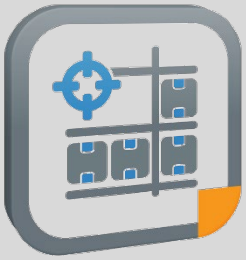
OPERATING INSTRUCTIONS

InspectorP Rack Fine Positioning

2D machine vision

SICK
Sensor Intelligence.



Product described

InspectorP Rack Fine Positioning

Manufacturer

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Trademarks

IBM is a trademark of the International Business Machine Corporation.
MS-DOS is a trademark of the Microsoft Corporation.
Windows is a trademark of the Microsoft Corporation.
Other product names in this document may also be trademarks and are only used here for identification purposes.

Legal notes

Original document

This document is a translation of the original document from SICK AG.

Contents

1 About this document

1.1 About these 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 instructions constitute an integral part of the product and are to be stored 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. For information about this, refer to the operating instructions of the specific machine.

Related publications

The following related publications must be read:

Part no.	Publication
8019946	InspectorP63x Flex C-mount and S-mount Operating Instructions
8018486	Technical Information for Ring Illumination Unit VI55I

1.2 Explanation of symbols

Warnings and important information in this document are labeled with symbols. The warnings are introduced by signal words that indicate the extent of the danger. These warnings must be observed at all times and care must be taken to avoid accidents, personal injury, and material damage.

HAZARD
... 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.

IMPORTANT
... 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
Other 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 variants, containing technical data, dimensional drawing, and specification diagrams
- These device operating instructions, available in English and German, and in other languages if applicable
- Other publications related to the devices described here
- Publications dealing with accessories

2 Safety information

2.1 Intended use

InspectorP Rack Fine Positioning is suited for storage and conveyor applications in which precise positioning of automated storage and retrieval systems is required when putting goods into and taking them out of storage.

The management, commissioning and operation of the device is done on a computer by using the SICK AppManager and SOPASair software. The device sends results to a higher-level control (e.g. PLC) in order to coordinate further processing via the host interface.

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 specifications 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 respective applicable safety standards for machines.
- The device must not be used in explosion-hazardous or corrosive areas or under extreme ambient 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:

- Device should be used only in accordance with its intended use.
- All information in these operating instructions must be strictly observed.

2.3 Internet protocol (IP) technology

NOTE
SICK uses standard IP technology in its products. The focus is on availability of products and services.
SICK always assumes the following prerequisites:

- The customer ensures the integrity and confidentiality of the data and rights affected by its own use of the aforementioned products.
- In all cases, the customer implements the appropriate security measures, such as network separation, firewalls, virus protection, and patch management.

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-compliance with product documentation (e.g. operating instructions)
- Improper use
- Use of untrained staff
- Unauthorized conversions
- Technical modifications
- Use of unauthorized spare parts, consumables, and accessories

The actual scope of delivery may differ from the features and illustrations shown here where special variants are involved, if optional extras have been ordered, or as a result of the latest technical changes.

2.5 Modifications and conversions

IMPORTANT
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.

This product documentation refers to the following qualification requirements for the various activities associated with the device:

- **Instructed personnel** have been briefed by the operating entity about the tasks assigned to them and about potential dangers arising from improper action.
- **Skilled personnel** have the specialist training, skills, and experience, as well as knowledge of the relevant regulations, to be able to perform tasks assigned to them and to detect and avoid any potential dangers independently.
- **Electricians** have the specialist training, skills, and experience, as well as knowledge of the relevant standards and provisions, to be able to carry out work on electrical systems and to detect and avoid any potential dangers independently. The electrician must comply with the provisions of the locally applicable work safety regulation.

The following qualifications are required for various activities:

Activities	Qualifications
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 Windows™ operating system in use • 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 specific 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 concerned

2.7 Operational safety and specific hazards

You can find more detailed safety information in the product documentation of the InspectorP63x Flex C-mount and S-mount. The product documentation is available in the Internet as a download at **www.sick.com/8019946**.

3 Product description

3.1 Scope of delivery

The scope of delivery includes the following components:

No. of units	Component	Remarks
1	Device in the version ordered	V2D63xP-xMx**SC**xx (single deep applications) or V2D63xP-xMx**SE**xx (single and double deep applications)
2	Sliding nut with 5.5 mm-deep M5 threaded mounting hole	Positioned in the slot on the right side of the device on delivery. Alternative mounting option for the device instead of tapped blind hole. Use in pairs.
1	Hexagon key WAF 2	For manual actuation of the focus screw.
4	Label (round, self-adhesive)	Protects the focus setting when using an S-mount lens. Adjustment is performed using the manual focus screw. The label is stuck 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.

3.2 Function and use

Temperature-, load- and steel construction-dependent influencing variables generate varying geometric conditions at transfer points in the storage and conveyor technology. These conditions make safe automated positioning of automated storage and retrieval systems more difficult when putting in and removing load carriers from storage.

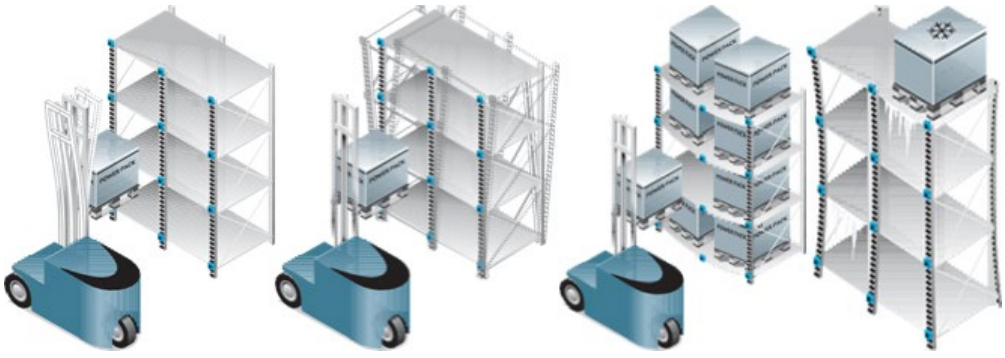

Figure 1: Negative influencing variables during automated positioning processes

InspectorP Rack Fine Positioning supports precise positioning when putting in and removing load carriers from storage. In doing so, positioning processes can be controlled both for single deep applications as well as combined applications with single and double deep racks. The device is mounted to the automated storage and retrieval system. The device takes pictures when putting goods into and taking them out of storage and detects a hole or a round reflector as a positioning mark in the rack. Using this positioning mark, the device sends a deviation of the current position of the

automated storage and retrieval system from the target position to a higher-level control (e.g. PLC), which initiates rack fine positioning of the automated storage and retrieval system. This prevents load carriers from colliding with the racks.

3.3 Principle of operation

Rack fine positioning takes place with a positioning mark on the rack. Positioning is possible over holes (recommended hole diameter: 13 mm) and round reflectors as positioning marks. A distinction is also made between single and double deep racks. 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. The device can handle both applications. Depending on the application (type of positioning mark, rack depth), there are differences in system design such as the selection of the lens focal length and the use of lighting filters.

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 typically 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 operating software. The device detects the current position of the positioning mark during operation and forwards the deviation from the target region to the control. 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 may be put onto and taken off 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.

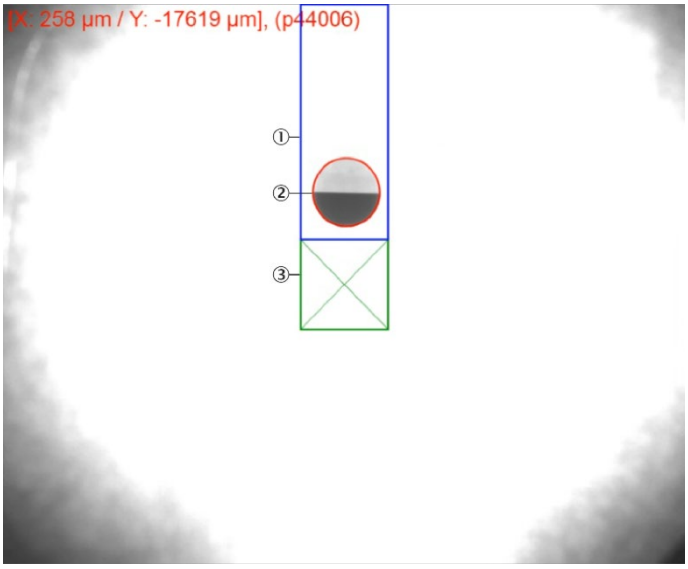

Figure 2: Detection and output related to the target region (example)

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

3.4 Single deep applications

Single deep applications can be used in the following cases:

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

1) Measured from the viewing window of the device to the rack. Depends on the application.

This application has a large field of view at close range.

3.5 Single and double deep applications

Combined applications with single and double deep racks can be used in the following cases:

Positioning mark	Rack depth	Working distance
Drill hole	Combination of single and double deep racks	200 mm ... 1,950 mm [1]
Drill hole	Single deep rack	200 mm ... 1,950 mm [1]

1) Measured from the viewing window of the device to the rack. Depends on the application.

3.6 Positioning mark

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 specific application situation must be considered individually.

Only relevant for single deep applications: The type of positioning mark (hole or reflector) can be set in SOPASair in the **Setup** window using the **Preconfiguration application** parameter.

Applications with holes

Holes as positioning marks can be used both for single deep applications as well as combined applications with single and double deep racks.

When using holes as positioning marks, please note:

- Recommended diameter of the hole: 8 mm ... 15 mm (typically 10 mm ... 13 mm).
- Surface characteristics of the steel around the hole: diffuse, lightly reflective.
  Recommendation: hot-dip galvanized steel.
- Ensure that there are no fully reflective surfaces behind the hole. Reduce the effect of any fully reflective surfaces with matt black spray paint or cover them with adhesive tape.

Applications with reflectors

Round reflectors as positioning marks can only be used for single deep applications. The surface characteristics of the steel around the reflector will have only a minor effect on the application and can be ignored.

NOTE

The following reflectors are recommended:

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

You can find the reflectors as accessories in the Internet at www.sick.com by entering the respective part number into the search field.

4 Installation

4.1 Software installation

4.1.1 SICK AppManager

Installation of the SICK AppManager is required to perform the following tasks:

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

Installing SICK AppManager

NOTE
The current version of SICK AppManager can be downloaded in the Internet at:
www.sick.com/SICK_AppManager

To install SICK AppManager, open the installation file (*.exe) and follow the instructions on the screen.

SICK AppManager user interface

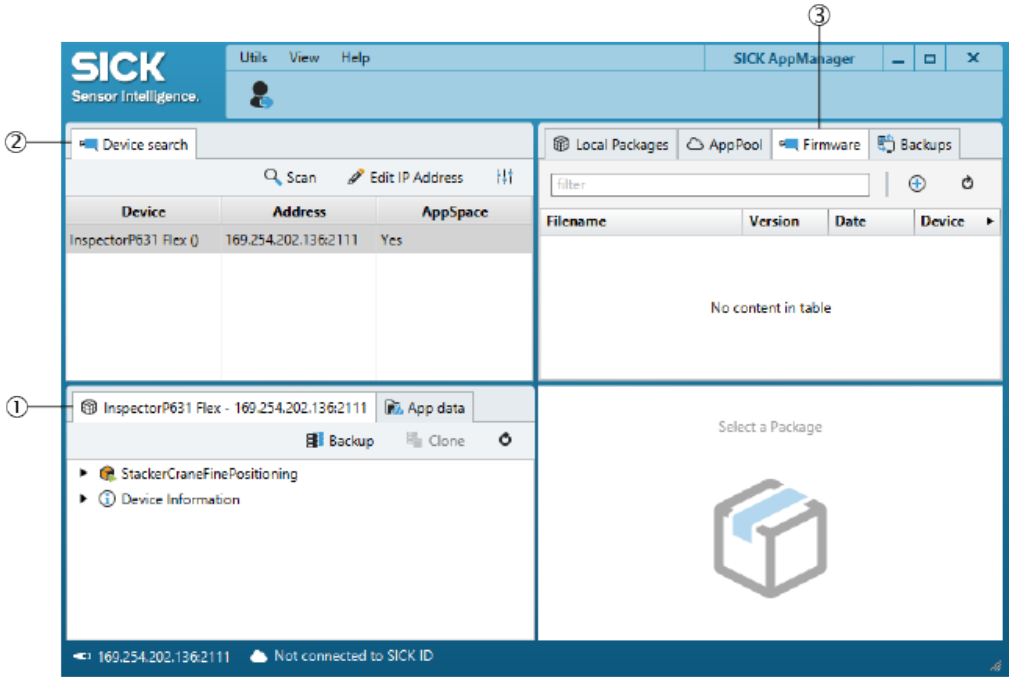

Figure 3: SICK AppManager user interface

(1) **Device** window (window name changes depending on the connected device)
(2) **Device Search** window
(3) **Firmware** window

4.1.2 SOPASair (web server)

The device is set up and parameterized using the SOPASair operating software. You can call up the operating software with a web browser (recommendation: Google Chrome). No installation of software is required. The device must be supplied with voltage and connected to the computer via the Ethernet interface in order to use the SOPASair web server.

Starting SOPASair

1. Start web browser (recommendation: Google Chrome).
2. Enter the device IP address into the address line.
   ✓ The SOPASair user interface appears.

4.1.3 Saving parameter set

The currently valid parameter set can be backed up using SICK AppManager. The complete environment of the device is then available if support is necessary.

Saving on the computer (backup)

1. In the SICK AppManager, in the **Device** window, click on the **Backup** button.
   ✓ The **Backup Apps and Data** window opens.

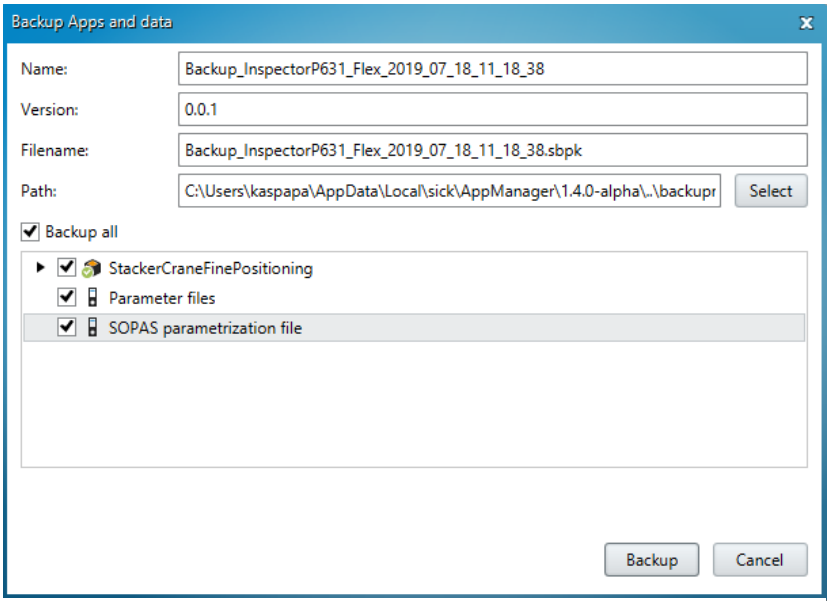

Figure 4: "Backup Apps and data" window

2. Fill out the **Name**, **Version** and **Filename** fields.
3. Select the path for data backup.
4. Select all available options.
5. To run the backup, click on the **Backup** button in the **Backup Apps and Data** window.

Saving on a microSD memory card (cloning)

IMPORTANT
Risk of damage to the memory card!
- To avoid damaging the 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 accordingly.

The card slot for the microSD memory card is located at the top of the device at the rear 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 again.
7. Switch on the supply voltage for the device.
8. In the SICK AppManager, in the **Device** window, click on the **Clone** button.
   ✓ From now on, the device will back up the current parameter set on the microSD memory card.

4.1.4 Installing firmware updates

To install firmware updates using SICK AppManager:

1. Pull the file with the firmware update into the **Firmware** window with drag and drop.
2. Select the file you want to install.
3. Click on the **Install** button in the lower right section of the window to install the update.

4.2 Mounting

4.2.1 Mounting requirements

General mounting requirements

- Distance from the device to the positioning mark (hole or reflector):
  100 mm ... 1,995 mm. The distance depends on the device type and type of positioning mark.
- The user can locate the positioning mark 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 must be within the area that is visible to the device in single and double deep applications when mounted at a permissible working distance.
- An algorithm is available to classify and ignore multiple positioning marks within the field of view of the device.

Mounting requirements: holes as positioning marks

- Ensure that no objects or contamination with distinct contours, or with a similar diameter or surface as the hole are present in the field of view.
- Ensure that there are no light sources mounted behind the hole.
- Ensure that 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

- Ensure that there are no light sources in the field of view of the device.
- Ensure that the reflector is not contaminated. A reflection must be ensured. If necessary, clean the reflector.
- During rack fine positioning with round reflectors, lights structures are searched for on darker surfaces. Use a polarizing filter to prevent total reflection of the illumination. The polarizing filter hides the total reflecting light from the surface. Do not use the polarizing filter for applications with holes.

NOTE
You can find the the polarizing filter (part number: 2088229) as an accessory in the Internet at www.sick.com by entering the part number into the search field.

The following graphic shows step-by-step mounting of the polarizing filter:

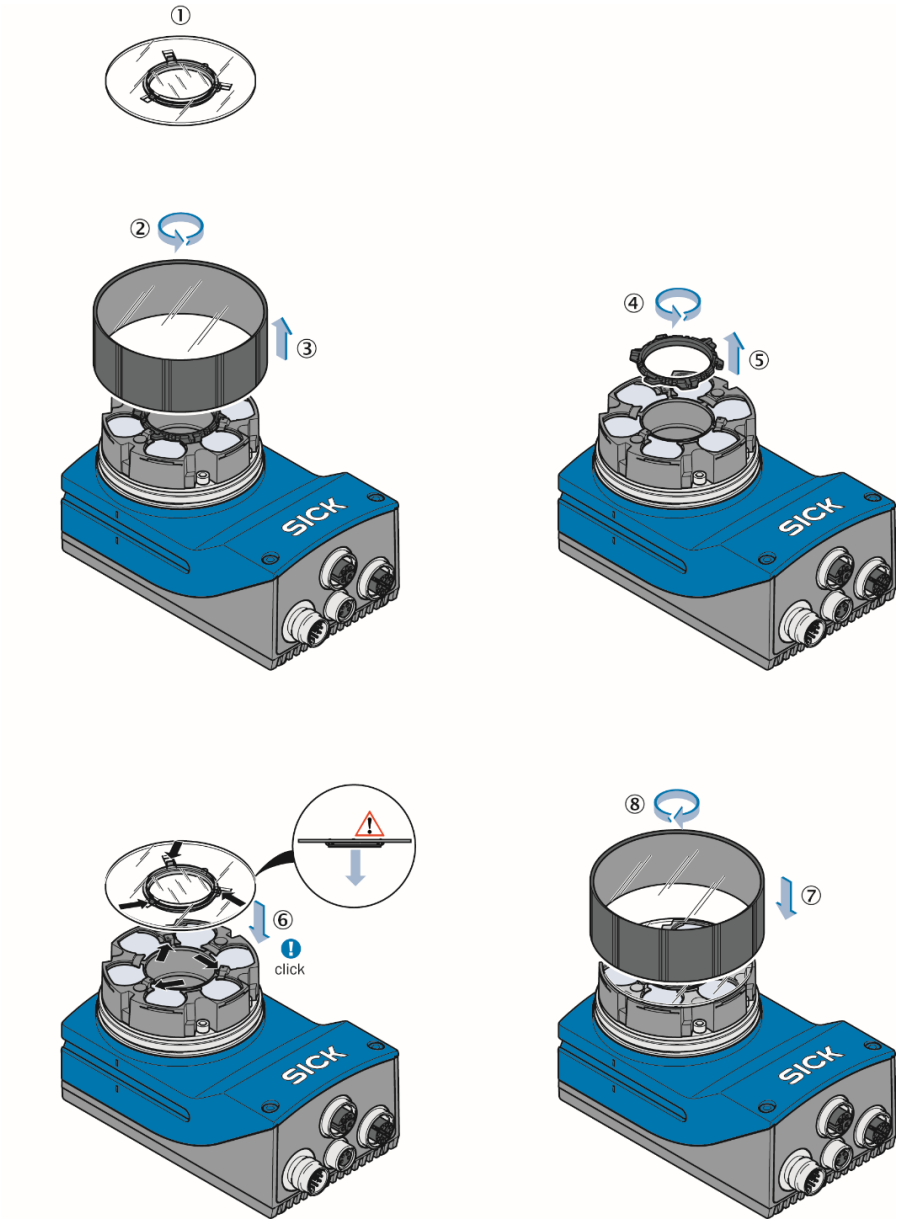

Figure 5: Polarizing filter mounting

(1) Scope of delivery of 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.

4.2.2 Mounting procedure

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 optics are already pre-focused at a distance which is suitable for most applications. It might be necessary to adjust the focus position in rare cases, see Figure 8: Manual focus screw, page 24.

The procedure for mounting the device is divided into the following steps:

- Mount the device with a view to the positioning mark
- Connect the device to interfaces and supply voltage
- Align the device using the laser alignment aid

4.2.3 Mounting device

Install the device to the mechanics with the bracket so that the device points vertically to the positioning mark on the rack.

NOTE
It should be mounted so that it is exposed to as little shock and vibration as possible. Ensure that the position of the device is not moved by vibrations during operation.

After switching on the supply voltage, the **Continuous measurement** parameter in the device is activated by default. The device immediately goes into measurement mode. Press the ▼ arrow button to switch the laser alignment aid on and off. The laser alignment aid helps align the device. The device projects two red laser points on the rack, signaling the viewing direction of the camera. The center of the image is between the two points. 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.

In a combined application with single and double deep racks, first align the device on the single deep rack. Then adjust the position of the device for the double deep rack, if applicable.

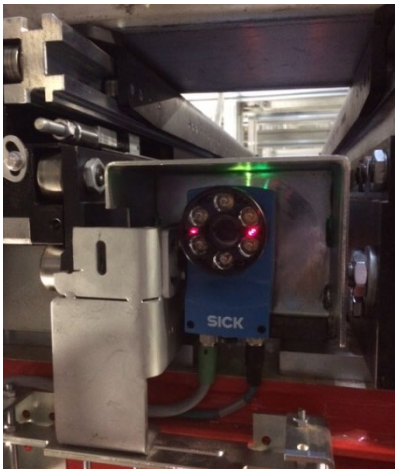

Figure 6: Mounting example

4.3 Electrical installation

4.3.1 Notes on electrical installation

NOTE
For detailed information on device connection, see the operating instructions of the InspectorP63x Flex C-mount and S-mount at **www.sick.com/8019946**.

4.3.2 Interfaces

The device offers both an Ethernet interface and digital inputs and digital outputs for communicating with the control. Parallel use of the two interfaces for communicating with the control is not recommended.

Ethernet interface

The user can parameterize the device via the Ethernet interface using the SOPASair operating software. Furthermore, the device transfers the deviation between the actual and the target position of the automated storage and retrieval system to the control via the Ethernet interface.

In doing so, the device precisely forwards the deviation between the actual position and the target position to the control using X- and Y-values. Based on these values, the control initiates position correction of the automated storage and retrieval system. The necessary communication protocol (PROFINET, TCP/IP or UDP) is set using the SOPASair operating software, see 5.3.9 Setting up Ethernet interface, page 28.

Digital inputs and digital outputs

The device is triggered via the digital input. The device outputs the position results using 4 digital outputs.

The device only delivers information on the direction (up, down, left, right) via the digital outputs. The automated storage and retrieval system approach the target position step-by-step based on this direction information. A quantitative statement about the deviation between the actual and the target position of the automated storage and retrieval system is not transmitted.

Use the following pins to use the digital inputs and digital outputs:

- Pin 10: Sensor 1, digital input, IN 1 (switch continuous measurement on and off)
- Pin 15: Sensor 2, digital input, IN 2 (activate and deactivate double deep mode)
- Pin 13: IN/OUT 3 (direction specification: up)
- Pin 14: IN/OUT 4 (direction specification: down)
- Pin 16: IN/OUT 5 (direction specification: right)
- Pin 17: IN/OUT 6 (direction specification: left)

For further information on digital inputs and digital outputs, see 5.4.6 Control via digital inputs and digital outputs, page 35.

5 Commissioning and operation

5.1 Establishing a connection: Ethernet

Opening user interface

The device must be supplied with voltage and connected to the computer via the Ethernet interface in order to use the SOPASair web server.

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
   ✓ The SOPASair user interface appears.

Changing the IP address

1. Start 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 application 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. Confirm changes with **OK**.

5.2 Establishing a connection: PROFINET

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

1. In the SICK AppManager, change the IP address.
2. Open SOPASair.
3. In SOPASair, switch to the **Operator** user level. 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.
   ✓ The device restarts.
   ✓ The PROFINET interface is active.

The PROFINET device name is used for identification. The IP address is usually assigned by the PROFINET IO controller (PLC) and then cannot be changed using SICK AppManager.

To make other settings on the PROFINET interface on the side of the PROFINET IO controllers (PLC), see 5.4.2 Interfaces, page 29.

5.3 Parameterizing device with SOPASair

5.3.1 SOPASair user interface

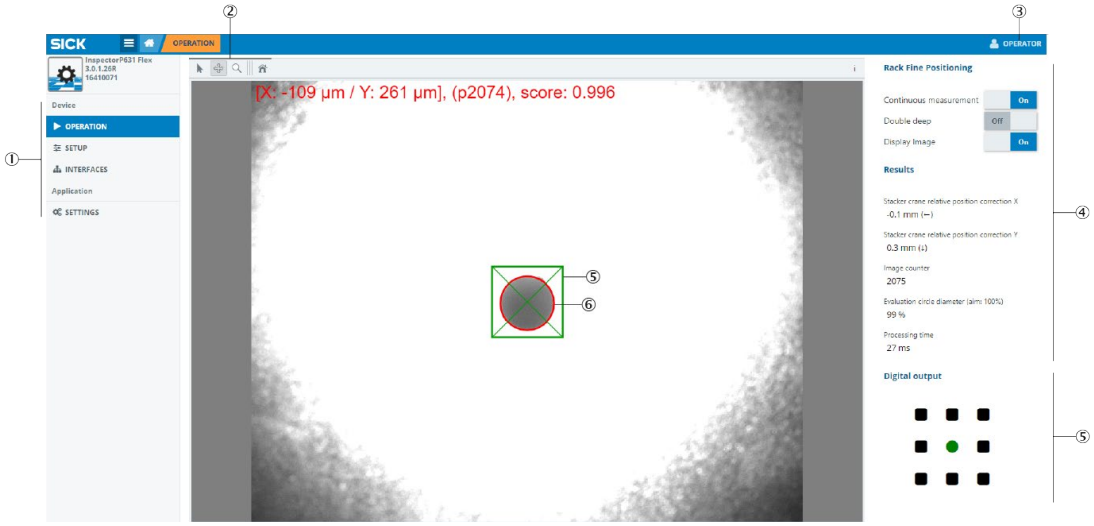

Figure 7: SOPASair user interface

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

5.3.2 Setting up user interface

Setting user level

Several user levels are available in SOPASair. To change the user level, click on the button with the currently set user level at the top right in the user interface.

The following user levels are available:

User levels	Password	Application
Run	No password required.	• Observe the system during operation • Switch continuous measurement on and off • Activate and deactivate double deep applications • Switch image output on and off
Operator	No password required.	• Additional settings needed for initial commissioning of the device • Minor adjustments during operation (e.g. measurement tolerances) • Since the device is preset when delivered, the parameters available here are usually sufficient for operation

User levels	Password	Application
Maintenance	Password: main	• User: Maintainer • Maximum number of available parameters • Adjust the device optimally to the circumstances • Deep understanding of the application necessary • Suited for fine adjustment during initial commissioning

All other user levels have no effect on the application and can be ignored. The higher the user level, the more parameters are available, making it possible to make detailed settings on the device.

SOPASair opens in the **Run** user level by default. Using the **Operator** or **Maintenance** user level is recommended for initial commissioning.

Adjusting language

The language of the user interface can be configured in the **Settings** window.

Loading default

If the device has already been parameterized for an application, then first load the default:

1. Switch to the **Maintenance** user level.
2. Open the **Advanced Setup** window.
3. Click on the **Restore all default parameters** button at the very bottom in the parameter bar.

5.3.3 Fine adjustment of the device

After the device has been roughly aligned during mounting, fine adjustment is done using the SOPASair operating software.

Prerequisites

- The device is mounted at the same height as the positioning mark.
- The device is aligned vertically to the rack with a view to the positioning mark.
- The **Operator** or **Maintenance** user level is set.

1. Open the **Operation** window in SOPASair.
2. Activate the **Continuous measurement** and **Display Image** switches.
   - ✓ The device begins recording and evaluating images and transmits the images to the computer.
3. Finely adjust the device mechanically using the image so that the following factors exist:
   - – The positioning mark (red) is located within the target region (green).
   - – Use of holes: The image is lit up so that the light-colored light spot can be seen uniformly around the dark hole.
   - – Use of reflectors: The image is lit up so that the light reflector is clearly identifiable compared to the dark background.
   - ✓ If the positioning mark is located in the target region, the feedback LED of the device lights up green.
   - ✓ The circle in the center is green in the **Digital Output** area. The surrounding squares are black. The current position of the positioning mark is therefore located within the target region.

NOTE
The optics are already pre-focused at a distance which is suitable for most applications. An adjust of the focus position may be necessary in rare cases only. In combined applications with single and double deep racks, always focus the device on the double deep rack.

4. Manually adjust the focus screws on the upper side of the device to optimize the focus position. Use a SW2 hexagon key.

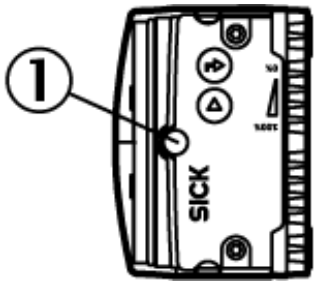

Figure 8: Manual focus screw

(1) Manual focus screw

5.3.4 Calibration of the device

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. First calibrate for single deep applications.

Prerequisites

- The **Operator** or **Maintenance** user level is set.
- The **Continuous measurement** and **Display Image** switches are activated.

1. Open the **Setup** window in SOPASair.
2. Measure the distance between the viewing window of the device and the rack with the positioning mark.
3. Make the following calculation:
   - Measured distance between the viewing window and rack +40 mm = calculated working distance
   - Example: 300 mm +40 mm = 340 mm
4. Enter the calculated working distance in the **Working distance** area into the **Working distance – single deep [mm]** input mask. With double deep applications, enter the calculated working distance in the **Working distance – double deep [mm]** input mask.
5. Measure the circle diameter of the positioning mark.
6. Enter the measured circle diameter into the **Circle diameter [mm]** input mask as the start value in the **Circle Setup** area.
   ✓ The device verifies the values and executes fine adjustment. The device constantly records images and evaluates these images.
7. In SOPASair, adjust the circle diameter in steps until the **Evaluation circle diameter (aim: 100%)** parameter shows the value 100% ± 5% in the **Results** area (target: 100%). The circle diameter set in SOPASair can deviate from the measured circle diameter.

5.3.5 Fine adjustment and calibration in single and double deep applications

The following steps are only relevant in combined applications with single and double deep racks.

1. Recalibrate the device to double deep applications.
   – Activate the **Double deep** switch in the **Rack Fine Positioning** area.
   ✓ The device is in Double deep mode.

NOTE
If you activate the **Double deep** switch, all parameters (including working distance and circle diameter) only apply for double deep applications. The values for the single deep application set in advance remain valid in the background and unchanged despite the newly-made settings.

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 fine adjustment for double deep applications, see 5.3.3 Fine adjustment of the device, page 23.
4. Repeat calibration for double deep applications, see 5.3.4 Calibration of the device, page 24.
5. After completion of fine adjustment and calibration for double deep applications, test the settings made for single deep applications again. Verify that both distance positions work reliably.
   – Deactivate the **Double deep** switch in the **Rack Fine Positioning** area.
   ✓ The device is in Single deep mode.
   – The automated storage and retrieval system is positioned so that only the positioning mark of the single deep rack is visible in the image.
   – Test fine adjustment and calibration in single deep applications.

5.3.6 Setting the evaluation mode

The selected evaluation mode affects which circle is detected as the positioning mark and used for the output of measured values. The user can select one of the available evaluation modes in SOPASair and via the Ethernet interface. The evaluation mode can also be set via a command. For information on the available evaluation modes, see Table 1: Available evaluation modes, page 26.

To set the evaluation mode in SOPASair:

1. Switch to the **Maintenance** user level, see Setting user level, page 22.
2. In SOPASair, open the **Advanced setup** window.
3. Select an evaluation mode in the drop-down menu of the **Selection** parameter.

In evaluation modes 1 – 8, the user defines a target region within which the positioning mark must be located. In evaluation modes 9 – 14, the user defines an area that will be excluded from the evaluation. This ensures that only circles within the target region will be used for the evaluation. The device ignores all circles outside the target region.

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 – 8 is set, the origin is located in the middle of the target region. For evaluation modes 1 – 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 – 14 is set, the origin is located at the center point of the image.

Table 1: Available evaluation modes

No.	Selection	Description
1	**Best circle score**	The circle with the highest score measured value [1] is used for the output of measured values. To exclude circles with a too low score measured value [1] 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 **Stacker crane 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 **Stacker crane 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 **Stacker crane 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 **Stacker crane relative position correction Y** parameter.
6	**Circle closest to 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 and can be shifted in SOPASair using the **Relative offset to origin X [mm]** and **Relative offset to origin Y [mm]** parameters.
7	**Follow first circle found**	The circle that is closest to the top left corner of the image in the first image taken after starting the device is used for the output of measured values and defined as the circle to follow. For every subsequent image taken, the circle that is closest to the previously followed circle is used for the output of measured values and defined as the circle to follow.
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 diameter**	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. 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 device ignores all circles outside the target region. The digital outputs are not supported. 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 **Stacker crane relative position correction X** parameter.
11	**Target Region – first circle right**	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. The circle with the smallest distance from the right edge of the image is used

No.	Selection	Description
		for the output of measured values. This is the circle with the largest value for the **Stacker crane relative position correction X** parameter.
12	**Target Region – first circle top**	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. 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 **Stacker crane relative position correction Y** parameter.
13	**Target Region – first circle bottom**	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. 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 **Stacker crane relative position correction Y** parameter.
14	**Target Region – no output at multiple circles**	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. Only one circle within the target region is used for the output of measured values. If there are several circles within the target region, no output of measured values occurs.

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

5.3.7 Adjusting the target region

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. However, this means 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.

Prerequisites

- The **Operator** or **Maintenance** user level is set.
- The **Continuous measurement** and **Display Image** switches are activated.

Adjusting the size of the target region

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

If it is not possible to mount the device so that the positioning mark is located in the center of the image, then also move the target region in the image. The **Maintenance** user level is required for this purpose.

Shifting 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.

5.3.8 Optimizing image brightness

The set image brightness is sufficient in most cases. Due to differing material qualities of the racks and the associated differing reflection behavior, however, it may be necessary to adjust the image brightness.

Relevant for combined applications with single deep and double deep racks: The image brightness and illumination time must be set high enough to achieve image brightness which is sufficient even in double deep racks. However, the camera image must not be too brightly lit in single deep racks.

1. Activate **Maintenance** user level.
2. If necessary, deactivate the **Double deep** parameter in the **Rack Fine Positioning** area.
   ✓ 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 (recommendation: 1.0 – 2.0).
   – In the **Camera configuration** area, set the **Shutter time [µs]** parameter (recommendation: 80...200 µs).

NOTE
For good image brightness, observe the edges of the positioning mark and any total reflections of the background as decision-making criteria. 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. The illumination time cannot be set separately for single and double deep applications.

5. In the **Rack Fine Positioning** area, activate the **Double deep** parameter.
   ✓ The device is in Double deep mode.
6. Increase the **Gain factor** parameter in Double deep mode to a value which offers sufficient image brightness for positioning marks in double deep racks. Do not set values greater than 5 to prevent increased image noise. If higher values are necessary, adjust the illumination time accordingly.
7. Check the settings in Single deep mode again. If necessary, reduce the **Gain factor** parameter in Single deep mode.
8. Activate the **Perform auto gain** parameter in order to automatically set a suitable image brightness using the Auto-gain assistant.
   ✓ The device records 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.

5.3.9 Setting up Ethernet interface

The device supports various communication protocols when using the Ethernet interface. To set the communication protocol used in SOPASair:

1. Open the **Interfaces** window in SOPASair.
2. In the **Ethernet mode** area, set the communication protocol.
3. Also define the IP address and port used so that communication between the controller and the device runs smoothly.

The device also offers the option of transmitting images via the file transfer protocol (FTP). The respective destination address can also be set up in the **Interfaces** window.

5.3.10 Additional parameters

Other parameters for fine adjustment of the device are available in the **Maintenance** user level. These additional parameters are not relevant for most applications, however. A table listing and explanation of all parameters can be found in the appendix, see 7.1 Parameter, page 39.

5.3.11 Completing configuration

After completing configuration, deactivating image output is recommended to achieve the maximum computing power of the device. This achieves the highest speed in the positioning process, and the throughput of the system is at its highest.

After successful parameterization using the SICK AppManager, we recommend creating a backup of the parameterization and saving the backup on the computer is recommended. Alternatively, the parameterization can be saved on a microSD memory card in the device via parameter cloning, see 4.1.3 Saving parameter set, page 15.

5.4 Specification of the interface and interaction with the controller

5.4.1 Communication process

After switching on the supply voltage, the **Continuous measurement** parameter in the device is activated by default. The device immediately goes into measurement mode. As long as continuous measurement is switched on, the device continuously records images and evaluates them. The measurement results are transferred to the controller cyclically. In doing so, 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. Determining the average value of the transmitted offset values in the controller and positioning the automated storage and retrieval system according to this average value is recommended. 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 recording.

In order to switch between Single and Double deep modes, the controller must report which rack depth is to be approached by means of a command.

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.

5.4.2 Interfaces

The device offers an Ethernet interface with various communication protocols (PROFINET, TCP/IP, UDP). The communication protocol used can be set using the SOPASair operating software, see 5.3.9 Setting up Ethernet interface, page 28.

In addition, the digital inputs and digital outputs can be used for communication with the controller.

PROFINET

If the PROFINET communication protocol is used, communication is done in Handshake mode via the 32 input bytes and 32 output bytes. The control bytes (Ctrl bits) of the PROFINET interface are not used.

Use the GSD file of the InspectorP63x. The GSD file can be downloaded at www.sick.com/InspectorP63x in the **Downloads** tab in the **Software** area.

The following SICK function blocks are recommended for receiving the measurement results and transmitting the command:

- S7 function block S7-1200/1500 TIA (hand-held / non-SOPAS devices, PROFIBUS, PROFINET)
- S7 function block S7-300/400 step 7 V5.5 (hand-held, non-SOPAS devices, PROFIBUS, PROFINET)
- S7 function block S7-300/400 TIA (hand-held, non-SOPAS devices, PROFIBUS, PROFINET)

The SICK function blocks can be downloaded at www.sick.com/InspectorP63x in the **Downloads** tab in the **Software** area.

An integration example for S7 PROFINET can be found as a download in the Internet at www.sick.com/InspectorP_Rack_Fine_Positioning in the **Downloads** tab in the **Software** area. The integration example, among other things, contains a recommended SICK function block and information on connecting to the device.

TCP/IP (PLC is the client)

For the **TCP/IP (PLC is client)** communication protocol (TCP/IP (PLC is client)), the device is the server. The connected host acts as the client. The measurement results and commands must be transmitted in binary format.

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UDP

For the **UDP** communication protocol, the data is transmitted via UDP. More information upon request.

Digital inputs and digital outputs

In addition to the Ethernet interface, the device can also be controlled via the digital inputs and digital outputs.

Image recording is started via a trigger on the “Sensor1” digital input. The “Sensor2” digital input is used to switch between the Single and Double deep modes. The measurement results are output via 4 digital outputs, see 5.4.6 Control via digital inputs and digital outputs, page 35.

The device only delivers information on the direction (up, down, left, right) via the digital outputs. The automated storage and retrieval system can approach the target position step-by-step based on this direction information. A quantitative statement about the deviation between the actual and the target position of the automated storage and retrieval system is not transmitted.

With the Ethernet interface, on the other hand, the device precisely forwards the deviation between the actual position and the target position to the controller using X- and Y-values. This is how the automated storage and retrieval system is controlled directly to the target position.

5.4.3 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 or 11 bytes (2 command bytes, 8 or 9 parameter bytes).

If the first byte (Command_H) equals <00>, then the device ignores the bytes following the command bytes, if applicable, since parameterization is not executed.

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

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

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

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

If a command is sent with the contents <00><01>, then continuous measurement is switched on in Single deep mode.

	Byte 1	Byte 2
Designation	Command_H	Command_L
Function	Command	
Example 2	<00>	<01>
Interpretation example 2	Switching on continuous measurement Activating Single deep mode	

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

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

	Byte 1	Byte 2
Designation	Command_H	Command_L
Function	Command	
Example 3	<00>	<02>
Interpretation example 3	Switching on continuous measurement Activating Double deep mode	

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

If the first byte (Command_H) equals <01>, then 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, then the parameters for Double deep mode are equated with the parameters of Single deep mode. Activation leads to parameter change and recalibration:

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

All parameters are evaluated as WORD in the controller.

As a response to parameterization in Single and Double deep modes, the device sends 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>, then the device evaluates the 9 bytes following the command bytes as parameters for specialist processing with several positioning marks in the image for Single deep mode. An evaluation mode with a target region is usually used for this purpose. In this evaluation mode, only a section of the entire camera image is evaluated, not the whole image. Non-relevant circles are hidden. Activation leads to parameter change, but not to recalibration:

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

The **Selection** (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 specialist single deep parameterization, the device sends 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>, then the device evaluates the 9 bytes following the command bytes as parameters for specialist processing with several positioning marks in the image for Double deep mode. An evaluation mode with a target region is usually used for this purpose. In this evaluation mode, only a section of the entire camera image is evaluated, not the whole image. Non-relevant circles are hidden. Activation leads to parameter change, but not to recalibration:

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

The **Selection** (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 specialist double deep parameterization, the device sends status bytes <00><80>. These status bytes are reset to <00><00> after successful parameterization.

Other parameters cannot be set by the host.

5.4.4 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.

	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10
Designation	Status_H	Status_L	XposH_H	XposH_L	XposL_H	XposL_L	YposH_H	YposH_L	YposL_H	YposL_L
Function	Status		Automated storage and retrieval system relative position correction X in µm				Automated storage and retrieval system relative position correction Y in µm			
Example 4	<00>	<03>	<00>	<00>	<40>	<AE>	<FF>	<FF>	<EC>	<D6>
Interpretation example 4	Circle found		16,558 µm				- 4,906 µm			

	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
Designation	PicNr_H	PicNr_L	Proc Time_H	Proc Time_L	Dia Eval_H	Dia Eval_L
Function	Image counter		Evaluation time in ms		Evaluation of the circle diameter in %	
Example 4	<8E>	<DC>	<00>	<27>	<00>	<6C>
Interpretation example 4	36572		39 ms		108%	

If continuous measurement is switched on, the status bytes are assigned as follows:

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

Bit position	Meaning
D0 (LSB)	Circle has been 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 allocated.
D5	Command 4: “Parameterization of diameter and distance” is currently being processed. The bit is deleted after successful implementation.
D6	Command 5: “Parameterization of evaluation with target region for single deep” is currently being processed. The bit is deleted after successful implementation.
D7 (MSB)	Command 6: “Parameterization of evaluation with target region for double deep” is currently being processed. The bit is deleted after successful implementation.

5.4.5 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 – 8 is set, the origin is located in the middle of the target region. For evaluation modes 1 – 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 – 14 is set, the origin is located at the center point of the image. The position of the automated storage and retrieval system relative to the positioning mark can be corrected 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.

NOTE
The coordinate system can be adjusted using the SOPASair configuration software. The user can rotate the coordinate system, or mirror the X axis or Y axis.

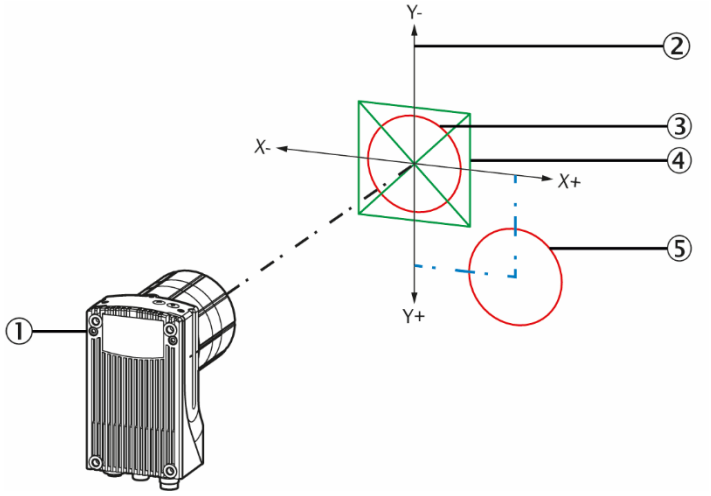


Figure 9: Interpretation of the position correction values

(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)

5.4.6 Control via digital inputs and digital outputs

Digital input sensor 1 activates and deactivates continuous measurement. The “Sensor2” digital input can be 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.

The IN/OUT 3 – IN/OUT 6 digital outputs give information about the current position of the positioning mark. In evaluation mode 1 – 8, all outputs in the following table are possible. In evaluation mode 9 – 13, the device only outputs via the digital outputs whether the positioning mark is located within the target region.

IN/OUT 3 (up)	IN/OUT 4 (down)	IN/OUT 5 (right)	IN/OUT 6 (left)	Position of the positioning mark relative to the target region
1	1	1	1	The positioning mark is located within the target region.
0	1	1	1	The positioning mark is located above the target region.
1	0	1	1	The positioning mark is located below the target region.
1	1	0	1	The positioning mark is located to the right of the target region.
1	1	1	0	The positioning mark is located to the left of the target region.

IN/OUT 3 (up)	IN/OUT 4 (down)	IN/OUT 5 (right)	IN/OUT 6 (left)	Position of the positioning mark relative to the target region
0	1	0	1	The positioning mark is located to the right above the target region.
0	1	1	0	The positioning mark is located to the left above the target region.
1	0	0	1	The positioning mark is located to the right below the target region.
1	0	1	0	The positioning mark is located to the left below the target region.
0	0	0	0	The positioning mark was not found in the image.

The device only delivers information on the direction (up, down, left, right) via the digital outputs. The automated storage and retrieval system can approach the target position step-by-step based on this direction information. A quantitative statement about the deviation between the actual and the target position of the automated storage and retrieval system is not transmitted.

The direction (top, bottom, right, left) is also displayed via the LEDs on the device.

(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)

The current position of the positioning mark is displayed in SOPASair in the **Digital Output** area. 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 position of the positioning mark in relation to the target region (up, down, left, right).

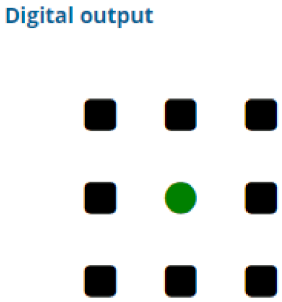


Figure 11: Positioning mark within the target region

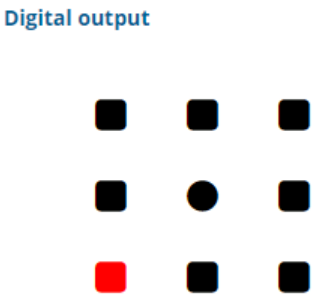


Figure 10: Positioning mark outside the target region

6 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.

IMPORTANT
Device damage due to improper cleaning!
Improper cleaning may result in device damage.

- Only use suitable cleaning agents.
- Never use sharp objects for cleaning.

NOTE
For detailed information on cleaning, see the operating instructions of the InspectorP63x Flex C-mount and S-mount at www.sick.com/8019946.

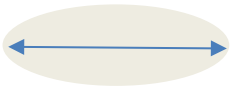
7 Annex

7.1 Parameter

The following table lists all the parameters with description and information for use.

Parameter	Description	Use
Display mode	Space-optimized display (device-specific).	Function currently not supported.
Restart app	Restart of app in the device.	Restart the app in the event of errors.
Working distance – single deep [mm] Working distance – double deep [mm]	Define measured distance between the front screen of the device and the rack with the positioning mark.	Necessary for recalculation of pixels in millimeters. When entering the distance, note the addition of 40 mm: Measured distance +40 mm = input value 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	Record a single image.	Record an image when setting up the device. This simplifies commissioning, as image recording does not have to be triggered by the controller.
Selection	Define hole or reflector which is to be used as the positioning mark. If several circles are located in the field of view of the device.	Selection of the correct hole or the correct reflector as the positioning mark. Hiding of the non-relevant image section for several circles in the image in evaluation mode 9 to 14.
Perform auto gain	Automatically set image brightness to make the positioning mark as visible as possible.	When executing Auto-gain, one positioning mark must be visible. All other settings must have been made correctly. The device records 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]	Adjust image brightness via the illumination time.	The illumination time usually does not have to be adjusted. However, this may be necessary for certain special applications.
Save image in the 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	Description	Use
Display image	Activate and deactivate image transmission for the SOPASair user interface.	Image output is necessary for setting up the device. In actual operation, switching off image output is recommended.
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. In continuous operation, switching off this function is recommending to achieve maximum throughput.
Image sharpness	Activate image sharpness measurement.	The device outputs a value for image sharpness. Adjust the focus position of the lens until the focus value is at the maximum, see Figure 8: Manual focus screw, page 24. When the focus is final, deactivate the **Image sharpness** switch.
Image transfer FTP	Transfer the current image to the address set in the **Interfaces** window using the FTP server.	Save images for documentation purposes or later evaluation.
Reset image counter	An internal image counter counts the recorded images. The image counter can be reset using the **Reset image counter** button.	Use of 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 reflectors)	Compensate for deformed circles which typically occur 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.	Report to the device that settings for close range (single deep) or long range (double deep) are being made internally. During set-up, this switch can be used to separately define input fields (e.g. working distance) for the Single and Double deep modes. During operation, the parameter is switched by the controller via a command depending on the approached shelf depth of the rack.
Dark circle on bright background (hole in steel)	Set polarity of the positioning mark (light circle on dark background or dark circle on light background).	Holes typically appear dark on light backgrounds. Reflectors appear light on dark backgrounds.
Diameter scaling min. - max.	Define spectrum in which the circle size can vary. Example: 0.85 ... 1.15 corresponds to 85% to 115% of the expected circle diameter.	The parameter defines which circle diameter is considered the valid positioning mark by the device. 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. This function is used to compensate for

Parameter	Description	Use
		the scaling effect based on the distance variation between the device and the rack.
Ellipse minor axis [mm]	Enter length of the minor axis (blue arrow) for elliptical hole shapes. 	If the positioning marks are displayed as ellipses (not as circles), detection sensitivity can be improved by specifying the minor axis length.
Ethernet mode	Set communication protocol for Ethernet interface.	Adjust setting to the communication protocol of the controller used.
Gain factor	Manual adjustment of image brightness.	Adjust the image brightness until the positioning mark is as visible as possible.
Reboot device	Device is restarted.	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)	Set polarity of the positioning mark (light circle on dark background or dark circle on light background).	Holes typically appear dark on light backgrounds. Reflectors appear light on dark backgrounds.
Invert X/Y axis	Exchange output values for X-axis and Y-axis.	Use this parameter, for example, if the device is installed upside down in the system.
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.	Define IP ports if the device is in the TCP server network.
Compact mode	Set compact display.	Function currently not supported.
Continuous measurement	Activate device. Image recording is started continuously and each image is evaluated.	Record 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 which must be reached to detect 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

Parameter	Description	Use
		to allow for detection of circles with unclear outlines (e.g. caused by corrosion). A value which is too low leads to error messages.
Relative offset to origin X [mm] Relative offset to deviation Y [mm] (Circle – target region)	Move X- and Y-position of the target region in the image.	Move target region in the image and compensate for mounting position. Use these parameters if the device cannot be mounted so that the positioning mark is located in the center of the image when putting goods into or taking them out of storage.
Language	Select interface language.	Restart SOPASair or update the web page using the F5 pushbutton to activate the set interface language.
Restore all default parameters	Reset device to factory settings.	Restart parameterization to delivery condition.
Tolerance range X [mm] Tolerance zone Y [mm] (Circle – target region)	Define the size of the target region in which the positioning mark must be located before putting goods into or taking them out of storage.	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 system throughput slower, however. The parameter is necessary for the use of digital outputs for position determination and to output positive feedback of successful positioning via the green feedback LED. In evaluation mode 9 to 14, the parameter defines the size of the target region, whereby everything outside the target region is ignored during evaluation.
Invert X/Y axis	Invert output values for the X-axis and Y-axis.	This parameter can be used, for example, if the device is installed so it is lying down in the system.
Preconfiguration application	Define type of positioning mark (hole or reflector).	Only relevant for single deep applications. Define whether holes or reflectors are used as positioning marks.

7.2 Licenses

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