Application Note

SBRD
use cases for duo camera application

SBRD (pn:8067301)

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Content

1 Hardware/Software

Typ/Name	Version Software/Firmware	Herstellungsdatum
SBRD-DemoCase	98237	
CCS	1.0.19231	

Table 1.1: Hardware/Software

1.1 Available manuals

SBRD

DE: Support Portal › C:\Program Files\Festo\CCS\help
EN: Support Portal › C:\Program Files\Festo\CCS\help

2 Description of the use cases

The SBRD is a remote head vision controller with USB 3 interface for 2 cameras. The highlight of the controller is that both cameras are processed simultaneously. This means that with a trigger signal both cameras record simultaneously.

Image processing and evaluation are also carried out together in one inspection program.

Independent use of the two cameras with different trigger inputs is not possible in the described software version. May be available in future developments.

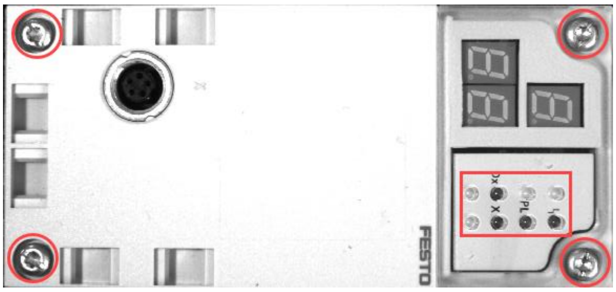
The addressed applications are usually designed to inspect one object in different views or in different positions.

In this Application Note we focus on 2 use cases:

First use case

Inspect an object by 2 different views. One camera will capture the top view of a part and inspect the quality. The second camera inspect a 2D code which is placed on the side of the object.

Top view camera:



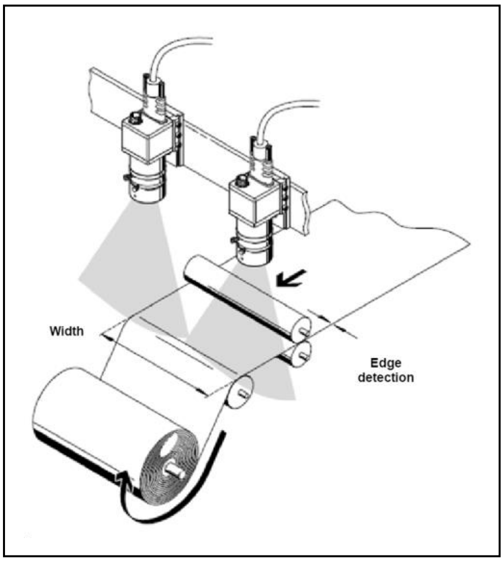
Side view camera:

The red marked area must be inspected. It has to be checked whether all 4 screw at the corner of the module are mounted and if only 4 of the maximum of 8 LED are available.(count LED)

The 2D code has to be read, and transmitted to an controller by ETH dataoutput.

Second use case

2 cameras detect the edge position of a wide band. The width of the band should be calculated upon the measures of the 2 cameras. The result is shown in mm values.

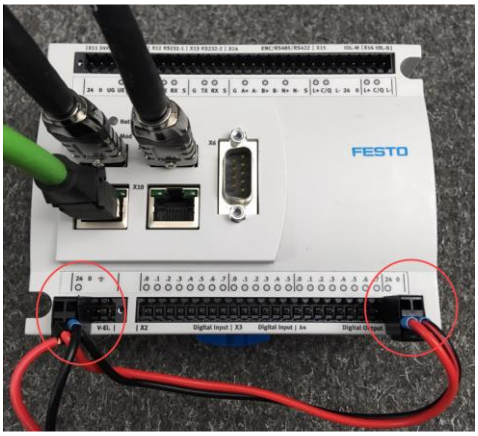


3 Basic configuration with software CCS Camera Configuration Studio

The camera at the SBRD controller is configured with the software „ CCS Camera Configuration Studio “ The software is available on the support portal. Before you connect to CCS you should check you ETH adapter setting on your PC and the camera. The demo work with fix IP addresses for the particular components. So adapt your PC setting to a fix ip-address in the same subnet as the camera. The camera has on default an address 192.168.4.2 255.255.255.0

The IP-setting of the camera could be changed by the software FFT Festo Field Device Tool. › available on Support Portal.

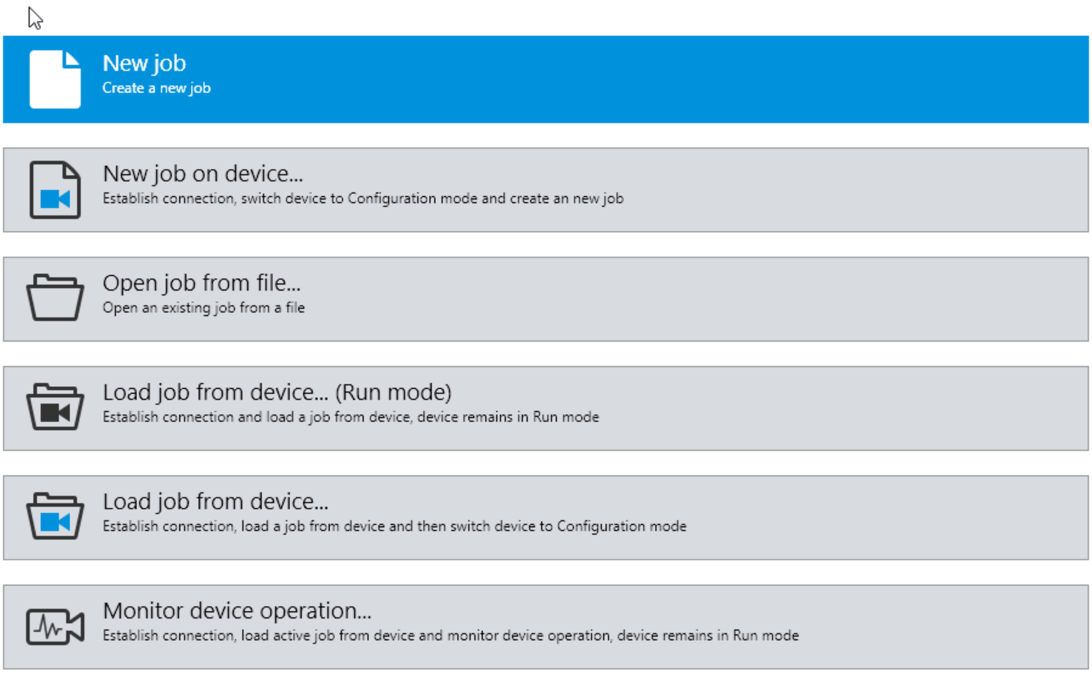
Connect both camera to the controller and supply the I/O 24V. (Both input left and right at the controller see photo)



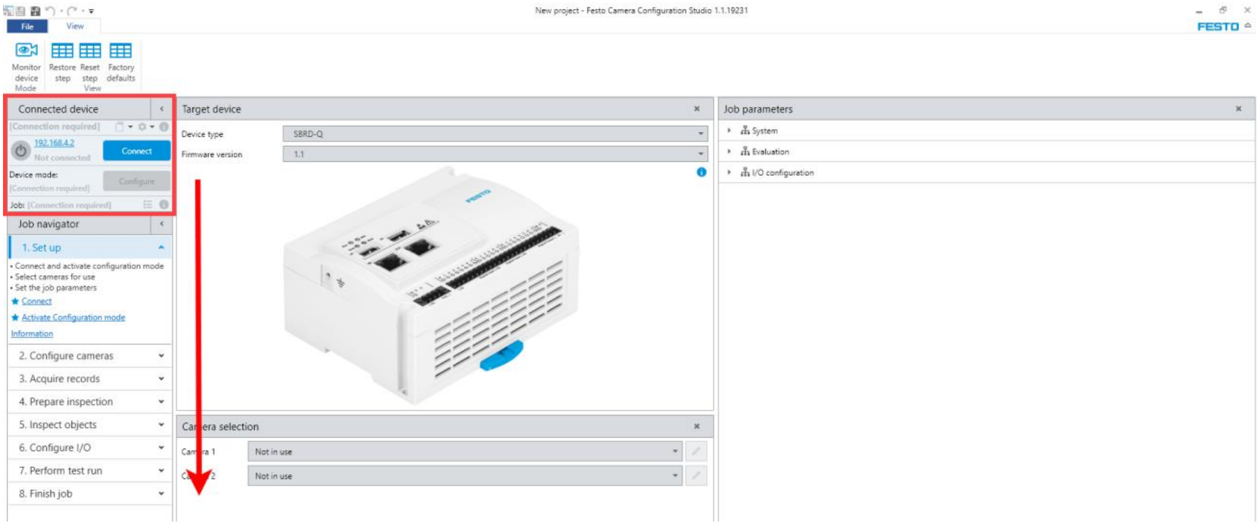
Remark: The assigment of the cameras in the software is independent of the used USB socket!

Start CCS software:

Select: New job

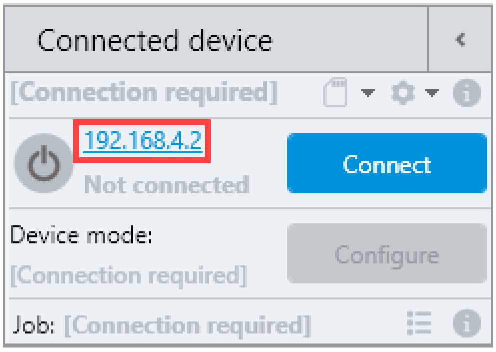


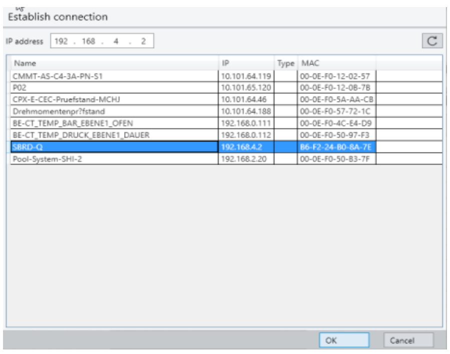
Follow the steps on the left column of the CCS software:



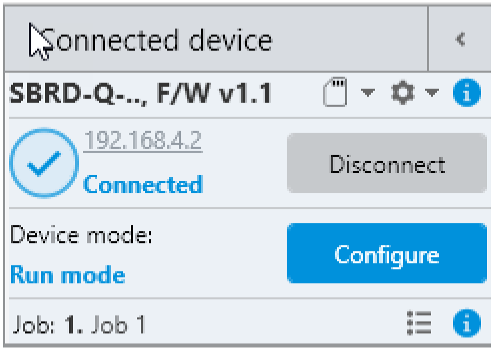
Connect or search device:

Click on the ip-address to search for devices on the network.



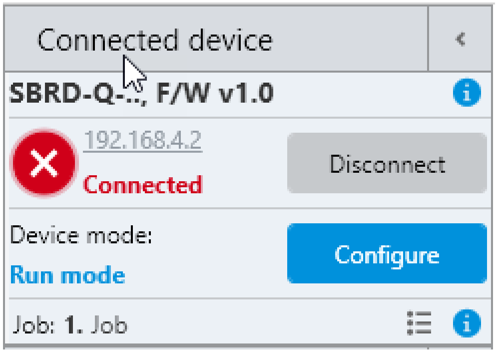


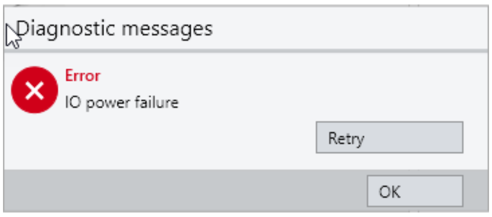
Click on  button for diagnostic information.



If connected is confirmed › Enter Configuration mode › press 

If Button appear red › click on button for diagnostic message





Resolve the Error cause to continue with the project.

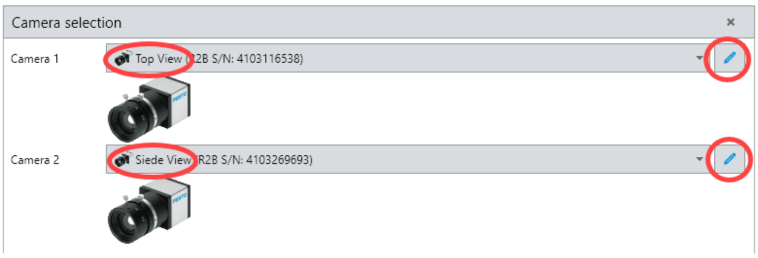
Configure Mode:

In configure mode the controller is forced to stop the active job processing. The current setting of the active job is not changed by the following adjustments. The new setting has to be downloaded to the controller, as described in step 8 of the job navigator. To abort you can switch to run mode and disconnect device.

Follow the steps in the Job navigator.

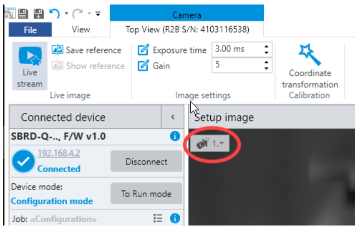
Step 1.: Set up

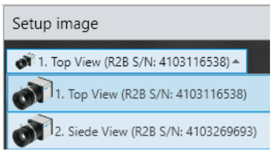
By the autodetect, the connected camera were shown in the camera selection window. You can edit own name for the particular camera by edit button.



Step 2.: Configure cameras

In the ribbon bar you set up the image parameter. The brightness by the exposure time and gain. The size of the image could be changed by shifting the limits with the mouse.
If needed the Coordinate Calibration could be performed in this step.
The image window show only one camera image. To change between the 2 cameras you have to select the active camera in the drop down box left top corner of the window:





Remark: The numbering of the camera is independent from the USB connector on the device! It is only a definition in the software! The assignment is based on the serial-no. of the camera device. If camera has to be exchanged you have to assign the new device in Set-up, otherwise you get an Error: “Camera type match failed”

When the images of both cameras are adjusted as the inspection demands, go on with the next step.

Step 3.: Acquire records

For the further steps we need to have images for a simulation of the inspection task. The CCS software manage the records in different container. Each container has a different meaning.

Teach records, only records of **GOOD** parts, Base for tolerance calculation

GOOD and **Bad** parts, Simulation result of the inspection program

Storage container for short period, will be deleted after closing CCS

Records captured online, that are evaluated, for confirming the set up and data logging, will be stored after closing CCS

The ribbon bar offers a button for Trigger. Every click on Trigger will capture an image of both cameras simultaneously. By default setting, the images were recorded in the Temporary records container as a filmstrip. By drop down menu you can see the different image of camera 1 and camera 2. Check both images if the capture is good for the task.

Remark:
Use only captures where both camera show good part images for the sample container!
Until step 3 the description fits to both use cases. Also to other use cases where only one camera is in use.

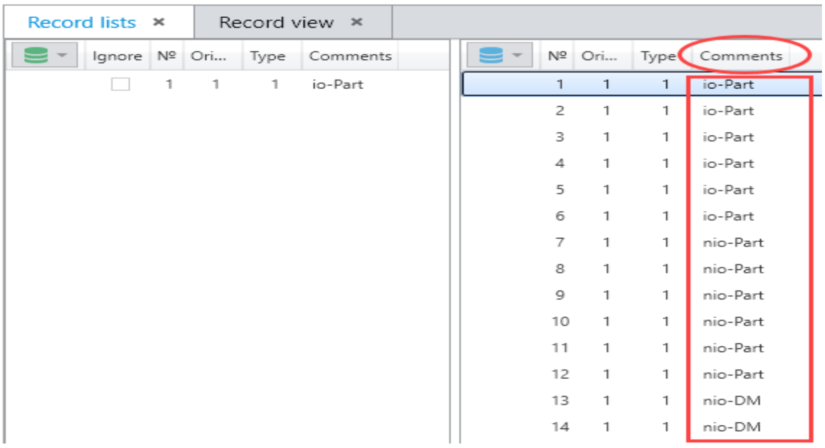
4 Setup the inspection Use case 1

Step 3.: Acquire records

The camera for side view must show the 2D code in all the possible positions. The topview camera should capture the entire part with the details for inspection in all possible positions.
At the end, the record list should contain images from Good parts and from Bad parts in all occurring variants.

After all the images recorded we have to drag and drop the image from the Temporary record filmstrip to the record list of Sample records and Inspection records.
At least we need 1 image for the Sample records list. All the other images were pasted in the Inspection record list. Image which are somehow damaged due to wrong operation could be deleted.

At the end of this step the record list should have at least following content.
Use the comment column to identify the parts failure. For multiple parts with the same comment, you can select the group and press F2 to assign comments to the whole group.



Record lists | Record view

Ignore	№	Ori...	Type	Comments
	1	1	1	io-Part

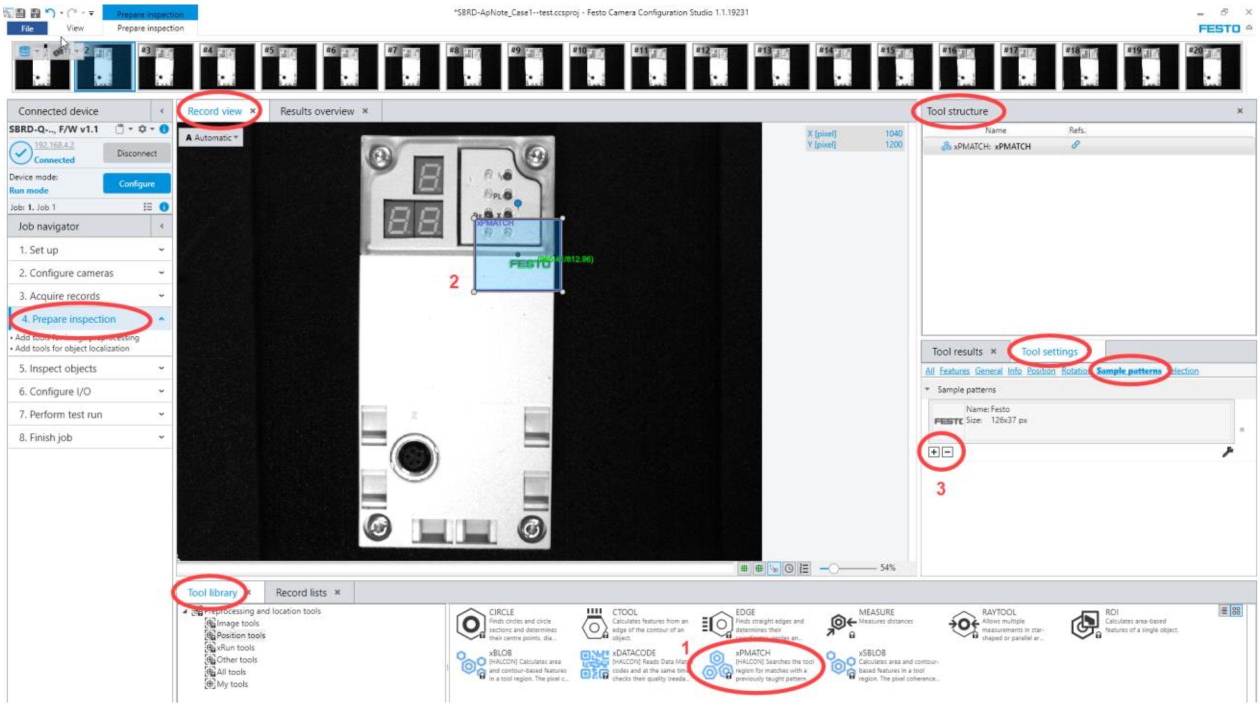
№	Ori...	Type	Comments
1	1	1	io-Part
2	1	1	io-Part
3	1	1	io-Part
4	1	1	io-Part
5	1	1	io-Part
6	1	1	io-Part
7	1	1	nio-Part
8	1	1	nio-Part
9	1	1	nio-Part
10	1	1	nio-Part
11	1	1	nio-Part
12	1	1	nio-Part
13	1	1	nio-DM
14	1	1	nio-DM

Step 4.: Prepare inspection

The meaning of this task is to set up tools, which calculate the position of the object in the image. These position coordinates are used to install the tools to evaluate the quality of the part in step 5.

The position detection for this task is made by xPMATCH tool. This tool search for a “learned” pattern in the image. In this example we learned the FESTO logo on the part for the position reference.

Learning procedure:
(1) Select the xPMATCH icon from Tool library and drag it in the Tool structure window.
(2) Move the search window of the xPMATCH to the area where the pattern could appear.
(3) Open the tab Sample patterns in the Tool setting window. With + you open the pattern wizard. Select the pattern and adjust the window. Use the automatically adjust button. Then define the origin coordinate system of the pattern. › Finish.
In the tab General, you can adjust the performance of the pattern search. E.g. the minimal match score. By default it is 80%, but in some cases it may has to be changed.
Example window and settings:



Before you continue with the next step, you should verify if the pattern is matched properly. Step through all the images in the filmstrip of the inspection records. FESTO has to be found in every record. (no invalid result is allowed!)

Step 5.: Inspect objects

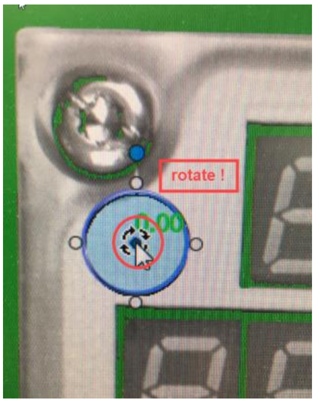
Inspection of the screws

Task is to check the presence of the 4 screws at the corner of the module. This could be done with 4 ROI tools. They have to be placed on the particular screw position.

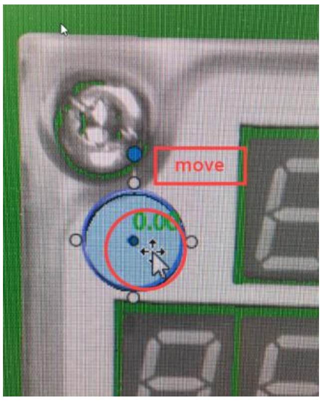
There are different possibilities to apply and add tools to a job. This Application show only one style!

Select a ROI tool from the Tool library, move and drop it in the image at its supposed position on one screw. We will adjust the necessary setting for the first ROI and afterwards copy the tool 4 times.

Move the ROI to the location of the first screw. Change the shape to circular in Tool setting, tab General. Adapt the size and position by mouse to the screw.
But pay attention to the mouse cursor! Do **not** move the tool by the blue center-point, you will change the offset values of the rotation point!

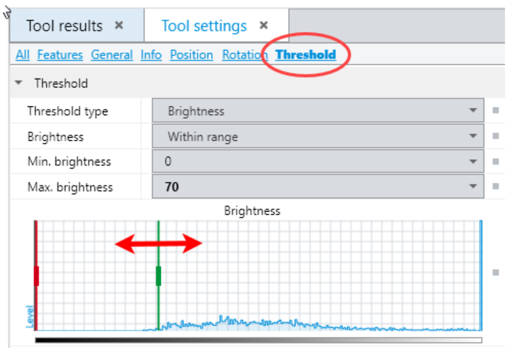


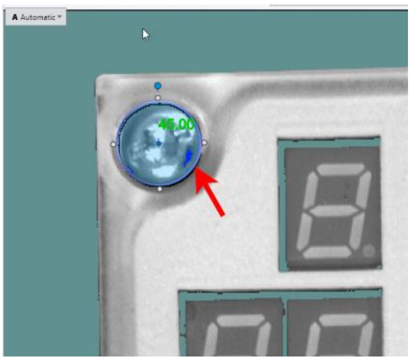
Look at the arrows at the mouse cursor!



Tab Threshold:

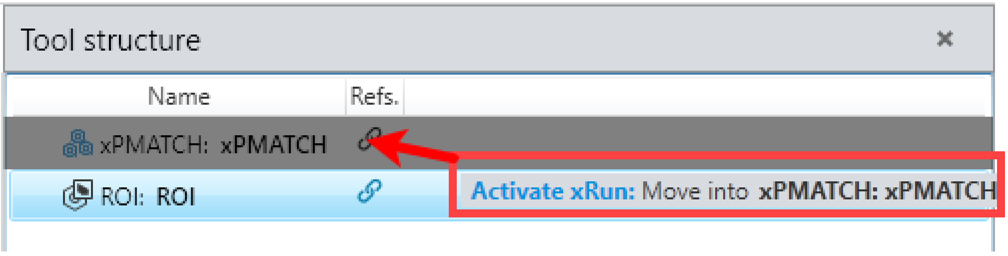
The ROI tool calculate the amount of Pixel in its region, based on the threshold setting of the brightness. In this inspection, we expect the missing screw with dark pixel. So we adjust the threshold to count the dark pixel. Open the Threshold tab and adjust the limit that only the dark pixel are recorded. You can shift the limit by mouse in respect to the shown histogram. In the image you can see the effect of the limit by blue colored pixel.



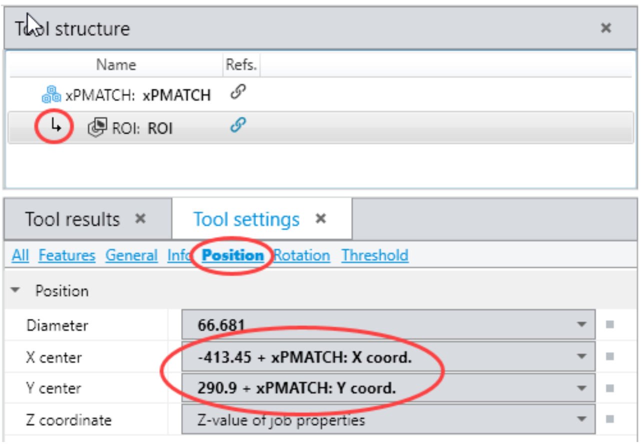


IF, shape, position and threshold is adjusted, you have to reference the ROI to the location of the pattern match results. This is made in the Tool structure window:

Select the ROI and move it on the xPmatch tool. A mouse over comment will show: Activate xRun Move into xPmatch.

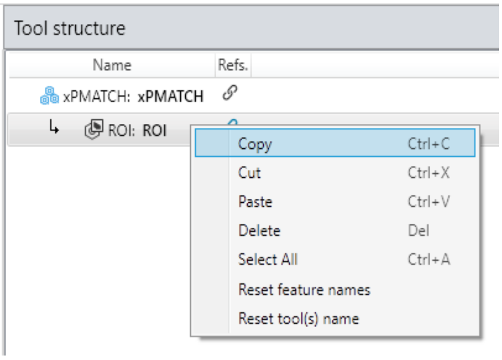


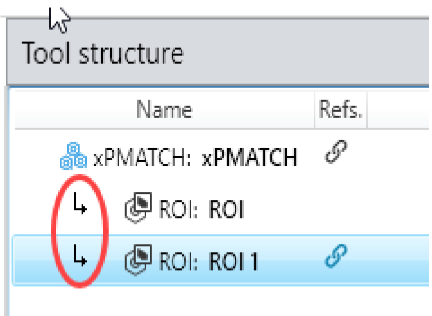
If you release the mouse button the ROI is referenced to the xPmatch and the Tool structure look like:



In the tool settings tab Position you can see the reference and the offset for the ROI. As well in the tab Rotation the xPmatch references are connected.

Now the first ROI is configured and it could copied 3 times. Select the ROI and click right mouse button for context menu. Select Copy

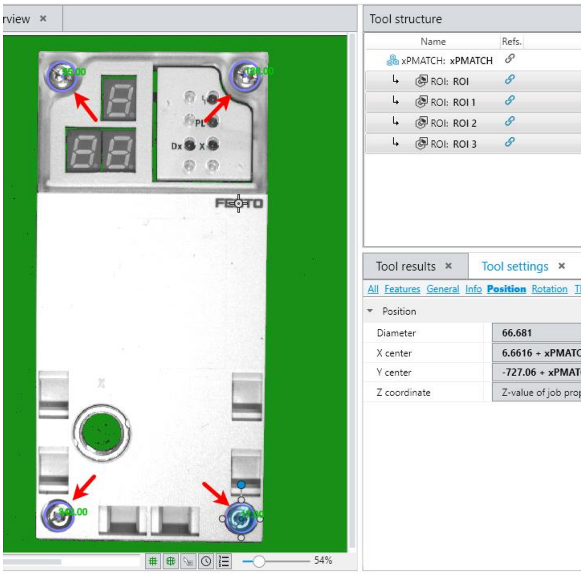


Paste direct on the ROI!


Now you get an exact copy of ROI with the name ROI 1. If The “Enter” symbol is like shown above, the copy of the Roi is also referenced to the xPmatch tool.

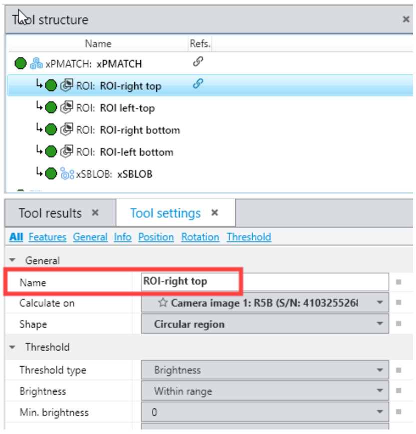
Repeat this sequence 3 times to get 4 ROI entries in the Tool structure.

Now all ROI located on the same screw. As next step move each ROI to the specific positions. (Record view)



If you multi select in Tool structure, all ROI were displayed.

To get a better overview for the different ROI, it is possible to give them separate names in the Tool settings “Name” field.



Inspection of the LED

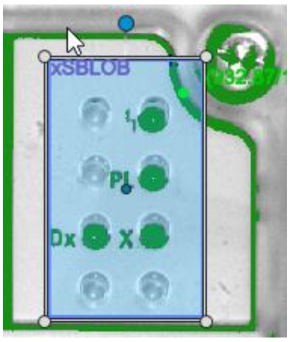
The next inspection is done by xSBLOB tool. The availability of the status LED were checked. The xBLOB will count the amount of blobs. Every blob represent 1 LED.

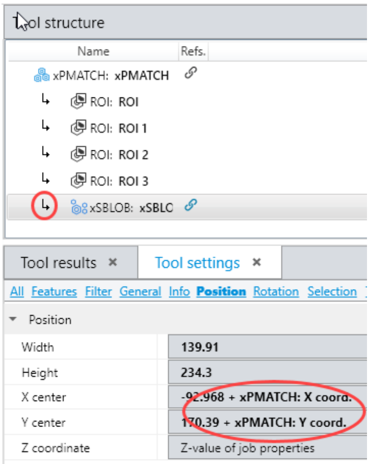
Select the xSBLOB tool from the Tool library, move and drop it in the image at its supposed position.

Adapt the region of the tool to cover the mounted status LED by mouse.

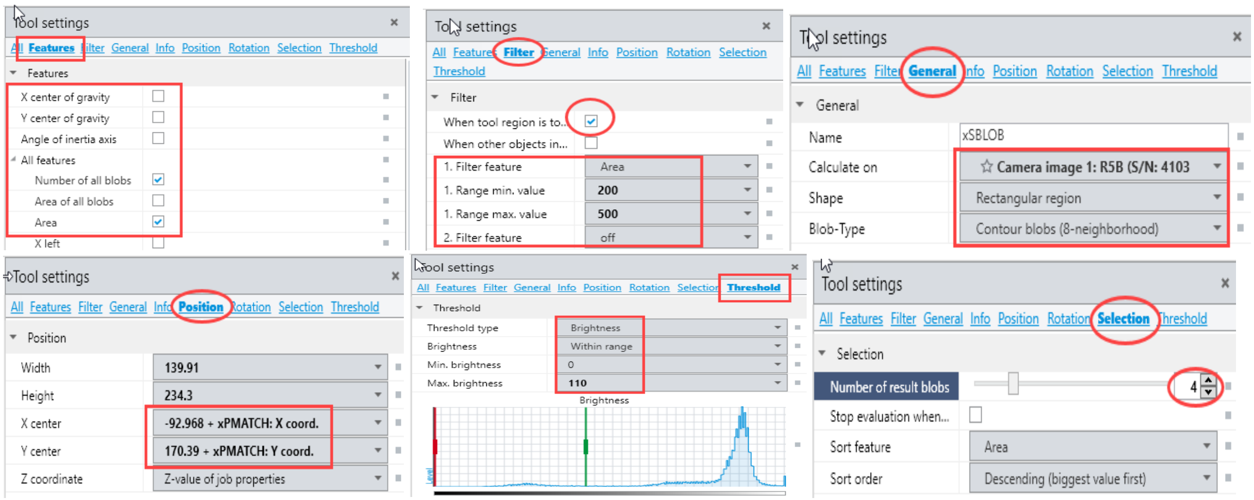
Assign the Position reference to the xPmatch tool:

Select the xSBLOB in Tool structure and move it on the xPmatch tool. A mouse over comment will show: “Activate xRun Move into xPmatch”





Then adjust the Tool settings as shown:



After the setting you can step through the images and check in Tool results, if always 4 Blob were found.

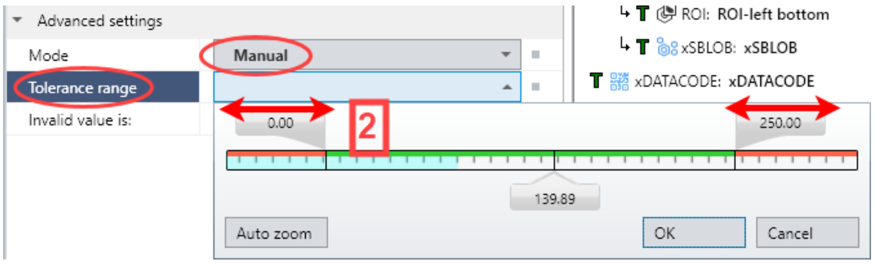
Quality classification setting

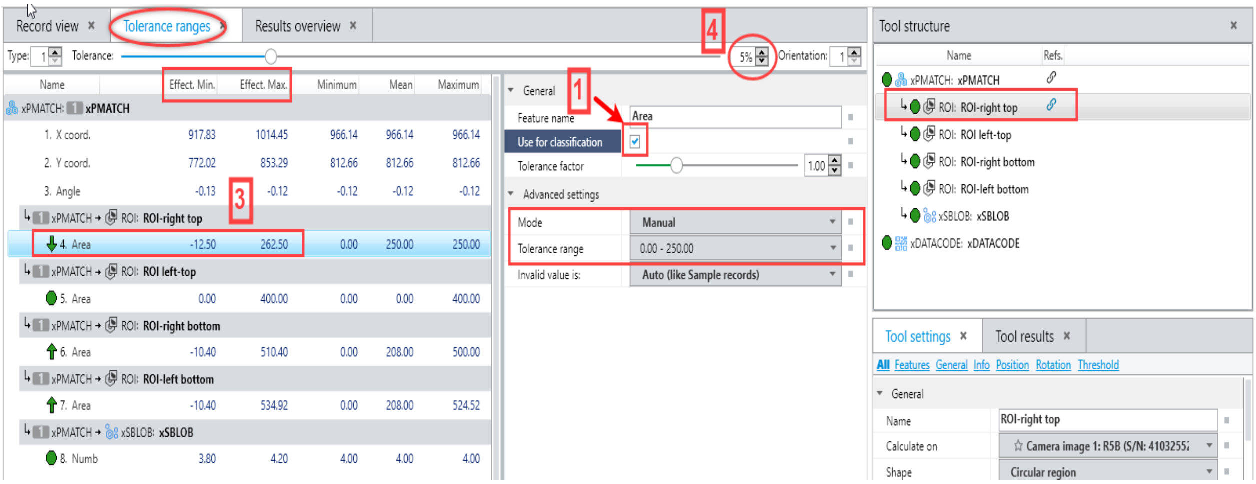
If all tools are adjusted it is necessary to set the quality classification. By default every tool is **not** used for a God/BAD decision. So the tools, that should check the quality, have to defined in the window Tolerance ranges.

Every tool can offer multiple feature results. But only some features were determined for the inspection of the quality. In this example the feature **“Area”** of the particular ROI´s are responsible for the quality. (the amount of pixel is called area, and a missing screw will cause a bigger area. This difference could be used for the quality inspection)

The area of **each** ROI must be assigned to use for the quality classification. So hook (1) the checkbox “Use for classification” in every ROI!

Then select the “Manual” mode in Advanced settings. After that, you can adjust in Tolerance range(2), the upper and lower limits for “Good-part”.



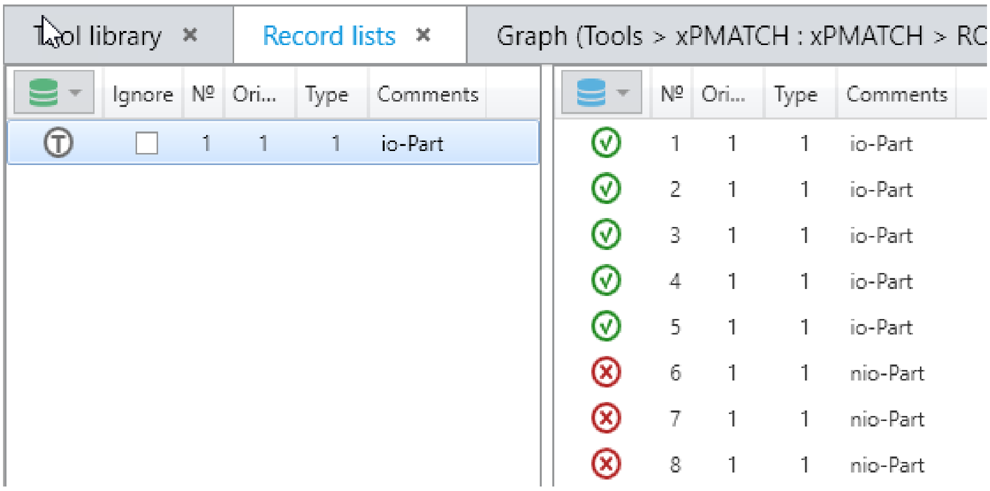


Every “used for classification” feature has to be within the limits, which is displayed in the column Effect. Min and Effect. Max. values.(3) This limits are calculated on the general tolerance(4): Default 5%

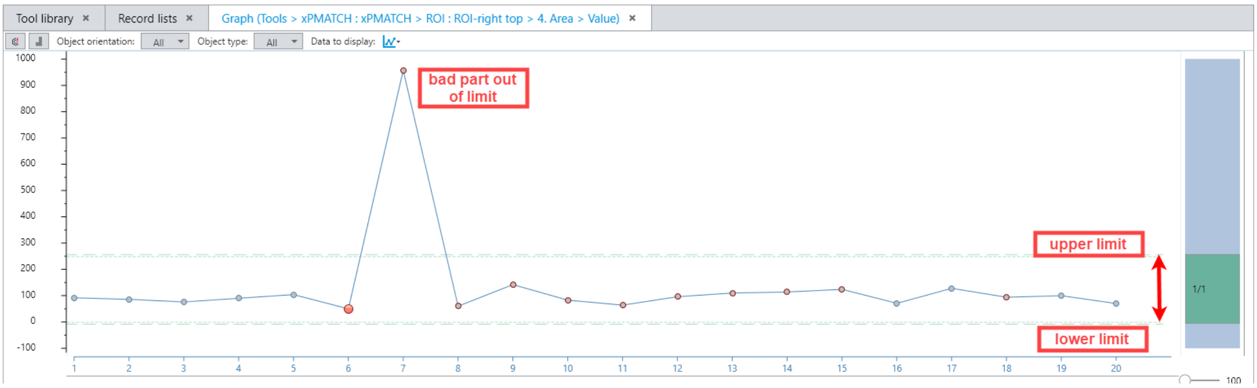
All measures out of this limits were classified as BAD-part.

You have to check if all parts were classified correctly. In Record list of the inspection parts, the result must be correct as the record of good and bad part are. Good part must have a green hook, bad parts will get a red cross.

If not, then you have to adjust the tolerance range of the affected tool. (Results overview show the result of every single feature.



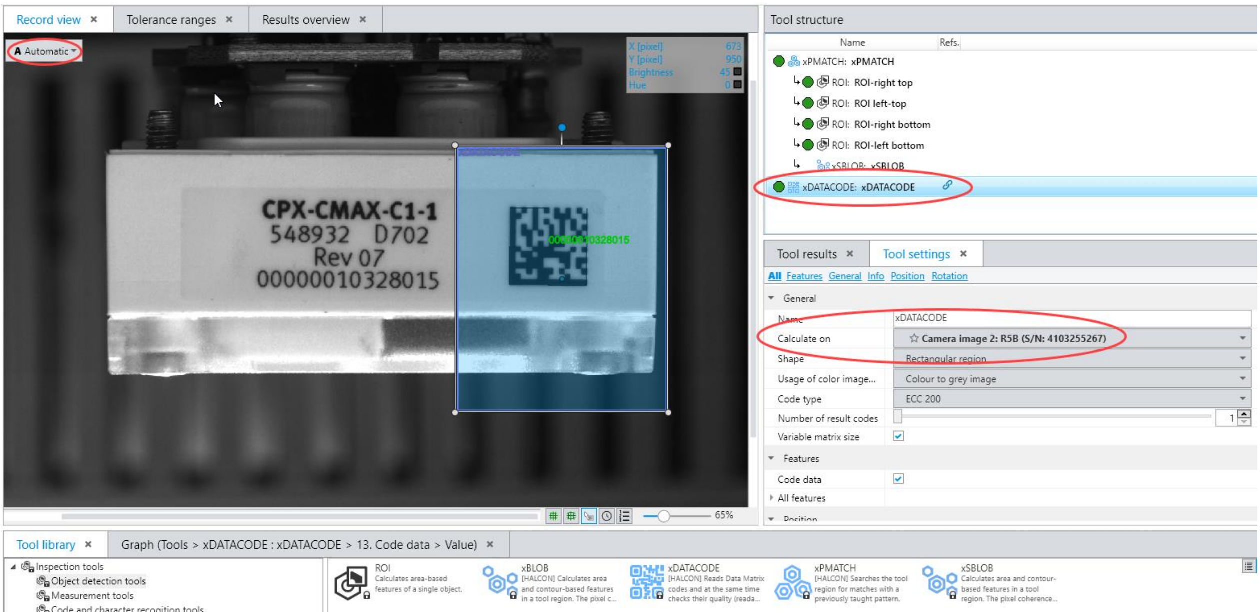
Additionally the Graph window support to evaluate the results of every feature. Every point respect one part. The limit of the values are shown with the green bar. Good-parts have to stay within that range. Every part out of this range is rated as a Bad-part.



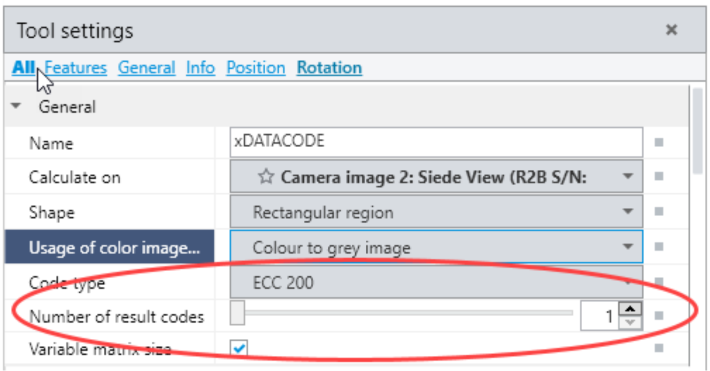
To change the value for the display, you can select another feature in the Tool structure or in any other window. Or do a selection in the “Data to display” drop down menu.

Code reading with the second camera

Drag and drop a xDATACODE tool from the Tool library to the end of the Tool structure.
(or double click on the tool icon)



Select the side view camera image in Tool settings tab. The record view is updated immediately when the Automatic option is activated.
Move the xDATACODE tool to the region where the 2D code is expected.
In the Tool settings the code type and number of expected codes can be adjusted

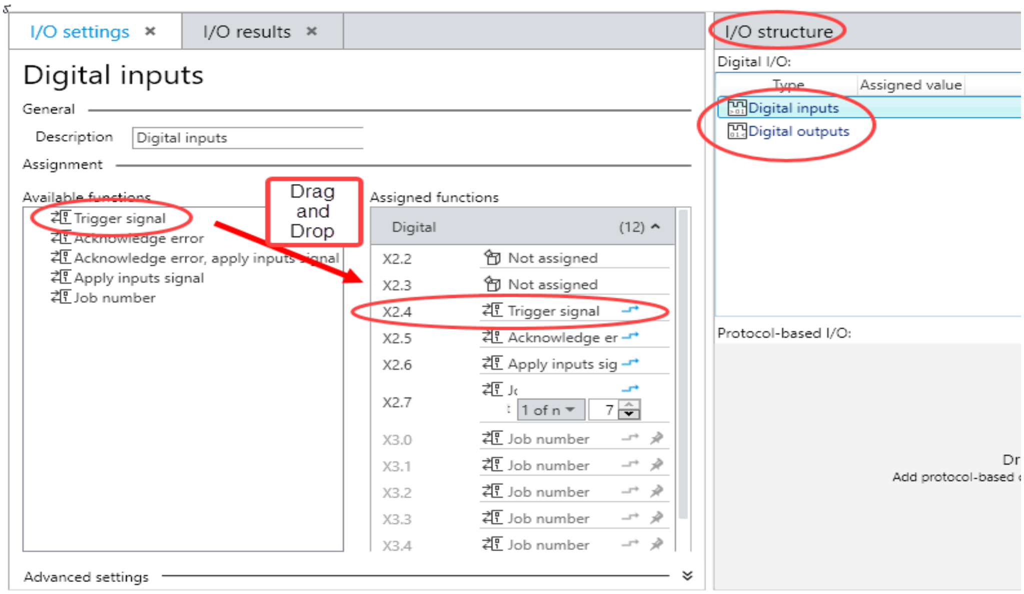


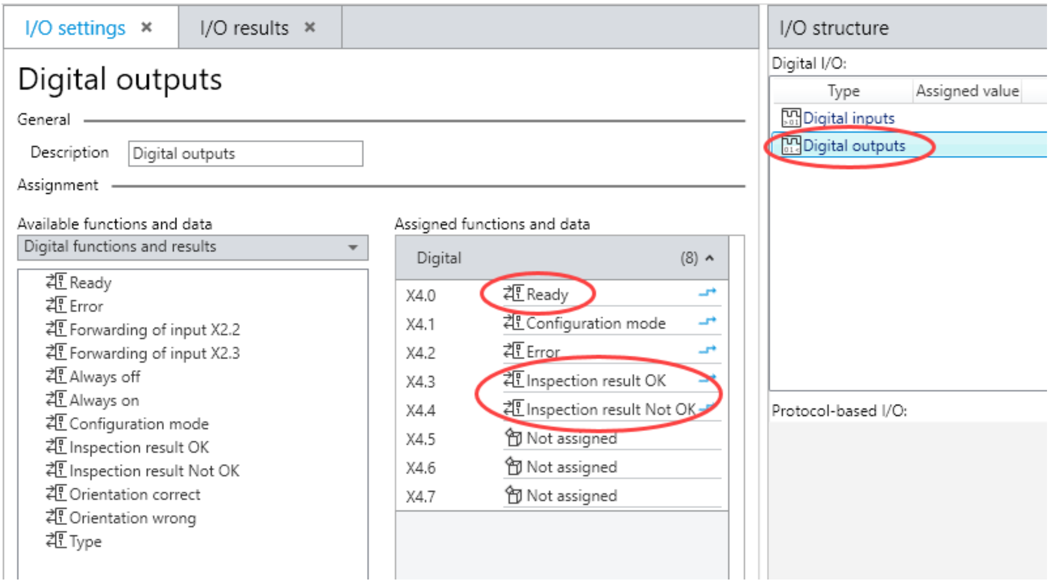
After the setting you can step through the images and check in Tool results, if all datacodes were readable.

If no other feature have to be inspected then next step.

Step 6.: Configure I/O

In this step the I/O assignment is adjusted. In this example we use the digital I/O for the trigger and result communication.
By default there is a basic setting for inputs and outputs. For this example we accept the default setting.
If any change is necessary, it could be proceeded by drag and drop the function on the column.
The pin assignment is also given. E.g. X2.4 Trigger signal.





To use the result of the 2D code, we need to set up a dataoutput for the communication to a PLC controller.

There are different protocols available. In this example we use the telnet protocol. This protocol is supported by the Festo Codesys controllers. The SBRD deliver the results in a so called “Telnet Data Collection”. This allows to send a couple of results by one access. Details are described in a Codesys library for the particular Festo controllers. Other telnet commands are described in the manual of the SBRD controller.

The I/O library show the available protocols. The Telnet data collection is installed by drag and drop from the I/O library to the window of I/O structure. (1)

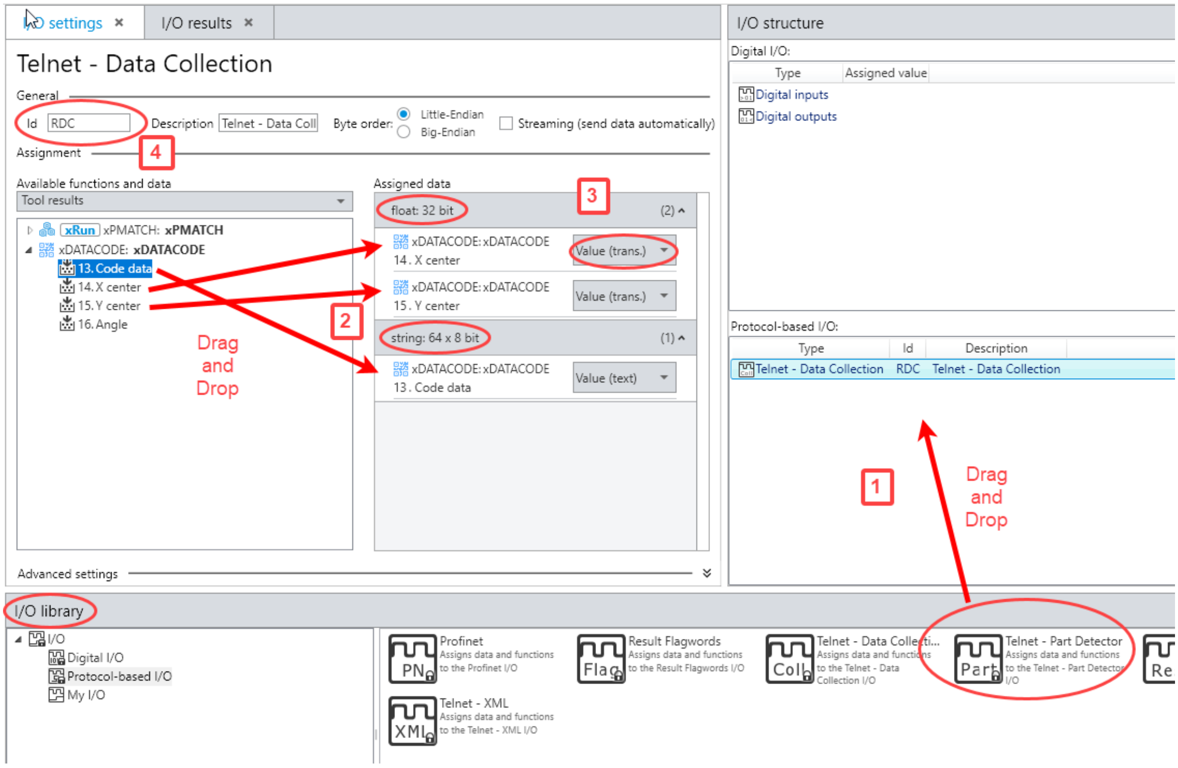
After this, the result data have to be assigned to the data collection.(2) Therefore the available Tool results can be assigned, by drag and drop, to the necessary data format. E.g. the code data has string format, so it has to be assigned to the “string 64x8 bit field”.

Other results, as coordinates of the code, can be assigned to the “float 32 bit” field.

If feature result is assigned, there is a possibility to change the dataformat of the particular value. (3). “Value(trans)” will transmit the result value in mm converted coordinates.

The addressing for communication to the controller is done by a “Id”. This Id is a name for the particular data collection. (4) In the example it is **RDC**. Details for possible names are described in the SBRD manual.

See the settings:



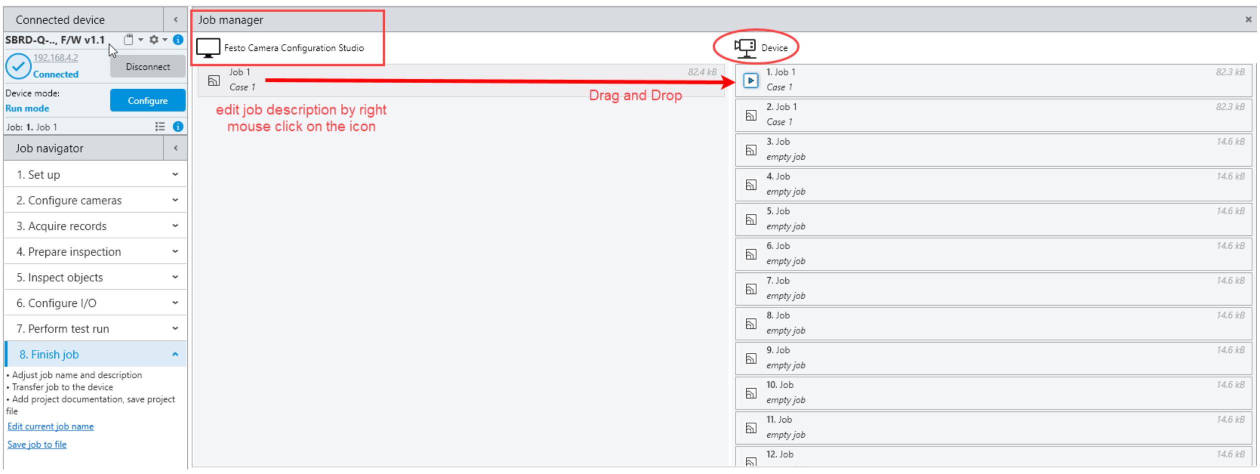
Step 7.: Perform test run

This step allows to evaluate the inspection program by the performance of the controller. In other steps the results were calculated on PC-CPU. In test run the results were calculated in the SBRD controller CPU. So we can get the real processing time of the inspection program.

Optimize steps

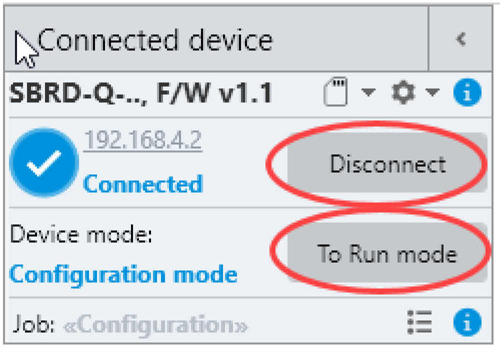
Step 8.: Finish job

All settings which are done in the first 7 steps are only stored on the PC in CCS software. To get the data on the device you have to download the job settings to a job memory.



By drag on the job on left side and drop it on a memory on right side, the setting are stored on the device.
The "play" button show the selected job which is processed in run mode.

Last action before you save and close the software: switch the device into run mode and disconnect.



First use case is finished.

5 Setup the inspection use case 2

For the second use case follow the step as described in the first use case until step 2 Configure cameras.

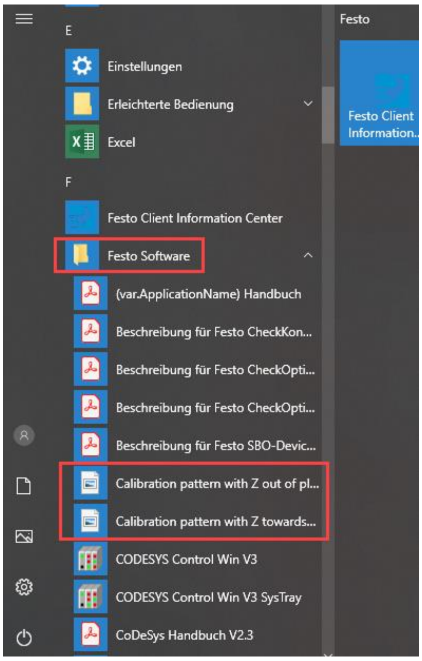
As in the task description mentioned we have to measure the width in mm-values. This demands to calibrate the cameras. We need to enable the cameras to do a coordinate transformation from the pixel values in the image to the mm value in real world format.

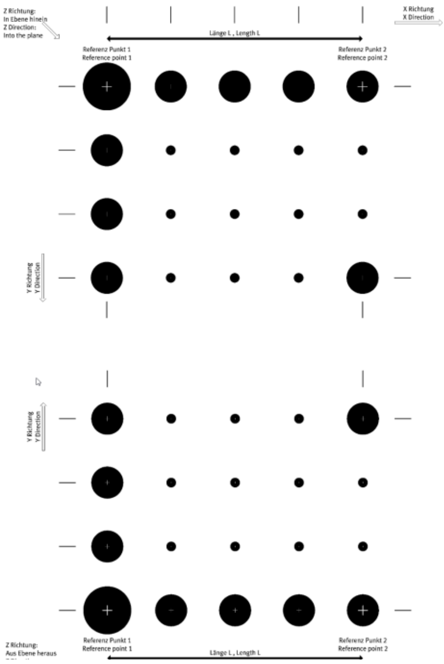
This procedure is supported by the “Coordinate transformation Calibration” wizard in step 2.

But before the wizard can be executed, it is necessary to get the calibration pattern available. In the start menu of windows you can find 2 files with the standardized pattern. The difference of the patterns are based on the z-direction, based on the “right hand rule” for x,y,z-handlings.

For this use case we work on 2D, so you are free to use one of the enclosed patterns.

Find the 2 calibration pattern in start menu:

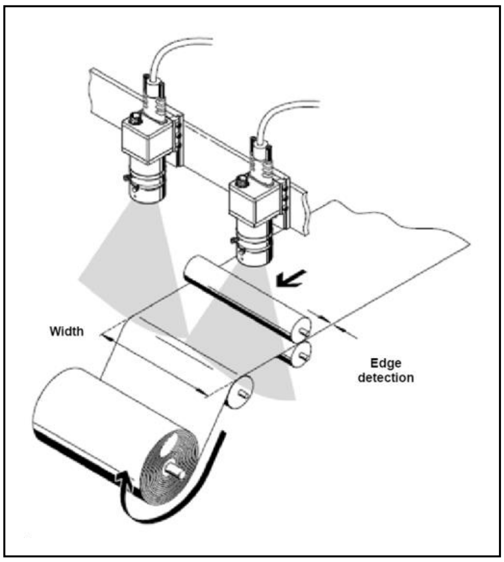


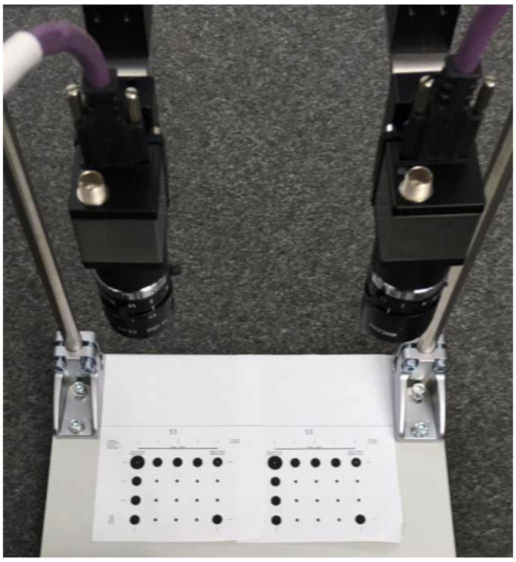


Based on the idea, that we use 2 cameras for the width measurement of a band, we achieve a good resolution. So we adjust the field of view that each camera cover the edge of the band. The area has to be as big as the movement of the band is possible.

Left: Principle of the application

Right: Set-up of the DemoCase

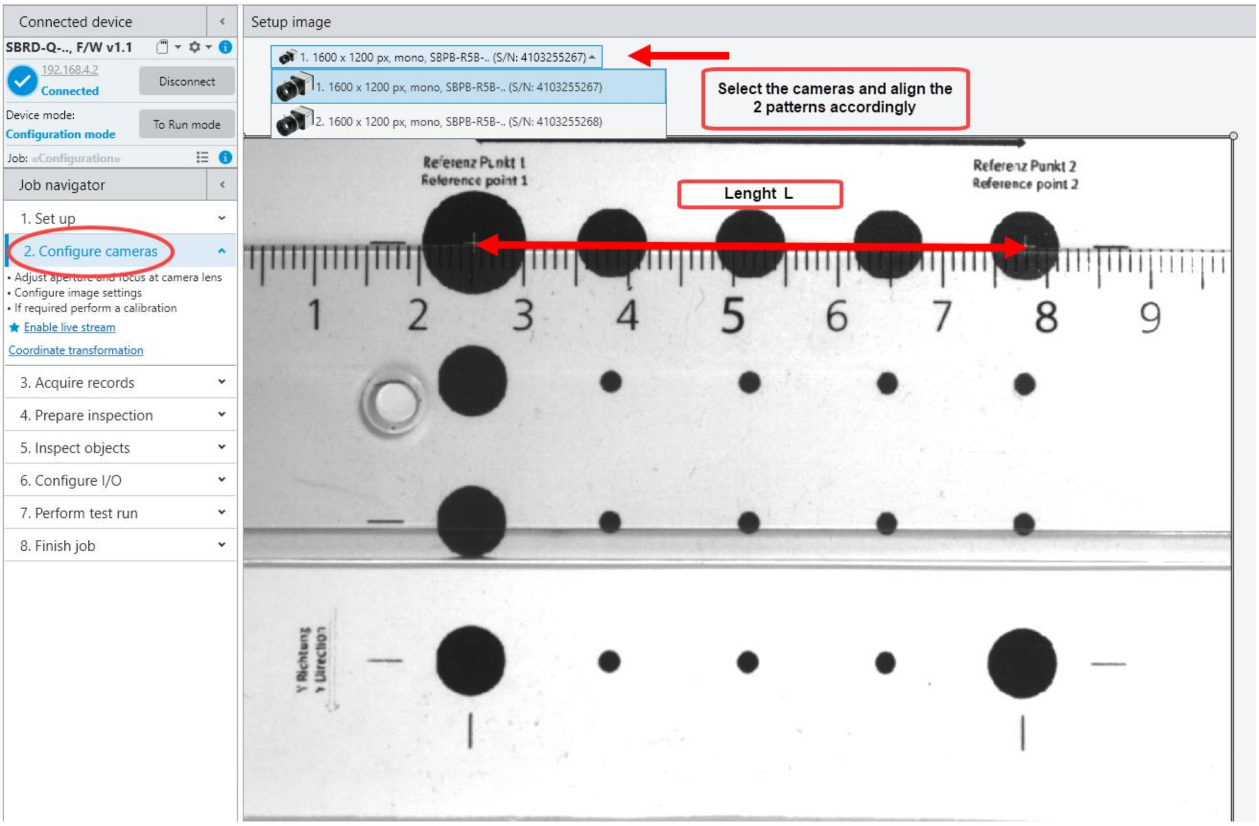




If the field of view is determined, you can print the calibration pattern, that it fits to that size. It should not be smaller than 80% of this area.

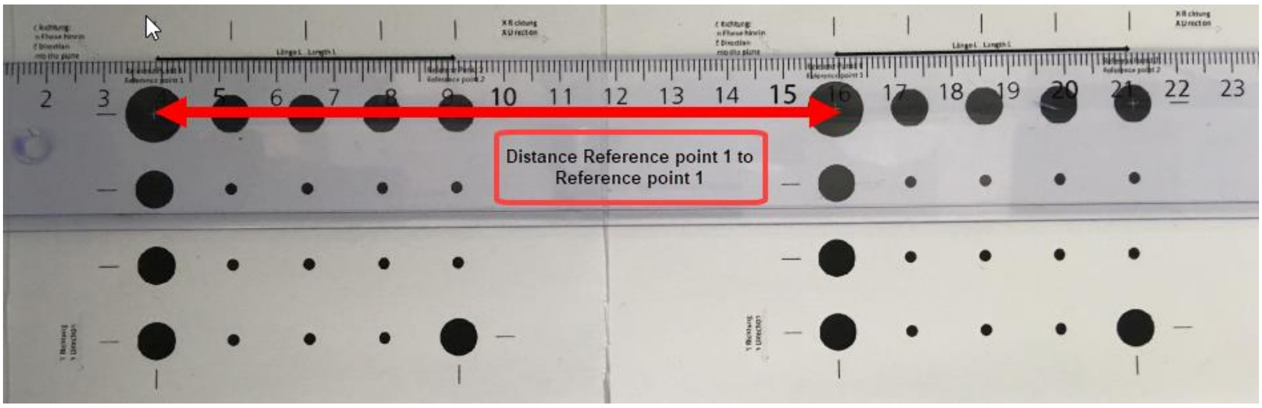
All the 20 black dots of the pattern should fit in the camera image! Print a pattern for each of the camera.

Put the pattern to the object area where the band is expected. Align the pattern to each other and check in the live image that the pattern fit into the image.



It is not possible to have a view of both cameras simultaneously! So in this example, a ruler help for the alignment process!

Photo of the object area:

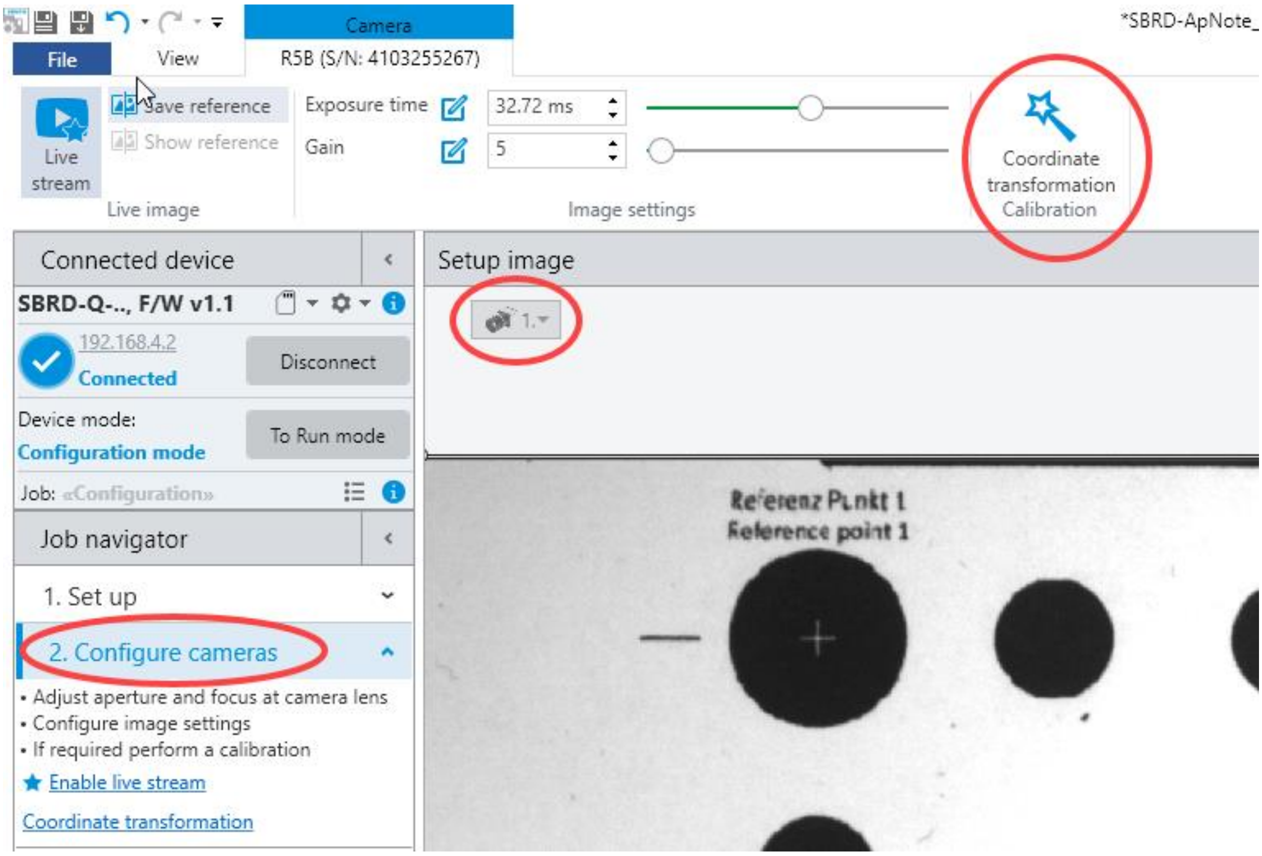


If both pattern aligned well, the calibration process could be done.

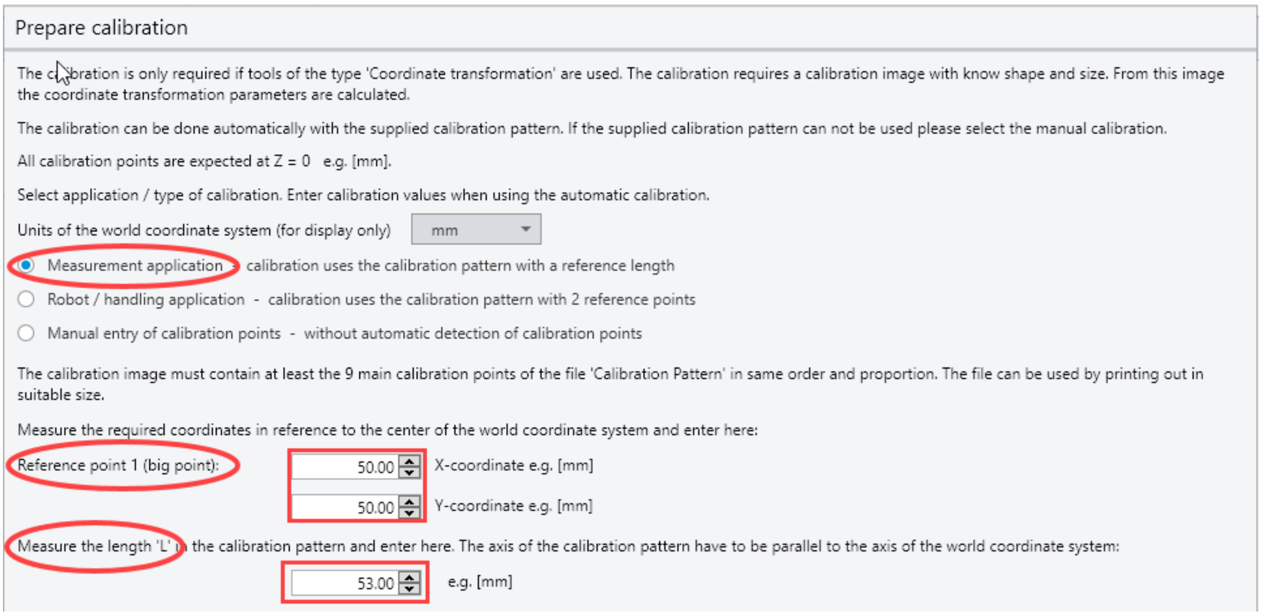
Remark!

Be sure that both cameras are adjusted in sharpness and brightness. Secure the lens setting by the available fixture screw. Any changes of the lens setting or position of the camera need a new calibration process!

Select the 1. Camera and click on the wizard icon in ribbon bar:



Then select the first option for Measurement application:

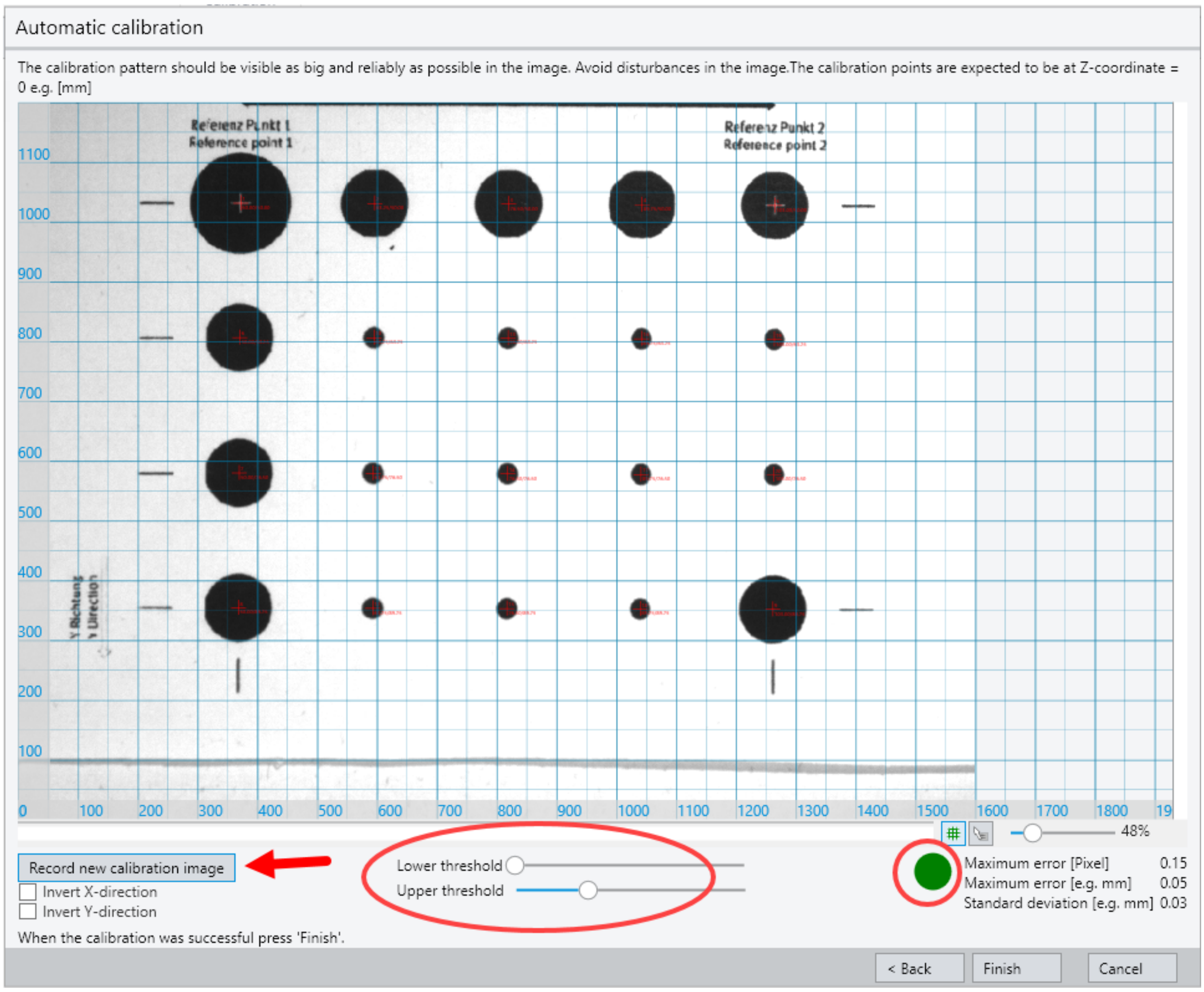


Now enter the value x,y-coordinate for Reference point 1. For this application with the measurement it is not very relevant which value is entered, because the width is measured relatively, not absolutely. So it could be the position of the reference point 1 in the field of view.

But important is the length L in the print of the pattern. In this example it is 53mm.

(The length L is indicated in the pattern, and it describe the distance from center reference point 1 and the reference point 2.)

➢ Next



Press the “Record new calibration pattern image”-button. Then an image is captured and evaluated. If the green dot appear, the calibration was successful. If the dot is red: Try different setting of the threshold sliders to achieve a better image until the dot get green.

Then press Finish. The 1st camera is calibrated.

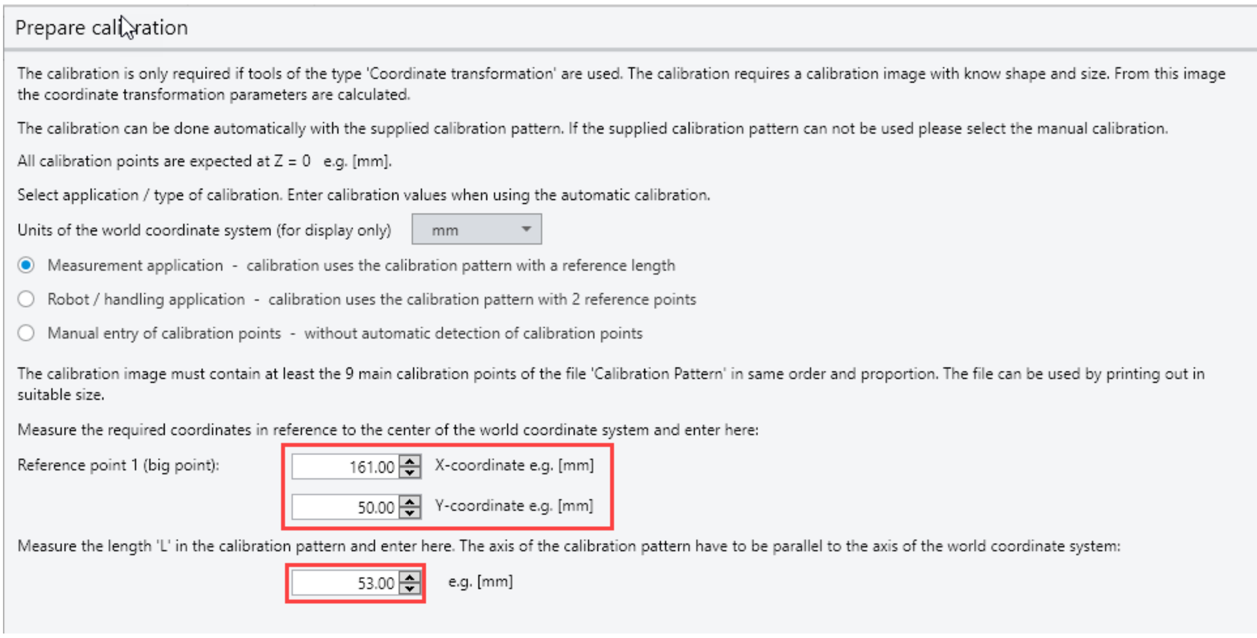
Select the 2nd camera in the Live image and start calibration wizard again.

Edit the value for the reference point 1. For the x-coordinate we add the distance between the two reference points to the value edited in the first camera.

First camera reference point 1= 50mm + distance 111mm measured with ruler (see photo of object area above) equals to 161mm for reference point 1 2nd camera.

As the y-coordinate is on the same line we keep the same value as in 1st camera.

The size of the pattern is also the same, so the length L is also the same.



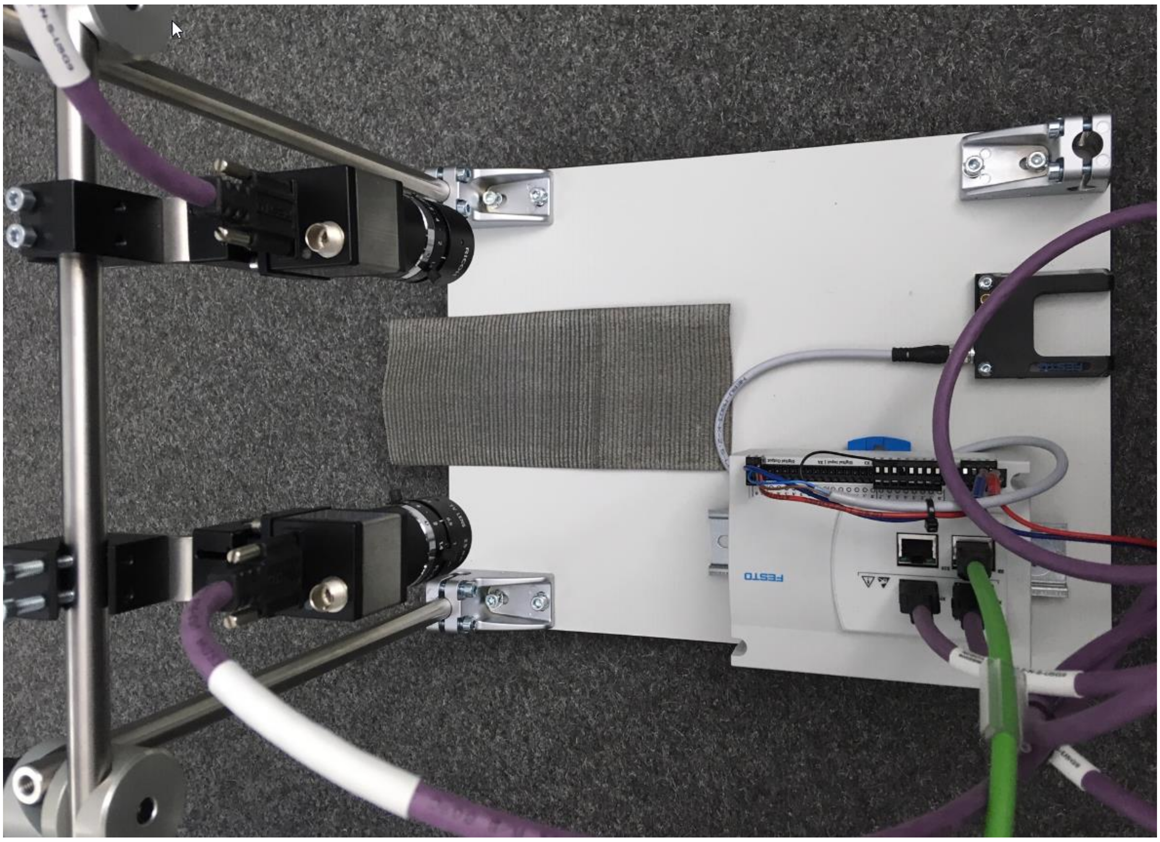
- Next

Press the “Record new calibration pattern image”-button. Then an image is captured and evaluated. If the green dot appear, the calibration was successful. If the dot is red: Try different setting of the threshold sliders to achieve a better image until the dot get green.

Then press Finish. The 2nd camera is calibrated.

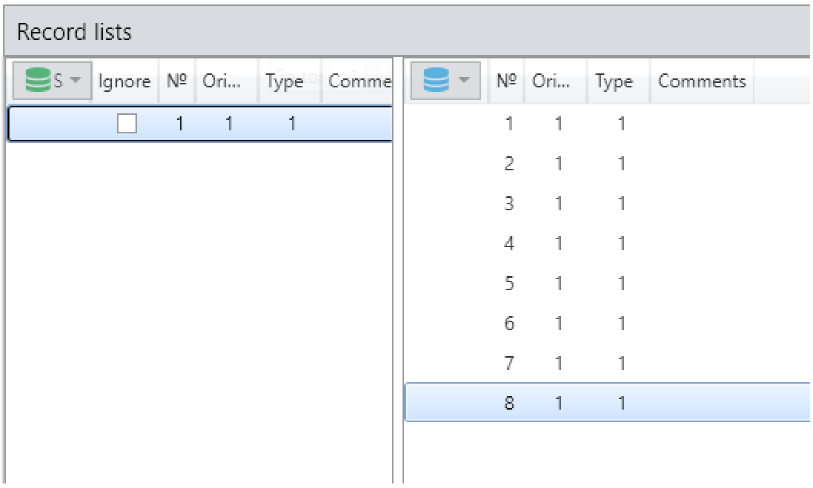
Now the pattern could be removed from the object area.

Place the band into the object area and continue with step 3 Acquire records.



Step 3.: Acquire records

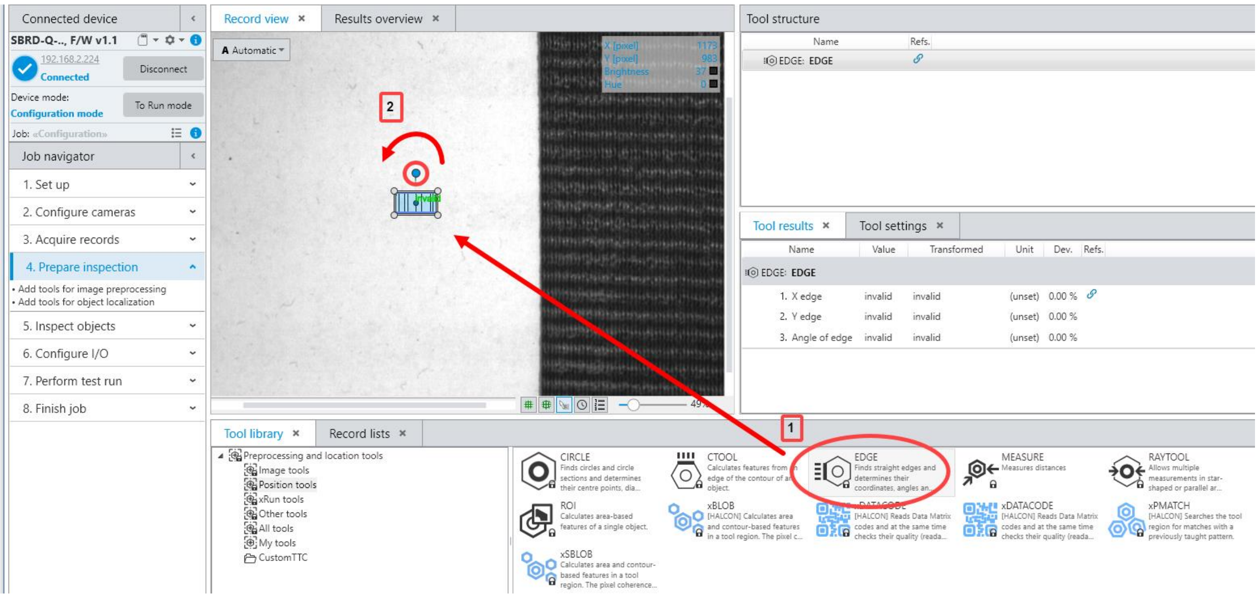
As in the first use case we capture records into the temporary records container. Then drag and drop one record to the sample record list and some other records into the Inspection record list.



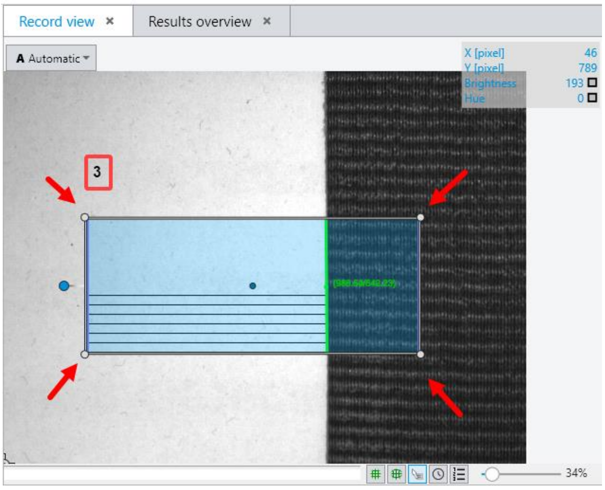
Step 4/5: Prepare inspection / Inspect objects

As we do in this use case 2 no quality inspection, we can proceed the set up of the tool in one of the step 4 or 5.

For the detection of the edge we can use different tool. In this example we focus on the edge tool.

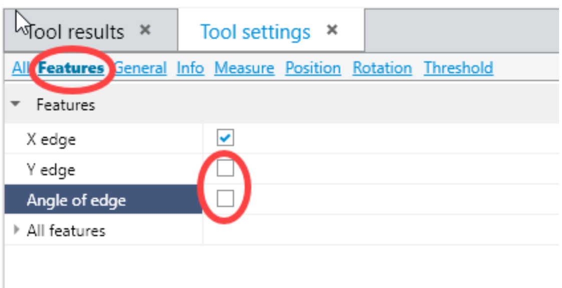


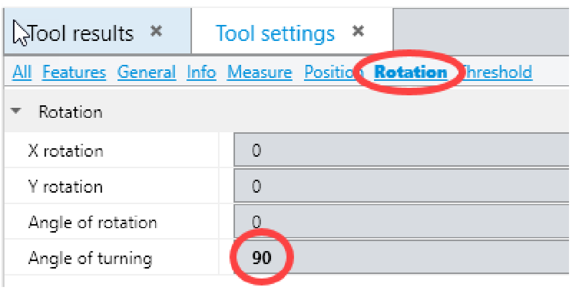
(1) Drag and drop edge tool into the record view window
(2) Turn the tool to 90 degree at the blue point at tool frame



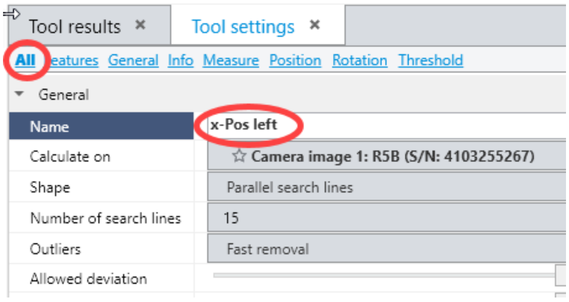
(3) Adapt the size of the tool to an appropriate position in the middle of the camera view.

Then the tool settings have to be adjusted. For the measure of the band width and position we need only the x-coordinate of the edge. So we can disable the not used feature **y** and **angle**.
And the angle of the tool region could be adjusted and verified.

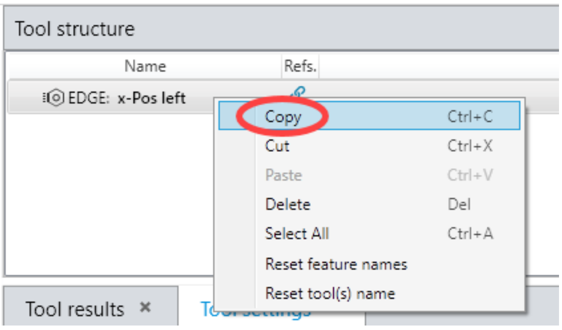


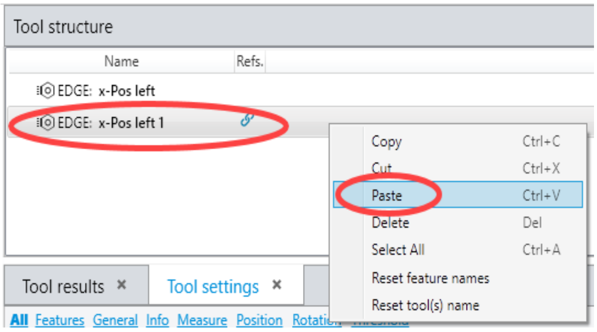


For a better description of the "meaning" from the edge tool in this program, we can give the tool an own name.
In this case we use this edge tool for the position of the band left side. So we can name it like: x-Pos left

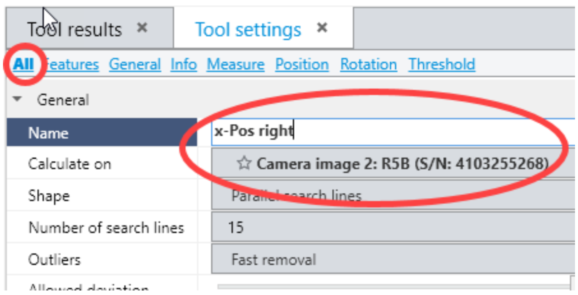


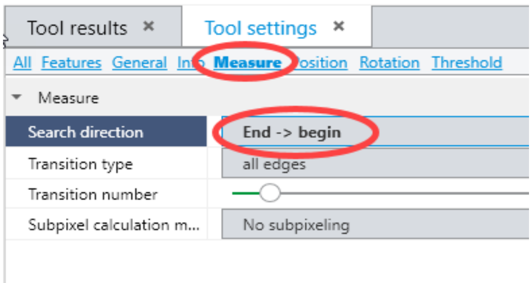
Now we can copy and paste the tool in Tool structure for the right edge of the band.



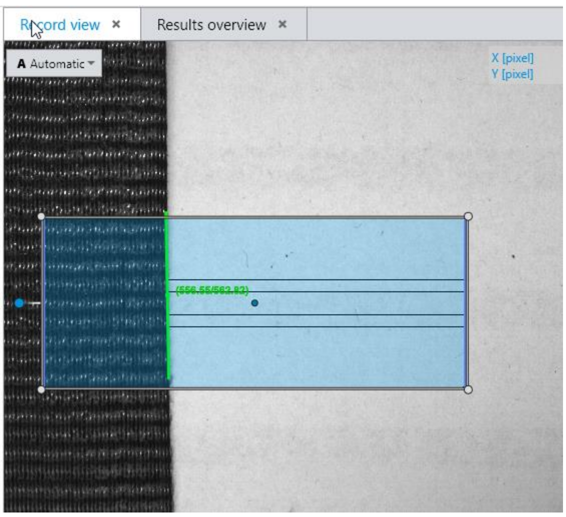


The copied tool has to be adjusted for the right side. There we select the second camera, adapt the tool name and the search direction of the edge detection:





In the image we should see the tool now on the right side of the band. And the search lines starting from right side.



Remark!

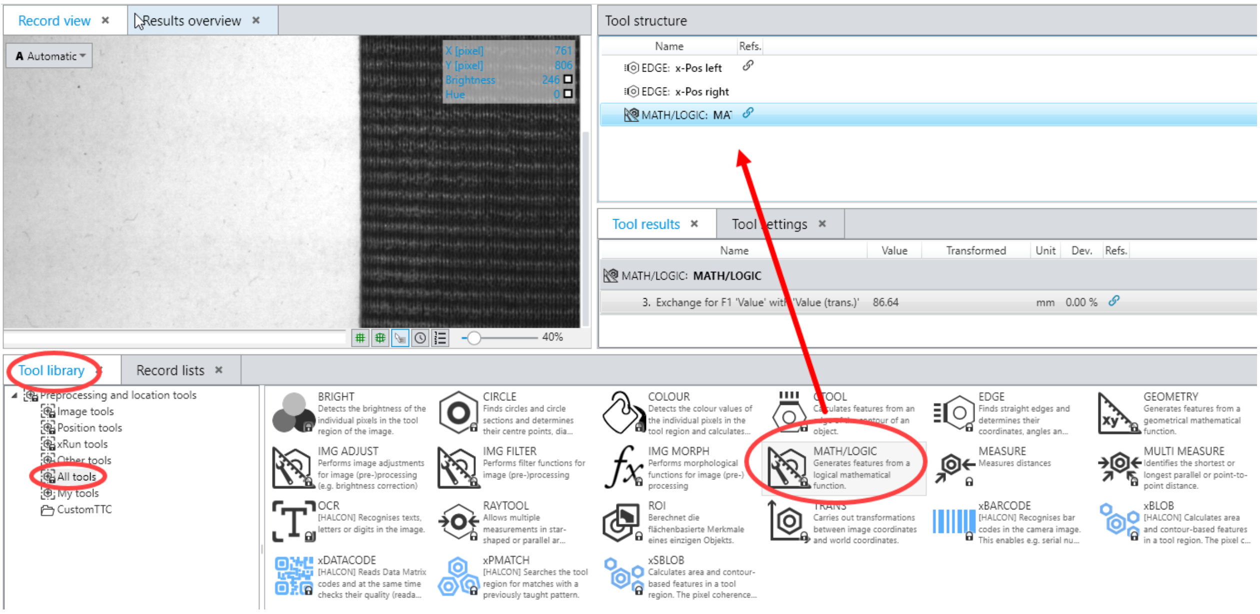
The edge tool offers a lot of different adjustments. For further explanation of the tool refer to the CCS manual.

Now we have the position of the two edges in two separate tool, due to the separate images. We can not measure with one tool the width of the band, because a measure tool can not operate with 2 images. So we have to do the calculation by Math/Logic tool. You can find this tool in Tool library “All tools”.
The idea is to subtract the x-Pos left from the x-Pos right coordinate. The difference equals the width of the band.
If we do the subtraction with the results of the edge tools we get the width in pixel value. The task is to have the width in mm value. So we have to do the subtraction with the mm result of the edge tools.

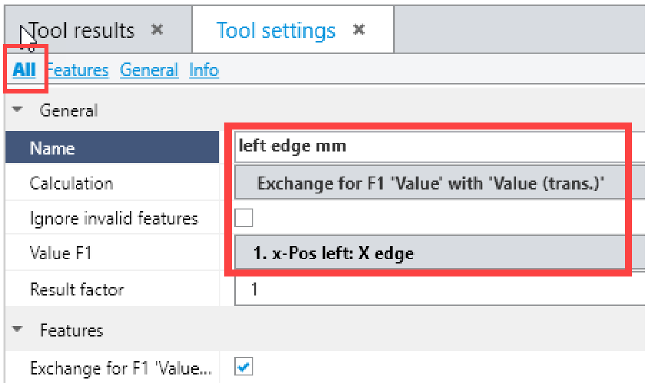
To get the mm value in the calculation we have to use a function, which shift the internal mm value into feature value. This function is available also in the Math/Logic tool. It is called:

“Exchange for F1 “Value with Value(trans.)

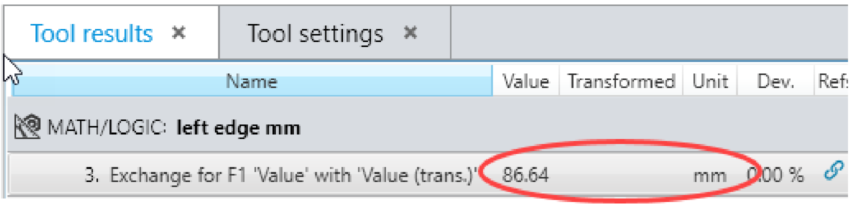
Apply a Math/Logic tool to the tool structure.



Adjust the tool setting for Calculation and the value F1 and give a name:

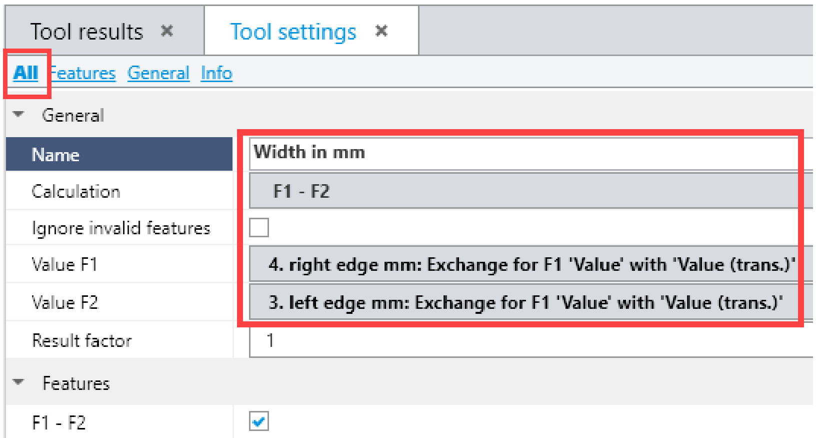


In Tool results we see the value in mm

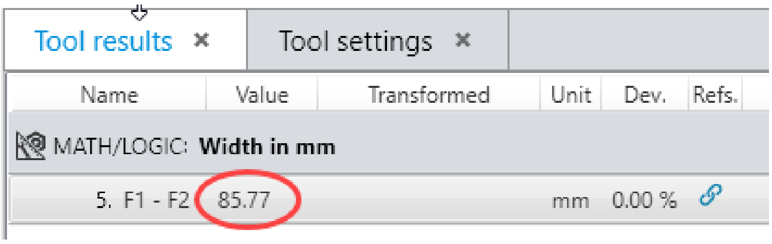


Then we do a second tool which exchange the value of the x-right.

If both coordinates are shifted to the mm value we can apply another Math/Logic tool for the subtraction.

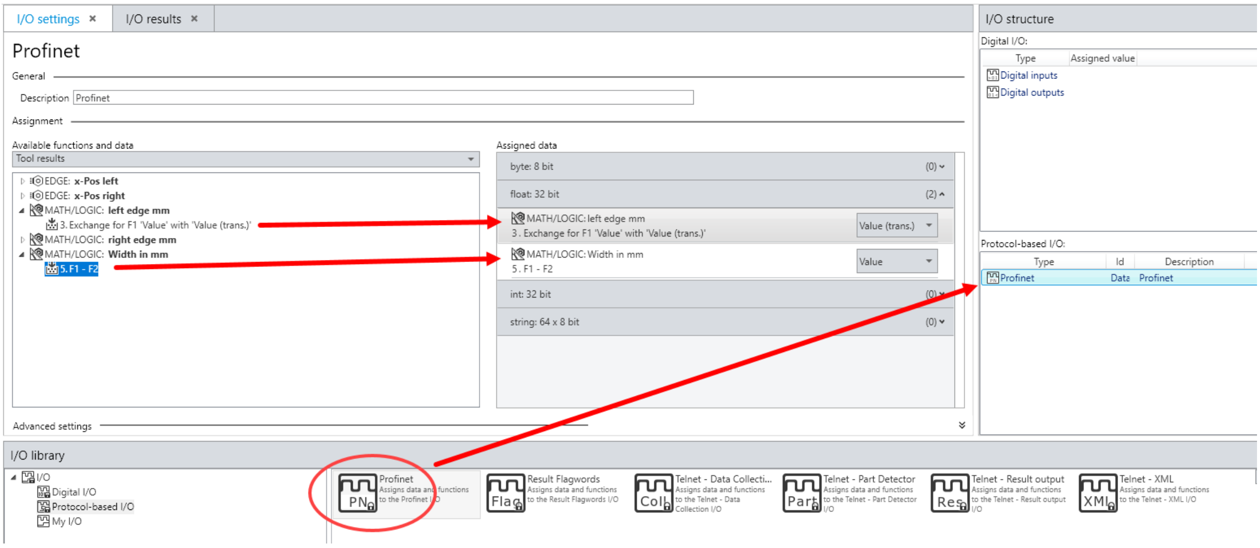


Result:



Step 6.: Configure I/O

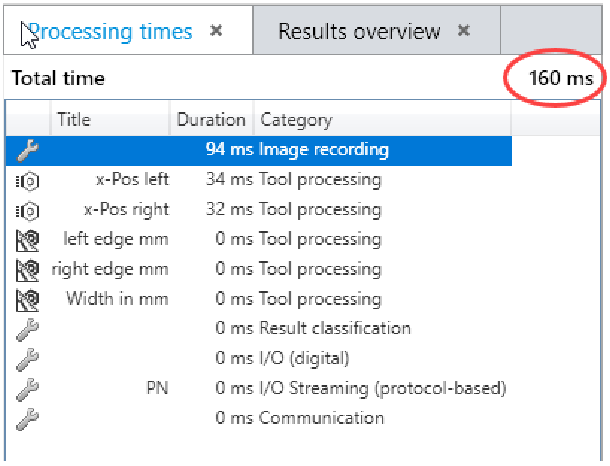
The results for such application are used in PLC for alignment process. So the left edge position and the value of the width should be transferred by data output.



In principle the same procedure as in use case 1. Assign the data by drag and drop.

Step 7.: Perform test run

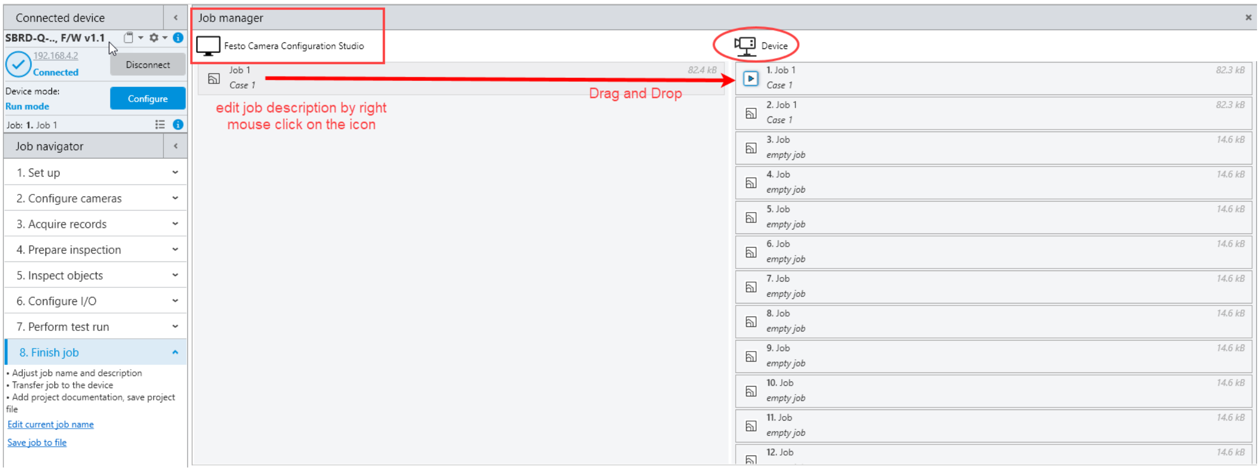
This step allows to evaluate the inspection program by the performance of the controller. In other steps the results were calculated on PC-CPU. In test run the results were calculated in the SBRD controller CPU. So we can get the real processing time of the inspection program.



Also the particular processing times of each tool can be evaluated.

Step 8.: Finish job

All settings which are done in the first 7 steps are only stored on the PC in CCS software. To get the data on the device you have to download the job settings to a job memory.



By drag on the job on left side and drop it on a memory on right side, the setting are stored on the device. The “play” button show the selected job which is processed in run mode.

End of document