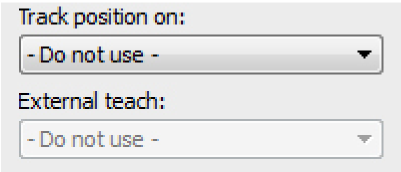
NOTE

The scales of the CIELab colour coordinate system are divided into increments of 10 and show up to 50.

Δ L = brightness (difference from target colour)
Δ a = red / green parts (difference from target colour)
Δ b = blue / yellow parts (difference from target colour)

Control buttons

You can move the CIELab coordinate system freely with the mouse and zoom with mouse wheel. There are also buttons to stop the animation and tilt the CIELab colour coordinate system.



- If the feature check is to be corrected by the result of the part location, you can choose this option here.

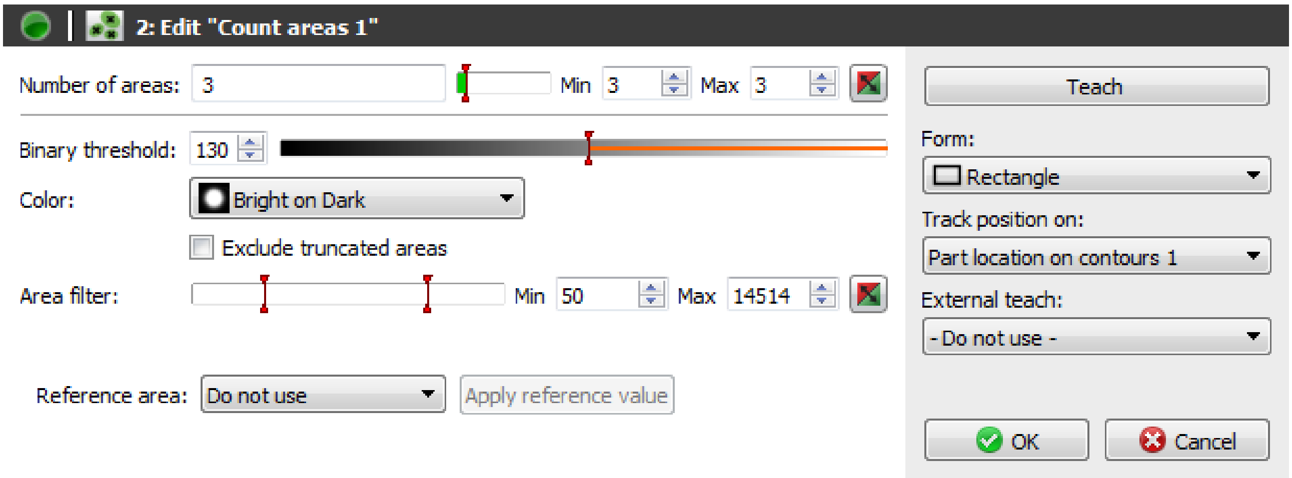
- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

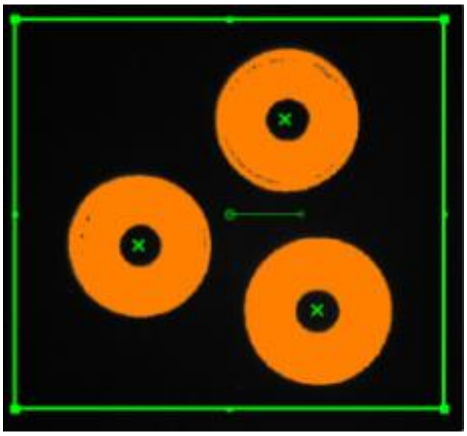
This feature check has the following output values for the datagram at the process interface:

Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Reference area brightness	Integer	
Field of view, colour, area	Integer list	Three values are listed for each combination of a field of view and a colour (field of view, colour, area). **Field of view:** Number, starting with 1 (not as letters) **Colour:** Number, starting with 1 **Area:** Proportion (in percent) of the field of view occupied by the colour
Dominant colour	Integer list	Number of the dominant colour for each field of view, or 0 if no colour is found
Pass/Fail	Text	Results for the individual fields of view as "P" (Pass) or "F" (Fail)

12.3.9 Count areas

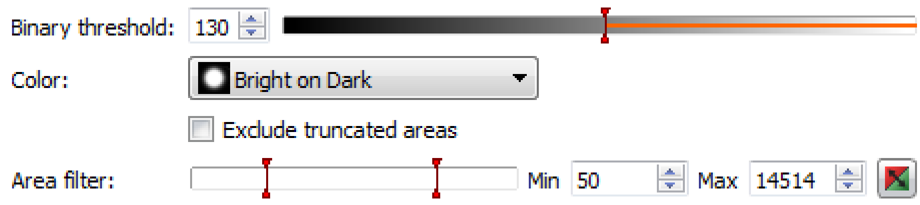
With this feature check, related areas in the field of view are counted.
This feature check supports external Teach. The switching points are adjusted as an absolute to the current measured value.



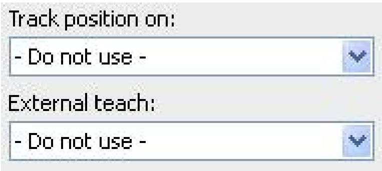


- Select the shape of the field of view. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by correspondingly dragging the lever in the centre with your mouse.

- The current result is displayed directly in the dialog as the *Number of areas*. The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.



- **Binary switching point:** Set the binary switching point at a value between 0 and 255.
- **Colour:** This is where you enter the phenomenon that differentiates the objects to be counted from their surroundings.
- **Exclude cropped areas:** Areas which touch the edge of the field of view are excluded from the analysis.
- **Areas filter:** Adjust the minimum and maximum number of pixels of the counted areas. You can invert the result using the right button.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

In order to be independent of fluctuations in the ambient light, the device offers a means of automatically correcting the brightness.

The mean brightness in the field of view of the reference area should exceed a grey scale value of 128 to ensure reliable operation.

- **Use, do not carry reference area:** Here, a field of view is defined as a reference area, for example by attaching a white label to the edge of the conveyor belt (static). The brightness correction is now guided by the brightness of this area.

- **Use, carry reference area:** This function is only available in connection with part location. A field of view is still used as the reference area. However, this is carried with the position correction. The brightness correction is now guided by the brightness of this carried area.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

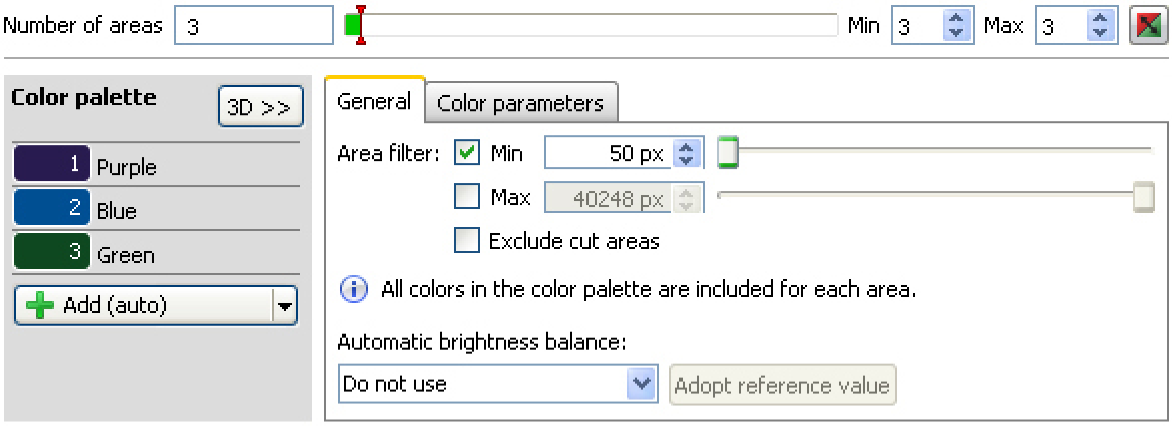
This feature check has the following output values for the datagram at the process interface:

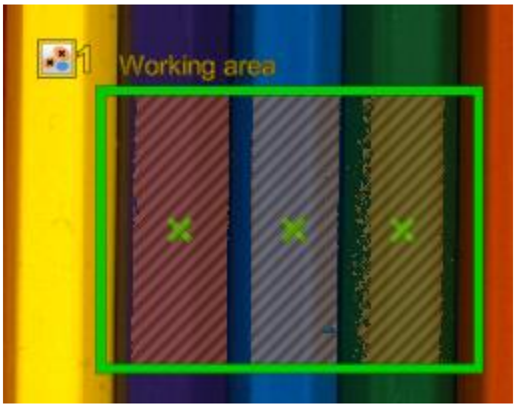
Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Number of objects	Integer	
Reference area brightness	Integer	
List of centres	Float-Point list	
List of areas	Float-Point list	
List of structure values	Integer list	Number of contour points within the respective area (BLOB).
List of lightness values	Integer list	Average grey value within the respective area.

12.3.10 Count areas (colour)

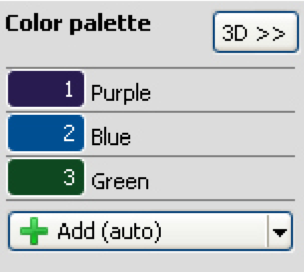
This feature check is used to count related areas of a particular colour or colour selection in the field of view.

This feature check supports external Teach. The switching points are adjusted as an absolute to the current calculated value.



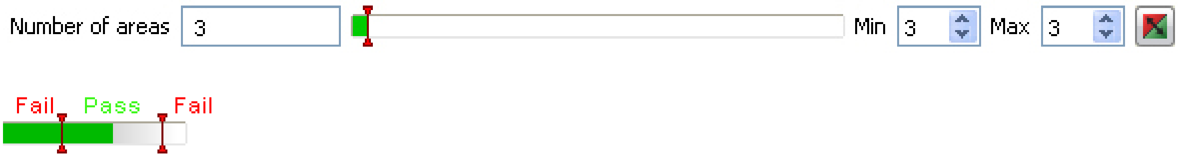


- Select the shape of the field of view. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by correspondingly dragging the lever in the centre with your mouse.

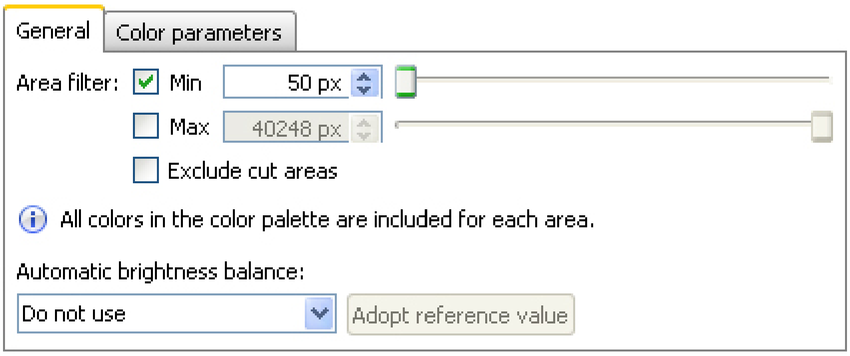


- Now select *Add* on the colour palette to teach in the first target colour to be counted.
- In the next step, mark the first target colour to be added on the image. This target colour can be located in any part of the image area and does not have to be in the detection area. However, only target colours in the defined detection area are counted. The marked target colours are displayed with a hatched pattern in the detection area.
- You can add up to 8 target colours to the colour palette. With *Add (auto)*, an area is automatically suggested for you to add as a new colour. Move the suggested area to the desired area and adjust its size if necessary.

3D>>: Here you can see where the defined colours are in a CIELab colour coordinate system. Unlike the CIELab colour coordinate system on the *Colour parameters* tab, the complete colour area is displayed and is not limited to 50 values per axis. The current target colour is marked with a grid. Only colour areas that do not overlap can be definitively detected.



- The current result is displayed directly in the dialog as the *Number of areas*. The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.



- **Areas filter:** Set the minimum and maximum size of the areas that are to be counted. These settings refer to all areas and not to an individual colour. If you hover the cursor over this area, you will see the size of the detected area in the detection area in the image.

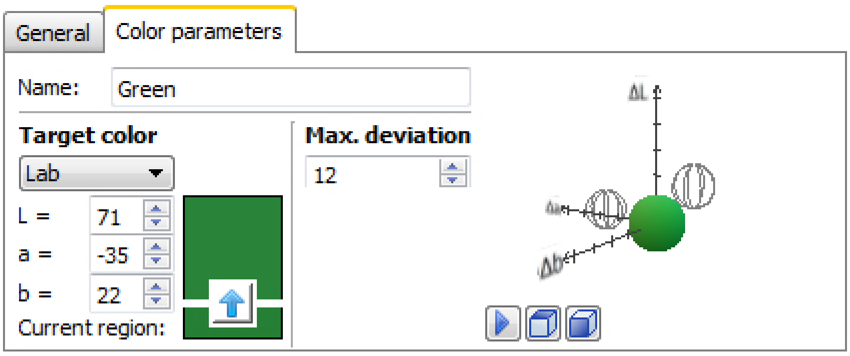
- **Exclude cropped areas:** Areas which touch the edge of the field of view are excluded from the analysis.

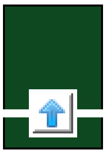
Automatic brightness correction

In order to be independent of fluctuations in the ambient light, the device offers a means of automatically correcting the brightness.

- **Use, do not carry reference area:** Here, a field of view is defined as a reference area, for example by attaching a white label to the edge of the conveyor belt (static). The brightness correction is now guided by the brightness of this area.

- **Use, carry reference area:** This function is only available in connection with part location. A field of view is still used as the reference area. However, this is carried with the position correction. The brightness correction is now guided by the brightness of this carried area.





- **Target colour:** In this area, you can set the colour that should be searched for in each field of view. Use the arrow to accept the colour currently detected as the target colour.

NOTE

We recommend that you calculate the target colour with a correct model piece. Entered values may deviate from the model piece.

- **Max. deviation:** Set the maximum permissible colour deviation (in ΔE - distance between two colour coordinates in the CIELab colour coordinate system) (max. 50) here. This change is displayed to you in the CIELab colour coordinate system. The cover of the sphere represents the maximum deviation. Only the current target colour is displayed as a coloured sphere, the other target colours are displayed as abstract spheres.

CIELab colour coordinate system scale

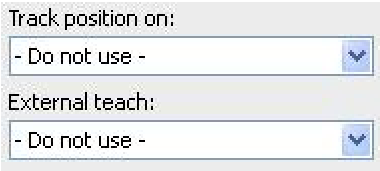
NOTE

The scales of the CIELab colour coordinate system are divided into increments of 10 and show up to 50.

Δ L = brightness (difference from target colour)
Δ a = red / green parts (difference from target colour)
Δ b = blue / yellow parts (difference from target colour)

Control buttons

You can move the CIELab coordinate system freely with the mouse and zoom with mouse wheel. There are also buttons to stop the animation and tilt the CIELab colour coordinate system.



- If the feature check is to be corrected by the result of a part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

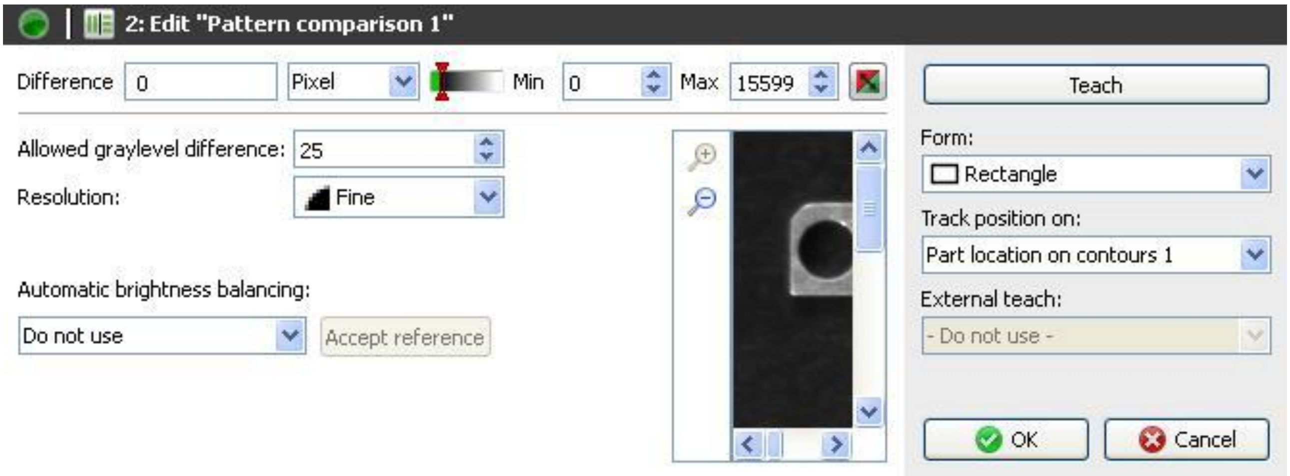
This feature check has the following output values for the datagram at the process interface:

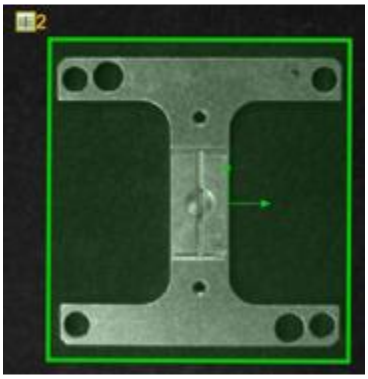
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Number of objects	Integer	
Reference area brightness	Integer	
List of centres	Float-Point list	
List of areas	Float-Point list	
List of structure values	Integer list	Number of contour points within the respective area (BLOB).

12.3.11 Pattern comparison

This feature check verifies the presence of a taught-in pattern.

It supports external teach. The current image area is adopted in the model, but the switching points remain unchanged.

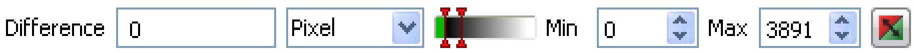




Proceed as follows for configuration:

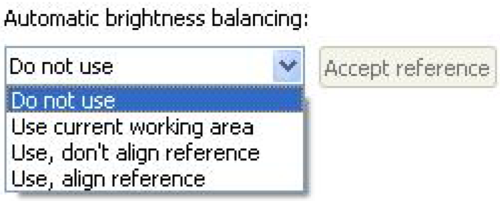
- The field of view must firstly be defined.

- Teach in a new pattern using this button.



- The current result is displayed directly in the dialog as the *Deviation*. You can also select whether the value should be displayed in *pixels* or in *percent*.
- A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.

- **Permissible grey scale variation:** Select the permissible grey scale variation. This corresponds with the absolute grey scale variation in the image.
- **Resolution:** You can choose the calculation accuracy and thereby the required processing time.



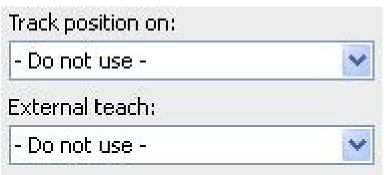
In order to be independent of fluctuations in the ambient light, the device offers a means of automatically correcting the brightness.

The mean brightness in the field of view of the reference area should exceed a grey scale value of 128 to ensure reliable operation.

- **Use current field of view:** The current defined field of view is used as a reference. It should only be used if the pattern being checked is very similar.

- **Use, do not carry reference area:** Here, a field of view is defined as a reference area, for example by attaching a white label to the edge of the conveyor belt (static). The brightness correction is now guided by the brightness of this area.

- **Use, carry reference area:** This function is only available in connection with part location. A field of view is still used as the reference area. However, this is carried with the position correction. The brightness correction is now guided by the brightness of this carried area.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

This feature check has the following output values for the datagram at the process interface:

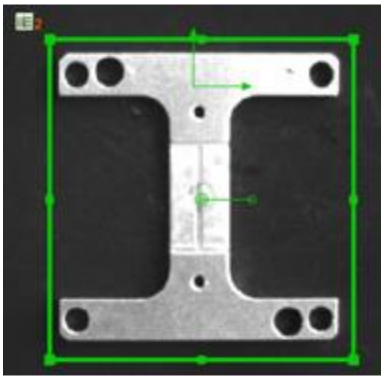
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Deviation	Integer	
Reference area brightness	Integer	

12.3.12 Pattern comparison (older version)

> **NOTE**
>
> The older version of the feature check is still available due to reasons of compatibility. It is strongly recommended that you use the newer, more powerful version. It is not possible to convert to the newer version.

This feature check verifies the presence of a taught-in pattern.

This feature check supports external Teach. The current image area is adopted in the model, but the switching points remain unchanged.



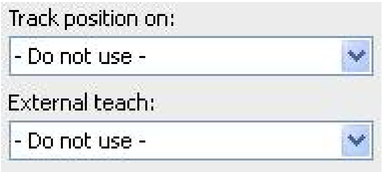
Proceed as follows for configuration:

- The field of view must firstly be defined.

- Teach in a new pattern using this button.

- The current result is displayed directly in the dialog as the *Match*. The switching point designated **Min** is adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.

- **Resolution:** You can choose the calculation accuracy and thereby the required processing time.
- **Automatic brightness correction:** You can choose an automatic brightness correction to increase the stability of the feature check under ambient conditions. Brightness correction corrects the brightest and darkest grey scale values in the image and thereby adjusts all other grey scale values to the corresponding level.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

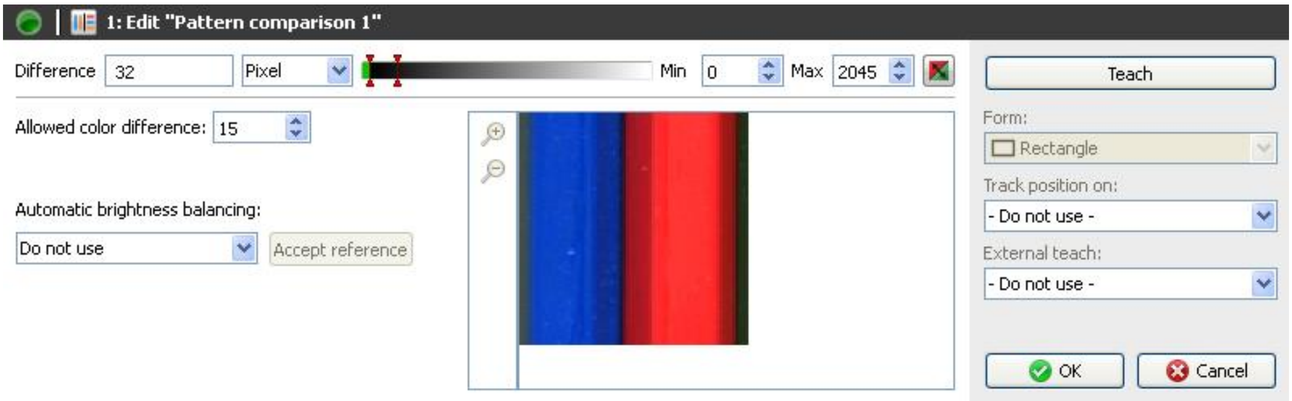
This feature check has the following output values for the datagram at the process interface:

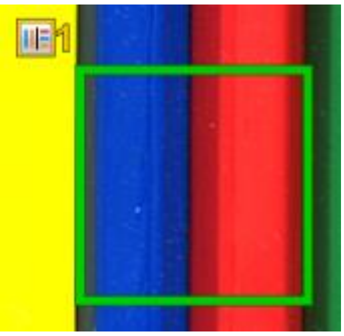
Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Conformity	Integer	

12.3.13 Pattern comparison (colour)

This feature check verifies the presence of a taught-in colour pattern.

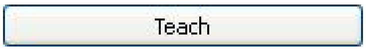
It supports external teach. The current image area is adopted in the model, but the switching points remain unchanged.





Proceed as follows for configuration:

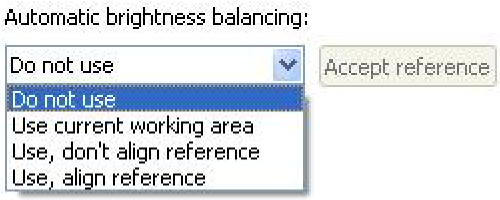
- Select the shape of the field of view. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by correspondingly dragging the lever in the centre with your mouse.



- Teach in a new pattern using *Teach*.

- The current result is displayed directly in the dialog as the *Deviation*. You can also select whether the value should be displayed in *pixels* or in *percent*.
- A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- The right button is used to invert the result of the feature check.

- **Permissible colour deviation:** Set the maximum permissible colour deviation (in ΔE - distance between two colour coordinates in the CIELab colour coordinate system).



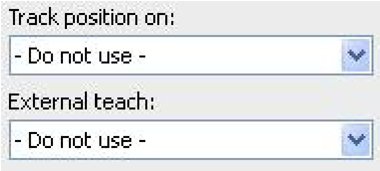
In order to be independent of fluctuations in the ambient light, the device offers a means of automatically correcting the brightness.

The mean brightness in the field of view of the reference area should exceed a grey scale value of 128 to ensure reliable operation.

- **Use current field of view:** The current defined field of view is used as a reference. It should only be used if the pattern being checked is very similar. However, we recommend that you choose a separate field of view.

- **Use, do not carry reference area:** Here, a field of view is defined as a reference area, for example by attaching a white label to the edge of the conveyor belt (static). The brightness correction is now guided by the brightness of this area.

- **Use, carry reference area:** This function is only available in connection with part location. A field of view is still used as the reference area. However, this is carried with the position correction. The brightness correction is now guided by the brightness of this carried area.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

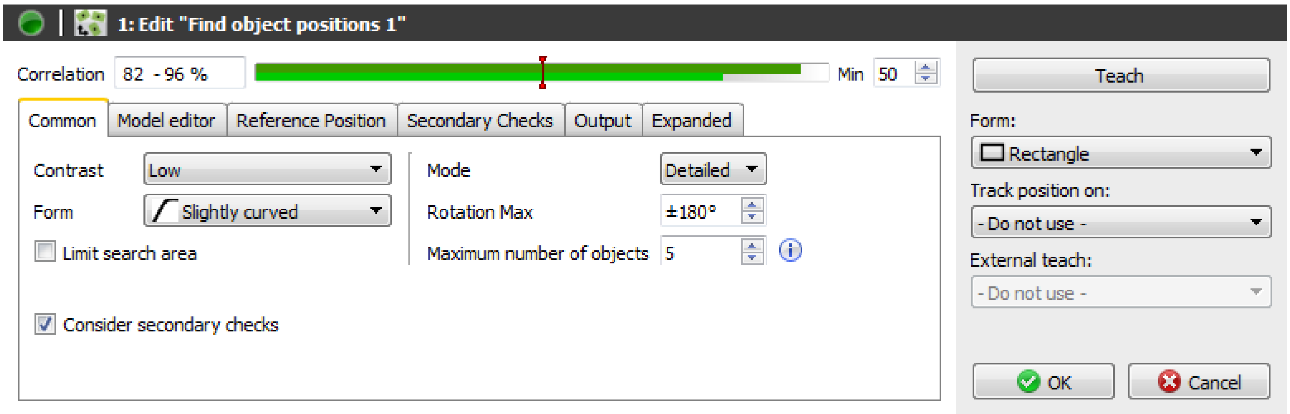
This feature check has the following output values for the datagram at the process interface:

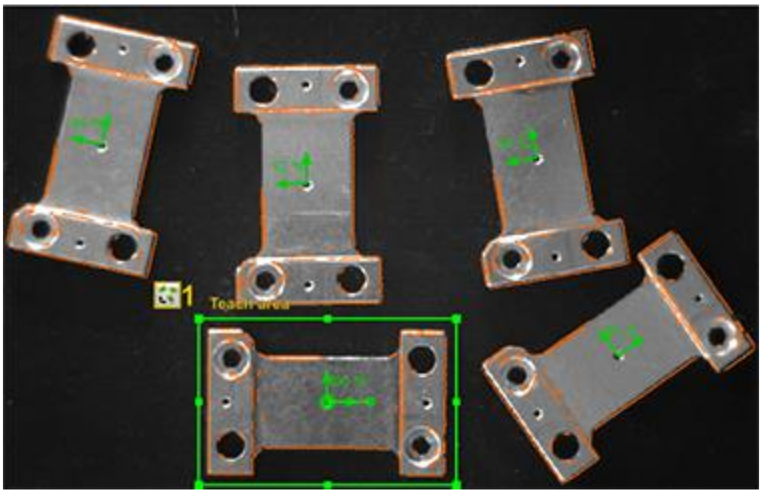
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Deviation	Integer	
Reference area brightness	Integer	

12.3.14 Finding object positions

This feature check finds multiple objects based on one programmed object. The found objects can then be filtered by several criteria, e.g. for pick and place applications.

This feature check does not support external teach.

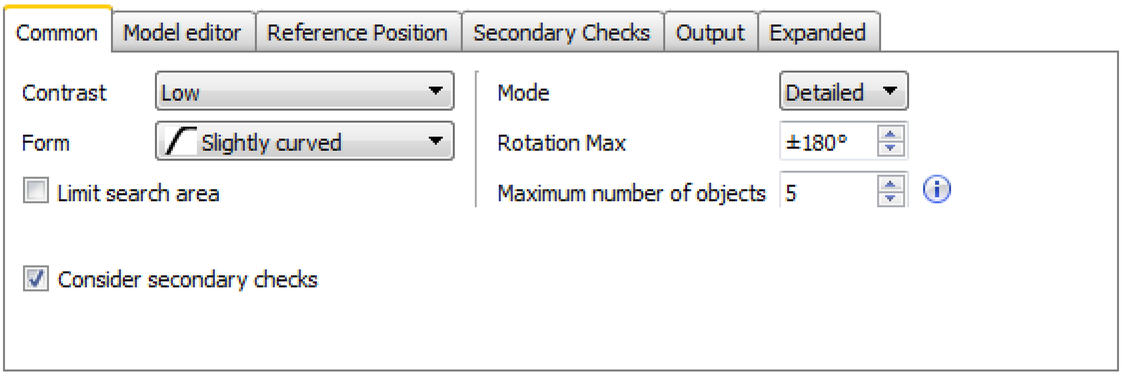




- Select the shape of the area in which you want to programme an object. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by correspondingly dragging the lever in the centre with your mouse.

Press *Teach* to search for new contours if you move the area.

- A match of the objects found will be directly displayed as a *Match* in the dialogue.
- The switching point designated **Min** is adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed. The upper bar shows the object with the highest match and the lower bar the object with the lowest match.



- **Contrast:** Set the minimum contrast of the contours that should be adopted in the model.
- **Form:** Select the shape of the contour that equates to the test object. (Limiting the angular range reduces processing time.)
- **Mode:** Set the amount of detail to be used in the inspection. (The more detailed the mode, the higher the processing time.)
- **Max. rotation:** If you want to find the object only in a limited angular range, you may specify the maximum rotational position here.
- **Maximum number of objects:** This is where you configure the maximum number of objects to be found. (Select the number to be as low as possible to reduce computation time.)

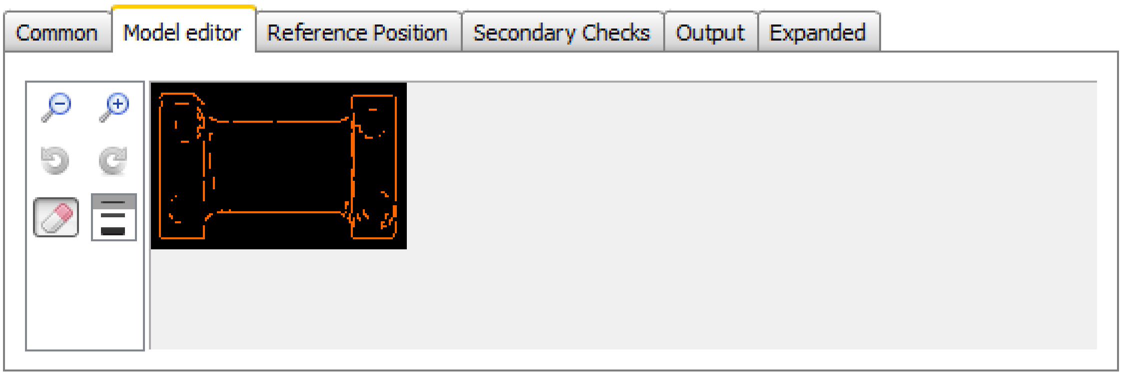
NOTE

Objects are more stable if they have contours that:

- have no parallel lines spaced up to 4 pixels
- are long (at least 20 pixels)
- have a slight curvature

Restricting the detection area: If you do not wish to search for the object in the entire image, set the tick and then limit the detection area.

Using additional tests: Enable this function if you want to conduct additional tests in the immediate surroundings of each located object. These tests are then to be configured on the corresponding tab.

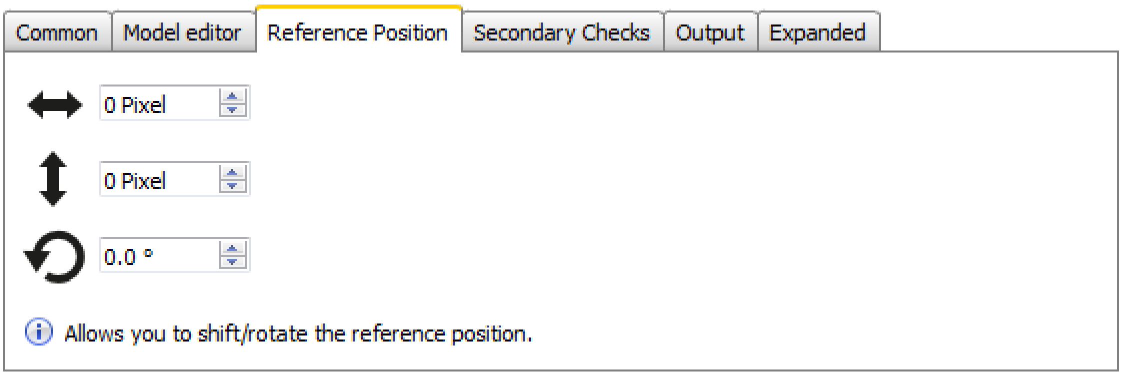


The *Model editor* tab can be used to edit the contours of the programmed object.

- You can use these two buttons to enlarge or reduce the model.

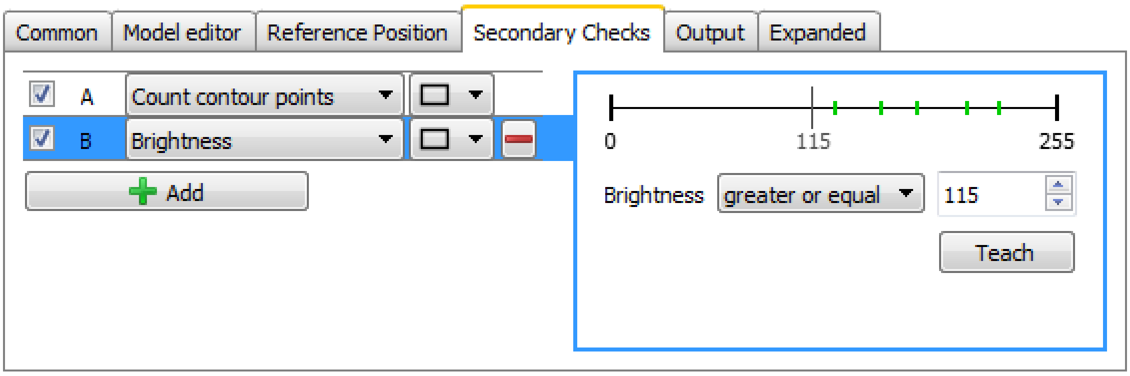
- You can gradually undo or redo the changes using these buttons.

- With the displayed model, you can use the mouse to delete contours which clearly do not belong to the reference object. Select the required tool strength to do this.



The reference position is by default the centre of the work area. The coordinates of this point can be output for each located object via the process interface.

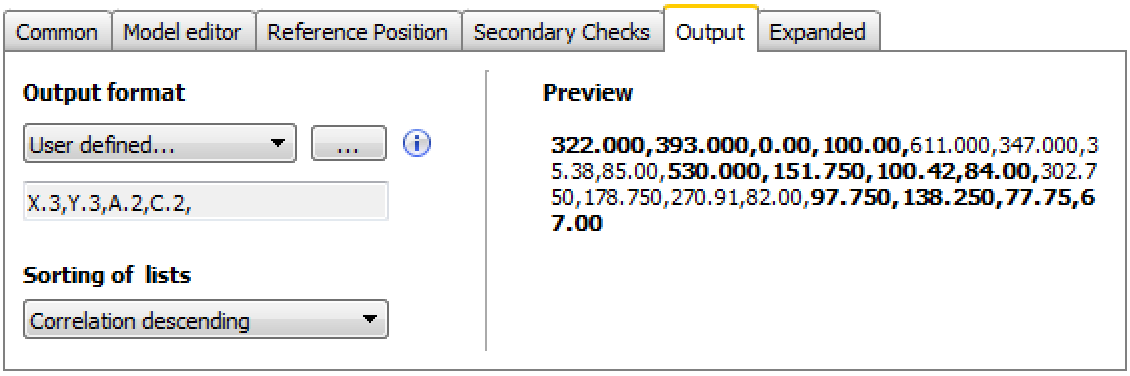
This tab can be used to amend the reference position. It can be moved horizontally and vertically and rotated.



The *Additional tests* tab can be used to determine the criteria for subsequent testing of each located object. This enables detection of overlapping objects, for example, by stipulating criteria in their vicinity or on the surface of the object.

These additional tests can be used to discard initially located objects.

- Select *Add* and then select a feature.
- Now a shape (rectangle, circle) can be selected for the area to be marked.
- The next step is to mark the test area within the image.
- Criteria for this feature check can now be configured in the area on the right.

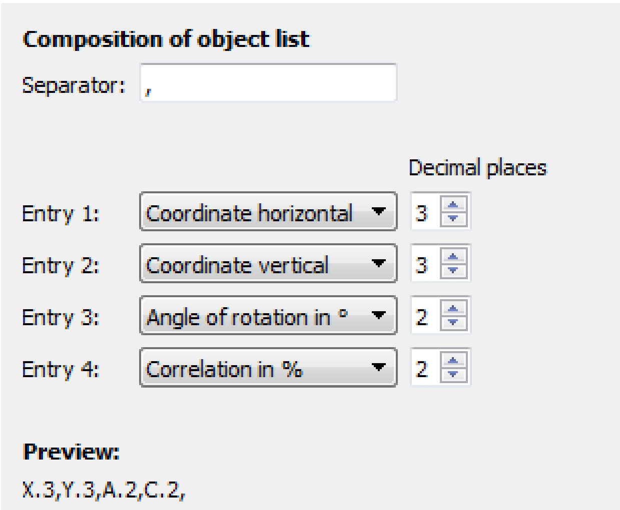


The *Output* tab can be used to define the content and structure of the *Formatted* list that can be output using the process interface. The *Formatted* list contains information about the located objects. The *Preview area* on the right displays the effect the settings have on the Formatted list in a live view.

Output format

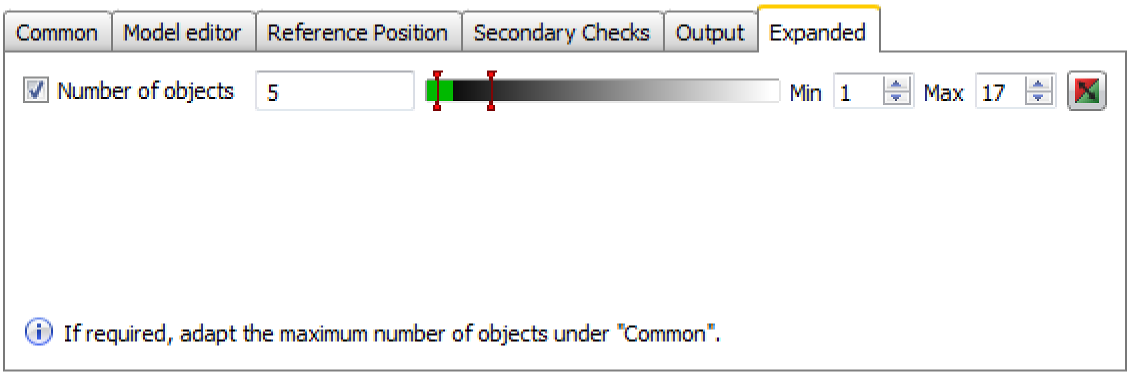
This is where you determine the format of the output. Select *User defined* to see further options for governing the Formatted list.

Open the wizard for the mask. There are further configuration options available.

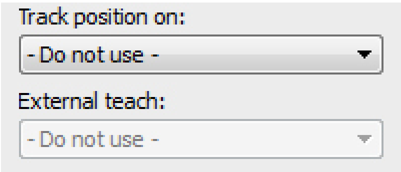


Sorting by lists

This offers you the opportunity to determine the sequence for outputting the coordinates of located objects.



The *Extended* tab can be used to govern the result of the feature check regarding the number of located objects.



- If the feature check is to be corrected by the result of a part location, you can choose this option here. The location of the detection area will be refreshed when this is activated.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

This feature check has the following output values for the datagram at the process interface:

Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Conformity	Integer	Model match (%) for the object with the lowest match
Number of objects	Integer	Number of located objects
Number of discarded objects	Integer	Number of objects discarded by additional tests
List of object centres	Float-Point list	
List of object rotation angles	Float list	
List of matches	Integer list	
Formatted list	Text	

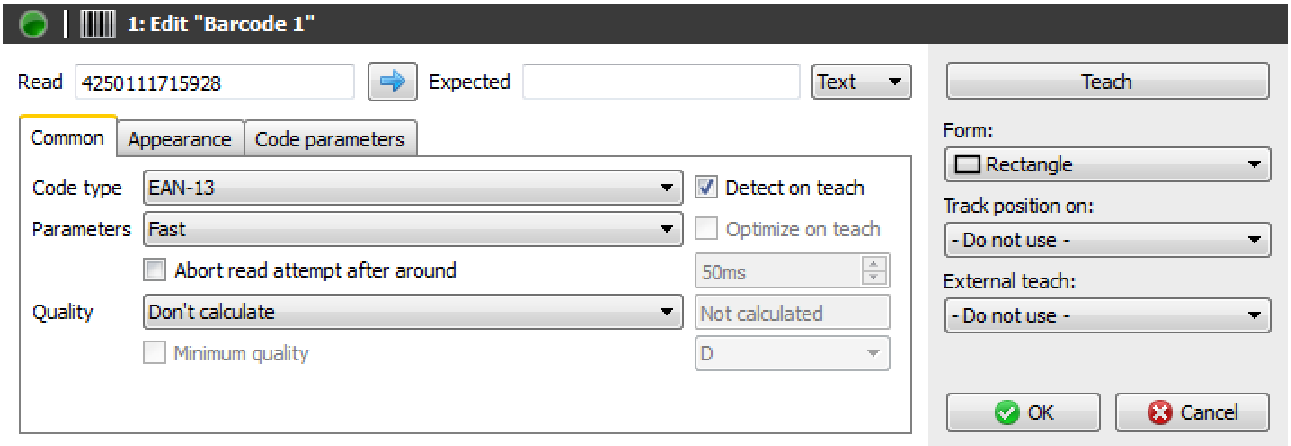
12.4 Identification

> **NOTE**
>
> For devices with integrated Industrial Ethernet:
>
> In the case of feature checks from the identification area, especially with code that is difficult to read, there can be slight deviations in the calculation of results between *Application Suite* and device. This is due to slight rounding differences caused by platforms that are technologically different. The results displayed after the device is activated are decisive.

12.4.1 Barcode

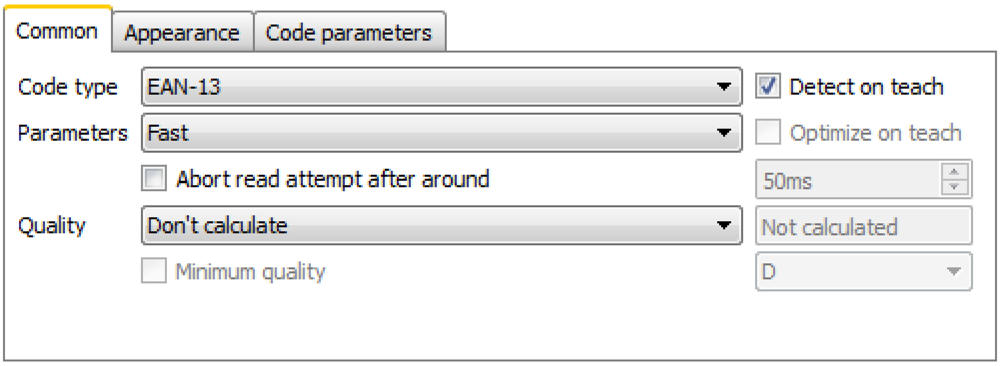
With this feature check barcodes can be read. In addition, the quality of the barcode can be determined according to ISO/IEC 15416.

This feature check supports external Teach. Here the parameters are adjusted for the identification and the expected value adopted.



- Choose the detection area.

- **Read:** The read result is displayed here.
- **Arrow:** Using the arrow, you can accept the current result as the new expected value.
- **Expected:** In addition, you may specify an expected value.
- **Text/binary:** Change the display between *Text* (ASCII) and *Binary* (hexadecimal).



- **Code type:** Select the type of barcode in the image.
- **Detection on teach:** Using the *Detection on teach* option, you can have the code type automatically determined during external teach.

- **Parameters:** Select the search parameters used to search for the code. *Fast, Robust and User defined* are available. In the case of the user-defined search, you can manually set the parameters for the display and the code.
- **Optimize on teach:** Using the *Optimize on teach* option, you can have the parameters automatically adjusted for the code search during the external teach. This is only necessary if you have set the search parameters in the User-defined option.

- **Abort read attempt after circa:** Use this function to limit computing time for code determination.

NOTE

If computing time for code determination is limited and code quality is also to be determined, you need to be aware that limiting computing time only applies to code determination. If necessary, the extra time required for determining code quality should be established empirically and planned in addition – so deducted from the maximum permitted computing time, for example.

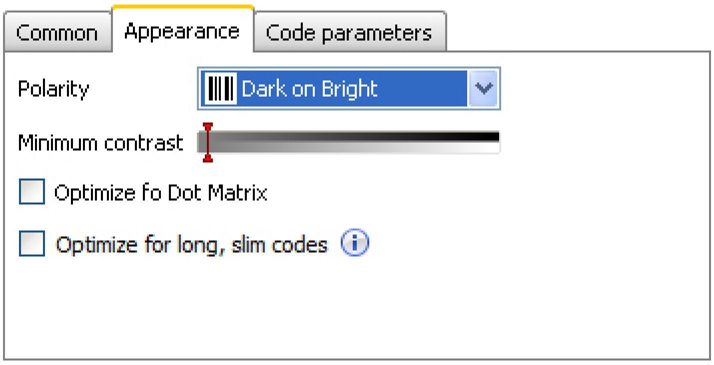
The limit on computing time may potentially vary between device and PC as they each have a different computing performance.

- **Quality:** If you also wish to check the code quality, you may activate the *Calculate based on ISO/IEC 15416* option. However, this also increases the processing time!
- **Minimum quality:** Activate this box if you want to specify a minimum quality.

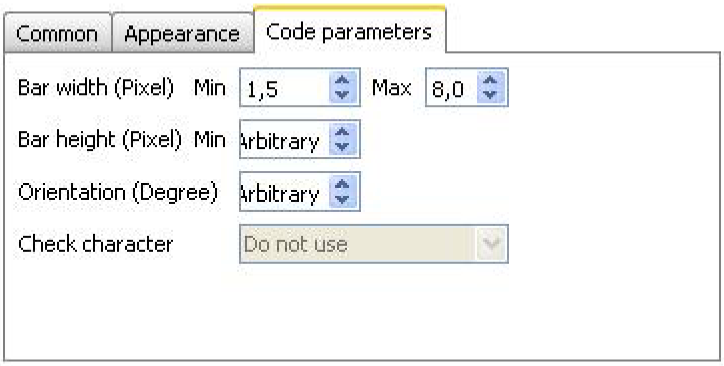
- The code quality is specified as follows:
  A - F (A = High quality ; F = Poor quality)

- The first parameter corresponds to the overall code quality.
- A total of 8 features are specified:
  Legibility, symbol contrast, minimal reflectance, edge contrast, modulation, defects, decodability, additional code-specific parameters.
- You can find more details on the quality characteristics in appendix: *Quality characteristics for barcodes and matrix codes*

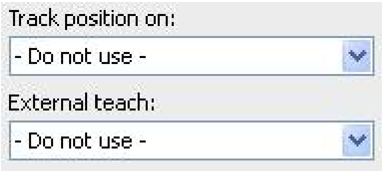
> **NOTE**
>
> In order to be able to make the settings "Appearance" and "Code parameters" on the tabs, you must set the Parameters on the "Common" tab to *User defined*.



- **Polarity:** Specify whether the code is brighter or darker than the background.
- **Minimum contrast:** Specify the minimum contrast of the barcode.
- **Optimise for dot matrix:** Activate this function if the barcode consists of a dot matrix.
- **Optimise for long, slim codes:** Activate this function if the height of the code is less than 15% of its width.



- **Bar width (pixel):** Specify the minimum width of one bar of the barcode.
- **Bar height (pixel):** Specify the height of one bar of the barcode.
- **Orientation (Degree):** To reduce processing time, you may restrict the barcode orientation. To do this, specify the maximum deviation with respect to the position of the field of view.
- **Check character:** Specify whether you want to use a check digit.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

This feature check has the following output values for the datagram at the process interface:

Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Read code	Text	Read result
Quality	Text	Overall quality
Quality (details)	Text	Individual quality characteristics
Output of position	Float point	Centre of the detected code

The following value can be set via the process interface. Please note that an expected value must be provided during parametrization of the feature check.

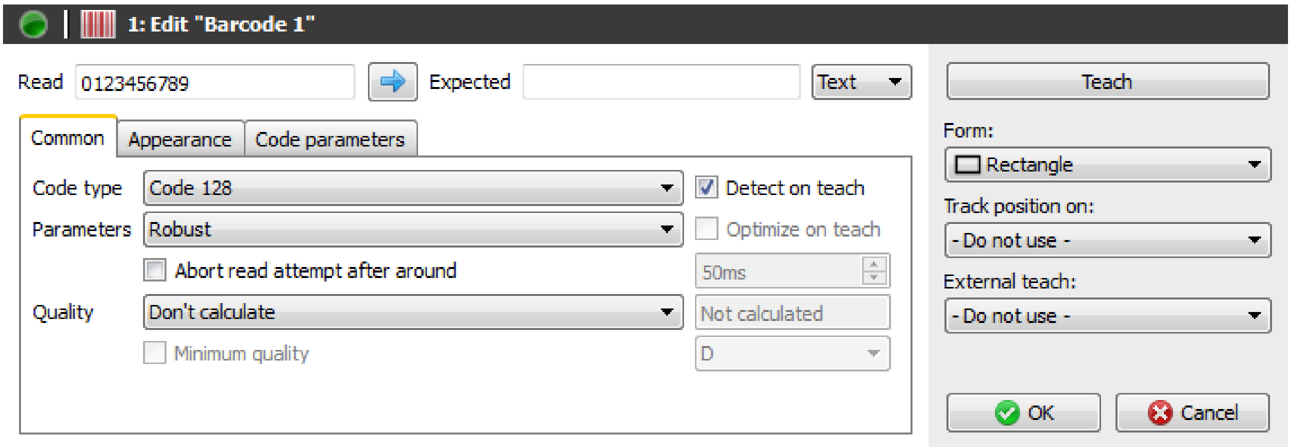
Input value	**Data type**	**Description**
to expected code	Text	expected code

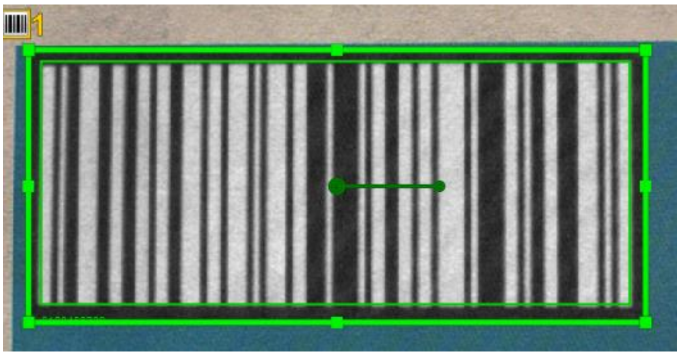
12.4.2 Barcode (colour)

This feature check enables coloured barcodes with coloured backgrounds to be read. The field of view is first converted into a black and white image. In addition, the quality of the barcode can be determined according to ISO/IEC 15416.

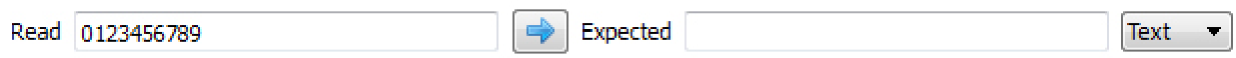
The quality is determined once the image has been converted to black and white. You cannot, therefore, observe any influence the colour has on the quality.

This feature check supports external Teach. Here the parameters are adjusted for the identification and the expected value adopted.

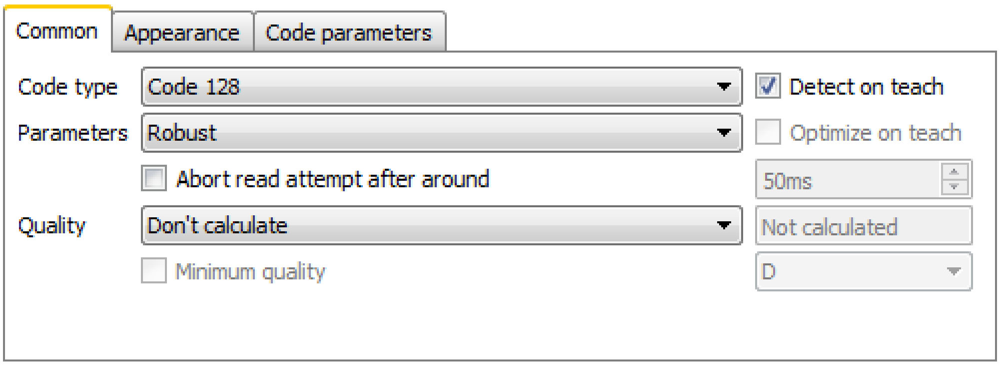




- Choose the detection area.



- **Read:** The read result is displayed here.
- **Arrow:** Using the arrow, you can accept the current result as the new expected value.
- **Expected:** In addition, you may specify an expected value.
- **Text/binary:** Change the display between *Text* (ASCII) and *Binary* (hexadecimal).



- **Code type:** Select the type of barcode in the image.
- **Detection on teach:** Using the *Detection on teach* option, you can have the code type automatically determined during external teach.

- **Parameters:** Select the search parameters used to search for the code. *Robust* and *User defined* are available. In the case of the user-defined search, you can manually set the parameters for the display and the code.
- **Optimize on teach:** Using the *Optimize on teach* option, you can have the parameters automatically adjusted for the code search during the external teach. This is only necessary if you have set the search parameters in the User-defined option.

- **Abort read attempt after circa:** Use this function to limit computing time for code determination.

NOTE

If computing time for code determination is limited and code quality is also to be determined, you need to be aware that limiting computing time only applies to code determination. If necessary, the extra time required for determining code quality should be established empirically and planned in addition – so deducted from the maximum permitted computing time, for example.

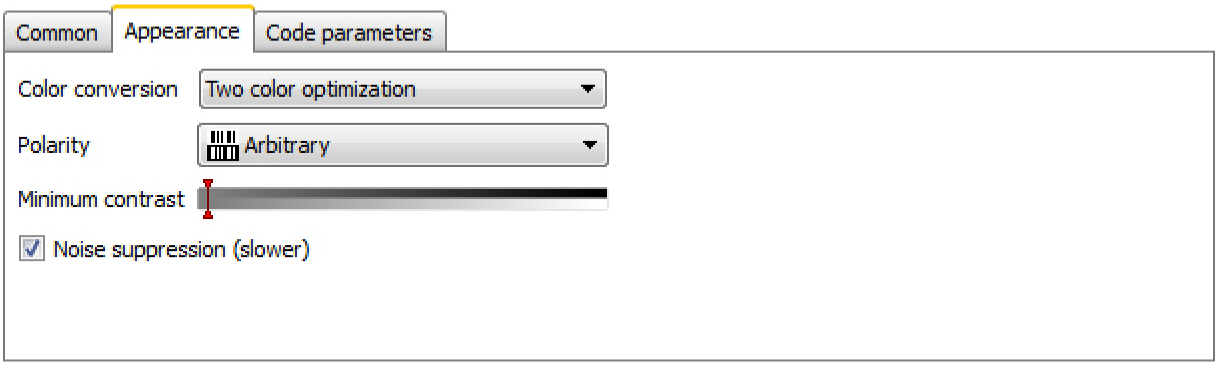
The limit on computing time may potentially vary between device and PC as they each have a different computing performance.

- **Quality:** If you also wish to check the code quality, you may activate the *Calculate based on ISO/IEC 15416* option. However, this also increases the processing time!
- **Minimum quality:** Activate this box if you want to specify a minimum quality.

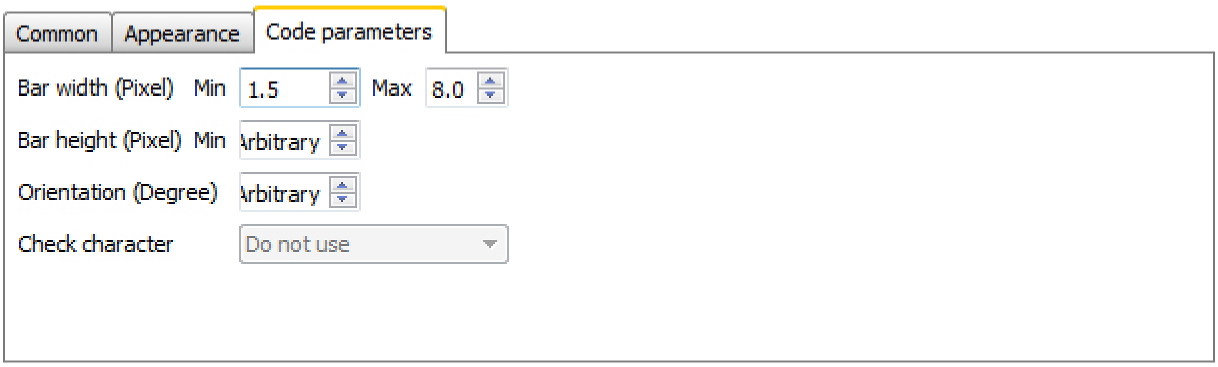
- The code quality is specified as follows:
  A - F (A = High quality ; F = Poor quality)
- The first parameter corresponds to the overall code quality.
- A total of 8 features are specified:
  Legibility, symbol contrast, minimal reflectance, edge contrast, modulation, defects, decodability, additional code-specific parameters.
- You can find more details on the quality characteristics in appendix: Quality characteristics for barcodes and matrix codes

NOTE

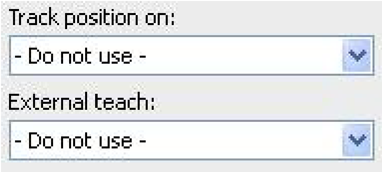
In order to be able to make the settings "Appearance" and "Code parameters" on the tabs, you must set the Parameters on the "Common" tab to *User defined*.



- **Colour conversion:** Enter the method you wish to use to convert the field of view into a black and white image here. Select *Gray value*, if the black and white version of the field of view contrasts well. Select *Two colour optimization* if the barcode and background appear in similarly light colours.
- **Polarity:** Specify whether the code is brighter or darker than the background. The *Arbitrary* option doubles the processing time.
- **Minimum contrast:** Specify the minimum contrast of the barcode.
- **Noise suppression:** Activate this function if you want to minimize noise.



- **Bar width (pixel):** Specify the minimum width of one bar of the barcode.
- **Bar height (pixel):** Specify the height of one bar of the barcode.
- **Orientation (Degree):** To reduce processing time, you may restrict the barcode orientation. To do this, specify the maximum deviation with respect to the position of the field of view.
- **Check character:** Specify whether you want to use a check digit.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

This feature check has the following output values for the datagram at the process interface:

Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Read code	Text	Read result
Quality	Text	Overall quality
Quality (details)	Text	Individual quality characteristics
Output of position	Float point	Centre of the detected code

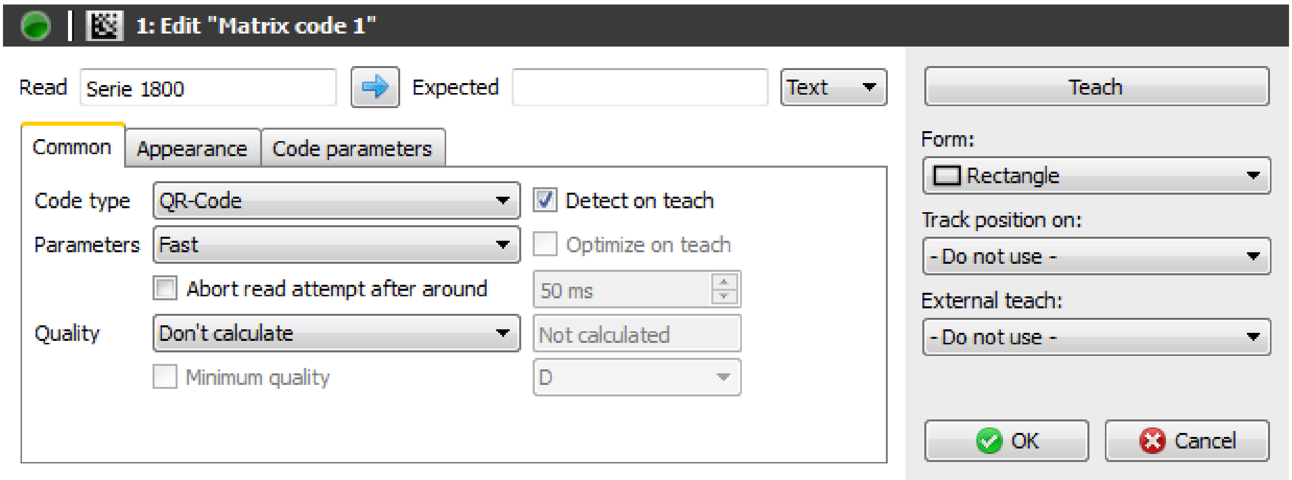
The following value can be set via the process interface. Please note that an expected value must be provided during parametrization of the feature check.

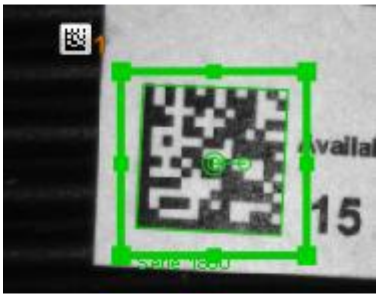
Input value	Data type	Description
to expected code	Text	expected code

12.4.3 Matrix code

Matrix codes (ECC 200, QR, PDF417) can be read using this feature check. In addition, the quality of the barcode can be determined according to ISO/IEC 15415 or AIM DPM-1-2006.

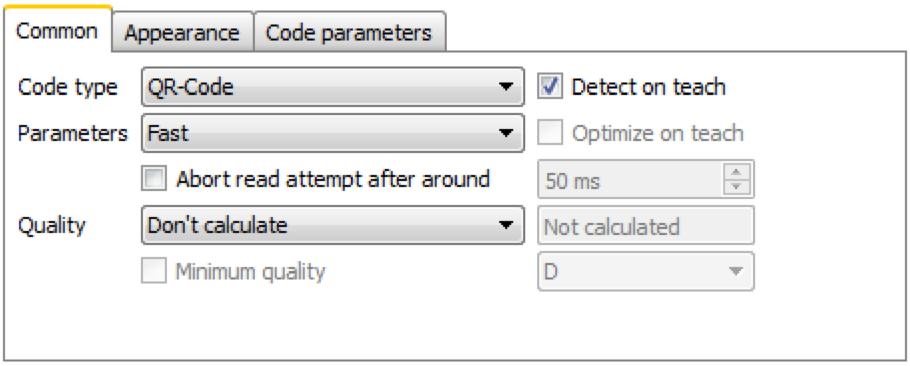
This feature check supports external Teach. In this process, the parameters for identification are adjusted and the expected value is accepted if an expected value has already been set.





- Choose the detection area.

- **Read:** The read result is displayed here.
- **Arrow:** Using the arrow, you can accept the current result as the new expected value.
- **Expected:** In addition, you may specify an expected value.
- **Text/binary:** Change the display between *Text* (ASCII) and *Binary* (hexadecimal).



- **Code type:** Select the type of matrix code in the image.
- **Detection on teach:** Using the *Detection on teach* option, you can have the code type automatically determined during external teach.

- **Parameters:** Select the search parameters used to search for the code. *Fast, Robust, Maximum and User defined* are available. In the *Robust or Maximum* modes, codes are found even with more demanding backgrounds. However, this places a burden on the processing time.
  In the case of the user-defined search, you can manually set the parameters for the display and the code.
- **Optimize on teach:** Using the *Optimize on teach* option, you can have the parameters automatically adjusted for the code search during the external teach. This is only necessary if you have set the search parameters in the User-defined option.

- **Abort read attempt after circa:** Use this function to limit computing time for code determination.

NOTE

If computing time for code determination is limited and code quality is also to be determined, you need to be aware that limiting computing time only applies to code determination. If necessary, the extra time required for determining code quality should be established empirically and planned in addition – so deducted from the maximum permitted computing time, for example.

The limit on computing time may potentially vary between device and PC as they each have a different computing performance.

- **Quality:** If you also wish to check the code quality, you may activate the *Calculate based on ISO/IEC 15415 or Calculate based on AIM DPM-1-2006* option. However, this also increases the processing time!
- **Minimum quality:** Activate this box if you want to specify a minimum quality.

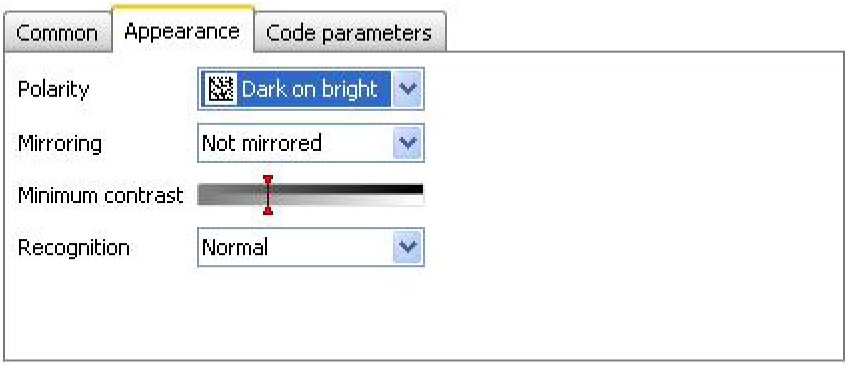
  The code quality is specified as follows:
  A - F (A = High quality ; F = Poor quality)
  The first parameter corresponds to the overall code quality.
  In the *ISO/IEC 15415* mode, various characteristics are determined:
    - ECC200 / QR-Code:
      Contrast, modulation, pattern damage, decodability, axial non-uniformity (evaluation of width and height), grid non-uniformity (evaluation of slope angle), unused error correction

- PDF417:
  Reflection properties of the start/stop pattern, decoded codeword yield, unused error correction, modulation, decodability, defects

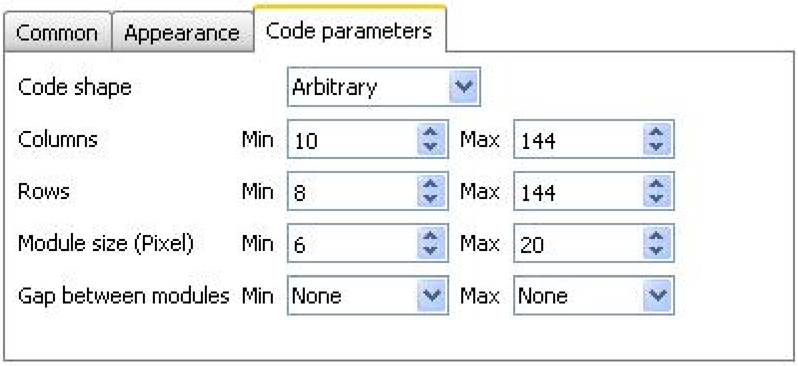
In the *AIM DPM-1-2006* mode, a total of 8 characteristics are determined (for *ECC200 / QR* code only):
Cell contrast, cell modulation, fixed pattern damage, decodability, axial non-uniformity (evaluation of the width and height), grid non-uniformity (evaluation of the slope angle), unused error correction, mean grey value of the light modules (0,70..0,86 → A; 0,86..1,0 and 0,55..0,7 → B; 0,4..0,55 → C; 0,25 .. 0,4 → D; below 0,25 → F).

NOTE

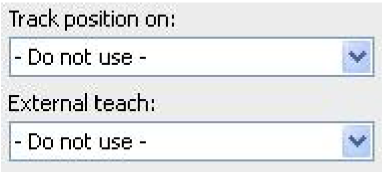
In order to be able to make the settings "Appearance" and "Code parameters" on the tabs, you must set the Parameters on the "Common" tab to *User defined*.



- **Polarity:** Specify whether the code is brighter or darker than the background.
- **Mirroring:** Specify whether the code is mirrored.
- **Minimum contrast:** Specify the minimum contrast of the matrix code.
- **Recognition:** If the outer contour of the code exhibits disturbances, you should activate "Tolerant" recognition. Otherwise, "Normal" recognition is sufficient.



- **Code shape:** Specify the shape of the code to be found. For code type Data Matrix: (rectangular, square, arbitrary). For code type QR code: (Model 1, Model 2, arbitrary).
- **Columns:** Specify the number of columns of the module.
- **Rows:** Specify the number of lines of the module.
- **Module size (Pixel):** Specify the size of a module.
- **Gap between the modules:** Specify whether gaps may occur between the modules.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

This feature check has the following output values for the datagram at the process interface:

Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Read code	Text	Read result
Quality	Text	Overall quality
Quality (details)	Text	Individual quality characteristics
Output of position	Float point	Centre of the detected code

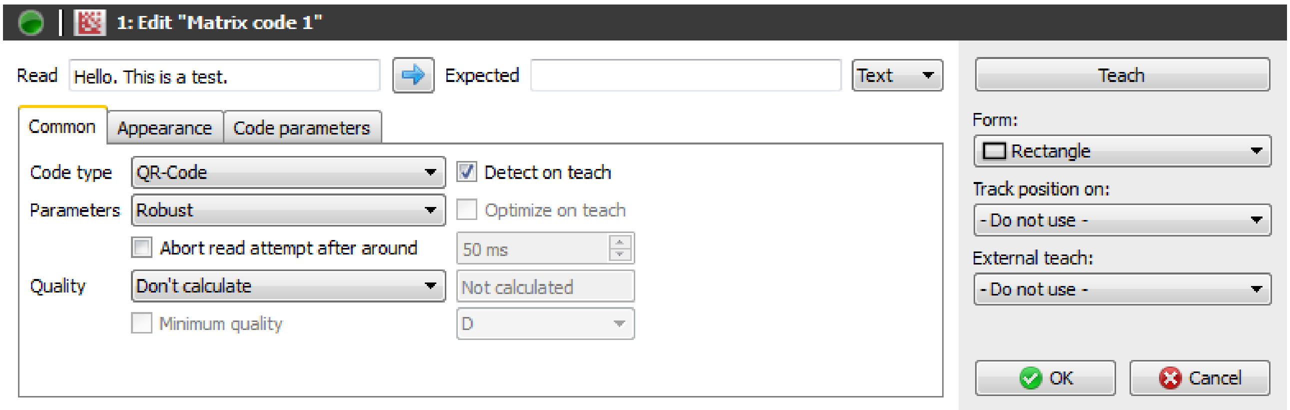
The following value can be set via the process interface. Please note that an expected value must be provided during parametrization of the feature check.

Input value	Data type	Description
to expected code	Text	expected code

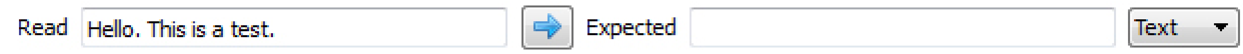
12.4.4 Matrix code (colour)

Coloured matrix codes (ECC 200, QR, PDF417) with coloured backgrounds can be read using this feature check. The field of view is first converted into a black and white image. In addition, the quality of the barcode can be determined according to ISO/IEC 15415 or AIM DPM-1-2006.

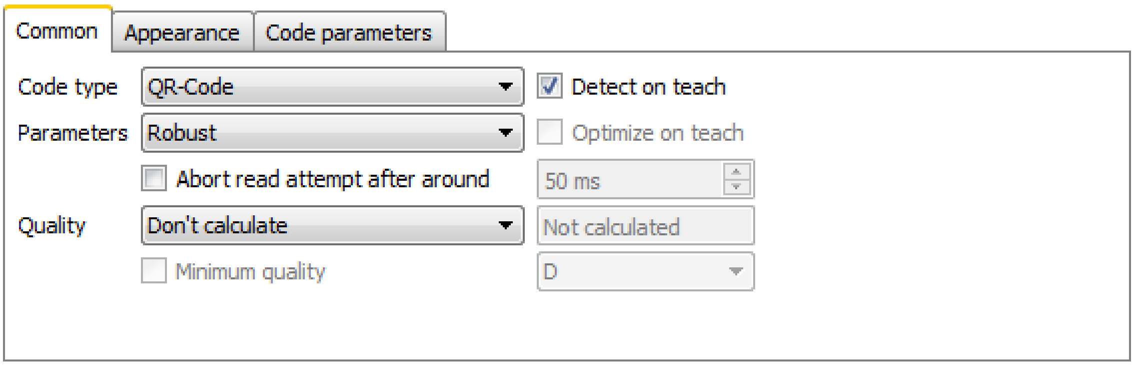
This feature check supports external Teach. In this process, the parameters for identification are adjusted and the expected value is accepted if an expected value has already been set.



- Choose the detection area.



- **Read:** The read result is displayed here.
- **Arrow:** Using the arrow, you can accept the current result as the new expected value.
- **Expected:** In addition, you may specify an expected value.
- **Text/binary:** Change the display between *Text* (ASCII) and *Binary* (hexadecimal).



- **Code type:** Select the type of matrix code in the image.
- **Detection on teach:** Using the *Detection on teach* option, you can have the code type automatically determined during external teach.

- **Parameters:** Select the search parameters used to search for the code. *Robust, Maximum and User defined* are available. In the *Robust or Maximum* modes, codes are found even with more demanding backgrounds. However, this places a burden on the processing time.
  In the case of the user-defined search, you can manually set the parameters for the display and the code.
- **Optimize on teach:** Using the *Optimize on teach* option, you can have the parameters automatically adjusted for the code search during the external teach. This is only necessary if you have set the search parameters in the User-defined option.

- **Abort read attempt after circa:** Use this function to limit computing time for code determination.

NOTE

If computing time for code determination is limited and code quality is also to be determined, you need to be aware that limiting computing time only applies to code determination. If necessary, the extra time required for determining code quality should be established empirically and planned in addition – so deducted from the maximum permitted computing time, for example.

The limit on computing time may potentially vary between device and PC as they each have a different computing performance.

- **Quality:** If you also wish to check the code quality, you may activate the *Calculate based on ISO/IEC 15415 or Calculate based on AIM DPM-1-2006* option. However, this also increases the processing time!
- **Minimum quality:** Activate this box if you want to specify a minimum quality.

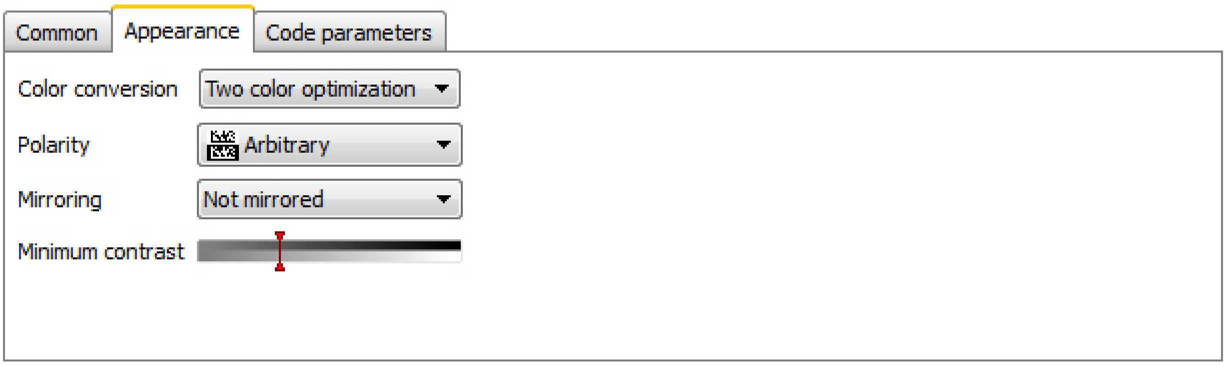
  The code quality is specified as follows:
  A - F (A = High quality ; F = Poor quality)
  The first parameter corresponds to the overall code quality.
  In the *ISO/IEC 15415* mode, various characteristics are determined:
  - ECC200 / QR-Code:
    Contrast, modulation, pattern damage, decodability, axial non-uniformity (evaluation of width and height), grid non-uniformity (evaluation of slope angle), unused error correction

- PDF417:
  Reflection properties of the start/stop pattern, decoded codeword yield, unused error correction, modulation, decodability, defects

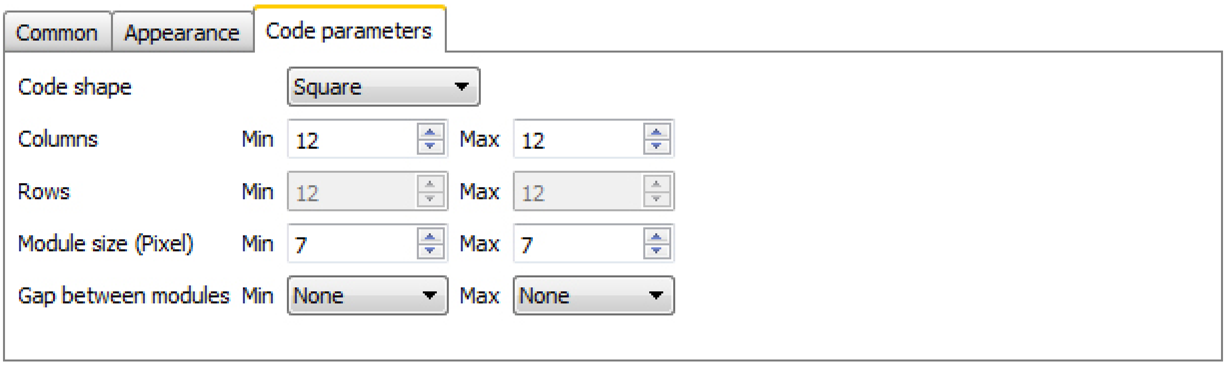
In the *AIM DPM-1-2006* mode, a total of 8 characteristics are determined (for *ECC200 / QR* code only):
Cell contrast, cell modulation, fixed pattern damage, decodability, axial non-uniformity (evaluation of the width and height), grid non-uniformity (evaluation of the slope angle), unused error correction, mean grey value of the light modules. (0,70..0,86 → A; 0,86..1,0 and 0,55..0,7 → B; 0,4..0,55 → C; 0,25..0,4 → D; under 0,25 → F).

NOTE

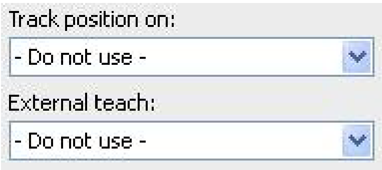
In order to be able to make the settings "Appearance" and "Code parameters" on the tabs, you must set the Parameters on the "Common" tab to *User defined*.



- **Colour conversion:** Enter the method you wish to use to convert the field of view into a black and white image here. Select *Gray value*, if the black and white version of the field of view contrasts well. Select *Two colour optimization* if the barcode and background appear in similarly light colours.
- **Polarity:** Specify whether the code is brighter or darker than the background.
- **Mirroring:** Specify whether the code is mirrored.
- **Minimum contrast:** Specify the minimum contrast of the matrix code.



- **Code shape:** Specify the shape of the code to be found. For code type Data Matrix: (rectangular, square, arbitrary). For code type QR code: (Model 1, Model 2, arbitrary).
- **Columns:** Specify the number of columns of the module.
- **Rows:** Specify the number of lines of the module.
- **Module size (Pixel):** Specify the size of a module.
- **Gap between the modules:** Specify whether gaps may occur between the modules.



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

This feature check has the following output values for the datagram at the process interface:

Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Read code	Text	Read result
Quality	Text	Overall quality
Quality (details)	Text	Individual quality characteristics
Output of position	Float point	Centre of the detected code

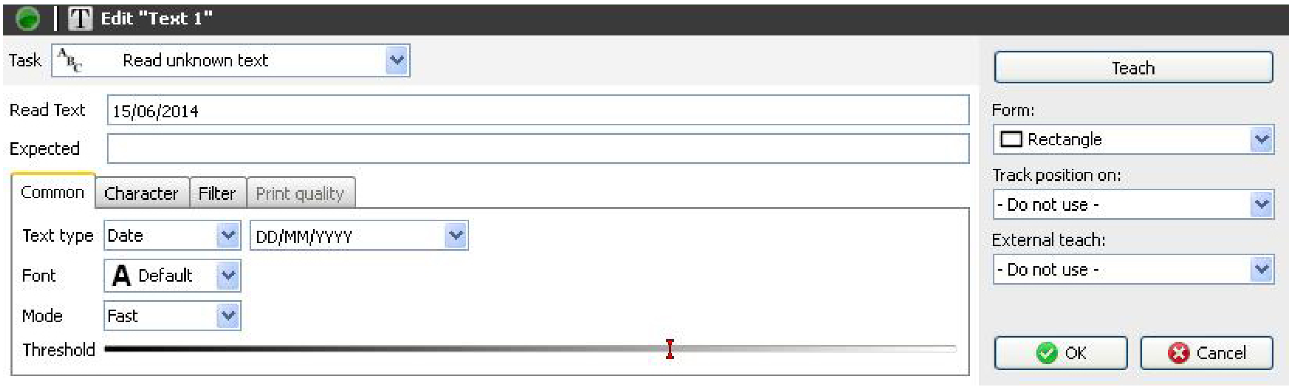
The following value can be set via the process interface. Please note that an expected value must be provided during parametrization of the feature check.

Input value	Data type	Description
to expected code	Text	expected code

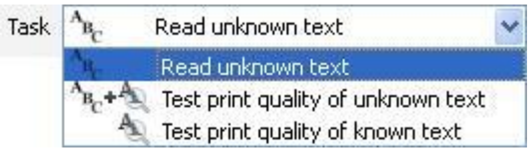
12.4.5 Text

You can read date specifications, numbers and words using this feature check. In addition, it is possible to compare the result to an expected value. You can also check the print quality of text.

This feature check supports external Teach. Here, the value actually read is adopted as a new expectation value.



- Select the area containing the text.
- Always mark only one line. If the text covers multiple lines, you must use several feature checks. Make sure that the text is marked as precisely as possible.
- If the text fluctuates in its location in the image, you can use the "Alignment to text line" feature check for part location.



- **Read unknown text:** Select this option if you want to read unknown text.
- **Test print quality of unknown text:** Select this option if you want to check the print quality of unknown text.
- **Test print quality of known text:** With this function, you can compare the print quality to a taught value.

Read unknown text

If you have selected Read unknown text, the read text is displayed. You can also enter the text expected into the Expected field. You can configure settings on the Common, Characters and Filter tabs. Using the arrow, you can accept the current result as the new expected value.

Check the print quality of unknown text

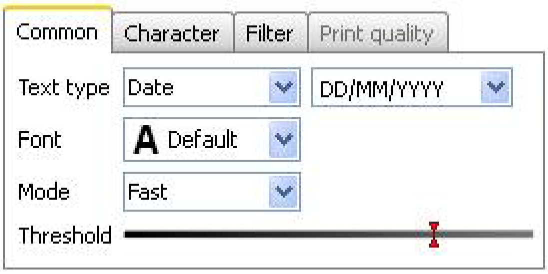
If you have selected *Check the print quality of unknown text*, you can compare the print quality of unknown text to previously taught reference characters. To use this function, you have to teach in the reference characters on the *Print quality* tab. You can also make settings on the Common, Characters and Filter tabs.

Check the print quality of known text

If you have selected Check the print quality of known text, you can compare the read text to previously taught characters and set it as a reference using external teach.

> **NOTE**
>
> Using teach, only the text contents are read and not the text format (e.g., date)!
> All characters to be read must be taught in advance using the Print quality tab!

You can teach in the reference characters on the Print quality tab. You can also make settings on the Common, Characters and Filter tabs.

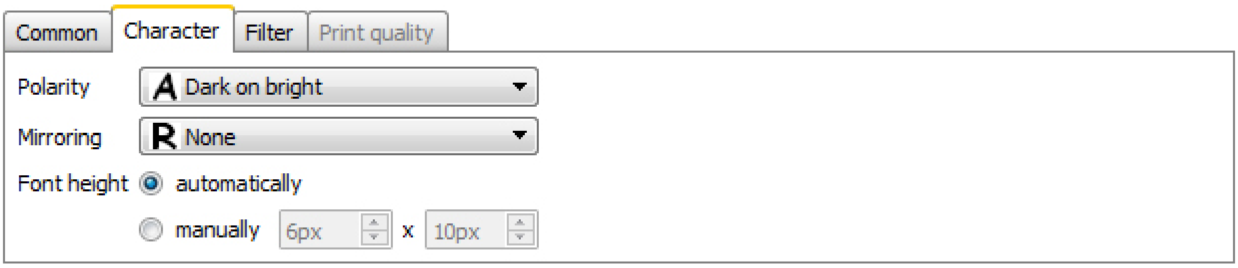


- **Text type:** Set the type of the text. You may select *Date, Numbers, Hexadecimal characters, Letters, Mask and Time*. You can describe the text type exactly on the right side, which is then displayed in accordance with the selected type.
- **Font:** Select the *Standard* font if you want to recognize Sans-serif writing (e.g., Arial, Verdana, Univers and OCR-B). Select the *Dot-Print* font if you want to recognize dot-matrix fonts.

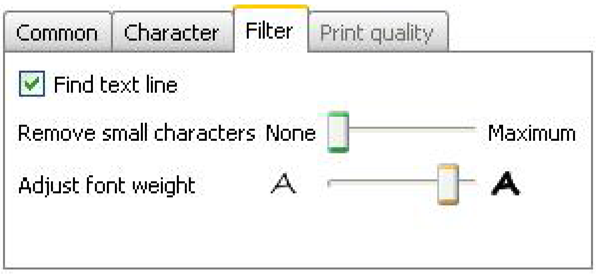
> **NOTE**
>
> With the Dot-Print font, lower case letters cannot be read.

- **Mode:** The selected mode determines the processing time required to process the feature check. The *Robust* mode requires the longest processing time but makes more stable read results possible if the print format is not optimal.

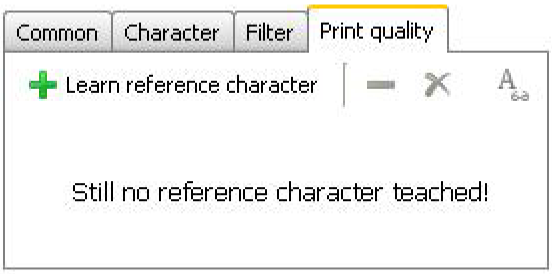
- **Threshold:** Set the threshold for the separation of background and characters. For optimal recognition, the background should have as little structure as possible!



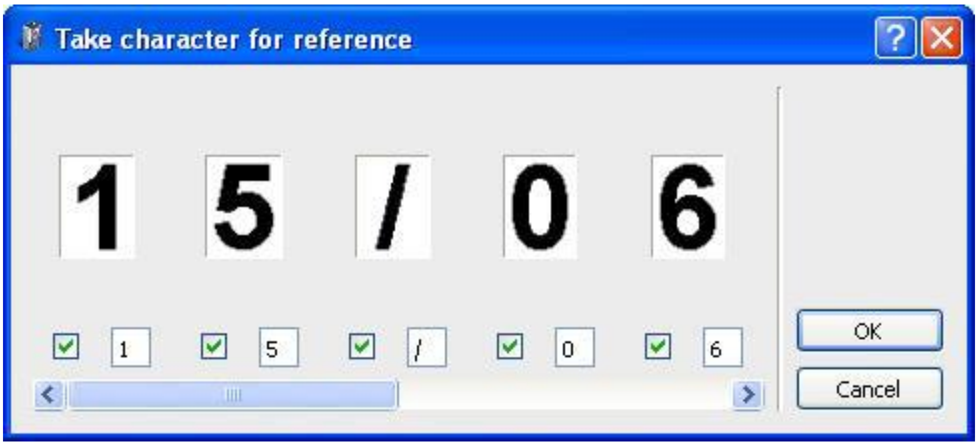
- **Polarity:** Specify whether the text is brighter or darker than the background.
- **Mirroring:** Specify whether the text is mirrored.
- **Font height:** Choose whether the character size is automatically recognized or whether it should be entered manually. With manual entry, you may enter this value or draw a frame in the image around one individual character.

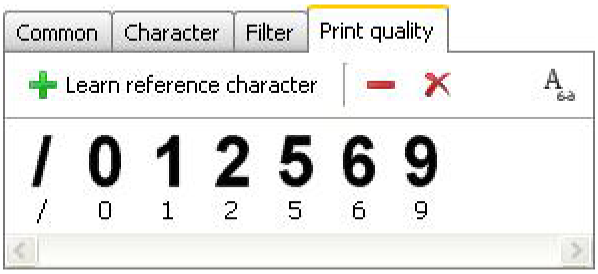


- **Find text line:** Activate the *Find text line* option if structures are present below or above the text and these structures are to be automatically masked.
- **Remove small characters:** In addition, you can set a minimum size for the characters to remove very small characters.
- **Adjust font weight:** It is also possible to reduce or increase the line thickness of the characters found.



- **Learn reference character:** Click on the + to teach in reference characters. The window below opens where you can assign values to the characters read.

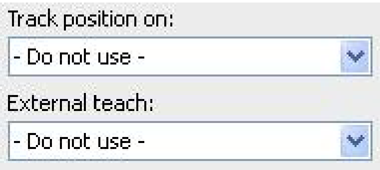




Delete the individually marked reference character

Delete all reference characters

Show/hide characters that have not been taught in



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the sensor. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

This feature check has the following output values for the datagram at the process interface:

Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Read text	Text	Read result

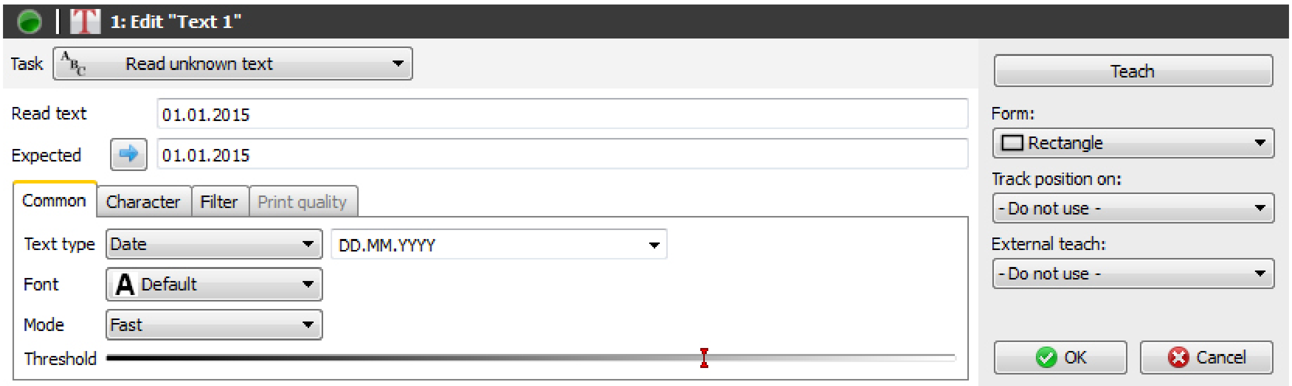
The following values can be set via the process interface. Please note that an expected value must be provided during parametrization of the feature check.

Input value	Data type	Description
Mask	Text	Masking of the expected text
Expected	Text	expected text

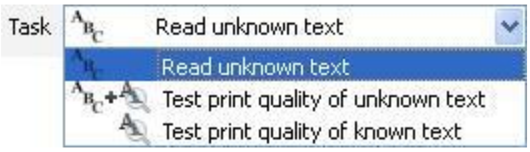
12.4.6 Text (colour)

You can read coloured dates, numbers and words on coloured backgrounds using this feature check. The field of view is first converted into a black and white image. It also gives you the option to compare the result to an expected value. You can also check the print quality of text.

This feature check supports external Teach. Here, the value actually read is adopted as a new expectation value.



- Select the area containing the text.
- Always mark only one line. If the text covers multiple lines, you must use several feature checks. Make sure that the text is marked as precisely as possible.
- If the text fluctuates in its location in the image, you can use the "Alignment to text line" feature check for part location.



- **Read unknown text:** Select this option if you want to read unknown text.
- **Test print quality of unknown text:** Select this option if you want to check the print quality of unknown text.
- **Test print quality of known text:** With this function, you can compare the print quality to a taught value.

Read unknown text

If you have selected Read unknown text, the read text is displayed. You can also enter the text expected into the Expected field. You can configure settings on the Common, Characters and Filter tabs. Using the arrow, you can accept the current result as the new expected value.

Check the print quality of unknown text

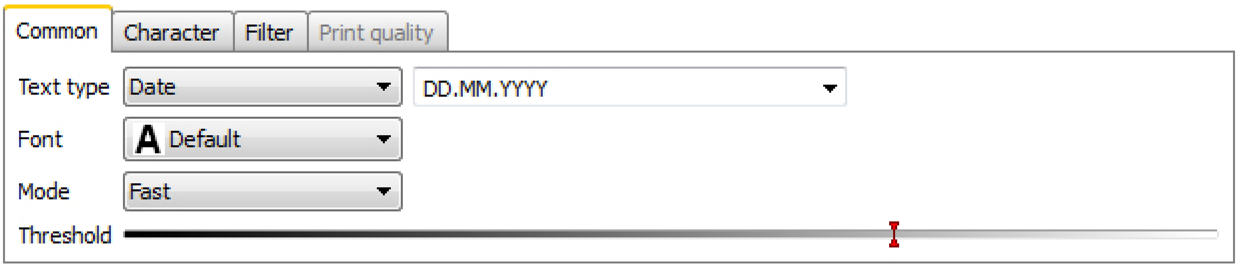
If you have selected *Check the print quality of unknown text*, you can compare the print quality of unknown text to previously taught reference characters. To use this function, you have to teach in the reference characters on the *Print quality* tab. You can also make settings on the Common, Characters and Filter tabs.

Check the print quality of known text

If you have selected Check the print quality of known text, you can compare the read text to previously taught characters and set it as a reference using external teach.

> **NOTE**
>
> Using teach, only the text contents are read and not the text format (e.g., date)!
> All characters to be read must be taught in advance using the Print quality tab!

You can teach in the reference characters on the Print quality tab. You can also make settings on the Common, Characters and Filter tabs.

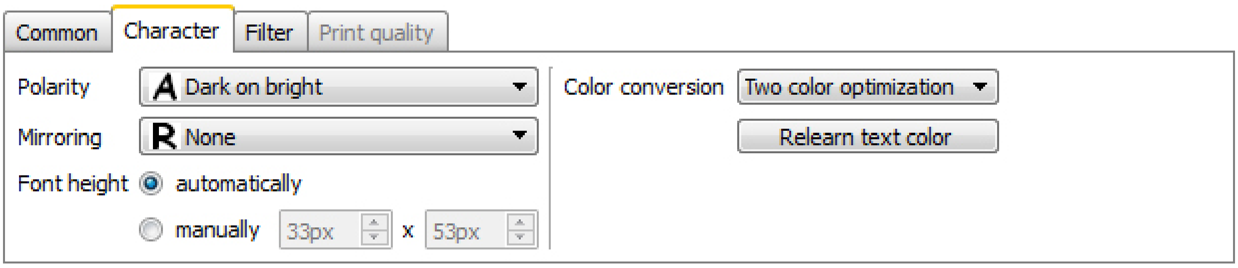


- **Text type:** Set the type of the text. You may select *Date, Numbers, Hexadecimal characters, Letters, Mask and Time*. You can describe the text type exactly on the right side, which is then displayed in accordance with the selected type.
- **Font:** Select the *Standard* font if you want to recognize Sans-serif writing (e.g., Arial, Verdana, Univers and OCR-B). Select the *Dot-Print* font if you want to recognize dot-matrix fonts.

> **NOTE**
>
> With the Dot-Print font, lower case letters cannot be read.

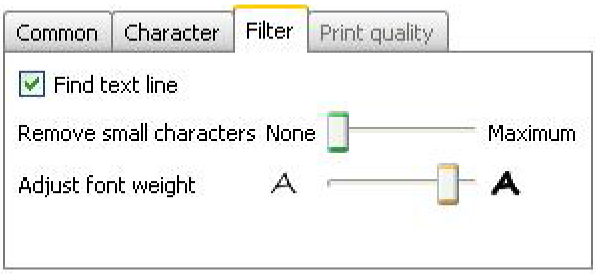
- **Mode:** The selected mode determines the processing time required to process the feature check. The *Robust* mode requires the longest processing time but makes more stable read results possible if the print format is not optimal.

- **Threshold:** Set the threshold for the separation of background and characters. For optimal recognition, the background should have as little structure as possible!

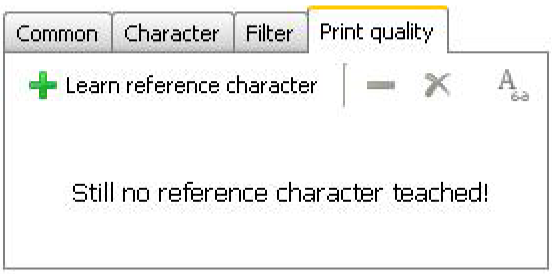


- **Polarity:** Specify whether the text is brighter or darker than the background.
- **Mirroring:** Specify whether the text is mirrored.
- **Font height:** Choose whether the character size is automatically recognized or whether it should be entered manually. With manual entry, you may enter this value or draw a frame in the image around one individual character.

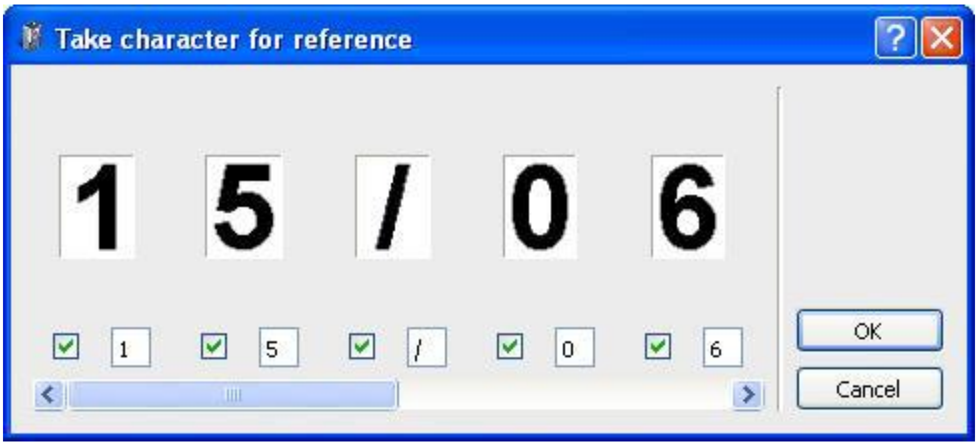
- **Colour conversion:** Enter the method you wish to use to convert the field of view into a black and white image here. Select *Gray value*, if the black and white version of the field of view contrasts well. Select *Two colour optimization* if the barcode and background appear in similarly light colours.
- **Re-learn text colour:** Use this function to optimize the way the field of view is converted into a black and white image. This is useful if the colours in the field of view have changed.

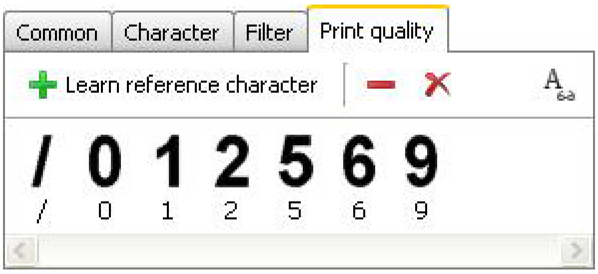


- **Find text line:** Activate the *Find text line* option if structures are present below or above the text and these structures are to be automatically masked.
- **Remove small characters:** In addition, you can set a minimum size for the characters to remove very small characters.
- **Adjust font weight:** It is also possible to reduce or increase the line thickness of the characters found.



- **Learn reference character:** Click on the + to teach in reference characters. The window below opens where you can assign values to the characters read.

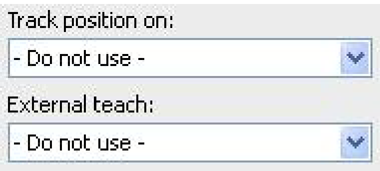




Delete the individually marked reference character

Delete all reference characters

Show/hide characters that have not been taught in



- If the feature check is to be corrected by the result of the part location, you can choose this option here. External teach also makes it possible to retrain the sensor. Select the appropriate option for this purpose.

- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

This feature check has the following output values for the datagram at the process interface:

Output value	Data type	Description
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Read text	Text	Read result

The following values can be set via the process interface. Please note that an expected value must be provided during parametrization of the feature check.

Input value	Data type	Description
Mask	Text	Masking of the expected text
Expected	Text	expected text

12.4.7 Appendix: Quality characteristics for barcodes and matrix codes

Numerous quality characteristics are defined for the various code types, these characteristics are described in more detail in the following. Keep in mind that illumination arrangements and quality requirements are defined on the image for these standards so that the values determined cannot be directly mapped to your installation situation!

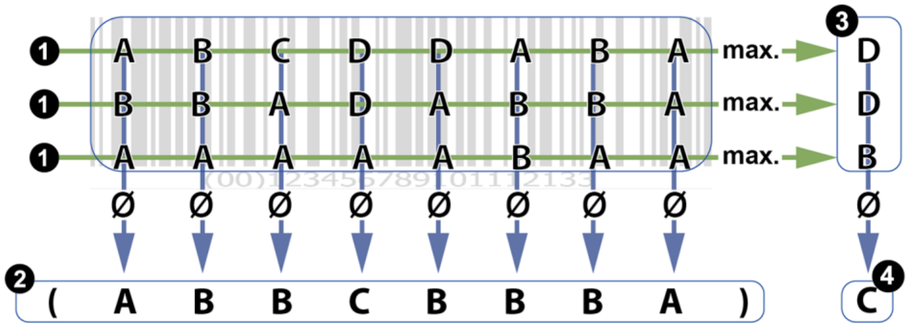
Barcode quality characteristics (ISO/IEC 15416)

Designation	Description
Legibility	A = Code legible F = Code not read
Symbol contrast	Difference between the maximum and minimum grey scale value of the symbols
Minimum reflection	A = Minimum grey scale value ≤ 0.5 * maximum grey scale value F = Other
Edge contrast	Minimum contrast between two symbol elements
Modulation	Amplitude between symbol elements
Defects	Irregularities in the grey scale profile of a symbol
Decodability	Deviations in the width of symbol elements
Additional code-specific parameters	Depending on code type, for example, evaluation of the width of the quiet zones or ratio of symbol widths.

Determining the quality of barcode

The barcode is scanned internally by multiple detection beams (1) and assessed by the above-named quality features. An average of the respectively matching quality features over all detection beams is determined and output (2).

The respectively poorest assessments (3) for a quality feature are also determined per detection beam, their average is formed and then output as overall quality (4).



NOTE

The overall quality of a barcode can in certain circumstances be poorer than all of the individual quality features. This is because in each case it is the poorest individual values (3) that flow into the overall assessment. The overall assessment is not formed from evaluations of the quality features (2).

If various individual values are conspicuously poor in different detection beams, this can result in poor overall quality without the individual quality features being assessed as worse.

Quality characteristics DataMatrix (ECC200) and QR code (ISO/IEC 15415 + AIM DPM-1-2006)

Designation	Example	Description
Contrast		Difference between the maximum and minimum grey scale value of the modules
Modulation		Amplitude between data code modules (dependant on error correction!)
Pattern damage		Disturbances in the frame pattern (finder pattern)
Legibility		A = Code legible F = Code not read
Axial non-uniformity		Evaluation of the width and height of the modules
Grid non-uniformity		Evaluation of the incline angle (perspective distortion)
Unused error correction		Proportion of the unused error redundancy

<table>
<tr><th>Designation</th><th>Example</th><th>Description</th></tr>
<tr><td>Gray scale value of the light modules</td><td></td><td>Average grey scale value of all light modules of the DataMatrix or QR code
<table>
<tr><th>Gray scale value</th><th>Evaluation</th></tr>
<tr><td>0.7.. 0.86</td><td>A</td></tr>
<tr><td>0.86.. 1.0</td><td>B</td></tr>
<tr><td>0.55.. 0.7</td><td>B</td></tr>
<tr><td>0.4.. 0.55</td><td>C</td></tr>
<tr><td>0.25.. 0.4</td><td>D</td></tr>
<tr><td>0.. 0.25</td><td>F</td></tr>
</table>
</td></tr>
</table>

Quality characteristics PDF 417 (ISO/IEC 15415)

Designation	Description
Reflection properties Start / Stop pattern	Analysis of reflection properties and bar width of the start/stop pattern
Proportion of decoded code words	Relative proportion of decoded code words
Unused error correction	Proportion of the unused error redundancy
Modulation	Amplitude between symbol modules
Decodability	Deviations in the width of symbol elements
Defects	Irregularities in the scanning profile within the module

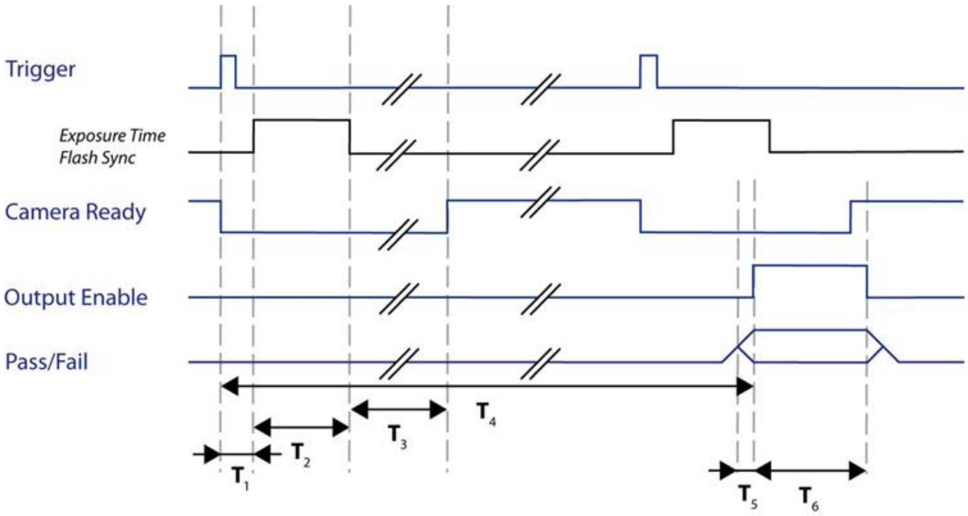
13 Digital interfaces

13.1 Explanation of terms from the timing diagram

Alarm	Indicates that an irregularity has occurred that should be investigated more closely by an expert.
Trigger	Input signal that triggers image acquisition
Flash Sync exposure time	Output signal for triggering external illumination
Camera ready	Shows that the result is at one of the outputs (pass/fail) and can, for example, be read by an PLC (not for varied output times). With the device, a new image can be recorded before the current analysis is completed. There is internal storage for two images for this reason.
Result invalid	Indicates that the result can be read at the outputs (pass/fail).
Pass	Feature check passed
Fail	Feature check failed
T	Time
Device activated	Shows that the device is activated and ready to run inspection task ("Run Mode").

13.2 Timing when an external trigger is used

The sequence of the individual signals and their designation are indicated in the diagram below:



Signal		**Full resolution**		**Reduced resolution** (device dependant)	
		min.	**max.**	**min.**	**max.**
Trigger-exposure time delay T_1		20 µs plus preset trigger delay			
Exposure time T_2	Internal illumination[1]	35 µs	10 ms	35 µs	5 ms
	External illumination	35 µs[1] / 10 µs[2]	65.5 ms	35 µs[1] / 10 µs[2]	65.5 ms
	Flash controller[2]	10 µs	1 ms / 65.5 ms	10 µs	1 ms
Image acquisition T_3		16 ms	20 ms	8 ms	11 ms
Output time (min / max) T_4		20 ms		11 ms	
Run-up output T_5		50 µs	2 ms	50 µs	2 ms
Result retention time T_6		1 ms	1 s or next result	1 ms	1 s or next result

)[1] Devices with integrated lenses)[2] Devices with interchangeable lenses

Following image acquisition, the *Image trigger* signal is deactivated. The Image trigger signal is activated again at the end of image acquisition and another image acquisition operation is possible immediately.

The Pass/Fail signal then switches at the set output time even if additional analyses have already been performed. The Result *valid* signal is active during this time.

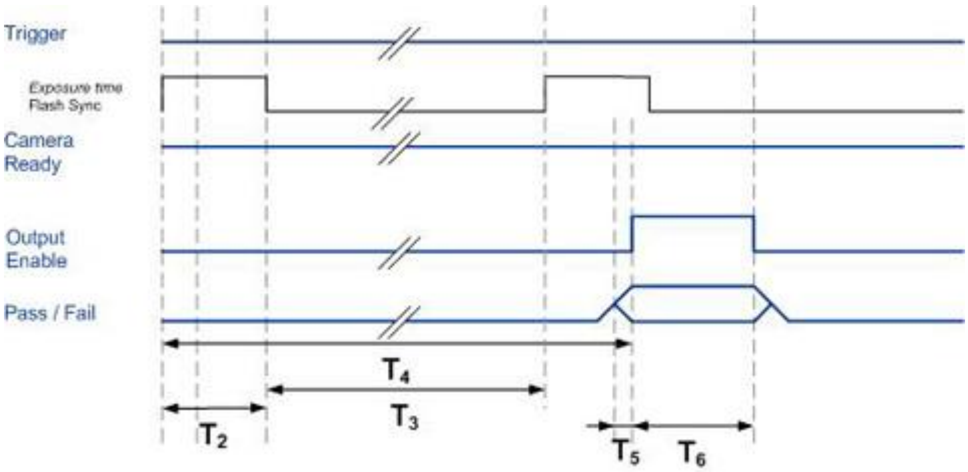
NOTE

If you have connected an encoder, you may set the output time and duration as a distance.

In addition, you can specify an "output run-up" in milliseconds to activate the Pass/Fail signal before reaching a specific position. This option is available if an exact output time has been specified and this is specified as a distance.
Keep in mind that, in this case, the conveyor speed must be constant!

13.3 Timing for continuous image acquisition

The sequence of the individual signals and their designation are indicated in the diagram below:



Signal		**Full resolution**		**Reduced resolution** (device dependant)	
		min.	**max.**	**min.**	**max.**
Exposure time T_2	Internal illumination[1]	35 µs	10 ms	35 µs	5 ms
	External illumination	35 µs[1] / 10 µs[2]	65.5 ms	35 µs[1] / 10 µs[2]	65.5 ms
	Flash controller[2]	10 µs	1 ms / 65.5 ms	10 µs	1 ms
Image acquisition T_3		16 ms	20 ms	8 ms	11 ms
Output time (min / max) T_4		20 ms		11 ms	
Run-up output T_5		50 µs	2 ms	50 µs	2 ms
Result retention time T_6		1 ms	1 s or next result	1 ms	1 s or next result

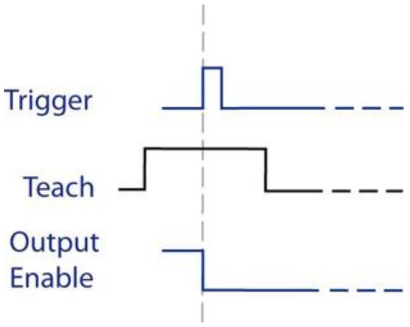
)[1] Devices with integrated lenses

)[2] Devices with interchangeable lenses

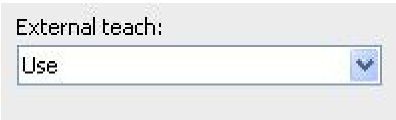
If continuous image acquisition is set in the job, the image acquisition operation occurs as soon as the previous image acquisition is complete. The *Image trigger* signal is continuously activated during this time. The Pass/Fail signal is switched at the end of image analysis but no earlier than the set output time. You can recognize this time by a rising edge of the *Result* valid signal.

13.4 External Teach

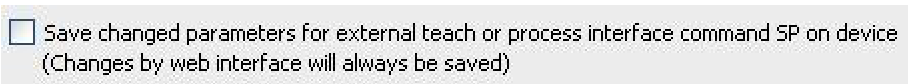
External Teach adjusts the switching thresholds and models in the feature checks so that the evaluations have OK as the result. External Teach is used if the product changes or there are new product versions.



The digital input “Teach" must be in the "active high" state at the trigger point.



To use external Teach, **Use External Teach:** Must be activated for the corresponding feature checks. External Teach is then triggered simultaneously for all appropriate feature checks.



Job changes are only stored temporarily until the device is deactivated. If you want to retain the settings, you must activate the option “*Save changed parameters from External Teach or process SP interface command to the device*".

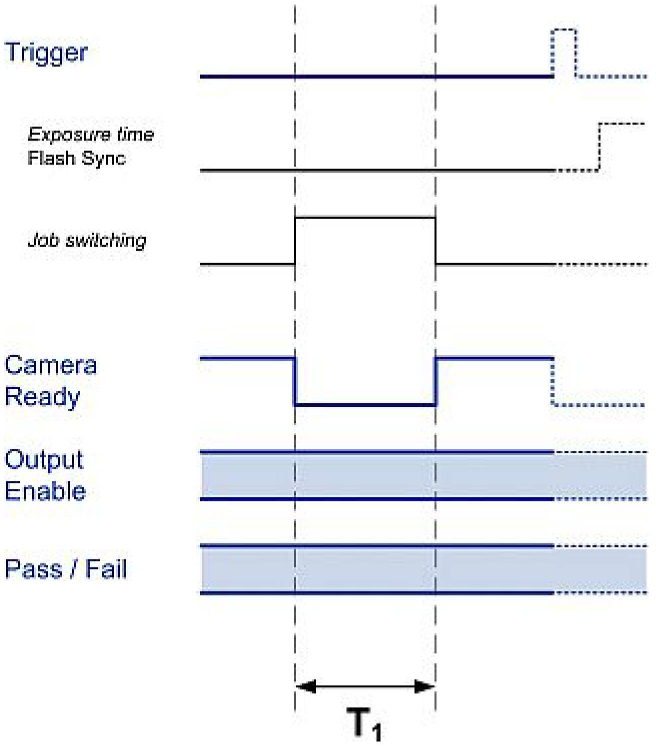
(*Device → Device settings → Job selection/Teach*)

13.5 Job switching

The jobs saved in the device can be activated by the corresponding switching signals with the digital inputs or individually via the process interface.

They are activated as soon as the command is received, however evaluations that are already running will be completed before the job is switched over. How long it takes to switch the job over depends mainly on its content (exposure time, number and type of feature checks, job position).

New images cannot be triggered during the switch-over.



Signal	**Switch-over times**
Run-up program selection T_1*	Jobs 1-16: 5 ms Jobs 17-255: typically < 1 s (plus the set exposure time)

During program selection (T_1), the device is not active and the signal. *Image trigger* signal is deactivated. Please wait with the next image analysis operation until the "Active" state is displayed again by the corresponding signal.
If the switch could not be performed, for example because the job number was invalid, an alarm signal is also output until the next trigger.

NOTE

If a job is selected again by way of Job switching, and this job is already active, the *Image trigger* signal is not deactivated!

13.6 Job selection via digital inputs

There are two ways of switching the active job of the device via the digital inputs:

- **Binary:** Bit serial: The stored jobs can be selected directly using a clock and data line.
- **Bit serial:** The stored jobs can be selected directly using a clock and data line.

Switching between jobs is only possible when the current mode is set to Activated. Switching between jobs is not possible in any other modes. Observe that you must activate the option *Job selection via digital inputs* in the Job Management to execute job selection by this means.

You can also switch the active job by transferring corresponding Commands via the process interface.

13.6.1 Binary job selection

For the device a maximum of four digital inputs are available for job selection.

It is possible to quickly switch between jobs 1 to 16 in this way.

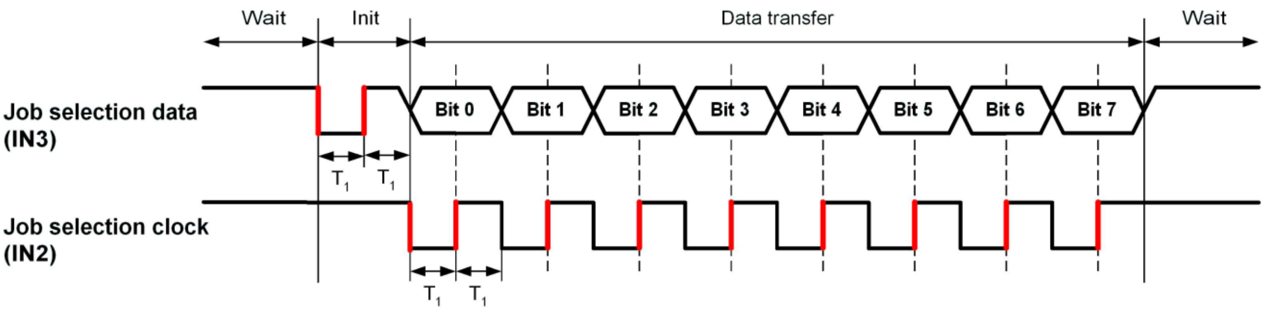
The allocation of the levels to the selected job is as follows:

	Binary job selection - Bit 0	**Binary job selection - Bit 1**	**Binary job selection - Bit 2**	**Binary job selection - Bit 3**
Job 1	Low	Low	Low	Low
Job 2	High	Low	Low	Low
Job 3	Low	High	Low	Low
Job 4	High	High	Low	Low
Job 5	Low	Low	High	Low
Job 6	High	Low	High	Low
Job 7	Low	High	High	Low
Job 8	High	High	High	Low
…				
Job 16	High	High	High	High

NOTE

Please observe that this table relates to the configuration of the inputs as "active high". If you have configured an input as "active low", you must invert the specified levels for this input in the overview.

13.6.2 Bit serial job selection



	Signal applied to the input	
	min.	**max.**
Result retention time T_1	10 ms	1,000 ms

For bit serial job switching, two digital inputs are required: digital inputs IN2 ("Bit serial job selection – Clock") and IN3 ("Bit serial job selection – Data"). When inactive, high levels are applied to both lines. The levels of the data line are set briefly to low and then returned to high to start the transfer.

The desired job number can then be transferred as a series of bits. The respective bits must be transferred with the following levels on the data line:

Value	**Level on the data line**
0	High
1	Low

As soon as a rising edge is detected on the clock line, the corresponding bit is read on the data line. The status of the data line must be held constant for the result retention time T_1 and may only change when a low level is set on the clock line.
When all 8 bits have been transferred in this way, the inactive state is restored.

We recommend that switching to the next bit on the data line should be done simultaneously with activation of the falling edge on the clock line.

NOTE

This description applies when the parameters of the inputs are set to "active high". If you have configured an input as "active low", you must invert the specified levels for these inputs in the description.

You should also make sure that you have made the following settings for bit-serial job selection:

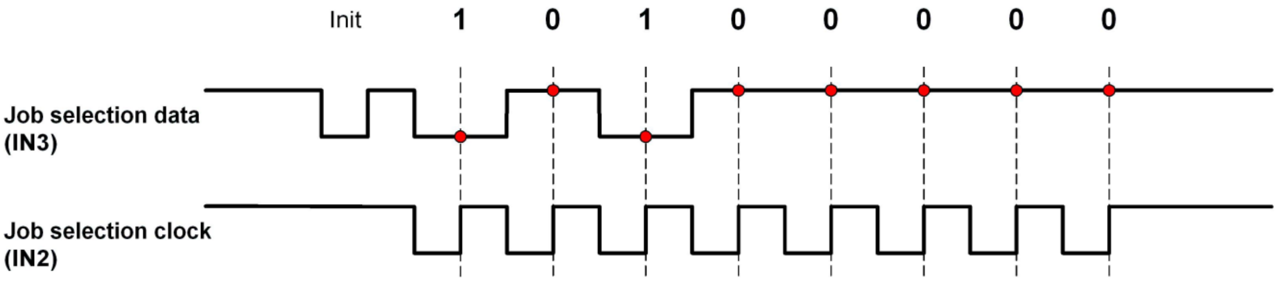
- In Job selection you must set the source "Digital inputs".
- For digital I/Os the parameters for the digital inputs 2 and 3 must be set as "Bit serial job selection – Clock" or "Bit serial job selection – Data".

Transfer the desired job number in this manner.

	Data to be transferred
Job 1	10000000
Job 2	01000000
Job 3	11000000
	...
Job 8	00010000
	...
Job 255	11111111

Example: Activation of job 5

You must switch the two digital inputs as follows to activate job 5:



13.7 Alarm signal

The alarm signal is activated under the following conditions in **parallel with the Pass/Fail signal** of the **current image acquisition/analysis operation**:

- Invalid trigger (trigger during image acquisition or job switching)
- Analysis aborted prematurely (output time exceeded)
- Error in job selection (invalid job number)
- Error at process interface
- FTP Alarm (An error occurred while transferring the images via the FTP client.)

If image analysis is not being performed at this time, the alarm signal is activated in parallel with the Pass/Fail signal of the **next image acquisition/analysis operation** if an error occurs.

> **NOTE**
>
> This output time for the alarm signal is not necessarily the next (seen chronologically) Pass/Fail signal if you are using the *Image trigger* or *Result valid* signals.

The alarm signal is activated immediately under the following circumstances and maintained **until the next trigger or until a successful job switch**:

- Job switching
  - if a job is selected that is not completely configured
  - if a job is selected that is not present

- Device activation
  - if an active job was not selected at Power On

14 Web interface

The device includes an integrated web server. This enables operation and reconfiguration (e.g. of machine control) via the web browser.

The web interface can be adapted to suit the application by configuring the 9 buttons for the main menu. Sub-functions and access rights for up to two user profiles can also be set.

In the web interface, you will be able to access the functions you have configured during job creation (*Configure interface → Web interface*) and in the device menu (*Device → Device settings → Configure web interface / Functions*).

NOTE

It is possible, but not essential, to use the web interface at the same time as the *Application Suite*.

14.1 Supported browsers

Due to differences in browser technology, there may be some differences in appearance between browsers and browser versions or even incompatibilities with the device. In our experience, these incompatibilities increase with the age of the browser due to a lack of standardization, for instance Internet Explorer® 7 and lower is not compatible with the device. We cannot test all browsers and their various releases, so untested browsers may also function with the device.

Currently the device officially supports the following browsers:

- Internet Explorer® 8/11 (not under Windows® CE 5.0, Internet Explorer® 8 - not for connection to multiple devices)
- Firefox 52

Cookies must be permitted.

NOTE

Users of the Siemens panel (web interfaces via WinCCflexible 2008 SP3 under Windows 7 Embedded) have reported that Internet Explorer 7 is launched, although Internet Explorers 9 should be installed. The web interface requires at least Internet Explorer 8 (see supported web browsers). If this happens, please contact Siemens Support.

NOTE

When using the web interface, ensure that security measures are in place to ensure that unauthorised persons do not have access.

This could include restricting access from outside sources or using VPN connections.

Only connect the Vision Sensor to a maximum of two browsers at any one time. Otherwise the web interface may not be displayed in its entirety.

In our experience the web technology only runs reliably to a limited extent in 24-hour operation, which may necessitate refreshing the browser from time to time.

NOTE

To use the web interface, you must activate JavaScript and Cookies!

Using pop-up blocker tools may result in the web interface not being correctly displayed. In this case, deactivate the pop-up blocker!

Users of Windows Internet Explorers® must also activate the use of ActiveX. You will find this setting under *Tools* > *Internet Options* > *Security* > *Security level for this zone* > *Run ActiveX controls and plug-ins*.

If necessary, add the IP address of the device to the "Local Intranet" zone. You can find this setting under *Tools* → *Internet Options* → *Security* → *Local Intranet* → *Sites* → *Extended*.

14.2 Connecting to the web interface

14.2.1 Connection to one device

Launch a supported browser and enter the IP address of the *device* or the defined domain name into the address bar.

> **NOTE**
>
> You can find the current IP address for your device on the *Info* tab next the *Help* tab in the *Application Suite*.
>
> You can set the domain name under: *Device → Device settings → Device name.*

You have the option to log into the device as an operator or expert via the address line in your browser (password assignment for user profiles: *Device → Device settings → Access rights / Web interface).*

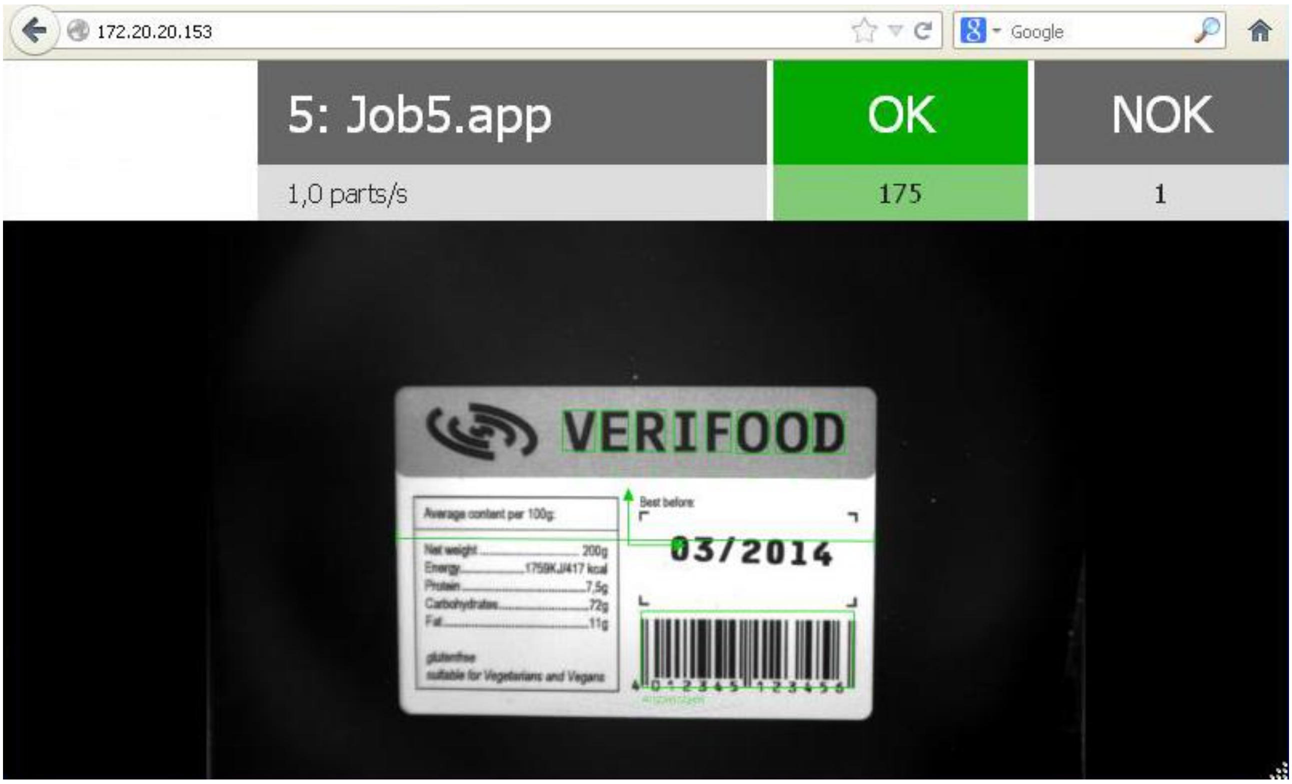
> **NOTE**
>
> Please ensure the URL is encoded correctly when entering your password via the browser!

```
http://[IP address]/?user=[Profi|Operator]&password=[password]
```

e.g.

```
http://173.194.35.23/?user=Profi&password=goodPassword
```

The following screen is displayed when the device is activated:



Click on the value to change the unit.

- Parts/ s → Parts/min → Parts/h
- OK (Parts → Percentage)
- NOK (Parts → Percentage)

Click on the picture to access the *Settings*.

14.2.2 Connection to multiple devices

If you have multiple devices in your network, you can display several devices simultaneously in a single browser window. By default you will see four frames with the available devices and their respective location in English.

NOTE

Do not use `https` to retrieve the function. Devices that support encrypted data transmission will switch to this mode automatically.

Launch a supported browser and enter the following into the address bar:

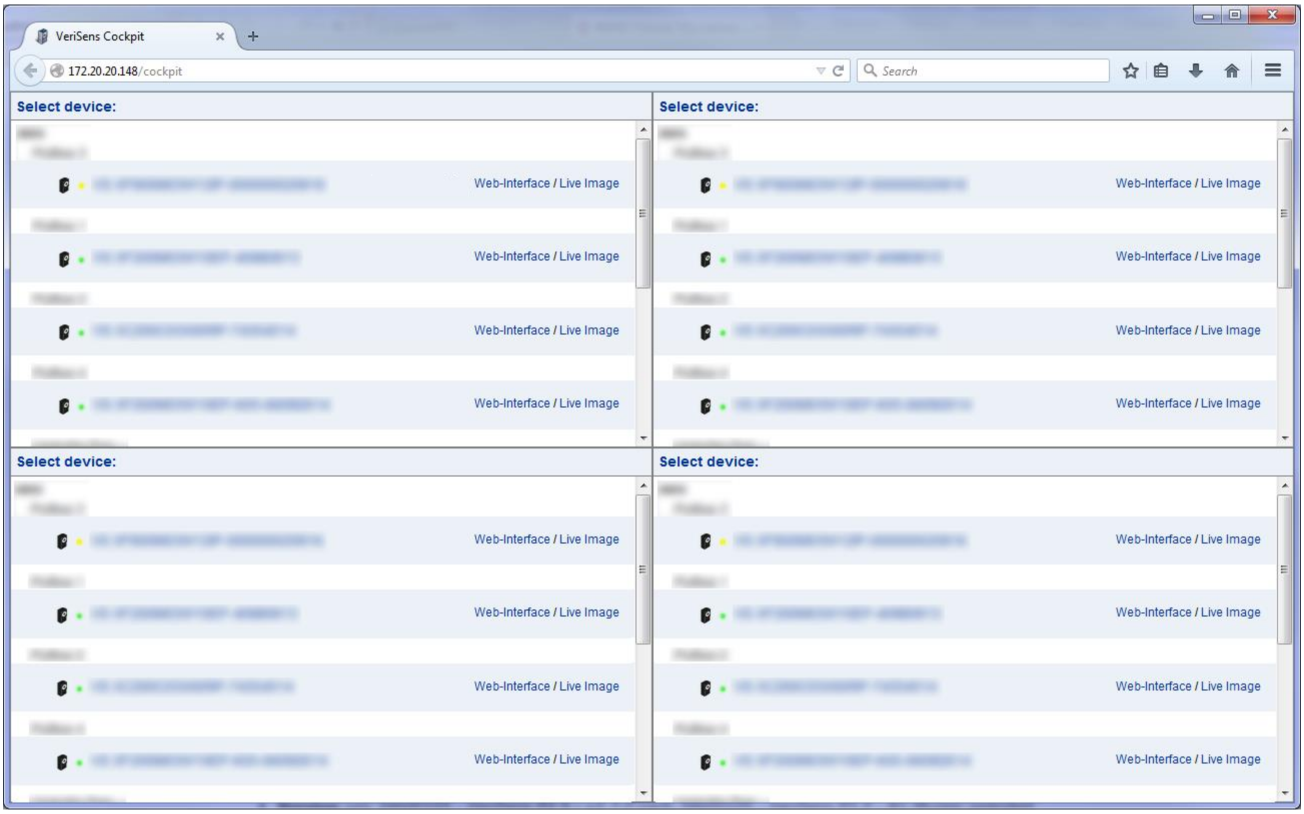
`http://opti-check.local/cockpit`	The device with the highest level of software will determine the layout of the viewer.
`http://[IP address]/cockpit` `http://[device name].local/cockpit`	The level of software of the accessed device will determine the layout of the viewer.
`http://[IP address]/cockpit?/c[column]r[row]Live=ip:[IP address1]&c[column]r[row]=ip:[IP address2]&c[column]r[row]=ip:[IP address3]&c[column]r[row]=ip:[IP address4]`	The level of software of the accessed device will determine the layout of the viewer and connect directly to a live view of the device in the selected rows and columns. **NOTE** Save the access parameters you created as a favourite to gain faster access to your devices.

NOTE

Please input the following to alter the number of frames to be displayed to nine (e.g. 3 windows per column and three per row):

`http://[IP address]/cockpit?view=3x3`

Other arrangements are possible, with up to four windows in a row and column.



Web interface: For establishing a web interface to the device.

Live image: For displaying a live image of the device in the frame. If the device is activated, graphical primitives will be displayed.

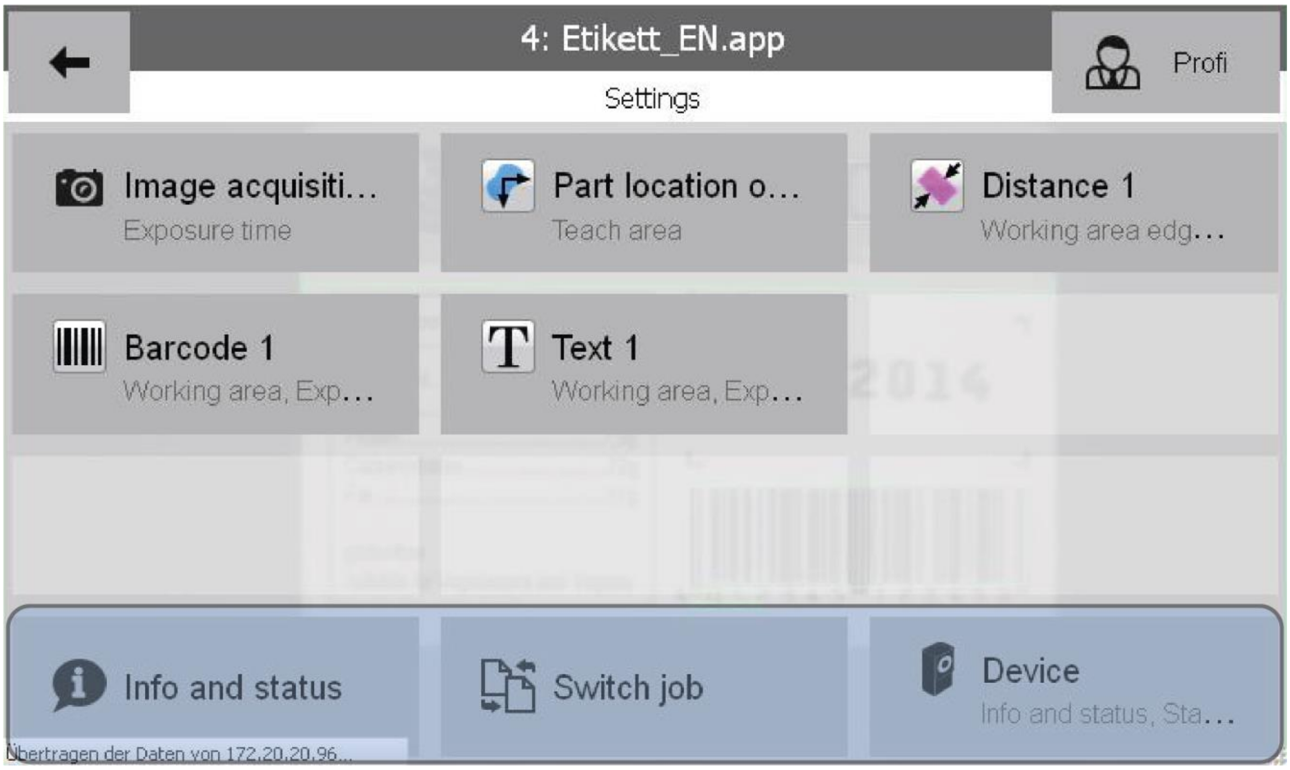
14.3 Device specific functions

The device specific functions that can be operated via the web interface are described below.

> **NOTE**
>
> You can set the availability of settings options and the corresponding rights through:
> *Device → Device settings → Configure web interface*.

Navigation

Back to start view	User profile (Only shown when user profiles are activated)	



Icon	Content
Info and status	• Device name • Device state • Device type • Firmware version • Serial number of the device
Statistics	• Name of job currently processing • Total number of checked parts • Number of parts marked good (OK) • Number of parts marked bad (NOK) • Number of alarms • All feature checks for the job with results (Number of OK/NOK)
Processing time	• Device processing time in ms (Parts/s) • Processing time and results for current feature check
Switch job	In this menu, you can change the active job. You can select any job on the device. The chosen job will activate immediately once selected.
Defect images	In this dialogue, you will see the currently saved defect images. You can save defect images in full resolution using your browser’s context menu.
Job management	Under job management you have the following options: ▪ Copy job (Copy the job from one save location on the device to another) ▪ Delete job (Delete job from the *device*) ▪ Access job (Download a job from the device to your computer) ▪ Transfer job (Transfer a job from your computer to the device) ▪ Job on Power on (Set which job should be active when the *device* is switched on) ▪ Change job name (Change the name of a job on the *device*) ▪ Change job location (Save the job to a different location)
Backup	▪ Create backup on the PC ▪ Restore from the PC ▪ Create on the FTP server ▪ Restore from the FTP server
Language	You can change the language here. Once the language is selected, you can make sure this language is always used by ensuring *Device → Device settings → Configuration → Web interface / Language settings functions / Save selection* via web interface is ticked.
Device	Device-specific functions (provides access to all device-specific functions via an additional menu level.)

14.4 Job specific functions

The job specific functions that can be used via the web interface are described below. Corresponding changes to the job are adopted and effective immediately.

The majority of feature checks support external teach, which can be triggered in the web interface by reconfiguring using the *Teach* button.

External teach must be activated during configuration of the relevant feature check in the *Application Suite*.

NOTE

You can set the availability of settings options and the corresponding rights for the feature check under:

Configure interface → Web interface tab

.

Navigation

Back	Apply settings and go back	Cancel	Display the live image if image acquisition is controlled via triggers	Trigger external teach	Determine the target colour

NOTE

The external teach triggered using the *Teach* button can also no longer be cancelled using the *Cancel* button!

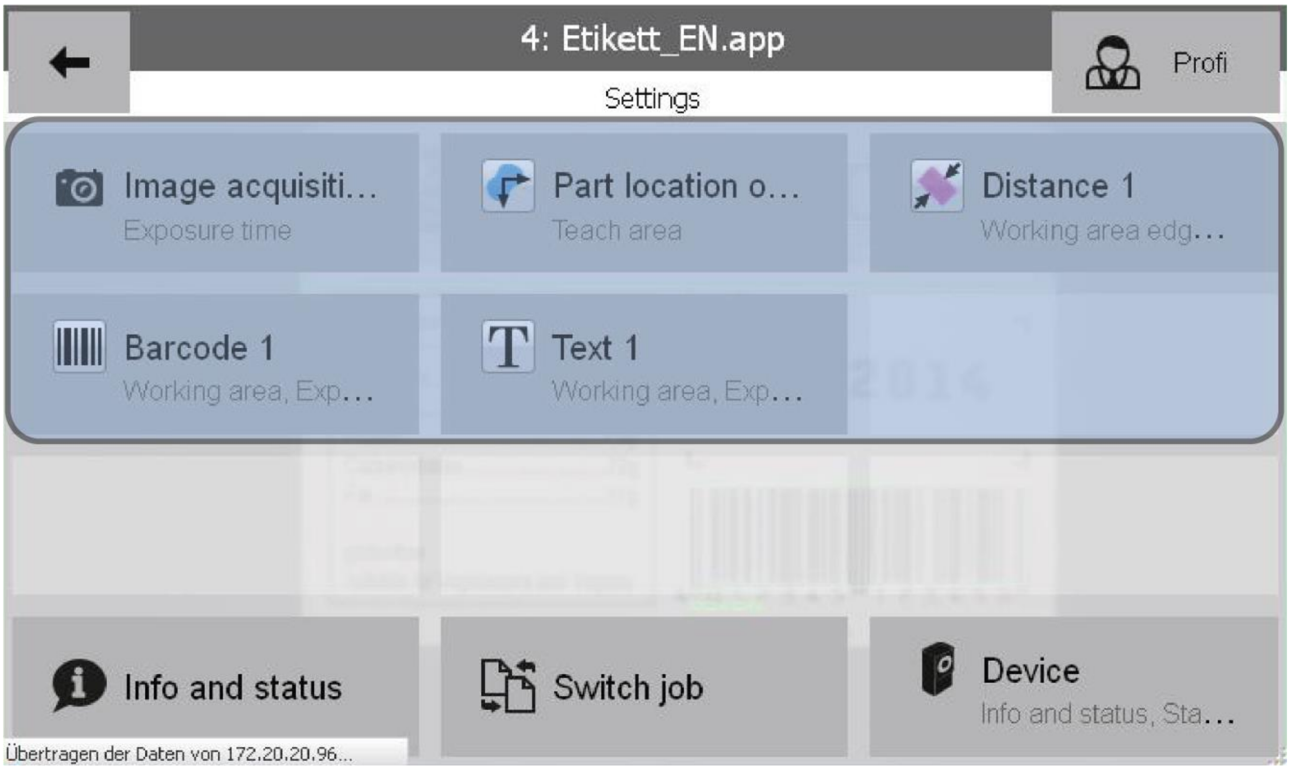
ATTENTION!

The live image function puts the device into "free running" mode, i.e. it runs without the external trigger signal. Please be aware of the effects this may have on later processes.

The user level required to access the live image display can be configured under:

Device settings → Configuration → Web interface/Functions

.



14.4.1 Image acquisition

Function	Icon	Adjustable parameters
Image acquisition		• Exposure time • Amplification • Edge sharpness • Gamma correction

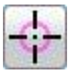
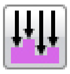
14.4.2 Part location

NOTE

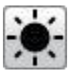
The web interface does not support chained part location.

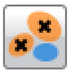
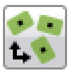
Function	Icon	Adjustable parameters
Part location on contours		• Teach area • Detection area • Conformity • Contrast • Maximum rotation • External Teach
Part location on edges		• Field of view edge A • Field of view edge A2 • Field of view of edge B
Part location on circle		• Field of view circle • Field of view edge for rotation
Part location on text line		• Field of view • Conformity

14.4.3 Geometry

Function	Icon	Adjustable parameters
Distance		• Field of view edge/circle A • Field of view edge/circle B • Distance • External Teach
Circle		• Field of view circle • Distance to the centre • Circle diameter • Roundness • External Teach
Angle		• Field of view edge A • Field of view edge B • Angle of the corner • External Teach
Count edges		• Field of view edges • Number of edges • External Teach
Point position		• Field of view • Rotation • Position X • Position Y • External Teach
Edge characteristics		• Field of view • Number of distances

14.4.4 Feature comparison

Function	Icon	Adjustable parameters
Count contour points		• Field of view • Number of contour points • External Teach
Contour comparison		• Field of view • Conformity • Tolerance • External Teach
Colour identification		• Field of view • Colour deviation (in ΔE)
Brightness		• Field of view • Brightness • External Teach

Contrast		• Field of view • Contrast • External Teach
Area size		• Field of view • Area • Colour • Binary threshold • External Teach
Area size (colour)		• Field of view • Area • Target colour
Colour positioning		• Fields of view • Target colour
Count areas		• Field of view • Number of areas • Colour • Binary threshold • Areas filter: Minimum • Areas filter: Maximum • External Teach
Count areas (colour)		• Field of view • Number of areas • Areas filter: Minimum • Areas filter: Maximum • Target colour
Pattern comparison		• Field of view • Deviation
Pattern comparison (colour)		• Field of view • Deviation
Finding object positions		• Detection area • Number of objects • Conformity • Contrast • Maximum rotation • Maximum number of objects • Horizontal reference shift • Vertical reference shift • Reference rotation

14.4.5 Identification

Function	Icon	Adjustable parameters
Barcode		• Field of view • Expected code • Type of code • Parameter set • Bar width: Minimum • Bar width Maximum • Bar height: Minimum • Polarity • Minimum contrast • Rotation tolerance • External Teach
Barcode (colour)		• Field of view • Expected code • Type of code • Parameter set • Bar width: Minimum • Bar height: Minimum • Polarity • Minimum contrast • Rotation tolerance
Matrix code		• Field of view • Expected code • Type of code • Parameter set • Polarity • Minimum contrast • Recognition • External Teach
Matrix code (colour)		• Field of view • Expected code • Type of code • Parameter set • Polarity • Minimum contrast • Recognition
Text		• Field of view • Expected • Mode • Colour • Threshold • Change character density • External Teach

Text (colour)		• Field of view • Expected code • Type of code • Parameter set • Polarity • Minimum contrast • Recognition

14.5 Functions selectable via the address bar

14.5.1 Language selection

The web interface will automatically launch in the same language as your operating system. However, you can change the language via the address bar of the browser.

Web interface in German:
`http://[IP address]/?lang=de`

Web interface in English:
`http://[IP address]/?lang=en`

Web interface in French:
`http://[IP address]/?lang=fr`

Web interface in Spanish:
`http://[IP address]/?lang=es`

Web interface in Chinese:
`http://[IP address]/?lang=zh`

Web interface in Japanese:
`http://[IP address]/?lang=ja`

Web interface in Korean:
`http://[IP-Adresse]/?lang=ko`

Web interface in Italian:
`http://[IP-Adresse]/?lang=it`

Web interface in Thai:
`http://[IP address]/?lang=th`

14.5.2 Scaling down the transferred image

To increase the image refresh rate in the web interface, you can scale down the image before transferring it (binning). The binning parameter can be combined with all of the other access options for the web interface.

Image in its original size
`http://[IP address]/?binning=none`

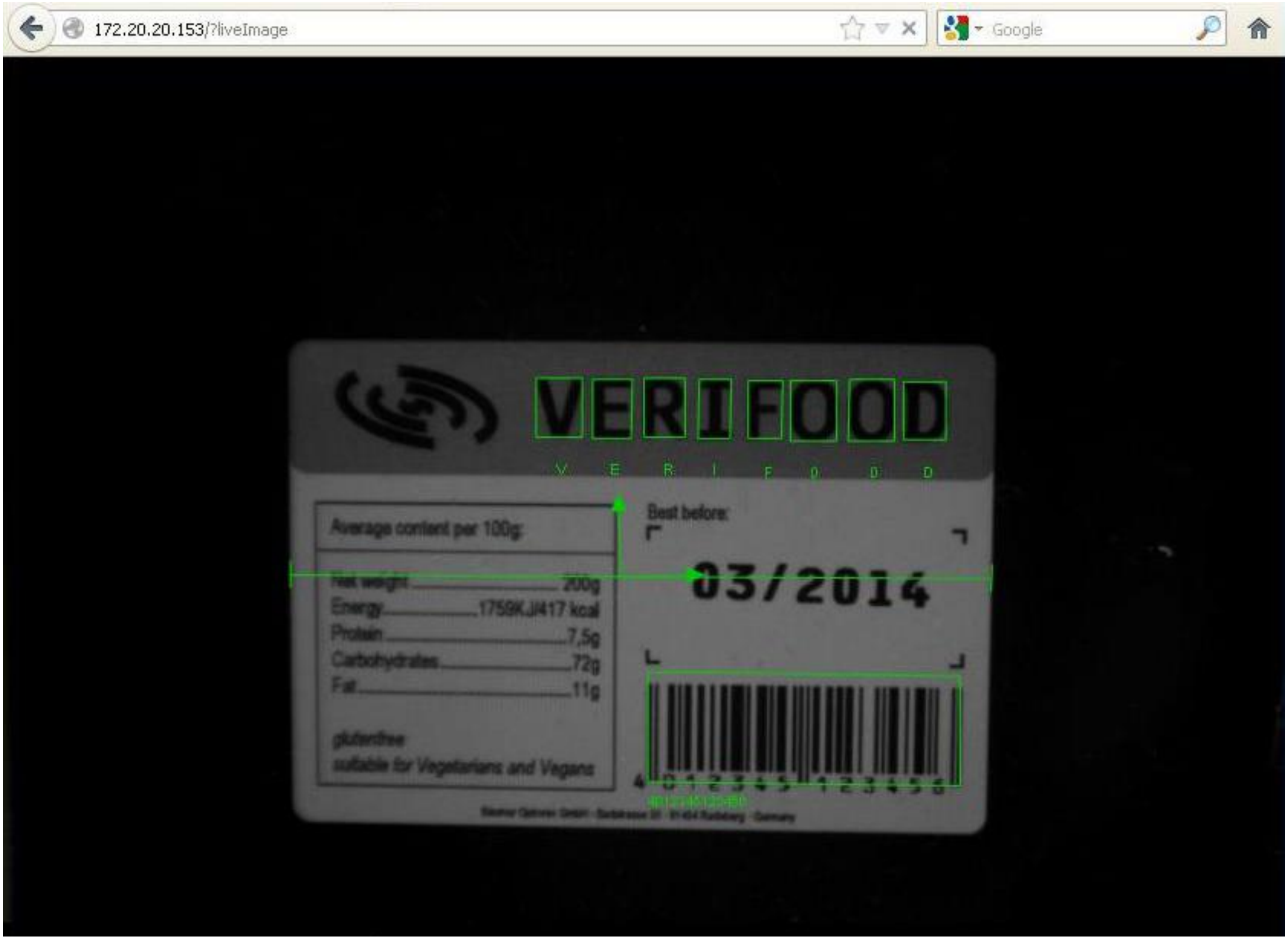
Image scaled down to half of its original height and width (default setting)
`http://[IP address]/?binning=2x2`

Image scaled down to quarter of its original height and width
`http://[IP address]/?binning=4x4`

14.5.3 Live image

View the live image in the full browser window via the browser's address field. If the device is activated, graphical primitives will be displayed:

```
http://[IP address]/?liveImage
```



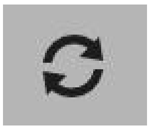
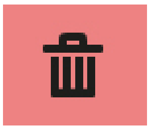
14.5.4 Defect images

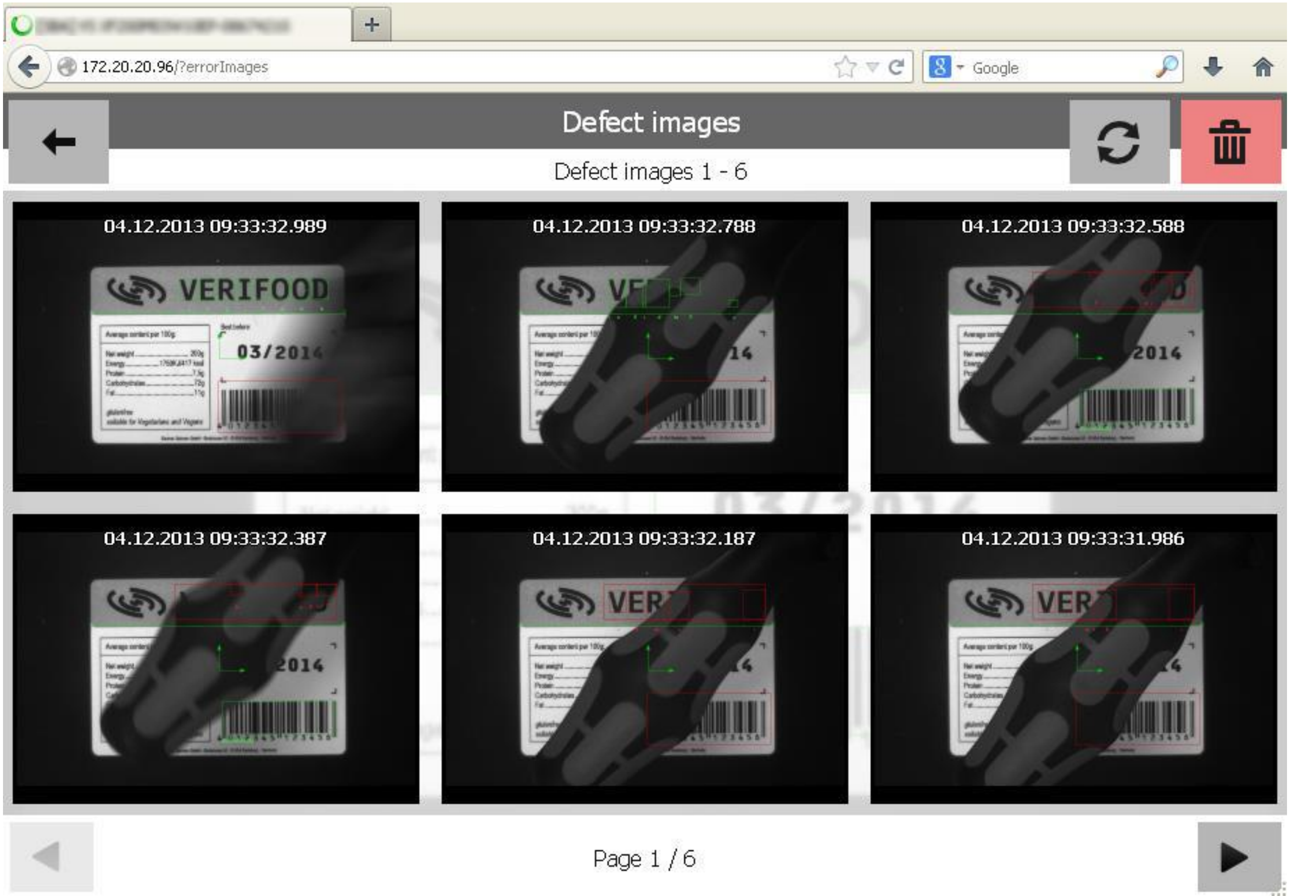
Access defect images via the browser's address field. You can save defect images in full resolution using your browser's context menu.

```
http://[IP address]/?defectImages
```

Other access options:

```
http://[IP address]/?errorImages
```

	
Update defect images	Delete defect images



14.5.5 Static images

You can access a single image without displaying the feature checks using the address field of the browser:

```
http://[IP address]/live_image.bmp
```

You can also display a single image showing the feature checks using the address field of the browser:

```
http://[IP address]/live_image.bmp?results=1
```

14.5.6 Setting the display screen

By default, the current image is refreshed as quickly as possible. If you want a constant image refresh rate, say to reduce network traffic, you can change this rate using a parameter on opening the web interface:

```
http://[IP address]/?refreshTime=t
```

The cycle time `t` is specified in milliseconds. A value of `0` means that the images are to be transferred as quickly as possible.

If display errors result when using a fixed image refresh rate, please increase the cycle time value.

NOTE

It is possible that the device is transferring image data via the web interface while simultaneously being linked to an *Application Suite*. In this case, the image data are preferably transferred to the *Application Suite* with the image frequency on the web interface being correspondingly reduced.

You can check in the *Status* area whether the device is linked to an *Application Suite*.

15 Communication via the process interface (device dependent)

This chapter provides an overview of the process interface of the device.

15.1 Process interface via TCP/UDP (device dependant)

15.1.1 Configuration of the Ethernet interface

The device is integrated via the process interface using an Ethernet connection and pre-configured port 23 ("Telnet"). For this purpose, connect the device with your machine and set the parameters, in particular the configuration of the IP address, using the *Application Suite*.
You can change the *Application Suite* parameters under: *Device → Device settings → Process interface.*

The following parameters are also required to control the logical transfer of the process data:

Parameters	Description	Values
<u>Result</u>	Time of result transfer	On request Continuous
<u>Receipt timeout</u>	Maximum duration between two characters	10 – 2,000 ms
Connection timeout	Maximum time between two received commands	Deactivated 1 – 3.600s

The transfer of the datagrams can occur at two different times:

- The Vision Sensor transfers the datagrams *on request*, i.e. as a response to the command "GD". This mode is designated "*Polling mode*".
- The Vision Sensor transfers data *continuously* after each image has been transferred. This mode is designated "Continuous mode".

NOTE

The connection timeout will in principal (depending on the duration of the process) not be reset, or not be reset at the correct time, for the following commands:

- Command GB (backup of the device)
- Command GF (retrieve individual pieces of data from the device)
- Command GI (retrieve an image)

15.1.2 Protocol structure – Ethernet

Command 2 Bytes	Parameter 0 - 12 Bytes	Data

After you have established a connection with the device via the set port, you can request data from the device or transfer commands. To do this, you may use the device protocol. This consists of a 2-byte command code followed by the parameters and the actual data.

The datagrams may also be terminated with the following control characters:

- `<CR>` (Hex: `0D`, Escape sequence: `\r`)
- `<LF>` (Hex: `0A`, Escape sequence: `\n`)
- `<CR><LF>` (Hex: `0D 0A`, Escape-Sequence: `\r\n`)
- without

15.2 Process interface via RS485 (device dependant)

You can communicate directly with the device via an RS485 connection.

15.2.1 Configuration of the RS485 interface

The integration of the device via the process interface is made with an RS485 connection. For this purpose, connect the device with your machine using the pins provided and set the RS485 parameters using the *Application Suite*.

The following parameters are available with which the physical transfer is controlled:

Parameters	Description	Values
Baud rate	Transfer speed	9600, 38400, 57600,115200, 230400 bps
Parity	Control of the parity bit	none, even, odd
Data bits	Number of bits per character	8
Stop bits	Number of stop bits as end code	1

The following parameters are also required to control the logical transfer of the process data:

Parameters	Description	Values
Device number	Address in the bus protocol	1 – 254
Protocol	Protocol type	Point-to-point Bus without checksum Bus with checksum
Result	Time of result transfer	On request Continuous
Receive timeout	Maximum duration between two characters	10 – 2,000 ms
Response delay	Duration between reception of a command and transmission of the response	Min: 0 – 2,000 ms Max: 500 – 10,000 ms

The transfer of the datagrams can occur at two different times:

- The Vision Sensor transfers the datagrams on *request*, i.e. as a response to the command "GD". This mode is designated "*Polling mode*".
- The Vision Sensor transfers data *continuously* after each image has been transferred. This mode is designated "Continuous mode".

15.2.2 Protocol structure – RS485

Two means of data transfer are available for the operation of the process interface:

- **Point-to-point protocol** This protocol is a shortened form of the bus protocol. It provides no means of addressing or verification with a checksum. This protocol is suitable when fast reaction times and low data volumes are concerned and transfers are verified by other means.

- **Bus protocol**
  This protocol permits up to 254 devices to be accessed on one RS485 bus. Communication security is ensured by the use of synchronization signals and an optional checksum. The formatting of the data is a so more strictly defined in this protocol, simplifying further processing.

Point-to-point protocol:

Command 2 Bytes	Parameter 0 - 12 Bytes	Data

The point-to-point protocol consists of a 2-byte command designator followed by the parameters and the actual data. No control codes are used. Synchronization can be achieved using receive timeout.

Bus protocol:

With checksum

{ 1 Byte	Length 4 Bytes	Device number 2 Bytes	Command 2 Bytes	Parameter 4 - 12 Bytes	Data	Checksum 2 Bytes	} 1 Byte

Max. 64 kBytes

Without checksum

[1 Byte	Length 4 Bytes	Device number 2 Bytes	Command 2 Bytes	Parameter 4 - 12 Bytes	Data	] 1 Byte

Max. 64 kBytes

If you wish to transfer more than 65,535 bytes, e.g. jobs, you can extend the length to 8 bytes (sufficient for 2^{32} bytes). This changes the start and end codes:

With checksum

(1 Byte	Length 8 Bytes	Device number 2 Bytes	Command 2 Bytes	Parameter 4 - 12 Bytes	Data	Checksum 2 Bytes	) 1 Byte

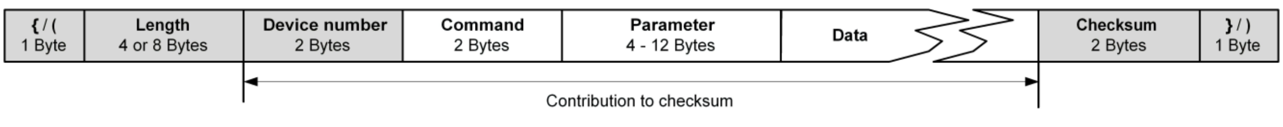
Without checksum

< 1 Byte	Length 8 Bytes	Device number 2 Bytes	Command 2 Bytes	Parameter 4 - 12 Bytes	Data	> 1 Byte

This protocol has a defined format:

Element	Size	Meaning
{ / [(/ <	1 byte	These codes are used for synchronization of the transfer. If you specify the length in 4 bytes, use the code "{" (datagram with checksum) or "[" (datagram without checksum). If you specify the length in 8 bytes, use the code ")"(datagram with checksum) or ">" (datagram without checksum).
Length	4 or 8 bytes ASCII-Hex	The length is equivalent to the number of transferred bytes from the device number (inclusive) to the end of the data, i.e. without any checksum. If the datagram exceeds a length of 65,535 bytes and you require 8 bytes for the length, you must use the start code "(" or "<".
Device number	2 byte ASCII hex	Each connected device has its own device number in a range from 1 („01")-254 („FE"). Number 0 is reserved to address the bus master (PLC, PC ...). Device number 255 ("FF") can be used to send commands to all connected devices simultaneously.
Command	2 byte	Command designation
Parameters	4-12 bytes	Each command has a parameter block at least 4 bytes in length, some of which remain unused.
Data	variable	Optional data section, which may contain result or job data.
Checksum	2 byte ASCII hex	The checksum is produced by linking all characters beginning with the device number to the end of the data byte for byte with XOR. The checksum must only be specified if the start code "{" or " (" is used, otherwise this entry is omitted.
} /]) / >	1 byte	These codes are used as the end codes of the command blocks. If you specify the length in 4 bytes, use the code "}" (datagram with checksum) or "]" (datagram without checksum). If you specify the length in 8 bytes, use the code ")"(datagram with checksum) or ">" (datagram without checksum).

The following section is used to calculate the checksum:



If you use the RS485 bus protocol (device number: 6), the formats change as follows:

Example (Retrieve the last feature check)

> **NOTE**
>
> You can set the structure of datagrams for input and output via the process interface during job creation under *Configure interface*.

{	0	0	0	8	0	6	G	D	0	0	0	0	0	5	}
Start	Length 8 byte				Device no.		Com-mand		unused				Check-sum		End

Retrieve a result

{	0	0	1	6	0	6	R	D	0	0	0	E	S	T	P		,	P		,	0	1	2	5	E	T	7	5	}
Start	Length 22 byte				Device no.		Response		Length 14 byte				Start Data		Result			Result Intensity 1			Brightness Intensity 1				End Data		Check-sum		End

Response datagram

15.3 General Information

15.3.1 General description of data formats

It is important to distinguish between primitive data types (integers, floats, text) and composite data types (integer points, float-points, lists) as well as the format of the corresponding data type (ASCII-dec, binary, ASCII-2 decimal places).

15.3.1.1 Integer

This data type is a whole number value and can also be negative.

Example: 234

Format	Text representation	Transferred value (process interface)
ASCII hex	„EA"	\45 \41
ASCII dec	„234"	\32 \33 \34
Binary	cannot be represented	\00 \00 \00 \EA

15.3.1.2 Float

This data type is a floating value and can also be negative.

Example: 10.02

Format	Text representation	Transferred value (process interface)
ASCII (2 decimal places)	„10.02"	\31 \30 \2E \30 \32
ASCII (Exponent)	„+1.002E+01“	\2B \31 \30 \30 \32 \45 \2B \30 \30 \31
Decimal	„10"	\31 \30
Binary (Little Endian)	cannot be represented	\EC \51 \20 \41
Binary (Big Endian)	cannot be represented	\41 \20 \51 \EC

15.3.1.3 Text

This data type can contain both printable and non-printable characters.

Example: „MHD"

Format	Text representation	Transferred value (process interface)
ASCII	„MHD"	\4D \48 \44
Binary	„MHD"	\4D \48 \44

15.3.1.4 Composite data type: Integer point

This composite data type is formed of two integer values, the x-coordinate and the y-coordinate.

Available format: Analogue integer

Portrayal: x coordinate <separator> y coordinate

Example: Value: (234, 123), Separator: „;"

Format	Text representation	Transferred value (process interface)
ASCII hex	"EA;7B"	\45 \41 \3B \37 \42
ASCII dec	„234;123"	\32 \33 \34 \3B \31 \32 \33
Binary	cannot be represented	\00 \ 00 \00 \EA \3B \00 \ 00 \00 \7B

15.3.1.5 Composite data type: Float point

This composite data type is formed of two float values, the x-coordinate and y-coordinate.

Available format: Analogue float

Portrayal: x coordinate <separator> y coordinate

Example: Value: (234.02, 123.03), Separator: „;"

Format	Text representation	Transferred value (process interface)
ASCII (2 decimal places)	„234.02;123.03"	\32 \33 \34 \2E \30 \32 \3B \31 \32 \33 \2E \30 \33
ASCII (Exponent)	"+2.3402E+02;1.2303E+02"	\2B \31 \30 \30 \32 \45 \2B \30 \30 \31
Decimal	„234;123"	\31 \30
Binary (Little Endian)	cannot be represented	\1F \05 \6A \43 \3B \5C \0F \F6 \42
Binary (Big Endian)	cannot be represented	\43 \6A \05 \1F \3B \42 \F6 \0F \5C

15.3.1.6 Composite data type: List

This composite data type is a list of values of arbitrary type.

Available format: Analogue used data type
Represented as: Number <separator> <1. value corresponding data type> <separator><2. Value corresponding data type><separator>…<separator><last value corresponding data type>

Example: (data type integer):
Values: (123,234,245), Separator: „;"

Format	Text representation	Transferred value (process interface)
ASCII hex	„03;7B;EA;F5"	\30 \33 \3B \37 \42 \3B \45 \41 \3B \46 \35
ASCII dec	„3;123;234;245"	\33 \3B \31 \32 \33 \3B \32 \33 \34 \3B \32 \34 \35
Binary	cannot be represented	\00 \00 \00 \03 \3B \00 \00 \00 \7B \3B \00 \00 \00 \EA \3B \00 \00 \00 \F5

15.3.2 Numeric values in commands

Various commands require numeric values as parameters or return numeric values. For example, when switching the current job, the corresponding job number must be specified and the new job number is returned in the status datagram.

NOTE

Numerals are always entered as ASCII Hex information in the command data. Observe that the Hex values must be specified in upper case letters!

For example, the Hex numbers below result from the following values:

Value	2 byte ASCII hex	4 byte ASCII hex
1	01	0001
10	0A	000A
100	64	0064
255	FF	00FF
1000	-	03E8

15.3.3 Conversion Table Decimal ↔ Hexadecimal ↔ Character

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
00	00	NUL	32	20	SP	64	40	@	96	60	`
01	01	SOH	33	21	!	65	41	A	97	61	a
02	02	STX	34	22	"	66	42	B	98	62	b
03	03	ETX	35	23	#	67	43	C	99	63	c
04	04	EOT	36	24	$	68	44	D	100	64	d
05	05	ENQ	37	25	%	69	45	E	101	65	e
06	06	ACK	38	26	&	70	46	F	102	66	f
07	07	BEL	39	27	'	71	47	G	103	67	g
08	08	BS	40	28	(	72	48	H	104	68	h
09	09	HT	41	29	)	73	49	I	105	69	i
10	0A	LF	42	2A	*	74	4A	J	106	6A	j
11	0B	VT	43	2B	+	75	4B	K	107	6B	k
12	0C	FF	44	2C	,	76	4C	L	108	6C	l
13	0D	CR	45	2D	-	77	4D	M	109	6D	m
14	0E	SO	46	2E	.	78	4E	N	110	6E	n
15	0F	SI	47	2F	/	79	4F	O	111	6F	o
16	10	DLE	48	30	0	80	50	P	112	70	p
17	11	DC1	49	31	1	81	51	Q	113	71	q
18	12	DC2	50	32	2	82	52	R	114	72	r
19	13	DC3	51	33	3	83	53	S	115	73	s
20	14	DC4	52	34	4	84	54	T	116	74	t
21	15	NAK	53	35	5	85	55	U	117	75	u
22	16	SYN	54	36	6	86	56	V	118	76	v
23	17	ETB	55	37	7	87	57	W	119	77	w
24	18	CAN	56	38	8	88	58	X	120	78	x
25	19	EM	57	39	9	89	59	Y	121	79	y
26	1A	SUB	58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
28	1C	FS	60	3C	<	92	5C	\	124	7C	|
29	1D	GS	61	3D	=	93	5D	]	125	7D	}
30	1E	RS	62	3E	>	94	5E	^	126	7E	~
31	1F	US	63	3F	?	95	5F	_	127	7F	DEL

Example: Command GB – access device backup

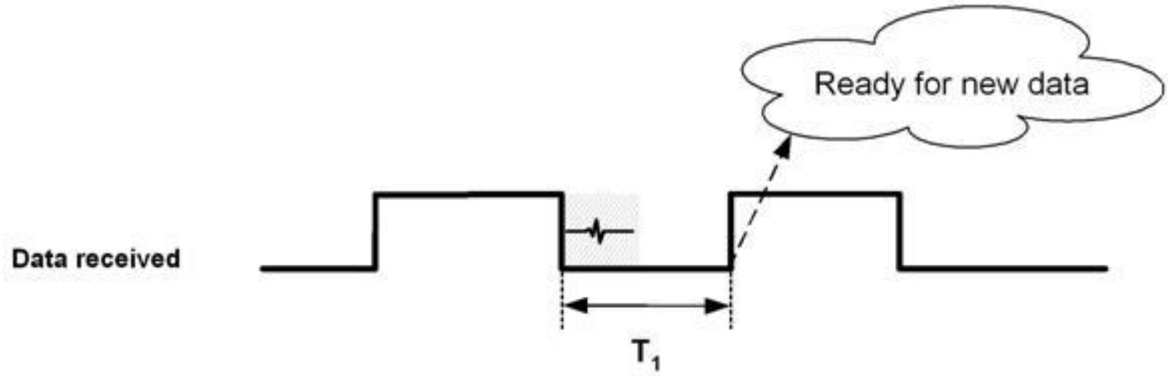
Command

Char	G	B	0	0	0	0
Dec	71	66	48	48	48	48
Hex	0x47	0x42	0x30	0x30	0x30	0x30

Response

Char	R	B	0	0	0	0	0	0	0	4	F	6	1	6	…
Dec	82	66	48	48	48	48	48	48	48	52	70	54	49	54	Data
Hex	0x52	0x42	0x30	0x30	0x30	0x30	0x30	0x30	0x30	0x34	0x46	0x36	0x31	0x36	

15.3.4 Receipt timeout

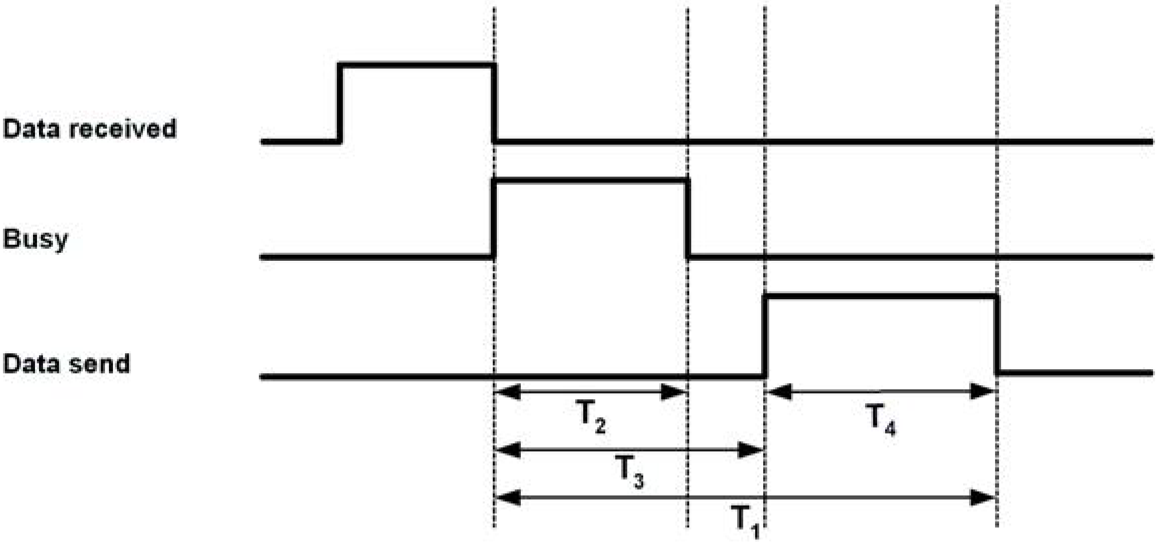


Signal	Duration	
	min.	max.
Receive timeout T_1	10 ms	2000 ms

If errors occur in the communication, receiving is terminated after a defined time. The data received to this point is then discarded. The possible error causes may be:

- The cable was unplugged or mechanically damaged during the transfer.
- Transmission of the data was prematurely terminated due to a technical fault.
- An error occurred in the transfer of the length information, so that the information is incorrectly transferred. The device then presumes an incorrect overall length of the data.

15.3.5 Response delay



Signal		Duration	
		min.	max.
Response time T_1 No further commands must be transferred during this time!		0 ms	max. { T_2, T_3 } + T_4
Reaction time T_2	Ethernet	1 ms	5 ms
	RS485 (device dependant)	1 ms	5 ms + 2.5 ms per 128 bytes of data
Response delay T_3		T_2	10,000 ms
Transfer time T_4		Dependant on the transfer parameters and the length of the data	

The transfer of the data begins not before time T_2 or the value set by the user.

If the time of the maximum response delay is exceeded without data being transferred, the possible response is discarded and you can transfer further commands.

Please observe that the received command will be processed in any case, even if no response datagram has been transferred due to the elapse of the maximum response time! For example, it is possible that this time could be exceeded when switching the active job. In this case, you will receive no confirmation, although the active job has been changed. If necessary, query the device status if you have received no confirmation.

15.4 Available commands for TCP / UDP / RS485

15.4.1 CS command – reset statistics

This function enables you to reset the statistics for individual jobs.

Example

Structure of the command PLC ➡ device						
Command		Parameters				
C	S	0	0	0	0	
Clear **S**tatistics		4 byte ASCII hex Job number 0000 = active job 0001 – 0010 = Job number 1-16 0011 – 00FF = invalid				

Structure of the Response PLC ⬅ device						
Response						
R	C	0	0	0	0	
Response Statistics **C**leared		4 byte ASCII hex Job number 0000 = active job 0001 – 0010 job number 1-16 0011 – 00FF = invalid				

15.4.2 Command DJ – delete job

This function enables you to delete some or all of the jobs on the device. The device must be in *Configuration* mode for jobs to be deleted.

NOTE

When a power-on job is deleted it will be deleted without replacement!

There is currently no option to insert a new power-on-job via command. Although power-on jobs can be amended via an update (Command – UJ).

Example

Structure of the command PLC ➡ device					
Command		Parameters			
D	J	0	0	0	0
Delete **J**ob		4 byte ASCII hex FFFF = all jobs on the device will be deleted 0001 (1) - 00FF (255) = individual jobs on the device will be deleted			

Structure of the command PLC ➡ device			
Command		Parameters	
R	J	0	0
Response **J**ob		2 byte ASCII hex 0000 = job(s) deleted 0001 = device not in Configuration mode 0002 = invalid job number (job does not exist)	

15.4.3 Command GA – temperature alarm queries

This function enables you to query the device's current temperature status.

An internal protection device intervenes when the device is operated outside of specification; this is intended to protect the components against destruction by heat.

The *Application Suite*, the web-interface and the process interfaces will output an overheating warning to notify users that the maximum permissible operating temperature has been reached (circa 85–90% of loading, see the *Request GT heat state command*).

Should the housing temperature continue to rise, the device will undergo emergency shutdown to protect it from damage.

Example

Structure of the command PLC ➡ device		
Command		Parameters
G	A	
Get **A**larm		none

Structure of the Response PLC ⬅ device										
Response										
R	A	0	0	0	0	0	0	0	0	
Response **A**larm		8 byte ASCII hex Temperature status								

Parameters of the "RA" command – current temperature status

The current temperature status will be transmitted using 8 characters, where the first 7 characters in a bit mask are always 0 and the current temperature status is contained in bits 0 and 1 of the eighth character.

Bits

3	**2**	**1**	**0**	**3**	**2**	**1**	**0**
1. ASCII characters				2. ASCII characters			
0				0			
3. ASCII characters				4. ASCII characters			
0				0			
5. ASCII characters				6. ASCII characters			
0				0			
7. ASCII characters				8. ASCII characters			
0				0		Thermal shutdown	Heat warning

15.4.4 Command GB – access device backup

This function enables you to access a backup of the device with firmware or the job as well as the device settings.

Example

Structure of the command PLC ➡ device						
Command		Parameters				
G	B	0	0	0	0	
Get **B**ackup		0000 = Backup with firmware 0001 = Only jobs and device settings				

Structure of the Response PLC ⬅ device														
Response														
R	B	0	0	0	0	0	0	0	4	F	6	1	6	…
Response **B**ackup		4 byte ASCII hex Parameters of the GB-command Error messages: F001 = Device is not deactivated F004 = Backup has already been called F008 = Password protection activated				8 Byte ASCII-Hex data length (32bit) For errors, the length is 0								Data

(device dependant)

NOTE

If the device backup contains calibrated lens distortion or shading correction, then the backup will only be completed when the *Application Suite* has been used to switch the device to set-up mode after recovery (*Device configuration*).

Switching via the SM command is insufficient for this.

15.4.5 GD command – retrieve last result

This function enables you to retrieve the result of the last feature check.

> **NOTE**
>
> You can set the content of the datagram for output via the process interface during job creation under *Configure interface* → *Output process interface*.

Example

Structure of the command PLC ➡ device		
Command		Parameters
G	D	
Get **D**ata		none

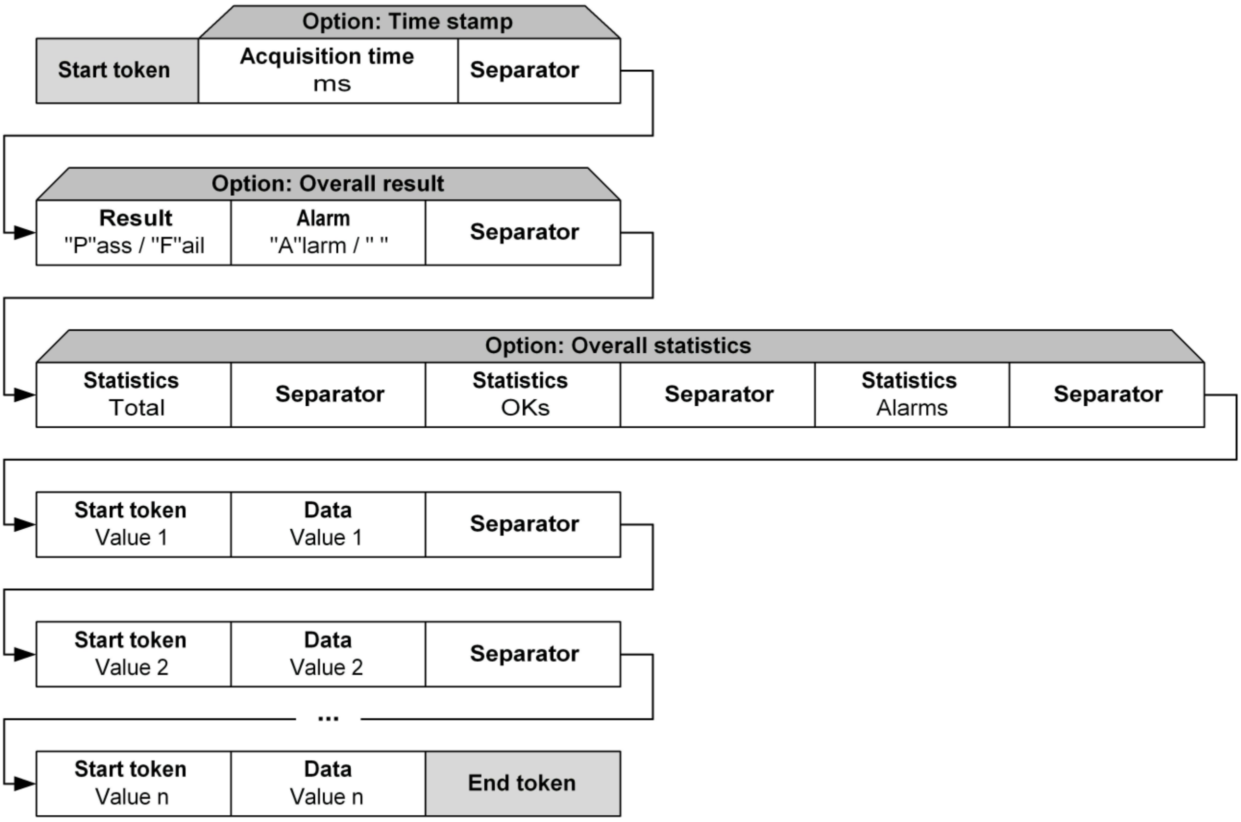
Structure of the Response PLC ⬅ device							
Response							
R	D	0	0	0	0	…	
Response **D**ata		4 byte ASCII hex Length of the result data				Data	

Parameters of the "RD" datagram response

The datagram contains the results of the last image analysis.

NOTE

You can set the content of the datagram for output via the process interface during job creation under *Configure interface → Output process interface*.



The time stamp in the datagram consists of 8 ASCII characters which specify the number of milliseconds since the system start of the device as a hexadecimal number. This value reverts from 4,294,967,295 ms to the value 0 ms after about 49.7 days.

Numbers in datagrams can be represented in different ways:

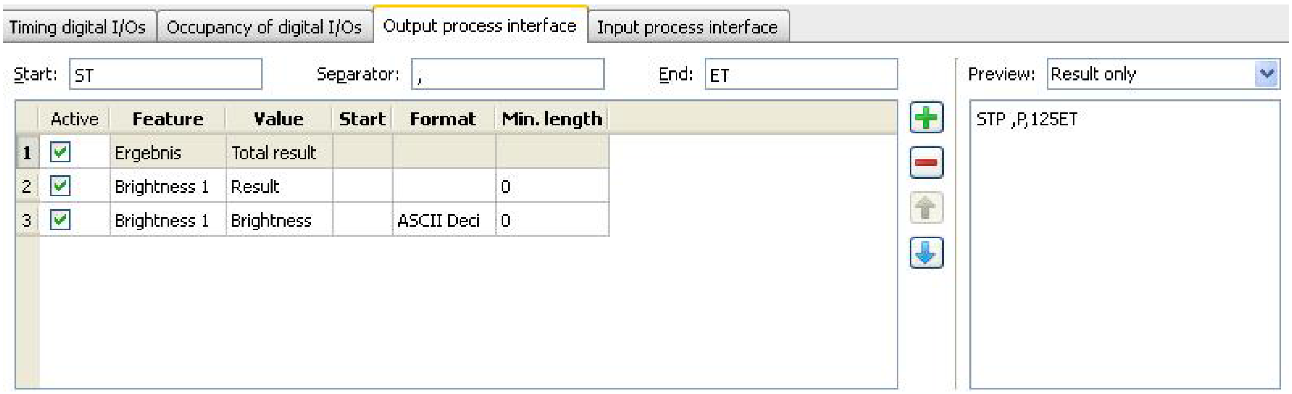
Representation	Description
ASCII decimal	Decimal notation of the number. Negative numbers are represented with "-". „123", „78", „89", „-123"
ASCII hexadecimal	Hexadecimal notation of the number. Negative numbers are represented as a complement. "7B", "4E", "59", FF85
Binary	Binary output of the number. Measured value 123: Characters output `0x00`, `0x00`, `0x00`, `0x7B`

NOTE

In ASCII decimal, the sign is included in the length. For example, if a length with the value of 4 is set, this results in a range of values from –999 to 9999.

Example for the transfer of result data

The configuration of the datagram is set as shown in the illustrations:



The response from the device would be:

Structure of the Response PLC ⬅ device																			
Response																			
R	D	0	0	0	E	S	T	P		,	P		,	0	1	2	5	E	T
Response **D**ata		4 byte ASCII hex Length of the result data				Start Data		Result			Result Brightness			Brightness				End Data	

Each feature check result is represented within 1 Byte. The inspection result is described by "P" (result OK) or "F" (result NOK).

An interpretation of this datagram produces:

The overall result of the last image analysis was OK. In the field of view for the "brightness" feature check, the measured value is defined as 125. The individual result for this feature check was also OK.

Each feature check can produce a range of parameters, which you can find in the description of the current feature check.

15.4.6 Command GF – retrieve individual files from the device

This function enables you to access individual data on the device.

Example

Structure of the command PLC ➡ device						
Command		Parameters				
G	F	0	0	0	0	
Get **F**ile		0000 = List of all jobs 01nn = Retrieve job (nn 2 byte ASCII-Hex Job number) 02nn = Call a job using the job name (nn:2-byte ASCII hex length of the file name + file name) 0300 = Access Logging				

Structure of the Response PLC ⬅ device																		
Response																		
R	F	0	0	0	0	0	0	0	0	0	0	0	0	F	1	2	3	...
Response **F**ile		4 bytes ASCII-hex, mirrored parameters of the GF request				2 bytes ASCII hex: Error code 00 = no error occurred 01 = is not in Configuration- or IDLE- mode 02 = File not found 04 = last file still being retrieved FF = internal error		2 bytes ASCII hex Reserved		8 bytes ASCII hex Length of the following data								Data

15.4.7 GI command – access an image (only via Ethernet)

This function enables you to access live images and defect images with and without the field of view.

Example

Structure of the command PLC ➡ device						
Command		Parameters				
G	I	0	0	0	0	
Get **I**mage		2 byte ASCII hex 00 = live image 01 = Live image with field of view 80 = Fault image 81 = Fault image with field of view		2 byte ASCII hex image number 00 = Last image, 01 = penultimate image, 02 = …		

Structure of the Response PLC ⬅ device														
Response														
R	I	0	0	0	0	0	0	0	4	F	6	1	6	…
Response **I**mage		2 byte ASCII hex 00 = live image 01 = Live image with field of view 80 = Fault image 81 = Fault image with field of view		2 byte ASCII hex Image number		8 byte ASCII hex Length of the image data								Image data in the format BMP

NOTE

A new *GI* command must be used to wait until the *RI* response to the previous request has been sent. Otherwise a precipitously renewed *GI* command will be acknowledged with the *RI000000000000* response.

15.4.8 GM command – access information about the device

This function enables you to access information about the connected device.

Example

Structure of the command PLC ➡ device						
Command		Parameters				
G	M	0	0	4	0	
Get **M**odel Information		4 byte ASCII hex Access single elements 0001 = Device type 0002 = MAC address 0004 = Serial number 0008 = Firmware version 0010 = Hardware version 0020 = Device name 0040 = Manufacturer 0000 = All (in the order given above)				

Structure of the Response PLC ⬅ device											
Response											
R	M	0	0	4	0	0	0	1	4	ipf electronic GmbH
Response **M**odel Information		4 byte ASCII hex mirrored parameters of the GM request				4 byte ASCII hex For each element: Length of the result data				Data

15.4.9 GP command – access the current configuration of the SP command

This function allows you to read out the current values that can be changed using the SP command (set parameters for feature checks).

This is useful, for example, if you wish to read out the expected value for the "Barcode" / "Matrix code" via the controller.

Example

Structure of the command PLC ➡ device		
Command		Parameters
G	P	
Get **P**arameter		none

Structure of the Response PLC ⬅ device														
Response														
R	G	0	0	0	8	1	5	.	0	2	.	1	4	
Response **G**et Parameter		4 byte ASCII hex Length of the result data				Data The content of the data corresponds with the expected values currently set for the feature check e.g. a date, or a combination of expected values for different feature checks and display settings.								

NOTE

You can set the content of the datagram for output via the process interface during job creation under *Configure interfaces* → *Output process interface*.

15.4.10 GS command – request status

This function enables you to access current status information for the device.

Example

Structure of the command PLC ➡ device		
Command		Parameters
G	S	
Get **S**tate		none

Structure of the Response PLC ⬅ device										
Response										
R	S	0	0	8	5	0	0	1	A	
Response **S**tate		4 byte ASCII hex Status				4 byte ASCII hex Number of the active job				

NOTE

A TCP/IP connection can be monitored, for example by the PLC cyclically sending the *GS* command. If the connection is broken, this is shown on the Vision Sensor page and the connection is reset.

Parameters of the "RS" command – Current status information

The current status information consists of 8 characters, of which the first 4 characters describe various states in a bit mask and the other 4 characters contain the current job number.

Bits

3	2	1	0	3	2	1	0
1. Status (ASCII)				2. Status (ASCII)			
Internal error	**Backup** OK	**Backup** Error	**Backup** Active	**Acquisition** Trigger possible	**Job Update** OK	**Job Update** Error	**Job Update** Active
3. Status (ASCII)				4. Status (ASCII)			
Mode Run Mode	**Mode** Test Mode	**Mode** Setup	**Mode** Recovery	**Acquisition** continuously	**Acquisition** External trigger	**Protocol** Continuous Mode	**Protocol** Polling Mode
1. Job number (ASCII)				2. Job number (ASCII)			
Number of active job							
3. Job number (ASCII)				4. Job number (ASCII)			
Number of active job							

When a job is being transferred via the process interface, the current status of this action can be queried by the PLC. The corresponding bit "Job update active" is set during the data transfer period. This bit remains set until the job has been completely transferred and stored or an error has occurred. The success of the action can then be assessed by the corresponding bits "Jobupdate – OK" and "Job update – error". These flags are retained until the next transfer of a job.

If the sensor is in *Activated* mode, the current job number is entered in the datagram. 0000 is entered here in all other operating modes.

Here are two examples of possible states of the device:

Character string	Meaning	
0 0 8 5 0 0 1 A	0 0 8 5 0 0 0 0 0 0 0 0 1 0 0 0 0 1 0 1	Current inspection mode: Activated Acquisition: External trigger Protocol: Polling mode Active job: 26 (Hex: 1A)
0 0 2 9 0 0 0 0	0 0 2 9 0 0 0 0 0 0 0 0 0 0 1 0 1 0 0 1	Current inspection mode: Configuration Acquisition: Continuous Protocol: Polling mode Active job: -

15.4.11 GS command – request thermal condition

This function enables you to query the device's current thermal state. The internal temperature sensor is queried for this and the capacity is output in %.

An internal protection device intervenes when the device is operated outside of specification; this is intended to protect the components against destruction by heat. The device will undergo emergency shutdown when 100% capacity is reached.

The *Application Suite*, the web-interface and the process interfaces will output an overheating warning to notify users that the maximum permissible operating temperature (circa 85–90% of loading) has been reached (see *GA temperature alarm command*).

Example

Structure of the command PLC ➡ device		
Command		Parameters
G	T	
Get **T**hermal Condition		none

Structure of the Response PLC ⬅ device										
Response										
R	T	0	0	0	0	0	0	0	0	
Response **T**hermal Condition		8 byte ASCII hex Thermal state								

Parameters of the "RS" command – current thermal state

The percentage value for capacity of the temperature range before emergency thermal shutdown (100% capacity) is transmitted using 8 characters, the first 6 characters in a bit mask are always 0 and the current thermal state is contained in ASCII characters 7 and 8.

Bits

3	2	1	0	3	2	1	0
1. ASCII characters				2. ASCII characters			
0				0			
3. ASCII characters				4. ASCII characters			
0				0			
5. ASCII characters				6. ASCII characters			
0				0			
7. ASCII characters				8. ASCII characters			
Thermal state							

15.4.12 SJ command – change to a different job

This function enables you to change to a different job.

To use this function, you must first activate the option Command SJ via process interface in the device settings.

Example

Structure of the command PLC ➡ device						
Command		Parameters				
S	J	0	0	1	A	
Switch **J**ob		4 byte ASCII hex desired job number				

Structure of the Response PLC ⬅ device										
Response										
R	S	0	0	8	5	0	0	1	A	
Response **S**tate		4 byte ASCII hex Status				4 byte ASCII hex Number of the active job				

NOTE

Further explanation of the parameters of the RS response can be found under "Request status (GS / RS)".

15.4.13 SM command – change operating mode

This command enables you to change the operating mode for the device as well as the parameters for data exchange.

Example

<table>
<tr><th colspan="5">Structure of the command PLC ➡ device</th></tr>
<tr><td colspan="2">Command</td><td colspan="3">Parameters</td></tr>
<tr><td>S</td><td>M</td><td>M</td><td>R</td><td></td></tr>
<tr><td colspan="2" rowspan="3">Switch
Mode</td><td colspan="3">2 byte ASCII hex

Mode

DC = Data transfer – Continuous Mode
The result data is autonomously transferred via the process interface after each analysis in Activated mode. You must also set the "Activate outputs" parameter during job testing.

DP = Data transfer – Polling Mode
In <u>Activated mode</u> and in <u>Configuration</u> <u>mode</u>, the result data is only transferred after the GD command has been received.

MR = Mode switch – Modus Run
The device is activated.
Data is only transferred autonomously if the Continuous mode is activated as described above.

MS = Mode switch – Modus Parametrieren
The device is switched to Configuration
No result data is transferred.</td></tr>
<tr><td colspan="3">For Ethernet only</td></tr>
<tr><td colspan="3">CC = Command delimiter – Carriage return
Data packets from the process interface are terminated using <code><CR></code>
(Hex: <code>0D</code>, Escape sequence: <code>\r</code>) complete

CL = Command delimiter – Line feed
Data packets from the process interface are terminated using <code><LF></code>
(Hex: <code>0A</code>, Escape sequence: <code>\n</code>) complete

CB = Command delimiter – Both carriage return + line feed
Data packets from the process interface are terminated using <code><CR><LF></code>

CN = Command delimiter – No sequence
Data packets from the process interface are not terminated using a sequence</td></tr>
</table>

Structure of the command PLC ➡ device						
Command		Parameters				
S	M	M	R			
Switch **M**ode		2 byte ASCII hex Mode				
		For RS485 only				
		Point-to-point protocol	Bus protocol			
		PP	PP	**P**rotocol mode – **P**oint-To-Point Changes the employed protocol to point-to-point protocol		
		PB	PB	**P**rotocol mode – **B**us without checksum Changes the used protocol to bus protocol without checksum		
		PC	PC	**P**rotocol mode – Bus with **C**hecksum Changes the used protocol to bus protocol with checksum		

Structure of the Response PLC ⬅ device										
Response										
R	S	0	0	8	5	0	0	1	A	
Response **S**tate		4 byte ASCII hex Status				4 byte ASCII hex Number of the active job				

NOTE

Further explanation of the parameters of the RS response can be found under "Request status (GS / RS)".

15.4.14 SP command – set parameters for the feature checks

With this function, you can adjust the expected values of the feature checks as well as adjust the parameters of the image settings such as exposure time, amplification, edge sharpness, trigger mode and trigger delay.

The expected values are set temporarily and remain valid until the device is restarted or switches to configuration mode.

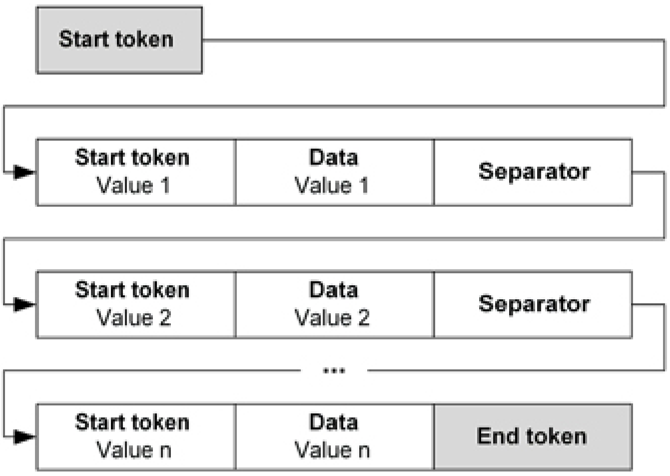
To save it long term, activate: *Device → Device settings→ Job selection / Teach → Save changed parameters from external Teach or process interface command XX to device…*

NOTE

You can set the content of the datagram for output via the process interface during job creation under *Configure interface → Output process interface*.

NOTE

When setting the exposure time for the job, the "Camera ready" signal must be active before the next image can be acquired.



Example

<table>
<tr><th colspan="20">Structure of the command PLC ➡ device</th></tr>
<tr><th colspan="2">Command</th><th colspan="18">Parameters</th></tr>
<tr><td>S</td><td>P</td><td>0</td><td>0</td><td>0</td><td>A</td><td colspan="14">1 7 . 0 3 . 2 0 2 5</td></tr>
<tr><td colspan="2" rowspan="3">Set
Parameter</td><td colspan="4">4 byte ASCII hex
Length of the result data</td><td colspan="14"><u>Example 1</u>

a date, or a combination of expected values for different feature checks</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>D</td><td>3</td><td>0</td><td>0</td><td>0</td><td>0</td><td>3</td><td>0</td><td>2</td><td>5</td><td>4</td><td>5</td><td>0</td><td>0</td><td></td></tr>
<tr><td colspan="4">4 byte ASCII hex
Length of the result data</td><td colspan="5">Exposure time (device dependent [µs])</td><td colspan="2">Reinforcement (0 - 100 [%])</td><td colspan="2">Sensitivity edge detection (5 - 100 [%])</td><td>Trigger mode (1 = continuous / 4 = external trigger)</td><td colspan="3">Trigger delay (e.g. 500 ms or set distance)</td><td></td></tr>
<tr><td colspan="2"></td><td colspan="4"></td><td colspan="14"><u>Example 2</u>

Parameters for image settings</td></tr>
</table>

Structure of the Response PLC ⬅ device										
Response										
R	P	0	0	0	0	0	0	0	0	
Response **P**arameter		4 byte ASCII hex Status 0000 = OK 0001 = defective data in data packet 0002 = device not in RUN mode 0003 = value range exceeded 0004 = no datagram defined in job other = internal fault				4 byte ASCII hex Error position				

Timing diagram for SP and TE commands

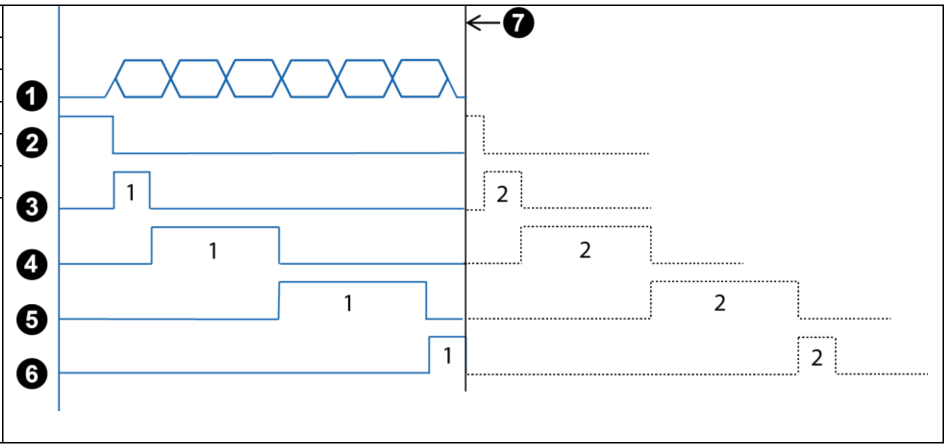
The SP and TE commands can be sent at any time and are buffered. The system simultaneously sets a flag to prevent further images from being acquired.

This means that all processes currently running are completed before a new one is triggered.

Example 1 (sequential processing)

All processes are completed up to result output 1. SP/TE then becomes effective.

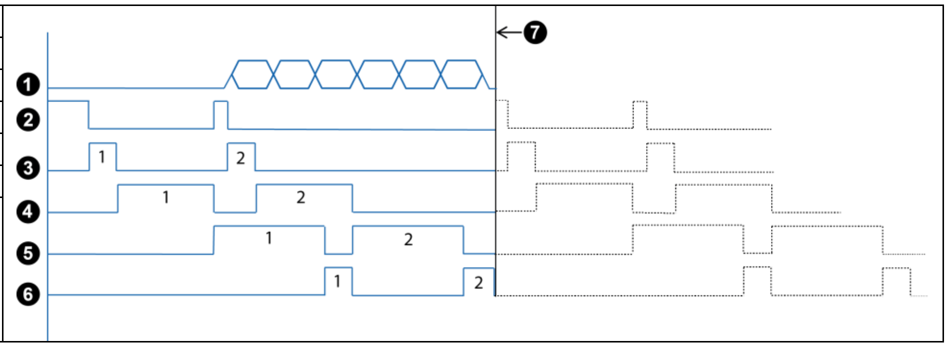
1	SP / TE command
2	Trigger permitted
3	Trigger
4	Image acquisition
5	Image processing
6	Result
7	Value stored < 1 ms



Example 2 (overlapped, clocked processing)

The command comes after the second trigger → all processes up to trigger 1 and trigger 2 are completed, SP/TE become effective after result 2.

1	SP / TE command
2	Trigger permitted
3	Trigger
4	Image acquisition
5	Image processing
6	Result
7	Value stored < 1 ms



15.4.15 TE command – use next image for external teach

This function enables you to use the next image for an external teach. However, image acquisition will not be triggered.

The function is set temporarily and remains valid until the device is restarted or switches to configuration mode.

To save it long term, activate: *Device → Device settings→ Job selection / Teach → Save changed parameters from external Teach or process interface command XX to device…*

Structure of the command PLC ➡ device		
Command		Parameters
T	E	
TEach Image		none

Structure of the Response PLC ⬅ device		
Response		
R	T	
Response **T**each		

Timing diagram for SP and TE commands

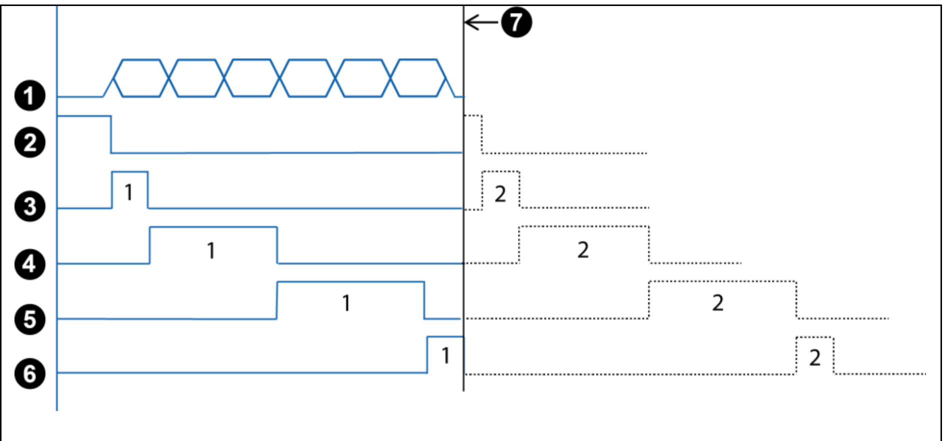
The SP and TE commands can be sent at any time and are buffered. The system simultaneously sets a flag to prevent further images from being acquired.

This means that all processes currently running are completed before a new one is triggered.

Example 1 (sequential processing)

All processes are completed up to result output 1. SP/TE then becomes effective.

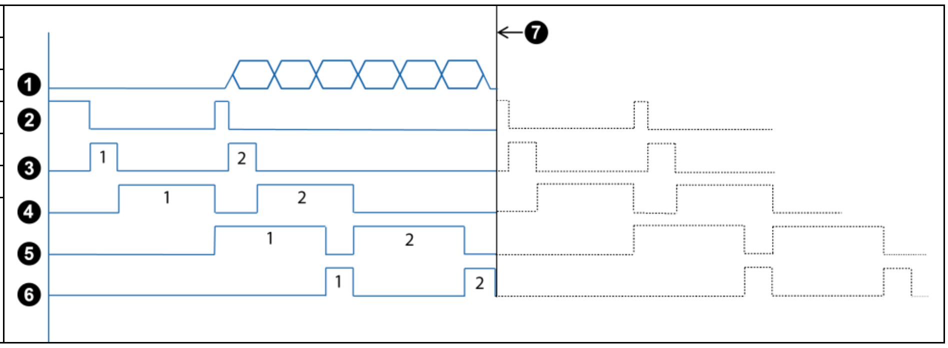
1	SP / TE command
2	Trigger permitted
3	Trigger
4	Image acquisition
5	Image processing
6	Result
7	Value stored < 1 ms



Example 2 (overlapped, clocked processing)

The command comes after the second trigger → all processes up to trigger 1 and trigger 2 are completed, SP/TE become effective after result 2.

1	SP / TE command
2	Trigger permitted
3	Trigger
4	Image acquisition
5	Image processing
6	Result
7	Value stored < 1 ms



15.4.16 TR command – request image acquisition and response datagram

This function enables you to immediately trigger image acquisition and request a response datagram if required (the trigger delay remains in effect). The response datagram will only be sent if the result is automatically sent following image evaluation and if the data is defined.

Example

Structure of the command PLC ➡ device		
Command		Parameters
T	R	
TRigger Image		none

Structure of the Response PLC ⬅ device							
Response							
R	D	0	0	0	E	…	
Response **D**ata		4 byte ASCII hex Length of the result data				Data	

NOTE

Further information on the composition of the datagram can be found using the command "Retrieve last result (GD / RD)".

15.4.17 TI command - trigger immediately

This function enables you to immediately trigger image acquisition and request a response datagram if required (any configured trigger delay is ignored). The response datagram will only be sent if the result is automatically sent following image evaluation and if the data is defined.

Example

Structure of the command PLC ➡ device		
Command		Parameters
T	I	
Trigger **I**mmediately		none

Structure of the Response PLC ⬅ device							
Response							
R	D	0	0	0	E	…	
Response **D**ata		4 byte ASCII hex Length of the result data				Data	

NOTE

Further information on the composition of the datagram can be found using the command "Retrieve last result (GD / RD)".

15.4.18 TD command – request image acquisition and transfer data

This function enables you to immediately acquire an image and response datagram. The response datagram will only be sent if the result is automatically sent following image evaluation and if the data is defined.

Unlike with command TR, this function can be used to transfer a string with the trigger, for example the part number of the current item being checked. The device allows you to use this string in the file name for the image when saving it to an FTP server. This is an easy way to establish a connection between images and objects.

Example

Structure of the command PLC ➡ device							
Command		Parameters					
T	D	0	0	0	0	…	
Trigger **D**ata		4 byte ASCII hex Length of the transferred string				Characters (0-255)	

Structure of the Response PLC ⬅ device							
Response							
R	D	0	0	0	0	…	
Response **D**ata		4 byte ASCII hex Length of the result data				Data	

A maximum of 156 characters is permitted in the data string (0-255).

15.4.19 UD command – transfer backup data (only for Ethernet)

This function enables you to transfer backup data to the device.

> **NOTE**
>
> The device must be restarted following use of the UD command and successful transfer of a backup, for example via the *VB0000* command.

Example

Structure of the command PLC ➡ device																		
Command		Parameters																
U	D	S	1	9	2	.	1	6	8	.	0	0	0	.	2	5	0	
Update **D**evice		IP address S = static D = DHCP	15 characters ASCII IP address															➔

Parameters																
2	5	5	.	2	5	5	.	2	5	5	.	0	0	0		
15 characters ASCII Subnet mask																➔

Parameters																
0	0	0	.	0	0	0	.	0	0	0	.	0	0	0		
15 characters ASCII Gateway																➔

Parameters																		
1	1	V	S	X	F	2	0	0	M	1	0	W	E	-	T	E	S	T
2-Byte ASCII Hex Length of device name		Device name																➔

Parameters								
0	0	B	6	B	B	4	6	…
8 byte ASCII hex Length of the following data								Data of the backup device

NOTE

If using DHCP, you can set what happens following a DHCP timeout as follows:

- Use DHCP and in case of DHCP failure, use the last IP address
  `UDD000.000.000.000000.000.000000.000.000...`

  or

  `UDD255.255.255.255000.000.000000.000.000...`

- Use DHCP, set an alternative IP address
  e.g. `UDD192.168.000.250255.255.255.000000.000.000.000...`
  (In this case, the alternative IP address is `192.168.0.250`)

The response datagram is only sent once the backup has been transferred and stored in full or an error occurs.

Structure of the Response PLC ⬅ device			
Response			
R	U	0	0
Response **U**pdate		2 byte ASCII hex 00 = received OK 01 = device not in Configuration mode 02 = invalid job number 03 = job could not be loaded 04 = job update still active 05 = invalid network settings 06 = invalid device name 07 = backup file device type not identical to the device 08 = user management is active 09 = device file is password protected 10 = file could not be opened for writing 11 = file write error 12 = incompatible backup 13 = only the firmware cannot be imported other = internal fault	

15.4.20 UJ command – transfer a new job

This function enables you to transfer a new job to the device.

> **NOTE**
>
> The job name including the file extension ".app" can be a maximum of 31 characters.

> **NOTE**
>
> Jobs cannot be renamed on the PC when using the UJ command for job transfers.

Example

Structure of the command PLC ➡ device														
Command		Parameters												
U	J	0	0	0	3	0	0	0	4	F	9	E	2	…
Update **J**ob		4 byte ASCII hex job number				8 byte ASCII hex Job size								Job as binary data

Structure of the Response PLC ⬅ device				
Response				
R	U	0	0	
Response **U**pdate	00 = received OK 01 = device not in Configuration mode 02 = invalid job number 03 = job could not be loaded 04 = job update still active 05 = invalid network settings 06 = invalid device name 07 = backup file device type not identical to the device 08 = user management is active 09 = device file is password protected 10 = file could not be opened for writing 11 = file write error 12 = incompatible backup 13 = only the firmware cannot be imported FA = Receipt timeout **NOTE** Timeout adjustable in the *Application Suite* under: *Device* → *Device settings* → *Process interface* other = internal fault			

15.4.21 VB command – restart device

This function enables you to restart the device or put it into recovery mode. This command does not send a response.

Example

Structure of the command PLC ➡ device							
Command		Parameters					
V	B	0	0	0	0		
Vision Sensor Re**B**oot		4 byte ASCII hex 0000 = Restart FFFF = Recovery mode					

15.5 Communication via Industrial Ethernet (device dependant)

It is possible to communicate with the Vision Sensor via various Industrial Ethernet protocols, such as PROFINET using a PLC.

15.5.1 Mode of operation

The data transfer protocol is determined by the Industrial Ethernet specification.

The following data can be transmitted:

- General control and status data (triggers, pass / fail, active job, etc.)
- Result data (configuration in the case of job creation via the *Output process interface*)
- Job parameters (configuration in the case of job creation via the *Input process interface*)
- Additional trigger data (data in addition to the trigger that can be transmitted for object identification)

The data will be combined into logical groups. Data transmission of each group can be secured with a handshake.

Mapping of the data in the PLC must be planned using the manufacturer-specific tool.

Selection of the protocol can be undertaken via the *Application Suite* as can the relevant settings. The setting options can be found under: *Device → Device settings → Process interface.*

15.5.2 Abbreviations for Industrial Ethernet

The following abbreviations are used in the next sections.

Abbreviation	Meaning
C	Controller (PLC)
D	Device (vision sensor)
HSS	Handshake simple
HSWA	Handshake with Acknowledge
HS	Handshake
ACT	Activation / Active
ACK	Acknowledge
pad	Padding
Img Proc	Image Processing
Res	Result
PIF	Process Interface
Buf OV	Buffer overflow
Pipe OV	Pipeline overflow
Inv	Invalid
TRG	Trigger
RDY	Ready
Res	Result
O	Originator
T	Target
SM	Switch Mode
SP	Set Parameter
SJ	Switch Job

15.5.3 Data

There is a difference between the transfer of cyclical and non-cyclical data.

15.5.3.1 Cyclical data

Cyclical data is data that is sent between the devices and the PLC at regular intervals. The cycle is defined via the PLC configuration.

Cyclical data is grouped into different modules. The consistency of the data can only be ensured within a module. If multiple modules in the PLC are interconnected (e.g. new trigger data for each trigger), this must be taken into account.

For example, you must ensure that the trigger in the *control and status* module is triggered after the new trigger data in the *trigger data* module. This can be achieved by setting the HS flag at the correct time.

If the cyclical data changes, the corresponding reactions are triggered. If the handshake is used, this only happens when the handshake flag changes. When the connection is first established, actions are triggered for some data even if this data does not change.

Element	Behaviour on initial receipt
Trigger	Is not analysed, is only stored to detect changes
Teach	Is analysed, 0 received → deactivate teach, 1 received → activate teach
Operating Mode	Is analysed, 0 received → Run mode is triggered, 1 received → Configuration mode is triggered
Current job number	Is analysed, 0 received → no change, all other values → switch to the given job
Reset Statistics	Is not analysed, is only stored to detect changes
Reset State SJ	Is not analysed, is only stored to detect changes
Reset State SP	Is not analysed, is only stored to detect changes
Reset State SM	Is not analysed, is only stored to detect changes
SetParam	"Immediately" used
TriggerData	"Immediately" used, data is scheduled for next image acquisition

Below there is a description of the individual data elements that could be exchanged in different compilations depending on the protocol used.

15.5.3.2 Group: Control and status

This group gives you access to Control (e.g. trigger, teach), Job number (switching between jobs), State (e.g. status of the job changeover) and Job result (results of the feature checks) and alarms.

<table>
<tr><th>Data element</th><th>Direction</th><th>Type</th><th>Length (byte)</th><th colspan="2">Description</th></tr>
<tr><td rowspan="5">Device controller</td><td rowspan="5">PLC → device</td><td rowspan="5">UINT8</td><td rowspan="5">1</td><td colspan="2">Control word</td></tr>
<tr><td>Bit 0</td><td>Trigger (switching from 0 -> 1 triggers image acquisition), corresponds with the "TR" process interface command</td></tr>
<tr><td>Bit 1</td><td>Teach (if 1 is triggered during image acquisition, Teach is carried out), corresponds with the "TE" process interface command</td></tr>
<tr><td>Bit 2</td><td>Operating mode (switching from 0 -> 1 switches to Configuration mode, switching from 1 -> 0 switches to run mode), corresponds with the "SM" process interface command</td></tr>
<tr><td>Bits 3..7</td><td>Reserved (always 0)</td></tr>
<tr><td>Job selection</td><td>PLC → device</td><td>UINT8</td><td>1</td><td colspan="2">Current job number (changing triggers job switching, job number eff. 0x01..0xFF, 0x00 -> does not trigger job switching ("Inactive"), corresponds with the "SJ" process interface command</td></tr>
<tr><td>Reset statistics</td><td>PLC → device</td><td>UINT8</td><td>1</td><td colspan="2">Reset statistics (changing triggers a statistics reset for the corresponding job number, eff. 0x01..0xFF, 0x00 -> does not trigger a statistics reset ("Inactive"), corresponds with the "CS" process interface command</td></tr>
<tr><td rowspan="7">Reset status (actions)</td><td rowspan="7">PLC → device</td><td rowspan="7">UINT8</td><td rowspan="7">1</td><td colspan="2">Resets the status for various actions</td></tr>
<tr><td>Bit 0</td><td>Reset job switching status (changing from 0 -> 1 triggers a reset if the status is not "in progress")</td></tr>
<tr><td>Bit 1</td><td>Reserved (always 0)</td></tr>
<tr><td>Bit 2</td><td>Reset SetParam status (changing from 0 -> 1 triggers a reset if the status is not "in progress")</td></tr>
<tr><td>Bit 3</td><td>Reserved (always 0)</td></tr>
<tr><td>Bit 4</td><td>Reset mode switching status (changing from 0 -> 1 triggers a reset if the status is not "in progress")</td></tr>
<tr><td>Bit 5..7</td><td>Reserved (always 0)</td></tr>
</table>

<table>
<tr><th>Data element</th><th>Direction</th><th>Type</th><th>Length (byte)</th><th colspan="2">Description</th></tr>
<tr><td rowspan="6">Device status</td><td rowspan="6">Device ➡ PLC</td><td rowspan="6">UINT8</td><td rowspan="6">1</td><td colspan="2">Status word, corresponds with the "GS" process interface command</td></tr>
<tr><td>Bit 0</td><td>TRG ready

0: Trigger not permitted,
1: Trigger permitted</td></tr>
<tr><td>Bit 1</td><td>Teach

0: Teach will not be carried out with the next image recorded
1: Teach will be carried out with the next image recorded</td></tr>
<tr><td>Bits 2..3</td><td>Mode

0: Run mode
1: Configuration mode
2: Test mode</td></tr>
<tr><td>Bit 4</td><td>ImgProcAct

0: Image acquisition/analysis not active
1: Image acquisition/analysis active</td></tr>
<tr><td>Bits 5..7:</td><td>Reserved (always 0)</td></tr>
<tr><td>Current job number</td><td>Device ➡ PLC</td><td>UINT8</td><td>1</td><td colspan="2">Current job number 1..255

0: if not in run mode or if job switching is active, corresponds with the "GS" process interface command</td></tr>
<tr><td>Thermal state</td><td>Device ➡ PLC</td><td>UINT8</td><td>1</td><td colspan="2">The device's current thermal state (capacity in percent), corresponds to the "GT" process interface command</td></tr>
<tr><td rowspan="5">Action status</td><td rowspan="5">Device ➡ PLC</td><td rowspan="5">UINT8</td><td rowspan="5">1</td><td colspan="2">Status for various actions, corresponds with the "GS" process interface command</td></tr>
<tr><td>Bits 0..1</td><td>Job switching status

0: idle (no request pending),
1: in progress
2: completed successfully
3: completed with errors</td></tr>
<tr><td>Bits 2..3</td><td>SetParam status

0: idle (no request pending)
1: in progress
2: completed successfully
3: completed with errors</td></tr>
<tr><td>Bits 4..5</td><td>SwitchMode status

0: idle (no request pending),
1: in progress
2: completed successfully
3: completed with errors</td></tr>
<tr><td>Bit 6..7</td><td>Reserved (always 0)</td></tr>
</table>

Data element	Direction	Type	Length (byte)	Description	
Job results	Device ➡ PLC	UINT32	4	1 bit "Pass" and 1 bit "Fail" for each total and partial result, if both bits=0 -> no result available	
				Bit 0	1 if the total result = "Pass", otherwise 0
				Bit 1	1 if the total result = "Fail", otherwise 0
				Bit 2	1 if a process alarm was produced during image analysis (details -> ProcessAlarm), otherwise 0
				Bits 3..15	Reserved (always 0)
				Bit 16	1 if partial result 1 = "Pass", otherwise 0
				Bit 17	1 if partial result 1 = "Fail", otherwise 0
				Bit 18	1 if partial result 2 = "Pass", otherwise 0
				Bit 19	1 if partial result 2 = "Fail", otherwise 0
				Bit 20	1 if partial result 3 = "Pass", otherwise 0
				Bit 21	1 if partial result 3 = "Fail", otherwise 0
				Bit 22	1 if partial result 4 = "Pass", otherwise 0
				Bit 23	1 if partial result 4 = "Fail", otherwise 0
				Bit 24	1 if partial result 5 = "Pass", otherwise 0
				Bit 25	1 if partial result 5 = "Fail", otherwise 0

Data element	Direction	Type	Length (byte)	Description	
Device alarms	Device ➡ PLC	UINT32	4	Process alarms in terms of device functionality: Each "total" and "alarm type" is 1 bit: "Alarm pending"	
				Bit 0	1 if any process alarm is pending, otherwise 0
				Bit 1	1 if the "invalid trigger" alarm is pending, otherwise 0
				Bit 2	1 if the "output time exceeded" alarm is pending, otherwise 0
				Bit 3	1 if the "job selection error" alarm is pending, otherwise 0
				Bit 4	1 if the "process interface error" alarm is pending, otherwise 0
				Bit 5	1 if the "FTP client was unable to send all data" alarm is pending, otherwise 0
				Bit 6	1 if the "buffer overflow" alarm is pending, otherwise 0
				Bit 7	1 if the "pipeline overflow" alarm is pending, otherwise 0
				Bit 8	1 if the "handshake error" alarm is pending, otherwise 0
				Bits 9..31	Reserved (always 0)

15.5.3.3 Group: Result data

This group is used to transfer the result data from job processing. The results datagram is configured during job creation in the *Application Suite* in the step *Configure interfaces → Output process interface*.

Versions are available with payload capacities of 4/8/16/32/64/128/250 bytes. You should choose the smallest possible version for the volume of data you expect to handle. An unnecessarily large selection reduces overall system performance.

The data corresponds to response to the "GD" command from the classic process interface.

Data element	Direction	Type	Length (byte)	Description
Actual length of the result data	Device ➡ PLC	UINT16	2	Length of data actually used in ResultData
Result data (<n> byte)	Device ➡ PLC	OCTET-STRING	4/8/16/32/64/128/250	Result data for job processing (data length corresponds with the selected module)

15.5.3.4 Group: Parameters

This group is used to transfer parameter data for the current job. It is configured during job creation in the Application Suite in the step *Configure interfaces → Input process interface*.

Depending on the protocol versions are available with payload capacities of 4/8/16/32/64/128/250 bytes. You should choose the smallest possible version for the volume of data you expect to handle. An unnecessarily large selection reduces overall system performance.

The data corresponds with the "SP" command in the classic process interface.

Data element	**Direction**	**Type**	**Length (byte)**	**Description**
Actual length of the parameters	PLC ➡ device	UINT16	2	Length of data actually used in ParamData
Parameter (<n> byte)	PLC ➡ device	OCTET-STRING	4/8/16/32/64/128/250	Parameter data for the current job

15.5.3.5 Group: Trigger data

This group is used to transfer the data that will be assigned to the next trigger. Versions are available with payload capacities of 4/8/16/32/64/128 bytes. You should choose the smallest possible version for the volume of data you expect to handle. An unnecessarily large selection reduces overall system performance.

It is used in the same way as the TD command in the process interface for FTP and in the results datagram, the only difference being that new trigger data does not automatically trigger image acquisition. Here, image acquisition must be triggered with an additional trigger.

If the data is not deleted (payload length → 0), the data is used for each new image acquisition thereafter.

Data element	Direction	Type	Length (byte)	Description
Actual length of the trigger data	PLC ➡ device	UINT8	1	Length of data actually used in TriggerData
Trigger data (<n> byte)	PLC ➡ device	OCTET-STRING	4/8/16/32/64/128	Data that is assigned to the next trigger

15.5.3.6 Handshake

The different processing speeds of the devices in the network mean that it is often necessary to synchronise the flow of data between the devices at application level, and therefore ensure that the data is communicated.

There are two different handshake procedures available for this: the *simple handshake* and the *handshake with acknowledgement*.

15.5.3.6.1 Simple handshake

Each time new data is sent, the sender inverts the handshake flag (flag bit). The receiver can then detect that new data is being sent, even if the content of the data is the same.

Example: The same result is produced for each job analysis (e.g. identical grey value or the same distance is detected). The handshake flag shows that a new image has been analysed and its (unchanged) results is being sent.

General process for the simple handshake for input data for the PLC (status, result data):

1. The PLC activates the simple handshake (outgoing handshake activation for input data bit 0).
2. The Vision Sensor confirms the activation of the handshake (ingoing handshake activation for input data bit 0).
3. When it sends new data, the Vision Sensor inverts the handshake flag (ingoing handshake flag for input data bit 4). If new data is ready to be sent, it is sent immediately with the handshake flag inverted once again.
4. The inverted handshake flag (ingoing handshake flag for input data bit 4) tells the PLC that new data has arrived and it begins to process it. The PLC does not need to confirm the receipt of the data, and this would be ignored by the Vision Sensor.

General process for the simple handshake for output data for the PLC (control, parameters, trigger data):

1. The PLC activates the handshake (outgoing handshake activation for output data bit 0).
2. The Vision Sensor confirms the activation of the handshake (ingoing handshake activation for output data bit 0).
3. When it sends new data, the PLC inverts the handshake flag (outgoing handshake flag for output data bit 4). If new data is ready to be sent, it is sent immediately with the handshake flag inverted once again.
4. The inverted handshake flag (outgoing handshake flag for output data bit 4) tells the PLC that new data has arrived and it begins to process it. The Vision Sensor does not need to confirm the receipt of the data, and this can be ignored by the PLC.

15.5.3.6.2 Handshake with acknowledgement

Each time new data is sent, the sender inverts the handshake flag (flag bit). The receiver sends the received handshake flag back to the sender. The sender can only send new data (with the handshake flag inverted once again) once it has received this acknowledgement. However, this mode reduces the amount of data that can be transferred simultaneously.

General process for the handshake with acknowledgement for input data for the PLC (status, result data):

1. The PLC activates the handshake (outgoing handshake activation for input data bit 1).
2. The Vision Sensor confirms the activation of the handshake (ingoing handshake activation for input data bit 1).
3. When it sends new data, the Vision Sensor inverts the handshake flag (ingoing handshake flag for input data bit 4) and waits for receipt of the acknowledgement (outgoing handshake act. flag for input data bit 4). If new data is ready to send, it remains in a pipeline.
4. The inverted handshake flag (ingoing handshake flag for input data bit 4) tells the PLC that new data has arrived and it begins to process it. It confirms receipt of the data by sending the received handshake flag back as an acknowledgement (outgoing handshake act. flag for input data bit 4).
5. The Vision Sensor detects the acknowledgement (outgoing handshake flag for input data bit 4) and therefore that the data has been received, and can now send new data and invert the handshake act. flag again.

General process for the handshake with acknowledgement for output data for the PLC (control, parameters, trigger data):

1. The PLC activates the handshake (outgoing handshake activation for output data bit 1).
2. The Vision Sensor confirms the activation of the handshake (ingoing handshake activation for output data bit 1).
3. When it sends new data, the PLC inverts the handshake flag (outgoing handshake flag for output data bit 4) and waits for receipt of the acknowledgement (ingoing handshake act. flag for output data bit 4). If new data is ready to be sent, there is the option to retain or discard the data as required.
4. The inverted handshake flag (outgoing handshake flag for output data bit 4) tells the Vision Sensor that new data has arrived and it begins to process it. It confirms receipt of the data by sending the received handshake flag back as an acknowledgement (ingoing handshake act. flag for output data bit 4).
5. The PLC detects the acknowledgement (ingoing handshake act. flag for output data bit 4) and therefore that the data has been received, and can now send new data and invert the handshake flag again.

15.5.3.6.3 Data elements for handshake

Data element	Direction	Type	Length (byte)	Description	
Handshake for Input data from the controller (Output: Activation and HS ACK)	PLC ➡ device	UINT8	1	Handshake for input data	
				Bit 0	1 if "simple" handshake should be activated, otherwise 0
				Bit 1	1 if handshake with acknowledgement should be activated, otherwise 0
				Bits 2..3	Reserved (always 0)
				Bit 4	Handshake act. flag - must always be set to the value of the most recent handshake flag received therefore acknowledges receipt for the device (if handshake with acknowledgement is activated)
				Bits 5..7	Reserved (always 0)
Handshake for Input data from the controller (Input: ACK for activation and HS control)	Device ➡ PLC	UINT8	1	Handshake for input data	
				Bit 0	1 if "simple" handshake was activated (ACK for activation), otherwise 0
				Bit 1	1 if handshake with acknowledgement was activated (ACK for activation), otherwise 0
				Bits 2..3	Reserved (always 0)
				Bit 4	Handshake flag - is inverted by the device simultaneously or after each new, valid piece of data is sent and signalises with the edge that this data can be transferred (if handshake is activated)
				Bits 5..7	Reserved (always 0)

<table>
<tr><th>Data element</th><th>Direction</th><th>Type</th><th>Length (byte)</th><th colspan="2">Description</th></tr>
<tr><td rowspan="6">Handshake for output data from the controller (Output: Activation and HS control)</td><td rowspan="6">PLC ➡ device</td><td rowspan="6">UINT8</td><td rowspan="6">1</td><td colspan="2">Handshake for output data</td></tr>
<tr><td>Bit 0</td><td>1 if "simple" handshake should be activated, otherwise 0</td></tr>
<tr><td>Bit 1</td><td>1 if handshake with acknowledgement should be activated, otherwise 0</td></tr>
<tr><td>Bits 2..3</td><td>Reserved (always 0)</td></tr>
<tr><td>Bit 4</td><td>Handshake flag is inverted by the device simultaneously or after each new, valid piece of data is sent and signalises with the edge that this data can be transferred (if handshake is activated)</td></tr>
<tr><td>Bits 5..7</td><td>Reserved (always 0)</td></tr>
<tr><td rowspan="6">Handshake for output data from the controller (Input: ACK for activation and HS ACK)</td><td rowspan="6">Device ➡ PLC</td><td rowspan="6">UINT8</td><td rowspan="6">1</td><td colspan="2">Handshake for output data</td></tr>
<tr><td>Bit 0</td><td>1 if "simple" handshake was activated (ACK for activation), otherwise 0</td></tr>
<tr><td>Bit 1</td><td>1 if handshake with acknowledgement was activated (ACK for activation), otherwise 0</td></tr>
<tr><td>Bits 2..3</td><td>Reserved (always 0)</td></tr>
<tr><td>Bit 4</td><td>Handshake flag ACK - must always be set to the value of the most recent handshake flag received therefore acknowledges receipt for the controller (if handshake with acknowledgement is activated)</td></tr>
<tr><td>Bits 5..7</td><td>Reserved (always 0)</td></tr>
</table>

15.5.4 PROFINET

15.5.4.1 LEDs on the Vision Sensor

LED	Meaning
LINK / ACT	Indicates that the Vision Sensor is connected to a network. • On: Network connection established • Blinking: Data traffic active
NET RUN	Indicates that data is being transferred via Profinet. • Off: Profinet will not be used • Long blinking: Waiting for first cyclical connection • On: Cyclical connection active • Short blinking: Cyclical connection ended (waiting for next connection) • 3 seconds of regular blinking: Device identification in the system

15.5.4.2 Cabling

Follow the general rules for cabling Industrial Ethernet.

Use a shielded cable for data transfer. The maximum cable length is 100m. Make sure during cable assembly that the cable shield is properly connected with the connector housing.

15.5.4.3 Connection to the PLC

The following section describes how to connect a Vision Sensor to a PLC. Connection of a *Siemens CPU 1516-3 PN/DP* with *TIA Portal v14 SP1* software is used as an example.

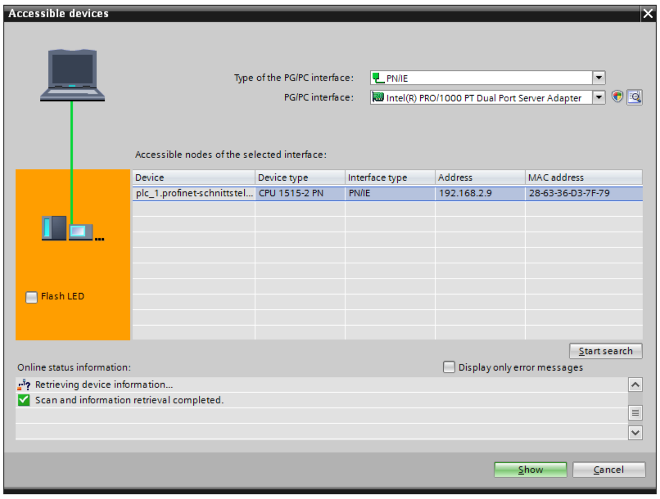
15.5.4.3.1 Determining a permanent IP address and name for the Vision Sensor

The Vision Sensor no longer visible in the PROFINET device list once it is connected to the PLC, since data transmission via PROFINET is disabled in the Vision Sensor's factory settings.

This section explains how PROFINET is enabled, a persistent IP address is assigned and a device name is determined for the Vision Sensor.

1. After connecting the Vision Sensor to the PLC, the *Accessible devices* dialogue contained in the Siemens PLC software package can be used to monitor whether the connected Vision Sensor is visible.

It is not, since the factory settings mean that PROFINET is disabled in the Vision Sensor.



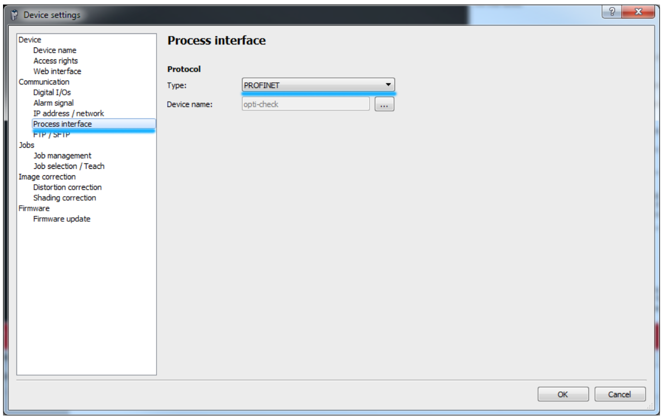
2. Open the *Application Suite*.

3. Connect to the desired Vision Sensor.

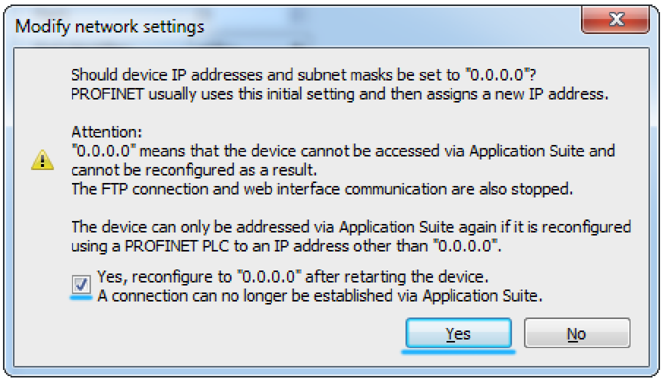
4. Switch to *Configuration* operating mode.

5. Open the *Device settings → process interface.*

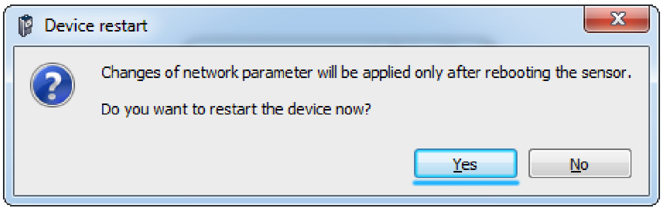
6. Select the PROFINET protocol.



7. Reset the network settings to the initial state.



8. Restart the Vision Sensor.



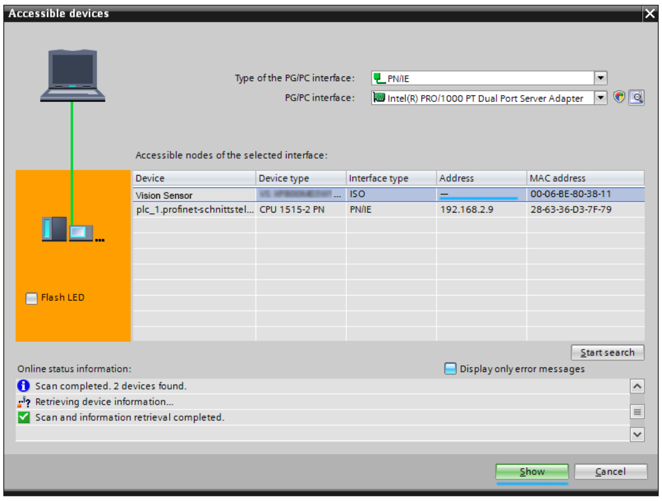
NOTE

It is not essential to reset the network settings to the initial state. A normal PROFINET device does not have any IP address (0.0.0.0) in the factory settings and the IP address is (permanently or temporarily) assigned by the PLC.

The *Application Suite* → *Device settings* or the Siemens PLC software package can always be used to configure the PROFINET network and device name settings.

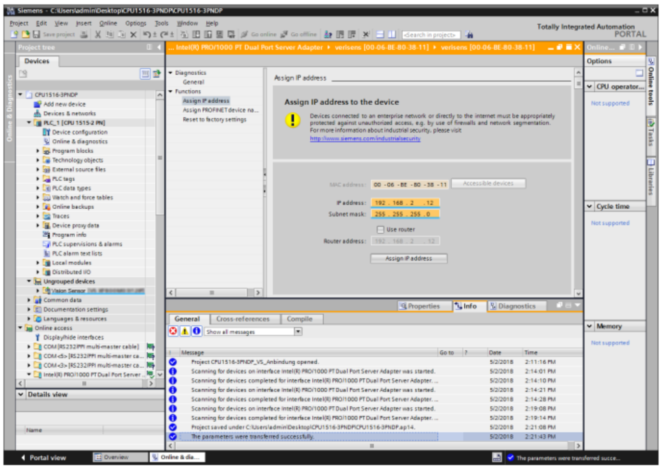
9. The *Accessible device* dialogue can now be used to find the Vision Sensor without an IP address.

Although it is still necessary to assign a permanent IP address and a device name.



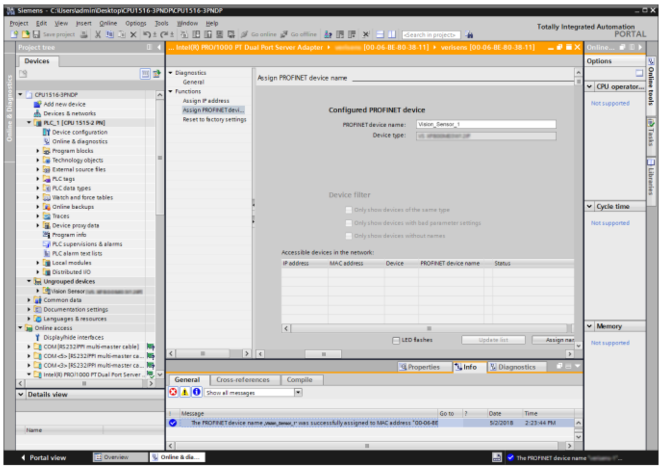
10. You have to open *Non-grouped devices* and use the TIA project to click on the Vision Sensor and *Online & Diagnostics* to assign a permanent IP address and a device name for the Vision Sensor.

Determine the *IP address* and *subnet mask* for the Vision Sensor.

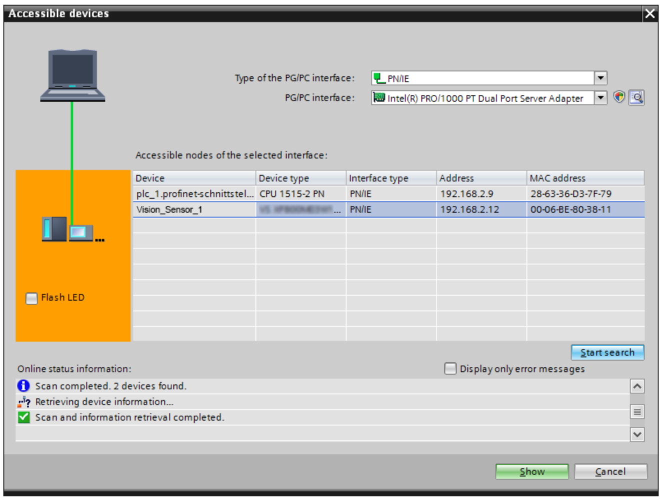


11. Click *Assign PROFINET device name* and assign a chosen name for the Vision Sensor.

The data will be saved in the Vision Sensor's flash memory and the Vision Sensor will immediately be reconfigured.



12. The *Accessible devices* dialogue will now show the Vision Sensor with its new IP address and device name.



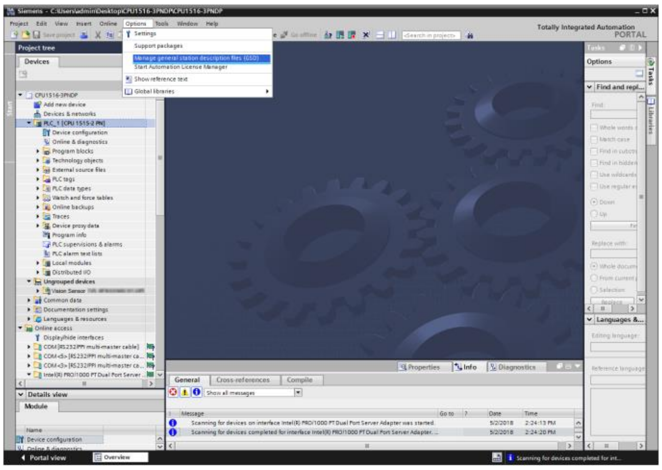
15.5.4.3.2 Installation of the GSD file

Integrating the Vision Sensor into the PLC project requires installation of a product-specific driver (GSD file).

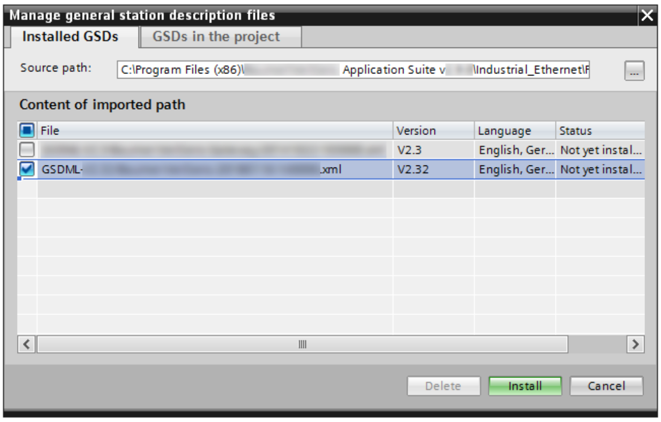
Data organisation in PROFINET is module-based. The product-specific driver describes which modules are being offered.

Follow the next instructions to install the driver.

1. Open the Siemens GSD file manager.



2. Select the device description file to be installed.



Storage location of the device description file after installation of the *Application Suite*

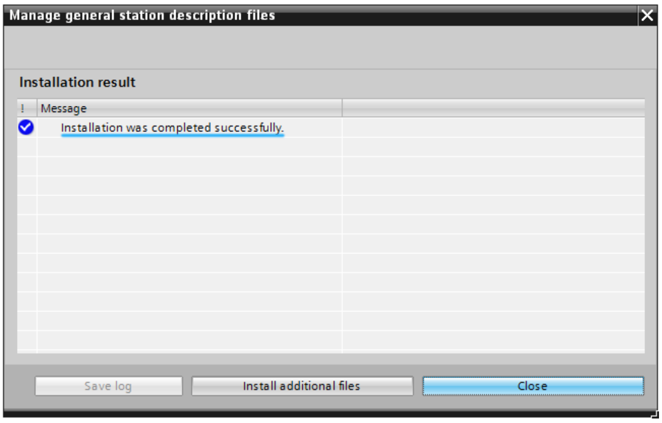
`<Installation path>\Industrial_Ethernet\PROFINET`

Device description file

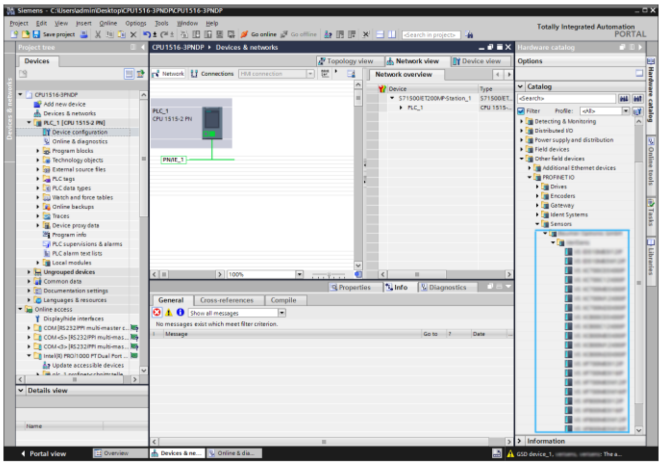
`GSDML-V2.32-ipf-opti-check-20190725-100000.xml`

Download the device description file under: : www.ipf-electronic.de (Products / camera sensors / Type / Downloads)

3. The device description file has now been installed.



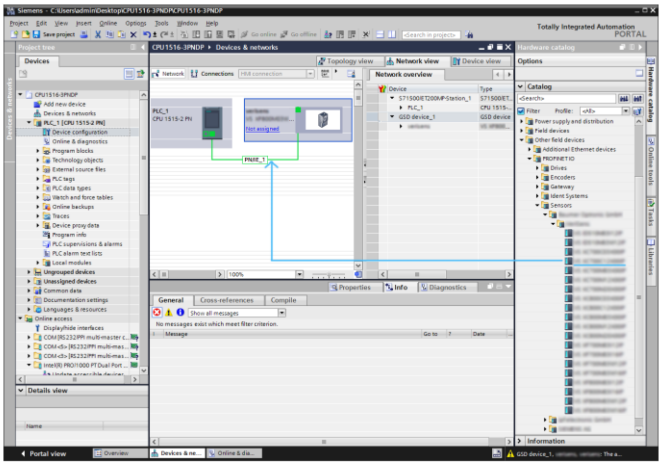
4. All of the Vision Sensors will be available in the catalogue after a brief waiting period (the hardware catalogue is being updated).



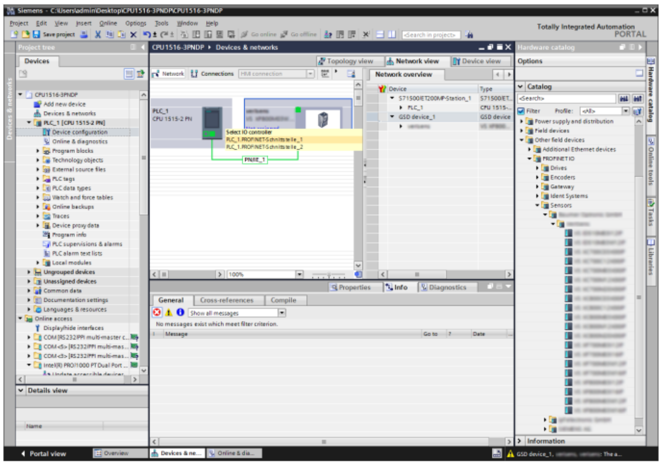
15.5.4.3.3 Integration of the device into the PLC project

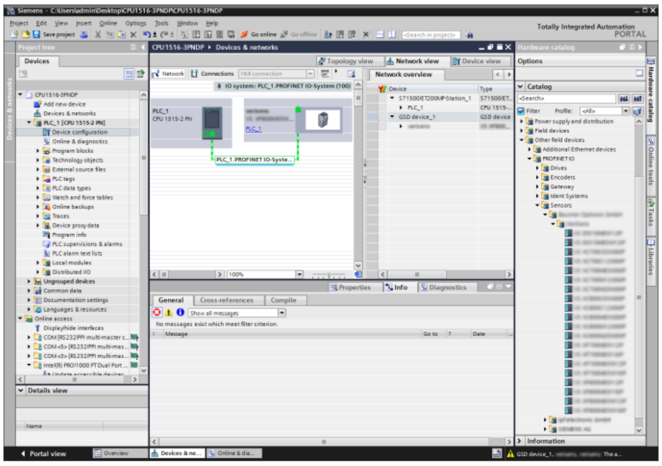
Follow the next instructions to integrate the Vision Sensor into the PLC project.

1. Use drag & drop to move the Vision Sensor onto the PROFINET subsystem.

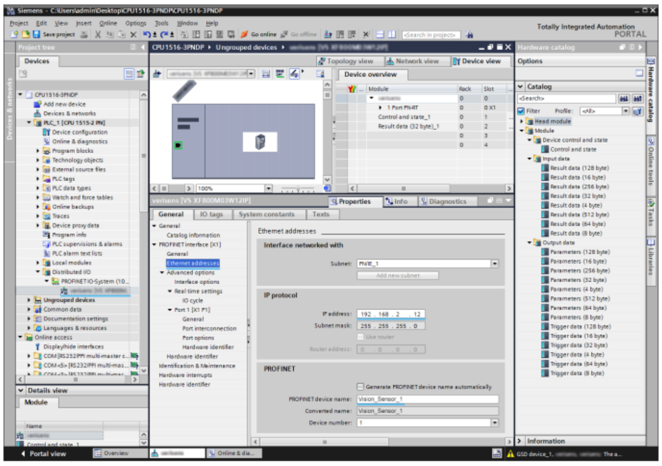


2. Assign the Vision Sensor to the correct PROFINET network group.





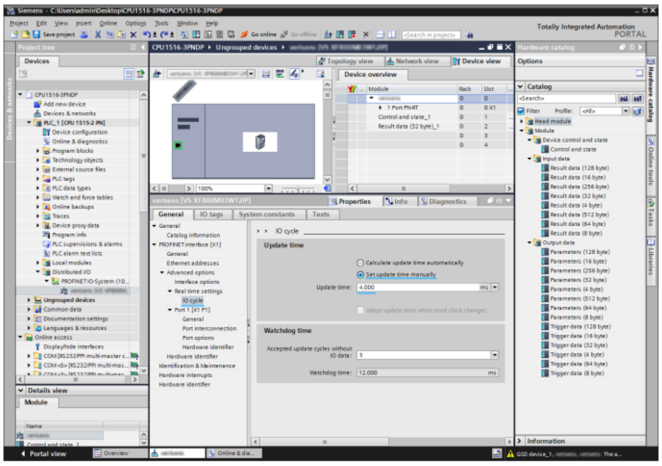
3. Access the properties and enter the correct name for the Vision Sensor and its stipulated IP address.



4. Configure the PROFINET cycle time (4 ms is advisable) in which data is to be transmitted.

The shortest period supported by Vision Sensor is 2 ms. Although a period of 4 ms is recommended.

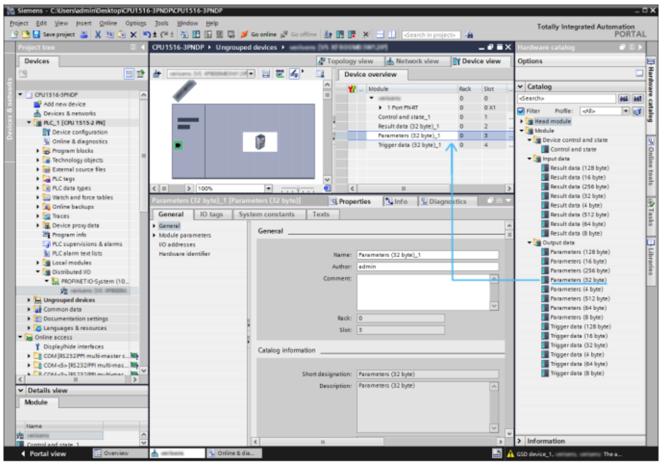
A shorter period could result in alarms on the PLC.



Shorter periods reduce the computing power available for feature checking in the Vision Sensor and thus analysis performance. Longer periods increase the delay during analysis of received data and when transmitting result data and thus reduce response performance.

The period you choose will therefore be a compromise between these factors.

5. Configure the data structure to be transmitted.

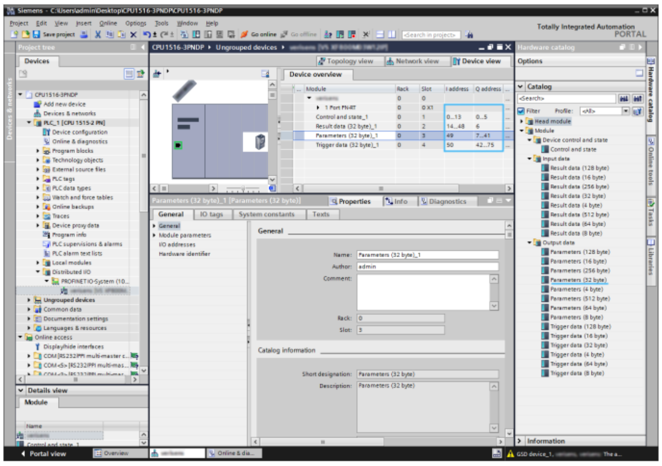


You can connect up to four modules. These modules must be plugged into certain, predefined slots:

Slots	Module
1	Control and status
2	Result data (selection of the user data size)
3	Parameters (selection of the user data size)
4	Trigger data (selection of the user data size)

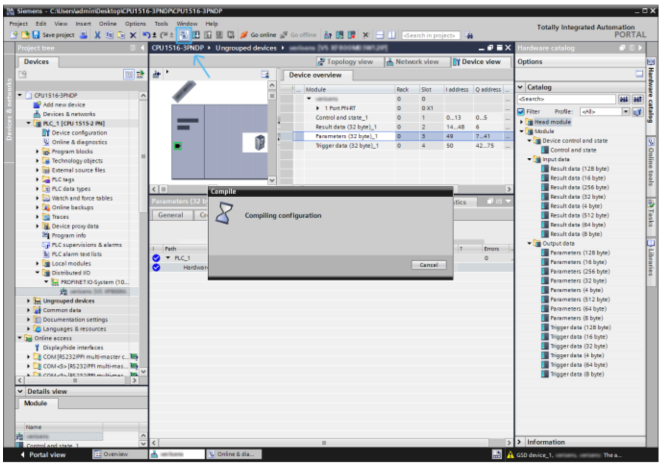
You can leave out individual modules. For example, only the *control* and *status* module and the result data module may be connected.

6. Configure the correct data input / output address range in the PLC process map.



→ The Vision Sensor has now been installed.

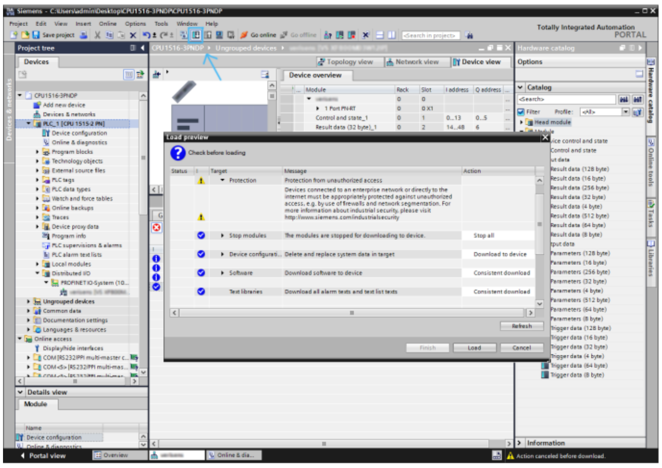
7. The project has to be compiled to test data transmission.

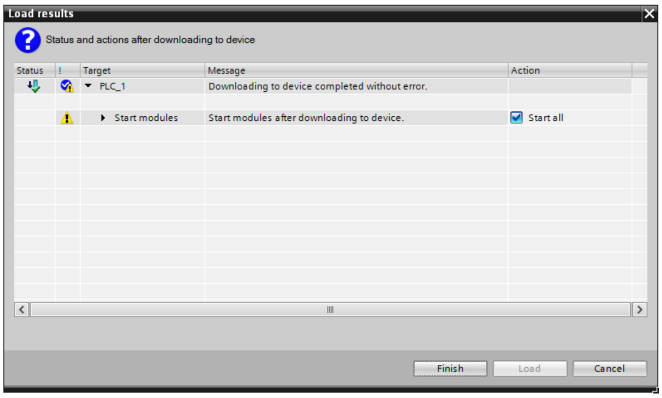


Click on the corresponding icon to do this.

8. Load the complete project into the PLC.

Switch the PLC to run mode.

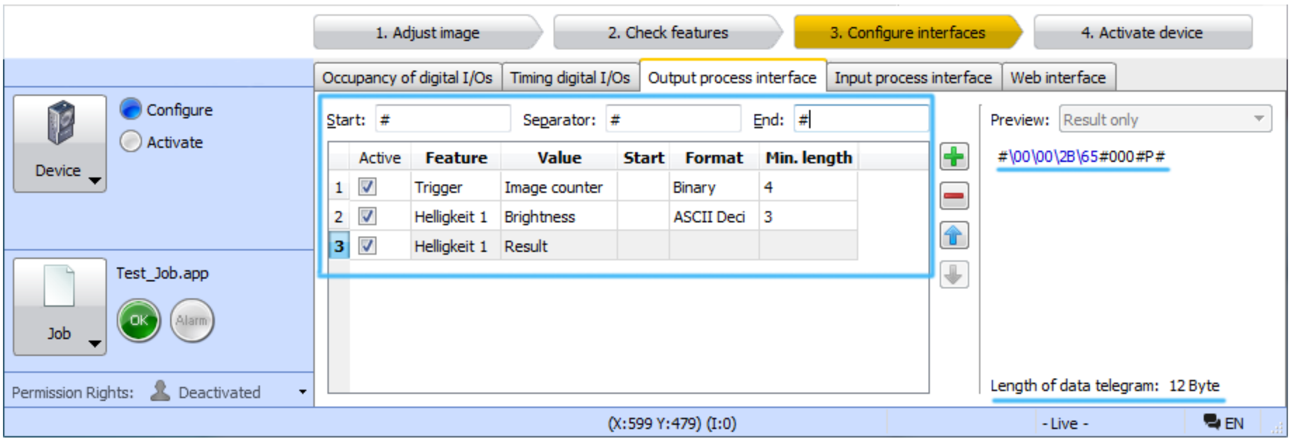




15.5.4.3.4 Configuring the Application Suite

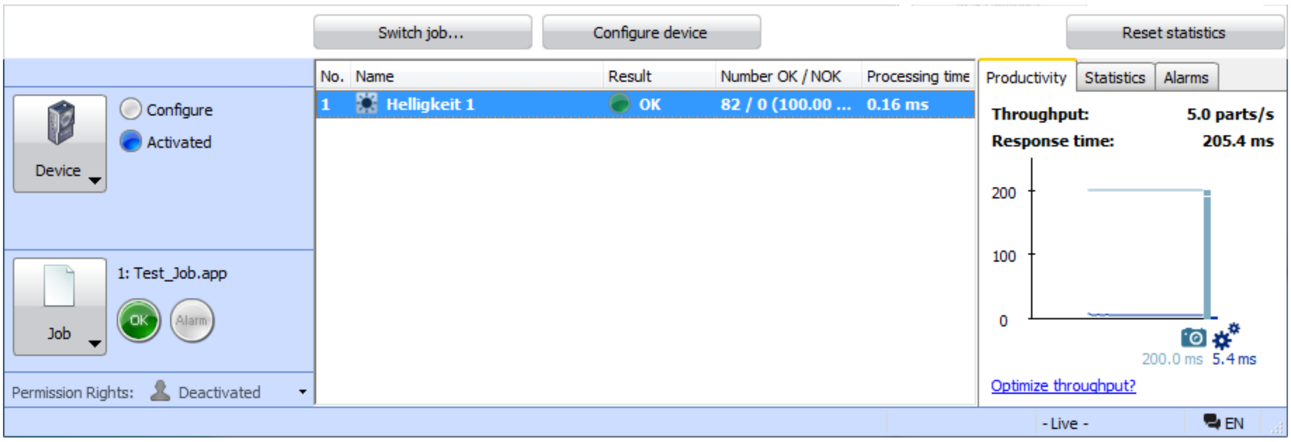
1. Open the *Application Suite* and create a new job with any chosen feature check.

Configure the process interface message that is to be transmitted to the PLC.

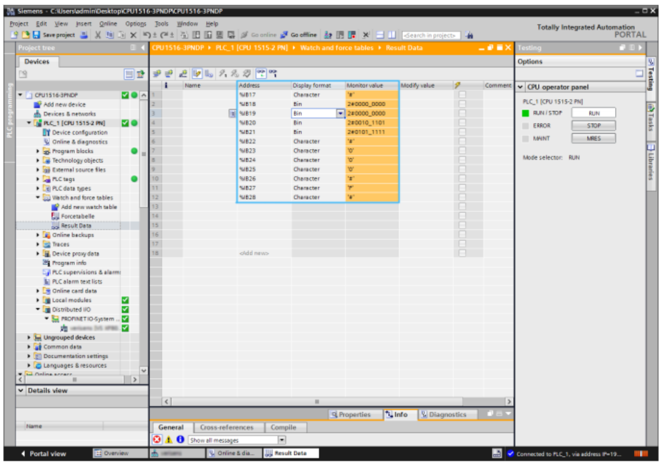


2. Save the job on the Vision Sensor.

Activate the Vision Sensor.



3. The process interface message will be sent to the PLC and the sent data can be monitored via *Watch table*.



15.5.4.4 Vision Sensor alarm

A PROFINET diagnosis alarm is triggered by the Vision Sensor for certain errors. An error code (a 32 bit value) is then transmitted. It is possible for multiple alarms to be triggered simultaneously.

The alarms are reset once the source of the error has been rectified.

Error code	Error description
Bit 0	Data buffer overrun: The amount of data produced by the Vision Sensor (e.g. result data) is larger than can be received by the module intended.
Bit 1	Pipeline overflow: The internal buffer for data output is full, the data was sent too slowly via PROFINET (or not at all).
Bit 2	Handshake error: The handshake mechanism was not used correctly, e.g. acknowledgement without a corresponding request being sent.
Bit 3	0 no thermal warning 1 thermal warning
Bit 4	0 no thermal shutdown 1 thermal shutdown Shutdown of the device has occurred.

15.5.4.5 Depiction of the data elements on the PROFINET module

The following tables provide a brief overview of the arrangement of data elements in the individual modules.

15.5.4.5.1 Module: Control and status

Input data (device ➡ PLC)

Byte	Data element	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Handshake for output data	pad (0)			C -> D HS ACK	pad (0)		C -> D HSWA ACT ACK	C -> D HSS ACT ACK
1	Handshake for input data	pad (0)			D -> C HS Flag	pad (0)		D -> C HSWA ACT ACK	D -> C HSS ACT ACK
2	Device status	pad (0)			Img Proc ACT	Operating Mode		Teach ACT	TRG RDY
3	Current job number	Active job number							
4	Thermal state	Thermal state							
5	Action status	pad (0)		Status SM		Status SP		Status SJ	
6	Job results	pad (0)						Sub Res 5 Fail	Sub Res 5 Pass
7		Sub Res 4 Fail	Sub Res 4 Pass	Sub Res 3 Fail	Sub Res 3 Pass	Sub Res 2 Fail	Sub Res 2 Pass	Sub Res 1 Fail	Sub Res 1 Pass
8		pad (0)							
9		pad (0)					Alarm	Total Res Fail	Total Res Pass
10	Device alarms	pad (0)							
11		pad (0)							
12									Alarm PIF HS Err
13		Alarm PIF Pipe OV	Alarm PIF Buf OV	Alarm FTP	Alarm PIF	Alarm Inv Job	Alarm Output Timeout	Alarm Inv TRG	Alarm (Any)

Output data (PLC ➡ device)

Byte	Data element	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Handshake for output data	pad (0)			C -> D HS Flag	pad (0)		C -> D HSWA ACT	C -> D HSS ACT
1	Handshake for input data	pad (0)			D -> C HS ACK	pad (0)		D -> C HSWA ACT	D -> C HSS ACT
2	Device controller	pad (0)					Operating mode	Teach	TRG
3	Job selection	Select job number							
4	Reset statistics	Reset statistics							
5	Reset status (actions)	pad (0)			Reset State SM	pad (0)	Reset State SP	pad (0)	Reset State SJ

15.5.4.5.2 Module: Result data

Input data (device ➡ PLC)

Byte	Data element	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Handshake for input data	pad (0)			D -> C HS Flag	pad (0)		D -> C HSWA ACT ACK	D -> C HSS ACT ACK
1 … 2	Actual Length Result data	Act Res Data Len							
3 …	Result data	Result data (4/8/16/32/64/128/250 byte)							

Output data (PLC ➡ device)

Byte	Data element	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Handshake for input data	pad (0)			D -> C HS ACK	pad (0)		D -> C HSWA ACT	D -> C HSS ACT

15.5.4.5.3 Module: Parameters

Input data (device ➡ PLC)

Byte	Data element	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Handshake for output data	pad (0)			C -> D HS ACK	pad (0)		C -> D HSWA ACT ACK	C -> D HSS ACT ACK

Output data (PLC ➡ device)

Byte	Data element	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Handshake for output data	pad (0)			C -> D HS Flag	pad (0)		C -> D HSWA ACT	C -> D HSS ACT
1 … 2	Actual length of the Parameters	Act Parameters Len							
3 …	Parameters	Parameters (4/8/16/32/64/128/250 byte)							

15.5.4.5.4 Module: Trigger data

Input data (device ➡ PLC)

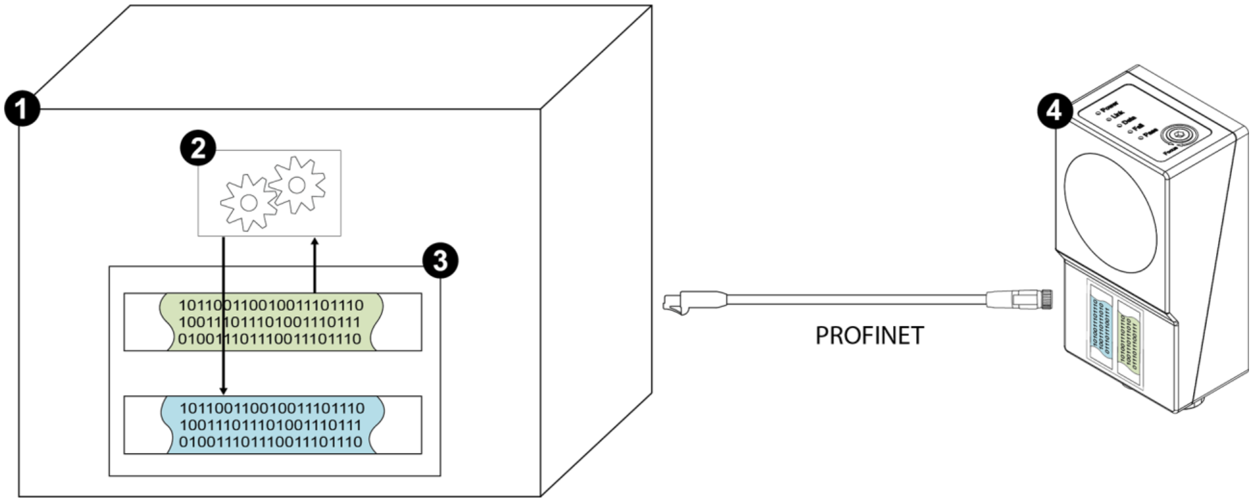
Byte	Data element	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Handshake for output data	pad (0)			C -> D HS ACK	pad (0)		C -> D HSWA ACT ACK	C -> D HSS ACT ACK

Output data (PLC ➡ device)

Byte	Data element	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Handshake for output data	pad (0)			C -> D HS Flag	pad (0)		C -> D HSWA ACT	C -> D HSS ACT
1	Actual length of the trigger data	Act Trigger Data Len							
2 …	Trigger data	Trigger data (4/8/16/32/64/128 byte)							

15.5.4.5.5 Example

The following examples provide a depiction of the mapping of data elements in memory for two module configurations.



<table>
<tr><th>Number</th><th>Description</th></tr>
<tr><td>1</td><td>PLC</td></tr>
<tr><td>2</td><td>PLC programme</td></tr>
<tr><td>3</td><td>PLC process map

<u>Example 1</u>
Simple configuration – use of the "Control and status" and "Result data (32 bytes)" modules with selected start address 1000 / 500 (start addresses subject to overall configuration).

Vision Sensor input data device ➡ PLC
<table>
<tr><th>Control and status</th><th>Result data</th></tr>
<tr><td>Start address: 1000 … Start address + 13</td><td>Start address + 14 … Start address + 48</td></tr>
</table>
Vision Sensor output data PLC ➡ device
<table>
<tr><th>Control and status</th><th>Result data</th></tr>
<tr><td>Start address: 500 … Start address + 5</td><td>Start address + 6</td></tr>
</table>

<u>Example 2</u>
Extensive configuration – use of the "Control and status", "Result data (250 byte)", "Parameters (128 byte)" and "Trigger data (64 byte)" modules with selected start address 200 / 100 (start addresses subject to overall configuration).

Vision Sensor input data PLC ➡ device
<table>
<tr><th>Control and status</th><th>Result data</th><th>Parameters</th><th>Trigger data</th></tr>
<tr><td>Start address: 200 … Start address + 13</td><td>Start address + 14 … Start address + 252</td><td>Start address + 253</td><td>Start address + 254</td></tr>
</table>
Vision Sensor output data device ➡ PLC
<table>
<tr><th>Control and status</th><th>Result data</th><th>Parameters</th><th>Trigger data</th></tr>
<tr><td>Start address: 100 … Start address + 5</td><td>Start address + 6</td><td>Start address + 7 … Start address + 137</td><td>Start address + 138 … Start address + 203</td></tr>
</table>
</td></tr>
<tr><td>4</td><td>Device</td></tr>
</table>

16 Cleaning

Due to its compact design, the device is characterized by almost maintenance-free operation.

When used for the intended purpose, it is possible that the device may need to be cleaned from time to time. Very clean optical surfaces (cover glass) are required for the consistent and reproducible operation of the device.

For cleaning, use a soft, lint-free cloth to clean the surface of the cover glass with a gentle pressure, without scratching.

To clean stubborn dirt, commonly available window cleaning agent is recommended.

ATTENTION!

Ensure that no residues of the cleaning agent or scratches remain on the glass. These can permanently damage the reproducibility of the results from the device.

ATTENTION!

As so many cleaning agents are available, we hope you understand that we cannot test every single one. Resistance to cleaning agents and areas of use depends upon the specific application.

Cleaning agents must be tested on an discreet area of the device under application conditions to evaluate if they are suitable.

17 Excess temperature behaviour (only devices with integral Industrial Ethernet)

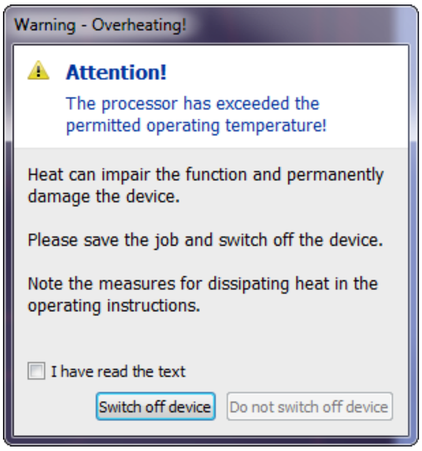
An internal protection device intervenes when the device is operated outside of specification; this is intended to protect the components against destruction by heat.

The *Application Suite*, the web-interface and the process interfaces will output an overheating warning message. This notifies the user that the maximum permissible operating temperature has been reached prior to the device undergoing emergency shutdown.

Warning message

Subject to temperature situation, work can be briefly continued at this warning level; to save the project, for example.

Confirm the query to do this.

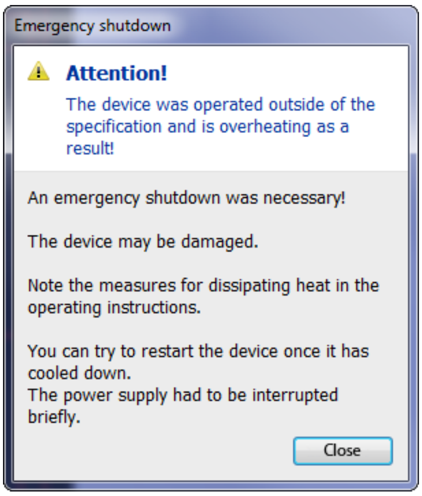


Emergency shutdown

Should the housing temperature continue to rise, the device will undergo emergency shutdown to protect it from damage.

After cooling, the supply voltage must be briefly interrupted and restored to be able to use the device again after shutdown.

A further warning message will provide information about the previous emergency shutdown of the device.



18 Technical data

18.1 Overview of feature checks

Feature checks	OC539X2X	OC53972X	OC539F2X	OC539G2X	OC53X42X OC53XD2X	OC53X52X OC53XE2X	OC53X12X	OC53X320 OC539C24	OC53922X
Part location									
Part location on contours	360°	360°	360°	360°	360°	360°	360°		
Part location on edges	•	•	•	•	•	•			
Part location on circle	•	•	•	•	•	•			
Part location on text lines	•	•	•	•	•	•		•	
Geometry									
Distance	•	•	•	•	•	•	•		
Circle	•	•	•	•	•	•	•		
Angle	•	•	•	•	•	•			
Count edges	•	•	•	•	•	•			
Point position	•	•	•	•	•	•			
Edge characteristics	•|-	•|-	•|•	•|•	•|•	•			
Feature comparison									
Count contour points (monochrome) | (colour)	•|•	•|•	•|•	•|•	•|•	•	•		
Contour comparison (monochrome) | (colour)	•|•	•|•	•|•	•|•	•|•	•	•	•	
Brightness	•|-	•|-	•|•	•|•	•|•	•	•		
Contrast	•|-	•|-	•|•	•|•	•|•	•			
Colour identification	-|•	-|•	-|•	-|•	-|•				
Area size (monochrome) | (colour)	•|•	•|•	•|•	•|•	•|•	•			
Count areas (monochrome) | (colour)	•|•	•|•	•|•	•|•	•|•	•			
Pattern comparison (monochrome) | (colour)	•|•	•|•	•|•	•|•	•|•	•			
Colour positioning	-|•	-|•	-|•	-|•	-|•				
Finding object positions			•|-	•|-					
Identification									
Barcode (monochrome) | (colour)		•|•		•|•		•		•	•
Matrix code (monochrome) | (colour)		•|•		•|•		•		•	•
Text (monochrome) | (colour)		•|•		•|•		•		•	

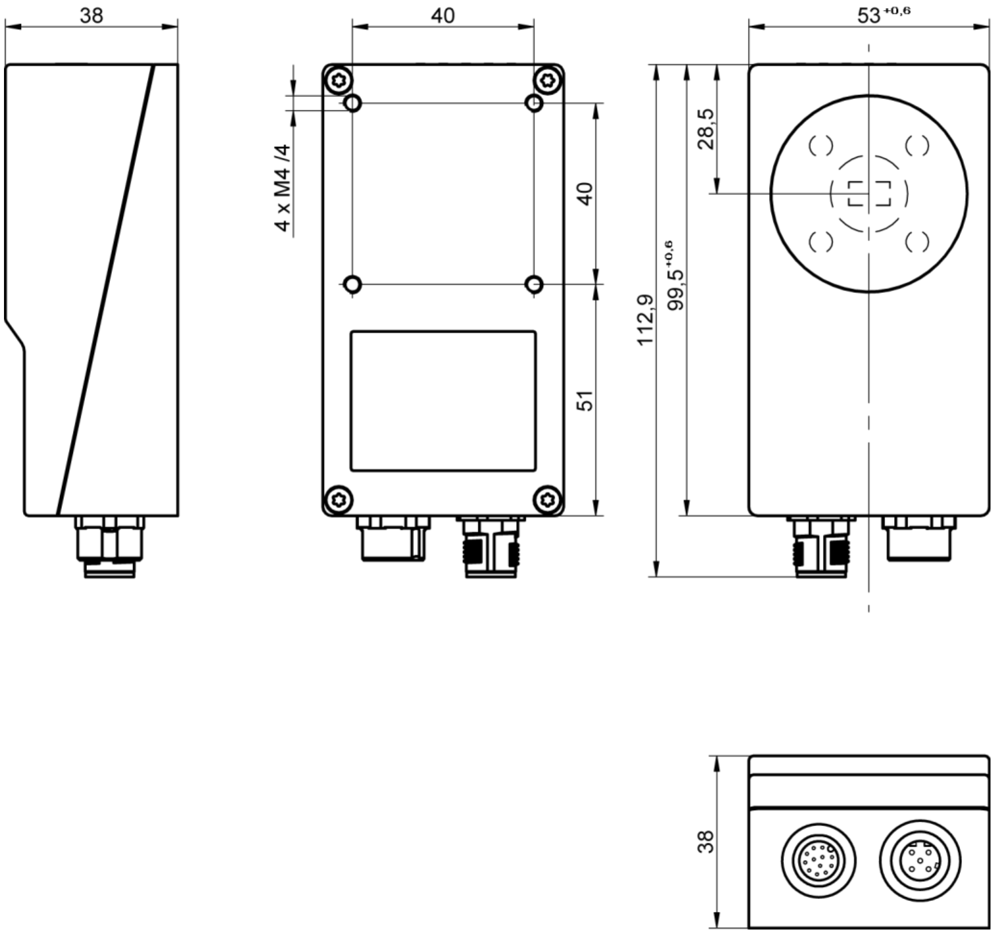
18.2 Overview Features

<table>
<tr><th></th><th>OC539X2X
OC539F2X</th><th>OC53972X
OC539G2X</th><th>OC53X42X
OC53XD2X</th><th>OC53X52X
OC53XE2
X</th><th>OC53X12X</th><th>OC53X320
OC539C24</th><th>OC53922X</th></tr>
<tr><td colspan="8">Image acquisition</td></tr>
<tr><td>Optics: 8 mm | 10 mm | 12 mm | 16 mm | C-mount</td><td>-|-|-|-|●</td><td>-|-|-|-|●</td><td>-|●|●|●|-</td><td>●[1]|●|●|●|-</td><td>-|●|-|●|-</td><td>-|-|●|-|-</td><td>-|●|-|●|-</td></tr>
<tr><td>Illumination: White | Infra-red (daylight filter integrated) | Integrated flash controller for external illumination</td><td>-|-|●</td><td>-|-|●</td><td>●|●|-</td><td>●|●|-</td><td>●|●|-</td><td>●|●|-</td><td>●|-|-</td></tr>
<tr><td>Configurable web interface (live image, job switching, retrieving defect images)</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td></tr>
<tr><td>Save images via FTP</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td></tr>
<tr><td>Configuration via Ethernet</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td></tr>
<tr><td colspan="8">Functions</td></tr>
<tr><td>Process linkage: Digital I/Os</td><td>5 | 3-5</td><td>5 | 3-5</td><td>5 | 3-5</td><td>5 | 3-5</td><td>5 | 5</td><td>5 | 3-5</td><td>5 | 3</td></tr>
<tr><td>Produce partial results via digital I/Os at different times</td><td>●</td><td>●</td><td>●</td><td>●</td><td></td><td></td><td></td></tr>
<tr><td>Process interface: Ethernet | RS485 (device dependent)</td><td>●|-</td><td>●|-</td><td>●|-</td><td>●|-</td><td>-|-</td><td>●|-</td><td>●|●</td></tr>
<tr><td>Conloc Image processor</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td></tr>
<tr><td>360° PosFix (360° part location)</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td></td><td></td></tr>
<tr><td>User administration / Password protection</td><td>●</td><td>●</td><td>●</td><td>●</td><td></td><td>●</td><td>●</td></tr>
<tr><td>Coordinate conversion</td><td>●</td><td>●</td><td>●</td><td>●</td><td></td><td></td><td></td></tr>
<tr><td>Distortion correction (monochrome only)</td><td>●[2]</td><td>●[2]</td><td>●[2]</td><td>●[2]</td><td></td><td></td><td></td></tr>
<tr><td colspan="8">Process linkage</td></tr>
<tr><td>Flexible result conjunction</td><td>●</td><td>●</td><td>●</td><td>●</td><td></td><td></td><td></td></tr>
<tr><td>Integrate digital inputs into results conjunction</td><td>●</td><td>●</td><td>●</td><td>●</td><td></td><td></td><td></td></tr>
<tr><td>Identification functions: Code | Text</td><td>-|-</td><td>●|●</td><td>-|-</td><td>●|●</td><td>-|-</td><td>●|●</td><td>●|-</td></tr>
<tr><td>Job test function</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td></tr>
<tr><td>High speed mode (monochrome only)</td><td>●</td><td>●</td><td>●</td><td>●</td><td></td><td></td><td></td></tr>
<tr><td>Gamma correction</td><td>●</td><td>●</td><td>●</td><td>●</td><td></td><td></td><td></td></tr>
</table>

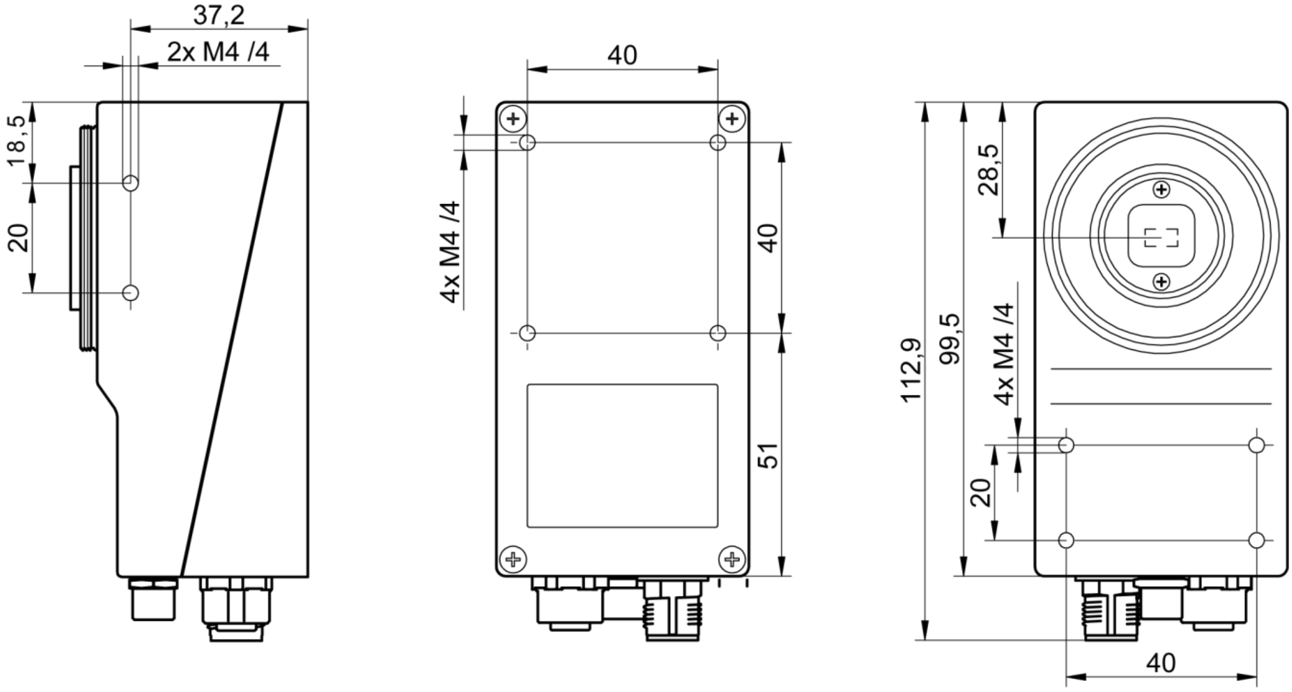
1) only OC53XE2X

2) only OC539F2X / OC539G2X or OC53XD2X / OC53XE2X

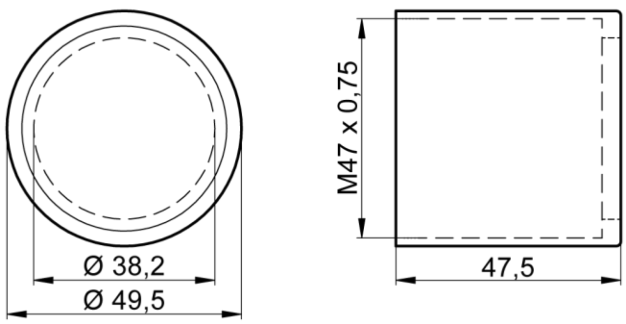
18.3 Technical drawing (except OC539x2x / OC53972x / OC539x2x / OC539G2x)

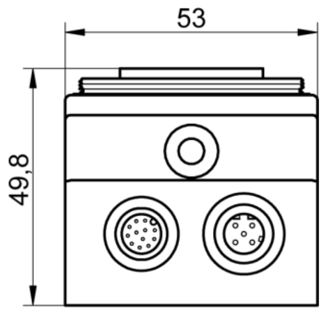


18.4 Technical drawing (OC539x2x / OC53972x / OC539x2x / OC539G2x only)

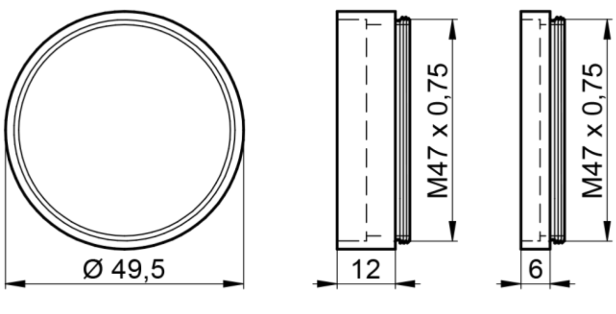


Tube





Tube Modul

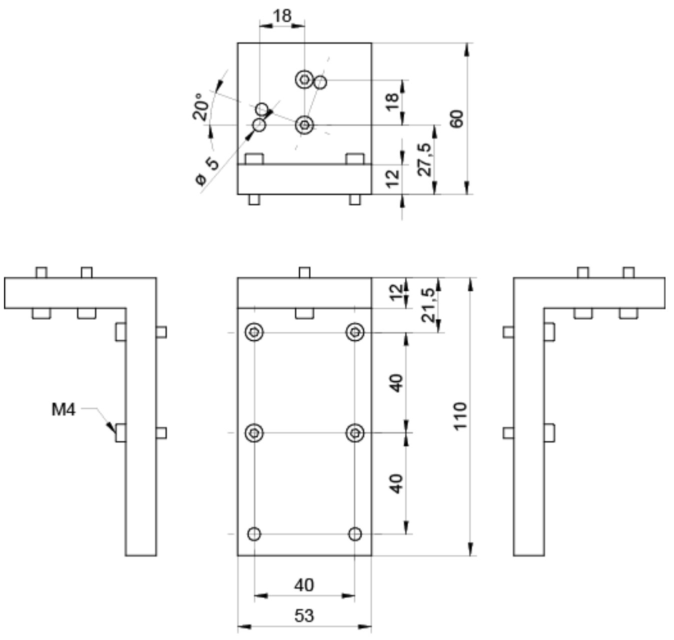


18.5 Fastening bracket, 90 degree (mounting adapter)

NOTE

For optimum heat dissipation use only this attachment bracket for Vision Sensors OC539C24 and OC53XD2X / OC53XE2X / OC539F2X / OC539G2X!

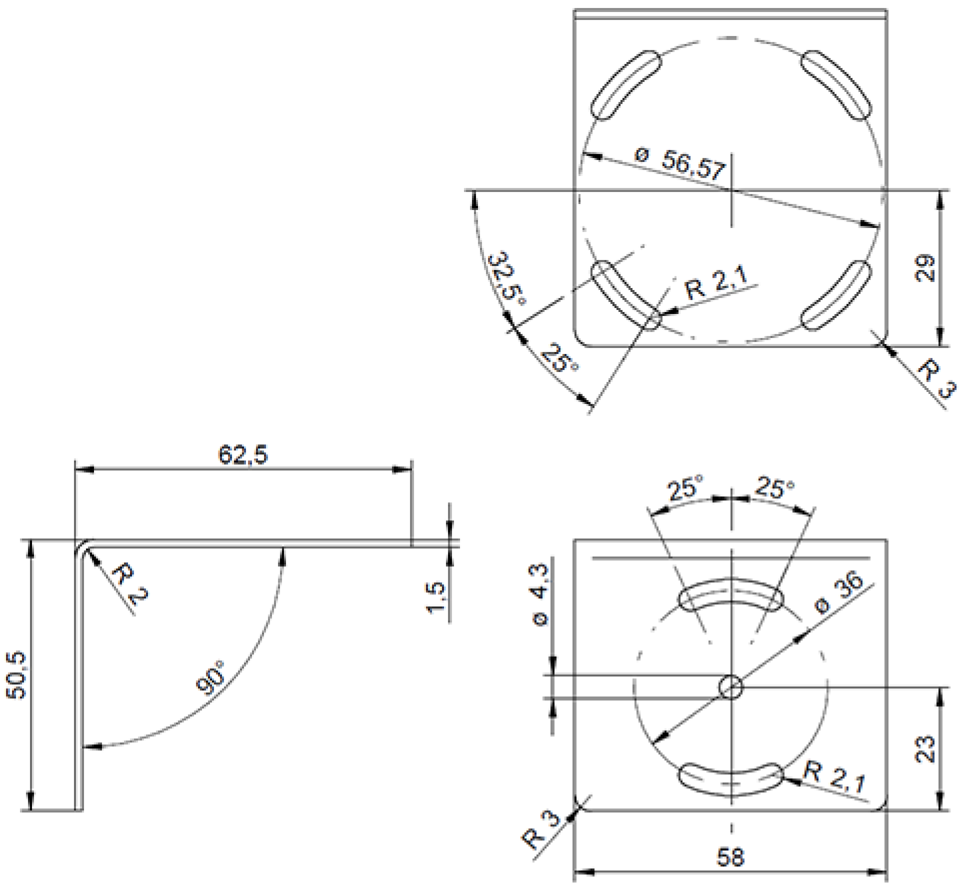
- Colour: black
- Material:anodized aluminium



18.6 Fastening bracket, 90 degree

> **NOTE**
>
> This attachment bracket is not suitable for Vision sensors OC539C24 and OC53XD2X / OC53XE2X / OC539F2X / OC539G2X due to its low thermal conductivity.

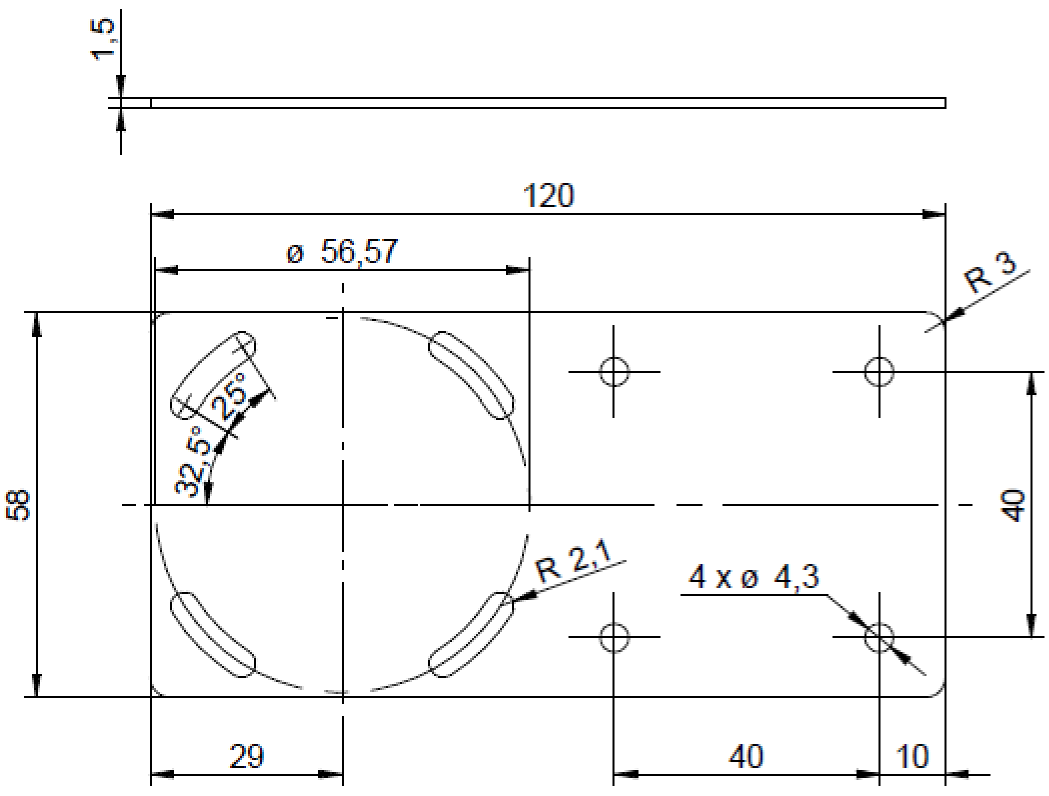
- Colour: Black
- Material: powder coated steel



18.7 Fastening bracket, straight

> **NOTE**
>
> This attachment bracket is not suitable for Vision sensors OC539C24 and OC53XD2X / OC53XE2X / OC539F2X / OC539G2X due to its low thermal conductivity.

- Colour: Black
- Material: powder coated steel



18.8 Technical data

General data	**OC539x2x / OC53972x / OC539x2x / OC539G2x**			**OC53x42x / OC53x52x / OC53xD2x / OC53xE2x | OC53x12x | OC53922x / OC53x320 / OC539C24**			
Resolution	640 × 480 px	1280 × 960 px	1600 × 1200 px	752 × 480 px			
Sensor (monochrome)	1/4" CCD (monochrome, colour)	1/3" CCD (monochrome, colour)	1/1.8" CCD (monochrome)	1/3" CMOS (monochrome, colour)			
LED illumination	Fully integrated flash controller for external illumination			White (LED class: Risk group 1 low risk, EN 62471:2008) Infra-red (LED class: free group risk free, EN 62471:2008) (860 nm)			
Lens	Replacement lens (C-mount)			f = 8 mm	f = 10 mm	f = 12 mm	f = 16 mm
Min. object distance	Depending on changeable lens			50 mm	50 mm	50 mm	70 mm / 100 mm[1)]
Max. object distance	Depending on changeable lens			450 mm	∞	450 mm	300 mm
Speed Full resolution Reduced, max. speed (reduced resolution, monochrome)	Max. Insp / s 50 | 116[1]) 100 | 144[1])	Max. Insp / s 12 | 31[1]) 25 | 54[1])	Max. Insp / s 7 | 21[1]) 15 | 35[1])	Max. Insp / s 50 100 (monochrome, only OC53x42x / OC53x52x / OC53xD2x / OC53xE2x) Reduced, max. brightness, (monochrome, OC53x42x / OC53x52x / OC53xD2x / OC53xE2x only)			
Defect image memory	32	8	4	32			
Number of jobs	Up to 255 on the device (can be exchanged via process interface)						
Features per job	32						

Electrical data		**OC539x2x / OC53972x / OC539x2x / OC539G2x**	**OC53x42x / OC53x52x / OC53xD2x / OC53xE2x | OC53x12x | OC53922x / OC53x320 / OC539C24**
Nominal voltage power supply	Socket 2	⎓ 24 V ± 25% / Class 2 according to NEC / protection class III The device is intended for supply from an isolated limited power source according to UL6101010-1, 3rd ed cl. 9.4 or a limited energy source according to UL60950-1 or Class 2 according to NEC.	
Power consumption	Socket 2	max. 42 W (with I/O and lighting)	max. 18 W (with I/O)
Inputs	Socket 2	8 ... 30 V (polarity protected)	
Outputs	Socket 2	PNP I_{peak} = 100 mA and I_{eff} = 50 mA (short-circuit proof)	
Digital input	Socket 2	Trigger, Job selection, External teach, Encoders (CH-A, CH-B) 500 kHz	
Digital output	Socket 2	Pass / Fail 1-5 [2]), flash sync, alarm, image trigger permitted, result valid	
Communication initial set-up Process interface	Socket 1	Ethernet (10BASE-T / 100BASE-TX) PROFINET (CC-A) [1]) / Ethernet/IP™ [1]), TCP / UDP (Ethernet) [3])	
	Socket 2	RS485 [4])	

[1]) only OC539F2X / OC539G2X and OC539C24
[2]) OC53922X: 1-3
[3]) except OC53X12X
[4]) only OC53922X

Integr. Flash controller		**OC539x2x / OC53972x / OC539x2x / OC539G2x**	**OC53x42x / OC53x52x / OC53xD2x / OC53xE2x | OC53x12x | OC53922x / OC53x320 / OC539C24**
Voltage (permanent) Voltage (pulsed)	Socket 3	⎓ 12 VDC or ⎓ 24 VDC ⎍ 24 VDC or ⎍ 48 VDC	–
Current (permanent) Current (pulsed)	Socket 3	I_{max} = 800 mA at ⎓ 24 VDC (+/-10 %, at least +/- 100 mA, at 25 °C) I_{max} = 4 A at ⎍ 48 VDC (+10/-20 %, at least +/- 100 mA, at 25 °C)	–
Flash time	Socket 3	Max. 1 ms (Duty Cycle max. 1:10)	–

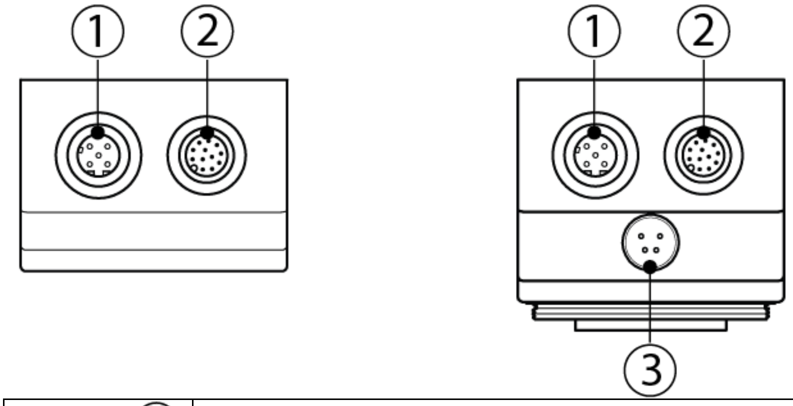
Operating conditions	**OC539x2x / OC53972x / OC539x2x / OC539G2x**	**OC53x42x / OC53x52x / OC53xD2x / OC53xE2x | OC53x12x | OC53922x / OC53x320 / OC539C24**
Operating temperature	Operating temperature: +5 … +55 °C @ measuring point	Operating temperature: +5 … +60 °C @ measuring point
Storage temperature	-20 … +70 °C	
Humidity	0 … 90 % (non-condensing)	
Protection class	IP 67 (OC539x2x / OC53972x / OC539x2x / OC539G2x: with tube)	IP 67
Vibration load	IEC 60068-2-6, IEC 60068-2-64	
Mech. shock resistance	EN 60068-2-27	

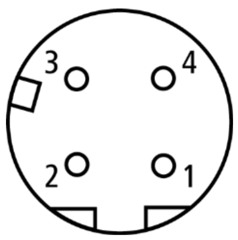
Mechanical data	**OC539x2x / OC53972x / OC539x2x / OC539G2x**	**OC53x42x / OC53x52x / OC53xD2x / OC53xE2x (OC53x42x / OC53x52x / OC53xD2x / OC53xE2x | OC53x12x | OC53922x / OC53x320 / OC539C24**
Width × Height × Depth	53 mm × 99.5 mm × 49.8 mm (without lens / tube)	53 mm × 99,5 mm × 38 mm
Material	Housing: Aluminium, cover glass tube: PMMA	Housing: Aluminium Cover glass: PMMA [5])
Weight	300 g (without lens / tube)	250 g (IP69K 700 g)

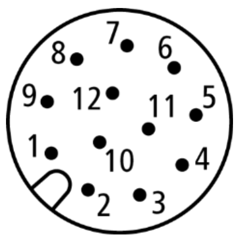
Code types / OCR	**Model: OC539G2X / OC53972X**	**Models: OC53X52X / OC53XE2X / OC53X320 | OC53922X**
Barcode [6)]	2/5 Industrial, 2/5 Interleaved, Codabar, Code 39, Code 93, Code 128, PharmaCode EAN 8, EAN 13, UPC-A, UPC-E: Base code + versions Add-On 2, Add-On 5 GS1 DataBar (RSS): Limited, Expanded, Expanded Stacked GS1 DataBar (RSS-14): Base code + versions Truncated, Stacked, Stacked Omnidir GS1 128	
Matrix code [6])	DataMatrix (ECC 200), GS1-DataMatrix, QR, PDF417	
Font [7)]	Optional fonts (recommended: sans serif, proportional), dot matrix, characters: A-Z a-z 0-9 + -. : / ( )	

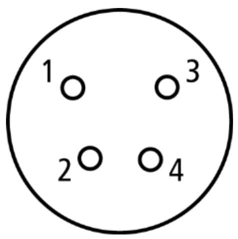
[5)] for OC53XD2X / OC53X42X / OC53XE2X / OC53X12X / OC53X320 / OC539C24 with infra-red illumination: 780 nm daylight filter built-in
[6]) incl. quality rating of all barcodes according to ISO / IEC 15416 as well as all matrix codes according to ISO / IEC 15415 or AIM DPM-1-2006
[7)] only OC539G2X / OC53972X / OC53XE2X / OC53X320 / OC539C24

18.9 Electrical Connection (View on Device)

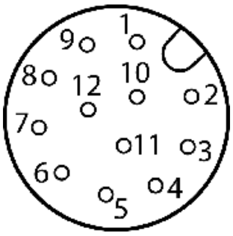


Socket (1)	Ethernet interface (M12), D-coded	
	**Pin**	**Pin Assignment**
	1	TD+
	2	RD+
	3	TD-
	4	RD-

Socket (2)	Power supply / Digital I/O (M12), A-coded	
	**Pin**	**Pin Assignment**
	1	Power (⎓ 24 V ± 25 %)
	2	Ground
	3	IN1 (Trigger)
	4	OUT 1 (PTC-protected)
	5	IN 2
	6	OUT 2 (PTC-protected)
	7	OUT 3 (PTC-protected)
	8	IN 3
	9	OUT 4 / (RS 485+, OC53922X only) (PTC-protected)
	10	IN 4
	11	IN 5
	12	OUT 5 / (RS 485-, OC53922X only) (PTC-protected)

Socket (3)	Illumination port (M8), (OC539x2x / OC53972x / OC539x2x / OC539G2x only)	
	**Pin**	**Pin Assignment**
	1	⎓ +24V or ⎍ +48V Flash
	2	⎓ +12V or ⎍ +24V Flash
	3	Ground
	4	Flash Sync [1]), (100 mA PNP)
	[1]) voltage according to power supply Voltage outputs configurable by software	

18.10 Power Cable M12 / 12-pin

<table>
<tr><th colspan="4">Pin assignment of the connecting cable (M12)</th></tr>
<tr><td rowspan="13">
</td><th>Pin</th><th>Designation</th><th>Colour code</th></tr>
<tr><td>1</td><td>Power (⎓24 V ± 25 %)</td><td>brown</td></tr>
<tr><td>2</td><td>Ground</td><td>blue</td></tr>
<tr><td>3</td><td>IN1 (Trigger)</td><td>white</td></tr>
<tr><td>4</td><td>OUT 1 (PTC-protected)</td><td>green</td></tr>
<tr><td>5</td><td>IN 2</td><td>pink</td></tr>
<tr><td>6</td><td>OUT 2 (PTC-protected)</td><td>yellow</td></tr>
<tr><td>7</td><td>OUT 3 (PTC-protected)</td><td>black</td></tr>
<tr><td>8</td><td>IN 3</td><td>grey</td></tr>
<tr><td>9</td><td>OUT 4 / RS 485+ (PTC-protected)</td><td>red</td></tr>
<tr><td>10</td><td>IN 4</td><td>violet</td></tr>
<tr><td>11</td><td>IN 5</td><td>grey-pink</td></tr>
<tr><td>12</td><td>OUT 5 / RS 485- (PTC-protected)</td><td>red blue</td></tr>
</table>

19 Conformity

19.1 CE

We declare under our sole responsibility that the devices described previously comply with the specifications of the CE guidelines.

19.2 RoHS (restriction of hazardous substances)

RoHS COMPLIANT

We declare under our sole responsibility that the devices described previously comply with the European Union RoHS recommendations.