

Educational Set Artificial Intelligence

SICK
Sensor Intelligence.



Described product

Educational Set Artificial Intelligence

Manufacturer

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Original document

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1 About This Document

Note

This document about the Educational Set Artificial Intelligence:

- Contains information that is required during the life cycle of the system.
- Must be available to all those who work with the system.
- Should be read carefully, and the contents fully understood before working with the system.

1.1 Limitation of liability

Note

Applicable standards and regulations, the latest state of technological development, and the many years of knowledge and experience of the manufacturer have all been taken into account when assembling the data and information contained in this document.

We would therefore like to point out that the manufacturer accepts no liability in particular in the following cases:

- Failure to observe this document.
- Non-compliance with notes and regulations.
- Unauthorized mounting and installation.
- Unauthorized technical and other modifications.
- Use of spare parts, wear and tear parts, and accessories not authorized by the manufacturer.
- Unauthorized changes, adjustments, and/or manipulations of software.
- Failure to perform and document regular maintenance work.

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

1.2 Purpose of this document

This document describes the Educational Set Artificial Intelligence.

1.3 Target groups

This document is intended for persons who install and operate the Educational Set Artificial Intelligence. The minimum age of the persons must not be less than 12 years.

1.4 Further information

Special local conditions

The local laws, regulations, technical rules and internal company operating instructions at the usage site must be observed.

Storage of documents

This document and other relevant technical documentation/information:

- Must be kept available for reference.
- Must be handed over to new system operators/new specialist personnel.

1.5 Other relevant technical documentation/information

- Operating instructions for the following system components can be downloaded from www.sick.com using the SICK Document ID:

SICK Document ID	Component	Manufacturer
8024438	InspectorP621	SICK

1.6 Document conventions

- ✂ Tools needed
- ▶ Action to be taken
- ↪ Completion of an action



Reference to another document

All measurement units used in this document are metric.

Subject to change without notice.

Figures may differ from the actual design.

2 Important Safety Instructions

2.1 Intended use

With the InspectorP621 mounted, black and white images are taken of objects located in the object recording area.

The sensor can be used for AI (artificial intelligence) applications. With the help of neural networks, the objects are identified and categorized into predefined classes.

Intended use also includes observance of this system description, in particular the safety notes as well as the repair and maintenance requirements.

2.2 General safety notes

- ▶ Please read this document through carefully and observe all the safety notes and information before working on the Educational Set Artificial Intelligence.
- ▶ Only qualified persons from the relevant departments are permitted to work on the Educational Set Artificial Intelligence.
- ▶ Follow operating processes.
- ▶ Follow local regulations.
- ▶ Follow all local regulations relating to working with electrical components.
- ▶ Only authorized persons are permitted to access the Educational Set Artificial Intelligence.

System damage/transport damage

Damage to the individual components can lead to malfunctions of the system as a whole.

- ▶ Do not ignore any damage caused to system components during transport.
- ▶ In case of damage, contact SICK Service.

2.3 Requirement for persons

Persons installing and operating the system must not be younger than 12 years of age.

Having the installation and operation of the system supervised by an educational specialist is recommended.

2.4 Sources of danger

Class 1 laser radiation

Injuries to the eyes and skin.

Electrical voltage

Touching live devices, which may still be energized, can lead to death, burns or electrical shock.

Suspended loads

Serious injuries from falling objects

Hot product surfaces

Skin burns

2.5 System warranty

No warranty claims will be accepted if:

- ▶ The safety notes and measures in this document are not observed.
- ▶ Parts or components of the Educational Set Artificial Intelligence have been installed, mounted or modified without authorization.
- ▶ The Educational Set Artificial Intelligence has been altered or modified.
- ▶ The software has been modified, customized, and/or tampered with without authorization.




2.6 RoHS Directive

This product has been designed for specific applications in large industrial plants according to Article 2 (4) e, RoHS 2011/65/EU, and must therefore only be used in such plants.

The product is neither suitable nor approved for use outside of these plants. SICK therefore cannot provide any warranty or accept any liability whatsoever for such use.

2.7 Safety conventions

The warnings used in this manual have the following meanings:




-  **DANGER**
Indicates a hazardous situation which, if not avoided, results in death or serious injury.
-  **WARNING**
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
-  **CAUTION**
Indicates a hazardous situation which, if not avoided, could result in moderate or minor injury.

NOTE

Indicates a situation which, if not avoided, may result in property damage.

2.8 Warning symbols on the system components




Warning symbols must not be removed or covered. If warning symbols (labels) are missing, these must be affixed. Damaged labels must be replaced.

Symbol	Meaning
	Hazardous point warning
	Hazardous electrical voltage warning
	Warning of laser class 1 radiation

2.9 Mandatory symbols

Mandatory symbols indicate a measure required to protect personal health and / or avoid the risk of personal injury.

Mandatory symbols on the system must not be removed or covered. If mandatory symbols (labels) are missing, these must be affixed. Damaged symbols must be replaced.

Symbol	Meaning
	Read document
	Use laser safety goggles
	Disconnect before maintenance or repairs

2.10 Safety notes



CAUTION

Class 1 laser radiation

The accessible radiation does not pose a danger when viewed directly for up to 100 seconds. It may pose hazards to the eyes and skin in the event of incorrect use.

- ▶ Do not open the housing
- ▶ Do not look directly into the beam.
- ▶ Keep mirrors and reflective objects away from the beam path.



DANGER

Electrical voltage.

Severe injury or death.

- ▶ Electrical work may only be performed on the system by qualified specialist personnel.
- ▶ Interrupt the voltage supply.
- ▶ Increased attention



DANGER

Heavy objects

Injuries to limbs

- ▶ Pay close attention when lifting loads.
- ▶ Lift heavy objects with at least two people.
- ▶ Comply with lifting instructions to prevent injuries and accidents.
- ▶ Position on a non-slip surface.



CAUTION

Risk of injury from hot product surfaces.

- ▶ Before performing work directly on the product (e.g. cleaning, disassembly), switch off the device and allow it to cool down.

NOTE

Do not install in locations exposed to direct sunlight or other weather conditions.

3 System Description

System for quality control of objects.

Using the InspectorP621 programmable camera and the cloud-based dStudio software, a neural network can be created in 4 steps with the Educational Set Artificial Intelligence. In this neural network, the quality control result is categorized into previously defined classes.

The InspectorP621 is a programmable vision sensor for high-resolution images.

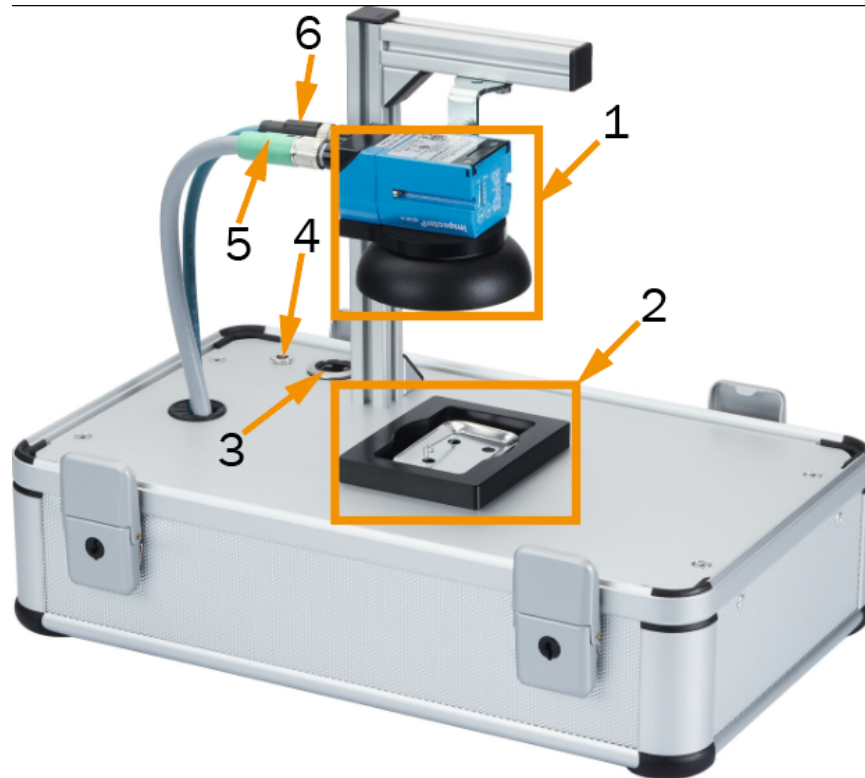


Fig. 1: SIA Smart Case

Legend	
1	InspectorP621
2	Object recording area
3	Ethernet cable connection
4	Voltage supply
5	Ethernet connection (female connector, M12, 4-pin, D-coded)
6	Power/Serial/CAN/I/O connection (male connector, M12, 17-pin, A-coded)
	Buttons and cubes (not shown in the figure).



Additional information on the InspectorP621 can be found in the corresponding SICK operating instructions.

3 SYSTEM DESCRIPTION

4 Installation

NOTE

Do not install in locations exposed to direct sunlight or other weather conditions.

4.0.1 Assembly

- ▶ Place Educational Set Artificial Intelligence on a level and non-slip surface.
 - ▶ Open Educational Set Artificial Intelligence and check for completeness.
 - Power connector
 - Ethernet cable
 - ▶ Check for damage.
 - If damage occurs, do not use the system and contact SICK.
- ↳ The Educational Set Artificial Intelligence is assembled.

4.0.2 Connection

- ▶ Attach the power plug and connect it to a voltage source (socket).
 - ▶ Connect Ethernet cable to a laptop/computer (Windows 10 operating system recommended).
 - ▶ Call up the "Network connections" option dialog, (e.g. by pressing the Windows key + R; enter `ncpa cpl` and confirm).
 - ▶ Right-click on "Realtek USB GbE Family Controller" Ethernet adapter and select Properties.
 - ▶ Double-click on Internet Protocol Version 4 (TCP/IPv4).
 - ▶ Assign the IP address 192.168.111 and the subnet mask 255.255.0.0 to the adapter and confirm.
- ↳ As soon as the user interface of the sensor appears, the connection has been successfully established.



Fig. 2: Establishing a connection

4.0.3 For connection problems

The prerequisite is that Windows 10 is installed.

If necessary, the "Realtek USB GbE Family Controller" driver must be updated.

- ▶ Install the supplied Dell Ethernet adapter.



Fig. 3: Dell Ethernet adapter

- ▶ Connect Ethernet cable from the Educational Set Artificial Intelligence to the Dell Ethernet adapter and then connect it to a USB port on the laptop/computer.
- ▶ In the device manager (Win+R → devmgmt.msc), search for the “Realtek USB GbE Family Controller” driver.

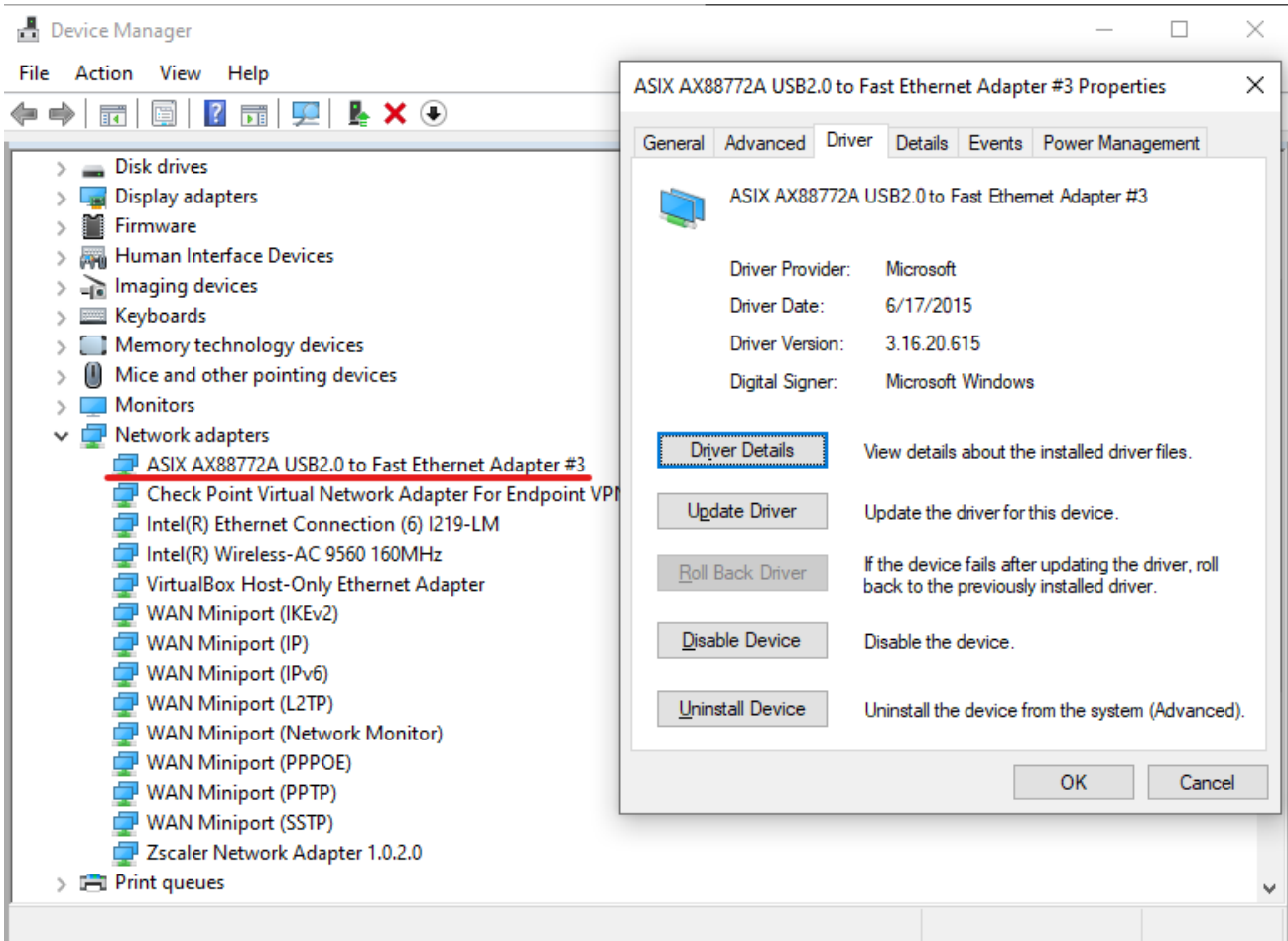


Fig. 4: Windows10 - device manager

- ▶ Right click on the driver in the network adapter list and select “Properties.”
- ▶ The Properties window appears.
- ▶ Click on the "Driver" tab.
- ▶ Click on “Update driver.”
- ↻ The driver is updated.

5 Taking Images

5.1 Sensor connection

- ▶ Search for sensor connection via IP address 192.168.0.1 in the browser field.



- ↳ After successful connection, the user interface of the sensor opens. "IMAGE ACQUISITION"

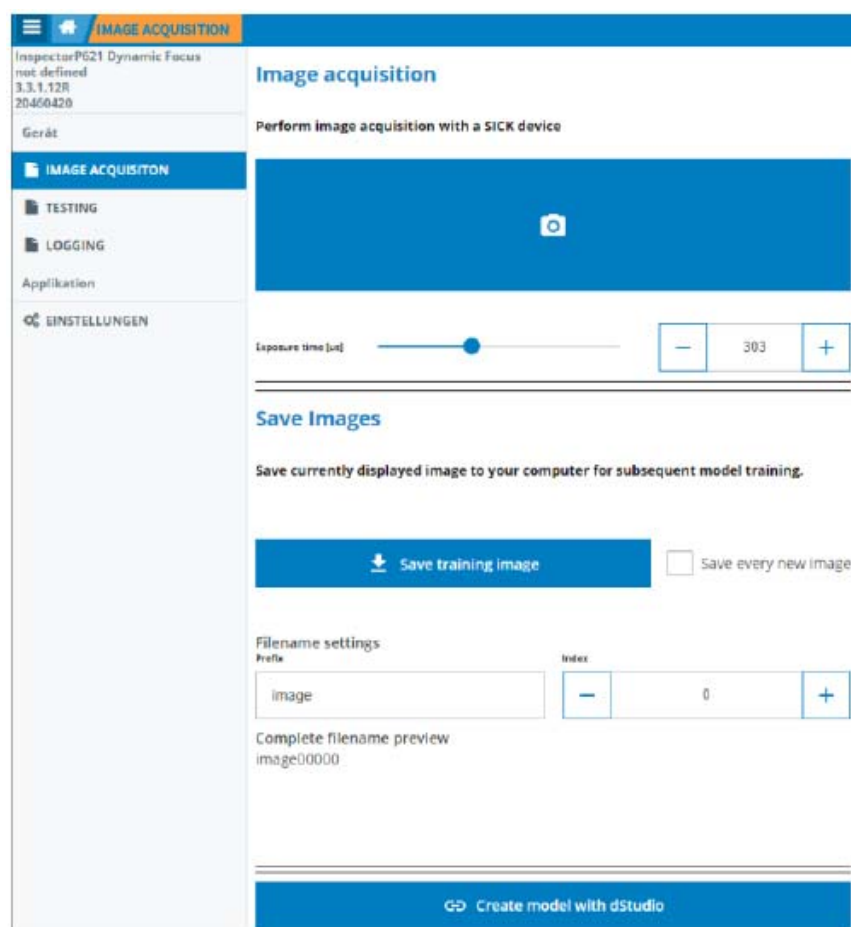


Fig. 5: User interface

5.1.1 Description of the user interface

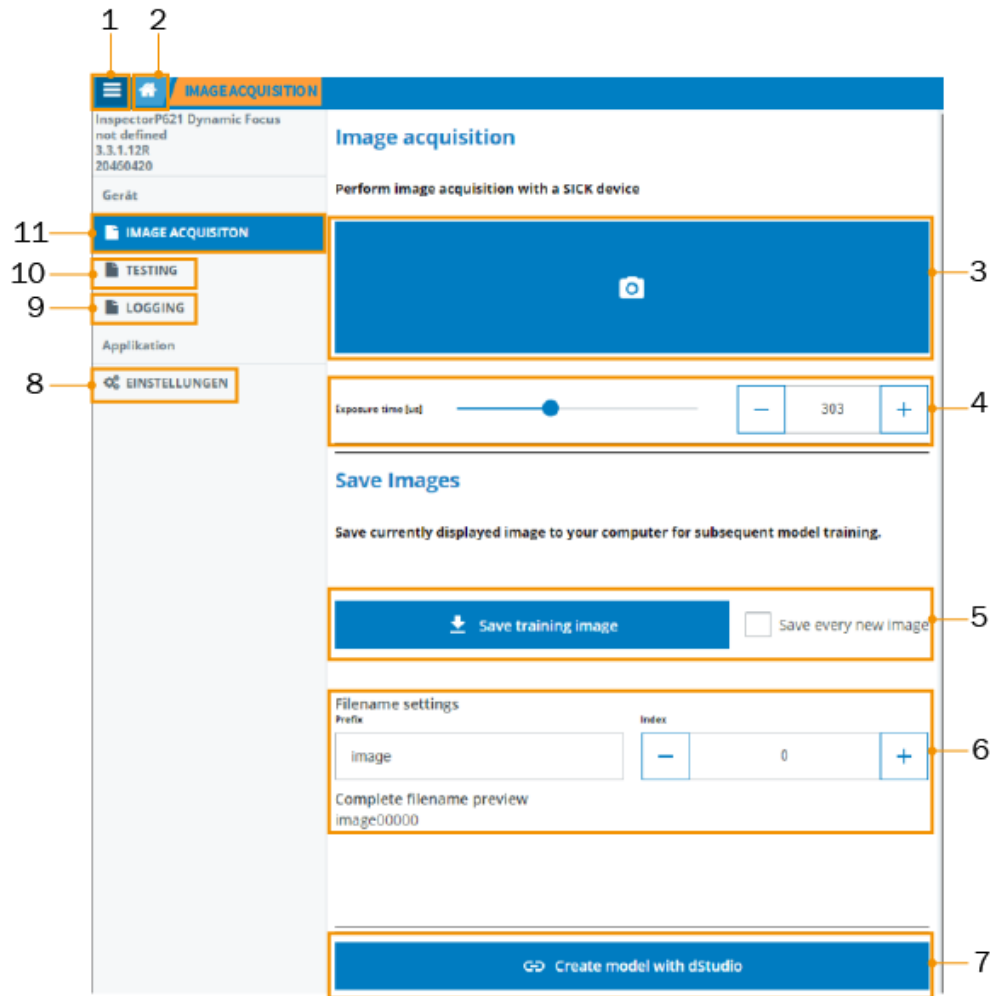



Fig. 6: User interface

Legend	
1	Toggle (switch) for side panel
2	Reset to default settings
3	Record image
4	Setting for exposure time in μs
5	Download last image
6	File name settings
7	Link to: dstudio.cloud.sick.com
8	Settings
9	Logging: protocol
10	Testing: classification page
11	Image acquisition page

5.2 Taking images

The **IMAGE ACQUISITION** tab contains the settings and buttons needed for recording images.

- ▶ Place any object in the object recording area and position it under the sensor.
- ▶ Clicking on the camera icon  (or pressing the space bar on the laptop/computer keyboard) will take a test image.

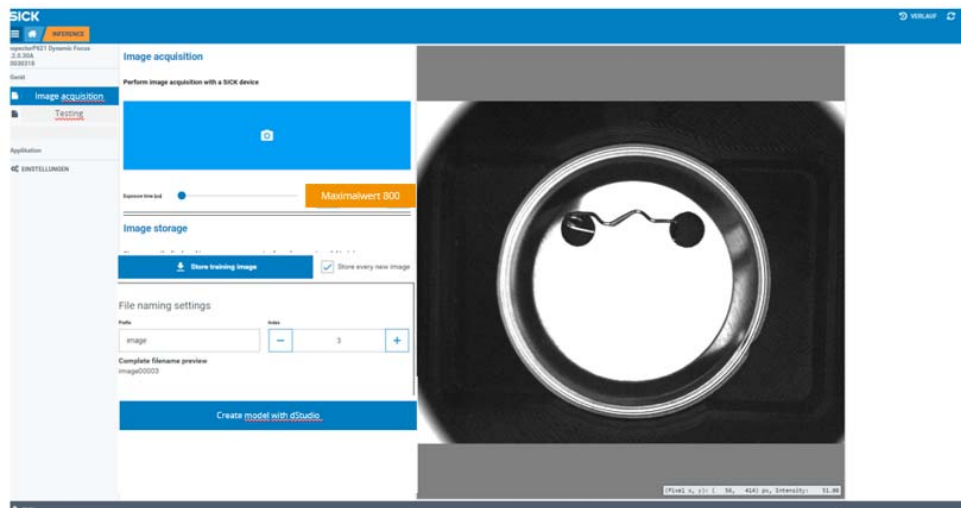


Fig. 7: Test image

5.2.1 Exposure time

The exposure time determines how long light hits the camera sensor.

The exposure time controller regulates the amount of light that hits the image sensor.

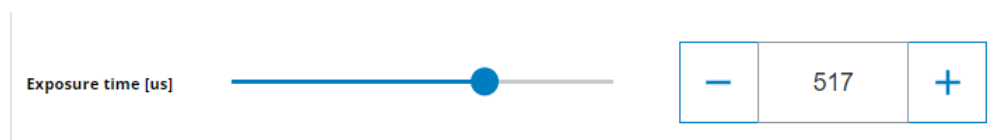


Fig. 8: Exposure time controller

- Short exposure time - dark image
- Long exposure time - bright image

6 Technical Data

6.1 Educational Set Artificial Intelligence

Type	Value
Dimensions	37 x 37 x 22 cm
Weight	4.7 kg
Supply voltage	220 V
Enclosure rating	IP68, IP69K
Operating temperature	-40 °C ... +80 °C
Storage temperature	-40 °C ... +80 °C
Housing material	Stainless steel

6.2 InspectorP621

Type	Value
Task assignment	Quality inspection Position determination Measurement, 2D, reading codes ¹
Technology	2D, snapshot, image analysis
Product category	Programmable, parameterizable
Preinstalled SensorApp	Quality Inspection, based on the SICK Nova SensorApp framework, which allows for functional extensions via tool plug-ins and user-defined adjustments
Toolkit	HALCON
Sensor	CMOS matrix sensor, grayscale values
Focus	Auto focus teach-in
Work tape	Depending on type
Integrated illumination unit	4 LEDs (2 left, 2 right) Light color combination, type-dependent, identifier <ul style="list-style-type: none"> • Visible blue light ($\lambda = 470 \text{ nm} \pm 15 \text{ nm}$) • Visible red light ($\lambda = 617 \text{ nm} \pm 15 \text{ nm}$) • Invisible infrared light ($\lambda = 850 \text{ nm} \pm 25 \text{ nm}$)
Feedback LED	1 LED: visible green light ($\lambda = 525 \text{ nm} \pm 15 \text{ nm}$)
Laser alignment aid	2 LEDs, can be switched off: visible red light ($\lambda = 630 \dots 680 \text{ nm}$)
Light source	Illumination LEDs: visible red light ($\lambda = 617 \pm 15 \text{ nm}$), visible blue light ($\lambda = 470 \pm 15 \text{ nm}$) Feedback spot: visible green light ($\lambda = 525 \pm 15 \text{ nm}$) Laser alignment aid: visible red light ($\lambda = 630 \dots 680 \text{ nm}$)
LED class	Risk group 1 (IEC 62471:2006-07, EN 62471:2008-09)
Laser class	1, complies with 21 CFR 1040.10 except for the tolerance specified in "Laser Notice No. 50" from June 24, 2007 (IEC 60825-1:2014)
Spectral range	Approx. 400 nm ... 900 nm
Lens	Integrated

- 1 Not yet available in preinstalled Quality Inspection SensorApp

6.2.1 Mechanics and electronics

Type	Value
Electrical connection	1 x M12, 17-pin male connector (serial, I/Os, voltage supply) 1 x M12, 4-pin female connector (Ethernet)
Supply voltage	DC 12 V ... 24 V, $\pm 20\%$ Voltage source according to ES1 and PS2 or lower (EN 62368-1) or according to safety extra-low voltage (EN 60950-1)
Power consumption	Type 4 W
Enclosure rating	IP65
Weight	170 g
Housing material	Aluminum die cast
Window material	PMMA

6.2.2 Performance

Type	Value
Image sensor resolution	Type code 4 ... 6: 1: 1.3 megapixel (1,280 px x 1,024 px)
Sampling rate/frame rate	50 Hz

6.2.3 Interfaces

Type	Value
Serial ¹	RS-232, RS-422 Data transmission rate: 300 baud ... 115.2 kBd
Ethernet	TCP/IP function: FTP ¹ , HTTP Data transmission rate: 10/100 Mbit/s
CAN	Function: SICK CAN sensor network
EtherNet/IP	Data transmission rate: 10/100 Mbit/s
EtherCAT ^{®1}	Type of fieldbus integration: optionally via CDF600 external fieldbus module
PROFINET	Function: PROFINET Single Port, PROFINET Dual Port (optionally via CDF600-2 external connection module) Data transmission rate: 10/100 Mbit/s
PROFIBUS DP ¹	Type of fieldbus integration: optionally via CDF600-2 external fieldbus module
Operator interfaces	Web server
Configuration software	Web interface (SensorApp configuration), SICK AppStudio (programming)
Data storage and retrieval	Image and data logging on microSD memory card Image and data logging on external FTP server ¹
Output current	≤ 100 mA
Max. encoder frequency	300 Hz
Control elements	2 pushbuttons ¹
Optical displays	16 LEDs (5 x status display, 10 x LED bar graph, 1 x feedback LED green/red)
Acoustic status indicator	Buzzer ¹

1 Not yet available in preinstalled Quality Inspection SensorApp

6.2.4 Ambient data

Type	Value
Impact load	EN 60068-2-27:2009-05
Vibration load	EN 60068-2-6:2008-02
Ambient operating temperature	0 °C ... +50 °C ¹
Storage temperature	-20 °C ... +70 °C ¹

1 Permissible relative humidity: 0% ... 90%, non-condensing

7 Disposal

Note

Only qualified persons with the relevant technical expertise are permitted to work on the system.

Only qualified personnel may switch off, decommission, transport and dispose of the system.

Note

The applicable local and statutory environmental regulations and guidelines for the disposal of industrial and electrical waste must be observed.

Disposal of batteries, electrical and electronic devices

In accordance with international directives and regulations, batteries, accumulators, and electrical or electronic devices must not be disposed of with household waste.

The owner is obligated to dispose of the devices at the end of their service life via the appropriate public disposal points.

This icon on the product, packaging, or in this document indicates that a product is covered by these provisions.



The following assemblies may contain substances that need to be disposed of separately:

- **Electronics:** Capacitors, accumulators, batteries
- **Displays:** Liquid in the LC displays

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