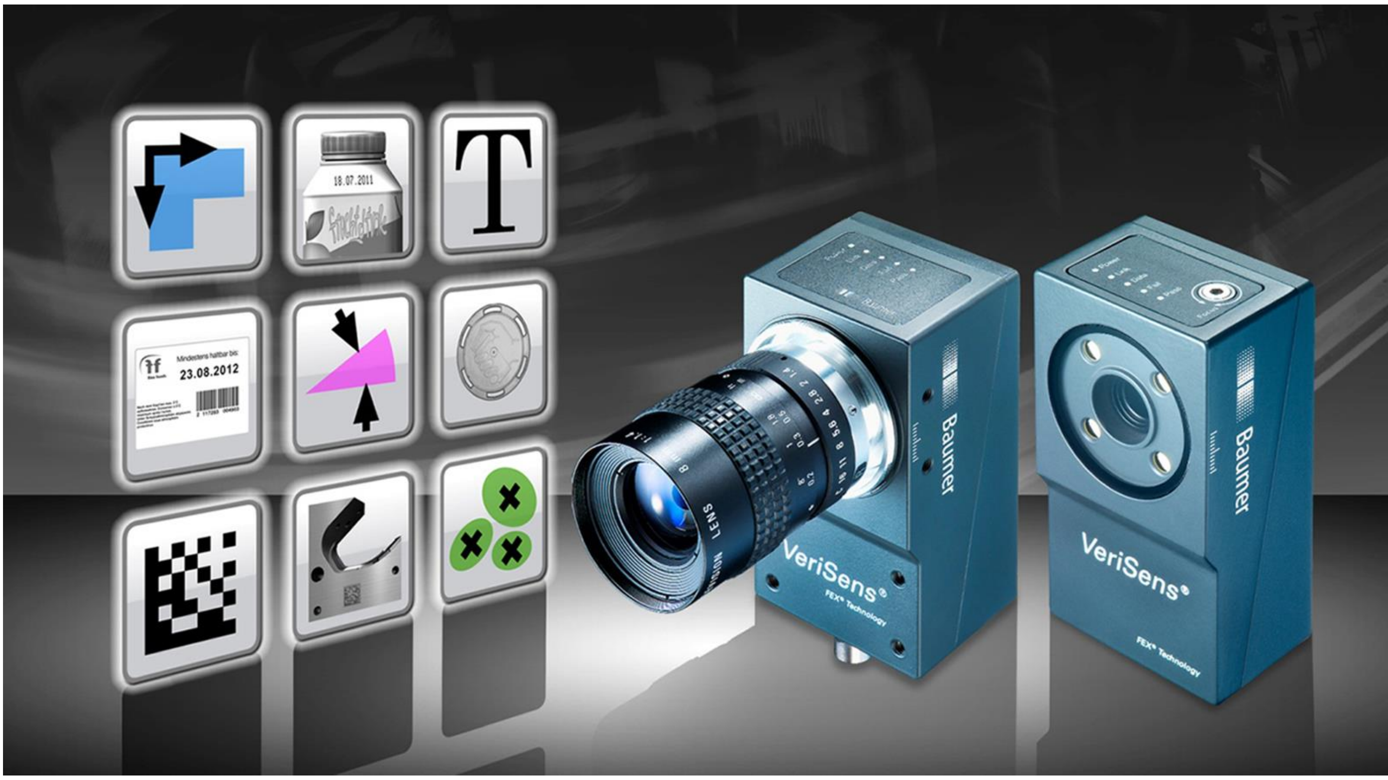

Technical Documentation

VeriSens® ID- / CS- / XF- / XC-Series

Contents

1 Welcome

Welcome to the 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

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Version 2.6.2

09/2015 Issue

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

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 commissioning 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 and, for protection class IP 69K devices, if the sealing screw on the lens setting opening is correctly screwed in.

ATTENTION!

The device may become warm during operation. High temperatures may damage the device. Ensure that where ambient temperatures are around 50°C, (+122°F) the housing is assembled in such a way that the generated heat is dissipated.

ATTENTION!

Incorrect supply voltage will destroy the device!

Pin 1: Power (+18…30 VDC)
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!

For devices with infrared illumination

NOTE

The device uses 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 device is used for its intended purpose.

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

4 Correct Use

Depending on the model, 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
- Color features

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

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

NOTE

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

ATTENTION!

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

Find the latest information about Baumer *VeriSens*® at http://www.baumer.com/verisens.

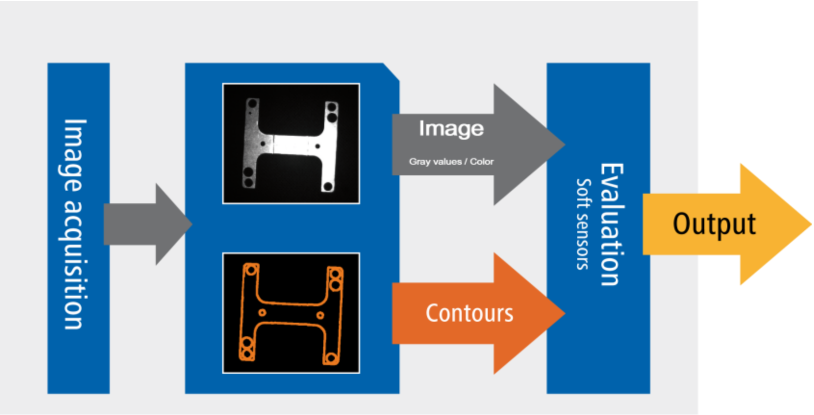
We recommend that you register for the Member Area, where you can access the latest software and useful tools.

5 Mode of operation

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

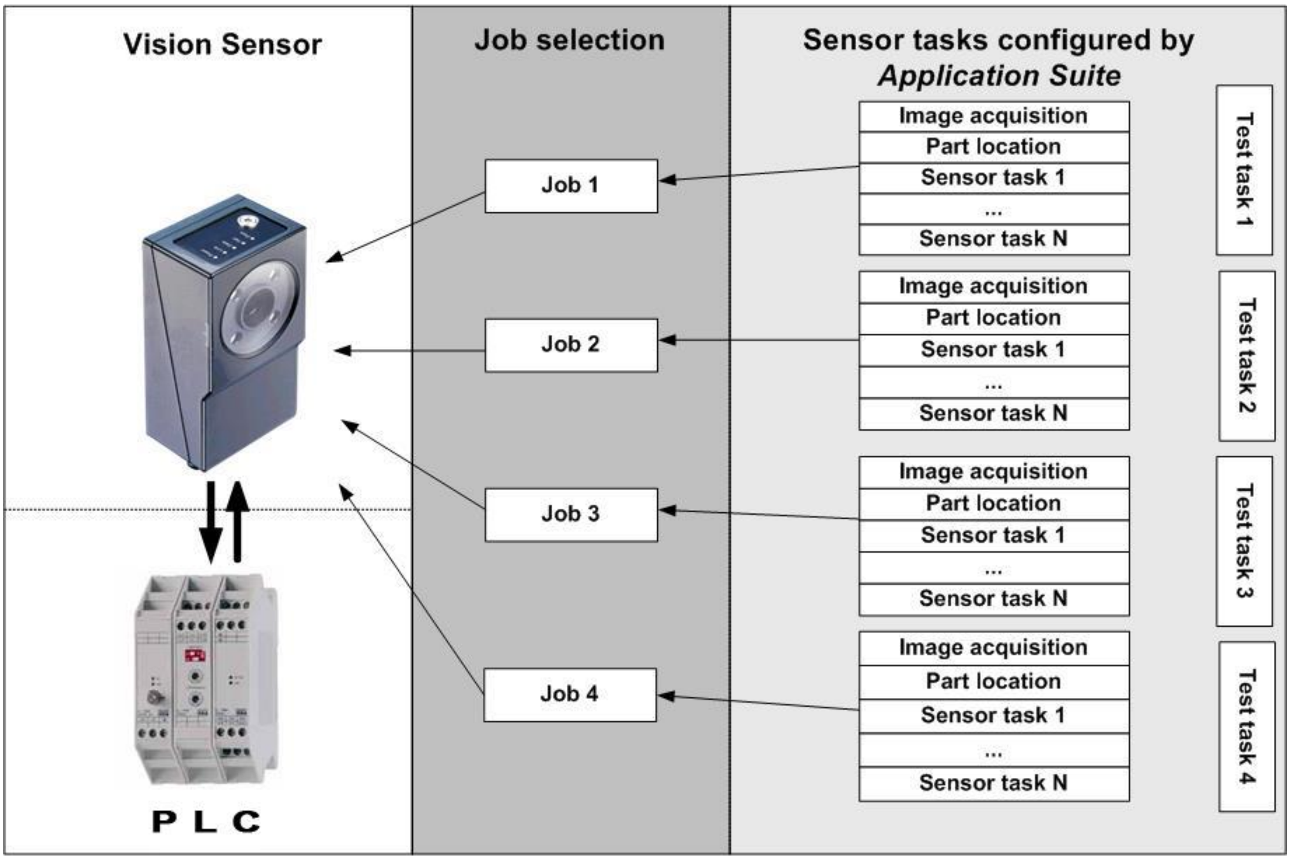
The strength of the device lies in the detection of contours. With the procedure, differences in brightness can be optimally tolerated, as contours are usually independent of the absolute brightness (e.g. variations in illumination).
Because a test object can normally be definitively described by its relevant contours, the device provides powerful tools to check their presence, position, completeness or color. 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 has 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.

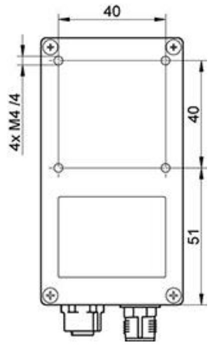
In *Configuration* mode, you can configure and set the parameters for the jobs and features to be checked. This is conducted using the *Application Suite*.
Because a high-quality digital image provides many means of visual inspection, the parameters of the jobs have to be set according to the inspection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

6 Installation and Commissioning

6.1 Mechanical installation

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 center 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.

The device and its built-in lens can inspect fixed areas at fixed distances. For this purpose, there are two variants with different focal distances of the optical systems (f = 10 mm and f = 16 mm).

NOTE

The field of view for devices with interchangeable lenses depends on the lens used.

ATTENTION!

Devices with protection class IP 69K must be mounted with the rear side against a good conductor of heat (metal) to draw away the warmth created.

Install the device so that water never gets blocked and can drain away.

The tables below contain the maximum fields of view:

Lens	**f = 10 mm**
Object distance	Max. inspection area
50 mm	26 mm x 17 mm
100 mm	50 mm x 32 mm
200 mm	98 mm x 62 mm
300 mm	145 mm x 93 mm

Lens	**f = 16 mm**
Object distance	Max. inspection area
70 mm	18 mm x 11 mm
100 mm	26 mm x 17 mm
200 mm	55 mm x 35 mm
300 mm	84 mm x 54 mm

6.2 Electrical installation

For commissioning, you will require:

- the Vision Sensor,
- Installation CD for the *Application Suite*,
- 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 Baumer.

ATTENTION!

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

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

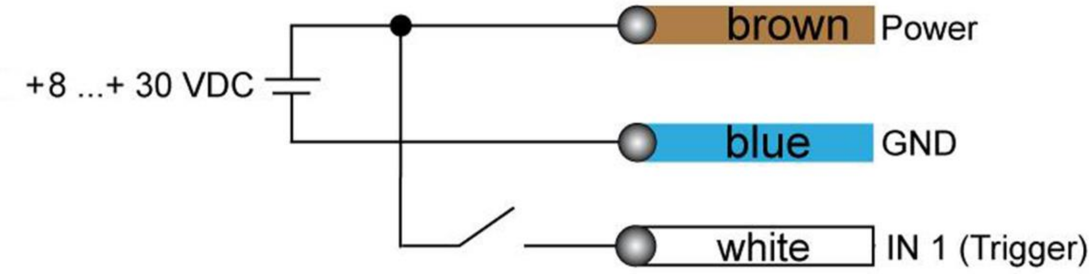
Screw the 12-pin power cable with M12 plug onto the power supply connection on the device.

NOTE

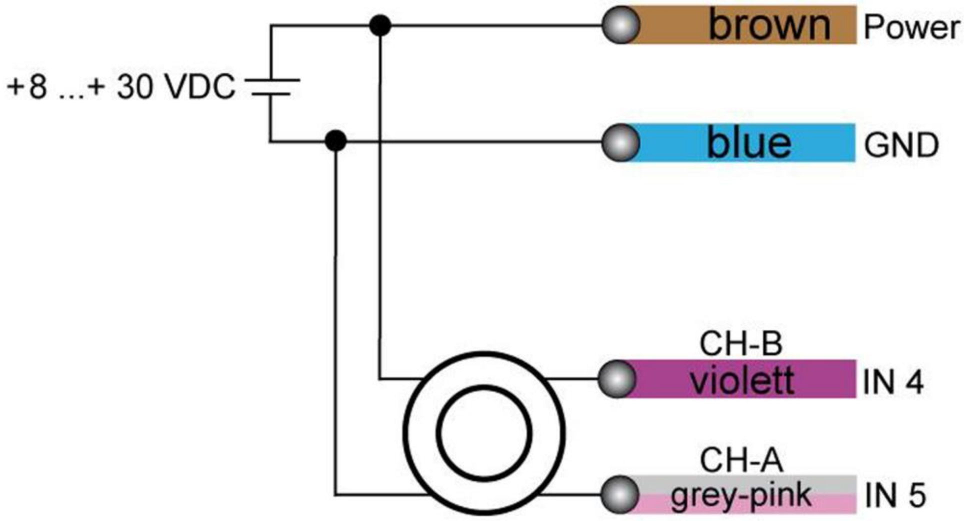
After installing the software, you can check the correct assignment of the digital connections in the menu: *Device → Digital I/O-Assistant.*

6.3 Wiring

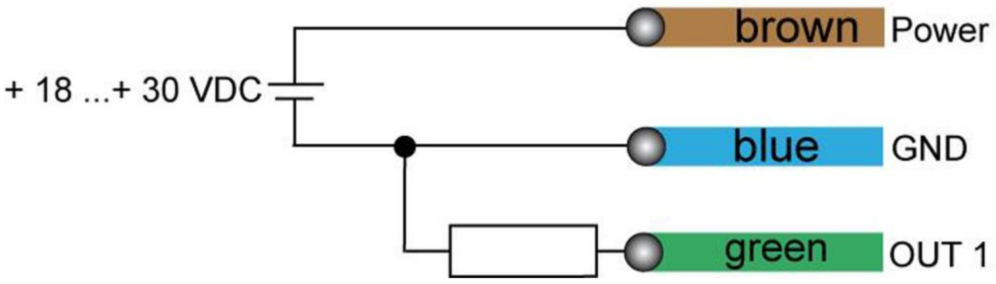
Input



Encoder



Output



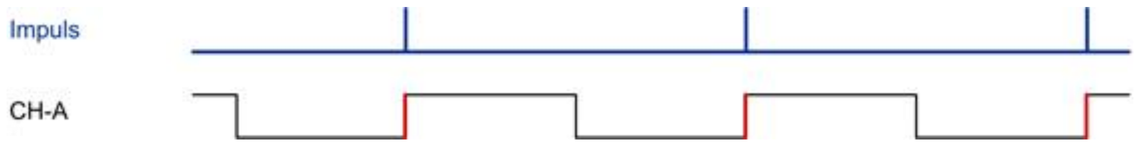
6.3.1 Notes on using an incremental encoder

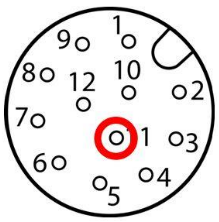
You have two options for operating the device with an encoder:

> **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.



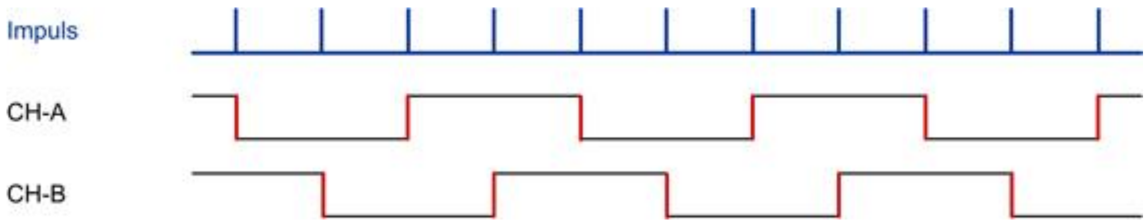


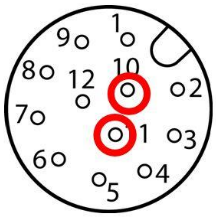
Pin assignment of the power cable

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

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

6.4 Software installation

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

- **Operating system:** Microsoft Windows XP SP2, 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, TrueColor 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.

The web Interface is supported by the following browsers:

- Internet Explorer® 8/9 (not Windows CE 5.0)
- Firefox 3.6.28
- Firefox 13 and later

Javascript and cookies must be enabled.

ATTENTION!

The IP protection class is only valid if all connectors are connected as described in the technical documentation and, for devices with protection class IP 69K, if the sealing screw on the lens setting opening is correctly screwed in.

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

1. Start the setup program from the CD and follow the installation instructions.

2. A link to the Application Suite will be made on your desktop. The software is launched by double clicking on this link.

3. 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 address)

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=zn (Chinese)

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.

6.5 Commissioning 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 XP, proceed as follows:

1) Open the "Start" menu and then move to "Settings > Control Panel > Network Connections".

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

3) Select the "Internet Protocol (TCP/IP)" entry in the list of elements and then click the **Properties** button below the selection list. The following dialog 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)

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.

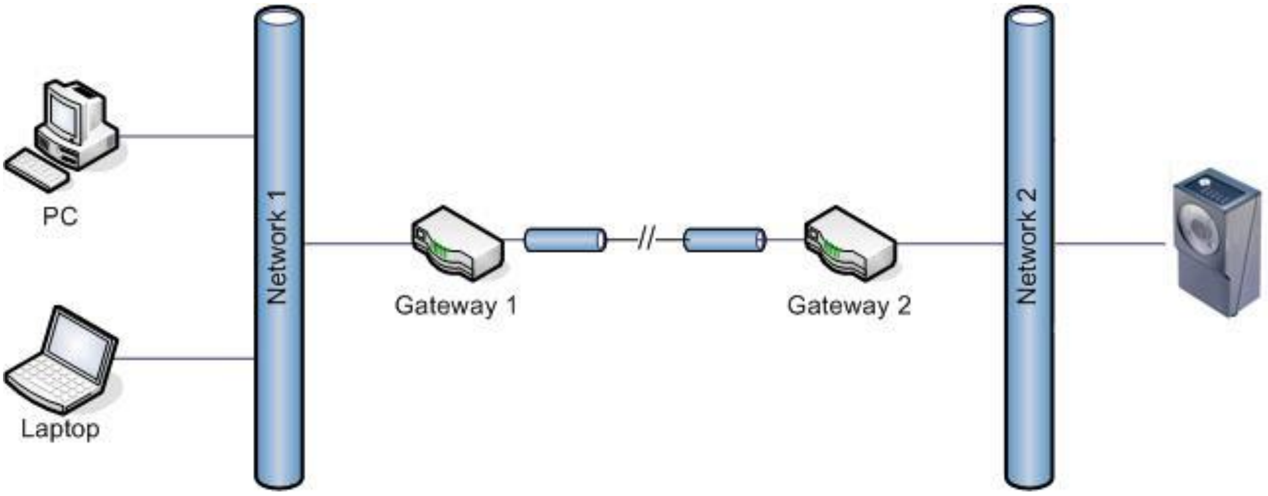
6.6 Notes on using gateways

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.

6.7 Important network terms

`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
Assignment of a➡ MAC address to a specific 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.

6.8 LED panel

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.

Power: indicates that the Vision Sensor is being supplied with electricity.

Link: indicates that the Vision Sensor is connected to the network.

Data: indicates that data is being transferred.

Fail: lights up when a feature check has been failed.

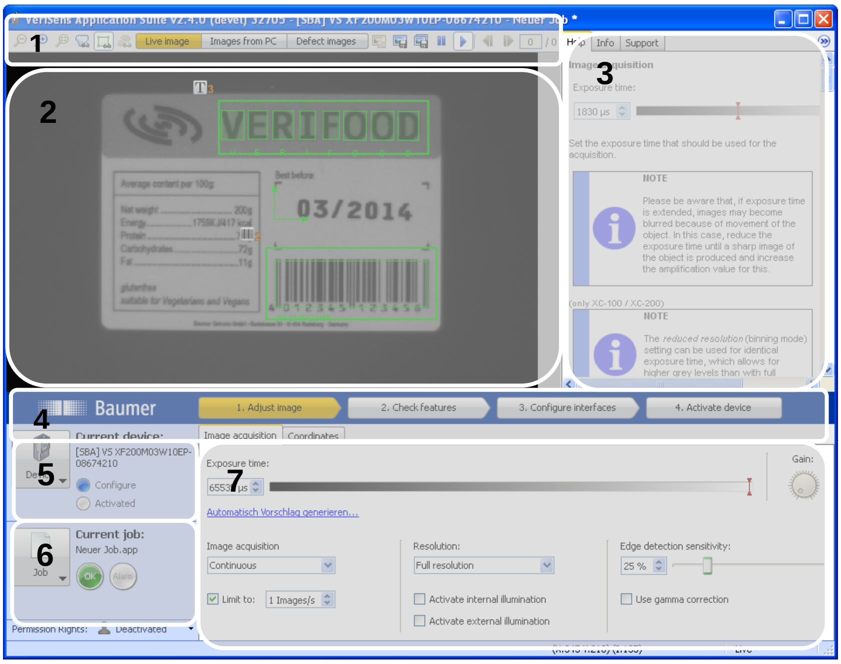
Pass: lights up when a feature check has been passed.

Pass/Fail flash quickly and alternately: Vision Sensor starts

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

7 Overview *of the Application Suite*

The *Application Suite* is used for the commissioning, job creation, parameterisation, 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

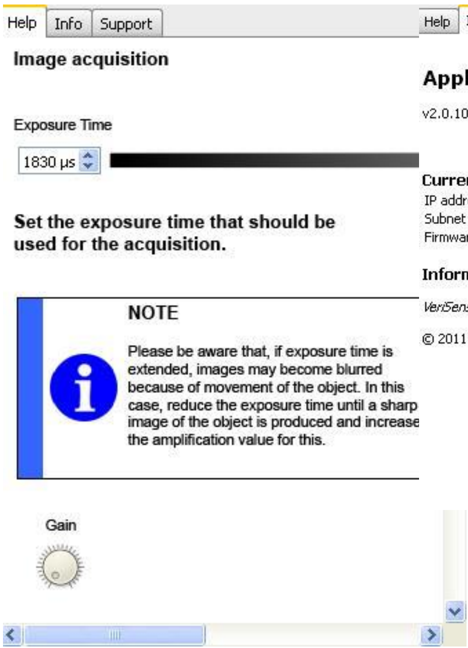
7 Parameterisation area

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 and support



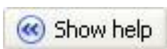
On the *Help* tab, there is a corresponding online help page for each dialog.

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.

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 grayed 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.

With these buttons you can switch:

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

> **NOTE**
>
> The image will not appear rotated in the web interface.

the contour points display

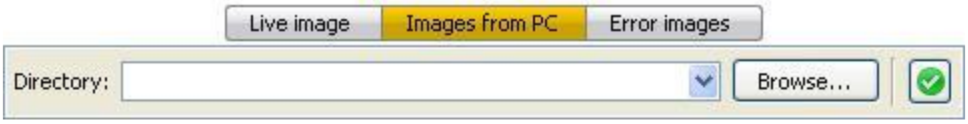
the field of view display

and the model display on and off.

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.

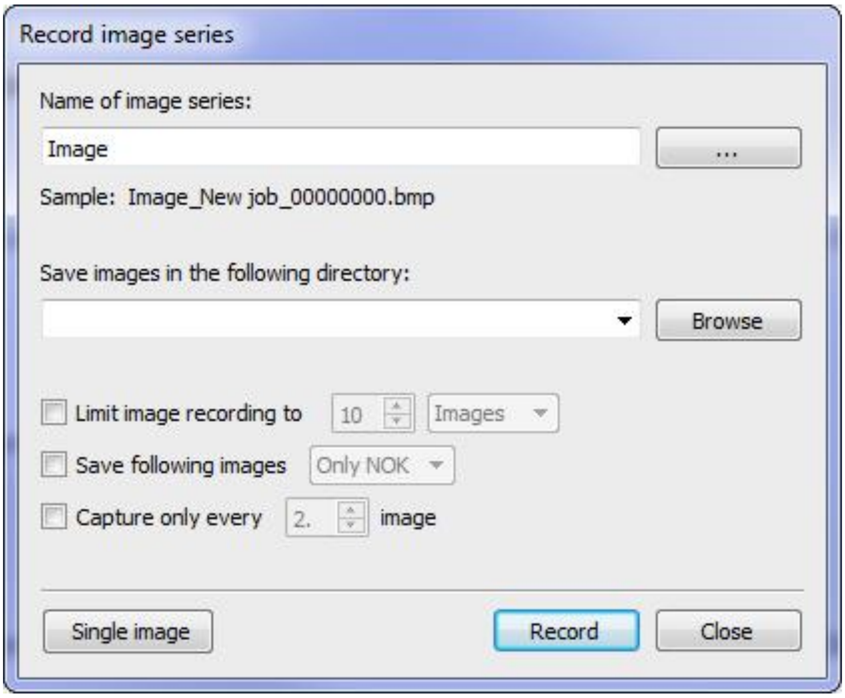
Use this button to save all defect images to your PC.

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.

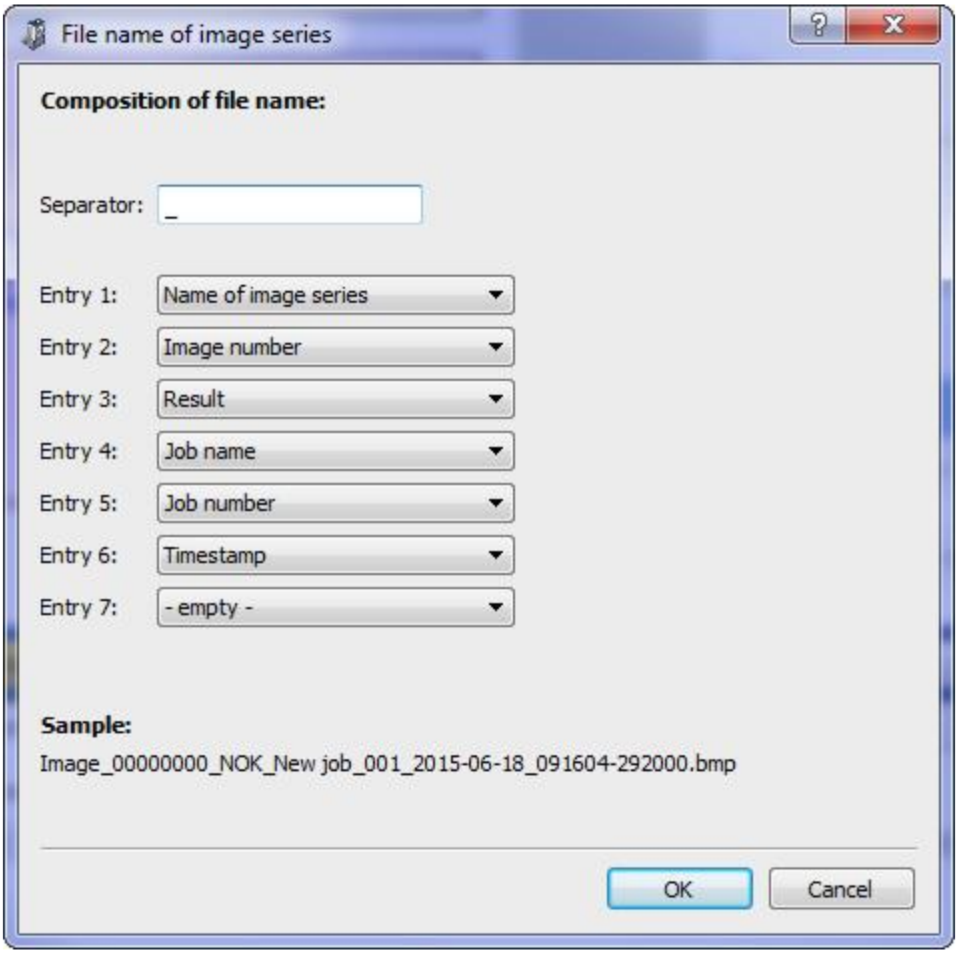
Use this button to record live images. The "*Record images*" dialog box opens after clicking.



Make the settings required for the image series in this dialog 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 a separation marker.

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.

ATTENTION!

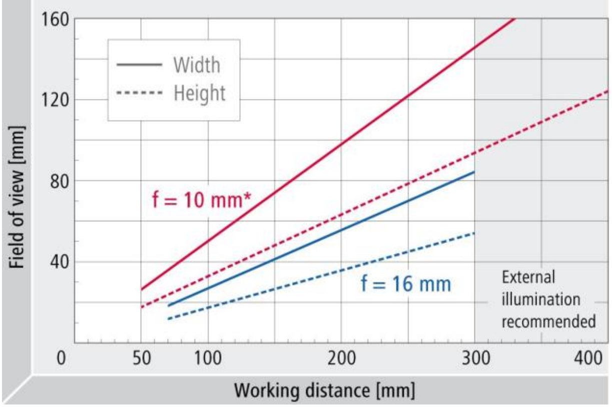
On devices with protection class IP 69K, the setting screw is protected from moisture by a sealing screw.

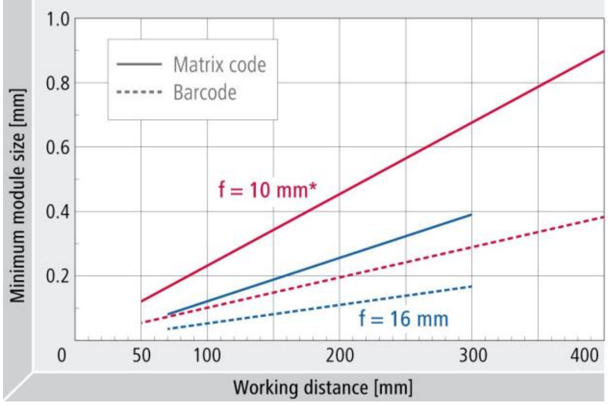
Do not remove the sealing screw in damp rooms and only remove it for a short amount of time as there are drying capsules on the inside that absorb moisture and may become saturated.

Reseal the setting screw with the sealing screw once you have configured the image focus!

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

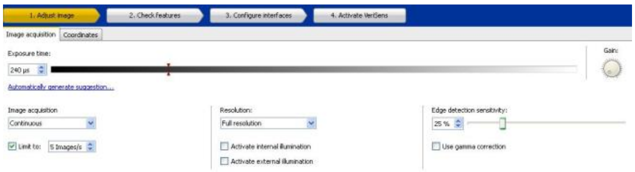
> **NOTE**
>
> The field of view and minimum module size for devices with interchangeable lenses depends on the lens installed.

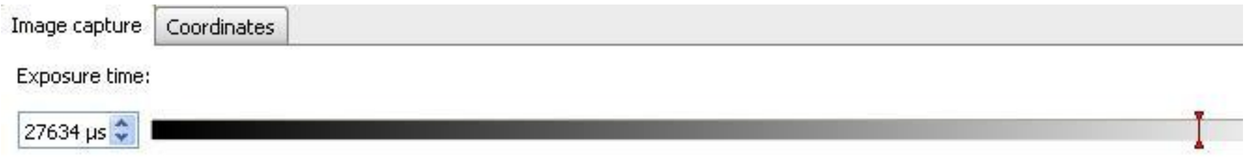




* Working distances > 400 mm possible

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

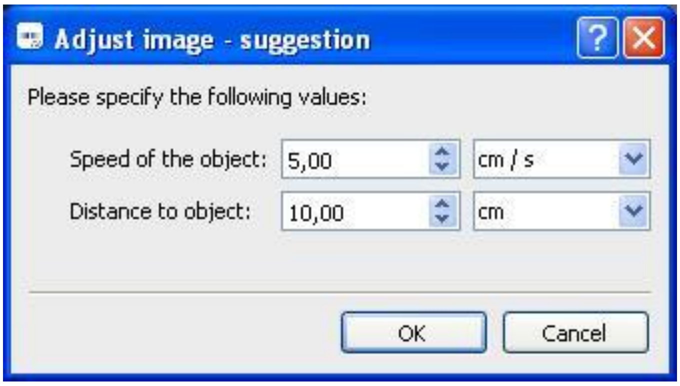
(model-dependant)

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

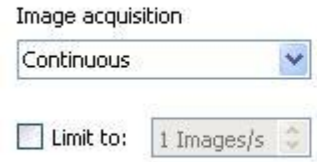
The image can also be brightened using the control gain (*Amplification*).

> **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.

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

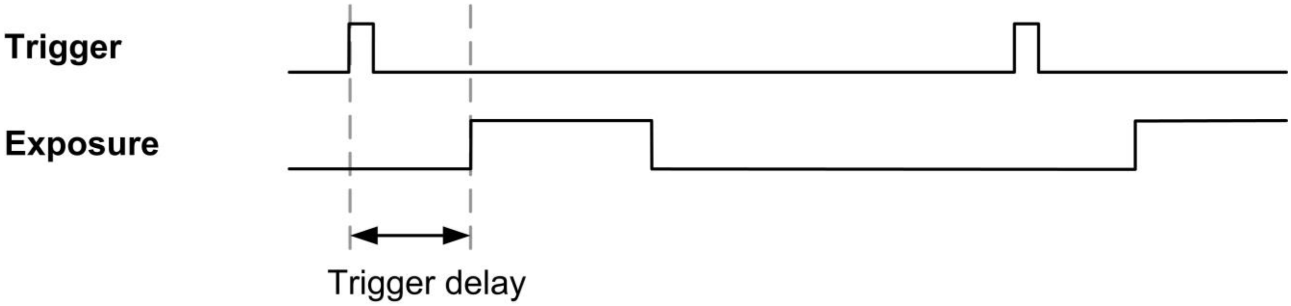


Enter the speed of the objects, and their distance from the camera, during inspection. The *Application Suite* automatically calculates the associated parameters. If the image is then still too dark or bright, you can adjust this using the control gain (Amplification).



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.

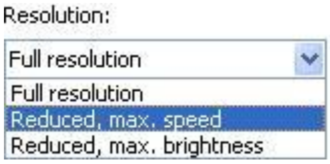
External trigger: A new image is acquired upon the occurrence of a corresponding external event.
If an encoder is connected, you can also specify the delay time or distance (ft = feet) between the trigger signal and the actual image acquisition. Any other trigger signals received during this period are 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.



(only for devices with interchangeable lenses)

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

(model-dependant)

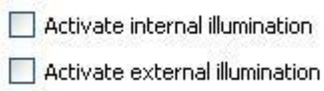


You can choose between two resolutions for the device, for the reduced resolution, additional profiles optimised for speed or brightness are available:

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.



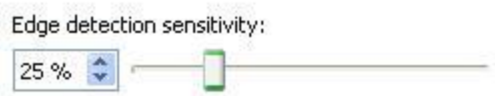
With the illumination settings, you can switch off the internal illumination and possibly activate external illumination with the *Flash sync output*. If you wish to use the external *Flash sync output*, this must be chosen accordingly in the *Digital I/O* menu. You can also activate both type of illumination.

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. For these, the signal is max. 1ms.

NOTE

Only use contour recognition sensitivity when all of the other image settings have been configured successfully.

(model-dependant)

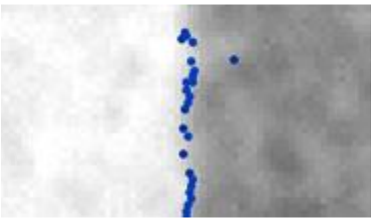


To ensure consistent evaluation, all contours must be calculated consistently. This means that the image is sharply focused and no overbiases occur.
For critical objects, it may be appropriate to adjust the sensitivity of edge detection manually. Set the Edge detection sensitivity to a value where the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

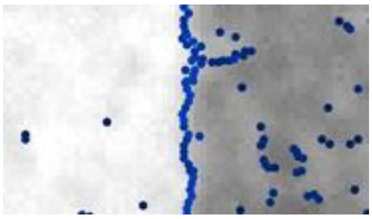
Make sure that the contours of the test object are consistently obtained and that not too many “pseudo-contours” are created.

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

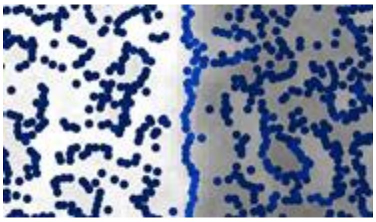
Example images of contours



too few contours
(contour recognition sensitivity must be decreased)



good contours
(optimum contour recognition sensitivity)



too many contours
(contour recognition sensitivity must be increased)

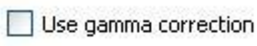
NOTE

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 setup:
  - 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.

(model-dependant)



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 area" function can only be used to a limited extent for certain feature checks (e.g. Brightness etc.)!

The following value can be set via the process interface:

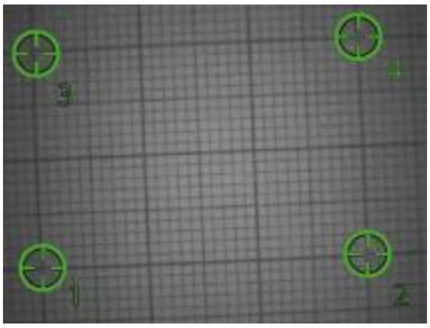
Entry value	**Data type**
Exposure time	Integer
Amplification	Integer
Contour recognition sensitivity	Integer

9.1.2 Coordinates (model-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.

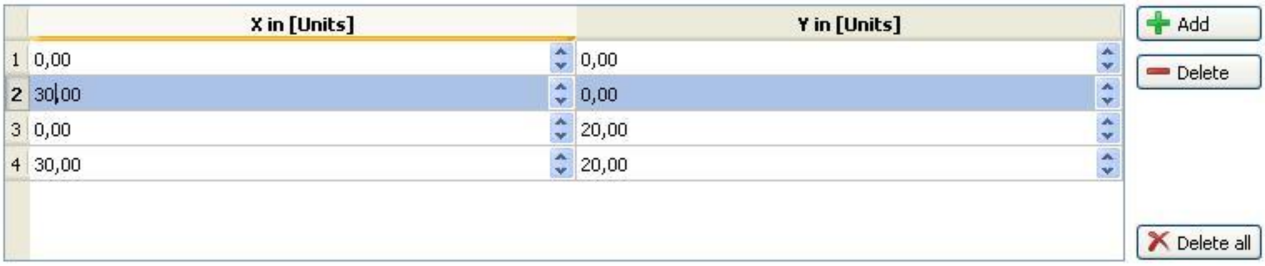


Process

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.



	X in [Units]	Y in [Units]
1	0,00	0,00
2	30,00	0,00
3	0,00	20,00
4	30,00	20,00

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.

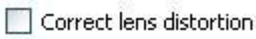
If you now allow the results of the corresponding feature checks to be given in [Units], the value produced conforms with your defined coordinates in millimetres.

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 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).

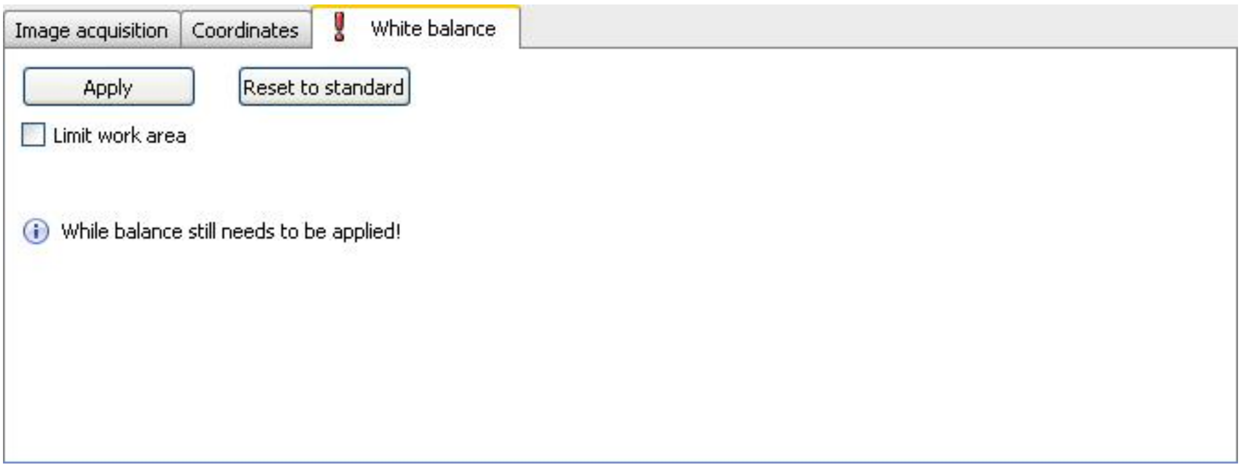
Reset best value: Use this to reset the best value to the current focus value.

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.

9.1.4 White balance (model-dependant)

The white balance adjusts the color 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 homogenous 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

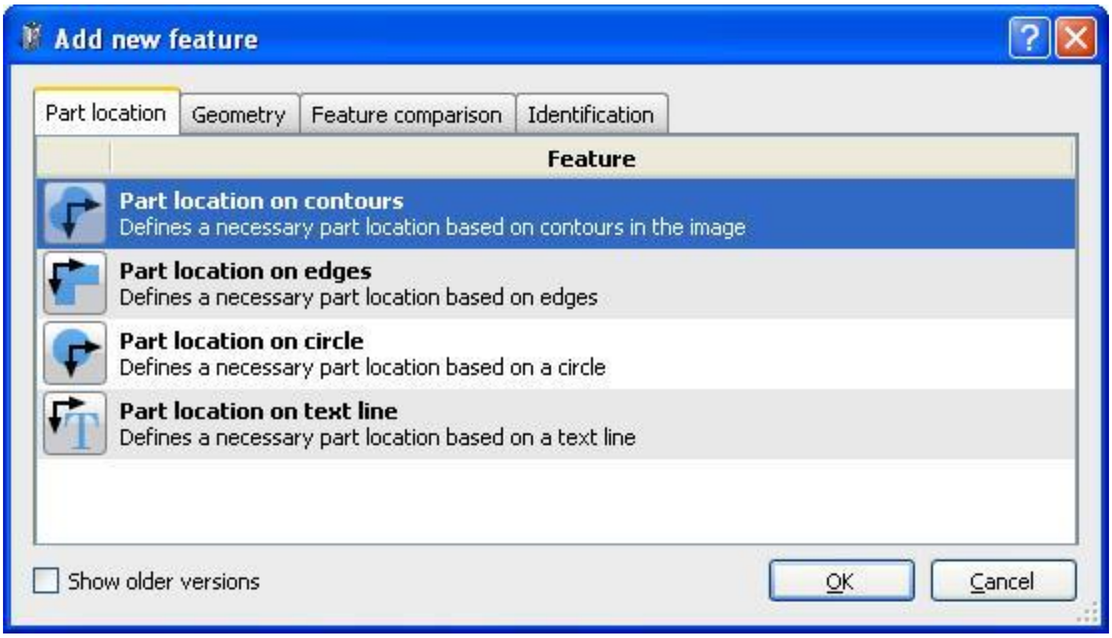
As each inspection task has tolerances with regard to the position of the test object, most jobs begin with part location. The part location feature searches for the reference edges of the test object and aligns all subsequent feature checks according to these reference edges.

Add opens the New feature check dialog. 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

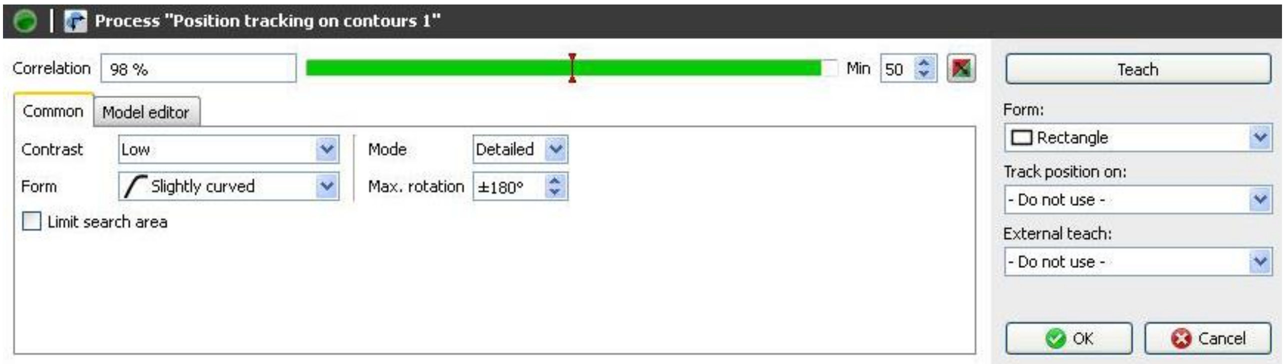
The results of the feature checks can be connected at a later stage (model-dependant).

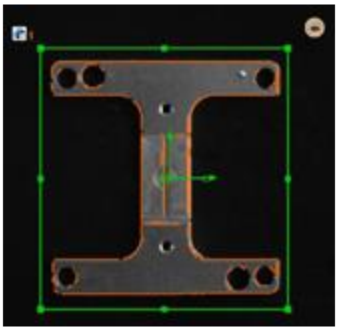
Right click on a configured feature check to access further functions.

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.



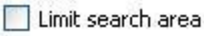


- Choose the shape of the area from which the contours are adopted.

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

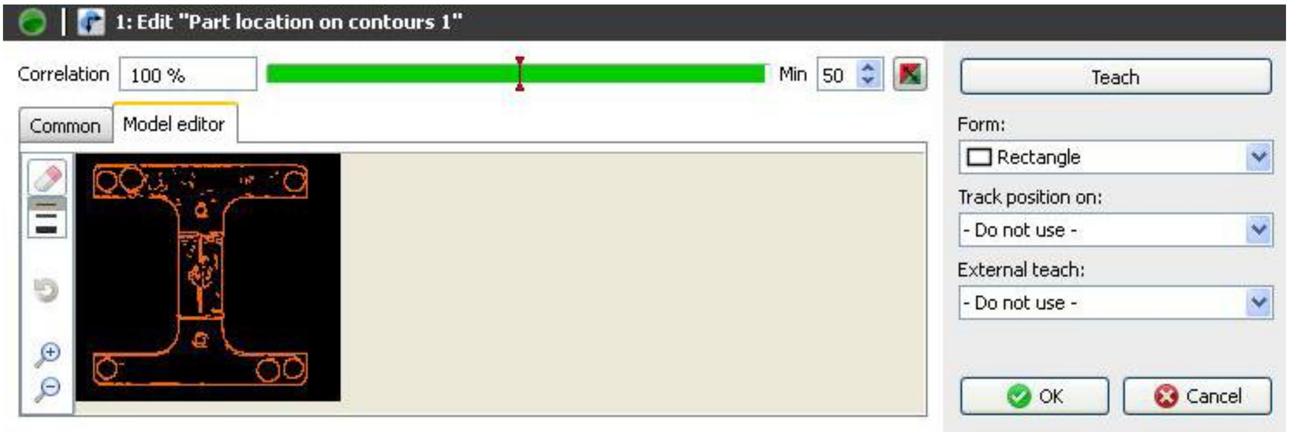
- The match of the contours with the found object in the image is displayed here.
- Using the appropriate switching points, set how good the match must be so that the object is found. The button on the extreme right inverts the set point.

- **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 search 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.

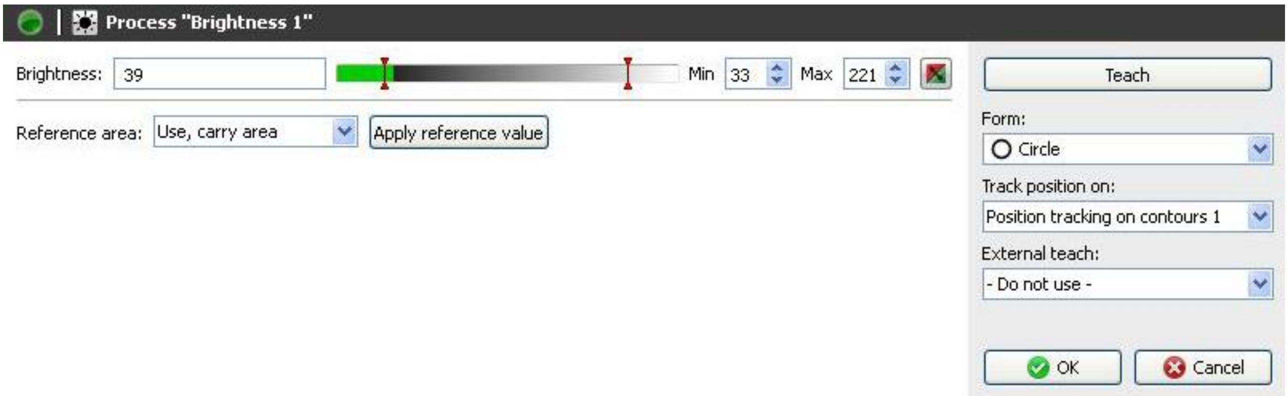
- You can use these two buttons to enlarge or reduce the model.

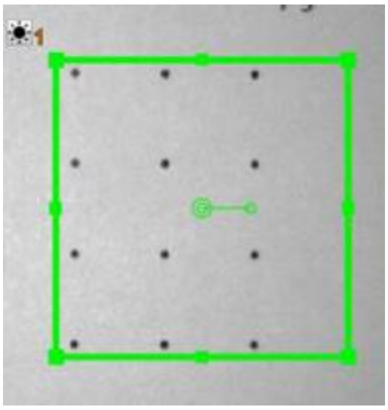
- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

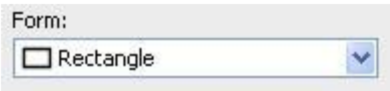
Sensor task Brightness

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

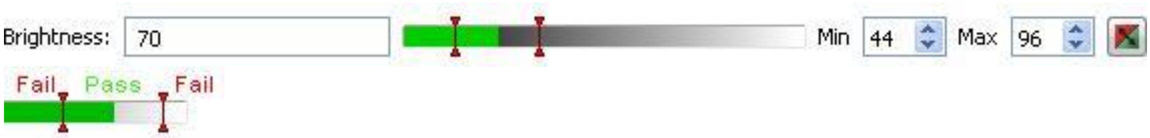
This feature check supports external Teach. The switching points are adjusted as an absolute to the current measured value.



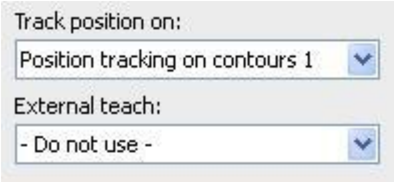




- Select the shape of the field of view. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by dragging with the mouse on the lever at the center.



- The current result for lightness 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-in 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 gray scale value of 128 to ensure reliable operation.

> **NOTE**
>
> If “Use, carry area” cannot be selected, then you have not defined part location.

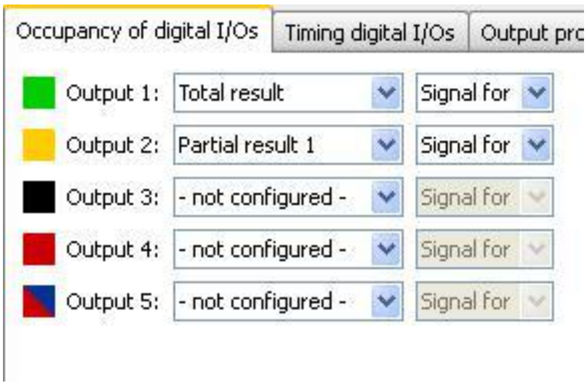
- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

> **NOTE**
>
> The *Application Suite* CD features a range of application examples that provide you with typical solutions for various inspection task and the use of the individual feature checks. After successful installation, the examples can be found in the directory
>
> `<installation path>\AppSuite\samples`
>
> on your PC.

9.3 Configuring interfaces

9.3.1 Occupancy of digital I/Os

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



NOTE

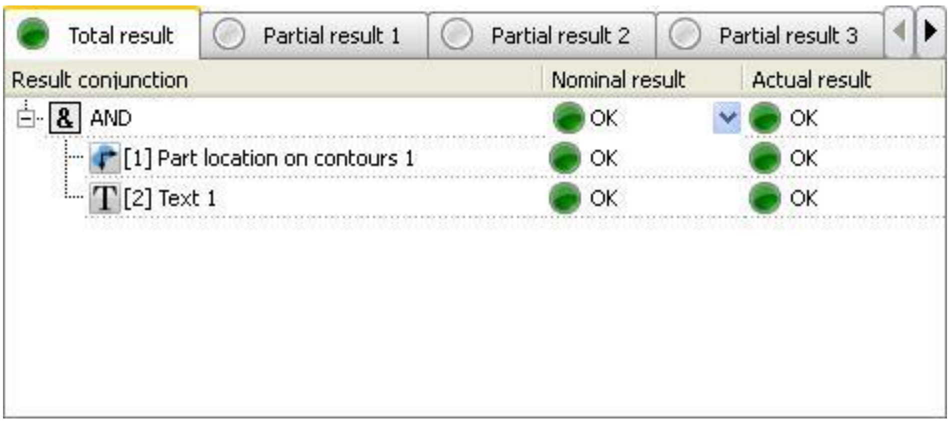
Please keep in mind that, during job switching, the device is not active and the "Camera Ready" output is deactivated. Please wait with the next image analysis operation until the "Active" state is displayed again by this signal. If the switch could not be performed, for example, because the job number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

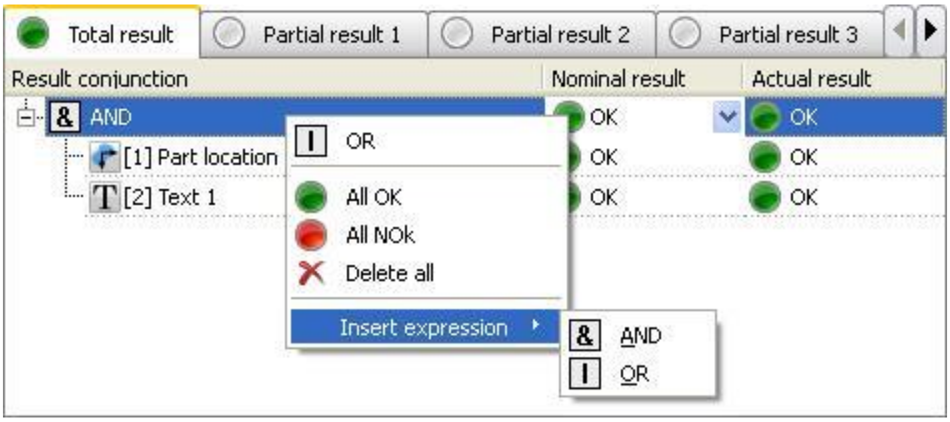
You may output the Total result and the Partial results via the digital interfaces. To do so, configure the required output in *Device menu*.

Flexible result conjunction (model-dependant)



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

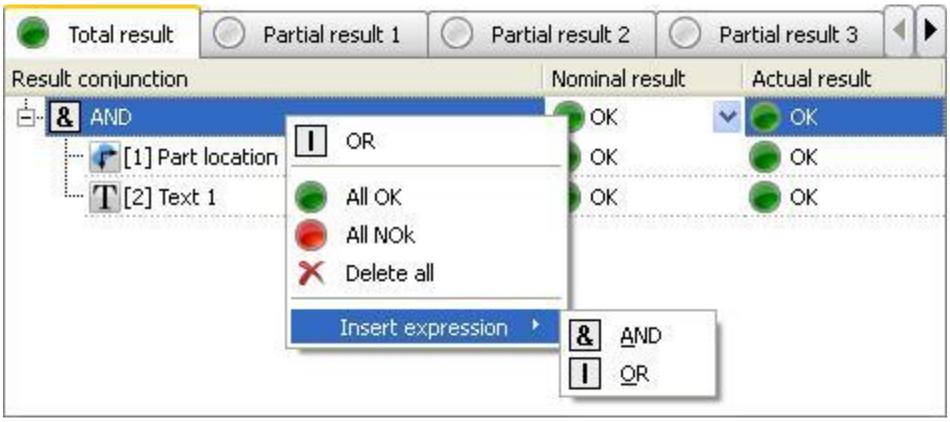
You can specify one Total result and several Partial results for each job. In addition, it is possible to use the Partial results for the configuration of the Total result.



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.")

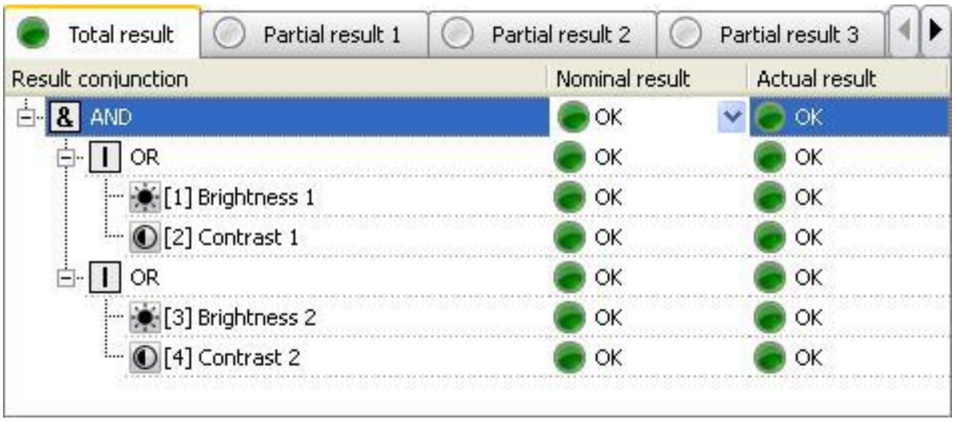
You can also invert and ignore the result of a link by selecting the entry "NOK" or "Ignore" in column "Nominal result".



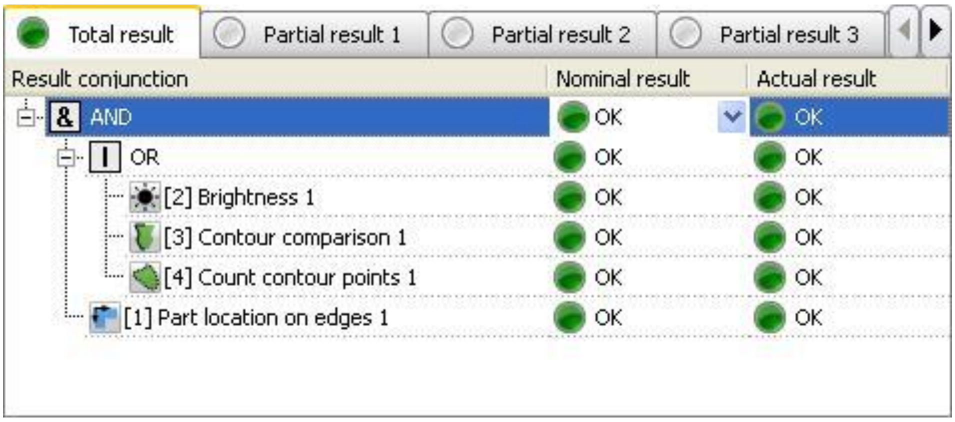
It is possible to nest the links to any desired depth to achieve even more complex expressions. You can insert new levels by selecting the "Insert expression" value in the context menu and then the appropriate type of link. For each sub-link, you can now select the corresponding feature checks to be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

Example

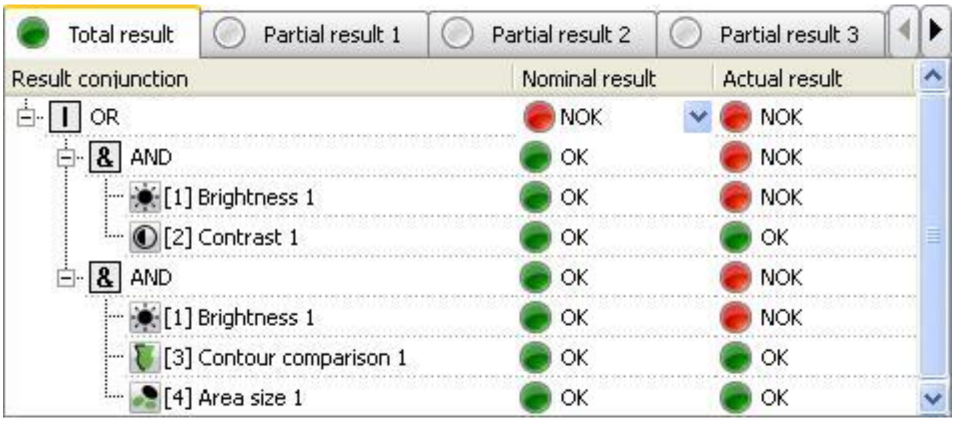
(Brightness 1 OR Contrast 1) AND (Brightness 2 OR Contrast 2)



Part location at 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 (model-dependant)

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

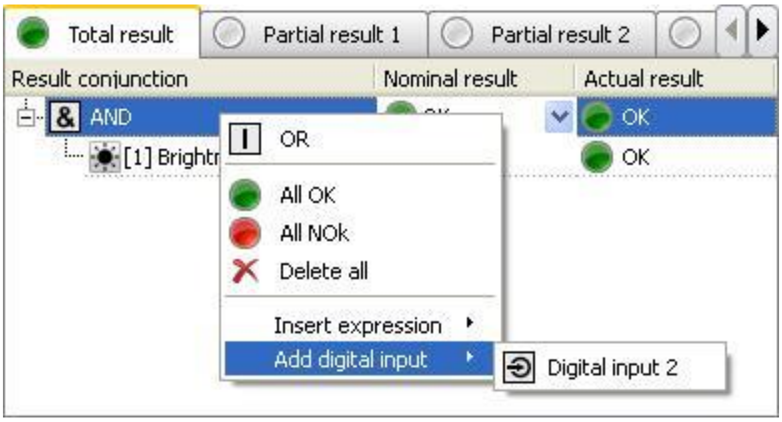
The states of the digital inputs are captured at the trigger point or at the start of image acquisition.

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

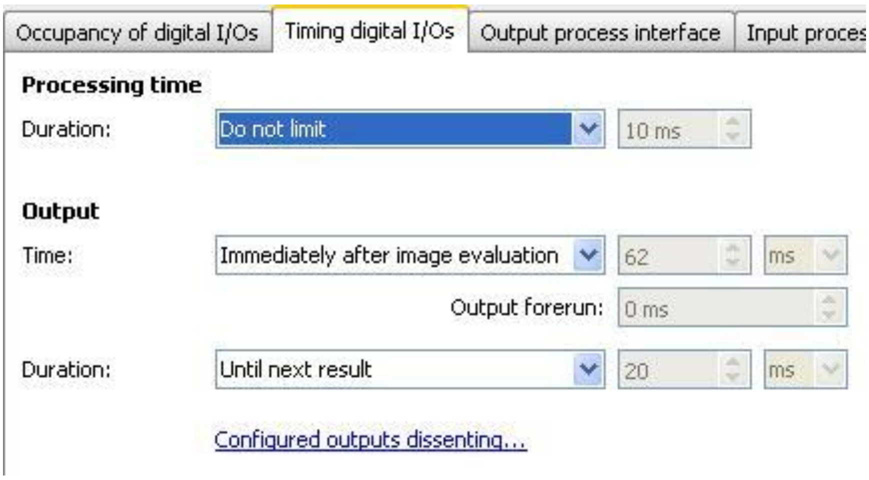
NOTE

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

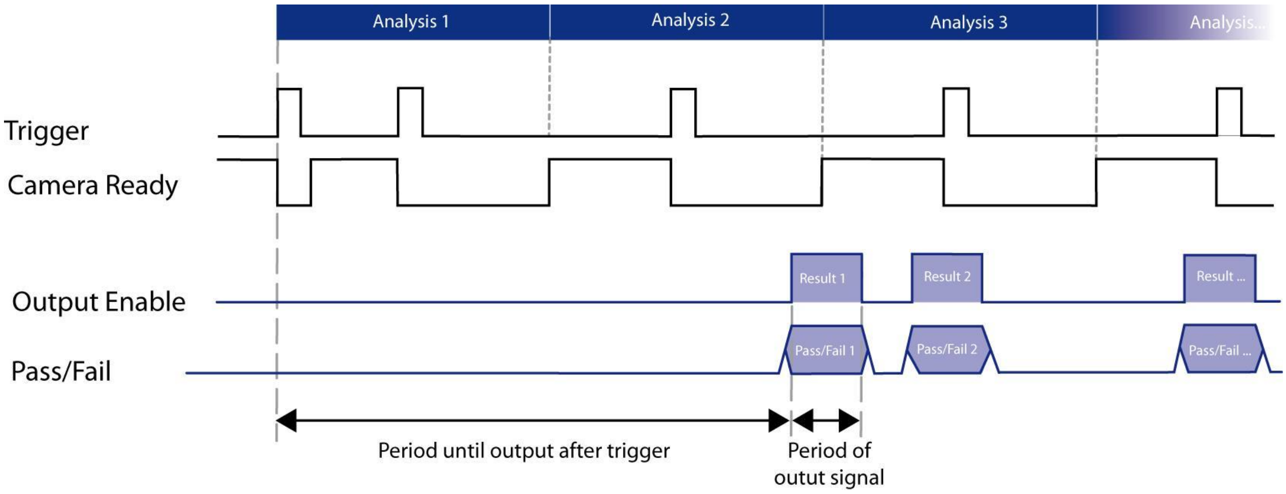
Device → Device Settings → Digital I/Os



9.3.2 Timing digital I/Os



In this dialog, 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 *Camera Ready* signal is deactivated. The *Camera Ready* 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.

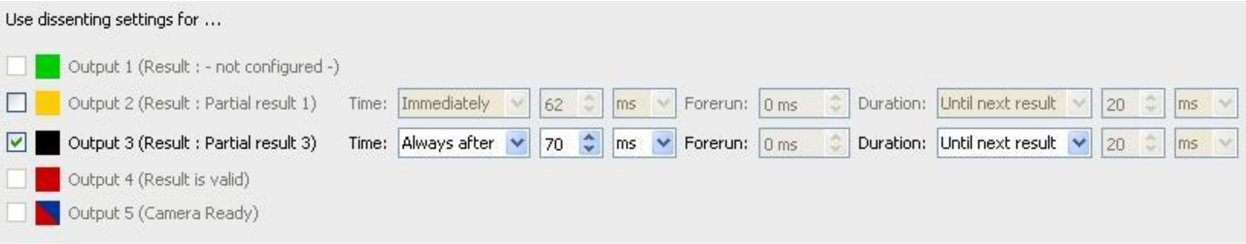
In addition, you can specify an "output run-up" in milliseconds to activate the Pass/Fail signal before reaching a specific position.

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.


System
Image acquisition (51 ms)
Processing time
Output
Immediately
Output 3
70 ms

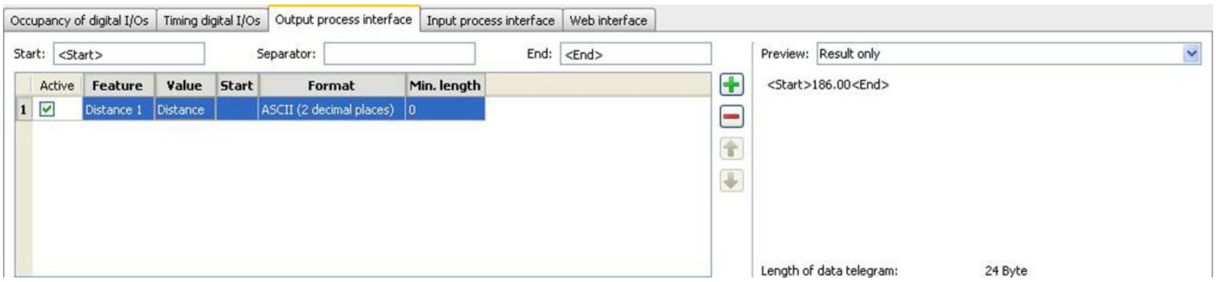

Conveyor speed:
1000 mm/s

9.3.3 Output process interface (model-dependant)

In this dialog, 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 parameterisation 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.
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.
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)

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.
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 characters):** "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.

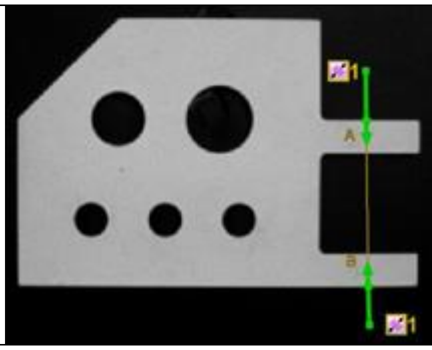
NOTE

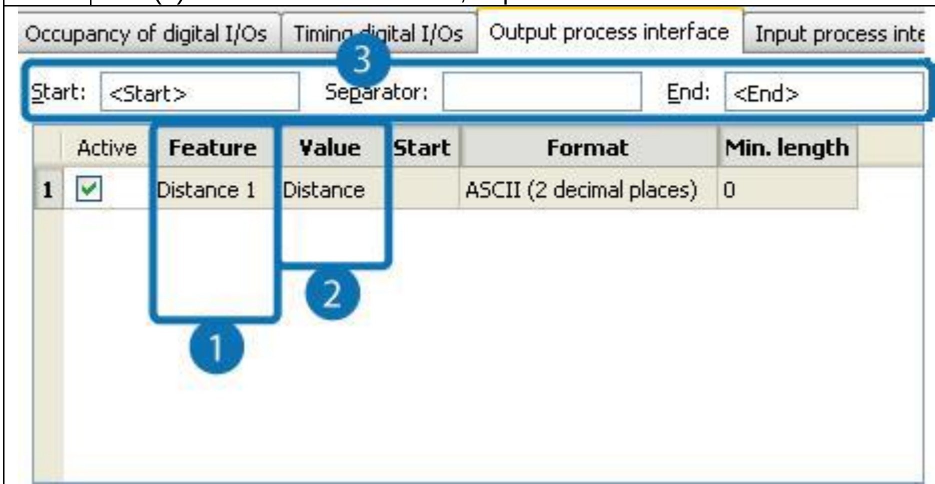
Following the descriptions of the individual feature checks, there is a table containing the values which can be output via the process interface.

Example

Output of read data for the *Distance* feature check via the process interface.

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

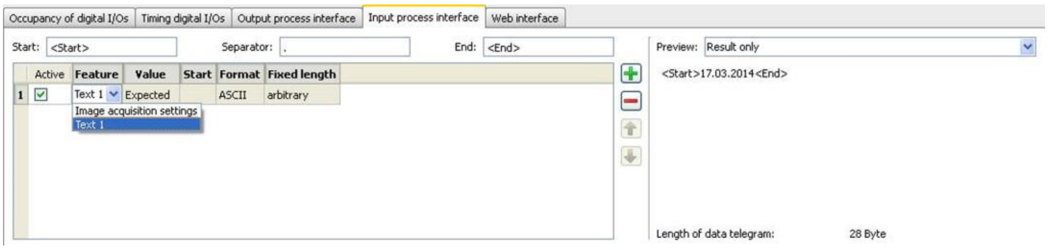
1.	Configure the *Distance* feature check.	
2.	Go to the *Configure interface → Output process interface* step.	
3.	Configure all of the settings in the overview for the data output (see Data table settings). (1) Select the feature to be output. (2) Select the value to be output. (3) Set the start character, separator and end character for the datagram.	



4.	You will see how the data will be output via the process interface in the preview window on the right. The RD (**R**esponse **D**ata) and the number of characters (4 byte ASCII-Hex) will also be prefixed (see RD response).	`<Start>186.00<End>`
5.	In this case, the device will 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 (model-dependant)

Via the 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).

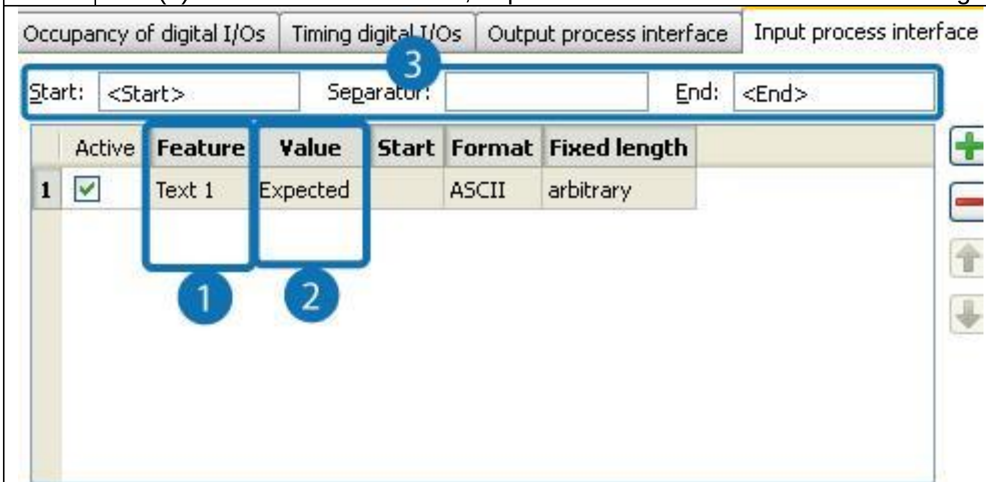
NOTE

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

Example

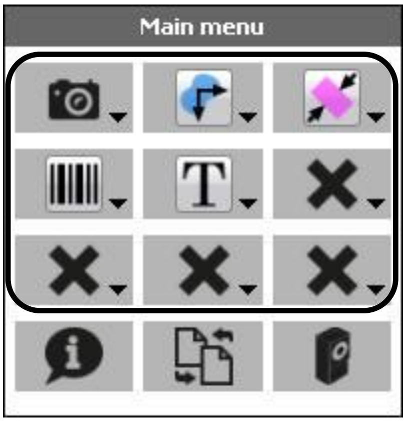
Setting an expected value for the *Text* feature check via the process interface and determining the required command.

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

1.	Configure the *Text* feature check.	
2.	Go to the *Configure interface → Input process interface* step.	
3.	Configure all of the settings in the overview for the data input (see Data table settings). (1) Select the feature to be input. (2) Select the value to be output. (3) Set the start character, separator and end character for the datagram.	
		
4.	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)	`<Start>17.03.2014<End>` **NOTE** If no value is set as "expected" during configuration of the feature check, no value will be shown in the preview window!
5.	The command to set the expected value for the device to this date is therefore:	`SP0017<Start>17.03.2014<End>` (Note: $0017_{HEX} = 23_{DEZ}$, length is therefore 23 characters)

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 grayed 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.

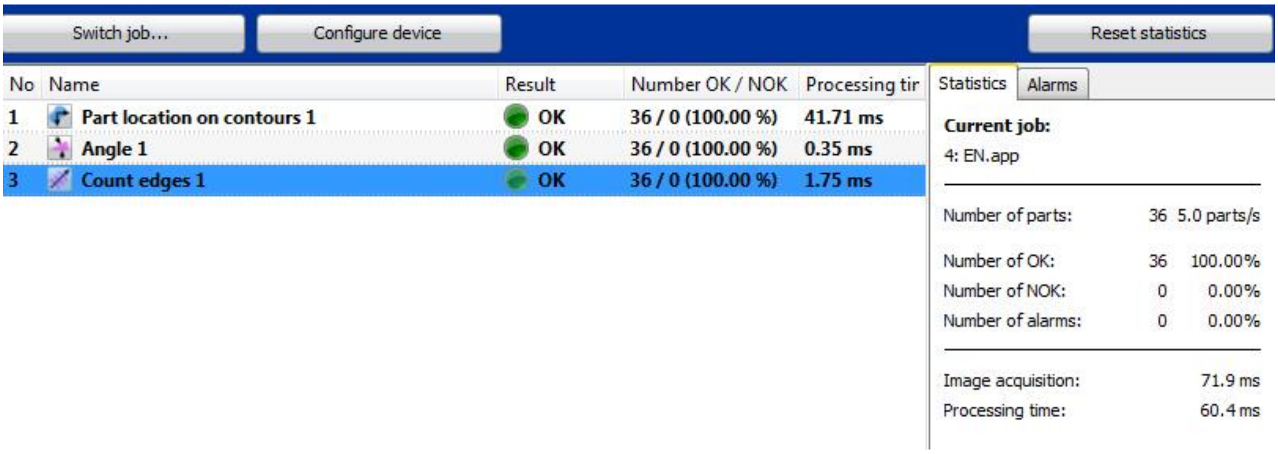
9.4 Device activation

Click on *Activate device*.

Confirm the question with *Yes*.

The Vision Sensor is now in Activated mode and processes the created job. The *Statistics / Details* are shown on the right of the parameterisation 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



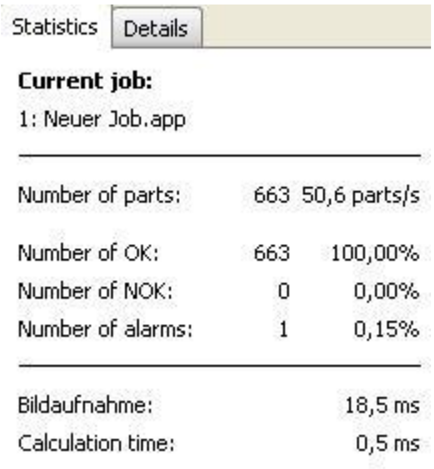
Click on *Switch job...*, to change to a different job stored in the Vision Sensor.

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 the display options).

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

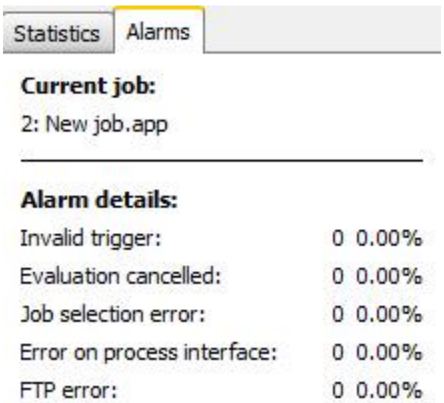
9.4.1 Statistics / Details



The statistics window displays the following values:

- Name of job currently processing
- 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)
- Device's processing time in ms (per image, incl. acquisition)

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



The details window displays the following values:

- Name of job currently processing
- 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*.

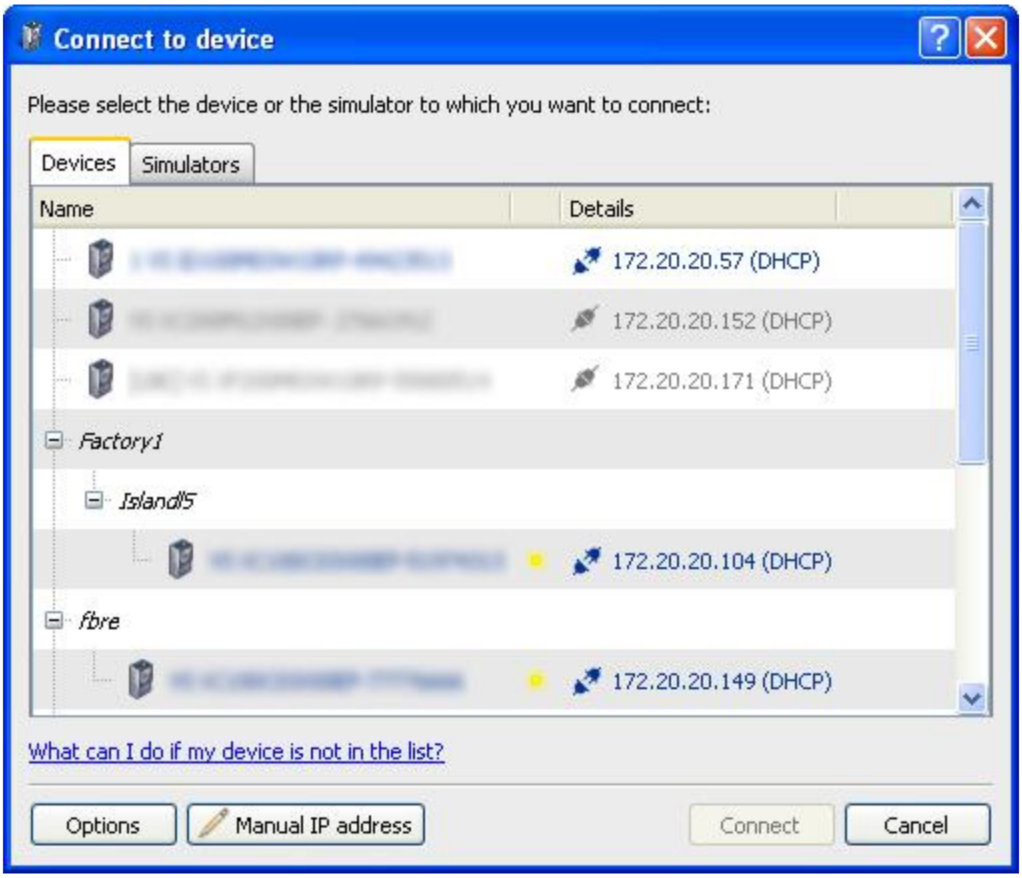
> **NOTE**
>
> Please observe that it may be necessary to configure the stored jobs if you change these settings.

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.

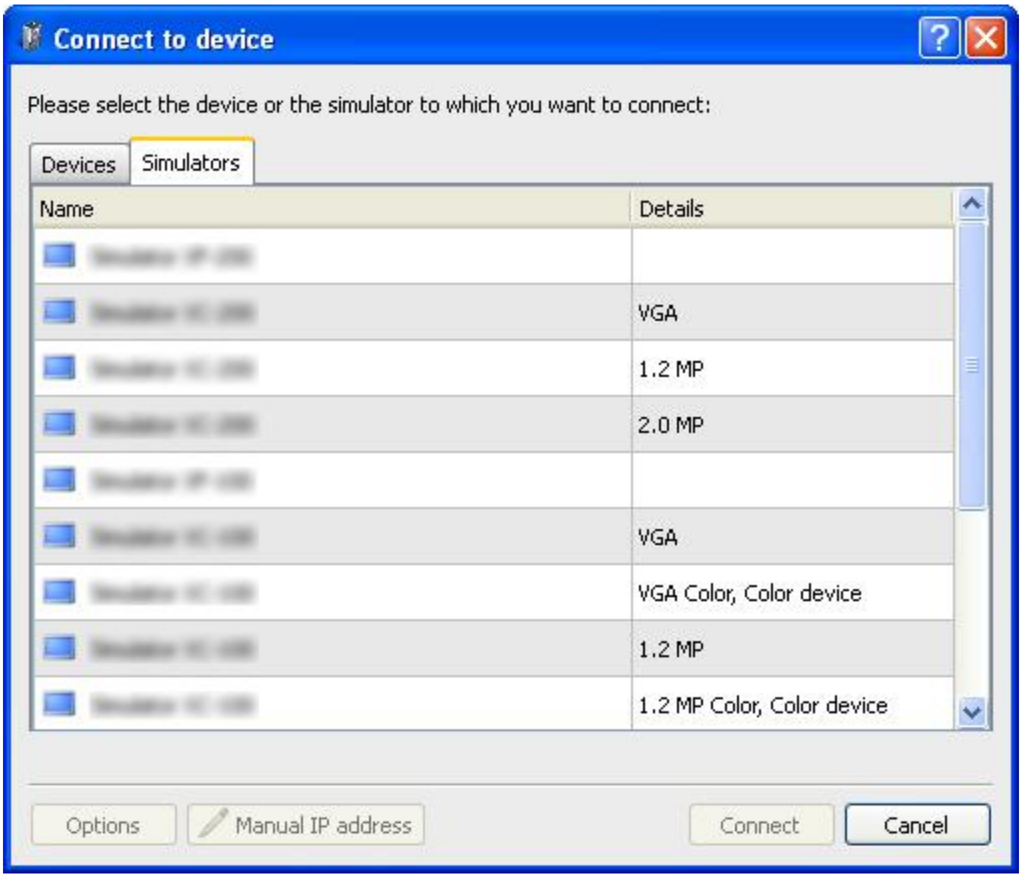


Options: Here you have the option of limiting the address area in which devices are searched for and of selecting an alternative port for communication. You can also activate the *User-defined list of known devices*.

Manual IP address: You can enter the IP address of a device manually here.

Connection: Create a connection to the selected device.

	The Vision Sensor is in the *Activated* operating mode.
	The Vision Sensor is in the *Parameterisation* 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 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 address)

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

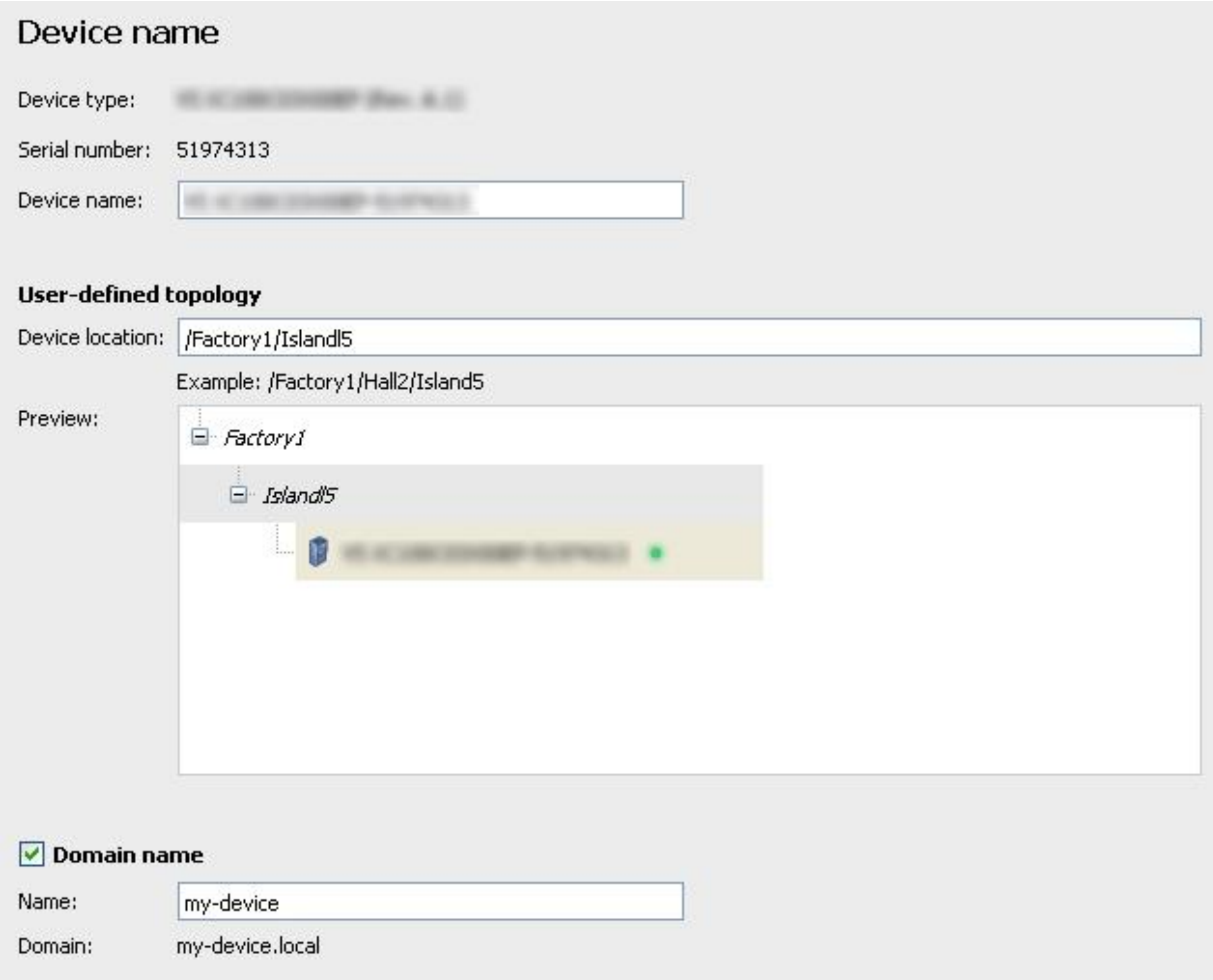
/l=de (German)
/l=en (English)
/l=fr (French)
/l=es (Spanish)
/l=zn (Chinese)

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

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 (model-dependant)

10.2.2.1 Application Suite

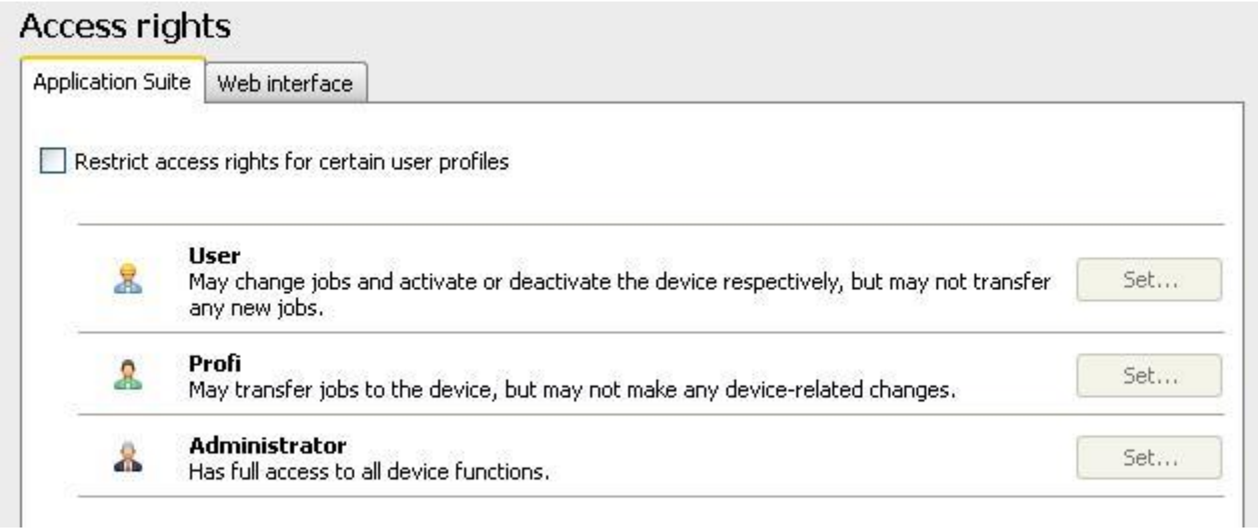
ATTENTION!

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			+

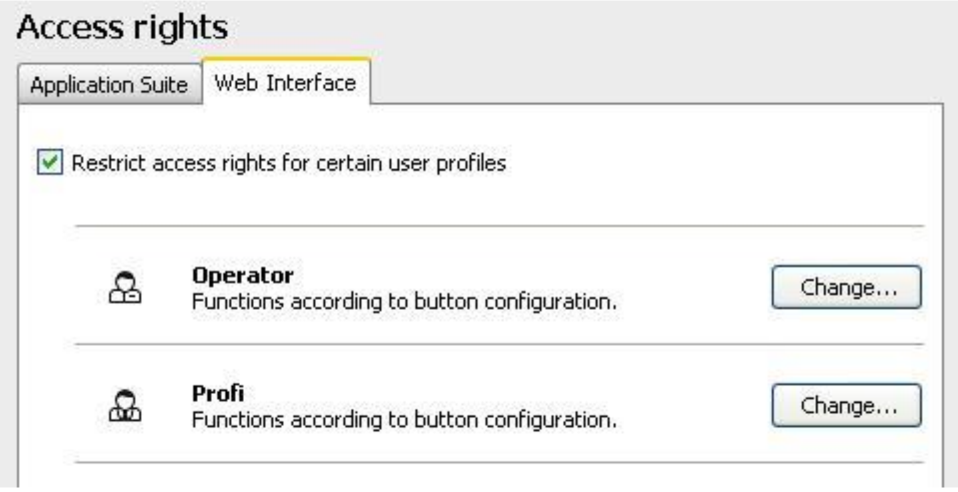


Activate the option *Restrict access* rights for certain user profiles for using user profiles.

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

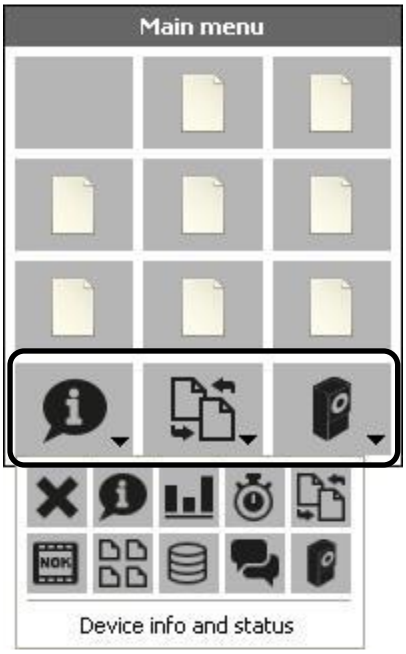
The rights to change individual functions relating to a job can be set during job creation as part of the *Configure interface* → *Web interface* step.

Rights for device-specific functions are set under *Device* → *Device settings* → *Configure web interface.*

10.2.3 Customizing web interface

10.2.3.1 Functions

In this dialog, 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.)

Configuration of device specific functions:

	User	☑ Profi
Device info and status	☐	☑
Statistics	☐	☑
Processing time	☐	☑
Switch job	☐	☑
Defect images	☐	☑
Job management	☐	☑
Backup	☐	☑
Language	☐	☑

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*".

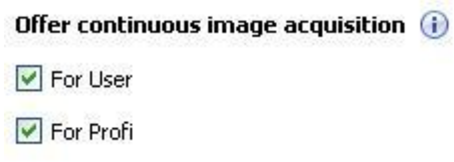
Language settings

Language: German

☑ Save selection by web interface

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.



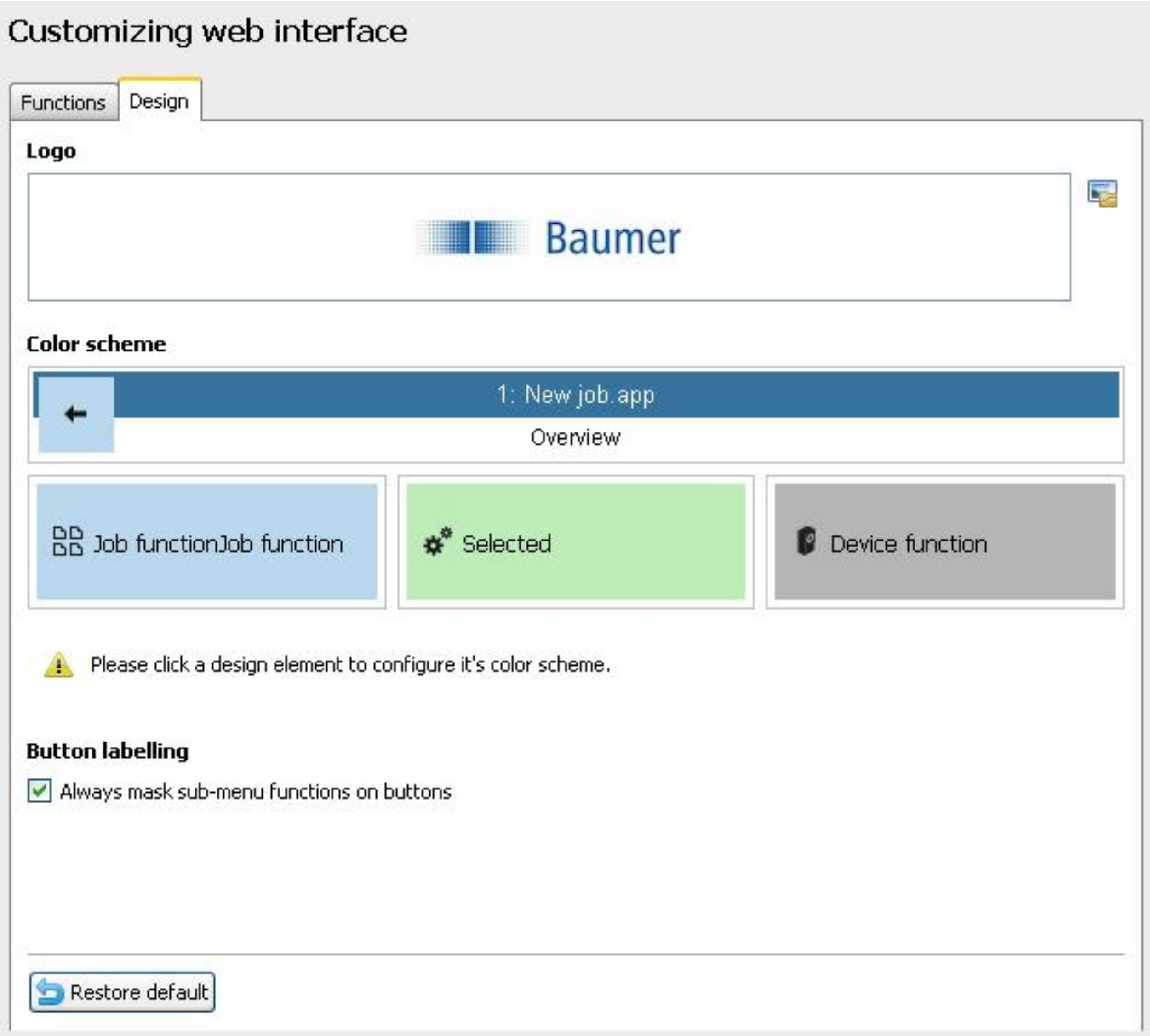
> **ATTENTION!**
>
> The live image function puts the device into "free running" mode, i.e. it runs without the external trigger signal. Please be aware of the effects this may have on later processes.

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 dialog, you have the option to adjust the color 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 color.

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

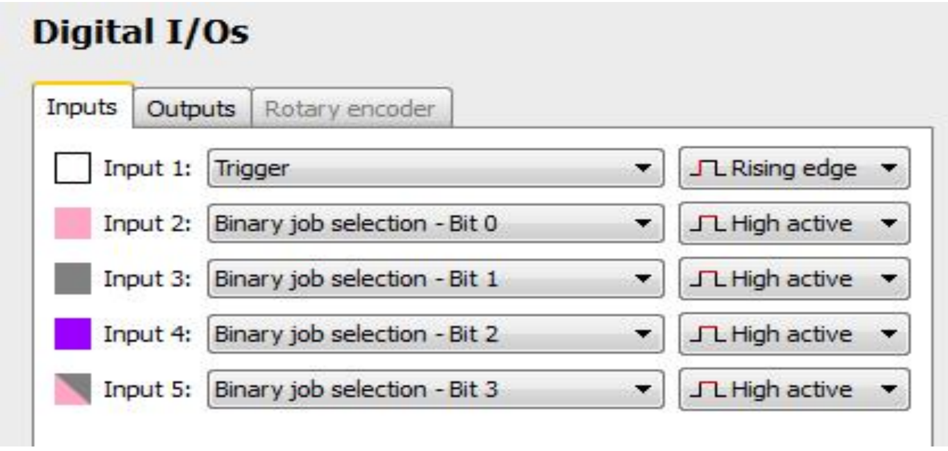
Button labels: Activate this function if you do not wish the second row of the buttons to be displayed in the web interface. This is particularly useful for smaller monitors.

Using this button, you can restore the original settings.

Digital I/Os

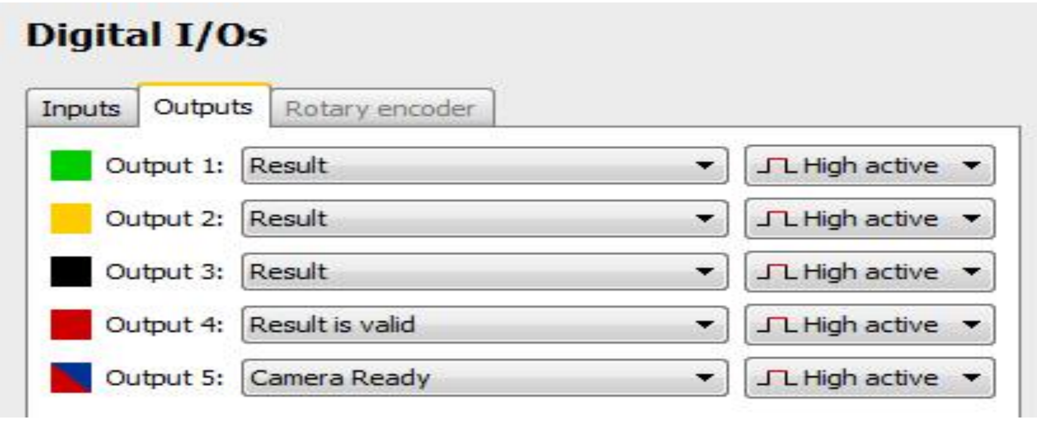
You can make the settings for the digital interface in this dialog page. You can also configure an incremental encoder and specify the polarity of the digital inputs and outputs.

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

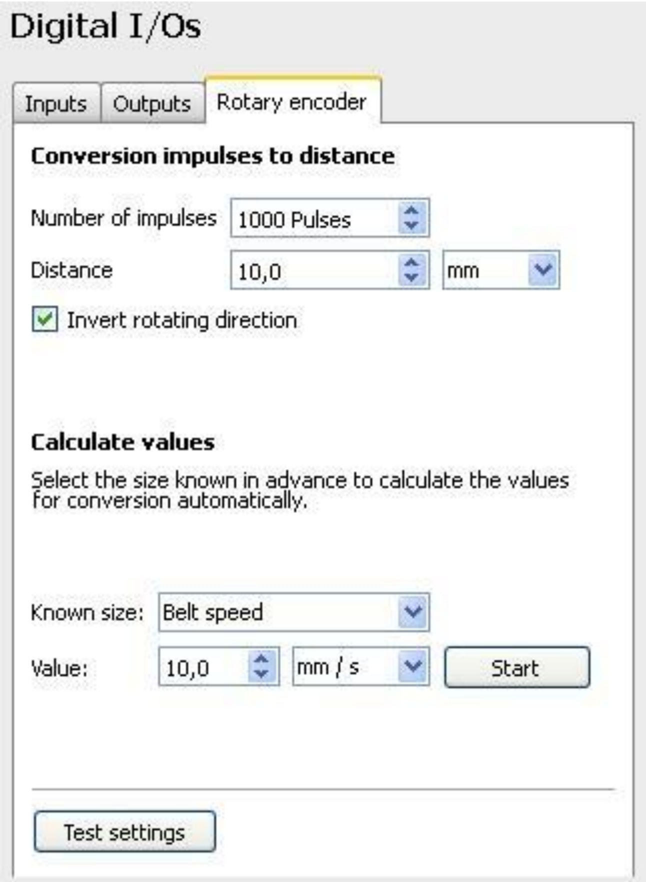


Enter how the outputs are to be activated here. You can output hardware signals (Flash Sync, Alarm, Camera Ready, Result is valid, device activated) for each output or configure the output for outputting job results.

NOTE

The number of configurable outputs is model-dependant.

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.

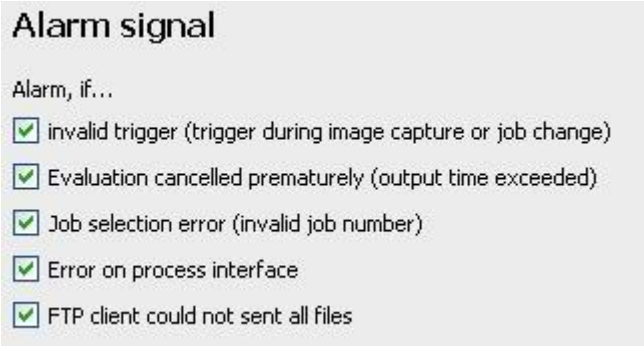
Press the Test configuration button to check the current setting.

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.

10.2.4 Alarm signal

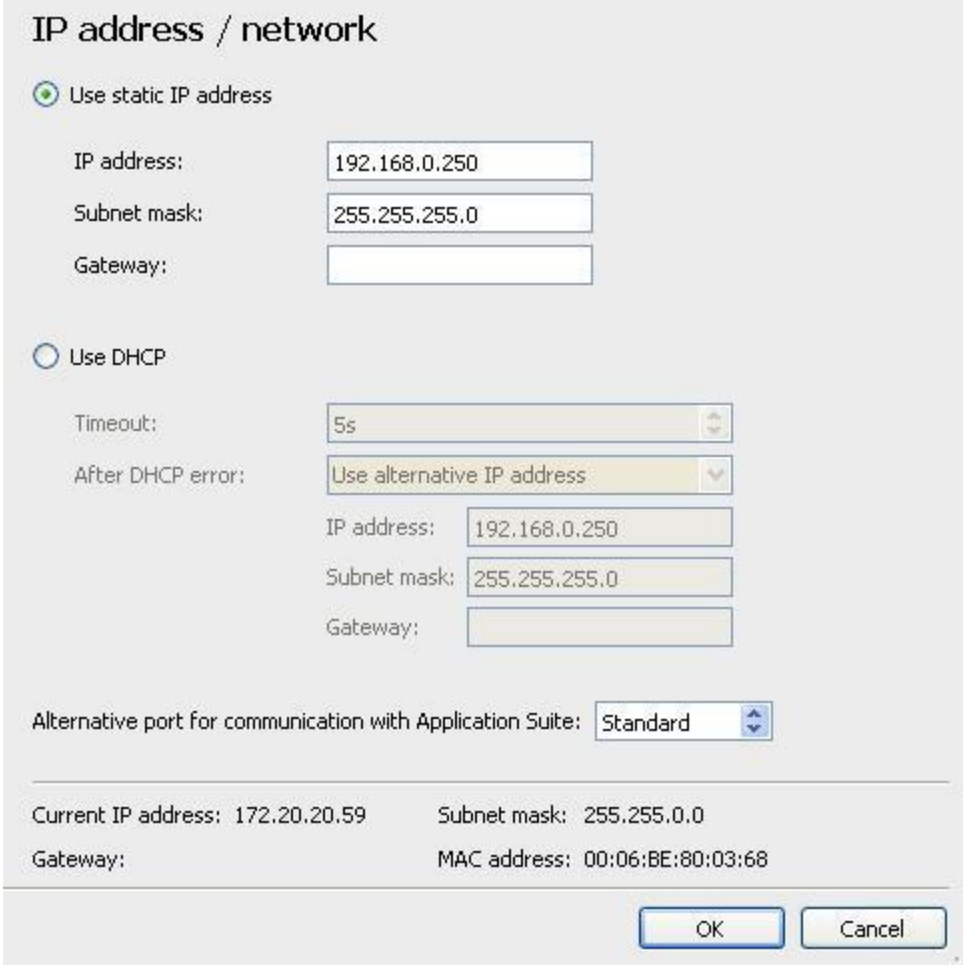


You can define the conditions which cause an alarm to be initiated here. Alarm signals indicate that an irregularity has occurred in the sensor.

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.

10.2.5 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.

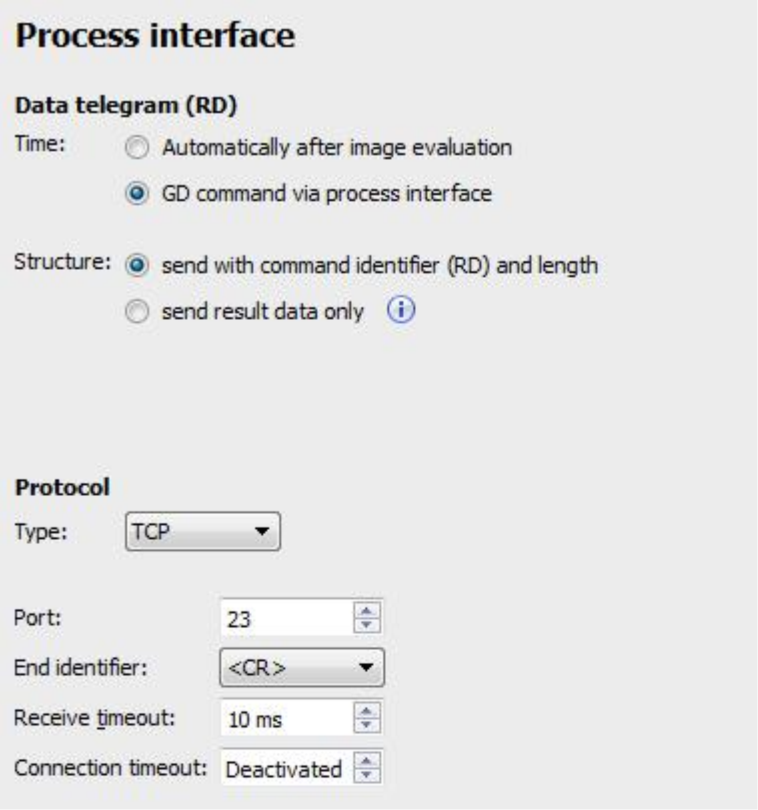
- **DHCP (Dynamic Host Configuration Protocol)**
  If you have integrated a DHCP server in your network, the IP address is obtained there. If this does not happen within a specific time and a timeout occurs, you can choose whether:
    - the last IP address obtained via DHCP is used
    - another fixed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

10.2.6 Process interface (model-dependant)



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

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).

Protocol

Type: Set the protocol here (TCP / UDP / RS485).

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.
Receive 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) (model-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)
Receive 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: Deactivate the terminating resistor if more than 6 devices are being operated on one 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 via RS485) (model-dependant)

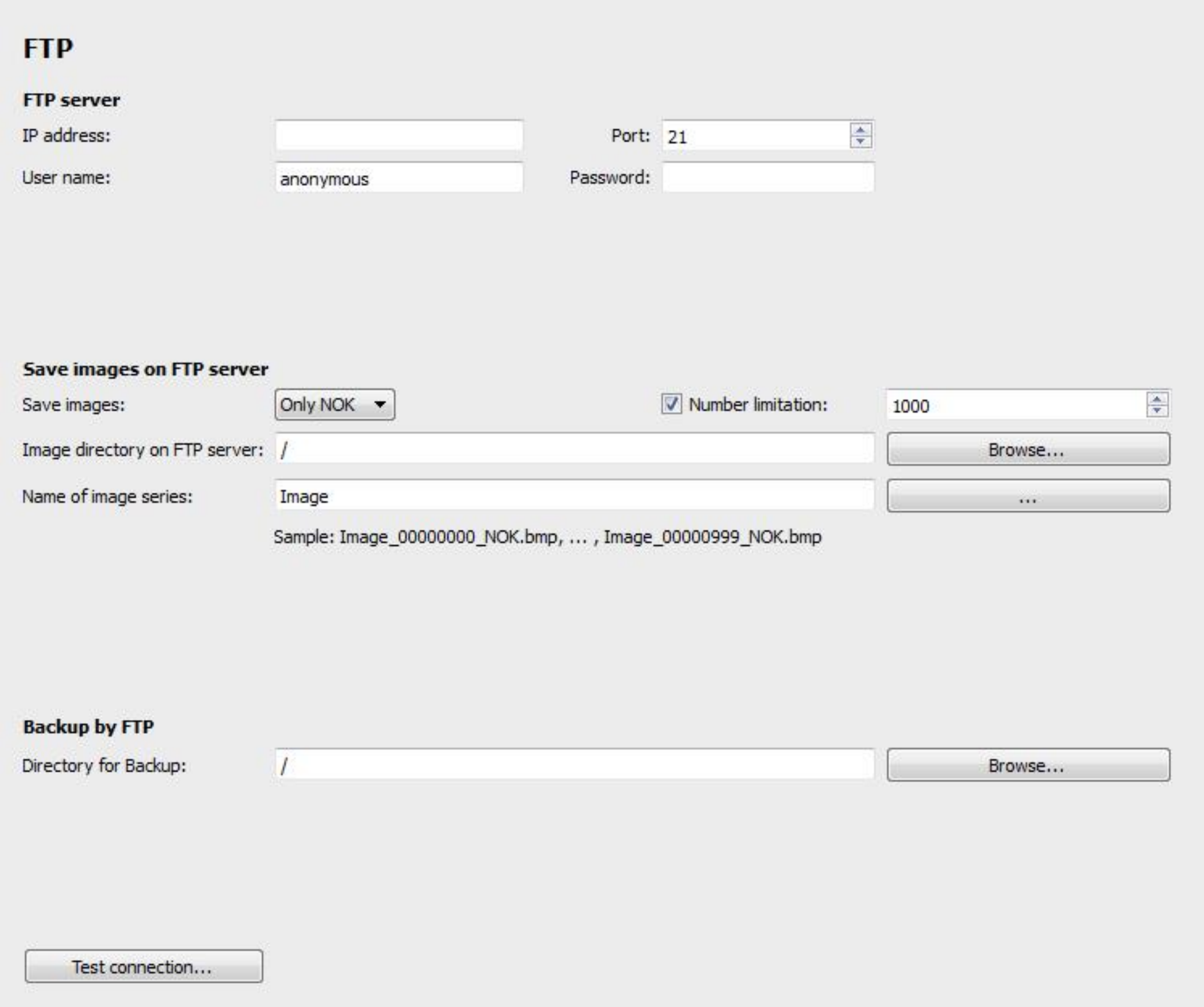
Here, you will find all parameters that can be used to configure data exchange over *PROFINET via the RS485 interface*. Parameters that are greyed out are not configurable and are only displayed.

Device number: If you have multiple devices on one PROFINET-RS485 bus, each device must be assigned a unique device number (1-4).

RS485 terminating resistor: Activate the terminating resistor for the last device in a PROFINET-RS485 bus**.**

10.2.7 FTP

Using the FTP function, you can save selected images on an FTP server during production. It is also possible to store backups of the device to FTP servers and to access them up from there.



FTP Server
IP address: IP address of the FTP server
Port: Port number for the FTP server

Username: Enter the username for FTP access.
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.

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

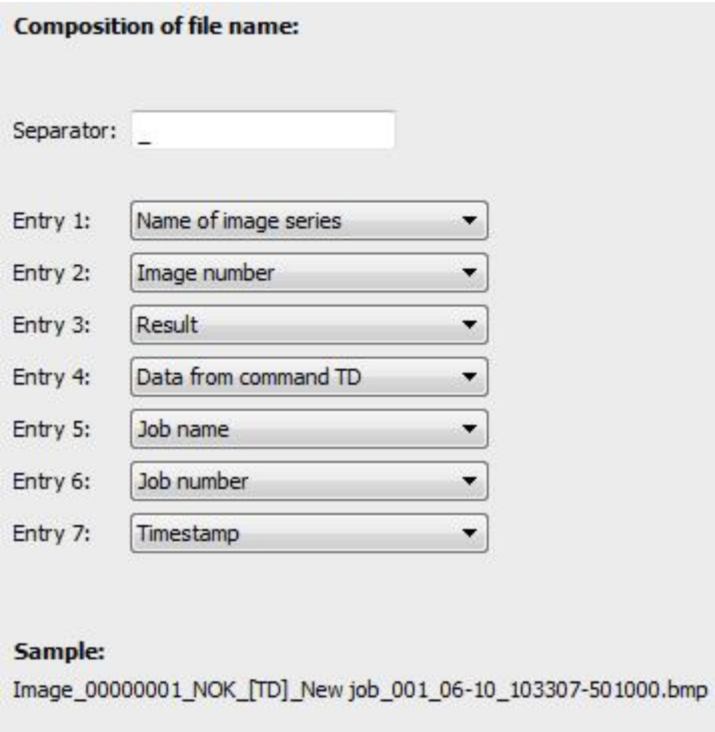
Saving images: Select the images to be stored on the FTP server.
(NOK only = all images with the total result of "Fail", OK only = all images with the total result of "Pass")

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 a separation marker.

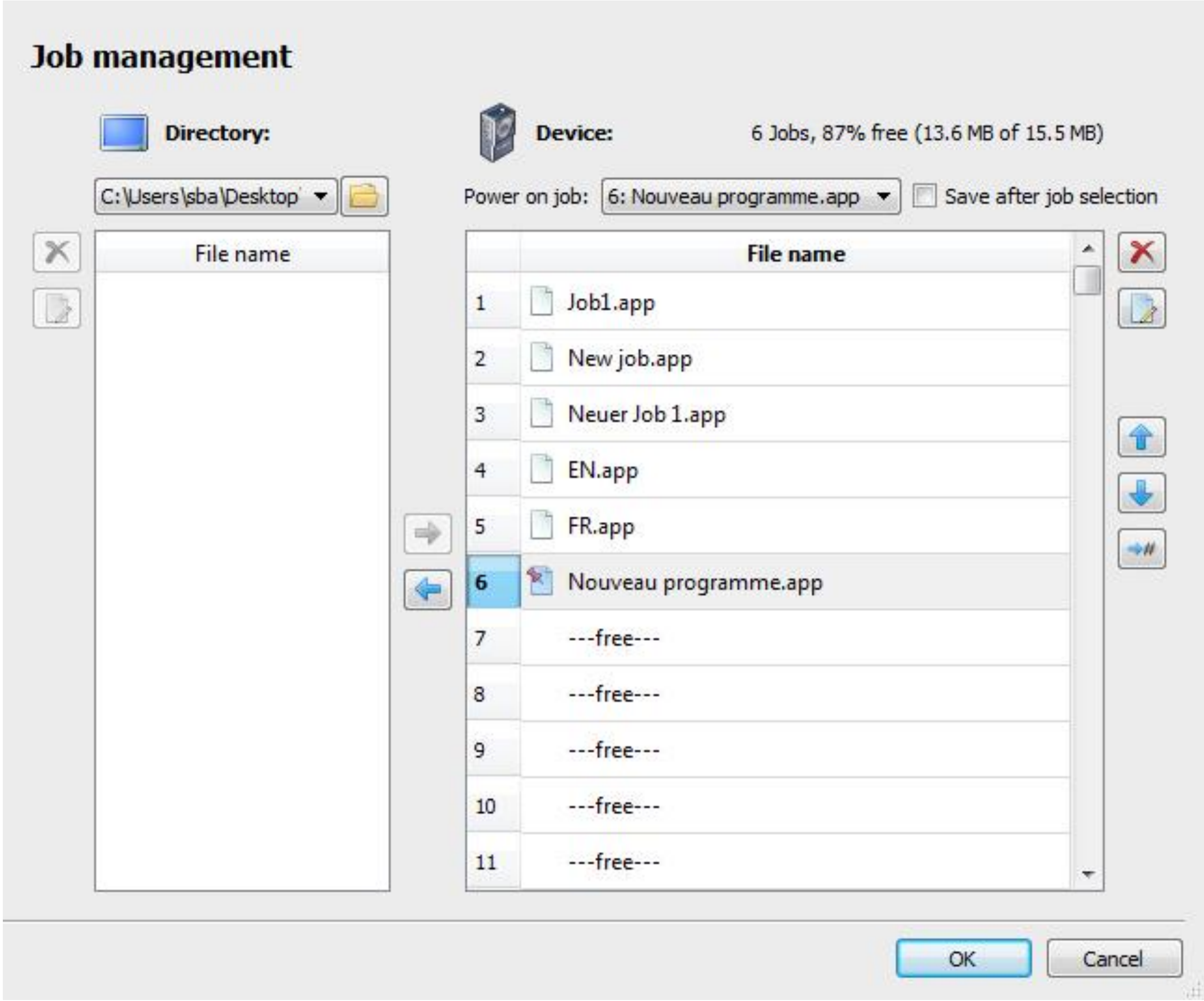
The entry options for the device are:

- 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 (when saving images to the PC and backups from the PC: PC time; backup from the browser: browser time (i.e. PC or plant computer; saving images to FTP: time from 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.

Job management

With this dialog, 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.

10.2.8 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.

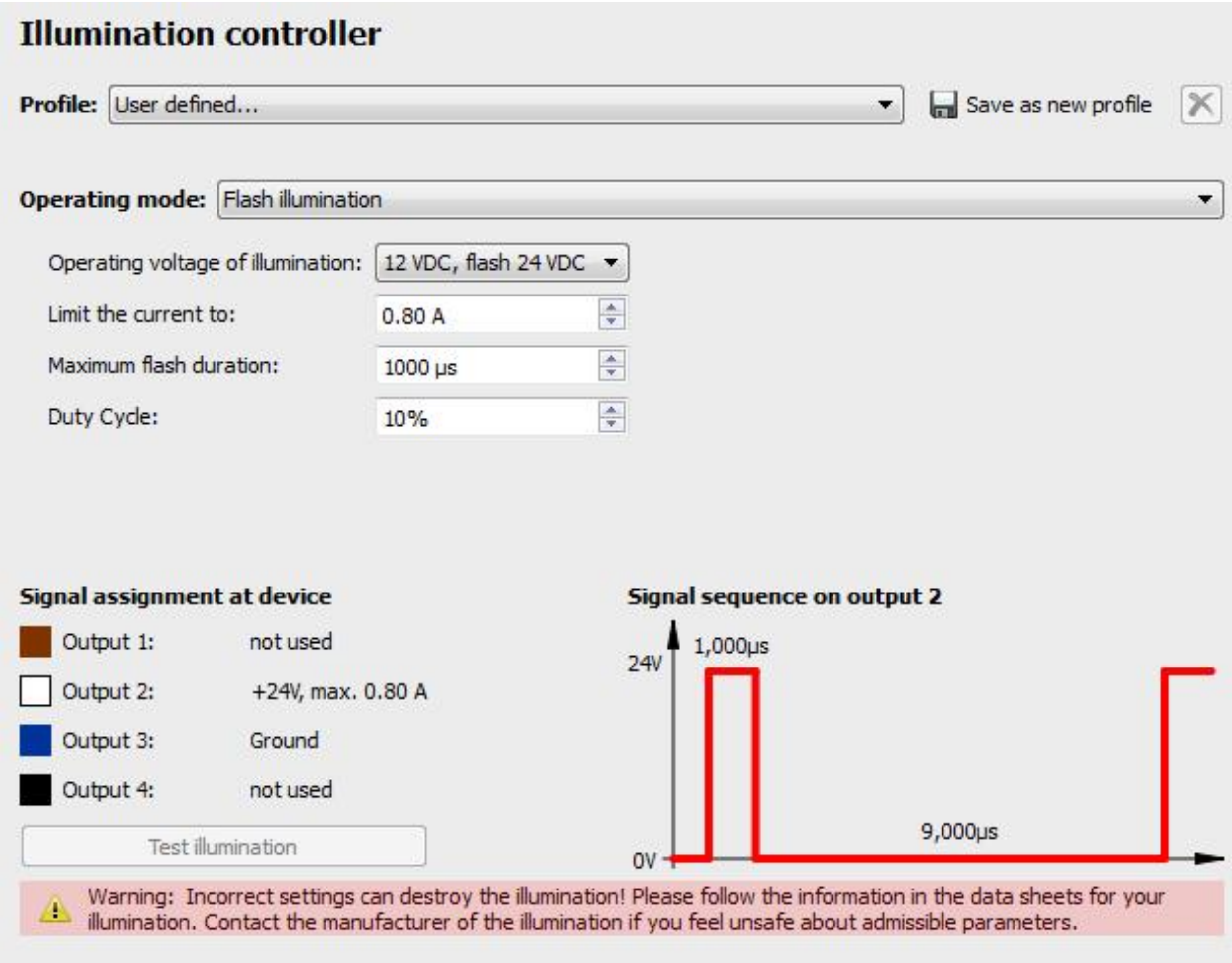
Digital inputs: Jobs are selected via the digital inputs.

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-in 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.

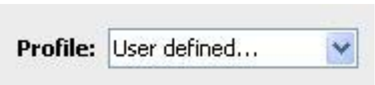
10.2.9 Illumination controller (model-dependant)



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.

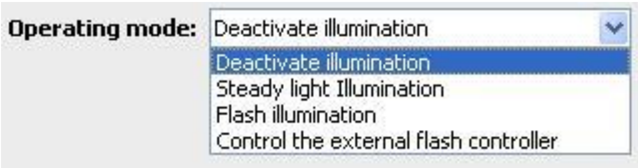
To use the illumination controller, the device must be in *Configuration* mode. If the menu item is not visible, your device does not support this function.



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

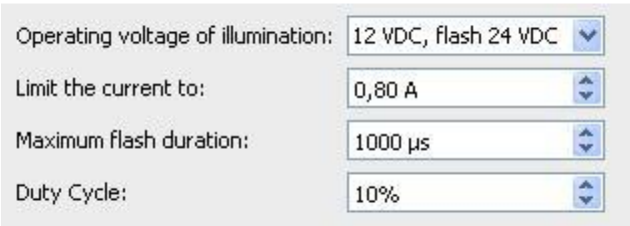
If you have made your own settings, you may save them as a new profile.

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



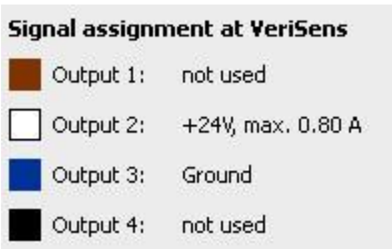
You have various operating modes available.

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

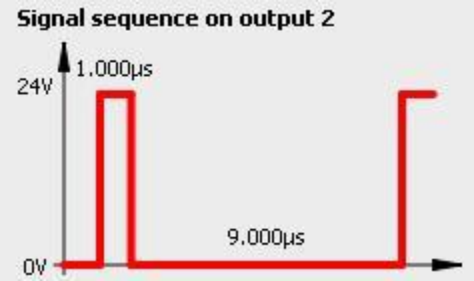


Here, you can define settings in the current operating mode.

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.



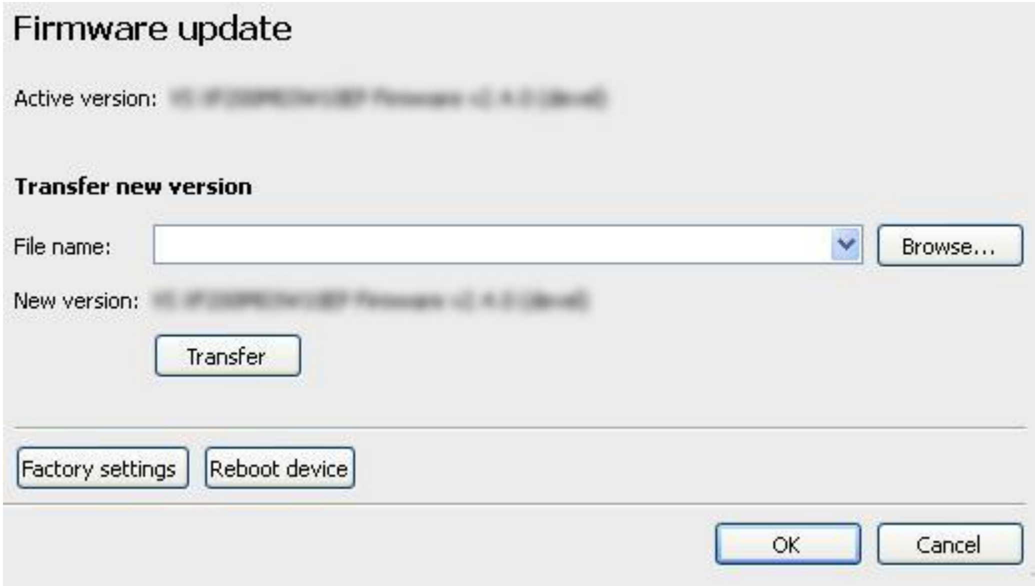
This diagram shows the current waveform at output 1 and output 2.

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.

10.2.10 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 dialog 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!

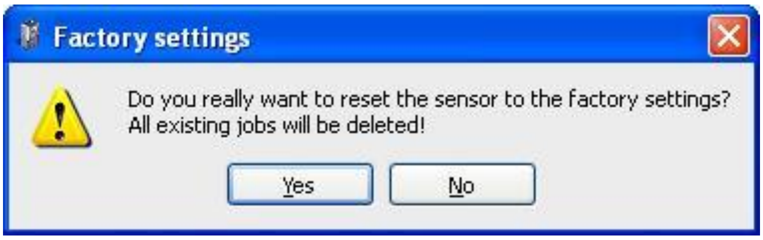
Click on the button *Browse* and select the firmware file to be transferred.
(File extension *.vsf).

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 function is equivalent to switching the power supply off
and back on.

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

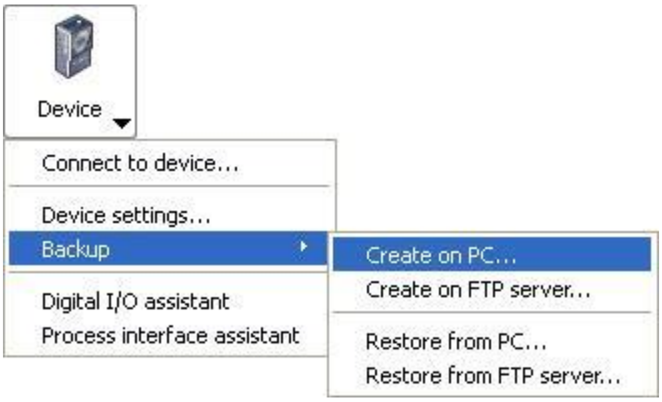
10.3 Backup

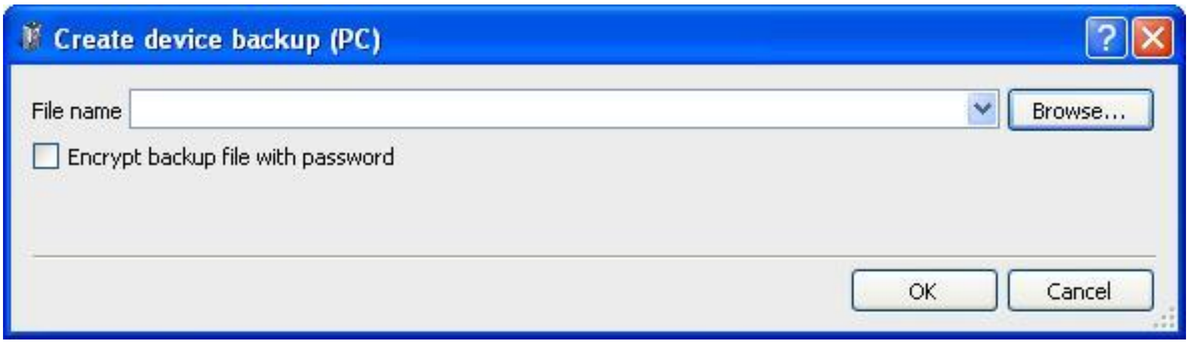
NOTE

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...



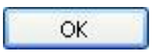


This dialog page supports you in making a complete device backup of your device on the PC. Here device settings, jobs and firmware are saved in a file. Activate the option "Encrypt backup file with a password" if the backup file is to be stored in protected mode.

NOTE

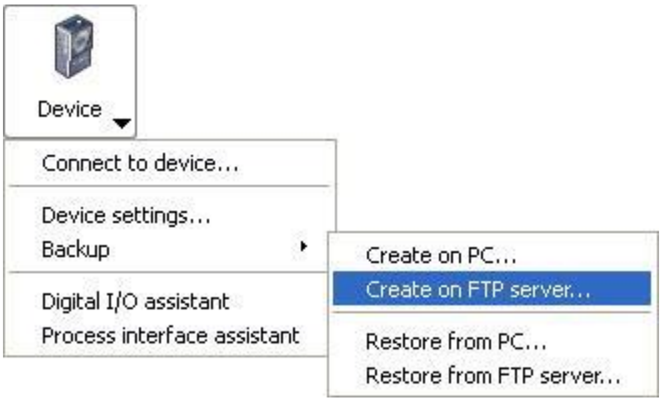
The device backup cannot be reloaded without knowing the password!

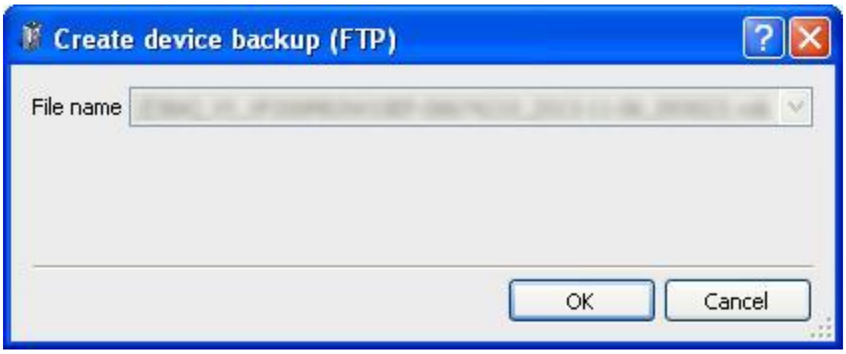
Specify a storage path and a file name for the backup file or click on *Search*. The file extension must be `*.vsb`.



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...





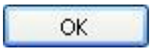
This dialog page allows you to create a complete device backup of your device on the FTP. Here device settings, jobs and firmware are saved in a file.

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

NOTE

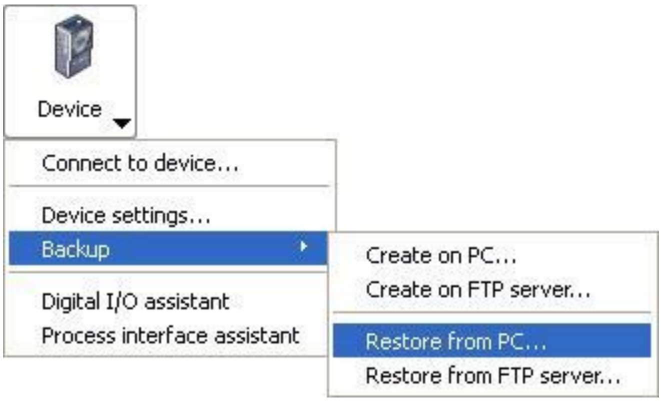
Do not save the images and backup file to the same folder on the FTP server. This can lead to long load times.

FTP settings: *Device → Device settings → FTP*

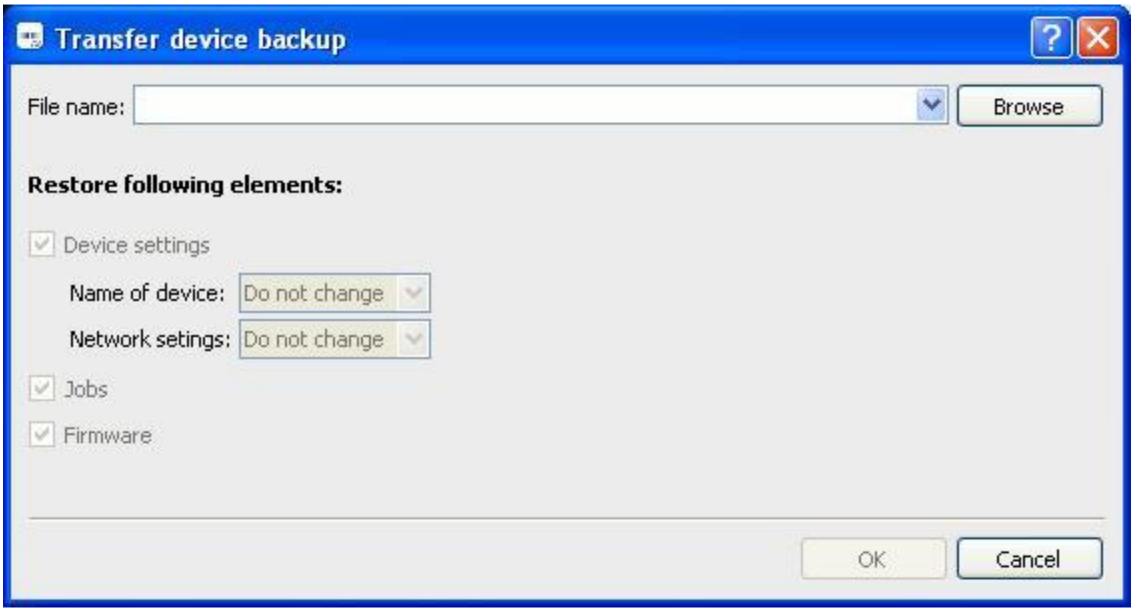


Click on *OK*. The required file is created. During this process, all device settings and jobs are transferred. This process may take a few minutes.

10.3.3 Backup – restoring from the PC...

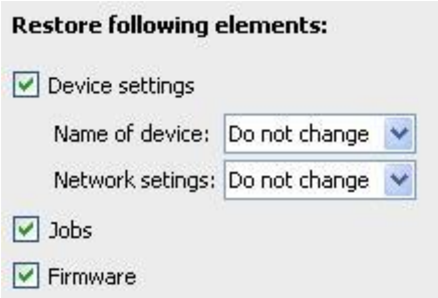


Use this dialog to transfer a device backup file from the PC to the device.



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.



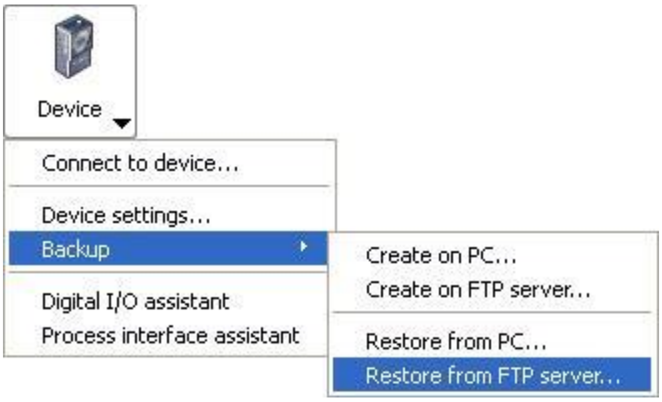
Here you select what components are to be transferred during the restore process.

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.

10.3.4 Backup - restoring from the FTP server



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

With this dialog, 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.

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 assistant, the device must be in Setup mode. If the menu option is still grayed, your device may have the wrong firmware version.

ATTENTION!

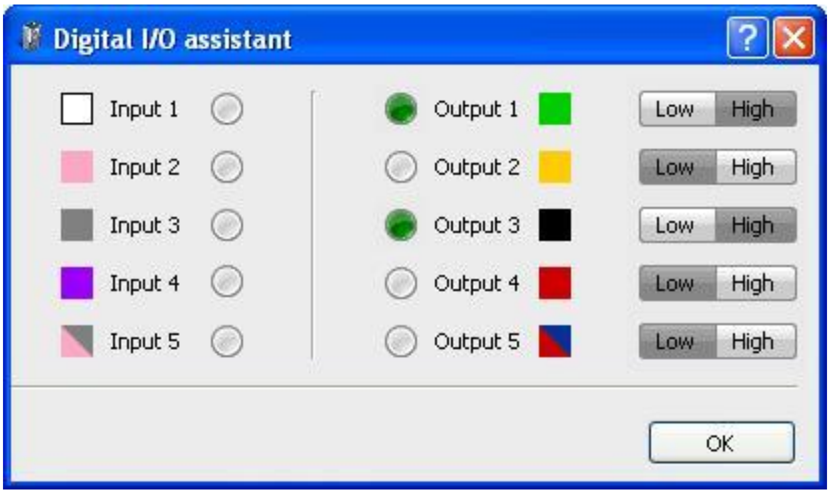
If your Vision Sensor has already been permanently integrated into your system, it is advisable during initial testing to check the outputs with a meter. Keep in mind that switching of the outputs will be transmitted to any connected controllers!

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.

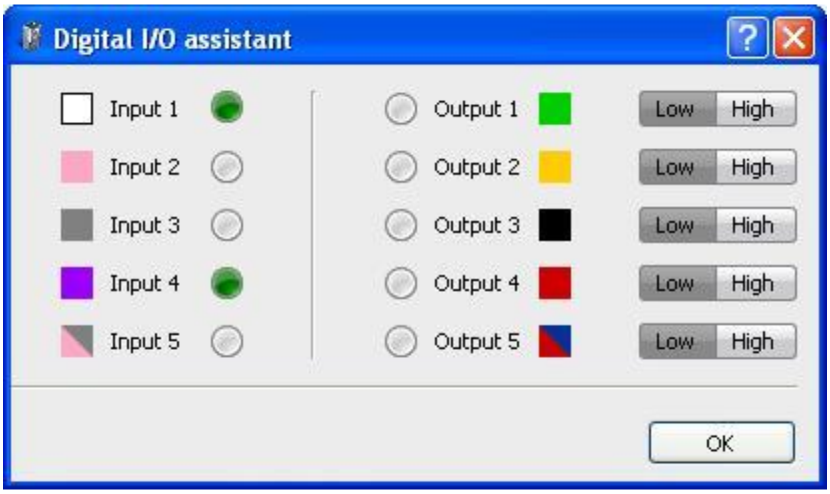
Example using outputs



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



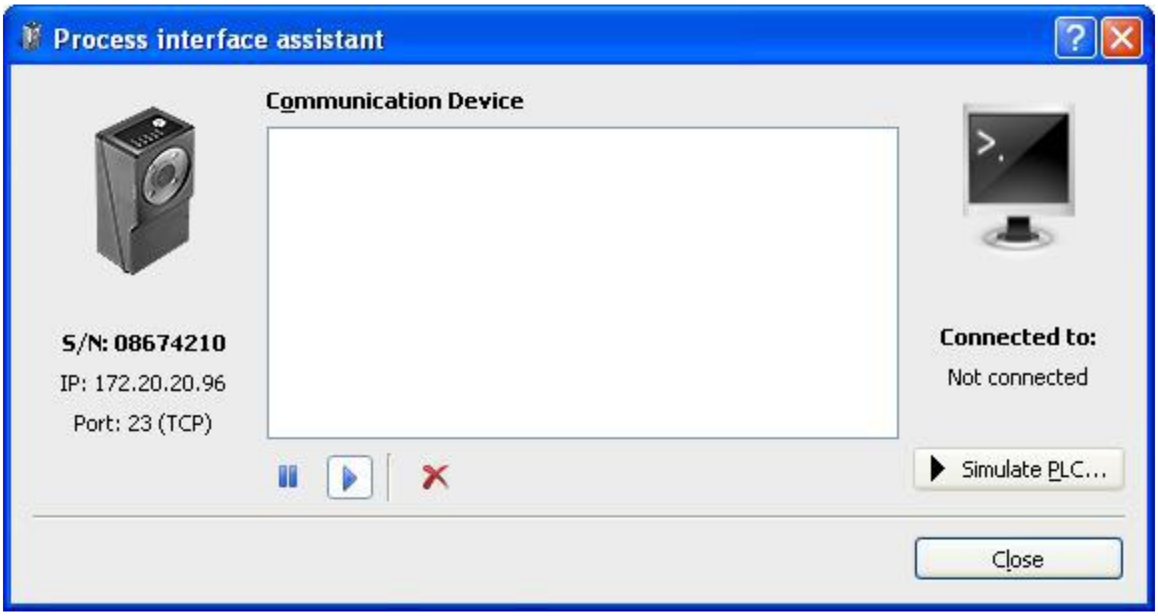
In the example, applied power is registered on Input 1 and Input 4.

10.5 Process interface assistant (model-dependant)

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.

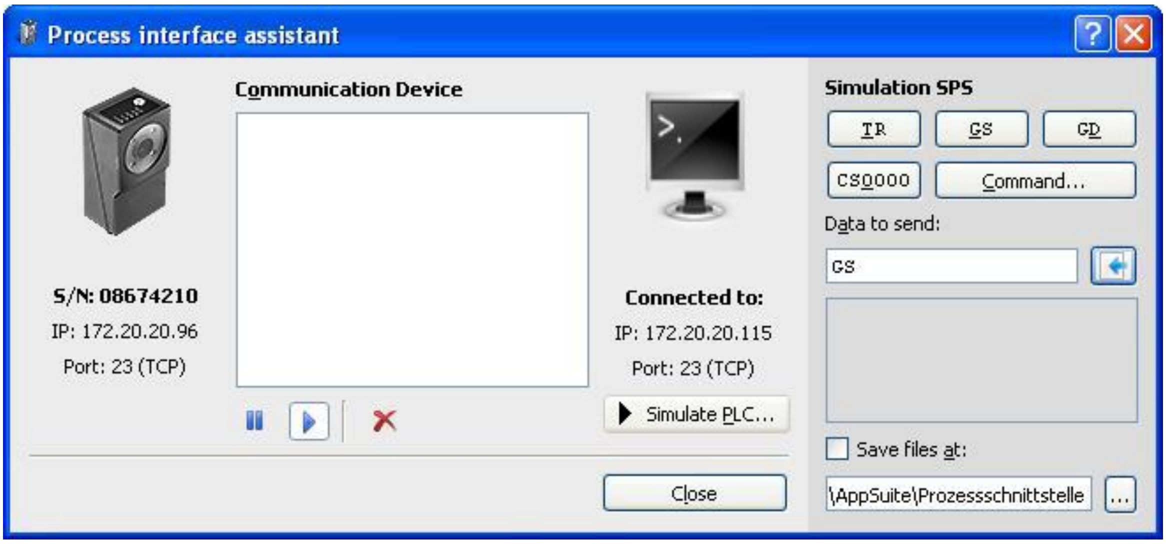
This window is updated immediately when a datagram is transferred through the process interface, regardless of whether it was sent from your PLC or PC.

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



You can also use this dialog 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

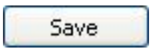
Device menu → Device settings → Job management.

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*.

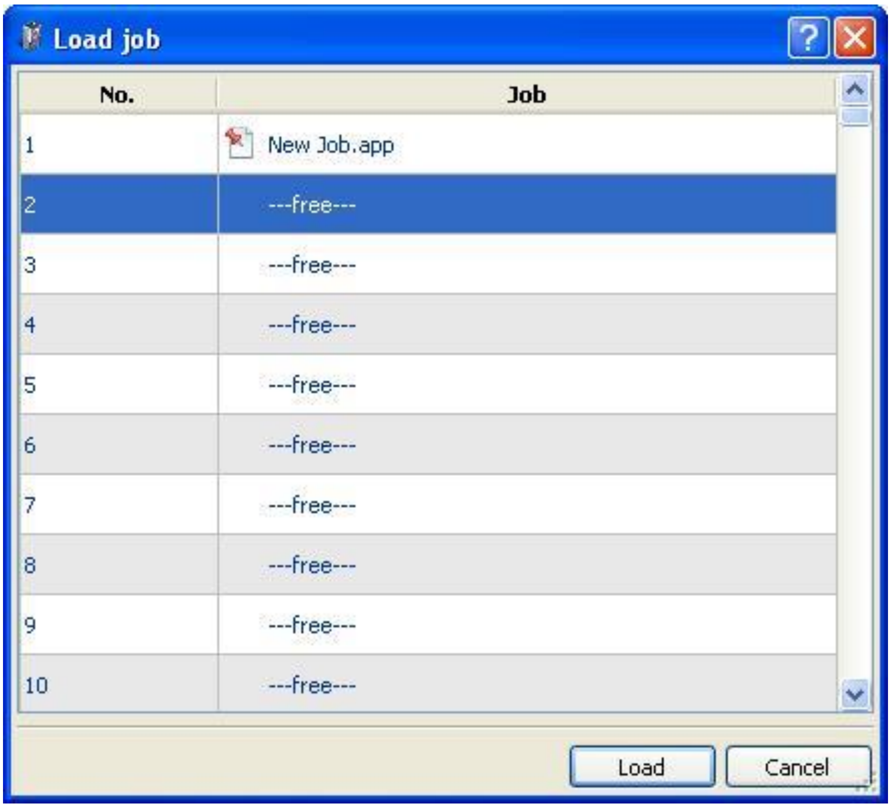
NOTE

Password-protected files cannot be loaded if the password is not known!

You can now process the loaded job.

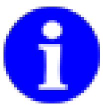
11.3 Load job from device...

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



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

Select the job and click on *Load*.

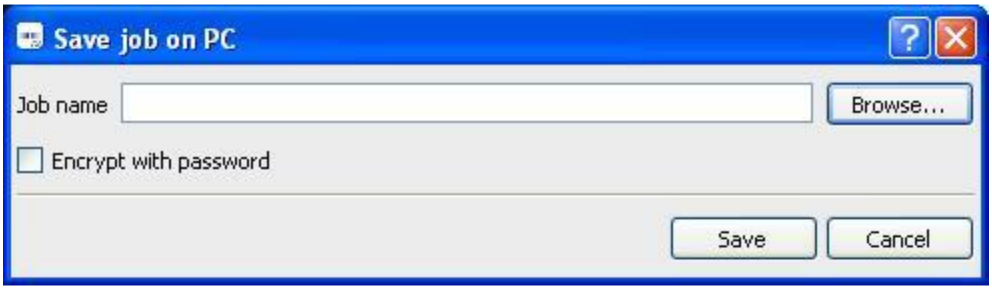


NOTE

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.

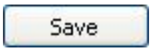


Use *Browse* to select a directory where you would like to save the job.

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

NOTE

The file cannot be reloaded afterward without knowing the password!



Click on *Save* to create the file.

11.5 Save to the device...

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

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

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".

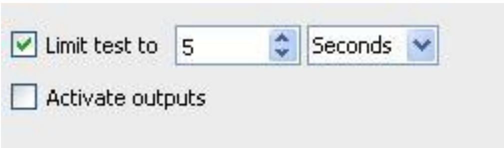
Specify the directory where the pre-selected images will be saved by using *Browse*.

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!



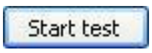
You can limit the duration of the test. Select a value and choose between seconds and images. You can also activate or deactivate the outputs.

NOTE

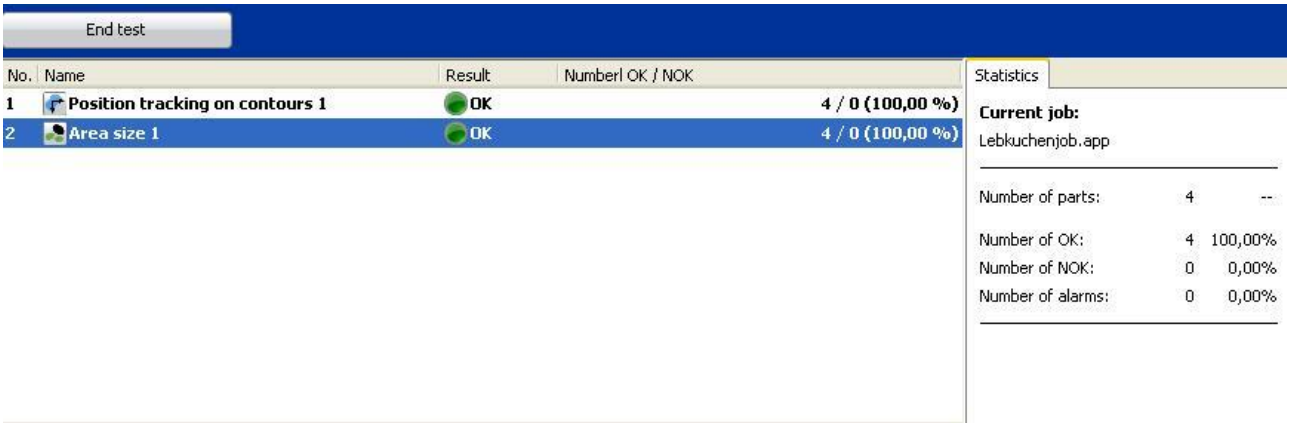
If you do not limit the test sequence you may terminate the test at any time using the *Finish* button.

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 behavior 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.

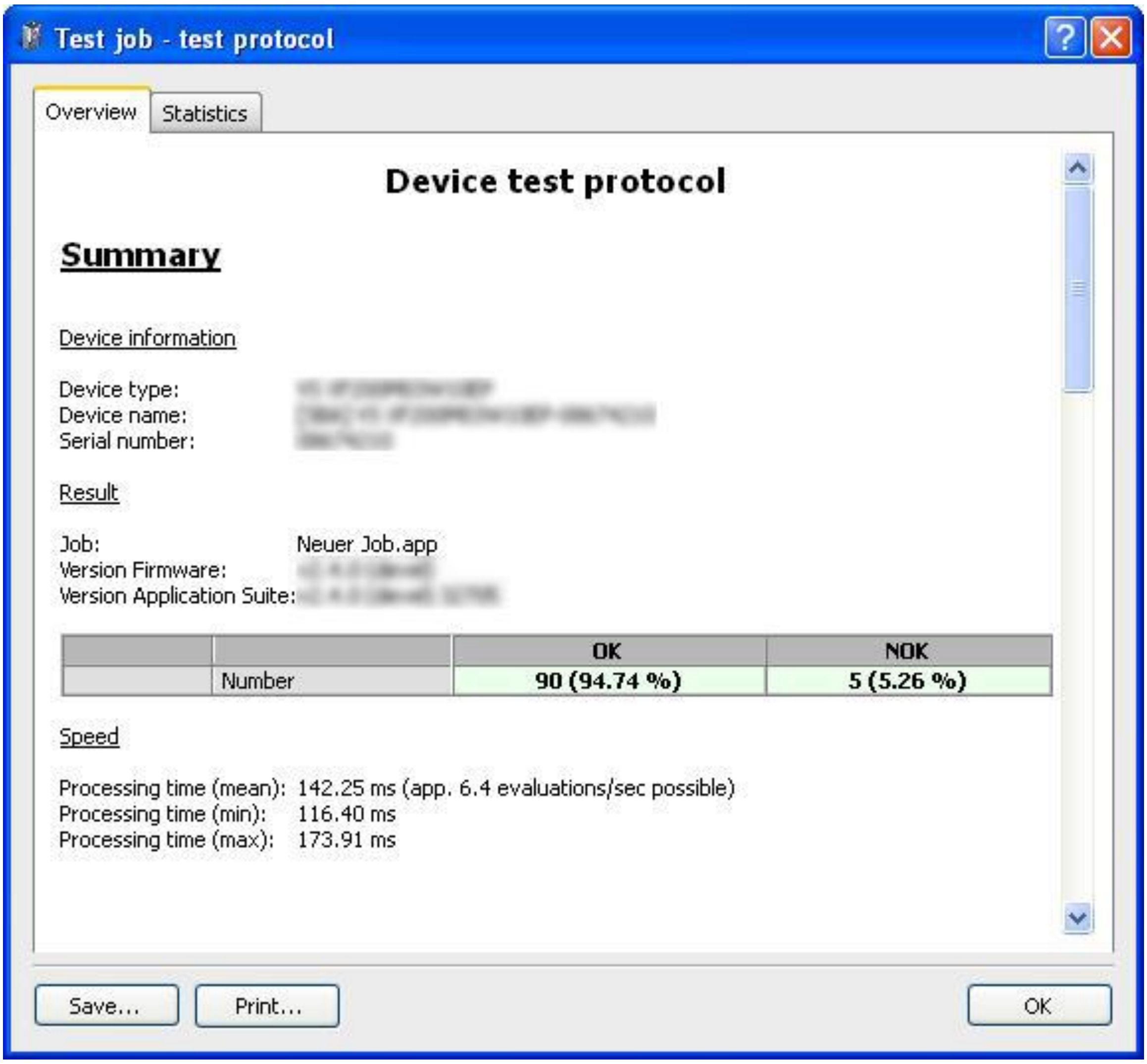


Click on "End test" when you want to end the test.

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 colors.

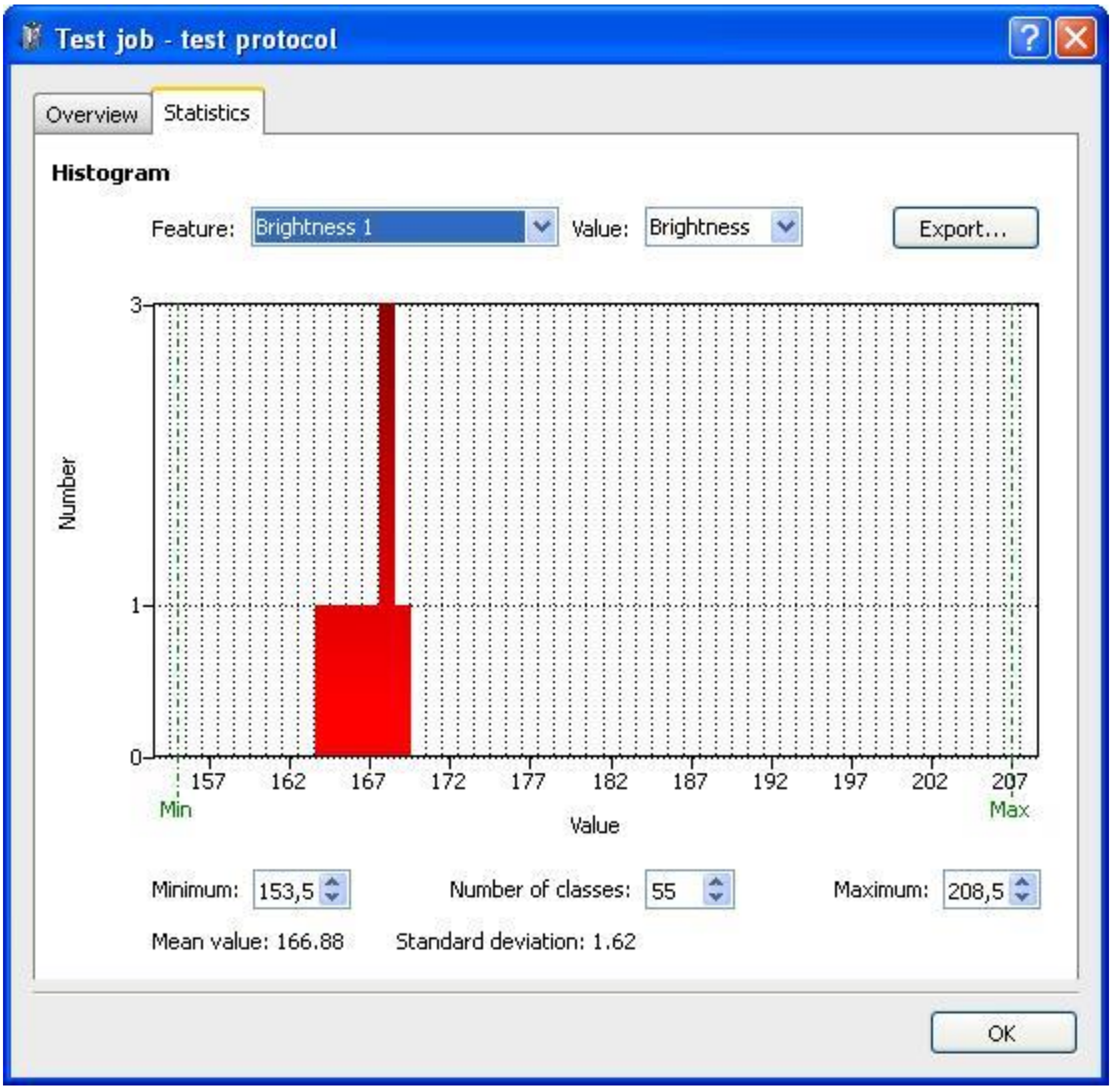


11.6.2 Test Protocol – Statistic

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 (model-dependant)

12 Feature checks

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

Please see the *Correct use* section for information as to which devices support which feature checks.

NOTE

The *Application Suite* CD features a range of application examples that provide you with typical solutions for various inspection task and for the use of the individual feature checks. After successful installation, the examples can be found in the subdirectory:

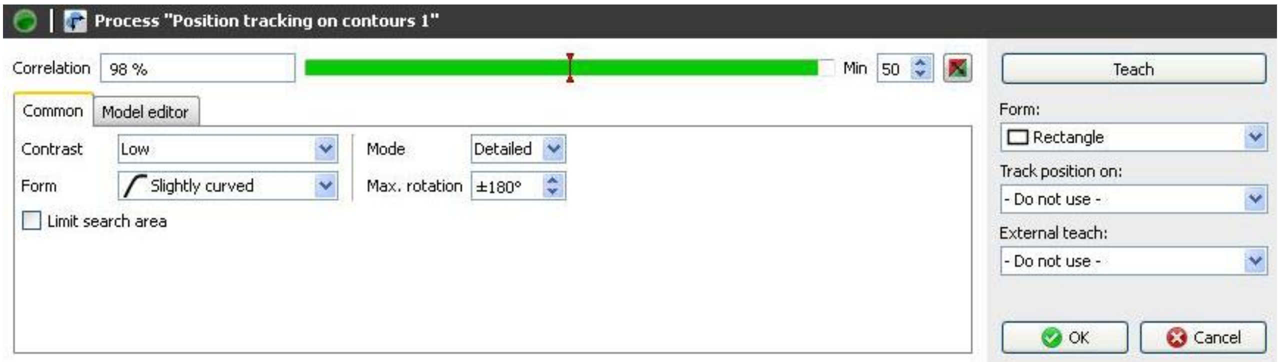
`<installation path>\AppSuite\Samples`

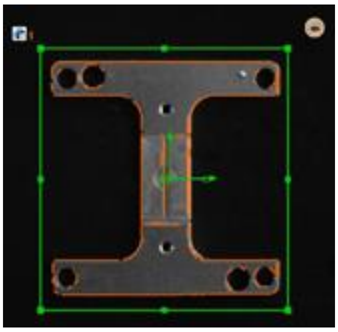
on your PC.

12.1 Part location

12.1.1 Part location on contours

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





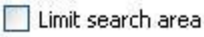
!

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

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

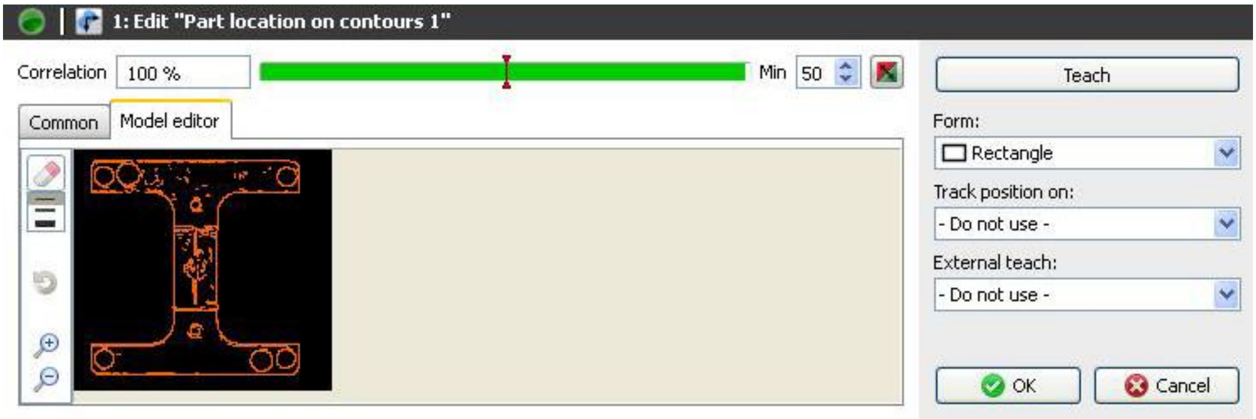
- The match of the contours with the found object in the image is displayed here.
- Using the appropriate switching points, set how good the match must be so that the object is found. The button on the extreme right inverts the set point.

- **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.
- **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 search area.

Model editor tab



- With the displayed model, you can now use the mouse to delete contours 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*.

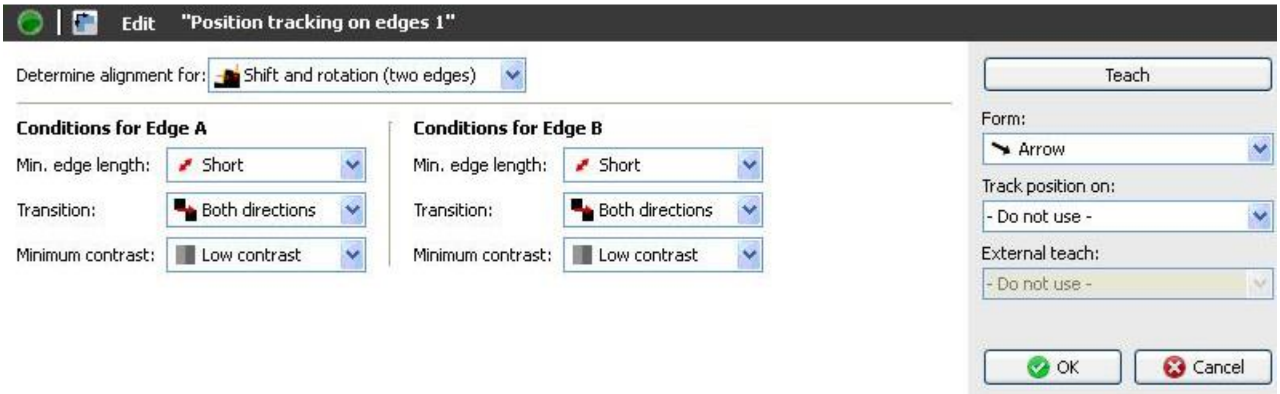
This feature check has the following output values for the datagram at the process interface:

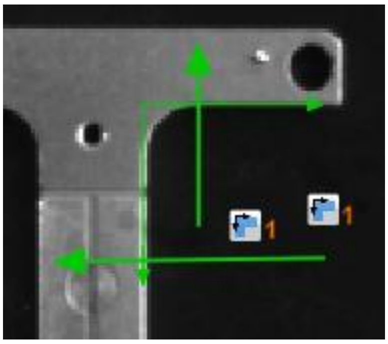
Output value	Data type	Description
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Conformity	Integer	Match of the model (%)
Center of object	Float-Point	Position of the object in the image (px)
Angle of object’s rotation	Float	Angle of the object (degrees)

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-in. If a teach-in procedure is still executed, the parameters set will be maintained.

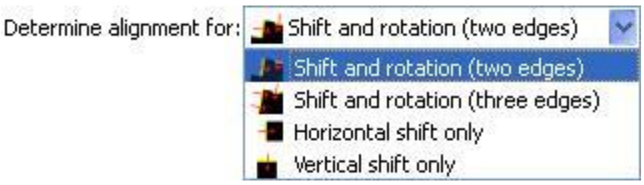




In this example, two edges of a test object are found, with a horizontal and a vertical search line, and the reference point for part location is determined at the intersection of the detected edges.

- 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 progresses from bright to dark or from dark to bright (model-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:

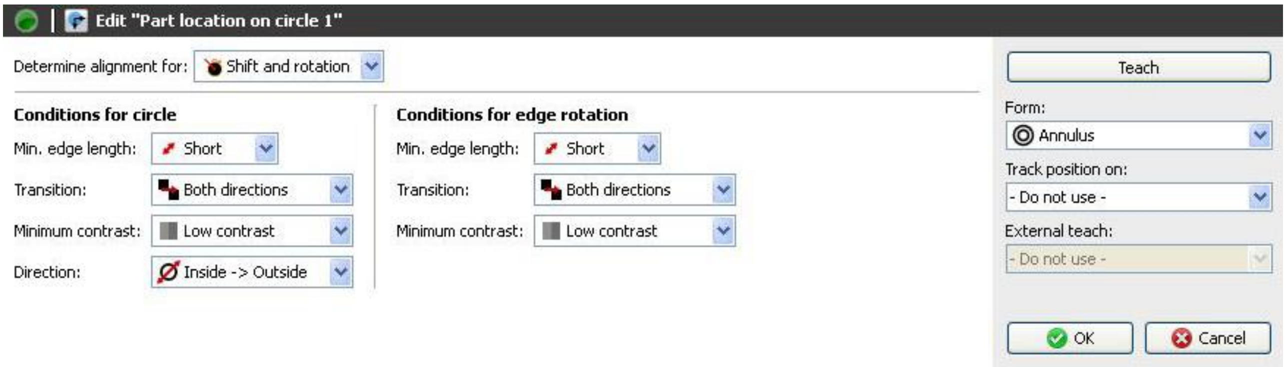
Output value	Data type	Description
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Center of object	Float-Point	Position of the object in the image (px)
Angle of object's rotation	Float	Angle of the object (degrees)
Edge A	Float	Coordinates of the found edge A: Start point X – separator Start 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

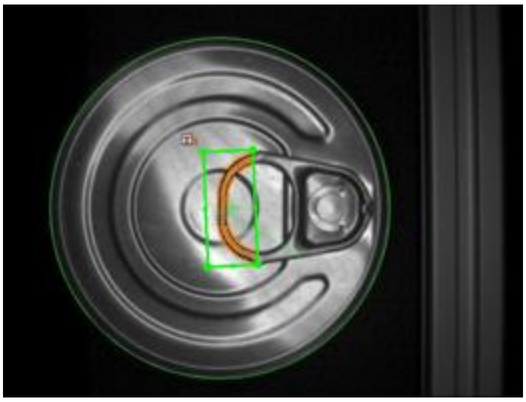
12.1.3 Part location on circle

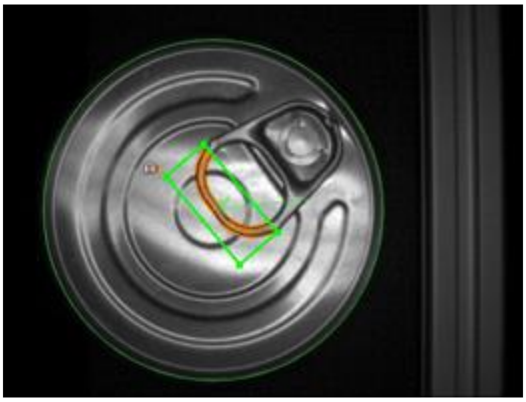
With this feature check, you can align a round object with regard to its center. It is also possible to correct the angle of rotation on the basis of an edge along the object.

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-in. If a teach-in procedure is still executed, the parameters set will be maintained.



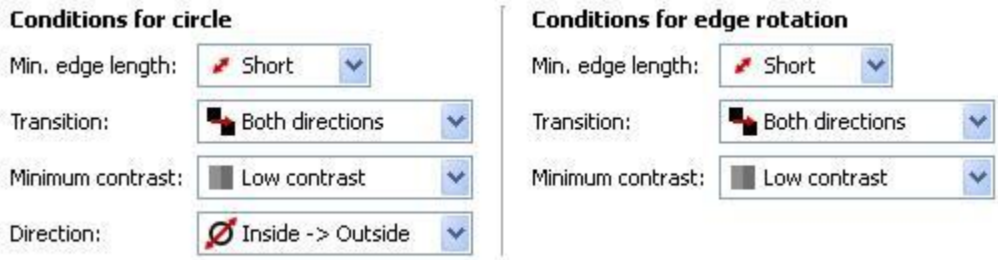




Configuration for part location on a circle as follows:

- 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 (model-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*.

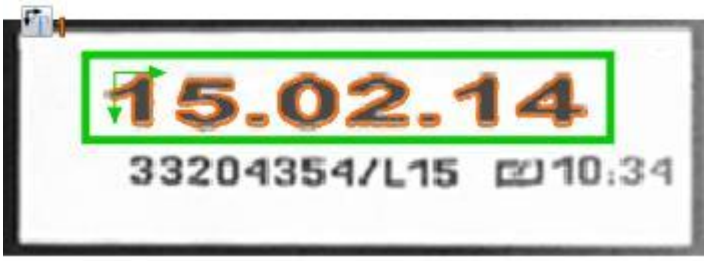
This feature check has the following output values for the datagram at the process interface:

Output value	Data type	Description
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Circle center	Float-Point	X – *Separator* – Y
Circle diameter	Integer	
Edge (for rotation correction)	Integer	Coordinates of the found edge for rotation correction: Start point X – *Separator* Start point Y – *Separator* Rising of edge ∆x – *Separator* Rising of edge ∆y – Separator

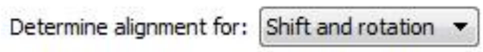
12.1.4 Part location on text line

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:

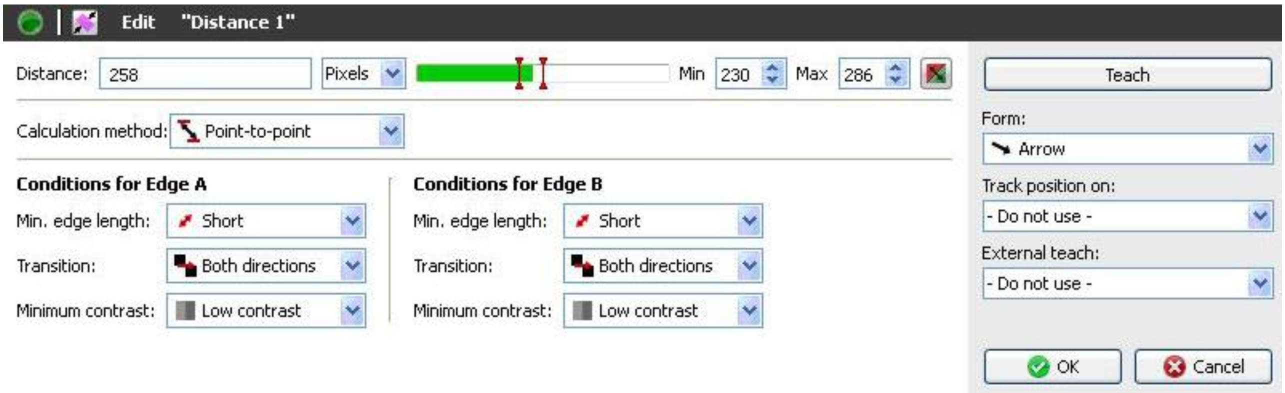
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Conformity	Integer	Match between the current object and the taught-in model (%)
Text position	Float-Point	X – *Separator* – Y
Text angle	Float	

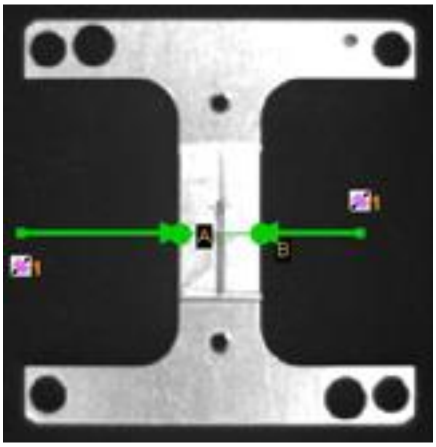
12.2 Geometry

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:

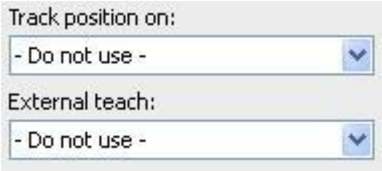
- The current result is displayed directly in the dialog as the distance. The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- 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 center of a circle
- **Circle to circle:** Distance between the centers 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 progresses from bright to dark or from dark to bright (model-dependant).
- **Minimum contrast:** 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-in 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*.

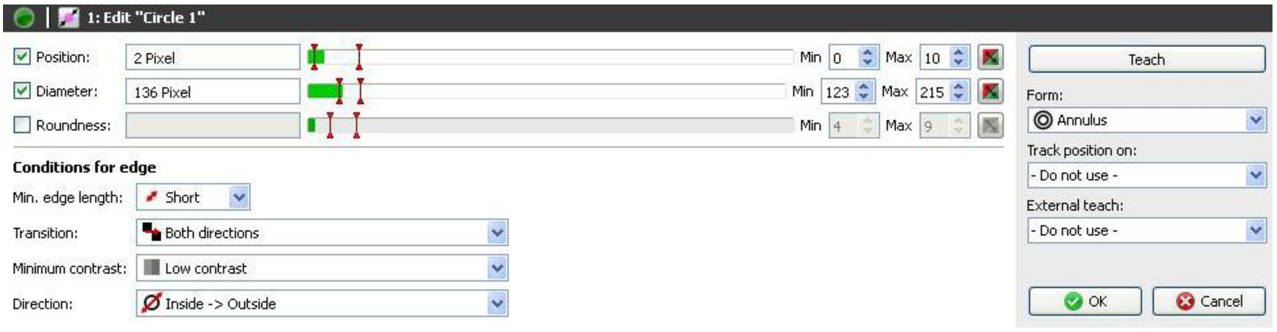
This feature check has the following output values for the datagram at the process interface:

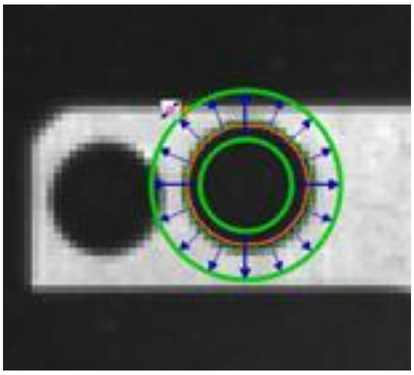
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Distance	Float	

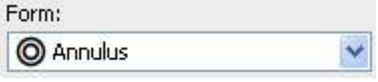
12.2.2 Circle

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 search 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.

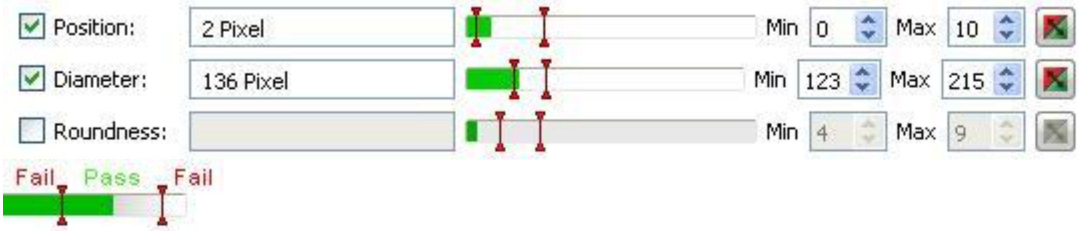






- Select the shape of the field of view. A circular ring and a circular ring sector can be chosen.
- Adjust the field of view by holding the left mouse button depressed.

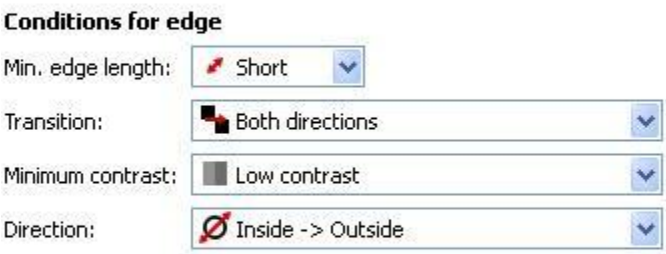
In this example, the diameter, position and roundness of a hole are determined by measuring from the outer circle towards the inner circle. Both results appear directly on the display:



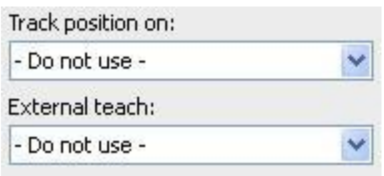
- **Position:** Determine the switching points of the position.
- **Diameter:** Determine the switching points for the diameter.
- **Roundness :** Determine the switching points of the roundness.

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

- If you wish to change the reference position of the center 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 progresses from bright to dark or from dark to bright (model-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-in 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*.

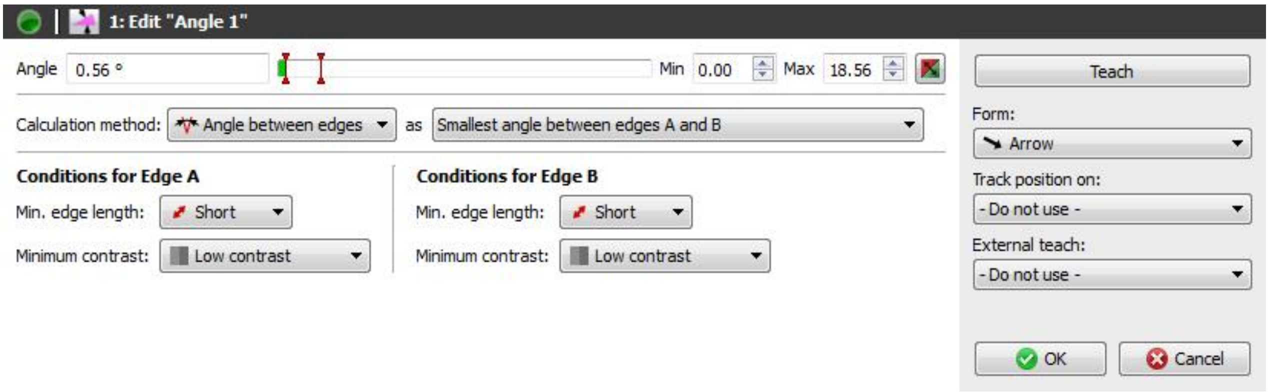
This feature check has the following output values for the datagram at the process interface:

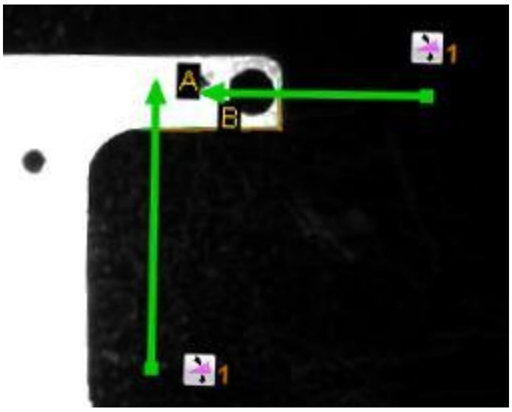
Output value	**Data type**	**Description**
Result		Result of the feature check: "P" (Pass); "F" (Fail)
Circle center	Float-Point	
Circle diameter	Float	
Distance of the center to the reference	Float	
Difference of the diameter to the reference	Float	
Roundness	Integer	

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.

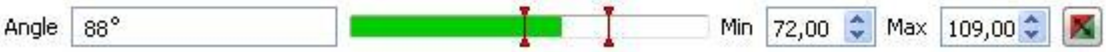
This feature check supports external Teach. The switching points are adjusted as an absolute to the current measured value.

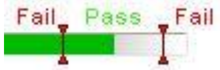




- Select the shape of the field of view. A search line and an arc (radial search for edges) can be chosen.
- Adjust the field of view by holding the left mouse button depressed.

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 dialog 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.

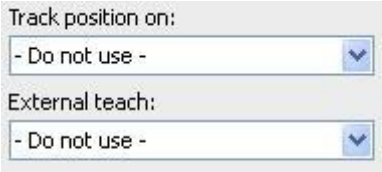
- **Calculation method:**
  Angle between edges: Angle between two edges
  Angle to reference: Angle to a reference edge

- **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 progresses from bright to dark or from dark to bright (model-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-in 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*.

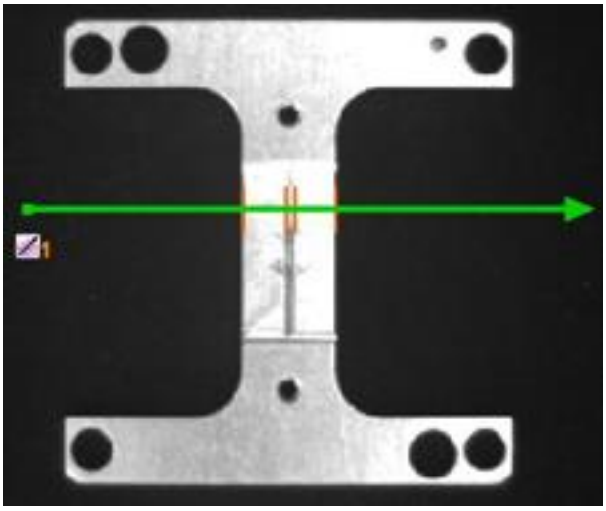
This feature check has the following output values for the datagram at the process interface:

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.



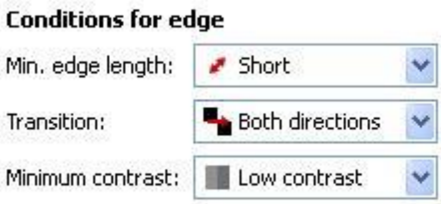
- Select the shape of the field of view. A search line and an arc can be chosen.
- Adjust the field of view by holding the left mouse button depressed.

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*.

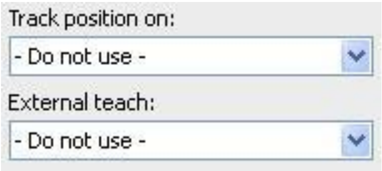
- The current result is displayed directly in the dialog as the *Number*. The switching points designated **Min** and **Max** are adjusted on the right hand side. A graphic display is located in the middle, in which the positions of the switching points are displayed and where they can be changed.
- 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 progresses from bright to dark or from dark to bright (model-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-in 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*.

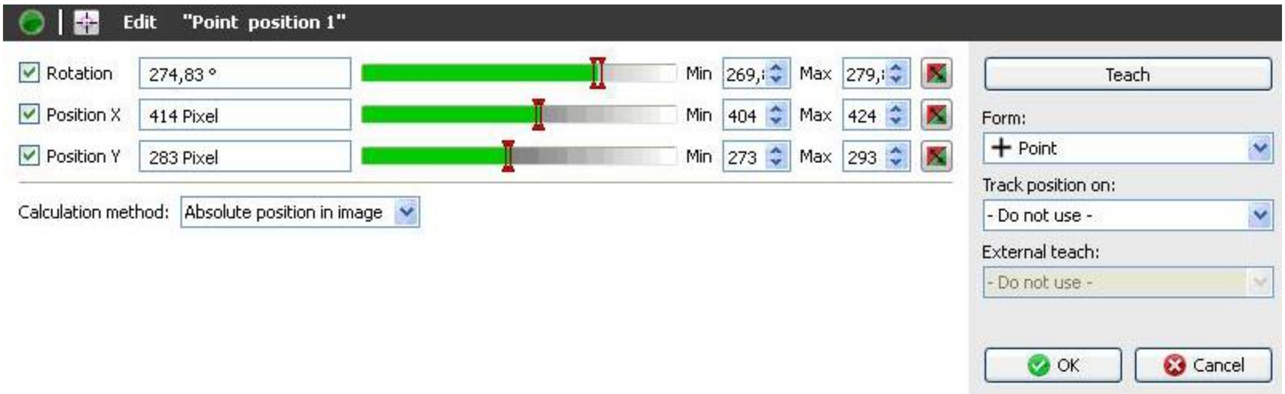
This feature check has the following output values for the datagram at the process interface:

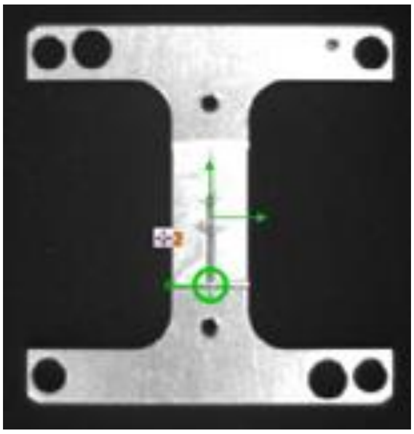
Output value	Data type	Description
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Number of edges	Integer	

12.2.5 Point position

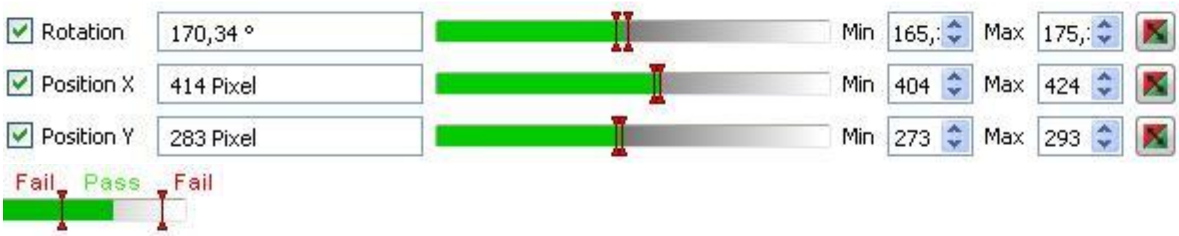
This feature check determines the position and rotational position of a point, as an absolute in the picture or relative to a reference. It is therefore advisable that it is only used with part location. This feature check can, e.g. be used to determine the grasp position for robots (pick and place).

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





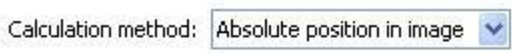
- Set the point on the position to be determined. You may need to rotate it with the lever.



Select the features that should be checked.

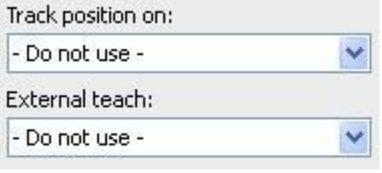
- **Rotation:** Determine the switching points of the rotation.
- **Position X:** Determine the switching points of the X position.
- **Position Y:** Determine the switching points of the Y position.

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-in 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*.

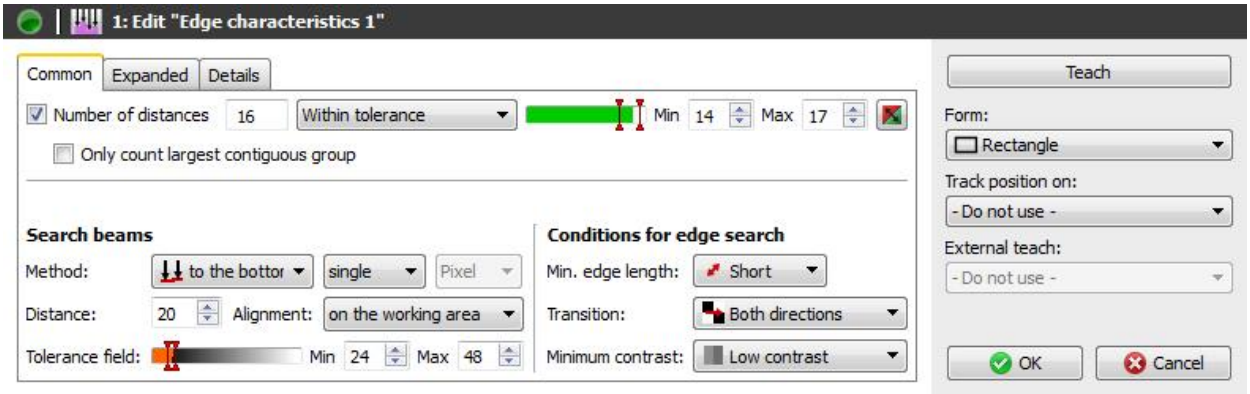
This feature check has the following output values for the datagram at the process interface:

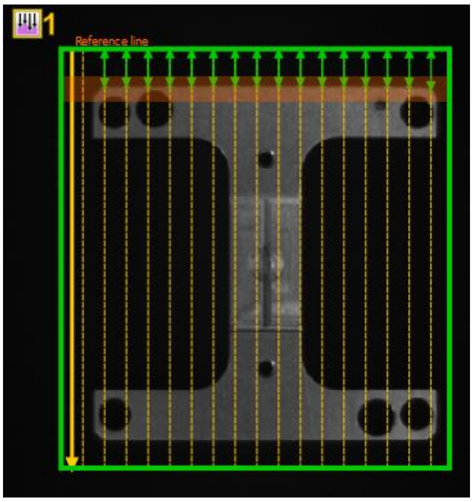
Output value	Data type	Description
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Rotation	Float	
Position X	Float	
Position Y	Float	

12.2.6 Edge characteristics

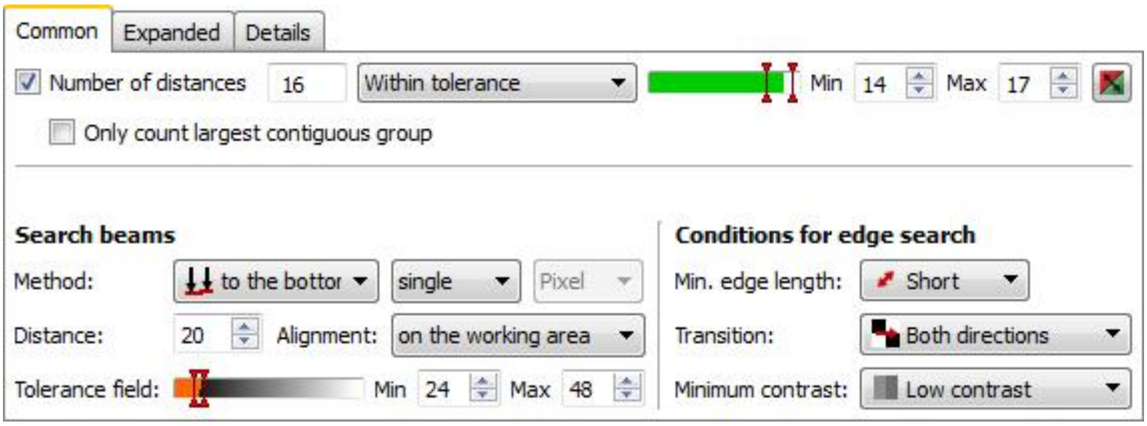
This feature check scans an edge with search beams and compares the distances detected with the defined conditions.

This feature check does not support external teach-in.

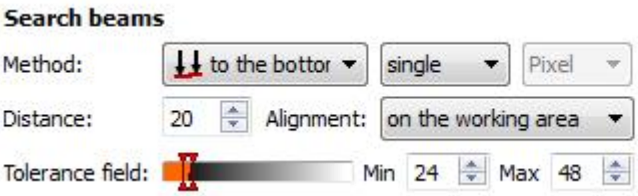




- Select the shape of the field of view. A rectangle, a circular ring and a circular ring sector can be chosen.



- 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 center line (double): The search for edges begins from both sides.
outwards (double): The search for edges begins from the center 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 center 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.

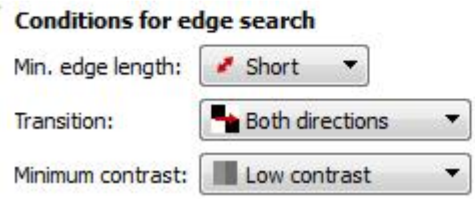
- **Distance:** Here, you can set the spacing between the search beams.

- **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.

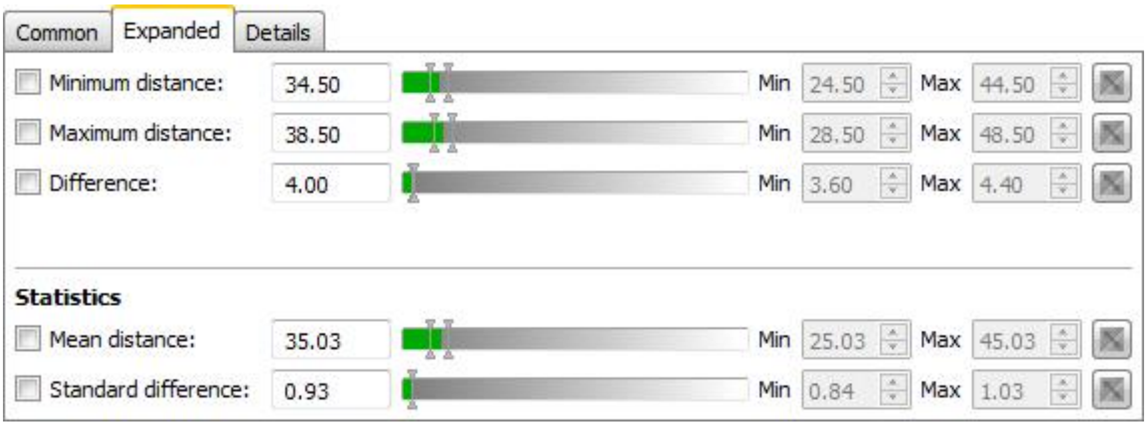


Specifications for the edge search

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.

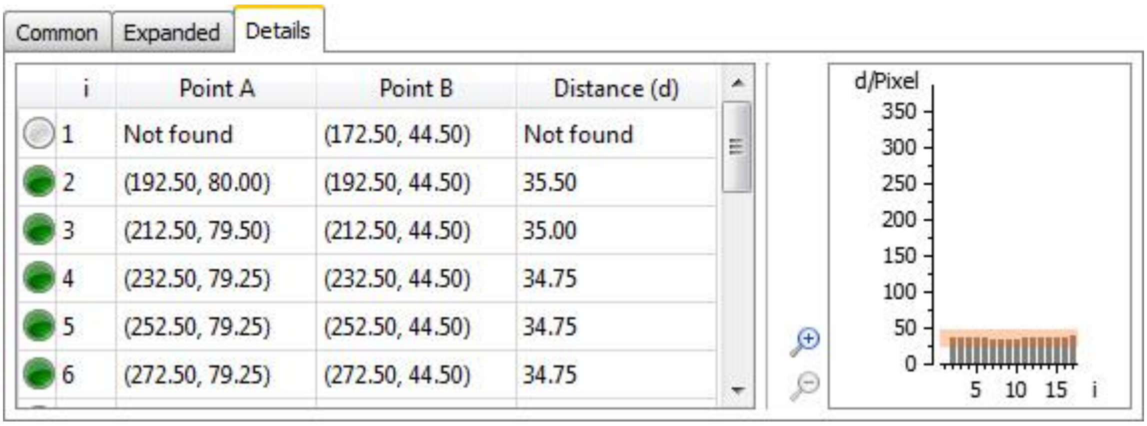
- **Maximum distance:** Define the criteria for the largest distance value located.

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

Statistics

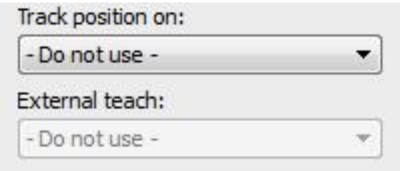
- **Mean distance:** Define the criteria for the average of all distance values located.

- **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:

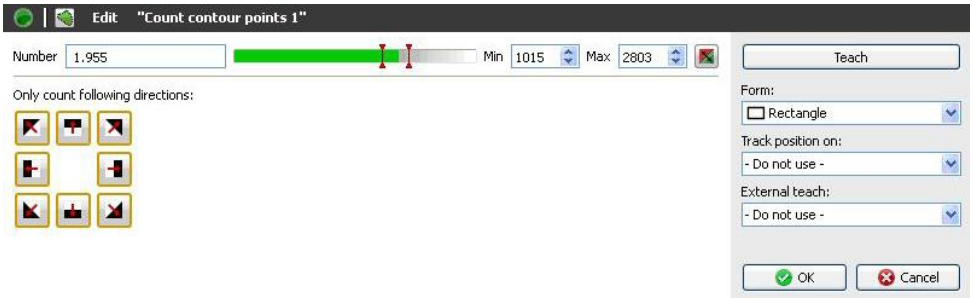
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Number of distances	Float	
Minimum distance	Float	
Maximum distance	Float	
Difference max-min	Float	
Mean distance	Float	
Standard difference	Float	
Distance list	Float list	
Edge point A list	Float-Point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

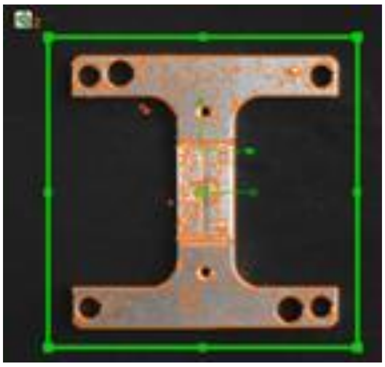
Feature comparison

12.2.7 Count contour points

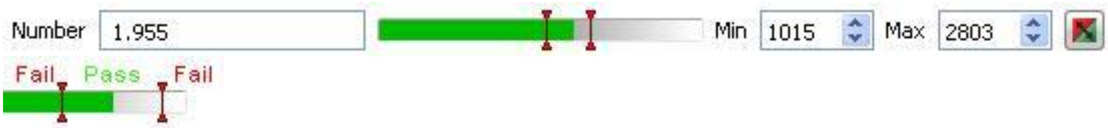
This feature check examines the number of contour points within the field of view.

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

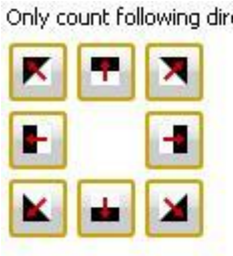




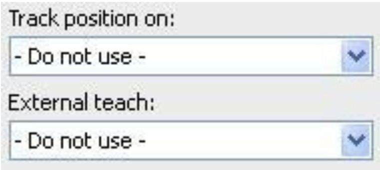
- Choose the shape of the field of view in this menu.



- 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 (model-dependant).



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

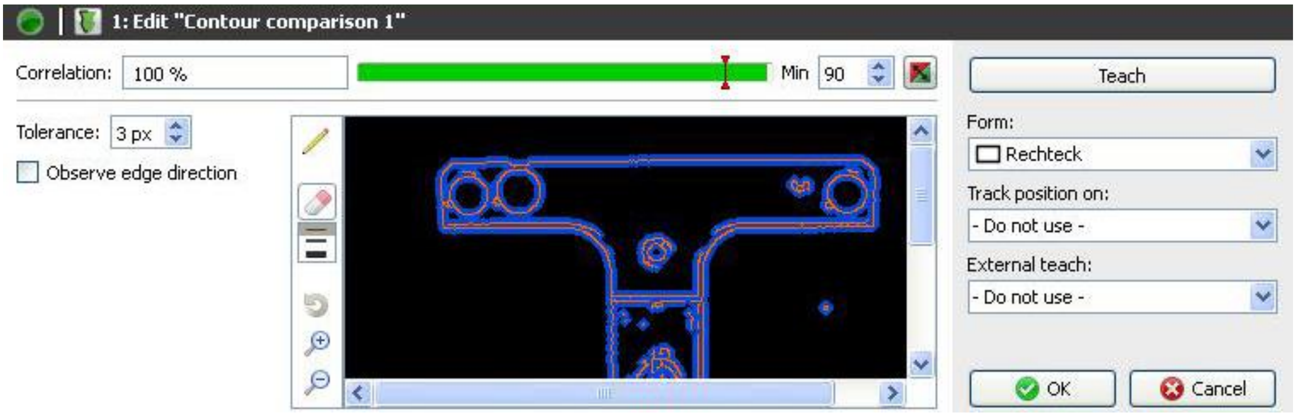
This feature check has the following output values for the datagram at the process interface:

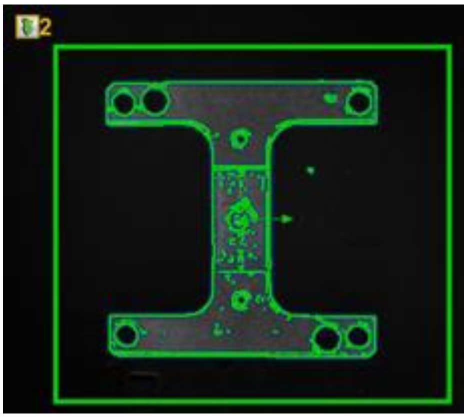
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Number of contour points	Integer	

12.2.8 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.

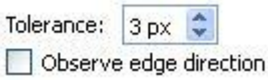
This feature check supports external Teach. Here all of the contours will be adopted in the model, but the switching points remain unchanged.



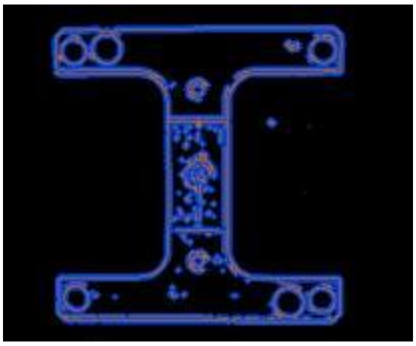


- The field of view must firstly be defined.

- 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 search area size in each direction up/down and right/left.
- **Observe edge direction:** Mark this option to increase accuracy during the examination.



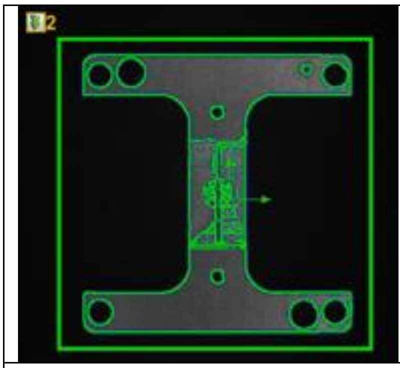
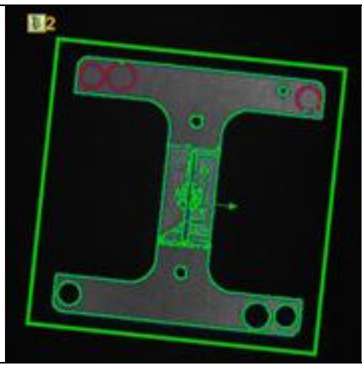
- With the displayed model, you can then use the mouse to delete pixels that clearly do not belong to the reference object or to supplement missing contour areas.

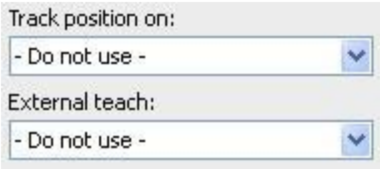
- This button resets the model to its default state.

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

- 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-in 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*.

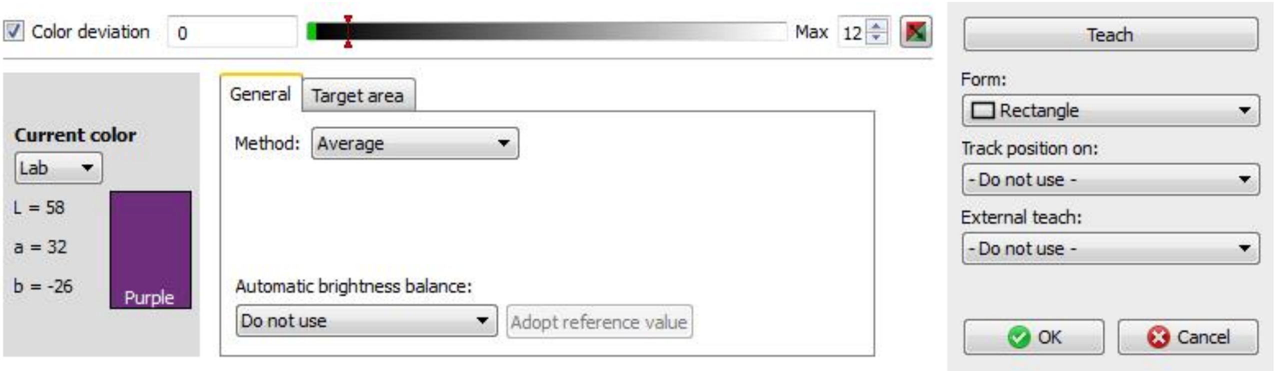
This feature check has the following output values for the datagram at the process interface:

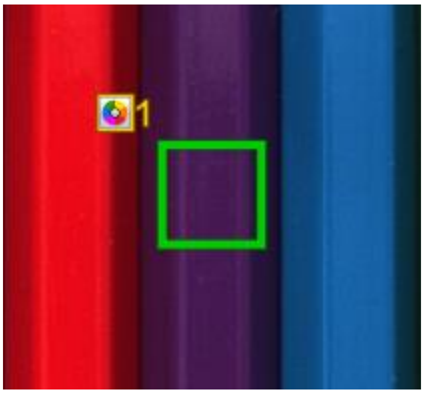
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Conformity	Integer	

12.2.9 Color identification

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

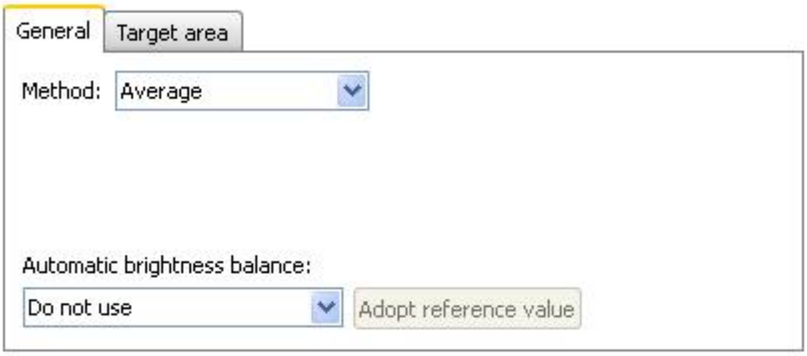
This feature check supports external Teach. The current color is taught as the target color.





- 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 dragging with the mouse on the lever at the center.

- Tick here if you want to calculate the color deviation, otherwise it will produce the current color of the field of view rather than the result (OK, NOK).
- The current result (in ΔE - distance between two color coordinates in the CIELab color coordinate system) is displayed under *Color 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.
- Activate



- **Methods: Average value:** The average value of all the pixels in the marked area is used.

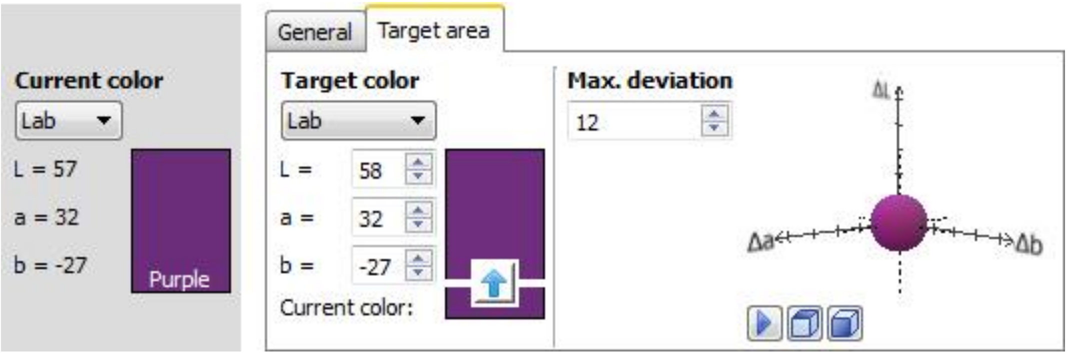
- **Methods: Dominant single color:** The dominant color in the spectrum in the marked field of view is calculated and used. This means that any small errors such as dirt or reflections can be ignored.

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

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

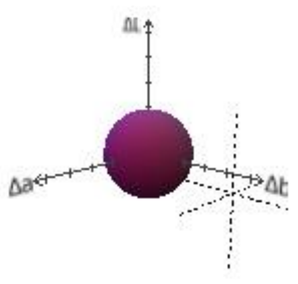
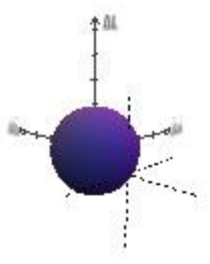
> **NOTE**
>
> We recommend that you calculate the target color with a correct model piece. Entered values may deviate from the model piece.

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

CIELab color coordinate system

The cover of the sphere represents the maximum permissible color deviation (ΔE) from the target color and changes as you make entries. This means that all color values for the current color, which are inside the sphere, are assessed as *OK*.

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

	
Current color outside of the target color - Result: *NOK*	Current color inside of the target color - Result: *OK*

NOTE

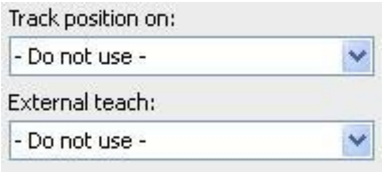
The scales of the CIELab color coordinate system are divided into increments of 10 and show up to 50.

CIELab color coordinate system scale

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

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 color 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-in 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*.

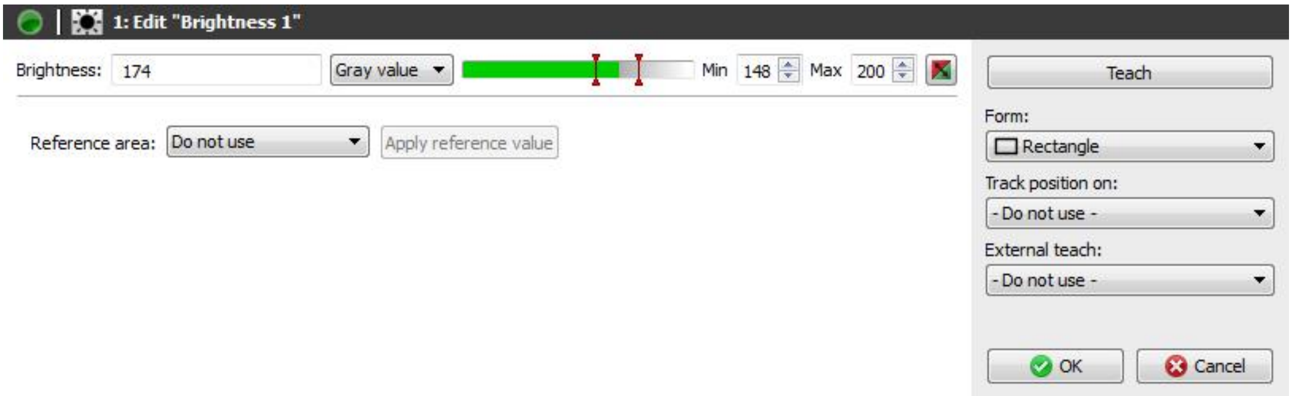
This feature check has the following output values for the datagram at the process interface:

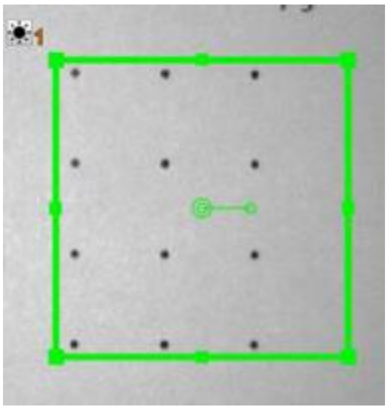
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Reference area brightness	Integer	
Color deviation (ΔE)	Integer	
Color (Lab)	Integer	
Color (RGB)	Integer	

12.2.10 Brightness

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

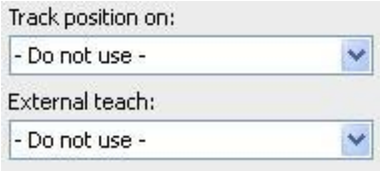
This feature check supports external Teach. The switching points are adjusted as an absolute to the current measured value.





- 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 dragging with the mouse on the lever at the center.

- The current result for lightness is shown as an average gray 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-in 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 gray 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*.

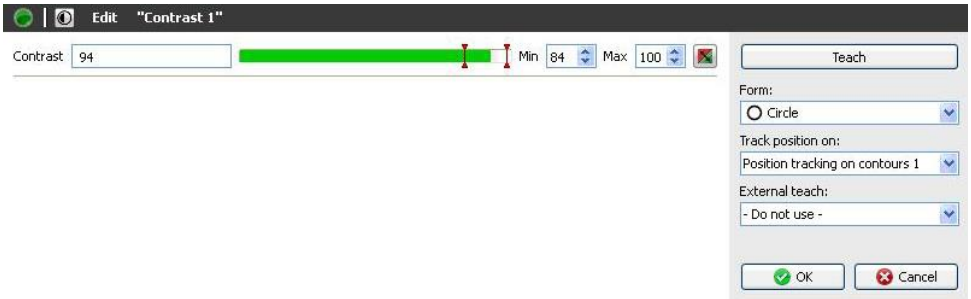
This feature check has the following output values for the datagram at the process interface:

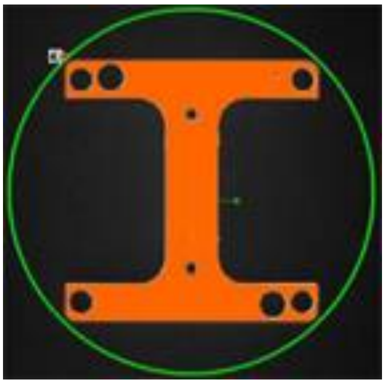
Output value	Data type	Description
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Brightness	Integer	
Reference area brightness	Integer	

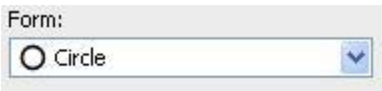
12.2.11 Contrast

The feature check measures the contrast in a field of view and compares the result with the specified switching points.

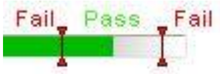
This feature check supports external Teach. The switching points are adjusted as an absolute to the current measured value.



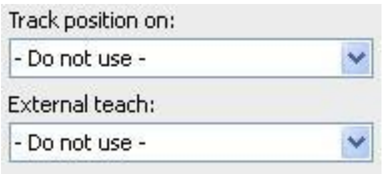




- Select the shape of the field of view. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by dragging with the mouse on the lever at the center.



- The current result of the contrast feature check is displayed directly in the dialog 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-in 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*.

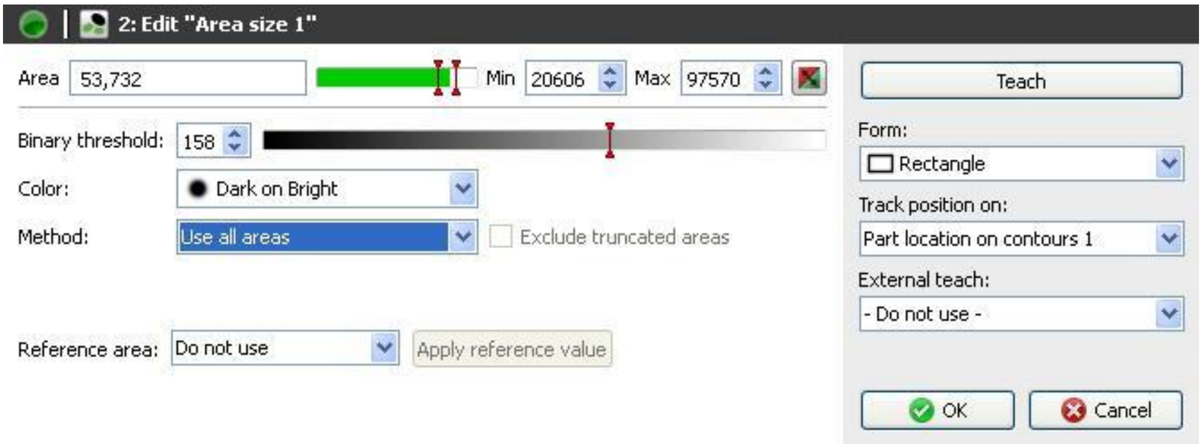
This feature check has the following output values for the datagram at the process interface:

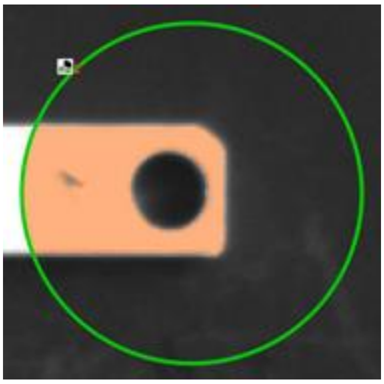
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Contrast	Integer	
Reference area brightness	Integer	

12.2.12 Area size

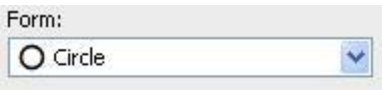
The feature check calculates the number of bright or dark pixels in a field of view and compares the result with specified switching points.

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





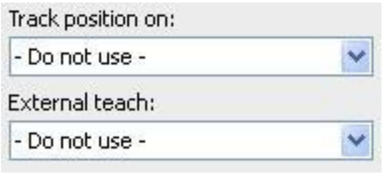
Proceed as follows for configuration:



- 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 dragging with the mouse on the lever at the center.

- The current result of the feature check is displayed directly in the dialog 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.
- **Color:** You can also decide whether the *dark* or the *bright* pixels in a field of view are to be counted.
- **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-in 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 gray 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*.

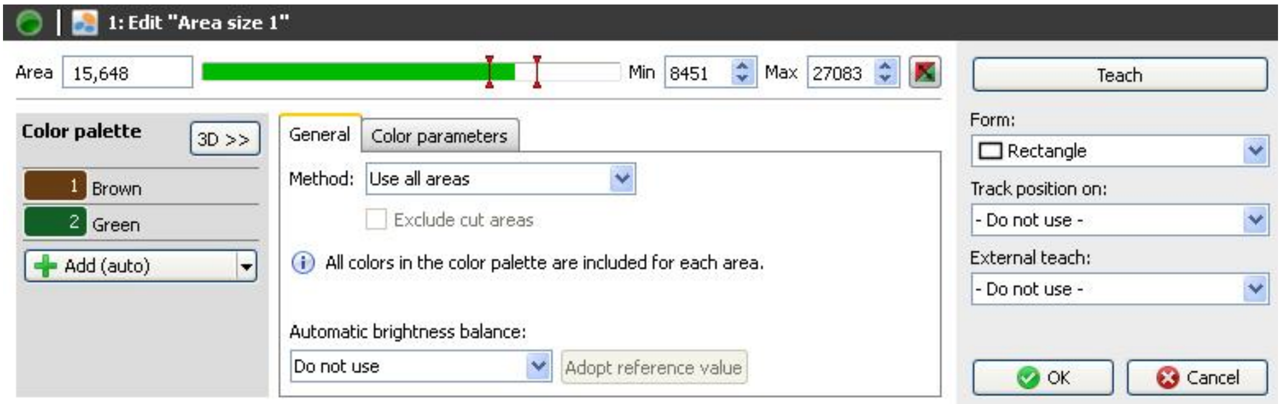
This feature check has the following output values for the datagram at the process interface:

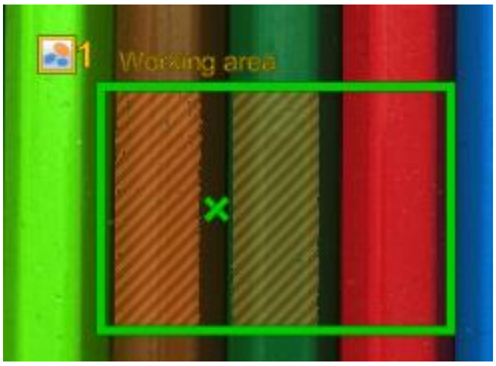
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Area	Integer	
Reference area brightness	Integer	
Center	Integer	

12.2.13 Area size (color)

This feature check calculates the number of pixels of particular colors in a field of view and compares the result with specified switching points.

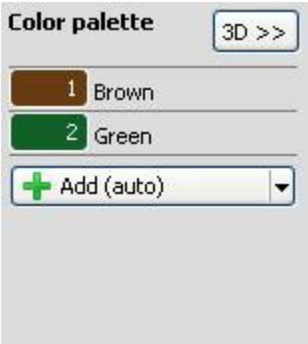
This feature check supports external Teach. The switching points are adjusted for the current calculated value.





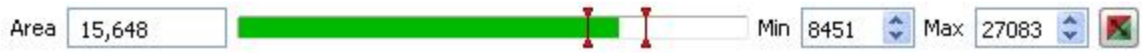
Proceed as follows for configuration:

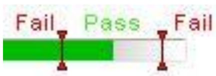
- Select the shape of the field of view. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by dragging with the mouse on the lever at the center.



- Now select *Add* on the color palette to teach in the first target color.
- In the next step, mark the first target color to be added on the image. This target color can be located in any part of the image area and does not have to be in the field of view. However, only target colors in the defined field of view are assessed as *OK* / *NOK*. The marked target colors are displayed with a hatched pattern in the field of view.
- You can add up to 8 target colors to the color palette. With *Add (auto)*, an area is automatically suggested for you to add as a new color. Move the suggested area to the desired area and adjust its size if necessary.

  3D>>: Here you can see where the defined colors are in a CIELab color coordinate system. Unlike the CIELab color coordinate system on the *Color parameters* tab, the complete color area is displayed and is not limited to 50 values per axis. The current target color is marked with a grid.





- The current result of the feature check is displayed directly in the dialog 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.

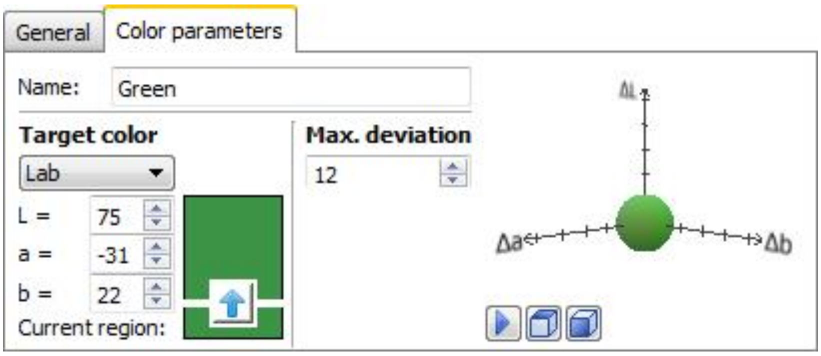
- **Methods:** Choose whether you want to count all areas or just the largest related areas.
- **Exclude cropped areas**: Areas which touch the edge of the field of view are excluded from the analysis. (only available for *only the largest related areas*).

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

> **NOTE**
>
> We recommend that you calculate the target color with a correct model piece. Entered values may deviate from the model piece.

- **Max. deviation:** Set the maximum permissible color deviation (in ΔE - distance between two color coordinates in the CIELab color coordinate system) (max. 50) here. This change is displayed to you in the CIELab color coordinate system. The cover of the sphere represents the maximum deviation. Only the current target color is displayed as a colored sphere, the other target colors are displayed as abstract spheres.

CIELab color coordinate system scale

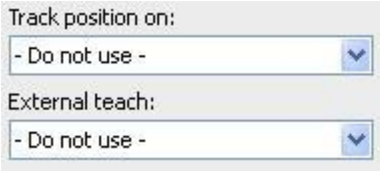
> **NOTE**
>
> The scales of the CIELab color coordinate system are divided into increments of 10 and show up to 50.

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

#

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 color 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-in also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

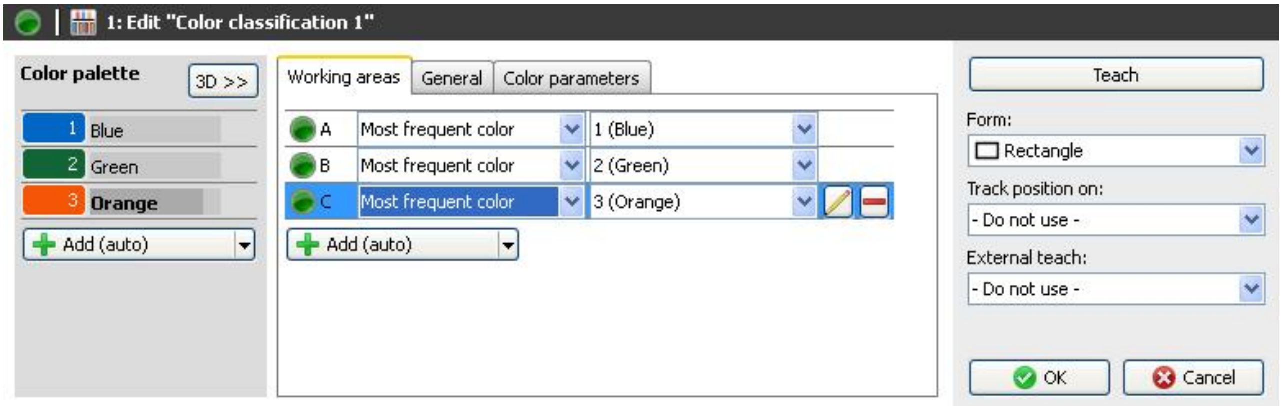
- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

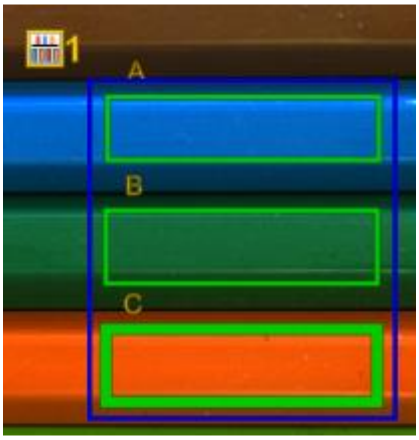
This feature check has the following output values for the datagram at the process interface:

Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Area	Integer	
Center	Integer	
Reference area brightness	Integer	
Structure	Integer	Number of contour points on hatched areas

12.2.14 Color positioning

This feature check checks the dominant color or the presence of individual colors in one or more fields of view. This can be used to classify colors, for example.



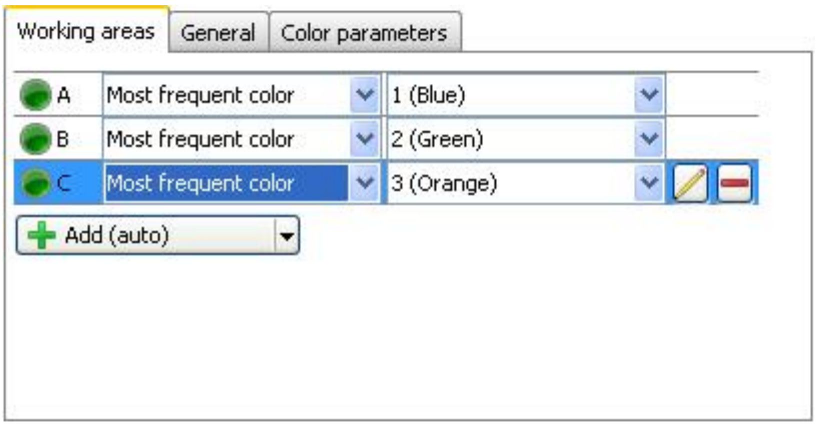


- Select *Add* on the color palette to teach in the first target color.

- In the next step, mark the first target color to be added on the image. This target color can be found anywhere across the entire image area. The marked target color in the image is displayed with a hatched pattern. If the target colors touch each other (spheres on the Color parameters tab), this is indicated with a warning triangle. A tool tip gives you information as to which other target color it is touching.

- You can add up to 24 target colors to the color palette. With *Add (auto)*, an area is automatically suggested for you to add as a new color.
- Move the suggested area to the desired area and adjust its size if necessary.

  3D>>: Here you can see where the defined colors are in a CIELab color coordinate system. Unlike the CIELab color coordinate system on the *Color parameters* tab, the complete color area is displayed and is not limited to 50 values per axis. The current target color is marked with a grid. Only color 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.

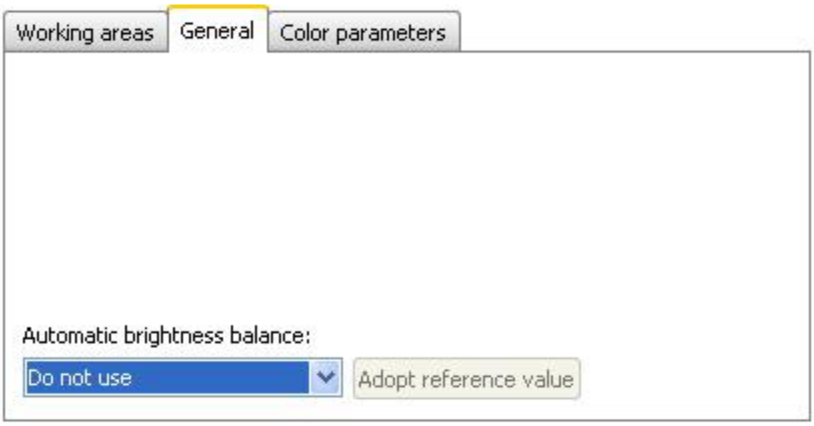
- Now select the method according to which the field of view should be analysed. The entire feature check will only be assessed as OK if all of the individual fields of view are OK, i.e. meet the defined criteria.

  Most frequent color: the selected color must be the most frequently occurring color in the field of view This method is automatically selected if one color in the color palette is dominant in the field of view.

Contains a color from: the working area must contain one of the selected colors, the minimum color proportion (in %) that must be present can also be adjusted.

Contains all colors from: the field of view must contain all of the selected colors

- You can use the buttons on the right to edit the minimum areas of the colors for the respective field of view, or to delete the entire field of view.

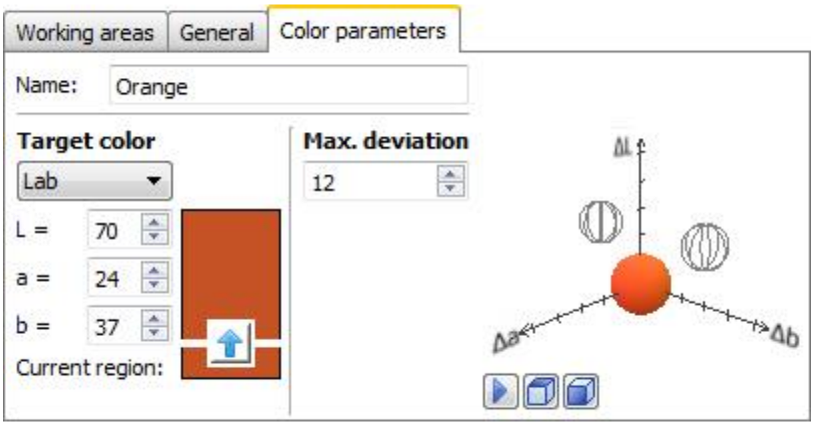


Automatic brightness correction:

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

NOTE

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

- **Max. deviation:** Set the maximum permissible color deviation (in ΔE - distance between two color coordinates in the CIELab color coordinate system) (max. 50) here. This change is displayed to you in the CIELab color coordinate system. The cover of the sphere represents the maximum deviation. Only the current target color is displayed as a colored sphere, the other target colors are displayed as abstract spheres.

CIELab color coordinate system scale

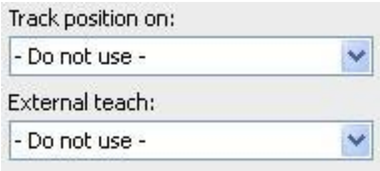
NOTE

The scales of the CIELab color coordinate system are divided into increments of 10 and show up to 50.

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

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 color 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-in also makes it possible to retrain the feature check. Select the appropriate option for this purpose.

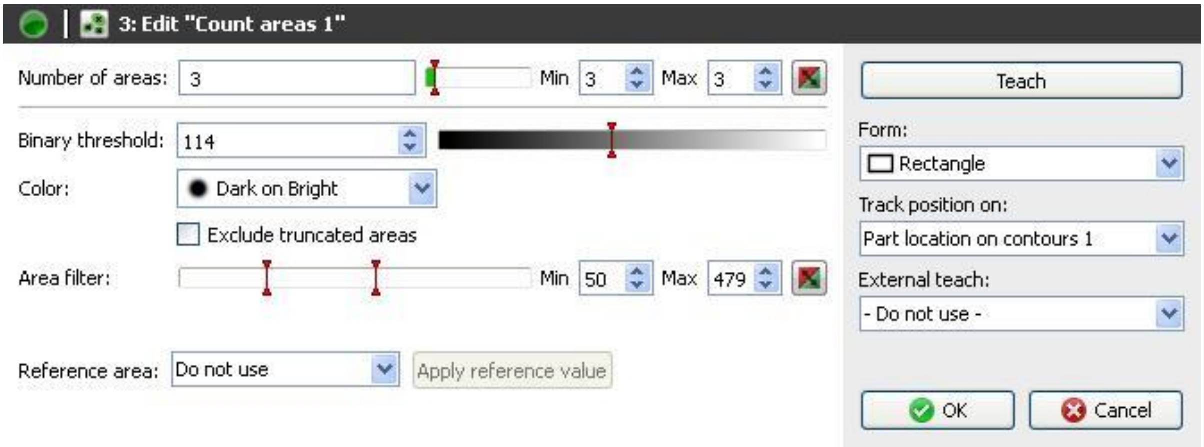
- Confirm your settings and return to the feature list with *OK*. Return to the feature list without making any changes with *Cancel*.

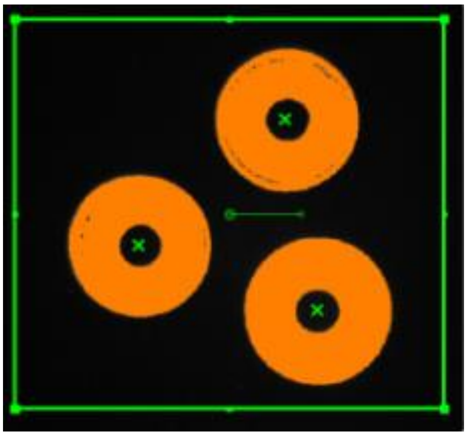
This feature check has the following output values for the datagram at the process interface:

Output value	Data type	Description
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Reference area brightness	Integer	
Field of view, color, area	Integer list	Three values are listed for each combination of a field of view and a color (field of view, color, area). **Field of view:** Number, starting with 1 (not as letters) **Color:** Number, starting with 1 **Area:** Proportion (in percent) of the field of view occupied by the color
Dominant color	Integer list	Number of the dominant color for each field of view, or 0 if no color is found
Pass/Fail	Text	Results for the individual fields of view as "P" (Pass) or "F" (Fail)

12.2.15 Count areas

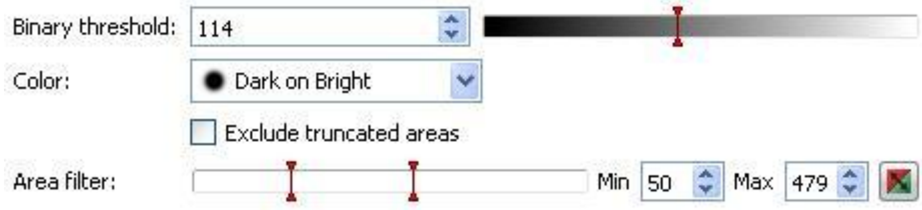
With this feature check, related areas in the field of view are counted.
This feature check supports external Teach. The switching points are adjusted as an absolute to the current measured value.



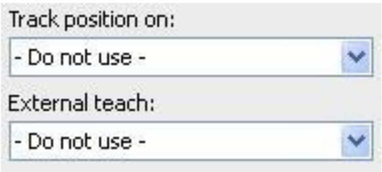


- Select the shape of the field of view. A circle, a rectangle and a freely definable polygon, a circular ring and a circular ring sector are available.
- Adjust the field of view by holding the left mouse button depressed. You can rotate the rectangle by dragging with the mouse on the lever at the center.

- 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.
- **Color:** Choose whether bright or dark objects are to be counted.
- **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-in 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 gray 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*.

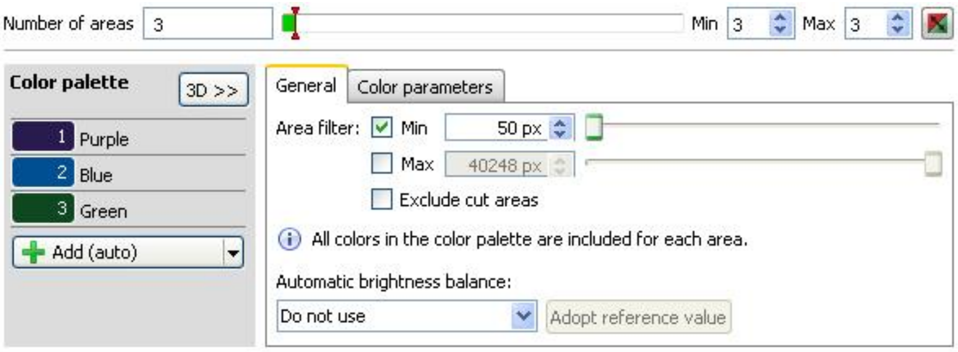
This feature check has the following output values for the datagram at the process interface:

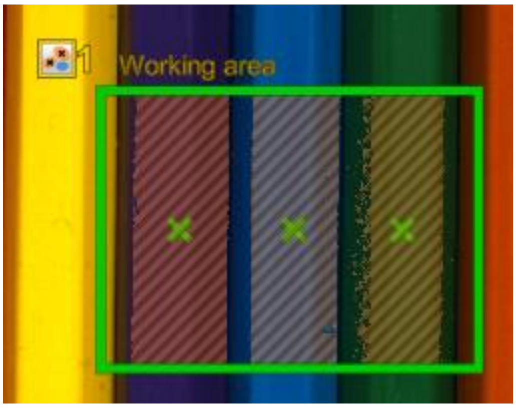
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Number of objects	Integer	
Reference area brightness	Integer	
List of centers	Float-Point list	
List of areas	Float-Point list	
List of structure values	Integer list	Number of contour points within the respective area (BLOB).
List of lightness values	Integer list	Average gray value within the respective area.

12.2.16 Count areas (color)

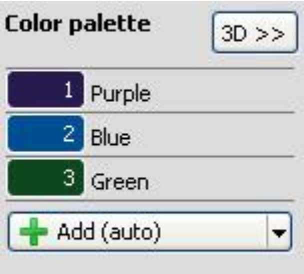
This feature check is used to count related areas of a particular color or color selection in the field of view.

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 dragging with the mouse on the lever at the center.



- Now select *Add* on the color palette to teach in the first target color to be counted.

- In the next step, mark the first target color to be added on the image. This target color can be located in any part of the image area and does not have to be in the detection area. However, only target colors in the defined detection area are counted. The marked target colors are displayed with a hatched pattern in the detection area.

- You can add up to 8 target colors to the color palette. With *Add (auto)*, an area is automatically suggested for you to add as a new color. Move the suggested area to the desired area and adjust its size if necessary.

3D>>: Here you can see where the defined colors are in a CIELab color coordinate system. Unlike the CIELab color coordinate system on the *Color parameters* tab, the complete color area is displayed and is not limited to 50 values per axis. The current target color is marked with a grid. Only color areas that do not overlap can be definitively detected.

- **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 color. If you hover the cursor over this area, you will see the size of the detected area in the detection area in the image.

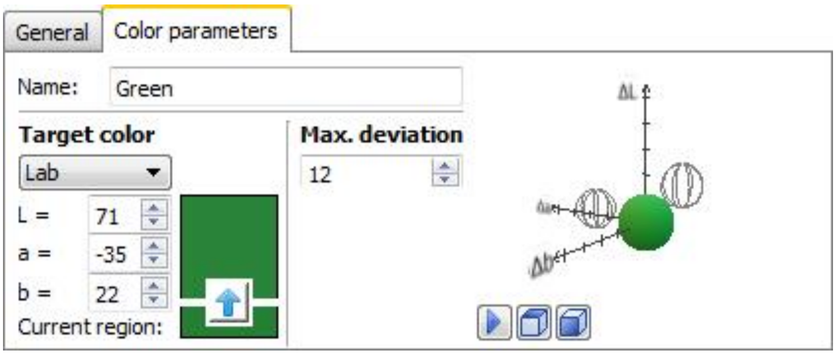
- **Exclude cropped areas**: Areas which touch the edge of the field of view are excluded from the analysis.

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

NOTE

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

- **Max. deviation:** Set the maximum permissible color deviation (in ΔE - distance between two color coordinates in the CIELab color coordinate system) (max. 50) here. This change is displayed to you in the CIELab color coordinate system. The cover of the sphere represents the maximum deviation. Only the current target color is displayed as a colored sphere, the other target colors are displayed as abstract spheres.

CIELab color coordinate system scale

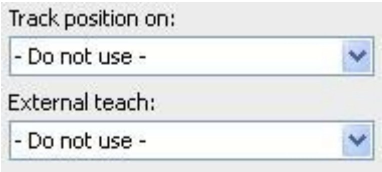
NOTE

The scales of the CIELab color coordinate system are divided into increments of 10 and show up to 50.

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

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 color 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-in 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*.

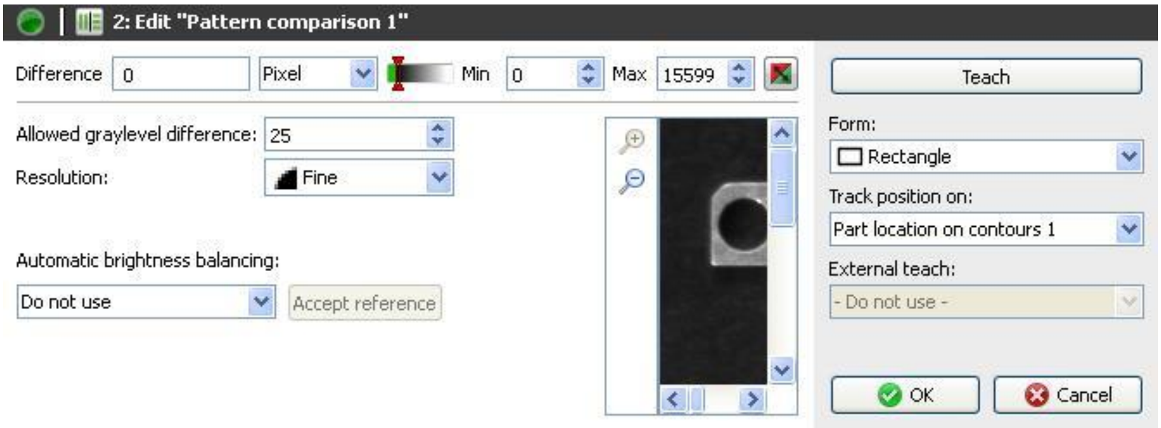
This feature check has the following output values for the datagram at the process interface:

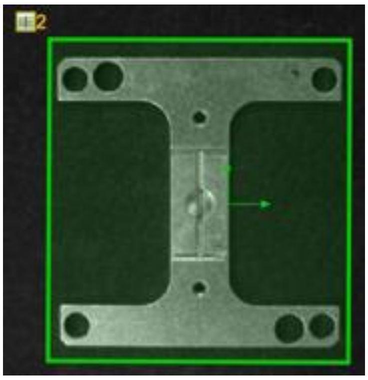
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Number of objects	Integer	
Reference area brightness	Integer	
List of centers	Float-Point list	
List of areas	Float-Point list	
List of structure values	Integer list	Number of contour points within the respective area (BLOB).

12.2.17 Pattern comparison

This feature check verifies the presence of a taught-in pattern.

It supports external teach-in. The current image area is adopted in the model, but the switching points remain unchanged.





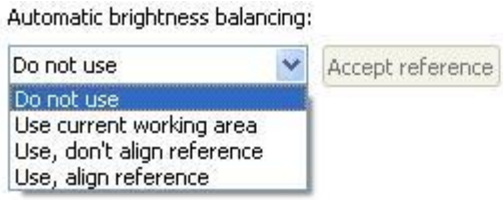
Proceed as follows for configuration:

- 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 gray scale variation:** Select the permissible gray 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.



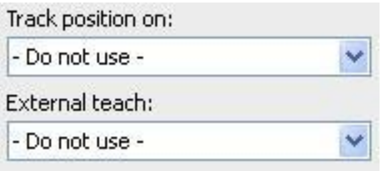
In order to be independent of fluctuations in the ambient light, the device offers a means of automatically correcting the brightness.

The mean brightness in the field of view of the reference area should exceed a gray 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-in 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:

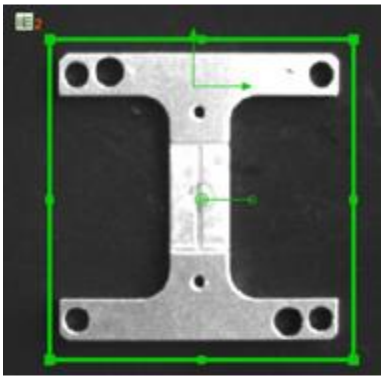
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Deviation	Integer	
Reference area brightness	Integer	

12.2.18 Pattern match (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.

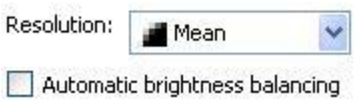


Proceed as follows for configuration:

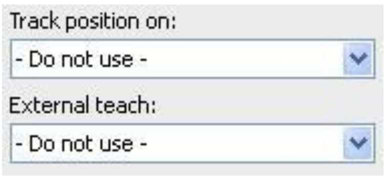
- The field of view must firstly be defined.

- 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 sensor task 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-in 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*.

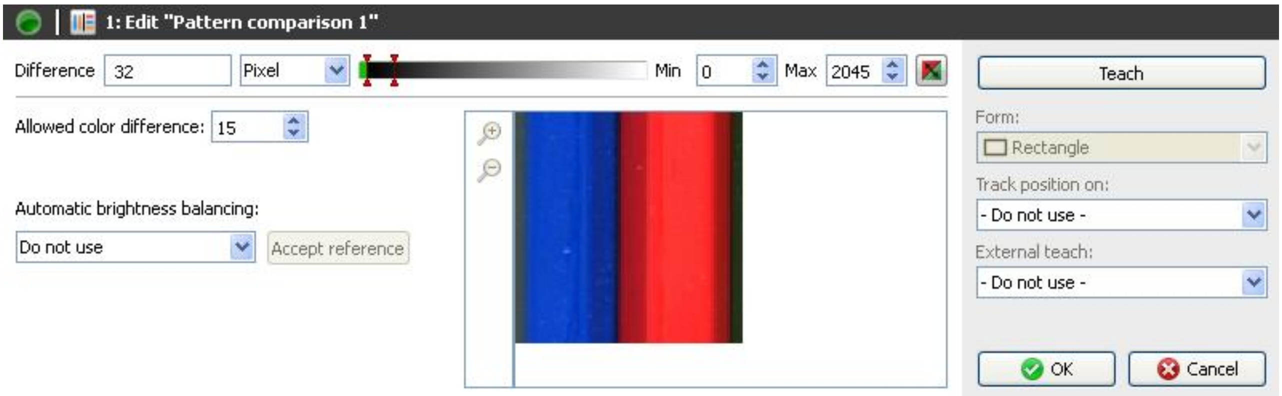
This feature check has the following output values for the datagram at the process interface:

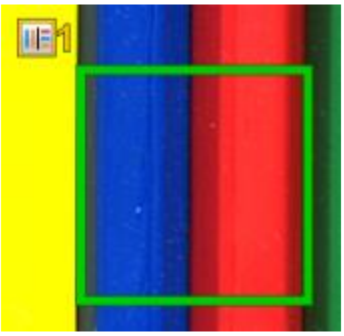
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Conformity	Integer	

12.2.19 Pattern match (color)

This feature check verifies the presence of a taught-in color pattern.

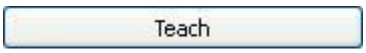
It supports external teach-in. The current image area is adopted in the model, but the switching points remain unchanged.





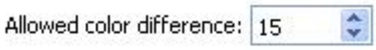
Proceed as follows for configuration:

- 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 dragging with the mouse on the lever at the center.

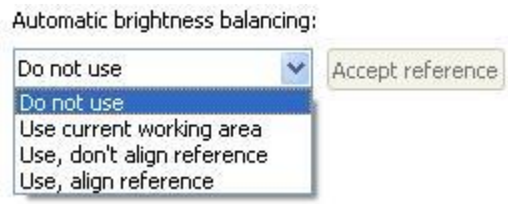


- Teach in a new pattern using *Teach*.

- 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 color deviation:** Set the maximum permissible color deviation (in ΔE - distance between two color coordinates in the CIELab color coordinate system).



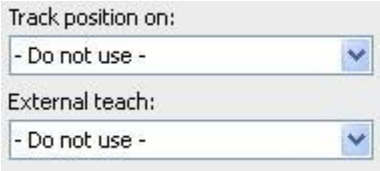
In order to be independent of fluctuations in the ambient light, the device offers a means of automatically correcting the brightness.

The mean brightness in the field of view of the reference area should exceed a gray 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-in 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:

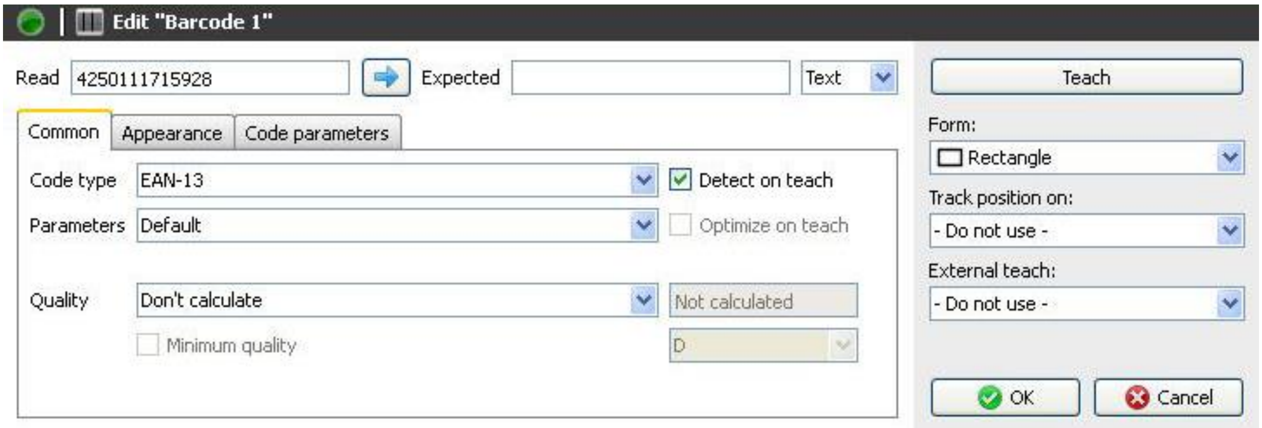
Output value	**Data type**	**Description**
Result		Result of the feature check: ”P“ (Pass); “F“ (Fail)
Deviation	Integer	
Reference area brightness	Integer	

12.3 Identification

12.3.1 Barcode

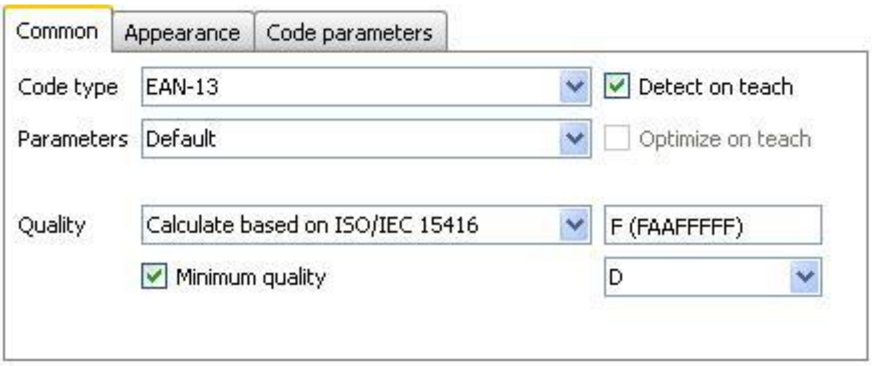
With this feature check barcodes can be read. In addition, the quality of the barcode can be determined according to ISO/IEC 15416.

This feature check supports external Teach. Here the parameters are adjusted for the identification and the expected value adopted.



- Choose the search 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).

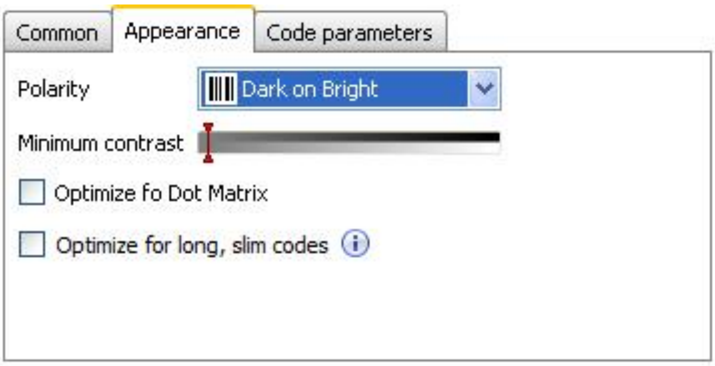


- **Code type:** Select the type of barcode in the image.
- **Detect on teach:** Using the *Detection on teach* option, you can have the code type automatically determined during external teach-in.
- **Parameters:** Select the search parameters used to search for the code. *Fast*, *Robust* and *User 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-in. This is only necessary if you have set the search parameters in the User-defined option.
- **Quality:** If you also wish to check the code quality, you may activate the Calculate per *ISO/IEC 15416* option. However, this also increases the processing time!
- **Minimum quality:** Activate this box if you want to specify a minimum quality.

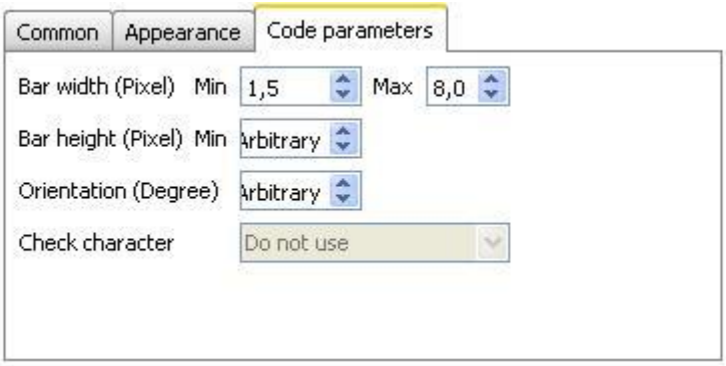
- The code quality is specified as follows:
  A - F (A = High quality ; F = Poor quality)
- The first parameter corresponds to the overall code quality.
- A total of 8 features are specified:
  Legibility, symbol contrast, minimal reflectance, edge contrast, modulation, defects, decodability, additional code-specific parameters.
- You can find more details on the quality characteristics in appendix: Quality characteristics for barcodes and matrix codes

NOTE

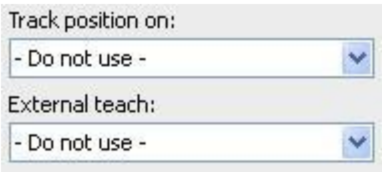
In order to be able to make the settings "Appearance" and "*Code parameters*" on the tabs, you must set the Parameters on the “Common" tab to *User defined*.



- **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-in 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	Center of the code

The following value can be set via the process interface. Please note that an expected value must be provided during parameterization of the feature check.

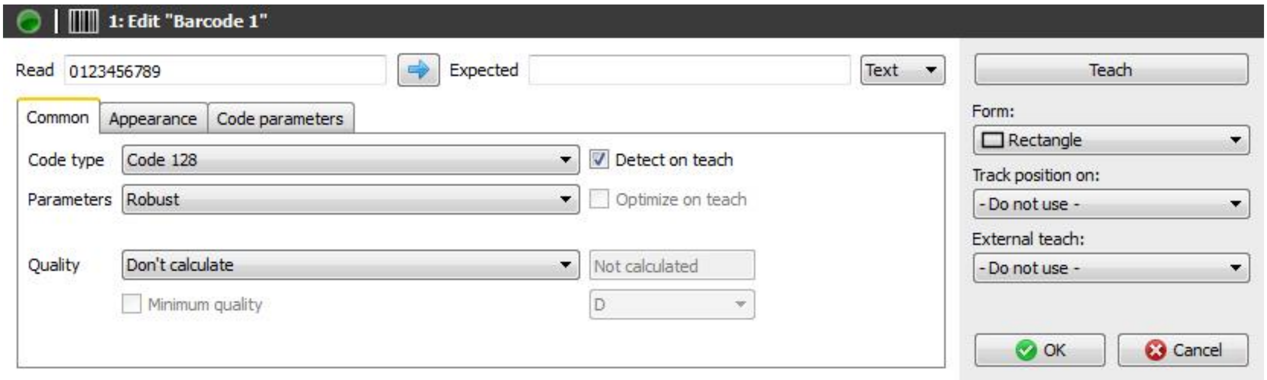
Input value	**Data type**	**Description**
to expected code	Text	expected code

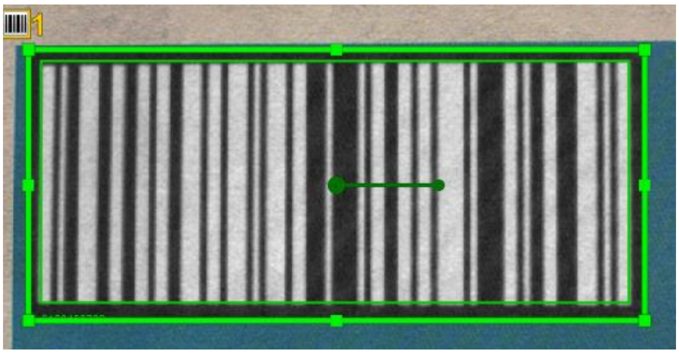
12.3.2 Barcode (color)

This feature check enables colored barcodes with colored 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.

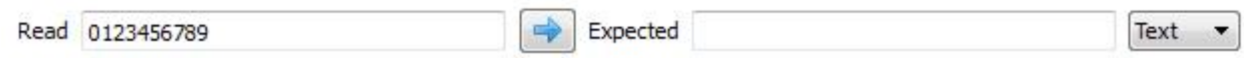
The quality is determined once the image has been converted to black and white. You cannot, therefore, observe any influence the color has on the quality.

This feature check supports external Teach. Here the parameters are adjusted for the identification and the expected value adopted.

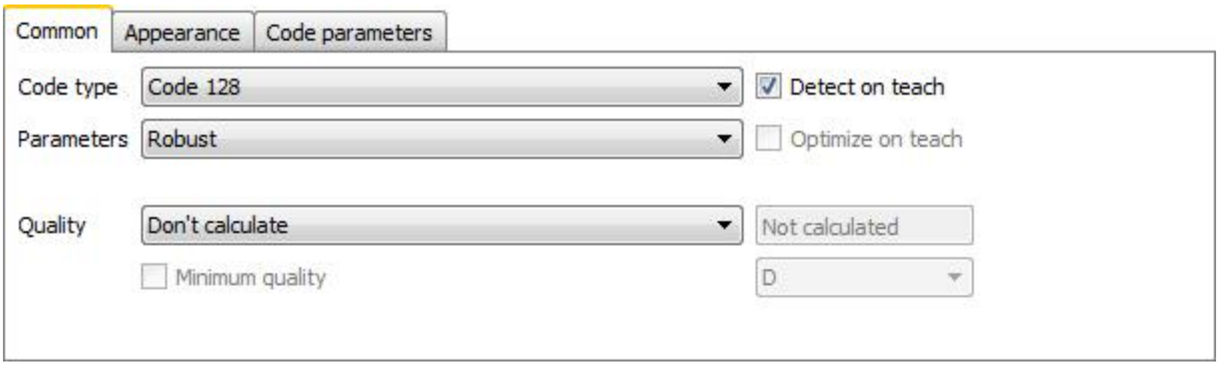




- Choose the search area.



- **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.
- **Detect on teach:** Using the *Detection on teach* option, you can have the code type automatically determined during external teach-in.

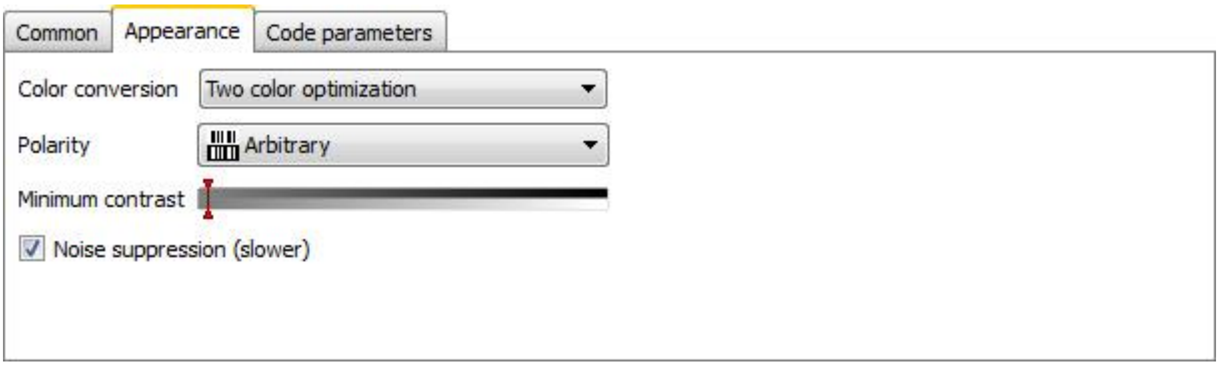
- **Parameters:** Select the search parameters used to search for the code. *Robust* and *User defined* are available. In the case of the user-defined search, you can manually set the parameters for the display and the code.
- **Optimize on teach:** Using the *Optimize on teach* option, you can have the parameters automatically adjusted for the code search during the external teach-in. This is only necessary if you have set the search parameters in the User-defined option.

- **Quality:** If you also wish to check the code quality, you may activate the Calculate per *ISO/IEC 15416* option. However, this also increases the processing time!
- **Minimum quality:** Activate this box if you want to specify a minimum quality.

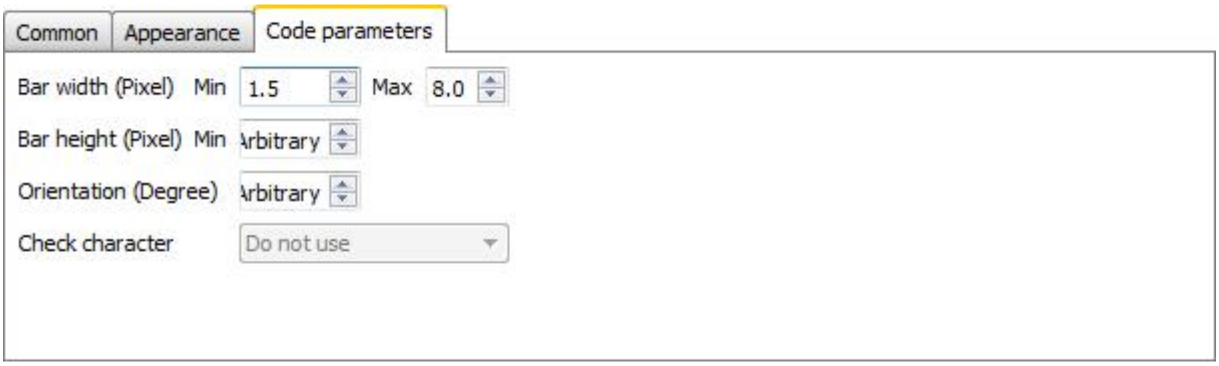
- The code quality is specified as follows:
  A - F (A = High quality ; F = Poor quality)
- The first parameter corresponds to the overall code quality.
- A total of 8 features are specified:
  Legibility, symbol contrast, minimal reflectance, edge contrast, modulation, defects, decodability, additional code-specific parameters.
- You can find more details on the quality characteristics in appendix: Quality characteristics for barcodes and matrix codes

NOTE

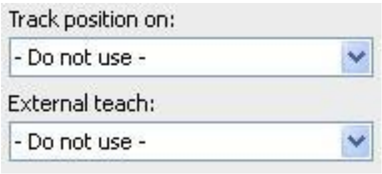
In order to be able to make the settings "Appearance" and "*Code parameters*" on the tabs, you must set the Parameters on the “Common" tab to *User defined*.



- **Color 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 color optimization* if the barcode and background appear in similarly light colors.
- **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-in 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	Center of the code

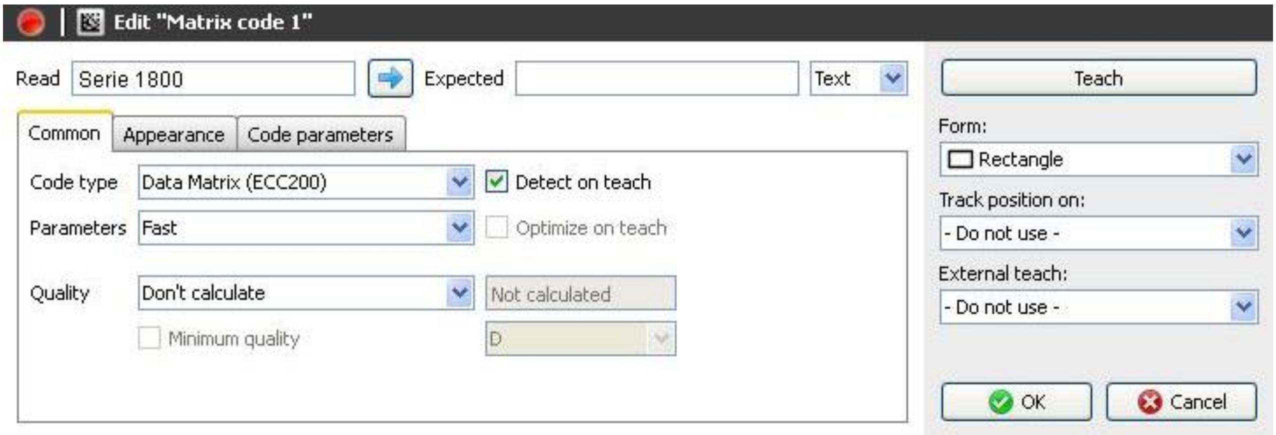
The following value can be set via the process interface. Please note that an expected value must be provided during parameterization of the feature check.

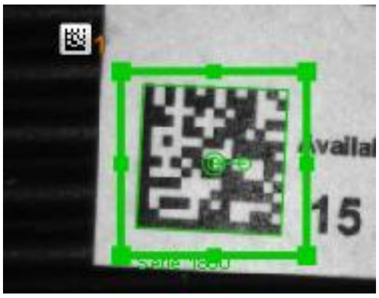
Input value	Data type	Description
to expected code	Text	expected code

12.3.3 Matrix code

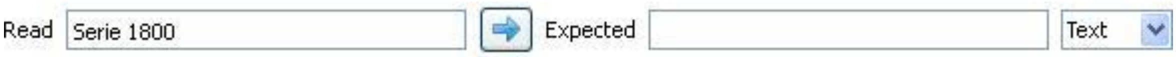
Matrix codes (ECC 200, QR, PDF417) can be read using this feature check. In addition, the quality of the barcode can be determined according to ISO/IEC 15415 or AIM DPM-1-2006.

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.

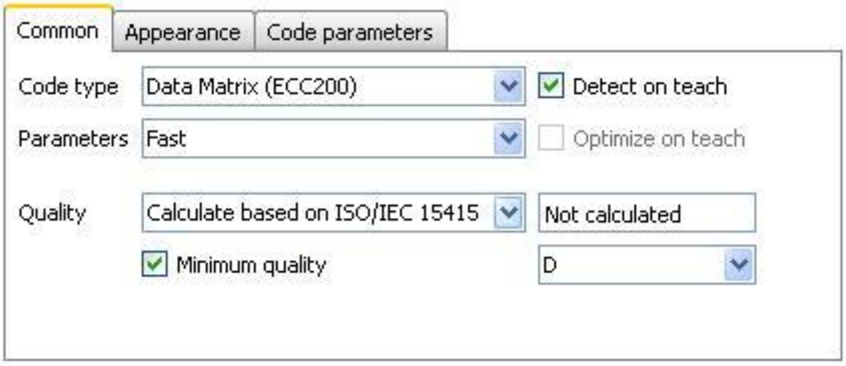




- Choose the search area.



- **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).



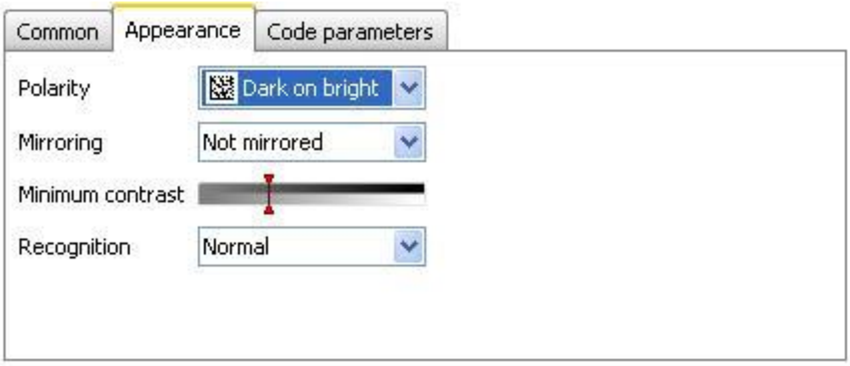
- **Code type:** Select the type of matrix code in the image.
- **Detect on teach:** Using the *Detection on teach* option, you can have the code type automatically determined during external teach-in.
- **Parameters:** Select the search parameters used to search for the code. *Fast, Robust*, *Maximum* 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-in. This is only necessary if you have set the search parameters in the User-defined option.
- **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

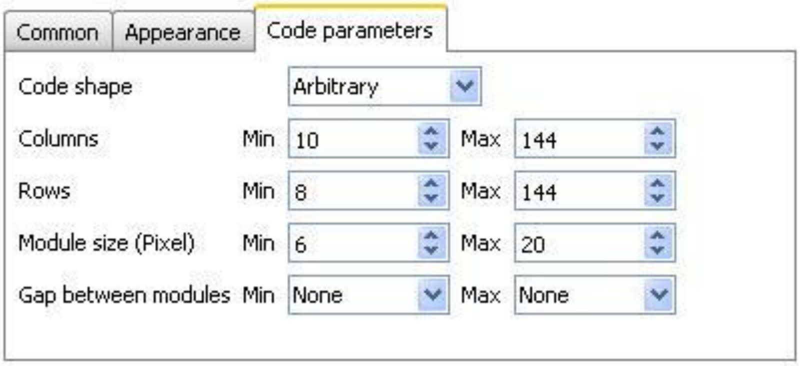
  In the *AIM DPM-1-2006* mode, a total of 8 characteristics are determined (for ECC200 / QR code only):
  Cell contrast, cell modulation, fixed pattern damage, decodability, axial non-uniformity (evaluation of the width and height), grid non-uniformity (evaluation of the slope angle), unused error correction, mean gray value of the light modules.

NOTE

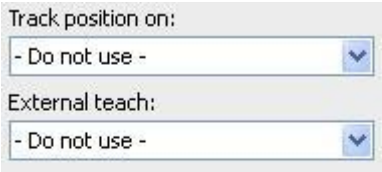
In order to be able to make the settings "Appearance" and "*Code parameters*" on the tabs, you must set the Parameters on the “Common" tab to *User defined*.



- **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-in 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	Center of the code

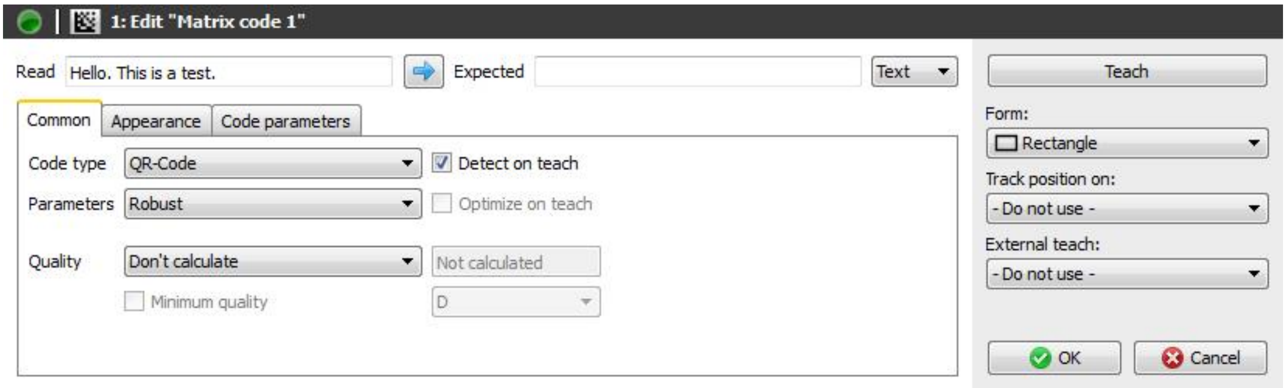
The following value can be set via the process interface. Please note that an expected value must be provided during parameterization of the feature check.

Input value	Data type	Description
to expected code	Text	expected code

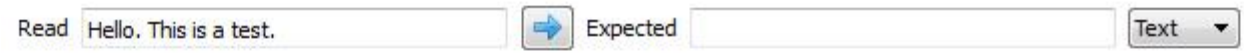
12.3.4 Matrix code (color)

Colored matrix codes (ECC 200, QR, PDF417) with colored 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.

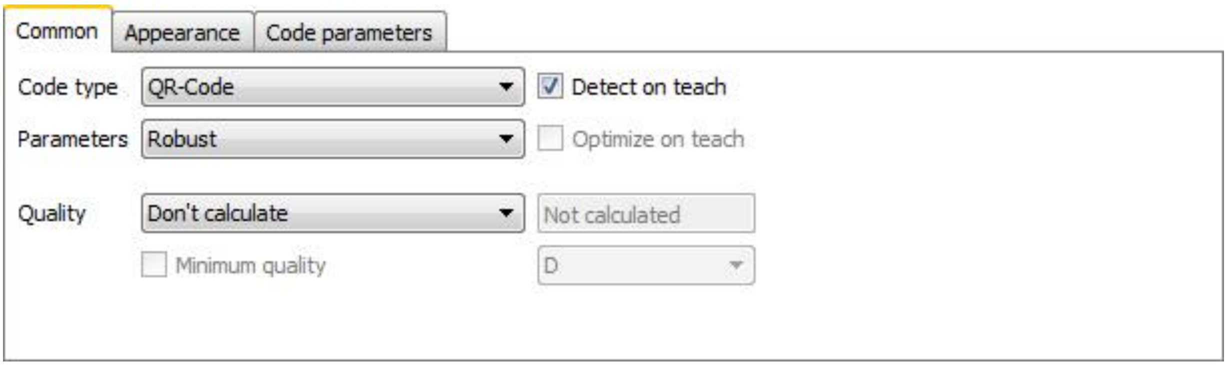
This feature check supports external Teach. In this process, the parameters for identification are adjusted and the expected value is accepted if an expected value has already been set.



- Choose the search 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.
- **Detect on teach:** Using the *Detection on teach* option, you can have the code type automatically determined during external teach-in.

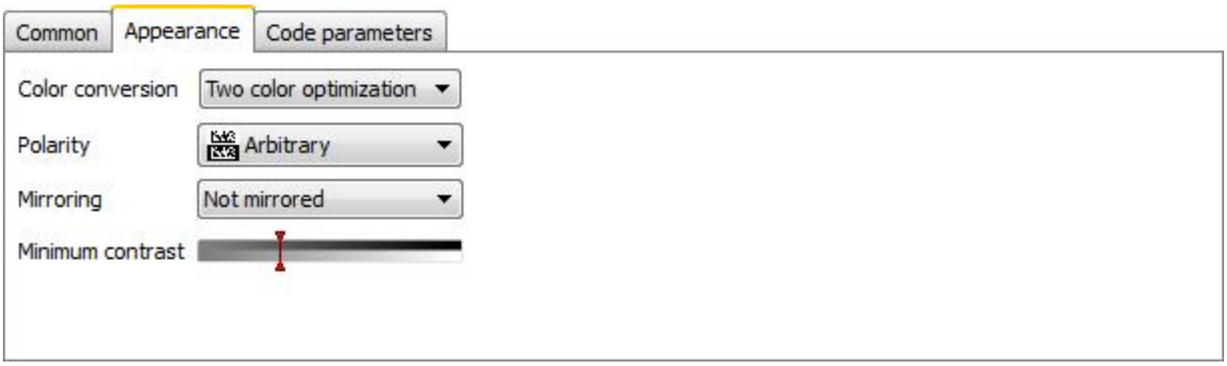
- **Parameters:** Select the search parameters used to search for the code. *Robust*, *Maximum* and *User defined* are available. In the *Robust* or *Maximum* modes, codes are found even with more demanding backgrounds. However, this places a burden on the processing time.
  In the case of the user-defined 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-in. This is only necessary if you have set the search parameters in the User-defined option.

- **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.

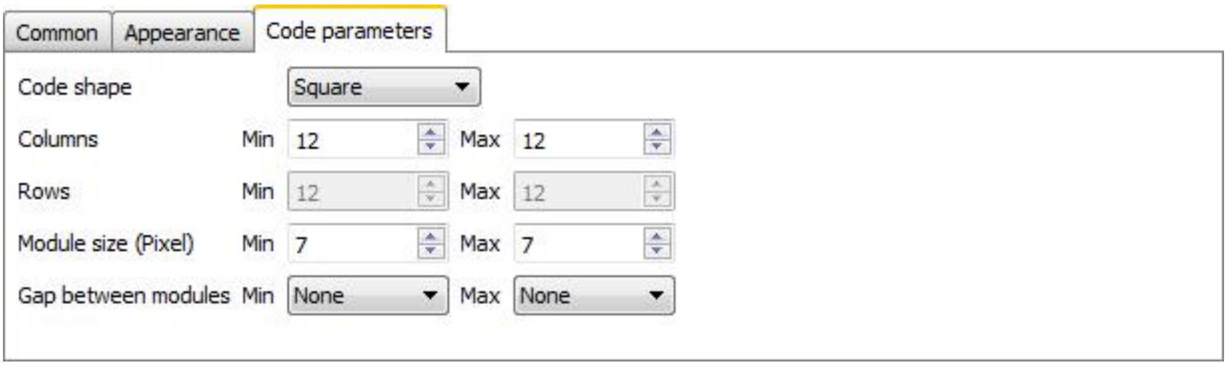
  The code quality is specified as follows:
  A - F (A = High quality ; F = Poor quality)
  The first parameter corresponds to the overall code quality.
  In the *ISO/IEC 15415* mode, various characteristics are determined:
    - ECC200 / QR code:
      Contrast, modulation, pattern damage, decodability, 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 gray value of the light modules.

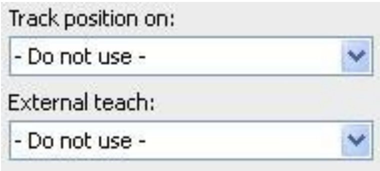
> **NOTE**
>
> In order to be able to make the settings "Appearance" and "*Code parameters*" on the tabs, you must set the Parameters on the “Common" tab to *User defined*.



- **Color 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 color optimization* if the barcode and background appear in similarly light colors.
- **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-in 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	Center of the code

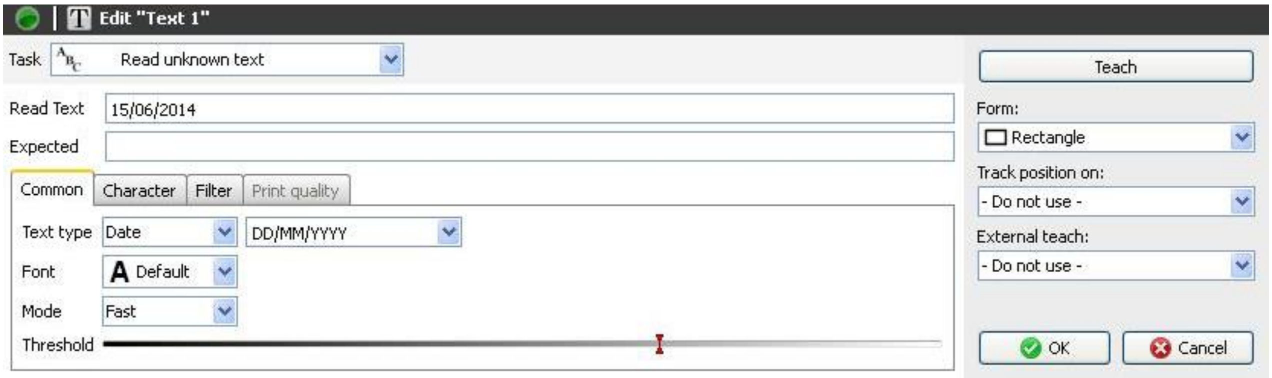
The following value can be set via the process interface. Please note that an expected value must be provided during parameterization of the feature check.

Input value	Data type	Description
to expected code	Text	expected code

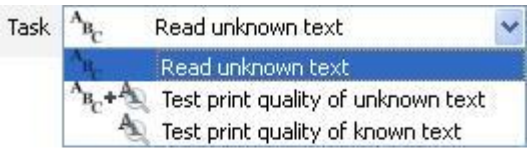
12.3.5 Text

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

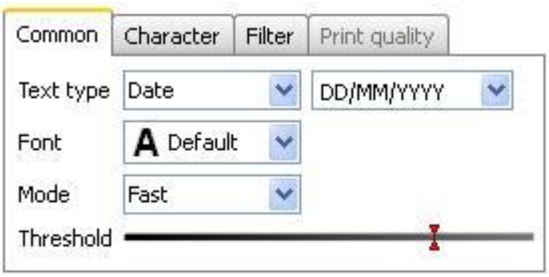
If you have selected Check the *print quality of unknown text*, you can compare the print quality of unknown text to previously taught reference characters. To use this function, you have to teach in the reference characters on the *Print quality* tab. You can also make settings on the Common, Characters 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-in.

> **NOTE**
>
> Using teach-in, 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.



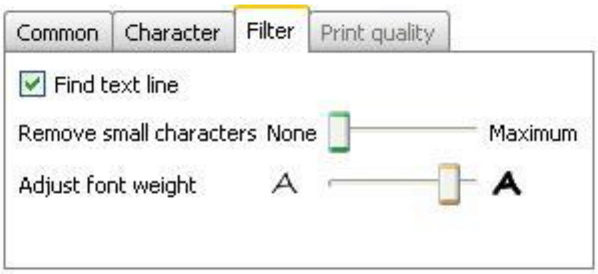
- **Text type:** Set the type of the text. You may select *Date, Numbers, Hexadecimal characters, Letters, Mask* and *Time*. You can describe the text type exactly on the right side, which is then displayed in accordance with the selected type.
- **Font:** Select the *Standard* font if you want to recognize 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.

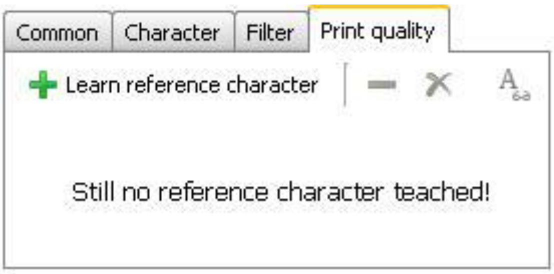
- **Mode:** The selected mode determines the processing time required to process the feature check. The *Robust* mode requires the longest processing time but makes more stable read results possible if the print format is not optimal.

- **Threshold:** Set the threshold for the separation of background and characters. For optimal recognition, the background should have as little structure as possible!

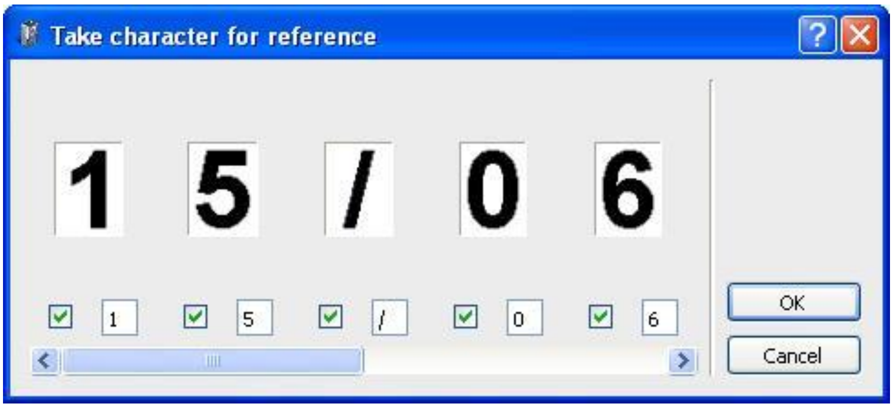
- **Polarity:** Specify whether the text is brighter or darker than the background.
- **Mirroring:** Specify whether the text is mirrored.
- **Font height:** Choose whether the character size is automatically recognized or whether it should be entered manually. With manual entry, you may enter this value or draw a frame in the image around one individual character.

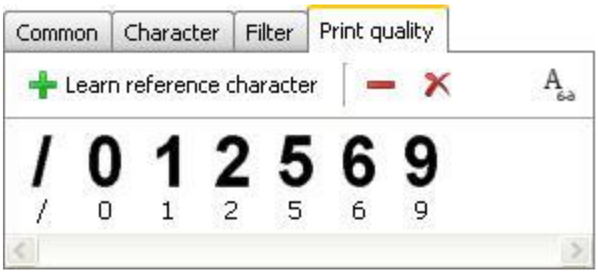


- **Find text line:** Activate the *Find text line* option if structures are present below or above the text and these structures are to be automatically masked.
- **Remove small characters:** In addition, you can set a minimum size for the characters to remove very small characters.
- **Adjust font 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.

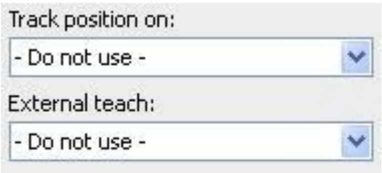




Delete the individually marked reference character

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-in 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

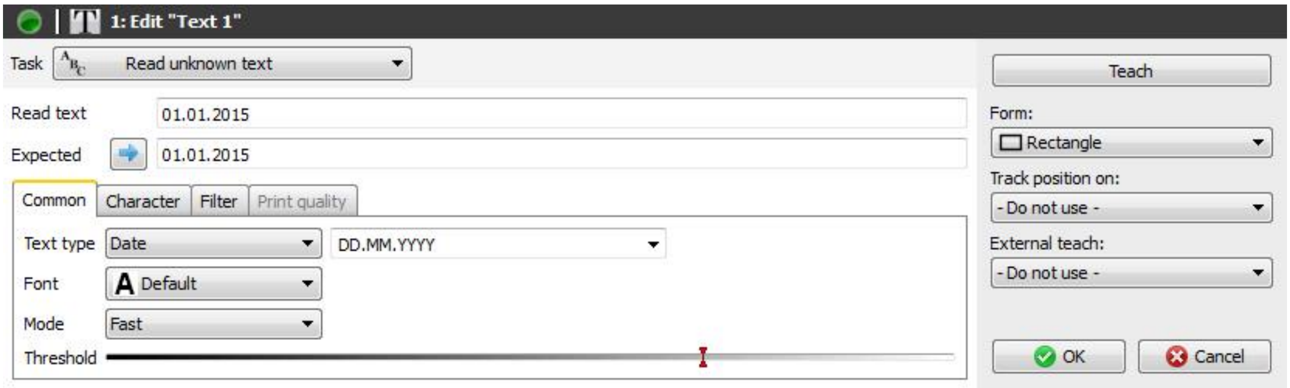
The following values can be set via the process interface. Please note that an expected value must be provided during parameterization of the feature check.

Input value	Data type	Description
Mask	Text	Masking of the expected text
Expected	Text	expected text

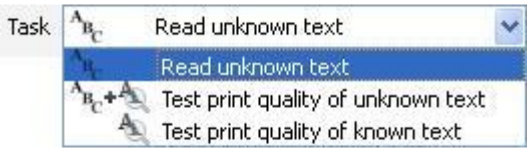
12.3.6 Text (color)

You can read colored dates, numbers and words on colored 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-in.

> **NOTE**
>
> Using teach-in, 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.

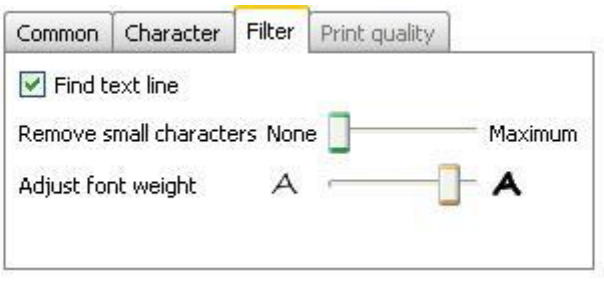
- **Text type:** Set the type of the text. You may select *Date, Numbers, Hexadecimal characters, Letters, Mask* and *Time*. You can describe the text type exactly on the right side, which is then displayed in accordance with the selected type.
- **Font:** Select the *Standard* font if you want to recognize 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.

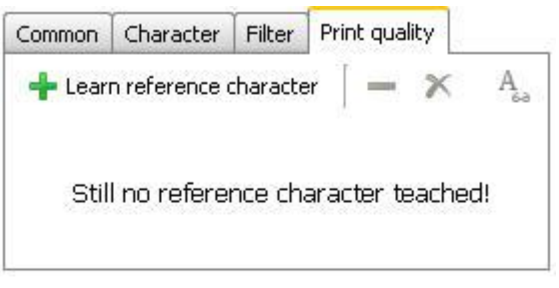
- **Mode:** The selected mode determines the processing time required to process the feature check. The *Robust* mode requires the longest processing time but makes more stable read results possible if the print format is not optimal.
- **Threshold:** Set the threshold for the separation of background 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.

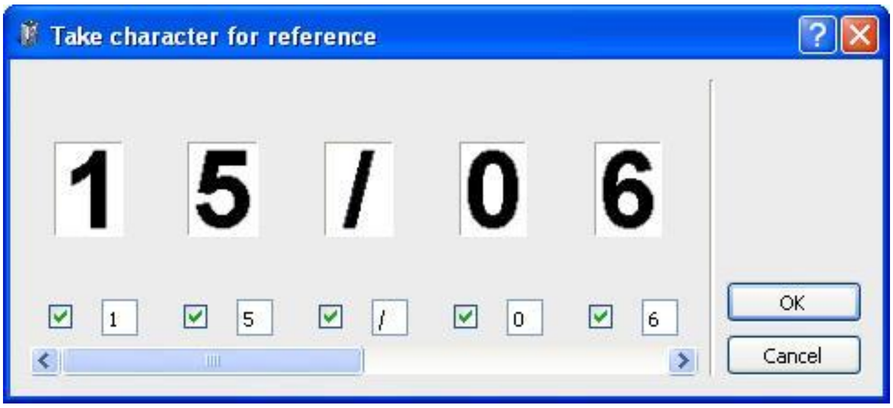
- **Color conversion**: Enter the method you wish to use to convert the field of view into a black and white image here. Select *Gray value*, if the black and white version of the field of view contrasts well. Select *Two color optimization* if the barcode and background appear in similarly light colors.
- **Re-learn text color:** Use this function to optimize the way the field of view is converted into a black and white image. This is useful if the colors in the field of view have changed.

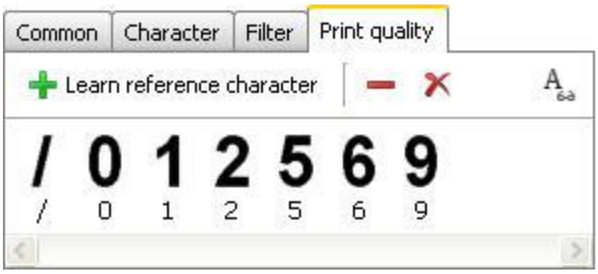


- **Find text line:** Activate the *Find text line* option if structures are present below or above the text and these structures are to be automatically masked.
- **Remove small characters:** In addition, you can set a minimum size for the characters to remove very small characters.
- **Adjust font 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.

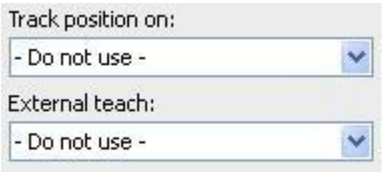




Delete the individually marked reference character

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-in 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 parameterization of the feature check.

Input value	**Data type**	**Description**
Mask	Text	Masking of the expected text
Expected	Text	expected text

12.3.7 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 gray scale value of the symbols
Minimum reflection	A = Minimum gray scale value ≤ 0.5 * maximum gray scale value F = Other
Edge contrast	Minimum contrast between two symbol elements
Modulation	Amplitude between symbol elements
Defects	Irregularities in the gray 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.

Quality characteristics Data matrix (ECC200) and QR code (ISO/IEC 15415 + AIM DPM-1-2006)

Designation	Example	Description
Contrast		Difference between the maximum and minimum gray scale value of the modules
Modulation		Amplitude between data code modules (dependent on error correction!)
Pattern damage		Disturbances in the frame pattern (finder pattern)
Legibility		A = Code legible F = Code not read

Designation	Example	Description
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
Gray scale value of the light modules		Average gray scale value of all light modules of the Data matrix or QR code

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

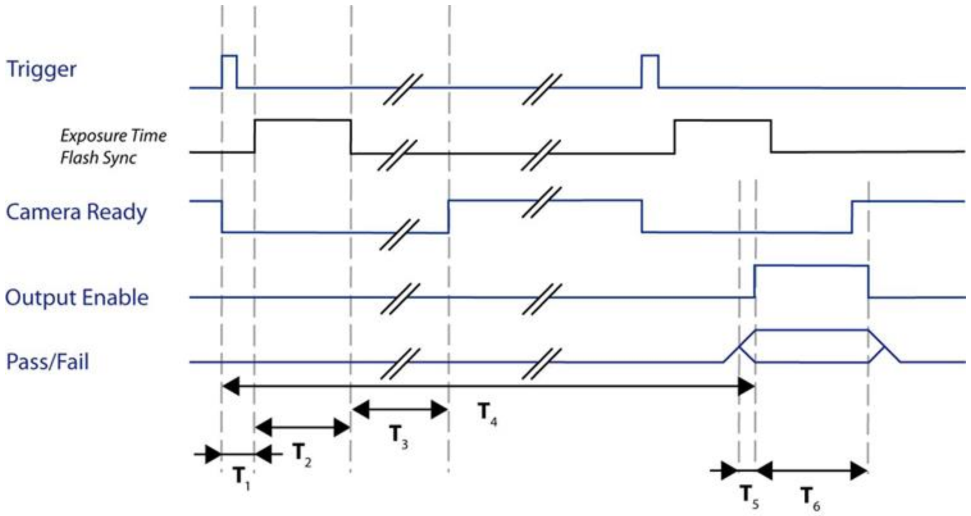
13 Digital interfaces

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 (model-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
	Lighting controller[2]	10 µs	1 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 *Camera Ready* signal is deactivated. The *Camera Ready* 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.

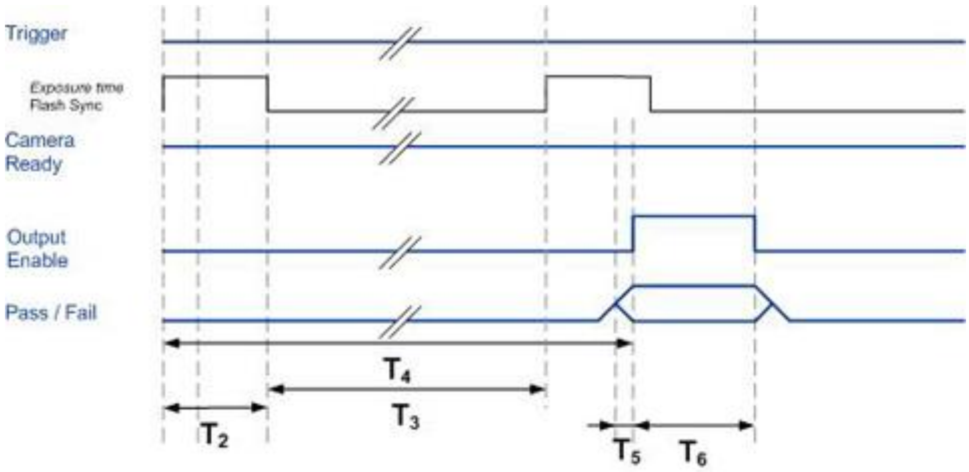
NOTE

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:



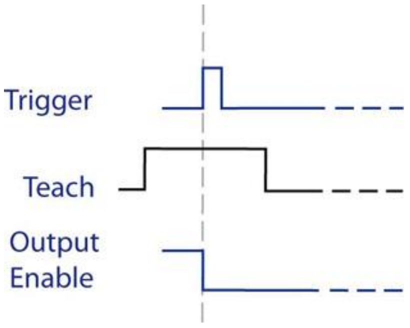
Signal		**Full resolution**		**Reduced resolution** (model-dependant)	
		min.	**max.**	**min.**	**max.**
Exposure time T_2	Internal illumination[1]	35 µs	10 ms	35 µs	5 ms
	External illumination	35 µs[1] / 10 µs[2]	65.5 ms	35 µs[1] / 10 µs[2]	65.5 ms
	Lighting controller[2]	10 µs	1 ms	10 µs	1 ms
Image 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

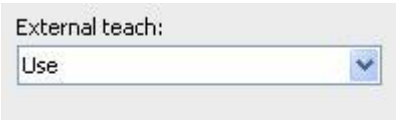
If continuous image acquisition is set in the job, the image acquisition operation occurs as soon as the previous image acquisition is complete. The *Camera Ready* signal is continuously activated during this time. The Pass/Fail signal is switched at the end of image analysis but no earlier than the set output time. You can recognize this time by a rising edge of the *Result valid* signal.

13.4 External Teach

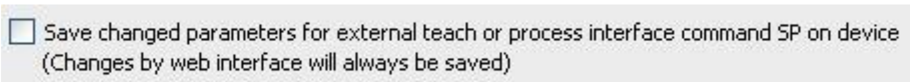
External Teach adjusts the switching thresholds and models in the feature checks so that the evaluations have OK as the result. External Teach is used if the product changes or there are new product versions.



The digital input "Teach-in" 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-in 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 "*Store changed parameters from External Teach-in or process SP interface command to the device*".

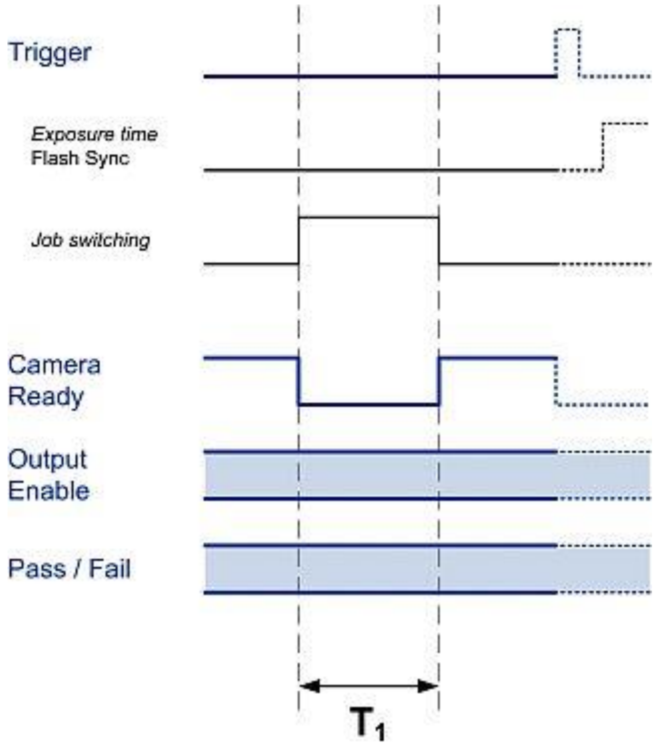
(*Device → Device settings → Job selection/Teach*)

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 switchover.



Signal	Switchover 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. *Camera ready* 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 *Camera Ready* 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. Note that you must activate the option *Job selection via digital inputs* under Job Management in order to execute job selection in this way.

You can also switch the active job by sending 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.

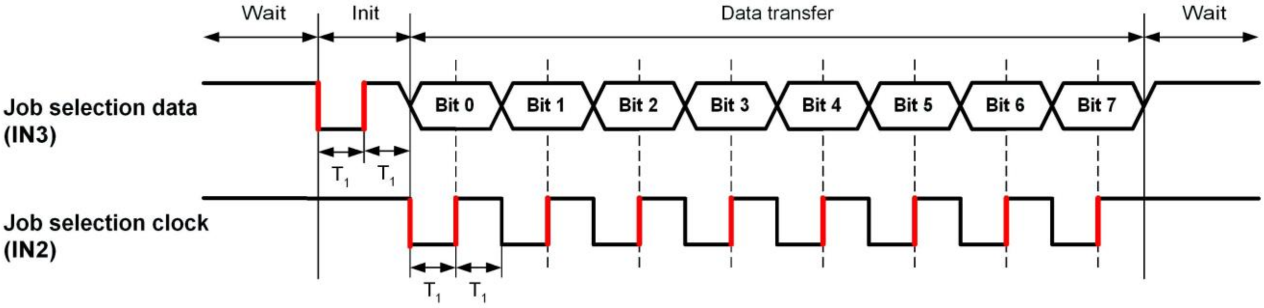
The allocation of the levels to the selected job is as follows:

	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.**
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:

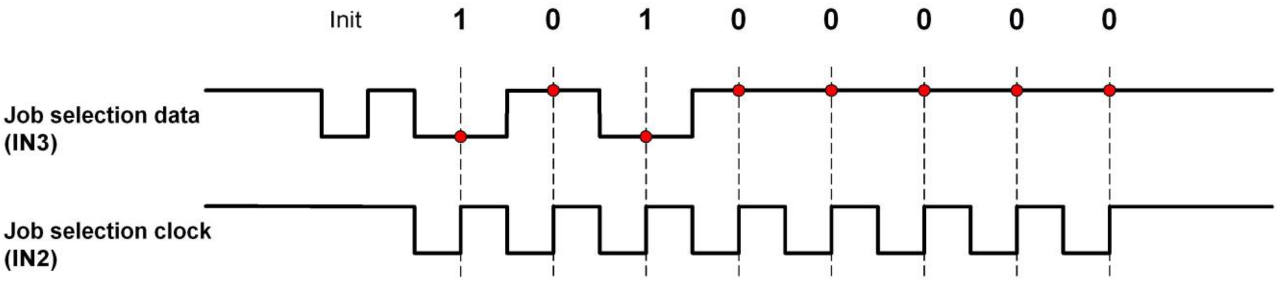
- In Job selection you must set the source "Digital inputs".
- For digital I/Os, the parameters for digital inputs 2 and 3 must be set as "Bit serial job selection – Clock" or "Bit serial job selection – Data".

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 *Camera Ready* 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

The following browsers are supported:

- Internet Explorer® 8/9 (not under Windows CE 5.0)
- Firefox 3.6.28
- Firefox 13 and later

Cookies must be permitted.

NOTE

Information for users operating the web interface from WinCCflexible 2008 SP3 on Windows 7 Embedded (Siemens panel): Customers report requests for Internet Explorer 7, even though Internet Explorer 9 is installed on Windows 7. The web interface requires at least Internet Explorer 8 (see supported web browsers). If this happens, please contact Siemens Support.

Due to differences in browser technology, there may be some difference in appearance between browsers.

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.

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!

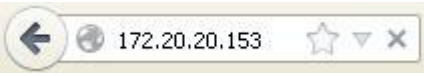
Users of Windows Internet Explorers® must also activate the use of ActiveX. You will find this setting under *Tools* > *Internet Options* > *Security* > *Security level for this zone* > *Run ActiveX controls and plug-ins*.

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

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*).

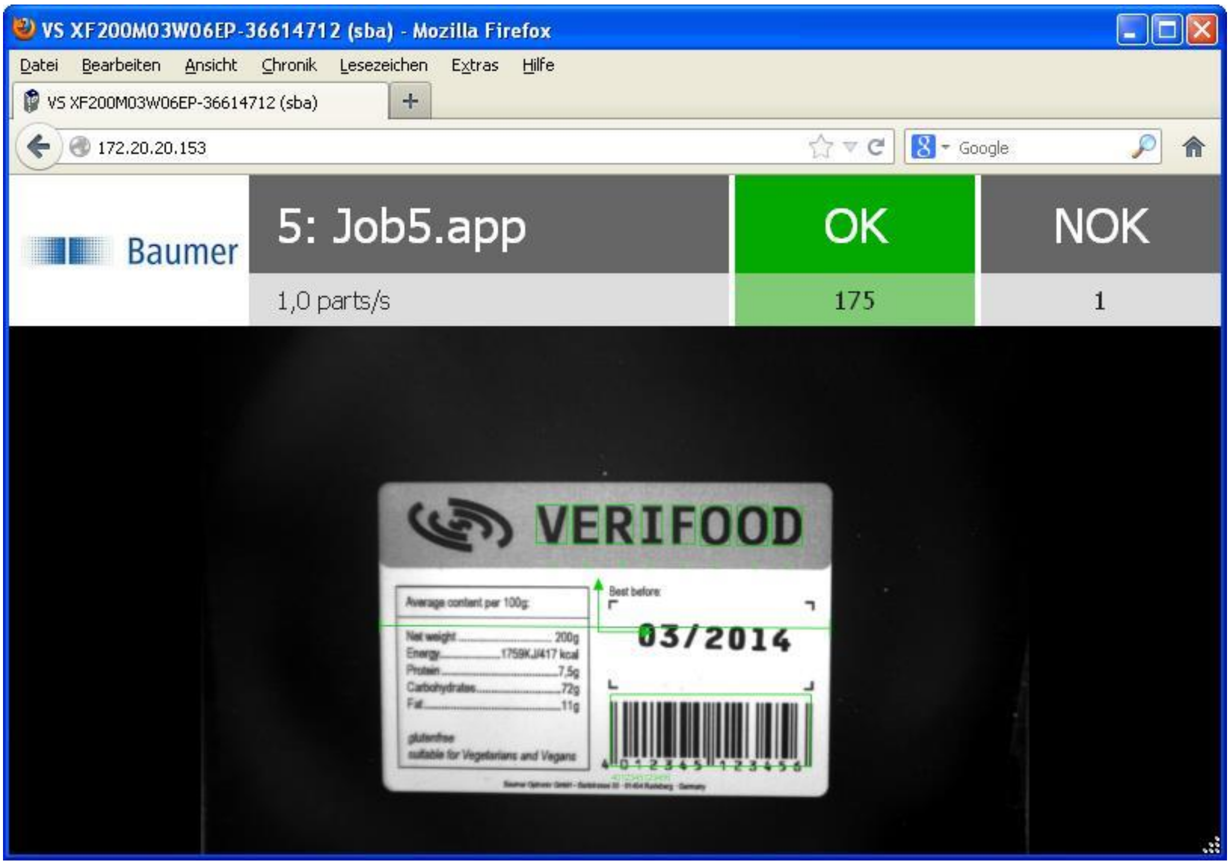
> **NOTE**
>
> Please ensure the URL is encoded correctly when entering your password via the browser!

```
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*.

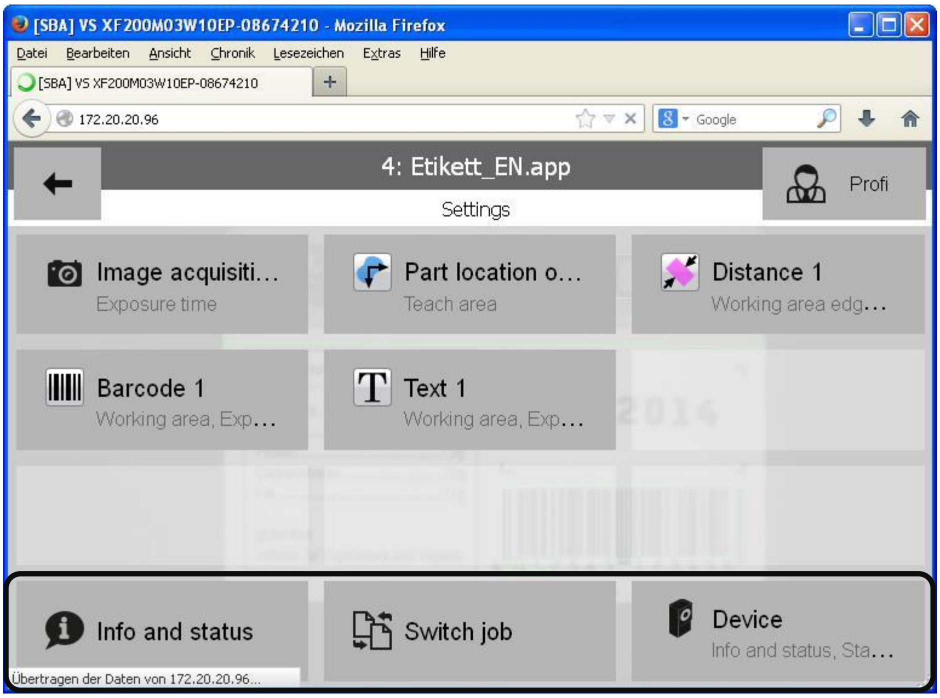
14.3 Device specific functions

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	Contents
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 dialog, you will see the currently saved error 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-in, which can be triggered in the web interface by reconfiguring using the *Teach* button.

External teach-in must be activated during parameterisation 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-in

NOTE

The external teach-in triggered using the *Teach* button can also no longer be cancelled using the *Cancel* button!

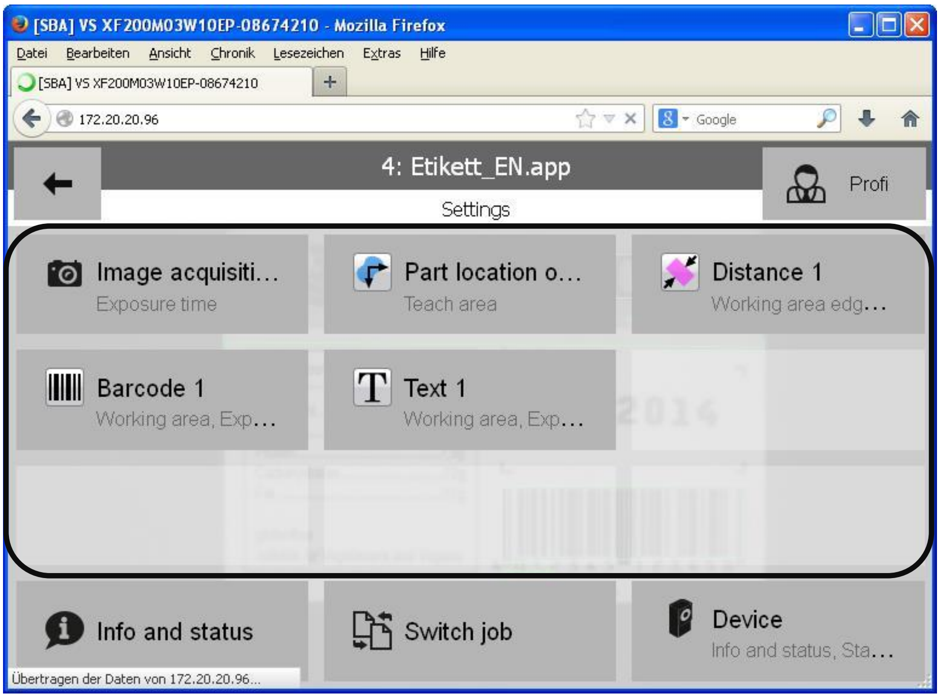
ATTENTION!

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

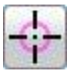
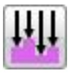
Function	**Icon**	**Adjustable parameters**
Image acquisition		• Exposure time • Amplification • Edge sharpness • Gamma correction

14.4.2 Part location

> **NOTE**
>
> The web interface does not support chained position tracking.

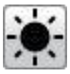
Function	Icon	Adjustable parameters
Part location on contours		• Teach area • Search area • Conformity • Contrast • Maximum rotation • External Teach
Part location on edges		• Field of view edge A • Field of view edge A2 • Field of view of edge B
Part location on circle		• Field of view circle • Field 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 center • 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
Color identification		• Field of view • Color deviation (in ΔE)

Brightness		• Field of view • Brightness • External Teach
Contrast		• Field of view • Contrast • External Teach
Area size		• Field of view • Area • Color • Binary threshold • External Teach
Area size (color)		• Field of view • Area • Target color
Color positioning		• Fields of view • Target color
Count areas		• Field of view • Number of areas • Color • Binary threshold • Areas filter: Minimum • Areas filter: Maximum • External Teach
Count areas (color)		• Field of view • Number of areas • Areas filter: Minimum • Areas filter: Maximum • Target color
Pattern comparison		• Field of view • Deviation
Pattern match (color)		• Field of view • Deviation

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
Matrix code		• Field of view • Expected code • Type of code • Parameter set • Polarity • Minimum contrast • Recognition • External Teach
Text		• Field of view • Expected • Mode • Color • Threshold • Change character density • External Teach

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`

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`

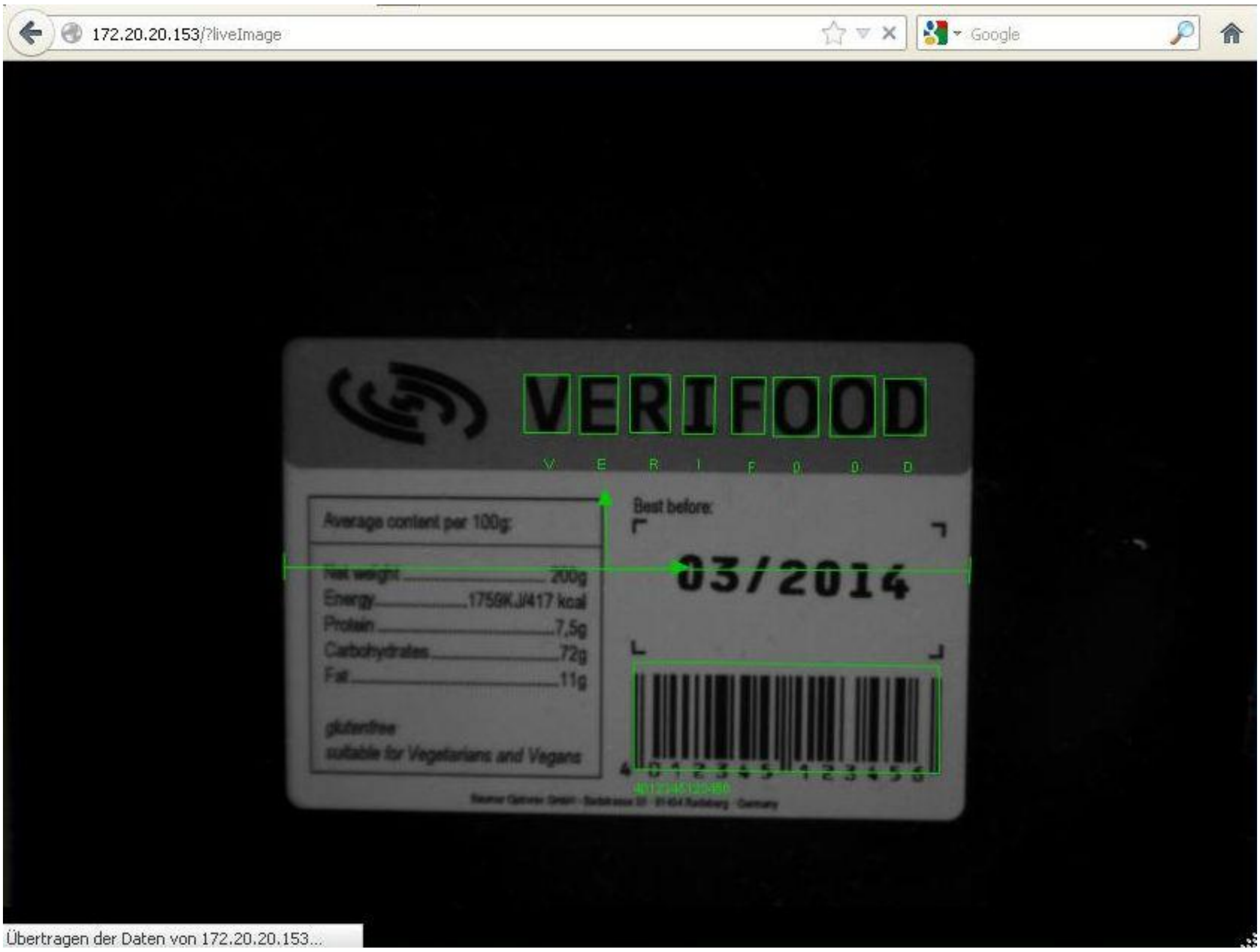
Image scaled down to half of its original height and width (default setting)
`http://[IP-address]/?binning=2x2`

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

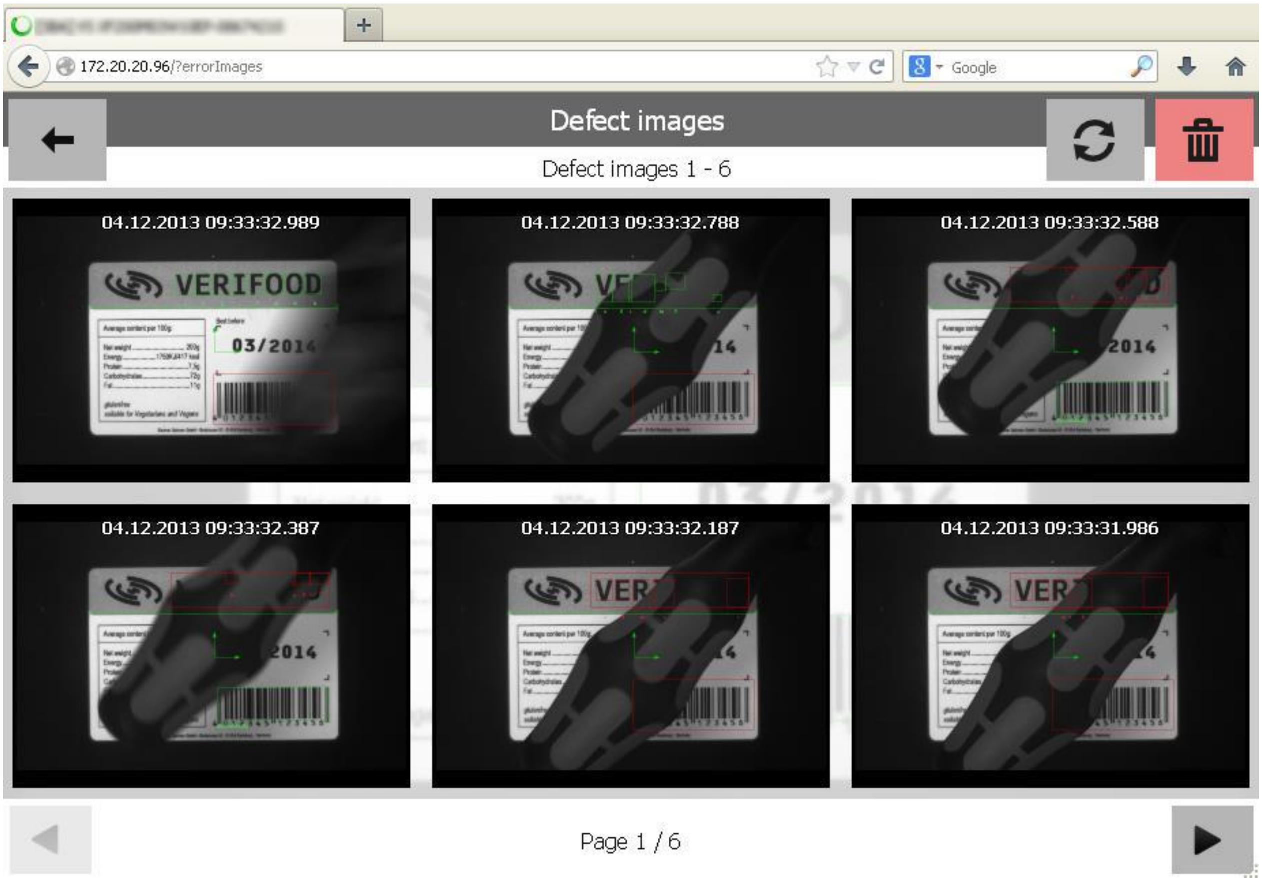
Access defect images via the browser's address field. You can save defect images in full resolution using your browser's context menu.

```
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 (model-dependant)

This chapter provides an overview of the process interface of the device.

15.1 Process interface via TCP/UDP (model-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 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
Result	Time of result transfer	On request Continuous
Receive timeout	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 (model-dependant)

You can communicate directly with the device via an RS485 connection. You can also use a gateway, which must be connected to the RS485 connector on the device, to communicate using the PROFINET protocol.

15.2.1 Configuration of the RS485 interface

The integration of the device via the process interface is made with an RS485 connection. To do this, connect the device to your machine using the pins provided and configure 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

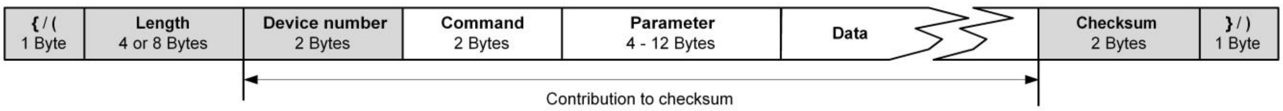
Without checksum

< 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.		Command		unused				Checksum		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		Checksum		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

This composite data type is formed of two integer values, the x-coordinate and the y-coordinate.

Available format: Analogue integer

Display: 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

Display: 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: analog 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

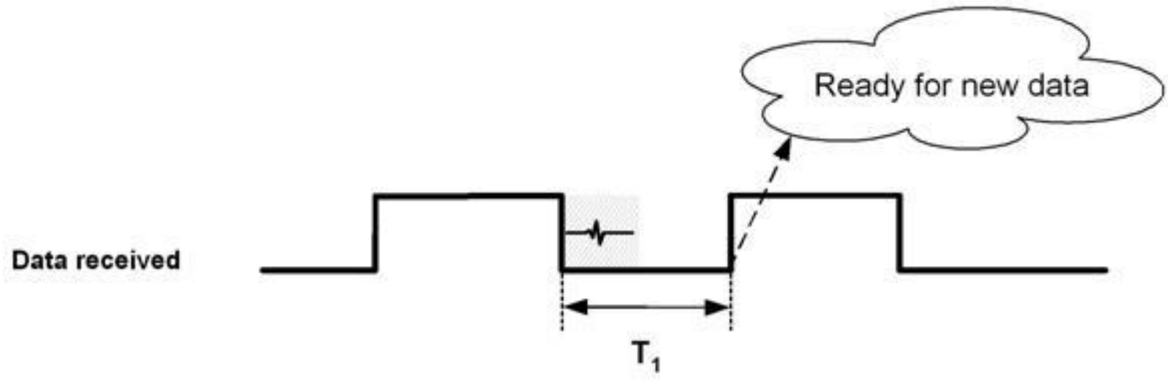
Command

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 Receive timeout

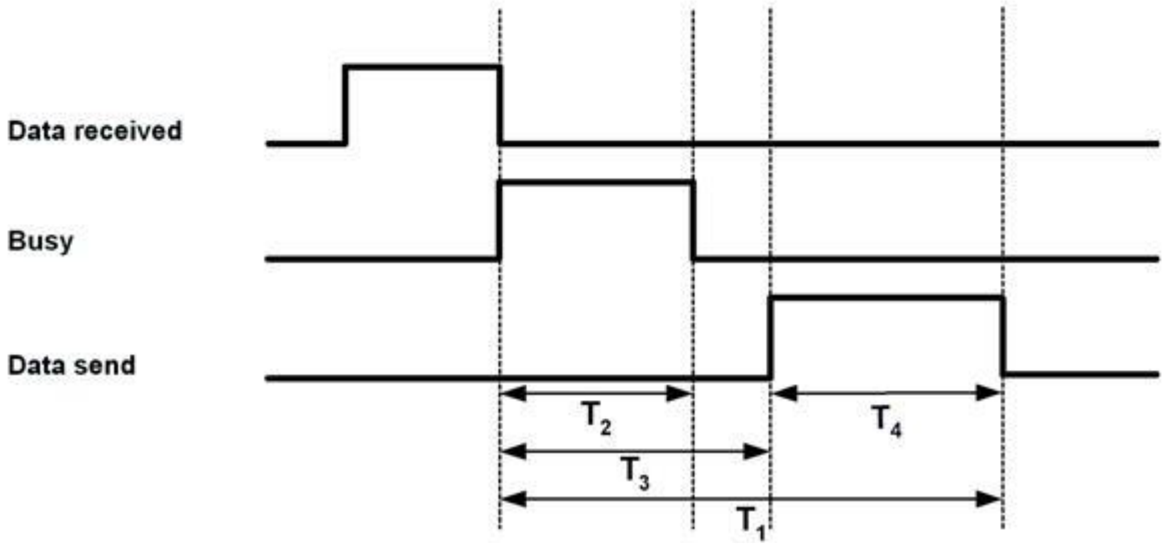


Signal	Duration	
	min.	max.
Receive timeout T_1	10 ms	2000 ms

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 (model-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		Dependent 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 GB – access device backup

This function enables you to access a backup of the device 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

15.4.3 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

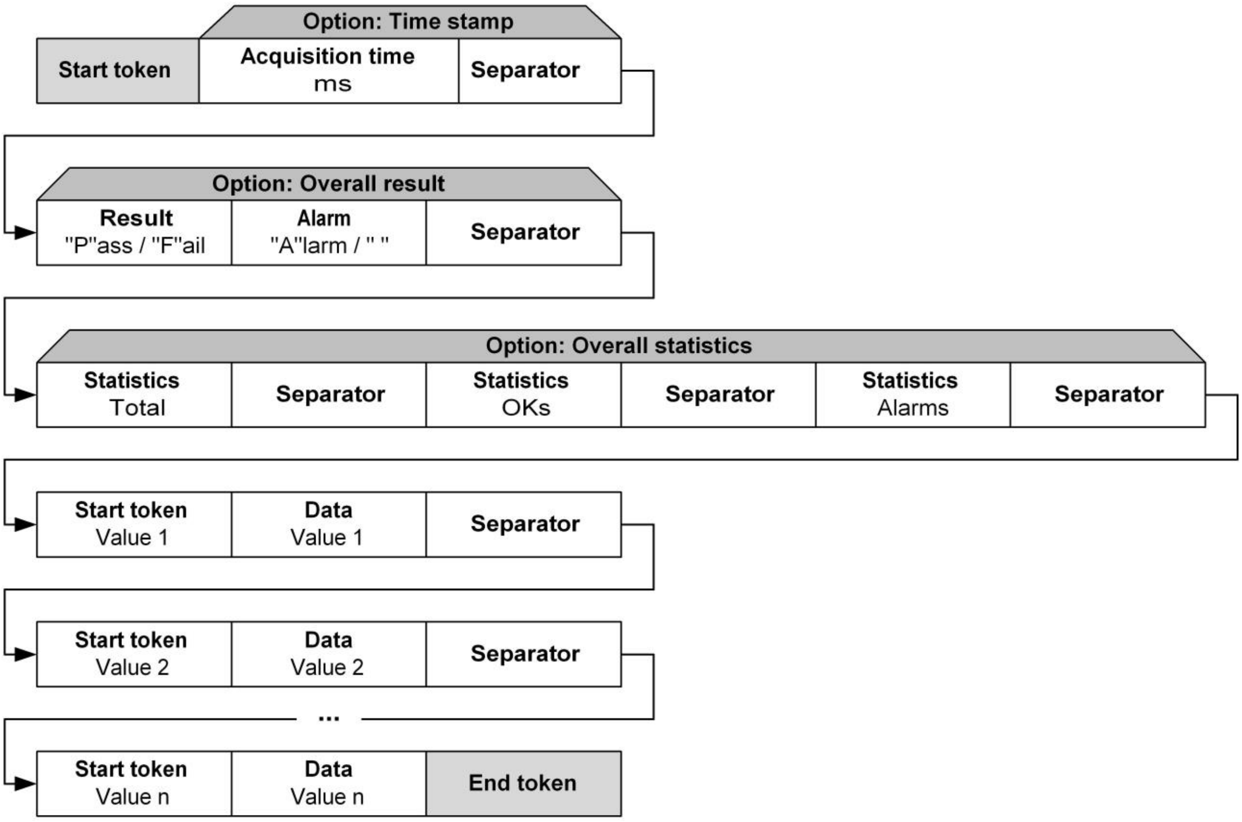
Structure of the command PLC ➡ device		
Command		Parameters
G	D	
Get **D**ata		none

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:

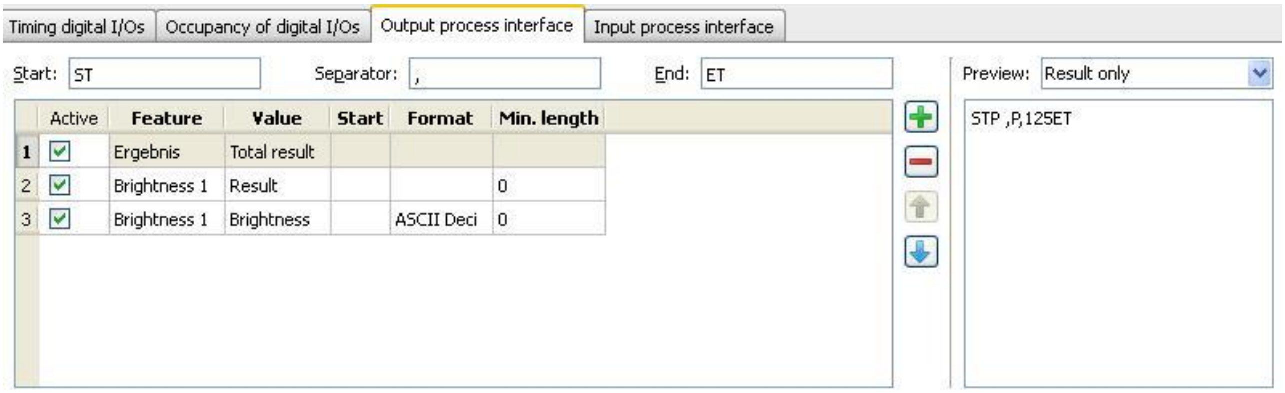
Representation	Description
ASCII decimal	Decimal notation of the number. Negative numbers are represented with "-". „123“, „78“, „89“, „-123“
ASCII hexadecimal	Hexadecimal notation of the number. Negative numbers are represented as a complement. "7B", "4E", "59", FF85
Binary	Binary output of the number. 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 sensor task's 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.

15.4.4 GF command – access individual data on 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 Setup- 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

15.4.5 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 80 = Fault image		2-byte ASCII hex Image number		8-byte ASCII hex Length of the image data								Image data in the format BMP

15.4.6 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	Baumer Optronic 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

15.4.7 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" / "Matrixcode" 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 **P**arameter		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								

NOTE

You can set the content of the datagram for output via the process interface during job creation under *Configure interfaces* → *Output process interface*.

15.4.8 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				

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 “Job update – 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: -

15.4.9 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)”.

15.4.10 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><td colspan="5">Structure of the command PLC ➡ device</td></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">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 Activated mode and in Configuration mode, 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 – Configuration mode
The device is switched to Configuration
No result data is transferred.</td></tr>
<tr><td colspan="2"></td><td colspan="3">For Ethernet only</td></tr>
<tr><td colspan="2"></td><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>)

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>)

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)”.

15.4.11 SP command – set parameters for the feature checks

This function enables you to set the expected values for the feature checks.

The expected values are set temporarily and remain valid until the device is restarted or switches to parameterisation mode.

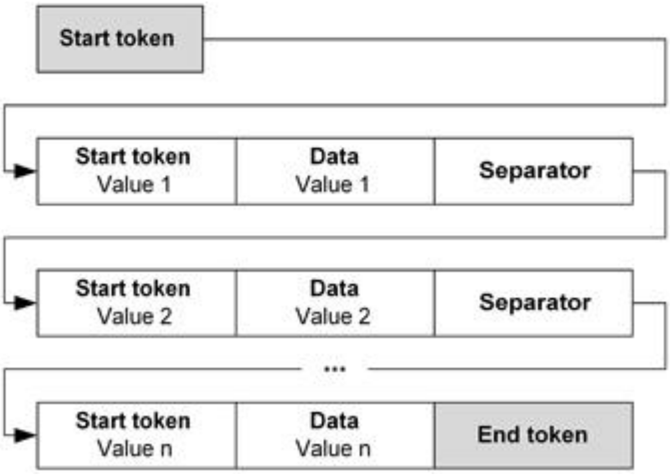
To save it long term, activate: *Device → Device settings→ Job selection / Teach → Save changed parameters from external Teach or process interface command XX to device…*

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

Structure of the command PLC ➡ device																
Command		Parameters														
S	P	0	0	0	8	1	7	.	0	3	.	2	0	1	4	
Set **P**arameter		4-byte ASCII hex Length of the result data				data e.g. a date, or a combination of expected values for different feature checks										

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

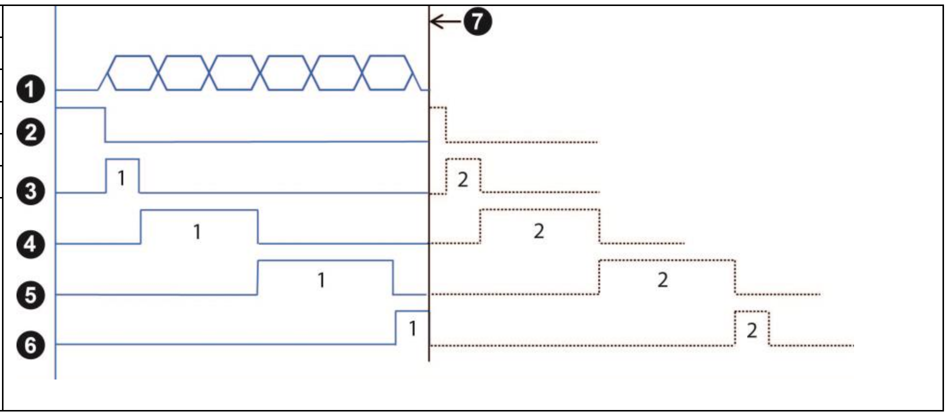
The SP and TE commands can be sent at any time and are buffered. The system simultaneously sets a flag to prevent further images from being acquired.

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.

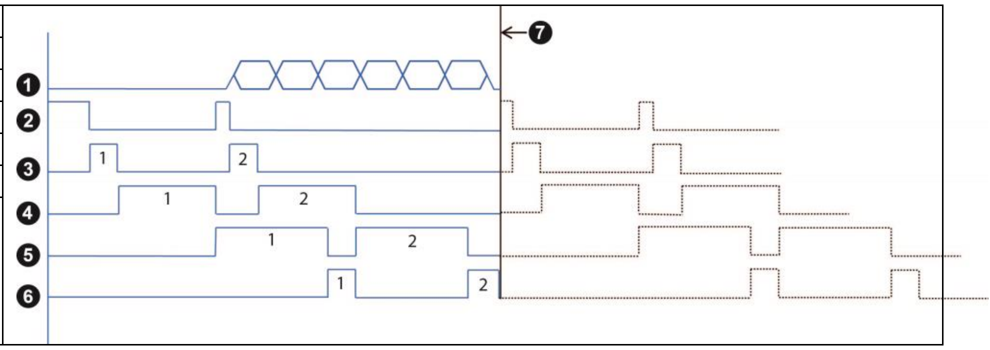
1	SP / TE command
2	Trigger permitted
3	Trigger
4	Image acquisition
5	Image processing
6	Result
7	Value stored < 1 ms



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



15.4.12 TE command – use next image for external teach

This function enables you to use the next image for an external teach-in. However, image acquisition will not be triggered.

The function is set temporarily and remains valid until the device is restarted or switches to parameterisation 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

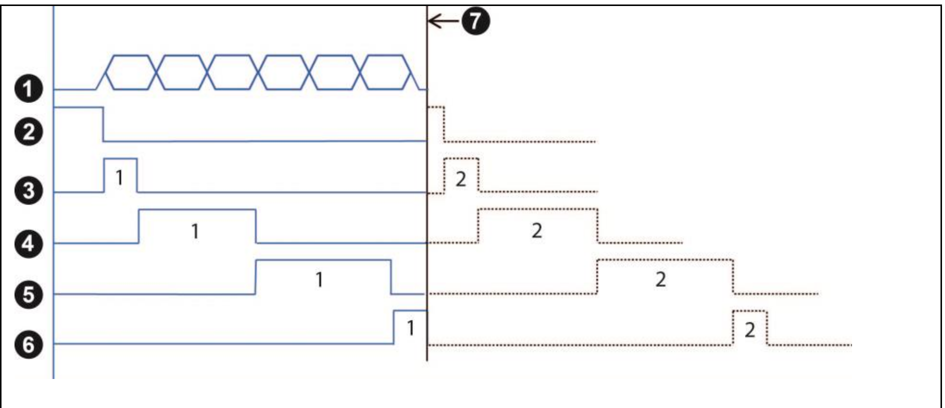
The SP and TE commands can be sent at any time and are buffered. The system simultaneously sets a flag to prevent further images from being acquired.

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.

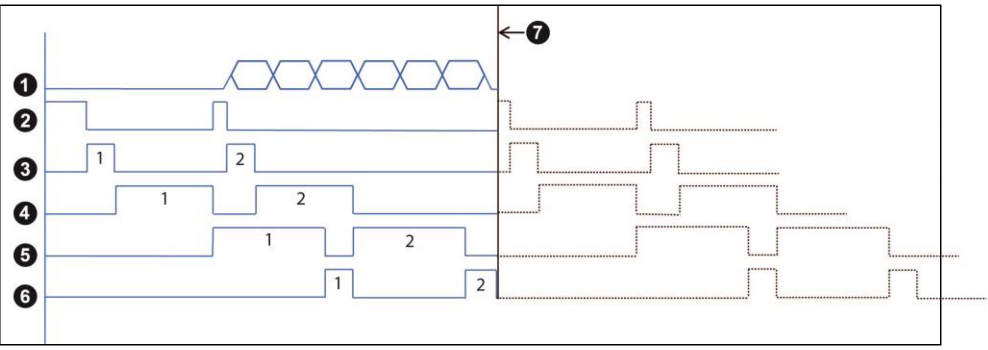
1	SP / TE command
2	Trigger permitted
3	Trigger
4	Image acquisition
5	Image processing
6	Result
7	Value stored < 1 ms



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



15.4.13 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)“.

15.4.14 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)“.

15.4.15 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).

15.4.16 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 SETUP 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		

15.4.17 UJ command – transfer a new job

This function enables you to transfer a new job to the device.

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 SETUP 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		

15.4.18 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 Process interface via industrial Ethernet (model-dependant)

It is possible to communicate with the Vision Sensor via various industrial Ethernet standards, such as PROFINET or Ethernet/IP™, using a PLC. Extra hardware - a gateway - is required for this.

The PLC communicates with the gateway via an industrial Ethernet connection (Ethernet cable) and the gateway in turn communicates with the connected devices (max. 4) via an RS485 connection.

The data transfer protocol is determined by the industrial Ethernet specification. The types of data that can be transferred in this way are described in the *Available data for PROFINET* or *Available data for Ethernet/IP™* chapters.

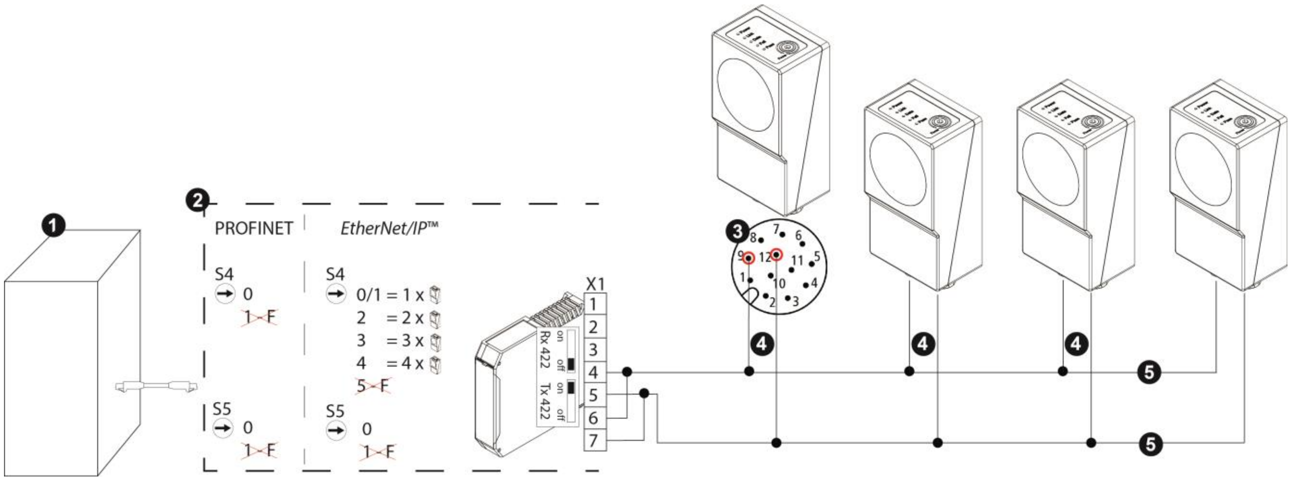
Adopt the settings for the RS485 parameters using the *Application Suite*. You can find the settings options under: *Device → Device settings → Process interface*.

15.5.1 Gateway cabling

> **ATTENTION!**
>
> Please observe and follow the information in the relevant user handbook from Deutschmann, which is included on the CD.
> PROFINET: German: *CL_PN_2Port_d.pdf* / English: *CL-PN_2Port-e.pdf*
> Ethernet/IP™: German: *CL_EtherNet_IP2Port.pdf* / English: *CL_EtherNetIP_2Port_e.pdf*

The devices are integrated using an industrial Ethernet gateway and industrial Ethernet protocols. Gateways are currently available for PROFINET and Ethernet/IP™. To integrate the devices, connect them to the gateway using the assigned pins. The gateway will then communicate with your PLC.

Activate the resistance in the gateway (switch setting Tx as in the diagram). Also activate the resistance in the last device in the bus via the *Application suite* (*Device → Device settings → Process interface*). The resistance must be deactivated for the other devices!



Number	Description
1	PLC
2	Gateway Switch settings for activating the resistance for RS485 (TX, RX). S4 switch settings for defining the number of connected devices using Ethernet/IP™. **Power X2 terminal** Pin 1: Operating voltage Pin 2: 0V **ATTENTION!** The gateway must have the same ground potential as the connected Vision Sensors. **X1 terminal** Pin 4, 6: RS485+ Pin 5, 7: RS485-
3	Pin assignment on the devices (max. 4) Pin 9 (red): RS485+ Pin 12 (red/blue): RS485-
4	Branch lines (AWG26 recommended, thicker cross sections possible, twisted) Max. length of the branch lines for all devices: < 20 m
5	Maximum cable length at 230400 baud: 200 m (AWG26 recommended, thicker cross sections possible, twisted, shielded)

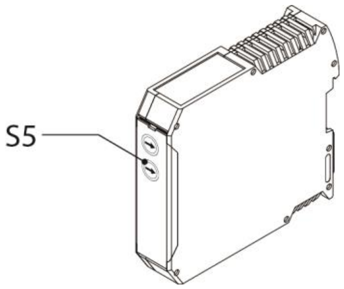
15.5.2 Activate DHCP on EtherNet/IP™ Gateway

A fixed IP address is set on the EtherNet/IP™ Gateway. To assign an IP address via DHCP, proceed as follows:

1. Switch off the power supply to the EtherNet/IP™ Gateway.

2. Set the *S5* switch on the Gateway to *F*.

3. Restore the power supply to the EtherNet/IP™ Gateway and wait while it restarts.



4. Switch off the power supply to the EtherNet/IP™ Gateway again.

5. Set the *S5* switch on the Gateway to *0*.

6. Restore the power supply to the EtherNet/IP™ Gateway again.

→ DHCP is now activated.

15.5.3 LEDs on the gateway

Descriptions of the PROFINET LEDs (state, power, link/act. P1/P2) can be found in the documentation for the PROFINET gateway (German: *CL_PN_2Port_d.pdf* / English: *CL_PN_2Port-e.pdf*), which is stored on the installation CD for the Application Suite.

Descriptions of the Ethernet/IP™ LEDs (net state, mod status, power, link/act. P1/P2) can be found in the documentation for the Ethernet/IP™ gateway (German: *CL_EI_2Port_d.pdf* / English: *CL_EI_2Port-e.pdf*), which is stored on the installation CD for the Application Suite.

Errors are indicated with an illuminated red status LED and the corresponding error code is displayed by LEDs 1-8 on the front of the gateway.

State	LED 1	LED 2	LED 4	LED 8	Error description
Flashes green when the gateway is waiting for the start of the cyclical Profinet communication.	off	off	off	off	n.a.
Illuminates in static green when the cyclical Profinet communication is active	Flashes green: Connection being established to device with ID "1"	Flashes green: Connection being established to device with ID "2"	Flashes green: Connection being established to device with ID "3"	Flashes green: Connection being established to device with ID "4"	n.a.
	Illuminates in static green: Serial connection to device with ID "1" is active	Illuminates in static green: Serial connection to device with ID "2" is active	Illuminates in static green: Serial connection to device with ID "3" is active	Illuminates in static green: Serial connection to device with ID "4" is active	n.a.
Flashes red quickly (2 Hz): Internal error -> LEDs 1-8 display error code	flashes	off	off	off	Hardware error
	off	flashes	off	off	EEROM error
	flashes	flashes	off	off	Internal storage error
	off	off	flashes	off	Field bus hardware error
	flashes	off	flashes	off	Script error
	flashes	flashes	flashes	off	RS sending buffer overrun
	off	off	off	flashes	RS receipt buffer overrun
	flashes	off	off	flashes	User-defined / RS timeout
	off	flashes	off	flashes	General field bus error
	flashes	flashes	off	flashes	RS parity or frame check error
	flashes	off	flashes	flashes	PROFINET configuration error
	off	flashes	flashes	flashes	PROFINET buffer overrun
Flashes red slowly (1 Hz): VeriSens application error -> LEDs 1-8 display error code	flashes	off	off	off	Configuration error (module configuration)
	off	flashes	off	off	Configuration error (duplicated device ID)
	flashes	flashes	off	off	RS protocol error
	off	off	flashes	off	Data buffer overrun
	flashes	off	flashes	off	Pipeline overrun
	off	flashes	flashes	off	Handshake error

15.5.4 Planning in the PLC

15.5.4.1 PROFINET

With PROFINET, data organisation is module-based. The available modules are described in the GSDML file (device description file).

The device description file *GSDML-V2.3-Baumer-VeriSens-Gateway-20140813-120000.xml* and the gateway help file can be found on the installation CD for the *Application Suite* and on the PC after installation.

Device description file:

PC: `<Installation path>\Industrial_Ethernet\PROFINET`
Installation CD: `<root>\Industrial_Ethernet\PROFINET`

Gateway help file:

PC: `<Installation path>\Help`
Installation CD: `<root>\Help`

The planning tool in the PLC is used to define which of the available modules are actually in use.

You can connect up to four modules per device. These modules must be plugged into certain, predefined slots:

Slots	Module
1	Module: Configuration and connection status
2, 3, 4, 5	four modules for the first device
6, 7, 8, 9	four modules for the second device
10, 11, 12, 13	four modules for the third device
14, 15, 16, 17	four modules for the fourth device

You can leave out individual modules. For example, only the *control and status* module and the *result data* module may be connected. Different modules can also be connected for each individual device.

The following chapters contain information regarding the respective modules.

15.5.4.2 Ethernet/IP™

With Ethernet/IP™, data organisation is based on assembly objects.

The available data and pre-defined connections are described in the ESD file (device description file)

The device description file *Baumer_VeriSens_Gateway_EIP.eds* and the gateway help file can be found on the installation CD for the *Application Suite* and on the PC after installation.

Device description file:

PC: `<Installation path>\Industrial_Ethernet\EtherNetIP`
Installation CD: `<root>\Industrial_Ethernet\EtherNetIP`

Gateway help file:

PC: `<Installation path>\Help`
Installation CD: `<root>\Help`

The planning tool in the PLC is used to define which of the available connections are actually used.

You can create one connection per device. Each connection represents one input and one output assembly object which contain the input and output data respectively for the assigned device.

The content of this data is described in the following chapters.

If two or more devices are connected to a single gateway, you must set the number of connected devices on the *S4* switch on the front panel of the gateway.

Position "0" (pre-set) or "1" are used if one device is connected, positions "2", "3" and "4" are used for two, three or four connected devices. All other positions are invalid.

The device IDs must then be assigned, starting with ID "1". (It will not work if a single device is connected with ID "4", for example.)

NOTE

Configuring more devices than are actually connected (e.g. having the *S4* switch is set to 3 with only one device connected) limits performance (data throughput and reaction time) dramatically!

15.6 Available data for PROFINET

There is a difference between the transfer of cyclical and non-cyclical data.

15.6.1 Cyclical data

Cyclical data is data that is sent between the gateway and the connected devices at regular intervals. The cycle is defined via the PLC parameterisation.

NOTE

The cycle cannot be shorter than 4 ms. We recommend cycles of 8 ms or longer. If you are using more than 2 Vision Sensors on a single gateway, the cycle must be no shorter than 8 ms, and a maximum of 2 Vision Sensors can be operated at 8 ms. Any further Vision Sensors must be operated with a cycle of 16 ms or longer.

Recommended minimum cycles:

	1. VS	**1. VS**	**1. VS**	**1. VS**
1 VS	8 ms	-	-	-
2 VS	8 ms	8 ms	-	-
3 VS	8 ms	8 ms	16 ms	-
4 VS	8 ms	8 ms	16 ms	16 ms

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 PROFINET 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 → Setup 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

15.6.1.1 Module: Configuration and connection status

The number of devices in use is configured in this module. You can also define which modules are used for which individual device.

NOTE

There is the option to automatically detect the modules on the connected devices.

However, in some special cases, automatic detection may not correctly detect the actual module configuration. This can lead to incorrect assignment. This must be corrected to the explicit module configuration.

If there is a conflict with the specifications on the *Configuration and connection status* module during assignment of the connected modules, a diagnosis alarm is produced with the code 101 and the error details 0x0000. This means that data cannot be exchanged with any of the devices.

The cause of this error may be that a module that should be available is not found in the module sequence or that more modules are connected into the planning system than there should be according to the specifications in the configuration and connection status module.

Module configuration

To ensure that data from the individual devices in the PLC is interpreted definitively and to prevent errors during reconfiguration, it has been defined that modules in slots 2..5 belong to the device with the ID 1, the modules in slots 6...9 belong to the device with the ID 2, the modules in slots 10...13 belong to the device with ID 3 and the modules in slots 14...17 belong to the device with ID 4.

At the start of cyclical communication, only the connected modules and their order are transmitted to the gateway via PROFINET, not their assignment to the slots. This means that the following configurations appear identical to the gateway: Control and status - result data - parameters - trigger data:

Slot		Example 1	Example 2	Example 3	Example 4
2	Device 1	Control and status	Control and status	Control and status	Control and status
3		Result data		Result data	Result data
4		Parameters			
5		Trigger data			
6	Device 2				
7			Result data		
8				Parameters	
9				Trigger data	
10	Device 3				
11					
12			Parameters		Parameters
13					
14	Device 4				
15					
16					
17			Trigger data		Trigger data

How automatic detection works:

The modules are analysed by the gateway according to their order and starting with device 1, are assigned to the current device if it does not yet have a module of this type.

If a module of this type has already been assigned to the current device, this device is assessed as completely configured and the current module (and all subsequent modules) are assigned to the next device.

So the following module sequences are assigned automatically as follows:

		Example 5	Example 6	Example 7	Example 8
Module sequence		Control and status	Control and status	Control and status	Control and status
		Result data	Result data	Result data	Result data
		Parameters	Control and status	Control and status	Control and status
		Trigger data	Result data	Trigger data	Parameters
				Control and status	Parameters
				Parameters	Trigger data
Slot					
2	Device 1	Control and status	Control and status	Control and status	Control and status
3		Result data	Result data	Result data	Result data
4		Parameters			
5		Trigger data			
6	Device 2		Control and status	Control and status	Control and status
7			Result data		
8					Parameters
9				Trigger data	
10	Device 3			Control and status	
11					
12				Parameters	Parameters
13					Trigger data
14	Device 4				
15					
16					
17					

With automatic assignment, it is therefore not possible to leave out a device, for example when a device is removed from an existing machine, without reconfiguring the others.

As you can see from the examples, module configurations 1-4 always lead to one and the same module sequence which can then be resolved during automatic configuration as shown in examples 1 and 5.

To assign the modules as connected in examples 1-4, the values in the *Configuration and connection status* module must be set as follows:

Slot		**Example 1**	**Example 2**	**Example 3**	**Example 4**
2	Device 1	Control and status	Control and status	Control and status	Control and status
3		Result data		Result data	Result data
4		Parameters			
5		Trigger data			
6	Device 2				
7			Result data		
8				Parameters	
9				Trigger data	
10	Device 3				
11					
12			Parameters		Parameters
13					
14	Device 4				
15					
16					
17			Trigger data		Trigger data
Configuration resolution via "Config module"					
Number of devices		0 or 1	0 or 4	0 or 2	0 or 4
Conf. device 1		0x00 or 0x0F	0x01	0x09	0x09
Conf. device 2		0x00 or 0x80	0x08	0x06	0x80
Conf. device 3		0x00 or 0x80	0x04	0x00 or 0x80	0x04
Conf. device 4		0x00 or 0x80	0x02	0x00 or 0x80	0x02 or 0x80

Module content

Data element	Direction	Type	Length (Byte)	Description
Number of devices in use	PLC ➡ device	UINT8	1	Number of devices actually connected, 0 for "auto detect" (including "skipped" devices, i.e. when using device 1 and device 3, you must enter 3!)

<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="7">Module in use (device 1)</td><td rowspan="7">PLC ➡ device</td><td rowspan="7">UINT8</td><td rowspan="7">1</td><td colspan="2">Bit mask for "connected modules" for device 1 - all bits == 0 -> all modules are "auto detect", otherwise: Bit == 1 -> module connected, Bit == 0 -> module not connected</td></tr>
<tr><td>Bit 0</td><td>1 if the "Control" module is connected, otherwise 0</td></tr>
<tr><td>Bit 1</td><td>1 if the "Trigger data" module is connected, otherwise 0</td></tr>
<tr><td>Bit 2</td><td>1 if the "Set Param" module is connected, otherwise 0</td></tr>
<tr><td>Bit 3</td><td>1 if the "Result data" module is connected, otherwise 0</td></tr>
<tr><td>Bits 4..6</td><td>Reserved (always 0)</td></tr>
<tr><td>Bit 7</td><td>1 if no modules are connected to device 1, otherwise 0</td></tr>
</table>

Data element	Direction	Type	Length (Byte)	Description	
Module in use (device 2)	PLC ➡ device	UINT8	1	Bit mask for "connected modules" for device 2 (if at least 2 devices are connected) - all bits == 0 -> all modules are "auto detect", otherwise: Bit == 1 -> module connected, Bit == 0 -> module not connected	
				Bit 0	1 if the "Control" module is connected, otherwise 0
				Bit 1	1 if the "Trigger data" module is connected, otherwise 0
				Bit 2	1 if the "Set Param" module is connected, otherwise 0
				Bit 3	1 if the "Result data" module is connected, otherwise 0
				Bits 4..6	Reserved (always 0)
				Bit 7	1 if no modules are connected to device 2, otherwise 0

Data element	Direction	Type	Length (Byte)	Description	
Module in use (device 3)	PLC ➡ device	UINT8	1	Bit mask for "connected modules" for device 3 (if at least 3 devices are connected) - all bits == 0 -> all modules are "auto detect", otherwise: Bit == 1 -> module connected, Bit == 0 -> module not connected	
				Bit 0	1 if the "Control" module is connected, otherwise 0
				Bit 1	1 if the "Trigger data" module is connected, otherwise 0
				Bit 2	1 if the "Set Param" module is connected, otherwise 0
				Bit 3	1 if the "Result data" module is connected, otherwise 0
				Bits 4..6	Reserved (always 0)
				Bit 7	1 if no modules are connected to device 3, otherwise 0

Data element	Direction	Type	Length (Byte)	Description	
Module in use (device 4)	PLC ➡ device	UINT8	1	Bit mask for "connected modules" for device 4 (if 4 devices are connected) - all bits == 0 -> all modules are "auto detect", otherwise: Bit == 1 -> module connected, Bit == 0 -> module not connected	
				Bit 0	1 if the "Control" module is connected, otherwise 0
				Bit 1	1 if the "Trigger data" module is connected, otherwise 0
				Bit 2	1 if the "Set Param" module is connected, otherwise 0
				Bit 3	1 if the "Result data" module is connected, otherwise 0
				Bits 4..6	Reserved (always 0)
				Bit 7	1 if no modules are connected to device 4, otherwise 0

Data element	Direction	Type	Length (Byte)	Description
Connection status (device 1)	PLC ⬅ device	UINT8	1	1 if the RS connection to device 1 is active, otherwise 0

Data element	Direction	Type	Length (Byte)	Description
Connection status (device 2)	PLC ⬅ device	UINT8	1	1 if the RS connection to device 2 is active (if at least 2 devices are connected), otherwise 0

Data element	Direction	Type	Length (Byte)	Description
Connection status (device 3)	PLC ⬅ device	UINT8	1	1 if the RS connection to device 3 is active (if at least 3 devices are connected), otherwise 0

Data element	Direction	Type	Length (Byte)	Description
Connection status (device 4)	PLC ⬅ device	UINT8	1	1 if the RS connection to device 4 is active (if 4 devices are connected), otherwise 0

15.6.1.2 Module: Control and status

This module 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.

Data element	Direction	Type	Length (Byte)	Description	
Handshake for output data from the controller (output: activation and HS control)	PLC → device	UINT8	1	Handshake for output data	
				Bit 0	1 if "simple" handshake should be activated, otherwise 0
				Bit 1	1 if handshake with acknowledgement should be activated, otherwise 0
				Bit 2..3	Reserved (always 0)
				Bit 4	Handshake flag - is inverted by the controller 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)

Data element	Direction	Type	Length (Byte)	Description	
Handshake for output data from the controller (input: ACK for activation and HS ACK)	PLC ← device	UINT8	1	Handshake for output 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
				Bit 2..3	Reserved (always 0)
				Bit 4	Handshake flag ACK - must always be set to the value of the most recently received handshake flag by the device, and therefore acknowledges receipt for the controller (if handshake with acknowledgement is activated)
				Bits 5..7	Reserved (always 0)

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
				Bit 2..3	Reserved (always 0)
				Bit 4	Handshake flag ACK - must always be set to the value of the most recently received handshake flag, and therefore acknowledges receipt for the device (if handshake with acknowledgement is activated)
				Bits 5..7	Reserved (always 0)

Data element	Direction	Type	Length (Byte)	Description	
Handshake for input data from the controller (input: ACK for activation and HS controller)	PLC ⬅ device	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
				Bit 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)

Data element	Direction	Type	Length (Byte)	Description	
Device controller	PLC ➡ device	UINT8	1	Control word	
				Bit 0	Trigger (switching from 0 -> 1 triggers image acquisition), corresponds with the "TR" process interface command
				Bit 1	Teach (if 1 is triggered during image acquisition, Teach is carried out), corresponds with the "TE" process interface command
				Bit 2	Operating mode (switching from 0 -> 1 switches to setup mode, switching from 1 -> 0 switches to run mode), corresponds with the "SM" process interface command
				Bits 3..7	Reserved (always 0)

Data element	Direction	Type	Length (Byte)	Description
Job selection	PLC ➡ device	UINT8	1	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

Data element	Direction	Type	Length (Byte)	Description
Reset statistics	PLC ➡ device	UINT8	1	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

Data element	Direction	Type	Length (Byte)	Description	
Reset status (actions)	PLC ➡ device	UINT8	1	Resets the status for various actions	
				Bit 0	Reset job switching status (changing from 0 -> 1 triggers a reset if the status is not "in progress")
				Bit 1	Reserved (always 0)
				Bit 2	Reset SetParam status (changing from 0 -> 1 triggers a reset if the status is not "in progress")
				Bit 3	Reserved (always 0)
				Bit 4	Reset mode switching status (changing from 0 -> 1 triggers a reset if the status is not "in progress")
				Bit 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">Device status</td><td rowspan="6">PLC ⬅ device</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: Setup 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>
</table>

Data element	**Direction**	**Type**	**Length (Byte)**	**Description**
Current job number	PLC ⬅ device	UINT8	1	Current job number 1..255, 0: if not in run mode or if job switching is active, corresponds with the "GS" process interface command

Data element	**Direction**	**Type**	**Length (Byte)**	**Description**
Reserved	PLC ⬅ device	UINT8	1	Reserved (always 0)

Data element	Direction	Type	Length (Byte)	Description	
Action status	PLC ⬅ device	UINT8	1	Status for various actions, corresponds with the "GS" process interface command	
				Bits 0..1	Job switching status 0: idle (no request pending), 1: in progress 2: completed successfully 3: completed with errors
				Bits 2..3	SetParam status 0: idle (no request pending) 1: in progress 2: completed successfully 3: completed with errors
				Bits 4..5	SwitchMode status 0: idle (no request pending), 1: in progress 2: completed successfully 3: completed with errors
				Bit 6..7	Reserved (always 0)

Data element	Direction	Type	Length (Byte)	Description	
Job results	PLC ← device	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	PLC ⬅ device	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)

15.6.1.3 Module: Result data

This module 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.

Modules are available with payload capacities of 4/8/16/32/64/128/256/512 bytes. You should choose the smallest one possible for the volume of data you expect to handle. Unnecessarily large modules reduce the overall performance of the system.

The result data module corresponds to response to the "GD" command from the classic process interface.

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 flag ACK - must always be set to the value of the most recently received handshake flag, and therefore acknowledges receipt for the device (if handshake with acknowledgement is activated)
				Bits 5..7	Reserved (always 0)

Data element	Direction	Type	Length (Byte)	Description	
Handshake for input data from the controller (input: ACK for activation and HS controller)	PLC ← device	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)

Data element	Direction	Type	Length (Byte)	Description

Actual length of the result data	PLC ⬅ device	UINT16	2	Length of data actually used in ResultData

Data element	**Direction**	**Type**	**Length (Byte)**	**Description**
Result data (<n> byte)	PLC ⬅ device	OCTET-STRING	4/8/16/32/64/128/256/512	Result data for job processing (data length corresponds with the selected module)

15.6.1.4 Module: Parameters

This module 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*.

Modules are available with payload capacities of 4/8/16/32/64/128/256/512 bytes. You should choose the smallest one possible for the volume of data you expect to handle. Unnecessarily large modules reduce the overall performance of the system.

The parameters module corresponds with the SP command in the classic process interface.

This module contains the cyclical data. However, it is also possible to send parameter data non-cyclically. This must be configured in the configuration and connection status module.

Cyclical transfer of the job parameters is suitable for parameters that change frequently. Non-cyclical transfer of the job parameters is more suitable for parameters that change infrequently. This increases the performance of the entire system.

> **NOTE**
>
> Changes to the cyclical data in the parameter module and write requests for the non-cyclical parameters compete with one another. Setting parameters in both ways in parallel can lead to undefined results. Do not set parameters in parallel.

<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 controller 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>
</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">Handshake for output data from the controller (input: ACK for activation and HS ACK)</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 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 recently received handshake flag by the device, and 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>

Data element	**Direction**	**Type**	**Length (Byte)**	**Description**
Actual length of the parameters	PLC ➡ device	UINT16	2	Length of data actually used in ParamData

Data element	**Direction**	**Type**	**Length (Byte)**	**Description**
Parameter (<n> byte)	PLC ➡ device	OCTET-STRING	4/8/16/32/64/128/256/512	Parameter data for the current job

15.6.1.5 Module: Trigger data

This module is used to transfer the data that will be assigned to the next trigger. Modules are available with payload capacities of 4/8/16/32/64/128/256/512 bytes. You should choose the smallest one possible for the volume of data you expect to handle. Unnecessarily large modules reduce the overall performance of the system.

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	
Handshake for output data from the controller (output: activation and HS control)	PLC ➡ device	UINT8	1	Handshake for output 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 flag - is inverted by the controller 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)

Data element	Direction	Type	Length (Byte)	Description	
Handshake for output data from the controller (input: ACK for activation and HS ACK)	PLC ⬅ device	UINT8	1	Handshake for output 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 ACK - must always be set to the value of the most recently received handshake flag by the device, and therefore acknowledges receipt for the controller (if handshake with acknowledgement is activated)
				Bits 5..7	Reserved (always 0)

Data element	Direction	Type	Length (Byte)	Description
Actual length of the trigger data	PLC ➡ device	UINT8	1	Length of data actually used in TriggerData

Data element	Direction	Type	Length (Byte)	Description
Trigger data (<n> byte)	PLC ➡ device	OCTET-STRING	4/8/16/32/64/128	Data that is assigned to the next trigger

15.6.2 Non-cyclical data

Non-cyclical data can be sent and read out at any time, independently of the cyclical communication that is already running. Non-cyclical data is used to transfer parameters that change infrequently. This means that you can avoid the constant transfer of identical data if the parameters do not change in the running process.

For example, this makes it possible to adjust a standard job to suit a concrete system without modifying the job, as the corresponding modified parameters are stored in the PLC.

The contents of the non-cyclical data correspond with the data on the *Parameters* module. A maximum of 512 bytes payload can be transferred.

Non-cyclical parameters are referenced using the slot number, sub-slot number and index. The following parameters are supported:

- Slot 1, Sub-slot 1, Index 1: Job parameters for the device with the ID 1
- Slot 1, Sub-slot 1, Index 2: Job parameters for the device with the ID 2
- Slot 1, Sub-slot 1, Index 3: Job parameters for the device with the ID 3
- Slot 1, Sub-slot 1, Index 4: Job parameters for the device with the ID 4

The parameters are always available, even if a corresponding device is not connected.

If you are using the parameters when the device is not connected, no action is triggered upon a write request and zeros or the value written for the last write command are returned for read requests.

A read request to a connected device always delivers the parameters for the job that is active at that point in time (zeros if the device is in setup mode). This behaviour is the same as that of the "GP" command in the classic process interface.

A write request corresponds with one-time configuration of the parameters for the current job, in the same way as the "SP" command in the classic process interface. In particular, if defective parameter combinations are entered, not all of the parameters can be adopted from the device. Once parameters have been set, the current parameters should always be read back and verified by the PLC.

When switching jobs or operating mode (setup mode/run mode), the data that is read out with a read request changes, as does the expected format for a write request. After switching jobs or modes, the current parameters should always be read back by the PLC and the desired parameters should be set again if required.

Write requests have no effect if the device is not in run mode. They are also not retained until run mode is activated.

NOTE

Please note that parameters set by the PLC are only saved if the *Store changed parameters from External Teach or SP process interface command to the device* option (*Device → Device settings → Job selection / Teach*) is activated.

Otherwise the original parameters will become active following a device restart or after deactivation/activation.

NOTE

Please note that the most recently active parameters (i.e. those used by the device) in the gateway remain stored and are set again by the gateway following a restart or exchanging the device.

After interrupting the connection to the device, the current parameters should always be read back by the PLC and the desired parameters should be set again if required.

15.6.2.1 Alarms

A PROFINET diagnosis alarm is triggered by the gateway for certain errors. If this happens, an error code (an 8 bit value) and an error description (a 16 bit value) are transmitted. It is possible for multiple alarms to be triggered simultaneously.

The alarms are reset once the source of the error has been rectified.

<table>
<tr><th>Error code</th><th>Error description</th><th colspan="2">Error details (16 bit value)</th></tr>
<tr><td>1</td><td>Hardware error</td><td colspan="2"></td></tr>
<tr><td>2</td><td>EEROM error</td><td colspan="2"></td></tr>
<tr><td>3</td><td>Internal storage error</td><td colspan="2"></td></tr>
<tr><td>4</td><td>Field bus hardware error</td><td colspan="2"></td></tr>
<tr><td>5</td><td>Script error</td><td colspan="2"></td></tr>
<tr><td>7</td><td>RS sending buffer overrun</td><td colspan="2"></td></tr>
<tr><td>8</td><td>RS receipt buffer overrun</td><td colspan="2"></td></tr>
<tr><td>9</td><td>User-defined / RS timeout</td><td colspan="2"></td></tr>
<tr><td>10</td><td>General field bus error</td><td colspan="2"></td></tr>
<tr><td>11</td><td>RS parity or frame check error</td><td colspan="2"></td></tr>
<tr><td>13</td><td>PROFINET configuration error</td><td colspan="2"></td></tr>
<tr><td>14</td><td>PROFINET buffer overrun</td><td colspan="2"></td></tr>
<tr><td rowspan="6">101</td><td rowspan="6">Module configuration error</td><td>Bits 15..8: Error code</td><td>Bits 7..0: further details</td></tr>
<tr><td>0x01: Invalid number of devices entered</td><td>always 0</td></tr>
<tr><td>0x02: Configured module could not be assigned to a device</td><td>Number of the first module in the module sequence that could not be assigned</td></tr>
<tr><td>0x03: Unknown module type</td><td>Number of the first module in the module sequence whose type could not be detected</td></tr>
<tr><td>0x04: There is no module corresponding with the preset configuration in the configured device setup</td><td>Bits 7..4: Device ID of the device (1..4) for which the module is missing
Bits 3..0: Module that is missing for this device: 1: "Control", 2: "Trigger data", 3: "Set Param", 4: "Result data"</td></tr>
<tr><td>0x05: There is a module in the configured device setup that is not permitted according to the preset configuration</td><td>Bits 7..4: Device ID of the device (1..4) for which the module is not permitted
Bits 3..0: Module that is not permitted for this device: 1: "Control", 2: "Trigger data", 3: "Set Param", 4: "Result data"</td></tr>
<tr><td>102</td><td>Device ID configuration error</td><td colspan="2">Bit 0 -> Device ID 1 used multiple times
Bit 4 -> Device ID 2 used multiple times
Bit 8 -> Device ID 3 used multiple times
Bit 12 -> Device ID 4 used multiple times</td></tr>
<tr><td>103</td><td>RS protocol error: The gateway has identified an error in the serial communication with the Vision Sensor (Vision Sensor is not responding [promptly], invalid data)</td><td colspan="2">Bit 0 -> Error identified on device with ID 1
Bit 4 -> Error identified on device with ID 2
Bit 8 -> Error identified on device with ID 3
Bit 12 -> Error identified on device with ID 4</td></tr>
</table>

104	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 0 -> Error identified by device with ID 1 Bit 4 -> Error identified by device with ID 2 Bit 8 -> Error identified by device with ID 3 Bit 12 -> Error identified by device with ID 4
105	Pipeline overrun: The internal buffer for data output is full, the data was sent too slowly via PROFINET (or not at all)	Bit 0 -> Error identified by device with ID 1 Bit 4 -> Error identified by device with ID 2 Bit 8 -> Error identified by device with ID 3 Bit 12 -> Error identified by device with ID 4
106	Handshake error: The handshake mechanism was not used correctly e.g. a sent handshake was not acknowledged correctly	Bit 0 -> Error identified by device with ID 1 Bit 4 -> Error identified by device with ID 2 Bit 8 -> Error identified by device with ID 3 Bit 12 -> Error identified by device with ID 4

15.7 Available data for Ethernet/IP™

15.7.1 Ethernet/IP™ object classes and instances

When using the Ethernet/IP™ protocol, access to object classes and instances is supported by non-cyclical access methods ("unconnected message requests“, "explicit messaging“).

The Ethernet/IP™ gateway supports the following general objects:

Class	Number of instances
0x01: Identification object	1
0x02: Message router object	1
0x04: Assembly object	8
0x06: Connection manager object	1
0xF4: Port object	2
0xF5: TCP/IP interface object	1
0xF6: Ethernet link object	2

The payloads from the connected devices are assigned to the assembly object instances as follows:

Instance	Type	Content	Size (bytes)
100	Output (O -> T)	Data from the PLC to device #1	267
101	Input (T -> O)	Data from device #1 to PLC	150
102	Output (O -> T)	Data from the PLC to device #2	267
103	Input (T -> O)	Data from device #2 to PLC	150
104	Output (O -> T)	Data from the PLC to device #3	267
105	Input (T -> O)	Data from device #3 to PLC	150
106	Output (O -> T)	Data from the PLC to device #4	267
107	Input (T -> O)	Data from device #4 to PLC	150

Non-cyclical access ("unconnected message requests", "explicit messaging") is available for all of these objects. However, cyclical connections ("explicit messaging") are generally recommended.

15.7.2 Data from the assembly instances

The data attribute (0x03) of the assembly object instance (100-107) should normally be accessed via cyclical I/O connections ("implicit messaging“).

The periods for this are set during configuration of the PLC. The shortest period available is 1ms. However, we recommend a period of 4 ms, 8 ms or longer in order to reduce the system load within the gateway and therefore increase data throughput.

On the other hand, longer periods increase response times. The period you choose will therefore be a compromise between these factors.

All instances with output or input data use the same data format. This is described in detail in the following chapters.

The payloads are divided into different logical modules:

- Logical module: Connection status
- Logical module: Control and status
- Logical module: Result data
- Logical module: Parameters
- Logical module: Trigger data

Each logical module is used once per device and can contain both output and input data. All modules with the exception of the *connection status* logical module use a handshake mechanism to facilitate data exchange.

A detailed description of how to use the handshake mechanism can be found in the *Handshake* chapter.

NOTE

In order to ensure data consistency in the PLC, we recommend the use of the CPS (Synchronous Copy File) command when planning using the Rockwell planning software.

If the cyclical data changes, the corresponding reactions are triggered. If *Handshake* is used, this only happens if the handshakeflag changes.

When the Ethernet/IP™ connection is first established, actions for some data are triggered, 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→ activate run mode, 1 received → activate setup mode
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
Trigger data	"Immediately" used, data is scheduled for next image acquisition

The following tables provide a brief overview of the data formats. The data is described in detail in the following chapters.

Output data (originator (O) to target (T), assembly instances 100, 102, 104, 106):

Byte	Logical module	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0		pad (0)					Operating mode	Teach	TRG
1		Select job number							
2		Reset statistics							
3		pad (0)			Reset State SM	pad (0)	Reset State SP	pad (0)	Reset State SJ
4		pad (0)			O -> T HS Flag	pad (0)	O -> T HSWA ACT	O -> T SHS ACT	pad (0)
5		pad (0)			T -> O HS ACK	pad (0)	T -> O HSWA ACT	T -> O SHS ACT	pad (0)
6	**Result data**	pad (0)			T -> O HS ACK	pad (0)		T -> O HSWA ACT	T -> O SHS ACT
7	**Parameters**	Act Parameters Len							
8		Parameters (128 byte)							
9 … 136		pad (0)			O -> T HS Flag	pad (0)		O -> T HSWA ACT	O -> T SHS ACT
137	**Trigger data**	Act Trigger Data Len							
138		Trigger data (128 byte)							
139 … 266		pad (0)			O -> T HS Flag	pad (0)		O -> T HSWA ACT	O -> T SHS ACT

Output data (originator (O) to target (T), assembly instances 101, 103, 105, 107):

Byte	Logical module	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	**Connection status**	Handshake error	Pipeline overrun error	Buffer overrun error	RS protocol error	Configuration error	System error	Dev unused by cfg	Dev conn state
1-3		pad (0)							
1		pad (0)			Img Proc ACT	Operating Mode		Teach ACT	TRG RDY
2		Active job number							
3		pad (0)							
4		pad (0)		Status SM		Status SP		Status SJ	
5		pad (0)					Alarm	Total Res Fail	Total Res Pass
6		pad (0)							
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)						Sub Res 5 Fail	Sub Res 5 Pass
9		Alarm PIF Pipe OV	Alarm PIF Buf OV	Alarm FTP	Alarm PIF	Alarm Inv Job	Alarm Output Timeout	Alarm Inv TRG	Alarm (Any)
10									Alarm PIF HS Err
11		pad (0)							
12		pad (0)							
13		pad (0)			O -> T HS ACK	pad (0)		O -> T HSWA ACT ACK	O -> T SHS ACT ACK
14		pad (0)			T -> O HS Flag	pad (0)		T -> O HSWA ACT ACK	T -> O SHS ACT ACK
15	**Result data**	Act Res Data Len							
16		Result data (128 byte)							
17 … 144		pad (0)			T -> O HS Flag	pad (0)		T -> O HSWA ACT ACK	T -> O SHS ACT ACK
145	**Parameters**	pad (0)			O -> T HS ACK	pad (0)		O -> T HSWA ACT ACK	O -> T SHS ACT ACK

146	**Trigger data**	pad (0)	O -> T HS ACK	pad (0)	O -> T HSWA ACT ACK	O -> T SHS ACT ACK

15.7.2.1 Logical module: Connection status

This module delivers information regarding the status of the connection between the assigned device and the gateway (RS 485), as well as the general status of the device (pending alarms).

Module content

Data element	Direction	Type	Length (Byte)	Description	
Connection status	PLC ← device	UINT8	1	Device connection status	
				Bit 0	1 if the RS connection is active, otherwise 0
				Bit 1	1 if the use of the device is locked due to the configuration of the "S4" gateway, otherwise 0
				Bit 2	1 if a gateway system error is pending, otherwise 0 (see description of the LEDs)
				Bit 3	1 if a configuration error is pending, otherwise 0 (invalid position of the "S4" switch, duplicated device ID)
				Bit 4	1 if an RS protocol error is pending, otherwise 0. (The gateway has identified an error in communication with the Vision Sensor, the Vision Sensor is not responding [promptly], invalid data)
				Bit 5	1 if there is a data buffer overrun, otherwise 0. (The data volume sent from the Vision Sensor (e.g. result data) is greater than the module can receive).
				Bit 6	1 if there is a pipeline overrun, otherwise 0. (The internal buffer for data output is full, the data was sent too slowly via Ethernet/IP™ (or not at all).
				Bit 7	1 if there is a handshake error, otherwise 0 (the handshake mechanism was used incorrectly, e.g. a sent handshake was not acknowledged correctly).
		UINT8	1	Reserved (always 0)	
		UINT8	1	Reserved (always 0)	
		UINT8	1	Reserved (always 0)	

15.7.2.2 Logical module: Control and status

This module 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.

Module content

Data element	Direction	Type	Length (Byte)	Description	
Device controller	PLC ➡ device	UINT8	1	Control word	
				Bit 0	Trigger (switching from 0 -> 1 triggers image acquisition), corresponds with the "TR" process interface command
				Bit 1	Teach (if 1 is triggered during image acquisition, Teach is carried out), corresponds with the "SM" process interface command
				Bit 2	Operating mode (switching from 0 -> 1 switches to setup mode, switching from 1 -> 0 switches to run mode), corresponds with the "SM" process interface command
				Bits 3..7	Reserved (always 0)

Data element	Direction	Type	Length (Byte)	Description
Job selection	PLC ➡ device	UINT8	1	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

Data element	Direction	Type	Length (byte)	Description
Reset statistics	PLC ➡ device	UINT8	1	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

Data element	Direction	Type	Length (byte)	Description	
Status reset (actions)	PLC → device	UINT8	1	Resets the status for various actions	
				Bit 0	Job switching status (changing from 0 -> 1 triggers a reset if the status is not "in progress")
				Bit 1	Reserved (always 0)
				Bit 2	Reset SetParam status (switching from 0 -> 1 triggers a reset if the status is not "in progress")
				Bit 3	Reserved (always 0)
				Bit 4	Reset mode switching status (changing from 0 -> 1 triggers a reset if the status is not "in progress")
				Bit 5..7	Reserved (always 0)

Data element	Direction	Type	Length (Byte)	Description	
Device status	PLC ← device	UINT8	1	Status word, corresponds with the "GS" process interface command	
				Bit 0	TRG ready 0: Trigger not permitted, 1: Trigger permitted
				Bit 1	Teach 0: Teach will not be carried out on the next image 1: Teach will be carried out on the next image
				Bits 2..3	Mode 0: Run mode 1: Setup mode 2: Test mode
				Bit 4	ImgProcAct 0: Image acquisition/analysis not active 1: Image acquisition/analysis active
				Bits 5..7:	Reserved (always 0)

Data element	Direction	Type	Length (Byte)	Description
Current job number	PLC ← device	UINT8	1	Current job number 1..255, 0: if not in run mode or job switching is active, corresponds with the "GS" process interface command

Data element	Direction	Type	Length (Byte)	Description
Reserved	PLC ← device	UINT8	1	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="5">Action status</td><td rowspan="5">PLC ← device</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	PLC ← device	UINT8	1	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..7	Reserved (always 0)
		UINT8	1	**Bits 0..7**	Reserved (always 0)
		UINT8	1	**Bit 0**	1 if partial result 1 = "Pass", otherwise 0
				Bit 1	1 if partial result 1 = "Fail", otherwise 0
				Bit 2	1 if partial result 2 = "Pass", otherwise 0
				Bit 3	1 if partial result 2 = "Fail", otherwise 0
				Bit 4	1 if partial result 3 = "Pass", otherwise 0
				Bit 5	1 if partial result 3 = "Fail", otherwise 0
				Bit 6	1 if partial result 4 = "Pass", otherwise 0
				Bit 7	1 if partial result 4 = "Fail", otherwise 0
		UINT8	1	**Bit 0**	1 if partial result 5 = "Pass", otherwise 0
				Bit 2	1 if partial result 5 = "Fail", otherwise 0
				Bit 2-7	Reserved (always 0)

Data element	Direction	Type	Length (Byte)	Description	
Device alarms	PLC ← device	UINT8	1	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
		UINT8	1	**Bit 0**	1 if the "handshake error" alarm is pending, otherwise 0
				Bits 1-7	Reserved (always 0)
		UINT8	1	**Bits 0-7**	Reserved (always 0)
		UINT8	1	**Bits 0-7**	Reserved (always 0)

Data element	Direction	Type	Length (Byte)	Description	
Handshake for output data from the controller (Output: activation and HS control)	PLC → device	UINT8	1	Handshake for output data	
				Bit 0	1 if "simple" handshake should be activated, otherwise 0.
				Bit 1	1 if handshake with acknowledgement should be activated, otherwise 0.
				Bit 2..3	Reserved (always 0)
				Bit 4	Handshake flag - is inverted by the controller 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)

Data element	Direction	Type	Length (Byte)	Description	
Handshake for output data from the controller (Input: ACK for activation and HS ACK)	PLC ← device	UINT8	1	Handshake for output data	
				Bit 0	1 if simple handshake was activated (confirmation for activation), otherwise 0.
				Bit 1	1 if handshake with acknowledgement was activated (response for activation), otherwise 0.
				Bit 2..3	Reserved (always 0)
				Bit 4	Handshake flag ACK - must always be set to the value of the most recently received handshake flag by the device, and therefore acknowledges receipt for the controller (if handshake with acknowledgement is activated)
				Bits 5..7	Reserved (always 0)

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.
				Bit 2..3	Reserved (always 0)
				Bit 4	Handshake Flag Ack - must always be set to the value of the most recently received handshake flag, and therefore acknowledges receipt for the device (if handshake with acknowledgement is activated)
				Bits 5..7	Reserved (always 0)

Data element	Direction	Type	Length (Byte)	Description	
Handshake for Input data from the controller (Input: ACK for activation and HS control)	PLC ← device	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.
				Bit 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)

15.7.2.3 Logical module: Result data

This module is used to transfer the result data from job processing. The result datagram is configured during job creation in the Application Suite in the step: *Configure interfaces → Output process interface*.

The result data module corresponds with response to the "GD" command from the classic process interface.

Data element	Direction	Type	Length (Byte)	Description
Actual Length Result data	PLC ← device	UINT8	1	Length of data actually used in ResultData

Data element	Direction	Type	Length (Byte)	Description
Result data (128 byte)	PLC ← device	OCTET-STRING	128	Result data for job execution

<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 Input data from the controller (Output: activation and HS ACK)</td><td rowspan="6">PLC → device</td><td rowspan="6">UINT8</td><td rowspan="6">1</td><td colspan="2">Handshake for input 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 ACK - must always be set to the value of the most recently received handshake flag, and therefore acknowledges receipt for the device (if handshake with acknowledgement is activated)</td></tr>
<tr><td>Bits 5..7</td><td>Reserved (always 0)</td></tr>
</table>

Data element	Direction	Type	Length (Byte)	Description	
Handshake for Input data from the controller (Input: ACK for activation and HS control)	PLC ⬅ device	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)

15.7.2.4 Logical module: Parameters

This module 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*.

The parameters module corresponds with the "SP" command in the classic process interface.

Data element	Direction	Type	Length (Byte)	Description
Actual length of the Parameters	PLC ➡ device	UINT8	1	Length of data actually used in ParamData

Data element	Direction	Type	Length (Byte)	Description
Parameters (128 byte)	PLC ➡ device	OCTET-STRING	128	Parameter data for the current job

Data element	Direction	Type	Length (Byte)	Description	
Handshake for output data from the controller (Output: activation and HS control)	PLC ➡ device	UINT8	1	Handshake for output 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 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)

Data element	Direction	Type	Length (Byte)	Description	
Handshake for output data from the controller (Input: ACK for activation and HS ACK)	PLC ⬅ device	UINT8	1	Handshake for output 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 ACK - must always be set to the value of the most recently received handshake flag, and therefore acknowledges receipt for the controller (if handshake with acknowledgement is activated)
				Bits 5..7	Reserved (always 0)

15.7.2.5 Logical module: Trigger data

This module is used to transfer the data that will be assigned to the next trigger.

It is used in the same way as the "TD" command in the FTP process interface and 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 trigger data	PLC ➡ device	UINT8	1	Length of data actually used in TriggerData

Data element	**Direction**	**Type**	**Length (Byte)**	**Description**
Trigger data (128 byte)	PLC ➡ device	OCTET-STRING	128	Data that is assigned to the next trigger

Data element	Direction	Type	Length (Byte)	Description	
Handshake for output data from the controller (Output: activation and HS control)	PLC ➡ device	UINT8	1	Handshake for output 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 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)

Data element	Direction	Type	Length (Byte)	Description	
Handshake for output data from the controller (Input: ACK for activation and HS ACK)	PLC ⬅ device	UINT8	1	Handshake for output 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 ACK - must always be set to the value of the most recently received handshake flag, and therefore acknowledges receipt for the controller (if handshake with acknowledgement is activated)
				Bits 5..7	Reserved (always 0)

15.8 Handshake

When using an industrial Ethernet gateway, the creation, transfer and processing of data is not synchronised. The gateway itself also represents an additional and unsynchronised delay element in the communication path.

The different processing speeds of the PLC, gateway and Vision Sensor mean that it is often necessary to synchronise the flow of data between the two devices at an application level, and therefore ensure that the data is communicated.

There are two different handshake procedures for this. These are the *Simple handshake* and the *Handshake with acknowledgement*.

The activation processes for the handshakes are described in the individual modules.

15.8.1 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 gray value or the same distance is measured). 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 for input data bit 0).
2. The Vision Sensor confirms the activation of the handshake (ingoing handshake 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 for output data bit 0).
2. The Vision Sensor confirms the activation of the handshake (ingoing handshake flag 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.

15.8.2 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 for input data bit 1).
2. The Vision Sensor confirms the activation of the handshake (ingoing handshake 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 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 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 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 for output data bit 1).
2. The Vision Sensor confirms the activation of the handshake (ingoing handshake flag 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 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 flag for output data bit 4).
5. The PLC detects the acknowledgement (ingoing handshake 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.

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.

Materials within the device with protection class IP 69K

Component, part	Material	Classification
Housing	Stainless steel 1.4404 (316L)	
Seal (housing)	polymerized silicone rubber (CAF)	FDA, BfR
Cover glass	PMMA	FDA, UL
Seal / adhesive (cover glass)	Silicone adhesive	FDA
Seals (O-rings)	Fluororubber (FPM)	FDA
Press-fitted optical fibre	Polycarbonate	
Sealing collar optical fibre	Epoxy resin	
Screw cover (rear side)	Silicone	FDA
Connector M12 / 12 pin	Stainless steel 1.4404 (316L)	

17 Technical data

17.1 Overview of feature checks

Feature checks	**ID-100**	**ID-110**	**CS-100**	**XF-100** **XF-105** **XC-100**	**XF-200** **XF-205** **XC-200**	**XC-100 color**
Part location						
Part location on contours			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			+	+	+	
Count contour points (color)						+
Contour comparison		+	+	+	+	
Contour comparison (color)						+
Color identification						+
Brightness			+	+	+	
Contrast				+	+	
Area size				+	+	
Area size (color)						+
Color positioning						+
Count areas				+	+	
Count areas (color)						+
Pattern comparison				+	+	
Pattern match (color)						+
Identification						
Barcode	+	+			+	
Matrix code	+	+			+	
Text		+			+	

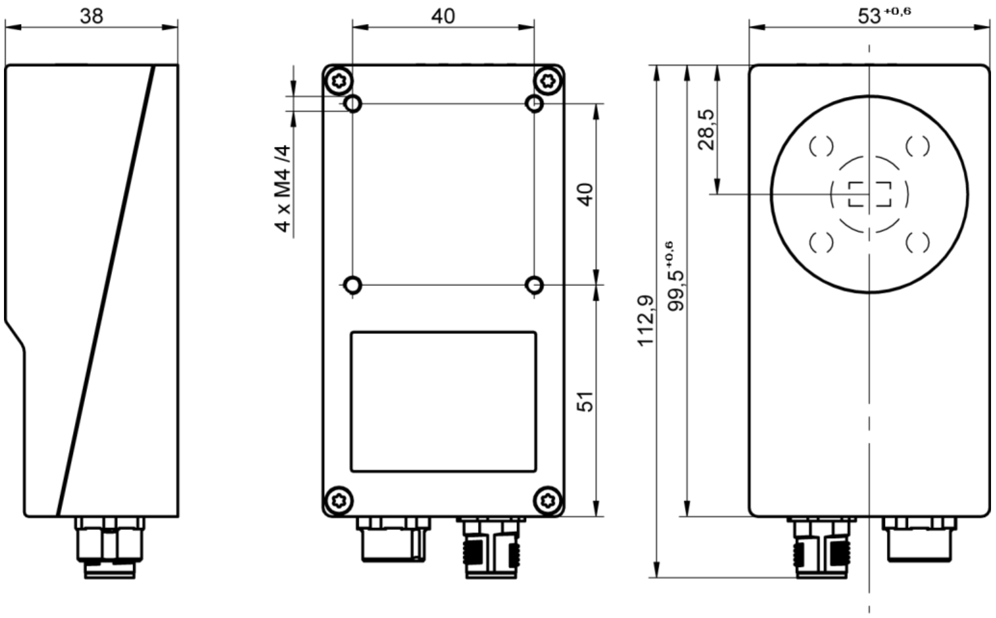
17.2 Overview Features

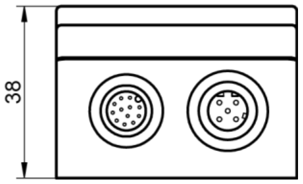
Features	**XC-100**	**XC-200**	**XF-100 XF-105**	**XF-200 XF-205**	**CS-100**	**ID-110**	**ID-100**
Optics: 10 mm | 16 mm | C-mount	-|-|●	-|-|●	●|●|-	●|●|-	●|●|-	●|-|-	●|●|-
Illumination: White | Infrared (daylight filter integrated) | Integrated flash controller for external illumination	-|-|●	-|-|●	●|●|-	●|●|-	●|●|-	●|●|-	●|-|-
Configurable web interface (live image, job switching, retrieving defect images)	●	●	●	●	●	●	●
Save images via FTP	●	●	●	●	●	●	●
Configuration via Ethernet	●	●	●	●	●	●	●
Process linkage: Digital I/Os	5 | 5	5 | 5	5 | 5	5 | 5	5 | 5	5 | 5	5 | 3
Produce partial results via digital I/Os at different times	●	●	●	●			
Process interface: Ethernet | RS485 (model-dependant) (PROFINET via RS485 Gateway)	●|-	●|-	●|-	●|-	-|-	●|-	●|●
Baumer ***FEX®*** Image processor	●	●	●	●	●	●	●
FEXLoc® (360° part location)	●	●	●	●	●		
User administration / Password protection	●	●	●	●		●	●
Coordinate conversion	●	●	●	●			
Flexible result conjunction	●	●	●	●			
Integrate digital inputs into results conjunction	●	●	●	●			
Identification functions: Code | Text	-|-	●|●	-|-	●|●	-|-	●|●	●|-
Job test function	●	●	●	●	●	●	●
High speed mode (monochrome only)	●	●	●	●			
Gamma correction	●	●	●	●			

17.3 Type code

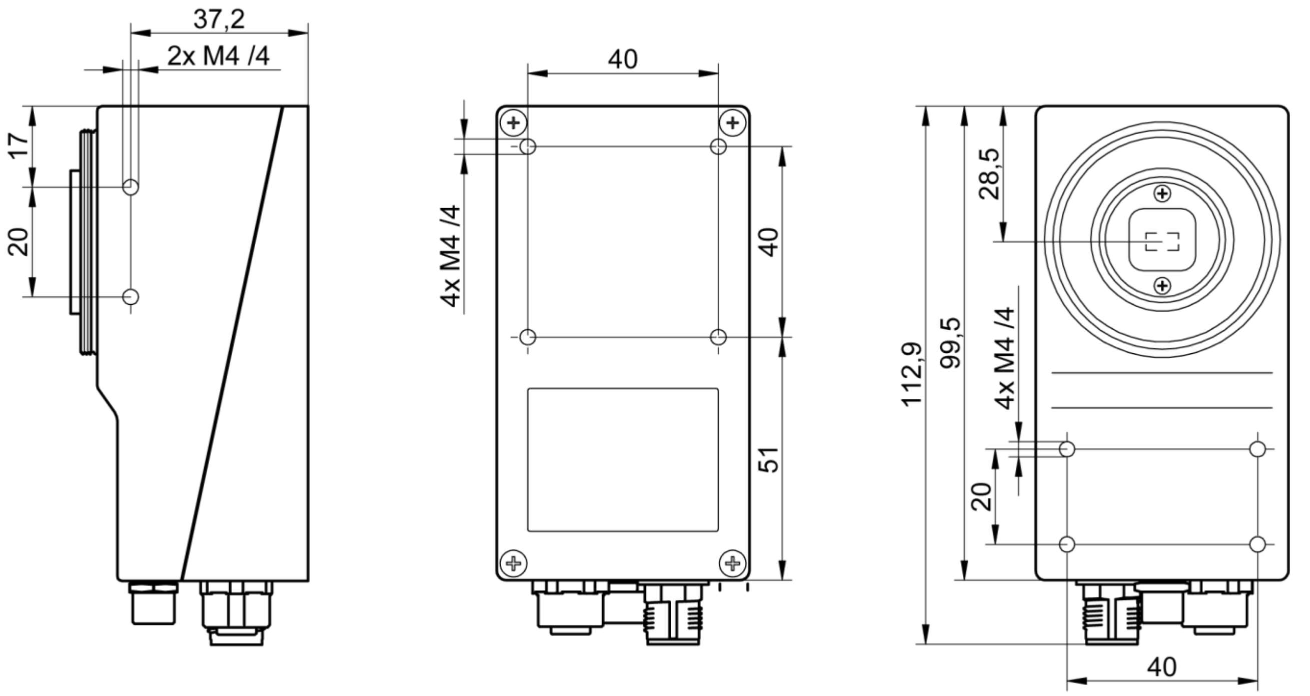
																				Customer specific		
Product family			**V**	**S**		**C**	**S**	**1**	**0**	**0**	**M**	**0**	**3**	**W**	**1**	**0**	**E**	**P**	-	K	X	X
Series																						
		ID				I	D															
		CS				C	S															
		XF				X	F															
		XC				X	C															
Product																						
								1	0	0												
								1	1	0												
								2	0	0												
Devices with protection class IP 69K										5												
Monochrome / color																						
		Monochrome									M											
		Color									C											
Image format		Number of Pixels x 100k																				
		640 x 480										0	3									
		1280 x 960										1	2									
		1600 x 1200										2	0									
Illumination																						
		Flash controller for external illumination												X								
		IR												I								
		White												W								
Optics / Lens																						
		No Lens C mount													0	0						
		Focal length 10mm													1	0						
		Focal length 16mm													1	6						
Interface																						
		Ethernet (TCP/IP) + serial (RS485)															R					
		Ethernet (TCP/IP)															E					
Output																						
		PNP																P				

17.4 Technical drawing (except XC-100 / XC-200)

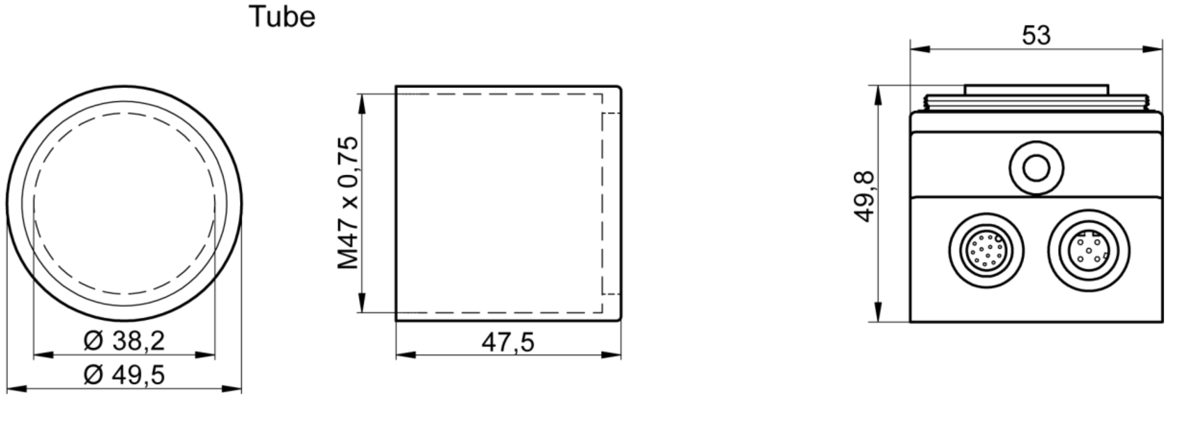




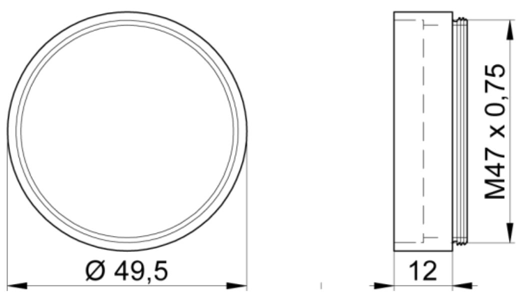
17.5 Technical drawing (XC-100 / XC-200 only)



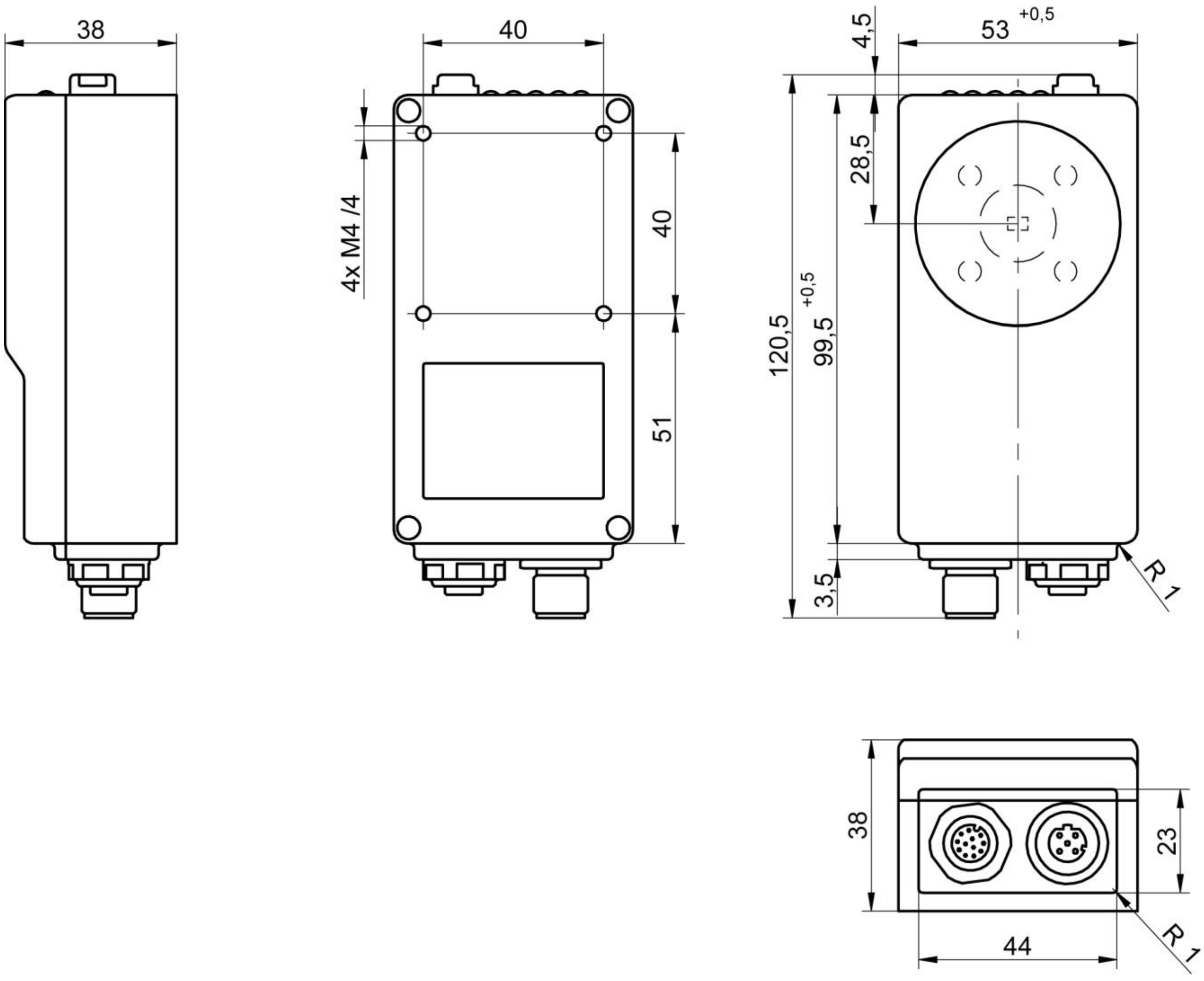
Tube



Tube Modul

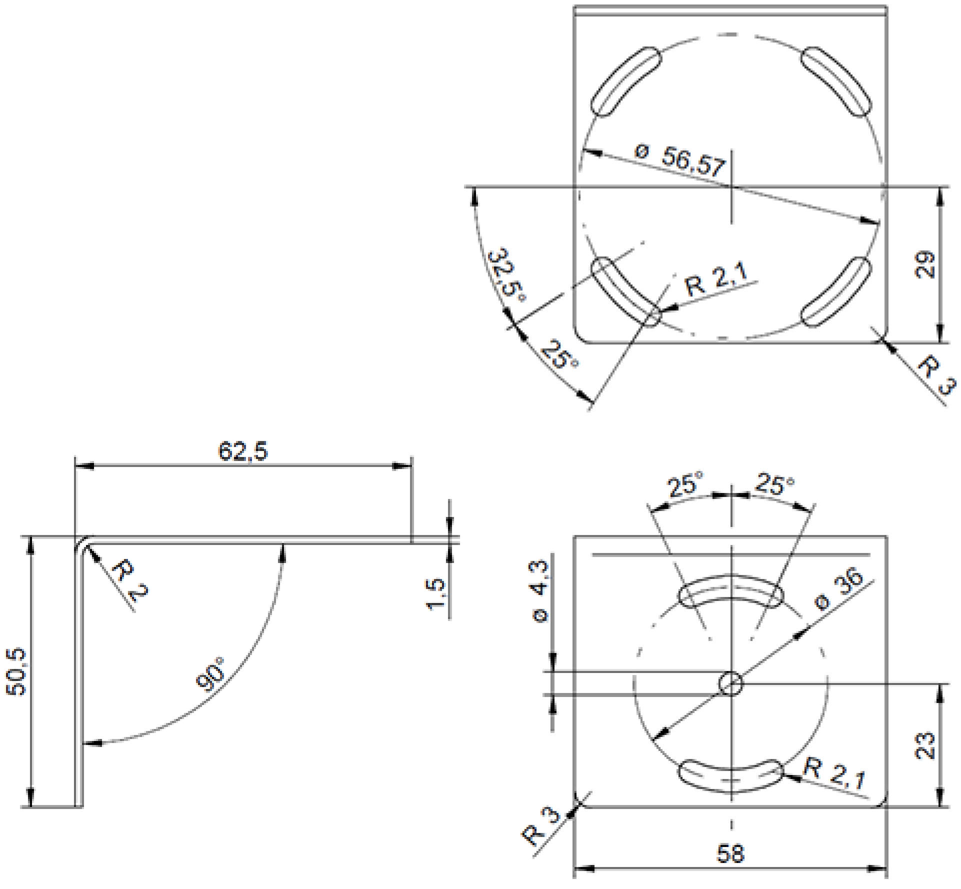


17.6 Technical drawing (XF-105, XF-205 only)



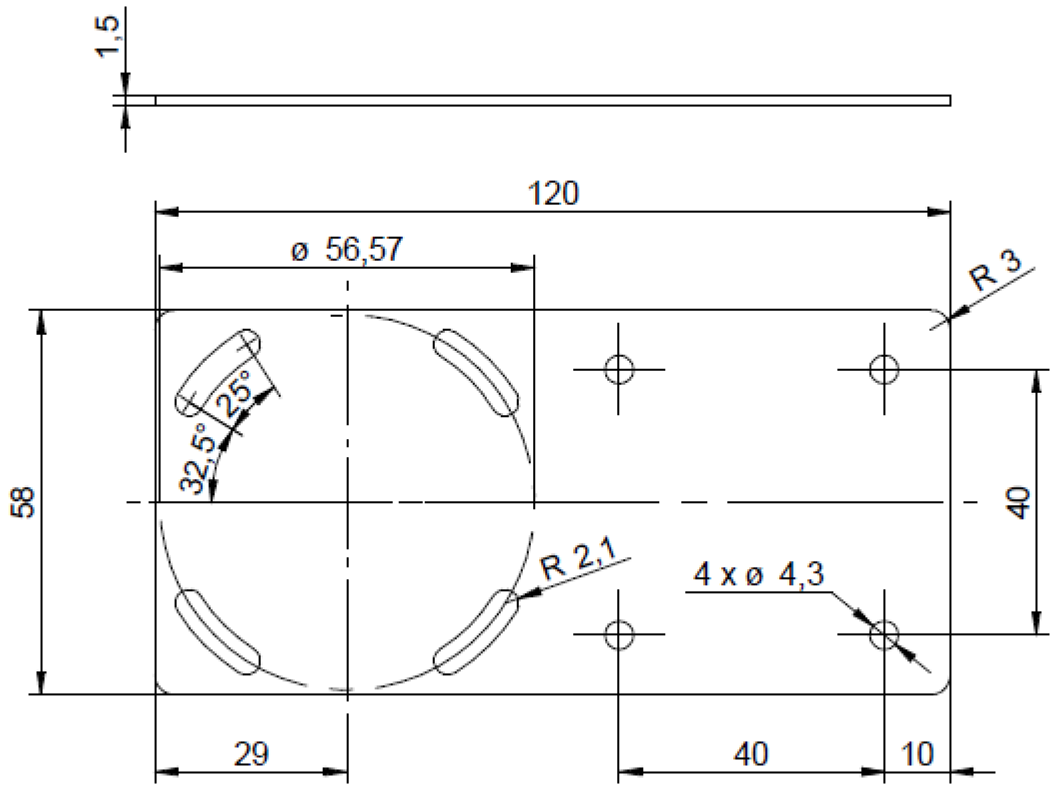
17.7 Fastening bracket, 90 degree

- Color: Black
- Material: powder coated steel



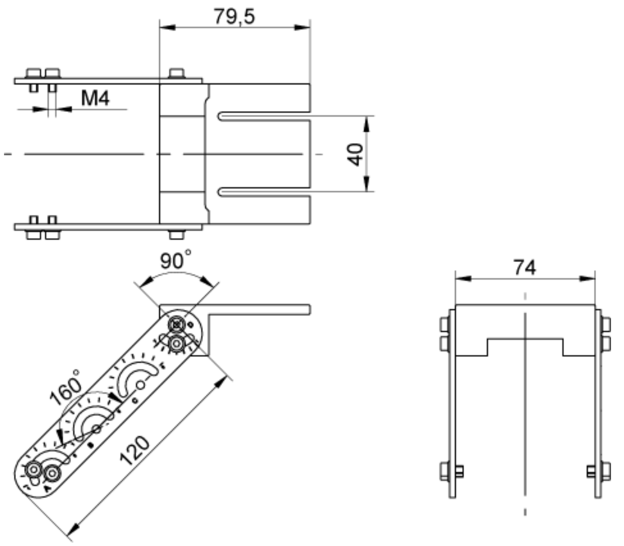
17.8 Fastening bracket, straight

- Color: Black
- Material: powder coated steel



17.9 Illumination mount "VB Fix Kit Bar Light 74"

- Color: Black
- Material: powder coated aluminum
- suitable with illumination "VB Bar Light 74" (Item no. 11081785)



17.10 Technical data

General data	**XC series**			**XF series | CS series | ID series**	
Resolution	640 × 480 px	1280 × 960 px	1600 × 1200 px	752 × 480 px	
Sensor (monochrome)	1/4“ CCD (monochrome, color)	1/3“ CCD (monochrome, color)	1/1.8“ CCD (monochrome)	1/3“ (monochrome)	
LED illumination	Integrated flash controller for external illumination			White (LED class: Risk group 1, low risk, EN 62471:2008) Infrared (LED class: free group risk free, EN 62471:2008) (860 nm)	
Lens	Changeable lens (C-mount)			f = 10 mm (integrated)	f = 16 mm (integrated)
Min. object distance	Depending on changeable lens			50 mm	70 mm
Max. object distance	Depending on changeable lens			∞	300 mm
Speed High-resolution mode High-speed mode (Binning 2 × 2 monochrome)	Max. 50 insp. / sec. Max. 100 insp. / sec.	Max. 12 insp. / sec. Max. 25 insp. / sec.	Max. 7 insp. / sec. Max. 15 insp. / sec.	Max. 50 insp. / sec. Max. 100 insp. / sec. (XF series 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	**XC series**	**XF series | CS series | ID series**
Power supply	⎓ +18 … 30 VDC	
Power consumption	Type 5 W (Imax = 1.5 A at 24 V)	Type 5 W (Imax = 1 A at 24 V)
Inputs	8 … 30 VDC	
Outputs	PNP 100 mA	
Digital input	Trigger, Job selection, External teach-in, Encoders (CH-A, CH-B) 500 kHz	
Digital output	Pass / Fail 1-5 [1], flash sync, alarm, image trigger permitted, result valid [1] VS XXXXXXXXXXXRX: 1-3	
Communication Initial setup Process interface	Ethernet (10BASE-T / 100BASE-TX) TCP | UDP (Ethernet) [2], RS485 [3], PROFINET via Gateway [3])	[2] except CS-100

Integr. Flash controller	**XC series**	**XF series | CS series | ID series**
Voltage (permanent) Voltage (pulsed)	⎓ 12 VDC or ⎓ 24 VDC ⎍ 24 VDC or ⎍ 48 VDC	–
Current (permanent) Current (pulsed)	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	Max. 1 ms (Duty Cycle max. 1:10)	–

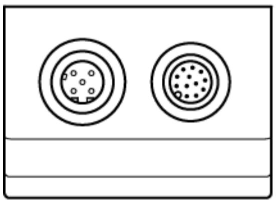
Operating conditions	**XC series**	**XF series | CS series | ID series**
Operating temperature	+5 … +50 °C / Storage temperature: -20 … +70 °C / Housing temperature max. +50 °C	
Humidity	0 … 90 % (non-condensing)	
Protection class	IP 67 (XC-Series: with tube)	IP 67, IP 69K (only XF series in IP 69K)
Vibration load	IEC 60068-2-6, IEC 60068-2-64	
Mech. shock resistance	EN 60068-2-27	

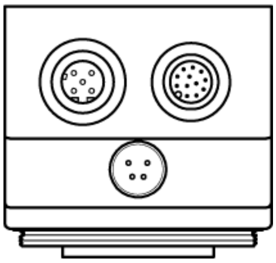
Mechanical data	**XC series**	**XF series (XF series in IP 69K) | CS series | ID series**
Width × Height × Depth	53 mm × 99.5 mm × 49.8 mm (without lens / tube)	53 mm × 107.5 mm × 38 mm
Material	Housing: Aluminum, Cover glass tube: PMMA	Housing: Aluminum (IP 69K: Stainless steel 1.4404) Cover glass: PMMA [4)]
Weight	300 g (without lens / tube)	250 g (640 g)

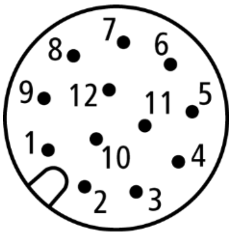
Code types / OCR	**Model: XC-200**	**Models: XF-200 / XF-205 | ID-110 | ID-100**
Barcode [5)]	2/5 Industrial, 2/5 Interleaved, Codabar, Code 39, Code 93, Code 128, PharmaCode EAN 8, EAN 13, UPC-A, UPC-E: Base code + variants Add-On 2, Add-On 5 GS1 DataBar (RSS): Limited, Expanded, Expanded Stacked GS1 DataBar (RSS-14): Base code + variants Truncated, Stacked, Stacked Omnidir GS1 128	
Matrix code [5)]	DataMatrix (ECC 200), GS1-DataMatrix, QR, PDF417	
Font [6)]	Optional fonts (recommended: sans serif, proportional), dot matrix, characters: A-Z a-z 0-9 + -. : / ( )	

[4)] for XF-100 / XF-105 / XF-200 / XF-205 / CS-100 / ID-110 with infrared illumination: Daylight filter integrated
[5)] 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
[6)] XF-200 / XC-205 / XC-200 / ID-110 only

17.11 Electrical Connection (View on Device)

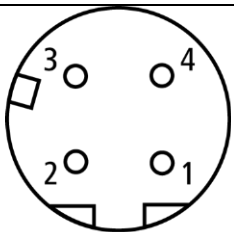






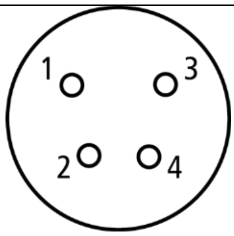
Pin Assignment(M12)

Pin	Designation
1	Power (⎓+ 18 - 30 VDC)
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+, ID-100 only) (PTC-protected)
10	IN 4
11	IN 5
12	OUT 5 / (RS 485-, ID-100 only), (PTC-protected)



Pin assignment of the Ethernet interface (M12)

Pin	Designation
1	TD+
2	RD+
3	TD-
4	RD-



Supply for external illumination (M8) (XC only)

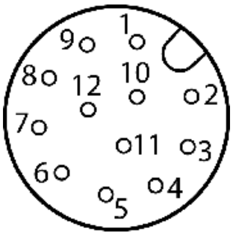
Pin	Designation
1	⎓ +24V or ⎍+48V Flash
2	⎓ +12V or ⎍+24V Flash
3	Ground
4	Flash Sync [1], (100 mA PNP)

[1] voltage according to power supply
Voltage outputs configurable by software

CE

RoHS COMPLIANT

17.12 Power Cable M12 / 12-pin



Pin assignment of the connecting cable (M12)

Pin	Designation	Color code
1	Power (⎓+ 18 - 30 VDC)	brown
2	Ground	blue
3	IN1 (Trigger)	white
4	OUT 1 (PTC-protected)	green
5	IN 2	pink
6	OUT 2 (PTC-protected)	yellow
7	OUT 3 (PTC-protected)	black
8	IN 3	grey
9	OUT 4 / RS 485+ (PTC-protected)	red
10	IN 4	violet
11	IN 5	grey-pink
12	OUT 5 / RS 485- (PTC-protected)	red-blue