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QUICKSTART

PLOC2D

2D Vision for Robot Guidance

SICK
Sensor Intelligence.

Product information

PLOC2D is a part locator sensor for robot guidance comprised of an InspectorP65x/63x and application specific software.

Make sure that the installation is performed by a qualified technician permitted to do electrical installations.

About this document

This document contains instructions and descriptions that support the basic setup of the PLOC2D sensor, including setup of basic image acquisition, part localization and robot integration.

This document is valid for the PLOC2D sensor. For more information on the PLOC2D sensor, please refer to the PLOC2D Operating Instructions.

Mount

NOTICE

Do not touch the electrical connections, the lens glass or the LEDs of the lighting ring.

Mount the sensor mechanically, i.e. using the SICK angled bracket (part no. 2069169), or bracket kit (part no. 2069171).

Reflections can occur in some instances if the sensor is mounted perfectly perpendicular. If a large white spot is seen in the sensor image, try to re-align the sensor to be 1 to 2 degrees off the perpendicular axis, accuracy decreases with higher angles.

Connect

⚠ WARNING

Ensure that the ground potential is the same at all grounding points. Incorrect grounding or connection can damage the device and cause fire.

Ensure that any loose cable ends are isolated.

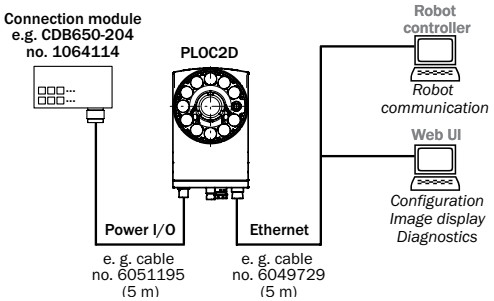
Do not plug in external I/O connectors to the InspectorP65x/63x while it is powered on.

To connect the PLOC2D sensor:

1. Use a Gigabit Ethernet cable to connect the P3/ Ethernet connector (see section E) to a network or directly to a computer.
2. Connect the power I/O to a 24 V power source.

See Appendix E for connection details.

Connection example diagram:



Get started with PLOC2D

The following sections outline how to integrate the PLOC2D sensor with a robot and configure the sensor image acquisition settings.

Connect to the PLOC2D sensor

The PLOC2D sensor is delivered with a preset IP address: 192.168.0.1. Use a web browser to access the user interface.

There are four user login levels available via the user icon in the upper right corner of the user interface:

Login	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 preconfigured 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 PLOC2D camera. Unlocks CALIBRATION workflow step.

Configuration workflow

Configure the PLOC2D sensor via the user interface pages INSTALLATION, CALIBRATION, ALIGNMENT, JOB, RUN and SYSTEM. The image exposure is controlled by three parameters:

Parameter	Description
Exposure time	Set the exposure time of the image sensor in micro seconds.
Brightness	Set brightness percentage of acquired images.
Contrast	Set contrast percentage of acquired images.

Changes to the exposure settings will be applied to the next acquired image.

Installation

Activate the AIMING LASER via the settings panel in the UI to confirm that the sensor is mounted in a appropriate position above the target surface.

Click ACQUIRE to acquire an image, or click CONTINUOUS to acquire a series of images. Adjust the camera focus and aperture until the image looks good.

A FOCUS ASSISTANT tool is available as a guide for focus adjustments. See the Operating Instructions for more information.

Calibration

Login as Service user to perform calibration, see Operating Instructions for more information.

Pre-calibrated PLOC2D versions should not be recalibrated.

Hand-eye alignment

The purpose of the hand-eye alignment is to align the sensor and robot coordinate systems using an alignment target (part no. 4092645). The objective is to provide a correction to the work frame so that the robot always utilizes the same pick position within the work frame.

NOTICE

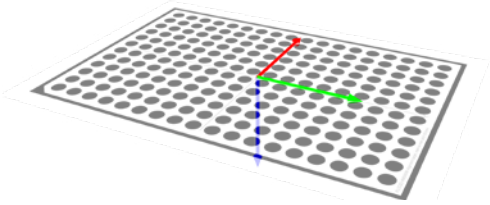
Do not remove or reposition the alignment target after sensor alignment until robot work frame alignment has been performed.

Place the alignment target on the target surface in the same plane as the features of the parts to be located.

Position the alignment target to allow the robot to measure the work frame as defined by the coordinate system on the target.

Click ALIGN to capture an image and align the sensor coordinate system with the alignment target.

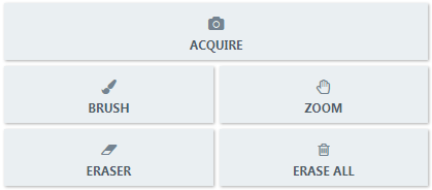
Define the robot work frame coordinates by jogging the robot to the alignment target points indicated by the arrows in the illustration below. Make sure that the alignment target is in the same position as it was when aligning the sensor coordinates.



Click VERIFY to control that the alignment is still valid, that is, that the camera has not moved in relation to the alignment target.

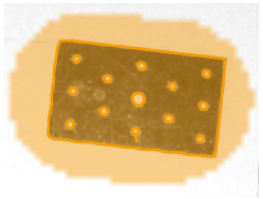
Job

Select a job from the JOB menu to start the configuration. Up to 64 jobs can be configured.



Click ACQUIRE to capture a reference image and click BRUSH to draw a mask that covers the part to be located.

When the system has located a part, the part contours are highlighted in the image window, as shown in the image below.



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 part to be located.

Use the mouse scroll wheel or the +/- keys to adjust the size of the BRUSH and ERASER tools. Click ZOOM to pan and zoom the camera view using the mouse scroll wheel. It is also possible to pan using the arrow keys and zoom using shift + up/down.

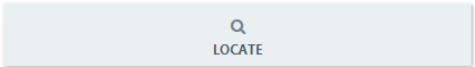
The following parameters are available on the JOB page. SENSITIVITY and MAX ROTATION are found in the ADVANCED section:

Parameter	Description
Job	Select job.
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.
SCORE THRESHOLD	The PLOC2D sensor assigns a percentage score to each located object. Only objects with scores above the score threshold will be reported.
MAX ROTATION	Set tolerance for object rotation in relation to the reference position.

Run

Use the job list in the SETTINGS section to select which jobs to run.

Click LOCATE to capture an image and confirm that the PLOC2D sensor system locates the parts of interest.



Use the NEXT and PREVIOUS buttons to toggle between the located parts. Part coordinates are displayed in the RESULTS section. Translations (x, y) are given in millimeters and rotations (rz) in degrees.

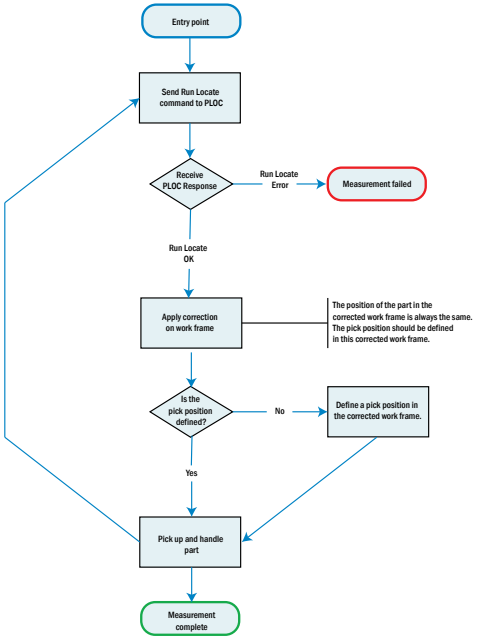
System

The system configuration page contains device and system settings and information, including:

- Illumination setup
- Network settings
- System log

Robot system workflow

See the flowchart diagram below for a step by step description of the robot system workflow. The robot interacts with the PLOC2D sensor mainly by the Run.Locate command, see “Robot commands” section for details.



Robot commands

The sensor accepts the following PLOC protocol commands formatted as either CSV or XML. Default port is 14158.

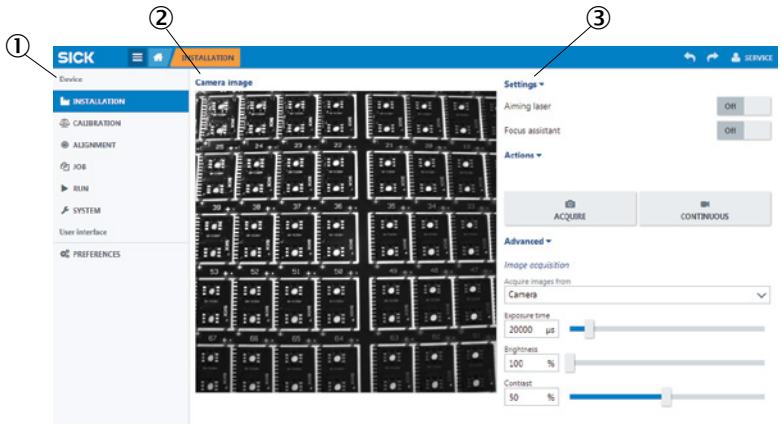
Command	Description
Alignment.Align,1	Capture a new image and perform a hand-eye alignment. **XML example:** message><name>Alignment.Align</name><alignment>1</alignment></message> **CSV example**: Alignment.Align,1
Run.Locate,[Job numbers]	Capture a new image and attempt to locate the parts from the specified job or jobs. **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 number],[Match]	Return a result from the previous Run.Locate command. The result to return is specified by the Match parameter. **XML example**: <message><name>Run.Locate</name><job>3</job><match>2</match></message> **CSV example**: Run.Locate,3,2
System.Restart.Software,[String]	Initiates a software, with a text message string for logging. **XML example:** <message><name>System.Restart.Software</name><reason>Initiated by robot program</reason></message> **CSV example:** System.Restart.Software,Initiated by robot program

Robot command error codes

See the table below for robot command error codes.

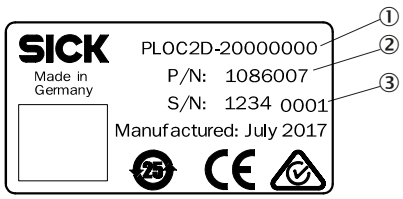
Error code	Description
9100	The image acquisition failed.
9101	The image could not be stored to the SD-card.
9200	No valid image found.
9201	PLOC2D not calibrated.
9202	PLOC2D not aligned.
9203	Job not valid.
9400	Alignment failed.
9401	Alignment target not found.
9600	Locate failed.
9601	Locate failed. Score too low.
9999	An unknown error occurred.

A. User interface overview



① Page selection panel
② Camera image window
③ Settings panel

B. Type label and accessories



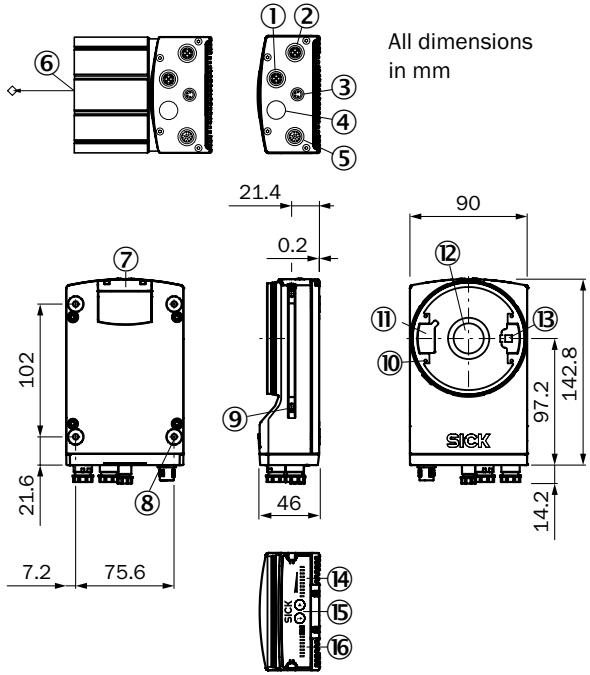
① Type code
② Product identification number
③ Serial number

All accessories for the PLOC2D system are available at *www.sick.com*.

See the table below for illumination and lens type options for the different PLOC2D variants.

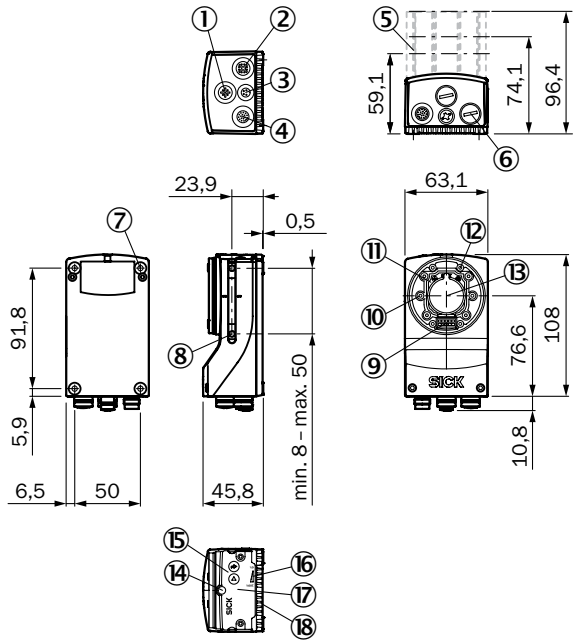
Accessory	Options
Illumination	**InspectorP63x:** White wide, White medium, White narrow, Blue wide, Blue medium, Blue narrow **InspectorP65x:** Red/Amber, White, Blue
Lens	**PLOC2D variants with C-mount lens:** 6 mm (f1.4–16), 8 mm (f1.4–16), 12 mm (f1.4–16), 15 mm (f1.4–16), 25 mm (f1.4–16), 35 mm (f1.4–16), 50 mm (f1.4–16) **PLOC2D variants with S-mount lens:** 9.6 mm (f8), 12.5 mm (f8), 17.5 mm (f8), 25 mm (f8)

C. Dimensional drawings (InspectorP65x)



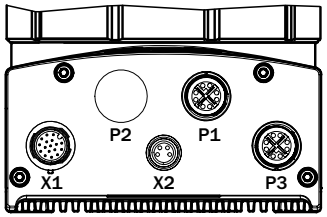
① Connector P1 (not used)
② Connector P3, GB Ethernet
③ Connector X2 (not used)
④ Connector P2 (not used)
⑤ Connector X1, Power I/O
⑥ Reference point for working distance (center of front window)
⑦ Cover for the micro SD card slot
⑧ M5 blind tapped holes, 5 mm deep (4 x), for mounting
⑨ Sliding nut M5, 5.5 mm deep (2 x), for alternative mounting
⑩ Threaded mounting holes M2.5, 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 buttons (2 x)
⑯ Status LEDs (2 levels), 10 x

D. Dimensional drawings (InspectorP63x)

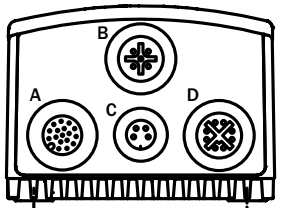


① External illumination connection
② Gigabit Ethernet port
③ USB port (not used)
④ Power, serial, CAN, and I/O connection
⑤ 22.7 mm, 37.7 mm, or 60 mm protective optics cover
⑥ Protective caps/plugs to seal any electrical connections that are not in use
⑦ M5 blind tapped holes, 5.5 mm deep (4 x), for 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)

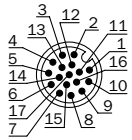
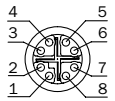
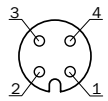
E. Connectors and pin assignment



Connector	Function
X1	Power I/O, and serial
X2	USB (not used)
P1	GB Ethernet (not used)
P2	–
P3	GB Ethernet



Connector	Function
A	Power, I/O, Serial Data, CAN
B	External illumination connection
C	USB (not used)
D	GB Ethernet

	Power I/O	GB Ethernet	External light
			
	17-pin M12 plug	8-pin M12 socket	4-pin M12 socket
Pin	**Signal**	**Signal**	**Signal**
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	TxD (RS-232), Host	TRD3_N	
7	TxD (RS-232), Aux	TRD2_P	
8	RxD (RS-232), Aux	TRD2_N	
9	SensGND		
10	In1		
11	RD+ (RS-422), Host		
12	RD– (RS-422), Host RxD (RS-232), Host		
13	Out1		
14	External illumination trigger output		
15	In2		
16	Conveyor tracking output		
17	Out4		

F. License texts

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More details can be found in the GNU General Public License. Specific info on open-source usage and license text for the PLOC2D system is available in the user interface. Printed copies of the license texts are also available on request.

H. Technical data

Attribute	Value
Features	
System type	Robot guidance
Application	Part localization for robot guidance
System features	Stand-alone sensor with in-line teach, for localization of parts using 2D measurements.
No. of jobs	64
Sensor	CMOS matrix sensor, gray scale
Spectral range	Approx. 400 nm ... 900 nm
LED class	White; Blue – Medium; Blue – Wide; Red + Feedback LED risk group 1 (low risk), in accordance with IEC 62471-1:2006-07/EN 62471-1:2008-09 Blue - Narrow + Feedback LED Risk group 2 (moderate risk) according to IEC 62471-1: 2006-07/EN 62471-1: 2008-09 due to exposure to blue light.
Aiming laser	Visible light, red (λ = 630 nm ... 680 nm), activated on command.
Laser class	Class 1 laser product (EN/IEC 60825-1:2014; class 1M for version EN/IEC 60825-1:2007), complies with 21 CFR 1040.10, except for the tolerance according to “Laser Notice No. 50” from June 24, 2007.
Lens	See Section B, “Type label and accessories”
Typical field of view	Dependent on sensor variant and lens. PLOC2D P654 Fix has a field of view of 2100 x 2100 mm at 3 meters.
Performance data	
Sensor resolution	**InspectorP65x:** 2048 x 2048 px (4.2 MP) **InspectorP631:** 1280 x 1024 px (1.3 MP) **InspectorP632:** 1600 x 1200 px (1.9 MP)
Typical part localization time	< 200 ms
Typical localization accuracy	± 0,5 px
Output data	x, y and rotation around z

Attribute	Value
Interfaces	
Protocol	TCP/IP XML and CSV (robot), TCP/IP (operator)
Operator interface	Web server
Output current	≤ 100 mA per output External illumination: ≤ 650 mA
Ethernet - Function - Data transmission rate - Protocol	 - Host, AUX, image transmission - 10/100/1000 Mbit/s - TCP/IP, FTP, HTTP
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	Configurable auditory signal
Memory card	MicroSD memory card (used for job storage)
Mechanical/electronical	
Typical power consumption	20 W ± 20 %, without switching output load
Enclosure rating	IP 65 (with hood and plugged unused connectors)
Housing	Aluminium
Window material	2 mm glass with scratch-proof coating
Weight	**InspectorP65x:** 635 g excluding optics **InspectorP63x:** 430 g excluding optics
Operating voltage	24 V DC ± 20 %
Ambient data	
Shock resistance	EN60068-2-27:2009-5
Vibration resistance	EN60068-2-6:2008:02
Ambient operating temperature	0 °C ... +50 °C
Ambient storage temperature	-20 °C ... +70 °C

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