Operating Instructions
FLOWSIC200 Transmitter

Flow Measuring Devices

Endress+Hauser
People for Process Automation

Described product
Product name: FLOWSIC200 Transmitter

Manufacturer
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Legal information

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

CE

Warning symbols

Hazard (general)

Voltage hazard

Warning levels / 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
Hazard or unsafe practice which *could* result in less severe or minor injuries.

NOTICE
Hazard which *could* result in property damage.

Information symbols

Important technical information for this product

Supplementary information

FLOWSIC200

1 Important information

1.1 Function of this document

These Operating Instructions describe for the FLOWSIC200 Transmitter measuring system:

- Device components
- Installation
- Operation
- For the maintenance work required for safe operation, detailed information on function testing/device setting, data backup, software update, fault and error handling and possible repairs, see the Service Manual.

Retention of documents

► Keep these Operating Instructions and all associated documents available for reference.

► Pass the documents on to a new owner.

1.2 Scope of application

These Operating Instructions apply exclusively to the FLOWSIC200 Transmitter measuring system with the described system components.

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

These Operating Instructions cover standard applications which conform with the technical data specified. Additional information and assistance for special applications are available from your Endress+Hauser representative.

It is generally recommended to take advantage of qualified consulting services provided by Endress+Hauser experts for your specific application.

1.3 Target groups

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

Requirements on the personnel's qualification

The measuring system may only be installed and operated by skilled technicians who, based on their technical training and knowledge as well as knowledge of the relevant regulations, can assess the tasks given and recognize the hazards involved. Skilled persons are persons according to DIN VDE 0105, DIN VDE 1000-10 or IEC 60050-826 or directly comparable standards.

The named persons must have exact knowledge of operational hazards caused, e.g., by low voltage, hot, toxic, explosive gases or gases under pressure, gas-liquid mixtures or other media as well as adequate knowledge of the measuring system gained through training.

1.4 Data integrity

Endress+Hauser 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 always assumes that the customer ensures the integrity and confidentiality of data and rights affected in connection with the use of 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.

1.5 Intended use

Purpose of the device

The FLOWSIC200 Transmitter measuring system is used for non-contact measurement of flow velocity and air temperature in traffic tunnels (road, railroad tunnels) or can be used in other tunnel facilities.

Correct use

- Only use the device as described in these Operating Instructions. The manufacturer bears no responsibility for any other use.
- Observe all measures necessary for conservation of value, e.g., for maintenance and inspection and/or transport and storage.
- Do not remove, add or modify any components to or on the device unless described and specified in the official manufacturer information. Otherwise, the device could become a hazard, any warranty of the manufacturer is void.

1.6 Safety information and protective measures

1.6.1 General information

WARNING: General information

Improper use or handling can cause health or material damage. Read this Section carefully and ensure you observe the safety precautions during all work on the FLOWSIC200 Transmitter, as well as the warning and caution information in the individual Sections of these Operating Instructions.

Adhere to the following:

- The relevant legal stipulations and associated technical regulations must be observed when preparing and carrying out work on the installation.
- All work must be carried out in accordance with the local, system-specific conditions and with due consideration to operating hazards and specifications.
- The Operating Instructions belonging to the measuring system as well as system documentation must be available on site. Always observe the information on the prevention of injuries and damage given therein.

WARNING: Danger through power voltage

The FLOWSIC200 Transmitter measuring system is an item of electrical equipment designed for use in industrial high-voltage systems.

- Disconnect power supply lines before working on power connections or parts carrying power voltage.
- Refit any contact protection removed before switching the power voltage back on again.
- The device may only be operated with the cover closed.
- Before opening the cover, the device must be disconnected from the power supply.
- The device must not be used when the electrical wiring (cables, terminals, ...) is damaged.

WARNING: Hazards through ultrasonic signals

Do not expose unprotected hearing to the sonic beam of the transducer.

- Wearing suitable hearing protection is recommended when inspecting the duct, connecting the device outside the duct or similar activities.

NOTICE:

The user must ensure:

- Neither failures nor erroneous measurements can lead to operational states that can cause damage or become dangerous.
- The specified maintenance and inspection tasks are carried out regularly by qualified, experienced personnel.

NOTICE:

The operator must ensure the following to avoid malfunctions that can indirectly or directly lead to injuries to persons or material damage:

- The responsible maintenance personnel are at hand at all times and as quickly as possible
- The maintenance personnel are adequately qualified to react correctly to malfunctions of the measuring system and any resulting operational interruptions (e.g., when used for measurement and control purposes),
- The malfunctioning equipment is switched off immediately in case of doubt and that switching off does not cause collateral malfunctions.

1.6.2 Basic safety information

Observe the safety information here and the warning information in the following Sections of these Operating Instructions to reduce health risks and avoid dangerous situations.

In the case of warning symbols on the devices, the Operating Instructions must be consulted to determine the nature of the potential hazard and the actions required to avoid the hazard.

- ► Only put the FLOWSIC200 Transmitter into operation after reading the Operating Instructions.
- ► Observe all safety information.
- ► If there is something you do not understand: Contact Endress+Hauser Customer Service.
- ► Only use the FLOWSIC200 Transmitter measuring system as described in these Operating Instructions. The manufacturer bears no responsibility for any other use.
- ► Do not carry out any work or repairs on the FLOWSIC200 Transmitter not described in this Manual.
- ► Do not remove, add or modify any components to or on the FLOWSIC200 Transmitter unless described and specified in the official manufacturer information.
- ► Only use accessories approved by the manufacturer.
- ► Do not use damaged components or parts.
- ► If you do not follow these guidelines, the following applies:
  - ► Any warranty by the manufacturer becomes void.
  - ► The FLOWSIC200 Transmitter can become dangerous.

1.6.3 Detecting malfunctions

Any deviations from normal operation must be regarded as a serious indication of a functional impairment. These include:

- Significant drifts in the measuring results
- Increased power input
- A rise in system component temperatures
- Triggering of monitoring devices
- Unusually strong vibrations or unusual operating noise from a purge air/cooling air blower
- Smells or smoke emission

1.6.4 Preventing damage

To prevent personal injury or damage to the system, the operator must ensure:

- The responsible maintenance personnel are at hand at all times and as quickly as possible
- The maintenance personnel is sufficiently qualified to respond to malfunctions on the FLOWSIC200 Transmitter and any resulting operational malfunctions
- Malfunctioning equipment is switched off immediately in case of doubt and that switching off does not cause collateral failures

FLOWSIC200

2 Product description

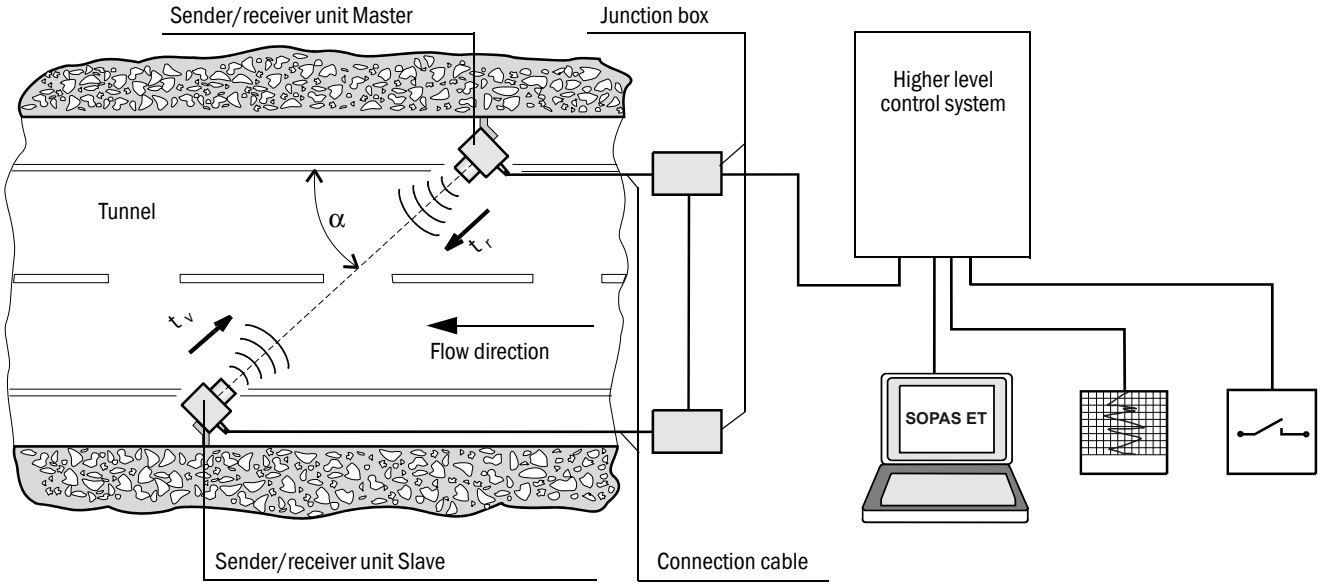
System overview, functional principle
System components
Computations
Check cycle

2.1 System overview, functional principle

2.1.1 System overview

- FLSE200 sender/receiver unit
  for transmitting and receiving ultrasonic pulses
- Bracket for FLSE200
  for mounting the sender/receiver units on the tunnel wall
- Connection cable
  Junction box for connection cable
- Connection cable to connect the FLSE200 to the junction box

Fig. 1 System components FLOWSIC200 Transmitter



2.1.2 Communication between sender/receiver units and higher level control system

Standard version

The two sender/receiver units (FLSE) work as Master and Slave. The master FLSE has a second interface to be able to completely separate communication to the slave FLSE and to the higher level control system. The master triggers the slave and controls measurement. The higher level control system can request measured values from the master unit independent of the measuring cycle (asynchronous).

For wiring, the junction box is installed on both FLSEs. Interface division runs in the master FLSE junction box.

Fig. 2 Bus connection FLSE200 - one measuring point

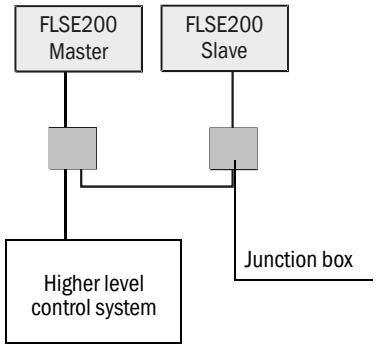
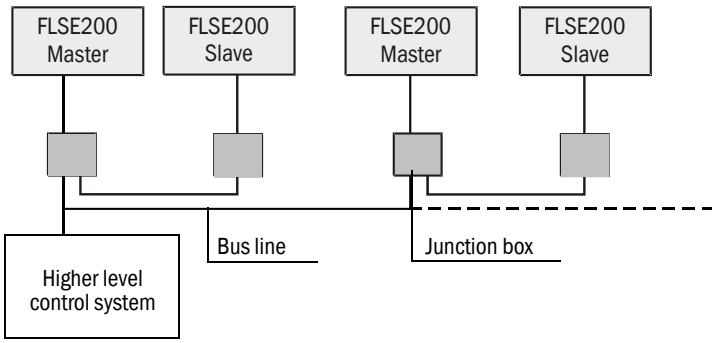


Fig. 3 Bus connection FLSE200 - several measuring points



NOTICE:

- For bus wiring, the factory-set termination must be disabled in the system components not at the end of the line.
- To ensure the power supply for all connected measuring points, follow the instructions on → p. 38, §3.3.2.2.
- The sender/receiver units of the FLOWSIC200 Transmitter can be set to address 1 ... 7 on the hardware side(→ p. 30, §3.2.2.2).
- The physical order of the sensors on the bus does not necessarily have to match the logical address assignment, it is just not allowed to assign addresses twice.

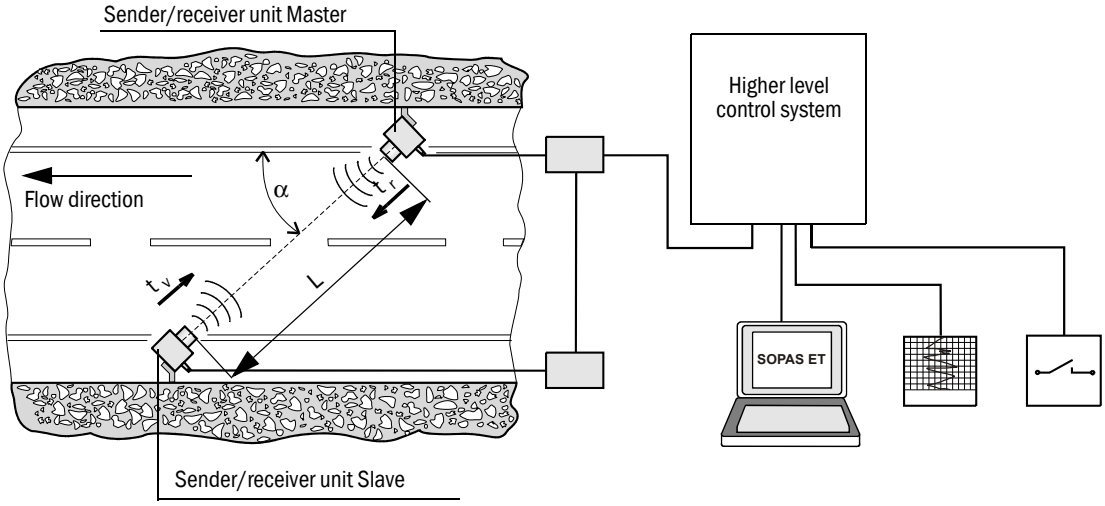
2.1.3 Functional principle

The FLOWSIC200 Transmitter works according to the principle of ultrasonic transit time difference measurement. Sender/receiver units are mounted on both sides of a tunnel at a certain angle of inclination to the gas flow (→ Fig. 4).

The sender/receiver units contain piezoelectric ultrasonic transducers which operate alternately as senders and receivers. The sound pulses are emitted at an angle α to the flow direction. Depending on angle α and the flow velocity, the transit time of the respective sound direction varies as a result of certain “acceleration and braking effects” (formulas 2.1 and 2.2). The higher the flow velocity and the smaller the angle to the flow direction are, the higher the difference in the transit times of the sound pulses.

Flow velocity v is determined from the difference of both transit times, independent of the sound velocity value. With this measuring method, changes of the sound velocity due to pressure or temperature fluctuations therefore have no influence on the flow velocity determined.

Fig. 4 Functional principle FLOWSIC200 Transmitter



$$v = \frac{L}{2 \cdot \cos \alpha} \cdot \left(\frac{1}{t_v} - \frac{1}{t_r} \right)$$

v = flow velocity in m/s
L = measuring distance in m
α = angle of inclination in °
t_v = sound transit time in flow direction
t_r = sound transit time against the flow

Determining the flow velocity

Measuring distance L is equivalent to the active measuring distance, i.e. the free flow path. Given measuring distance L, sound velocity c, and angle of inclination α between the sound and flow direction, the following applies for the transit time of the sound when sound is emitted in flow direction (forward direction):

$$(2.1) \quad t_v = \frac{L}{c + v \cdot \cos \alpha}$$

Valid against the flow is:

$$(2.2) \quad t_r = \frac{L}{c - v \cdot \cos \alpha}$$

The resolution to v gives:

$$(2.3) \quad v = \frac{L}{2 \cdot \cos \alpha} \cdot \left(\frac{1}{t_v} - \frac{1}{t_r}\right)$$

A relation in which, apart from the two measured transit times, only the active measuring distance and the angle of inclination are constants.

Determining the air temperature

The temperature dependency of the sound velocity allows using the calculated transit times to determine the air temperature.

Simultaneous detection of flow velocity and temperature can be used to warn of icy conditions when the road surface is wet and temperatures are below or around freezing point.

The sound velocity is obtained by resolving to c:

$$(2.4) \quad c = \frac{L}{2} \cdot \left(\frac{t_v + t_r}{t_v \cdot t_r}\right)$$

For the temperature dependence of the sound velocity, the following applies with standard sound velocity c_0 at 0 °C (= 331.4 m/s) and air temperature ϑ in °C:

$$(2.5) \quad c = c_0 \cdot \sqrt{1 + \frac{\vartheta}{273\ °C}}$$

This results in the following for the air temperature:

$$(2.6) \quad \vartheta = 273\ C \cdot \left(\frac{L^2}{4 \cdot c_0^2} \cdot \left(\frac{t_v + t_r}{t_v \cdot t_r}\right) - 1\right)$$

Formula 2.6 shows that the determined temperature depends not only on the measured transit times but also quadratically on the measuring distance and the standard sound velocity.

This means precise temperature measurement is only possible when measuring distance L has been determined very accurately and a calibration has been carried out (→ p. 64, §4.2.62) and the air composition is constant.

2.2 System components

2.2.1 FLSE200 sender/receiver unit

The sender/receiver unit consists of the electronics unit and the ultrasonic transducer. The electronics unit contains all the necessary assemblies for signal processing, digitalization and communication. The ultrasonic transducer is firmly connected to the enclosure.

The sender/receiver unit is supplied with 24 V. Communication to higher level control system is via a bus-capable serial connection.

The sender/receiver units are available in three versions:

Sender/receiver unit type		
FLSE200-M	**FLSE200-HM**	**FLSE200-H**
Use without special requirements	Use in highly saline ambient air	Use in highly saline ambient air, for large measuring distances or interference with ultrasonic transmission
Aluminum transducer, medium power, in protective tube made of aluminum protection	Titanium transducer, medium power	Titanium transducer, high power
Electronics unit housing made of aluminium, anodized, powder-coated and painted grey	Electronics unit housing made of stainless steel V4A	Electronics unit housing made of stainless steel V4A
Measuring distance 5 … 25 m		Measuring distance 5 … 40 m

The protective tube of the FLSE200-M serves to protect the ultrasonic transducer from excessive contamination and mechanical damage (e.g. during tunnel cleaning).

Fig. 5 FLSE200-M sender/receiver unit

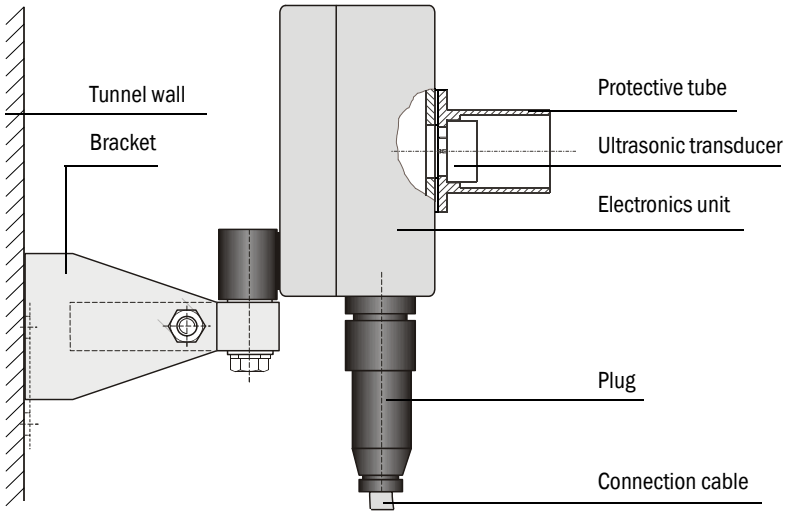
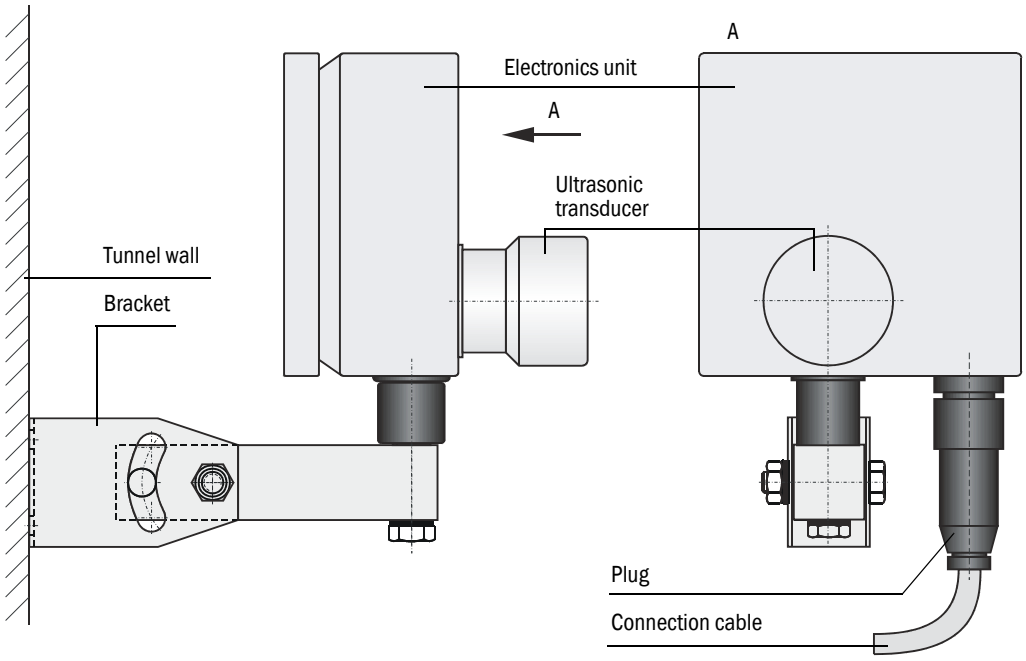


Fig. 6 FLSE200-H, FLSE200-HM sender/receiver unit



2.2.2 Bracket for sender/receiver unit

The bracket serves mounting the sender/receiver unit. It also allows the FLSE200s to be aligned with each other with the required accuracy. Two hexagonal bolts and dowels serve to fasten the bracket on the tunnel wall (or ceiling).

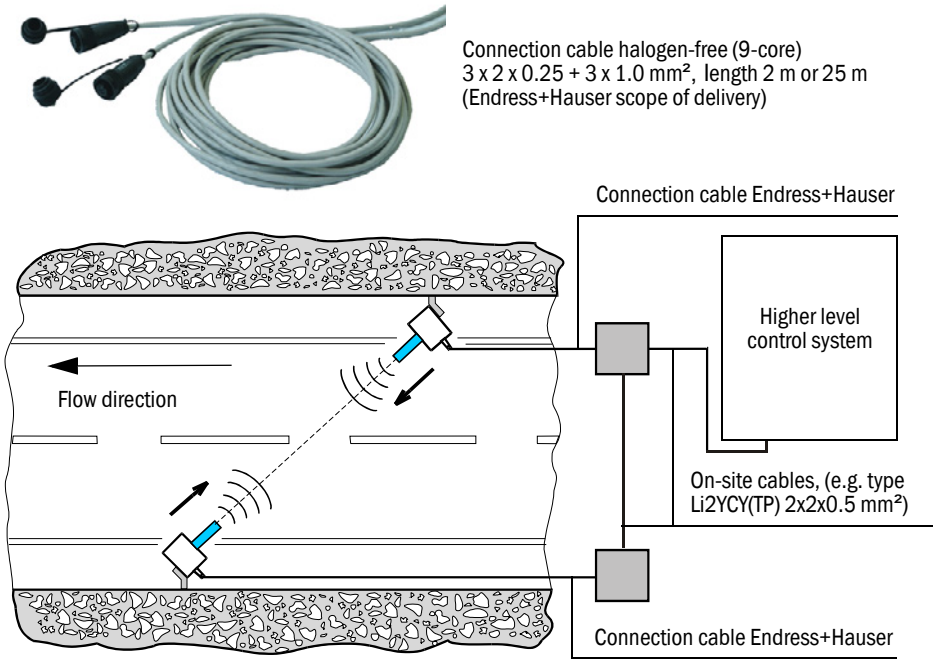
The brackets are adapted to the respective sender/receiver unit design, i.e. there are two types:

- Bracket for FLSE200-M (→ p. 18, Fig. 5)
  Parts made of stainless steel and aluminium.
- Bracket for FLSE200-H or FLSE200-HM (→ Fig. 6)
  All parts made of stainless steel.

2.2.3 Connection cable

The sender/receiver units are connected to the junction boxes using cables included in the scope of delivery. The junction boxes must be connected to the higher level control system via on-site cables

Fig. 7 Connection cable



2.2.4 Mounting kit

Various mounting kits are available for mounting the bracket assemblies for the sender/ receiver unit and junction box on the tunnel wall or ceiling. Selection depends on the actual requirements. The Table below lists the respective parts and their usage options.

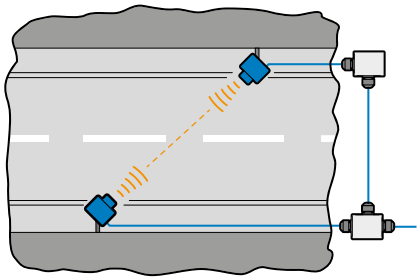
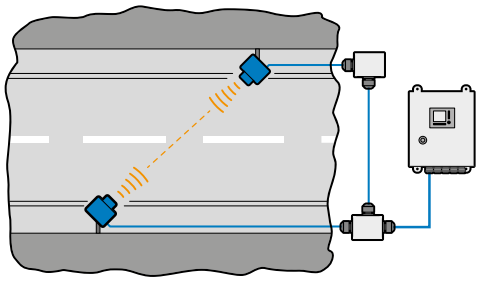
Mounting kit		Usage		
Designation (Part No.)	Components	Requirements	For component	Qty. per comp.
2D8-1.4571/PA (2031888)	– 2x Fischer dowel S10 – 2x hexagon wood-screw 8*50 A4	No special	– Bracket for FLSE200-M – Bracket for FLSE200-HM – Bracket for FLSE200-H	1
2M8-1.4571 (2031891)	– 2x dowel SLM 8N A4 – 2x hexagon screw 8*55 A4	Stainless steel only	– Bracket for FLSE200-M – Bracket for FLSE200-HM – Bracket for FLSE200-H	1
			– Junction box in stainless steel housing	2
2M8-1.4529 (2031886)	2x Fischer anchor bolt FAZ 8/10 C	Aggressive ambient air	– Bracket for FLSE200-M – Bracket for FLSE200-M Material 1.4529 – Bracket for FLSE200-HM – Bracket for FLSE200-H – Bracket for FLSE200-H and FLSE200-HM 1.4529	1
4D8-1.4571/PA (2031889)	– 4x Fischer dowel S10 – 4x hexagon wood-screw 8*50 A4	No special	– Junction box in stainless steel housing	1
2D4-1.4571/PA (2031890)	– 2x Fischer dowel S6 – 2x round head wood-screw 3.5*40 A4		– Junction box	1
4M8-1.4529 (2031887)	4x Fischer anchor bolt FAZ 8/10 C	Aggressive ambient air	– Junction box in stainless steel housing	1

2.3 System configuration

The FLOWSIC200 Transmitter is a basic measuring system and can be extended with an optional control unit.

The control unit offers additional functions, such as further analog and digital interfaces, an additional 230 V AC voltage supply and a display to show the measured values.

Fig. 8 Comparison of variants

	FLOWSIC200 Transmitter	FLOWSIC200
		
Standard delivery scope	Sensors incl. interconnection cable	Sensors incl. interconnection cable
	-	MCU
I/O	Modbus® RTU	Modbus® RTU/TCP Analog incl. HART digital / frequency PROFIBUS
Display	No	Yes
Voltage supply	24 V DC	24 V DC 90 V ... 250 V DC
Advantages	Lean measurement solution for basic requirements	Extended functionality

2.4 Computations

2.4.1 Flow velocity calibration

When the measured velocity does not agree with the mean value of the flow velocity in the entire tunnel cross-section, the FLOWSIC200 Transmitter can be calibrated by a network measurement with a comparison measuring system. Regression coefficients Cv2, Cv1 and Cv0 are determined from the measured values of the two measuring systems, which are entered into the FLOWSIC200 Transmitter during parameterization (→ p. 64, §4.2.6). The device then calculates the calibrated flow velocity v from measured value x of the FLOWSIC200 Transmitter according to the following formula:

$v = Cv2 \cdot x^2 + Cv1 \cdot x + Cv0$

If no calibration is required, Cv2, Cv0 = 0, Cv1 = 1 (default factory setting). The value x then corresponds to the representative velocity.

2.4.2 Temperature calibration

The calibration of the temperature measurement with the FLOWSIC200 Transmitter can be done by a comparison measurement with a separate temperature sensor (e.g. Pt100), but is generally not necessary, since the active measuring distance can be determined extremely accurately (± 1 cm) (see formula 2.6, → p. 16, §2.1.3).

2.5 Check cycle

2.5.1 Overview

To test whether all device components are functioning correctly, a check cycle can be triggered on the FLOWSIC200 Transmitter. Any deviations from normal behavior are output as a warning or error.

The check cycle includes the zero point check. The check values can be called up via the SOPAS user interface and MODBUS. The progress of a check cycle is displayed in the SOPAS user interface and in the MODBUS device status.

- ▶ The last measured value is output via MODBUS for the duration of the check cycle (approx. 6 s if there are no errors).
- ▶ The zero point check and check cycle can be triggered manually via the SOPAS user interface in the “Manual function check” menu.

The detailed description of the MODBUS protocol is available for download as a separate document.

2.5.2 Zero point check

A special circuit arrangement in the sender/receiver units ensures transmission signals from the transducers can be read back without delay and with the original waveform. These transmission signals are received as reception signals, amplified, demodulated, and evaluated. If the device is operating correctly, the exact zero point is calculated here. This check comprises a full check of all the system components, including the transducers. A warning is output for offsets greater than approx. 0.25 m/s (depending on the measuring distance and gas temperature). In this case, check the transducers and electronic components. If the signal amplitude or waveform does not match the expected values, the transducers or electronic components are defective and, in this case, an error message is output.

A check cycle is output via the SOPAS user interface and MODBUS as follows:

- Result value: “Zero point offset”
- Warning “Zero point offset”

FLOWSIC200

3 Mounting and electrical installation

Project planning
Mounting
Electrical installation

3.1 Project planning

3.1.1 Planning steps

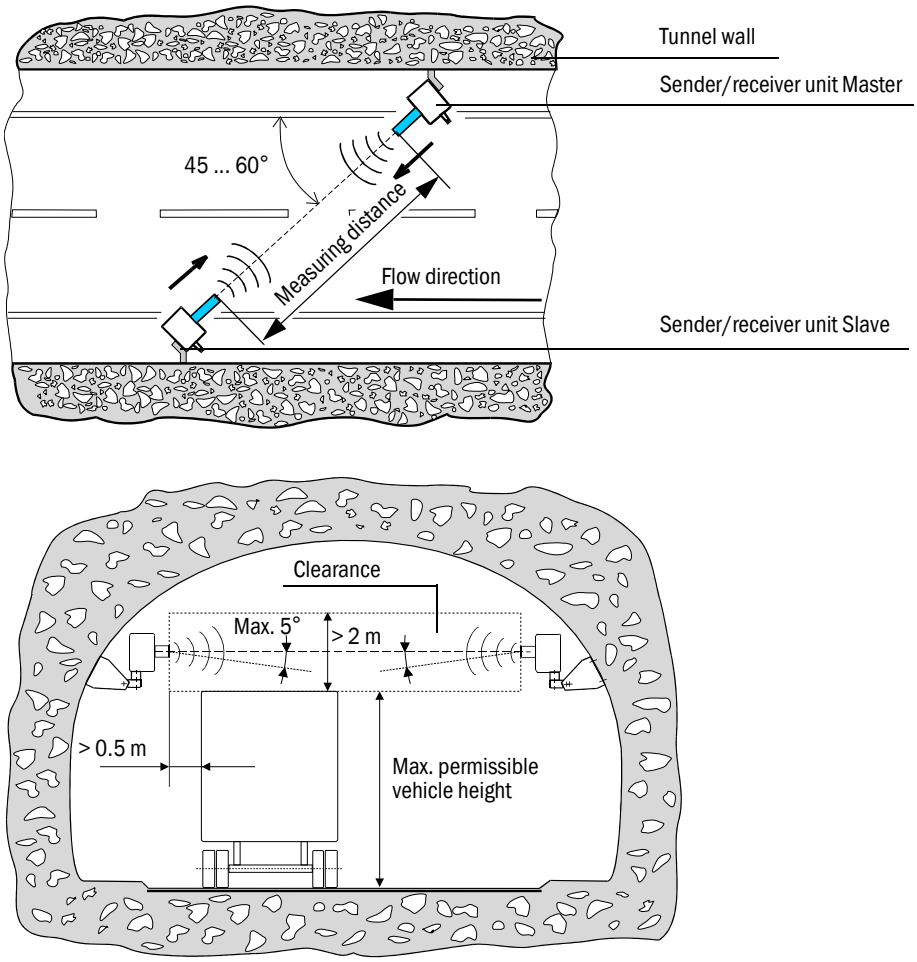
Plan the following before starting assembly and installation work:

- Determine measuring location(s).
- Select system components according to → p. 18, §2.2 meeting the conditions of use and customer requirements.
- Define installation locations for sender/receiver units and junction boxes.
- Plan power supply.

3.1.2 Requirements for the installation location for the sender/receiver units

The master and slave sender/receiver units must be installed on opposite tunnel walls at a sufficient height above the road surface, offset to the side (→ Fig. 9). The angle between the measuring axis and tunnel axis should not be significantly greater than 60° (minimum value 45°).

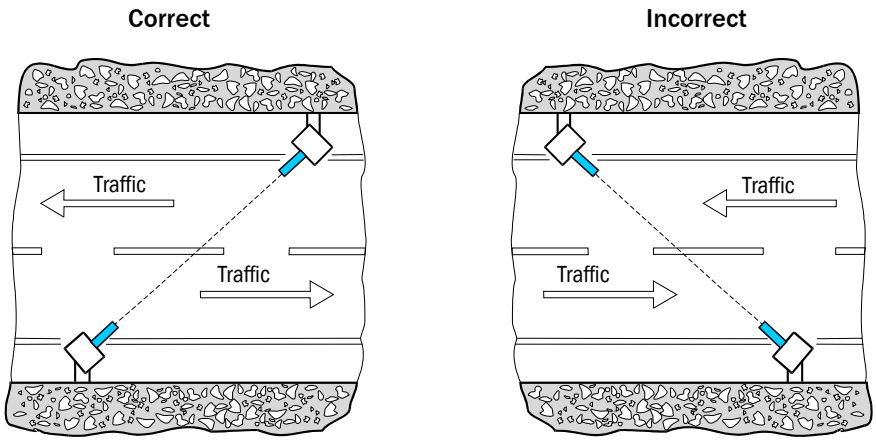
Fig. 9 Installation location for sender/receiver units



WARNING:

- The measuring distance between the opposite sender/receiver units must be free of fixtures or similar to ensure unobstructed sound propagation (observe clearance as specified in → p. 26, Fig. 9).
- The minimum distance to passing vehicles must be maintained (→ p. 26, Fig. 9).
- Arrange the sender/receiver units so that as little splash water and dirt as possible can hit the transducers, i.e. with the direction of travel of the vehicles (→ Fig. 10).

Fig. 10 Arrangement of sender/receiver units



- If, due to structural conditions, the measurement axis has to be set so low that the maximum permissible vehicle height reaches into the necessary clearance, the measurement can be interrupted in the event of traffic congestion.
- If the required distance between the measurement axis and tunnel ceiling cannot be maintained, especially in the case of rectangular tunnel cross-sections, sound reflections can occur on the tunnel ceiling with resulting measurement disturbances.

This can be remedied by slightly tilting the measuring axis of both sender/receiver units downward by max. 5° (→ p. 26, Fig. 9) or by installing sound-absorbing materials on the tunnel ceiling.

3.2 Mounting

Carry out all assembly work on-site. This includes:

- ► Fitting the brackets for the sender/receiver units.
- ► Configuring the bus systems (when used).
- ► Fitting the sender/receiver units and junction boxes.

WARNING:

- ▸ Observe the relevant safety regulations as well as the safety notices in Section 1 during all assembly work!
- ▸ If possible, only carry out assembly work when the tunnel is closed!
- ▸ Take suitable protective measures against possible hazards!

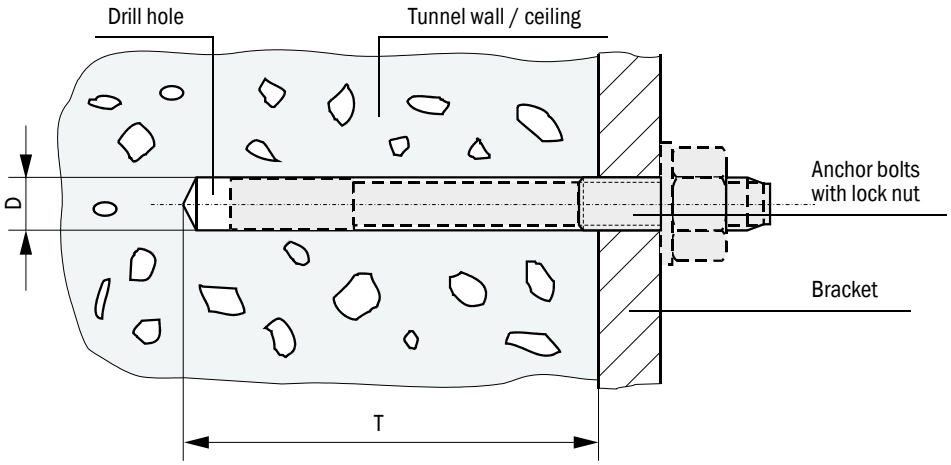
All dimensions in mm.

3.2.1 Fitting the brackets for the sender/receiver units

The brackets are fastened to the tunnel wall/ceiling with the respective required mounting kit (selection according to Section → p. 21, §2.2.4). The following steps are then necessary:

- ► Drill 2 holes 40 mm apart (drill hole dimensions → Fig. 11).
- ► Insert dowels (mounting kits 2D4/2D8/4D8-1.4571/PA, 2M8-1.4571) or anchor bolts (mounting kit 2M8/4M8-1.4529).
- ► Fasten the brackets with the hexagon head screws or nuts.

Fig. 11 Drill hole dimensions



Mounting kit	Dia.	Depth	Remark
2D4-1.4571/PA	6	≥40	The dowel should be flush with the tunnel wall/ ceiling
2D8/4D8-1.4571/PA	10	≥70	
2M8-1.4571	12	≥60	
2M8/4M8-1.4529	8	≥65	The anchor bolt must not protrude more than 12 mm from the tunnel wall/ceiling

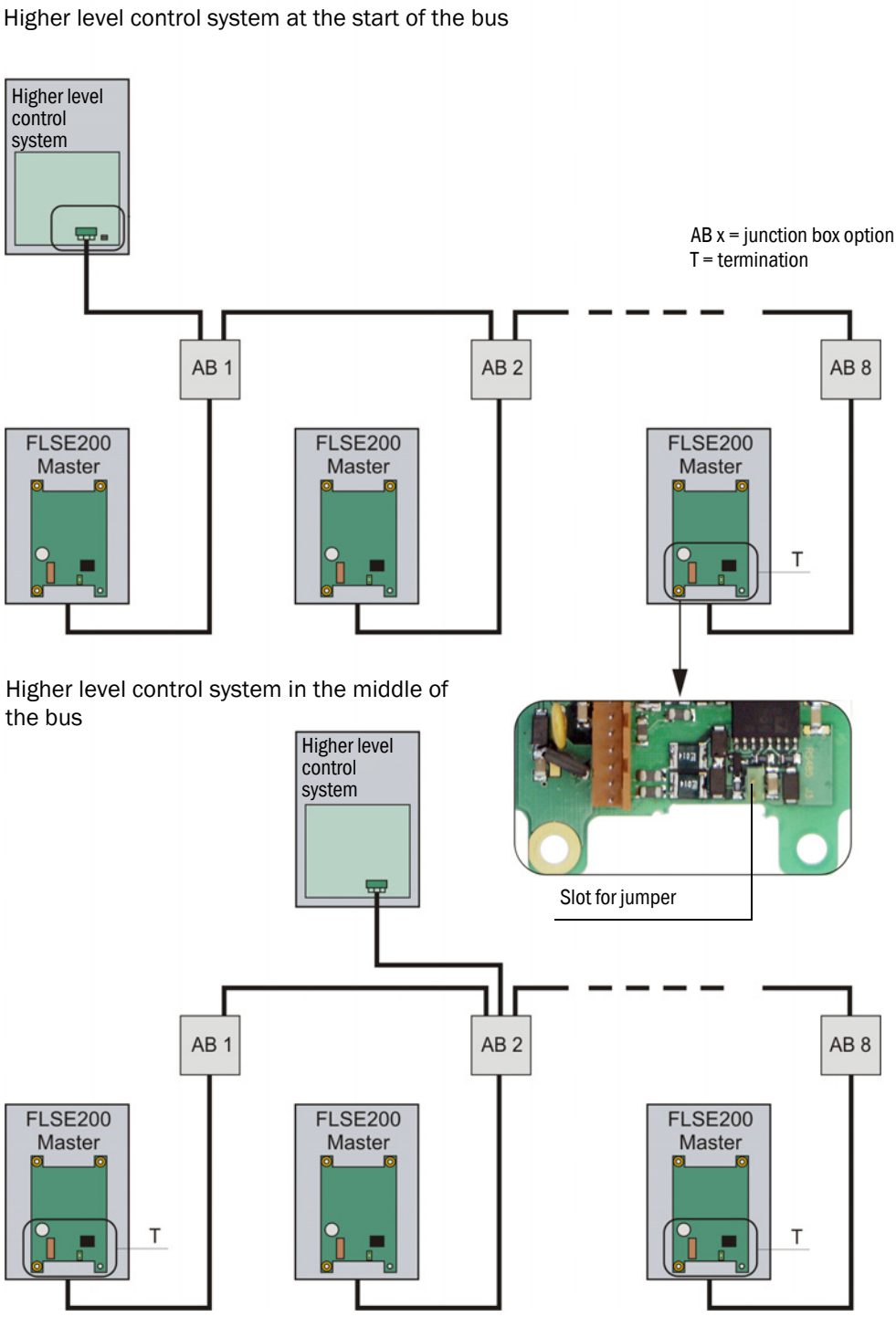
3.2.2 Setting the bus systems

3.2.2.1 Check the termination

The connection between the sender/receiver units and the higher level control system must be terminated at both ends with resistors. Jumpers are already present on the boards of the FLSE200 Master.

To check/change the termination, open the sender/receiver units, position the jumpers on the respective pins depending on the higher level control system layout, and then close the device components again.

Fig. 12 Termination



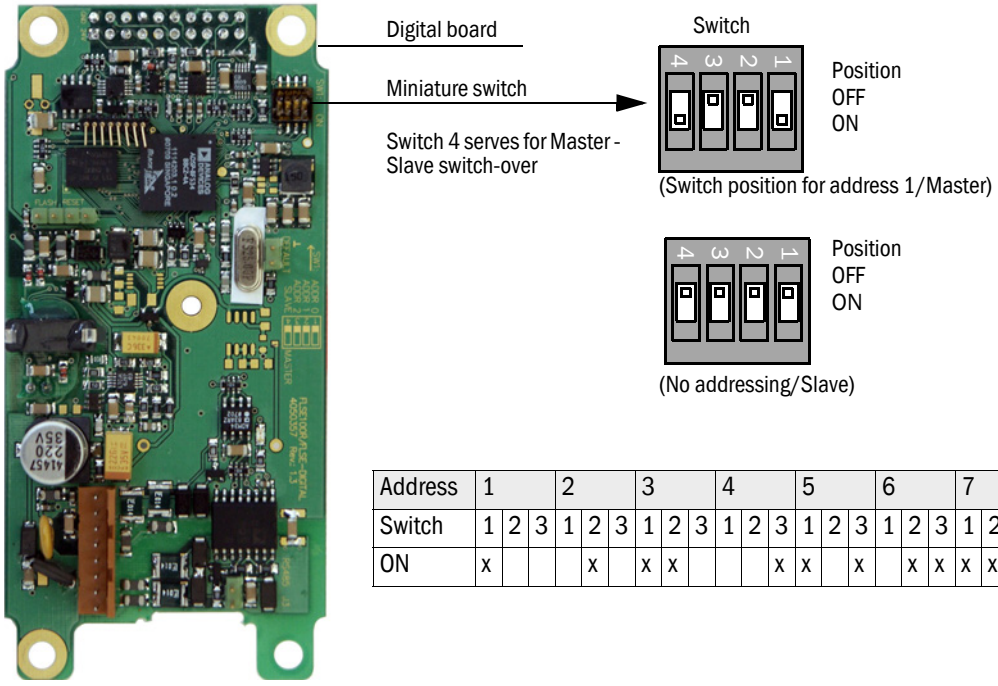
3.2.2.2 Bus addressing via hardware setting

The bus address of a sender/receiver unit (only Master) required for the bus systems can be assigned by hardware or software. Hardware addressing is read in when SOPAS ET starts (→ p. 42, §4.1) and has a higher priority than software addressing.

> ***NOTICE:***
> For bus systems, it must be ensured that the bus addressing of the Master FLSE200 is set correctly.
> The sender/receiver units must have different addresses. Identical addresses for several units cause the communication with the higher level control system to abort!

As standard, the address is set using a miniature switch on the digital board in the sender/receiver unit (3 switches for hexadecimal addressing from address 1 to 7; → Fig. 13). To change the address, open the sender/receiver unit and set the desired address. Then close the sender/receiver unit again.

Fig. 13 Hardware addressing of sender/receiver unit



Address	1			2			3			4			5			6			7		
Switch	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
ON	x				x		x	x				x	x		x		x	x	x	x	x

3.2.3 Fitting the sender/receiver units

Attach the sender/receiver units to the fitted brackets. Arrange with the connection cable downwards (→ Fig. 14 and → p. 32, Fig. 16, as well as → p. 33, Fig. 18) should be preferred.

For precise alignment to each other according to → p. 33, §3.2.4, the sender/receiver units can be rotated vertically and tilted horizontally over a wide range. This allows easy adaptation to local conditions such as the slope of the tunnel wall, road inclination, curves.

The two mounting holes in the part of the bracket that is directly connected to the sender/receiver unit serve to increase or extend the swivel range in the horizontal direction.

FLSE200-M sender/receiver unit

Fig. 14 Positioning with connection cable from below

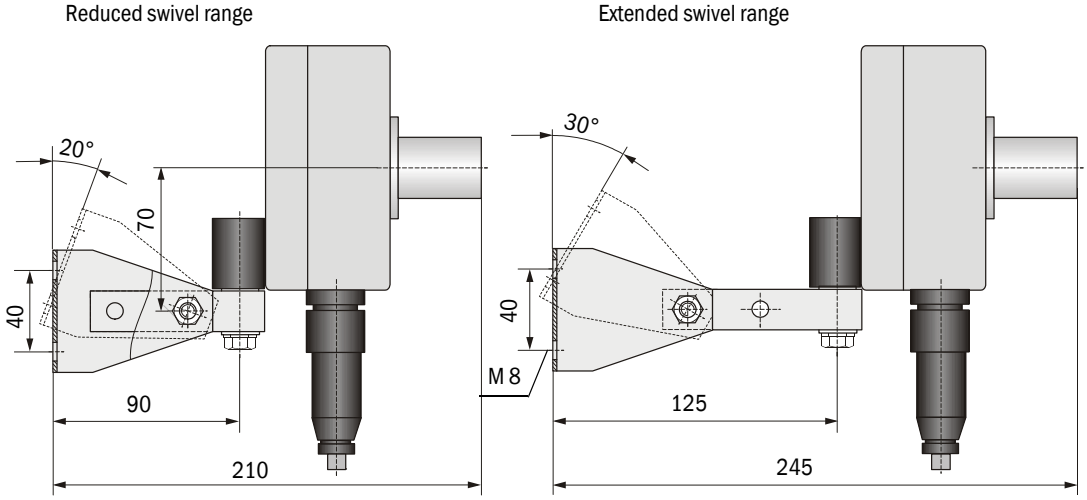


Fig. 15 Positioning with connection line from above

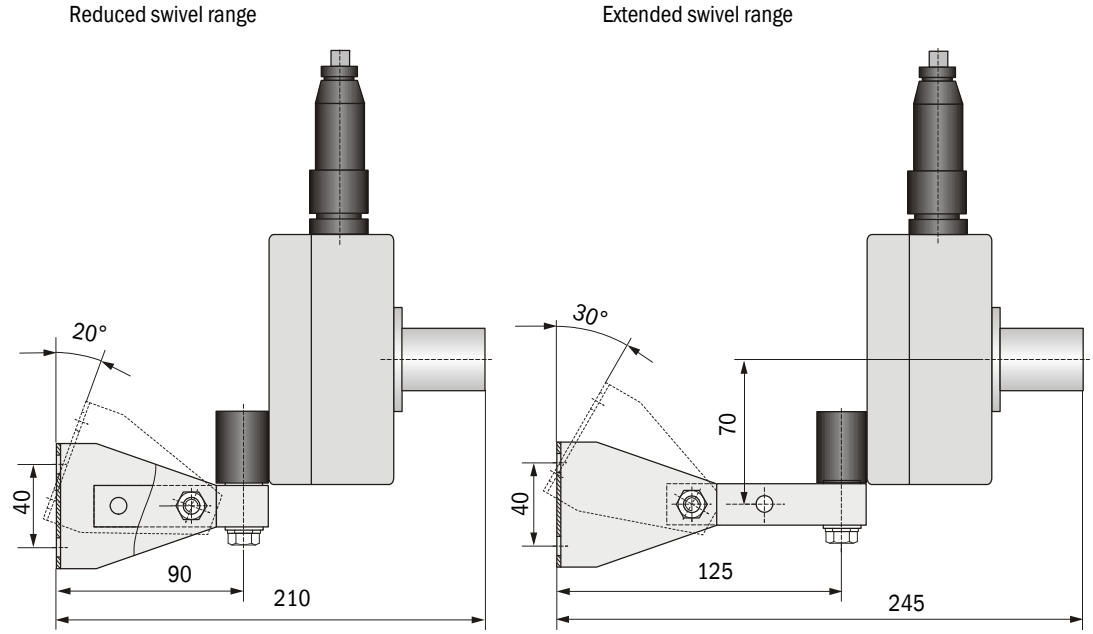


Fig. 16 Hanging positioning with connection line from below

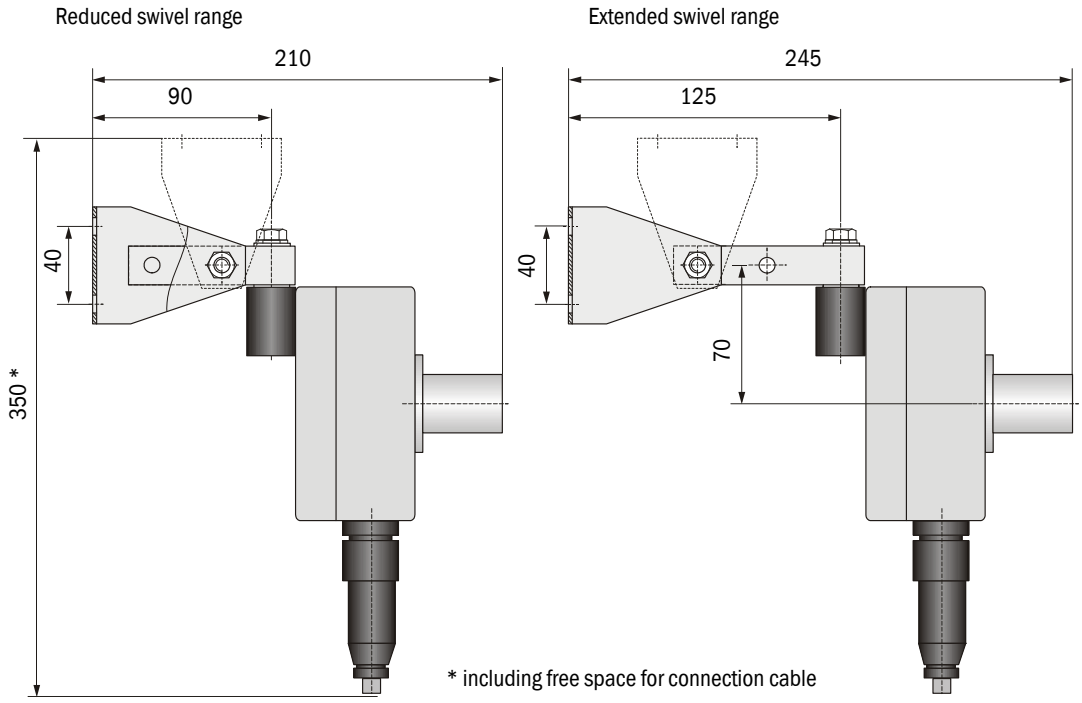
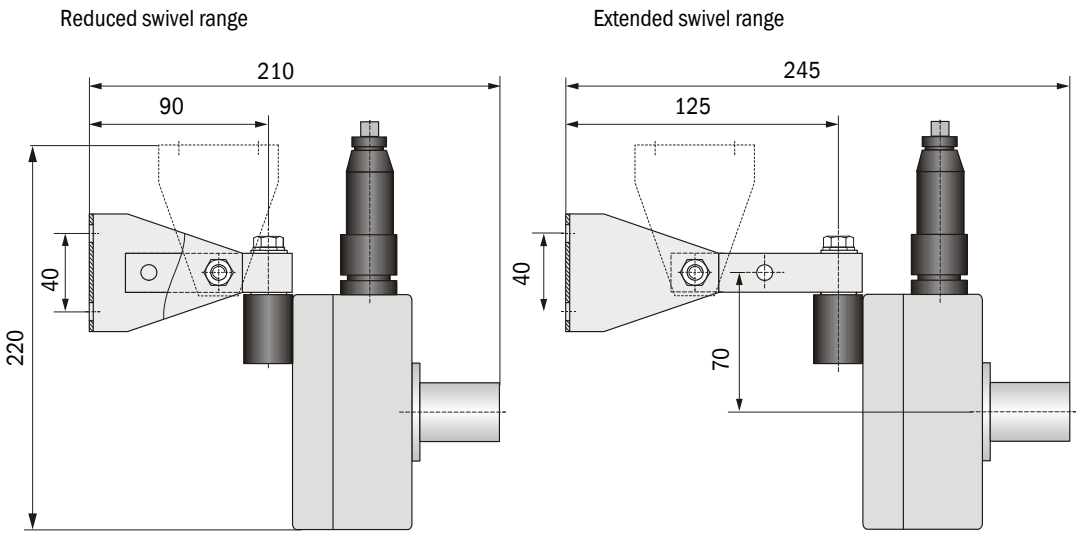
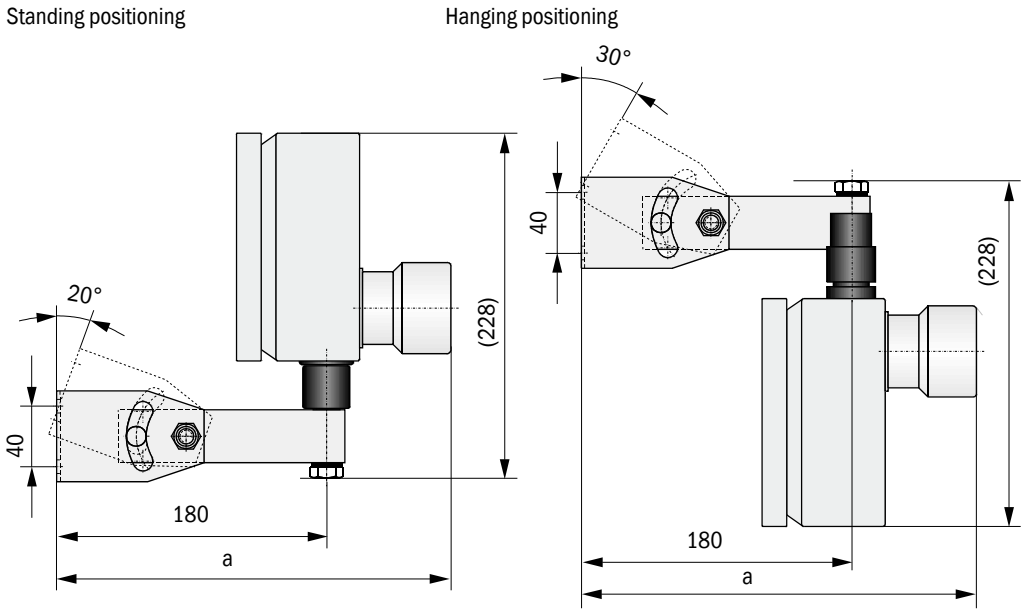


Fig. 17 Hanging positioning with connection line from above



FLSE200-H / FLSE200-HM sender/receiver unit

Fig. 18 Installing the FLSE200-H / FLSE200-HM sender/receiver unit



FLSE200-H FLSE200-HM
a =263

3.2.4 Aligning the sender/receiver units

After installation, the sender/receiver units must be aligned so that the respective transmission directions match (→ Fig. 19 and → p. 34, Fig. 20).

Fig. 19 Permissible swivel range in flow direction

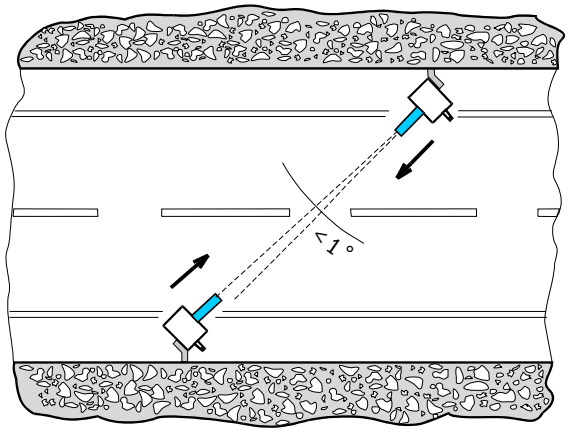
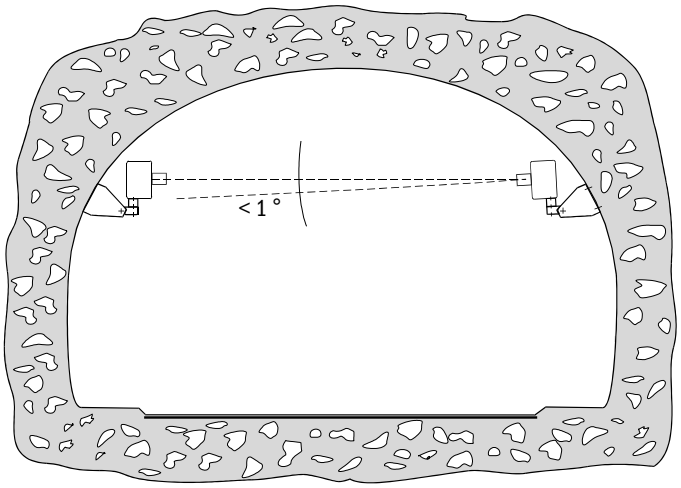


Fig. 20 Permissible horizontal swivel range



In exceptional cases, both sender/receiver units can be installed tilted downwards by up to 5° (→ p. 26, §3.1.2).

The sender/receiver units can be aligned in 2 steps:

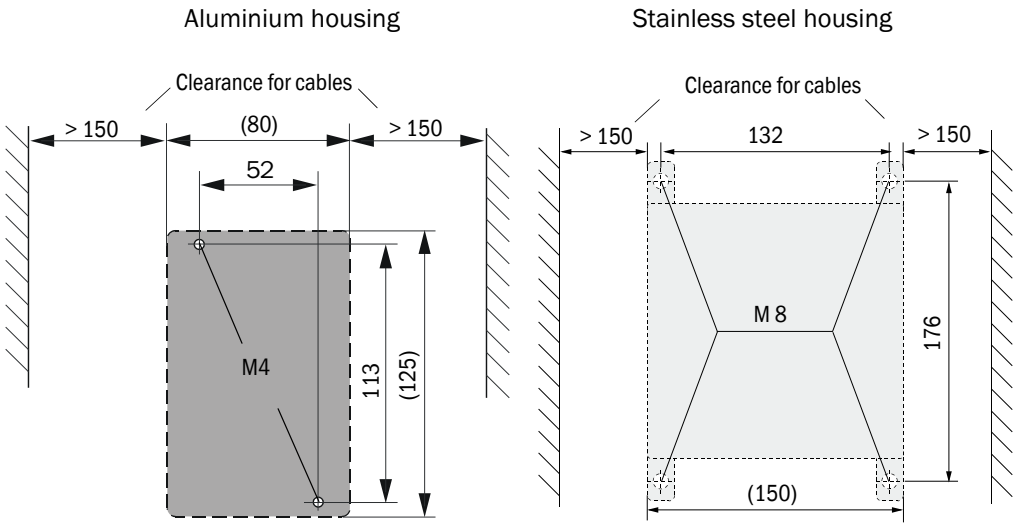
1 Rough alignment with aid (string or similar) or by sight

2 Fine adjustment with laser pointer or similar.

3.2.5 Installing the junction box

Install this component on a level surface (tunnel wall or roof) as shown in → Fig. 21. For fastening, the respective suitable mounting kits can be used according to → p. 21, §2.2.4 (drill hole measurements and fitting → p. 28, Fig. 11).

Fig. 21 Junction box installation dimensions



3.3 Electrical installation

WARNING:
- Observe the relevant safety regulations as well as the safety notices in Section 1 during all installation work.
- Take suitable protective measures against possible local or installation-specific hazards.
- All work may only be carried out when the device is disconnected from the power supply.
- Before opening the cover, the device must be disconnected from the power supply.

WARNING: Voltage hazard
- The cables and wires must be permanently installed. The plant operator must provide adequate strain relief.

3.3.1 General information, prerequisites

The assembly work described in §3.2 must have been carried out before starting installation.

Carry out all assembly work on-site. This includes:

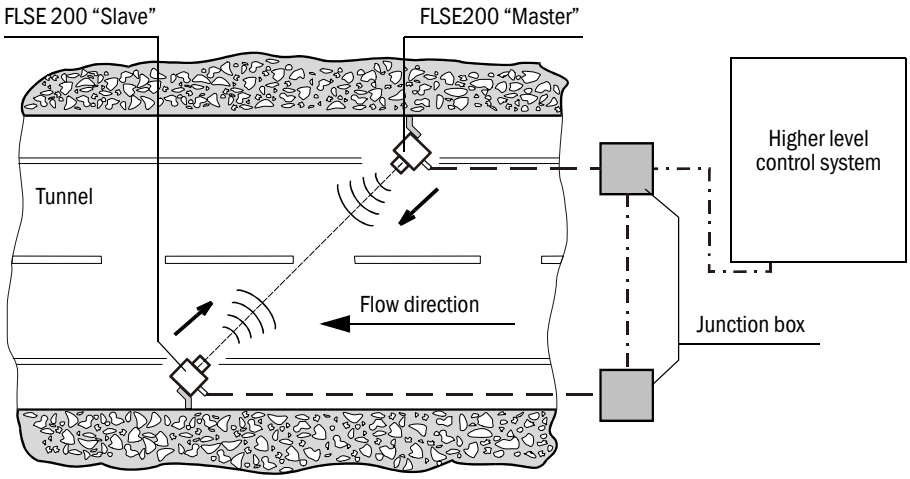
- Laying all the power supply and signal cables
- Connecting the power supply and signal cables to the system components

WARNING: Danger due to missing fuse protection of the power supply line
- An external line fuse must be provided during installation. Internally, the main power supply lines are designed for an overcurrent protection device up to max. 16 A.
  Requirements for the external main power switch:
  - A main power switch must be provided in the installation.
  - The main power switch must be located at a suitable position and must be easily accessible.
  - The main power switch must be marked as disconnecting device for the device.

- Plan adequate cable cross-sections (→ p. 36, §3.3.2).
- The cable ends with plugs for connecting the sender/receiver units must be long enough.
- Cable connectors that are not connected must be protected from dirt and moisture (fit cover).

3.3.2 Information on wiring

Fig. 22 Wiring



— — FLSE200 connection cable (Endress+Hauser scope of delivery)

– · – · – Connection cable between higher level control system and junction boxes (on-site wiring)

3.3.2.1 Cable specification (connection of a measuring point)

Connecting	Data transfer	Power supply FLSE200	Cable type
Sender/receiver unit and junction box (Endress+Hauser scope of delivery)	FLSE200 Master connection: 2 pairs of wires (twisted pair), operating capacitance wire/wire < 110 pF/m, wire cross-section ≥ 0.25 mm²	1 pair of wires with wire cross-section 1 mm²	UNITRONIC FD P BUS Combi 3 x 2 x 0.25 mm² + 3 x 1 mm²
	FLSE200 Slave connection: 1 pair of wires (twisted pair), operating capacitance wire/wire < 110 pF/m, wire cross-section ≥ 0.25 mm²		
▶ Higher level control system and junction box (on-site wiring) ▶ Junction box - junction box (on-site wiring)	1 pair of wires (twisted pair), operating capacitance wire/wire < 110 pF/m, wire cross-section ≥ 0.25 mm²	1 pair of wires with wire cross-section ≥ 0.5 mm² (AWG20)	E.g. UNITRONIC Li2YCYv (TP) 2 x 2 x 0.5 mm² or equivalent

Recommended cable types for on-site connection of higher level control system and junction box

1 UNITRONIC LiYCY (TP) 2 x 2 x 05 mm²
1 pair of wires for RS485, 1 pair of wires for transducer power supply;
not suitable for underground laying (protected installation required if necessary)

2 UNITRONIC Li2YCYv (TP) 2 x 2 x 0.5 mm²
1 pair of wires for RS485, 1 pair of wires for transducer power supply; can be used as an alternative to pos. 1; suitable for underground laying

3 UNITRONIC Bus FD P Combi 3 x 2 x 0.25 + 3 x 1.0 mm²
1 pair of wires for RS485, 1 pair of wires with cross-section 1.0 mm² for transducer power supply, for cable lengths up to 1000 m with 2 measuring points connected

4 Special cable type ASS 4 x 2 x 0.5 mm²
1 pair of wires for RS485, 1 to 3 pairs of wires for power supply to the transducers; silicone, halogen-free, highly heat and cold resistant, sheath color red (similar to RAL 3000)
Accessories: Braided cable PA-S 4, color black; as mechanical protection or to cover the sheath color if required.

- ▶ Manufacturer of cable type UNITRONIC: LAPP-Kabel
- ▶ Manufacturer of special cable: metrofunk KABEL-UNION GmbH
- ▶ Cables from other manufacturers can be used when they have the same transmission characteristics.
- ▶ We recommend coordinating the wiring with several measuring points with the manufacturer (→ p. 20, §2.2.3).
- ▶ For standard wiring (bus wiring), the factory-set termination must be disabled in the system components not at the end of the line.

NOTICE:

- ▶ The manufacturer does not assume any warranty for the proper functioning of the device when cables that do not comply with the specifications are used.
- ▶ The cables are to be laid continuously without changing to other cables or lines and shielded throughout.
- ▶ Not suitable are telephone cables such as type A-2YF(L)2Y... .

3.3.2.2 Cable lengths

When connecting bus versions with several sensors, the maximum cable length is reduced as follows depending on the number of measuring points connected:

Number of measuring points	Cable type 2 x 2 x 0.5 mm^2 (e. g. UNITRONIC Li2YCYv(TP))	Cable type 3 x 2 x 0.25 + 3 x 1.0 mm^2 (e.g. UNITRONIC FD P BUS Combi)
1	1000 m	1000 m
2	500 m	1000 m
3	330 m	660 m
4	250 m	500 m
5	200 m	400 m

Proceed as follows when longer cable lengths are used to connect several sensors:

Use larger diameter, e.g. cable type with 3 or 4 pairs of wires and 2 pairs of wires for power supply.

To ensure the power supply for long cable lengths, the following key data for the FLOWSIC200 Transmitter must be observed when selecting the wire diameter:

Sender/receiver unit supply	Type 200M	Type 200H, 200HM
Current consumption per FLSE200	35.5 mA	38 mA
Required voltage to the FLSE200	18 - 24 V DC	18 - 24 V DC

NOTICE:
The maximum cable length is 1000 m even when using larger wire diameters.

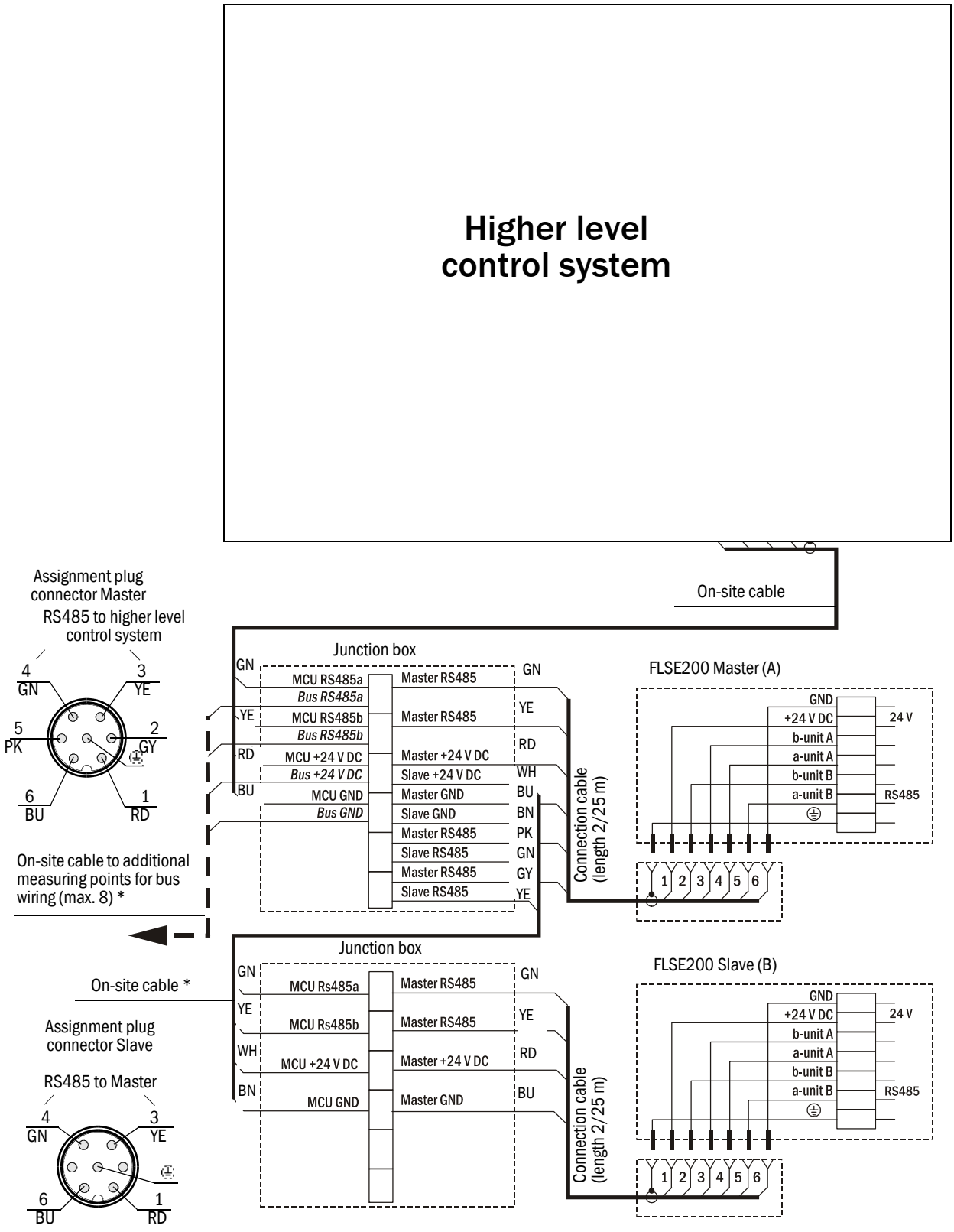
3.3.3 Connecting sender/receiver units and junction boxes

These components are to be interconnected as shown in p. 39, Fig. 23:

- Between the sender/receiver unit and the junction box using the cables with connector included in the scope of delivery,
- Between the junction boxes and the higher level control system with cable provided by customer.

Bus wiring

Fig. 23 Bus wiring



FLOWSIC200

4 Commissioning and configuring

Basics
Standard commissioning procedure
Calibrating velocity and temperature measurement
Maintenance

4.1 Basics

4.1.1 General information

Commissioning primarily comprises entering system data (e.g. measuring distance, installation angle), parameter settings for output variables and reaction times and, if required, setting the check cycle. A zero adjust is not required.

Additional calibration of the velocity measurement by means of network point measurement using a reference system (for example, dynamic pressure probe) is then only necessary when the velocity profile along the measuring axis is not representative for the entire cross-section. The regression coefficients determined can then be entered into the device without problems (→ p. 64, §4.2.6).

The ‘‘SOPAS Engineering Tool” (SOPAS ET) is supplied with the device for parameterizing the system parameters. The required settings can be easily configured using the software menus. Further functions are also available (e.g., data storage, graphic displays).

4.1.2 Installing the operating and parameter program SOPAS ET

Administrator rights are required for the installation.

Prerequisites

- Laptop/PC with:
  - Processor: At least Pentium III 500 MHz (or comparable type)
  - USB interface (alternative - RS232 via adapter)
  - Working memory (RAM): At least 1 GB
  - Operating system: MS-Windows XP, VISTA, Windows 7 and Windows 8 (32/64 bit)
  - Free memory: 450 MB
- RS485/USB interface set (Part No. 6030669): adapter, USB cable, plug for connecting laptop/PC and FLOWSIC200 Transmitter
- The operating and parameter program must be installed on the laptop/PC.
- The device must be supplied with power.

Installing program SOPAS ET

Insert the enclosed CD into the disk drive on the PC, select the language, choose “Software” and follow the instructions.

If the startup screen does not appear, run the “setup.exe” file.

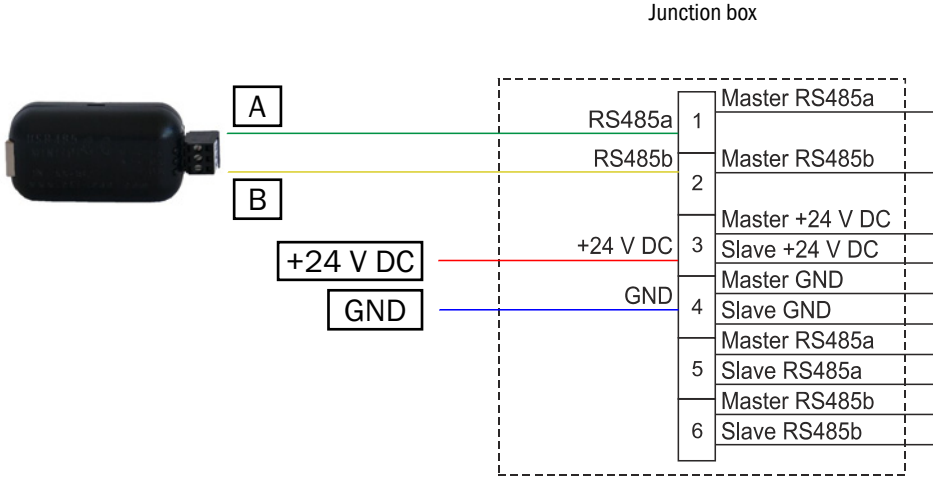
4.1.3 Connecting to the device

If commissioning is performed directly on the sender/receiver unit, a mobile power supply is required and the correct pin assignment must be observed.

WARNING: Electrical hazard
Incorrect cabling can cause serious injuries, device malfunctions or failure of the measurement system.
- Observe the relevant safety regulations as well as the safety notices in
- → p. 10, §1.6 during all installation work.
- Take suitable protection measures against possible local hazards or hazards arising from the equipment.

1 Open the cover of the electronics and connect the RS485/USB adapter according to the connection diagram:
- USB-485: A → Sensor RS-485: A
- USB-485: B → Sensor RS-485: B

Fig. 24 Connection diagram



2 Connect USB cable to laptop/PC.

NOTICE:
A serial interface (COM port) is simulated via which the connection is made.

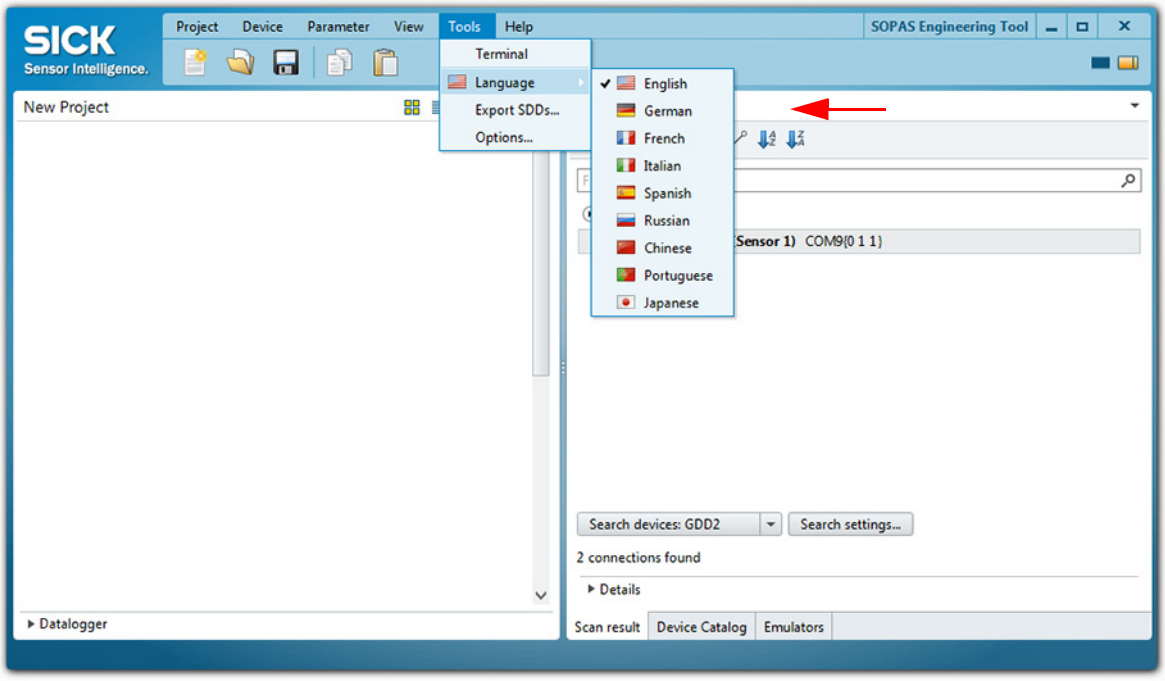
4.1.4 Starting SOPAS ET

1 Install SOPAS ET, → p. 42, §4.1.2.
2 Start the software from the “SICK\SOPAS” start menu.
3 The start page is displayed.

4.1.5 Changing the language

- If required, set the desired language in the “Tools / Language” menu (→ p. 44, Fig. 25).
- Confirm the dialog shown with “Yes” to restart SOPAS ET with the changed language.

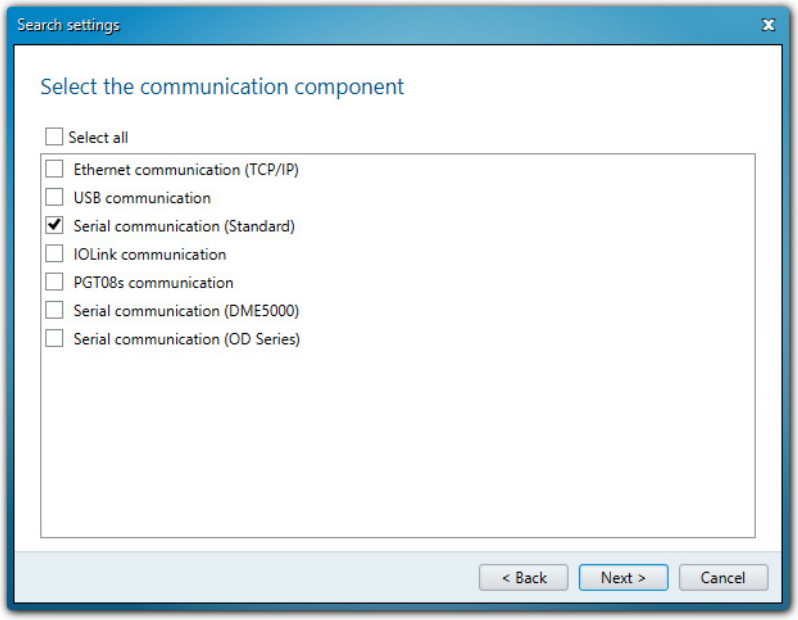
Fig. 25 Changing the language setting



4.1.6 Establishing a connection with SOPAS ET using advanced mode

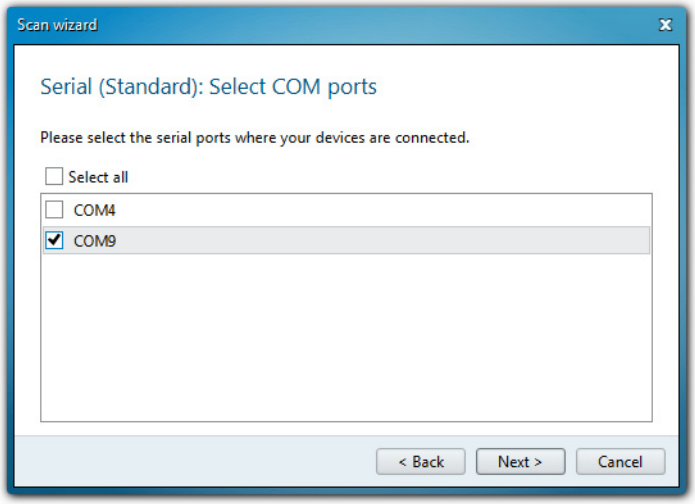
1 Click “Search settings”.
2 Select search mode “Interface oriented search”.
3 Select “Serial communication” and press the “Next” button.

Fig. 26 Selecting the communication interface



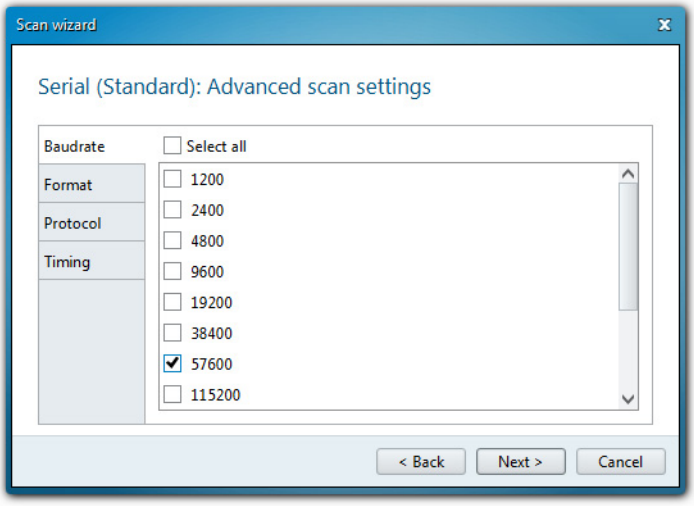
4 Select the COM ports used and press the “Next” button.
If you are not sure which COM ports are used, select all COM ports.

Fig. 27 Selecting COM ports



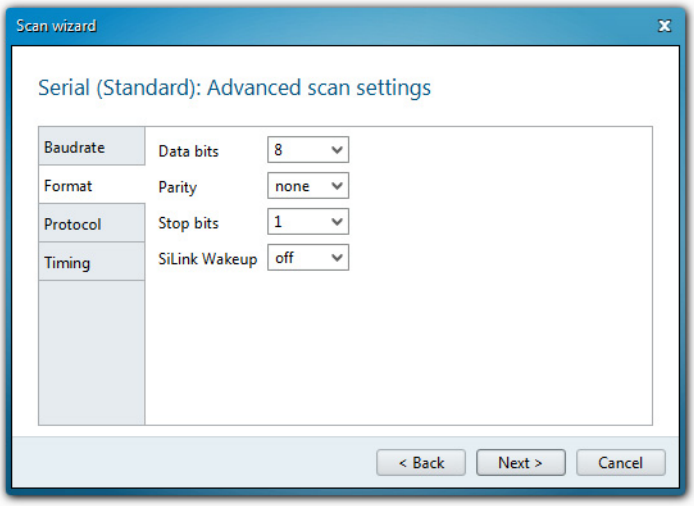
5 Configure the “Advanced scan settings”.
– Configure the baud rate settings in the “Baudrate” directory according to → p. 46, Fig. 28.

Fig. 28 Selecting the baud rate



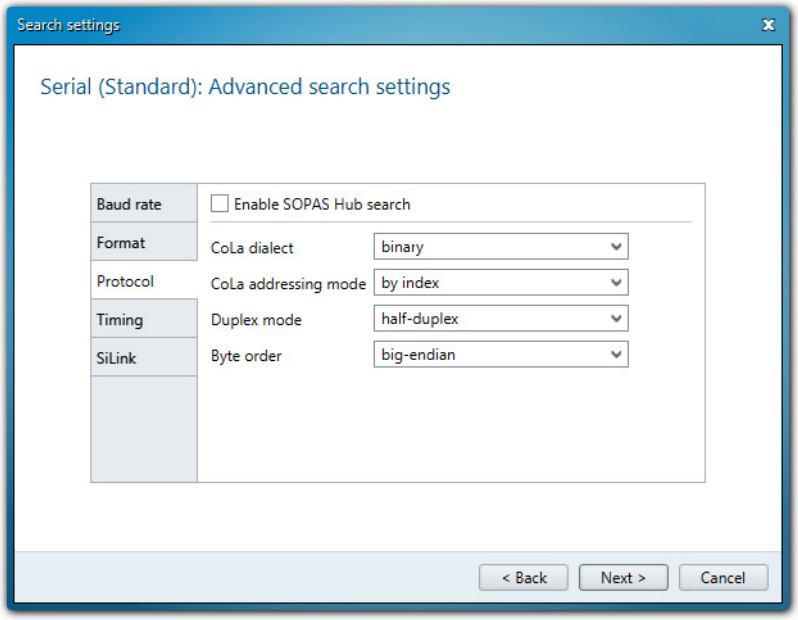
– Configure the data format in the “Format” directory according to → p. 46, Fig. 29.

Fig. 29 Configuring the data format



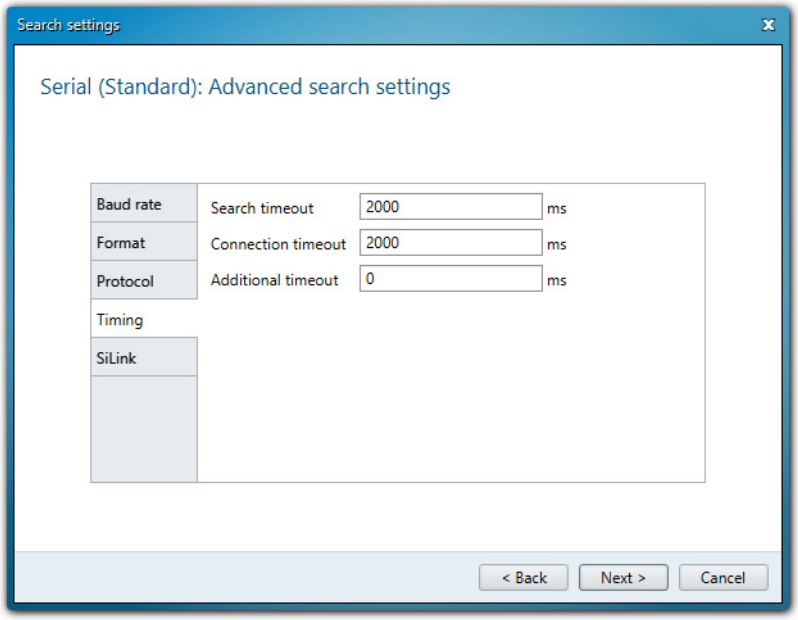
– Define the protocol settings in the “Protocol” directory according to → p. 47, Fig. 30.

Fig. 30 Configuring the protocol



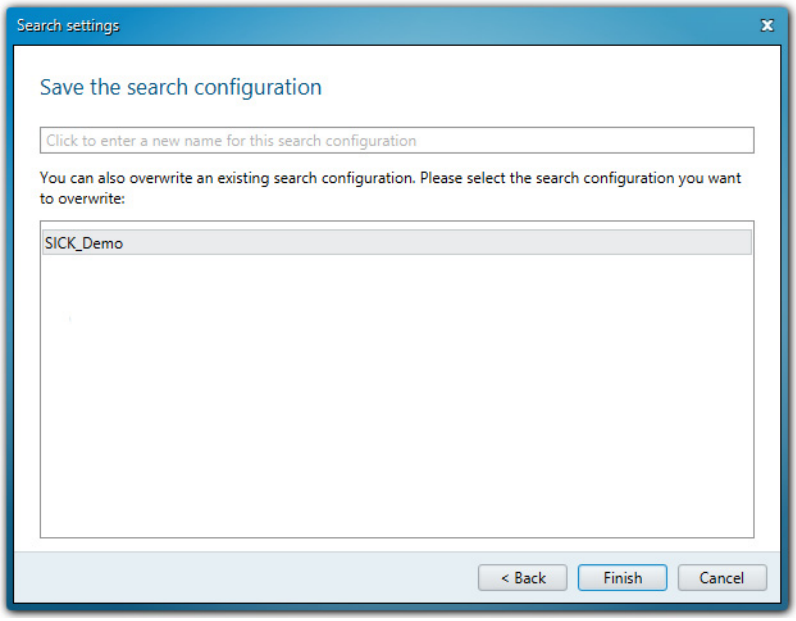
– Define the timeout settings in the “Timing” directory according to → p. 47, Fig. 31.

Fig. 31 Defining the timeout settings



6 To save the search settings, enter a name and click “Finish”.

Fig. 32 Saving the search settings

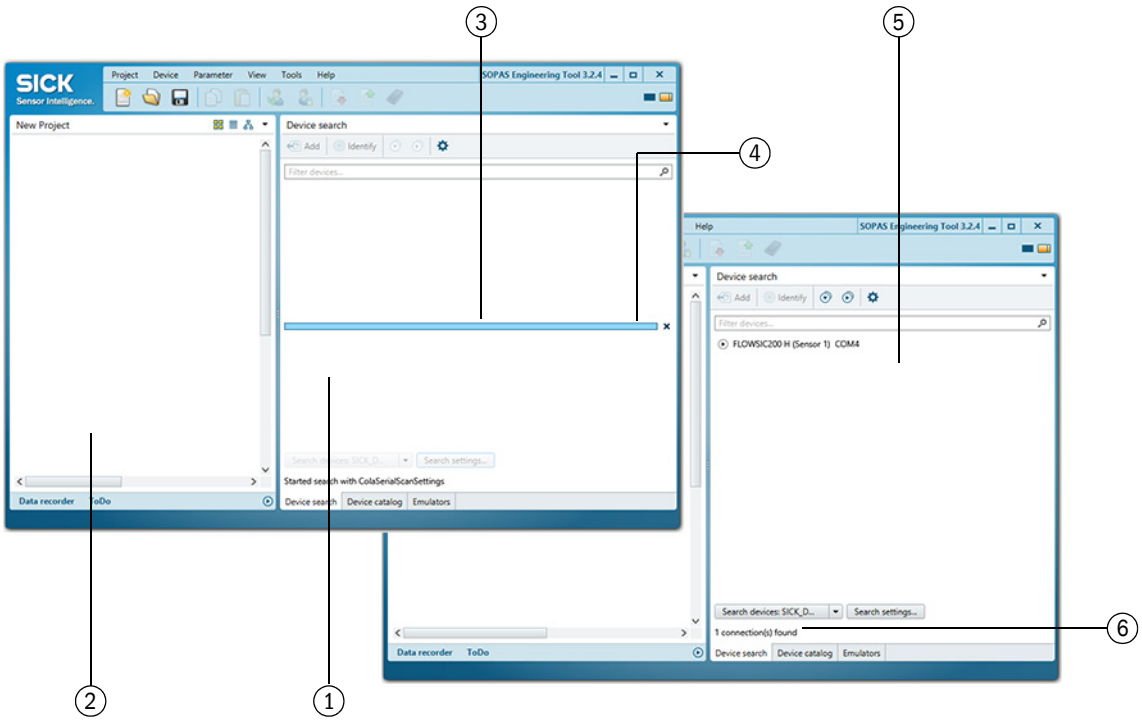


SOPAS ET starts the device search.

The devices found are displayed in the “Device search” area when the device search is finished (→ p. 49, Fig. 33).

4.1.7 Information on using the program

Fig. 33 Overview



1 Device search
2 Project area
3 Device search progress
4 Device search abort
5 Device search result
6 Number of devices found

Device selection

► Move the required devices with drag-and-drop or a double-click on the required device into the project area.
  – The configuration of the devices is shown in a separate device window.
  – The device windows can be opened by a double-click on the respective device file or the context menu (→ p. 51, Fig. 35).

Fig. 34 Device selection

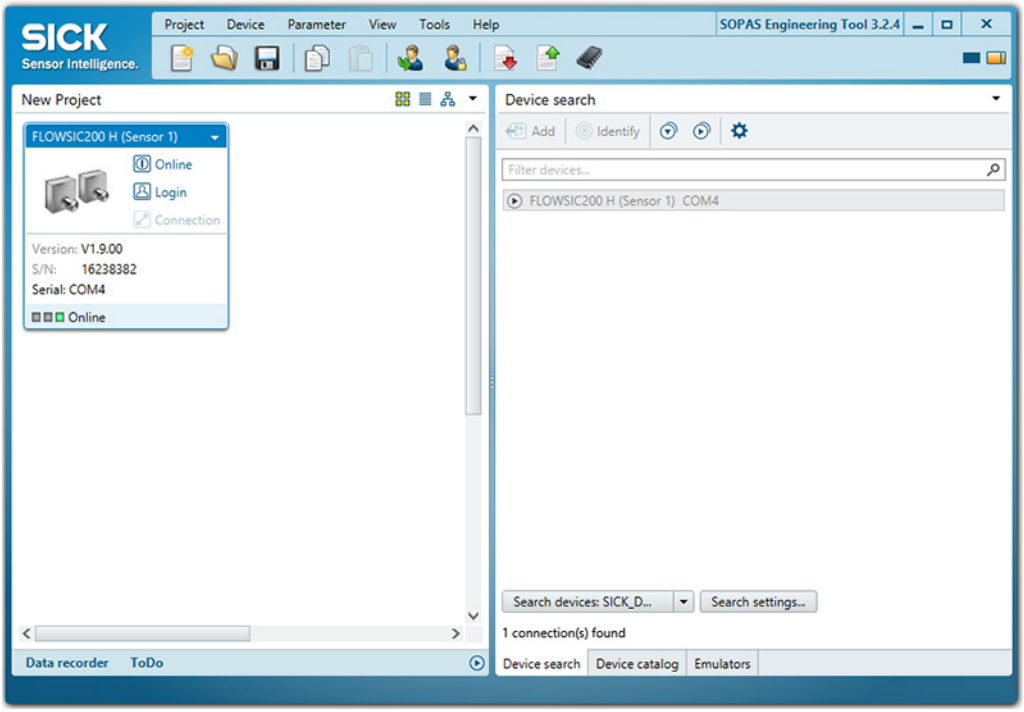


Fig. 35 Device context menu

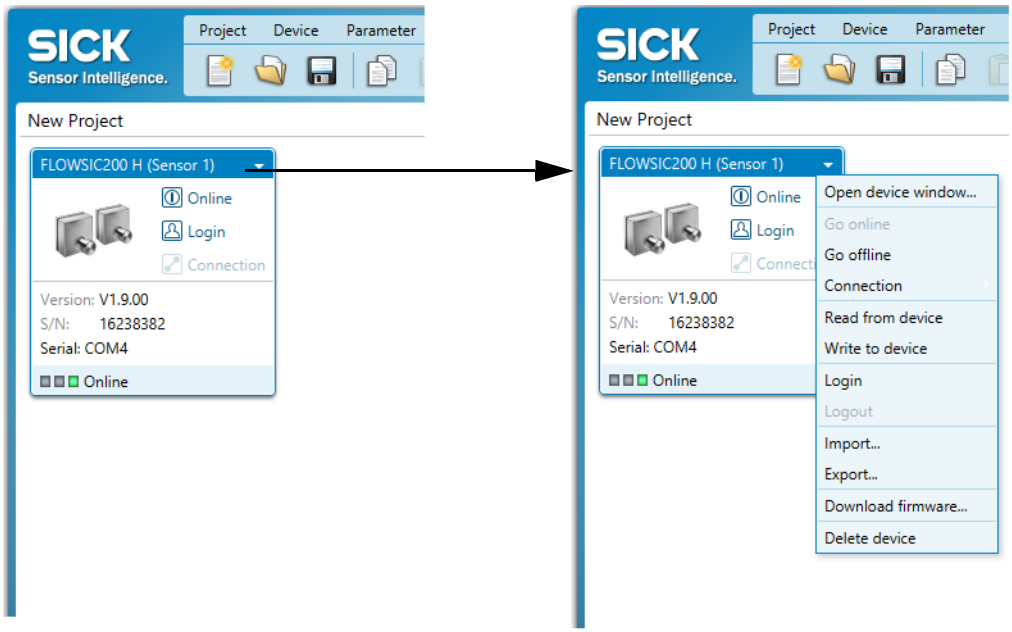


Table 1 Contents of device context menu

Context menu	Description
Go online	Establishes the connection between SOPAS ET and the device.
Go offline	Interrupts the connection between SOPAS ET and the device.
Connection	Select Connection: Changes the connection settings. Delete Connection: Deletes the connection settings.
Upload from device	Uploads all parameter values from the connected device and transfers them to SOPAS ET.
Download to device	Downloads the parameter values from SOPAS ET to the connected device. Only those parameter values which can be written at the currently logged in user level are downloaded.
Login	Opens the login dialog.
Logout	Logs out the user from the device.
Import	Imports a suitable device from the *.sopas file and overwrites the parameter values with the values saved in the *.sopas file. During import to an online device, the parameters are immediately downloaded to the device. Only those parameter values which can be written at the currently logged in user level are downloaded.
Export	Exports the device information and the associated project information and saves them in a *.sopas file.
Delete device	Deletes the device from the project.

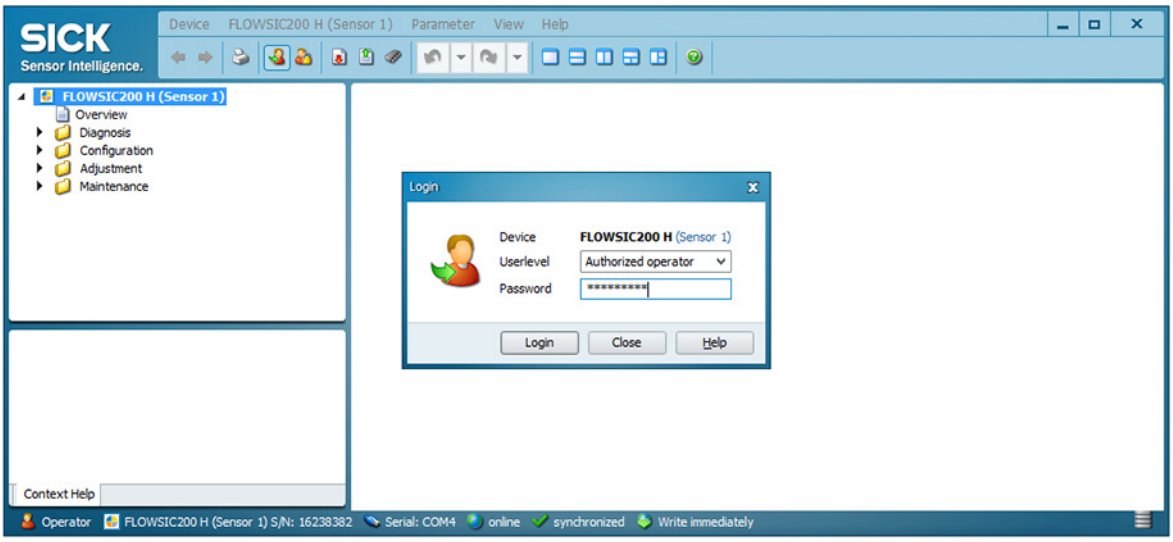
Password

Certain device functions are first accessible after a password has been entered (→ Fig. 36). Access rights are assigned in 3 levels:

User level		Access to
0	“Machine supervisor”	Displays measured values and system states
1	“Authorized Client”	Displays, inquiries and parameters required for commissioning or adjustment to customer-specific demands and diagnosis
2	“Service”	Displays, inquiries as well as all parameters required for service tasks (e.g., diagnosis and clearance of possible malfunctions)

The level 1 default password is included in the Annex.

Fig. 36 Entering the password



4.2 Standard commissioning procedure

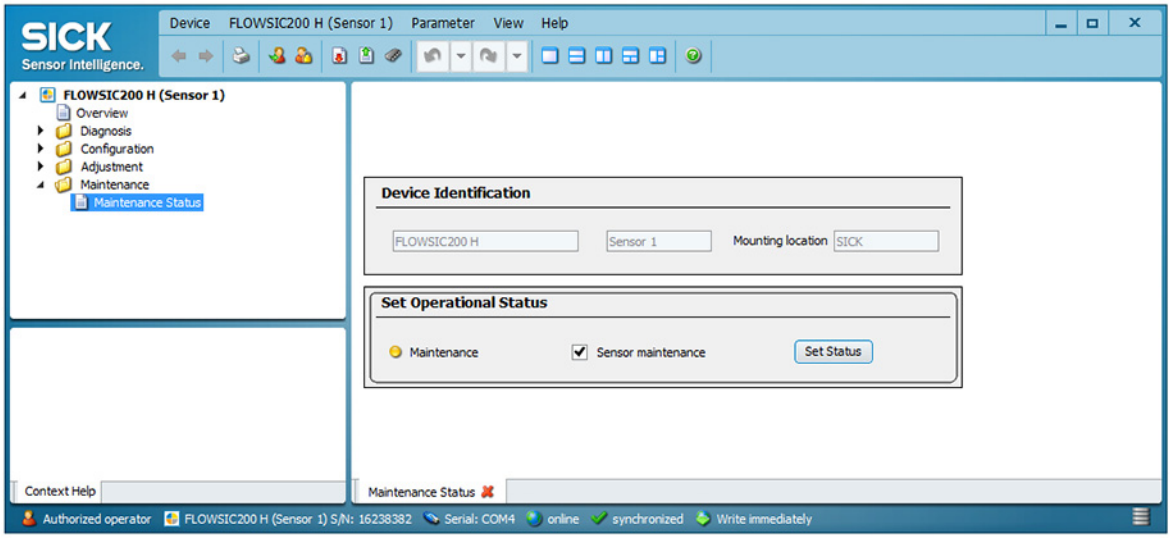
This Section describes all the settings required for the device function.

Error message “Error Parameter” is output as long as the plant data (→ p. 55, §4.2.2) have not been entered completely.

To set/change the parameters, carry out the following procedure:

- Connect the measuring system to the SOPAS ET program, scan the network and add the required device file (“FLOWSIC200 M/FLOWSIC200 H/FLOWSIC200 H-M”) to the current project (→ p. 49, §4.1.7).
- Enter the Level 1 password (→ p. 49, §4.1.7) and open directory “Maintenance / Maintenance / Operation”.
- Activate checkbox “Sensor maintenance” (sender/receiver unit) and click “Set Status”.

Fig. 37 Switching to Maintenance mode

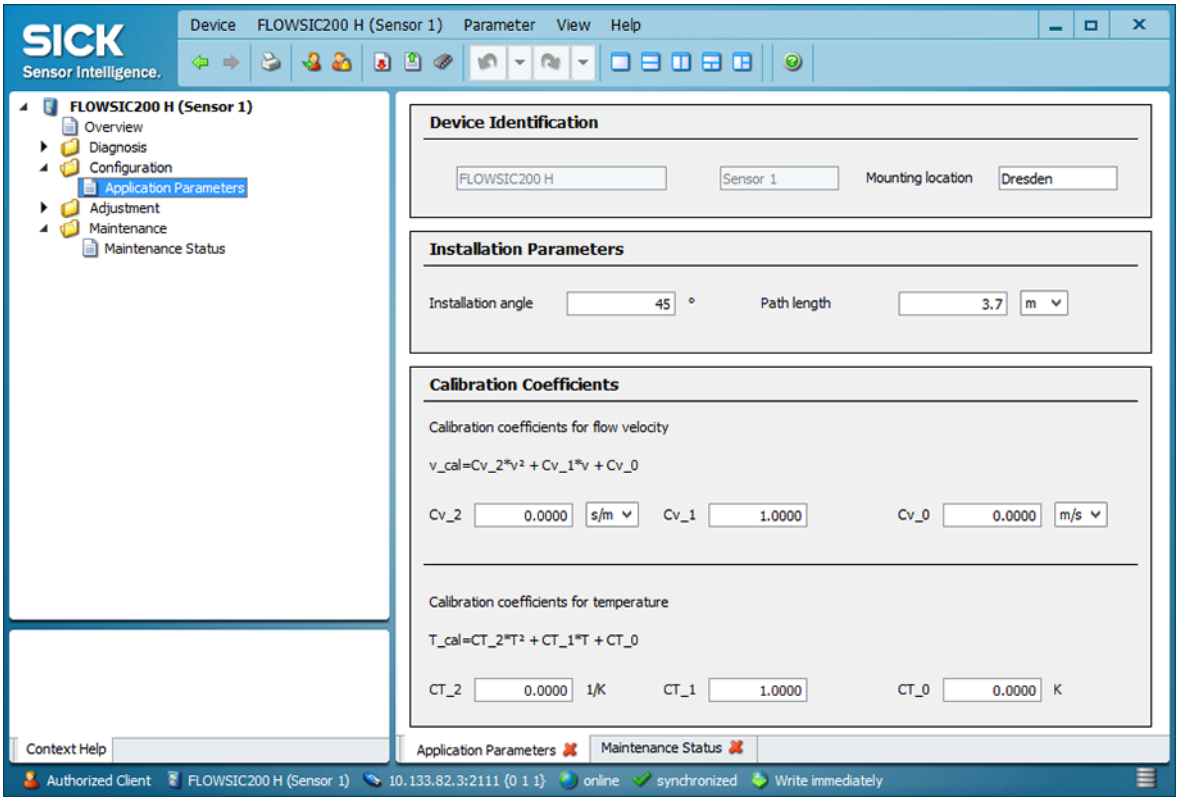


4.2.1 Assigning the measuring system to the measuring location

The sender/receiver units can be clearly assigned to the respective measuring location.

- ► Open device file “FLOWSIC200 M” or “FLOWSIC200 H” or “FLOWSIC200 H-M” for the sender/receiver unit, select directory “Configuration / Application Parameters”, set the sender/receiver unit to “Maintenance” and enter the Level 1 password.
- ► Enter the desired information in the “Mounting location” field.

Fig. 38 Directory “Configuration / Application Parameters” (settings example)



4.2.2 Entering system data

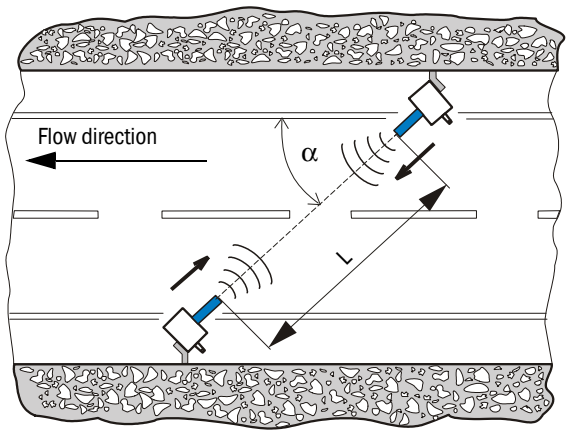
Basic requirement for every measurement is selecting the unit system (metric or imperial units) to be used and entering the installation parameters (measuring distance, installation angle). Carry out the following steps for setting:

- Open device file “FLOWSIC200 M”, “FLOWSIC200 H” or “FLOWSIC200 H-M“.
- Set the sender/receiver unit in “Maintenance” and enter the Level 1 password (→ p. 49, §4.1.7).
- Select directory “Configuration / Application Parameters“ (→ p. 54, Fig. 38).
- In field “Installation Parameters“ (→ p. 54, Fig. 38), enter the path length and installation angle (→ p. 55, Fig. 39). The settings are uploaded to the FLOWSIC200 Transmitter after switching from “Maintenance” to “Measurement”.

The installation parameter settings are converted automatically when the unit system is changed.

The following is applicable for application parameters:

Fig. 39 Basic parameters



Entry field	Parameter
Installation angle	α Angle between measurement axis and flow direction
Measuring distance	L Distance transducer - transducer

4.2.3 Data backup

All parameters relevant for recording, processing and input/output of measured values as well as current measured values can be saved and printed. This allows easy reentering of set device parameters as needed (e.g. after a firmware update) as well as the registration of device data or device states for diagnostic purposes. The following options are available:

- Saving as a project (particularly advantageous for diagnosis and troubleshooting)
- Not only device parameters but also data logs can be saved.
- Saving as a device file
- Saved parameters can be processed without a device connected and transferred to the device again later.
- Saving as a protocol

  Device data and parameters are registered in the Parameter protocol.

  A Diagnosis protocol can be created for analysis of the device function and recognition of possible malfunctions.

4.2.3.1 Saving as a project

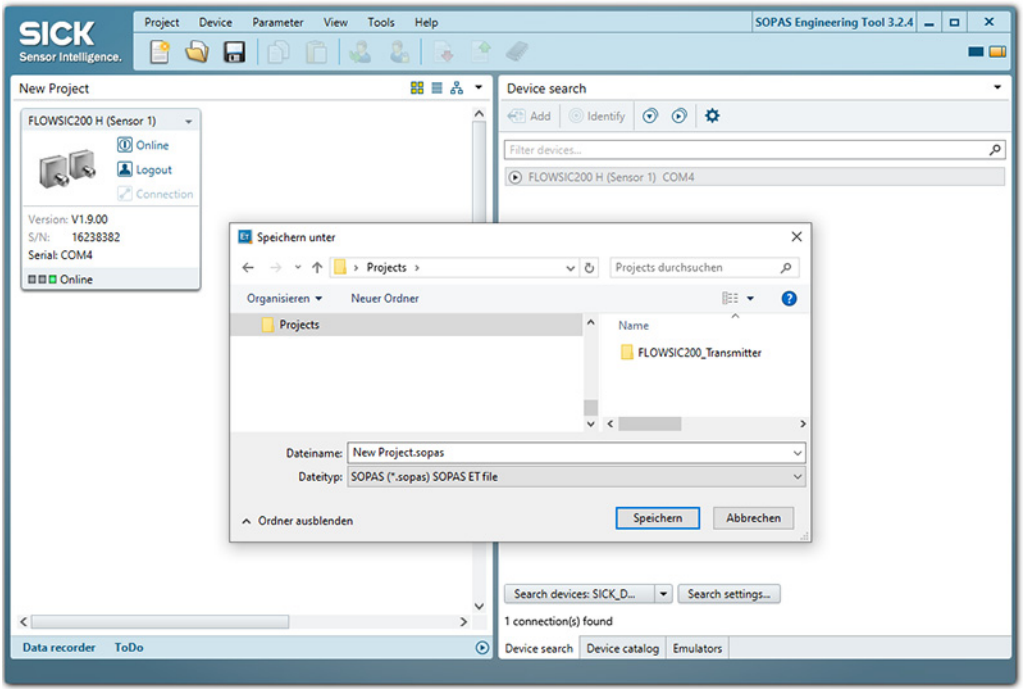
It is recommended to save frequent connections as a “Project”. It is then only necessary to open this “Project” when reconnecting to the device. All data saved beforehand are then transferred automatically to SOPAS ET.

Select menu “Project / Save project as” and specify the target directory and file name. .

The name of the file to be stored can be chosen freely. The name of the file to be stored can be chosen freely.

It is useful to specify a name with a reference to the measuring point involved (name of the company, equipment name).

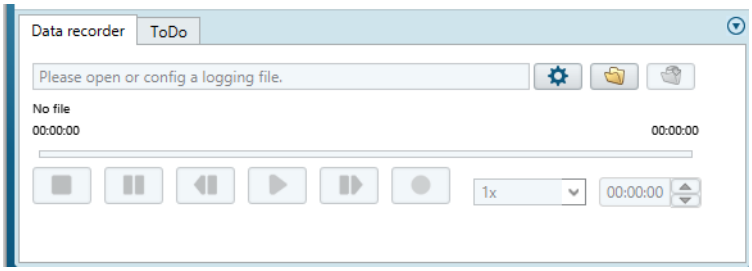
Fig. 40 Menu “Project / Save project“



4.2.3.2 **Creating data recordings**

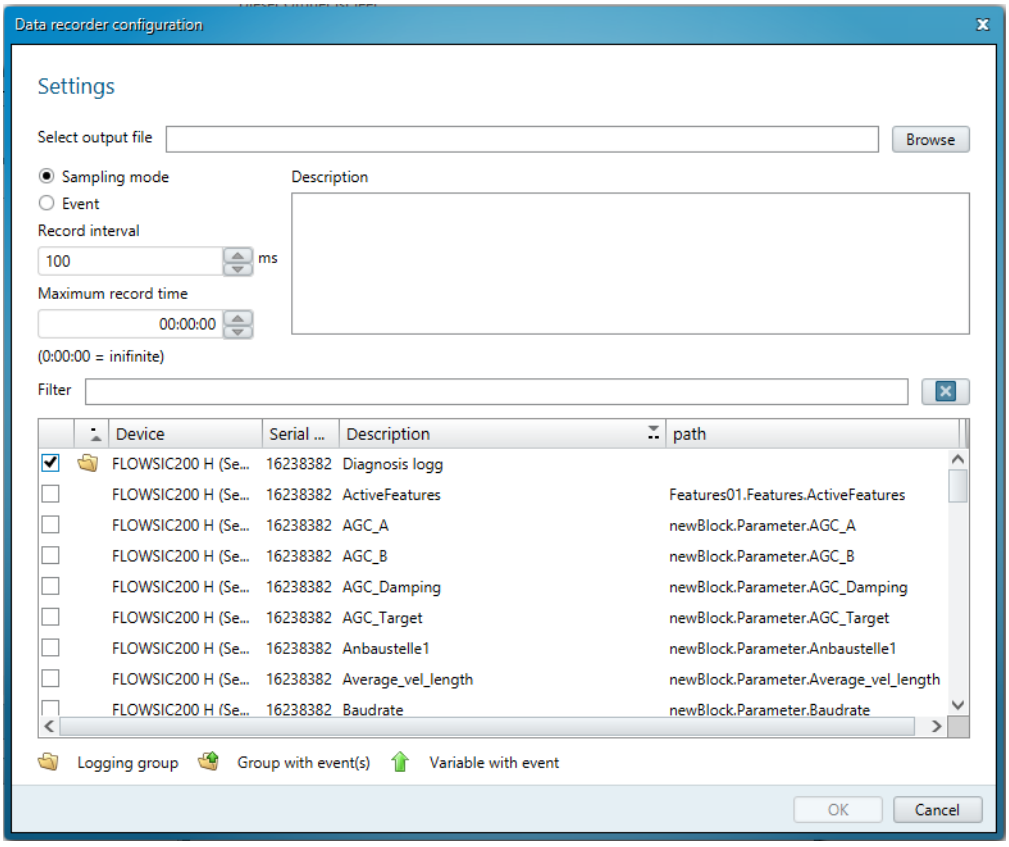
- ► Save the project.
- ► Open the data recorder in SOPAS ET.

Fig. 41 Opening the data recorder



- ► Configure the data recorder:
  - Select output file.
  - Adjust the recording interval as required (depending on what is to be shown).
  - Activate the “Diagnosis log” checkbox.

Fig. 42 Configuring the data recorder



- ► Click “OK”.
- ► Then start the recording.

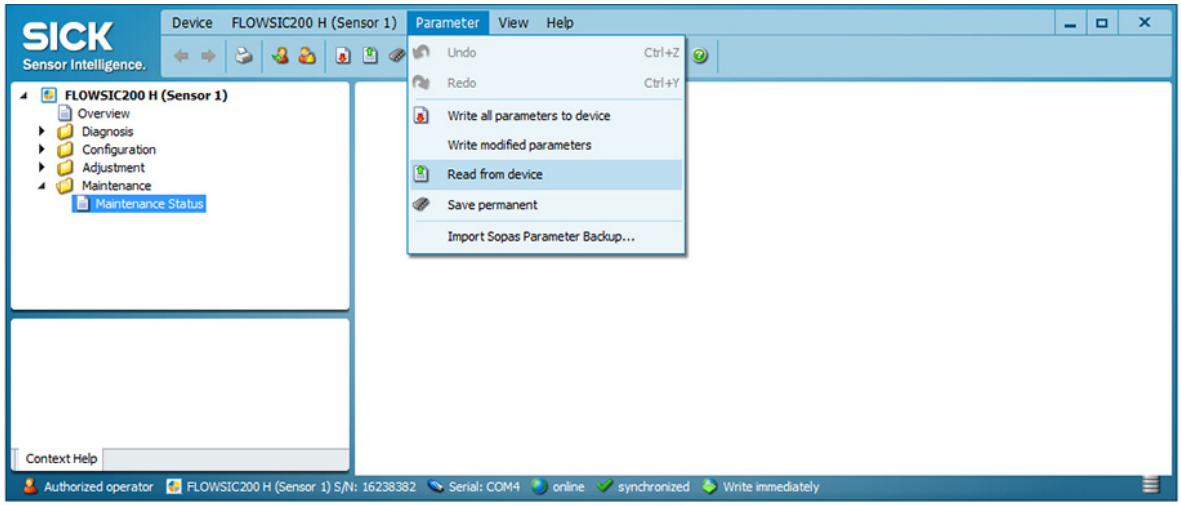
► After finishing the recording, save the project again.

If the data recording is to be sent to Endress+Hauser for evaluation, the following files are required:
- .prg file
- .properties file
- .data file
- .script file

4.2.3.3 **Saving as a protocol**

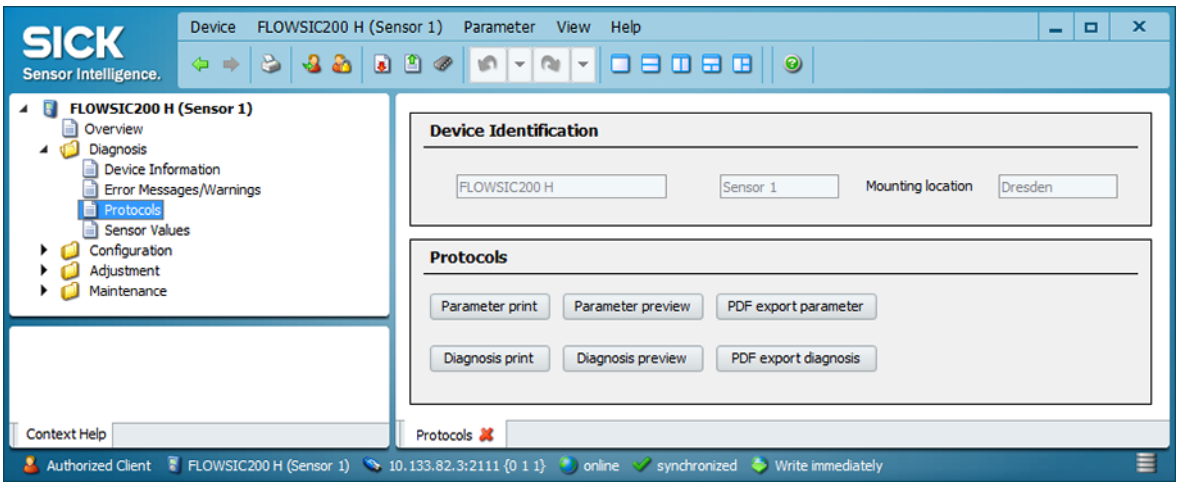
► Select device and update device data by selecting “Parameters/ Read from device” in the menu.

Fig. 43 Updating device data



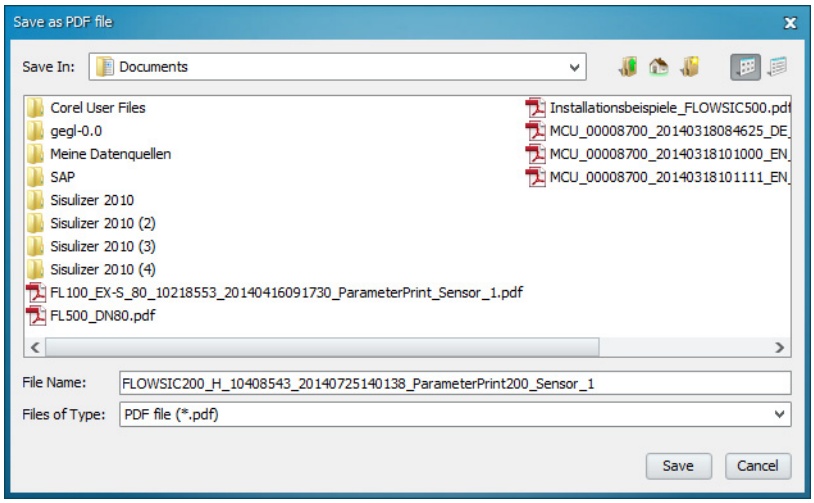
► Select directory “Diagnosis / Protocols” and click the desired protocol type.

Fig. 44 Directory “Diagnosis / Protocols”



The file name and storage location must be specified for export to a PDF file.

Fig. 45 Specifying file name and storage location



Example of a Parameter protocol

Fig. 46 Parameter protocol (example)

FLOWSIC200 - Parameter Protocol

Device type: FLOWSIC200 H

Mounting location: SICK

Sensor 1

Device Information

Device type	*FLOWSIC200 H*
Firmware version	*01.9.00*
Firmware CRC (HEX)	*xCC9FBA77*
Parameter CRC (HEX)	*xD4F1*
SN S/R-Unit Master	*16238382*
SN S/R-Unit Slave	*16238383*
Modbus protocol	*yes*

Application Parameters

Path length	*0.3000m*
Installation angle	*45.00°*
Velocity Cv_0	*0.0000m/s*
Velocity Cv_1	*1.0000*
Velocity Cv_2	*0.0000s/m*
Temperature CT_0	*0.0000*
Temperature CT_1	*1.0000*
Temperature CT_2	*0.0000*
Fix temperature	*5.00°C*
Norm. speed of sound	*331.500m/s*

Transmit Parameters

Transmit frequency A (Master)	*17.5kHz*
Transmit frequency B (Slave)	*17.5kHz*
Total periods A (Master)	*5.0*
Total periods B (Slave)	*5.0*
Activation periods A (Master)	*3.0*
Activation periods B (Slave)	*3.0*
Retarding attenuation A (Master)	*10.0*
Retarding attenuation B (Slave)	*10.0*
Amplitude A (Master)	*0.1*
Amplitude B (Slave)	*0.1*
Sensortype	*18kHz*
System runtime A (Master)	*210.0µs*
System runtime B (Slave)	*210.0µs*

Signal Processing

Lower fraction	*35%*
Upper fraction	*50%*
Number of averaged signals	*10*
Median buffer size	*21*
Average median	*70%*
Multiburst	*3*
Measuring cycle	*1000ms*
Transmit delay B (Slave)	*200ms*

Gain

Gain level A (Master)	*20dB*
Gain level B (Slave)	*20dB*
Target amplitude	*60%*
Damping	*10*
Gain control deactivated	*no*

Receiving Window

Window size	*2000*
Precounter	*0.00ms*
Control deactivated	*no*

Limits

Limit warning	*80%*
Limit malfunction	*97%*
Limit SNR	*15dB*
Plausib. threshold	*20%*
Limit range	*60.00m/s*
Limit. max. transd. temp.	*250.0°C*
Low flow cut off	*0.2m/s*

Serial Interface

Baud rate	*57600baud*
Bus address	*1*
Response delay	*4ms*

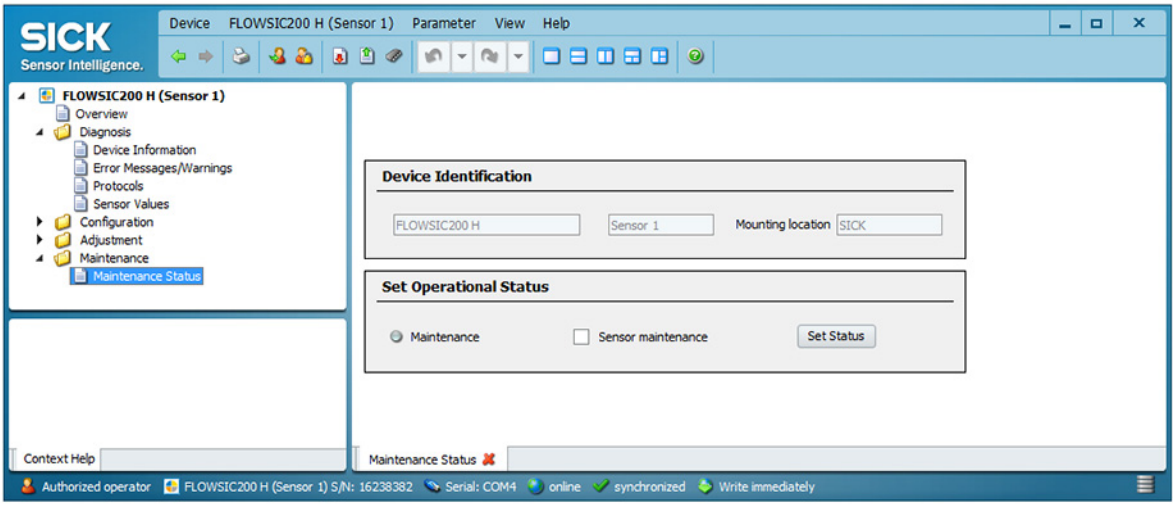
4/30/24 4:47 PM *page 1/1*

4.2.4 Starting normal measuring operation

Set the measuring system to “Measurement” mode after entering or modifying parameters. By deactivating Maintenance mode, the normal measuring operation is started:

- ► Open directory “Maintenance/Maintenance”.
- ► Deactivate checkbox “Sensor maintenance” (sender/receiver unit) and click “Set Status”.

Fig. 47 Setting the operational state



4.2.5 Checking the signal waveform

Checking the signal waveform allows an assessment on the quality of the received ultrasonic signals.

For display on the screen, open the device file “FLOWSIC200 M” or “FLOWSIC200 H” or “FLOWSIC200 H-M” and select the directory “Diagnosis/Sensor values” (operating mode “Measurement”).

The ultrasonic signals of both transducers are then displayed in the “Signal Display” field alternating as raw signal and envelope curve.

Setting the “View Envelope Curve” function shows the envelope curves of both transducers. The signal waveform should match the waveforms in the → p. 62, Fig. 48 to → p. 63, Fig. 51.

Type FLSE200-M

Fig. 48 Burst waveform HF signal (unconditioned signal)

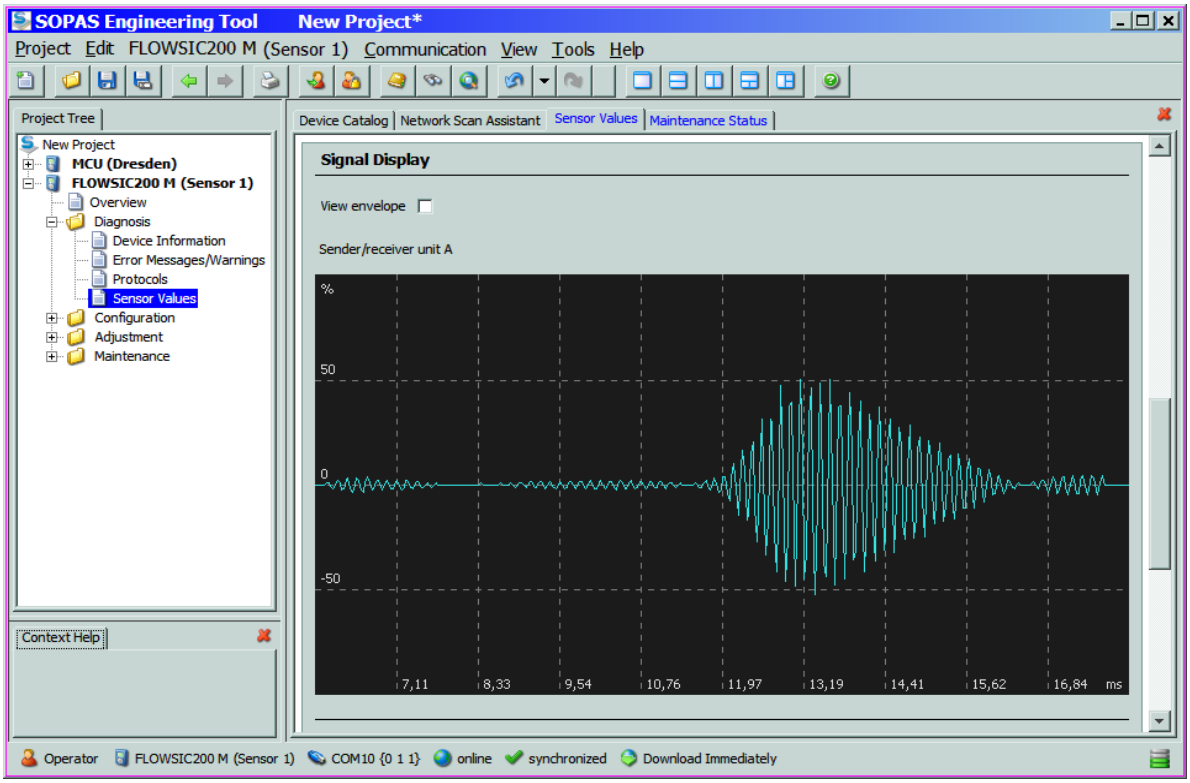
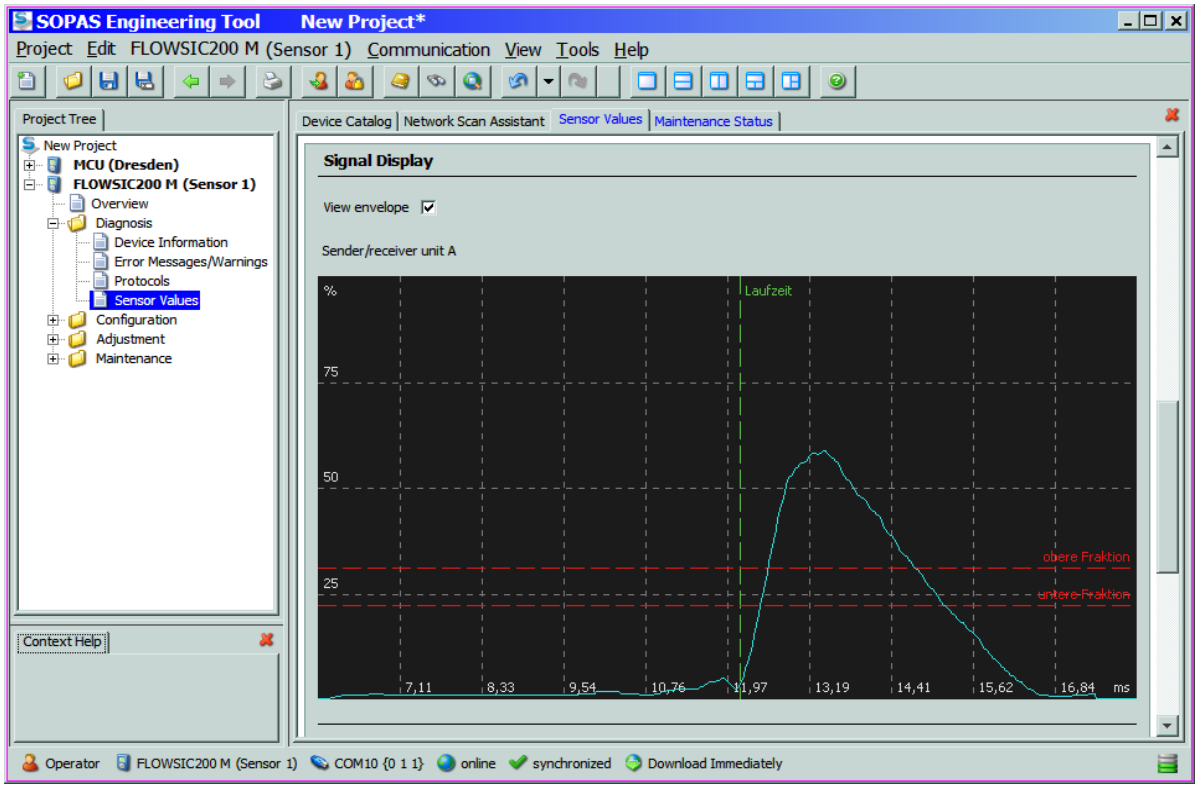


Fig. 49 Burst waveform demodulated signal (envelope)



Type FLSE200-H and FLSE200-HM

Fig. 50 Burst waveform HF-signal (unconditioned signal)

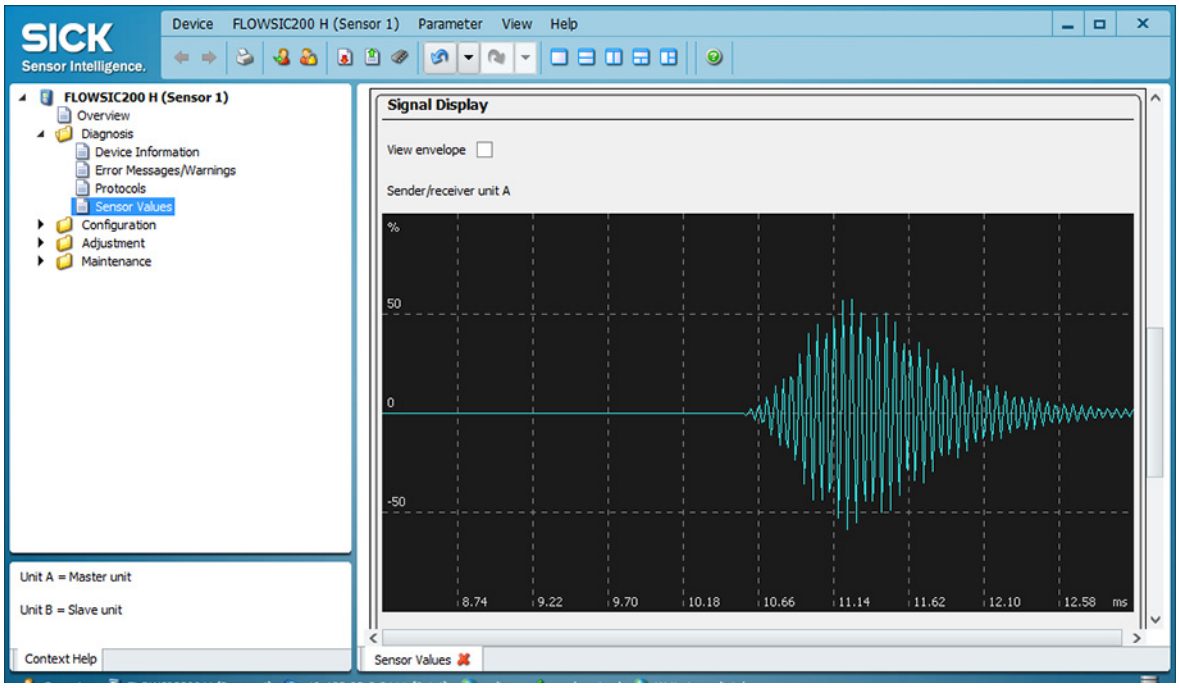
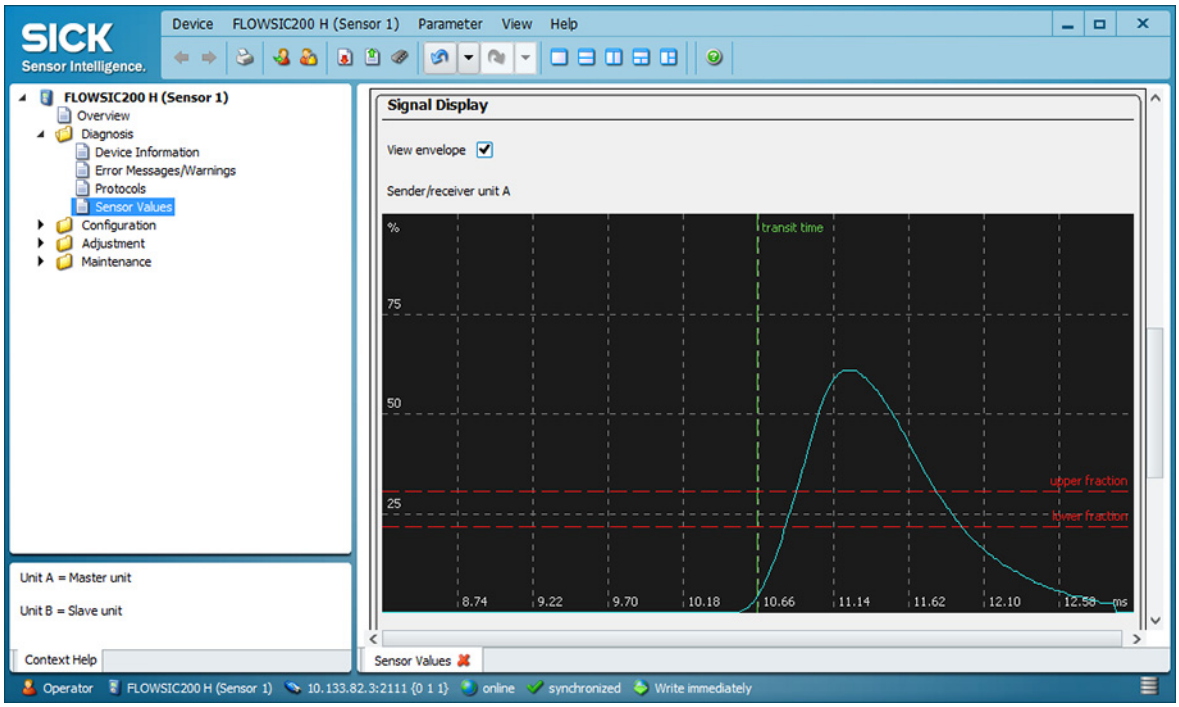


Fig. 51 Burst waveform demodulated signal (envelope)



4.2.6 Calibrating velocity and temperature measurement

This Section describes the entries required for calibrating the flow velocity and temperature measurement. For input, open the device file “FLOWSIC200 M”, “FLOWSIC200 H” or “FLOWSIC200 H-M” and select directory “Configuration / Application Parameters” (→ p. 54, Fig. 38). Then set the measuring system to ”Maintenance” and enter the Level 1 password.

Enter calibration coefficients for flow velocity measurement

Enter the calibration coefficients determined with a network measurement using a reference system in field “Calibration coefficients for flow velocity“ at Cv_2 (square), Cv_1 (linear) und Cv_0 (absolute).

Default values from the factory are Cv2 = 0, Cv1 = 1, Cv0 = 0.

Calibrate temperature measurement

The accuracy of the acoustic temperature measurement with the FLOWSIC200 Transmitter is a square function of the measuring path and sound velocity of the real gas under standard conditions (→ p. 16, §2.1.3). Exact acoustic temperature measurement is only possible when the sound velocity of the real gas remains constant at a reference temperature.

The sound velocity parameter can be set at “Service” user level (see Service Manual). It is set to 331.5 m/s at the factory.

To calibrate, determine the value pairs from separately measured gas temperature (for example, with PT100 sensor) at a minimum of two different gas temperatures. Convert the calculated values to absolute temperatures (add 273.15 K). Then use a regression function to calculate the coefficients (for two pairs by linear, with more value pairs also by square regression). Enter CT_2, CT_1 and CT_0 in the “Calibration Coefficients / Calibration coefficients for temperature” group.

Default settings from the factory are CT_2 = 0, CT_1 = 1, CT_0 = 0.

Example:

Measurement	FLOWSIC display		Measured value PT100	
	T in °C	$T_{absolute}$ in K	T in °C	$T_{absolute}$ in K
1	128	401	115	388
2	186	459	170	443

$$T_{KAL} = CT\_1 \cdot T_{FLOWSIC} + CT\_0$$

$$CT\_1 = \frac{T2_{PT100} - T1_{PT100}}{T2_{FLOWSIC} - T1_{FLOWSIC}}$$

$$CT\_0 = \frac{1}{2} \cdot (T2_{PT100} + T1_{PT100} - CT\_1 \cdot (T2_{FLOWSIC} + T1_{FLOWSIC}))$$

$$CT\_1 = 0.9483$$

$$CT\_0 = 7.7310$$

FLOWSIC200

5 Maintenance

General

Measures to be taken when cleaning the tunnel

5.1 General

> ***NOTICE:***
> When replacing components, only use parts that have been approved by Endress+Hauser!
> After all maintenance work, make sure the entire measuring system and any accessories installed are in a safe condition.
> If you have questions, contact the relevant Endress+Hauser subsidiary.

Maintenance strategy

Just like any other electronic measuring system, the FLOWSIC200 Transmitter requires regular maintenance. By inspecting the system regularly and replacing wear-and-tear parts in good time, the service life of the device can be lengthened significantly and ensures measurements are always reliable. Due to the measuring principle and system design, the FLOWSIC200 Transmitter requires very little maintenance.

Maintenance tasks

Routine maintenance is limited to cleaning system parts from external contamination.

Before carrying out these maintenance tasks, set the FLOWSIC200 Transmitter to “Maintenance” mode. This can be done by means of an external maintenance switch or by using the SOPAS ET operating and parameter program.

Switch back to “Operation” after completing maintenance work.

> ***NOTICE:***
> The ultrasonic transducers of the FLSE200-M sender/receiver units are extremely touch-sensitive components.
> - Avoid direct contact when cleaning (for example clean by careful blowing out, soft brush; no compressed air).

Maintenance intervals

Maintenance intervals depend on the local conditions and are therefore to be determined by the plant operator. As a rule, the maintenance intervals are more than 24 weeks. For the FLOWSIC200 Transmitter with sender/receiver units FLSE200-H and FLSE200-HM, maintenance cycles of up to 5 years are possible when used according to specifications.

The work to be carried out by the operator as well as the completion is to be documented in a Maintenance Manual.

Maintenance agreement

Regular maintenance activities can be carried out by the plant operator. Only qualified personnel according to Section 1 should be allowed to do the work. If desired, Endress+Hauser Service or authorized Service support centers can carry out all maintenance work. Endress+Hauser offers a range of economical maintenance and repair agreements. As part of these agreements, Endress+Hauser assumes responsibility for all maintenance activities, repairs are carried out by specialists on site (as far as possible).

5.2 Measures to be taken when cleaning the tunnel

With FLSE200-M sender/receiver units installed, it is essential to prevent water from reaching the ultrasonic transducers. Safe protection is ensured by covering the protective tubes with the supplied caps.

No protective measures are required for the FLSE200-H and FLSE200-HM sender/receiver units during tunnel cleaning.

When automatic tunnel cleaning equipment (cleaning with brushes) is used, an adequate distance to the sender/receiver units must be kept to prevent possible misadjustment.

FLOWSIC200

6 Malfunctions

Implausible measured values
General system malfunctions
Warning and error messages in SOPAS ET

6.1 Implausible measured values

In some cases, the FLOWSIC200 Transmitter delivers measured values that do not seem plausible or have too large short-term fluctuations.

Symptom	Possible cause	Action
Measured values are stable, but calculated velocity is (seemingly) wrong	▶ Incorrect parameter setting of measuring distance and installation angle ▶ Incorrect regression coefficients ▶ Measuring axis not optimal for existing flow conditions	▶ Check parameter settings ▶ Check installation situation (→ p. 26, §3.1.1) ▶ Calibrate velocity measurement (→ p. 64, §4.2.6)
Measured temperature value is (seemingly) incorrect	Measuring distance not determined or entered exactly	▶ Check transducer - transducer distance ▶ Calibrate temperature measurement (→ p. 64, §4.2.6)
Measured values correct on average, but too unsteady or jumps	Disturbance of measured values due to traffic conditions (measuring distance influenced by high vehicles)	▶ Check installation situation (→ p. 26, §3.1.1) ▶ Contact Endress+Hauser Service.

6.2 General system malfunctions

Symptom	Possible cause	Action
No communication between measuring system and SOPAS ET	▶ Wrong COM port on the PC ▶ Incorrect parameter setting of interface	▶ Check interface settings (→ p. 45, §4.1.6) ▶ Exit the SOPAS ET program, make a restart and establish connection again ▶ Contact Endress+Hauser Service.

6.3 Warning and error messages in SOPAS ET

Warnings or device malfunctions are output as follows:

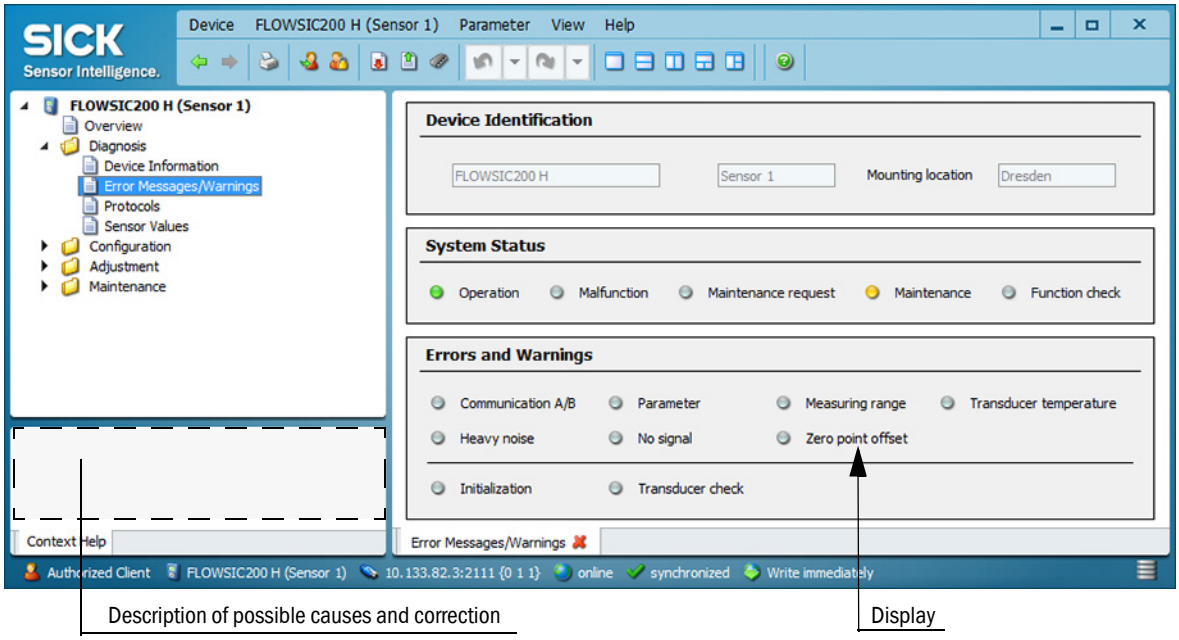
Detailed information on the current device status is provided by the “Diagnosis / Error messages / Warnings” directories.

Move the mouse pointer to the respective message to display more details on the significance of individual messages in a separate window. Clicking on the display shows a short description of possible causes and corrections under “Help”.

Warning messages are output when internal limits for individual device functions/ components are reached or exceeded which can then lead to erroneous measured values or an imminent failure of the measuring system.

Warning messages do not imply a malfunction of the measuring system. The measurement is still valid.

Fig. 52 Directory “Diagnosis / Error Messages/Warnings“



Malfunctions listed below can probably be cleared onsite.

SOPAS ET	Possible cause	Action
Communication A/B	▶ Connection cable not connected correctly ▶ Cables used do not comply with required specification ▶ Both sender/receiver units are set to Master or Slave ▶ A sender/receiver unit is defective	▶ Check wiring (→ p. 35, §3.3)
Parameter	▶ Device has not yet been configured ▶ Base parameters set to 0 after type change	▶ Enter system data (again) (→ p. 53, §4.2)
Measuring range	Configured measuring range overrun	▶ Check parameter settings

FLOWSIC200

7 Specification

7.1 Technical data

Measured value recording		
Measured variables	Flow velocity, air temperature	
Measuring range	-20 ... +20 m/s; infinitely variable; higher on request	
Typical accuracy [1)]	± 0.1 m/s	
Response time	1 ... 300 s; freely selectable	
Installation		
Measuring distance transducer - transducer	FLSE200-M and FLSE200-HM	5 ... 25 m
	FLSE200-H	5 ... 40 m
Installation angle	Up to 10 m measuring distance 45°, for longer measuring distances 60°	
Air temperature	-40 ... +60 °C	
Moisture	< 100%	
Total cable length between FLSE200 and higher level control sysem	Max. 1000 m [2)]	
Communication interfaces		
RS485	MODBUS RS485 RTU / ASCII	
Power supply		
Operating voltage	90 ... 250 V AC; 50/60 Hz	
Power consumption	Approx. 20 W	
Ambient conditions		
Temperature range	-40 ... +60 °C	
Storage temperature	-40 ... +70 °C	
Enclosure rating	FLSE200: IP66	

1): The accuracy depends on calibration, installation conditions, flow profile, temperature and length of the measuring distance
2) For operation with standard configuration (factory setting)

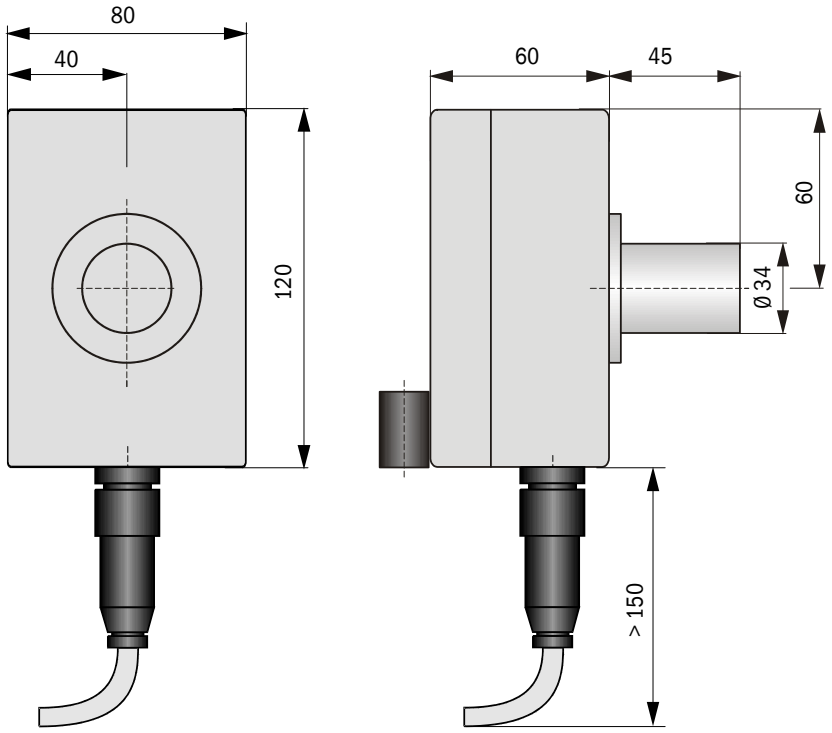
7.2 Dimensions, Part Nos.

All dimensions are in mm.

7.2.1 Sender/receiver units

FLSE200-M

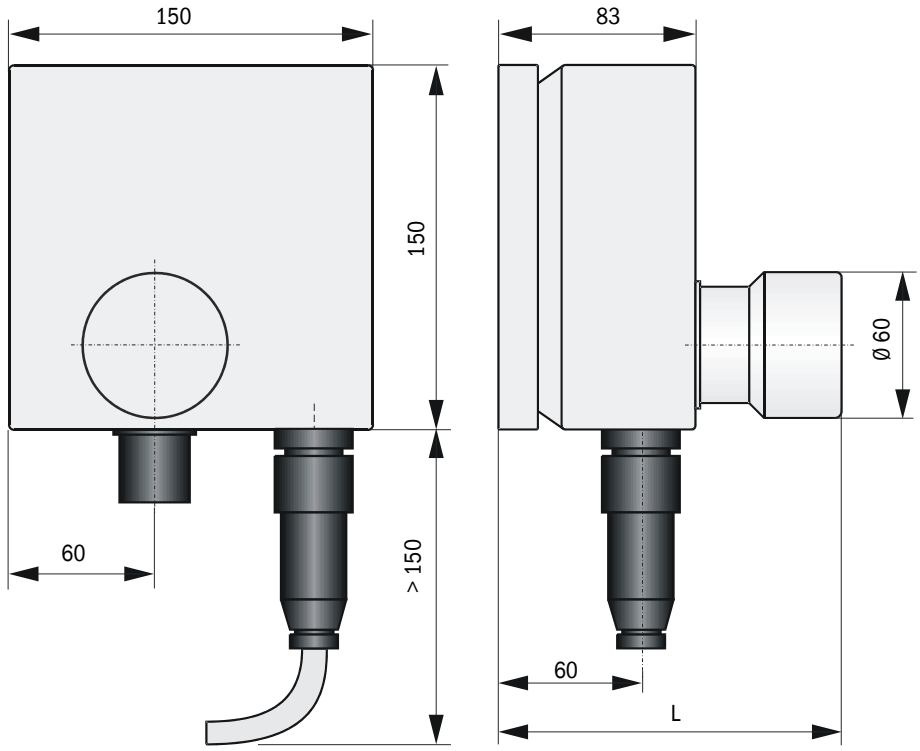
Fig. 53 FLSE200-M sender/receiver unit



Designation	Quantity	Part No.
FLSE200-M sender/receiver unit	2	1044804

FLSE200-H, FLSE200-HM

Fig. 54 FLSE200-H, FLSE200-HM sender/receiver unit

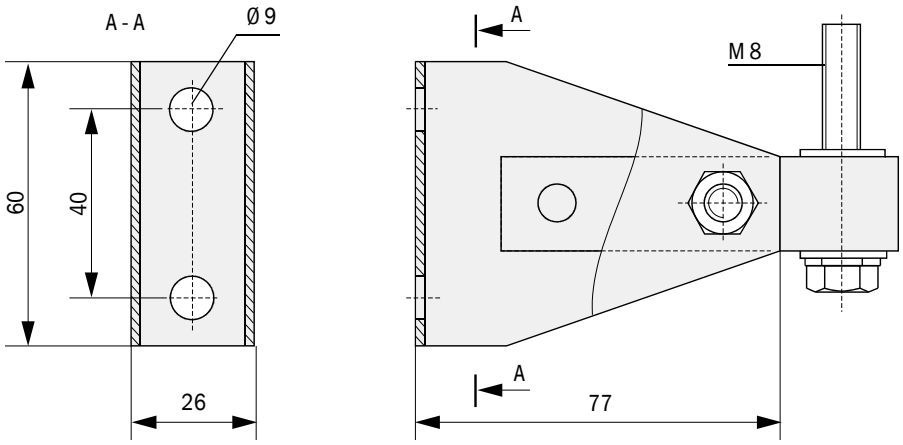


Component	Dimension L	Part No.
FLSE200-HM sender/receiver unit	141	1057565
FLSE200-H sender/receiver unit	141	1044842

7.2.2 Bracket for sender/receiver unit

Bracket for FLSE200-M

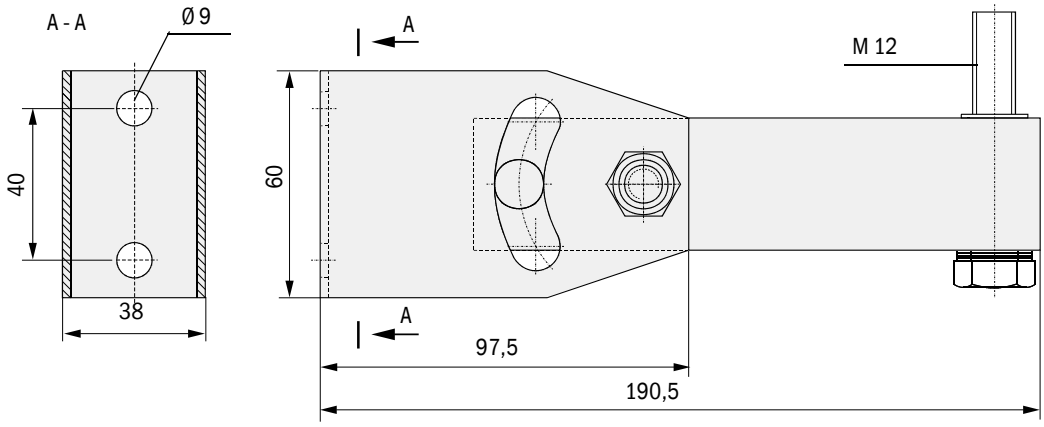
Fig. 55 Bracket for FLSE200-M



Designation	Part No.
Bracket for FLSE200-M	7042039
Bracket for FLSE 200-M, material 1.4529	2031880

Bracket for FLSE200-H, FLSE200-HM

Fig. 56 Bracket for FLSE200-H, FLSE200-HM

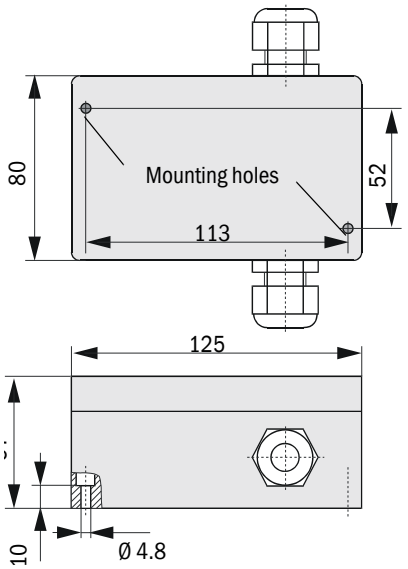


Designation	Part No.
Bracket for FLSE200-H, FLSE200-HM	7042077
Bracket for FLSE200-H and FLSE200-HM, material 1.4529	2031881

7.2.3 Junction box

In aluminium housing

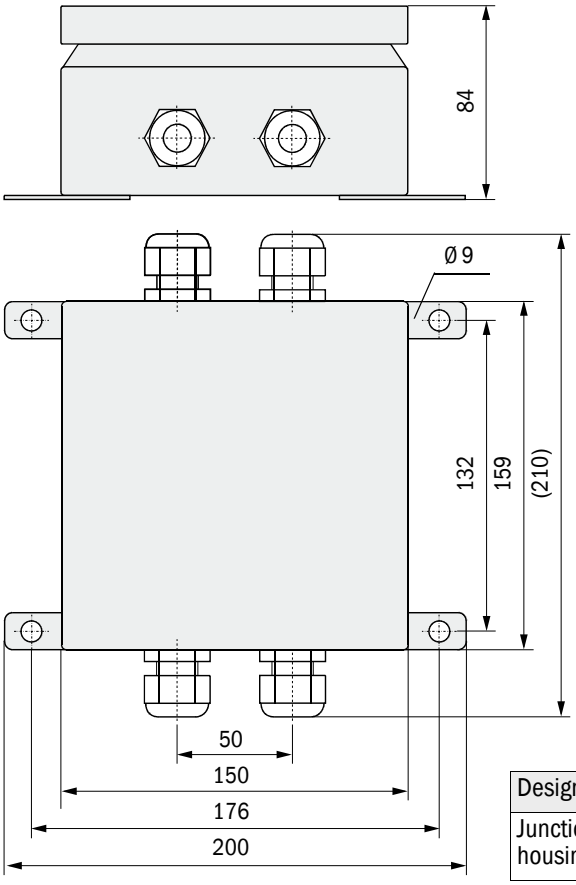
Fig. 57 Junction box



Designation	Part No.
Junction box	2046418

In stainless steel housing

Fig. 58 Junction box in stainless steel housing



Designation	Part No.
Junction box in stainless steel housing	2048067

7.3 Accessories

7.3.1 Assembly accessories

Designation	Part No.
Mounting kit 2M8-1.4529	2031886
Mounting kit 4M8-1.4529	2031887
Mounting kit 2D8-1.4571/PA	2031888
Mounting kit 4D8-1.4571/PA	2031889
Mounting kit 2D4-1.4571/PA	2031890
Mounting kit 2M8-1.4571	2031891

7.3.2 Connection cable, sender/receiver unit - junction box

Designation	Quantity	Part No.
Connection cable, length 2 m, halogen-free	2	2048074
Connection cable, length 25 m, halogen-free	2	2048075

7.4 Options

7.4.1 Miscellaneous

Designation	Part No.
Hook spanner	7042115
DME 2000 distance sensor	1010578

7.5 Consumable parts for 2-years operation

Designation	Quantity	Part No.
Tube with transducer for FLSE200-M	2	7042043

7.6 Password

Passwort „Autorisierter Kunde“

Nach dem Start des Bedien- und Parametrierprogrammes SOPAS ET sind nur die Programmfunktionen verfügbar, die keinen Einfluss auf die Gerätefunktion haben.

Nicht eingewiesenes Personal kann keine Änderungen der Parameter vornehmen.
Zur Nutzung des erweiterten Funktionsumfanges wird das

Passwort **sickoptic** benötigt.

Falls zur Eingabe eine falsche Taste gedrückt wird, muß das Fenster geschlossen und anschließend die Passworteingabe wiederholt werden.

Password "Authorized Client"

After the start of the SOPAS ET operating and parameterization program, only menus are available which have no effect on the functioning of the device.
Untrained personnel cannot alter the device parameters. To access the extended range of functions the

password **sickoptic** must be entered

If a wrong key is pressed when entering the password, the window must be closed and then the entering repeated.

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