

Programming manual

PC operating program
for O2D

UK

efector250[®]

E2D200

Version 3.0



www.ifm.com

efector[®]
dualis

Object recognition

Parameter setting software

Version : 3.0 (Build : 0053)

Art. no. : E2D200

www.ifm.com

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The chapters marked with * are available from firmware version 1028.

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1 Preliminary note

1.1 Symbols used

- Instruction
- > Reaction, result
- [...] Designation of pushbuttons, buttons or indications
- Cross-reference
-  Important note
Non-compliance can result in malfunctions or interference.
-  Information
Supplementary note

2 Safety instructions

Please read the operating instructions prior to set-up of the device. Ensure that the device is suitable for your application without any restrictions.

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

3 System requirements

3.1 Hardware

- PC with Pentium III processor or higher, clock frequency min. 500 MHz
- min. 128 MB RAM
- min. 35 MB freely available hard disc memory
- CD-ROM drive
- XGA compatible graphic card with min. 1024 x 768 pixel resolution
- Ethernet network card for 10Base-T/100Base-TX, TCP//UDP/IP protocol
- PC mouse

3.2 Software

- Operating system Microsoft Windows 2000 (SP4), XP or Vista

3.3 Required accessories

- Crossover cable for parameter setting connection (Ethernet), M12 connector/RJ45 connector, 4 poles, e.g. article no. E11898 (2 m)
- Connection cable for supply voltage and process connection, M12 socket, 8 poles, e.g. article no. E11950 (2 m, wirable cable end)

You can find more information about the available accessories at:

www.ifm.com → Data sheet direct → e.g. O2D220 → Accessories

4 Functions and features

In conjunction with the object recognition sensor the PC operating program provides the following options:

- The sensor uses incident light or backlight to detect the image of an object and compares it with the defined contours of one or several models in a reference image. Depending on the degree of conformity, orientation and tolerances the object is classified as being good or bad.
- Creation, administration and deletion of application-specific applications
- Real-time monitor mode for set-up
- Analysis of the application via the service report

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5 Installation

Installation and setting for operation with a fixed assigned IP address are described below (= direct connection to the PC).

This is the factory-preset operating mode of the sensor.

The figures and texts show the installation process under Windows XP.

5.1 Hardware

- ▶ Connect the device to the Ethernet interface of the PC using a crossover cable.
- ▶ Supply the device via the process connection.
Wiring → type label, data sheet O2D22x or included operating instructions
- > Green Power LED lights
- > Green Eth LED lights for correct Ethernet connection

5.2 Software

The PC operating program can be started directly from the CD or can be installed on the PC.

5.2.1 Start program without installation

- ▶ Insert the CD in the drive.
- > The start menu opens.
- ▶ Select the menu item "Start efector dualis".
- > The program starts.

 If the autostart function for CD drives is deactivated and the start menu does not open automatically:

- ▶ Start the "O2Dstart.exe" file in the main directory of the CD with a double click.
- > The program starts.

5.2.2 Install program on the hard disk

- ▶ Insert the CD in the drive.
- > The start menu opens.
- ▶ Select the menu item "Install efector dualis" and follow the instructions of the installation routine.
- > The program is installed.

 If the autostart function for CD drives is deactivated and the start menu does not open automatically:

- ▶ Start the "O2Dstart.exe" file in the main directory of the CD with a double click.
- > The start menu opens.
- ▶ Select menu item "Install efector dualis" and then follow the instructions of the installation routine.
- > The program is installed.

5.3 Factory setting

5.3.1 Network setting IP address range

The IP address range of the device and the PC have to match.

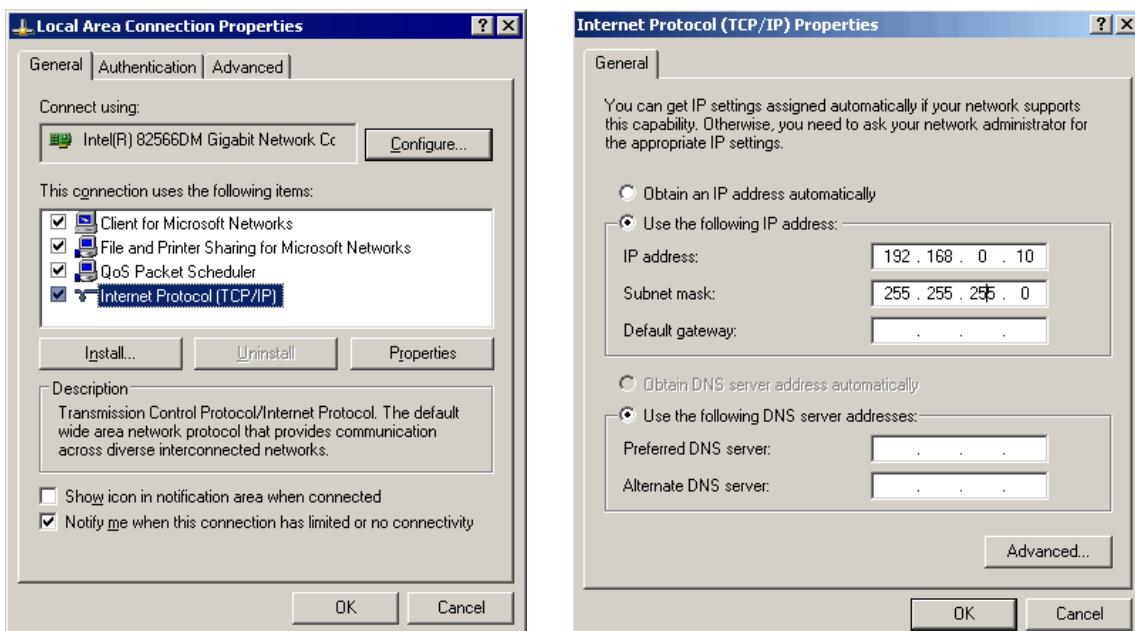
	Network address	Station address
efector dualis O2D2xx	192.168.0	49
	=	≠
PC	192.168.0	e.g. 10

5.3.2 Factory setting parameters

efector dualis O2D2xx parameters	Description	Factory setting
DHCP	Dynamic Host Configuration Protocol	off
IP	IP address	192.168.0.49
nETm	subnet mask	255.255.255.0
GWIP	gateway address	192.168.0.201

5.3.3 Verify and set the IP address of the PC

- ▶ Activate the menu "Internet protocol (TCP/IP) Properties".
The Windows menu "Internet protocol (TCP/IP) Properties" is accessible for example via: Start → Control Panel → Network Connections → Local Area Connection → Properties.
- ▶ Select the menu item "Use the following IP address".
- ▶ Verify and set the IP address, if necessary (here e.g. 192.168.0.10).
- ▶ Enter the subnet mask (255.255.255.0).
- ▶ Leave default gateway blank.
- ▶ Confirm the settings with [OK].



! Changes in the network settings of the PC require extended user rights.
Contact your system administrator.

5.3.4 Verify and set the IP address on the device

- Select the parameter "IP" (IP address) with [MODE/ENTER] and [SET].
- > The IP address is processed automatically and shown in 4 groups (A, b, C, d).
- Verify the IP address and set with [SET], if necessary.

5.3.5 Adjustable parameters

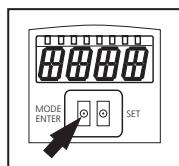
APP	Memory location Select an application. The device can save up to 32 applications. By pressing the SET button the memory location number is incremented in the display. The current state of the memory location is visualised in the first digit of the display: F = memory location available I = memory location used by an inactive application A = memory location used by an active application E = memory location (selected by external selection of the application)
nET	Network operation Here you set the parameters for network operation.
DHCP	Network settings via DHCP If the sensor is to get its network settings via DHCP, select the setting "On" in this menu item. With the setting "Off" the fixed network settings (see next menu items) are used. In the DHCP mode the sensor must be operated in a network with DHCP server. Otherwise it is not accessible via the operating program E2D200.
IP	Set IP address Here the IP address of the sensor is set. This setting is used when the sensor does not work in the DHCP mode. The input is made in the "dotted decimal" notation, e.g. 192.168.0.3. Using the SET button you can select the four groups of the address. The respective group is visualised by a letter in the first digit of the display.
nETm	Set subnet mask Here the subnet mask of the sensor is set. This setting is used when the sensor does not work in the DHCP mode. The subnet mask must match the IP address. It is input in the same way as the IP address.
GWIP	Set gateway address Here the gateway address used by the sensor is set. This setting is used when the sensor does not work in the DHCP mode. It is input in the same way as the IP address.
EF	Access extended functions Here you activate the extended functions.
d, S	Rotate / switch off display Here you set whether a text is displayed normally (d) or rotated by 180° (rd). You also set whether the display is to be switched off (oFF) in the evaluation mode.
rES	Reset sensor Here you reset the sensor to the factory setting.
FW	Firmware version In this menu item you can enquire about the firmware version of the sensor.

5.3.6 Parameter setting on the device

Set the parameter values via pushbuttons and display on the device.

The sensor is programmed using the two buttons [Mode/Enter] and [Set].

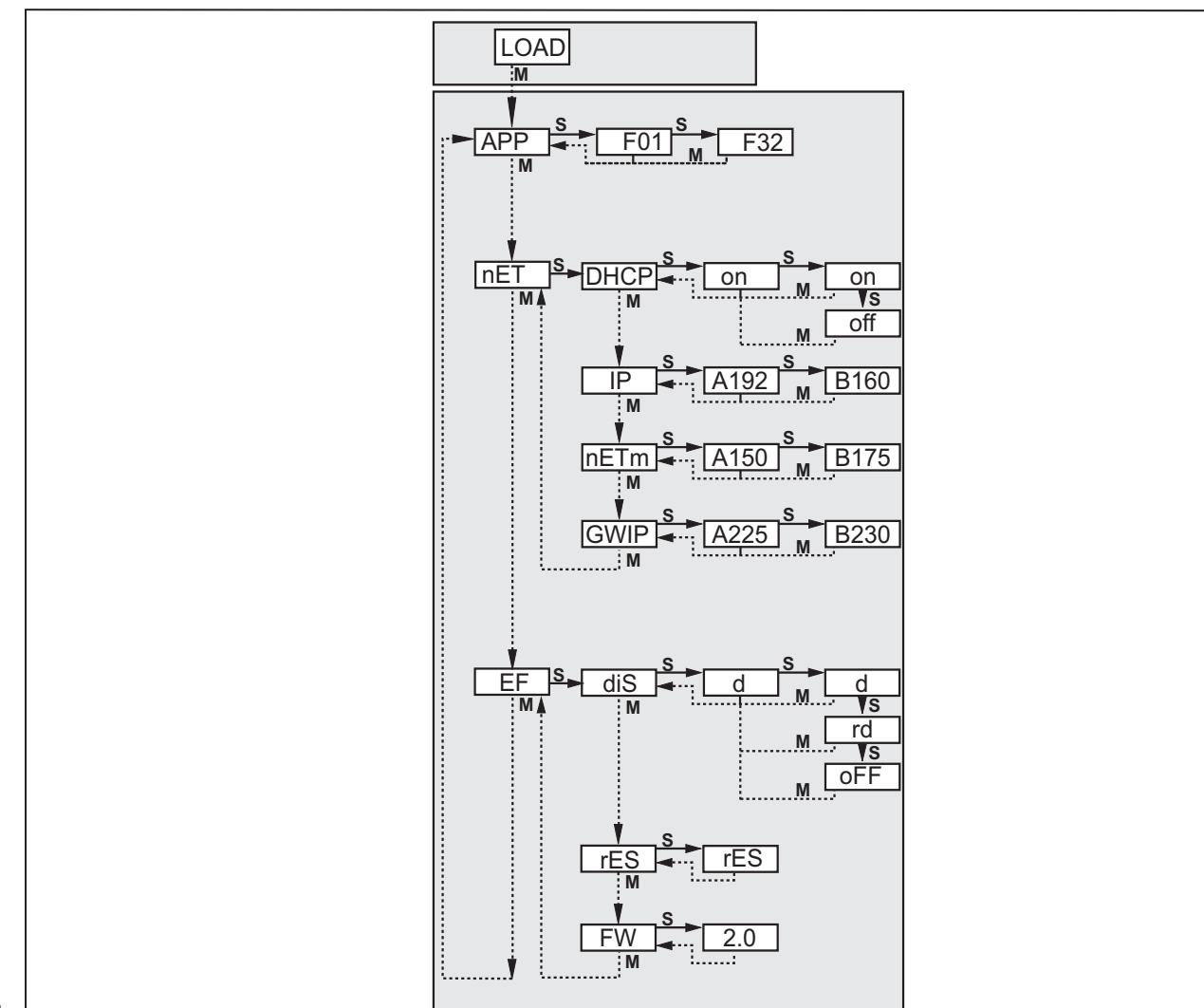
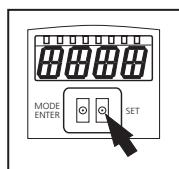
First activate a parameter with the [Mode/Enter] button, select the requested value with the [Set] button and confirm it pressing again the [Mode/Enter] button.



The device goes to the parameter setting mode when

- ▶ [MODE/ENTER] is pressed for longer than 1 s.
- > The first menu item is displayed.
- ▶ Press [MODE/ENTER] so often until the requested parameter is displayed.
- ▶ Press [SET].
- ▶ The menu item is activated and the current setting is displayed.
- > Keep [SET] pressed.
- ▶ The display flashes, after 5 s with pressed SET button the display stops flashing.
- ▶ Press [SET] and change setting.
- ▶ Press [MODE/ENTER].
- > The change is acknowledged and the previous menu item is shown again.

If no button is pressed longer than 15 s, you will get to the next higher menu item or the evaluation mode.



Parameters	Description	Selection	
APP	Memory location for application	Enter value between 1...32	
nET	Set network parameters		
	DHCP	Dynamic Host Configuration Protocol	on Network settings via DHCP off Fixed network settings
	IP	IP address sensor	Enter address
	nETm	Subnet mask	Enter subnet mask
	GWIP	Gateway address	Enter address
EF	Extended functions		
	diS	Display	d Normal
			rd Rotated by 180°
			oFF Display off (in evaluation mode)
rES	Reset	Reset to factory setting	
FW	Firmware version	Enquire about firmware version	

5.3.7 Display of the sensor

Onli	Connection with the operating program
Parm	Parameter setting via operating program
SErP	Connection with the operating program, service report mode
ErrP	Selection of a non-existing application via switching inputs
ErrD	Critical hardware error
SC	Short circuit of one of the switching outputs
Init	Device initialisation after power-on
run	Sensor waiting for connection (no application active)
LOAd	Application is being loaded
done	Loading application completed
Monl	Monitor mode
Lock	Pushbuttons locked
uLoc	Pushbuttons not locked
no[xx]	Application successful (number of the application)
Fail	Application not successful
rEdY	Sensor ready for trigger
FWUP	Firmware update running
DHCP nolP	No DHCP server found (display flashes alternately)
WAIT	Sensor is busy (display flashes)

5.3.8 Lock / unlock the sensor

Lock sensor

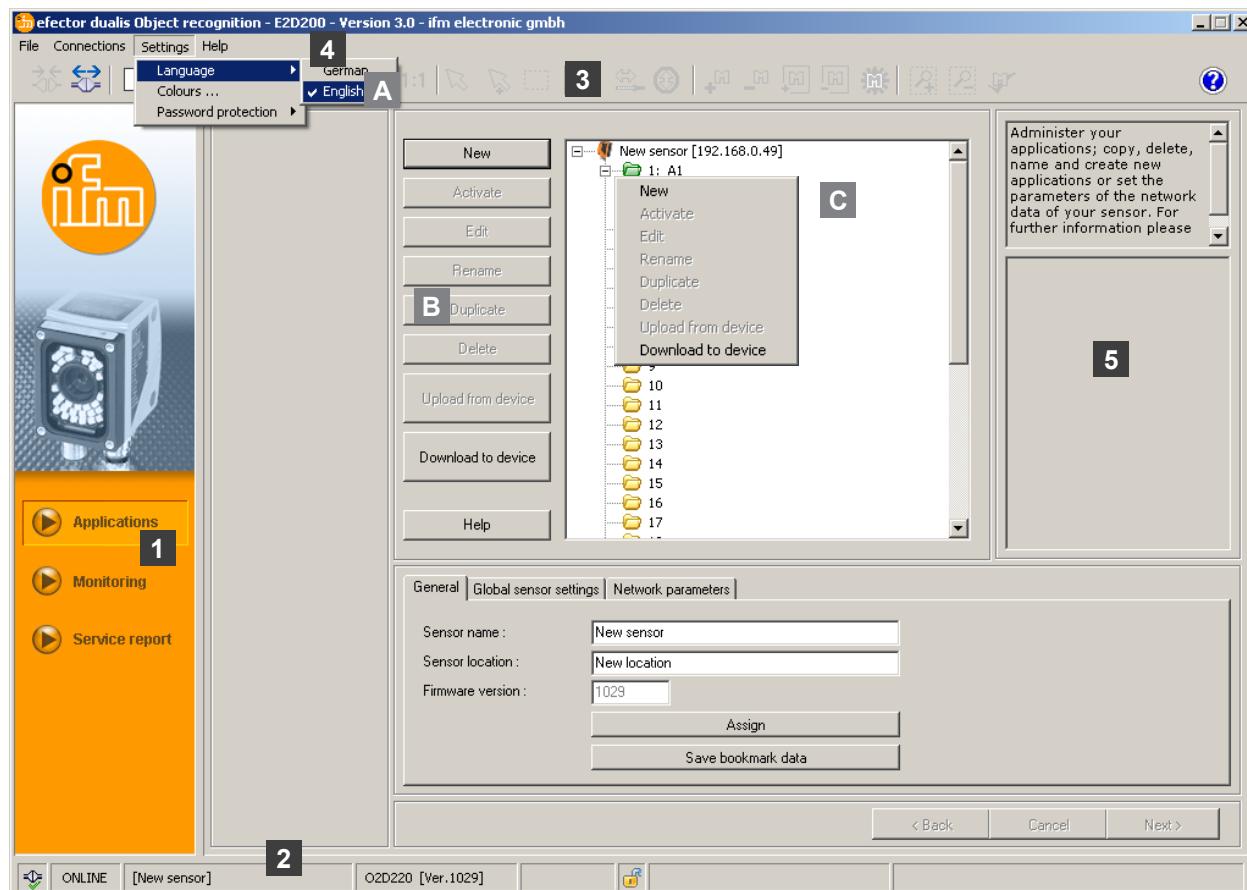
- Keep [Mode/Enter] and [Set] pressed simultaneously for 10 s.
- > Display changes to uLoc.
- Press [Set].
- Display changes to Lock.
- Confirm with [Mode/Enter].
- > The sensor is locked.

Unlock the sensor

- Keep [Mode/Enter] and [Set] pressed simultaneously for 10 s.
- > Display shows Lok1, changes to Lock after 10 s.
- Press [Set].
- > Display changes to uLoc.
- Confirm with [Mode/Enter].
- > The sensor is unlocked, display changes to run.

6 Basic functions of the program

6.1 Basics of the user interface



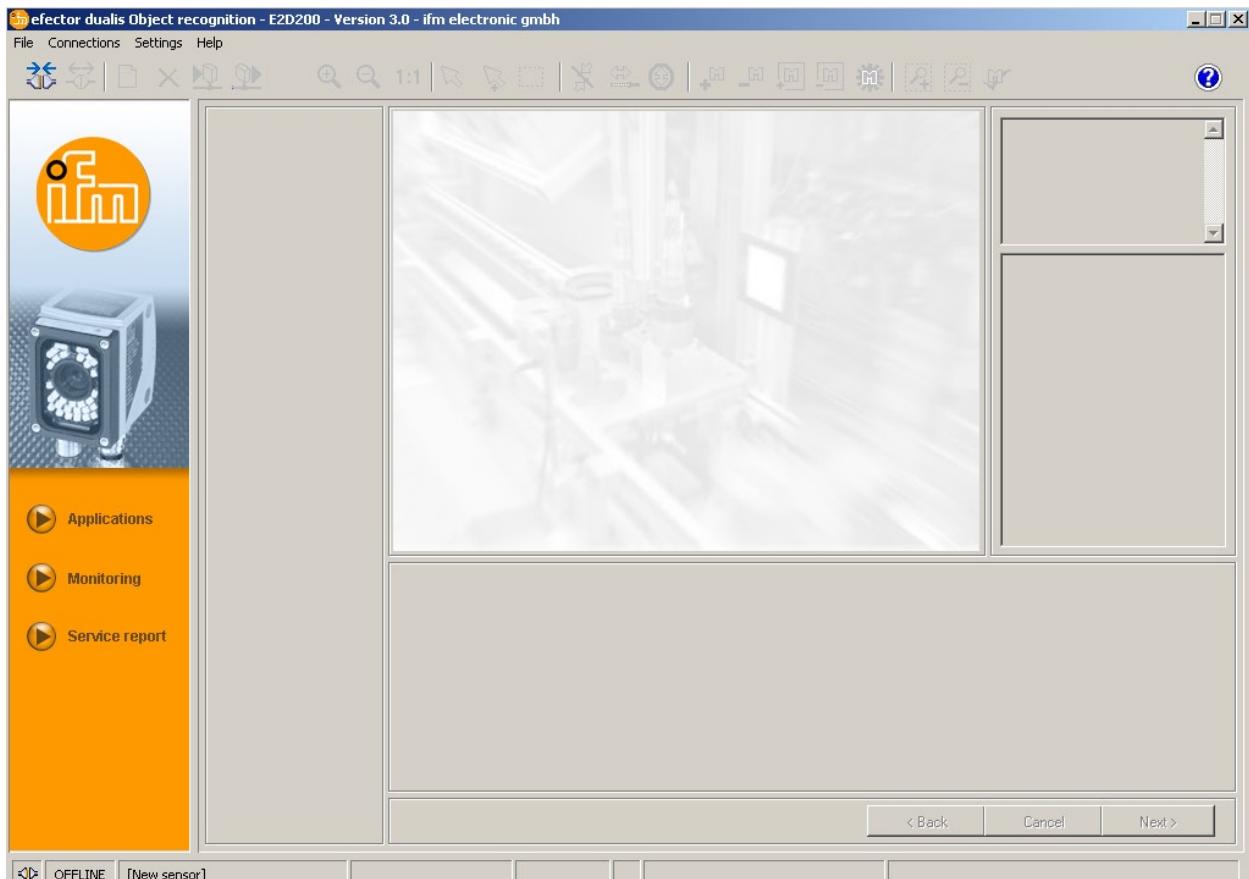
Item	Operating elements	Contents
1	Mode	<ul style="list-style-type: none"> Applications Create, edit, delete etc. applications Monitor Display or visualisation <ul style="list-style-type: none"> of the images (detected object) of the contours of the tolerances of the search zones of the results Service report Display evaluations Save reports, images, etc.
2	Status bar	<ul style="list-style-type: none"> Network status of the device (OFFLINE/ONLINE) Device name Article number/production status/firmware of the connected device Device password protected or unprotected (lock symbol)
3	Tool bar	Buttons (e.g. "Save" or "Connect") Commands that cannot be selected are displayed in grey.
4	Menu bar	Pulldown menus with program functions.
5	Result field	<ul style="list-style-type: none"> Display of the set parameters Display of the results
A/B/C	Selection variants	<p>Identical commands can be selected in different ways (depending on the program function).</p> <p>A = selection via pulldown menu in the menu bar</p> <p>B = selection via button</p> <p>C = selection via context menu (click with right mouse button)</p>

6.1.1 Tool bar icons

Symbol	Function
	Connect sensor.
	Disconnect sensor.
	Copy existing application to the sensor.
	Loads application from the sensor.
	Enlarge sensor image.
	Reduce sensor image.
	Generates original size of the sensor image.
	Mode for selecting contours.
	Add more contours to selection.
	Select contour with a drag frame.
	Select contour element.
	Edit segment selection.
	Adds all contours / removes all contours.
	Adds all selected contours / removes all selected contours.
	Adds new search zone / removes existing search zone.
	Tests the current model.

6.2 Program start

- Start the PC operating program.
- > The start screen displays the article number, program designation and version number for approx. 5 s. When the program is started for the first time and the device is in the offline status, a neutral user interface will be displayed.
(On delivery = no application saved)



Status: OFFLINE

Mode: no button activated

Monitor window: blank

Result window: blank

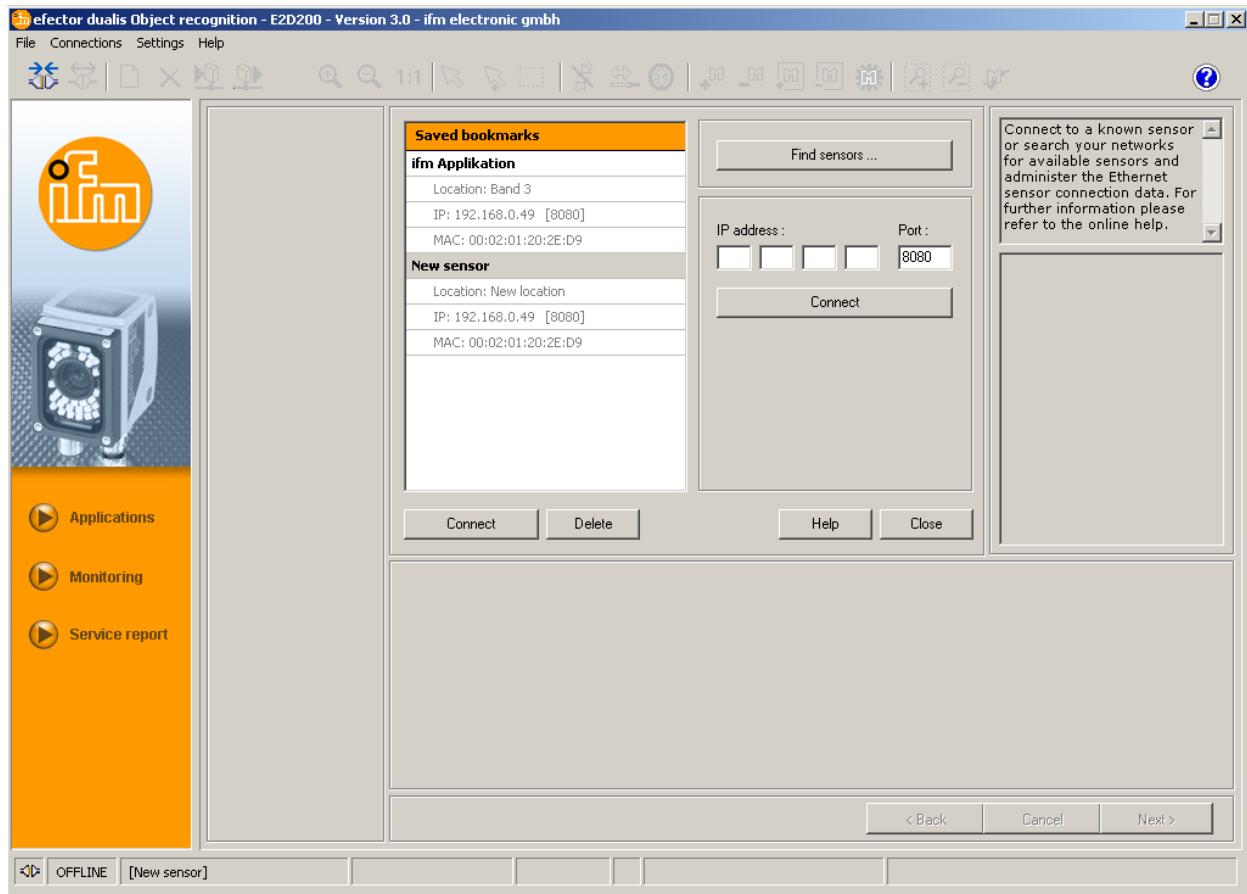
6.3 Connect device to the operating program

6.3.1 Alternative 1: bookmark entry

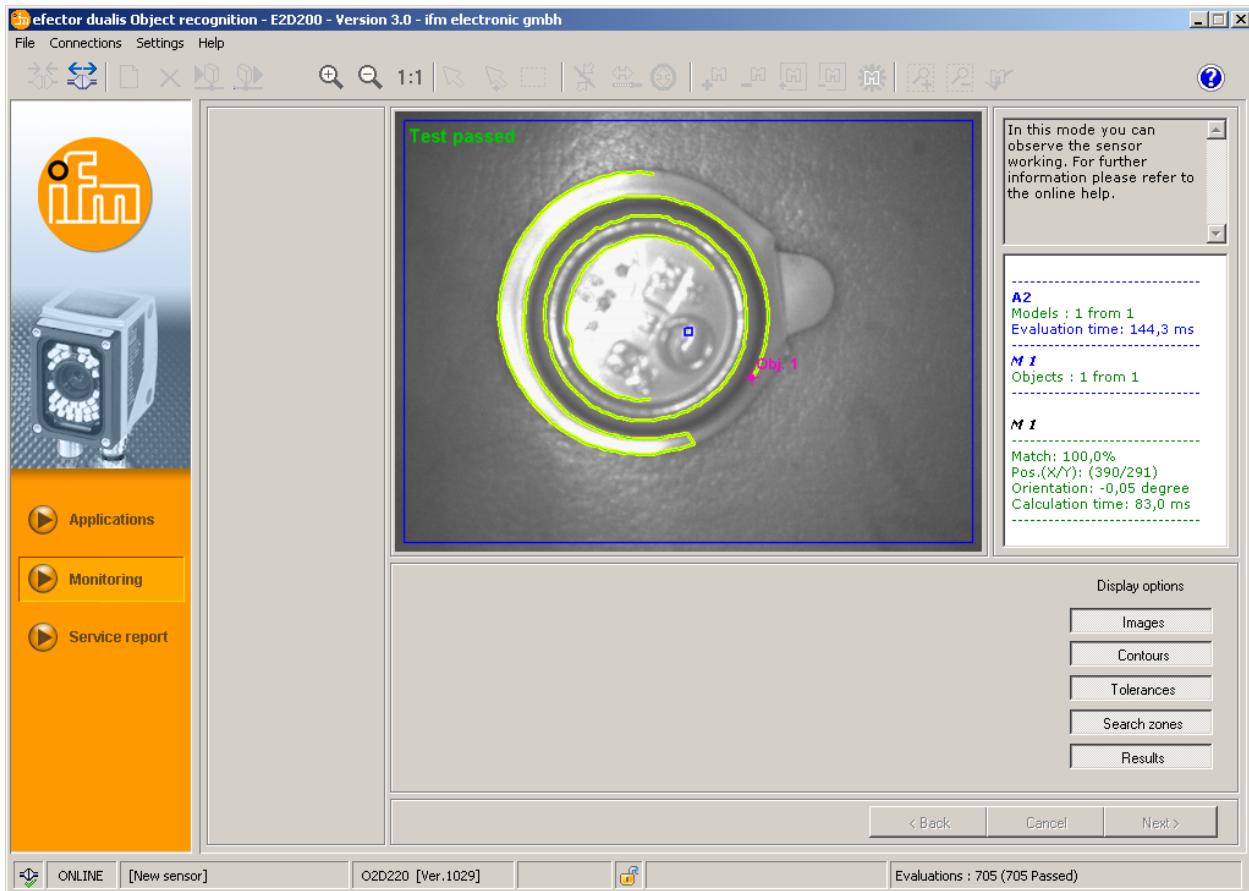
- Select [Connections] → [IP address] in the menu bar.



- > User interface changes to the connection settings.
- > "Saved bookmarks" contains a bookmark entry "New sensor" with the factory settings of the device.
(If this is not the case, continue with 6.3.2 or 6.3.3)



- ▶ Single-click on the bookmark entry "New sensor" and click on [Connect].
As an alternative: double-click on the entry.
- > Change of status: OFFLINE → ONLINE
 - Active application file saved on the device:
The user interface changes to the monitor mode.
The [Monitor] button is activated.
After a trigger pulse the monitor window displays the current capture of the image.
The result field on the right displays the current results.
 - No active application file saved on the device:
The user interface changes to the application mode.



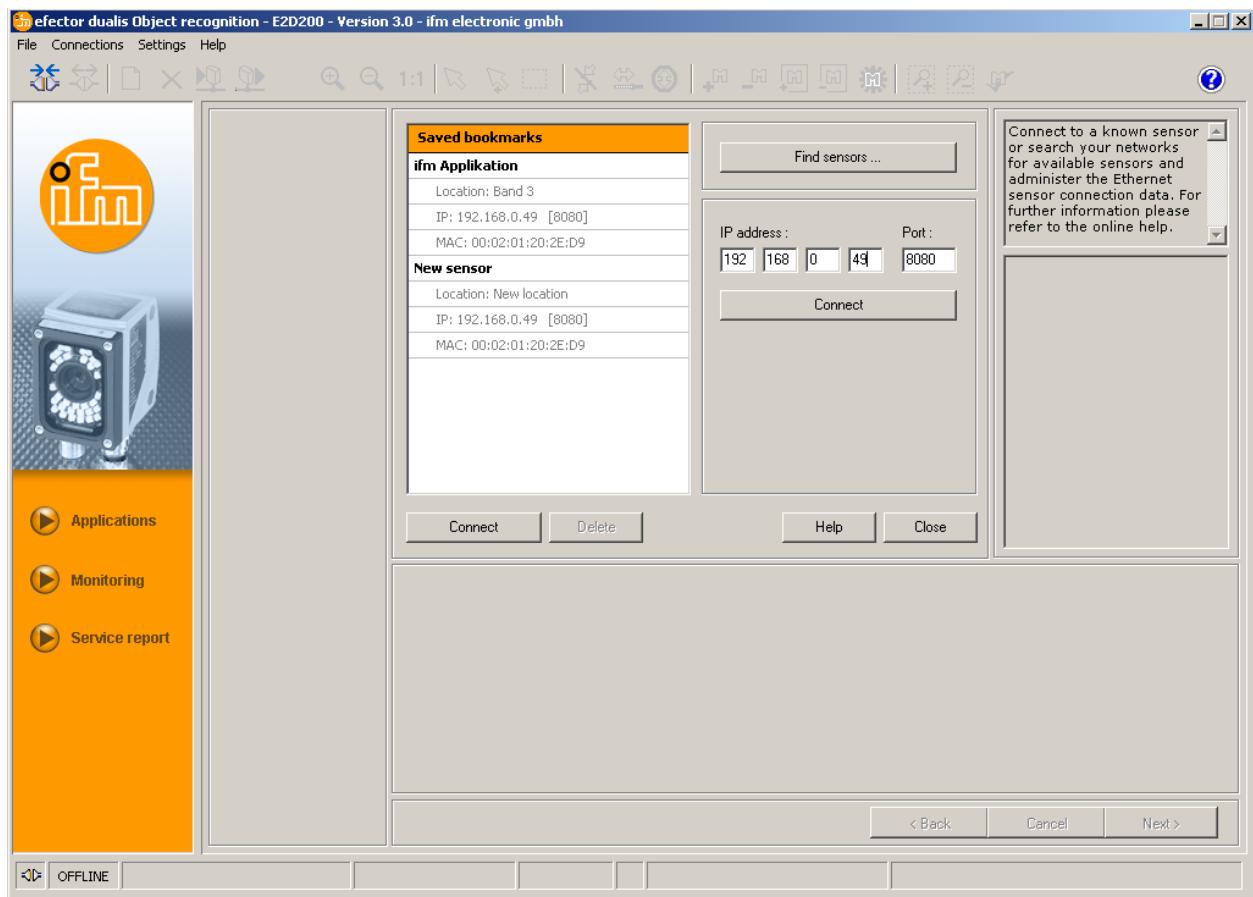
 Establishing the connection may take several seconds.

6.3.2 Alternative 2: enter IP address of the device

- ▶ Select [Connections] → [IP address] in the menu bar.



- ▶ Enter the IP address of the device in the input mask "IP address".
- ▶ Assign preset port number 8080.
-  If a firewall is active on the PC, ensure that this port and the port number 50002 have been enabled for image transmission.
- ▶ Click on [Connect].



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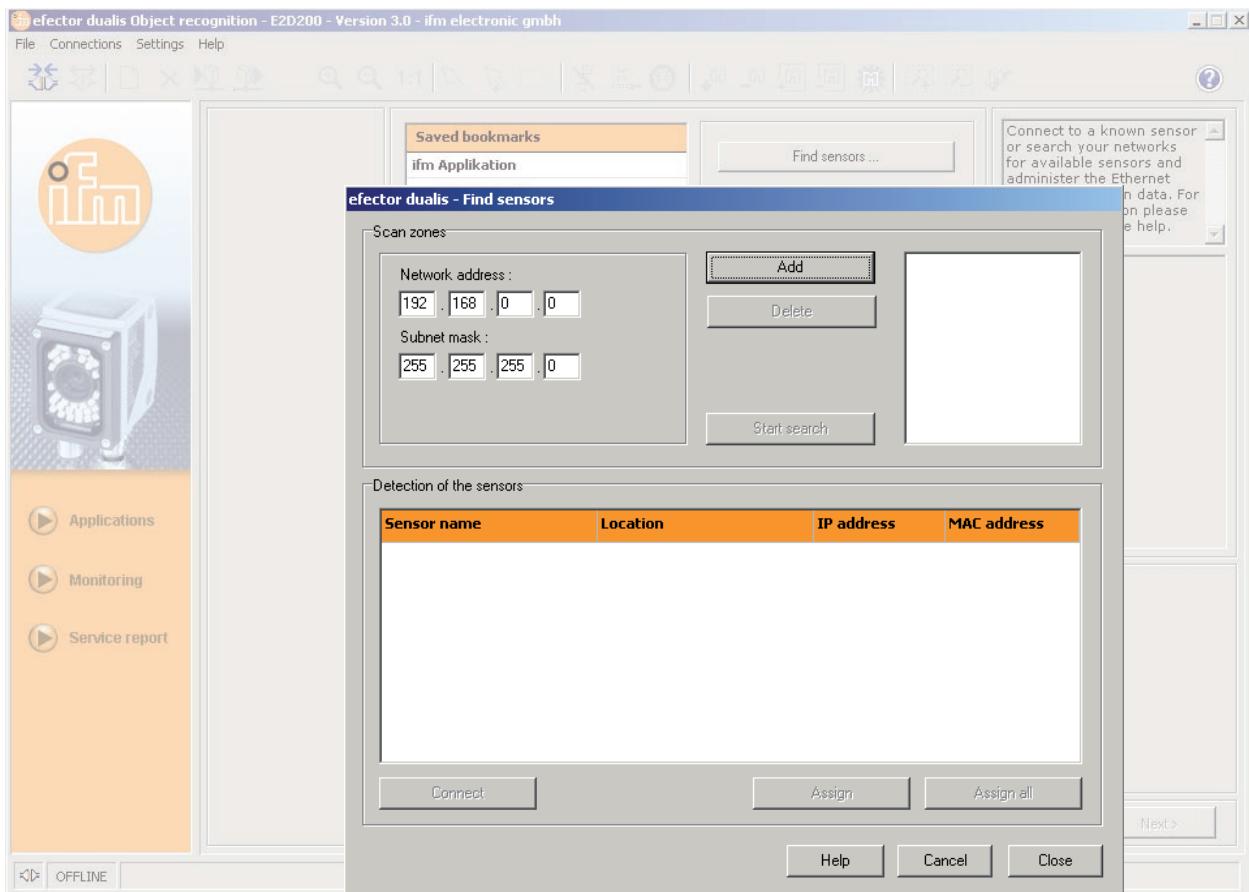
- > Change of status: OFFLINE → ONLINE
(like 6.3.1)

6.3.3 Alternative 3: find IP address of the device

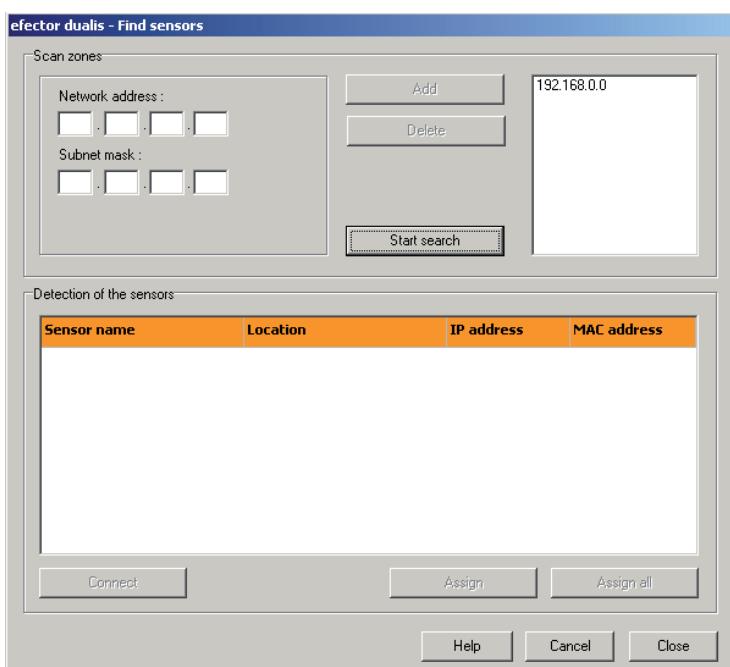
- Select [Connections] → [IP address] in the menu bar.



- Click on [Find sensors...].
- > The window "Find sensors" opens.

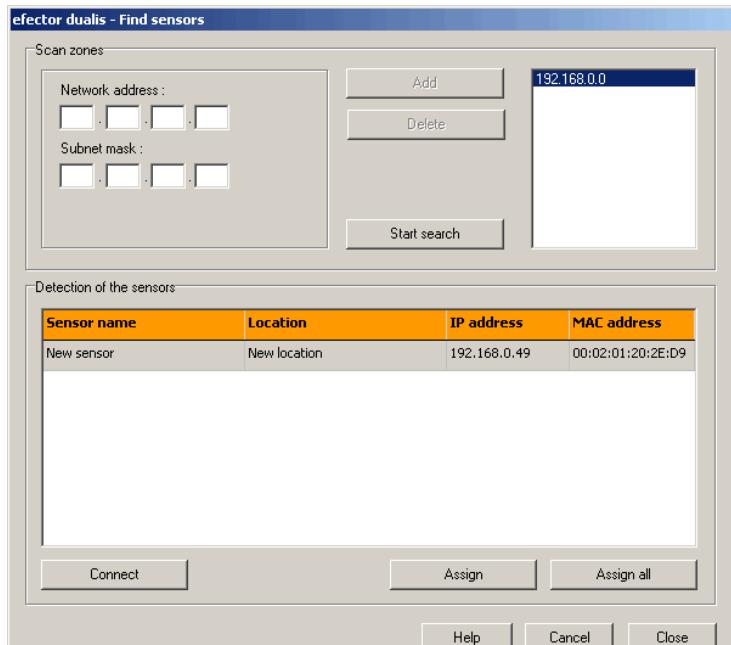


- ▶ Enter the IP address range at "Network address", here e.g. 192.168.0.0
- ▶ Enter the "Subnet mask", here e.g. 255.255.255.0
- ▶ Click on [Add].
- ▶ The network address is added to the search list.
Input fields for the network address and subnet mask are blank so that other entries can be made in the search list.



- ▶ Click on [Start search].

- > The devices found are listed in the "Detection of the sensors" box.
- Click on [Assign].
- > All network data necessary for the connection to the device is saved locally on the PC in a bookmark entry with the indicated device name and its location.



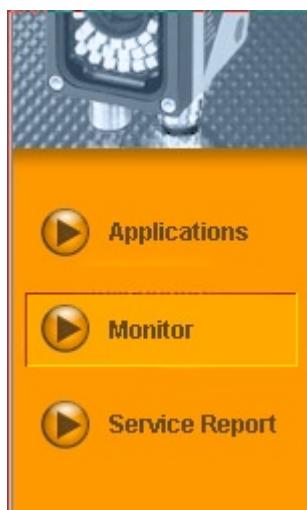
- Single-click on the entry in the search list and then on [Connect].
As an alternative: double-click on the entry in the search list.

Change of status: OFFLINE → ONLINE
(like 6.3.1)

7. Operating modes

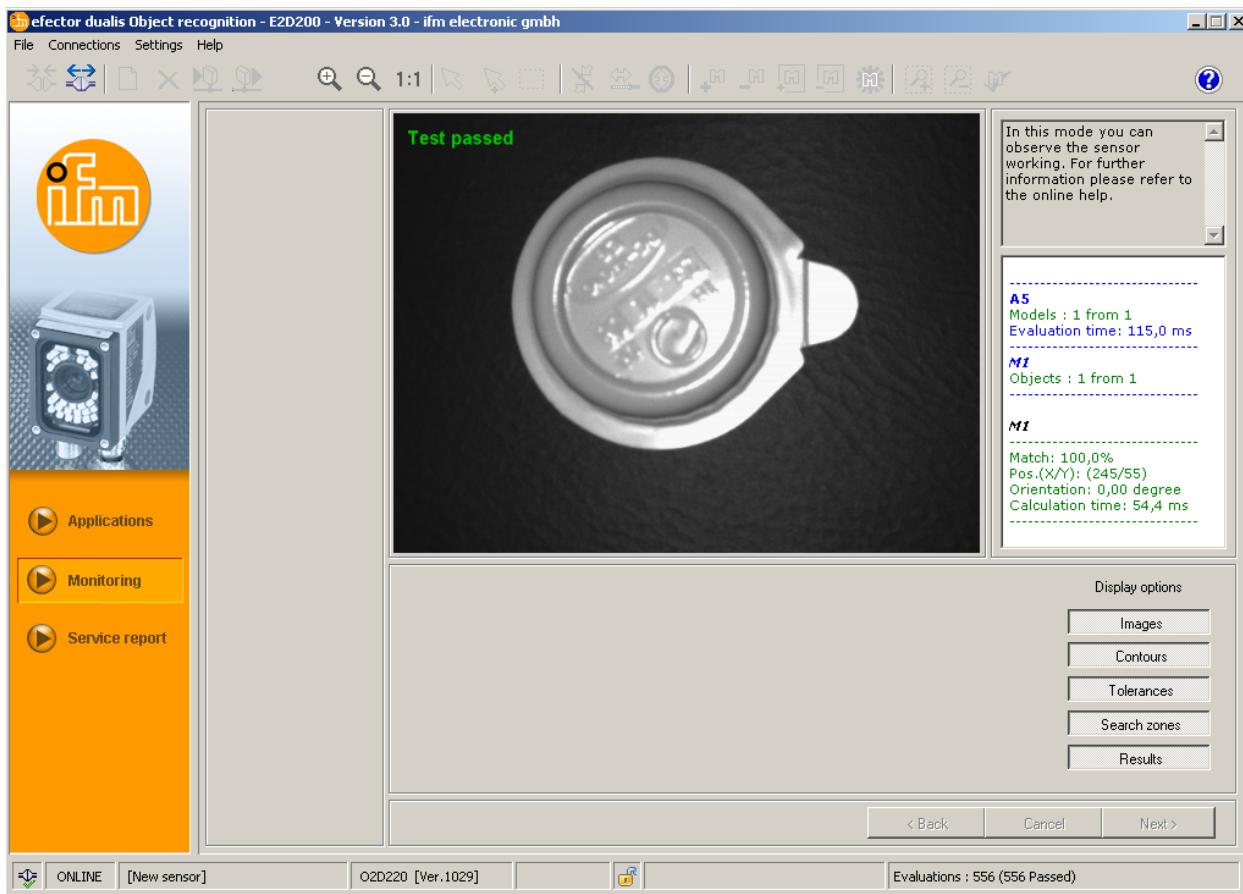
The device distinguishes three operating modes:

- Applications
- Monitor
- Service Report



7.1 Monitor

After power-on and connection to the PC the device changes to the monitor mode when an active application is saved. Here you can observe the device working. It is in the evaluation mode.

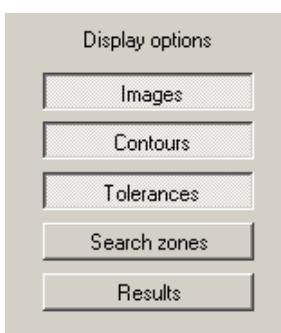


The status line informs about

- network status of the device (OFFLINE/ONLINE)
- device number / article number / production status / firmware version of the connected device
- device password protected or unprotected (lock symbol)
- number of evaluations



Under display options you define which information is shown. Display options highlighted in light grey are shown, dark grey options are suppressed.



Example: image (object), contour and tolerance shown, search zone and result field suppressed.



On the right in the result output field you find information about

- detected object
- evaluation time
- per cent value of the match
- position of the object
- orientation of the object

```
-----
A2
Models : 1 from 1
Evaluation time: 137,5 ms
-----
M 1
Objects : 1 from 1
-----
M 1
-----
Match: 98,9%
Pos.(X/Y): (394/281)
Orientation: -4,33 degree
Calculation time: 75,9 ms
-----
```

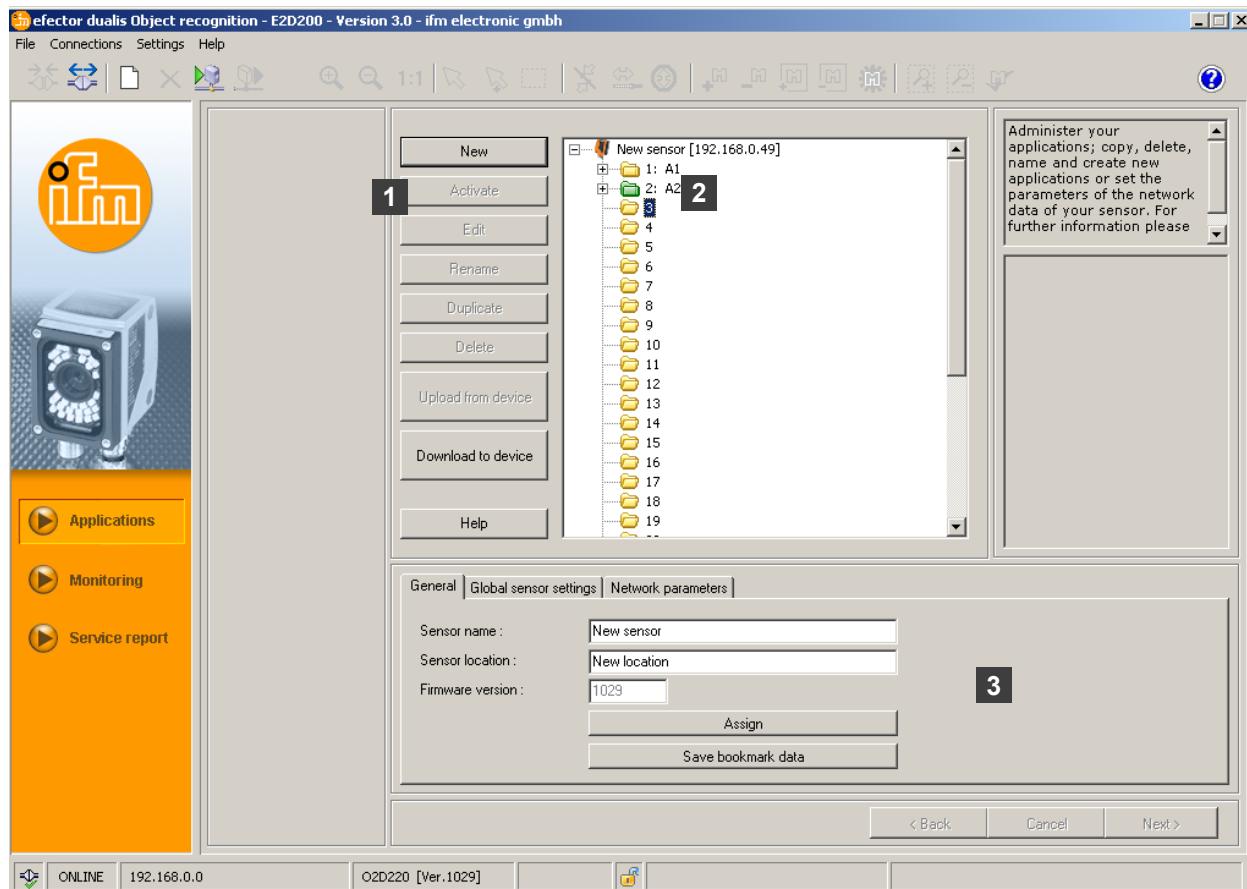
7.2. Applications

The device can save up to 32 applications (= parameter sets).
 When creating an application the user is guided via a predefined navigation.
 The following settings and indications are polled and defined step by step:

1. Image quality
2. Model definition
3. Process interface
4. Trigger configuration
5. Overall function test

7.2.1 Activate application mode

► Click on [Applications]



Pos.	Element	Function
1	Administer applications	New, activate, edit, rename etc.
2	Application directory	Overview, structure and selection of the applications.
3	General administration Global sensor settings Network parameters	<p>Device-specific information, info about the software version.</p> <ul style="list-style-type: none"> • Trigger input debouncing (on/off) • External selection of the application (on/off) <p>Possible basic settings of the performance and network parameters of the device.</p> <p>• Network parameters (DHCP on/off, IP address etc.)</p>

7.2.2 General (general administration)

- Enter sensor name and sensor location according to the application.
- Transfer the entries to the device with [Assign].
- Transfer all network data, sensor names and location designations for connection to the sensor to the PC and save with [Save bookmark data].

General | Global sensor settings | Network parameters

Sensor name :

Sensor location :

Firmware version :

Field	Function
Sensor name	Any application-specific device name
Sensor location	Location description (e.g. belt 3)
Software version	Firmware version of the device (cannot be changed)

7.2.3 Global sensor settings

- Click on [Global sensor settings ...].
- Switch on or off trigger input debouncing and external selection of the application.

General | Global sensor settings | Network parameters

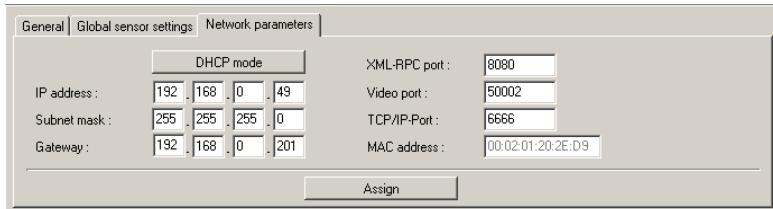
Trigger input debouncing :

External selection of the application :

Field	Function
Trigger input debouncing	Prevents that several pulses occurring shortly after each other cause a trigger process on the device (mechanical trigger switch). With "On" a stable pulse has to be on the input for at least 3 ms so that it is recognised as a trigger pulse. Shorter pulses are ignored.
External selection of the application	If this option is activated, pins 7 and 8 of the process interface are used as inputs which can externally switch the first four applications. Pin 7 is the least significant bit (LSB), pin 8 is the most significant bit (MSB). Possible switching operations: Pin 7: 0, pin 8: 0 -> application on memory location 1 active Pin 7: 1, pin 8: 0 -> application on memory location 2 active Pin 7: 0, pin 8: 1 -> application on memory location 3 active Pin 7: 1, pin 8: 1 -> application on memory location 4 active

7.2.4 Network parameters

- ▶ Enter, check and change, if necessary, network parameters.



Field	Function
Network parameters DHCP	In the DHCP mode the input fields for IP address, mask and gateway are blocked. The device is assigned an address by the DHCP server.
IP address	Currently assigned IP address of the device.
Subnet mask	Default setting network mask.
Gateway	Default gateway address.
XML-RPC port	Port number for the communication via the XML-RPC protocol (Remote Procedure Call).
Video port	Port number for the transmission of images.
TCP/IP port	Port number for the communication via the TCP/IP protocol.
MAC address	MAC address of the device (cannot be changed).

- ▶ Transfer network parameters to the device with [Assign].

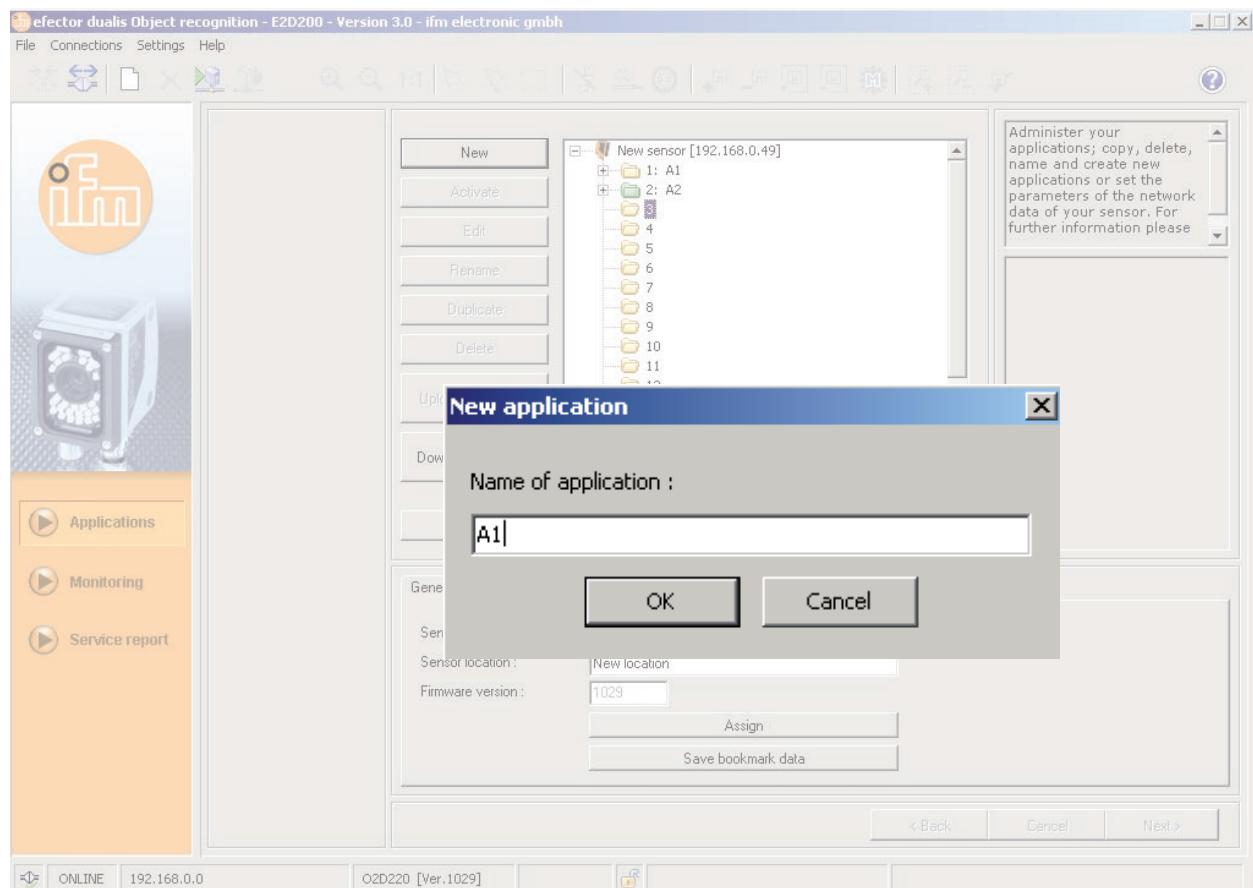
 Network parameters are adopted only after a new start of the device.

7.3 Administer applications

7.3.1 Create new applications

 New applications can only be created in an empty memory location.

► Click on [New].



► Enter the name of the new application.

Required information:

Length of the name 1..32 characters

Umlauts allowed (Ä, ä etc.)

No blank or tabulator characters before and after an entry

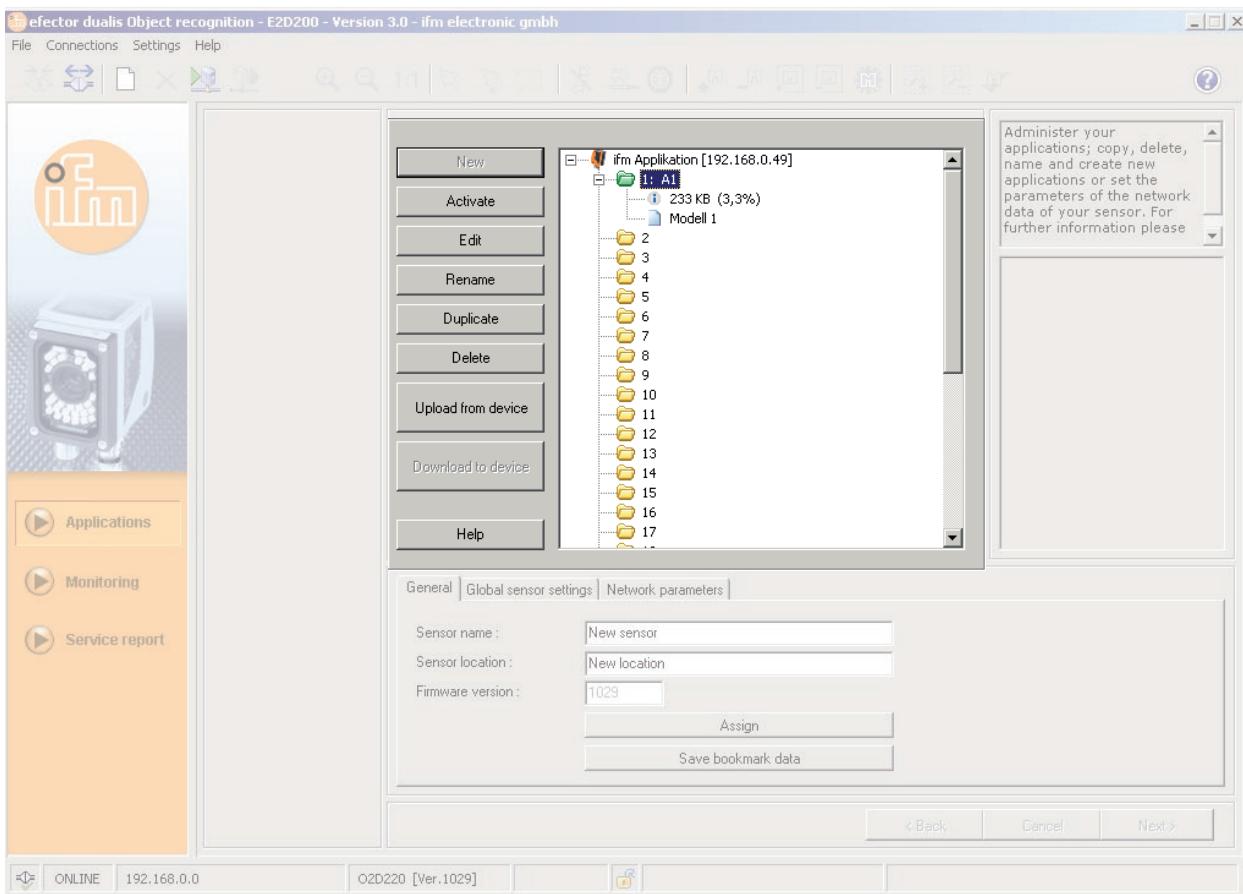
No special characters (&, \$, -, _, etc.)

► Acknowledge with [OK].

> The new application is created.

> The user interface changes to the first application step "Image quality" (→ chapter 8.2).

7.3.2 Activate existing application



- ▶ Single-click on the name/number of the application in the directory structure.
Click on [Activate].
As an alternative: selection via the context menu (right mouse button)
- > The colour of the activated folder changes from yellow to green and vice versa.

7.3.3 Edit existing application

- ▶ Single-click on the name/number of the application in the directory structure.
Click on [Edit].
As an alternative: selection via the context menu (right mouse button)
- > The user interface changes to the first application step "Image quality" (→ chapter 8.2).

7.3.4 Rename existing application

- ▶ Single-click on the name/number of the application in the directory structure.
Click on [Rename].
As an alternative: selection via the context menu (right mouse button)
- ▶ Enter the new name in the new window "Rename application".
- ▶ Acknowledge with [OK].

7.3.5 Duplicate existing application

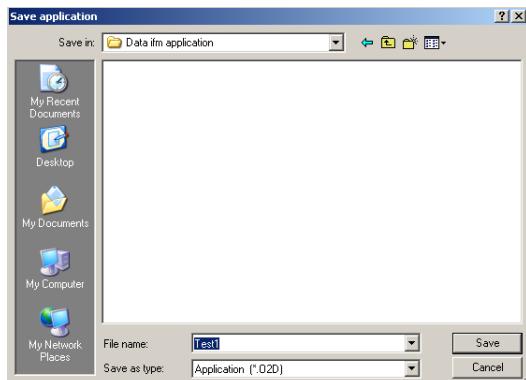
- ▶ Single-click on the name/number of the application in the directory structure.
Click on [Duplicate].
As an alternative: selection via the context menu (right mouse button)
- ▶ Enter the new name in the new window "Duplicate application".
- ▶ Acknowledge with [OK].

7.3.6 Delete existing application

- ▶ Single-click on the name/number of the application in the directory structure.
Click on [Delete].
As an alternative: selection via the context menu (right mouse button)
- ▶ Acknowledge the safety query in the new window with [Yes].
- > The application is deleted.

7.3.7 Upload from device

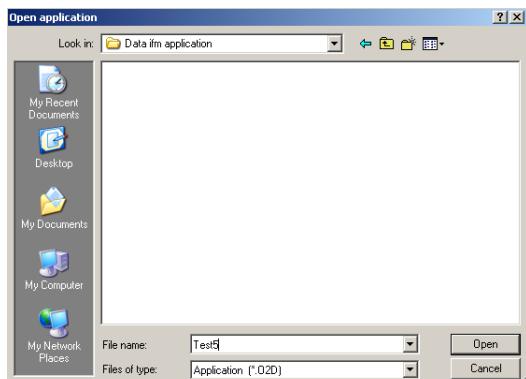
- ▶ Single-click on the name/number of the application in the directory structure.
Click on [Upload from device].
As an alternative: selection via the context menu (right mouse button) or via the tool bar → 
- ▶ Define the memory location on the hard disk and assign a file name.



- ▶ Acknowledge with [Save].

7.3.8 Download to device

- ▶ Single-click on the number of the application in the directory structure.
Click on [Download to device].
As an alternative: selection via the context menu (right mouse button) or via the tool bar → 
- ▶ Select the file on the hard disk and click on [Open].



- ▶ Enter the name of the new application.
Required information:
Length of the name 1..32 characters
Umlauts allowed (Ä, ä etc.)
No blank or tabulator characters before and after an entry
No special characters (&, \$, -, _, etc.)
- > The application is downloaded to the device and can be seen in the directory structure.

7.3.9 Help

Opens the by-topic online help.

8 Create applications and set parameters

When a new application has been created or an existing one has been edited, the user interface changes to the first application step "Image quality".

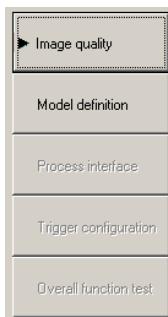
8.1 Navigation

There are two possibilities to navigate through the process of parameter setting:

- with the navigation buttons Back, Cancel and Next



- jump to the requested screen with the module buttons



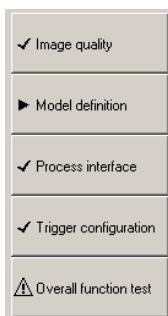
The module buttons of processed module screens are enabled when they are exited so that you can jump to them directly during the following process.

Save application

- Click on all module buttons one after the other, confirm with [Next].
- Click on [Save].

When you jump back to a module already processed, the module buttons of the screens which may be affected by the following changes are provided with a warning symbol.

- Open the marked screens and check settings.

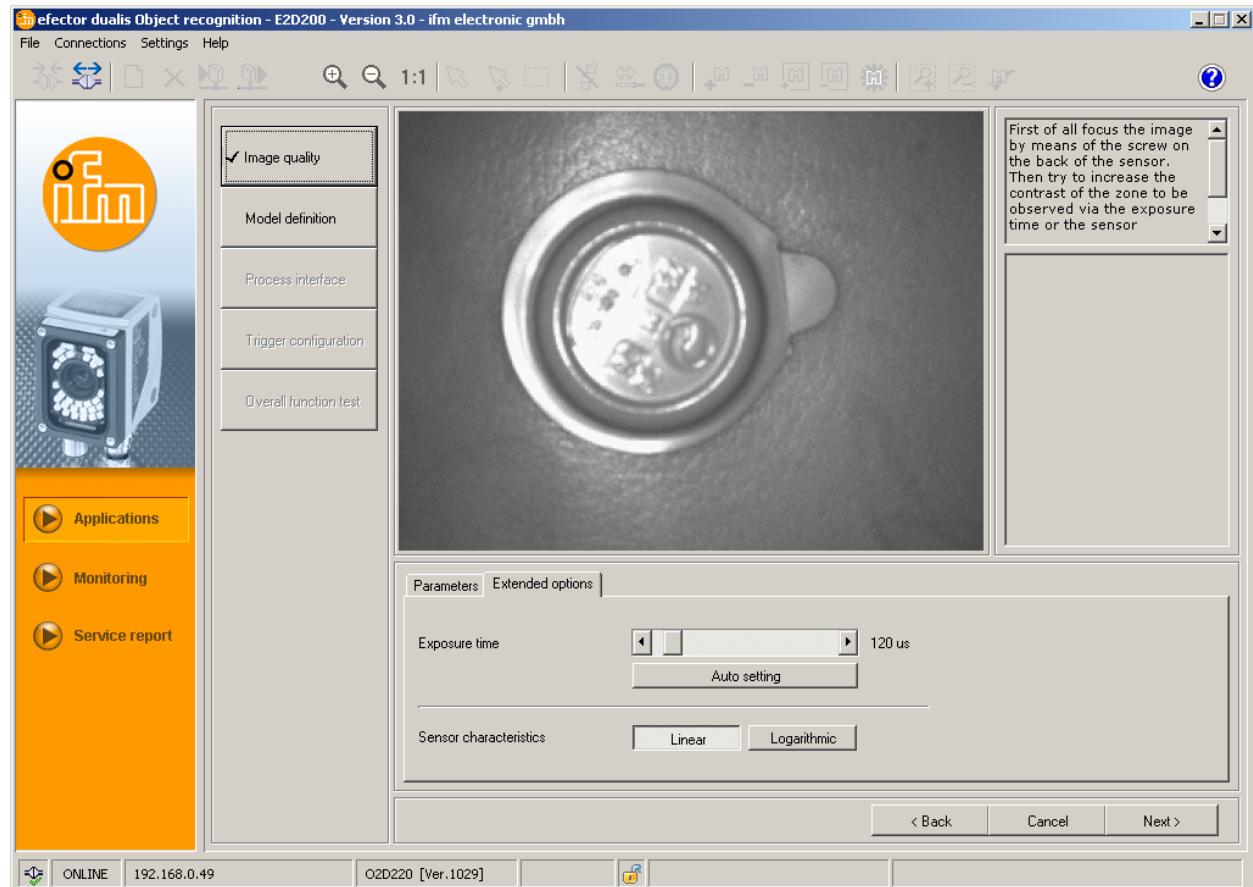


All module screens processed successfully are marked with a tick. To save the application all screens must be ticked.

8.2 Image quality

In this module you set the parameters for optimum image capture.

- A good contrast must be created for an optimum evaluation. The object to be detected must contrast clearly with the background (cross-fading).



8.2.1 Image quality settings

Image definition

- Set the image section.
- Set the distance of the sensor to the object surface.
- Optimise the image definition via the setting screw on the back of the device.

Display mode

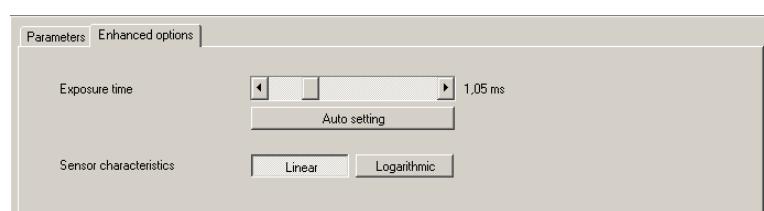
- Single-click on [Freeze] or [Live].

Illumination

In the display mode "Live" single-click on Illumination [Internal] or [External].

Exposure time

- Single-click on [Enhanced options].



The exposure time is preset automatically. The current value is indicated in microseconds or milliseconds in the parameter field.

Manual setting of exposure time

- ▶ Move the slider bar [Exposure time] with the mouse pointer.

Automatic setting of exposure time

- ▶ Single-click on [Auto setting].

> The sensor redetermines and sets the exposure time.

Sensor characteristics

Linear characteristics for non-reflective objects (irradiation of the sensor image).

- ▶ Single-click on [Linear].



Logarithmic characteristics for (strongly) reflective objects (reduced image dynamics).

- ▶ Single-click on [Logarithmic].



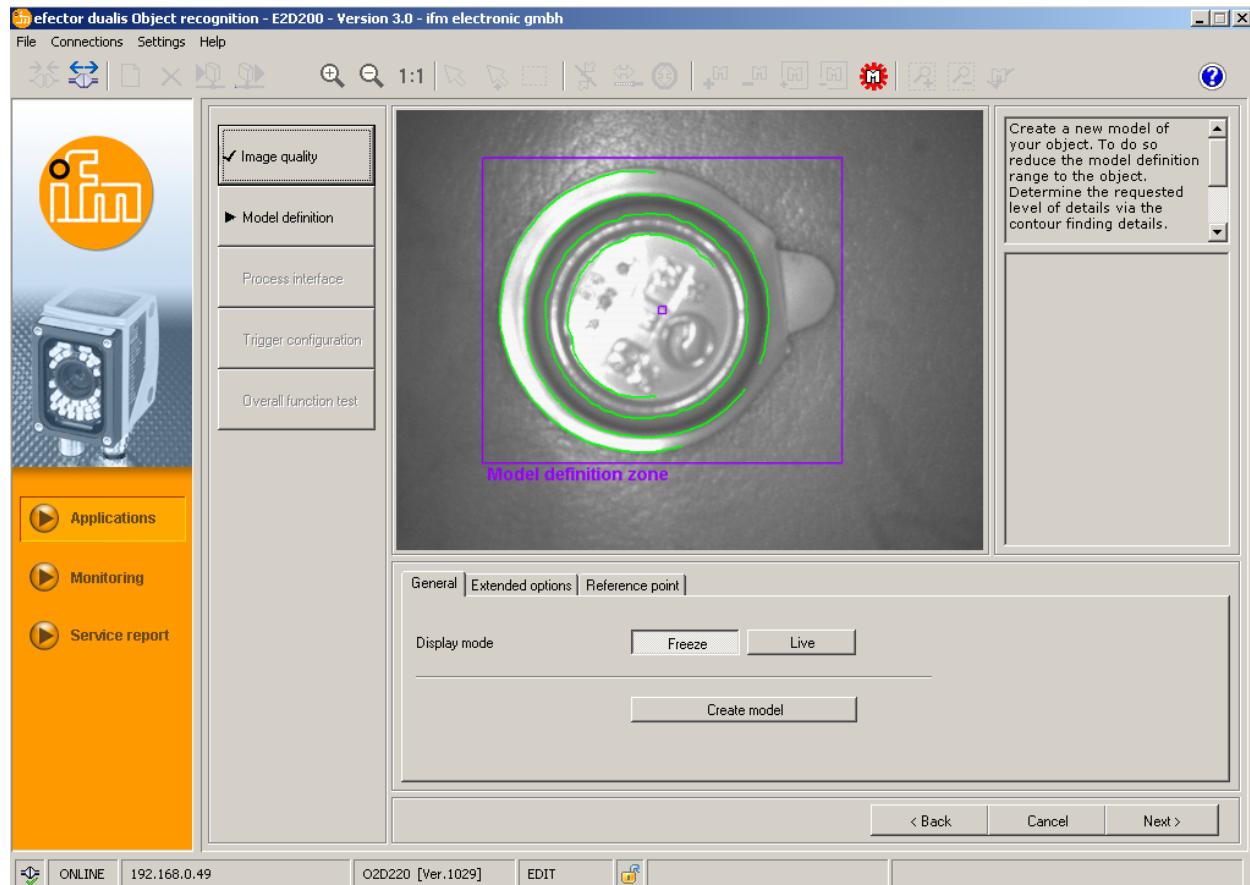
- ▶ Single-click on [Cancel] when you would like to cancel parameter setting.

- ▶ Single-click on [Next] when the sensor image is in focus and all parameters are set as you want.

> Change to the parameter setting module "Model definition".

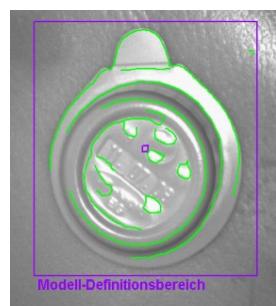
8.3 Model definition

In this module you create a model of your object.



8.3.1 Define model

- Drag the model definition zone around the object with the mouse pointer.
- > Every determined object edge, called "contour" in the following, is shown by a green line, the model definition zone by a purple frame. This can be enlarged or reduced with the mouse and should tightly limit the object to be detected.



Contours are searched within this model definition zone.

- Change object position, select display mode [Live].
- > New object position is displayed.
- Select [Freeze].
- > Contours are visible.

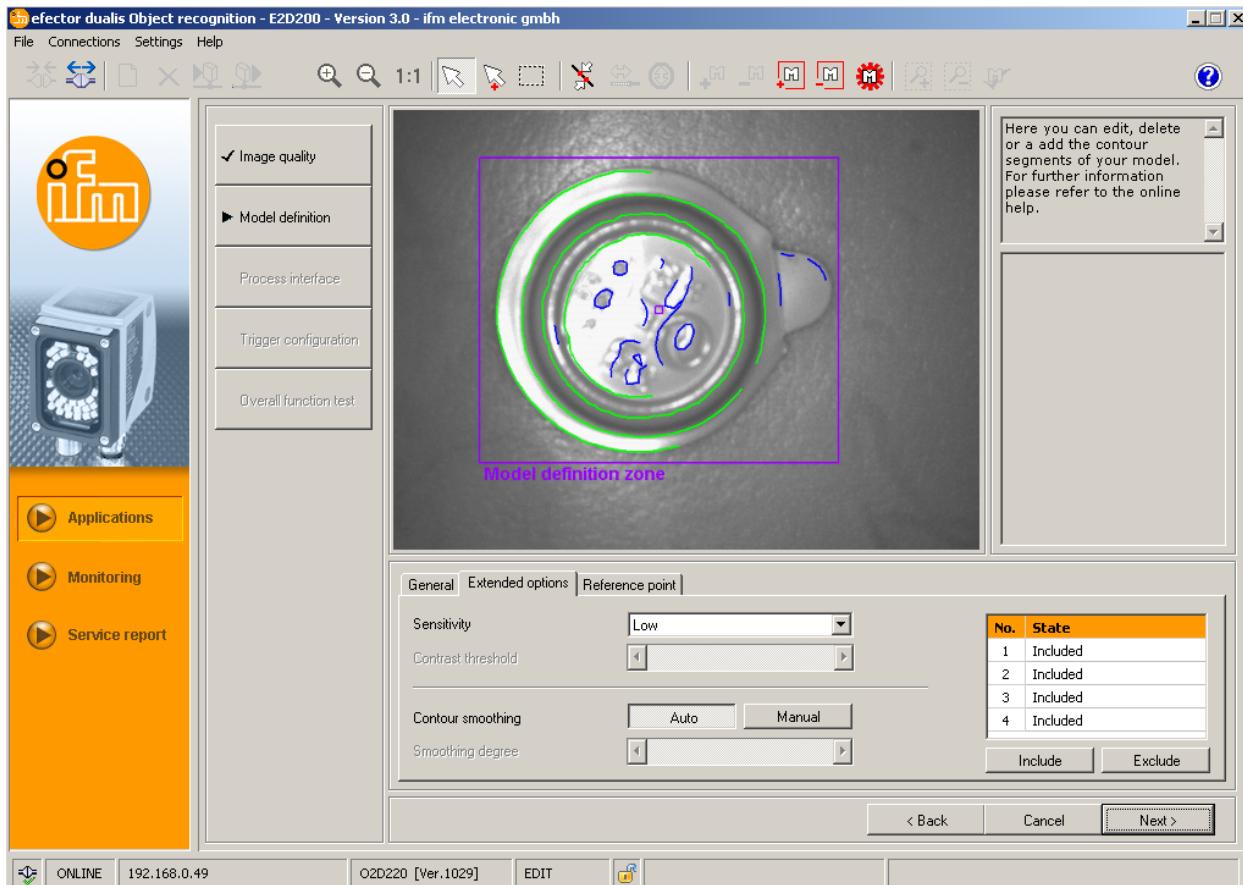
 Limit the model definition zone to the object, image size and memory load are reduced.

If the model definition zone is smaller than the model, the representation can be enlarged using the magnify function.

- ▶ Single-click on  in the tool bar.
- ▶ Move the magnifying glass over the image zone and click with the right mouse button so often until the requested enlargement is achieved.

8.3.2 Enhanced options

- ▶ Single-click on [Enhanced options].



- ▶ Change process parameters.
- ▶ Exclude individual contours from detection.
- ▶ Include individual contours in the current model definition.

Further buttons (icons) are enabled in the tool bar.

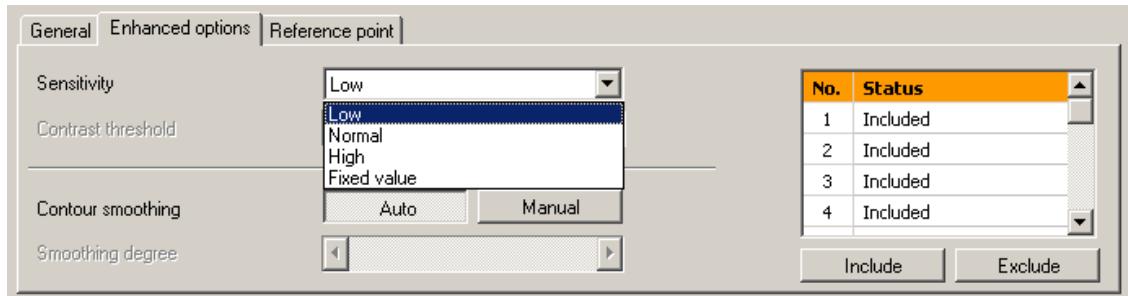


- Edit contours shown in the image field.

In addition to the green contours, you can now also see blue contours. These are contours determined by the search logarithm but which are not part of the model.

Sensitivity

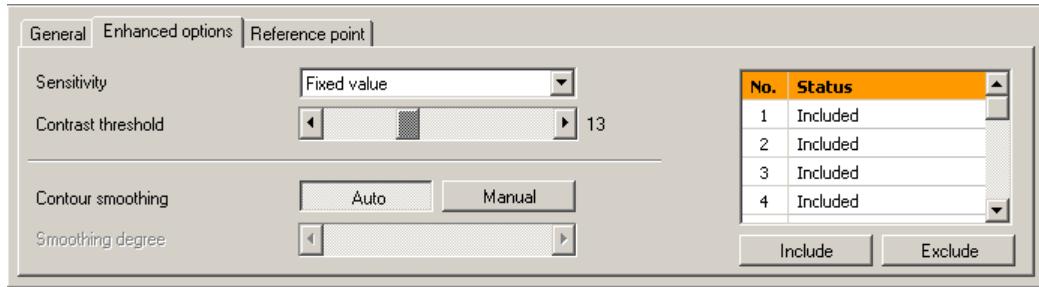
The sensitivity of the contour detection process can be changed either in three predefined steps or by entering a value of your choice.



- Select the sensitivity "Low", "Normal" or "High".

Contrast threshold

This value defines the minimum (grey shade) contrast value at which a contour is detected.



- Set the sensitivity to "Fixed value".
- Move the slider bar [Contrast threshold] with the mouse pointer (value range 1...255).

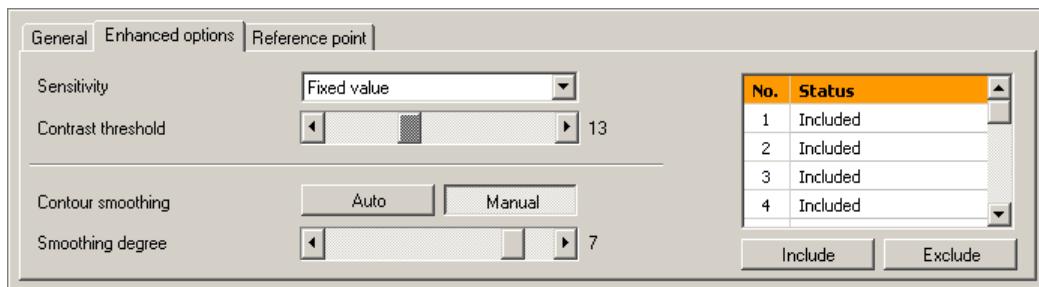
Increase the value only to such an extent that contours for recognition are displayed.

Contour smoothing

This value defines the smoothing degree of contours.

Contour smoothing can be changed automatically or by entering a value.

A high value leads to a larger smoothing, filigree changes of the contour edge are not taken into account. Small "peaks" which deviate from the main contour line are not taken into account. A small value follows up the contour edge more precisely.



- Single-click on [Manual].
- Move the slider bar [Smoothing degree] with the mouse pointer (value range 1...8).

This value has significant influence on the calculation time during model recognition. Only select the value necessary for the application as unnecessarily high details will considerably slow down the evaluation.

UK

8.3.3 Work with contours

The contour detection process distinguishes between included and excluded contours.

An included contour (in green) is part of the model definition, an excluded contour (in blue) has also been detected but is not part of the model definition.

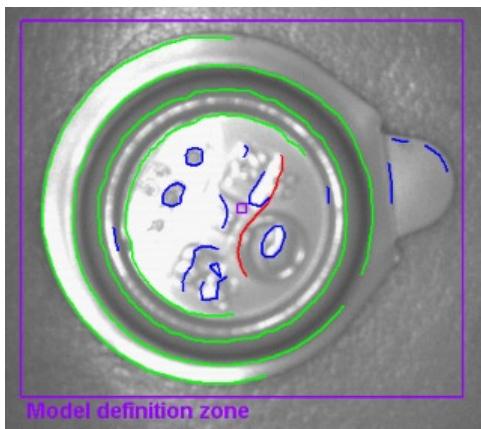
In the mode "General" (automatic model definition mode) only included contours are shown. They are not editable.

In the mode "Enhanced options" you additionally see all excluded contours (blue). You can add, exclude and edit contours (cut out individual contour segments).

8.3.4 Select contours

Standard selection mode (selection of an individual contour element)

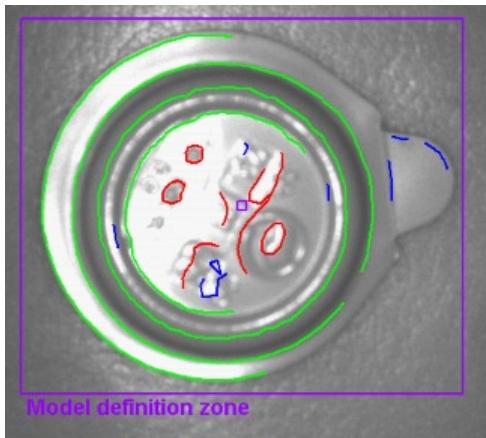
- ▶ Single-click on  in the tool bar.
- ▶ Move the mouse pointer over the image zone.
- > The mouse pointer changes from white to red if there is a contour element at this position.
- ▶ Click on the contour with the right mouse button.
- > The colour of the selected contour changes to red.



 In the standard selection mode only one contour element can be selected. When you click on another element, the selected element is deselected again. A click on a free space in the image field cancels the selection made.

Multi-selection mode (selection of several contour elements)

- ▶ Single-click on  in the tool bar.
- ▶ Move the mouse pointer over the image zone.
- > The mouse pointer changes from white to red if there is a contour element at this position.
- ▶ Click on contour(s) with the right mouse button.
- > The colour of the selected contours changes to red.



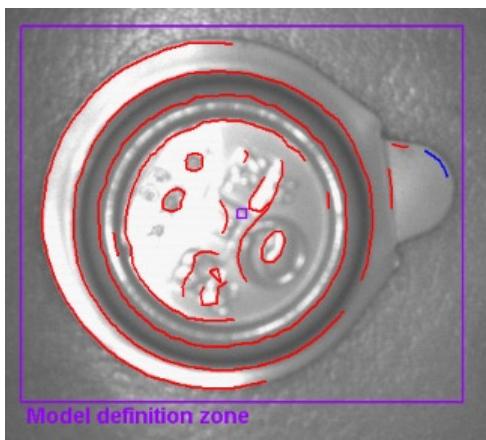
UK

 A click on a free space in the image field cancels the selections made.

Zone selection mode (selection of a zone of contour elements)

- ▶ Single-click on  in the tool bar.
- ▶ Click into the image field with the left mouse button, keep the mouse button pressed, drag a frame of requested size and release the mouse button.
- > The colour of all contours in the frame changes to red.

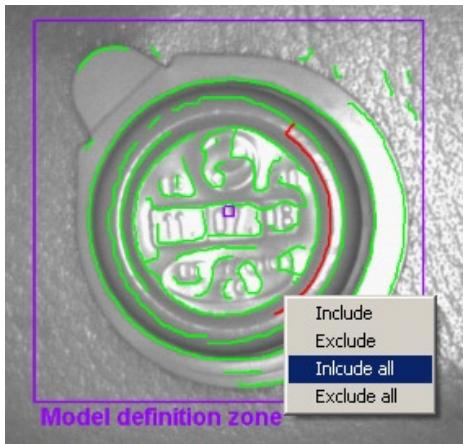
 As an alternative to the use of the button in the tool bar, you can also drag the required zone by simultaneously pressing the [Shift] button.



 A click on a free space in the image field will cancel the selection made.

Include all

- ▶ Click into the image field with the right mouse button and select "Include all".



- > The colour of all contours changes to green.

Exclude all

- Click into the image field with the right mouse button and select "Exclude all".

- > The colour of all contours changes to blue.

Status table

The status table lists all included contours by length. The longest (most relevant) contours are at the top of the list.

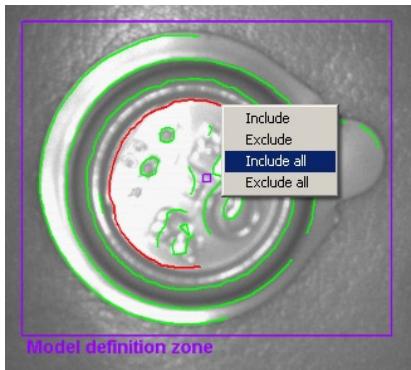
No.	Status
1	Included
2	Included
3	Included
4	Included

- Mark the deactivated contour in the image field with a single click of the left mouse button and activate with [Include].
- Deactivate included and marked contours in the table with a single click on [Exclude].

Change contour status

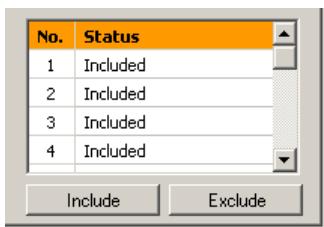
There are several options to manage the use of contours in the model.

- Via the tool bar
- Single-click on  in the tool bar to select requested action.
- > Add / exclude selected contours.
- Single-click on  in the tool bar to select requested action.
- > Add / exclude all contours.
- Via the context menu
- Click into the image field with the right mouse button and select requested action.



UK

- Via the status table
- Single-click on [Include] or [Exclude] to activate or deactivate marked contours.

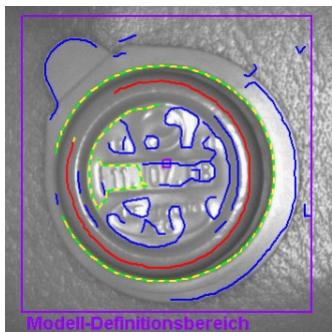


8.3.5 Edit contours

In some cases it can be useful to change individual contour lines. To do so, you can select a portion of a contour.

Model segment mode

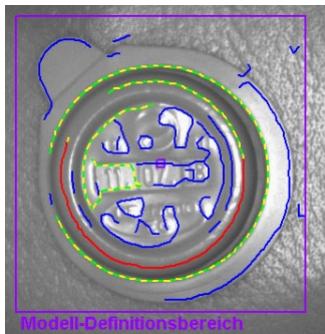
- Single-click on  in the tool bar.
- Click on two points of a contour.
- > The contour segment included between these points is marked in red.



 As an alternative to the tool bar button, you can also select these two points by simultaneously pressing the [Alt] key.

Edit contour segments

- Single-click on  in the tool bar.
- Click on any point of the same contour element.
- > The selected segment is extended or reduced to the newly defined point.



Invert selection

- Single-click on  in the tool bar.
- > The selection is displayed in an inverted manner.

If you have, for example, selected a section in the middle of a contour, the two segments between the defined points and contour ends are selected after inversion. Another click on  inverts this selection again.

After you have defined the requested contour segment, you can exclude it from the model definition.

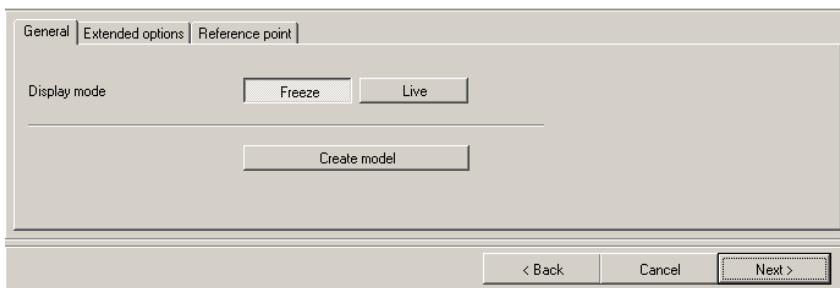
- Single-click on  in the tool bar.
- > The selected contour segment is excluded.

 Contour elements are internally not saved as individual points but as detailed contour sections. It is not possible to select any point of the contour but only the respective starting points of the individual sections.

If there is no such starting point at a clicked position, the next nearest point is selected. This can result in slight deviations between the selection point and marked point.

To obtain a finer grading, edge smoothing (smoothing degree) must be minimised.

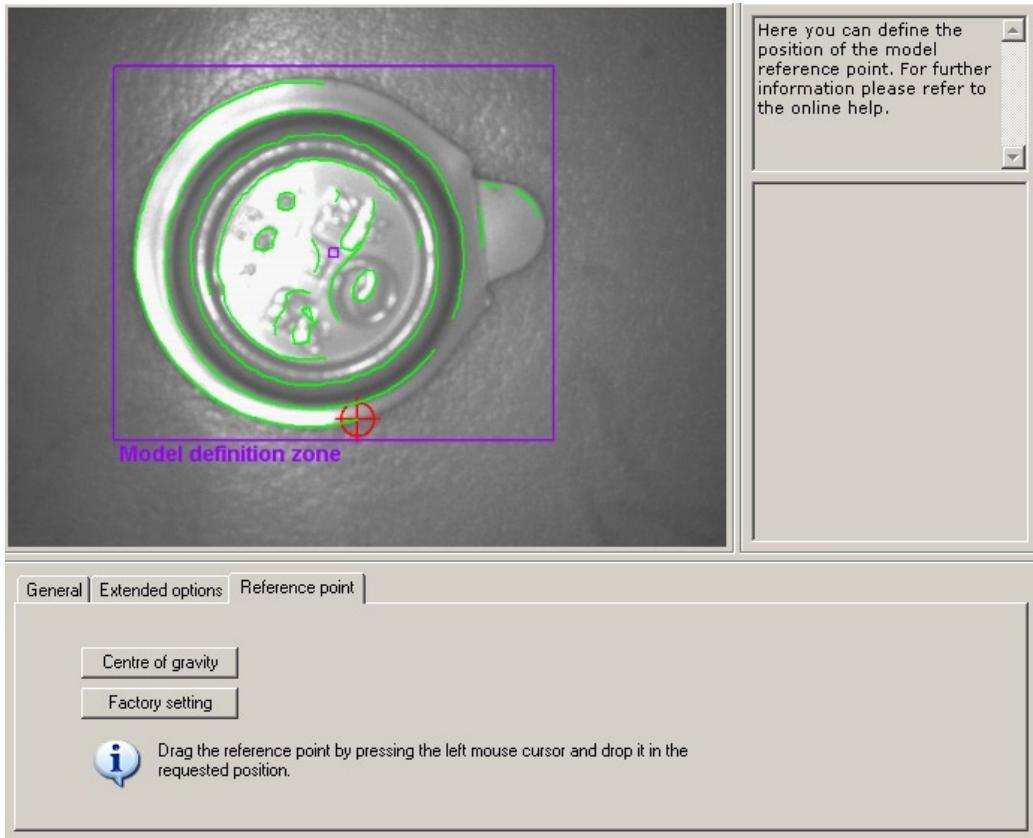
Changes to the contour cannot be cancelled. If you want to change segment definitions in your model, you must select again "Create model". In the process the changes made so far will be lost.



- Single-click on [Create model].
- > Changes in the register "Enhanced options" are reset.

8.3.6 Reference point *

The reference point of a model is the coordinate which describes the position of the detected model. The default setting is the first pixel coordinate of the first contour of the model (X = 0...639 ; Y = 0...479 pixels, the coordinate origin is at the top left in the image).



- Position the reference point on the geometric centre of gravity of the model.
- ▶ Single-click on [Centre of gravity].
 - > The reference point is moved to the centre of gravity.
- Position to any point within the sensor image field.
- ▶ Position the mouse pointer to the reference point.
 - > The mouse pointer changes from the arrow symbol to the move symbol.
- ▶ Click on the reference point with the left mouse button, keep the mouse button pressed and move to the requested position. Release the mouse button.
 - > The reference point is moved.

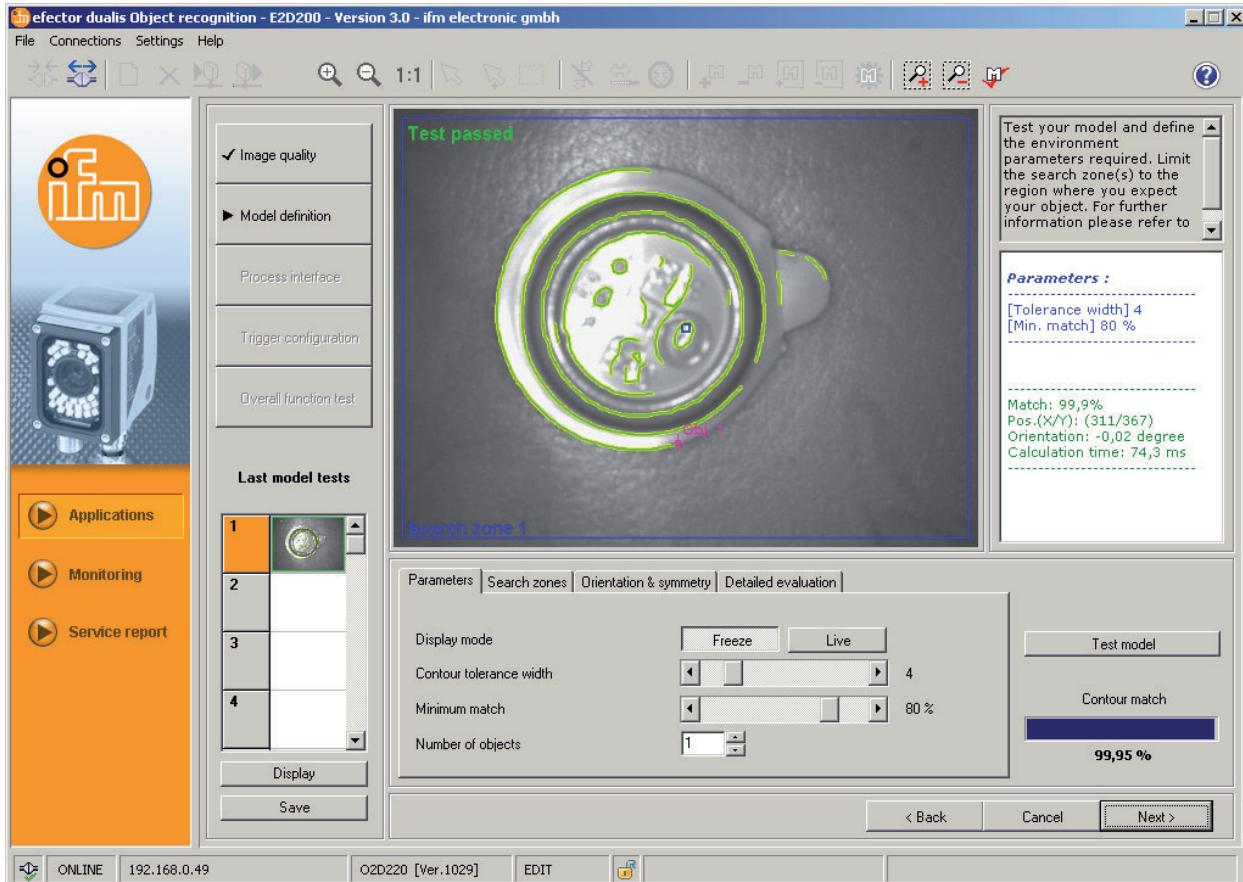
Back to factory setting

- ▶ Single-click on [Factory setting].
 - > Changes to the first pixel coordinate of the first contour of the model.

- Single-click on [Next] when all parameters in the menu item "Model definition" are set as you want.

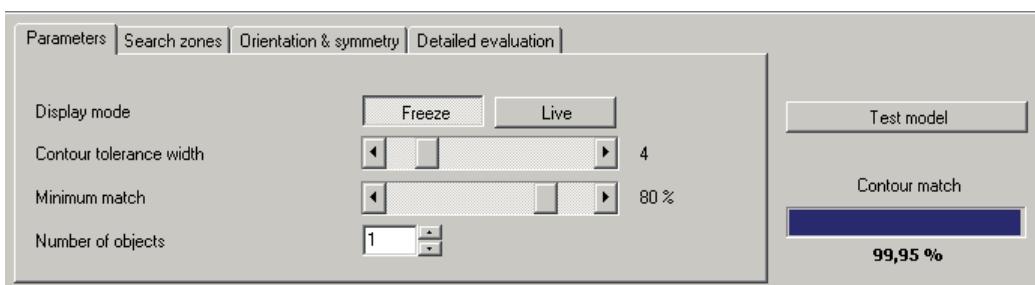
8.4 Model test

- The view changes to the model test and a test with default parameters is automatically carried out. The evaluation of this test is displayed in the result output field on the right.



With the settings described in the following chapters you will optimise your model test to your application.

8.4.1 Model test parameters



Contour tolerance width

Describes the maximum permissible tolerance between expected and found contour of the input image. The tolerance width is shown in yellow.

- Move the slider bar [Contour tolerance width] with the mouse pointer (value range 1...20).

Minimum match

Corresponds to the minimum match [%] which is necessary to output the contour as recognised.

- Move the slider bar [minimum match] with the mouse pointer (value range 0...100 %).

Number of objects

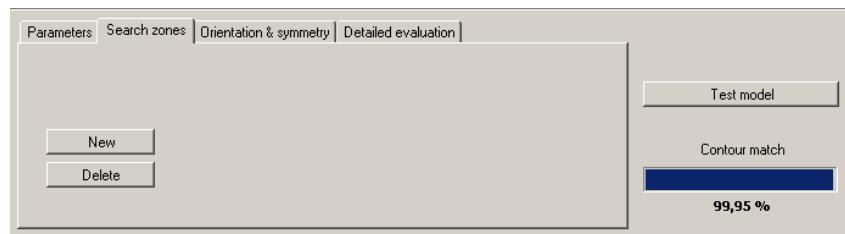
Number of models to be detected. If **not all** models are found with the match, the test is considered as not passed.

 If you have defined more than one search zone, you can only detect **one** model per search zone.

8.4.2 Model test search zones

The search zone where models are to be found is shown in the image field. You can edit this zone and define several search zones, if necessary.

► Single-click on  in the tool bar or as an alternative click on [New] or [Delete]



> A frame "search zone" is shown in the image field.
 ► Click on the frame in the image field with the left mouse button, keep the mouse button pressed, drag a frame of requested size and release the mouse button.

 Minimise search zones to the zone where the object is expected.
 > Minimise calculation time.

 Search zones cannot be enlarged to full image size, a minimum distance to the image border is added automatically.

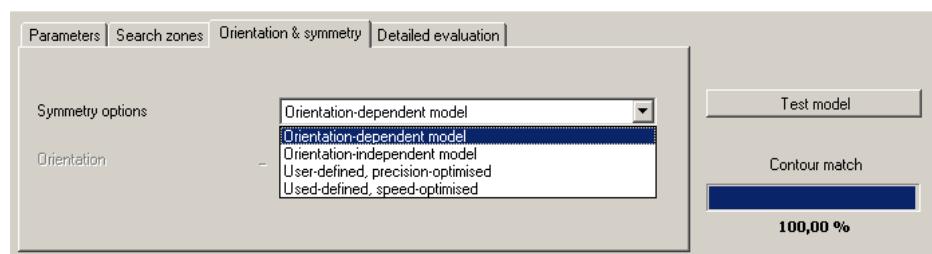
 The definition of several search zones increases the evaluation time. Check whether you want to use this functionality or whether it would not be better to search **several** models within **one** search zone.

 If you have defined more than one search zone, you can only detect **one** model per search zone.

8.4.3 Model test orientation and symmetry *

The original orientation of the initial model is taken for reference, relatively to this 0° orientation you can set the permissible orientation deviation for both directions separately. The permissible default orientation deviation is in the range from 180° to +180°.

If the sensor recognises symmetries on the object while testing a model, this is indicated. The tab register "Orientation & Symmetry" is activated and offers more options for a better object recognition.



Orientation-dependent model

The model is searched in its initial orientation, the input fields of the orientation range are disabled. This setting is particularly suited for models with several symmetry axes, especially for circular objects.

Orientation-independent model

The model is searched in the complete orientation range, the input fields of the orientation range are disabled. This setting is suitable for models with fewer symmetry axes, e.g. rectangles or other polygonal objects (nuts, etc.).

User-defined (precision-optimised)

The model is searched in the defined orientation range which can be changed by the user. The search algorithm is rated for the optimum model search, this increases the evaluation time considerably.

- Enter the value for orientation (value range -180°...+180°).

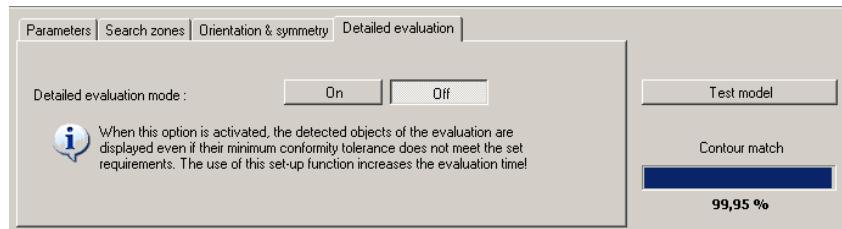
User-defined (speed-optimised)

The model is searched in the defined orientation range which can be changed by the user. The search algorithm is rated for optimum speed, this can reduce the recognition rate.

- Enter the value for orientation (value range -180°...+180°).

 Because of many additional external influencing factors it is not possible to indicate one generally valid rule for the use of the individual options. For optimum object recognition various tests with different values should be carried out to determine the best search algorithm.

8.4.4 Model test detailed evaluation *

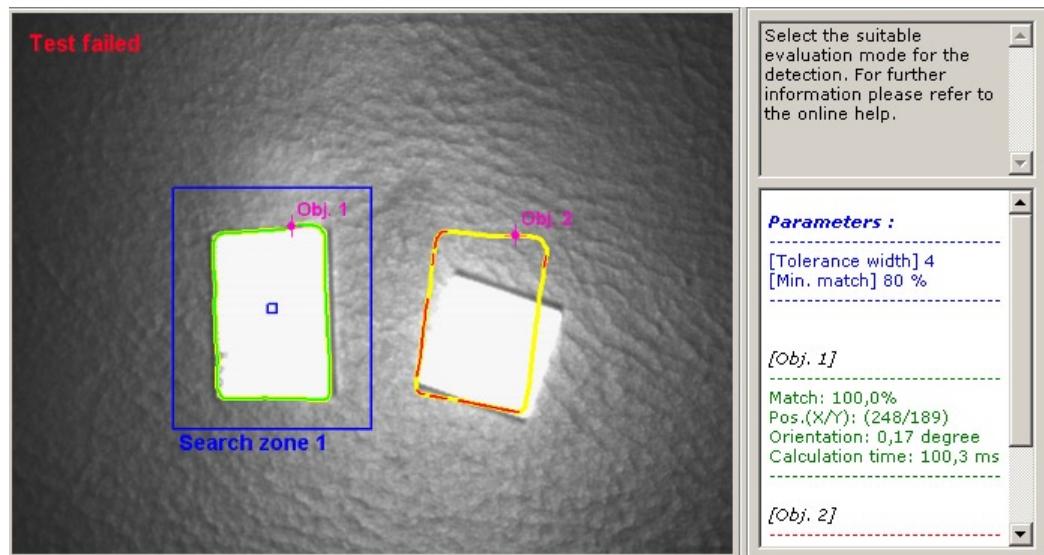


When this function is activated, even models are displayed which are detected below the set match value (min. 30 %). The good/bad differentiation is made by different colours in the contour display and result output.

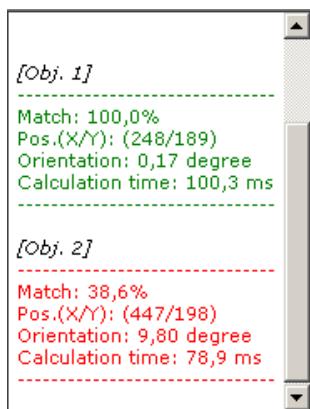
This mode is especially suitable for set-up. Settings which led to problems can be followed up in the model test, function test and service report.

This function considerably increases the calculation time and should only be activated for analysis.

- Single-click on [On] to select the detailed evaluation mode and then click on [Test model].

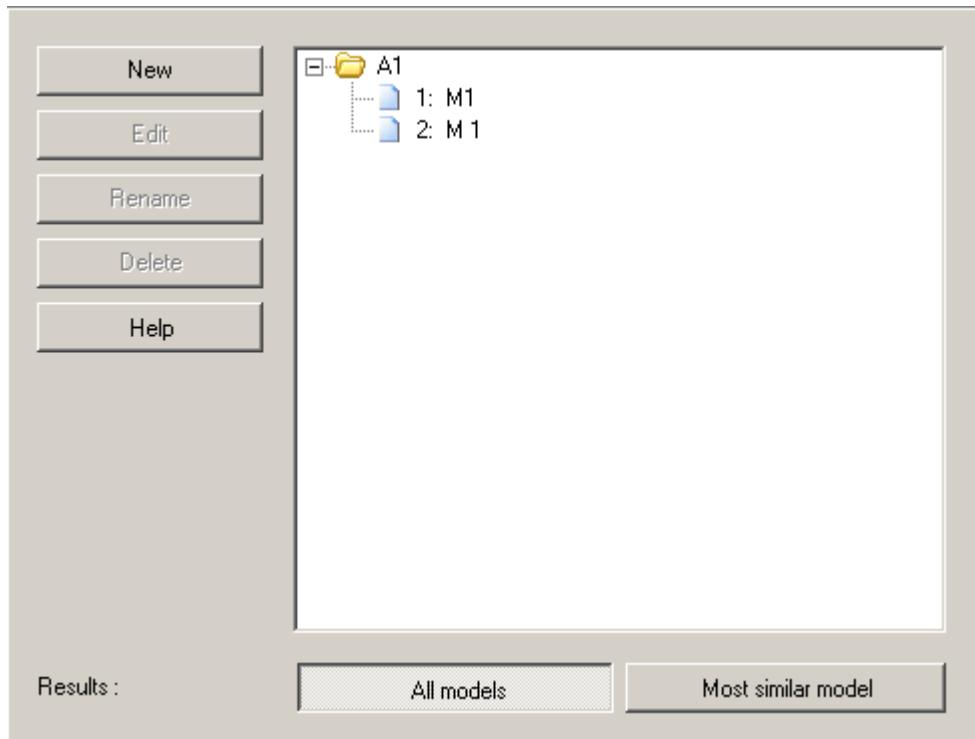


Result output



8.4.5 Administer models

Each application can contain one or several models. For administration, the model administration menu is available. You automatically get to this menu when you confirm the query "Assign model to" with [OK] or when you edit an existing application.



New

Creates a new model.

Edit

Changes an existing model.

Rename

Renames a model.

Delete

Deletes a model.

Help

Activates the online help on this topic.

8.4.6 Evaluation modes

If you have defined more than one model in your application, you can select between two result evaluations.

All models

In this mode the evaluation is considered as passed when all defined models are found in the image field.

Most similar model

This mode is used for sorting. All defined models are searched, but only the model with the highest match is provided as the result. In the process interface configuration this model number can be provided in an index-based form, selectively as a signal on a pin defined by you or via TCP/IP.

You can assign bits 0 to 3 of the found model number to the pins.

Bit 3	Bit 2	Bit 1	Bit 0	Result
0	0	0	0	No model detected
0	0	0	1	Model 1 detected
0	0	1	0	Model 2 detected
0	0	1	1	Model 3 detected
0	1	0	0	Model 4 detected
0	1	0	1	Model 5 detected
0	1	1	0	Model 6 detected
0	1	1	1	Model 7 detected
1	0	0	0	Model 8 detected

More tables → chapter 15.5 (annex).



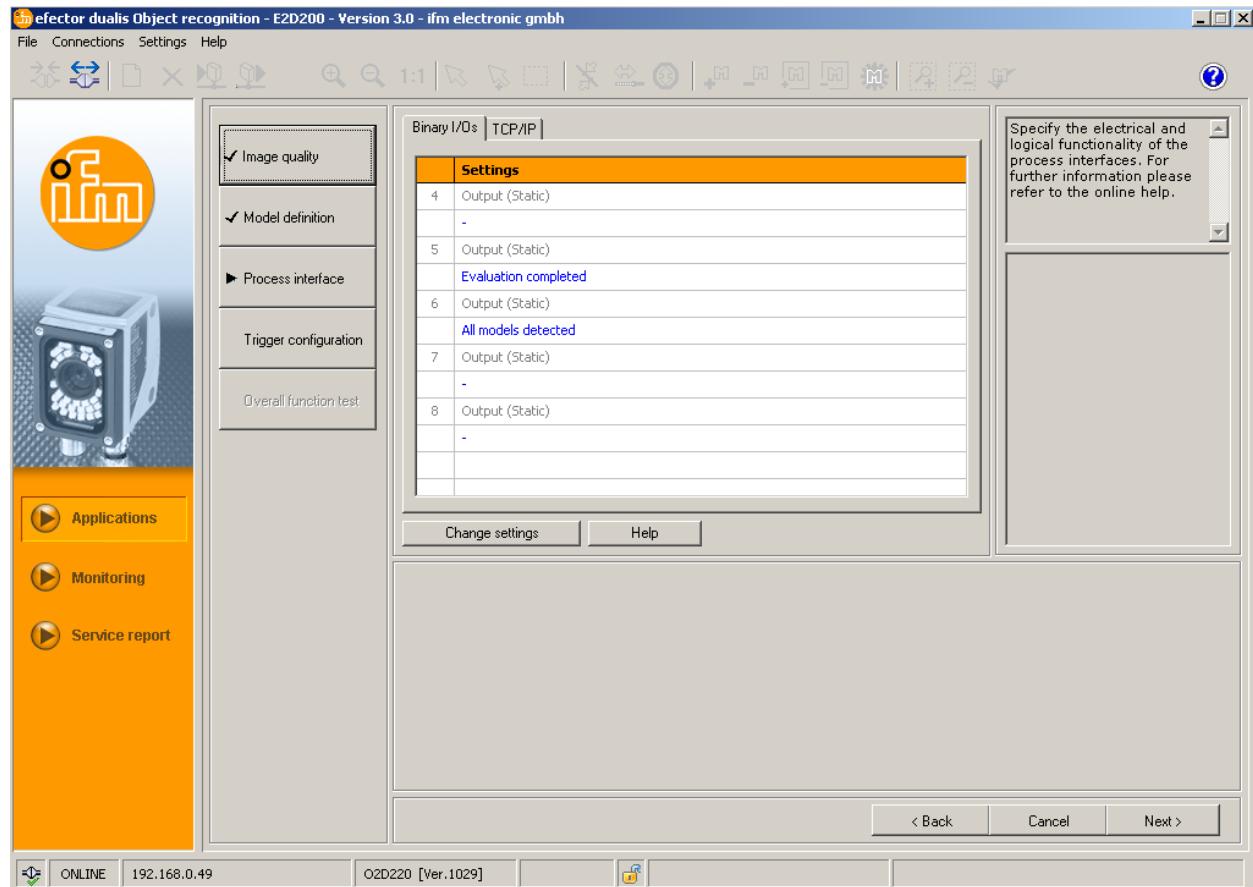
If in an existing application with several models you switch from [Most similar model] to [All models], certain settings of the process interface configuration which are not available in this mode are reset automatically by the sensor. Therefore you receive a warning and should check your settings!

9 Process interface

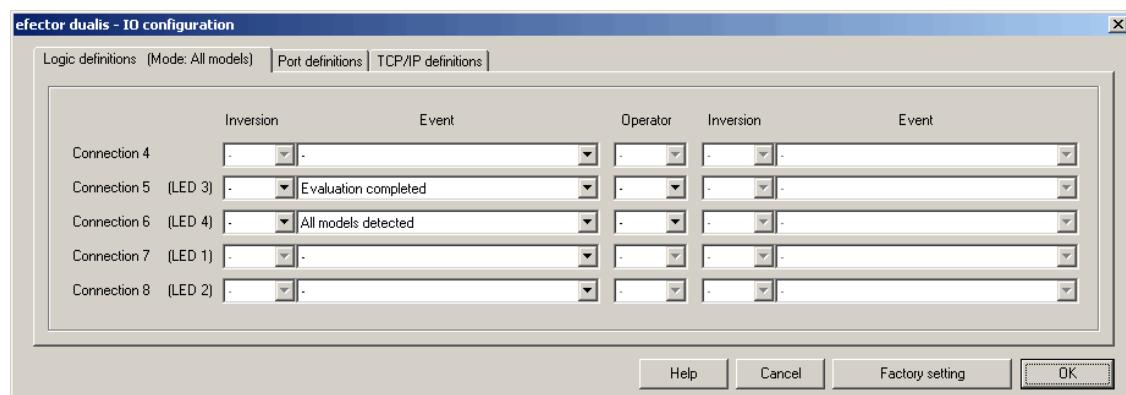
9.1 Configure process interface

9.1.1 Binary outputs

All sensor outputs have the default parameters. It is recommended to adopt these settings to start with.



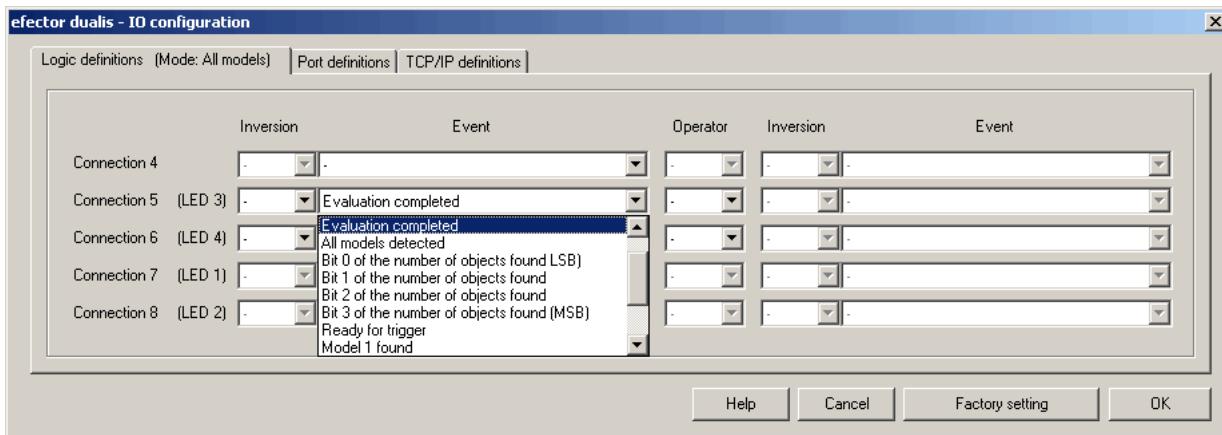
- ▶ Single-click on [Next].
- > Change to the mode "Trigger configuration".
- Adapt settings - register Logic definitions.
- ▶ Single-click on [Change settings].
- > A new dialogue window opens which is divided in electric and logic functionalities.
- ▶ Enter changes for setting the output logic.



In the register "Logic definitions" you link the connections with the requested events.

The possible event assignments for the pins of the process interface are listed in the table. You can select them from the respective list and negate them via the item "NOT" from the preceding selection list [Inversion].

An output event can be linked with another one. To do so, select the requested link event from the operator list box.



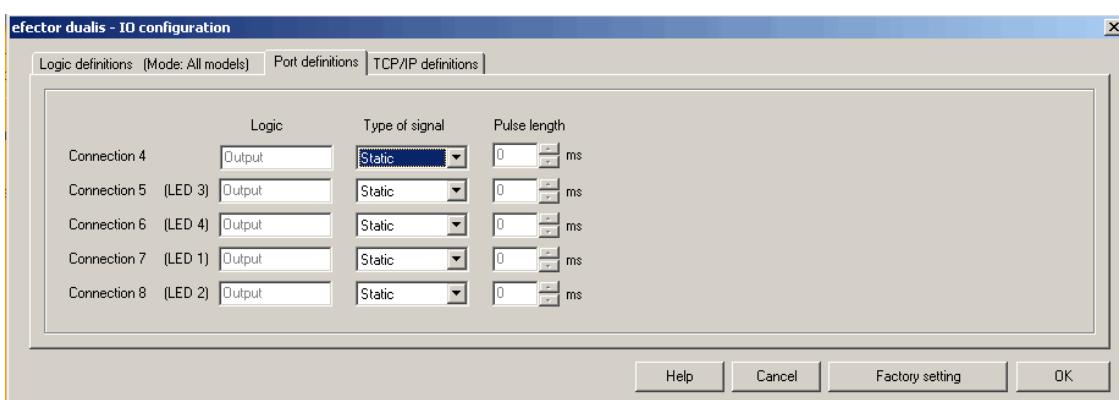
If in the module "Image quality" an external illumination source was selected, pin 4 is predefined as trigger output for this illumination.

If in the global sensor settings the option "External switching of the application" is active, pins 7 and 8 are reserved for this function as inputs and cannot be changed.

- Accept changes: click on [OK].
- Reject changes: click on [Cancel].
- Back to factory settings: click on [Factory setting].

Adapt settings - register Port definitions.

- Single-click on register [Port definitions].
- > A new dialogue window opens.
- Define and enter changes of the electric parameters of the process interface.



The field "Logic" shows the basic function of the pin. In the selection field "Type of signal" you set whether this is a static signal or signal pulse (pulse). In the event of a signal pulse, you can define the requested pulse length from 50...1000 ms in the following input field.

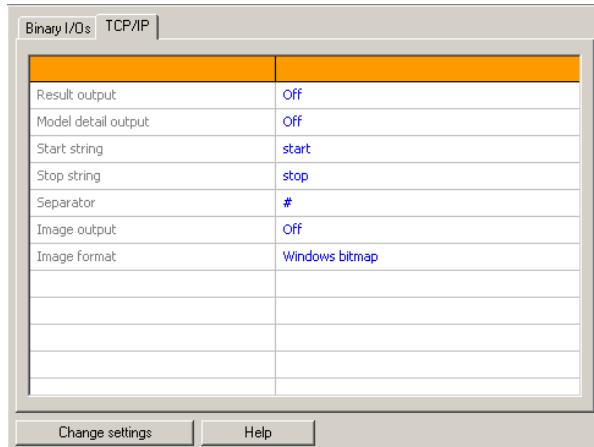
- Accept changes: click on [OK].
- Reject changes: click on [Cancel].
- Back to factory settings: click on [Factory setting].

9.1.2 TCP/IP *

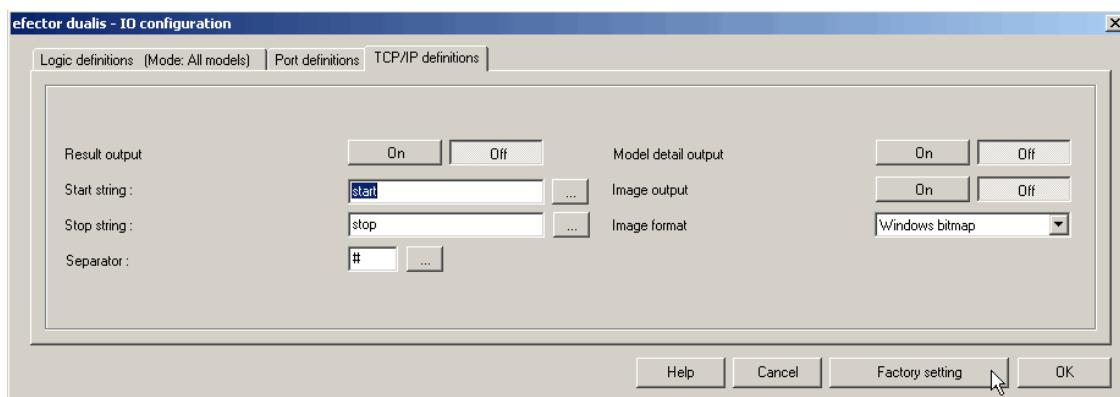
In addition to the cable-conducted switching inputs or outputs, the sensor also has a TCP/IP interface via Ethernet. The result output, the start and stop string as well as the separator can be set separately for each application.

The model detail and image output in different image formats can be activated or deactivated. The port used for the TCP/IP interface communication can be selected in the global sensor settings.

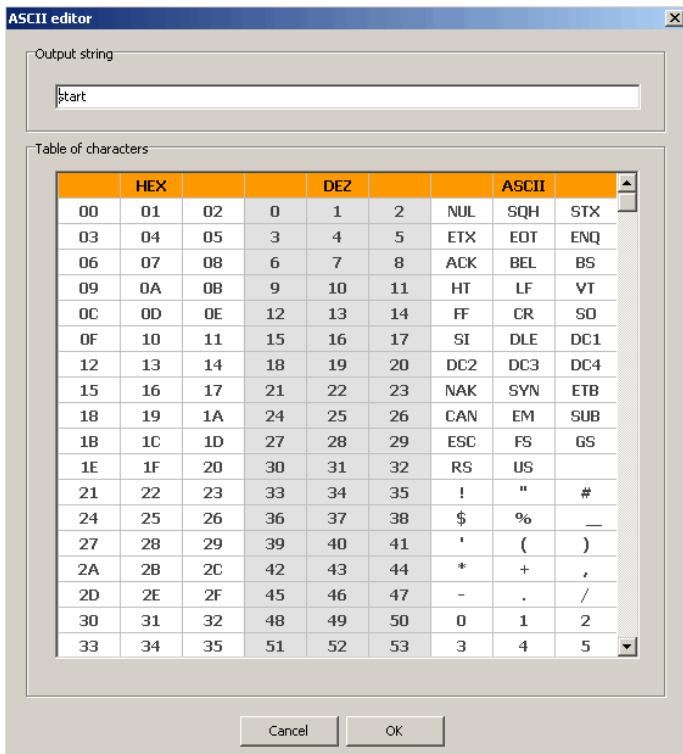
- Single-click on the register [TCP/IP].



- Single-click on [Next].
- > Change to the mode "Trigger configuration".
- Or adapt settings
- Single-click on [Change settings].
- > A new dialogue window opens.
- Single-click on the register [TCP/IP definitions].
- Adapt and enter settings.



- Single-click on Result output [On] or [Off].
- > The result is shown or suppressed in the result field.
- Select [Start string], [Stop string] and [Separator].
- > The result is shown in a character string.
- An ASCII editor is available for the selection of the characters to be provided via TCP/IP, especially for the entry of non-printable characters.
- Single-click on the button in the line [Start string] or [Stop string].

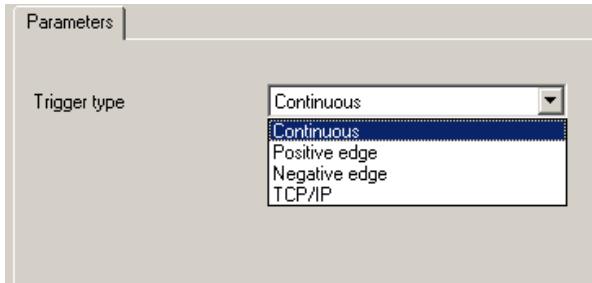


- ▶ Select characters and confirm with [OK].
- ▶ Accept changes: click on [OK].
- ▶ Reject changes: click on [Cancel].
- ▶ Single-click on the model detail output [On] or [Off].
- > All details are shown or suppressed.
- ▶ Single-click on Image output [On] or [Off].
- > Image is shown or suppressed (image output can take a long time).
- ▶ Select Image format in the pulldown menu (Windows bitmap or RAW).
- ▶ Back to factory settings: click on [Factory setting].
- ▶ Change to the next step "Trigger configuration" with [Next].

10 Trigger configuration

In this module you select the trigger type and test the trigger.

- Select trigger type in the pulldown menu.



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- External triggering (positive edge)
- External triggering (negative edge)
- Internal triggering (continuous)
- External triggering (TCP/IP)

- Click on [Test trigger].

> After triggering the captured image and the test results are displayed in the result field.

End the test mode if triggering functions as you want.

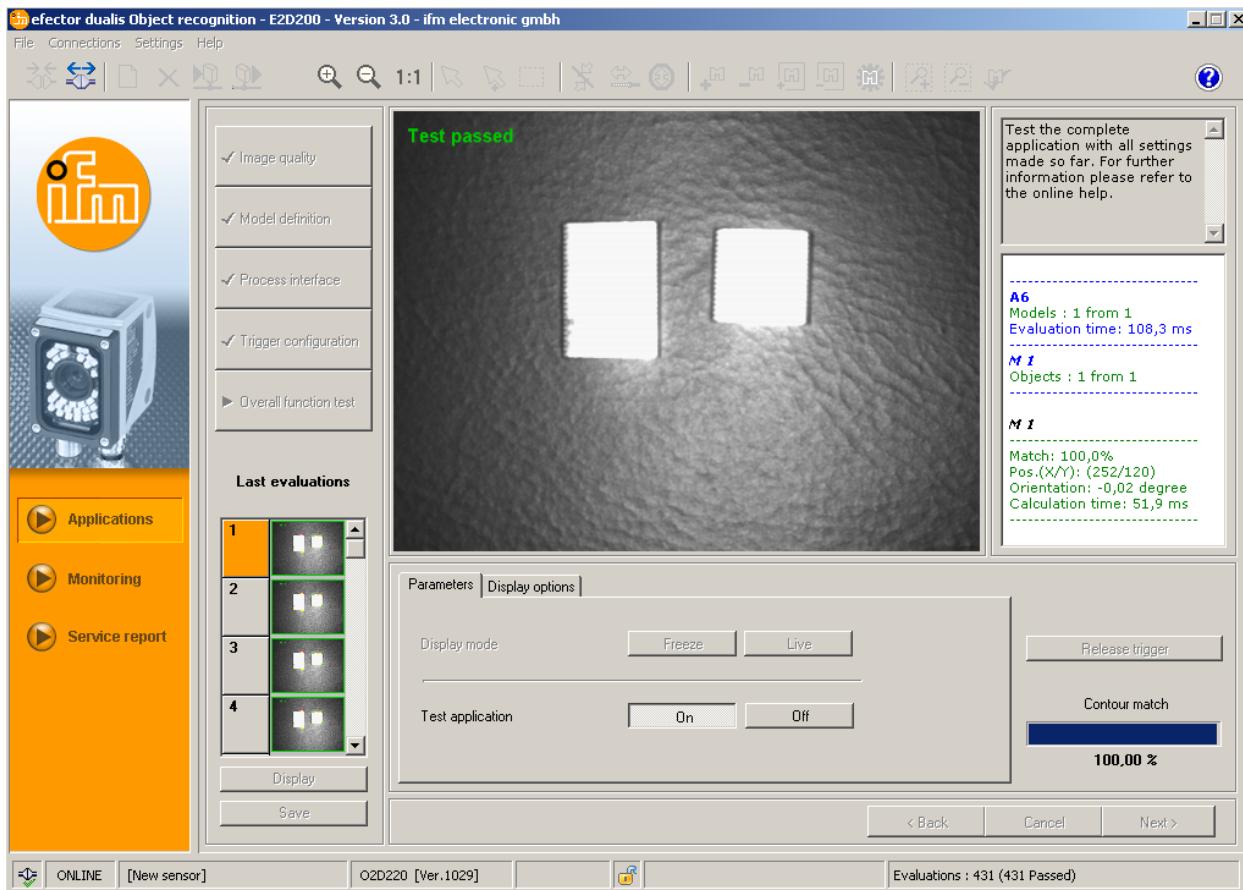
- Click on [Test trigger].

 During the test mode all other functionalities are disabled. It is not possible to test the continuous trigger.

- Change to the next step "Overall function test" with [Next].

11 Overall function test

This final step tests all settings of the new configuration.



- ▶ Click on Test application [On].
- ▶ Click on [Release trigger] if "continuous trigger" or "external trigger" was not selected before.
- > The device performs a complete test on the basis of the previous settings.
- > The result field shows:
 - number of models
 - evaluation time
 - objects
 - match
 - position
 - orientation

With internal triggering [Release trigger] is deactivated. After a click on Test application [On] the test is carried out.

- ▶ To end, click on Test application [Off].
- ▶ To confirm the configuration, click on [Next].
- ▶ Acknowledge the note with [OK].

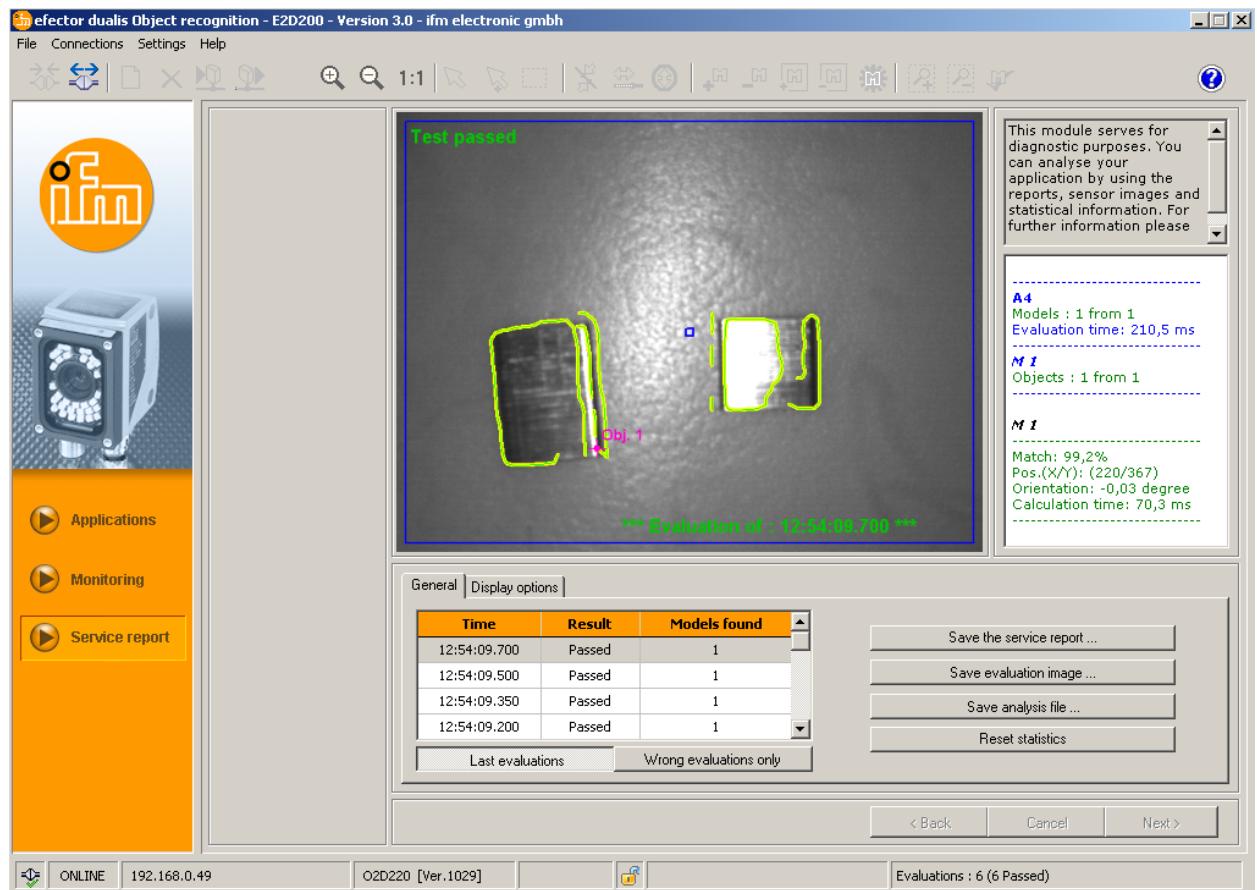


- > The configuration is saved.
- The program returns to the directory structure (→ 7.3.1 Create new applications).
- The newly created application is active.

12 Service report

This mode is used for diagnosis. The sensor stops the active application and all determined results. In the image field the current sensor images and all parameter objects such as search zones, tolerance widths, contours, etc. are displayed.

In addition you can open and save reports, make statistical evaluations as well as load, display and save the last images of good or bad readings from the sensor.



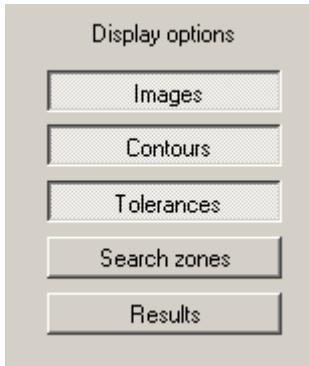
Evaluation table

In the mode [Last evaluations] the table in the lower field shows the last 15 evaluations, in the mode [Wrong evaluations only] the last wrong evaluations (up to 15) are shown. It also shows the time of the evaluation (according to the system time of the visualising PC), number of found models and the evaluation result.

- Click to select an evaluation.
- > Display of the related sensor image and complete evaluation results in the image and result field.

Display options

Under display options you define which information is shown. Display options highlighted in light grey are shown, dark grey options are suppressed.



Save the service report

Creates and saves a report with various diagnostic and statistical data.

Save evaluation image

Saves the evaluation image of the evaluation selected from the table on the host PC.

Save analysis file

Saves all evaluations from the image table in a file. This can be evaluated by ifm electronic (e.g. for fault analysis).

Reset statistics

Deletes all generated statistical data.

13 Additional functions

13.1 Select user language

- Select [Settings] → [Language] → [German], [English] in the menu bar.



- > The program changes to the selected language.

13.2 Update sensor firmware

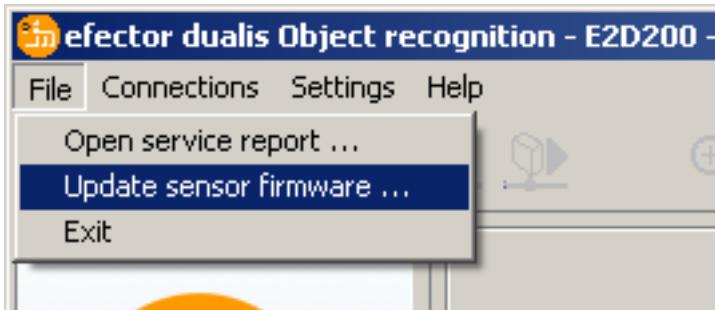
The update consists of a file with the extension .swu.

- Save file in a directory of your choice.
- Connect to the requested sensor.
- Change to the [Applications] mode.



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Select [File] → [Update sensor firmware] in the menu bar.



► Acknowledge warning with [Yes].



- > The user interface changes.
- Select the SWU file for the sensor update.
- > The data is transferred to the sensor.
- > Display FWuP

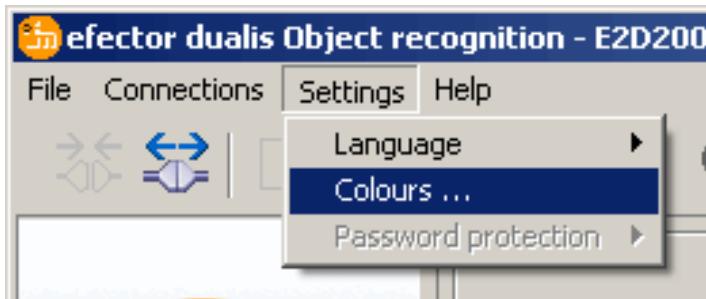
This process will take a while. After successful transmission you receive a message. Then the sensor automatically makes a reset. After initialisation you can connect to the sensor as usual.

 Do not interrupt the current supply to the sensor during the update process. This results in loss of data and functionality of the sensor.

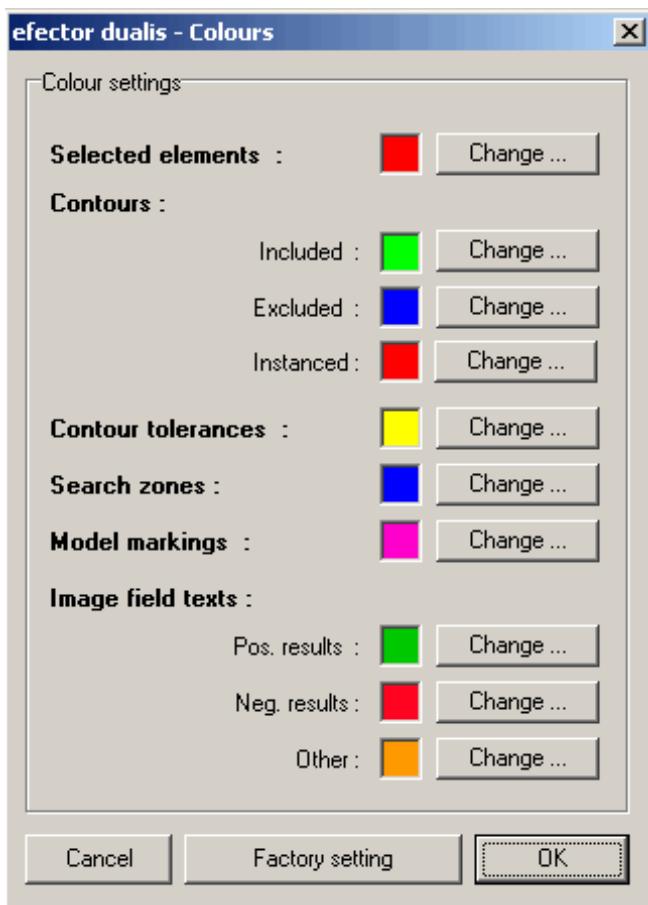
 During the update of the firmware, BIOS is also updated at irregular intervals. The sensor display will then remain dark for some seconds.

13.3 Select colours

- Select [Settings] → [Colours] in the menu bar.



- Change the colour settings individually in the new window.



- Confirm all selected settings with [OK] or reject the changes and restore the factory setting via [Factory setting].

13.4 Password protection *

13.4.1 Set up password protection

 The password protection is only enabled in the administration menu.

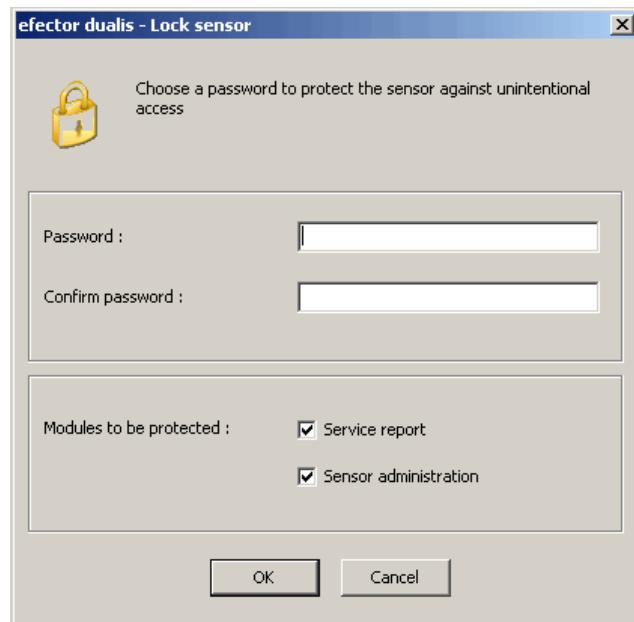
► Select [Settings] → [Password protection] → [Lock Sensor] in the menu bar.



► Assign a password in the new window and confirm once more.

 The password must have a minimum length of 6 characters. The following characters are allowed: 0-9, a-z, A-Z, -, _, #, \$, *, +, , , ..

► Select or deselect the modules to be protected: Service report module and / or Sensor administration.



► Acknowledge with [OK].

> The sensor is locked.

In the status line the lock symbol is shown locked.



 The password also protects against changes via the 2-button menu.

> Display LoK1.

13.4.2 Login

With activated protection function the user gets to the monitor mode after connection to the sensor. If the user now selects either "Monitor" or "Applications", a dialogue window for the entry of the password opens if the respective module is disabled.



- ▶ Enter password and acknowledge with [OK].
- ▶ As an alternative, select [Settings] → [Password protection] → [Login].
- ▶ As in chapter 13.4.1, enter password and acknowledge with [OK].
- > When changing to the individual modules (monitoring, applications, service report) it is not necessary to enter the password again.



13.4.3 Logout

- ▶ To log out, select [Settings] → [Password protection] → [Logout].



13.4.4 Remove password protection

- Select [Settings] → [Password protection] → [Unlock sensor] in the menu bar.

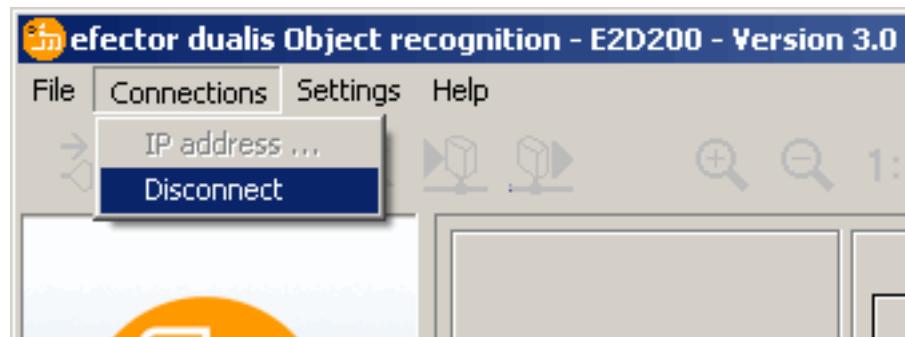


- Acknowledge with [OK].
- > The password protection is removed.

14 Exit program

14.1 Disconnect

- Select [Connections] → [Disconnect] in the menu bar.
As an alternative: click on the disconnect symbol in the tool bar → .



- Acknowledge with [OK].
- > The device is disconnected from the program.

14.2 Close program

- Select [File] → [Exit] in the menu bar.

15 Annex

After installation, electrical connection and parameter setting, check whether the sensor operates correctly. Align the sensor to the object to be detected.

15.1 Factory settings

Device settings

Device name	New sensor
Device location	New location
DHCP	Not active
IP address	192.168.0.49
Subnet mask	255.255.255.0
Gateway	192.168.0.0.201
XML-RPC port	8080
Video port	50002
Application selection via switching inputs	Not active
Trigger debouncing	Not active

Application settings

Minimum match	80%
Contour tolerance width	4
Number of models	1
Orientation	-10°... +10° (operating program)
Device connection 4	Trigger output
Device connection 5	Switching output, function evaluation completed (ready)
Device connection 6	Switching output, function all models detected
Device connection 7	Switching output 1
Device connection 8	Switching output 2
Illumination	Internal
Trigger mode	Continuous

15.2 Wiring

Process connection:	Parameter setting connection:
M12 connector, 8-pole	M12 connector, 4-pole, D-coding
 U+ trigger input 0 V switching output 5 / trigger output switching output 3 / ready switching output 4 / OUT switching output 1 / input 1 switching output 2 / input 2	 1: TD+ 2: RD+ 3: TD- 4: RD- S: Shield

15.2.1 Process connection

Connect the supply voltage (24 V DC) to the M12 process connection (wiring → chapter 15.2 or type label on the sensor).

 If you use an external trigger source (e.g. a diffuse reflection sensor), connect the trigger signal to the trigger input of the sensor. If you use external illumination, it must be controlled via the trigger output of the sensor.

Depending on the device setting, one of four configuration files saved in the sensor can be selected via two switching inputs. Information about the test result is provided via switching outputs.

15.2.2 Parameter setting connection

Connect the 4-pole M12 socket for Ethernet connection (E11898) to the parameter setting connection of the sensor. An existing connection is signalled via an LED (Eth) on the device.

15.2.3 Operating modes

Evaluation mode (normal operating mode)

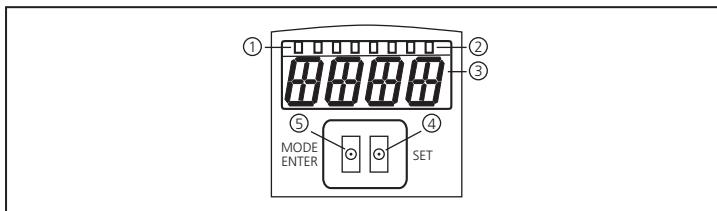
After power-on the device is in the evaluation mode. If an active application is saved on the device, it carries out its monitoring function and generates output signals according to the set parameters. The display indicates the current evaluation result, the yellow LEDs signal the switching status of the outputs or inputs.

Operation via operating program E2D200

Setting the parameter values via the operating program

An existing connection to the operating program is signalled via the green LED "Con". Depending on the application mode, the text "OnLi" (online), "Parm" (parameter setting), "Monl" (monitor) or "SErP" (service report) is displayed. The buttons on the device are disabled.

15.3 Operating and display elements



1	3 x LED green	Lighting LED Power (readiness for operation) Eth (Ethernet connection status) Con (status of the connection to the operating program (software))
2	4 x LED yellow	Indication of the switching status; lights when the corresponding input or output is switched. LED 1 status indication switching output 1 / switching input 1 LED 2 status indication switching output 2 / switching input 2 LED 3 status indication switching output 3 LED 4 status indication switching output 4
3	4-digit alphanumeric display	Indication of the evaluation results, parameters, parameter values, warnings and error messages
4	Programming button Set	Setting of the parameter values (scrolling by holding pressed; incremental by pressing briefly)
5	Programming button Mode / Enter	Selection of the parameters and acknowledgement of the parameter values

15.4 LED display

- LED green Power: ready for operation display
 - lights: ready for operation
 - flashes (20 Hz): device fault
 - flashes (2 Hz): no application on the device
- LED green Eth: Ethernet connection status
 - lights: connection available
 - flashes: data traffic
- LED green Con: connection status to operating program
 - lights: connection available
- LED yellow 1: switching status indication
 - out: switching input 1 / switching output 1 not switched
 - on: switching input 1 / switching output 1 switched
 - flashes (20 Hz): short circuit switching output 1
- LED yellow 2: switching status indication
 - out: switching input 2 / switching output 2 not switched
 - on: switching input 2 / switching output 2 switched
 - flashes (20 Hz): short circuit switching output 2
- LED yellow 3: switching status indication
 - out: switching output 3 not switched
 - on: switching output 3 switched
 - flashes (20 Hz): short circuit switching output 3
- LED yellow 4: switching status indication
 - out: switching output 4 not switched
 - on: switching output 4 switched
 - flashes (20 Hz): short circuit switching output

15.5 Annex tables

Inputs

Decimal digit	Code	Connection 8 input 2	Connection 7 input 1	Application
0	0 0	0	0	1
1	0 1	0	1	2
2	1 0	1	0	3
3	1 1	1	1	4

Sorting task model number (factory setting)

Decimal digit	Code	Output 7 bit 3	Connection 6 bit 2	Connection 5 bit 1	Connection 4 bit 0	Model
0	0 0 0 0	0	0	0	0	-
1	0 0 0 1	0	0	0	1	1
2	0 0 1 0	0	0	1	0	2
3	0 0 1 1	0	0	1	1	3
4	0 1 0 0	0	1	0	0	4
5	0 1 0 1	0	1	0	1	5
6	0 1 1 0	0	1	1	0	6
7	0 1 1 1	0	1	1	1	7
8	1 0 0 0	1	0	0	0	8

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