



Software manual
Universal vision sensor

GB

O2D5xx
O2I4xx
O2I5xx
O2Uxxx

Version 2.7.9

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1 Preliminary note

You will find instructions, technical data, approvals and further information using the QR code on the unit / packaging or at documentation.ifm.com.

1.1 Symbols used

- ✓ Requirement
- Instructions
- ▷ Reaction, result
- [...] Designation of keys, buttons or indications
- Cross-reference
-  Important note
Non-compliance may result in malfunction or interference.
-  Information
Supplementary note

1.2 Legal and copyright information

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1.3 Open source information

-  For more open source information see: documentation.ifm.com.

2 Safety instructions

Please read the operating instructions prior to set-up of the device. The device must be suitable for the application without any restrictions.

If the operating instructions or the technical data are not adhered to, personal injury and damage to property can occur.

3 Intended use

The software manual describes the functions of the ifm Vision Assistant software:

- recognising the device in the local subnet,
- configuring the device,
- collecting, storing and evaluating data,
- installing and monitoring applications on the device.



As soon as an application is installed on the device, the device can be operated without the ifm Vision Assistant.

4 Disclaimer of warranties

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5 Installation

5.1 System requirements

Software

The following software is required for operation.

- Operating system: Windows 10 (32/64-bit)
- ifm Vision Assistant software 2.7.9 or higher
- Firmware of the device: 1.31.11032 or higher



Other versions

- ▷ Other versions of software and firmware may contain modified or new functions that are not described in this software manual.

Hardware

The following hardware is required for operation:

- Hard disk: min. 1 GB free memory space
- Monitor: Resolution of min. 1024x768 pixels, 32-bit colour depth

Accessories

- Network connection (Ethernet) cables for setting the parameters:
 - E11898 (2 m, M12 plug/RJ45 plug, 4 poles)
 - E12283 (5 m, M12 plug/RJ45 plug, 4 poles)
 - E12204 (10 m, M12 plug/RJ45 plug, 4 poles)
 - E12205 (20 m, M12 plug/RJ45 plug, 4 poles)
- Power supply and process connection cables:
 - EVC070 (2 m, M12 socket, 5 poles, A-coded, open cable end)
 - EVC071 (5 m, M12 socket, 5 poles, A-coded, open cable end)
- Y connection cable:
 - EVC847 (splitter for camera and external trigger)
 - EVC848 (splitter for camera and external illumination unit)
- Power supply 24 V, 1.6 A
- Mounting set for the device (clamp mounting): E2D500



▷ Information about the accessories: www.ifm.com

5.2 Hardware



▷ Detailed information on installation and electrical connection can be found in the operating instructions of the device: documentation.ifm.com

5.3 Software

Installing ifm Vision Assistant

- ▶ Download the ifm Vision Assistant: documentation.ifm.com
- ▶ Copy the zip file to a directory on the PC and unzip.
- ▷ The ifm Vision Assistant is installed and can be started via the "ifmVisionAssistant.exe".



The ifm Vision Assistant does not start

- ▷ If the ifm Vision Assistant does not appear within 5 to 10 seconds after starting:
 - ▶ Check the system requirements. ([→ System requirements](#) 9)
 - ▶ Check the unzipped zip file for completeness.

5.3.1 Uninstall

Uninstalling the ifm Vision Assistant

- ▶ Delete the installation folder of the ifm Vision Assistant.
- ▷ The ifm Vision Assistant is uninstalled.



- ▷ Existing settings and log files are not deleted.

Deleting the settings and log files

- ▶ Delete the following directory: „%AppData%\ifm_electronic\ifmVisionAssistant“

5.4 Command line parameters

The command line parameters influence the start of ifm Vision Assistant by attaching parameters to the exe file. Several parameters can be appended one after the other, separated by a space.

Command line parameters via command prompt

Start ifm Vision Assistant via the command prompt:

- ▶ In the prompt, add the command line parameters after `ifmVisionAssistant.exe` separated by a space.
- ▷ Example: `"ifmVisionAssistant.exe -log"`

Command line parameters via Windows

Start ifm Vision Assistant with command line parameters via Windows:

- ▶ Right-click on [ifm Vision Assistant].
- ▶ Click on [Properties] in the submenu.
- ▶ Click on the [Shortcut] tab.
- ▶ Click on the [Target] field and move the cursor to the end of the line.
- ▶ Enter a space followed by the command line parameter.
- ▶ Click [OK].

Available command line parameters

The following command line parameters are available:

Command line parameter	Description
<code>-disableclosebtn</code>	Disables the button for terminating ifm Vision Assistant.

Command line parameter	Description
<code>-log</code>	Creates a log file for detailed error analysis. The log file is saved in the following folder: "%APPDATA%\ifm electronic\ifmVisionAssistant\logs"
<code>-autoconnect filename.xml</code>	Automatically establishes the connection to a device. The file "filename.xml" must contain the following XML code: <pre><?xml version="1.0" encoding="UTF-8"?> <sensor> <sensorType>O2Uxxx</sensorType> <addressType>IP</addressType> <name>My sensor</name> <address> <ip>192.168.0.69</ip> <pcic_port>50010</pcic_port> <web_port>80</web_port> <mac>00:02:01:21:b9:ee</mac> </address> </sensor></pre> ► Adjust the information in the XML file: IP address, ports, etc.
<code>-geometry [screen]:[width]x[height]+[x]+[y]</code>	Sets the windows size and position of ifm Vision Assistant (incl. Windows frame). The minimum window size is 1024x768 pixels. Example: <pre>-geometry 1:1380x768+0+0"</pre> The window is placed on screen 1 (screen=1). The window size including Windows frame is set to 1380x768 (width = 1380 and height = 768). The window is positioned at the top left (x=0 and y=0). When negative values are entered for the window position x and y, the opposite corner is used as zero point. Example: <pre>" +0+0 " window at the top left " -0+0 " window at the top right " +0-0 " window at the bottom left " -0-0 " window at the bottom right</pre>
<code>-frameless</code>	Starts ifm Vision Assistant without the native Windows frame window.
<code>-cmd "Mon:rec:startRecording=file.dat"</code>	Switches to the [Monitor] area after the start and starts recording data. A PowerShell script can be used to automatically insert the date and time into the file name of the recording: <pre>-cmd "Mon:rec:startRecording=c:/dat/ \$((Get-Date).ToString('yyyy-dd-MM_hh-mm-ss'))_Cam.dat"</pre>
<code>-cmd "Mon:rec:durationSecs=-1"</code>	Sets the duration of the recording in seconds. "-1": unlimited recording time
<code>-cmd "Mon:rec:fileSplitSizeMB=3000"</code>	Splits the recorded data into blocks. The block size can be set in MB. The file names of the blocks contain a continuous counter.
<code>-cmd "Mon:g2d:deviceByIndex=2"</code>	Sets the video source by index. For example, an external frame grabber can be used as a video source. For notebooks, index="1" is often the built-in camera.
<code>-cmd "Mon:g2d:deviceByName=Hauppauge Cx23100 Video Capture_2"</code>	Sets the video source by name. For example, an external frame grabber can be used as a video source.

Kiosk mode

In kiosk mode, the Windows frame is hidden and ifm Vision Assistant cannot be closed normally by the user. The mode is ideal for trade fairs and demonstrations.

Use the kiosk mode:

► Use the following command line parameters in succession:

```
ifmVisionAssistant.exe -disableclosebtn -frameless
```



The key combination “Ctrl+F4” closes ifm Vision Assistant.

6 Getting started

The chapter explains the first steps with the device and the ifm Vision Assistant software.

Connecting the device

Installation and electrical connection are described in the operating instructions of the device.

Using ifm Vision Assistant

- ▶ Start the ifm Vision Assistant software. Software ([→ Software](#) 10)
- ▶ Click on the [Find device] button on the start page. Find device ([→ Find sensor](#) 15)
 - ▷ Once the device is connected, the [Monitor] area is displayed.

ifm Vision Assistant: [Monitor] area

The [Monitor] area displays the received data of the device in a **live image**. The application is monitored in this area. The device is in the operating mode.

ifm Vision Assistant: [Application] area

An application sets the device for a specific application. You can quickly switch between the applications.



Up to 32 applications can be added. An application contains up to 10 models.

Typically, an application contains the following settings:

- Device camera and triggers: Images and triggers ([→ Images & trigger](#) 29)
- Recognition of contours, analysis of surfaces, search for codes and text recognition: Model settings ([→ Models](#) 65)
- Sequence of processing of images and models: Flow ([→ Flow](#) 115)
- Output logic for data transfer to an external controller: Logic ([→ Logic](#) 118)
- Configuration of the output via the interfaces: Interfaces ([→ Interfaces](#) 146)
- Collection of statistical data: Test ([→ Test](#) 166)

Recognising an object, code or text with the device

- ▶ Click on the [Application] button: .
 - ▷ The “Application” area shows the applications stored on the device. ([→ Application](#) 26)
- ▶ Click on the [Add new application] button: .
 - ▷ The [wizard] guides you through adding an application in several steps. The application will then be activated and the [Monitor] area will be displayed.
 - ▷ The [User-defined mode] button is used to customise the application.

The device will then be ready for operation and run the active application.

7 Start page

The start page contains the basic functions of the ifm Vision Assistant.

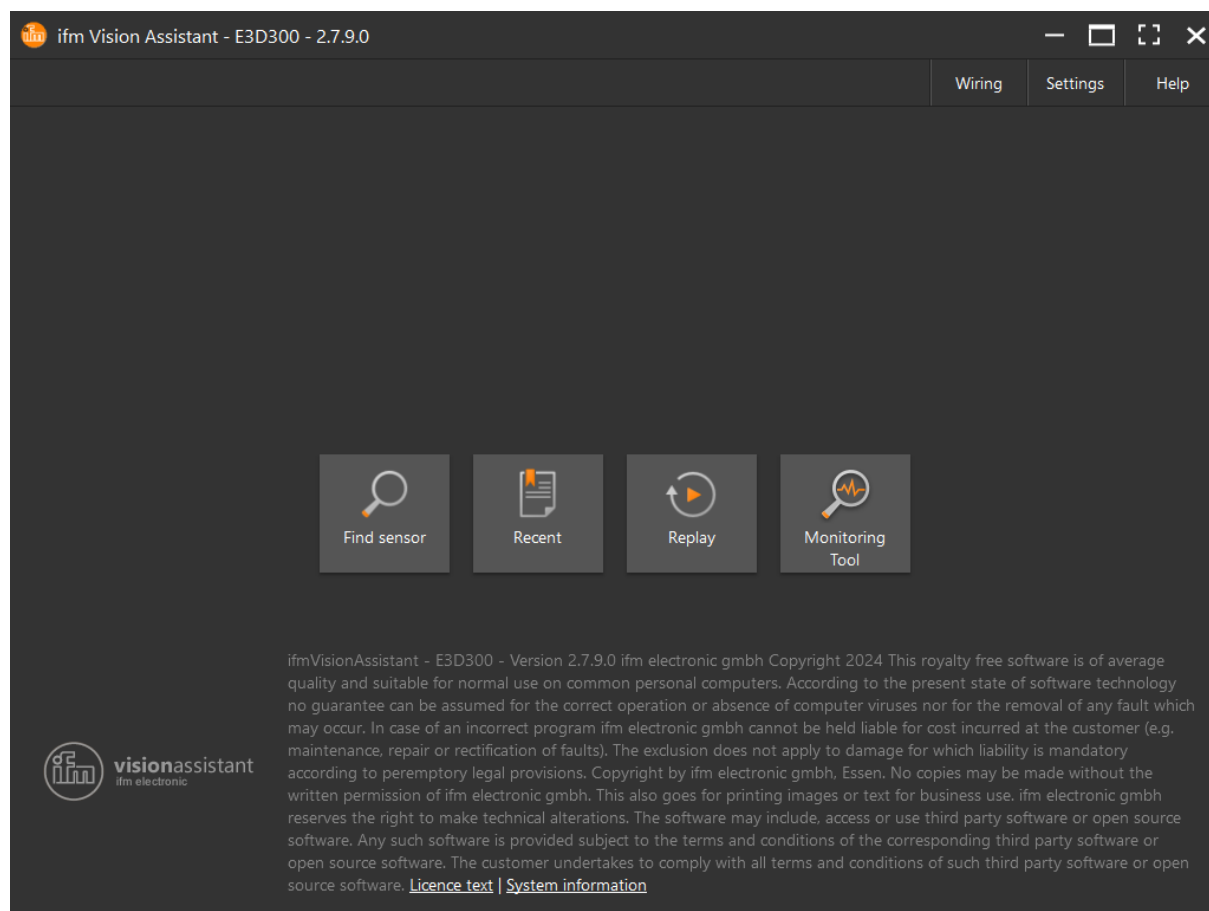


Fig. 1: Home page

Symbol	Name	Description
	Zoom out	Reduces the size of the window.
	Zoom in	Enlarges the window.
	Full screen	Displays the window in full screen mode.
	Exit	Closes the software.

Tab. 1: Title bar



▷ With the F11 key, you can switch between full screen and window view.

Name	Description
[Device status]	Displays information about the hardware and firmware of the connected device. The information can be saved in a text file for diagnostics by the support staff. For the [Device status] function, the device must be connected.
[Wiring]	Displays information on wiring and connection aids.
[Settings]	Sets the language and colour of the user interface.

Name	Description
[Help]	Displays the documentation and contact details for support.

Tab. 2: Menu bar

Button	Name	Description
	Find device	Searches for connected devices and displays them in a list. (→ Find sensor □ 15) For this function, the device must be connected.
	Recent	Displays list of devices that have already been used. (→ Connecting a device that has already been used □ 16) For this function, the device must be connected.
	Replay	Plays back a saved image capture. (→ Playing back image captures □ 16)
	Monitoring tool	Monitors applications on several connected devices. (→ Monitor □ 21) The monitoring tool is described in a separate software manual: documentation.ifm.com

Tab. 3: Buttons

7.1 Find sensor

This function searches for new devices and displays them in a list. A device can then be connected.

Preparations

- ▶ Connect the device to the voltage supply.
- ▶ Connect the device to a PC via Ethernet.
- ▶ Unblock the following ports in the network firewall:
 - UDP-Port: 3321
 - TCP/HTTP: 80 and 8080
 - TCP: 50010

Connect a new device

- ▶ Click on the [Find sensor] button: 
- ▷ The ifm Vision Assistant searches for connected devices. A list shows the devices found and their settings.
- ▶ Select a found device.
- ▷ The connection to the device will be established.



Connection issues

- ▷ If the device is not found:
 - ▶ Check the connections and the operating status of the device.
 - ▶ The IP addresses of device and PC must be in the same subnet.
 - ▶ Connect the device to the PC directly via Ethernet without any intermediate network devices (e.g. router).
 - ▶ Connect the device manually. (→ [Connecting the device manually](#) □ 16)



Messages in the ifm Vision Assistant

- ▷ With the key combination [Ctrl+C], the text of a message is copied to the clipboard.

7.1.1 Connecting the device manually

A device can be connected manually by entering the IP address.

- ▶ Click on the [Find device] button: .
- ▶ Click on the message [Manual connection].
- ▷ The [Manual connection] window is displayed.
- ▶ Select [manual connection] in the list O2Uxxx.
- ▶ Enter the IP address of the device.
- ▷ Preset: 192.168.0.69.
- ▶ Click on the [Connect] button.



Connection issues

- ▷ The IP addresses of device and PC must be in the same subnet.

7.2 Connecting a device that has already been used

The [Recent] function displays devices that have already been used before in a list.

- ▶ Click on the [Recent] button: .
- ▷ The [Recent] window is displayed.
- ▶ Select a device from the list.
- ▷ The device will be connected and can then be used.

7.3 Playing back image captures

The [Replay] function plays back a saved image capture. Recordings are saved in the "Monitor" area.
(→ [Monitor](#)  21)

The function contains the following operating elements:

Operating element	Name	Description
	Previous image	Jumps to the previous image.
	Replay	Starts the replay.
	Next image	Jumps to the next image.
	Pause	Pauses the replay.
	Progress bar	Indicates the current position of the replay.
[Open other file]	Open other file	Opens another image capture.

Tab. 4: Operating elements

Playing back image captures

- ▶ Click on the [Replay] button: 
 - ▷ A window for opening an image capture is displayed. The image captures are saved in the following folder by default: %appdata%\ifm_electronic\ifmVisionAssistant\capture

- ▶ Select an image capture.
- ▶ Click on the [Open] button.
- ▷ The image capture is displayed.

7.3.1 Converting an image capture

This function converts an image capture into another output format. The image capture is converted via the following operating elements.

Operating element	Type	Description
[Output format]	List	Sets the output format.
[Output path]	Output field	Displays the set output path.
[...]	Button	Sets the output path.
[Data format]	List	Sets the data format. The list is displayed when the [Output format] is set to [O3D3XX PLY export of point cloud].
[Create surfaces]	Checkbox	Creates a surface for the point cloud. The checkbox is displayed when the [Output format] is set to [O3D3XX PLY export of point cloud].
[Output range]	List	Sets the output range.
[Convert]	Button	Starts converting the image capture.

Output format

Output format	Description
[HDF5 ifm streams (*.h5)]	Flexible data container.
[ADTF data capture file (*.dat)]	Proprietary format.
[O2X5XX export of JSON/JPEG]	JSON/JPEG files of an O2X5XX image capture.
[O3D3xx CSV export of image chunks]	CSV file of the image chunks of an O3D3XX capture.
[O3D3XX PLY export of point cloud]	PLY file of the point cloud of an O3D3XX capture.



Depending on the format of the open image capture, some output formats may not be displayed.

Data format

Data format	Description
[ASCII]	Sets the data format to "ASCII".
[Binary little endian]	Sets the data format to "Binary little endian".
[Binary big endian]	Sets the data format to "Binary big endian".



Depending on the output format set, the data format may not be displayed.

Output range

Output range	Description
[Whole file]	Converts the whole image capture.
[From current position to end of file]	Converts from the current position of the progress bar to the end of the image capture.
[From start to current position]	Converts from the start of the image capture to the current position of the progress bar.

Output range	Description
[Just the next frame]	Converts the next frame of the image capture, viewed from the current position of the progress bar.

8 Structure of the user interface

The user interface is divided into the following areas:

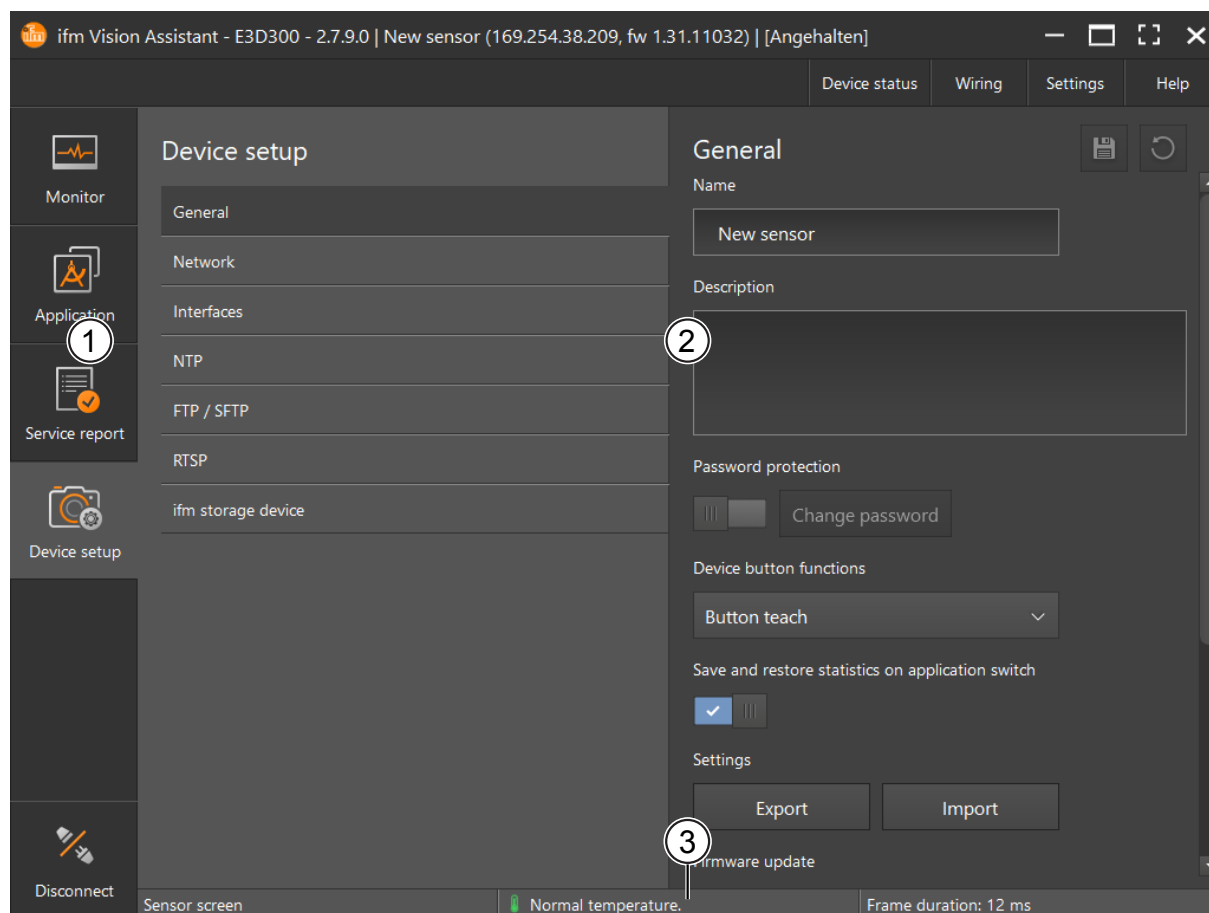


Fig. 2: User interface

- 1 Navigation bar
- 3 Status bar

- 2 Main area

Navigation bar

The buttons in the navigation bar are used to switch between the different areas of ifm Vision Assistant.

Button	Name	Description
	Monitor	Displays the received data of the device. (→ Monitor □ 21)
	Application	Displays the applications. (→ Application □ 26)
	Service report	Displays an evaluation of the device. (→ Service report □ 168)
	Device setup	Displays the device setup. (→ device set-up □ 170) The device and network are set in the device setup.
	Disconnect	Disconnects from the device.

Main area

The settings of the selected function are displayed in the main area.

Status bar

The status bar shows current device information:

- the current window name, for example [Sensor window]
- the temperature of the device
- **processing time** for an image, for example 18 ms

9 Monitor

The [Monitor] area displays the received data of the device in a **live image**. The application is monitored in this area. The device is in the operating mode.

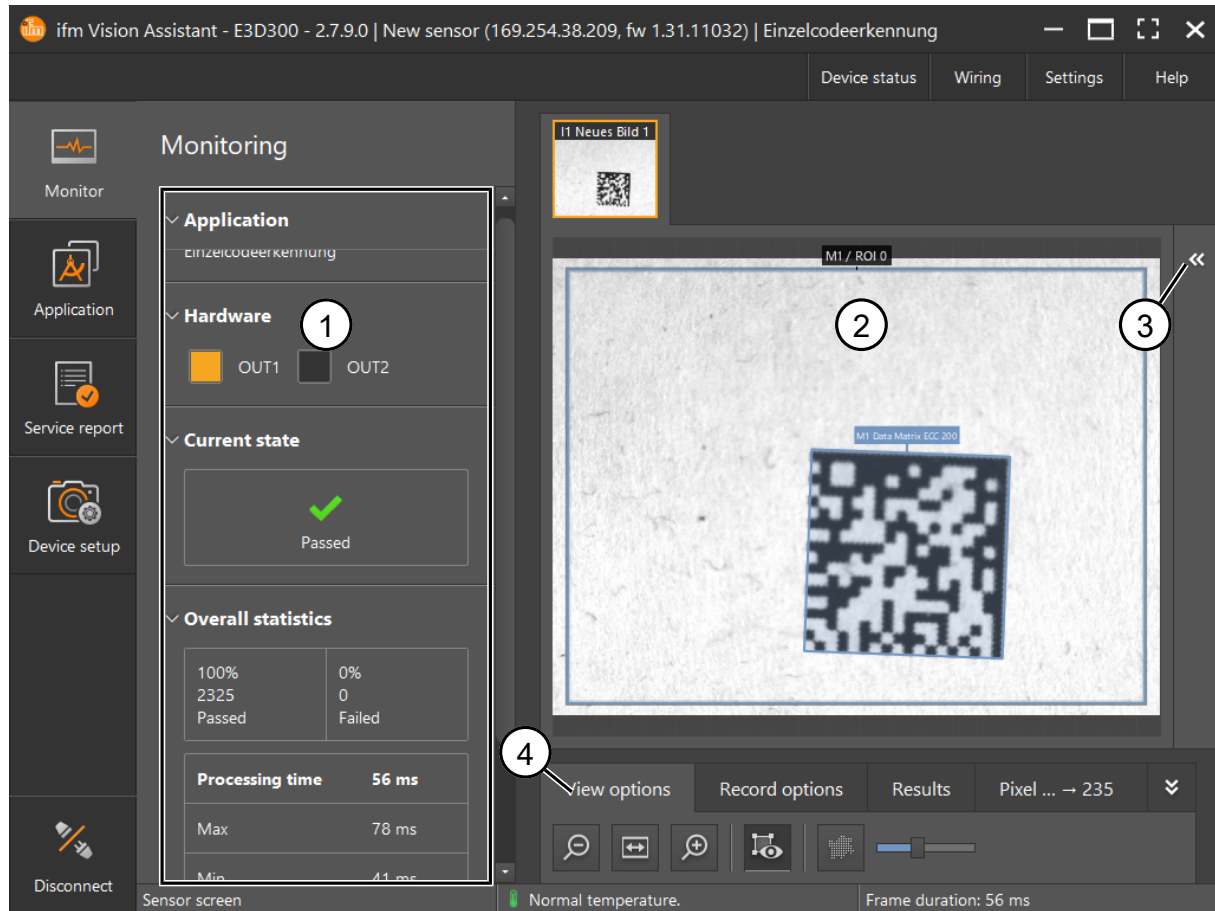


Fig. 3: [Monitor] area

1 Status indicators
3 Code details

2 Live image
4 Tabs

Status indicators

The [Status indicators] show the states of the digital outputs and the statistics on the active application.

- [Application]: shows the name of the active application.
- [Hardware]: shows the status of the digital outputs. If a signal is present, the LED lights yellow.
- [Current state]: shows the current state of the application.
- [Overall statistics]: shows the recorded values of all models of the active application and the number of total measurements. The values **Passed** and **Failed** are incremented via a counter. The ratio of the two values is indicated as a percentage.
- [Processing time]: shows the current, maximum and minimum processing time.
- [Reset all statistics]: this button resets the overall statistics.

Live image

The [live image] displays the current camera image of the device.



The live image is continuously updated in trigger mode [Continuous]. In another trigger mode, a trigger must first be released for the live image to update.

Code details

The [Code details] display details of the code, BLOB or contour selected in the live image.

Tabs

The [Monitor] area contains the following tabs:

Tab	Description
[View options]	Sets the live image.
[Recording]	Records the data from the camera and the results of the applications.
[Results]	Displays the results of models, images and calibrations. The results can be restricted to specific models, images or calibrations.
[Pixel x y]	Displays pixel and greyscale values in the area of a line, rectangle or circle. Displays pixel and greyscale values at the position of the mouse pointer. Displays calibrated coordinates and lengths if the application contains calibrated images. (→ Calibration wizards ▢ 35)

The [View options] tab contains the following operating elements.

Operating element	Name	Description
	Zoom out	Reduces the size of the live image. The zoom level can also be changed using the mouse wheel.
	Reset zoom	Resets the live image to the standard size.
	Zoom in	Enlarges the live image. The zoom level can also be changed using the mouse wheel.
	Show all ROIs of all models	Displays the ROIs of all models in the live image.
	Overlay application reference image	Displays the reference image in the live image. The [Overlay application reference image] button is displayed as soon as a reference image has been saved (→ Reference image ▢ 61) The slider adjusts the transparency of the reference image. The colour field to the right of the slider sets the colour of the reference image.
	Change object opacity	Adjusts the opacity of detected objects in the live image using the slider.

The [Record options] tab contains the following operating elements:

Operating element	Name	Description
	Save current image as JPEG	Saves the current live image as a JPEG file.
[Duration]	Duration	Sets the duration of the image capture. Approx. 250 MB/minute are required. If the duration is set to [Continuous], the image capture is limited by the free memory capacity of the data carrier.
	Start/Stop	Starts or stops the image capture. The image capture is saved in a file with the extension "*.h5" or "*.dat".
- / 02:00	Image capture time	Shows the duration of the current image capture and the maximum capture time.

The [Results] tab contains the following operating elements.

Operating element	Name	Description
	Filter table by selected image	Filters the table according to the selected image.
	Filter table by selected model	Filters the table according to the selected model.
	[Code result table]	Displays the results of the code analysis.
	[BLOB result table]	Displays the results of the BLOB analysis. The [Calibrated BLOB results] checkbox is used to restrict the results table to calibrated values.
	[Contour result table]	Shows the results of the contour detection.
[Show ROI results]	[Show ROI results]	Shows the results of the ROI groups in the table.

The [Pixel x | y] tab contains the following operating elements:

Operating element	Name	Description
	Measure pixels along a line	Displays the following values along a line: - Start and end point - Angle - Length [px] - Greyscale (0-255).
	Measure pixels in a rectangle	Displays the following values in the area of a rectangle: - Length x width [px] - Area [px] - Greyscale (0-255).
	Measure pixels in a circle	Displays the following values in the area of a circle: - Position of the centre of the circle - Radius [px] - Area [px] - Greyscale (0-255).
[At mouse pointer]	Measure pixels at the position of the mouse pointer	Displays the following values at the position of the mouse pointer: - Position X - Position Y - Greyscale (0-255).



The results can be copied to the clipboard with the key combination Ctrl+C.

9.1 Creating a region of interest (ROI)

Within the search zone (ROI: region of interest), the device searches for codes, BLOBs or contours. With default setting and when a new model is added, an ROI covering the entire live image is automatically created. Up to 64 ROIs can be created per model.



The operating elements for creating an ROI are only displayed in the model settings. (→ [Models](#)  65)

Creating an ROI:

- Select a model.

- ▷ If no model exists, one must be added. (→ [Add new model](#) 66)
- ▶ Click on the [Create rectangular ROI] button: 
- ▶ Create the region of interest in the live image by clicking and dragging using the mouse.
- ▷ Click and drag to move the created region of interest.

The following functions are used to set the region of interest:

Button	Function	Description
	Change the size and shape of the region of interest	Click and drag the small square to the new position to change the region of interest.
	Rotate region of interest	Click and drag the round button to rotate the region of interest.
	Group regions of interest	Select several regions of interest while pressing the Shift key. Then click the button to group regions of interest.
	Copy region of interest	Click the button to copy the selected region of interest.
	Delete region of interest	Click the button to delete the selected region of interest.



If a region of interest cannot be selected:

- ▶ click on the name of the region of interest.

9.2 Creating a region of disinterest (ROD)

Within the exclusion zone (ROD: region of disinterest), the device does not search for codes, BLOBs or contours. Up to 64 regions of disinterest can be created per model.



The operating elements for creating a region of disinterest are only displayed in the model settings. (→ [Models](#) 65)

Creating a region of disinterest:

- ▶ Select a model.
- ▷ If no model exists, one must be added. (→ [Add new model](#) 66)
- ▶ Click on the [Create rectangular ROD] button: 
- ▶ Create the region of disinterest in the live image by clicking and dragging using the mouse.
- ▷ Click and drag to move the created region of disinterest.

The following functions are used to set the region of disinterest:

Button	Function	Description
	Change the size and shape of the region of disinterest	Click and drag the small square to the new position to change the region of disinterest.
	Rotate region of disinterest	Click and drag the round button to rotate the region of disinterest.
	Copy region of disinterest	Click the button to copy the selected region of disinterest.
	Delete region of disinterest	Click the button to delete the selected region of disinterest.



If a region of disinterest cannot be selected:

- ▶ click on the name of the region of disinterest.

10 Application

The [Application] area manages the applications of the connected device. An application contains application-specific settings.

Typically, an application contains the following settings:

- Device camera and triggers: Images and triggers (→ [Images & trigger](#) ▢ 29)
- Search for codes, BLOBs or contours within the image: Model settings (→ [Models](#) ▢ 65)
- Sequence of processing of images and models: Flow (→ [Flow](#) ▢ 115)
- Output logic for data transfer to an external controller: Logic (→ [Logic](#) ▢ 118)
- Configuration of the output via the interfaces: Interfaces (→ [Interfaces](#) ▢ 146)
- Collection of statistical data: Test (→ [Test](#) ▢ 166)

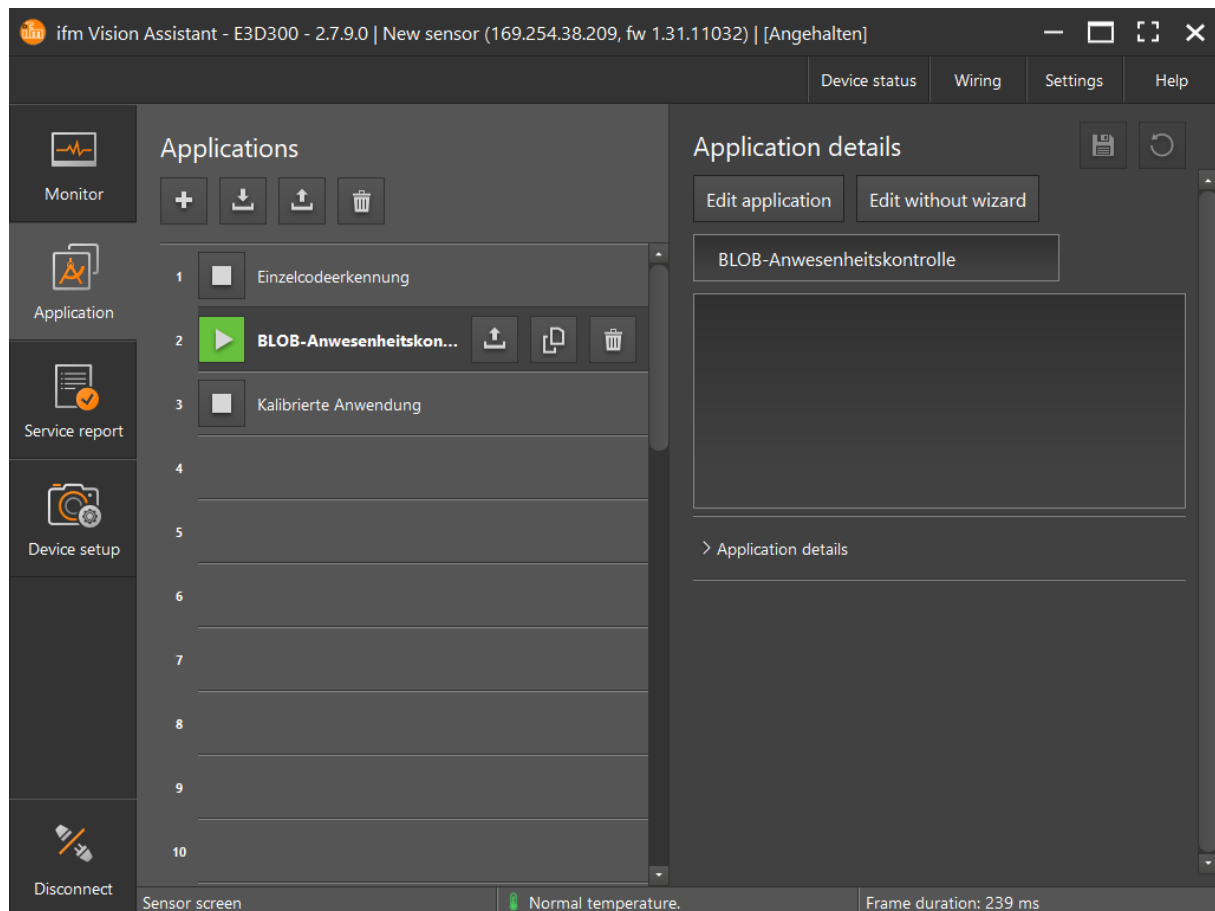


Fig. 4: [Application] area



Up to 32 applications can be added. An application contains up to 10 models. (→ [Models](#) ▢ 65)

The [Application] area contains the following operating elements:

Operating element	Name	Description
	Add new application	Displays the following buttons for adding a new application: [User-defined mode]: starts the user-defined mode. All settings are displayed. The mode is intended for advanced users. [Single-code detection]: starts the wizard for the detection of a code. The wizard guides you through adding an application in several steps. [Date code verification]: starts the wizard for the verification of a date code. The wizard guides you through adding an application in several steps. [Contour presence control]: Starts the wizard for analysing the contours of an object. [BLOB presence control] Starts the wizard for analysing the number, arrangement and brightness of the pixels of an object, such as a thread. [Measurement and robot calibration] Starts the calibration wizard for length measurements and coordinate transformation between a robot and the device. [BLOB analysis]: starts the wizard for analysing the surface characteristics of an object.
	Import application	Imports one or more applications from a file with the extension *.o2i4xxapp.
	Export all applications / Export application	Exports one or more applications to a file with the extension *.o2i4xxapp.
	Delete all applications / Delete application	Deletes all applications or a single application after confirmation. Deleted applications cannot be restored.
	Activate	Activates the selected application.
	Duplicate	Duplicates the selected application. The duplicate can be used for tests, for example.
	Save	Saves the changed application details.
	Discard unsaved changes	Discards the changed application details and restores the status saved last.
[Edit application]	Edit application with or without wizard	Edits the selected application in the [User-defined mode]. If the application was created with a wizard, the wizard will open.
[Edit without wizard]	Edit application without wizard	Edits the selected application in the [User-defined mode].
[One-code application]	Application name	Sets the name of the selected application.
[Application description]	Application description	Sets a description for the selected application.
[Application details]	Application details	Displays details of the selected application.

Edit application

The application is set in the [Edit application] area. An application contains application-specific settings.

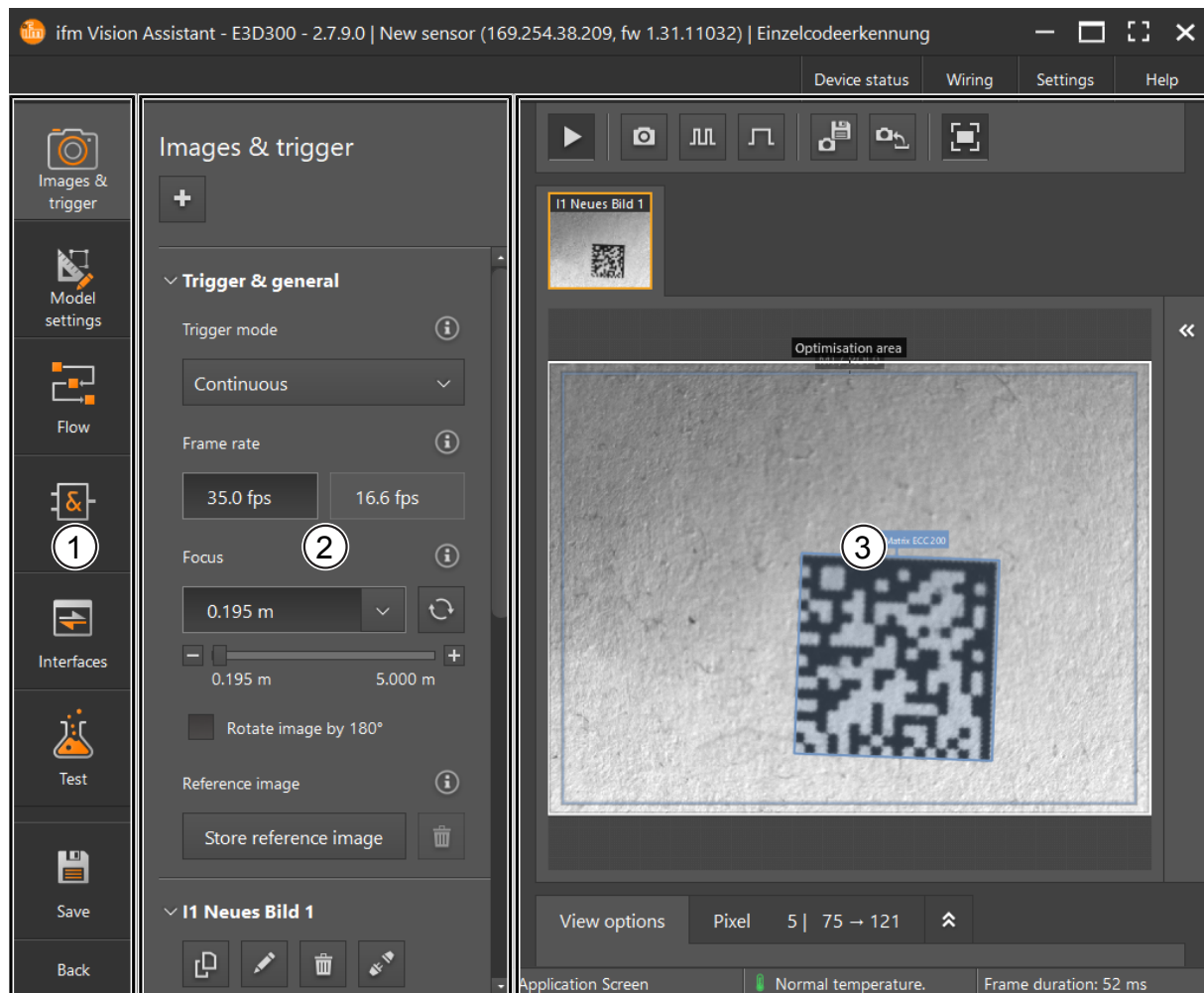


Fig. 5: [Edit application] area

1 Navigation bar
3 Main area

2 Settings

The [Edit application] area can be accessed in two ways:

- add a new application,
- edit the selected application.

Navigation bar

The buttons in the navigation bar are used to switch between functions.

Function	Name	Description
	Images & trigger	Sets the image and trigger settings of the application. (→ Images & trigger □ 29)
	Model settings	Sets the type of code, BLOB or contour. (→ Models □ 65)
	Flow	Sets the processing order of the images and models. (→ Flow □ 115)
	Logic	Sets the output logic. (→ Logic □ 118) The model and pin events are assigned to the outputs in the output logic.
	Interfaces	Sets the data packages which are sent via the interface. (→ Interfaces □ 146)
	Test	Displays statistics and states of the connected device. (→ Test □ 166)

Settings

The selected function is set in the settings.

Main area

The codes, BLOBs and contours found and the live image are displayed in the main area. The live image contains the following operating elements:

Operating element	Name	Description
	Live image	Continuously refreshes the live image independently of the set trigger source and frame rate.
	Force trigger	Refreshes the live image once independently of the set trigger source.
	React to all triggers	Refreshes the live image on each trigger signal.
	Wait for one trigger	Refreshes the live image once on the next trigger signal.
	Save snapshot	Saves the current live image in a file. If several images exist, all are saved in a file. The file has the extension *.o2x5xximg.
	Load snapshot	Loads the live image from a file. The loaded file is displayed instead of the live image. The file has the extension *.o2x5xximg. If a file contains several images, there may be an error message when the live image is loaded. Before loading the live image, add the number of images in the ifm Vision Assistant. (→ Add new image ▢ 33)
	Enable code reading	Enables detection of codes, BLOBs and contours.
	Create rectangular ROI	Creates a search zone (ROI: region of interest) in which codes are recognised. (→ Creating a region of interest (ROI) ▢ 23)
	Create rectangular ROD	creates a region of disinterest (ROD) in which no codes are recognised. (→ Creating a region of disinterest (ROD) ▢ 24)



Some buttons are only visible in certain areas of the ifm Vision Assistant.

10.1 Images & trigger

The function [Images & triggers] sets the camera of the device and the triggers.

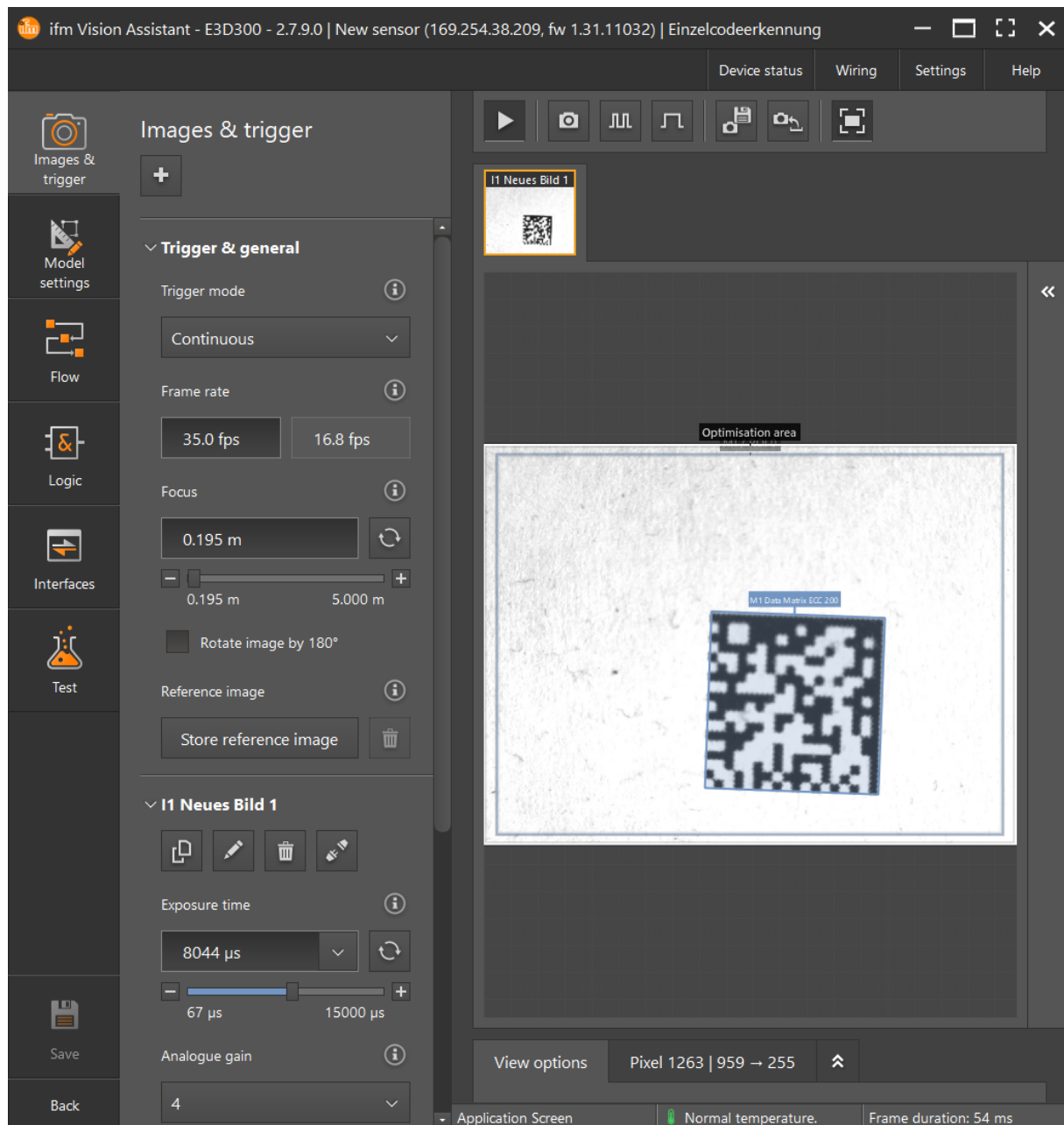


Fig. 6: Function [Images & triggers]



To detect codes, models have to be added. (→ [Models](#) 65)

The function [Images & triggers] contains the following operating elements:

Operating element	Type	Description
	Button	Adds a new image. (→ Add new image 33)

Area [Trigger & general]:

Operating element	Type	Description
[Trigger mode]	List	Sets the trigger. (→ Trigger mode 33)
[Gate duration]	Input field	Stops the image recording after the set [gate duration] has elapsed. The setting is only available for the [Gated time-based] trigger mode.

Operating element	Type	Description
[Trigger delay]	Input field	Sets a time delay in [ms] for the trigger.
[Enable burst trigger]	Checkbox / input field	Enables the burst trigger. The input field is used to set how often the application is triggered. For example, an application with 3 set images and burst trigger=" 10 " takes a total of 30 images. After the image capture, the images are evaluated. The first image rated as "pass" is output. Other images rated as "pass" are discarded. The burst trigger is particularly suitable for dynamic applications.
[Trigger gate logic]	List	Sets the logic of the [Gated...] trigger modes: [High active]: As long as the trigger is on High , images are captured with a fixed frame rate. The device stops capturing images on Low . [Low active]: As long as the trigger is on Low , images are captured with a fixed frame rate. The device stops capturing images on High .
[Only one result per trigger gate]	List	Sets the handling of found codes in the [Gated...] trigger modes: [Off]: All recorded images are output. [Relaxed]: The [Continuous] trigger mode is active. If the gate is active and a code is found: The gate is immediately terminated and the result is output. If no code is found: The gate is terminated externally by a controller or a hardware trigger after a certain time. If an image is taken at the time of termination, the image will still be evaluated. [Strict]: The [Continuous] trigger mode is active. If the gate is active and a code is found: The gate is immediately terminated and the result is output. If no code is found: The gate is terminated externally by a controller or a hardware trigger after a certain time. If an image is taken at the time of termination, the image will not be evaluated.
[Frame rate]	Input field	Sets the frame rate to be achieved. (→ Frame rate □ 34) The setting is only available for certain trigger modes.
[Focus]	Input field	Sets the focus. (→ Selection □ 34)
	Button	automatically optimises the focus.
[Calibrate]	Button	Opens the calibration wizard. (→ Calibration wizards □ 35) The wizard guides the user through the calibration with a measuring tool or calibration pattern (with robot tool tip). Calibration increases the accuracy of measurements with the device.
	Button	Imports a calibration from a file with the extension .o2xcalib .
	Button	Exports a calibration to a file with the extension .o2xcalib .
[Rotate image by 180°]	Checkbox	Rotates the live image by 180°.

Operating element	Type	Description
[Save reference image]	Button	Saves the current live image as a reference image. (→ Reference image ▢ 61)
	Button	Deletes the saved reference image.

Area [I1 New image 1] (name):

Operating element	Type	Description
	Button	Copies the image and changes to the new image.
	Button	Renames the image.
	Button	Deletes the image.
	Button	Deactivates the image.
[Exposure time]	Input field	Sets the exposure time. (→ Exposure time ▢ 61)
	Button	Automatically sets the exposure time.
[Analogue gain]	List	Sets the amplification factor of the analogue signal (→ Analogue gain ▢ 61)
[Illumination]	List	Sets the internal and external illumination. (→ Illumination ▢ 62)
[Illumination internal segments]	Button	Displays the status of the internal illumination. When internal illumination is active, individual segments are deactivated and activated by clicking in the graphic.
[Filter type]	List	Sets the filter for the image. (→ Filter type ▢ 63)
[Filter strength]	List	Sets the intensity of the selected filter type. (→ Filter strength ▢ 63)
[Invert image]	Checkbox	Inverts the brightness values of the image. (→ Invert image ▢ 63)

[Image quality check] area:

Operating element	Type	Description
[Activated]	Checkbox	Activates the image quality check. (→ Image quality check ▢ 64) The image quality check checks the image quality of the entire image and not only the code quality.
[Reset statistics]	Button	Resets the statistics.
[Sharpness]	Graphical representation	Shows the current measuring range (orange line), the measured value (green dot) and the permitted value range (blue brackets). The blue brackets can be moved within the graphic.
[Teach]	Button	Sets the current measuring range as the permitted value range.
[Mean brightness]	Graphical representation	Shows the current measuring range (orange line), the measured value (green dot) and the permitted value range (blue brackets). The blue brackets can be moved within the graphic.

Operating element	Type	Description
[Teach]	Button	Sets the current measuring range as the permitted value range.
[Underexposed area]	Graphical representation	Shows the current measuring range (orange line), the measured value (green dot) and the permitted value range (blue brackets). The blue brackets can be moved within the graphic.
[Teach]	Button	Sets the current measuring range as the permitted value range.
[Overexposed area]	Graphical representation	Shows the current measuring range (orange line), the measured value (green dot) and the permitted value range (blue brackets). The blue brackets can be moved within the graphic.
[Teach]	Button	Sets the current measuring range as the permitted value range.

10.1.1 Add new image

The [Add new image] button adds a new image. The following settings are saved in an “image”:

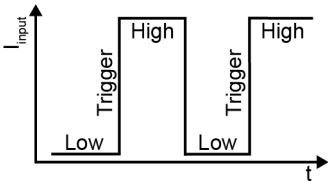
- exposure time
- analogue gain
- illumination
- filter
- image quality check

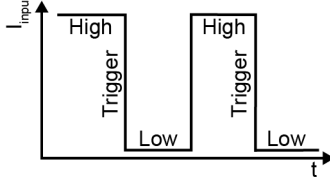
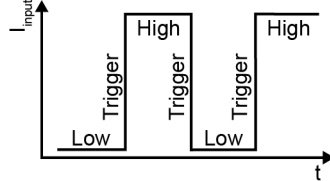
Up to 5 images with their own settings can be used in parallel. Several images ensure detection of codes, BLOBs and contours with different

- qualities,
- surfaces,
- lighting conditions, etc.

10.1.2 Trigger mode

The list [Trigger mode] contains the following trigger modes:

Trigger mode	Description
[Continuous]	The device continuously captures images. This mode is usually used for tests.
[Process interface]	The device is triggered via the process interface (e.g. by a PLC).
[Positive edge]	The device is triggered via the rising edge of an input signal. 

Trigger mode	Description
[Negative edge]	The device is triggered via the falling edge of an input signal. 
[Both edges]	The device is triggered via the rising and falling edge of an input signal. 
[Gated via IO]	If [Trigger gate] logic is set to [High active]: The device starts continuous image capture with a rising edge. As long as the trigger is on High, images are captured with a fixed frame rate. The device stops capturing images on Low. With [Trigger gate logic] set to [Low active], the behaviour reverses.
[Gated PCIC]	The device starts continuous image capture with the g command of the process interface: <pre>1234L000000008 1234g1</pre> Images are captured with a fixed frame rate. The device stops capturing images with the following g command: <pre>1234L000000008 1234g0</pre>
[Gated time-based]	If [Trigger gate] logic is set to [High active]: The device starts continuous image capture with a rising edge. As long as the trigger is on High, images are captured with a fixed frame rate. The device ends the image recording with the state Low or after the set [gate duration] has expired. With [Trigger gate logic] set to [Low active], the behaviour reverses.

10.1.3 Frame rate

The input field [Frame rate] defines a maximum frame rate for the device.

Set the frame rate:

- Enter the frame rate in the input field [Frame rate] and confirm with [Enter].



The frame rate only influences the trigger modes [Continuous] and [Gated ...].

Depending on which additional settings are active, the requested frame rate will not be reached.

10.1.4 Selection

The [Focus] input field sets the distance in metres [m] between the lens and the code, BLOB or contour to be detected. The optimum focus has been reached when the code, BLOB or contour in the live image is sharply displayed and is detected by the device.



The set focus is used for all images. The focus cannot be set separately for each image.

The focus can be set in 3 ways:

- via the input field,
- via the [Optimise].button ,
- via the slider below the input field,
- Via the buttons  /  next to the slider.



In the [Focus] input field, the  button appears if the focus has been optimised automatically. A click on the button shows the focus levels found by the automatic focus.

10.1.5 Calibration wizards

The calibration wizards for [Rough measurement] and [Precise measurement] assist in calibrating the instrument. The [Robot sensor calibration] wizard sets the coordinate transformation between the machine and the robot.

The 3 wizards guide you step by step through the calibration of the device.

During calibration, the image pixels are transformed into world coordinates.

Start calibration wizard

The calibration wizards are started via the [Calibrate] button in the [Images & triggers] area of an application. ([→ Images & trigger](#)  29)

Calibration wizard [Rough measurement]

Rough measurement is fast and provides precise calibrations with simple measuring tools. ([→ Rough measurement](#)  35) For example, a caliper or ruler is suitable as a measuring tool.

Calibration wizard [Precise measurement]

Precise measurement recognises the pattern on a marker sheet and determines the number of image pixels in a specific area. ([→ Precise measurement](#)  42) A marker sheet is a prerequisite for precise measurement. The marker sheet is printed with the calibration wizard.

Calibration wizard [Robot sensor calibration]

Robot sensor calibration transforms the device's image coordinate system into the robot's world coordinate system. ([→ Robot sensor calibration](#)  51)

The device sends the coordinates of found objects to the robot. The data can be used by the robot for robot gripper navigation (pick & place), for example.

A prerequisite for robot sensor calibration is a marker sheet. The marker sheet is printed with the calibration wizard.

10.1.5.1 Rough measurement

The rough measurement is fast and provides precise calibrations with simple measuring tools. For example, a vernier calliper or ruler is suitable as a measuring tool.

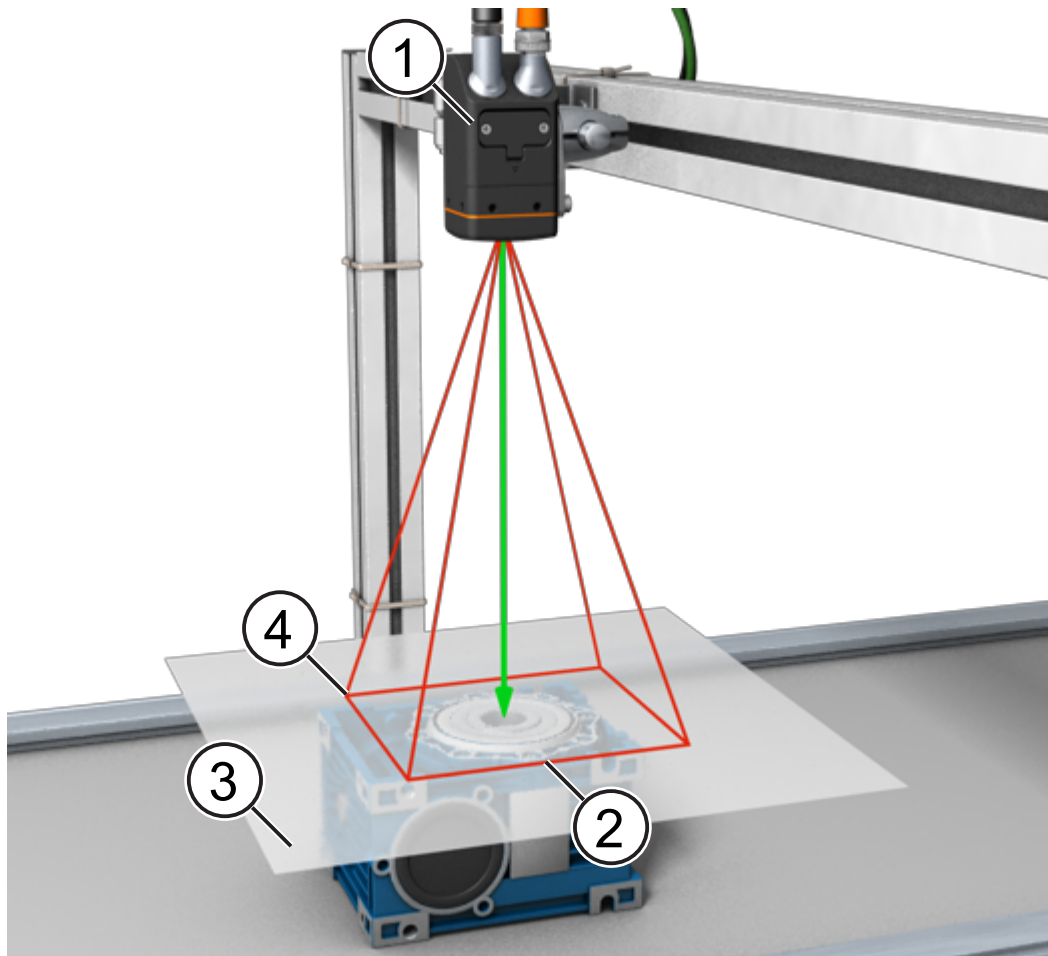


Fig. 7: Rough measurement

- 1 Bottom of the device with maintenance flap for ifm memory stick
- 3 Working plane

- 2 Field of view of the device (red rectangle)
- 4 Zero point



The zero point (4) is located at the top left of the live image for the rough measurement, starting from the bottom of the device (1).

The individual pages of the wizard are described below.

1. Overview

The [Overview] page summarises the function of the wizard.

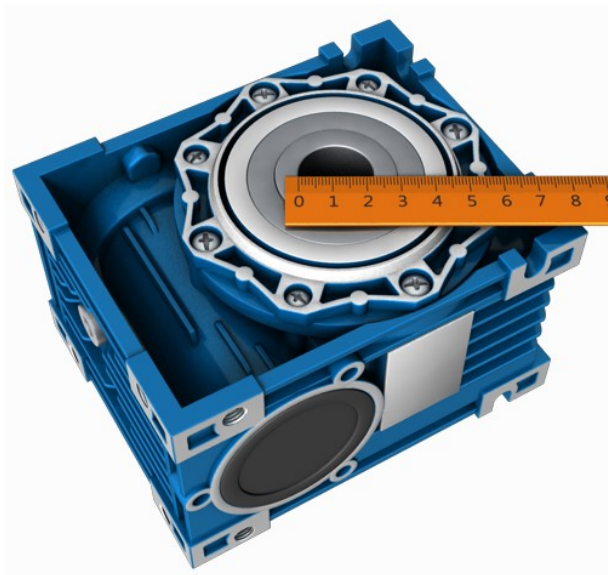


Fig. 8: Rough measurement



Rough measurement requires a measurement tool such as a

- calliper gauge
- ruler or
- similar measuring tool with metric length indication.

2. Prepare calibration

On the [Prepare calibration] page, the calibration is prepared.

Before calibrating the device, follow the instructions below:

- For installation, follow the operating instructions of the device.

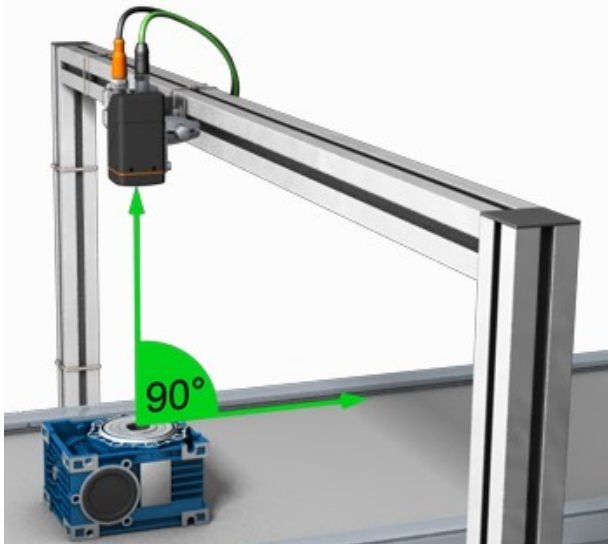


Fig. 9: The device is aligned with an angle of 90° perpendicular to the working plane.

- Place the object in the field of view of the device.
- Avoid reflections from the subject by adjusting the picture settings.
 - ▷ Depending on the type, the device has polarisation filters and different illumination colours, which can reduce reflections.
- Place the measuring tool (calliper, ruler etc.) on the object.
 - ▷ For an accurate measurement result, the measuring tool must be on the same plane (surface) as the object to be tested.



If the measuring tool has an inherent height of several millimetres: A sheet of paper printed with a metric scale gives a more accurate measurement result.

3. Image settings focus

On the [Image settings focus] page, the focus of the device is set automatically or manually.

The focus describes the distance between

- the lens of the device (orange marking on the device) and
- the object that should be in focus.

The plane perpendicular to the optical axis is called the focal plane. The device automatically finds the optimal focal plane.

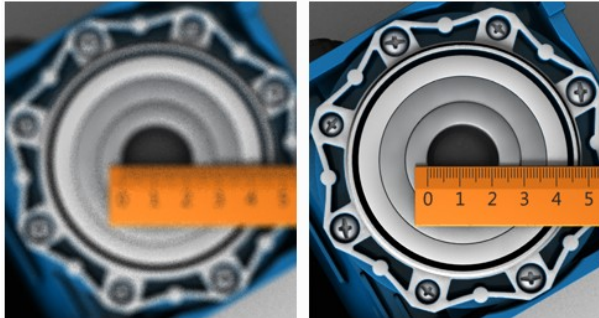


Fig. 10: Measuring tool placed on the object with focus out of focus (left) and in focus (right).

Adjust focus

- ▶ Place the object in the field of view of the device.
- ▶ Place the measuring tool on the object.
- ▶ Select the [Autofocus] button: 
 - ▷ The focus is adjusted automatically.
- ▶ Alternatively, adjust the focus manually with the buttons  or the slider.

Rotate image

The live image can be rotated by 180°.

- ▶ Select the [Rotate image by 180°] button.



The live image can be adjusted using the mouse:

- ▶ Use the mouse wheel to enlarge or reduce the live image.
- ▶ Move the enlarged live image with the mouse pointer.

3.1 Image settings exposure

On the [Image settings exposure] page, the contrast of the object can be set. High contrast makes it easier for the device to recognise structures.

The exposure of the object can be set automatically or manually.

Exposure time

The exposure time sets the amount of time in [µs] for taking a picture.

The exposure time can be set in several ways:

- via the input field,
- via the [Optimise].button ,
- via the slider below the input field,

- Via the buttons  /  next to the slider.

Analogue gain

The [Analogue gain] list sets the gain factor of the analogue signal. The analogue gain is linear to the exposure time. Therefore, with double analogue gain, half the exposure time can be used. Especially dynamic applications benefit from the short exposure times.



The analogue gain slightly increases the image noise.

Illumination segments

The [Illumination segments] set the internal illumination of the device.

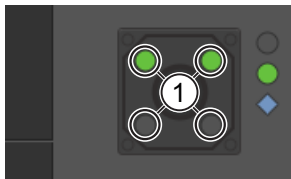


Fig. 11: Setting the internal illumination

1 Click-activated LED

Clicking on an LED (1) in the [Internal illumination graphic] activates or deactivates the LED.

The status of an LED is displayed in colour:

Colour	State
grey	The LED is deactivated.
green	The LED is activated.
blue	The LED with polarisation filter is activated.



The polarisation filters and the [Colour of the internal illumination] buttons are only available for the RGB-W units O2D50x, O2D51x and O2D54x.

The infrared units O2D52x, O2D53x and O2D55x are not equipped with polarisation filter and LED colours.



In case of unwanted reflections, use the LEDs with polarisation filters.

Colour of the internal illumination

The [Colour of the internal illumination] buttons are used to set the LED colour of the internal illumination.

► Depending on the colour of the object, set a suitable LED colour.

▷ A matching LED colour creates a great contrast with the measuring tool.

The following LED colours are available:

- [white]
- [green]
- [blue]
- [red]

Illumination

The [Illumination] list describes the types of illumination. The following quality parameters are available:

Illumination	Description
[None]	Deactivates the internal and external illumination.

Illumination	Description
[Internal]	Activates the internal illumination of the device. The graphic below the list [Illumination segments] shows the status of the internal illumination. When internal illumination is active, individual segments are deactivated and activated by clicking in the graphic.
[External]	Activates the external illumination. The external illumination unit is connected to switching output OUT5 of the device. In addition, the external illumination has to be activated. The external illumination unit is active as long as switching output is in the " high " state. The external illumination unit and the OUT5 output are only available for 8-pole devices.
[Both]	Activates the internal and external illumination.

4. Sensor calibration

On the [Sensor calibration] page, the measuring tool can be used to calibrate the sensor of the device:

- Place the measuring tool centrally or diagonally in the sensor's field of view.

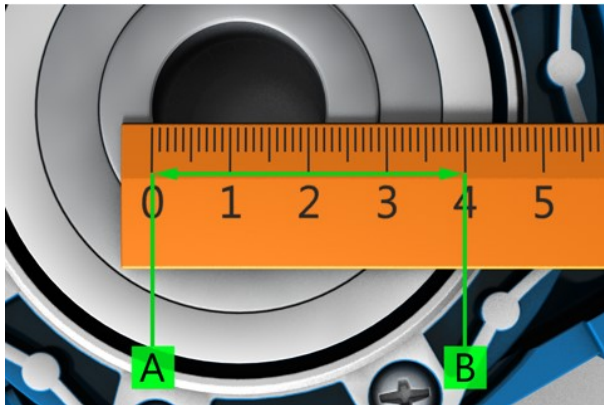


Fig. 12: Measuring points placed along the measuring tool

- Use buttons [A] and [B] to place the measuring points in the live image along the measuring tool.
 - ▷ The measurement is more accurate if the measuring points [A] and [B] are placed as far apart as possible.

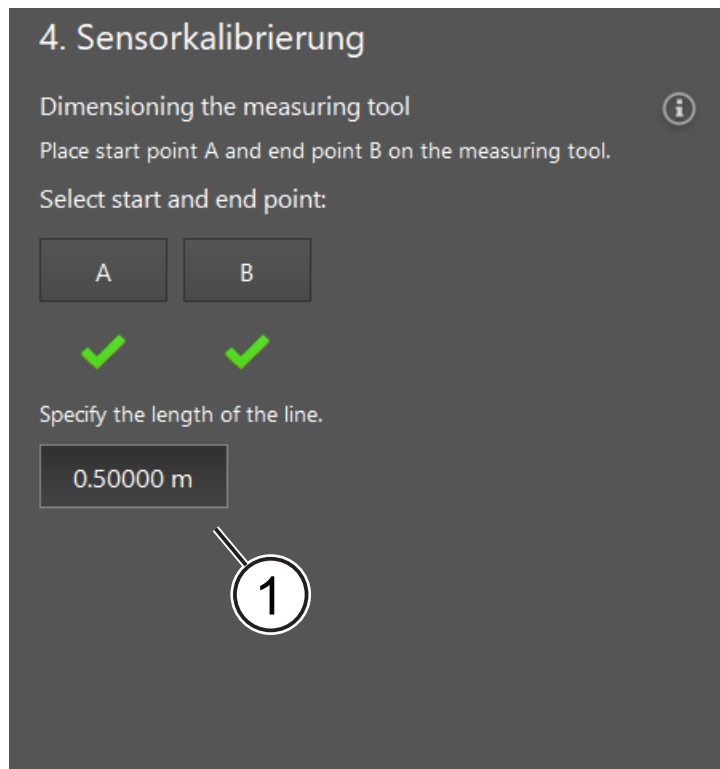


Fig. 13: Sensor calibration

1 Input field for the length

► Enter the distance between the measuring points in the [input field] for the length.

5. Test

The [Test] page displays the result of the calibration. In addition, the calibration can be tested.

Calibration details

The [Calibration details] tab shows the result of the calibration:

- Position of point A [px] / [mm]
- Position of point B [px] / [mm]
- Average conversion factor [px] in [mm]
- Length: Distance between the measuring points [mm]

Test measurement

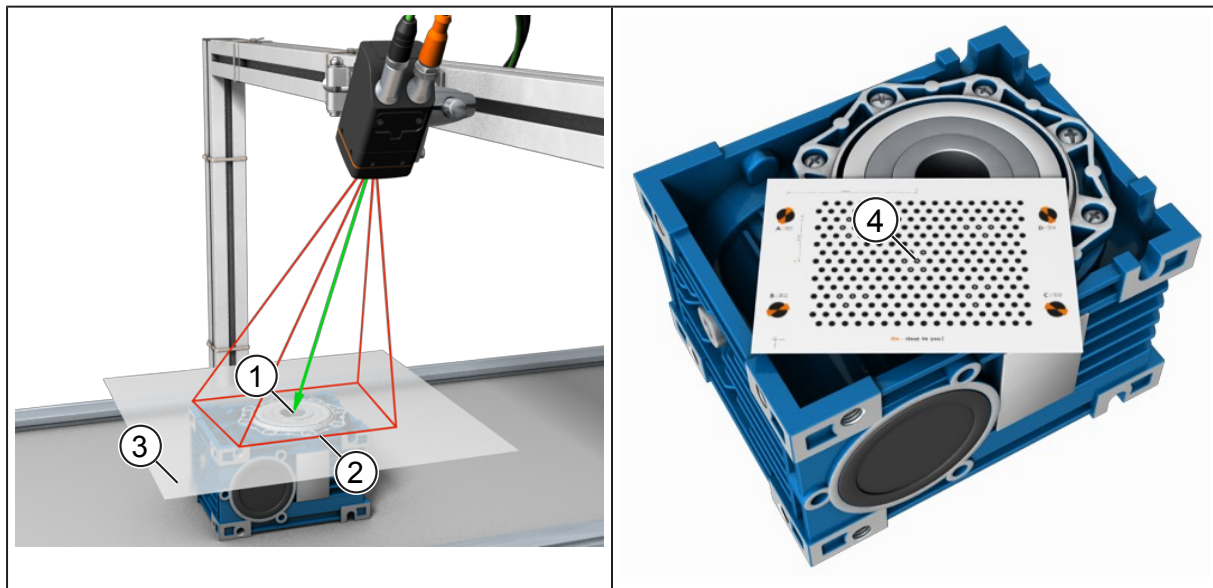
The [Test measurement] tab provides tools for testing the calibration:

Button	Description
	Draws a line in the live image. The table contains measurement results for the drawn line: • Start point (x/y) [mm] • End point (x/y) [mm] • Length [mm]
	Draws a rectangle in the live image. The table contains measurement results for the drawn rectangle: • Width / height [mm] • Range [mm²]

Button	Description
	Draws a circle in the live image. The table contains measurement results for the drawn circle: • Centre point [mm] • Radius [mm] • Range [mm²]

10.1.5.2 Precise measurement

The precise measurement detects the pattern on a marker sheet and determines the number of image pixels in a specific area. A marker sheet is a prerequisite for precise measurement. The marker sheet is printed with the calibration wizard.



- 1 Zero point
3 Working plane

- 2 Field of view of the device (red rectangle)
4 Central dot pattern of the marker sheet



The zero point (1) is taught during precise measurement via the central dot pattern of the marker sheet (4). If the marker sheet is placed in the centre of the live image, the zero point is approximately in the centre of the image.

The individual pages of the wizard are described below.

1. Overview

The [Overview] page summarises the function of the wizard.

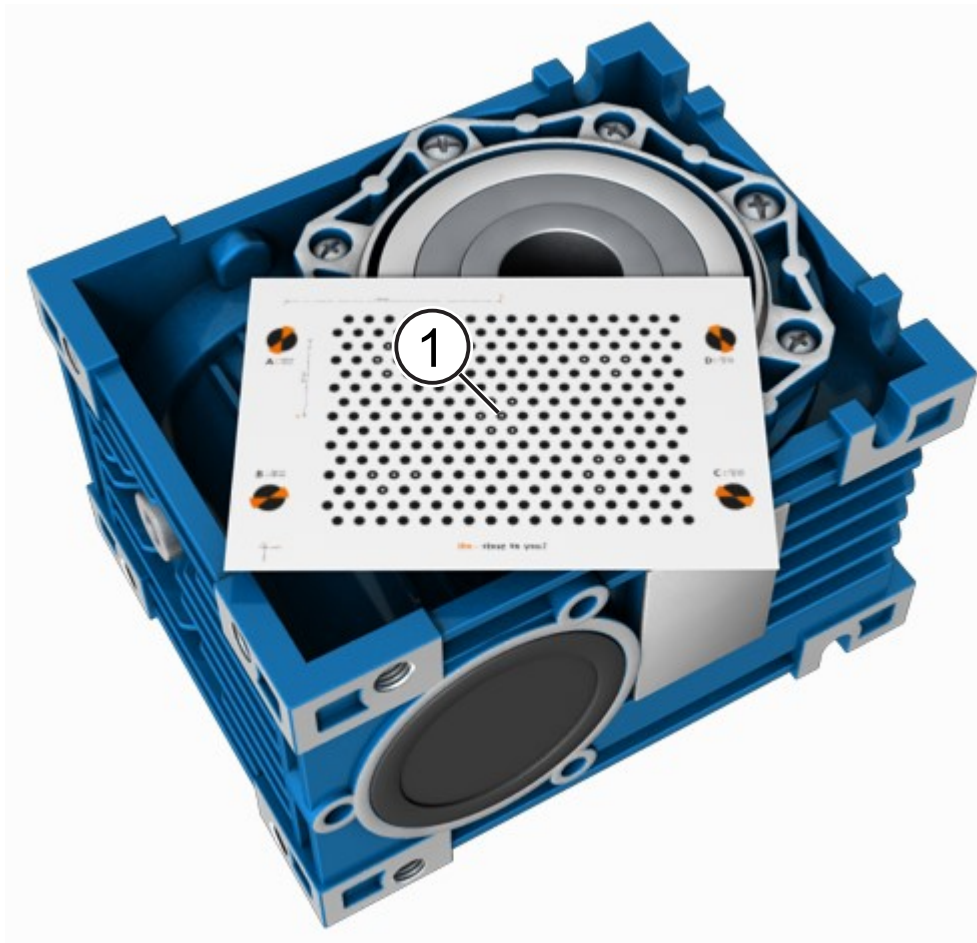


Fig. 14: Precise measurement

1 Zero point



A marker sheet is a prerequisite for calibration.

2. Prepare calibration

On the [Prepare calibration] page, the calibration is prepared.

Before calibrating the device, follow the instructions below:

- For installation, follow the operating instructions of the device.

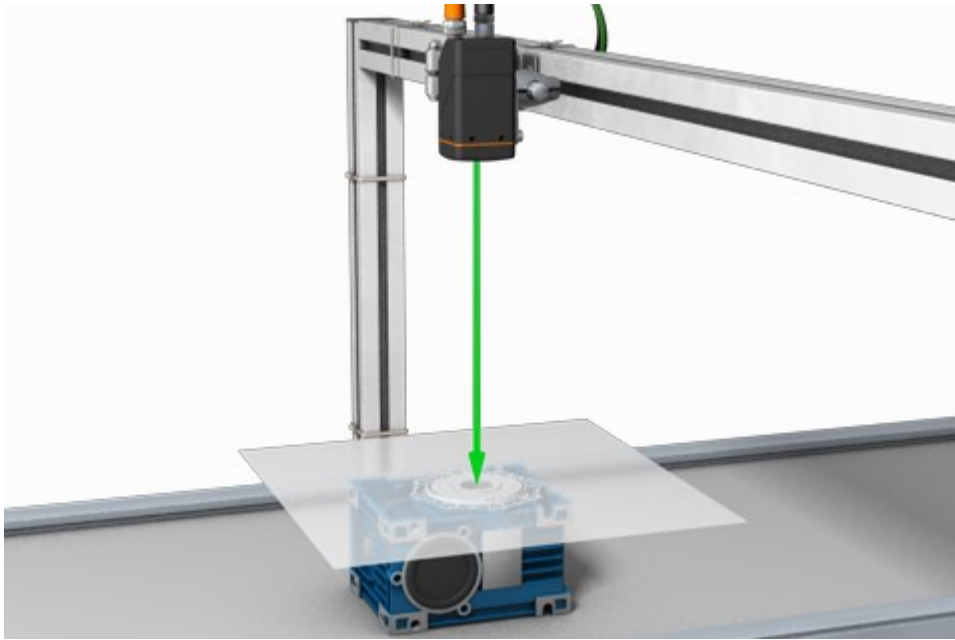


Fig. 15: The marker sheet is placed on the object

- Place the object in the field of view of the device.

2. Prepare calibration

Select distance i

Specify the distance to the working plane. The currently used focus distance is preset. You can set the distance via manual input.

1.000 m

↺

Print marker i

Print a marker sheet. The size of the marker sheet is preselected depending on the distance entered above.

Important:
Ensure high print quality (max. dpi).
The printout must not be scaled!

Marker 3 (< 2.00m) A4
▼

Print marker

Must be printed on A4.

Fig. 16: Prepare calibration

1 Input field for the distance

- Enter the distance from the orange seal of the device to the object in the input field (1).
 - ▷ The [Reset to focus]  button resets the input field to the pre-set distance.
- Print the marker sheet.
- Place the marker sheet on the object or on the work plane.
 - ▷ The height difference between the object plane and the working plane can be compensated for on the [Calibration Z offset] page.

Print marker sheet

The marker sheet is used to calibrate the device. Before printing the marker sheet, make sure that the original scaling and no printer economy modes are activated. Otherwise, the calibration will be inaccurate.

Print marker sheet

- Go to the [Prepare calibration] step.

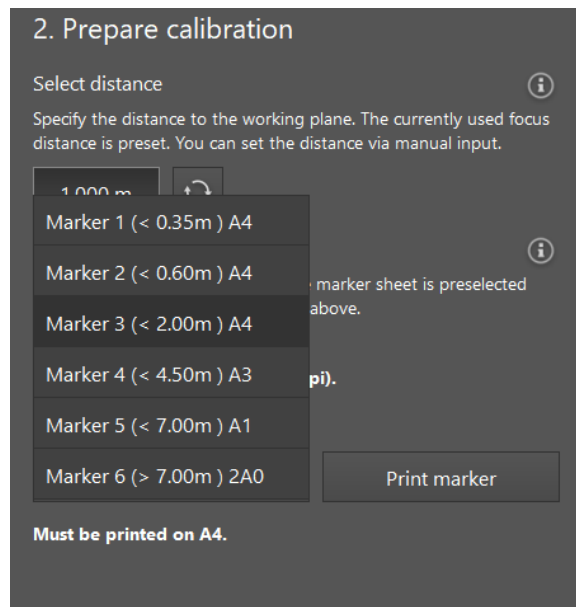


Fig. 17: List of available marker sheets

- Select a marker sheet from the list.
 - ▷ The length in brackets indicates the approximate distance between the device and the object. The size of the marker sheet increases with the distance. With a distance of " $> 5,20 \text{ m}$ ", the marker sheet is printed in DIN 2A0 format (1189 x 1682 mm).
- Select the [Print markers] button.
 - ▷ The marker sheet is displayed.
- Select the [Print] button.

Set scaling

- Select the printer.
- Select the [Advanced] tab.
- In the [Page scaling] area, select [Use original page sizes] .
 - ▷ The marker sheet must be printed in the original scale.

Deactivating the economy modes of the printer

- Select the [General] tab.
- Select the [Settings] button.
- Deactivate all economy modes for colour, toner, etc.
 - ▷ The marker sheet must be printed in the best quality.
- Select the [OK] button.
- Select the [Print] button.
 - ▷ The marker sheet is printed in the original scale and without economy modes.

Check printed marker sheet

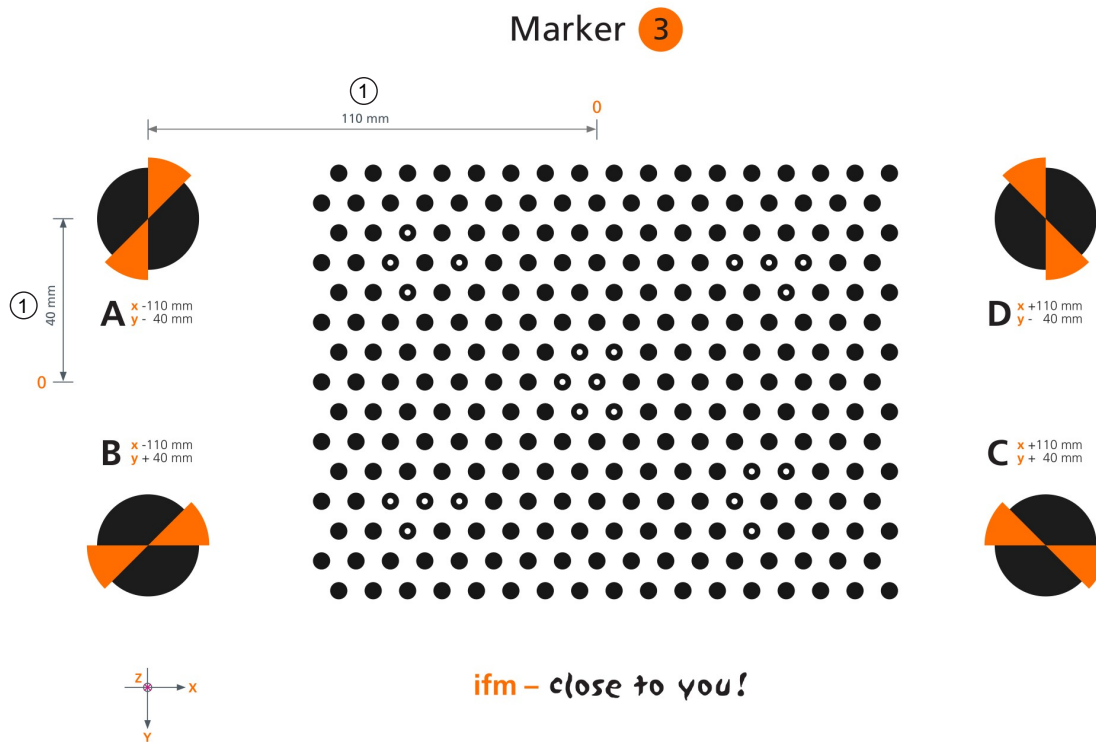


Fig. 18: Printed marker sheet with scales

1 Scale

There are scales (1) on the marker sheet to check the scaling. The marker sheet must be printed in the original scale.

► Use a ruler to check the scales on the X and Y axes of the marker sheet.

3. Image settings focus

On the [Image settings focus] page, the focus of the device is set automatically or manually.

The focus describes the distance between

- the lens of the device (orange marking on the device) and
- the object that should be in focus.

The plane perpendicular to the optical axis is called the focal plane. The device automatically finds the optimal focal plane.

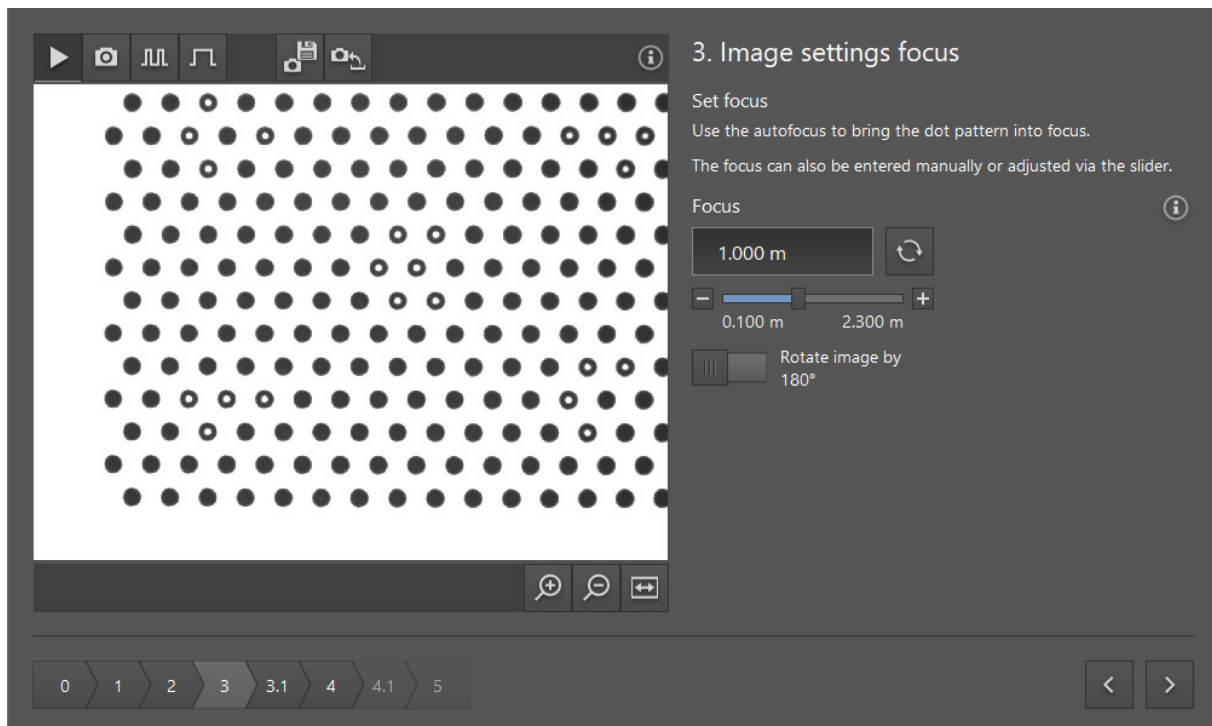


Fig. 19: The live image shows a section of the marker sheet.

Adjust focus

- ▶ Place the object in the field of view of the device.
- ▶ Place the marker sheet on the object.
- ▶ Select the [Autofocus] button: 
 - ▷ The focus is adjusted automatically.
- ▶ Alternatively, adjust the focus manually with the buttons  /  or the slider.

Rotate image

The live image can be rotated by 180°.

- ▶ Select the [Rotate image by 180°] button.



The live image can be adjusted using the mouse:

- ▶ Use the mouse wheel to enlarge or reduce the live image.
- ▶ Move the enlarged live image with the mouse pointer.

3.1 Image settings exposure

On the [Image settings exposure] page, the contrast of the object can be set. High contrast makes it easier for the device to recognise structures.

The exposure of the object can be set automatically or manually.

Exposure time

The exposure time sets the amount of time in [μs] for taking a picture.

The exposure time can be set in several ways:

- via the input field,
- via the [Optimise].button ,
- via the slider below the input field,

- Via the buttons  /  next to the slider.

Analogue gain

The [Analogue gain] list sets the gain factor of the analogue signal. The analogue gain is linear to the exposure time. Therefore, with double analogue gain, half the exposure time can be used. Especially dynamic applications benefit from the short exposure times.



The analogue gain slightly increases the image noise.

Illumination segments

The [Illumination segments] set the internal illumination of the device.

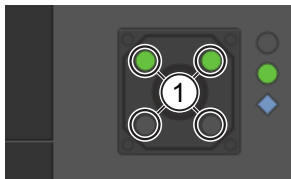


Fig. 20: Setting the internal illumination

1 Click-activated LED

Clicking on an LED (1) in the [Internal illumination graphic] activates or deactivates the LED.

The status of an LED is displayed in colour:

Colour	State
grey	The LED is deactivated.
green	The LED is activated.
blue	The LED with polarisation filter is activated.



The polarisation filters and the [Colour of the internal illumination] buttons are only available for the RGB-W units O2D50x, O2D51x and O2D54x.

The infrared units O2D52x, O2D53x and O2D55x are not equipped with polarisation filter and LED colours.



In case of unwanted reflections, use the LEDs with polarisation filters.

Colour of the internal illumination

The [Colour of the internal illumination] buttons are used to set the LED colour of the internal illumination.

► Depending on the colour of the object, set a suitable LED colour.

▷ A matching LED colour creates a great contrast with the measuring tool.

The following LED colours are available:

- [white]
- [green]
- [blue]
- [red]

Illumination

The [Illumination] list describes the types of illumination. The following quality parameters are available:

Illumination	Description
[None]	Deactivates the internal and external illumination.

Illumination	Description
[Internal]	Activates the internal illumination of the device. The graphic below the list [Illumination segments] shows the status of the internal illumination. When internal illumination is active, individual segments are deactivated and activated by clicking in the graphic.
[External]	Activates the external illumination. The external illumination unit is connected to switching output OUT5 of the device. In addition, the external illumination has to be activated. The external illumination unit is active as long as switching output is in the " high " state. The external illumination unit and the OUT5 output are only available for 8-pole devices.
[Both]	Activates the internal and external illumination.

4. Sensor calibration

On the [Sensor calibration] page, the marker sheet is used to calibrate the device:

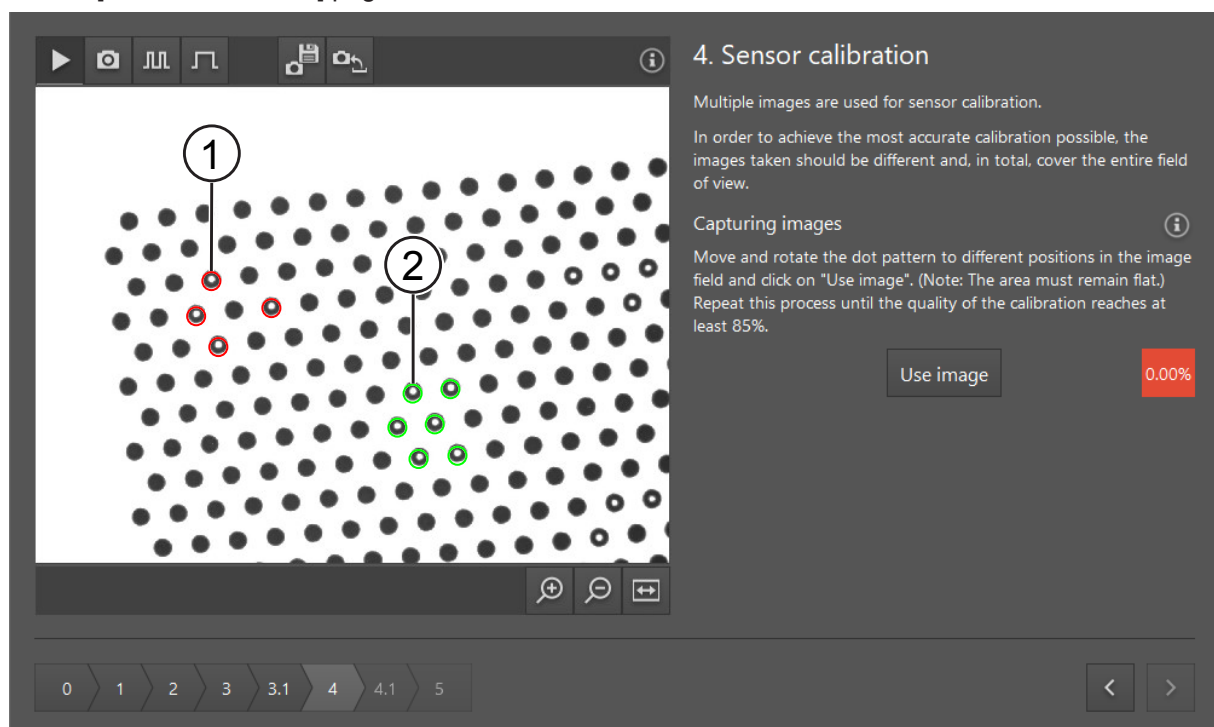


Fig. 21: Marker sheet placed underneath the device

1 Dot pattern (marked red)

2 Central dot pattern (marked green)



Do not subject the device to movement, shocks or vibrations during calibration.

- ▶ Place the object in the field of view of the device.
- ▶ Place the marker sheet on the working plane.
 - ▷ One of the dot patterns (1) must be in the field of view of the device, lying flat.
 - ▷ The central dot pattern (2) is used as the zero point. The central dot pattern may be outside the field of view of the device as the position is calculated by other dot patterns found.
- ▶ Click on the [Use image] button.
 - ▷ The [percent indication] next to the button shows the quality of the calibration in percent. The live image used is displayed below the button.
- ▶ Move and rotate the marker sheet as required.
 - ▷ One of the dot patterns (1) must be in the field of view of the device, lying flat.

- Click on the [Use image] button.
- Repeat the last two instructions until the [percent indication] shows a value of "> 85 %".
 - ▷ Higher percentage values than "> 85 %" increase the quality of the calibration. Up to 16 images can be used.

Delete used live images

The live images used can negatively influence the calibration if they are blurred, for example.

Deleting a live image:

- Select the live image with the buttons < and >.
- Delete the selected live image with the  button.
- Alternatively, use the [Delete all] button to delete all live images used.

4.1 Calibration of the Z offset

On the [Calibration Z offset] page, the difference between the calibration plane and the working plane is compensated. Ideally, the calibration plane corresponds to the working plane. If this is the case, the [Calibration Z offset] page can be skipped.

The [Calibration Z offset] page is necessary if the marker sheet was not directly on the object in the [Sensor calibration] step. This happens when the calibration plane (marker sheet) is not equal to the working plane (object).

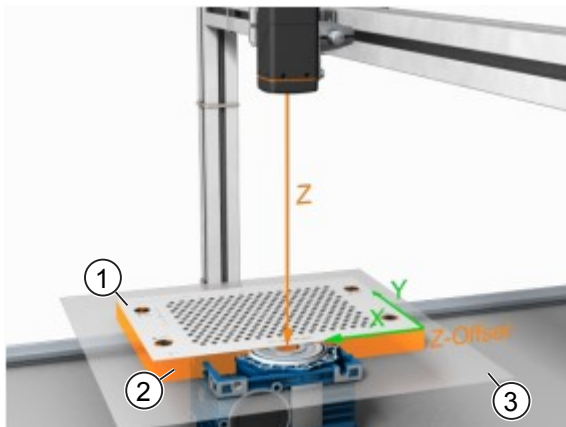


Fig. 22: Z offset

1 Calibration plane with marker sheet
3 Working plane

2 Z offset (orange area)

For certain applications, the calibration level cannot be at the same level as the working plane. For example, when

- a hole within a workpiece carrier is to be measured,
- the object to be measured protrudes from the calibration plane.

Setting the Z offset

The sign of the [Z offset] indicates whether the calibration plane with the marker sheet is in front of or behind the working plane.

Setting the [Z offset]:

- Activate the [Z offset] button.

When the calibration plane with the marker sheet is above the working plane:

- Enter a positive [Z offset] in the input field.

When the calibration plane with the marker sheet is below the working plane:

- Enter a negative [Z offset] in the input field.



Large values for [Z offset] degrade the accuracy of the calibration.

5. Test

The [Test] page displays the result of the calibration. In addition, the calibration can be tested.

Calibration details

The [Calibration details] tab shows the result of the calibration:

- Number of images [max. 16 images]
- Quality of calibration [%]
- Average conversion factor [px] in [mm]

Test measurement

The [Test measurement] tab provides tools for testing the calibration:

Button	Description
	Draws a line in the live image. The table contains measurement results for the drawn line: • Start point (x/y) [mm] • End point (x/y) [mm] • Length [mm]
	Draws a rectangle in the live image. The table contains measurement results for the drawn rectangle: • Width / height [mm] • Range [mm²]
	Draws a circle in the live image. The table contains measurement results for the drawn circle: • Centre point [mm] • Radius [mm] • Range [mm²]

10.1.5.3 Robot sensor calibration

The robot sensor calibration transforms the image coordinate system of the device into the world coordinate system of the robot.

The device sends the coordinates of found objects to the robot. The data can be used by the robot for robot gripper navigation (pick & place), for example.

A prerequisite for robot sensor calibration is a marker sheet. The marker sheet is printed with the calibration wizard.

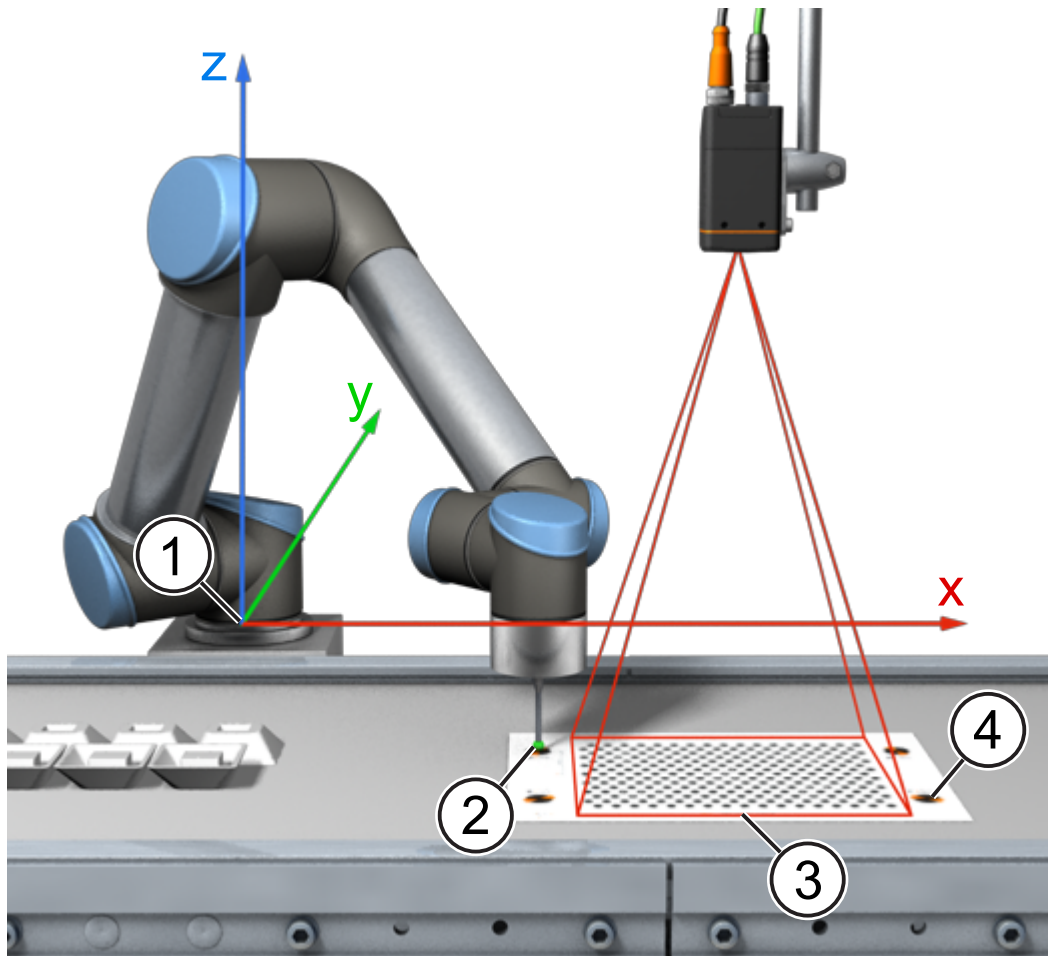


Fig. 23: Robot sensor calibration

- | | |
|---|------------------|
| 1 Zero point | 2 Tool tip |
| 3 Field of view of the device (red rectangle) | 4 Marking points |



The zero point (1) is located in the centre of the robot's coordinate axes during robot sensor calibration.

The individual pages of the wizard are described below.

1. Overview

The [Overview] page summarises the function of the wizard.

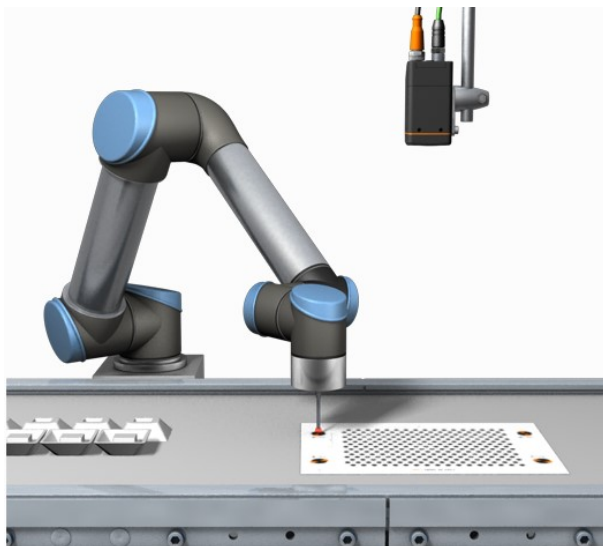


Fig. 24: Robot sensor calibration



A marker sheet is a prerequisite for calibration.

2. Prepare calibration

On the [Prepare calibration] page, the calibration is prepared.

Before calibrating the device, follow the instructions below:

- For installation, follow the operating instructions of the device.

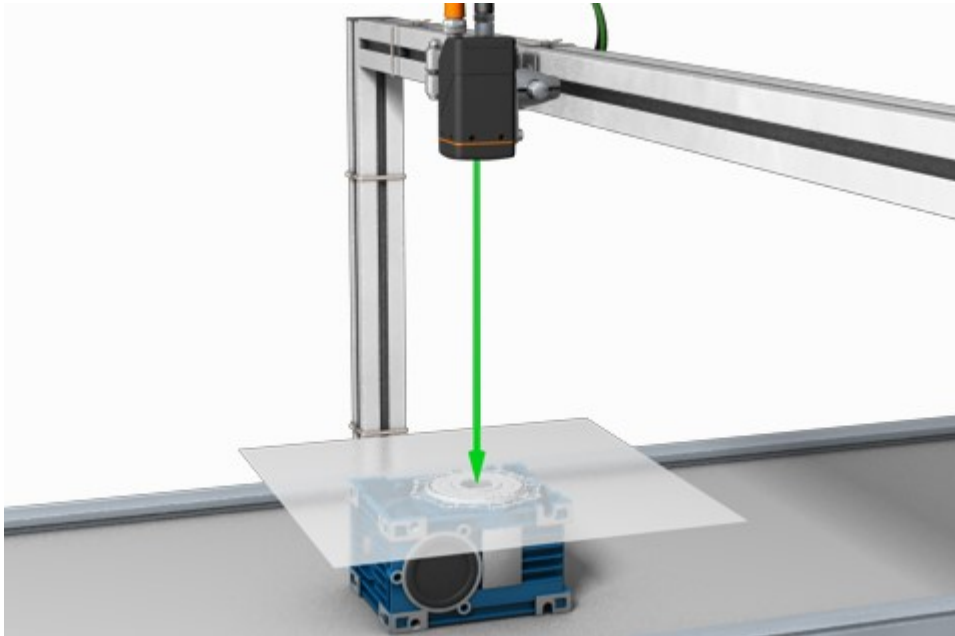


Fig. 25: The marker sheet is placed on the object

- Place the object in the field of view of the device.

2. Prepare calibration

Select distance ⓘ

Specify the distance to the working plane. The currently used focus distance is preset. You can set the distance via manual input.

1.000 m ↺

Print marker ⓘ

Print a marker sheet. The size of the marker sheet is preselected depending on the distance entered above.

Important:
Ensure high print quality (max. dpi).
The printout must not be scaled!

Marker 3 (< 2.00m) A4 ▼ Print marker

Must be printed on A4.

Fig. 26: Prepare calibration

1 Input field for the distance

- Enter the distance from the orange seal of the device to the object in the input field (1).

- ▷ The [Reset to focus]  button resets the input field to the pre-set distance.
- ▶ Print the marker sheet.
- ▶ Place the marker sheet on the object or on the work plane.
 - ▷ The height difference between the object plane and the working plane can be compensated for on the [Calibration Z offset] page.

Print marker sheet

The marker sheet is used to calibrate the device. Before printing the marker sheet, make sure that the original scaling and no printer economy modes are activated. Otherwise, the calibration will be inaccurate.

Print marker sheet

- ▶ Go to the [Prepare calibration] step.

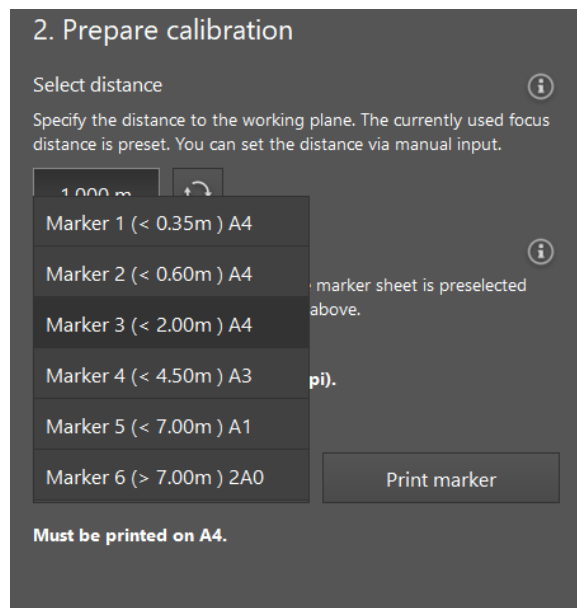


Fig. 27: List of available marker sheets

- ▶ Select a marker sheet from the list.
 - ▷ The length in brackets indicates the approximate distance between the device and the object. The size of the marker sheet increases with the distance. With a distance of "> 5,20 m", the marker sheet is printed in DIN 2A0 format (1189 x 1682 mm).
- ▶ Select the [Print markers] button.
 - ▷ The marker sheet is displayed.
- ▶ Select the [Print] button.

Set scaling

- ▶ Select the printer.
- ▶ Select the [Advanced] tab.
- ▶ In the [Page scaling] area, select [Use original page sizes] .
 - ▷ The marker sheet must be printed in the original scale.

Deactivating the economy modes of the printer

- ▶ Select the [General] tab.
- ▶ Select the [Settings] button.
- ▶ Deactivate all economy modes for colour, toner, etc.

- ▷ The marker sheet must be printed in the best quality.
- ▶ Select the [OK] button.
- ▶ Select the [Print] button.
- ▷ The marker sheet is printed in the original scale and without economy modes.

Check printed marker sheet

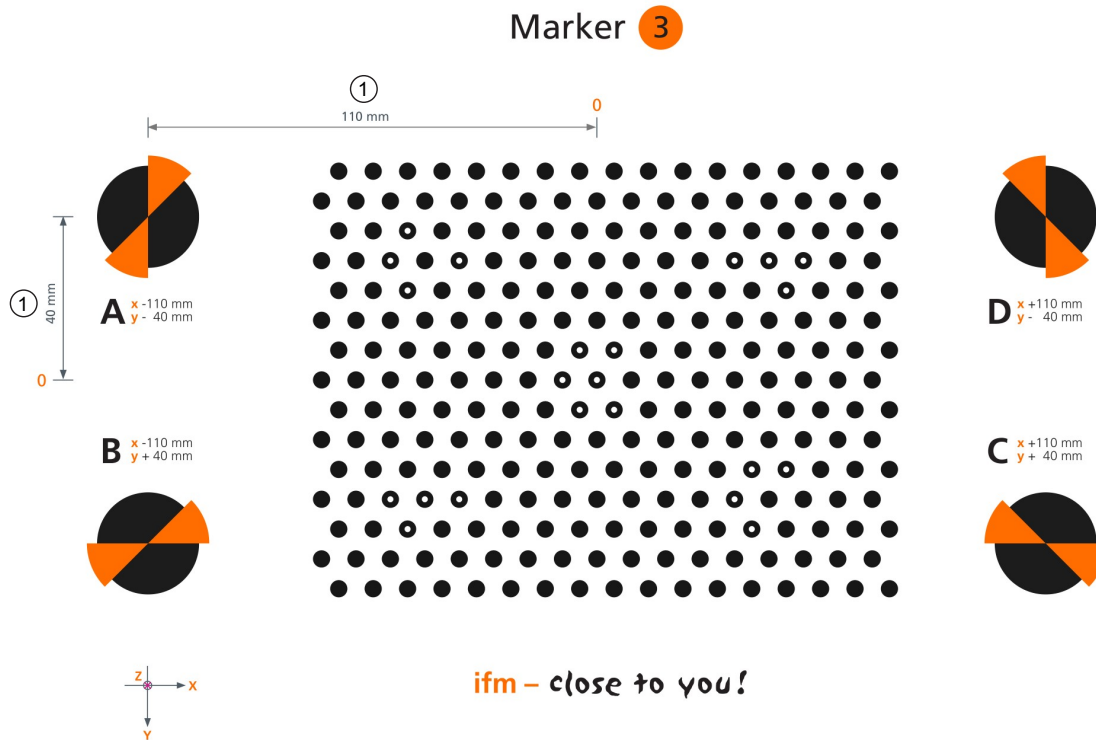


Fig. 28: Printed marker sheet with scales

1 Scale

There are scales (1) on the marker sheet to check the scaling. The marker sheet must be printed in the original scale.

- ▶ Use a ruler to check the scales on the X and Y axes of the marker sheet.

3. Image settings focus

On the [Image settings focus] page, the focus of the device is set automatically or manually.

The focus describes the distance between

- the lens of the device (orange marking on the device) and
- the object that should be in focus.

The plane perpendicular to the optical axis is called the focal plane. The device automatically finds the optimal focal plane.

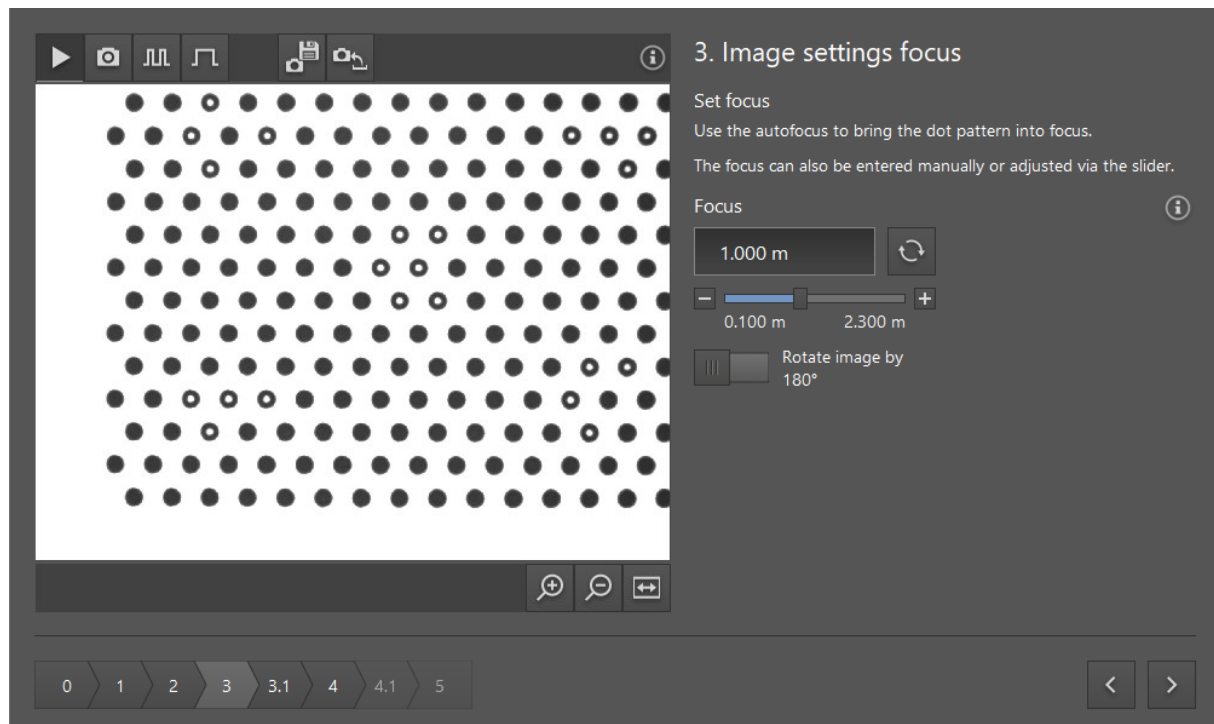


Fig. 29: The live image shows a section of the marker sheet.

Adjust focus

- ▶ Place the object in the field of view of the device.
- ▶ Place the marker sheet on the object.
- ▶ Select the [Autofocus] button: 
 - ▷ The focus is adjusted automatically.
- ▶ Alternatively, adjust the focus manually with the buttons  /  or the slider.

Rotate image

The live image can be rotated by 180°.

- ▶ Select the [Rotate image by 180°] button.



The live image can be adjusted using the mouse:

- ▶ Use the mouse wheel to enlarge or reduce the live image.
- ▶ Move the enlarged live image with the mouse pointer.

3.1 Image settings exposure

On the [Image settings exposure] page, the contrast of the object can be set. High contrast makes it easier for the device to recognise structures.

The exposure of the object can be set automatically or manually.

Exposure time

The exposure time sets the amount of time in [μs] for taking a picture.

The exposure time can be set in several ways:

- via the input field,
- via the [Optimise].button ,
- via the slider below the input field,

- Via the buttons  /  next to the slider.

Analogue gain

The [Analogue gain] list sets the gain factor of the analogue signal. The analogue gain is linear to the exposure time. Therefore, with double analogue gain, half the exposure time can be used. Especially dynamic applications benefit from the short exposure times.



The analogue gain slightly increases the image noise.

Illumination segments

The [Illumination segments] set the internal illumination of the device.

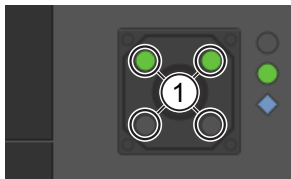


Fig. 30: Setting the internal illumination

1 Click-activated LED

Clicking on an LED (1) in the [Internal illumination graphic] activates or deactivates the LED.

The status of an LED is displayed in colour:

Colour	State
grey	The LED is deactivated.
green	The LED is activated.
blue	The LED with polarisation filter is activated.



The polarisation filters and the [Colour of the internal illumination] buttons are only available for the RGB-W units O2D50x, O2D51x and O2D54x.

The infrared units O2D52x, O2D53x and O2D55x are not equipped with polarisation filter and LED colours.



In case of unwanted reflections, use the LEDs with polarisation filters.

Colour of the internal illumination

The [Colour of the internal illumination] buttons are used to set the LED colour of the internal illumination.

► Depending on the colour of the object, set a suitable LED colour.

▷ A matching LED colour creates a great contrast with the measuring tool.

The following LED colours are available:

- [white]
- [green]
- [blue]
- [red]

Illumination

The [Illumination] list describes the types of illumination. The following quality parameters are available:

Illumination	Description
[None]	Deactivates the internal and external illumination.

Illumination	Description
[Internal]	Activates the internal illumination of the device. The graphic below the list [Illumination segments] shows the status of the internal illumination. When internal illumination is active, individual segments are deactivated and activated by clicking in the graphic.
[External]	Activates the external illumination. The external illumination unit is connected to switching output OUT5 of the device. In addition, the external illumination has to be activated. The external illumination unit is active as long as switching output is in the " high " state. The external illumination unit and the OUT5 output are only available for 8-pole devices.
[Both]	Activates the internal and external illumination.

4. Robot coordinates

On the [Robot coordinates] page, the coordinate transformation between the machine and robot is set. For the coordinate transformation, the 4 marking points on the marker sheet are approached with the tool tip.



Do not move the marker sheet while approaching the 4 marking points.

- ▶ Use adhesive tape to stick the marker sheet to the object.
- ▶ Approach the 4 marking points A, B, C and D on the marker sheet one after the other with the tool tip of the robot (Tool Centre Point).
- ▶ Position the tool tip exactly in the centre of the marking point.
 - ▷ The more accurate the positioning, the more accurate the calibration.



Fig. 31: Marking point

- ▶ Enter the approached positions of the marking points A to D in the Robot coordinates table.

4. Robot coordinates

Approaching marker points

Use the robot's Tool Center Point to move to the four marker points A to D on the marker sheet one after the other. Enter the values of the approached positions in the table below.

Position the tool tip here

Important:
The marker sheet must not be moved between measurements.

	A	B	C	D
X	0.440 m	0.000 m	0.000 m	0.000 m
Y	-0.380 m	0.000 m	0.000 m	0.000 m
Z	-0.050 m	0.000 m	0.000 m	0.000 m

Teach Use marker 3 coordinates

0 1 2 3 3.1 4 5 5.1 6

Fig. 32: The table contains exemplary coordinates for marker point A.

► Click on the [Teach] button.

- ▷ After clicking the button, the fine calibration to the working plane and the relative rotation to the robot are taught. The dot pattern in the centre of the marker sheet is used for teaching.

Using marker coordinates

The [Use marker coordinates] button transfers the distance values starting from the central point pattern of the marker sheet. So the base of the robot is assumed to be in the middle of the marker sheet.

If the translatory values in X and Y as well as the rotatory value around Z are known (for example in the case of a tool carrier), the coordinates can be inherited from the marker sheet.

After clicking the [Use marker coordinates] button, the values of the marker sheet for X, Y and Z coordinates are transferred to the table.

5. Sensor calibration

On the [Sensor calibration] page, the marker sheet is used to calibrate the device:

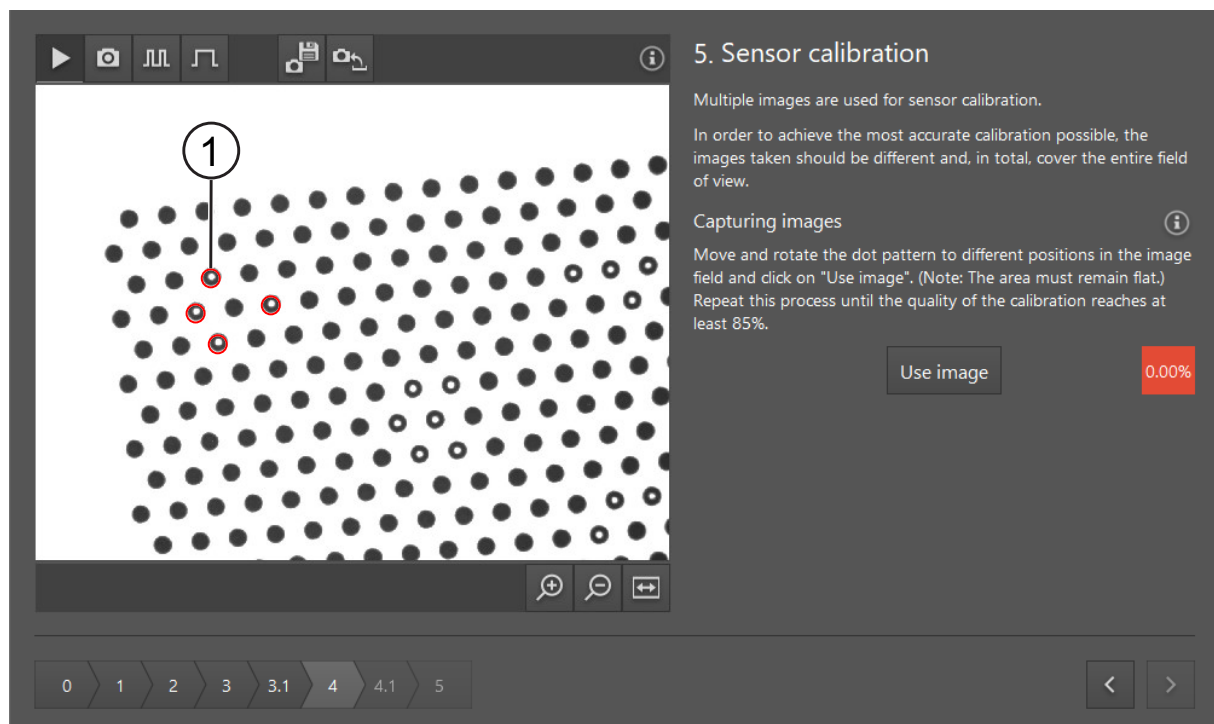


Fig. 33: Marker sheet placed underneath the device

1 Dot pattern (marked red)



Do not subject the device to movement, shocks or vibrations during calibration.

- Place the object in the field of view of the device.
- Place the marker sheet on the working plane.
 - ▷ One of the dot patterns (1) must be in the field of view of the device, lying flat.
- Click on the [Use image] button.
 - ▷ The [percent indication] next to the button shows the quality of the calibration in percent. The live image used is displayed below the button.
- Move and rotate the marker sheet as required.
 - ▷ One of the dot patterns (1) must be in the field of view of the device, lying flat.
- Click on the [Use image] button.
- Repeat the last two instructions until the [percent indication] shows a value of "> 85 %".

- ▷ Higher percentage values than "> 85 %" increase the quality of the calibration. Up to 16 images can be used.

Delete used live images

The live images used can negatively influence the calibration if they are blurred, for example.

Deleting a live image:

- ▶ Select the live image with the buttons < and >.
- ▶ Delete the selected live image with the  button.
- ▶ Alternatively, use the [Delete all] button to delete all live images used.

5.1 Calibration of the Z offset

On the [Calibration Z offset] page, the difference between the calibration plane and the working plane is compensated. Ideally, the calibration plane corresponds to the working plane. If this is the case, the [Calibration Z offset] page can be skipped.

The [Calibration Z offset] page is necessary if the marker sheet was not directly on the object in the [Sensor calibration] step. This happens when the calibration plane (marker sheet) is not equal to the working plane (object).

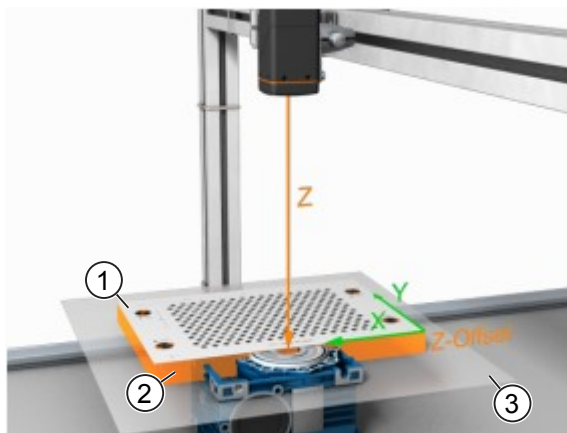


Fig. 34: Z offset

1 Calibration plane with marker sheet
3 Working plane

2 Z offset (orange area)

For certain applications, the calibration level cannot be at the same level as the working plane. For example, when

- a hole within a workpiece carrier is to be measured,
- the object to be measured protrudes from the calibration plane.

Setting the Z offset

The sign of the [Z offset] indicates whether the calibration plane with the marker sheet is in front of or behind the working plane.

Setting the [Z offset]:

- ▶ Activate the [Z offset] button.

When the calibration plane with the marker sheet is above the working plane:

- ▶ Enter a positive [Z offset] in the input field.

When the calibration plane with the marker sheet is below the working plane:

- ▶ Enter a negative [Z offset] in the input field.



Large values for [Z offset] degrade the accuracy of the calibration.

6. Test

The [Test] page displays the result of the calibration. In addition, the calibration can be tested.

Calibration details

The [Calibration details] tab shows the result of the calibration:

- Number of images [max. 16 images]
- Quality of calibration [%]
- Average conversion factor [px] in [mm]

Test measurement

The [Test measurement] tab provides tools for testing the calibration:

Button	Description
	Draws a line in the live image. The table contains measurement results for the drawn line: • Start point (x/y) [mm] • End point (x/y) [mm] • Length [mm]
	Draws a rectangle in the live image. The table contains measurement results for the drawn rectangle: • Width / height [mm] • Range [mm²]
	Draws a circle in the live image. The table contains measurement results for the drawn circle: • Centre point [mm] • Radius [mm] • Range [mm²]

10.1.6 Reference image

The button [Store reference image] saves the current live image as a reference image. The reference image is used as an overlay in the area [Monitor]. [Monitor \(→ 21\)](#)

The reference picture is used to help align the device. Examples:

- The orientation of the device changes and the original position is to be restored.
- The device is replaced and the new device is to be aligned in the same way.

10.1.7 Exposure time

The input field [Exposure time] sets the period in [μs] for the image capture.

The exposure time can be set in 3 ways:

- via the input field,
- via the [Optimise].button ,
- via the slider below the input field,
- Via the buttons  /  next to the slider.

10.1.8 Analogue gain

The [Analogue gain] list sets the gain factor of the analogue signal. The analogue gain is linear to the exposure time. Therefore, with double analogue gain, half the exposure time can be used. Especially dynamic applications benefit from the short exposure times.



The analogue gain slightly increases the image noise.

10.1.9 Illumination

The [Illumination] list sets the internal and external illumination. The following illuminations are available:

Illumination	Description
[None]	Deactivates both internal and external illumination.
[Internal]	Activates the internal illumination of the device. The graphic below the [Illumination] list shows the status of the internal illumination. When internal illumination is active, individual segments are deactivated and activated by clicking in the graphic.
[External]	Activates the external illumination. The external illumination unit is connected to the device's switching output. In addition, the external illumination has to be activated. (→ Interfacing □ 146) The illumination unit is active as long as the switching output is in the " high " state.
[Both]	Activates internal and external illumination.



Which switching output the external illumination is connected to is specified in the operating instructions for the device.

10.1.10 Illumination of internal segments

The [Illumination internal segments] graphic sets the internal illumination of the device. The internal illumination is activated with the [Illumination] list. (→ [Illumination □ 62](#))

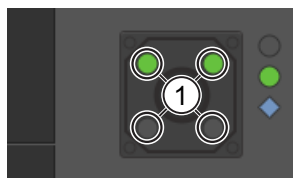


Fig. 35: Setting the internal illumination

1 Click-activated LED

Clicking on an LED (1) in the [Illumination internal segments] graphic activates or deactivates the LED. The status of an LED is displayed by its colour:

Colour	State
Grey	The LED is deactivated.
Green	The LED is activated.
Blue	The LED with polarisation filter is activated.



LEDs with polarisation filter are only available for devices with polarisation filter: www.ifm.com



In case of unwanted reflections, use the LEDs with polarisation filters.

Colour of the internal illumination

The [Colour of the internal illumination] buttons are used to set the LED colour of the internal illumination.

► Depending on the colour of the object, set a suitable LED colour.

▷ A matching LED colour creates a great contrast with the measuring tool.

The following LED colours are available:

- [white]
- [green]
- [blue]
- [red]



The [Colour of the internal illumination] buttons are only available for the RGB-W devices:
www.ifm.com



The focus of the device depends on the LED colour.

- ▶ After changing the LED colour, readjust the focus. (→ [Selection](#) 34)



The focus setting always applies to the application. This means that all images in the application use the same focus setting.

- ▷ If different LED colours are used:
 - ▶ create a separate application for each LED colour or
 - ▶ set a focus that provides an acceptable result for all images.

10.1.11 Filter type

The list [Filter type] sets filters for the image with which the representation is optimised. The following filters are available:

Filter type	Description
[No filter]	Deactivates the filter.
[Enlarge dark pixels]	Enlarges dark pixel groups and decreases light pixel gaps.
[Enlarge light pixels]	Enlarges light pixel groups and decreases dark pixel gaps.
[Smoothing]	Reduces noise and spurious pixels by first sorting the neighbouring pixel values in numerical order. Subsequently, the respective pixel value is replaced by the mean pixel value. The [Median] filter type is more robust than the [Mean value] filter type. Individual non-representative pixel values influence the median value only insignificantly.
[Mean value]	Reduces noise and spurious pixels by replacing each pixel value with the average value of the neighbouring pixel values. This means that only the pixel values that are representative of their surroundings will be retained.

10.1.12 Filter strength

The list [Filter strength] sets the intensity of the selected filter type. The following filter intensities are available:

Filter strength	Description
[1 (weak)]	Uses a weak intensity for the selected filter type (preset).
[2]	...
[3]	...
[4]	...
[5 (strong)]	Uses a strong intensity for the selected filter type.

10.1.13 Invert image

The [Invert image] checkbox inverts the brightness values of the selected image:

black/white becomes white/black.



Inversion of the image is necessary with inverted 1D barcodes, e.g. for lasered metal surfaces.

10.1.14 Image quality check

The checkbox [Enabled] activates the image quality check. The image quality check checks whether the measured values received from the camera are within the permitted value range. The following measured values are recorded:

- Sharpness
- Mean brightness
- Underexposed area (all pixels with grey value < 10)
- Overexposed area (all pixels with grey value > 245)

If a measured value is outside the permitted value range, this can be signalled via the process interface.

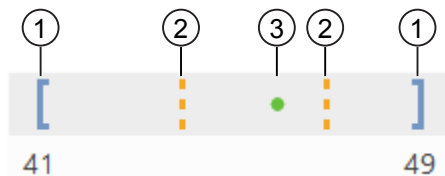


Fig. 36: Image quality check

- 1 Permitted value range
3 Current measured value

2 Min/max value

Permitted value range

The permitted value range is indicated by the blue square brackets. The brackets can be moved within the graphic using the mouse. If the measured value (green dot) is outside the permitted value range (blue brackets), this is indicated by an exclamation mark: . In addition, this can be signalled via the process interface. For this, the process interface must be configured accordingly via the function "Interface". ([→ Interfaces](#)  146)

Min/max value

The min/max values are indicated by the orange dashed lines. The lines mark the min/max values of the taught measured values. The lines overlap if the measured value has not yet changed.

The button [Reset statistics] discards the taught min/max values.

The button [Teach] adopts the current min/max values (orange dashed lines) as the default for the permitted value range (blue square brackets).

Current measured value

The current measured value is indicated by the green dot. The min/max values are indicated by the orange dashed lines.

Operating elements

The area [Image quality check] contains the following operating elements:

Operating element	Type	Description
[Activated]	Checkbox	Activates the image quality check.
[Reset statistics]	Button	Resets the min/max values.
[Sharpness]	Blue square brackets	Sets the permitted value range (blue brackets). The brackets can be moved within the graphic.

Operating element	Type	Description
[Teach]	Button	Adopts the min/max values (orange dashed lines) as the default for the permitted value range (blue square brackets).
[Mean brightness]	Blue square brackets	Sets the permitted value range. The blue brackets can be moved within the graphic.
[Teach]	Button	Adopts the min/max values (orange dashed lines) as the default for the permitted value range (blue square brackets).
[Underexposed area]	Blue square brackets	Sets the permitted value range. The blue brackets can be moved within the graphic.
[Teach]	Button	Adopts the min/max values (orange dashed lines) as the default for the permitted value range (blue square brackets).
[Overexposed area]	Blue square brackets	Sets the permitted value range. The blue brackets can be moved within the graphic.
[Teach]	Button	Adopts the min/max values (orange dashed lines) as the default for the permitted value range (blue square brackets).

10.2 Models

The [Models] function sets the codes, BLOBs and contours to be detected. A model is the taught-in “good” condition of one or more codes, BLOBs and contours. Up to 10 models can be added.

The device captures the image of a test part and compares it with the taught-in codes, BLOBs and contours of the added models. Depending on the degree of agreement, a model is considered to have been found.

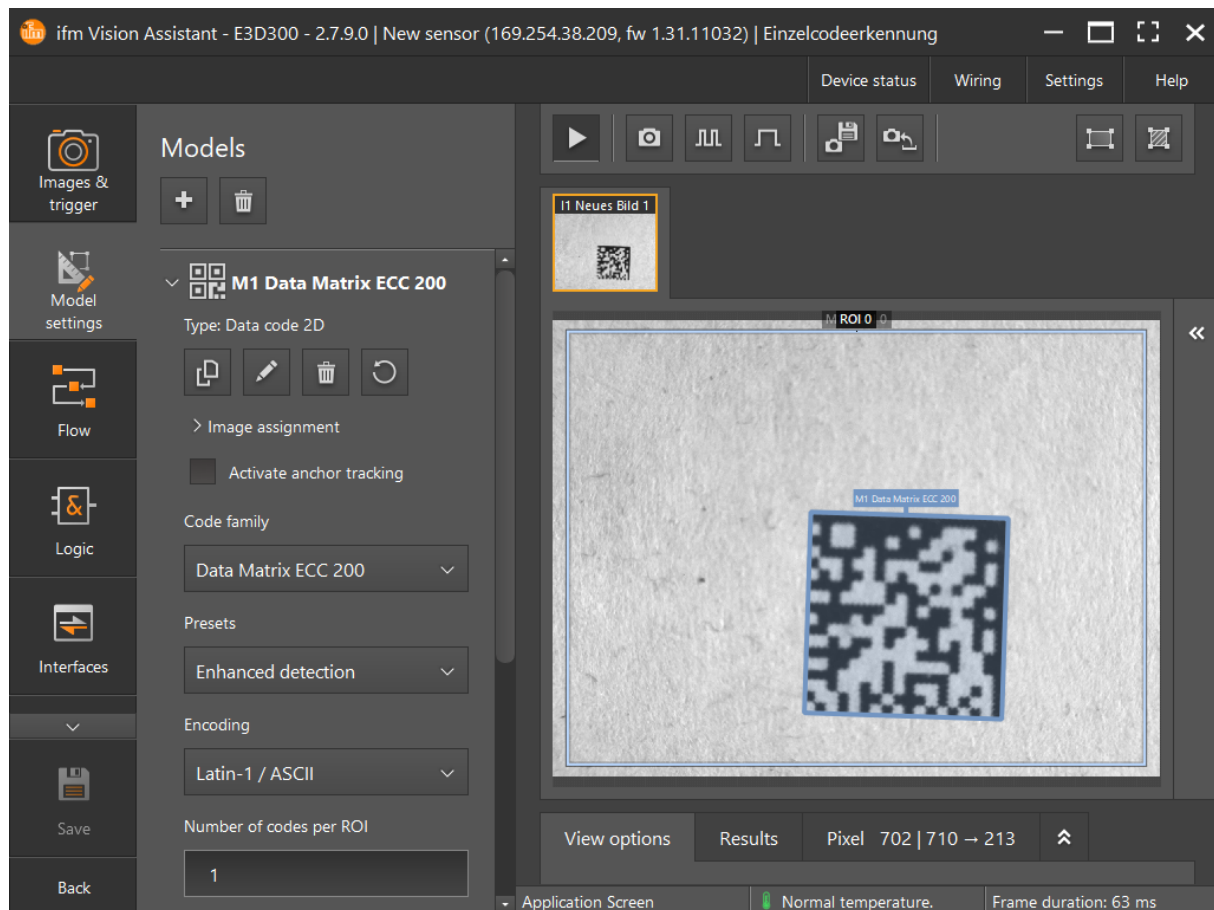


Fig. 37: [Models] function

The [Models] function contains the following operating elements:

Operating element	Name	Description
	Create new model	Adds a new model. (→ Add new model 66)
	Delete all models	Deletes all models. The models are irrevocably deleted.

“Model name” area:

Operating element	Name	Description
[Type]	Type	Indicates the code type of the model. The code type is set when the model is created.
	Copy model	Copies the model and changes to the new model.
	Rename model	Renames the model.
	Delete model	Deletes the model.
	Return to the default values	Resets all settings to the default values.
[Image assignment] [I1 New image 1]	Image assignment	Assigns the model to the selected images.

10.2.1 Add new model

The [Add new model] button adds a new model. A model has to be added to detect codes. The settings for detection of codes, BLOBs and contours are stored in the model.



Up to 32 applications can be added. An application contains up to 10 models. ([→ Models](#) [□ 65](#))

After the [Add new model] button has been clicked, the following buttons are displayed:

Model type	Description
[Automatic code search]	Starts the [Create mode] wizard. The wizard detects 1D and 2D code families and creates a matching model. The wizard does not detect the following code families: - PharmaCode - MSI
[Bar code 1D]	Creates a model for recognising a 1D barcode. (→ Bar code 1D □ 67)
[Data code 2D]	Creates a model for recognising a 2D data code. (→ Data code 2D □ 77)
[OCR]	creates a model for recognising text content. (→ OCR ; □ 88) OCR stands for Optical Character Recognition and refers to the recognition of text in captured images. The text can then be processed further. The text recognition can be adjusted in many ways. This increases the processing speed and reduces possible sources of error.
[BLOB analysis]	Creates a model that recognises objects via BLOB analysis. (→ BLOB analysis □ 95) The number, arrangement and brightness of the pixels of an object are analysed. [BLOB analysis] is particularly suitable for applications in which the objects vary in shape, size or colour value.
[Contour detection]	Creates a model that recognises objects via contour detection. (→ Contour detection □ 104) The contours of an object are analysed. [Contour detection] is particularly suitable for applications where the shape of the objects is repeated.
[Contour anchor]	Creates a model to recognise a unique contour. The contour will be recognised regardless of its position in the image. (→ Contour anchor □ 112)
[Bar code 1D anchor]	Creates a model for recognising a 1D barcode. The 1D barcode is recognised regardless of its position in the image. (→ 1D barcode anchor tracking □ 115)
[Data code 2D anchor]	Creates a model for recognising a 2D data code. The 2D data code will be recognised regardless of its position in the image. (→ 2D data code anchor tracking □ 115)

10.2.2 Bar code 1D

The [1D Barcode] model contains settings for recognising a 1D barcode.

The model contains the following operating elements:

Operating element	Type	Description
[Activate anchor tracking]	Checkbox	Activates anchor tracking. The 1D barcode is recognised regardless of its position in the image.
[Code family]	List	Sets the code family. (→ Code family □ 69)
[Encoding]	List	Sets the character encoding. (→ Encoding □ 69)
[Number of codes per ROI group]	Input box	Sets the number of codes per ROI group. (→ Number of codes per ROI group □ 70)

Operating element	Type	Description
[Timeout]	Checkbox	Sets a timeout terminating the search for codes when the time has elapsed. (→ Timeout □ 70)
[Measure ISO quality]	Checkbox	Sets the quality classification according to ISO. (→ Measure ISO quality □ 70)
[Check char]	List	Evaluates the check character of a barcode. (→ Check char □ 71)

[Optimiation] area:

Operating element	Type	Description
[Minimum contrast]	Input box	Sets the minimum contrast between foreground and background. (→ Minimum contrast □ 72)
[Min code length]	Input box	Sets the minimum code length. (→ Min code length □ 72)
[Quiet zone]	List	Sets the verification of the quiet zones of a code. (→ Quiet zone □ 72)
[Use bar orientation]	Checkbox	Improves the code contours. (→ Use bar orientation □ 73)
[Symbology identifier]	List	Displays FNC1 and ECI characters in codes. (→ Symbology identifier □ 73)

[Advanced] area:

Operating element	Type	Description
[Orientation]	Input box	Sets the orientation of the code. (→ Orientation □ 74)
[Orientation tolerance]	Input box	Sets a zone for the orientation in which the code is detected. (→ Orientation tolerance □ 74)
[Number of scanlines]	Input box	Sets the number of scanlines for the detection of a code. (→ Number of scanlines □ 74)
[Majority voting]	Checkbox	Sets the majority voting for the scanlines of single-line barcodes. (→ Majority voting □ 75)
[Merge scanlines]	Checkbox	Sets merging of scanlines of single-line barcodes. (→ Merge scanlines □ 75)
[Minimum identical scanlines]	Input box	Sets the minimum number of successfully read scanlines. (→ Minimum identical scanlines □ 75)
[Start/Stop tolerance]	List	Sets the tolerance for start and stop patterns. (→ Start/Stop tolerance □ 76)
[Element size variable]	Checkbox	Activates the compensation of the smallest element sizes of barcodes. (→ Element size variable □ 76)

[Size restriction area]:

Operating element	Type	Description
[Barcode height min]	List	Sets the minimum barcode height. (→ Barcode height min □ 76)
[Barcode width min]	List	Sets the minimum barcode width. (→ Barcode width min □ 76)

[ROI size check] area:

Operating element	Type	Description
[Activated]	Checkbox	Warns if the code moves further out of the ROI with each trigger. (→ ROI size check p 76)

10.2.2.1 Code family

The list [Code family] sets the code family. The following code families are available for a 1D barcode:

Code families for 1D barcodes
2/5 Industrial
2/5 Interlaced
Codabar
Code 128
Code 39
Code 93
EAN-13 Add-On 2
EAN-13 Add-On 5
EAN-13
EAN-8 Add-On 2
EAN-8 Add-On 5
EAN-8
GS1 DataBar Expanded Stacked
GS1 DataBar Expanded
GS1 DataBar Limited
GS1 DataBar Omnidir
GS1 DataBar Stacked Omnidir
GS1 DataBar Stacked
GS1 DataBar Truncated
GS1-128
MSI
PharmaCode
UPC-A Add-On 2
UPC-A Add-On 5
UPC-A
UPC-E Add-On 2
UPC-E Add-On 5
UPC-E

10.2.2.2 Encoding

The list [Encoding] sets the character encoding of the code contents.

The list [Encoding] contains the following trigger modes:

Setting	Description
[Latin-1 / ASCII]	Decodes the characters according to ISO 8859-1.
[UTF-8]	Decodes the characters according to UTF-8.
[UTF-16]	Decodes the characters according to UTF-16.

10.2.2.3 Number of codes per ROI group

The input field [Number of codes per ROI] sets the number of codes to be detected for an ROI group.
[Creating a region of interest \(ROI\) \(→ 23\)](#)



A search is made for the set number of codes. If more or fewer codes are found, the model is considered “failed” in the overall statistics. ([→ Monitor 21](#))

Example

[Number of codes per ROI] = 2

- If 1 ROI exists: 2 codes are searched in this one ROI.
- If 2 ungrouped ROIs exist (each ROI counts as ROI group): 2 codes are searched in each ROI. Altogether, 4 codes are searched.
- If 2 grouped ROIs exist (1 ROI group): 2 codes are searched in this one ROI group. Altogether, 2 codes are searched. The codes may
 - both be contained in the first ROI,
 - both be contained in the second ROI,
 - 1 code each contained in each ROI.



A large number of codes to be detected increases the evaluation time of the device.

10.2.2.4 Timeout

The checkbox [Timeout] sets a timeout terminating the search for codes when the time has elapsed. For example, a maximum decoding time can be ensured with the timeout.

10.2.2.5 Measure ISO quality

The checkbox [Measure ISO quality] evaluates the code quality of 1D code types following ISO/IEC 15416. The evaluation of the code quality is available for the following 1D code types:

- 2/5 Interleaved, 2/5 Industrial
- Code 39, Code 93, Code 128
- EAN8, EAN8 Add-On 2, EAN8 Add-On 5
- EAN13, EAN13 Add-On 2, EAN13 Add-On 5
- UPC-A, UPC-A Add-On 2, UPC-A Add-On 5
- UPC-E, UPC-E Add-On 2, UPC-E Add-On 5
- GS1 Databar
- GS1-128
- MSI Barcode
- Codabar
- Pharmacode

Set the ISO quality parameters:

► Activate the checkbox [Measure ISO quality].

▷ The selection field [User-defined quality grade] is displayed. The contained quality parameters are deselected by clicking [x] and added by clicking [+].

The following quality parameters are available:

Quality parameter	Description
[Additional Requirements]	Additional requirements

Quality parameter	Description
[Decodability]	Decodability
[Decode]	Decode
[Defects]	Defects
[Minimal Edge Contrast]	Minimum edge contrast
[Minimal Reflectance]	Minimum reflectance
[Modulation]	Modulation
[Symbol Contrast]	Symbol contrast

In addition, the following quality parameters are available for GS1 Databar codes:

Quality parameter [Composite ...]	Description
[Codeword Yield]	Codeword yield
[Decodability]	Decodability
[Decode]	Decode
[Defects]	Defects
[Modulation]	Modulation
[Unused Error Correction]	Unused error correction
[Composite RAP ...]	Description
[Contrast]	Contrast
[Decodability]	Decodability
[Defects]	Defects
[Minimal Edge Contrast]	Minimum edge contrast
[Minimal Reflectance]	Minimum reflectance
[Modulation]	Modulation
[Overall]	Overall quality



The function increases the evaluation time of the device.

10.2.2.6 Check char

The list [Check char] evaluates the check character of a barcode. The check character is used to check whether the user data of the barcode has been read correctly.

Some code types contain a check character by default. For these code types, the content of the check character cannot be read.

For code types such as **Code 39**, **Codabar**, **2/5 Industrial** and **2/5 Interleaved**, the list [Check char] is used to set how the check character is handled.

The list [Check char] contains the following settings:

Setting	Description
[Absent]	The barcode does not contain a check character. The complete content of the barcode is interpreted as user data. Preset: [Absent].
[Present]	The barcode contains a check character. The correctness of the user data is checked using the check character. If the checksum of the user data does not correspond to the check character, the barcode is classified as unreadable and is not provided as a result. The content of the check character is not provided.

Setting	Description
[Preserved]	The barcode contains a check character. The correctness of the user data is checked using the check character. If the checksum of the user data does not correspond to the check character, the barcode is classified as unreadable and is not provided as a result. The content of the check character is provided.

10.2.2.7 Minimum contrast

The input field [Contrast min] sets the minimum contrast between foreground and background. If a code has a lower contrast, it is not detected.

Preset: 0.

10.2.2.8 Min code length

The input field [Min. code length] sets the minimum code length. If a code is of shorter code length, it is not detected.

Preset: 0.



For the code types 2/5 Industrial and 2/5 Interleaved, the value 3 is preset.

Code lengths <3 lead to reading errors with these code types: The code types are erroneously detected in texts and samples.

10.2.2.9 Quiet zone

The list [Quiet zone] sets the verification of quiet zones of a code. The quiet zone is at least of the width of the narrowest bar of the barcode.

The list [Quiet zone] contains the following settings:

Setting	Description
[False]	Detects the codes when the quiet zones do not meet the specified minimum widths. The setting can lead to the detection of small codes within a large code.
[True]	Detects the codes when the quiet zones do meet the specified minimum widths. The following table contains the specified minimum widths as a multiple of a module width.
[Tolerant]	The codes are detected if a limited number of corners occur in the quiet zones. Maximum 1 corner per 4 module widths is allowed.
[Custom]	A factor is entered in the input field. The factor defines the minimum width of the quiet zones. With factor 1, codes are detected if the quiet zone is at least 1 x the width of the narrowest bar of the barcode. The following table contains the specified minimum widths as a multiple of a module width. Factor 2 requires double the minimum widths.

The following quiet zones apply to 1D barcodes:

Code families for 1D barcodes	Minimum width left quiet zone	Minimum width right quiet zone
2/5 Industrial	10	10
2/5 Interlaced	10	10
Codabar	10	10
Code 128	10	10
Code 39	10	10

Code families for 1D barcodes	Minimum width left quiet zone	Minimum width right quiet zone
Code 93	10	10
EAN-13 Add-On 2	7	5
EAN-13 Add-On 5	7	5
EAN-13	11	7
EAN-8 Add-On 2	7	5
EAN-8 Add-On 5	7	5
EAN-8	7	7
GS1 DataBar Expanded Stacked	1	1
GS1 DataBar Expanded	1	1
GS1 DataBar Limited	1	1
GS1 DataBar Omnidir	1	1
GS1 DataBar Stacked Omnidir	1	1
GS1 DataBar Stacked	1	1
GS1 DataBar Truncated	1	1
GS1-128	10	10
MSI	10	10
PharmaCode	5	5
UPC-A Add-On 2	9	5
UPC-A Add-On 5	9	5
UPC-A	9	9
UPC-E Add-On 2	9	5
UPC-E Add-On 5	9	5
UPC-E	9	7

10.2.2.10 Use bar orientation

The checkbox [Use bar orientation] improves code contours. This allows for more stable results when rotating the code, which is especially important for position tracking.

10.2.2.11 Symbology identifier

The list [Symbology identifier] shows whether the code contains an FNC1 and ECI character.

The list [Symbology identifier] contains the following settings:

Setting	Description
[Off]	Deactivates the output of the symbology identifier.
[Only mandatory]	Activates the output of required symbology identifiers.

FNC1 character

The FNC1 character (Function 1 Character) indicates that the data in the symbol is formatted according to certain industry and application standards.

ECI mark

The ECI (Extended Channel Interpretation) protocol indicates that the data is formatted with a 6-digit code according to specific code tables. This can be an international character set, for example. In the output stream, the data is encoded as \nnnnnn. If the symbol contains one or more ECI codes, all backslashes in the normal data stream \ (ASCII code 92) are doubled.

Only the actual value according to the specifications for **Code 128** and **GS1-128** is returned as symbology identifier.

If necessary, the symbology identifier, which is composed of the prefix and the value "m", must be manually prefixed to the decoded string (usually only if $m > 1$).

Code	Prefix
Code 128	]C0
GS1-128	]C1

10.2.2.12 Orientation

The input field [Orientation] sets the orientation of the code.

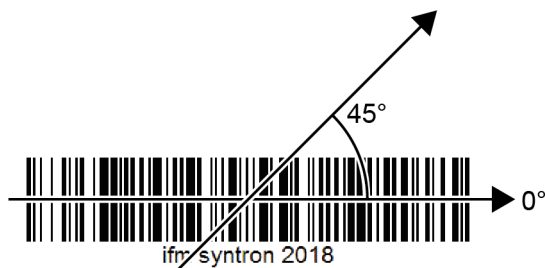


Fig. 38: Orientation of the code

A code is detected if the average orientation of its bars corresponds to the value [Orientation].

Preset: 0° .

The value range is $-90^\circ \dots 90^\circ$.



For **PharmaCode**, the value range is: $-180^\circ \dots 180^\circ$.



The input field [Orientation tolerance] extends the individual value [Orientation] to a range. [Orientation tolerance](#) (→ [74](#))

10.2.2.13 Orientation tolerance

The input field [Orientation tolerance] sets a tolerance for the function [Orientation]. The code is detected if the average orientation of its bars is in the range [Orientation tolerance].

Preset: 90° .

The value range is $0^\circ \dots 90^\circ$.



The function increases the evaluation time of the device.



With the maximum value 90° , all codes are detected, independently of the orientation.

10.2.2.14 Number of scanlines

The input field [Num scanlines] sets the number of scanlines for detecting a code. The function reacts differently for single-row and stacked barcodes.

With a single-row barcode, scanning stops as soon as a barcode has been detected. A single-row barcode of poor quality requires more scanlines than a code of good quality. For a code of average quality, a value of $2 \dots 5$ is sufficient. The value must be increased when the code is no longer detected.

With a stacked barcode, all scanlines are evaluated. A stacked barcode is composed of several rows (maximum 11 rows). The number of scanlines can be reduced if a low number of rows is expected.

With the preset value **0**, a certain number of scanlines is used depending on the code type:

Code type	Description
Single-row barcode: Code 128, EAN 13, GS1 DataBar Limited etc.	10
Stacked barcode: GS1 DataBar Stacked (Omnidirectional)	20
Stacked barcode: GS1 DataBar Expanded Stacked Stacked	55



If an image contains many incorrect code candidates, the evaluation time of the device is reduced with a small value of [Num scanlines].

10.2.2.15 Majority voting

The checkbox [Majority voting] sets the majority voting for scanning single-row barcodes. The function reduces the number of incorrectly detected codes. If the function is activated, the result detected by the majority of all scanlines is used as overall result.



The function increases the evaluation time of the device.

10.2.2.16 Merge scanlines

The checkbox [Merge scanlines] sets merging of scanlines in single-row barcodes. If no barcode was detected, scanlines are merged. A barcode is searched again in the merged scanlines which increases the chance of detection.



The function increases the evaluation time of the device.

10.2.2.17 Minimum identical scanlines

The input field [Min identical scanlines] sets the minimum number of successfully detected scanlines. As soon as the minimum number is reached, the function forwards the result of the scan. The function reduces the probability of erroneously detecting barcodes.

The following applies with the value **0**:

- The contents of a single-row barcode is already transferred with the first successful scanline.
- The contents of a multi-row barcode is transferred when each row of the barcode has been scanned successfully.

The following values are preset:

Code type	Preset
2/5 Industrial	2
2/5 Interleaved	2
Alle anderen Codetypen	0



If [Majority voting] is also activated, the performance of [Min identical scanlines] changes. [Majority voting \(→ 75\)](#)



If [Merge scanlines] is also activated, [Min identical scanlines] sets the number of scanlines with successfully detected edges. [Merge scanlines \(→ 75\)](#)

10.2.2.18 Start/Stop tolerance

The list [Start/Stop tolerance] sets the tolerance of the scanline for the start and stop patterns of codes.

The list [Start/Stop tolerance] contains the following settings:

Setting	Description
High	Detects a code with a higher probability. Poorly readable codes can be misrecognised.
Low	Detects a code with a lower probability. Poorly readable codes are rarely misrecognised.



The list [Start/Stop tolerance] is only available for code types **Code 128** and **GS1-128**.

10.2.2.19 Element size variable

The checkbox [Element size variable] compensates the smallest element sizes. The smallest element sizes of a barcode can vary in size due to perspective-related distortions or distorted surfaces, making the barcode difficult to read. If the checkbox is activated, such distortions are balanced out where possible.



The checkbox [Element size variable] is only available for the following code types: **GS1 DataBar Expanded Stacked**, **GS1 DataBar Expanded** and **GS1 DataBar Limited**.

10.2.2.20 Barcode height min

The list [Barcode height min] sets the minimum barcode height. The barcode height is automatically detected in the default setting. The user-defined setting improves the detection of codes.

The list [Barcode height min] contains the following settings:

Setting	Description
[Automatic]	Automatically sets the barcode height.
[Custom]	Manually sets the barcode height in pixels. The smallest possible value is 8 Pixel.

10.2.2.21 Barcode width min

The list [Barcode width min] sets the minimum barcode width. The barcode width is automatically detected in the default setting. The user-defined setting improves the detection of codes.

The list [Barcode width min] contains the following settings:

Setting	Description
[Automatic]	Automatically sets the barcode width.
[Custom]	Manually sets the barcode width in pixels.

10.2.2.22 ROI size check

The checkbox [Enabled] activates the function [ROI size check]. The function provides a warning if the code moves to the edge of the defined ROI.

The function can be used as a predictive maintenance tool. The results of the function are forwarded to a controller if desired.

Example

Packages, each with a code to be read, move on a belt. If the belt speed or the position of the packages does not match the trigger rate of the device exactly, the packages and thus the codes will move out of the ROI. If the code is completely outside the ROI, it will be no longer read. The function [ROI size check] warns against this.

The function [ROI size check] contains the following input fields:

Input box	Description
[Threshold ROI warning]	If the distance of at least one code contour to the ROI falls below the set value, a warning is issued. If a code is found, the warning area is displayed in colour in the live image.
[Threshold distance to mean position]	A mean value is formed from N read codes and stored as the mean position ($N_{max} = 100$, where N = number of codes read). If the distance of a read code is greater than the set value, a warning is issued. The mean value is reset if a code is not read successfully. The last N positions are displayed in the form of a "track" in the live image.
[Threshold movement score]	If a code continues to move in the same direction in several consecutive images, the probability that it will continue to move in that direction increases. If the probability exceeds the set value, a warning is issued.

10.2.3 Data code 2D

The [Data code 2D] model contains settings for recognising a 2D barcode.

The model contains the following operating elements:

Operating element	Type	Description
[Activate anchor tracking]	Checkbox	Activates anchor tracking. The 2D data code will be recognised regardless of its position in the image.
[Code family]	List	Sets the code family. (→ Code family □ 78)
[Presets]	List	Prepares the model to detect certain codes. (→ Presets □ 79)
[Encoding]	List	Sets the character encoding. (→ Encoding □ 79)
[Number of codes per ROI group]	Input box	Sets the number of codes per ROI group. (→ Number of codes per ROI group □ 79)
[Timeout]	Checkbox	Sets a timeout terminating the search for codes when the time has elapsed. (→ Timeout □ 80)
[Quality grading]	List	Sets the quality grading. (→ Quality grading □ 80)

[Optimisation] area:

Operating element	Type	Description
[Polarity]	List	Sets the polarity of the code to be detected. (→ Polarity □ 83)
[Strict quiet zone]	Checkbox	Sets the behaviour in the event of a fault in the quiet zone of a code. (→ Strict quiet zone □ 83)
[Symbology identifier]	List	Displays FNC1 and ECI characters in codes. (→ Symbology identifier □ 83)

[Advanced] area:

Operating element	Type	Description
[Contrast tolerance]	List	Sets the tolerance to contrast differences for finding codes. (→ Contrast tolerance □ 84)
[Finder pattern tolerance]	List	Sets the behaviour in the event of errors in the finder pattern of the code. (→ Finder pattern tolerance □ 85)
[Module grid]	List	Sets the calculation of the centre of a module. (→ Module grid □ 85)
[Max slant]	Input box	Sets the maximum slant of the L-shaped finder pattern relative to a right angle. (→ Max slant □ 85)
[Mirrored]	List	Sets the detection of mirrored codes. (→ Mirrored □ 86)

[Size restriction area]:

Operating element	Type	Description
[Symbol shape]	List	Restricts the form of the codes to be detected. (→ Symbol shape □ 86)
[Symbol columns min]	Input box	Sets the minimum number of columns for the detection of a code. (→ Symbol columns min □ 86)
[Symbol columns max]	Input box	Sets the maximum number of columns for the detection of a code. (→ Symbol columns max □ 86)
[Symbol rows min]	Input box	Sets the minimum number of rows for the detection of a code. (→ Symbol rows min □ 86)
[Symbol rows max]	Input box	Sets the maximum number of rows for the detection of a code. (→ Symbol rows max □ 87)
[Symbol size min.]	Input box	Sets the minimum number of symbol elements on the X/Y axis for the detection of a code. (→ Symbol size min. □ 87)
[Symbol size max.]	Input box	Sets the maximum number of symbol elements on the X/Y axis for the detection of a code. (→ Symbol size max. □ 87)

[ROI size check] area:

Operating element	Type	Description
[Activated]	Checkbox	Warns if the code moves further out of the ROI with each trigger. (→ ROI size check □ 87)

10.2.3.1 Code family

The [Code family] list sets the code family. The following code families are available for a 2D data code:

Code families for 2D data codes
Data Matrix ECC 200
QR Code
Micro QR Code
PDF417
Aztec Code
DotCode
GS1 DataMatrix

Code families for 2D data codes
GS1 QR Code
GS1 Aztec Code
GS1 DotCode

10.2.3.2 Presets

The list [Presets] prepares the model to detect certain codes.

The list [Presets] contains the following settings:

Setting	Description
[Standard detection]	Sets the fast detection of codes. Codes with a good contrast of a sufficient size are detected.
[Enhanced detection]	Sets the reliable detection of codes. Inverted codes and codes with difficult contrast and size conditions are detected.
[Maximum detection]	Sets the detection of codes with defects or hidden finder patterns. The probability of detecting existing codes increases compared to [Standard detection] and [Enhanced detection].

10.2.3.3 Encoding

The list [Encoding] sets the character encoding of the code contents.

The list [Encoding] contains the following trigger modes:

Setting	Description
[Latin-1 / ASCII]	Decodes the characters according to ISO 8859-1.
[UTF-8]	Decodes the characters according to UTF-8.
[UTF-16]	Decodes the characters according to UTF-16.

10.2.3.4 Number of codes per ROI group

The input field [Number of codes per ROI] sets the number of codes to be detected for an ROI group. [Creating a region of interest \(ROI\) \(→ □ 23\)](#)



A search is made for the set number of codes. If more or fewer codes are found, the model is considered “failed” in the overall statistics. (→ [Monitor □ 21](#))

Example

[Number of codes per ROI] = 2

- If 1 ROI exists: 2 codes are searched in this one ROI.
- If 2 ungrouped ROIs exist (each ROI counts as ROI group): 2 codes are searched in each ROI. Altogether, 4 codes are searched.
- If 2 grouped ROIs exist (1 ROI group): 2 codes are searched in this one ROI group. Altogether, 2 codes are searched. The codes may
 - both be contained in the first ROI,
 - both be contained in the second ROI,
 - 1 code each contained in each ROI.



A large number of codes to be detected increases the evaluation time of the device.

10.2.3.5 Timeout

The checkbox [Timeout] sets a timeout terminating the search for codes when the time has elapsed. For example, a maximum decoding time can be ensured with the timeout.

10.2.3.6 Quality grading

The list [Quality grading] evaluates the code quality of 2D code types.

The list [Quality grading] contains the following settings:

Setting	Description
[None]	No quality grading set.
[ISO quality]	Sets the grading of the quality following ISO/IEC 15415. Then the overall quality can be set.
[AIM / ISO-TR29158 quality]	Sets the grading of the quality following AIM DPM-1-2006. Then the overall quality can be set.
[SEMI T10 quality]	Sets the grading of the quality following SEMI T10. The quality grading [SEMI T10 quality] is only available for the code family Data Matrix ECC200.

Setting the quality grading:

- Select a quality grading from the list [Quality grading].
- ▷ The selection field [User-defined quality grade] is displayed. The contained quality parameters are deselected by clicking [x] and added by clicking [+].



The quality parameters are calculated on the basis of the selected quality grading. The following is required for the standard-compliant quality assessment of the image capture:

- a defined illumination and measurement geometry,
- an adjustment of the image brightness by means of a calibrated code,
- the definition of a measurement device suitable for the application.

ISO quality

The quality grading [ISO quality] evaluates code quality in 5 levels:

Code quality	Description
4	passed, very good, highest quality
3	passed
2	passed
1	passed
0	not passed, lowest quality

The quality grading [ISO quality] contains the following quality parameters:

Quality parameter	Data Matrix ECC 200	QR code	Micro QR Code	PDF417	Aztec code	GS1 Data Matrix	GS1 QR Code	GS1 Aztec Code	Description
Axial non-uniformity	•	•	•	-	•	•	•	•	Ratio of the module size in horizontal and vertical direction.
Contrast	•	•	•	-	•	•	•	•	Contrast of the modules relative to the background.
Modulation	•	•	•	•	•	•	•	•	Uniformity of the light and dark modules.

Quality parameter	Data Matrix ECC 200	QR code	Micro QR Code	PDF417	Aztec code	GS1 Data Matrix	GS1 QR Code	GS1 Aztec Code	Description
Decoding	•	•	•	-	•	•	•	•	Rating "4" if the code can be decoded, otherwise "0".
Fixed pattern damage	•	•	•	-	•	•	•	•	Error rate in the 3 basic elements of the code (finder pattern, alternating pattern and quiet zone).
Format information	-	•	•	-	-	-	•	-	Contains information on error correction and the mask pattern.
Grid non-uniformity	•	•	•	-	•	•	•	•	Orientation of the modules relative to the specific symbol grid.
Print growth	•	•	•	-	•	•	•	•	Ratio dark/light modules in the alternating pattern.
Reflectance	•	•	•	-	•	•	•	•	Assessment of the amplitude between the DataCode modules.
Unused error correction	•	•	•	•	•	•	•	•	Error of the code and share of the available error correction mechanisms to successfully decode the code.
Version information	-	•	•	-	-	-	•	-	Contains information on the version of the QR code.
Codeword yield	-	-	-	•	-	-	-	-	Assessment of the relative number of correctly decoded words.
Decodability	-	-	-	•	-	-	-	-	Assessment of the relative number of correctly decoded words.
Defects	-	-	-	•	-	-	-	-	Assessment of the bar/gap representation of the code.
Start/Stop pattern	-	-	-	•	-	-	-	-	Assessment of the start and stop patterns.
"•": Quality grading available "-": Quality grading not available									

AIM / ISO-TR29158 quality

The quality grading [AIM / ISO-TR29158 quality] contains the following quality parameters:

Quality parameter	Data Matrix ECC 200	QR code	Micro QR Code	PDF417	Aztec code	GS1 Data Matrix	GS1 QR Code	GS1 Aztec Code	Description
Axial non-uniformity	•	•	•	-	•	•	•	•	Ratio of the module size in horizontal and vertical direction.
Cell contrast	•	•	•	-	•	•	•	•	Contrast of the modules relative to the background.
Cell modulation	•	•	•	-	•	•	•	•	Uniformity of the light and dark modules.
Decoding	•	•	•	-	•	•	•	•	Rating "4" if the code can be decoded, otherwise "0".

Quality parameter	Data Matrix ECC 200	QR code	Micro QR Code	PDF417	Aztec code	GS1 Data Matrix	GS1 QR Code	GS1 Aztec Code	Description
Fixed pattern damage	•	•	•	-	•	•	•	•	Error rate in the 3 basic elements of the code (finder pattern, alternating pattern and quiet zone).
Format information	-	•	•	-	-	-	•	-	Contains information on error correction and the mask pattern.
Grid non-uniformity	•	•	•	-	•	•	•	•	Orientation of the modules relative to the specific symbol grid.
Print growth	•	•	•	-	•	•	•	•	Ratio dark/light modules in the alternating pattern.
Reflectance	•	•	•	-	•	•	•	•	Assessment of the amplitude between the DataCode modules.
Unused error correction	•	•	•	-	•	•	•	•	Error of the code and share of the available error correction mechanisms to successfully decode the code.
Version information	-	•	•	-	-	-	•	-	Contains information on the version of the QR code.
“•”: Quality grading available „-”: Quality grading not available									

SEMI T10 quality

The quality grading [SEMI T10 quality] returns the following values:

Value	Description
P1 row	Pixel coordinates of corner 1.
P1 column	Pixel coordinates of corner 1.
P2 row	Pixel coordinates of corner 2.
P2 column	Pixel coordinates of corner 2.
P3 row	Pixel coordinates of corner 3.
P3 column	Pixel coordinates of corner 3.
P4 row	Pixel coordinates of corner 4.
P4 column	Pixel coordinates of corner 4.
Rows	Number of lines [Modules].
Columns	Number of columns [Modules].
Symbol contrast	Contrast between light and dark modules in % related to 255 grey levels.
Symbol contrast SNR	Signal-to-noise ratio of “Symbol contrast”.
Horizontal mark growth	Relative width of dark modules, related to the total width of a light and dark module [%]: $\text{Breite_dunkel} / (\text{Breite_dunkel} + \text{Breite_hell}) * 100$ The optimum value is " 50% " (dark and light modules have the same width). The value increases as the dark modules become wider. The value decreases as the light modules become wider.

Value	Description
Vertical mark growth	Relative height of dark modules, related to the total height of a light and dark module [%]: $\frac{\text{Höhe_dunkel}}{(\text{Höhe_dunkel} + \text{Höhe_hell})} * 100$ The optimum value is " 50% " (dark and light modules have the same height). The value increases as the dark modules become higher. The value decreases as the light modules become higher.
DataMatrix cell width	Average module width [pixels]
DataMatrix cell height	Average module height [pixels]
Horizontal mark misplacement	Shifting of the modules of the "Alternating Pattern" (the alternating light-dark pattern at the top and left edge of the code). Indication in [%] referred to the module width. A value close to zero is ideal.
Vertical mark misplacement	Shifting of the modules of the "Alternating Pattern" (the alternating light-dark pattern at the top and left edge of the code). Indication in [%] referred to the module height. A value close to zero is ideal.
Cell defects	Incorrectly classified symbol pixels [%] (i.e. light instead of dark or vice versa). A value close to zero is ideal.
Finder pattern defects	Incorrectly classified pixel of the finder pattern [%]. A value close to zero is ideal.
Unused error correction	Percentage value of the unused error correction. One value is used per Reed Solomon block. The code size determines how often the value occurs.

10.2.3.7 Polarity

The list [Polarity] sets the polarity of the code to be detected.

The list [Polarity] contains the following settings:

Setting	Description
[Dark on light]	Detects dark codes on a light background.
[Light on dark]	Detects light codes on a dark background.
[Any]	Detects dark codes on a light background and light codes on a dark background.

10.2.3.8 Strict quiet zone

The checkbox [Strict quiet zone] sets the performance in the event of a fault in the quiet zone of a code. The quiet zone is an empty zone framing the code. The quiet zone separates the code from other objects.

If the checkbox [Strict quiet zone] is activated, codes with a damaged quiet zone are not detected. In addition, the erroneous detection of Micro QR Codes within text or QR codes is reduced.



The code type **Aztec Code** does not have a quiet zone.

10.2.3.9 Symbology identifier

The list [Symbology identifier] shows whether the code contains an FNC1 and ECI character.

The list [Symbology identifier] contains the following settings:

Setting	Description
[Off]	Deactivates the output of the symbology identifier.
[Only mandatory]	Activates the output of required symbology identifiers.

FNC1 character

The FNC1 character (Function 1 Character) indicates that the data in the symbol is formatted according to certain industry and application standards.

ECI mark

The ECI (Extended Channel Interpretation) protocol indicates that the data is formatted with a 6-digit code according to specific code tables. This can be an international character set, for example. In the output stream, the data is encoded as \nnnnnn. If the symbol contains one or more ECI codes, all backslashes in the normal data stream \ (ASCII code 92) are doubled.

Only the actual value according to the specifications for Data Matrix-, QR Code, Aztec Code, PDF417 and DotCode is returned as symbology identifier:

```
(
  m∈[0,6] (QR-Code),
  m∈[0,12] (Data Matrix ECC 200 und Aztec Code),
  m∈[0,2] (PDF417) bzw.
  m∈[0,5] (DotCode)
)
```

If necessary, the symbology identifier, which is composed of the prefix and the value `m`, must be manually prefixed to the decoded string (usually only if `m>1`).

Code	Prefix
Data Matrix ECC 200	]d
QR Code	]Q
Aztec Code	]z
PDF417	]L
DotCode	]J
GS1 DataMatrix	]d2
GS1 QR Code	]Q3
GS1 Aztec Code	]z1
GS1 DotCode	]J1



DotCodes are supported from firmware version 1.22.

10.2.3.10 Contrast tolerance

The list [Contrast tolerance] sets the tolerance to contrast differences for code finding. Contrast differences are, for example, glare or reflections.



The list [Contrast tolerance] is only available for the code family Data Matrix ECC200.

The list [Contrast tolerance] contains the following settings:

Setting	Description
[Low]	Sets the tolerance of code finding with contrast differences to low. Under normal conditions, contrast differences are detected. This setting is suited for most applications. The setting has almost no influence on the evaluation time.
[High]	Sets the tolerance of code finding with contrast differences to high. The setting has a significant influence on the evaluation time.

Setting	Description
[Any]	Sets the tolerance of code finding with contrast differences based on an algorithm.

10.2.3.11 Finder pattern tolerance

The list [Finder pattern tolerance] sets the behaviour in the event of errors in the finder pattern of the code. The limiting lines framing the DataMatrix code are called finder pattern.



The [Finder pattern tolerance] is only available for the code family **Data Matrix ECC200**.

The list [Finder pattern tolerance] contains the following settings:

Setting	Description
[Low]	The code is detected if there is a high degree of finder pattern and there is almost no noise.
[High]	The code is detected if the finder pattern is defective or partly hidden. Only codes with a module grid of the same size are detected. (→ Module grid ▢ 85) Perspective distortions reduce the detection rate.
[Any]	The code is detected if • there is a high degree of finder pattern and there is almost no noise or • the finder pattern is defective or partly hidden.

10.2.3.12 Module grid

The list [Module grid] sets the calculation of the centre of a module. A DataMatrix code consists of several modules.



The [Module grid] is preset to [Fixed] and cannot be changed if the [Finder pattern tolerance] is set to [High].



The [Finder pattern tolerance] is only available for the code family **Data Matrix ECC200**.

The list [Module grid] contains the following settings:

Setting	Description
[Fixed]	Uses constant spacing for the module grid.
[Variable]	Uses the alternating pattern opposite the finder pattern (L-pattern) for the module grid.
[Any]	Uses the module grids [Fixed] and [Variable] one after the other.

10.2.3.13 Max slant

The input field [Max slant] sets the maximum slant of the L-shaped finder pattern relative to a right angle. The angle is indicated in degrees and corresponds to the distortion occurring when the code is printed or an image is captured.



The [Max slant] is only available for the code family **Data Matrix ECC200**.

The value range is **0...30°**.

Preset: **30°**.

10.2.3.14 Mirrored

The list [Mirrored] sets the detection of mirrored codes. Codes are detected which are mirrored on the vertical or horizontal axis.

The list [Mirrored] contains the following settings:

Setting	Description
[No]	Deactivates the detection of mirrored codes.
[Yes]	Activates the detection of mirrored codes.
[Any]	Activates the detection of mirrored and non-mirrored codes.

10.2.3.15 Symbol shape

The list [Symbol shape] restricts the shape of the code to be detected.



If [Finder pattern tolerance] is set to [Low], the function [Symbol shape] is ignored.

If [Finder pattern tolerance] is set to [High] or [Any], the setting [Rectangle] or [Square] considerably reduces the evaluation time.



The [Symbol shape] is only available for the code family **Data Matrix ECC200**.

The list [Symbol shape] contains the following settings:

Setting	Description
[Rectangle]	Activates the detection of rectangular codes.
[Square]	Activates the detection of square codes. With the symbol shape [Square], the number of rows and columns is set with the input fields [Symbol size min] and [Symbol size max].
[Any]	Activates the detection of codes regardless of the symbol shape.

10.2.3.16 Symbol columns min

The input field [Symbol columns min] sets the minimum number of columns for the detection of a code.

Depending on the [Symbol shape], use the following values for [Symbol columns min]:

Symbol shape	Symbol columns min
[Rectangle]	≥ 18
[Any]	≥ 10

10.2.3.17 Symbol columns max

The input field [Symbol columns max] sets the maximum number of columns for the detection of a code.

Depending on the [Symbol shape], use the following values for [Symbol columns max]:

Symbol shape	Symbol columns max
[Rectangle]	≤ 48
[Any]	≤ 144

10.2.3.18 Symbol rows min

The input field [Symbol rows min] sets the minimum number of rows for the detection of a code.

Depending on the [Symbol shape], use the following values for [Symbol rows min]:

Symbol shape	Symbol rows min
[Rectangle]	>= 8
[Any]	>= 8

10.2.3.19 Symbol rows max

The input field [Symbol rows max] sets the maximum number of rows for the detection of a code.

Depending on the [Symbol shape], use the following values for [Symbol rows max.]:

Symbol shape	Symbol rows max
[Rectangle]	<= 16
[Any]	<= 144

10.2.3.20 Symbol size min.

The input field [Symbol size min] sets the minimum number of symbol elements on the X/Y axis for the detection of a code.



The input field [Symbol size min.] is only available when the symbol shape [Square] is set.

Use the following values for the symbol shape [Square]:

Symbol shape	Symbol size min
[Square]	>= 10

10.2.3.21 Symbol size max.

The input field [Symbol size max.] sets the maximum number of symbol elements on the X/Y axis for the detection of a code.



The input field [Symbol size max] is only available when the symbol shape [Square] is set.

Use the following values for the symbol shape [Square]:

Symbol shape	Maximum symbol size
[Square]	<= 144

10.2.3.22 ROI size check

The checkbox [Enabled] activates the function [ROI size check]. The function provides a warning if the code moves to the edge of the defined ROI.

The function can be used as a predictive maintenance tool. The results of the function are forwarded to a controller if desired.

Example

Packages, each with a code to be read, move on a belt. If the belt speed or the position of the packages does not match the trigger rate of the device exactly, the packages and thus the codes will move out of the ROI. If the code is completely outside the ROI, it will be no longer read. The function [ROI size check] warns against this.

The function [ROI size check] contains the following input fields:

Input box	Description
[Threshold ROI warning]	If the distance of at least one code contour to the ROI falls below the set value, a warning is issued. If a code is found, the warning area is displayed in colour in the live image.
[Threshold distance to mean position]	A mean value is formed from N read codes and stored as the mean position ($N_{max} = 100$, where N = number of codes read). If the distance of a read code is greater than the set value, a warning is issued. The mean value is reset if a code is not read successfully. The last N positions are displayed in the form of a "track" in the live image.
[Threshold movement score]	If a code continues to move in the same direction in several consecutive images, the probability that it will continue to move in that direction increases. If the probability exceeds the set value, a warning is issued.

10.2.4 OCR;

The [OCR] model contains settings for recognising text content.

OCR stands for Optical Character Recognition and refers to the recognition of text in captured images. The recognition proceeds as follows:

1. Separating the text blocks from graphic elements,
2. Recognising the line structures and separating individual characters,
3. Assigning a numerical value to the characters according to text coding.

The text can then be processed further.

The text recognition can be adjusted in many ways. This increases the processing speed and reduces possible sources of error.

The model contains the following operating elements:

Operating element	Type	Description
[Activate anchor tracking]	Checkbox	Activates anchor tracking. (→ Activate anchor tracking □ 89) The text will be recognised regardless of its position in the image.
[Preferred characters]	Checkbox	Activates recognition of specific characters. (→ Preferred characters □ 89)
[Special characters]	Checkbox	Activates recognition of special characters. (→ Special characters □ 89)
[Dot print text]	Checkbox	Activates recognition of dot matrix text. (→ Special characters □ 89)
[Italics]	Checkbox	Activates recognition of text in Italics. (→ Special characters □ 89)
[Classifier]	List	Activates a suitable font to reduce the processing time. (→ Classifiers □ 90)
[Number of lines per ROI]	Checkbox / input field	Sets the number of rows per ROI group. (→ Number of rows per ROI □ 90)

[Advanced] area:

Operating element	Type	Description
[Use character selection]	Checkbox	Activates recognition of [Preferred characters] and [Special characters]. (→ Using character selection □ 91)

Operating element	Type	Description
[Regular expression]	Input field	Sets the characters to be recognised with a regular expression. (→ Regular expression □ 91)
[Relative text orientation]	List	Sets the text orientation in the image measured along the horizontal axis of the image. (→ Relative text alignment □ 91)
[Text orientation]	Input field	Sets a zone for the relative text orientation in which the text is detected. (→ Text orientation □ 92)
[Mode]	List	Sets automatic or manual recognition of text. (→ Mode □ 93)

[ROI size check] area:

Operating element	Type	Description
[Activated]	Checkbox	Warns if the OCR content moves further out of the ROI with each trigger. (→ ROI size check □ 94)

10.2.4.1 Activate anchor tracking

The check box [Activate anchor tracking] enables the anchor tracking for the model. Subsequently, objects are detected regardless of their orientation and position in the image.

The anchor tracking requires a separate anchor model. If no anchor model is available, one can be created directly.



The anchor model is not used for reading characters and codes. This requires a separate model that is linked to the anchor model.

The following models can be used as anchor models:

- [Contour anchor tracking]
- [1D barcode anchor tracking]
- [2D data code anchor tracking]

10.2.4.2 Preferred characters

The [Preferred characters] checkboxes activate recognition of certain characters. Text recognition is optimised for industrial applications. Only the characters listed below can be recognised.

The [Preferred characters] checkboxes contain the following settings:

Setting	Description
[Uppercase letters A...Z]	Activates recognition of the upper-case letters A to Z.
[Lowercase letters a...z]	Activates recognition of the lower-case letters a to z.
[Digits 0...9]	Activates recognition of the digits 0 to 9.
[Currency symbols € £ ¥ \$]	Activates recognition of the currency symbols € £ ¥ \$.

The setting changes the [Regular expression] input field in the [Advanced] area. [Regular expression](#) (→ □ 91)

10.2.4.3 Special characters

The checkboxes [Special characters] activate the recognition of special characters. The special characters are activated individually.

In addition to the 17 special characters, the following checkboxes can also be activated:

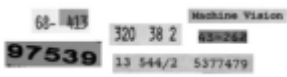
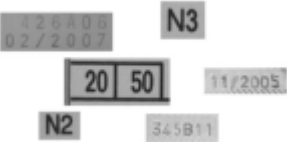
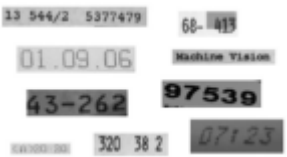
Setting	Description
[Dot print text]	Activates the recognition of dot matrix characters. Dot matrix characters are printed on packaging, for example, for the expiry and production dates of food.
[Italics]	Activates the recognition of characters in Italics.

The setting changes the [Regular expression] input field in the [Advanced] area. [Regular expression](#) (→ [91](#))

10.2.4.4 Classifiers

A font for recognising characters is set in the [Classifiers] list. The appropriate font will reduce the processing time.

The following fonts are available:

Font	Description	Example
[Document]	Sets the [Document] font. The font is particularly suitable for recognising characters in Arial, Courier and Times New Roman.	
[Industrial]	Sets the [Industrial] font. The font is particularly suitable for recognising characters in Arial, OCR-B and other sans-serif fonts.	
[OCR-A]	Sets the [OCR-A] font. The font is particularly suitable for recognising characters in OCR-A.	0123456789 ABCDEFGHIJKLM NOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz nopqrtsuvxyz -?!/\+=<>.#\$%&()@*
[OCR-B]	Sets the [OCR-B] font. The font is particularly suitable for recognising characters in OCR-B.	0123456789 ABCDEFGHIJKLM NOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz nopqrtsuvxyz -?!/\+=<>.#\$%&()@*
[Pharma]	Sets the [Pharma] font. The font is particularly suitable for recognising characters in Arial, OCR-B and other fonts used in the pharmaceutical industry. The [Pharma] font does not recognise lower case letters.	
[SEMI]	Sets the [SEMI] font. The font is particularly suitable for recognising characters in [SEMI]. The font is characterised by the fact that the characters are easily distinguishable.	ABCDEFGHIJKLMNO PQRSTUVWXYZ- 0123456789.
[Universal]	Sets the [Universal] font. The font is particularly suitable for recognising characters in Document, DotPrint, SEMI and Industrial.	

10.2.4.5 Number of rows per ROI

The [Number of rows per ROI] input field sets the number of rows to be detected for an ROI group.



A search is made for the set number of text lines. If more or fewer text lines are found, the model will be considered “failed” in the overall statistics. (→ [Monitor](#) [21](#))

Example

Anzahl der Textzeilen pro ROI = 2

- If 1 ROI exists: 2 text lines are searched for in this one ROI.
- If 2 ungrouped ROIs exist (each ROI counts as an ROI group): 2 text lines are searched for in each ROI. Altogether, 4 text lines are searched for.
- If 2 grouped ROIs exist (1 ROI group): 2 text lines are searched for in this one ROI group. Altogether, 2 text lines are searched for. The text lines can
 - both be contained in the first ROI,
 - both be contained in the second ROI,
 - be contained separately, one in each ROI.



A large number of text lines to be detected increases the evaluation time of the device.

10.2.4.6 Using character selection

Enables the recognition of [Preferred characters] and [Special characters]. Which characters are recognised is shown in the [Regular expression] input field.

When [Using character selection] is disabled:

- the [Regular expression] input field can be edited and
- the settings in [Preferred characters] and [Special characters] are ignored.

10.2.4.7 Regular expression

Sets the characters to be recognised with a regular expression. The regular expression describes a set of strings with syntactical rules.

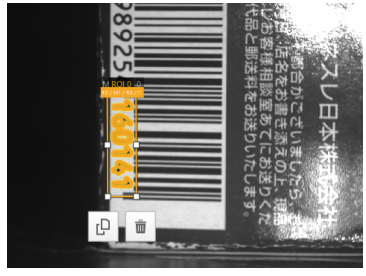
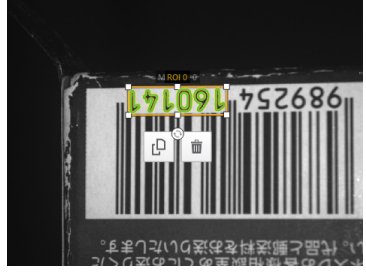
When [Using character selection] is disabled:

- the [Regular expression] input field can be edited and
- the settings in [Preferred characters] and [Special characters] are ignored.

10.2.4.8 Relative text alignment

The [Relative text orientation] list sets the reading direction of text. The following settings are available:

Setting	Description	Live image
[-90]	Reads text from bottom to top.	

Setting	Description	Live image
[0]	Reads text from left to right.	
[90]	Reads text from top to bottom.	
[180]	Reads text upside down from right to left.	

The text is recognised when the average orientation of the text is within the range of [Relative text orientation].

Preset: [0]: Reads text from left to right.



The function increases the evaluation time of the device.

10.2.4.9 Text orientation

The [Text orientation] input field sets a tolerance for the reading direction of text.

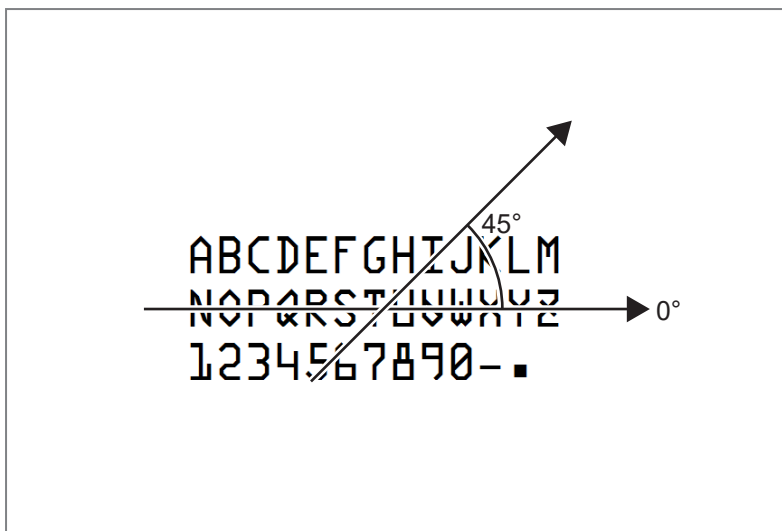


Fig. 39: Text orientation

A text is recognised if the average orientation of the text is within the range of [Text orientation].

The value range is 0 . . . 90 .

Preset: 45 .



The [Relative text orientation] list sets the reading direction of text.

10.2.4.10 Mode

The [Mode] list sets the recognition of text.

The following settings are available:

Setting	Description
[auto]	Recognises text automatically for the most part. Automatic detection increases the evaluation time of the device.
[manual]	Recognises text individually depending on the settings selected. Manual detection reduces the evaluation time of the device.

Mode [auto]

In [auto] mode, the following settings are displayed:

Setting	Description
[Min. contrast]	Sets the minimum contrast between the letters and the background. Preset: 15 .
[Min. character height]	Sets the minimum height of a letter in pixels. The setting does not affect punctuation and separators.
[Max. character height]	Sets the maximum height of a letter in pixels. The setting does not affect punctuation and separators.
[Min. character width]	Sets the minimum width of a letter in pixels. The setting does not affect punctuation and separators.
[Max. character width]	Sets the maximum width of a letter in pixels. The setting does not affect punctuation and separators.
[Min. stroke width]	Sets the minimum stroke width of a letter in pixels. The setting does not affect punctuation and separators.
[Max. stroke width]	Sets the maximum stroke width of a letter in pixels. The setting does not affect punctuation and separators.
[Separate touching characters]	Sets the separation of regions of adjacent characters. Detected regions are divided into at least 2 individual characters. Settings: [standard]: delivers fast results. [enhanced]: gives more accurate results, a little slower. [false]: deactivates the separation of touching characters. Preset: [standard].
[Eliminate blobs at the edge]	Removes the regions that touch the edge of the defined image.
[Output of punctuation marks]	Assigns small punctuation marks such as full stops or commas to the segmented letters. Provided the punctuation marks are close to the baseline of the line of text.
[Output of separators]	Assigns separators such as minus or equal signs to the segmented letters.
[Add fragments]	Assigns fragments like the dot on an "i" to the segmented letters. Matching the fragments can lead to disturbances of the segmented letters.
[Dot print]	Sets dot printing for the segmented letters.

Setting	Description
[Dot print close character spacing]	Sets the recognition of small spaces between dot print letters. The distance between 2 letters is detected if it is smaller than the distance between 2 points of a letter. If the exact distance between the letters is known, the setting [Dot print min. character spacing] provides better results. When using [Dot print min. character spacing], the setting [Dot print close character spacing] is ignored.
[Dot print max. dot spacing]	Sets the maximum distance between 2 points of a dot print letter in pixels. The setting can speed up text recognition considerably. If the distance between 2 dots is greater than the distance between 2 letters, additionally use the following setting: [Dot print close character spacing] or [Dot print min. dot spacing].
[Dot print min. character spacing]	Sets the minimum distance between 2 dot print letters in pixels. The setting increases the accuracy of segmented letters when the distance between 2 letters is smaller than the distance between 2 dots. If the distance between the letters is minimal and the minimum distance between 2 dots is unknown, use the setting [Dot print close character spacing].

Mode [manual]

In [manual] mode, the following settings are displayed:

Setting	Description
[Character height]	Sets the height of an upper case letter in pixels. Preset: 30 .
[Character width]	Sets the width of an upper case letter in pixels. Preset: 20 .
[Stroke width]	Sets the stroke width of a letter in pixels. Preset: 4 .
[Base line tolerance]	Sets the maximum deviation of a letter from the baseline as a percentage of the letter height. Preset: 0 .
[Upper case only]	Restricts text recognition to upper case letters and numbers.
[Is dot print]	Sets dot printing for the segmented letters.
[Is imprinted]	Recognises text with a lot of local changes in polarity due to reflections.
[Eliminate horizontal lines]	Eliminates horizontal lines near the segmented texts.
[Eliminate blobs at the edge]	Removes the regions that touch the edge of the defined image.
[Output of punctuation marks]	Assigns small punctuation marks such as full stops or commas to the segmented letters.
[Output of separators]	Assigns separators such as minus or equal signs to the segmented letters.
[Add fragments]	Assigns fragments like the dot on an "i" to the segmented letters. Matching the fragments can lead to disturbances of the segmented letters.
[Min. fragment size]	Sets a minimum size for the fragments. The setting is relevant when [Add fragments] is used.

10.2.4.11 ROI size check

The checkbox [Enabled] activates the function [ROI size check]. The function provides a warning if the text moves to the edge of the defined ROI.

The function can be used as a predictive maintenance tool. The results of the function are forwarded to a controller if desired.

Example

Packages, each with a text to be read, move on a belt. If the belt speed or the position of the packages does not match the trigger rate of the device exactly, the packages and thus the texts will move out of the ROI. If the text is completely outside the ROI, it will be no longer read. The function [ROI size check] warns against this.

The function [ROI size check] contains the following input fields:

Input box	Description
[Threshold ROI warning]	If the distance of at least one text contour to the ROI falls below the set value, a warning is issued. If a text is found, the warning area is displayed in colour in the live image.
[Threshold distance to mean position]	A mean value is formed from N read texts and stored as the mean position ($N_{\max} = 100$, where N = number of texts read). If the distance of a read text is greater than the set value, a warning is issued. The mean value is reset if a text is not read successfully. The last N positions are displayed in the form of a "track" in the live image.
[Threshold movement score]	If a text continues to move in the same direction in several consecutive images, the probability that it will continue to move in that direction increases. If the probability exceeds the set value, a warning is issued.

10.2.5 BLOB analysis

The [BLOB analysis] model analyses the number, arrangement and brightness of the pixels of an object.

First, the greyscale value histogram is used to select which pixels are to be analysed. The selection is then refined with the object properties:

- Geometry
- Circular
- Rectangular
- Greyscale
- etc.

BLOB analysis is particularly suitable for applications in which the objects vary in shape, size or colour value.

Operating elements

The model contains the following operating elements:

Operating element	Name	Description
	Copy model	Copies the model and changes to the new model.
	Rename model	Renames the model.
	Delete model	Deletes the model irrevocably.

Image assignment

The [Image assignment] area contains the following operating elements:

Operating element	Type	Description
[I1 New image 1]	Checkbox	Assigns the selected images to the model. A new image is added with [Images & triggers]. Images & trigger (→ 29) Up to 5 images can be added. The 5 images are assigned to the model as "I1" to "I5".

Object definition

In the [Object definition] area, an area is set to be searched for within the ROI.

After opening the [Object definition] area, the [Object definition area] is displayed in the live image. (→ [Object definition area of a BLOB](#) [103](#))

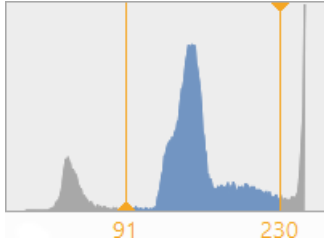
The area contains the following operating elements above the live image:

Operating element	Type	Description
	Button	Copies the object definition image from another model.
	Button	Uses the last image as the object definition image.
	Button	Triggers and updates the object definition image.
	Button	Uses the set trigger to update the object definition image. (→ Trigger mode 33)
	Button	Saves the object definition image as a JPEG.
	Button	Loads an image and uses it as an object definition image. Possible file formats: *.o2x5xximg *.o2i5xximg *.jpg

BLOB definition

In the [BLOB definition] area, you set what is to be recognised as an object.

The area contains the following operating elements:

Operating element	Type	Description
[Auto segmentation]	Button	Segments the greyscale levels displayed in the histogram. The selected segment is highlighted in blue in the histogram.
	List	Displays the recognised segments in a list. The selected segment is highlighted in blue in the histogram.
	Slider	Adjusts the segment with the vertical orange lines in the histogram.
	Slider	Adjusts the segment in the histogram.

Operating element	Type	Description
[Min]	Input field	Sets the lower limit of the segment (darkest colour).
	Button	Changes the mouse pointer to a pipette for selecting a pixel in the live image. The greyscale level of the pixel sets the lower limit of the segment (darkest colour).
[Max]	Input field	Sets the upper limit of the segment (lightest colour).
	Button	Changes the mouse pointer to a pipette for selecting a pixel in the live image. The greyscale level of the pixel sets the upper limit of the segment (lightest colour).
[Inverted segmentation]	Checkbox	Inverts the lower and upper limits of the segment. This makes it easier to detect particularly bright or dark areas.

Edit BLOBs

In the [Edit BLOBs] area, the allowed area, the handling of holes and the filter are set.

The area contains the following operating elements:

Operating element	Type	Description
[Include objects]	Checkbox	Detects objects whose area lies within a certain range. This is particularly suitable for excluding very small or very large objects.
[Min]	Input field	Sets the minimum area of the objects to be detected.
[Max]	Input field	Sets the maximum area of the objects to be detected.
[Fill holes]	Checkbox / input field	Fills holes inside objects. Holes appear in uniformly bright objects as bright or dark pixels. Triggers for this are, for example, rough material surfaces or image distortions. The size of the holes is entered absolutely in number of pixels.
[Morphology type]	List	Sets a filter for the object: [None]: does not use a filter. [Opening]: removes objects that are smaller than the [Morphology radius]. For example, narrow connections between 2 objects are removed. [Closing]: fills holes within objects that are smaller than the [Morphology radius]. [Erosion]: reduces objects at their edge by the [Morphology radius]. This applies to all objects that are larger than the [Morphology radius]. [Dilation]: enlarges objects at their edge by the [Morphology radius]. This fills holes that are smaller than the [Morphology radius].
[Morphology radius]	Input field	Sets the radius used for [Morphology type] in pixels.
[Sort objects]	List	Sets the sorting of the objects: • [by size] • [by position]

Model parameters

In the [Model parameters] area, the ROI, the ROD and the allowed number of objects can be set.

The area contains the following operating elements:

Operating element	Type	Description
[Add regions (ROI)]	Button	Sets the region of interest (ROI). (→ Creating a region of interest (ROI) □ 23)
[Exclusion zone (ROD)]	Button	Sets the exclusion zone (ROD: region of disinterest). (→ Creating a region of disinterest (ROD) □ 24)
[Activate anchor tracking]	Checkbox	Activates anchor tracking. (→ Activate anchor tracking □ 103) Anchor tracking recognises objects despite changed position and rotation.
[Number of objects per ROI]	Input field	Sets the number of objects per ROI. (→ Number of objects per ROI □ 98) This setting influences the pass/fail status of the overall statistics. (→ Test □ 166)

Object properties

In the [Object properties] area, recognition of objects is restricted.

The area contains the following operating elements:

Operating element	Type	Description
	Button	Adds object properties to the model. (→ Object properties □ 99) In the [Object properties] area, recognition of an object can be restricted.
	Button	Deletes all [Object properties]. The object properties will be irrevocably deleted.

ROI size check

In the “ROI size check” area, a warning is activated for objects that move out of the ROI.

The area contains the following operating elements:

Operating element	Type	Description
[Activated]	Checkbox	Warns if the object moves further out of the ROI with each trigger. (→ ROI size check □ 103)
[Threshold ROI warning]	Input field	Sets the threshold for the warning.
[Threshold distance to mean position]	Input field	Sets a distance to the mean position of the objects.
[Threshold movement score]	Input field	Sets a threshold for the movement trend of the objects.

10.2.5.1 Number of objects per ROI

The [Number of objects per ROI] function sets the number of objects to be detected per ROI.



If more or fewer objects are found, the model will be considered “failed” in the overall statistics. (→ [Test](#) □ 166)

Example

With the input fields [Min] = "1" and input field [Max] = "3" 1-3 objects per ROI are recognised.

- If 1 ROI exists: Within the ROI, 1 to 3 objects are searched for.

- If 2 non-grouped ROIs exist: In each ROI, 1 to 3 objects are searched for.
- If 1 ROI group of 2 ROIs exists: In the ROI group, 1 to 3 objects are searched for.



The function increases the evaluation time of the device.

10.2.5.2 Object properties

The object properties restrict the recognition of objects. If an object meets the setting criteria, it can be processed further.

After the  [Add object properties] button has been clicked, the following menu is displayed:

[Geometry] area	Description
[Object area]	The area of the object. 
[Object areas in ROI]	The total area of all objects in the ROI. 
[Position X]	The centre of gravity of the object on the X-axis, measured from the left border of the image. 
[Position Y]	The centre of gravity of the object on the Y-axis, measured from the top border of the image. 
[Object height]	The height of the smallest rectangle that completely encloses the object and whose sides are parallel to the image border. 
[Object width]	The width of the smallest rectangle that completely encloses the object and whose sides are parallel to the image border. 

[Circular] area	Description
[Roundness]	The roundness of the object describes the shape factor of the contour. The distance of the contour to the centre of gravity of the area is measured. Wide notches in the object do not greatly affect the value, as the centre of gravity does not change significantly. A perfectly round circle has the value "100". 
[Circularity]	The circularity of the object describes the similarity to a perfect circle. A perfectly round circle has the value "100". 
[Outer radius]	The radius of the smallest circle that completely encloses the object. 
[Inner radius]	The radius of the largest circle that fits completely inside the object. 

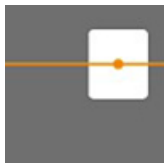
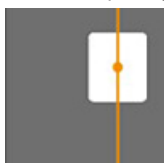
[Rectangular] area	Description
[Rectangularity]	The rectangularity of the object. A perfect rectangle has the value "100". 
[Inner width]	The width of the largest rectangle that fits completely inside the object and whose sides are parallel to the image border. 

[Rectangular] area	Description
[Inner height]	The height of the largest rectangle that fits completely inside the object and whose sides are parallel to the image border. 

[Greyscale] area	Description
[Min. greyscale value]	The lowest greyscale value of the object. 
[Max. greyscale value]	The highest greyscale value of the object. 
[Average greyscale value]	The average greyscale value of the object. 
[Greyscale value deviation]	The standard deviation of the object (homogeneity). The value is low for uniformly grey objects and high for irregular surfaces or greyscale gradients. 

[Other] area	Description
[Compactness]	The compactness of the object. Empty regions have the value "0"; circular objects have the value "1". Long narrow objects have average values. Entangled objects and objects with holes have high values. 

[Other] area	Description
[Number of holes]	The number of holes in the object. 
[Orientation]	The orientation of the object in degrees. 

[Shape] area	Description
[Perimeter]	Length of the outer contour of the object. 
[Centre X of the bounding box]	Horizontal coordinate of the object's geometric centre, measured from the left image border. 
[Centre Y of the bounding box]	Vertical coordinate of the object's geometric centre, measured from the top image border. 

Activating the checkboxes activates the corresponding object properties.

An activated object property has the following operating elements:

Operating element	Type	Description
	Button	Deletes the object property irrevocably.
	Button	Displays the description of the object property.
[Min]	Input field	Sets the minimum value of the object property.
[Max]	Input field	Sets the maximum value of the object property.
	Slider	Sets the minimum and maximum value of the object property.

10.2.5.3 ROI size check

The checkbox [Enabled] activates the function [ROI size check]. The function warns when an object moves to the edge of the defined ROI.

The function can be used as a predictive maintenance tool. The results of the function are forwarded to a controller if desired.

The function [ROI size check] contains the following input fields:

Input box	Description
[Threshold ROI warning]	If the distance of at least one object to the ROI falls below the set value, a warning will be issued. If an object is found, the warning area will be displayed in colour in the live image.
[Threshold distance to mean position]	An average value is formed from N detected objects and saved as the average position. $N_{\max} = 100$ $N = \text{Anzahl der erkannten Objekte}$ If the distance of a detected object is greater than the set value, a warning will be issued. The mean value will be reset if an object is not successfully detected. The last N positions are displayed in the form of a "track" in the live image.
[Threshold movement score]	If an object continues to move in the same direction in successive images, the probability that the object will continue to move in that direction increases. If the probability exceeds the set value, a warning is issued.

Example

Objects to be recognised move on a belt.

If the belt speed or position of the objects does not match the trigger rate of the device exactly, the objects will move out of the ROI. If the object is outside the ROI, it is not recognised. The function [ROI size check] warns against this.

10.2.5.4 Activate anchor tracking

The anchor tracking recognises objects despite changed position and rotation. The anchor tracking is taught automatically.



Before anchor tracking can be used, the [Contour anchor tracking] model must be added. ([→ Contour anchor](#) [112](#))



The evaluation time of the device may increase when anchor tracking is activated, depending on the number and size of the objects.

10.2.5.5 Object definition area of a BLOB

After opening the [Object definition] area, the [Object definition area] is displayed in the live image.

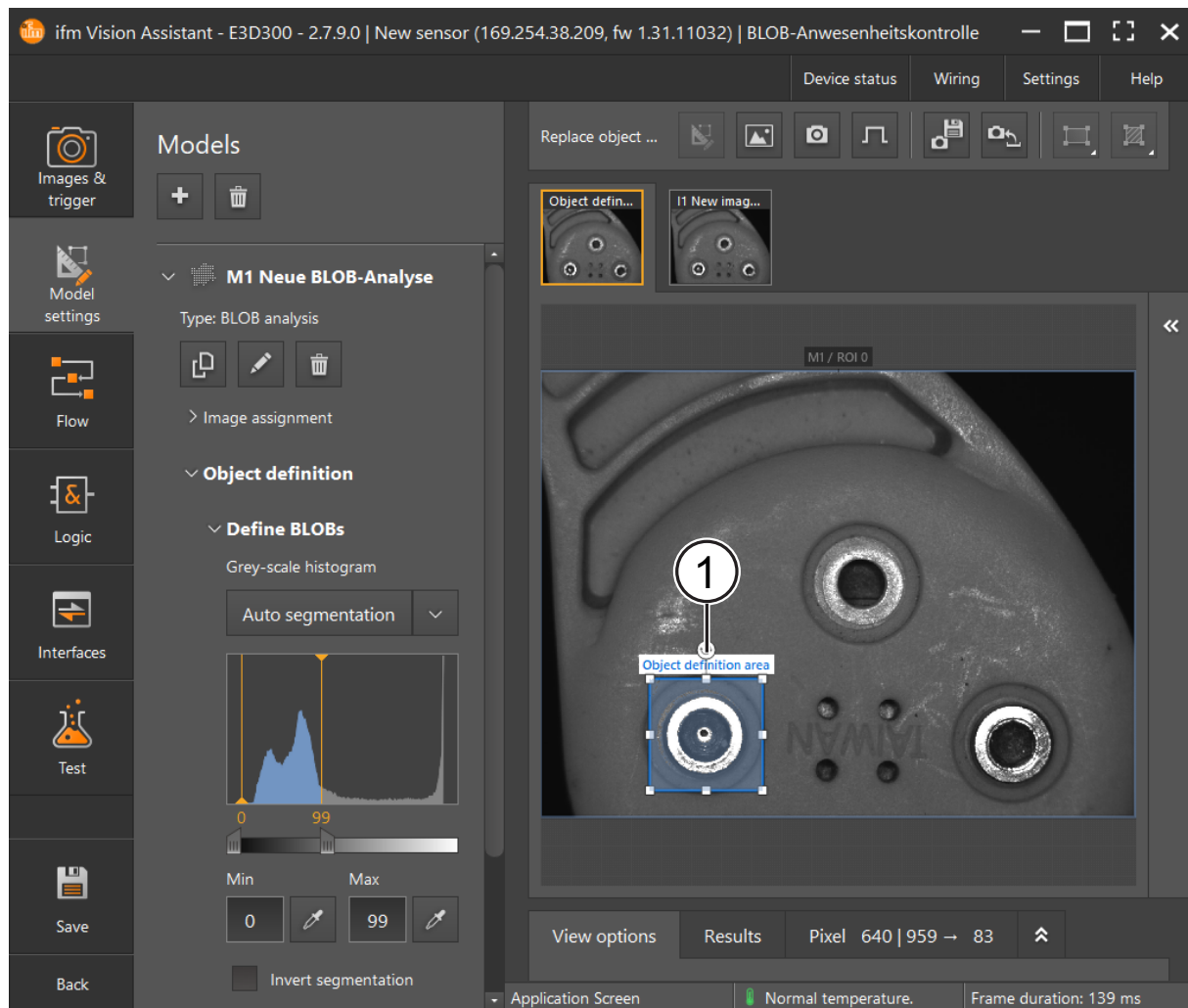


Fig. 40: Object definition area

1 Object definition area

In the [Object definition area], an area is set to be searched for within the ROI. The [Object definition area] can be detected several times within the ROI, for example solder joints of the same shape and size.

Setting the object definition area:

- Using the mouse pointer, place the object definition area in the live image as close as possible around the object.
- ▷ The object is automatically recognised within the object definition area and highlighted in colour.

10.2.6 Contour detection

The [Contour detection] model analyses the contours of an object.

First, the contour of a good part is taught. The contour detection checks the degree of conformity between the taught contour and the contours of the test parts. Additional quality characteristics can be defined for the test.

Contour detection is particularly suitable for applications where the shape of the objects is repeated.

Operating elements

The model contains the following operating elements:

Operating element	Name	Description
	Copy model	Copies the model and changes to the new model.
	Rename model	Renames the model.
	Delete model	Deletes the model irrevocably.

Image assignment

The [Image assignment] area contains the following operating elements:

Operating element	Type	Description
[11 New image 1]	Checkbox	Assigns the selected images to the model. A new image is added with [Images & triggers]. Images & trigger (→ 103) Up to 5 images can be added. The 5 images are assigned to the model as "I1" to "I5".

Object definition

In the [Object definition] area, contours are taught in using an object definition image.

After opening the [Object definition] area, the [Object definition area] is displayed in the live image. (→ [Object definition area of a BLOB](#) [103](#))

The area contains the following operating elements above the live image:

Operating element	Type	Description
	Button	Copies the object definition image from another model.
	Button	Uses the last image as the object definition image.
	Button	Triggers and updates the object definition image.
	Button	Uses the set trigger to update the object definition image. (→ Trigger mode 33)
	Button	Saves the object definition image as a JPEG.
	Button	Loads an image and uses it as an object definition image. Possible file formats: *.o2x5xximg *.o2i5xximg *.jpg

Define contours

The contours to be recognised are set in the [Define contours] area.

The area contains the following operating elements:

Operating element	Type	Description
[Contrast threshold]	Checkbox / input field	Sets the lower contrast threshold for determining the contours.
[Min. contour length]	Checkbox / input field	Sets the minimum contour length. Smaller contours are ignored.

Advanced

Advanced settings can be changed in the [Advanced] section.



▷ **The [Advanced] area contains settings that are unnecessary for typical configurations.**

► Only change the settings if you know exactly what the effects will be.

The area contains the following operating elements:

Operating element	Type	Description
[Point reduction]	List	Reduces the number of contour points used. [Automatic]: Automatically reduces the contour points. [None]: Does not reduce contour points. [Point reduction low]: Reduces a low number of contour points. [Point reduction medium]: Reduces a medium number of contour points. [Point reduction high]: Reduces a high number of contour points.

Edit contours

In the [Edit contours] area, the contours are edited directly in the live image using the mouse pointer.

The area contains the following operating elements:

Operating element	Type	Description
	Button	Draws an additional contour in the live image. The mouse pointer is displayed as a crosshair.
	Button	Deletes parts of the contour. A mouse click deletes the contour inside the circle. The deleted contour is shown as a blue line. The size of the circle can be adjusted with [Tool size].
	Button	Restores parts of the deleted contour. The deleted contour is shown as a blue line. A mouse click restores the contour inside the circle. The size of the circle can be adjusted with [Tool size].
	Button	Deletes the complete contour. A mouse click deletes the selected contour. The deleted contour is shown as a blue line. The size of the circle can be adjusted with [Tool size].
	Button	Restores deleted contour. The deleted contour is shown as a blue line. A mouse click restores the selected contour. The size of the circle can be adjusted with [Tool size].
[Tool size]	Input field / slider	Sets the size of the circle.

Used contours

The used contours are displayed in the [Used contours] area. The used contours are shown in green in the live image.

The area contains the following operating elements:

Operating element	Type	Description
[111 point contour]	Text field	Displays the number of points "111" of the selected contour. The selected contour is displayed orange in the live image. The contour is selected by moving the mouse pointer over the text field.
	Button	Deletes the selected contour. The deleted contour is moved to the [Unused contours] area.

Unused contours

The unused contours are displayed in the [Unused contours] area. The unused contours are shown in blue in the live image.

The area contains the following operating elements:

Operating element	Type	Description
[111 point contour]	Text field	Displays the number of points "111" of the selected contour. The selected contour is displayed orange in the live image. The contour is selected by moving the mouse pointer over the text field.
	Button	Restores deleted contour. The restored contour is moved to the [Used contours] area.

Reference point

The zero point of the objects is set in the [Position reference] area. The coordinates of objects given in the ifmVisionAssistant refer to the zero point. Example: in the [Results] tab, the "Position X" and "Position Y". ([→ Monitor ▢ 21](#))

The area contains the following operating elements:

Operating element	Type	Description
	Button	Moves the zero point to a new position with the mouse pointer.
	Button	Restores the original position.

Model parameter

In the [Model parameters] area, the defined contour is further set so that it can be found in an application.

The area contains the following operating elements:

Operating element	Type	Description
[Add region (ROI)]	Button	Sets the Region of Interest (ROI) (→ Creating a region of interest (ROI) ▢ 23)
[Exclusion zone (ROD)]	Button	Sets the Region of Disinterest (ROD) (→ Creating a region of disinterest (ROD) ▢ 24)
[Activate anchor tracking]	Checkbox	Activates anchor tracking. (→ Models ▢ 65) The anchor tracking recognises objects despite changed position and rotation.
[Number of objects per ROI]	Input box	Sets the allowed number of objects per ROI. (→ Number of objects per ROI ▢ 109) The setting influences the pass/fail status of the overall statistics. (→ Test ▢ 166)

Operating element	Type	Description
[Tolerance width (±)]	Input box	Sets the tolerance range of the contour detection. A contour within the tolerance width is detected.
[Maximum orientation]	Input fields	Sets the maximum orientation. Objects are detected within the area.
[Min. score]	Input field / slider	Sets the minimum score for the evaluation. The contour must reach the score to be recognised. The theoretical value "1" is not achieved in practice.
[Analysis mode]	Checkbox	Activates the analysis mode. If the analysis mode is activated, the objects that do not reach the [minimum score] will also be displayed. The setting is only intended for analysis in case of problems. The evaluation time of the device increases considerably.
[Max. overlap]	Input field / slider	Sets the maximum overlap of contours. The contours of 2 objects may overlap by the set value. Example: 2 square objects lie next to each other and the contours overlap (red line).  With the value "0.25" (1/4 of the object, i.e. one side) 2 objects will be detected.

Advanced

Advanced settings can be changed in the [Advanced] section.



▷ **The [Advanced] area contains settings that are unnecessary for typical configurations.**

► Only change the settings if you know exactly what the effects will be.

The area contains the following operating elements:

Operating element	Type	Description
[Timeout]	Checkbox / input field	Sets a timer for detecting objects. With the end of the timer, the detection will be cancelled.
[Min. contrast]	Input box	Sets a minimum contrast that must be present in the current image. No analysis will be carried out in areas with a low grey value difference (min. contrast <10). In areas with higher contrast, the defined contours will be searched for. This means that the search algorithm can, for example, very quickly exclude a homogeneous background (consistently white or black).
[Orientation steps]	Checkbox / input field	Sets the orientation steps for the [Maximum orientation] [°]. A rotated object is searched for in the set steps. Small values increase the evaluation time of the device.

Operating element	Type	Description
[Subpixel]	List	Activates the sub-pixels. The sub-pixels form a mean value from the neighbouring pixels. The sub-pixels can reduce jitter in the live image and improve the accuracy of the orientation. [None]: Deactivates the sub-pixels. The setting is only recommended if a particularly short evaluation time of the device is required. [Interpolation]: Uses linear interpolation for the average of 2 neighbouring pixels. [Least squares]: Determines a function (usually a straight line) for a set of pixels that summarises the pixels as well as possible. [Least squares high]: Determines a function, as with [Least Squares], with high accuracy. [Least squares very high]: Determines a function, as with [Least Squares], with very high accuracy.
[Search acceleration]	Input field / slider	Accelerates the search for contours with a high value. Accelerated search is less accurate than slow search. A high value can influence the [min. score] because then the [min. score] will be outside the defined limits.
[Number of levels]	Checkbox / input field	Sets the resolution levels at which contours are searched for. With only 1 level, a search is made in the original image of the device, which significantly increases the evaluation time. Each additional level reduces the resolution and thus the evaluation time.
[Lowest level]	Input box	Sets the level up to which images are analysed.
[Position limits]	Input fields	Restricts the area in which contours are detected.

ROI size check

In the “ROI size check” area, a warning is activated for objects that move out of the ROI.

The area contains the following operating elements:

Operating element	Type	Description
[Activated]	Checkbox	Warns if the object moves further out of the ROI with each trigger. (→ ROI size check □ 103)
[Threshold ROI warning]	Input field	Sets the threshold for the warning.
[Threshold distance to mean position]	Input field	Sets a distance to the mean position of the objects.
[Threshold movement score]	Input field	Sets a threshold for the movement trend of the objects.

10.2.6.1 Number of objects per ROI

The [Number of objects per ROI] function sets the number of objects to be detected per ROI.



If more or fewer objects are found, the model will be considered “failed” in the overall statistics.

Example

With the setting "3", 3 objects will be detected per ROI.

- If 1 ROI exists: Within the ROI, 3 objects are searched for.
- If 2 non-grouped ROIs exist: In each ROI, 3 objects are searched for.
- If 1 ROI group of 2 ROIs exists: 3 objects are searched in the ROI group.



The function increases the evaluation time of the device.

10.2.6.2 Pyramid levels

The "pyramid" level method in industrial image processing is used to speed up the evaluation time of image analyses. In this method, resolution of the original image is reduced. Reducing the resolution can be done several times, so that there are several "levels" that are pictorially represented as a pyramid. With each level, the resolution of the image is reduced to $\frac{1}{4}$ and thus the evaluation time is reduced.

Then, the defined contours will first be searched for in the low-resolution images. When contours are found, they will be verified again on the high-resolution image. The procedure leads to significantly shorter evaluation times with consistently high accuracy.

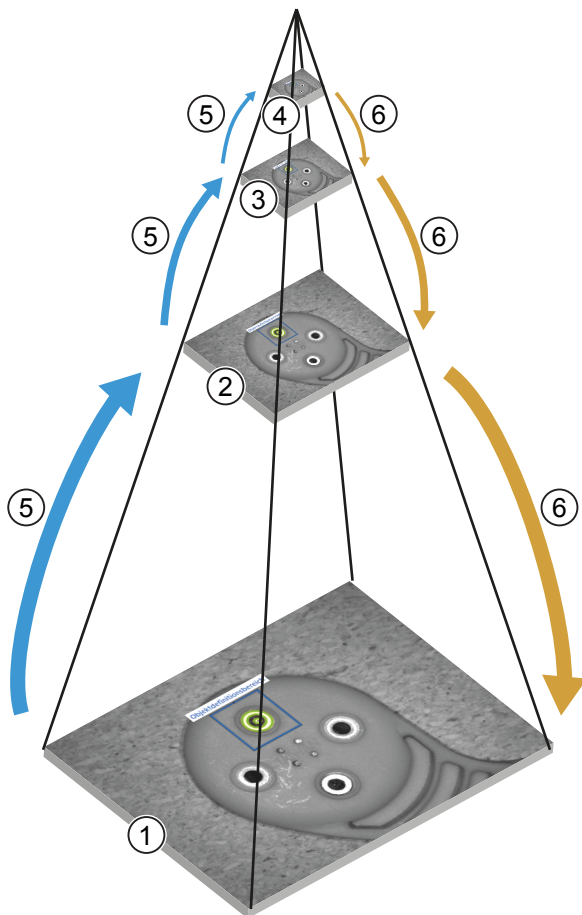


Fig. 41: Number of levels

- 1 Image of the first level (high resolution image)
- 2 Image of the second level
- 3 Image of the third level
- 5 Reduce resolution to $\frac{1}{4}$

- 2 Image of the second level
- 4 Image of the fourth level
- 6 Detecting contours in the image

First the original image is reduced by the set [number of levels]. Then, starting with the smallest image, contours will be searched for. If all contours are already found in the smallest image, the following (larger) image will be used for verification.

For typical applications, the setting [Number of levels] = "4" is sufficient, which corresponds to the 4th level. Level with 1/64 of the original resolution. Only to recognise very small structures, a high resolution is required.

Lowest level

The lowest level sets up to which level the images are to be analysed. For example, with the value "2", the 1st level (the image in the original resolution) is not used for analyses.

10.2.6.3 Object definition area of a contour

After opening the [Object definition] area, the [Object definition area] is displayed in the live image.

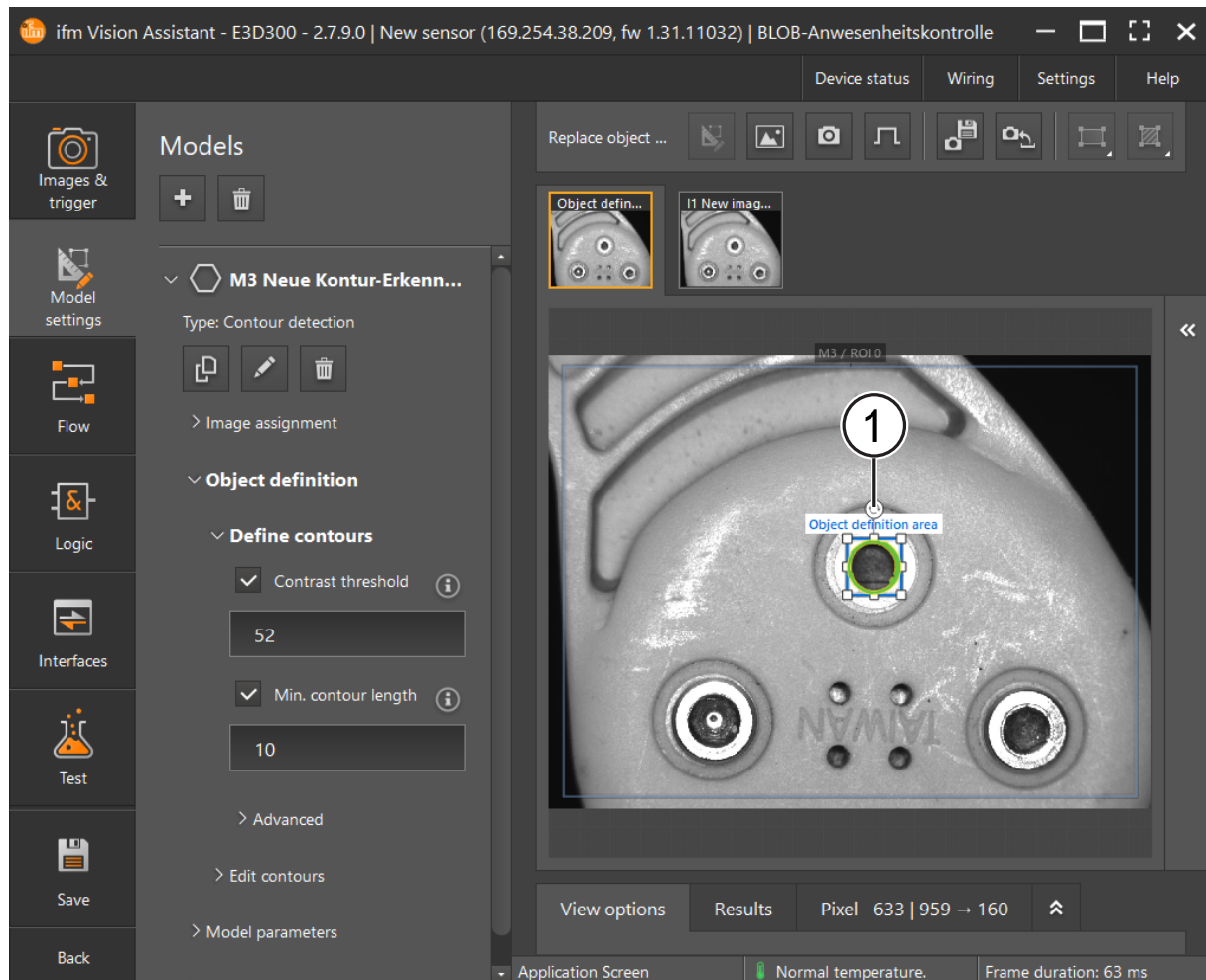


Fig. 42: Object definition area

1 Object definition area

Contours are taught in the [object definition area]. By setting the object definition image, the contours are determined automatically. The contours can then be adjusted manually. The [object definition area] can be detected several times within the ROI, for example the orientation of screw heads.

The contour taught-in in the object definition image is also called "target contour" and "good part".

Setting the object definition area:

- Using the mouse pointer, place the object definition area in the live image as close as possible around the object.
- ▷ The object is automatically recognised within the object definition area and highlighted in colour.

10.2.7 Contour anchor

The [Contour anchor] model analyses the contours of an object and tracks the contours of other models. Additional quality characteristics can be defined for the analysis.

The [Contour anchor] model is particularly suitable for applications where the shape of the objects is repeated.

Object definition

The object definition is set in the live image. An object for the model is set in the [Object definition area]. The contours found in the [Object definition area] are taught in automatically.

The contours taught in the object definition screen are also called “target contour” and “good part”. The [Object definition area] can be detected several times within the ROI, for example the orientation of screw heads.

Set the object definition area:

- ▶ Set the object definition area in the live image with the mouse pointer as close as possible around the contour to be recognised.
 - ▷ The contour is automatically recognised within the object definition area and highlighted in colour.
- ▶ Adjust the contours with the operating elements described below.

Operating elements

The [Contour anchor] model includes the following operating elements:

[Define contours] area:

Operating element	Type	Description
[Contrast threshold]	Checkbox / input field	Sets the lower contrast threshold for determining the contours.
[Min. contour length]	Checkbox / input field	Sets the minimum contour length. Smaller contours are ignored.

[Advanced] area:

Operating element	Type	Description
[Point reduction]	List	Reduces the number of contour points used. [Automatic]: automatically reduces the contour points. [None]: does not reduce any contour points. [Point reduction low]: reduces a low number of contour points. [Point reduction medium]: reduces a medium number of contour points. [Point reduction high]: reduces a high number of contour points.

[Edit contours] area:

Operating element	Type	Description
	Button	Draws additional contours.
	Button	Deletes unwanted parts of contours.
	Button	Restores deleted parts of contours.
	Button	Deletes unwanted contours.
	Button	Restores deleted contours.

Operating element	Type	Description
[Tool size]	Input field / slider	Sets the size of the tool used to draw and erase contours.



The mouse wheel can be used to zoom in and out of the live image. Individual contours are thus more visible.

[Used contours] area:

The used contours are displayed in the [Used contours] area. The used contours are shown in the live image in the colour [Green].

[Unused contours] area:

The unused contours are displayed in the [Unused contours] area. The unused contours are shown in the live image in the colour [Blue].

[Position reference] area:

The zero point of the object definition area can be set in the position reference area. The area contains the following operating elements:

Operating element	Type	Description
	Button	Sets the zero point of the object definition area. The set zero point is indicated by a cross.
	Button	Resets the zero point setting.

[Model parameters] area:

Operating element	Type	Description
	Button	Sets a rectangular search zone (ROI).
	Button	Sets an elliptical search zone (ROI).
	Button	Sets a polygonal search zone (ROI).
	Button	Sets a rectangular exclusion zone (ROD).
	Button	Sets an elliptical exclusion zone (ROD).
	Button	Sets a polygonal exclusion zone (ROD).
[Tolerance width]	Input field	Sets the maximum permissible deformation of the contour. Contours within the tolerance width are taken into account.
[Max. orientation]	Input fields	Sets the maximum orientation. Objects within the orientation will be detected.
[Min. score]	Input field / slider	Sets the minimum score of a detected contour so that it will be considered found. The value 1 means complete agreement. The value is not achieved in practice due to disturbances in the environment such as image noise, changing light conditions, etc.
[Analysis mode]	Checkbox	Also takes into account contours that lie below the [Min. score]. The contours will be marked as failed. The [Analysis mode] is only intended for analysis in case of problems. The processing time of the device increases considerably.

[Advanced] area:

Operating element	Type	Description
[Timeout]	Checkbox / input field	Sets a timeout for the search for contours. The value 0 sets the timeout to the maximum value 7000 ms.
[Min. contrast]	Input field	Sets a minimum contrast that must be present in the current image. No analysis will be carried out in areas with a low greyscale value difference ([min. contrast] < 10). In areas with higher contrast, the defined contours will be searched for. This means that the search algorithm can, for example, very quickly exclude a homogeneous background (consistently white or black) and only search in the contrasting ones.
[Orientation steps]	Checkbox / input field	Sets the size of the intermediate steps of the set orientation. (→ Orientation □ 74) A rotated object is searched for in the set steps. Small values increase the processing time of the device.
[Subpixels]	List	Activates the subpixels. The subpixels form a mean value from the neighbouring pixels. The subpixels can reduce jitter in the live image and improve the accuracy of the orientation. [None]: deactivates the subpixels. The setting is only recommended if a particularly short processing time of the device is required. [Interpolation]: uses linear interpolation for the average of 2 neighbouring pixels. [Least squares]: determines a function (usually a straight line) for a set of pixels that summarises the pixels as well as possible. [Least squares high]: determines a function, as with [Least squares], with high accuracy. [Least squares very high]: determines a function, as with [Least squares], with very high accuracy.
[Search acceleration]	Input field / slider	Accelerates the contour search at a high rate. Accelerated search is less accurate than slow search. The setting affects [Min. Score] because [Min. Score] cannot be within the set limits in a fast/inaccurate search.
[Number of levels]	Checkbox / input field	Sets the resolution levels at which contours are searched for. (→ Pyramid levels □ 110) With only 1 level, a search is made in the original image of the device, which significantly increases the processing time. Each additional level reduces the resolution and thus the processing time.
[Lowest level]	Input field	The lowest level sets the level up to which the images are to be analysed. (→ Pyramid levels □ 110)
[Position limits]	Input fields	Restricts the area in which contours are detected.

[ROI size check] area:

Operating element	Type	Description
[Activated]	Checkbox	Warns if the OCR content moves further out of the ROI with each trigger. (→ ROI size check 76)

10.2.8 1D barcode anchor tracking

The [1D barcode anchor tracking] model tracks the search zone (ROI) from other models. The position and orientation are taken into account. This means that objects do not have to be in the same position and in the same orientation for the application to work correctly.

The [1D barcode anchor tracking] model is linked to models that have already been created. It then traces the search zone (ROI). The search zone is used to search for objects.

Only one model of the [1D barcode anchor tracking] type can be created.

The operating elements of the [1D barcode anchor tracking] model are identical to those of the [1D barcode] model. Only difference: The [1D barcode] model can recognise multiple contours; the [1D barcode anchor tracking] model can only detect one contour.



For reliable recognition of objects, the contour anchor may only be visible once in the image.



The function increases the evaluation time of the device.

10.2.9 2D data code anchor tracking

The [2D data code anchor tracking] model tracks the search zone (ROI) from other models. The position and orientation are taken into account. This means that objects do not have to be in the same position and in the same orientation for the application to work correctly.

The [2D data code anchor tracking] model is linked to models that have already been created. It then traces the search zone (ROI). The search zone is used to search for objects.

Only one model of the [2D data code anchor tracking] type can be created.

The operating elements of the [2D data code anchor tracking] model are identical to those of the [2D data code] model. Only difference: The [2D data code] model can recognise multiple contours; the [2D data code anchor tracking] model can only detect one contour.



For reliable recognition of objects, the contour anchor may only be visible once in the image.



The function increases the evaluation time of the device.

10.3 Flow

The [Flow] function displays the images and models available in a flow chart. In just a few steps

- the evaluation order of the images and models is set,
- images are activated/ deactivated,
- timeouts for models are set.

In addition, the capture times of images and evaluation times of the models are displayed.

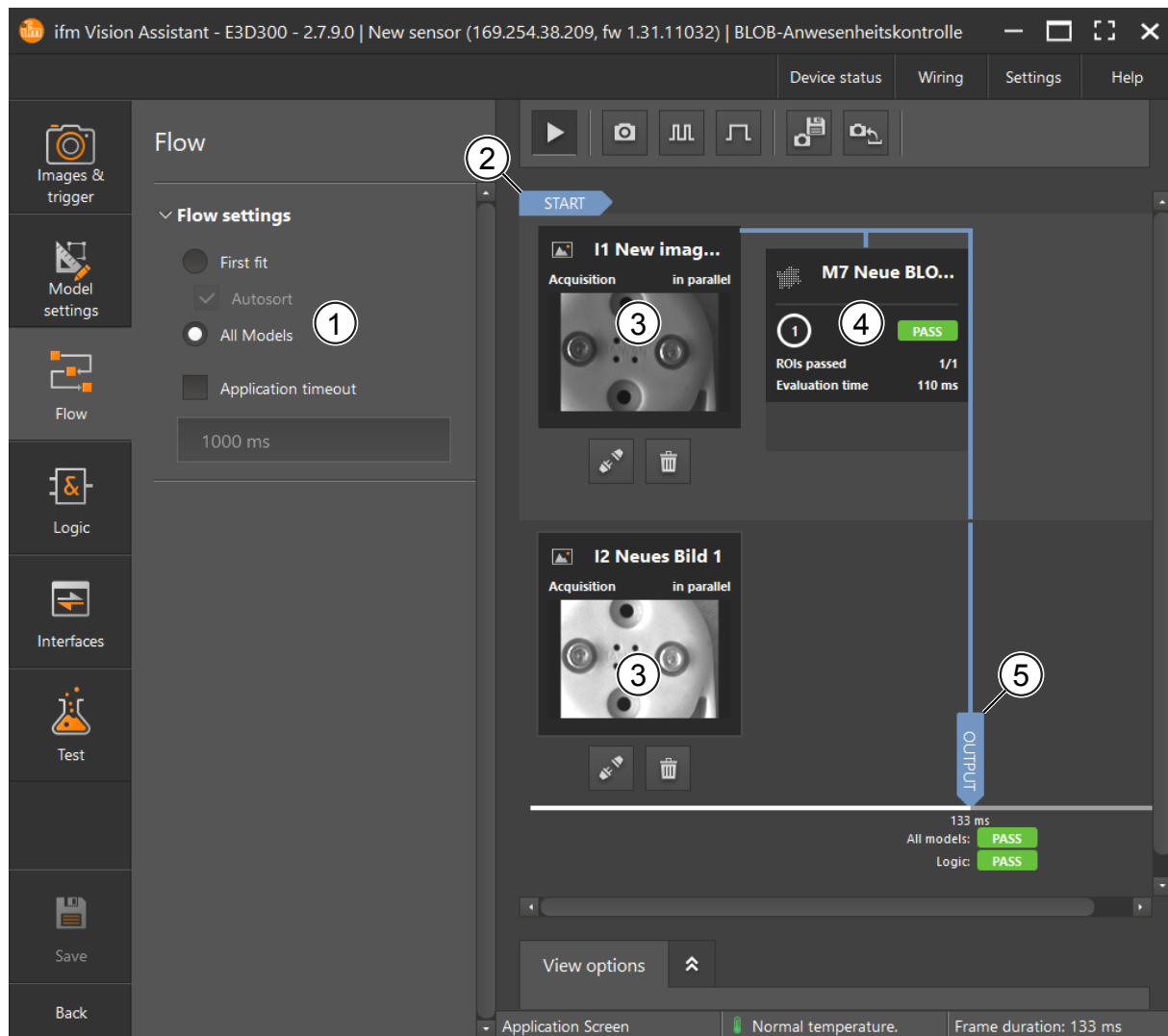


Fig. 43: [Flow] function

1 Flow settings

3 Image

5 End of the flow chart

2 Start of the flow chart

4 Model

Flow settings

The flow settings are used to set the processing order of the images and models.

The flow settings contain the following settings:

Flow settings	Type	Description
[First Fit]	Option field	Runs the model that first successfully completes the search task in the flow chart. The models following in the flow chart are not executed.
[Autosort]	Checkbox	Runs the model first that successfully detected a code in the previous pass.
[All Models]	Option field	Runs all models. The total evaluation time increases.
[Application timeout]	Checkbox	Sets a timeout for the application. If the evaluation time of the application exceeds the timeout, the evaluation is stopped.

Flow chart

The flow chart starts with the image underneath [START] (2). The active models (4) are connected with the blue line. Disabled models are greyed out and encircled with a dashed line.

The flow chart ends with [OUTPUT] (5). The total evaluation time is displayed underneath [OUTPUT]. The total evaluation time is composed of the capture time of the image and the evaluation times of the models.



Double-clicking on an image or a model links directly to the respective settings.

The following properties are displayed within an image (3):

- image name
- current camera image
- capture time (corresponds to the exposure and image read-out time of the image)

Within a model (4) the following properties are displayed:

- Model name
- Model type
- Model status (ROI criteria met)
- Number of ROI criteria met / number of ROI
- Processing time (influenced by the settings of the model) (→ [Models](#) □ 65)
- Timeout (→ [Models](#) □ 65)

Setting images

The following functions are used to set images:

Function	Button	Description
[Change position]	-	Press the mouse button and move the image to the new position.
[Activate/deactivate]		Activates the selected image.
[Delete]		Deletes the selected image from the device's system.

Setting models

The following functions are used to set a model:

Function	Button	Description
[Change position]	-	Press the mouse button and move the model to the new position.
[Image references]		Connects the model to an available image.
[Delete]		Deletes the selected model from the device's system.
[Timeout]	-	Sets a timeout for the model. If the evaluation time of the model exceeds the timeout, the evaluation is stopped.

10.4 Logic

The function [Logic] creates an output logic by means of logic blocks. In addition to binary signals, numbers and strings are also processed. The model and pin data is assigned to the outputs in the output logic. Then the data is transferred to a controller (PLC/PC) via the outputs.

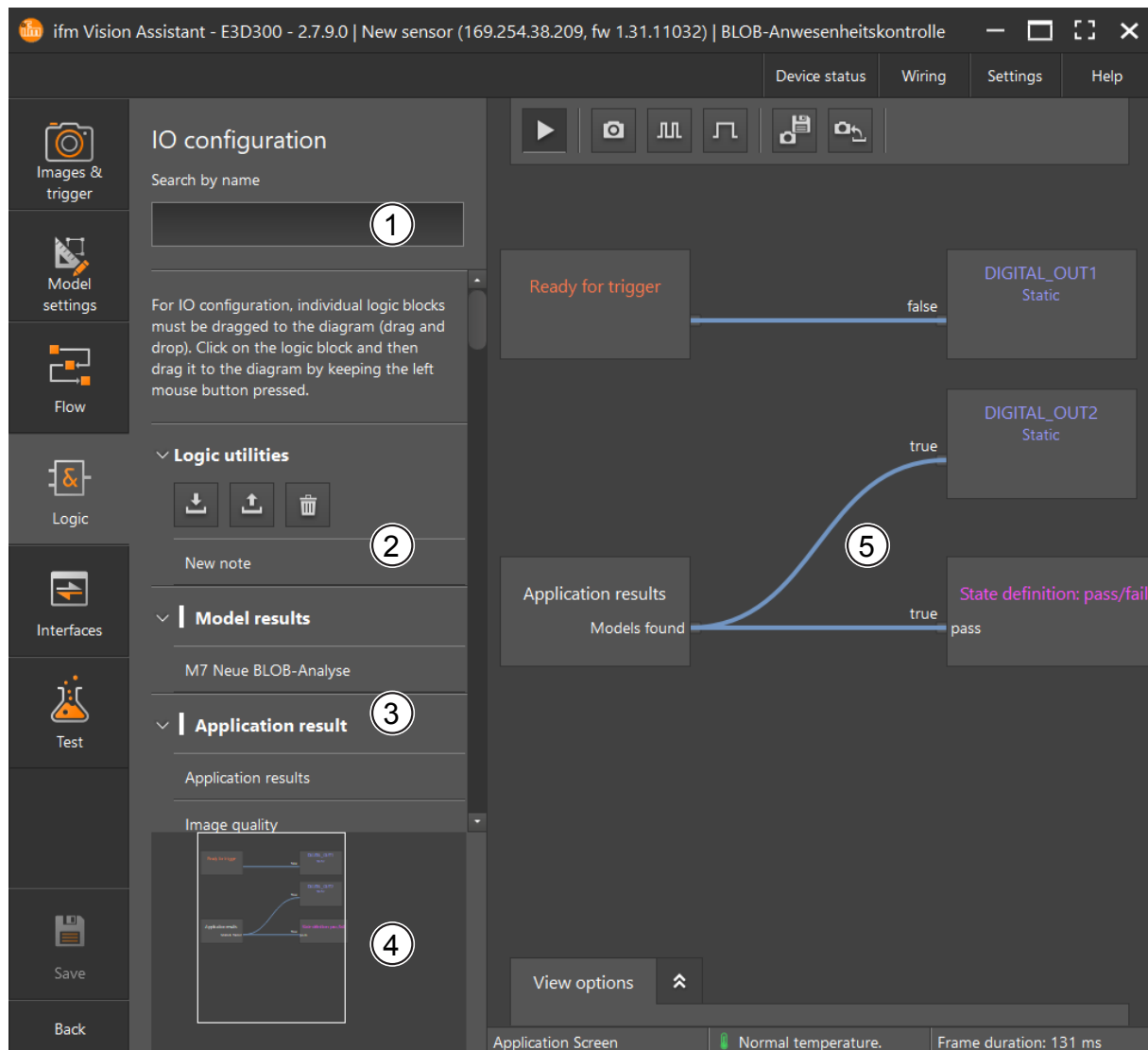


Fig. 44: Function [Logic]

- 1 Search by name
- 2 Logic utilities
- 3 Logic blocks
- 4 Overview area
- 5 Chart

Search by name

In the input field [Search by name], a logic element is searched for by entering the name.

Logic utilities

The [Logic utilities] import and export an output logic. (→ [Logic utilities](#) 119) The export saves the output logic and makes it interchangeable with other devices.

Logic blocks

The logic blocks are used to create an output logic in the diagram. (→ [Logic block](#) 119) The logic blocks are placed in the diagram by clicking and dragging using the mouse:

- Click the logic block and keep the mouse button pressed.
- Drag the logic block into the diagram and release the mouse button.

▷ The logic block is placed.



At the edge of each logic block, there is at least one contact area via which the logic blocks are connected. (→ [Logic block](#) 119)

Overview area

The overview area displays a reduced overview of the diagram. The white frame is shifted using the mouse. By this, the logic blocks outside the visible area can be displayed.

Diagram

The output logic is created in the diagram. (→ [Output logic](#) 120) The pin events and the outputs are displayed as logic blocks with different designations and font colours. The logic blocks are connected by connecting lines. The connecting lines represent the data flow between the logic blocks. Next to the inputs of the logic blocks, the current state of the input is displayed.

10.4.1 Logic utilities

The [Logic utilities] function imports, exports and deletes an output logic. The export saves the output logic in a file that can be used with other devices.

The function [Logic utilities] contains the following operating elements:

Operating element	Name	Description
	Importing logic	Imports the output logic from a file with the extension *.o2x1gc .
	Exporting entire logic	Exports the output logic to a file with the extension *.o2x1gc .
	Deleting logic	Deletes the created output logic in the diagram after confirmation. The data cannot be restored.

10.4.2 Logic block

Editing a logic block

Logic blocks can be edited in several ways. The available functions are displayed as buttons for the selected logic block.

The following buttons are used to edit a logic block:

Operating element	Function	Description
	Duplicate	Creates a duplicate of the selected logic block.
	Delete	Deletes the selected logic block.
	Set	Sets the selected logic block.

Connect logic block

The contact areas at the border connect the logic blocks.

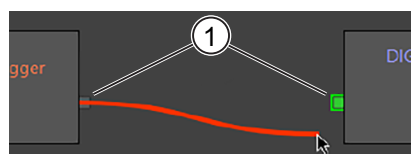


Fig. 45: Contact surfaces with red connecting line

1 Contact areas

Connect a logic block:

- Click the contact area at the right border of a logic block and keep the mouse button pressed.
- ▷ The contact areas of the outputs are at the right border.
- Drag the connecting line to a free contact area on the left border of a logic block and release the mouse button.
- ▷ The contact areas of the inputs are at the left border.



During connection, the compatibility of the logic block is verified. For example, a numeric output cannot be connected to a Boolean input. The inputs compatible with the output value are displayed in blue.

The units of measurement of the logic blocks are not checked when connecting.

Delete a connecting line:

- Click the connecting line.
- Click on the button [Delete]: 
- ▷ The connecting line is deleted.

Select multiple logic blocks

By holding down the Ctrl key and clicking with the left mouse button, several logic blocks are selected. The selected logic blocks can then be exported as a bundle, duplicated or deleted.

The selected logic blocks are highlighted with a frame. The following operating elements are displayed below the frame:

Operating element	Function	Description
	Duplicate	Duplicates the selected logic blocks. Some logic blocks may only be present once in the output logic and therefore cannot be duplicated.
	Export	Exports the selected logic blocks to a file with the extension *.o2x1gc .
	Delete	Deletes the selected logic blocks.

10.4.3 Output logic

The output logic is created in the diagram. The model and pin data is assigned to the outputs in the output logic. The following rules apply for creating an output logic:

- The pin events are provided as Boolean numbers (1 = true, 0 = false) and assigned to digital outputs.
- The model results are numerical values and are processed as follows:
 - use of operators,
 - digitalisation by comparison with other results or values,
 - transfer of digitalised numerical values by applying arithmetic operators and logic functions,
 - output of a Boolean value via a digital output or a virtual pin.

The following figure shows an overview of the configuration options in the output logic. The numbers identify the connection between the logic blocks.

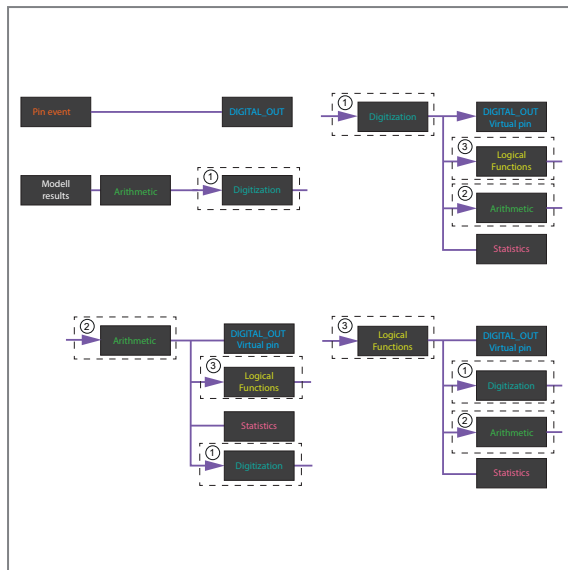


Fig. 46: Output logic

10.4.4 Logic block [New note]

The logic block [New note] inserts notes into the diagram. The notes contain any text and behave like a sticky note.

The following functions are used to set the logic block:

Function	Button	Description
Edit text	-	Clicking within the note displays a cursor that is used to add and edit text.

10.4.5 Logic blocks [Model results]

In the area [Model results], the created models are listed as logic blocks. (→ [Models](#) 65) The logic blocks provide the characteristics of the detected codes at the outputs.

1D barcode and 2D data code

After placing the logic block [Model results] -> [1D barcode] or [2D data code] with or without anchor tracking, the function is set:

List	Description
[Code details]	Sets the function of the logic block: [Code details]: provides the code details at the outputs. [Quality grading]: provides the results of the quality assessment at the outputs. [ROI]: provides the status of a specific ROI group at the outputs. [OCR]: provides the results of the text recognition at the outputs. [Model overview]: provides the status of all ROI groups and the decoding status at the outputs.
[ROI 0]	Sets the ROI group.
[Code index 0]	Sets a specific code. For access to a specific code, the number of codes per ROI group must be set to a value "≥0". (→ Number of codes per ROI group 70)
[Row number 0]	Sets a specific line of text recognition.

With the [Code details] function, the logic block provides the following outputs:

Output	Number format	Description
[Code content]	alphanumeric	Content of the code taking into account the coding. (→ Encoding □ 69)
[Code found]	bool	State of the code: “ Code gefunden “ “ Code nicht gefunden “
[Centre X]	numeric	The centre of the code on the X-axis.
[Centre Y]	numeric	The centre of the code on the Y-axis.
[Orientation]	numeric	Orientation of the code in degrees.
[Half width]	numeric	Half width of the code.
[Half height]	numeric	Half height of the code.
[Binary code content]	byte array	Code content as uncoded raw data (byte array). The output must be connected to the “Equal bytes” logic block. (→ Logic blocks [Binary operations] □ 135)

With the [Quality grading] function, the logic block provides the following outputs for 1D barcodes:

Output	Number format	Description
[User-defined overall quality]	Float	The overall quality of the code corresponds to the individual characteristic with the poorest rating, depending on the quality parameters set.
[Overall quality]	Float	The overall quality of the code corresponds to the individual characteristic with the poorest effect. The following quality gradings exist: 0-4 (0 = bad; 4 = very good) A-F (F = bad; A = very good) The grading 0-4 or A-F is determined by the standard used.
[Additional requirements]	Float	Specific requirements of the symbology
[Decodability]	Float	Deviations of the symbol element widths from the nominal value. The nominal value is defined in the symbology standard.
[Decode]	Float	Readability of the code: 4 : readable 0 : not readable
[Defects]	Float	Defects are irregularities in the grey-scale value profile of symbol elements or quiet zones.
[Minimum edge contrast]	Float	Assessment of the minimum contrast between two adjoining symbol elements in the grey-scale value profile (light to dark element or dark to light element).
[Minimum reflectance]	Float	Minimum reflection value of the grey-scale value profile: 4 : the minimum reflection value is $\leq 0,5$ of the maximum reflection value 0 : the minimum reflection value is $> 0,5$ of the maximum reflection value
[Modulation]	Float	Uniformity of the light and dark bars.
[Symbol contrast]	Float	Contrast of the bars against the background.

With the [Quality grading] function, the logic block provides the following outputs for 2D data codes and the quality grading “ISO”:

Out	Number format	Description
[User-defined overall quality]	Float	The overall quality of the code corresponds to the individual characteristic with the poorest effect, depending on the quality parameters set.
[Overall quality]	Float	The overall quality of the code corresponds to the individual characteristic with the poorest effect. The following quality gradings exist: 0-4 (0 = bad; 4 = very good) A-F (F = bad; A = very good) The grading 0-4 or A-F is determined by the standard used.
[Contrast]	Float	Contrast of the modules relative to the background.
[Modulation]	Float	Uniformity of the light and dark modules.
[Fixed pattern damage]	Float	Error rate in the 3 basic elements of the code: finder pattern, alternating pattern and quiet zone.
[Decode]	Float	Readability of the code: 4 : readable 0 : not readable
[Axial non-uniformity]	Float	Ratio of the module size in horizontal and vertical direction.
[Grid non-uniformity]	Float	Orientation of the modules relative to the specific symbol grid.
[Unused error correction]	Float	Codes with error correction have redundancy for correcting reading errors. The value indicates how much of the redundancy is not used during reading.
[Reflectance]	Float	Assessment of the amplitude between the DataCode modules.
[Print growth]	Float	Ratio dark/light modules in the alternating pattern.
[Contrast uniformity]	Float	Smallest numerical value for the modulation in the entire code.
[Aperture]	Float	Size indication of the synthetic aperture in relation to the module size of the symbol. The aperture is used to create the reference grey-scale image which is required for the quality assessment.
[Format information (µQR/QR only)]	Float	Assessment of the modules containing the format information.
[Version information (µQR/QR only)]	Float	Assessment of the modules containing the version information.

With the [Quality grading] function, the logic block provides the following outputs for 2D data codes and the quality grading "AIM / ISO-TR29158":

Out	Number format	Description
[User-defined overall quality]	Float	Overall quality of the code corresponds to the individual characteristic with the poorest effect. Depends on the set quality parameters.
[Overall quality]	Float	Overall quality of the code corresponds to the individual characteristic with the poorest effect.
[Cell contrast]	Float	Contrast of the modules relative to the background.
[Cell modulation]	Float	Uniformity of the light and dark modules.

Out	Number format	Description
[Fixed pattern damage]	Float	Error rate in the 3 basic elements of the code: finder pattern, alternating pattern and quiet zone.
[Decode]	Float	Readability of the code: 4 : readable 0 : not readable
[Axial non-uniformity]	Float	Ratio of the module size in horizontal and vertical direction.
[Grid non-uniformity]	Float	Orientation of the modules relative to the specific symbol grid.
[Unused error correction]	Float	Error of the code and share of the available error correction mechanisms to successfully decode the code.
[Mean light]	Float	Assessment of the image quality, calculated via the medium grey-scale value of the centres of the bright DataCode modules. The values are in the range 0,0 (0 %) to 1,0 (100 %) of the full grey-scale range (255 for byte images).
[Reflectance]	Float	Assessment of the amplitude between the DataCode modules.
[Print growth]	Float	Ratio dark/light modules in the alternating pattern.
[Contrast uniformity]	Float	Smallest numerical value for the modulation in the entire code.
[Aperture]	Float	Size indication of the synthetic aperture in relation to the module size of the symbol. The aperture is used to create the reference grey-scale image which is required for the quality assessment.
[Format information (mqr/qr only)]	Float	Assessment of the modules containing the format information.
[Version information (mqr/qr only)]	Float	Assessment of the modules containing the version information.

With the [Quality grading] function, the logic block provides the following outputs for 2D data codes and the quality grading "SEMI T10":

Out	Number format	Description
[P1 row]	Float	Corner 1 position Y coordinates
[P1 column]	Float	Corner 1 position X coordinates
[P2 row]	Float	Corner 2 position Y coordinates
[P2 column]	Float	Corner 2 position X coordinates
[P3 row]	Float	Corner 3 position Y coordinates
[P3 column]	Float	Corner 3 position X coordinates
[P4 row]	Float	Corner 4 position Y coordinates
[P4 column]	Float	Corner 4 position X coordinates
[Rows]	Float	ECC200 N (rows)
[Columns]	Float	ECC200 M (columns)
[Symbol contrast]	Float	The value for symbol contrast designates the contrast between light and dark classified symbol pixels in percent of the full grey-scale value range (255 for byte images).
[Symbol contrast SNR]	Float	Symbol contrast SNR is the corresponding signal-to-noise ratio.

Out	Number format	Description
[Horizontal mark growth]	Float	Module width relative to the sum of light and dark modules [%]
[Vertical mark growth]	Float	Module height relative to the sum of light and dark modules [%]
[Data matrix cell width]	Float	Average module width
[Data matrix cell height]	Float	Average module height
[Horizontal mark misplacement]	Float	Misplacement in horizontal direction [%]
[Vertical mark misplacement]	Float	Misplacement in vertical direction [%]
[Cell defects]	Float	Misclassified symbol pixels [%]
[Finder pattern defects]	Float	Misclassified finder pattern pixels [%]
[First unused error correction]	Float	Unused capacities for error correction [%]

With the [Quality grading as string] function, the logic block provides the following output:

Out	Number format	Description
[Qualities]	numeric	Result of the quality grading as a string. The individual quality values are separated by delimiters. Which quality values are output is determined by the setting of the model. The quality values are output in the pin order of their respective code quality blocks. The grading scheme and the delimiters can be set.

With the [ROI] function, the logic block provides the following outputs:

Out	Number format	Description
[All codes found]	bool	State of the code: “all codes found” “no code found” or “not all codes found”
[Decoding status]	numeric	State of the selected ROI group: 0 : The ROI group has not yet been completely executed. 1 : The ROI group has been completely executed. 2 : The ROI group is not executed due to timeout. 3 : The ROI group is not completely executed because of an unknown error.
[Found codes]	numeric	Number of codes found.
[Searched codes]	numeric	Number of codes searched for.

With the [OCR] function, the logic block provides the following outputs:

Out	Number format	Description
[Corrected text]	string	The detected text. Preset: empty.
[Centre X]	numeric	The centre of the code on the X-axis.
[Centre Y]	numeric	The centre of the code on the Y-axis.
[Result]	numeric	How well the line of text matches the regular expression. Preset: 0.0

With the [Model overview] function, the logic block provides the following outputs:

Out	Number format	Description
[All ROIs passed]	bool	State of the ROI groups.
[Decoding status]	numeric	State of the selected model: 0 : The model was not completely executed. 1 : The model was completely executed. 2 : The model is not executed due to a timeout. 3 : The model is executed incompletely due to unknown errors.

Contour detection and anchor tracking contour

After placing the logic element [Model results] -> [Contour detection] or [Contour anchor tracking], the function is set. Some functions are only available for calibrated devices. ([→ Calibration wizards](#) [135](#))

List	Description
[Object properties]	Sets the function of the logic block: [Object properties]: provides the properties of the object at the outputs. [Object properties (calibrated)]: provides the properties of the object with calibrated values at the outputs of a device. [ROI result]: provides the status of a specific ROI group at the outputs. [ROI result (calibrated)]: provides the status of a specific ROI group at the outputs of a calibrated device. [Model overview]: provides the status of all ROI groups and the decoding status at the outputs.
[ROI 0]	Sets the ROI group.
[0]	Sets an object index. For access to a specific object, the number of objects per ROI group must be set to a value " ≥ 0 ".

With the functions [Object properties] and [Object properties (calibrated)], the logic block provides the following outputs:

Out	Number format	Description
[Position X]	numeric	Position of the object on the X-axis.
[Position Y]	numeric	Position of the object on the Y-axis.
[Position Z]	numeric	Position of the object on the Z-axis. The output is only available for calibrated devices.
[Orientation]	numeric	Orientation of the object.
[Score]	numeric	Evaluation of the object.

With the functions [ROI result] and [ROI result (calibrated)], the logic block provides the following outputs:

Out	Number format	Description
[ROI passed]	bool	Status of an ROI.
[Number of objects]	numeric	Number of objects found
[ROI score min.]	numeric	Value of the contour with the lowest score within the ROI.
[ROI score max.]	numeric	Value of the contour with the highest score within the ROI.
[Matches centre X]	numeric	Averaged X-value of all contours found in the ROI. The position reference of the contour is decisive. (→ Contour detection 104)

Out	Number format	Description
[Matches centre Y]	numeric	Averaged Y-value of all contours found in the ROI. The position reference of the contour is decisive. (→ Contour detection ▢ 104)
[Matches centre Z]	numeric	Averaged Z-value of all contours found in the ROI. The position reference of the contour is decisive. (→ Contour detection ▢ 104) The output is only available for calibrated devices. (→ Calibration wizards ▢ 35)

With the [Model overview] function, the logic block provides the following outputs:

Out	Number format	Description
[All ROIs passed]	bool	Status of all ROI groups.
[Model number of matches]	numeric	Number of objects found
[Model score min.]	numeric	Value of the contour with the lowest score within the model.
[Model score max.]	numeric	Value of the contour with the highest score within the model.

BLOB analysis

After placing the logic element [Model results] -> [BLOB analysis], the function is set. Some functions are only available for calibrated devices. ([→ Calibration wizards ▢ 35](#))

List	Description
[Geometry]	Sets the function of the logic block: [Geometry]: The geometrical properties of the object. [Geometry (calibrated)]: The numerical properties of an object with calibrated values at the outputs of the device. [Circular]: The circularity of the object [0..100]. For a perfect circle, the output value is " 100 ". [Circular (calibrated)]: The circularity [0..100] of an object with calibrated values at the outputs of the device. For a perfect circle, the output value is " 100 ". [Rectangular]: The rectangularity of the object [0..100]. For a perfect rectangle, the output value is " 100 ". [Rectangular (calibrated)]: The rectangularity [0..100] of an object with calibrated values at the outputs of the device. For a perfect rectangle, the output value is " 100 ". [Greyscales]: The greyscales of the object. [Other]: Other properties of the object. [ROI result]: The status of a particular ROI group. [ROI result (calibrated)]: The status of a specific ROI group of an object with calibrated values at the outputs of the device. [Model overview]: The status of all ROI groups, the number of model objects and the total area model. [Model overview (calibrated)]: The status of all ROI groups, the number of model objects and the total area model of an object with calibrated values at the outputs of the device.
[ROI 0]	Sets the ROI index.
[0]	Sets an object index. For access to a specific object, the number of objects per ROI group must be set to a value " >=0 ".

With the [Geometry] and [Geometry (calibrated)] functions, the logic block provides the following outputs:

Out	Number format	Description
[Valid object area]	bool	Validity of the object area.

Out	Number format	Description
[Object area]	numeric	The area of the object defined via the ROI and object index. 
[Valid position X]	bool	Validity of position X.
[Position X]	numeric	The centre of gravity of the object on the X-axis, measured from the left image border. 
[Valid position Y]	bool	Validity of position Y.
[Position Y]	numeric	The centre of gravity of the object on the Y-axis, measured from the top image border. 
[Position Z]	numeric	Position Z starting from the position reference. The output is only available for calibrated devices. (→ Calibration wizards 35)
[Valid object height]	bool	Validity of the object height.
[Object height]	numeric	The height of the smallest rectangle that completely encloses the object and whose sides are parallel to the image border. 
[Valid object width]	bool	Validity of the object width.
[Object width]	numeric	The width of the smallest rectangle that completely encloses the object and whose sides are parallel to the image border. 

With the [Circular] and [Circular (calibrated)] functions, the logic block provides the following outputs:

Out	Number format	Description
[Valid roundness]	bool	Validity of roundness.

Out	Number format	Description
[Roundness]	numeric	The roundness describes the ratio of all distances of the contour points to the centre of gravity to the average deviation. A narrow notch in the object (pizza slice) has a significant effect on its roundness. A perfectly round circle has the value "100". Formula • "p": centre of gravity. • "p_i": points. • "F": area of the contour. $Distance = \frac{1}{F} \sum \ p - p_i\ $ $Sigma^2 = \frac{1}{F} \sum (\ p - p_i\ - Distance)^2$ $Roundness = 1 - \frac{Sigma}{Distance}$ 
[Valid outer radius]	bool	Validity of the outer radius.
[Outer radius]	numeric	The radius of the smallest circle that completely encloses the object. 
[Valid inner radius]	bool	Validity of the inner radius.
[Inner radius]	numeric	The radius of the largest circle that fits completely inside the object. 
[Valid circularity]	bool	Validity of circularity. The output is only available for non-calibrated devices.

Out	Number format	Description
[Circularity value]	numeric	The circularity describes the maximum distance of a contour point to the centre of gravity in relation to the object area of the BLOB object. A narrow notch in the object (pizza slice) has a small effect on the circularity. A perfectly round circle has the value "100". The output is only available for uncalibrated devices. Formula • "F": area of the region. • "max": max. distance from the centre of gravity to all contour points. • "C": Circularity $C' = \frac{F}{(max^2 * \pi)}$ 

With the [Rectangular] and [Rectangular (calibrated)] functions, the logic block provides the following outputs:

Out	Number format	Description
[Valid rectangularity]	bool	Validity of the rectangularity.
[Rectangularity]	numeric	The rectangularity of the object. A perfect rectangle has the value "100". 
[Valid inner width]	bool	Validity of the inner width.
[Inner width]	numeric	The width of the largest rectangle that fits completely inside the object and whose sides are parallel to the image border. 
[Valid inner height]	bool	Validity of the inner height.
[Inner height]	numeric	The height of the largest rectangle that fits completely inside the object and whose sides are parallel to the image border. 

With the [Greyscales] function, the logic block provides the following outputs:

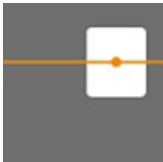
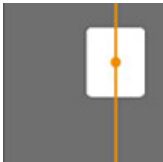
Out	Number format	Description
[Valid min. greyscale value]	bool	Validity of the minimum greyscale value.
[Min. greyscale value]	numeric	The lowest greyscale value of the object. 
[Valid max. greyscale value]	bool	Validity of the maximum greyscale value.
[Max. greyscale value]	numeric	The highest greyscale value of the object. 
[Valid greyscale value deviation]	bool	Validity of the greyscale value deviation.
[Greyscale value deviation]	numeric	The standard deviation of the object (homogeneity). The value is low for uniformly grey objects and high for irregular surfaces or greyscale gradients. 
[Valid average greyscale value]	bool	Validity of the average greyscale value.
[Average greyscale value]	numeric	The average greyscale value of the object. 

With the [Others] function, the logic block provides the following outputs:

Out	Number format	Description
[Valid compactness]	bool	Validity of compactness.
[Compactness]	numeric	The compactness of the object. Empty regions have the value "0"; circular objects have the value "1". Long narrow objects have average values. Entangled objects and objects with holes have high values. 
[Valid number of holes]	bool	Validity of the number of holes.

Out	Number format	Description
[Number of holes]	numeric	The number of holes in the object. 
[Valid orientation]	bool	Validity of the orientation.
[Orientation]	numeric	The orientation of the object in degrees. 

With the [Shape] function, the logic block provides the following outputs:

Out	Number format	Description
[Valid perimeter]	bool	Validity of the perimeter.
[Perimeter]	numeric	Length of the outer contour of the object. 
[Valid centre X of the bounding box]	bool	Validity of the horizontal coordinate of the object's geometric centre.
[Centre X of the bounding box]	numeric	Horizontal coordinate of the object's geometric centre, measured from the left image border. 
[Valid centre Y of the bounding box]	bool	Validity of the vertical coordinate of the object's geometric centre.
[Centre Y of the bounding box]	numeric	Vertical coordinate of the object's geometric centre, measured from the top image border. 

With the [ROI result] and [ROI result (calibrated)] functions, the logic block provides the following outputs:

Out	Number format	Description
ROI passed	bool	Status of an ROI.
Number of matches	numeric	Number of objects found within the ROI.
Total area	numeric	Size of the total area within the ROI.

With the [Model overview] and [Model overview (calibrated)] functions, the logic block provides the following outputs:

Out	Number format	Description
All ROIs passed	bool	Status of all ROIs
Number of model objects	numeric	Number of objects found within the model.
Total area model	numeric	Size of the total area within the model.

10.4.6 Logic block [Application result]

The following logic blocks are provided in the [Application result] area:

Logic block	Number format on the output	Description
[Application results]	bool	Displays the state of the models contained in the application: [All models found] [Not all models found]
[Image quality]	[Sharp warning]: bool [Sharpness]: numerical [Brightness warning]: bool [Brightness]: numerical [Under-exposed warning]: bool [Under-exposed]: numerical [Overexposed warning]: bool [Overexposed]: numerical	Provides the warning flag and value for each quality aspect (sharpness, brightness, underexposure, overexposure).
[Anchor tracking result]	[Valid] bool [Orientation]: numerical [Displacement X]: numerical [Shift Y]: numerical	Displays values of the anchor tracking at the outputs.

10.4.7 Logic blocks [String operations]

The following logic blocks are provided in the [String operations] area:

Logic block	Number format on the input	Number format on the output	Description
[Fixed string]	-	alphanumeric	Provides an adjustable character string which is used for operations with character strings.
[PCIC input string]	-	alphanumeric	Provides an adjustable character string (ID 00 to 09) which is transferred to a controller for operations. The character string can be changed during the runtime with the J Command (see separate Programmer's Guide).
[Equal strings]	alphanumeric	bool	Compares the character string on both inputs in view of identical content: a==b = 1 : The character strings are identical. a!=b = 1 : The character strings are not identical.

Logic block	Number format on the input	Number format on the output	Description
[Match regex]	alphanumeric	alphanumeric	Applies a regular expression (regex) to the character string on the input. If an expression is found, the [Match pattern] output provides a Boolean 1. The expression found is provided at the [Output string] output. Example: For <code>\b([0-9]{4})\b</code> , the result is <code>True</code> if the code has exactly 4 digits.
[Match pattern]	alphanumeric	bool	Searches a pattern in the input string. Wildcards such as <code>*</code> and <code>?</code> are accepted for the pattern (example: <code>*.png</code>). If the input string contains the pattern, a Boolean 1 is provided at the output.
[Split by delimiter]	alphanumeric	alphanumeric	Searches the delimiter in the character string. The character string is split at the positions of the delimiter. The split string of characters is provided one after the other on the 7 outputs without the delimiter. If the character string is split in more than 7 segments at the input, the segments >7 are provided at the outputs.
[Split string at position]	character string: alphanumeric, position: numeric	alphanumeric	Splits a character string at a certain position. The split character string is provided on the outputs.
[Concatenation]	alphanumeric	alphanumeric	Concatenates up to 7 character strings, optionally with a delimiter. The character string and the optional delimiter are provided via the [Fixed string] logic blocks, for example.
[Selection]	bool / alphanumeric	alphanumeric	If there is a Boolean 0 on the [Selection (true / false)] input, the character string is provided on the [Option false] input. If there is a Boolean 1 on the [Selection (true / false)] input, the character string is provided on the Option true input.
[Find first wildcard match]	string	[is a match]: bool [ID of match]: number [match string]: string	Applies the pattern to all strings until the result is true. If successful, the output contains: • state, • ID of the string, • matching Wildcards such as <code>*</code> and <code>?</code> are accepted for the pattern (example: <code>*.png</code>). Case sensitivity can be activated in the settings.
[Case converter]	string	string	Converts the string at the input into lower- or upper-case letters.

10.4.8 Logic blocks [Binary operations]

The following logic blocks are provided in the area [Binary operations]:

Logic block	Number format on the input	Number format on the output	Description
[Fixed binary data]	-	byte array	Provides adjustable binary data which is used for operations with binary data.
[Binary data input]	-	byte array	Provides adjustable binary data (ID 00 to 09) which is transferred to a controller for operations. The binary data can be changed during the runtime with the J Command (see separate document Programmers Guide).
[Equal bytes]	byte array	bool	Compares the binary data at the inputs in view of identical content: $a == b = 1$: The binary data is identical. $a != b = 1$: The binary data is not identical.
[Split binary by delimiter]	byte array	byte array	Searches the delimiter in the binary data. The binary data is split at the positions of the delimiter. The split binary data is provided one after the other at the 7 outputs without the delimiter. If the binary data is split in more than 7 segments at the input, the segments >7 are provided at the outputs.
[Split binary at position]	byte array	byte array	Splits the binary data at a certain position. The split binary data is provided at the outputs.
[Concatenate binaries]	byte array	byte array	Concatenates up to 7 binary data, optionally with a delimiter. The binary data and the optional delimiter are provided via the logic blocks "Fixed binary data", for example.
[Select binary]	byte array	byte array	If there is a Boolean 0 at the input [Switch (0/1)], the binary data is provided at the input [Option 0]. If there is a Boolean 1 at the input [Switch (0/1)], the binary data is provided at the input [Option 1].

10.4.9 Logic blocks [Arithmetic]

The following logic blocks are provided in the area [Arithmetic]:

Logic block	Number format on the input	Number format on the output	Description
[DIFF]	numeric	numeric	The signals on the inputs are subtracted. The two outputs provide the result with different signs.
[ADD]	numeric	numeric	The signals on the inputs are added.

Logic block	Number format on the input	Number format on the output	Description
[COUNT]	bool	numeric	The signals on the inputs are added. The Boolean values at the input are treated as numerical values.
[Min max value]	numeric	numeric	The minimum and maximum values are determined on the basis of the signals on the inputs.
[Fixed value]	–	numeric	A floating point number is set as a fixed value. The fixed value is provided and can be used for the logic blocks [DIFF] and [ADD] (for example to set an offset).
[Distance between points]	numeric	numeric	Calculates the distance between 2 points in pixels. All 4 values are necessary for the calculation.
[DIV]	numeric	[a/b]: numeric [Valid]: bool	Divide [a] by [b]. If divided by zero, [a/b] will output 0 and [Valid] false.
[MUL]	numeric	numeric	Multiplies [a] by [b].
[MOD]	numeric	[a%b]: numeric [Remainder]: numeric [Valid]: bool	Calculates the quotient and remainder from the Modulo operation of [a] by [b]. If divided by zero, [a%b] will output 0 and [Valid] false.
[Amount]	numeric	numeric	Outputs the absolute value of [a]. The values at the input and output have the same number format.

10.4.10 Logic blocks [Converter]

The following logic blocks are provided in the area [Converter]:

Logic block	Number format on the input	Number format on the output	Description
[String to number]	alphanumeric	numeric	Converts the alphanumeric data at the input to numeric data at the output.
[Number to string]	numeric	alphanumeric	Converts the numeric data at the input to alphanumeric data at the output.
[Binary to string]	byte array	alphanumeric	Converts the binary data at the input to alphanumeric data at the output.
[String to binary]	alphanumeric	byte array	Converts the alphanumeric data at the input to binary data at the output.
[Number to binary]	numeric	byte array	Converts the numeric data at the input to binary data at the output.

Logic block	Number format on the input	Number format on the output	Description
[Bool to string]	bool	alphanumeric / numeric	Converts the Boolean data at the input depending on the setting of the logic element: [Word] setting: returns the alphanumeric value [true] or [false]. [Numeric] setting: outputs the numeric value 1 or 0.
[Bool to binary]	bool	byte array	Converts the Boolean data at the input to binary data at the output.
[String to bool]	alphanumeric	bool	Converts the alphanumeric data at the input to Boolean data at the output.
[Binary to bool]	byte array	bool	Converts the binary data at the input to Boolean data at the output.
[Number to bits]	numeric	bool	Converts the numeric data at the input into an integer number with 32 bits. The lowest 8 bits are output. If the [Cap bit] setting of the logic element is activated and set to >0, true is present at all outputs, even if the number at the input would result in a larger bit value. Example for [Cap bit] = >0 : There are 5 pins available at the output. If a number >=32 appears at the input, true should be present at all outputs.
[Bits to number]	bool	numeric	Converts bit data at the input to numeric data between 0 and 255. Unused inputs are treated as 0.

10.4.11 Logic blocks [Digitalisation]

The following logic blocks are provided in the area [Digitalisation]:

Logic block	Number format on the input	Number format on the output	Description
[Min. quality check]	numeric	bool	Compares the [quality grading value] at the input with a set comparison value. Possible comparison values: A-F 4-0 If the result of the comparison is better or equal, 1 will be output.
[Comparator]	numeric	bool	Compares the signals at the inputs with each other. Signals on the outputs: 1 : The relation displayed in the output name applies. 0 : The relation displayed in the output name does not apply.

Logic block	Number format on the input	Number format on the output	Description
[Window function FNC]	numeric	bool	Compares the [value] input with the 2 threshold values [THR1] and [THR2]. The output behaves like an NC contact (normally closed): 0 : Value < THR1 0 : Value > THR2 1 : Value $\geq$ THR1 AND Value $\leq$ THR2
[Window function FNO]	numeric	bool	Compares the [value] input with the 2 threshold values [THR1] and [THR2]. The output behaves like a NO contact (normally open): 1 : Value < THR1 1 : Value > THR2 0 : Value $\geq$ THR1 AND Value $\leq$ THR2
[Window function FNCh]	numeric	bool	Compares the [value] input with the 2 threshold values [THR1] and [THR2]. The output behaves like an NC contact (normally closed). Switching at the threshold values is delayed (switching hysteresis): 0 : Value < (THR1 - 0.5 * hysteresis) 0 : Value > (THR2 + 0.5 * hysteresis) 1 : Value $\geq$ (THR1 + 0.5 * hysteresis) AND value $\leq$ (THR2 - 0.5 * hysteresis) The output value remains unchanged in the hysteresis ranges: Hysteresis = 0.05 * (THR2 - THR1) Hysteresis = 2 mm if 0.05 * (THR2 - THR1) $\leq$ 2 mm
[Window function FNOh]	numeric	bool	Compares the [value] input with the 2 threshold values [THR1] and [THR2]. The output behaves like an NO contact (normally open). Switching at the threshold values is delayed (switching hysteresis): 1 : Value > (THR2 + 0.5 * hysteresis) 0 : Value $\geq$ (THR1 + 0.5 * hysteresis) AND value $\leq$ (THR2 - 0.5 * hysteresis) The output value remains unchanged in the hysteresis ranges: Hysteresis = 0.05 * (THR2 - THR1) Hysteresis = 2 mm if 0.05 * (THR2 - THR1) $\leq$ 2 mm

Logic block	Number format on the input	Number format on the output	Description
[Hysteresis HNC]	numeric	bool	Compares the [value] input with the 2 threshold values [THR1] and [THR2]. The output behaves like an NC contact (normally closed). The threshold values correspond to the switching values of the hysteresis: 0 : Value < THR1 1 : Value > THR2 In the hysteresis ranges, the output value remains unchanged ($\text{THR1} \leq \text{value} \leq \text{THR2}$).
[Hysteresis HNO]	numeric	bool	Compares the [value] input with the 2 threshold values [THR1] and [THR2]. The output behaves like an NO contact (normally open). The threshold values correspond to the switching values of the hysteresis: 1 : Value < THR1 0 : Value > THR2 In the hysteresis ranges, the output value remains unchanged ($\text{THR1} \leq \text{value} \leq \text{THR2}$).
[String changed]	alphanumeric	bool	Monitors a string at the input for changes: true : The character string has changed. false : The character string has not changed. After changing or switching an application, a true will be output once, regardless of the character string at the input.

Logic block	Number format on the input	Number format on the output	Description
[Number changed]	numeric	bool	Monitors a number at the input for changes: <code>true</code> : The number structure has changed. <code>false</code> : The number has not changed. A tolerance can be set. Subsequently, only changes that exceed the tolerance will be detected. ► For integer numbers at the input, set the tolerance to <code>0</code>. ► For floating point numbers at the input, set the tolerance to <code>>0</code>. ▷ This takes into account natural inaccuracies of floating point numbers. If the tolerance is set to <code>>0</code>, the comparison value remains unchanged until the tolerance has been exceeded. This allows subtle value deviations to be detected. After changing or switching an application, a <code>true</code> will be output once, regardless of the character string at the input. Example: The tolerance is set to <code>0,1</code>. The following values are at the input: <code>1 1.03 1.06 1.09 1.12 1.15 1.22 1.23</code>. The logic element outputs the following values: <code>true, false, false, false, true, false, false, true</code>.
[Bool changed]	bool	bool	Monitors a Boolean value at the input for changes: <code>true</code> : The value has changed. <code>false</code> : The value has not changed. After changing or switching an application, a <code>true</code> will be output once, regardless of the character string at the input.

10.4.12 Logic blocks [Logical functions]

The following logic blocks are provided in the [Logical functions] area:

Logic block	Number format on the input	Number format on the output	Description
[AND]	bool	bool	Compares the signals on the inputs with each other. Signals on the output: <code>1</code> : All signals on the inputs are <code>1</code>. <code>0</code> : At least one signal on the inputs is <code>0</code>.

Logic block	Number format on the input	Number format on the output	Description
[OR]	bool	bool	Compares the signals on the inputs with each other. Signals on the output: 1 : At least one signal on the inputs is 1. 0 : All signals on the inputs are 0.
[Terminal board]	bool	bool	Transmits the signal on the input to the output.
[NOT]	bool	bool	Inverts the signal on the input. Signals on the output: 1 : The signal on the input is 0. 0 : The signal on the input is 1.
[Fixed bool]	bool	bool	Outputs an adjustable Boolean value.

10.4.13 Logic blocks [Output]

The following logic blocks are provided in the area [Output]:

Logic block	Number format on the input	Description
[String output]	alphanumeric	Saves the received string. The logic block [Output string] is available up to 10x. The content of the logic blocks is retrieved via the process interface. (→ Interfaces □ 146)
[Binary output]	byte array	Saves the received binary data. The logic block [Binary output] is available up to 10x. The byte array has a maximum size of 256 bytes. The content of the logic blocks is retrieved via the process interface. (→ Interfaces □ 146)
[FTP file prefix]	string	Uses the string at the input as a prefix for the FTP/SFTP file name. A maximum of 128 characters is accepted as a string. After that, it will be cut off.
[FTP file suffix]	string	Uses the string at the input as a suffix for the FTP/SFTP file name. A maximum of 128 characters is accepted as a string. After that, it will be cut off.
[DIGITAL_OUT1]	bool	Switches the digital output with or without limited signal duration. The digital outputs have the following settings: [Static]: Switches the digital output without a limited signal duration (recommended setting). [Pulsed]: Switches the digital output with a limited signal duration (≥ 10 ms).
[DIGITAL_OUT2]	bool	
[Virtual pins bytes 1-8]	bool	Transfers the data from the logic area to an interface. The virtual pins are memory banks. A virtual pin consists of an 8-bit order. The 8 virtual pins are arranged in sequence to maximum 64 Boolean values and provided via an interface. (→ Interfaces □ 146) Non-assigned virtual pins provide a Boolean 0.

10.4.14 Logic blocks [Pin events]

The following logic blocks are provided in the [Pin events] area:

Logic block	Number format on the output	Description
[Ready for trigger]	bool	The device is ready for trigger to capture a new image.
[Error]	bool	The device has found an error.
[Image capture finished]	bool	The device has finished the image capture.
[Process Interface]	bool	The digital output is switched via the process interface with the <code>o</code> command (set logic state of an ID). The command is described in the separate "Programmer's Guide": documentation.ifm.com
[Change of application finished]	bool	The application was successfully changed. The logic element can only be connected to the [DIGITAL_OUTx] logic elements.

10.4.15 Logic element [Result status]

The following logic block is provided in the [Result status] area:

Logic block	Number format on the input	Description
[Status definition: pass/fail]	bool	Outputs the result of an application: 1 : The application was successfully executed. 0 : The application was not successfully executed. The result is written in the service report and is available for statistical calculations.
[Publish result (scanner mode)]	bool	Displays a result on the output interfaces (I/O, PCIC, fieldbuses, FTP, USB) when <code>true</code> is present at the input. The results of the output interfaces are published as usual if the logic block is not used. In edit mode, the logic block has no effect, except for test mode.

10.4.16 Example – code found

A digital signal is provided when the device finds a code.

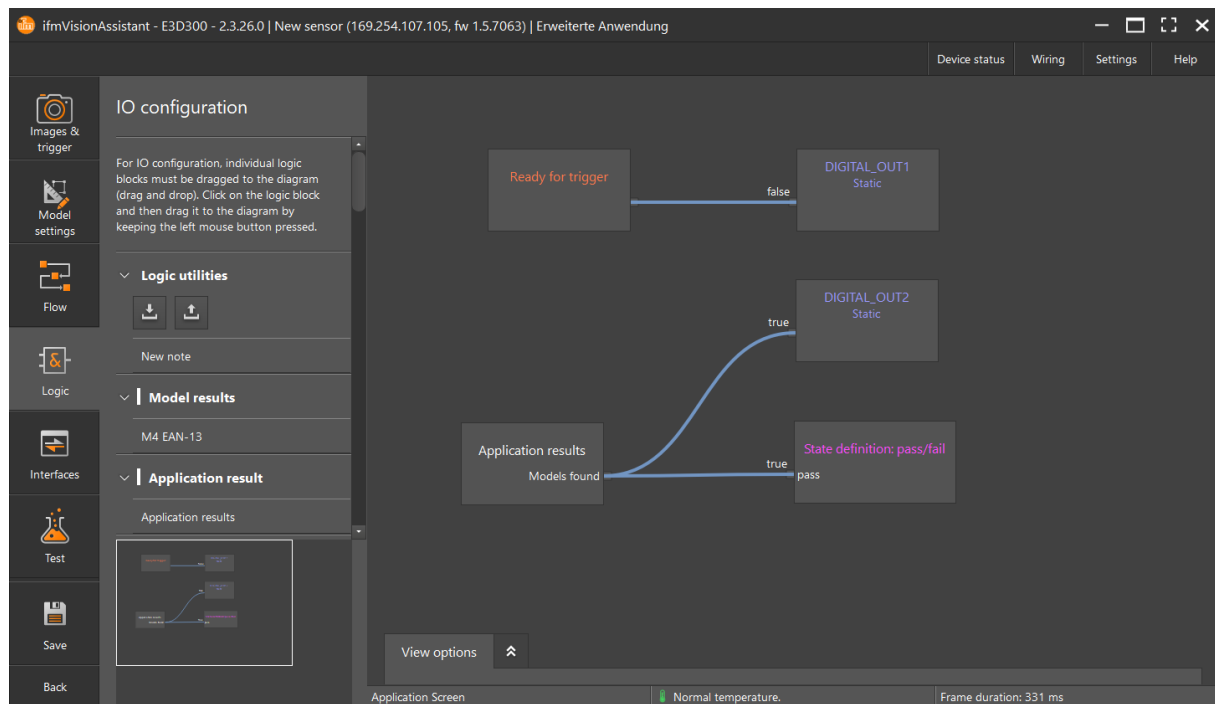


Fig. 47: Example of “Code found”

If the model set in the [Application results] logic block detects the code, the [DIGITAL_OUT2] logic block will provide the signal **High**. If no code is detected, the [DIGITAL_OUT2] logic block will provide the signal **Low**.

10.4.17 Example – compare reference code

A digital signal is provided if two character strings are identical.

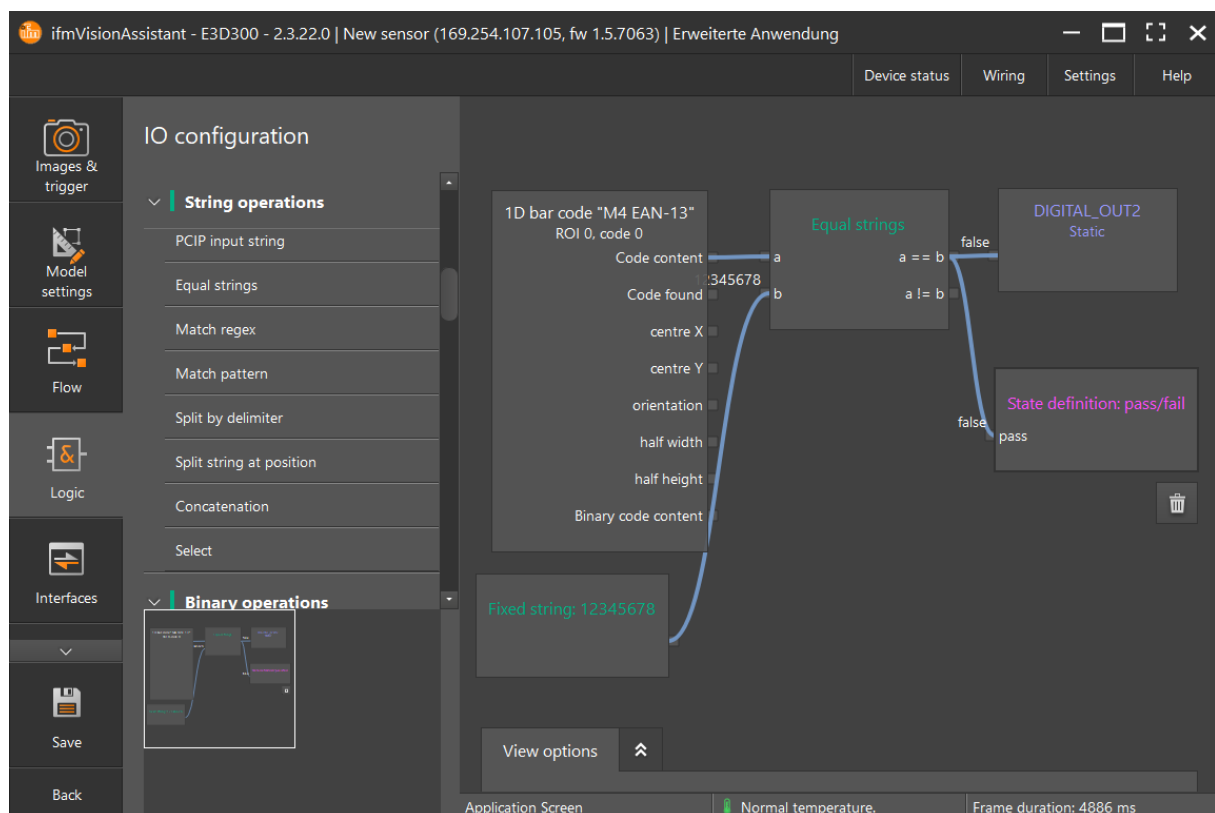


Fig. 48: Example of “Compare reference code”

If the code content of the set model is identical with the character string in the [Fixed string] logic block, the [DIGITAL_OUT2] logic block will provide the signal **High**. If no code is recognised, the [DIGITAL_OUT2] logic block will provide the signal **Low**.

10.4.18 Example – compare reference code

A digital signal is provided if two character strings are identical. One of the character strings can be adapted via the process interface.

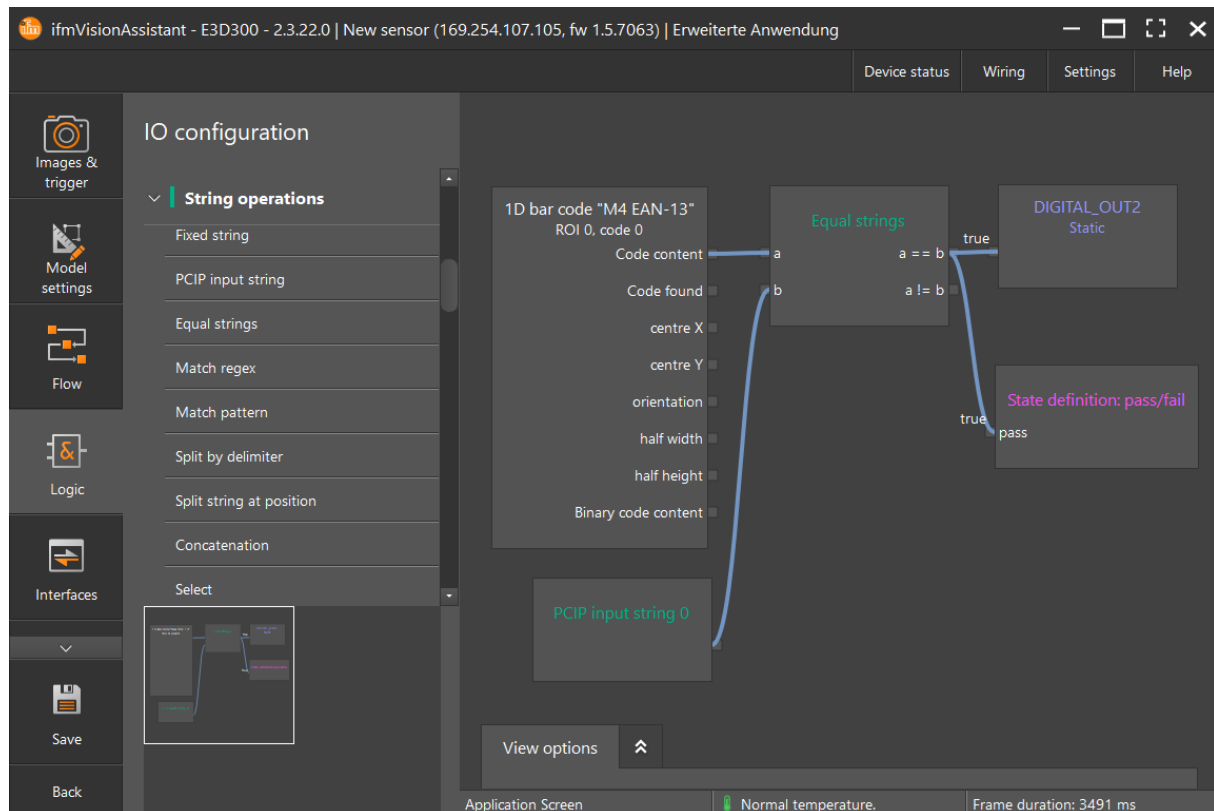


Fig. 49: Example of "Compare reference code"

If the code content of the set model matches the character string in the [PCIP input string] logic block, the [DIGITAL_OUT2] logic block will provide the signal **High**. If no code is recognised, the [DIGITAL_OUT2] logic block will provide the signal **Low**.

The [PCIP input string] logic block is addressed with the **j** Command via the process interface.



The **j** Command is described in the separate Programmer's Guide.

10.4.19 Example – compare distance values

The X and Y positions of two models are compared.

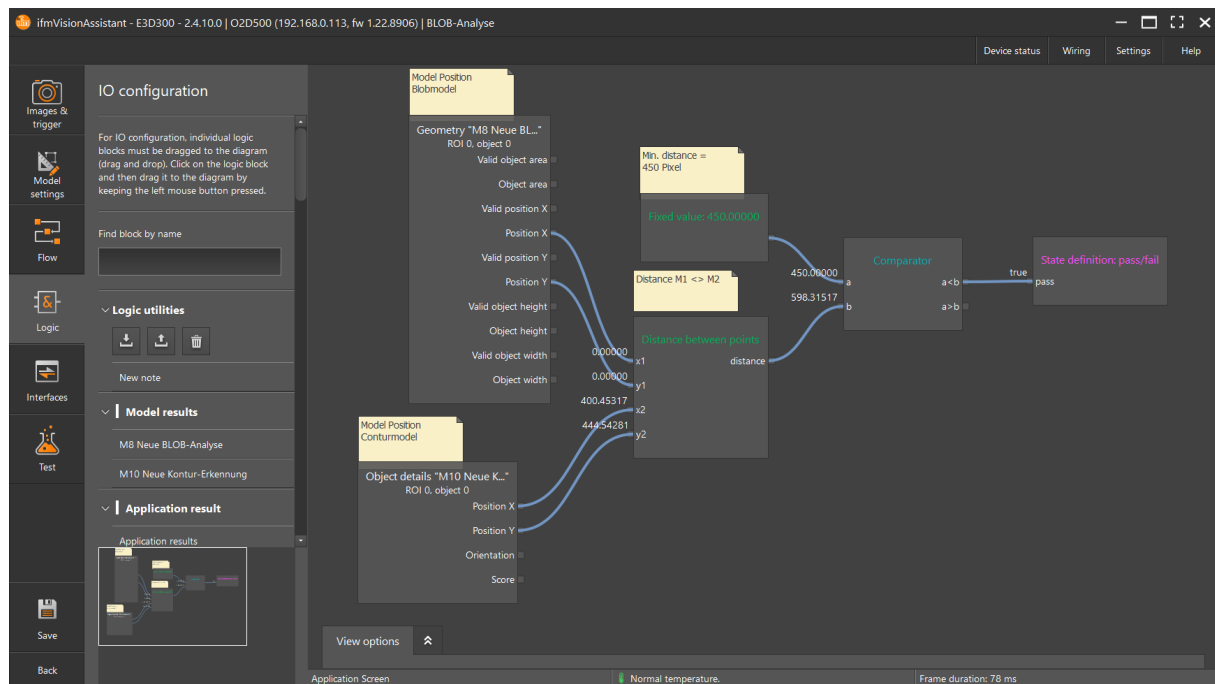


Fig. 50: Example of "Compare distance values"

If the distance is greater than "450 pixels", the "High" signal is output.

10.4.20 Example – counter and comparator

Sums up the ROI results of the models and outputs them as a binary value.

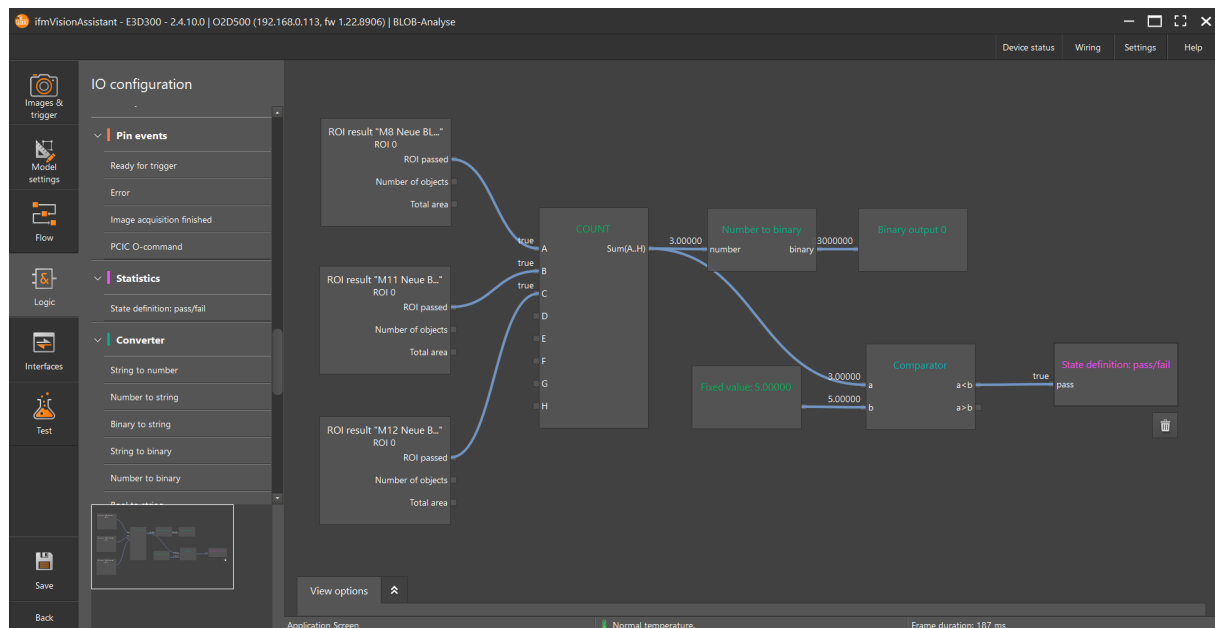


Fig. 51: Example of a counter and comparator

In addition, the sum of the ROI results is compared with a constant and statistically recorded if there are fewer than five ROI results.

10.4.21 Example – converter

The number of objects found in a model is converted into a string and output.

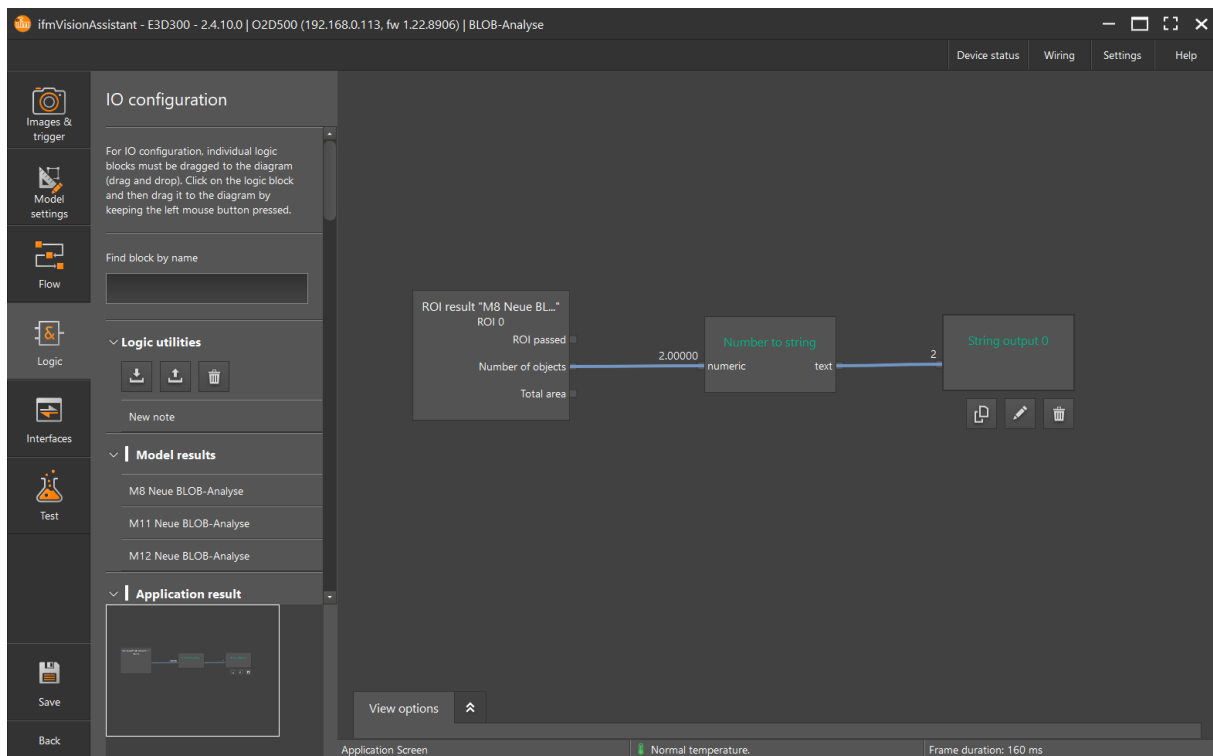


Fig. 52: Example of a converter

10.5 Interfaces

The [Interfaces] function sets the interfaces of the selected application.

For that purpose the data packages that are sent via the [TCP/IP] and [IO-Link] interface are defined.

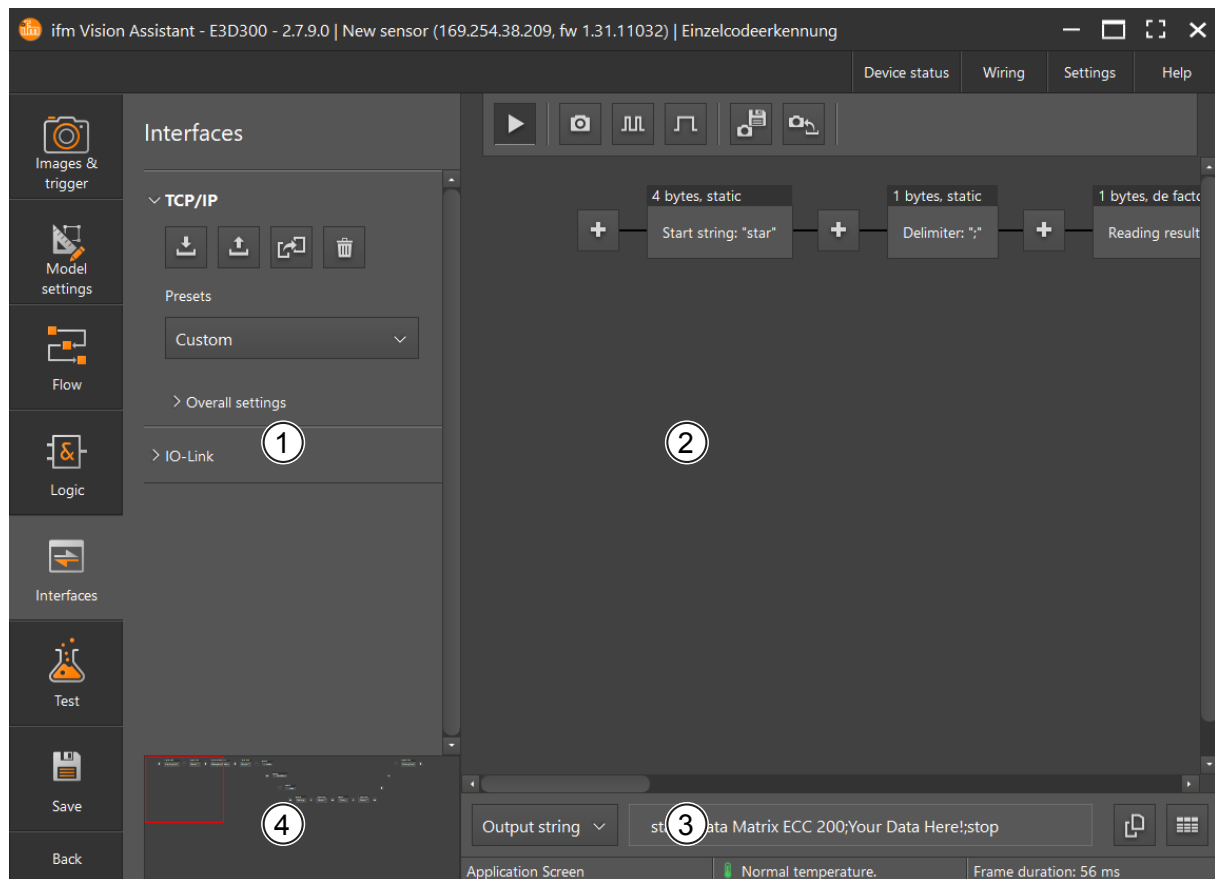


Fig. 53: [Interfaces] function

1 Settings
3 String output

2 Main area
4 Overview area

Settings

The interfaces are set in the [TCP/IP] and [IO-Link] area. The area contains the following operating elements:

Operating element	Type	Description
	Button	Imports the configuration from a file with the extension *.o2xpcic .
	Button	Exports the configuration to a file with the extension *.o2xpcic .
	Button	Generates the TCP/IP command of the current configuration in the main area. The c command sets the TCP/IP interface configuration. The command is described in the separate "Programmer's Guide": documentation.ifm.com The button has no function for the [IO-Link] interface.
	Button	Deletes the created configuration in the main area after confirmation. The configuration cannot be restored.
	Button	Resets the setting to the default setting.
[Presets]	List	Sets sets of preset data packages. Included are sets for typical applications and robot manufacturers. The sets can be adapted. An adapted set is saved as a [Custom] preset.

Operating element	Type	Description
[Data encoding]	List	Sets the data encoding: [ASCII] [binary]
[Precision]	Input field	Sets the number of decimal places.
[Display format]	List	Sets the display format: [Fixed]: fixed point number [Scientific]: exponential
[Decimal separator]	Input field	Sets the decimal separator. The decimal separator is a 7-bit character (e.g. .).
[Base]	List	Sets the output format: [Binary]: Base 2 [Octal]: Base 8 [Decimal]: Base 10 [Hex]: Base 16
[Width]	Input field	Sets the minimum total length of the value.
[Numeric fill]	List	Sets the values of non-used bits: [On]: Each non-used bit is assigned a Boolean 0 and positive values are preceded by a plus sign. [Off]: Bits which are not used remain blank.
[Fill]	Input field	Sets the fill character.
[Alignment]	List	Sets the alignment of the value within the defined bit width: [Left] [Right]
[Byte order]	List	Sets the byte order: [little endian]: least significant byte of binary data at the first position or at the lowest memory address. [big endian]: most significant byte of binary data at the first position or at the lowest memory address. [Network byte order]: byte order specified by the network protocol. [Fieldbus-dependent]: byte order specified by the fieldbus.

Main area

The data packages of the interface are set in the main area. The data packages are displayed as rectangles. The size and type are displayed above each data package.

The data packages are connected via dashed connecting lines. The data is sent from left to right in the order of the data packages.

The [main area] contains the following operating elements:

Operating element	Type	Description
	Button	Adds a data package at the position. (→ Data packages □ 149)
	Button	Sets the selected data package.
	Button	Deletes the selected data package.

Operating element	Type	Description
	Button	Shows or hides the loop of the [Models] data package. The [Models] data package consists of several data packages which are connected via loops. Depending on the ROIs contained, this loop is passed through several times.

String output

The [String output] is changed with the data packages in the main area. Depending on the selected data encoding in the [Settings] area, [String output] will be displayed as ASCII or Boolean code.

The [String output] area contains the following operating elements:

Operating element	Type	Description
[String output]	List	Sets the format of the [String output]: [String output]: output as ASCII or Boolean code, depending on the set data coding. [Hex view]: output in hexadecimal system. The output can be adjusted. (→ Output as hex view or INT16 table □ 165) [INT16 table]: output as INT16 table. The output can be adjusted. (→ Output as hex view or INT16 table □ 165)
	Button	Adds an overlay to the output string. (→ Output as hex view or INT16 table □ 165)
	Button	Deletes the overlay. (→ Output as hex view or INT16 table □ 165)
	Button	Copies the [String output] to the clipboard.
	Button	Displays the data of data packages. (→ Display data from the data packages □ 165)



[String output] cannot be set directly. The setting is made via the data packages in the main area.

Overview area

The [overview area] displays a reduced overview of the main area. The red frame is shifted using the mouse. This way, the data packages outside the visible area can be displayed.

10.5.1 Data packages

A data package is inserted in the main area with the  button. After clicking on the button, a list opens. The data package is set with the elements in the list.



The content of the list is variable and depends on the position of the data package in the [Output string].

Data Packages [General]

The list contains the following data packages in the area [Allgemein]:

Data package	Description
[Start string]	Adjustable character string for starting a data transfer.
[End string]	Adjustable character string for ending a data transfer.

Data package	Description
[User-driven input]	Adjustable character string within data transfer.
[Index of the active application]	Index of the active application
[Application decoding time [ms]]	Evaluation time of the application in [ms]

Data packages [Logic layer]

The list contains the following data packages in the area [Logic layer]:

Data package	Description
[Reading result (pass/fail)]	Reading result of the logic block "Status definition: pass/fail" (→ Logic element [Result status] □ 142)
[Number of bytes in output string 0-9]	Size in bytes of the content of the logic block "Output string". (→ Logic blocks [Output] □ 141)
[Output string 0-9]	Content of the logic block "Output string". (→ Logic blocks [Output] □ 141)
[Digital output]	Bit order with the values at the digital outputs.
[Virtual output]	8-byte order with the values at the inputs of the virtual pins.

Data packages [Application results]

The area [Application results] contains the following data packages:

Data package	Description
[Anchor model ID]	Model ID of the anchor tracking
[Anchor result]	Result of the anchor tracking (→ Anchor result □ 150)
[Number of images]	Number of the images defined for the application.
[Images]	The image information is output in a grouping element. (→ Images □ 151)
[Number of models]	Number of the images created for the application.
[Models]	The data of the defined models is provided one after the other. (→ Models □ 154)

Data package [Delimiter]

The data package [Delimiter] has the following function:

Data package	Description
[Delimiter]	Delimiter to split data packages.

10.5.1.1 Anchor result

Data packages [Anchor result]

The [Anchor result] area contains the following data packages:

Data package	Description
[Valid]	Model recognised.
[Translation X]	Displacement on the X-axis, related to the taught position.
[Translation Y]	Displacement on the Y-axis, related to the taught position.

Data package	Description
[Rotation]	The orientation of the object in degrees, related to the taught position. 
[User-driven input]	Adjustable character string within data transfer.
[Delimiter]	Delimiter to split data packages.

10.5.1.2 Images

Data packages [Images]



The quality values are only displayed when the image quality check is activated.

- ▶ Activate [Image quality check] for the selected image. (→ [Image quality check](#) ▢ 64)
- ▷ The quality values are displayed.

The [Images] area contains the following operating elements:

Data package	Description
[Image ID]	ID of the image.
[Image blob]	Provides the recorded images in JPEG format one after the other. The header and image data must be decoded. Information on decoding can be found in the Programmer's Guide of the device, in the chapters "Receiving Images" and "Image Data": www.ifm.com
[Quality]	Quality values of the images. (→ Quality ▢ 151)
[User-driven input]	Adjustable character string within data transfer.
[Delimiter]	Delimiter to split data packages.

Quality

Data packages [Quality]



The quality values are only displayed when the image quality check is activated.

- ▶ Activate [Image quality check] for the selected image.
- ▷ The quality values are displayed.

The [Quality] area contains the following data packages:

Data package	Description
[Overexposed area]	Quality values for overexposed areas of the image. (→ Overexposed area ▢ 152)
[Underexposed area]	Quality values for underexposed areas of the image. (→ Underexposed area ▢ 152)
[Brightness]	Quality values for brightness of the image. (→ Brightness ▢ 153)
[Sharpness]	Quality values for sharpness of the image. (→ Sharpness ▢ 153)
[User-driven input]	Adjustable character string within data transfer.
[Delimiter]	Delimiter to split data packages.

Overexposed area

Data packages [Overexposed area]

The [Overexposed] area contains the following data packages:

Data package	Description
[Warning]	Warning if the [Value] is higher than [Threshold max] or lower than [Threshold min].
[Value]	Value for the image.
[Value min]	Smallest [Value] reached since the start of the measurements.
[Value max]	Highest [Value] reached since the start of the measurements.
[Value short term]	Short-term exponential smoothing (exponential filter). Formula $(1 - 0.2) * [\text{Value short term}] + 0.2 * [\text{Value short term}]$
[Value mid term]	Medium-term exponential smoothing (exponential filter). Formula $(1 - 0.02) * [\text{Value mid term}] + 0.02 * [\text{Value mid term}]$
[Value long term]	Long-term exponential smoothing (exponential filter). Formula $(1 - 0.005) * [\text{Value long term}] + 0.005 * [\text{Value long term}]$
[Threshold min]	The set [min. value] from the [Image quality check] area. Image quality check (→ 64)
[Threshold max]	The set [max. value] from the [Image quality check] area. Image quality check (→ 64)
[Trend]	Absolute deviation calculated from the last N values (default: N = 500). The sign indicates the direction of the trend.
[User-driven input]	Adjustable character string within data transfer.
[Delimiter character]	Delimiter to split data packages.

Underexposed area

Data packages [Underexposed area]

The [Underexposed] area contains the following data packages:

Data package	Description
[Warning]	Warning if the [Value] is higher than [Threshold max] or lower than [Threshold min].
[Value]	Value for the image.
[Value min]	Smallest [Value] reached since the start of the measurements.
[Value mx]	Highest [Value] reached since the start of the measurements.
[Value short term]	Short-term exponential smoothing (exponential filter). Formula: $(1 - 0.2) * [\text{Short-term value}] + 0.2 * [\text{Short-term value}]$
[Value mid term]	Medium-term exponential smoothing (exponential filter). Formula: $(1 - 0.02) * [\text{Medium-term value}] + 0.02 * [\text{Medium-term value}]$
[Value long term]	Long-term exponential smoothing (exponential filter). Formula: $(1 - 0.005) * [\text{Long-term value}] + 0.005 * [\text{Long-term value}]$

Data package	Description
[Threshold min]	The set [min value] from the [Image quality check] area.
[Threshold max]	The set [max value] from the [Image quality check] area.
[Trend]	Absolute deviation calculated from the last N values (default: N = 500). The sign indicates the direction of the trend.
[User-driven input]	Adjustable character string within data transfer.
[Delimiter]	Delimiter to split data packages.

Brightness

Data packages [Brightness]

The [Brightness] area contains the following data packages:

Data package	Description
[Warning]	Warning if the [Value] is higher than [Threshold max] or lower than [Threshold min].
[Value]	Value for the image.
[Value min]	Smallest [Value] reached since the start of the measurements.
[Value mx]	Highest [Value] reached since the start of the measurements.
[Value short term]	Short-term exponential smoothing (exponential filter). Formula: $(1 - 0.2) * [\text{Short-term value}] + 0.2 * [\text{Short-term value}]$
[Value mid term]	Medium-term exponential smoothing (exponential filter). Formula: $(1 - 0.02) * [\text{Medium-term value}] + 0.02 * [\text{Medium-term value}]$
[Value long term]	Long-term exponential smoothing (exponential filter). Formula: $(1 - 0.005) * [\text{Long-term value}] + 0.005 * [\text{Long-term value}]$
[Threshold min]	The set [min value] from the [Image quality check] area.
[Threshold max]	The set [max value] from the [Image quality check] area.
[Trend]	Absolute deviation calculated from the last N values (default: N = 500). The sign indicates the direction of the trend.
[User-driven input]	Adjustable character string within data transfer.
[Delimiter]	Delimiter to split data packages.

Sharpness

Data packages [Sharpness]

The [Sharpness] area contains the following data packages:

Data package	Description
[Warning]	Warning if the [Value] is higher than [Threshold max] or lower than [Threshold min].
[Value]	Value for the image.
[Value min]	Smallest [Value] reached since the start of the measurements.
[Value mx]	Highest [Value] reached since the start of the measurements.

Data package	Description
[Value short term]	Short-term exponential smoothing (exponential filter). Formula: $(1 - 0.2) * [\text{Short-term value}] + 0.2 * [\text{Short-term value}]$
[Value mid term]	Medium-term exponential smoothing (exponential filter). Formula: $(1 - 0.02) * [\text{Medium-term value}] + 0.02 * [\text{Medium-term value}]$
[Value long term]	Long-term exponential smoothing (exponential filter). Formula: $(1 - 0.005) * [\text{Long-term value}] + 0.005 * [\text{Long-term value}]$
[Threshold min]	The set [min value] from the [Image quality check] area.
[Threshold max]	The set [max value] from the [Image quality check] area.
[Trend]	Absolute deviation calculated from the last N values (default: N = 500). The sign indicates the direction of the trend.
[User-driven input]	Adjustable character string within data transfer.
[Delimiter]	Delimiter to split data packages.

10.5.1.3 Models

[Models] data packages

The [Models] area contains the following data packages:

Data package	Description
[Model ID]	The [Model ID] consists of a consecutive number (0-999) in the order in which the models were defined. After 999 IDs have been assigned in an application, the IDs of deleted models are assigned again.
[Numeric model type]	Type of model in numerical form.
[Model decoding status]	Decoding status of the model. (→ Logic blocks [Model results] □ 121)
[Model: Number of codes searched for]:	Number of codes searched for in the model.
[Model pass/fail]	Pass/fail status definition.
[Number of ROI results]	Number of ROI groups in the model. (→ Logic blocks [Model results] □ 121)
[ROI results]	Results of the ROI groups (→ ROI results □ 154)
[All models passed]	Status of the models.
[String model type]	Model type as a string.
[Model name]	Name of the model.
[User-driven input]	Adjustable character string.
[Delimiter character]	Delimiter to split data packages.

ROI results

[ROI results] data packages

The [ROI results] area contains the following data packages:

Data package	Description
[ROI check]	Results of ROI monitoring. (→ ROI monitoring □ 155)
[Contour detection ROI values]	Results of the ROI values for contour detection. (→ Contour detection ROI values □ 155)

Data package	Description
[BLOB analysis ROI values]	Results of the ROI values for the BLOB analysis. (→ BLOB analysis ROI values □ 156)
[ROI ID]	ID of an ROI
[ROI passed]	status of an ROI
[Number of codes found]	Number of codes found within an ROI.
[Number of codes searched]	Number of codes searched for.
[Codes]	Results of the code search.
[Lines (OCR)]	Results of text recognition.
[Number of lines (OCR)]	Number of lines in text recognition.
[Number of contour matches]	Number of contour matches within an ROI.
[Contour matches]	Results of the contour matches. (→ Contour matches □ 158)
[Number of failed contour matches]	Number of contour matches that do not fulfil [Model parameters] such as [Min. score] or [Max. orientation]. Contour detection (→ □ 104) [Number of failed contour matches] will only be output when the analysis mode is activated. Contour detection (→ □ 104)
[Failed contour matches]	Contour matches that do not fulfil [Model parameters] such as [Min. score] or [Max. orientation]. Failed contour matches (→ □ 158) [Failed contour matches] will only be output when the analysis mode is activated. Contour detection (→ □ 104)
[Number of BLOBs]	Number of BLOBs within an ROI.
[BLOB analysis]	Results of the BLOB analysis. (→ BLOB analysis □ 159)
[Number of failed BLOBs]	Number of BLOB objects that do not fulfil Model parameters (→ BLOB analysis □ 95) or Object properties (→ Object properties □ 99). Failed BLOB analysis
[Failed BLOB analysis]	BLOB objects which do not fulfil Model parameters (→ BLOB analysis □ 95) or Object properties (→ Object properties □ 99). Failed BLOB analysis
[Image ID]	ID of an image.
[User-driven input]	Adjustable character string.
[Delimiter character]	Delimiter to split data packages.

ROI monitoring

Data packages [ROI monitoring]

The [ROI monitoring] area contains the following data packages:

Data package	Description
[ROI warning]	Warning if [Min. distance to ROI] is smaller than the parameter [Threshold ROI warning].
[Min. distance to ROI]	Least distance of an object to the boundary of its ROI.
[Threshold ROI warning]	Threshold value for the minimum distance between an ROI and a code.

Contour detection ROI values

Data packages [Contour detection ROI values]

The [Contour detection ROI values] area contains the following data packages:

Data package	Description
[ROI score min.]	Value of the contour with the lowest score within a ROI.
[ROI score max.]	Value of the contour with the highest score within a ROI.

Data package	Description
[Matches centre X]	Averaged X-value of all contours found in the ROI. The position reference of the contour is decisive. (→ Contour detection □ 104)
[Matches centre Y]	Averaged Y-value of all contours found in the ROI. The position reference of the contour is decisive. (→ Contour detection □ 104)
[Number of objects]	Number of matches of the contour detection.

BLOB analysis ROI values

Data packages [BLOB analysis ROI values]

The [BLOB analysis ROI values] area contains the following data packages:

Data package	Description
[Number of objects]	Number of matches of the BLOB analysis.
[Total area]	Total area of all found objects

Codes

[Codes] data packages

The [Codes] area contains the following operating elements:

Data package	Description
[Geometry details]	Details of the geometry of the code. (→ Geometry details □ 157)
[ROI check]	Results of ROI monitoring. (→ ROI check □ 157)
[Code Index]	Index of the code found.
[Code found]	Message regarding code found.
[Code family]	Family of the code found.
[Number of bytes in content]	Number of bytes in the code content.
[Content]	Content of the code.
[Number of bytes in composite code]	Number of bytes in a composite code.
[Composite code (1D composite only)]	Content of the 1D composite code.
[Has ISO 15415 quality]	Code quality corresponds to ISO 15415.
[ISO 15415 numbers (2D only)]	Content of the code in numbers in accordance with ISO 15415.
[ISO 15415 letters (2D only)]	Content of the code in letters in accordance with ISO 15415.
[Has ISO 15416]	Code quality corresponds to ISO 15416.
[ISO 15416 numbers (1D only)]	Content of the code in numbers in accordance with ISO 15416.
[ISO 15416 letters (1D only)]	Content of the code in letters in accordance with ISO 15416.
[Has AIM / ISO-TR29158 quality]	Code quality corresponds to AIM / ISO-TR29158.
[AIM / ISO-TR29158 quality (numbers)]	Content of the code in numbers in accordance with AIM / ISO-TR29158.
[AIM / ISO-TR29158 quality (letters)]	Content of the code in letters in accordance with AIM / ISO-TR29158.
[Has SEMI-T10]	Code quality corresponds to SEMI T10.
[SEMI-T10]	Content of the SEMI T10 code.
[User-defined overall quality (number)]	Configured overall quality of the code as a number.
[User-defined overall quality (letter)]	Configured overall quality of the code as a letter.

Data package	Description
[User-driven input]	Adjustable character string.
[Delimiter character]	Delimiter to split data packages.

Geometry details

[Geometry details] data packages

The [Geometry details] area contains the following operating elements:

Data package	Description
[Orientation]	Orientation of the code in degrees.
[Centre point]	Centre point of the code.
[Half width]	Half width of the code.
[Half height]	Half height of the code.
[Outline]	Outline of the code.

ROI check

[ROI check] data packages

The [ROI check] area contains the following data packages:

Data package	Description
[Distance warning to mean position]	Warning if [Distance to mean position] is smaller than the parameter [Threshold distance to mean position].
[Distance to mean position]	Smallest distance of a code to the boundary of an ROI.
[Threshold distance to mean position]	Threshold value for the minimum distance between an ROI and a code.
[Movement warning]	If the distance of at least one code contour to the ROI falls below the set value, a warning is issued.
[Movement score]	A mean value is formed from N read codes and stored as the mean position ($N_{max} = 100$, where N = number of codes read). If the distance of a read code is greater than the set value, a warning is issued. The mean value is reset if a code is not read successfully.
[Threshold movement score]	If an object continues to move in the same direction in successive images, the probability that the code will continue to move in that direction increases. If the probability exceeds the set value, a warning is issued.

Lines (OCR)

[Lines (OCR)] data packages

The [Lines (OCR)] area contains the following data packages:

Data package	Description
[Corrected text]	Corrected detected text.
Corrected text length	Length of the corrected detected text.
[Score]	Evaluation of the detected text.
[Centre X]	The centre of the detected text on the X-axis.
[Centre Y]	The centre of the detected text on the Y-axis.
[Line index]	Line index of the detected text.
[User-driven input]	Adjustable character string.
[Delimiter character]	Delimiter to split data packages.

Contour matches

Data packages [Contour matches]

The [Contour matches] area contains the following operating elements:

Data package	Description
[Robot sensor calibration]	After calibrating (→ Calibration wizards  35) the device, the following data packages are available: [X (calibrated)]: calibrated X-position of the object in world/robot coordinates [m]. [Y (calibrated)]: calibrated Y-position of the object in world/robot coordinates [m]. [Z (calibrated)]: calibrated Z-position of the object in world/robot coordinates [m]. [Angle (calibrated)]: Calibrated orientation of the object in world/robot coordinates.
[Rotation]	Orientation of the object
[Position X]	X-position of the object in world/robot coordinates [m].
[Position Y]	Y-position of the object in world/robot coordinates [m].
[Score]	Evaluation of the object.
[Object index]	Index of the object.
[User-driven input]	adjustable character string
[Delimiter]	Delimiter to split data packages.

Failed contour matches

[Failed contour matches] data packages

[Failed contour matches] are contour matches that do not fulfil [Model parameters] such as [Min. score] or [Max. orientation]. [Contour detection](#) (→  104)

[Failed contour matches] will only be output when the [analysis mode] is activated. [Contour detection](#) (→  104)

The [Failed contour matches] area contains the following data packages:

Data package	Description
[Robot sensor calibration]	After calibrating the device, the following data packages are available: [X (calibrated)]: calibrated X-position of the object in world/robot coordinates [m]. [Y (calibrated)]: calibrated Y-position of the object in world/robot coordinates [m]. [Z (calibrated)]: calibrated Z-position of the object in world/robot coordinates [m]. [Angle (calibrated)]: Calibrated orientation of the object in world/robot coordinates.
[Rotation]	Orientation of the object
[Position X]	X-position of the object in world/robot coordinates [m].
[Position Y]	Y-position of the object in world/robot coordinates [m].
[Score]	Evaluation of the object.
[Object index]	Index of the object.
[User-driven input]	adjustable character string
[Delimiter]	Delimiter to split data packages.

BLOB analysis

Data packages [BLOB analysis]

The [BLOB analysis] area contains the following the data packages:

Data package	Description
[Robot sensor calibration]	After calibrating (→ Calibration wizards  35) the device, the following data packages are available: [Centre X (calibrated)]: calibrated centre of the X-position of the object in world/robot coordinates [m]. [Centre Y (calibrated)]: calibrated centre of the Y-position of the object in world/robot coordinates [m]. [Centre Z (calibrated)]: calibrated centre of the Z-position of the object in world/robot coordinates [m].
[Object index]	Index of the object.
[Object area]	The area of the object defined via the ROI and object index. 
[Position X]	The centre of gravity of the object on the X-axis, measured from the left edge of the image. 
[Position Y]	The centre of gravity of the object on the Y-axis, measured from the top of the image. 
[Object height]	The height of the smallest rectangle that completely encloses the object and whose sides are parallel to the edge of the image. 
[Object width]	The width of the smallest rectangle that completely encloses the object and whose sides are parallel to the edge of the image. 

Data package	Description
[Roundness]	The roundness of the object describes the shape factor of the contour. The distance of the contour to the centre of gravity of the surface is measured. Wide cut-outs into the object do not have much effect on the value, as the centre of gravity does not change significantly. A perfectly round circle has the value "100". 
[Circularity]	The circularity of the object describes the similarity to a perfect circle. A perfectly round circle has the value "100". 
[Compactness]	The compactness of the object. Empty regions have the value "0"; circular objects have the value "1". Long narrow objects have average values. Entangled objects and objects with holes have high values. 
[Rectangularity]	The rectangularity of the object. A perfect rectangle has the value "100". 
[Outer radius]	The radius of the smallest circle that the object completely encloses. 
[Inner radius]	The radius of the largest circle that fits completely inside the object. 
[Inner width]	The width of the largest rectangle that fits completely inside the object and whose sides are parallel to the edge of the image. 

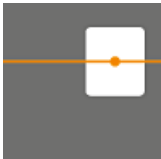
Data package	Description
[Inner height]	The height of the largest rectangle that fits completely inside the object and whose sides are parallel to the edge of the image. 
[Number of holes]	The number of holes in the object. 
[Rotation]	The orientation of the object in degrees. 
[Min. grey-scale value]	The lowest grey value of the object. 
[Max. grey-scale value]	The highest grey value of the object. 
[Average grey-scale value]	The average grey value of the object. 
[Grey-scale value deviation]	The standard deviation of the object (homogeneity). The value is low for uniformly grey objects and high for irregular surfaces or greyscale gradients. 
[User-driven input]	adjustable character string.
[Delimiter]	Delimiter to split data packages.

Failed BLOB analysis

[Failed BLOB analysis] data packages

[Failed BLOB analysis] are BLOB objects that do not fulfil Model parameters (→ [BLOB analysis](#) □ 95) or Object properties (→ [Object properties](#) □ 99).

The [Failed BLOB analysis] area contains the following the data packages:

Data package	Description
[Robot sensor calibration]	After calibrating the device, the following data packages are available: [Centre X (calibrated)]: calibrated centre of the X-position of the object in world/robot coordinates [m]. [Centre Y (calibrated)]: calibrated centre of the Y-position of the object in world/robot coordinates [m]. [Centre Z (calibrated)]: calibrated centre of the Z-position of the object in world/robot coordinates [m].
[Object index]	Index of the object.
[Object area]	The area of the object defined via the ROI and object index. 
[Position X]	The centre of gravity of the object on the X-axis, measured from the left edge of the image. 
[Position Y]	The centre of gravity of the object on the Y-axis, measured from the top of the image. 
[Object height]	The height of the smallest rectangle that completely encloses the object and whose sides are parallel to the edge of the image. 
[Object width]	The width of the smallest rectangle that completely encloses the object and whose sides are parallel to the edge of the image. 

Data package	Description
[Roundness]	The roundness of the object describes the shape factor of the contour. The distance of the contour to the centre of gravity of the surface is measured. Wide cut-outs into the object do not have much effect on the value, as the centre of gravity does not change significantly. A perfectly round circle has the value "100". 
[Circularity]	The circularity of the object describes the similarity to a perfect circle. A perfectly round circle has the value "100". 
[Compactness]	The compactness of the object. Empty regions have the value "0"; circular objects have the value "1". Long narrow objects have average values. Entangled objects and objects with holes have high values. 
[Rectangularity]	The rectangularity of the object. A perfect rectangle has the value "100". 
[Outer radius]	The radius of the smallest circle that the object completely encloses. 
[Inner radius]	The radius of the largest circle that fits completely inside the object. 
[Inner width]	The width of the largest rectangle that fits completely inside the object and whose sides are parallel to the edge of the image. 

Data package	Description
[Inner height]	The height of the largest rectangle that fits completely inside the object and whose sides are parallel to the edge of the image. 
[Number of holes]	The number of holes in the object. 
[Rotation]	The orientation of the object in degrees. 
[Min. grey-scale value]	The lowest grey value of the object. 
[Max. grey-scale value]	The highest grey value of the object. 
[Average grey-scale value]	The average grey value of the object. 
[Grey-scale value deviation]	The standard deviation of the object (homogeneity). The value is low for uniformly grey objects and high for irregular surfaces or greyscale gradients. 
[User-driven input]	adjustable character string.
[Delimiter]	Delimiter to split data packages.

10.5.2 Example of “Provide overall quality”

In the example, the data packages were configured such that the overall quality is provided via the interface.

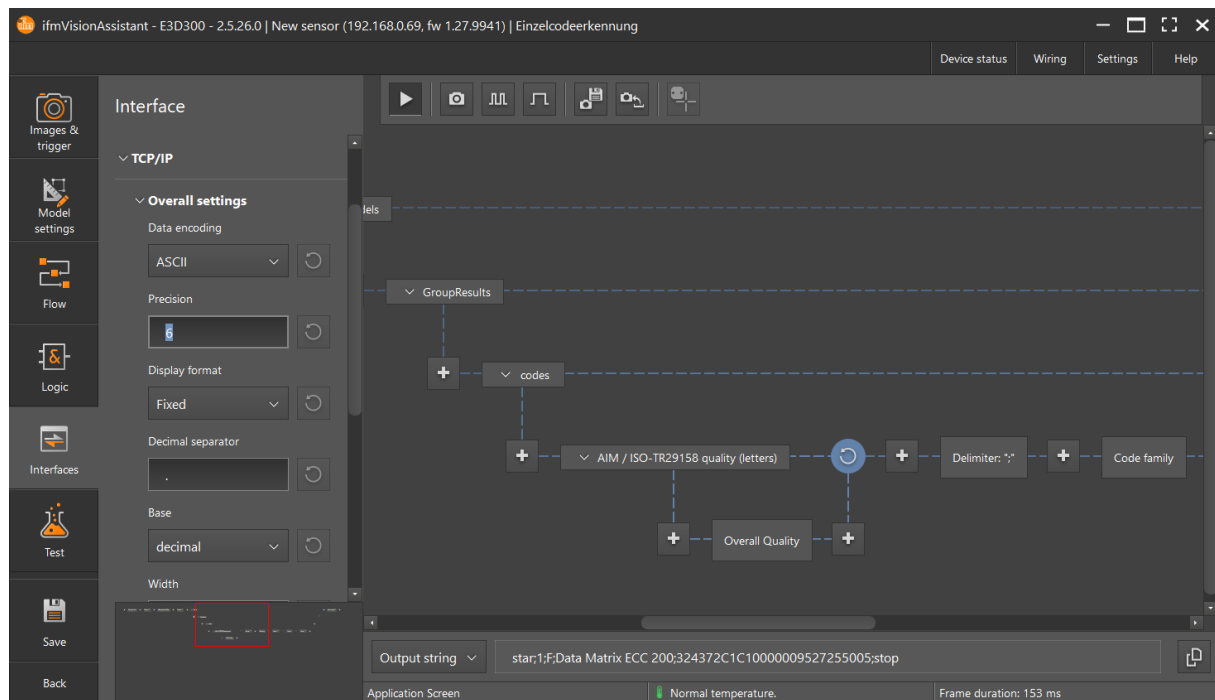


Fig. 54: Provide overall quality

10.5.3 Output as hex view or INT16 table

The output of the clipboard as a [hex view] or [INT16 table] can be customised:

Operating element	Type	Description
[Little endian]	List	Sets the byte order of the integer values. The setting is only available for [INT16 table].
+	Button	Adds an overlay to the output string. After clicking the button, the data format and the byte order of the overlay are set.
🗑️	Button	Deletes the overlay.

10.5.4 Display data from the data packages

The [List byte positions of data fields] button displays the data contained in static data packages.

After clicking the [Data layout info] button, the [Data layout info] window opens. The following data is displayed in the window:

- Offset
- Size [bytes]
- Meaning
- Context

The window contains the following operating elements:

Operating element	Type	Description
Split by comma / semicolon / tab char	List	Sets the separator for export as a CSV file.
Export as CSV	Button	Exports the table as a CSV file.



Only data from static data packages can be displayed. A dynamic data package in the main area cancels the table view in the [Data layout info] window.

10.6 Test

The function [Test] records statistical data on the selected application. During the test, the current states of the device are displayed.

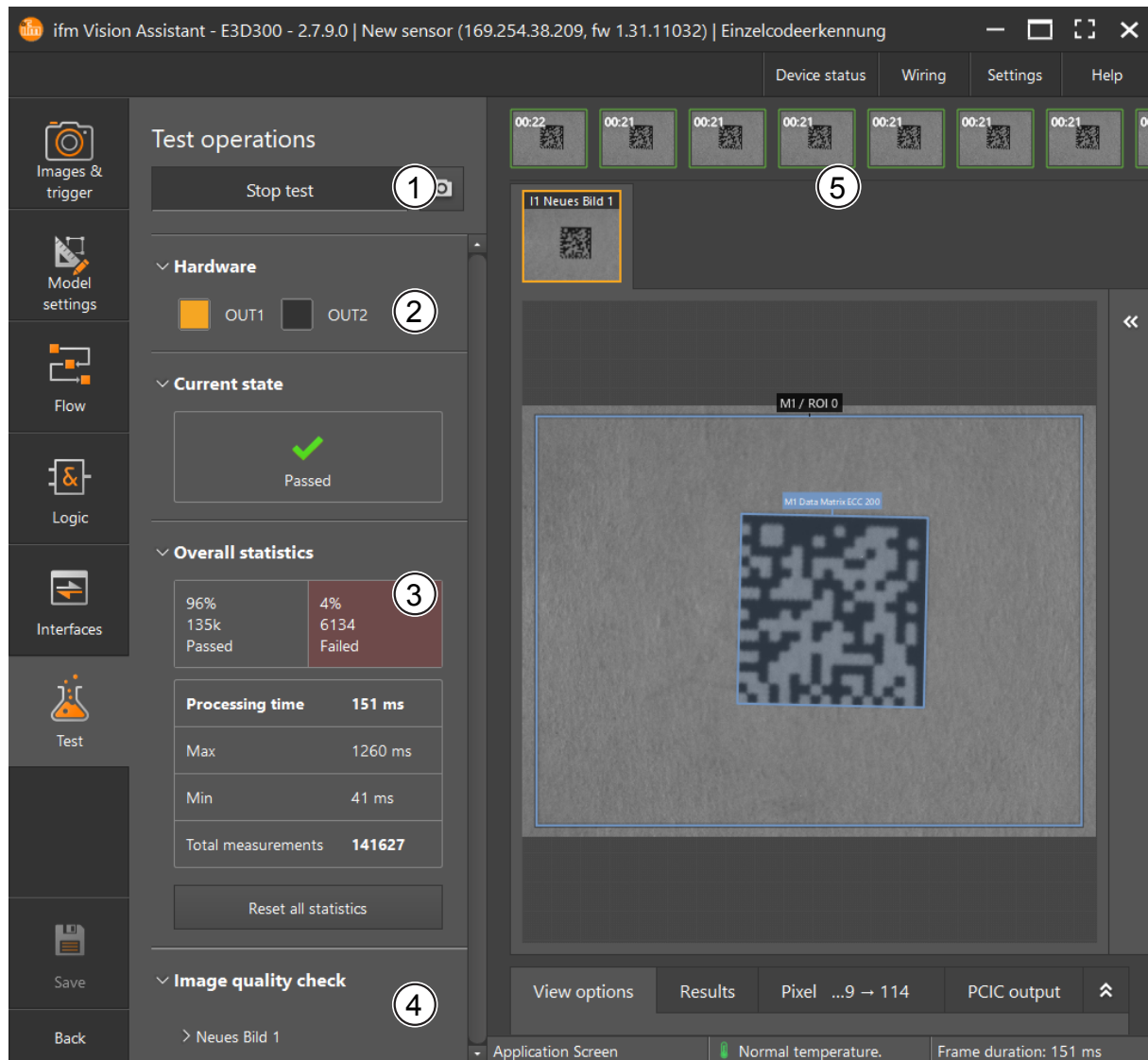


Fig. 55: [Test] function

- 1 Start/stop test and apply trigger
- 3 Overall statistics
- 5 Test images

- 2 State of the digital outputs
- 4 Image quality check

The function [Test] contains the following operating elements:

Operating element	Type	Description
[Start test]	Button	Starts the test according to the setting "Trigger mode". (→ Trigger mode 33)
[Stop test]	Button	Stops the test.
	Button	Forces a trigger manually.
[Reset All Statistics]	Button	Resets all statistics.

Overall statistics

The overall statistics include the following data:

- number of detected and non-detected codes
- evaluation time of the test images
- number of the total measurements

Image quality check

The image quality check checks whether the measured values received from the camera are within the permitted value range. (→ [Image quality check](#)  64)

Test images

Image capture generates test images while the test is active. The test images are chronologically sorted. The most current test image is on the very left.

Additional information is saved with each test image:

- State of the digital outputs
- overall statistics
- capture time as from test start in minutes:seconds

By clicking on a test image, it is displayed enlarged in the area [Live image]. The states of the digital outputs and the overall statistics are displayed at the time the test image is captured.



Clicking the reduced test image several times switches between the selected test image and the last recorded test image.

11 Service report

The area [Service report] creates an evaluation of the last 17 pass and fail evaluations with information on the software and hardware of the device. The service report can be exported for support requests.

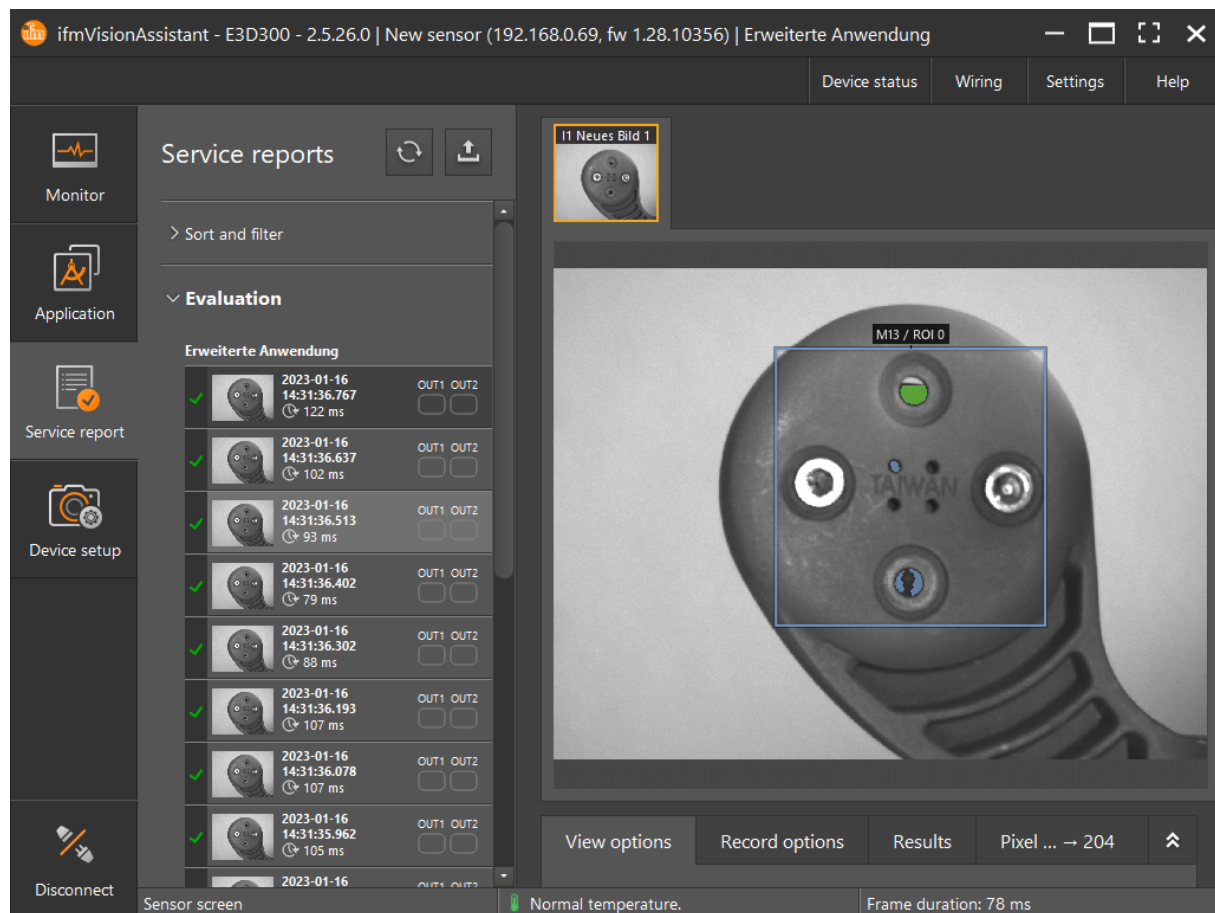


Fig. 56: [Service report] area

The area [Service report] contains the following operating elements:

Operating element	Name	Description
	Reload	Reloads the evaluation of the service report. Reloading may take up to 1 min.
	Export	Exports the evaluation of the service report to a folder.

[Sort and filter] area:

Name	Type	Description
[Sort by]	List	Sorts the evaluation according to the following characteristics: [Newest first]: The most recent measurements are displayed first. [Failed -> Passed]: Failed measurements are displayed first. [Passed -> Failed]: Passed measurements are displayed first. [OUT1 -> OUT2]: Output 1 is displayed before output 2. [OUT2 -> OUT1]: Output 2 is displayed before output 1. [Application name]: The measurements are sorted alphabetically by the name of the application. [Duration long -> short]: The longest measurement is displayed first. [Duration short -> long]: The shortest measurement is displayed first.
[Filter status failed]	Checkbox	Filters the measurements with the status [Failed] if the checkbox is deactivated.
[Filter status passed]	Checkbox	Filters the measurements with the status [Passed] if the checkbox is deactivated.
[Filter OUT1 active]	Checkbox	Filters the measurements with active output 1 if the checkbox is deactivated.
[Filter OUT1 inactive]	Checkbox	Filters the measurements with inactive output 1 if the checkbox is deactivated.
[Filter OUT2 active]	Checkbox	Filters the measurements with active output 2 if the checkbox is deactivated.
[Filter OUT2 inactive]	Checkbox	Filters the measurements with inactive output 2 if the checkbox is deactivated.



The evaluation is not filtered by default.

12 device set-up

The device and the networks used are set in the area [Device setup].

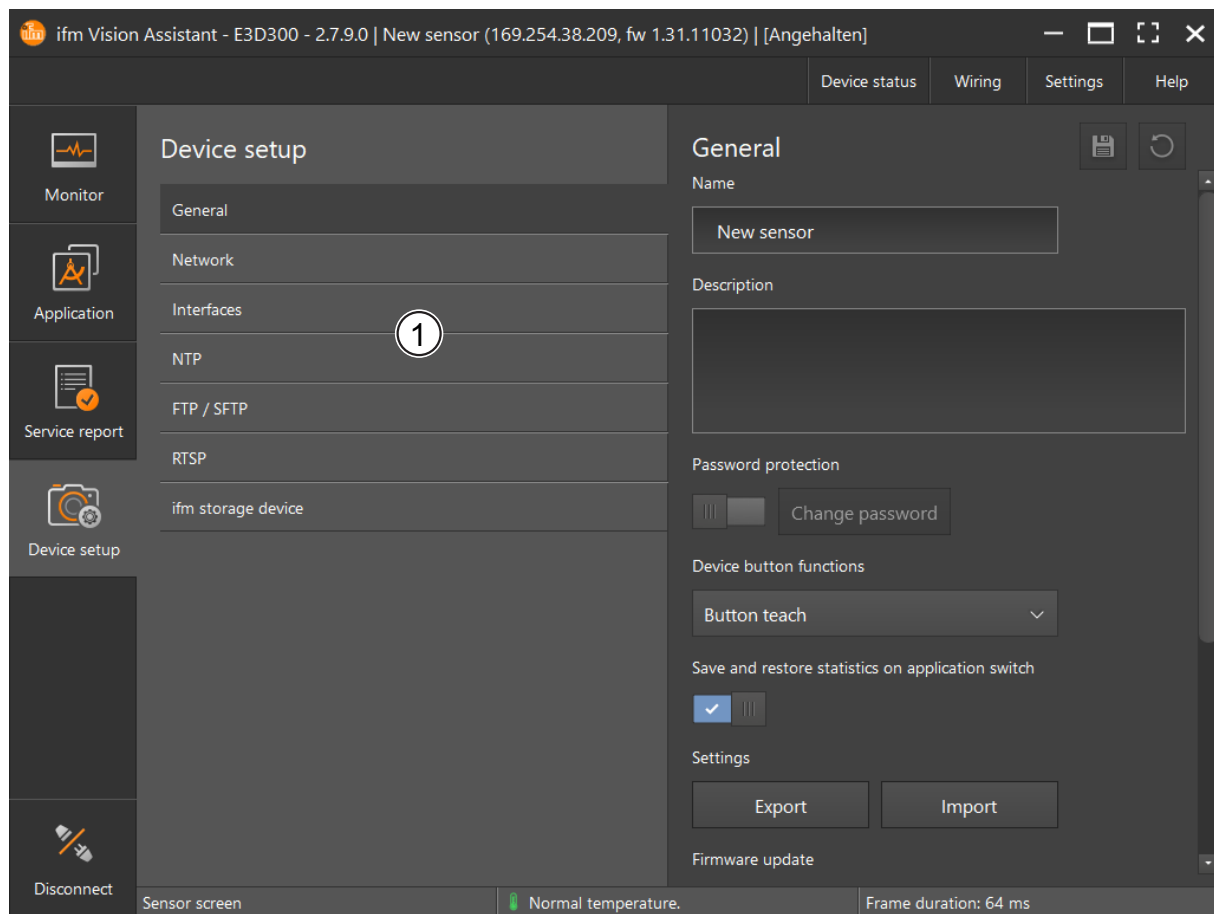


Fig. 57: [Device setup] area.

1 List

The [Device setup] area contains the following list items:

Element	Description
[General]	Sets the device, updates the firmware and imports/exports the settings. (→ General □ 170)
[Network]	Sets the Ethernet interface. (→ Network □ 171)
[Interfaces]	Sets the process interfaces. (→ Interfaces □ 172)
[NTP]	Synchronises the time of the device. (→ NTP □ 173)
[FTP / SFTP]	Sets the connection to an FTP/SFTO server. (→ FTP / SFTP □ 174)
[RTSP]	Sets the Real-Time Streaming Protocol. (→ RTSP □ 175)
[ifm storage device]	Sets the ifm mass storage device. (→ ifm mass storage device □ 176)

12.1 General

The item [General] sets the device, updates the firmware and imports/exports the settings.

The [General] item contains the following operating elements:

Operating element	Type	Description
	Button	Saves the settings on the device.

Operating element	Type	Description
	Button	Resets the changed settings.
[Name]	Input field	Sets the name of the device.
[Description]	Input field	Sets a description for the device.
[Password protection]	Switch	Activates the password protection. Password protection activates write protection for the following areas: - [Application] - [Device setup] - Teaching via button on the device The password unlocks the areas. The [Monitor] area can always be accessed, regardless of password protection.
[Change password]	Button	Changes the password. If the password is lost, contact the manufacturer's support quoting the serial number of the device.
[Device button functions]	Switch	Sets the function of the device buttons. The [Button teach] function is used to teach the device directly (see operating instructions).
[Save and restore statistics on application switch]	Switch	Saves the statistics of an application before switching to another application. If there are already statistics saved for an application, they are restored.
[Export]	Button	Exports the settings of the device to a file.
[Import]	Button	Imports the settings of the device from a file. The settings and applications on the device are overwritten during import.
[Update]	Button	Updates the firmware of the device. The current firmware version is shown next to the button. In order for the firmware to update successfully, a static IP address needs to be assigned to the device beforehand. (→ Assigning a static IP address ▢ 178)
[Reset]	Button	Restores the factory settings and deletes all settings and applications.
[Reboot]	Button	Reboots the device.

12.2 Network

The [Network] item sets the Ethernet interface.

The item [Network] contains the following operating elements:

Operating element	Type	Description
	Button	Saves the settings on the device.
	Button	Resets the changed settings.
[DHCP]	Switch	Activates the automatic assignment of the network settings (DHCP). With activated DHCP, the input fields [IP address], [Subnet mask] and [Gateway] are not available.

Operating element	Type	Description
[IP address]	Input field	Changes the IP address of the device. Preset: 192.168.0.69 . The device must be rebooted if the process interface is used after a change of the IP address. If TCP/IP is used as process interface, it is not necessary to reboot the device.
[Connected via ...]	Output field	Displays the current connection type and IP address.
[Subnet mask]	Input field	Sets the subnet mask of the device. Preset: 255.255.255.0 .
[Gateway]	Input field	Sets the gateway of the device. Preset: 192.168.0.201 .
[MAC address]	Output field	Displays the MAC address of the device.

12.3 Interfaces

The [Interfaces] item sets the process interfaces. In addition, a wiring test can be carried out.

The [Interfaces] item contains the following operating elements:

Operating element	Type	Description
	Button	Saves the settings on the device.
	Button	Resets the changed settings.
[Process interface version]	List	Sets the version of the process interface protocol.
[TCP/IP port for PCIC]	Input field	Sets the TCP/IP port for the data of the process interface with a socket connection. Preset: 50010 .
[PCIC TCP/IP scheme auto update]	Switch	Activates the corresponding PCIC data output (see operating instructions) when the active application is changed. If the switch is deactivated, the PCIC data output of the previous application remains active when the active application is changed (see operating instructions). Only if the connection to the device is separated, will the PCIC data output change.
[Active fieldbus]	List	Sets the fieldbus for the communication with connected controllers. The setting has an effect on all applications.
[IO-Link segmentation enabled]	Switch	Activates dividing of IO-Link data blocks that are >30 bytes. Each data block must be acknowledged manually or the [Maximum IO-Link hold time] must be waited for.
[Maximum IO-Link hold time]	Input field	Sets the time between sending data blocks. When this time has elapsed, the next data block is sent. Preset: 20 ms .
[Output logic]	List	Sets the output logic of the digital outputs of the device: [PNP]: switch positive potential to the output. [NPN]: switch ground to the output.

Operating element	Type	Description
[IO debouncing]	Switch	Activates the debouncing of the trigger. Then a signal has to be present for at least 4 ms to be detected as trigger signal. Shorter signals are ignored.
[External illumination]	List	Reserves the digital output OUT2 for external illumination (see operating instructions): [Disabled]: The external illumination is not used and is deactivated. [Using OUT2] The digital output OUT2 is reserved for external illumination. Output OUT2 is no longer available as a logic block.
[OUT 1]	Switch	Switches the digital output OUT1. The wiring test must be active.
[OUT 2]	Switch	Switches the digital output OUT2. The wiring test must be active.
[Start]	Button	Starts the wiring test to test the digital outputs. During the wiring test the applications are disabled.

12.4 NTP

The [NTP] item synchronises the time of the device. The time is synchronised via the **Network Time Protocol (NTP)**.



In the event of connection problems activate port 123 in the firewall.



The clock is not buffered by a battery. If the current supply fails, the clock is reset.

The [NTP] item contains the following operating elements:

Operating element	Type	Description
	Button	Saves the settings on the device.
	Button	Resets the changed settings.
[Activate NTP]	Switch	Activates the Network Time Protocol.
[NTP server IP]	Input field	Sets the IP address of the server. The date and the time are synchronised with the server. Several servers can be set. Besides the IP address, the status of the server is displayed: [Green field]: The server responds. [Red field]: The server does not respond. [Grey field]: So far no request has been sent to the set NTP server.
	Button	Checks the IP address of the server.
	Button	Deletes the IP address of the server. The button is only displayed after checking an IP address.
	Button	Adds a server. The button is only displayed after checking an IP address.

Operating element	Type	Description
[Synchronisation time]	Input field	Sets the waiting time of the NTP server when the device is rebooted. During the waiting time the device is not accessible for the ifm Vision Assistant.
[Time zone]	List	Sets a time zone.
	Button	Selects the local time zone from the [Time zone] list.
[Current time set on device]	Output field	Displays the time currently used in the device.
[Current time in the time zone of the device]	Output field	Shows the time in the time zone of the device.
[Set time without NTP]	Button	Sets the ID of the device. The current time of the system on which the ifm Vision Assistant is active is used as the source.

12.5 FTP / SFTP

The item [FTP / SFTP] sets the connection to an FTP server. The device sends current images and configurations to the FTP server if certain events occur.



FTP transfers data such as user name and password unencrypted. The data can be read and manipulated by third parties.

- ▶ Do not use the user name and the password of the FTP server for other services.
- ▶ Restrict the visibility of the FTP server to the local network.
- ▶ Do not use the function [FTP] if the FTP server is visible on the internet.
- ▶ Use an SFTP server for additional security.



In the event of connection problems, activate ports 20 and 21 in the firewall.

The item [FTP / SFTP] contains the following operating elements:

Operating element	Type	Description
	Button	Saves the settings on the device.
	Button	Resets the changed settings.
	Button	Adds a server.
[Status of the FTP server]	Output field	Displays the status of the server via a coloured field: [Green field]: The server responds. [Red field]: The server does not respond. [Grey field]: So far no request has been sent to the server.
	Button	Renames the server.
	Button	Deletes the IP address of the server.
[Activate]	Checkbox	Activates the client of the device.

Area [Connection]:

Operating element	Type	Description
[Connection type]	List	Sets the server type for the connection: [FTP] [SFTP]
[Server IP address] [port]	Input field	Sets the IP address and the port of the FTP server. Presetting of the port: 21.
[User] [Password]	Input field	Sets the user name and the password of the FTP server if authentication is required.

Area [Folders]:

Operating element	Type	Description
[Transfer decoding results]	Checkbox	Activates the transfer of decoding results to the FTP server.
[Path]	Input field	Sets the path to transfer the decoding results.
[Transfer image data]	Checkbox	Activates the transfer of the image data to the FTP server.
[Path]	Input field	Sets the path to transfer the image data.
[Transfer device and application data]	Checkbox	Activates the transfer of device and application data to the FTP server.
[Path]	Input field	Sets the path to transfer the device and application data.

[Configuration] area:

Operating element	Type	Description
[Passive mode]	Checkbox	Activates the passive mode. The passive mode reduces connection problems in context with a firewall.
[Keep alive]	Checkbox	Activates the keep-alive function. Depending on the configuration, the connection is quickly stopped on the server side. With the keep-alive function, the connection remains active.
[Warranty of data transfer]	Checkbox	Activates the warranty of data transfer. It is ensured that all data is transferred. If the data is not transferred fast enough, it is possible that - image capture is delayed, - the frame rate is reduced.
[Result types that should be pushed]	List	Sets the result type which is transferred to the FTP server: [Only fail results] [Only pass results] [All results]

12.6 RTSP

The item **RTSP** controls the transfer of the live image as video data stream. The stream can be replayed with a client software (video player with RTSP support).

As soon as the item [RTSP] is active and the following conditions apply, the live image of the device is transmitted:

- an application is active, ([→ Application ▢ 26](#))
- at least one model has been added. ([→ Add new model ▢ 66](#))

Together with the live image, the ROIs are transmitted, depending on the model set. (→ [Models](#) 65)
The live image can be retrieved via the displayed URL.



The function increases the evaluation time of the device.



In the event of connection problems activate the port 554 in the firewall.

The item [RTSP] contains the following operating elements:

Operating element	Type	Description
	Button	Saves the settings on the device.
	Button	Resets the changed settings.
[Activate RTSP]	Switch	Activates the Real-Time Streaming Protocol.
[Image repetition rate]	Slider / input field	Sets the images per second. High values lead to smoother image transitions and require more band width in the network.
[Image quality]	Slider / input field	Sets the quality of the images. High values increase the image quality, reduce the compression and increase the required bandwidth. Small values reduce the image quality, increase the compression and reduce the required bandwidth.
[Port]	Output field	Displays the preset port.
[RTSP stream url]	Output field	Displays the URL set for retrieving the RTSP. Clicking on the URL opens the URL in a compatible video player. Right-click to copy the URL to the clipboard.

12.7 ifm mass storage device

The [ifm storage device] item sets the ifm storage device of the device.

The ifm mass storage device is inserted into the device after opening a service lid (see operating instructions). The configuration of the device and error images are saved on the ifm mass storage device. The stored content can be accessed via a web interface.

If the device fails due to a defect, the configuration is saved on the ifm mass storage device and can be quickly transferred to a replacement device (see operating instructions).



The ifm mass storage device has a data retention time of 3 years at a maximum storage temperature of 55 °C. If this time is exceeded, data loss is possible. During operation, the stored data is refreshed periodically.



The service lid may only be opened for the transfer of the configuration.

► Only open the service lid in a clean and dry environment (pollution degree 2).



The ifm mass storage device must only be used for the O2x4xx and O2x5xx devices.

► Do not use the ifm mass storage device with a PC, notebook, etc.

The [ifm storage device] item contains the following operating elements:

Operating element	Type	Description
	Button	Saves the settings on the device.

Operating element	Type	Description
	Button	Resets the changed settings.
[Enable failed image storage]	Switch	Activates saving of images to the ifm mass storage device in case of an error.
[Enable configuration change storage]	Switch	Activates saving of configurations on the ifm mass storage device.
[Format storage]	Button	Formats the ifm mass storage device. Formatting cannot be reversed. All data on the ifm mass storage device is deleted.
[Import config]	Button	Imports the configuration saved last on the ifm mass storage device. After clicking the button, the configurations for the import are selected: [Global settings] [Network] [Application settings] The currently used configuration is overwritten by the import.
[Status]	Output field	Displays the status of the ifm mass storage device. The status of the partitions contained is also displayed.
[Web interface URL]	Output field	Displays the URL to the web interface of the ifm mass storage device. A click on the URL shows the content of the ifm mass storage device in the web browser.

13 Appendix

13.1 Assigning a static IP address

Below you find a description of how to assign a static IP address to the PC. A static IP address is necessary if

- the assignment of a dynamic IP address is not possible due to the network configuration,
- the firmware of the device is to be updated.



The details of the network settings in this document describe the procedure for PCs with the operating system Windows 10. Changing network settings on a PC requires administrator rights. The following ports must be enabled in the firewall:

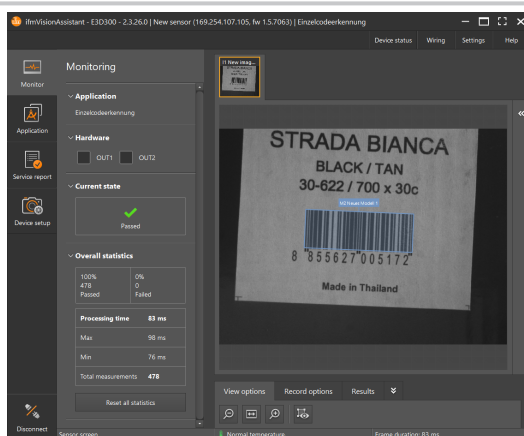
- UDP: 3321
- TCP/HTTP: 80 and 8080
- TCP: 50010

Assigning a static IP address:

- ▶ Open the [Network and Sharing Centre] in Windows.
- ▶ Click the name of the local network.
- ▷ The window [Ethernet Status] opens.
- ▶ Click on the [Properties] button.
- ▷ The window [Ethernet Properties] opens.
- ▶ Activate the checkbox [Internet Protocol Version 4 (TCP/IPv4)].
- ▶ Click on the [Properties] button.
- ▷ The window [Internet Protocol Version 4 (TCP/IPv4) Properties] opens.
- ▶ Activate the option field [Use the following IP address].
- ▶ Set 192.168.0.1 for the IP address.
- ▶ Set 255.255.255.0 for the subnet mask.
- ▶ Set 192.168.0.201 for the standard gateway.
- ▶ Click on the [OK] button.

Glossary

Live image



The live image displays the received data of the device.

NTP

The Network Time Protocol synchronises the local time with the time of an NTP server.

Processing time

The processing time indicates the transit time of the signal from the trigger input to the process interface.

RTSP

The Real-Time Streaming Protocol controls the transmission of audio-visual data as a stream. It controls the session between receiver and transmitter. Communication takes place via port "554".

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