

2-D LiDAR Sensor R2000 Measuring Sensors

Manual



Your automation, our passion.

 **PEPPERL+FUCHS**

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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 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 Safety

2.1 Safety Information

Read the following information carefully and follow this information when working with the device. Failure to observe the safety notices and warning messages in this documentation can lead to malfunctions and hazardous operating scenarios during operation.

This can result in serious personal injury or death.

Target Group, Personnel

The personnel must be appropriately trained and qualified in order to carry out mounting, installation, commissioning, operation, maintenance, and dismantling of the device. The trained and qualified personnel must have read and understood the instruction manual.

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

Reference to Further Documentation

Observe laws, standards, and directives applicable to the intended use and the operating location.

Intended Use

The R2000 2-D LiDAR sensor is a 360° measuring instrument with an all-round display. It is used on automated transport systems or other movable machinery in intralogistics. It is also used on stationary equipment in the area of factory and building automation.

The device is only approved for appropriate and intended use. Ignoring these instructions will void any warranty and absolve the manufacturer from any liability.

Operation, Maintenance, Repair

Do not remove the nameplate.

Do not remove the warning markings.

Do not repair, modify, or manipulate the device.

If there is a defect, always replace the device with an original device.

Only use accessories specified by the manufacturer.

When using the device with rack feeders and moving carriages, observe the applicable safety guidelines for these applications.

Supply the device with a power supply that meets the requirements for safety extra-low voltage (SELV) or protective extra-low voltage (PELV).

Do not point the device directly at the sun. Do not use the device to conduct measurements into the sun.

Delivery, Transport, Disposal

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

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.

2.2 Laser Class 1

Class 1 Laser Product

This sensor is certified according to laser protection class 1.



Warning!

Class 1 laser light

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

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

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

Caution: Use of controls, adjustments, or performance of procedures other than those specified herein may result in harmful laser beam exposure.

3 Product Description

3.1 Validity

This manual applies to all R2000-series measuring devices from firmware version 1.50 and hardware version 1.50 onward. The versions can be found in the device menu; see chapter 6.3.3.

For devices using older versions, documentation is available on request.

3.2 R2000 2-D LiDAR Sensor

The 2-D LiDAR sensor is a compact 360° sensor with an integrated all-round display.

The sensor offers a high measurement frequency, a small angular resolution, a precise light spot, and, depending on the version, a visible measurement beam (OMD10M-R2000-B23), all of which make it suitable for numerous factory automation applications. In addition to completing familiar industrial tasks such as logistics, transportation, and material handling, the sensor can be used for innovative applications relating to building automation, automatic navigation of autonomous vehicles, or monitoring rooms.

Design

The device comprises a static body on which a continuously turning measurement module with an emitter laser and a receiver element is located. The LiDAR sensor uses Pulse Ranging Technology (PRT). This functional principle permits continuous scanning of the surrounding area through a full 360°.

User-Friendly All-Round Display

The LiDAR sensor has a row of LEDs on the back of the measurement module that acts as an all-round display. When the sensor is rotated, this row of LEDs produces a cylindrical projection surface for displaying text and images. This enables commissioning and operation without a PC or laptop. Operating and diagnosis information can therefore be directly displayed during operation.

Safety Certification to Laser Class 1

The R2000 2-D LiDAR sensor fulfills the safety requirements of laser class 1 in measurement mode. The low amount of laser light emitted ensures that operating personnel are not injured or harmed.



3.3 Functional Principle

The LiDAR sensor uses the principle of Pulse Ranging Technology (PRT). This means the device measures the time between the emission of a light pulse and the receipt of the pulse reflected by an object. Due to the constancy of the speed of light, this time is a measurement of distance.

Compared with other distance measurement processes, runtime measurement is affected very little by disturbances in the measuring environment. As a result, this measurement process ensures a high level of accuracy even under tough everyday industrial conditions. The light emitter and light receiver are located in the rotating sensor head.



Note

Influence of ambient conditions

The speed of light depends on the air temperature and barometric pressure.

The influence of the air temperature is 1 ppm/K.

The influence of the barometric pressure is -0.3 ppm/hPa.

The user must take these faults into consideration when measuring long distances.

In the operating range of -10 °C ... +50 °C, this fault amounts to 0.6 mm at a distance of 10 m.

3.4 Technical Data

The technical data for this product can be found in the datasheet at www.pepperl-fuchs.com.

3.5 Indicators and Operating Elements

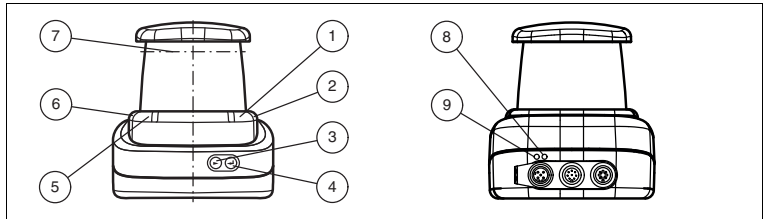


Figure 3.1 Indicators and Controls

No.	Description	Color
1	Operating indicator	Green
2	Fault indicator	Red
3	"Next" menu button	
4	"Return" menu button	
5	"Q2" signal indicator	Yellow
6	"Q1" signal indicator	Yellow
7	Laser beam outlet	
8	Ethernet activity indicator	Yellow
9	Ethernet link indicator	Green

Table 3.1 Indicators and operating elements

3.6 Interfaces and Connections

The following connections are found on all devices:

Power Supply

There is a 4-pin M12 plug on the rear of the housing for connecting the power supply. The following diagram shows the pinout:

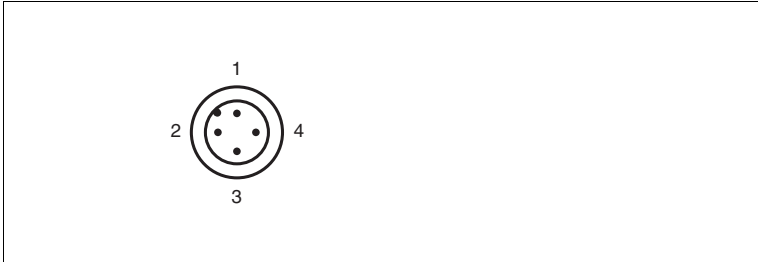
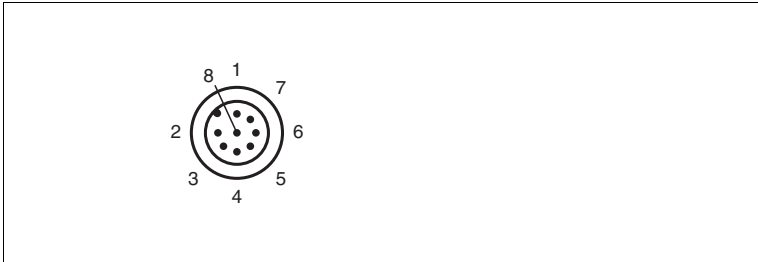


Figure 3.2 Power supply connection layout

- 1 24 V power supply
- 2 I/Q2
- 3 Ground (GND)
- 4 I/Q1

MultiPort

There is an 8-pin M12 plug on the rear of the housing for service purposes.



- 1 DNC (Do not connect)
- 2 DNC (Do not connect)
- 3 DNC (Do not connect)
- 4 DNC (Do not connect)
- 5 DNC (Do not connect)
- 6 I/Q2
- 7 I/Q1
- 8 DNC (Do not connect)

All pins with "DNC (Do not connect)" must not be connected!

Interface:

There is a 4-pin M12 socket on the rear of the housing for connecting the Ethernet interface. The following diagram shows the pinout:

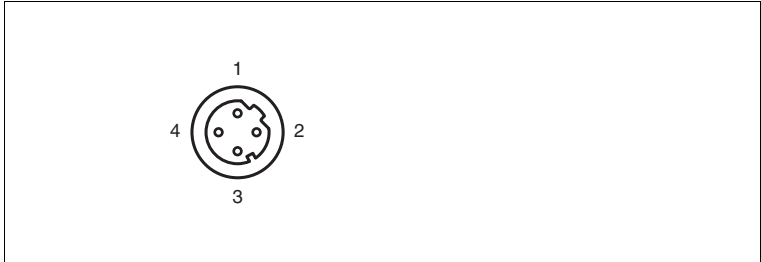


Figure 3.3 Ethernet connection layout

- 1 TD+
- 2 RD+
- 3 TD-
- 4 RD-

The connector housing is located on the shield.

3.7 Scope of Delivery

The scope of delivery includes:

- R2000
- Quick start guide
- Protective cover
- 3 x socket cap screws, M5 x 10
- 3 x washers, size 5



Note

Installation Instructions for North America

If a connection is made to the M12 multi-pin connector, the product shall be used with a UL-listed cable/connector (CYJV) assembly rated minimum 30 VDC, minimum 1.0 A, in the final installation for power supply.

3.8 Accessories

The following products are available as accessories.

Name	Description
V1SD-G-2M-PUR-ABG-V45-G	Patch cable, M12 to RJ45, length 2 m
V1SD-G-5M-PUR-ABG-V45-G	Patch cable, M12 to RJ45, length 5 m

Name	Description
V1SD-G-ABG-PG9	Single-ended male cordset, M12 D-coded, 4-pin for bus cable
V1-G-2M-PUR	Single-ended female cordset, straight, M12, 4-pin, PUR cable
V1-W-2M-PUR	Single-ended female cordset, angled, M12, 4-pin, PUR cable
MH-R2000	Mounting bracket, quick-release and adjustment device



Note

Installation note for North America

If a connection is made with the M12 multi-pin connector, in the final installation of the power supply the product must be used with a UL-listed cable/connector assembly (CYJV) that is designed for at least 30 VDC and at least 1.0 A.

Name	Description
V1-G-BK-2M-PUR-U	Single-ended female cordset, straight, M12, 4-pin, PUR cable, length 2 m, "UL recognized"
V1-G-BK-5M-PUR-U	Single-ended female cordset, straight, M12, 4-pin, PUR cable, length 5 m, "UL recognized"
V1-G-BK-10M-PUR-U	Single-ended female cordset, straight, M12, 4-pin, PUR cable, length 10 m, "UL recognized"

To parameterize the R2000 conveniently via a software interface, you will need the corresponding device type manager (DTM) in addition to the FDT framework program (PACTware 4.x or above). PACTware and the DTM are available at www.pepperl-fuchs.com.

4 Installation

4.1 Storage and Transport

Package the device for storage and transport such that it is protected from impact and moisture. The original packaging provides optimum protection. Also take note of the permitted ambient conditions.



Note

If the temperature is subject to major fluctuations during transport, the device must be allowed to acclimatize for around two hours prior to installation and use. During this acclimatization period, avoid subjecting the device to condensation at all costs, as this could have an effect on internal parts and cause damage.

4.2 Unpacking

Check the product for damage while unpacking. If the product should be damaged, inform the post office or parcel service and notify the supplier.

Retain the original packaging in case the device must be stored or shipped again at a later date.

Should you have any questions, please contact Pepperl+Fuchs.

4.3 Mounting



Caution!

Aggressive environments may damage the sensor lens or cause it to malfunction

Using the device in aggressive environments may damage the sensor lens and lead to impaired sensor function.

Never use the device in aggressive environments.



Caution!

Condensation may cause property damage and malfunction

Strong fluctuations in ambient temperature and humidity may damage the sensor lens and lead to impaired sensor function.

Avoid excessive fluctuations in temperature and humidity to prevent condensation.



Caution!

Excessive sunlight may result in property damage or malfunction

Continuous exposure to direct sunlight may damage the sensor lens and lead to impaired sensor function. Taking measurements in direct sunlight may lead to erroneous measurement results.

Protect the device from continuous exposure to direct sunlight.
Do not point the device's sensor at the sun.



Mounting the 2-D LiDAR Sensor

Only mount the sensor in locations that fulfill the following safety-relevant requirements: no aggressive environments, no direct sunlight, no excessive fluctuations in temperature and humidity.

1. In addition, note the following when selecting a mounting location:
 - The sensor must not be obstructed visually, e.g., behind a cover.
 - The sensor should be installed so it is protected from rain.
2. Mount the device on the underside using the supplied socket head screws with washers.



Caution!

The wrong screw-in depth may result in property damage

If you screw the screws deeper than 8 mm into the base, the device will be mechanically destroyed.

When mounting, make sure that the screw-in depth on the base is $\geq 5 \text{ mm} \dots \leq 8 \text{ mm}$.

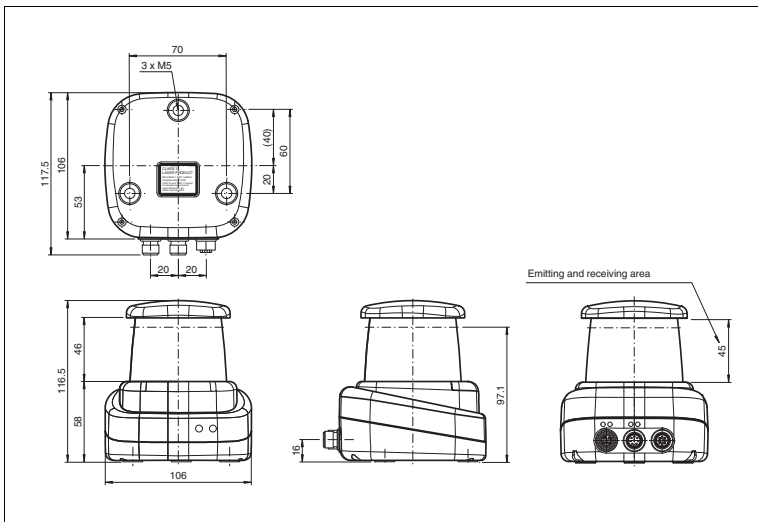


Figure 4.1 Dimensional drawing of R2000 2-D LiDAR sensor

3. Check that the sensor is securely seated.



Note

Keep the emitting/receiving area clear

When mounting, make sure the emitting area and the receiving area are kept clear. Covering the emitting/receiving area reduces the performance of the 2-D LiDAR sensor.

4.4 Device Connection



Electrical connection in accordance with IP65

- Put protective covers on unused M12 connectors.

↳ The IP65 degree of protection is achieved. The protective covers can be ordered as accessories; see chapter 3.8.



Danger!

Danger to life from electric shock

Absent or insufficient insulation can result in electric shock.

Only connect supplies that provide protection against electric shock (e. g. SELV or PELV).

The device conforms to protection class III. This means the power supplied to the device must be a safety extra-low protective voltage (PELV).

The power supply of the device uses a direct current of 10 V DC ... 30 V DC. Due to the integrated motor, a higher startup current is required than with normal operation. We recommend the use of power supplies with 1 A (for 24 V) or with 2 A (for 12 V).

The maximum cable length is 30 m.

The pin assignment is as follows:

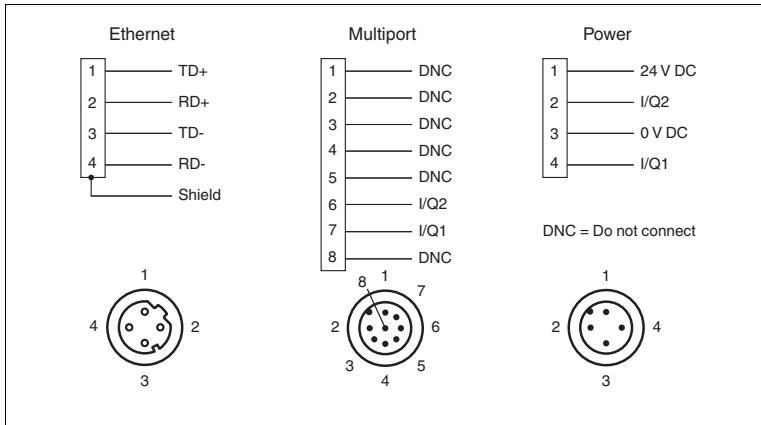


Figure 4.2 R2000 pin assignment

4.5 Grounding / Shielding

The grounding of the cable shields on the metallic flush-type connectors is not protective grounding in the sense of personnel protection, but is a functional grounding.

The functional grounding of the cable shields is recommended, if the housing does not have its own grounding. In environments with severe interference, it is also sensible to shield and to position the shield on both sides.

For shield grounding, use the preassembled insertion prong, which is fixed to the Ethernet socket.



5 Commissioning

The sensor has been tested and calibrated before delivery. It can be put into operation immediately.



Commissioning the LiDAR sensor



Danger!

Danger to life from electric shock

Absent or insufficient insulation can result in electric shock.

Only connect supplies that provide protection against electric shock (e. g. SELV or PELV).

1. Connect the device to the appropriate power supply.
 - ↳ The initialization phase lasts approx. 15 seconds. This phase is shown by circles moving down the all-round display.
2. After the initialization phase, the Pepperl+Fuchs logo will appear on the all-round display.
 - ↳ The device is now ready for operation.



Tip

Factoring in a warm-up phase

To achieve the best measurement accuracy, allow the device to warm up for at least 30 minutes after switching on.

5.1 Ethernet Configuration

The sensor has 3 different addressing options that can be used as required. The setting is configured using the menu interface on the sensor itself.



Note

Point-to-point connection

The sensor does not meet the requirement of the modern cybersecurity directives and therefore is an unsafe component in the network structure.

We recommend establishing an isolated point-to-point connection between sensor and the higher-level control.

Auto IP

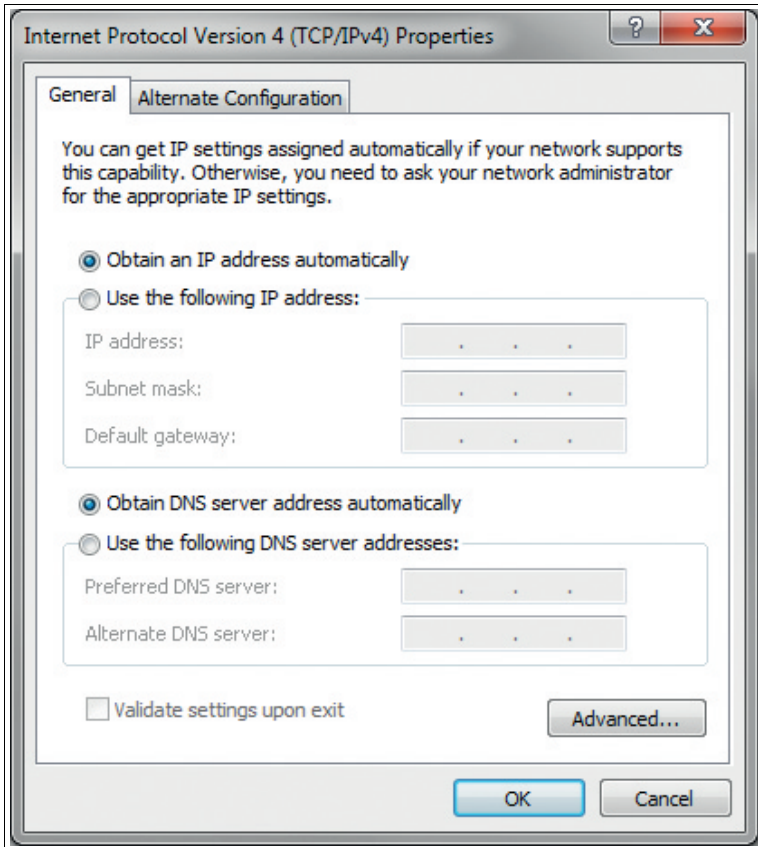
In the Auto IP setting, the sensor independently assigns a "link-local" IP address in the 169.254.0.0/16 range. During this process, the system ensures that the selected address is not already being used by another device.



Configuring a Connection via Auto IP

The sensor is set to Auto IP by default. The Auto IP setting is the best way to connect directly to a PC.

1. If the network configuration of the sensor no longer matches the factory setting:
 1. Under **Ethernet Setup > Address Mode**, set the sensor to "Auto IP."
 2. Restart the sensor to apply the configuration.
3. To connect the sensor to the PC, set the PC to Dynamic Host Configuration Protocol (DHCP).
4. Adjust the properties of the PC network card accordingly. To do this, select the TCP/IP protocol in the network card properties.
5. In the Internet protocol properties, select **Obtain an IP address automatically**.



6. Click **OK** to confirm.

↳ After approx. 30 seconds, Microsoft® Windows® assigns an auto IP for the PC.

DHCP

Connecting via DHCP requires the availability of a DHCP server, such as a router, on the local network; see Auto IP, PC network card settings.

If this requirement is fulfilled, you can set the sensor to DHCP.



Configuring a Connection via DHCP

1. Under **Ethernet Setup > Address Mode**, set the sensor to "DHCP."
2. Restart the sensor to apply the configuration.

Manual IP

You can also address the sensor via an IP address set manually. You can set the PC network card and the sensor to an IP address of your choice.



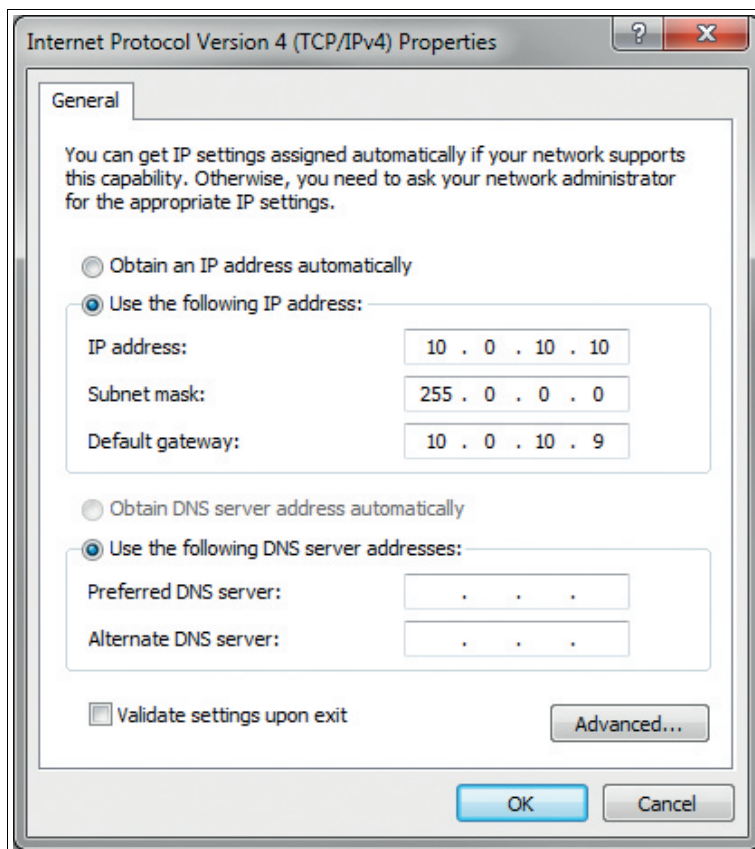
Note

The IP address of the sensor is set to 10.0.10.9 and the subnet mask to 255.0.0.0 by default.



Configuring a Connection via a Manual IP Address

1. Configure the sensor:
 1. Under **Ethernet Setup > Address Mode**, set the sensor to "Manual."
 2. Enter the required address under **Ethernet Setup > IP Address**.
3. Restart the sensor to apply the configuration.
4. To connect the sensor to the PC, enter the required IP address in the menu for the PC network card. Select the TCP/IP protocol in the PC network card properties.
5. Select "Use the following IP address" and enter the required IP address and subnet mask.



- Click **OK** to confirm.



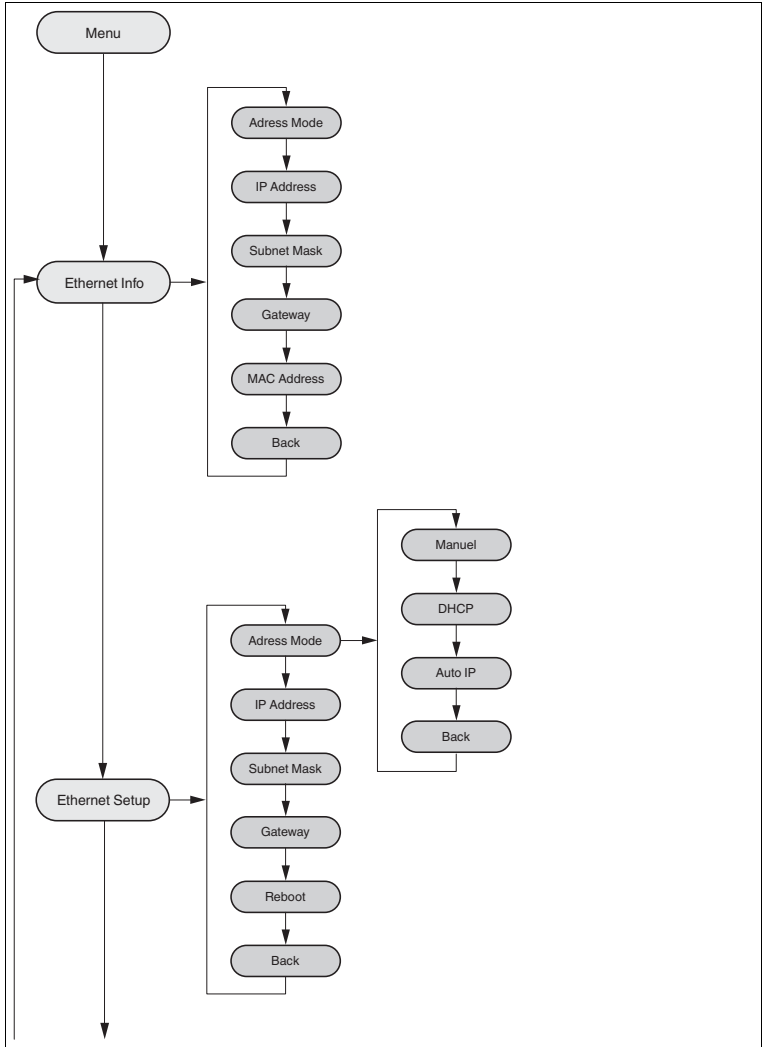
Note

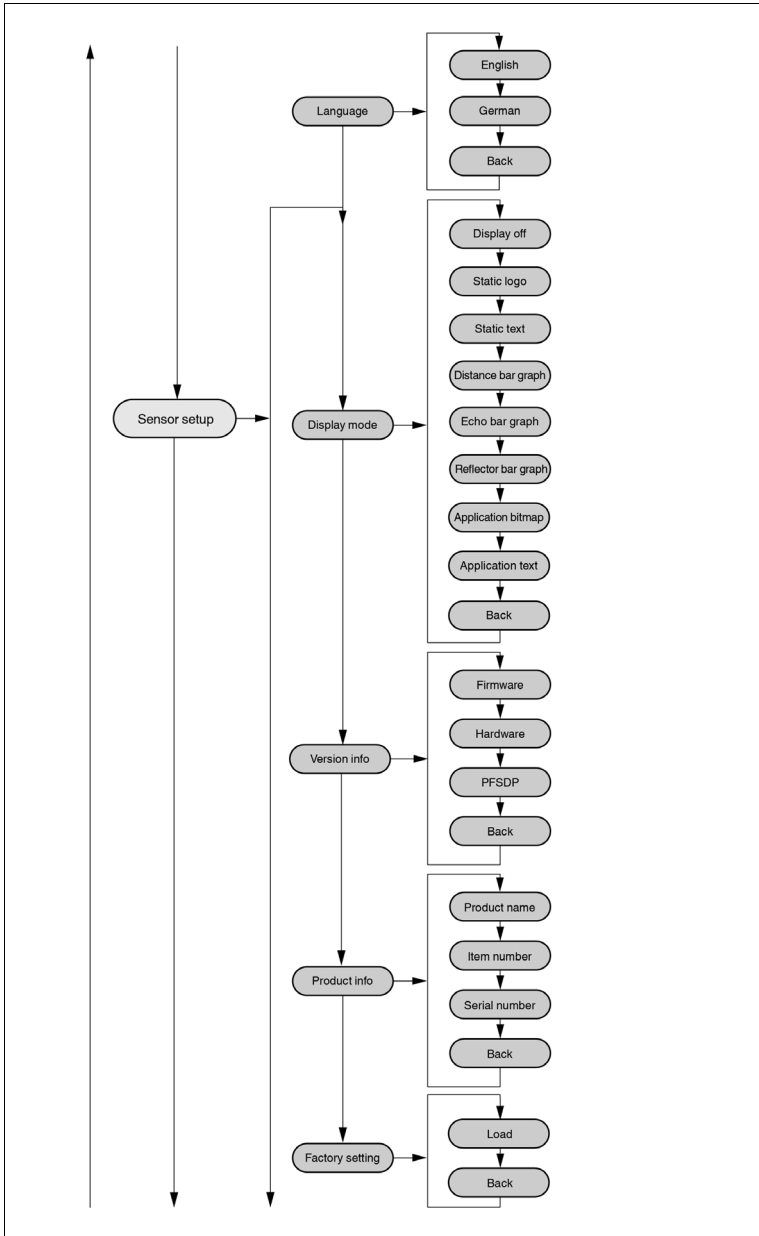
Device restart

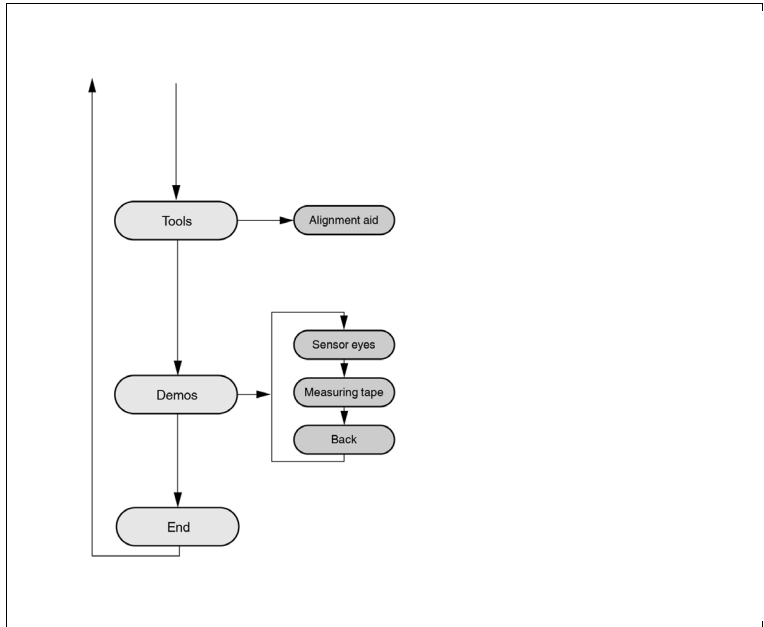
You must restart the sensor after changing the Ethernet configuration.

6 Operation

6.1 Menu Structure









6.2 Operation

The sensor is operated using the two buttons on the front. These buttons can be used to navigate within the menu structure. You can also use the two buttons to change parameters or enter values. The content of the all-round display will vary according to the input data.



Meaning of Buttons

Button	Explanation
	<p>ARROW button. Press this button</p> <ul style="list-style-type: none"> To navigate to the next menu item, To change a value. <p>This button has a similar function to the ARROW button on the computer keyboard.</p>
	<p>ENTER button. Press this button to select a menu item from the display. This button has a similar function to the ENTER button on the computer keyboard.</p>

In each menu item, the set values are indicated by an underscore. These values can be changed.





Note

Device settings may only be configured by trained and qualified personnel.



If no buttons are pressed in the menu levels for ≥ 60 seconds, the menu is exited automatically.

Navigation in the Menu


Menu display	
Top row	The current menu level is shown in the top row.
Bottom row	The currently selected element is shown in the bottom row.


Dash	One dash means you are in the main menu. Two dashes mean you are in the submenu.
Operation	
Pressing the ENTER button takes you into the menu structure.	
	Takes you to the next menu element. Keep the ARROW button or the ENTER button pressed for > 1 second to go to the next menu element up.
	Takes you to the selected menu element. Keep the ARROW button or the ENTER button pressed for > 1 second to go to the next menu element up.
Menu entry	
End	This menu entry exits the main menu.
Back	This menu entry takes you to the next menu element up.

Changing Count Parameters



Menu display	
Top row	This shows the current parameter.
Bottom row	This shows the currently selected parameter value.
Underlined parameter value	This is the currently activated value.
Operation	
	Takes you to the next available parameter value. Keep the button pressed for > 1 second to go to the next menu element up without changing the parameter.
	Activates the parameter value currently displayed. Keep the button pressed for > 1 second to activate the displayed parameter and return to the higher-level menu element.

Changing Numerical Parameters

Menu display	
Top row	This shows the name of the displayed parameter.
Bottom row	This shows the current value of the parameter.
Underlined parameter value	This is the parameter value to be edited.
Operation	
	Increase the currently selected digit. Keep the button pressed for > 1 second to increase the selected digit at a quicker rate.

	Takes you to the next editable digit.
	Keep the button pressed for > 1 second to go to the Confirm menu.
Confirm menu	
Top row	This shows the changed number.
Bottom row	This shows the executable actions (Save, Edit, Cancel).
"Save" action	The changed value is applied and saved.
"Edit" action	Takes you back to the edit display.
"Cancel" action	Rejects the changes and takes you to the higher-level menu.

IP Configuration Display

Menu display	
Top row	Name of the displayed parameter.
Bottom row	This shows the current value of the parameter.
Operation	
	Takes you to the next menu element.
	Keep the ARROW button or the ENTER button pressed for > 1 second to go to the next menu element up.
	No function.
	Keep the ARROW button or the ENTER button pressed for > 1 second to go to the next menu element up.

Back Menu Item

The "Back" menu item returns you to the higher-level menu.

6.3 Description of Menu Items

6.3.1 "Ethernet Info" Menu Item

This menu item provides quick access to the IP configuration currently in use. The data can be read only in this menu item.

Address Mode

The address mode currently being used is displayed in this subitem.

IP Address

The IP address currently being used is displayed in this subitem.

Subnet Mask

The subnet mask currently being used is displayed in this subitem.

Gateway

The gateway currently being used is displayed in this subitem.

MAC ID

The MAC ID currently being used is displayed in this subitem.



Note

Changing the IP configuration

Changes to the IP configuration are only applied after a restart.

The IP configuration currently used by the device is displayed in the "Ethernet Info" menu item. If these settings differ from the configuration specified under the "Ethernet Setup" menu item, the device must be restarted.

6.3.2

"Ethernet Setup" Menu Item

This menu item is used to change the IP configuration data.

Address Mode

- "Manual:" Enables you to manually assign the IP address, the subnet mask, and the gateway to the device.
- "DHCP:" Enables you to assign an IP address to the device from a DHCP server (e.g., a Windows® PC).
- "AutoIP:" Enables automatic detection of the device on the network.

IP Address

The IP address to be used in the "Manual" address mode can be set in this menu item.

Subnet Mask

The subnet mask to be used in the "Manual" address mode can be set in this menu item.

Gateway

The gateway can be set in this subitem.

Restart

The device can be restarted in this menu item.



Note

Changing the IP configuration

Changes to the IP configuration are only applied after a restart.

The IP configuration currently used by the device is displayed in the "Ethernet Info" menu item. If these settings differ from the configuration specified under the "Ethernet Setup" menu item, the device must be restarted.

6.3.3 "Sensor Setup" Menu Item

Language

This menu item can be used to set the language to German or English.

Display Mode

The display mode defines the display in normal operation when the menu is not active. Display mode is set on a permanent basis. The display is active following a restart.

- **Display off:** The display goes dark as soon as the menu is exited.
- **Static logo:** The display shows the Pepperl+Fuchs logo. The logo can be replaced with a custom bitmap file that will still be available after the device is switched on/off. The information is saved in the EEPROM. See the Ethernet protocol description for details about programming.
- **Static text:** The "Pepperl+Fuchs R2000" logo is shown on the display. The text can be replaced with custom text that will still be available after the device is switched off/on. The information is saved in the EEPROM. See the Ethernet protocol description for details about programming.
- **Distance bar graph:** The display depicts distances in the form of a bar chart that shows data in all directions. The bars become smaller as the distance increases.
- **Reflector bar graph:** A bar is shown on the display at the point at which a reflector is detected.
- **Echo bar graph:** The measured signal strength is shown on the display in the form of a graph.
- **Application bitmap:** A custom bitmap file (24 x 252 bit) is shown on the display. The file is saved in the RAM, so is no longer available after the device is switched off. See the Ethernet protocol description for details about programming.
- **Application text:** Custom text is shown on the display; the text is saved in the RAM, so is no longer available after the device is switched off. See the Ethernet protocol description for details about programming.



Note

The **Static logo** and **Static text** display modes are suitable for infrequent changes to the logo and text data.

The **Application bitmap** and **Application text** display modes are suitable for frequent changes to the logo and text data.

Product Info

- **Product name:** The display shows the current product name.
- **Item number:** The display shows the individual item number.
- **Serial number:** The display shows the individual serial number.

Version Info

- **Firmware:** The display shows the current firmware version.
- **Hardware:** The display shows the current hardware version.
- **PFSDP:** The display shows the current version of the Pepperl+Fuchs Scan Data Protocol.

Factory Settings

The factory settings for the sensor can be loaded in this menu item. To do this, select "Load" in the submenu and press the ENTER key to confirm. Restart the device to apply all the changes.

6.3.4 "Demos" Menu Item

A demo is only active temporarily. As soon as another option is selected in the menu, the demo becomes inactive. A restart has the same effect.

Sensor Eyes

The display shows a pair of eyes that focuses on moving objects. If no activity is detected within approx. five seconds, the "eyes" close. The "eyes" open again if the sensor detects movement.

Measuring Tape

In this demo, the scanner measures the distance in a forward direction (X axis). The value is shown on the display.

6.3.5 "Tools" Menu Item

Alignment Aid

A bar is shown on the display at the point at which a reflector is detected. An angular scale is shown at the bottom of the display.

6.3.6 "End" Menu Item

End

Pressing the ENTER button to confirm exits the menu and displays the set display mode.

7 Maintenance and Repair

7.1 Maintenance



Caution!

Failure to clean and improper cleaning may cause property damage and malfunction.

Failure to follow these instructions for cleaning the device may result in lens damage and impaired function.

Keep the glass on the device clean.

Never clean the glass on the device when the glass is dry. Always use a soft cloth and water, with a little detergent if necessary.

Do not use aggressive solvent-based cleaning agents such as acetone.

Observe the applicable national regulations when maintaining the device.

The sensor is largely maintenance free.

Check the technical safety of the sensor system at regular intervals by looking for damage to the housing. Check the sensor for dirt occasionally.

To clean the sensor, wipe it with a damp soft cloth at regular intervals. This will ensure it continues to function properly. The housing is made of plastic. For this reason, do not use acetone or detergents containing solvents.

7.2 Repairs

If it appears that safe operation of the system is no longer possible, the system must be taken out of operation and steps taken to prevent it being used inadvertently. If the device needs to be repaired, return it to Pepperl+Fuchs. If you open or modify the device yourself, not only are you endangering yourself and others but you will void any warranty and absolve the manufacturer from any liability.

8 Troubleshooting

8.1 Potential Causes of Faults

If the sensor reports no data or incorrect data, check the following:

- Is the sensor securely mounted or is it vibrating?
=> Check installation.
- Is the sensor partially covered?
=> Check installation point for visual obstacles.
- Is the sensor exposed to rain or condensation?
=> Check installation point for moisture and environmental fluctuations.
- Is the sensor exposed to sunlight or positioned so that it is measuring into the sun?
=> Check installation point for sunlight.

If none of these suggestions rectifies the fault, contact Pepperl+Fuchs.

Do not repair, modify, or manipulate the device.

If there is a defect, always replace the device with an original device.



Note

Note on insulation measurement

When conducting an insulation measurement, be aware that suppressor diodes have been installed for EMC resistance.

9 Appendix

9.1 Data Filter

The R2000 allows you to preprocess data. This can be useful for suppressing measured value noise or reducing the volume of output data, for example. The following measured data filters are available:

- **Average value filter:** All distance data and amplitude data is determined arithmetically using an appropriate filter width.
- **Median filter:** A value (median) is determined using a selectable filter width; half of the data is greater than or equal to this value.
- **Maximum filter:** Using a selectable filter width, the arithmetic mean is determined for a subset of the data. Starting with the highest measured value from the measurements within the filter width, the data is used that is shorter than the maximum value by a selectable range or which has the same measured value as the maximum value. Data outside of this range is discarded.
- **Reflectivity filter:** Using a selectable filter width, the arithmetic mean is determined for the data. The calculation only includes data with signal amplitudes greater than or equal to an adjustable amplitude threshold.

Note: Details about the data filters can be found in the "Ethernet Communication Protocol" manual at www.pepperl-fuchs.com.

9.2 Amplitude Characteristics

In addition to the measured value output for the distance, the R2000 generates an echo amplitude for each measuring step. The measured value for the echo amplitude is a value without a unit of measurement, ranging from 0 ... 4095 digits.

The echo amplitude is a measure of the energy received by the R2000. The measured value is dependent on the surface properties of the measurement object (reflectivity, structure), the distance from the measurement object, and the angle of incidence of the measurement beam. The measurement of the echo amplitude is not calibrated and is used for relative distinction between different object reflectivities.

In particular, evaluation of the echo amplitudes can be used to distinguish between natural surfaces and reflective film.

The picture below shows the curve of the echo amplitude on reflective film (diamond grade 983-10). The curve shows the smallest expected measured value in relation to the distance.

The second curve represents the largest value on a white (90 % reflectivity), natural surface in relation to the distance.

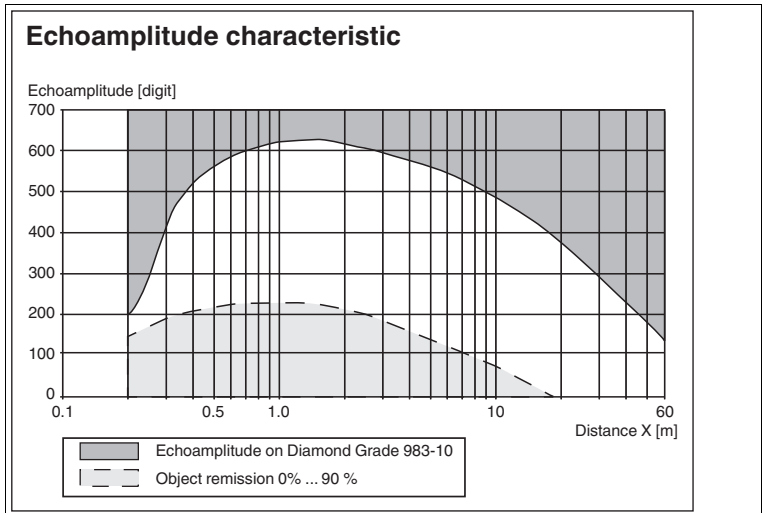


Figure 9.1 Amplitude characteristics for OMD10M-R2000-B23-V1V1D*

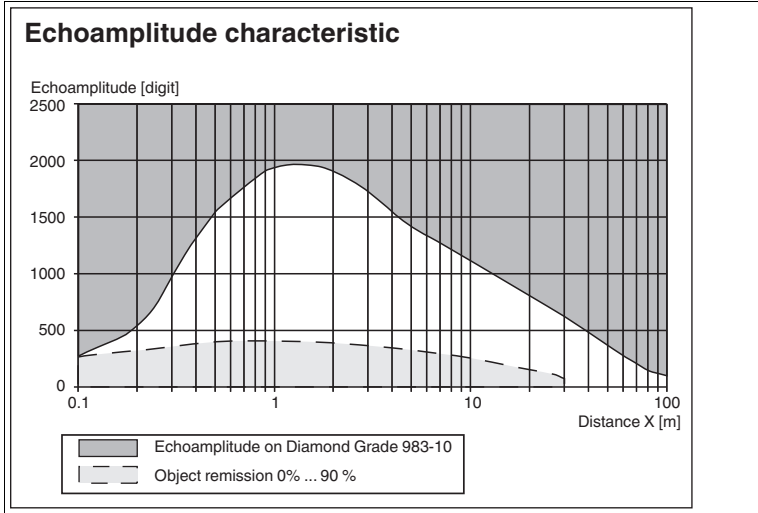


Figure 9.2 Amplitude characteristics OMD30M-R2000-B23-V1V1D*; OMD30M-R2000-B23-V1VD-HD-1L (ends at 30m); OMD12M-R2000-B23* (ends at 12 m)

The measurement on reflective film is based on a vertical angle of incidence on a 40 mm-wide reflective strip and an angular resolution of 0.071°.

The measurement on a white (90 % reflectivity), natural surface is based on a vertical angle of incidence and an emitted beam that hits the entire surface of the measurement object.

If the emitted beam is at an entrance angle of 60° ... 70° on the reflective film, the measured value drops by approximately 50 % compared to the value for a vertical entrance angle.

9.3 Pulse Ranging Technology (PRT) Glossary

Term	Explanation
Accuracy	The degree to which the measurement result corresponds to the true value of the measurement. The accuracy is a relative error based on a measurement standard. For practical applications, a distinction is made between different influencing factors.
Absolute accuracy	The total of all systematic measurement errors (e.g., linearity, device offset) over a defined distance range, reflectivity range, and temperature range that cannot be eliminated by other actions such as average determination.

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Term	Explanation
Repeat accuracy (repeatability)	The measurement is repeated on the same target and under the same conditions. The error is the repeatability value. The measured value noise is not taken into account.
Measured value noise	Randomly distributed deviation of a measured value by an average value. The distribution of the individual measurement values typically follows a statistical normal distribution.
Measuring range	The range between the smallest and largest object distance in which the measuring instrument supplies readings within the specification.

9.4 Using Open Source Programs

Pepperl+Fuchs uses a range of open source software in the R2000. These are the programs listed individually below from 1 to 12. We have edited programs 1 to 4:

1. U-Boot
2. Blackfin uClinux
3. Xenomai
4. Mongoose web server
5. Libedit
6. Giflib
7. Libncurses
8. ST standard peripherals library
9. ARM CMSIS header
10. IAR LIBC
11. AVR LIBC
12. CRC library

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- 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
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