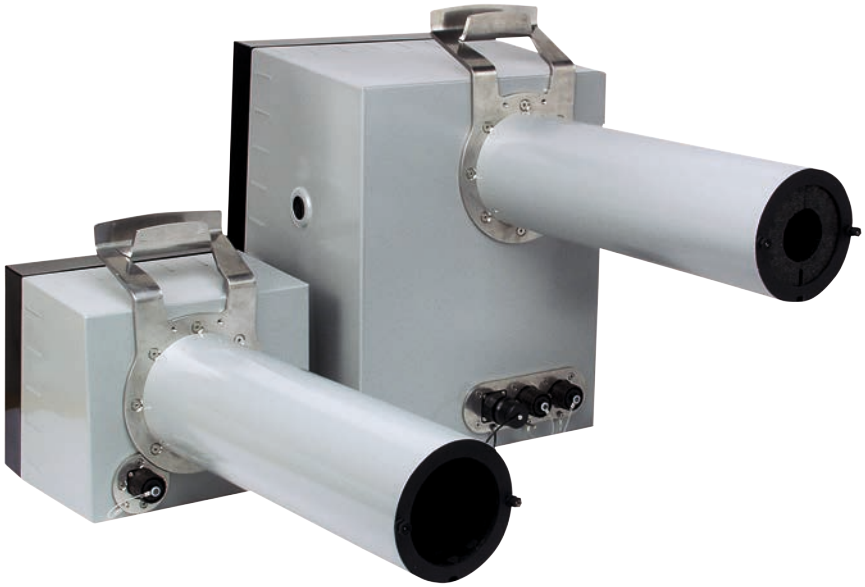
Operating Instructions
VICOTEC320

Air Quality Tunnel Sensors



Endress+Hauser
People for Process Automation

Described Product

Product name: VICOTEC320
Variants: VICOTEC321
VICOTEC322
VICOTEC323
VICOTEC325

Manufacturer

Endress+Hauser SICK GmbH+Co. KG
Bergener Ring 27
01458 Ottendorf-Okrilla
Germany

Legal information

Original document

This document is an original document of Endress+Hauser SICK GmbH+Co. KG.

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Contents

1 About this document

1.1 Function of this document

These Operating Instructions describe:

- Device components
- Installation
- Operation
- Maintenance work required for reliable operation

1.2 Scope of application

These Operating Instructions are only applicable for the measuring device described in the product identification.

They are not applicable for other Endress+Hauser measuring devices.

The standards referred to in these Operating Instructions are to be observed in the respective valid version.

1.3 Target groups

This Manual is intended for persons installing, operating and maintaining the device.

1.4 Further information

▶ Observe the supplied documents.

Additional instructions

The following documents are applicable in addition to these Operating Instructions:

- SOPAS ET Software Manual

1.5 Symbols and document conventions

1.5.1 Warning symbols

Symbol	Significance
	Hazard (general)
	Hazard by voltage
	Hazard in potentially explosive atmospheres
	Hazard through explosive substances/substance mixtures
	Hazard by ultraviolet radiation (UV light)

1.5.2 Information symbols

Symbol	Significance
	Important technical information for this product
	Important information on electric or electronic functions

1.5.3 Warning levels and signal words

DANGER:
Risk or hazardous situation which *will* result in severe personal injury or death.

WARNING:
Risk or hazardous situation which *could* result in severe personal injury or death.

CAUTION:
Risk or hazardous situation which *could* result in less severe or minor injuries.

NOTICE:
Hazard which *could* result in property damage.

Note:
Hints

1.6 Data integrity

Endress+Hauser SICK GmbH+Co. KG uses standardized data interfaces such as standard IP technology, in its products. The focus here is on the availability of the products and their properties.

Endress+Hauser SICK GmbH+Co. KG always assumes that the customer is responsible for the integrity and confidentiality of data and rights involved in connection with using the products.

In all cases, the customer is responsible for the implementation of safety measures suitable for the respective situation, e.g., network separation, firewalls, virus protection and patch management.

2 For your safety

2.1 Basic safety information

Read and always observe the safety and warning information in these Operating Instructions.

WARNING: Hazards through defective device

The VICOTEC320 is likely to be unsafe when it:

- Shows visible damage on the outside.
- Has been penetrated by moisture.
- Has been stored or operated under irregular conditions.

When safe operation is no longer possible:

- ▶ Put the VICOTEC320 out of operation, separate all connectors from the power supply and secure against unauthorized commissioning.

WARNING: Risk of explosions through explosive sample gas

- ▶ Do not use the VICOTEC320 to measure explosive, combustible or flammable gases.

WARNING: Explosion hazard in potentially explosive atmospheres

- ▶ Do not use the VICOTEC320 in potentially explosive atmospheres.

CAUTION: Eye injuries caused by improper handling of UV or blue light beams

The UV beam of the deuterium lamp or the blue light beam of the LED can cause serious injuries through direct eye and skin contact. This results in the following safety measures when working on the switched on device with access to the light beam exit:

- ▶ Always wear UV protective goggles (in accordance with standard EN 170)
- ▶ The UV goggles do not provide protection against injuries caused by blue light beams, therefore switch the LED off when working.
- ▶ Use the lamps only when they are perfectly safe. Operation is not allowed when the lamp, supply lines or operating parts are visibly damaged.

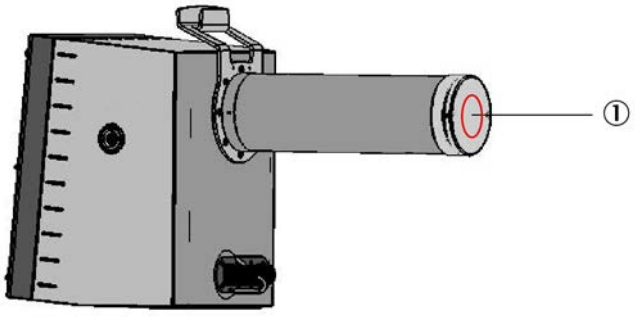


Fig. 1: Sender/receiver unit

1 Light beam exit

2.2 Intended use

Devices of the VICOTEC320 series only serve continuous measurement of concentrations of certain gases, visibility and the temperature in the atmosphere in road tunnels.

2.3 Responsibility of user

- Only put the VICOTEC320 into operation after reading the Operating Instructions.
- Observe all safety instructions.
- If there is something you do not understand: Contact Endress+Hauser Customer Service.

Designated users

All operators of the VICOTEC320 should be specifically trained on this device, knowledgable of relevant regulations, and able to assess potential hazards related to its operation.

The VICOTEC320 may only be maintained by persons properly instructed on the tasks assigned, possible risks and protective measures.

Operation

The device may only be operated by authorized persons who, based on their training on, and knowledge of the specific device, as well as knowledge of the relevant regulations can assess the tasks given and recognize the hazards involved.

Installing and maintaining

Skilled persons are required for installation and maintenance.

Please observe the information at the beginning of the respective Sections.

Correct use

- Only operate the VICOTEC320 according to the intended use (see “Intended use”, page 10).
- Follow all specifications in these Operating Instructions and only operate the VICOTEC320 as described in these Operating Instructions.
  Contact your local Endress+Hauser representative before performing any work described where the information in these Operating Instructions is inadequate or capable of being misunderstood.
- Keep passwords in a separate, safe place and secure against unauthorized use.
- Pay attention to the prescribed maintenance work.
- Do not change any settings on or in the device and do not modify any components when such changes are not described in these Operating Instructions or in documents referred to in these Operating Instructions.

Special local requirements

- Observe the local laws, regulations and company internal operating instructions applicable at the installation location.

Retention of documents

These Operating Instructions:

- Must be available for reference.
- Must be passed on to new owners.

3 Product description

3.1 Product identification

Product name:	VICOTEC320
Manufacturer:	Endress+Hauser SICK GmbH+Co. KG Bergener Ring 27 · D-01458 Ottendorf-Okrilla · Germany

3.1.1 Type plate

The type plate is located at the following positions:

Device	Type plate location
Sender/receiver unit	Outside: Next to the connections Inside: At the bottom of the left enclosure side
Reflector	Outside: Next to the connections Inside: At the middle of the right enclosure side
Connection unit	Outside: At the top of the right enclosure side Inside: Next to the connections

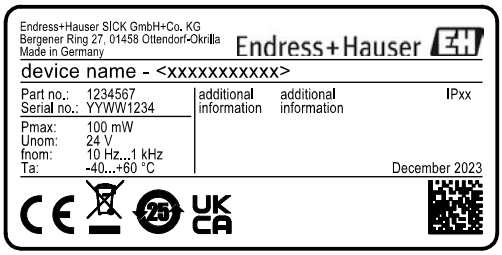


Fig. 2: Type plate

3.2 Product features

- Fast, representative local measurement
- Very low detection limits for NO and NO_2
- Automatic function monitoring and zero adjust
- Independent maintenance prompt when contaminated
- Very sturdy design: IP 69K, stainless steel 1.4571
- Compatible to assembly consoles and measuring path lengths of the VICOTEC 410 from Endress+Hauser

3.3 Device variants

The following device variants are available depending on the measuring task and the application:

Variant	Measured components
VICOTEC 321	Measurement of visibility and NO_2
VICOTEC 322	Measurement of visibility and NO
VICOTEC 323	Measurement of visibility, NO and NO_2
VICOTEC 325	Measurement of visibility, NO, NO_2 and NO_x (option: CO)

The device variants differ with respect to the following:

- Measurable components
- Connection unit interfaces

The sender/receiver unit and the reflector are available for the following measuring distances:

- 10 m

The connection unit is available with the following interfaces:

- Analog/digital
- Ethernet
- The connection unit can contain an optional CO sensor (electrochemical cell)

3.4 Special features

- Operating hour meter for sender lamp and logbook function
- High-precision adjustment through automatic mirror tracking
- Integrated ambient temperature measurement
- Reflector, heated
- Communication via CAN System bus or Ethernet (optional)

3.5 Layout and function

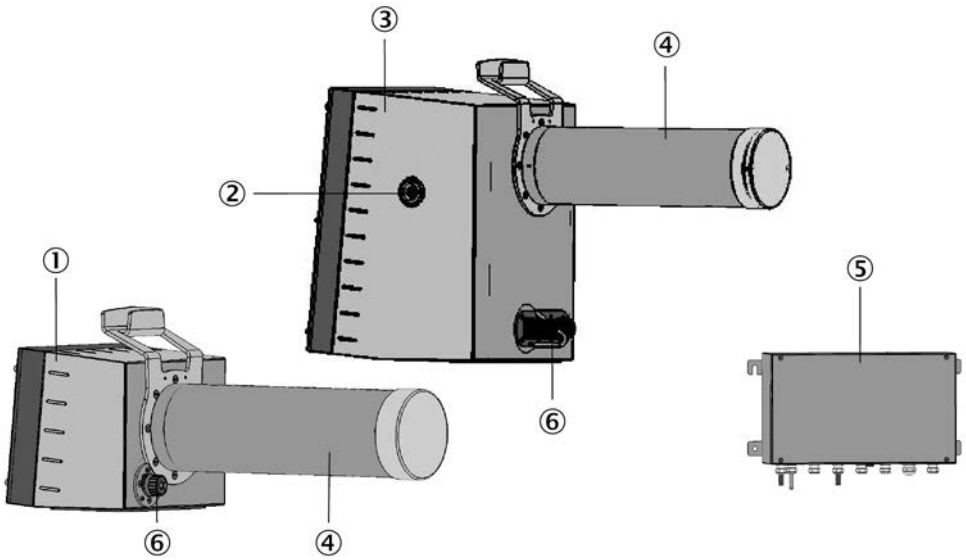


Fig. 3: Layout of measuring device components

1 Reflector
2 LED matrix to signal automatic beam tracking
3 Sender/receiver unit
4 Dust protection tube
5 Connection unit
6 Plug connections

3.5.1 Functional principle

The VICOTEC320 is a sensor system for continuous measurement of NO, NO_2 and CO (option) concentrations as well as visibility and temperature in road tunnels.

The following functional principles are used:

- NO, NO_2: DOAS (Differential Optical Absorption Spectroscopy)
- CO: Electrochemical cell
- Visibility: Transmission measurement with blue LED

4 Project planning

4.1 Assembly project planning

4.1.1 Arrangement along the tunnel section

The number and distribution of measuring points depends on the ventilation system used. Single factors are:

- Type of tunnel profile
- Section route
- Ventilation system design
- Number and arrangement of fans
- Regional regulations

Measuring point selection depends primarily on the following criteria:

- A combination of VICOTEC320 with VICOTEC 410 or VISIC100SF is recommended for optimum measuring results.
- The recommended distance between visibility measurements depends on whether these are also to be used for smoke detection:
  - Without smoke detection: ≤ 400 m
  - With smoke detection: ≤ 150 m
- We recommend VISIC50SF for smoke detection.
- An even spread along the tunnel length is recommended for semi and transverse ventilation, with at least 2 measuring points per ventilation section.
- NO/NO_2 can be measured every 400 – 1000 m. Position the measuring points preferably at the tunnel exit in tunnels with one-way traffic.
- Two-way traffic can still arise in tunnels with one-way traffic. It is therefore recommended to install at least 3 measuring points for visibility in tunnels with lengthwise ventilation: one each about 150 m from the entrance and at least one in the middle of the tunnel.
- It is recommended to install additional fog sensors (e.g. VISIC620) near the tunnel portals when there is a risk that fog can be sucked into the tunnel. Dust particles acting as additional condensation crystals can strengthen the fog effect in the tunnel sections. Fog moisture overlays visibility due to dust particles. Fog sensors serve to prevent fog drifts being sucked into the tunnel. Alternately, visibility can be measured at the tunnel portals using measuring devices (e.g. VISIC100SF or VICOTEC450) that heat the air sucked in and therefore evaporate fog moisture.
- When the tunnel roadway curves, ensure that the measuring beam between single sensors is not interrupted by the tunnel wall, fixtures or vehicles passing each other (see “Arrangement with special prerequisites”, page 16).

4.1.2 Arrangement in cross-section profile

Particle concentration distribution in a tunnel is generally very even across the profile cross-section during traffic movement. Traffic flows and lengthwise flows through natural ventilation and the piston effect of vehicle movement in separate tunnel sections for each direction effect rapid swirling of the air in the tunnel. The turbulence behind vehicles strengthens this effect.

The height is not critical due to excellent swirling. A fitting height between 2.8 and 4.5 meters is aimed at. The sensors contaminate faster when fitted lower and the maintenance effort increases when the sensors are fitted higher.

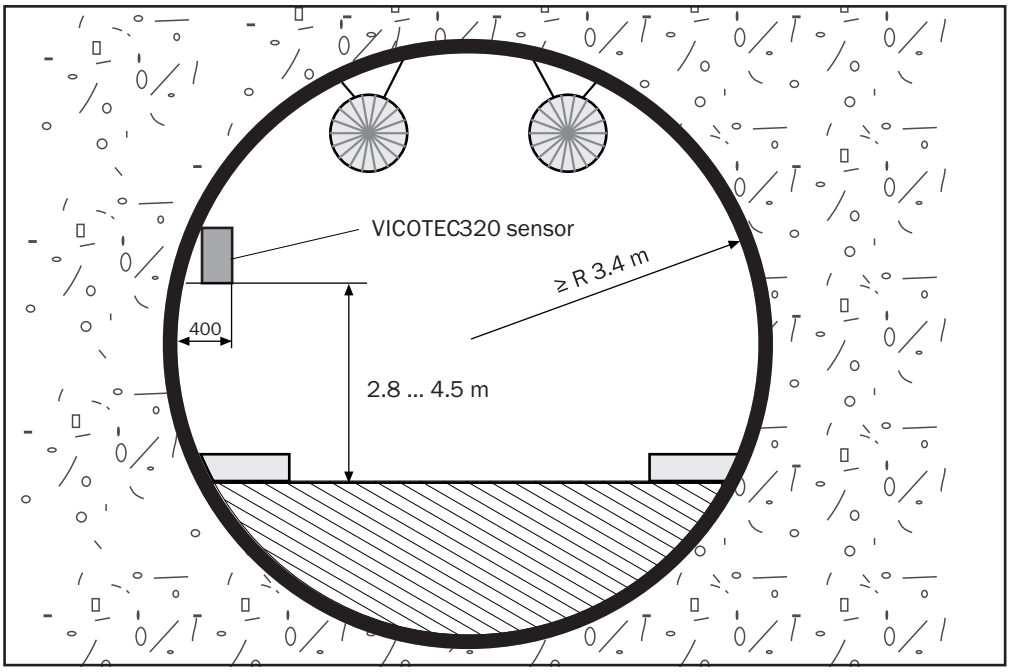


Fig. 4: VICOTEC320 fitting height

Fitting location selection of the respective sensor pairs depends primarily on the following criteria:

- Mount the sensors at a safe distance from traffic movement (see for example Section 2 of the German “Richtlinie für die Ausstattung und den Betrieb von Straßentunneln RABT”, version 2006 (Regulations governing equipping and operating road tunnels)).
- Good access for maintenance and checking work must be ensured. Locate the sensors in a protected recess when possible.
- Do not locate sensors in close vicinity to ventilators or in the fresh air flow from blowout units so that the measured value records the effective concentration ratios.
- The measuring beam must run lengthwise between sensors and must not be hindered by fixtures or vehicles passing each other. Fixtures that shine (e.g. emergency exit signs) should be at least 1 m from the optical axis.
- No reflecting paint should be on the wall between sensors.
- Maintain a distance of $10^{\pm 0.1}$ m between both sensors.
- Plan sufficient clearance to be able to flap or remove the enclosure cover.

Measured values of gases are kept constant at first when the light beams are interrupted. A malfunction message is sent to the evaluation unit when interruptions last longer than two minutes.

Fitting options:

- Both sensors on a wall in a recess (recommended).
- Both sensors on a wall above the side strip; requires safety measures for maintenance work in cramped conditions.

4.1.3 Arrangement with special prerequisites

Tunnel curvature

The sensors can be used with tunnel curvatures up to the following curve radiuses:

Measuring section (A)	10 m
Inner radius (R_1)	Min. 58 m
Outer radius (R_2)	Min. 147 m

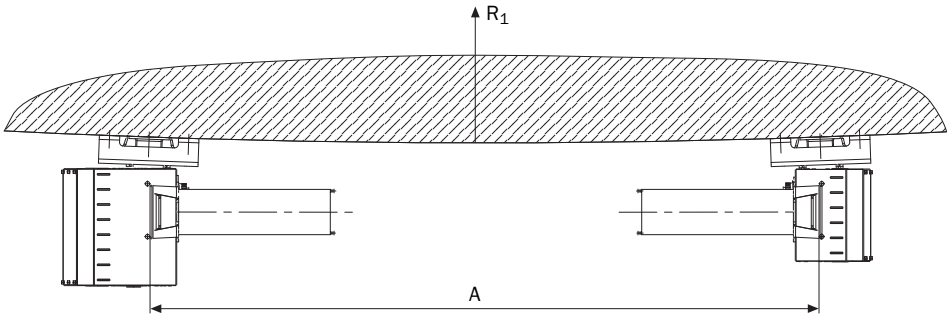


Fig. 5: Fitting sensors on the inner curve wall

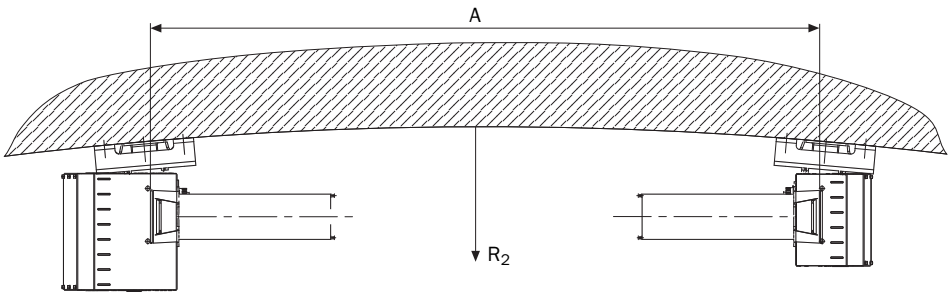


Fig. 6: Fitting sensors on the outer curve wall

Tunnel with sound insulation wall

Provide appropriate assembly bases onsite when fitting sensors on a tunnel wall with sound insulation.

The assembly bases must provide a firm base suitable for reliable sensor fitting.

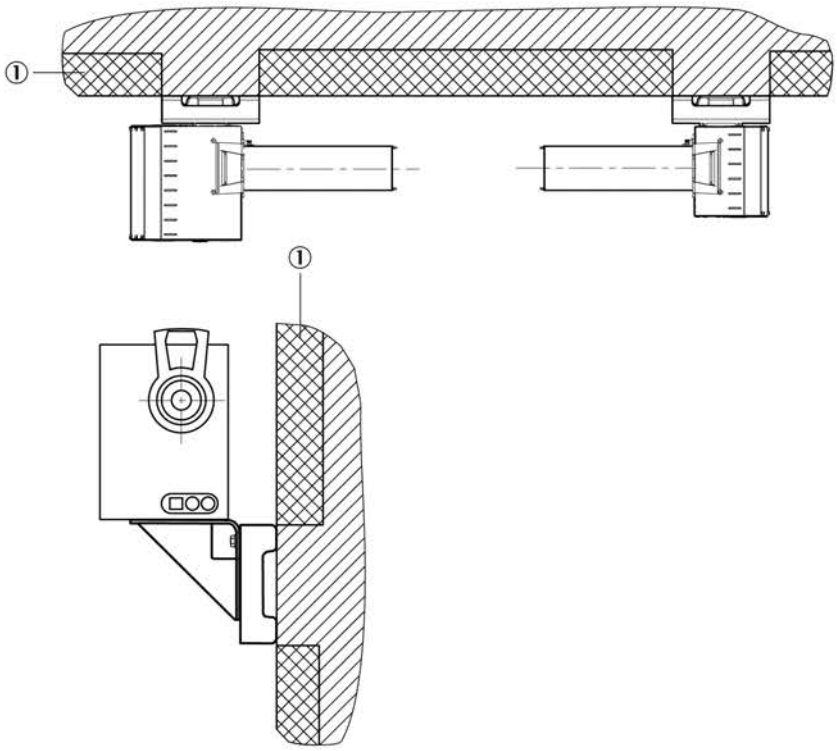


Fig. 7: Fitting sensors with sound insulation

1 Sound insulation

4.2 Electrical installation project planning

Observe the relevant safety regulations during all installation work. Take suitable protective measures against all possible local risks or those arising in connection with the system (see “For your safety”, page 9).

- Sender/receiver unit (2) must always be fitted on the left (see Fig. “Sensor arrangement”, page 18), so that visor (4) is accessible.
- Position connection unit (1) so that it can be connected to the sender/receiver unit with a 1 m long cable.
- It must be possible to separate every device singly from the power supply system, e.g. using a switch or circuit breaker.

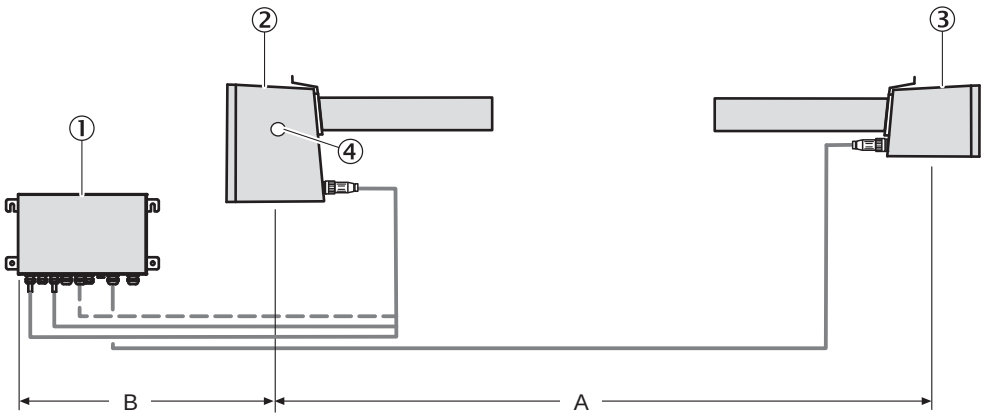


Fig. 8: Sensor arrangement

1 Connection unit
2 Sender/receiver unit
3 Reflector
4 Visor
A Measuring path (10 $^{\pm 0.1}$ m)
B Max. 0.7 m (cable length max. 1 m)

5 Installation

5.1 Tools required

Apart from standard tools (such as drill, water level, tape measure), you also need the following tools for the installation:

- 8 mm drill bit
- 15 mm drill bit
- Blowout pump for dowel holes
- 18 mm Allen key
- 19 mm Allen key
- Jaw wrench, 22 mm
- Torque wrench
- Rubber or plastic hammer
- Two laser adjustment units (see “Accessories”, page 68)

5.2 Material required

- 2 stainless steel assembly consoles incl. fixing accessories
- Connection lines (see “Connection lines”,page 26)

5.3 Preparing the installation location

CAUTION: Accident risk through inadequate fastening of the device

- ▶ Consider the weight of the device when selecting fastenings.
- ▶ Check the load capability/state of the wall/rack on which the device is to be fitted.

Preparatory actions

- ▶ Secure the place of work
- ▶ Provide adequate lighting and power
- ▶ Provide a jack lift or stable ladder with clearance to wall

5.4 Transport

Only use the packing provided by Endress+Hauser to transport sensors. Warranty claims are void when this is not observed.
The packing can be obtained from Endress+Hauser free of charge when required.

5.5 Scope of delivery

Included in scope of delivery:

- Sender/receiver unit (incl. screws for fastening on assembly console)
- Reflector (incl. screws for fastening on assembly console)
- Connection unit (incl. dowels and screws for wall fitting)
- Connection lines from the connection unit to the sender/receiver unit and to the reflector
- Protective covers

Keep protective covers. Use protective covers when the equipment is put out of operation for a short time (e.g. during tunnel cleaning).

Not included in scope of delivery:

- Stainless steel assembly consoles for the sensors

5.6 Assembly

Assembly work must only be carried out by skilled persons familiar with the assembly work.

5.6.1 Fitting the assembly consoles

The assembly consoles comprise 3 parts:

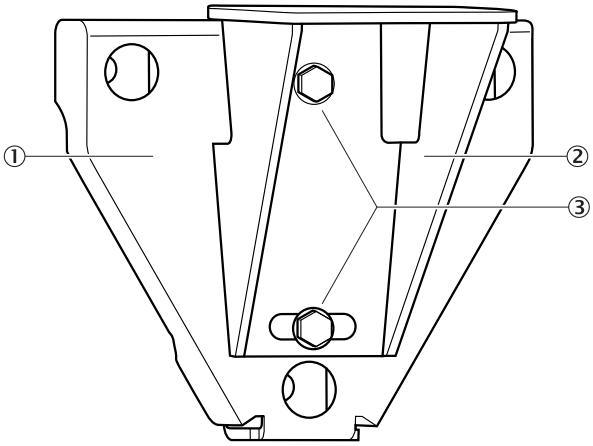


Fig. 9: Assembly console

1 Wall holder for wall fitting
2 Angle bracket to fasten the sensor
3 Angle bracket screws

Two angle bracket screws fasten the wall holder and the assembly console together. The angle bracket can be swiveled up to ±7.5° to compensate any assembly unevenness.

Observe the following points during assembly:
- ▶ Observe local valid safety measures.
- ▶ Only use high-strength and absolutely non-corrosive fastening material made of stainless steel because the tunnel atmosphere is highly corrosive.
- ▶ Ensure there is enough space to remove the tube and device cover.
- ▶ Keep the length of the measuring section as exact as possible. Record small deviations in the Assembly protocol.
- ▶ Mount both assembly consoles at the same height. Height differences in the optical axis can be compensated later by swiveling the angle bracket.
- ▶ Align both assembly consoles at the same tilt angle to the tunnel wall. Different tilt positions to the tunnel profile make the following sensor alignment difficult. Insert washers under the wall holder when necessary.

Procedure

1 Determine the installation location for the assembly consoles according to the project planning.
2 Drill the wall holder openings according to the Drilling plan, see see Fig. “Wall holder assembly drilling plan”, page 21.
3 Insert dowels or wall ties according to the manufacturer's assembly specifications (walls must be made of at least C20/25 to C25/30 concrete).

4 Screw the wall holder on and tighten the screws with 70 Nm according to the manufacturer's assembly specifications, use a torque wrench as necessary.
5 Screw the consoles on provisionally at first.

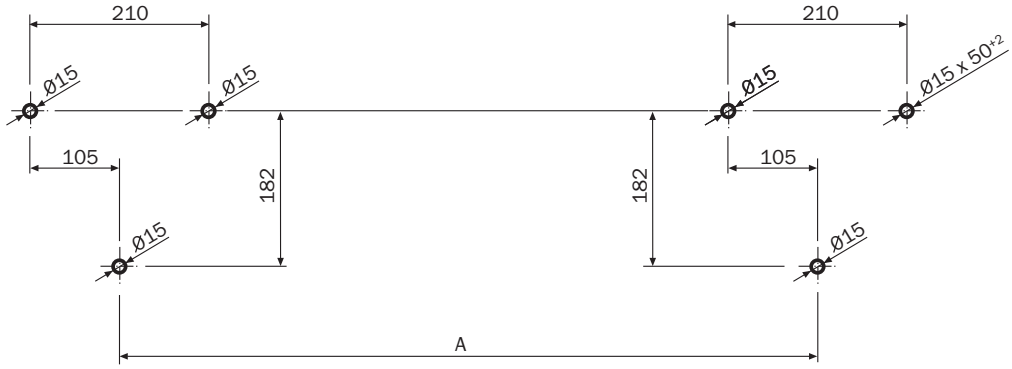


Fig. 10: Wall holder assembly drilling plan

Tolerances for measuring path A
10 $^{\pm 0.1}$ m

5.6.2 Fitting the VICOTEC320 sensors

1 Position the sender/receiver unit on the **left** assembly console and screw it on lightly with both the retaining screws included in the delivery.
2 Position the reflector on the **right** assembly console and screw it on lightly with both the retaining screws included in the delivery.
3 Screw a laser adjustment unit on each sensor above the tube using both knurled-head screws.

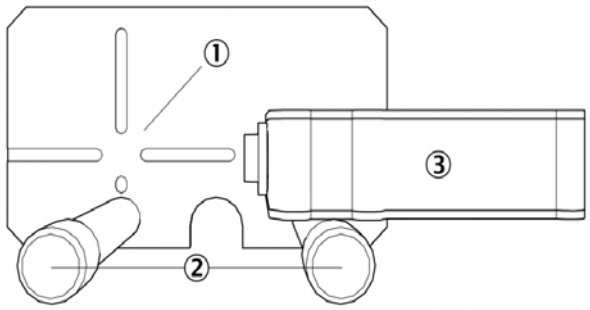


Fig. 11: Laser adjustment unit

1 Crosshair
2 Knurled-head screws
3 Adjustment laser

WARNING: Laser class 2
▶ Laser radiation – do not look in the beam.

4 Switch on the laser adjustment unit on the reflector.

5 Align the sensor **horizontally** so that the laser beam strikes the vertical line of the cross-hair of the other laser adjustment unit see Fig. “Laser adjustment unit”, page 21). To do this, tap very lightly against the front lower edge of the sensor enclosure with a rubber hammer (see Fig. “Horizontal sensor alignment”, page 22).

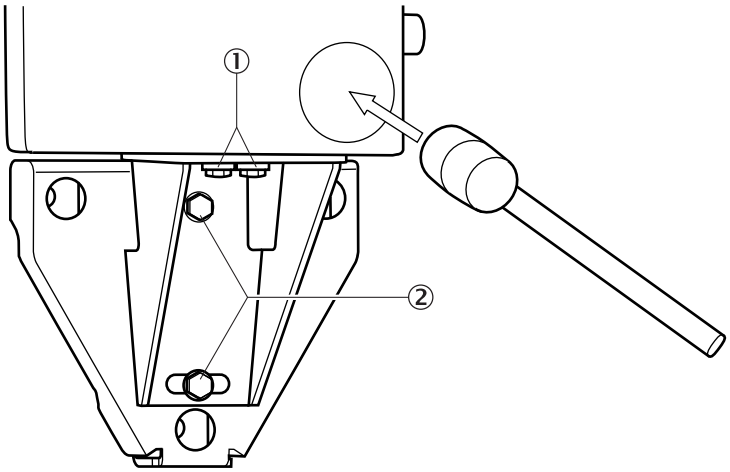


Fig. 12: Horizontal sensor alignment

1 Retaining screws
2 Angle bracket screws

6 Tighten both retaining screws of the sensor with 45 Nm, use a torque wrench as necessary.
7 Slightly loosen the angle bracket screws.
8 Align the sensor **vertically** so that the laser beam strikes the **horizontal line** of the cross hair of the other laser adjustment unit (see Fig. “Laser adjustment unit”, page 21). To do this, tap very lightly against the front lower edge of the angle bracket with a rubber hammer (see Fig. “Vertical sensor alignment”, page 22).

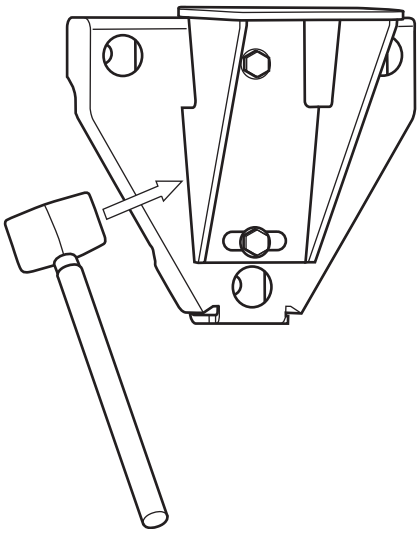


Fig. 13: Vertical sensor alignment

9 Tighten the angle bracket, use a torque wrench as necessary.
10 Check again whether the laser beam strikes the crosshair and correct as necessary.
11 Switch the laser adjustment unit off.

12 Repeat steps 5 to 11 on the opposite sensor and laser adjustment unit.
13 Unscrew and remove the laser adjustment unit.

5.6.3 Fitting the connection unit

Position the connection unit so that it can be connected to the sender/receiver unit with the 1 m long cables.

1 Determine the installation location for the connection unit according to the project planning.
2 Drill the openings according to the Drilling plan, see Fig. “Connection unit assembly drilling plan”, page 23.
3 Insert dowels or wall ties according to the manufacturer's assembly specifications (walls must be made of at least C20/25 to C25/30 concrete).
4 Screw the connection unit on.

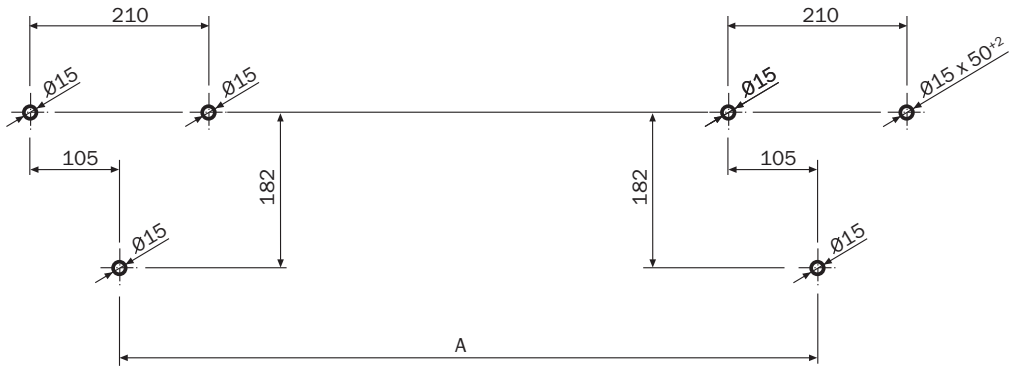


Fig. 14: Connection unit assembly drilling plan

5.7 Electrical installation

WARNING: Hazard by voltage.
- ▶ Only allow an authorized electrician to work on the electric system.
- ▶ Observe the relevant safety regulations during all installation work.
- ▶ Take suitable protective measures against local risks and those arising from the system.

WARNING: Endangerment of electrical safety during installation and maintenance work when the power supply is not switched off

An electrical accident can occur during installation and maintenance work when the power supply to the device or lines is not switched off using a power isolating switch/ circuit breaker.
- ▶ Before starting the work on the device, ensure the power supply can be switched off using a power isolating switch/circuit breaker in accordance with DIN EN 61010.
- ▶ Make sure the power isolating switch is easily accessible.
- ▶ An additional disconnecting device is mandatory when the power disconnector switch cannot be accessed or only with difficulty after installation of the device connection.
- ▶ After completion of the work or for test purposes, the power supply may only be activated again by authorized personnel complying with the safety regulations.

WARNING: Endangerment of electrical safety through power cable with incorrect rating

Electrical accidents can occur when the specifications for replacement of a removable power cable have not been adequately observed.
- ▶ Always observe the exact specifications in the Operating Instructions (Technical data Section) when replacing a removable power cable.

CAUTION: Device damage through incorrect or non-existing grounding

During installation and maintenance work, it must be ensured that the protective grounding to the devices and/or lines involved is effective in accordance with EN 61010-1.

Note: Responsibility for system safety

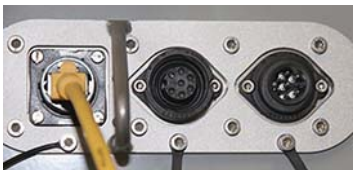
The person setting the system up is responsible for the safety of the system in which the device is integrated.

5.7.1 Electrical protection

- Insulation: Class of protection 1 in accordance with EN 61140
- Insulation coordination: Overvoltage category II in accordance with EN61010-1
- Contamination: Degree of contamination II in accordance with DIN EN 61010-1

5.7.2 Connecting the sensors to the connection unit

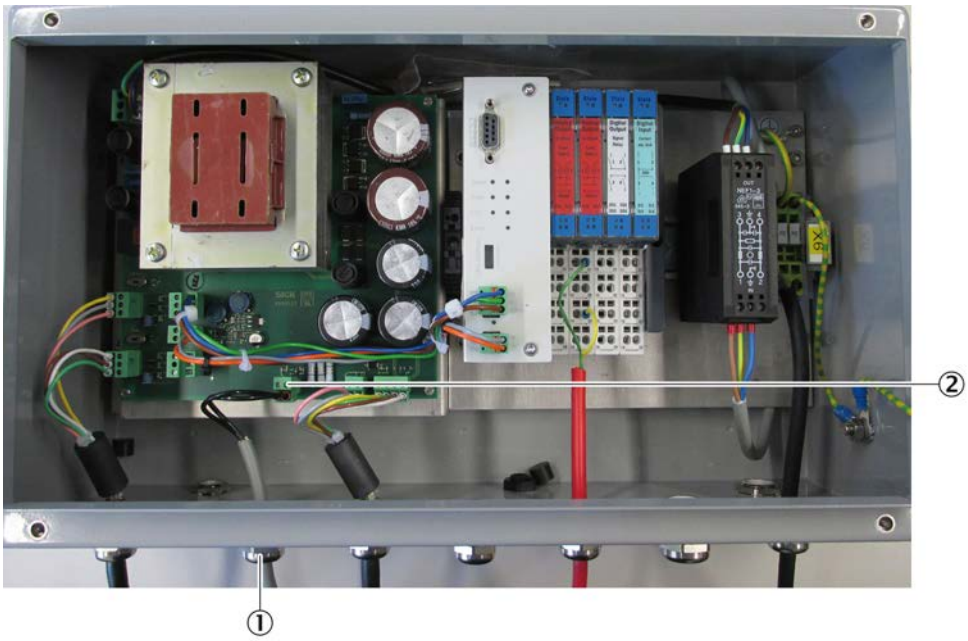
1 Plug the connection lines that are mounted firmly on the connection unit in the corresponding sockets of the sender/receiver unit.



2 Connect the connection line to the reflector with the connection unit:

Observe the wiring diagram on the rear of the cover.

a) Open the connection unit.
b) Unscrew M screw fitting for W3 (1).



c) Pull the connection line through the M screw fitting and connect to the W3 connection (2).
d) 35
e) Tighten the M screw fitting tight with a jaw wrench.

3 Plug the connection line into the reflector.

4 Fasten the connection lines to the tunnel wall.

5.7.3 Connection unit cabling

Connection lines

The following connection lines can be used:

For	Line/type	Max. length	Cross-section
Energy supply: 115/230 V AC; 50/60 Hz		Dependent on cable resistance	3 x 1.5 mm²
Digital input	A2Y(L)2Y	Dependent on cable resistance	2 x 2 x 0.75 mm²
Relay outputs	A2Y(L)2Y	Dependent on cable resistance	4 x 2 x 0.75 mm²
Ethernet	– Category 5 copper line according to ANSI/TIA -568 – Fiber optic cable	– 100 m – Up to about 5 km according to type	
Analog outputs: 0 ... 20 mA	Screened and twisted in pairs	Dependent on cable resistance	4 x 2 x 0.75 mm²

Warranty claims are void when you use cables not released by Endress+Hauser for use with the VICOTEC320 (see “Connection lines”, page 26).

Cabling of voltage supply

Set the power voltage for the connection unit to 115 V or 230 V before connecting the unit to the power supply system.

Use slide switch (1) in the connection unit to the correct voltage.

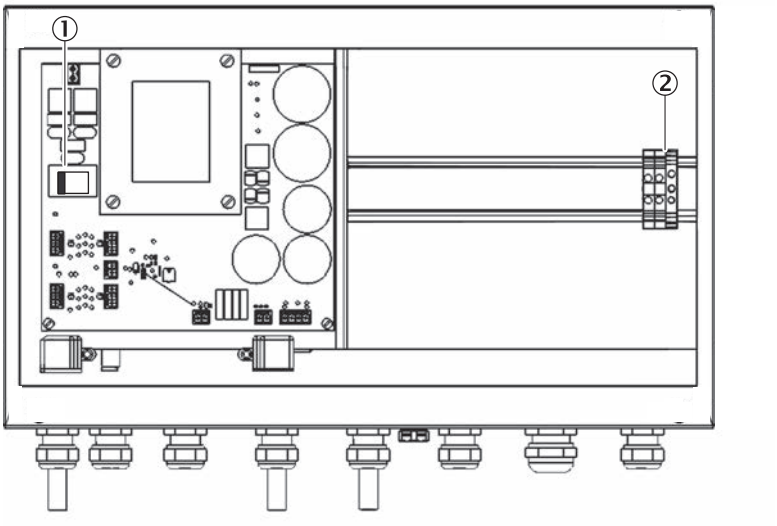


Fig. 15: Slide switch and voltage supply

1 Slide switch for voltage selection
2 Terminals for power supply

▶ Connect voltage supply according to terminal designation (L1/N/PE).

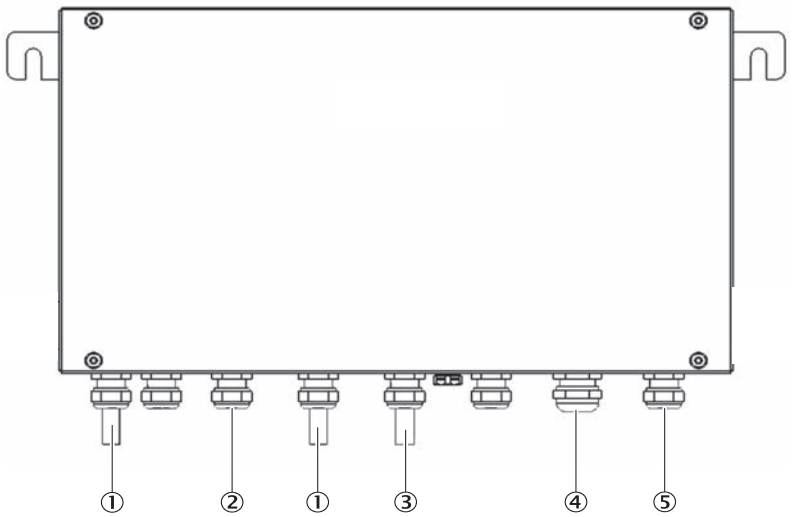


Fig. 16: Connection options for peripherals

1 Sender/receiver unit connection (2x)
2 Reflector connection
3 Ethernet (when used)
4 Input and/or output signals (when used)
5 Voltage supply

Input/output cabling for analog/digital variants

The CAN bus terminator must be set to “ON” (LED must be on: see Fig. “Location of LEDs in the connection unit for the analog/digital variant”, page 30)

The inputs and outputs of the connection unit are assigned as follows:

Input or output	Assignment
Analog	
Output 1	Visibility
Output 2	Temperature
Output 3	NO
Output 4	NO_2
Output 5	CO
Output 6	NO_x
Digital	
Relay 1	Operation/fault for NO, NO_2, visibility • Operation: Relay is closed • Fault: Relay is open
Relay 2	Maintenance request signal • No maintenance request: Relay is open • Maintenance request (e.g.: contamination): Relay is closed
Relay 3	Measuring operation signal • Measuring operation: Relay is open • Not in measuring operation (e.g. during maintenance, adjustment etc.): Relay is closed

Input or output	Assignment
Relay 4	Operation/fault for CO (option) • Operation: Relay is open • Fault: Relay is closed
Input 1	Maintenance mode (measured values frozen)

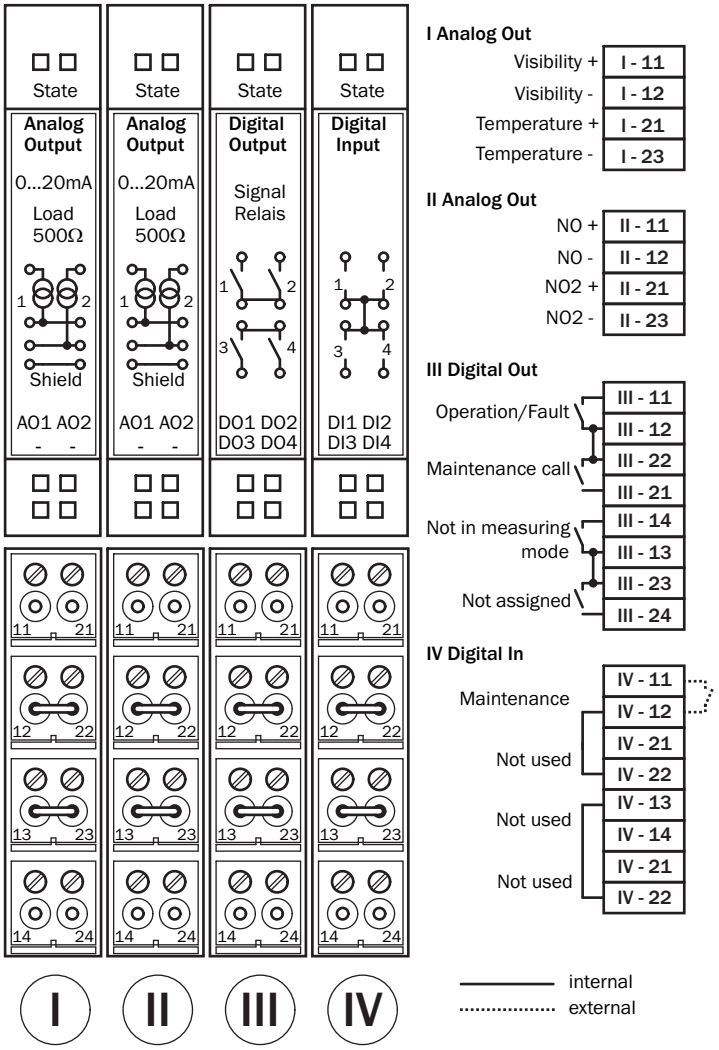


Fig. 17: I/O modules and circuit diagram of analog modules without CO and NO_x-inlets/outlets

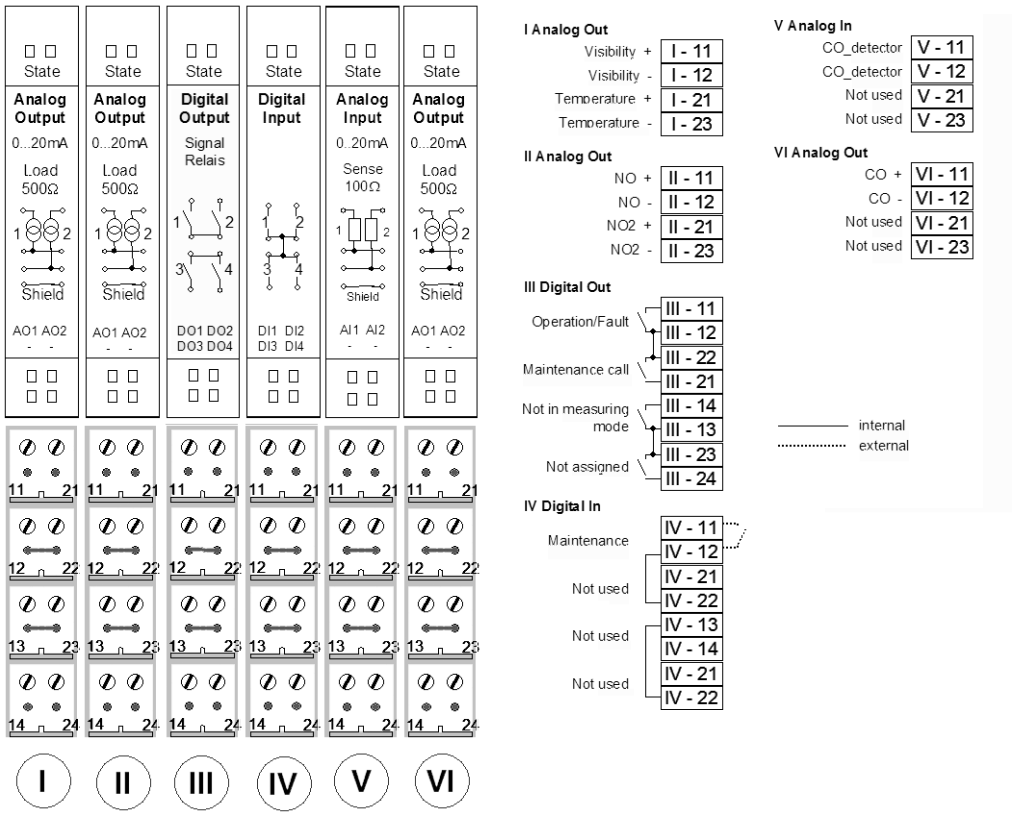


Fig. 18: I/O modules and circuit diagram of analog modules with CO and NO_x inlets/outlets

Module	LED	Significance
Digital out	Green	Active
Digital in	Green	Contact closed
Analog out	Green	Actual current value = rated current value
Analog in	Green Off	0 mA ≤ I_{on} < 22 mA I_{on} ≥ 22 mA

▶ Connect the power supply.

Checking cabling

Correct cabling can be checked as follows (see Fig. “Location of LEDs in the connection unit for the analog/digital variant”, page 30):

- The gateway LEDs are green (State, CAN, I/O).
- The error LED on the gateway is off.
- The 120 V LED and the 24 V LED are green.
- The status LEDs of the I/O module blink green.
- The reflector heating LED is green.
- The alignment LEDs on the sender/receiver unit flash sequentially.

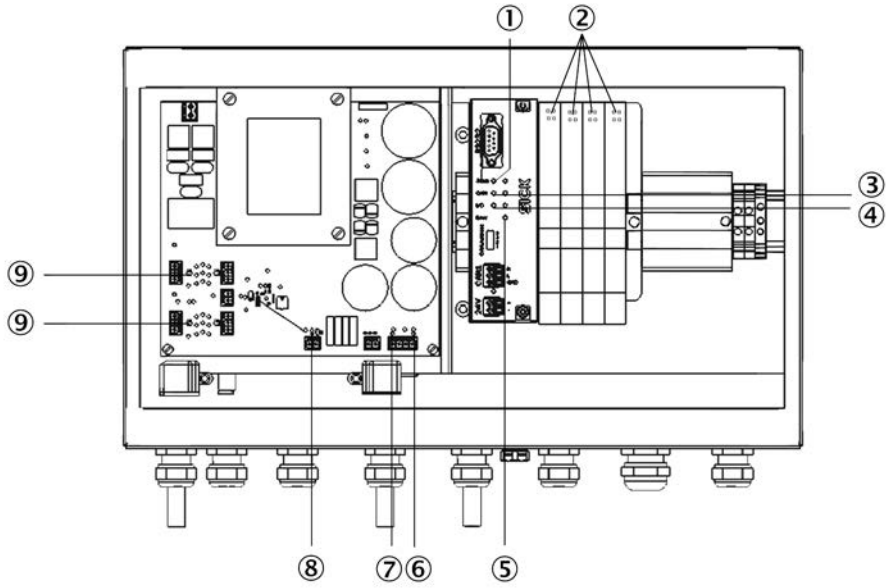


Fig. 19: Location of LEDs in the connection unit for the analog/digital variant

1	Gateway state	Green LED blinks in operation Red LED on: CAN bus is connected but not initialized
2	I/O module state	LED1 blinks in I^2C bus cycle pulse LED2 blinks in data transfer cycle pulse
3	Gateway CAN	LEDs blink: Data transfer via CAN bus LEDs on: No CAN bus connected
4	Gateway I/O	LED1 blinks in I^2C bus cycle pulse LED2 blinks in data transfer cycle pulse
5	Gateway error	LED on: No I/O module found on gateway or one or more modules failed during operation
6	120 V	
7	24 V	
8	Reflector heating 24 V	
9	CAN bus connection	LED is green: CAN bus terminator is activated.

Connecting the Ethernet cable for Ethernet variant

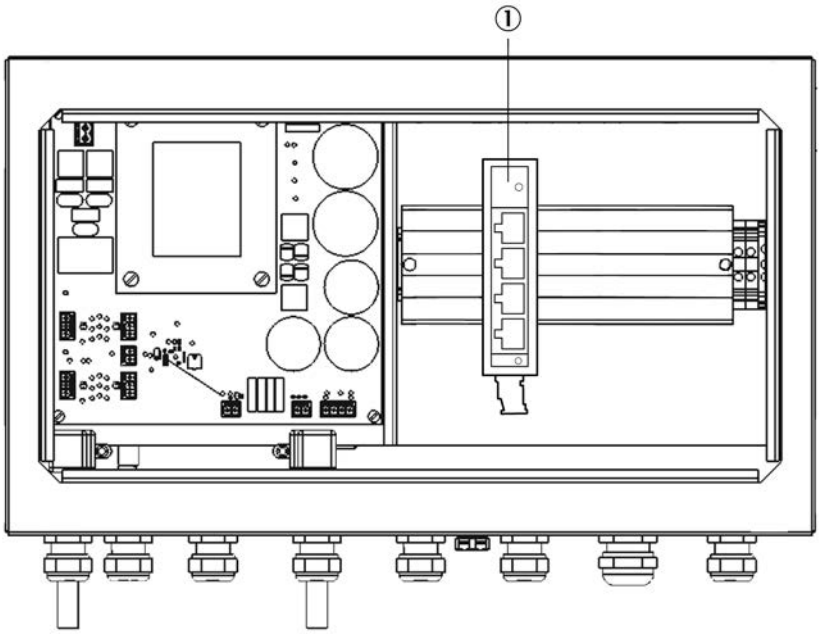


Fig. 20: Ethernet connection

▶ Lead the Ethernet cable through the nearest cable gland (see Fig. “Connection options for peripherals”, page 27) and plug into switch (1).

6 Commissioning

6.1 Necessary technical knowledge for commissioning

The commissioning must only be performed by authorized technicians and is described in the Service Manual.

Wait two hours after commissioning until the system has heated up. It has then reached a thermal balance and delivers measured values within the tolerance band.

6.2 Commissioning checklist

The up-to-date Operating Instructions must be available.

Please request the up-to-date commissioning checklist from Endress+Hauser Service.

First enter the customer data.

6.2.1 Device data

Enter the device data here.

- Serial number: See type plate or SOPAS.
- Specify kind and type of process optics.

6.2.2 Tunnel data

Enter location and measuring point here.

SOPAS supports the value of the active measuring path.

6.3 Alignment

The mechanical alignment of the measuring device and the reflector must have already been performed by using the laser adjustment units.

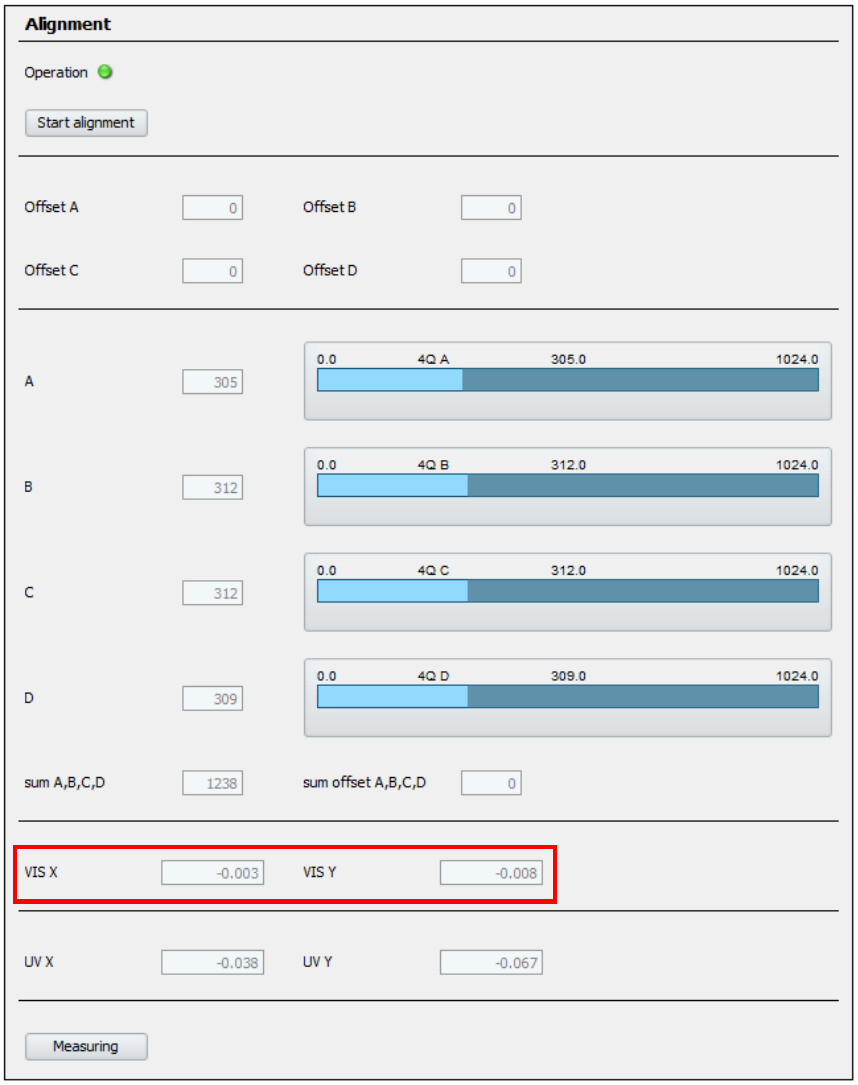


Fig. 21: Menu Adjustment / Alignment.

1 Open “Adjustment/Alignment” in the SOPAS menu tree.

Fine adjustment of horizontal alignment

1 Slightly loosen the retaining screws of the measuring device on the assembly console so that the device can be moved.
2 Using a small plastic or rubber hammer, very carefully tap the position shown below (see Fig. “Vertical sensor alignment”, page 34).
3 Tap until the **VIS X value** on the display reaches <0.15.
4 Tighten the retaining screws again.

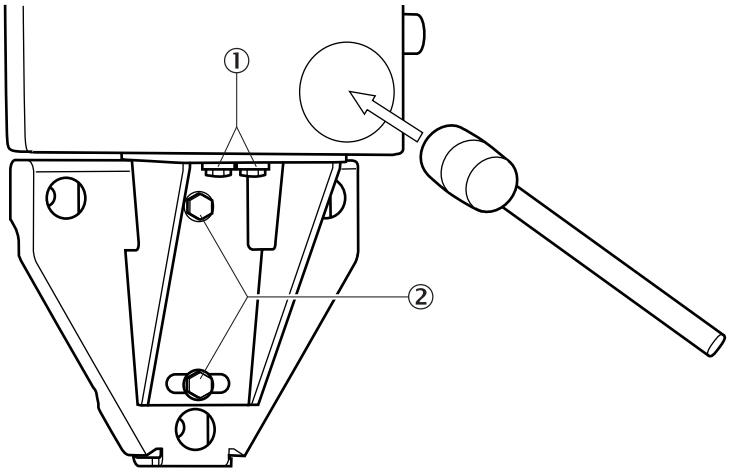


Fig. 22: Horizontal sensor alignment

1 Retaining screws
2 Angle bracket screws

Fine adjustment of vertical alignment

1 Slightly loosen the angle bracket screws.
2 Using a small plastic or rubber hammer, very carefully tap the position shown below (see Fig. “Vertical sensor alignment”, page 34).
3 Tap until the **VIS Y value** on the display reaches <0.15.
4 Tighten the angle bracket screws again.

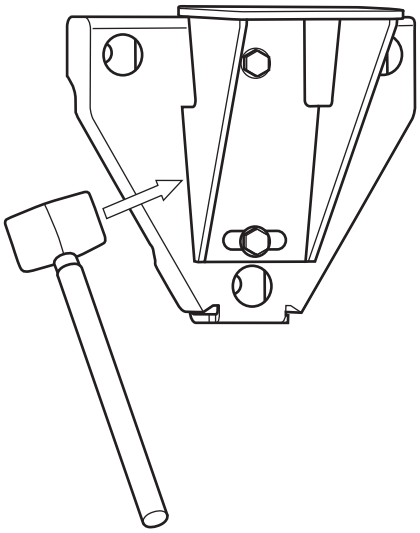


Fig. 23: Vertical sensor alignment

The LED grid in the visor of the sender/receiver unit shows the position of the light beam in relation to the reflector center. After fine adjustment, one of the 3 x 3 LEDs in the center of the grid should light.
If a LED outside the 3 x 3 LEDs in the center lights, fine adjustment must be performed again.

6.4 Spectral analysis

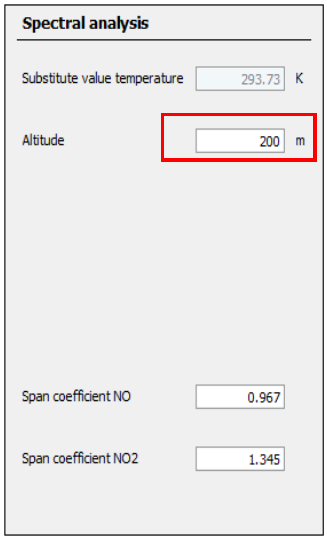


Fig. 24: Menu Parameter/Spectral analysis

1 Open “Parameter/Spectral analysis” in the SOPAS menu tree.
2 Enter the installation altitude (above sea level).

6.5 Visibility and smoke detection

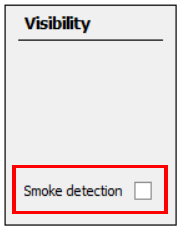


Fig. 25: Menu Parameter/Visibility

1 Open “Parameter/Visibility” in the SOPAS menu tree.
››› Default setting: Smoke detection not activated.

+i	Measured values of gases are kept constant at first when the light beams are interrupted. A malfunction message is sent to the evaluation unit when interruptions last longer than two minutes.

2 To activate smoke detection: Set checkmark.

+i	A value above 22 mA is transmitted at the analog output when the light beams are interrupted (quick drop of visibility). No malfunction message is output.

6.6 Signal outputs

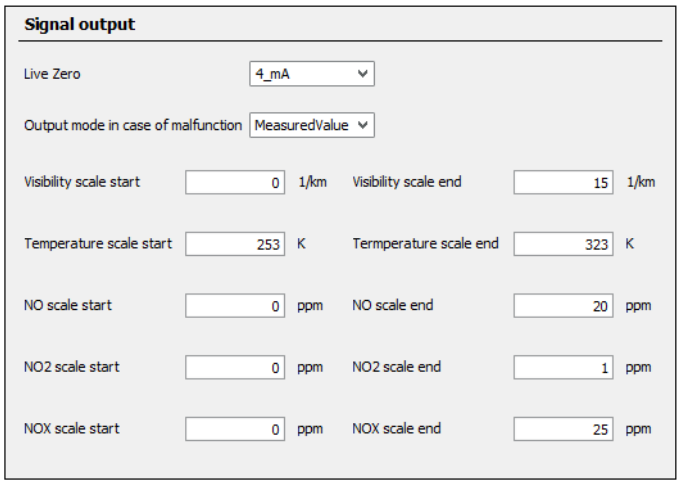


Fig. 26: Menu Parameter\Signal output

1 Open “Parameter/Signal output” in the SOPAS menu tree.
2 Change the predefined setting when required.

6.7 Saving data

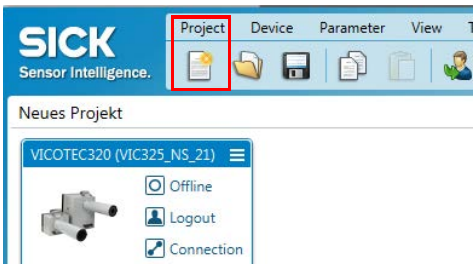


Fig. 27: SOPAS main window

1 Open “Project/Save as” in the SOPAS main window.
2 Specify project name and storage location.

7 Operation

7.1 Operating the VICOTEC320

The VICOTEC320 runs automatically after commissioning and does not require further operator intervention. You can however use the SOPAS ET software to change the configuration or display measured values.

8 Using the VICOTEC320

8.1 Software SOPAS ET

The SOPAS ET software serves to set the VICOTEC320 parameters. The parameter records can be stored as a Project file as well as archived on the PC. Measured values can also be read out.

8.1.1 Functions (overview)

The Online Help of the SOPAS ET software (Help menu) describes the general function of the software and how to use it.

- Menu language selection
- Setting up communication with the VICOTEC320
- Password protected configuration for different operator levels
- Output current measured values
- System diagnostics

The password can be found in the Annex, see “Password”, page 75.

8.1.2 Installing the SOPAS ET software

1 Start the PC and insert the Installation CD.
2 Call setup.exe directly from the CD when installation does not start automatically.
3 Follow the operating instructions to complete installation.

8.2 Using SOPAS ET

The SOPAS ET interface is described in the SOPAS ET Manual.

See menu: Help/SOPAS ET Manual.

8.2.1 Creating a connection

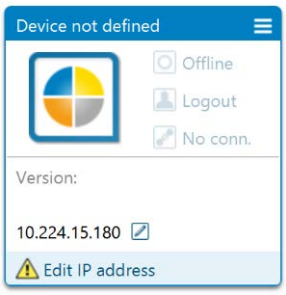
Connect data interfaces

1 Ensure the supply voltage of the VICOTEC320 is switched on.
2 Switch the PC on.
3 Make sure the WLAN is switched off.
4 Connect PC (Ethernet interface) and VICOTEC320 via Ethernet line.
5 Insert the network cable.
6 Wait until the laptop has initialized the Ethernet interface (approx. 1 min.)

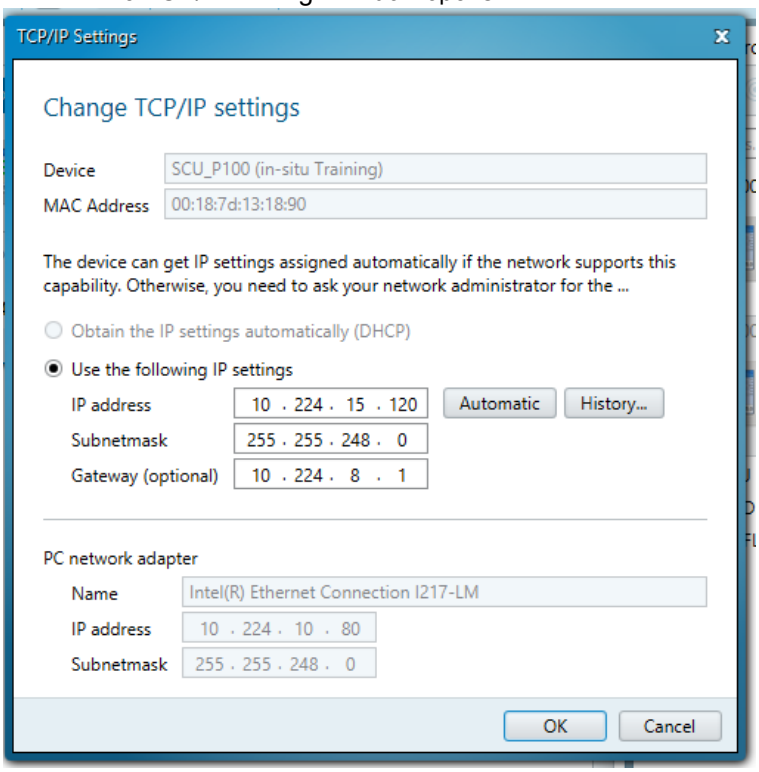
Start the SOPAS ET software

1 Start the software.
   ››› The device should be found automatically and added to the project.

2 The IP address of the device must be adapted.
a) Click “Edit IP address”.

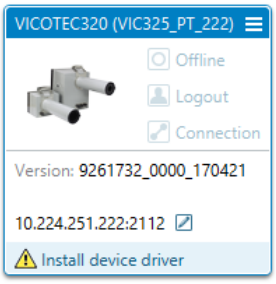


»» The TCP/IP settings window opens.

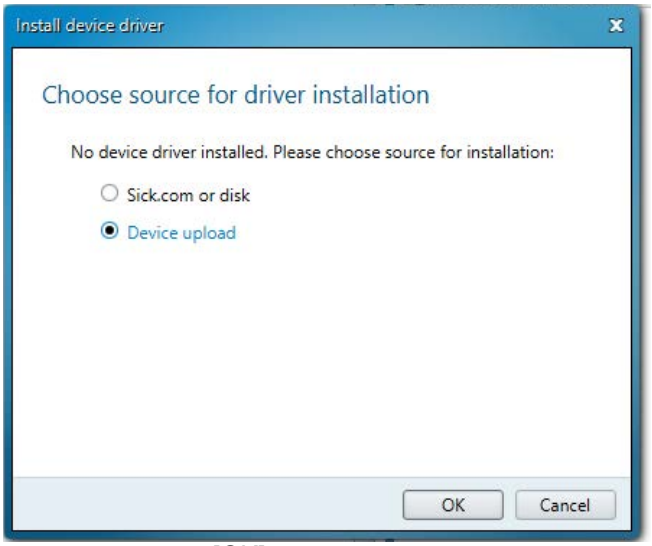


b) Record the current IP settings (if the device was logged off the customer network and then has to be logged in again).
c) Select the [Automatic] button.
»» A corresponding IP address is displayed.
d) Confirm with [OK].
»» The IP address is sent to the device.

3 Install device driver.
a) Click “Install device driver”.



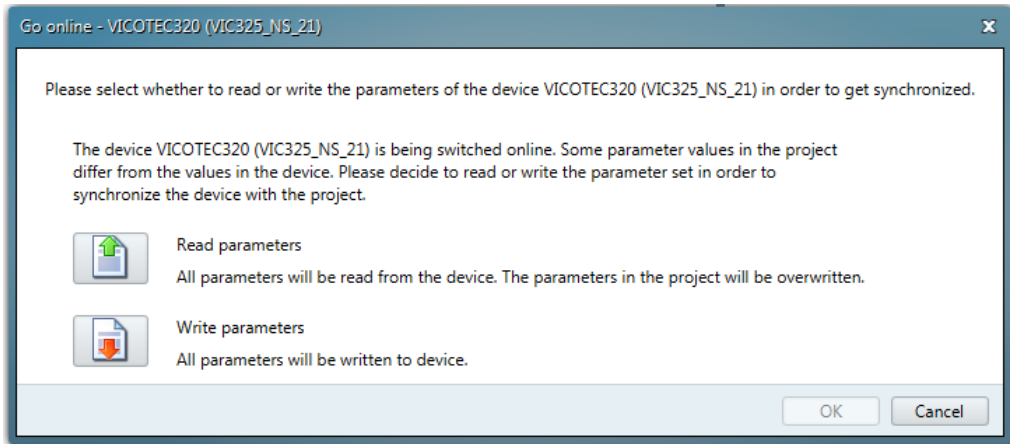
b) Select the device driver source. Recommended: Select “Device upload”.



c) Confirm with [OK].
››› Driver is loaded from the device.

Setting device parameters

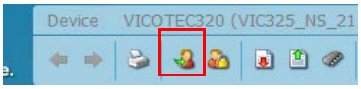
1 Double-click “Offline”.
››› The Go online window opens.



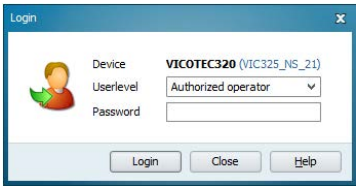
2 Select the “Read parameters” function.
3 Double-click the header
››› The device window opens.

Login to the device

1 Click “Login” at the top of the menu bar.



››› The login window opens.



2 Enter the desired user level “Authorized operator”.
3 Enter password (see “Password”, page 75).
4 Click [Login].

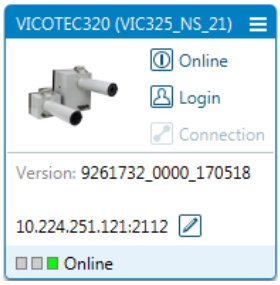
Integration in customer network

The sensor IP address of the device must be adapted to the customer network when the VICOTEC320 is integrated in a network or connected to a customer WLAN module.

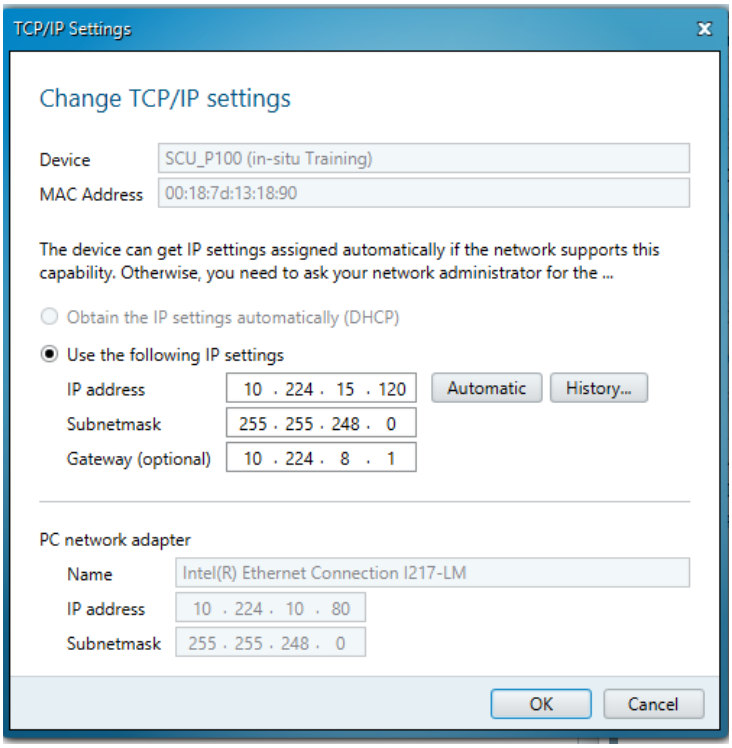
1 Close the device window.

In the SOPAS main window

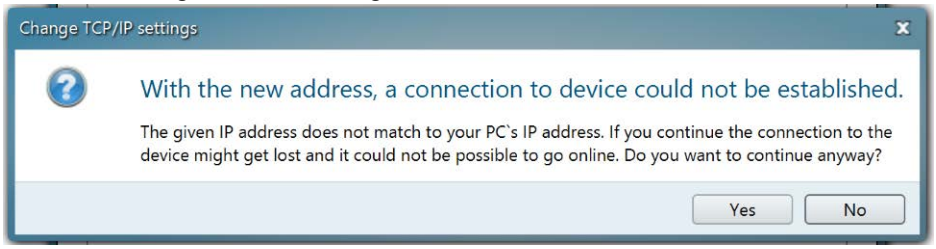
2 Click the button next to the IP address [pen].



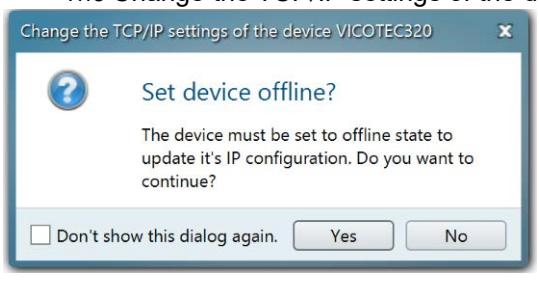
››› The TCP/IP settings window opens.



3 Enter the network information (to be provided by the customer) for the device in section “Use the following IP settings”.
4 Confirm with [OK].
   ››› The Change TCP/IP settings window opens.



5 Confirm with [Yes].
   ››› The Change the TCP/IP settings of the device ... window opens.



6 Confirm with [Yes].
   ››› The settings are transferred to the device.
   ››› The Device not found window opens.
7 Confirm with [OK].
8 Connect the device with the customer network.

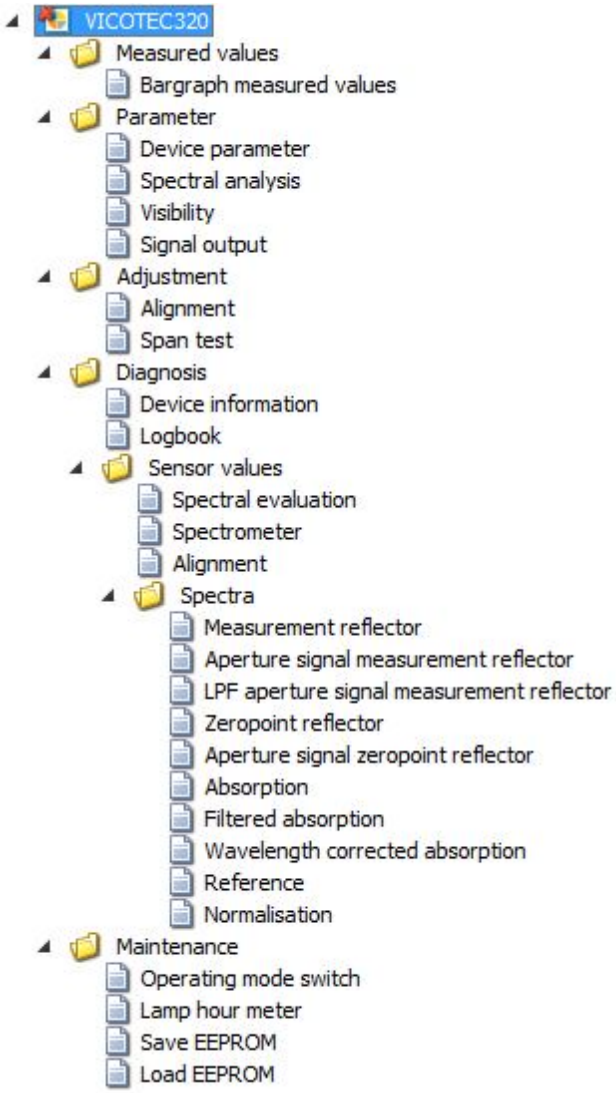


Fig. 28: Menu tree VICOTEC320

8.2.2 Reading out the VICOTEC320 and operating manually

The corresponding operator level must first be selected to configure a device with the SOPAS ET software. The SOPAS ET software runs in the operator level “Operator” after commissioning and parameters can only be read.

- To change the operating level to “Authorized operator”: Login via the [Login] button > enter password (see “Password”, page 75).
- Double-click one of the functions in the project tree to start this function.
- To save all the data, select the “Export SDV file” command in the Device menu .

The following tabs are important for you; the other tabs are shown colored gray and are only relevant for Service technicians.

Bargraph measured values

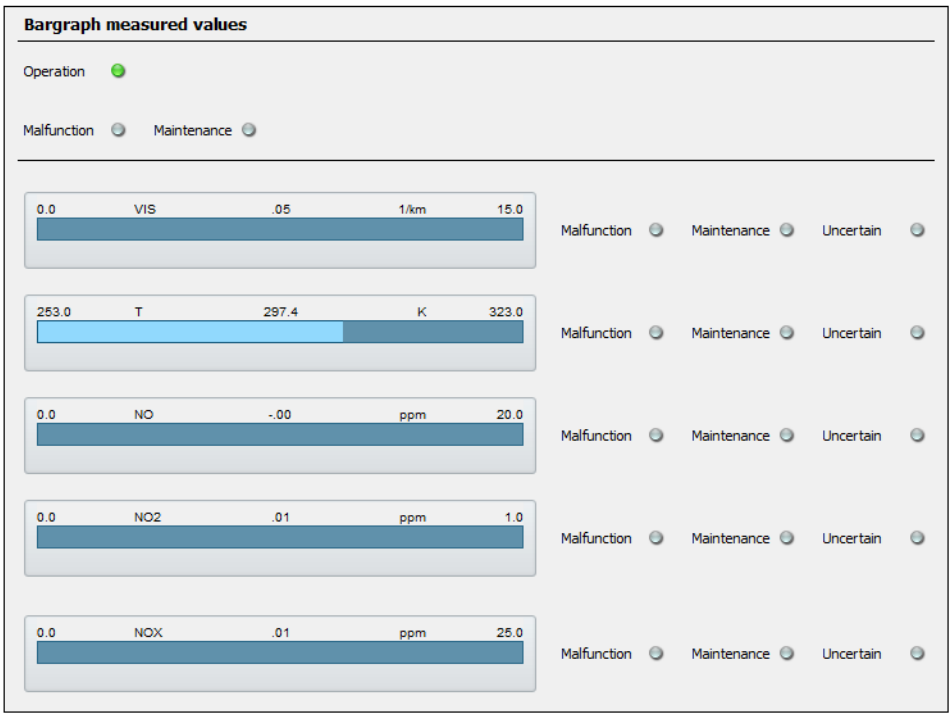


Fig. 29: Bargraph measured values

This screen shows whether the sensors are in measuring operation or whether a fault or maintenance requirement exist.

Apart from that, the current measured values for visibility, temperature, NO, NO_2 and NO_x are displayed (depending on the device variant).

When fault or maintenance request is shown, the measurement triggering the fault or maintenance request is shown next to the measured values.

The “Uncertain” LED next to the measured values signals that the measured value is “uncertain” (e.g.: Calibration range exceeded. → Logbook).

Alignment

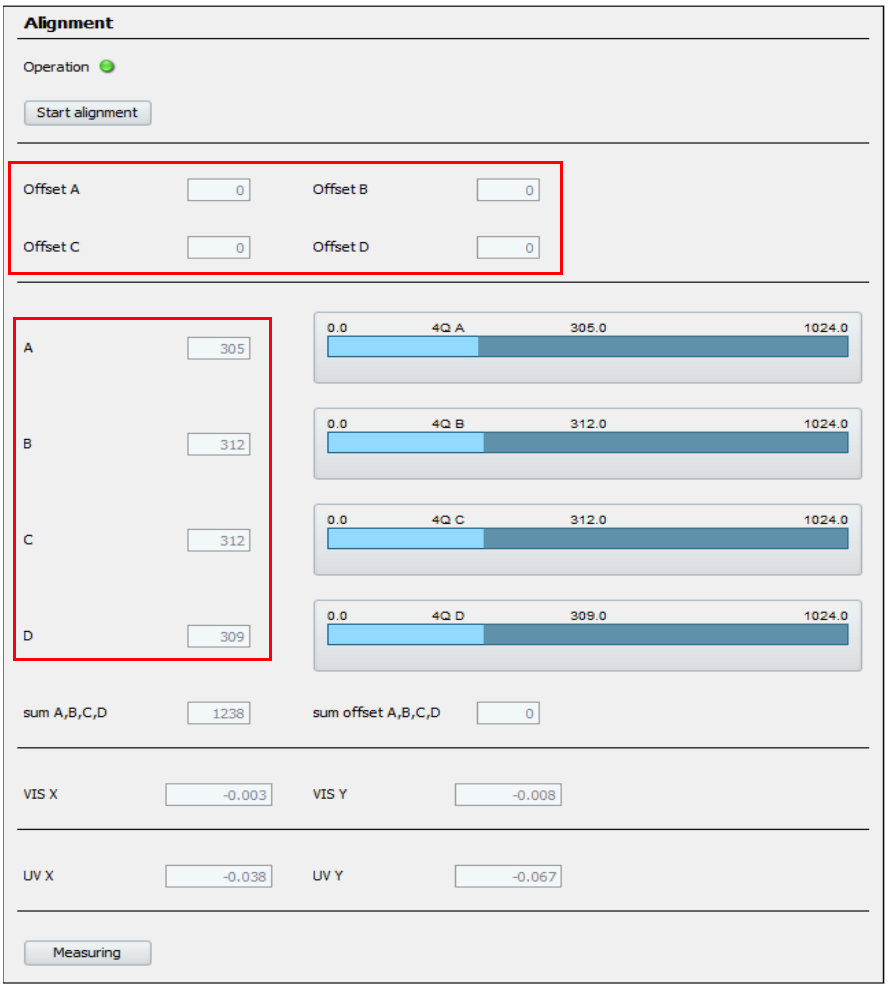


Fig. 30: Alignment

	Nominal values
1	Offset <100
2	A,B,C,D: 250-500

The light beam is tracked automatically to the center of the reflector.

Manual alignment is only possible for authorized operators:

Device information

Menu: *Diagnosis/Device information*:

This screen shows the serial number, device process and operating hours of the sender lamp.

Logbook

All sensor messages are stored in the Logbook. Messages marked with a red dot are still active, messages with a green dot are already completed.

Messages can be filtered according to type:

▶ Click on the dropdown box and select the type of message required.

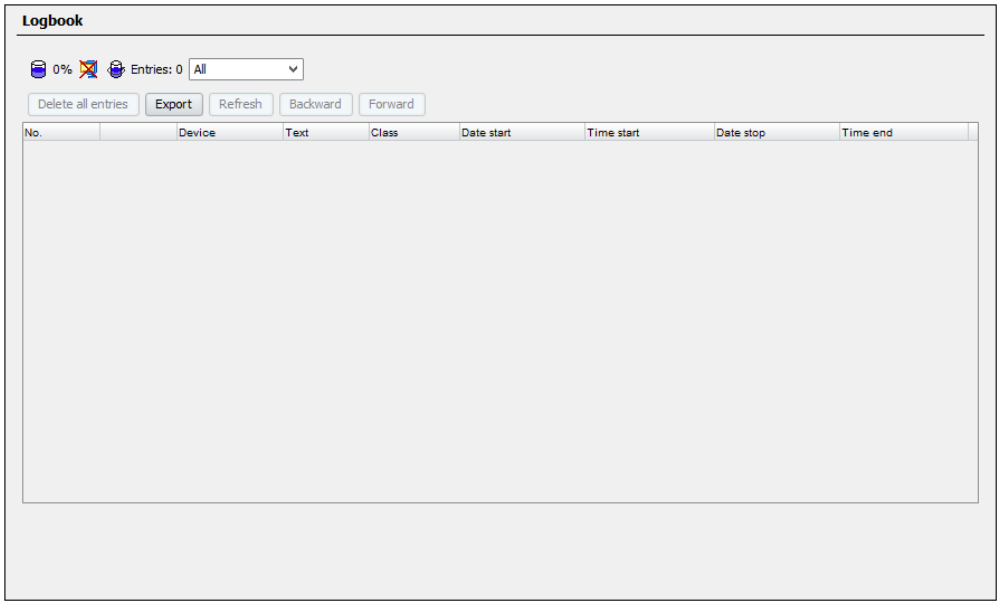


Fig. 31: Logbook

Symbol	Remark
	Logbook fill level in %. When the characters are *red*: The logbook is full. Warning mode: Further entries are not accepted. Circular buffer mode: Oldest entries are overwritten.
	Data storage: Symbol *not crossed out*: Compressed. Symbol *crossed out*: Uncompressed.
	Circular buffer mode Warning mode
Entries	Number of entries of selected filter.
Filter for messages	Only filtered messages are shown. - Show active failures - Show all failures - Show active maintenance request - Show all maintenance requests - Show active uncertain - Show all uncertain - Show active extended messages - Show all extended messages - Show active messages - Show all messages Classification → Further on in this Table.
Reset	Clear all entries.

Symbol	Remark
Export (Only in SOPAS ET)	All entries selected via the filter (→ Further back in this Table) are saved on the PC as .log file. Format: CSV (comma-separated list). Viewable in, e.g., EXCEL.
Update	Update display of logbook entries.
Last Data	Scroll back.
Next Data	Scroll forward.
▲▼	Sort in ascending/descending order. To switch sorting on or change sequence: Touch column header.
	Consecutive message number. *Red* LED: Message still pending. *Green* LED: Message no longer pending.
Device	Activating element: System, measured value identifier (sample gas component), subassembly, Evaluation module
Entries[1]	Number of times the error has occurred.
Text	Logbook message.
Classification	F = Failure M = Maintenance request C = Check U = Uncertain X = Extended message
Date start	Format: yy-mm-dd For "*Uncompressed*": Occurrence of message. For "*Compressed*": Last occurrence of message.
Time start	Format: hh:mm:ss For "*Uncompressed*": Occurrence of message. For "*Compressed*": Last occurrence of message.
Date stop	Format: yy-mm-dd For "*Uncompressed*": Clearing of message. For "*Compressed*": Last clearing of message.
Time end	Format: hh:mm:ss For "*Uncompressed*": Clearing of message. For "*Compressed*": Last clearing of message.

[1] Only for compressed data storage

8.2.2.1 *Exporting messages*

1 Click [Export].
2 Select the storage location and file names.
3 Click [Save].
›» The Logbook is saved as a Log file.

Operating mode switch

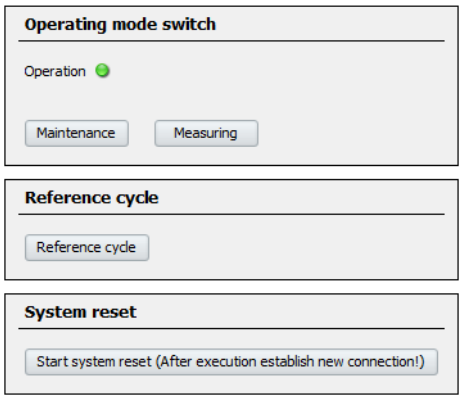


Fig. 32: Menu Maintenance/Operating mode switch

This screen serves to switch between Measuring mode and Maintenance mode. Apart from that, a reference cycle and a system restart can also be initiated. The parameters are not deleted. The connection between SOPAS and VICOTEC320 must be established again after a system restart (see “Creating a connection”,page 38).

8.2.3 Saving the current parameter set

1 Save the parameter set. The saved file can then be restored, for example on new hardware.
Select: *Device/Export SDV file*
2 Storing the project (a “project” can be several devices). This file can then, for example, be printed but can however *not* be restored in the device.
a) To store the current parameter set, select the *Save as* command in the *Project* menu.
b) Enter a file name in the dialog window and confirm with [Save].

9 Maintenance

9.1 Cleaning

Set device to Maintenance mode

9.1.1 Cleaning sensors

The tube can be removed in order to clean the protective screen of the sender/receiver unit or reflector.

CAUTION: Eye injuries caused by improper handling of UV or blue light beams
The UV beam of the deuterium lamp or the blue light beam of the LED can cause serious injuries through direct eye and skin contact. This results in the following safety measures when working on the switched on device with access to the light beam exit:
- ▶ Always wear UV protective goggles (in accordance with standard EN 170)
- ▶ The UV goggles do not provide protection against injuries caused by blue light beams, therefore switch the LED off when working.
- ▶ Use the lamps only when they are perfectly safe. Operation is not allowed when the lamp, supply lines or operating parts are visibly damaged.

1 Loosen both nuts at the end of the tube and pull the tube off.
2 Clean the protective screens with clean optical tissues.
3 Check the tube and the optical beam path for soiling though deposits or animals and clean when necessary.
4 Position the tube and tighten both nuts.

9.1.2 Tunnel cleaning

Cover every sensor tube with a protective cap during tunnel cleaning.

▶ Set device to Maintenance mode

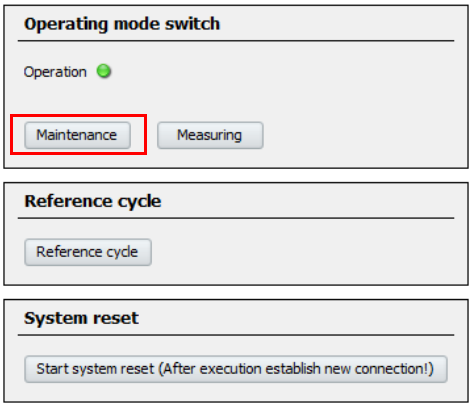


Fig. 33: Menu Maintenance/Operating mode switch

1 Open “Maintenance/Operating mode switch” in the SOPAS menu.
2 Click [Maintenance] below Operation.

9.2 Maintenance work

9.2.1 Persons authorized to carry out maintenance

Maintenance going beyond the tasks described here must be performed by authorized technicians only and is described in the Service Manual.

WARNING: Hazard by voltage.
Live parts are accessible when the device is open!
- ▶ Switch the supply voltage off before opening the device.
- ▶ Only use suitable, insulated tools.

9.2.2 Replacing the activated charcoal

The activated charcoal sachet is located in the sender/receiver unit.

▶ Replace the used activated charcoal bag with a new one.

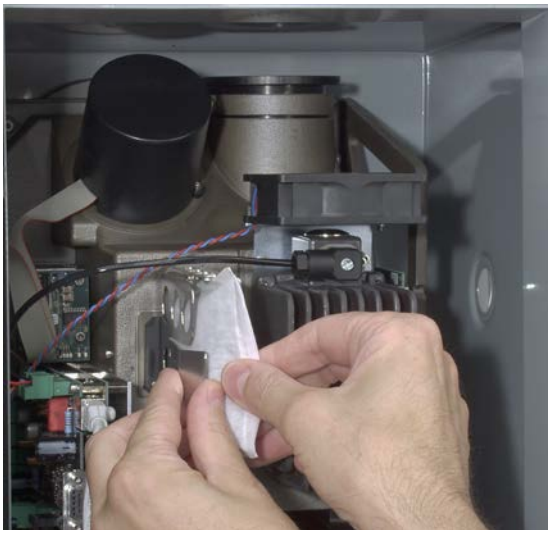


Fig. 34: Replacing the activated charcoal bag

9.2.3 Replacing the drying agent cartridge

The drying agent cartridge is located in the reflector.

▶ Unscrew the lid with pin key and replace the drying agent cartridge.

Fig. 35: Replacing the drying agent cartridge

9.2.4 Replacing the sender lamp and LED

Exchange the sender lamp at regular intervals. These intervals are approx. 1 to 4 years. The intervals can also be longer or shorter depending on the configuration of the devices and the ambient conditions in the tunnel.

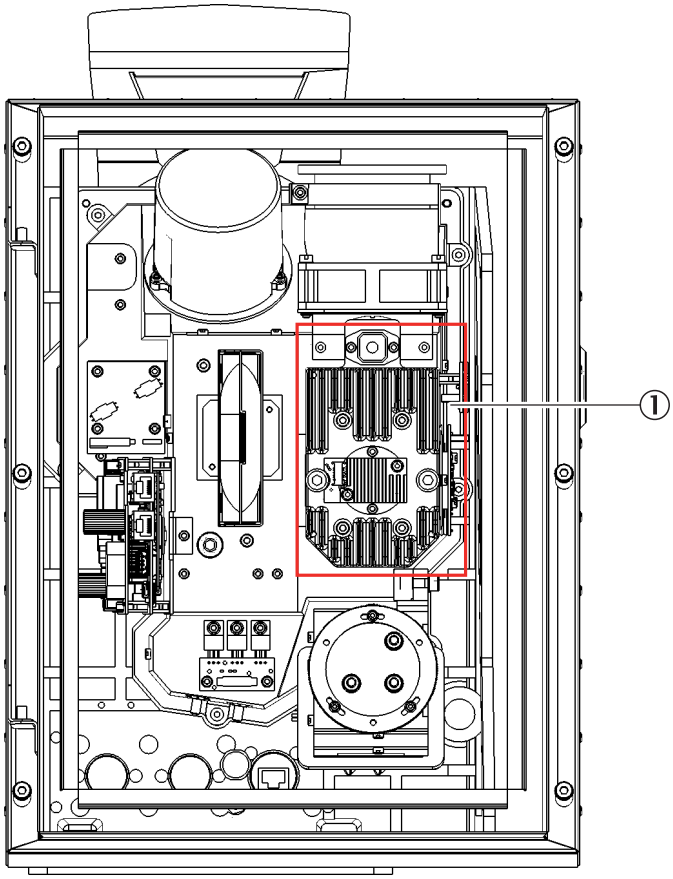


Fig. 36: Position of sender lamp

1 Sender lamp

WARNING: The sender lamp is hot
Risk of skin burns
▶ Let the sender lamp cool down before exchanging it.

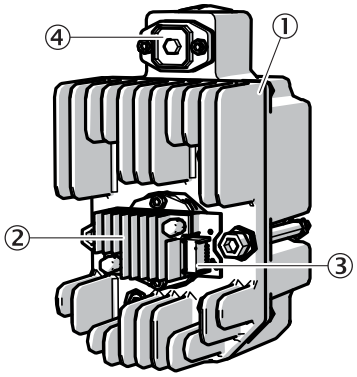


Fig. 37: Sender lamp with LED unit

1 Sender lamp
2 LED unit
3 Connection of LED unit power supply
4 Connection of sender lamp power supply

Exchanging the sender lamp with LED unit

WARNING: Hazard by voltage.
Live parts are accessible when the device is open!
- ▶ Switch the supply voltage off before opening the device.
- ▶ Only use suitable, insulated tools.

1 Loosen 6 screws on the rear side of the SR-unit and swivel the rear side out.
2 Pull off the voltage supply line of the LED.
3 Loosen screw (crosshead) of the plug of the sender lamp voltage supply and disconnect the plug.

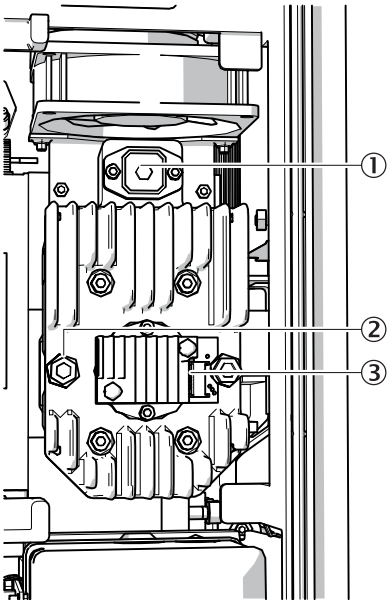


Fig. 38: Sender lamp

1 Connection of voltage supply line
2 Screws of sender lamp
3 Connection of LED unit power supply

4 Loosen the plug of the LED unit's (3) power supply connection.

Note:
Risk of contamination of the optical mirrors after removing the sender lamp.
▶ Cover the opening to the optical mirrors after removing the sender lamp.

5 Loosen the two screws (5 mm Allen screw) on the sender lamp and take the sender lamp off.
6 Remove the cap from the new sender lamp.
7 Plug in new sender lamp and screw tight.
8 Connect the plug (1) and screw tight.
9 Insert plug (3).
10 Screw the rear cover tight.

Adjustment is not required.

Note:
Reset the lamp hour meter (Maintenance > Lamp hour meter) after exchanging the light source.

Replacing the LED unit

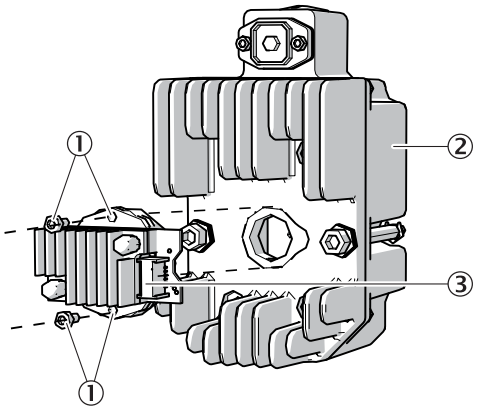


Fig. 39: Remove the LED unit from the sender lamp

1 Screws for fastening the LED unit
2 Sender lamp
3 Connection of LED unit power supply

Note:
The fastening screws of the LED unit are not self-locking.

Note:
The optical surfaces can be contaminated when touched with your fingers.
▶ Avoid touching the optical surfaces with your fingers.

1 Loosen 6 screws on the rear side of the SR-unit and swivel the rear side out.
2 Loosen the two fastening screws of the LED unit.
3 Loosen the plug of the LED unit's power supply connection (3).
4 Pull the LED unit off.
5 Plug in new LED unit and screw tight.
6 Insert plug (3).
7 Screw the rear cover tight.

Adjustment is not required.

Note:
Reset the lamp hour meter (Maintenance > Lamp hour meter) after exchanging the light source.

9.2.5 Replacing the CO sensor

▶ Replace the CO sensor once a year (recommendation).

WARNING: Hazard by voltage.
Live parts are accessible when the device is open!
▶ Switch the supply voltage off before opening the device.
▶ Only use suitable, insulated tools.

Procedure

Removing the old CO sensor:

1 Disconnect plug ① from CO sensor ②.
2 Counter the CO sensor from the outside with an open-end wrench SW27.
3 Loosen and remove nut ③ from the inside with an open-end wrench SW32.
4 Unscrew splash guard ④ from the CO sensor and store it.

Installing the new CO sensor:

1 Screw the CO sensor with new seal ⑤ tightly onto the existing splash guard.
2 Place new seal ⑥ on top of the CO sensor.
3 Insert the CO sensor into the thread from the outside and fix it hand-tight with a new nut ③.
4 Counter the CO sensor from the outside with an open-end wrench SW27.
5 Tighten the new nut with open-end wrench SW32 a quarter turn.
6 Connect plug ① with CO sensor.

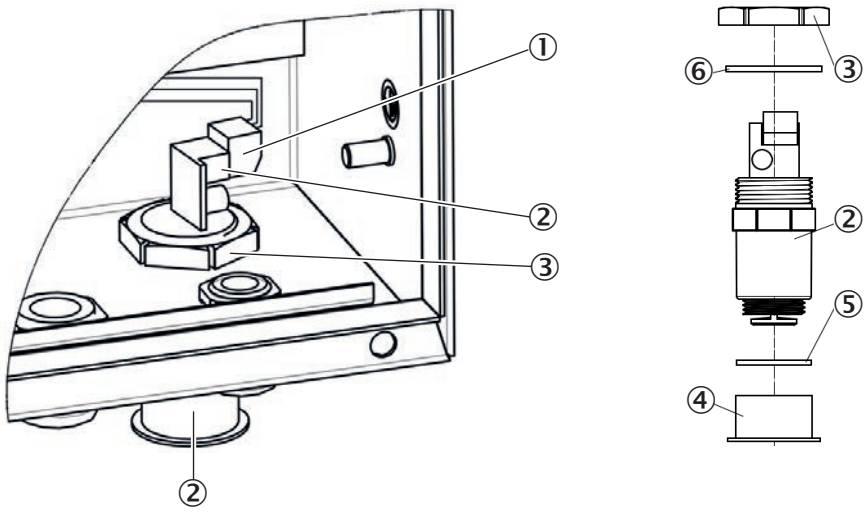


Fig. 40: Position of the CO sensor in the connection unit

1 Plug
2 CO sensor
3 Nut
4 Splash guard
5 Seal
6 Seal

9.2.6 Span Test

Note:
Perform the span test every 5 years.

Tools required

Part No.	Designation
2046658	Test tool

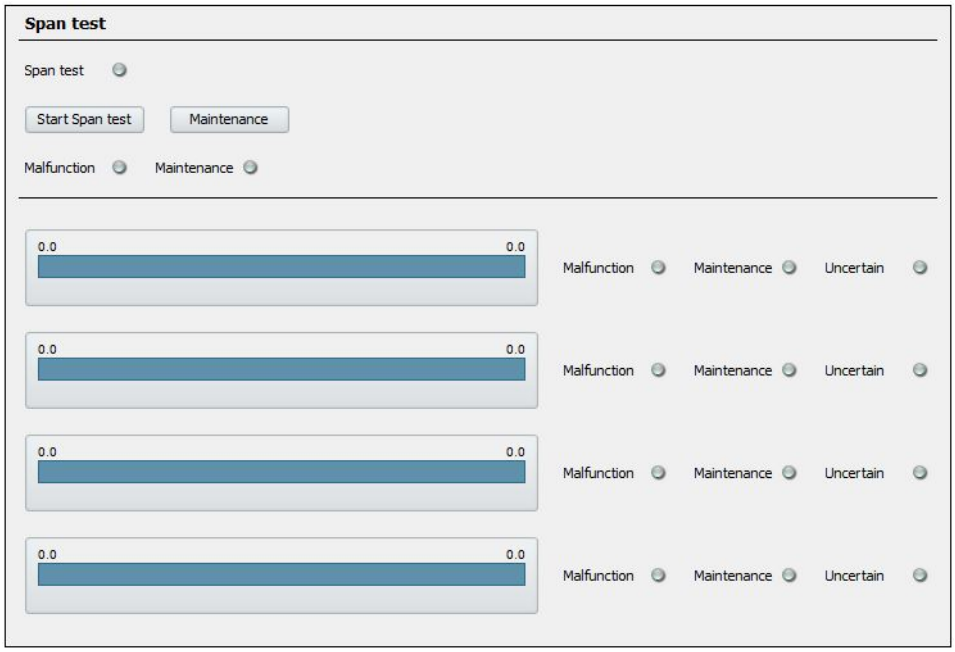


Fig. 41: Menu Adjustment/Span test

Designation/function	Description
Span test	LED shows the status.
Start Span test	Activates the span test.
Maintenance	Activates the Maintenance mode.
Malfunction	LED shows whether the system has a malfunction.
Maintenance	LED shows whether the system is in Maintenance mode.

1 Login as “Authorized operator”.
2 Select *Adjustment/Span test* in the menu.
3 Click [Maintenance].

4 Attach the test tool on the front of the sender/receiver unit.

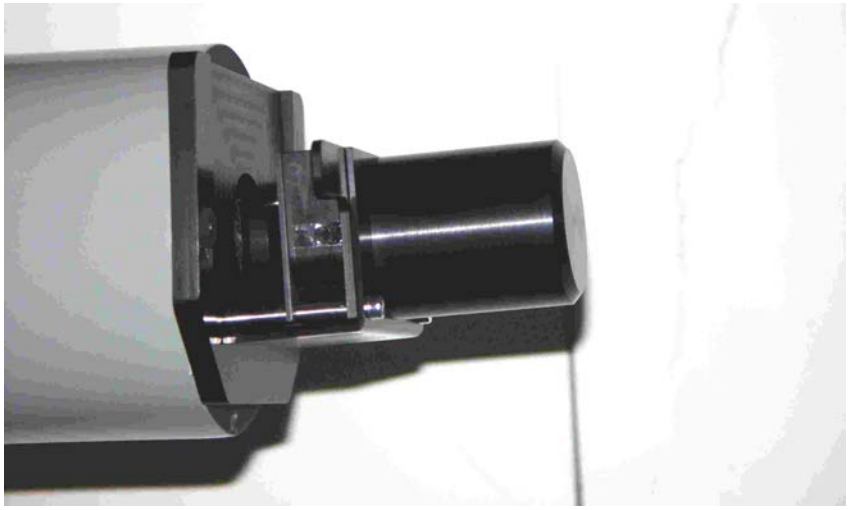


Fig. 42: Attach the test tool on the front of the sender/receiver unit.

5 Click the [Start Span test] button.
   »» The system performs a zero adjust with the test reflector, followed by a reference cycle. The current status is shown in the Operating state text field.
   »» The process takes approx. 10 minutes and is terminated when "*Spantest (insert cuvette)*" is displayed.
6 Check the signal strength
   ▶ Menu: *Diagnosis/Sensor values/Spectra/Measurement reflector*.
   »» The maximum intensity for NO should be in the range from 23000 to 28000 and for NO_2 in the range from 42000 to 48000.
7 Observe the measured values for the zero point for approx. 5 minutes and determine the average zero point. Use this value as zero point offset for the next steps.
   Example: The default values of the test cuvettes must be added to the zero point offset.

   The zero point offset can also be negative.

8 Insert cuvette or filter and wait for at least 5 minutes until the measurement has stabilized.
9 Observe the displayed measured value for approx. 5 minutes and use the average value. Compare the measured value with the default value of the test cuvette + zero point offset (= actual default value). If required, calculate the correction factor (span coefficient) (see "Determination and setting of the span factors", page 59).
10 Repeat steps 7 to 9 for every test point.
11 Click [Maintenance] and wait until operating state shows "*Maintenance remove cuvette*".

   Do not remove test tool beforehand.

12 Remove the test tool.
13 Restart the system:
   ▶ Menu: *Maintenance/Operating mode switch/System reset*
   ▶ Click [Start system reset].
14 Wait for one minute. Reconnect SOPAS ET (switch "Online").
15 Wait until the reference cycle has completed.
   »» The operating state is now "*Measuring*".

9.2.6.1 *Determination and setting of the span factors*

The span factors for the VIS, NO and NO_2 cuvette must be determined using calibrated neutral density filters (VIS) or gas cuvettes (NO, NO_2).

VIS	NO	NO_2
2 x filter 2039966	NO Mid 2043200	NO_2 High 2043204

VIS measurement

Calculate the span factor according to the following equation:

$$span_{vis} = \frac{\text{Nominal value of neutral density filter}}{\text{Measured value of neutral density filter} - \text{VIS measurement offset}}$$

NO/NO_2 measurement:

Calculate the span factor according to the following equation:

$$span_{NO/NO2} = \frac{\text{Nominal value of cuvette}}{\text{Measured value of cuvette}}$$

The determined span factors must fulfil the following criteria.

Span factor	SOPAS variable	Nominal/ typical	Lower tolerance	Upper tolerance
VIS	VIS_coeff	1	0.85	1.15
NO	NO_coeff	1	0.7	1.3
NO_2	NO2_coeff	1	0.7	1.3

Enter span factors

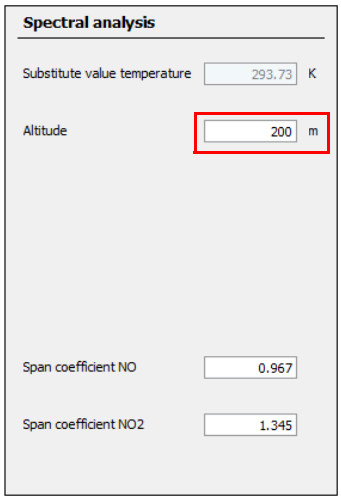


Fig. 43: Menu Parameter/Spectral analysis

1 Open “Parameter/Spectral analysis” in the SOPAS menu tree.
2 Enter span coefficient NO/NO2.

10 Troubleshooting

10.1 Error messages

Error messages are shown in the SOPAS ET configuration software Logbook.

Only those error messages are shown that the user can clear in own responsibility. Please contact Endress+Hauser Customer Service for all other error messages.

Source	Error message	Significance	Clearance
System	Lamp fault	Sender lamp does not go on.	Exchange sender lamp (see “Replacing the sender lamp and LED”, page 52).
System	Mirror adj. End	Mirror tracking has reached maximum position.	Check alignment and realign when necessary (contact Endress+Hauser Service).
Visibility	No signal	Sudden signal loss of more than 50% (light path interrupted).	Check for animals or dirt in the dust tubes or other obstacles in the optical beam path (see “Cleaning sensors”,page 49).
System	Lamp spectro	UV sender lamp current for spectrometer operation exceeds 1000 mA (limit).	Exchange the UV sender lamp if required (see “Replacing the sender lamp and LED”, page 52) or correct the parameter settings (contact Endress+Hauser Service).
System	Lamp 4Q	UV sender lamp current for visibility measurement operation exceeds 1000 mA during adjustment (limit).	Exchange the UV sender lamp if required (see “Replacing the sender lamp and LED”, page 52) or correct the parameter settings (contact Endress+Hauser Service).
System	Temp. Extern	External temperature sensor defective.	Check connection, exchange the sensor if required (contact Endress+Hauser Service).
Tempera-ture	Temp failure	Temperature sensor signal invalid.	Check connection, exchange the sensor if required (contact Endress+Hauser Service).
System	CO failure	The read in current of the CO sensors is below the error limit (see SOPAS ET: Factory setting 35 mA) or above 21 mA.	Check the wiring of the CO sensor. Check the settings of the analog input (in SOPAS ET). Otherwise: Replace the CO sensor (see “Replacing the CO sensor”, page 56).
System	System start	Shows when the last system start was made.	-
System	Zero adjust	Shows when the last adjustment was made.	-
System	Span test	Shows when the last spantest was made.	-

11 Technical data

11.1 Dimension drawings

11.1.1 Sender/receiver unit

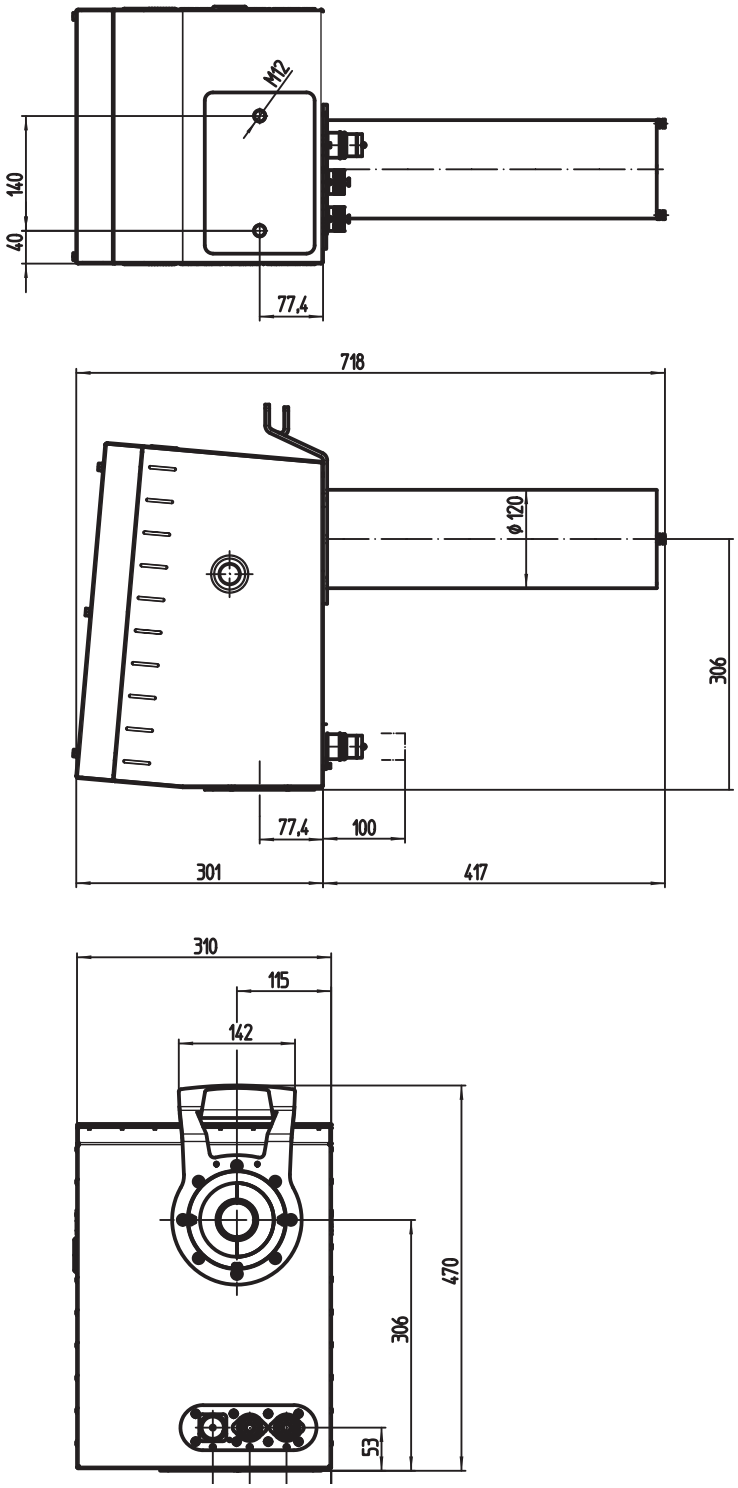


Fig. 44: Sender/receiver unit dimensions

11.1.2 Reflector

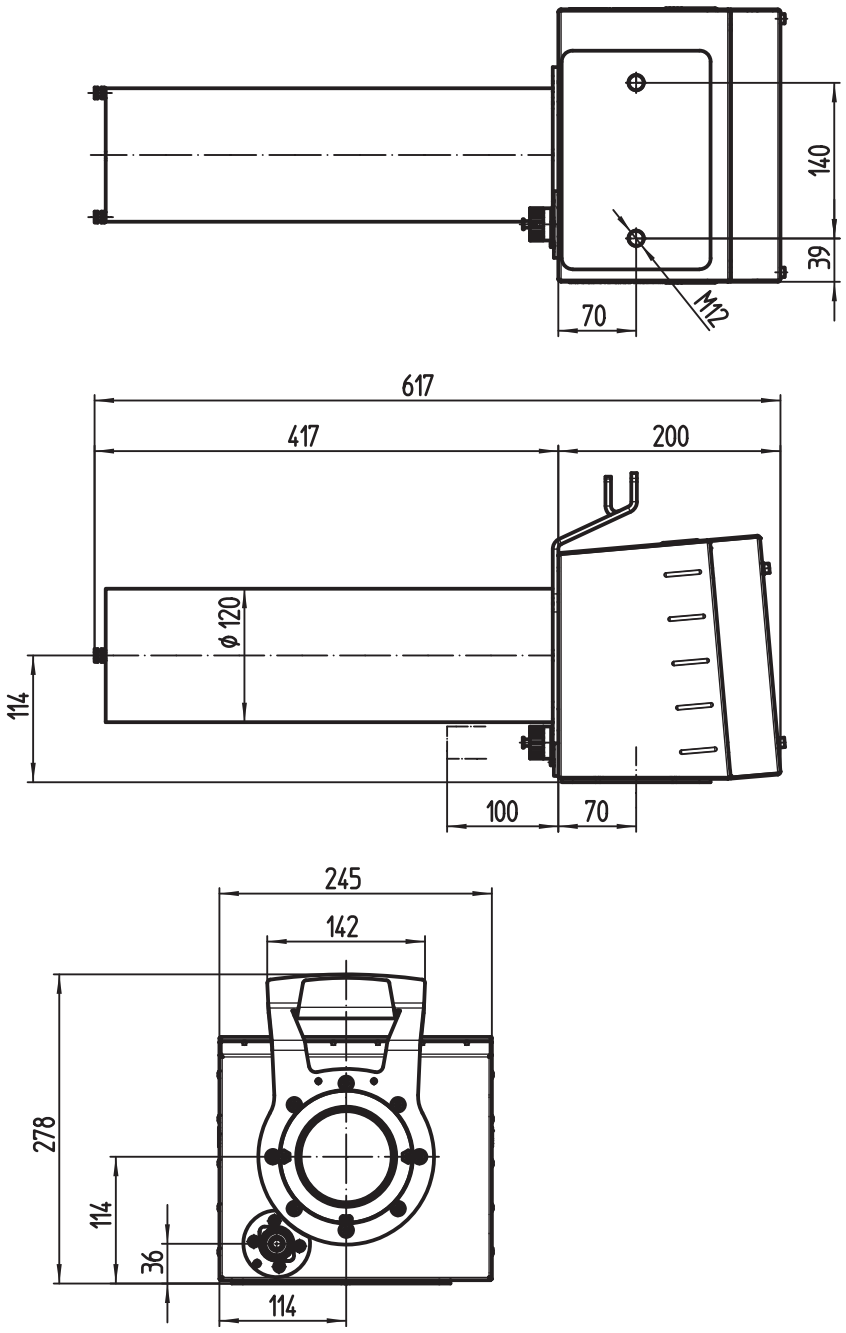


Fig. 45: Reflector dimensions

11.1.3 Connection unit

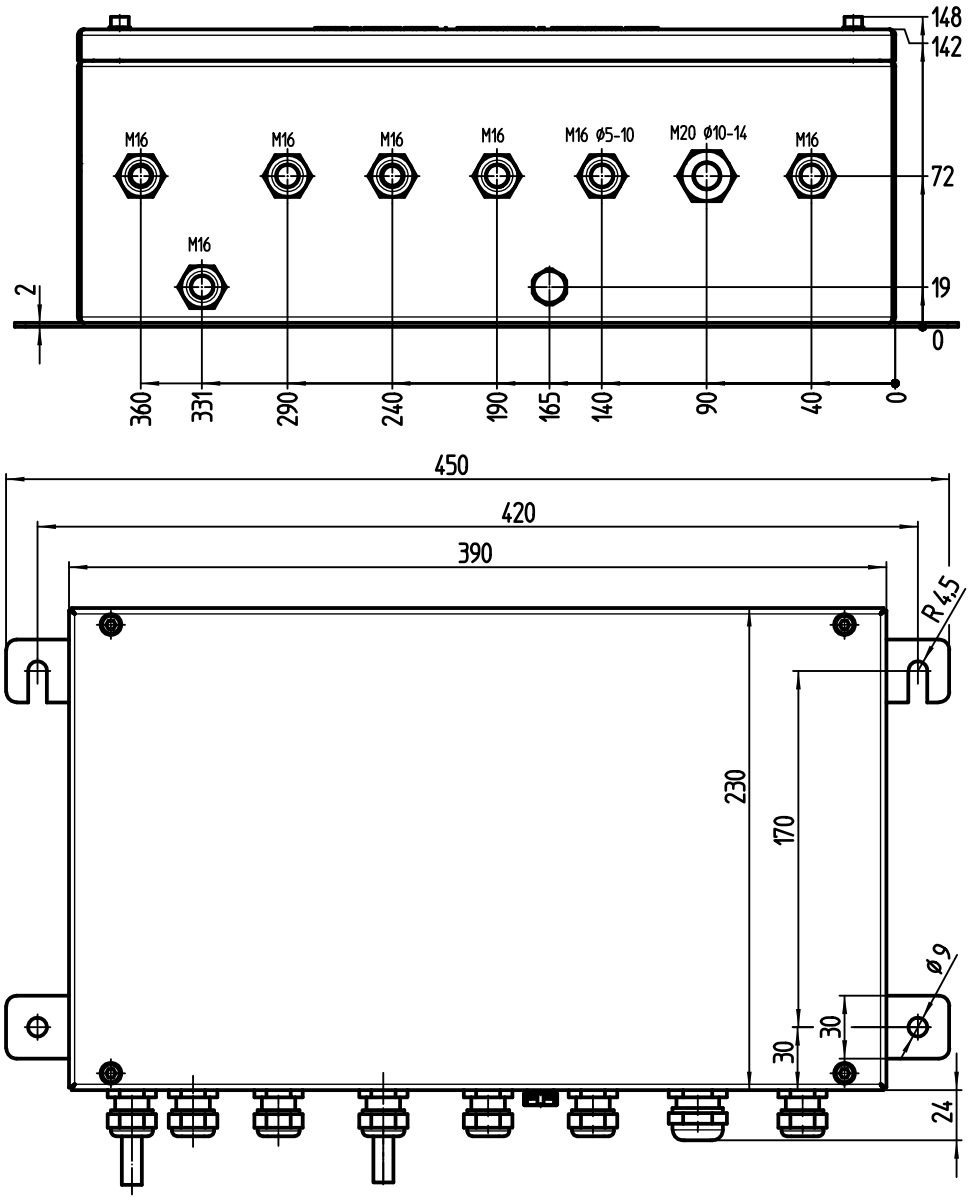


Fig. 46: Connection unit dimensions

11.2 Technical data

Measured variables	Visibility (k-value), NO, NO_2, NO_x, CO, temperature
Maximum number of measured variables	5
Measuring principles	Differential Optical Absorption Spectroscopy (DoAs), transmission measurement, electrochemical cell, resistance thermometer
Measuring path length	10 m
Measuring ranges	
k value	0 … 15 km^{-1} / 0 … 200 km^{-1}
NO	0 … 20 ppm / 0 … 45 ppm
NO_2	0 … 1 ppm / 0 … 5 ppm
CO	0 … 100 ppm / 0 … 300 ppm
Temperature	–20 … +55 °C / –25 … +75 °C
Response time (t_{90})	
Visibility (k-value)	5 s … 360 s
	Adjustable (45 s preset)
NO, NO_2	5 s … 360 s
	Adjustable (45 s preset)
CO	≤ 60 s
Linearity	
NO	± 0.48 ppm
NO_2	± 0.035 ppm
Detection limit	
Visibility (k-value)	0.03 km^{-1}
NO	0.002 ppm
NO_2	0.007 ppm
Repeatability	
Visibility (k-value)	0.017 km^{-1}
NO	0.031 ppm
NO_2	0.007 ppm
Ambient temperature	
	–20 °C … +55 °C
CO sensor	–10 °C … +40 °C
Storage temperature	
	–25 °C … +75 °C
CO sensor	0 °C … +20 °C
Ambient pressure	700 hPa … 1.200 hPa
Ambient humidity	10 % … 95 % relative humidity; non-condensing
Conformities	ASTRA “Guideline - Ventilation of Road Tunnels” (2008) RABT 2006 RVS 09.02.22
Electrical safety	CE
Degree of protection	IP69K
Analog outputs	6 outputs: 0 … 20 mA Depending on device version
Digital outputs	4 relay contacts: Depending on device version
Digital inputs	4 potential-free contacts
I/O extensions	Optional optical fiber connection

Ethernet	✔
Function	Connection with software SOPAS ET or OPC server
Modbus	✔
Type of field bus integration	TCP
CAN bus	✔
Function	For connection of an SCU control unit
Operation	Via software SOPAS ET
Dimensions (W x H x D)	718 mm x 470 mm x 310 mm (sender/receiver unit) 617 mm x 278 mm x 245 mm (reflector unit) 450 mm x 254 mm x 148 mm (connection unit)
Weight	Sender/receiver unit: ± 20 kg Reflector unit: ± 9 kg Connection unit: ± 8 kg
Material	Stainless steel 1.4571, powder coated
Energy supply	
Voltage	115 V / 230 V
Frequency	50 Hz / 60 Hz
Power input	≤ 200 W
Control functions	Automatic check cycle for zero and reference point Contamination monitoring Manual linearity test
Options	CO sensor

11.3 Part Nos.

11.3.1 Device components

Part No.	Designation	Type code
1028793	VIC320-A011 CONNECTION UNIT	VIC320-A011
1041130	VIC320-A012 CONNECTION UNIT	VIC320-A012
1040009	VIC320-A013 CONNECTION UNIT	VIC320-A013
1041069	VIC320-A014 CONNECTION UNIT	VIC320-A014
1088581	VIC320-A0150 CONNECTION UNIT	VIC320-A0150
1044818	VIC320-A0151 connection unit with electrochemical cell for CO	VIC320-A0151
1040643	VIC320-R02 REFLECTOR MS=10M	VIC320-R02
1081791	VIC325-M04 OPTICAL HEAD MS=10M	VIC325-M04
1081792	VIC321-M04 OPTIC HEAD MS=10M	VIC321-M04
1088295	VIC322-M04 OPTIC HEAD MS=10M	VIC322-M04
1088296	VIC323-M04 OPTIC HEAD MS=10M	VIC323-M04

11.3.2 Type code

Device family

VIC	VICOTEC measuring system for tunnels

Measuring components

320	Type No. for reflector and connection unit
321	VIS, NO2
322	VIS, NO
323	VIS, NO, NO2
325	VIS, NO, NOx

System components

M	Detector
R	Reflector
A	Connection unit

Device version

	Detector
00	Special version
02	Without external Ethernet connector - active measuring path 10m
04	With external Ethernet connector - active measuring path 10m
	Reflector
00	Special version
02	Standard version - active measuring path 10m
	Junction box
00	Special version
01	Standard version, 390 x 230 x 140

Interfaces - connection unit and options

	Measuring head or reflector
0	Special version
1	CAN with 6-pole terminal block
2	RJ45 converter for fiber optics connection
3	4AO, 4DO, 4DI
5	6AO, 2AI, 4DO, 4DI

CO measurement, electrochemical (only junction box)

	No
1	Yes

Model

	Standard model
S	Special model
M	Sample model

VIC	320	-	A	01	1	1	S

11.3.3 Accessories

Part No.	Designation
2044095	Laser adjustment unit (2 units)
2060148	Adjustment plate for alignment (recommended)
2038938	Line RJ45/RJ45 with enclosure IP67
2045455	Assembly console made of 1.4571 stainless steel
2045456	Assembly console made of 1.4529 stainless steel
2045457	Fixing accessories for assembly console made of 1.4571 stainless steel
2045458	Fixing accessories for assembly console made of 1.4529 stainless steel
2040063	Test tool in case NO, filter F1, filter F2
2043226	Test tool in case NO, NO2, filter F1, filter F2
2058989	Test tool in case NO2, filter F1, filter F2

11.3.4 Expendable and wearing parts

Part No.	Designation
2086187	SPARE PARTS SET SENDER LAMP DEUTERIUM KOMBI
2086188	SPARE PARTS SET SENDER LAMP LED BLUE
2086189	SPARE PARTS SET SENDER LAMP LOW NO_X
2012785	Drying agent cartridge (reflector)
5323946	Activated charcoal sachet (sender/receiver unit)
2045856	CO sensor

12 Annex

12.1 Conformities and approvals

The technical version of this device complies with the following EU directives and EN standards:

- EU Directive: LVD (Low Voltage Directive)
- EU Directive: EMC (Electromagnetic Compatibility)

Applied EN standards:

- EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use

Laboratory use

- EN 61326, Electrical equipment for measurement, control and laboratory use - EMC requirements

12.2 Mapping table SCU

Mapping Table for SCU parameter settings

12.2.1 Measured values on SCU

- Measured value (MV)

Index	Measured value
MV01	VIS [1/Km]
MV02	T [K]
MV03	NO (not used on VICOTEC321)
MV04	NO2 [ppm]
MV05	CO [ppm]
MV06	NO_X [ppm]

12.2.2 Operating State Table

- States (S)

Index	Operating state
S01	Initialization
S02	Warming up
S03	Measuring
S04	Maintenance
S05	Maintenance Switch
S06	Zero Adjust
S07	Alignment
S08	RCycle
S09	Restart
S10	Span Test

12.2.3 Status

- Failure, Maintenance, Uncertain, Check, Extended

Index	Diagnostic message
F01..F64	Failure messages
M01..M32	Maintenance messages
U01..U08	Uncertain messages
C01..C08	Check messages
E01..E16	Extended messages

12.2.4 Status of measured values

- MVxx (xx = 01...04 and 06)

Index	Diagnostic message
MVxxF01..F64	Failure messages
MVxxE01..E32	Extended messages
MVxxU01..U16	Uncertain messages
MVxxM01..M08	Maintenance messages
MVxxC01..C08	Check messages

12.3 Modbus Mapping Table

12.3.1 Overview

Name	Item	Modicon	Address		Data type	Register type	Comment
		Address	Start	Width			
Component 1 VIS (321, 322, 323, 325)"	Measured Value	35001	5000	2	32 Bit float	Input register	Measuring value
	Status	35003	5002	1	16 Bit integer	Input register	Status 0)
	Start of measuring range	30004	5003	2	32 Bit float	Input register	min of range
	End of measuring range	30006	5005	2	32 Bit float	Input register	max of range
	Offset / C0	30008	5007	2	32 Bit float	Input register	Offset (PK0)
	Slope / C1	30010	5009	2	32 Bit float	Input register	Slope (PK1)
	Correction Factor / C2	30012	5011	2	32 Bit float	Input register	Correction factor (C2 / PK2)
Component 2 Temp (321, 322, 323, 324, 325)	Measured Value		5013	2	32 Bit float	Input register	
	Status		5015	1	16 Bit integer	Input register	
	Start of measuring range		5016	2	32 Bit float	Input register	
	End of measuring range		5018	2	32 Bit float	Input register	
	Offset		5020	2	32 Bit float	Input register	
	Slope		5022	2	32 Bit float	Input register	
	Correction Factor		5024	2	32 Bit float	Input register	
Component 3 NO (322, 323, 324, 325)	Measured Value		5026	2	32 Bit float	Input register	
	Status		5028	1	16 Bit integer	Input register	
	Start of measuring range		5029	2	32 Bit float	Input register	
	End of measuring range		5031	2	32 Bit float	Input register	
	Offset		5033	2	32 Bit float	Input register	
	Slope		5035	2	32 Bit float	Input register	
	Correction Factor		5037	2	32 Bit float	Input register	
Component 4 NO2 (321, 323, 324, 325)	Measured Value		5039	2	32 Bit float	Input register	
	Status		5041	1	16 Bit integer	Input register	
	Start of measuring range		5042	2	32 Bit float	Input register	
	End of measuring range		5044	2	32 Bit float	Input register	
	Offset		5046	2	32 Bit float	Input register	
	Slope		5048	2	32 Bit float	Input register	
	Correction Factor		5050	2	32 Bit float	Input register	
Component 5 CO	Measured Value		5052	2	32 Bit float	Input register	
	Status		5054	1	16 Bit integer	Input register	
	Start of measuring range		5055	2	32 Bit float	Input register	
	End of measuring range		5057	2	32 Bit float	Input register	
	Offset		5059	2	32 Bit float	Input register	
	Slope		5061	2	32 Bit float	Input register	
	Correction Factor		5063	2	32 Bit float	Input register	

Name	Item	Modicon	Address		Data type	Register type	Comment
		Address	Start	Width			
common OUT	Year of current date		5065	1	16 Bit integer	Input register	> 2000 1)
	Month of current date		5066	1	16 Bit integer	Input register	1 – 12 1)
	Day of current month		5067	1	16 Bit integer	Input register	1 – 31 1)
	Hour of current time		5068	1	16 Bit integer	Input register	0 – 23 1)
	Minute of current time		5069	1	16 Bit integer	Input register	0 – 59 1)
	Second of current time		5070	1	16 Bit integer	Input register	0 – 59 1)
	Failure [collective]		5071	2	32 Bit integer	Input register	Bit Field 2)
	Maintenance required [collective]		5073	2	32 Bit integer	Input register	Bit Field 3)
	Reserved		5075	2	32 Bit integer	Input register	
	Out of Spec. [collective]		5077	2	32 Bit integer	Input register	Bit Field 5)
	Reserved		5079	2	32 Bit integer	Input register	
	Temperature		5081	2	32 Bit float	Input register	
	Lamp Current		5083	2	32 Bit float	Input register	Lamp pulse (mA) 12)
	Lamp Integration		5085	2	32 Bit float	Input register	Exposure (ms) 12)
	Temperature Optic Housing		5087	2	32 Bit float	Input register	
	Temperature Spectrometer		5089	2	32 Bit float	Input register	
	reserved		5091	2	32 Bit float	Input register	
	Operating state		5093	1	16 Bit integer	Input register	8)
Component 6 NOX (325)	Measured Value		5094	2	32 Bit float	Input register	
	Status		5096	1	16 Bit integer	Input register	
	Start of measuring range		5097	2	32 Bit float	Input register	
	End of measuring range		5099	2	32 Bit float	Input register	
	Offset		5101	2	32 Bit float	Input register	
	Slope		5103	2	32 Bit float	Input register	
	Correction Factor		5105	2	32 Bit float	Input register	
	reserved	06002	6001	1	1 Bit	Coil	
	Maintenance switch	06004	6003	1	1 Bit	Coil	sticky 10)

12.3.2 Status

Bit No.	Multiplier	Name	Comment
0	0x0001	Failure	Bit=1: active
1	0x0002	Maintenance_Request	Bit=1: active
2	0x0004	reserved	Bit=1: active
3	0x0008	Out of Spec	Bit=1: active
4	0x0010	reserved	Bit=1: active
5	0x0020	reserved	Bit=1: active
6	0x0040	reserved	Bit=1: active
7	0x0080	Maintenance	Bit=1: active
8	0x0100	reserved	Bit=1: active
9	0x0200	Rcycle	Bit=1: active
10	0x0400	reserved	Bit=1: active
11	0x0800	reserved	Bit=1: active
12	0x1000	reserved	Bit=1: active
13	0x2000	reserved	Bit=1: active
14	0x4000	reserved	Bit=1: active
15	0x8000	reserved	Bit=1: active

12.3.3 Failure

Bit No.	Multiplier	Name	Comment
0	0x000001	EEPROM	Bit=1: active
1	0x000002	Spectro com.	Bit=1: active
2	0x000004	Zero com.	Bit=1: active
3	0x000008	Extinction calc	Bit=1: active
4	0x0000010	Reference calc	Bit=1: active
5	0x0000020	IIR Filter	Bit=1: active
6	0x0000040	Interpolation	Bit=1: active
7	0x0000080	Filter com.	Bit=1: active
8	0x0000100	Mirror com.	Bit=1: active
9	0x0000200	Visor fault	Bit=1: active
10	0x0000400	Visor 4Q values	Bit=1: active
11	0x0000800	Zero adj. mc adj.	Bit=1: active
12	0x0001000	Lamp fault	Bit=1: active
13	0x0002000	Visor no signal	Bit=1: active
14	0x0004000	Mirror adj. End	Bit=1: active
15	0x0008000	File measval	Bit=1: active
16	0x0010000	File config	Bit=1: active
17	0x0020000	File conditions	Bit=1: active
18	0x0040000	File espec	Bit=1: active
19	0x0080000	File cact	Bit=1: active
20	0x0100000	Visor com.	Bit=1: active
21	0x0200000	Lamp com.	Bit=1: active

Bit No.	Multiplier	Name	Comment
22	0x0400000	Spectro para.	Bit=1: active
23	0x0800000	Eval modul com.	Bit=1: active
24	0x1000000	Reflector Heating	Bit=1: active
25	0x2000000	LED com.	Bit=1: active
26	0x4000000	LED fault	Bit=1: active
27	0x8000000	Failure eval module	Bit=1: active

12.3.4 Maintenance request

Bit No.	Multiplier	Name	Comment
0	1	Lamp spectro	Bit=1: active
1	2	Lamp 4Q	Bit=1: active
2	4	Data logging: writing data	Bit=1: active
3	8	Data logging: open file	Bit=1: active
4	16	Temp. extern Sensor break	Bit=1: active
5	32	Flashcard missing	Bit=1: active
6	64	Logbook error	Bit=1: active
7	128	IO com.	Bit=1: active
8	256	IO error	Bit=1: active
9	512	ZPR exposure minimum	Bit=1: active
10	1024	CO failure	Bit=1: active
11	2048	Temp. extern short circuit	Bit=1: active
12	4096	MR exposure minimum	Bit=1: active
13	8192	Ratio TPR-MR higher 5	Bit=1: active
14	16384	Ratio TPR-MR lower 1	Bit=1: active
15	32768	MR exposure maximum	Bit=1: active
16	65536	LED Peltier error	Bit=1: active
17	131072	LED temperature mismatch	Bit=1: active
18	262144		Bit=1: active
19	524288		Bit=1: active
20	1048576		Bit=1: active
21	2097152		Bit=1: active
22	4194304		Bit=1: active
23	8388608		Bit=1: active
24	16777216		Bit=1: active
25	33554432		Bit=1: active
26	67108864		Bit=1: active
27	134217728		Bit=1: active
28	268435456		Bit=1: active
29	536870912		Bit=1: active
30	1073741824		Bit=1: active
31	2147483648		Bit=1: active

12.4 Password

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