OPERATING INSTRUCTIONS

PLOC2D 2.3

2D Vision for Robot Guidance

SICK
Sensor Intelligence.

Described product

PLOC2D

Manufacturer

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Legal information

Original document

This document is an original document of SICK AG.

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 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.

1.2 Scope

This document applies to the following products of the PLOC series:

- PLOC2D

1.3 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.

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.

1.4 Customer service

If you require any technical information, our customer service department will be happy to help. To find your representative, see the final page of this document.

NOTE
Before calling, make a note of all type label data such as type code, serial number, etc. to ensure faster processing.

2 Safety information

2.1 Intended use

PLOC2D is a part locator sensor for robot guidance. PLOC2D is primarily designed for use in industrial and logistics areas, and it meets the requirements for industrial ruggedness, interfaces and data processing. It is not a safety component as per the Machinery Directive 2006/42/EC. It is not intended and not permitted to be used in areas with explosive atmospheres, in corrosive environments, or in extreme ambient conditions.

2.2 Incorrect 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.

If the device is to be used under other conditions or in different environments, then the manufacturing service may issue an operating license in consultation with the customer and in exceptional cases.

2.3 IP technology

NOTE

SICK uses standard IP technology in its products. The emphasis is placed on availability of products and services. SICK always assumes that the integrity and confidentiality of the data and rights affected by the use of the aforementioned products will be ensured by the customer. In all cases, appropriate security measures, such as network separation, firewalls, virus protection, and patch management, must be taken by the customer on the basis of the situation in question.

2.4 Limitation of liability

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

- Failing to observe the operating instructions
- Incorrect use
- Use by untrained personnel
- Unauthorized conversions
- Technical modifications
- Use of unauthorized spare parts, consumables, and accessories

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.

2.5 Modifications and conversions

Modifications and conversions to the product and/or the installation may result in unforeseeable dangers. Before any technical modifications to and expansions of the product, the prior written approval of the manufacturer must be obtained.

2.6 Operational safety and particular hazards

Please observe the safety information and the warnings listed here and in other chapters of these operating instructions to reduce the possibility of risks to health and avoid dangerous situations.

CAUTION
Class 1/1M laser beam!

The accessible beam does not represent a hazard even if you view it directly for a long period of time (base period of 100 seconds).

1. Never look into the laser beam directly with optical instruments (e.g., magnifying glasses, microscopes, telescopes/binoculars)
2. Current national regulations regarding laser protection must be observed.

CAUTION
LED risk group 1

The accessible beam from the illumination unit (RG 1) does not represent a risk due to the normal restrictions imposed by human behavior.

LED risk group 2

The accessible beam from the illumination unit (RG 2) does not represent a risk due to aversion responses to very bright light sources and the perception of heat.

For both types of beams

It is not possible to entirely rule out temporary, disorienting optical effects on the human eye (e.g., dazzle, flash blindness, afterimages, impairment of color vision, photosensitive epilepsy at flash frequencies of between 1 Hz and 160 Hz, depending on the configuration), particularly in conditions of dim lighting. No safety precautions are required.

Comply with the latest version of the applicable regulations on photobiological safety of lamps and lamp systems as well as on laser protection.

If the product is operated in conjunction with external illumination systems, the risks described here may be exceeded. This must be taken into consideration by users on a case-by-case basis.

CAUTION
Dangerous exposure to radiation

If any operating or adjusting devices other than those specified here are used or other methods are employed, this can lead to dangerous exposure to radiation. Damage to the eyes is possible.

- If the product is operated in conjunction with external illumination systems, the risks described here may be exceeded. This must be taken into consideration by users on a case-by-case basis.
- Do not look into the light source when it is switched on.
- Comply with the latest version of the applicable regulations on photobiological safety of lamps and lamp systems as well as on laser protection.

For internal illumination, only units provided by SICK for that purpose may be used.

2.7 Qualification requirements for personnel

WARNING
Risk of injury due to insufficient training.

Improper handling may result in considerable personal injury and material damage.

- All work must only ever be carried out by the stipulated persons.

These operating instructions list the training requirements for the various fields of activity, as follows:

- **Instructed personnel** have been given a briefing by the operator 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 delegated to them and to detect 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 any potential dangers independently. Relevant applicable national regulations must be observed.

3 Product description

3.1 System overview

PLOC2D is a part locator sensor for robot guidance comprised of an InspectorP6xx and application specific software.

PLOC2D is configured with a PC via a web-based graphical user interface.

3.2 Scope of delivery

Depending on the device version and the accessories ordered, the scope of delivery will include the listed items:

- PLOC2D sensor
- Two sliding nuts, M5
- Light inlet and electrical connections fitted with protective caps/plugs.
- SW 2 hexagon key for opening and closing the cover of the micro SD card slot.
- SICK lens cloth

Accessories

Accessories, such as brackets and connecting cables, are only supplied if ordered separately

3.3 Product ID

3.3.1 Type label

The type label gives information for identification of the sensor.

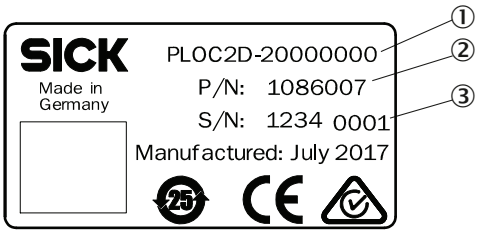


Figure 1: Type label design for the sensor

① Type code

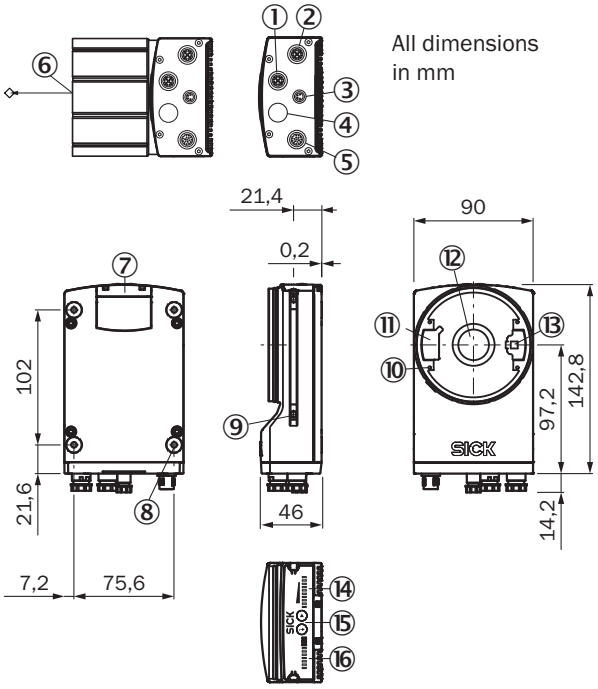
② Product identification number

③ Serial number

3.4 Product characteristics

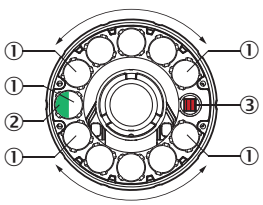
3.4.1 Device view (InspectorP65x)

Dimensional drawing of InspectorP65x devices



① Connection P1, not used
② Connection P3, Gigabit Ethernet
③ Connection X2, not used
④ Connection P2, not used
⑤ Connection X1, Power and I/O
⑥ Reference point for working distance (center of front screen) from PLOC2D to object
⑦ Black cover for the micro SD memory card slot
⑧ M5 blind tapped holes, 5 mm deep (4 x), for mounting the PLOC2D
⑨ Sliding nut M5, 5.5 mm deep (2 x), pivoting, for an alternative method of mounting the PLOC2D
⑩ M2.5 blind tapped holes, 5.5 mm deep (4 x), for mounting the lighting spacers
⑪ Cover for lighting connector
⑫ Light inlet with C-mount thread
⑬ Outlet opening for light beam from aiming laser
⑭ Bar graph display (10 x LEDs)
⑮ Function button (2 x)
⑯ LEDs for status display (10 x 2 levels)

Integrable illumination unit (fixed)



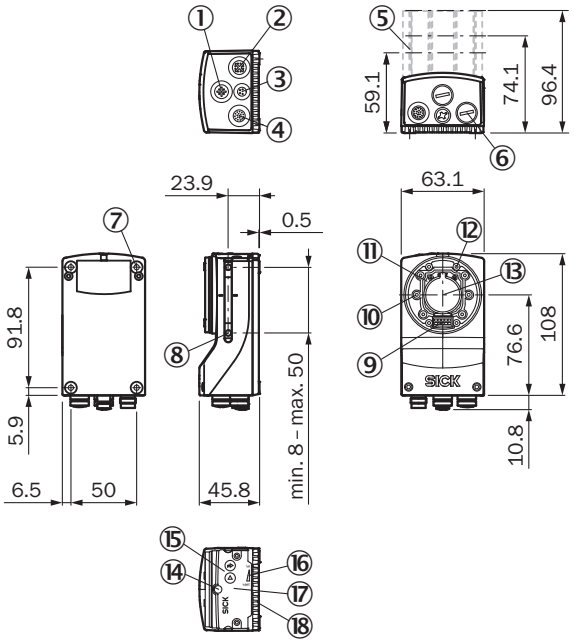
① Illumination via 11 LEDs

② Feedback LED

③ Opening in the illumination for the aiming laser

3.4.2 Device view (InspectorP63x)

Dimensional drawing of InspectorP63x devices



① External illumination connection

② Gigabit Ethernet port

③ USB port, not used

④ Power, serial, CAN, and I/O connection

⑤ 22.7 mm, 37.7 mm, or 60 mm protective optics cover

⑥ Protective caps/plugs to seal any electrical connections that are not in use

⑦ M5 blind tapped holes, 5.5 mm deep (4 x), for mounting the sensor

⑧ M5 sliding nut, 5.5 mm deep (4 x), pivoting, for an alternative method of mounting the sensor

⑨ Internal illumination connection

⑩ Aiming laser (2 x)

⑪ S-mount or C-mount optics module

⑫ 2.5 mm blind tapped holes (4 x) for mounting the spacers for the integrable illumination

⑬ Optical axis and center of the image sensor

⑭ Manual focus screw, underneath cover/label (S-mount)

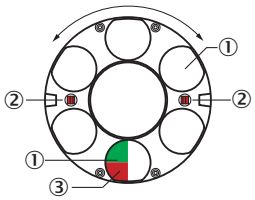
⑮ Function button (2 x)

⑯ LED bar graph (5 x)

⑰ Removable cover for microSD card and manual focus screw (S-mount)

⑱ LEDs for status display (5 x 2 levels)

Integrable illumination unit (option)



① Illumination via 6 LEDs

② 2 openings in the illumination for the aiming laser for alignment: the red laser LEDs can be switched off and each generates a red dot on the object within the field of view

③ Feedback LED

3.4.3 Status indicators and functions

① Return pushbutton

② Arrow pushbutton (not used)

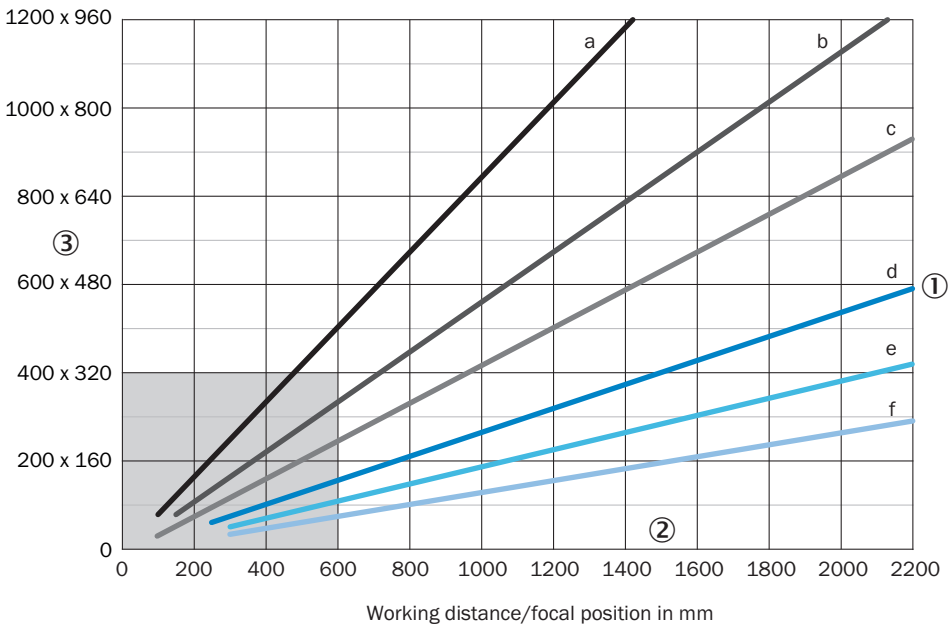
Status indicators are only used to indicate that the PLOC2D system is powered on.

3.4.4 Field of view diagrams

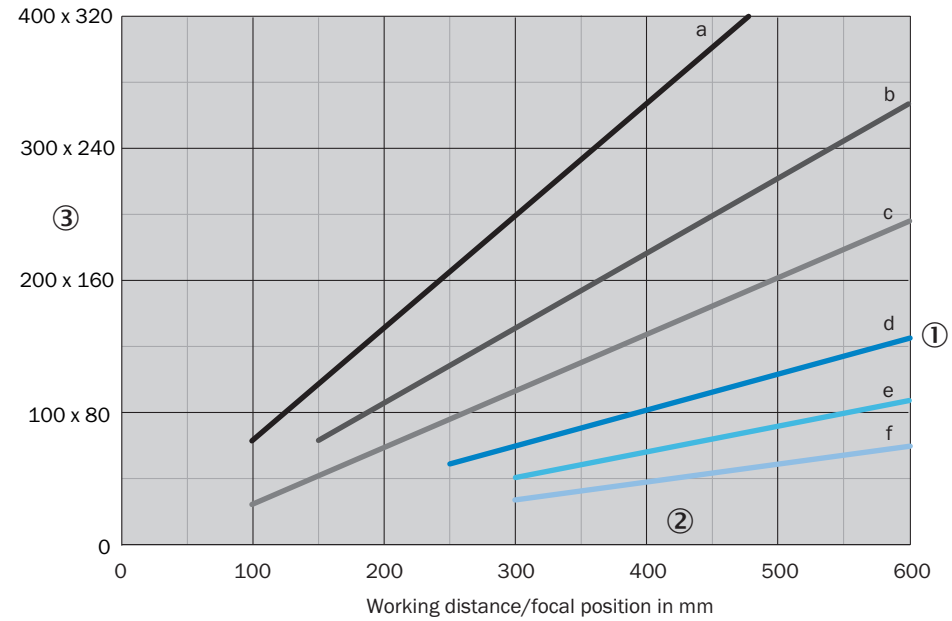
The diagrams show the dimensions of the field of view for a certain working distance and lens focal length.

InspectorP631 C-mount

Field of view in mm²



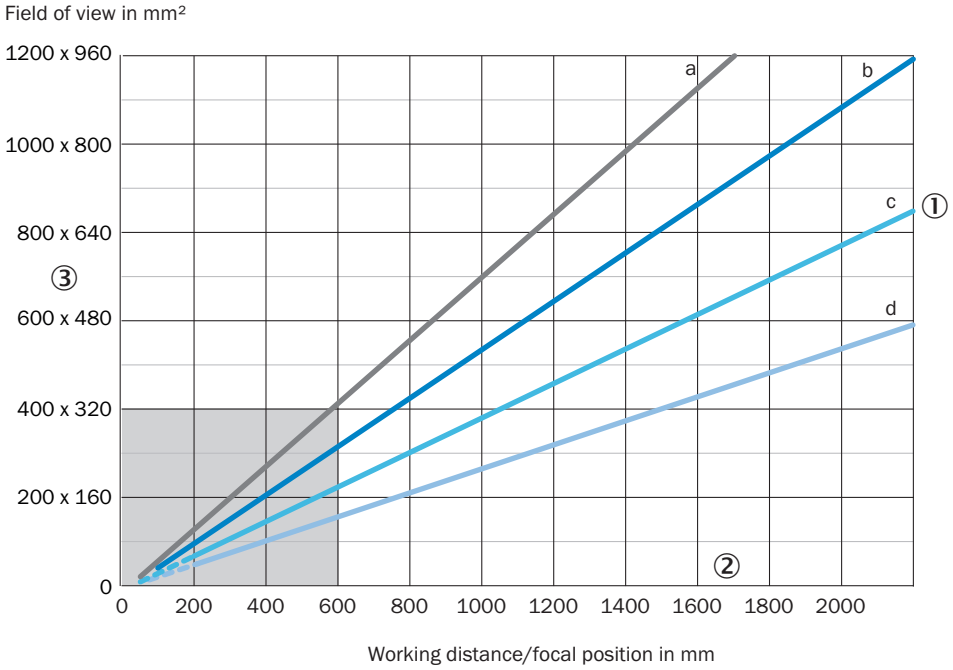
Field of view in mm²

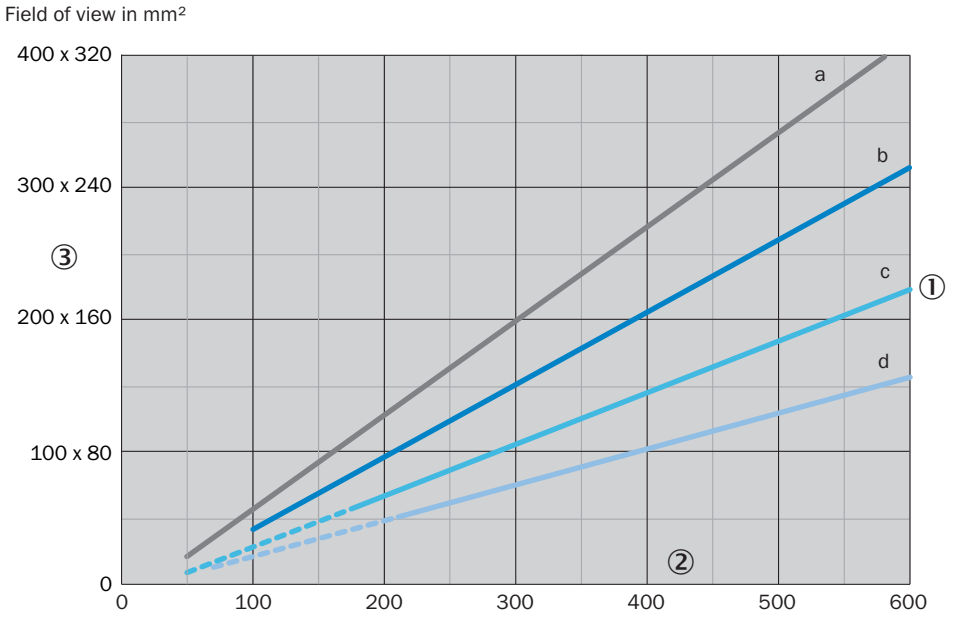


a: f = 8.0 mm (only C-mount standard)
b: f = 12.0 mm
c: f = 16.0 mm
d: f = 25.0 mm
e: f = 35.0 mm
f: f = 50.0 mm

① Lens focal length
② Working distance in mm
③ Field of view in mm²

InspectorP631 S-mount



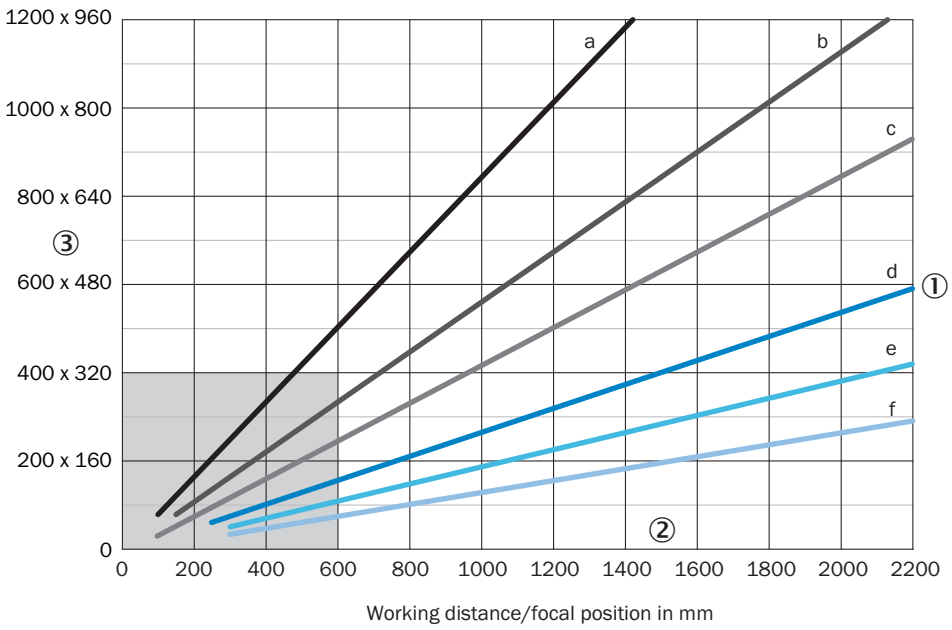


a: f = 9.6 mm
b: f = 12.5 mm
c: f = 17.5 mm
d: f = 25.0 mm
Optional distance ring required

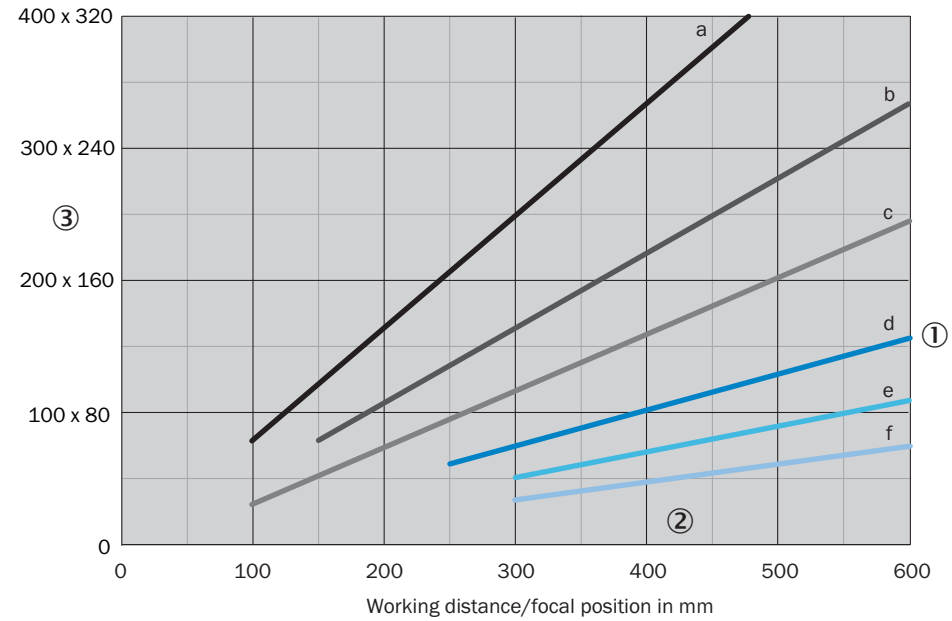
① Lens focal length
② Working distance in mm
③ Field of view in mm²

InspectorP632 C-mount

Field of view in mm²



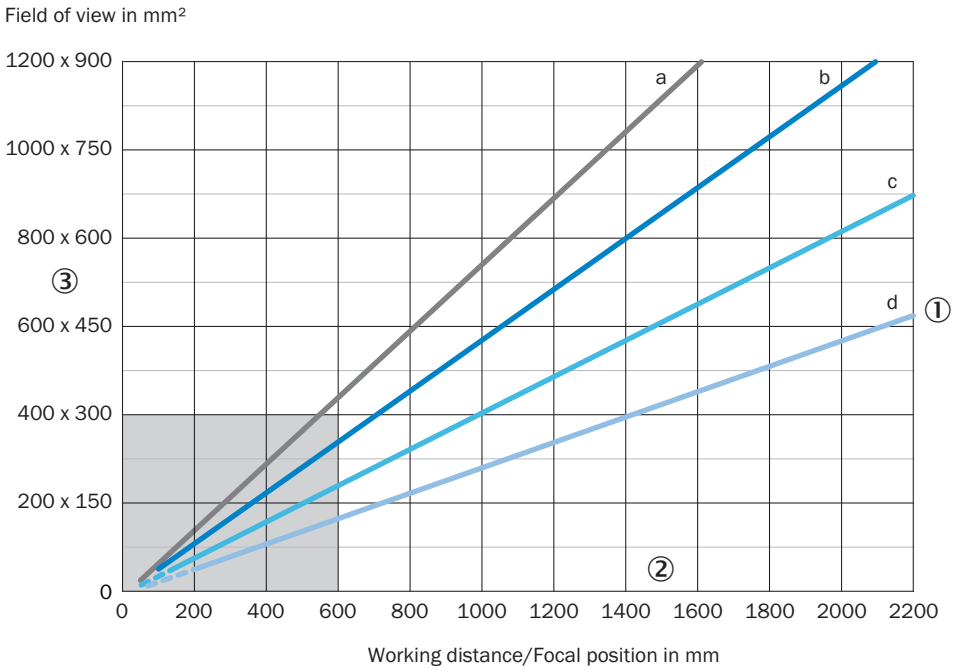
Field of view in mm²

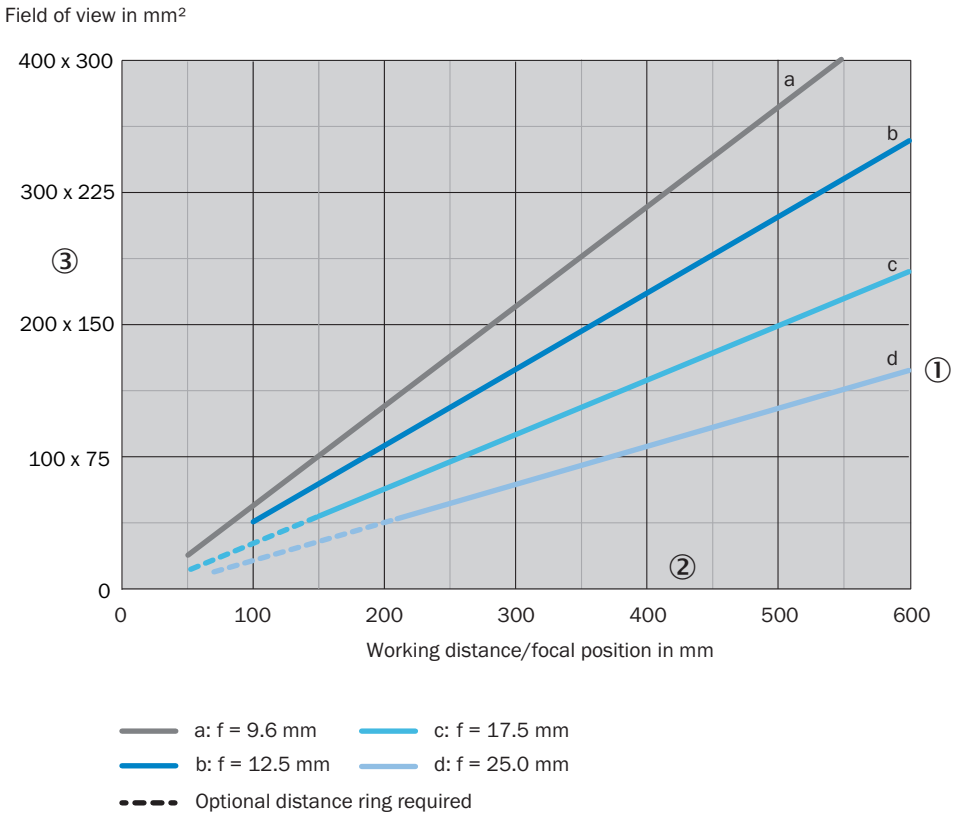


a: f = 8.0 mm (only C-mount standard)
b: f = 12.0 mm
c: f = 16.0 mm
d: f = 25.0 mm
e: f = 35.0 mm
f: f = 50.0 mm

① Lens focal length
② Working distance in mm
③ Field of view in mm²

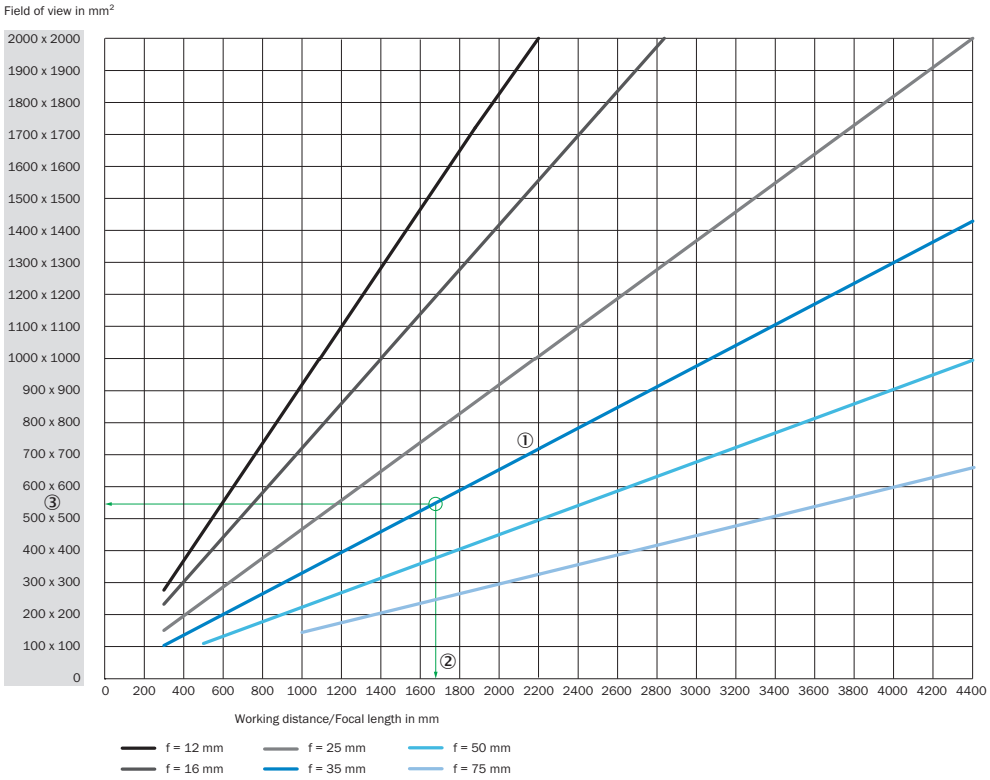
InspectorP632 S-mount





① Lens focal length
② Working distance in mm
③ Field of view in mm²

InspectorP65x



① Lens focal length

② Working distance in mm

③ Field of view in mm²

4 Transport and storage

4.1 Transport

For your own safety, please read and observe the following notes:

NOTICE

Damage to the product due to improper transport.

- The device must be packaged for transport with protection against shock and damp.
- Recommendation: Use the original packaging as it provides the best protection.
- Transport should be performed by trained specialist staff only.
- The utmost care and attention is required at all times during unloading and transportation on company premises.
- Note the symbols on the packaging.
- Do not remove packaging until immediately before you start mounting.

4.2 Transport inspection

Immediately upon receipt in Goods-in, check the delivery for completeness and for any damage that may have occurred in transit. In the case of transit damage that is visible externally, proceed as follows:

- Do not accept the delivery or only do so conditionally.
- Note the scope of damage on the transport documents or on the transport company's delivery note.
- File a complaint.

NOTE

Complaints regarding defects should be filed as soon as these are detected. Damage claims are only valid before the applicable complaint deadlines.

4.3 Storage

Store the device under the following conditions:

- Recommendation: Use the original packaging.
- Do not store outdoors.
- Store in a dry area that is protected from dust.
- So that any residual damp can evaporate, do not package in airtight containers.
- Do not expose to any aggressive substances.
- Protect from sunlight.
- Avoid mechanical shocks.
- Storage temperature: see "Ambient data", page 55.
- Relative humidity: see "Ambient data", page 55.
- For storage periods of longer than 3 months, check the general condition of all components and packaging on a regular basis.

5 Mounting

5.1 Overview of mounting procedure

The mounting of the device is divided into the following steps:

- Mount the device.
- Connect the device to interfaces and supply voltage.
- Adjust the device for the intended target area.

5.2 Preparation for mounting

5.2.1 Mounting requirements

NOTICE
Radio interference may occur when the device is used in residential areas!
Only use the device in industrial environments (EN 61000-6-4).

- Typical space requirement: See "Product characteristics", page 12 for type-specific field of view diagrams and dimensional drawings.
- Comply with technical data, such as the permitted ambient conditions for operation (e.g., temperature range, EM interference emissions, ground potential), see "Technical data", page 54.
- To prevent condensation, avoid exposing the device to rapid changes in temperature
- Protect from direct sunlight
- Ensure that there is good heat transfer from the device, in particular at high ambient temperatures (e.g., via the bracket to the mounting base or ensure that the back of the device is a sufficient distance from the wall of a housing)
- Only to be mounted using the threaded mounting holes provided for this purpose or the sliding nuts.
- Shock and vibration-free mounting
- Clear view of the objects to be detected

Equipment required

- Mounting device (bracket) with sufficient load-bearing capacity and suitable dimensions
- Two or four M5 screws for mounting on a mounting device supplied by the customer. Screw length is dependent on the mounting base (wall thickness of the bracket)
  When using an optional SICK bracket, the screws for mounting are included with delivery.
- Tool and tape measure

5.2.2 Mounting the device

The device is mounted using threaded mounting holes (M5) or sliding nuts.

The threaded mounting holes are located on the rear of the device.

The sliding nuts can each be inserted into a slot on the side of the housing.

SICK offers prefabricated brackets which are optimally suited for mounting the device in a wide range of applications (www.sick.com).

User-supplied brackets

A user-supplied bracket must meet the following requirements:

- Alignment of the device in the x and y axes can be adjusted
- The mounting device must be able to bear the weight of the device and connecting cables free of vibrations
- In mounting situations with strong vibrations, shock mounts may need to be provided
- Mounting options must be available for the 4 threaded mounting holes or the two sliding nuts

5.3 Mount the optics

NOTE
This mounting step is only required if the optional optics accessory has been included in the order for PLOC2D Flex. This does not apply for the Dynamic Focus type.

5.3.1 Mounting the lens and illumination unit

NOTICE
Possible impairment of image quality!
Dust and fingerprints on optical boundary surfaces can reduce image quality and may also affect the decoding performance of the device.

- ▶ When mounting the optics accessories, always ensure that the environment is free of dust.
- ▶ Do not touch the image sensor (CMOS) in the light inlet opening of the sensor or the glass lenses at either end of the lens unit.

NOTE
When mounting the optics accessories on the camera housing, always ensure that there is no power to the system.

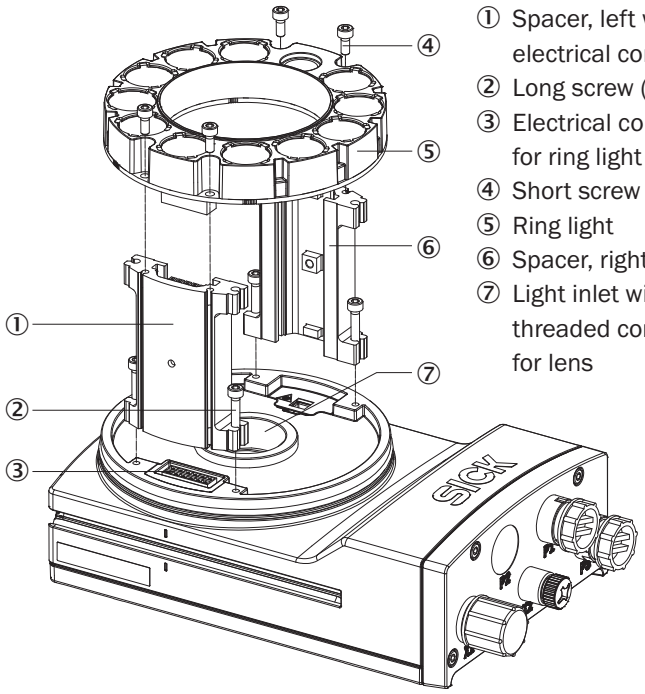
Mount the optics

1. Place the camera housing on a nonslip base.
2. Remove the protective cap from the round light inlet.
3. If necessary, carefully insert the filter (optional) and spacer disk into the light inlet.
4. Screw the lens unit into the C-mount thread. This will also lock the optional filter in place at the same time (if applicable).

Mounting the illumination unit

NOTICE
Risk of damage due to electrostatic discharge!
Electrostatic discharge from the human body may damage parts of the illumination unit or the camera housing.
The illumination variants for lenses with a focal distance of 12 mm or 16 mm do not feature any plastic lenses in front of the LEDs in the round recesses.

- ▶ Do not insert your fingers into the recesses.
- ▶ Do not touch the open contacts of the electrical connection for the illumination unit on the camera housing.



① Spacer, left with electrical connection
② Long screw (4 x)
③ Electrical connection for ring light
④ Short screw (4 x)
⑤ Ring light
⑥ Spacer, right
⑦ Light inlet with threaded connection for lens

1. Peel off the white protective sticker on the camera housing that covers the electrical connection ③ for the illumination unit.
2. Take two pairs of long screws and screw them into the threaded mounting holes to attach each spacer (① and ⑥) to the correct side of the camera housing.
3. Use the 4 short screws to attach the illumination unit ⑤ to the two spacers.
4. Manually preset the sharpness and aperture of the lens unit.
5. Mount the optics protective hood.

6 Electrical installation

6.1 Security

6.1.1 Notes on electrical installation

NOTICE
Equipment damage due to incorrect supply voltage!

An incorrect supply voltage may result in damage to the equipment.

The device may only be powered using a voltage source that meets the following requirements:

- SELV (EN 60950-1) or ES-1 (EN 62368-1)
- LPS (EN 60950-1 or EN 62368-1)

NOTICE
Equipment damage or unpredictable operation due to working with live parts!

Working with live parts may result in unpredictable operation.

- Only carry out wiring work when the power is off.
- Only connect and disconnect electrical connections when the power is off.

- **The electrical installation must only be performed by electrically qualified personnel.**
- **Standard safety requirements must be met when working on electrical systems!**
- Only switch on the supply voltage for the device when the connection tasks have been completed and the wiring has been thoroughly checked.
- When using extension cables with open ends, ensure that bare wire ends do not come into contact with each other (risk of short-circuit when supply voltage is switched on). Wires must be appropriately insulated from each other.
- Wire cross-sections in the supply cable from the customer's power system must be designed in accordance with the applicable standards. When this is being done in Germany, observe the following standards: DIN VDE 0100 (Part 430) and DIN VDE 0298 (Part 4) and/or DIN VDE 0891 (Part 1).
- Circuits connected to the device must be designed as SELV circuits (SELV = Safety Extra Low Voltage).
- Protect the device with a separate fuse at the start of the supply circuit.

NOTE
Layout of data cables

- Use screened data cables with twisted-pair wires.
- Implement the screening design correctly and completely.
- To avoid interference, e.g. from switching power supplies, motors, clocked drives, and contactors, always use cables and layouts that are suitable for EMC.
- Do not lay cables over long distances in parallel with power supply cables and motor cables in cable channels.

The IP 67 enclosure rating for the device is only achieved under the following conditions:

- The cables plugged into the M12 and M8 connections are screwed tight.
- Any electrical connections that are not being used must be fitted with protective caps/plugs that are screwed tight (as in the delivery condition).
- The black cover of the USB interface must be closed and lie flush on the device.

If this is not done, the device does not fulfill any specified IP enclosure rating!

6.1.2 Wiring notes

NOTICE

Faults due to incorrect wiring.

Incorrect wiring may result in operational faults.

- For data transmission, use only screened cables with twisted-pair wires.
- Follow the wiring notes precisely.

NOTE

Preassembled cables can be found online at:

▶ www.sick.com

All electrical connections of the device are configured as round connectors . The IP65 protection class is only achieved with screwed plug connectors or cover caps.

Please observe the following wiring notes:

- A correct and complete cable shielding design is required for trouble-free data transmission.
- The cable shield must be connected at both ends in the electrical enclosure and at the device. The cable shield of the pre-assembled cables is connected to the nut and thus also to a large area of the device housing.
- The cable shield in the control cabinet must be connected to a large area of the signal ground, see figure 5, page 27).
- Appropriate measures must be taken to prevent equipotential bonding currents flowing through the cable shield.
- During installation, pay attention to the different cable groups. The cables are grouped into the following 4 groups according to their sensitivity to interference or radiated emissions.
  - Group 1: Cables very sensitive to interference, such as analog measuring cables
  - Group 2: Cables sensitive to interference, such as sensor cables, communication signals, bus signals
  - Group 3: Cables which are a source of interference, such as control cables for inductive loads, motor brakes
  - Group 4: Cables which are powerful sources of interference, such as output cables from frequency inverters, welding system power supplies, power cables
  - ▷ Cables in groups 1, 2 and 3, 4 must be crossed at right angles see figure 2, page 26
  - ▷ Cables in groups 1, 2 and 3, 4 must be routed in different cable channels or metallic separators must be used, see figure 3, page 26 and see figure 4, page 26. This applies particularly where cables of devices with a high level of radiated emission, such as frequency converters, are laid parallel to sensor cables.

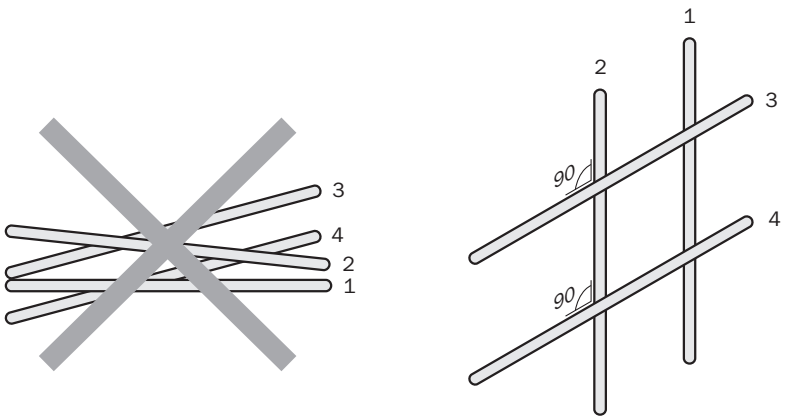


Figure 2: Cross cables at right angles

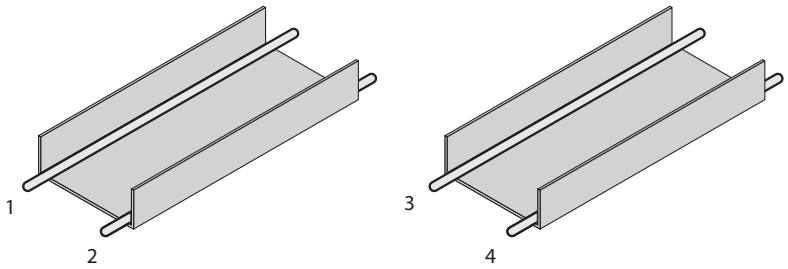


Figure 3: Ideal laying – Place cables in different cable channels

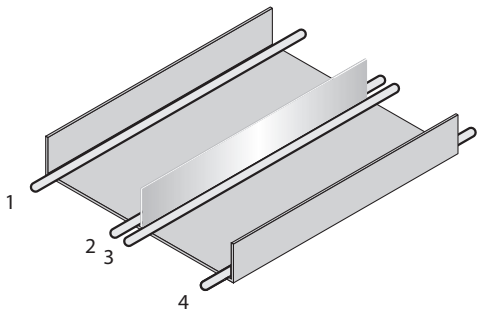


Figure 4: Alternative laying – Separate cables with metallic separators

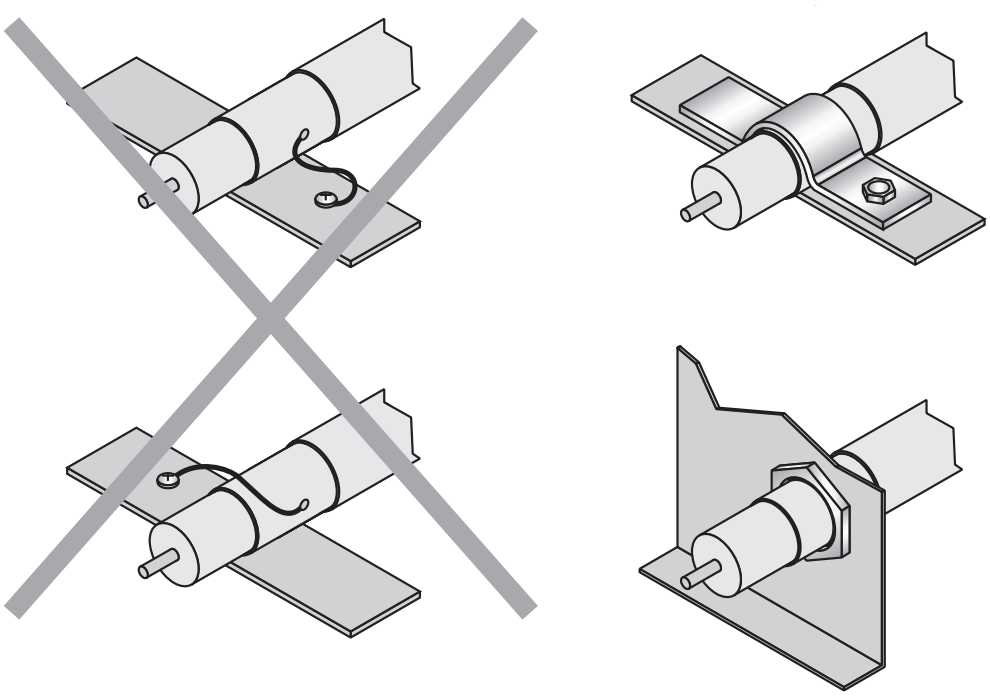


Figure 5: Make an extensive and low-impedance ground connection of the cable shield in the control cabinet.

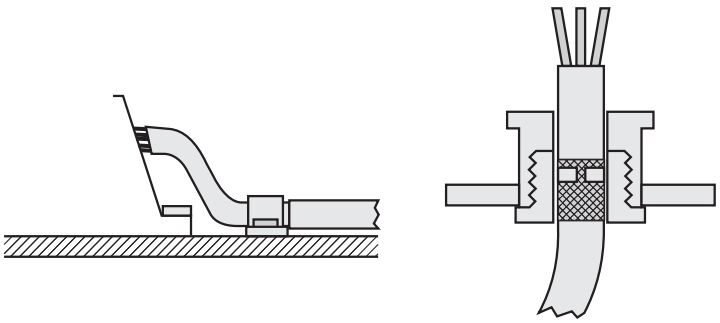


Figure 6: Shield connection in plastic housings

6.1.3 Prerequisites for the safe operation of the device in a system

WARNING
Risk of injury and damage caused by electrical current!

As a result of equipotential bonding currents between the SICK device and other grounded devices in the system, faulty grounding of the SICK device can give rise to the following dangers and faults:

- Dangerous voltages are applied to the metal housings
- Devices will behave incorrectly or be destroyed
- Cable shielding will be damaged by overheating and cause cable fires

Remedial measures

- ▶ Only skilled electricians should be permitted to carry out work on the electrical wiring.
- ▶ Ensure that the ground potential is the same at all grounding points.
- ▶ If the cable insulation is damaged, disconnect the voltage supply immediately and have the damage repaired.
- ▶ Where local conditions are unfavorable and therefore do not meet conditions for a safe grounding method (same ground potential at all grounding points), take measures in accordance with the following formats.

The device is designed and tested for electrical safety in accordance with EN 60950-1. It is connected to the peripheral devices (voltage supply, any local trigger sensor(s), PLC) via shielded cables. The cable shield – for the data cable, for example – rests against the metal housing of the SICK device. The device can either be grounded through the cable shield or through one of the threaded mounting holes.

If the peripheral devices have metal housings and if the cable shields also lie on their housings, it is assumed that all devices involved in the installation have the **same ground potential**.

This is achieved by complying with the following conditions:

- Mounting the devices on conductive metal surfaces
- Correct grounding of the devices/metal surfaces in the system.
- If necessary: low-impedance and current-carrying equipotential bonding between areas with different ground potentials

If these conditions are not fulfilled, equipotential bonding currents can flow along the cable shielding between the devices due to differing ground potentials; this can be dangerous. This is, for example, possible in cases where there are devices within a widely distributed system covering several buildings.

Remedial measures

The most common solution to prevent equipotential bonding currents on cable shields is to ensure low-impedance and current-carrying equipotential bonding. If this is not possible, the following solution approaches serve as a suggestion.

NOTICE
We expressly advise against opening up the cable shields. This would mean that the EMC limit values can no longer be complied with and that the safe operation of the device data interfaces can no longer be guaranteed.

Measures for widely distributed system installations

On widely distributed system installations with correspondingly large potential differences, the setting up of local islands and connecting them using commercially available **electro-optical signal isolators** is recommended. This measure achieves a high degree of resistance to electromagnetic interference while at the same time complying with all the requirements of EN 60950-1.

The use of electro-optical signal isolators between the islands isolates the ground loop. Within the islands, a stable equipotential bonding prevents equalizing currents on the cable shields.

Measures for small system installations

For smaller installations with only slight potential differences, insulated mounting of the SICK device and of peripheral devices may be a sufficient solution.

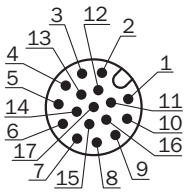
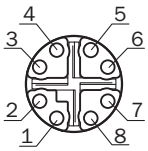
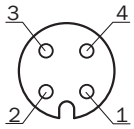
Even in the event of large differences in the ground potential, ground loops are effectively prevented. As a result, equalizing currents can no longer flow via the cable shields and metal housing.

NOTICE

The power supply for the SICK device and the connected peripheral devices must also guarantee the required level of insulation.

Under certain circumstances, a tangible potential can develop between the insulated metal housings and the local ground potential.

6.2 Connections and pin assignment

Pin	Power/SerialData/CAN/IO	GB Ethernet	External Light
	 17-pin M12 male connector, A-coded	 8-pin M12 female connector, X-coded	 4-pin M12 female connector, A-coded
1	GND	TRD0_P	DC 24 V switchable output
2	DC 24 V ± 20%	TRD0_N	Trigger illumination DC 24 V
3	CAN L	TRD1_P	GND
4	CAN H	TRD1_N	Not connected
5	TD+ (RS-422), Host	TRD3_P	–
6	TD- (RS-422), Host TxD (RS-232), Host	TRD3_N	–
7	TxD (RS-232), Aux	TRD2_P	–
8	RxD (RS-232), Aux	TRD2_N	–
9	SensGND	–	–
10	Sensor 1 switching input	–	–
11	RD+ (RS-422), Host	–	–
12	RD– (RS-422), Host RxD (RS-232), Host	–	–
13	Out1	–	–
14	External illumination trigger output	–	–

Pin	Power/SerialData/CAN/IO	GB Ethernet	External Light
15	In2	–	–
16	Conveyor tracking output	–	–
17	Out4	–	–

6.3 Connecting the device

6.3.1 Connection diagram

Connection principle

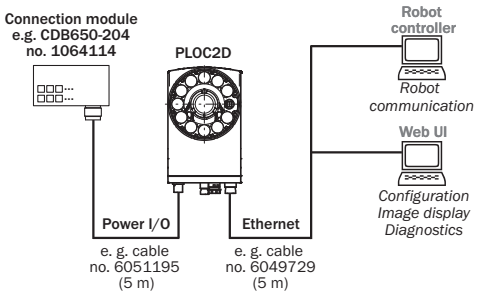


Figure 7: General connection principle

When PLOC2D is used with a CDB650 connection module, connect **External illumination trigger output** (pin 14) to terminal 21 and **Conveyor tracking output** (pin 16) to terminal 50.

Wiring without a SICK connection module

For use with a custom connection unit, see "Connections and pin assignment", page 29.

6.3.2 Wiring the data interface

Wiring the Ethernet interface

To connect the sensor to the PC:

1. Connect the sensor to the PC via Ethernet.

To connect the sensor to the PC and the robot controller:

1. Connect the sensor to a network switch by an Ethernet cable.
2. Connect the network switch to the PC via Ethernet.
3. Connect the network switch to the robot controller via Ethernet.

NOTE

The Ethernet interface for the device has an Auto-MDIX function. This automatically adjusts the transmission speed as well as any necessary crossover connections.

6.3.3 Conveyor tracking

Connect the robot controller to pin 16 on the **Power/SerialData/CAN/IO** connector (terminal 50 on CDB650-204) to activate conveyor tracking, which allows the robot controller to synchronize the conveyor encoder with the exact time for an image exposure.

Conveyor tracking principle

The robot controller sends a **Run.Locate** command to the PLOC2D to start the part localization. Each part localization consists of up to four image exposures. The conveyor tracking signal is high during each image exposure, which means that up to four signal pulses will be sent as output to the robot controller.

The robot controller records an index (1 – 4) for each exposure, and matches the index with the corresponding encoder value. When the part localization result is received from the PLOC2D, the robot controller can map the located part to its position on the conveyor.

6.3.4 External illumination

Connect the external illumination to pin 14 on the **Power/SerialData/CAN/IO** connector. If you use the CDB650-204 connection module, the external illumination is available on terminal 21.

On PLOC2D-63x devices, you can also use the separate external illumination connection, see "Device view (InspectorP63x)", page 13. This connection is not available on PLOC2D-65x devices.

7 Operation

7.1 PLOC2D user interface

7.1.1 Accessing the user interface

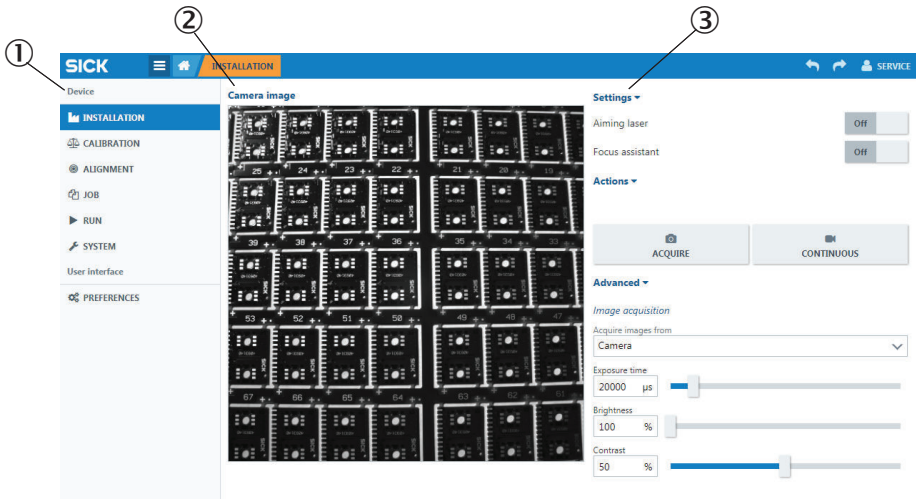
PLOC2D uses a web based user interface. To access the interface, follow the steps below:

1. Open a web browser window.
2. Type the preset IP address: 192.168.0.1.

NOTE
Make sure that the network communication settings on the computer are correctly set up:

- The computer must be on the same network as the PLOC2D.
- The computer must not use the same IP address as the PLOC2D.

7.1.2 Overview of the user interface



① Page selection panel
② Camera image viewer
③ Settings panel

The PLOC2D user interface consists of the following parts:

- The Page selection panel, which contains workflow steps and system settings.
- The camera image viewer, where images are displayed.
- The Settings panel, which displays settings for the currently selected workflow step.

7.1.3 User levels

At the first use of the interface, the user is automatically logged in with user level **Run**. Click the "Run" symbol in the upper right part of the user interface to log in with a different user level.

The following user levels are available:

User level	Description
Run (no password)	Default first-time login. Monitor production by viewing localization results or system log. **Run** and **System** workflow steps are visible but no changes are possible.
Operator (no password)	Verify that pre-configured jobs work before starting a new production batch. Unlocks **Run** workflow step. **Job** and **System** workflow steps are visible but no changes are possible.
Maintenance (password: main)	Adjust image acquisition settings, perform hand-eye alignment, configure jobs and change system settings. Unlocks **Installation**, **Alignment**, **Job**, **Run** and **System** workflow steps.
Service (password: servicelevel)	Calibrate the PLOC2D sensor. Unlocks **Calibration** workflow step.

7.2 Configuration workflow

User level **Service** is required to do a complete configuration of the PLOC2D sensor. User level **Maintenance** is required for configuration of pre-calibrated PLOC2D variants, which do not need calibration.

The PLOC2D configuration consists of the following steps:

Workflow step	Description
Installation	Aim the sensor and optimize the focus and aperture for the intended working distance.
Calibration	Calibrate the system to compensate for camera and system distortion.
Hand-eye alignment	Align the sensor and robot coordinate systems using an alignment target.
Job configuration	Acquire a reference image and teach a reference part for each job.
Run jobs	Confirm that the PLOC2D sensor locates the parts of interest.

Illumination setup

Before starting the configuration, make sure that the illumination is correctly set up. For details, see "Image settings", page 44.

Image exposure settings

The image exposure is controlled by three parameters:

- **Exposure time**, which sets the exposure time of the sensor (µs).
- **Brightness**, which sets the brightness percentage of the acquired images.
- **Contrast**, which sets the contrast percentage of the acquired images.

Adjust the parameters to obtain an image where the features to be located have good contrast in relation to the background. Changes to the exposure settings are applied to the next acquired image.

7.2.1 Installation

The purpose of this workflow step is to aim the rigged sensor and optimize the focus and aperture for the intended working distance. User level **Maintenance** is required.

Focus assistant

When the **Focus assistant** option is enabled, a colored curve is plotted on top of the image in the image window (see figure 8). A new value is plotted for each image acquisition, indicating whether the focus is better or worse compared to the previous image.

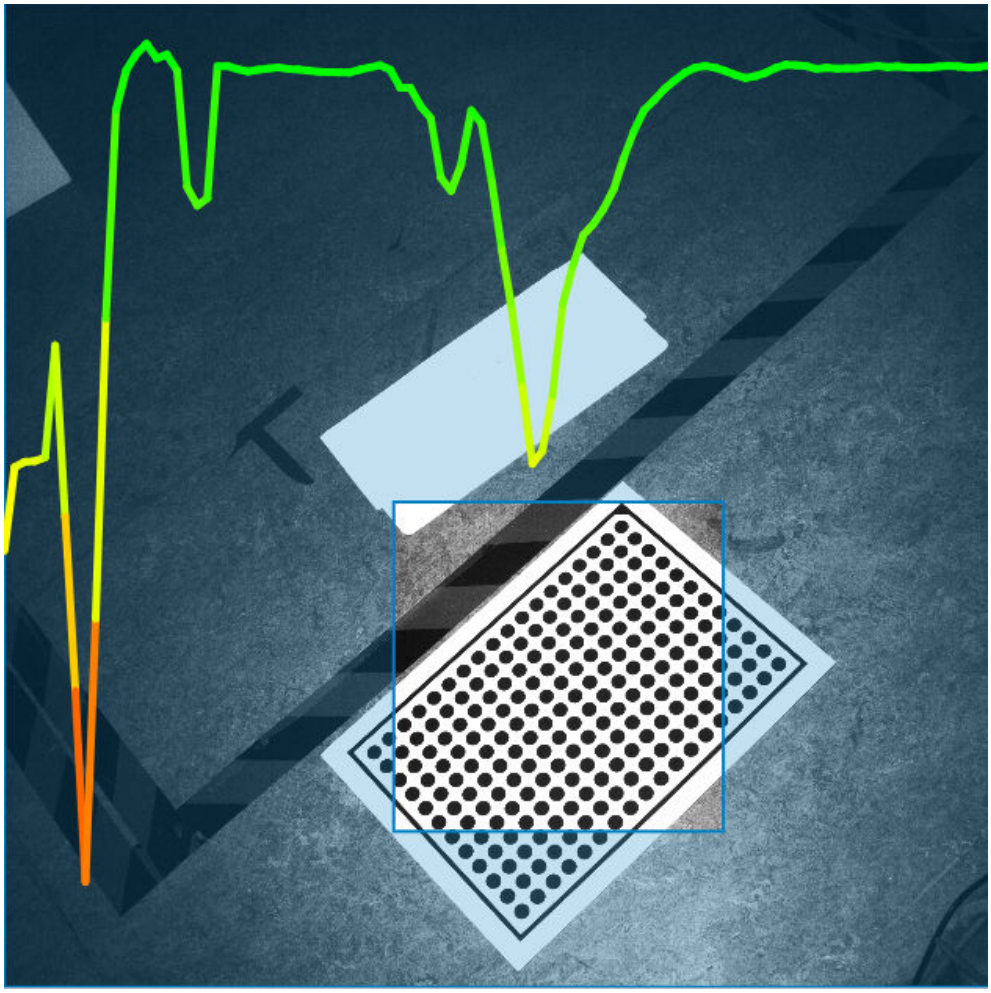


Figure 8: Focus assistant curve

Procedure

1. In the user interface, go to the **Installation** tab.
2. Set the **Aiming laser** option to **On** to confirm that the sensor is mounted in an appropriate position above the target surface.
3. Click **Acquire** to acquire an image.
4. If the image looks under- or overexposed, adjust the **Exposure settings** parameters.
5. Repeat steps 3. – 4. until the image looks good.
6. Set the **Focus assistant** option to **On** to enable the focus assistant tool.

✓ A blue focus region is displayed in the image window.

7. Click and hold or double-click a place in the image to move the focus region.
8. Click **Continuous** to acquire images continuously, or **Acquire** to acquire single images.

✓ During the image acquisition, the **Focus assistant** curve is plotted in the image window on top of the displayed images. A new value is plotted for each image acquisition.

9. Adjust the aperture, exposure settings, and focus of the camera until the focus region looks sharp and the **Focus assistant** curve has reached a plateau.

7.2.2 Calibration

The purpose of the calibration is to compensate for the internal camera and lens system distortion in order to locate parts with high accuracy. This is achieved by measuring a well-defined calibration target in different poses and estimating the internal camera parameters based on these measurements. User level **Service** is required.

A successful calibration procedure is crucial in order to obtain valid part localization results.

NOTICE
Calibration must not be performed on pre-calibrated PLOC2D variants.

NOTE
It is difficult to cover the entire field of view in every image if the calibration target is smaller than the field of view at the nominal working distance. Minimizing the aperture allows placing the calibration target closer to the camera, but results in darker images.

Pre-requisites

Observe the following before starting the calibration procedure:

- The aperture is set to a suitable value.
- The camera is focused at the intended working distance.
- The correct calibration target is selected in the **Calibration target** list.
- Suitable exposure settings are set up.
- The specified focal length in the user interface matches the lens on the camera.

Procedure

In the user interface, go to the **Calibration** tab.

A good calibration requires a number of images that show the calibration target in different poses that together cover the entire field of view. Ideally, each part of the field of view should be covered with calibration target data at least three times at different tilt angles. If possible, cover the entire field of view in every image.

The calibration procedure consists of the following steps:

- Collect image data.
- Start calibration.
- Check results.

Collect image data

1. Click **Acquire** or **Continuous** in the user interface to acquire calibration images.
2. For each image acquisition, place the calibration target in a new position and with a new tilt angle in the camera's field of view.
   A colored circle and a colored grid are displayed in the image window to indicate the progress (see figure 9, figure 10 and figure 11):
   - The fill level of the circle represents the overall coverage (%) of the field of view.
   - The grid represents the coverage in the different regions of the field of view:
     - Each time a region is covered with calibration target data, the grid gradually changes color from orange to green.
     - When a region has been covered with calibration target data three times, the grid disappears.

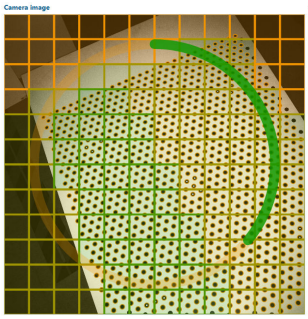


Figure 9: 30% coverage

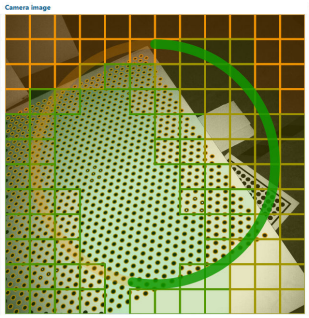


Figure 10: 50% coverage

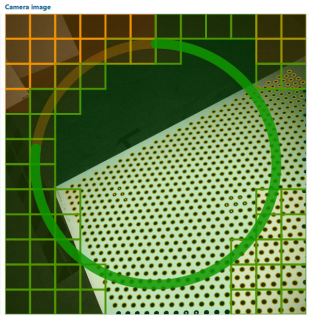


Figure 11: 80% coverage

3. Collect as many images as necessary for good coverage of the field of view, up to 32 images.
   An image will only be added to the calibration image set if the target can be accurately located, which is indicated in the image window by in-painted calibration marks.

The calibration image slots can be browsed using the **Previous** and **Next** buttons in the user interface. Images can be removed from the calibration image set by clicking **Remove**.

Start calibration

Once a good calibration image set has been collected, click **Calibrate** to start the calibration. Note that the calibration may take up to a few minutes.

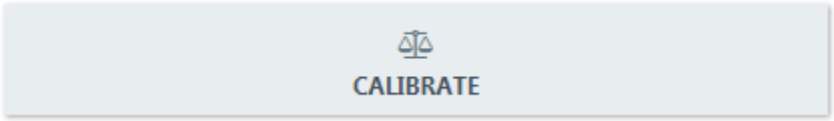


Figure 12: Calibration button

Calibration results

When the calibration is finished, the results are displayed in the **Active calibration** section in the user interface (see figure 13). The calibration results, including the calibration image set, can be downloaded and saved by clicking **Download calibration data**.

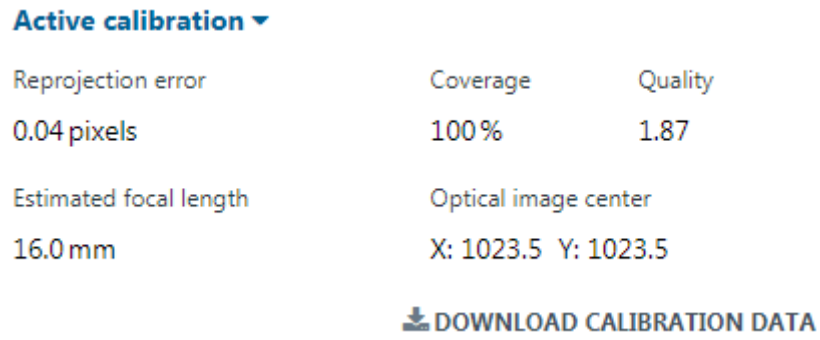


Figure 13: Calibration results

The goal of the calibration is to achive a high coverage and a low reprojection error. Plausibility checks on estimated focal length and optical image center are recommended.

- The **Reprojection error** parameter should be as low as possible. The reprojection error depends on the coverage; a higher coverage normally yields a higher reprojection error. As a general rule, a reprojection error < 1 is recommended.
- The **Coverage** parameter indicates how much of the field of view that has been covered by the detected calibration marks.
- The **Quality** parameter should be as high as possible, preferably > 1. To obtain a good calibration, it is important to find a good balance between high coverage and low reprojection error.
- The **Estimated focal length** parameter is the focal length estimated by the system. It should not be very far from the specification of the lens.
- The **Optical image center** parameter represents the pixel coordinates of the estimated optical center. It should be close to the actual center of the image.

7.2.3 Hand-eye alignment

The purpose of this workflow step is to align the sensor and robot coordinate systems using an alignment target (e.g. part no. 4092645). User level **Maintenance** or higher is required.

The alignment target is illustrated in figure 14. Note that the illustration is not to scale and can not be used for alignment.

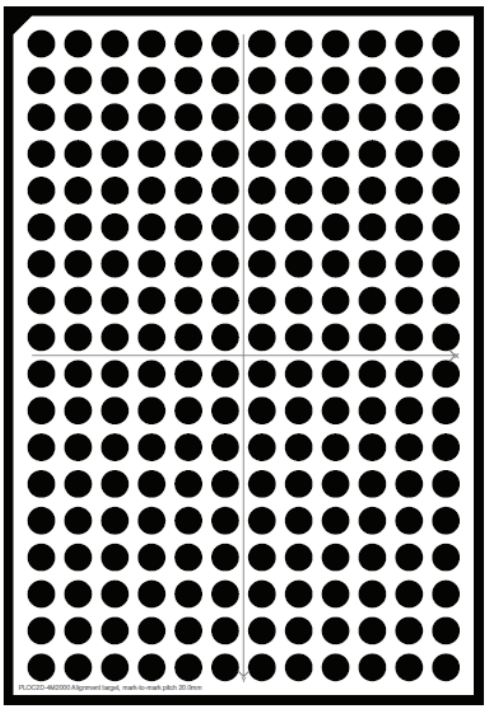


Figure 14: Example of a PLOC2D alignment target.

NOTE
Do not remove or reposition the alignment target after sensor alignment until robot work frame alignment has been performed.

NOTE
If the sensor alignment is changed, a new reference image must be captured for each job under the **Job** tab in order to re-configure the job settings.

Procedure

1. In the user interface, go to the **Alignment** tab.
2. Place the alignment target on the target surface in the same plane as the parts to be located.
3. Position the alignment target to allow the robot to measure the work frame as defined by the coordinate system on the target. The target should be completely visible in the camera image.
4. Click **Align** to acquire an image and align the sensor coordinate system with the alignment target.
5. If alignment fails, adjust the exposure settings to obtain a clear image.
6. Repeat steps 4 – 5 until an "Alignment successful" message is displayed in the user interface.
7. Define the robot work frame coordinates by jogging the robot to the alignment target points indicated by the arrows in figure 15.

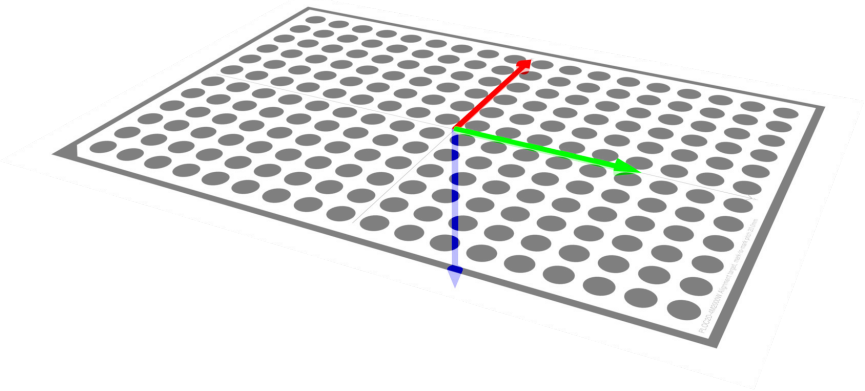


Figure 15: Alignment target frame.

Results

When the alignment is ready, an image of the alignment target is displayed in the image window. The displayed image is rectified, which means projected onto the defined alignment frame. A blue circle, representing the position and the direction of the alignment target, is displayed on top.

The aligned sensor coordinates are displayed in the **Active alignment** section.

7.2.3.1 Verify alignment

If the alignment target has not been moved after hand-eye alignment, it is possible to confirm that the PLOC2D sensor has not moved.

Click **Verify** to capture an image and confirm that the alignment target is found in the expected position. Use the **Verification threshold** slider to set the tolerance for how much the sensor and the alignment target are allowed to move in relation to each other.

Figure 16: Verification threshold slider

7.2.4 Job configuration

The purpose of this workflow step is to configure a job for each part type to be located. User level **Maintenance** or higher is required.

For each job configuration, a reference image is acquired and a reference part is located. A maximum of 128 jobs can be configured.

Procedure

1. In the user interface, go to the **Job** tab.
2. Select a job in the **Job** list.
3. Place the reference part in the camera's field of view.
4. Click **Acquire** to acquire a reference image.

✓ The displayed reference image is rectified, which means projected onto the defined alignment plane.

5. Click **Brush** to draw a mask that covers the reference part. See figure 17.
   - Use the mouse scroll wheel or the **+** and **-** keys to adjust the size of the **Brush** tool.
   - Zoom by pressing **Shift+Up arrow** or **Shift+Down arrow**
   - Pan the zoomed view with the arrow keys.
   - Click **Clear** to remove the applied mask.

✓ When the system locates the part, a "Job configured" message is displayed in the user interface and the part contours are highlighted in the image window. See figure 18.

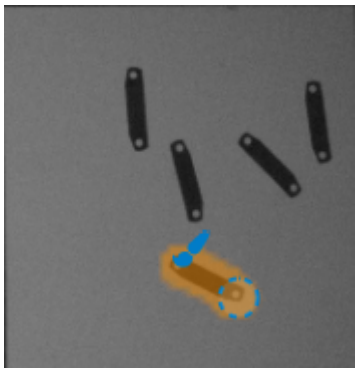


Figure 17: Masking the part

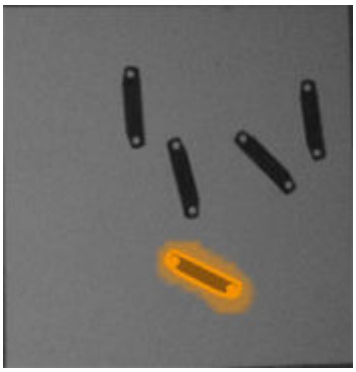


Figure 18: Highlighted part contours

6. If needed, click **Eraser** to manually remove masking of any contours or features that are not present in the alignment plane or that do not belong to the reference part. See figure 19.

Figure 19: Left image: Masking the entire part. Right image: Using the eraser to exclude holes from the mask

- Use the mouse scroll wheel or the **+** and **-** keys to adjust the size of the **Eraser** tool.
- Zoom by pressing **Shift+Up arrow** or **Shift+Down arrow**
- Pan the zoomed view with the arrow keys.

Step 7. and step 8. are optional:

7. Click **Part reference point** to start the part reference point tool.

✓ The part reference point is highlighted.

8. Drag the part reference point from its position at the origin to a position relative to the detected shape. It can for example be at the center of the shape or at a corner.
   - To place the part reference point with high accuracy, zoom in on the part.
   - To rotate the part reference point, use its rotation handle.
   - To reset the part reference point to the origin, click **Reset** at the upper left corner of the image.

✓ This is now the reference position of the part. All pick positions defined by the robot are defined relative to this position.

Zoom view

- Click **Zoom** to zoom the camera view using the mouse scroll wheel.
- Pan the zoomed in camera view by dragging the image.

Exposure settings

Each job uses one of four global exposure settings or a job-specific setting that control the exposure time, brightness and contrast. Select an option (**Global setting 1 – 4** or **For this job only**) from the **Exposure settings** list in the **Advanced** section to change the exposure settings for the selected job. When new exposure settings have been selected, click **Acquire** to update the reference image.

To control the exposure settings, adjust the **Exposure time**, **Brightness**, or **Contrast** parameters. Note that changes to these parameters are applied to all jobs that use the specified exposure setting (**Global setting 1 – 4**).

NOTE
It is not recommended to use job-specific settings if the system locates multiple jobs simultaneously. Image acquisition takes a longer time if every job has different image settings.

Job settings

Adjust the **Score threshold** parameter in the **Settings** section.

In the **Advanced** section, adjust the **Max rotation**, **Sensitivity** and **Z-offset** parameters.

Setting	Description
Score threshold	The PLOC2D sensor assigns a percentage score to each located part. Only parts with scores above the score threshold will be reported.
Max rotation	Set tolerance for part rotation in relation to the reference position.
Sensitivity	If there are many edges or features in the image the sensitivity may need to be lowered. If the image is uncluttered, the sensitivity can be raised to increase speed.
Z-offset	If the pick position is offset from the alignment plane, or if there are jobs with different part heights, set a Z-offset.

7.2.5 Run jobs

When the sensor is installed and configured, use this workflow step to confirm that the PLOC2D sensor system locates the parts of interest.

Procedure

1. In the user interface, go to the **Run** tab.
2. In the list in the **Settings** section, select which jobs to run:
   - Hover over a job to view the job details.
   - Click on a job to select or unselect it.
3. Collapse the list by clicking the arrow in the upper right corner, or somewhere outside the list.
4. Click **Locate** to acquire an image and search for the parts of interest.

✓ When the system has located the parts for all selected jobs, a "Shape found" message is displayed in the user interface.

If locate fails, see "Troubleshooting", page 52.

Results

Click **Previous** and **Next** to display the result information for each located part. If the buttons are disabled, it means that no part or only one part has been located. Each result that is displayed is also added to the **History** log.

Each result is represented in the image window by a shape contour and a blue circle. The circle represents the movement and rotation of the part in relation to the reference part. See figure 20.

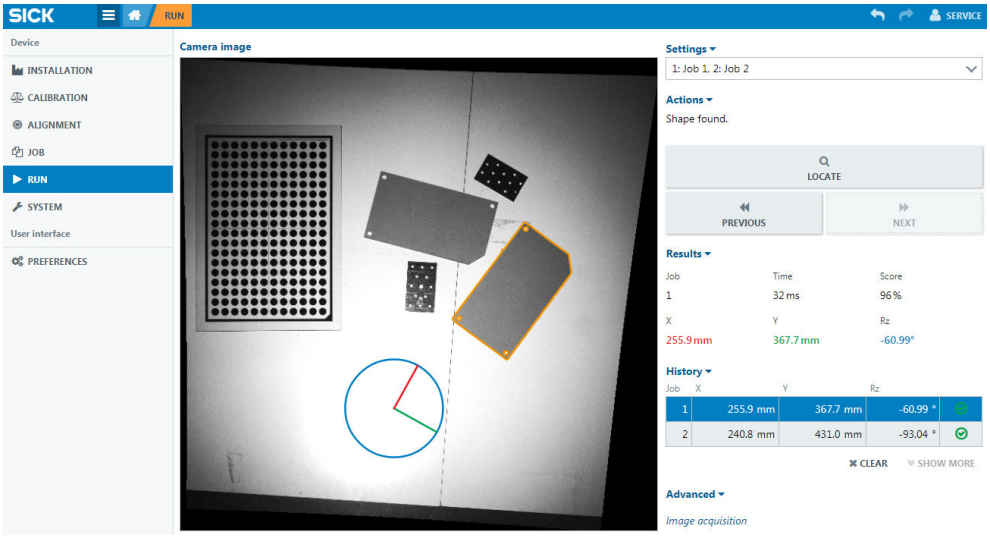


Figure 20: Result information for a located part

The **Results** section contains additional information about each result, including the job number and the coordinates (x,y) and degrees of rotation (Rz) in relation to the reference part.

History log

Results received either in the PLOC2D user interface or by the robot via the Run.Locate command are added to the log in the **History** section. The log stores information about the 20 most recent results. New results are added to the top of the list.

- Click on a list row to get result information.
- Click **Clear** to clear the log.

NOTE
The **Previous** and **Next** buttons are not connected to the History log and can be used to toggle between the log results.

Advanced

By default results are sorted by score. For applications where the parts are aligned in a ordered structure and the order of results are important, select **Lanes** in the **Result sort order** list.

The lane positions are automatically adjusted to the first found part. All parts found in a specific lane are then sorted within the lane in the sorting direction.

To adjust the width and rotation of lanes, drag the **Lane width** and **Lane angle** sliders or use the lane tool in the image view.

To use the lane tool

- Click  .

✓ The lane tool controls are visible in the image view.

To adjust the width of lanes

- Move the pointer to a lane border. When the the pointer becomes a  , drag the pointer to adjust the lane widths.

To adjust the rotation of lanes

- Move the pointer over the lanes. When the the pointer becomes a  , drag the pointer to rotate the lanes.

To change the lane order

- Click the lane order buttons to change the lane order.
- Click  to order lanes from left to right and report results within lanes from top to bottom.
- Click  to order lanes from left to right and report results within lanes from bottom to top.
- Click  to order lanes from right to left and report results within lanes from top to bottom.
- Click  to order lanes from right to left and report results within lanes from bottom to top.
- Click  to order lanes from top to bottom and report results within lanes from right to left.
- Click  to order lanes from top to bottom and report results within lanes from left to right.
- Click  to order lanes from bottom to top and report results within lanes from left to right.
- Click  to order lanes from bottom to top and report results within lanes from right to left.
- Click  to zoom out.
- Click an arrow in a lane to change the order in that specific lane.

7.2.6 System settings

Use the **System** tab to adjust system settings and monitor the system log. The **System** tab is located below the workflow steps in the user interface.

7.2.6.1 Identification

This section contains identification information about the device. We recommend that you give the device a unique name in the **Device name** field.

7.2.6.2 Network settings

The IP settings for the PLOC2D are configured in the **Network settings** section.

Make sure that the network communication settings are correctly set up:

- The computer must be on the same network as the PLOC2D.
- The computer must not use the same IP address as the PLOC2D.

7.2.6.3 Communication

This section contains settings for the communication with the robot controller.

- **Native protocol** is the recommended protocol. It allows access to all commands that are available in PLOC2D. This protocol also automatically identifies the syntax that the robot controller uses. If it is not possible for PLOC2D to clearly identify the syntax (for example if the robot controller sends a command that is applicable to more than one syntaxes) you can select a syntax in the **Syntax** drop-down list.
- **Compatibility protocol** is used when a customer specific protocol has been implemented.

7.2.6.4 Image settings

The PLOC2D system can be configured to use either internal or external illumination, or a combination of both. The illumination configuration is applied system wide. For information about external illumination, see "External illumination", page 31.

Internal and external illumination can be individually enabled. For external illumination, a list of different modes are available.

Set the **Pixel size** parameter so that the part features to be located by the sensor are clearly visible in the image. A smaller pixel size allows for finer shape detail definition, while a larger pixel size increases the localization speed.

7.2.6.5 System log

The system log is found in the **Diagnostics** section, and contains device event descriptions with corresponding timestamps. The system log can be filtered using a case sensitive text filter that supports negation via the ! operator.

The system log is cleared each time the sensor is re-started. Click **Clear** to clear all items manually, or click **Save to file** to save the current system log to a file.

7.2.6.6 Reboot and restart

Reboot

A complete reboot of the device will take about 90 seconds. There are two ways to do it:

- Click the reboot button that is found in the **Maintenance** section in the user interface.

Figure 21: Reboot button in user interface

- Press and hold the Enter button for 10 seconds. The Enter button is found on the top of the physical device.

Figure 22: Enter button on device

Restart

To restart only the software in the device, press and hold the Enter button for 3 seconds.

7.3 Robot system workflow

7.3.1 Part localization

During a part localization cycle, the robot controller communicates with the PLOC2D sensor by the Run.Locate command. The Run.Locate command acquires a new image and performs a localization of the parts in the specified jobs. The command accepts two optional parameters:

- Jobs: The index of the job in string form or an array of jobs separated by space, e.g. '1' or '1 3 8 12'. If this parameter is omitted, all configured jobs will be located.
- Match: The index of the match to return from a previous Run.Locate command. If this parameter is omitted, the operation will always trigger a new image and return the first result.

NOTE
The Match parameter can only be used to get additional localization results from the same image as a previous Run.Locate command without the Match parameter.

NOTE
Performing Run.Locate on all jobs may be slow since the jobs are located in sequence.

The results for a job are sorted by X-position followed by Y-position, with regard to the alignment target.

For a full list of commands and associated parameters, see "Robot commands", page 46.

Conveyor tracking

The image exposures for each Run.Locate command can be registered using conveyor tracking. Connect the robot controller to pin 16 on the Power/SerialData/CAN/IO connector on the PLOC2D sensor to activate conveyor tracking. For more information, see "Conveyor tracking", page 30.

7.3.2 Robot program

See the flowchart diagram in figure 23 for a step by step description of how a PLOC2D sensor and a robot interacts during a part localization cycle. Robot programs for different types of robots are available for download via the **SICK Support Portal**.

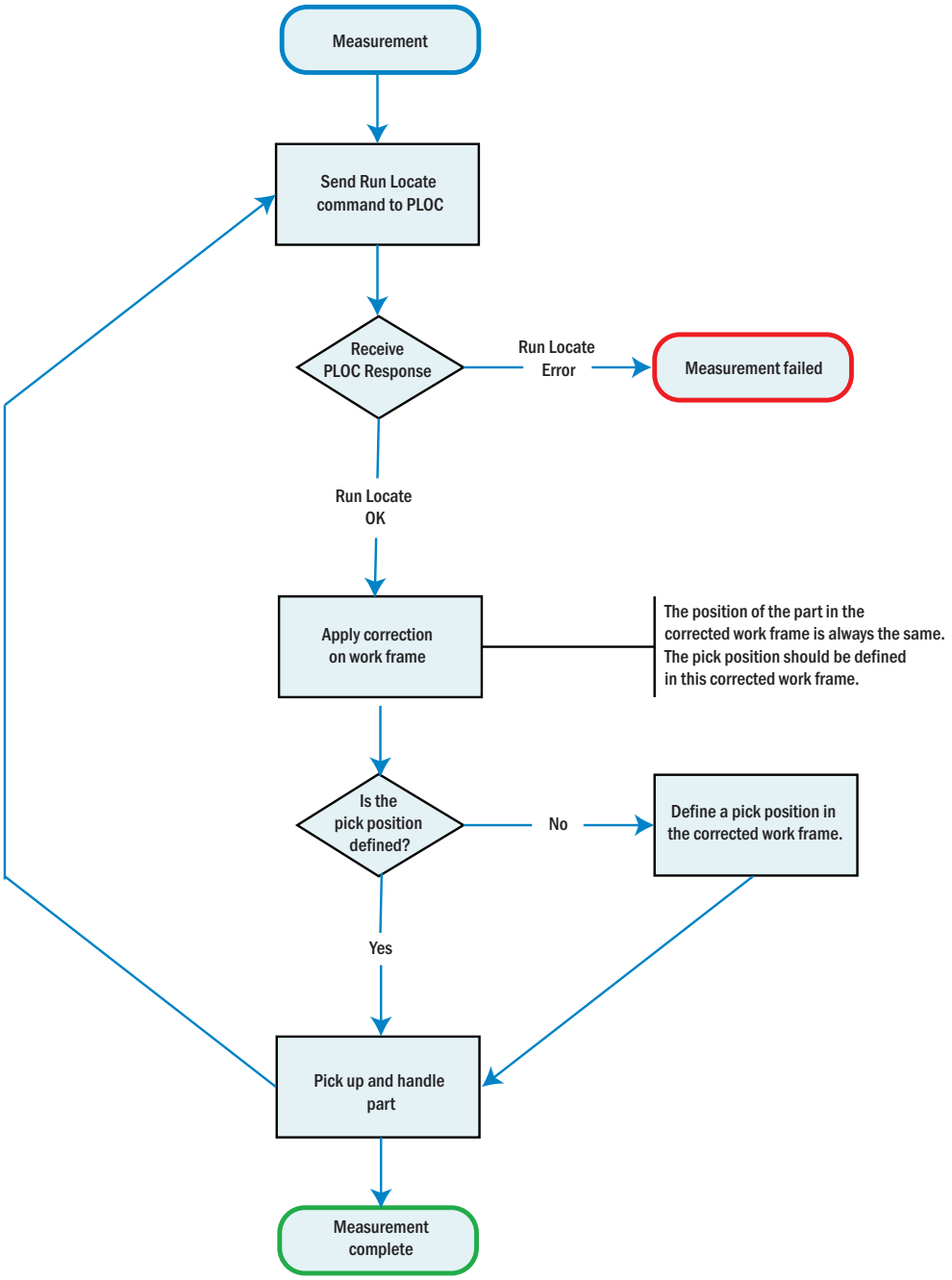


Figure 23: Robot operation flowchart

7.3.3 Robot commands

NOTE
Correctly typed PLOC2D robot commands always yields a response message (Ok/Error).

Commands

PLOC2D accepts the following commands, formatted as either CSV or XML.

Table 1: PLOC2D commands

Command	Description
Aligment.Align,1	Acquire a new image and perform a hand-eye alignment.

Command	Description
Run.Locate,[Job numbers]	Acquire a new image and attempt to locate the parts from the specified job. More than one job can be specified. If no job is specified, the command locates all configured jobs and returns the first result.
Run.Locate,[Job numbers], [Match]	Return a result from the previous Run.Locate command. The result to return is specified by the Match parameter. No new image is acquired when using the Run.Locate command with the Match parameter.
System.Restart.Software, [String]	Initiates a software restart with a text message string for logging.

Examples

See table 2 for XML and CSV command examples.

Table 2: PLOC2D command examples

Command	Examples
Aligment.Align,1	**XML example:** <message><name>Alignment.Align</name><alignment>1</alignment></message>
	CSV example: Alignment.Align,1
Run.Locate,[Job numbers]	**XML example 1:** <message><name>Run.Locate</name><job>1</job></message>
	CSV example 1: Run.Locate,1
	XML example 2: <message><name>Run.Locate</name><job>2 3</job></message>
	CSV example 2: Run.Locate,2 3
Run.Locate,[Job numbers], [Match]	**XML example:** <message><name>Run.Locate</name><job>3</job><match>2</match></message>
	CSV example: Run.Locate,3,2
System.Restart.Software, [String]	**XML example:** <message><name>System.Restart.Software</name><reason>Initiated by robot program</reason></message>
	CSV example: System.Restart.Software,Initiated by robot program

Responses

See table 3 for command responses. All response parameters are explained in table 4.

Table 3: PLOC2D command responses

Command	Response
Aligment.Align,1	Aligment.Align.Ok alignment x y z rx ry rz Alignment.Align.Error alignment error
Run.Locate,[Job numbers]	Run.Locate.Ok job match matches x y z rx ry rz scale score time exposure identified Run.Locate.Error job score time error
System.Restart.Software, [String]	System.Restart.Software.Ok System.Restart.Software.Error error

Table 4: PLOC2D response parameters

Parameter(s)	Description
alignment	The number of the current alignment. The value of this parameter is always 1.

Parameter(s)	Description
error	Error code returned by the PLOC2D sensor: 9100 = The image acquisition failed. 9101 = The image could not be stored to the SD-card. 9200 = No valid image found. 9201 = PLOC2D sensor not calibrated. 9202 = PLOC2D sensor not aligned. 9203 = Job not valid. 9400 = Alignment failed. 9401 = Alignment target not found. 9600 = Locate failed. 9601 = Locate failed. Score too low. 9999 = An unknown error occured.
exposure	The exposure settings index used to acquire the image upon which the localization was based.
identified	The integer indices of the identified jobs in string form, separated by space.
match	The index of the current match.
matches	The number of matches found.
x y z	For Alignment command: Distance (in mm) between the aligned workframe and the camera's position. For Run command: The reference frame of the located part in the aligned work frame, distances in millimeters. Since distances are observed in the aligned workframe, the z parameter is 0.
rx ry rz	For Alignment command: Rotation (in degrees) of the aligned workframe in relation to the camera's position. For Run command: The reference frame of the located part in the aligned work frame, rotations in degrees. Since rotations are observed in the aligned workframe, the rx and ry parameters are 0.
scale	Size of the current part compared to the reference part. If scale > 1, it means that the current part is closer to the sensor than the reference part.
score	Score value (%) for the current result. See "Job configuration", page 39 for details.
time	Part localization time.

8 Maintenance

8.1 Maintenance plan

The product requires the following maintenance work at regular intervals:

Table 5: Maintenance schedule

Interval	Maintenance work	To be carried out by
Cleaning interval depends on ambient conditions and climate	Clean housing and front screen	Specialist
Every 6 months	Check the screw connections and plug connections	Specialist

8.2 Cleaning the device

At regular intervals, check the inspection window and the housing of the device for contamination (see "Maintenance plan", page 49). This is especially relevant in harsh operating environments (dust, abrasion, damp, fingerprints, etc.).

The inspection window lens must be kept clean and dry during operation.

NOTE
Excercise caution when cleaning the device. If the device position is changed during cleaning, the sensor and robot frame must be re-aligned.

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

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

Cleaning the inspection window

NOTICE
Damage to the inspection window!
Reduced analysis performance due to scratches or streaks on the inspection window!

- ▶ Only clean the inspection window when wet.
- ▶ Use a mild cleaning agent that does not contain powder additives. Do not use aggressive cleaning agents, such as acetone, etc.
- ▶ Avoid any movements that could cause scratches or abrasions on the inspection window.
- ▶ Only use cleaning agents suitable for the screen material (2 mm glass with scratch proof coating).

NOTE
Static charge may cause dust particles to stick to the inspection window. This effect can be avoided by using an anti-static cleaning agent in combination with the SICK lens cloth (can be obtained from www.sick.com).

NOTE
If the inspection window is scratched or damaged (cracked or broken), the lens must be replaced. Contact SICK Service to arrange this.

Cleaning procedure

CAUTION
Laser and LED safety
See "Operational safety and particular hazards", page 9 for information regarding laser and LED safety.
See "Operational safety and particular hazards" for information regarding laser and LED safety.

- ▶ Switch off the device for the duration of the cleaning operation. If this is not possible, use suitable laser protection goggles. These must absorb radiation of the device's wavelength effectively.
- ▶ Glass lens: Remove dust from the inspection window using a soft, clean brush. If necessary, also clean the inspection window with a clean, damp, lint-free cloth, and a mild anti-static lens cleaning fluid.
- ▶ Plastic lens: Clean the inspection window only with a clean, damp, lint-free cloth, and a mild anti-static lens cleaning fluid.

Cleaning the housing

In order to ensure that heat is adequately dissipated from the device, the housing surface must be kept clean.

- ▶ Clear the build up of dust on the housing with a soft brush.

8.3 Backup and restore

NOTE
If the mounting position of the PLOC2D changes due to the SD card access procedure, we recommend to re-align the PLOC2D, see "Hand-eye alignment", page 37.

There are two ways to backup your PLOC2D, either remove the SD card and make a backup to a computer, or access the SD card via FTP. We recommend to make a backup to an additional SD card and keep it on site.

The following files and folders must be restored after a back-up:

- `Alignments` folder
- `Jobs` folder
- `config.json` file
- `Calibrations` folder

The files are located in the `ploc` directory of the SD card (see figure 24).

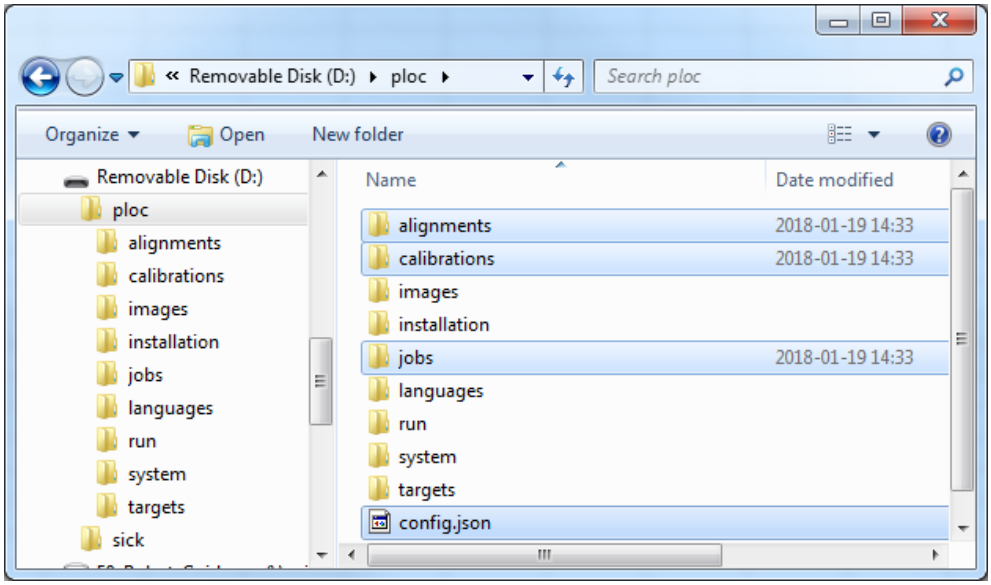


Figure 24: Structure of the PLOC2D SD card

Accessing via FTP

Use an FTP client to access the PLOC2D.

- User: ploc
- Pass: ploc

NOTE
When logging in via FTP, the user is routed directly to the `ploc` directory on the SD card.

Removing SD card

Make sure that the PLOC2D is powered off before removing the SD card. For information about how to physically access the SD card, see "Product description", page 11. Use an SD card reader to copy essential files from the SD card.

Restoring data

Copy the backed up files to the `ploc` directory on the SD card and replace the SD card in the PLOC2D. Make sure that the PLOC2D is powered off before replacing the SD card.

9 Troubleshooting

9.1 Functional

Connection/IP

If there are connection issues with the PLOC2D device, check the following:

- Is the ethernet cable connected?
- Is the PLOC2D and the computer on the same network?
- Is there an IP address conflict between the PLOC2D and the computer?

Power supply

If the PLOC2D device LED:s are not lit, check the following:

- Is the power supply connected?
- Is the power supply the correct specification?

9.2 Operational

Not finding target

If the calibration or alignment target cannot be found, check the following:

- Is the target selected in the UI the same as the target used?

Locate failure

If the PLOC2D fails to locate the object, check the following:

- Is the score threshold too high?
- Is the sensitivity too high?
- Is the maximum rotation to low?
- Is the teach-in faulty?

Low accuracy

If the PLOC2D performs with lower than normal accuracy, check the following:

- Is calibration adequate?
- Is robot frame alignment accurately performed?
- Has the gripper position been altered?
- Has the sensor position been altered?
- Is the gripper tool centre part definition correct?

Erratic measurements

If the PLOC2D displays erratic measurements, check the following:

- Has a teach in been succesfully performed?
- Is the sensitivity too high?
- Is the maximum allowed rotation too high?

9.3 Repairs

Repairs on the product may only be carried out by the manufacturer. Any interruption or modification of the product will invalidate the manufacturer warranty.

9.4 Disposal

CAUTION
Risk of injury due to hot device surface!

The surface of the device can become hot during operation.

- Before commencing disassembly, switch off the device and allow it to cool down as necessary.

Any device which can no longer be used at the end of the product life cycle must be disposed of in an environmentally friendly manner in accordance with the respective applicable country-specific waste disposal regulations. As they are categorized as electronic waste, the device must never be disposed of with household waste.

ATTENTION
Danger to the environment due to improper disposal of the product!

Disposing of the product improperly may cause damage to the environment.

Therefore, take note of the following information:

- Always observe the valid regulations on environmental protection.
- Following correct disassembly, pass on any disassembled components for reuse.
- Separate the recyclable materials by type and place them in recycling containers.

10 Technical data

10.1 Optics and Illumination

Type	PLOC2D
Focus	**InspectorP65x:** Manual adjustment of the focus and aperture on the optional lens unit. **InspectorP63x:** Compact C-mount lenses: Fixed aperture, manual sharpness setting on the lens C-mount lenses: Manual sharpness and aperture setting on the lens S-mount lenses: Fixed aperture, working distances can be implemented using distance ring, manual sharpness setting using focus screw
Illumination for field of view	Optional e.g., variants of the VI83I integrable illumination unit: 11 x LED, visible light. White (λ = 6,000 ± 500 K) Blue (λ = 455 ± 20 nm) Red (λ = 620 ± 30 nm).
Feedback LED (spot in field of view)	Optional e.g., variants of the VI83I integrable illumination unit: 1 x LED, visible light. Green (λ = 525 ± 15 nm).
LED risk group of illumination unit	"White + Feedback LED" option "Blue – Medium + Feedback LED" option "Blue – Wide + Feedback LED" option "Red + Feedback LED" option • Risk group 1 (low risk) according to IEC 62471-1: 2006-07/EN 62471-1: 2008-09. **Radiance:** L_B: < 10 x 10^3 W/(m^2sr) within 100 s; at a distance of ≥ 200 mm L_R: < 7 x 10^5 W/(m^2sr) within 10 s; at a distance of ≥ 200 mm
	"Blue - Narrow + Feedback LED" option • Risk group 2 (moderate risk) according to IEC 62471-1: 2006-07/EN 62471-1: 2008-09 due to exposure to blue light. **Radiance:** L_B: < 10 x 10^3 W/(m^2sr) within 50 s (RG 2); at a distance of ≥ 200 mm L_R: < 7 x 10^5 W/(m^2sr) within 10 s (RG 1); at a distance of ≥ 200 mm Risk RG 1 (low risk) corresponding to L_B < 10 x 10^3 W/(m^2sr) within 100 s for distances > 1 m.
Aiming laser (field of view)	Visible light. Red (λ = 630 nm ... 680 nm), can be disengaged
Laser class	Class 1 laser product (EN/IEC 60825-1:2014; class 1M for version EN/IEC 60825-1:2007)

10.2 Performance

Type	PLOC2D
Working distance	**InspectorP65x:** see "Field of view diagrams", page 14 **InspectorP63x:** see "Field of view diagrams", page 14
Lens unit	see "Field of view diagrams", page 14
Image sensor resolution	**InspectorP65x:** 4.2 MP **InspectorP63x:** 1.3 MP (InspectorP631), 1.9 MP (InspectorP632)
Image sensor type	**InspectorP65x:** 4.2 MP CMOS matrix sensor, gray scale **InspectorP63x:** Monochrome
Ambient light tolerance	2000 lx on surface

Type	PLOC2D
Image memory	2 GB on microSD memory card.

10.3 Interfaces

Type	PLOC2D
Ethernet	Image transmission (FTP). 10/100/1,000 Mbit/s, TCP/IP, Ethernet/IP. MAC address(es).

10.4 Mechanics and electronics

Type	PLOC2D
Optical indicators	**InspectorP65x:** 10 x RGB status LEDs 10 x bar graph 1 x green feedback spot **InspectorP63x:** 5 x RGB LEDs: status indicators 1 x LED: feedback LED, green/red 5 x RGB LEDs: bar graph, blue
Acoustic indicators	1 x beeper for signaling events, can be deactivated
Supply voltage	DC 24 V ± 20% SELV (EN 60950-1: 2014-08) and LPS (EN 60950-1: 2014-08) or Class 2 (UL 1310) required
Current consumption	**InspectorP65x:** Max. 2.0 A (with switching outputs) **InspectorP63x:** Max. 1.5 A (with switching outputs)
Power consumption	InspectorP65x: Typically 20 W (for switching outputs without load) InspectorP63x: 10 W (for switching outputs without load)
Weight	**InspectorP65x:** 635 g excluding optics **InspectorP63x:** 430 g excluding optics
Material Housing	Aluminum die cast
Material Viewing window	Glass or plastic (PMMA), 2 mm thick, with scratch-proof coating.
Electrical protection class	III, in accordance with DIN EN 60950-1: 2014-08
Enclosure rating	According to EN 60529: 2000-09

10.5 Ambient data

Type	PLOC2D
Vibration resistance	According to EN 60068-2-6: 2008-02
Shock resistance	In accordance with EN 60068-2-27: 2009-05
Ambient temperature	Operation[1]: 0 °C ... +50 °C Storage: –20 °C ... +70 °C
Permissible relative humidity	0% ... 90%, non-condensing

1) Notes regarding adequate dissipation of lost heat: see "Mounting requirements", page 21

11 Accessories

NOTE
Accessories and where applicable mounting information can be found online at:

- www.sick.com/TriSpector1000

11.1 General

All accessories for the product can be found at www.sick.com/PLOC2D.

All accessories for the product can be found at www.sick.com/PLR.

11.2 Lens types

The following lens types are available for PLOC2D:

PLOC2D variants	Lens types and f-numbers
Variants with C-mount lens	6 mm (f1.4–16), 8 mm (f1.4–16), 12 mm (f1.4–16), 15 mm (f1.4–16), 25 mm (f1.4–16), 35 mm (f1.4–16), 50 mm (f1.4–16)
Variants with S-mount lens	9.6 mm (f8), 12.5 mm (f8), 17.5 mm (f8), 25 mm (f8)

11.3 Illumination

Illumination

The following types of illumination are available for PLOC2D:

PLOC2D variants	Illumination types
Variants with an InspectorP63x sensor	White wide, White medium, White narrow, Blue wide, Blue medium, Blue narrow
Variants with an InspectorP65x sensor	Red/Amber, White, Blue

12 Appendix

12.1 Licenses

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8020736/148P2019-06/en

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