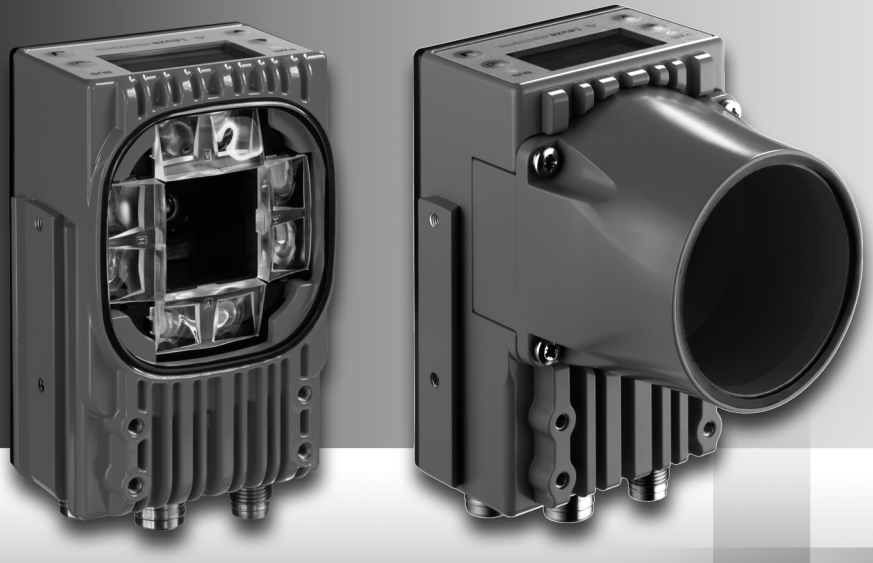
Leuze electronic

the sensor people

LSIS 4xx*i* *webConfig*

Operating instructions for version 3.2



en 05-2014/03 50111900-04
We reserve the right to make technical changes

User's guide

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1 General information

1.1 About the "LSIS 4xx*i* *webConfig*" program – System requirements

Leuze's ***webConfig*** is used to configure smart cameras of the **LSIS 4xx*i*** series using an operating-system-independent, web-technology-based, graphical user interface.

Through the use of HTTP as communication protocol and the client-side restriction to standard technologies (HTML, JavaScript and AJAX), which are supported by all of today's popular, modern browsers, it is possible to operate Leuze's ***webConfig*** on any Internet-enabled PC.

Notice!

The following browsers are supported:

- ***Mozilla Firefox® 3..16, 19+***
- ***Microsoft® IE® 8+***

LSIS 4xxi webConfig *is completely contained in the firmware of the* ***LSIS 4xxi****.*

The ***webConfig*** menus are intuitive to operate and contain both help texts as well as tool tips. The software description can be found in the download area of the Leuze electronic website.

www.leuze.com

Activities in webConfig

The software offers the following possibilities for setting up the **LSIS 4xx*i***:

- Create, configure, save, load, change and activate check programs
- Configure the communication interfaces
- Set up the camera and the integrated illumination
- Display and manage diagnostic-relevant data, such as event logs and communication diagnostics, by defining output logs
- Display of the current production data
- Management of authorized users
- Firmware updates and setting the system time

1.2 Explanation of symbols

The symbols used in this description are explained below.



Attention!

This symbol precedes text messages which must strictly be observed. Failure to comply with this information results in injuries to persons or damage to the equipment.



Notice!

This symbol indicates text passages containing important information.

↳ *This symbol asks you to carry out an action.*

The `Courier` font indicates terms contained in the software interface of **LSIS 4xx*i* *webConfig***.

1.3 Contact address

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2 First steps

First, make certain that the **LSIS 4xx*i*** was correctly mounted and connected. Information on this topic can be found in chapters "Installation and mounting" and "Electrical connection" of the technical description **LSIS 4xx*i***.

Furthermore, you must ensure that the connection between PC and **LSIS 4xx*i*** was established as described in the technical description **LSIS 4xx*i*** (chapter "Commissioning and configuration").

2.1 Starting the program

- *Start a browser on your PC and enter the address of your* **LSIS 4xx*i*** *previously set by you or the address assigned by the DHCP server.*

Notice!

The default Leuze service address for communication with smart cameras of the ***LSIS 4xxi*** *series is* ***192.168.60.101****. Further information on manual or automatic address assignment via DHCP can be found in chapter "Commissioning and configuration" of the technical description* ***LSIS 4xxi****.*

You can check the network address of the **LSIS 4xx*i*** by pressing the enter button ↵ on the display three times in sequence during normal operation of the **LSIS 4xx*i***.

If the IP address is entered correctly in the browser, the following start page appears on your PC.

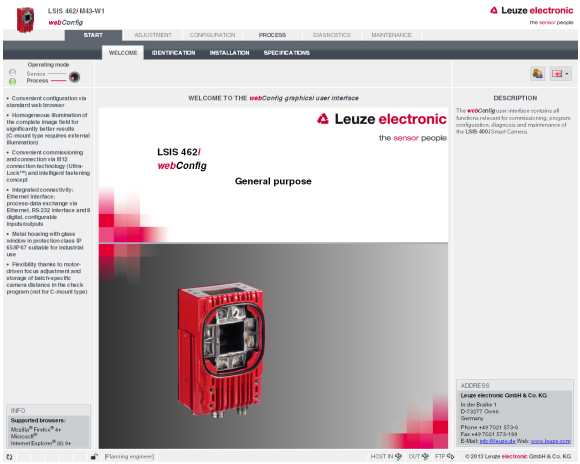


Figure 2.1: Start page **LSIS 4xx*i* *webConfig***

Notice!

The ***webConfig*** *is completely contained in the firmware of the* ***LSIS 4xxi****. Depending on firmware version, the start page may vary from that shown above.*

2.2 Program concept: Operating modes – users – modules

Operating modes

Depending on the requirements of the work process, **LSIS 4xx*i* *webConfig*** can be used in two operating modes – "Service" and "Process".

During production operation, the **LSIS 4xx*i*** works in Process mode: the device is controlled from the host computer, it receives control signals and yields outputs; configuration via ***webConfig*** is deactivated.

The configuration, administration and diagnostic tasks necessary for designing and optimizing production operation are performed in service mode: In this mode, the device is configured via ***webConfig***. The sending and receiving of signals to and from the host computer is switched off by default in Service mode (except for one trigger input and, if configured, one output for controlling an external flash)

User roles

To prevent unintended operating errors as far as possible and to facilitate user-dependent access permissions, the **LSIS 4xx*i* *webConfig*** functions with a role concept that assigns the different users a specific "Role" with various hierarchically structured authorizations. By default, the program interface opens in the "Process" operating mode with the highest user authorization, "planning engineer".

Detailed information on this topic can be found in chapter 3.6.1, "User management" tab on page 141.

Work modules

The work steps necessary for a given activity are, in turn, grouped together in modules, in a single operating mask where possible. The availability of these "work modules" depends on both the authorization – the role – of the current user as well as on the selected operating mode.

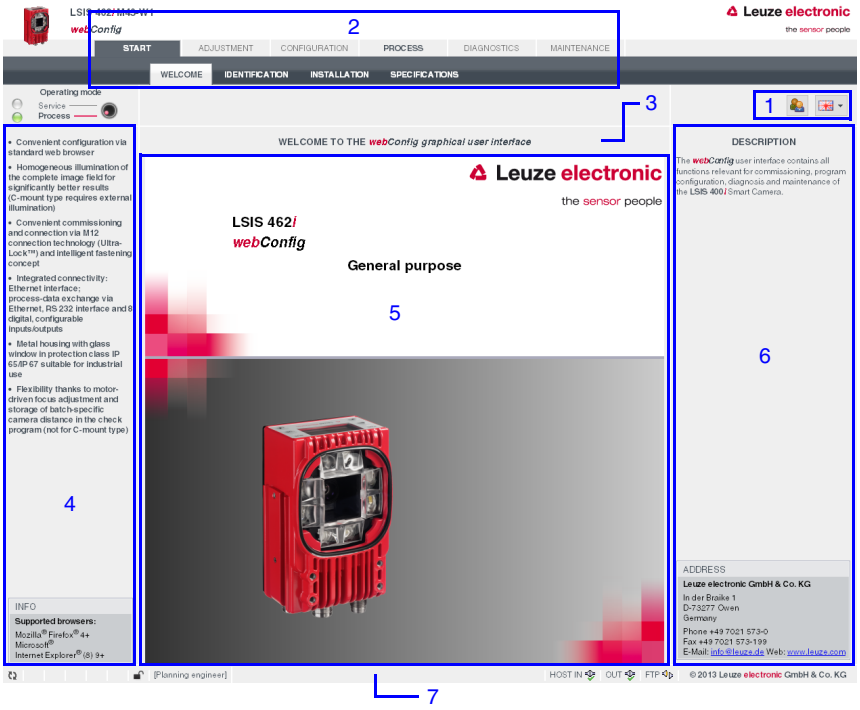
The following overview shows which modules are available in which operating mode.

Module	Available in operating mode
Start	Process, Service
Adjustment	Service
Configuration	Service
Process	Process, Service
Diagnostics	Service
Maintenance	Service

3 Descriptions of the user interface and menu

Information on the basic structure

The **LSIS 4xx*i* *webConfig*** program interface consists of various elements, the availability and content of which depends – on the one hand – on the user authorization, and – on the other – on the currently selected work module. On delivery, the program interface opens in the "Process" operating mode with the highest user authorization, "planning engineer". The following start window appears in this case:



1 - User (authority level) and language
2 - Work module selection
3 - Title bar
4 - Menu window / selection of operating mode
5 - Main window
6 - Dialog window (variable display and input window)
7 - Status bar

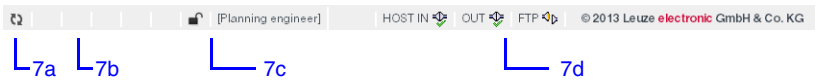


Figure 3.1: **LSIS 4xx*i* *webConfig*** start window/status bar

In general, **LSIS 4xx*i* *webConfig*** facilitates an intuitive, logical work method from top to bottom and from left to right. After setting the desired interface language in the appropriate list box **(1)**, **LSIS 4xx*i* *webConfig*** supports you with context-sensitive descriptions of the interface elements and parameters in the lower part of the dialog window **(6)**. Title and status bars serve to provide orientation during the work process. You can see at first glance in the title bar **(3)** which check program is active. In the status bar **(7)**, the current user (authority level) **(7c)** and host connection status **(7d)** are displayed. A pencil icon **(7b)** indicates changes to the device parameters that may still need to be saved. An animated icon of rotating arrows **(7a)** visualizes the processing status of input: If the arrows rotate, the sensor is processing the input and no other actions are possible for a brief period of time.

To illustrate the meaning of the sometimes seemingly abstract parameters, the individual parameters are displayed and edited in graphic form in the main window and/or dialog window **(5** and **6)**. Some graphics in the main window can be enlarged by clicking or are mouse sensitive, which means that certain features can be accessed both via menu items and by directly clicking.

Operating mode

As already mentioned, **LSIS 4xx*i* *webConfig*** starts in the "Process" operating mode, i.e. the device is controlled from the master computer, it receives control signals and yields output. Because the configuration is deactivated via webConfig, the user only has access to the "Start" and "Process" work modules depending on his respective authority level.

To control the device from ***webConfig***, you have the option of switching to the "Service" operating mode by either clicking the desired operating mode or the button displayed below. In this mode, communication with the master computer is switched off by default (exception: a trigger input and, if set up, an output for controlling an external flash) and you can access the required configuration, management and diagnostic tasks.

Further information on the dependencies of operating modes, user authority levels and work modules can be found in chapter "Program concept: Operating modes – users – modules".

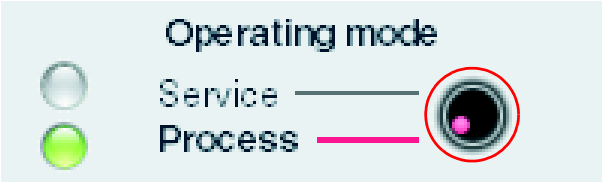


Figure 3.2: Changing the operating mode by means of a button or by selecting a menu item

Selecting the work modules

As already mentioned, the **LSIS 4xx*i* *webConfig*** user interface is divided into various main work areas, or work modules, whose functionality is, in part, grouped into individual subareas in the form of tabs.

Notice

Depending on the selected operating mode and the currently logged-in user, different pages and functions are enabled for display and editing/use.

The following modules are available:

- **Start**
  Main interface for "getting to know" the device and for logging in the current user.
- **Adjustment**
  Adjust the camera and define default image acquisition parameters.
- **Configuration**
  Main interface for configuring the device and the individual tasks (programs and tools); configuration of the communication interfaces and the internal image memory.
- **Process**
  Display in process operation depending on configuration. In addition to the display of statistical data, a live image display as well as the output of data from the active program are possible.
- **Diagnostics**
  Display and management of diagnostic-relevant data, such as event logs and communication diagnostics.
- **Maintenance**
  Management of authorized users, updating of firmware, creation and loading of backup files as well as setting the system time.

All working modules are briefly introduced in the following. However, because operation is often self-explanatory, and ***webConfig*** provides you with context-sensitive help and descriptive texts, only the windows which make available editable parameters or special operating options are described in greater detail.

Notice!

Please note that, unless stated separately, the description which follows is from the perspective of the authority level set by default, "planning engineer".

Information on the typical workflow and the individual work steps can be found in chapter "Basic procedure – Step-by-step configuration of a BLOB analysis" on page 148.

3.1 "Start" module

The "Start" module provides you with a compact description of the device. The individual aspects are summarized in the "Welcome", "Identification", "Installation" and "Specifications" tabs. In addition to these strictly informative pages, on which the user has only read access, the "Login" tab offers the possibility to login as the current user.

This is the only module that is available in both operating modes and to all users.

3.1.1 "Welcome" tab

The "Welcome" tab corresponds to the **LSIS 4xx*i* *webConfig*** start window. The main device features are presented in the left window area. In addition, you can see which browsers are supported.

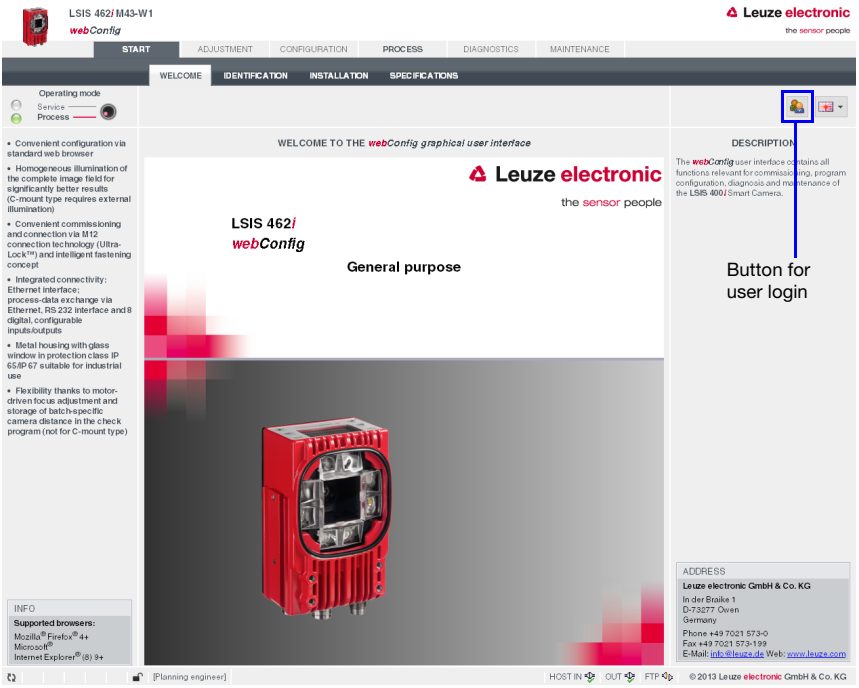


Figure 3.3: "Start" module, "Welcome" tab – Device features

3.1.2 "Identification" tab

Here, you will first find an explanation of the name plate and, after selecting the appropriate menu item in the left window area, detailed release notes and information on changes to the hardware and software used in this device. In the event of problems, this may serve as important information for Leuze Support.

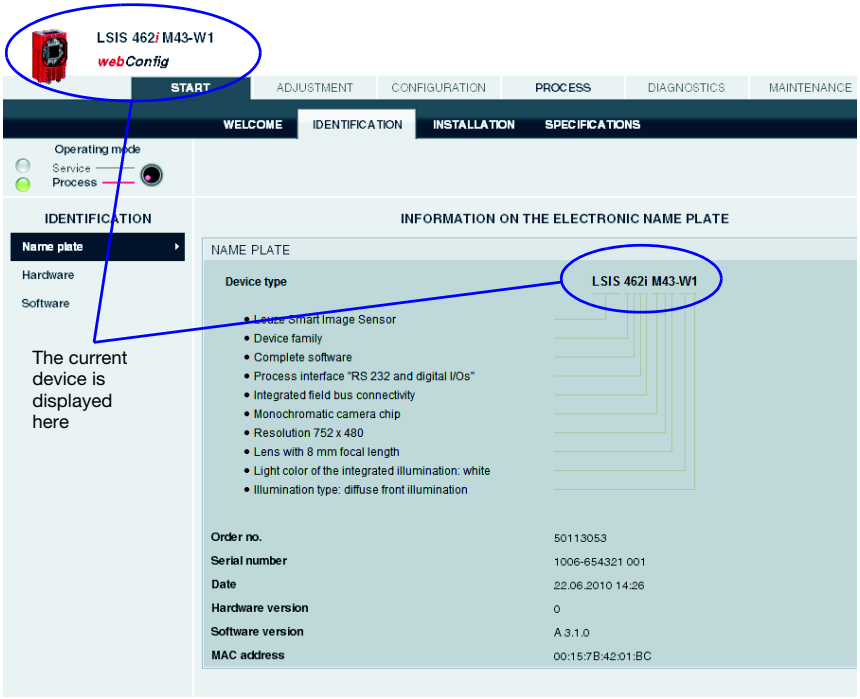


Figure 3.4: "Start" module, "Identification" tab – Explanation of the name plate

3.1.3 "Installation" tab

Select the appropriate menu item in the left window area to display descriptions of the device connections, mounting and display functions in the right window area.

Because the graphics contained in the overview windows are mouse sensitive, the display of the individual connections, of the status displays, of the display and of the control buttons can be activated both by selecting the respective submenu item as well as by clicking the corresponding graphic element. A magnifying glass icon identifies graphics that can be enlarged by clicking once with the mouse; clicking again reduces the image to its original size.

Notice!

Notice about the mouse-sensitive screen elements:
If the device is in "Service" mode, you can access the `Connections -> PWR, -> BUS OUT and -> SERVICE` *menus by clicking the mouse on the* ***pin assignment display*** *directly on the corresponding configuration page.*

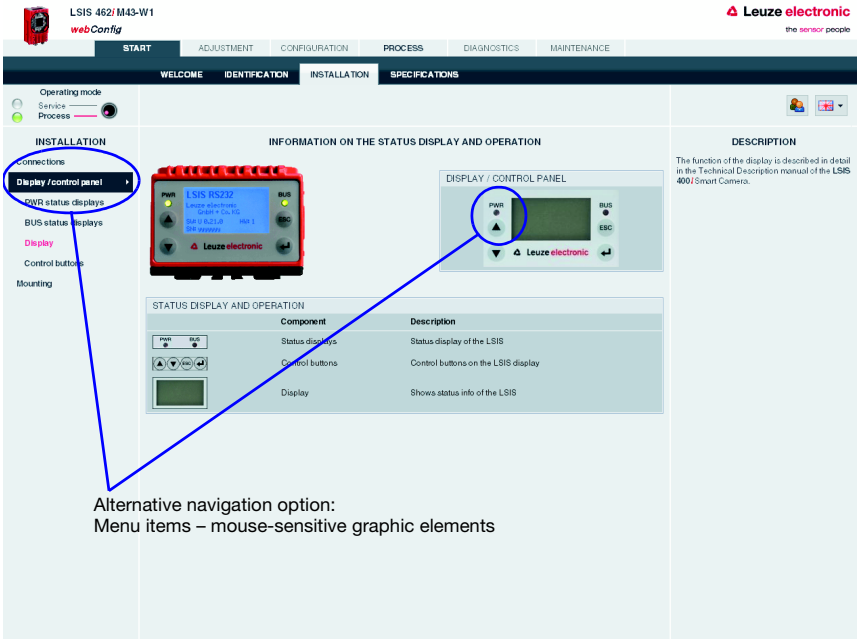


Figure 3.5: "Start" module, "Installation" tab

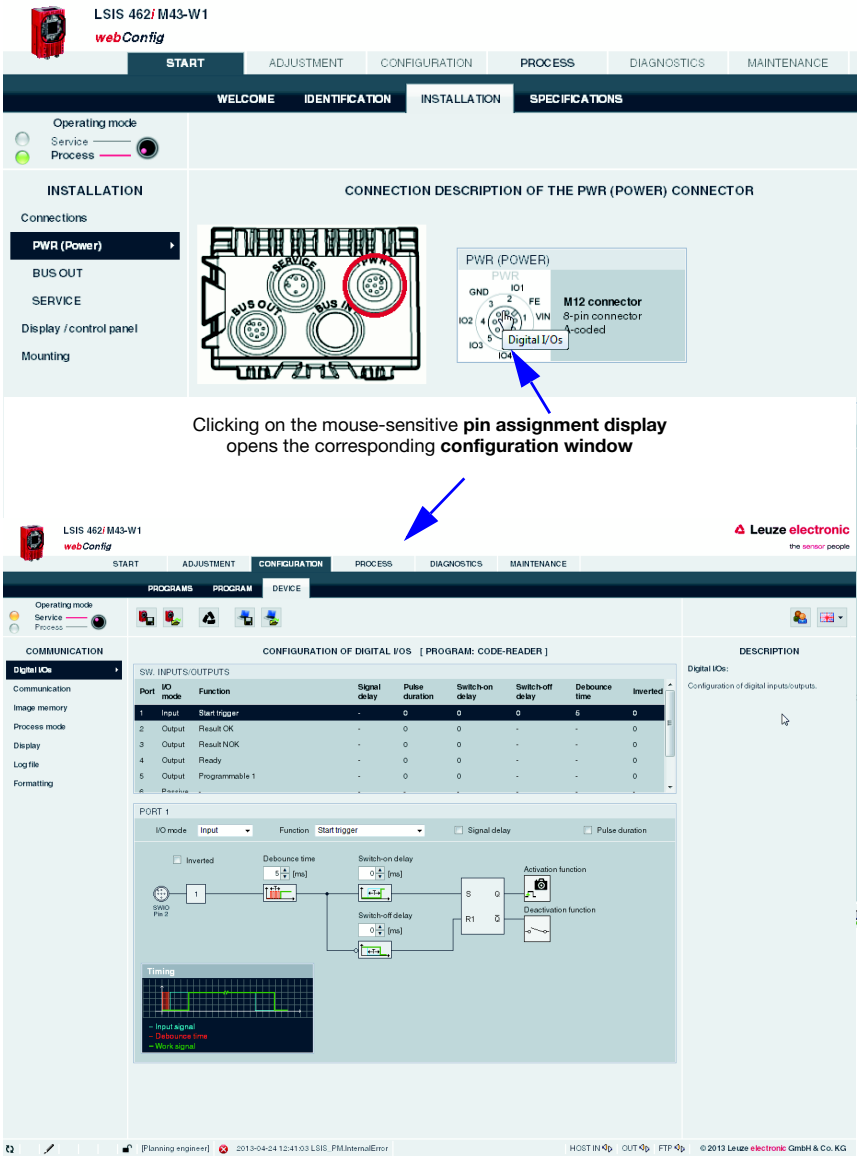


Figure 3.6: Use mouse-sensitive graphic elements

3.1.4 "Specifications" tab

The mechanical, electrical and optical device data is displayed here in tabular form. For a device of one of the **LSIS 422*i*** and **LSIS 462*i*** (with code reading) series, the available code types and the respective, underlying standards are listed here as well.

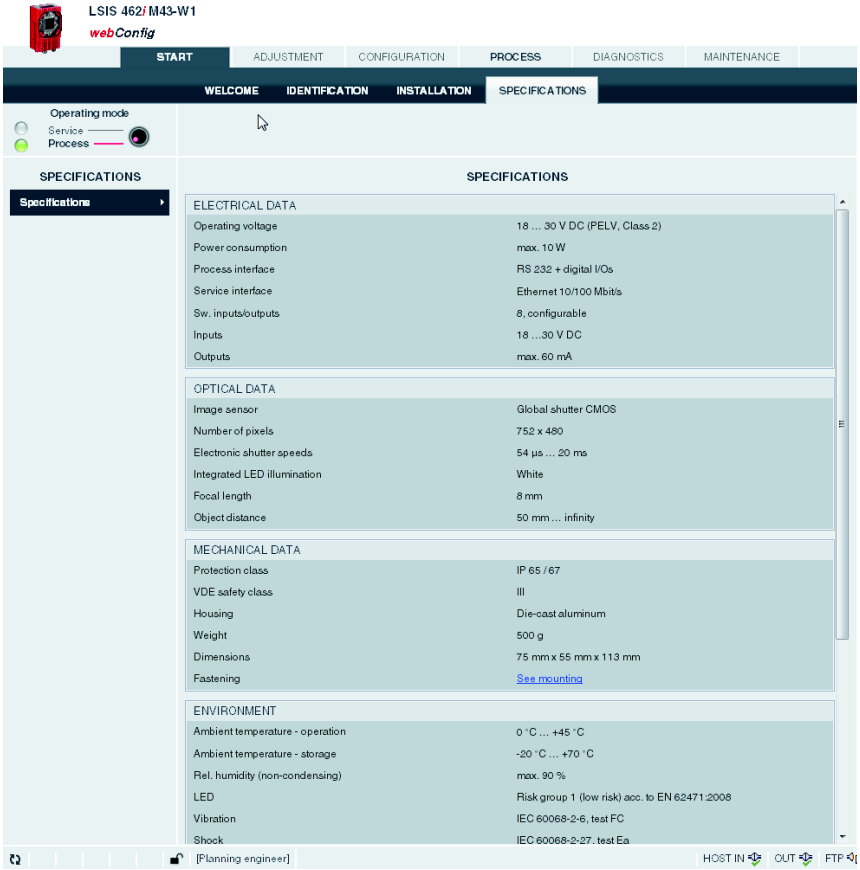


Figure 3.7: "Start" module, "Specifications" tab

3.1.5 "Login" button

The "Login" button is used to log in the respective user.

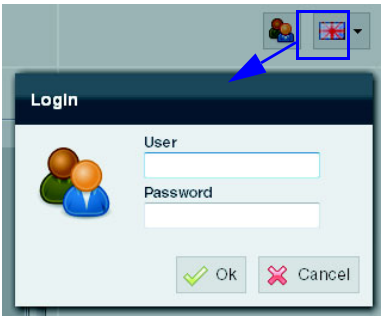


Figure 3.8: "Start" module, "Login" button

Notice!

Only a user who has already been created *can log in. Management of the user data, i.e. the creation and deletion of users as well as the assignment of passwords and authorizations, occurs in the "Maintenance" module, see description ""User management" tab" on page 141.*

3.2 "Adjustment" module

Using the displayed current image, you can align the camera without needing to configure a check program, e.g., during the first installation. The image acquisition parameters used in this process are only temporary, but can be saved as a preset for all future check programs.

Notice!

Please note that these settings do not overwrite the camera settings already saved in existing check programs.

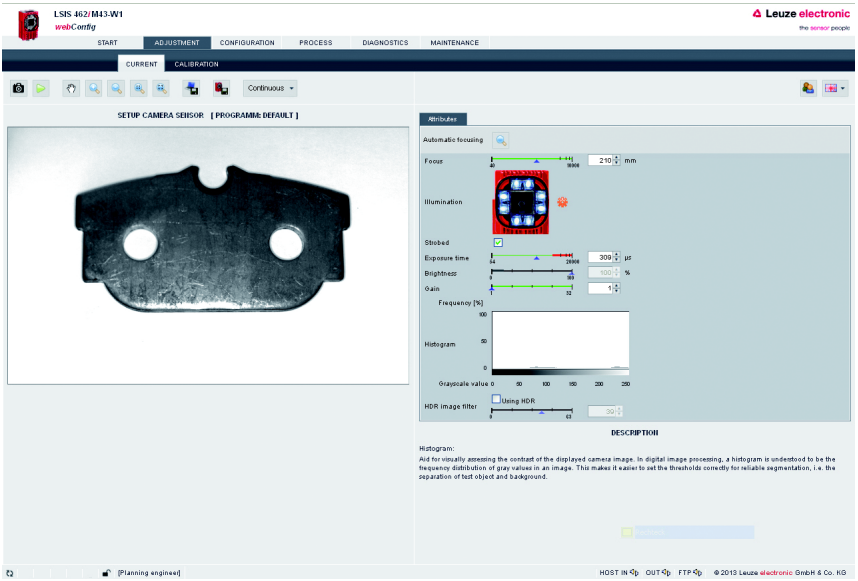


Figure 3.9: User interface of the "Adjustment" module - "Current" tab

In the left window area you see a live image and can select the desired camera operating mode from a list box. The parameters necessary for image acquisition are made available to you in the right window area. In the lower area, you can find context-sensitive information on the parameters and the various operational controls.

Notice!

To more quickly set up the focal position and exposure time, the "Automatic focusing" button can be used.

3.2.1 "Current" tab

Buttons



Pressing this button triggers the acquisition of a single image, taking into account the operating mode of the camera. After the button has been pressed, the web browser waits for the image to be transmitted. During the waiting time, ***webConfig*** cannot be operated, i.e. any further entries are ignored and/or not accepted.

In the "Continuous" camera operating mode, the waiting time can be ignored, since the image is displayed within just a few hundred milliseconds. In the "Triggered" camera operating mode, this is undefined, since the arrival of a trigger signal is not guaranteed. To again enable operation via ***webConfig***, a timeout elapses in the web browser. If no image is supplied within 5 seconds after the image is requested, ***webConfig*** interrupts the waiting time and is again available to the user.



Pressing this button switches the live mode of the **LSIS 4xx*i*** on and off. In live mode, the images are continuously captured, taking into account the operating mode of the camera. In the web browser, images are updated at a rate of up to 3 per second. The update rate here is dependent on a number of program-specific parameters, the power of the connected PC, the hardware and software used as well as other factors.

In the "Continuous" camera operating mode, a request is issued for a new image as soon as the acquisition of the previous image has concluded. In the "Triggered" camera operating mode, a request for a new image is likewise immediately issued provided the acquisition of the previous image has concluded. But, because, image acquisition is dependent on the arrival of a trigger signal, a timeout of 5 seconds must elapse first. If a request for image acquisition is not answered within 5 seconds, ***webConfig*** interrupts the current image acquisition and starts the next one.



Displacing image:
Pressing this button displaces the view of the image. Move the mouse pointer ("Hand") onto the image and drag it in the desired direction. Pressing this button again deactivates this function.



Zoom in:
Pressing this button enlarges the view of the current image. A previously executed image displacement is not canceled.



Zoom out:
Pressing this button reduces the view of the current image. A previously executed image displacement is not canceled.



Original size:
Pressing this button displays the image in the original size (100 %). A previously executed image displacement is not canceled.



Original size centered:
Pressing this button displays the image in the original size (100 %) and cancels a previously executed image displacement.

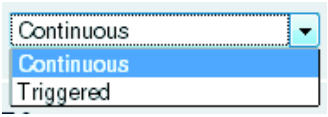


Pressing this button saves the current image on the PC that is connected to the **LSIS 4xx*i***. This function is not available in live mode!



After pressing this button, all image acquisition parameters set in the **Attribute** section are permanently saved in the flash memory of the **LSIS 4xx*i*** as default settings. These settings are used as default values for image acquisition from this point on when creating new check programs.

Operational control: "Camera operating mode" list box for selecting the camera operating mode



You have two options here for selecting the camera operating mode and, thus, for determining the point in time of image acquisition.

In the "**Continuous**" camera operating mode, an image is recorded immediately after the corresponding button is pressed or after an image acquisition parameter is changed; the image is then displayed in the browser. This can be helpful if, for example, an object is manually placed in front of the camera and no trigger signal is available for image acquisition.

In the "**Triggered** camera operating mode, image acquisition and the display in the web browser are process-controlled with the rising edge of a trigger signal via a digital trigger input. Prerequisite for this operating mode is that a digital input of the **LSIS 4xx*i*** be defined as a trigger input. Information on this topic can be found in chapter 3.3.3.

This setting only applies in Configuration mode; for Process mode, you can find this configuration option under "Configuration - Device - Process mode".

The following parameters and operational controls are available in the right window area:

"Attributes" parameter group

Parameter	Explanation
Focus	Setting for the object distance for primarily obtaining a sharp image. The object distance corresponds to the distance between the front edge of the camera and the object in mm.
Automatic focusing	With this button, an automatic determination of the focal position is started. In doing so, both the setting for the distance to the object as well as the exposure time are varied until a high image sharpness is achieved. This process may take some time. This function should only be used with flat test objects (e.g., labels) and while at a standstill. Alternatively, the focal position and the exposure time can be set manually.
Illumination	Designed as four light areas ("Quadrants") which can be individually switched on and off, e.g. to reduce the reflexions in the image or to highlight structures in the test object. Deactivating individual or all four quadrants is possible, e.g. when using external illumination.

<table>
<tr><th>Parameter</th><th>Explanation</th></tr>
<tr><td>Strobed</td><td>Switch between strobed light and continuous light. For continuous light, the maximum light power is reduced to keep from shortening the life expectancy of the LEDs.
Please observe the dependencies between the "Strobed", "Exposure time" and "Brightness" image acquisition parameters:
<table>
<tr><td></td><td>Strobed operation
"Strobed" option active</td><td>Continuous light operation
"Strobed" option not active</td></tr>
<tr><td>Exposure time</td><td>Max. 1.8 ms, dependent on the set brightness</td><td>Freely adjustable from 54 µs to 20 ms</td></tr>
<tr><td>Brightness</td><td>Min. 15 %
Max. dependent on the set exposure time</td><td>"Brightness" regulator deactivated</td></tr>
</table>
</td></tr>
<tr><td>Exposure time</td><td>Setting the exposure time in strobed operation between a minimum of 54 µs and a maximum of approx. 1.8 ms (approx. 20 ms in continuous light). To get a sharp picture during fast moving processes, the exposure time - when using sufficient image contrast - should be as short as possible. The values for the exposure time and brightness are coupled to one another in order to always enable the maximum possible current through the integrated LED illumination and, thus, the maximum light yield.</td></tr>
<tr><td>Brightness</td><td>As long as the exposure time is > 54 µs, the function is deactivated; it is only possible to set the brightness of the integrated illumination between 15 % and 100 % if the exposure time is below 54 µs. The values for the exposure time and brightness are coupled to one another in order to always enable the maximum possible current through the integrated LED illumination and, thus, the maximum light yield.</td></tr>
<tr><td>Gain</td><td>Set the gain between 1 and 32. Doing so can increase the brightness of the image, e.g. when short exposure times are required during fast moving processes, but the contrast or image brightness must be increased. In addition to the brightness of the image, the noise in the image is also increased, i.e. interferences are amplified.</td></tr>
<tr><td>HDR</td><td>The use of HDR (High Dynamic Range) aids in the evaluation of large differences in brightness at a given illumination setting (e.g., various object distances). The greater the object distances vary, the larger the value of the HDR image filter that is to be set.</td></tr>
</table>

Notice!

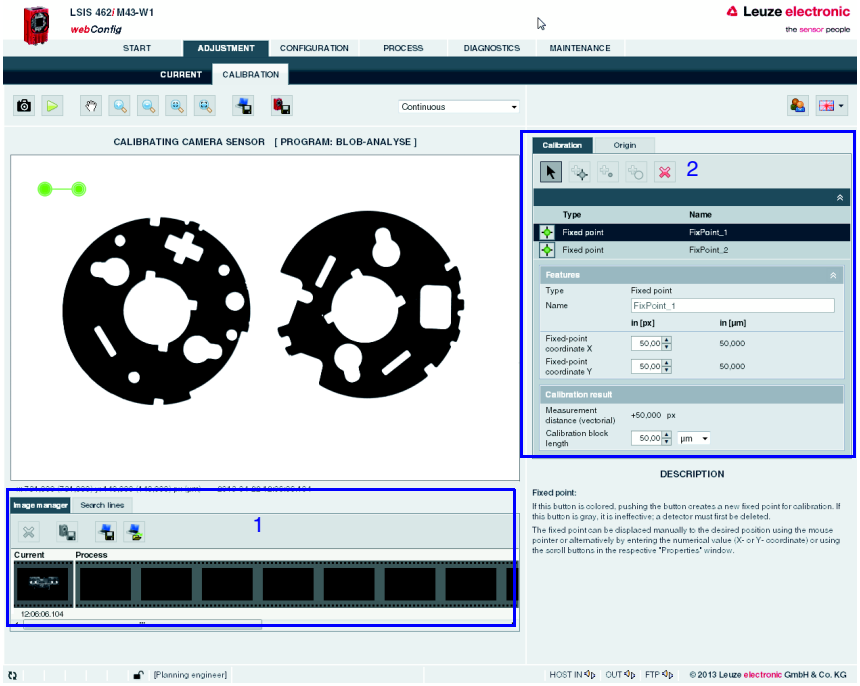
Please observe the following dependencies between the "Exposure time" and "Brightness" image acquisition parameters:

While a reduction in the exposure time is generally advantageous (better depth of focus and less "Smearing" in the image with quickly moving objects), the reduction in brightness of the internal illumination makes image acquisition more sensitive to ambient light.
To rule out the case of faulty operation in which the brightness is reduced instead of the exposure time for an image that is too bright, the "Exposure time" and "Brightness" parameters are mutually interlocked: as long as the exposure time is greater than the minimum adjustable value of 54µs, the brightness value of the internal illumination is always 100% and cannot be changed.
Only at or above the minimum adjustable value for the exposure time of 54µs can the brightness of the internal illumination be reduced in order to further reduce the image brightness. In practice, this is only necessary in exceptional cases, for example, if it is necessary to check a bright label at close range.

"Histogram" operational control

Aid for visually assessing the contrast of the displayed camera image. In digital image processing, a histogram is understood to be the frequency distribution of gray values in an image. This makes it easier to set the thresholds correctly for reliable segmentation, i.e. the separation of test object and background.

3.2.2 "Calibration" tab



1 - Image processing tab
2 - Calibration tab

Figure 3.10: User interface of the "Adjustment" module - "Calibration" tab

Image manager

You can find the image manager in the lower part of the window. Displayed in the film strip are the last current image and a maximum of 14 process and reference images. A time stamp is located under each image that uniquely identifies it.

Process images are displayed with a green or red frame, depending on whether they resulted in a good or bad test result at the time they were taken.

In contrast to process images, reference images are stored permanently in the flash memory of the **LSIS 4xx*i***. In order to store a new or additional reference image, there must be at least one free space available or configured in the reference image memory range. A maximum of eight reference images can be saved.

Calibration

In this tab, tools are provided which enable calibration in the area (2D). This makes it possible to convert coordinates determined from image data into real coordinates ("world coordinates") and provide them with a unit of measurement, e.g. [mm].

In this process, a two-point calibration is used such as is typically done in measurement technology using calibration blocks (e.g. parallel gauge blocks). For a calibration, the calibration block should cover more than half the image field and be at the level of the object to be measured; camera or object distance should remain constant. In addition, the detectors should be positioned for calibration such that the line connecting both detectors is parallel to the known reference length of the calibration block.

Several "Detectors" are offered ("**fixed point**", "**Point detector**" and "Circle detector") with which positions are set manually or edge positions or circle center points are automatically determined (notice: this is not the case, however, with the "Count edges" edge selection).

Notice!

Make sure that a two-point calibration only takes place in the connection direction of the detectors. Geometric tilting, perspective or lens distortions, etc. are not taken into account in this process.



Select detector:
By pressing this button, a detector that already exists or that is to be added new to the two-point calibration can be selected here – as an alternative to directly selecting with the mouse pointer.

When selecting an existing detector, the corresponding properties window along with its parameters becomes accessible; this detector is highlighted by a dark gray bar. Alternatively, the point corresponding to the selected detector (heavily filled circular area) can be directly grabbed and moved.



Fixed point:
If this button is colored, pushing the button creates a new fixed point for calibration. If this button is gray, it is ineffective; a detector must first be deleted.

The fixed point can be displaced manually to the desired position using the mouse pointer or alternatively by entering the numerical value (X or Y coordinate) or using the scroll buttons in the respective "Properties" window.



Point detector:
If this button is colored, pushing the button creates a new detector for calibration. If this button is gray, it is ineffective; a detector must first be deleted.

The new detector is created by drawing a rectangle (with the left mouse button pressed down) in the camera image display. If the left mouse button is released, the corresponding "Properties" window appears. The length, width, angle and position of the rectangle can be modified.

In contrast to the manual fixed point, the edge position is determined automatically along the search line, depending on the selected properties.



Circle detector:
If this button is colored, pushing the button creates a new detector for calibration. If this button is gray, it is ineffective; a detector must first be deleted.

The new detector is created by drawing a cylinder ring (with the left mouse button pressed down) in the camera image display. If the left mouse button is released, the corresponding "Properties" window appears. The size (inner and outer circle), angle and position of the cylinder ring can be modified. In addition, a cylinder ring section can be created; to do so, the turquoise lozenge must be touched with the mouse pointer and pulled correspondingly.

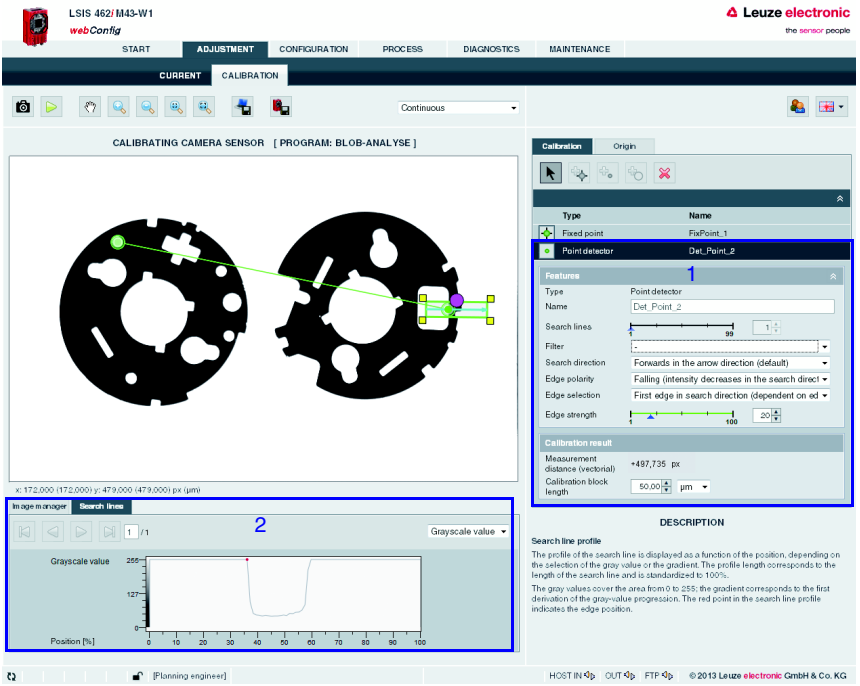
In addition, two dashed, orange circles are visible. These describe the maximum and minimum radius. The point of the maximum or minimum radius is indicated by an orange dot on the respective dashed circle.

In contrast to the manual fixed point, the edge positions are determined automatically along the search lines (default: 5 search lines), depending on the selected properties.



Delete detector:
Pressing this button deletes the selected detector.

Point detector properties



1 - Point detector properties
2 - Search lines tab (point detector)

Figure 3.11: "Calibration" tab - Point detector properties / "Search lines" tab

"Properties" parameter group (point detector)

Parameter	Explanation
Type	Type of the selected detector – "Point detector" in this case
Name	Name of the selected detector (automatic name assignment, cannot be edited)
Search lines	The number of search lines (here: 1 search line) cannot be changed. With increasing length of the search line, the evaluation time increases.

Parameter	Explanation
Filter	**Smoothing filter**: Is a one-dimensional Gaussian-like smoothing filter for suppressing statistical noise in the image. Fine structures are wiped out when rough structures are preserved; edges become fuzzy. **Bilateral filter**: Two one-dimensional filters are implemented one after the other. First a Gaussian filter for suppressing statistical noise in the image. Then a filter for sharpening the image is implemented, meaning edges get steeper transitions. **Adaptive filter**: Two one-dimensional filters are implemented one after the other – similar to the bilateral filter. In addition, local histogram values are taken into consideration with the Gaussian filter.
Search direction	• Forwards in the arrow direction (default) • Backwards (arrow direction rotated by 180°)
Edge polarity	• All (rising and falling) • Rising (intensity increases in the search direction: gray-value progression dark to light) • Falling (intensity decreases in the search direction: gray-value progression light to dark)
Edge selection	• First edge in search direction (dependent on edge polarity) • Strongest edge in search direction (dependent on edge polarity) • Counting of all edges (depending on edge polarity)
Edge strength	Represents the rise or fall of an edge - depending on the edge polarity selected, with regard to a defined standard edge width. The values are standardized and have a value range of 0 to 100; the default value is 20.

Calibration result (point detector)

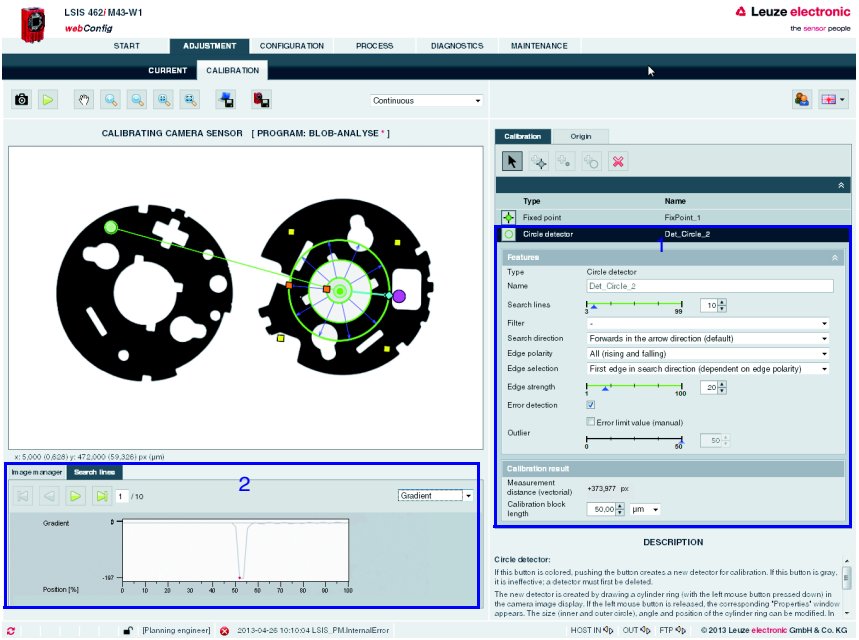
Parameter	Explanation
Measurement distance (vectorial)	Here, the vectorially ascertained distance between the detectors is output in pixels [px]; in the example (figure 3.11), this is the distance between fixed point and ascertained edge position. In combination with the specification of the real length of the calibration block, it is possible to convert the coordinates ascertained from the image data to real coordinates ("world coordinates") and provide them with a unit of measurement, e.g. [mm].
Calibration block length	Real length of the calibration block.

"Search lines" tab (point detector)

The profile of the search line is displayed as a function of the position, depending on the selection of the gray value or the gradient. The profile length corresponds to the length of the search line and is standardized to 100%.

The gray values cover the area from 0 to 255, the gradient corresponds to the first derivation of the gray-value progression. The red point in the search line profile indicates the edge position.

Circle detector properties



1 - Circle detector properties
2 - Search lines tab (circle detector)

Figure 3.12: "Calibration" tab - Circle detector properties / "Search lines" tab

"Properties" parameter group (circle detector)

Parameter	Explanation
Type	Type of the selected detector – "Circle detector" in this case
Name	Name of the selected detector (automatic name assignment, cannot be edited)
Search lines	The number of search lines (default: 5 search lines) can be selected between 3 and 99. With increasing length or number of search lines, the evaluation time increases.

Parameter	Explanation
Filter	**Smoothing filter**: Is a one-dimensional Gaussian-like smoothing filter for suppressing statistical noise in the image. Fine structures are wiped out when rough structures are preserved; edges become fuzzy. **Bilateral filter**: Two one-dimensional filters are implemented one after the other. First a Gaussian filter for suppressing statistical noise in the image. Then a filter for sharpening the image is implemented, meaning edges get steeper transitions. **Adaptive filter**: Two one-dimensional filters are implemented one after the other – similar to the bilateral filter. In addition, local histogram values are taken into consideration with the Gaussian filter.
Search direction	- Forwards in the arrow direction (default) - Backwards (arrow direction rotated by 180°)
Edge polarity	- All (rising and falling) - Rising (intensity increases in the search direction: gray-value progression dark to light) - Falling (intensity decreases in the search direction: gray-value progression light to dark)
Edge selection	- First edge in search direction (dependent on edge polarity) - Strongest edge in search direction (dependent on edge polarity)
Edge strength	Represents the rise or fall of an edge - depending on the edge polarity selected, with regard to a defined standard edge width. The values are standardized and have a value range of 0 to 100; the default value is 20.
Error detection / outliers	The detection of errors and outliers of a circular object can be activated by clicking on the check box. Errors and outliers are ignored in the default settings. If error detection is activated, the error or outlier is automatically detected (default).
Error limit value (manual)	By clicking the "Error limit value (manual)" check box, a limit value can be specified manually (deviation from optimal circle fit in %). If the deviation of the edge position of a search line is larger than this limit value, this edge position is ignored in the calculation of the optimal circle fit.

Calibration result (point detector)

Parameter	Explanation
Measurement distance (vectorial)	Here, the vectorially ascertained distance between the detectors is output in pixels [px]; in the example (figure 3.12), this is the distance between fixed point and ascertained circle center. In combination with the specification of the real length of the calibration block, it is possible to convert the coordinates ascertained from the image data to real coordinates ("world coordinates") and provide them with a unit of measurement, e.g. [mm].
Calibration block length	Real length of the calibration block.

"Search lines" tab (circle detector)

The profile of the search line is displayed as a function of the position, depending on the selection of the gray value or the gradient. The profile length corresponds to the length of the search line and is standardized to 100 %.

The gray values cover the area from 0 to 255, the gradient corresponds to the first derivation of the gray-value progression. The red point in the search line profile indicates the edge position.



The buttons in the upper left part of the "Search lines" tab can be used to select the individual search lines and display their profile

Origin

In this tab, you can define the coordinate system of the camera (image-data coordinates in pixels [px]). Absolute camera-image position values are output in new programs in this coordinate system.



Editing coordinate system:

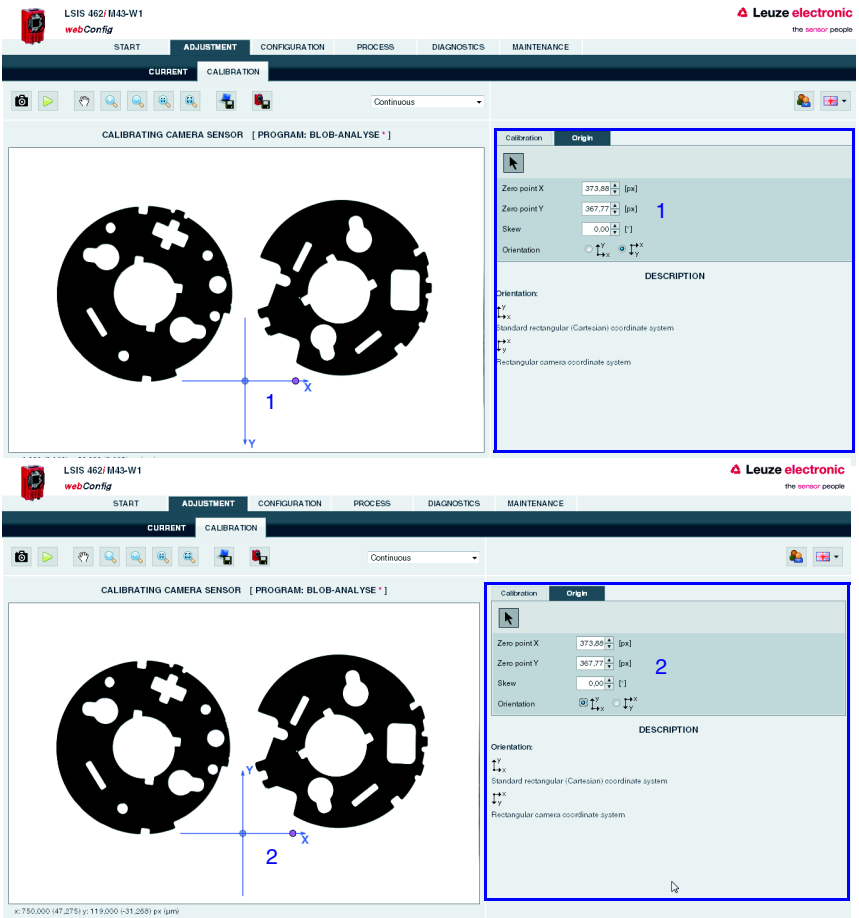
- **Zero point X** [px] (value range 0 … 752)
- **Zero point Y** [px] (value range 0 … 480)
- **Skew** [°] (value range 0 … 360)
- **Orientation**



Selection **Rectangular camera coordinate system** (default)



Selection **Standard rectangular (Cartesian) coordinate system**



1 - Rectangular camera coordinate system
2 - Standard rectangular (Cartesian) coordinate system

Figure 3.13: "Origin" tab - Camera coordinate system definition

3.3 "Configuration" module

The "Configuration" module serves as the main interface for configuring the device and the individual tasks (programs or tools) and for configuring the communication interfaces. The parameters required for this purpose are made available in the "Programs", "Program" and "Device" tabs.

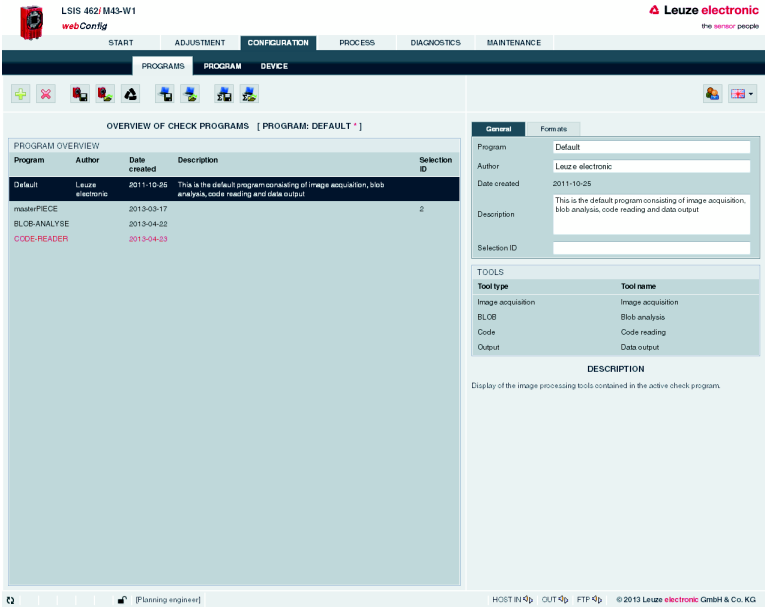


Figure 3.14: User interface of the "Configuration" module

3.3.1 "Programs" tab

This tab is used for managing check programs. In the left part of the window, you will find a list of the check programs that have been saved in the camera – whereby the currently active check program is displayed with a dark gray background. The name of the active check program is also displayed in the title bar below the tab name.

Click a line to activate the corresponding check program. As soon as a parameter of the check program is changed after the last time that it was saved, or if a different check program in the list was set to active by means of a mouse click, a "*" appears next to the name. This indicates to the operator that changes made to the check program have not yet been saved in the device. The symbol disappears after the check program is saved.

Various operational controls can be used to create and delete and save and load check programs. But they can also be used to name and add a description or store a selection ID for implementing an automatic change of check programs via the master computer.

Also visible in the lower part of the right window are the image processing tools contained in the active program.



Figure 3.15: "Configuration" module, "Programs" tab

Buttons

The button bar contains the following elements:


Pressing this button creates a new check program at the end of the list and then activates it.


Pressing this button deletes the active check program.


After pressing this button, all check programs are permanently saved in the flash memory of the **LSIS 4xx*i***.


Pressing this button discards all changes by reloading the check programs saved in the flash memory of the **LSIS 4xx*i***.


Pressing this button discards all changes and loads the default programs present on delivery.


Pressing this button saves the current check program on the PC that is connected to the **LSIS 4xx*i***.


Pressing this button loads a single program from the PC that is connected to the **LSIS 4xx*i*** appends it to the end of the list, and activates it.


Pressing this button saves all programs on a PC.


Pressing this button loads multiple programs from a file on a PC on which the file was previously saved. The current program list is overwritten.

"General" parameter group

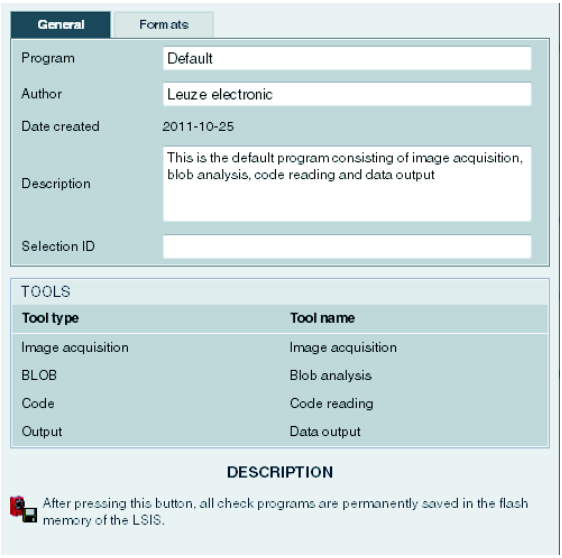


Figure 3.16: "Configuration" module, "Programs" tab - "General" parameter group

Parameter	Explanation
Program	Optional entry of the check program name. Can be changed at a later point in time.
Author	Optional entry of the author. Can be changed at a later point in time.
Date created	Display of the date on which the check program was created. Cannot be changed.
Description	Optional description of the tool. Can be changed at a later point in time.
Selection ID	Optional entry of the selection ID. Can be changed at a later point in time. The selection ID can be used to trigger an automatic change of check program via digital inputs. A plausibility check prevents the same number from being entered multiple times.

"Formats" parameter group

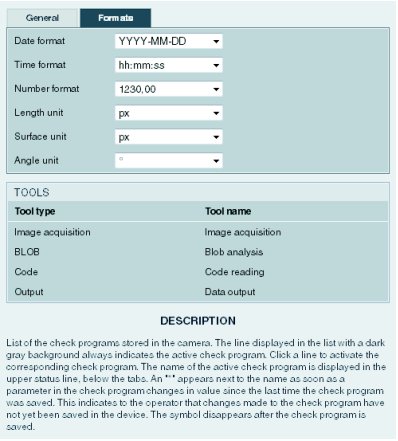


Figure 3.17: "Configuration" module, "Programs" tab - "General" parameter group

Parameter	Explanation
Date format	The drop-down list box allows different date formats to be selected: • **YYYY-MM-DD** [Year, 4 digits] - [Month, 2 digits] - [Day, 2 digits] • **YYYY-MM-DD** [Year, 4 digits] / [Month, 2 digits] / [Day, 2 digits] • **DD.MM.YYYY** [Day, 2 digits] . [Month, 2 digits] . [Year, 4 digits]
Time format	The drop-down list box allows different time formats to be selected: • **hh:mm:ss** [hour, 2 digits] : [minute, 2 digits] : [second, 2 digits] • **h:mm:ss** [hour, 1 or 2 digits] : [minute, 2 digits] : [second, 2 digits]
Number format	The drop-down list box allows different number formats to be selected: • **1.230,00** Thousand with "Point" separator character, decimals with "Comma" separator character • **1230,00** Thousand without separator character, decimals with "Comma" separator character • **1 230,00** Thousand separated by space, decimals with "Comma" separator character • **1,230.00** Thousand with "Comma" separator character, decimals with "Point" separator character • **1230.00** Thousand without separator character, decimals with "Point" separator character • **1 230.00** Thousand separated by space, decimals with "Point" separator character

Parameter	Explanation
Length unit	The drop-down list box allows different length units to be selected: • **µm** micrometer = 1 x 10^{-6} m = 0.000 001 m • **mm** millimeter = 1 x 10^{-3} m = 0.001 m • **cm** centimeter = 1 x 10^{-2} m = 0.01 m • **dm** decimeter = 1 x 10^{-1} m = 0.1 m • **m** meter = 1 m • **px** pixel = image point = elementary resolution of the camera chip
Surface unit	The drop-down list box allows different surface units to be selected: • **µm²** micrometer^2 = 1 x 10^{-12} m^2 = 0.000 000 000 001 m^2 • **mm²** millimeter^2 = 1 x 10^{-6} m^2 = 0.000 001 m^2 • **cm²** centimeter^2 = 1 x 10^{-4} m^2 = 0.000 1 m^2 • **dm²** decimeter^2 = 1 x 10^{-2} m^2 = 0.01 m^2 • **m²** meter^2 = 1 m^2 • **px²** pixel^2 = image point^2 = elementary surface of the camera chip
Angle unit	The drop-down list box allows different angle units to be selected: • **°** angle specification in degrees (full angle of a circle = 360°) • **rad** angle specification in radian measure (full angle of a circle = 2π)

3.3.2 "Program" tab

In accordance with its key role in the configuration process, numerous functions for configuring the current check program are available in this window. The window consists of three main areas, which offer selection-dependent operational controls.

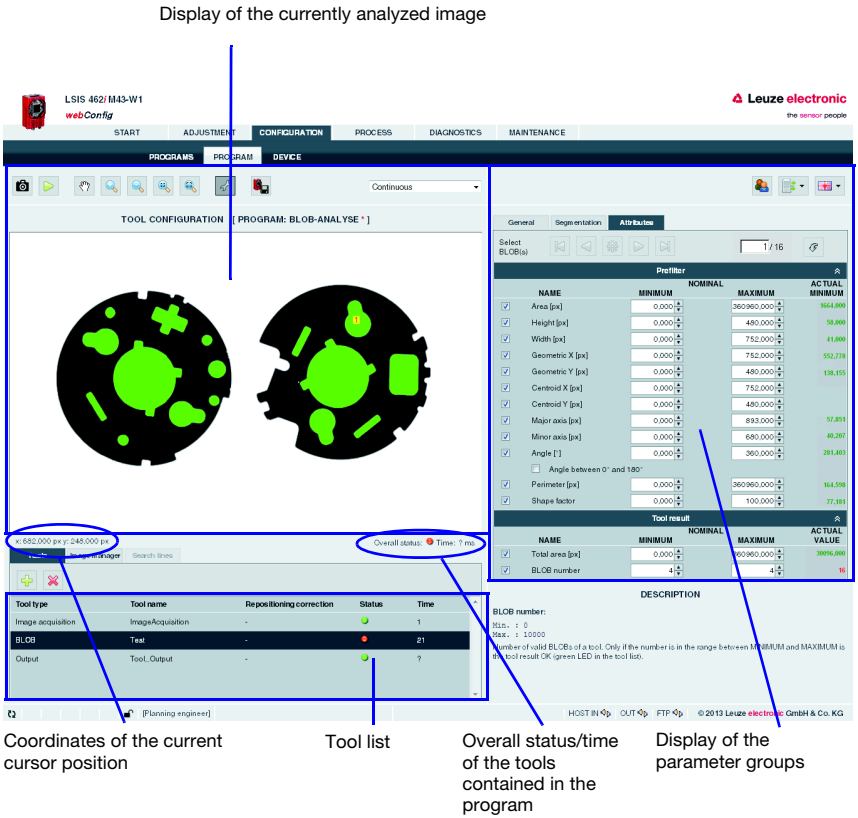


Figure 3.18: Three-part structure of the "Program" tab

The display in this window is primarily dependent on which tool type is selected in the lower left area – "Image acquisition", "BLOB" ,"Output" or, for **LSIS 422*i*** or **LSIS 462*i***, "CODE". The parameters of the active tool are displayed in the right window area. Independent of this, there are, however, several buttons and operational controls that are available for all tool types.

3.3.2.1 Tool-type-independent buttons and operational controls

Buttons

The button bar in the left part of the window area contains the following elements:



Pressing this button triggers the acquisition of a single image, taking into account the operating mode of the camera. After the button has been pressed, the web browser waits for the image to be transmitted. During the waiting time, ***webConfig*** cannot be operated, i.e. any further entries are ignored and/or not accepted.

In the "**Continuous**" camera operating mode, the waiting time can be ignored, since the image is displayed within just a few hundred milliseconds. In the "**Triggered**" camera operating mode, this is undefined, since the arrival of a trigger signal is not guaranteed. To again enable operation via ***webConfig***, a timeout elapses in the web browser. If no image is supplied within 5 seconds after the image is requested, ***webConfig*** interrupts the waiting time and is again available to the user.



Pressing this button switches the live mode of the **LSIS 4xx*i*** on and off. In live mode, the images are continuously captured, taking into account the operating mode of the camera. Depending on the performance level of the connected PC, up to 3 images are updated in the web browser per second.

In the "**Continuous**" camera operating mode, a request is issued for a new image as soon as the acquisition of the previous image has concluded. In the "**Triggered**" camera operating mode, a request for a new image is likewise immediately issued provided the acquisition of the previous image has concluded. But, because, image acquisition is dependent on the arrival of a trigger signal, a timeout of 5 seconds must elapse first. If a request for image acquisition is not answered within 5 seconds, ***webConfig*** interrupts the current image acquisition and starts the next one.



Displacing image:
Pressing this button displaces the view of the image. Move the mouse pointer ("Hand") onto the image and drag it in the desired direction. Pressing this button again deactivates this function.



Zoom in:
Pressing this button enlarges the view of the current image. A previously executed image displacement is not canceled.



Zoom out:
Pressing this button reduces the view of the current image. A previously executed image displacement is not canceled.



Original size:
Pressing this button displays the image in the original size (100 %). A previously executed image displacement is not canceled.



Original size centered:
Pressing this button displays the image in the original size (100 %) and cancels a previously executed image displacement.



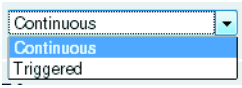
This is a toggle button. Pressing the button switches the display of a tool-overlay image on and off, provided the active tool makes available an overlay image.



Save changes in device

As soon as a parameter in the check program is changed, an "*" appears next to the name of the active check program (displayed in the upper status line below the tab). This indicates to the operator that changes made to the check program have not yet been saved in the device. After clicking this button, all changes are permanently saved in the flash memory of the **LSIS 4xx*i***. Afterward, this symbol disappears.

"*Camera operating mode*" *list box for selecting the camera operating mode*



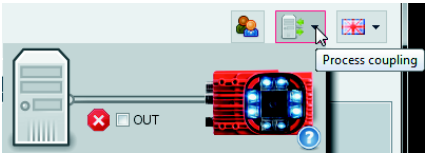
You have two options here for selecting the camera operating mode and, thus, for determining the point in time of image acquisition during program creation.

In the "**Continuous**" camera operating mode, an image is recorded immediately after the corresponding button is pressed or after an image acquisition parameter is changed; the image is then displayed in the browser.

In the "**Triggered**" camera operating mode, an image is recorded with the rising edge of a trigger signal via a digital trigger input; the image is then displayed in the web browser. Prerequisite for this operating mode is that a digital input of the **LSIS 4xx*i*** be defined as a trigger input.

The following operational controls are available in the right window area:

"*Process coupling*" *check box for connecting to the process during configuration*



If the check box is selected, all outputs (digital outputs, event output, …) activated in the output tool are handled as in process operation, i.e. results are transferred to the outside. In addition, the calculated time appears below the image display and in the tool list. If the check box is not activated, the camera is completely separated from the process, i.e. regardless of the test result, no digital outputs are set and no result output and time calculation occurs, even if an output string was defined.

3.3.2.2 *Tool list*

Here, you will find a list of the tools contained in the current check program. The active tool has a yellow background. Click a line to activate the corresponding tool.

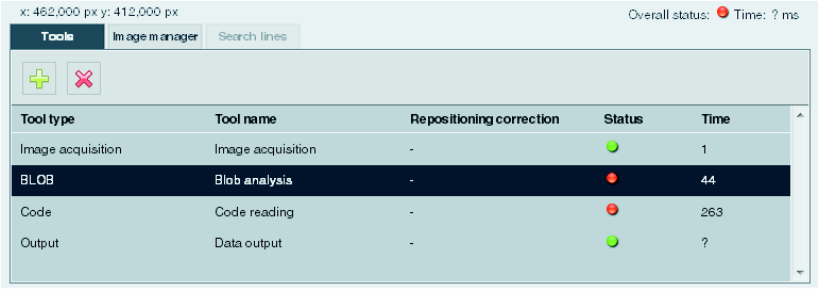


Figure 3.19: Tool list

The following operational controls are available in this window area:

"Tools" tab

Display of the image processing tools contained in the active check program with specification of name, reference, duration and, above all, the status. Here, a green status LED indicates OK; a red LED, on the other hand, indicates a status of NOK. If the states of all tools contained in the program are OK, the overall status, shown below the image display, is also OK. For tool type output, the time is only displayed here if process coupling is activated, see page 38.

Buttons

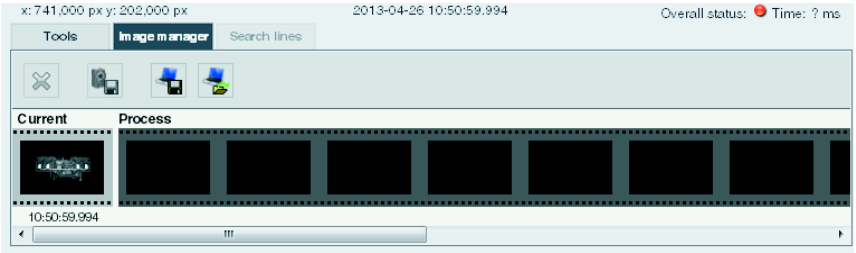


Pressing this button creates a new tool and then activates it.



Pressing the button deletes the active tool.

"Image manager" tab



Displayed in the film strip are the current image and 14 process and reference images. Each image is labeled with a time stamp that uniquely identifies it.

Process images are displayed with a green or red frame, depending on whether they resulted in a good or bad test result at the time they were taken.

Fault images are saved automatically by default. This allows an error to be found quickly, e.g., after adjusting the ROI. With the aid of the fault images, "pseudo errors" can be analyzed and the check parameters adjusted accordingly.

The reference images are permanently saved in the flash memory of the **LSIS 4xx*i***. In order to store a new reference image, there must be at least one free space available in the memory range that is configured for reference images, see chapter 3.3.3.6 ""Image memory" menu".

Buttons



Pressing this button deletes the active image from the image manager.



Pressing this button permanently saves the active image in the flash memory of the **LSIS 4xx*i***.

This action is only possible if there is still at least one free memory place available for reference images.



Pressing this button saves the current image on the PC that is connected to the LSIS. This function is not available in live mode!



Pressing this button loads an image from a PC that is connected to the **LSIS 4xx*i*** as the current image.

The active check program is immediately executed on the loaded image and the results displayed in the current view.

"Search lines" tab

This tab is only available in the "Calibration" tab (chapter 3.2.2) and in the measuring tool (chapter 3.3.2.6).

3.3.2.3 *Display for the "Image acquisition" tool type*

The current gray-value image is displayed in the image display.

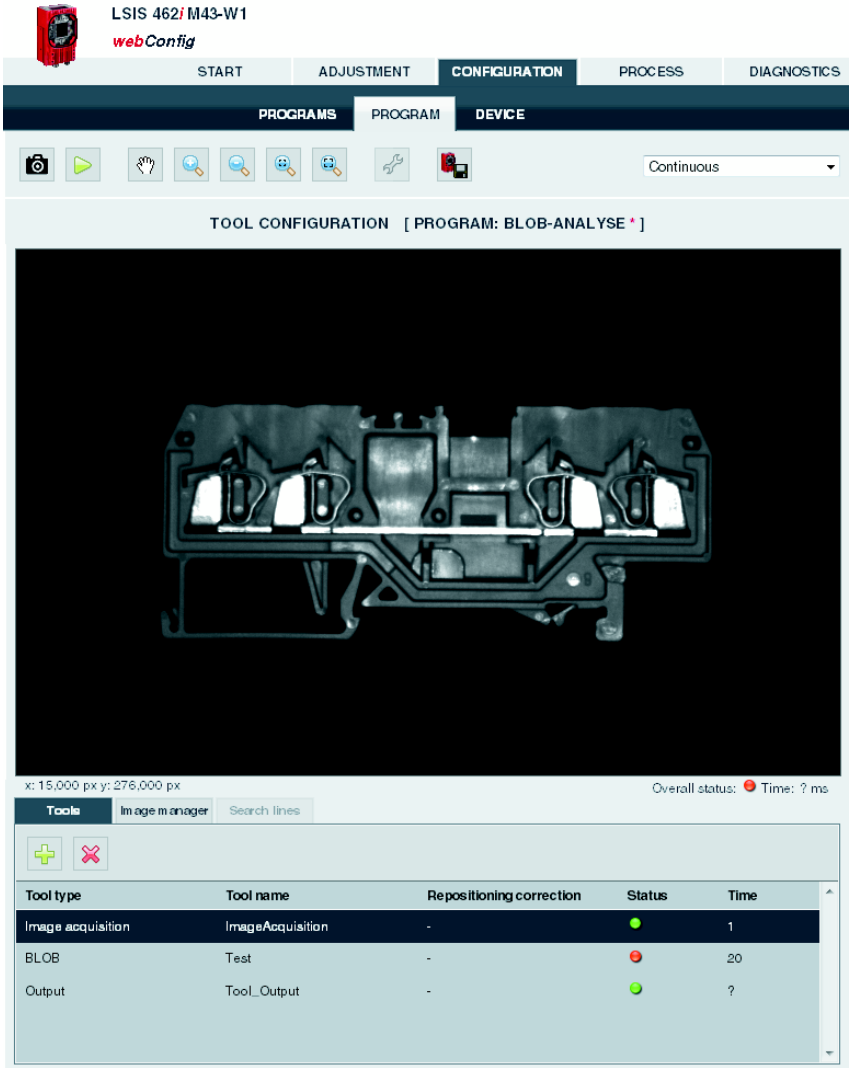


Figure 3.20: "Image acquisition" image display

Parameters for image acquisition

The "General" and "Attributes" tabs, described in chapter 3.2.1, are available at the right for image acquisition. Please note, however, that unlike editing the image parameters in the "Adjustment" module, **all settings made here apply only to the current program**!

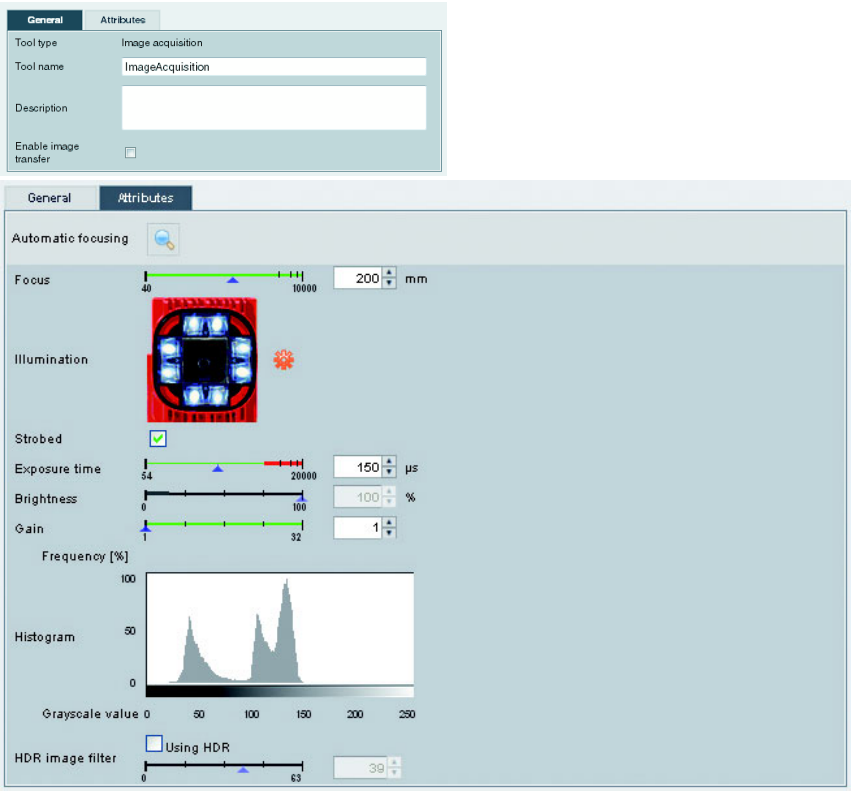


Figure 3.21: Image acquisition parameters

In addition, the "General" tab offers another operational control.

"Enable image transfer" check box

If this option is active, the current image for output on the Ethernet interface is prepared and can also be displayed in the terminal window of the process data (see "Process" module on page 134). This requires computing time (approx. 60 ms) and, thus, lengthens the cycle time of a test. The port via which the image request of an external control is read and the recorded image is also transferred is defined in the configuration of the Ethernet process interface, see chapter 3.3.3 ""Device" tab", section ""Communication -> Process - Ethernet" menu" on page 122. Details on transferring images and log data via FTP can be found in the description of "Communication -> FTP Client" menu on page 126.

Check box "Using HDR"

The HDR function (**H**igh **D**ynamic **R**ange) aids in the evaluation of large differences in brightness at a given illumination setting (e.g., various object distances). The greater the object distances vary, the larger the value of the HDR image filter that is to be set.

Notice!

*Please observe the following **dependencies** between the **"Strobed", "Exposure time" and "Brightness"** image acquisition parameters:*
*In **continuous light operation** ("Strobed" option not active), the exposure time can be freely set between 54µs and 20ms; the "Brightness" regulator is deactivated.*
*In **strobed operation** ("Strobed" option active), the following applies for the "Exposure time" and "Brightness" image acquisition parameters:*

While a reduction in the exposure time is generally advantageous (better depth of focus and less "Smearing" in the image with quickly moving objects), the reduction in brightness of the internal illumination makes image acquisition more sensitive to ambient light.
To rule out the case of faulty operation in which the brightness is reduced instead of the exposure time for an image that is too bright, the "Exposure time" and "Brightness" parameters are mutually interlocked: as long as the exposure time is greater than the minimum adjustable value of 54µs, the brightness value of the internal illumination is always 100% and cannot be changed. Only at or above the minimum adjustable value for the exposure time of 54µs can the brightness of the internal illumination be reduced in order to further reduce the image brightness.
In practice, this is only necessary in exceptional cases, for example, if it is necessary to check a bright label at close range.

3.3.2.4 *Display of the "BLOB" tool type*

With the BLOB tool, a red/green-colored overlay, which can be switched on and off and which represents the result of the segmentation/binarization, is placed over the gray-value image.

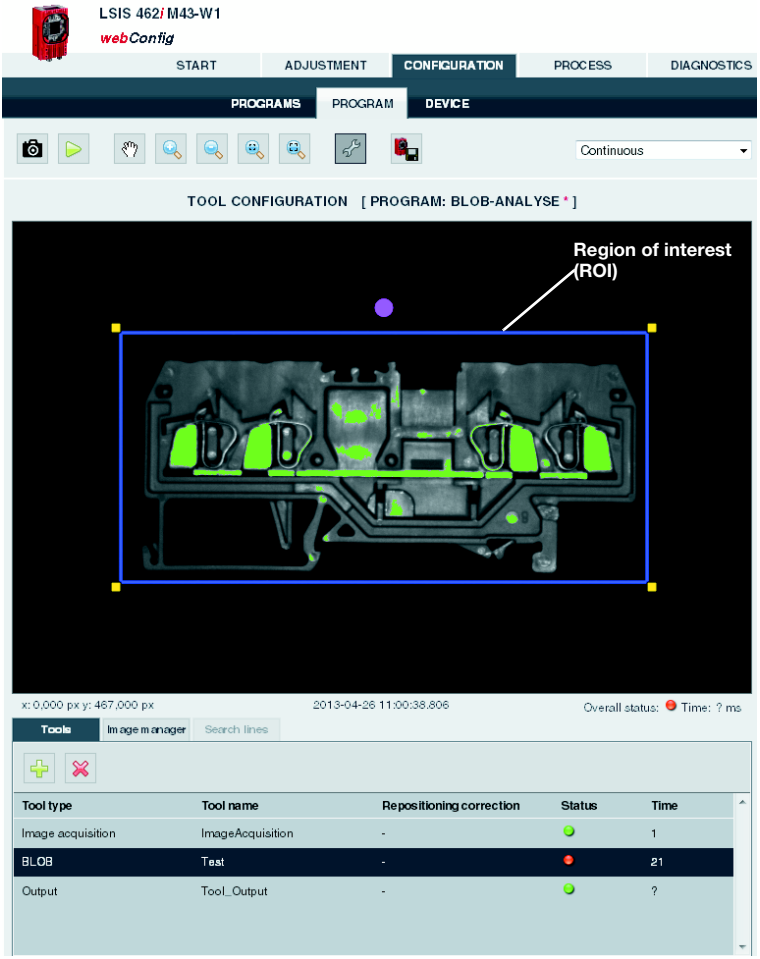


Figure 3.22: "BLOB" image display

All parameters necessary for BLOB analysis are contained in the "General", "Segmentation" and "Attributes" tabs. Workflow takes place logically from left to right:

1. Defining regions of interest (ROI)
2. Segment image
3. Evaluate BLOB attributes

If the calculation of the centroid (Center X, Center Y) or the size of the circumscribing rectangle (Height, Width) was activated under the BLOB properties ("Attributes" parameter group, see page 50), the BLOB number of the active BLOB is displayed on the image at the location of the centroid.

BLOB tool: "General" parameter group

Located here are general settings for the BLOB tool.

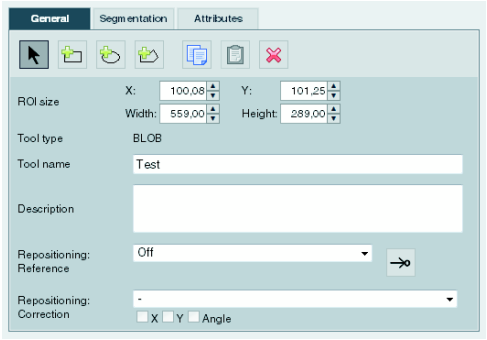


Figure 3.23: General parameters of the BLOB tool

Regions of interest (ROIs) can be used for excluding interfering elements in the image (e.g., an adjacent component that should not be detected, or reflections). This reduces the evaluation time, as the entire image no longer needs to be considered.
For a composite ROI consisting of multiple, overlapping regions of interest, the set-theoretic union of the contained pixels is evaluated.

Notice!

If no region of interest is defined, the complete image is defined as the region of interest. When using repositioning (see following table), an offset rectangle can then be displayed as region of interest, even if no region of interest was initially defined.

Notice!

When using regions of interest (ROIs), the histogram displayed under "Segmentation" refers only to the actually evaluated pixels, i.e. all points that are located within a region of interest.

For further information on working with ROIs, see chapter 4.1 "Basic procedure – Step-by-step configuration of a BLOB analysis".

Parameter	Explanation
Change ROI	Tools for restricting the ROI. The following elements are available:  **Select ROI** Pressing this button puts the mouse in selection mode, i.e. the mouse can be used to select, and thus activate, a ROI. The activated ROI can be moved and its dimensions changed. The selection mode is the default mode.  **Add rectangular ROI** Clicking on this button allows rectangular ROIs to be created. To do so, a rectangle needs to be drawn in the camera image display (with the left mouse button pressed down). If the left mouse button is released, the corresponding ROI appears. The length, width, angle and position of the rectangle can be modified if the rectangle is active or activated by a click. To create an additional rectangular ROI, this button must be clicked on again and the ROI created; the currently existing ROI is supplemented.  **Add elliptical ROI** Clicking on this button allows elliptical ROIs to be created. To do so, an ellipse needs to be drawn in the camera image display (with the left mouse button pressed down). If the left mouse button is released, the corresponding ROI appears. The length, width, angle and position of the ellipse can be modified if the ellipse is active or activated by a click. To create an additional elliptical ROI, this button must be clicked on again and the ROI created; the currently existing ROI is supplemented.  **Add polygon-type ROI** Clicking on this button allows polygon-like ROIs to be created. To do this, click the left mouse button in the camera image display to create the starting point of the polygon. Each additional mouse click in the camera image display adds an additional polygon point. The polygon area is closed if the user clicks on the starting point again. The entire length, width, angle and position of the polygon can be modified if the polygon is active or activated by a click; in addition, the individual polygon points can be repositioned by touching them in the camera image display. To create an additional polygon-like ROI, this button must be clicked on again and the ROI created; the currently existing ROI is supplemented.  **Copy ROI** Pressing this button saves the currently selected ROI.  **Paste ROI** The most recently saved ROI is inserted in the active tool.  **Delete ROI** Pressing this button deletes the activated ROI.
ROI size	In the default setting the coordinate origin (X=0, Y=0) is located in the upper left corner of the camera image display. The values of the X coordinates increase to the right; the values of the Y coordinates increase downward. Values "X" and "Y" describe the coordinates of the upper left corner of the ROI closest to the origin. For elliptical or polygonal ROIs, the circumscribing rectangle is used as a basis. Width and height define the dimensions of a rectangle that encloses the selected ROI. If the coordinate system has been changed – it can be dragged, rotated and, depending on the selected coordinate system regarding Y-orientation, can have another counting direction of the Y-axis – the coordinate information may deviate from the default settings. Negative X and Y coordinates are also possible. If a two-point calibration has been performed in the check program and the values have been accepted, the values are displayed according to the new standard.
Tool type	Display of the tool type. Cannot be changed.
Tool name	Optional entry of the tool name. Can be changed at a later point in time.
Description	Optional description of the tool. Can be changed at a later point in time.

Parameter	Explanation
Repositioning: Reference [1)]	In the drop-down list box, you can select whether a reference for repositioning ROIs of the subsequent tools should be created or not. The following modes exist: `Off`: default setting – in the current tool, no reference for repositioning is created. `Displacement`: in the current tool, a reference is created for horizontal (X) and vertical (Y) repositioning; for this purpose, one or more found objects can be used. By clicking on the "Teach-in" button ⇥, the coordinates of the current area centroid of the valid objects are taught in as reference coordinates. In new image analyses, the area centroid of the valid objects that exist at the given point in time are ascertained, compared to the taught-in reference coordinates and values for the displacement of subsequent tools are calculated. If the "Teach-in" button ⇥ has not been pressed, the tool result in this mode is NOK (red LED in the tool list) and a red exclamation mark appears in the "Reference" column of the tool list. `Displacement and rotation`: in the current tool, a reference is created for a horizontal (X), vertical (Y) and rotational (skew) repositioning. To do this, a suitable (arrow or pointer-like) object must be found in order to enable unique angle assignment; in the "Attributes" tab, the "MINIMUM=1" and "MAXIMUM=1" values must be set in the "Tool result" field. Clicking on the "Teach-in" button ⇥ teaches in the coordinates and angular position of the current area centroid of the valid object as reference coordinates and angles. In new image analyses, the area centroid of the valid object existing at the given point in time is ascertained, compared to the taught-in reference coordinates and reference angle and values for the displacement and rotation of subsequent tools are calculated. If the "Teach-in" button ⇥ has not been pressed, the tool result in this mode is NOK (red LED in the tool list) and a red exclamation mark appears in the "Reference" column of the tool list.
Repositioning: Correction	In the drop-down list box, you can select whether a correction (repositioning) of ROIs should take place in the current tool. To do this, click on a tool suitable as a reference in this list. Clicking on the "X", "Y" and "Angle" fields defines how the ROIs of the tool are to be repositioned. In the "-" default setting, the ROIs are not corrected. If the tool selected as reference provides no or insufficient corrective values, the tool result in this mode is NOK (red LED in the tool list) and the name of the referenced tool is displayed in red in the "Repositioning correction" column of the tool list.

1) ***Notices on the use of repositioning:***
In the following, only one repositioning is considered on the basis of the center of gravity or area centroid; here, only the BLOB or the code tool is used. To do this, the following conditions must be satisfied:

1. *In the tool used for repositioning, the minimum number of results to be found (BLOBs or codes) must be set to 1; if angle tracking is to be performed as well, the maximum number must also be 1, as unique orientation cannot otherwise be ascertained. Angle tracking is only useful if the corresponding result has a clear orientation (no circles - here, the angle is, in effect, undefined)!*
2. *In the same tool, "Repositioning: Reference" must be set and the "Teach" button then pressed. Each time one of this tool's parameters is changed or the camera is mechanically realigned, it is recommended that the repositioning reference be re-taught.*
3. *For the tool that is repositioned (also of type BLOB or code), the respective tool that offers the repositioning must be selected under "Repositioning correction". Repositioning can occur in the X or Y direction (default: X and Y). Repositioning by angle can be selected if this is offered by the projected tool (see 1.).*

BLOB tool: "Segmentation" parameter group

The settings for segmenting the image are made on this tab.

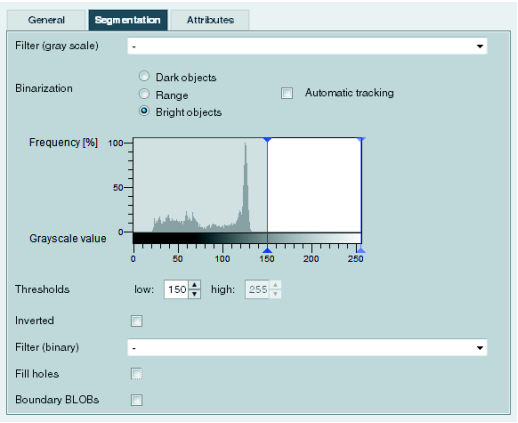


Figure 3.24: Segmentation parameters of the BLOB tool

Notice!

When using regions of interest (ROIs), the histogram refers only to the actually evaluated pixels, i.e. all points that are located within a region of interest.

Parameter	Explanation
Filter (gray scale)	In the drop-down list box, a "Smoothing" filter can be selected in order to suppress statistical noise in the gray-value image. In the "-" default setting, no filter is used.
Binarization	This option assists in the preselection process to specify whether the system is to search for dark or light objects. To reduce operating errors, the respective left or right segmentation limit cannot be changed in these cases. The threshold values for the binarization of the gray-value image can be preset as follows: **Dark objects**: 0 - 100, lower threshold fixed **Range**: 50 - 200 **Light objects**: 150 - 255, upper threshold fixed Unfixed threshold values can be changed as desired. Automatic tracking: The "Automatic tracking" option compensates for uniform brightening or darkening of the image, such as may be caused by ambient light, a drop in light output caused by aging, etc. If the image becomes uniformly darker due to, e.g., a drop in light power, the originally set thresholds are automatically re-adjusted in the darker part of the histogram. If, on the other hand, ambient light leads to a uniform brightening of the image, the thresholds are shifted in the lighter part.
Automatic tracking	By clicking on this field, automatically tracking the set segmentation thresholds for the binarization of objects is enabled. This counterbalances a uniform brightening or darkening of the image, e.g. with changing ambient light.
Histogram	Aid for visually assessing the contrast of the displayed camera image. In digital image processing, a histogram is understood to be the frequency distribution of gray values in an image. This makes it easier to set the thresholds correctly for reliable segmentation, i.e. the separation of test object and background.
Thresholds	The two thresholds for the binarization of the gray-value image can be defined via the two sliders in the histogram or by directly entering the values. Pixels with gray values within the defined range are active and are displayed in the overlay in green or red.

Parameter	Explanation
Inverted	Select the check box to invert the binarization specified by the thresholds. This means that active pixels become inactive and vice versa.
Filter (binary)	The dropdown box enables the use of a binary filter on the generated overlay. **Erosion**: This is used to enlarge dark structures in the image and thereby eliminate bright, interfering pixels. **Dilatation**: This is used to enlarge bright structures in the image and thereby eliminate dark, interfering pixels. **Open**: Erosion is performed followed by dilation. This results in the closure of gaps in dark objects without changing the object size. **Close**: Dilation is performed followed by erosion. This results in the closure of gaps in bright objects without changing the object size. **Comment:** When displaying binarized objects in the image, "bright structures" and "bright objects" always refer to the active pixels displayed in color (red or green) in the image; "dark structures" or "dark objects" always refer to the remaining image area.
Fill holes	The parameter specifies that holes in the localized BLOBs are to be filled automatically.
Boundary BLOBs	The parameter specifies whether or not localized BLOBs that touch the edge of a ROI are taken into account. The option is active by default.

BLOB tool: "Attributes" parameter group

Here, the desired objects are separated from the undesired objects in the image and the criteria for the tool result are defined.

Notice!

Note that the processing time is extended as the number of attributes that must be checked increases. Furthermore, the processing time increases considerably as the number of found BLOBs increases. The evaluation time also increases if at least one of the three attributes "Major axis", "Minor axis" and "Angle" was activated!



Figure 3.25: Setting the BLOB attributes

The BLOB analysis is divided into the "Prefilter" and "Tool result" areas. These can be opened and closed by clicking the "Arrow" icon :

1. The segmentation yields a list with active BLOBs. The BLOBs whose properties lie within the borders defined by the prefilter (= actual value in the prefilter list marked in green) are valid BLOBs and are displayed in green in the overlay; the other, invalid BLOBs in the overlay are displayed in red.
2. A second analysis is performed for the valid BLOBs. If, depending on activation, the number of BLOBs in the list and/or the total area of these BLOBs lies within the specified borders, the analysis of the tool yields the result OK, otherwise NOK. The actual values of these criteria are also marked in color in the result list (green = actual value within the defined min/max range, red = actual value outside of the defined min/max range).

Buttons

The button bar contains the following elements:



Click this button to mark the first BLOB in the list of localized BLOBs.



Click this BLOB to get back to the previous BLOB. Once the start of the BLOB list is reached, focus remains on the first BLOB.



Click this button to change to the overall view.



Click this BLOB to get to the next BLOB. Once the end of the BLOB list is reached, focus remains on the last BLOB.



Click this button to get to the last BLOB in the list of localized BLOBs.



Click this button to accept the values of the selected BLOB with a tolerance of ± 15 % as minimum or maximum allowed value for all active attributes (± 15 ° for angle).

Parameter	Explanation
Area [1]	Min: 0 Max: 360960 Prefilter according to BLOB size (in pixels): Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.
Height [1]	Min: 0 Max: 480 Prefilter according to height (in pixels) of the smallest rectangle that encloses the BLOB with sides parallel to the horizontal and vertical image border. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.
Width [1]	Min: 0 Max: 752 Prefilter according to width (in pixels) of the smallest rectangle that encloses the BLOB with sides parallel to the horizontal and vertical image border. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.
Geometric X [1] [2]	Min: 0.00 Max: 752.00 Prefilter according to the X coordinate of the BLOB's area centroid. Coordinate origin is the upper left corner of the image. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.
Geometric Y [1] [2]	Min: 0.00 Max: 480.00 Prefilter according to the Y coordinate of the BLOB's area centroid. Coordinate origin is the upper left corner of the image. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.
Centroid X [1] [2]	Min: 0.00 Max: 752.00 Prefilter according to the X coordinate of the BLOB's area centroid. In the default setting, the coordinate origin is located in the upper left corner of the image; if the coordinate system is changed, the position can deviate from this. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.

Parameter	Explanation
Centroid Y [1) 2)]	Min: 0.00 Max: 480.00 Prefilter according to the Y coordinate of the BLOB's area centroid. In the default setting, the coordinate origin is located in the upper left corner of the image; if the coordinate system is changed, the position can deviate from this. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.
Major axis [1) 3)]	Min: 0.00 Max: 892.13 Prefilter according to the length (in pixels) of the major axis, i.e. the length of the smallest rotated rectangle that encloses the BLOB. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.
Minor axis [1) 3)]	Min: 0.00 Max: 679.82 Prefilter according to the length (in pixels) of the minor axis, i.e. the height of the smallest rotated rectangle that encloses the BLOB. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.
Angle [3)]	Min: 0.00 Max: 360.00 Prefilter according to the angle of the mass centroid axis of the BLOB (0° … 360°, pointing to the "Heavy" side of the BLOB, relative to the X-axis). Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.
Angle between 0° and 180°	Function for the support of symmetric objects. If this function is active, the same angle is displayed for two objects whose position differs by one half turn (180°). For symmetric objects, the same angle is, thus, understandably always displayed. The function limits the input for MINIMUM and MAXIMUM of the angle to a maximum value of 180°.
Perimeter [1)]	Min: 0.00 Max: 360960.00 Prefilter according to the length (in pixels) of the outer contour line of the BLOB. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.
Shape factor	Min: 0.00 Max: 100.00 Prefilter according to the shape factor. This is the ratio between the area and the perimeter of the BLOB, normalized to values between 0 and 100. The shape factor classifies the geometric shape of the BLOB: "100" represents a perfect circle, "0" a perfect line. The formula is (4π * area/perimeter²) * 100. Only BLOBs in the region between MINIMUM and MAXIMUM are valid and are displayed in the overlay in green.
Total area [1)]	Min: 0 Max: 360960 Total area of all valid BLOBs of a tool. Only if the total area is in the range between MINIMUM and MAXIMUM is the tool result OK (green LED in the tool list).
BLOB count	Min: 0 Max: 10000 Number of valid BLOBs of a tool. Only if the number is in the range between MINIMUM and MAXIMUM is the tool result OK (green LED in the tool list).

1) If a two-point calibration is performed, other values are possible for the MINIMUM and MAXIMUM.
2) If the coordinate system has been changed – it can be dragged, rotated and, depending on the selected coordinate system regarding Y-orientation, can have another counting direction of the Y-axis – the coordinate information may deviate from the default settings. Negative X and Y coordinates are also possible.
3) The evaluation of one or more of the three marked attributes can considerably increase the evaluation time for each found BLOB.

For further information on the evaluation of the BLOB attributes, see chapter 4.1 "Basic procedure – Step-by-step configuration of a BLOB analysis".

3.3.2.5 *Display of the "Code" tool type*

In the image display, the current gray-value image and, if applicable, the result of the read code are displayed.

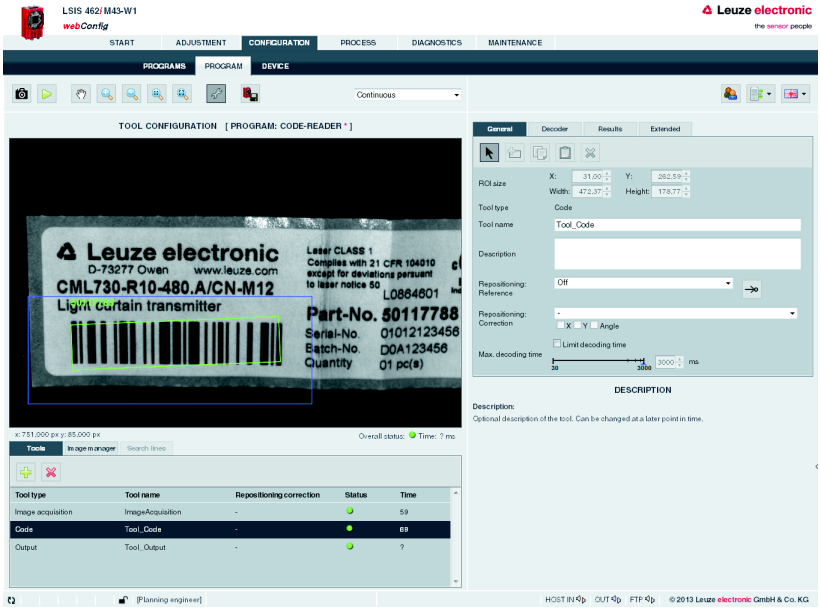


Figure 3.26: "Code" image display

The settings necessary for configuring code reading are made in the "General", "Decoder", "Results" and "Extended" tabs.

Code tool: "General" parameter group

Located here are general settings of the code tool; these are already familiar to you from BLOB analysis. You also have the option to limit the maximum execution time of a code tool by defining the maximum decoding time. If both 1D as well as 2D-codes are activated in the tool, each of these two groups uses a maximum of half of the set time!

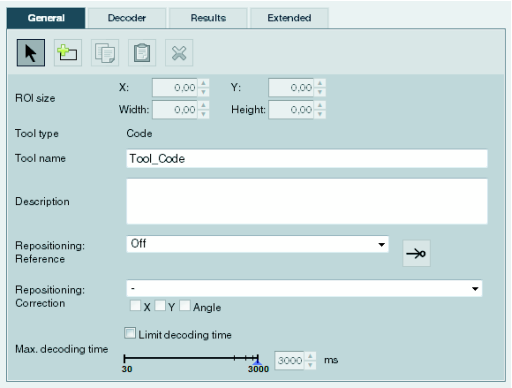


Figure 3.27: General parameters of the code tool

Notice!

With the code tool, only a rectangular region of interest is permissible.

Parameter	Explanation
Change ROI	Tools for restricting the ROI. The following elements are available:  **Select ROI** Pressing this button puts the mouse in selection mode, i.e. the mouse can be used to select, and thus activate, a ROI. The activated ROI can be moved and its dimensions changed. The selection mode is the default mode.  **Add rectangular ROI** Clicking on this button allows rectangular ROIs to be created. To do so, a rectangle needs to be drawn in the camera image display (with the left mouse button pressed down). If the left mouse button is released, the corresponding ROI appears. The length, width, angle and position of the rectangle can be modified if the rectangle is active or activated by a click. The creation of several ROIs is not supported in the code tool.  **Copy ROI** Pressing this button saves the currently selected ROI.  **Paste ROI** The most recently saved ROI is inserted in the active tool.  **Delete ROI** Pressing this button deletes the activated ROI.
ROI size	In the default setting the coordinate origin (X=0, Y=0) is located in the upper left corner of the camera image display. The values of the X coordinates increase to the right; the values of the Y coordinates increase downward. Values "X" and "Y" describe the coordinates of the upper left corner of the ROI closest to the origin. Width and height define the dimensions of a rectangle that encloses the selected ROI. If the coordinate system has been changed – it can be dragged, rotated and, depending on the selected coordinate system regarding Y-orientation, can have another counting direction of the Y-axis – the coordinate information may deviate from the default settings. Negative X and Y coordinates are also possible. If a two-point calibration has been performed in the check program and the values have been accepted, the values are displayed according to the new standard.
Tool type	Display of the tool type. Cannot be changed.
Tool name	Optional entry of the tool name. Can be changed at a later point in time.
Description	Optional description of the tool. Can be changed at a later point in time.

Parameter	Explanation
Repositioning: Reference [1)]	In the drop-down list box, you can select whether a reference for repositioning ROIs of the subsequent tools should be created or not. The following modes exist: **`Off`**: default setting – in the current tool, no reference for repositioning is created. **`Displacement`**: in the current tool, a reference is created for horizontal (X) and vertical (Y) repositioning; for this purpose, one or more found codes can be used. By clicking on the "Teach-in" button, the coordinates of the current area centroid of the valid objects are taught in as reference coordinates. In new image analyses, the area centroid of the valid codes that exist at the given point in time is ascertained, compared to the taught-in reference coordinates and values for the displacement of subsequent tools are calculated. If the "Teach-in" button has not been pressed, the tool result in this mode is NOK (red LED in the tool list) and a red exclamation mark appears in the "Reference" column of the tool list. **`Displacement and rotation`**: in the current tool, a reference is created for a horizontal (X), vertical (Y) and rotational (skew) repositioning. To do this, a suitable code must be found in order to enable unique angle assignment; in the "Attributes" tab, the "MINIMUM=1" and "MAXIMUM=1" values must be set in the "Tool result" field. Clicking on the "Teach-in" button teaches in the coordinates and angular position of the current area centroid of the valid code as reference coordinates and angles. In new image analyses, the area centroid of the valid code existing at the given point in time is ascertained, compared to the taught-in reference coordinates and reference angle and values for the displacement and rotation of subsequent tools are calculated. If the "Teach-in" button has not been pressed, the tool result in this mode is NOK (red LED in the tool list) and a red exclamation mark appears in the "Reference" column of the tool list.
Repositioning: Correction [1)]	In the drop-down list box, you can select whether the correction (repositioning) of a ROI should take place in the current tool. To do this, click on a tool suitable as a reference in this list. Clicking on the "X", "Y" and "Angle" fields defines how the ROIs of the tool are to be repositioned. In the "-" default setting, the ROI is not corrected. If the tool selected as reference provides no or insufficient corrective values, the tool result in this mode is NOK (red LED in the tool list) and the name of the referenced tool is displayed in red in the "Repositioning correction" column of the tool list.
Max. decoding time	When the check box has been clicked on, the "Max. decoding time" property can be used: Min: 30 ms Max: 3000 ms This determines the maximum permissible execution time for decoding codes with the code tool; after this time, decoding is discontinued. If both 1D as well as 2D codes are activated in the code tool, each of these two groups uses a maximum of half of the set decoding time.

1) ***Notices on the use of repositioning:***
In the following, only one repositioning is considered on the basis of the center of gravity or area centroid; here, only the BLOB or the code tool is used. To do this, the following conditions must be satisfied:

1. *In the tool used for repositioning, the minimum number of results to be found (BLOBs or codes) must be set to 1; if angle tracking is to be performed as well, the maximum number must also be 1, as unique orientation cannot otherwise be ascertained. Angle tracking is only useful if the corresponding result has a clear orientation (no circles - here, the angle is, in effect, undefined)!*
2. *In the same tool, "Repositioning: Reference" must be set and the "Teach" button then pressed. Each time one of this tool's parameters is changed or the camera is mechanically realigned, it is recommended that the repositioning reference be re-taught.*
3. *For the tool that is repositioned (also of type BLOB or code), the respective tool that offers the repositioning must be selected under "Repositioning correction". Repositioning can occur in the X or Y direction (default: X and Y). Repositioning by angle can be selected if this is offered by the projected tool (see 1.).*

Code tool: "Decoder" parameter group

You have the option here of restricting reading to certain code types by activating only the respective, required codes. Deactivating irrelevant codes reduces the execution time of the tool.

If both 1D as well as 2D-codes are activated, each of these two groups uses a maximum of half the available decoding time ("Maximum decoding time" option in the "General" tab, see page 54).

Notice!

Note that it is not possible to combine Pharmacodes and other codes.



Figure 3.28: Decoder parameters of the code tool

Parameter	Explanation
"Code type" area	
Data Matrix Code ECC 200 	ls part of the group of 2D-codes (two-dimensional codes) and is made up of dots (so-called cells). Camera-based systems (objective, camera and corresponding decoder and evaluation unit) are generally used for reading, as conventional reading methods fail here. The advantage of this matrix code is in the information density, which is approximately 15-times higher than possible with simple bar codes. The Data Matrix code can be read omnidirectionally and supports the representation of a variety of different character and typesets. It is used primarily in various areas of production for traceability and in the pharmaceutical industry. There are different development levels of the Data Matrix code (ECC 0 through ECC 200); all have a horizontal and a vertical boundary line (orientation lines). Depending on the size, up to 2334 ASCII characters (seven bit), 1558 extended ASCII characters (eight bit) or 3116 digits can be encoded. The information-carrying area of the Data Matrix code (square area in the middle) is called the data region. This is framed by the so-called finder pattern, which has an L-shape, and an alternating pattern. This is used for orienting the reader device. The Data Matrix code is AIM standardized and is specified in standard ISO/IEC 16022. Damaged or unprinted cells can be calculated and corrected with the Reed - Solomon error algorithm. This allows even bad codes to be decoded.
Code 2/5 Interleaved 	Numeric bar code (characters 0 – 9) consisting of two wide and three narrow bars and spaces, giving the code the name "2/5". "Interleaved" refers to the overlapping representation of the characters. The ratio of narrow to wide bars (or spaces) is 1:2 to 1:3. Restriction: If the narrow element has a width of less than 0.5 mm, the following applies: narrow element:wide element = 1:2.25 (to maximum 1:3). The code always consists of one start character, an even number of digits (pairs of digits), as well as a stop character. The first digit is represented by five bars, the second digit by the spaces in between the bars. The last space is limited by the first bar of the next pair of digits or the stop character. To encode various digits with five elements, exactly two wide and three narrow modules are used per digit. The Code 2/5 Interleaved has a high information density. With a module width of 0.3 mm, for example, only 2.7 mm is required for each represented digit. The disadvantages of this bar code are, on the one hand, the small number of data characters (only numeric data) and, on the other hand, a lower tolerance (± 10 %), which is due to the information-carrying spaces. The exact code specifications can be found in standard EN 801. The number of data characters is arbitrary (depends on the maximum scanning width), but is always even (pairs of digits). The optional check digit is calculated according to modulo 10 with weighting 3; weighting begins at the right.

Parameter	Explanation
Code 39  	Alphanumeric code that supports the representation of digits 0 to 9, the 26 letters (no umlauts) and a total of seven special characters. Each character consists of nine elements (five bars and four spaces). Three of the elements are wide and six are narrow, with the exception of the representation of the special characters. The ratio for Code 39 is 1:2 to 1:3 (narrow element:wide element). If the narrow element has a width of less than 0.5mm, the ratio: 1:2.25 to maximum 1:3 applies. At just ± 10%, Code 39 has a low tolerance as well as a relatively low information density: At a module width of 0.3mm and a ratio of 1:3, one digit requires 4.8mm of space. Code 39 takes its name from both its character set (originally 39 characters, now 43 characters) as well as from its structure—the characters are formed from three wide and six narrow elements which are made of up five bars and four spaces (5 + 4 = 9). The exact specifications for Code 39 can be found in ANSI MH10.8-1983, section 4.4, and in standard EN 800. Depending on how the used decoder is programmed, the + – . / % characters may have a control-character function. The number of data characters is arbitrary; depending on the scanning width, a maximum of 20 is recommended. The recommended size is a height of at least 20mm or 25% of the width. Optionally, Code 39 can also be used without a check digit. This applies only for very specific application cases, however. The check digit is calculated according to modulo 43; the calculated number is again assigned a character from the Code 39 character set according to the reference number, e.g.: Data digits (example): 12ABCXY Sum of the reference numbers: 1+2+10+11+12+33+34 = 103 Modulo 43: 138 / 43 = 2, remainder 17 Check digit: "H" = reference number for 17.

Parameter	Explanation
Code UPC   	**Code UPC-A**: Universal Product Code; an American, machine-readable, self-checking product number code (bar code) which is compatible with the European EAN code. A distinction is made between UPC A and UPC E, both of which can only represent numeric characters (digits 0 to 9). Version A has 12-digits and is very similar to the EAN-13 code; version E corresponds to the EAN-8 code. The bars and spaces can be 1, 2, 3 or 4 modules wide. A character always consists of seven modules. In addition to this are two edge characters and one separator character. The check digit for the UPC code can be calculated as follows (modulo 10, weighting 3/1): Example: Sequence of data digits: 14084589938 Sum of digits at the "odd places", beginning from left: 1 + 0 + 4 + 8+ 9 + 8 = 30 Multiply by 3: 30 × 3 = 90 Sum of the "odd places": 4 + 8 + 5 + 9 + 3 = 29 Addition: 90 + 29 = 119 Subtraction from the next-higher Multiples of 10: 120 – 119 = 1 Check digit: 1 **Code UPC-E**: Abbreviated version of UPC-A for applications with little space. The UPC-E check sum is, however, calculated somewhat differently: UPC-E check digits are calculated with the aid of an expansion that is based on the sixth digit. Example: Example data: 123456 Expand to 10 digits using the table. Because the UPC-E example code ends with a 6, the digits 0000 are inserted in front of the sixth digit (insertion position 6) to expand the code to 10 digits: 1234500006 A zero is to be placed in front of the resulting 10-digit code, the number system character: 01234500006 The check digit of the resulting 11-digit code is calculated using the UPC-A procedure. The data to be printed are a number with eight digits consisting of the number system character, the original UPC-E code with six digits and the check digit: 01234565

Parameter	Explanation
Code EAN   	**Code EAN 13:** European Article Numbering; name of a bar code family which exists in a wide number of versions. With regard to structure, the EAN code is compatible with the American UPC code. The exact code specifications can be found in standard EN 799. EAN 13 takes its name from the maximum number of digits that can be represented with this code. Specification: numeric code, digits 0...9 can be represented. Each character consists of eleven elements; all bars and spaces carry information. Only 13 characters can be displayed together. Standardized sizes are SC0 through SC9 and Nominal SC2, whereby, in practical use, the code height is often reduced. The clear text line is not intended for machine detection. The EAN 13 code is used across Europe in standardized form in (self-service) product packages, based on the UPC specification. The first two digits carry the national ID (for example, "04" represents Germany, "08" Italy and "03" France); the next five digits specify the company ID within the country, the remaining five digits represent a part no. within the company or manufacturer. The last digit is a check digit. The advantage is the high information density with standardized sizes. The disadvantage is the requirement of very small tolerances. The EAN 13 symbology is divided to two halves of six digits each. These are separated from one another by a separator character. The 13th digit (first character from left) is not encoded separately in the bar code field, but is instead encrypted within the six characters of the left half of the symbol. In practical use, common sizes are between SC0 and SC3. **Code EAN 8:** Bar code with a specification similar to EAN 13, though only eight digits can be represented together. Like the EAN 13, standardized sizes exist for this code as well (SC0...SC9). The height of this code is not typically shortened, however. EAN 8 is preferred whenever it is not deemed necessary to use the larger EAN 13 on the packages. The meaning of the characters is identical. To achieve the lower number of eight characters, successive zeros are, however, omitted. The EAN 8 symbology is divided to two halves of four digits each. There is a separator character between the two halves. Advantage is the high information density with standardized sizes and check digit; disadvantage is the requirement of very small tolerances.

Parameter	Explanation
Code 128  	Code 128 is a universal, alphanumeric bar code that can represent the entire ASCII character set without character combinations. This is, of course, not directly possible; one must, therefore, distinguish between three character sets: Code A, Code B and Code C. These can be selected depending on the area of application. The character sets can also be mixed, however. There are separate codes for switching between the three character sets. Each character in Code 128 consists of a total of eleven modules that are divided into three bars and three spaces. The bars always consist of an even number (even parity) of modules and the spaces always consist of odd number of modules. The stop character is an exception here and consists of 13 modules (eleven modules and one guard bar with two modules). While Code 128 can use the entire ASCII character set and has a high information density, it has a low error tolerance. The number of data characters is arbitrary, but does, of course, depend on the maximum scanning width. The recommended size for the bar code is a height of at least 6.0 mm or 15% of the bar code length. The symbology is generally: quiet zone, Code B start character, data characters, check character, stop character, quiet zone. The exact code specifications can be found in standard EN 799. The sum of the modules is always 11, with the exception of the start/stop character (13). Example: Character A: 1+1+1+3+2+3=11 Character B: 1+3+1+3+2+1=11, etc. Code 128 supports multiple reading. As a result, it is possible to encode strings of data characters as bar codes that exceed the maximum scanning width. This method can generally be switched on and off in the scanner. The check digit for Code 128 is calculated according to modulo 103; weighting begins with 1 and is increased by 1 with each character (from left to right). The character used as a check digit is the calculated checksum that corresponds to the associated reference number. Example check digit calculation: Data digits: 123ABC Sum of the reference numbers: 104+1×17+2×18+3×19+4×33+5×34+6+35=726 Modulo 103: 726 / 103 = 7, remainder 5 Characters of reference number 5: % **Code 128 B:** Bar code, which, unlike Code 128, is always started with the "Code B" start character. It is also possible to switch to Code C, though entered digits are not automatically converted to the respective characters. The check digit is calculated in the same way as described for Code 128. **Code 128 C:** Bar code that contains only digits (0 to 9), but which has a higher information density. In the character set, the entered digit pairs correspond to the numbers from 0 to 99 (reference number). Each of these pairs of numbers is coded with a character. The check digit is calculated according to modulo 103; weighting begins with 1 and is increased by 1 with each pair of digits (from left to right). The character used as a check digit is the calculated check number that corresponds to the associated reference number. Character set C of Code 128 allows shorter bar code symbols to be used in certain cases in which several numeric characters follow in sequence. Symbology: quiet zone, start code C, data digits, check character, stop character, quiet zone. Example Code 128 C: Data digits: 123456 Sum of the reference numbers: 105 + 1×12 + 2×34 + 3×56 = 353 Modulo 103: 353 / 103 = 3, remainder 44 Character of reference number 44: L

Parameter	Explanation
Codabar  	Numeric bar code with six additional special characters. This can be used to represent the following characters: 0 1 2 3 4 5 6 7 8 9 – $: / . + Each character consists of seven elements (bars/spaces). Either two or three wide elements and four or five narrow elements are used to represent the code. The spaces between the characters contain no information. Codabar has a low information density. With a module width of 0.3 mm and a ratio of 1:3, for example, 5.5 mm / digit is required. The main areas of use for Codabar are medicinal/clinical applications and photo labs, as well as libraries. It is frequently used to label stored blood. The exact code specifications can be found in standard EN 798(?). Symbology: Quiet zone, start character, data digits, check digit, stop character, quiet zone. The check digit is calculated according to modulo 16; the calculated number is assigned a character from the reference table. Example Codabar: Data digits: 1234 Start and stop, each: A Complete character string: A1234A Reference numbers: 16 1 2 3 4 16 Sum of the reference numbers: 42 Modulo 16: 42 / 16 = 2, remainder 10 Subtracted from 16: 16 – 10 = 6 Check digit for reference number 6: 6 Thus, the entire character string is: A12346A, whereby start/stop characters and check digit do not appear in the clear text line.
Pharmacode  	The one-track Pharmacode is strictly a numeric code. Code assignment on printed materials occurs using so-called code lists. The codes are used primarily in the pharmaceutical packaging industry to prevent mix-ups with packaging or package inserts. The code length is measured from the start of the first bar to the end of the last bar. A necessary quiet zone is not taken into account in length determination. The ratio is 1:2:3, narrow bar to gap to wide bar. For the one-track Pharmacode, this is: 0.5 mm:1.0 mm (gap):1.5 mm For the miniature one-track Pharmacode, this is: 0.35 mm:0.65 mm (gap):1.0 mm The Pharmacode contains absolutely no special characters, such as start-stop characters or check digits. Thus, reading of the code is direction dependent. A different result is therefore obtained if read from the left or from the right. It must also be ensured that only the complete Pharmacode is in the reading window; the results may otherwise be incorrect partial readings due to missing start/stop characters. Supported Pharmacodes include: • Standard one-track Pharmacode • Miniature one-track Pharmacode Additional color codes for one-track Pharmacodes or two-track Pharmacodes are not supported. Data digits: strictly numeric acc. to code lists Special characters: none Check digits: none Start/stop characters: none

"Code parameters" area	
Code size Code ECC 200	Selection of admissible code sizes for ECC 200 Data Matrix codes (multiple selection is possible via the list box).
Number of digits Code 2/5 Interleaved Code 39 Code UPC Code EAN Code 128 Codabar code	Number of digits in the codes that are to be decoded.
Check digit method Code 2/5 Interleaved Code 39 Code UPC Code EAN Code 128 Codabar code	Configuration of the check digit method used to compute the check digit.
Check digit transmission Code 2/5 Interleaved Code 39 Code UPC Code EAN Code 128 Codabar code	Selection of the check digit output enables the output of the check digit together with the data characters.
Conversion method for Code 39 Code 39	Configuration of the conversion method to be applied for Code 39. The "Standard" method stands for the usual Code 39 conversion. The "ASCII" method uses the entire ASCII character set. It extends the usual Code 39 character set. "Standard/ASCII" permits a mixed conversion according to the Standard and ASCII methods.
Conversion UPC-E to UPC-A Code UPC	Activation of conversion of a UPC-E code to a UPC-A code.
Output EAN 128 header Code 128	With Code 128, the output of the EAN 128 header can be activated or deactivated.
Number of bars Pharmacode	Here, you can define the number of bars of the Pharmacode.
Read direction Pharmacode	Here, you can define the read direction of the Pharmacode.
Polarity Pharmacode	Here, you can preset whether the background is white and the bars are black or if the background is black and the bars are white.
Min. bar width Pharmacode	Here, you can define the minimum bar width of the Pharmacode.
Ratio Pharmacode	The ratio is 1:2:3, narrow bar to gap to wide bar. Bars as well as gaps may have the following min. and max. tolerances: Standard: 25 % Relaxed: 50 % (exception: min. tolerance of wide bars = 35 %) User defined: bars and gaps can be assigned individual min./max. tolerances.

Code tool: "Results" parameter group

This parameter group is similar in function to that of the "Attributes" group for BLOB analysis. Here, the desired objects are separated from the undesired objects in the image and the criteria for the tool result are defined.

Notice!

Note that the processing time is extended as the number of attributes that must be checked increases.

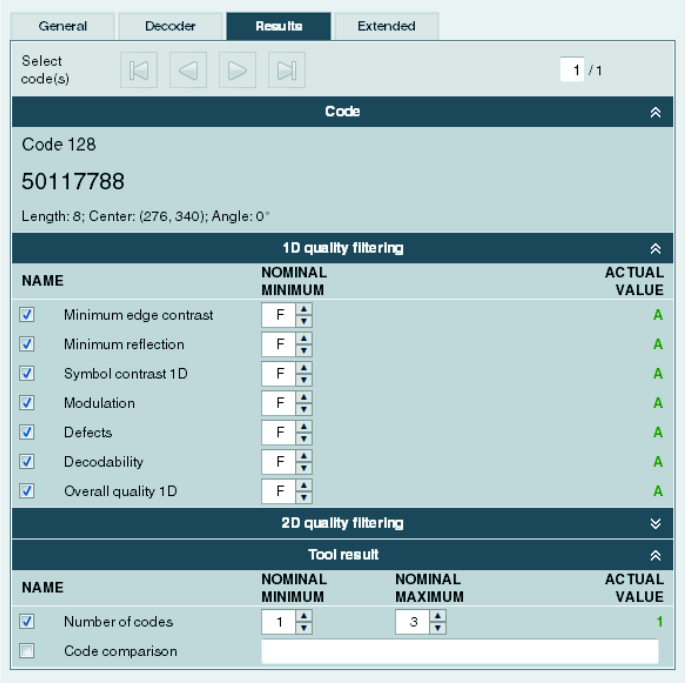


Figure 3.29: Setting the code attributes

Code analysis is divided into the "Code", "Quality filtering 1D/2D" and "Tool results" areas; these can be opened by clicking on the "-" icon:

1. The "Code" area is used for displaying the current code.
2. The code reading yields a list with active codes. The codes whose properties lie within the borders defined by the quality filter (= actual value in the quality filter list marked in green) are valid codes and are displayed in green in the overlay; the other, invalid codes in the overlay are displayed in red.
3. A second analysis is performed for the valid codes. If, depending on activation, the number of codes in the list and/or the comparison result of these codes lies within the specified borders, the analysis of the tool yields the result OK, otherwise NOK. The

actual value of the number of codes is also marked in color in the result list (green = actual value within the defined min/max range, red = actual value outside of the defined min/max range).

Buttons

The button bar contains the following elements:


Click this button to get to the first code in the list of localized codes.


Click this button to get back to the previous code. Once the start of the code list is reached, focus remains on the first code.


Click this button to change to the overall view.


Click this button to get to the next code. Once the end of the code list is reached, focus remains on the last code.


Click this button to get to the last code in the list of localized codes.

Parameter	Explanation
1D quality filtering	
Minimum edge contrast	The minimum edge contrast (also called adjacency contrast) is the difference between Rs and Rb of adjacent elements including light zones. The lowest value of an adjacency contrast of a scan reflection profile is the minimum adjacency contrast. $EC = R_s - R_b$
Minimum reflection	Minimum reflection (R_{min}) is the lowest reflection value in the reflection profile. R_{min} should not be greater than 0.5 R_{max}. This parameter shall ensure that R_{min} is not too high and guarantees that an adequate distance exists between background and bar reflection, especially for high values of R_{max}.
Symbol contrast 1D	The symbol contrast is the difference between the highest and the lowest reflection value in a scan reflection profile. $SC = R_{max} - R_{min}$ The value is divided into classes.
Modulation	The modulation is the ratio of minimum edge contrast to symbol contrast, whereby the edge contrast is the difference between the space reflectance and the bar reflectance of adjacent elements. $MOD = EC_{min} / SC$ The value is divided into classes.
Defects	Defects are irregularities within elements or light zones. They are measured as irregularities of the element reflection. An irregular element reflection within a given element or light zone is the difference between the reflection of the global maximum and the reflection of the global minimum. If an element consists of a single maximum or a single minimum, its irregular reflection is equal to zero. The highest value of an irregular element reflection of a scan reflection profile is the maximum irregularity of an element reflection. The degree of a defect is expressed as the ratio of maximum irregularity of an element reflection (ERN_{max}) to the symbol contrast. $Defects = ERN_{max} / SC$ The value is divided into classes.

Parameter	Explanation
Decodability	The decodability of a bar code symbol is a measure of its print accuracy relative to the corresponding reference decoding algorithm. Normally, bar code readers achieve better results with symbols having a higher decodability level than with symbols having a lower decodability. The relevant rules for the nominal measurements of each bar code symbology are specified in the respective symbology specifications. The reference decoding algorithm provides adequate leeway for errors in the printing and reading process through the definition of one or more reference threshold values, which are used when making decisions regarding the element width or other measurements. The value is divided into classes.
Overall quality 1D	The individual results are summarized and classified here. The overall quality corresponds to the poorest ascertained individual quality.
2D quality filtering	
Vertical print growth	The vertical print growth is the percentage deviation from the nominal dimension of the cells. The measurement value is ascertained with the vertical timing cells. A positive value represents enlarged cells; a negative value represents reduced cells.
Horizontal print growth	The horizontal print growth is the percentage deviation from the nominal dimension of the cells. The measurement value is ascertained with the horizontal timing cells. A positive value represents enlarged cells; a negative value represents reduced cells.
Symbol contrast 2D	The symbol contrast is the difference between the highest and the lowest reflection value in a gray-value image. $SC = R_{max} - R_{min}$ The value is divided into classes.
Axial non-uniformity	Axial non-uniformity provides information on possible horizontal or vertical distortion of the code; it is divided into classes.
Unused error correction	The Data Matrix code includes error correction that can correct errors in individual modules. The sum of the corrected errors is subtracted from the maximum possible number of errors and is then classified as "unused error correction".
Overall quality 2D	The individual results are summarized and classified here. The overall quality corresponds to the poorest ascertained individual quality.
Tool result	
Number of codes	Min: 1 Max: 999 Number of valid codes of a tool. Only if the number is in the range between MINIMUM and MAXIMUM is the tool result OK (green LED in the tool list).
Code comparison	Input field for a comparison with the code contents. Please be certain to enter the code contents exactly. A new reference code can also be defined through direct input via the interface ('RS' command, see "Manual definition of the reference code" on page 210).

Code tool: "Extended" parameter group

Located here are further settings for the code tool.

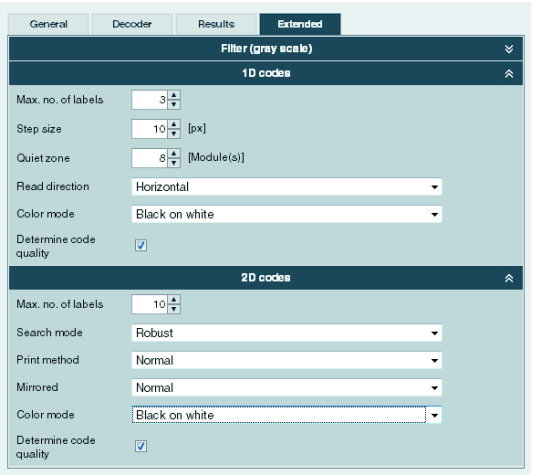


Figure 3.30: "Extended" parameters of the code tool

Parameter	Explanation
1D codes	
Filter (gray scale)	The dropdown box enables the use of a filter on the recorded gray-value image.
Max. no. of labels	Data type: UINT16 Min: 0 Max: 99 Default: 99 Defines the maximum number of bar codes that are decoded in a tool. Reaching the maximum number of sought-after codes is an abort criterion for the search algorithm. This means that if the maximum number of codes to be expected in an image (ROI) is small and known, the code search can be accelerated. ATTENTION: Codes that do not match the search criteria must also be taken into account here!
Step size	Specifies the step size from one decoding line to the next. This value is specified in pixels.
Quiet zone	Defines the size of the quiet zone before the start character and after the stop character in modulus width. The module thickness is the dimension of the narrow/narrowest element (bar or space) in the bar code. A common value when printing the bar code is 10-times the module thickness.
Read direction	Here, you can preset the read direction of the bar code.
Color mode	Here, you can preset whether the background is white and the dots are black (normal) or if the background is black and the dots are white (inverted). If both can occur, automatic can be selected.
Determine code quality	Activation of the code quality for bar codes. The values appear in the Results tab. The values can also be transferred via the interfaces (see Output tool).

Parameter	Explanation
2D-codes	
Max. no. of labels	Data type: UINT16 Min: 0 Max: 99 Default: 99 The maximum number of 2D-codes that are decoded in a tool. Reaching the maximum number of sought-after codes is an abort criterion for the search algorithm. This means that if the maximum number of codes to be expected in an image (ROI) is small and known, the code search can be accelerated. ATTENTION: Codes that do not match the search criteria must also be taken into account here!
Search mode	Here, you can preset whether the search mode for decoding the 2D-codes is to be "Fast" or "Robust". The "Fast" search mode is recommended for decoding high-contrast and large 2D-codes. If the 2D-codes are low contrast or small, the "Robust" search mode should be selected.
Print method	Here, the type of 2D-code that is to be decoded can be preset. For 2D-codes with square cells, the "Normal" setting is recommended. If the cells only appear as dots, the "Dot matrix" setting is recommended. This is the case, for example, if the codes are applied with a dot-peen marking device or an inkjet printing system. Only when setting "Print method = normal" can the "Determine code quality" option be activated.
Mirrored	Here, you can preset whether the 2D-code is printed normally or mirrored. If both are to be detected, select "Automatic".
Color mode	Here, you can preset whether the background is white and the dots are black (normal) or if the background is black and the dots are white (inverted). If both can occur, automatic can be selected.
Determine code quality	Activation of the code quality for bar codes. The values appear in the Results tab. The values can also be transferred via the interfaces (see Output tool). Can only be activated when setting "Print method = normal" and is automatically deactivated when subsequent setting "Print method = dot matrix".

Notice!

The following reference values with regard to the minimum size of a module (1D-code) or of a cell (2D-code) are to be observed:

- *Printed code with good contrast: 3 pixels*
- *Directly marked code: 5 pixels*

For optimum reading performance, twice the stated value is recommended!

3.3.2.6 *Display for the "Measurement" tool type*

In the image display, the current gray-value image and, if applicable, the detectors defined for the measurements are displayed.

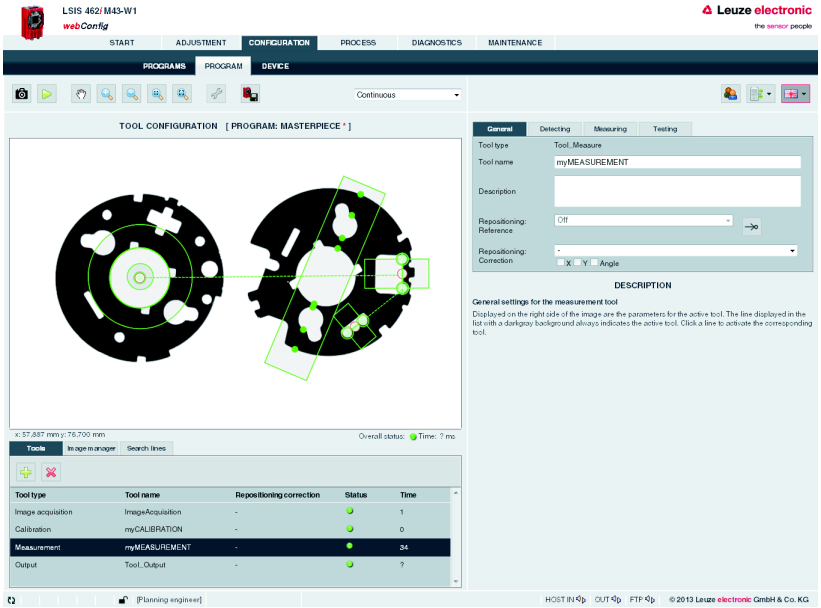


Figure 3.31: "Measurement" image display

The settings necessary for configuring measurement are made in the "General", "Detecting", "Measuring" and "Testing" tabs.

Measuring tool: "General" parameter group

Located here are general settings of the measuring tool; these are, in part, already familiar to you from BLOB analysis.

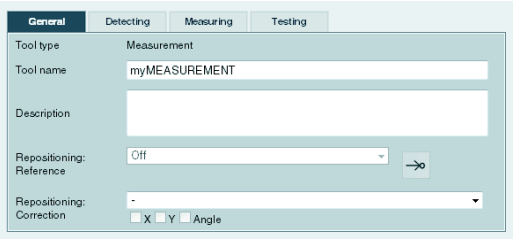


Figure 3.32: General parameters of the measuring tool

Parameter	Explanation
Tool type	Display of the tool type. Cannot be changed.
Tool name	Optional entry of the tool name. Can be changed at a later point in time.
Description	Optional description of the tool. Can be changed at a later point in time.
Repositioning: Reference	In the drop-down list box, you can select whether a reference for repositioning ROIs of the subsequent tools should be created or not. The following modes exist: **`Off`**: default setting – in the current tool, no reference for repositioning is created. **`Displacement`**: in the current tool, a reference is created for horizontal (X) and/or vertical (Y) repositioning; for this purpose, one or more detectors with exactly one subsequent measurement can be used: • Point or circle detector with a subsequent coordinate measurement • Line detector, e.g. with a subsequent two-line measurement Click the "Teach-in" button to accept the corresponding, valid values of the measurement as reference. In new image analyses, the valid values are then compared with those of the taught reference and the new values for the displacement of subsequent tools calculated. If the "Teach-in" button has not been pressed, the tool result in this mode is NOK (red LED in the tool list) and a red exclamation mark appears in the "Reference" column of the tool list. **`Displacement and rotation`**: in the current tool, a reference is created for a horizontal (X), vertical (Y) and rotational (skew) repositioning. For this purpose, two suitable line detectors must be found with exactly one, two-line measurement in order to make possible a unique angle assignment. Click the "Teach-in" button to accept the corresponding, valid values of the measurement including the angular position as reference. In new image analyses, the valid values are then compared with those of the taught reference and reference angle and the new values for the displacement and rotation of subsequent tools calculated. If the "Teach-in" button has not been pressed, the tool result in this mode is NOK (red LED in the tool list) and a red exclamation mark appears in the "Reference" column of the tool list.
Repositioning: Correction	In the drop-down list box, you can select whether the correction (repositioning) of a ROI should take place in the current tool. To do this, click on a tool suitable as a reference in this list. Clicking on the "X", "Y" and "Angle" fields defines how the ROIs of the tool are to be repositioned. In the "-" default setting, the ROIs are not corrected. If the tool selected as reference provides no or insufficient corrective values, the tool result in this mode is NOK (red LED in the tool list) and the name of the referenced tool is displayed in red in the "Repositioning correction" column of the tool list.

Measuring tool: "Detecting" parameter group

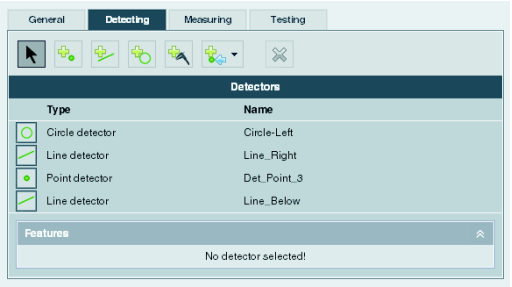


Figure 3.33: "Detecting" parameter of the measuring tool

Select detector:
This button is permanently activated and enables the direct selection of a detector with the mouse pointer.

When selecting an existing detector, the corresponding properties window along with its parameters becomes accessible; this detector is highlighted by a dark gray bar.

Point detector:
Clicking on this button allows a new point detector to be created. This can be used for localizing an individual edge along the search line (intersection point between search line and edge) or for counting edges along the search line.

The new detector is created by drawing a rectangle (with the left mouse button pressed down) in the camera image display. If the left mouse button is released, the corresponding "Properties" window appears. The length, width, angle and position of the rectangle can be modified.

The edge position is determined automatically along the search line, depending on the selected properties.

Line detector:
Clicking on this button allows a new line detector to be created. This can be used to localize an edge along several search lines.

The new detector is created by drawing a rectangle (with the left mouse button pressed down) in the camera image display. If the left mouse button is released, the corresponding "Properties" window appears. The length, width, angle and position of the rectangle can be modified.

The edge position is determined automatically along the search lines, depending on the selected properties.



Circle detector:
Clicking on this button allows a new circle detector to be created. This can be used to localize a circular edge along radial search lines.

The new detector is created by drawing a cylinder ring (with the left mouse button pressed down) in the camera image display. If the left mouse button is released, the corresponding "Properties" window appears. The size (inner and outer circle), angle and position of the cylinder ring can be modified. In addition, a cylinder ring section can be created; to do so, the turquoise lozenge must be touched with the mouse pointer and pulled correspondingly.

The two dashed orange circles describe the maximum and minimum radius. The point of the maximum or minimum radius is indicated by an orange dot on the respective dashed circle.

The edge position is determined automatically along the search lines, depending on the selected properties.



Vernier caliper detector:
Clicking on this button allows a new vernier caliper detector to be created. This can be used for easily determining distances or thicknesses in the area along opposite search lines.

The new detector is created by drawing a rectangle (with the left mouse button pressed down) in the camera image display. If the left mouse button is released, the corresponding "Properties" window appears. The length, width, angle and position of the rectangle can be modified.

The edge position is determined automatically along the search lines, depending on the selected properties.



Import function:
Clicking on this button opens a selection box, whereby a few results from the tools (BLOB analysis or code tool) upstream from the measuring tool can be imported and used in the measuring tool (e.g. area centroid of a BLOB or of a code). To do this, a tool must be selected.

If no upstream tools are defined, the import function is not available – the button is not active and is grayed out.



Delete detector:
If a detection has been activated, the selected detection can be deleted using this button. When using a detection in a measurement, the measurement itself is preserved; the detection, however, is no longer available.

If no detector is selected, the delete function is not available – the button is not active and is grayed out.

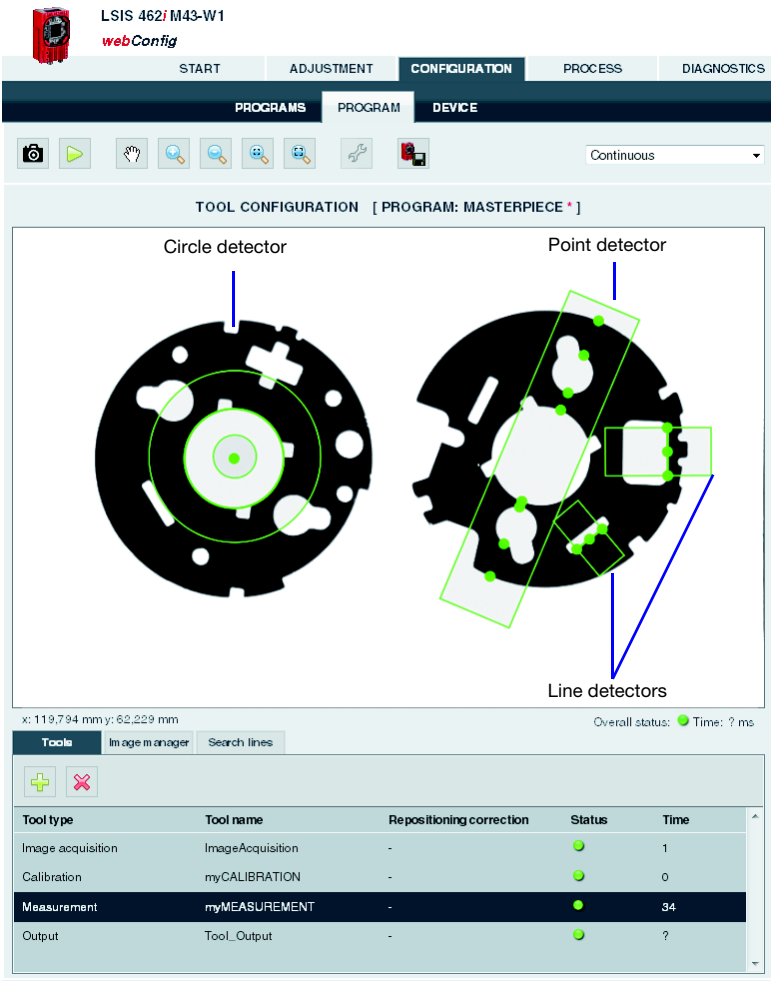
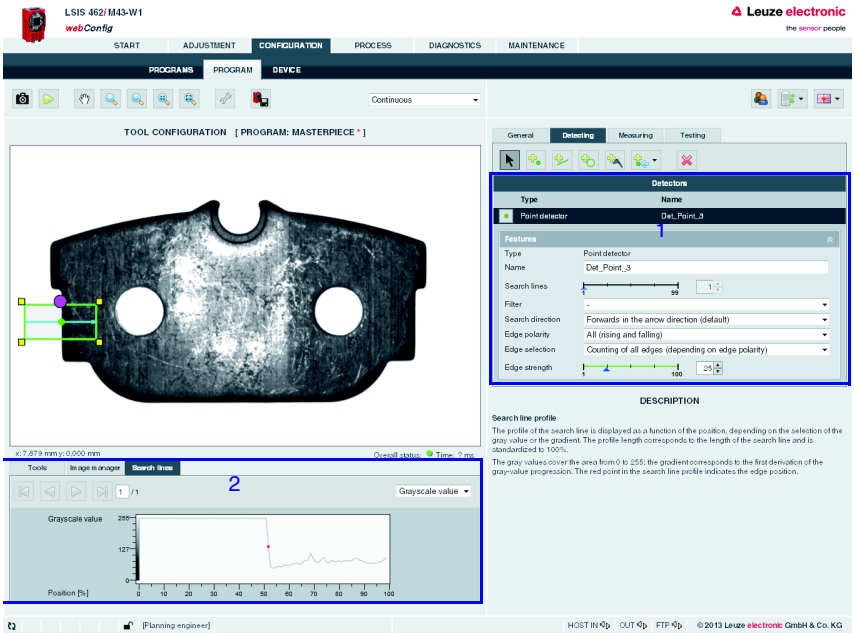
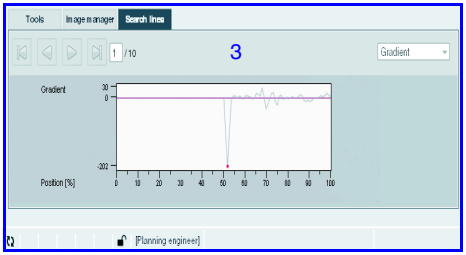


Figure 3.34: Detectors of the measuring tool in the camera image display

Point detector properties





1 - Point detector properties
2 - Search lines tab (point detector) - Gray value
3 - Search lines tab (point detector) - Gradient

Figure 3.35: "Detecting" tab - Point detector properties / "Search lines" tab

"Properties" parameter group (point detector)

Parameter	Explanation
Type	Type of the selected detector – "Point detector" in this case
Name	Name of the detector. Can be changed at a later point in time.
Search lines	The number of search lines (here: 1 search line) cannot be changed. With increasing length of the search line, the evaluation time increases.
Filter	**Smoothing filter**: Is a one-dimensional Gaussian-like smoothing filter for suppressing statistical noise in the image. Fine structures are wiped out when rough structures are preserved; edges become fuzzy. **Bilateral filter**: Two one-dimensional filters are implemented one after the other. First a Gaussian filter for suppressing statistical noise in the image. Then a filter for sharpening the image is implemented, meaning edges get steeper transitions. **Adaptive filter**: Two one-dimensional filters are implemented one after the other – similar to the bilateral filter. In addition, local histogram values are taken into consideration with the Gaussian filter.
Search direction	• Forwards in the arrow direction (default) • Backwards (arrow direction rotated by 180°)
Edge polarity	• All (rising and falling) • Rising (intensity increases in the search direction: gray-value progression dark to light) • Falling (intensity decreases in the search direction: gray-value progression light to dark)
Edge selection	• First edge in search direction (dependent on edge polarity) • Strongest edge in search direction (dependent on edge polarity) • Counting of all edges (depending on edge polarity)
Edge strength	Represents the rise or fall of an edge - depending on the edge polarity selected, with regard to a defined standard edge width. The values are standardized and have a value range of 0 to 100; the default value is 20.

"Search lines" tab (point detector)

The profile of the search line is displayed as a function of the position, depending on the selection of the gray value or the gradient (see figure 3.35, areas **2** and **3**). The profile length corresponds to the length of the search line and is standardized to 100 %.

The gray values cover the area from 0 to 255, the gradient corresponds to the first derivation of the gray-value progression. The red point in the search line profile indicates the edge position.

Line detector properties

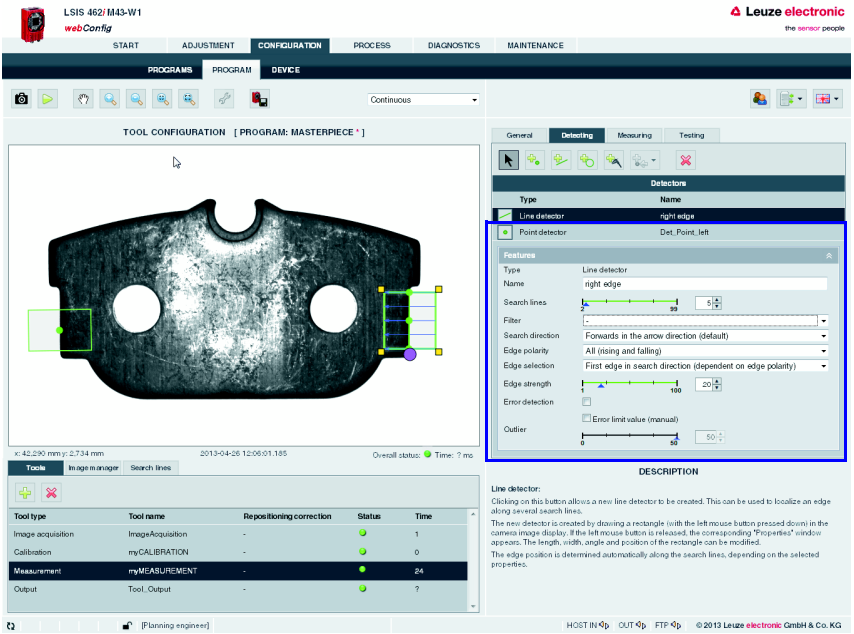


Figure 3.36: "Detecting" tab - Line detector properties

"Properties" parameter group (line detector)

Parameter	Explanation
Type	Type of the selected detector – "Line detector" in this case
Name	Name of the detector. Can be changed at a later point in time.
Search lines	The number of search lines (default = 5 search lines) can be changed between 2 and 99. With increasing length and number of search lines, the evaluation time increases.

Parameter	Explanation
Filter	**Smoothing filter**: Is a one-dimensional Gaussian-like smoothing filter for suppressing statistical noise in the image. Fine structures are wiped out when rough structures are preserved; edges become fuzzy. **Bilateral filter**: Two one-dimensional filters are implemented one after the other. First a Gaussian filter for suppressing statistical noise in the image. Then a filter for sharpening the image is implemented, meaning edges get steeper transitions. **Adaptive filter**: Two one-dimensional filters are implemented one after the other – similar to the bilateral filter. In addition, local histogram values are taken into consideration with the Gaussian filter.
Search direction	• Forwards in the arrow direction (default) • Backwards (arrow direction rotated by 180°)
Edge polarity	• All (rising and falling) • Rising (intensity increases in the search direction: gray-value progression dark to light) • Falling (intensity decreases in the search direction: gray-value progression light to dark)
Edge selection	• First edge in search direction (dependent on edge polarity) • Strongest edge in search direction (dependent on edge polarity) • Counting of all edges (depending on edge polarity)
Edge strength	Represents the rise or fall of an edge - depending on the edge polarity selected, with regard to a defined standard edge width. The values are standardized and have a value range of 0 to 100; the default value is 20.
Error detection / outliers	The detection of errors and outliers of a linear object can be activated by clicking on the check box. Errors and outliers are ignored in the default settings. If error detection is activated, the error or outlier is automatically detected (default).
Error limit value (manual)	By clicking the "Error limit value (manual)" check box, a limit value can be specified manually (deviation from optimal line fit in %). If the deviation of the edge position of a search line is larger than this limit value, this edge position is ignored in the calculation of the line fit.

"Search lines" tab (line detector)

The profile of the search line is displayed as a function of the position, depending on the selection of the gray value or the gradient (see figure 3.35, areas **2** and **3**). The profile length corresponds to the length of the search line and is standardized to 100 %.

The gray values cover the area from 0 to 255, the gradient corresponds to the first derivation of the gray-value progression. The red point in the search line profile indicates the edge position.



The buttons in the upper left part of the "Search lines" tab can be used to select the individual search lines and display their profile

Circle detector properties

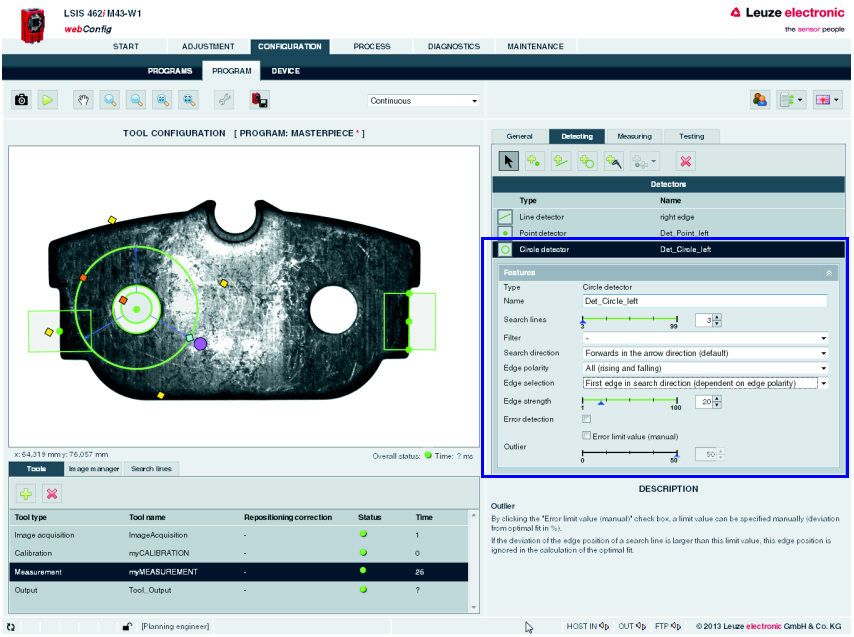


Figure 3.37: "Detecting" tab - Circle detector properties

"Properties" parameter group (circle detector)

Parameter	Explanation
Type	Type of the selected detector – "Circle detector" in this case
Name	Name of the detector. Can be changed at a later point in time.
Search lines	The number of search lines (default: 5 search lines) can be selected between 3 and 99. With increasing length or number of search lines, the evaluation time increases.

Parameter	Explanation
Filter	**Smoothing filter**: Is a one-dimensional Gaussian-like smoothing filter for suppressing statistical noise in the image. Fine structures are wiped out when rough structures are preserved; edges become fuzzy. **Bilateral filter**: Two one-dimensional filters are implemented one after the other. First a Gaussian filter for suppressing statistical noise in the image. Then a filter for sharpening the image is implemented, meaning edges get steeper transitions. **Adaptive filter**: Two one-dimensional filters are implemented one after the other – similar to the bilateral filter. In addition, local histogram values are taken into consideration with the Gaussian filter.
Search direction	- Forwards in the arrow direction (default) - Backwards (arrow direction rotated by 180°)
Edge polarity	- All (rising and falling) - Rising (intensity increases in the search direction: gray-value progression dark to light) - Falling (intensity decreases in the search direction: gray-value progression light to dark)
Edge selection	- First edge in search direction (dependent on edge polarity) - Strongest edge in search direction (dependent on edge polarity)
Edge strength	Represents the rise or fall of an edge - depending on the edge polarity selected, with regard to a defined standard edge width. The values are standardized and have a value range of 0 to 100; the default value is 20.
Error detection / outliers	The detection of errors and outliers of a circular object can be activated by clicking on the check box. Errors and outliers are ignored in the default settings. If error detection is activated, the error or outlier is automatically detected (default).
Error limit value (manual)	By clicking the "Error limit value (manual)" check box, a limit value can be specified manually (deviation from optimal circle fit in %). If the deviation of the edge position of a search line is larger than this limit value, this edge position is ignored in the calculation of the optimal circle fit.

"Search lines" tab (circle detector)

The profile of the search line is displayed as a function of the position, depending on the selection of the gray value or the gradient (see figure 3.35, areas **2** and **3**). The profile length corresponds to the length of the search line and is standardized to 100 %.

The gray values cover the area from 0 to 255, the gradient corresponds to the first derivation of the gray-value progression. The red point in the search line profile indicates the edge position.



The buttons in the upper left part of the "Search lines" tab can be used to select the individual search lines and display their profile

Vernier caliper detector properties

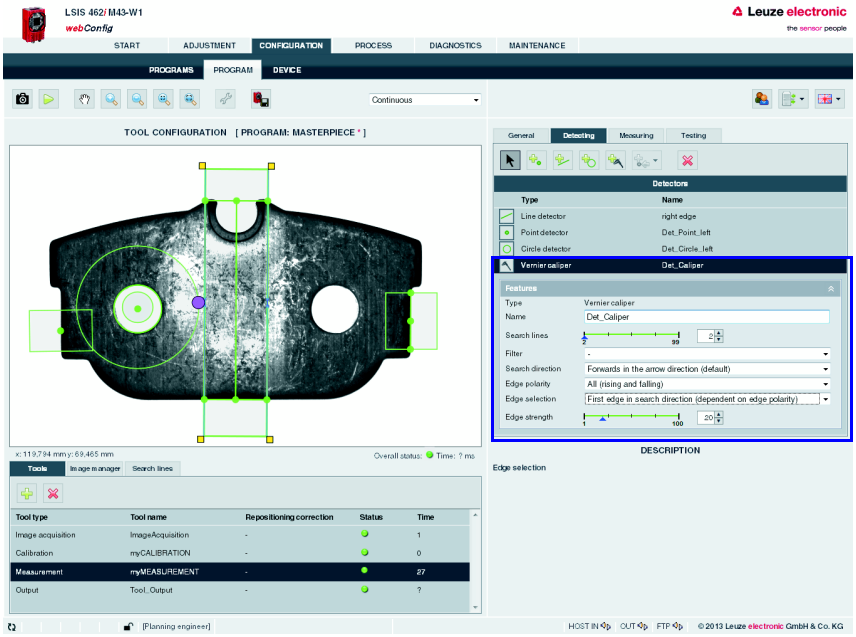


Figure 3.38: "Detecting" tab - Vernier caliper detector properties

"Properties" parameter group (vernier caliper detector)

Parameter	Explanation
Type	Type of the selected detector – "Vernier caliper detector" in this case
Name	Name of the detector. Can be changed at a later point in time.
Search lines	The number of search lines (default = 5 search lines in opposite directions) can be changed to between 2 and 99. With increasing length and number of search lines, the evaluation time increases.

Parameter	Explanation
Filter	**Smoothing filter**: Is a one-dimensional Gaussian-like smoothing filter for suppressing statistical noise in the image. Fine structures are wiped out when rough structures are preserved; edges become fuzzy. **Bilateral filter**: Two one-dimensional filters are implemented one after the other. First a Gaussian filter for suppressing statistical noise in the image. Then a filter for sharpening the image is implemented, meaning edges get steeper transitions. **Adaptive filter**: Two one-dimensional filters are implemented one after the other – similar to the bilateral filter. In addition, local histogram values are taken into consideration with the Gaussian filter.
Search direction	• Forwards in the arrow direction (default) • Backwards (arrow direction rotated by 180°)
Edge polarity	• All (rising and falling) • Rising (intensity increases in the search direction: gray-value progression dark to light) • Falling (intensity decreases in the search direction: gray-value progression light to dark)
Edge selection	• First edge in search direction (dependent on edge polarity) • Strongest edge in search direction (dependent on edge polarity) • Counting of all edges (depending on edge polarity)
Edge strength	Represents the rise or fall of an edge - depending on the edge polarity selected, with regard to a defined standard edge width. The values are standardized and have a value range of 0 to 100; the default value is 20.

"Search lines" tab (vernier caliper detector)

The profile of the search line is displayed as a function of the position, depending on the selection of the gray value or the gradient (see figure 3.35, areas **2** and **3**). The profile length corresponds to the length of the search line and is standardized to 100 %.

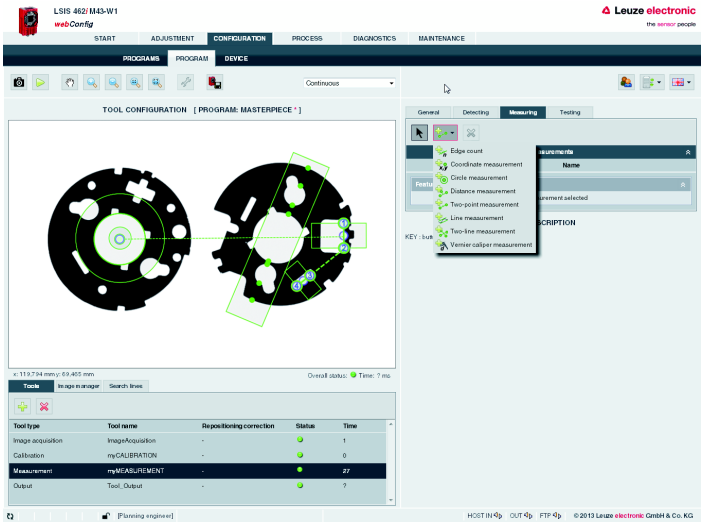
The gray values cover the area from 0 to 255, the gradient corresponds to the first derivation of the gray-value progression. The red point in the search line profile indicates the edge position.



The buttons in the upper left part of the "Search lines" tab can be used to select the individual search lines and display their profile

Measuring tool: "Measuring" parameter group

In this tab, measurement regulations can be created with the detectors generated before; this flexibility makes the tool very powerful.



Supported measurement regulations:

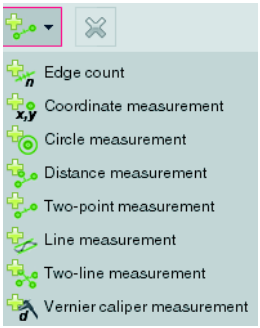


Figure 3.39: "Measuring" parameter of the measuring tool / supported measurement regulations

The following measurement regulations are supported:

- Edge count
- Coordinate measurement
- Circle measurement
- distance measurement
- Two-point measurement
- Line measurement
- Two-line measurement
- Vernier caliper measurement

Measurement regulation properties



Edge count:
This measurement regulation is based on a "Point detector" with the "Count edges" edge selection.

Results:
Display of measurement results if a point detector from the "Available detectors" field is touched with the mouse and (with the left mouse button held down) dragged into the "Selected detectors" field. If the left mouse button is released, the "Number of edges found" result appears.
If the check box is activated, the measurement results can then be tested in the "Testing" tab.



Coordinate measurement:
This measurement regulation is based on a "Point detector", "Line detector", "Circle detector" or an upstream tool from the "Import" function.

Point index:
Acts on a "Point detector" with the "Count edges" edge selection and allows an edge position to be selected if several edges are found.

Results:
Display of measurement results if a detector from the "Available detectors" field is touched with the mouse and (with the left mouse button held down) dragged into the "Selected detectors" field. If the left mouse button is released, the "X coordinate" and "Y coordinate" results appear.
If the coordinate system has been changed – it can be dragged, rotated and, depending on the selected coordinate system regarding Y-orientation, can have another counting direction of the Y-axis – the coordinate information may deviate from the default settings. Negative X and Y coordinates are possible.
If a two-point calibration has been performed in the check program and the values have been accepted, the values are displayed according to the new standard.



Circle measurement:
This measurement regulation is based on a "Circle detector".

Results:
Display of measurement results if a circle detector from the "Available detectors" field is touched with the mouse and (with the left mouse button held down) dragged into the "Selected detectors" field. If the left mouse button is released, the "X center", "Y center", "Radius", "Minimum radius", "Maximum radius" and "Deviation" (i.e. the difference between the maximum and minimum radius) results appear.
If the coordinate system has been changed – it can be dragged, rotated and, depending on the selected coordinate system regarding Y-orientation, can have another counting direction of the Y-axis – the coordinate information may deviate from the default settings. Negative X and Y coordinates are possible.
If a two-point calibration has been performed in the check program and the values have been accepted, the values are displayed according to the new standard.
If the check box is activated, the measurement results can then be tested in the "Testing" tab.



Distance measurement:
This measurement regulation requires a "Line detector" (or, alternatively, two points to define a line) as well as an additional detector from the "Point detector" or "Circle detector" group or an upstream tool from the "Import function".

Results:
Display of measurement results if suitable detectors from the "Available detectors" field are touched with the mouse and (with the left mouse button held down) dragged into the "Selected detectors" field. If the left mouse button is released, the "X coordinate", "Y coordinate" and "Absolute distance" results appear.
If the coordinate system has been changed – it can be dragged, rotated and, depending on the selected coordinate system regarding Y-orientation, can have another counting direction of the Y-axis – the coordinate information may deviate from the default settings. Negative X and Y coordinates are possible.
If a two-point calibration has been performed in the check program and the values have been accepted, the values are displayed according to the new standard.
If the check box is activated, the measurement results can then be tested in the "Testing" tab.



Two-point measurement:
This measurement regulation requires two detectors from the "Point detector" (edge position), "Line detector" (midpoint of the line), "Circle detector" (circle center) group or an upstream tool from the "Import" function (area centroid).

Results:
Display of measurement results if suitable detectors from the "Available detectors" field are touched with the mouse and (with the left mouse button held down) dragged into the "Selected detectors" field. If the left mouse button is released, the "Midpoint X", "Midpoint Y", "ΔX change", "ΔY change", "Absolute distance" and "Angle α" (stretched from a straight line from point 1 in the direction of point 2) results appear.
If the coordinate system has been changed – it can be dragged, rotated and, depending on the selected coordinate system regarding Y-orientation, can have another counting direction of the Y-axis – the coordinate information may deviate from the default settings. Negative X and Y coordinates are possible.
If a two-point calibration has been performed in the check program and the values have been accepted, the values are displayed according to the new standard.
If the check box is activated, the measurement results can then be tested in the "Testing" tab.



Line measurement:
This measurement regulation requires a "Line detector".

Results:
Display of measurement results if a suitable line detector from the "Available detectors" field is touched with the mouse and (with the left mouse button held down) dragged into the "Selected detectors" field. If the left mouse button is released, the "Starting point X", "Starting point Y", "Endpoint X", "Endpoint Y", "Midpoint X", "Midpoint Y", "Deviation" and "Angle α" (stretched from the line from (starting) point 1 in the direction of (end) point 2) results appear. The starting point is located in the direct vicinity of the "turning handle" for rotating the line detector; the "Deviation" is a measure of the maximum straightness deviation of the measurement values from a "best-fit line".
If the coordinate system has been changed – it can be dragged, rotated and, depending on the selected coordinate system regarding Y-orientation, can have another counting direction of the Y-axis – the coordinate information may deviate from the default settings. Negative X and Y coordinates are possible.
If a two-point calibration has been performed in the check program and the values have been accepted, the values are displayed according to the new standard.
If the check box is activated, the measurement results can then be tested in the "Testing" tab.



Two-line measurement:
This measurement regulation requires two "Line detectors" or, alternatively, a corresponding number of points to define lines (i.e. detectors from the "Point detector", "Line detector" or "Circle detector" group or an upstream tool from the "Import" function).

Results:
Display of measurement results if suitable detectors from the "Available detectors" field are touched with the mouse and (with the left mouse button held down) dragged into the "Selected detectors" field (when doing so, pay attention to the position in the "Selected detectors" field). If the left mouse button is released, the "X coordinate", "Y coordinate", "Angle α" results and whether the lines are "Parallel" or "Identical" appear.
If the coordinate system has been changed – it can be dragged, rotated and, depending on the selected coordinate system regarding Y-orientation, can have another counting direction of the Y-axis – the coordinate information may deviate from the default settings. Negative X and Y coordinates are possible.
If a two-point calibration has been performed in the check program and the values have been accepted, the values are displayed according to the new standard.
If the check box is activated, the measurement results can then be tested in the "Testing" tab.



Vernier caliper measurement:
This measurement regulation is based on a "Vernier caliper detector".

Results:
Display of measurement results if a vernier caliper detector from the "Available detectors" field is touched with the mouse and (with the left mouse button held down) dragged into the "Selected detectors" field. If the left mouse button is released, the "Distance" (i.e. the distance between the edges found of the scan lines going in the opposite direction) result appears.
If the check box is activated, the measurement results can then be tested in the "Testing" tab.

Measuring tool: "Testing" parameter group

You will find all measurement results of the previously defined measurement regulations here for which the "Test" check box was activated.

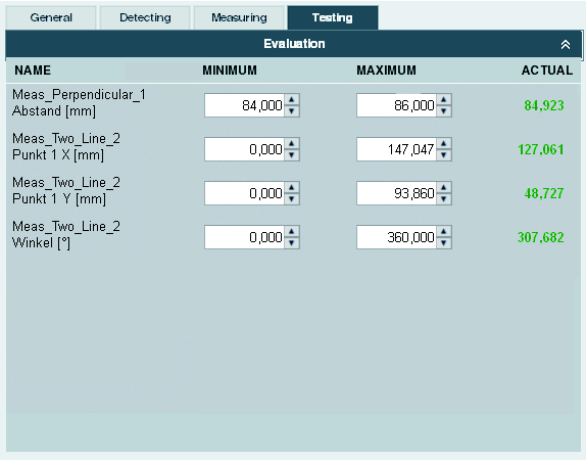


Figure 3.40: "Testing" parameter of the measuring tool

You can define a lower tolerance limit "MINIMUM" and an upper tolerance limit "MAXIMUM" here for each measurement result that is to be tested.

If the current measurement result is within these tolerance limits, it is displayed in green in the "ACTUAL" column. If outside of these limits, it is displayed in red.

3.3.2.7 *Display of the "Output" tool type*

Located on the left side of the window in the "Output" tool are seven tabs for configuring the program-specific output data via various media and interfaces. These are the "Ethernet", "RS 232", "FTP", "Process", "Display" and "Digital I/O" tabs. In the right part of the window, you can optionally enter a name and a description.

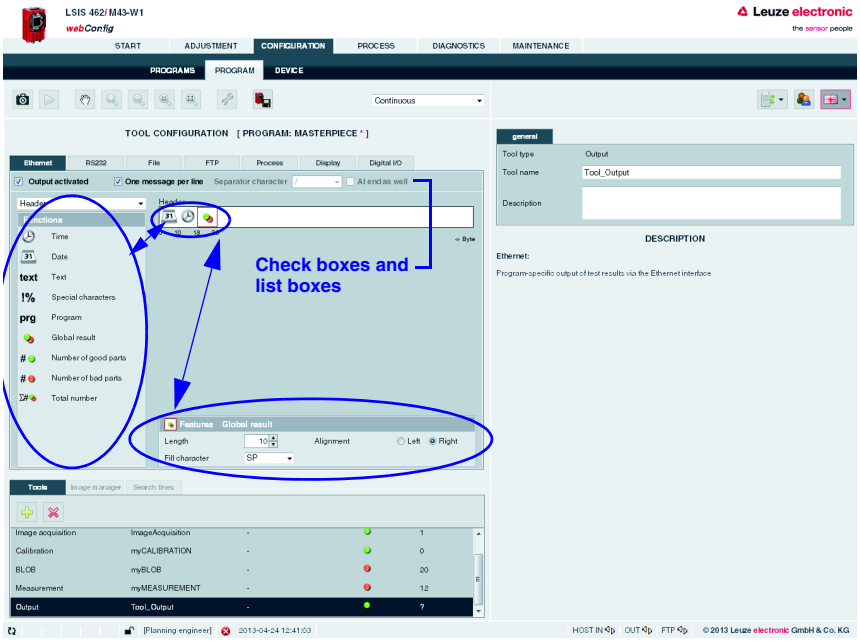


Figure 3.41: Window for configuring the output

Directly below the tabs, you will find several check boxes and list boxes for defining the output in greater detail.

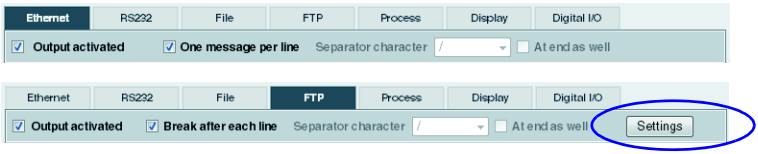


Figure 3.42: Window for configuring the output

"*Output activated*" check box

Only if the respective option is selected is the data output via the corresponding interface, the device display or to a text file. Furthermore, it is possible to assign tool results to programmable digital outputs.

"*One message per line*" check box (output via Ethernet, RS 232, process)

If this option is active, each line is packed in a telegram for output via Ethernet. With RS 232, each individual line uses the defined framing protocol. If the option is deactivated, this means that all lines that are to be output are packed in a telegram or are enclosed by the defined RS 232 framing protocol.

"*Break after each line*" check box (output in file, via FTP, in the display)

If the option is active, a line break is output after each line.

"*Separator character*" list box

If the central part of a tool output is passed through several times because multiple BLOBs were found by a BLOB tool or multiple codes were found by a code tool, the line can be terminated with a separator character after each pass (0 .. n); as an option, a separator character can also be added to the last line (check box "At end as well").

"*Adjustment*" button (output via FTP)

Changeover between "Settings" and "Output": the "Settings" button is generally used to define to what extent and with which name image(s) and/or log file(s) are to be transferred.

The "Output" button is used to define the content of the log file.

"*Structure of the output data*" list box

Located in the "Functions" area below the "Header" with the just described options is a list box for structuring the output data. In general, the output is divided into a **header**, into the **output data of the individual tools** of the current check program and into a **trailer**. Here, you can select which part you would like to edit. Delimiters between the individual pieces of data and the use of separate lines increase the "Readability" of the output data. Of course, if the BLOB, code or measuring tool is selected in the following, you have much more extensive selection and input options.

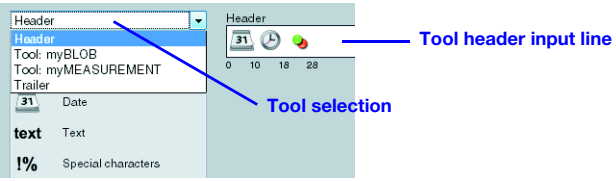


Figure 3.43: Tool selection for the output

The selection contains:

- General header
- All tools except for image acquisition, calibration and output
- General trailer

List of functions / input lines

Displayed in the left window area is a list of "output functions" with which you can define (independent of output type) what is to be output and in what order. Using drag & drop, the desired elements can be inserted into the input lines provided for this purpose at the right as well as removed by pulling them back to the left list area. The currently active element is indicated by a red marking. Information on the individual elements (date, time etc.) and other possibilities for the specification are available as usual in the right part of the window. Considerably more functions are available for the description of the individual tools than for a header or trailer.

With regard to the input lines of the BLOB, code or measuring tool:

- Parameters entered in the "Tool header" and "Tool trailer" lines are output once.
- Parameters entered in the "Output for tool result ..." lines are cyclically output in a dynamically created list.
- These input lines are passed through once for each valid BLOB, each read code or each valid measurement. As a result, a table with various parameters for multiple BLOBs, codes or measurements can be created. In the case of "Tool result not OK", this list can be reduced by means of the "One-time NOK output" option to exactly one pass to e.g., create a single text output in the event of an NOK case.

Notice!

Please note that the loop is executed for each result (i.e. each BLOB in the BLOB tool, each code in the code tool, each measurement in the measuring tool). If no result is returned, i.e. not a single BLOB was found, not a single code read or not a valid measurement made, the loop is not executed and no output is carried out unless a "one-time NOK output" is defined. In the NOK case, this is output exactly 1x, independent of the number of found results (even for 0)!

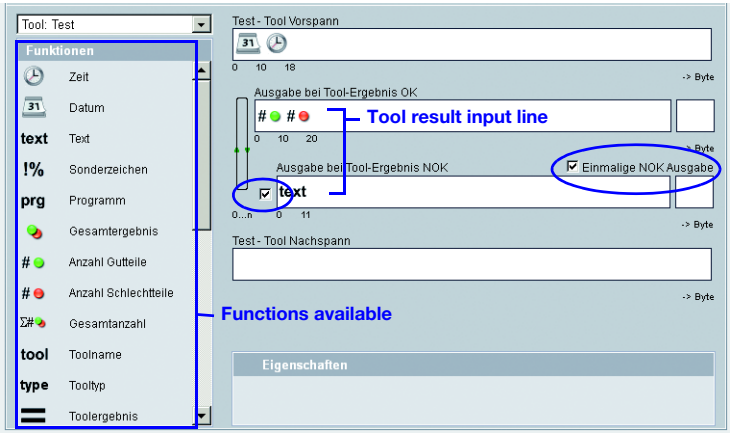


Figure 3.44: Options for outputting the tool results

The list of output functions contains the following elements:

General functions

Time:
Time of the check-program evaluation in "hh:mm:ss" or "h:mm:ss" format.

Date:
Date of the check-program evaluation in "YYYY-MM-DD" or "YYYY/MM/DD" or "DD.MM.YYYY" format.

text **Text**:
Freely definable text.

!% **Special characters**:
Output of a single, unprintable character.

prg **Program**:
Optional entry of the check program name. Can be changed at a later point in time.

Global result:
Global result (OK/not OK) of the active check program.

Number of good parts:
Total number of good parts produced since the last reset (program change).

Number of bad parts:
Total number of bad parts produced since the last reset (program change).

Total number:
Total number of all checked parts (good and bad parts).

BLOB-tool-specific functions [1)]

tool **Tool name**:
Optional input of the tool name. Can be changed at a later point in time.

type **Tool type**:
Display of the tool type. Cannot be changed.

Tool result:
Display of the tool result (OK/not OK)
Min: 0 - not OK
Max: 1 - OK

Σ# **BLOB number**:

Min: 0
Max: 10000

Number of valid BLOBs of a tool. Only if the number is in the range between MINIMUM and MAXIMUM is the tool result OK (green LED in the tool list).

Total area:

Min: 0
Max: 360960

Total area of all valid BLOBs of a tool. Only if the total area is in the range between MINIMUM and MAXIMUM is the tool result OK (green LED in the tool list).

Area:

Min: 0
Max: 360960

Prefilter according to BLOB size (in pixels):
Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.

Width:

Min: 0
Max: 752

Prefilter according to width (in pixels) of the smallest rectangle that encloses the BLOB with sides parallel to the horizontal and vertical image border. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.

Height:

Min: 0
Max: 480

Prefilter according to height (in pixels) of the smallest rectangle that encloses the BLOB with sides parallel to the horizontal and vertical image border. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.

Center X:

Min: 0.00
Max: 752.00

Prefilter according to the X coordinate of the BLOB's area centroid. Coordinate origin is the upper left corner of the image. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.

Center Y:

Min: 0.00
Max: 480.00

Prefilter according to the Y coordinate of the BLOB's area centroid. Coordinate origin is the upper left corner of the image. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.

Perimeter:

Min: 0.00
Max: 360960.00

Prefilter according to the length (in pixels) of the outer contour line of the BLOB. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.

Angle:

Min: 0.00
Max: 360.00

Prefilter according to the angle of the mass centroid axis of the BLOB (0° ... 360°, pointing to the "Heavy" side of the BLOB), relative to the X-axis. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.

Shape factor:

Min: 0.00
Max: 100.00

Prefilter according to the shape factor. This is the ratio between the area and the perimeter of the BLOB, normalized to values between 0 and 100. The shape factor classifies the geometric shape of the BLOB:
"100" represents a perfect circle, "0" a perfect line. The formula is (4π * area/ perimeter^2) * 100. Only BLOBs in the region between MINIMUM and MAXIMUM are valid and are displayed in the overlay in green.



Major axis:

Min: 0.00
Max: 892.13

Prefilter according to the length (in pixels) of the major axis, i.e. the length of the smallest rotated rectangle that encloses the BLOB. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.



Minor axis:

Min: 0.00
Max: 679.82

Prefilter according to the length (in pixels) of the minor axis, i.e. the height of the smallest rotated rectangle that encloses the BLOB. Only BLOBs in the range between MINIMUM and MAXIMUM are valid and are displayed in green in the overlay.

1) For the Area, Height, Width, Center X, Center Y, Major axis, Minor axis, Perimeter and Total area functions, the following applies:

   If a two-point calibration is performed, other values are possible for the MINIMUM and MAXIMUM.

   Also applicable for the Center X and Center Y functions:

   If the coordinate system has been changed - it can be dragged, rotated and, depending on the selected coordinate system regarding Y-orientation, can have another counting direction of the Y-axis – the coordinate information may deviate from the default settings. Negative X and Y coordinates are also possible.

Code-tool-specific functions [1)]

tool **Tool name**:
Optional input of the tool name. Can be changed at a later point in time.

type **Tool type**:
Display of the tool type. Cannot be changed.

Tool result:
Display of the tool result (OK/not OK)

Min: 0 - not OK
Max: 1 - OK

Number of codes:

Min: 1
Max: 999

Number of valid codes of a tool. Only if the number is in the range between MINIMUM and MAXIMUM is the tool result OK (green LED in the tool list).

Code type:

0 : No code
1 : Code 2/5 interleaved
2 : Code 39
6 : Code UPC
7 : Code EAN
8 : Code 128
9 : Pharmacode
11: Codabar
32: Datamatrix ECC 200

The code type may include other values between "0" and "64" if they are supported by the firmware.

Center X:

Min: 0.00
Max: 752.00

X coordinate of the center point of the code. Coordinate origin is the upper left corner of the image.

Center Y:

Min: 0.00
Max: 480.00

Y coordinate of the center point of the code. Coordinate origin is the upper left corner of the image.

Angle:

Min: 0.00
Max: 360.00

Angular position of the code (in read direction), relative to the X-axis.

Code length:

Number of digits in the read code.

Code content:

All decoded characters of the read code.

Number of bars:

Here, you can define the number of bars of the Pharmacode.

Minimum edge contrast:

The minimum edge contrast (also called adjacency contrast) is the difference between Rs and Rb of adjacent elements including light zones. The lowest value of an adjacency contrast of a scan reflection profile is the minimum adjacency contrast.

$EC = R_s - R_b$

Minimum reflection:

Minimum reflection (R_{min}) is the lowest reflection value in the reflection profile. Rmin should not be greater than 0.5 R_{max}. This parameter shall ensure that Rmin is not too high and guarantees that an adequate distance exists between background and bar reflection, especially for high values of R_{max}.

Symbol contrast 1D:

The symbol contrast is the difference between the highest and the lowest reflection value in a scan reflection profile.

$SC = R_{max} - R_{min}$

The value is divided into classes.

Modulation:

The modulation is the ratio of minimum edge contrast to symbol contrast, whereby the edge contrast is the difference between the space reflectance and the bar reflectance of adjacent elements.

$MOD = EC_{min} / SC$

The value is divided into classes.

Defects:

Defects are irregularities within elements or light zones. They are measured as irregularities of the element reflection.

An irregular element reflection within a given element or light zone is the difference between the reflection of the global maximum and the reflection of the global minimum. If an element consists of a single maximum or a single minimum, its irregular reflection is equal to zero. The highest value of an irregular element reflection of a scan reflection profile is the maximum irregularity of an element reflection. The degree of a defect is expressed as the ratio of maximum irregularity of an element reflection (ERNmax) to the symbol contrast.

$Defects = ERN_{max} / SC$

The value is divided into classes.



Decodability:

The decodability of a bar code symbol is a measure of its print accuracy relative to the corresponding reference decoding algorithm. Normally, bar code readers achieve better results with symbols having a higher decodability level than with symbols having a lower decodability.

The relevant rules for the nominal measurements of each bar code symbology are specified in the respective symbology specifications. The reference decoding algorithm provides adequate leeway for errors in the printing and reading process through the definition of one or more reference threshold values, which are used when making decisions regarding the element width or other measurements.

The value is divided into classes.



Overall quality 1D:

The individual results are summarized and classified here. The overall quality corresponds to the poorest ascertained individual quality.



Symbol contrast 2D:

The symbol contrast is the difference between the highest and the lowest reflection value in a gray-value image.

$SC = R_{max} - R_{min}$

The value is divided into classes.



Axial non-uniformity:

Axial non-uniformity provides information on possible horizontal or vertical distortion of the code; it is divided into classes.



Unused error correction:

The Data Matrix code includes error correction that can correct errors in individual modules. The sum of the corrected errors is subtracted from the maximum possible number of errors and is then classified as "unused error correction".



Horizontal print growth:

The horizontal print growth is the percentage deviation from the nominal dimension of the cells. The measurement value is ascertained with the horizontal timing cells. A positive value represents enlarged cells; a negative value represents reduced cells.



Vertical print growth:

The vertical print growth is the percentage deviation from the nominal dimension of the cells. The measurement value is ascertained with the vertical timing cells. A positive value represents enlarged cells; a negative value represents reduced cells.



Overall quality 2D:

The individual results are summarized and classified here. The overall quality corresponds to the poorest ascertained individual quality.



Code comparison result:

The code comparison result is a value that states whether the code comparison was successful or not.

1) Applicable for the Center X and Center Y functions:

If a two-point calibration is performed, other values are possible for the MINIMUM and MAXIMUM.

If the coordinate system has been changed – it can be dragged, rotated and, depending on the selected coordinate system regarding Y-orientation, can have another counting direction of the Y-axis – the coordinate information may deviate from the default settings. Negative X and Y coordinates are also possible.

Measuring-tool-specific functions [1)]

tool **Tool name**:
Optional input of the tool name. Can be changed at a later point in time.

type **Tool type**:
Display of the tool type. Cannot be changed.

Tool result:
Display of the tool result (OK/not OK)

Min: 0 - not OK
Max: 1 - OK

Edge count number:
Number of found edges for a tool.

Min: 0

Max: 893

Only if the number of edges found is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).

Coordinate measurement Point 1 X:
X coordinate of the found edge or position.

Min: 0

Max: 752 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4512)

Depending on the used detector, the coordinate has the following meaning:

"Point detector"	X coordinate of the edge position of the point detector on the search line. If "Counting all edges" was selected in "Point detector" in the "Detecting" tab under edge selection, one of the found edges can be selected with "Point index" in the "Measuring" tab.
"Line detector"	X coordinate of the center point of the line detector in the direction of the search lines.
"Circle detector"	X coordinate of the circle center point of the circle detector.
"Import function"	X coordinate of the area centroid of the import function from the BLOB analysis or code tool.

Only if the X coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).

Coordinate measurement Point 1 Y:
Y coordinate of the found edge or position.

Min: 0

Max: 480 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4240)

Depending on the used detector, the coordinate has the following meaning:

"Point detector"	Y coordinate of the edge position of the point detector on the search line. If "Counting all edges" was selected in "Point detector" in the "Detecting" tab under edge selection, one of the found edges can be selected with "Point index" in the "Measuring" tab.
"Line detector"	Y coordinate of the center point of the line detector in the direction of the search lines.
"Circle detector"	Y coordinate of the circle center point of the circle detector.
"Import function"	Y coordinate of the area centroid of the import function from the BLOB analysis or code tool.

Only if the Y coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).

Circle measurement Point 1 X:

X coordinate of the circle center point.

Min: 0

Max: 752 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4512)

Only if the X coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).

Circle measurement Point 1 Y:

Y coordinate of the circle center point.

Min: 0

Max: 480 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4240)

Only if the Y coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).

Circle measurement Radius:

Average radius of the ascertained circle.

Min: 0

Max: 446 (for values within the image field; depending on the type of measurement, calculated values may reach up to 10636)

Only if the mean radius is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Circle measurement Min. radius:

Minimum radius of the ascertained circle.

Min: 0

Max: 446 (for values within the image field; depending on the type of measurement, calculated values may reach up to 10636)

Only if the minimum radius is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Circle measurement Max. radius:

Maximum radius of the ascertained circle.

Min: 0

Max: 446 (for values within the image field; depending on the type of measurement, calculated values may reach up to 10636)

Only if the maximum radius is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Circle measurement Deviation:

Difference between maximum and minimum radius of the ascertained circle.

Min: 0

Max: 446 (for values within the image field; depending on the type of measurement, calculated values may reach up to 10636)

Only if the deviation is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Distance measurement Point 1 X:

X coordinate of the intersection point of a line and a point detector.

Min: 0

Max: 752 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4512)

Only if the X coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Distance measurement Point 1 Y:

Y coordinate of the intersection point of a line and a point detector.

Min: 0

Max: 480 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4240)

Only if the Y coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Distance measurement Vertical distance:

Absolute distance between a line and a point detector.

Min: 0

Max: 892 (for values within the image field; depending on the type of measurement, calculated values may reach up to 10636)

Only if the vertical distance is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Two-point measurement Midpoint X:

X coordinate of the center point of a path between two points.

Min: 0

Max: 752 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4512)

Only if midpoint X is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Two-point measurement Midpoint Y:

Y coordinate of the center point of a path between two points.

Min: 0

Max: 480 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4240)

Only if midpoint Y is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Two-point measurement ΔX change:

Distance between two points in X-direction.

Min: 0

Max: 752 (for values within the image field; depending on the type of measurement, calculated values may reach up to 10636)

Only if the ΔX change is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Two-point measurement ΔY change:

Distance between two points in Y-direction.

Min: 0

Max: 480 (for values within the image field; depending on the type of measurement, calculated values may reach up to 10636)

Only if the ΔY change is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Two-point measurement Absolute distance:

Vectorial (or Euclidean) distance between two points.

Min: 0

Max: 892 (for values within the image field; depending on the type of measurement, calculated values may reach up to 10636)

Only if the absolute distance is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Two-point measurement Angle α:

Angle α between the straight line from point 1 to point 2 and the horizontal axis.

Min: 0°

Max: 360°

Only if the angle is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Line measurement Point 1 X:

X coordinate of the starting point of the line detector.

Min: 0

Max: 752 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4512)

Only if the X coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Line measurement Point 1 Y:

Y coordinate of the starting point of the line detector.

Min: 0

Max: 480 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4240)

Only if the Y coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Line measurement Point 2 X:

X coordinate of the endpoint of the line detector.

Min: 0

Max: 752 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4512)

Only if the X coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Line measurement Point 2 Y:

Y coordinate of the endpoint of the line detector.

Min: 0

Max: 480 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4240)

Only if the Y coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Line measurement Midpoint X:

X coordinate of the center point of the line detector.

Min: 0

Max: 752 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4512)

Only if the X coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).



Line measurement Midpoint Y:

Y coordinate of the center point of the line detector.

Min: 0

Max: 480 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4240)

Only if the Y coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).

Line measurement Deviation:

A measure of the maximum straightness deviation of the measurement values from a "best-fit line".

Min: 0

Max: 892 (for values within the image field; depending on the type of measurement, calculated values may reach up to 10636)

Only if the deviation is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).

Line measurement Angle α:

Angle α between the straight line from (starting) point 1 to (end) point 2 and the horizontal axis.

Min: 0°

Max: 360°

Only if the angle is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).

Two-line measurement Point 1 X:

X coordinate of the intersection point of two lines.

Min: 0

Max: 752 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4512)

Only if the X coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).

Two-line measurement Point 1 Y:

Y coordinate of the intersection point of two lines.

Min: 0

Max: 480 (for values within the image field; depending on the type of measurement, calculated values may reach up to 4240)

Only if the Y coordinate is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).

Two-line measurement Angle α:

Angle of intersection of two lines, taking into account the line orientation (always from the starting point to the end point, angle from the first line to the second line).

Min: 0°

Max: 360°

Only if the angle is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).

Two-line measurement Parallel:

Indicates whether two lines are parallel to one another.

Notice: No test is available for this information!

Two-line measurement Identical:

Indicates whether two lines are identical in position.

Notice: No test is available for this information!

Vernier caliper measurement Distance:

Distance between the found edges of the opposing scan lines of the vernier caliper detector.

Min: 0

Max: 892 (for values within the image field; depending on the type of measurement, calculated values may reach up to 10636)

Only if the distance is in the range between MINIMUM and MAXIMUM in the "Testing" tab is the tool result OK (green LED in the tool list).

1) For functions
- Point 1 X, Point 1 Y, Point 2 X, Point 2 Y, Midpoint X, Midpoint Y
- Radius, Min. radius, Max. radius, Deviation, ΔX change, ΔY change,
- Absolute distance, Vernier caliper distance

the following applies:

If a two-point calibration is performed, other values are possible for the MINIMUM and MAXIMUM.

For functions
- Point 1 X, Point 1 Y, Point 2 X, Point 2 Y, Midpoint X, Midpoint Y

the following applies as well:
If the coordinate system has been changed – it can be dragged, rotated and, depending on the selected coordinate system regarding Y-orientation, can have another counting direction of the Y-axis – the coordinate information may deviate from the default settings. Negative X and Y coordinates are also possible.

Features

In this area, you can define options such as length, alignment, fill character, etc. for the function element currently active in the input line. In this way, you achieve better structuring of the output data.

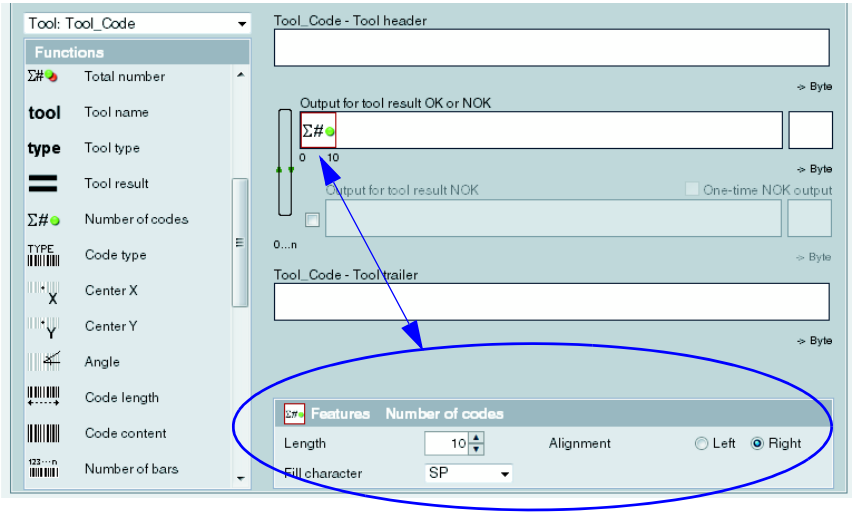


Figure 3.45: Defining characteristics of the active function element

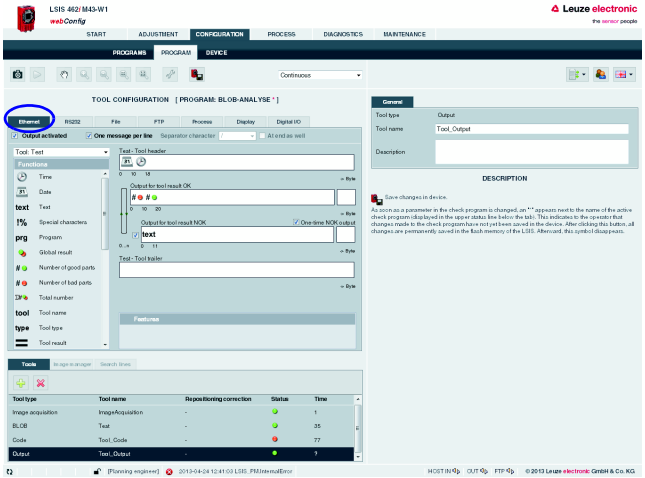
Configuring process-data output

The procedure for configuring process data output via Ethernet or RS 232 interface, to a text file, or even on the device display is, in principle, always the same. Following the window structure, work through the operational controls from top to bottom and from left to right.

- Activate output (select check box)
- Define the part that is to be edited (header, tools, trailer)
- Add/remove output functions to/from the input line by means of drag&drop
- Specify element options, such as length, alignment, fill character, etc., in the lower part of the Features area
- If necessary, permanently save the settings in the flash memory of the **LSIS 4xx*i*** with the button

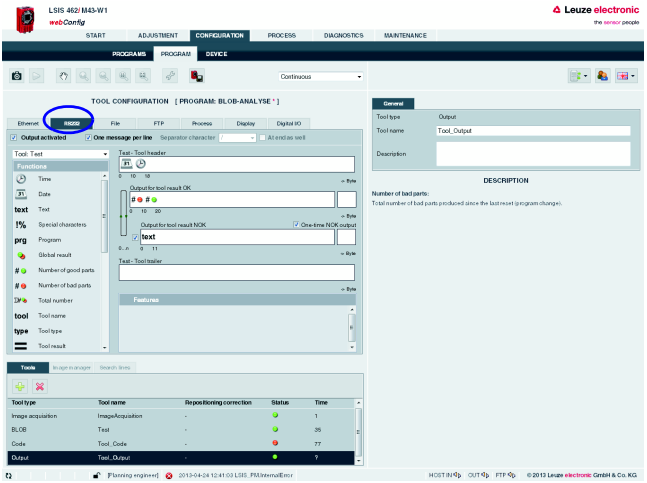
Notice!

Notice about deleting icons:
Particularly when working with lower-performance PCs, the following visual acknowledgement assists when deleting elements in the output fields by means of drag&drop: If an icon is clicked on and pulled out of the output field, the output field briefly has a red border. This indicates that the delete function has been activated. If the icon is then "Dropped" outside of the field, the delete operation is concluded and the corresponding element is removed from the respective line.



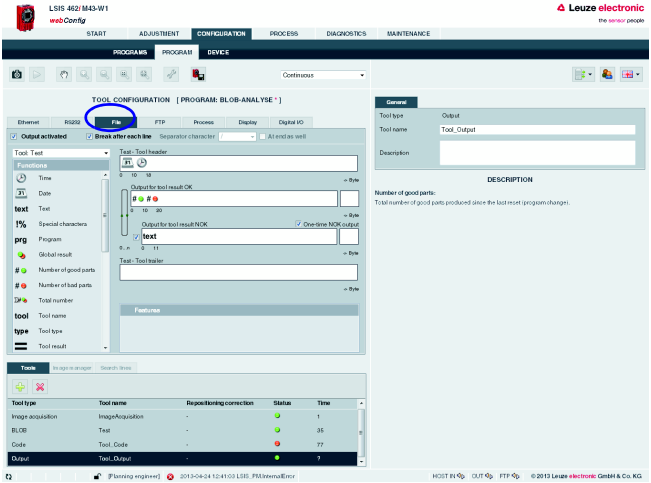
Configuring the **Ethernet** output

Figure 3.46: Configuring process data output: Ethernet



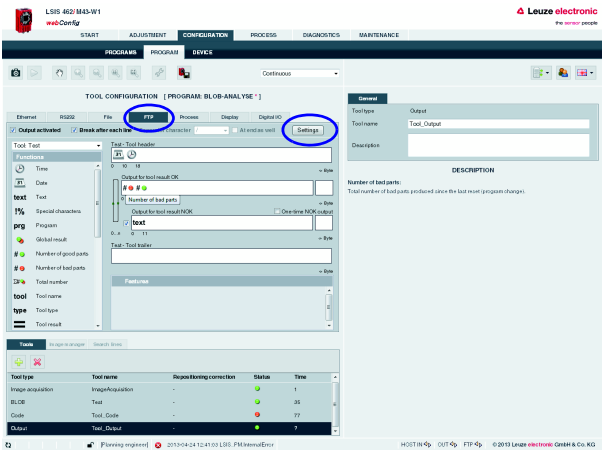
Configuring **RS 232** output

Figure 3.47: Configuring process data output: RS 232



Configuring **file** output

Figure 3.48: Configuring process data output: file



Configuring the **FTP** output

Note that, in addition to the log file, you can also configure the transfer of images

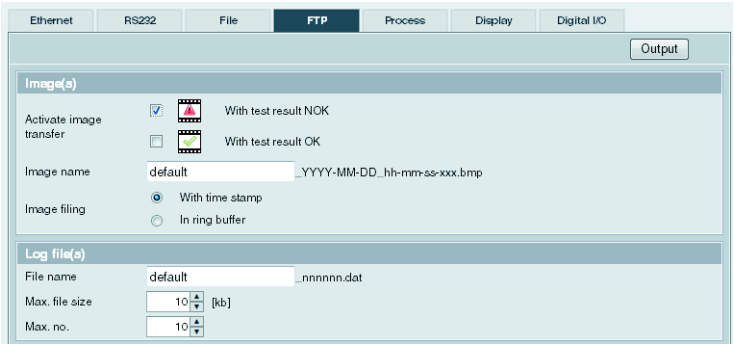
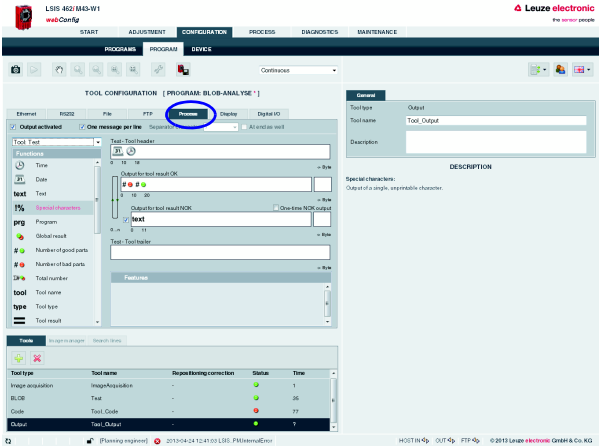


Figure 3.49: Configuring process data output: FTP

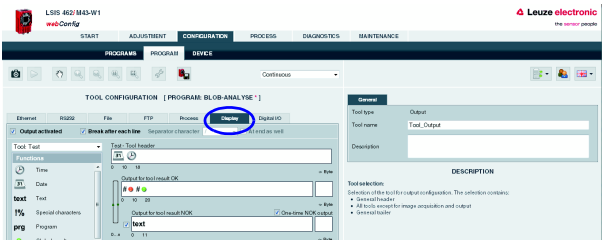
Parameter	Explanation
Image(s)	
Activate image transfer	Determination of whether images – in *.bmp format - with "test result OK" and/or "test result NOK" are to be transferred.
Image name	Entry of a basis name during the saving of an image • which is supplemented by a date and time specification (option "with time stamp") • which is supplemented by a running number (option "in ring buffer")
Image filing	• With time stamp: name of the saved image = basis name + "_" + YYYY-MM-DD_hh-mm-ss-[ms][ms][ms] + ".bmp" • In ring buffer: name of the saved image = basis name + "_" + running number + ".bmp"
Max. no.	When filing in the ring buffer: maximum number of images to be saved. If the maximum value is reached when saving additional images, the oldest is overwritten.

Parameter	Explanation
Log file(s)	
File name	Entry of a basis name which is supplemented by a running number when saving the log file.
Max. file size	Defines the maximum file size of a single log file. If this file size is reached, the next log file is started until the defined maximum number of files is reached.
Max. no.	Max. no.: Defines the maximum number of log files to be created. If the maximum number of files is reached, the oldest file is overwritten (ring buffer principle).



Configuring the **process** output

The settings made here determine which process data is displayed in the "Process" module.



Configuring **display** output

Note that the area available on the display for output is very limited.
The output data of a new input line overwrites that of the previous input line.

Figure 3.50: Configuring the output of process data: "Process tab" and display

Configuring programmable outputs

If you would like to set a digital output in the case of specific tool results, you have the option in the "*Digital I/O*" tab of assigning program-specific tool results to programmable outputs. To do this, for the programmable outputs you need only to select program-specific tool results from the list box.

Notice!

Available here are only programmable outputs that were previously configured under "Configuration - Device - Digital I/Os" (standard setting = none)!

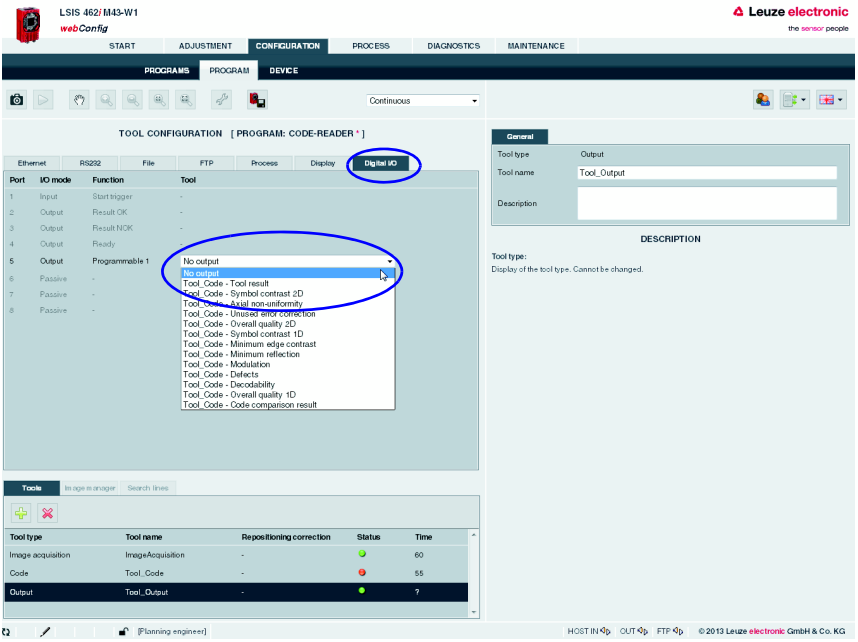


Figure 3.51: Configuring programmable outputs

3.3.3 "Device" tab

This window makes available the device parameters used throughout the check program. Select the respective menu in the left window area to activate the corresponding input window in the middle area. You can then define the settings for the existing digital inputs and outputs, the communication between device and master computer, and the necessary image memory.

The parameters for serial communication, such as baud rate, data mode and handshake, are defined in the "Communication -> RS 232" menu. The IP address, subnet mask and gateway are configured in the "Communication -> Service - Ethernet" menu: Here, you will find the parameters for the Ethernet service interface. The parameters for process data transfer to an external host system via Ethernet can be found in the "Communication -> Process - Ethernet" menu. Defined here, for example, is whether the **LSIS 4xx*i*** performs the server or the client function during TCP/IP communication of if communication occurs via UDP.

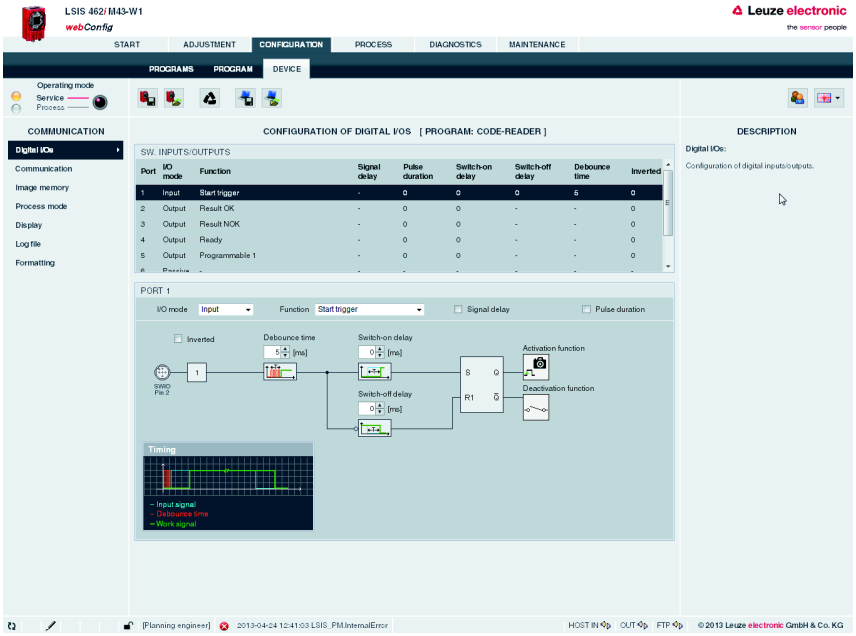


Figure 3.52: "Configuration" module, "Device" tab

Notice!

A pencil icon in the status bar alerts you of any unsaved changes to the device parameters.

Buttons

The button bar contains the following elements:



After pressing this button, all changes to the parameters are saved in the flash memory of the **LSIS 4xx*i***.



Pressing this button discards all changes by reloading the device parameters saved in the flash memory of the **LSIS 4xx*i***.



Pressing this button resets the device parameter to the original state.



After pressing this button, the device parameters can be saved on the PC.



Pressing this button loads saved device parameters from the PC to the **LSIS 4xx*i*** flash memory.

3.3.3.1 "Digital I/Os" menu

The parameters of the digital inputs and outputs are set here. In the top part of the middle window, all eight digital I/Os are displayed in a list. The associated parameters are set in the bottom part of the window with the aid of list boxes, input fields and check boxes.

"I/O Port" parameter group

Parameter	Explanation
Port	Number of the selected digital input/output.
I/O mode	Possible functions of the digital ports: **Passive** **Input** **Output**

Parameter	Explanation
Function	***Notice!*** *Further important details on the following functions are provided at the end of this table for the sake of clarity.*
	Possible functions for ***inputs***: **Trigger** Trigger input for an image acquisition **Reading gate start/stop** Trigger input for a reading gate control **Reading gate start** Trigger input for opening the reading gate **Reading gate stop** Trigger input for closing the reading gate **Program selection, bit n** External check-program preselection Can only be set in logical order (1, 2, 3, …) Can only be reset in logical order (…, 3, 2, 1) **Program change** Acceptance bit for program changeover Can only be selected if at least one program selection bit is present. The "program change" signal causes the check program encoded by the check-program bit to be loaded at the earliest possible time. If the signal is input during a running check, the changeover to the new check program does not take place until after the running check has ended. The maximum number of externally selectable programs is 64 (via 6 bit). In this context, the debounce times assigned to the input signals are to be observed. For further information, see chapter "Additional information on the functions of the digital I/Os".
	Possible functions for ***outputs***: ***Notice!*** *Available here are only programmable outputs that were previously configured under "Configuration - Device - Digital I/Os" (standard setting = none)!* **Result OK/NOK** Overall result (AND-link of the results of the individual tools) **Ready** Ready for testing, trigger can be processed. The following applies during process operation: If a trigger signal is received while a check program is being processed, i.e. while the device is not ready for testing, a "Lost trigger" warning is entered in the diagnostic log **Programmable** Output can be assigned to an individual result from image processing tools. **External flash** Trigger pulse for switchable external illumination or external flash module; pulse duration corresponds to exposure time. **Device error** Signals an error at the device
	Possible functions for ***passive ports***: digital port has no function.
Pulse duration [ms]	Only possible for the "**Result OK/NOK**" and "**Programmable**" functions). Only values between 0 and 65535 can be entered. If a value that is too large is entered, "65535" is displayed. The value represents the pulse length of the output, "0" means "Static" and allows the output to remain pending until the next trigger.
Signal delay [ms]	Only possible for the "**Trigger**", "**Ready**", "**Result OK/NOK**" and "**Programmable**" functions). With "**Trigger**": Delayed image acquisition after the rising edge of the trigger pulse. The trigger pulse must be applied for at least the duration of the signal delay. For output signals: Start-up delay of the output signal. Only values between 0 and 65535 can be entered. If a value that is too large is entered, "65535" is displayed.
Debounce time [ms]	Only possible for "**Trigger**", "**Program selection**" and "**Program change**". Minimum pulse length of an input signal; shorter pulses (induced by electromagnetic interference) are ignored. Only values between 0 and 1000 can be entered. If a value that is too large is entered, "1000" is displayed.

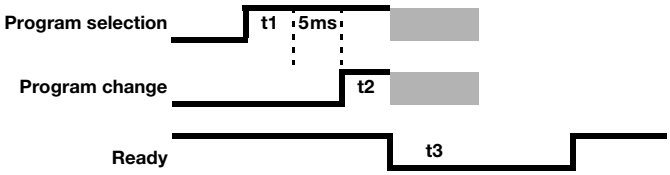
Parameter	Explanation
Inverted	For **outputs**: Signal is inverted For **trigger**: Input responds to falling edge

Additional information on the functions of the digital I/Os

Program change - Debounce times

- In the simplest case (debounce times = 0), the signals for "program selection" should be applied for at least 5ms before the "program change" signal is set.
- If the debounce times of the input signals are not equal to 0, the "Program selection" signal is activated no sooner than after the set debounce time t1 + 5ms has elapsed, i.e. the "Program change" signal cannot be set before this time. However, this, too, is not active until after debounce time t2 has elapsed.
  Thus, the minimum pulse length of the program selection signals = 5ms + t1 + t2

While the new check program is being loaded, an inactive "Ready" indicates that no trigger signals can be processed.



t1/t2 = debounce time
t3 = loading time of a new check program

Max. number of externally selectable programs: 64 (via 6 bit).

A certain input function (trigger, program selection bit x, program change) may only be assigned to one port at a time.

Notice on automatically changing check programs via digital inputs

In the "Configuration-> Programs" tab, the check programs are first created and assigned a selection ID. At least two programs must be created with an individual selection ID (0 and 1). With n bits, 2^n different states can be represented. For example, with two bits, $2^2 = 4$ different check programs can be addressed – specifically: 00 (0), 01 (1), 10 (2) and 11 (3).

In the "Configuration-> Device" tab, the digital inputs for the program-selection bits and for the program change are defined.

*Save the configuration in the **LSIS 4xxi** and switch to Process mode.*

Following program selection via the corresponding program-selection bits, the "program change" input must be activated.

The program changeover now occurs. Depending on the focus setting range, program changeover may take a few seconds. The new check program, with all illumination and analysis settings, is loaded and the motor-driven focus moves to the check-program-specific position.

If two or more programs have the same focus setting (e.g., 100mm), a change between these programs typically takes between 50ms and 100ms; no reference movement then occurs.

For the following reasons, the automatic check program change is intended only for lot changes, and not constantly during the process:

- *The stepping motor for moving the objective is designed for max. 10,000 movement cycles*
- *During every tenth movement, the stepping motor also passes over a reference position for synchronization if the focus position between the programs that are being changed between is not the same. During the process, this would result in a considerably longer change time (several seconds) on every tenth program change.*
  Comment: *A movement cycle consists of two movement operations. It follows that a reference movement consists of one cycle, and a normal movement to a new focus position consists of a half cycle.*

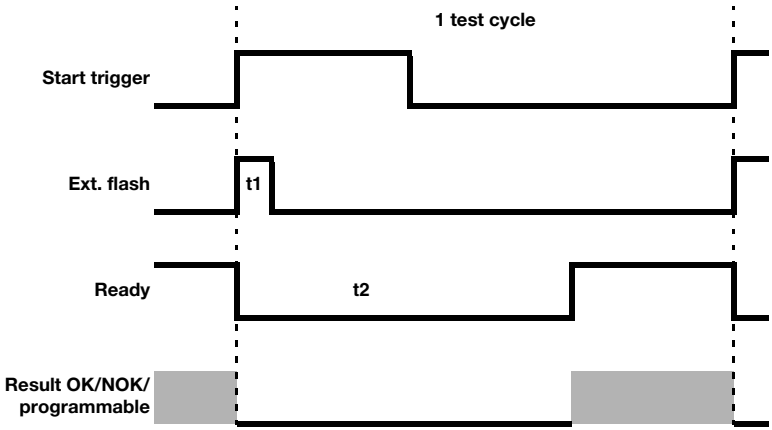
Dependencies and time behavior of the inputs / outputs

For the sake of clarity, the individual signal curves for "Signal delay = 0" and "Pulse duration = static" are displayed.

For "Signal delay not equal to 0", the trigger signal triggers image acquisition with a corresponding delay / sets the affected outputs with a corresponding delay.

For "Pulse duration not equal to static", the corresponding outputs are reset after the corresponding time.

The "Device error" output remains pending statically.



t1 = shutter time
t2 = execution time of check program

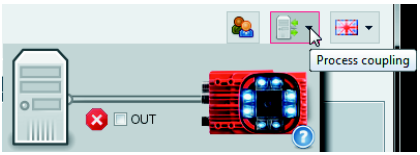
Notice!

As an alternative to the digital trigger input, the RS 232 or Ethernet interface can also be used for triggering or changing the check program in the "Process" operating mode.
*For **triggering**, the "+" character must be sent to the **LSIS 4xxi** via RS 232 or the defined Ethernet process interface.*
To implement the application where the "+" character starts the reading gate control, the "Command-controlled reading gate" check box must be activated.

*To **change the check program**, the "GAI=xxx" command is sent to the **LSIS 4xxi** via the RS 232 or the defined Ethernet process interface. Here, "xxx" stands for the selection ID of the check program in the program list.*
After successfully changing to a different check program, the device sends the "GS=00" character string as confirmation. A value not equal to "00" signals an error
(see "Program changeover" on page 212 for details).

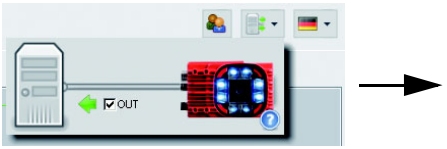
Notice!

***Effects of the "Process coupling"** check box*



With respect to the digital outputs and the RS 232 and Ethernet communication, deactivating this check box has the same effect as mechanically disconnecting the plug:

- If the check box is active (check set), the outputs function in the same way as during process operation.





Display in the status line

- If the check box is passive (no check set), the outputs are deactivated (0V) and the RS 232 or Ethernet output suppressed.
  Exception: The "Tunneled" output for controlling an external flash is always active.



Display in the status line

3.3.3.2 "*Communication -> RS 232*" menu

The RS 232 interface is configured in this window.

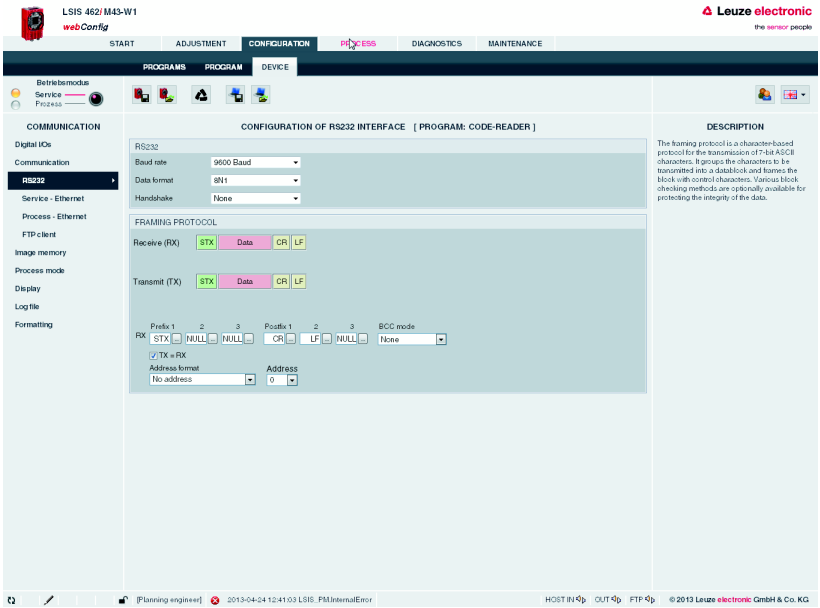


Figure 3.53: "Configuration" module, "Device" tab – "RS 232" communication

"*RS 232*" *parameter group*

Parameter	Explanation
Baud rate	Selection of the serial communication baud rate. The baud rate specifies the speed of the data transmission. It must be identical on transmitter and receiver side in order to enable communication.
Data format	Selection of the serial communication data mode. This is specified with the number of data bits, parity and number of stop bits. For example, "**8N1**" means 8 data bits, no parity, 1 stop bit.
Handshake	Selection of the serial communication handshake.

"Framing protocol" parameter group

The framing protocol is a character-based protocol for the transmission of 7-bit ASCII characters. It groups the characters to be transmitted into a datablock and frames the block with control characters. Various block checking methods are optionally available for protecting the integrity of the data.

Parameter	Explanation
Prefix 1	Minimum: 0 Maximum: 127 Default: 2 Data type: UINT 8
Prefix 2	Minimum: 0 Maximum: 127 Default: 0 Data type: UINT 8
Prefix 2	Minimum: 0 Maximum: 127 Default: 0 Data type: UINT 8
Postfix 1	Minimum: 0 Maximum: 127 Default: 13 Data type: UINT 8
Postfix 2	Minimum: 0 Maximum: 127 Default: 10 Data type: UINT 8
Postfix 3	Minimum: 0 Maximum: 127 Default: 0 Data type: UINT 8
BCC mode	Minimum: none Maximum: BCC mode 11 Default: none Data type: UINT 8 Computation algorithm for the receive check character of the respective interface. In order to detect transmission errors, it is possible to add a check character to the message. The check character is computed from the data in a message. A transmission error can be detected by the receiver recomputing the same computation and comparing its check character with the check character received.
Address format	Minimum: no address Maximum: auto. address Default: no address Data type: UINT 8 Address format of the address of the serial interface. The address identifies the receiver or transmitter of a message. In this context, all participants have different addresses.
Address	Minimum: 0 Maximum: 32 Default: 0 Data type: UINT 8 The address identifies a single device within a network. The device can be addressed in the framing protocol via this address.

3.3.3.3 "*Communication -> Service - Ethernet*" menu

The Ethernet service interface can be set here.

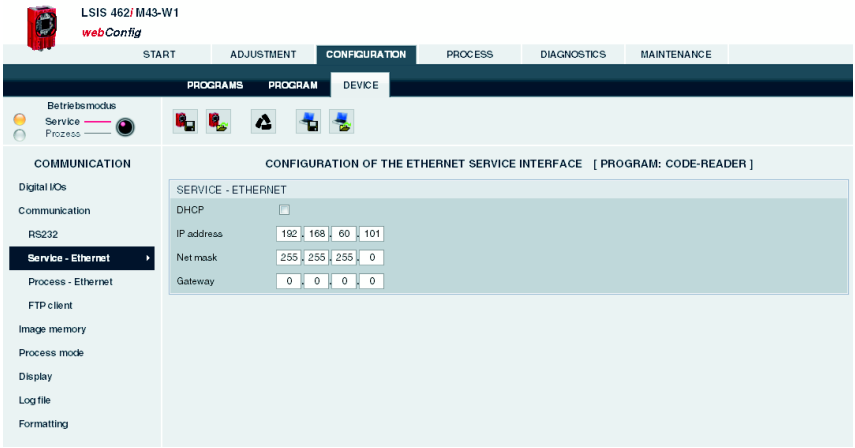


Figure 3.54: "Configuration" module, "Device" tab – "Service - Ethernet" communication

Notice!

Upon changing the IP address, it is necessary to save the settings and restart the device in order to work effectively with the new address.
After restarting the device, it can then only be reached via the new address.

"*Service - Ethernet*" *parameter group*

Parameter	Explanation
DHCP activated	If set, TCP/IP parameters are determined by a DHCP server.
IP address	The IP address is used as a unique address for the device in an IP network. It consists of a 32 bit value that is subdivided into four 8 bit values each. These can each have a value of 0 to 255.
Subnet mask	The subnet mask is used to identify the subnet part of the IP address. It has the same length as the IP address (32 bits), and, in binary form, must consist of a sequence of 1-bits followed by 0-bits. It is normally entered in the same format as an IP address - four numbers, each from 0 to 255.
Gateway	The gateway address identifies a particular device in an IP (sub-)net that acts as a gateway to other (sub-)nets. The address is only required when communication across network boundaries is necessary.

3.3.3.4 "*Communication -> Process - Ethernet*" menu

In this window, you will find parameters for process data transfer via Ethernet. Defined here, for example, is whether the **LSIS 4xx*i*** performs the server or the client function during TCP/IP communication of if communication occurs via UDP.

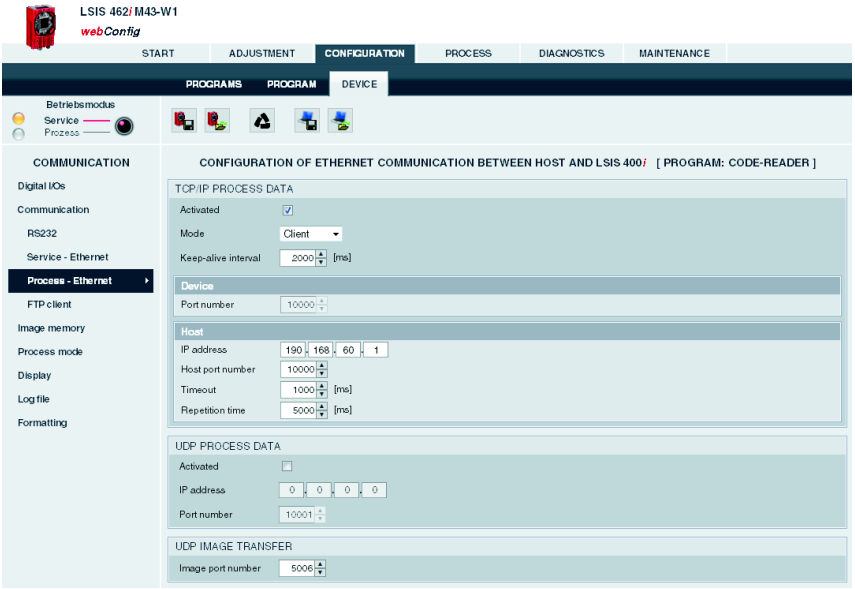


Figure 3.55: "Configuration" module, "Device" tab – "Process - Ethernet" communication

"Process - Ethernet-> TCP/IP process data transfer" parameter group - LSIS in server mode (default)

In TCP server mode, the primary host system (PC / PLC) actively establishes the connection and the connected **LSIS 4xx*i*** waits for the connection to be made. The TCP/IP stack must be informed by the user as to the local port of the **LSIS 4xx*i*** (port number) on which connection requests from a client application (host system) are to be received. If a connection request and connection setup are pending from the primary host system (PC / PLC as client), the **LSIS 4xx*i*** (server mode) accepts the connection,enabling the sending and reception of data.

Parameter	Explanation
TCP/IP process data	
Activated	Data type: BOOL Default: false Host TCP/IP communication activated.
Mode	TCP/IP mode: Data type: ENUM Min: server Max: client Default: server Mode of the host TCP/IP communication.
Keep-alive interval	Keep-alive interval: Data type: UINT16 Min: 0 [ms] Max: 65535 [ms] Default: 2000 [ms] In order for the device to determine whether the connection to the host still exists, keep-alive messages, which are answered by the host, can be cyclically transmitted. This parameter defines the time interval [ms] in which the keep-alive messages are transmitted. A value of 0 deactivates the transmission of keep-alive messages.
Device	
Port number	Port number: Data type: UINT16 Min: 0 Max: 65535 Default: 10000 The LSIS400i is waiting for connections from the host at this port number. The corresponding IP address is set under the 'Service - Ethernet' menu item

"Process - Ethernet-> TCP/IP process data transfer" parameter group - LSIS in client mode

In TCP client mode, the **LSIS 4xx*i*** actively establishes the connection to the primary host system (PC / PLC as server). The **LSIS 4xx*i*** requires from the user the IP address of the server (host system) and the port number on which the server (host system) accepts a connection. In this case, the **LSIS 4xx*i*** determines when and with whom a connection is established!

Parameter	Explanation
TCP/IP process data	
Activated	Data type: BOOL Default: false Host TCP/IP communication activated.
Mode	TCP/IP mode: Data type: ENUM Min: server Max: client Default: server Mode of the host TCP/IP communication.
Keep-alive interval	Keep-alive interval: Data type: UINT16 Min: 0 [ms] Max: 65535 [ms] Default: 2000 [ms] In order for the device to determine whether the connection to the host still exists, keep-alive messages, which are answered by the host, can be cyclically transmitted. This parameter defines the time interval [ms] in which the keep-alive messages are transmitted. A value of 0 deactivates the transmission of keep-alive messages.
Host	
IP address	Host IP address for LSIS400i connection to the host in client mode.
Host port number	Host port number: Data type: UINT16 Min: 0 Max: 65535 Default: 10000 Host port number for LSIS400i connection to the host in client mode.
Timeout	Timeout: Data type: UINT16 Min: 100 Max: 60000 Default: 1000 After this time passes, the LSIS400i terminates its attempt to establish a connection to the host.
Repetition time	Repetition time: Data type: UINT16 Min: 100 Max: 60000 Default: 5000 If a connection cannot be established to the host, the device waits this amount of time before the next attempt.

"*Process - Ethernet-> UDP process data transfer*" parameter group - *Communication via UDP*

The **LSIS 4xx*i*** requires from the user the IP address and the port number of the communication partner. In the same way, the host system (PC / PLC) now also requires the set IP address of the **LSIS 4xx*i*** and the selected port number. By assigning these parameters, a socket is formed via which the data can be sent and received.

Parameter	Explanation
UDP process data	
Activated	Activated: Data type: BOOL Default: false Host UDP communication activated.
IP address	Host IP address for UDP communication.
Port number	Port number: Data type: UINT16 Min: 0 Max: 65535 Default: 10001 Host port number for UDP communication.

"*Process - Ethernet-> UDP image transfer*" parameter group

Parameter	Explanation
UDP image transfer	
Image port number	Image port number: Data type: UINT16 Min: 0 Max: 65535 Default: 5006 The image port number specifies via which port an image request from an external control is read and the recorded image is transferred. Upon request from a PLC or PC, the "get img" command then transfers the last recorded image via Ethernet (UDP). Prerequisite for this is that the "Enable image transfer" option be selected for the image acquisition tool (see section ""Enable image transfer" check box" on page 42). The corresponding IP address is set under the 'Service - Ethernet' menu item.

3.3.3.5 "*Communication -> FTP Client*" menu

In this window, you will find parameters for process data transfer via FTP. Here, you can set the IP address and the port number of the FTP server with which communication is to occur. You can assign user names and password settings or use the "Passive mode" option to define the direction of communication. Activating this option causes the FTP client to establish an outgoing connection to the server here. This is recommended if one wishes to prevent the blocking of an incoming connection (FTP-server connection to the client) by a firewall.

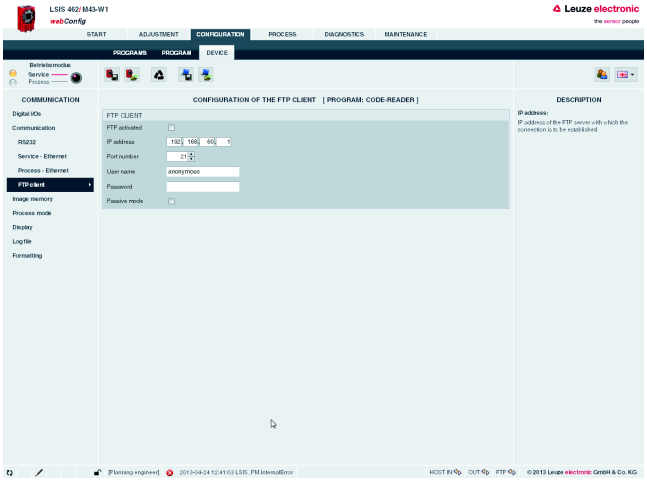


Figure 3.56: "Configuration" module, "Device" tab – "FTP Client" communication

Transferring images and log files via FTP

Parameter	Explanation
FTP activated	FTP communication activated.
IP address	IP address of the FTP server with which the connection is to be established.
Port number	Port number of the FTP server with which the connection is to be established.
User name	The LSIS 400i uses this user name to log onto the FTP server.
Password	Optional: when needed from the FTP server for logging in.
Passive mode	The FTP server connects to the FTP client during active establishment of communication. If an FTP client is located behind a firewall, this can block access. The connection between the FTP client and the FTP server is not made. During passive establishment of communication (check box active), the FTP client connects to the FTP server. If the FTP client is located behind a firewall, however, the connection is made because it is an outgoing connection which is not blocked by the firewall.

3.3.3.6 "*Image memory*" menu

The internal image memory is used for quickly logging process images (fault images/good images) as well as permanently saving reference images. You can configure the image memory by first organizing the memory and then defining the storage mode, selection and recording for the process images.

Process images are stored in RAM memory and are deleted if power is lost. Reference images are stored in non-volatile FLASH memory and are retained if power is lost.

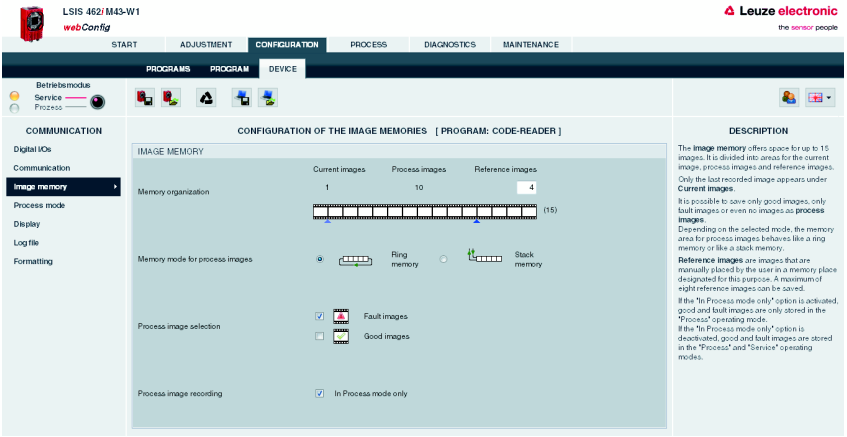


Figure 3.57: "Configuration" module, "Device" tab – Image memory

Notice!

Changing how the memory is organized results in the deletion of all saved process images and, if necessary, the deletion of individual reference images as well.

"*Image memory*" *parameter group*

Parameter	Explanation
Memory organization	Displayed in the film strip are a current image and 14 process and reference images. Each image is labeled with a time stamp that uniquely identifies it. Process images are displayed with a green or red frame, depending on whether they resulted in a good or bad test result at the time they were taken. The reference images are stored permanently in the flash memory of the LSIS. In order to store a new reference image, there must be at least one free space available in the memory range that is configured for reference images. Reference images are manually placed by the user in a memory place designated for this purpose; a maximum of eight reference images can be saved. **Attention!** Changing how the memory is organized results in the deletion of all stored process images and, if necessary, the deletion of individual reference images as well.
Memory mode for process images	Select from the following options: **Ring memory** – the oldest images are overwritten first. I.e. this option is used for evaluating the most recently recorded images. **Stack memory** – only the last image is updated. This is used for evaluating the first recorded images.
Process image selection	The following options are made available by selecting the check boxes: Only **Good images**, only **Fault images**, **all** or **none**.
Process image recording	Here, you can select whether recording of the process images occurs only in Process mode or in Configuration mode as well.

3.3.3.7 "*Process operation*" *menu*

This window is used to configure process operation. With the camera operating mode, you specify the mode in which the check program is executed in process operation: either in an endless loop or once following an external trigger signal. Furthermore, you define in the "Process" module whether the image and/or process data is displayed in a terminal window. You can configure the contents of the terminal window in the check program in the "Output" tool. By activating the "Command-controlled reading gate" option, you can then define that the "+" character is to be interpreted as reading gate start. If the option is deactivated (default), the "+" character is interpreted as trigger.

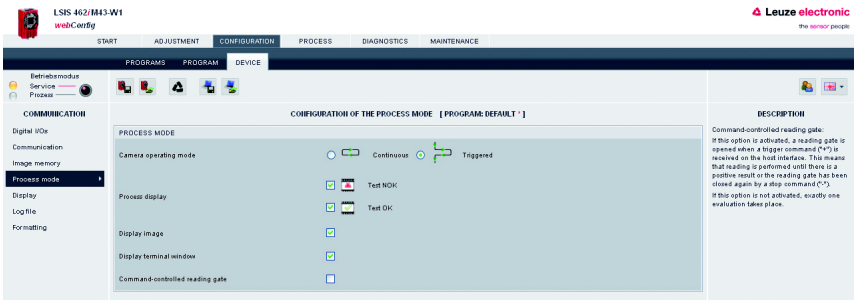


Figure 3.58: "Configuration" module, "Device" tab – Process operation

Parameter	Explanation
Camera operating mode	The camera operating mode determines the point in time of image acquisition. The individual options are: In the "**Continuous**" camera operating mode, the check program is run in an endless loop as soon as the device is in process operation ("Process" operating mode). In the **Triggered** camera operating mode, an image is recorded and evaluated via a digital trigger input on the rising edge of a trigger signal. Prerequisite for "Triggered": a digital input of the LSIS 400i must be defined as a trigger input!
Process display	Settings for "Process" tab display: "**Test OK**": Image and/or process data is displayed when the test result is OK "**Test NOK**": Image and/or process data is displayed if the test result is NOK
Image displays	Image display settings: If they are activated, the analyzed image is displayed in the "Process" tab.
Display terminal window	Settings for terminal window display: When activated, the result data of the displayed image are shown in the "Process" tab in the terminal window. Which process data are displayed is defined under "Configuration -> Program -> Output -> Process".
Command-controlled reading gate	If this check box is activated, a reading gate is opened when a trigger command ("+") is received on the host interface. This means that reading is performed until there is a positive result or the reading gate has been closed again by a stop command ("-"). If this option is not activated, exactly one image acquisition and evaluation takes place.

3.3.3.8 "*Display*" menu

Basic settings for the device display can be made in this window. Thus, it is possible to select the background lighting, the contrast and the language not only on the device itself, but also in ***webConfig***. The option to rotate the display by 180° simplifies reading of the display information in difficult installation situations.

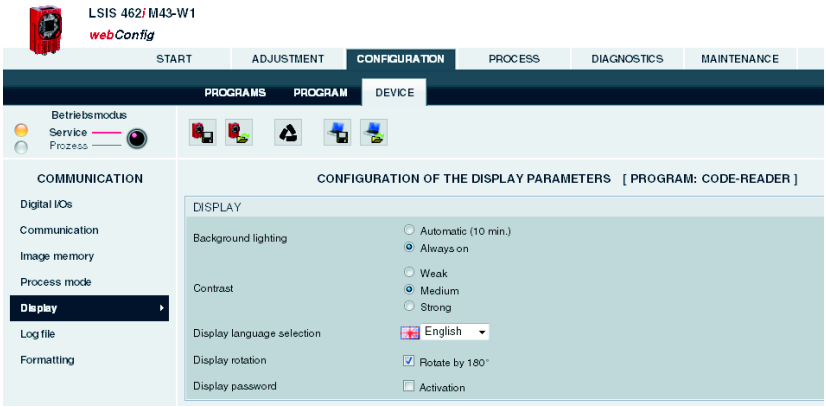


Figure 3.59: "Configuration" module, "Device" tab – Display

Parameter	Explanation
Background lighting	This parameter takes care of the background lighting of the display. The following values are possible: Automatic (0): if no button is pressed for 10 minutes, the background lighting is switched off. Always on(1): background lighting is always on.
Display contrast	This parameter is responsible for the display contrast. The following values are possible: Weak(0): low contrast Medium(1): average contrast (default) Strong(2): strong contrast
Display language selection	This parameter is responsible for the display language.
Display rotation	This parameter is responsible for display rotation.

3.3.3.9 *"Log file" menu*

Here, you can select whether the log file is to be written only in the "Process" operating mode or if it should also be written in the "Service" operating mode.



Figure 3.60: "Configuration" module, "Device" tab - Log file

Parameter	Explanation
Configuration of the log file	If the "In Process mode only" option is activated, the log file is only written in the "Process" operating mode. If the "In Process mode only" option is deactivated, the log file is written in the "Process" and "Service" operating modes.

3.3.3.10 "Formatting" menu

Basic settings for formatting date and time values and for numbers can be made in this window. Units for length, area and angle can also be defined here.

For the check programs, a format that differs from the settings made here (chapter 3.3.1) can be selected.

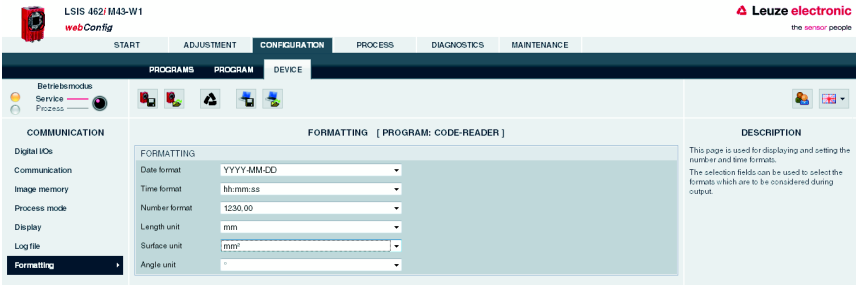


Figure 3.61: "Configuration" module, "Device" tab - Formatting

Parameter	Explanation
Date format	The drop-down list box allows different date formats to be selected: • **YYYY-MM-DD** [Year, 4 digits] - [Month, 2 digits] - [Day, 2 digits] • **YYYY-MM-DD** [Year, 4 digits] / [Month, 2 digits] / [Day, 2 digits] • **DD.MM.YYYY** [Day, 2 digits] . [Month, 2 digits] . [Year, 4 digits]
Time format	The drop-down list box allows different time formats to be selected: • **hh:mm:ss** [hour, 2 digits] : [minute, 2 digits] : [second, 2 digits] • **h:mm:ss** [hour, 1 or 2 digits] : [minute, 2 digits] : [second, 2 digits]
Number format	The drop-down list box allows different number formats to be selected: • **1.230,00** Thousand with "Point" separator character, decimals with "Comma" separator character • **1230,00** Thousand without separator character, decimals with "Comma" separator character • **1 230,00** Thousand separated by space, decimals with "Comma" separator character • **1,230.00** Thousand with "Comma" separator character, decimals with "Point" separator character • **1230.00** Thousand without separator character, decimals with "Point" separator character • **1 230.00** Thousand separated by space, decimals with "Point" separator character

Parameter	Explanation
Length unit	The drop-down list box allows different length units to be selected: • **µm** micrometer = 1 x 10^{-6} m = 0.000 001 m • **mm** millimeter = 1 x 10^{-3} m = 0.001 m • **cm** centimeter = 1 x 10^{-2} m = 0.01 m • **dm** decimeter = 1 x 10^{-1} m = 0.1 m • **m** meter = 1 m • **px** pixel = image point = elementary resolution of the camera chip
Surface unit	The drop-down list box allows different surface units to be selected: • **µm²** micrometer^2 = 1 x 10^{-12} m^2 = 0.000 000 000 001 m^2 • **mm²** millimeter^2 = 1 x 10^{-6} m^2 = 0.000 001 m^2 • **cm²** centimeter^2 = 1 x 10^{-4} m^2 = 0.000 1 m^2 • **dm²** decimeter^2 = 1 x 10^{-2} m^2 = 0.01 m^2 • **m²** meter^2 = 1 m^2 • **px²** pixel^2 = image point^2 = elementary surface of the camera chip
Angle unit	The drop-down list box allows different angle units to be selected: • **°** angle specification in degrees (full angle of a circle = 360°) • **rad** angle specification in radian measure (full angle of a circle = 2π)

3.4 "Process" module

In the "Process data" window, current production operation is depicted with a display of the counter states for the total number of parts that have been tested as well as the parts tested as OK and NOK. Please note that the data may be displayed with a time delay depending on the current processing speed and the type of data being displayed.

With the appropriate authority level, you have the option here of selecting between Process and Service mode by clicking the respective term or the button in the left area. In addition, you can set the counter to zero.

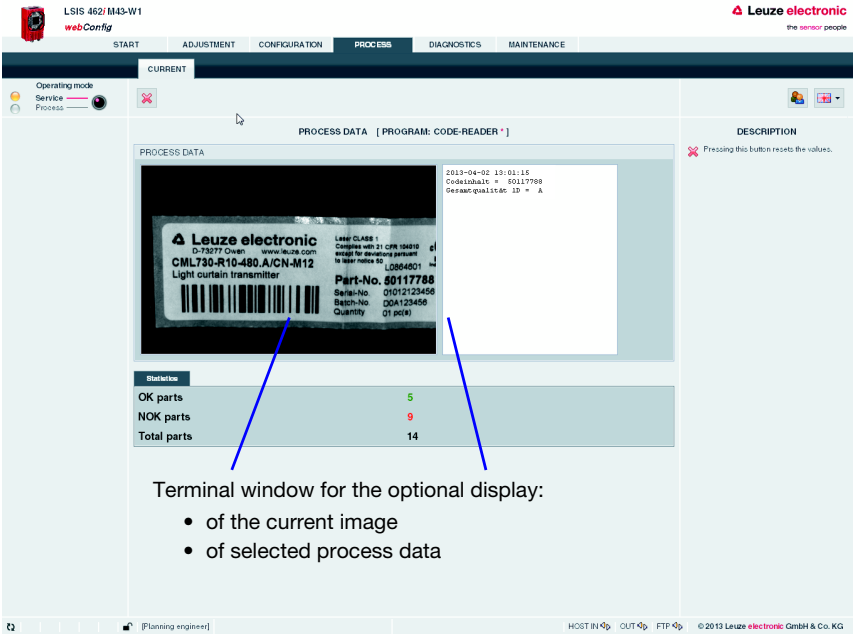


Figure 3.62: User interface of the "Process" module

The button bar contains the following element:



Pressing this button resets the values.

The most recently recorded image can optionally be displayed in the upper part of the window. To do this, the following conditions must be satisfied:

- Image transfer must be activated in the image acquisition of the check program sequence. See "Configuration -> Program -> Image acquisition -> General" of the respective program (1).
- In the "Configuration" module, with "Device -> Process operation", the image display for process operation must be switched on (2) and which test results are to be displayed must be selected (3).

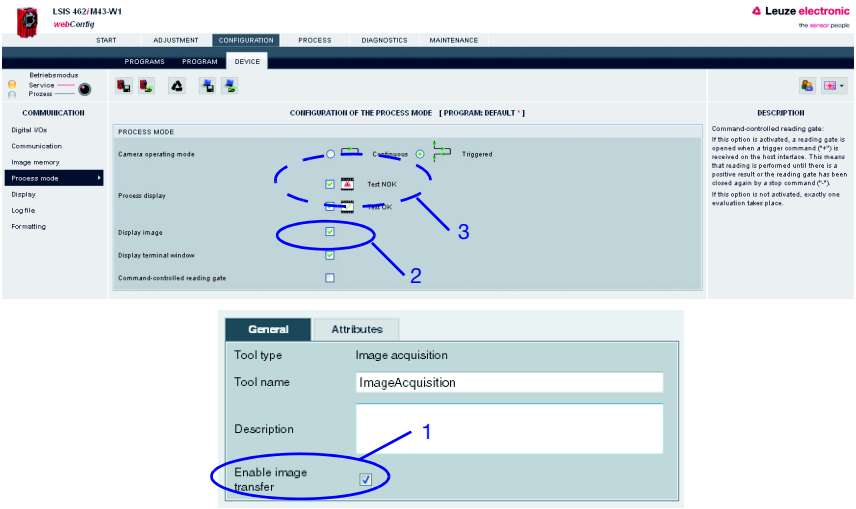


Figure 3.63: Prerequisites for displaying images in the "Process" tab

To display process data in the terminal window, the following conditions must be satisfied:

- In the "Configuration" module, with "Device -> Process operation", the terminal display must be switched on in process operation.
- In the "Configuration" module, which data is to be output in what form must be defined for the output tool of the respective program. See "Configuration -> Program -> Output -> Process" of the respective program.

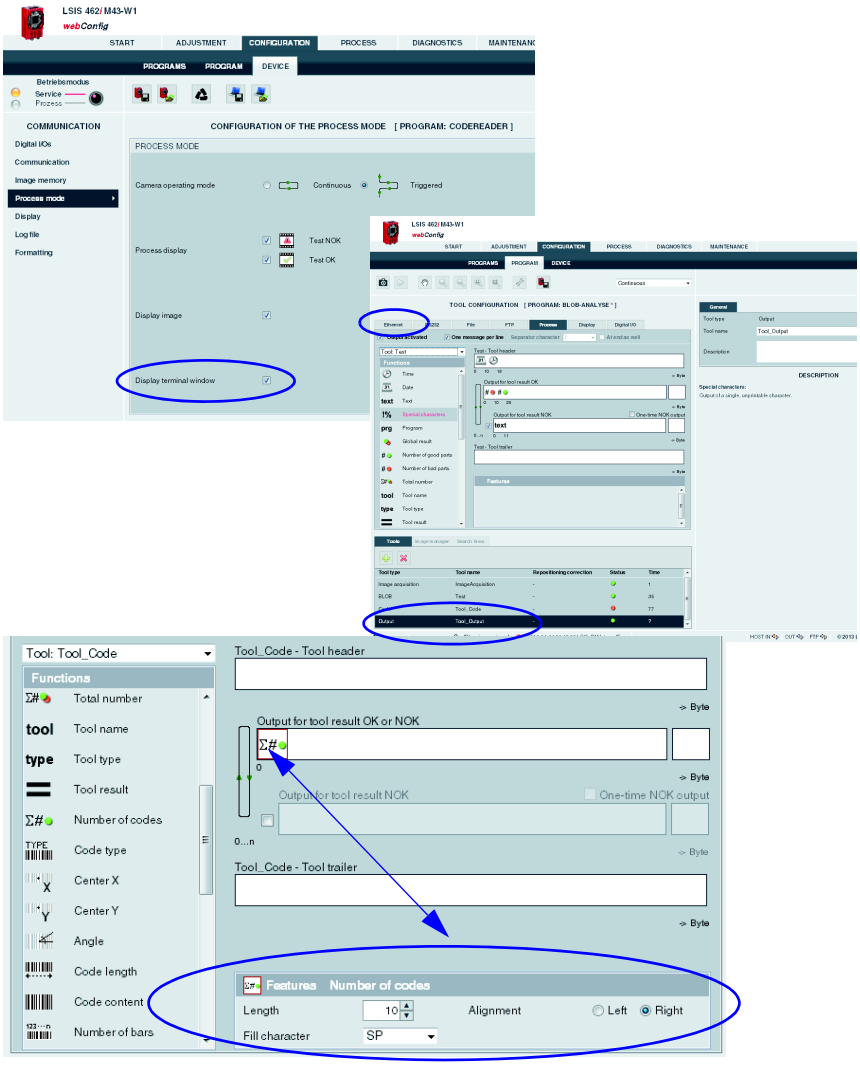


Figure 3.64: Prerequisites for displaying data in the "Process" tab

3.5 "Diagnostics" module

The "Diagnostics" module is used for logging events and output data.

Noteworthy system events are recorded in an event log. Depending on their importance, these are classified as warning, error or info. Errors result in a red PWR-LED; in addition, an assigned output is set. The output data is recorded in a log file, the format of which was configured previously in the output tool of the check programs, see page 36et seq.

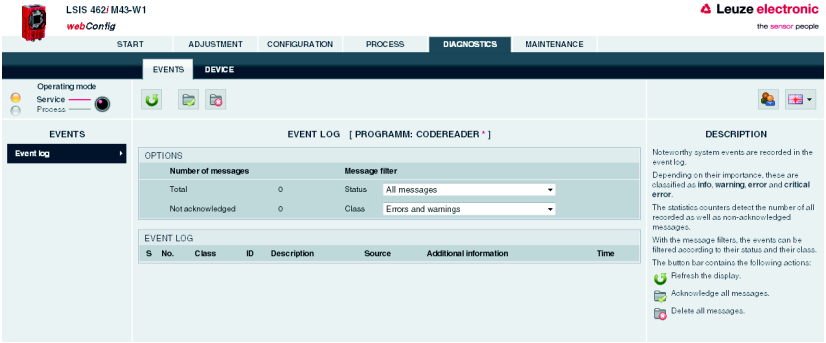


Figure 3.65: User interface of the "Diagnostics" module

Logs are displayed and configured in the "Events" and "Device" tabs.

3.5.1 "Events" tab

The event log is displayed in this window. The number of all recorded as well as non-acknowledged messages is recorded in a statistics counter.

Notice!

Please note that the error memory only contains 25 entries; the total number is, however, counted until the next reset.

To select events according to their status and their class, select the required message filter from a list box.

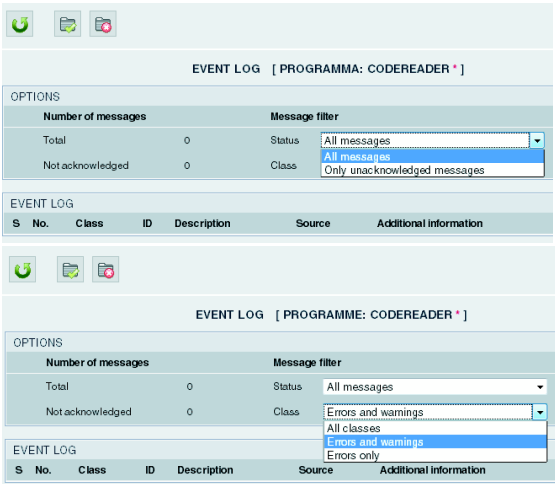


Figure 3.66: Event selection according to status and class

Use the corresponding buttons to update the display, acknowledge messages and – provided you have the necessary authorization – also delete messages.

Buttons

The button bar contains the following elements:


Refresh the display.


Acknowledge all messages.


Delete all messages.

3.5.2 "Device" tab

In the "Device" tab, it is possible to define the digital inputs and outputs and to display the log of the output data.

3.5.2.1 "Digital I/Os" menu

With the "Set/Reset" button, it is possible to permanently set or reset the output: **`Set`** forces the output to "1", **`Reset`** forces the output to "0"

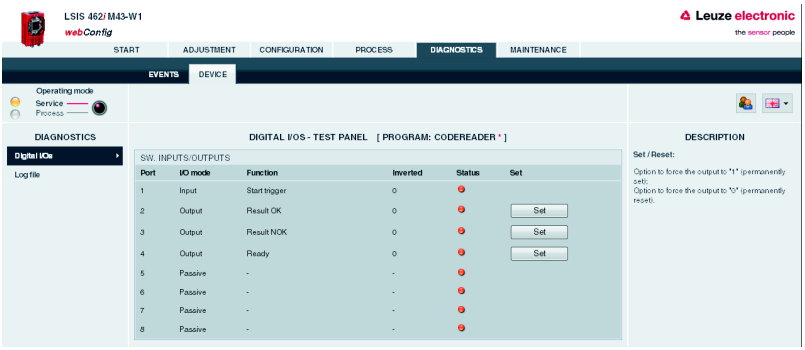


Figure 3.67: "Diagnostics" module, "Device" tab - Digital I/Os

The status of the inputs is displayed in the "Status" column:

Orange LED: no voltage present

Green LED: voltage present

Gray LED : I/O passive

3.5.2.2 "Log file" menu

The output data is logged in the log file. As long as the device is in the Process operating mode, the output data is written to an internal buffer. Upon change to the Service operating mode, the data is written from the buffer to the log file and can then be displayed here. The maximum size of the log file is 500kB.

Notice!

The format of the log file is configured in the output tool of the check programs, see page 36 et seq.

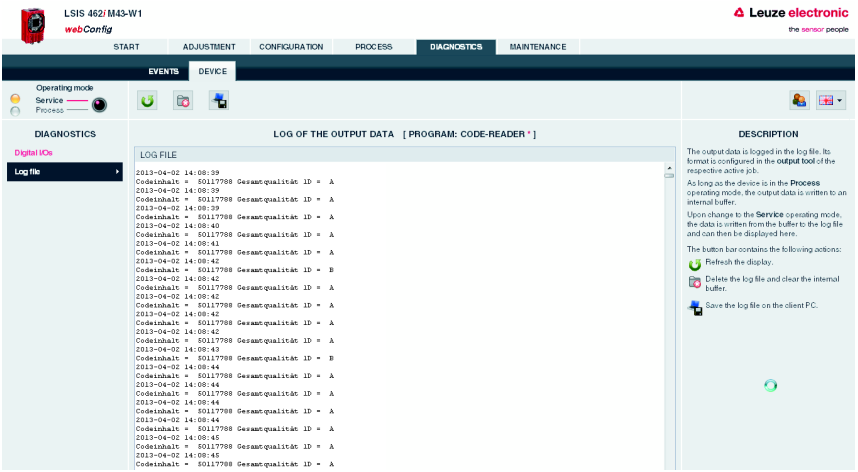


Figure 3.68: "Diagnostics" module, "Device" tab - Log file

Buttons

The button bar contains the following elements:



Refresh the display.



Delete the log file and clear the internal buffer.



Save the log file on the client PC.

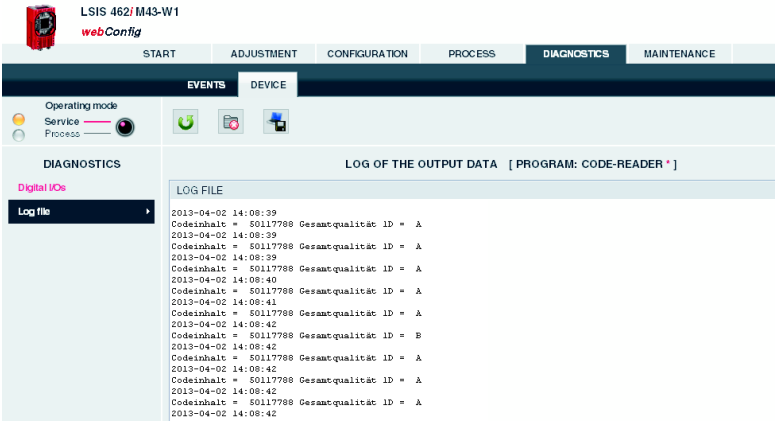


Figure 3.69: Display of the output data in the log file

3.6 "Maintenance" module

Depending on authority level, the "User management" and "System" tabs are available in the "Maintenance" module.

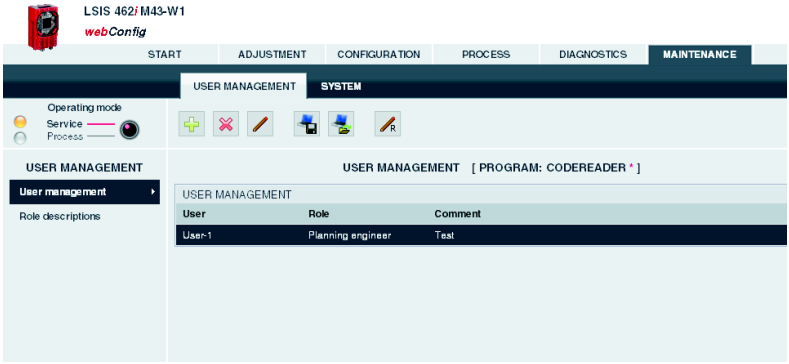


Figure 3.70: User interface of the "Maintenance" module

3.6.1 "User management" tab

The "User management" tab first offers you a list of the created users and their respective "Role". Using the appropriate buttons and taking into account your own authority level, you can create new users or delete existing users here. In addition, password definitions can be changed and user data can be imported and exported. Information on the required authority levels can be found in the descriptions of the respective buttons given below.

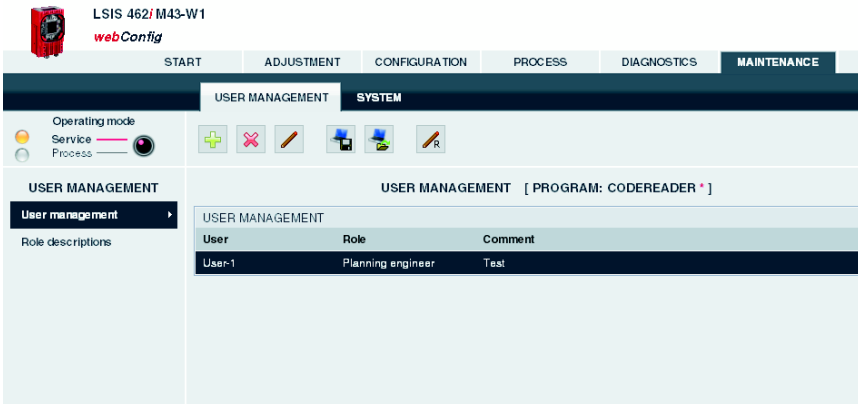


Figure 3.71: "Maintenance" module, "User management" tab

3.6.1.1 "*User management*" menu

Buttons

The button bar contains the following elements:



This button can be used to create a new user; properties include role, password and description. This button is available beginning with the "planning engineer" authority level. It is not possible to create a user with an authority level higher than one's own.

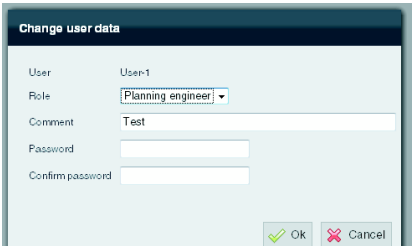


Figure 3.72: User management – Enter user data



The selected user is deleted using this button. This button is only available in the "planning engineer" authority level. It is not possible to delete a user with an authority level higher than one's own.



With this button, a user can change the password and the description of his own user entry. A "planning engineer" can also change the user data for other users and, in doing so, has access to the role. It is not possible to change user data for a user with an authority level higher than one's own; it is likewise not possible to assign a level higher than one's own.



This button can be used to export the user file to the PC that is connected to the **LSIS 4xx*i***. The file contains encrypted passwords, but not the default role.



This button can be used to import the user file from the PC that is connected to the **LSIS 4xx*i***. The file contains encrypted passwords, but not the default role.



Set here is the default role assigned to a user who is not logged in. This role is preset to "planning engineer".

If various password-protected authority levels are to be used, a "planning engineer" can be assigned a default role here with corresponding, lower level.

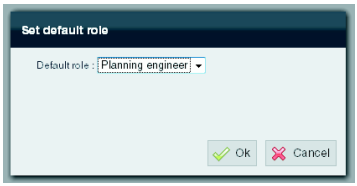


Figure 3.73: User management – Set default role

3.6.1.2 "*Role descriptions*" menu

Click the "Role descriptions" menu item to display a detailed description of the "Roles" that can be used in **LSIS 4xx*i* *webConfig*** and the assigned authorizations. This window is for information purposes only and cannot be edited.

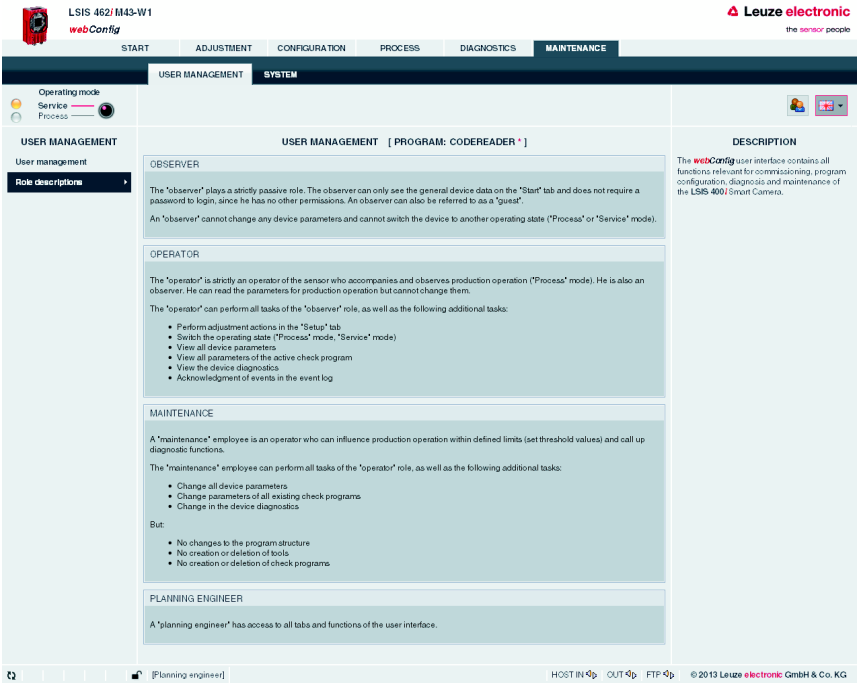


Figure 3.74: "Role descriptions" user interface

3.6.2 "System" tab

The "System" tab groups together functions for system maintenance, such as saving or restoring various device or program states, updating the firmware or setting the system time.

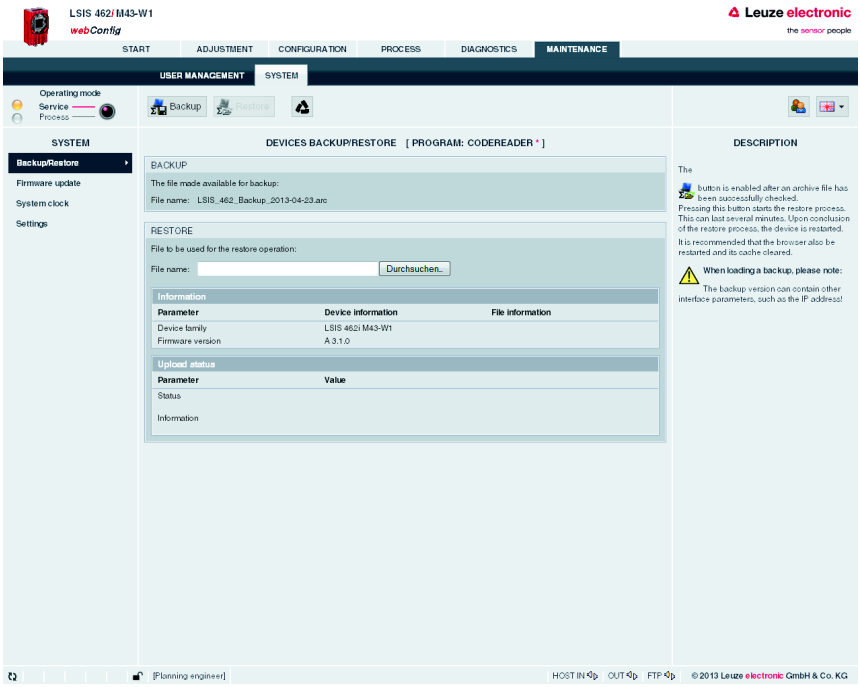


Figure 3.75: "Maintenance" module, "System" tab

3.6.2.1 "Backup/Restore" menu

Three different parameter categories are saved in the **LSIS 4xxi**:

- Program parameters (all check programs with all tool parameters)
- Device parameters (all check-program-independent device settings)
- User parameters (all defined user roles including passwords)

Use the appropriate buttons to save each of these categories on the PC or to load them into the device.

The "Backup/Restore" option, on the other hand, can be used to **completely backup of all parameters** to the PC or to restore the entire device configuration by reading a restore file from the PC.

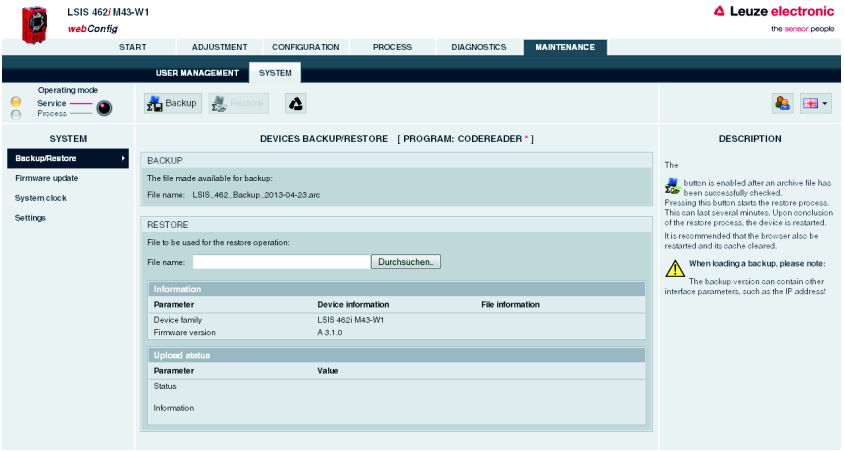


Figure 3.76: "Backup/Restore" user interface

Buttons

The button bar contains the following elements:



Pressing this button creates a device backup on a PC.



The button is enabled after an archive file has been successfully checked by means of the "Search" button.

Pressing this button starts the restore process. This can last several minutes. Upon conclusion of the restore process, the device is restarted. It is recommended that the browser also be restarted and its cache cleared.

Notice:
When loading a backup, please note:
The backup version may contain other interface parameters, such as the IP address!



Pressing this button resets the device to the factory settings. The reference images stored in the device are deleted.
The TCP/IP connection parameters are not changed!
The device retains its IP address.

3.6.2.2 "Firmware update" menu

The "Firmware update" window provides information about the currently used firmware and enables the planning engineer to load new firmware versions.

Notice!

The reload procedure briefly requires a relatively large portion of the flash memory in order to extract the files.
If the flash memory in the device is mostly filled with user data, the reload procedure may, under certain circumstances, terminate! To prevent this, a warning notice appears in the event of memory space problems so that you can first delete any unneeded reference images and/or check programs in the "Configuration" area.
The following rule of thumb applies: The memory space of three reference images or three medium-size check programs is sufficient for safely performing the reload procedure.
If you must delete reference images and/or check programs for the reload procedure that are actually still needed, you should first export them.

Attention!

A complete export does not save any reference images.

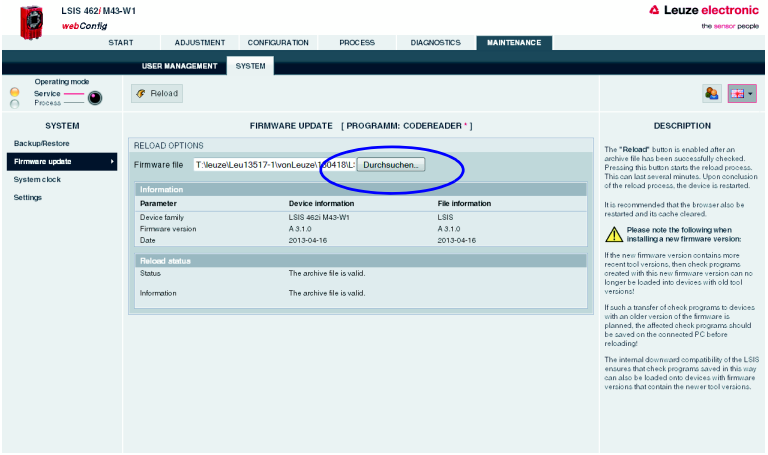


Figure 3.77: "Firmware reload" user interface

Notice!

The following must absolutely be observed when installing a new firmware version:
Because a new firmware may contain newer program functionalities, check programs created with this new firmware can no longer be loaded into devices with older firmware!

If such a transfer of check programs to devices with an older firmware is planned, the affected check programs should be saved on the connected PC before reloading!
*The internal backward compatibility of the **LSIS 4xxi** ensures that check programs saved in this way can also be loaded into devices with a more recent firmware.*

Buttons

The button bar contains the following action:



The **Reload** button is enabled after an archive file has been successfully checked.

Pressing this button starts the reload process. This can last several minutes. Upon conclusion of the reload process, the device is restarted.

It is recommended that the browser also be restarted and its cache cleared.

3.6.2.3 "System clock" menu

This page is used for displaying and setting the current system time. The system time can be changed manually via the input fields. In addition, by selecting the appropriate check box, you can specify whether the output is to be in local time or in universal time.

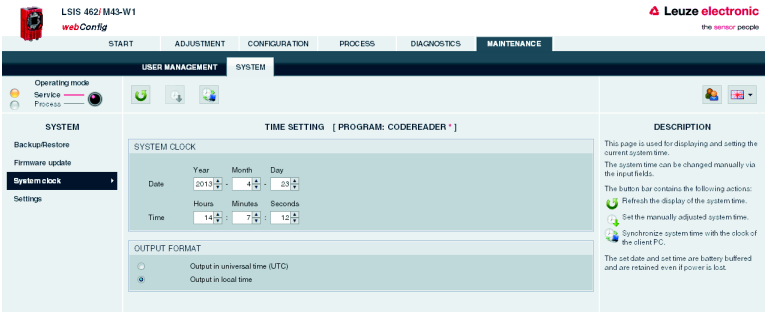


Figure 3.78: "System clock" user interface

Buttons

The button bar contains the following elements:



Refresh the display of the system time.



Set the manually adjusted system time.



Synchronize system time with the clock of the client PC.

4 Working with LSIS 4xx*i* *webConfig*

This chapter explains the configuration of the **LSIS 4xx*i*** using sample applications. The following points should be observed when using ***webConfig*** for the setup process:

- Configure at least one check program and activate it.
- Set up one of the 8 I/Os as a trigger input for the check program. Make certain that this input is correctly connected.
- If you use the RS 232 or Ethernet interface to communicate with the process control, you must configure the transmission parameters of the corresponding interface in the device parameters as well as the data to be output in the data output tool of the respective check program.

4.1 Basic procedure – Step-by-step configuration of a BLOB analysis

In the following, we will explain the procedure, using as an example an electronic component to be inspected for the presence of four metal contact surfaces.

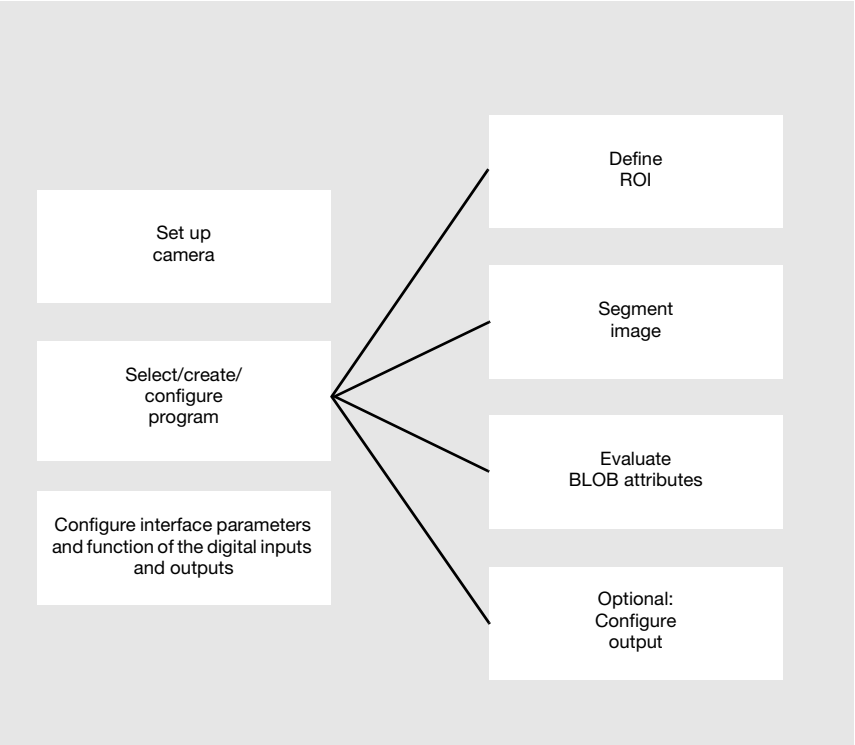


Figure 4.1: Schematic illustration of the BLOB analysis

After switching on the device, **LSIS 4xx*i* *webConfig*** starts in Process mode.

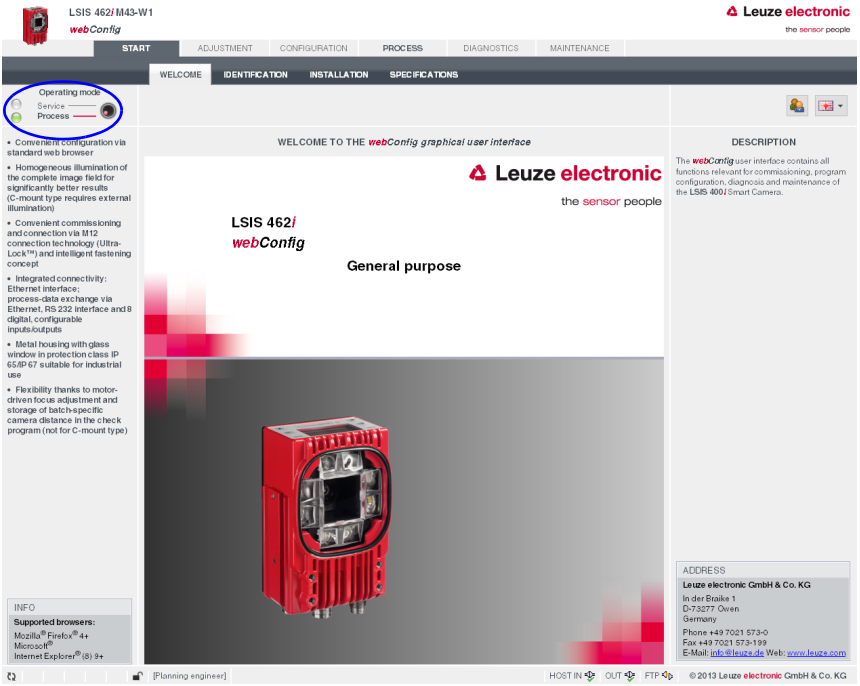


Figure 4.2: Program start in Process mode

In order to access the configuration, management and diagnostic tasks, which are necessary for performing the configuration, you must first switch to Service mode.

↳ *First, select the "Service" operating mode by clicking the* **`Service`** *menu item or the corresponding button.*

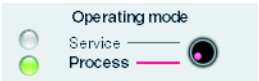


Figure 4.3: Changing the operating mode

You can now select the tabs which were initially disabled.

↳ *Activate the "Configuration" work module.*



Figure 4.4: "Configuration" work module

4.1.1 Setting the parameters for image acquisition

The image acquisition parameters are usually set just once during commissioning. Once the optimum image acquisition parameters, such as focus setting and exposure time, have been set, they can be saved as default values in the camera. They then apply as an editable preset for subsequently created programs.

↳ *Activate the "Adjustment" work module if you would like to change the default settings* for new programs.

If you would only like to change the settings for a single program, proceed as follows:

↳ *Activate the "Configuration" work module in the "Program" tab.*

↳ *Select the "Image Acquisition" tool type in the "Tool selection" area to make the corresponding settings.*

↳ *Make the desired settings in the "Attributes" parameter group.*

With the "Automatic focusing" button an automatic determination of the focal position is started. In doing so, both the setting for the distance to the object as well as the exposure time are varied until a high image sharpness is achieved. This process may take some time. An optimum result is only achieved with flat objects (e.g., labels).

Notice!

Automatic focusing functionality is only available in Service mode as configuration support. An autofocus function that would be usable in Process mode is not implemented on the ***LSIS 4xxi****.*

Save your settings as follows:

- *If you are in the "Program" tab in the "Configuration" work module, save the image acquisition parameters **for the current program** by pressing the button.*
- *If you are in the "Adjustment" work module, save the image acquisition parameters permanently in the flash memory of the **LSIS 4xxi** as default settings by pressing the button.*

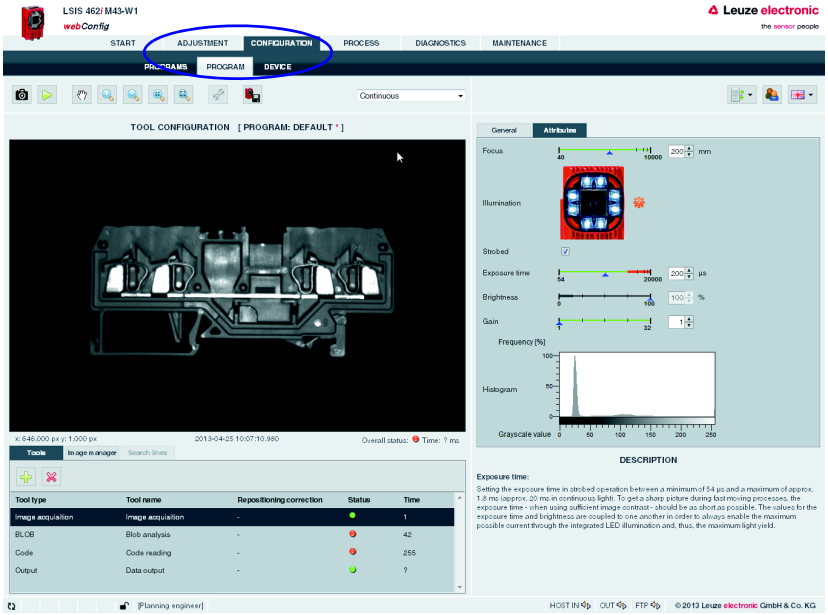


Figure 4.5: Setting the image acquisition parameters

4.1.2 Selecting or creating a new check program

↳ *In the "Configuration" work module, switch to the "Programs" tab.*

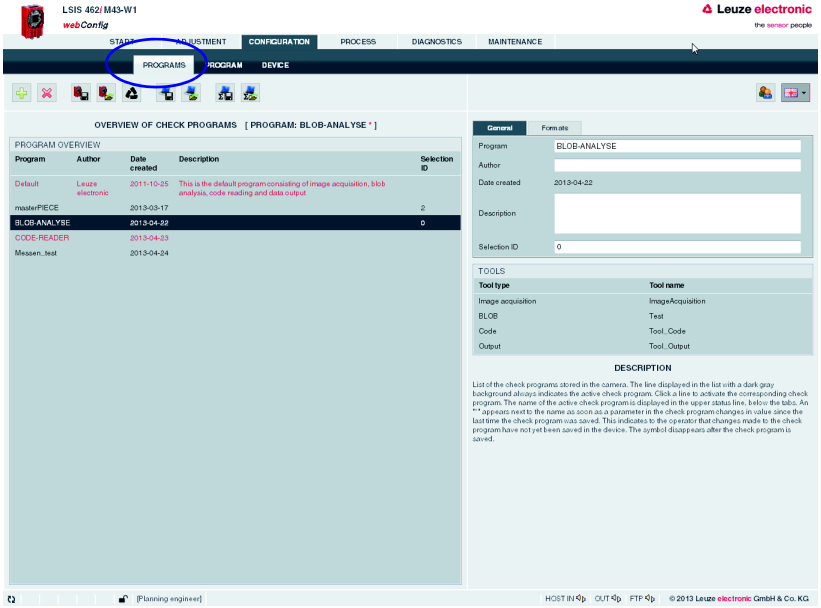


Figure 4.6: Selecting or creating a new check program

↳ *Click the line of the desired program to activate it*

or

↳ *use the* *button to create a new check program, to append it to the list and to activate it.*

↳ *Make the desired entries in the "Program" parameter group in the right window area. You may optionally store e.g., explanatory text for the respective program here.*

Notice!

For each device variant, a new check program is preset with the appropriate tools:

Tool	LSIS 412*i*	LSIS 422*i*	LSIS 462*i*
Image acquisition	x	x	x
BLOB	x	–	x
CODE	–	x	x
Output	x	x	x

4.1.3 Defining regions of interest (ROI) within the field of view (FOV)

By defining ROIs (areas framed in blue), it is possible to restrict the analysis to individual parts of the image. If no ROIs are defined, the entire image is analyzed.

↳ *Switch to the "Program" tab.*

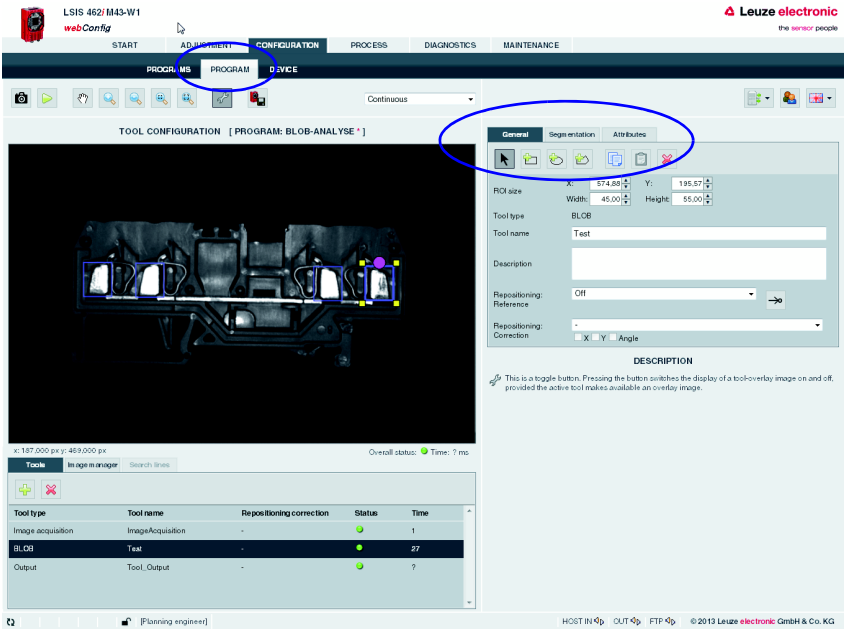


Figure 4.7: Defining the ROI

↳ *If the desired BLOB tool is not already active (= dark gray background), click the appropriate line in the tool selection area.*

At the right, you will now see the "General", "Segmentation" and "Attributes" tabs.

↳ *Use the buttons in the "General" tab to sensibly limit the ROI and thereby optimize the processing speed.*

Notice!

It is, in principle, beneficial to position the ROIs as small and as precisely as possible in order to obtain fewer faults and a fast evaluation. In doing so, note that this is only possible for very precisely positioned parts or if there is a need for additional repositioning!

4.1.4 Segmentation of the image

↳ *Switch to the "Segmentation" tab.*

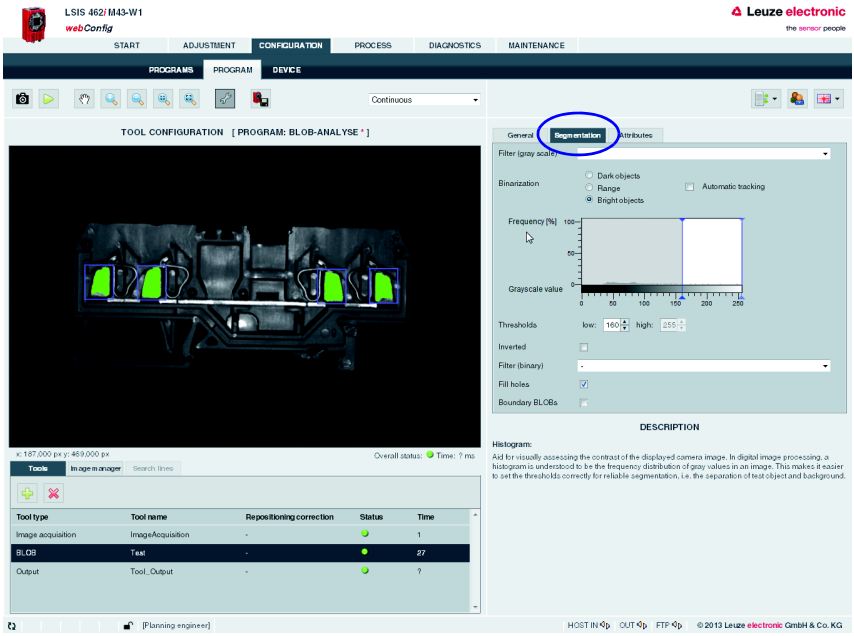


Figure 4.8: Segmentation of the image

In the "Segmentation " tab, the segmentation threshold is set so that the bright metal parts are separated from the dark background. The goal is to display the metal bodies that are to be inspected as large objects that are separated from the background. Any interfering, narrow "Bridges", caused by thin metal connections or reflections, can be eliminated with the aid of filters such as an "Open" binary filter.

↳ *In this example, use the default option of "Bright objects" for the binarization and move the left slider of the histogram to a value that clearly separates the bright metal bodies from the background.*

or

↳ *For the* **`Thresholds`** *parameter, make manual entries in order to display the desired brightness range.*

↳ *Activate the options and filters that are appropriate for your task, see chapter 4.5.*

↳ *If necessary, activate the* **`Boundary BLOBs`** *option to ensure that BLOBs that touch the edge of the ROI are displayed as well.*

4.1.5 Evaluating object attributes

After segmentation, the criteria for the detected objects (BLOBs) must now be set.

↳ *Switch to the "Attributes" tab.*

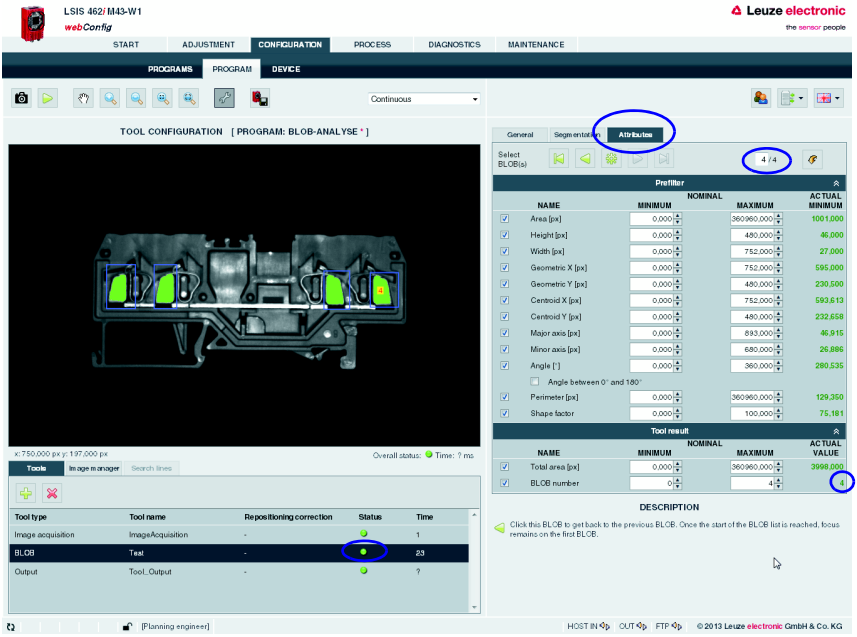


Figure 4.9: Evaluating object attributes: Part OK

In the above example, four BLOBs were detected in the four ROIs. For each of these BLOBs, the permissible minimum or maximum size (area) of the valid objects is now defined in the "Area" prefilter. As a result, minor interference and reflections can be filtered out (displayed in red), and only the large metal bodies to be inspected are retained as valid objects (displayed in green).

↳ *Activate the required attributes for all BLOBs in the Prefilter area by setting the appropriate check marks and entering the minimum and maximum values.*

↳ *In doing so, use the buttons or click on the image to change to the next BLOB.*

Notice!

Note that the processing time increases with the number of attributes that are to be inspected and with the number of found BLOBs. The calculation of the "major axis", "minor axis" and "Angle" attributes is particularly time intensive, whereby it makes no difference if one or all three are calculated!
Depending on the ascertained actual values, shown in the right column, the objects classified as good are shown in green in the overlay of the image display and the objects classified as bad, if applicable, are shown in red.

In the lower part, the entire area and/or the number of found BLOBs are used to define when the tool is to report an "OK" result, i.e. when a checked part is to be evaluated as good or bad. Only if these criteria are satisfied does the analysis return the result OK and does a green status LED appear in the tool list.

↳ *In the lower area, define how large the total area must be or how many BLOBs must be present.*
In the above example: Only parts that have exactly four BLOBs are to be classified as good.

In the event of a faulty part - in this example, one of the metal bodies to be checked is missing - too few valid (displayed in green) objects are found:

The tool reports an "NOK" result - indicated by the red LED in the corresponding line of the tool list.

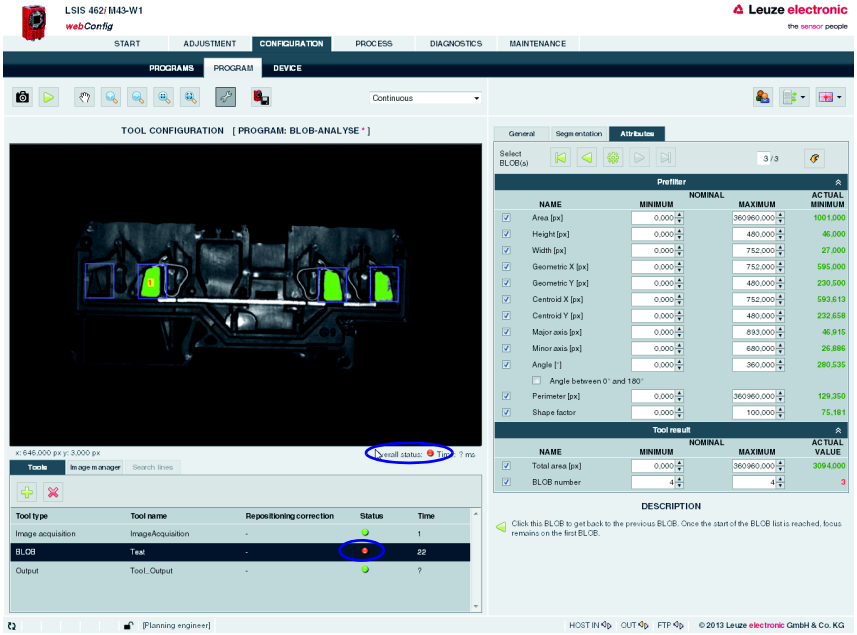


Figure 4.10: Evaluating the BLOB attributes: Part faulty

4.1.6 Configuring digital inputs/outputs

The interface parameters and function of the digital inputs and outputs are usually configured only once during commissioning, since the settings are saved as device parameters and apply for all check programs. Important device parameters include, for example, the digital interface signals to the primary control: The trigger input, inputs for automatic program selection and device outputs.

- *Switch to the "Device" tab in the "Configuration" work module to configure the digital I/Os.*

Defining the function of the digital inputs and outputs

- *In the upper part of the tab ("Digital I/Os"), activate the given I/O that is to be set up. In the lower part of the tab ("I/O Port"), make the desired changes by selecting the required options from the list box and making your entries.*
- *Save your entries in the flash memory of the **LSIS 4xxi** by pressing the button.*

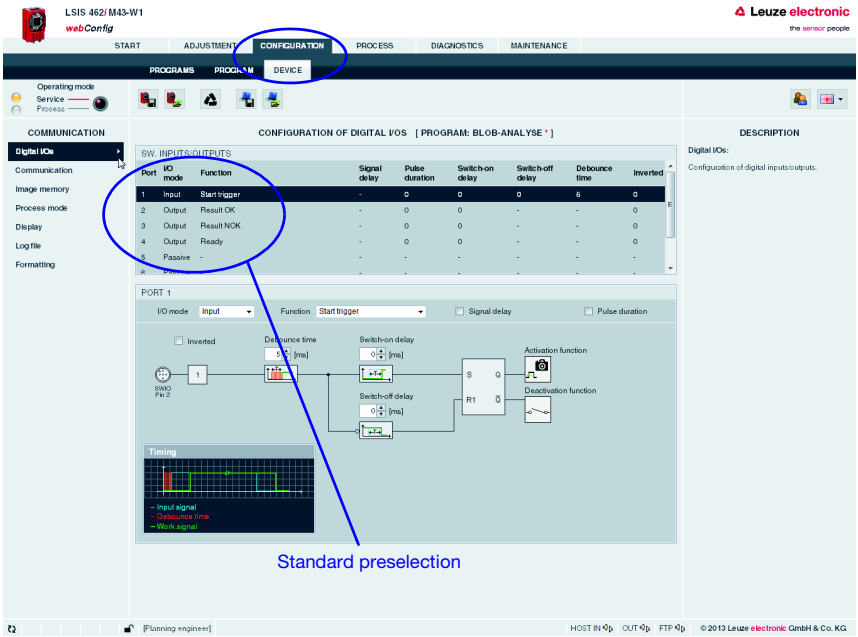


Figure 4.11: Configuration of the digital inputs and outputs

4.2 Basic procedure – Step-by-step configuration of code reading

Provided in the following is an application description for code reading with the help of an **LSIS 462*i*** M4x-W1. In this example, a directly marked code on a metal part is read and the code contents are then output via Ethernet.

Notice!

*The configuration of the code tool for devices of the **LSIS 422*i*** series is performed in an analogous manner.*

After switching on the device, **LSIS 4xx*i* *webConfig*** starts in Process mode.

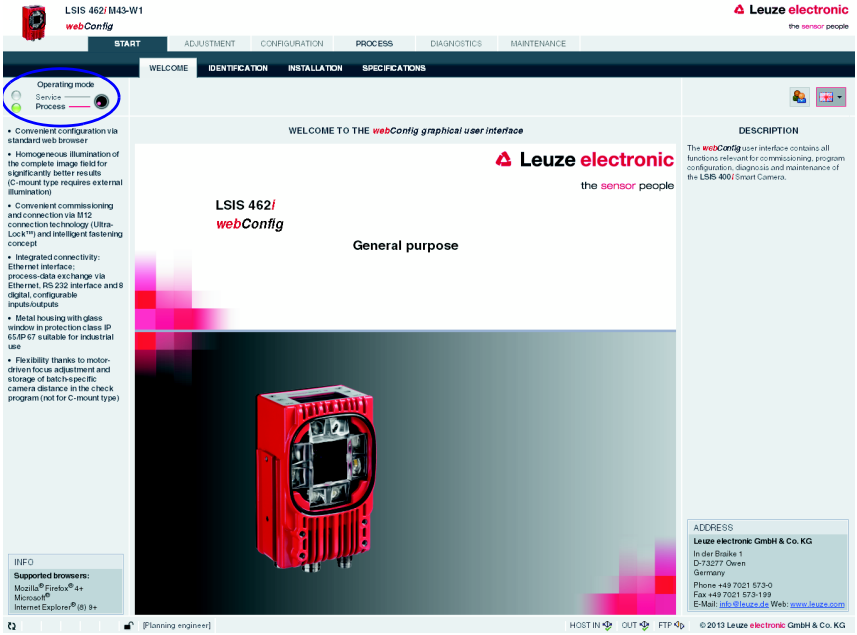


Figure 4.12: Program start in Process mode

In order to access the configuration, management and diagnostic tasks, which are necessary for performing the configuration, you must first switch to Service mode.

↳ *First, select the "Service" operating mode by clicking the* **`Service`** *menu item or the corresponding* ● *button.*

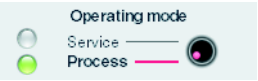


Figure 4.13: Changing the operating mode

You can now select the tabs which were initially disabled.

↳ *Activate the "Configuration" work module.*

4.2.1 Create new check program

- *In the "Configuration" work module, switch to the "Programs" tab.*
- *Use the button to create a new check program and to append it to the existing program list.*
- *Make the desired entries in the "Program" parameter group in the right window area. You may optionally store e.g., explanatory text for the respective program here.*

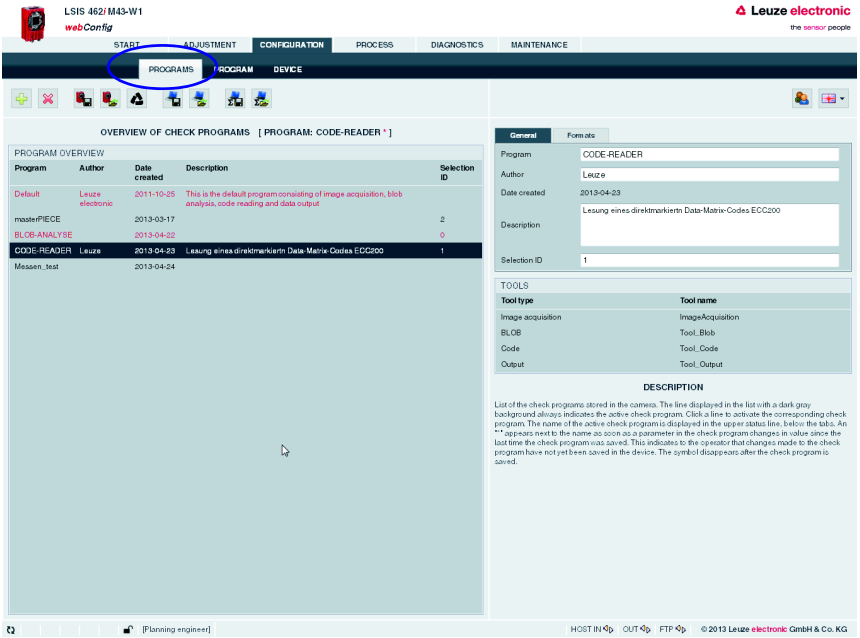


Figure 4.14: Create new check program

In the "Program" tab, the newly created check program can now be edited and extended.

4.2.2 Setting the parameters for image acquisition

↳ *In the "Configuration" work module, switch to the "Program" tab.*

↳ *Click on the first tool in the tool list (-> image acquisition).*

The corresponding configuration masks open on the right side.

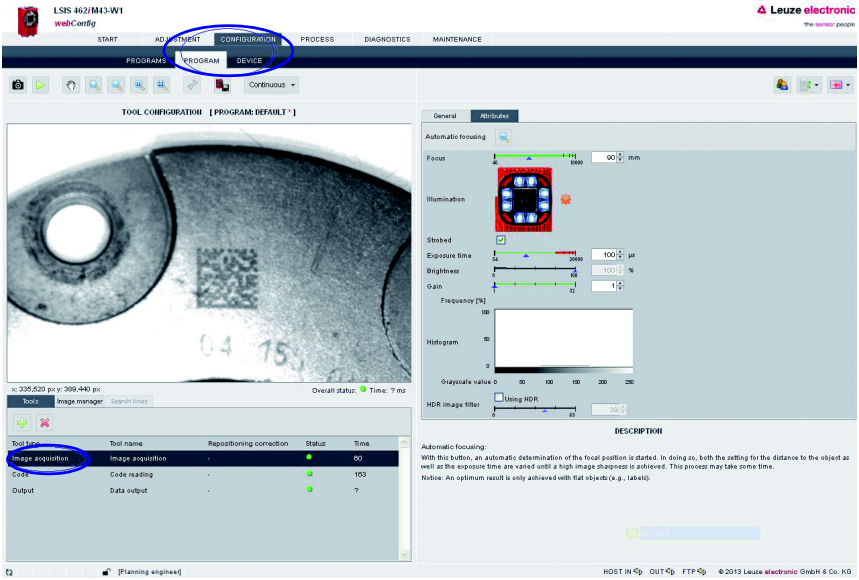


Figure 4.15: Image acquisition parameters

↳ *In the "Attributes" parameter group, set the parameters relevant for image acquisition, such as focus setting and exposure time.*

With the "Automatic focusing" button an automatic determination of the focal position is started. In doing so, both the setting for the distance to the object as well as the exposure time are varied until a high image sharpness is achieved. This process may take some time. An optimum result is only achieved with flat objects (e.g., labels).

4.2.3 Setting the parameters for code reading

↳ *Activate the second tool in the tool list (->Code).*

The fields for configuring this tool are located on the right side.

↳ *In the "General" parameter group, define a region of interest around the area in which the code to be read must be located in order to reduce the execution time of the tool.*

If no ROI is defined, the entire image is analyzed.

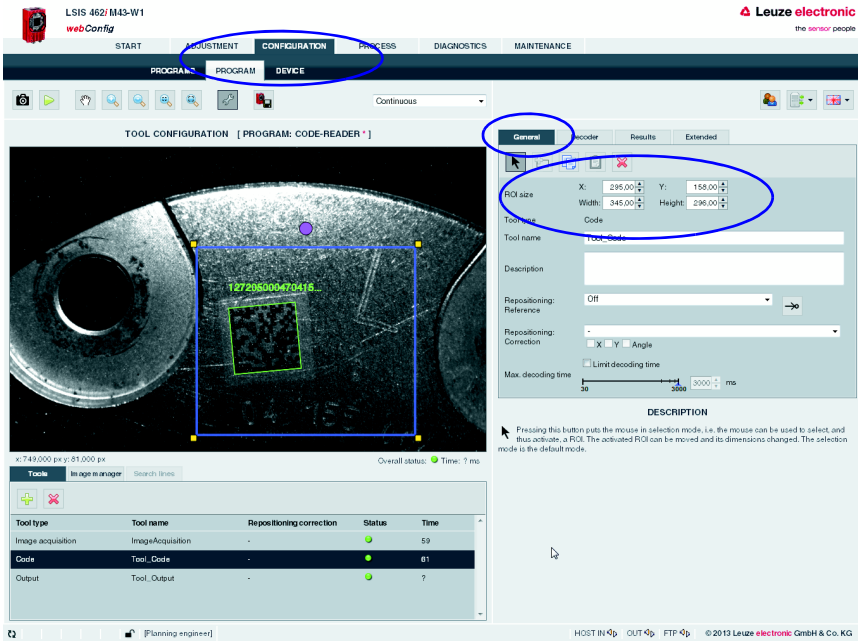


Figure 4.16: Defining the ROI

Notice!

A smaller ROI means faster evaluation. The condition is that the code itself and a suitable quiet zone be positioned safely within the ROI; repositioning is to be used if necessary.

- *Switch to the "Decoder" parameter group.*
- *Deactivate the unneeded codes in order to reduce the execution time of the tool or to restrict reading to certain code types.*

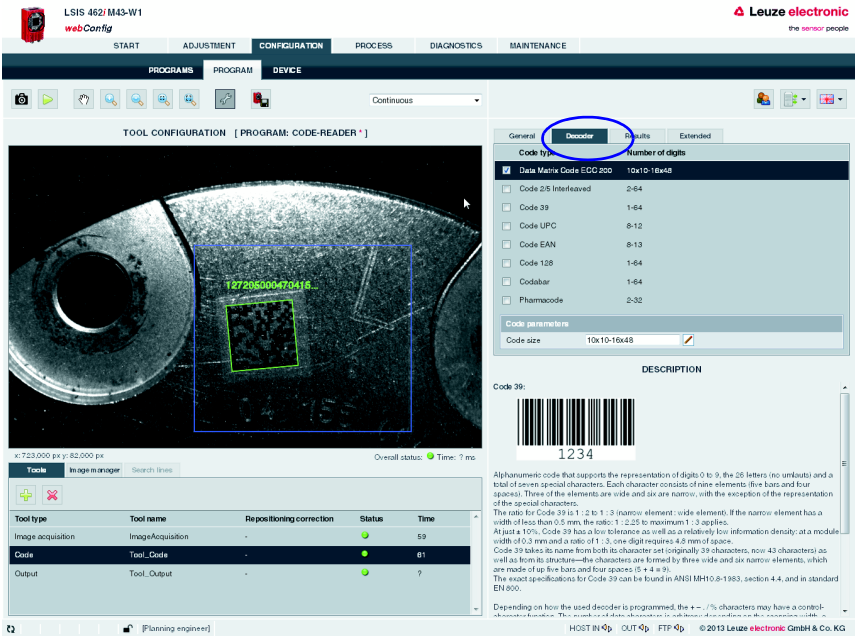


Figure 4.17: "Decoder" parameter group – Deactivating unneeded codes

In this example, the deactivation of all 1D bar codes results in a considerable reduction of the execution time (in the same way, deactivation of the 2D Data Matrix code leads to a considerable reduction if only a 1D bar code is being searched for).

Change to the "Results" parameter group to view details on the read codes in the image or region of interest.

Various "OK criteria" can also optionally be defined here for the tool result – with respect to the quality parameters of the read code, the number of codes to be found or with respect to a code comparison.

In the current example, exactly one code is to be found with arbitrary quality parameters (= F).

Set the corresponding options, as shown in the figure.

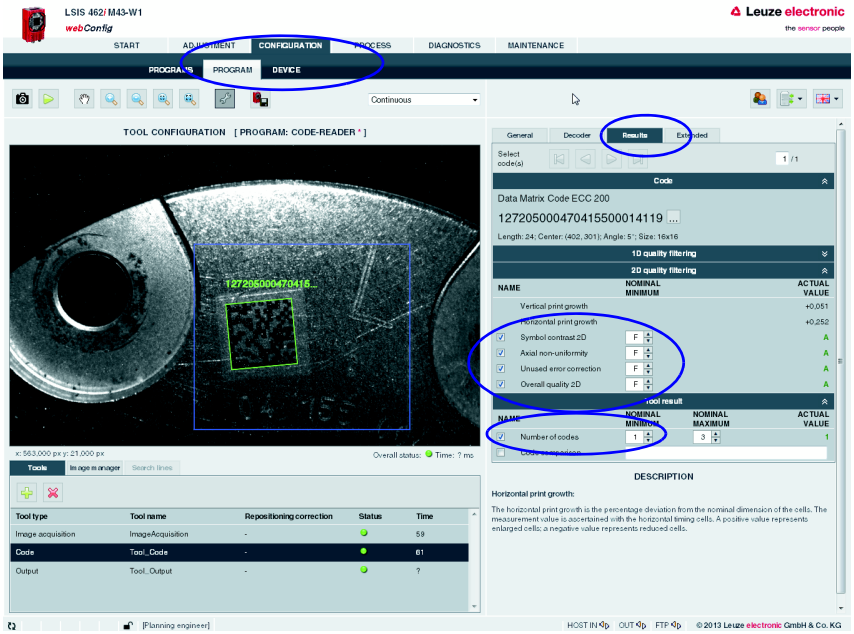


Figure 4.18: "Results" parameter group – Use quality filter and number to define tool result

4.2.4 Optional: Configuring process data output

In the "Program" tab of the Configuration module, switch to the "Output" tool type to configure an output sequence.

This sequence is output following processing of the check program, e.g., via the Ethernet process interface.

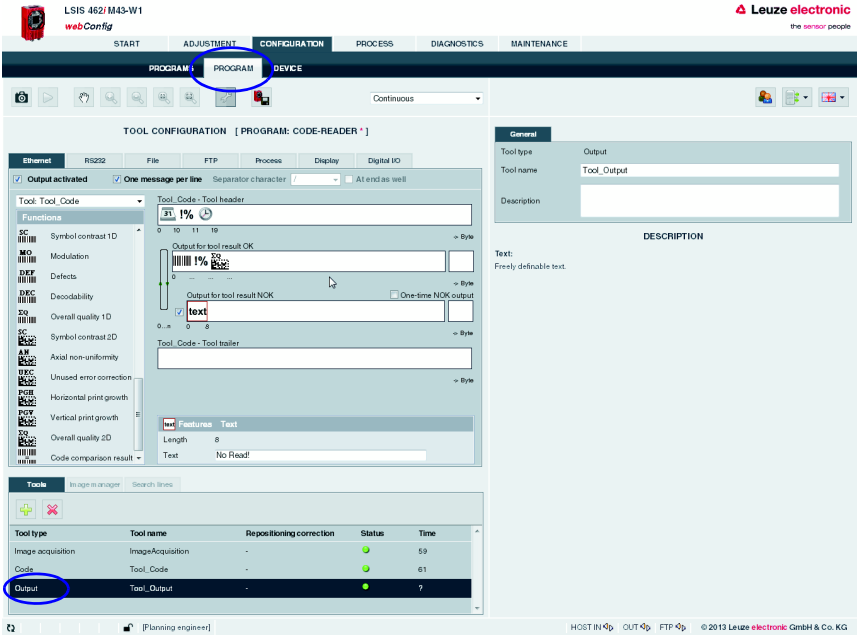


Figure 4.19: Window for configuring the output

Displayed in the left area is a list of the available "output functions". Information on the individual elements (date, time etc.) and other possibilities for the specification are available as usual in the right part of the window.

Configuring the Ethernet output

- *Activate the* **`Ethernet output activated`** *check box.*
- *In the list box, first define whether you would like to configure the header, the code tool or the trailer.*
- *Insert the desired elements from the function list in the input line provided for this purpose at the right by means of drag & drop.*
- *Specify element options, such as length, alignment, fill character, etc., in the lower part of the Features area.*

Delimiters between the individual pieces of data and the use of separate lines increase the "Readability" of the output data.

In the current example, the code contents are output in the case of an OK; for an NOK (no code detected), a freely definable text "no code found!" is output.

Activation of the "Host LSIS" check box in the upper right causes the otherwise not displayed tool execution time to be calculated and displayed for the data output.

Notice!

The transmission time of the output data depends largely on the speed of the connection, particularly if many objects are found for which an output is configured.
For example, the standard setting for RS 232 transmission is set to 9600 baud for compatibility reasons, even though 115200 baud is, in principle, possible.

4.2.5 Optional: Configuring cross-program device settings for process-data transmission

- *In the "Configuration" work module, switch to the "Device" tab.*
- *In the "Process - Ethernet" submenu, specify the parameters for Ethernet communication with the primary control that is to receive the process data.*

In the current example, a TCP/IP connection is established with the LSIS as server.

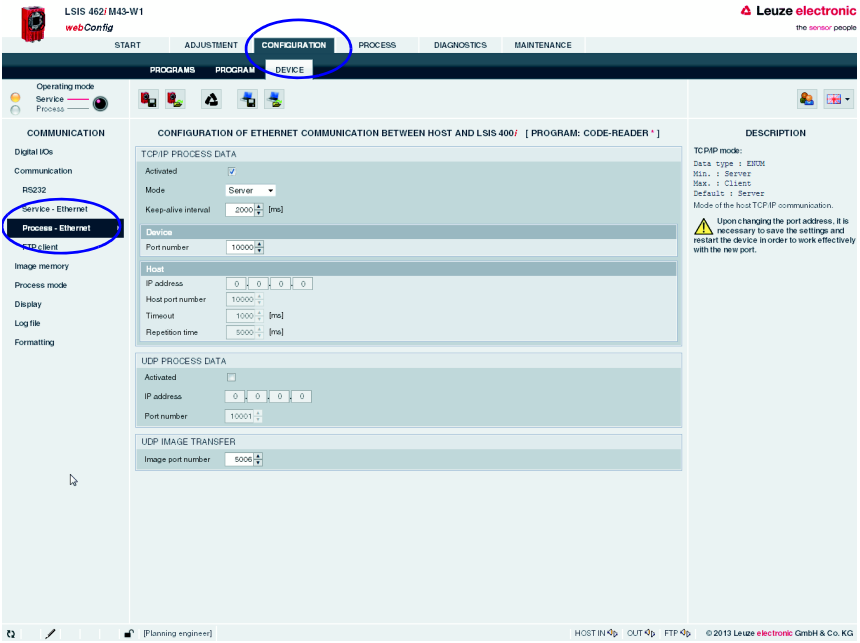


Figure 4.20: Defining Ethernet communication with the primary control

4.3 Basic procedure – Step-by-step configuration with the measuring tool

How to work practically with the measuring tool will be explained using an example. For this purpose, various measurements are performed on a metal part. To test the metal part for dimensional accuracy, i.e. adherence to the specified tolerances, calibration is first performed. This involves converting the image data to real coordinates ("world coordinates") and providing them with a unit of measure.

The process itself is similar to that of the previous tool applications (BLOB analysis and code tool):

Tools	Important functions	Task / objectives
Image acquisition	• Focus position • Illumination • Exposure time	• Sharp object image • Avoid interfering reflections • High-contrast image
Calibration	• Calibration • Origin	• Conversion into real coordinates • (not performed in this example)
Measuring	• Detecting • Measuring • Testing	• Determination of edge positions • Link the edge position in a measurement regulation • Test the measurement results for adherence to the tolerances
Output	• Status output • Data output	• Part OK / NOK • Output of measurement values

Figure 4.21: Sequence of the step-by-step configuration with the measuring tool

The test object

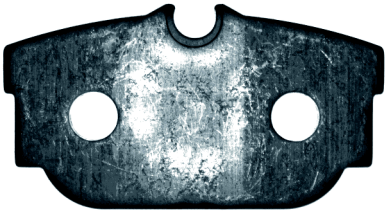


Figure 4.22: Step-by-step configuration with the measuring tool - Example test object

The task

- Distance measurement from "left bore hole" to "top recess"
- Angle measurement from "left edge" to "bottom edge"
- Vertical distance measurement from "right bore hole" to "right edge"
- Roundness measurement of right bore hole

After switching on the device, **LSIS 4xx*i* *webConfig*** starts in Process mode.

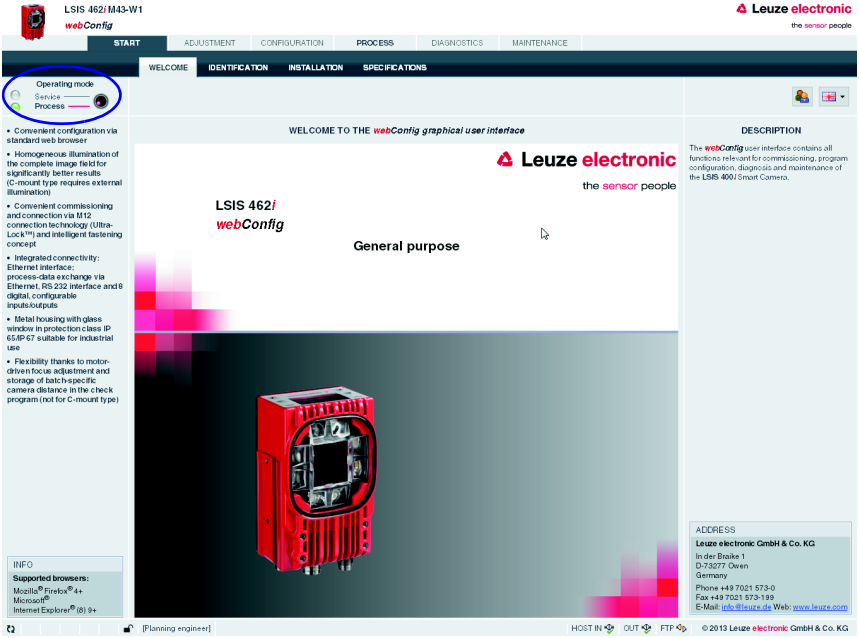


Figure 4.23: Program start in Process mode

In order to access the configuration, management and diagnostic tasks, which are necessary for performing the configuration, you must first switch to Service mode.

↳ *First, select the "Service" operating mode by clicking the* **`Service`** *menu item or the corresponding button.*

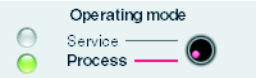


Figure 4.24: Changing the operating mode

You can now select the tabs which were initially disabled.

↳ *Activate the "Configuration" work module.*

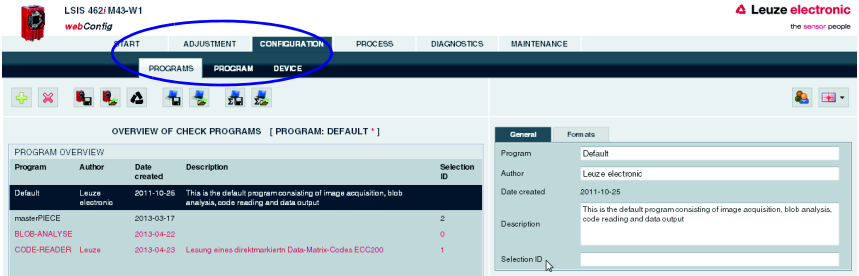


Figure 4.25: "Configuration" work module

4.3.1 Setting the parameters for image acquisition

The image acquisition parameters are usually set just once during commissioning. Once the optimum image acquisition parameters, such as focus setting and exposure time, have been set, they can be saved as default values in the camera. They then apply as an editable preset for subsequently created programs.

↳ *Activate the "Adjustment" work module if you would like to change the default settings for new programs.*

If you would only like to change the settings for a single program, proceed as follows:

↳ *Activate the "Configuration" work module in the "Program" tab.*

↳ *Select the "Image Acquisition" tool type in the "Tool selection" area to make the corresponding settings.*

↳ *Make the desired settings in the "Attributes" parameter group.*

Save your settings as follows:

- *If you are in the "Program" tab in the "Configuration" work module, save the image acquisition parameters for the current program by pressing the*  *button.*
- *If you are in the "Adjustment" work module, save the image acquisition parameters permanently in the flash memory of the* ***LSIS 4xxi*** *as default settings by pressing the*  *button.*

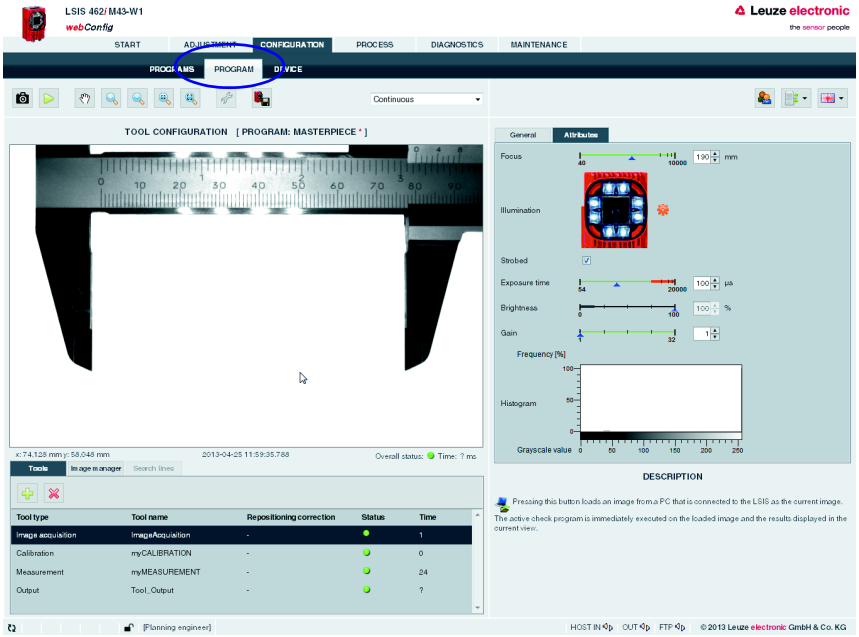


Figure 4.26: Setting the image acquisition parameters

In the "Program" tab, the newly created check program can now be edited and extended.

4.3.2 Selecting or creating a new check program

↳ *In the "Configuration" work module, switch to the "Programs" tab.*

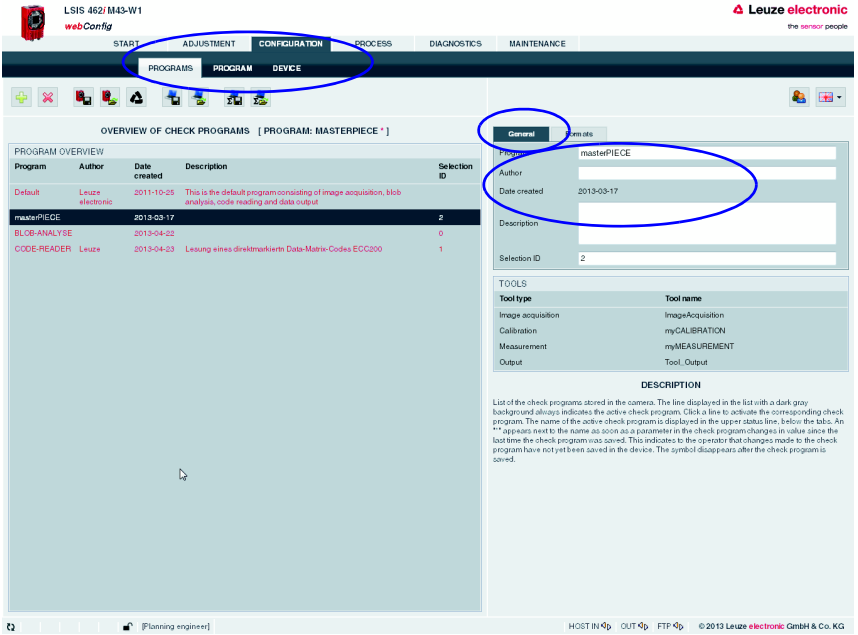


Figure 4.27: Selecting or creating a new check program

↳ *Click the line of the desired program to activate it*

or

↳ *Use the button to create a new check program, to append it to the list and to activate it.*

↳ *Make the desired entries in the "Program" parameter group in the right window area. You may optionally store e.g., explanatory text for the respective program here.*

Notice!

*With the **LSIS 462i**, a new check program – in addition to the mandatory "image acquisition" and "Output" tools – is preset with the "BLOB" and "Code" tools. These are to be deleted in this example and the "Calibration" and "Measurement" tools inserted instead.*

4.3.3 Performing calibration

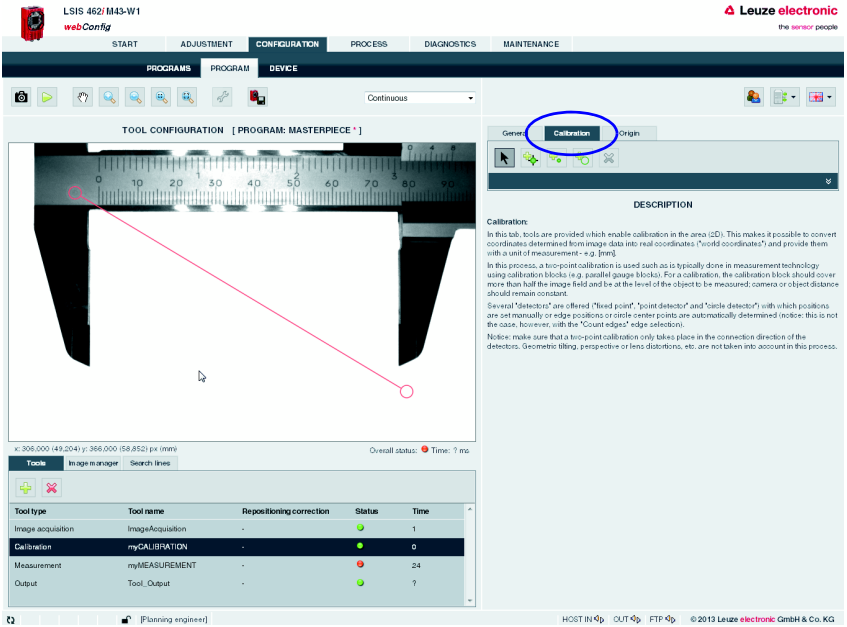


Figure 4.28: Performing calibration

With the object selected here, point detectors are well suited for calibration; one point detector is placed at both the left and the right cutting edge:

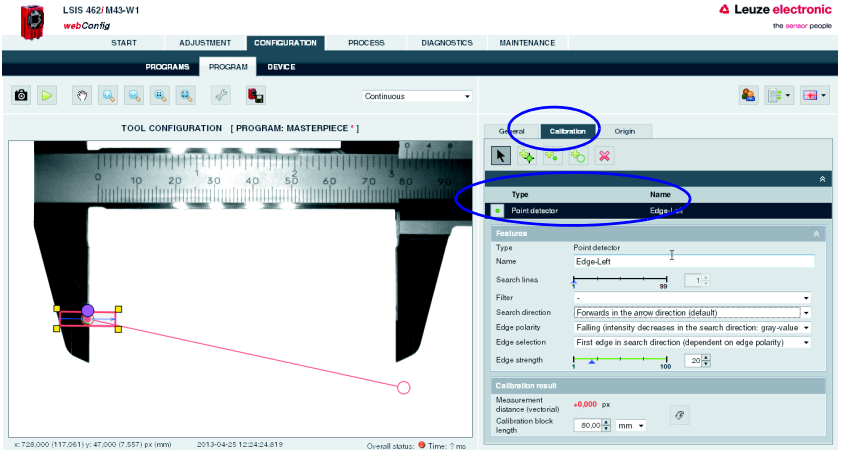


Figure 4.29: Calibration – Creating the left point detector

- *Click the corresponding button; you can then draw the rectangular point detector in the camera image.*
- *Check whether the edge is reliably detected; it may be necessary to change the search direction, the edge polarity, the edge selection and the edge strength.*
- *It may also be helpful to click the "Search lines" tab in the lower left part of the window and then check the edge strength in the gray-value display. The greater the gray value difference (contrast) between the light and dark area in the direct vicinity of the edge, the more reliably the edge can be detected.*
- *It may also be necessary to change the illumination or to use a different edge for calibration.*

You create the second point detector in the same way. The second detector should be positioned such that the line connecting both detectors is parallel to the known reference length of the calibration block. Then enter the value for the "Calibration block length" parameter and press the corresponding button for activating or making available the calibration in the program.

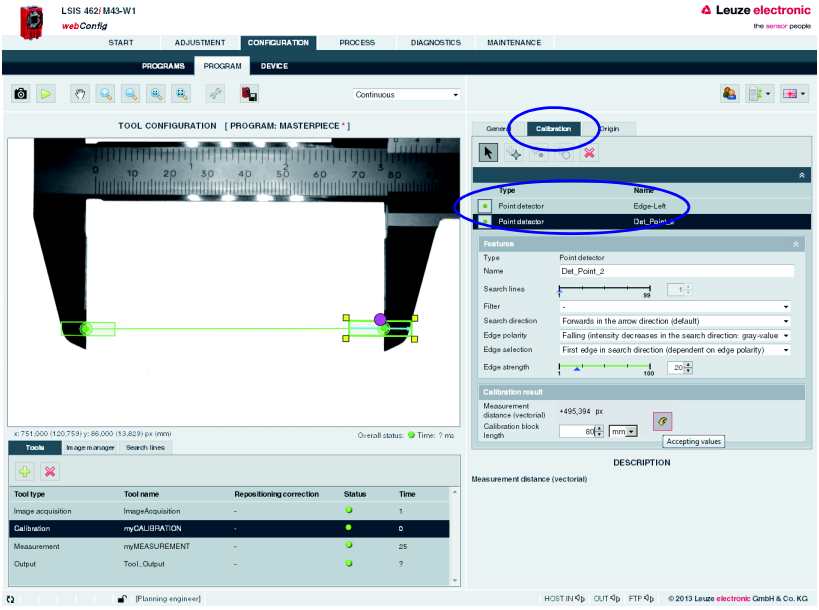


Figure 4.30: Creating the right point detector / accepting the calibration

- *Save the intermediate state of your check program.*

4.3.4 Setting up the "Measuring" tool

"*General*" tab

↳ *Click the "Measuring" tool to activate:*

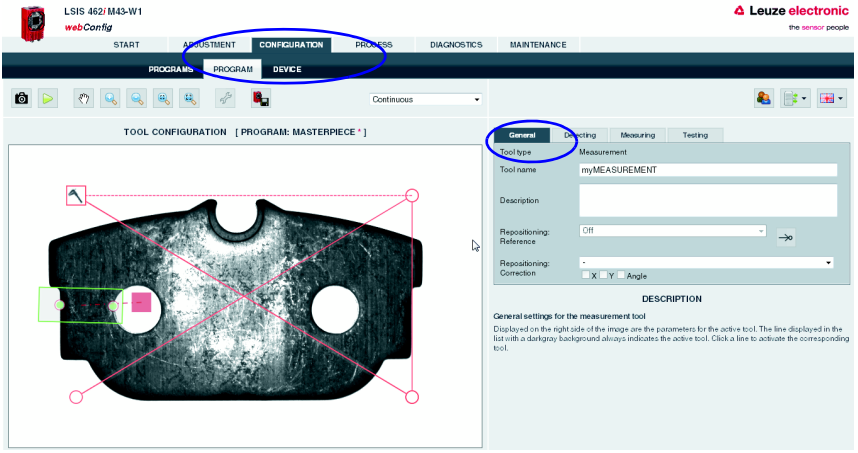


Figure 4.31: Setting up the measuring tool - "General" tab

"*Detecting*" tab

↳ *Click the "Detecting" tab to set up the corresponding edge detections:*

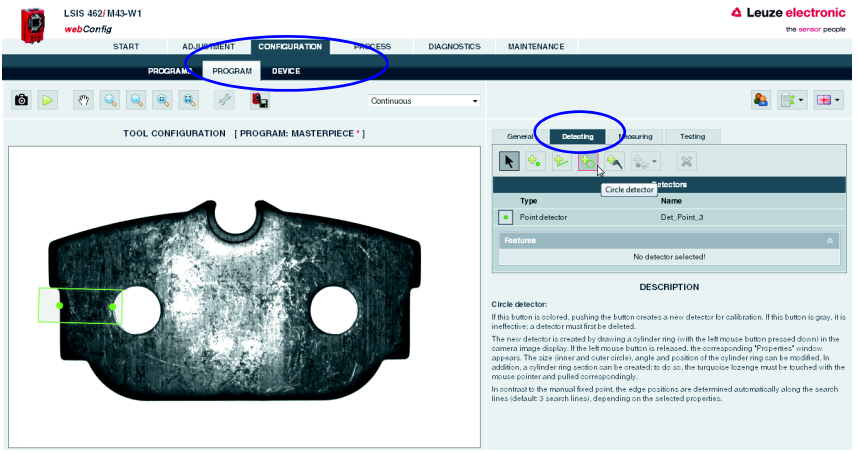


Figure 4.32: Setting up the measuring tool - "Detecting" tab

- *Click the circle detector button to draw the circular area in the camera image.*
- *Check whether the circle detection is reliable; it may be necessary to change the "search lines", "search direction", "edge polarity", "edge selection" and "edge strength" parameters.*
- *Give the detector a speaking name.*
- *If necessary, check the strengths of the edges in the gray-value display of the "Search lines" tab in the lower left area .*

Notice!

The shorter or smaller the created regions of interest and the lower the number of used scan lines, the faster the evaluation. The corresponding settings must, however, always be selected such that no compromises are made at the cost of evaluation reliability.

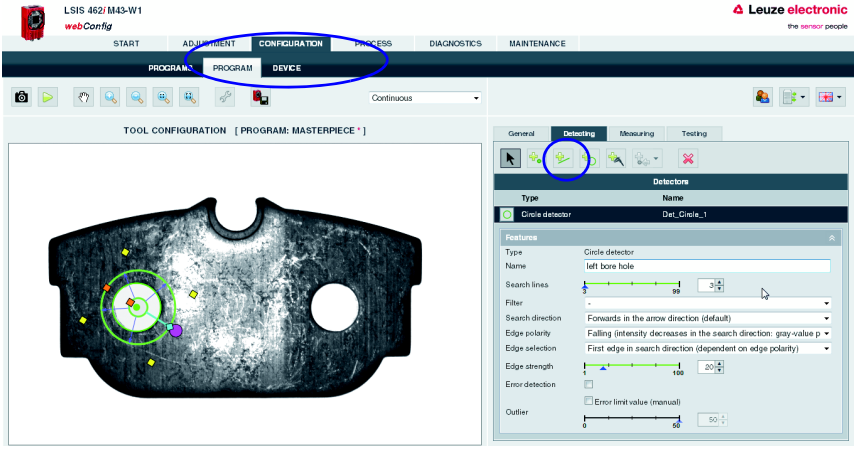


Figure 4.33: "Detecting" tab – First created "Left bore hole" circle detector

The second circle detector for the top recess is created in a similar manner. What is different here is that only one circle segment is taken into account:

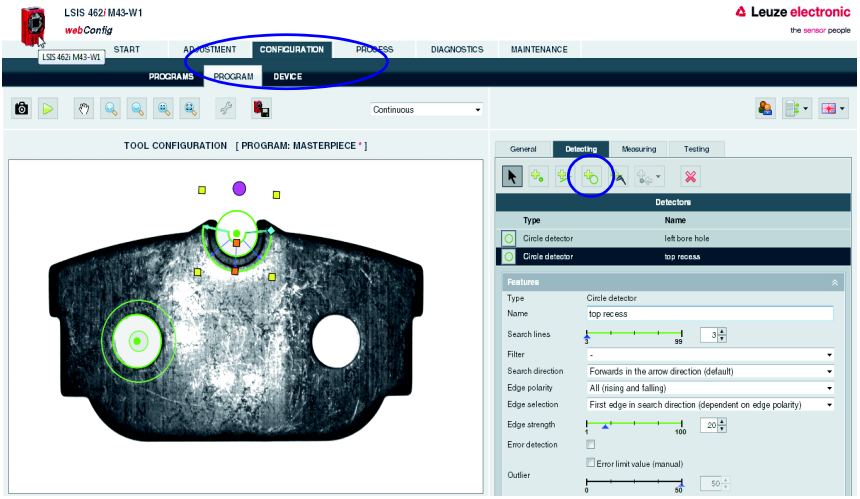


Figure 4.34: "Detecting" tab – Second created "Top recess" circle detector

Now a line detector is drawn on the left edge:

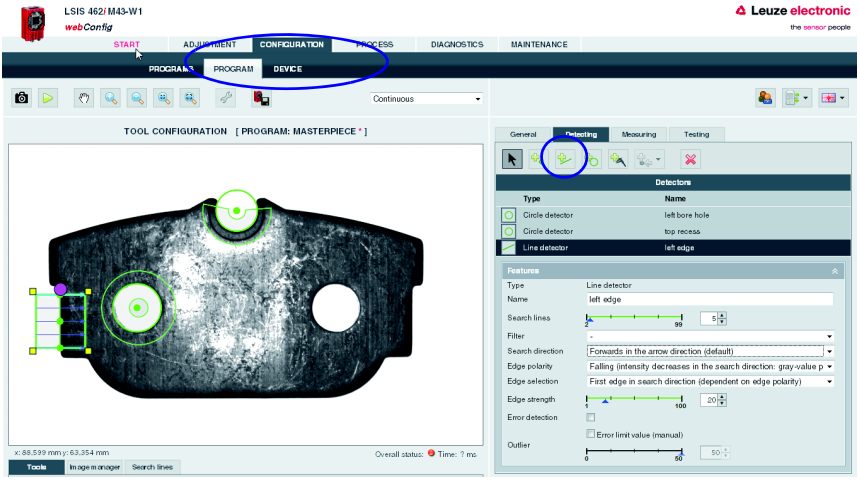


Figure 4.35: "Detecting" tab – Created "Left edge" line detector

Additional detectors are created in a corresponding manner until all desired detectors are set up:

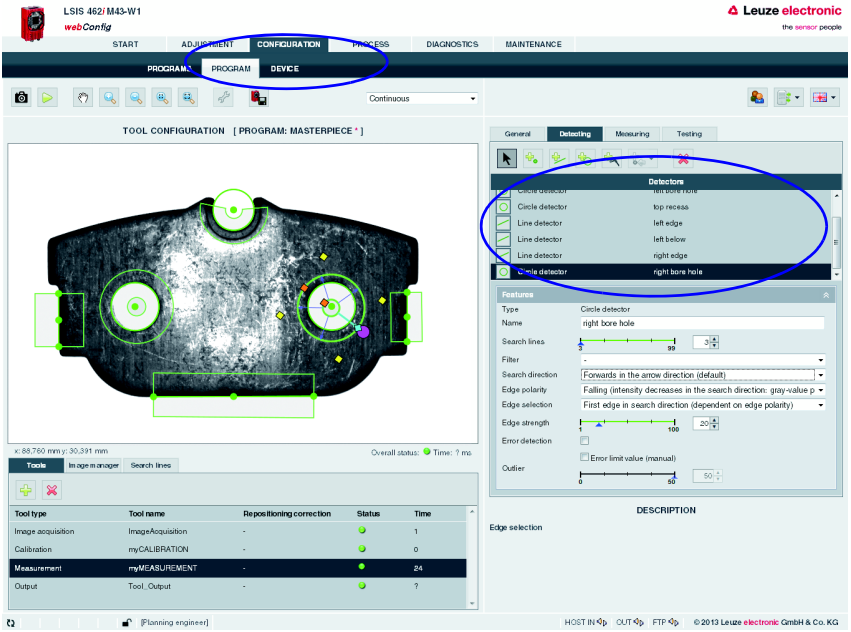


Figure 4.36: "Detecting" tab – All detectors are created

"Measuring" tab

↳ *Click the "Measuring" tab to create the corresponding measurement regulations through a suitable combination of detectors:*

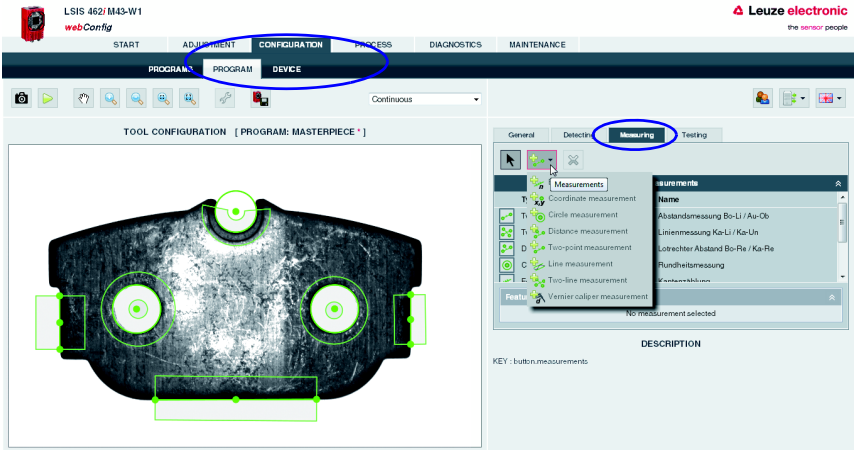


Figure 4.37: "Measuring" tab - Selecting measurement regulations

As a first measurement, the distance measurement from "left bore hole" to "top recess" is created. To do this, click the "Two-point measurement" measurement regulation:

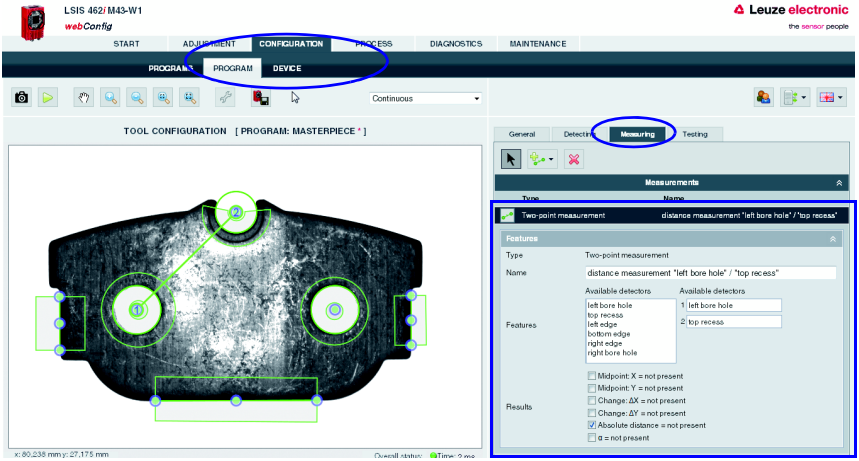


Figure 4.38: "Measuring tab" – Distance measurement from "Left bore hole" to "Top recess"

↳ *To do this, drag the desired, suitable detectors from the "Properties/Available detectors" field to the "Selected detectors" field.*

The measured values then appear in the "Properties/Results" field. Select the check box preceding the respective result to make this value available in the "Testing" tab.

The other measurements are set up in the same way – in the following, the angle measurement from "left edge" to "bottom edge":

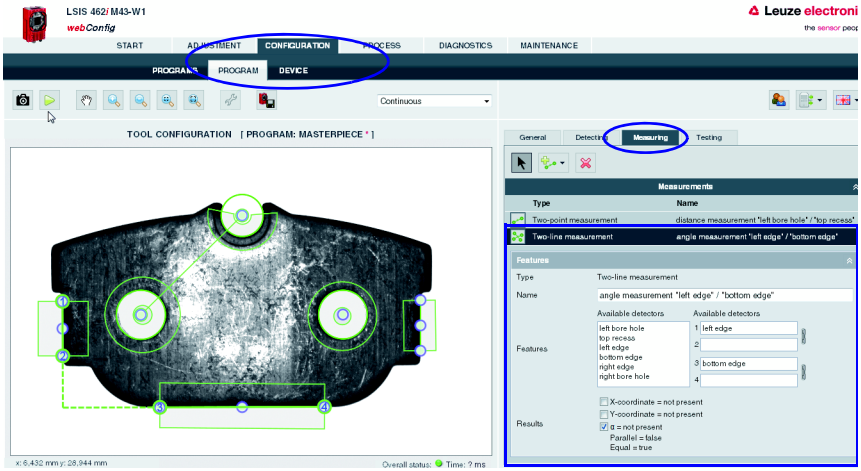


Figure 4.39: "Measuring" tab – Angle measurement from "Left edge" to "Bottom edge"

↳ *To do this, drag the desired, suitable "left edge" and "bottom edge" detectors into the "Selected detectors" field.*

↳ *When doing this, note that the direction of the evaluation (orientation of the angle) is specified by the sequence of points 1, 2, 3 and 4. If the line detectors are oriented differently, an angle of 270°, for example, could be determined instead of 90°.*

As an alternative, for example, four individual point detectors could have been used here as well. These would then be dragged in pairs into fields 1 and 2 of the "Selected detectors" area similar to the "left edge" line detector.

The measured values then appear in the "Properties/Results" field. Select the check box preceding the respective result to make this value available in the "Testing" tab.

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Another measurement is performed – vertical distance measurement from "Right bore hole" to "Right edge":

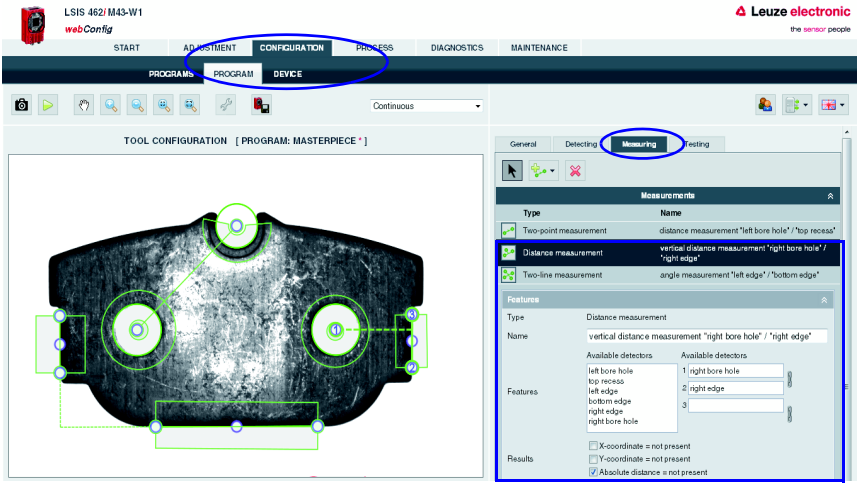


Figure 4.40: "Measuring" tab – Vertical distance measurement from "Right bore hole" to "Right edge"

As a final measurement, a roundness measurement is performed with the "Circle measurement" measurement regulation. To obtain more exact results, more search lines should be used (e.g., 20); this will allow smaller deviations to be detected as well:

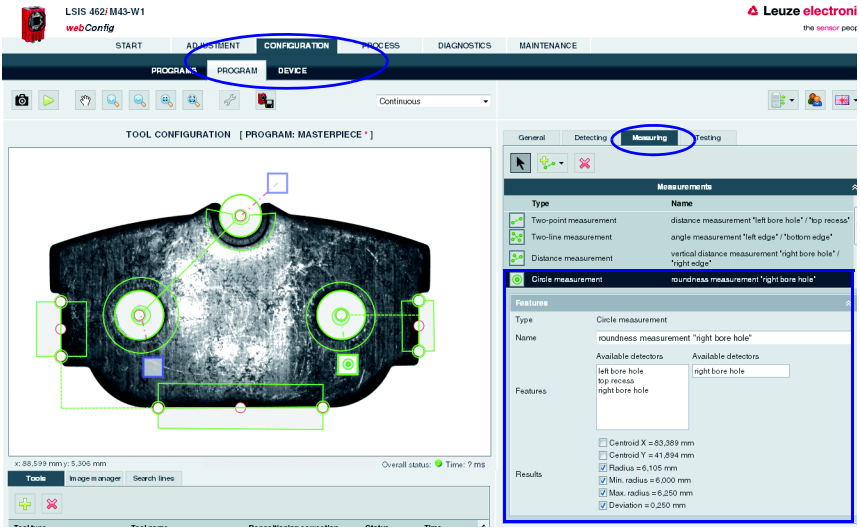


Figure 4.41: "Measuring" tab – Roundness measurement of the "Right bore hole"

"*Testing*" *tab*

↳ *Click the "Testing" tab to enter the corresponding presets (tolerances) with which the measurement results are compared ("Tested"):*

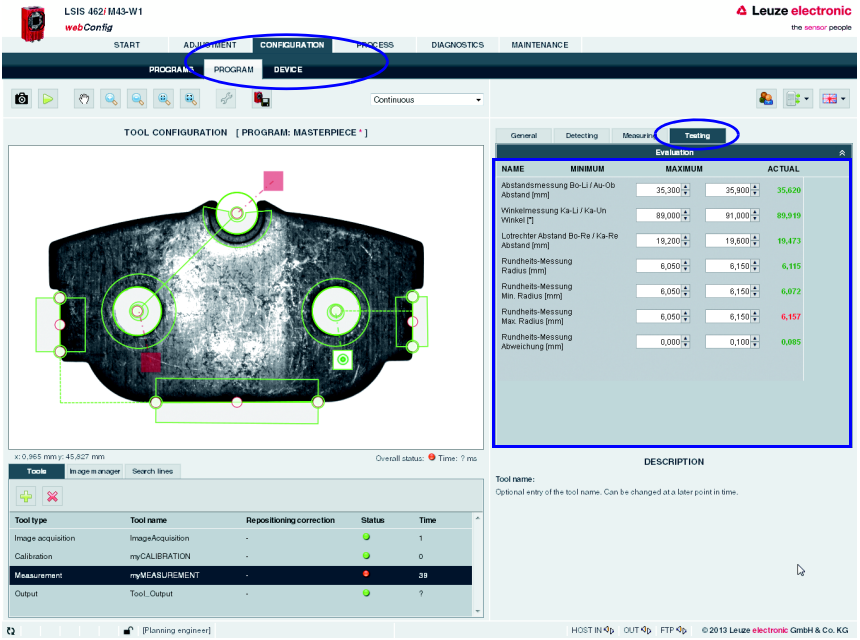


Figure 4.42: "Testing" tab – Test for adherence to the specified tolerances

4.3.5 Optional: Configuring process data output

In the "Program" tab of the Configuration module, switch to the "Output" tool type to configure an output sequence.

This sequence is output following execution of the check program, e.g., via the Ethernet process interface.

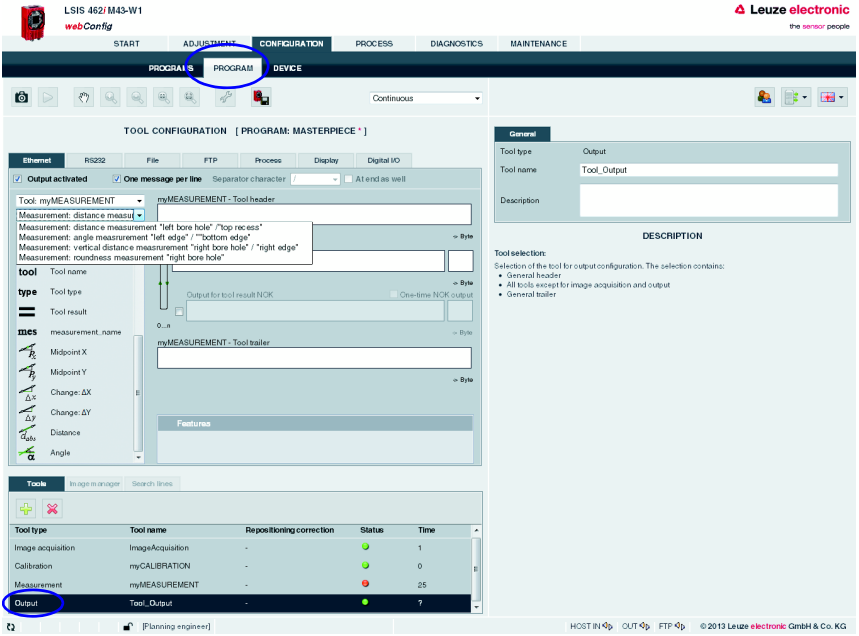


Figure 4.43: Window for configuring the output

Displayed in the left area is a list of the available "Output functions". Information on the individual elements (date, time etc.) and other possibilities for the specification are available as usual in the right part of the window.

Configuring the Ethernet output

- *Activate the* **`Ethernet output activated`** *check box.*
- *In the list box, first define whether you would like to configure the header, measurements from the "Measuring" tool (see figure 4.43) or the trailer.*
- *Insert the desired elements from the function list in the input line provided for this purpose at the right by means of drag & drop.*
- *Specify element options, such as length, alignment, fill character, etc., in the lower part of the Features area.*

Delimiters between the individual pieces of data and the use of separate lines increase the "Readability" of the output data.

4.4 Basic procedure – Step-by-step configuration of a combined BLOB analysis and code reading

Provided in the following is an application description for a combined BLOB analysis and code reading using an LSIS 462 M4x-W1 as an example. A presence inspection and a print inspection are performed here for code and plain text on a label with subsequent output of the read code via Ethernet.

After switching on the device, **LSIS 4xx*i* *webConfig*** starts in Process mode.

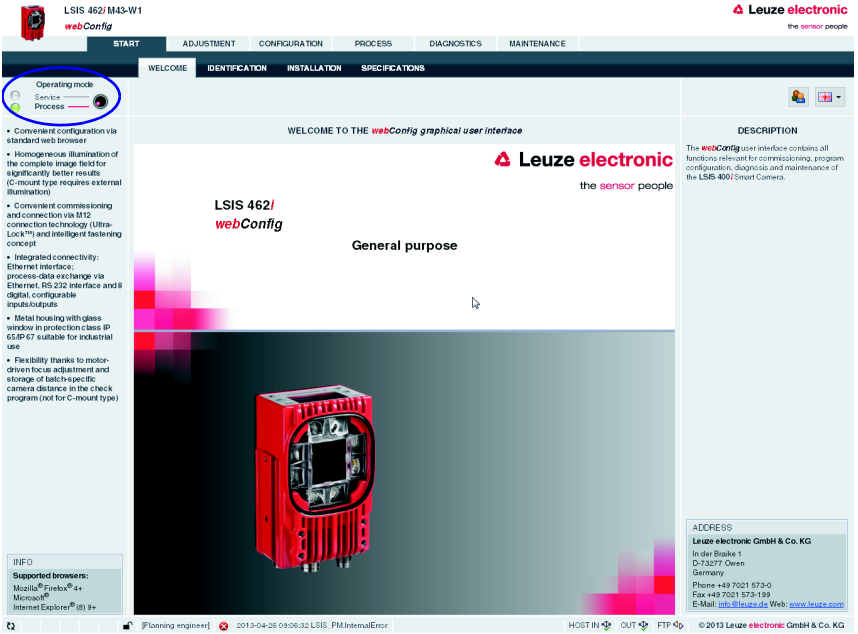


Figure 4.44: Program start in Process mode

In order to access the configuration, management and diagnostic tasks, which are necessary for performing the configuration, you must first switch to Service mode.

↳ *First, select the "Service" operating mode by clicking the* `Service` *menu item or the corresponding button.*

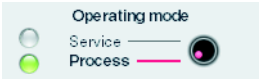


Figure 4.45: Changing the operating mode

You can now select the tabs which were initially disabled.

↳ *Activate the "Configuration" work module.*

4.4.1 Create new check program

- *In the "Configuration" work module, switch to the "Programs" tab.*
- *Use the button to create a new check program and to append it to the existing program list.*
- *Make the desired entries in the "Program" parameter group in the right window area. You may optionally store e.g., explanatory text for the respective program here.*

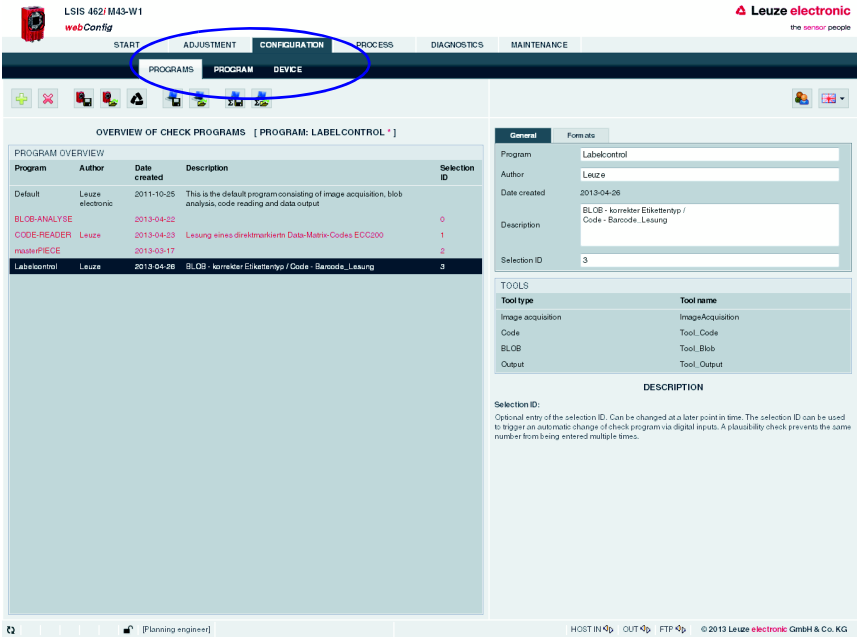


Figure 4.46: Create new check program

In the "Program" tab, the newly created check program can now be edited and extended.

Notice!

*With the **LSIS 462i** "General Purpose", 1 BLOB tool and 1 code tool are created by default in a new program (in addition to image acquisition and output)!*

4.4.2 Setting the parameters for image acquisition

↳ *In the "Configuration" work module, switch to the "Program" tab.*

↳ *Click on the first tool in the tool list (-> image acquisition).*

The corresponding configuration masks open on the right side.

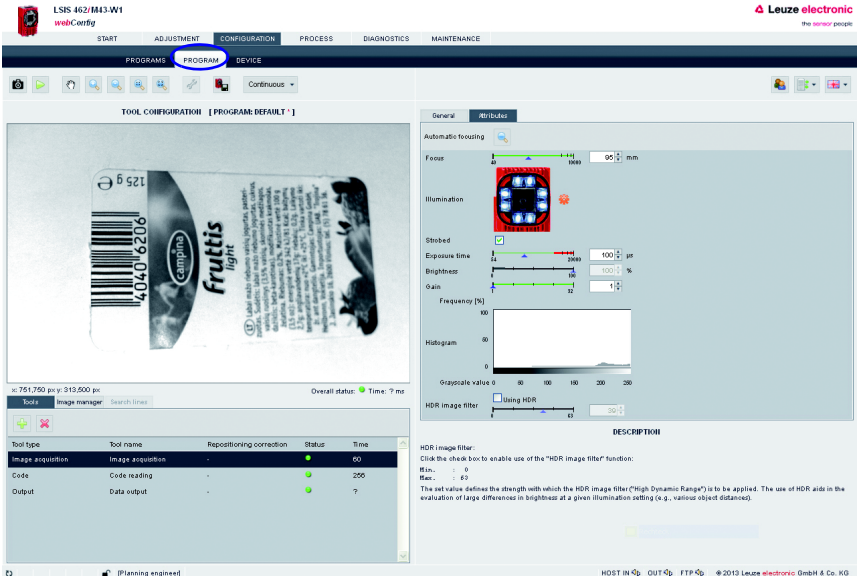


Figure 4.47: Image acquisition parameters

↳ *In the "Attributes" parameter group, set the parameters relevant for image acquisition, such as focus setting and exposure time.*

With the "Automatic focusing" button an automatic determination of the focal position is started. In doing so, both the setting for the distance to the object as well as the exposure time are varied until a high image sharpness is achieved. This process may take some time. An optimum result is only achieved with flat objects (e.g., labels).

4.4.3 Tool for editing BLOB analysis

↳ *In the tool list, activate the "BLOB" tool.*

The configuration masks associated with this tool open on the right side.

Defining ROIs

↳ *In the "General" parameter group, define the regions of interest (areas framed in blue) to restrict the evaluation to individual areas of the image.*

If no ROIs are defined, the entire image is analyzed.

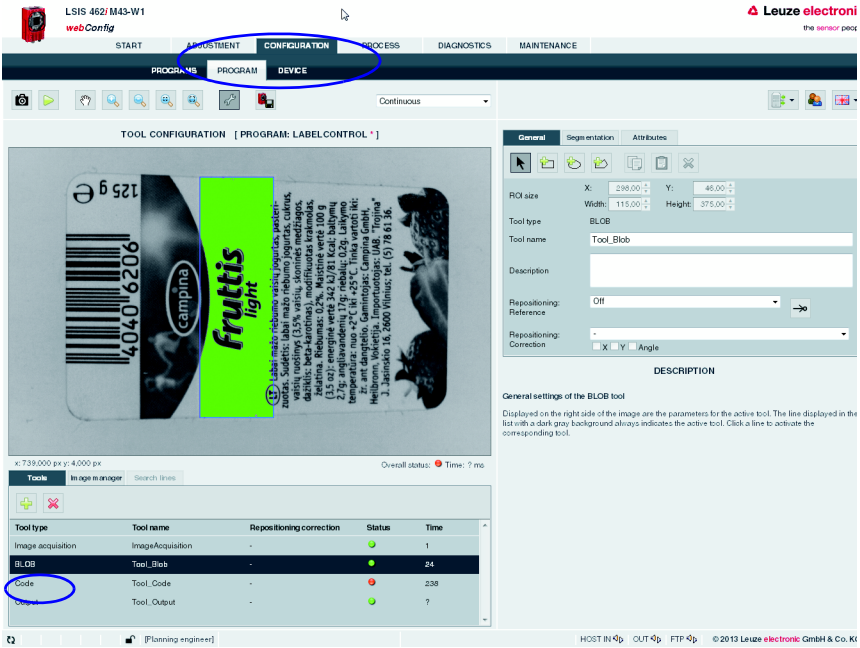


Figure 4.48: Defining the region of interest for the BLOB analysis

Segmentation of the image

↳ *Switch to the "Segmentation" tab.*

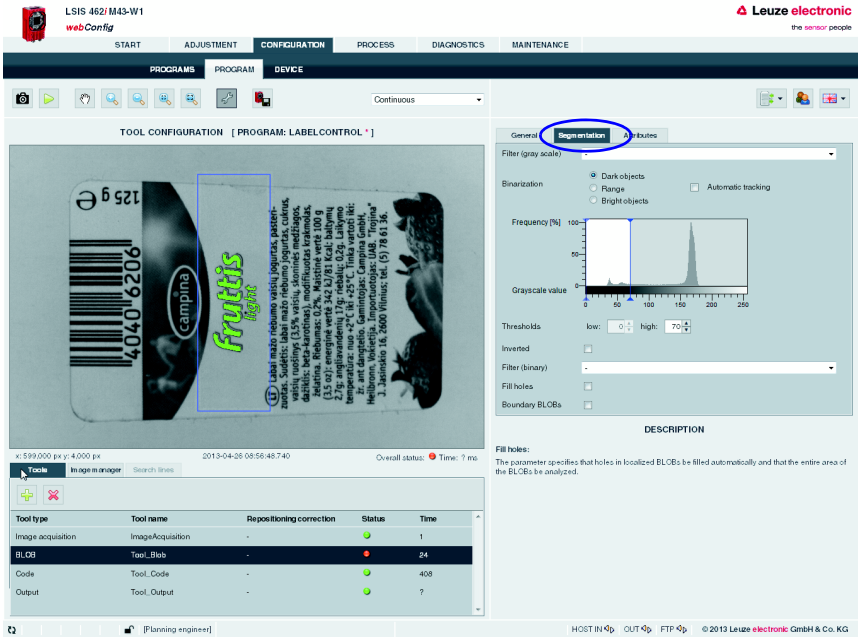


Figure 4.49: Segmentation of the image

In the "Segmentation" tab, select the "Dark objects" option to make a rough presetting of a suitable segmentation threshold for dark objects in the image. The objective is to cleanly separate dark letters from the light background, e.g., to use the presence of one or more defined objects (here: letters) to detect the correct label or label side.

↳ *In this example, use the default option of "Dark objects".*

↳ *To make* fine adjustments, use the sliding upper threshold in the histogram.

4.4.4 Evaluating object attributes

After segmentation, the criteria for the detected objects (BLOBs) must now be set.

↳ *Switch to the "Attributes" tab.*

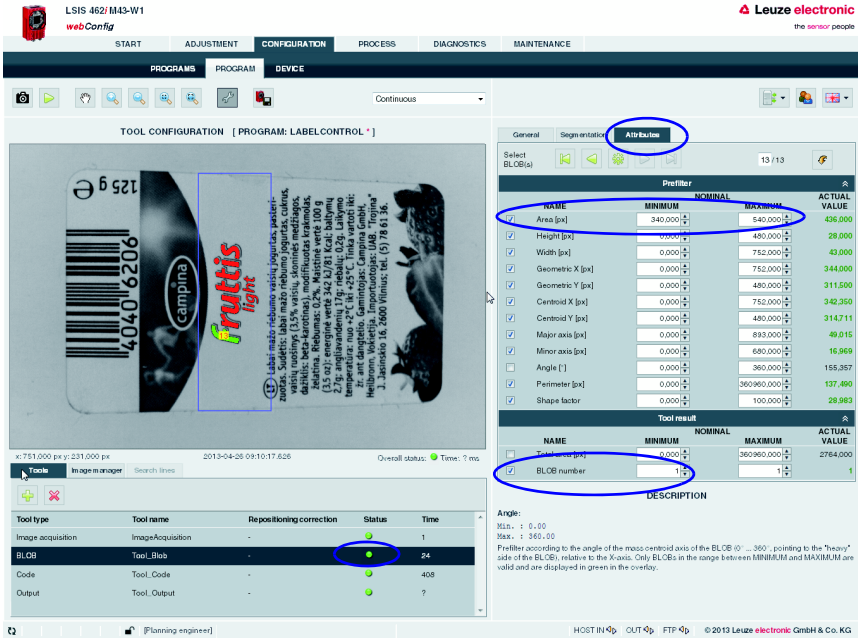


Figure 4.50: Evaluating object attributes

To detect the correct label type or the correct label side, a characteristic character is searched for, in this example, the letter "f".

↳ *For this purpose, a permissible minimum and maximum size (area) is defined in the "Area" prefilter of the "Attributes" tool tab. This area is oriented to displayed area of the character being searched for, the letter "f".*

As a result, all objects are filtered out whose area does not correspond to that of the object being searched for.

Notice!

If the "Area" attribute is not sufficient for clearly identifying the "f" because there are other objects with similar or even identical areas in the evaluation range, it would be necessary to include other attributes, such as "Circumference", "Shape factor", … to distinguish the character.

In this way, all other dark objects are filtered out (displayed in red), and only the searched-for "f" remains as a valid object (displayed in green).

↳ *In the bottom line, define that the tool should report an "OK" result if exactly one object (BLOB number minimum = maximum = 1) is found.*

The corresponding line ("BLOB" tool type) of the tool list now has a green LED.

4.4.5 Setting the parameters for code reading

↳ *In the tool list, activate the "Code" tool.*

The configuration masks associated with this tool open on the right side.

Defining the ROI

↳ *In the "General" parameter group, define a region of interest around the area in which the code to be read must be located in order to reduce the execution time of the tool.*

If no ROI is defined, the entire image is analyzed.

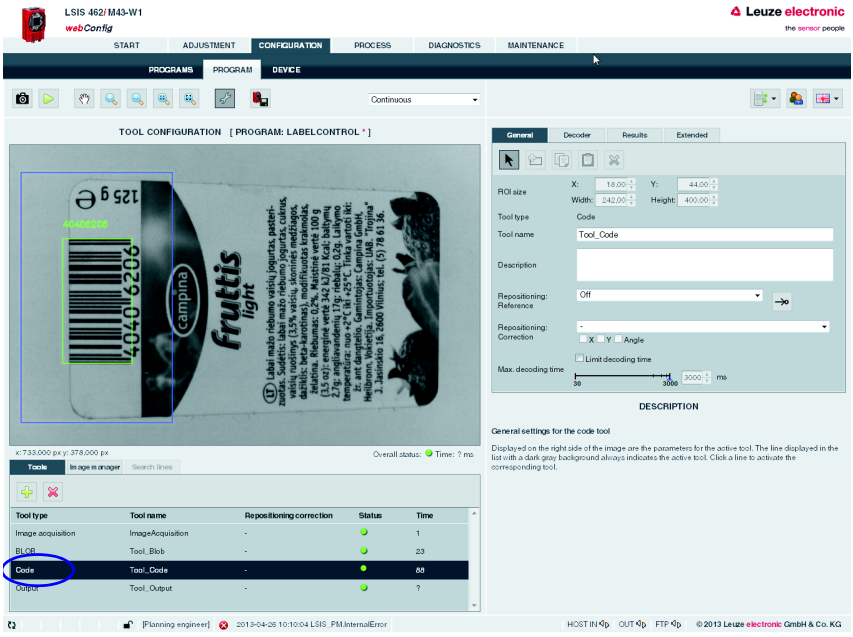


Figure 4.51: Defining the ROI

Deactivating any unneeded codes

- *Switch to the "Decoder" parameter group.*
- *Deactivate the unneeded codes in order to reduce the execution time of the tool or to restrict reading to certain code types.*

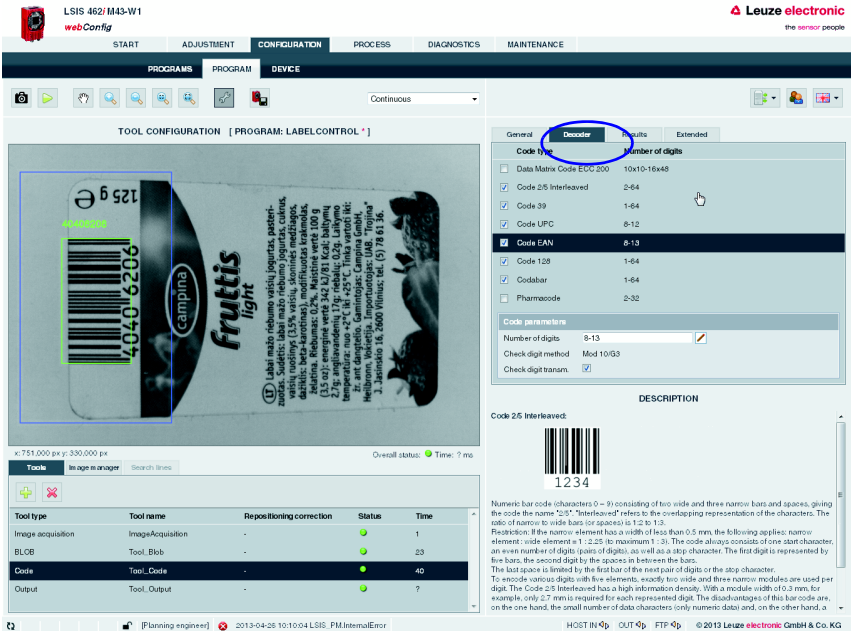


Figure 4.52: "Decoder" parameter group – Deactivating unneeded codes

In this example, the deactivation of the 2D Data Matrix code results in a considerable reduction of the execution time (in the same way, deactivation of all 1D bar codes leads to a considerable reduction if only a Data Matrix code is being searched for).

Defining the quality filter and number of codes to be found

↳ *Change to the "Results" parameter group to view details on the read codes in the image or region of interest.*

Various "OK criteria" can also optionally be defined here for the tool result – with respect to the quality parameters of the read code, the number of codes to be found or with respect to a code comparison.

In the current example, exactly one code is to be found with arbitrary quality parameters (= F).

↳ *Set the corresponding options, as shown in the figure.*

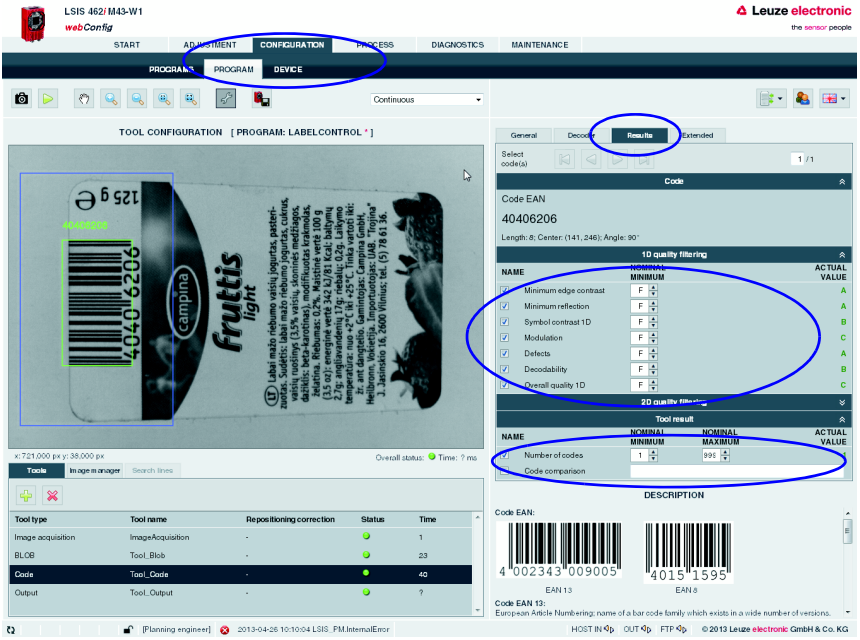


Figure 4.53: "Results" parameter group – Use quality filter and number to define tool result

Example for code reading with combined BLOB analysis in which the object attributes do not correspond to the criteria

The inspection with an "Incorrect" label that does contain the searched-for letter "f" shows that the code is read (green status LED in the "Code" line), but the BLOB analysis fails (red status LED in the "BLOB" line).

As soon as a tool in the tool list yields an NOK result (red status LED), the global result is NOK as well (red "global result" status LED below the camera image).

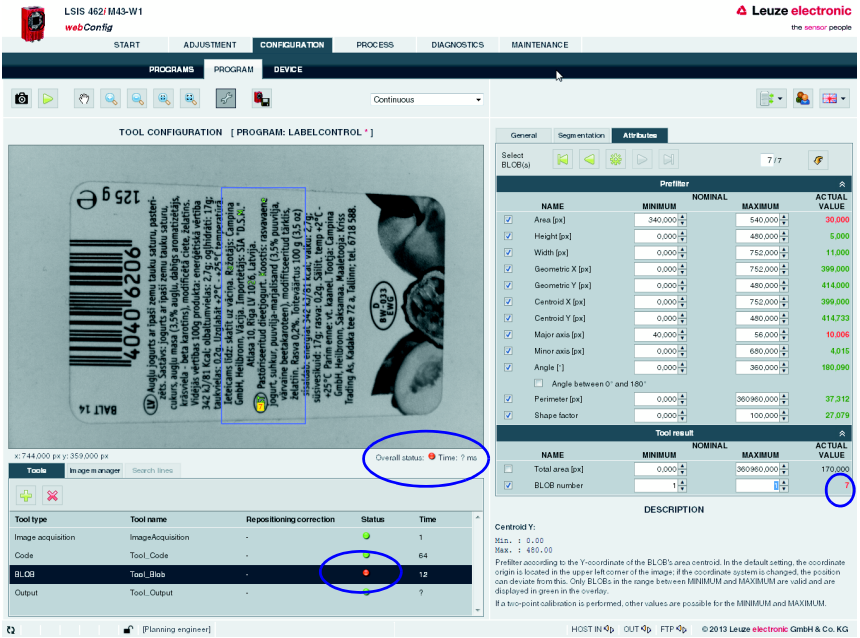


Figure 4.54: Evaluating object attributes

4.4.6 Optional: Configuring process data output

In the "Program" tab of the Configuration module, switch to the "Output" tool type to configure an output sequence.

This sequence is output following processing of the check program, e.g., via the Ethernet process interface.

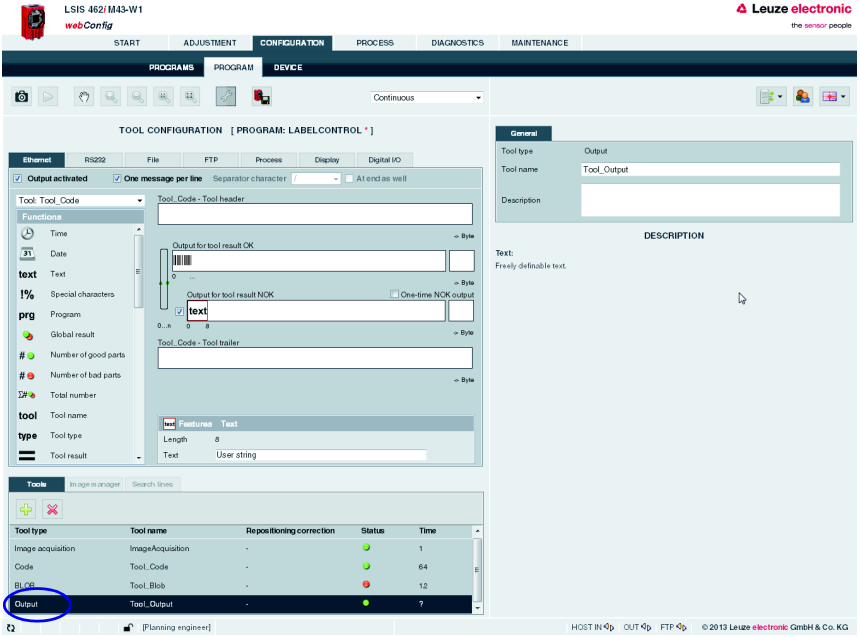


Figure 4.55: Window for configuring the output

Displayed in the left area is a list of the available "output functions". Information on the individual elements (date, time etc.) and other possibilities for the specification are available as usual in the right part of the window.

Configuring the Ethernet output

- *Activate the* **`Ethernet output activated`** *check box.*
- *In the list box, first define whether you would like to configure the header, the code tool or the trailer.*
- *Insert the desired elements from the function list in the input line provided for this purpose at the right by means of drag & drop.*
- *Specify element options, such as length, alignment, fill character, etc., in the lower part of the Features area.*

Delimiters between the individual pieces of data and the use of separate lines increase the "Readability" of the output data.

In the current example, the code contents are output in the case of an OK; for an NOK (no code detected), a freely definable text "no code found!" is output.

Activation of the "Host LSIS" check box in the upper right causes the otherwise not displayed tool execution time to be calculated and displayed for the data output.

4.4.7 Optional: Configuring cross-program device settings for process-data transmission

- *In the "Configuration" work module, switch to the "Device" tab.*
- *In the "Process - Ethernet" submenu, specify the parameters for Ethernet communication with the primary control that is to receive the process data.*

In the current example, a TCP/IP connection is established with the LSIS as server.

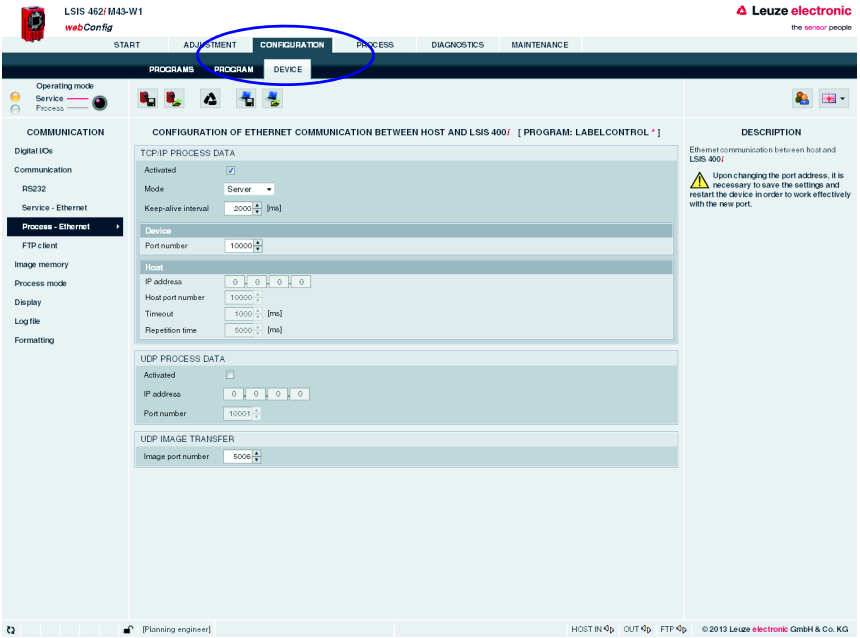


Figure 4.56: Defining Ethernet communication with the primary control

4.5 Tips and tricks

4.5.1 Camera alignment and setup in the case of reflective objects

To avoid interfering reflections in the gray-value image during image acquisition on highly reflective objects, such as crown caps, it is recommended that the camera be mounted at a slight incline and with adjusted illumination focus according to object size and object distance. This is illustrated in the following images.

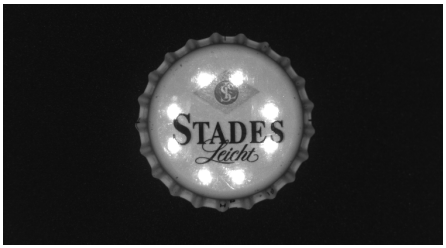


Figure 4.57: Vertical camera alignment - maximum reflections



Figure 4.58: Inclined camera alignment with all four illumination quadrants active - better, but reflections still visible in one quadrant



Figure 4.59: Inclined camera alignment with only three illumination quadrants active (reflected quadrant is off) - nearly all reflections in the image are suppressed

Depending on the material and surface structure of the object to be tested, the use of accessory parts such as the plastic diffuser plate or the polarization filter may be helpful.

4.5.2 Using filters in the BLOB analysis

The following morphological filters can be applied to the binary image created following segmentation:

- Erosion
- Dilatation
- Open
- Close

Notice!

When speaking of "Bright" in the context of binary filters, the active pixels displayed in color in the image overlay are always meant.
When speaking of "Dark" in the context of binary filters, the remaining area of the image is always meant.

4.5.2.1 "Erosion" binary filter

Enlarge dark structures, eliminate bright interfering pixels

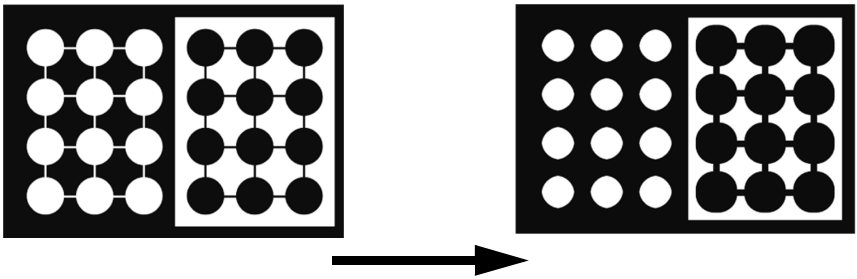


Figure 4.60: Original/processed image

4.5.2.2 "Dilatation" binary filter

Enlarge bright structures, eliminate dark interfering pixels

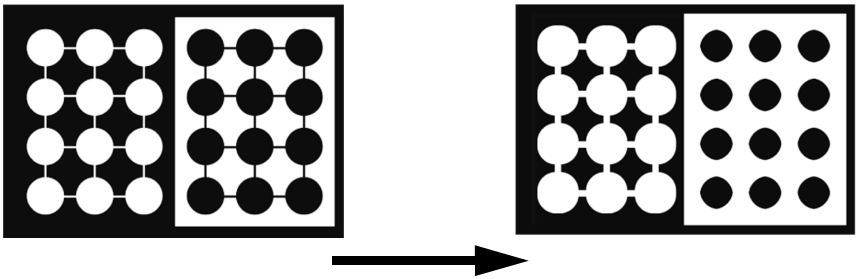


Figure 4.61: Original/processed image

4.5.2.3 "Open" binary filter

Close gaps in dark objects without changing the object size

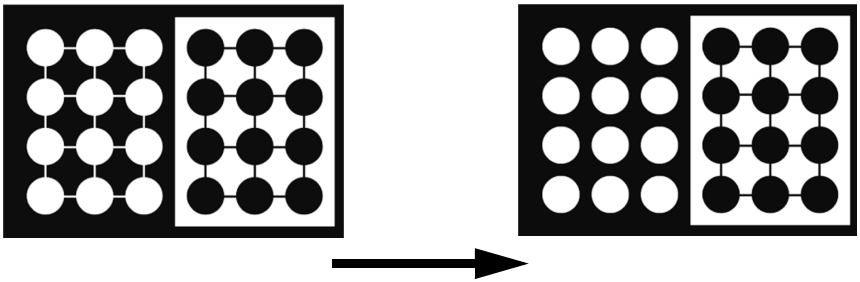


Figure 4.62: Original/processed image

4.5.2.4 "Close" binary filter

Close gaps in bright objects without changing the object size

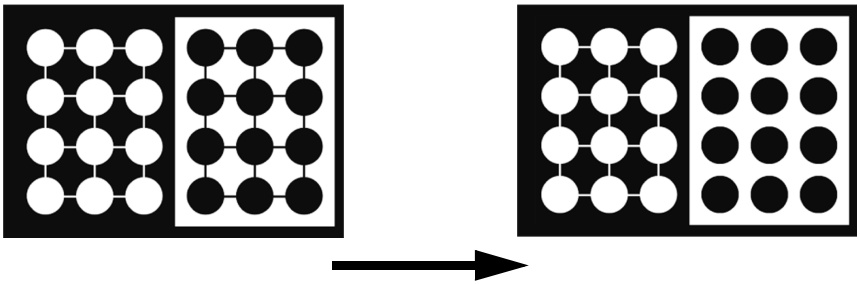


Figure 4.63: Original/processed image

4.5.3 Illumination

Decisive for image processing is the highlighting of characteristic features of the object to be inspected.

Problems could arise as the result of:

- Shadows
- Reflections
- Too much light
- Too little light
- Reflective surfaces
- Poor contrast

Various **lighting techniques** can be used:

- Rear illumination
- Front illumination
- Bright field illumination
- Dark field illumination
- Telecentric illumination
- Diffuse light source
- Continuous illumination
- Pulsed illumination (flash)
- Light color (red, IR, UV, ...)

Rear illumination

Illumination type where the object is located between the camera and the light source.

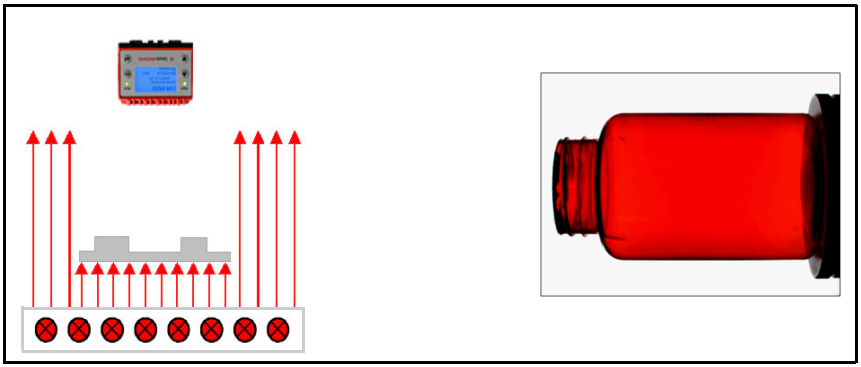


Figure 4.64: Rear illumination

Notice!

This can be used to create silhouettes with sharp edges and very good contrast for contour inspections.

Front illumination

Illumination type where the camera and the light source are located in front of the object.

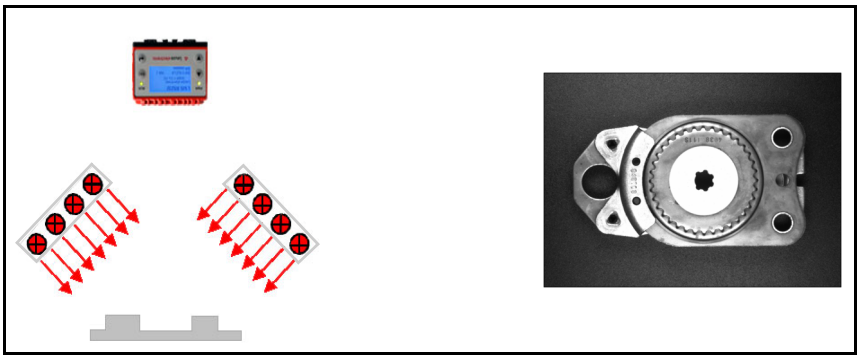


Figure 4.65: Front illumination

Notice!

Diffuse (scattering) objects are always visible, glossy objects only at an appropriate angle relative to the objective.

Bright field

Illumination type in which the camera detects the light directly reflected by the object surface.

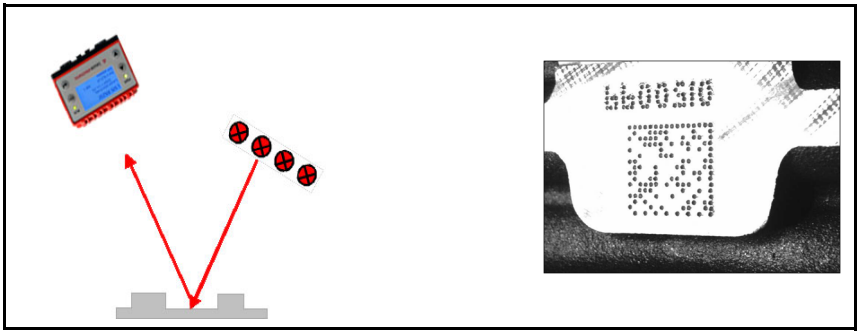


Figure 4.66: Bright field

Notice!

The reflecting surfaces appear bright, while the scattering surfaces appear dark. Gloss is possible!

Dark field

Illumination type where the camera detects the light spread by the object surface (scratches, indentations).



Figure 4.67: Dark field

Notice!

The scattering surfaces appear bright, while the reflecting surfaces appear dark.

Directed illumination

Illumination type where the incident light has a narrow angular distribution. Ideal case: Telecentric illumination (parallel light).

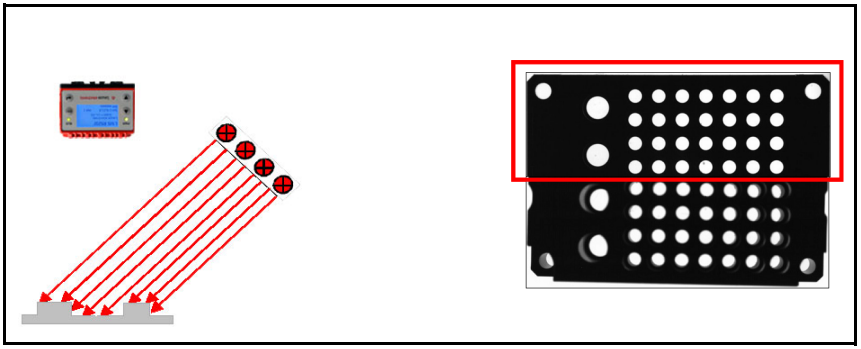


Figure 4.68: Directed illumination

Notice!

Yields very strong edge contrast and emphasizes object surface structures.

Diffuse illumination

Homogeneous illumination of a half-space from all directions (primarily for reflective/glossy objects).

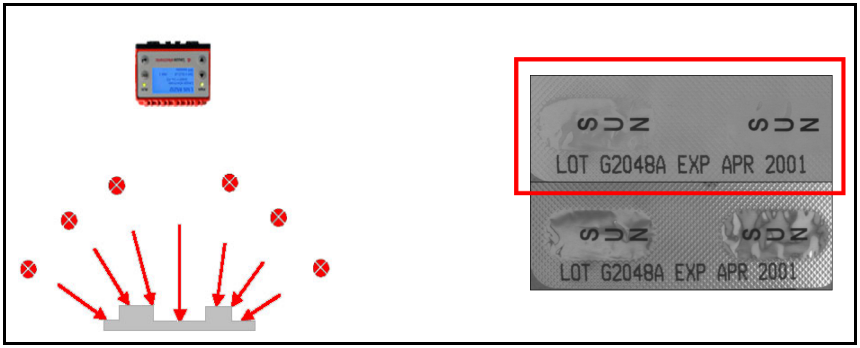


Figure 4.69: Diffuse illumination

Notice!

With homogeneous rear illumination, dark objects appear smaller (lighter edges as a result of diffused light).

5 Appendix

5.1 Online commands

5.1.1 Overview of commands and parameters

Online commands can be used to send commands directly to the device for control and configuration.

For this purpose, the **LSIS 4xx*i*** must be connected to a host- or service computer via the interface. The commands described can be sent either via the host or the service interface.

Online commands

With the commands, you can:

- control/decode.
- read/write parameters.
- set reference codes.
- call up error messages.
- call up statistical device information.
- carry out a software reset in order to reinitialize the device.

Syntax

"Online" commands consist of one or two ASCII characters followed by command parameters.

No separation characters may be entered between the command and the command parameter(s). Both small and capitalized letters can be used.

Example:

Command **'GAI=<>'**:	Program changeover
Parameter **'001'**:	Program number
Transmitted is:	**'GAI=<001>'**

Notation

Commands, command parameters and returned data are enclosed between single quotation marks **' '** in the text of this manual.

Most online commands are acknowledged by the **LSIS 4xx*i***. For commands that are not acknowledged, command execution can be observed or monitored directly on the device.

5.1.2 General online commands

Software version number

Command	'V'
Description	Requests device version information
Parameter	No
Acknowledgment	**e. g. 'LSIS462i M43 - W1 HW V3.2.0 2014-01-01'** The first line contains the device type of the **LSIS 4xx*i***, followed by the device version number and version date. (The data which is actually displayed may vary from the values given here.)

Notice!

This command returns the major release number of the software packet. This major release number also appears on the display during start-up.
This command can be used to check whether the connected host or service computer is properly connected and configured. If you do not receive an acknowledgment, please check interface connections, protocol and service switches.

Software reset

Command	'H'
Description	Carries out a software reset. The device is restarted and reinitialized, leaving it in the same state as when the supply voltage is switched on.
Parameter	No
Acknowledgment	**'S'** (start character) Acknowledgment takes place only with an RS232 connection. No response with an Ethernet connection.

Device status

Command	'SST?'
Description	With this command, the current device status is queried independent of whether the **LSIS 4xx*i*** is in Configuration mode or Process mode.
Parameter	No
Acknowledgment	**'SST=xxxxxxxx'** Each "x" represents a single bit (0 or 1) from the following list. Bit 7 is at the far left, bit 0 is at the far right. **Bit 0 Ready for testing** **'1' =** The **LSIS 4xx*i*** is ready to receive a trigger and start a check program. **'0' =** The **LSIS 4xx*i*** does not respond to an incoming trigger signal. **Bit 1 Operating mode** **'1' =** Process mode. **'0' =** Service mode. **Bit 2 Device error** **'1' =** Device error, no inspection possible. **'0' =** No device error, ready. **Bit 3 No function**, value is always = 0 **Bit 4 No function**, value is always = 0 **Bit 5 No function**, value is always = 0 **Bit 6 No function**, value is always = 0 **Bit 7 No function**, value is always = 0 Alternatively, the following acknowledgment is output: **'DS=xx'** **'00' Syntax error** **'01' Other error**

Notice!

The maximum response time is 1s.

Manual definition of the reference code

Command	RS
Description	This command can be used to define a new reference code in the **LSIS 422*i*** / **LSIS 462*i*** by means of direct input via the interface. The data is placed in the work buffer for direct further processing according to your entry under tool 1 … n.
Parameter	**'RSyvxxzzzzzzzz'** **y**, **v, x** and **z** are placeholders (variables) for the actual input. **y** Defined tool no. **'1'** Code tool 1 **'2'** Code tool 2 **v** Storage location for reference code: **'3'** RAM **xx** Defined code type **'01'** 2/5 Interleaved **'02'** Code 39 **'03'** Code 32 **'06'** UPC (A, E) **'07'** EAN **'08'** Code 128, EAN 128 **'10'** EAN Addendum **'11'** Codabar **'12'** Code 93 **'13'** GS 1 Databar Omnidirectional **'14'** GS 1 Databar Limited **'15'** GS 1 Databar Expanded **'32'** Data Matrix Code **z** Defined code information (1 … 63 characters)
Acknowledgment	**'RSx'** **x** Status **'0'** Valid '**RS**' command **'1'** Invalid command **'2'** Insufficient memory for reference code **'3'** Reference code has not been saved **'4'** Reference code invalid
Example	Input = 'RS133212345678' Code tool 1 (1), RAM (3), Data Matrix Code (32), code information (12345678)

Notice!

Defined code information in the 'RS' command is the character set from 20_h to $7F_h$.
The 'RS' command applies only for the currently valid check program.

5.1.3 Online commands for system control

Activating sensor input

Command	'+'
Description	The command activates the valid check program (e.g., decoding). Depending on the configuration in **webConfig**, the '+' command activates a single shot or a reading gate control.
Parameter	No
Acknowledgment	The response can be freely defined. The response is defined program-specific in the output tool.

Deactivating sensor input

Command	'-'
Description	The command ends the reading gate control. Upon receipt of '-', ongoing processing of an image acquisition continues to run so that the final results can still be output.
Parameter	No
Acknowledgment	None

5.1.4 Online commands for program control

Program query

Command	'GAI?'
Description	The command queries the currently valid check program.
Parameter	No
Acknowledgment	**'GAI=<bbb>'** Sent as response is the ID of the currently active program, e.g., 'GAI=0'

Program changeover

Command	'GAI=<xxx>'
Description	This command activates a changeover to the desired check program
Parameter	The program number (ID) must be specified as a 3-digit number, e.g., '001'
Acknowledgment	**'GS=<bb>'** whereby the following values are defined for <bb>: **'00'** = Positive response **'01'** = Syntax error **'02'** = Wrong parameter **'03'** = Wrong operating mode **'04'** = Other error

Notice!

In general, the "Ready for testing" bit (see "Device status" on page 209) is set to "0" during the program change. The output is activated if the program changes or the focal position is reached. At this moment, confirmation 'GS=00' is also output. This command is executed independent of operating mode (Service/Process).

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