InspectorP Rack Fine Positioning

2D machine vision

SICK
Sensor Intelligence.

Described product

InspectorP Rack Fine Positioning

Manufacturer

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Legal information

Original document

This document is an original document of SICK AG.

1) Valid for device type InspectorP63x only.

Contents

1 About this document

1.1 Information on the operating instructions

These operating instructions provide important information on how to use devices from SICK AG.

Prerequisites for safe work are:

- Compliance with all safety notes and handling instructions supplied.
- Compliance with local work safety regulations and general safety regulations for device applications

The operating instructions are intended to be used by qualified personnel and electrical specialists.

NOTE

Read these operating instructions carefully to familiarize yourself with the device and its functions before commencing any work.

The operating instructions are an integral part of the product. Store the instructions in the immediate vicinity of the device so they remain accessible to staff at all times. Should the device be passed on to a third party, these operating instructions should be handed over with it.

These operating instructions do not provide information on operating the machine or system in which the device is integrated. Information on this can be found in the operating instructions for the machine or system.

1.1.1 Related applicable documents

Carefully read through the relevant document below for the device type being using before commencing any work on the device. Download the documents from the Internet at **www.sick.com**. To do so, enter the part number in the search field.

Part number	Document
8024439	InspectorP621, operating instructions
8027368	InspectorP621, Lector621: V2D621x-xxxxxx6x, cold store usage, addendum to operating instructions
8019946	InspectorP63x Flex C-mount and S-mount, operating instructions
8018486	VI55I ring illumination unit, Technical Information

1.2 Explanation of symbols

Warnings and important information in this document are labeled with symbols. Signal words introduce the instructions and indicate the extent of the hazard. To avoid accidents, damage, and personal injury, always comply with the instructions and act carefully.

DANGER

... indicates a situation of imminent danger, which will lead to a fatality or serious injuries if not prevented.

WARNING

... indicates a potentially dangerous situation, which may lead to a fatality or serious injuries if not prevented.

⚠ **CAUTION**

... indicates a potentially dangerous situation, which may lead to minor/slight injuries if not prevented.

❗ **NOTICE**

... indicates a potentially harmful situation, which may lead to material damage if not prevented.

ⓘ **NOTE**

... highlights useful tips and recommendations as well as information for efficient and trouble-free operation.

1.3 Further information

ⓘ **NOTE**

Further documentation for the device can be found on the online product page at:

- **www.sick.com/InspectorP_Rack_Fine_Positioning**

There, additional information has been provided depending on the product, such as:

- Model-specific online data sheets for device types, containing technical data, dimensional drawing, and specification diagrams
- Declarations of conformity and certificates of the product family
- Dimensional drawings and 3D CAD dimension models of the device types in various electronic formats
- Other publications related to the devices described here
- Publications dealing with accessories

2 Safety information

2.1 Intended use

InspectorP Rack Fine Positioning is suitable for rack fine positioning applications. The device consists of a combination of an InspectorP 2D vision sensor (InspectorP621, InspectorP63x) and a SensorApp (Rack Fine Positioning).

InspectorP Rack Fine Positioning is used for storage and conveyor applications. The device supports the precise positioning of automated storage and retrieval systems used for storing and retrieving load carriers. It supports positioning operations for single-deep rack storage, and combined single-deep and double-deep rack storage applications.

Management, commissioning and operation of the device is performed on a computer using the SICK AppManager and SOPASair software programs. The device sends the results to a higher-level controller (e.g., PLC) via the host interface for further central-ized processing.

SICK AG assumes no liability for losses or damage arising from the use of the product, either directly or indirectly. This applies in particular to use of the product that does not conform to its intended purpose and is not described in this documentation.

2.2 Improper use

Any use outside of the stated areas, in particular use outside of the technical specifica-tions and the requirements for intended use, will be deemed to be incorrect use.

- The device does not constitute a safety component in accordance with the respec-tive applicable safety standards for machines.
- The device must not be used in explosion-hazardous areas, in corrosive environ-ments or under extreme environmental conditions.
- Any use of accessories not specifically approved by SICK AG is at your own risk.

⚠️ **WARNING**
Danger due to improper use!
Any improper use can result in dangerous situations.

Therefore, observe the following information:

- Product should be used only in accordance with its intended use.
- All information in these operating instructions must be strictly observed.
- Shut down the product immediately in case of damage.

2.3 Cybersecurity

To protect against cybersecurity threats, it is necessary to continuously monitor and maintain a comprehensive and holistic cybersecurity concept. A suitable concept com-prises organizational, technical, procedural, electronic, and physical levels of defense and provides suitable measures for different types of risks. SICK's products and solu-tions must be viewed as a component of this concept.

Information on Cybersecurity can be found at: **www.sick.com/psirt** .

2.4 Limitation of liability

Relevant standards and regulations, the latest technological developments, and our many years of knowledge and experience have all been taken into account when compiling the data and information contained in these operating instructions. The manufacturer accepts no liability for damage caused by:

- Non-adherence to the product documentation (e.g., operating instructions)
- Incorrect use
- Use of untrained staff
- Unauthorized conversions or repair
- Technical modifications
- Use of unauthorized spare parts, consumables, and accessories

2.5 Modifications and conversions

> **!** **NOTICE**
>
> Modifications and conversions to the device may result in unforeseeable dangers.

Interrupting or modifying the device or SICK software will invalidate any warranty claims against SICK AG. This applies in particular to opening the housing, even as part of mounting and electrical installation.

2.6 Requirements for skilled persons and operating personnel

> ⚠ **WARNING**
> **Risk of injury due to insufficient training.**
>
> Improper handling of the device may result in considerable personal injury and material damage.
>
> - All work must only ever be carried out by the stipulated persons.

The following qualifications are required for various activities:

Table 1: Activities and technical requirements

Activities	Qualification
Mounting, maintenance	- Basic practical technical training - Knowledge of the current safety regulations in the workplace
Electrical installation, device replacement	- Practical electrical training - Knowledge of current electrical safety regulations - Knowledge of the operation and control of the devices in their particular application
Commissioning, configuration	- Basic knowledge of the computer operating system used - Basic knowledge of the design and setup of the described connections and interfaces - Basic knowledge of data transmission - Knowledge of the programming of image-processing systems and network components
Operation of the device for the particular application	- Knowledge of the operation and control of the devices in their particular application - Knowledge of the software and hardware environment for the particular application

2.7 Operational safety and specific hazards

The product documentation for the device contains detailed safety information. The product documentation can be downloaded from the Internet at see "Related applicable documents", page 5.

3 Product description

3.1 Scope of delivery

The delivery of the device includes the following components:

Table 2: Scope of delivery

No. of units	Component	Note
1	Device in the version ordered	**InspectorP62x device types:** • V2D621P-xxxxBxxS51 (single-deep) • V2D621P-xxxxFxxS51 (double-deep) **InspectorP63x device types:** • V2D631P-xxIxCxxS50 (single-deep) • V2D631P-xxWxExxS50 (double-deep)
2	Sliding nut with 5.5 mm-deep M5 threaded mounting hole	Positioned in the slot on the right side of the device. Alternative mounting option for the device instead of tapped blind hole. Use in pairs.
1	Hex key SW2 [1]	For manual actuation of the focus screw
4	Label (round, self-adhesive) [1]	Protects the focus setting when using an S-mount lens. The image sharpness is adjusted using the manual focus screw. Apply the adhesive label over the access opening for the focus screw on the top of the device.
1	Printed safety notes, multilingual	Brief information and general safety notes

[1] Valid for device type V2D631P only.

With special variants, where optional extras have been ordered, or owing to the latest technical changes, the actual scope of delivery may vary from the features and illustrations shown here.

3.2 Function and use

Temperature-, load- and steel construction-dependent influencing factors result in varying geometric conditions at transfer points in storage and conveyor systems. These conditions make safe automated positioning of automated storage and retrieval systems more difficult when storing and retrieving load carriers.
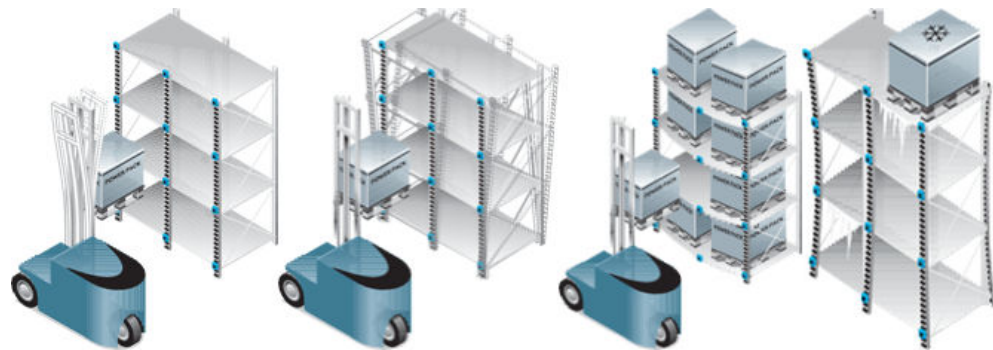
Figure 1: Negative influencing factors during automated positioning processes

InspectorP Rack Fine Positioning supports the precise positioning of automated storage and retrieval systems used for storing and retrieving load carriers.

The device is delivered with pre-mounted illumination, pre-focused optics, pre-installed software and pre-configured defaults. This enables quick and easy commissioning. The device is mounted to the automated storage and retrieval system. The device captures images during storage and retrieval. While doing so, it detects a hole or round reflector as a positioning mark in the rack. Based on this positioning mark, the device sends to a higher-level controller (e.g., PLC) the difference between the current position and target position of the automated storage and retrieval system. The controller then initiates fine positioning of the automated storage and retrieval system. This prevents load carriers from colliding with the racks.

Either holes or round SICK PL22-x reflectors can be used as positioning marks. Positioning operations for single-deep rack storage, and combined single-deep and double-deep rack storage applications are supported. In single deep racks, the shelf has space for a storage unit. In double deep racks, two storage units are operated one behind another, whereby the shelf is twice as deep.

Depending on the application (type of positioning mark, rack storage), there are differences in system design such as the selection of the lens focal length and the use of lighting filters. The accuracy and tolerance when detecting the positioning mark and in the subsequent position correction depends on the working distance, the sensor resolution, and the ambient conditions. Each application situation must be considered individually.

3.3 Positioning mark

Drill holes

Holes can be used as positioning marks for single-deep rack storage, and combined single-deep and double-deep rack storage applications.

Requirements
- Diameter of the hole: 8 mm to 15 mm (typically 10 mm to 13 mm)
- Surface characteristics of the steel around the hole: diffuse, lightly reflective (recommendation: hot-dip galvanized steel)
- Reduce the effect of any fully reflective surfaces behind the hole by using a matt black spray paint or by covering them with adhesive tape.

Reflectors

Round SICK PL22-x reflectors can only be used as positioning marks for single-deep rack storage. The surface characteristics of the steel around the reflector have a negligible effect.

> **(i) NOTE**
> InspectorP621: Only the red LEDs on the device are active. The blue LEDs are deactivated automatically.

SICK PL22-x reflectors
- PL22-1 (part number: 1003546)
- PL22-2 (part number: 1003621)
- PL22-3 (part number: 1004488)
- PL22-4 (part number: 5327829)

The SICK PL22-x reflectors are available as accessories on the Internet at www.sick.com. Enter the part number in the search field.

3.4 Target region

Definition of target region

The positioning mark (hole or reflector) is typically placed in the center of the camera image and defined as the target region during alignment and rack fine positioning of the device. The target region then corresponds to the area around the center point of the image. If necessary, the target region can be moved into another area of the image using the SOPASair operating software. During operation, the device detects the current location of the positioning mark. Depending on the selected evaluation mode, the device transfers to the controller the difference between this location and the target region or center point of the image. Using the information provided by the device, the control initiates rack fine positioning of the automated storage and retrieval system. If the positioning mark is located in the target region, goods can be stored in or retrieved from the rack. If the positioning mark is outside the target region, the relative position in relation to the target region is displayed using ambient sectors.
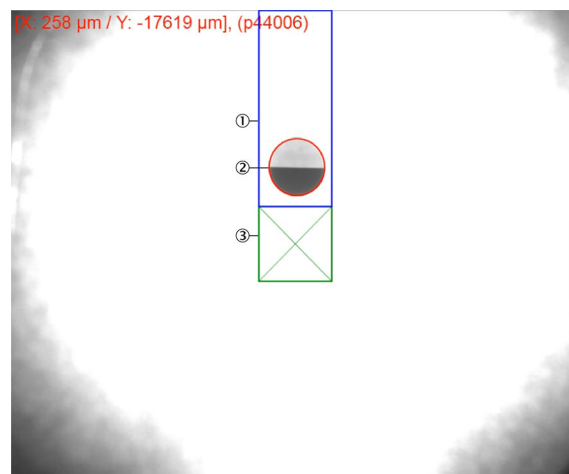
Figure 2: Detection and output of the hole position relative to the target region (example)

①   Ambient sector (blue)
②   Positioning mark (red)
③   Target region (green)

Further topics

- Evaluation mode
- Adjusting the size of the target region
- Shifting the target region

3.5 Single-deep rack storage

Single-deep rack storage applications have a large field of view at close range.

Positioning mark	Rack depth	Working distance	
		V2D621P	**V2D631P**
Drill hole	Single deep	50 mm ... 350 mm [1]	100 mm ... 350 mm [1]
Reflector	Single deep	50 mm ... 700 mm [1]	150 mm ... 700 mm [1]

[1]   The distance is measured from the viewing window of the device to the rack. The working distance depends on the application.

3.6 Single- and double-deep rack storage

Positioning mark	Rack depth	Working distance	
		V2D621P	**V2D631P**
Drill hole	Single deep and double deep	50 mm ... 1,950 mm [1]	100 mm ... 1,950 mm [1]
Drill hole	Single deep	50 mm ... 1,950 mm [1]	100 mm ... 1,950 mm [1]

[1] The distance is measured from the viewing window of the device to the rack. The working distance depends on the application.

4 Mounting

4.1 Mounting requirements

Important notes

> ⚠ **NOTICE**
>
> Different operating conditions to the standard device apply for the device type V2D621x-xxxxxx6x (cold storage applications). The operating conditions must be adhered to at all times.
>
> Information on the operating conditions is included in the addendum to operating instructions for the "InspectorP621, Lector621: V2D621x-xxxxxx6x" (part number: 8027368, www.sick.com/8027368).
>
> Carefully read the supplement to operating instructions before using the device.

General mounting requirements

- The working distance from the device to the positioning mark depends on the device type and type of positioning mark.
- The positioning mark can be positioned anywhere in the field of view of the device to suit the application situation. Recommendation: Locate the positioning mark at the center point of the image.
- The positioning mark is located in the field of view for single-deep and double-deep rack storage.
- Multiple positioning marks within the field of view of the device can be classified and ignored.
- Orient the device perpendicular to the metal surface or positioning mark. Do not angle the device relative to the surface.
- Mount the device in a shock and vibration insulated manner. Ensure that the position of the device is not moved by vibrations during operation.

Mounting requirements: hole as positioning mark

- No objects or contamination with distinct contours, a similar diameter, or a similar surface are present in the field of view.
- Do not mount any light sources behind the hole.
- The beams of the high-bay rack system are not heavily contaminated in the area of the hole. If necessary, clean the area around the hole.

Mounting requirements: reflector as positioning mark

- Do not mount any light sources in the field of view of the device.
- The reflector is not contaminated. No reflections are possible. If necessary, clean the reflector.
- When fine positioning using reflectors, the device searches the image for bright structures against a dark surrounding. Use a polarizing filter to prevent total reflection of the illumination. The polarizing filter hides the total reflecting light from the surface.

Complementary information

You can find the polarizing filter as an accessory on the Internet at www.sick.com by entering the part number in the search field.

Polarizing filter
- InspectorP621P polarizing filter: part number 2088228
- InspectorP631P polarizing filter, part number 2088229

Further topics

- Working distance Single-deep rack storage , Single- and double-deep rack storage
- Mounting the polarizing filter

4.2 Mounting the polarizing filter

Important notes

> **NOTE**
> Only use the polarizing filter for applications with reflectors.

Procedure

InspectorP621: Mount the polarizing filter securely on the device using the enclosed screws.

InspectorP631: Mount the polarizing filter as described in the following graphic.
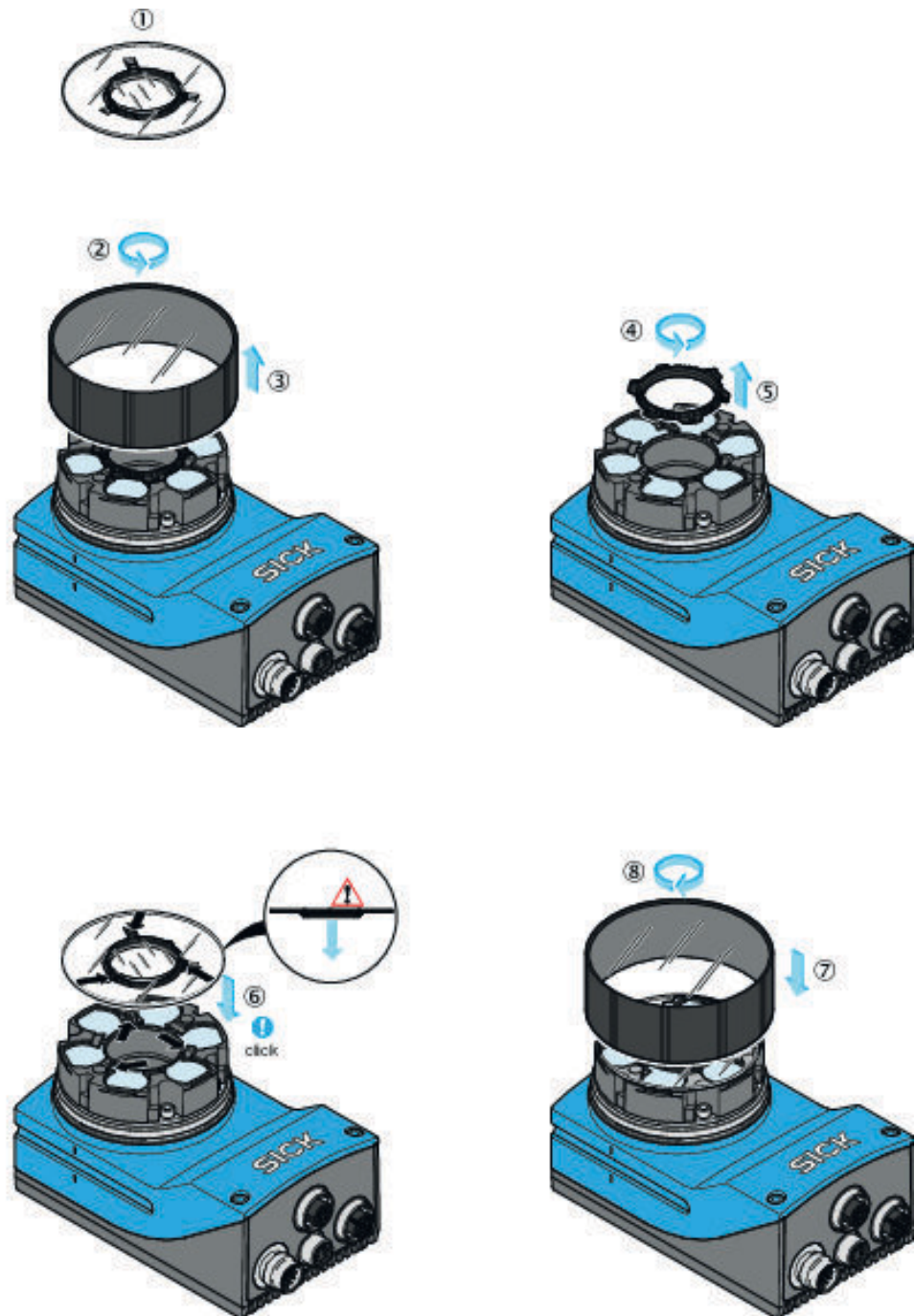
Figure 3: Mounting the polarizing filter (InspectorP631)

①   Scope of delivery of the polarizing filter kit (part number: 2088229): Polarizing filter disk
②   Turn optics cover counterclockwise.
③   Remove optics cover.
④   Turn spacer ring counterclockwise.
⑤   Remove spacer ring.
⑥   Clip on the polarizing filter disk. Make sure the alignment is correct (centering ring downwards, recesses over retaining clips).
⑦   Put on optics cover.
⑧   Turn optics cover clockwise.

4.3 Mounting the device

Important notes

> **NOTE**
>
> For an application with single-deep and double-deep rack storage, first align the device to the single deep rack. Then, if necessary, adjust the position of the device for the double deep rack.

> **NOTE**
>
> InspectorP631: The optics are already pre-focused at a distance that is suitable for most applications. It is rarely necessary to adjust the focus position, see figure 7, page 22.

Procedure

1. Install the device to the mechanics with the bracket so that the device points vertically to the positioning mark on the rack. Do not angle the device relative to the surface.
2. Connect the device to the interfaces and supply voltage.
✓ The **Continuous measurement** parameter is enabled by default. The device starts in measurement mode.
3. To switch the laser alignment aid on and off, press the ▷ pushbutton on the device. The laser alignment aid helps align the device.
✓ The device projects two red laser points on the rack. The laser points indicate the viewing direction of the camera. The center of the image is between the two points.
4. Align the device so that the positioning mark on the rack is between the two laser points and is therefore in the center of the image.
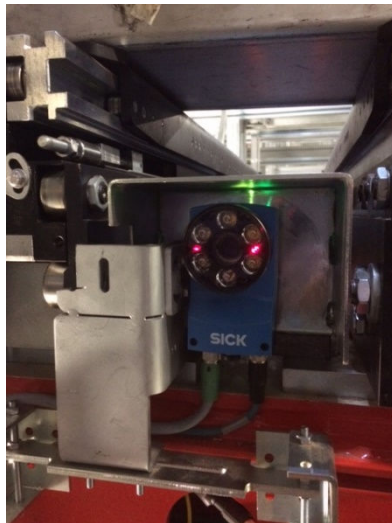
Figure 4: Example installation

5   Electrical installation

5.1   Notes on electrical installation

The product documentation for the device contains detailed information on electrical installation. The product documentation can be downloaded from the Internet at see "Related applicable documents", page 5.

5.2   Ethernet interface

Function of the Ethernet interface

- Parameterizing the device using the SOPASair software.
- Forwarding the difference between the actual position and target position of the automated storage and retrieval system to the controller.

The precise difference between the actual position and target position are forwarded to the controller as X-values and Y-values. Based on these values, the control initiates position correction of the automated storage and retrieval system. The device supports various communication protocols when using the Ethernet interface. The communication protocol can be set using the SOPASair operating software.

Further topics

- Communication protocols
- Setting the communication protocol

5.3   Digital inputs and digital outputs

Function of the digital inputs and digital outputs

- Communicating with the controller.
- Forwarding information on the position of the automated storage and retrieval system to the controller.

The device transmits direction information (up, down, right, left) via the digital outputs. The automated storage and retrieval system approach the target position step-by-step based on this direction information. The device does not transmit any quantitative information about the difference between the actual position and target position of the automated storage and retrieval system.

The device is triggered via the digital input. The device outputs the position results using 4 digital outputs. Use the pins listed below.

Pins

PIN	Description	Function
10	Sensor 1, digital input, IN 1	Switch continuous measurement on and off.
15	Sensor 2, digital input, IN 2	Activate and deactivate double deep mode.
13	IN/OUT 3	Direction information: top
14	IN/OUT 4	Direction information: bottom
16	IN/OUT 5	Direction information: right
17	IN/OUT 6	Direction information: left

Further topics

- Control via digital inputs and digital outputs

6 Commissioning

6.1 Software

6.1.1 SICK AppManager

Function of the software

- Reading out and changing the IP address.
- Saving the currently valid parameter set on the computer (backing up) or to a microSD memory card in the device (cloning).
- Installing firmware updates.

Installing SICK AppManager

The current version of SICK AppManager can be downloaded from **www.sick.com/ SICK_AppManager**. To install SICK AppManager, open the installation file (*.exe) and follow the instructions on the screen.

6.1.2 SOPASair

Function of the software

The device can be set up and parameterized using the SOPASair software.

Starting SOPASair

SOPASair can be started via a web browser (recommendation: Google Chrome). No software installation is required. For information on operation, see "Parameterization using SOPASair", page 20.

6.2 SICK AppManager user interface
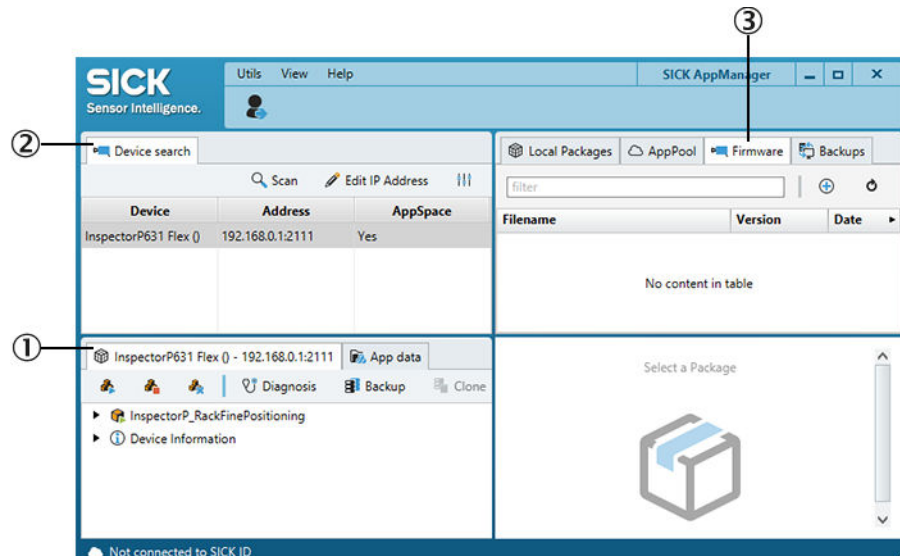
Figure 5: SICK AppManager user interface

① Device window, window name depends on the connected device

② **Device Search** window

③ **Firmware** window

6.3 Changing the IP address

Procedure

1. Open SICK AppManager.
✓ The connection status of the device and software is displayed below in the list.
2. In the **Device Search** window, click on the **Scan** button.
✓ The network is scanned.
✓ The **Device Search** window lists all devices found in the network.
3. Select the desired device.
✓ The device window shows the SensorApp currently loaded on the device.
4. Click on the **Edit IP Address** button.
✓ The **Edit IP Address** window opens.
5. Select the **Use manual IP settings** option.
6. Enter an IP address.
7. Click **OK** to confirm the changes.

6.4 Establishing a PROFINET connection

Procedure

In order to use the PROFINET communication protocol, the local device setting must be in the PROFINET Ethernet mode.

Setting the PROFINET Ethernet mode
1. In the SICK AppManager, change the IP address.
2. Open SOPASair.
3. In SOPASair, set the user level to **Operator**. To do so, click on the button with the currently set user level at the top right in the user interface.
4. Open the **Interfaces** window.
5. In the **Ethernet mode** area, set the **PROFINET** mode.
6. Reboot the device.
✓ The PROFINET interface is active.

Complementary information

The PROFINET device name is used for identification. The IP address is allocated by the PROFINET IO Controller (PLC). The IP address can then no longer be changed using SICK AppManager.

To configure other PROFINET interface settings on the PROFINET IO Controller (PLC) side, .

6.5 Parameterization using SOPASair

6.5.1 SOPASair user interface
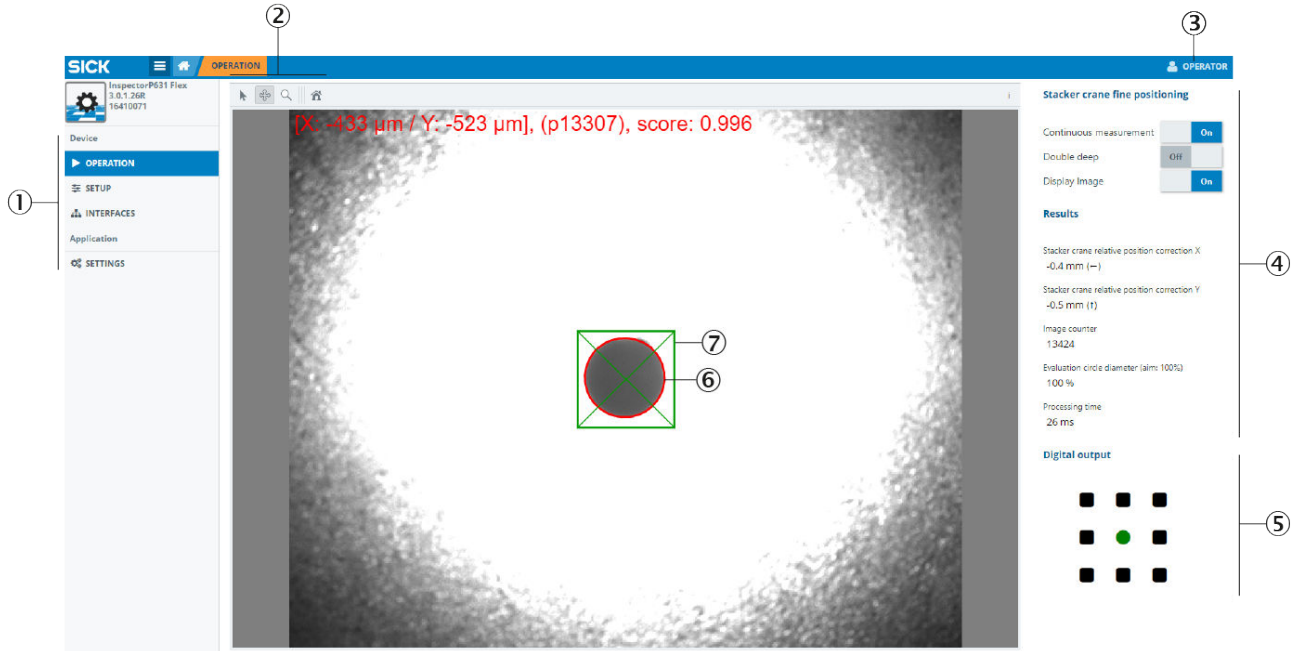
Figure 6: SOPASair user interface

①   Menu bar with available windows
②   Settings for image output
③   Currently set user level
④   Parameter bar, areas with available parameters
⑤   The **Digital output** area shows the current location of the positioning mark.
⑥   Target region (green)
⑦   Positioning mark (red)

6.5.2 Opening the SOPASair user interface

Prerequisites

- Device is supplied with voltage.
- Device is connected to a computer via the Ethernet interface.

Procedure

1. Start web browser (recommendation: Google Chrome).
2. Enter the device IP address into the address line. The following IP address is pre-configured by default: **192.168.0.1** or **192.168.0.123**.
✓ The SOPASair user interface appears.

6.5.3 User levels

The following table shows the available user levels. User levels that are not listed in the table have no effect on the parameterization. These user levels can be ignored. The higher the user level, the more parameters are available. This allows detailed settings to be configured.

By default, SOPASair opens in the **Run** user level. It is recommended to use the **Operator** or **Maintenance** user level for initial commissioning. To change the user level, click on the button with the currently set user level.

Table 3: Available user levels

User levels	Password	Use
Run	No password required	• Observe the system during operation. • Switch continuous measurement on and off. • Activate and deactivate double deep mode. • Switch image output on and off.
Operator	No password required	• Configure additional settings for initial commissioning of the device. • Adjust settings during operation (e.g., measurement tolerances). • Since the device is preconfigured on delivery, the parameters available here are usually sufficient for operation.
Maintenance	Main	• User: Maintenance • Deep understanding of the application necessary. • All parameters are available. • Adjust the device optimally to the circumstances. • Detailed configuration of settings during initial commissioning.

6.5.4 Setting the user interface language

Procedure

▶ Set the user interface language in the **Settings** window.

6.5.5 Loading the device defaults

Procedure

If the device has already been parameterized for another application, then first load the defaults.

1. Set the user level to **Maintenance**.
2. Open the **Advanced setup** window.
3. Click on the **Restore all default parameters** button.

6.5.6 Setting the positioning mark

Important notes

ℹ **NOTE**
Setting the positioning mark is only relevant for single-deep rack storage.

Procedure

▶ In the **Setup** window in SOPASair, set the **Preconfiguration application** parameter.

6.5.7 Performing a fine adjustment

Prerequisites

• Device is mounted at the same height as the positioning mark.
• Device is oriented perpendicular to the metal surface or positioning mark.
• User level **Operator** or **Maintenance** is set.

Procedure

After roughly aligning the device during mounting, fine adjustment is performed using the SOPASair operating software.

1. In SOPASair, open the **Operation** window.
2. Enable the **Continuous measurement** and **Display image** switches.
✓ The device starts capturing and evaluating images. The device transmits the images to the computer.
3. Finely adjust the device mechanically using the image so that the following factors exist:
    o Positioning mark (red) is within the target region (green).
    o Holes: The image is sufficiently illuminated that the light-colored light spot is uniformly visible around the dark hole.
    o Reflectors: The image is sufficiently illuminated that the light reflector is clearly differentiated from the dark background.
✓ If the positioning mark is within the target region, the feedback LED on the device lights up green.
✓ If the positioning mark is within the target region, the circle in the center in the **Digital output** area in SOPASair is green. The surrounding squares are black.

ℹ **NOTE**

Single-deep and double-deep rack storage application:
- InspectorP621: The device automatically focuses on the configured double deep working distance.
- InspectorP631: The optics are already pre-focused at a distance that is suitable for most applications. Adjustment of the focus position is only necessary in rare cases. For single-deep and double-deep rack storage applications, focus the device on the double deep working distance.

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4. InspectorP631: Manually adjust the focus screws on the upper side of the device to optimize the focus position. Use a SW2 hexagon key.
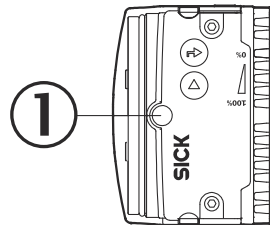
Figure 7: Manually adjust the focus position (InspectorP631)

① Manual focus screw

6.5.8 Performing a calibration

Prerequisites

- User level **Operator** or **Maintenance** is set.
- The **Continuous measurement** and **Display image** switches are enabled.

Procedure

In order to receive exact position correction values from the device, the working distance and the circle diameter of the positioning mark must be calibrated. For a single-deep and double-deep rack storage application, first calibrate the device for the single deep rack.

1. In SOPASair, open the **Setup** window.
2. Measure the distance between the viewing window of the device and the rack with the positioning mark.
3. Enter the measured working distance for the actual rack depth in the **Working distance – Single deep [mm]** or **Working distance – Double deep [mm]** field in the **Working distance** area.
4. Measure the circle diameter of the positioning mark.
5. Enter the measured circle diameter as an initial value in the **Circle diameter [mm]** field in the **Circle Setup** area.
6. Enable the **Continuous measurement** switch.
✓ The device captures images continuously and evaluates them.
7. In SOPASair, adjust the circle diameter in steps until the **Evaluation circle diameter (aim: 100%)** parameter in the **Results** area shows the value 100% ± 5%. The circle diameter set in SOPASair can deviate from the measured circle diameter.

6.5.9 Fine adjustment and calibration

Important notes

> **i** **NOTE**
>
> The following steps are only relevant for single-deep and double-deep rack storage applications.

> **i** **NOTE**
>
> If you enable the **Double deep** switch, all parameters (including working distance and circle diameter) only apply to the double-deep rack storage. The values previously set for the single-deep rack storage remain valid in the background and remain unchanged despite the newly-made settings.
>
> In Double deep mode, the field of view in the X and Y direction is limited to 25%. If required, a larger field of view can be implemented on request.

Procedure

1. Reparameterize the device for double-deep rack storage. To do so, enable the **Double deep** switch in the **Rack Fine Positioning** area.
✓ The device is in Double deep mode.
2. The automated storage and retrieval system is positioned so that only the positioning mark of the double deep rack is visible in the image.
3. Repeat the fine adjustment for the double deep rack.
4. Repeat the calibration for the double deep rack.
5. After completing the fine adjustment and calibration for the double-deep rack storage, test the configured settings again for the single-deep rack storage. Verify that both distance positions work reliably.
   o Activating Single deep mode: Disable the **Double deep** switch in the **Rack Fine Positioning** area.
   o The automated storage and retrieval system is positioned so that only the positioning mark of the single deep rack is visible in the image.
   o Test the fine adjustment and calibration of the single deep rack.

Further topics

- Performing a fine adjustment
- Performing a calibration

6.5.10 Evaluation mode

The configured evaluation mode affects which circle is detected as the positioning mark and used for the output of measured values. The following table provides information on the available evaluation modes.

In evaluation modes 1 to 8, the user defines a target region in which the positioning mark is located.

In evaluation modes 9 to 14, the user defines an area that will be excluded from the evaluation. Only circles within the target region will be used for the evaluation. The device ignores all circles outside the target region. The digital outputs are not supported in evaluation modes 9 to 14.

The device determines the location of the positioning mark based on a coordinate system in the field of view. The measured value (X value and Y value) that the device outputs is relative to the origin of the coordinate system. When evaluation mode 1 to 8 is set, the origin is located in the middle of the target region. For evaluation modes 1 to 8, the origin can also be shifted in SOPASair using the **Relative offset to origin X [mm]** and **Relative offset to origin Y [mm]** parameters. When evaluation mode 9 to 14 is set, the origin is located at the center point of the image.

No.	Evaluation mode	Description
1	Best circle score	The circle with the highest measured score value [1] is used for the output of measured values. To exclude circles with a too low measured score value from the evaluation, adjust the **Min acceptance score** parameter.
2	First circle left	The circle with the smallest distance from the left edge of the image is used for the output of measured values. This is the circle with the smallest value for the **Automated storage and retrieval system relative position correction X** parameter.
3	First circle right	The circle with the smallest distance from the right edge of the image is used for the output of measured values. This is the circle with the largest value for the **Automated storage and retrieval system relative position correction X** parameter.
4	First circle top	The circle with the smallest distance from the top edge of the image is used for the output of measured values. This is the circle with the smallest value for the **Automated storage and retrieval system relative position correction Y** parameter.
5	First circle bottom	The circle with the smallest distance from the bottom edge of the image is used for the output of measured values. This is the circle with the largest value for the **Automated storage and retrieval system relative position correction Y** parameter.
6	Circle nearest to the origin	The circle with the smallest distance from the origin is used for the output of measured values. The origin is located in the center of the image. The origin can also be shifted using the **Relative offset to origin X [mm]** and **Relative offset to origin Y [mm]** parameters.
7	Follow first circle found	The device starts and captures the first image. The circle that is closest to the top left corner of the image after the first image capture is used for the output of measured values. This circle is defined as the circle to follow. For every subsequent image capture, the circle that is closest to the previously followed circle is used for the output of measured values. This circle is then defined as the circle to follow.

No.	Evaluation mode	Description
8	Best circle diameter [default]	The circle with the smallest difference to the target value that was set for the **Circle diameter [mm]** parameter is used for the output of measured values. This evaluation mode is the default.
9	Target region - best circle diameter	Only circles within the target region will be used for the evaluation. The circle with the smallest difference to the target value that was set for the **Circle diameter [mm]** parameter is used for the output of measured values.
10	Target region - first circle left	Only circles within the target region will be used for the evaluation. The circle with the smallest distance from the left edge of the image is used for the output of measured values. This is the circle with the smallest value for the **Automated storage and retrieval system relative position correction X** parameter.
11	Target region - first circle right	Only circles within the target region will be used for the evaluation. The circle with the smallest distance from the right edge of the image is used for the output of measured values. This is the circle with the largest value for the **Automated storage and retrieval system relative position correction X** parameter.
12	Target region - first circle top	Only circles within the target region will be used for the evaluation. The circle with the smallest distance from the top edge of the image is used for the output of measured values. This is the circle with the smallest value for the **Automated storage and retrieval system relative position correction Y** parameter.
13	Target region - first circle bottom	Only circles within the target region will be used for the evaluation. The circle with the smallest distance from the bottom edge of the image is used for the output of measured values. This is the circle with the largest value for the **Automated storage and retrieval system relative position correction Y** parameter.
14	Target region - no output for multiple circles	Only circles within the target region will be used for the evaluation. If there are several circles within the target region, no output of measured values occurs.

[1] The measured score value specifies how well the located circle corresponds to an ideal circle. The measured score value is displayed at the top of the live image in SOPASair.

Further topics

- Setting the evaluation mode

6.5.11 Setting the evaluation mode

Procedure

1. Set the user level to **Maintenance**.
2. Open the **Advanced setup** window.
3. Select an evaluation mode in the drop-down menu of the **Selection** parameter.

Further topics

- Evaluation mode
- Setting the evaluation mode using a command: Commands from the controller to the device.

6.5.12 Adjusting the size of the target region

Prerequisites

- User level **Operator** or **Maintenance** is set.
- The **Continuous measurement** and **Display image** parameters are enabled.

Procedure

The size of the target region can be adjusted. The closer the set size is to the actual circle diameter of the positioning mark, the more exact the positioning of the automated storage and retrieval system is. This means, however, that more position adjustments have to be made until the positioning mark is located in the target region. The complete positioning mark must be located in the target region to release the processes of putting goods into and taking them out of storage.

1. Open the **Setup** window.
2. In the **Circle – Target region** area, adjust the **Tolerance range X [mm]** and **Tolerance range Y [mm]** parameters.

6.5.13 Shifting the target region

Prerequisites

- The user level **Maintenance** is set.
- The **Continuous measurement** and **Display image** parameters are enabled.

Procedure

If the positioning mark is not located in the center of the image, shift the target region in the image.

1. Open the **Advanced setup** window.
2. In the **Circle – Target region** area, adjust the **Relative offset to origin X [mm]** and **Relative offset to origin Y [mm]** parameters as required.

6.5.14 Optimizing image brightness

Important notes

> **(i) NOTE**
> Combined single-deep and double-deep rack storage applications: The shutter time cannot be separately configured for single-deep and double-deep rack storage. The image brightness and illumination time must be set high enough to achieve an image brightness that is sufficient even for double deep racks. Ensure that the camera image for single deep racks is not overexposed.

> **(i) NOTE**
> As a decision-making criterion for good image brightness, observe the edges of the positioning mark and any total reflections of the background. With holes, the dark circle must be clearly differentiated from the light background. With reflectors, the light circle must be clearly differentiated from the dark background.

Procedure

The set image brightness is sufficient in most cases. It may be necessary to adjust the image brightness due to the different material characteristics of racks and the associated different reflection behavior.

1. Set the user level to **Maintenance**.
2. In the **Fine positioning** area, disable the **Double deep** switch.

✓   The device is in Single deep mode.

3.   Open the **Camera adjustment** window.

4.   How to set the image brightness in Single deep mode:
- ○   In the **Camera configuration** area, set the **Gain factor** parameter.
- ○   In the **Camera configuration** area, set the **Shutter time [μm]** parameter.

5.   In the **Fine positioning** area, enable the **Double deep** switch.

✓   The device is in Double deep mode.

6.   Increase the **Gain factor** parameter in double deep mode to a value that offers sufficient image brightness for positioning marks in double deep racks. To prevent increased image noise, avoid high values. If high values are necessary, adjust the shutter time accordingly.

7.   Check the settings in Single deep mode again. If necessary, correct the **Gain factor** in single deep mode.

8.   Activate the **Perform auto gain** parameter to automatically set a suitable image brightness using the Auto-gain assistant.

✓   The device captures a series of images and automatically sets the **Gain factor** parameter. The Auto-gain assistant and continuous measurement are automatically deactivated after they are successfully executed.

6.5.15 Setting the communication protocol

Procedure

1.   In SOPASair, open the **Interfaces** window.
2.   In the **Ethernet mode** area, set the communication protocol.

Further topics

- Communication protocols

6.5.16 Image transfer FTP

Procedure

The device can transmit images to an FTP server using file transfer protocol (FTP).

▶   Configure the destination address in SOPASair in the **Interfaces** window.

Complementary information

Access details for FTP transfer
- Name: AppStudio
- Password: AppStudio

6.5.17 Additional parameters

Other parameters for fine adjustment of the device are available in the **Maintenance** user level. These additional parameters are only relevant to a few applications. A table listing and explaining all parameters can be found in the appendix, see "Parameter", page 40.

6.5.18 Completing the parameterization

Procedure

1.   To achieve the maximum processing power of the device, image output is disabled after parameterization has been completed.

✓   A faster positioning process is possible. The system throughput is at its highest.

2.   Save the parameter set on the computer (backup) or to a microSD memory card (parameter cloning).

Further topics

- Saving the parameter set on the computer
- Saving the parameter set to a microSD memory card

6.6 Saving the parameter set on the computer

Procedure

1. Open SICK AppManager.
2. In the device window, click on the **Backup** button.
✓ The **Backup Apps and Data** window opens:
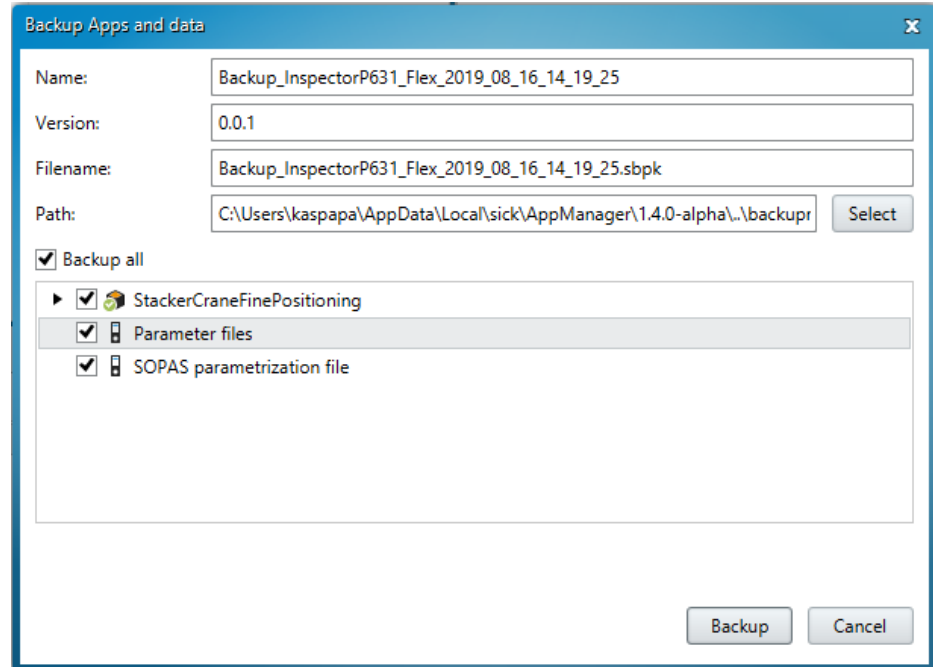
3. Complete the **Name**, **Version** and **Filename** fields.
4. Select the path for data backup.
5. Select all available options.
6. To perform the backup, click the **Backup** button in the **Backup Apps and Data** window.

6.7 Saving the parameter set to a microSD memory card

Important notes

> ⚠ **NOTICE**
> **Risk of damage to the memory card!**
>
> ▶ To avoid damaging the microSD memory card, make sure the device is **de-energized** when you insert or remove the card. For this purpose, disconnect the device from the supply voltage.

Procedure

InspectorP621: The card slot for the microSD memory card is located at the top of the rear of the device under the hinged cover.

InspectorP631: The card slot for the microSD memory card is located at the top of the device under the hinged cover.

1. Switch off the supply voltage to the device.
2. Undo the screws on the hinged cover.
3. Open the cover.
4. Insert the microSD memory card.
5. Close the hinged cover. Make sure that the cover is completely flush with the housing.
6. Tighten the screws on the hinged cover.
7. Switch on the supply voltage for the device.
8. In SICK AppManager, click the **Clone** button in the device window.
✓ The device saves the current parameter set to the microSD memory card.

6.8 Installing firmware updates

Procedure

1. Open SICK AppManager.
2. Drag and drop the file into the **Firmware** window.
3. In the **Firmware** window, select the file to be installed.
4. In the bottom right window, click the **Install** button.
✓ The firmware update is installed.

7 Specification of the interface and interaction with the controller

7.1 Communication sequence

After switching on the supply voltage, the **Continuous measurement** parameter in the device is activated by default. The device starts in measurement mode. As long as continuous measurement is switched on, the device captures images and evaluates them. The measurement results are transferred to the controller cyclically. The device sends offset values of the center point of the positioning mark relative to the origin of the coordinate system to the controller. The offset values are transmitted in micrometers.

In the controller, determine the average value of the transmitted offset values. Position the automated storage and retrieval system based on this average value. Once the automated storage and retrieval system has completed the put away or retrieval process and has moved away from the target region, and the positioning mark is outside the field of view, the **Continuous measurement** parameter is deactivated by the controller. This will stop image capturing.

The controller notifies via a command which rack depth (single deep, double deep) will be moved to.

If the position of the device and the defined target region do not agree with the positioning mark on a rack in individual cases, this deviation needs to be taken into consideration on the controller side. Do not reparameterize the device for this purpose.

7.2 Interfaces

For the communication with the controller, do not use the Ethernet interface in parallel to the digital inputs and digital outputs.

7.2.1 Ethernet interface

The device offers an Ethernet interface with various communication protocols. The communication protocol used can be set using the SOPASair operating software.

Further topics

- Setting the communication protocol

7.2.1.1 Communication protocols

PROFINET

In the case of the PROFINET communication protocol, communication occurs in handshake mode via the 32 input bytes and 32 output bytes. The control bytes (Ctrl bits) of the PROFINET interface are not used.

When implementing the PROFINET interface, use the GSD file of the device and function blocks. The function blocks are used to receive measurement results and transmit commands.

An integration example for S7-PROFINET can be downloaded at **www.sick.com/Inspec-torP_Rack_Fine_Positioning** > **Downloads** > **Software**. The integration example includes, among other things, a recommended SICK function block, and information on connecting to the device.

TCP/IP (PLC is the client)

The device is the server. The connected host acts as the client. The measurement results and commands are transmitted in binary format.

TCP/IP (PLC is the server)

The device is the client. The connected host acts as the server. The measurement results and commands are transmitted in binary format.

UDP

The data are transferred via UDP. More information is available on request.

7.2.2 Digital inputs and digital outputs

The digital inputs and digital outputs allow communication with the controller.

The device transmits direction information (up, down, right, left) via the digital outputs. The automated storage and retrieval system can approach the target position step-by-step based on this direction information. The device does not transmit any quantitative information about the difference between the actual position and target position of the automated storage and retrieval system.

The Ethernet interface transfers the precise difference between the actual position and target position to the controller using X-values and Y-values. This is how the automated storage and retrieval system is controlled directly to the target position.

Further topics

- Control via digital inputs and digital outputs
- Digital inputs and digital outputs (Pins)

7.3 Commands from the controller to the device

The commands listed here are used for device control and parameterization.

The functional implementation described below refers to a field with a length of 10 bytes or 11 bytes (2 command bytes, 8 or 9 parameter bytes). If the first byte (Command_H) equals <00>, the device ignores any bytes following the command bytes since the device is not being parameterized.

Command 1: Switch off continuous measurement: <00> <00>

If a command is sent with the contents <00><00>, continuous measurement is switched off.

	Designation	Function	Example	Interpretation example
Byte 1	Command_H	Command	<00>	Switching off continuous measurement
Byte 2	Command_L		<00>	

Command 2: Switch on continuous measurement, Single deep: <00> <01>

If a command is sent with the contents <00><01>, continuous measurement is switched on in single deep mode. The device remains in this mode after switching on.

	Designation	Function	Example	Interpretation example
Byte 1	Command_H	Command	<00>	Switch on continuous measurement
Byte 2	Command_L		<01>	Activate single deep mode

Command 3: Switch on continuous measurement, Double deep: <00> <02>

If a command is sent with the contents `<00><02>`, continuous measurement is switched on in double deep mode.

	Designation	Function	Example	Interpretation example
Byte 1	Command_H	Command	`<00>`	Switch on continuous measurement
Byte 2	Command_L		`<02>`	Activate double deep mode

Command 4: Parameterization of diameter and distance: <01> <00>

If the first byte (Command_H) equals `<01>`, the device evaluates the 8 bytes following the command bytes as parameters for the single and double deep modes. If the device is only used for single deep mode, the parameters for double deep mode are set equal to the parameters for single deep mode. Activation leads to a parameter change and recalibration.

	Designation	Function	Example	Interpretation example
Byte 1	Command_H	Command	`<01>`	Single and double deep parameterization
Byte 2	Command_L		`<00>`	
Byte 3	DiaSD_H	Single deep diameter in 1/10 mm	`<00>`	125/10 mm = 12.5 mm
Byte 4	DiaSD_L		`<7D>`	
Byte 5	DiaDD_H	Double deep diameter in 1/10 mm	`<00>`	125/10 mm = 12.5 mm
Byte 6	DiaDD_L		`<7D>`	
Byte 7	DistSD_H	Single deep distance in mm	`<01>`	350 mm
Byte 8	DistSD_L		`<5E>`	
Byte 9	DistDD_H	Double deep distance in mm	`<06>`	1,666 mm
Byte 10	DistDD_L		`<82>`	

All parameters are evaluated as WORD in the controller.

InspectorP621: The focus control enables the SensorApp to automatically adjust the focus position. If the "Double deep distance in mm" value is adjusted, the focus position is changed to this value. Only adjust the focus position during commissioning.

As a response to parameterization for the single and double deep modes, the device sends the status bytes `<00><20>`. These status bytes are reset to `<00><00>` after successful parameterization.

Command 5: Parameterization of evaluation with target region for single deep: <02> <00>

If the first byte (Command_H) equals `<02>`, the device evaluates the 9 bytes following the command bytes as parameters for specialized processing with, if applicable, several positioning marks in the image for single deep mode. Use an evaluation mode with target region. In this evaluation mode, only a section of the entire camera image is evaluated, not the whole image. Irrelevant circles are hidden. Activation leads to a parameter change, but not to recalibration.

	Designation	Function	Example	Interpretation example
Byte 1	Command_H	Command	<02>	Specialist single deep parameterization
Byte 2	Command_L		<00>	
Byte 3	CircSel	Evaluation mode	<09>	Evaluation mode 9: Target region - best circle diameter
Byte 4	OffX_H	Relative offset to origin X in 1/10 mm	<00>	100/10 mm = 10 mm
Byte 5	OffX_L		<64>	
Byte 6	OffY_H	Relative offset to deviation Y in 1/10 mm	<FF>	-200/10 mm = -20 mm
Byte 7	OffY_L		<38>	
Byte 8	TolX_H	Tolerance X in 1/10 mm	<01>	500/10 mm = 50 mm
Byte 9	TolX_L		<F4>	
Byte 10	TolY_H	Tolerance Y in 1/10 mm	<01>	300/10 mm = 30 mm
Byte 11	TolY_L		<2C>	

The **Evaluation mode** parameter in byte 3 is evaluated as BYTE in the controller. All other parameters are evaluated as WORD in byte 4 to byte 11.

As a response to specialized single deep parameterization, the device sends the status bytes <00><40>. These status bytes are reset to <00><00> after successful parameterization.

Command 6: Parameterization of evaluation with target region for double deep: <03> <00>

If the first byte (Command_H) equals <03>, the device evaluates the 9 bytes following the command bytes as parameters for specialized processing with, if applicable, several positioning marks in the image for double deep mode. An evaluation mode with target region can be used. In this evaluation mode, only a section of the entire camera image is evaluated, not the whole image. Irrelevant circles are hidden. Activation leads to a parameter change, but not to recalibration.

	Designation	Function	Example	Interpretation example
Byte 1	Command_H	Command	<03>	Specialist double deep parameterization
Byte 2	Command_L		<00>	
Byte 3	CircSel	Evaluation mode	<08>	Evaluation mode 8: Best circle diameter [default]
Byte 4	OffX_H	Relative offset to origin X in 1/10 mm	<00>	0/10 mm = 0 mm
Byte 5	OffX_L		<00>	
Byte 6	OffY_H	Relative offset to deviation Y in 1/10 mm	<00>	0/10 mm = 0 mm
Byte 7	OffY_L		<00>	
Byte 8	TolX_H	Tolerance X in 1/10 mm	<00>	80/10 mm = 8 mm
Byte 9	TolX_L		<50>	
Byte 10	TolY_H	Tolerance Y in 1/10 mm	<00>	80/10 mm = 8 mm
Byte 11	TolY_L		<50>	

The **Evaluation mode** parameter in byte 3 is evaluated as BYTE in the controller. All other parameters are evaluated as WORD in byte 4 to byte 11.

As a response to specialized double deep parameterization, the device sends the status bytes <00><80>. These status bytes are reset to <00><00> after successful parameterization.

7.4 Response from the device to the controller

As long as continuous measurement is switched on, the device cyclically transmits measurement results to the controller. For each image, 16 bytes are reported back to the controller from the device.

	Designation	Function	Example	Interpretation example
Byte 1	Status_H	Status	<00>	Circle found
Byte 2	Status_L		<03>	
Byte 3	XposH_H	Automated storage and retrieval system relative position correction X in µm	<00>	16,558 µm
Byte 4	XposH_L		<00>	
Byte 5	XposL_H		<40>	
Byte 6	XposL_L		<AE>	
Byte 7	YposH_H	Automated storage and retrieval system relative position correction Y in µm	<FF>	-4,906 µm
Byte 8	YposH_L		<FF>	
Byte 9	YposL_H		<EC>	
Byte 10	YposL_L		<D6>	
Byte 11	PicNr_H	Image counter	<8E>	36572
Byte 12	PicNr_L		<DC>	
Byte 13	Proc- Time_H	Evaluation time in ms	<00>	39 ms
Byte 14	Proc- Time_L		<27>	
Byte 15	DiaEval_H	Evaluation of the circle diameter in %	<00>	108%
Byte 16	DiaEval_L		<6C>	

If continuous measurement is switched on, the status bytes are assigned as described below.

- Status_H = 00 hex
- Status_L is bit-coded:

Bit position	
D0 (LSB)	Circle was found. Measured values are valid.
D1	Continuous measurement is switched on.
D2	1: Double deep is activated. 0: Single deep is activated.
D3	Saving the images on a microSD memory card is activated.
D4	Not assigned
D5	Command 4: "Parameterization of diameter and distance" is being processed. When the command is executed, the bit is cleared.
D6	Command 5: "Parameterization of evaluation with target region for single deep" is being processed. When the command is executed, the bit is cleared.

Bit position	
D7 (MSB)	Command 6: "Parameterization of evaluation with target region for double deep" is being processed. When the command is executed, the bit is cleared.

7.5   Interpretation of the position correction values

The device determines the location of the positioning mark based on a coordinate system in the field of view. To do so, the device determines the offset of the positioning mark from the origin of the coordinate system on the X axis and Y axis. When evaluation mode 1 to 8 is set, the origin is located in the middle of the target region. For evaluation modes 1 to 8, the origin can also be shifted in SOPASair using the **Relative offset to origin X [mm]** and **Relative offset to origin Y [mm]** parameters. When evaluation mode 9 to 14 is set, the origin is located at the center point of the image. The device corrects the position of the automated storage and retrieval system relative to the positioning mark based on the X values and Y values determined. When the positioning mark is precisely in the middle of the target region or at the center point of the image, depending on the selected evaluation mode, the offset from the origin of the coordinate system is Y = 0 and X = 0.

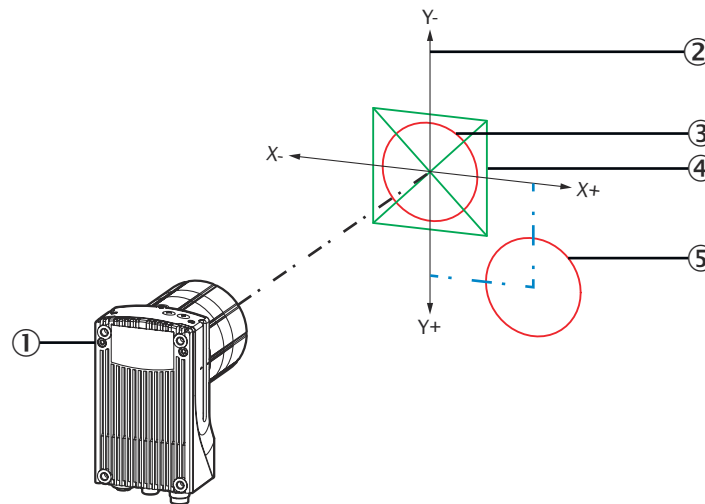The coordinate system can be modified in SOPASair. You can rotate the coordinate system and mirror the axes.

Figure 8: Interpretation of the position correction values

①   Device
②   Coordinate system, for determining the location of the positioning mark
③   Positioning mark in the middle of the target region (X = 0 μm, Y = 0 μm)
④   Target region
⑤   Positioning mark below the target region and to the right (X = 14,000 μm, Y = 15,000 μm)

7.6   Control via digital inputs and digital outputs

Digital input sensor 1 activates and deactivates continuous measurement. Continuous measurement is activated after switching on the device even if the sensor 1 digital input is switched off. This allows operation without digital inputs. The sensor 2 digital input is used to switch between the single and double deep modes.

Sensor 1		
	1	Continuous measurement is switched on.
	0	Continuous measurement is switched off.

| Sensor 2 | 1 | Double deep mode is activated. |
| | 0 | Single deep mode is activated. |

Information about the current location of the positioning mark is output via the digital outputs IN/OUT 3 to IN/OUT 6. The device transmits direction information (up, down, right, left) via the digital outputs. The automated storage and retrieval system approach the target position step-by-step based on this direction information. The device does not transmit any quantitative information about the difference between the actual position and target position of the automated storage and retrieval system.

In evaluation mode 1 to 8, all outputs in the following table are possible. In evaluation mode 9 to 13, the device only outputs via the digital outputs whether the positioning mark is located in the target region.

IN/OUT 3 (top)	IN/OUT 4 (bottom)	IN/OUT 5 (right)	IN/OUT 6 (left)	Location of the positioning mark
1	1	1	1	Inside the target region
0	1	1	1	Above the target region
1	0	1	1	Below the target region
1	1	0	1	At the right of the target region
1	1	1	0	At the left of the target region
0	1	0	1	At the right above the target region
0	1	1	0	At the left above the target region
1	0	0	1	At the right below the target region
1	0	1	0	At the left below the target region
0	0	0	0	Positioning mark not found in the image

LEDs on the device

For the InspectorP621, information about the configured rack depth and depth information is output via the LED bar graph.
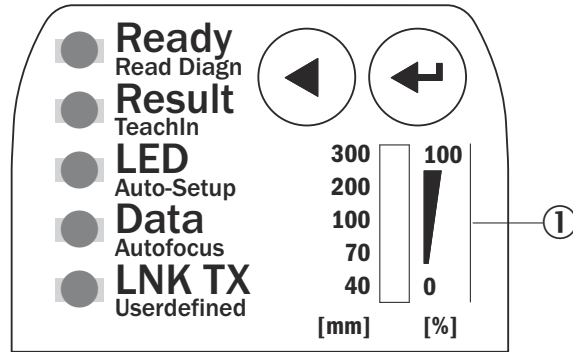
① LED bar graph (0 to 9), InspectorP621

API name	Digital input/output	LED behavior (color)	Status
BAR0_LED	Sensor 2	○	Single deep
		● (green)	Double deep
BAR3_LED	IN/OUT 3	● (green)	Direction information: top
BAR5_LED	IN/OUT 4	● (green)	Direction information: bottom
BAR7_LED	IN/OUT 5	● (green)	Direction information: right

API name	Digital input/output	LED behavior (color)	Status
BAR9_LED	IN/OUT 6	🟢 (green)	Direction information: left

For the InspectorP631, depth information is output via the LED bar graph.

Figure 9: LED bar graph (0 to 4), InspectorP631

①   IN/OUT 6 (direction specification: left)

②   IN/OUT 5 (direction specification: right)

③   IN/OUT 4 (direction specification: down)

④   IN/OUT 3 (direction specification: up)

SOPASair

The current location of the positioning mark is displayed in the **Digital output** area in SOPASair. If the positioning mark is located in the target region, the circle in the center is green and surrounding squares are black. If the positioning mark is located outside the target region, a surrounding circle is shown in red depending on the location of the positioning mark relative to the target region (up, down, right, left).

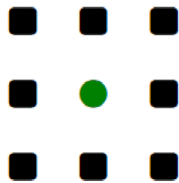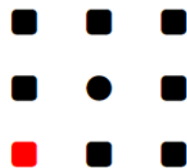*Figure 10: Positioning mark in the target region*

Figure 11: Positioning mark outside the target region

8 Cleaning

Cleaning includes the viewing window and the housing of the device. Contamination of the viewing window on the device will result in a reduced measurement accuracy and faulty measurements. Clean the viewing window of the device before operation.

> **!** **NOTICE**
> **Equipment damage due to improper cleaning.**
> Improper cleaning may result in equipment damage.
>
> - Only use recommended cleaning agents and tools.
> - Never use sharp objects for cleaning.

The product documentation for the device contains detailed information on cleaning. The product documentation can be downloaded from the Internet at see "Related applicable documents", page 5.

9 Accessories

> **NOTE**
> Accessories and, if applicable, mounting information can be found online at:
> - **www.sick.com/InspectorP_Rack_Fine_Positioning**

10 Annex

10.1 Parameter

The following table lists the available parameters with description and usage information.

Parameter	Function	Use
Display mode	Space-optimized display (device-specific)	Function is not supported.
Restart app	Restarts the SensorApp.	Restarts the SensorApp in the event of an error.
Working distance - single deep [mm] Working distance - double deep [mm]	Measured distance between the viewing window of the device and the rack with the positioning mark	Converts the distance from pixels to millimeters. Enter values for the Single and Double deep modes separately. The displayed parameter value depends on the switch setting of the **Double deep** parameter for the single or double deep mode.
Snap single image	Captures a single image.	When the device is set up, capture an image. Simplifies commissioning, as the image capture does not need to be triggered by the controller.
Selection	Specifies whether the positioning mark is a hole or reflector.	Select the correct hole or the correct reflector as the positioning mark if there are multiple circles in the field of vision of the device. Hide the irrelevant image section in evaluation mode 9 to 14.
Perform auto gain	Automatically sets the image brightness.	Optimizes the visibility of the positioning mark. When executing Auto-gain, one positioning mark must be visible. All other settings must have been made correctly. The device captures a series of images and automatically sets the **Gain factor** parameter. The switch is automatically deactivated after successful automated setting of the gain factor.
Shutter time [µs]	Adjusts the image brightness via the shutter time.	The illumination time usually does not have to be adjusted. This may, however, be necessary for certain specialized applications.
Store image in device	Save the currently visualized image in the device.	Save a single image in the device for a short time during commissioning for later analysis.

Parameter	Function	Use
Display image	Activates and deactivates image transmission for the SOPASair user interface.	Image output is necessary for setting up the device. Switches off image output during actual operation.
Store images to SD card	Save images on the microSD memory card in the device.	Analyze settings over a long period of time. Typical shapes and, if applicable, problematic marks can be identified using images. During continuous operation, switch off this function to achieve maximum throughput.
Image sharpness	Activate image sharpness measurement.	The device outputs a value for image sharpness. Adjusts the focus position of the lens until the focus value is at the maximum, see "Performing a fine adjustment", page 21. When the focus has been finalized, disable the **Image sharpness** switch.
Image transfer FTP	Transfers the current image to the address set in the **Interfaces** window using the FTP server.	Saves images for documentation purposes or later evaluation.
Reset image counter	Resets the internal image counter.	An internal image counter counts the captured images. Using the image counter and resetting it can simplify commissioning, for example for comparing the signals arriving at the controller with the counter.
Deformation factor (for triple reflector)	Compensates for deformed circles.	Deformed circles typically appear when using triple reflectors. If reflectors are not exactly circular, this parameter ensures that the reflectors are still detected as positioning marks. The detection of the positioning mark is optimized in relation to the deviating shape.
Double deep	Switch between the Single and Double deep modes.	Reports to the device that settings for close range (single deep) or long range (double deep) are being made internally. During setup, use this switch to separately define the input fields (e.g., the working distance) for the single and double deep modes. During operation, the controller changes the parameter via a command based on the rack depth moved to.

Parameter	Function	Use
Dark circle on bright background (hole in steel)	Sets the polarity of the positioning mark.	Set whether a light circle on a dark background or a dark circle on a light background is present. Holes appear dark on light backgrounds. Reflectors appear light on dark backgrounds.
Diameter scaling min - max	Defines the allowed variance in the circle size.	Example: 0.85 … 1.15 corresponds to 85% to 115% of the expected circle diameter. Circle diameter defines what the device considers to be a valid positioning mark. If the area is set too high or too low, circles can be overlooked or too many potential circles could be detected as possible positioning marks. Use this parameter to compensate for the scaling effect based on variations in the distance between the device and the rack.
Ellipse minor axis [mm]	Enter length of the minor axis (blue arrow) for elliptical hole shapes. 	Use this parameter for ellipse-shaped positioning marks. Specifying the minor axis length enables the positioning mark to be detected more reliably.
Ethernet mode	Set communication protocol for Ethernet interface.	Adjust setting to the communication protocol of the controller used.
Gain factor	Manually adjust the image brightness.	Manually adjust the image brightness so that the positioning mark is as visible as possible.
Reboot device	Reboot device.	Restart the device in the event of errors.
View stored image	Display the currently saved image in SOPASair.	The saved image is displayed and current continuous measurement is switched off.
Reprocess stored image	Reprocess and evaluate the image currently saved in the device.	The saved image is processed again with the adapted settings of the algorithm.
Bright circle on dark background (reflector)	Sets the polarity of the positioning mark.	Set whether a light circle on a dark background or a dark circle on a light background is present. Holes appear dark on light backgrounds. Reflectors appear light on dark backgrounds.
Invert X/Y axis	Exchange output values for X-axis and Y-axis.	Possible application: The device has been installed in the system upside down.

Parameter	Function	Use
IP address FTP server	Set IP address of the FTP server.	Define target address for image transmission.
IP address PLC	Set IP address of controller.	Define target address for data output to the controller.
IP port InspectorP for TCP (PLC is client)	Set IP ports for the device.	If the device is in the TCP server network, define the IP ports.
Compact mode	Set compact display.	Function is not supported.
Continuous measurement	Activate device. Start continuous image capturing and evaluate every image.	Capture and evaluate images continuously during commissioning. During actual operation, continuous measurement is activated by the controller via a command as soon as the automated storage and retrieval system is in front of the rack and the positioning mark is in the field of view of the device.
Circle diameter [mm]	Define circle diameter of the positioning mark to be searched for.	Optimize performance and positioning accuracy.
Min acceptance score	Minimum measured value for detecting a hole or a reflector as a positioning mark	The lower the measured value, the more elements are detected as the positioning mark. This can be useful to allow for detection of circles with unclear outlines (e.g., due to corrosion). A value which is too low leads to error messages.
Relative offset to origin X [mm] Relative offset to origin Y [mm] (**Circle – target region**)	Move X- and Y-position of the target region in the image.	Shift the target region in the image. If the device cannot be mounted in such a way that the positioning mark is located in the center of the image during storage and retrieval, shift the target region.
Language	Select interface language.	Restart SOPASair or update the web page using the F5 push-button to activate the set interface language.
Restore all default parameters	Reset device to factory settings.	Reparameterize the device based on the delivery state.

Parameter	Function	Use
Use temporary gain offset	Temporarily adjust the gain factor automatically for the next image capture.	Device did not find a positioning mark in the previous image. Compensate for slight contamination or overexposure in the field of view. If adjusting the gain factor leads to the positioning mark being found, the gain factor is used until continuous measurement is deactivated. When continuous measurement is deactivated, the gain factor is reset. If continuous measurement is not activated first for positioning marks in the field of view, do not use the temporary gain offset. If the gain factor is used in this case, undesirable image brightness fluctuations can occur.
Tolerance range X [mm] **Tolerance zone Y [mm]** **(Circle – target region)**	Set the size of the target region.	For storage or retrieval, the positioning mark must be located in the target region. The more accurately the size of the target region corresponds to the size of the positioning mark, the more exact the positioning is. This makes the system throughput slower, however. Required for the following functions: • Use of digital outputs for position determination • Once the positioning has been performed, the green feedback LED provides positive feedback. In evaluation mode 9 to 14, the parameter defines the size of the target region. Everything outside the target region is ignored in the evaluation.
Swap X/Y axis	Invert output values for the X-axis and Y-axis.	Possible application: The device has been installed in the system in the lying position.
Preconfiguration application	Set the type of positioning mark (hole or reflector).	The parameter is only relevant for single-deep applications. Define whether holes or reflectors are used as positioning marks.

10.2 Declarations of conformity and certificates

The declarations of conformity and certificates can be downloaded from the Internet at:

- **www.sick.com/InspectorP_Rack_Fine_Positioning**

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