

SmartRunner 3-D ToF

3-D time-of-flight sensor

Manual



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1 Introduction

1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal



Note

For full information on the product, refer to the further documentation on the Internet at www.pepperl-fuchs.com.



Note

For specific device information such as the year of construction, scan the QR code on the device. As an alternative, enter the serial number in the serial number search at www.pepperl-fuchs.com.

The documentation comprises the following parts:

- This document
- Datasheet

In addition, the documentation may comprise the following parts, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Functional safety manual
- Other documents

1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismantling lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismantling of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.

1.3 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:



Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.



Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.



Caution!

This symbol indicates a possible fault.

Non-observance could interrupt the device and any connected systems and plants, or result in their complete failure.

Informative Symbols



Note

This symbol brings important information to your attention.



Action

1. This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

2 Product Specifications

2.1 Function Principle

This manual describes the SmartRunner Explorer 3-D with time-of-flight technology (hereinafter referred to as sensor).

The object in the field of view is illuminated by a modulated, invisible infrared light (1). The object reflects the light (2) on the sensor through the lens. The reflected light is detected with a spatial resolution of 640 x 480 pixels. The distance data to the object is determined independently for each pixel by measuring the phase shift. The phase position of the brightness-modulated light source is measured using the "continuous-wave time-of-flight procedure." Four measurements with different phases are performed. The phase shift of the reflected light is the equivalent of the distance "d." The result of the measuring cycle is a 3-D point cloud that contains intensity data for each pixel.

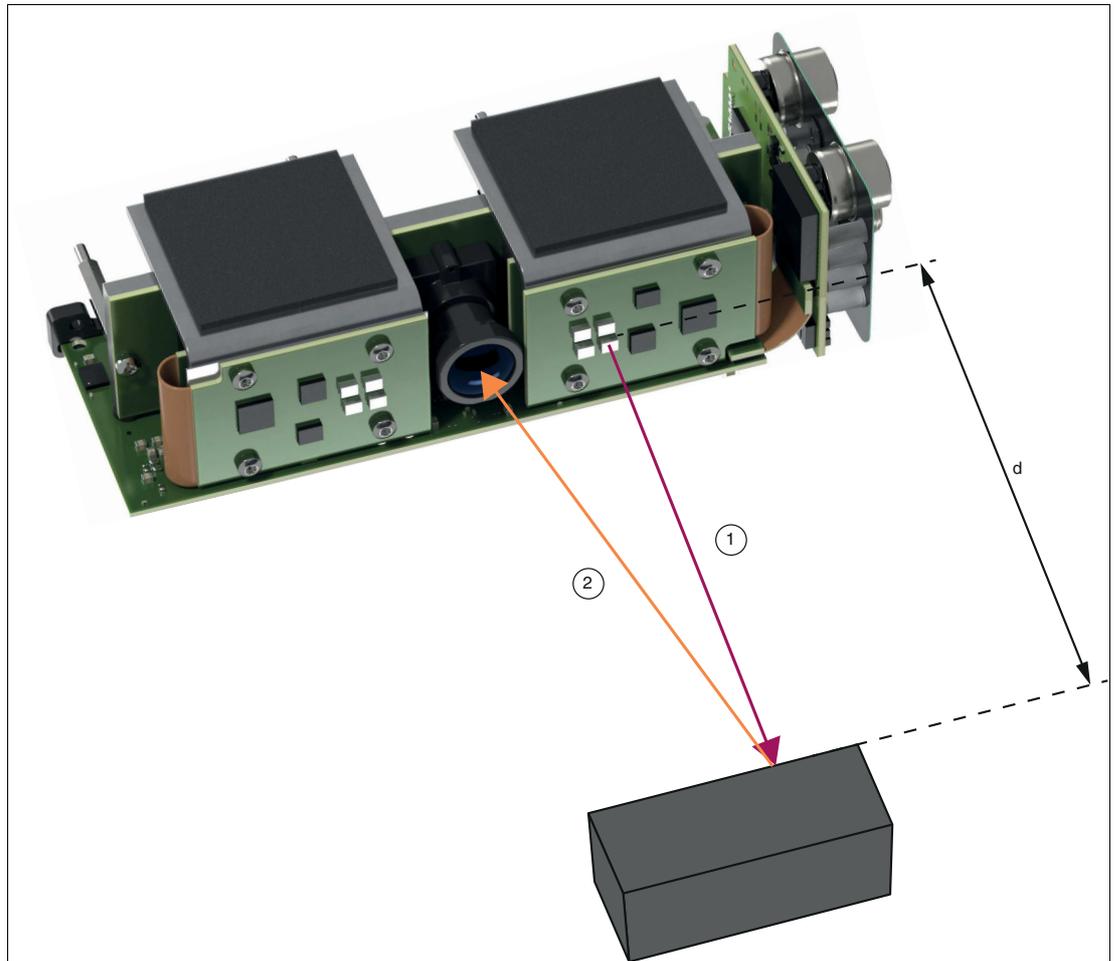


Figure 2.1 Function Principle

An example of how the measurement results can be displayed is a 3-D point cloud in the "ViSolution" application software (see chapter 6.2.1).

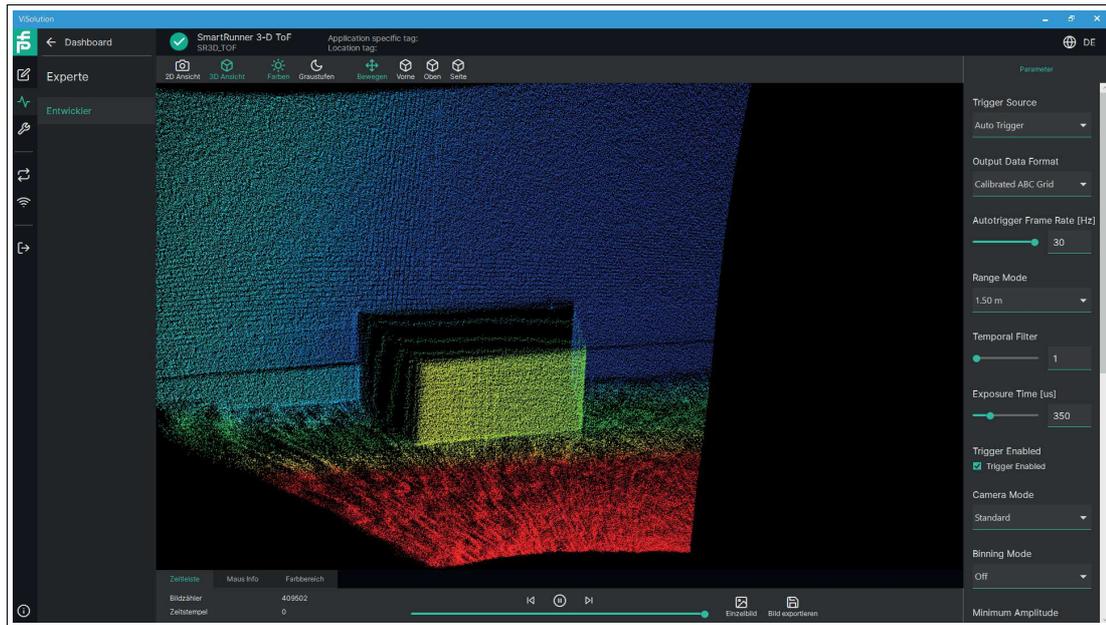


Figure 2.2 ViSolution

2.2 Symbols on the Sensor

Overview of labeling



Figure 2.3 Overview of labeling

Nameplate



Figure 2.4 Nameplate

The nameplate provides the following information:

- Part number
- CE marking
- UKCA marking
- MAC ID: 00-0D-81-0C-5E-5B
- Default IP: 192.168.2.4
- Serial number: 40000049970886
- Manufactured 37/2021 Mannheim
- UL marking
- Class 2 power source
- $U_B = 24\text{ V} \pm 10\%$
- $I_B = 520\text{ mA}$
- $P_0 = 12.5\text{ W}$
- Made in Germany 07
- 68307 Mannheim, Germany
- www.pepperl-fuchs.com
- Crossed-out garbage can symbol
- Laser information

Disposal



Figure 2.5 Disposal

Devices marked with this symbol must not be disposed of with household waste. These devices must only be disposed of by specialist companies approved at the operating location.

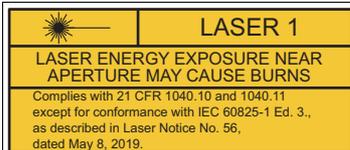
Hot surface



Figure 2.6 Hot surface

This label indicates a possible risk of burns from hot surfaces. Exercise the necessary caution when touching the sensor in this area.

Information on Laser Class 1



This sensor is certified according to laser protection class 1.

Note the information on the sensor that laser radiation near the aperture can cause burns.

Install the device so that the warning is clearly visible and readable.

2.3 Dimension Drawing

The sensor housing has the following dimensions.

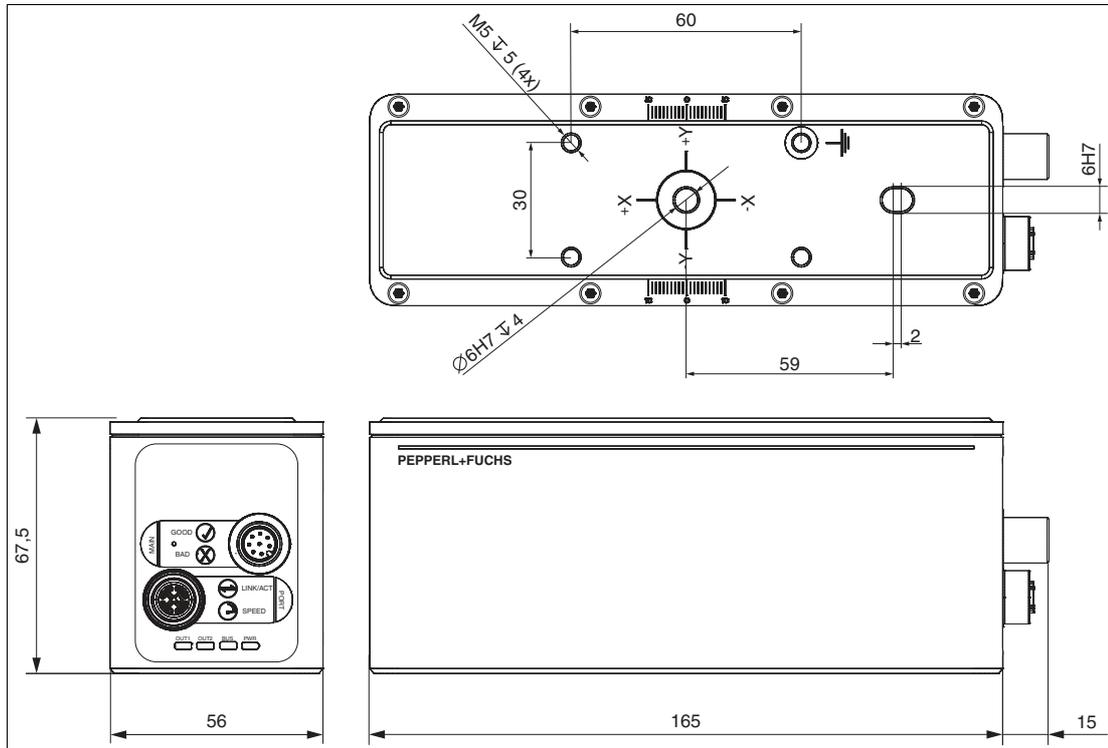


Figure 2.7 Dimension Drawing

All dimensions in mm.



Note

Further technical data can be found on the datasheet for the sensor. You will find the datasheets on our website.

2.4 Display elements

The sensor has eight LEDs that signal various operating states or events.

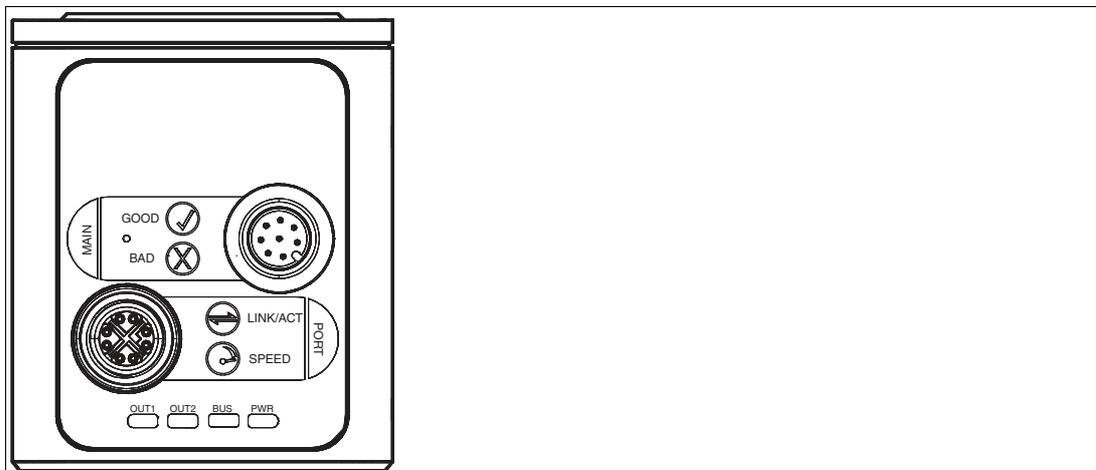


Figure 2.8 Display elements

Designation		LED color	Description
MAIN	GOOD	green	Reserved
	BAD	red	Reserved
PORT	LINK/ACT	yellow	The LED flashes at short intervals when bus data is being exchanged.
	SPEED	green/yellow	<ul style="list-style-type: none"> No connection or 10 MBit connection—LED off 100 MBit connection—LED lights up yellow 1 Gbit connection—LED lights up green
Operating mode	OUT1	green/yellow	Reserved
	OUT2	yellow	The OUT2 LED flashes once briefly when the image capture starts.
	BUS	-	No function
	PWR	red	<ul style="list-style-type: none"> The LED lights up red when the sensor restarts or is in update mode. The LED lights up red in the event of a system-related malfunction.

2.5 Accessories

Model number	Description
LTGLÜT 24V 2xM12 Xm 8pol ROB	M12 plug, 8-pin, straight, to M12 socket, 8-pin, straight, A-coded, 360° shielding, self-locking screw connection, PUR cable, torsion-proof, shielded, halogen-free
V19SX-G-GN5M-PUR-ABG-V45-G	Bus cable, Ethernet, M12 plug, X-coded, 8-pin to RJ45, Ethernet-coded, 8-pin, PUR cable, green, Cat6A, shielded
V19-G-BK1.5M-PUR-U/ABG	Single-ended female cordset, M12, straight, A-coded, 8-pin, PUR cable, black, shielded, UL-approved

Additional accessories can be found online at www.pepperl-fuchs.com.

3 Installation

3.1 Storage and Disposal

Keep the original packaging. Always store and transport the device in the original packaging.

Store the device in a clean and dry environment. The permitted ambient conditions must be considered, see datasheet.

The device, built-in components, packaging, and any batteries contained within must be disposed in compliance with the applicable laws and guidelines of the respective country.

3.2 Preparation



Unpacking the Device

1. Check the packaging and contents for damage.
↳ In the event of damage, inform the shipping company and notify the supplier.
2. Check the package contents against your order and the shipping documents to ensure that all items are present and correct.
↳ Should you have any questions, direct them to Pepperl+Fuchs.
3. Retain the original packaging in case the device is to be stored or shipped again at a later date.

3.3 Sensing Range

The figures below show fields of view at different measuring distances. The values serve as a point of reference.

The maximum measuring distance of sensor VTE7500-F400-B12-A1500 is 7.5 m.

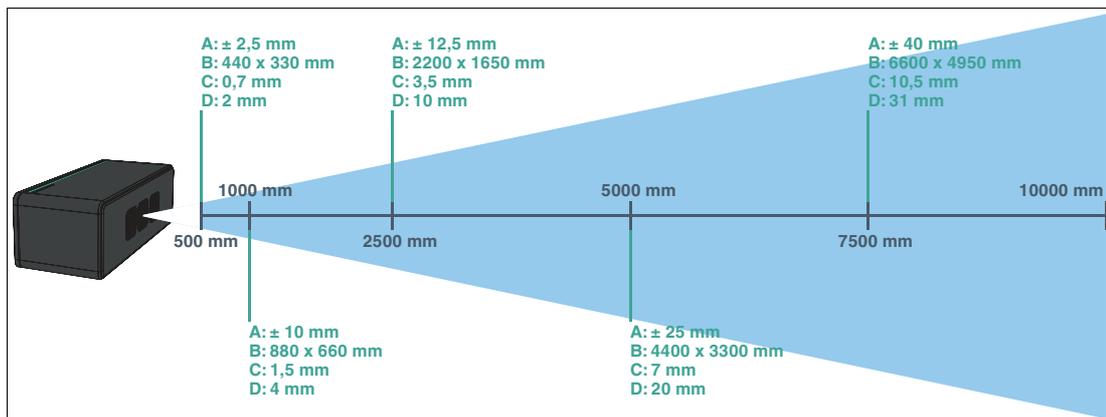


Figure 3.1 Sensing range - VTE7500-F400-B12-A1500

- A Depth resolution
- B Image window size x,y
- C Resolution x,y
- D Min. object size

Opening Angle

The opening angle of the 3-D measuring range on the vertical axis is 35°.

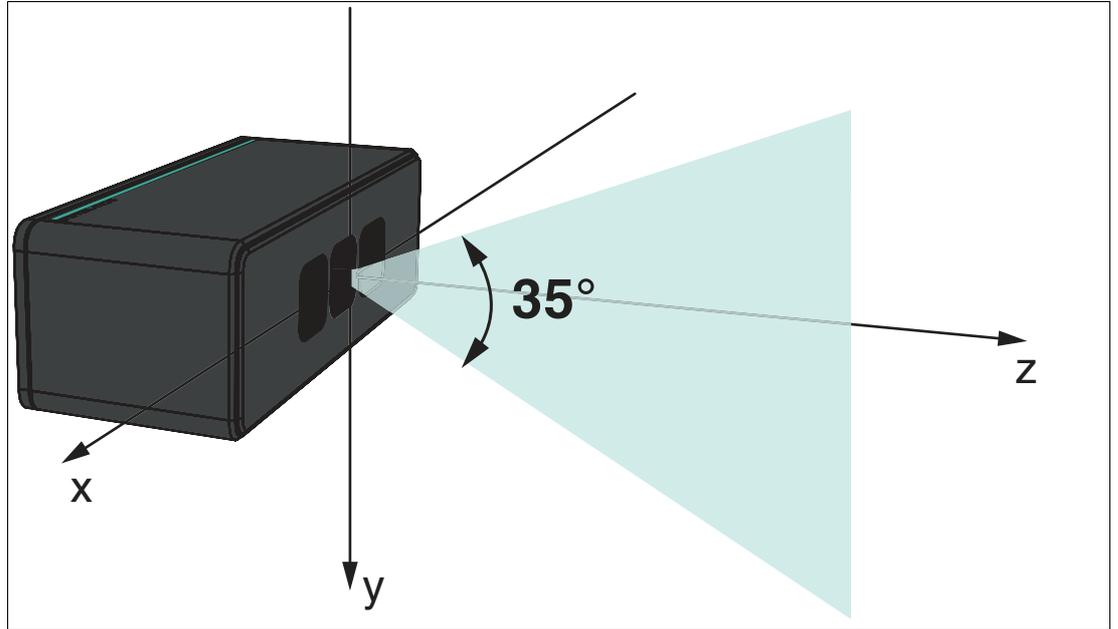


Figure 3.2 Vertical axis - VTE7500-F400-B12-A1500

The opening angle of the 3-D measuring range on the horizontal axis is 47°.

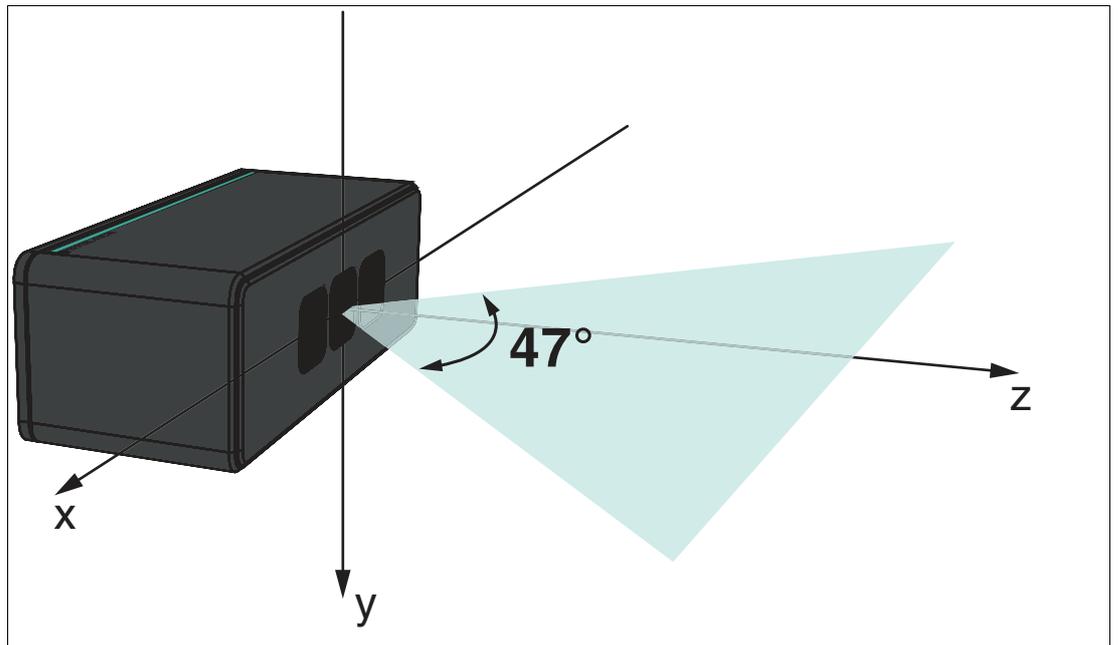


Figure 3.3 Horizontal axis - VTE7500-F400-B12-A1500

3.4 Error Factors

There are some influencing factors that can affect the measurement of the sensor and limit the measurement accuracy. You should consider these when planning your application.

Temperature

The temperature has a significant influence on the measurement behavior of the sensor.

- Noise in the sensor increases as the temperature increases.
- The sensor requires a stable temperature. Measurement accuracy varies with temperature fluctuations even if the total temperature is within the permissible range.
- The sensor requires a warm-up time to reach a stable operating temperature.
- Note the operating temperature range of $-20\text{ °C} \dots 45\text{ °C}$. Reliable operation of the camera can no longer be guaranteed in temperatures outside the operating temperature range.
- If the maximum permissible sensor temperature is exceeded, the frame rate is reduced.

Optimal heat sink must be ensured for proper functioning. Mount the sensor over as wide an area as possible on thermally conductive surfaces.

Ambient light

The measurement is based on the reflection of the light emitted by the sensor, so any additional light, such as artificial light sources and sunlight, may affect the measurement results. Avoid using the sensor in bright sunlight. Ensure that the sensor is protected from overexposure to ensure that the correct reflection is measured.

Scattered light

Reflections inside or behind the camera lens can produce scattered light. Scattered light is easily produced by bright surfaces in the immediate vicinity of the light source. Avoid placing objects in the scene that are not part of the planned shot. In particular, mirrors or other shiny surfaces/objects should be avoided in the capture area. Avoid placing the sensor flat in the middle of an area.

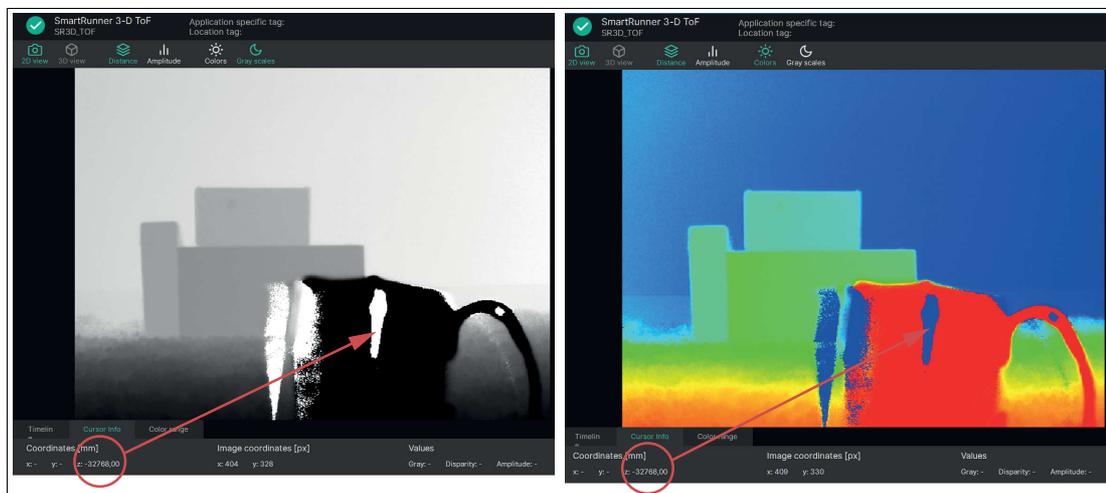


Figure 3.4 Shiny surfaces in the capture area

Multiple reflections

Accurate measurement data is only supplied reliably by light that is reflected once. Any light that is reflected several times by other objects in the field of view of the sensor or the surrounding area can distort the measurement. Square shapes (e.g., room corners) are especially problematic, because the light pulse can jump between the different surfaces. Mirrors and highly reflective surfaces, such as painted table tops, can cause multiple reflections or completely distract the light pulse.

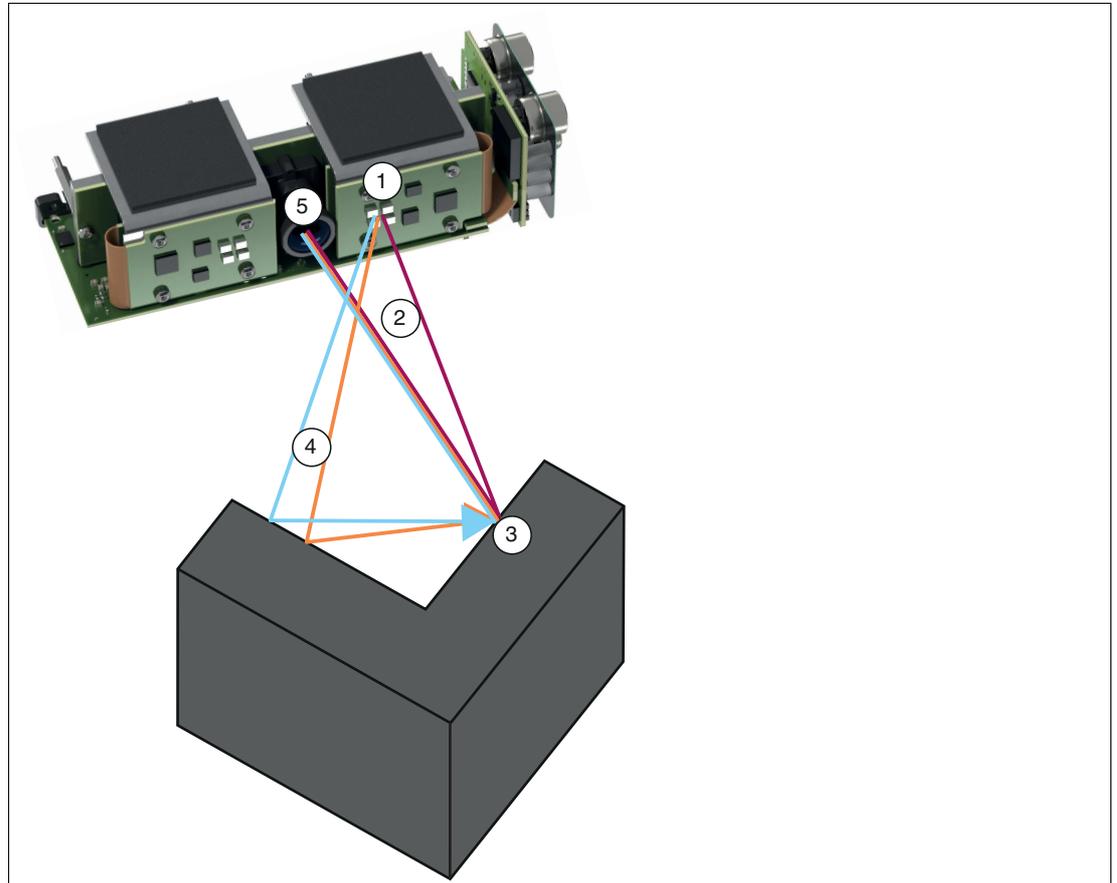


Figure 3.5 Multiple reflections (Multipath)

- 1 Light source
- 2 Light reflected once
- 3 Measurement object
- 4 Multiple reflections (Multipath)
- 5 Lens

Reflectance of measurement objects

The reflectance of the measurement object affects the accuracy of the measurement. The surface structure and the color of the measurement object play an important role in this.

With surface structure, a distinction is made between two types of reflection, diffuse reflection and mirroring reflection.

Diffuse reflection occurs in matt objects (e.g., paper or wood). The diffuse reflection in which the light pulses are reflected at all angles is uniform.

The mirroring reflection occurs in shiny and transparent materials (e.g., mirrors) and can lead to overexposure in direct reflection or to multiple reflections (multipath). Accurate measurement can be difficult with shiny or transparent materials.

With regard to the color of measurement objects, bright objects provide better results because they can generally reflect more light. Dark objects absorb a certain amount of light and therefore do not return to the sensor. For bright objects, the distance to the sensor plays an important role. Bright objects reflect so much light that they can become oversaturated when they are near the sensor. Once the pixels are oversaturated, they no longer contribute to distance measurement. As a result, the quality of the measurement decreases.

Ambiguous Range

The range of uniqueness, e.g., on the sensor VTE7500-F400-B12-A1500, is 1.5 m; 3.75 m, or 7.5 m, depending on the set distance mode. This means that the distances of objects measured in each area reflect the actual distance of the object. As a result, every 1.5 m, 3.75 m, or 7.5 m, depending on the selection, a new measurement interval begins at 0 m. E.g., if the "Range Mode" is set to 7.5 m and the object is 8.5 m away from the sensor, its distance is measured as 1 m.

Flying pixels

Flying pixels are produced by measuring points falling on corners and edges or by different object distances within a pixel. To avoid measuring errors at these points, use the Flying Pixel Filter (see chapter 6.2.2.5).



Figure 3.6 Examples of flying pixels

Sensor Configuration

The sensor has several parameters. The parameters are used to optimally set the sensor for its application. In addition to exposure time and frame rate, various filters influence the measurement result. The Setup Wizard is available to set the sensor to your application. This will guide you through all the steps necessary to set up the sensor step by step. See chapter 6.2.2.

3.5 Sensor Coordinate System

A coordinate system is located on the rear for orienting the sensor. The sensor operates in a right-handed coordinate system with the down y-axis.

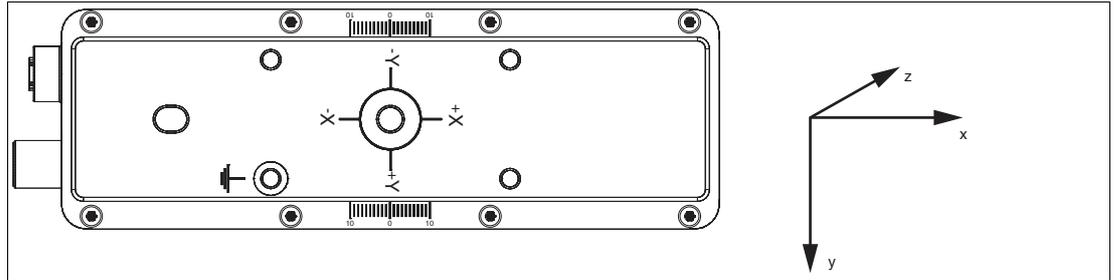


Figure 3.7 Sensor coordinate system

As shown on the back of the sensor, the origin of the coordinate system is defined by the following positions:

- The X and Y coordinates are 0 for the pixel in the center of the sensor
- The Z coordinate is 0 on the front of the sensor housing

3.6 Mounting



Note

Mounting the Sensor

To obtain reliable measurements, follow these instructions when mounting:

- Protect the sensor against direct and prolonged sunlight.
- Do not point the sensor into the sun.
- Prevent condensation from forming by ensuring that the sensor is not subjected to any major temperature fluctuations.
- Avoid placing objects in the scene that are not part of the target shot, especially mirrors or other shiny surfaces/objects.
- Avoid placing the sensor flat in the middle of a surface.
- Keep the glass on the device clean. Use soft cloths and standard glass cleaner to clean the device if necessary.
- Maintain a stable housing temperature during operation.
- Secure the sensor.

We recommend that the optical surfaces are cleaned, and that screws and electrical connections are checked at regular intervals.

The surface must be level to prevent the housing from becoming misaligned when the fittings are tightened. Ensure that there is still sufficient space to connect the connection cable to the sensor once the sensor is mounted.



Caution!

Damage to the equipment caused by improper mounting!

Device components can be damaged if the permissible screw-in depth and the maximum permissible tightening torque is exceeded.

Note that the threads on the bottom of the housing are not thru-holes.

Observe the maximum permissible screw-in depth to avoid damaging the device or mounting it incorrectly.

Never exceed the maximum permissible tightening speed for the fixing screws. The maximum tightening torque of the mounting screws must not exceed 2 Nm.



Note

Positioning the Sensor

The sensor has two reference holes on the back of the housing with a diameter of 6 mm and a depth of 3.5 mm. One of these holes is located exactly in the center of the sensor. The other hole is designed as a slot to prevent over-specification.



Mounting the sensor

The sensor includes 4 M5 threads on the back of the housing to ensure easy and stable mounting in your installation.

1. Place the sensor carefully in the required position in your installation. Ensure that the M5 threaded bushes on the sensor are correctly aligned with the corresponding holes or threaded holes on the installation.
2. Screw in the M5 screws clockwise by hand to ensure that they engage with the threads.



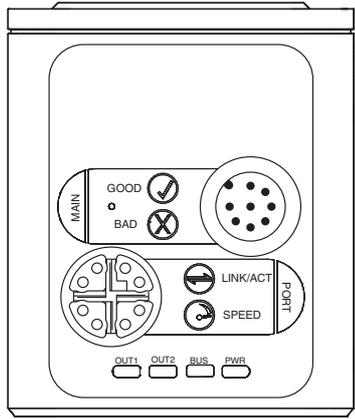
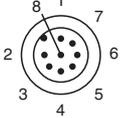
Note

One of the four fixing screws is not anodised, so it can be used to earth the device.

3. Use the screwdriver to tighten the M5 screws. Make sure not to overtighten the screws to avoid damaging the thread or the sensor. The maximum torque is 2 Nm.
4. Finally, check that the sensor is securely mounted to your installation. Make sure there is no loose connection or play.

3.7 Power Source

Connection Assignment

	MAIN	
	M12 plug, A-coded, 8-pin	
		<ul style="list-style-type: none"> 1. IN trigger 2. + UB 3. nc 4. nc 5. nc 6. nc 7. GND 8. nc
	PORT	
M12 socket, X-coded, 8-pin		
		<ul style="list-style-type: none"> 1. MDX0+ 2. MDX0- 3. MDX1+ 4. MDX1- 5. MDX3+ 6. MDX3- 7. MDX2+ 8. MDX2-



Connecting the Supply Voltage

The sensor is connected electrically via a **MAIN** 8-pin M12 connector plug on the front of the housing. The power is supplied via this connection. To connect the sensor, proceed as follows:

1. Plug the M12 8-pin socket into the plug on the front of the housing.
2. Screw the union nut onto the connector until it reaches the end stop. This ensures that the power cable cannot be pulled out inadvertently.



Note

It may take several minutes for the sensor to reach a stable operating temperature. Otherwise, it may result in measurement errors.

3.8 Setting up Windows Network Communication Between the Sensor and a PC/Laptop

When delivered, the sensor has a fixed IP address **192.168.2.4** and subnet mask **255.255.255.0**. To enable communication within the network, the network settings of your PC/laptop must be synchronized with the sensor and may need to be adjusted. To do so, proceed as follows:



Note

Due to the large amount of data supplied by the sensor per second, the sensor(s) must be connected to the PC via a Gigabit Ethernet network without any other interfering data traffic.



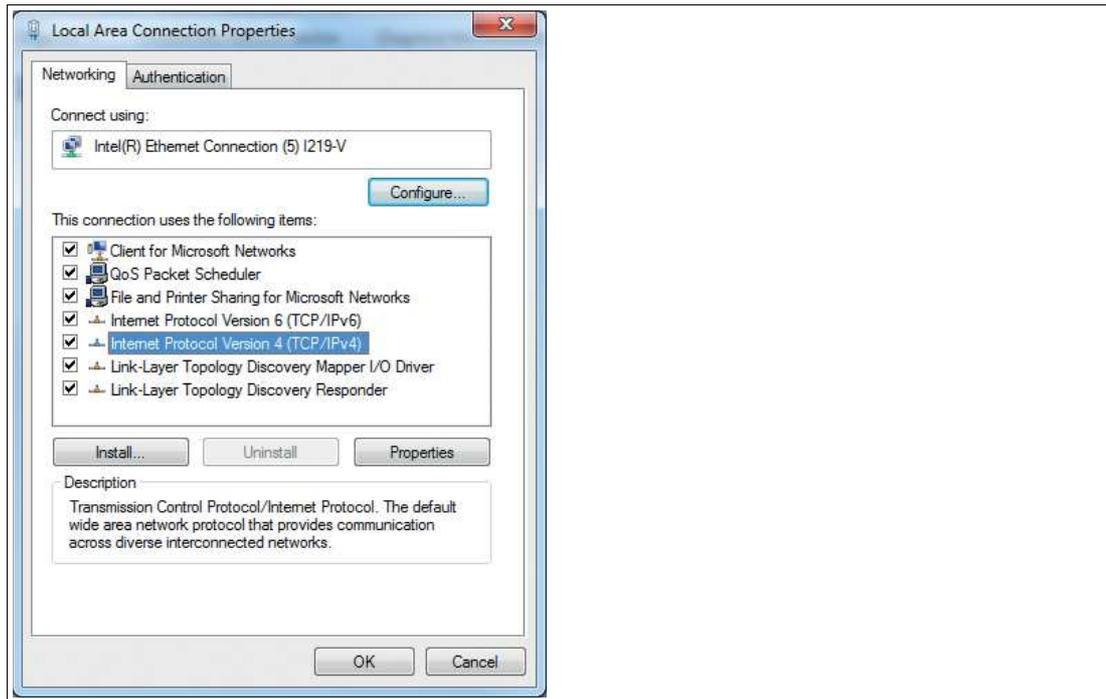
Setting the IP Address

The following section describes how to check the network connection settings of your Windows PC and adapt them accordingly. The illustrations in this description were created using Windows 10. The description below also applies to later versions of Windows.

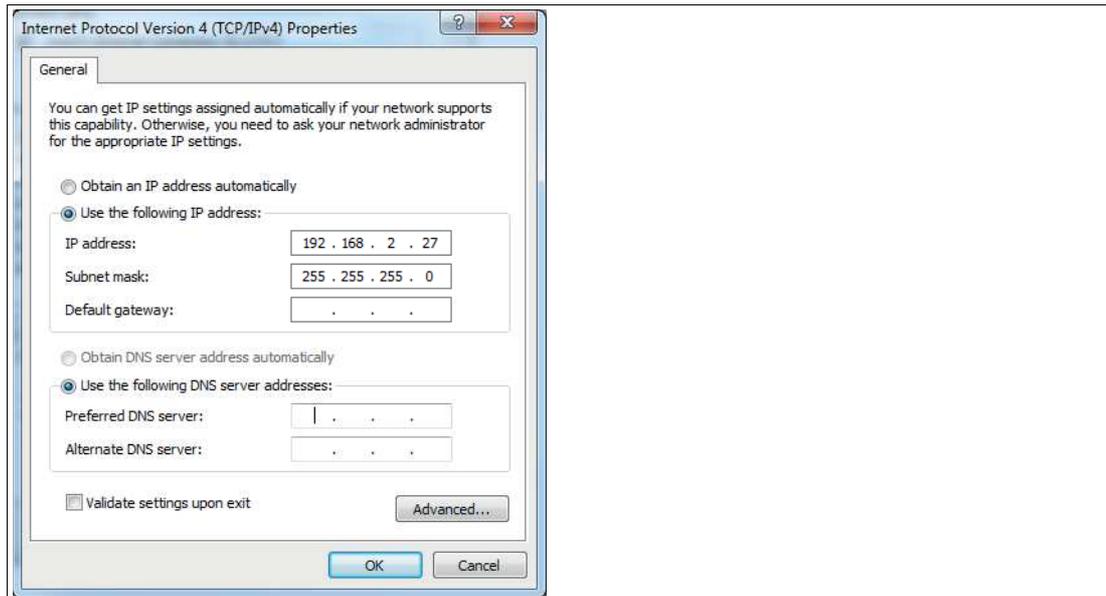
1. Click the Windows **"Start"** button.
2. Select **"Control Panel > Network and Sharing Center."**
3. In the left window range, click **"Change adapter settings."**
4. Select the required connection and right-click on your selection. In the selection window, select **Properties**.



5. Double-click **"Internet Protocol Version 4 (TCP/IPv4)."**



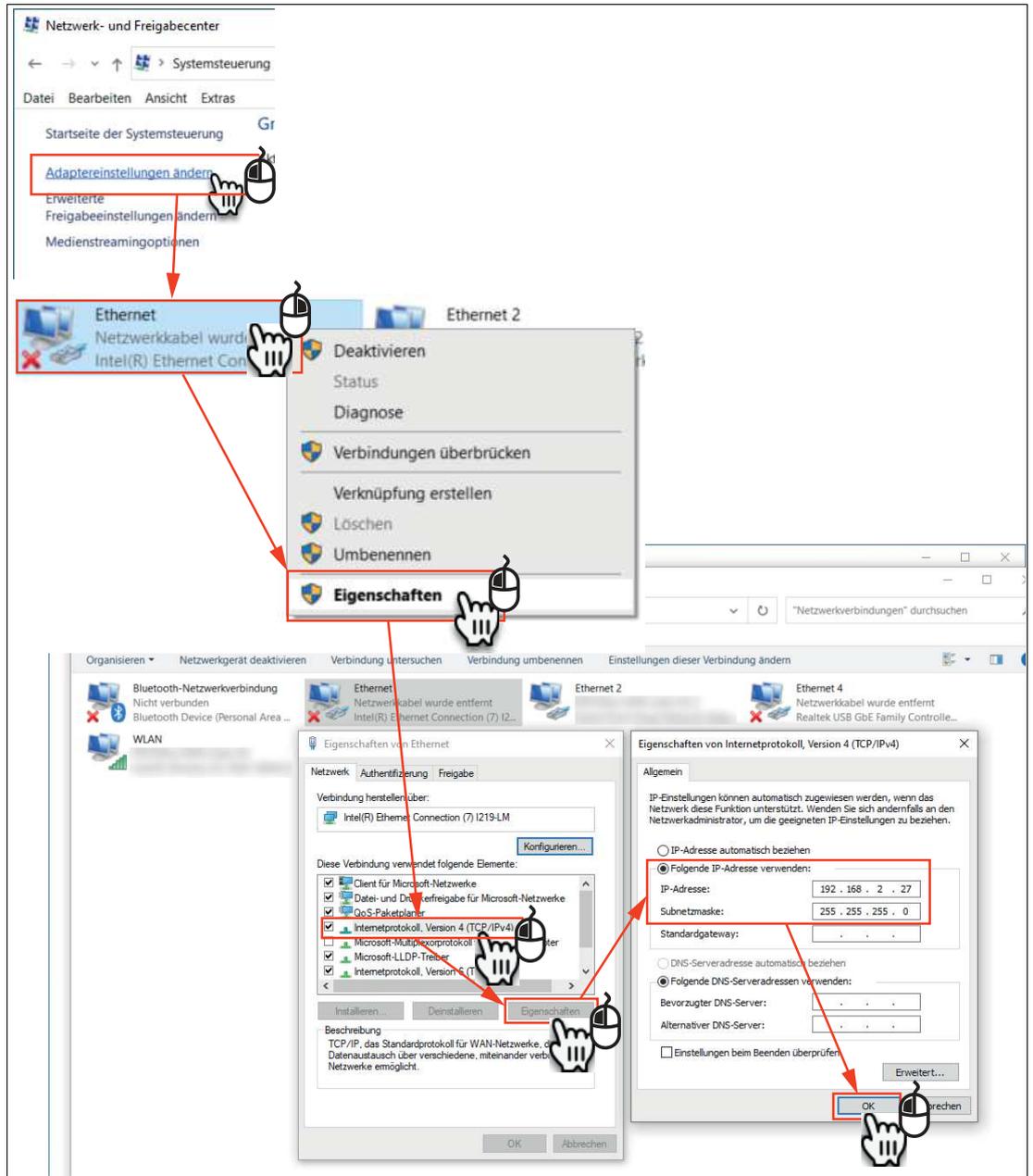
↳ The **Properties** window for the TCP/IP protocol opens.



6. Select the **"General"** tab.
7. Select the input function **"Use the following IP address."**
8. Enter the IP address of the sensor, but only the first three segments of the IP address. The last segment must be different from the IP address of the sensor. S
9. In this example, enter the following IP address and subnet mask:
 - **IP address: 192.168.2.27**
 - **Subnet mask: 255.255.255.0**
10. Click **OK** and click **Cancel** in the next dialog.

↳ This completes the network configuration so that the device can be used.

Quick Overview—Assign a Fixed IP Address



Note

Changes to the network settings of the PC/laptop require advanced user rights. If necessary, consult with your administrator.

4 Commissioning

Overview of the commissioning steps:

1. Set offset to object, see chapter 3.3.
2. Note the influencing factors that can affect the measurement, see chapter 3.4.
3. Optimize the orientation, see chapter 3.5.
4. Mount the sensor, see chapter 3.6.
5. Perform the electrical connection, see chapter 3.7.
6. Set up Windows network communication between the sensor and a PC/laptop, see chapter 3.8.
7. Parameterize the sensor using the ViSolution configuration software, see chapter 6.

5 Configuration

5.1 Parameters

Before the sensor can be used in the system, it must be parameterized. The parameters used for the sensor are listed below. Refer to the ViSolution operating software see chapter 6.2.3.1 for additional parameters.

AcquisitionControl

Provides parameters associated with image capture, trigger control, and exposure time control. This includes:

Parameter name	Data type	read (r)/ write (w) ¹	enum values / default string value	Description
Trigger Enable	bool	r/w	-	-
Autotrigger Frame Rate	float	r/w	-	Controls the acquisition rate (in hertz) at which the images are acquired. Frame rate in Hz (Autotrigger)
Exposure Time	float	r/w	-	Sets the exposure time (in ms)
Trigger Software	command	-/w	-	Generates an internal trigger.
Trigger Source	enum	r/w	Software, Line1, Auto Trigger	Specifies the internal signal or physical input line to be used as the trigger source.
Trigger Activation	enum	r/w	Falling Edge, Rising Edge	Specifies the trigger activation mode.

1. The "read (r)/write (w)" column indicates whether the feature is readable ("r"), writable ("w"), or both ("r/w").

Proprietary Parameters

Contains parameters relating to control and to general information about the sensor. These are used to identify the sensor during the enumeration process and to obtain information about the sensor resolution. Additional information and controls that affect the general status of the sensor are also included in this category.

Feature name	Data type	read (r)/ write (w) ¹	enum values / default string value	Description
Range Mode	enum	r/w	1.5 m; 3.75 m; 7.5 m	Sensing Range
Binning	enum	r/w	Off, 2x2, 4x4	Combine pixels
Output Data Format	enum	r/w	Calibrated ABC Grid, Calibrated ABC Grid + Amplitude, Calibrated C, Calibrated C + Amplitude, Distance + Amplitude, Distance	Specifies the content for the output data
Camera Mode	enum		Standard, HighDynamic, FastMovement	Camera mode

1. The "read (r)/write (w)" column indicates whether the feature is readable ("r"), writable ("w"), or both ("r/w").

5.2 VsxProtocolDriver

General

VsxProtocolDriver is the driver used to support the creation of a graphical user interface for sensors that use the VSX protocol. The driver connects to the sensor and handles the communication in accordance with the communication protocol. The user can access functions for setting parameters on the sensor, retrieving parameter values from the sensor, and saving and loading entire parameter sets both locally and on the sensor. The user can also receive sensor images. Each function also contains an error object from which information can be obtained in the event of an error in the function.

The driver is implemented in C# and requires .NET Standard 2.0 or higher.

The functions of the driver can be used **synchronously** or **asynchronously**. For this, the required instance must be created using the Init function.

Asynchronous

```
VsxProtocolDriver _asyncVsxDriver = VsxProtocolDriver.Init(string
serialPort, int baudrate, string sensorType, TheSensor.ConnectionType
connectionType, string pluginName = "");
```

Synchronous

```
VsxProtocolDriverSync _syncVsxDriver =
VsxProtocolDriverSync.Init(string serialPort, int baudrate, string
sensorType, TheSensor.ConnectionType connectionType, string
pluginName = "");
```

Synchronous and Asynchronous Functions

The auxiliary classes used in the parameters are described below.

Static Functions

List of All VSX Devices via UDP Broadcast

```
public static async Task<(bool Succ, List<Device> DeviceList, Error
ErrorDesc)> UdpDeviceList()
public static (bool Succ, List<Device> DeviceList, Error ErrorDesc)
UdpDeviceList()
```

The function returns a list of the Vsx devices that are found on the network via UDP broadcast.
Possible error IDs: VSX_DRIVER_CONNECTION_ERROR

Adjust Network Setting via UDP Broadcast

```
public static async Task<(bool Succ, Error ErrorDesc)> SetNetwork-
SettingsViaUdp(string macAddress, string ipAddress, string network-
Mask, string gateway)
public static (bool Succ, Error ErrorDesc) SetNetworkSettingsVi-
aUdp(string macAddress, string ipAddress, string networkMask, string
gateway)
```

The function changes the network settings on the sensor via UDP.
Possible error IDs: None

New Driver Instance for TCP/IP

```
public static VsxProtocolDriver Init(string ipAddress, int port =
VSXPORT, string pluginName = "")
public static VsxProtocolDriverSync Init(string ipAddress, int port
=VSXPORT, string pluginName = "")
```

Initializes a new driver instance that can be used to communicate with the device via TCP/IP. While the IP address must be specified, the default VSXPORT = 50005 can be used.
Possible error IDs: None

New Driver Instance, Serial

```
public static VsxProtocolDriver Init(string serialPort, int baudrate, string sensorType, TheSensor.ConnectionType connectionType, string pluginName = "")
public static VsxProtocolDriverSync Init(string serialPort, int baudrate, string sensorType, TheSensor.ConnectionType connectionType, string pluginName = "")
```

Initializes a new driver instance that allows serial communication with the device.
Possible error IDs: None

Send the Contents of a File

```
public static bool Succ, Error ErrorDesc) UploadData(string filename)
public static bool Succ, Error ErrorDesc) UploadData(string filename)
```

Sends the contents of a file, which may be either image data or a DynamicContainer, to the device.
Possible error IDs: VSX_DRIVER_LOAD_FILE_ERROR

IVsxMessage

```
public static (bool Succ, Error ErrorDesc) SaveData(string filename, IVsxMessage message)
public static (bool Succ, Error ErrorDesc) SaveData(string filename, IVsxMessage message)
```

Saves an IVsxMessage under the specified file name.
Possible error IDs: VSX_DRIVER_DATA_ERROR, VSX_DRIVER_INVALID_DATA_ERROR, VSX_DRIVER_SAVE_FILE_ERROR

Point Cloud File

```
public static (bool Succ, Error ErrorDesc) Save3DPointCloudData(string filename, VsxImageData2Message x, VsxImageData2Message y, VsxImageData2Message z)
public static (bool Succ, Error ErrorDesc) Save3DPointCloudData(string filename, VsxImageData2Message x, VsxImageData2Message y, VsxImageData2Message z)
```

Saves a point cloud file consisting of levels x, y, and z under the specified file name.
Possible error IDs: VSX_DRIVER_DATA_ERROR, VSX_DRIVER_SAVE_FILE_ERROR

Non-Static Functions**Establish a Connection**

```
public async Task<(bool Succ, Error ErrorDesc)> Connect(int timeout = CONNECTION_TIMEOUT_MS)
public (bool Succ, Error ErrorDesc) Connect(int timeout = VsxProtocolDriver.CONNECTION_TIMEOUT_MS)
```

Establishes a connection to the device using the parameters set using Init. CONNECTION_TIMEOUT_MS = 1000 can be used as the timeout for opening the connection. A connection to the device must be established to use all non-static functions.
Possible error IDs: VSX_DRIVER_CONNECTION_ERROR

Disconnecting

```
public async Task<(bool Succ, Error ErrorDesc)> Disconnect()
public (bool Succ, Error ErrorDesc) Disconnect()
```

Disconnects from the device.
Possible error IDs: None

Re-establish a Connection

```
public async Task<(bool Succ, Error ErrorDesc)> ReConnect(string
ipAddress, int port = VSXPORT)
public (bool Succ, Error ErrorDesc) ReConnect(string ipAddress, int
port = VSXPORT)
public async Task<(bool Succ, Error ErrorDesc)> ReConnect(string
serialPort, int baudrate, TheSensor.ConnectionType connectionType)
public (bool Succ, Error ErrorDesc) ReConnect(string serialPort, int
baudrate, TheSensor.ConnectionType connectionType)
```

Disconnects the device and re-establishes the connection using the transferred parameters. These functions can be used if the connection parameters need to be changed at runtime.
Possible error IDs: VSX_DRIVER_CONNECTION_ERROR

Device Information

```
public async Task<(bool Succ, Device CurrentDevice, Error Error-
Desc)> GetCurrentDeviceInformation()
public (bool Succ, Device CurrentDevice, Error ErrorDesc) GetCur-
rentDeviceInformation()
```

Returns information about the device.
Possible error IDs: VSX_DRIVER_CONNECTION_ERROR

Device Features

```
public async Task<(bool Succ, float XmlVersion, Hashtable Feature-
List, Error ErrorDesc)> GetFeatureList()
public (bool Succ, float XmlVersion, Hashtable FeatureList, Error
ErrorDesc) GetFeatureList()
```

Returns the list of features available on the device.
Possible error IDs: VSX_DRIVER_CONNECTION_ERROR

Device Parameters

```
public async Task<(bool Succ, List<Parameter> ParameterList, Error
ErrorDesc)> GetParameterList()
public (bool Succ, List<Parameter> ParameterList, Error ErrorDesc)
GetParameterList()
```

Returns a list of all parameters available on the device, including detailed information and their current values.
Possible error IDs: VSX_DRIVER_GENERAL_ERROR, VSX_DRIVER_DATA_ERROR, VSX_DRIVER_CONNECTION_ERROR

Return the Value of a Single Device Parameter

```
public async Task<(bool Succ, object parameterValue, Error Error-
Desc)> GetSingleParameterValue(Parameter parameter)
public async Task<(bool Succ, object parameterValue, Error Error-
Desc)> GetSingleParameterValue(string parameterId)
public async Task<(bool Succ, object parameterValue, Error Error-
Desc)> GetSingleParameterValue(ushort settingsVersion, ushort con-
figVersion, string configId, string parameterId)
public (bool Succ, object parameterValue, Error ErrorDesc) GetSin-
gleParameterValue(Parameter parameter)
public (bool Succ, object parameterValue, Error ErrorDesc) GetSin-
gleParameterValue(string parameterId)
public (bool Succ, object parameterValue, Error ErrorDesc) GetSin-
gleParameterValue(ushort settingsVersion, ushort configVersion,
string configId, string parameterId)
```

Returns the value of an individual parameter of the device. This can be defined via a parameter object that can be obtained, for example, from the list for the "GetParameterList" function. Alternatively, it is uniquely defined by its version and IDs. A shortened version of this accepts only the "ParameterId." This version can be used if the "ParameterId" of the desired parameter is unique across the device.

Possible error IDs: VSX_DRIVER_CONNECTION_ERROR, VSX_DRIVER_DATA_ERROR

Set the Value of a Single Device Parameter

```
public async Task<(bool Succ, Error ErrorDesc)> SetSingleParameter-
Value(Parameter parameter, object value)
public async Task<(bool Succ, Error ErrorDesc)> SetSingleParameter-
Value(string parameterId, object value)
public async Task<(bool Succ, Error ErrorDesc)> SetSingleParameter-
Value(ushort settingsVersion, ushort configVersion, string configId,
string parameterId, object value)
public (bool Succ, Error ErrorDesc) SetSingleParameterValue(Parame-
ter parameter, object value)
public (bool Succ, Error ErrorDesc) SetSingleParameterValue(string
parameterId, object value)
public (bool Succ, Error ErrorDesc) SetSingleParameterValue(ushort
settingsVersion, ushort configVersion, string configId, string
parameterId, object value)
```

Sets the value of a single parameter on the device. The parameter is defined by transferring the function parameters in the same way as for the GetSingleParameterValue function (see description for this function). In addition, the desired value is transferred.

Possible error IDs: VSX_DRIVER_CONNECTION_ERROR, VSX_DRIVER_DATA_ERROR

Change Network Settings

```
public async Task<(bool Succ, Error ErrorDesc)> SetNetworkSet-
tings(string ipAddress, string networkMask, string gateway)
public (bool Succ, Error ErrorDesc) SetNetworkSettings(string ipAd-
dress, string networkMask, string gateway)
```

Changes the network settings on the device. The connection to the device is disconnected and must be re-established using the "Connect" function.

Possible error IDs: VSX_DRIVER_CONNECTION_ERROR

Send the Firmware File

```
public async Task<(bool Succ, Error ErrorDesc)> SendFirmware(string
fileName)
public (bool Succ, Error ErrorDesc) SendFirmware(string fileName)
```

Sends the firmware file to the device under the specified path and file name. The current status can be read out via "Firmware StateChannelReader" while the update is in progress.

Possible error IDs: VSX_DRIVER_CONNECTION_ERROR, VSX_DRIVER_DEVICE_ER-
ROR

Read and Save the Parameter Set

```
public async Task<(bool Succ, Error ErrorDesc)> DownloadParameterSet(string destinationFileName)
public (bool Succ, Error ErrorDesc) DownloadParameterSet(string destinationFileName)
```

Reads the current parameter set from the device and saves it under the specified path and file name.

Possible error IDs: VSX_DRIVER_SAVE_FILE_ERROR

Load Parameter Set

```
public async Task<(bool Succ, Error ErrorDesc)> UploadParameterSet(string sourceFileName)
public async Task<(bool Succ, Error ErrorDesc)> UploadParameterSet(List<Parameter> parameterSet)
public (bool Succ, Error ErrorDesc) UploadParameterSet(string sourceFileName)
public (bool Succ, Error ErrorDesc) UploadParameterSet(List<Parameter> parameterSet)
```

Loads a parameter set stored under the specified path and file name and sends it to the device. Optionally, you can transfer a list of all parameters, which must be complete.

Possible error IDs: VSX_DRIVER_CONNECTION_ERROR

Save Parameter Settings

```
public async Task<(bool Succ, Error ErrorDesc)> SaveParameterSetOnDevice()
public (bool Succ, Error ErrorDesc) SaveParameterSetOnDevice()
```

Saves the current parameter settings on the device. The set values are then set each time the device is started.

Possible error IDs: VSX_DRIVER_CONNECTION_ERROR

Load Parameter Settings

```
public async Task<(bool Succ, List<Parameter> ParameterList, Error ErrorDesc)> LoadParameterSetOnDevice()
public (bool Succ, List<Parameter> ParameterList, Error ErrorDesc) LoadParameterSetOnDevice()
```

Loads the parameter settings saved via "SaveParametersetOnDevice()" on the device. The parameters then have the previously saved values. A current parameter list is returned.

Possible error IDs: VSX_DRIVER_GENERAL_ERROR, VSX_DRIVER_DATA_ERROR, VSX_DRIVER_CONNECTION_ERROR

Load Factory Settings

```
public async Task<(bool Succ, List<Parameter> ParameterList, Error ErrorDesc)> LoadDefaultParameterSetFromDevice()
public (bool Succ, List<Parameter> ParameterList, Error ErrorDesc) LoadDefaultParameterSetFromDevice()
```

Loads the factory settings of all parameters on the device. A current parameter list is returned.

Possible error IDs: VSX_DRIVER_GENERAL_ERROR, VSX_DRIVER_DATA_ERROR, VSX_DRIVER_CONNECTION_ERROR

Grabbing of Sensor Data

```
public void ResetDynamicContainerGrabber(int bufferSize, int startCondition = -1, Strategy strategy = Strategy.DROP_OLDEST)
public void ResetDynamicContainerGrabber(int numberOfItems, int startCondition = -1, Strategy strategy = Strategy.DROP_OLDEST)
```

Restarts the grabbing of sensor data. The sensor data for each trigger is packaged in `VsxDynamicContainer`. The data can be called up with the `GetDynamicContainer` function. For more details, see the container description. The "bufferSize" specifies how many containers can be buffered by the driver, the "startCondition" specifies the container from which buffering should be performed, and the "strategy" determines what should happen if the buffer is full. `DROP_OLDEST` indicates that the oldest container currently stored is discarded, while `DROP_WRITE` means the latest container received is discarded.
Possible error IDs: None

Output of the Oldest Buffered "DynamicContainer"

```
public async Task<(bool Succ, IVsxDynamicContainer Container, int NumberOfDiscardedItems, Error ErrorDesc)> GetDynamicContainer(int timeoutMs = Timeout.Infinite)
public (bool Succ, IVsxDynamicContainer Container, int NumberOfDiscardedItems, Error ErrorDesc) GetDynamicContainer(int timeoutMs = Timeout.Infinite)
```

Returns the oldest buffered "DynamicContainer" (see "ResetDynamicContainerGrabber"). "timeoutMs" specifies the time in ms for which an attempt is made to read a container from the buffer. If no container is present during this time, the function returns an error.
Possible error IDs: `VSX_DRIVER_INIT_ERROR`, `VSX_DRIVER_TIMEOUT_ERROR`

Grabbing Log Data

```
public void ResetLogMessageGrabber(int bufferSize, int typeMask, Strategy strategy = Strategy.DROP_OLDEST)
public void ResetLogMessageGrabber(int bufferSize, int typeMask, Strategy strategy = Strategy.DROP_OLDEST)
```

Restarts the grabbing of log data. The log data can be called up with the "GetLogMessage" function. The "bufferSize" specifies how many log data messages can be buffered by the driver. The "typeMask" specifies which log data types should be transferred from the device, and the "strategy" specifies what should happen when the buffer is full. "DROP_OLDEST" indicates that the oldest log message currently stored is discarded, while "DROP_WRITE" means the latest log message received is discarded.
Possible error IDs: None

Output of the Oldest Buffered "LogMessage"

```
public async Task<(bool Succ, VsxLogMessage LogMessage, int NumberOfDiscardedItems, Error ErrorDesc)> GetLogMessage(int timeoutMs = Timeout.Infinite)
public (bool Succ, VsxLogMessage LogMessage, int NumberOfDiscardedItems, Error ErrorDesc) GetLogMessage(int timeoutMs = Timeout.Infinite)
```

Returns the oldest buffered "LogMessage" (see "ResetLogMessageGrabber"). "timeoutMs" specifies the time in ms for which an attempt is made to read a log message from the buffer. If no log message is present during this time, the function returns with an error.
Possible error IDs: `VSX_DRIVER_INIT_ERROR`, `VSX_DRIVER_TIMEOUT_ERROR`

Special Asynchronous Functions

Information about Firmware Updates

```
public ChannelReader<FirmwareState> FirmwareStateChannelReader
```

Can be read out asynchronously and contains information about the current status during a firmware update.

Properties

Connection Status

```
public bool Connected { get; }
```

Indicates the connection status.

Timeout

```
public int WaitTimeout { get; set; }
```

Timeout in ms. This indicates how long the device will wait for a response to its request. Depending on the connection type, the default value is "DEFAULT_ETHERNET_TIMEOUT_MS" or "DEFAULT_SERIAL_TIMEOUT_MS."

Number of Discarded "DynamicContainer" or "LogMessages"

```
public int MissingContainerFramesCounter { get; }
public int MissingLogMessagesCounter { get; }
```

Specifies the number of "DynamicContainer" or "LogMessages" discarded since the last reset grabber, once there was no more space in the buffer.

Number of Buffered "DynamicContainer" or "LogMessages"

```
public int DynamicContainerQueueSize { get; }
public int LogMessageQueueSize { get; }
```

Specifies how many dynamic containers or log messages can be buffered by the driver.

Indication of Containers or Log Messages to Be Discarded

```
public Strategy DynamicContainerGrabberStrategy { get; }
public Strategy LogMessageGrabberStrategy { get; }
```

Specifies which containers or log messages should be discarded if the buffer is full. "DROP_OLDEST" discards the oldest stored container or log message, while "DROP_WRITE" discards the most recent one received.

Events

Loss of Connection

```
public event Action<string, string> OnDisconnect
```

Triggered as soon as the driver detects a loss of connection to the device. The parameters are the IP of the previously connected device and a message indicating why the connection was lost. This event is only triggered if a TCP/IP connection is used.

Auxiliary Classes

Device

```
public string PhysicalAddress;
public int PhysicalPort;
public string IpAddress;
public string NetworkMask;
public string Gateway;
public string MacAddress;
public string Identifier;
public string FirmwareVersion;
public string SensorType;
```

Contains information about the currently connected device.

Error

```
public ErrorId Id;
public string Tag;
public string Message;
```

Contains information about an error that has occurred.

Possible Error IDs

```
VSX_DRIVER_NO_ERROR = 0x0,
VSX_DRIVER_INIT_ERROR = -0x1,
VSX_DRIVER_TIMEOUT_ERROR = -0x2,
VSX_DRIVER_SAVE_FILE_ERROR = -0x3,
VSX_DRIVER_DATA_ERROR = -0x4,
VSX_DRIVER_CONNECTION_ERROR = -0x5,
VSX_DRIVER_INVALID_DATA_ERROR = -0x6,
VSX_DRIVER_DEVICE_ERROR = -0x7,
VSX_DRIVER_GENERAL_ERROR = -0x1000
```

Parameters

```
ushort settingsVersion;
ushort configVersion;
string configId;
string parameterId;
string name;
Vsx.ParameterTypes type;
Vsx.ValueTypes valueType;
bool enable;
bool visible;
object min;
object max;
string userLevel;
object value;
object defaultValue;
string unit;
List<ItemTuple> items;
```

Contains information about a device parameter. Important properties here are the details of the version and IDs, which are required for setting a parameter. Another property is "Value," which provides the current value of the parameter. Not every property is used for every parameter.

FirmwareState

```
public int Id;
public string Tag;
public string Message;
```

Contains information about the current status of a firmware update that is running.

VsxDynamicContainerMessage : IVsxMessage

```
public bool ContainsMessage(string tag)
public IVsxMessage GetMessage(string tag)
```

Contains a list of "IVsxMessages," which in turn contain data sent by the device. The contained messages are identified in the list using a string. The possible messages are device-specific.

VsxImageData2Message : IVsxMessage

```
public ImageData2Format;
public int Width;
public int Height;
public int LinePitch;
public long FrameCounter;
public double CoordinateScale;
public double CoordinateOffset;
public double AxisMin;
public double AxisMax;
public double InvalidDataValue;
public byte[] ImageData;
public float[] ImageDataFloats;
```

Contains image data of a specific image. Depending on whether the individual image values are bytes or floats, they are stored in the respective "ImageData" or "ImageDataFloats" array.

VsxDisparityDescriptorMessage : IVsxMessage

```
public double FocalLength;
public double PrincipalPointU;
public double PrincipalPointV;
public double Baseline;
```

VsxTransformationMessage : IVsxMessage

```
public double TranslationTX;
public double TranslationTY;
public double TranslationTZ;
public double QuaternionQ0;
public double QuaternionQ1;
public double QuaternionQ2;
public double QuaternionQ3;
```

SmartRunner 3-D

A "DynamicContainer" received by the SmartRunner 3-D can contain the following messages:

TagName	Type	Status	Description
"DisparityC"	ImageDa- ta2[Coord3D_C16]	Optional	Disparity map (1)
"DisparityDesc"	DisparityDescriptor	Optional	Needed by Disparity map (1)
"CalibratedA" ¹	ImageDa- ta2[Coord3D_A16]	Optional	X layer of calibrated grid
"CalibratedB" ²	ImageDa- ta2[Coord3D_B16]	Optional	Y layer of calibrated grid
"CalibratedC" ³	ImageDa- ta2[Coord3D_C16]	Optional	Z layer of calibrated grid
"Transformation"	Transformation	Optional	Transformation of XYZ
"Confidence"	ImageData2[Confi- dence8]	Optional	Confidence map (2)

1. The three layers "CalibratedA," "CalibratedB," and "CalibratedC" are sent on the device side. The "ProcessDevice-Data" function calculates the respective level of the "PointCloud."
2. The three layers "CalibratedA," "CalibratedB," and "CalibratedC" are sent on the device side. The "ProcessDevice-Data" function calculates the respective level of the "PointCloud."
3. The three layers "CalibratedA," "CalibratedB," and "CalibratedC" are sent on the device side. The "ProcessDevice-Data" function calculates the respective level of the "PointCloud."

6 Operation with ViSolution

The "ViSolution" software can be used to configure sensor parameters and evaluate measurement results. The software is also very helpful when mounting the sensor, for adjusting camera parameters such as the exposure time.

The user interface offers various options for displaying the measurement results. You can also save measurement results to a file for later use. You can change the settings for the sensor and immediately see how the changes affect the measurement result. The user interface is therefore useful for determining the best parameter settings for a particular application.

After the sensor has been set up to provide measurement data, the settings can be saved to a parameter file on the PC.

To do this, you must have the **ViSolution** configuration software installed on your PC/laptop. This configuration software for a PC/laptop can be downloaded free of charge from www.pepperl-fuchs.com.

6.1 Establishing a Connection to the Sensor

After starting the ViSolution software, the following "Device overview" window is displayed:

Device Overview

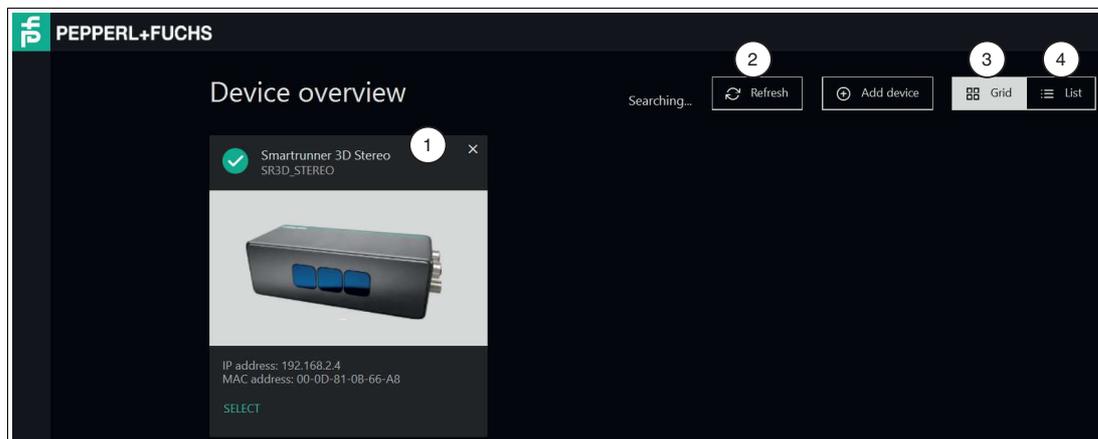


Figure 6.1 Device overview

Item	Designation	Function
1	Device overview	All identified sensors are displayed here. You will also receive information about the sensor. <ul style="list-style-type: none"> Name of the sensor Sensor type IP address of the sensor MAC address of the sensor SELECT is highlighted in green for sensors to which a connection can be established; if no connection can be established, SELECT is grayed out. If the list contains multiple sensors, you can use the SELECT button to select the sensor that you wish to connect to.
2	Refresh	You can use the "Refresh" button to start a sensor search.
3	Grid	You can use the "Grid" button to change the way the sensors found are displayed. If you select "Grid," the sensors found are displayed as tiles.
4	List	You can use the "List" button to change the way the sensors found are displayed. If you select "List," the sensors found are displayed in a list.



Selecting a Sensor

1. Click the button highlighted in green **SELECT** for the sensor that has been found.
↳ A connection to the sensor is established. The main screen of the software opens.
If your sensor is not recognized in the device overview, connect your sensor as follows:

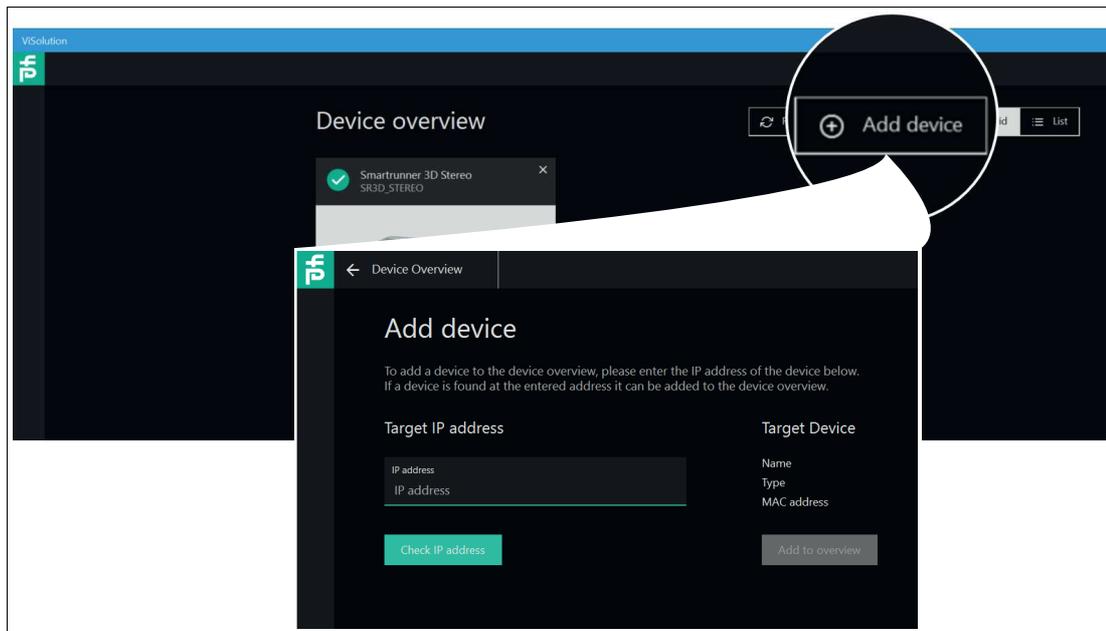


Figure 6.2 Device Overview



Finding a Sensor

This function can be used to search for connected sensors or to establish a connection to a connected device. To do so, proceed as follows:

1. Ensure that the sensor and the PC/laptop are ready for operation and that there is an Ethernet connection.
2. Click the "Add device" button to search for sensors.

↳ The "Add device" input window opens.

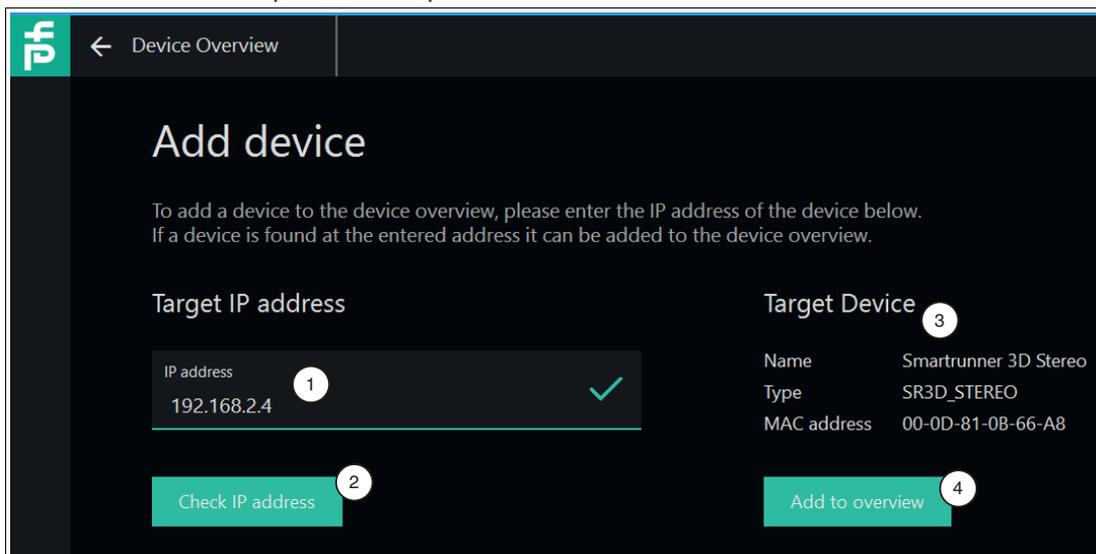


Figure 6.3 Entering the IP address

3. Enter the IP address of your sensor in the "Target IP address" input field (1). The default IP address of the sensor can be found on the device.
4. Click the "Check IP address" button (2) to search for the device with the entered IP address.
 - ↳ A green check mark in the search field indicates that the device with the entered IP address has been found. In addition, the following information on the sensor is displayed under "Target Device" (3):
 - Name of the sensor
 - Sensor type
 - MAC address
5. Click the "Add to overview" button (4).
 - ↳ The sensor is displayed on the overview screen (see "Device Overview" on page 37) of all sensors found.



Note

If no sensor is detected:

- Check that the sensor is connected properly and ready for operation. See chapter 3.7.
- Check that Windows network communication is set up correctly between the device and the PC/laptop. See chapter 3.8.

6.2 ViSolution Main Screen

The basic ViSolution functions can be selected on the main screen.

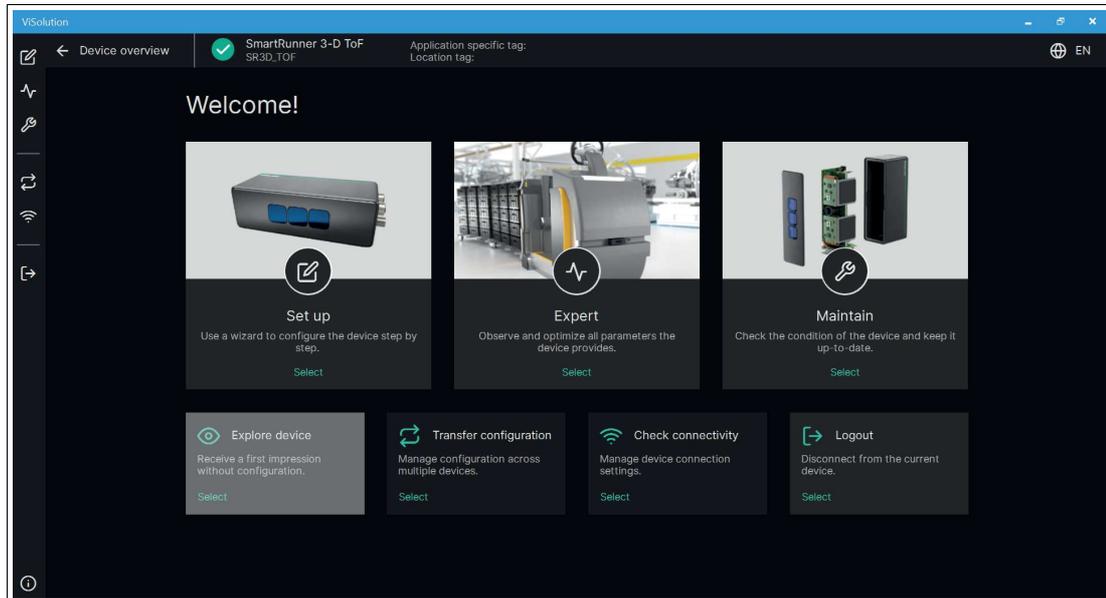


Figure 6.4 Main screen

Basic functions on the main screen:

Designation	Description
Set Up	The Setup Wizard will guide you through all the steps necessary to set up the sensor step by step. See chapter 6.2.2.
Expert	In the expert view, all parameters are displayed at a glance and can be monitored or set during operation. .see chapter 6.2.3
Maintain	You can use the Maintain function to check the status of the sensor and keep it up to date. See chapter 6.2.4.
Explore device	This function is not implemented in the current software version.
Transfer configuration	Manage configurations across multiple sensors. See chapter 6.2.6.
Check connectivity	Use this menu to manage connections to the network and display connection data. See chapter 6.2.7.
Logout	Use "Logout" to exit the user interface and access the device overview screen. See chapter 6.2.8.

6.2.1 User Interface

The ViSolution user interface is structured as follows:

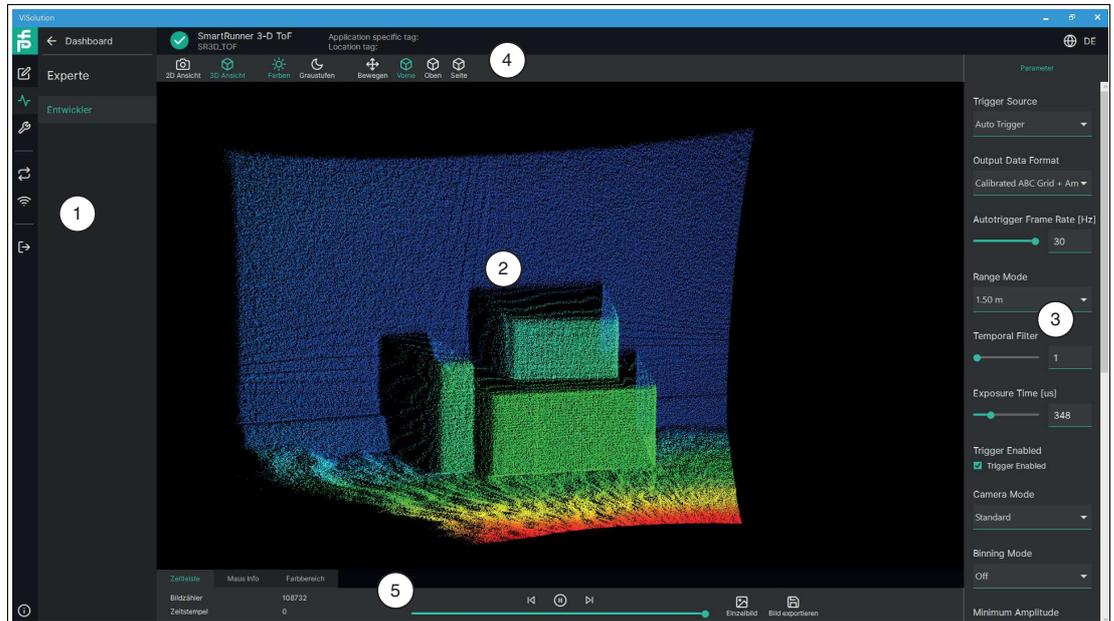


Figure 6.5 Structure of the user interface

Item	Designation	Function
1	Menu bar	Use the menu bar to access the sensor settings.
2	Display window	The running application can be displayed and monitored in the display window.
3	Configuration window	You can set the sensor-specific parameters in this area.
4	Navigation bar	In the navigation bar, you can select the desired option to show the type of visualization.
5	Information bar and controls	The information bar provides information about the captured scene. In addition, other controls are available for visualizing the captured scene.

Navigation bar

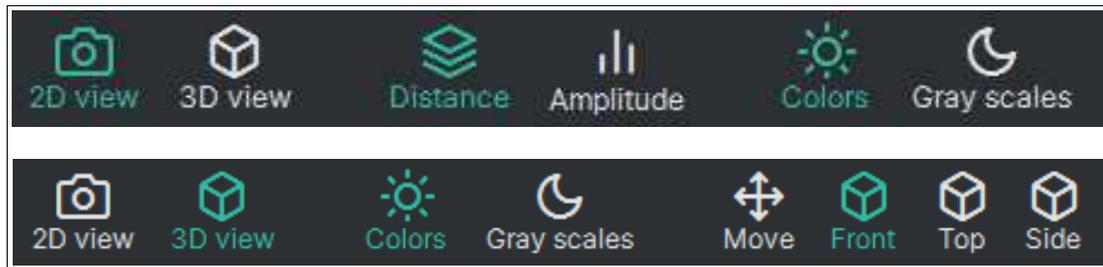
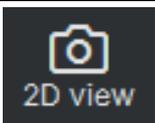
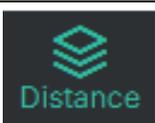
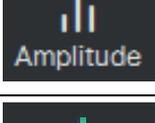
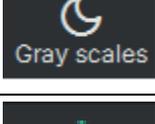


Figure 6.6 Navigation bar

Controls

Control	Designation	Function
	2-D view	In the display window, the sensor data is displayed as a 2-D visualization and is displayed in color or in grayscale according to the distance values.
	3-D view	In the display window, the sensor data is displayed as a 3-D visualization and is displayed in color or in grayscale according to the distance values.
	Distance	In the 2-D view, the distance to the object is displayed in mm in the information bar under the "Cursor info" tab. NOTE: Whether a distance image or an amplitude image (brightness) is more suitable for display depends on the shape and reflectance of the objects: - Distance image: distinctive shapes of the objects (e.g., box with bottles) - Amplitude image: objects with high-contrast reflectivity values in the infrared range
	Amplitude	In the 2-D view, the amplitude value is displayed under the "Cursor info" tab in the information bar. Represents the pixels according to the amplitude values (brightness).
	Colors	Representation of amplitude or distance as a gradient.
	Grayscale	Switch from color image to grayscale.
	Move	With the left mouse button pressed, you can move the 3-D view freely. With the Shift key pressed and the left mouse button pressed, you can move the entire 3-D view to the left/right and up/down.
	Front view	3-D view settings: Front view

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Control	Designation	Function
	Top view	3-D view settings: Top view
	Side view	3-D view settings: Side view



Note

Zoom in 3-D View

Right-click and drag up to zoom in and drag down to zoom out.

Alternatively, you can use a mouse with a scroll wheel to zoom in and out.

Information Bar + Controls

Timeline

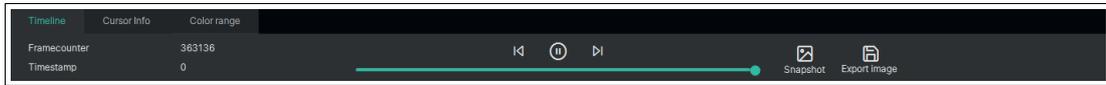
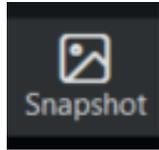


Figure 6.7

Control	Designation	Function
Frame counter	Image counter	Displays all captured images
Timestamp	Timestamp	Counts all captured images from a specific time
 Playback option	Start	Previously recorded process data can be played back with this function
	Stop	Stop recording
	Forward	Play the recording forward
	Back	Play the recording backward
	Progress bar	Progress bar indicates the current position in the recording. Clicking on a position in the progress bar will resume playback from the corresponding image.
 Snapshot	Snapshot	Single image capture when the sensor is in the "Pause" position.
 Export image	Export image	Export image.

Cursor Info



Figure 6.8

Control		Designation	Function
Coordinates [mm]	x	x coordinate	Spatial coordinates of the cursor (x, y, z coordinates) x coordinate
	y	y coordinate	y coordinate
	z	z coordinate	z coordinate/distance
Image coordinates [px]	x	x image coordinate	The "Image coordinates" show information about the selected pixel in the 2-D view x coordinates of the selected pixel
	y	y image coordinate	y coordinate of the selected pixel
Values	Gray	Gray	The grayscale value is only displayed for the SmartRunner Explorer 3-D Stereo
	Disparity	Disparity	The disparity value is only displayed for SmartRunner Explorer 3-D Stereo
	Amplitude	Amplitude	Amplitude value of the selected pixel

Color Range

The slider bar can be used to manually adjust the color range of the display. This will not cause the results of the application to change.

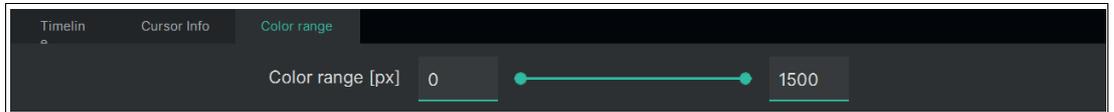
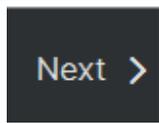
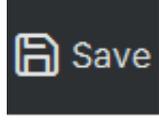


Figure 6.9

Control	Designation	Function
Color range [px]	Color range	The shade depends on the measured distance of the point and the color scale setting. The color scale changes depending on the set "range mode" (1.5 m; 3.75 m or 7.5 m) Red (black for grayscale): z coordinate value ≤ minimum of the set color scale. Blue (white for grayscale): z coordinate value ≥ maximum of the set color scale.

Basic Functions of the Setup Wizard

The basic functions are available in the Setup Wizard, in the menu bar to the right under the display window.

Control	Designation	Function
 Next >	Next	Proceed to the next step.
 < Previous	Previous	Return to the previous step. From step 1, you return to the Device information page of the Setup Wizard.
 Save	Save	When you have completed the last "Review results" step, you can save your settings.

6.2.2 Setup Wizard (Set up)

The Setup Wizard will guide you through all the steps necessary to set up the sensor step by step.

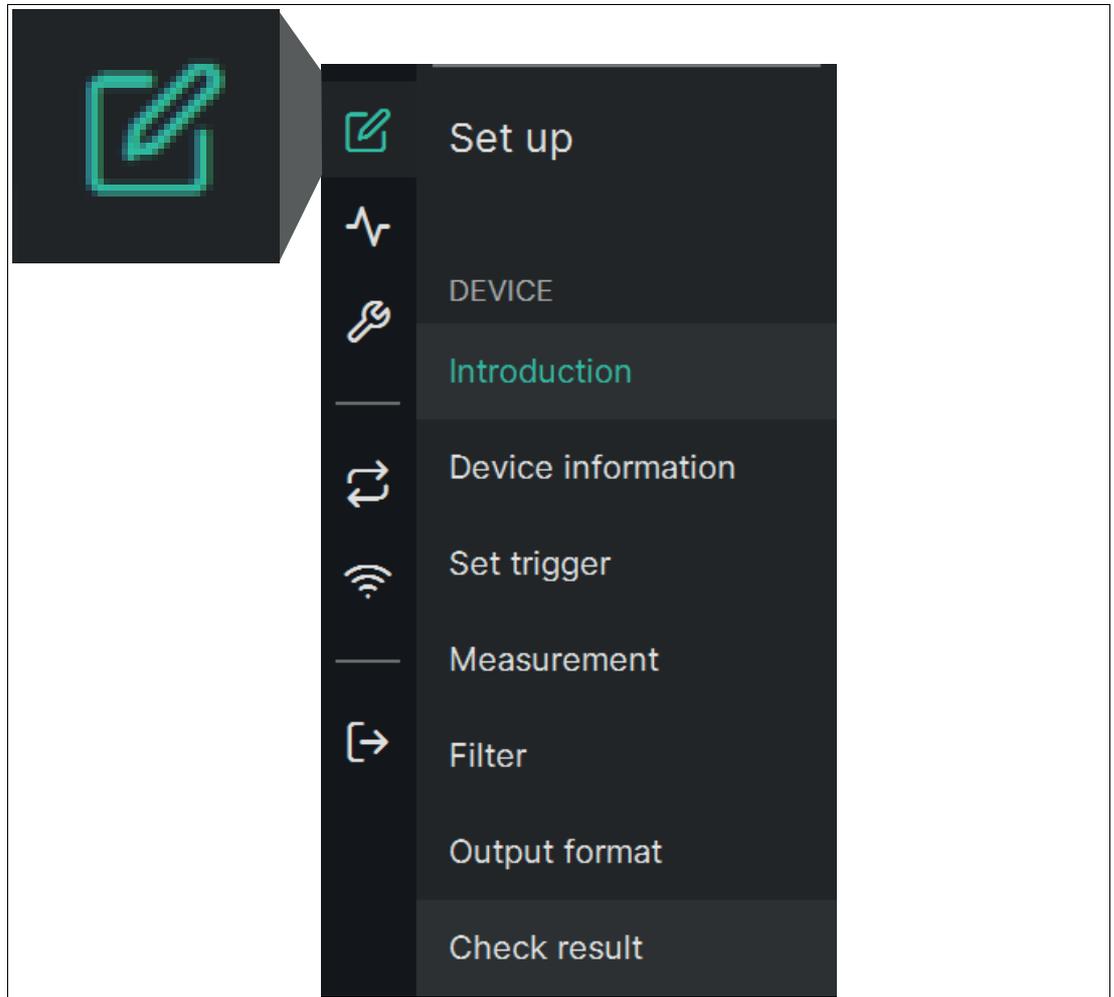


Figure 6.10 Set up

Link to chapter

Area	Function	Link
DEVICE	Introduction	See chapter 6.2.2.1
	Device information	See chapter 6.2.2.2
	Set trigger	See chapter 6.2.2.3
	Measurement	See chapter 6.2.2.4
	Filter	See chapter 6.2.2.5
	Output format	See chapter 6.2.2.6
	Check result	See chapter 6.2.2.7

6.2.2.1 Introduction

Use "Set up" > "Introduction" to access the "Wizard introduction" window. From this page, a Setup Wizard can be started that guides you through all the necessary steps to set all required sensor parameters step by step.

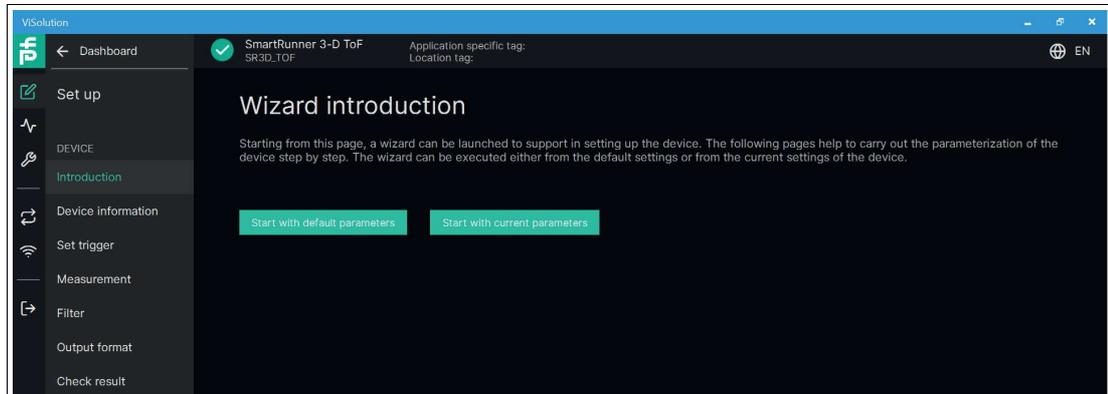


Figure 6.11 Wizard introduction

The Setup Wizard can be run either from the default settings or from the current sensor settings.

6.2.2.2 Device Information

Use "Set up" > "Device information" to access the "Device information" window. A preview image of the camera shot and basic information about the sensor are displayed.

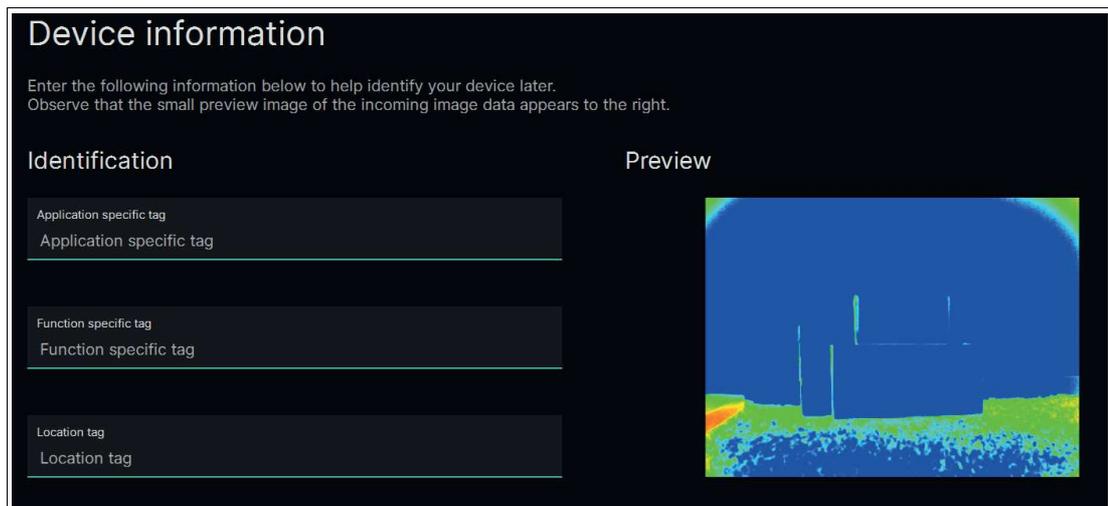


Figure 6.12 Device information

Enter the following information to identify your sensor at a later time. Make sure that the preview of the incoming image appears on the right.

Information	Description
Application specific tag	Application-specific tag
Function specific tag	Function-specific tag
Location tag	Location tag
Preview	A live preview of the camera shot is displayed in the right window range.

6.2.2.3 Set Trigger

Use "Set up" > "Set Trigger" to access "Set Trigger." The trigger source starts an event. It triggers the capture and evaluation of scenes.

There are a number of ways to trigger object detection by the camera. An external signal can be used to trigger the individual objects. The camera can also be configured to capture objects at regular intervals without any external trigger signal.

The sensor distinguishes between different trigger sources:

Trigger Source

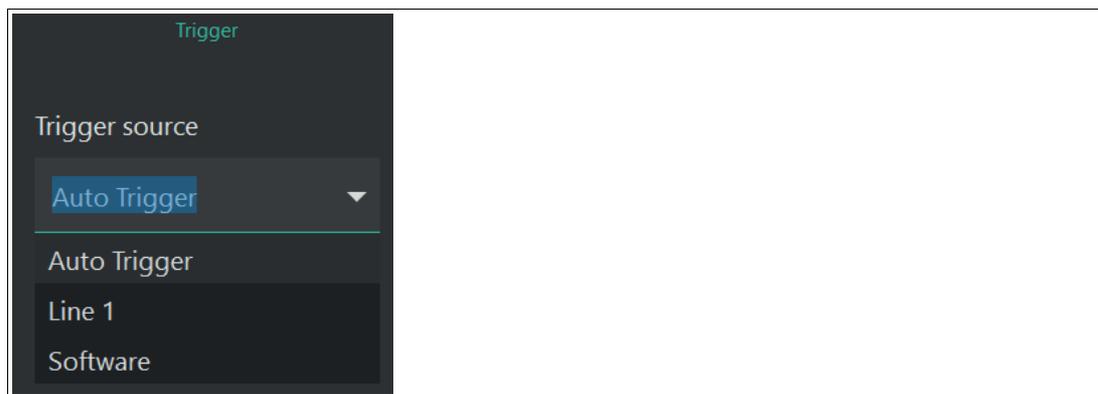


Figure 6.13 Trigger source

Option	Description
Auto Trigger	The sensor continuously captures images at a preset frame rate.
Line 1	The sensor is triggered via the rising or falling edge of an input signal (see "Trigger Activation" on page 50).
Software	The sensor is controlled via the process interface of the connected control panel (e.g., from PLC/PC).

Frame Rate (Autotrigger Fame Rate [Hz])



Figure 6.14 Frame Rate

Option	Description
Autotrigger Fame Rate [Hz]	If you select "Auto Trigger" as the trigger source, you can set the frame rate in Hz. The "Auto trigger frequency" slider can be used to change the frame rate or enter it in the display window. The maximum frame rate that can be set is 30 Hz.



Note

With a higher frame rate, the sensor's own heat increases. The noise in the sensor increases as the temperature increases. This can have a negative effect on the measurement results.

When the maximum sensor temperature is exceeded, the frame rate is reduced.

Trigger Activation

The "Trigger Activation" parameter has only one effect in the line 1—trigger (see "Trigger Source" on page 49).

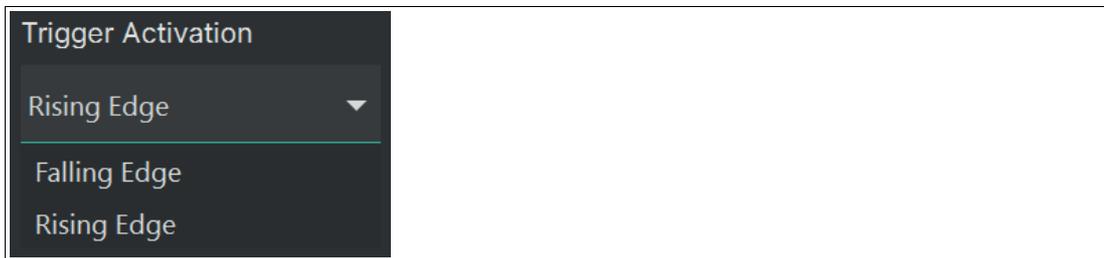


Figure 6.15 Trigger Activation

Option		Description
Trigger Activation	Rising Edge	The sensor is triggered by hardware via the rising edge of an input signal.
	Falling Edge	The sensor is triggered by hardware via the falling edge of an input signal.

6.2.2.4 Measurement

Use "Set up" > "Measurement" to access the "Measurement" window.

Default Settings

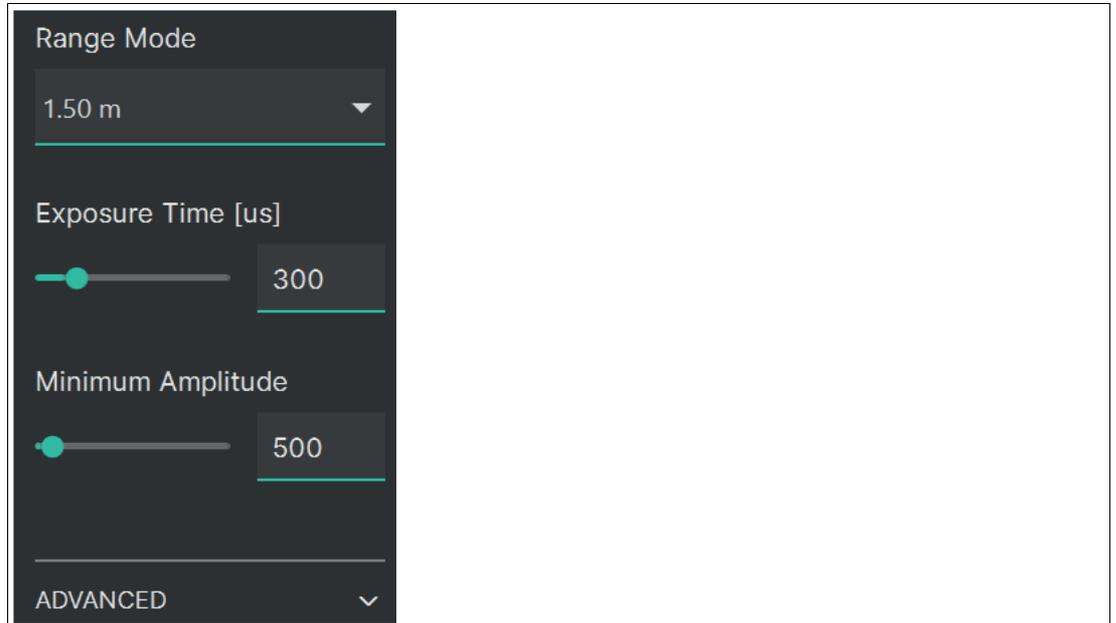


Figure 6.16

Option		Description
Range Mode	1.5 m	Distance setting in m For static objects, set the "Range Mode" according to the distance from the object to be measured. For example, if the object is 1.4 m away, set the Range Mode to 1.5 m. From 1.5 m onwards, a new measurement interval starts again at 0 m. As a result, an object that is, for example, 2.5 m away from the sensor measures its distance as 1 m.
	3.75 m	
	7.5 m	
Exposure Time [μs]		The exposure time is set in μs. The value for the exposure time can be changed with the slider or entered in the text field.
Minimum Amplitude		The minimum amplitude indicates which pixels are still accepted as a valid measurement. All pixels with an amplitude lower than the set value are discarded

Advanced Settings

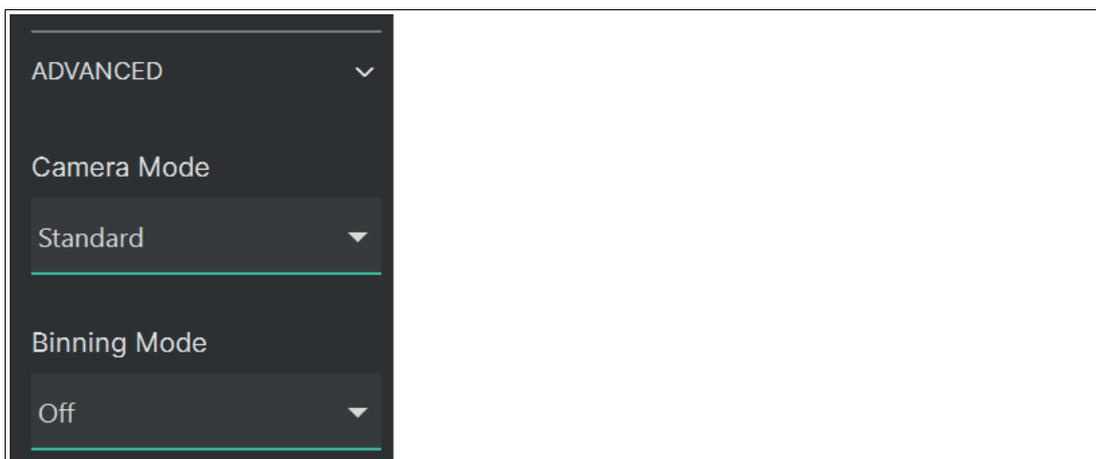


Figure 6.17

Option		Description
Camera Mode	FastMovement	Camera mode for scenes with very fast movements.
	HighDynamic	Exposure mode for scenes with high dynamics. In this case, the image quality can be increased by two exposures with different exposure times. This mode is especially useful for areas with very different reflectivity (e.g., glossy, white, black). The maximum frame rate decreases to 15 Hz. In addition, this mode is more susceptible to motion blur.
	Standard	Standard camera mode
Binning Mode	2x2	Combine 4 pixels in one pixel
	4x4	Combine 16 pixels in one pixel
	Off	Switch off binning

6.2.2.5 Filter

Use "Set up" > "Filter" to access the "Filter" window.

Filter Settings

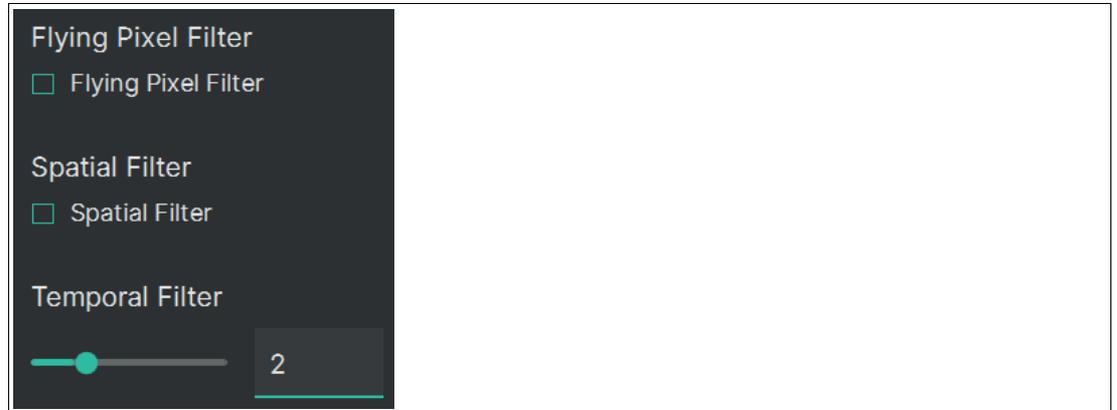


Figure 6.18

Option	Description
Flying Pixel Filter	Flying pixels occur in spatial regions with uneven depth. Here, superimposed phase shifts result in mixed signals, which lead to incorrect distance values. The filter detects and removes the "flying pixels" at the edges of the distance image.
Spatial Filter	Spatial filter that uses the values of the neighboring pixels to filter out the spatial noise in an image capture. The filter is used to smooth bumps on surfaces.
Temporal Filter	The temporal filter determines the values of a pixel at different times to filter out the temporal noise in an image capture. The slider controls the number of images that are averaged.

6.2.2.6 Output Data Format

Use "Set up" > "Output format" to access the "Output data format" window.

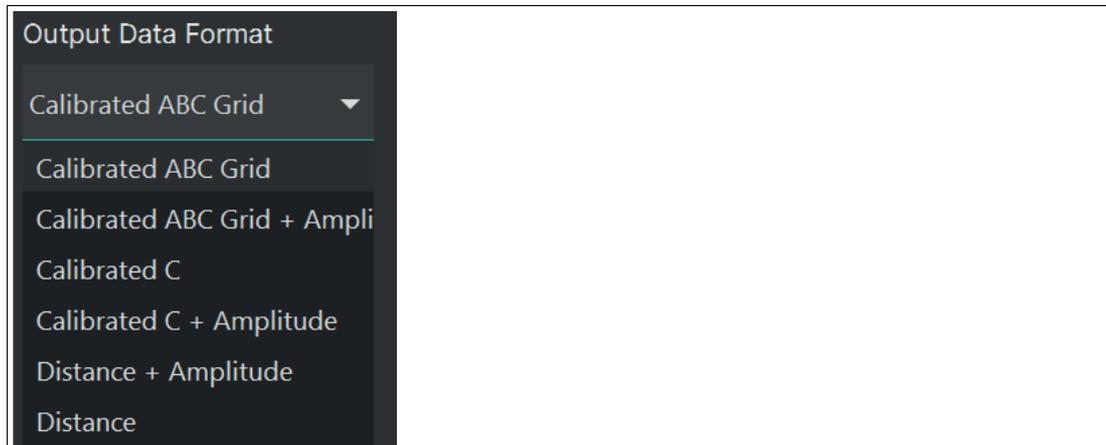


Figure 6.19

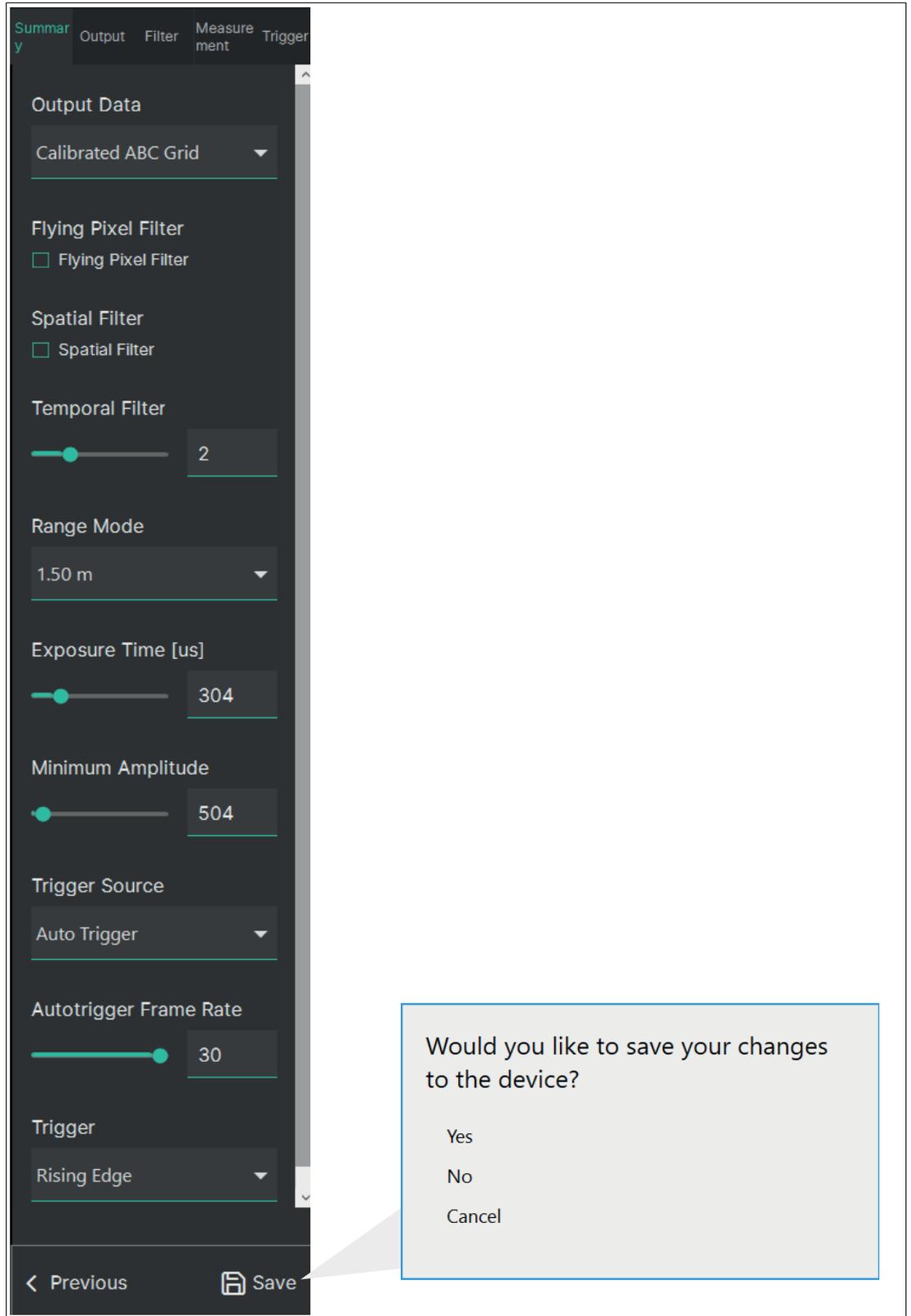
Output data format

Output data format	Description
Calibrated ABC Grid	The result of the measuring cycle is a 3-D point cloud. These are spatial coordinates of the reflecting surfaces in a Cartesian coordinate system (x,y,z). The unit is millimeters. The sensors are geometrically calibrated at the factory for the exact calculation of these values.
Calibrated ABC Grid + Amplitude	The result of the measuring cycle is a 3-D point cloud that contains intensity data for each pixel. These are spatial coordinates of the reflecting surfaces in a Cartesian coordinate system (x,y,z). The unit is millimeters. The sensors are geometrically calibrated at the factory for the exact calculation of these values.
Calibrated C	The depth image outputs the Z coordinate of the measured scene. If the sensor is perfectly aligned with an object 1 m away, the sensor would measure 1 m for each measurement point.
Calibrated C + Amplitude	The depth image outputs the Z coordinate of the measured scene. If the sensor is perfectly aligned with an object, e.g., 1 m away, the sensor would measure 1 m for each measuring point. In addition, the amplitude values of each pixel are measured.
Distance + Amplitude	Outputs the actual distance the light travels. In addition, the amplitude values of each pixel are measured. For clarity, imagine the sensor looking at a flat white wall. The light that is reflected from the edges of the wall has to travel a longer distance than light that is reflected from a point directly opposite the sensor, i.e., the distances vary while the z value remains the same.
Distance	Outputs the actual distance the light travels.

6.2.2.7 Check Result

Use "Set up" > "Check result" to access the "Check Result" window.

The results display a summary of the application features. The results depend on the features you have previously set in the Setup Wizard.



You can save the settings to the sensor using the "Save" button.

2023-05

6.2.3 Advanced Configuration Mode (Expert)

In advanced configuration mode, all configuration parameters are presented in an overview. Here you can adjust the sensor to the optimal level for your application.

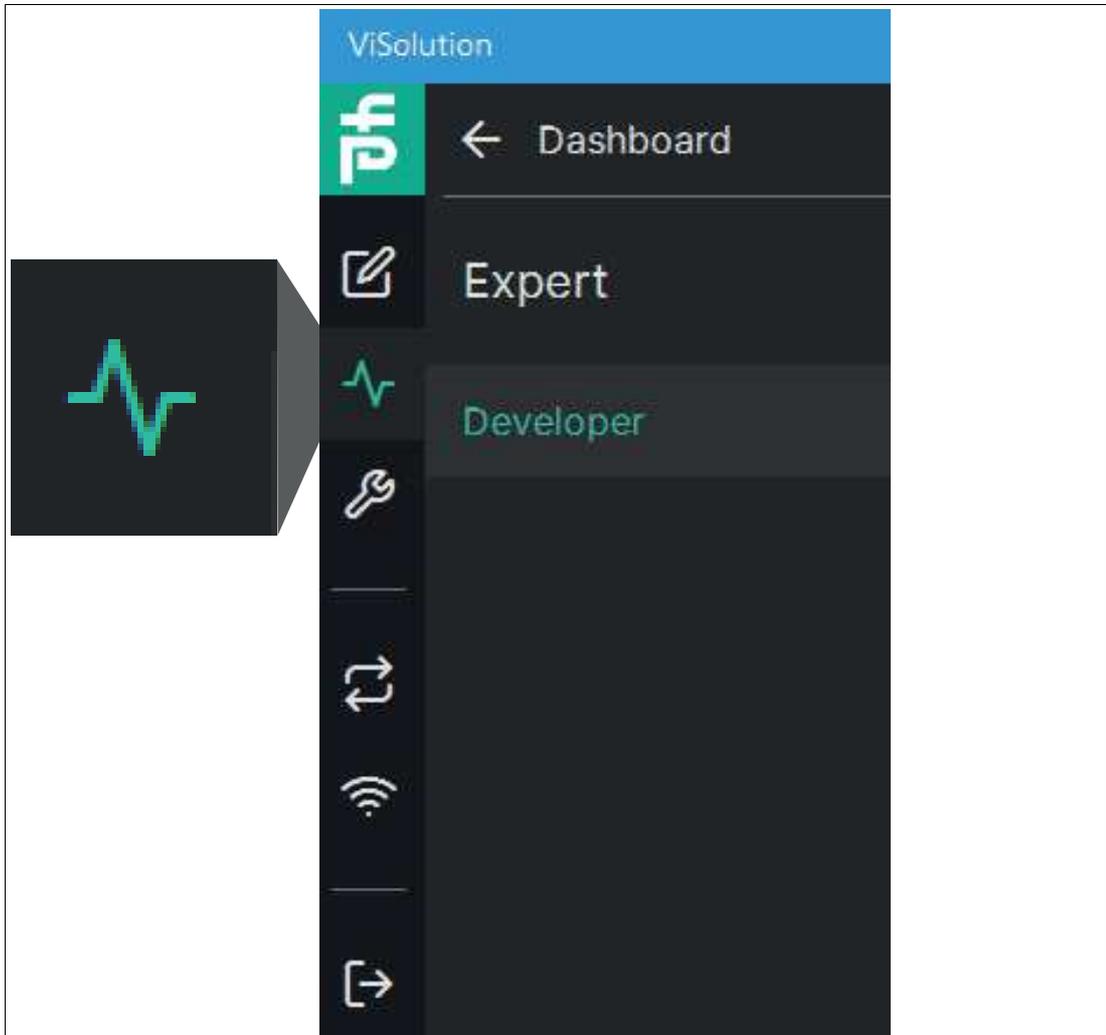


Figure 6.20 Expert

Link to Chapter

Area	Function	Link
Explorer	Developer	See chapter 6.2.3.1

6.2.3.1 Advanced Configuration Mode (Expert)

Use "Expert" > "Developer" to access the advanced configuration mode window. The display window shows live images while parameters are being edited.

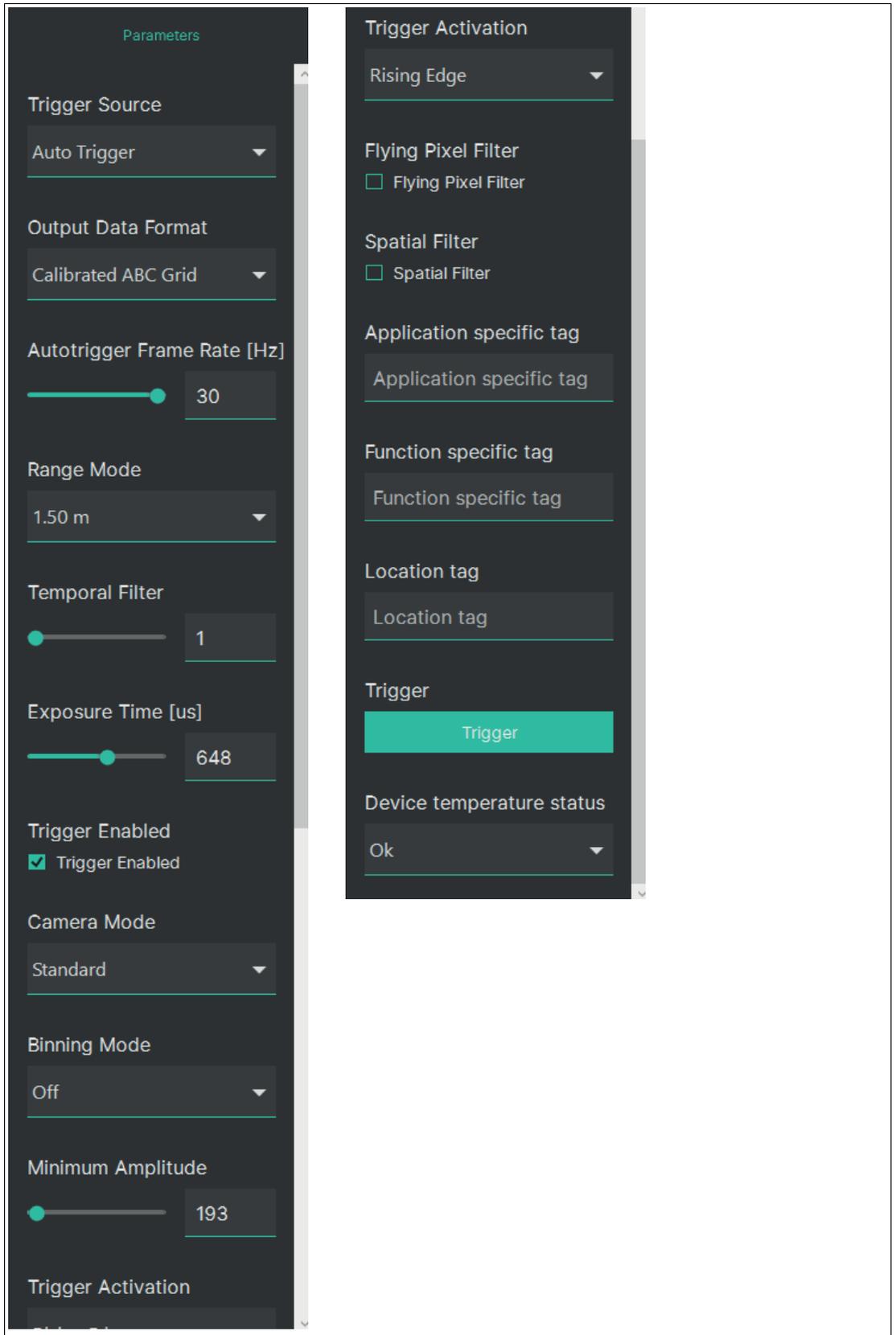


Figure 6.21 Expert

2023-05

Trigger Source

Option	Description
Auto Trigger	The sensor continuously captures images at a preset frame rate.
Line 1	The sensor is triggered by hardware via the rising or falling edge of an input signal.
Software	The sensor is controlled via the process interface of the connected control panel (e.g., from PLC/PC).

Output Data Format

Output data format	Description
Calibrated ABC Grid	The result of the measuring cycle is a 3-D point cloud. These are spatial coordinates of the reflecting surfaces in a Cartesian coordinate system (x,y,z). The unit is millimeters. The sensors are geometrically calibrated at the factory for the exact calculation of these values.
Calibrated ABC Grid + Amplitude	The result of the measuring cycle is a 3-D point cloud that contains intensity data for each pixel. These are spatial coordinates of the reflecting surfaces in a Cartesian coordinate system (x,y,z). The unit is millimeters. The sensors are geometrically calibrated at the factory for the exact calculation of these values.
Calibrated C	The depth image outputs the Z coordinate of the measured scene. If the sensor is perfectly aligned with an object 1 m away, the sensor would measure 1 m for each measurement point.
Calibrated C + Amplitude	The depth image outputs the Z coordinate of the measured scene. If the sensor is perfectly aligned with an object, e.g., 1 m away, the sensor would measure 1 m for each measuring point. In addition, the amplitude values of each pixel are measured.
Distance + Amplitude	Outputs the actual distance the light travels. In addition, the amplitude values of each pixel are measured. For clarity, imagine the sensor looking at a flat white wall. The light that is reflected from the edges of the wall has to travel a longer distance than light that is reflected from a point directly opposite the sensor, i.e., the distances vary while the z value remains the same.
Distance	Outputs the actual distance the light travels.

Frame Rate (Autotrigger Fame Rate [Hz])

Option	Description
Autotrigger Fame Rate [Hz]	If you select "Auto Trigger" as the trigger source, you can set the frame rate in Hz. The "Auto trigger frequency" slider can be used to change the frame rate or enter it in the display window. The maximum frame rate that can be set is 30 Hz.

Range Mode

Option	Description
Range Mode	Distance setting in m For static objects, set the "Range Mode" according to the distance from the object to be measured. For example, if the object is 1.4 m away, set the Range Mode to 1.5 m. From 1.5 m onwards, a new measurement interval starts again at 0 m. As a result, an object that is, for example, 2.5 m away from the sensor measures its distance as 1 m.
	1.5 m
	3.75 m
	7.5 m

Temporal Filter

Option	Description
Temporal Filter	The temporal filter determines the values of a pixel at different times to filter out the temporal noise in an image capture. The slider controls the number of images that are averaged.

Exposure Time [μ s]

Option	Description
Exposure Time [μ s]	The exposure time is set in μ s. The value for the exposure time can be changed with the slider or entered in the text field.

Trigger Enable

Option	Description
Trigger Enable	Enable or disable the trigger

Camera Mode

Option	Description	
Camera Mode	FastMovement	Camera mode for scenes with very fast movements.
	HighDynamic	Exposure mode for scenes with high dynamics. In this case, the image quality can be increased by two exposures with different exposure times. This mode is especially useful for areas with very different reflectivity (e.g., glossy, white, black). The maximum frame rate decreases to 15 Hz. In addition, this mode is more susceptible to motion blur.
	Standard	Standard Camera Mode

Binning Mode

Option	Description	
Binning Mode	2x2	Combine 4 pixels in one pixel
	4x4	Combine 16 pixels in one pixel
	Off	Switch off binning

Minimum Amplitude

Option	Description
Minimum Amplitude	Set the minimum amplitude range of your image capture using the slider. The amplitude is used to set the strength of the measuring signal.

Trigger Activation

Option	Description	
Trigger Activation	Rising Edge	The sensor is triggered by hardware via the rising edge of an input signal.
	Falling Edge	The sensor is triggered by hardware via the falling edge of an input signal.

Flying Pixel Filter

Option	Description
Flying Pixel Filter	Flying pixels occur in spatial regions with uneven depth. Here, superimposed phase shifts result in mixed signals, which lead to incorrect distance values. The filter detects and removes the "flying pixels" at the edges of the distance image.

Spatial Filter

Option	Description
Spatial Filter	Spatial filter that uses the values of the neighboring pixels to filter out the spatial noise in an image capture. The filter is used to smooth bumps on surfaces.

Device Information

Information	Description
Application specific tag	Application-specific tag
Function specific tag	Function-specific tag
Location tag	Location tag

Trigger

Option	Description
Trigger	By clicking on the "Trigger" button, a software trigger event is sent.

Device Temperature Status

Option	Description
Device Temperature Status	Sensor temperature information, e.g., "OK"

6.2.4 Maintain

You can use the Maintain function to check the status of the sensor and keep it up to date.

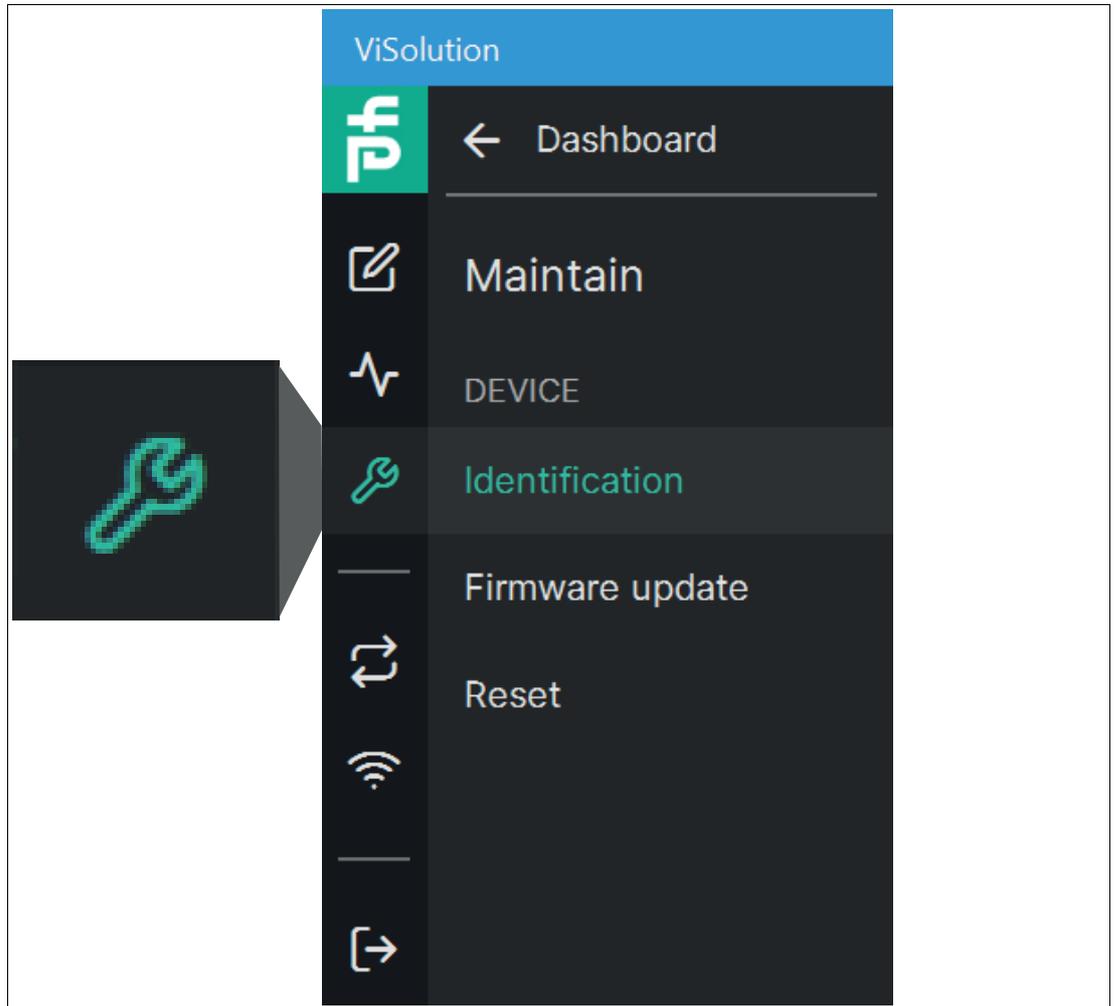


Figure 6.22 Maintain

Link to Chapter

Area	Function	Link
DEVICE	Identification	See chapter 6.2.4.1.
	Firmware Update	See chapter 6.2.4.2.
	Reset	See chapter 6.2.4.3

6.2.4.1 Identification

Use "Maintain" > "Identification" to access the "Identification" window.

Information	Description
Application specific tag	Application-specific tag
Function specific tag	Function-specific tag
Location tag	Location tag

Identification parameters

ID card	Description
VendorName	Manufacturer
VendorURL	Manufacturer's URL
ProductName	Product name
PartNumber	Product number
ProductClass	Product class
SerialNumber	Serial number
FirmwareVersion	Firmware version
HardwareVersion	Hardware version
ProtocolStackRevision	Protocol stack revision
UniqueProductID	Unique product ID

6.2.4.2 Firmware Update

Use "Maintain" > "Firmware Update" to access the "Firmware Update."



Updating Firmware

To update the firmware on your device, proceed as follows:

1. Select a valid update file.
2. Start the update process.

↳ The selected file is uploaded to the sensor. Once it is uploaded, the update will start automatically.



Note

The update process may take a few minutes. Do not switch off the sensor during this time.

6.2.4.3 **Resetting to the Factory Settings (Reset)**

Use "Maintain" > "Reset" to access the "Reset to factory settings" window.

To erase all the data on the device (configuration, applications, etc.), the sensor can be reset to the factory settings. The firmware version is not reset during this process.



Note

Existing settings and applications will be deleted when reset to factory defaults. If necessary, export the existing settings beforehand.



Resetting to the Factory Settings

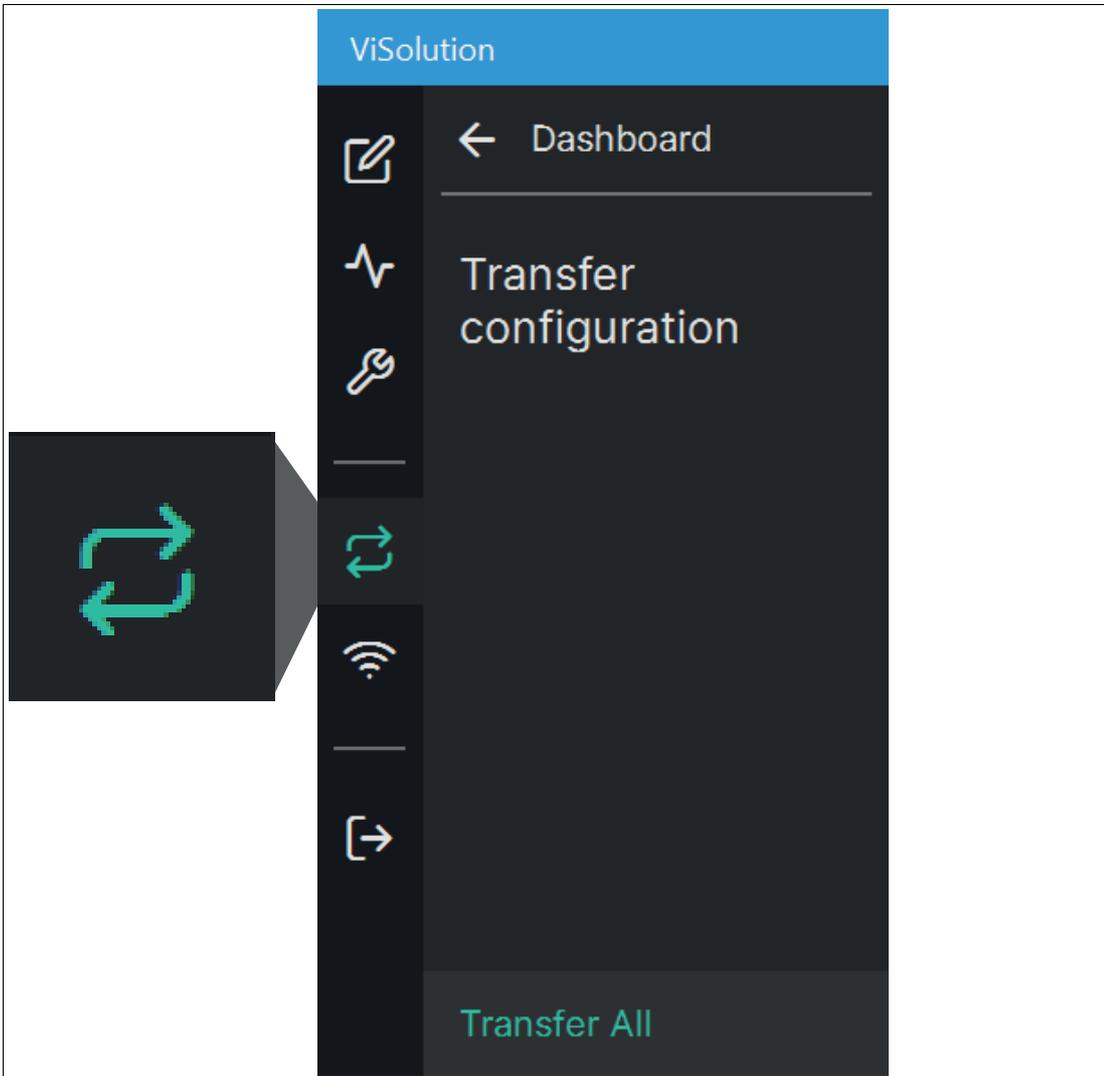
1. Click the "Reset parameters" button.
↳ A confirmation prompt is displayed.
2. Click "Yes" to confirm.
↳ All settings will be reset. A "Device reset" confirmation appears.

6.2.5 **Explore Device**

The "Explore Device" menu allows you to gain an initial impression of the sensor without configuring the sensor. This menu is not available in the current software version.

6.2.6 Transfer Configuration

You can use the "Transfer Configuration" menu to save your current sensor parameters to a file or to load such a file onto the sensor.



Link to Chapter

Area	Function	Link
Transfer Configuration Transfer All	Export configuration	See chapter 6.2.6.1
	Import settings	See chapter 6.2.6.2

6.2.6.1 Export Configuration

The "Export configuration" function is used to export all settings and applications from the sensor to the PC.



Export configuration

1. Click the "Export configuration" button to start the export of the settings.
↳ The selected storage path is displayed (c:\tmp). The file name contains the current time-stamp.
2. If necessary, change the name and click Save.
↳ The settings are saved to a file with the extension .sr3d_tof_pfc.

6.2.6.2 Import Configuration

During imports, parameter settings can be loaded from the selected file.



Note

Importing the new parameter settings will overwrite the current parameter settings for the sensor. If necessary, export the existing settings beforehand.



1. Click on the "Import configuration" button.
↳ The "P+F parameter file" window opens.
2. Select the file to import with the extension .sr3d_tof_pfc.
3. Click "Open."
↳ The import starts.

6.2.7 Check Connectivity

Manage connections to the network.

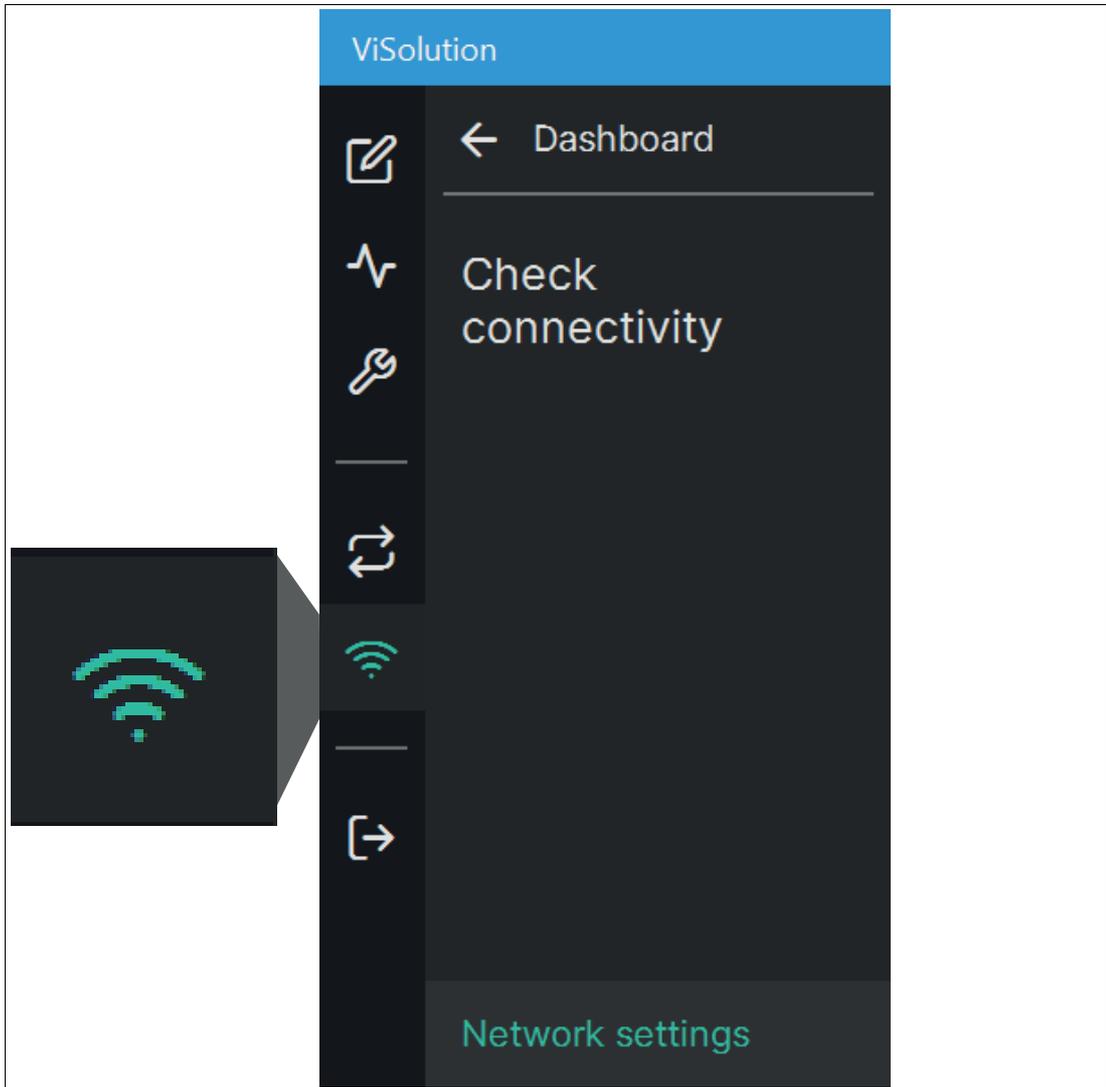


Figure 6.23 Check connectivity

Link to Chapter

Function	Link
Network Settings	See chapter 6.2.7.1.

6.2.7.1 Network Settings

Use "Check Connectivity" > "Network Settings" to access the "Network Settings" window.

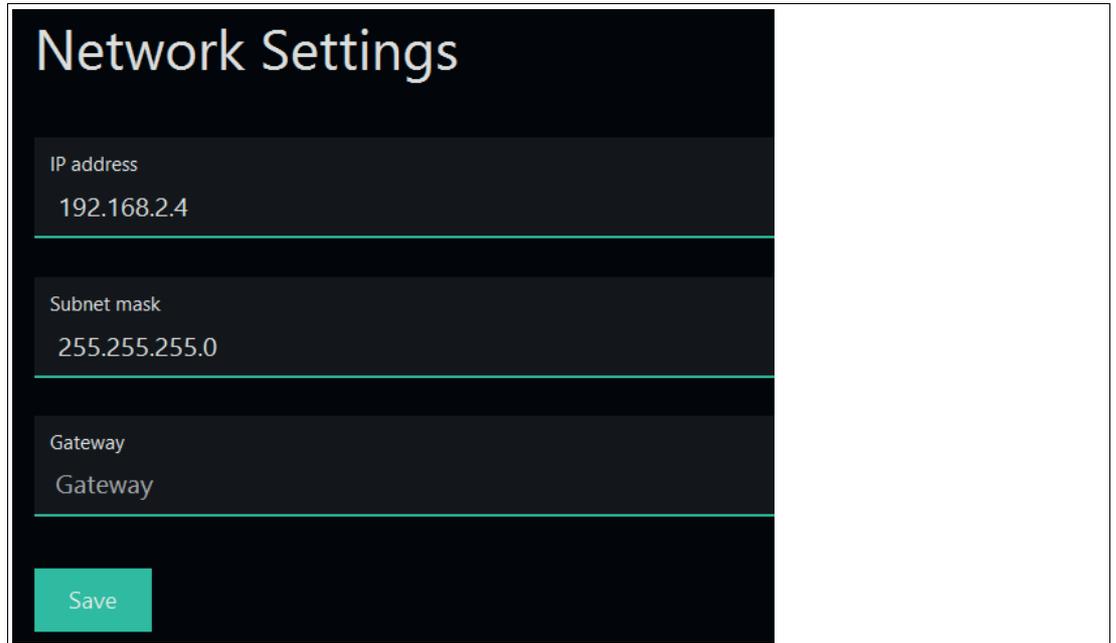


Figure 6.24 Network settings

Information	Description
IP address	IP address setting
Subnet mask	Subnet mask setting
Gateway	Gateway setting

6.2.8 Logout

Use "Logout" to exit the user interface and access the device overview screen (see "Device Overview" on page 37).

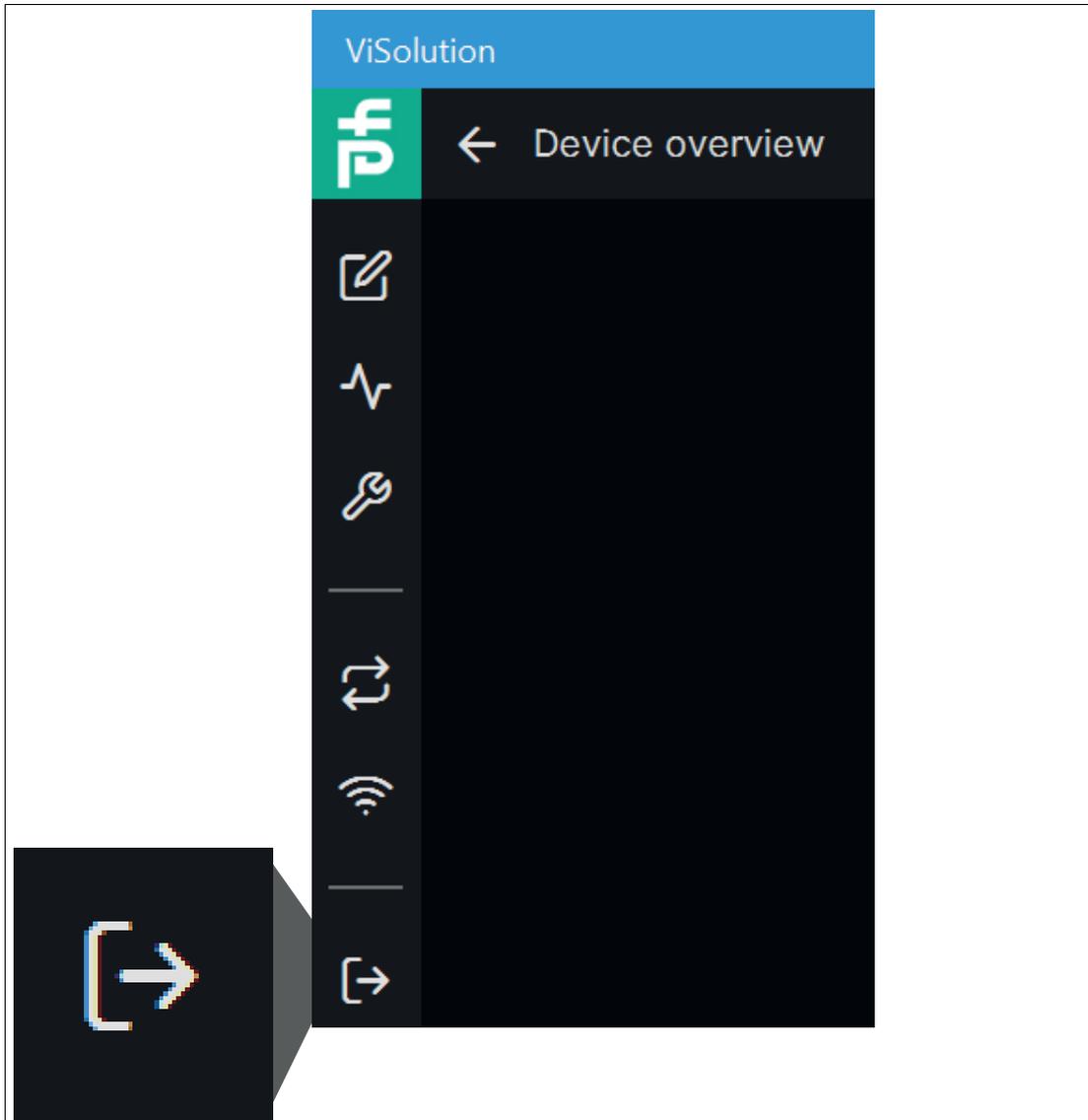


Figure 6.25 Logout

7 Maintenance and Repair

7.1 Servicing



Danger!

Danger to life due to electrical current!

Contact with live parts causes immediate danger to life.

- Allow only qualified electricians to carry out work on the electrical installation.
 - Switch off the power supply before carrying out servicing, cleaning, and repairs, and prevent the supply from being switched on again.
 - Keep the live parts free from moisture.
-

The device is maintenance-free. To get the best possible performance out of your device, keep the optical unit on the device clean, and clean it when necessary.

Observe the following instructions when cleaning:

- Do not touch the optical unit with your fingers.
- Do not immerse the device in water. Do not spray the device with water or other liquids.
- Do not use abrasive agents to clean the surface of the device.
- Use a cotton or paper cloth moistened (not soaked) with water or isopropyl alcohol.
- Remove any residual alcohol using a cotton or paper cloth moistened (not soaked) with distilled water.
- Wipe the device surfaces dry using a lint-free cloth.

7.2 Repair

The device must not be repaired, changed, or manipulated. In case of failure, always replace the device with an original device.

8 Troubleshooting

8.1 What to Do in the Event of a Fault

Before you have the device repaired, perform the following actions:

- Test the system according to the checklist below.
- Contact our service center to localize the problem.

Checklist

Fault	Cause	Fault Repair
"PWR" LED does not light up	The power supply is switched off	Determine whether there is a reason why the power supply is switched off (installation or maintenance work, etc.). Switch on the power supply if necessary.
	Wiring error, cable break	Check the wiring carefully and repair any faults with the wiring. Check the cables to ensure that they are functioning properly. See chapter 3.7.
Control panel receiving no measurement data	Connection cable not connected	Connect the connection cable.
	Incorrect connection cable used	Use the appropriate connection cable only. See chapter 2.5.
	Sensor incorrectly parameterized	Make sure that you have set the correct parameterization. See chapter 6.
Test object not detected	Incorrect sensing range or opening angle	Observe the sensing range and opening angle, see chapter 3.3.
	Front panel dirty	Clean the front panel. See chapter 7.1 .
	Error factors: <ul style="list-style-type: none"> • Temperature • Ambient light • Scattered light • Multiple reflections • Reflectance of measurement objects • Ambiguous range • Flying pixels • Incorrect sensor configuration 	There are some influencing factors that can affect the sensor measurements and limit the measurement accuracy, see chapter 3.4.
Measurement errors	Test object outside the sensing range	Better positioning of the test object, see chapter 3.3
	Incorrect distance to the test object	Observe the distance values, see chapter 3.3
	Housing incorrectly mounted	Mount the housing correctly,

Fault	Cause	Fault Repair
No connection to the sensor	Alternating-current voltage or supply voltage too high	Connect sensor to direct-current voltage (DC) only. Ensure that the supply voltage level is within the specified sensor range.
	Network settings	Set up Windows network communication between the sensor and a PC/laptop, see chapter 3.8
		Due to the large amount of data supplied by the sensor per second, the sensor(s) must be connected to the PC via a Gigabit Ethernet network.
	Forgot IP address	You can set the IP address manually using Windows network communication. Note that the sensor and PC/laptop (or NIC [network interface controller]) are on the same subnet, see chapter 3.8.

- If none of the above remedies the problem, please contact our service center. Please have the error images and the version number of the firmware available. The firmware version number can be found at the top right of the user interface.

Your automation, our passion.

Explosion Protection

- Intrinsic Safety Barriers
- Signal Conditioners
- FieldConnex® Fieldbus
- Remote I/O Systems
- Electrical Ex Equipment
- Purge and Pressurization
- Industrial HMI
- Mobile Computing and Communications
- HART Interface Solutions
- Surge Protection
- Wireless Solutions
- Level Measurement

Industrial Sensors

- Proximity Sensors
- Photoelectric Sensors
- Industrial Vision
- Ultrasonic Sensors
- Rotary Encoders
- Positioning Systems
- Inclination and Acceleration Sensors
- Fieldbus Modules
- AS-Interface
- Identification Systems
- Displays and Signal Processing
- Connectivity

Pepperl+Fuchs Quality

Download our latest policy here:

www.pepperl-fuchs.com/quality

