

ifm electronic



Programming manual

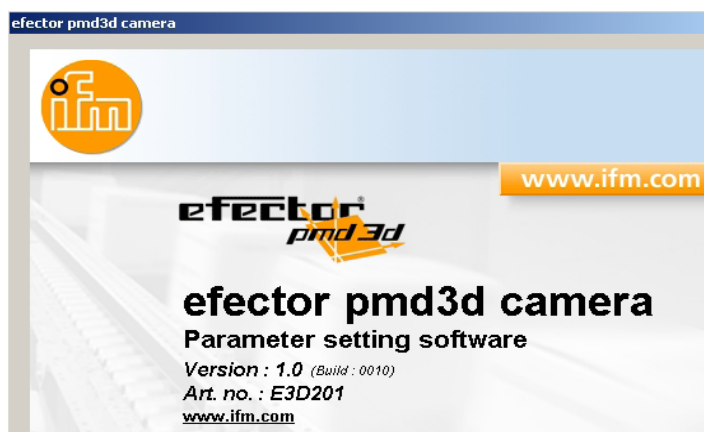
PC operating program  
for efector pmd3d camera

UK

**efector250<sup>®</sup>**

**E3D201**

704619 / 00 05/2009



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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 malfunction 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 available hard disk space
- CD-ROM drive
- XGA compatible graphic card with min. 1024 x 768 pixel resolution
- Ethernet network card for 10Base-T/100Base-TX, TCP/IP protocol
- PC mouse

### 3.2 Software

- Operating system Microsoft XP or Vista

### 3.3 Required accessories

- Crossover cable for parameter setting connection (Ethernet), M12 connector/RJ45 connector, 4 poles, e.g. art. no.: E11898 (2 m)
- Connection cable for supply voltage and process connection, M12 socket, 8 poles, e.g. art. no. E11231 (2 m, wirable cable end)

You can find more information about the available accessories (here e.g. for O3D201):  
[www.ifm.com](http://www.ifm.com) → Search options → O3D201 → Accessories

## 4 Functions and features

In conjunction with efector pmd3d the PC operating program E3D201 provides the following:

- Visualisation of the camera image (Monitor)
- Parameter setting of the camera (Parameters)

## 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 camera.

The figures and texts show the installation process under Windows XP. In other Windows versions installation is carried out in the same way.

### 5.1 Hardware

- ▶ Connect the device to the Ethernet interface of the PC using a crossover cable.

### 5.2 Software

To start the PC user program you have the following options:

- Start directly from the CD
- Copy to the PC and direct start
- Installation on the PC

#### 5.2.1 Start the program from CD without installation

- ▶ Insert the CD in the drive.
- > The start menu opens.
- ▶ Select menu item "Start efector pmd3d".
- > The program starts.



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

- ▶ Start the "O3Dstart.exe" file in the main directory of the CD with a double click.
- > The start menu opens.
- ▶ Select menu item "Start efector pmd3d camera".
- > The program starts.

#### 5.2.2 Start the program from the hard disk without installation

- ▶ Copy the PC operating program from the CD to the hard disk.
- ▶ Start the "O3Dstart.exe" file in the main directory with a double click.
- > The start menu opens.
- ▶ Select menu item "Start efector pmd3d camera".
- > The program starts.

#### 5.2.3 Install program on the hard disk

- ▶ Insert the CD in the drive.
- > The start menu opens.
- ▶ Select menu item "Install efector pmd3d camera" 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 "O3Dstart.exe" file in the main directory of the CD with a double click.
- > The start menu opens.
- ▶ Select menu item "Install efector pmd3d camera" and 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 pmd3d camera O3D2xx	192.168.0	69
	=	≠
PC	192.168.0	e.g. 10

### 5.3.2 Factory setting parameters

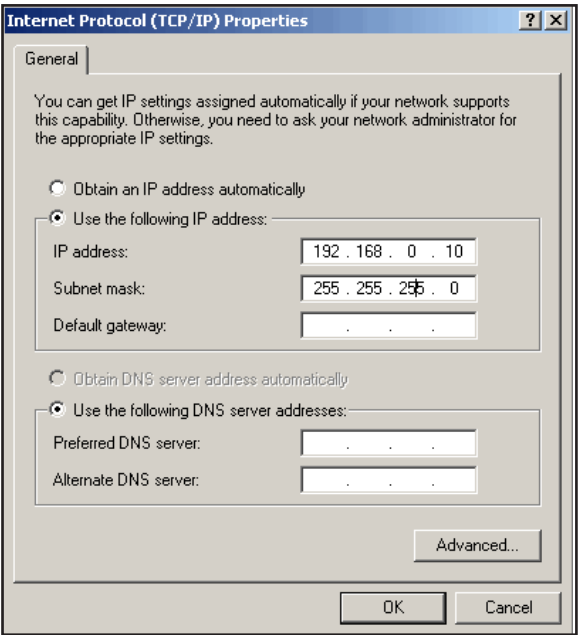
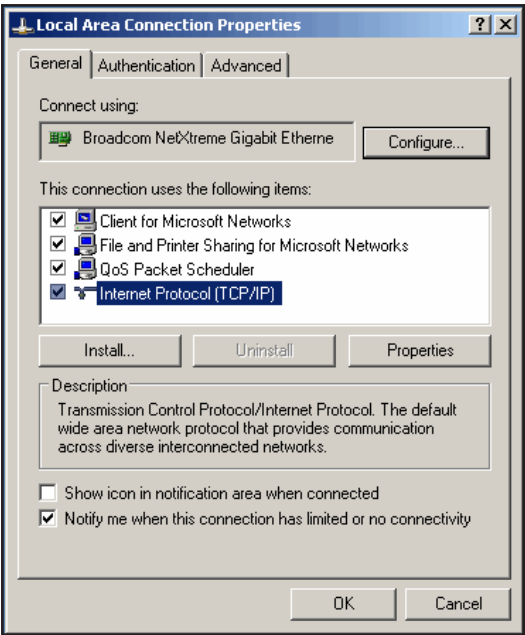
efector pmd3d O3D2xx parameters	Description	Factory setting
DHCP	Dynamic Host Configuration Protocol	off
IP	IP address	192.168.0.69
nETm	Subnet mask	255.255.255.0
GWIP	Gateway address	192.168.0.201

### 5.3.3 Verify and set the IP address of the PC



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

- ▶ 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 option "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].

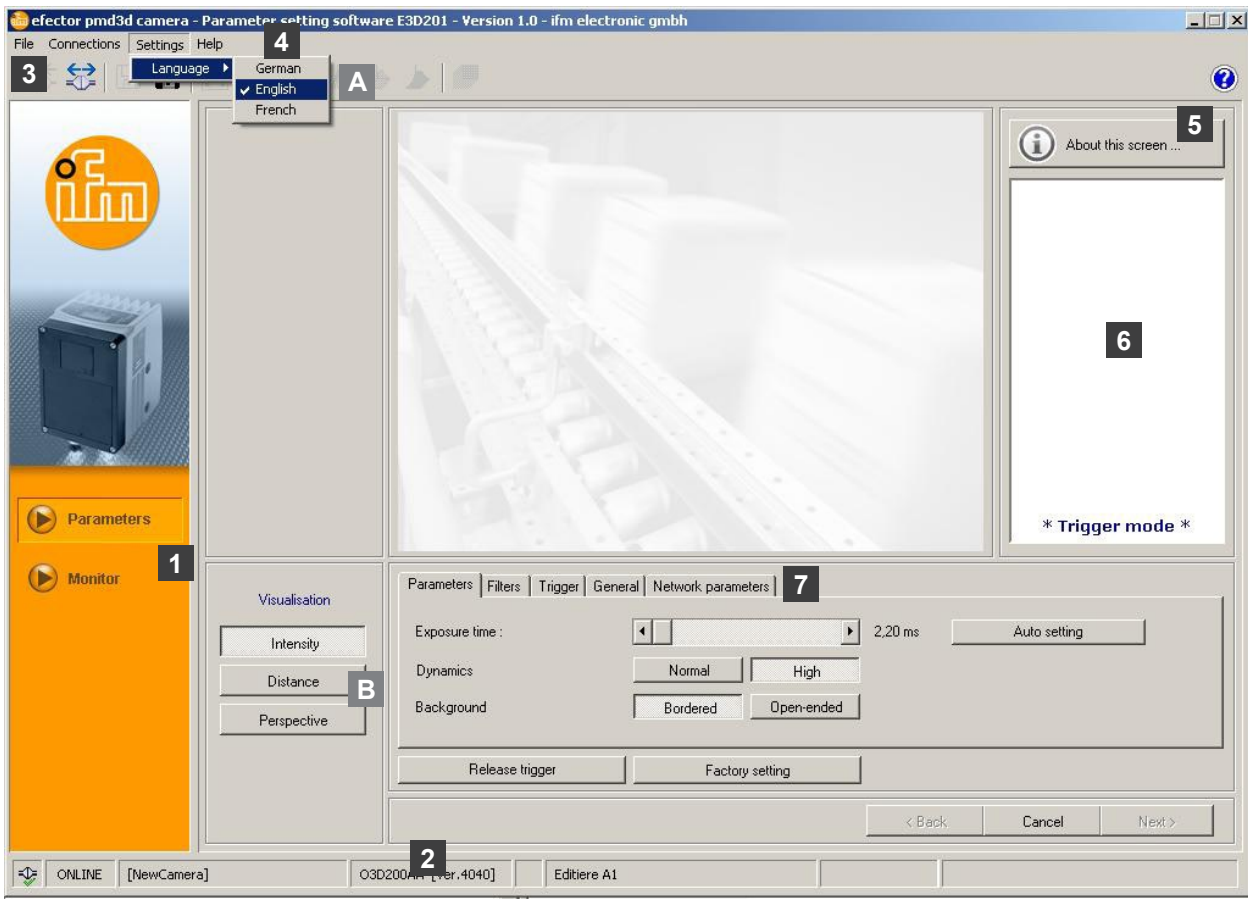


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## 6 Basic functions of the program

### 6.1 Basics of operation

#### 6.1.1 User interface



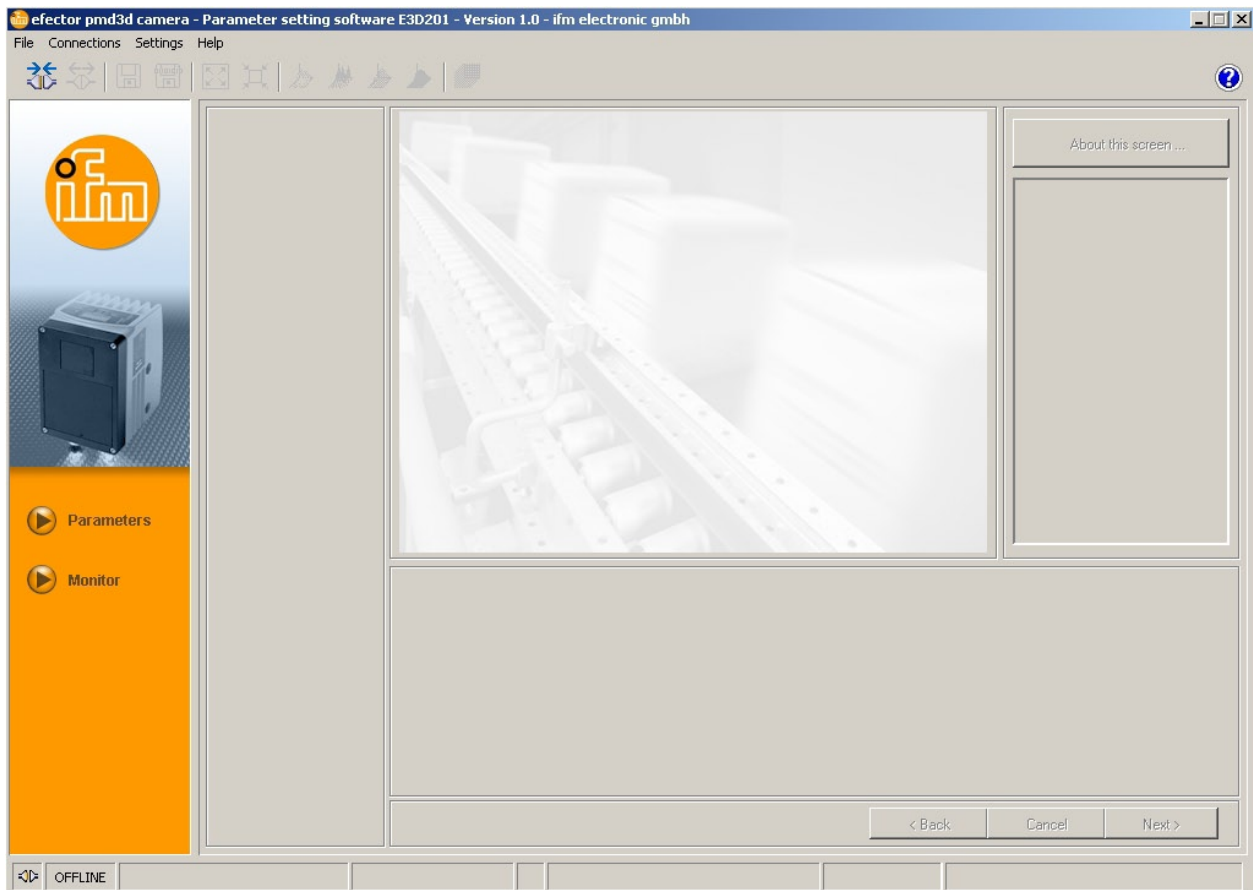
Pos.	Operating elements	Function
1	Mode	<ul style="list-style-type: none"> <li>Parameters               <ul style="list-style-type: none"> <li>Edit parameters</li> </ul> </li> <li>Monitor               <ul style="list-style-type: none"> <li>Display or visualisation                   <ul style="list-style-type: none"> <li>of the detected object</li> <li>of the set parameter values</li> </ul> </li> </ul> </li> </ul>
2	Status bar	<ul style="list-style-type: none"> <li>Network status of the device (OFFLINE/ONLINE)</li> <li>Device name</li> <li>Article number/production status of the device/firmware of the connected device</li> <li>Visualised display of the camera temperature</li> <li>Evaluation time</li> </ul>
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	Button [About this screen...]	<ul style="list-style-type: none"> <li>Information on the current window</li> </ul>
6	Result window	<ul style="list-style-type: none"> <li>e.g. selected sensor program</li> <li>Result (e.g. 230 mm)</li> </ul>
7	Tabs	Tabs for the configuration of different setting options
A/B	Selection variants	Identical commands can be selected in different ways (depending on the program function). A = selection via pulldown menu in the menu bar B = selection via button

## 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 as supplied, the neutral user interface will be displayed.  
(On delivery an application with default settings is stored.)



Status: OFFLINE

## 6.3 Select user language

- Select the desired language in the menu bar with [Settings] → [Language].



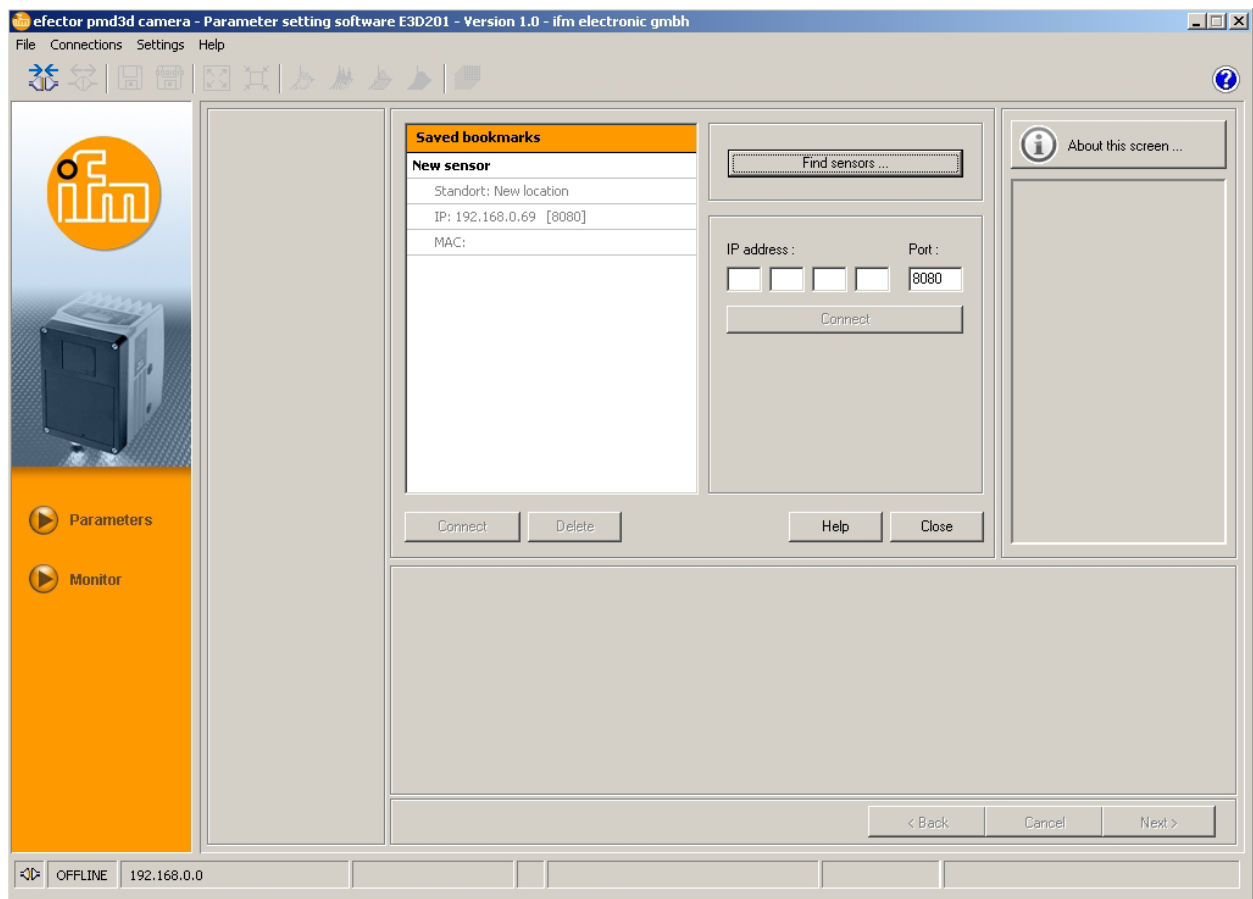
## 6.4 Connect device to the operating program

### 6.4.1 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 with the default settings of the device.  
(If this is not the case, continue with 6.4.2 or 6.4.3).

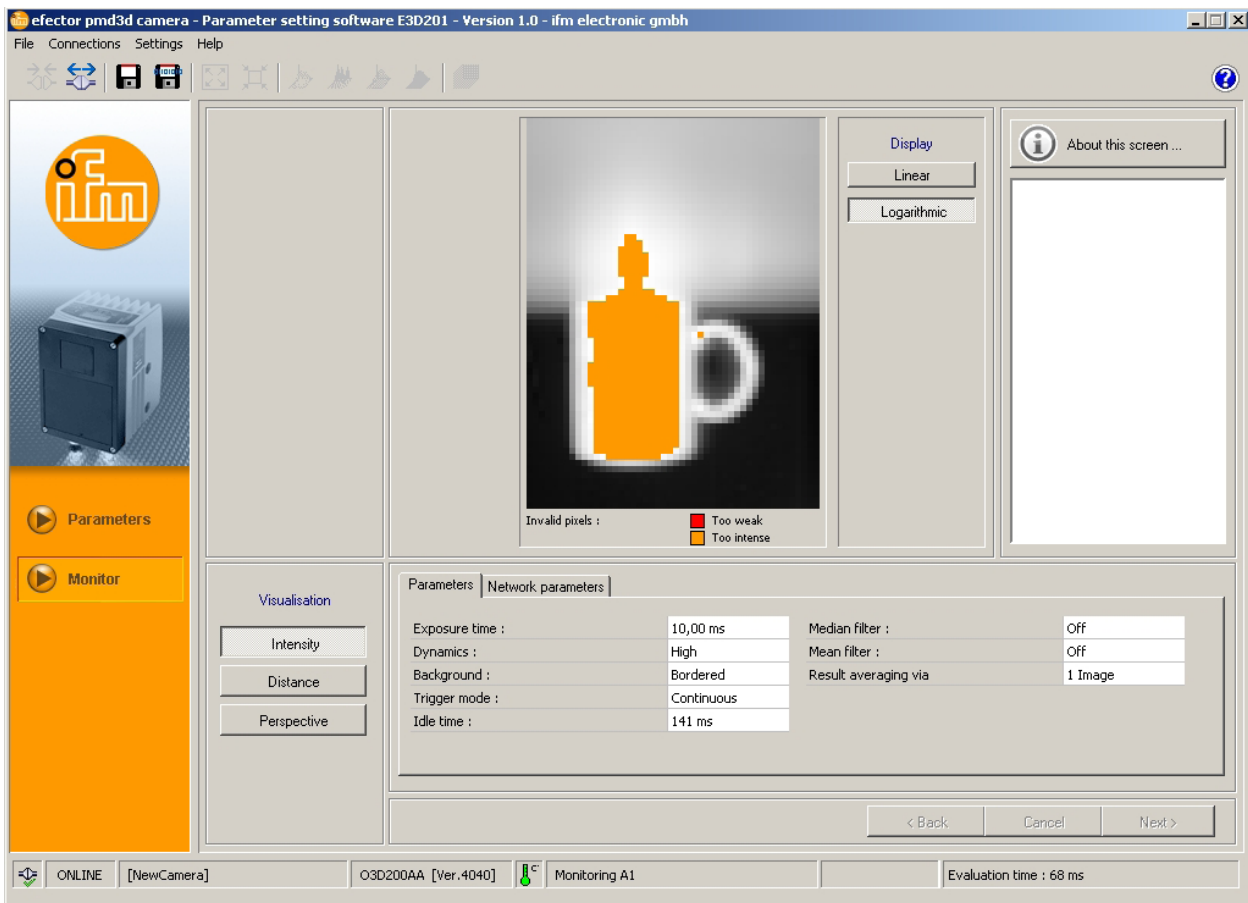


- Mark the bookmark entry (e.g. "New camera") and click on [Connect].  
As an alternative: double-click on the entry.

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> Change of status: OFFLINE → ONLINE

- 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 device.



Establishing the connection may take several seconds.

## 6.4.2 Alternative 2: enter the IP address of the device

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



- > User interface changes to the connection settings.
- Enter the IP address of the device in the field "IP address".
- Assign preset port number 8080.



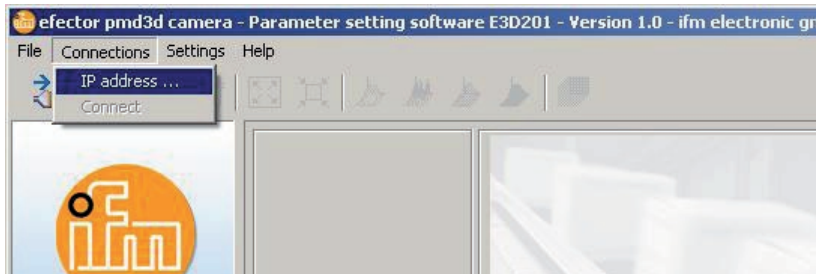
If a firewall is active on the PC, ensure that this port and the port number 50002 have been enabled for image transmission.

- Click on [Connect].

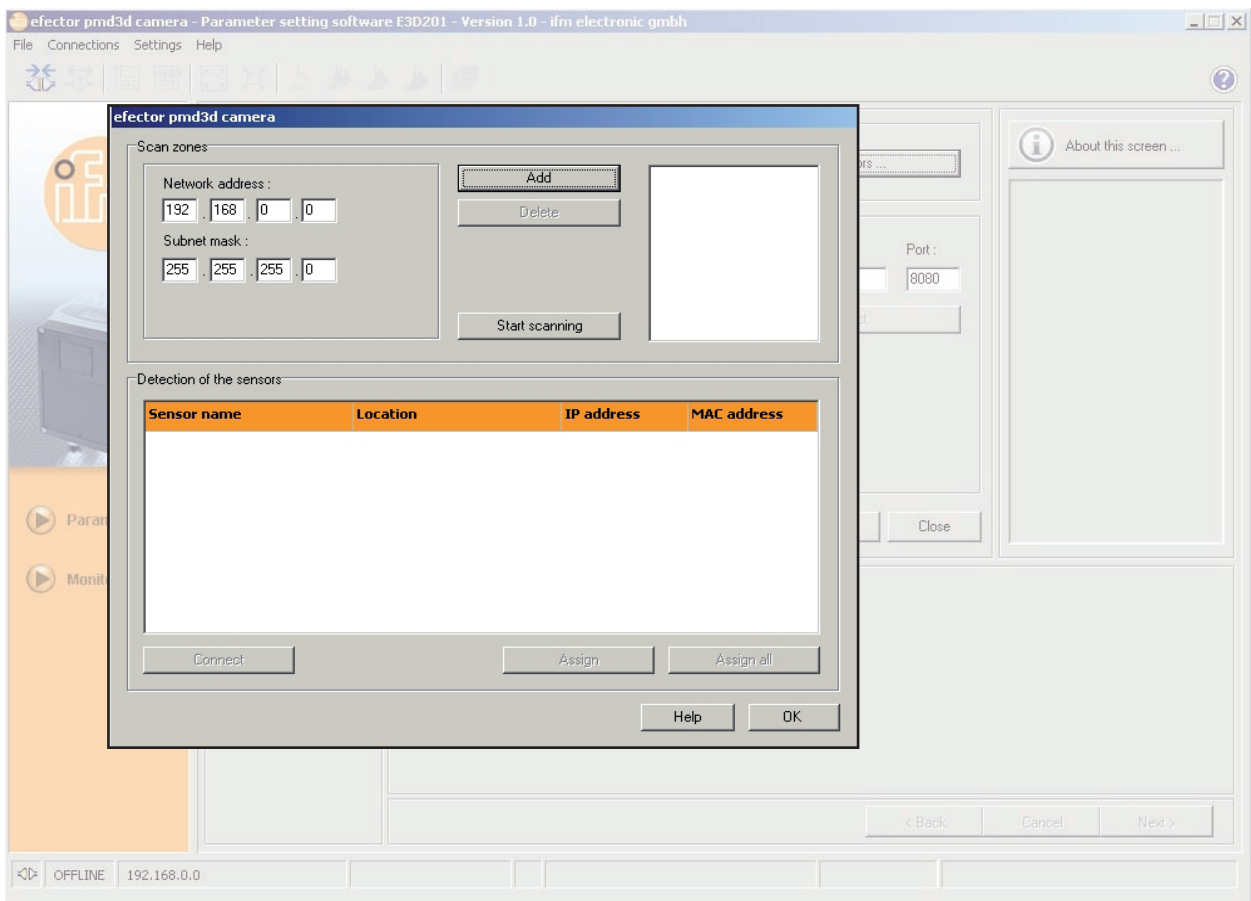
- > Change of status: OFFLINE → ONLINE  
(like 6.4.1)

### 6.4.3 Alternative 3: find IP address of the device

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



- > User interface changes to the connection settings.
- Click on [Find cameras ...]
- > The window "Network search" opens.



- > Under "Scan zones" the IP range set on the PC is automatically assigned (here e.g. 192.168.0.0).



If you want to search other networks, you have to ensure that the gateways of your PC are correctly set. In case of doubt, contact your network administrator.

- If you want to search other networks, overwrite the IP address range in the field "Network address".
- Click on [Add].
- > The network address is added to the search list.  
The fields for the network address and subnet mask are blank so that other entries can be made in the search list.

**efector pmd3d camera**

Scan zones

Network address :  
 .  .  .

Subnet mask :  
 .  .  .

Add  
Delete  
Start scanning

192.168.0.0

Detection of the sensors

Sensor name	Location	IP address	MAC address

Connect Assign Assign all

Help OK

- Click on [Start scanning].
- > The devices found are listed in the "Detection of the cameras" 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.

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Scan zones

Network address :  
 .  .  .

Subnet mask :  
 .  .  .

Add  
Delete  
Start scanning

192.168.0.0

Detection of the sensors

Sensor name	Location	IP address	MAC address
NewCamera	NewLocation	192.168.0.99	00:02:01:20:4E:A5

Connect Assign Assign all

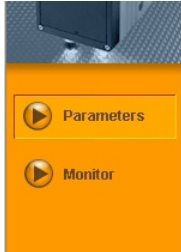
Help OK

- Mark entry in the search list and click on [Connect].  
As an alternative: double-click on the entry in the search list.
- > Change of status: OFFLINE → ONLINE  
(like 6.4.1)

## 7 Operating modes

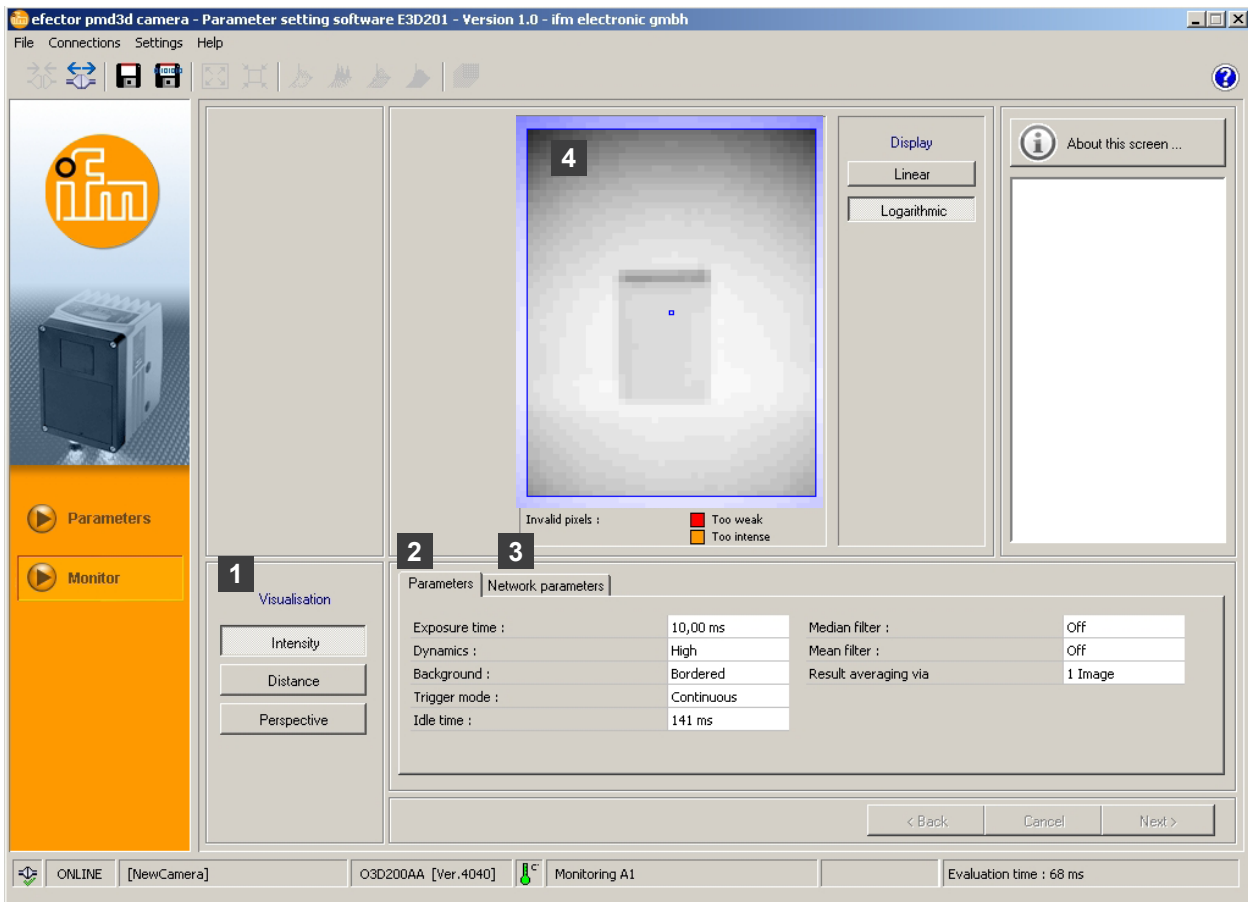
The device distinguishes two operating modes:

- Parameters
- Monitor

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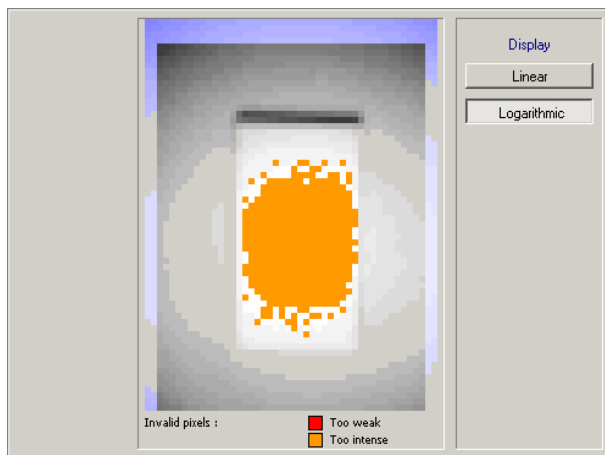
## 7.1 Monitor

When you have switched on the unit you are in the monitor mode. Here you can watch the sensor working.



Pos.	Element	Function
1	Visualisation	Alternatives for visualising the camera image
2	Tab [Parameters]	<ul style="list-style-type: none"> <li>• Exposure time</li> <li>• Dynamics</li> <li>• Background</li> <li>• Trigger mode</li> <li>• Idle time</li> <li>• Status of the filter</li> <li>• Setting of result averaging</li> </ul>
3	Tab [Network parameters]	<ul style="list-style-type: none"> <li>• IP address</li> <li>• Subnet mask</li> <li>• Gateway etc.</li> </ul>
4	Camera image	Visualisation of the current camera image depending on the setting of the visualisation

### 7.1.1 Intensity image



The intensity image describes the visualisation on the basis of the reflectivity of the object to be displayed. It can be compared with a black and white image of a camera.

This mode is suitable for the following activities:

- setting the focus of the lens (by means of the setting screw on the back of the unit)
- adjusting the position of the active image section

#### Colour indicators

- Red-shaded image zones:  
Pixels with too weak a light reflection are visualised in red.
- Orange-shaded image zones:  
Pixels with too intense a reflection are visualised in orange (too little distance to the object).

Red and orange image zones provide no distance values.

Red and orange image zones should be avoided. Corrections are possible when the image quality is adjusted.

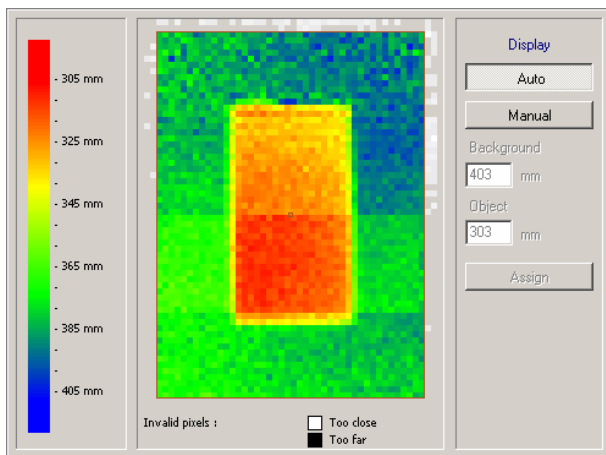
For visualisation the individual pixels are standardised across the entire image zone. Pixels of high intensity are displayed as light, pixels of low intensity are displayed as dark.

If the dynamics of the image is very high, i.e. the difference between the "strongest" and the "weakest" pixels is significant, the zones of weak reflection are displayed as very dark, contours at a larger distance can often no longer be recognised.

In that case the band width of intensities can be displayed as a logarithm which is almost like a reduction in contrast.

- Select [Linear] or [Logarithmic] display.

## 7.1.2 Distance image



The distance image describes the object scenario on the basis of the distance to the camera. In this process each pixel is assigned a corresponding colour from the spectrum depending on the distance to the camera. Short distances start in the red range and within the spectrum change to shades of blue for larger distances via the yellow and green ranges.

### Display

When the [Auto] button is activated, the entire range of the distance values is displayed in an optimum way on the colour spectrum available. The assignment of the distances to the colours is shown in the bar graph on the left.

Normalisation is carried out on the basis of the first distance values to be visualised and is kept. If the distance values are significantly changed in the course of image visualisation, for example due to major changes in the scenario, normalisation is adapted automatically.

When the [Manual] button is activated, you can change the distribution of the colour spectrum. In the input fields you set the minimum and the maximum distance values in whose range the colour spectrum is to be redistributed. The "Background" field stands for the maximum distance value, "Object" for the minimum distance value.

### Adapt colour spectrum manually

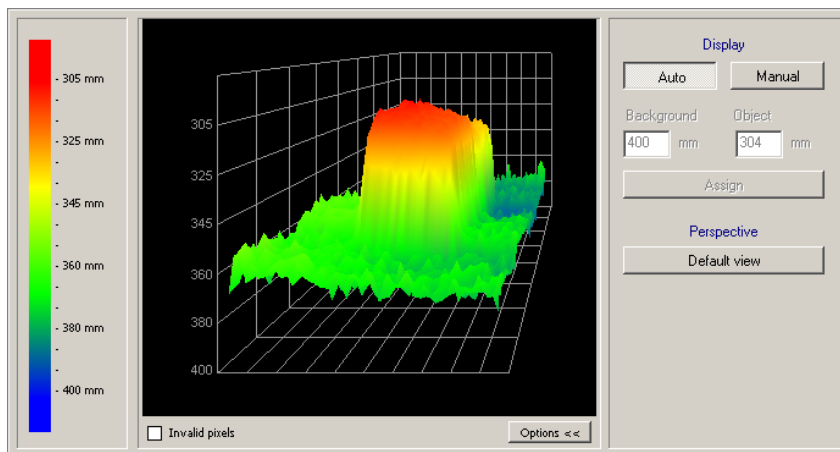
- ▶ Click on [Manual].
- > The background and object fields are enabled.
- ▶ To determine the current distance of a special pixel, click on the requested pixel with the right mouse button.
- > The measured distance value is displayed below the camera image.
- ▶ Enter requested values between 0 and 6500 mm for "Background" and "Object" .



The input value for "Background" must be greater than the value for "Object".

- ▶ Click on [Assign].

### 7.1.3 Perspective view



In principle the perspective view corresponds to the distance image view. There is, however, spatial visualisation. In this process each pixel is assigned a corresponding colour from the spectrum depending on the distance to the camera.

Short distances start in the red range and within the spectrum change to shades of blue for larger distances.

Invalid pixels are shown in white. They are either at a distance of more than 6.5 m from the device or they are not included due to their high degree of reflection.

#### Types of display

- Select the types of display of the perspective view in the tool bar

Symbol	Function
	Displays the distance data of the camera as individual coloured pixels.
	Displays the distance data of the camera as a coloured bar.
	Displays the distance data of the camera as a coloured mesh network.
	Displays the distance data of the camera as a coloured perspective model.
	Shows/hides the coordination grid.
	Enlarges the perspective view.
	Reduces the perspective view (default setting).

#### Display

When the [Auto] setting is enabled, the entire range of the distance values is displayed in an optimum way on the colour spectrum available. The assignment of the distances to the colours is shown in the bar graph on the left.

Normalisation is carried out on the basis of the first distance values to be visualised and is kept. If the distance values are significantly changed in the course of image visualisation, for example due to major changes in the scenario, normalisation is adapted automatically.

When the [Manual] button is activated, you can change the distribution of the colour spectrum. In the input fields you set the minimum and the maximum distance values in whose range the colour spectrum is to be redistributed. The "Background" field stands for the maximum distance value, "Object" for the minimum distance value.

Using the [Options] button you can show or hide the option field for image adjustment. If the options are suppressed, you will see the result window.

### Adapt colour spectrum manually

- ▶ Click on [Manual].
- > The "Background" and "Object" input fields are enabled.
- ▶ Enter values between 0 and 6500 mm for [Background] and [Object].



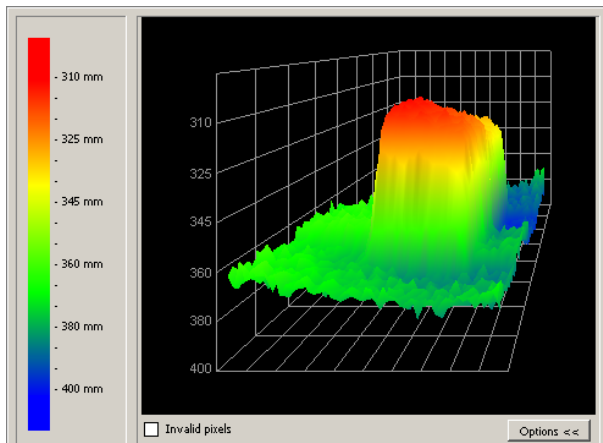
The input value for "Background" must be greater than the value for "Object".

- ▶ Click on [Assign].

### Change the viewing position

You can change the position interactively.

- ▶ Left-click into the field of view and move the mouse, keeping the mouse button pressed, into the required direction of rotation.
- > The object moves around its centre of gravity into the required viewing position.





### Restore the initial perspective

- ▶ Click on [Default view].

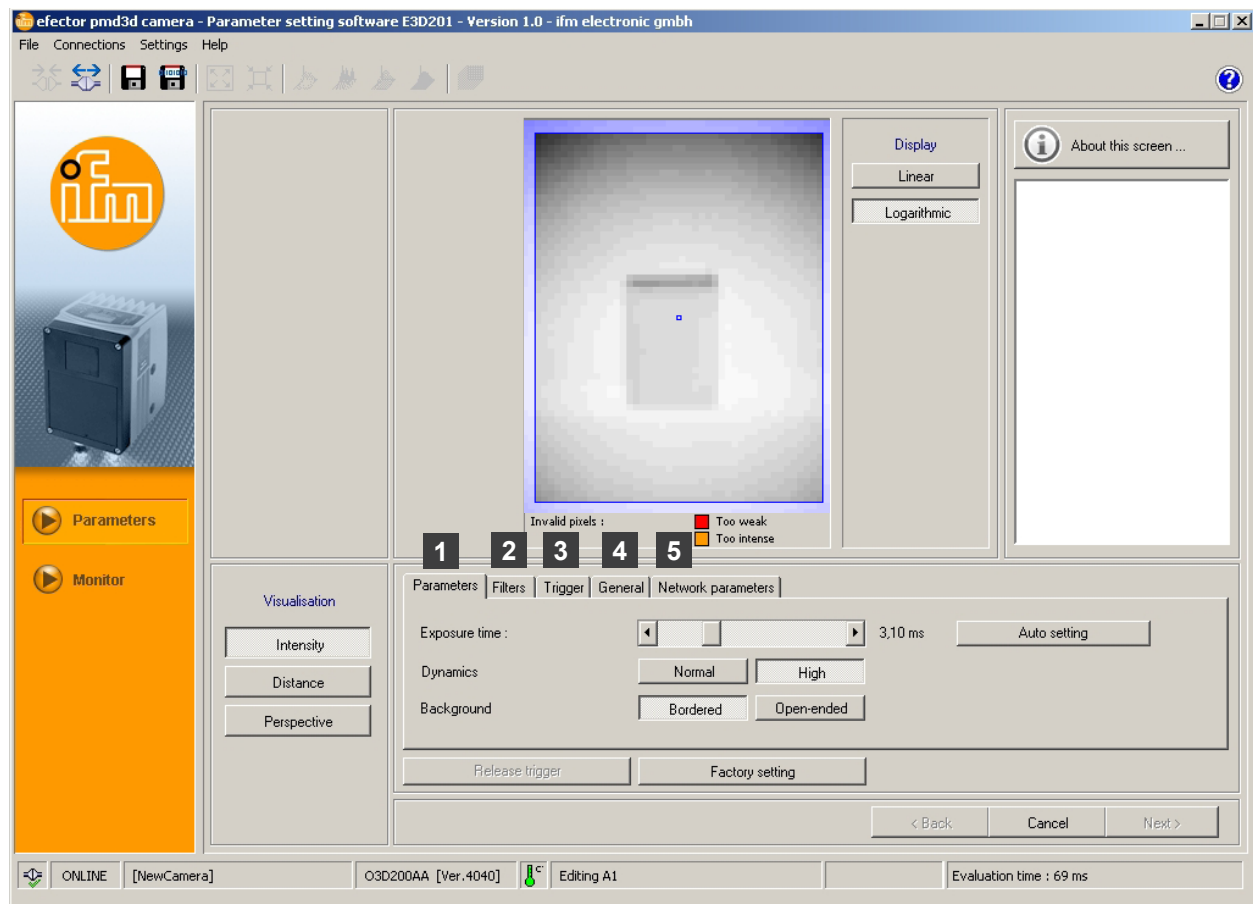
### 7.1.4 Save data

The current evaluation image and the current image data can be saved as follows:

Symbol	Function
	Saves the current evaluation image as a bitmap file (*.bmp) ► Indicate the file name and the memory location in the newly opened window.
	Saves the current image data (intensity or distance values) in table format (*.csv) Image data of the perspective view cannot be saved. The values are structured by lines, the individual values are separated by a semicolon so that the data can be imported in standard spreadsheet programs. ► Indicate the file name and the memory location in the newly opened window.

## 7.2 Parameters

► Click on [Parameters]



Pos.	Element	Function
1	Parameters	Setting of exposure time, dynamics and background
2	Filters	Selection of the filters median and mean as well as result averaging
3	Trigger	Select trigger mode
4	General	General administration (device-specific names, info about software version etc.)
5	Network parameters	Set network parameters (DHCP on/off, IP address etc.)

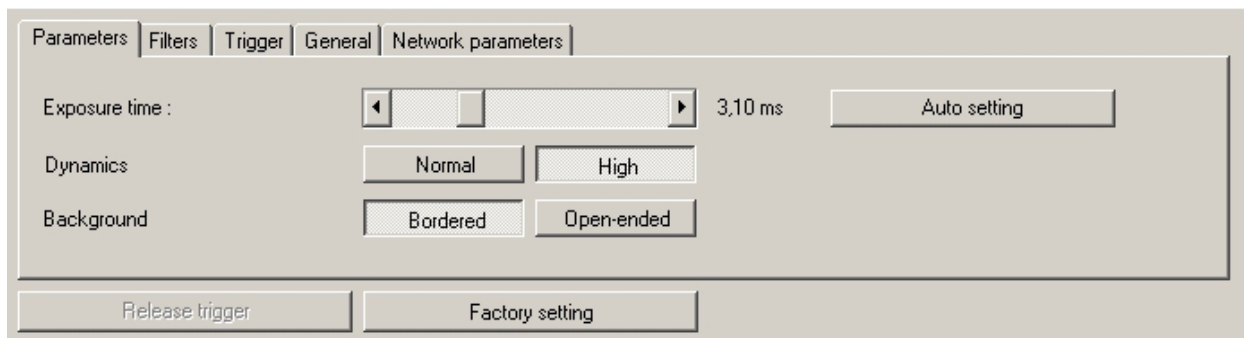
► Optimise the image definition via the setting screw on the back of the device.



Due to the low resolution and the different distances in a scenario manual setting has only little influence on the result of the measurement.

## 7.2.1 Parameters

You define the characteristics of image capture in the [Parameters] tab.



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### Exposure time

The exposure time means the time it takes to capture the camera image. You can have the exposure time set automatically or you can set it manually. In the following cases it is necessary to change the exposure time:

Image quality	Setting
Many white image zones (overexposure)	Reduce exposure time
Many black image zones (underexposure)	Increase exposure time
White and black image zones (high dynamics due to high-contrast image)	<ul style="list-style-type: none"> <li>• Set dynamics to [High]</li> <li>• Increase exposure time</li> </ul>
Considerable noise or flickering of the image	<ul style="list-style-type: none"> <li>• Increase exposure time</li> </ul>

### Dynamics

For high contrast images, light objects reflect too much light, dark objects, however, too little light. In the "Dynamics" field you can compensate this contrast. The following settings are recommended:

Image quality	Setting
No white and black image zones simultaneously (low dynamics due to low contrasts)	[Normal]
White and black image zones (high dynamics due to high-contrast image)	[High]

For the setting [High] the camera works with double exposure. It measures with a short and then with a second long exposure time. During the short exposure time it fills up extremely overexposed zones.

Double exposure prolongs the total exposure time which may cause blurred edges for moving objects.

### Background

Image quality	Setting
Scene has a defined background.	[Bordered]
Scene does not have a defined background. The camera detects objects at a distance greater than 6,5 m.	[Open-ended]

If the camera detects objects at a distance greater than 6.5 m, it only provides meaningful results with the setting [Open-ended] activated. With this setting the measuring range of the camera is set to longer distances. The exposure time, however, is doubled which may cause blurred edges with moving objects.

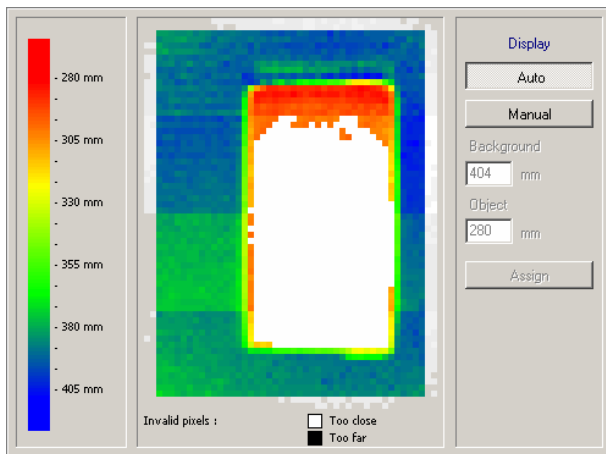
→ Operating instructions → Chapter Unambiguous range

### Parameter setting

To determine the optimum parameters take the following steps:

- ▶ Open the [Parameters] tab.
- ▶ Click on [Normal] in the "Dynamics" field.

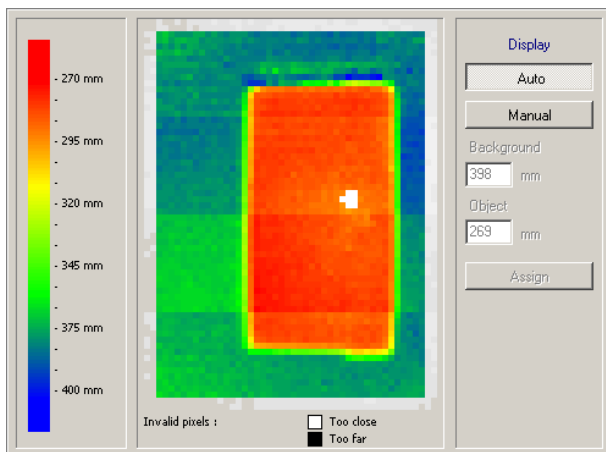
- > The overexposed areas are identified by the white pixels. In these areas too much light is reflected.



- Click on [Auto setting].
- > The exposure time is calculated and the slider bar in the "Exposure time" field is set automatically.

As an alternative: set the exposure time manually by means of the slider bar.

- Reduce the exposure time if there are overexposed areas (white pixels).
- Increase the exposure time if there are underexposed areas (black pixels).



- If the image shows overexposed and underexposed areas (white and black pixels), click [High] in the "Dynamics" field.
- If there are white pixels, noise or flickering of the image, optimise the exposure time.
  - White pixels: reduce exposure time.
  - Noise or flickering: increase exposure time.

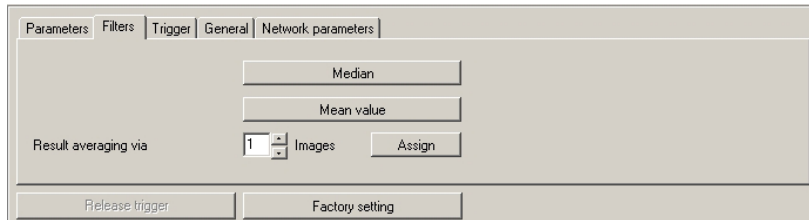
## 7.2.2 Filter

Select the suitable filter for smoothing noisy data in the [Filters] tab. During filtering the information of neighbouring pixels is used to change the value of the central pixel. Filtering results in smoothing of the surfaces and rounding of the edges. The more a surface is smoothed, the more an edge is rounded.

Filters influence the exposure time only insignificantly. Several filters can be combined.



Filters help improve poor data; however they remain poor data. Therefore optimisation should first of all be effected by exposure.



With the spatial filters median and mean, "3x3 averaging" is used.

First of all the measured value of a pixel to be filtered is considered. Then it is put into relation with the 8 adjoining pixels. Each filter calculates a mean value from the 9 pixels, the calculation conditions for the various filters vary.

### Median filter

This filter has excellent smoothing characteristics and influences the edges insignificantly (default setting). It excludes the 4 extreme values from the 9 pixels (2 positive and 2 negative outliers) and calculates the mean value of the other 5 pixels.

### Mean filter

This filter has excellent smoothing characteristics and generates very blurry edges. The mean value is calculated from the algebraic averaging of the 9 pixels: they are added and divided by 9.

### Result averaging

Determines the number of images used for calculating an output value. The default setting is 1 image, i.e. the output of the result is calculated on the basis of each individual image.

The number of images can be increased for time-uncritical applications, e.g. for level detection. This leads to more precise results; at the same time, however, it also increases the evaluation time (sampling rate). Result averaging means smoothing the results with regard to time.

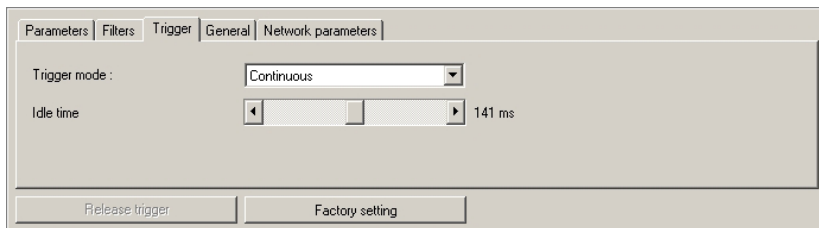
Calculation of the output frequency:  $\text{output frequency} = \text{sampling rate} / \text{number of images result averaging}$ .

### Select filter

- ▶ Open [Filters] tab.
- ▶ Select or deselect requested filter.
- ▶ If necessary, increase the number of images in the "Result averaging" field.
- ▶ Acknowledge with [Assign].

### 7.2.3 Trigger

Select the trigger mode and the idle time in the [Trigger] tab.



#### Trigger mode

The trigger mode describes the trigger source. The following sources are available:

Entry	Function
Positive edge	External triggering with positive edge
Negative edge	External triggering with negative edge
Continuous	Internal triggering

#### Idle time

The idle time influences the sampling rate. The sampling rate corresponds to the number of images captured per second in continuous, internally triggered operation.

Longer exposure times or higher sampling rates lead to increased heat generation. To ensure that the sampling rate does not exceed 25 Hz even with short exposure times, the minimum idle time is 100 ms.

#### Restore factory settings

- Click on [Factory setting].
- > The parameter values are reset to
  - exposure time: 10.1 ms
  - sampling rate: 4 Hz
  - result averaging via: 1

#### Test trigger

Using the [Release trigger] button you can test the trigger.

- Select the trigger mode in the "Trigger mode" field:
  - external triggering (positive edge)
  - external triggering (negative edge)
  - internal triggering (continuous)
- Click on [Release trigger].
- > After triggering the captured image and the test results are displayed in the result window.

## 7.2.4 General

You can enter the camera name and the location in the tab [General].

Field	Function
Camera name	Any application-specific device name
Camera location	Description of the location (e.g. hall 4a)
Firmware version	Firmware version of the device (cannot be edited and can only be changed via update)

- Enter the camera name and camera location according to the application.
- Transfer the entries to the device with [Assign].

## 7.2.5 Define network parameters

- Open the [Network parameters] tab.

- Verify and, if necessary, change all entries.
- Transfer the entries to the device with [Assign].

Field	Function
DHCP mode	In the DHCP mode the fields for IP address, mask and gateway are blocked. The camera is assigned an address by the DHCP server.
IP address	Currently assigned IP address of the device
Subnet mask	Default setting subnet 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
MAC address	MAC address of the device (cannot be changed)

## 8 Update camera software



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

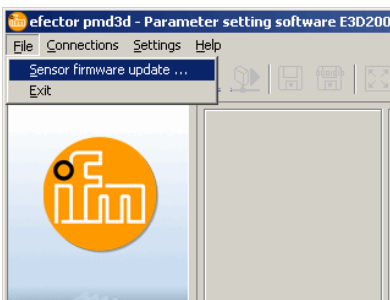


During the update all data stored on the camera will get lost.

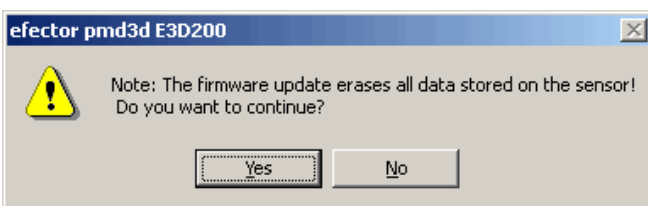
- ▶ If necessary, store the data saved on the camera.
- ▶ Save the update file (file extension: \*.swu) in a directory of your choice.
- ▶ Connect to the required camera.
- ▶ Change to the [Parameters] mode.



Select [File] [Sensor Firmware Update] in the menu bar.



- ▶ If the data saved on the camera has been stored, acknowledge warning with [Yes].



- > The user interface changes.
- ▶ Select SWU file for the sensor update.
- > The file is transferred to the camera.

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




When the firmware is updated, the IP address is reset to the factory setting.

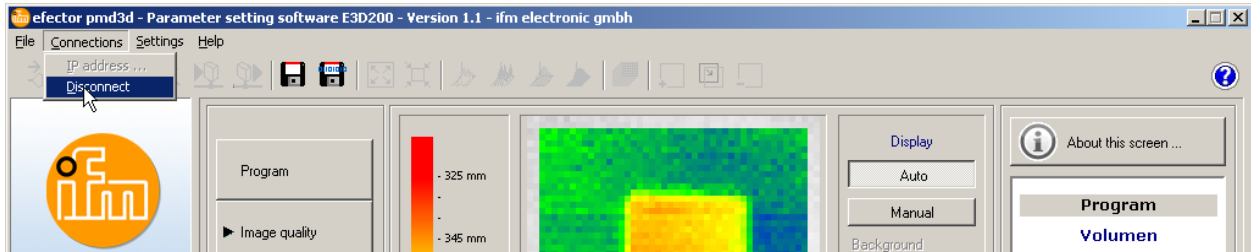


Do not interrupt the current supply to the camera during the update process! This results in loss of data and functionality of the camera.

## 9 Exit program

### 9.1 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.

### 9.2 Close program

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

UK