SmartRunner Detector

Laser-line triangulation sensor for high-precision field monitoring

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 dismounting lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting 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.

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2 Product Specifications

2.1 Use and Application

This manual applies to the SmartRunner Detector (hereafter referred to as sensor). The sensor monitors a defined area and detects objects smaller than 1 mm.

The sensor is based on the SmartRunner technology and combines the light section method with a 2D Vision sensor including LED illumination.

An emitter optic is used to project a laser line onto an object as part of the light section method. This is detected by a camera at a specific angle. A height and width profile is created using the triangulation principle. This laser technology provides reliable measurements on different surfaces.

The integrated camera function, including LED lighting, enables parameterization using Data-Matrix control codes as well as the recording of error images for quick and targeted intervention in the event of process disruptions.

Structure of the Sensor

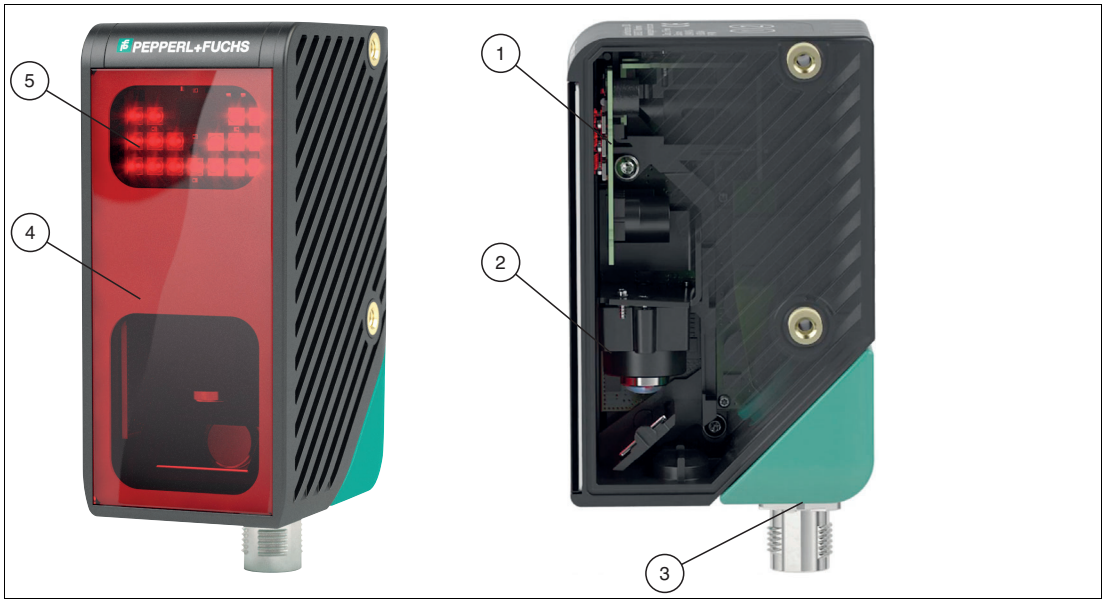

Figure 2.1 Structure of the Sensor

1 Emitter optic
2 Camera
3 Movable connection
4 Protective cover
5 LED lighting

Examples of use

The illustration shows the inner workings of a laser machine used to calibrate the switching distance of sensors. Different clamping devices (4) are used for the different sensor variants. When the program is activated, the laser moves to the appropriate height and the calibration process begins. However, if a device (4) is used that is too high, protruding objects can damage the lens (1).

To prevent this, the **laser profile sensor** (2) spans a detection field (3) below the lens (1). To do this, the wall (5) in the background is taught in via teach-in. If an object breaks through this previously defined field, the **laser profile sensor** (2) emits a corresponding signal and the process is stopped. This makes it possible to avoid damage to components while simultaneously increasing machine availability.

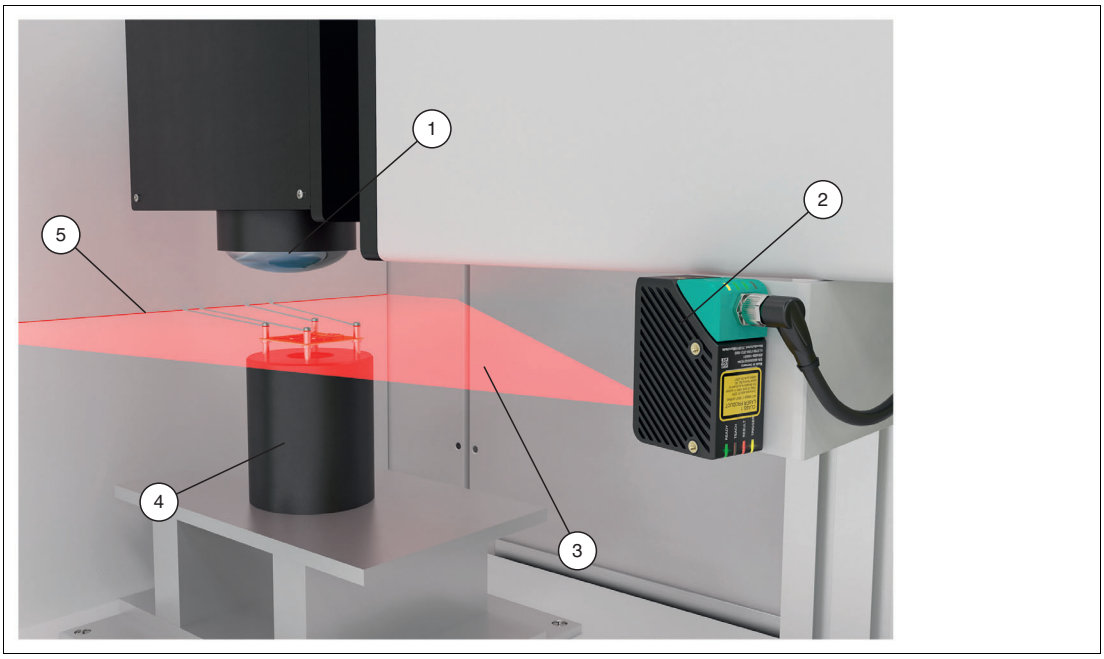

Figure 2.2 Application example: area monitoring for machine protection

Double evaluation

The sensor also detects objects that are not visible to the camera. For example, the surface of an object might reflect light away so that the camera cannot see the object. Because the SmartRunner Detector evaluates both the laser line on the object and on the background, the measurement results are always reliable. A broken background line or an object in the detection area causes the target to be recognized.

To do this, the background is taught in. If an object breaks through this previously defined field, the sensor emits a corresponding signal. If the defined field is not broken, a "Good" signal is emitted. If the field is broken, a "Bad" signal is emitted.

This is how the sensor works for monitoring the background and detecting objects:

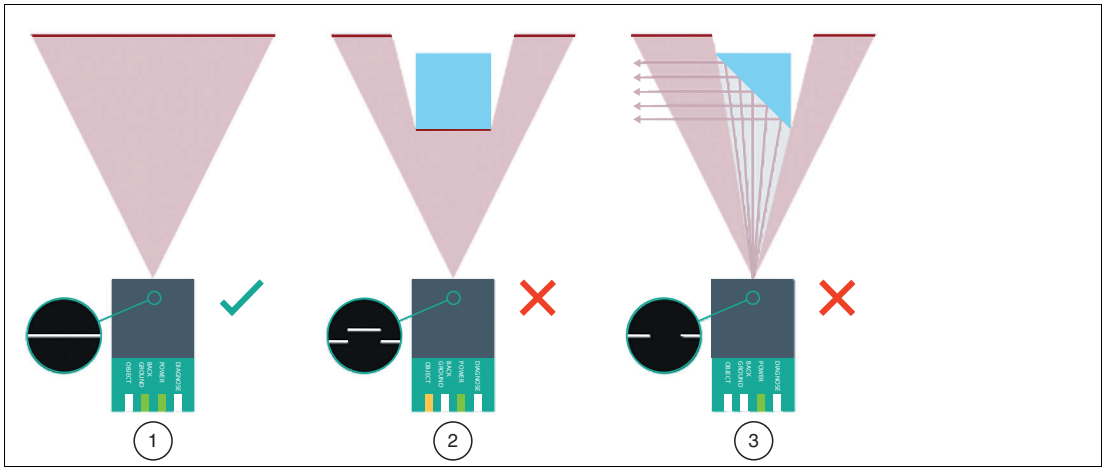

Figure 2.3 Capturing the background and recognizing objects

Position	Designation	Function
1	Good-signal-scenario 1	The laser line is not interrupted by any object. The machine operation proceeds as planned.
2	Good-signal-scenario 2	The detector recognizes an object in the monitoring field. The sensor delivers a switching signal. The machine operation is stopped.
3	Good-signal-scenario 3	A difficult-to-detect object with a mirror surface interrupts the laser line. Since the detector analyzes both the laser line on the object and on the background, the detection results are always reliable. Consequently, an interrupted background line also indicates the presence of an object in the detection area, causing the sensor to respond immediately. This parallel analysis ensures that the user has an absolutely reliable process.

Parameterization and Operating Modes

The laser-line triangulation sensor can be configured or parameterized via 3 different methods.

- Reading in code cards via the sensor camera
- Processing configuration telegrams via the bus interface
- Using the Vision Configurator software

The sensor has different operating modes, which can be activated for configuration, presentation, or normal operation.

- Runtime mode: measurement mode, sensor works as configured
- Configuration mode: mode for configuring the sensor via data telegrams and via the Vision Configurator configuration program
- Code card mode: mode for configuring the sensor via Data Matrix control codes without the assistance of a PC
- Presentation mode: mode for presentation or testing without the assistance of a PC

2.2 Hazards of Laser Radiation

This section describes the contents and location of the warning label.

The sensor used corresponds to the safety standard IEC 60825-1:2014 for a laser class 1 product. In addition, the US regulation 21 CFR 1040.10 and 1040.11 is fulfilled except for **Laser Notice No. 56** dated May 8, 2019.

Warning!

Class 1 laser light

The laser light can be an irritant, especially in a dark environment. Do not point lasers at people!

Never look into the laser beam port if the sensor is operating.

Maintenance and repairs must be carried out by authorized service personnel only!

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

Do not remove the sensor's protective cover.

The warning label is fixed to the back of the housing as shown in the following figure.

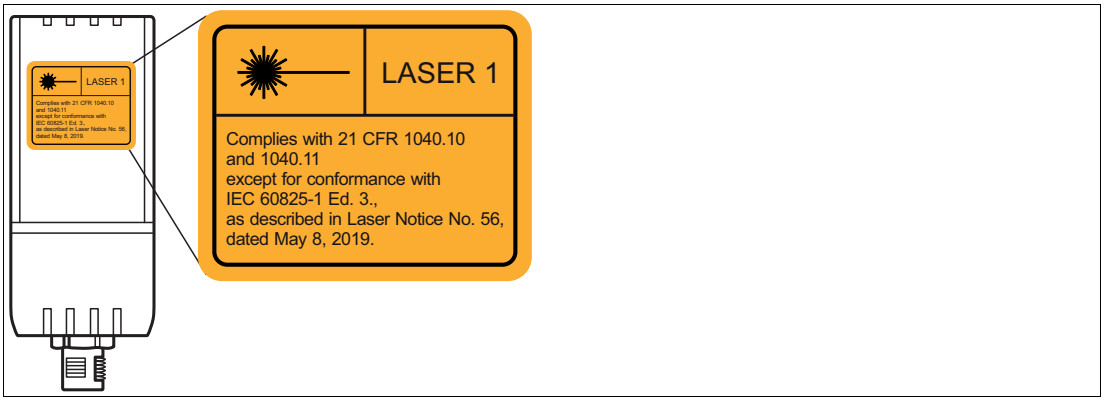

Figure 2.4 Laser radiation warning message

2.3 Dimensions

The devices in the SmartRunner series have the following identical housing dimensions.

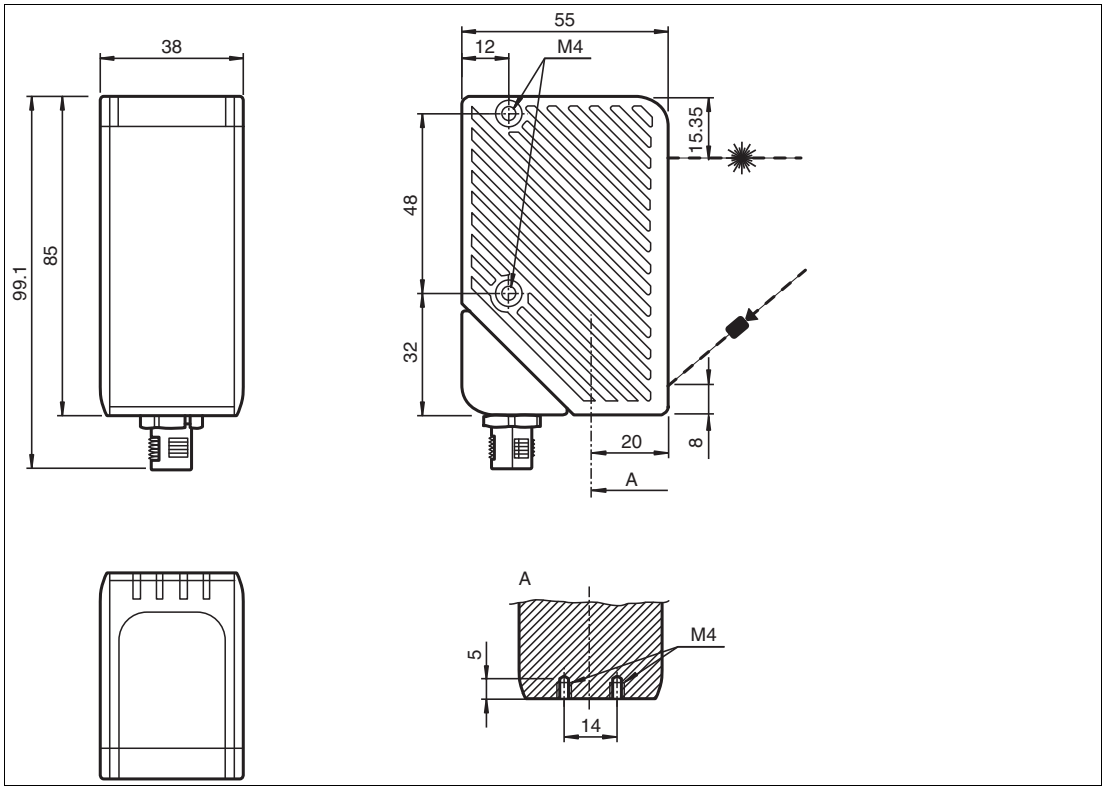

Figure 2.5 Dimensions of the SmartRunner series

2.4 Displays and Controls

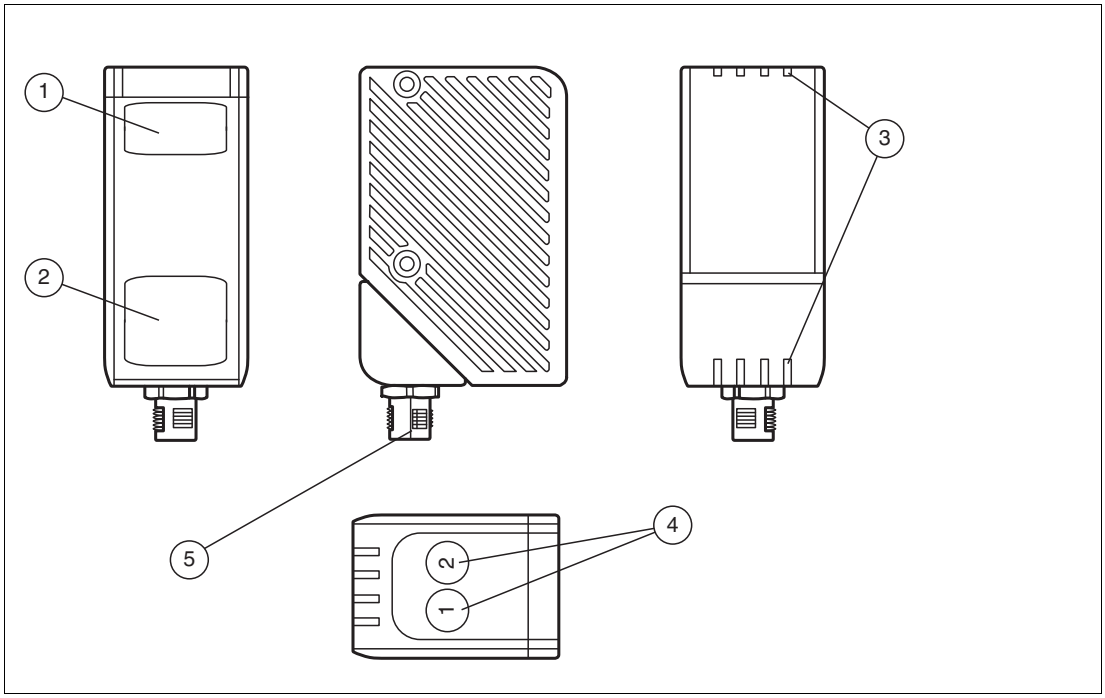

Figure 2.6 Overview of displays and controls

Position	Designation	Function
1	Emitter optic protective cover	Is used to protect against damage and contamination
2	Reception optic protective cover	Is used to protect against damage and contamination
3	LEDs	The functional description for the LEDs can be found in the table below.
4	Function keys in Presentation mode	• Function key 1: triggers an evaluation • Function key 2: when pressed and held for 2 seconds, activates the teach-in process. When pressed and held for longer than 2 seconds, activates Code Card mode
	Function keys in Runtime mode	• Function key 1: no function • Function key 2: when pressed and held for longer than 2 seconds, activates Code Card mode
5	Electrical Connection	The sensor is connected electrically via a MAIN 8-pin M12 connector plug on the bottom of the housing. See chapter 3.4.

Note

The function keys are only activated during a parameterizable time span after the sensor is switched on, after which they are locked. The default value for this time span is 5 minutes.

The function keys have different functions depending on the selected operating state.

Description of the LEDs

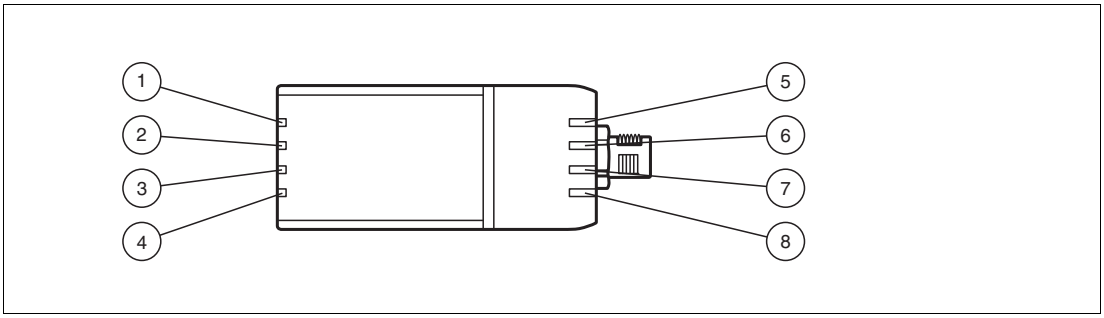

Figure 2.7 LEDs overview

Position Designation	Bezeichnung	Function
1	Ready (green/red)	• Lights up red if there is a sensor fault • Lights up green when the sensor is ready for operation • Flashes green if the sensor is in Configuration mode • Flashes green quickly when the sensor is in code card mode
2	Teach in (yellow)	• Lights up yellow during the teach in process
3	Result (green/red)	• Lights up green when the background line is not interrupted and no object has been detected. • Lights up red when an object is detected and the background line is interrupted.
	Applies in Code Card mode	• Lights up green when a correct code has been read • Lights up red when an incorrect code has been read • Off if no code has been read

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Position Designation	Bezeichnung	Function
4	TRIGGER (yellow)	• Lights up yellow if the hardware trigger signal is activated
5	Diagnosis (red)	• Lights up red if a bus error has occurred • Lights up red if a system error has occurred on the interface controller • Flashes red if the sensor is in Update mode
6	POWER (green)	• Lights up as soon as voltage is present
7	Background (green)	• Lights up green when output 1 is set
8	Object (yellow)	• Lights up yellow when output 2 is set

2.5 Interfaces

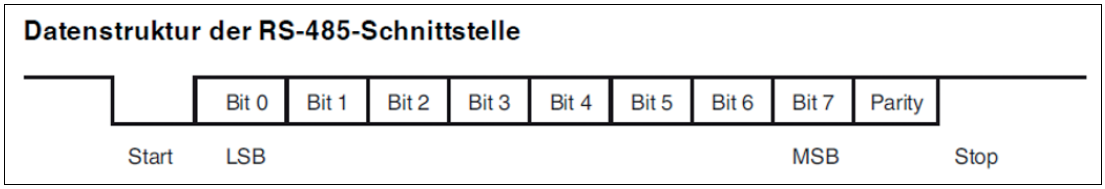
The RS-485 Interface

The reader is equipped with an RS-485 interface for communication purposes, i.e., parameterizing the reader functions or reading out current process data during operation. This interface is operated in 8-E-1 operating mode and fitted with a terminator that can be activated or deactivated by parameterizing the sensor head.

The RS-485 interface supports the following transfer rates:

- 38400 bit/s
- 57600 bit/s
- 76800 bit/s
- **115200 bit/s** (default value)
- 230400 bit/s

Data structure of the RS-485 interface



2.6 Accessories

Order designation	Description
V19-G-5M-PUR-ABG	Single-ended female cordset, M12, 8-pin, shielded, PUR cable
VLX-MB1	Mounting aid, adaptable 360° adjustment of mounting head and mounting foot
VLX-MB2	Mounting aid, fixing bracket
PCV-USB-RS485 Converter Set	USB to RS 485 interface converter

Other 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 Mounting the Sensor

Note

Mounting an optical device

- Do not aim the sensor at the sun.
- Protect the sensor from direct long-term exposure to sun.
- Prevent condensation from forming by not exposing the sensor to any major fluctuations in temperature.
- Do not expose the sensor to the effects of any aggressive chemicals.
- Keep the lenses and reflector of the device clean. Clean with a soft cloth, using standard commercial glass cleaner if necessary.

We recommend to clean the optical surface and to check screw fittings and electrical connections at regular intervals.

The operating distance differs depending on the sensor. The correct operating distance can be found in the datasheet for the sensor to be installed.

The following two figures show the orientation of the sensor under extraneous light:

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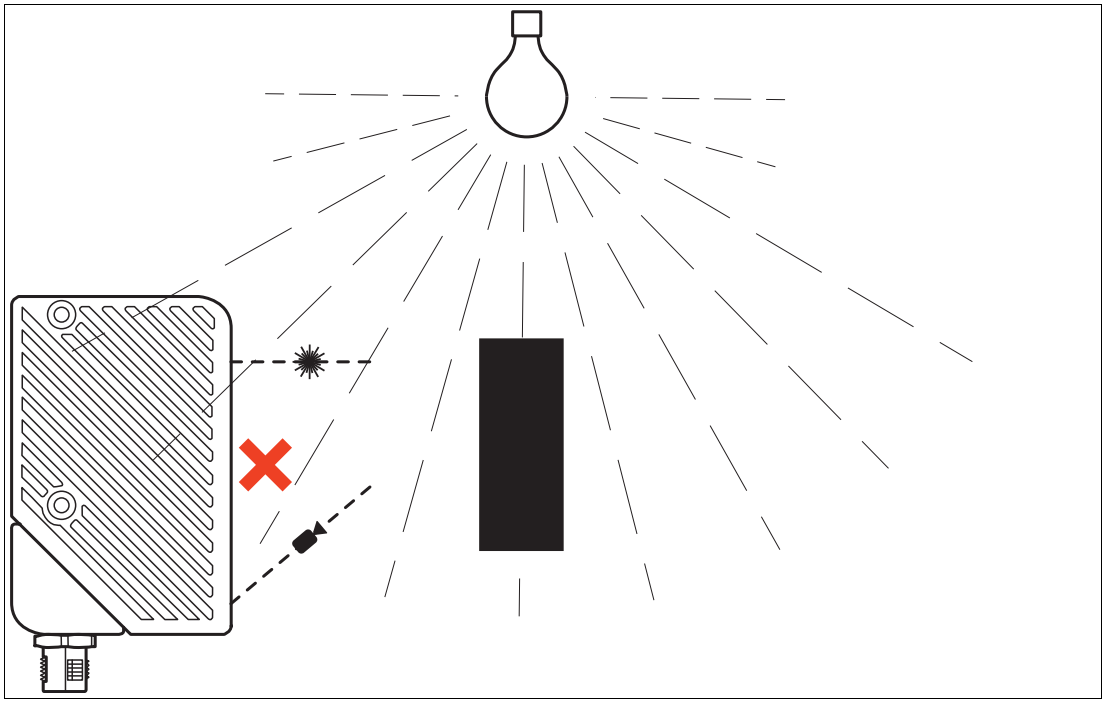

Figure 3.1 Incorrect orientation

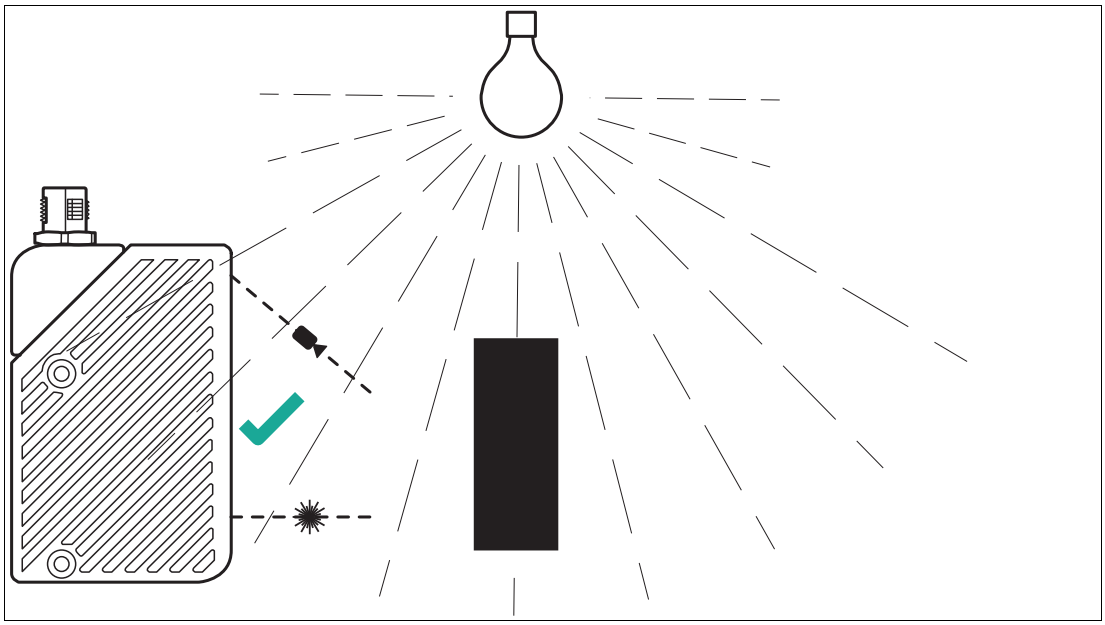

Figure 3.2 Correct orientation

The surface must be level to prevent the housing from becoming misaligned when the fittings are tightened. We advise securing the screws with spring disks to prevent the sensor becoming misaligned. Following installation of the sensor, ensure that there is still sufficient space to connect the connection cable to the sensor

Caution!

Damage to the equipment caused by improper installation!

Device components can be damaged if the permissible screw-in depths 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 incorrectly.

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

Mounting the Housing

The device has 2 M4 threads on the base and on both sides of the housing to allow easy installation of the sensor in your plant. This means there are 3 different ways to mount the sensor in your plant.

- One-sided lateral mounting with M4 screws: You can mount the housing on its right-hand or left-hand side using the 2 M4 threaded sleeves. The maximum screw-in depth of the M4 screws is 8 mm.
- Continuous lateral mounting with M3 screws: M4 threaded sleeves are designed in such a manner that M3 screws pass all the way through the housing. Use 2 sufficiently long M3 screws with 2 lock nuts to mount the device in the plant
- Mounting on the underside of the device with M4 screws: You can use the 2 threaded sleeves to mount the housing on the underside of the device. The maximum screw-in depth of the M4 screws is 5 mm.

Positioning the Sensor

When positioning the sensor, ensure that the camera's field of vision is not obscured by the objects being scanned.

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3.4 Electrical Connection

Connecting the Supply Voltage

The sensor is connected electrically via a **MAIN** 8-pin M12 connector plug on the bottom of the housing. The power supply and data transfer take place via this connection. To connect the sensor, proceed as follows:

1. Plug the 8-pin M12 socket into the plug on the bottom of the housing.
2. Screw the lock nut onto the connector as far as it will go. This ensures that the power cable cannot be pulled out inadvertently.

Tip

The corner of the housing where the **MAIN** 8-pin M12 connector plug is located can be rotated. Depending on the mounting position, you can rotate the connector plug in a different direction to ensure simple cabling.

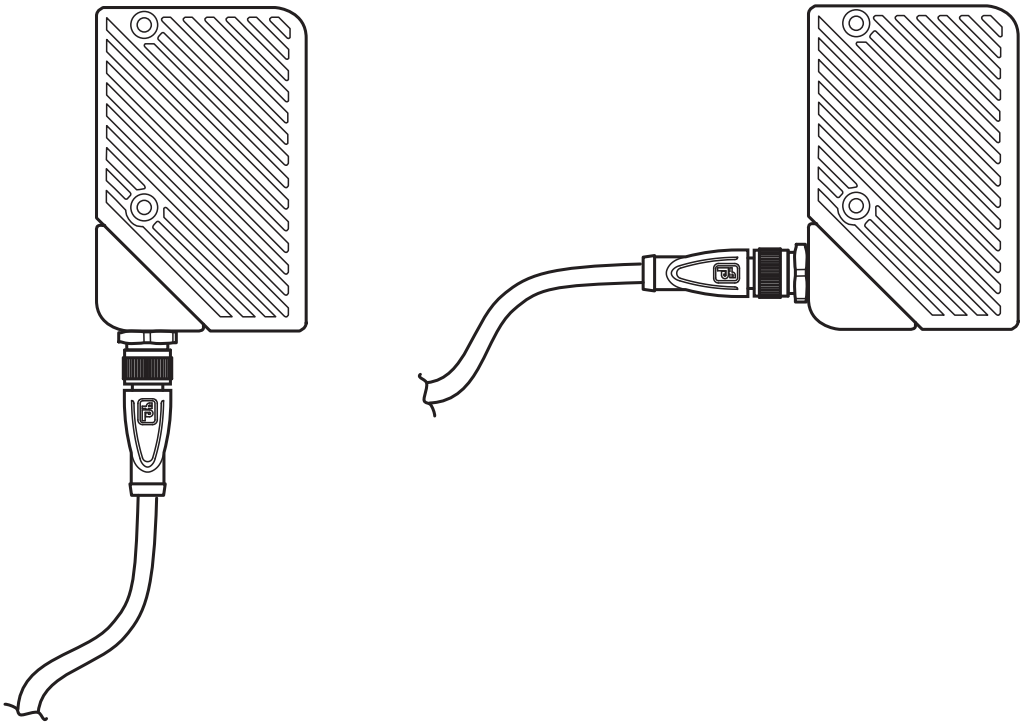


Figure 3.3 M12 connector plug

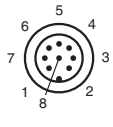


Figure 3.4 Connection layout

Pepperl+Fuchs single-ended female cordsets are manufactured in accordance with EN60947-5-2. When using a V19-G-5M-PUR-ABG single-ended female cordset with an open cable end, connector pins are assigned as follows:

Pin	Wire color	Signal	Description
1	white	IN trigger	Trigger input. Triggers an evaluation, if the sensor is in continuous evaluation mode (independent)
2	brown	+UB	+ 24 V power supply
3	green	Data+ RS-485	RS-485 interface: Data +
4	yellow	Data- RS-485	RS-485 interface: Data -
5	gray	Teach	Control signal for teaching in the background line
6	pink	Good	Output 1 is set if the height profile detected matches the taught-in profile in terms of form and position. Once the teach-in process has been performed, this output signals that teach-in was successful
7	blue	GND	Ground for the + 24 V power supply
8	red	Bad	Output 2 is set if: • No object has been detected or • The form detected does not match the taught-in form or • The position detected is outside the tolerance. Once the teach-in process has been performed, this output signals that teach-in has not been successful

Connection using the RS-485 Interface

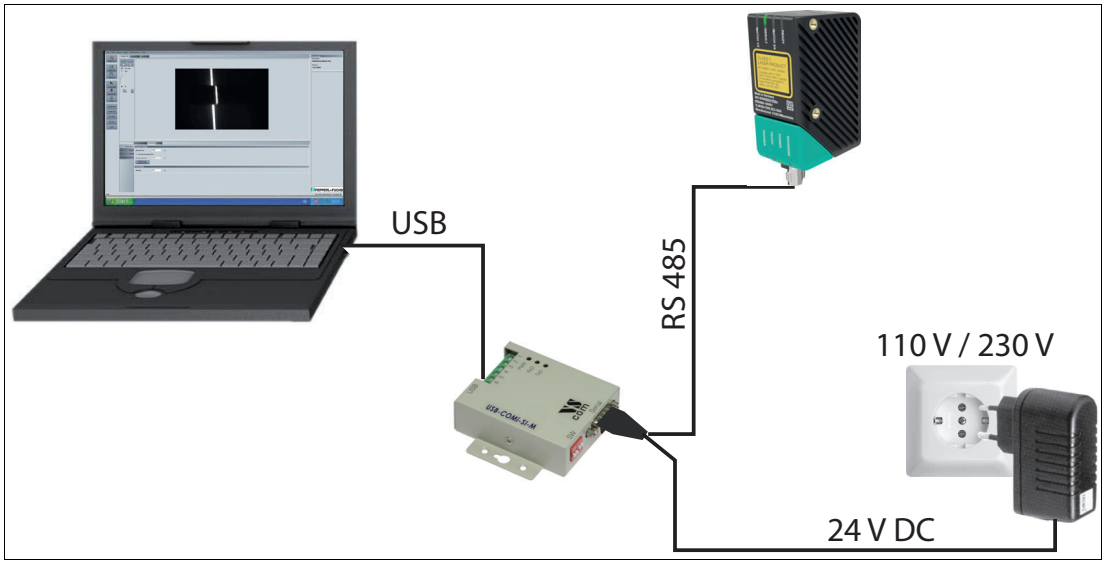


Figure 3.5 PCV-USB-RS-485 Converter Set

1. Plug a plug-in power supply into a socket and connect it to the interface converter.

   ↳ The indicator LEDs on the sensor light up.

2. Establish a USB connection between the PC system and interface converter.

   ↳ The PWR LED on the interface converter lights up red.

Caution!

Damage to the device

Connecting an alternating current or excessive supply voltage can damage the device or cause the device to malfunction.

Electrical connections with reversed polarity can damage the device or cause the device to malfunction.

Connect the device to direct current (DC). Ensure that the supply voltage rating is within the specified device range. Ensure that the connecting wires on the female cordset are connected correctly.

Shielding Cables

The shielding of connection lines is required to suppress electromagnetic interference. Establishing a low resistance or low impedance connection with the protective conductor or equipotential bonding circuit is a particularly important factor in ensuring that these interference currents do not become a source of interference themselves. Only use connection lines with braid. Avoid connection lines with foil shield because this would increase the line capacities. The shielding is integrated at both ends, i.e., in the switch cabinet or on the PLC, **and** on the read head. The grounding terminal available as an accessory allows easy integration in the equipotential bonding circuit.

In exceptional cases, the shielding of a connection at one end may be more favorable if:

- An equipotential bonding cable is not laid or cannot be laid.
- A film shield is used.

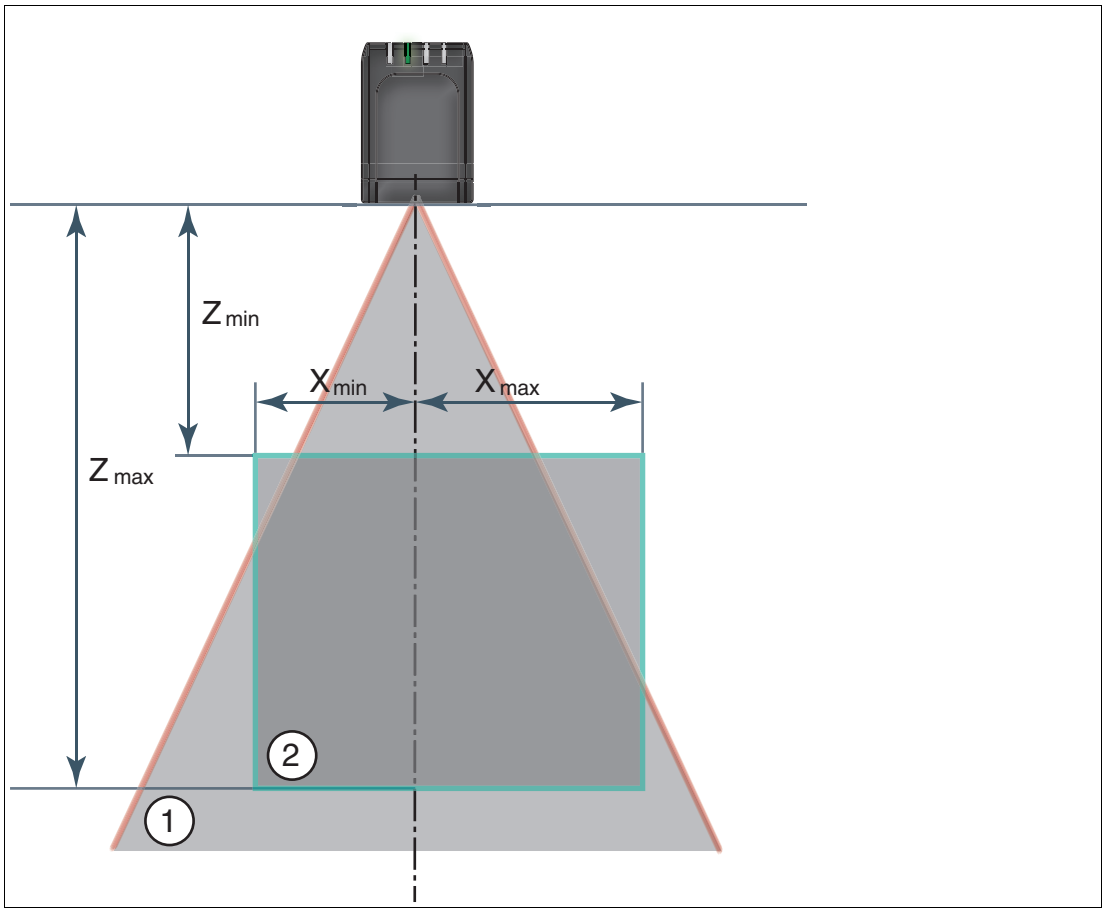
The following points relating to shielding must be noted:

- Use metal cable clips that cover large areas of the shielding.
- Place the cable shield onto the equipotential bonding rail immediately on entering the switch cabinet.
- Direct the protective grounding connections to a common point in a star configuration.
- The cross-section of the cables used for grounding should be as large as possible.

Additional Ground Connection

Order designation	Description
PCV-SC12	Clip for mounting an additional ground connection.
PCV-SC12A	

3.5 Detection Range



1 Field of view

2 Detection range

Note the detection range of the SmartRunner detector when planning your plant. The following table contains information on the detection range and the resolution.

	Detection range X	Distance Y to the sensor	Minimum object size
min	45 mm	55 mm	0.25 mm
max	350 mm	700 mm	1.0 mm

Note

The smallest possible object size increases linearly with the distance Y to the sensor.

4 Commissioning

4.1 Connecting the Sensor

The sensor is configured using the Vision Configurator software. You have the opportunity to carry out settings on the sensor directly using the Vision Configurator software.

Aligning the Sensor

Use the image display and diagram display in the Vision Configurator software to optimally align the sensor.

1. Power the reader via the 24 VDC socket on the device.
2. Use the automatic exposure time control to set an appropriate exposure value.

   ↳ If exposure time control was successful, the result LED will light up green.
3. Align the sensor so that a complete line that is as narrow as possible can be seen in the image display.

   ↳ The optimal reading distance between the sensor and the measurement object is set.

5 Vision Configurator Software

The sensor is commissioned and operated using the Vision Configurator software.

The Vision Configurator software makes it easy to operate the sensor with its user-friendly interface. Standard functions include making connections to the sensor, specifying the operating parameters, saving data sets, and displaying data and error diagnostics.

Note

The following user roles are predefined with different authorizations in the Vision Configurator.

User Rights and Password

User rights	Description	Password
Default	View all information Sensor configuration Create users at same or lower level	A password is not required
User	View all information Sensor configuration Create users at same or lower level	User
Admin	View all information Sensor configuration	Request the admin password from Pepperl+Fuchs

Table 5.1 The users have different access and administration rights depending on the respective user role.

Establishing a Network Connection

To establish a network connection with the sensor, proceed as follows:

1. Supply the sensor with power.
2. Start the Vision Configurator software.
3. Enter your user name and password.

Note

Additional steps for user-defined installation and installation of additional components are described in the Vision Configurator manual. The Vision Configurator manual can be found online at www.pepperl-fuchs.com.

5.1 Connecting to Vision Configurator

Connect Vision Configurator

1. Connect the SmartRunner to a PC.

Note

Use a suitable RS-485/USB connecting cable and an adapter cable to do this:

Function	Order designation
USB interface converter to RS-485 including cable unit with power supply	PCV-USB-RS485-Converter Set
Cable unit with power supply for USB/RS-485 interface converter	PCV-KBL-V19-STR-RS485

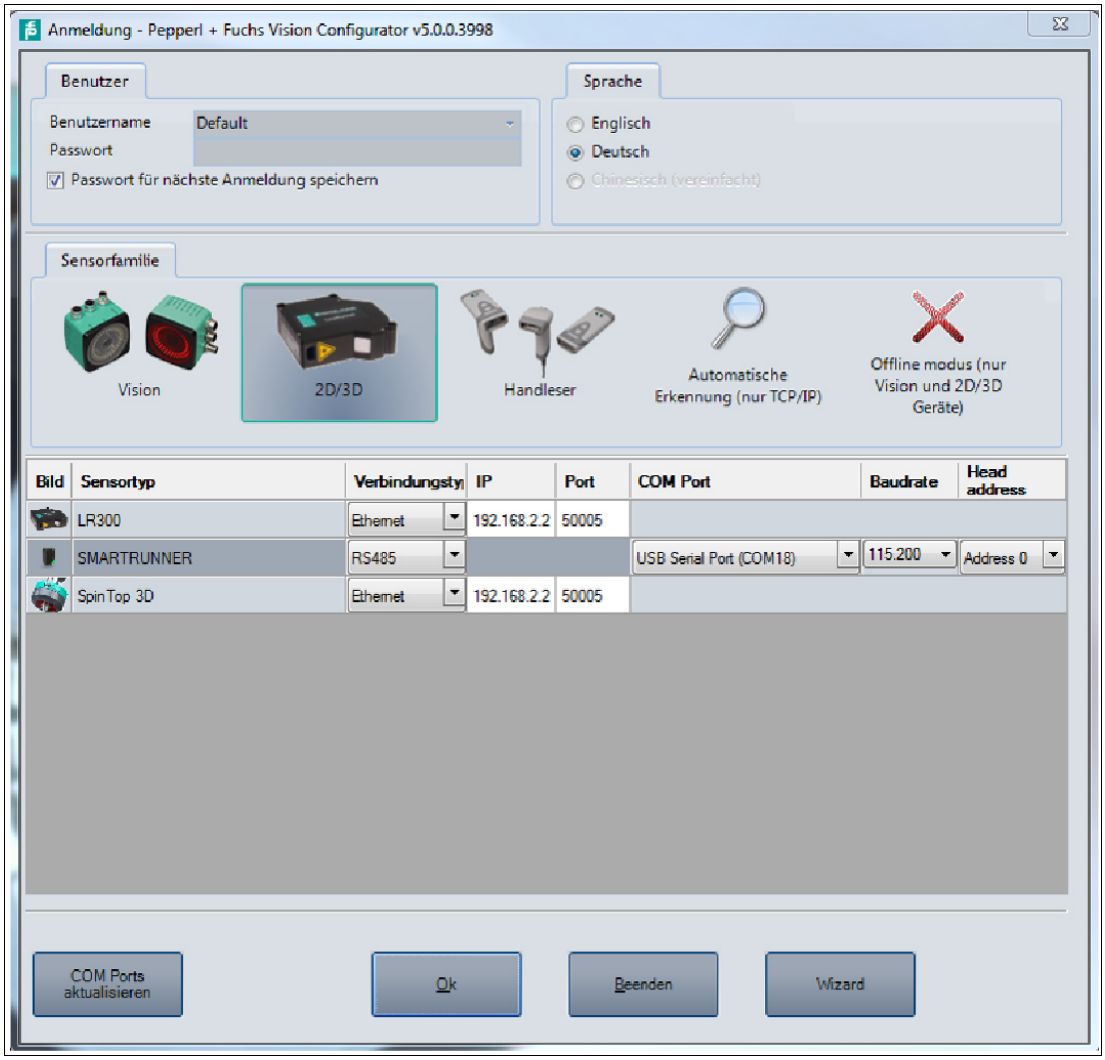


Figure 5.1 Home screen

Wizard - Operation assistant for Vision Configurator

The **Wizard** complements the Vision Configurator configuration software. Double-click on the Wizard button to launch the operation assistant. You will be guided step-by-step through the individual settings.

Proceed as follows to launch the Vision Configurator.

Starting Vision Configurator

1. Select the **2-D/3-D** button on the "Sensor Family" tab.
2. Select **SMARTRUNNER** in the "parameter range" with connection type **RS485**.
3. Select the required **COM port**.
4. In the **Baud rate** window ensure that the value **115,200** is set. Otherwise select the value.
5. In the **Head address** window, ensure that the address is set to **Address 0**. Otherwise select the address.
6. Use the **OK** button to confirm your settings.

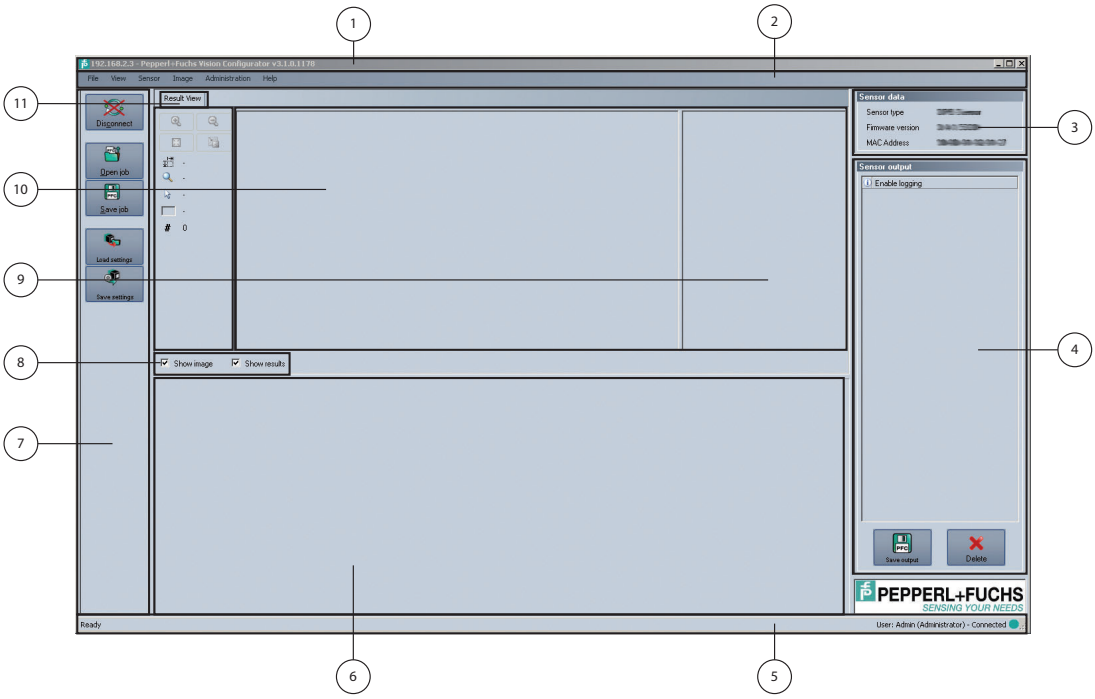
   ↳ The application window will open.

5.2 Application Window Structure

The application screen opens after you log in.

Note

The individual functions depend on the type of sensor connected and the current authorization level, so they are not always all visible.



The software is designed to be similar to most Windows applications.

1	Title bar	• Shows the IP address, the software name, and the version number • Contains the **Minimize/Maximize/Close** buttons
2	Menu bar	• Displays all the menus in the program • Provides an overview and helps with navigation
3	**Sensor data** screen	• Displays data for the connected sensor
4	**Sensor output** screen	• Shows the log display
5	Status bar	• Displays status information about the application
6	Configuration window	• Contains the sensor-specific parameters that you can set
7	Toolbar	• Contains icon buttons as an extension to the menu
8	Check boxes	• **Show images**: Enables or disables the image display • **Show results**: Enables or disables the results area
9	Results area	• Displays results from the sensor • A varying number of tabs can be displayed depending on which sensor is connected • This field can be enabled or disabled via **Show results**

10	Image display	• Displays the images captured or stored in the error memory • This field can be enabled or disabled via **Show images**
11	Tab	Displays information about the current image and the pixel under the mouse pointer. The following items are displayed: • Image size • Zoom level • Mouse position in image coordinates • Current grayscale value • Image number

5.3 Menu Bar

The menu bar contains a list of menu items. The functionality depends on the type of sensor that is connected and the permissions of the user logged in.

Figure 5.2 Menu Bar

5.3.1 *File* Menu

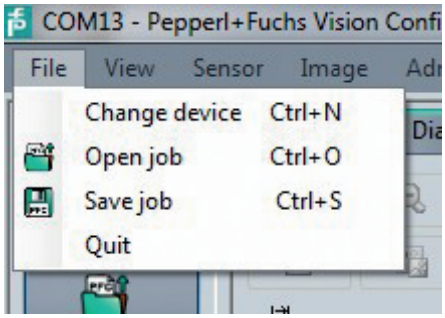


Figure 5.3 **File** Menu

Change device	Disconnects the device and returns to the Login dialog.
Open job	Loads a sensor configuration stored on the PC.
Save job	Saves the current sensor configuration on the PC.
Quit	Terminates the program.

Table 5.2 **File** Menu

5.3.2 *View* Menu

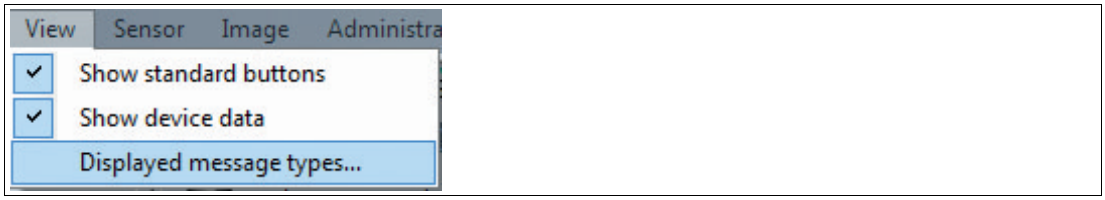


Figure 5.4 **View** Menu

Show standard buttons	Toggles the display of the buttons in the bar on the left on and off.
Show device data	Hides the display of the sensor data in the top right of the screen.
Displayed message types...	Opens a selection window in which the following display windows can be activated or deactivated: Info, Result OK, Result not OK, Warning, Error, Critical, Assert.

Table 5.3 **View** menu

5.3.3 *Sensor* Menu

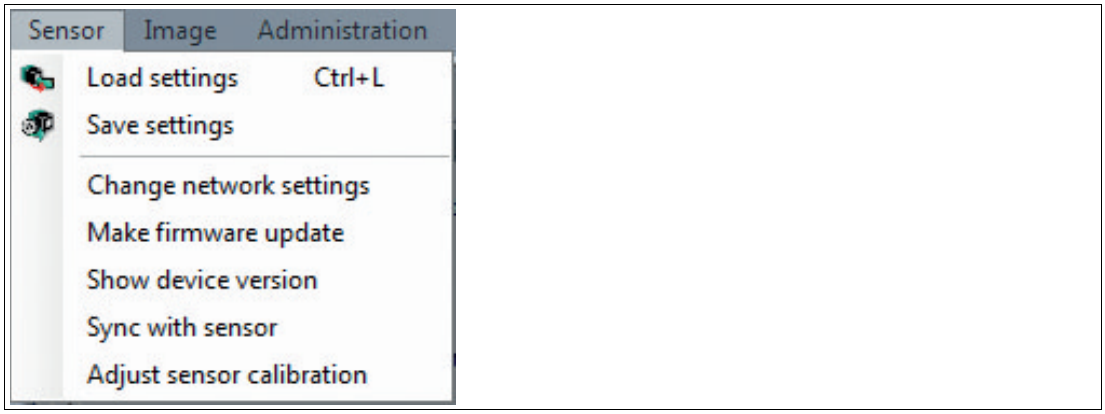


Figure 5.5 **Sensor** menu

Load settings	Loads the saved settings from the sensor
Save settings	Saves the settings to the sensor
Change network settings	Change the network settings. The settings window allows you to set the IP address, subnet mask, gateway address, and DHCP
Make firmware update	Performs firmware updates. This command should be used by experienced users only
Show device version	Displays the device version
Sync with sensor	Synchronization with the sensor
Adjust sensor calibration	Adjust the sensor calibration

Table 5.4 **Sensor** menu

Note

Firmware Update

Once you have upgraded the firmware and **Update complete** is displayed, restart the sensor.

5.3.4 *Image* Menu

Figure 5.6 **Image** menu

Load imagefile	Loads the image file
Open image folder	Opens the folder in which images are currently saved
Save image	Saves the image currently displayed on the PC
Copy image to clipboard	Loads an image file to the clipboard
Upload image to device	Uploads an image to the device
Show graphic	Switches display data sent from the sensor on and off in the image.

Table 5.5 **Image** menu

5.3.5 *Administration* Menu

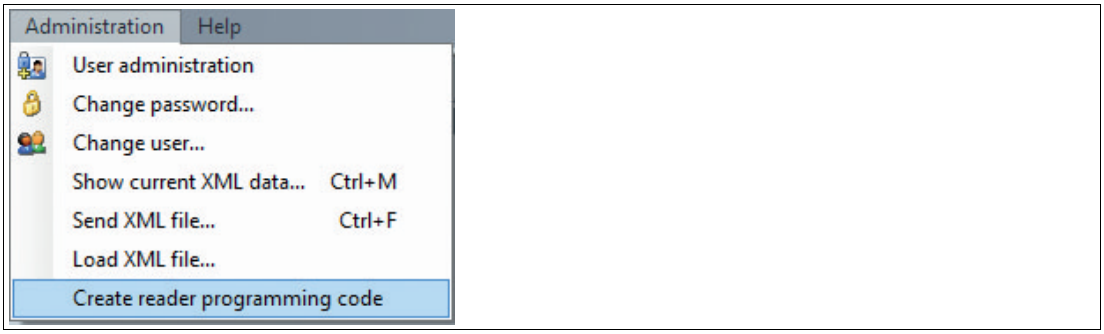


Figure 5.7 **Administration** menu

User administration	Opens a window that shows all currently created users at the same authorization level or lower. New users at the same authorization level or lower can also be created and deleted here. In addition, a user password can be reset to the default password for the relevant user level.
Change password	Changes the current user's password.
Change user	The login screen opens and a different user and/or sensor can be selected.
Send XML file...	Saves the XML data on a computer.
Load XML file...	Loads XML data from a computer.
Create reader programming code	Creates a reader programming code

Table 5.6 **Administration** menu

5.3.6 *Help* Menu

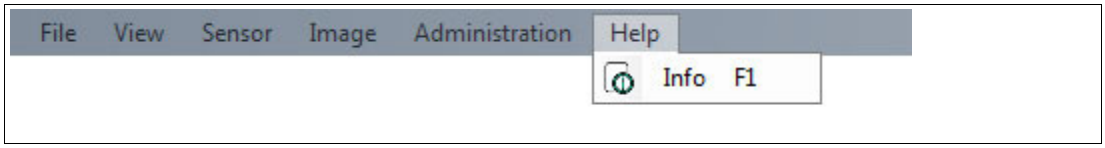


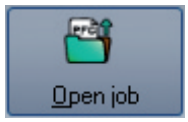
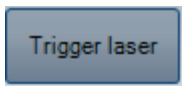
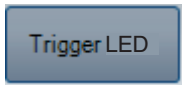
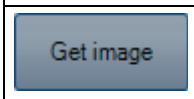
Figure 5.8 **Help** menu

Info	Displays information about Vision Configurator.

Table 5.7 **Help** menu

5.4 Toolbar

The toolbar can be used to select various functions.

	Selecting the Connect button establishes a connection between the PC and the sensor.
	The connection between the PC and the sensor is disconnected.
	Opens a saved setting.
	Saves the settings made.
	Settings are read out from the sensor.
	All settings made are saved on the sensor.
	Reset to default settings.
	Perform manual trigger.
	Perform LEDs trigger Caution: If autotrigger is activated, a line image will be issued using the "Trigger LED."
	Current sensor image is loaded.

Get lines	The line image is loaded.
Teach	Profile is taught in using the next trigger.

5.5 Sensor Data

This section shows the connected device type and firmware version.

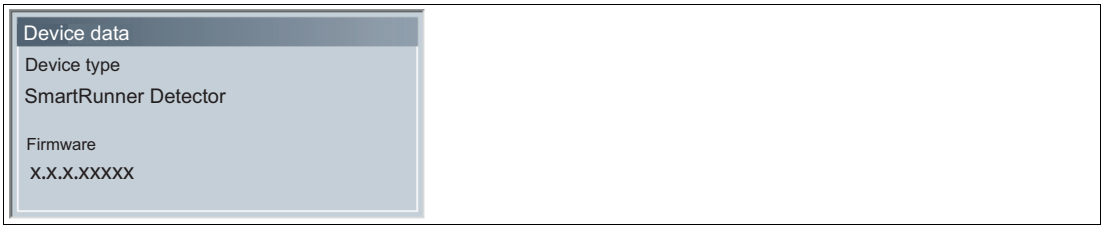


Figure 5.9 Device data

5.6 Image Display

Image View

Displays image data. Selected via the "Image View" button. "Get image" loads the last captured image on the PC and displays it in the window. To capture a new image, "Trigger" must have been clicked.

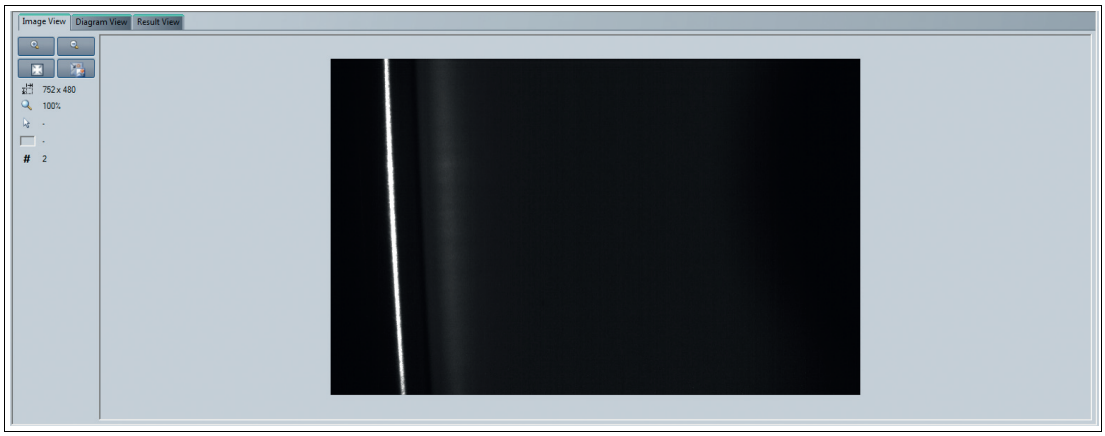


Figure 5.10 Image View

Diagram View

Displays the results data in graphical form. The results data is retrieved by clicking "Get lines". The most recent results are then retrieved and displayed graphically. The "Get lines" function does not trigger a new image capture and evaluation process. "Trigger" must have been clicked in order to do this.

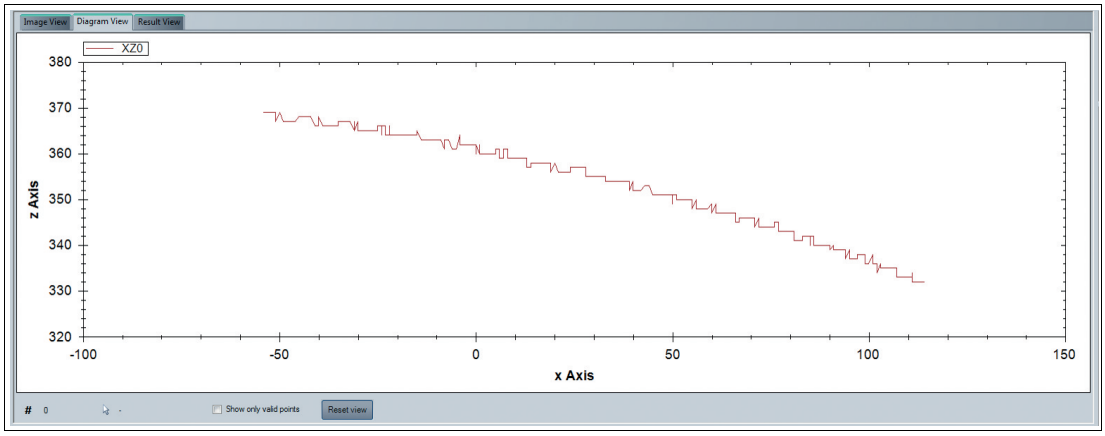


Figure 5.11 Diagram View

Result View

Displays the results of the image evaluation. "Start request" starts the transfer.

Figure 5.12 Result View - Start request

"Stop request" stops the transfer.

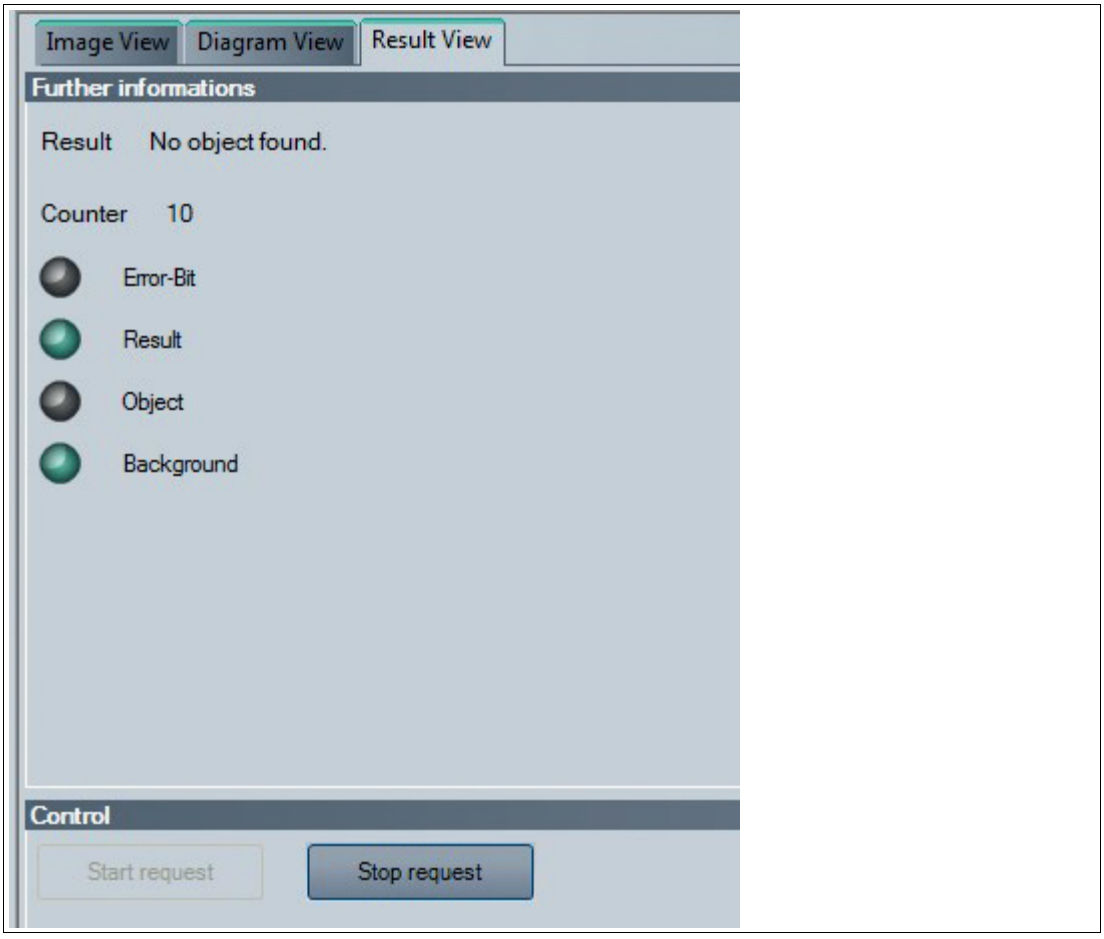


Figure 5.13 Result View

5.7 Configuration window

Various parameters are specified in the configuration window. The individual parameters depend on the current authorization level and are, therefore, not always all visible. Some features are available in different variants only. Depending on the parameters set, some fields will be grayed out.

5.7.1 Sensor Information

Sensor Information Tab

Name: "Pepperl+Fuchs GmbH"

Homepage: "http://www.pepperl-fuchs.com/"

Product name: "Smartrunner"

Firmware version: Current firmware version of the main processor.

The version designation as a whole is made up as follows: Major Version.Minor Version.

Tag Number– Revision Number

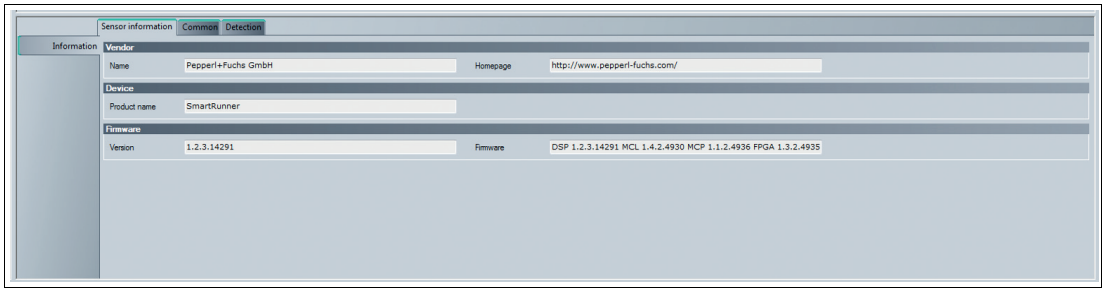


Figure 5.14 Sensor Information Tab

5.7.2 Common Tab

There are 4 menu items available under the **Common** tab. The purpose of this section is to present the menu items in detail.

Communication menu item

You can adjust the connection parameters between the sensor and computer under the **Communication** menu item.

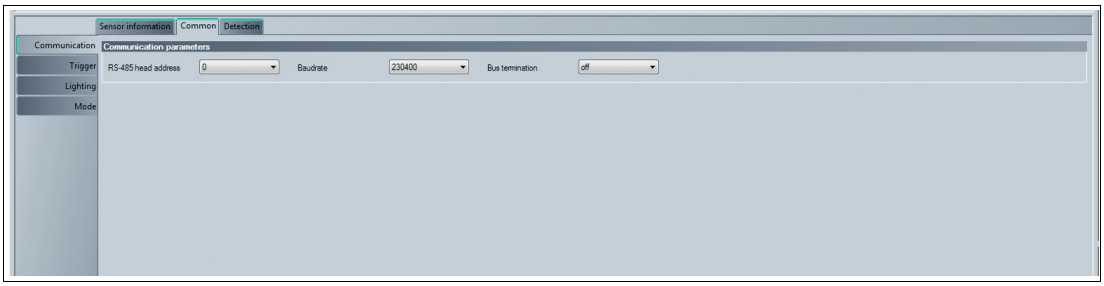


Figure 5.15 Communication menu item

Designation	Function
RS-485 head address	Address in the RS-485 bus. The address is sent with every RS485 command (see chapter 2.5) and is used for identification purposes if multiple sensors are installed in the bus.
Baud rate	Data transfer speed setting. The default value of the sensor is 115200 bps. When you change the baud rate, the baud rate of the Vision Configurator is automatically changed so that communication remains possible.
Bus termination	Activates the integrated terminating resistor to terminate the RS-485 bus on the sensor

Trigger menu item

You can enable or disable the autotrigger under the **Trigger** menu item.

Figure 5.16 Trigger menu item

Designation	Function
Autotrigger	A cyclic trigger is activated when the check mark is set.

Illumination menu item

You can adjust the sensor's exposure under the **Illumination** menu item.

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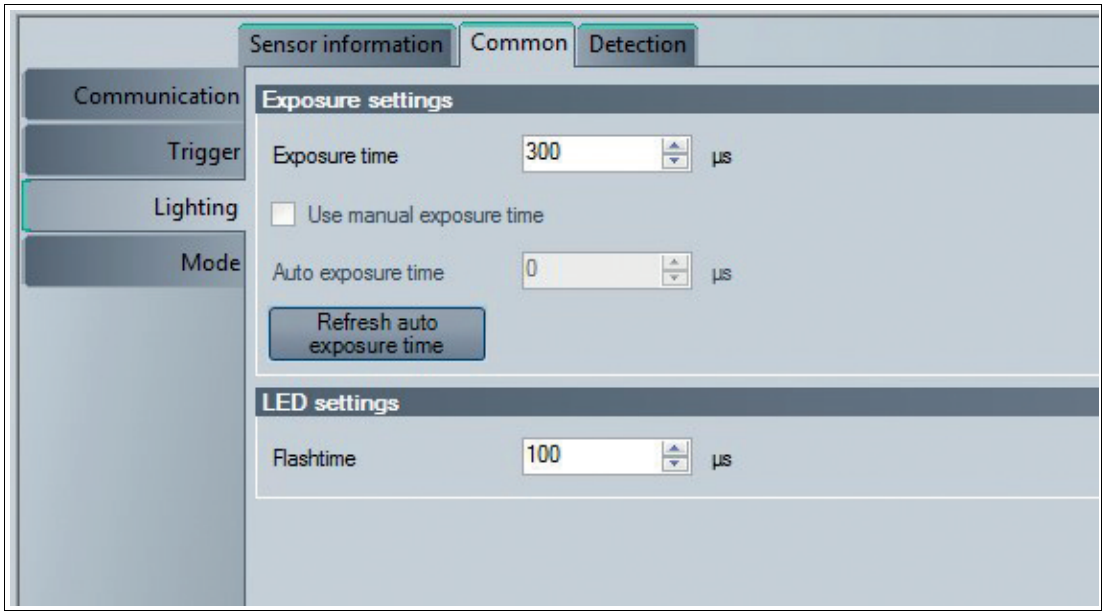

Figure 5.17 Illumination menu item

Bezeichnung	Funktion
Exposure time	Setting the manual exposure time. The "Use manual exposure time" function must be activated to manually adjust the exposure time. By increasing the value, the exposure time and thus the image brightness increase. Values below 1000 µs are suitable in most cases
Use manual exposure time	When enabled, the manually set exposure time is used. If this box is not checked, the exposure time during the teach-in process is controlled automatically
Auto exposure time	The current exposure time is output in this field
Refresh auto exposure time	The "Auto exposure time" field is updated by pressing the button

Mode menu item

You can enable or disable "Presentation mode" and "function keys 1 and 2" under the **Mode** menu item. "Presentation mode" and "function keys 1 and 2" are activated if checked and deactivated if unchecked.

Figure 5.18 Mode menu item

Designation	Function
Presentation mode	Mode of operation for presentation or testing without the assistance of a PC

5.7.3 Detection

Detection Tab

General tab for configuring the camera

"Detection" Tab

Figure 5.19 Detection tab—Detection

- **Minimum object size**: camera setting, adjust the resolution to the object size.

"ROI" Tab

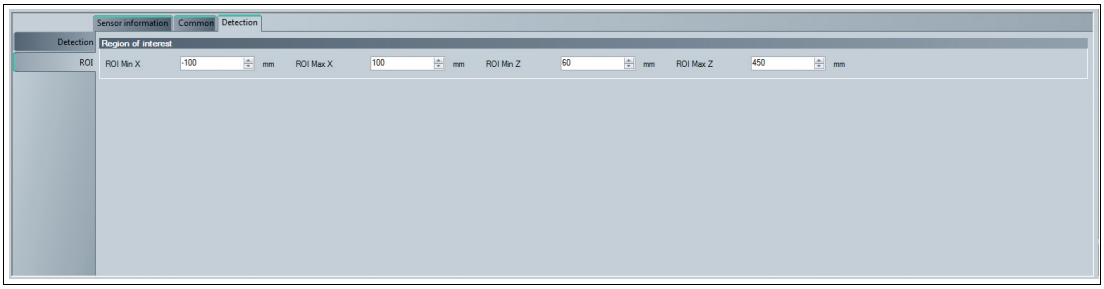

Figure 5.20 Detection tab—region of interest

- **ROI**: defines the detection area

6 Operation

6.1 Configuration Mode

To adjust the sensor, it must be in configuration mode.

The command to put the sensor in this mode is 0xA8 0x57. After successfully changing mode, the sensor responds with an Acknowledge (0x81 0xAC 0x00 0x2D). After an error when converting the configuration, the sensor responds with a No Acknowledge (0x81 0x53 0xXX 0xYY, where XX = error code and YY = checksum). To check whether the sensor is in configuration mode, the command Is_In_Config_Mode (0x00 0xFE 0xFE) can be sent. If the sensor is in configuration mode, it responds with an Acknowledge, otherwise there is no response.

Error codes with "No Acknowledge":

0x00 = everything OK
0x01 = checksum incorrect
0x04 = parameter has a different length than that transferred
0x05 = internal error
0x06 = parameter index is unknown
0x07 = read/write access, although not allowed
0x09 = parameter value range is violated
0x0B = other error
0x0E = configuration command too long/short

In configuration mode, messages are sent according to the extended protocol:

Byte/ bit	8	7	6	5	4	3	2	1	0
1	Parity	R/W	Length6	Length5	Length4	Length3	Length2	Length1	Length0
2	Parity	Index7	Index6	Index5	Index4	Index3	Index2	Index1	Index0
3	Parity	Data 1.7	Data 1.6	Data 1.5	Data 1.4	Data 1.3	Data 1.2	Data 1.1	Data 1.0
...	Parity	...	...	...	...	...	...	...	...
n	Parity	Data (n-2).7	Data (n-2).6	Data (n-2).5	Data (n-2).4	Data (n-2).3	Data (n-2).2	Data (n-2).1	Data (n-2).0
n+1	Parity	xor B1.7...B (n).7	xor B1.6...B (n).6	xor B1.5...B (n).5	xor B1.4...B (n).4	xor B1.3...B (n).3	xor B1.2...B (n).2	xor B1.1...B (n).1	xor B1.0...B (n).0

Table 6.1

R/W:
0: write
1: read/command
Length: row data length (Data1 ... Data(n-2))

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Description of Messages

Index	Parameter name	Data Length/ bytes	Read/ write	Description
0x01	VendorName	Variable	R	String containing "Pepperl+Fuchs"
0x02	VendorHomepage	Variable	R	String containing the Pepperl+Fuchs homepage
0x03	ProductName	Variable	R	String containing the product name
0x07	SoftwareVersionDSP	Variable	R	String containing the version information
0x64	Trigger	-	W	Triggers an image capture with evaluation
0xE0	GetImage	-	W	Loads the current image from the sensor
0xFE	InParamMode	-	R	Queries whether the sensor is in parameterization mode
0xF3	Save settings	-	W	Saves the current settings in the flash memory
0xFF	LeaveParamMode	-	W	Request to exit parameterization mode
0x20	Interface_Address	1	R/W	Set the bus address, value range 0-3
0x23	Interface Baudrate	4	R/W	Baud rate int32 little endian in baud (9600 - 230400)
0x25	Termination enable	1	R/W	Enable/disable termination of the RS-485 bus
0x68	Laser exposure time	4	R/W	Sets the exposure time in µs increments
0x10	Flash time	4	R/W	Sets the exposure time (LED lighting) in µs
0xFD	Presentation mode	4	R/W	Presentation mode on [0] or off [1]
0x6D	Go to teach mode	-	W	Puts the sensor in teach-in mode
0xC8	ROI Evaluation	16	R/W	"Region of interest" evaluation, 4 bytes in each case: X_{min}, X_{max}, Z_{min}, Z_{max} in mm
0xC6	MinObjectsize	4	R/W	Minimum object size in 0.1 mm increments. All smaller objects are ignored
0xC7	Background tolerance	4	R/W	Tolerance band around the background line in 0.1 mm increments
0x9F	Switching threshold	4	R/W	Sensitivity for object detection in % [0 - 100]
0x51	Autotrigger	4	R/W	Activates the autotrigger function. When enabled, the sensor triggers itself cyclically.

Note

All values are transferred in little-endian format. This saves the least significant byte at the lowest address, i.e. the least significant component is specified first.

Example

ROI for evaluation: Sets the ROI to ±50 mm in the X direction and to between +100 mm and +200 mm in the Z direction:

`0x 10 C8 CE FF FF FF 32 00 00 00 64 00 00 00 C8 00 00 00 77`

`0x10` = data length

`0xC8` = Index

`0xCEFFFFFF` = X_{min} -50 mm (little-endian, two's complement)

`0x32000000` = X_{min} +50 mm (little-endian, two's complement)

`0x64000000` = Z_{min} +100 mm (little-endian, two's complement)

`0xC8000000` = Z_{min} +200 mm (little-endian, two's complement)

Response telegram:

13.02.2017 11:39:17.68 [TX] `-80 C8 48`

13.02.2017 11:39:17.69 [RX] `-90 C8 CE FF FF FF 32 00 00 00 64 00 00 00 C8 00 00 00 F7`

6.2 Code Card Mode

The built-in camera function including LED lighting allows for parameterization using Data Matrix control codes. The control codes are generated using the "Vision Configurator" operating software. All sensor parameters can be specified in a Data Matrix control code. For this purpose, the Data Matrix control code is placed in front of the camera. The control code is registered immediately and decoded. The sensor automatically activates the parameters contained within. So a large number of sensors can be put into operation easily and quickly.

Note

Combination of several parameters in a control code

Combining several parameters in a control code reduces the resolution of the code, which can affect readability by the sensor. It is therefore important to limit the number of parameters per control code. If the number is too large, the parameters should be divided between several control codes.

If all parameters are enabled, a minimum of 3 control codes for the parameters and 1 additional control code for "Save settings" are required for reliable detection.

Tip

It is also possible to generate control codes when no sensor is connected to Vision Configurator. In this case, you can, for example, generate a control code to assign a particular IP address to a sensor and then establish a connection with a PC.

Generating a control code

1. In the menu bar, select **Administration > Create reader programming code**.
2. In the **Device type** section, select sensor type **SMARTRUNNER**.
3. Select the required parameters in the **Select function** section.

   ↳ The control code is displayed in different sizes in the **Control Code** section.
4. To print the control code, click **Print** or **Print preview**.
   To save the control code, click **Save image**.

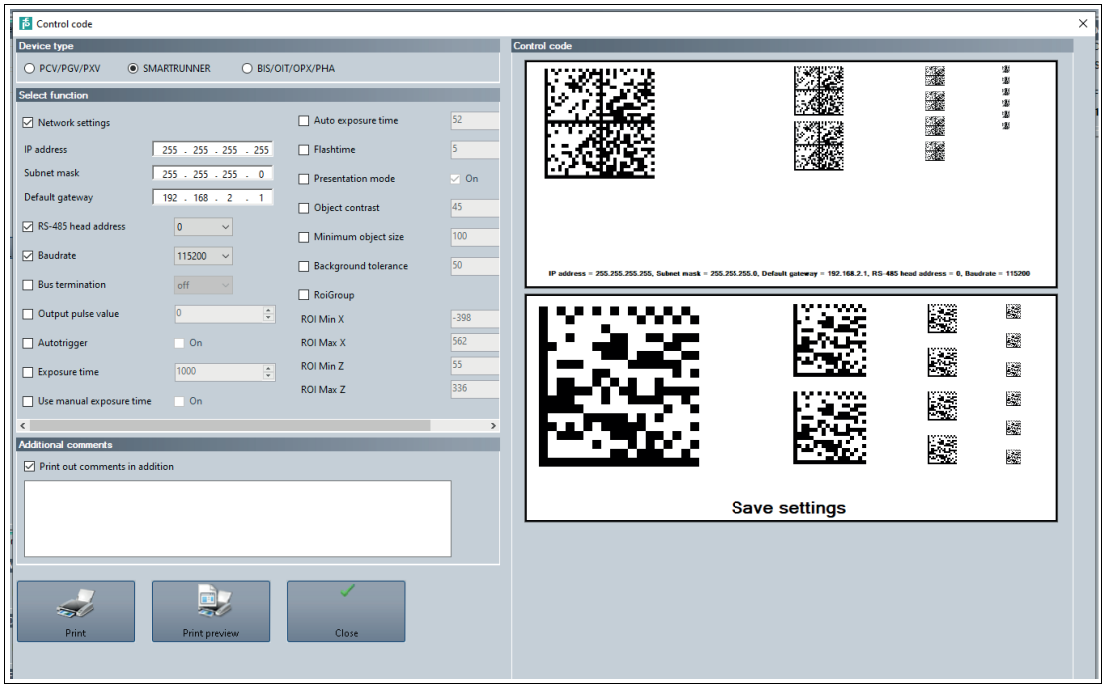

Figure 6.1 Generating a control code

6.2.1 Setting Device Parameters via Control Code

Use Vision Configurator to generate control codes.

Note

Parameterization mode can be activated only within 10 minutes of the sensor being switched on.

Enabling Code Card Mode

1. Hold down the **2** button on the back of the sensor for more than 2 seconds. Then release the button.

   ↳ The Ready LED flashes rapidly and the sensor's camera system begins to flash.

Setting Parameters

1. To assign a parameter, position the relevant control code in the sensor's field of view.

   ↳ If a valid code is detected, the Result LED lights up green briefly
   If an invalid code is detected, the Result LED lights up red briefly

2. The modified parameter is now saved in the sensor's volatile memory. The "Save settings" control code saves the parameter in the non-volatile memory if necessary.

Disabling Code Card Mode

1. Press the **2** button on the back of the sensor.

   ↳ The Ready LED stops flashing and the camera system stops flashing.

6.3 Presentation Mode

You can demonstrate or test the sensor in Presentation mode without the assistance of a PC. Furthermore, the control buttons are activated/deactivated.

Setting Presentation Mode

1. Connect the sensor to a power supply.
2. Align the sensor to the measurement object.
3. Teach in the measurement object by tapping button 2 on the sensor.

Figure 6.2 Result LED

↳ The result LED lights up red.

4. Press button 1.

↳ The trigger is activated. The result LED lights up green. The measurement object is taught in.
The result LED lights up red if the profile contour deviates.

Note

If the autotrigger is activated in the Vision Configurator operating software, you just need to press button 2 to teach in the measurement object. If the autotrigger is deactivated, the trigger must be activated by pressing button 1 once the measurement object has been taught in.

6.4 Communication via the RS-485 Interface

The control panel and reader communicate via the RS-485 interface during operation. Make sure that the basic communication settings have been made on the reader, such as setting the reader address and baud rate.

A distinction is made between request telegrams that the control panel sends to the reader and response telegrams that the reader sends to the control panel. Each byte of a request or response telegram consists of 9 bits (8 data bits + 1 parity bit).

Parity Bit

A bit assigned to a binary string used to detect errors. It is added in such a way that the sum modulo 2 of all bits that are regarded as binary digits in the string, including the parity bit, is either 0 or 1 depending on the requirement; additional bit that is added to each string or each byte for control purposes so that the sum of all bits containing binary 1 in the characters or bytes including control bit results in an odd or even value.

6.4.1 Request Telegram

A request telegram always consists of 2 bytes. The second byte corresponds to the first byte, however the 8 data bits of the first byte are inverted.

Structure of a Request Telegram

		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Parity	R/W	Req. bit 4	Req. bit 3	Req. bit 2	Req. bit 1	Req. bit 0	A1	A0
Byte 2	Parity	~R/W	~Req. bit 4	~Req. bit 3	~Req. bit 2	~Req. bit 1	~Req. bit 0	~A1	~A0

Meaning of bits:

R/W: 0 = response, 1 = request

Meaning of Bits

8	7	6	5	4	3	2	1	0	<- Bit	
PAR	R/W	R.4	R.3	R.2	R.1	R.0	A.1	A.0	Value	Function
Parity	0	x	x	x	x	x	x	x		Answer
Parity	1	x	x	x	x	x	x	x		Request
Parity	1	x	x	x	x	x	0	0		Read head addr. 0
Parity	1	x	x	x	x	x	0	1		Read head addr. 1
Parity	1	x	x	x	x	x	1	0		Read head addr. 2
Parity	1	x	x	x	x	x	1	1		Read head addr. 3
Parity	1	0	0	0	0	0	x	x	0x80	Status (is alive)
Parity	1	0	0	0	0	1	x	x	0x84	Result data
Parity	1	0	0	1	0	1	x	x	0x94	Teach
Parity	1	0	1	0	1	0	x	x	0xA8	Enable Configuration Mode
Parity	1	1	0	1	1	0	x	x	0xD8	Generate a software trigger

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6.4.2 Response Telegram

The response telegram may contain 6 to 9 bytes, depending on the content. The first byte contains the address of the responding reader and status information. The X position of the reader is transmitted in bytes 2 to 5, starting with the MSB. Depending on the controller request, information such as speed and the Y position is transmitted in the subsequent bytes. These bytes are omitted if a corresponding request is not sent. The last byte is used to detect faults during the data transfer.

Status (is alive)

The status always returns 0x55 if the sensor is ready for operation.

	8	7	6	5	4	3	2	1	0
Byte	PAR	R/W	R.4	R.3	R.2	R.1	R.0	A.1	A.0
1	Parity	0	1	0	1	0	1	0	1

Result Data

Result Data provides the measurement status and result as a response.

Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1 - Status	Parity	0	-	Addr 1	Addr 0	Event	WRN	No Pos.	ERR
Byte 2 - Result	Parity	0	0	R5	R4	R3	R2	R1	R0
Byte 3 - Counter	Parity	0	C06	C05	C04	C03	C02	C01	C00
Byte 4 - Checksum	Parity	0	xor	xor	xor	xor	xor	xor	xor

Legend

Status	Addr	Device address
	Event	Event occurred, currently read as 0
	WRN	Unused
	No Pos.	Is always read as 0
	ERR	System error or evaluation error
Result	R0	Faulty background line
	R1	Object detected
	R3	Unused
	R4	Unused
	R5	Unused
Counter		Increments for each evaluation, is restarted at 0x3F

Software Trigger

After sending the sequence for the software trigger, the sensor triggers an image capture. No response telegram is generated to the command.

Teach-In

After sending the sequence for the teach-in, the sensor begins the teach-in routine. No response telegram is generated to the command.

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.

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8 Troubleshooting

8.1 What to Do in Case of a Fault

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

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

Checklist

Fault	Cause	Remedy
"Power" LED does not light up	The power supply is switched off	Check whether there is a reason why the power supply is switched off (installation or maintenance work, etc.). Switch on the power supply if appropriate.
	Wiring fault in the splitter or control cabinet, cable break	Check the wiring carefully and repair any faults with the wiring. Check the cable to ensure proper function.
Control panel receiving no measurement data	Connection cable not connected	Connect the connection cable.
	Incorrect connection cable used	Use the appropriate connection cable only.
	Incorrect baud rate set	Make sure that you have set the correct baud rate for the sensor.
Measurement object not recognized	Protective cover dirty	Clean protective cover.
	Reflections	Avoid reflections
	Foreign exposure	Avoid foreign exposure
	Exposure time control	Set exposure ()
	Teach-in range set incorrectly	Set teach-in range ()
	Evaluation range set incorrectly	Set evaluation range ()
	Tolerance range set incorrectly	Set tolerance range ()
Measurement errors	Surfaces with pronounced scored structure and reflective surfaces	Improved arrangement of sensor components to the measurement object
	Temperature change in the sensor	Allow sensor to warm up for around 15 minutes before the measuring process is started.
	Incorrect distance to the measuring object	Note distance values
	Housing incorrectly mounted	Install housing correctly (see chapter 3.3)
Presentation mode not working	Presentation mode not activated	Enable **Presentation mode** and **Autotrigger** and confirm using "Save settings"
No connection to the sensor	AC voltage or supply voltage too high	Connect sensor to direct current (DC) only. Ensure that the level of supply voltage is within the specified sensor range.
Data Matrix control code is not detected	Maximum number of parameters exceeded	We recommend a maximum of 10 parameters

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

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